OpenVMS Connectivity Developer Guide

Contains COM for OpenVMS, OpenVMS Registry, and OpenVMS Events information

July 2000

This document contains information about *COM for OpenVMS*, the OpenVMS Registry, and OpenVMS Events logging. It also includes information about OpenVMS and Windows NT authentication and interoperation.

Revision/Update Information:	This is an updated manual.
Software Version:	COM Version 1.1-B for OpenVMS OpenVMS Alpha Version 7.2-1 Microsoft Windows NT 4.0 SP3 or higher

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The *Compaq OpenVMS* documentation set is available on CD-ROM.

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Preface

Intended Audience

This document is designed primarily for developers who want to use OpenVMS infrastructure to develop applications that move easily between the OpenVMS and Windows NT environments. These developers include the following:

- *COM for OpenVMS* developers: those who are encapsulating existing OpenVMS applications or data, as well as those who are creating new COM applications for OpenVMS systems.
- OpenVMS Registry developers: those who want to use the OpenVMS Registry to store information about their OpenVMS systems alone, or who want to use the OpenVMS Registry as a shared repository for both OpenVMS and Windows NT registry information.

This document is not intended as an introduction to COM or the registry. It assumes that readers are already familiar with object-oriented (OO) concepts and COM development techniques, as well as how the registry works on a Windows NT system. The document does provide pointers to online information about COM and the registry and recommends other books about COM, OO development, and the registry.

Document Structure

This document contains all the information you need to develop *COM for OpenVMS* applications and use the OpenVMS Registry. The document is divided into the following sections:

- Release notes

  COM for OpenVMS, OpenVMS Registry, and OpenVMS Events release notes.

- Part I

  COM for OpenVMS information, including installing, configuring, and running *COM for OpenVMS*; how to develop a *COM for OpenVMS* application. This part also includes information about authenticating users and applications between OpenVMS and Windows NT systems, and information about the Active Template Library (ATL) and how to develop ATL applications on *COM for OpenVMS*.

- Part II

  OpenVMS Registry information, including OpenVMS Registry overview and concepts, OpenVMS Registry server startup and system management, OpenVMS Registry system services, and OpenVMS Registry server management.

- Part III

  OpenVMS Events information.

- Part IV

  Reference information, including MIDL compiler information, *COM for OpenVMS* cookbook examples, COM APIs supported by *COM for OpenVMS*, how to upgrade from previous versions of *COM for OpenVMS*, how to run in unauthenticated mode, lists of installed files, coupons for related COM books, a glossary, and a list of acronyms.

- Index

Win32 API Calls Shown in Example Code

Win32® API calls shown in example code throughout this document and included on the *COM for OpenVMS* kit are provided for *documentation purposes only*.

COM for OpenVMS includes only those Win32 APIs that the *COM for OpenVMS* software requires. These COM APIs are listed in Appendix F, Lists of Differences, APIs, and Interfaces.

Win32 API calls that are not listed in Appendix F but that appear in examples in this document and in code samples on the *COM for OpenVMS* kit are provided by software vendors other than Compaq. If you want to use any Win32 APIs on OpenVMS other than those listed in Appendix F, you must purchase those interfaces from an independent software vendor such as Bristol Technologies (`www.bristol.com`).

Related Documents

For additional information on the Open Systems Software Group (OSSG) products and services, access the Compaq OpenVMS World-Wide Web site with the following address:

`www.compaq.com/openvms`

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Conventions

In this manual, any reference to OpenVMS is synonymous with Compaq OpenVMS.

VMScluster systems are now referred to as OpenVMS Cluster systems. Unless otherwise specified, references to OpenVMS Clusters or clusters in this document are synonymous with VMSclusters.

In this manual, every use of DECwindows and DECwindows Motif refers to DECwindows Motif for OpenVMS software.

The following conventions are also used in this manual:

Ctrl/*x*	A sequence such as Ctrl/*x* indicates that you must hold down the key labeled Ctrl while you press another key or a pointing device button.
PF1 *x*	A sequence such as PF1 *x* indicates that you must first press and release the key labeled PF1 and then press and release another key or a pointing device button.
Return	In examples, a key name enclosed in a box indicates that you press a key on the keyboard. (In text, a key name is not enclosed in a box.) In the HTML version of this document, this convention appears as brackets, rather than a box.
. . .	A horizontal ellipsis in examples indicates one of the following possibilities: • Additional optional arguments in a statement have been omitted. • The preceding item or items can be repeated one or more times. • Additional parameters, values, or other information can be entered.
. . .	A vertical ellipsis indicates the omission of items from a code example or command format; the items are omitted because they are not important to the topic being discussed.
( )	In command format descriptions, parentheses indicate that you must enclose the options in parentheses if you choose more than one.
[ ]	In command format descriptions, brackets indicate optional elements. You can choose one, none, or all of the options. (Brackets are not optional, however, in the syntax of a directory name in an OpenVMS file specification or in the syntax of a substring specification in an assignment statement.)
[|]	In command format descriptions, vertical bars separating items inside brackets indicate that you choose one, none, or more than one of the options.
{ }	In command format descriptions, braces indicate required elements; you must choose one of the options listed.
text style	This text style represents the introduction of a new term or the name of an argument, an attribute, or a reason. In the HTML version of this document, this convention appears as *italic text*.

italic text	Italic text indicates important information, complete titles of manuals, or variables. Variables include information that varies in system output (Internal error *number*), in command lines (/PRODUCER=*name*), and in command parameters in text (where *dd* represents the predefined code for the device type).
UPPERCASE TEXT	Uppercase text indicates a command, the name of a routine, the name of a file, or the abbreviation for a system privilege.
`Monospace type`	Monospace type indicates code examples and interactive screen displays. In the C programming language, monospace type in text identifies the following elements: keywords, the names of independently compiled external functions and files, syntax summaries, and references to variables or identifiers introduced in an example.
-	A hyphen at the end of a command format description, command line, or code line indicates that the command or statement continues on the following line.
numbers	All numbers in text are assumed to be decimal unless otherwise noted. Nondecimal radixes—binary, octal, or hexadecimal—are explicitly indicated.

1
COM for OpenVMS Release Notes

The release notes in this chapter apply to *COM Version 1.1-B for OpenVMS*.

1.1 COM for OpenVMS Versions

This section describes the versions of *COM for OpenVMS*.

- **COM Version 1.0 for OpenVMS**

  This was the first release of *COM for OpenVMS* that shipped with OpenVMS Version 7.2. *COM Version 1.0 for OpenVMS* is an unauthenticated implementation that does not utilize NTLM security. This release requires OpenVMS Version 7.2 or later. For a list of security differences between an unauthenticated implementation and an authenticated implementation, see Table 1–1.

- **COM Version 1.1 for OpenVMS**

  This was the second release of *COM for OpenVMS* that shipped with OpenVMS Version 7.2-1. *COM Version 1.1 for OpenVMS* is an authenticated implementation that utilizes the NTLM security features that are part of OpenVMS Version 7.2-1. This release requires OpenVMS Version 7.2-1 or later. For a list of security differences between an unauthenticated implementation and an authenticated implementation, see Table 1–1.

- **COM Version 1.1-A for OpenVMS**

  This was the third release of *COM for OpenVMS*. It is a maintenance release that fixed a number of problems in *COM Version 1.1 for OpenVMS*.

- **COM Version 1.1-B for OpenVMS** (this release)

  This is the fourth release of *COM for OpenVMS*. *COM Version 1.1-B for OpenVMS* provides an option that allows you to choose between running COM applications in the default authenticated mode (using NTLM security features), and running COM applications in an unauthenticated mode. See Appendix E for more information.

  COM Version 1.1-B for OpenVMS also provides the Active Template Library (ATL) Version 3.0 for simpler development of COM applications on OpenVMS. See Chapter 9 for more information.

  As of *COM Version 1.1-B for OpenVMS*, the DCOM-MIDL license is no longer required.

  For a list of problems fixed since the last release, see Section 1.3.

Table 1–1 Summary of Security Differences

Area	Unauthenticated COM (V1.0, V1.1-B)	Authenticated COM (V1.1, V1.1-A, V1.1-B)
Client requests	Authenticated on Windows NT; not authenticated on requests to OpenVMS.	Authenticated on Windows NT and OpenVMS.
Security	Servers can run with the client's identity on Windows NT and with a prespecified OpenVMS identity on OpenVMS.	Servers can run with the client's identity on Windows NT and on OpenVMS.
Security	Per-method security is allowed on Windows NT, but only processwide security is allowed on OpenVMS.	Per-method security is allowed on Windows NT and on OpenVMS.
Outbound COM requests	Authenticated on Windows NT only.	Authenticated on Windows NT and OpenVMS.
Registry access	*On Windows NT:* controlled by NT credentials.	*On Windows NT:* controlled by NT credentials.
	On OpenVMS: relies on OpenVMS security controls such as privileges or rights identifiers.	*On OpenVMS:* controlled either by Windows NT credentials or by OpenVMS security controls.
Event logging	Windows NT only.	Windows NT and OpenVMS.

1.2 Upgrading from a Previous Version of COM to COM Version 1.1-B for OpenVMS

If you are upgrading from an earlier version of *COM for OpenVMS* to Version 1.1-B, follow the upgrade instructions in Section 4.3. In addition:

- If you are upgrading from *COM Version 1.0*, follow the upgrade instructions in Appendix D.
- If you are upgrading from *COM Version 1.0* or *COM Version 1.1*, perform the tasks described in Section 1.2.1 and Section 1.2.2.
- If you are upgrading from *COM Version 1.1-A*, you do not need to perform any additional tasks.

1.2.1 You Must Repopulate the OpenVMS Registry for COM Version 1.1-B for OpenVMS

Note

If you are upgrading from *COM Version 1.1-A for OpenVMS*, you do not need to repopulate the OpenVMS Registry.

For *COM Version 1.1-B for OpenVMS*, you must repopulate the OpenVMS Registry to include security settings. Use the `DCOM$SETUP` command to display the OpenVMS COM Tools menu, and choose option 3.

When you populate the OpenVMS Registry for *COM Version 1.1-B for OpenVMS*, the system prompts you to confirm the repopulation. You must answer YES each time. For example:

```
        [ Starting to Populate the COM for OpenVMS Registry ]

         Populating the Registry for OpenVMS may take up to 15 minutes
         depending on your system.

Enter Y[ES] to continue: YES

         The COM for OpenVMS Registry has already been loaded. This
         action will overwrite the current COM for OpenVMS values
         and data.

Enter Y[ES] to continue: YES
```

Note

Repopulating the OpenVMS registry does not affect the registration of existing COM applications.

1.2.2 Previously Registered Applications That Use Logical Names for the Local Server Path

If you previously registered any COM application using a logical name for the local server path, you must modify (reregister) the application using the actual name for the local server path.

For example, if you used the REGISTER_SIMPLE.COM command procedure to register the ''Simple'' application under *COM Version 1.0 for OpenVMS*, you must reregister the ''Simple'' application using the new REGISTER_SIMPLE.COM command procedure.

Compaq updated the registration command files as of *COM Version 1.1-A for OpenVMS*.

The system stores the COM application local server path in the OpenVMS Registry as a value data as follows:

```
  "HKEY_CLASSES_ROOT\CLSID\{GUID}\LOCALSERVER32"
```

Use the following REG$CP command to modify the local server path:

```
  $ MCR REG$CP CREATE VALUE HKEY_CLASSES_ROOT\CLSID\{GUID}\Localserver32 -
  _$
/TYPE=SZ/DATA=device:[directory]image-name.EXE
```

A GUID is the COM application CLSID. For more information on Localserver32 and CLSID, see Section 7.5.

1.2.3 Changes to the Examples

In *COM Version 1.1-A for OpenVMS*, the names of the server images in the Dispatch_Sample1 example changed. If you previously built and registered this application and you want to build the new version, you must reregister the server after it has been built.

1.3 Problems Fixed in the Current Release

The following notes describe previously documented problems that have been fixed in *COM Version 1.1-B for OpenVMS*.

1.3.1 Memory Leak in COM for OpenVMS Servers

In previous versions of *COM for OpenVMS*, the MIDL compiler generated server proxy code that caused memory to be allocated and not released for certain types of method calls. This resulted in memory leaks in server applications. Testing by Compaq has shown that this problem occurs if the parameter list for any method call includes user defined structures as input parameters, and either FLOAT or DOUBLE datatypes. If you think your *COM for OpenVMS* server may have this problem, recompile your .IDL file using the new MIDL compiler, recompile the generated files, and relink your application.

If you discovered this problem, you may have compensated for it by deallocating the structures directly, even though COM programming rules state that you do not have to deallocate input parameters. If so, you should remove your workaround and rebuild the application as directed in the preceding paragraph.

1.3.2 DCOM$RPCSS Process Resource Exhaustion

The *COM for OpenVMS* run-time environment requires that the `DCOM$RPCSS` process is always running.

In previous versions of *COM for OpenVMS*, Compaq discovered that after `DCOM$RPCSS` creates and deletes a large number of *COM for OpenVMS* application servers, `DCOM$RPCSS` can run out of resources. If this happens, `DCOM$RPCSS` automatically attempts to restart itself.

This limitation has been corrected.

1.3.3 Passing an Interface Pointer through IDispatch

In previous versions of *COM for OpenVMS*, passing an interface pointer as a parameter through the IDispatch interface produced an access violation error. This problem has been corrected.

1.4 Known Problems (with Fixes) in the Current Release

The following notes describe the known problems associated with *COM Version 1.1-B for OpenVMS*. These problems can be corrected by obtaining ECOs or updates from the Compaq Support Centers.

1.4.1 Trusted-Domain Authentication Feature Requires ECO

Compaq has discovered a number of problems associated with COM applications running between systems in different domains with trusts established between the domains. Some of these problems can be corrected by installing the Advanced Server for OpenVMS V7.2-A-ECO1 kit. Please contact your Compaq Support Center and ask for this kit. Other problems that may still occur are listed in the following sections. If you experience these problems, please contact your Compaq Support Center for additional information.

1.4.1.1 NET3004 Messages Broadcast to Administrator on Windows NT Server System

When COM applications are run between systems in trusted domains, one or both of the systems may report NET3004 errors and broadcast these errors to Windows NT systems logged into the Administrator account. The Administrator will see a popup message box containing the NET3004 error. You can eliminate these broadcasts by stopping the Alerter Service on the Domain Controller that is generating the messages.

1.4.1.2 Password Synchronization Errors (NET5716, NET5722, NET5723)

Under certain conditions, a Windows NT workstation can lose the ability to authenticate with an Advanced Server domain controller. If this happens you will need to remove the workstation from the domain, then re-add it back to the domain.

1.4.1.3 Hostmap Problem

Under certain conditions, the hostmap entries in a trusted domain can become invalid. See Section 5.4.6 for a way to resolve this problem.

1.4.2 DCERPC-E-UNKNOWNREJECT Failure (EE128302)

OpenVMS COM clients sometimes report this error when communicating with NT COM components. This is due to a problem in the RPC Runtime. A fix for this problem is available from the Compaq Support Centers. Contact your Support Center and ask for the update to DCE$LIB_SHR.EXE.

1.4.3 DCERPC-E-WHOAREYOUFAILED Failure (EE1282FA)

OpenVMS COM clients sometimes report this error when communicating with NT COM components. This is due to a problem in the RPC Runtime. A fix for this problem is available from the Compaq Support Centers. Contact your Support Center and ask for the update to DCE$LIB_SHR.EXE.

1.4.4 NTARPC-E-PROTOCOL_ERROR Failure (800706C0)

OpenVMS COM clients sometimes report this error when communicating with NT COM components. This is due to a problem in the RPC Runtime. A fix for this problem is available from the Compaq Support Centers. Contact your Support Center and ask for the update to DCE$LIB_SHR.EXE.

1.4.5 Cached IID Value Not Equal to Registry Value Failure

Compaq's testing has shown that OpenVMS processes that run more than 2000 iterations of a *COM for OpenVMS* application may receive this error. The error is caused by a bug in the Registry client that returns a failure status after a process has made over 16,000 OpenKey requests. A fix for this problem is available from the Compaq Support Centers. Contact your Support Center and ask for the update to `SYS$NTA.EXE`.

1.4.6 IGNORE_EXTAUTH Support

Support for the IGNORE_EXTAUTH flag in the SECURITY_POLICY SYSGEN parameter is now available in a patch kit from the Compaq Support Centers. Contact your Support Center and ask for the update to VMS$VMS_ACMESHR.EXE.

1.5 Known Problems (without Fixes) in the Current Release

The following notes describe the known problems associated with *COM Version 1.1-B for OpenVMS*. These problems currently do not have fixes.

1.5.1 Kernel Threads and Upcalls Not Supported

COM for OpenVMS applications cannot be built with kernel threads or upcalls enabled. This support will be available in a future release.

1.6 Limitations and Restrictions

The following sections contain general release note information.

1.6.1 DCOM$RPCSS Stalls on Restart

If a system running DCOM$RPCSS in a cluster crashes and restarts, the DCOM$RPCSS process may hang during startup. In this condition, the process name remains DCOM$STARTUP-** and the SYS$STARTUP:DCOM$RPCSS.OUT file contains the following error message:

```
%PPL-W-SYSERROR, system service error
-SYSTEM-W-VALNOTVALID, value block is not valid
```

To recover from this condition, stop *COM for OpenVMS* on each node in the cluster using the following command:

```
$ @SYS$STARTUP:DCOM$SHUTDOWN
```

Then restart *COM for OpenVMS* on each node in the cluster using the following command:

```
$ @SYS$STARTUP:DCOM$STARTUP
```

1.6.2 MIDL Limitations and Restrictions

The following release notes pertain to MIDL.

1.6.2.1 MIDL -w Switch

The MIDL compiler allows you to specify either -w or -warn to throttle the level of warnings generated by the compiler. The MIDL compiler for OpenVMS supports only the -w switch.

1.6.2.2 MIDL Compiler Treats wchar_t Literals as char

When using DEC C Version 5.7 or earlier, *COM for OpenVMS* incorrectly handles wide character literal strings in IDL files. These strings are mishandled as ''char'' types. (If you are using DEC C Version 6.0 or above, you can disregard this release note.)

For example, suppose an IDL file contains the following string literal:

```
const wchar_t * PROGRAM_ID     = L"Sample.Component";
```

The MIDL compiler on Windows NT would produce the following macro definition:

```
#define PROGRAM_ID      ( L"Sample.Component" )
```

However, the MIDL compiler for *COM for OpenVMS* produces the following by default:

```
#define PROGRAM_ID       ( "Sample.Component" )
```

The following workarounds are available:

1. Avoid using the DEC C preprocessor if possible.

To run the MIDL compiler without the preprocessor, include the -nocpp or -no_cpp switch on the command line. For example:

```
$ midl -Oicf -nocpp -idcom$library: server.idl
```

Caution

Do not use this workaround if the IDL source file or any IDL source file imported by the main IDL source file contains any conditional assembly switches (for example, #ifdef" . . . "#endif").

2. Define all character string constants as ''char'' type instead of ''wchar_t'' type.

   Using this workaround causes the MIDL compiler on Windows NT and on OpenVMS to create character string constants that are not wide characters. If the software requires a wide character string literal, the software can convert the ANSI string to a wide character string before the value is used.

3. Replace the wide character string constants with macro definitions inside the IDL source file.

   For example, instead of defining the string literal as:

   ```
   const wchar_t * PROGRAM_ID     = L"Sample.Component";
   ```

   Use a #define inside an IDL cpp_quote() directive as follows:

   ```
   cpp_quote("#define PROGRAM_ID L\"Sample.Component\"")
   ```

   Even when you use the DEC C preprocessor, the output header file produced by the MIDL compiler for Windows NT and OpenVMS will be as follows:

   ```
   #define PROGRAM_ID L"Sample.Component"
   ```

1.6.2.3 SAFEARRAY Limitation

Because the *COM for OpenVMS* MIDL compiler is based on Microsoft's MIDL compiler V3.00.44, *COM for OpenVMS* supports the use of SAFEARRAYs only inside a LIBRARY block in an .IDL file. Microsoft's MIDL compiler V3.00.44 has the same limitation.

1.6.3 DCOM$CNFG Limitations and Restrictions

The following release note pertains to DCOM$CNFG when run in a cluster.

1.6.3.1 DCOM$CNFG Utility and Disabling Applications: Possible Unintended Side Effects

The *COM for OpenVMS* DCOM$CNFG utility includes several options that allow a developer to modify application properties (for example, changing the location of the computer on which an application can run). If you select one of these options, you are modifying an OpenVMS Registry entry.

Because the OpenVMS Registry supports a single database in a cluster, modifying one of these options affects all nodes in the cluster that are running *COM for OpenVMS*.

For example, if you use the System-wide Default Properties submenu option 1 to disable *COM for OpenVMS*, you effectively disable *COM for OpenVMS* on the entire cluster. In the same way, if you use the Application Location submenu option 1 to prevent an application from running on this computer, you effectively prevent the application from running on any computer in the cluster.

1.6.4 Other Limitations and Restrictions

The following release notes pertain to *COM for OpenVMS*.

1.6.4.1 Windows 2000 Limitations

Windows 2000 is not supported in *COM Version 1.1-B for OpenVMS*.

Preliminary results from Compaq's ongoing testing of interoperability between *COM for OpenVMS* and Windows 2000 indicate that a Windows 2000 client can successfully communicate with a *COM for OpenVMS* server application. However, authentication problems occur between a *COM for OpenVMS* client and a Windows 2000 server. Full support for Windows 2000 will be available in a future release.

1.6.4.2 COM Version 1.0 for OpenVMS and COM Version 1.1-B for OpenVMS Not Supported in the Same Cluster

When you install and configure *COM Version 1.1-B for OpenVMS* on any node in a cluster, you make clusterwide modifications to the OpenVMS Registry that prevent *COM Version 1.0 for OpenVMS* from running on any other node in the same cluster.

1.6.4.3 Remote Activation of an In-Process Server

If a server component is registered only as an in-process server, the component cannot be activated remotely on OpenVMS. If the system tries to activate an in-process server remotely, the remote client receives a ''REGDB_E_CLASSNOTREG (80040154)'' error. To activate a server component remotely, the component must be registered as an out-of-process server so the `DCOM$RPCSS` process can start the component on the client's behalf.

1.6.4.4 Threading Model Supported by COM for OpenVMS

COM Version 1.1-B for OpenVMS supports only the multithreaded apartment (MTA, also known as free threads) model for application servers. The MTA model allows a component to have more than one thread. However, you must ensure that your code is thread safe.

The threading model initialization call is as follows:

```
CoInitializeEx(
   NULL,
   COINIT_MULTITHREADED
   )
```

Because `CoInitialize()` implies the single-threaded apartment (STA) model, you cannot use it in place of `CoInitializeEx()` in a server application.

1.6.4.5 SP4 with Enhanced NTLM Enabled is Not Supported

COM Version 1.1-B for OpenVMS supports Windows NT SP4 with the following limitation: *COM Version 1.1-B for OpenVMS* does not support SP4 with enhanced NTLM enabled.

If you want to use *COM Version 1.1-B for OpenVMS* with SP4, you must be sure that enhanced NTLM is disabled.

Although SP4 and *COM for OpenVMS* appear to interoperate with SP4 enhanced NTLM disabled, SP4 has not been fully tested with *COM for OpenVMS* and is not officially supported.

Compaq's ongoing SP4 testing has identified the following limitation with SP4 and enhanced NTLM disabled: authentication requests fail if you use passwords that are longer than 12 characters.

1.6.4.6 Specifying Activation Security in CoCreateInstanceEx

The `pServerInfo` parameter of the `CoCreateInstanceEx` API allows you to specify a username and password that will be used for authentication on the remote server system. The username and password are part of the `COAUTHIDENTITY` structure inside the `COAUTHINFO` structure, which is inside the `COSERVERINFO` structure that is passed as the `pServerInfo` parameter to `CoCreateInstanceEx`.

The current NTLM security implementation on OpenVMS does not support this feature for COM client applications on OpenVMS. This feature is supported for COM clients on Windows NT communicating with COM servers on OpenVMS.

1.6.4.7 RPC Communication Failures Caused by Advanced Server

In a cross domain environment, under some load situations, COM applications may report errors that are a side effect of the Advanced Server for OpenVMS having lost a connection between domain controllers. The Advanced Server for OpenVMS reports this error as follows:

```
NET5719:    No domain controller for the domain 'xxxxx' is available.
```

A series of these events over a limited time interval may lead to COM applications reporting RPC communications failures (%x8007071c). In this situation, a stop and start of DCOM$RPCSS may be required to clear the error.

See Section 5.4.6 for more information. If the NET5719 events persist, contact your Compaq Support Center.

1.6.4.8 Specific Error Messages

The following sections list and describe specific *COM for OpenVMS* error messages.

1.6.4.8.1 RPC Cannot Support Failure (800706E4) If you attempt to use the single-threaded apartment (STA) model, some COM APIs may display the following return status code:

```
(800706E4)
```

This model is not supported in *COM Version 1.1-B for OpenVMS*. For more information, see Section 1.6.4.4.

2
OpenVMS Registry Release Notes

2.1 Release Notes

The information in the following sections applies to this release.

2.1.1 No Key Change Notifications When a Key's Attributes are Modified

When you specify the REG$M_CHANGEATTRIBUTES value for the REG$_NOTIFYFILTER item code, the system should notify you of any changes to that OpenVMS Registry key. However, when you modify the attributes of a OpenVMS Registry key, the system fails to notify the processes that have requested notifications.

To correct this problem, specify a different value for the REG$_NOTIFYFILTER item code: use either REG$M_CHANGENAME or REG$M_CHANGELASTSET.

2.1.2 Database Searches Limited

The REG$CP server management utility SEARCH command and calls to the $REGISTRY system service using the REG$FC_SEARCH_TREE_DATA, REG$FC_SEARCH_TREE_KEY, or REG$FC_SEARCH_TREE_VALUE function codes may result in more data being returned to the client than the communications buffers on the client node can handle. These functions are limited to paths that are no more that 16 levels deep and return data of no more than 4 KB.

To avoid this problem, limit the search depth by specifying an exact path—that is, avoid searching the entire database when the database is large.

This restriction will be lifted in a future release.

2.1.3 Key Access Policy

When a user requests access to an OpenVMS Registry key or value, the OpenVMS Registry validates the specified key path by checking the first key and the last key of the key path.

2.1.4 OpenVMS Registry Maximum Data Size Restrictions

The maximum size of any single block of data that can be sent to the OpenVMS Registry server for storage in the OpenVMS Registry database is limited to no more than 7880 bytes. If you exceed this limit, the system displays the following error:

```
REG-F_NORESPONSE, registry server failed to respond within allotted time period
```

This limit is imposed by the communication protocol between the OpenVMS Registry server and the OpenVMS Registry client which limits the transfer to 8 K bytes.

This restriction will be lifted in a future release.

2.1.5 REG$_EXQUOTA Errors

If you set the OpenVMS Registry File Quota to be less than the current size of the OpenVMS Registry database, the system displays the following error for all OpenVMS Registry operations:

```
REG-E-EXQUOTA, registry file quota or page file quota exceeded
```

Note

You will not see this error message on a single delete operation that brings the size of the OpenVMS Registry database file within quota limits.

As a workaround, you can raise the File Quota temporarily above the current size of the OpenVMS Registry database file, then perform delete operations to bring the OpenVMS Registry database file size within the desired File Quota limit. (For information about changing these quotas, see Section 10.6.3.)

To determine the approximate number of bytes applied towards the two OpenVMS Registry File Quotas, multiply the size of the SYS$REGISTRY:REGISTRY$LOCAL_MACHINE.REG and SYS$REGISTRY:REGISTRY$USERS.REG files by 512. The result of this calculation gives you the approximate number of bytes applied towards quota for each file. For information about how to set OpenVMS Registry file quotas, see Section 2.1.6.

This restriction will be lifted in a future release.

2.1.6 OpenVMS Registry Maximum Database Size Restrictions

The maximum amount of data that can be stored in the OpenVMS Registry database is limited to approximately 1.7 MB. If you exceed this limit, the system displays the following error:

```
REG-F-DBACCESS, cannot access registry database object
```

This is a fatal error and prevents further access to the OpenVMS Registry database.

To prevent the REG-F-DBACCESS error, Compaq recommends that you establish quotas to limit the database size so that the OpenVMS Registry can never reach 1.7 MB.

You can establish quotas using either of the following procedures:

- Modify the Default File Quota value.

  Use the following command to set the Default File Quota value:

  ```
  $ mcr reg$cp modify value/name="Default File Quota"/type=dword -
  _$ /data=%D1700000 "hkey_local_machine\system\registry\File Quotas"
  ```

- Create or modify the File Quota value on individual OpenVMS Registry database files.

  Use the following command to set individual File Quota values:

  Note

  If you have previously set File Quota values, use the MODIFY command in place of the CREATE command in the following examples.

```
$ mcr reg$cp create value/name=REGISTRY$LOCAL_MACHINE/type=dword -
_$ /data=%D1700000 "hkey_local_machine\system\registry\File Quotas"

$ mcr reg$cp create value/name=REGISTRY$USERS/type=dword -
_$ /data=%D1700000 "hkey_local_machine\system\registry\File Quotas"
```

You must specify a value for the /DATA qualifier that is between 32,000 and 2,000,000 (0x7D00 and 0x1E8480 hexadecimal).

If you set a value below 32,000, the system will ignore the value and instead use the **Default File Quota** value of 10,000,000. **This Default File Quota value is too high.**

If you set a value above 2,000,000, the system generates a `REG-F-DBACCESS` error when the OpenVMS Registry database size exceeds that value.

A fix for this problem is available from the Compaq Support Centers. Contact your Support Center and ask for the update to REGISTRY$SERVER.EXE.

Part I

COM for OpenVMS

The following chapters provide an overview of *COM for OpenVMS*, provide instructions for installing and configuring *COM for OpenVMS* and related software, and describe and explain how to create COM applications using *COM for OpenVMS*.

3
Overview of COM for OpenVMS

3.1 What is COM?

Component Object Model (COM) is a technology from Microsoft that lets developers create distributed network objects. First introduced by Microsoft in its Windows 3.*x* product, COM was initially called Object Linking and Embedding (OLE). COM provides a widely available, powerful mechanism for customers to adopt and adapt to a new style multivendor distributed computing, while minimizing new software investment.

Digital Equipment Corporation (now Compaq Computer Corporation) and Microsoft jointly developed the COM specification. First released as NetOLE (Network OLE) and then renamed DCOM (Distributed COM), the COM specification now includes network functionality. That is, COM now supports distributed network objects.

COM is an object-based programming model designed to promote software interoperability. COM allows two or more applications (or components) to cooperate with one another easily, even if the objects are written by different vendors at different times and in different programming languages, or if they are running on different machines with different operating systems. To support its interoperability features, COM defines and implements mechanisms that allow applications to connect to each other as software objects.

COM implementations are available on Windows NT, Windows 95™, Windows 98, OpenVMS, and Compaq Tru64™ UNIX®, as well as other UNIX platforms.

3.1.1 Suggested Reading

The following resources can provide you with more information on COM and related topics:

- Third-party books on COM:
  - — *Inside COM/Microsoft's Component Object Model*, Dale Rogerson, Microsoft Press, Redmond, WA, 1997. ISBN: 1-57231-349-8.

    The examples in this document are taken from Dale Rogerson's book and are used with the publisher's permission.
  - — *Essential COM*, Don Box, Addison Wesley Longman, Reading, MA, 1998. ISBN: 0-201-63446-5.

    (See Appendix H for a special offer on this book.)
  - — *Effective COM*, Don Box, Keith Brown, Tim Ewald, and Chris Sells, Addison Wesley Longman, Reading, MA, 1998. ISBN: 0-201-37968-6.

    (See Appendix H for a special offer on this book.)
  - — *DCOM Explained*, Rosemary Rock-Evans, Digital Press, Woburn, MA, 1998. ISBN: 1-55558-216-8.

Provides a good introduction to DCOM and COM, and discusses COM implementations on various platforms.

(See Appendix H for a special offer on this book.)

— *Understanding ActiveX and OLE*, David Chappell, Microsoft Press, Redmond, WA, 1996. ISBN: 1-57231-216-5.

- Websites:

  — *The Component Object Model Specification*, available from the Microsoft COM website:

    `www.microsoft.com/com`

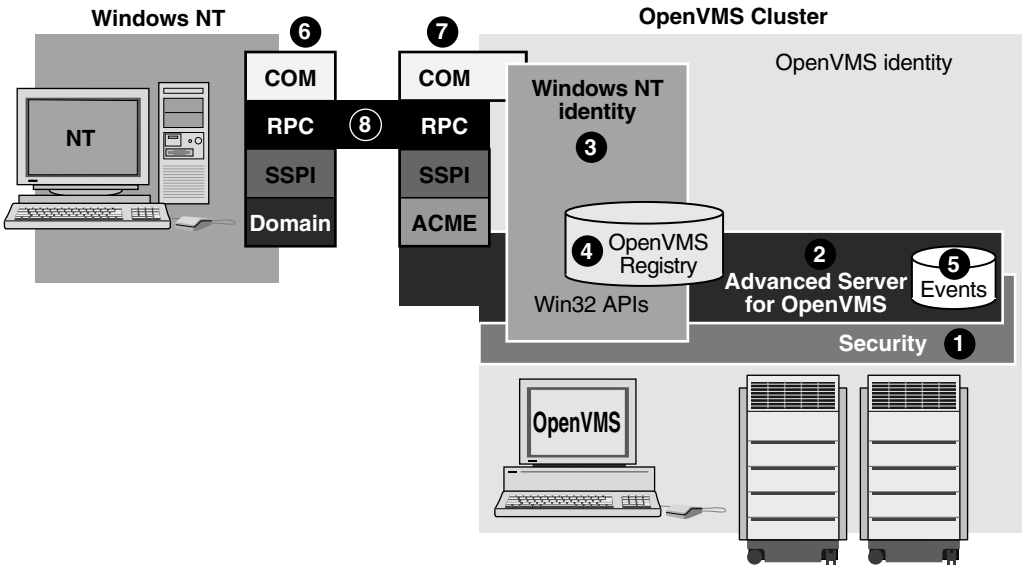
3.2 Overview of COM for OpenVMS

COM for OpenVMS is Compaq's implementation of Microsoft's Windows NT 4.0 Service Pack 3 (SP3) Component Object Model (COM) software on the OpenVMS Alpha operating system.

In support of *COM for OpenVMS*, Compaq ported Windows NT infrastructure to OpenVMS, including a registry, event logger, NTLM security, and Win32 APIs. *COM for OpenVMS* is layered on The Open Group's Distributed Computing Environment (DCE) RPC. *COM for OpenVMS* supports communication among objects on different computers on a local area network (LAN), a wide area network (WAN), or the Internet. *COM for OpenVMS* is important to the Affinity for OpenVMS program because it delivers a key piece of connectivity with Windows NT.

Figure 3–1 shows the OpenVMS infrastructure.

Figure 3–1 OpenVMS Infrastructure and COM for OpenVMS



In Figure 3–1 the key pieces of the OpenVMS infrastructure are as follows:

Windows NT system

The smaller box on the left side of Figure 3–1 represents the Windows NT system.

OpenVMS Cluster/OpenVMS identity

The large box on the right side of Figure 3–1 represents the OpenVMS system. Within and around this box you can see several other boxes labeled with numbers. The following list describes these numbered items:

❶ OpenVMS security

This is the standard OpenVMS security (login, authentication, ACLs, and so on) available with all OpenVMS systems.

❷ Advanced Server for OpenVMS

The Advanced Server for OpenVMS provides authentication of Windows NT users to OpenVMS and provides a connection to the OpenVMS Registry and events viewer for Windows NT users.

❸ Windows NT identity/Win32 APIs

The OpenVMS Security, MSV1_0 ACME agent, Advanced Server for OpenVMS, OpenVMS Registry, event logger, and Win32 APIs (COM APIs) all contribute to the creation of a Windows NT identity within the OpenVMS system.

❹ OpenVMS Registry

The OpenVMS Registry, like the registry on Windows NT systems, allows you to store system, software, and hardware configuration information on OpenVMS. *COM for OpenVMS* uses the OpenVMS Registry to store information about COM applications. For detailed information about the OpenVMS Registry, see Part II of this document.

❺ Event logger

Like the event logger on Windows NT systems, the event logger on OpenVMS records informational, warning, and error messages about COM events. For detailed information about the OpenVMS Events, see Chapter 14.

❻ Windows NT COM stack

On the Windows NT system, COM requests and responses pass through the COM, RPC, SSPI (security), and Domain layers.

❼ OpenVMS COM stack

The OpenVMS system mirrors the Windows NT COM stack, with some additions. On the OpenVMS system, COM requests and responses pass through the COM, RPC, SSPI (security), MSV1_0 ACME agent, and Advanced Server for OpenVMS layers. The MSV1_0 ACME agent (shown as ACME in Figure 3–1) is an extension to the Authentication and Credential and Management (ACM) authority. Authentication is explained in detail in Chapter 8.

❽ Connection through RPC layer

The COM connection between the Windows NT system and OpenVMS is always through the RPC layer.

For developers, the *COM for OpenVMS* developer's kit provides a Microsoft Interface Definition Language (MIDL) compiler and C-style header files for application development. For more information about the OpenVMS MIDL compiler, see Section F.1.4.1.

OpenVMS now includes a function to get Windows NT credentials. For more information about getting Windows NT credentials through NTA$LOGON, see Section 5.1 and Chapter 8.

COM for OpenVMS also provides a free run-time environment on OpenVMS Alpha for the deployment of *COM for OpenVMS* client and server applications.

You can find a complete description of Microsoft's COM, including protocol specifications and programming documentation, at the Microsoft COM website at the following location:

```
www.microsoft.com/com
```

The *COM for OpenVMS* implementation is a subset of the full Microsoft COM implementation. For a complete list of the *COM for OpenVMS* APIs, supported interfaces, and implementation differences, see Appendix F.

While general interest in COM continues to grow, COM remains a sophisticated technology. It is not aimed at the naive user, but rather at skilled programmers, such as independent software vendors (ISVs) and large management information system (MIS) shops.

3.2.1 How COM for OpenVMS Uses the OpenVMS Registry

COM for OpenVMS requires the OpenVMS Registry. Like its registry database counterpart on Windows NT systems, the OpenVMS Registry stores information about COM applications—specifically those COM applications running on OpenVMS. These *COM for OpenVMS* applications use the OpenVMS Registry to store CLSIDs (class IDs), startup information, security settings, and so on in the OpenVMS Registry database. *COM for OpenVMS* uses the Win32 APIs implemented on OpenVMS to read and write this information to the OpenVMS Registry.

COM for OpenVMS requires access to the OpenVMS Registry database. If *COM for OpenVMS* cannot access the OpenVMS Registry, *COM for OpenVMS* will not start. For more information about the OpenVMS Registry, see Chapter 10.

3.3 Using COM for OpenVMS

You can use *COM for OpenVMS* to do the following:

- Develop new *COM for OpenVMS* COM applications
- Encapsulate existing applications for use with *COM for OpenVMS*

The following sections discuss new application development and encapsulation in more detail.

An example of a COM application to encapsulate an existing OpenVMS application is included with this release. The example can be found in DCOM$EXAMPLES:[WRAPPER]. A README file describes the example and how to build it.

3.3.1 Developing New Applications

Your organization might use *COM for OpenVMS* to develop new applications under the following circumstances:

- You want to share data between an OpenVMS server and Windows NT clients in a two-tier client/server computing model.
- You want to share data and to place business logic in the middle tier of a three-tier computing environment.

  For example, you might have a Windows NT system as the client so you can take advantage of its graphical user interface. You could write business logic as a collection of COM objects on a middle-tier server; while the third-tier large-capacity, high-availability OpenVMS server provides database access.
- You want to share data between one or more OpenVMS systems or between OpenVMS and other non-Windows systems using COM.

The advantages of using *COM for OpenVMS* include:

- *COM for OpenVMS* provides a good programming model for programmers with C++ and object-oriented programming skills.
- *COM for OpenVMS* provides multivendor interoperability. COM is a standard with implementations available on a number of platforms today, and ports for additional platforms are in development.
- The *COM for OpenVMS* run-time provides automated data marshaling and unmarshaling.
- COM provides OLE Automation services to support communications with Microsoft Visual Basic® applications. Visual Basic is a very popular programming environment for client/server computing.
- COM provides version support for components so you can upgrade applications over time without breaking existing environments.

See Chapter 7 and Appendix C for examples of developing *COM for OpenVMS* applications.

3.3.2 Encapsulating Existing Applications

If you have monolithic applications written in procedural languages (such as Fortran and COBOL) with character-cell interfaces, you can put a COM ‘‘wrapper’’ or jacket around these applications to allow them either to run on new platforms or to remain on OpenVMS and run in a client/server environment.

The risk associated with completely reengineering some older applications is high. Many applications are large, complex, poorly documented, and not well understood by their current maintainers. Encapsulating a legacy application can be less risky than reengineering and can be the first step in a rewrite. Over time, pieces of the legacy application can be rewritten, while the older version of the application remains stable and available. Encapsulation also allows developers to reuse code, saving time and resources.

Disadvantages to encapsulation include more complex maintenance efforts and the inability to make changes to the underlying code. If the legacy application was unstable or hard to maintain, the encapsulated application will not be any better, and might be made worse because of the wrapper.

Overview of COM for OpenVMS
3.3 Using COM for OpenVMS

There are several layers of a traditional procedural application that you can encapsulate: the user interface (UI), the database, and the data manipulation routines.

— User interface

If you choose to encapsulate the user interface, the UI could be supported on some other platform (for example, from a graphical user interface [GUI] on a Windows NT system).

Encapsulating and moving the UI to the user's desktop can mean that the rest of the application remains on OpenVMS. Batch processing programs are well suited to user interface encapsulation. Applications that do screen management (for example, SMG or FMS) could have their older character-cell interface encapsulated using *COM for OpenVMS*, providing users access through newer Windows NT style dialog boxes.

— Database

If you choose to encapsulate a database using *COM for OpenVMS*, the database could be accessed from parts of a distributed application running on other platforms. The advantage of this approach is that the programmer can keep the database on OpenVMS (a stable, 24x365 system), while the user interface and data access routines are on remote (and perhaps less reliable) systems.

— Database manipulation routines

If you choose to encapsulate the database manipulation routines, the routines could be accessed from any other COM component in a heterogeneous computing environment.

Encapsulating an OpenVMS application using *COM for OpenVMS* means that you write a *COM for OpenVMS* server that talks to the application being encapsulated. The *COM for OpenVMS* server passes arguments to the application in the order and format that the application expects. The *COM for OpenVMS* server then intercepts the output from the application and directs it to the display device, user interface, or other routines.

4
Installing the COM for OpenVMS Kit

This chapter provides a list of the contents of the *COM for OpenVMS* kit, a list of prerequisite software, and preinstallation requirements. It also describes how to install *COM for OpenVMS* and includes postinstallation instructions.

4.1 Contents of the COM Version 1.1-B for OpenVMS Kit

COM Version 1.1-B for OpenVMS contains the following:

- Software
  - *COM for OpenVMS* Run-Time libraries
  - *COM for OpenVMS* MIDL compiler and header files
  - *COM for OpenVMS* configuration utilities
  - Active Template Library Version 3.0
  - Sample applications
- Documentation
  - *OpenVMS Connectivity Developer Guide* (in PostScript, HTML, and PDF formats)

4.2 Prerequisites

The following software is required:

- For OpenVMS systems
  - OpenVMS Version 7.2-1 or higher
  - For *COM for OpenVMS* application development:
    DEC C Version 5.6 or higher and DEC C++ Version 5.6 or higher
    To build ATL applications on OpenVMS:
    Compaq C++ Version 6.2-016 or higher
  - DIGITAL TCP/IP Services for OpenVMS Version 5.0 or equivalent
  - DECwindows Motif® (see Section 4.2.1)
  - Advanced Server for OpenVMS Version 7.2A or higher

    (Advanced Server for OpenVMS is not required if you are running *COM for OpenVMS* in unauthenticated mode.)
  - Before installing *COM for OpenVMS* check that you have the required free global pages, global sections, and disk blocks. The following table lists the requirements.

Software	Global pages	Global sections	Disk blocks
COM for OpenVMS	11,000	27	57000
RPC Runtime	3,300	14	N/A

For Advanced Server requirements: See the *Advanced Server for OpenVMS Server Installation and Configuration Guide*.
For TCP/IP requirements: See the *DIGITAL TCP/IP Services for OpenVMS: Installation and Configuration* document.

- For Windows® NT™ systems
  - — Windows NT 4.0 with Service Pack 3 or higher installed
  - — Microsoft® Visual C++ or Visual Basic (for Windows NT client development and information about MIDL compiler). See the Microsoft website for compiler version requirements.
  - — TCP/IP enabled (needed for OpenVMS connectivity)

4.2.1 DECwindows Motif Required to Run COM for OpenVMS

You must install DECwindows Motif for OpenVMS on any system running *COM for OpenVMS*. If you already have DECwindows Motif installed on your system, you do not need to do anything else. If you do not have DECwindows Motif installed on your system, you can find the installation kit for DECwindows Motif on the OpenVMS Version 7.2-1 CD-ROM in the `[KITS.DWMOTIF125_KIT]` directory.

Note

If you are installing DECwindows Motif to meet the *COM for OpenVMS* requirements *only*, you do not need the DW-MOTIF license.

4.3 Supported COM for OpenVMS Installations

The following sections describe *COM Version 1.1-B for OpenVMS* installation and upgrade options.

Note

If you want to run *COM Version 1.1-B for OpenVMS* in unauthenticated mode, see Section E.1.

If you want to do this	Read this section
Install *COM for OpenVMS* on an OpenVMS standalone system for the first time.	See Section 4.4.
Install *COM for OpenVMS* on an OpenVMS Cluster system for the first time.	See Section 4.6.
Upgrade from earlier versions of *COM for OpenVMS* on an OpenVMS standalone system.	See Section 4.5.
Upgrade from earlier versions of *COM for OpenVMS* on an OpenVMS Cluster system.	See Section 4.7.

4.4 Installing COM for OpenVMS on an OpenVMS Standalone System

Use the following procedure:

1. Install OpenVMS Version 7.2-1. For this procedure, see the *OpenVMS Alpha Version 7.x Upgrade and Installation Manual.*
2. Install TCP/IP. For this procedure, see the *DIGITAL TCP/IP Services for OpenVMS: Installation and Configuration* manual or your TCP/IP supplier's documentation.
3. Boot the installed system from the system disk.
4. Install *COM Version 1.1-B for OpenVMS*. For this procedure, see Section 4.9.
5. Install Advanced Server for OpenVMS. For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide.*
6. Configure TCP/IP (set up for startup and reboot); start TCP/IP. You must configure the PWIP driver for Advanced Server for OpenVMS to use TCP/IP. For information about configuring TCP/IP, see the *DIGITAL TCP/IP Services for OpenVMS: Installation and Configuration* manual or your TCP/IP supplier's documentation.
7. Configure the OpenVMS Registry as follows:
   - Run `REG$CONFIG.COM` to configure the OpenVMS Registry. See Section 11.2.
   - Edit the `SYLOGICALS.COM` file to define the `SYS$REGISTRY` logical as follows:

     ```
     $ DEFINE/SYSTEM SYS$REGISTRY directory-specification
     ```
8. Start OpenVMS Registry by running the `REG$STARTUP.COM` file.
9. If you want to run DCE, start DCE now.

   Note

   You do not need DCE to run *COM for OpenVMS*, but if your environment uses DCE, Compaq recommends that you start DCE now.

   For this procedure, see the *DIGITAL DCE Installation and Configuration Guide.*

   For more information about OpenVMS external authentication, see Section 5.1.
10. Configure Advanced Server for OpenVMS. You need to reboot to finish Advanced Server for OpenVMS configuration. You must reboot 0 to *n* times, depending on your system configuration. For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide.*
11. Start Advanced Server for OpenVMS (set up for startup on reboot). For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide.*
12. Start the ACME server. Use the following command:

    ```
    $ @SYS$STARTUP:NTA$STARTUP_NT_ACME
    ```

13. Start RPC. Use the following command:

```
$ @SYS$STARTUP:DCE$RPC_STARTUP.COM
```

14. Configure *COM for OpenVMS*. For this procedure, see Section 4.10 and Section 6.2.
    - Populate the OpenVMS Registry. For this procedure, see Section 6.2. Use option 3 to populate the OpenVMS Registry database.
    - Create any OpenVMS and Advanced Server for OpenVMS accounts needed by the *COM for OpenVMS* Service Control Manager. For more information, see Section 6.2. Use option 8 to create the accounts.
15. Edit the SYLOGICALS.COM file and add the following line:

```
$ DEFINE DCOM$TO_BE_STARTED TRUE
```

16. Start *COM for OpenVMS*. For this procedure, see Section 4.11.

4.5 Upgrading COM for OpenVMS on an OpenVMS Standalone System

Note

Before you start, Compaq recommends that you disable any Advanced Server for OpenVMS, OpenVMS Registry, and layered products automatic startups so these products do not start until you have upgraded *COM for OpenVMS* and its associated components.

Use the following procedure:

- Edit the SYLOGICALS.COM file to stop the following products from starting:
  - — OpenVMS Registry (remove the line DEFINE REG$TO_BE_STARTED TRUE or DEFINE/SYSTEM REG$TO_BE_STARTED TRUE)
  - — *COM for OpenVMS* (comment the line DEFINE DCOM$TO_BE_STARTED TRUE)
- Edit the SYS$STARTUP:SYSTARTUP_VMS.COM file to stop the following products from starting:
  - — Advanced Server for OpenVMS (comment the line @SYS$STARTUP:PWRK$STARTUP.COM).

If *COM for OpenVMS* is currently running, shut down *COM for OpenVMS* first, Advanced Server for OpenVMS (if running), and then the OpenVMS Registry.

Use the following procedure:

1. Upgrade to OpenVMS Version 7.2-1. For this procedure, see the *OpenVMS Alpha Version 7.x Upgrade and Installation Manual.*
2. If you need to upgrade TCP/IP, upgrade TCP/IP now. For this procedure, see the *DIGITAL TCP/IP Services for OpenVMS: Installation and Configuration* manual or your TCP/IP supplier's documentation.
3. Boot the upgraded system from the system disk.
4. Upgrade *COM for OpenVMS*. For this procedure, see Section 4.9.

5. Install or upgrade Advanced Server for OpenVMS. You must reboot 0 to *n* times, depending on your system configuration. For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide.*
6. Start TCP/IP unless you have enabled TCP/IP to start on a reboot. For this procedure, see the *DIGITAL TCP/IP Services for OpenVMS: Installation and Configuration* manual or your TCP/IP supplier's documentation.
7. Start the OpenVMS Registry unless you have enabled the OpenVMS Registry to start on a reboot. For this procedure, see Section 11.2.
8. If you want to run DCE, start DCE now.

   Note

   You do not need DCE to run *COM for OpenVMS*, but if your environment uses DCE, Compaq recommends that you start DCE now.

   For this procedure, see the *DIGITAL DCE Installation and Configuration Guide.*

   For more information about OpenVMS external authentication, see Section 5.1.
9. Configure Advanced Server for OpenVMS. You must reboot to finish Advanced Server for OpenVMS configuration. You need to reboot 0 to *n* times, depending on your system configuration. For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide.*
10. Start Advanced Server for OpenVMS (set up for startup on reboot). For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide.*
11. Start the ACME server. Use the following command:

    ```
    $ @SYS$STARTUP:NTA$STARTUP_NT_ACME
    ```
12. Start RPC. Use the following command:

    ```
    $ @SYS$STARTUP:DCE$RPC_STARTUP.COM
    ```
13. See Appendix D for detailed information about upgrading from *COM Version 1.0 for OpenVMS* to *COM Version 1.1-B for OpenVMS*.
14. Configure *COM for OpenVMS*. For this procedure, see Section 4.10 and Section 6.2.
    - Populate the OpenVMS Registry. For this procedure, see Section 6.2. Use option 3 to populate the OpenVMS Registry database.
    - Create any OpenVMS and Advanced Server for OpenVMS accounts needed by the *COM for OpenVMS* Service Control Manager. For more information, see Section 6.2. Use option 8 to create the accounts.
15. Edit the `SYLOGICALS.COM` file and add the following line:

    ```
    $ DEFINE DCOM$TO_BE_STARTED TRUE
    ```
16. Start *COM for OpenVMS*. For this procedure, see Section 4.11.

4.6 Installing COM for OpenVMS on an OpenVMS Cluster

Note

This cluster installation procedure assumes you are installing *COM for OpenVMS* on a single system disk.

Use the following procedure:

1. Install OpenVMS Version 7.2-1 on all system disks as required. For this procedure, see the *OpenVMS Alpha Version 7.x Upgrade and Installation Manual.*
2. Install TCP/IP. For this procedure, see the *DIGITAL TCP/IP Services for OpenVMS: Installation and Configuration* manual or your TCP/IP supplier's documentation.
3. Boot the installed system from the system disk.
4. Install *COM Version 1.1-B for OpenVMS*. For this procedure, see Section 4.9.
5. Install Advanced Server for OpenVMS on this node in the cluster. For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide.*

Note

You must install Advanced Server for OpenVMS on at least one Alpha node in the cluster. On the other nodes, you can either install Advanced Server for OpenVMS or select `External Authentication images (only)`.

6. Configure TCP/IP (set up for startup on reboot on each node) and start TCP/IP. You must configure the PWIP driver for Advanced Server for OpenVMS to use TCP/IP. For information about configuring TCP/IP, see the *DIGITAL TCP/IP Services for OpenVMS: Installation and Configuration* manual or your TCP/IP supplier's documentation.
7. Configure the OpenVMS Registry:
   - Run `REG$CONFIG.COM` to configure the OpenVMS Registry. You need to configure the OpenVMS Registry only once for the cluster. See Section 11.2.
   - Set the `SYS$REGISTRY` logical to `DEFINE/SYSTEM` on every Alpha node in the cluster that will run the OpenVMS Registry server.
   - Edit the `SYLOGICALS.COM` file on every node in the cluster as follows:
     — If the cluster uses a single, cluster-common `SYLOGICALS.COM` file that is called by each node's `SYLOGICALS.COM` file, you do not need to make any changes.
     — On those nodes where you do not want the OpenVMS Registry server to run, add the following line to the `SYLOGICALS.COM` file:

```
$ DEFINE/SYSTEM REG$TO_BE_STARTED FALSE
```

     Advanced Server for OpenVMS requires that the OpenVMS Registry be running on a node in the cluster.

8. Configure DCE.

   Note

   You do not need DCE to run *COM for OpenVMS*, but if your environment uses DCE, Compaq recommends that you start DCE now.

   For this procedure, see the *DIGITAL DCE Installation and Configuration Guide*.

9. If you want to run DCE, start DCE now. You must configure DCE on each node on which you want to run DCE.

   For more information about OpenVMS external authentication, see Section 5.1.

10. Configure and start Advanced Server for OpenVMS. For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide*.

    If this node is running Advanced Server for OpenVMS, set up Advanced Server for OpenVMS for startup on reboot (edit the SYS$STARTUP file as necessary). You must reboot 0 to *n* times as needed, depending on your system configuration.

    If this node is not running Advanced Server for OpenVMS, edit the `SYLOGICALS.COM` file and define the `PWRK$ACME_SERVER` logical. For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide*. For more information about the `PWRK$ACME_SERVER` logical, see Table 8–2.

11. Start the ACME server. Use the following command:

    ```
    $ @SYS$STARTUP:NTA$STARTUP_NT_ACME
    ```

12. Start RPC. Use the following command:

    ```
    $ @SYS$STARTUP:DCE$RPC_STARTUP.COM
    ```

13. Configure *COM for OpenVMS*. For this procedure, see Section 4.10 and Section 6.2.

    - Populate the OpenVMS Registry. For this procedure, see Section 6.2. Use option 3 to populate the OpenVMS Registry database. You need to populate the OpenVMS Registry only once in a cluster.
    - Create any OpenVMS and Advanced Server for OpenVMS accounts needed by the *COM for OpenVMS* Service Control Manager. For more information, see Section 6.2. Use option 8 to create the accounts. You need to create these accounts only once in a cluster.

14. Edit the `SYLOGICALS.COM` file and add the following line:

    ```
    $ DEFINE DCOM$TO_BE_STARTED TRUE
    ```

15. Start *COM for OpenVMS*. For this procedure, see Section 4.11.

4.7 Upgrading COM for OpenVMS in an OpenVMS Cluster

Note

This cluster upgrade procedure assumes you are installing *COM for OpenVMS* on a single system disk.

Note

Before you start, Compaq recommends that you disable any Advanced Server for OpenVMS and layered products automatic startups so these products do not start until you have upgraded *COM for OpenVMS* and its associated components.

Use the following procedure:

- Edit the `SYLOGICALS.COM` file to stop the following products from starting:
  - OpenVMS Registry (comment the line `DEFINE/SYSTEM REG$TO_BE_STARTED TRUE`)
  - *COM for OpenVMS* (comment the line `DEFINE DCOM$TO_BE_STARTED TRUE`)
- Edit the `SYS$STARTUP:SYSTARTUP_VMS.COM` file to stop the following products from starting:
  - Advanced Server for OpenVMS (comment the line `@SYS$STARTUP:PWRK$STARTUP.COM`)

If *COM for OpenVMS* is currently running, shut down *COM for OpenVMS* first, Advanced Server for OpenVMS (if running), and then the OpenVMS Registry on all nodes in the cluster.

Use the following procedure:

1. Upgrade to OpenVMS Version 7.2-1 on all required system disks. For this procedure, see the *OpenVMS Alpha Version 7.x Upgrade and Installation Manual.*
2. Upgrade TCP/IP. For this procedure, see the *DIGITAL TCP/IP Services for OpenVMS: Installation and Configuration* manual or your TCP/IP supplier's documentation.
3. Boot the upgraded system from the system disk.
4. Upgrade to *COM Version 1.1-B for OpenVMS*. For this procedure, see Section 4.9.
5. Upgrade Advanced Server for OpenVMS on this node in the cluster. For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide.*

Note

You must install Advanced Server for OpenVMS on at least one Alpha node in the cluster. On the other nodes, you can either install Advanced

Server for OpenVMS or select `External Authentication images (only)`.

---

6. Configure TCP/IP (set up for startup on reboot on each node). You must configure the PWIP driver for Advanced Server for OpenVMS to use TCP/IP. For information about configuring TCP/IP, see the *DIGITAL TCP/IP Services for OpenVMS: Installation and Configuration* manual or your TCP/IP supplier's documentation.
7. Configure the OpenVMS Registry as follows:
   - Run `REG$CONFIG.COM` to configure the OpenVMS Registry. See Section 11.2. You need to configure the OpenVMS Registry only once for the cluster.
   - Edit the `SYLOGICALS.COM` file on every node that will run the OpenVMS Registry server to define the `SYS$REGISTRY` logical. For example:

     ```
     $ DEFINE/SYSTEM SYS$REGISTRY cluster-visible-directory-specification
     ```

     Edit the `SYLOGICALS.COM` file on every node in the cluster as follows:
     - — If the cluster uses a single, cluster-common `SYLOGICALS.COM` file that is called by each node's `SYLOGICALS.COM` file, you do not need to make any changes.
     - — On those nodes where you do not want the OpenVMS Registry server to run, add the following line to the `SYLOGICALS.COM` file:

       ```
       $ DEFINE/SYSTEM REG$TO_BE_STARTED FALSE
       ```
8. Configure and start Advanced Server for OpenVMS. For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide.*

   If this node is running Advanced Server for OpenVMS, set up Advanced Server for OpenVMS for startup on reboot (edit the SYS$STARTUP file as necessary). You must reboot 0 to *n* times as needed, depending on your system configuration.

   If this node is not running Advanced Server for OpenVMS, edit the `SYLOGICALS.COM` file and define the `PWRK$ACME_SERVER` logical. For this procedure, see the *Advanced Server for OpenVMS/Server Installation and Configuration Guide.* For more information about the `PWRK$ACME_SERVER` logical, see Table 8–2.
9. Start the ACME server. Use the following command:

   ```
   $ @SYS$STARTUP:NTA$STARTUP_NT_ACME
   ```
10. Start RPC. Use the following command:

    ```
    $ @SYS$STARTUP:DCE$RPC_STARTUP.COM
    ```
11. See Appendix D for detailed information about upgrading from *COM Version 1.0 for OpenVMS* to *COM Version 1.1-B for OpenVMS*.
12. Configure *COM for OpenVMS*. For this procedure, see Section 4.10 and Section 6.2.
    - Populate the OpenVMS Registry. For this procedure, see Section 6.2. Use option 3 to populate the OpenVMS Registry database. You need to populate the OpenVMS Registry only once in a cluster.

- Create any OpenVMS and Advanced Server for OpenVMS accounts needed by the *COM for OpenVMS* Service Control Manager. For more information, see Section 6.2. Use option 8 to create the accounts. You need to create these accounts only once in a cluster.

13. Edit the `SYLOGICALS.COM` file and add the following line:

```
$ DEFINE DCOM$TO_BE_STARTED TRUE
```

14. Start *COM for OpenVMS* on a particular node. For this procedure, see Section 4.11.

4.8 Understanding the COM for OpenVMS Environment

COM for OpenVMS relies on a number of interrelated servers (processes) and operating system images. In most cases, the servers start automatically when you restart the system. (Automatic startup requires that you have installed and configured each component and have made appropriate changes to the `SYLOGICALS.COM` file.) For more information about starting and configuring the servers, see Section 4.3.

Figure 4–1 shows the relationships and dependencies of the processes and operating system layers.

Figure 4–1 Processes/Layers Relationships

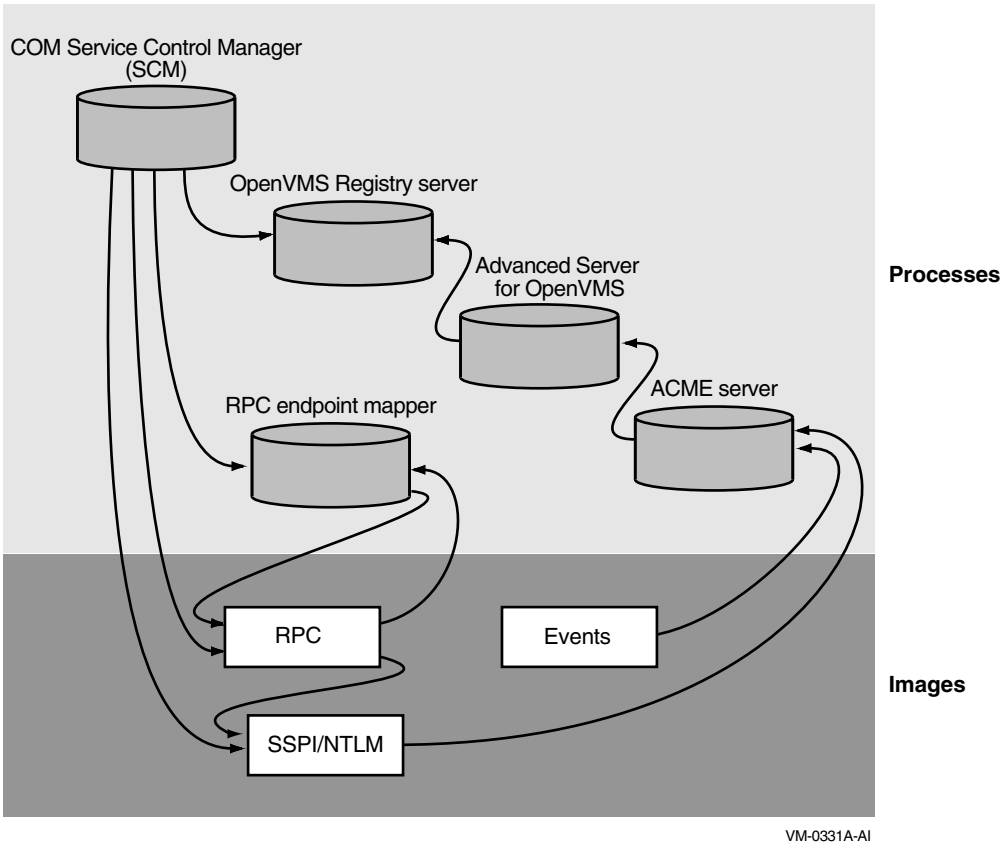


Table 4–1 lists the process names and maps each name to its corresponding server.

Table 4–1 Process Name to Server Name Mapping

Process name	Server name	For more information
DCOM$RPCSS	*COM for OpenVMS* Service Control Manager (SCM)	Section 4.8.1
REGISTRY_ SERVER	OpenVMS Registry server	Section 4.8.2
PWRK*xxx*	Advanced Server for OpenVMS server (multiple processes)	Section 4.8.3
ACME_SERVER	ACME server	Section 4.8.4
DCE$RPCD	RPC endpoint mapper	Section 4.8.5

The following sections list and describe the servers and the layers.

4.8.1 COM for OpenVMS Service Control Manager (SCM)

The *COM for OpenVMS* Service Control Manager enables *COM for OpenVMS*.

Process name: DCOM$RPCSS

Requires: OpenVMS Registry, OpenVMS (RPC and SSPI/NTLM layers)

Required by: COM applications

Configured by: DCOM$SETUP. See Section 6.2.

Started by: DCOM$SETUP, option 4. See Section 6.2.

Shutdown procedure: DCOM$SETUP, option 5. See Section 6.2.

4.8.2 OpenVMS Registry Server

The OpenVMS Registry server manages the OpenVMS Registry database.

Process name: REGISTRY_SERVER

Requires: None.

Required by: *COM for OpenVMS*, Advanced Server for OpenVMS

Configured by: REG$CONFIG. See Section 11.2.

Started by: REG$STARTUP. See Section 11.3.1.

Shutdown procedure: SET SERVER REGISTRY_SERVER/EXIT. For more information, see Section 11.4.

4.8.3 Advanced Server for OpenVMS Server

The Advanced Server for OpenVMS server provides Windows NT and OpenVMS connectivity.

Process names:

NETBIOS
PWRK$ADMIN_0
PWRK$KNBDAEMON
PWRK$LICENSE_R
PWRK$LMBROWSER
PWRK$LMDMN

PWRK$LMMCP
PWRK$LMSRV
PWRK$MASTER
PWRK$MONITOR
PWRK$NBDAEMON

The ACME server requires the PWRK$LMSRV process specifically.

Requires: OpenVMS Registry

Required by: ACME server

Configured by: PWRK$CONFIG

Started by: PWRK$STARTUP

Shutdown procedure: PWRK$SHUTDOWN

For more information, see the *DIGITAL PATHWORKS for OpenVMS (Advanced Server) Server Migration Guide*.

4.8.4 ACME Server

The ACME server controls the granting of credentials.

Process name: ACME_SERVER

Requires: Advanced Server for OpenVMS

Required by: OpenVMS (RPC and SSPI/NTLM layers) and OpenVMS Events

Started:

- Automatically when the SYLOGICALS.COM file contains the following line:
  NTA$NT_ACME_TO_BE_STARTED YES
- You can also start the ACME server manually by entering the following command:

```
$ @SYS$STARTUP:NTA$STARTUP_NT_ACME
```

Shutdown procedure:

```
$ SET SERVER ACME {/EXIT | /ABORT}
```

For more information, see Section 8.3.2.

4.8.5 RPC Endpoint Mapper

The RPC endpoint mapper controls authentication and security.

Process name: DCE$RPCD

Requires: RPC image

Required by: *COM for OpenVMS* Service Control Manager, RPC image

Started by: OpenVMS

Shutdown procedure: Use the following command procedure:

```
$ @SYS$STARTUP:DCE$RPC_SHUTDOWN.COM
```

For more information, see the *DIGITAL DCE for OpenVMS VAX and OpenVMS Alpha* manual.

4.8.6 RPC and SSPI/NTLM Layers

The RPC and SSPI/NTLM layers provides remote procedure call and Windows NT-style authentication on OpenVMS.

Process name: n/a (part of OpenVMS operating system)

Requires: OpenVMS, ACME server

Required by: *COM for OpenVMS*

Started by: OpenVMS

Shutdown procedure: n/a

4.8.7 OpenVMS Events

The Events layer provides Windows NT-style event logging on OpenVMS.

Process name: n/a (part of OpenVMS operating system)

Requires: ACME server

Required by: *COM for OpenVMS*

Started by: OpenVMS

Shutdown procedure: n/a

For more information, see Chapter 14.

4.9 Installing COM for OpenVMS

The *COM for OpenVMS* installation kit contains a single POLYCENTER Software Installation file. The name of the kit is `DEC-AXPVMS-DCOM-V0101-B-1.PCSI`. You must install the *COM for OpenVMS* files on an OpenVMS Alpha Version 7.2-1 system. Please check the prerequisites before installing the kit. See Section 4.2.

To install *COM for OpenVMS*, invoke the POLYCENTER Software Installation utility using the following command:

```
$ PRODUCT INSTALL /SOURCE=device:[user] DCOM
```

For *device*:[*user*], specify the device name and directory location of the kit, respectively.

MIDL compiler license no longer required

The *COM for OpenVMS* MIDL compiler no longer requires the DCOM-MIDL license.

Example 4–1 shows a sample installation.

Example 4–1 Sample *COM for OpenVMS* Installation

```
$ product install dcom/source=disk:[directory]

The following product has been selected:
    CPQ AXPVMS DCOM V1.1-B                Layered Product

Do you want to continue? [YES]

Configuration phase starting ...

You will be asked to choose options, if any, for each selected product
and for any products that may be installed to satisfy software dependency
requirements.

CPQ AXPVMS DCOM V1.1-B

    Copyright Compaq Computer Corporation 2000. All rights reserved.

Do you want the defaults for all options? [YES]

    The following software is required to run COM for OpenVMS

      - OpenVMS Alpha V7.2-1 or later
        - Includes DCE RPC and OpenVMS Registry
      - TCP/IP Services for OpenVMS V5.0 or later (or equivalent product)
      - Advanced Server for OpenVMS V7.2A or later


    Do you want to continue? [YES]

Do you want to review the options? [NO]

Execution phase starting ...

The following product will be installed to destination:
    CPQ AXPVMS DCOM V1.1-B
DISK$AXP_72PLUS:[VMS$COMMON.]

Portion done:
0%...10%...20%...30%...40%...50%...60%...70%...80%...90%...100%

The following product has been installed:
    CPQ AXPVMS DCOM V1.1-B                Layered Product

$
```

4.10 COM for OpenVMS Postinstallation Procedures

After you install the *COM for OpenVMS* kit, do the following:

1. Verify that the OpenVMS Registry is running. (See Chapter 11.)
2. Verify that the Advanced Server for OpenVMS is running. (See Section 4.8.3 for the Advanced Server for OpenVMS process names.)
3. Verify that the ACME server is running. (See Section 4.8.4 for the name of this process.)
4. Verify that the RPC daemon is running. (See Section 4.8.5 for the name of the process.)
5. Populate the OpenVMS Registry with the required *COM for OpenVMS* keys and values using the `DCOM$SETUP` utility, option 3. (See Section 6.2.) You must do this only once on an OpenVMS cluster.
6. Configure the DCOM$RPCSS account using the `DCOM$SETUP` utility, option 8. (See Section 6.2.1.) You must do this only once on an OpenVMS cluster.
7. Start *COM for OpenVMS* using the `DCOM$SETUP` utility, option 4. (See Section 6.2.) You must do this on every node in an OpenVMS cluster.

8. If you want *COM for OpenVMS* to start automatically when the system reboots, modify the DEFINE DCOM$TO_BE_STARTED line in the SYLOGICALS.COM file. (See Section 4.11.1.) You must do this on every node in an OpenVMS cluster.
9. Configure *COM for OpenVMS* security. See Chapter 5.

4.11 Starting COM for OpenVMS (COM for OpenVMS Service Control Manager)

Use the following command to start *COM for OpenVMS*:

```
$ @SYS$STARTUP:DCOM$STARTUP
```

Alternately, you can run DCOM$SETUP and choose option 4. (See Section 6.2.)

The *COM for OpenVMS* Service Control Manager can be in one of the following states: initializing/running or not started. Depending on the *COM for OpenVMS* Service Control Manager state, you will see one of the following messages:

- If the *COM for OpenVMS* Service Control Manager is running on this node, the system reports that the process is already active:

  ```
  DCOM Service Control Manager daemon (DCOM$RPCSS) is active [pid=xxxxxxxx]
  ```

  If the *COM for OpenVMS* Service Control Manager is initializing on this node, the system reports that the process is already active:

  ```
  DCOM Service Control Manager daemon (DCOM$STARTUP-**) is active [pid=xxxxxxxx]
  ```

- If the *COM for OpenVMS* Service Control Manager is not started on this node, the system starts *COM for OpenVMS* as follows:

  ```
  The OpenVMS Registry server is already started on this node.
           ***  DCOM system startup procedure  ***
   Starting DCOM Service Control Manager daemon ( "DCOM$STARTUP-**" ) . . .
   After initialization, the daemon will use process name "DCOM$RPCSS" . . .
  %RUN-S-PROC_ID, identification of created process is xxxxxxxx
           ***  DCOM startup successful  ***
      ***  DCOM Startup Procedure Complete  ***
  ```

4.11.1 Starting COM for OpenVMS Automatically after a Reboot

Compaq recommends that you modify the SYS$MANAGER:SYLOGICALS.COM command file to control *COM for OpenVMS* startup.

OpenVMS includes a revised SYLOGICALS.TEMPLATE file that includes new startup commands for *COM for OpenVMS* and related components. Review the ''Coordinated Startup'' section of this template file and add the appropriate information to your existing startup files.

To have *COM for OpenVMS* start automatically when the system boots, copy the following line to your SYLOGICALS.COM file, uncomment the line, and make sure it is set to TRUE:

```
$ DEFINE DCOM$TO_BE_STARTED TRUE
```

If you do not set *COM for OpenVMS* to start automatically when the system boots, you can start *COM for OpenVMS* using the DCOM$SETUP OpenVMS COM Tools menu, option 4 (see Section 6.2).

4.12 Shutting Down COM for OpenVMS (COM for OpenVMS Service Control Manager)

Use the following command to shut down *COM for OpenVMS*:

```
$ @SYS$STARTUP:DCOM$SHUTDOWN
```

Alternately, you can run DCOM$SETUP and choose option 5. (See Section 6.2.)

The *COM for OpenVMS* Service Control Manager can be in one of the following states: stopped, running, or initializing. Depending on the *COM for OpenVMS* Service Control Manager state, you will see one of the following messages:

- If the *COM for OpenVMS* Service Control Manager is stopped on this node, the system reports that there is nothing to shut down:

```
        ***  DCOM system shutdown procedure  ***

   There is no active DCOM$RPCSS daemon on this system.

     ***  DCOM Shutdown Procedure Complete  ***
```

- If the *COM for OpenVMS* Service Control Manager is running on this node, the system shuts down the process as follows:

```
        ***  DCOM system shutdown procedure  ***

************************** Warning ********************************
***  Stopping the DCOM Service Control Manager daemon (DCOM$RPCSS)
***  Active DCOM applications will no longer be operational.

Do you want to proceed with this operation (YES/NO/?) [N]?
```

  Enter Y to continue with the shutdown procedure.

  Note

  For information about suppressing this confirmation step, see Section 4.12.1.

  The system displays the following messages:

```
   Terminating DCOM Service Control Manager daemon (DCOM$RPCSS) . . .

        ***  DCOM shutdown successful  ***

     ***  DCOM Shutdown Procedure Complete  ***
```

- If the *COM for OpenVMS* Service Control Manager is initializing on this node, the system shuts down the process as follows:

```
        ***  DCOM system shutdown procedure  ***

************************** Warning ********************************
***  Stopping the DCOM Service Control Manager daemon (DCOM$RPCSS)
***  Active DCOM applications will no longer be operational.

Do you want to proceed with this operation (YES/NO/?) [N]?
```

  Enter Y to continue with the shutdown procedure. The system displays the following messages:

```
   Terminating DCOM Service Control Manager daemon (DCOM$STARTUP-**) . . .

        ***  DCOM shutdown successful  ***

     ***  DCOM Shutdown Procedure Complete  ***
```

4.12.1 Suppressing the DCOM$SHUTDOWN Confirmation Request

You can suppress the DCOM$SHUTDOWN command confirmation request by specifying the NOCONFIRM parameter. Use the following command:

```
$ @SYS$STARTUP:DCOM$SHUTDOWN NOCONFIRM
```

The system displays the following shutdown messages without prompting you to confirm the shutdown:

```
        ***  DCOM system shutdown procedure  ***
Terminating DCOM Service Control Manager daemon (DCOM$RPCSS) . . .
        ***  DCOM shutdown successful  ***
    ***  DCOM Shutdown Procedure Complete  ***
```

5
COM for OpenVMS Security

COM Version 1.1-A for OpenVMS and *COM Version 1.1-B for OpenVMS* support NTLM (NT LAN Manager) authentication for controlling access to COM objects.

Processes that execute client and server applications must obtain Windows NT credentials in order to be authenticated. Processes created automatically by `DCOM$RPCSS` to execute server applications obtain Windows NT credentials based on the Registry settings for the server being launched. Interactive processes that are used to execute client and server applications must obtain Windows NT credentials by running the `NTA$LOGON` utility (see Section 8.2).

This chapter applies to *COM for OpenVMS* in authenticated mode. See Appendix E for information about running *COM for OpenVMS* in an unauthenticated environment.

This chapter discusses the following topics:

- How to configure an OpenVMS system for NTLM authentication
- How to acquire Windows NT credentials
- The way security affects COM applications
- The way your domain configuration affects COM applications
- The Application Server run-time environment

5.1 System Configuration

NTLM authentication on OpenVMS is implemented in three major components of the operating system (see Section 4.8).

- ACME server — controls the granting of credentials
- RPC and SSPI — provide remote procedure calls and Windows NT-style authentication
- Advanced Server for OpenVMS — maintains Windows NT accounts and provides mapping of Windows NT accounts to OpenVMS accounts

The ACME server, RPC, and SSPI are installed as part of the OpenVMS operating system and require no special configuration. Advanced Server for OpenVMS must be installed as a layered product and must be configured to support NTLM authentication for COM applications (see Section 4.4).

After installing Advanced Server for OpenVMS, you must create network accounts that will be used to execute COM applications. You must also map the network accounts to OpenVMS accounts.

The Advanced Server ADMINISTER utility is used to create network accounts. For example, to create the network account NTUSER1, use the following command:

```
$ ADMINISTER ADD USER NTUSER1 /PASSWORD="pppppp" /FLAG=NOPWDEXPIRED
```

The password is case sensitive, so it is enclosed in quotation marks in order to maintain case. A password without quotation marks is converted to uppercase. By default, network accounts are created with the password pre-expired, thus forcing the user to change the password at the first login. The NOPWDEXPIRED flag overrides this default.

A hostmap entry defines the association between a Windows NT user account and a local OpenVMS user account. When OpenVMS authenticates a Windows NT user, OpenVMS uses the hostmap entry to map the OpenVMS user account to the Windows NT user account and build the local OpenVMS user profile and the Windows NT user profile. If no hostmap entry exists, OpenVMS uses the Windows NT user account name as the local OpenVMS user account name.

Use the Advanced Server for OpenVMS ADMINISTER utility to define hostmap information. For example, to map the network account NTUSER1 to the OpenVMS account VMSUSER1, use the following command:

```
$ ADMINISTER ADD HOSTMAP NTUSER1 VMSUSER1
```

If the OpenVMS account does not already exist, you must create the account using the OpenVMS Authorize utility (AUTHORIZE). The OpenVMS account must have the EXTAUTH flag set, or the IGNORE_EXTAUTH flag (bit 11, %X0800) must be set in the SECURITY_POLICY SYSGEN parameter (see Section 5.1). This policy allows the OpenVMS system manager to control which OpenVMS user accounts can be used with Windows NT authentication. For example, to set the EXTAUTH flag for an OpenVMS account VMSUSER1, use the following command. For example:

```
$ MCR AUTHORIZE MODIFY VMSUSER1 /FLAG=EXTAUTH
```

5.1.1 LOGINOUT.EXE Use of External Authentication

The EXTAUTH flag also directs `LOGINOUT.EXE` to use external authentication to authenticate an OpenVMS user during the login process (that is, local, dialup, remote, interactive, and network logins). When you set the EXTAUTH flag, `LOGINOUT.EXE` uses external authentication, not the password in the SYSUAF.DAT record, to verify the OpenVMS user name and password.

LOGINOUT external authentication always requires that you set the EXTAUTH flag in the SYSUAF account record. Unlike `NTA$LOGON` and authenticated RPC, you cannot override this requirement using the IGNORE_EXTAUTH flag.

5.1.2 DCE Integrated Login Restriction

A site cannot use both external authentication and the older LGI-callout feature on the same system. If you have an LGI-callout image installed, external authentication is disabled for login purposes. Because DCE integrated login uses the LGI-callout mechanism, OpenVMS does not allow logins using Windows NT-based external authentication if DCE integrated login is enabled.

5.2 Cross-Domain Configuration

You can run a COM application on a system in one domain and have the application authenticated by a system in a second domain.

To configure authentication across Windows NT domains, you must do the following:

1. Set up trust relationships between domains.

   For more information, see the *Advanced Server for OpenVMS Server Administrator's Guide*.

2. Set up the HostMapDomains parameter on Advanced Server for OpenVMS domains (see Example 5–1).

   For more information, see the *Advanced Server for OpenVMS Server Administrator's Guide*.

3. Set up account hostmap entries between the Windows NT user account and a local OpenVMS user account.

Example 5–1 shows how you can set up the HostMapDomains parameter. In this example, there are two domains: DOMAIN_1 and DOMAIN_2. Domain DOMAIN_2 is running Advanced Server for OpenVMS; domain DOMAIN_1 is a Windows NT domain. The commands in Example 5–1 introduce DOMAIN_2 to DOMAIN_1.

Example 5–1 Sample: Setting Up HostMapDomains

```
SYSJANE$ show sym regutl
  REGUTL == "$SYS$SYSTEM:PWRK$REGUTL.EXE"
SYSJANE$ regutl
REGUTL> SET PARAM /CREATE VMSSERVER HOSTMAPDOMAINS DOMAIN_1
REGUTL> SHOW VALUE * HOSTMAPDOMAINS
Key: SYSTEM\CurrentControlSet\Services\AdvancedServer\UserServiceParameters
Value: HostmapDomains
Type: String
Current Data: DOMAIN_1
```

5.3 Acquiring Windows NT Credentials

After the network account and the OpenVMS account have been set up as described in Section 5.1, you can log in to the OpenVMS account using the usual OpenVMS login procedures. You can then acquire Windows NT credentials using the NTA$LOGON utility. For example:

```
$ MCR NTA$LOGON NTUSER1 "pppppp"
```

In this format, *pppppp* is the password you specified when you created the network account. The password is enclosed in quotation marks to preserve case. A password without quotation marks is converted to lowercase. If the user name or password is not specified on the command line, the program prompts the user for the required input (see Section 8.2).

To acquire Windows NT credentials for a network account using NTA$LOGON, you must be logged in to the OpenVMS account that is mapped to the network account. Alternatively, if you are logged in to a different OpenVMS account, you must have the IMPERSONATE privilege and use the /OVERRIDE_MAPPING switch. For example:

```
$ MCR NTA$LOGON /OVERRIDE_MAPPING NTUSER2 "pppppp"
```

To determine whether a process has Windows NT credentials, use the NTA$LOGON utility with the /LIST switch. For example:

```
$ MCR NTA$LOGON /LIST
```

5.4 Application Security

The COM security model allows the creation of secure distributed applications. COM security can be enabled by using settings in the OpenVMS Registry and by using COM security APIs and interfaces. There are two primary areas of security that can be applied to COM applications: launch security and activation security.

Launch security and activation security have system default settings; application-specific settings override these defaults. The settings are stored in the Registry and are maintained by using the DCOMCNFG utility on Windows NT and by using the DCOMCNFG option of DCOM$SETUP.COM on OpenVMS. The COM API CoInitializeSecurityEx can be used from within an application to enhance or override the Registry settings.

5.4.1 Launch Security

Launch security determines which network accounts can be used to create, or ''launch'' server processes. The launch security settings are referenced when a COM request is received on a system that will result in the launching of a server process to satisfy the request. These settings can explicitly or implicitly allow or disallow a user request to launch a server. The DCOM$RPCSS process authenticates the incoming request to determine the identity of the client. If DCOM$RPCSS determines that it needs to launch a server process to satisfy the request, DCOM$RPCSS allows or disallows the launching of the server based on the identity of the client and the launch security settings.

5.4.2 Activation Security

Activation security determines which network accounts can be used to execute method calls in server applications. The activation security settings are referenced when a COM request is received on a system for a method call in an existing server process. The server process authenticates the incoming request to determine the identity of the client. The server process allows or disallows the execution of the method call based on the identity of the client and the activation security settings.

5.4.3 Server Process Identity

A server process created by DCOM$RPCSS on OpenVMS is a detached process that has an OpenVMS identity and follows all the OpenVMS security rules for a detached process. In addition, it has a network identity that is used to enforce the COM security model (see Section 5.5).

COM servers create separate server threads to execute each client request. These server threads have their own OpenVMS identity and network identity, based on the identity of the client. When a server thread is executing a request on behalf of a client, it is the thread's identities, not the process' identities, that are used to enforce security.

5.4.4 Domain Issues

Two systems running COM client and server applications can exist in one of three possible domain configurations:

- Systems are in the same domain
- Systems are in separate domains with trusts established between the two domains
- Systems are in separate domains without trusts, or systems are not in a domain

The ability for servers and DCOM$RPCSS to authenticate client requests are affected by the domain configurations. When both systems are in the same domain or when the systems are in separate but trusted domains there is no problem authenticating. The trusted domain configuration is a bit more complex and requires that the trusts and mappings be configured correctly but once configured, there is no trouble authenticating (see Section 5.2).

Systems in separate, nontrusted domains or systems not in any domain cannot be authenticated using the normal mechanisms. To run authenticated COM applications between such systems, you must pass authentication information (user name and password) from the client to the server. COM provides this capability in the CoCreateInstanceEx API. The pServerInfo parameter of the CoCreateInstanceEx API allows you to specify a user name and password to be used for authentication on the remote server system. The user name and password are part of the COAUTHIDENTITY structure, within the COAUTHINFO structure within the COSERVERINFO structure, that is passed as the pServerInfo parameter to CoCreateInstanceEx.

Section C.3 shows how you can authenticate a remote client that is neither in the server's domain nor in a domain that has a trust with the server's domain.

The current NTLM security implementation on OpenVMS does not support this feature for COM client applications on OpenVMS. This feature is supported for COM clients on Windows NT that communicate with COM servers on OpenVMS. To run COM client applications on OpenVMS where the server is not in the same domain or in a trusted domain, you must disable authentication for the application, as described in Section 5.4.5.

5.4.5 Disabling Authentication

Under certain conditions, you may want to disable authentication between a client and server applications. This feature disables many of the security features of COM and of the operating system and should not be used in an environment where security is required. There are two ways to disable authentication for COM applications:

- Use DCOMCNFG to change the default authentication level to **None** on both systems.
- Add a call to CoInitializeSecurity in both the client and server applications and set the dwAuthnLevel parameter to RPC_C_AUTHN_LEVEL_NONE.

The server must be configured to run with a specific NTLM account identity. Since the client will not be authenticated, there is no way for the server to run with a client's identity. To configure a server to run with a specific NTLM identity, use DCOMCNFG and change the application properties to select the NTLM account.

5.4.6 Access Denied Problems (80070005)

The most common security error a COM application will encounter is access denied (error status value 80070005). The following is a list of the most common causes of this error:

- Client process on OpenVMS does not have Windows NT credentials. Run NTA$LOGON to acquire Windows NT credentials.
- Application-specific launch or access permissions do not allow access. Check the application settings using DCOMCNFG (see Section 6.3.1).
- System default launch or access permissions do not allow access. Check the system defaults using DCOMCNFG (see Section 6.3.6).
- CoInitializeSecurityEx API call is incorrect. Verify that the client and server security calls are valid.
- Server process or thread does not have permission to perform a particular operation. Verify that the OpenVMS identity being used to execute a client request has the necessary privileges to perform the operation.
- Server process does not have access to the server images. Verify that the OpenVMS identity used to launch a server process has read and execute permissions for the server image and any dynamically loaded images (.EXE files).
- Advanced Server hostmap entry problems. In order for NTLM authentication to work correctly, network accounts must be mapped to OpenVMS accounts (see Section 5.1). To verify the mapping of network accounts to OpenVMS accounts, use the ADMINISTER command:

  ```
  $ ADMINISTER SHOW HOSTMAP
  ```

  In a multiple-domain environment with trusts established between domains, cross-domain mappings must be created (see Section 5.2). Under certain conditions, the Advanced Server is unable to verify a user account associated with a hostmap entry. Any attempt to display the hostmap entry of a user name that can not be verified will result in the user name being displayed using its eight-digit hexadecimal internal representation (for example, "DOMAINNAME\000003fd"). If this happens, verify that the Advanced Server is running on each machine. You should also verify the trusts between domains using the following ADMINISTER command:

  ```
  $ ADMINISTER SHOW TRUST
  ```

  If the trusts are valid and the hostmap entries are still displayed with the numeric format, you should shut down and restart the Advanced Server.

5.5 Server Run-Time Environment

When DCOM$RPCSS launches a server in response to a client request for a COM object, DCOM$RPCSS creates a detached process and executes either the server image or server command file in the context of the detached process. The image or command file that is executed is determined by the value of the Registry key HKEY_CLASSES_ROOT\CLSID\{*iid*}\LocalServer32, where *iid* is the unique identifier of the COM object.

The run-time environment of the detached process is as follows:

- Default directory

The default directory of the detached process is the same as the default directory of DCOM$RPCSS. This is determined by the default directory of the process that executed the DCOM$STARTUP command file. If DCOM$STARTUP is executed by the system startup procedure, then the default directory will be SYS$SYSTEM.

- Windows NT identity

  Depends on the application identity setting. This setting is made using DCOMCNFG.

  If the application identity is set to ''launching user'' (the default), then the Windows NT identity of the detached process is the same as the Windows NT identity of the client.

  If the application identity is set to a specific NTLM account then the Windows NT identity of the detached process is that of the NTLM account.

- OpenVMS user name

  The OpenVMS user name of the detached process is the user name that is mapped to the Windows NT identity of the detached process. The mapping of OpenVMS user name to Windows NT identity is established using the Advanced Server ADMINISTER utility (see Section 5.1).

- OpenVMS privileges

  Depends on the application identity setting. This setting is made using DCOMCNFG.

  If the application identity is set to ''launching user'' (the default), then the privileges depend on the location of the client. If the client is running on the same system as the server, then the privileges of the detached process will match the privileges of the client. If the client is running on a different system from the server, then the privileges of the detached process will be the default privileges of the OpenVMS user name account.

  If the application identity is set to a specific NTLM account then the privileges of the detached process will be the default privileges of the OpenVMS user name account.

- Process logicals

  SYS$INPUT and SYS$OUTPUT are defined to the disk device where the server image or command file is located. For example, if the server image is DKA0:[TEST]CMPNT.EXE, then SYS$INPUT and SYS$OUTPUT are defined to DKA0:. SYS$SCRATCH is not defined.

  If these environment settings are not sufficient for the successful execution of your server, then you should explicitly define the environment settings you need. One way to easily set up an environment for your server is to create a command file to run your server, and register the command file, instead of the executable image, as the file to be executed when the server is launched. You can define the environment in the command file prior to executing the server image. For example, if you build SAMPLE1 in the directory DKA0:[SAMPLE1] and register it using the BUILD_SAMPLE1 command file, then the server image will be named DKA0:[SAMPLE1]CMPNT.EXE. The Registry key HKEY_CLASSES_ROOT\CLSID\{0C092C21-882C-A6BB-0080C7B2D682}\LocalServer32 will have a value of DKA0:[SAMPLE1]CMPNT.EXE. You can change the value of that key to DKA0:[SAMPLE1]RUN_CMPNT.COM and create the command file, as follows:

```
$! RUN_CMPNT.COM
$! Command file to run SAMPLE1
$ set default DKA0:[SAMPLE1]
$ define sys$output DKA0:[SAMPLE1]SAMPLE1.LOG
$ ! Other definitions as needed
$  RUN CMPNT.EXE
$ exit
```

When DCOM$RPCSS receives a request for SAMPLE1 and launches a server, the server executes this command file in the detached process.

6

COM for OpenVMS Utilities for Application Development and Deployment

This chapter describes how to configure your OpenVMS system (and, optionally, your Windows NT system) to develop and deploy COM applications. It describes the following *COM for OpenVMS* utilities:

- The DCOM$SETUP utility, which helps a system manager configure the *COM for OpenVMS* system environment.
- The DCOM$CNFG utility, which helps an application developer configure and examine COM applications.
- The DCOM$REGSVR32 utility, which allows an application developer to register and unregister in-process server applications.

This chapter also includes information about configuring OpenVMS and Windows NT systems to interoperate.

Before you begin

Before you configure *COM for OpenVMS* on your OpenVMS system, you must install and configure required components and install *COM for OpenVMS*. See Chapter 4 for information about these steps.

6.1 DCOM$SETUP Utility

DCOM$SETUP is a collection of tools to help a system manager configure the *COM for OpenVMS* system environment.

DCOM$SETUP Conventions and Requirements

- For Yes/No questions, you can enter any one of the following:
  - YES or NO
  - Y or N
  - Return (to accept the default value)
- Some DCOM$SETUP options require system manager privileges and OpenVMS Registry access.

6.2 Running DCOM$SETUP

To run DCOM$SETUP, enter @SYS$STARTUP:DCOM$SETUP at the OpenVMS system prompt.

The system displays the OpenVMS COM Tools menu.

Figure 6–1 DCOM$SETUP OpenVMS COM Tools Menu

```
------------------------------------------------------
                    OpenVMS COM Tools

          1) DCOMCNFG, COM Configuration Properties
          2) GUIDGEN, Globally Unique Identifier Generator
          3) Populate the Registry database for COM
          4) Start the COM server
          5) Stop the COM server
          6) Register a COM application
          7) Create the DCOM$GUEST account and directory
          8) Configure the DCOM$RPCSS accounts

          H) Help
          E) Exit

Please enter your choice:
------------------------------------------------------
```

To choose an option, enter the option number. The options are as follows:

- 1) DCOMCNFG, COM Configuration Properties

  Use to query information and manipulate properties of *COM for OpenVMS* applications. For more information, see Section 6.3.

- 2) GUIDGEN, Globally Unique Identifier Generator

  Generate CLSIDs (class IDs) (or GUIDs [globally unique identifiers]) in various formats (for example, the OpenVMS Registry or Windows NT Registry format). The CLSID tags each application with a unique identifier.

  This version of DCOM$SETUP generates GUIDs in OpenVMS Registry and Windows NT Registry formats only. For a discussion of other formats, see Section 7.1.

- 3) Populate the Registry database for COM

  Set up the OpenVMS Registry database. *COM for OpenVMS* requires that specific keys and values be added to the OpenVMS Registry database. You must have both write access to the OpenVMS Registry and Windows NT Administrator privileges.

- 4) Start the COM server

  Start the *COM for OpenVMS* Server Control Manager server (DCOM$RPCSS). DCOM$SETUP calls the SYS$STARTUP:DCOM$STARTUP procedure to start the server. For more information, see Section 6.2.2.

- 5) Stop the COM server

  Shut down the *COM for OpenVMS* Service Control Manager server (DCOM$RPCSS). DCOM$SETUP calls the SYS$STARTUP:DCOM$SHUTDOWN procedure to stop the server. For more information, see Section 6.2.2.

- 6) Register a COM application

Register a *COM for OpenVMS* server application. You can register the following types of servers:

— In-process server

When you register an in-process server, the system prompts you for the server's location.

— Local server or out-of-process server

When you register a local server or out-of-process server, the system prompts you for the following information:

+ Full path information (location of the server)

  This is a required value. Use the following syntax: *device*::[*directory*]*file-name.ext*

+ Application title

  This is an optional value. If you do not supply a title, the system uses a default title.

+ CLSID (GUID)

  This is a required value. If the server does not have a CLSID, the system generates one automatically. For more information about CLSIDs and LocalServer32, see Section 7.5.1.

After you complete the registration process, the system generates the following files:

1. A Windows NT Registry file (*server-name*.REG_NT) that you can use to register the application on a Windows NT system.
2. An OpenVMS command procedure (*server-name*.REG_VMS) that you can use to register the server on an OpenVMS system.

When you use these files on other systems, you must modify the path statement to point to the server's current location. For more information, see Section 6.2.3.

- 7) Create the DCOM$GUEST account and directory

  You must create the DCOM$GUEST account before you can use *COM for OpenVMS* without NTLM authentication.

- 8) Configure the DCOM$RPCSS accounts

  Configure and create the DCOM$RPCSS Advanced Server for OpenVMS user and SYSUAF accounts. The *COM for OpenVMS* Service Control Manager (DCOM$RPCSS) requires these accounts for authentication. For more information, see Section 6.2.1.

- H) Help

  Display help about each menu option.

- E) Exit

  Exit the menu.

6.2.1 Creating and Configuring DCOM$RPCSS Accounts

To display these functions, choose option 8 from the OpenVMS COM Tools menu. The system displays the following:

```
------------------------------------------------------
Configure the COM for OpenVMS Service Control Manager (DCOM$RPCSS) accounts

   1) Create the DCOM$RPCSS account in both the SYSUAF database and the
      Advanced Server for OpenVMS SAM database. The password you specify
      for the new DCOM$RPCSS user is stored in a protected file.

   2) Update the DCOM$RPCSS user password in the COM for OpenVMS Service
      Control Manager password file.

   E) Exit

Please enter your choice:
------------------------------------------------------
```

Enter one of the following:

- `1) Create the DCOM$RPCSS account . . .`

  This option creates the `DCOM$RPCSS` account in both the SYSUAF database and the Advanced Server for OpenVMS SAM database.

  The password you specify for the DCOM$RPCSS user is stored in a protected file that the *COM for OpenVMS* Service Control Manager uses to log into the NTLM network and obtain a Windows NT identity.

  Note

  The system creates this account in the Advanced Server for OpenVMS database with a password that will not expire. To change this behavior (that is, modify the account so that the password expires according to the Advanced Server for OpenVMS User Policy), use the following procedure:

  1. Run the Advanced Server for OpenVMS ADMIN utility.
  2. Log into the Administrator account.
  3. Issue the following ADMIN command:

     ```
     ADMIN> MODIFY USER DCOM$RPCSS/FLAG=NODISPWDEXP
     ```

  To determine the maximum password age in the Advanced Server for OpenVMS User Policy, enter the following ADMIN command:

  ```
  ADMIN> SHOW ACCOUNT POLICY
  ```

  If you change the Advanced Server for OpenVMS password of the DCOM$RPCSS account, you must update the password in the *COM for OpenVMS* Service Control Manager password file. (See option 2 [Update the DCOM$RPCSS user password].)

  Use the following procedure:

  1. Enter `1`.

     The system displays the following:

```
        To create a new account, you must be logged on to an existing
        Advanced Server for OpenVMS account that is capable of adding
        new users.

Enter Y[ES] to log on to this account:
```

You must belong to the PATHWORKS administrator group to create this account.

2. Enter `Y`.

   The system prompts you to log on. The password is not displayed as you enter it.

```
Enter username: JOSEPHM
Password:
Confirm password:
```

   The system prompts you to enter a new password, and then asks you to confirm the password. The password is not displayed as you enter it.

```
        Enter the new DCOM$RPCSS password.

Enter password:
Confirm password:
```

   The system uses this password for both the SYSUAF account (DCOM$RPCSS) and the PATHWORKS user account (DCOM$RPCSS). The system stores this password in the *COM for OpenVMS* Service Control Manager password file.

   The system displays the following account creation information:

```
%PWRK-S-USERADD, user "DCOM$RPCSS" added to domain "DCOM1_DOMAIN"

Username: DCOM$RPCSS                        Owner:  COM
Account:                                    UIC:    [37776,1] ([DCOM$RPCSS])
CLI:      DCL                               Tables: DCLTABLES
Default:  SYS$SYSDEVICE:[DCOM$RPCSS]
LGICMD:
Flags:  ExtAuth
Primary days:   Mon Tue Wed Thu Fri
Secondary days:                     Sat Sun
No access restrictions
Expiration:            (none)    Pwdminimum:  6   Login Fails:     0
Pwdlifetime:           (none)    Pwdchange:      (pre-expired)
Last Login:            (none) (interactive),           (none) (non-interactive)
Maxjobs:         0  Fillm:       100  Bytlm:        64000
Maxacctjobs:     0  Shrfillm:      0  Pbytlm:           0
Maxdetach:       0  BIOlm:       150  JTquota:       4096
Prclm:           8  DIOlm:       150  WSdef:         1024
Prio:            4  ASTlm:       250  WSquo:         4000
Queprio:         4  TQElm:        10  WSextent:      8000
CPU:        (none)  Enqlm:      2000  Pgflquo:     130000
Authorized Privileges:
  NETMBX       TMPMBX
Default Privileges:
  NETMBX       TMPMBX
%PWRK-S-HOSTMAPADD, user "DCOM$RPCSS" mapped to host user "DCOM$RPCSS"

Press RETURN to continue:
```

- `2) Update the DCOM$RPCSS user password . . .`

  If you change the DCOM$RPCSS user password in the Advanced Server for OpenVMS SAM database, you must also update the password in the *COM for OpenVMS* Service Control Manager password file.

Use the following procedure:

1. Enter 2.

   The system displays the following:

```
        Enter the new DCOM$RPCSS password.

Enter password:
Confirm password:
```

2. Enter the new password and confirm the password.

- E) Exit

  Exit the menu.

6.2.2 Starting and Stopping the COM Server (DCOM$RPCSS Process)

COM for OpenVMS requires that the COM server process (DCOM$RPCSS) always be running. The DCOM$RPCSS process on OpenVMS provides the same functions for the COM run-time environment that the RPCSS process provides on Microsoft Windows NT, including the following:

- Build and maintain the list of server objects running on the system.
- Build and maintain a cache of known applications as defined in the registry. This cache improves COM performance.
- Start a server as a detached process whenever a client requests a connection to a server object that is not currently running.
- Communicate with the RPCSS process on remote Windows NT systems or the DCOM$RPCSS process on OpenVMS systems to locate or start remote server objects.

To start DCOM$RPCSS, either use DCOM$SETUP option 4 (''Start'') (see Section 6.2) or call the *COM for OpenVMS* startup procedure directly from SYS$STARTUP:DCOM$STARTUP. See Section 4.11 for information on starting *COM for OpenVMS*.

To stop DCOM$RPCSS on your system, either use the DCOM$SETUP option 5 (''Stop'') (see Section 6.2) or call the *COM for OpenVMS* shutdown procedure directly from SYS$STARTUP:DCOM$SHUTDOWN. See Section 4.12 for information on shutting down *COM for OpenVMS*.

6.2.3 Registering an Application

The following example shows how to register the *COM for OpenVMS* ''Simple'' application included on the *COM for OpenVMS* kit. You can use the resulting Windows NT file to register the server on a Windows NT system as long as the application is available on your Windows NT system.

To build the ''Simple'' application on a Windows NT system, see and execute the instructions in the README-SIMPLE.TXT file in DCOM$EXAMPLES:[SIMPLE].

Note

You must build and compile the application before you can register it. For complete details, see the step-by-step example in DCOM$EXAMPLES:[SIMPLE] included in the *COM for OpenVMS* kit.

Use the following procedure:

1. From the DCOM$SETUP menu, enter 6 or REGISTER.
2. Answer the questions as follows:

Note

The ''Simple'' application already has a CLSID.

Example 6–1 Sample "Simple" Application Registration on OpenVMS

```
Enter server type (1. In-Proc  2. Out-Proc): 2 Return
Enter Local Path (device:[directory]filename.ext): DKA0:[SMITH]SSERVER.EXE Return
Enter Application Name (<RETURN> to assign default): COM Simple Server Return
Does the server have a CLSid {GUID} (Yes/No) [N]: Y Return
Enter the CLSid (i.e. {xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx}:
   {5e9ddec7-5767-11cf-beab-00aa006c3606} Return

Verify Application Information:

         Application Name: COM SIMPLE SERVER
         Local Path: DKA0:[SMITH]SSERVER.EXE
         Application ID: {5E9DDEC7-5767-11CF-BEAB-00AA006C3606}

Is the information correct (Yes/No) [Y]: Return
Register application (Yes/No)? [Y]: Return

SETUP-I-NEWFILES, The following files have been created:

      DKA0:[SMITH]SSERVER.REG_NT
      DKA0:[SMITH]SSERVER.REG_VMS

SETUP-I-SRVIN, Server has been registered
Press RETURN to continue: Return
```

To register the ''Simple'' application on a Windows NT system, use the following procedure:

1. Copy all the files in the DCOM$EXAMPLES:[SIMPLE] directory to your Windows NT system.
2. Rename SSERVER.REG_NT to SSERVER.REG.
3. Edit the file to point to the local server path.

   For example, replace DEVICE:\SSERVER with C:\SSERVER.
4. Run the Install.bat program to add the necessary keys to the Windows NT registry.

Example 6–2 shows the contents of SSERVER.REG_NT.

Example 6–2 Contents of SSERVER.REG_NT

```
REGEDIT
HKEY_CLASSES_ROOT\CLSID\{5E9DDEC7-5767-11CF-BEAB-00AA006C3606}\ = DCOM server application SSERVER
HKEY_CLASSES_ROOT\CLSID\{5E9DDEC7-5767-11CF-BEAB-00AA006C3606}\LaunchPermission = Y
HKEY_CLASSES_ROOT\CLSID\{5E9DDEC7-5767-11CF-BEAB-00AA006C3606}\LocalServer32 = DEVICE:\SSERVER
```

To reregister the ''Simple'' application on an OpenVMS system, enter the following command at the system prompt:

```
$ @SSERVER.REG_VMS
```

Example 6–3 shows the contents of the SSERVER.REG_VMS command procedure:

Example 6–3 Contents of SSERVER.REG_VMS

```
$ Set noon
$ regcp :=  $regcp
$ crekey := $regcp create key
$ creval := $regcp create value
$ modval := $regcp modify value
$ lisval := $regcp list value
$ crekey HKEY_CLASSES_ROOT\CLSID\{5E9DDEC7-5767-11CF-BEAB-00AA006C3606}
$ creval HKEY_CLASSES_ROOT\CLSID\{5E9DDEC7-5767-11CF-BEAB-00AA006C3606} -
             /data="DCOM server application SSERVER" /type=sz
$ creval HKEY_CLASSES_ROOT\CLSID\{5E9DDEC7-5767-11CF-BEAB-00AA006C3606}/name="AppID" -
             /data="{5E9DDEC7-5767-11CF-BEAB-00AA006C3606}" /type=sz
$ crekey HKEY_CLASSES_ROOT\CLSID\{5E9DDEC7-5767-11CF-BEAB-00AA006C3606}\LaunchPermission
$ creval HKEY_CLASSES_ROOT\CLSID\{5E9DDEC7-5767-11CF-BEAB-00AA006C3606}\LaunchPermission -
             /data="Y" /type=sz
$ crekey HKEY_CLASSES_ROOT\CLSID\{5E9DDEC7-5767-11CF-BEAB-00AA006C3606}\LocalServer32
$ creval HKEY_CLASSES_ROOT\CLSID\{5E9DDEC7-5767-11CF-BEAB-00AA006C3606}\LocalServer32 -
             /data="DKA0::[SMITH]SSERVER.EXE" /type=sz
$
```

6.3 Running DCOM$CNFG

DCOM$CNFG is a utility to help COM developers configure and manage *COM for OpenVMS* applications on OpenVMS. Use the DCOM$CNFG utility to query information and manipulate properties of *COM for OpenVMS* applications.

To use the DCOM$CNFG utility, choose option 1 from the DCOM$SETUP menu.

Note

Before running the DCOM$CNFG utility, you must:

- Have OpenVMS Registry **Read** access to read application properties, and **Write** access to modify application properties.
- Ensure that the ACME server is running on the current system. The ACME server must be running to view and change application security properties. For more information, see Table 4–1.
- Acquire Windows NT security credentials before you can change an application identity. For more information, see Section 8.2.

The system displays the DCOM$CNFG Main menu.

Figure 6–2 DCOM$CNFG Main Menu

```
------------------------------------------------------
               DCOM$CNFG Main

   1 - Applications List
   2 - System-wide Default Properties
   3 - System-wide Default Security

   (E to Exit)
   (H for Help)

   Enter <CTRL-Z> or 'E' to return to the previous menu at any time

   Please enter your choice:
------------------------------------------------------
```

The options are as follows:

- `1 - Applications List`

  Lists all applications registered on this machine. For more information about this option, see Section 6.3.1.

- `2 - System-wide Default Properties`

  Allows you to set systemwide machine properties. For more information about this option, see Section 6.3.5.

- `3 - System-wide Default Security`

  Allows you to set systemwide security parameters. For more information about this option, see Section 6.3.6.

6.3.1 The DCOM$CNFG Application List Submenu

To display this submenu, from the `DCOM$CNFG` Main menu, choose option 1.

The system displays the Applications List submenu.

Figure 6–3 Applications List Submenu

```
------------------------------------------------------
               Applications List

   Index    Name
    1      Inside COM, Chapter 11 Example
    2      application 2
    3      application 3
    .      ...
    .      ...
    .      ...

  (E to Exit to previous menu)
  (H for Help)

  Please enter Index number to select an Application:
------------------------------------------------------
```

Enter a number to select an application. You can then view or configure its properties.

This option displays the Application Properties submenu.

Note

The system stores the Application Properties (Location, Security, and Identity) (see Figure 6–4) in a special key in the OpenVMS Registry that

is associated with each application. You cannot change the Application Properties until you create this special key using the DCOM$CNFG utility. The DCOM$CNFG utility creates this special key when the utility discovers a newly registered application. In this case, the DCOM$CNFG user must have acquired Windows NT security credentials for an account that is a member of the Administrator group. Otherwise, the key will not be created. For more information about acquiring Windows NT credentials, see Section 8.2).

Use the following procedure to manage the Application Properties:

1. Register the application.
2. Do either of the following:
   - Acquire Windows NT security credentials for an account that is a member of the Administrator group and then run DCOM$CNFG.
   - Have a system administrator with the appropriate credentials run DCOM$CNFG.
3. Run DCOM$CNFG from your own account to manage the properties.

Figure 6–4 Application Properties Submenu

```
------------------------------------------------------------------
               Application Properties

   General Properties of this DCOM Application

   Application name:  Inside COM, Chapter 11 Example
   Application id:    {0C092C2C-882C-11CF-A6BB-0080C7B2D682}
   Application type:  local server
   Local path:        DISK1:[SMITH.DISPATCH_SAMPLE1]CMPNT.EXE
   Type Library:      {D3011EE1-B997-11CF-A6BB-0080C7B2D682}
   version: 1.0  DISK1:[SMITH.DISPATCH_SAMPLE1]Server.tlb

   1 - Location    Machine to run application
   2 - Security    Security permissions for application
   3 - Identity    User account to use to run application

   (E to Exit to previous menu)
   (H for Help)

   Please enter Application Property you wish to change:
------------------------------------------------------------------
```

If the system cannot find the type library file or if the type library is unaccessible, the system displays an error message next to the type library file name.

The options are as follows:

- `1 - Location: Machine to run application`

  This option allows you to set or change the machine on which the COM application will run.

  The system displays the Application Location submenu.

Figure 6–5 Application Location Submenu

```
------------------------------------------------------
               Application Location

   The following settings allow DCOM to locate the correct computer
   for this application. If more than one machine is selected then
   DCOM uses the first available one. Client applications may override
   these selections.

   Application name:  Inside COM, Chapter 11 Example

   1 - Run application on this computer (Yes/No)
          Current value: Yes

   2 - Run application on another computer
          Current value: Currently Disabled

   (E to Exit to previous menu)
   (H for Help)

   Please enter your choice:
------------------------------------------------------
```

The options are as follows:

— `1 - Run application on this computer`

Indicates whether the application will be run on the local computer. Select the option to change the current value.

— `2 - Run application on another computer`

Indicates that the application will be run on the specified computer. Select the option and enter one of the following:

+ A valid system name to change the current value.
+ A hyphen (-) to disable the value. This sets the field to ''Currently Disabled.''

- `2 - Security: Security permissions for application`

  This option allows you to set the following security properties:

  — Access permission: allow or deny access to users or groups to access this application.

  — Launch permission: allow or deny access to users or groups to run this application.

  — Configuration permission: identify users or groups who have read, write, or special access to the OpenVMS Registry area that contains information about the application.

- `3 - Identity: User account to use to run application`

  This option allows you to run the application server using the security context of the specified user account.

  The system displays the Application Identity submenu. See Section 6.3.4.

The system uses the systemwide default security values unless you specify a different setting.

The system displays the Application Security submenu.

Figure 6–6 Application Security Submenu

```
------------------------------------------------------
               Application Security

   Application name:  Inside COM, Chapter 11 Example
   Current Access permissions:  Custom
   Current Launch permissions:  Custom
   Current Configuration permissions:  Default

   1 - Use Default Access permission
   2 - Edit Custom Access permission
   3 - Use Default Launch permission
   4 - Edit Custom Launch permission
   5 - Use Default Configuration permission
   6 - Edit Custom Configuration permission

   (E to Exit to previous menu)
   (H for Help)

   Please enter your choice:
------------------------------------------------------
```

The options are as follows:

- `1 - Use Default Access permission`

  Sets the system to the default access permission values.

- `2 - Edit Custom Access permission`

  Displays the Registry Value Permissions submenu. This submenu allows you to view, add, modify, and delete access permission values for this application. For this set of submenus, see Section 6.3.2.

  The ACL Editor starts with the systemwide default values unless you previously set other values.

- `3 - Use Default Launch permission`

  Use the systemwide default launch permission values.

- `4 - Edit Custom Launch permission`

  Displays the Registry Value Permissions submenu. This submenu allows you to view, add, modify, and delete launch permission values for this application. For this set of submenus, see Section 6.3.2.

  The ACL Editor starts with the systemwide default values unless you previously set other values.

- `5 - Use Default Configuration permission`

  Use the systemwide configuration permission values.

- `6 - Edit Custom Configuration permission`

  The system displays the Registry Key Permissions submenu. This submenu allows you to view, add, modify, delete, and configure special access security permissions for this application. For this set of submenus, see Section 6.3.3.

6.3.2 Registry Value Permissions Submenus

To display this submenu:

1. From the DCOM$CNFG menu, choose option 1.
2. From the Applications List submenu, choose any application.
3. From the Application Properties submenu, choose option 2.
4. From the Application Security submenu, choose option 2 or 4.

Figure 6–7 Registry Value Permissions Submenu

```
------------------------------------------------------
               Registry Value Permissions

   Application name: Inside COM, Chapter 11 Example
   Registry Value: LaunchPermission
   Owner: Administrator

   Index    Name                          Type of Access
     1      OPENVMS_DCOM\USER1               Deny
     2      BUILTIN\Administrators           Allow
     3      Everyone                         Allow
     4      NT AUTHORITY\SYSTEM              Allow
     5      OPENVMS_DCOM\USER2               Allow

        (Index Number to Delete or Modify Access)
        (A to Add to list)

        (E to Exit to previous menu)
        (H for Help)

       Please enter your choice:
------------------------------------------------------
```

The options are as follows:

- `Index Number...`

  To change or delete an access type, enter the corresponding index number. The system displays Edit Registry Value Permissions submenu. See Figure 6–8.

- `A to Add to List`

  This option displays the Add Registry Value Permissions submenu. This submenu allows you to add a new entry to the OpenVMS Registry value's Access Control List. See Figure 6–9.

Figure 6–8 Edit Registry Value Permissions Submenu

```
------------------------------------------------------
               Edit Registry Value Permissions

        Application name: Inside COM, Chapter 11 Example
        Registry Value: AccessPermission
        Owner: Administrator

        Name: OPENVMS_DCOM\USER1
        Type of Access: Deny

        1 - Delete entry from list
        2 - Change Access

        (E to Exit to previous menu)
        (H for Help)

        Please enter your choice:
------------------------------------------------------
```

The options are as follows:

- `1 - Delete entry from list`

  Delete the entry from the Access Control List. If you delete all entries, you will deny access and launch permissions to everyone for the selected value.

- `2 - Change Access`

  Toggle the access type from Allow to Deny or Deny to Allow.

Figure 6–9 Add Registry Value Permissions Submenu

```
------------------------------------------------------
             Add Registry Value Permissions

   Application name: Inside COM, Chapter 11 Example
   Registry Value: LaunchPermission
   Owner: ROLLO

   1 - Add Specific User or Group
   2 - Add Everyone
   3 - Add NT AUTHORITY\System
   4 - Add BUILTIN\Administrators

   (E to Exit to previous menu)
   (H for Help)

   Please enter your choice:
------------------------------------------------------
```

The options are as follows:

— `1 - Add Specific User or Group`

Prompts for a user/group name and type of access. Specify the user name as *domain\username* or *username* if the account exists on the current domain.

— `2 - Add Everyone`

Allow or Deny `Everyone` Access/Launch permission to the application.

— `3 - Add NT AUTHORITY\System`

Allow or Deny `System` Access/Launch permission to the application.

— `4 - Add BUILTIN\Administrators`

Allow or Deny Administrator Access/Launch permission to the application.

When a user is part of two or more groups, Deny access takes precedence over Allow access.

6.3.3 Registry Key Permissions Submenus

To display this submenu:

1. From the DCOM$CNFG menu, choose option 1.
2. From the Applications List submenu, choose any application.
3. From the Application Properties submenu, choose option 2.
4. From the Application Security submenu, choose option 6.

Figure 6–10 Registry Key Permissions Submenu

```
------------------------------------------------------------
                Registry Key Permissions

   Application name: Inside COM, Chapter 11 Example
   Registry Key: Inside COM, Chapter 11 Example
   Owner: Administrator

   Index    Name                      Type of Access

   1     BUILTIN\Administrators       Full Control
   2     NT AUTHORITY\SYSTEM          Full Control
   3     CREATOR OWNER                Full Control
   4     Everyone                     Special Access
   5     OPENVMS_DCOM\USER1           Read

   (Index Number to Delete or Modify Access)
   (A to Add to list)

   (E to Exit to previous menu)
   (H for Help)

   Please enter your choice:
------------------------------------------------------------
```

The options are as follows:

- Index Number...

  To change or delete an access type, enter the corresponding index number. The system displays Edit Registry Key Permissions submenu. See Figure 6–11.

- A to Add to List

  This option displays the Add Registry Key Permissions submenu. This submenu allows you to add a new entry to the OpenVMS Registry key's Access Control List. See Figure 6–13.

Figure 6–11 Edit Registry Key Permissions Submenu

```
------------------------------------------------------------
                Edit Registry Key Permissions

   Application name: Inside COM, Chapter 11 Example
   Registry Key: Inside COM, Chapter 11 Example
   Owner: Administrator

   Name: BUILTIN\Administrators
   Type of Access: Full Control

   1 - Delete entry from list
   2 - Allow Full Control
   3 - Allow Read Access
   4 - Set/View Special Access

   (E to Exit to previous menu)
   (H for Help)

   Please enter your choice:
------------------------------------------------------------
```

The options are as follows:

- `1 - Delete entry from list`

  Delete the entry from the security permissions list. If you delete all entries, noone can access the key and only the owner can change the permissions.

- `2 - Allow Full Control`

  Allow the user to access, to edit, and to take ownership of the key.

- `3 - Allow Read Access`

  Allow the user to read the key but not to save any changes to it.

- `4 - Set/View Special Access`

  Displays the Special Access Registry Key Permissions submenu. This submenu allows you to set customized permissions for the selected user or groups. See Figure 6–12.

Figure 6–12 Special Access Registry Key Permissions Submenu

```
------------------------------------------------------------
               Special Access Registry Key Permissions

   Application name: Inside COM, Chapter 11 Example
   Registry Key: Inside COM, Chapter 11 Example

   Name: Everyone

   Type of Access                          Current Value

   0 - Query Value                           Yes
   1 - Set Value                             Yes
   2 - Create Subkey                         Yes
   3 - Enumerate Subkeys                     Yes
   4 - Notify                                Yes
   5 - Create Link                           No
   6 - Delete                                Yes
   7 - Write DACL                            No
   8 - Write Owner                           No
   9 - Read Control                          Yes

   (E to Exit to previous menu)
   (H for Help)

   Please enter your choice:
------------------------------------------------------------
```

The options are as follows:

- `0 - Query Value`

  Allow the user to read a value from the key.

- `1 - Set Value`

  Allow the user to set one or more values for the key.

- `2 - Create Subkey`

  Allow the user to create subkeys on the key.

- `3 - Enumerate Subkeys`

  Allow the user to identify the subkeys of the key.

- `4 - Notify`

  Allow the user to audit notification events from the key.

- `5 - Create Link`

  Allow the user to create a symbolic link in the key.

- `6 - Delete`

  Allow the user to delete the key.

- `7 - Write DACL`

  Allow the user access to the key to write a discretionary ACL to the key.

- `8 - Write Owner`

  Allow the user access to the key to take ownership of the key.

- `9 - Read Control`

Allow the user access to the security information on the key.

Figure 6–13 Add Registry Key Permissions Submenu

```
------------------------------------------------------
               Add Registry Key Permissions

   Application name: Inside COM, Chapter 11 Example
   Registry Key: Inside COM, Chapter 11 Example
   Owner: Administrator

   1 - Add Specific User or Group
   2 - Add Everyone
   3 - Add NT AUTHORITY\System
   4 - Add BUILTIN\Administrators

   (E to Exit to previous menu)
   (H for Help)

   Please enter your choice:
------------------------------------------------------
```

The options are as follows:

- `1 - Add Specific User or Group`

  Prompts for a user/group name and type of access. Specify the user name as *domain\username* or *username* if the account exists on the current domain.

- `2 - Add Everyone`

  Allow `Everyone` Full Control or Read Access to the application.

- `3 - Add NT AUTHORITY\System`

  Allow `System` Full Control or Read Access to the application.

- `4 - Add BUILTIN\Administrators`

  Allow `Administrator` Full Control or Read Access to the application.

6.3.4 Application Identity Submenu

To display this submenu:

1. From the DCOM$CNFG menu, choose option 1.
2. From the Applications List submenu, choose any application.
3. From the Application Properties submenu, choose option 3.

The system displays the Application Identity submenu.

Figure 6–14 Application Identity Submenu

```
------------------------------------------------------
               Application Identity

   Which user account do you want to use to run this application?

   Application name:  Inside COM, Chapter 11 Example
   Current Identity:  NTLM Account OPENVMS_DCOM\USER2

   1 - Launching User
   2 - NTLM Account
   3 - OpenVMS Username
   4 - OpenVMS DCOM Guest Account

   (E to Exit to previous menu)
   (H for Help)

   Please enter account you wish to use:
------------------------------------------------------
```

The options are as follows:

- `1 - Launching User`

  Specifies that the application will run using the security context of the user who started the application. This is the default if NTLM security is available.

- `2 - NTLM Account`

  Specifies that the application will run using the security context of the specified NTLM account. If you specify a valid User/Group name, the system prompts you for a password. The system checks that the password matches the password you used to log on (through `NTA$LOGON`). If the passwords do not match, you can either continue and write this new password to the OpenVMS Registry or reenter a password that matches your logon password.

  Note

  If you enter a new password, the system does not synchronize the new password with any other password. You must synchronize the passwords manually.

  You must have the IMPERSONATE privilege for the password to be validated.

  You must have system write access (SYSPRV or REG$UPDATE) to the OpenVMS Registry to write the password to the database.

- `3 - OpenVMS Username`

  Specifies that the application will run using the security context of the specified OpenVMS account. This option is active only when you are using unauthenticated *COM for OpenVMS*.

- `4 - OpenVMS DCOM Guest Account`

  Specifies that the application will run using the security context of the OpenVMS DCOM Guest account. This option is active only when you are using unauthenticated *COM for OpenVMS*. If you are using unauthenticated *COM for OpenVMS*, this option is the default.

6.3.5 The DCOM$CNFG System-wide Default Properties Submenu

To display this submenu, from the DCOM$CNFG Main menu, choose option 2.

The system displays the System-wide Default Properties submenu.

Figure 6–15 System-wide Default Properties Submenu

```
------------------------------------------------------------
            System-wide Default Properties

   1 - Enable Distributed COM on this computer (Yes/No)
             Current value: Yes
   2 - Default Authentication Level
   3 - Default Impersonation Level


   (E to Exit to previous menu)
   (H for Help)

   Please enter your choice:
------------------------------------------------------------
```

The options are as follows:

- `1 - Enable Distributed COM on this computer (Yes/No)`

  Enables or disables COM on this computer.

- `2 - Default Authentication Level`

  Sets packet-level security on communications between applications. This systemwide default applies to all applications installed on this computer.

Figure 6–16 Default Authentication Level Submenu

```
------------------------------------------------------------------
                Default Authentication Level

   The Authentication Level specifies security at the packet level.

   Current value: Connect

      1 - Default
      2 - None
      3 - Connect
      4 - Call
      5 - Packet
      6 - Packet Integrity

      (E to Exit to previous menu)
      (H for Help)

    Please enter your choice:
------------------------------------------------------------------
```

  Enter a number to select the desired Authentication level. When installed, the system default for the Default Authentication Level is `Connect`.

- `3 - Default Impersonation Level`

  Specifies whether applications can determine who is calling them, and whether the application can perform operations using the client's identity.

Figure 6–17 Default Impersonation Level Submenu

```
------------------------------------------------------------------
               Default Impersonation Level

   The Impersonation Level specifies whether applications can determine
   who is calling them, and whether the application can perform
   operations using the client's identity.

   Current value: Identify

      1 - Anonymous
      2 - Identify
      3 - Impersonate

      (E to Exit to previous menu)
      (H for Help)

   Please enter your choice:
------------------------------------------------------------------
```

Enter a number to select the desired Impersonation level. When installed, the system default for the Default Impersonation Level is `Identify`.

6.3.6 System-wide Default Security Submenu

To display this submenu, from the DCOM$CNFG Main Menu, choose option 3.

The system displays the System-wide Default Security submenu.

Figure 6–18 System-wide Default Security Submenu

```
------------------------------------------------------------------
               System-wide Default Security

       1 - Access Permissions Default
       2 - Launch Permissions Default
       3 - Configuration Permissions Default

       (E to Exit to previous menu)
       (H for Help)

       Please enter your choice:
------------------------------------------------------------------
```

The options are as follows:

- `1 - Access Permissions Default:`

  Displays the Registry Value Permissions submenu. This submenu allow you to view, add, modify, and delete Access permission values for the systemwide default for all applications.

- `2 - Launch Permissions Default:`

  Displays the Registry Value Permissions submenu. This submenu allows you to view, add, modify, and delete Launch Permission Values for the systemwide default for all applications. You must restart the *COM for OpenVMS* Service Control Manager for the new setting to take effect.

- `3 - Configuration Permissions Default:`

  Displays the security permission values for the HKEY_CLASSES_ROOT Registry key.

When you first install the system, by default only Administrator and System accounts have application launch and access permissions. Compaq recommends that you do not change these default settings. Typically you modify an individual application's launch and access security to grant or deny permissions to Everyone, various Groups, or even specific users. Compaq recommends this technique over adjusting the machinewide default security settings that affect all applications.

6.4 Registering In-Process Servers: DCOM$REGSVR32 Utility

All COM components (implemented as either an out-of-process server or as an in-process server) must be registered in the OpenVMS Registry before you can use them.

Out-of-process servers, which are implemented as executable programs (.EXE files), usually contain code to register and unregister the components contained within them. The advantage an out-of-process server has over an in-process server is that you can run the executable and automatically create the necessary registry keys.

In-process servers, which are usually implemented as dynamic link libraries (.DLL files) on Windows NT or as shareable images on OpenVMS, also contain code to register and unregister the components within them automatically. However, these in-process servers cannot be run the same way as an executable image because they do not contain a main entry point. As a result, you must manually register the components contained within a .DLL, or create a command procedure to perform the registration.

Microsoft provides the REGSVR32 utility that you can use to register the components contained within a DLL. REGSVR32 takes as a command line argument the following:

- DLL name
- Switches to register or unregister the components

When registering a DLL's components, REGSVR32 searches the specified DLL for the DllRegisterServer symbol and, if found, calls it. When unregistering a DLL, REGSVR32 calls DllUnregisterServer. This means that all in-process components that you want to register automatically must include these two entry points in their export files.

To facilitate the registration of components contained within shareable images on OpenVMS systems, Compaq created the DCOM$REGSVR32 utility. The DCOM$REGSVR32 utility does the same things that the Microsoft REGSVR32 utility does. Any shareable images that contain components to be registered must also include the DllRegisterServer and DllUnregisterServer universal symbols in their symbol vectors. Both the DCOM$REGSVR32 and the REGSVR32 utilities use the same command line syntax.

During the *COM for OpenVMS* installation, the system places the DCOM$REGSVR32.EXE file in the SYS$SYSTEM directory.

Before you use the DCOM$REGSVR32 utility, you must define a symbol that allows the utility to accept foreign command lines. For example:

```
$ regsvr32 :== $DCOM$REGSVR32
```

Alternatively, you can activate the DCOM$REGSVR32 utility as follows:

```
$ MCR DCOM$REGSVR32
```

You can use either method to activate the utility, and register or unregister components contained in shareable images.

To display help for DCOM$REGSVR32, enter the following:

```
$ regsvr32 -?
```

Table 6–1 summarizes the DCOM$REGSVR32 command line options.

Table 6–1 DCOM$REGSVR32 Command Line Options

Switch	Use
-?, /?	Display help file (this table).
shareable-image-name	Register the specified shareable image name.
-u or /u *image-name*	Unregister the specified shareable image name.

Note

The DCOM$REGSVR32 utility requires that the shareable image name contain a full directory specification.

Example 6–4 demonstrates how to register an in-process component (contained within a shareable image) using the DCOM$REGSVR32 utility.

Example 6–4 Registering a Component Using the DCOM$REGSVR32 Utility

```
$ regsvr32 USER$DISK:[SEYMOUR.DISPATCH_SAMPLE1]CMPNT$SHR.EXE
Class factory:          Create self.
DllRegisterServer:      Registering Server DLL
Creating key CLSID\{0C092C2C-882C-11CF-A6BB-0080C7B2D682}
Creating key CLSID\{0C092C2C-882C-11CF-A6BB-0080C7B2D682}\InProcServer32
Creating key CLSID\{0C092C2C-882C-11CF-A6BB-0080C7B2D682}\ProgID
Creating key CLSID\{0C092C2C-882C-11CF-A6BB-0080C7B2D682}\VersionIndependentProgID
Creating key CLSID\{0C092C2C-882C-11CF-A6BB-0080C7B2D682}\TypeLib
Creating key InsideCOM.Chap11
Creating key InsideCOM.Chap11\CLSID
Creating key InsideCOM.Chap11\CurVer

Creating key InsideCOM.Chap11.1
Creating key InsideCOM.Chap11.1\CLSID
Class factory:          Destroy self.
```

Example 6–5 demonstrates how to unregister an in-process component (contained within a shareable image) using the DCOM$REGSVR32 utility.

Example 6–5 Unregistering a Component Using the DCOM$REGSVR32 Utility

```
$ regsvr32 /u USER$DISK:[SEYMOUR.DISPATCH_SAMPLE1]CMPNT$SHR.EXE

Class factory:          Create self.
DllUnregisterServer:    Unregistering Server DLL
Deleting key InProcServer32
Deleting key ProgID
Deleting key VersionIndependentProgID
Deleting key TypeLib
Deleting key LocalServer32
Deleting key CLSID\{0C092C2C-882C-11CF-A6BB-0080C7B2D682}
Deleting key CLSID
Deleting key CurVer
Deleting key InsideCOM.Chap11
Deleting key CLSID
Deleting key InsideCOM.Chap11.1
Class factory:          Destroy self.
```

7
Developing a COM for OpenVMS Application

This chapter explains how to develop COM applications for OpenVMS.

Note

You can find the sample COM applications shown in this chapter in the following directories on the *COM for OpenVMS* kit:

```
DCOM$EXAMPLES:[SAMPLE1]
DCOM$EXAMPLES:[SIMPLE]
DCOM$EXAMPLES:[DISPATCH_SAMPLE1]
```

`SAMPLE1` and `DISPATCH_SAMPLE1` are taken from Dale Rogerson's book, *Inside COM*, published by Microsoft Press. This book is a good reference for developing COM applications.

The following sections describe how to create a *COM for OpenVMS* application.

Note

Building *COM for OpenVMS* applications places demands on the virtual memory requirements of a process. You should have a minimum page file quota of 100,000 pagelets before building a *COM for OpenVMS* application. This is a DEC C++ compiler requirement.

7.1 Step 1: Generate Unique Identifiers

Use the `DCOM$GUIDGEN` utility to generate 16-byte globally unique identifiers (GUIDs). The utility supports both OpenVMS and UNIX styles. For example:

- OpenVMS style

  Enter the following commands:

  ```
  $ SET COMMAND DCOM$LIBRARY:DCOM$GUIDGEN.CLD
  $ DCOM$GUIDGEN [/FORMAT=value] [/COUNT=value] [/OUTPUT=value]
  ```

- UNIX style

  Enter the following command:

  ```
  $ mcr dcom$guidgen [-cdghirs?] [-on]
  ```

The following table summarizes the GUID format options.

OpenVMS qualifier (*value*)	UNIX switch	Use
IDL	`-i`	Output GUID in an IDL interface template.
STRUCT	`-s`	Output GUID as an initialized C struct.
IMPLEMENT_ OLECREATE	`-c`	Output GUID in IMPLEMENT_OLECREATE(...) format.
DEFINE_GUID	`-d`	Output GUID in DEFINE_GUID(...) format.
GUID_STRUCT	`-g`	Output GUID as an initialized static const GUID struct.
REGISTRY_GUID	`-r`	Output GUID in registry format.

Note

The last four options in the preceding table are the same as the four options in the Windows NT `Guidgen` utility.

The following table lists additional options supported by the `DCOM$GUIDGEN` utility.

OpenVMS qualifier	UNIX switch	Use
/OUTPUT=*filename*	`-o` *`filename`*	Redirect output to a specified file.
/COUNT=*number*	`-n` *`number`*	Number of GUIDs to generate.
not available	`-h, -?`	Display command option summary.

You can specify more than one format for the same GUID.

7.2 Step 2: Build an Application Using the MIDL Compiler

The following sections describe how to use the MIDL compiler to build an application.

7.2.1 Running the MIDL Compiler

The MIDL compiler consists of the following separate images:

- `SYS$SYSTEM:DCOM$MIDL.EXE`

  The executable image that takes its arguments (parameters) from the DCL command line.

- `SYS$SHARE:DCOM$MIDL_SHR.EXE`

  A shareable image library that does the actual work for `DCOM$MIDL.EXE`.

To run MIDL, you must first define a DCL symbol. For example:

```
$ midl :== $dcom$midl
$ midl -?
$ midl -Oicf -idcom$library: example.idl
```

The `midl -?` command displays a list of valid command line arguments. For a list of these arguments, see Appendix A.

7.2.2 Running the MIDL Compiler with DCOM$RUNSHRLIB

The DCOM$MIDL.EXE utility gets its arguments from the DCL foreign command line buffer. DCL foreign commands can have a maximum of 255 characters.

Because of the number of arguments that DCOM$MIDL.EXE can accept, you might exceed this maximum number of characters if you specify a complex MIDL command (for example, a command that contains mixed-case arguments that require quotation marks).

As a workaround, you can use the SYS$SYSTEM:DCOM$RUNSHRLIB.EXE utility. Use the following procedure:

1. Define the DCL command DCOM$RUNSHRLIB.

   A process that needs to use DCOM$RUNSHRLIB.EXE must first use the OpenVMS DCL Command Definition utility to define the DCL command DCOM$RUNSHRLIB. For example:

   ```
   $ SET COMMAND DCOM$LIBRARY:DCOM$RUNSHRLIB.CLD
   ```

   DCOM$LIBRARY:DCOM$RUNSHRLIB.CLD defines the DCOM$RUNSHRLIB DCL command. The following table shows the command's parameters.

Argument	Value	Required/Optional
P1	Name of the shareable image library. This can be a logical name, the name of an image in SYS$SHARE:, or a full file specification.	Required
P2	Name of the routine to be called as a C or C++ main( ) routine with an argc/argv vector.	Required
P3	List of qualifiers in quotation marks.	Optional

2. Define the DCL symbol midl to use DCOM$RUNSHRLIB.EXE to parse the command line and call the DCOM$MIDL_MAIN function in the DCOM$MIDL_SHR shareable image library. For example:

   ```
   $ midl :== DCOM$RUNSHRLIB DCOM$MIDL_SHR DCOM$MIDL_MAIN
   ```

   The new DCL command MIDL accepts multiple command line arguments inside a single quoted string. If the command becomes too long, you can specify multiple quoted strings, using a comma to separate the strings.

   For example, here is a complex MIDL command that fails:

   ```
   $ midl :== $dcom$midl
   $ midl -Zp8 -Oicf -Os -oldnames -char unsigned -
      -error allocation -error bounds_check -error stub_data -
      -ms_ext -c_ext -out [.OBJ] -
      -I[INC] -I[PROJECT_WIDE_INC] -I[COMMON_INC] -IDCOM$LIBRARY: -
      -DRMS_DB "-DOpenVMS_Definitions" "-DPermanentProcess" -
      -header [.obj]example.h -client none -server none example.idl
   %DCL-W-TKNOVF, command element is too long - shorten
   ```

   You can successfully specify this command using DCOM$RUNSHRLIB as follows:

```
$ set command dcom$library:dcom$runshrlib.cld
$ midl :== DCOM$RUNSHRLIB DCOM$MIDL_SHR DCOM$MIDL_MAIN
$ midl "-Zp8 -Oicf -Os -oldnames -char unsigned",-
   "-error allocation -error bounds_check -error stub_data",-
   "-ms_ext -c_ext -out [.OBJ]",-
   "-I[INC] -I[PROJECT_WIDE_INC] -I[COMMON_INC] -IDCOM$LIBRARY:",-
   "-DRMS_DB -DOpenVMS_Definitions -DPermanentProcess",-
   "-header [.obj]example.h -client none -server none example.idl"
```

7.2.3 Required MIDL Switches

When running MIDL on OpenVMS, you must specify the `-Oicf` MIDL command line switch.

7.2.4 Required Include Directories

MIDL components typically import `UNKNWN.IDL`, which contains the component definitions for `IUnknown` and `IClassFactory`. `UNKNWN.IDL` and other COM-related IDL and header files are located in `DCOM$LIBRARY`. To build your component's IDL file, use the following switch:

```
-IDCOM$LIBRARY:
```

7.2.5 Required Header File

The `VMS_DCOM.H` header file contains macro definitions that enable your *COM for OpenVMS* application to compile properly with Bristol's Wind/U® Win32 environment. You must include this header file in every source file and header file you create that relies on COM APIs or Win32 APIs. Because the files generated by MIDL rely on parts of the Win32 environment, Compaq has modified the MIDL compiler for OpenVMS to include `VMS_DCOM.H` in all output files.

7.3 Step 3: Compile the COM Application

The following sections describe how to compile *COM for OpenVMS* applications.

Note

A COM application developer will need access to the OpenVMS registry to register and control access to a given application. For more information about OpenVMS Registry privileges, see Section 10.5.1 and Section 6.3.

7.3.1 Required Macro Definitions

The `VMS_DCOM.H` file defines several macros used by the Wind/U Win32 environment. An include statement that specifies this header file should be the first noncommented line in any source file (code or header files) that you write. However, this is not always guaranteed to be true for files generated by MIDL. Be sure to always include the following /DEFINE qualifier on all of your C and CXX commands:

```
/DEFINE=(UNICODE=1,_WINDU_SOURCE=0X041000,_WIN32_DCOM)
```

The `UNICODE` macro ensures that the wide character variants of Win32 APIs and data structures are enabled when you compile your code. (This macro is also defined in `VMS_DCOM.H`.) Omitting this macro can lead to compilation failures when building with the Wind/U Win32 environment.

The other two macro definitions are recognized by the Wind/U header files and are required to ensure the proper definition of structures and COM APIs.

7.3.2 Required Include Directories

COM for OpenVMS applications typically require header files that come from DCOM$LIBRARY.

Include the following qualifier on your C and CXX command lines:

```
/INCLUDE=DCOM$LIBRARY
```

If you already have an /INCLUDE qualifier on your command line, modify the command to include DCOM$LIBRARY.

7.3.3 Required Header File: VMS_DCOM.H

The VMS_DCOM.H header file defines several macros used by the Wind/U header files.

Include this header file as the first noncommented line in your source files (both header files and implementation files).

7.3.4 Required C++ Qualifiers

You must specify the following C++ qualifiers when you build *COM for OpenVMS* applications:

- /EXCEPTIONS=CLEANUP

  Specify the /EXCEPTIONS=CLEANUP qualifier on C++ commands to enable C++ exceptions.

- /STANDARD=CFRONT

  The C++ compiler supports many different compilation standards. Compaq recommends that you use /STANDARD=CFRONT.

  /STANDARD=CFRONT informs the compiler that it should follow the language conventions defined in the AT&T® cfront implementation. This switch works well with the Wind/U header files because those header files are used by several UNIX platforms in addition to the OpenVMS platform.

7.3.5 Required C Qualifiers

There are no qualifiers unique to DEC C that you must specify when you build *COM for OpenVMS* applications.

7.4 Step 4: Link the COM Application

To build a *COM for OpenVMS* application, you must build both client and component images. Because you can implement a component as either an in-process component or an out-of-process component, you must build either a shareable image or an executable image, or both. If you are creating a new interface, you must also build a proxy/stub shareable image, unless you are using the IDispatch interface. In that case, the Automation Marshaler will be used instead of the proxy/stub shareable image. The proxy/stub shareable image provides an interface-specific object that packages parameters for that interface in preparation for a remote method call. A proxy runs in the sender's address space and communicates with a corresponding stub in the receiver's address space.

The following sections describe the steps you must follow to link the client, component, and proxy/stub images.

7.4.1 Linking the Client and the Out-of-Process Component

Although you do not need to specify any qualifiers to link the client or the component executable images, you must link both images with the following:

- The Wind/U shareable images (to satisfy Win32 dependencies)
- The DCOM OLE32 shareable image (to satisfy references to COM APIs)

The specific link-time dependencies are as follows:

- DCOM$WIN32:WINDU.OPT
- DCOM$LIBRARY:DCOM.OPT

If you have one or more C++ modules, use the C++ linker (CXXLINK) instead of the standard OpenVMS linker so you can specify the location of your C++ repository (/CXX_REPOSITORY qualifier). For example:

```
$  CXXLINK/your-specific-linker-qualifiers list-of-object-modules, -
_$ DCOM$WIN32:WINDU.OPT/OPTIONS, DCOM$LIBRARY:DCOM.OPT/OPTIONS -
_$ application.OPT/OPTIONS /REPOSITORY=[.CXX_REPOSITORY]
```

Other ways of including the options file are as follows:

- Include the list of object modules in an options file instead of on the command line.
- Use DCOM$LIBRARY:DCOM.OPT.

7.4.2 Linking the In-Process Component Shareable Image

The component in-process shareable image dependency list differs slightly from that of the client and component executables. The specific link-time dependencies are as follows:

- DCOM$WIN32:WINDU.OPT
- DCOM$LIBRARY:DCOM.OPT

7.4.2.1 Creating a Symbol Vector

Linking the in-process component shareable image requires that you create a symbol vector for the entry points that *COM for OpenVMS* expects to call within the shareable image. The Win32 run-time environment enforces a naming standard on the DllMain entry point, which must contain the following:

- _Windu_ prefix
- Actual entry point name
- A suffix that includes the image name or a portion of the image name, depending on the format of the image name.

  If the image name ends in $SHR (for example, CMPNT$SHR), the suffix is the image name up to and including the dollar sign ($).

  If the image name ends in anything other than $SHR (for example, CMPNT_SHARE), the suffix is the full image name.

For example, a component shareable image with the name CMPNT$SHR would define the symbol vector using the following options file:

```
!
! The list of symbols exported by CMPNT$SHR.EXE.
!
SYMBOL_VECTOR=(-
        _WindU_DllMain_CMPNT$/DllMain  = PROCEDURE,-
        DllGetClassObject               = PROCEDURE,-
        DllCanUnloadNow                 = PROCEDURE,-
        DllRegisterServer               = PROCEDURE,-
        DllUnregisterServer             = PROCEDURE)
```

A component shareable image with the name CMPNT_SHARE would define the symbol vector using the following options file:

```
!
! The list of symbols exported by CMPNT_SHARE.EXE.
!
SYMBOL_VECTOR=(-
        _WindU_DllMain_CMPNT_SHARE/DllMain  = PROCEDURE,-
        DllGetClassObject               = PROCEDURE,-
        DllCanUnloadNow                 = PROCEDURE,-
        DllRegisterServer               = PROCEDURE,-
        DllUnregisterServer             = PROCEDURE)
```

7.4.3 Linking the Proxy/Stub Shareable Image

The proxy/stub shareable image dependency list differs slightly from that of the client and component executables. The specific link-time dependencies are as follows:

- DCOM$WIN32:WINDU.OPT
- SYS$LIBRARY:DCOM$RPCRT4_SHR.EXE

7.4.3.1 Creating a Symbol Vector

Linking the proxy/stub shareable image is more involved because you must create a symbol vector for the entry points that *COM for OpenVMS* expects to call within the shareable image. The Win32 run-time environment enforces a naming standard on the DllMain entry point, which must contain the following:

- _Windu_ prefix
- Actual entry point name
- A suffix that includes the image name or a portion of the image name, depending on the format of the image name.

  If the image name ends in $SHR (for example, PROXY$SHR), the suffix is the image name up to and including the dollar sign ($).

  If the image name ends in anything other than $SHR (for example, PROXY_SHARE), the suffix is the full image name.

For example, a proxy/stub shareable image with the name PROXY$SHR would define the symbol vector using the following options file:

```
!
! RPC Shareable Image
!
 SYS$LIBRARY:DCOM$RPCRT4_SHR.EXE/SHARE
!
!
! The list of symbols exported by PROXY$SHR.EXE.
!
SYMBOL_VECTOR=(-
        _Windu_DllMain_PROXY$/DllMain   = PROCEDURE,-
        DllGetClassObject               = PROCEDURE,-
        DllCanUnloadNow                 = PROCEDURE,-
        GetProxyDllInfo                 = PROCEDURE,-
        DllRegisterServer               = PROCEDURE,-
        DllUnregisterServer             = PROCEDURE)
```

A proxy/stub shareable image with the name PROXY_SHARE would define the symbol vector using the following options file:

```
!
! RPC Shareable Image
!
 SYS$LIBRARY:DCOM$RPCRT4_SHR.EXE/SHARE
!
!
! The list of symbols exported by PROXY_SHARE.EXE.
!
SYMBOL_VECTOR=(-
        _Windu_DllMain_PROXY_SHARE/DllMain = PROCEDURE,-
        DllGetClassObject                  = PROCEDURE,-
        DllCanUnloadNow                    = PROCEDURE,-
        GetProxyDllInfo                    = PROCEDURE,-
        DllRegisterServer                  = PROCEDURE,-
        DllUnregisterServer                = PROCEDURE)
```

7.5 Required OpenVMS Registry Entries

The following sections list and describe the required OpenVMS Registry entries.

7.5.1 HKEY_CLASSES_ROOT\CLSID

The CLSID subkey contains all CLSIDs for the components supported on your system. You must register your components' CLSIDs here. Each registered CLSID should contain the following:

- An unnamed value whose type is a zero-terminated string with a data value describing the component.
- A named value, AppID, whose type is a zero-terminated string with a data value that is the CLSID of the component.

7.5.1.1 Component CLSIDs

A class identifier (CLSID) is a globally unique identifier (GUID) associated with an OLE class object. *COM for OpenVMS* server applications typically register their CLSIDs in the OpenVMS Registry so clients can locate and load the executable code associated with the OLE class object.

Register the CLSID for the component under the subkey HKEY_CLASSES_ROOT\CLSID.

A component CLSID registration should contain the following subkeys:

- LocalServer32

This key's value should contain a zero-terminated string with a data value that is the location of the out-of-process server executable.

- `ProgID`

  This key's value should contain a zero-terminated string with a data value that is the programmatic ID of the CLSID. These are typically of the format *program.component.version*.

- `VersionIndependentProgID`

  This key's value should contain a zero-terminated string with a data value that is the programmatic ID (less the version number) of the CLSID. These are typically of the format *program.component*.

- `InProcServer32`

  This key's value should contain a zero-terminated string with a data value that is the location of the in-process server's shareable image.

- `Type Libraries`

  Type libraries are important for implementing the `IDispatch` interface. A type library registers itself when it calls the OLE Automation `RegisterTypeLib` run-time routine. You must also add a `Typelib` subkey under your component's CLSID. The `Typelib` subkey contains your type library's GUID. For example, the following key should contain your LIBID:

  ```
  HKEY_CLASSES_ROOT\CLSID\{GUID}\TYPELIB {value=LIBID}
  ```

7.5.1.2 Proxy/Stub CLSIDs

The proxy/stub shareable image provides an interface-specific object for packaging parameters for that interface. Because the proxy/stub shareable image contains an object, it needs a CLSID and it needs to be included in the OpenVMS Registry. You must register a CLSID for the proxy in the OpenVMS Registry the same way as the CLSID for the component.

The CLSID for the proxy should be registered under the subkey `HKEY_CLASSES_ROOT\CLSID`.

A proxy/stub CLSID registration should contain the following subkey:

- `InProcServer32`

  The `InProcServer32` value should contain a zero-terminated string with a data value that is the location of the proxy/stub shareable image. The proxy/stub CLSID and its subkey enable COM to locate the proxy/stub shareable image.

7.5.2 HKEY_CLASSES_ROOT\Interface

The `Interface` subkey contains all interfaces registered with the system. You must register the component's interface IDs (IIDs) in this subkey.

Each interface registered contains at least one of the following subkeys:

- `NumMethods`

  The `NumMethods` value should contain a zero-terminated string with a data value that is the number of methods contained in the interface.

- `ProxyStubClsid32`

The ProxyStubClsid32 value should contain a zero-terminated string with a data value that is the CLSID of the proxy/stub shareable image. This CLSID should be the same as that described in Section 7.5.1.2.

7.6 Converting OpenVMS and Windows Error Codes to Text

As you develop and test COM components, you will find that the OpenVMS and Windows NT systems return seemingly indecipherable error codes. To help you make these codes more understandable, Compaq has included the NTA$VMSGetMessage routine to translate error codes into displayable text.

To implement this routine, you must include the NTA_MESSAGE.H file in the DCOM$LIBRARY: directory and link with the DCOM$LIBRARY:NTA_GETMSG.OBJ object module.

The following section describes the NTA$VMSGetMessage routine.

NTA$VMSGetMessage

The NTA$VMSGetMessage routine translates error codes into displayable text. The input error code must be one of the following:

- An OpenVMS error code
- A Windows HRESULT
- A Windows Win32 error code
- A Windows NT status code set as ‘‘user defined’’

Format

Return=NTA$VMSGetMessage (status, text, flag, [count])

Arguments

status

OpenVMS usage: error_code
type: longword (unsigned)
access: read only
mechanism: by value

This status field must be one of the following:

Input Error Code	Example
OpenVMS error code	0x074AA6BA
Windows HRESULT	0x80070031
Windows Win32 error code	0x00000031
Windows NT status code with the user-defined bit set	0xE74AA6BA

If the security API returns a Windows NT status code, the format of the status field is an OpenVMS status code OR’d with the Windows NT status control bits set. For example:

Input Error Code	Result
OpenVMS error code	0x074AA6BA
Windows NT status code	0xE74AA6BA

text

OpenVMS usage: error_text
type: character string
access: write
mechanism: by reference

This argument is a NULL terminated string that contains the returned text from the SYS$GETMSG system service. The maximum size returned (as defined by the SYS$GETMSG system service) is 256 bytes. To avoid overwriting memory, the caller must provide a buffer address of at least 257 bytes.

flag

OpenVMS usage: flag
type: longword (unsigned)
access: read only
mechanism: by value

Controls the translation of the error code. The following values are defined in NTA_MESSAGE.H:

NTAWIN$_UNKNOWN	Unknown error code
NTAWIN$_VMS	OpenVMS error code
NTAWIN$_NT	Windows HRESULT error code
NTAWIN$_WINDOWS	Windows Win32 error code
NTAWIN$_USER	Windows NT status code

If you provide the value NTAWIN$_UNKNOWN, the routine makes its best estimate as to the correct text. The routine parses the text as follows:

1. Check for a Windows HRESULT (high-order nibble = 0x8). If this check fails, go to the next step.
2. Check for a Windows NT user defined status code (high-order nibble = 0xE). If this check fails, go to the next step.
3. Assume this is an OpenVMS error code.

   The system cannot tell the difference between an OpenVMS error code and a Windows Win32 error code.

count

OpenVMS usage: FAO count
type: longword (unsigned)
access: write
mechanism: by reference

This argument is the optionally returned FAO argument count in the returned message. Currently all NTAWIN messages use ASCII substitution arguments (!AS) only. The caller must convert all numeric data to ASCII before performing the substitution with SYS$FAO.

Description

This routine uses the OpenVMS SYS$GETMSG system service. The messages are stored in the SYS$MESSAGE:NTAWINMSG.EXE and SYS$MESSAGE:NTARPCMSG.EXE images.

To call this routine, you must include the NTA_MESSAGE.H file in the DCOM$LIBRARY: directory and link with the SYS$LIBRARY:DCOM$WIN32_SHR shareable image.

Condition Values Returned

Any status from the SYS$GETMSG system service.

For more information about the SYS$GETMSG system service, see the *OpenVMS System Services Reference Manual.*

8
Authentication

8.1 What is Authentication?

Authentication is the act of verifying a user's identity by the computer system before permitting access to the system. After successfully authenticating a user, the system binds the user's authorization information to the user's process in the form of *credentials*. The system uses these credentials to determine whether to grant or deny access to system resources.

OpenVMS provides both native (SYSUAF-based) and Windows NT-compatible authentication and authorization capabilities as follows:

- Native: The system performs authentication using password information stored in the SYSUAF.DAT file. Authorization information consists of UIC, privileges, and rights identifiers.
- Windows NT: The system performs authentication using password information stored in a SAM database managed by domain controllers. Authorization information consists of primary SID, group SIDs, session key, and privileges obtained from the user's account information in the SAM database.

After OpenVMS successfully authenticates a user (either native or Windows NT), OpenVMS attaches the user's native credentials to the process using a structure known as a *persona*. If the system used Windows NT for authentication, OpenVMS also attaches the user's Windows NT credentials to the process (as an extension to the persona).

8.2 Acquiring Windows NT Credentials Using NTA$LOGON

NTA$LOGON is a utility that allows you to acquire NTLM credentials. All processes that need Windows NT security to access the OpenVMS Registry or *COM for OpenVMS* facilities require NTLM credentials.

You must provide NTA$LOGON with a user account name, a password, and (if required) a domain name. NTA$LOGON uses the Authentication and Credential Management (ACM) Authority to contact the domain controller and acquire a Windows NT access token. NTA$LOGON merges the Windows NT information with the user's OpenVMS credentials.

For a detailed review of NTA$LOGON dependencies and a description of how NTA$LOGON interacts with other parts of the OpenVMS infrastructure, see Section 5.1 and Section 4.8 (especially the ACME server and Advanced Server for OpenVMS server).

To use the NTA$LOGON utility, you can enter any of the following:

- Enter the following command to run the NTA$LOGON utility:

```
$ RUN SYS$SYSTEM:NTA$LOGON
```

The system prompts you for a user account name and password.

- Define a DCL symbol to use NTA$LOGON to parse the command line. For example:

```
$ NTLOGON :== $NTA$LOGON
$ NTLOGON
```

  You can specify parameters on the command line. Table 8–1 shows the command line parameters. If you do not specify any parameters, the system prompts you for the required information.

- Use the MCR command to use NTA$LOGON to parse the command line. For example:

```
$ MCR NTA$LOGON
```

  You can specify parameters on the command line. Table 8–1 shows the command line parameters. If you do not specify any parameters, the system prompts you for the required information.

Table 8–1 shows the NTA$LOGON utility command line parameters.

Table 8–1 NTA$LOGON Utility Command Line Parameters

Argument	Value	Required/Optional
P1	User account name. If an account name is needed but was not specified on the command line, NTA$LOGON prompts for input.	Optional
P2	Password. If a password is needed but was not supplied on the command line, NTA$LOGON prompts for input (echoing suppressed).	Optional

Example 8–1 shows a typical NTA$LOGON session to acquire credentials.

Example 8–1 Sample NTA$LOGON Session

```
$ NTLOGON :== $NTA$LOGON
$ NTLOGON joesmith
Password:
```

Note

Windows NT domain names and user account names are not case sensitive. NTA$LOGON converts all domain names and user account names to uppercase. If you specify a password on the command line, DCL converts all characters to uppercase, unless you enclose the password in quotation marks ("").

8.2.1 NTA$LOGON Optional Qualifiers

NTA$LOGON accepts the following optional qualifiers:

- **/DELETE**

  Deletes the current Windows NT credentials.

  If you specify the **/DELETE** qualifier with the **/WRITE_FILE** qualifier, the system deletes the password record for the specified domain name and user account name from the file.

- **/DOMAIN=***name*

  Specifies a domain name. This qualifier converts the name to uppercase. If you do not specify this qualifier, the system uses the default domain name.

- **/LIST**

  Lists the domain name and the user account name assigned to the current process.

  If you use the **/LIST** qualifier with the **/READ_FILE** or **/WRITE_FILE** qualifier, the system lists the contents of the file.

- **/LOG**

  Displays a message when an operation completes.

- **/OVERRIDE_MAPPING**

  Acquires Windows NT credentials for the specified Windows NT user account name even if the OpenVMS user name of the process does not match the OpenVMS user name associated with that Windows NT user account name in the domain controller.

  This qualifier requires the IMPERSONATE privilege.

- **/READ_FILE** [=*file*]

  This qualifier causes the system to search the binary input file created by the **/WRITE_FILE** qualifier for the specified domain name and user account name, instead of reading the password from the user input device. The **/READ_FILE** qualifier supports only binary files created by the NTA$LOGON/WRITE_FILE command.

  If the system finds a matching record, NTA$LOGON attempts to use that password to acquire Windows NT credentials.

  If you do not provide a file specification, the system uses the following default file specification:

  ```
  DCE$COMMON:[000000]NTA$LOGON.DAT
  ```

- **/TYPE={BATCH | DIALUP | LOCAL | NETWORK | REMOTE}**

  Specifies the rules under which access is to be granted or denied. If you do not specify this qualifier, the default is the type of the current process. This qualifier is usually used for detached processes (detached processes do not have a default type).

  This qualifier requires IMPERSONATE privilege.

- **/WRITE_FILE** [=*file*]

  This qualifier causes the system to write the specified domain name, user account name, and password into an output file to be used later (see the **/READ_FILE** qualifier), instead of using the user-supplied password.

If you do not provide a file specification, the system uses the following default location and file name:

```
DCE$COMMON:[000000]NTA$LOGON.DAT
```

Caution

The **/READ_FILE** and **/WRITE_FILE** qualifiers are intended to be used only by servers that have no other way to acquire Windows NT credentials to access the OpenVMS Registry or *COM for OpenVMS* facilities. Compaq does not recommend general use of the **/READ_FILE** and **/WRITE_FILE** qualifiers.

Once you have written a password into a disk file, Compaq recommends you take strong precautions to protect the password file from unauthorized access.

8.2.2 Examples of Using NTA$LOGON to Acquire Windows NT Credentials

Example 8–2 shows how a user acquires NT credentials for the first time.

Example 8–2 Acquiring Windows NT Credentials for the First Time

```
$ NTLOGON :== $NTA$LOGON
$ NTLOGON/LIST
ERROR: NtOpenProcessToken() failure: -1073741700 0xc000007c
%SYSTEM-E-NOSUCHEXT, no such extension found

$ NTLOGON/LOG JOESMITH
[Persona #1 NT extension: Account= "JOESMITH" Domain= "NT_DOMAIN" ]
Password:
```

Example 8–3 shows how the user replaces the Windows NT credentials.

Example 8–3 Replacing Windows NT Credentials

```
$ NTLOGON/DELETE
$ NTLOGON/OVERRIDE_MAPPING/DOMAIN=OTHER_DOMAIN
Username: janebrown
Password:
```

Example 8–4 shows how a user saves a password in a disk file. The system requests that the user enter the password twice with echoing suppressed.

Example 8–4 Saving a Password to a File

```
$ NTLOGON :== $NTA$LOGON
$ NTLOGON/WRITE_FILE=DEV:[DIR]NTA$LOGON.DAT COM_SERVER
Password:
Confirm:
$ NTLOGON/READ_FILE=DEV:[DIR]NTA$LOGON.DAT/LIST
File DEV:[DIR]NTA$LOGON.DAT contains the following records:
02-MAR-1999 16:57:23.20 COM_SERVER
```

After you have created this file, you can add the following to a DCL command procedure:

```
$ NTLOGON :== $NTA$LOGON
$ NTLOGON/READ_FILE=DEV:[DIR]NTA$LOGON.DAT COM_SERVER
```

8.3 The Authentication and Credential Management (ACM) Authority

The Authentication and Credential Management authority authenticates users and determines the user security profile for OpenVMS and Windows NT. The ACME_SERVER process provides these ACM services. The ACME_SERVER process uses plug-in modules called ACME agents. ACME agents perform the actual work of responding to authentication requests, query requests, and event requests.

The OpenVMS ACME agent (VMS$VMS_ACMESHR.EXE) provides OpenVMS native services. The MSV1_0 ACME agent (PWRK$MSV1_0_ACMESHR.EXE, an Advanced Server for OpenVMS product component) provides Windows NT connectivity services.

The MSV1_0 ACME agent forwards Windows NT connectivity service requests from NTA$LOGON and SSPI/NTLM to an Advanced Server for OpenVMS process running on one or more systems in the cluster. The PWRK$ACME_SERVER logical name can contain a comma-delimited list of cluster node names to which the MSV1_0 ACME can forward requests. Running the Advanced Server for OpenVMS process on more than one cluster node and including the node names in the PWRK$ACME_SERVER logical name allows the MSV1_0 ACME agent to fail over a request automatically if a connection is interrupted. If the logical name is undefined, the system defaults to the local machine name.

The ACME_SERVER process must be present on any system running RPC or *COM for OpenVMS*. However, the Advanced Server for OpenVMS process needs to be present on only one node in the cluster.

8.3.1 Windows NT Authentication on OpenVMS

Because the ACME_SERVER returns to its callers a complete OpenVMS persona with the requested attached Windows NT persona extension, the VMS ACME agent enforces the following rules:

- Every Windows NT user must be mapped to a local OpenVMS user name.

  The MSV1_0 ACME provides this mapping through the Advanced Server for OpenVMS HOSTMAP database.

- The mapped OpenVMS user name must be a valid (and not disabled) account in the SYSUAF.DAT. The account's access restrictions must allow access during the specified days and times. *COM for OpenVMS* and RPC typically require NETWORK access during authentication.

- The mapped OpenVMS user name must be an account with the EXTAUTH flag set. EXTAUTH allows the system manager fine control over which OpenVMS accounts can be used for mapping. You can use the IGNORE_ EXTAUTH bit (bit number 11 [decimal]) in the SECURITY_POLICY system parameter to override this per-account feature. If you set the IGNORE_ EXTAUTH bit to 1, OpenVMS allows you to map to any account, regardless of the account's EXTAUTH setting. Note that the IGNOTE_EXTAUTH is used only for the ACME_SERVER and is ignored by Loginout.

8.3.2 Managing the ACME_SERVER Process (ACME Server Commands)

To start the ACME_SERVER process and configure the MSV1_0 ACME agent at system startup, add the following entry to SYLOGICALS.COM:

```
$ DEFINE NTA$NT_ACME_TO_BE_STARTED YES
```

You can also start the ACME_SERVER process manually using the following startup command file:

```
$ @SYS$STARTUP:NTA$STARTUP_NT_ACME
```

To shut down ACME_SERVER, enter the following command:

```
$ SET SERVER ACME/EXIT
```

If an abnormal condition in an ACME agent prevents a normal server shutdown, use the **/ABORT** qualifier in the place of the **/EXIT** qualifier to force the ACME_SERVER to terminate.

To turn on ACME_SERVER logging, enter the following command:

```
$ SET SERVER ACME/LOG
```

This command creates a ACME$SERVER.LOG file in the SYS$MANAGER directory. You might find this file useful when you are trying to diagnose potential problems.

To display the ACME_SERVER configuration information, enter the following command:

```
$ SHOW SERVER ACME[/FULL]
```

8.3.3 Configuring the MSV1_0 ACME Agent

Table 8–2 lists and describes systemwide logical names you can use to control certain features of the MSV1_0 ACME agent.

Table 8–2 MSV1_0 ACME Agent Logical Names

Logical name	Description
PWRK$ACME_SERVER	Comma-delimited list of cluster SCS node names that are running Advanced Server for OpenVMS processes that can service Windows NT connectivity requests. If you do not define the node names, the MSV1_0 ACME agent tries to connect to the Advanced Server for OpenVMS process on the local system.
PWRK$ACME_RETRY_COUNT	The maximum number of retry attempts the MSV1_0 ACME agent performs when connecting to an Advanced Server for OpenVMS process. The default value is 10.
PWRK$ACME_RETRY_INTERVAL	The number of tenths of seconds between retry attempts. The default is 2.5 seconds.

9
Active Template Library

9.1 COM for OpenVMS and ATL

ATL (Active Template Library) is a set of template-based C++ classes from Microsoft that simplify the development of COM components. ATL provides support for key COM features, such as stock implementations of `IUnknown`, `IClassFactory`, `IDispatch`, dual interfaces, and connection points. It also provides support for more advanced COM features, such as enumerator classes and tear-off interfaces.

The ATL COM AppWizard and ATL Object Wizard in Microsoft Visual Studio can be used to quickly create code for simple COM objects that can be copied to OpenVMS systems and built with very few modifications.

The *COM for OpenVMS* ATL is based on Microsoft ATL Version 3.0. You must be running *COM Version 1.1-B for OpenVMS* or higher. ATL on OpenVMS Alpha Version 7.2-1 requires Compaq C++ Version 6.2-016 or higher.

COM for OpenVMS provides ATL as source code in header files that you include in your application.

Table 9–1 shows the differences between the ATL implementation on Windows NT and OpenVMS.

Table 9–1 ATL Implementation Differences

Implementation	Windows NT	OpenVMS
Interface	GUI	Character cell
Server models	Single threaded or multithreaded	Multithreaded only
ATL available as DLL	Yes (not required)	No
Application registration	Automatic using UpdateRegistryFromResource function in ATLBASE.H	Automatic using UpdateRegistryFromFile function in ATLBASE.H
ATL component types	In-process as DLL Out-of-process as EXE	In-process as shareable image Out-of-process as an executable image

9.2 Developing a COM for OpenVMS Application Using ATL

The following sections describe how to create a *COM for OpenVMS* application using ATL.

9.2.1 Step 1: Create the ATL Component in Microsoft Visual Studio

Generate the code using the Microsoft Visual Studio ATL COM AppWizard. For information about using the ATL COM AppWizard, see the Microsoft Developer Network (MSDN) documentation.

Copy the generated files to OpenVMS. For example, copy the files using File Transfer Protocol (FTP) in ASCII mode. Table 9–2 lists and describes the files that the ATL COM AppWizard would generate for a project named `mycomapp`.

Table 9–2 Files Generated by ATL COM AppWizard for `mycomapp`

File name	Description	Platform	In-Process or Out-of-Process
`mycomapp.cpp`	Contains the implementation of DllMain, DllCanUnloadNow, DllGetClassObject, DllRegisterServer and DllUnregisterServer. Also contains the object map, which is a list of the ATL objects in your mycomapp. This is initially blank, because you have not created an object yet.	Windows NT/OpenVMS	Both
`mycomapp.def`	The standard Windows module definition file for the DLL. **Note:** `MYCOMAPP.DEF` becomes `MYCOMPAP$SHR.OPT` on OpenVMS.	Windows NT	In-process
`mycomapp.dsw`	The mycomapp workspace.	Windows NT	Both
`mycomapp.dsp`	The file that contains the mycomapp settings.	Windows NT	Both
`mycomapp.idl`	The interface definition language file, which describes the interfaces specific to your objects.	Windows NT/OpenVMS	Both
`mycomapp.rc`	The resource file, which initially contains the version information and a string containing the mycomapp name.	Windows NT	Both
`Resource.h`	The header file for the resource file.	Windows NT/OpenVMS	Both
`mycomappps.mk`	The make file that can be used to build a proxy/stub DLL. You do not need this file.	Windows NT	Proxy/stub
`mycomapps.def`	The module definition file for the proxy/stub DLL. **Note:** `MYCOMAPPPS.DEF` becomes `MYCOMAPPPS$SHR.OPT` on OpenVMS.	Windows NT	Proxy/stub
`StdAfx.cpp`	The file that will include the ATL implementation files.	Windows NT/OpenVMS	Both
`StdAfx.h`	The file that will include the ATL header files. To make the mycomapp DLL useful, you need to add a control, using the ATL Object Wizard.	Windows NT/OpenVMS	Both
`mycomapp.rgs`	A registrar script for your COM server.	Windows NT/OpenVMS	Both

(continued on next page)

Table 9–2 (Cont.) Files Generated by ATL COM AppWizard for `mycomapp`

File name	Description	Platform	In-Process or Out-of-Process
`myinterface.rgs`	A registrar script for your COM server.	Windows NT/OpenVMS	Both
`myinterface.cpp`	The interfaces specific to your object.	Windows NT/OpenVMS	Both
`myinterface.h`	The header file for the interfaces.	Windows NT/OpenVMS	Both

9.2.2 Step 2: Modify Generated Files for ATL Applications on OpenVMS

Make the following changes to the generated files before you build ATL applications on OpenVMS.

9.2.2.1 Remove _ATL_MIN_CRT

When the ATL COM AppWizard generates `mycomapp`, it also defines the macro `_ATL_MIN_CRT` as part of the GUI support. Because OpenVMS does not have a graphical interface, you must remove (or not define) `_ATL_MIN_CRT` when you build on OpenVMS.

9.2.2.2 Include ATLMAIN.CXX

On OpenVMS, you must include ATLMAIN.CXX for out-of-process components. ATLMAIN.CXX defines the wWinMain( ) function.

9.2.2.3 Modify Registration Procedure

OpenVMS does not support registering the application using the `UpdateRegistryFromResource` function. You must use the OpenVMS `UpdateRegistryFromFile` function in the `ATLBASE.H` header file. You must make the necessary changes to your application. The following table shows the changes you must make.

File to search	Search for	Replace with
Interface header file	DECLARE_REGISTRY_RESOURCEID	DECLARE_REGISTRY_FILE
Project source file	_Module.UpdateRegistryFromResource	_Module.UpdateRegistryFromFile

The following example shows sample coding changes.

```
#ifdef __vms
DECLARE_REGISTRY_FILE(_T("MYINTERFACE.RGS"))
#else
DECLARE_REGISTRY_RESOURCEID(IDR_MYINTERFACE)
#endif
```

```
#ifdef __vms
_Module.UpdateRegistryFromFile(_T_"MYCOMAPP.RGS"), TRUE);
#else
_Module.UpdateRegistryFromResource(IDR_MYCOMPAPP, TRUE);
#endif
```

9.2.3 Step 3: Build an Application Using the MIDL Compiler

This process is the same as shown in Section 7.2.

For example (in-process):

```
$ MIDL :== $DCOM$MIDL.EXE
$ MIDL  -nologo -Oicf mycompapp.idl -
  -IDCOM$LIBRARY -
  -iid mycompapp_i.c -
  -proxy mycompapp_p.c -
  -dlldata dlldata.c -
  -tlb mycompapp$shr.tlb
```

For example (out-of-process):

```
$ MIDL :== $DCOM$MIDL.EXE
$ MIDL  -nologo -Oicf mycompapp.idl -
  -IDCOM$LIBRARY -
  -iid mycompapp_i.c -
  -proxy mycompapp_p.c -
  -dlldata dlldata.c -
  -tlb mycompapp.tlb
```

Compaq recommends that the name of your type library match the name of your executable or shareable image.

9.2.4 Step 4: Compile the ATL COM Application

The following sections describe how to compile *COM for OpenVMS* applications.

9.2.4.1 Required Header File: ATLBASE.H

The `VMS_ATL.H` header file defines several macros used by the Wind/U header files. `VMS_ATL.H` is already included in the `ATLBASE.H` header file. When creating ATL source code, you must include `ATLBASE.H` as the first noncommented line in your source (both header and implementation) files.

9.2.4.2 Required Macro Definitions

Include the following /DEFINE qualifier on all of your C and CXX commands:

```
/DEFINE=(UNICODE=1,_WINDU_SOURCE=0X041000,_WIN32_DCOM,_ATL_STATIC_REGISTRY)
```

The UNICODE macro ensures that wide-character variants of Win32 APIs and data structures are enabled when you compile. (The UNICODE macro is also defined in VMS_DCOM.H.) If you omit the UNICODE macro, your compile fails when you build using the Wind/U Win32 environment.

The other two macro definitions are recognized by the Wind/U header files and are required to ensure the proper definition of structures and COM APIs.

The `_ATL_STATIC_REGISTRY` macro enables you to statically link with the ATL registry component (`Registrar`) for optimized Registry access. You can add the macro either by including the /DEFINE qualifier on the command line or by adding the stdafx.h header file to your code.

9.2.4.3 Required Include Directories

COM for OpenVMS applications typically require header files that come from `DCOM$LIBRARY`. The ATL header files and source files are also located in `DCOM$LIBRARY`.

Include the following qualifier on your C and CXX command lines:

```
/INCLUDE=DCOM$LIBRARY
```

If you already have an /INCLUDE qualifier on your command line, modify the command to include DCOM$LIBRARY.

9.2.4.4 Required C++ Qualifiers

You must specify the following C++ qualifiers when you build *COM for OpenVMS* applications:

- /EXCEPTIONS=CLEANUP

  Specify the /EXCEPTIONS=CLEANUP qualifier on C++ commands to enable C++ exceptions.

- /STANDARD=MS

  The C++ compiler supports many different compilation standards. You must use /STANDARD=MS for COM applications created by ATL.

  /STANDARD=MS informs the compiler that it should follow the language constructs supported by the Visual C++ compiler. This switch works well with the code generated by ATL.

- /TEMPLATE_DEFINE=(NOALL,NOPRAGMA)

  This switch controls the instantiation of C++ templates. You must specify the following options:

  — [NO]ALL

  Instantiate all function template entities declared or referenced in the compilation unit, including typedefs. For each fully instantiated template class, all its member functions and static data members are instantiated even if they were not used. Nonmember template functions are instantiated even if the only reference was a declaration. Instantiations are created with external linkage. Overrides /REPOSITORY at compile time. The compiler places instantiations in the user's object file. The template definition must be present before the point of each instantiation in the source file.

  The default is /TEMPLATE_DEFINE=NOALL.

  — [NO]PRAGMA

  Determines whether the C++ compiler ignores #PRAGMA DEFINE_TEMPLATE directives encountered during the compilation. This option lets you quickly switch to automatic instantiation without having to remove all the pragma directives from your program's code base.

  The default is /TEMPLATE_DEFINE=PRAGMA, which enables #PRAGMA DEFINE_TEMPLATE.

9.2.5 Step 5: Link the ATL COM Application

To build a *COM for OpenVMS* application, you must build both client and component images. Because you can implement a component as either an in-process component or an out-of-process component, you must build either a shareable image or an executable image, or both.

The following sections describe the steps you must follow to link the client, component, and proxy/stub images.

9.2.5.1 Linking the Client and the Out-of-Process Component

Although you do not need to specify any qualifiers to link the client or the component executable images, you must link both images. The specific link-time dependency is as follows:

- DCOM$LIBRARY:DCOM.OPT

If you have one or more C++ modules, use the C++ linker (CXXLINK) instead of the standard OpenVMS linker so you can specify the location of your C++ repository (/CXX_REPOSITORY qualifier). For example:

```
$  CXXLINK/your-specific-linker-qualifiers list-of-object-modules, -
_$ DCOM$LIBRARY:DCOM.OPT/OPTIONS, application.OPT/OPTIONS  -
_$ /REPOSITORY=[.CXX_REPOSITORY]
```

You can also include the list of object modules in an options file instead of on the command line.

9.2.5.2 Linking the In-Process Component Shareable Image

The in-process component shareable image dependency list differs slightly from that of the client and component executables. The specific link-time dependencies are as follows:

- [*directory-name*]MYCOMPAPP$SHR.OPT
- DCOM$LIBRARY:DCOM.OPT

9.2.5.3 Creating a Symbol Vector

Use the procedure described in Section 7.4.2.1 to create a symbol vector for the in-process component shareable image.

Use the procedure described in Section 7.4.3 to create a symbol vector for the proxy/stub shareable image.

9.3 ATL Samples

TESTATL is an out-of-process sample, and MATH101 is an in-process sample.

You can find the sample ATL applications shown in this chapter in the following directories on the *COM for OpenVMS* kit:

```
DCOM$EXAMPLES:[TESTATL_OUTPROC]
DCOM$EXAMPLES:[TESTATL_INPROC]
```

Note

If you are running authenticated COM, before you build the application on OpenVMS, you must run NTA$LOGON and acquire Windows NT credentials. For more information, see Section 8.2.

9.3.1 Out-of-Process COM Sample (TESTATL_OUTPROC)

This sample implements a COM client and server in which the component provides one interface: `ISum`.

Given sources initially generated by the Microsoft Visual Studio ATL AppWizard and a few applied changes, the sample demonstrates the build, registration, and execution of the ATL application on OpenVMS.

The following sections describe how to create the application using the Microsoft ATL AppWizard on Windows NT and how to build the application on an OpenVMS system.

9.3.1.1 Creating the Application on Windows NT

Use the following guidelines when generating a skeleton project and simple objects using the Microsoft Visual Studio ATL AppWizard.

- Generate the skeleton project
  - Select the ATL COM AppWizard and name your skeleton project.
  - Choose **Executable (EXE)** as the server type.
- Add objects
  - Start the ATL Object Wizard.
  - From the **Objects** category, select **Simple Object**.
  - From the **Attribute** tab, choose the **Both** threading model.

9.3.1.2 Building, Registering, and Running the Application on OpenVMS

A README file describes how to build, register, and run this COM for OpenVMS sample. The file is located in:

```
DCOM$EXAMPLES:[TESTATL_OUTPROC]README-TESTATL_OUTPROC.TXT
```

9.3.2 In-Process COM Sample (TESTATL_INPROC)

This sample implements a COM client and server in which the component provides three interfaces: `ISum`, `IDiv`, and `IMul`.

Given sources initially generated by the Microsoft Visual Studio ATL AppWizard, the sample demonstrates the build, registration, and execution of the shareable application on an OpenVMS system.

The following sections describe how to build the application.

9.3.2.1 Creating the Application on Windows NT

Use the following guidelines when generating a skeleton project and simple objects using the Microsoft Visual Studio ATL AppWizard.

- Generate the skeleton project
  - Select the ATL COM AppWizard and name your skeleton project.
  - Choose **Dynamic Link Library (DLL)** as the server type.
- Add objects
  - Start the ATL Object Wizard.
  - From the **Objects** category, select **Simple Object**.
  - From the **Attribute** tab, choose the **Both** threading model.

9.3.2.2 Building, Registering, and Running the Application on OpenVMS

A README file describes how to build, register, and run this COM for OpenVMS sample. The file is located in:

```
DCOM$EXAMPLES:[TESTATL_INPROC]README-TESTATL_INPROC.TXT
```

9.4 Suggested Reading

The following resources can provide you with more information about ATL:

- Third-party books about ATL:
  - *Beginning ATL COM Programming*, Grimes and Stockton, Templeman and Reilly, Wrox Press, Olton, Birmingham, UK, 1998. ISBN: 1-861000-11-1.
  - *Professional ATL COM Programming*, Dr Richard Grimes, Wrox Press, Olton, Birmingham, UK, 1998. ISBN: 1-861001-4-01.
- Websites:
  - *The Component Object Model Specification*, available from the Microsoft COM website:

    `www.microsoft.com/com`

Part II

OpenVMS Registry

The following chapters describe the OpenVMS Registry database, its structure, and the $REGISTRY and $REGISTRYW system services that interface with the OpenVMS Registry.

10
Overview of OpenVMS Registry

10.1 What is the Registry?

The Windows NT Registry is a single, systemwide, hierarchical database of configuration information about hardware and software (both the operating system and applications). The Windows NT Registry replaced Windows 3.*x* `.ini` files, providing a single place for storing application and configuration information.

To allow OpenVMS and Windows NT to interoperate, Compaq has provided a registry on OpenVMS. Like the Windows NT Registry, the OpenVMS Registry is made up of two components: the OpenVMS Registry database and the OpenVMS Registry server. The OpenVMS Registry database is a systemwide or clusterwide hierarchical database of configuration information. This information is stored in a database structure of keys and associated values. The OpenVMS Registry server controls all OpenVMS Registry operations, such as creating and backing up the OpenVMS Registry database, and creating, displaying, modifying, or deleting keys and values.

The OpenVMS Registry includes interfaces (COM APIs and system services) to allow applications to control the OpenVMS Registry server and to read and write to the OpenVMS Registry database. The OpenVMS Registry also includes server management utilities to allow system managers to display and update OpenVMS Registry information from the OpenVMS DCL command line.

The OpenVMS Registry is compatible with the Windows NT Registry. Windows NT client applications such as `RegEdt32` can connect to and edit the OpenVMS Registry.

10.1.1 Suggested Reading

The following resources can provide you with more information about Windows NT Registry and related topics:

- Third-party books about the Windows NT Registry:
  - *Windows NT Server 4.0 Unleashed*, Jason Garms, SAMS Publishing, Indianapolis, IN, 1998. ISBN: 0-672-30933-5.

10.2 OpenVMS Registry Concepts and Definitions

The OpenVMS Registry, like the Windows NT Registry, is a hierarchical database with several branches.

The following sections list and explain OpenVMS Registry database elements and operation.

10.2.1 Keys, Subkeys, and Values

A **key** is one of the basic building blocks of the OpenVMS Registry database. A key contains information specific to the computer, system, or user; it is a header field in the OpenVMS Registry database. Keys can be arranged in a hierarchy (or tree).

There are two main (or root) keys in the OpenVMS Registry:

- `HKEY_USERS` contains information about each user.
- `HKEY_LOCAL_MACHINE` contains hardware, software, security, and general system configuration information.

The key `HKEY_CLASSES_ROOT` points to the `CLASSES` subkey in `HKEY_LOCAL_MACHINE`. These root keys are discussed in more detail in Section 10.3.

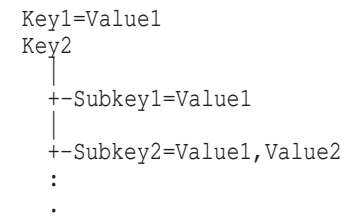
A **subkey** is a key that is a child to another key. A key can have zero or more subkeys. Subkeys allow you to group related keys together below another key in a hierarchy or tree.

A **value entry** (or **value**) is a named element of data; it is a record field in the registry database. A key has zero or more associated values. A value has a value name, a value type, a collection of flags, and associated data (defined by the value's type). OpenVMS Registry supports the following value types:

- Null-terminated string
- Null-terminated array of null terminated strings
- Null-terminated string containing environment variables (logical names or symbols)
- 32-bit data item
- 64-bit data item
- Raw binary

Figure 10–1 summarizes the relationship between keys, subkeys, and values.

Figure 10–1 Key, Subkey, and Value Relationships



10.2.1.1 Key and Value Volatility

You can define OpenVMS Registry keys and values as either **nonvolatile** or **volatile**. Nonvolatile keys are saved to OpenVMS Registry files. Volatile keys are cached to a temporary file.

On Windows NT systems, volatile keys and values are removed when the system restarts.

On OpenVMS, volatile keys and values are automatically removed when all nodes in a cluster are rebooted. OpenVMS extends the lifetime of volatile keys to survive server failover but not a cluster reboot. (In a standalone system, volatile keys and values are lost when the system reboots.)

10.2.1.2 Key Write-through and Write-behind

When you create a key, you can specify when the OpenVMS Registry should write that key's changed information. The write options are as follows:

- **Write-through:** Write the changes to disk immediately.
- **Write-behind:** Cache the changes and write them later.

The `Cache Action` attribute allows you to specify a key's write characteristics. If you do not specify the cache action attribute when you create the key, the key inherits this attribute from its parent.

When you use the `SYS$REGISTRY` interface, you can use the the `REG$M_NOW` function code modifier for a request in progress to force an immediate write (write-through), regardless of the cache action attribute value.

10.2.1.3 Linking a Key to Other Keys and Values

OpenVMS Registry keys can link to other OpenVMS Registry keys, providing multiple paths to the same piece of data. In the same way, OpenVMS Registry values can link to other OpenVMS Registry values. These key and value links, or **symbolic links**, are similar to file links. Symbolic links are name references.

For example, you can link `Key A` to `Key B`. When you query `Key A` and its value, the system returns `Key B`'s value.

You can also **chain** symbolic links. That is, `Key A` can point to `Key B` and `Key B` can point to `Key C`; as a result, `Key A` also points to `Key C`. You can specify a link through the $REGISTRY system service or through the OpenVMS Registry server management command-line interface.

10.2.1.4 Rules for Creating OpenVMS Registry Keys and Value Names

The following rules apply to key and value names:

- A key can have subkeys and values.
- A key name can be composed of any Unicode (4 bytes) character except the backslash (\) character and the null character. You must specify at least one character.
- A value name can be composed of any Unicode (4 bytes) character.
- A key string can be either a name (for example, `disk`) or a path (for example, `Hardware\cosmos\disk`).
- A value string can be a name *only*.
- When you define a key, if you specify a path but the system does not find one or more of the path subkeys, the system creates these subkeys automatically. The created keys inherit the attributes of their parent.
- The key and value names are case preserved in the OpenVMS Registry database. Name comparisons are case insensitive unless you specify the `REG$M_CASESENSITIVE` function code modifier with calls to the $REGISTRY system service.

- For pure binary data, the maximum size of a value is 1 MB (for Windows NT compatibility).

10.2.2 Class

The `Class` attribute allows you to store additional descriptive information with each key. For example, specifying `Class text string` could allow you store permitted data types with a specified key.

10.2.3 Hive

A **hive** is a collection of related keys, subkeys, and values stored in the OpenVMS Registry.

On Windows NT systems, a hive is stored in a single file in the `%SystemRoot%\system32\config` directory, along with an associated `LOG` file. Windows NT allows users to save hives to specified files on disk so that these files can be loaded at a later time.

On OpenVMS systems, the entire OpenVMS Registry database consists of two hives: `REGISTRY$LOCAL_MACHINE.REG` and `REGISTRY$USERS.REG`. OpenVMS does not support loading and unloading hives.

10.3 OpenVMS Registry Structure

To allow Windows NT applications to interface with the OpenVMS Registry database, the OpenVMS Registry database includes a subset of the Windows NT Registry predefined keys and subkeys.

The OpenVMS Registry includes the following predefined standard keys:

- `HKEY_CLASSES_ROOT`

  On Windows NT systems, this key is reserved for the definition of classes of documents and the properties associated with these classes.

  On OpenVMS systems, this key by default does not have any subkey or value.

  This entry point maps to the `HKEY_LOCAL_MACHINE\SOFTWARE\Classes` subkey.

- `HKEY_USERS`

  On Windows NT systems, the entries under this entry point define the default user configuration for users on the local system and the user configuration for the current user.

  On OpenVMS systems, this key by default does not have any subkey or value.

- `HKEY_LOCAL_MACHINE`

  The entries under this entry point are reserved for system configuration information.

  On Windows NT systems, this area contains information about the bus type, system memory, and installed hardware and software.

  On OpenVMS systems, this key has the following predefined subkeys:

  — `Hardware`

    On Windows NT systems, the system constructs the volatile subkeys of this key from the information gathered at boot time.

    On OpenVMS systems, this key does not have any subkey or value by default.

  — `Security`

On Windows NT systems, these keys contain all the security information for the local computer. The system owns the information in these keys and protects them accordingly.

On OpenVMS systems, this key by default does not have any subkey or value.

— Software

On Windows NT systems, this key contains information about the software on the local system that is independent of per-user configurations.

On OpenVMS systems, this key has the following predefined subkeys:

* Classes
* Compaq Computer Corporation
* Microsoft

— System

On Windows NT systems, this key contains information about devices and services.

On OpenVMS systems, this key has the following predefined subkeys:

* CurrentControlSet

  On Windows NT systems, this key contains information about Control, Enum, and Hardware Profiles and Services.

  On OpenVMS systems, this key is reserved for use by Advanced Server for OpenVMS.

* Registry

  This subkey does not exist on Windows NT systems. On OpenVMS systems, this key contains the OpenVMS Registry server configuration parameters in the form of subkeys and values. The predefined subkeys are as follows:

  + File Quotas

    This subkey is empty when you create the OpenVMS Registry database. A system manager can assign quota for each OpenVMS Registry database file by creating a value whose name is the name of the OpenVMS Registry file. If no value exists for a file, the OpenVMS Registry server uses the default value for the **Default File Quota** setting.

    For example, a system manager could use REG$CP to assign a 1 MB quota to the OpenVMS Registry REGISTRY$LOCAL_MACHINE.REG file by issuing the following command:

```
$ MCR REG$CP
REG> CREATE VALUE/NAME=REGISTRY$LOCAL_MACHINE/TYPE=DWORD/ -
_REG> DATA=%D1000000 "hkey_local_machine\system\registry\File Quotas"
```

  + File Monitor

    This subkey is not used.

  + Priority

This subkey is empty at OpenVMS Registry database creation. A system manager can change the priority of the OpenVMS Registry server on a specified node by creating a value whose name is the node name of the system in the cluster on which the OpenVMS Registry server resides.

For example, a system manager could use the REG$CP server management utility to assign a priority of 100 to node COSMOS by issuing the following command:

```
$ MCR REG$CP
REG> CREATE VALUE/NAME=COSMOS/TYPE=DWORD/DATA=%D100 -
_REG> "hkey_local_machine\system\registry\Priority"
```

10.4 Reading and Writing to the OpenVMS Registry

You can read and write to the OpenVMS Registry in the following ways:

- Using *COM for OpenVMS*, through the COM APIs available on OpenVMS. This allows application programmers to enter, modify, and delete OpenVMS Registry keys and values.
- Through the $REGISTRY and $REGISTRYW system services and the OpenVMS Registry server management utility commands. This allows application programmers to enter, modify, and delete OpenVMS Registry keys and values. For more information, see Section 10.4.1.
- From Windows NT, through the Windows NT Registry APIs, or using RegEdt32 (the Windows NT Registry Editor). This allows Windows NT users to view and edit OpenVMS Registry keys and values.

10.4.1 $REGISTRY System Services

The OpenVMS Registry includes two OpenVMS system services that provide an interface to the OpenVMS Registry server. The OpenVMS Registry system services allow you to query, update, and create keys, subkeys, and values in the OpenVMS Registry database.

For more information about the $REGISTRY and $REGISTRYW system services, see Chapter 13.

10.4.2 REG$CP Server Management Utility

The REG$CP server management utility allows you to display and update OpenVMS Registry information from the OpenVMS DCL prompt. The utility also allows you to back up and restore the entire OpenVMS Registry database to or from a file, as long as you have the required system privileges.

For more information about the REG$CP server management utility, see Chapter 12.

10.5 OpenVMS Registry Security

The OpenVMS Registry implements both the OpenVMS and Windows NT security models.

To access to the OpenVMS Registry database, the calling process must have the proper OpenVMS Registry rights identifier for the operation you want to perform (for example, REG$LOOKUP for read operations, REG$UPDATE for write operations, or REG$PERFORMANCE for statistics operations) or the calling process must have the SYSPRV privilege.

The following sections describe the two models.

10.5.1 OpenVMS Security Model

When a user requests access to the OpenVMS Registry, the OpenVMS system checks the user's Windows NT credentials and allows access as follows:

1. Does the user have Windows NT credentials?
   - If the user has Windows NT credentials because the user has connected to OpenVMS from a Windows NT system, OpenVMS allows the user access to the OpenVMS Registry based on the user's supplied credentials.
   - If the user has Windows NT credentials because the user is a *COM Version 1.1-B for OpenVMS* client, OpenVMS allows the user access to the OpenVMS Registry based on the user's supplied credentials.
   - If the user has Windows NT credentials because the user has logged on to OpenVMS through single signon, OpenVMS allows the user access to the OpenVMS Registry based on the user's supplied credentials.

     If the user is not allowed access to the OpenVMS Registry based on the user's supplied credentials, skip to Step 2.
   - If the user does not have Windows NT credentials, continue to the next step.
2. Does the user have the OpenVMS SYSPRV privilege?
   - If the user has the SYSPRV privilege, OpenVMS allows the user full access to the OpenVMS Registry.
   - If the user does not have the SYSPRV privilege, continue to the next step.
3. Does the user have the `REG$UPDATE`, `REG$LOOKUP`, or `REG$PERFORMANCE` rights identifier?
   - If the user has the `REG$UPDATE`, `REG$LOOKUP`, or `REG$PERFORMANCE` rights identifier, OpenVMS allows the user access to the OpenVMS Registry using the supplied rights identifier. The user can access the OpenVMS Registry database as follows:
     - `REG$UPDATE`: Allows full access to the OpenVMS Registry except for maintenance requests.
     - `REG$LOOKUP`: Allows read-only access to the OpenVMS Registry.
     - `REG$PERFORMANCE`: Allows access to performance data collected by the OpenVMS Registry server.
   - If the user does not have the `REG$UPDATE`, `REG$LOOKUP`, or `REG$PERFORMANCE` rights identifier, continue to the next step.
4. If the user has no Windows NT credentials, OpenVMS grants the OpenVMS user Windows NT `Everyone` group access. In this case, the OpenVMS user's access to OpenVMS Registry keys depends on what permissions the key owner defined for `Everyone` when the key owner created the key or subkey. Based on these permissions, the OpenVMS user will be able to do one of the following:
   - Read the key and its subkeys.
   - Not see the key and its subkeys.

10.5.1.1 Granting OpenVMS Registry Access Rights Using the AUTHORIZE Utility

You can use the OpenVMS Authorize utility (AUTHORIZE) to add the SYSPRV privilege and REG$UPDATE, REG$LOOKUP, and REG$PERFORMANCE identifiers to user processes.

Caution

Granting OpenVMS Registry rights overrides Windows NT security access checks.

Because rights identifiers are specific to an application, you cannot use the AUTHORIZE command to create the rights identifiers. Use the REG$CP server management utility to create these rights on your system. Running the REG$CP server management utility creates these rights by default. You must run REG$CP from a privileged account. For more information about running REG$CP, see Chapter 12.

The following example shows how to use the SET RIGHTS_LIST command to allow all users to view keys and data in the OpenVMS Registry database. This command adds the REG$LOOKUP identifier to the system rights list.

```
$ SET RIGHTS_LIST/ENABLE/SYSTEM REG$LOOKUP
```

Example 10–1 shows how to use AUTHORIZE to grant and remove OpenVMS Registry rights to a specific user.

Example 10–1 Using AUTHORIZE to Grant Rights to a User

```
$ SET DEF SYS$SYSTEM
$ RUN AUTHORIZE

UAF> GRANT/IDENTIFIER REG$LOOKUP SMITH ❶
UAF> GRANT/IDENTIFIER/ATTRIBUTES=DYNAMIC REG$UPDATE SMITH ❷
UAF> REVOKE/IDENTIFIER REG$UPDATE SMITH ❸
UAF> GRANT/IDENTIFIER REG$PERFORMANCE SYSTEM ❹
```

❶ This AUTHORIZE command grants the REG$LOOKUP identifier to user Smith, allowing Smith to view keys and data in the OpenVMS Registry database.

❷ This AUTHORIZE command grants the REG$UPDATE identifier to user Smith, allowing Smith to modify keys and data in the OpenVMS Registry database. The dynamic attribute allows Smith to remove or restore the REG$UPDATE identifier from the process rights list by using the SET RIGHT/ENABLE or the SET RIGHT/DISABLE command.

❸ This AUTHORIZE command removes the REG$UPDATE identifier from user Smith.

❹ This AUTHORIZE command grants the REG$PERFORMANCE identifier to the system manager account, allowing the system manager to enable and disable the monitoring of OpenVMS Registry performance data.

10.5.2 Windows NT Security Model

Windows NT users can access the OpenVMS Registry only through the Advanced Server for OpenVMS. OpenVMS grants Windows NT users access to the OpenVMS Registry based on the user's Windows NT credentials.

10.6 Controlling the OpenVMS Registry Server Operations

OpenVMS Registry server operations include control of file quotas, server priority, error recovery actions, frequency of database backup, and OpenVMS Registry server tuning.

The following sections describe OpenVMS Registry server operations, and provide minimum, maximum, and default values for each setting. For information about how to change these settings, see Chapter 12.

10.6.1 Defining Maximum Reply Age/Age Checker Interval Settings

The OpenVMS Registry server handles duplicate requests by tracking work in progress and returning a `REG$_DUPLREQUEST` error. The OpenVMS Registry server also holds completed requests in case a duplicate request is received for work that is already completed. In this case, the OpenVMS Registry server reconstructs the reply. After a specified time, the requests are discarded. The **Maximum Reply Age** setting determines how long these requests are retained. The **Age Checker Interval** setting determines how often the OpenVMS Registry server checks for requests that exceed this age.

By default, the server checks for old completed requests every five seconds. By default, the server discards completed requests that are older than five seconds.

Setting Name	Default value	Minimum value	Maximum value
Maximum Reply Age	5	1	60
Age Checker Interval	5	1	60

10.6.2 Defining the Database Log Cleaner Interval/Initial Log File Size Settings

The OpenVMS Registry uses a a two-phase commit process to write modifications to the OpenVMS Registry database. The OpenVMS Registry first writes the modifications to a log file and then applies the log file to the OpenVMS Registry database. The **Database Log Cleaner Interval** setting determines how often the OpenVMS Registry applies the log file to the OpenVMS Registry database. After the OpenVMS Registry applies the log file, the OpenVMS Registry creates a new log file based on the size you specify in the **Initial Log File Size** setting.

The **Database Log Cleaner Interval** setting should be short enough so that writes to the database do not require that the log file be extended. Also, the log file size should be small to keep the amount of time spent applying the log relatively short, because this operation blocks writes to the database.

By default, the log file is applied every five seconds. By default, the OpenVMS Registry log file is created using a size of 32 blocks (16 KB).

Setting Name	Default value	Minimum value	Maximum value
Database Log Cleaner Interval	5	1	30
Initial Log File Size	32	16	256

10.6.3 Defining Default File Quota/File Quota Interval Settings

The OpenVMS Registry server limits the size of OpenVMS Registry database files by applying file quotas. You can assign file quotas to the individual files that make up the OpenVMS Registry database. If you do not assign a file quota, the OpenVMS Registry uses the **Default File Quota** setting.

The OpenVMS Registry server periodically recalculates the size of the OpenVMS Registry database files to see whether quota is exceeded. The **File Quota Interval** setting determines how often the OpenVMS Registry performs this calculation.

By default, the **Default File Quota** setting is 10 MB. By default, the server recalculates the file quota every 30 seconds.

Setting Name	Default value	Minimum value	Maximum value
Default File Quota	0x10000000	0x7d00	0x3fffffff
File Quota Interval	30	10	60

10.6.4 Defining the Scan Interval Setting

In an OpenVMS Cluster, you can run OpenVMS Registry servers on more than one node; however, only one OpenVMS Registry server is active at a time. A OpenVMS Registry server's priority relative to the other OpenVMS Registry servers in the cluster determines which OpenVMS Registry server is active. If the cluster configuration changes, the system manager can adjust the priority of one or more OpenVMS Registry servers. After the system manager changes the priority, the OpenVMS Registry servers in the cluster determine which server now has the highest priority and automatically change their states as necessary. The **Scan Interval** setting determines how often a OpenVMS Registry server checks for changes in its priority.

By default, a server checks for changes in priority every 120 seconds.

Setting Name	Default value	Minimum value	Maximum value
Scan Interval	120	60	300

10.6.5 Defining the Log Registry Value Error Setting

The OpenVMS Registry server logs an error if one of the OpenVMS Registry server parameter values is out of the acceptable range. If the OpenVMS Registry detects an out-of-range error, the OpenVMS Registry server uses the default value for that parameter. The **Log Registry Value Error** setting is a Boolean value that determines whether the error should be logged.

By default, the OpenVMS Registry server does not log out-of-range errors.

Setting Name	Default value	Minimum value	Maximum value
Log Registry Value Error	0	0	1

10.6.6 Defining the Operator Communications Interval Setting

If an I/O error occurs, the OpenVMS Registry server can display a message to the operator console using OPCOM. The **Operator Communications Interval** setting determines how long the OpenVMS Registry server waits after the I/O error to determine if the error is going to persist. If the error does persist, OpenVMS Registry writes a message to the operator console.

By default, the OpenVMS Registry server writes a message to the operator console if the error persists longer than 60 seconds.

Setting Name	Default value	Minimum value	Maximum value
Age Checker Interval	5	1	60
Operator Communication Interval	60	30	120

10.6.7 Defining the Process Time Limit Setting

The OpenVMS Registry server writes a message to the server log file if it takes too long to process a request. The **Process Time Limit** setting determines when a request has taken too long.

By default, 180 seconds are allowed per request before the OpenVMS Registry logs a message.

Setting Name	Default value	Minimum value	Maximum value
Process Time Limit	180	60	600

10.6.8 Defining the Reply Log Cleaner Interval Setting

The OpenVMS Registry server maintains a log of recent replies that it uses to reconstruct work in progress in the case of failover. After a specified time, the server discards these replies. The **Reply Log Cleaner Interval** setting determines how often the OpenVMS Registry discards these replies.

By default, the OpenVMS Registry server discards replies every five seconds.

Setting Name	Default value	Minimum value	Maximum value
Reply Log Cleaner Interval	10	5	60

10.6.9 Defining Snapshot Interval/Snapshot Location/Snapshot Versions Settings

The OpenVMS Registry server maintains backup copies of the OpenVMS Registry database. The **Snapshot Interval** setting determines how often the OpenVMS Registry server creates a backup copy. The **Snapshot Location** setting determines where the OpenVMS Registry stores the copy. The **Snapshot Versions** setting determines how many previous copies the OpenVMS Registry keeps.

By default, the OpenVMS Registry database is copied to backup once per day. By default, the OpenVMS Registry database is copied to the location determined by the definition of the `SYS$REGISTRY` logical name. By default, the OpenVMS Registry keeps five previous versions of the OpenVMS Registry database.

Setting Name	Default value	Minimum value	Maximum value
Snapshot Interval	86400	3600	604800
Snapshot Location	SYS$REGISTRY	—	—
Snapshot Versions	5	1	10

10.6.10 Defining the Write Retry Interval Setting

In the OpenVMS Registry finds an error when writing to the OpenVMS Registry database, the OpenVMS Registry server retries the write at an interval specified by the **Write Retry Interval** setting.

By default, the OpenVMS Registry server attempts to retry failed writes to the OpenVMS Registry database every five seconds.

Setting Name	Default value	Minimum value	Maximum value
Writer Retry Interval	5	1	30

11

OpenVMS Registry System Management

11.1 Installing the OpenVMS Registry

The OpenVMS Registry server is installed as part of the OpenVMS Version 7.2-1 system installation.

Before you can use the OpenVMS Registry, you must configure the OpenVMS Registry server and populate the OpenVMS Registry database. For more information about configuring the OpenVMS Registry server, see Section 11.2. For more information about populating the OpenVMS Registry database, see Section 6.2.

The first time you start the OpenVMS Registry server using the startup process described in Section 11.3, the OpenVMS system creates the OpenVMS Registry database.

You can access the OpenVMS Registry in several ways. Depending on how you want to access the OpenVMS Registry, you must install the following products:

- If you want to access the OpenVMS Registry using the COM APIs, you must install *COM for OpenVMS*. For more information, see Chapter 4.
- If you want to access the OpenVMS Registry using the Windows NT application `RegEdt32`, you must first install, configure, and start Advanced Server for OpenVMS. For more information, see the Advanced Server for OpenVMS documentation.

You can also access the OpenVMS Registry using the OpenVMS Registry server management utility or the OpenVMS Registry system services, which are installed as part of the OpenVMS Registry in OpenVMS Version 7.2-1.

11.2 Configuring the OpenVMS Registry: the REG$CONFIG Configuration Utility

The OpenVMS Registry Configuration utility (REG$CONFIG) provides information about the OpenVMS Registry server status and the OpenVMS Registry database location, and allows you to change OpenVMS Registry logical names and paths.

Enter the following command to start the OpenVMS Registry Configuration utility:

```
$ @SYS$MANAGER:REG$CONFIG
```

The system displays the following menu:

```
------------------------------------------------------
        OpenVMS Registry Configuration Utility
        ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
        1 - Configure OpenVMS Registry logical names and directory paths
        2 - Display OpenVMS Registry logical names and directory paths
        3 - Check the state of the OpenVMS Registry server
        4 - Start the OpenVMS Registry server on this node
        H - Help about this utility
       [E] - Exit
Please enter your choice :
------------------------------------------------------
```

To select an option, enter the option number. The options are as follows:

- `1 - Configure OpenVMS Registry logical names and directory paths`

  Allows you to configure the OpenVMS Registry server startup value and specify the location of the OpenVMS Registry database.

  For this procedure, see Section 11.2.1.

- `2 - Display OpenVMS Registry logical names and directory paths`

  Displays the current values of the OpenVMS Registry server logical (startup value) for this node and the OpenVMS Registry database location.

- `3 - Check the state of the OpenVMS Registry server`

  Displays the current state of the OpenVMS Registry server. The system displays one of the following:

  ```
  The OpenVMS Registry server is started in the cluster.
  The OpenVMS Registry server is started on this node.
  The OpenVMS Registry server is not started.
  ```

- `4 - Start the OpenVMS Registry server on this node`

  Starts the OpenVMS Registry server on the current node. The system displays the following message:

  ```
  The OpenVMS Registry server has successfully started.
  ```

- `H - Help about this utility`

  Displays online help for OpenVMS Registry Configuration utility options.

- `[E] - Exit`

  Exits the OpenVMS Registry Configuration utility.

Tip: Enter Q (Quit) at any time

You can enter `Q` at any prompt to return to the OpenVMS Registry Configuration utility menu.

If you quit while you are configuring logical names, the system updates only those values for which you have received a confirmation message.

11.2.1 Configuring OpenVMS Registry Values

The system displays the following questions:

1. The system prompts you to enter standalone or cluster information. The system displays the following message:

```
Is this system now a node in a cluster or will this system
become part of a cluster? (Y/N/Q):
```

2. The system displays the current information about the REG$TO_BE_STARTED logical, then prompts you to change the value.

```
            - REG$TO_BE_STARTED -

   [current value of REG$TO_BE_STARTED]

        NOTE: Setting this logical to TRUE starts the OpenVMS Registry
          server automatically when the system boots. Setting this logical
          to FALSE prevents the OpenVMS Registry server from starting
          when the system boots and prevents other products from starting
          the OpenVMS Registry server. If the OpenVMS Registry Server is not
          started at boot time, but other products that require an OpenVMS
          Registry server are able to start the OpenVMS Registry server, you
          do not need to assign a value to this logical.

Do you want to change this value? (Y/N/Q) [Y]:
```

If you choose Y, the system prompts you for the new value.

```
Enter the new value (TRUE/FALSE/NOVAL/Q):
```

Enter one of the following:

Action	Value
Start the OpenVMS Registry server on reboot. Allow other products to start the server.	TRUE
Do not start the OpenVMS Registry server on reboot. Do not allow other products to start the server.	FALSE
Do not start the OpenVMS Registry server on reboot. Allow other products to start the server. (Deassigns the logical name.)	NOVAL
Quit this procedure and return to the OpenVMS Registry Configuration utility menu.	Q

```
In which logical name table do you want the logical defined?
       (SYSTEM/SYSCLUSTER/CLUSTER/Q) :
```

Enter one of the following:

Action	Value
Add the REG$TO_BE_STARTED logical to the LNM$SYSTEM logical name table. This table contains names that are shared by all processes in the system.	SYSTEM
Add the REG$TO_BE_STARTED logical to the LNM$SYSCLUSTER logical name table. This table contains names that are shared by all processes in an OpenVMS Cluster.	SYSCLUSTER
Add the REG$TO_BE_STARTED logical to the LNM$CLUSTER logical name table. This table is the parent table for all clusterwide logical name tables.	CLUSTER
Quit this procedure and return to the OpenVMS Registry Configuration utility menu.	Q

After you enter the new or updated value, the system confirms the change and displays the line you must add to your SYLOGICALS.COM file.

```
        The logical REG$TO_BE_STARTED has been temporarily defined.
        Before you reboot the system you must edit your SYLOGICALS.COM
        to include the line:

        DEFINE/TABLE=table-name REG$TO_BE_STARTED value

Press [Enter] to continue.
```

3. The system displays the current information about the SYS$REGISTRY logical, then prompts you to change the value.

```
             - SYS$REGISTRY logical -

   current value of SYS$REGISTRY

        Note: When the OpenVMS Registry server is started, the system
          creates an OpenVMS Registry database at this location.
          If an OpenVMS Registry database already exists on your system,
          you must redefine the SYS$REGISTRY logical to point to the
          existing OpenVMS Registry database location.

Do you wish to change this value? (Y/N/Q) [Y]:
```

   If you choose Y, the system prompts you for the new value.

```
Enter the new value for SYS$REGISTRY ("yourvalue"/NOVAL/Q):
```

   Enter one of the following:

Action	Value
Define a new or changed location for the OpenVMS Registry database.	A valid directory specification, such as DKA0:[SYS$REGISTRY].
Deassign the logical name.	NOVAL
Quit this procedure and return to the OpenVMS Registry Configuration utility menu.	Q

4. The system displays your updated value and prompts you to confirm the value.

```
 You have entered:  value
 Is this correct? (Y/N/Q) [Y]:
```

5. The system prompts you to enter a logical table name in which to store the new or updated logical.

```
In which logical name table do you want the logical defined?
       (SYSTEM/SYSCLUSTER/CLUSTER/Q):
```

   Enter one of the following:

Action	Value
Add the SYS$REGISTRY logical to the LNM$SYSTEM logical name table. This table contains names that are shared by all processes in the system.	SYSTEM
Add the SYS$REGISTRY logical to the LNM$SYSCLUSTER logical name table. This table contains names that are shared by all processes in an OpenVMS Cluster.	SYSCLUSTER
Add the SYS$REGISTRY logical to the LNM$CLUSTER logical name table. This table is the parent table for all clusterwide logical name tables.	CLUSTER
Quit this procedure and return to the OpenVMS Registry Configuration utility menu.	Q

After you enter the new or updated value, the system confirms the change and displays the line you must add to your SYLOGICALS.COM file.

```
The logical SYS$REGISTRY has been temporarily defined.
Before you reboot the system you must edit your SYLOGICALS.COM file
to include the line:

DEFINE/TABLE=table-name SYS$REGISTRY dir-spec

Press [Enter] to continue.
```

6. The system displays information about the location of the OpenVMS Registry database.

```
            - SYS$REGISTRY directory -

  [directory status]
```

If the directory does not exist, the system prompts you to create the directory.

```
!!Caution!!  When the OpenVMS Registry server starts, the system
  creates an OpenVMS Registry database at this location. If you
  already have an OpenVMS Registry database on your system, you must
  redefine the SYS$REGISTRY logical to point to that location.

Do you wish to create the directory? (Y/N/Q) [Y]:
```

If you enter Y the system confirms the directory creation.

```
The SYS$REGISTRY directory has now been created.

Press [Enter] to return to the menu.
```

11.3 Starting the OpenVMS Registry

You can control how the OpenVMS Registry will start as follows:

- Start the OpenVMS Registry automatically when the system reboots.
- Have products that require the OpenVMS Registry to be running start the OpenVMS Registry.
- Start the OpenVMS Registry manually.
- Prevent the OpenVMS Registry from starting.

Use the OpenVMS Registry Configuration utility described in Section 11.2 to control how the OpenVMS Registry starts.

11.3.1 Starting the OpenVMS Registry Manually

Under some conditions, you might want to start the OpenVMS Registry server manually.

Compaq recommends that you use the SYS$STARTUP:REG$STARTUP.COM command procedure. The following command procedure ensures that the server process quotas are set to the required minimum values:

```
$ @SYS$STARTUP:REG$STARTUP.COM
```

Alternately, you can use the following command to start the OpenVMS Registry manually:

```
$ SET SERVER REGISTRY_SERVER/START
```

11.4 Shutting Down the OpenVMS Registry

The OpenVMS Registry server is shut down automatically as part of a system shutdown.

If you want to shut down the OpenVMS Registry manually, use the following command:

```
$ SET SERVER REGISTRY_SERVER/EXIT
```

11.5 OpenVMS Registry Server Commands

The OpenVMS Registry server commands allow you to display (SHOW) and change (SET) the state of the OpenVMS Registry server. The following sections list and describe the OpenVMS Registry server commands.

SHOW SERVER REGISTRY_SERVER

Show the current status of the OpenVMS Registry on a specified node.

This command requires the SYSPRV privilege.

Format

SHOW SERVER REGISTRY_SERVER

[/MASTER | /CLUSTER | /NODE=(*node*,...)]

[/PAGE]

Qualifiers

/MASTER
Displays the node and process ID (PID) of the current OpenVMS Registry master server in the cluster. This command does not communicate with the OpenVMS Registry servers in the cluster. Requires SYSLCK privilege as well as the SYSPRV privilege.

/CLUSTER
Returns the show output from each OpenVMS Registry server in the cluster, listing the OpenVMS Registry master server information first.

/NODE=(*node*,...)]
Returns OpenVMS Registry server information about the servers on the specified nodes, listed in the order in which you enter the node names. The node names you specify must be in the current cluster.

/PAGE
Displays the returned show output in a scrollable page display.

SET SERVER REGISTRY_SERVER

Change the state of the OpenVMS Registry.

This command requires the SYSPRV privilege.

Format

SET SERVER REGISTRY_SERVER

[/MASTER | /CLUSTER | /NODE=(*node*,...)]

[/START | /RESTART | /EXIT | /ABORT]

[/[NO]LOG]

Qualifiers

/MASTER
Issues the specified command to the OpenVMS Registry master server only. Requires the SYSLCK privilege as well as the SYSPRV privilege.

/CLUSTER
Issues the SET command to each OpenVMS Registry server in the cluster, setting the OpenVMS Registry master server last.

/NODE=(*node*,...)
Issues the SET command to the OpenVMS Registry servers on the specified nodes, in the order in which you enter the node names. The node names must be in the current cluster.

/START[=(*node*,...)]
Starts the OpenVMS Registry server on the specified node or nodes in the cluster.

/EXIT[=(*node*,...)]
Stops the OpenVMS Registry server on the specified node or nodes in the cluster.

/ABORT[=(*node*,...)]
Aborts the OpenVMS Registry server on the specified node or nodes in the cluster.

/[NO]LOG
Creates a new OpenVMS Registry log file in SYS$REGISTRY. NOLOG is the default.

11.6 OpenVMS Registry Failover in a Cluster

To increase the availability and reliability of the OpenVMS Registry, you can run multiple OpenVMS Registry servers in a cluster, up to one per node. No matter how many OpenVMS Registry servers you run, you have only one OpenVMS Registry database.

When you run more than one OpenVMS Registry server in a cluster, only one OpenVMS Registry server process is active and writing to the OpenVMS Registry database. The other OpenVMS Registry server processes are standing by.

By default, the first OpenVMS Registry server process that is active in the cluster remains active until either the process no longer exists or the priority among OpenVMS Registry server processes changes.

11.6.1 Changing the Priority of OpenVMS Registry Server Processes

You can change the priority of OpenVMS Registry server processes by creating and modifying the priority value of each node in the cluster that will run the OpenVMS Registry server process: the higher the value, the higher the priority.

Example 11–1 shows priority values being assigned so that NODENAME1 will be the active OpenVMS Registry server process in the cluster.

Example 11–1 Setting Priority Values

```
$ mcr reg$cp
REG> CREATE VALUE HKEY_LOCAL_MACHINE\SYSTEM\REGISTRY\PRIORITY -
_REG> /NAME=NODENAME1/DATA=15/TYPE=DWORD
REG> CREATE VALUE HKEY_LOCAL_MACHINE\SYSTEM\REGISTRY\PRIORITY -
_REG> /NAME=NODENAME2/DATA=10/TYPE=DWORD
REG> CREATE VALUE HKEY_LOCAL_MACHINE\SYSTEM\REGISTRY\PRIORITY -
_REG> /NAME=NODENAME3/DATA=5/TYPE=DWORD
```

In Example 11–1, if NODENAME1 shuts down, control of the OpenVMS Registry database passes to the server process on NODENAME2.

Example 11–2 shows the system manager increasing the priority value of NODENAME3 to 20.

Example 11–2 Changing Priority Values

```
$ mcr reg$cp
REG> MODIFY VALUE HKEY_LOCAL_MACHINE\SYSTEM\REGISTRY\PRIORITY -
_REG> /NAME=NODENAME3/DATA=20/TYPE=DWORD
```

In Example 11–2, the OpenVMS Registry server process on NODENAME1 goes into standby mode and the OpenVMS Registry server process on NODENAME3 becomes active.

11.7 Connecting to the OpenVMS Registry from a Windows NT System

To connect to the OpenVMS Registry from a Windows NT system, you must do the following:

- On the OpenVMS system:
  - — Install the Advanced Server for OpenVMS.

  - — Configure the Advanced Server for OpenVMS.
- On the Windows NT system:
  - — Install and configure any required hardware.
  - — Install and configure the Windows NT Server or Workstation software.

When you access the OpenVMS Registry database from a Windows system, you will have all the privileges granted on your Windows NT system. For example, if you are logged on to the Windows NT system as an Administrator, you will be able to read and write to all keys and values in the OpenVMS Registry. Access to OpenVMS Registry keys is based on your Windows NT user profile (`username` and `Group` membership). Connect to the OpenVMS Registry through Advanced Server for OpenVMS; use the Windows `Regedt32` application to view and change keys, values, and security settings.

Caution

Be careful when you modify OpenVMS Registry database keys and values. If you damage the OpenVMS Registry database, you can affect all applications and users on the entire OpenVMS system or cluster.

11.8 OpenVMS Registry Quotas

A quota mechanism limits the size of the OpenVMS Registry database. The system assigns a quota to the root key datafile for every OpenVMS Registry file. By default, these root keys are the `USERS` key (`REGISTRY$USERS.REG`) and the `LOCAL_MACHINE` key (`REGISTRY$LOCAL_MACHINE.REG`).

The quota limits the size of the information contained within the file but does not include the size of information stored in other files, even if the files are part of the subtree.

The default quota and file-specific quotas are stored in the OpenVMS Registry under the `HKEY_LOCAL_MACHINE\SYSTEM\Registry` key. For more information about these keys, see Section 10.3.

11.9 OpenVMS Registry Security

A user can access (read and modify) the OpenVMS Registry directly in the following ways:

- From a Windows NT system (through a connection through Advanced Server for OpenVMS)
- Using the OpenVMS Registry system services ($REGISTRY[W])
- Using the OpenVMS Registry server management utility (`REG$CP`)

For a discussion of what system privileges and right identifiers each user needs, see Section 10.5.1. For a description of how to grant the necessary system privileges and right identifiers, see Section 10.5.1.1.

You can change a key's security attributes only from a Windows NT system—you cannot change a key's security attributes from an OpenVMS system. OpenVMS does not create or manage Windows NT security attributes.

11.10 Backing Up and Restoring the OpenVMS Registry Database

The OpenVMS Registry includes a server management utility that allows you to back up and restore the entire OpenVMS Registry database to or from a file from the OpenVMS DCL prompt as long as you have the required system privileges.

For more information about backing up and restoring the OpenVMS Registry database, see Section 12.2 and the `REG$CP` server management utility CREATE SNAPSHOT command and the EXPORT command.

11.11 Using the OpenVMS Registry in an OpenVMS Alpha Mixed-Version Cluster

The OpenVMS Registry Server can run in an OpenVMS Alpha mixed-version cluster. That is, the OpenVMS Registry can run in a cluster that includes OpenVMS versions other than OpenVMS Version 7.2-1; but the OpenVMS Registry server must be running on the node that is running OpenVMS Version 7.2-1.

11.12 Internationalization and Unicode Support

To integrate with Windows NT, the OpenVMS Registry is Unicode compliant. For more information about Unicode, see the *OpenVMS Guide to Extended File Specifications*.

12

OpenVMS Registry Server Management

12.1 Managing the OpenVMS Registry Server from the Command Line

The OpenVMS Registry includes a server management utility that allows you to update and display OpenVMS Registry information from the OpenVMS DCL prompt.

The utility also allows you to back up and restore the entire OpenVMS Registry database to or from a file, as long as you have the required system privileges. For more information about backing up and restoring the OpenVMS Registry database, see Section 12.2 and the CREATE SNAPSHOT, EXPORT, and IMPORT commands in the command reference section of this chapter.

To start the OpenVMS Registry server management utility, enter one of the following commands:

```
$ RUN SYS$SYSTEM:REG$CP
```

or

```
$ MCR REG$CP
```

Note

Before you can access the OpenVMS Registry database, the OpenVMS Registry server must be running either in the cluster or on the standalone system.

Table 12–1 lists and describes OpenVMS Registry server management utility commands.

Table 12–1 OpenVMS Registry Server Management Utility Commands

Command	Identifier	Action
CREATE DATABASE	SYSPRV	Creates a new OpenVMS Registry database file.
CREATE KEY	REG$UPDATE	Creates one or more keys in the OpenVMS Registry database.
CREATE SNAPSHOT	SYSPRV	Makes an immediate backup of the OpenVMS Registry database files.
CREATE VALUE	REG$UPDATE	Specifies the data component for a key.

(continued on next page)

Table 12–1 (Cont.) OpenVMS Registry Server Management Utility Commands

Command	Identifier	Action
DELETE KEY	REG$UPDATE	Removes one or more keys from the OpenVMS Registry database.
DELETE VALUE	REG$UPDATE	Removes one or more values from a specified key.
EXPORT	REG$LOOKUP	Exports the OpenVMS Registry to a text format.
IMPORT	REG$UPDATE	Imports a text-formatted version of a registry database to the OpenVMS Registry format.
LIST KEY	REG$LOOKUP	Displays all subkey information for a specified key.
LIST VALUE	REG$LOOKUP	Displays all values of a specified key.
MODIFY KEY	REG$UPDATE	Modifies the information of a specified key.
MODIFY VALUE	REG$UPDATE	Modifies the information of a specified value.
MODIFY TREE	REG$UPDATE	Modifies the information of a specified key and its subkeys.
SEARCH KEY	REG$LOOKUP	Displays the path name of all keys that match a specified key.
SEARCH VALUE	REG$LOOKUP	Displays the path name of all keys that match a specified value name.
SHOW COUNTERS	REG$PERFORMANCE	Displays counter information.
SHOW FILE	REG$PERFORMANCE	Displays OpenVMS Registry database file statistics.
SHOW INTERNAL	REG$PERFORMANCE	Displays internal values (used by shared libraries).
START MONITOR	REG$PERFORMANCE	Enables monitoring functions.
STOP MONITOR	REG$PERFORMANCE	Disables monitoring functions.
ZERO COUNTERS	REG$PERFORMANCE	Resets monitoring counters.

Note

A user who has the SYSPRV privilege can can execute all the commands listed in Table 12–1. You must specify an OpenVMS Registry identifier only if the user does not have SYSPRV privilege.

If you grant a user the `REG$UPDATE` identifier, in addition to the commands listed in Table 12–1, the user can also execute the following commands:

```
LIST KEY
LIST VALUE
SEARCH KEY
SEARCH VALUE
```

12.2 Backing Up and Restoring the OpenVMS Registry Database

The REG$CP server management utility includes two commands that allow you to back up and restore an OpenVMS Registry database.

- The EXPORT command allows you to back up the OpenVMS Registry keys and values on demand in OpenVMS or Windows NT format.

  You can use this command to export part or all of an OpenVMS Registry database. The corresponding IMPORT command allows you to restore or import OpenVMS Registry or Windows NT Registry keys and values.

  For more information, see the EXPORT and IMPORT commands in the command reference section of this chapter.

- The CREATE SNAPSHOT command allows you to back up the OpenVMS Registry database files automatically on a specified schedule.

  By default, the REGISTRY_SERVER process creates a snapshot of the OpenVMS Registry database every 24 hours. You can change this interval by modifying the **Snapshot Interval** setting in the OpenVMS Registry server operations. (For more information about these operations, see Section 10.6.)

  The following example shows how to modify the interval between automatic snapshots of the OpenVMS Registry database from the default of once every 24 hours to once every hour.

```
$ MCR REG$CP
REG> MODIFY VALUE HKEY_LOCAL_MACHINE\SYSTEM\REGISTRY -
_REG> /NAME="Snapshot Interval"/DATA=3600/TYPE=DWORD
```

  For more information, see the CREATE SNAPSHOT command in this chapter.

12.2.1 Creating a Snapshot of the OpenVMS Registry Database

Use the following procedure to create a snapshot of the OpenVMS Registry database:

1. Verify that the REGISTRY_SERVER process is running in the cluster.
2. From an account with the SYSPRV privilege, enter the following commands:

```
$ MCR REG$CP
REG> CREATE SNAPSHOT
```

   The resulting snapshot consists of the following two files, located in the specified directory:

```
REGISTRY$LOCAL_MACHINE.RSS
REGISTRY$USERS.RSS
```

12.2.2 Restoring a Snapshot of the OpenVMS Registry Database

Use the following procedure to restore a snapshot of the OpenVMS Registry database:

1. Shut down the REGISTRY_SERVER process on all nodes in the cluster. (For information about shutting down the OpenVMS Registry, see Section 11.4.)
2. Verify that the OpenVMS Registry snapshot files are in the SYS$REGISTRY directory.

   If the OpenVMS Registry snapshot files are not in the SYS$REGISTRY directory, copy the OpenVMS Registry snapshot files to the SYS$REGISTRY directory.

3. Rename the OpenVMS Registry snapshot files as follows:

```
$ RENAME REGISTRY$LOCAL_MACHINE.RSS REGISTRY$LOCAL_MACHINE.REG
$ RENAME REGISTRY$USERS.RSS REGISTRY$USERS.REG
```

4. Restart the REGISTRY_SERVER process. (For information about starting the OpenVMS Registry manually, see Section 11.3.1.)

Caution

Any information that the system has written to the OpenVMS Registry database between the time of the last snapshot and this restore process will be lost.

12.3 OpenVMS Registry Server Management Utility Syntax

The following command section describes each OpenVMS Registry command in alphabetical order.

Note

In all the commands in this section, the **key-name** parameter is a string that specifies the full path of the key, beginning from one of following entry points:

```
HKEY_LOCAL_MACHINE
HKEY_USERS
HKEY_CLASSES_ROOT
```

You can also specify the strings REG$_HKEY_LOCAL_MACHINE, REG$_HKEY_USERS, and REG$_HKEY_CLASSES_ROOT.

For all server management commands, links are not followed. (For more information about links, see Section 10.2.1.3.)

To make key and values names case sensitive, enclose the keys and values in quotation marks (for example: "value").

CREATE DATABASE

Creates the basic OpenVMS Registry database files in the location specified by the SYS$REGISTRY logical. The command creates an empty database and loads the predefined keys.

If you enter this command and the database files already exist, the utility does not overwrite the existing files. The system displays a warning that the files already exist. If you want to create a new OpenVMS Registry database, you must first delete all previous versions of the database files. If you delete the OpenVMS Registry database files, you will lose all keys, subkeys, and values stored in the OpenVMS Registry.

This command requires the SYSPRV privilege.

The following table lists and describes the OpenVMS Registry database files.

File	Description
REGISTRY$ROOT.DAT	Root of the database
REGISTRY$USERS.REG	HKEY_USERS tree
REGISTRY$LOCAL_MACHINE.REG	HKEY_LOCAL_MACHINE tree
REGISTRY$MASTER.RLG	The master commit log file
REGISTRY$REPLY.RLG	Log file that tracks modification requests to the OpenVMS Registry database

Format

CREATE DATABASE

Parameters

None

Qualifiers

None

Examples

```
REG> CREATE DATABASE
```

Regenerates the basic OpenVMS Registry database files if the database files are lost or deleted.

CREATE KEY

Creates one or more keys in the OpenVMS Registry database.

This command requires the SYSPRV privilege or the REG$UPDATE rights identifier.

Format

CREATE KEY key-name [,...]

Parameters

key-name[,...]
Specifies the name of the key to create. You can create multiple keys by separating the keys with commas

Qualifiers

/WRITEBEHIND
/NOWRITEBEHIND (default)
Specifies that the key information must be written to disk immediately. /NOWRITEBEHIND specifies a write-through operation.

/VOLATILE=*level*
/NONVOLATILE (default)
Specifies whether or not the new key is volatile. If you are running the OpenVMS Registry on a standalone OpenVMS system, volatile keys are lost when the system reboots. If you are running the OpenVMS Registry in an OpenVMS cluster, volatile keys are lost when all notes in the cluster are rebooted.

The values for *level* are as follows:

- NONE (same as /NONVOLATILE)
- CLUSTER

/CACHE_ACTION=*value*
Specifies the cache attribute for the new key. The *value* can be WRITEBEHIND (default) or WRITETHRU (write to disk immediately).

/CLASS_NAME=*string*
Specifies the class name of the key.

/SECPOLICY=*policy*
Defines the security policy for the key. Currently the only valid policy is NT_40.

/LINK=(TYPE=*value*, NAME=*key-name*)
Defines the key as a link to another key. The link value must be one of the following:

- SYMBOLICLINK
- NONE

To remove a link, enter the following:

```
/LINK=(TYPE=NONE,NAME="")
```

Examples

```
REG> CREATE KEY/CACHE_ACTION=WRITEBEHIND HKEY_USERS\GUEST, HKEY_USERS\SYSTEM
```

Creates the GUEST and SYSTEM keys under the HKEY_USERS entry point. The keys are created with the write-behind attribute.

CREATE SNAPSHOT

Creates a snapshot of the OpenVMS Registry database. That is, the system writes all cached OpenVMS Registry keys or values and makes a copy of the OpenVMS Registry database files.

This command requires the SYSPRV privilege.

Format

CREATE SNAPSHOT

Parameters

None

Qualifiers

/DESTINATION=*file-spec*
Controls where the system will write the snapshot files. By default, the system creates the snapshot in the location specified by the SYS$REGISTRY logical.

If you specify the /DESTINATION qualifier but do not provide a valid directory, the system creates the snapshot files in the directory in which you started the OpenVMS Registry server.

/VERSIONS=*number*
Specifies how many previous versions of the snapshot files to keep.

Examples

```
REG> CREATE SNAPSHOT/DESTINATION=SYS$REGISTRY/VERSION=3
```

Creates a snapshot of the OpenVMS Registry database in the SYS$REGISTRY directory. If more than three versions of the OpenVMS Registry database snapshot files exist, the system deletes the oldest version (the same as purge/keep=3 command).

CREATE VALUE

Specifies the data component for the specified key. If the value does not exist, the command creates the value.

This command requires the SYSPRV privilege or the REG$UPDATE rights identifier.

Format

```
CREATE VALUE  key-name
```

Parameters

key-name
Specifies the name of the key for which you will set the value.

Qualifiers

/FLAGS=*flag*
Specifies the data flags value. This is an application-dependent 64-bit flag specified as a decimal number or as a hexadecimal number preceded by 0x or %X.

/WRITEBEHIND
/NOWRITEBEHIND (default)
Specifies that the value must be written to disk immediately. /NOWRITEBEHIND specifies a write-through operation.

/DATA=*value*
The value can be one of the following:

- String (for example, /DATA=COSMOS)
- An array of strings separated by a comma and enclosed in parentheses (for example, /DATA=(COSMOS,Noidea)
- A longword in octal (%O), decimal, or hexadecimal (%X) format (for example, /DATA=%X1A0FCB or /DATA=1234)

/NAME=*string*
Specifies the name of the new value.

/TYPE_CODE=*type*
Specifies the type of the new value. The type value must be one of the following:

- SZ: a null-terminated Unicode string
- EXPAND_SZ: a string of Unicode characters
- MULTI_SZ: a concatenated array of SZ strings
- DWORD: a 32-bit number

/LINK=(TYPE=*value*, NAME=*key-name*)
Defines the key as a link to another key. The link value must be one of the following:

- SYMBOLICLINK
- NONE

To remove a link, enter the following:

```
/LINK=(TYPE=NONE,NAME="")
```

Examples

```
REG> CREATE VALUE/DATA=COSMOS/TYPE=SZ/NAME=COMPUTERNAME HKEY_LOCAL_MACHINE\NODE
```

Creates the COMPUTERNAME value for the key HKEY_LOCAL_MACHINE\NODE and sets its type to SZ and its data value to COSMOS.

DELETE KEY

Removes a specified key from the OpenVMS Registry database. The system does not delete a key if the key has subkeys.

Caution

Deleting a key results in symbolic links not being followed. This is because the system deletes the key you specified, even if it has symbolic links.

Note

The OpenVMS Registry database predefined keys are reserved keys and cannot be deleted. These keys include HKEY_USER, HKEY_LOCAL_MACHINE, and HKEY_CLASSES_ROOT. For a complete list, see Section 10.3.

This command requires the SYSPRV privilege or the REG$UPDATE rights identifier.

Format

DELETE KEY key-path key-name

Parameters

key-path
Specifies the key path.

key-name
Specifies the name of the key to delete.

Qualifiers

/WRITEBEHIND
/NOWRITEBEHIND (default)
Specifies that the key information must be written to disk immediately. /NOWRITEBEHIND specifies a write-through operation.

Examples

```
REG> DELETE KEY HKEY_USERS\NODE GUEST
```

Deletes the GUEST key from the OpenVMS Registry database.

DELETE VALUE

Removes a value from a specified key.

Caution

Deleting a value results in symbolic links not being followed. This is because the system deletes the value you specified, even if it has symbolic links.

This command requires the SYSPRV privilege or the REG$UPDATE rights identifier.

Format

DELETE VALUE key-name value-name

Parameters

key-name
Specifies the key name whose value should be removed.

value-name
Specifies the value to remove.

Qualifiers

/WRITEBEHIND
/NOWRITEBEHIND (default)
Specifies that the information must be written to disk immediately. /NOWRITEBEHIND specifies a write-through operation.

Examples

```
REG> DELETE VALUE HKEY_USERS\GUEST PASSWORD
```

Deletes the PASSWORD value from the GUEST key.

EXPORT

Allows a user to export the OpenVMS Registry database content to a text format. You can export the entire database or specific keys and subkeys.

You can specify the exported file as a Windows NT compatible format or in an OpenVMS format. The IMPORT command support both Windows NT 4.0 Regedit format and the OpenVMS Registry format.

This command requires the REG$LOOKUP rights identifier. If you do not have the REG$LOOKUP rights identifier, you must have the SYSPRV privilege to export keys that require the REG$LOOKUP rights identifier.

Format

EXPORT [DATABASE | KEY [*key-name* [/[NO]SUBKEYS]]] [/LOG] [/OUTPUT=*file-name*] [/FORMAT=[NT | OPENVMS]]

Parameters

DATABASE
Exports the full OpenVMS Registry database.

KEY [*key-name* [/[NO]SUBKEYS]]
Exports a specific OpenVMS Registry key and, optionally, its subkeys. NOSUBKEYS is the default.

Qualifiers

/LOG
Displays the export progress to the screen.

/OUTPUT=*file-name*
Specifies a name for the exported file. The default output file name is `REGISTRY.TXT`.

/FORMAT=[NT | OPENVMS]
Specifies the format in which the system writes the database. OPENVMS is the default.

Examples

```
REG> EXPORT DATABASE/LOG/OUTPUT=TUES_VERSION.TXT/FORMAT=NT
```

The `EXPORT` command in this example logs the progress of the export to the screen as the system exports the entire OpenVMS Registry database to the `TUES_VERSION.TXT` file in Windows NT 4.0 Regedit format.

IMPORT

Allows a user to import a text-formatted file (created by the EXPORT command) into an OpenVMS Registry database.

Also allows a user to import into an OpenVMS Registry database the Windows NT data exported by Windows NT 4.0 Regedit (from the **Registry** menu choose the **Export Registry File...** option).

Conversion of Windows NT binary values

You can import Windows NT binary values (such as configuration data) into the OpenVMS Registry database, even though OpenVMS does not support the binary values. The system displays a message when importing and converting unsupported binary values.

This command requires the REG$UPDATE rights identifier. If you do not have the REG$UPDATE rights identifier, you must have the SYSPRV privilege to import keys that require the REG$LOOKUP or REG$UPDATE rights identifier.

The following table summarizes how rights identifiers and privileges affect your ability to import and export keys.

If you have:	You can export from Windows NT:	You can import to the OpenVMS Registry:
No privileges. No rights identifiers	All keys created by Advanced Server for OpenVMS except `HKEY_LOCAL_MACHINE\SECURITY`	Nothing
REG$LOOKUP	All keys created by Advanced Server for OpenVMS	Nothing
REG$UPDATE	All keys created by Advanced Server for OpenVMS	All keys created by Advanced Server for OpenVMS
SYSPRV	All keys created by Advanced Server for OpenVMS	All keys created by Advanced Server for OpenVMS

Format

IMPORT [/LOG] [/INPUT=*file-name*]

Parameters

None

Qualifiers

/LOG
Displays the import progress to the screen.

/INPUT=*file-name*
Specifies a name of the file to import. The default input file name is `REGISTRY.TXT`.

Examples

```
REG> IMPORT/LOG/INPUT=TUES_VERSION.TXT
```

The IMPORT command in this example logs the progress of the import to the screen as the system imports the TUES_VERSION.TXT file.

LIST KEY

Displays the attributes for the specified key.

Note

Symbolic links are not followed.

This command requires the SYSPRV privilege or the REG$LOOKUP rights identifier.

Format

LIST KEY key-name

Parameters

key-name
Specifies the name of the key to list.

Qualifiers

/FULL
Displays all available information—that is, information displayed by the /LAST_WRITE, /CACHE_ACTION, /INFORMATION, /LINK_PATH, and /CLASS_NAME qualifiers.

/CACHE_ACTION=*value*
Specifies the cache attribute for the subkey. The *value* can be WRITEBEHIND (default) or WRITETHRU (write to disk immediately).

/CLASS_NAME
Displays the class name of the subkey.

/INFORMATION
Displays the information (subkey number, value number, subkey name max, and so on) about the specified key.

/LAST_WRITE
Displays the time when the subkey was last updated.

/LINK_PATH
Displays the key path to which the subkey is linked.

/OUTPUT=*file-spec*
Controls where the output of the command is sent. If you do not specify a file name, the system uses the default name REGISTRY.LIS.

Examples

```
REG> LIST KEY/FULL HKEY_USERS\GUEST

Key name:            HKEY_USERS\GUEST
Security policy:     REG$K_POLICY_NT_40
Volatile:            REG$K_NONE
Cache:               REG$K_WRITEBEHIND
Class:               System Authorization
Link Type:           REG$K_NONE
Last written:         7-AUG-1998 12:42:08.55

Key information:
  Number of subkeys:             2        Number of values:             0
  Max size of subkey name:      40        Max size of class name:      40
  Max size of value name:        0        Max size of value data:       0

Subkey(s):

    Key name:            QUOTAS
    Security policy:     REG$K_POLICY_NT_40
    Volatile:            REG$K_NONE
    Cache:               REG$K_WRITEBEHIND
    Class:               Disk quota
    Link Type:           REG$K_NONE
    Last written:         7-AUG-1998 12:41:19.21

    Key information:
      Number of subkeys:             0        Number of values:             0
      Max size of subkey name:       0        Max size of class name:       0
      Max size of value name:        0        Max size of value data:       0

    Key name:            IDENTIFIER
    Security policy:     REG$K_POLICY_NT_40
    Volatile:            REG$K_NONE
    Cache:               REG$K_WRITETHRU
    Class:               Disk quota
    Link Type:           REG$K_SYMBOLICLINK
    Link Path:           HKEY_LOCAL_MACHINE\SOFTWARE\IDENTIFIER\GUEST
    Last written:         7-AUG-1998 12:42:08.55

    Key information:
      Number of subkeys:             0        Number of values:             0
      Max size of subkey name:       0        Max size of class name:       0
      Max size of value name:        0        Max size of value data:       0
```

The LIST KEY/FULL command in this example displays the GUEST key attributes as well as the name and attributes of the subkeys of GUEST.

Note

The Max sizes information shows the number of bytes, not characters. (Each character is 4 bytes long.)

LIST VALUE

Displays all values and value attributes of the specified key.

Note

Symbolic links are not followed.

This command requires the SYSPRV privilege or the REG$LOOKUP rights identifier.

Format

LIST VALUE key-name

Parameters

key-name
Specifies the name of the key to enumerate.

Qualifiers

/FULL
Displays all available information—that is, information displayed by the /TYPE_CODE, /LINK_PATH, /DATA_FLAGS, and /VALUE_DATA qualifiers.

/TYPE_CODE
Display the type code of the value.

/FLAGS
Displays an ASCII representation of the data flag of the value in hexadecimal format.

/LINK_PATH
Displays the key path to which the subkey is linked.

/DATA
Displays an ASCII representation of the value in hexadecimal format.

/OUTPUT=*file-spec*
Controls where the output of the command is sent. If you do not specify a file name, the system uses the default name REGISTRY.LIS.

Examples

```
REG> LIST VALUE/TYPE_CODE/DATA HKEY_LOCAL_MACHINE\SOFTWARE\FORTRAN

   Key name:            HKEY_LOCAL_MACHINE\SOFTWARE\FORTRAN
   Security policy:     REG$K_POLICY_NT_40
   Volatile:            REG$K_NONE
   Last written:        11-AUG-1998 16:27:55.81

   Value(s):

     Value name:   Version
     Volatile:     REG$K_NONE
     Type:         REG$K_SZ
     Data:         5.3-50
```

```
Value name:   Date Installed
Volatile:     REG$K_NONE
Type:         REG$K_SZ
Data:         04-Jan-1998
```

The LIST VALUE/TYPE_CODE/DATA command in this example displays the FORTRAN key and its value names, types, and data.

MODIFY KEY

Modifies the attributes of the specified key.

Caution

Modifying a key results in symbolic links not being followed. This is because the system modifies the key you specified, not the key pointed to by the symbolic link.

This command requires the SYSPRV privilege or the REG$UPDATE rights identifier.

Format

MODIFY KEY key-name

Parameters

key-name
Specifies the name of the key to modify.

Qualifiers

/CACHE_ACTION=*value*
Specifies the cache attribute for the new key. The *value* can be WRITEBEHIND (default) or WRITETHRU (write to disk immediately).

/CLASS_NAME=*string*
Specifies the new class name of the key.

/WRITEBEHIND
/NOWRITEBEHIND (default)
Specifies that the key information must be written to disk immediately. /NOWRITEBEHIND specifies a write-through operation.

/NEW_NAME=*new-key-name*
Specifies the new name of the key.

/SECPOLICY=*policy*
Defines the security policy for the key. Currently the only valid policy is NT_40.

/LINK=(TYPE=*value*, NAME=*key-name*)
Defines the key as a link to another key. The link value must be one of the following:

- SYMBOLICLINK
- NONE

To remove a link, enter the following:

```
/LINK=(TYPE=NONE,NAME="")
```

Examples

```
REG> MODIFY KEY/CACHE_ACTION=WRITEBEHIND HKEY_USERS\GUEST
```

Modifies the cache attribute of the GUEST key.

MODIFY VALUE

Specifies the data component for the specified value. This command modifies an existing value.

Caution

Modifying a value results in symbolic links not being followed. This is because the system modifies the value you specified, not the value pointed to by the symbolic link.

This command requires the SYSPRV privilege or the REG$UPDATE rights identifier.

Format

MODIFY VALUE /NAME=*string* key-name

Parameters

key-name
Specifies the name of the key for which to set the value.

Qualifiers

/FLAGS=*flag*
Specifies the data flags value. This is an application-dependent 64-bit flag specified as a decimal number or as a hexadecimal number preceded by 0x or %X.

/WRITEBEHIND
/NOWRITEBEHIND (default)
Specifies that the value information must be written to disk immediately. /NOWRITEBEHIND specifies a write-through operation.

/DATA=*value*
Specifies the data for the value. The value can be:

- A string (for example, /DATA=COSMOS)
- An array of strings separated by a comma and enclosed in parentheses (for example, /DATA=(COSMOS,Noidea)
- A longword in octal (%O), decimal, or hexadecimal (%X) format (for example, /DATA=%X1A0FCB or /DATA=1234)

/NAME=*string*
Specifies the name of the value.

/TYPE_CODE=*type*
Specifies the type of the new value. The type value must be one of the following:

- SZ: a null-terminated Unicode string
- EXPAND_SZ: a string of Unicode characters
- MULTI_SZ: a concatenated array of SZ strings
- DWORD: a 32-bit number

/LINK=(TYPE=*value*, NAME=*key-name*)
Defines the key as a link to another key. The link value must be one of the following:

- SYMBOLICLINK
- NONE

To remove a link, enter the following:

```
/LINK=(TYPE=NONE,NAME="")
```

Examples

```
REG> MODIFY VALUE/DATA=COSMOS/TYPE=SZ/NAME=COMPUTERNAME HKEY_LOCAL_MACHINE\NODE
```

Creates COMPUTERNAME value for the key HKEY_LOCAL_MACHINE\NODE, and sets its type code to SZ and its data value to COSMOS.

MODIFY TREE

Modifies the information for the specified key and its subkeys.

Caution

Modifying a tree results in symbolic links not being followed. This is because the key and subkeys you specify are modified, not the key pointed to by the symbolic link.

This command requires the SYSPRV privilege or the REG$UPDATE rights identifier.

Format

MODIFY TREE key-name

Parameters

key-name
Specifies the name of key to modify.

Qualifiers

/CACHE_ACTION=*value*
Specifies the cache attribute for the key and its subkeys. The *value* can be WRITEBEHIND (default) or WRITETHRU (write to disk immediately).

/CLASS_NAME=*string*
Specifies the new class name for the given key and all its subkeys.

/WRITEBEHIND
/NOWRITEBEHIND (default)
Specifies that the key information must be written to disk immediately. /NOWRITEBEHIND specifies a write-through operation.

/SECPOLICY=*policy*
Defines the security policy for the key. Currently the only valid policy is NT_40.

Examples

```
REG> MODIFY TREE/CACHE_ACTION=WRITEBEHIND HKEY_USERS\GUEST
```

Modifies the cache attribute of the GUEST key and all its subkeys.

SEARCH KEY

Displays the path name of all the keys that match the specified key.

This command requires the SYSPRV privilege or the REG$LOOKUP rights identifier.

Format

SEARCH KEY key-search

Parameters

key-search
Specifies the key name for which to search.

Qualifiers

/OUTPUT=*file-spec*
Controls where the output of the command is sent. If you do not specify a file name, the system uses the default name REGISTRY.LIS.

Examples

```
REG> SEARCH KEY HKEY_LOCAL_MACHINE\...\NODE
HARDWARE\CLUSTER\NODE
HARDWARE\LOCAL\NODE
NODE
```

Displays all the key paths that match the HKEY_LOCAL_MACHINE\...\NODE selection. The ellipsis (...) wildcard specifies that there can be any number of subkeys between the HKEY_LOCAL_MACHINE entry point and the NODE subkey. Note that the search is not case sensitive.

SEARCH VALUE

Displays the path name of all the values that match the specified value name.

This command requires the SYSPRV privilege or the REG$LOOKUP rights identifier.

Format

SEARCH VALUE key-name value-name

Parameters

key-name
Specifies the name of the key path to search.

value-name
Specifies the value name for which to search.

Qualifiers

/OUTPUT=*file-spec*
Controls where the output of the command is sent. If you do not specify a file name, the system uses the default name REGISTRY.LIS.

Examples

```
REG> SEARCH VALUE HKEY_LOCAL_MACHINE\... *AM%
HARDWARE\CLUSTER\Name
HARDWARE\CLUSTER\NODE\Name
HARDWARE\LOCAL\NODE\Name
NODE\COMPUTERNAME
```

Displays all the value names that match the HKEY_LOCAL_MACHINE\...*am% selection. The ellipsis (...) wildcard specifies that there can be any number of subkeys between the HKEY_LOCAL_MACHINE entry point and the *am% value name. Note that the search is not case sensitive.

SHOW

Displays OpenVMS Registry server internal statistics and information.

- **SHOW COUNTERS**

  Displays monitoring information from the OpenVMS Registry server.

- **SHOW FILE**

  Displays status information on files loaded into the OpenVMS Registry server.

This command requires the SYSPRV privilege or the `REG$PERFORMANCE` rights identifier.

Format

SHOW COUNTERS/FILE [name]

SHOW FILE [name]

Parameters

name
Identifies the file (used with the /FILE qualifier only).

Qualifiers

/FILE
Displays counters for the specified file or for all files.

/PERFORMANCE
Displays performance counters.

/OUTPUT=*file-spec*
Controls where the output of the command is sent. If you do not specify a file name, the system uses the default name `REGISTRY.LIS`.

Examples

```
REG> SHOW COUNTERS/FILE
```

Displays monitoring information from the OpenVMS Registry server.

START MONITORING

Starts a monitoring component within the OpenVMS Registry server.

This command requires the SYSPRV privilege or the REG$PERFORMANCE rights identifier.

Format

START MONITORING/FILE [name]

START MONITORING/PERFORMANCE

Parameters

name
Identifies the file (used with the /FILE qualifier only).

Qualifiers

/FILE
Start gathering counters for the specified file or for all files.

/PERFORMANCE
Start gathering performance counters.

Examples

```
REG> START MONITORING/PERFORMANCE
```

Enables a monitoring component of the OpenVMS Registry.

STOP

Stops a monitoring component within the OpenVMS Registry server.

This command is used to stop a monitoring component within the OpenVMS Registry server.

This command requires the SYSPRV privilege or the REG$PERFORMANCE rights identifier.

Format

STOP MONITORING/FILE [name]

STOP MONITORING/PERFORMANCE

Parameters

name
Identifies the file (used with the /FILE qualifier only).

Qualifiers

/FILE
Stop gathering counters for the specified file or for all files.

/PERFORMANCE
Stop gathering performance counters.

Examples

```
REG> STOP MONITORING/PERFORMANCE
```

Disables a monitoring component of the OpenVMS Registry.

ZERO COUNTERS

Initializes counters within the OpenVMS Registry server.

This command requires the SYSPRV privilege or the REG$PERFORMANCE rights identifier.

Format

ZERO COUNTERS/FILE [name]

ZERO COUNTERS/PERFORMANCE

Parameters

name
Identifies the file (used with the /FILE qualifier only).

Qualifiers

/FILE
Initializes the file counters for the specified file or for all files.

/PERFORMANCE
Initializes all performance counters.

Examples

```
REG> ZERO COUNTERS/PERFORMANCE
```

Resets the performance counters.

13

OpenVMS Registry System Services

This chapter lists and describes the OpenVMS Registry $REGISTRY and $REGISTRYW system services.

$REGISTRY and $REGISTRYW Interface to the OpenVMS Registry Database

The $REGISTRY and $REGISTRYW system services are the interface to the OpenVMS Registry database server. The $REGISTRY service allows you to query, update, and set keys, subkeys, and values in the OpenVMS Registry database.

The $REGISTRY service supports both asynchronous and synchronous operations. For asynchronous completion, use the Registry ($REGISTRY) system service. For synchronous completion, use the Registry and Wait ($REGISTRYW) system service. The $REGISTRYW system service is identical to the $REGISTRY system service, except that $REGISTRYW returns to the caller after the system completes the requested operation. For additional information about system service completion, see the Synchronize ($SYNCH) system service.

This system service is 64-bit compatible.

Format

SYS$REGISTRY [efn], func, 0, itmlst, [iosb or iosa_64], [astadr or astadr_64], [astprm or astprm_64]

SYS$REGISTRYW [efn], func, 0, itmlst, [iosb or iosa_64], [astadr or astadr_64], [astprm or astprm_64]

Arguments

efn

OpenVMS usage: ef_number
type: longword (unsigned)
access: read only
mechanism: by value

Number of the event flag to be used by $REGISTRY. If you do not specify the event flag, the system defaults to event flag 0. The event flag is initially cleared by $REGISTRY and then set when the operation completes.

func

OpenVMS usage: function_code
type: longword (unsigned)
access: read only
mechanism: by value

Function code specifying the action that $REGISTRY is to perform. The **func** argument is a longword containing this function code. The function code can contain function modifiers. For more information on function modifiers, see the **Function Modifiers** section in this chapter.

A single call to $REGISTRY can specify only one function code. All function codes require additional information to be passed in the call with the **itmlst** argument.

itmlst

OpenVMS usage: item_list3 or item_list_64b
type: longword (unsigned)
access: read only
mechanism: by reference

Item list supplying information that the system will use to perform the function specified by the **func** argument. The **itmlst** argument is the address of the item

list. The item list consists of one or more sets of item descriptors. Each descriptor is either an item-list-3 or item-list-64b format.

Some function codes allow you specify multiple operations in a single call. In this case, you must place the REG$_SEPARATOR item code between each set of item codes. Each request, separated by a REG$_SEPARATOR item code, can contain the item codes in any order.

You can specify item codes as either input or output parameters. Input parameters modify functions, set context, or describe the information to be returned. Output parameters return the requested information. For item-list-3 lists, you must terminate the list with a longword of 0. For item-list-64b lists, you must terminate the list with a quadword of 0.

Figure 13–1 shows the structure of an item-list-3 descriptor.

Figure 13–1 Item-list-3 Structure

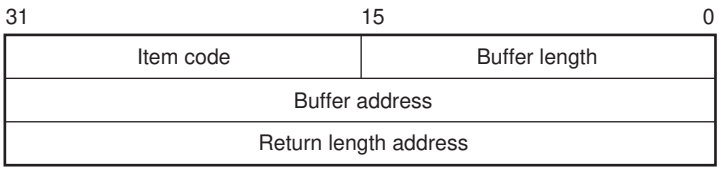


Figure 13–2 shows the structure of an item-list-64b descriptor.

Figure 13–2 Item-list-64b Structure

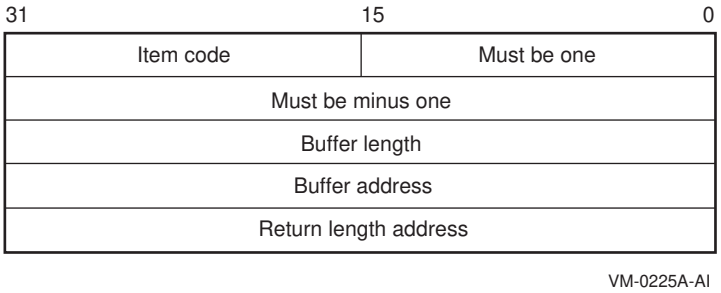


Table 13–1 defines the item descriptor fields.

Table 13–1 Item Descriptor Fields

Descriptor Field	Definition
Buffer length	A word that specifies the length of the buffer. The buffer either supplies information to be used by $REGISTRY, or receives information from $REGISTRY. The required length of the buffer varies, depending on the item code specified. Each item code description specifies the required length.

(continued on next page)

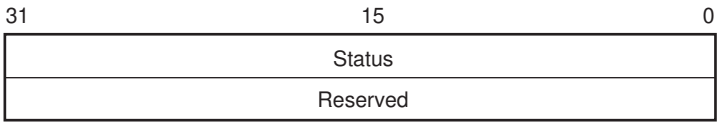
Table 13–1 (Cont.) Item Descriptor Fields

Descriptor Field	Definition
Item code	A word containing a symbolic code that describes the type of information currently in the buffer or that is returned in the buffer. The buffer address field points to the location of the buffer.
Buffer address	A longword that contains the address of the buffer that specifies or receives the information.
Return length address	A longword that contains the address of a word that specifies the actual length in bytes of the information returned by $REGISTRY. The information resides in a buffer identified by the buffer address field. The field applies to output item list entries only, and must be 0 (zero) for input entries. If the return length address is 0, it is ignored.

iosb or iosa_64

OpenVMS usage: status_block
type: buffer
access: write only
mechanism: by reference

Status block to receive the final completion status and information of the $REGISTRY operation. If multiple operations are requested for a function code, the value returned in **iosb** is either `SS$_NORMAL` or `SS$_REGERROR`. A more specific return status for each operation is returned in the `REG$_RETURNSTATUS` item code (if specified). The **iosb** argument is the address of the $REGISTRY status block.



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When $REGISTRY begins execution, it clears the quadword I/O status block if you specify the **iosb** argument.

Although the **iosb** argument is optional, Compaq strongly recommends that you specify it for the following reasons:

- If you are using an event flag to signal the completion of the service, you can test the I/O status block for a condition value to be sure that the event flag was not set by an event other than service completion.
- If you are using the `$SYNCH` system service to synchronize completion of the service, the I/O status block is a required argument for `$SYNCH`.

The condition value returned in R0 and the condition value returned in the I/O status block provide information about different aspects of the call to the $REGISTRY service. The condition value returned in R0 provides information about the success or failure of the service call itself; the condition value returned in the I/O status block provides information about the success or failure of the service operation.

To assess the success or failure of the call to $REGISTRY accurately, you must first check the condition value returned in R0. If R0 contains a successful value, you must check the condition value in the I/O status block.

Table 13–2 defines the item descriptor fields.

Table 13–2 Descriptor Fields

Descriptor Field	Definition
Status	A longword specifying the final status of the $REGISTRY service. If you request multiple operations for a function code, the system returns either SS$_NORMAL or SS$_REGERROR to **iosb**. This field is set to 0 (zero) when the operation begins.
Reserved	A reserved longword.

astadr or astadr_64

OpenVMS usage: ast_procedure
type: procedure value
access: call without stack unwinding
mechanism: by reference

AST service routine to be executed when $REGISTRY completes. The **astadr** argument is the address of this routine. If you specify **astadr**, the AST routine executes at the same access mode as the caller of the $REGISTRY service.

If the $REGISTRY service is not called successfully (that is, if it returns an error immediately), the AST routine is not executed.

astprm or astprm_64

OpenVMS usage: user_arg
type: longword (unsigned)
access: read only
mechanism: by value

AST parameter to be passed to the AST service routine specified by the **astadr** argument. The **astprm** argument specifies this longword parameter.

Description

The $REGISTRY service provides the means to create, delete and modify registry keys, key values, and key attributes.

The $REGISTRY service uses process P1 space to store handles to keys. The $REGISTRY service must be called at IPL 0, and requires system dynamic memory to deliver AST requests.

Related Services

$REGISTRYW

Condition Values Returned

SS$_ACCVIO	One of the arguments cannot be read/written
SS$_BADPARAM	Function code or one of the item list code is invalid
SS$_EXASTLM	Exceeded AST limit
SS$_EXBYTLM	Exceeded byte count quota
SS$_ILLEFC	Illegal event flag number
SS$_INSFARG	Insufficient number of argument supplied
SS$_INSFMEM	Insufficient dynamic memory
SS$_NORMAL	Normal successful completion
SS$_TOO_MANY_ARGS	Too many arguments
REG$_ACCESSDENIED	Requested access to key is denied
REG$_BADFILEVER	Bad file version number
REG$_BUFFEROVF	Buffer overflow
REG$_CANTCLEANVOLSEG	Cannot clean the registry volatile segments
REG$_CANTCONVCS	Code set conversion error
REG$_CANTOPENOUTFILE	Cannot open the specified output file
REG$_DBACCESS	Cannot access registry database object
REG$_DBALREADYLOADED	Database is already loaded
REG$_DBCREATE	Cannot create registry database
REG$_DBCSMISMATCH	Database checksum mismatch: Stored=!XL Calculated=!XL
REG$_DBFIND	Cannot locate registry database
REG$_DBFULL	Registry database is full
REG$_DBLOAD	Cannot load registry database
REG$_DBNOTYETLOADED	Database is not yet loaded
REG$_DBVERMISMATCH	Database version mismatch: Current=V!UW.!UW Database=V!UW.!UW
REG$_DELROOTKEY	Root key was deleted
REG$_DOUBLEDEALLOC	Structure is already on the free list
REG$_DTMUTEXERROR	DECthreads mutex lock/unlock error
REG$_DTMUTEXINIT	DECthreads mutex init error !UL
REG$_DTMUTEXLOCK	DECthreads mutex lock error !UL
REG$_DTMUTEXLOCKED	DECthreads mutex is already held by another thread
REG$_DTMUTEXUNLOCK	DECthreads mutex unlock error !UL
REG$_DTRWLOCKINIT	DECthreads read/write lock init error !UL
REG$_DTRWLOCKLOCK	DECthreads read/write lock error !UL
REG$_DTRWLOCKUNLOCK	DECthreads read/write unlock error !UL
REG$_DUPLREQUEST	Work-in-progress hash table insert found duplicate request
REG$_EXQUOTA	Registry file quota or page file quota exceeded

REG$_FILECREATE	Error creating !AZ!AZ
REG$_FILENAMEINVAL	Invalid file name
REG$_FILEOPEN	Error opening !AZ!AZ
REG$_FILEREADEOF	Attempt to read past end of file; FTE !XL
REG$_FNAMMISMATCH	Physical/logical file name mismatch; FTE=!AZ LTE=!AZ
REG$_FSOCORRUPT	File was previously flagged as corrupt; FSO: !XL !XL
REG$_FSOFILEINDEX	Invalid file index in FSO: !XL !XL
REG$_FSOOFFSET	Invalid offset in FSO: !XL !XL
REG$_FSOSEGNUMBER	Invalid segment number in FSO: !XL !XL
REG$_FSOSEGREADERR	Error reading segment in FSO: !XL !XL
REG$_FTEALLOC	Error allocating file table entry !XL for !AZ
REG$_FTEALREADYEXIST	Cannot create file !AZ!AZ; file already exists
REG$_FTEALREADYOPEN	File is already open
REG$_FTEDUPNAME	Error allocating file table entry; duplicate file name
REG$_FTEINSUFFINFO	Specified file table entry is not allocated
REG$_FTEINUSE	Error allocating file table entry; entry in use
REG$_FTENOTEXIST	Specified file table entry does not exist
REG$_FTENOTOPEN	Specified file is not open
REG$_FTIMISMATCH	Physical file index mismatch; LTE = !XL, FTE = !XL
REG$_HASLINK	Key has a link to another key
REG$_HAVESUBKEYS	Cannot delete a key with subkeys
REG$_INTERNERR	Registry internal error
REG$_INVCACHEACTION	Invalid cache action parameter
REG$_INVCREDENTIALS	NT credentials are not valid
REG$_INVDATA	Invalid data value
REG$_INVDATATYPE	Invalid data type parameter
REG$_INVFUNCCODE	Invalid function code
REG$_INVKEYFLAGS	Invalid key flags
REG$_INVKEYID	Key does not exist or invalid key ID was specified
REG$_INVKEYNAME	Invalid key name
REG$_INVLINK	Invalid link or link type
REG$_INVLINKPATH	Invalid link path
REG$_INVLOG	Invalid log file
REG$_INVLOGREC	Invalid log record
REG$_INVPARAM	Invalid parameter
REG$_INVPATH	Invalid key path
REG$_INVSECDESCRIPTOR	Invalid security descriptor
REG$_INVSECPOLICY	Invalid security policy parameter
REG$_INVSEGNUM	Invalid segment number

REG$_INVVOLROOTKEY	Cannot create a new file with a volatile root key
REG$_IOREADERR	Disk read error at block !UL for length !UL
REG$_IOWRITERR	Disk write error at block !UL for length !UL
REG$_IPCCONACC	IPC connect accept failure: !XL
REG$_IPCCONREJ	IPC connect reject failure: !XL
REG$_IPCDCLAST	IPC cannot declare AST for synch completion: !XL
REG$_IPCOPEASS	IPC open association failure: !XL
REG$_IPLTOOHIGH	Callers above IPL 0 cannot call this service
REG$_KEYCHANGED	Key or subkey has changed
REG$_KEYEXIST	Key already exists
REG$_KEYLOCKED	Key locked by another thread
REG$_KEYNAMEEXIST	Key name already exists
REG$_LOGFILETABFULL	Logical file table is full
REG$_LTENOTEXIST	Specified logical file table entry does not exist
REG$_MOREDATA	Buffer provided is too small for requested data
REG$_NOBLOCKFOUND	Registry database has no available blocks
REG$_NOKEY	Specified key does not exist
REG$_NOMEMORY	Insufficient memory
REG$_NOMOREITEMS	No more items for specified key
REG$_NOMORESEG	No more segments available
REG$_NOMORESUBSTRING	No substring found
REG$_NOPATHFOUND	Path not found
REG$_NORESPONSE	OpenVMS Registry server not available
REG$_NOSUCHFILE	No such file
REG$_NOTROOTKEY	Invalid root key index
REG$_NOTSUPPORTED	Function code, item code, or item value is not supported
REG$_NOVALUE	Specified value does not exist
REG$_OBJWITHLINK	Deleted key or value had link(s)pointing to it
REG$_REQRECEIVED	Received request for key change notification
REG$_RESERVED	Cannot delete or modify a reserved key or value
REG$_ROOTINSFILE	Insufficient file list in root file
REG$_RUIDMISMATCH	Root key UID mismatch; LTE = !@XQ !@XQ; Root key = !@XQ !@XQ
REG$_SECVIO	Violates the security access method specified when this key was last opened
REG$_SEGREADERR	Error reading segment !UL of file !AZ
REG$_STRINGTOOLONG	Input string too long
REG$_STRINGTRUNC	Output buffer is not large enough to contain the converted string
REG$_SVRVERMISMATCH	Version mismatch: Server=V!UL.!UL Database=V!UL.!UL

REG$_SVRSHUTDOWN	Server shutdown in progress
REG$_TOOMANYOPENKEY	Number of opened keys exceeds the limit; close some opened key
REG$_UNKTHRREQ	Unknown thread request code
REG$_VALUEEXIST	Value already exists
REG$_VOLMISMATCH	Cannot create nonvolatile subkey for a volatile key

Function Codes

Table 13–3 provides a summary of valid function codes, a brief description of their function, and the OpenVMS Registry rights identifier required to perform the function. You can find a detailed description of each item code in the **Item Codes** section of this chapter.

The OpenVMS Registry identifier is required only if you do not provide a valid NT access token and you do not have the SYSPRV privilege. If you have a granted REG$UPDATE identifier, you can perform all the functions in Table 13–3.

Table 13–3 Valid Function Codes

Function Code	Identifier	Description
REG$FC_CLOSE_KEY	REG$LOOKUP	Closes an open key or subkey.
REG$FC_CREATE_KEY	REG$UPDATE	Creates (and opens) a subkey.
REG$FC_DELETE_KEY	REG$UPDATE	Removes a subkey from a key.
REG$FC_DELETE_VALUE	REG$UPDATE	Removes a value from a key.
REG$FC_ENUM_KEY	REG$LOOKUP	Lists (enumerates) the subkeys of a key.
REG$FC_ENUM_VALUE	REG$LOOKUP	Lists (enumerates) the values of a key.
REG$FC_FLUSH_KEY	REG$UPDATE	Ensures that all information for the key is backed to disk.
REG$FC_MODIFY_KEY	REG$UPDATE	Modifies a key.
REG$FC_MODIFY_TREE_KEY	REG$UPDATE	Modifies a key and all its subkeys.
REG$FC_NOTIFY_CHANGE_KEY_VALUE	REG$UPDATE	Notifies when a key or value has changed.
REG$FC_OPEN_KEY	REG$LOOKUP	Opens a key or subkey.
REG$FC_QUERY_KEY	REG$LOOKUP	Fetches information about a key.
REG$FC_QUERY_VALUE	REG$LOOKUP	Fetches information about a value.
REG$FC_SEARCH_TREE_DATA	REG$LOOKUP	Searches the value data of key and its subkeys.
REG$FC_SEARCH_TREE_KEY	REG$LOOKUP	Searches the names of a key and its subkeys.
REG$FC_SEARCH_TREE_VALUE	REG$LOOKUP	Searches the values of a key and its subkeys.
REG$FC_SET_VALUE	REG$UPDATE	Changes the data associated with a value name.

REG$FC_CLOSE_KEY

This request releases the open resources of the specified key. If REG$_KEYID indicates a predefined key, the system ignores the action and returns success.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_KEYID	Yes	Input
REG$_RETURNSTATUS	No	Output

REG$FC_CREATE_KEY

If the key does not exist, this request creates a new subkey under the key specified by REG$_KEYID. If the key does exist, the system does not modify it.

If you specify the REG$_KEYRESULT item code, the system opens the specified subkey.

The system returns the result in the REG$_DISPOSITION item code buffer.

Using this function code, you can group multiple requests into a single call to the $REGISTRY service. To use the multiple-request feature, you must use the REG$_SEPARATOR item code to indicate the end of the set of item codes for the current request and that there is another request to process.

To set a value for a key, call the $REGISTRY service with the REG$FC_SET_VALUE function code.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_CACHEACTION	No	Input
REG$_CLASSNAME	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_DISPOSITION	No	Output
REG$_KEYFLAGS	No	Input
REG$_KEYID	Yes	Input
REG$_KEYRESULT	No	Output
REG$_LINKPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_LINKTYPE	No	Input
REG$_RETURNSTATUS	No	Output
REG$_SECACCESS	No	Input
REG$_SECURITYPOLICY	No	Input
REG$_SEPARATOR	No	n/a
REG$_SUBKEYNAME	Yes	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_VOLATILE	No	Input

If you specify the REG$_LINKPATH item code, it must point to a key path already defined in the OpenVMS Registry; otherwise the system returns the REG$_INVALIDPATH error.

Note

If you do not specify the REG$_CACHEACTION item code, the new key is created with the same cache action value as the parent key. The same rule applies to the REG$_VOLATILE and REG$_SECURITYPOLICY item codes.

REG$FC_DELETE_KEY

This request removes the specified subkey and its values from the OpenVMS Registry database. If the specified key has subkeys, the key is not deleted. You must delete the subkeys first.

Using this function code, you can group multiple requests into a single call to the $REGISTRY service. If you use this multiple-request feature, use the REG$_SEPARATOR item code to indicate the end of the set of item codes for the current request and that there is another request to process.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_KEYID	Yes	Input
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_RETURNSTATUS	No	Output
REG$_SEPARATOR	No	n/a
REG$_SUBKEYNAME	Yes	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)

REG$FC_DELETE_VALUE

This request deletes the specified value from the key.

Using this function code, you can group multiple requests into a single call to the $REGISTRY service. If you use this multiple-request feature, use the REG$_SEPARATOR item code to indicate the end of the set of item codes for the current request and that there is another request to process.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_KEYID	Yes	Input
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_RETURNSTATUS	No	Output
REG$_SEPARATOR	No	n/a
REG$_VALUENAME	Yes	Input

REG$FC_ENUM_KEY

This request retrieves information about one subkey of the key. You identify the subkey in the REG$_SUBKEYINDEX item code. To enumerate all the key's subkeys, the application must call the $REGISTRY service repeatedly using the REG$FC_ENUM_KEY function code. Begin with a REG$_SUBKEYINDEX of zero, then increment the count until the request returns a REG$_NOMOREITEMS error.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_CACHEACTION	No	Output
REG$_CLASSNAME	No	Output (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_KEYFLAGS	No	Output
REG$_KEYID	Yes	Input
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_LASTWRITE	No	Output
REG$_LINKCOUNT	No	Output
REG$_LINKPATH	No	Output (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_LINKTYPE	No	Output
REG$_RETURNSTATUS	No	Output
REG$_SECURITYPOLICY	No	Output
REG$_SUBKEYINDEX	Yes	Input
REG$_SUBKEYNAME	No	Output (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_VOLATILE	No	Output

REG$FC_ENUM_VALUE

This request retrieves information about a value of the specified key identifier. The value to retrieve is identified in the REG$_VALUEINDEX item code.

To enumerate all a key's values, the application must call the $REGISTRY service repeatedly using the REG$FC_ENUM_VALUE function code. Begin with a REG$_VALUEINDEX of zero, then increment the count until the request returns a REG$_NOMOREITEMS error.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_DATAFLAGS	No	Output
REG$_DATATYPE	No	Output
REG$_KEYID	Yes	Input
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_RETURNSTATUS	No	Output
REG$_VALUEDATA	No	Output
REG$_VALUEINDEX	Yes	Input
REG$_VALUENAME	No	Output
REG$_VOLATILE	No	Output

REG$FC_FLUSH_KEY

This request writes all the information about a specified key to disk. This request returns only after the operation is complete and all attributes of the key have been written to the OpenVMS Registry database.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_KEYID	Yes	Input
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_RETURNSTATUS	No	Output

REG$FC_MODIFY_KEY

This request modifies a specified key's attributes.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_CACHEACTION	No	Input
REG$_CLASSNAME	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_KEYFLAGS	No	Input
REG$_KEYID	Yes	Input
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_LINKPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_LINKTYPE	No	Input
REG$_NEWNAME	No	Input
REG$_RETURNSTATUS	No	Output
REG$_SECURITYPOLICY	No	Input

To remove the link from the specified key, enter a REG$_LINKPATH item code with an address of zero. You cannot add a link to a key that has either values or subkeys (or both).

REG$FC_MODIFY_TREE_KEY

This request modifies a specified key and all its subkey attributes. No link will be followed or modified.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_CACHEACTION	No	Input
REG$_CLASSNAME	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_KEYID	Yes	Input

Item Code	Required	Parameter Type
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_RETURNSTATUS	No	Output
REG$_SECURITYPOLICY	No	Input

REG$FC_NOTIFY_CHANGE_KEY_VALUE

This request notifies the calling process when a specified key or any of its subkeys has changed. That is, the requested function waits for the specified condition before returning.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_FLAGSUBKEY	Yes	Input
REG$_KEYID	Yes	Input
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_NOTIFYFILTER	Yes	Input
REG$_RETURNSTATUS	No	Output

REG$FC_OPEN_KEY

This request opens the specified key. If you do not specify a subkey, the system opens the key specified in REG$_KEYID. If REG$_KEYID specifies a key other than a predefined key, the system opens the key again (duplicates the key).

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_KEYID	Yes	Input
REG$_KEYRESULT	Yes	Output
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_RETURNSTATUS	No	Output
REG$_SECACCESS	Yes	Input
REG$_SUBKEYNAME	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)

REG$FC_QUERY_KEY

This request retrieves attributes about a specified key.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_CACHEACTION	No	Output

Item Code	Required	Parameter Type
REG$_CLASSNAME	No	Output (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_CLASSNAMEMAX	No	Output
REG$_KEYFLAGS	No	Output
REG$_KEYID	Yes	Input
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_LASTWRITE	No	Output
REG$_LINKCOUNT	No	Output
REG$_LINKPATH	No	Output (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_LINKTYPE	No	Output
REG$_RETURNSTATUS	No	Output
REG$_SECURITYPOLICY	No	Output
REG$_SUBKEYNAMEMAX	No	Output
REG$_SUBKEYSNUMBER	Yes	Output
REG$_VALUEDATAMAX	No	Output
REG$_VALUENAMEMAX	No	Output
REG$_VALUENUMBER	No	Output
REG$_VOLATILE	No	Output

REG$FC_QUERY_VALUE

This request retrieves the type, data flags, and data for the specified value name.

Using this function code, you can group multiple requests into a single call to the $REGISTRY service. If you use this multiple-request feature, use the REG$_SEPARATOR item code to indicate the end of the set of item codes for the current request and that there is another request to process.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_DATAFLAGS	No	Output
REG$_DATATYPE	No	Output
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_KEYID	Yes	Input
REG$_LINKCOUNT	No	Output
REG$_LINKPATH	No	Output (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_LINKTYPE	No	Output
REG$_RETURNSTATUS	No	Output
REG$_SEPARATOR	No	n/a
REG$_VALUEDATA	No	Output

Item Code	Required	Parameter Type
REG$_VALUENAME	Yes	Input
REG$_VOLATILE	No	Output

REG$FC_SEARCH_TREE_DATA

This request scans a specified key and all its descendants for a match with a specified set of data information. The set of data information can be either the REG$_DATAFLAGS item code, or the pair REG$_DATATYPE and REG$_VALUEDATA item codes, or all three item codes.

The REG$_FLAGOPCODE item code specifies how the REG$_DATAFLAGS item code should be matched against the database. (See the item codes description for more information about the REG$_FLAGOPCODE item code.)

Every time the system finds a match, it appends the path name relative to the specified key to the REG$_PATHBUFFER item code. A Unicode null character is used to separate the value path names.

If the buffer supplied by the application is not big enough to hold all the value path names found, the system returns the SS$_BUFFEROVF error message in the **iosb** argument, and the length required to complete the operation successfully is returned in the REG$_REQLENGTH item (if specified).

Use the ellipsis (...) wildcard to match zero or more subkeys in the REG$_KEYPATH item code. (For example, Hardware\...\disks finds all the paths that start with the Hardware subkey and end with the disk subkey, with zero or more subkeys in between.) Use the asterisk (*) wildcard to match an entire subkey or a portion of a subkey in the REG$_KEYPATH item code. Use the percent (%) wildcard to match one character in a key name in the REG$_KEYPATH item code.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_DATAFLAGS	No	Input
REG$_DATATYPE	No	Input
REG$_FLAGOPCODE	No	Input
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_KEYID	Yes	Input
REG$_PATHBUFFER	Yes	Output
REG$_REQLENGTH	No	Output
REG$_RETURNSTATUS	No	Output
REG$_VALUEDATA	No	Input

REG$FC_SEARCH_TREE_KEY

This request scans a specified key and all its descendants for a specified key path.

For this function code, a valid key path is a Unicode string that can include the ellipsis (...), asterisk (*), or percent (%) wildcard character, but that cannot start with the backslash character (\).

Use the ellipsis (...) wildcard to match zero or more subkeys in the REG$_KEYPATH item code. (For example, Hardware\...\disks finds all the paths that start with the Hardware subkey and end with the disk subkey, with zero or more subkeys in between.) Use the asterisk (*) wildcard to match an entire subkey or a portion of a subkey in the REG$_KEYPATH item code. Use the percent (%) wildcard to match one character in a key name in the REG$_KEYPATH item code.

An example of a valid key path is as follows:

```
hardware\system\*\disk%%
```

Every time the system finds a match, the system appends its path name relative to the specified key identifier to the REG$_PATHBUFFER item code. A Unicode null character (4 bytes) separates the subkey path names.

If the buffer supplied by the application is not big enough to contain all the subkey path names found, the system returns the SS$_BUFFEROVF error message in the **iosb** argument, and the system returns the required length to complete the operation successfully in the REG$_REQLENGTH item (if specified).

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_KEYID	Yes	Input
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_PATHBUFFER	Yes	Output
REG$_REQLENGTH	No	Output
REG$_RETURNSTATUS	No	Output

REG$FC_SEARCH_TREE_VALUE

This request scans a specified key and all its descendants for a specified value name.

For this function code a valid key name is a Unicode string that can include the ellipsis (...), asterisk (*), or percent (%) wildcard character, but cannot start with the backslash character (\).

Use the ellipsis (...) wildcard to match zero or more subkeys in the REG$_KEYPATH item code. (For example, Hardware\...\disks finds all the paths that start with the Hardware subkey and end with the disk subkey, with zero or more subkeys in between.) Use the asterisk (*) wildcard to match an entire subkey or a portion of a subkey in the REG$_KEYPATH item code. Use the percent (%) wildcard to match one character in a key name in the REG$_KEYPATH item code.

An example of a valid key path is as follows:

```
hardware\system\...
```

For this function code, a valid name is a Unicode string that can include the asterisk (*) and percent (%) wildcard characters.

Every time the system finds a match, the system appends its path name relative to the specified key identifier to the REG$_PATHBUFFER item code. A Unicode null character (4 bytes) separates the subkey path names.

If the buffer supplied by the application is not big enough to contain all the subkey path names found, the system returns the SS$_BUFFEROVF error message in the **iosb** argument, and the system returns the required length to complete the operation successfully in the REG$_REQLENGTH item (if specified).

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_KEYID	Yes	Input
REG$_PATHBUFFER	Yes	Output
REG$_REQLENGTH	No	Output
REG$_RETURNSTATUS	No	Output
REG$_VALUENAME	Yes	Input

REG$FC_SET_VALUE

This request sets value and type information for a specified key.

Using this function code, you can group multiple requests into a single call to the $REGISTRY service. If you use this multiple-request feature, use the REG$_SEPARATOR item code to indicate the end of the set of item codes for the current request and that there is another request to process.

When a value is set to a link, the system validates the link unless you specify the REG$M_IGNORE_LINKS function code modifier.

Specify the item codes as follows:

Item Code	Required	Parameter Type
REG$_DATAFLAGS	No	Input
REG$_DATATYPE	No	Input
REG$_KEYID	Yes	Input
REG$_KEYPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_LINKPATH	No	Input (Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_LINKTYPE	No	Input
REG$_RETURNSTATUS	No	Output
REG$_SEPARATOR	No	n/a
REG$_VALUEDATA	No	Input
REG$_VALUENAME	No	Input

Item Codes

Table 13–4 provides a summary of item codes that are valid as an item descriptor in the **itmlst** argument. The table lists the item codes, input/output usage, and data types. Complete descriptions of each item code are provided in the sections that follow this table.

Table 13–4 Item Code Summary

Item Code	Input/Output	Data Type
REG$_CACHEACTION	Input, output	Longword
REG$_CLASSNAME	Input, output	(Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_CLASSNAMEMAX	Output	Longword
REG$_DATAFLAGS	Input, output	Quadword
REG$_DATATYPE	Input, output	Longword
REG$_DISPOSITION	Output	Longword
REG$_FILELOAD	Input	Unicode string
REG$_FLAGOPCODE	Input	Longword
REG$_FLAGSUBKEY	Input	Longword
REG$_KEYPATH	Input	(Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_KEYFLAGS	Input, output	Longword
REG$_KEYID	Input, output	Longword
REG$_KEYRESULT	Output	Longword
REG$_LASTWRITE	Output	Quadword
REG$_LINKCOUNT	Output	Longword
REG$_LINKPATH	Input, output	(Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_LINKTYPE	Input, output	Longword
REG$_NEWNAME	Input	Unicode string
REG$_NOTIFYFILTER	Input	Longword
REG$_PATHBUFFER	Output	Buffer
REG$_REQLENGTH	Output	Longword
REG$_RETURNSTATUS	Output	Longword
REG$_SECACCESS	Input	Longword
REG$_SECURITYPOLICY	Input, output	Longword
REG$_SEPARATOR	n/a	None
REG$_SUBKEYINDEX	Input	Longword
REG$_SUBKEYNAME	Input, output	(Pointer to Unicode string. Unicode character is 4 bytes long.)
REG$_SUBKEYNAMEMAX	Output	Longword

(continued on next page)

Table 13–4 (Cont.) Item Code Summary

Item Code	Input/Output	Data Type
REG$_SUBKEYSNUMBER	Output	Longword
REG$_VALUEDATA	Input, output	Buffer
REG$_VALUEDATAMAX	Output	Longword
REG$_VALUEINDEX	Input	Longword
REG$_VALUENAME	Input, output	Unicode string
REG$_VALUENAMEMAX	Output	Longword
REG$_VALUENUMBER	Output	Longword
REG$_VOLATILE	Input, output	Longword

REG$_CACHEACTION

The REG$_CACHEACTION item code is an input item code. It is a longword flag that specifies whether the information on a specified object should be written to disk immediately. It takes one of the following values:

Cache Value	Description
REG$K_WRITEBEHIND	Write information about the specified object written to disk at a later time (default).
REG$K_WRITETHRU	Write information about the specified object to disk immediately.

Note

If you do not specify this item code, the value or key inherits its value from the parent object. By default, the entry points (REG$_HKEY_CLASSES_ROOT, REG$_HKEY_LOCAL_MACHINE, and REG$_HKEY_USERS) are set with a value equal to that of REG$K_WRITEBEHIND.

REG$_CLASSNAME

The REG$_CLASSNAME item code is, depending on the function code, either an input or output item code. The class name is an information field for a key. The type of an object is an example of a class name. It can be composed of any string of Unicode characters. A Unicode character is 4 bytes long.

REG$_CLASSNAMEMAX

The REG$_CLASSNAMEMAX item code is an output item code. It receives the length, in bytes, of the longest string specifying a subkey class name.

REG$_DATAFLAGS

Depending on the function code, the REG$_DATAFLAGS item code is either an input or output item code. It is a 64-bit application-dependent value data flag.

REG$_DATATYPE

Depending on the function code, the REG$_DATATYPE item code is either an input or output item code. It is a longword that either specifies the type of information

to be stored as a value data or receives the type of information of a specified value data component. It takes one of the following values:

Type code	Description
REG$K_BINARY	Binary data
REG$K_DWORD	A 32-bit number
REG$K_EXPAND_SZ	A string of Unicode characters
REG$K_MULTI_SZ	A concatenated array of REG$K_SZ strings
REG$K_NONE	No defined value type (default)
REG$K_QWORD	A 64-bit number
REG$K_SZ	A null-terminated Unicode string

The difference between REG$K_EXPAND_SZ and REG$K_SZ

A string is a set of characters usually in human-readable form. Many value entries in the OpenVMS Registry are written using a **string** (REG_SZ) or an **expandable string** (REG_EXPAND_SZ) format. An expandable string is usually human-readable text, but it can also include a variable that will be replaced when the string is called by an application.

For example, on a Windows NT system, in the value entry %SystemRoot%\System32\Bootok.exe, %SystemRoot% is the expandable portion of the variable. This part is replaced with the actual location of the directory that contains the Windows NT system files.

REG$_DISPOSITION

The REG$_DISPOSITION item code is an output item code. It is a longword and takes one of the following values:

Disposition value	Description
REG$K_CREATENEWKEY	The key did not exist and was created.
REG$K_OPENEXISTINGKEY	The key existed and was opened.

REG$_FLAGOPCODE

The REG$_FLAGOPCODE item code is an input item code. It is a longword flag that indicates how the REG$_DATAFLAGS input item code should be matched against the data flags field in the OpenVMS Registry database. It takes one of the following values:

Operator code options	Description
REG$K_ANY	The data field in the OpenVMS Registry database must contain at least one of the flags in the REG$_DATAFLAGS input item code.
REG$K_EXACTMATCH	The REG$_DATAFLAGS input item code must match exactly the data flags field in the OpenVMS Registry database.

Operator code options	Description
REG$K_EXCLUDE	The data flags field in the OpenVMS Registry database must *not* contain the flags in the REG$_DATAFLAGS input item code.
REG$K_INCLUDE	The data flags field in the OpenVMS Registry database must contain, at a minimum, the flags in the REG$_DATAFLAGS input item code.
REG$K_NOTANY	The data field in the OpenVMS Registry database must *not* contain any of the flags in the REG$_DATAFLAGS input item code.

REG$_FLAGSUBKEY
The REG$_FLAGSUBKEY item code is an input item code. It is a longword Boolean field that indicates the following:

- If set to 1, report changes in a specified key and any of its subkeys.
- If set to 0, report changes to a specified key only.

REG$_KEYID
The REG$_KEYID item code is an input item code. It is a longword that contains the key identifier.

REG$_KEYRESULT
The REG$_KEYRESULT item code is an output item code. It is a longword that receives a key identifier. The key identifier can be passed to other Registry calls using the REG$_KEYID item code.

REG$_KEYPATH
The REG$_KEYPATH item code is an input item code. It is a string of Unicode characters that specifies a key path. A Unicode character is 4 bytes long.

REG$_LASTWRITE
The REG$_LASTWRITE item code is an output item code. It is a quadword representation of absolute time that receives the time a specified key was last written to (including changes to its values).

REG$_LINKCOUNT
The REG$_LINKCOUNT item code is an output item code. It is longword count of the number of symbolic links that refer to the item.

REG$_LINKPATH
The REG$_LINKPATH item code is, depending on the function code, either an input or an output item code. It is a string of Unicode characters that specifies the key path to which a specified key is linked. A Unicode character is 4 bytes long.

REG$_LINKTYPE
The REG$_LINKTYPE item code is, depending on the function code, either an input or an output item code. It is longword type that indicates the link type.

Link Type	Description
REG$K_NONE	No link (default)

Link Type	Description
REG$K_SYMBOLICLINK	Symbolic (logical) link

REG$_NEWNAME
The REG$_NEWNAME item code is a string of Unicode characters that specifies the new name of the key.

REG$_NOTIFYFILTER
The REG$_NOTIFYFILTER item code is an input item code. It is a longword mask that specifies which changes to the specified key and its subkeys and values to report. It takes any combination of the following values:

Value	Description
REG$M_CHANGEATTRIBUTES	An attribute change of the specified key or its subkeys.
REG$M_CHANGELASTSET	Changes to the last write time of the specified key or its subkeys.
REG$M_CHANGENAME	A key name change, including creation and deletion, of the specified key or its subkeys.

Note

The system report changes to subkeys of the specified key only if the REG$_FLAGSUBKEY item code is set to 1.

REG$_PATHBUFFER
The REG$_PATHBUFFER item code is an output item code. It is a buffer that receives a set of either key paths or value paths, separated by a null Unicode character (4 bytes long). (The third longword of the item descriptor contains the number of bytes written to the buffer.)

REG$_REQLENGTH
The REG$_REQLENGTH item code is an output item code. It is a longword that receives the required buffer size (in bytes) to complete the operation successfully.

REG$_RETURNSTATUS
The REG$_RETURNSTATUS item code is an output item code. It is a longword that receives the final completion status for a specified operation. For more information, see the **Condition Values Returned** section of this chapter.

REG$_SECACCESS
The REG$_SECACCESS item code is an input item code. It is a longword mask that specifies the desired security access for the new key. It takes any combination of the following values:

Security access mask	Description
REG$M_ALLACCESS	A combination of the following access values: REG$K_CREATELINK REG$K_CREATESUBKEY REG$K_ENUMSUBKEYS REG$K_NOTIFY REG$K_QUERYVALUE REG$K_SETVALUE
REG$M_CREATELINK	Allows creation of a symbolic link.
REG$M_CREATESUBKEY	Allows creation of subkeys.
REG$M_ENUMSUBKEYS	Allows enumeration of subkeys.
REG$M_EXECUTE	Allows read access.
REG$M_NOTIFY	Allows change notification.
REG$M_QUERYVALUE	Allows queries of subkey data.
REG$M_READ	A combination of the following access values: REG$K_ENUMSUBKEYS REG$K_QUERYVALUE REG$K_NOTIFY
REG$M_SETVALUE	Allows setting of values and data.
REG$M_WRITE	A combination of the following access values: REG$K_CREATESUBKEY REG$K_SETVALUE

REG$_SECURITYPOLICY

The REG$_SECURITYPOLICY item code is an input item code. It is a longword that specifies the security policy to enforce for the key. It takes the following value:

Policy Setting	Description
REG$K_POLICY_NT_40	Access is required to the first key and the requested key (default).

REG$_SEPARATOR

The REG$_SEPARATOR item code is an empty item code that provides a separator between sets of item codes.

Using this item code, you can group multiple requests into a single call to the $REGISTRY service. If you use this multiple-request feature, use the REG$_SEPARATOR item code to indicate the end of the set of item codes for the current request and that there is another request to process.

REG$_SUBKEYINDEX

The REG$_SUBKEYINDEX item code is an input item code. It is a longword that specifies the index of the subkey to retrieve.

REG$_SUBKEYNAME

The REG$_SUBKEYNAME item code is an input item code. It is a string of Unicode characters that specifies the name of a subkey. A Unicode character is 4 bytes long.

REG$_SUBKEYNAMEMAX
The REG$_SUBKEYNAMEMAX item code is an output item code. It is a longword that receives the length (in characters) of a specified key's longest subkey name.

REG$_SUBKEYSNUMBER
The REG$_SUBKEYSNUMBER item code is an output item code. It is a longword that receives the number of subkeys contained in a specified key.

REG$_VALUEINDEX
The REG$_VALUEINDEX item code is an input item code. It is a longword that specifies the index of the value to retrieve within a specified key. Note that the value index starts at zero and can be any value up to one less than the count returned by REG$_VALUENUMBER.

REG$_VALUEDATA
The REG$_VALUEDATA item code is, depending on the function code, either an input or output item code. It is a buffer that contains either the value data component to write to the OpenVMS Registry (input), or it receives a data value component from the OpenVMS Registry (output).

REG$_VALUEDATAMAX
The REG$_VALUEDATAMAX item code is an output item code. It is a longword that receives the length (in bytes) of the specified key's longest data component value.

REG$_VALUENAME
The REG$_VALUENAME item code is, depending on the function code, either an input or an output item code. It is a string of Unicode characters that specifies the name of a value.

REG$_VALUENAMEMAX
The REG$_VALUENAMEMAX item code is an output item code. It is a longword that receives the length (in characters) of a specified key's longest value name.

REG$_VALUENUMBER
The REG$_VALUENUMBER item code is an output item code. It is a longword that receives the number of values contained in a specified key.

REG$_VOLATILE
The REG$_VOLATILE item code identifies the volatility of an item. As an output, it returns the volatility of the object. On OpenVMS, volatile keys and values are lost when all nodes running an OpenVMS Registry server are rebooted. (In a standalone system, volatile keys and values are lost when the system reboots.)

Volatile Type	Description
REG$K_CLUSTER	The item is removed when the cluster reboots.
REG$K_NONE	The item is not volatile (default).

Function Modifiers

You can optionally specify the high-order bits of a function code value with function modifiers. These individual bits can alter the operation of the function.

For example, you can specify the function modifier REG$M_CASE_SENSITIVE with the function REG$FC_CREATE_KEY. When you use the function and function modifier together, the data passed to the OpenVMS Registry is treated as case sensitive. The two values are written in DEC C as REG$M_CASE_SENSITIVE | REG$FC_CREATE_KEY.

The OpenVMS Registry function modifiers are defined in the header file REGDEF.H.

REG$M_CASE_SENSITIVE
Use case-sensitive matching for keys and values.

REG$M_DISABLE_WILDCARDS
Treat wildcard characters as normal characters for this function.

REG$M_IGNORE_LINKS
Force the operation to not follow any symbolic links associated with a key or a value.

By default, if a key or value is symbolically linked to another key or value, the system follows all links so that the operation specified by the function code is performed on the linked key or value.

When you specify the REG$M_IGNORE_LINKS function modifier, the operation specified by the function code affects only the specified key or value, not the linked key or value.

By default, if a key or value has a symbolic link, it can not be deleted. If you specify the REG$M_IGNORE_LINKS function modifier, the system deletes the key or value.

REG$M_NOW
Write to disk immediately, regardless of the REG$_CACHEACTION item code value.

Part III

OpenVMS Events

This part contains reference information about OpenVMS Events.

14
OpenVMS Events

14.1 What are Events?

On a Windows NT system, an **event** is any significant occurrence in the system or an application—for example, a service starting or stopping, a user logging on or off, or accessing resources. When the system encounters an event, the **Event Log service** writes the event (or audit entry) in the form of a record that contains date and time, source, category, event number, user, and computer information to a system, security, or application log, creating an audit trail. On Windows NT systems, you display these logs and their recorded events using the **Event Viewer**.

With *COM Version 1.0 for OpenVMS*, OpenVMS wrote all *COM for OpenVMS* events to the DCOM$EVENTLOG.RPT text file. With *COM Version 1.1-B for OpenVMS*, OpenVMS supports both Windows NT logging and Advanced Server for OpenVMS logging of *COM for OpenVMS* events. You can now log a *COM for OpenVMS* event (such as the starting of a COM server on OpenVMS), and review these OpenVMS events from a Windows NT system or an OpenVMS system.

For a detailed review of OpenVMS Events dependencies and a description of how OpenVMS Events interacts with other parts of the OpenVMS infrastructure, see Section 4.8.

14.1.1 Suggested Reading

The following sources can provide you with more information on Events and related topics:

- Third-party books on event logging:
  - — *Windows NT Server 4.0 Unleashed*, Jason Garms, SAMS Publishing, Indianapolis, IN, 1998. ISBN: 0-672-30933-5.
  - — *Win32 System Services: The Heart of Window 95 and Windows NT*, Marshall Brain, Prentice Hall, Upper Saddle River, NJ, 1996. ISBN: 0-13-324732-5.
- Other sources:
  - — Microsoft *Win32 Software Development Kit*

    In particular, see the sections about the `RegisterEventSource`, `ReportEvent`, and `DeregisterEventSource` functions, and System Services: *Event Logging* section.

14.2 Overview of OpenVMS Events

The system logs OpenVMS Events to a Windows NT event log, to the Advanced Server for OpenVMS event log, and to a log file on the OpenVMS system.

You can use the following techniques to view OpenVMS Events:

- Windows NT event viewer (see Section 14.2.1)
- Advanced Server for OpenVMS event viewer (see Section 14.2.2)
- OpenVMS event log file (see Section 14.2.3)

14.2.1 Viewing OpenVMS Events Using Windows NT Event Viewer

Use the following procedure to view OpenVMS Events through the Windows NT event viewer:

1. Start the Windows NT event viewer.

   From the **Start** menu, select **Programs**, **Administrative Tools**, **Event Viewer**.

2. From the Event Viewer window, click the menu bar **Log** option. Click **Select Computer....**, and select the OpenVMS system from the list box.

3. From the Event Viewer window, click the menu bar **Log** option. Click **System** to display the System event log. The System event log contains the *COM for OpenVMS* events.

   To display *COM for OpenVMS* events only, use the following procedure:

   - From the Event Viewer window, click the menu bar **View** option. Click **Filter Events...**.

     The system displays the Filter window.

   - On the Filter window, click the Source: list box. From the list, choose DCOM.

14.2.2 Viewing OpenVMS Events Using Advanced Server for OpenVMS Event Viewer

Use the following procedure to view the *COM for OpenVMS* events:

1. Ensure that the Advanced Server for OpenVMS is running.

2. Enter the following Advanced Server for OpenVMS ADMINISTRATOR command:

   ```
   $ ADMIN SHOW EVENTS/TYPE=SYSTEM/SOURCE=DCOM/FULL
   ```

   The viewer displays *COM for OpenVMS* events only, along with any additional information associated with the *COM for OpenVMS* event.

14.2.3 Event Logging on OpenVMS Only

In some cases, you might want to write and view *COM for OpenVMS* events only on an OpenVMS system. In place of the Windows NT log, Compaq has included an alternate event logger that writes COM event information to an OpenVMS file. You can find this file in the following location:

```
SYS$MANAGER:DCOM$EVENTLOG.RPT
```

COM for OpenVMS creates this event logging report automatically when the COM server (DCOM$RPCSS) encounters an error. The event logger appends new events at the bottom (end) of the file. A logged event has the following format:

```
event type : ddd mmm dd hh:mm:ss yyyy
First event message

event type : ddd mmm dd hh:mm:ss yyyy
Second event message
.
.
.
```

Example 14–1 shows the contents of an event log.

Example 14–1 Sample OpenVMS Event Log

```
$ Type SYS$MANAGER:DCOM$EVENTLOG.RPT

❶
ERROR : Tue Sep 15 11:18:54 1998
Unable to start a DCOM Server: {5E9DDEC7-5767-11CF-BEAB-00AA006C3606}
Runas (null)/SMITH
The Windows NT error: 1326
Happened while starting: device:[account]SSERVER.EXE

❷
ERROR : Tue Sep 15 19:14:45 1998
The server {0C092C21-882C-11CF-A6BB-0080C7B2D682} did not register
with DCOM within the required timeout.
```

❶ The system logged the first error event on Tue Sep 15 11:18:54 1998. The COM server (DCOM$RPCSS) was unable to start the COM application *device*:[*account*]SSERVER.EXE on behalf of the client running under the SMITH account. (The client may have received an error such as ‘‘access denied.’’) The resulting Windows NT error was 1326, which translates as "Logon failure: unknown user name or bad password."

If you see this error, check the validity of the user account using the OpenVMS Authorize utility (AUTHORIZE).

❷ The system logged the second error event on Tue Sep 15 19:14:45 1998. The COM server (DCOM$RPCSS) was able to start the COM application {0C092C21-882C-11CF-A6BB-0080C7B2D682}, but the application did not run successfully. The application failed to register with DCOM$RPCSS within the specified time limit. (The client may have received an error such as ‘‘Server execution failed’’ CO_E_SERVER_EXEC_FAILURE.)

If you see this error, run the server application interactively to determine its integrity.

NTA$EVENTW
Interface to OpenVMS Events

Allows an application to record information in the event log files.

The NTA$EVENTW routine completes all operations synchronously.

Format

NTA$EVENTW [nullarg], func, itmlst, evsb

Arguments

nullarg

OpenVMS usage: reserved
type: longword (unsigned)
access: read only
mechanism: by value

Reserved for Compaq use.

func

OpenVMS usage: function_code
type: longword (unsigned)
access: read only
mechanism: by value

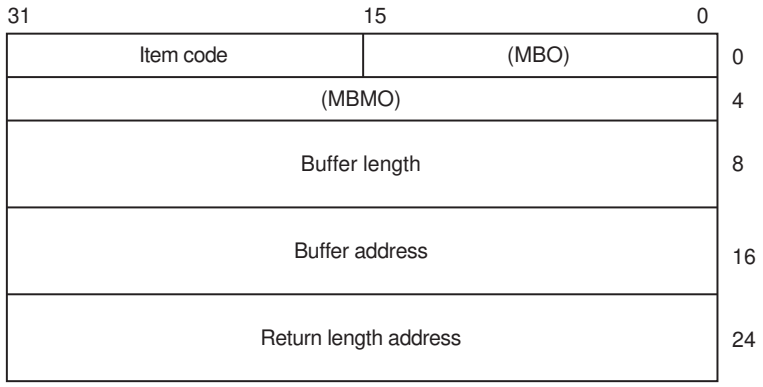
Function code specifying the function NTA$EVENTW is to perform. The func argument is a longword containing this function code. The $EVENTDEF macro defines the names of each function code.

itmlst

OpenVMS usage: address of item list
type: 64-bit address
access: read only
mechanism: by value

Item list specifying information about the event source or the event. The itmlst argument is the 64-bit address of a list of item descriptors, each of which describes an item of information. An item list in 64-bit format is terminated by a quadword of 0.

The following diagram shows the 64-bit format of a single item descriptor.



evsb

OpenVMS usage: address of status block
type: 64-bit address
access: write only
mechanism: by reference

Event status block to contain the completion status for the requested operation.

NTA$EVENTW sets the status block to 0 upon request initiation. Upon request completion, the EVT$L_VMS_STATUS field contains the primary (OpenVMS) completion status for the operation.

If an error occurs, EVT$L_NT_STATUS (if non-zero) is the secondary error status to further define the error condition.

Function Codes

EVT$_FC_REGISTER_EVENT_SOURCE

Open an association with an event log.

Item code	Required	Parameter	Data type
EVT$_SERVER_NAME	No	Input	String (4-byte Unicode)
EVT$_SOURCE	No	Input	String (4-byte Unicode)
EVT$_HANDLE	Yes	Output	Unsigned longword

- EVT$_SERVER_NAME

  The universal naming convention (UNC) name of the server on which this operation is to be performed.

  UNC names have the form *server**share**path**file*. This item must be zero or unspecified. This performs the operation on an available Advanced Server for OpenVMS server in the cluster.

- EVT$_SOURCE

  The name of the application that logs the event. This field associates an application message file that contains descriptive text with the application's event log entries.

If specified, the source must be a subkey of the Eventlog\System key, the Eventlog\Security key, or the Eventlog\Application registry key. For example, a source name of Myapp indicates a registry entry in the following:

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\
   Services\Eventlog\Application\Myapp)
```

The Myapp registry value EventMessageFile names the path and message file to be used to translate this application's events.

The source can be unspecified or specified as NULL. In this case, the system logs events to the Application log file but the application logs no message file (and, as a result, no replacement text) for the associated events.

- EVT$_HANDLE

  Returns a handle to the Application event log. This handle is required input for other $EVENT functions.

  On failure, a handle of 0 is returned. This handle is outside the responsibility of the CloseHandle API.

EVT$_FC_REPORT_EVENT

Generate an event log entry.

Item code	Required	Parameter	Data type
EVT$_HANDLE	Yes	Input	Unsigned longword
EVT$_EVENT_TYPE	Yes	Input	Word mask
EVT$_EVENT_CATEGORY	No	Input	Word
EVT$_EVENT_ID	Yes	Input	Longword
EVT$_USER_SID	No	Input	NT Security ID
EVT$_NUMSTRINGS	No	Input	Word
EVT$_DATASIZE	No	Input	Longword
EVT$_STRING_ARRAY	No	Input	Array of varying-length descriptors. (4-byte Unicode)
EVT$_RAW_DATA	No	Input	Binary data

- EVT$_HANDLE

  Value returned by a previous EVT$_FC_REGISTER_EVENT_SOURCE call.

- EVT$_EVENT_TYPE

  Indicates the severity of the event. The type is one of the following:

  EVT$_SUCCESS
  EVT$_ERROR
  EVT$_WARNING
  EVT$_INFO
  EVT$_AUDIT_SUCCESS
  EVT$_AUDIT_FAILURE

  The severity type maps to its Windows NT equivalent, defined in WINNT.H.

- EVT$_EVENT_CATEGORY

  An integer value from 1 to 65535. EVT$_EVENT_CATEGORY is unique to a particular source.

EVT$_EVENT_CATEGORY allows an application to divide its message file into sections, each indexed by event ID. If you do not specify a category, the system defaults to a category of zero.

- EVT$_EVENT_ID

  An unlimited integer value. This value indexes the category in an application message file that locates the text string displayed for this event message. The event ID is unique to a particular source.

- EVT$_USER_SID

  The optional Windows NT Security ID of the thread logging the event. An application that has acquired Windows NT credentials through the $PERSONA system service can obtain its SID through calls to the `OpenProcessToken` and `GetTokenInformation` Win32 APIs. The format is opaque to this service.

- EVT$_NUMSTRINGS

  A count of the strings specified in the EVT$_STRING_ARRAY item code.

- EVT$_DATASIZE

  Length in bytes of the buffer indicated by the EVT$_RAW_DATA item code.

- EVT$_STRING_ARRAY

  An array of string pointers. Each entry points to a null terminated string. A description string in a message file can contain string placeholders in the form *%n*, where %1 indicates the first placeholder. Strings specified in this array replace these placeholders when the system displays the event message.

- EVT$_RAW_DATA

  Allows you to include binary data in an event message.

  For example, you might use this to dump a data structure from a failing component.

EVT$_DEREGISTER_EVENT_SOURCE

Close an association with an event log.

Item code	Required	Parameter	Data type
`EVT$_HANDLE`	Yes	Input	Unsigned longword

- EVT$_HANDLE

  Value returned by a previous EVT$_FC_REGISTER_EVENT_SOURCE call.

Item Codes

Item Code	Parameter Type	Data Type
`EVT$_SERVER_NAME`	Input	String
`EVT$_SOURCE`	Input	String
`EVT$_HANDLE`	Input/Output	Unsigned longword

OpenVMS Events Routine NTA$EVENTW

Item Code	Parameter Type	Data Type
EVT$_EVENT_TYPE	Input	Word mask
EVT$_EVENT_CATEGORY	Input	Word
EVT$_EVENT_ID	Input	Longword
EVT$_USER_SID	Input	NT security ID
EVT$_NUMSTRINGS	Input	Word
EVT$_DATASIZE	Input	Longword
EVT$_STRING_ARRAY	Input	Array of string pointers
EVT$_RAW_DATA	Input	Binary data

Description

The NTA$EVENTW routine allows you to register and deregister an event source and report event data. This event logging allows you to record information from within an application. You can use the events routines to track progress within an application or identify problems encountered by an application.

The NTA$EVENTW routine completes synchronously; that is, control is returned to the caller only after the request completes.

Use the following process to write event data:

1. Register the event source.

   This operation defines the event log to which the system writes event data.

2. Report the event.

   This operation causes the system to write the information to the appropriate event log.

3. Deregister the event source.

   This operation frees resources acquired as part of the event source registration operation.

Condition Values Returned

SS$_NORMAL	Service completed successfully.
SS$_ACCVIO	One of the arguments cannot be read/written.
SS$_BADPARAM	Bad parameter.
SS$_NOPRIV	Insufficient privilege to access the specified event log.
SS$_TIMEOUT	Request timed out.
SS$_UNREACHABLE	Events service unavailable.
SS$_REJECT	The Windows NT LAN Manager server encountered an error. See the Win32 status for more information.

14.3 Writing Your Own Events

By default, the system logs DCOM events generated by *COM for OpenVMS*. In addition to recording *COM for OpenVMS* events, the system can also log COM application events for COM applications that you create.

The *COM for OpenVMS* kit includes sample code that shows how to generate an application event using Win32 APIs. You can use this example as is on a Windows NT system. The example also builds correctly using the instructions for building *COM for OpenVMS* applications on OpenVMS (to get the required header files from DCOM$LIBRARY). See Chapter 7 for these instructions. The example also includes the linking instructions to build the example using Wind/U.

14.4 Troubleshooting OpenVMS Events

Errors that occur during event reporting can be difficult to trace because of the number of intervening software layers through which the event passes. The following list describes how OpenVMS Events pass through other software layers until they are recorded in the Windows NT log.

1. An application calls one of the Win32 event functions (`RegisterEventSource`, `ReportEvent`, or `DeregisterEventSource`).
2. Using the supplied arguments, the Win32 API builds an appropriate item list and calls the NTA$EVENTW routine.
3. The NTA$EVENTW routine validates the information supplied (function code, item list, and so on) and builds an appropriate item list for the SYS$ACM system service.

   If NTA$EVENT detects any errors NTA$EVENT returns the errors to the Win32 API using R0 and the event status block.
4. The SYS$ACM system service validates the information and passes it to the NT ACME.

   If SYS$ACM detects any errors, SYS$ACM returns the errors to NTA$EVENTW using R0 and the ACM status block..
5. The NT ACME passes the supplied information (using an IPC pipe) to a dispatcher in the Advanced Server for OpenVMS.

   If the NT ACME detects any errors, the NT ACME returns the errors to the caller using the ACM status block.
6. The Advanced Server for OpenVMS dispatcher validates the information and calls the appropriate routines to perform the requested operation (register, report, or deregister).

   If the Advanced Server for OpenVMS detects any errors, it reports the errors to the NT ACME. The NT ACME passes the errors back to the other callers.

Checking the contents of the event status block help you determine where the failure might have happened. Table 14–1 lists (in order of importance) the checks you should perform.

Table 14–1 Troubleshooting OpenVMS Events Failures

R0 Status	Status Field Value	Component to Check
Failure (bit 0 clear)	EVT$L_NT_STATUS field is nonzero.	Error most likely occurred within Advanced Server for OpenVMS.
Failure	EVT$L_VMS_STATUS field is nonzero and the EVT$L_NT_STATUS is zero.	Error most likely occurred within the SYS$ACM system service or the NT ACME.
Failure	EVT$L_VMS_STATUS is zero and EVT$L_NT_STATUS is zero.	Error most likely occurred within the SYS$ACM system service.

Note

The Win32 API usually converts the error status to an appropriate NT error status code and makes it available through the GetLastError Win32 API. (The status returned by the event API simply indicates a generic failure.)

Part IV
Appendixes

This part contains reference information about *COM for OpenVMS* and the OpenVMS Registry.

The appendixes provide information about the MIDL compiler, troubleshooting tips, COM sample code, running *COM for OpenVMS* in an unauthenticated environment, and APIs and interfaces.

This part also includes coupons for related COM books, a glossary, and a list of acronyms.

A

MIDL Compiler Options

A.1 Mode

Switch	Use
/ms_ext	Microsoft extensions to the IDL language (default)
/c_ext	Allow Microsoft C extensions in the IDL file (default)
/osf	OSF mode - disables /ms_ext and /c_ext options
/app_config	Allow selected ACF attributes in the IDL file
/mktyplib203	MKTYPLIB Version 2.03 compatibility mode

A.2 Input

Switch	Use
/acf filename	Specify the attribute configuration file
/I directory-list	Specify one or more directories for include path
/no_def_idir	Ignore the current and the INCLUDE directories

A.3 Output File Generation

Switch	Use
/client none	Do not generate client files
/client stub	Generate client stub file only
/out directory	Specify destination directory for output files
/server none	Generate no server files
/server stub	Generate server stub file only
/syntax_check	Check syntax only; do not generate output files
/Zs	Check syntax only; do not generate output files
/old	Generate old format type libraries
/new	Generate new format type libraries

A.4 Output File Names

Switch	Use
/cstub filename	Specify client stub file name
/dlldata filename	Specify dlldata file name
/h filename	Specify header file name

Switch	Use
/header filename	Specify header file name
/iid filename	Specify interface UUID file name
/proxy filename	Specify proxy file name
/sstub filename	Specify server stub file name
/tlb filename	Specify type library file name

A.5 C Compiler and Preprocessor Options

Switch	Use
/cpp_cmd cmd_line	Specify name of C preprocessor
/cpp_opt options	Specify additional C preprocessor options
/D name[=def]	Pass #define name, optional value to C preprocessor
/no_cpp	Turn off the C preprocessing option
/nocpp	Turn off the C preprocessing option
/U name	Remove any previous definition (undefine)

A.6 Environment

Switch	Use
/char signed	C compiler default char type is signed
/char unsigned	C compiler default char type is unsigned
/char ascii7	Char values limited to 0-127
/dos	Target environment is MS-DOS client
/env dos	Target environment is MS-DOS client
/env mac	Target environment is Apple Macintosh
/env powermac	Target environment is Apple PowerMac
/env win16	Target environment is Microsoft Windows 16-bit (Win 3.x)
/env win32	Target environment is Microsoft Windows 32-bit (NT)
/mac	Target environment is Apple Macintosh
/ms_union	Use Midl 1.0 non-DCE wire layout for non-encapsulated unions
/oldnames	Do not mangle version number into names
/powermac	Target environment is Apple PowerMac
/rpcss	Automatically activate rpc_sm_enable_allocate
/use_epv	Generate server side application calls via entry-pt vector
/no_default_epv	Do not generate a default entry-point vector
/prefix client str	Add ‘‘str’’ prefix to client-side entry points
/prefix server str	Add ‘‘str’’ prefix to server-side manager routines
/prefix switch str	Add ‘‘str’’ prefix to switch routine prototypes
/prefix all str	Add ‘‘str’’ prefix to all routines
/win16	Target environment is Microsoft Windows 16-bit (Win 3.x)
/win32	Target environment is Microsoft Windows 32-bit (NT)

A.7 Error and Warning Messages

Switch	Use
/error none	Turn off all error checking options
/error allocation	Check for out of memory errors
/error bounds_check	Check size vs transmission length specification
/error enum	Check enum values to be in allowable range
/error ref	Check ref pointers to be non-null
/error stub_data	Emit additional check for server side stub data validity
/no_warn	Suppress compiler warning messages

A.8 Optimization

Switch	Use
/align {1|2|4|8}	Designate packing level of structures
/pack {1|2|4|8}	Designate packing level of structures
/Zp{1|2|4|8}	Designate packing level of structures
/Oi	Generate fully interpreted stubs
/Oic	Generate fully interpreted stubs for standard interfaces and stubless proxies for object interfaces as of NT 3.51 release
/Oicf	Generate fully interpreted stubs with extensions and stubless proxies for object interfaces as of NT 4.0 release
/Os	Generate inline stubs
/hookole	Generate HookOle debug info for local object interfaces

A.9 Miscellaneous

Switch	Use
@response_file	Accept input from a response file
/?	Display a list of MIDL compiler switches
/confirm	Display options without compiling MIDL source
/help	Display a list of MIDL compiler switches
/nologo	Suppress displaying of the banner lines
/o filename	Redirects output from screen to a file
/W{0|1|2|3|4}	Specify warning level 0-4 (default = 1)
/WX	Report warnings at specified **/W** level as errors

B
Troubleshooting

B.1 RPC Troubleshooting

When you perform a significant number of simultaneous NTLM authentications, the following errors are likely to occur. Several factors affect the number of simultaneous NTLM authentications, however, you are most likely to see these errors when the network is congested or when the RPC application server does not respond to requests in a timely manner. The errors are returned as standard RPC application return values.

Table B–1 provides a description of the suspected cause and possible workarounds.

Table B–1 RPC Errors

Error	Cause/Corrective Actions
RPC_S_CONNECTION_REJECTED	This error is seen by the client application as an exception when using either DECnet Phase IV or DECnet Phase V as a transport and when the server is heavily loaded servicing other DECnet clients. The system returns this error when the client RPC run time binds to a newly created socket and the socket call returns error 61 (connection refused). **Possible solutions:** 1. Raise DECnet resource quotas. 2. Enhance the client RPC program to catch the exception and either retry the RPC or choose a different server.

(continued on next page)

Table B–1 (Cont.) RPC Errors

Error	Cause/Corrective Actions
RPC_S_CONNECTION_TIMED_OUT	This error is seen by the client application as an exception when using TCP or DECnet as a transport and when the server is heavily loaded. The system returns this error when the client RPC run time binds to a newly created socket and the server takes too long to either accept or reject the connection. **Possible solutions:** 1. Configure TCP or DECnet to wait longer before sockets time out. 2. Enhance the RPC client application to call `rpc_mgmt_set_com_timeout()` and instruct the RPC run time to retry when it gets this socket error. 3. Recode the client RPC program to catch the exception and either retry the RPC or choose a different server.
RPC_S_ASSOC_SHUTDOWN	This error is seen by the client application as an exception when using TCP or DECnet as a transport and when the client is heavily loaded (usually when the client is also an RPC server). After an RPC server receives an RPC_BIND packet from a client and the server sends back an RPC_BIND_ACK packet to the client, the server expects to receive a `REQUEST` packet within 12 seconds. If the client does not send the `REQUEST` packet within 12 seconds, the RPC server deletes the association and sends a `SHUTDOWN` packet to the client. The client RPC run time raises an exception to the RPC application. This scenario is likely to occur when the client RPC application is also acting as an RPC server and that RPC server is already heavily loaded. **Possible solutions:** 1. Implement the client RPC program to catch the exception and either retry the RPC or choose a different server.

(continued on next page)

Table B–1 (Cont.) RPC Errors

Error	Cause/Corrective Actions
RPC_S_COMM_FAILURE	This error is seen by the client application as an exception when using DG (UDP) as a transport and when the RPC server is heavily loaded. The RPC client sends a `REQUEST` packet to the server. If the client does not get a `WORKING` packet response from the server within 30 seconds, the client sends a `PING` packet to the server to see if the server is still active and working on the client's request. If the RPC server is under heavy load, the server may not return the `WORKING` packet to the client before the client times out. **Possible solutions:** 1. RPC client application can call `rpc_mgmt_set_com_timeout()` to instruct the RPC run time to wait longer than 30 seconds before timing out. 2. Implement the client RPC program to catch the exception and either retry the RPC or choose a different server.

B.2 Troubleshooting the ACME server

Use the following procedure to troubleshoot problems with the ACME server:

1. Verify that the ACME_SERVER process is running (use the `SHOW SERVER ACME` command) and verify there is a connection between the MSV1_0 ACME agent and the Advanced Server for OpenVMS process.
2. If no connection exists, verify that the PWRK$ACME_SERVER logical name contains the SCS node names of systems in the cluster that are running the Advanced Server for OpenVMS process.
3. If the PWRK$ACME_SERVER logical name is defined correctly, verify that the Advanced Server for OpenVMS process is running on the systems specified (look for the `PWRK$LMSRV` process).
4. If authentications are failing, check the following:
   - Interdomain authentication (EASTOSHKOSK\JOE) requires trust relationships. Use the Advanced Server for OpenVMS ADMINISTER ADD TRUST[/TRUSTED] or [/PERMITTED] command to establish the desired trust relationships between two domains.
   - Windows NT passwords are case sensitive. Be sure you have entered the passwords using the correct case.
   - Windows NT user either has no OpenVMS hostmap account or maps to an invalid OpenVMS account (the default UAF mapping is PWRK$DEFAULT, which has DISUSER flag set). Use the Advanced Server for OpenVMS ADMINISTER ADD HOSTMAP command to map the Windows NT user name to a valid OpenVMS account.

- Windows NT user account is invalid, expired, disabled, or has an invalid password. Use the Advanced Server for OpenVMS ADMINISTER SHOW USER/FULL command to display the complete user account information. Use the Advanced Server for OpenVMS ADMINISTER SHOW ACCOUNT POLICY command to display the domain policy information.
- OpenVMS account does not have EXTAUTH flag set. In AUTHORIZE, use the UAF utility MODIFY *user-name*/FLAG=EXTAUTH command. (You can override this requirement by setting the IGNORE_EXTAUTH bit (bit number 11 [decimal]) in the SECURITY_POLICY system parameter.)
- UAF record flag is set to DISUSER. In AUTHORIZE, use the UAF utility MODIFY *user-name*/FLAG=NODISUSER command.
- UAF record modal restrictions prevent ''login'' (check local dialup, remote, network, and batch access restrictions). In AUTHORIZE, use the UAF utility MOD *user-name*/LOCAL (or DIALUP, BATCH, NETWORK,REMOTE) keywords; INTERACTIVE sets LOCAL, DIALUP, and REMOTE access restrictions.
- Intrusion subsystem has entered break-in evasion mode because the number of failed logins has exceeded the system threshold (set by SYSGEN parameter LGI_BRK_LIM). Use the SHOW INTRUSION command to view the intrusion database. Use the DELETE/INTRUSION *source* command to remove entries from the database. If the LGI_BRK_ DISUSER is set, the UAF record may be set to DISUSER. Use the OpenVMS AUTHORIZE command to reset the flag.

B.3 Troubleshooting the DCOM$RPCSS Process

The DCOM$RPCSS process must be running to run any *COM for OpenVMS* applications on your OpenVMS system. The DCOM$STARTUP.COM command file is automatically starts this process. If you have problems running *COM for OpenVMS* applications, check that this process is running. Use the following command:

```
$ SHOW SYSTEM
```

If the process is initializing, the process name is DCOM$STARTUP-**. If the process is in its normal running state, the process name is be DCOM$RPCSS.

Check the SYS$MANAGER:DCOM$RPCSS.OUT log file for error messages from the DCOM$RPCSS process. The messages can include the following:

- `%ACME-E-PWDEXPIRED, password has expired`

  If the DCOM$RPCSS log file contains this error, do the following:

  1. Run the Advanced Server for OpenVMS ADMIN utility and to change the password of the DCOM$RPCSS account. See Section 6.2.1.
  2. Update the *COM for OpenVMS* Service Control Manager password file. See Section 6.2.1.

B.4 Troubleshooting the Advanced Server for OpenVMS

The Advanced Server for OpenVMS must be running to authenticate users with NT credentials.

A troubleshooter may wish to enable the audit policy to capture failures for logonoff and system events. For example, on systems running Advanced Server for OpenVMS, issue the command:

```
$ ADMINISTER SET AUDIT POLICY/AUDIT/FAILURE=(LOGONOFF,SYSTEM)
```

To monitor events, issue the commands:

```
$ ADMINISTER SHOW EVENT /FULL /TYPE=SYSTEM
$ ADMINISTER SHOW EVENT /FULL /TYPE=SECURITY
```

For more information, the *Advanced Server for OpenVMS Server Administrator's Guide* provides a chapter on Monitoring Events and Troubleshooting.

Additionally, the system manager may want to check the system operator log, SYSMANAGER:OPERATOR.LOG, to verify that no network errors have occurred.

B.5 Troubleshooting COM for OpenVMS Application Failures

This section describes problems you may encounter when running a COM application.

B.5.1 Access Denied Failures

For information on access denied failures, see Section 5.4.6.

C

Cookbook Examples: Building a Sample Application on OpenVMS

Note

SAMPLE1 and DISPATCH_SAMPLE1 are taken from Dale Rogerson's book, *Inside COM*, published by Microsoft Press.

C.1 COM Example (Sample1)

This sample implements a COM client and server in which the component provides two interfaces: IX and IY. The client also queries the component for a third interface, IZ, an interface that the component does not provide.

This sample demonstrates connectivity between two OpenVMS systems, between two Windows NT systems, or between an OpenVMS system and a Windows NT system.

Note

Before you build the application on OpenVMS, you must run NTA$LOGON and acquire Windows NT credentials. For more information, see Section 8.2.

C.1.1 OpenVMS Instructions

The following sections describe how to build the application on an OpenVMS system.

C.1.1.1 Building the Application on OpenVMS

Copy files from the DCOM examples directory to your local directory. For example:

```
$ set default mydisk:[mydirectory]
$ copy dcom$examples:[sample1]*.* []
```

To build the application, run the following command procedure:

```
$ @build_sample1
```

If you have MMS, you can use the included description file as follows:

```
$  MMS/DESCRIPTION=BUILD_SAMPLE1.MMS
```

The BUILD file builds and registers both the in-process and out-of-process servers.

C.1.1.2 Registering the Application on OpenVMS

The build procedure automatically registers both DISPCMPNT$SHR.EXE and DISPCMPNT.EXE. To register the components manually, use the following procedure:

- To register the in-process server, use the REGSVR32 utility as follows:

```
$ regsvr32 :== $DCOM$REGSVR32.EXE
$ regsvr32 path-nameDISPCMPNT$SHR.EXE
```

- To unregister the in-process server, use the REGSVR32 utility as follows:

```
$ regsvr32 /u path-nameDISPCMPNT$SHR.EXE
```

- To register the out-of-process server:

```
$ dispcmpnt :== $path-nameDISPCMPNT.EXE
$ dispcmpnt /regserver
```

- To unregister the out-of-process server:

```
$ dispcmpnt /unregserver
```

- To register the Proxy Stub, use the REGSVR32 utility as follows:

```
$ regsvr32 path-namePROXY$SHR.EXE
```

- To unregister the Proxy Stub, use the REGSVR32 utility as follows:

```
$  regsvr32 /u path-namePROXY$SHR.EXE
```

C.1.1.3 Running the Application on OpenVMS as an Out-of-Process Server

To run the sample where the component is an out-of-process server, run DISPCMPNT.EXE. When the system displays the Server: Waiting message from the component, run the client in a separate window or terminal session.

- Window (or terminal session) 1:

```
$ run dispcmpnt
```

- Window (or terminal session) 2:

```
$ client :== $path-nameCLIENT.EXE
For OutProc:
$ client
2
$
```

The client displays the following:

```
To which server do you want to connect?
 1) In-Process Server
 2) Out-of-Process Server
 :
```

Enter 2 to select the out-of-process server.

C.1.1.4 Running the Application on OpenVMS and Specifying a Remote Server

Run DISPCMPNT.EXE on the system you designate as the remote machine (or server system). The remote system can also be a Windows NT system. When you receive the Server: Waiting message from the component, run the client on the system you designate as the local machine (or client system). For example:

```
$ client :== $path-nameCLIENT.EXE
$ client remote-system-name
2
$
```

The client displays the following:

```
To which server do you want to connect?
 1) In-Process Server
 2) Out-of-Process Server
 :
```

Enter 2 to select remote server execution, out-of-process server.

C.1.1.5 Running the Application on OpenVMS as an In-Process Server

To run the sample where the component is an in-process server, run only the client. For example:

```
For InProc:
$ client
1
$
```

The client displays the following:

```
To which server do you want to connect?
 1) In-Process Server
 2) Out-of-Process Server
 :
```

Enter 1 to select the in-process server.

C.1.2 Windows NT Instructions

The following sections describe how to build the application on a Windows NT system.

Note

In order to build Visual C++ applications from a DOS window, you must first set up a number of environment variables. If you did not select the option to have these variables set up automatically when you installed Visual C++, you will need to set them up each time you create a DOS window. To set up these variables, execute the file

```
C:\Program Files\Microsoft Visual Studio\VC98\BIN\VCVARS32.BAT
```

C.1.2.1 Building the Application on Windows NT

Copy the `README-SAMPLE1.TXT` file and the following files from the COM examples directory to your Windows NT system:

```
CLIENT.CXX
DCLIENT.CXX
DISPCMPNT.CXX
DISPCMPNT.DEF
DISPCMPNT.IDL
MAKE-ONE.
MAKEFILE.BAT
REGISTRY.CXX
REGISTRY.H
```

Build the sample using the `MAKEFILE.BAT` file. For example:

```
> MAKEFILE
```

The Makefile builds and registers both the in-process and out-of-process servers.

C.1.2.2 Registering the Application on Windows NT

The build procedure make-one automatically registers DISPCMPNT.DLL, PROXY.DLL, and CMPNT.EXE as follows:

```
regsvr32 -s Dispcmpnt.dll
regsvr32 -s Proxy.dll
Dispcmpnt /RegServer
```

To unregister the application, enter the following:

```
regsvr32 -u Dispcmpnt.dll
regsvr32 -u Proxy.dll
Dispcmpnt /UnRegServer
```

C.1.2.3 Running the Application on Windows NT

Run CLIENT. Follow the same procedure as described for OpenVMS for running the application as an in-process server (Section C.1.1.5) and out-of-process server Section C.2.1.3).

Use the name of a remote machine (UNC or DNS) as an argument to instantiate the object on the remote machine. For example:

```
>Client hostname        ! point the client at the remote system
2                       ! means outproc invocation
>
```

C.2 Automation Example (Dispatch_Sample1)

This sample implements the Automation component server as a dual interface. There are two separate clients: Dclient, which connects to the dual interface through the dispinterface, and Client, which is a COM client implementation that connects through the IUnknown interface (using a v-table).

This sample demonstrates connectivity between two OpenVMS systems, between two Windows NT systems, or between an OpenVMS system and a Windows NT system.

C.2.1 OpenVMS Instructions

The following sections describe how to build the application on an OpenVMS system.

C.2.1.1 Building the Application on OpenVMS

Copy files from the DCOM examples directory to your local directory. For example:

```
$ set default mydisk:[mydirectory]
$ copy dcom$examples:[dispatch_sample1]*.* []
```

To build the application, run the following command procedure:

```
$ @build_dispatch_sample1
```

If you have MMS, you can use the included description file as follows:

```
$  MMS/DESCRIPTION=BUILD_DISPATCH_SAMPLE1.MMS
```

The BUILD file builds and registers both the in-process and out-of-process servers.

C.2.1.2 Registering the Application on OpenVMS

The build procedure automatically registers both DISPCMPNT$SHR.EXE and DISPCMPNT.EXE. To register the components manually, use the following procedure:

- To register the in-process server, use the REGSVR32 utility as follows:

```
$ regsvr32 :== $DCOM$REGSVR32.EXE
$ regsvr32 path-nameDISPCMPNT$SHR.EXE
```

- To unregister the in-process server, use the REGSVR32 utility as follows:

```
$ regsvr32 /u path-nameDISPCMPNT$SHR.EXE
```

- To register the out-of-process server:

```
$ dispcmpnt :== $path-nameDISPCMPNT.EXE
$ dispcmpnt /regserver
```

- To unregister the out-of-process server:

```
$ dispcmpnt /unregserver
```

C.2.1.3 Running the Application on OpenVMS as an Out-of-process Server

To run the sample where the component is an out-of-process server, run DISPCMPNT.EXE.

When the system displays the Server: Waiting message from the component, run the client in a separate window or terminal session.

- Window (or terminal session) 1:

```
$ run dispcmpnt
```

- Window (or terminal session) 2:
  - For dispatch client:

```
$ run dclient
```

  - For COM client:

```
$ run client
```

The client displays the following:

```
To which server do you want to connect?
 1) In-Process Server
 2) Out-of-Process Server
 :
```

Enter 2 to select the out-of-process server.

C.2.1.4 Running the Application on OpenVMS and Specifying a Remote Server

Run DISPCMPNT.EXE on the system you designate as the remote machine (or server system). The remote system can also be a Windows NT system. When you receive the Server: Waiting message from the component, run the client on the system you designate as the local machine (or client system). For example:

To use the COM client, enter the following:

```
$ client :== $path-nameCLIENT.EXE
$ client remote-system-name
To which server do you want to connect?
 1) In-Process Server
 2) Out-of-Process Server
 :
```

Enter 2 to select remote server execution, out-of-process server.

C.2.1.5 Running the Application on OpenVMS as an In-Process Server

To run the sample where the component is an in-process server, run only the client. For example:

- For dispatch client:

```
$ run dclient
```

- For COM client:

```
$ run client
```

The client displays the following:

```
To which server do you want to connect?
 1) In-Process Server
 2) Out-of-Process Server
 :
```

Enter 1 to select the in-process server.

C.2.2 Windows NT Instructions

The following sections describe how to build the application on a Windows NT system.

Note

In order to build Visual C++ applications from a DOS window, you must first set up a number of environment variables. If you did not select the option to have these variables set up automatically when you installed Visual C++, you will need to set them up each time you create a DOS window. To set up these variables, execute the file

```
C:\Program Files\Microsoft Visual Studio\VC98\BIN\VCVARS32.BAT
```

C.2.2.1 Building the Application on Windows NT

Copy the README-DISPATCH-SAMPLE1.TXT file and the following files from the COM examples directory to your Windows NT system:

```
CLIENT.CXX
DCLIENT.CXX
DISPCMPNT.CXX
DISPCMPNT.DEF
DISPCMPNT.IDL
MAKE-ONE.
MAKEFILE.BAT
REGISTRY.CXX
REGISTRY.H
```

Build the sample using the MAKEFILE.BAT file. For example:

```
C:> MAKEFILE
```

The Makefile builds and registers both the in-process and out-of-process servers.

C.2.2.2 Registering the Application on Windows NT

The build procedure `make-one` automatically registers `DISPCMPNT.DLL`, `PROXY.DLL`, and `DISPCMPNT.EXE` as follows:

```
regsvr32 -s Dispcmpnt.dll
Dispcmpnt /RegServer
```

To unregister the application, enter the following:

```
regsvr32 -u Dispcmpnt.dll
Dispcmpnt /UnRegServer
```

C.2.2.3 Running the Application on Windows NT

Run `DCLIENT` or `CLIENT`. Follow the same procedure as described for OpenVMS for running the application as an in-process server (Section C.2.1.5) and an out-of-process server (Section C.2.1.3).

Use the name of a remote machine (UNC or DNS) as an argument to instantiate the object on the remote machine.

C.3 Cross-Domain Security Example (CLIENTAUTH)

This sample shows how you can authenticate a remote client that is not in the server's domain or in a domain that has a trust with the server's domain. The client must pass to this application the credentials (user name, domain and password) of an account on the server's domain that is allowed access and launch permissions. In fact, the client need not be in any domain and can be anywhere on the network. This is demonstrated in Section C.3.1.3.

C.3.1 OpenVMS Instructions

The following sections describe how to build the application on an OpenVMS system.

Note

Not all functionality is present in the underlying Windows NT infrastructure on OpenVMS. Therefore, you cannot currently run the client on OpenVMS. This sample works when you run the client on Windows NT and the server on OpenVMS.

Copy files from the DCOM examples directory to your local directory.

```
$ set default mydisk:[mydirectory]
$ copy dcom$examples:[clientauth]*.* []
```

To build the application, run the command procedure:

```
$ @build_clientauth
```

The BUILD file builds and registers both the in-process and out-of-process servers.

C.3.1.1 Registering the Application on OpenVMS

PROXY$SHR.EXE, CLIENTAUTH$SHR.EXE, and CLIENTAUTH.EXE are registered automatically by the build procedure. To register the application manually, use the following procedure:

- To register the in-process server, use the REGSVR32 utility provided:

```
$ regsvr32 :== $DCOM$REGSVR32.EXE
$ regsvr32 <path-name>CLIENTAUTH$SHR.EXE
$ regsvr32 <path-name>PROXY$SHR.EXE
```

- To unregister the in-process server:

```
$ regsvr32 /u <path-name>CLIENTAUTH$SHR.EXE
$ regsvr32 /u <path-name>PROXY$SHR.EXE
```

- To register the out-of-process server:

```
$ clientauth :== $<path-name>CLIENTAUTH.EXE
$ clientauth /regserver
```

- To unregister the out-of-process server:

```
$ clientauth /unregserver
```

C.3.1.2 Running the Application on OpenVMS as an Out-of-Process Server

To run the sample where the component is an out-of-process server, run CLIENTAUTH.EXE. When you receive the server waiting message from the component, run the client (in a separate window or terminal session).

- Window (or terminal session) 1:

```
$ run clientauth
```

- Window (or terminal session) 2:

```
$ client :== $<path-name>CLIENT.EXE
For OutProc:
$ client
2
$
```

The client will ask whether you want to start an in-process server or an out-of-process server. Select out-of-process server.

C.3.1.3 Running the Application on OpenVMS and Specifying a Remote Server

Run CLIENTAUTH.EXE on the system you designate as the remote machine, or server system. The remote system can also be a Windows NT system. When you receive the server waiting message from the component, run the client on the system you designate as the local machine, or client system.

```
$ client :== $<path-name>CLIENT.EXE
$ client <remote-system-name>
2
$ Please enter account to use on remote machine:
$ Username:
$ Domain:
$ Password:
```

The client will ask whether you want to start an in-process server or an out-of-process server. For remote server execution, select out-of-process server. You will then be prompted to enter the user name, domain and password of an account on the remote server. Make sure this account has been granted access and launch permissions to the component (see Section 6.3.2).

C.3.1.4 Running the Application on OpenVMS as an In-Process Server

To run the sample where the component is an in-process server, run only the client:

```
For InProc:
 $ client
 1
 $
```

The client will ask whether you want to start an in-process server or an out-of-process server. Select in-process server.

C.3.2 Windows NT Instructions

The following sections describe how to build the application on a Windows NT system.

Note

In order to build Visual C++ applications from a DOS window, you must first set up a number of environment variables. If you did not select the option to have these variables set up automatically when you installed Visual C++, you will need to set them up each time you create a DOS window. To set up these variables, execute the file

```
C:\Program Files\Microsoft Visual Studio\VC98\BIN\VCVARS32.BAT
```

C.3.2.1 Building the Application on Windows NT

Copy this file `README-CLIENTAUTH.TXT` and the following files from the DCOM examples directory to your Windows NT system:

```
CLIENT.CXX
CLIENTAUTH.CXX
CLIENTAUTH.DEF
CLIENTAUTH.IDL
GUIDS.CXX
MAKE-ONE.
MAKEFILE.BAT
PROXY.DEF
REGISTRY.CXX
REGISTRY.H
```

Build the sample using the `MAKEFILE.BAT` file.

```
> MAKEFILE
```

The Makefile builds and registers both the in-process and out-of-process servers.

C.3.2.2 Registering the Application on Windows NT

`CLIENTAUTH.DLL`, `PROXY.DLL`, and `CLIENTAUTH.EXE` are registered automatically by the build procedure <make-one>:

```
regsvr32 -s clientauth.dll
regsvr32 -s Proxy.dll
clientauth /RegServer
```

To unregister:

```
regsvr32 -u clientauth.dll
regsvr32 -u Proxy.dll
clientauth /UnRegServer
```

C.3.2.3 Running the Application on Windows NT

Run CLIENT. Follow the same procedure as described for OpenVMS for running application as in-process and out-of-process (see Section C.3.1.2 and Section C.3.1.4).

Do not use command line arguments to instantiate the object on the current machine. Use the name of a remote machine (UNC or DNS) as an argument to instantiate the object on the remote machine.

```
(i.e) >Client hostname        ! point the client at the remote system
      2                       ! means outproc invocation
      >
      >Username:
      >Domain:
      >Password:
```

D

Upgrading to COM Version 1.1-B for OpenVMS from COM Version 1.0 for OpenVMS

D.1 Upgrading from Earlier Versions of COM for OpenVMS

The following sections describe tasks you must complete when upgrading from a previous version of *COM for OpenVMS*.

D.1.1 Rebuild Existing COM for OpenVMS Applications

If your *COM for OpenVMS* applications include references to any of the following APIs, you must recompile the modules that include the references and relink the application:

```
LoadLibraryA
LoadLibraryW
LoadLibraryExW
LoadLibraryExA
GetModuleFileNameA
GetModuleFileNameW
GetModuleHandleW
GetProcAddress
FreeLibrary
```

Some sample COM applications that shipped with *COM Version 1.0 for OpenVMS* include references to these APIs in the modules REGISTRY and CMPNT. If you built any samples, or if you built your own COM applications based on these samples, you should recompile and relink those applications.

D.1.2 Configuring the Windows NT Systems

For *COM Version 1.0 for OpenVMS* (unauthenticated COM) the *COM for OpenVMS* documentation instructed you to change specific values in your Windows NT registry to allow unauthenticated *COM for OpenVMS* to interoperate with Windows NT. *COM Version 1.1-A for OpenVMS* and *COM Version 1.1-B for OpenVMS* support authentication. As a result, you must set or reset the Windows NT Registry values we asked you to change for *COM Version 1.0 for OpenVMS* back to their default authenticated settings. To set the Windows NT Registry values, use the following procedure:

1. Start the Windows NT Registry editor.
2. Select the following registry key:

   ```
   HKEY_LOCAL_MACHINE\Software\Microsoft\Ole
   ```

3. Delete the following value names and value data:

Value name	Recommended COM V1.0 setting	Default (Authenticated) Value data (COM V1.1-B setting)	Registry type
ActivationSecurity	N	Remove	REG_SZ
PersonalClasses	N	Remove	REG_SZ

4. Verify the **Default Authentication Level** and **Default Impersonation Level** and change if necessary. Use the following procedure:

Note

You must have Windows NT Administrator privileges to view and update these settings.

a. From the **Start** menu, choose **Run...**

b. In the Run dialog box, enter `dcomcnfg`.

The system displays the *Distributed COM Configuration Properties* sheet.

c. Click the **Default Properties** tab.

- The *Default Authentication Level* list box should display **Connect**. If it does not, click the list box arrow and select **Connect** from the list.
- The *Default Impersonation Level* list box should display **Identity**. If it does not, click the list box arrow and select **Identity** from the list.

5. You must reboot the Windows NT system for these changes to take effect.

D.1.3 Configuring the OpenVMS System

On OpenVMS systems, you must set or reset the specific OpenVMS Registry values. You can use the Windows NT Registry editor to edit the OpenVMS Registry, or you can use the REG$CP utility. To set the OpenVMS Registry values, use the following procedure:

1. Select the following OpenVMS Registry key:

```
HKEY_LOCAL_MACHINE\Software\Microsoft\Ole
```

2. Delete the `ActivationSecurity`, `PersonalClasses`, `LegacyAuthenticationLevel`, and `LegacyImpersonationLevel` keys. Use the following commands to delete the keys:

```
$ MCR REG$CP
REG> LIST VALUE HKEY_LOCAL_MACHINE\Software\Microsoft\Ole
REG> DELETE VALUE HKEY_LOCAL_MACHINE\Software\Microsoft\Ole ActivationSecurity
REG> DELETE VALUE HKEY_LOCAL_MACHINE\Software\Microsoft\Ole PersonalClasses
REG> DELETE VALUE HKEY_LOCAL_MACHINE\Software\Microsoft\Ole LegacyAuthenticationLevel
REG> DELETE VALUE HKEY_LOCAL_MACHINE\Software\Microsoft\Ole LegacyImpersonationLevel
REG> LIST VALUE HKEY_LOCAL_MACHINE\Software\Microsoft\Ole
REG> EXIT
```

D.2 Previously Configured Applications on Windows NT

If you configured an application to run with *COM Version 1.0 for OpenVMS* (unauthenticated *COM for OpenVMS*) on Windows NT, you might want to reconfigure the Windows NT settings to take advantage of *COM Version 1.1-B for OpenVMS* (authenticated *COM for OpenVMS*).

Under *COM Version 1.0 for OpenVMS* after you registered a component, the *COM for OpenVMS* documentation instructed you to check the security properties on that component to ensure that an unauthenticated user can activate the image. Use the following procedure:

1. From the Windows NT **Start** menu, choose **Run...**
2. In the Run dialog box, enter `dcomcnfg`.

   The system displays the *Distributed COM Configuration Properties* sheet.
3. Select the object by name from the Applications list, then click the **Properties...** button.

   The system displays the property sheet for the selected object.
4. From the property sheet, click the **Security** tab.

   - For *COM Version 1.0 for OpenVMS* you had to set the access permissions (Registry value `AccessPermission`) so that user **Everyone** was allowed access (**Allow access**).

     For *COM Version 1.1-B for OpenVMS*, you can set custom access permissions (Registry value `AccessPermission`) to a specific user.

     Click *Use custom access permissions* , then click the **Edit** button to display the **Registry Key Permissions** box.
   - For *COM Version 1.0 for OpenVMS* you had to set the launch permissions (Registry value `LaunchPermission`) so that user **Everyone** was allowed to launch the application server (**Allow launch**).

     For *COM Version 1.1-B for OpenVMS*, you can set the custom launch permissions (Registry value `LaunchPermission`) to remove **Everyone**.

     Click *Use custom access permissions* , then click the **Edit** button to display the **Registry Key Permissions** box.
   - For *COM Version 1.0 for OpenVMS* you had to set the configuration permissions so that user **Everyone** was allowed at least **Read** access to the Registry values.

     For *COM Version 1.1-B for OpenVMS*, you can set the custom configuration permissions to remove **Everyone**.

     Click *Use custom access permissions* , then click the **Edit** button to display the **Registry Key Permissions** box.

   Under *COM Version 1.0 for OpenVMS* after you set security properties, you had to set the identity of the account to run the application.

   For *COM Version 1.1-B for OpenVMS*, you can set the identity of the account to option 1 or 2.

   Click the **Identity** tab to display the user account selection. Select *The interactive user* option.

Upgrading to COM Version 1.1-B for OpenVMS from COM Version 1.0 for OpenVMS
D.2 Previously Configured Applications on Windows NT

D.2.1 You Must Repopulate the OpenVMS Registry for COM Version 1.1-B for OpenVMS

For *COM Version 1.1-B for OpenVMS*, you must repopulate the OpenVMS Registry to include security settings. Use the DCOM$SETUP command procedure to display the OpenVMS COM Tools menu, and choose option 3.

D.2.2 Changing Application Security Settings in the OpenVMS Registry

COM Version 1.0 for OpenVMS, which shipped with OpenVMS 7.2, did not support NTLM security. As a result, the OpenVMS account through which you (or the system) registered the *COM Version 1.0 for OpenVMS* COM application was the owner for any OpenVMS Registry keys created as part of the application registration. For example, using *COM Version 1.0 for OpenVMS*, if you logged into the SYSTEM account and registered the SAMPLE1 application, all SAMPLE1's OpenVMS Registry keys are owned by SYSTEM.

COM Version 1.1-B for OpenVMS supports NTLM security. The system now uses the network account to control access to the OpenVMS Registry keys. As a result of this change, previous security settings might prevent a nonprivileged user from accessing an application's registry keys. This means that a nonprivileged user working on an existing application might not be able to unregister or reregister an application.

To prevent this registration lockout, you must change the permission of the application. You can change the permission from either the Windows NT system or the OpenVMS system. Use either of the following procedures:

- Changing the permission from a Windows NT system

  1. From a Windows NT system, start RegEdt32.
  2. From the **Registry** menu, choose **Select Computer** and connect to the OpenVMS system that contains the OpenVMS Registry.
  3. Select the key associated with the application you want to change.
  4. From the **Security** menu, choose **Permissions...** and grant the user Full Control.
  5. Repeat the last two steps for each registry key associated with the application. For a list of COM application-related registry keys, see Section D.2.2.1.

- Changing the permission from an OpenVMS system

  1. Log into a privileged OpenVMS account.
  2. Unregister the application. Use the DCOM$REGSVR32 utility. See Example 6–5.
  3. Delete all registry keys associated with the application. For a list of COM application-related registry keys, see Section D.2.2.1.
  4. Log into the nonprivileged user account.
  5. Register the application. Use the DCOM$REGSVR32 utility (see Example 6–4), or from the OpenVMS COM Tools menu, choose option 6 (see Section 6.2).

D.2.2.1 COM Application Registry Keys

A COM application can have several registry keys associated with it. You must be sure to change all keys associated with the application. An application usually registers the following keys:

HKEY_CLASSES_ROOT\CLSID\{*guid*} and subkeys
HKEY_CLASSES_ROOT\APPID\{*guid*}
HKEY_CLASSES_ROOT\APPID*filename*
HKEY_CLASSES_ROOT\TYPELIB\{*typelib guid*}
HKEY_CLASSES_ROOT\INTERFACES\{*interface guid(s)*} and subkeys
HKEY_CLASSES_ROOT*name* and subkeys
HKEY_CLASSES_ROOT*version independent name* and subkeys

Note

HKEY_CLASSES_ROOT is an alias for HKEY_LOCAL_MACHINE\SOFTWARE\Classes. If you connect to the OpenVMS Registry from Windows NT using Regedt32 and you want to edit the HKEY_CLASSES_ROOT key, edit the HKEY_LOCAL_MACHINE\SOFTWARE\Classes key.

E

Running COM Version 1.1-B for OpenVMS in an Unauthenticated Mode

COM Version 1.1-B for OpenVMS includes an option that allows you to run the software in an unauthenticated environment in which NTLM support is not utilized. If you enable this option, only OpenVMS security semantics are used to control COM applications' access to resources. This is essentially the same behavior as in *COM Version 1.0 for OpenVMS*.

For a list of security differences between an unauthenticated implementation and an authenticated implementation of *COM for OpenVMS*, see Table 1–1.

Note

When you run *COM for OpenVMS* in unauthenticated mode, detached processes started by `DCOM$RPCSS` to run COM servers run in the context of the OpenVMS `DCOM$GUEST` account. These detached processes have the security attributes of the `DCOM$GUEST` account.

The following sections describes tasks you must complete in order to run *COM for OpenVMS* in an unauthenticated environment.

E.1 Installing COM V1.1-B for OpenVMS to Run in Unauthenticated Mode

If you are installing *COM for OpenVMS* for the first time, or if you are upgrading from an earlier version, perform the following steps:

- Follow the installation and upgrade procedures described in Chapter 4. **Note:** You can skip the steps relating to the installation, configuration, and startup of Advanced Server for OpenVMS.
- Follow the configuration procedures in Section E.2 to configure *COM for OpenVMS* in unauthenticated mode.

The ACME Server process is started automatically by RPC, but it is not required if you are in unauthenticated mode. To cause the ACME Server process to not start when the system reboots, edit the SYLOGICALS.COM file as follows:

```
$  DEFINE ACME$TO_BE_STARTED FALSE              ! ACME Server
```

E.2 Configuring COM V1.1-B for OpenVMS to Run in Unauthenticated Mode

The following section describes how to configure *COM Version 1.1-B for OpenVMS* to run in an unauthenticated environment.

Note

Before you begin configuring *COM for OpenVMS* for unauthenticated mode, make a note of your current Windows NT system default values and application settings. This makes returning to authenticated mode easier. (See Section E.5 for information on how to convert from unauthenticated mode to authenticated mode.)

E.2.1 Define the DCOM$UNAUTHENTICATED Logical Systemwide

Define `DCOM$UNAUTHENTICATED` to be "Y" or "YES" systemwide. If this logical is undefined or defined as any other value, *COM V1.1-B for OpenVMS* will run in the usual authenticated mode utilizing NTLM security.

To cause *COM for OpenVMS* to start automatically in unauthenticated mode when the system boots, edit the SYLOGICALS.COM file and add the following line:

```
$ DEFINE/SYSTEM DCOM$UNAUTHENTICATED YES
```

E.2.2 Populate the OpenVMS Registry

Use option 3 in the `DCOM$SETUP` utility to populate the OpenVMS Registry. (See Section 6.2 for more information.)

Note

If you are upgrading from *COM V1.1-A for OpenVMS*, you do not need to populate the OpenVMS Registry.

E.2.3 Create the DCOM$GUEST Account

Create the OpenVMS `DCOM$GUEST` account using option 7 in the `DCOM$SETUP` utility. (See Section 6.2 for more information.)

E.2.4 Create the DCOM$RPCSS Account

Create the OpenVMS `DCOM$RPCSS` account using option 8 in the `DCOM$SETUP` utility. (See Section 6.2 for more information.)

E.3 Configuring Windows NT to Interoperate with Unauthenticated COM

For COM objects to interoperate correctly between unauthenticated *COM V1.1-B for OpenVMS* systems and Windows NT, perform the steps described in the following sections. This will configure the COM objects to run without security enabled on the Windows NT system.

E.3.1 Setting the Windows NT Systemwide Authentication Level

On Windows NT systems, set the systemwide authentication level using this procedure:

1. Run DCOMCNFG on the Windows NT system.
2. Select the **Default Properties** tab.
3. Set the **Default Authentication Level** to **None**.

E.3.2 Setting Windows NT Application Security Properties

After a COM application has been registered, check the security properties on that application to ensure that an unauthenticated user can activate the image.

To do this, perform the following steps:

1. Run DCOMCNFG on the Windows NT system.
2. Select the application by name.
3. Click the **Properties** button.
4. Click the **Security** tab.

Set the access permissions (Registry value AccessPermission) so that user **Everyone** is allowed access (**Allow** access).

Set the launch permissions (Registry value LaunchPermission) so that user **Everyone** is allowed access (**Allow** access).

Set the configuration permissions so that user **Everyone** is allowed at least **Read** access to the Registry values.

E.3.3 Setting the Windows NT Application Security Identity

After you set security permissions, you must set the identity of the account to run the application. To do this, click the **Identity** tab, and select **The interactive user**.

E.4 Expected Failures from CLIENTAUTH Sample Program

While you are running *COM Version 1.1-B for OpenVMS* in unauthenticated mode, the Cross-Domain Security example (CLIENTAUTH) does not work because it requires NTLM authentication to be enabled.

E.5 Converting from Unauthenticated Mode to Authenticated Mode

If you performed the steps in this appendix to run *COM Version 1.1-B for OpenVMS* in unauthenticated mode and you now want to return to authenticated mode, perform the following steps.

1. Log in to the SYSTEM account.
2. Stop the COM server. Use option 5 in the DCOM$SETUP utility. (See Section 6.2 for more information.)
3. Edit SYLOGICALS.COM with the following changes:
   - Undefine the DCOM$UNAUTHENTICATED logical by entering:

```
$ DEFINE/SYSTEM DCOM$UNAUTHENTICATED NO
```

- Comment the following line, as shown:

```
$! DEFINE ACME$TO_BE_STARTED FALSE      ! ACME Server
```

4. Enter the following command:

```
$ DEFINE/SYSTEM DCOM$UNAUTHENTICATED NO
```

5. Install, configure, and start Advanced Server for OpenVMS, if it is not already present.
6. Repopulate the OpenVMS Registry.

   To do this, use option 3 in the DCOM$SETUP utility. (See Section 6.2 for more information.)
7. Add the DCOM$RPCSS account to include the Advanced Server for OpenVMS account and hostmap. Use option 8 in the DCOM$SETUP utility. (See Section 6.2 for more information.)
8. Reset your Windows NT system default values and application settings to the values that were set before you followed the procedure in Section E.3.
9. Start the COM server. Use option 4 in the DCOM$SETUP utility. (See Section 6.2 for more information.)
10. Update or add network accounts. (See Section 5.1 for more information.)

F

Lists of Differences, APIs, and Interfaces

This appendix contains a list of implementation differences between *COM for OpenVMS* and Microsoft COM as well as a list of APIs and interfaces provided in this release of *COM for OpenVMS*.

F.1 Differences between COM for OpenVMS and Microsoft COM

The following sections list important implementation differences between *COM for OpenVMS* and Microsoft's COM.

F.1.1 Service Control Manager (SCM)

OpenVMS does not provide an equivalent to the Windows NT Service Control Manager. As a result, applications that depend on Server services (such as stop, start, pause, and resume) rely on the OpenVMS features that provide similar functionality (if the features are available).

For example, you would use the OpenVMS site-specific startup and shutdown command procedures to implement automatic starting of services at system startup and automatic shutdown of services at system shutdown. Service APIs such as `RegisterServiceCtrlHandler`, `ChangeServiceConfig`, and so on, are not provided on OpenVMS.

F.1.2 Server Application Stack Size

In *COM for OpenVMS*, server application functions run in the context of server threads. As a result, server functions have a limited stack space of 48 KB. If you require additional space for local variables or structures, you should allocate dynamic memory for local variables or structures.

F.1.3 Use of the "char" Datatype

OpenVMS and Windows NT translate the IDL base data type ''char'' differently.

OpenVMS translates the data type as MIDL_CHAR, which is defined to be CHAR, and further defined to be ''char.'' The OpenVMS compiler by default takes this to be equivalent to ''unsigned char;'' in most cases they can be used interchangeably. The two are *not* the same—C++ treats them as different data types you specify them in class member definitions.

Windows NT translates the data type directly as ''unsigned char.'' This causes conflicts with Visual C++, which treats the ''char'' datatype as equivalent to ''signed char.'' As in OpenVMS, ''char'' is not the same as ''signed char'' in class member definitions.

There are two workarounds to this mismatch:

- Use the data type ''CHAR'' instead of ''char'' in the IDL file and all member definitions. This is the most portable solution; you can expect this to work on other systems (such as UNIX) as well.

- Conditionally compile the method definitions so that OpenVMS sees the object methods defined as ‘‘char’’ and Windows NT sees the methods defined as ‘‘unsigned char.’’

F.1.4 MIDL Compiler Version

The MIDL compiler supplied with *COM for OpenVMS* is based on Microsoft's MIDL compiler V3.00.44.

F.1.4.1 The OpenVMS MIDL Compiler

The OpenVMS MIDL compiler is identical to the Microsoft Interface Definition Language (MIDL) compiler V3.00.44 except for the following:

1. The Microsoft MIDL implementation supports several optimization levels. The OpenVMS MIDL implementation supports only `-Oicf`. Do not use any other optimization level.
2. The `/cpp_cmd` and `/cpp_opt` switches are not fully functional in the OpenVMS MIDL implementation.
3. On a Windows NT system, Microsoft MIDL commands, switches, and qualifiers are case sensitive. The OpenVMS MIDL compiler is not case sensitive; all commands, switches, and qualifiers passed to the OpenVMS MIDL compiler are lowercase. As a result, the Microsoft MIDL switches `/I` and `/i` are equivalent on OpenVMS.
4. MIDL-generated files are platform specific.

   You must run MIDL on both platforms. The MIDL output files generated on one platform (OpenVMS or Windows NT) cannot be copied and used on the other platform.
5. MIDL `-w` switch

   The Microsoft MIDL compiler allows you to specify either `-w` or `-warn` to limit the level of warnings generated by the compiler. The OpenVMS MIDL compiler supports only the `-w` switch.

F.1.5 Using DCOM$CNFG to Change Application Configuration Permission

Use the Application Security Submenu options 5 and 6 to change the OpenVMS Registry key permissions of some keys associated with an application. Option 5 and 6 affect the security settings of the following keys:

`HKEY_CLASSES_ROOT\APPID\{`*guid*`}`
`HKEY_CLASSES_ROOT\CLSID\{`*guid*`}` and subkeys

On Windows NT systems, the security settings of the subkeys under `HKEY_CLASSES_ROOT\CLSID\{`*guid*`}` are changed *only if the existing security settings match* the original settings of `HKEY_CLASSES_ROOT\APPID\{`*guid*`}`.

On OpenVMS systems, the settings of the subkeys are changed *even if the existing settings do not match* the original settings of `HKEY_CLASSES_ROOT\APPID\{`*guid*`}`.

Options 5 and 6 do not change the settings of all keys associated with an application. For example, options 5 and 6 do not affect the following keys:

`HKEY_CLASSES_ROOT\APPID\`*filename*
`HKEY_CLASSES_ROOT\TYPELIB\{`*typelib guid*`}`
`HKEY_CLASSES_ROOT\INTERFACES\{`*interface guid(s)*`}` and subkeys.
`HKEY_CLASSES_ROOT\`*name* and subkeys
`HKEY_CLASSES_ROOT\`*version independent name* and subkeys

To change the security settings of these keys, use the following procedure:

1. From a Windows NT system, start RegEdt32.
2. From the **Registry** menu, choose **Select Computer** and connect to the OpenVMS system that contains the OpenVMS Registry.
3. Select the key associated with the application you want to change.
4. From the **Security** menu, choose **Permissions...** and grant the user Full Control.
5. Repeat the last two steps for each registry key associated with the application (see the list of keys described earlier in this section).

Note

`HKEY_CLASSES_ROOT` is an alias for `HKEY_LOCAL_MACHINE\SOFTWARE\Classes`. If you connect to the OpenVMS Registry from Windows NT using Regedt32 and you want to edit the `HKEY_CLASSES_ROOT` key, edit the `HKEY_LOCAL_MACHINE\SOFTWARE\Classes` key.

F.2 APIs

APIs that require security support are not supported in *COM Version 1.0 for OpenVMS*.

The APIs supported in this release are as follows:

```
BindMoniker
BstrFromVector
CLSIDFromProgID
CLSIDFromString
CoAddRefServerProcess
CoCopyProxy
CoCreateErrorInfo
CoCreateFreeThreadedMarshaler
CoCreateGuid
CoCreateInstance
CoCreateInstanceEx
CoDisconnectObject
CoDosDateTimeToFileTime
CoFileTimeNow
CoFileTimeToDosDateTime
CoFreeAllLibraries
CoFreeLibrary
CoFreeUnusedLibraries
CoGetCallContext
CoGetClassObject
CoGetCurrentProcess
CoGetErrorInfo
CoGetInstanceFromFile
CoGetInstanceFromIStorage
CoGetInterfaceAndReleaseStream
CoGetMalloc
CoGetMarshalSizeMax
CoGetPSClsid
CoGetStandardMarshal
CoGetTreatAsClass
```

```
CoImpersonateClient
CoInitialize
CoInitializeEx
CoInitializeSecurity
CoIsHandlerConnected
CoLoadLibrary
CoLockObjectExternal
CoMarshalInterface
CoQueryAuthenticationServices
CoQueryClientBlanket
CoQueryProxyBlanket
CoRegisterChannelHook
CoRegisterClassObject
CoRegisterMallocSpy
CoRegisterMessageFilter
CoRegisterPSClsid
CoReleaseMarshalData
CoReleaseServerProcess
CoResumeClassObjects
CoRevertToSelf
CoRevokeClassObject
CoRevokeMallocSpy
CoSetErrorInfo
CoSetProxyBlanket
CoSuspendClassObjects
CoTaskMemAlloc
CoTaskMemFree
CoTaskMemRealloc
CoTreatAsClass
CoUninitialize
CoUnmarshalInterface
CreateAntiMoniker
CreateBindCtx
CreateClassMoniker
CreateDataAdviseHolder
CreateDispTypeInfo
CreateErrorInfo
CreateGenericComposite
CreateILockBytesOnHGlobal
CreateItemMoniker
CreatePointerMoniker
CreateStdDispatch
CreateStreamOnHGlobal
CreateTypeLib
DispGetIDsOfNames
DispGetParam
DispInvoke
DllCanUnloadNow
DllGetClassObject
DllGetClassObject
DllMain
DllRegisterServer
DllUnregisterServer
DosDateTimeToVariantTime
FreePropVariantArray
GetActiveObject
GetAltMonthNames
GetClassFile
GetConvertStg
GetErrorInfo
GetHGlobalFromILockBytes
GetHGlobalFromStream
GetRunningObjectTable
IIDFromString
IsEqualCLSID
```

```
IsEqualGUID
IsEqualIID
IsValidIid
IsValidInterface
IsValidPtrIn
IsValidPtrOut
LHashValOfName
LHashValOfNameSys
LoadRegTypeLib
LoadTypeLibEx
MkParseDisplayName
MonikerCommonPrefixWith
MonikerRelativePathTo
ProgIDFromCLSID
PropStgNameToFmtId
PropVariantClear
PropVariantCopy
QueryPathOfRegTypeLib
ReadClassStg
ReadClassStm
ReadFmtUserTypeStg
RegisterActiveObject
RegisterTypeLib
ReleaseStgMedium
RevokeActiveObject
SafeArrayAccessData
SafeArrayAllocData
SafeArrayAllocDescriptor
SafeArrayCopy
SafeArrayCopyData
SafeArrayCreate
SafeArrayCreateVector
SafeArrayDestroy
SafeArrayDestroyData
SafeArrayDestroyDescriptor
SafeArrayGetDim
SafeArrayGetElement
SafeArrayGetElemsize
SafeArrayGetLBound
SafeArrayGetUBound
SafeArrayLock
SafeArrayPtrOfIndex
SafeArrayPutElement
SafeArrayRedim
SafeArrayUnaccessData
SafeArrayUnlock
SetConvertStg
SetErrorInfo
StgCreateDocfile
StgCreateDocfileOnILockBytes
StgCreatePropSetStg
StgCreatePropStg
StgIsStorageFile
StgIsStorageILockBytes
StgOpenPropStg
StgOpenStorage
StgOpenStorageOnILockBytes
StgSetTimes
StringFromCLSID
StringFromGUID2
StringFromIID
SysAllocString
SysAllocStringByteLen
SysAllocStringLen
SysFreeString
```

```
SysReAllocString
SysReAllocStringLen
SysStringByteLen
SysStringLen
SystemTimeToVariantTime
UnRegisterTypeLib
VarDateFromUdate
VarNumFromParseNum
VarParseNumFromStr
VarUdateFromDate
VariantChangeType
VariantChangeTypeEx
VariantClear
VariantCopy
VariantCopyInd
VariantInit
VariantTimeToDosDateTime
VariantTimeToSystemTime
VectorFromBstr
WriteClassStg
WriteClassStm
WriteFmtUserTypeStg
```

F.3 Interfaces

The interfaces supported in this release are as follows:

```
IAdviseSink
IBindCtx
IClassActivator
IClassFactory
IConnectionPoint
IConnectionPointContainer
ICreateErrorInfo
ICreateTypeInfo
ICreateTypeLib
IDataAdviseHolder
IDataObject
IDispatch
IEnumCallBack
IEnumConnectionPoints
IEnumConnections
IEnumFORMATETC
IEnumMoniker
IEnumOLEVerb
IEnumSTATDATA
IEnumSTATPROPSETSTG
IEnumSTATSTG
IEnumString
IEnumUnknown
IEnumVariant
IErrorInfo
IExternalConnection
ILockBytes
IMalloc
IMallocSpy
IMarshal
IMessageFilter
IMoniker
IMultiQI
IParseDisplayName
IPersist
IPersistFile
IPersistStorage
IPersistStream
```

IPropertySetStorage
IPropertyStorage
IRootStorage
IRunnableObject
IRunningObjectTable
IStdMarshalInfo
IStorage
IStream
ISupportErrorInfo
ITypeComp
ITypeInfo
ITypeInfo2
ITypeLib
ITypeLib2
IUnknown

G

List of Files Installed by COM for OpenVMS

G.1 Files Installed by COM for OpenVMS

The following files are installed as part of the *COM for OpenVMS* installation process:

```
[000000]DEC-AXPVMS-DCOM-V0101-B-1.PCSI$TLB
[DCOM$LIBRARY]ATLBASE.H
[DCOM$LIBRARY]ATLCOM.H
[DCOM$LIBRARY]ATLCONV.CPP
[DCOM$LIBRARY]ATLCONV.H
[DCOM$LIBRARY]ATLDEF.H
[DCOM$LIBRARY]ATLIFACE.H
[DCOM$LIBRARY]ATLIFACE.IDL
[DCOM$LIBRARY]ATLIMPL.CPP
[DCOM$LIBRARY]ATLMAIN.CXX
[DCOM$LIBRARY]CDERR.H
[DCOM$LIBRARY]CGUID.H
[DCOM$LIBRARY]COGUID.H
[DCOM$LIBRARY]COMCAT.H
[DCOM$LIBRARY]COMCAT.IDL
[DCOM$LIBRARY]COMMDLG.H
[DCOM$LIBRARY]CONIO.H
[DCOM$LIBRARY]CRTDBG.H
[DCOM$LIBRARY]DCOM$GUIDGEN.CLD
[DCOM$LIBRARY]DCOM$REGDATA.REG
[DCOM$LIBRARY]DCOM$RUNSHRLIB.CLD
[DCOM$LIBRARY]DCOM.OPT
[DCOM$LIBRARY]DDE.H
[DCOM$LIBRARY]DDEML.H
[DCOM$LIBRARY]DLGS.H
[DCOM$LIBRARY]EXCPT.H
[DCOM$LIBRARY]IMM.H
[DCOM$LIBRARY]INITGUID.H
[DCOM$LIBRARY]LZEXPAND.H
[DCOM$LIBRARY]MCX.H
[DCOM$LIBRARY]MIDLES.H
[DCOM$LIBRARY]MIDL_STUB_TYPES.H
[DCOM$LIBRARY]MMSYSTEM.H
[DCOM$LIBRARY]NB30.H
[DCOM$LIBRARY]NTA_MESSAGE.H
[DCOM$LIBRARY]OAIDL.ACF
[DCOM$LIBRARY]OAIDL.H
[DCOM$LIBRARY]OAIDL.IDL
[DCOM$LIBRARY]OBJBASE.H
[DCOM$LIBRARY]OBJIDL.H
[DCOM$LIBRARY]OBJIDL.IDL
[DCOM$LIBRARY]OCIDL.ACF
[DCOM$LIBRARY]OCIDL.H
[DCOM$LIBRARY]OCIDL.IDL
[DCOM$LIBRARY]OLE2.H
[DCOM$LIBRARY]OLEAUTO.H
[DCOM$LIBRARY]OLECTL.H
[DCOM$LIBRARY]OLEIDL.H
```

List of Files Installed by COM for OpenVMS
G.1 Files Installed by COM for OpenVMS

```
[DCOM$LIBRARY]OLEIDL.IDL
[DCOM$LIBRARY]POPPACK.H
[DCOM$LIBRARY]PRSHT.H
[DCOM$LIBRARY]PSHPACK1.H
[DCOM$LIBRARY]PSHPACK2.H
[DCOM$LIBRARY]PSHPACK4.H
[DCOM$LIBRARY]PSHPACK8.H
[DCOM$LIBRARY]PTHREAD.H
[DCOM$LIBRARY]PTHREAD_EXCEPTION.H
[DCOM$LIBRARY]RPC.H
[DCOM$LIBRARY]RPCDCE.H
[DCOM$LIBRARY]RPCDCEP.H
[DCOM$LIBRARY]RPCNDR.H
[DCOM$LIBRARY]RPCNSI.H
[DCOM$LIBRARY]RPCNSIP.H
[DCOM$LIBRARY]RPCNTERR.H
[DCOM$LIBRARY]RPCPROXY.H
[DCOM$LIBRARY]SERVPROV.H
[DCOM$LIBRARY]SERVPROV.IDL
[DCOM$LIBRARY]SHELLAPI.H
[DCOM$LIBRARY]SHLWAPI.H
[DCOM$LIBRARY]STATREG.CPP
[DCOM$LIBRARY]STATREG.H
[DCOM$LIBRARY]STDOLE2.TLB
[DCOM$LIBRARY]STDOLE32.TLB
[DCOM$LIBRARY]TCHAR.H
[DCOM$LIBRARY]UNKNWN.H
[DCOM$LIBRARY]UNKNWN.IDL
[DCOM$LIBRARY]URLMON.H
[DCOM$LIBRARY]URLMON.IDL
[DCOM$LIBRARY]UUID.OLB
[DCOM$LIBRARY]VMS_ATL.H
[DCOM$LIBRARY]VMS_DCOM.H
[DCOM$LIBRARY]VMS_IOCTL.H
[DCOM$LIBRARY]WCHAR.H
[DCOM$LIBRARY]WINBASE.H
[DCOM$LIBRARY]WINCON.H
[DCOM$LIBRARY]WINDEF.H
[DCOM$LIBRARY]WINDOWS.H
[DCOM$LIBRARY]WINDU_PLATFORM.H
[DCOM$LIBRARY]WINDU_STDLIB.H
[DCOM$LIBRARY]WINDU_STRING.H
[DCOM$LIBRARY]WINDU_VTBL.H
[DCOM$LIBRARY]WINERROR.H
[DCOM$LIBRARY]WINGDI.H
[DCOM$LIBRARY]WINNETWK.H
[DCOM$LIBRARY]WINNLS.H
[DCOM$LIBRARY]WINNT.H
[DCOM$LIBRARY]WINPERF.H
[DCOM$LIBRARY]WINREG.H
[DCOM$LIBRARY]WINSOCK.H
[DCOM$LIBRARY]WINSPOOL.H
[DCOM$LIBRARY]WINSVC.H
[DCOM$LIBRARY]WINUSER.H
[DCOM$LIBRARY]WINVER.H
[DCOM$LIBRARY]WTYPES.H
[DCOM$LIBRARY]WTYPES.IDL
[DCOM$LIBRARY]WUEXTEN.H
[DCOM$LIBRARY]WUUNALIGNED.H
[DCOM$LIBRARY]WUVERSION.H
[DCOM$WIN32.NLS]BIG5.NLS
[DCOM$WIN32.NLS]CTYPE.NLS
[DCOM$WIN32.NLS]C_037.NLS
[DCOM$WIN32.NLS]C_10000.NLS
[DCOM$WIN32.NLS]C_10001.NLS
```

```
[DCOM$WIN32.NLS]C_10002.NLS
[DCOM$WIN32.NLS]C_10003.NLS
[DCOM$WIN32.NLS]C_10004.NLS
[DCOM$WIN32.NLS]C_10005.NLS
[DCOM$WIN32.NLS]C_10006.NLS
[DCOM$WIN32.NLS]C_10007.NLS
[DCOM$WIN32.NLS]C_10008.NLS
[DCOM$WIN32.NLS]C_10010.NLS
[DCOM$WIN32.NLS]C_10017.NLS
[DCOM$WIN32.NLS]C_10029.NLS
[DCOM$WIN32.NLS]C_10079.NLS
[DCOM$WIN32.NLS]C_10081.NLS
[DCOM$WIN32.NLS]C_10082.NLS
[DCOM$WIN32.NLS]C_1026.NLS
[DCOM$WIN32.NLS]C_1250.NLS
[DCOM$WIN32.NLS]C_1251.NLS
[DCOM$WIN32.NLS]C_1252.NLS
[DCOM$WIN32.NLS]C_1253.NLS
[DCOM$WIN32.NLS]C_1254.NLS
[DCOM$WIN32.NLS]C_1255.NLS
[DCOM$WIN32.NLS]C_1256.NLS
[DCOM$WIN32.NLS]C_1257.NLS
[DCOM$WIN32.NLS]C_1258.NLS
[DCOM$WIN32.NLS]C_1361.NLS
[DCOM$WIN32.NLS]C_20105.NLS
[DCOM$WIN32.NLS]C_20261.NLS
[DCOM$WIN32.NLS]C_20269.NLS
[DCOM$WIN32.NLS]C_20273.NLS
[DCOM$WIN32.NLS]C_20277.NLS
[DCOM$WIN32.NLS]C_20278.NLS
[DCOM$WIN32.NLS]C_20280.NLS
[DCOM$WIN32.NLS]C_20284.NLS
[DCOM$WIN32.NLS]C_20285.NLS
[DCOM$WIN32.NLS]C_20290.NLS
[DCOM$WIN32.NLS]C_20297.NLS
[DCOM$WIN32.NLS]C_20420.NLS
[DCOM$WIN32.NLS]C_20423.NLS
[DCOM$WIN32.NLS]C_20833.NLS
[DCOM$WIN32.NLS]C_20838.NLS
[DCOM$WIN32.NLS]C_20866.NLS
[DCOM$WIN32.NLS]C_20871.NLS
[DCOM$WIN32.NLS]C_20880.NLS
[DCOM$WIN32.NLS]C_20905.NLS
[DCOM$WIN32.NLS]C_21025.NLS
[DCOM$WIN32.NLS]C_21027.NLS
[DCOM$WIN32.NLS]C_28592.NLS
[DCOM$WIN32.NLS]C_28593.NLS
[DCOM$WIN32.NLS]C_28594.NLS
[DCOM$WIN32.NLS]C_28595.NLS
[DCOM$WIN32.NLS]C_28596.NLS
[DCOM$WIN32.NLS]C_28597.NLS
[DCOM$WIN32.NLS]C_28598.NLS
[DCOM$WIN32.NLS]C_28599.NLS
[DCOM$WIN32.NLS]C_29001.NLS
[DCOM$WIN32.NLS]C_437.NLS
[DCOM$WIN32.NLS]C_500.NLS
[DCOM$WIN32.NLS]C_708.NLS
[DCOM$WIN32.NLS]C_720.NLS
[DCOM$WIN32.NLS]C_737.NLS
[DCOM$WIN32.NLS]C_775.NLS
[DCOM$WIN32.NLS]C_850.NLS
[DCOM$WIN32.NLS]C_852.NLS
[DCOM$WIN32.NLS]C_855.NLS
[DCOM$WIN32.NLS]C_857.NLS
[DCOM$WIN32.NLS]C_860.NLS
```

G.1 Files Installed by COM for OpenVMS

```
[DCOM$WIN32.NLS]C_861.NLS
[DCOM$WIN32.NLS]C_862.NLS
[DCOM$WIN32.NLS]C_863.NLS
[DCOM$WIN32.NLS]C_864.NLS
[DCOM$WIN32.NLS]C_865.NLS
[DCOM$WIN32.NLS]C_866.NLS
[DCOM$WIN32.NLS]C_869.NLS
[DCOM$WIN32.NLS]C_870.NLS
[DCOM$WIN32.NLS]C_874.NLS
[DCOM$WIN32.NLS]C_875.NLS
[DCOM$WIN32.NLS]C_932.NLS
[DCOM$WIN32.NLS]C_936.NLS
[DCOM$WIN32.NLS]C_949.NLS
[DCOM$WIN32.NLS]C_950.NLS
[DCOM$WIN32.NLS]KSC.NLS
[DCOM$WIN32.NLS]LOCALE.NLS
[DCOM$WIN32.NLS]L_EXCEPT.NLS
[DCOM$WIN32.NLS]L_INTL.NLS
[DCOM$WIN32.NLS]PRC.NLS
[DCOM$WIN32.NLS]PRCP.NLS
[DCOM$WIN32.NLS]SORTKEY.NLS
[DCOM$WIN32.NLS]SORTTBLS.NLS
[DCOM$WIN32.NLS]UNICODE.NLS
[DCOM$WIN32.NLS]XJIS.NLS
[DCOM$WIN32]WINDU$GDISHR.EXE
[DCOM$WIN32]WINDU$KERNELSHR.EXE
[DCOM$WIN32]WINDU$PRNTSHR.EXE
[DCOM$WIN32]WINDU$USERSHR.EXE
[DCOM$WIN32]WINDU.INI
[DCOM$WIN32]WINDU.OPT
[SYS$STARTUP]DCOM$RPCSS.COM
[SYS$STARTUP]DCOM$SHUTDOWN.COM
[SYS$STARTUP]DCOM$STARTUP.COM
[SYSEXE]DCOM$CNFG.EXE
[SYSEXE]DCOM$COMREGEDT.EXE
[SYSEXE]DCOM$GUIDGEN.EXE
[SYSEXE]DCOM$MIDL.EXE
[SYSEXE]DCOM$REGSVR32.EXE
[SYSEXE]DCOM$RPCSS.EXE
[SYSEXE]DCOM$RUNSHRLIB.EXE
[SYSEXE]DCOM$SCLIENT.EXE
[SYSEXE]DCOM$SSERVER.EXE
[SYSEXE]DCOM$SSERVER_REG.COM
[SYSEXE]DCOM$TOOL.EXE
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]BUILD_CLIENTAUTH.COM
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]CLIENT.CXX
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]CLIENTAUTH$SHR.OPT
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]CLIENTAUTH.CXX
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]CLIENTAUTH.DEF
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]CLIENTAUTH.IDL
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]MAKE-ONE.
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]MAKEFILE.BAT
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]PROXY$SHR.OPT
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]PROXY.DEF
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]README-CLIENTAUTH.TXT
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]REGISTRY.CXX
[SYSHLP.EXAMPLES.DCOM.CLIENTAUTH]REGISTRY.H
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]BUILD_DISPATCH_SAMPLE1.COM
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]BUILD_DISPATCH_SAMPLE1.MMS
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]CLIENT.CXX
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]DCLIENT.CXX
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]DISPCMPNT$SHR.OPT
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]DISPCMPNT.CXX
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]DISPCMPNT.DEF
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]DISPCMPNT.IDL
```

```
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]MAKE-ONE.
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]MAKEFILE.BAT
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]README-DISPATCH-SAMPLE1.TXT
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]REGISTRY.CXX
[SYSHLP.EXAMPLES.DCOM.DISPATCH_SAMPLE1]REGISTRY.H
[SYSHLP.EXAMPLES.DCOM.EVENTS]BUILD_EVENTS_SAMPLE.COM
[SYSHLP.EXAMPLES.DCOM.EVENTS]EVENTS_SAMPLE.C
[SYSHLP.EXAMPLES.DCOM.EVENTS]EVENTS_SAMPLE.H
[SYSHLP.EXAMPLES.DCOM.EVENTS]NTA_WIN32.C
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]BUILD_SAMPLE1.COM
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]BUILD_SAMPLE1.MMS
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]CLIENT.CXX
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]CMPNT$SHR.OPT
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]CMPNT.CXX
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]CMPNT.DEF
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]MAKE-ONE.
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]MAKEFILE.BAT
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]PROXY$SHR.OPT
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]PROXY.DEF
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]README-SAMPLE1.TXT
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]REGISTRY.CXX
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]REGISTRY.H
[SYSHLP.EXAMPLES.DCOM.SAMPLE1]SERVER.IDL
[SYSHLP.EXAMPLES.DCOM.SIMPLE]BUILD_SIMPLE.COM
[SYSHLP.EXAMPLES.DCOM.SIMPLE]INSTALL.BAT
[SYSHLP.EXAMPLES.DCOM.SIMPLE]MAKEFILE.
[SYSHLP.EXAMPLES.DCOM.SIMPLE]README-SIMPLE.TXT
[SYSHLP.EXAMPLES.DCOM.SIMPLE]REGISTER_SIMPLE.COM
[SYSHLP.EXAMPLES.DCOM.SIMPLE]SCLIENT.CPP
[SYSHLP.EXAMPLES.DCOM.SIMPLE]SSERVER.CPP
[SYSHLP.EXAMPLES.DCOM.SIMPLE]SSERVER.REG
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]BUILD_TESTATL_INPROC.COM
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]BUILD_TESTATL_INPROC.MMS
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]CLIENT.CXX
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]MATH101$SHR.OPT
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]MATH101.CXX
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]MATH101.IDL
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]MATH101PS$SHR.OPT
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]MATHFORMULAS.CXX
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]MATHFORMULAS.H
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]MATHFORMULAS.RGS
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]README-TESTATL_INPROC.TXT
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]RESOURCE.H
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]STDAFX.CXX
[SYSHLP.EXAMPLES.DCOM.TESTATL_INPROC]STDAFX.H
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]BUILD_TESTATL_OUTPROC.COM
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]BUILD_TESTATL_OUTPROC.MMS
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]CLIENT.CXX
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]INSIDEDCOM.CXX
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]INSIDEDCOM.H
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]INSIDEDCOM.RGS
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]README-TESTATL_OUTPROC.TXT
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]RESOURCE.H
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]STDAFX.CXX
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]STDAFX.H
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]TESTATL.CXX
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]TESTATL.IDL
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]TESTATL.RGS
[SYSHLP.EXAMPLES.DCOM.TESTATL_OUTPROC]TESTATLPS$SHR.OPT
[SYSHLP.EXAMPLES.DCOM.WRAPPER]BUILD_WRAPPER.COM
[SYSHLP.EXAMPLES.DCOM.WRAPPER]MAKE-ONE.
[SYSHLP.EXAMPLES.DCOM.WRAPPER]MAKEFILE.BAT
[SYSHLP.EXAMPLES.DCOM.WRAPPER]README.TXT
[SYSHLP.EXAMPLES.DCOM.WRAPPER]REGISTRY.CXX
[SYSHLP.EXAMPLES.DCOM.WRAPPER]REGISTRY.H
```

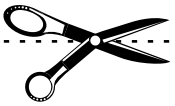
List of Files Installed by COM for OpenVMS
G.1 Files Installed by COM for OpenVMS

```
[SYSHLP.EXAMPLES.DCOM.WRAPPER]TEST.COM
[SYSHLP.EXAMPLES.DCOM.WRAPPER]VBCLIENT.FRM
[SYSHLP.EXAMPLES.DCOM.WRAPPER]VBCLIENT.VBP
[SYSHLP.EXAMPLES.DCOM.WRAPPER]WR$SHR.OPT
[SYSHLP.EXAMPLES.DCOM.WRAPPER]WRAPPER.CXX
[SYSHLP.EXAMPLES.DCOM.WRAPPER]WRAPPER.DEF
[SYSHLP.EXAMPLES.DCOM.WRAPPER]WRAPPER.IDL
[SYSHLP.EXAMPLES.DCOM.WRAPPER]WRAPPERCLIENT.CXX
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700.HTML
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700.PDF
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700.PS
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700_001.HTML
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700_002.HTML
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700_003.HTML
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700_004.HTML
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700_005.HTML
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700_006.HTML
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700_CONTENTS.HTML
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700_CONTENTS_001.HTML
[SYSHLP]OVMS_CONNECT_DEV_GDE_0700_INDEX.HTML
[SYSHLP]VM-0126A.GIF
[SYSHLP]VM-0224A.GIF
[SYSHLP]VM-0225A.GIF
[SYSHLP]VM-0226A.GIF
[SYSHLP]VM-0227A.GIF
[SYSHLP]VM-0228A.GIF
[SYSHLP]VM-0283A.GIF
[SYSHLP]VM-0331A.GIF
[SYSHLP]VM-8782A.GIF
[SYSHLP]ZK-8782A.GIF
[SYSLIB]DCOM$MIDL_SHR.EXE
[SYSLIB]DCOM$NT_WRAPPERS_SHR.EXE
[SYSLIB]DCOM$OLE32_SHR.EXE
[SYSLIB]DCOM$OLEAUT32_SHR.EXE
[SYSLIB]DCOM$RPCRT4_SHR.EXE
[SYSLIB]DCOM$WIN32_SHR.EXE
[SYSMGR]DCOM$CREATE_ACCOUNT.COM
[SYSMGR]DCOM$REGISTRY_KEYS.COM
[SYSMGR]DCOM$SETUP.COM
[SYSMSG]DCOM$GUIDGEN_MSG.EXE
[SYSMSG]NTARPCMSG.EXE
[SYSMSG]NTAWINMSG.EXE
[000000]DEC-AXPVMS-DCOM-V0101-B-1.PCSI$DESCRIPTION
```

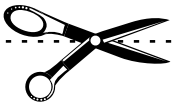
H

Discount Coupons for COM Books

By special arrangement with the publishers, Compaq is able to provide *COM for OpenVMS* developers with the following discount coupons for some of the third-party COM books mentioned in this manual. Please follow the instructions on the coupon when ordering books.



COUPON



Essential COM

by Don Box, *Addison-Wesley Object Technology Series*

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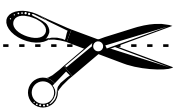

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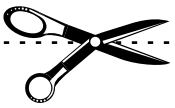

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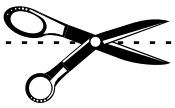

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50 Ways to Improve your COM and MTS-based Applications

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Written by best-selling author Don Box, along with other instructors from DevelopMentor, *Effective COM* offers fifty concrete guidelines for COM derived from the communal wisdom formed over the past five years of COM-based development. This book is targeted at developers who are living and breathing COM, humbled by its complexity and challenged by the breadth of distributed object computing. Although the book is written for developers who work in C++, many of the topics (e.g., interface design and security) are accessible by developers who work in Visual Basic®, Java®, or Object Pascal. The authors, four COM experts, provide insight on complex subjects such as the difference between pure C++ development and COM-based C++ development, COM interface design, concurrency and apartments, and security. ISBN: 0-201-37968-6, Paperback, 240 pages. Copyright © 1999.

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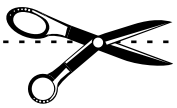

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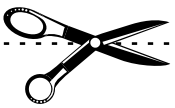

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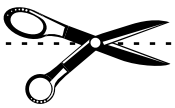

DCOM Explained

by Rosemary Rock-Evans

DCOM Explained helps describes what services DCOM provides, both development and runtime. Thus the aim of the book is not to teach how to program using DCOM, but to explain what DCOM does so readers will become better able to use it more effectively, understand the options available when using DCOM, and understand the types of applications that can be built by using DCOM.

CONTENTS: Introduction, What is DCOM?, Main Concepts Used in DCOM, Main Services of DCOM, COM, Active X, MS RPC, Cedar, Other Communication Functions, DCOM and Windows NT, DCOM and Other Platform Support, DCOM and the Internet, Microsoft Transaction Server, MSMQ (Falcon), OLE DB and Active Data Objects, Security, Directory Services, Administration, Summary.
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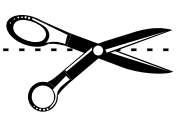

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I

Glossary

class (registry class)

Registry element attribute that allows you to store additional descriptive information with a registry key or subkey.

encapsulation

The process of updating or extending the life of existing application code by leaving most of the code and its functionality intact, while including new or updated code (usually in a different programming language) at key entry points.

For example, you might add a Windows graphical interface to a character-cell application by writing some Visual Basic code that collects information from a Windows client, then formats and submits the data to the existing character cell application as if the data had come from the character cell interface.

hive

A discrete set of keys, subkeys, and value entries contained in the registry.

in-process server

An application that is located on the same system as the requesting client. On Windows NT systems, in-process servers are usually implemented as DLLs. On OpenVMS systems, in-process servers are usually implemented as shareable images.

key (registry key)

Registry element that contains information specific to the computer, system, or user.

out-of-process server

An application that is located on a different system than the requesting client. On Windows NT systems, out-of-process servers are usually implemented as .EXE files.

registry

A hierarchical database consisting of one or more files that stores configuration information about system hardware and software.

subkey (registry subkey)

Registry element that is a child of a registry key. A registry key can have zero or more subkeys.

value (registry value)

Registry element that is the entry or value for a registry key or subkey.

wrapper

See **encapsulation**.

J
Acronyms

ACM

Authentication and Credential Management Authority

ACME

Authentication and Credential Management Extension

API

Application Program Interface

ATL

Active Template Library

COM

Component Object Model

CLSID

Class ID

DCOM

Distributed Component Object Model

DLL

Dynamic Link Library

FMS

Forms Management System

GUI

Graphical User Interface

GUID

Globally Unique Identifier

MIDL

Microsoft Interface Definition Language

OO

Object oriented

RPC

Remote Procedure Call

Acronyms

SAM
Security Account Manager

SID
Security Identifier

SMG
Screen Management Facility

SSPI
Security Support Provider Interface

UI
User Interface

UIC
User Identification Code

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