HP Open Source Security for OpenVMS
Volume 3: Kerberos

Kerberos Version 2.0 for OpenVMS, based on MIT Kerberos V5 Release 1.2.6

OpenVMS Alpha Version 7.2-2 or higher
OpenVMS VAX Version 7.3

This is a new manual.

Manufacturing Part Number: AA-RUEBA-TE
September 2003

Legal Notice

See Appendix A Open Source Notices for information regarding certain open source code included in this product.

The HP OpenVMS documentation set is available on CD-ROM.

ZK6666

Contents

1. Introduction to Kerberos

Kerberos Terminology 25
Understanding Kerberos 26
Realms 27
Security Limitations in Kerberos 27
Kerberos Components 28
KDC 28
Authentication Service 29
Ticket-Granting Service 29
The Kerberos Database 29
Kerberos Utility Programs 29

2. Installation and Configuration

Prerequisites 31
Downloading the Kit 31
Expanding the Kit 32
Installing and Configuring Kerberos on OpenVMS Version 7.3-2 and Higher 32
Updating and Configuring Kerberos on OpenVMS Version 7.3-1 35
Installing and Configuring Kerberos on OpenVMS Version 7.2-2 and 7.3 39

3. Kerberos Client Programs

User Client Programs 45
kinit 45
klist 47
kdestroy 48
kpasswd 48
Administrative Client Programs 49
kadmin and kadmin_local 49
kdb5_util 50
kprop 53

4. Kerberos Programming Concepts

Overview of Building a Kerberos Application on OpenVMS 57
Compiling a Kerberos Program on OpenVMS 57
Linking a Kerberos Program on OpenVMS 57
Kerberos Example Programs 58
DCL Example Programs 58
GMAKE Example Programs 60

5. GSSAPI (Generic Security Services Application Programming Interface)

gss_accept_sec_context — Establish a security context 66
C Prototype 66
Arguments 66
Description 68
Return Values 69
gss_acquire_cred — Acquire credential handle 71

Contents

C Prototype . . . 71
Arguments . . . 71
Description . . . 72
Return Values . . . 72
gss_add_cred — Construct credentials incrementally . . . 73
C Prototype . . . 73
Arguments . . . 73
Description . . . 74
Return Values . . . 75
gss_add_oid_set_member — Add an object identifier to a set . . . 76
C Prototype . . . 76
Arguments . . . 76
Description . . . 76
Return Values . . . 76
gss_canonicalize_name — Convert internal name to internal mechanism name . . . 77
C Prototype . . . 77
Arguments . . . 77
Description . . . 77
Return Values . . . 77
gss_compare_name — Allow application to compare two internal names . . . 78
C Prototype . . . 78
Arguments . . . 78
Description . . . 78
Return Values . . . 78
gss_context_time — Check how much longer context is valid . . . 79
C Prototype . . . 79
Arguments . . . 79
Description . . . 79
Return Values . . . 79
gss_create_empty_oid_set — Create a set containing no object identifiers . . . 80
C Prototype . . . 80
Arguments . . . 80
Description . . . 80
Return Values . . . 80
gss_delete_sec_context — Delete a security context . . . 81
C Prototype . . . 81
Arguments . . . 81
Description . . . 81
Return Values . . . 81
gss_display_name — Provide textual representation of opaque internal name . . . 82
C Prototype . . . 82
Arguments . . . 82
Description . . . 82
Return Values . . . 82
gss_display_status — Convert GSSAPI status code to text for user display . . . 83
C Prototype . . . 83

Arguments . . . 83
Description . . . 83
Return Values . . . 84
gss_duplicate_name — Create a copy of an internal name . . . 85
C Prototype . . . 85
Arguments . . . 85
Description . . . 85
Return Values . . . 85
gss_export_name — Convert an internal mechanism name to export form . . . 86
C Prototype . . . 86
Arguments . . . 86
Description . . . 86
Return Values . . . 86
gss_export_sec_context — Transfer a security context to another process . . . 87
C Prototype . . . 87
Arguments . . . 87
Description . . . 87
Return Values . . . 87
gss_get_mic — Generate a cryptographic MIC for a message . . . 88
C Prototype . . . 88
Arguments . . . 88
Description . . . 88
Return Values . . . 88
gss_import_name — Convert a printable string to an internal form . . . 90
C Prototype . . . 90
Arguments . . . 90
Description . . . 90
Return Values . . . 90
gss_import_sec_context — Import a transferred context . . . 91
C Prototype . . . 91
Arguments . . . 91
Description . . . 91
Return Values . . . 91
gss_indicate_mechs — Allow an application to determine which security mechanisms are available . 92
C Prototype . . . 92
Arguments . . . 92
Description . . . 92
Return Values . . . 92
gss_init_sec_context — Establish a security context . . . 93
C Prototype . . . 93
Arguments . . . 93
Description . . . 96
Return Values . . . 97
gss_inquire_context — Extract security context information . . . 99
C Prototype . . . 99
Arguments . . . 99

Contents

Description 101
Return Values 101
gss_inquire_cred — Provide calling application with information about a credential 102
C Prototype 102
Arguments 102
Description 102
Return Values 102
gss_inquire_cred_by_mech — Obtain per-mechanism information about a credential 104
C Prototype 104
Arguments 104
Description 104
Return Values 105
gss_inquire_names_for_mech — Return set of supported nametypes 106
C Prototype 106
Arguments 106
Description 106
Return Values 106
gss_process_context_token — Pass a security context to the security service 107
C Prototype 107
Arguments 107
Description 107
Return Values 107
gss_release_buffer — Free storage associated with a buffer 108
C Prototype 108
Arguments 108
Description 108
Return Values 108
gss_release_cred — Mark a credential for deletion 109
C Prototype 109
Arguments 109
Description 109
Return Values 109
gss_release_name — Free storage associated with an internal name that was allocated by a GSSAPI routine. 110
C Prototype 110
Arguments 110
Description 110
Return Values 110
gss_release_oid_set — Free storage associated with a gss_OID_set object 111
C Prototype 111
Arguments 111
Description 111
Return Values 111
gss_test_oid_set_member — Determine whether an object identifier is a member of the set 112
C Prototype 112
Arguments 112

Description . . . 112
Return Values . . . 112
gss_unwrap — Verify a message with attached MIC and decrypt message content . . . 113
C Prototype . . . 113
Arguments . . . 113
Description . . . 113
Return Values . . . 113
gss_verify_mic — Check that a cryptographic MIC fits the applied message . . . 115
C Prototype . . . 115
Arguments . . . 115
Description . . . 115
Return Values . . . 115
gss_wrap — Attach a MIC to a message and encrypt the message . . . 117
C Prototype . . . 117
Arguments . . . 117
Description . . . 117
Return Values . . . 118
gss_wrap_size_limit — Check expected size of wrapped output . . . 119
C Prototype . . . 119
Arguments . . . 119
Description . . . 119
Return Values . . . 120

6. KRB5 (Kerberos V5) Application Programming Interface

krb5_425_conv_principal — Convert a Kerberos V4 principal name to V5 format . . . 122
C Prototype . . . 122
Arguments . . . 122
Description . . . 122
Return Values . . . 122
krb5_address_compare — Compare two addresses . . . 123
C Prototype . . . 123
Arguments . . . 123
Description . . . 123
Return Values . . . 123
krb5_address_order — Return an ordering of two addresses . . . 124
C Prototype . . . 124
Arguments . . . 124
Description . . . 124
Return Values . . . 124
krb5_address_search — Search for address in address list . . . 125
C Prototype . . . 125
Arguments . . . 125
Description . . . 125
Return Values . . . 125
krb5_aname_to_localname — Convert a principal name to a local name . . . 126
C Prototype . . . 126

Arguments . . . 126
Description . . . 126
Return Values . . . 126
krb5_auth_con_free — Free auth_context . . . 127
C Prototype . . . 127
Arguments . . . 127
Description . . . 127
Return Values . . . 127
krb5_auth_con_init — Initialize the auth_context . . . 128
C Prototype . . . 128
Arguments . . . 128
Description . . . 128
Return Values . . . 128
krb5_auth_con_getaddrs — Retrieve address fields from the auth_context . . . 129
C Prototype . . . 129
Arguments . . . 129
Description . . . 129
Return Values . . . 129
krb5_auth_con_getauthenticator — Retrieve authenticator used during mutual authentication . . . 130
C Prototype . . . 130
Arguments . . . 130
Description . . . 130
Return Values . . . 130
krb5_auth_con_getflags — Retrieve the flags in auth_context . . . 131
C Prototype . . . 131
Arguments . . . 131
Description . . . 131
Return Values . . . 131
krb5_auth_con_getkey — Retrieve keyblock from auth_context . . . 132
C Prototype . . . 132
Arguments . . . 132
Description . . . 132
Return Values . . . 132
krb5_auth_con_getlocalseqnumber — Retrieve and store the local sequence number . . . 133
C Prototype . . . 133
Arguments . . . 133
Description . . . 133
Return Values . . . 133
krb5_auth_con_getlocalsubkey — Retrieve the local_subkey keyblock from auth_context . . . 134
C Prototype . . . 134
Arguments . . . 134
Description . . . 134
Return Values . . . 134
krb5_auth_con_getremoteseqnumber — Retrieve and store the remote sequence number . . . 135
C Prototype . . . 135
Arguments . . . 135

Description . . . 135
Return Values . . . 135
krb5_auth_con_getremotesubkey — Retrieve the remote_subkey keyblock from auth_context . . . 136
C Prototype . . . 136
Arguments . . . 136
Description . . . 136
Return Values . . . 136
krb5_auth_con_setaddrs — Set address fields in auth_context . . . 137
C Prototype . . . 137
Arguments . . . 137
Description . . . 137
Return Values . . . 137
krb5_auth_con_setflags — Set the flags in auth_context . . . 138
C Prototype . . . 138
Arguments . . . 138
Description . . . 138
Return Values . . . 138
krb5_auth_con_setports — Set port fields in the auth_context . . . 139
C Prototype . . . 139
Arguments . . . 139
Description . . . 139
Return Values . . . 139
krb5_auth_con_setrcache — Set the replay cache . . . 140
C Prototype . . . 140
Arguments . . . 140
Description . . . 140
Return Values . . . 140
krb5_auth_con_setuseruserkey — Set keyblock field in auth_context to temporary key . . . 141
C Prototype . . . 141
Arguments . . . 141
Description . . . 141
Return Values . . . 141
krb5_build_principal — Build a principal name . . . 142
C Prototype . . . 142
Arguments . . . 142
Description . . . 142
Return Values . . . 142
krb5_build_principal_ext — Build a principal name extension . . . 143
C Prototype . . . 143
Arguments . . . 143
Description . . . 143
Return Values . . . 143
krb5_cc_close — Close the credentials cache . . . 144
C Prototype . . . 144
Arguments . . . 144
Description . . . 144

Contents

Return Values 144
krb5_cc_default — Resolve the default credentials cache name 145
C Prototype 145
Arguments 145
Description 145
Return Values 145
krb5_cc_default_name — Return the name of the default credentials cache 146
C Prototype 146
Arguments 146
Description 146
Return Values 146
krb5_cc_destroy — Destroy a credentials cache 147
C Prototype 147
Arguments 147
Description 147
Return Values 147
krb5_cc_end_seq_get — Finish processing credentials cache entries 148
C Prototype 148
Arguments 148
Description 148
Return Values 148
krb5_cc_gen_new — Generate a new credentials cache identifier 149
C Prototype 149
Arguments 149
Description 149
Return Values 149
krb5_cc_get_name — Return the name of the credentials cache 150
C Prototype 150
Arguments 150
Description 150
Return Values 150
krb5_cc_get_principal — Retrieve the primary principal of the credentials cache 151
C Prototype 151
Arguments 151
Description 151
Return Values 151
krb5_cc_initialize — Create/refresh a credentials cache 152
C Prototype 152
Arguments 152
Description 152
Return Values 152
krb5_cc_next_cred — Fetch the next credentials entry 153
C Prototype 153
Arguments 153
Description 153
Return Values 153

krb5_cc_remove_cred — Remove credentials from the credentials cache 154
C Prototype 154
Arguments 154
Description 154
Return Values 155
krb5_cc_resolve — Resolve a credentials cache name 156
C Prototype 156
Arguments 156
Description 156
Return Values 156
krb5_cc_retrieve_cred — Search the cache for a credential and return it if found 157
C Prototype 157
Arguments 157
Description 158
Return Values 158
krb5_cc_set_flags — Set the flags on the credentials cache 159
C Prototype 159
Arguments 159
Description 159
Return Values 159
krb5_cc_start_seq_get — Start sequential read of cached credentials 160
C Prototype 160
Arguments 160
Description 160
Return Values 160
krb5_cc_store_cred — Store a credential in the credentials cache 161
C Prototype 161
Arguments 161
Description 161
Return Values 161
krb5_copy_addresses — Copy Kerberos addresses 162
C Prototype 162
Arguments 162
Description 162
Return Values 162
krb5_copy_authdata — Copy a Kerberos authdata structure 163
C Prototype 163
Arguments 163
Description 163
Return Values 163
krb5_copy_authenticator — Copy an authenticator structure 164
C Prototype 164
Arguments 164
Description 164
Return Values 164
krb5_copy_checksum — Copy a checksum structure 165

C Prototype 165
Arguments 165
Description 165
Return Values 165
krb5_copy_creds — Copy a credentials structure 166
C Prototype 166
Arguments 166
Description 166
Return Values 166
krb5_copy_data — Copy a Kerberos data structure 167
C Prototype 167
Arguments 167
Description 167
Return Values 167
krb5_copy_keyblock — Copy a keyblock 168
C Prototype 168
Arguments 168
Description 168
Return Values 168
krb5_copy_keyblock_contents — Copy a keyblock's contents 169
C Prototype 169
Arguments 169
Description 169
Return Values 169
krb5_copy_principal — Copy a principal structure 170
C Prototype 170
Arguments 170
Description 170
Return Values 170
krb5_copy_ticket — Copy a Kerberos ticket structure 171
C Prototype 171
Arguments 171
Description 171
Return Values 171
krb5_free_addresses — Free addresses allocated by krb5_copy_addresses 172
C Prototype 172
Arguments 172
Description 172
Return Values 172
krb5_free_ap_rep_enc_part — Free subkey and other data allocated by krb5_rd_rep or krb5_send_auth 173
C Prototype 173
Arguments 173
Description 173
Return Values 173
krb5_free_authdata — Free an authdata structure 174

C Prototype 174
Arguments 174
Description 174
Return Values 174
krb5_free_authenticator — Free authenticator storage 175
C Prototype 175
Arguments 175
Description 175
Return Values 175
krb5_free_checksum — Free a checksum 176
C Prototype 176
Arguments 176
Description 176
Return Values 176
krb5_free_context — Free a context structure 177
C Prototype 177
Arguments 177
Description 177
Return Values 177
krb5_free_cred_contents — Free credential structures 178
C Prototype 178
Arguments 178
Description 178
Return Values 178
krb5_free_creds — Free credentials 179
C Prototype 179
Arguments 179
Description 179
Return Values 179
krb5_free_data — Free storage associated with a krb5_data object 180
C Prototype 180
Arguments 180
Description 180
Return Values 180
krb5_free_error — Free error information 181
C Prototype 181
Arguments 181
Description 181
Return Values 181
krb5_free_host_realm — Free storage allocated by krb5_get_host_realm 182
C Prototype 182
Arguments 182
Description 182
Return Values 182
krb5_free_keyblock — Free keyblock memory 183
C Prototype 183

Arguments . . . 183
Description . . . 183
Return Values . . . 183
krb5_free_principal — Free the pwd_data allocated by krb5_copy_principal . . . 184
C Prototype . . . 184
Arguments . . . 184
Description . . . 184
Return Values . . . 184
krb5_free_tgt_creds — Free TGT credentials . . . 185
C Prototype . . . 185
Arguments . . . 185
Description . . . 185
Return Values . . . 185
krb5_free_ticket — Free ticket allocated by krb5_copy_ticket . . . 186
C Prototype . . . 186
Arguments . . . 186
Description . . . 186
Return Values . . . 186
krb5_get_credentials — Get an additional ticket for the client . . . 187
C Prototype . . . 187
Arguments . . . 187
Description . . . 187
Return Values . . . 188
krb5_get_default_realm— Retrieve the default realm . . . 189
C Prototype . . . 189
Arguments . . . 189
Description . . . 189
Return Values . . . 189
krb5_get_host_realm — Get the Kerberos realm names for a host . . . 190
C Prototype . . . 190
Arguments . . . 190
Description . . . 190
Return Values . . . 190
krb5_get_message — Convert an error code into the string representation . . . 191
C Prototype . . . 191
Arguments . . . 191
Description . . . 191
Return Values . . . 191
krb5_get_server_rcache — Create a replay cache for server use . . . 192
C Prototype . . . 192
Arguments . . . 192
Description . . . 192
Return Values . . . 192
krb5_init_context — Initialize a Kerberos context structure . . . 193
C Prototype . . . 193
Arguments . . . 193

Description . . . 193
Return Values . . . 193
krb5_kt_add_entry — Add an entry to a key table . . . 194
C Prototype . . . 194
Arguments . . . 194
Description . . . 194
Return Values . . . 194
krb5_kt_close — Close a key table . . . 195
C Prototype . . . 195
Arguments . . . 195
Description . . . 195
Return Values . . . 195
krb5_kt_default — Return a handle to the default keytab . . . 196
C Prototype . . . 196
Arguments . . . 196
Description . . . 196
Return Values . . . 196
krb5_kt_default_name — Get default key table name . . . 197
C Prototype . . . 197
Arguments . . . 197
Description . . . 197
Return Values . . . 197
krb5_kt_end_seq_get — Complete a series of sequential key table entry retrievals . . . 198
C Prototype . . . 198
Arguments . . . 198
Description . . . 198
Return Values . . . 198
krb5_kt_get_entry — Retrieve an entry from the key table . . . 199
C Prototype . . . 199
Arguments . . . 199
Description . . . 199
Return Values . . . 199
krb5_kt_get_name — Get key table name . . . 200
C Prototype . . . 200
Arguments . . . 200
Description . . . 200
Return Values . . . 200
krb5_kt_next_entry — Retrieve the next entry from the key table . . . 201
C Prototype . . . 201
Arguments . . . 201
Description . . . 201
Return Values . . . 201
krb5_kt_read_service_key — Retrieve a service key from the key table . . . 202
C Prototype . . . 202
Arguments . . . 202
Description . . . 202

Return Values 202
krb5_kt_remove_entry — Remove an entry from a key table 203
C Prototype 203
Arguments 203
Description 203
Return Values 203
krb5_kt_start_seq_get — Start a sequential retrieve of key table entries 204
C Prototype 204
Arguments 204
Description 204
Return Values 204
krb5_kuserok — Determine whether the local user is authorized to log in 205
C Prototype 205
Arguments 205
Description 205
Return Values 205
krb5_mk_error — Format an error message 206
C Prototype 206
Arguments 206
Description 206
Return Values 206
krb5_mk_priv — Format a KRB_PRIV message 207
C Prototype 207
Arguments 207
Description 207
Return Values 208
krb5_mk_rep — Format and encrypt an AP_REP message 209
C Prototype 209
Arguments 209
Description 209
Return Values 209
krb5_mk_req — Format a KRB_AP_REQ message 210
C Prototype 210
Arguments 210
Description 210
Return Values 211
krb5_mk_req_extended — Format a KRB_AP_REQ message with additional options 212
C Prototype 212
Arguments 212
Description 212
Return Values 213
krb5_mk_safe — Format a KRB_SAFE message 214
C Prototype 214
Arguments 214
Description 214
Return Values 215

krb5_os_localaddr — Return all protocol addresses of this host 216
C Prototype 216
Arguments 216
Description 216
Return Values 216
krb5_parse_name — Convert string principal name to protocol format 217
C Prototype 217
Arguments 217
Description 217
Return Values 217
krb5_principal_compare — Compare two principals 218
C Prototype 218
Arguments 218
Description 218
Return Values 218
krb5_read_password — Read a password from the keyboard 219
C Prototype 219
Arguments 219
Description 219
Return Values 219
krb5_rd_priv — Parse a KRB_PRIV message 220
C Prototype 220
Arguments 220
Description 220
Return Values 220
krb5_rd_rep — Parse and decrypt an AP_REP message 221
C Prototype 221
Arguments 221
Description 221
Return Values 221
krb5_rd_req — Parse a KRB_AP_REQ message 222
C Prototype 222
Arguments 222
Description 222
Return Values 223
krb5_rd_safe — Parse a KRB_SAFE message 224
C Prototype 224
Arguments 224
Description 224
Return Values 225
krb5_recvauth — Receive authenticated message 226
C Prototype 226
Arguments 226
Description 226
Return Values 227
krb5_sendauth — Send authenticated message 228

C Prototype . . . 228
Arguments . . . 228
Description . . . 229
Return Values . . . 229
krb5_set_default_realm — Sets the default realm . . . 230
C Prototype . . . 230
Arguments . . . 230
Description . . . 230
Return Values . . . 230
krb5_sname_to_principal — Generate a full principal name from a service name . . . 231
C Prototype . . . 231
Arguments . . . 231
Description . . . 231
Return Values . . . 231
krb5_timeofday — Retrieves the system time of day (in seconds) since local system's epoch . . . 232
C Prototype . . . 232
Arguments . . . 232
Description . . . 232
Return Values . . . 232
krb5_unparse_name — Convert protocol format principal name to string format . . . 233
C Prototype . . . 233
Arguments . . . 233
Description . . . 233
Return Values . . . 233
krb5_unparse_name_ext — Convert multiple protocol format principal names to string format . . . 234
C Prototype . . . 234
Arguments . . . 234
Description . . . 234
Return Values . . . 234
krb5_us_timeofday — Retrieves the system time of day (in seconds and microseconds) . . . 235
C Prototype . . . 235
Arguments . . . 235
Description . . . 235
Return Values . . . 235

A. Open Source Notices

Acknowledgements . . . 237
Kerberos Copyright Notice . . . 237
OpenVision Technologies Copyright Notice . . . 237
University of California Copyright Notice . . . 238

Glossary . . . 241

Index . . . 243

Figures

Figure 1-1. Interrelationships Among Kerberos Components 28

Figures

Preface

HP Open Source Security for OpenVMS, Volume 3: Kerberos describes how to install, configure, and use Kerberos Version 2.0 for OpenVMS, which is based on MIT Kerberos V5 Release 1.2.6.

The information in this manual applies to OpenVMS VAX as well as to OpenVMS Alpha.

Intended Audience

This document is for application developers who want to implement the Kerberos protocol that uses strong cryptography, so that a client can prove its identity to a server (and vice versa) across an insecure network connection.

Document Structure

This manual consists of the following chapters:

Chapter 1 provides an overview of Kerberos.

Chapter 2 contains installation and configuration instructions.

Chapter 3 includes information about client programs.

Chapter 4 is a programming tutorial about how to use Kerberos in your application.

Chapter 5 is a reference section that includes documentation about the GSSAPI.

Chapter 6 is a reference section that includes documentation about the KRB5 APIs.

Related Documents

The following HP OpenVMS documents are recommended for further information:

- *HP Open Source Security for OpenVMS, Volume 1: Common Data Security Architecture*
- *HP Open Source Security for OpenVMS, Volume 2: HP SSL for OpenVMS*
- *HP OpenVMS Guide to System Security*

The following MIT Kerberos documents are available from the Kerberos for OpenVMS web site, and in the Kerberos Version 2.0 kit in the `KRB$ROOT:[DOC]` directory:

- *Kerberos V5 Application Programming Library* (`LIBRARY.PDF`)
- *Kerberos V5 Implementer's Guide* (`IMPLEMENT.PDF`)
- *Kerberos V5 Installation Guide* (`INSTALL-GUIDE.PS`)
- *Kerberos V5 System Administrator's Guide* (`ADMIN-GUIDE.PS`)
- *Kerberos V5 UNIX User's Guide* (`USER-GUIDE.PS`)
- *Upgrading to Kerberos V5 from Kerberos V4* (`KRB425-GUIDE.PS`)

For additional information about OpenVMS products and services, see the following World Wide Web address:

`http://www.hp.com/go/openvms/`

For information about downloading the latest version of Kerberos for OpenVMS, see the following World Wide Web address:

http://h71000.www7.hp.com/openvms/products/kerberos/

For additional information about Kerberos, see the MIT Kerberos web site at the following World Wide Web address:

http://web.mit.edu/kerberos/www/

Reader's Comments

HP welcomes your comments on this manual.

Please send comments to either of the following addresses:

Internet: openvmsdoc@hp.com

Postal Mail:
Hewlett-Packard Company
OSSG Documentation Group
ZKO3-4/U08
110 Spit Brook Road
Nashua, NH 03062-2698

How to Order Additional Documentation

For information about how to order additional documentation, visit the following World Wide Web address:

http://www.hp.com/go/openvms/doc/order/

Conventions

Convention	Meaning
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 (x) or a pointing device button.
Return	In examples, a key name in bold indicates that you press that key.
…	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 arguments, 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 choices in parentheses if you specify more than one.

Convention	Meaning
[ ]	In command format descriptions, brackets indicate optional choices. You can choose one or more items or no items. Do not type the brackets on the command line. However, you must include the brackets in the syntax for OpenVMS directory specifications and for a substring specification in an assignment statement.
|	In command format descriptions, vertical bars separate choices within brackets or braces. Within brackets, the choices are optional; within braces, at least one choice is required. Do not type the vertical bars on the command line.
{ }	In command format descriptions, braces indicate required choices; you must choose at least one of the items listed. Do not type the braces on the command line.
bold type	Bold type represents the introduction of a new term. It also represents the name of an argument, an attribute, or a reason. In command or script examples, bold text indicates user input.
italic type	Italic type 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 arguments in text (where (*dd*) represents the predefined par code for the device type).
UPPERCASE TYPE	Uppercase type indicates a command, the name of a routine, the name of a file, or the abbreviation for a system privilege.
`Example`	This typeface indicates code examples, command examples, and interactive screen displays. In text, this type also identifies URLs, UNIX command and pathnames, PC-based commands and folders, and certain elements of the C programming language.
–	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 Introduction to Kerberos

Kerberos is a network authentication protocol designed to provide strong authentication for client/server applications by using secret-key cryptography. It was developed at the Massachusetts Institute of Technology as part of Project Athena in the mid-1980s. Project Athena's mandate was to explore diverse uses of computing and to build the knowledge base needed for longer-term strategic decisions about how computers fit into the MIT curriculum.

Kerberos is the name of the three-headed dog that guarded the gates of Hades in Greek mythology. Cerberus, who many argue should be the name used, is the Latin name for the equivalent entity in Roman mythology.

Until Kerberos V4, this technology was not available to the general public. Prior versions were for only internal Project Athena use. Kerberos V5, the current implementation, is the first commercial-ready release.

The Kerberos protocol uses strong cryptography, so that a client can prove its identity to a server (and vice versa) across an insecure network connection. After a client and server have used Kerberos to prove their identity, they can also encrypt all of their communications to assure privacy and data integrity.

OpenVMS provides support for both Kerberos clients and servers, beginning with OpenVMS Version 7.3-1. Kerberos Version 2.0 for OpenVMS is based on MIT Kerberos V5 Release 1.2.6.

Kerberos Terminology

The following are commonly used Kerberos terms and their definitions.

Key Distribution Center (KDC)

The Ticket-Granting Service (TGS) and the Authentication Server are usually collectively known as the Key Distribution Center.

Principal Name

A principal is a unique identity to which Kerberos can assign tickets. It is analogous to an OpenVMS user. The Kerberos database, which performs a function similar to the UAF file on OpenVMS, stores information about principals.

By convention, a principal name is divided into three parts:

- A primary – For a user, a user name. For a system, the word *host*.
- The instance – An optional string that qualifies the primary.
- The realm – Generally, the DNS domain name in uppercase letters.

Realm

The administrative domain that encompasses Kerberos clients and servers is called a realm. Each Kerberos realm has at least one Kerberos server, zero or more Kerberos slave servers, and any number of clients. The master Kerberos database for that site or administrative domain is stored on the Kerberos server. Slave servers have read-only copies of the database that are periodically propagated from the master server.

Secret vs. Private

Secret and private are often used interchangeably. In this manual, it takes two (or more) to share a secret, therefore a shared DES key is a secret key. A key is private only when no one but its owner knows it. Therefore, in public key cryptosystems, one has a public and a private key.

Tickets

Kerberos tickets, also known as credentials, are a set of electronic information used to verify your identity. Kerberos tickets can be stored in a file, or they may exist only in memory.

The first ticket you obtain is a generic Ticket-Granting Ticket (TGT), which is granted upon your initial login to the Kerberos realm. The TGT allows you to obtain additional tickets that give you permission for specific services.

Understanding Kerberos

Kerberos performs authentication as a trusted third-party authentication service by using conventional (shared secret key) cryptography. Kerberos provides a means of verifying the identities of principals, without relying on authentication by the host operating system, without basing trust on host addresses, without requiring physical security of all the hosts on the network, and under the assumption that packets traveling along the network can be read, modified, and inserted at will.

When you integrate Kerberos into an application, it is important to review how and when Kerberos routines ensure that the application design does not compromise the authentication. For instance, an application is not secure if it uses Kerberos routines only on initiation of a stream-based network connection and assumes the absence of any active attackers who might hijack the stream connection.

The Kerberos protocol code libraries, whose API is described in Chapters 5 and 6, can be used to provide encryption to any application. To add authentication to its transactions, a typical network application adds one or two calls to the Kerberos library, which results in the transmission of the necessary messages to achieve authentication.

The two methods for obtaining credentials—the initial ticket exchange and the TGT exchange—use slightly different protocols and require different API routines. The basic difference an API programmer will see is that the initial request does not require a TGT. It does require the client's secret key, because the reply is sent back encrypted in the client's secret key. Usually this request is for a TGT, and TGT-based exchanges are used from then on. In a TGT exchange, the TGT is sent as part of the request for tickets and the reply is encrypted in the session key from the TGT. For example, once a user's password is used to obtain a TGT, it is not required for subsequent TGT exchanges.

The reply consists of a ticket and a session key, encrypted either in the user's secret key (password) or the TGT session key. The combination of a ticket and a session key is known as a credentials cache. (In Kerberos V4, a credentials cache was called a ticket file.) An application client can use these credentials to authenticate to the application server by sending the ticket and an authenticator to the server. The authenticator is encrypted in the session key of the ticket and contains the name of the client, the name of the server, and the time the authenticator was created.

In order to verify the authentication, the application server decrypts the ticket using its service key, which is known only by the application server and the Kerberos server. Inside the ticket, the Kerberos server had placed the name of the client, the name of the server, a key associated with this ticket, and some additional information. The application server then uses the ticket session key to decrypt the authenticator, and verifies that the information in the authenticator matches the information in the ticket and that the timestamp in the

authenticator is recent (to prevent reply attacks). Because the session key was generated randomly by the Kerberos server and delivered encrypted only in the service key and in a key known only by the user, the application server can be confident that user is really who he or she claims to be, because the user was able to encrypt the authenticator in the correct key.

To provide detection of both replay attacks and message stream modification attacks, the integrity of all the messages exchanged between principals can also be guaranteed by generating and transmitting a collision-proof checksum of the client's message, keyed with the session key. Privacy and integrity of the messages exchanged between principals can be secured by encrypting the data to be passed using the session key.

Realms

The Kerberos protocol operates across organizational boundaries. Each organization that runs a Kerberos server establishes its own realm. The name of the realm in which a client is registered is part of the client's name and can be used by the end service to decide whether to honor a request.

By establishing inter-realm keys, the administrators of two realms can allow a client authenticated in the local realm to use its credentials remotely. The exchange of inter-realm keys (a separate key may be used for each direction) registers the ticket-granting service of each realm as a principal in the other realm. A client is then able to obtain a ticket-granting ticket for the remote realm's ticket-granting service from its local realm. When that ticket-granting ticket is used, the remote ticket-granting service uses the inter-realm key (which usually differs from its own normal TGS key) to decrypt the ticket-granting ticket and to assure that it was issued by the client's own TGS. Tickets issued by the remote ticket-granting service will indicate to the end service that the client was authenticated from another realm.

This method can be repeated to authenticate across multiple realms. To build a valid authentication path to a distant realm, the local realm must share an inter-realm key with an intermediate realm that communicates with either the distant realm or yet another intermediate realm.

Realms are typically organized hierarchically. Each realm shares a key with its parent and a different key with each child. If two realms do not directly share an inter-realm key, the hierarchical organization allows an authentication path to be easily constructed. If a hierarchical organization is not used, it may be necessary to consult some database to construct an authentication path between realms.

Although realms are typically hierarchical, intermediate realms may be bypassed to achieve cross-realm authentication through alternate authentication paths. It is important for the end service to know which realms were transited when deciding how much faith to place in the authentication process. To make this easier, a field in each ticket contains the names of the realms that were involved in authenticating the client.

Security Limitations in Kerberos

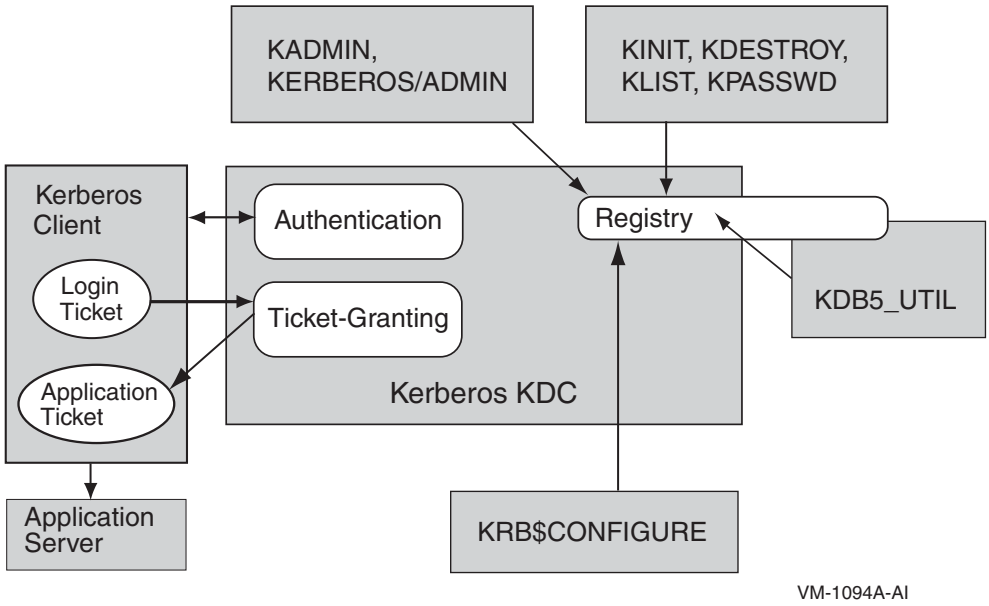
When you are designing your security application, be aware of the following limitations in Kerberos:

- Kerberos does not address denial of service attacks. There are places in the Kerberos protocols where an intruder can prevent an application from participating in the proper authentication steps. Detection and solution of such attacks (some of which can appear to be normal failure modes for the system) is usually best left to the human administrators and users.
- Principals must keep their secret keys secret. If an intruder somehow steals a principal's key, it can masquerade as that principal or impersonate any server to the legitimate principal.
- Password-guessing attacks are not solved by Kerberos. If a user chooses a poor password, it is possible for an attacker to successfully mount an offline dictionary attack by repeatedly attempting to decrypt, with successive entries from a dictionary, messages obtained that are encrypted under a key derived from the user's password.

Kerberos Components

Figure 1-1 depicts the interrelationship between the various components of Kerberos.

Figure 1-1 Interrelationships Among Kerberos Components



When a client logs in to the realm, an authentication request is sent to the Kerberos Key Distribution Center (KDC). A Ticket-Granting Ticket (TGT) is returned as the result of authentication. When the client application starts, the TGT is used to request an application ticket. The application ticket is then sent to the application server, which verifies the application ticket with the KDC. Normal communication can then begin.

The Kerberos registry can be manipulated in several ways. It is initially created via the `KRB$CONFIGURE` command procedure. Other tools used to access the Kerberos information are:

- `kadmin` – Used for reading or updating the Kerberos registry.
- `kinit` – Creates credentials for a user.
- `klist` – Displays the existing credentials for a user.
- `kdestroy` – Deletes a user's credentials.
- `kpasswd` – Changes a user's Kerberos password.
- `kdb5_util` – Dumps or loads the Kerberos database for save and restore operations.

KDC

Each Kerberos realm will have at least one Kerberos server. This server, the Key Distribution Center, contains the Authentication Service, the Ticket-Granting Service, and the master database for Kerberos. These services are implemented as a single daemon: the KDC (`KRB$KRB5KDC`).

Authentication Service

The authentication service handles user authentication, or the process of verifying that principals are correctly identified. It consists of the security server (or servers) in the KDC (or KDCs), and security clients.

A security client communicates with a security server to request information and operations. The security server accesses the registry database to perform queries and updates and to validate user logins.

Ticket-Granting Service

Once authenticated, a principal will be granted a TGT and a ticket session key, which gives the principal the right to use the ticket. This combination of the ticket and its associated key is known as your credentials.

A principal's credentials are stored in a credentials cache, which is often just a file in the principal's local directory tree.

The Kerberos Database

The Kerberos database contains all of the realm's Kerberos principals, their passwords, and other administrative information about each principal.

Each KDC contains its own copy of the Kerberos database. The master KDC contains the primary copy of the database, which it propagates at regular intervals to the slave KDCs. All database changes are made on the master KDC. Slave KDCs provide ticket-granting services only, with no database administration. This allows clients to continue to obtain tickets when the master KDC is unavailable.

Kerberos Utility Programs

OpenVMS provides three different versions of each of the Kerberos user interface programs: the original UNIX® style, a DCL version, and an X Windows version. The DCL interface for the user utilities (`kinit, klist, kdestroy, kpasswd`) is invoked by the DCL command:

```
$ KERBEROS
```

The DCL interface for the administrative utility (`kadmin`) is invoked by the DCL command:

```
$ KERBEROS/ADMIN
```

Either DCL interface can be modified with an `/INTERFACE` qualifier to invoke the X Windows version. For example, the command line for the administrative program is as follows:

```
$ KERBEROS/ADMIN/INTERFACE=DECWINDOWS
```

DCL help is available within each of the DCL interfaces.

kadmin

The `kadmin` program allows for the maintenance of Kerberos principals, policies, and service key tables (keytabs).

kinit

The `kinit` program explicitly obtains Kerberos tickets. Similarly, if a user's Kerberos ticket expires, `kinit` is used to obtain a new one.

klist

The `klist` program displays the existing tickets for a principal and various details about those tickets, including expiration time.

kdestroy

The `kdestroy` program removes all of the tickets for a principal. Because Kerberos tickets can be stolen and because someone who steals a ticket can masquerade as another principal, Kerberos tickets should be destroyed when you are away from your computer.

kpasswd

The `kpasswd` program changes a Kerberos principal's password. Passwords should be changed periodically.

kdb5_util

The `kdb5_util` program creates, destroys, dumps, and loads the Kerberos database. It also allows the creation of a key stash file, which allows a KDC to authenticate itself to the database utilities. Unlike the Kerberos utility programs (with the exception of `kadmin`), access to `kdb5_util` is generally limited to Kerberos administrators.

kprop

The `kprop` program propagates the master KDC database to slave KDC servers.

2 Installation and Configuration

This chapter contains information about installing and configuring Kerberos for OpenVMS.

NOTE For the latest release notes for the current version of Kerberos for OpenVMS, see the Kerberos for OpenVMS web site at:

`http://h71000.www7.hp.com/openvms/products/kerberos/`

Prerequisites

Operating System

HP OpenVMS Alpha Version 7.2-2 or higher, or

HP OpenVMS VAX Version 7.3

TCP/IP Transport

HP TCP/IP Services for OpenVMS Version 5.3 or higher

NOTE If you are running a third-party TCP/IP network product such as MultiNet or TCPware from Process Software Corporation, contact your provider regarding running Kerberos Version 2.0 with their TCP/IP network product.

Downloading the Kit

The Kerberos for HP OpenVMS kit is available for the Alpha and VAX platforms as compressed self-extracting files.

- Kerberos Version 2.0 is included in the OpenVMS V7.3-2 operating system distribution media. Kerberos Version 1.0 is included in the OpenVMS V7.3-1 operating system distribution media. If you are running OpenVMS Version 7.2-2 or OpenVMS Version 7.3-1, you should download and install Kerberos Version 2.0 at your earliest opportunity. Kerberos Version 2.0 corrects security vulnerabilities announced by MIT.
- To download the Alpha or VAX kit from the OpenVMS web site, fill out and submit the Kerberos for OpenVMS registration form at the following URL:

  `http://h71000.www7.hp.com/openvms/products/kerberos/kerberos_register.html`

Expanding the Kit

After you download a Kerberos for OpenVMS kit, expand the self-extracting file by entering one of the following commands, depending on the kit (Alpha or VAX) you download:

```
$ RUN HP-AXPVMS-KERBEROS-V0200-6-1.PCSI-DCX_AXPEXE ! for Alpha
$ RUN HP-VAXVMS-KERBEROS-V0200-6-1.PCSI_DCX_VAXEXE ! for VAX
```

At the `Decompress into (file specification)`: prompt, press Return. The system expands the file and names the decompressed file `HP-AXPVMS-KERBEROS-V0200-6-1.PCSI` or `HP-VAXVMS-KERBEROS-V0200-6-1.PCSI`. Do not rename this file.

Installing and Configuring Kerberos on OpenVMS Version 7.3-2 and Higher

Kerberos Version 2.0 is automatically installed during installation of OpenVMS Version 7.3-2 or during an upgrade from a previous version of OpenVMS to Version 7.3-2.

If you have not previously configured an earlier version of Kerberos on your system, you must run the configuration program before starting Kerberos. Example 2-1 shows a configuration log.

Once you have a valid configuration, start Kerberos with the following command:

```
$ @SYS$STARTUP:KRB$STARTUP.COM
```

Example 2-1 Kerberos Configuration Log on OpenVMS Version 7.3-2

```
$ @SYS$STARTUP:KRB$CONFIGURE

    Kerberos V2.0 for OpenVMS Configuration Menu

    Configuration options:

           1  -  Setup Client configuration
           2  -  Edit Client configuration

           3  -  Setup Server configuration
           4  -  Edit Server configuration

           5  -  Shutdown Servers
           6  -  Startup Servers

           E  -  Exit configuration procedure

    Enter Option: 1

  Where will the OpenVMS Kerberos 5 KDC be running [ system ]:
  What is the OpenVMS Kerberos 5 default domain [ abc.xyz.com ]:
  What is the OpenVMS Kerberos 5 Realm name [ SYSTEM.ABC.XYZ.COM ]:

  Press Return to continue ...
```

```
  Kerberos V2.0 for OpenVMS Configuration Menu

  Configuration options:

         1  -  Setup Client configuration
         2  -  Edit Client configuration

         3  -  Setup Server configuration
         4  -  Edit Server configuration

         5  -  Shutdown Servers
         6  -  Startup Servers

         E  -  Exit configuration procedure

  Enter Option: 3

Where will the OpenVMS Kerberos 5 KDC be running [ system ]:
What is the OpenVMS Kerberos 5 default domain [ abc.xyz.com ]:
What is the OpenVMS Kerberos 5 Realm name [ SYSTEM.ABC.XYZ.COM ]:
The type of roles the KDC can perform are:
    NO_KDC     -- where the KDC will not be run
    SINGLE_KDC -- where the KDC is the only one in the realm
    MASTER_KDC -- where the KDC is the master of 1 or more other KDCs
    SLAVE_KDC  -- where the KDC is slave to another KDC
What will be the KDC's role on this node [ SINGLE_KDC ]:
Create the OpenVMS Kerberos 5 database [ Y ]:

Creating OpenVMS Kerberos 5 database ...
Initializing database 'krb$root:[krb5kdc]principal' for realm
'SYSTEM.ABC.XYZ.COM',
master key name 'K/M@SYSTEM.ABC.XYZ.COM'
You will be prompted for the database Master Password.
It is important that you NOT FORGET this password.

Enter KDC database master key:
Re-enter KDC database master key to verify:
Priority: info
No dictionary file specified, continuing without one.

Please enter a default OpenVMS Kerberos 5 administrator [ SYSTEM ]:
Authenticating as principal SYSTEM/admin@SYSTEM.ABC.XYZ.COM with password.

Enter password for principal "SYSTEM/admin@SYSTEM.ABC.XYZ.COM":
Re-enter password for principal "SYSTEM/admin@SYSTEM.ABC.XYZ.COM":
Principal "SYSTEM/admin@SYSTEM.ABC.XYZ.COM" created.
Priority: info
No dictionary file specified, continuing without one.
WARNING: no policy specified for SYSTEM/admin@SYSTEM.ABC.XYZ.COM; defaulting to no policy
Create OpenVMS Kerberos 5 principals [ Y ]: N
Authenticating as principal SYSTEM/admin@SYSTEM.ABC.XYZ.COM with password.
Priority: info
No dictionary file specified, continuing without one.
KADMIN_LOCAL: Entry for principal kadmin/admin with kvno 3, encryption type Triple
DES cbc mode with HMAC/sha1 added to keytab WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.

KADMIN_LOCAL: Entry for principal kadmin/admin with kvno 3, encryption type DES
cbc mode with CRC-32 added to keytab WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.
```

```
Authenticating as principal SYSTEM/admin@SYSTEM.ABC.XYZ.COM with password.
Priority: info
No dictionary file specified, continuing without one.
KADMIN_LOCAL: Entry for principal kadmin/changepw with kvno 3, encryption type Triple
DES cbc mode with HMAC/sha1 added to keytab WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.

KADMIN_LOCAL: Entry for principal kadmin/changepw with kvno 3, encryption type DES
cbc mode with CRC-32 added to keytab WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.

Press Return to continue ...

  Kerberos V2.0 for OpenVMS Configuration Menu

  Configuration options:

         1  -  Setup Client configuration
         2  -  Edit Client configuration

         3  -  Setup Server configuration
         4  -  Edit Server configuration

         5  -  Shutdown Servers
         6  -  Startup Servers

         E  -  Exit configuration procedure

  Enter Option: 6


Starting OpenVMS Kerberos Servers (Role: SINGLE_KDC)...

Starting OpenVMS Kerberos server KRB$KRB5KDC ...
%RUN-S-PROC_ID, identification of created process is 00000060
Starting OpenVMS Kerberos server KRB$KADMIND ...
%RUN-S-PROC_ID, identification of created process is 00000061

Press Return to continue ...

  Kerberos V2.0 for OpenVMS Configuration Menu

  Configuration options:

         1  -  Setup Client configuration
         2  -  Edit Client configuration

         3  -  Setup Server configuration
         4  -  Edit Server configuration

         5  -  Shutdown Servers
         6  -  Startup Servers

         E  -  Exit configuration procedure

  Enter Option: E
```

Updating and Configuring Kerberos on OpenVMS Version 7.3-1

If you previously installed Kerberos Version 1.0 on OpenVMS Version 7.3-1, perform the following steps to update Kerberos to Version 2.0. Example 2-2 shows an upgrade installation log. Example 2-3 shows a configuration log.

1. Shut down Kerberos Version 1.0 by executing the SYS$STARTUP:KRB$SHUTDOWN.COM. (Kerberos Version 1.0 was installed by default when you installed OpenVMS Version 7.3-1.)
2. Create a directory to temporarily hold the upgrade command procedure and kit contents.
3. Set default to the temporary directory.

CAUTION Using a temporary directory is important. If you do not use a temporary directory, you may lose files in a subsequent cleanup operation.

4. Download OVERLAY_KRB5KIT.COM from the Kerberos for OpenVMS website at http://h71000.www7.hp.com/openvms/products/kerberos/.

CAUTION Do not install the OVERLAY_KRB5KIT.COM that is packaged with the Kerberos Version 2.0 kit.

5. Install the Kerberos Version 2.0 kit by executing OVERLAY_KRB5KIT.COM.
6. Execute KRB$CONFIGURE.COM, if Kerberos Version 1.0 was not previously configured.
7. Start Kerberos by executing SYS$STARTUP:KRB$STARTUP.COM.

Example 2-2 Kerberos Upgrade Installation Log on OpenVMS Version 7.3-1

```
Username: system
Password:

       Last interactive login on Tuesday, June 3, 2003 11:32 AM
      Last non-interactive login on Wednesday, June 4, 2003 03:45 PM

$ @SYS$STARTUP:KRB$SHUTDOWN
$ CREATE/DIRECTORY [.OVERLAY]
$ SET DEFAULT [.OVERLAY]
$ @OVERLAY_KRB5KIT
=======================================================
Installing an overlay of HP-AXPVMS-KERBEROS-V2.0

%DELETE-W-SEARCHFAIL, error searching for SYS$COMMON:[SYSLIB]KRB$RTL32.EXE;
-RMS-E-FNF, file not found
.
.
.

%CREATE-I-EXISTS, SYS$COMMON:[SYSHLP.EXAMPLES.KRB] already exists

The following product has been selected:
    HP AXPVMS KERBEROS V2.0               Layered Product
```

```
Portion done: 0%...100%

OVERLAY of Kerberos V2.0 on top of VMS 7.3-1 is complete.
```

Example 2-3 Kerberos Configuration Log on OpenVMS Version 7.3-1

NOTE Configure Kerberos Version 2.0 only if Kerberos Version 1.0 was not previously configured.

```
$ @SYS$STARTUP:KRB$CONFIGURE
    Kerberos V2.0 for OpenVMS Configuration Menu

    Configuration options:

           1  -  Setup Client configuration
           2  -  Edit Client configuration

           3  -  Setup Server configuration
           4  -  Edit Server configuration

           5  -  Shutdown Servers
           6  -  Startup Servers

           E  -  Exit configuration procedure

    Enter Option: 1

  Where will the OpenVMS Kerberos 5 KDC be running [ system ]:
  What is the OpenVMS Kerberos 5 default domain [ abc.xyz.com ]:
  What is the OpenVMS Kerberos 5 Realm name [ SYSTEM.ABC.XYZ.COM ]:

  Press Return to continue ...

    Kerberos V2.0 for OpenVMS Configuration Menu

    Configuration options:

           1  -  Setup Client configuration
           2  -  Edit Client configuration

           3  -  Setup Server configuration
           4  -  Edit Server configuration

           5  -  Shutdown Servers
           6  -  Startup Servers

           E  -  Exit configuration procedure

    Enter Option: 3

  Where will the OpenVMS Kerberos 5 KDC be running [ system ]:
  What is the OpenVMS Kerberos 5 default domain [ abc.xyz.com ]:
  What is the OpenVMS Kerberos 5 Realm name [ SYSTEM.ABC.XYZ.COM ]:
  The type of roles the KDC can perform are:
      NO_KDC     -- where the KDC will not be run
```

```
    SINGLE_KDC -- where the KDC is the only one in the realm
    MASTER_KDC -- where the KDC is the master of 1 or more other KDCs
    SLAVE_KDC  -- where the KDC is slave to another KDC
What will be the KDC's role on this node [ SINGLE_KDC ]:
Create the OpenVMS Kerberos 5 database [ Y ]:

Creating OpenVMS Kerberos 5 database ...
Initializing database 'krb$root:[krb5kdc]principal' for realm
'SYSTEM.ABC.XYZ.COM',
master key name 'K/M@SYSTEM.ABC.XYZ.COM'
You will be prompted for the database Master Password.
It is important that you NOT FORGET this password.

Enter KDC database master key:
Re-enter KDC database master key to verify:
Priority: info
No dictionary file specified, continuing without one.

Please enter a default OpenVMS Kerberos 5 administrator [ SYSTEM ]:
Authenticating as principal SYSTEM/admin@SYSTEM.ABC.XYZ.COM with password.

Enter password for principal "SYSTEM/admin@SYSTEM.ABC.XYZ.COM":
Re-enter password for principal "SYSTEM/admin@SYSTEM.ABC.XYZ.COM":
Principal "SYSTEM/admin@SYSTEM.ABC.XYZ.COM" created.
Priority: info
No dictionary file specified, continuing without one.
WARNING: no policy specified for SYSTEM/admin@SYSTEM.ABC.XYZ.COM; defaulting to no policy
Create OpenVMS Kerberos 5 principals [ Y ]: N
Authenticating as principal SYSTEM/admin@SYSTEM.ABC.XYZ.COM with password.
Priority: info
No dictionary file specified, continuing without one.
KADMIN_LOCAL: Entry for principal kadmin/admin with kvno 3, encryption type Triple
DES cbc mode with HMAC/sha1 added to keytab WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.

KADMIN_LOCAL: Entry for principal kadmin/admin with kvno 3, encryption type DES
cbc mode with CRC-32 added to keytab WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.

Authenticating as principal SYSTEM/admin@SYSTEM.ABC.XYZ.COM with password.
Priority: info
No dictionary file specified, continuing without one.
KADMIN_LOCAL: Entry for principal kadmin/changepw with kvno 3, encryption type Triple
DES cbc mode with HMAC/sha1 added to keytab WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.

KADMIN_LOCAL: Entry for principal kadmin/changepw with kvno 3, encryption type DES
cbc mode with CRC-32 added to keytab WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.

Press Return to continue ...

  Kerberos V2.0 for OpenVMS Configuration Menu

  Configuration options:

         1  -  Setup Client configuration
         2  -  Edit Client configuration

         3  -  Setup Server configuration
         4  -  Edit Server configuration
```

```
              5  -  Shutdown Servers
              6  -  Startup Servers

              E  -  Exit configuration procedure

      Enter Option: 6


    Starting OpenVMS Kerberos Servers (Role: SINGLE_KDC)...

    Starting OpenVMS Kerberos server KRB$KRB5KDC ...
    %RUN-S-PROC_ID, identification of created process is 00000060
    Starting OpenVMS Kerberos server KRB$KADMIND ...
    %RUN-S-PROC_ID, identification of created process is 00000061

    Press Return to continue ...

      Kerberos V2.0 for OpenVMS Configuration Menu

      Configuration options:

              1  -  Setup Client configuration
              2  -  Edit Client configuration

              3  -  Setup Server configuration
              4  -  Edit Server configuration

              5  -  Shutdown Servers
              6  -  Startup Servers

              E  -  Exit configuration procedure

      Enter Option: E

  $ @SYS$STARTUP:KRB$STARTUP

  %KRB-I-UPDATE2DO,  Kerberos V2.0 will complete its post-installation
  procedure.

================================================================================
     KRB$V2_UPDATE is migrating your Kerberos V1.0/7.3-1 configuration to V2.0.

================================================================================
  %% Delete sys$common:[sysexe]kerberos_v1dir_2remove.dir;
  %% and its sub-directories when your Kerberos configuration is complete.


  Starting OpenVMS Kerberos Servers (Role: SINGLE_KDC)...

  Starting OpenVMS Kerberos server KRB$KRB5KDC ...
  %RUN-S-PROC_ID, identification of created process is 00000425
  Starting OpenVMS Kerberos server KRB$KADMIND ...
  %RUN-S-PROC_ID, identification of created process is 00000426
  $
```

Installing and Configuring Kerberos on OpenVMS Version 7.2-2 and 7.3

If you previously installed Kerberos Version 1.0 on OpenVMS Version 7.2-2 or 7.3, perform the following steps to update Kerberos to Version 2.0. Example 2-4 shows an update installation log on OpenVMS Version 7.2-2. Example 2-5 shows a configuration log on OpenVMS Version 7.3.

1. Shut down Kerberos Version 1.0, if it was previously installed, by executing SYS$STARTUP:KRB$SHUTDOWN.COM.
2. Remove Kerberos Version 1.0, if it was previously installed, by entering the PRODUCT REMOVE KERBEROS command. (Do not remove the Kerberos data and directories if you want to preserve your Kerberos V1 configuration.)
3. Install the Kerberos Version 2.0 kit by entering PRODUCT INSTALL KERBEROS.
4. Add @SYS$STARTUP:KRB$SYMBOLS to SYS$MANAGER:SYLOGIN.COM, if Kerberos Version 1.0 was not previously installed and configured.
5. Execute KRB$CONFIGURE.COM, if Kerberos Version 1.0 was not previously installed and configured.
6. Start Kerberos by executing SYS$STARTUP:KRB$STARTUP.COM.

Example 2-4 Kerberos Update Installation Log on OpenVMS Version 7.2-2

```
Username: system
Password:

     Last interactive login on Tuesday, June 3, 2003 11:12 AM
    Last non-interactive login on Wednesday, June 4, 2003 02:30 PM

$ @SYS$STARTUP:KRB$SHUTDOWN
$ PRODUCT REMOVE KERBEROS

The following product has been selected:
    CPQ ALPVMS KERBEROS V1.0              Layered Product

Do you want to continue? [YES]

The following product will be removed from destination:
    CPQ ALPVMS KERBEROS V1.0              DISK$TUTU_SYS:[VMS$COMMON.]

Portion done: 0%...10%
Remove OpenVMS Kerberos 5 V1.0 data & directories ? [ Y ]: N

 ...30%...40%...50%...60%...70%...80%...90%...100%

The following product has been removed:
    CPQ ALPVMS KERBEROS V1.0              Layered Products

$ PRODUCT INSTALL KERBEROS

The following product has been selected:
    HP AXPVMS KERBEROS V2.0               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.

HP AXPVMS KERBEROS V2.0

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

Do you want to review the options? [NO]

Execution phase starting ...

The following product will be installed to destination:
    HP AXPVMS KERBEROS V2.0               DISK$TUTU_SYS:[VMS$COMMON.]

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

The following product has been installed:
    HP AXPVMS KERBEROS V2.0               Layered Product

HP AXPVMS KERBEROS V2.0

    Configure the OpenVMS Kerberos clients & servers

    Please take the time to run the following command after the installation:

        @SYS$STARTUP:KRB$CONFIGURE.COM

    The Kerberos 5 V2.0 documentation has been provided as it was received from
    MIT.  This documentation may differ slightly from the OpenVMS Kerberos
    implementation as it describes the Kerberos implementation in a Unix
    environment.

    The documents are:

        KRB$ROOT:[DOC]IMPLEMENT.PDF
        KRB$ROOT:[DOC]LIBRARY.PDF
        KRB$ROOT:[DOC]ADMIN-GUIDE.PS
        KRB$ROOT:[DOC]INSTALL-GUIDE.PS
        KRB$ROOT:[DOC]KRB425-GUIDE.PS
        KRB$ROOT:[DOC]USER-GUIDE.PS
```

Example 2-5 Kerberos Configuration Log on OpenVMS Version 7.3

NOTE Configure Kerberos Version 2.0 if Kerberos Version 1.0 was not previously installed and configured.

```
$ @SYS$STARTUP:KRB$SYMBOLS
$ @SYS$STARTUP:KRB$CONFIGURE

Kerberos V2.0 for OpenVMS Configuration Menu

Configuration options:
```

```
          1  -  Setup Client configuration
          2  -  Edit Client configuration

          3  -  Setup Server configuration
          4  -  Edit Server configuration

          5  -  Shutdown Servers
          6  -  Startup Servers

          E  -  Exit configuration procedure

Enter Option: 1

Where will the OpenVMS Kerberos 5 KDC be running [ system ]:
What is the OpenVMS Kerberos 5 default domain [ abc.xyz.com ]:
What is the OpenVMS Kerberos 5 Realm name [ SYSTEM.ABC.XYZ.COM ]:

Press Return to continue ...

  Kerberos V2.0 for OpenVMS Configuration Menu

  Configuration options:

          1  -  Setup Client configuration
          2  -  Edit Client configuration

          3  -  Setup Server configuration
          4  -  Edit Server configuration

          5  -  Shutdown Servers
          6  -  Startup Servers

          E  -  Exit configuration procedure

Enter Option: 3

Where will the OpenVMS Kerberos 5 KDC be running [ system ]:
What is the OpenVMS Kerberos 5 default domain [ abc.xyz.com ]:
What is the OpenVMS Kerberos 5 Realm name [ SYSTEM.ABC.XYZ.COM ]:
The type of roles the KDC can perform are:
    NO_KDC     -- where the KDC will not be run
    SINGLE_KDC -- where the KDC is the only one in the realm
    MASTER_KDC -- where the KDC is the master of 1 or more other KDCs
    SLAVE_KDC  -- where the KDC is slave to another KDC
What will be the KDC's role on this node [ SINGLE_KDC ]:
Create the OpenVMS Kerberos 5 database [ Y ]:

Creating OpenVMS Kerberos 5 database ...
Initializing database 'krb$root:[krb5kdc]principal' for realm
'SYSTEM.ABC.XYZ.COM',
master key name 'K/M@SYSTEM.ABC.XYZ.COM'
You will be prompted for the database Master Password.
It is important that you NOT FORGET this password.

Enter KDC database master key:
Re-enter KDC database master key to verify:
Priority: info
```

```
No dictionary file specified, continuing without one.

Please enter a default OpenVMS Kerberos 5 administrator [ SYSTEM ]:
Authenticating as principal KRBTSTADM/admin@SYSTEM.ABC.XYZ.COM with
password.

Enter password for principal "SYSTEM/admin@SYSTEM.ABC.XYZ.COM":
Re-enter password for principal "SYSTEM/admin@SYSTEM.ABC.XYZ.COM":
Principal "SYSTEM/admin@SYSTEM.ABC.XYZ.COM" created.
Priority: info
No dictionary file specified, continuing without one.
WARNING: no policy specified for SYSTEM/admin@SYSTEM.ABC.XYZ.COM;
defaulting to no policy
Create OpenVMS Kerberos 5 principals [ Y ]: N
Authenticating as principal SYSTEM/admin@SYSTEM.ABC.XYZ.COM with
password.
Priority: info
No dictionary file specified, continuing without one.
KADMIN_LOCAL: Entry for principal kadmin/admin with kvno 3,
encryption type Triple
DES cbc mode with HMAC/sha1 added to keytab
WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.

KADMIN_LOCAL: Entry for principal kadmin/admin with kvno 3,
encryption type DES
cbc mode with CRC-32 added to keytab
WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.

Authenticating as principal SYSTEM/admin@SYSTEM.ABC.XYZ.COM with
password.
Priority: info
No dictionary file specified, continuing without one.
KADMIN_LOCAL: Entry for principal kadmin/changepw with kvno 3,
encryption type Triple
DES cbc mode with HMAC/sha1 added to keytab
WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.

KADMIN_LOCAL: Entry for principal kadmin/changepw with kvno 3,
encryption type DES
cbc mode with CRC-32 added to keytab
WRFILE=KRB$ROOT:[KRB5KDC]KADM5.KEYTAB.

Press Return to continue ...

  Configuration options:

         1  -  Setup Client configuration
         2  -  Edit Client configuration

         3  -  Setup Server configuration
         4  -  Edit Server configuration

         5  -  Shutdown Servers
         6  -  Startup Servers

         E  -  Exit configuration procedure

  Enter Option: 6
```

```
  Starting OpenVMS Kerberos Servers (Role: SINGLE_KDC)...

  Starting OpenVMS Kerberos server KRB$KRB5KDC ...
  %RUN-S-PROC_ID, identification of created process is 00000429
  Starting OpenVMS Kerberos server KRB$KADMIND ...
  %RUN-S-PROC_ID, identification of created process is 0000042A

  Press Return to continue ...
    Kerberos V2.0 for OpenVMS Configuration Menu

    Configuration options:

           1  -  Setup Client configuration
           2  -  Edit Client configuration

           3  -  Setup Server configuration
           4  -  Edit Server configuration

           5  -  Shutdown Servers
           6  -  Startup Servers

           E  -  Exit configuration procedure

    Enter Option: E

  $ @SYS$STARTUP:KRB$STARTUP

  %KRB-I-UPDATE2DO,  Kerberos V2.0 will complete its post-installation
  procedure.

================================================================================
    KRB$V2_UPDATE is migrating your Kerberos V1.0 configuration to V2.0.

================================================================================
  %% Delete sys$common:[sysexe]krb5kdc.dir;,etc.dir;,bin.dir;,log.dir;,tmp.dir;,doc.dir;
  %% and their sub-directories when your Kerberos configuration is complete.


  Starting OpenVMS Kerberos Servers (Role: SINGLE_KDC)...

  Starting OpenVMS Kerberos server KRB$KRB5KDC ...
  %RUN-S-PROC_ID, identification of created process is 00000425
  Starting OpenVMS Kerberos server KRB$KADMIND ...
  %RUN-S-PROC_ID, identification of created process is 00000426
  $
```

3 Kerberos Client Programs

In addition to the Kerberos database and Key Distribution Center, there are a number of user and administrative programs that allow interaction with Kerberos. This chapter will detail the use of those programs.

The Kerberos user client programs include the following:

- **kinit** – Obtains Kerberos tickets
- **klist** – Lists cached Kerberos tickets
- **kdestroy** – Destroys Kerberos tickets
- **kpasswd** – Changes a user's Kerberos password

The Kerberos administrative client programs include the following:

- **kadmin** and **kadmin_local** – Administers the Kerberos database
- **kdb5_util** – Dumps and restores the Kerberos database
- **kprop** – Propagates the master KDC database to slave KDCs

The symbols for these programs are defined by SYS$MANAGER:KRB$SYMBOLS.COM.

On OpenVMS, these programs are located in the system directory and are prefaced by KRB$; for example, `SYS$SYSTEM:KRB$KINIT.EXE`.

NOTE All options for the client programs are case sensitive. Uppercase options should be enclosed in double quotation marks. For example:

```
$ kinit "-R"
```

User Client Programs

This section describes the user client programs, including `kinit, klist, kdestroy`, and `kpasswd`.

kinit

The `kinit` program allows the user to obtain and cache a Kerberos ticket-granting ticket. A Kerberos principal name must have already been created for the user, or another pre-existing principal must be specified.

The `kinit` program optionally uses the logical name `KRB5CCNAME` to specify the location and name of the credentials (ticket) cache. The default location for the credentials cache is in the `[.KRB.<nodename>]` subdirectory of the user's login directory. The default name of the credentials cache is `KRB5CC_xxxxxx.`; where *xxxxxx* is a randomly generated numeric string.

SYNOPSIS

`kinit` [-5] [-4] [-V] [-l *lifetime*] [-s *start_time*] [-r *renewable_life*]
[-p] [-P] [-f] [-F] [-A] [-v] [-R] [–k [-t *keytab_file*]]
[-c *cache_name*] [-S *service_name*] [*principal*]

OPTIONS

-5 Get Kerberos 5 tickets, overriding the default built-in behavior. This option may be used with `-4`.

-4 Get Kerberos 4 tickets, overriding the default built-in behavior. This option may be used with `-5`.

-V Display verbose output.

-l *lifetime* Request a ticket whose lifetime is specified by *lifetime*. The value for *lifetime* must be followed immediately by one of the following delimiters:

s *seconds*

m *minutes*

h *hours*

d *days*

For example:

```
kinit -l 90m
```

You cannot mix units; a value of `30h30m` will result in an error.

If the `-l` option is not specified, the default ticket lifetime (configured by each site) is used. Specifying a ticket lifetime longer than the maximum ticket lifetime (configured by each site) results in a ticket with the maximum lifetime.

-s *start_time* Request a postdated ticket, valid starting at `start_time`. Postdated tickets are issued with the invalid flag set, and need to be fed back to the KDC before use.

-r *renewable_life* Request renewable tickets, with a total lifetime of `renewable_life`. The duration is the same format as the `-l` option, with the same delimiters. (Not applicable to Kerberos 4.)

-f Request tickets that can be forwarded to another system. (Not applicable to Kerberos 4.)

-F Do not request forwardable tickets. (Not applicable to Kerberos 4.)

-p Request proxiable tickets. (Not applicable to Kerberos 4.)

-P Do not request proxiable tickets. (Not applicable to Kerberos 4.)

-A Request address-less tickets. (Not applicable to Kerberos 4.)

-v Request that the ticket granting ticket in the cache (with the invalid option set) be passed to the KDC for validation. If the ticket is within its requested time range, the cache is replaced with the validated ticket. (Not applicable to Kerberos 4.)

-R	Request renewal of the ticket-granting ticket. Note that an expired ticket cannot be renewed, even if the ticket is still within its renewable life. When using this option with Kerberos 4, the KDC must support Kerberos 5 to Kerberos 4 ticket conversion.
-k [**-t** ***keytab_file***]	Request a host ticket, obtained from a key in the local host's keytab file. The name and location of the keytab file may be specified with the `-t keytab_file` option; otherwise the default name and location will be used. When using this option with Kerberos 4, the KDC must support Kerberos 5 to Kerberos 4 ticket conversion.
-c ***cache_name***	Use `cache_name` as the credentials (ticket) cache name and location; if this option is not used, the default cache name and location are used. The default credentials cache may vary between systems. If the `KRB5CCNAME` logical name is set, its value is used to name the default ticket cache. Any existing contents of the cache are destroyed by `kinit`. (Not applicable to Kerberos 4).
-S ***service_name***	Specify an alternate service name to use when getting initial tickets.

klist

The `klist program` allows the user to display information about their cached Kerberos tickets. (Applicable to Kerberos 5, or to Kerberos 4 ticket conversion if you use both Kerberos 5 and Kerberos 4 with a KDC that supports Kerberos 5.)

SYNOPSIS

`klist` [-5] [-4] [-e] [[-c] [-f] [-s] [-a [-n]]] [-k [-t] [-K]]

[*cache_name* | *keytab_name*]

OPTIONS

-5	List Kerberos 5 credentials. This overrides whatever the default built-in behavior may be. This option may be used with `-4`.
-4	List Kerberos 4 credentials. This overrides whatever the default built-in behavior may be. This option may be used with `-5`.
-e	Display the encryption types of the session key and the ticket for each credential in the credential cache, or each key in the keytab file.
-c	List the tickets held in a credentials cache. This is the default if neither `-c` nor `-k` is specified.
-f	Show the options present in the credentials. Possible options are as follows: **F** Forwardable **f** forwarded **P** Proxiable **p** proxy **D** postDateable **d** postdated

R Renewable

I Initial

i invalid

-s Cause `klist` to run silently (produce no output) but to still set the exit status according to whether it finds the credential cache. The exit status is `SS$_NORMAL` if `klist` finds a credentials cache.

-a Display list of addresses in credentials.

-n Show numeric addresses instead of reverse-resolving addresses.

-k List the keys held in a keytab file.

-t Display the time entry timestamps for each keytab entry in the keytab file.

-K Display the value of the encryption key in each keytab entry in the keytab file.

If *cache_name* or *keytab_name* is not specified, `klist` will display the credentials in the default credentials cache or keytab file as appropriate. If the `KRB5CCNAME` logical name is set, its value will be used to name the default ticket cache.

kdestroy

The `kdestroy` program destroys the user's active Kerberos authorization tickets by writing zeros to the specified credentials cache that contains them. If the credentials cache is not specified, the default credentials cache is destroyed. The default behavior is to destroy both Kerberos 5 and Kerberos 4 credentials.

SYNOPSIS

`kdestroy` [-5] [-4] [-q] [-c *cache_name*]

OPTIONS

-5 Destroy Kerberos 5 credentials. This overrides whatever the default built-in behavior may be. This option may be used with –4.

-4 Destroy Kerberos 4 credentials. This overrides whatever the default built-in behavior may be. This option may be used with –5.

-q Quiet mode. Normally, `kdestroy` beeps if it fails to destroy the user's tickets, in addition to issuing an error message. The `-q` option suppresses the beep, and only an error is issued.

-c *cache_name* Use *cache_name* as the credentials (ticket) cache name and location. If this option is not used, the default cache name and location are used.

If the `KRB5CCNAME` logical name is set, its value is used to name the default ticket cache.

HP recommends that you place the `kdestroy` command in a logout command file, so that your tickets are destroyed automatically when you log out.

kpasswd

The `kpasswd` program is used to change a Kerberos principal's password. The `kpasswd` program prompts for the current Kerberos password, which is used to obtain a `changepw` ticket from the KDC for the user's Kerberos realm. If `kpasswd` successfully obtains the `changepw` ticket, the user is prompted twice for the new password, and the password is changed.

If the principal is governed by a policy that specifies the length or number of character classes required in the new password, the new password must conform to the policy. (The five-character classes are: lowercase, uppercase, numbers, punctuation, and all other characters.)

SYNOPSIS

`kpasswd` [*principal*]

OPTIONS

principal Change the password for the Kerberos principal specified by `principal`. Otherwise, the principal is derived from the identity of the user invoking the `kpasswd` command.

Administrative Client Programs

This section describes the administrative utilities, including `kadmin, kadmin_local, kdb5_util`, and `kprop`.

kadmin and kadmin_local

The `kadmin` program allows the Kerberos administrator to make changes to the Kerberos database. The `kadmin` program provides for the maintenance of Kerberos principals, policies, and service key tables (keytabs). It exists as both a Kerberos client (`kadmin`), using Kerberos authentication and an RPC to operate securely from anywhere on the network, and as a local client (`kadmin_local`), intended to run directly on the KDC without Kerberos authentication.

SYNOPSIS

`kadmin` [-r *realm*] [-p *principal*] [-w *password*] [-q *query*]
[-s *admin_server[:port]*] [[-c *credentials_cache*] |
[-k *keytab*]]

`kadmin_local` [-d *dbname*] [-e *"enc:salt …"*] [-m]

Options

-r *realm* Use *realm* as the default Kerberos realm for the database.

-p *principal* Use the Kerberos principal *principal* to authenticate to Kerberos. If this option is not given, `kadmin` will append `admin` to either the primary principal name or to the username of the current process.

-w *password* Use *password* as the password instead of prompting for one.
Caution: Placing the password for a Kerberos principal with administrative access into a command file can be dangerous if unauthorized users gain read access to the file.

-q *query* Pass the string *query* directly to `kadmin`. This is useful for writing command procedures that pass specific queries to `kadmin`.

-s *admin_server[:port]* Use *admin_server* as the KDC to contact. Optionally specify the TCP/IP port to use for communication.

-c *credentials_cache* Use *credentials_cache* as the credentials cache. The credentials cache should contain a service ticket for the `kadmin/admin` service, which can be acquired with the `kinit` program. If this option is not specified, `kadmin` requests a new service ticket from the KDC and stores it in its own temporary cache.

-k *keytab* Use the keytab *keytab* to decrypt the KDC response instead of prompting for a password on the terminal. In this case, the principal will be `host/hostname`.

-d *dbname* This option is valid for `kadmin_local` only. Specify the filename of the KDC database.

-e *"enc:salt..."* This option is valid for `kadmin_local` only. It sets the list of cryptosystem and salt types to be used for any new keys created. Available types include `des3-cbc-sha1:normal, des-cbc-crc:normal`, and `des-cbc-crc:v4`.

-m This option is valid for `kadmin_local` only. Specify the KDC database master key.

kdb5_util

The `kdb5_util` program provides a way for the Kerberos administrator to create, delete, load, or dump a Kerberos database. It also includes a command to stash a copy of the master database key in a file on a KDC, so that the KDC can authenticate itself to the `kadmind` and `krb5kdc` daemons at boot time.

SYNOPSIS

`kdb5_util` [-r *realm*] [-d *dbname*] [-k *mkeytype*] [-M *mkeyname*]
[-sf *stashfilename*] [-m] command [*command_options*]

OPTIONS

-r *realm* Use *realm* as the default Kerberos realm for the database.

-d *dbname* Specify the filename at the KDC database.

-k *mkeytype* Specify the encryption type to use from the list of supported `mtypes` in `KDC.CONF`.

-M *mkeyname* Specify the master key name.

-sf *stashfilename* Specify the file that stores the master key. If you specify this file, you are not prompted for the master key.

-m Specify the KDC database master key.

command

The `kdb5_util` command can be one of the following:

ark [-e *etype_list*] *principal*

Add a random key for a Kerberos 5 database entry principal. This assumes the *max key* version number. As a side effect, all old keys older than the maximum key version number are deleted.

-e *etype_list*

Specify the key salt to use for the random key.

create [-s]

Create a new Kerberos database. If you specify the `-s` option, `kdb5_util` stashes a copy of the master key in a stash file.

destroy [-f]

Destroy the existing Kerberos database. If you do not specify the `-f` option, you are prompted with "are you sure?" before the database is destroyed.

dump [-old] [-b6] [-ov] [-verbose] [-mkey_convert] [-new_mkey_file *mkey_file*] [-rev] [-recurse] [*filename* [princs...]]

Dump a Kerberos database to a file.

-old

Cause the dump file to be Kerberos 5 Beta 5 and earlier dump format (`kdb5_edit load_dump version 2.0`).

-b6

Cause the dump file to be Kerberos 5 Beta 6 format ("kdb5_edit load_dump version 3.0").

-ov

Cause the dump to be in `ovsec_adm_export` format.

-verbose

Cause the name of each principal and policy to be printed as it is dumped.

-mkey_convert

Change master key as part of dump.

-new_mkey_file *mkey file*

Get master key from file `mkey_file`.

-rev

Dump in reverse order.

-recurse

Do recursive descent tree traversal of database instead of using previous/next pointers.

filename

File name of the dump file to be output.

[**princs**]

Principal name to be dumped.

dump_v4 *filename*

Dump a Kerberos database to a file in Kerberos V4 format.

filename

File name of the dump file to be output.

load [-old] [-b6] [-ov] [-verbose] [-update] *filename*

Restore a Kerberos database dump from a file, specified by *filename*.

-old

Requires the dump to be in the Kerberos 5 Beta 5 and earlier dump format (`kdb5_edit load_dump v2.0`).

-b6

Require the dump to be in the Kerberos 5 Beta 6 format (`kdb5_edit load_dump v3.0`).

-ov

Require the dump to be in `ovsec_adm_export` format

-verbose

Cause the name of each principal and policy to be printed as it is dumped.

-update

Cause records from the dump file to be updated in or added to the existing database.

filename

File name of the dump file to load.

load_v4 [-t] [-n] [-v] [-K] [-s *stashfile*] *inputfile*

Restore a Kerberos database dump from a Kerberos V4 format dump file (specifed by *inputfile*).

-t

Allow modification of an existing database. If you do not specify `-t`, the load will abort if the database exists.

-n

Read the Kerberos V4 master key from the key file.

-v

Cause the name of each principal and policy to be printed as it is dumped.

-K

Prompt for the Kerberos V5 database master password.

-s *stashfile*

Specify the location of the Kerberos V4 master key file.

inputfile

Filename of the V4 dump file to load.

stash [-f *keyfile*]

Create a stash file, which allows a KDC to authenticate itself to the database programs `kadmin, kadmind, krb5kdc`, and `kdb5_util`. If the `-f` option is not specified, `kdb5_util` stashes the key in the file specified in the `KRB$ROOT:[KRB5KDC]KDC.CONF` file.

kprop

The `kprop` program propagates the master KDC database to slave KDCs.

The following sections describe the procedure you should use to propagate your master KDC database. This procedure involves performing steps first on the master system, then the slave system, and back and forth again until finishing with the master system.

In the following procedure, the steps are numbered M1, M2, and so on for the master KDC server, and S1, S2 and so on for the slave KDC server.

Kerberos must be installed on both the master and slave systems.

PROCEDURE

Step 1: Configure the Master KDC Server for Propagation

M1. On the master KDC server, enter the following command:

```
$ @SYS$STARTUP:KRB$CONFIGURE
```

M2. Set up the client.

M3. Set up the server.

M4. Exit the `KRB$CONFIGURE.COM` file.

M5. If you added additional `USER/admin` principals during your configuration (other than your first admin principal), add them to `KRB$ROOT:[KRB5KDC]KADM5.ACL`.

M6. Add your anticipated slave hosts to `KRB$ROOT:[ETC]KRB5.CONF` under the `realms` tag using a `kdc` tag as follows:

```
USER/admin@REALM

kdc = nodename.domain:88
```

M7. To create `KRB$ROOT:[BIN]KRB$KPROP.DAT` from the template file `KRB$KPROP_DAT.TEMPLATE`, copy `KRB$KPROP_DAT.TEMPLATE` to `KRB$KPROP.DAT`, and edit `KRB$KPROP.DAT` as follows:

a. Comment out the example node name lines with a # sign.

b. Add all of your slave node names either as just the simple node name or as fully qualified node names that include their respective domain names. Be consistent in the naming method you choose. It is safest to use the node name form that is used to define your node names in your local TCP/IP host setting. If you use DNS to manage your local host lookups, you will need to use fully qualified node and domain name strings.

   If you specify local host names, know the form of the node name you use, define all propagation node names that way in the local TCP/IP host database, and enter these propagation node names in the form that they are locally defined.

Try to define all propagation nodes in your local TCP/IP hosts database, or leave them all defined in DNS and not in your local database. If you see client not found errors during propagation, review your node name definitions and the form that you have in the local TCP/IP database.

c. The KRB$KPROP.DAT file is simply a data file that is read by the kprop command file to see where database propagation is performed. Make sure you do not include the local server node name in this data file. The propagation server does not need its own data propagated to itself.

d. You need only perform step M7 on those nodes that might act as the master KDC server at some future point, and need to have master database changes propagated to them.

M8. Create the KRB$ROOT:[KRB5KDC]KPROPD.ACL file as follows. There is no template for this file. This file defines the names of the hosts that will be involved in propagation and includes the master server entity. (This step will also have to be performed on each of your slave KDCs.)

a. Edit KRB$ROOT:[KRB5KDC]KPROPD.ACL to add each slave KDC host/name keytab entry that will be created in Step M11.

The form depends on how your node names are defined in TCP/IP. You can use either of the following forms. The @REALM portion is required.

```
host/yournode@REALM

host/yournode.yourdomain@REALM
```

b. If your local TCP/IP database defines the node names, the form of your node name in Step M8a must match that of your TCP/IP database

c. Be sure to include the host/entry for your master KDC.

M9. Start your master server and run KADMIN.

NOTE In steps M10 and M11, it is critical that the node names are in the same form as your local TCP/IP node name. You can use either simple node names or fully qualified DNS node names, as long as you are consistent.

M10. Add the host/principals with the following commands:

```
addprinc -randkey host/yourmasternode

addprinc -randkey host/yourslavenode
```

M11. Add/export the host/keytabs with the following commands:

```
ktadd host/yourmasternode@REALM

ktadd host/yourslavenode@REALM
```

NOTE The @REALM part of this file name is important and must match the REALM entered into KPROPD.ACL in step M8.

M12. Restart your master KDC server using the latest configuration.

Step 2: Configure the Slave KDC Servers for Propagation

After you configure the master server, perform the following steps to configure the slave KDC server.

S1. To configure your slave KDC client, enter the master KDC server name when asked where the master KDC server resides. Do not use your local node name.

S2. Set up your slave KDC server by entering the following command:

```
$ @SYS$STARTUP:KRB$CONFIGURE
```

Note the following:

- Your KDC node name is your local node, not the master KDC node name.
- Specify `SLAVE_KDC`, if it is not the default.
- Add a local `admin` principal. (This will not be used.)
- Accept the defaults for the remaining questions.

S3. Exit the configuration file and perform step M7 from the previous section only if, in the future, you may use this slave KDC as a master KDC server. Otherwise, go to step S4.

S4. Perform Step 1, M8 on your slave KDC node. You can copy the file from the server or edit a new file using the same `host/entry` information. This step is required for propagation.

S5. Export the master server's `host/keytabs` to the local KDC slave server keytab file. Because the slave server is configured as a client in the master KDC, you can `kinit` as the master KDC server's admin and run `kadmin` to extract the server's keytabs as shown in Step 1, M11. This will create your local keytab file with the MASTER KDC server keytab information. Issue a `listprincs` command and then `ktadd` the host principals.

S6. Edit `KRB$ROOT:[KRB5KDC]KRB$ROLE.DAT`. Change the second data line from a zero to a one (0 to 1), and save the file. This tells `KRB$CONFIGURE` that the `KRB$KPROPD.EXE` daemon must be started when the slave server is started.

S7. Edit `KRB$ROOT:[ETC]KRB5.CONF` and add the slave and master KDC nodes under the `realms` tag, if they do not exist. Here, you can safely specify fully qualified node names with their domain names as follows:

```
kdc = yourmasternode.yourdomain:88

kdc = yourslavenode.yourdomain:88
```

Make sure the record format for `KRB5.CONF` and `KPROPD.ACL` is `STREAM_LF`.

CAUTION Do not start the slave server yet.

Step 3: Complete the Configuration of the Master KDC Server

Perform the following steps on the master server.

M13. Run `kadmin` and re-export only the master's `host/keytab` as in Step 1, M11. Because this keytab was exported on one or more slaves, the key version number is now greater than when this keytab was originally exported, and the slave KDCs will not be able to authenticate to the master KDC with a lower key version number.

M14. In `kadmin`, enter the following command:

```
ktadd host/yourmaster@REALM
```

NOTE You may have to remove the host keytabs and principals and re-add them if the slave and master cannot agree on the key version numbers. This is an issue only with the master KDC keytab after keys are added to the slaves. This step does correct certain authentication problems.

M15. Restart the master server.

Step 4: Complete the Configuration of the Slave KDC Server

Perform the following steps on the slave server.

S8. Use `kinit` to get to your master server's `admin` account. This will refresh the master's host keytab on the local system and start the slave server in preparation for its first propagation from the master.

Step 5: Propagate the Master KDC Server to Each Configured Slave Server

Perform the following steps to complete the propagation procedure.

M16. Enter the following command:

```
@KRB$ROOT:[BIN]KRB$KPROP.COM
```

The `kprop` command procedure causes the following to occur:

a. The master server is stopped, the database dumped, the servers restarted, and a connection to each slave `kpropd` daemon is made in order to transfer the master database to the slave servers listed in `KRB$ROOT:[BIN]KRB$KPROP.DAT`.

b. The slave servers are stopped, the master KDC database is loaded, the slave servers are restarted, and a signal is sent to the master server that the propagation has successfully completed.

c. The master server produces a file called `SLAVE_DATATRANS_DAT_YOURSLAVENODE.LAST_PROP` that indicates that the propagation to the individual slave node has completed.

d. When propagation to each slave server completes, the kpropd.exe daemon exits. The next propagation can be done only after starting the `kpropd` daemon on each of the KDC slave servers. This is why `kpropd` should be a TCP/IP service. The TCP/IP system automatically starts the `kpropd` daemon for each slave server requested by the master server.

4 Kerberos Programming Concepts

This chapter provides an overview of programming with Kerberos on OpenVMS.

Information in this chapter includes:

- An overview of building a Kerberos application on OpenVMS
- Descriptions of the Kerberos example programs

Overview of Building a Kerberos Application on OpenVMS

Kerberos programming on OpenVMS works much the same as on any other platform. The following sections indicate differences and important information.

Compiling a Kerberos Program on OpenVMS

When you compile your program, you will need to add the `/INCLUDE=KRB$ROOT:[INCLUDE]` qualifier to your compiler command line. For example:

```
$ cc/list/include=krb$root:[include]/prefix=all gss_client
```

Linking a Kerberos Program on OpenVMS

Kerberos on OpenVMS provides shareable libraries in both 64-bit and 32-bit formats. All Kerberos libraries can be found in `SYS$LIBRARY`.

Library Name	Bit Format
`GSS$RTL.EXE`	64 bits
`GSS$RTL32.EXE`	32 bits
`KRB$RTL.EXE`	64 bits
`KRB$RTL32.EXE`	32 bits

One of the `GSS$RTL*` libraries should be used when your program calls the GSS API. If the KRB5 API is called, then one of the `KRB$RTL*` libraries will need to be linked with the program.

Because Kerberos routines are located in shareable libraries, the use of a link options file is recommended. For details about using link options files, refer to the *HP OpenVMS Linker Utility Manual*. The Kerberos example programs described in this chapter provide examples of using link options files for Kerberos applications.

Kerberos Example Programs

This section describes the Kerberos example programs. Kerberos must be configured before any example program is run. For the configuration procedure, see Chapter 2.

The Kerberos example programs are found in SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS...].

The Kerberos example programs are divided between those examples that use DCL to build and those that use GMAKE to build.

DCL Example Programs

The SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS.DCL] directory in the Kerberos example directory tree contains the Version 1.0 example programs and build procedures. (No new examples were added to the DCL directory for Version 2.0.) These example programs are described in the following sections.

There are two DCL example programs, each of which has a client and server piece. Command procedures to build and help set up the example programs are provided, along with readme files specific to each example.

The examples should be built and run from a local build area or directory. The following table lists the DCL example programs and information about what aspect of Kerberos each program is attempting to convey.

DCL Example Program	Description
GSS_CLIENT and GSS_SERVER	GSSAPI example program
KRB_CLIENT and KRB_SERVER	KRB5 API example program

GSSAPI Example Program

The GSSAPI example program is a simple client/server program that authenticates using the GSSAPI.

To run the GSSAPI example client program, perform the following steps:

1. Create a Kerberos principal name of gss_sample/<node name>@<realm name> before this program is run.
2. Copy the GSS_*.* example files and the BUILD.COM and SETUP.COM files into a local build area, and then execute the BUILD command file as follows:

```
$ COPY SYS$COMMON:[SYSHLP.EXAMPLES.KRB]GSS*.* <local_build_area>
$ COPY SYS$COMMON:[SYSHLP.EXAMPLES.KRB]*.COM <local_build_area>
$ SET DEF <local_build_area>
$ @BUILD GSS
```

3. Execute the SETUP command file to define the necessary symbols to run the example.
4. Ensure that Kerberos has been initialized and started, and that the necessary Kerberos principal name has been created in the Kerberos database. The SETUP command file has additional information about creating the principal name.
5. Copy either GSS_CLIENT.EXE or GSS_SERVER.EXE to another node in the same Kerberos realm, along with the SETUP command file.
6. Start the client program and server programs using the symbols defined in SETUP.COM.

GSS_CLIENT

SYNOPSIS

```
gss_client [-p port] [message] [host] [service]
```

OPTIONS

-p *port*

Specifies the TCP/IP port to use for communications. If this argument is absent, port number 4444 is used.

message

Specifies the text message to pass between client and server.

host

Specifies the host system where the GSS_SERVER is located.

service

GSS_SERVER

SYNOPSIS

```
gss_server [-p port] [-l logfile] [service]
```

OPTIONS

-p *port*

Specifies the TCP/IP port to use for communications. If this argument is absent, port number 4444 is used.

-l *logfile*

Indicates that a logging file with the file name specified by *logfile* should be opened when the GSS_SERVER program is started.

service

Specifies the service name. If this argument is absent, gss_sample is used as the service name.

KRB5 API Example Program

The KRB5 example program is a simple client/server program that authenticates using the Kerberos API.

To run the KRB5 API example program, perform the following steps:

1. Create a Kerberos principal name of krb_sample/<node name>@<realm name> before this program is run.
2. Copy the KRB_*.* example files and the BUILD.COM and SETUP.COM files into a local build area, and then execute the BUILD command file as follows:

```
$ COPY SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS.DCL]KRB*.* <local_build_area>
$ COPY SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS.DCL]*.COM <local_build_area>
$ SET DEF <local_build_area>
$ @BUILD KR
```

3. Execute the SETUP command file to define the necessary symbols to run the example.

4. Ensure that Kerberos has been initialized and started and that the necessary Kerberos principal name has been created in the Kerberos database. The SETUP command file has additional information about creating the principal name.
5. Copy either the KRB_CLIENT.EXE or KRB_SERVER.EXE to another node in the same Kerberos realm, along with the SETUP command file.
6. Start the client and server programs using the symbols defined in SETUP.COM.

KRB5_CLIENT

SYNOPSIS

krb5_client [-p *port*] [*message*] [*host*] [*service*]

OPTIONS

-p port

Specifies the TCP/IP port to use for communications. If this argument is absent, port number 4444 is used.

message

Specifies the text message to pass between client and server.

host

Specifies the host system where the KRB_SERVER is located.

service

Specifies the service name. If this argument is absent, krb_sample is used as the service name.

KRB5_SERVER

SYNOPSIS

krb_server [-p *port*] [-l *logfile*] [*service*]

OPTIONS

-p *port*

Specifies the TCP/IP port to use for communications. If this argument is absent, port number 4444 is used.

-l *logfile*

Indicates that a logging file with the file name specified by *logfile* should be opened when the KRB_SERVER program is started.

service

Specifies the service name. If this argument is absent, krb_sample is used as the service name.

GMAKE Example Programs

The SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS.GMAKE...] directory in the Kerberos example directory tree contains the Version 2.0 examples that build with GMAKE.

GMAKE.VMS Directory

The example programs in the SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS.GMAKE.VMS] subdirectory contain the original OpenVMS Kerberos Version 1.0 example programs (GSSAPI and KRB5). These examples are built with GMAKE instead of DCL. These programs show you how the two GMAKE and DCL build processes compare using the same code base.

This build can produce the GSS and KRB example programs built against the 64-bit and 32-bit Kerberos and GSS libraries respectively. Both types of builds can be produced without directory conflict, and they can be run out of their respective build directories.

The server awaits a connection on a socket, receives a message from the client that it prints out, and then echoes back to the client. Run each program with "-?" to see the runtime options for the client and server.

GMAKE.MIT Directory

Four example programs are new to Version 2.0 and are found in the SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS.GMAKE.MIT] subdirectory.

Each of these examples builds against the 32-bit KRB and GSS runtime libraries. Because of the form of UNIX I/O functions that they use, the 64-bit Kerberos libraries cannot be used.

The following table lists the new GMAKE example programs found in SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS.GMAKE.MIT] and information about what aspect of Kerberos each program is attempting to convey.

GMAKE Example Program	Description
GSS-SAMPLE	32-bit based application that uses the 32-bit GSS$RTL32 library on Alpha, and the 32-bit implementations of the UNIX I/O library function calls
SAMPLE	Demonstration client/server application
SIMPLE	UDP-based client and server application
USER_USER	Demonstrates a TCP/IP service name used to securely communicate between two network applications

GSS-SAMPLE Example Program

The SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS.GMAKE.MIT.GSS-SAMPLE] subdirectory contains a GSS-SAMPLE.README file that describes in detail the function and operation of the GSS-SAMPLE program. It is a 32-bit based application that uses the 32-bit GSS$RTL32 library on Alpha. It also uses the 32-bit implementations of the UNIX I/O library function calls.

This directory also contains a sample GSSAPI client and server application. In addition to serving as an example of GSSAPI programming, this application is also intended to be a tool for testing the performance of GSSAPI implementations. Each time the client is invoked, it performs one or more exchanges with the server.

The client application can be used to simulate a variety of workloads on the server. It can serve as an example of how to create a performance application to test a new Kerberos GSSAPI based application of your own.

Several command line options can be used to define how the client will interact with the server. The GSS-SAMPLE.README file lists these options in detail. The following is a summary of GSS-SAMPLE options:

SYNOPSIS

```
gss-sample [-d] [-f] [-ccount] [-mcount] [-na] [-nx] [-nw] [-nm]
```

OPTIONS

-d

Tells the client to delegate credentials to the server. For the Kerberos GSSAPI mechanism, this means that a forwardable TGT will be sent to the server, which will put it in its credential cache. You must have acquired your tickets with `kinit -f` for this to work.

-f

Tells the client that the `msg` argument is actually the name of a file whose contents should be used as the message.

-ccount

Specifies how many sessions the client should initiate with the server (the `connection count`).

-mcount

Specifies how many times the message should be sent to the server in each session (the `message count`).

-na

Tells the client not to do any authentication with the server. Implies `-nw`, `-nx` and `-nm`.

-nx

Tells the client not to encrypt messages.

-nw

Tells the client not to wrap messages. Implies `-nx`.

-nm

Tells the client not to ask the server to send back a cryptographic checksum (MIC).

SAMPLE Example Program

The `SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS.GMAKE.MIT.SAMPLE]` subdirectory contains the build for a server and a client called `sserver` and `sclient`, respectively, that are a simple demonstration client/server application.

When `sclient` connects to `sserver`, it performs a Kerberos authentication, then `sserver` returns to `sclient` the Kerberos principal that was used for the Kerberos authentication. This example provides a good test that Kerberos has been successfully installed and configured on a machine.

The `sclient` and `sserver` images are built in separate directories, but the client and server are run from the top-level directory. There is a complete README file in the `sserver` directory that describes the detailed information for configuring and running these examples. You can get a fast start by simply running `SAMPLE_SETUP.COM` in this directory for both the client and the server windows.

SIMPLE Example Program

The `SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS.GMAKE.MIT.SIMPLE]` subdirectory contains a UDP-based client and server example. It is similar to the original Version 1.0 `KRB_CLIENT` and `KRB_SERVER` examples, except that it uses UDP socket-based I/O. The server receives a message from the client and simply reports what it has received. The client reports that it successfully sent the data.

USER_USER Example Program

The SYS$COMMON:[SYSHLP.EXAMPLES.KERBEROS.GMAKE.MIT.USER_USER] subdirectory holds a client and a server example that can be used to see how a TCP/IP service name can be used to securely communicate between two network applications. It is similar to the original Version 1.0 KRB_CLIENT and KRB_SERVER examples, except that a TCP/IP service name is defined and used to tell the client the port number on which the server is listening. The client sends its data to the server and the server responds to the client with the message the client sent.

5 GSSAPI (Generic Security Services Application Programming Interface)

This chapter describes the C language bindings for the routines that make up the Generic Security Services Application Programming Interface (GSSAPI).

The GSSAPI provides security services to its callers, and is intended for implementation atop alternative underlying cryptographic mechanisms. In this manual, the underlying cryptographic mechanism is assumed to be Kerberos.

The GSSAPI allows a communicating application to authenticate the user associated with another application, to delegate rights to another application, and to apply security services such as confidentiality and integrity on a per-message basis.

There are four stages to using the GSSAPI:

- The application acquires a set of credentials with which it can prove its identity to other processes.
- A pair of communicating applications establish a joint security context using their credentials. The security context is a pair of GSSAPI data structures that contain shared state information.
- Per-message services are invoked to apply either integrity and data origin authentication, or confidentiality, integrity, and data authentication to application data.
- At the completion of a communications session, the peer applications call GSSAPI routines to delete the security context.

Routines described in this chapter are implemented in the Generic Security Service library (`GSS$RTL.EXE` for 64-bit interfaces, or `GSS$RTL32.EXE` for 32-bit interfaces) in `SYS$LIBRARY`.

gss_accept_sec_context — Establish a security context

C Prototype

```
OM_uint32 gss_accept_sec_context(
      OM_uint32                 minor_status,
      gss_ctx_id_t              context_handle,
      gss_cred_id_t             acceptor_cred_handle,
      gss_buffer_t              input_token_buffer,
      gss_channel_bindings_t    input_chan_bindings,
      gss_name_t                src_name,
      gss_OID                   mech_type,
      gss_buffer_t              output_token,
      OM_uint32                 ret_flags,
      OM_uint32                 time_rec,
      gss_cred_id_t             delegated_cred_handle );
```

Arguments

minor_status (output)	Mechanism-specific status code.
context_handle (input/output)	The context handle for the new context. Supply GSS_C_NO_CONTEXT for the first call; use the value returned in subsequent calls. Once `gss_accept_sec_context` has returned a value via this argument, resources have been assigned to the corresponding context, and must be freed by the application after use with a call to `gss_delete_sec_context`.
acceptor_cred_handle (input)	The credential handle claimed by the context acceptor. Specify GSS_C_NO_CREDENTIAL to accept the context as a default principal. If GSS_S_NO_CREDENTIAL is specified, but no default acceptor principal is defined, GSS_S_NO_CRED will be returned.
input_token_buffer (input)	The token obtained from the remote application.
input_chan_bindings (input)	Application-specified bindings. Allows the application to securely bind channel identification information to the security context. If channel bindings are not used, specify GSS_C_NO_CHANNEL_BINDINGS.
src_name (output)	The authenticated name of the context initiator. After use, this name should be deallocated by passing it to `gss_release_name`. If not required, specify NULL.
mech_type (output)	The security mechanism used. The returned OID value will be a pointer into static storage, and should be treated as read only by the caller (in particular, it does not need to be freed). If not required, specify NULL.
output_token (output)	The token to be passed to the peer application. If the length field of the returned token buffer is zero, then no token need be passed to the peer application. If a nonzero length field is returned, the associated storage must be freed after use by the application with a call to `gss_release_buffer`.

ret_flags (output)

A bit mask which contains various independent flags, each of which indicates that the context supports a specific service option. Symbolic names are provided for each flag, and the symbolic names corresponding to the required flags should be logically ANDed with the `ret_flags` value to test whether a given option is supported by the context. The flags are:

GSS_C_DELEG_FLAG

TRUE — Delegated credentials are available via the `delegated_cred_handle` argument.

FALSE — No credentials were delegated.

GSS_C_MUTUAL_FLAG

TRUE — The remote peer asked for mutual authentication.

FALSE — The remote peer did not ask for mutual authentication.

GSS_C_REPLAY_FLAG

TRUE — Replay of protected messages will be detected.

FALSE — Replayed messages will not be detected.

GSS_C_SEQUENCE_FLAG

TRUE — Out-of-sequence protected messages will be detected.

FALSE — Out-of-sequence messages will not be detected.

GSS_C_CONF_FLAG

TRUE — Confidentiality service may be invoked by calling the `gss_wrap` routine.

FALSE — No confidentiality service (via `gss_wrap`) is available. The `gss_wrap` routine will provide message encapsulation, data-origination authentication and integrity services only.

GSS_C_INTEG_FLAG

TRUE — Integrity service may be invoked by calling either the `gss_get_mic` or `gss_wrap` routine.

FALSE — Per-message integrity service is unavailable.

GSS_C_ANON_FLAG

TRUE — The initiator does not wish to be authenticated; the src_name argument (if requested) contains an anonymous internal name.

FALSE — The initiator has been authenticated normally.

GSS_C_PROT_READY_FLAG

TRUE — Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available if the accompanying status return value is either GSS_S_COMPLETE or GSS_S_CONTINUE_NEEDED.

FALSE — Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available only if the accompanying status return value is GSS_S_COMPLETE.

GSS_C_TRANS_FLAG

	TRUE — The resultant security context may be transferred to other processes via a call to `gss_export_sec_context`. FALSE — The security context is not transferable. All other bits should be zero.
time_rec (output)	The number of seconds for which the context will remain valid. Specify NULL if not required.
delegated_cred_handle (output)	The credential handle for credentials received from the context initiator. Only valid if `deleg_flag` in `ret_flags` is TRUE, in which case an explicit credential handle (that is, not GSS_C_NO_CREDENTIAL) will be returned; if `deleg_flag` is false, `gss_accept_context` will set this argument to GSS_C_NO_CREDENTIAL. If a credential handle is returned, the associated resources must be released by the application after use with a call to `gss_release_cred`. Specify NULL if not required.

Description

This routine allows a remotely initiated security context between the application and a remote peer to be established. The routine may return an `output_token` that should be transferred to the peer application, where the peer application will present it to `gss_init_sec_context`. If no token need be sent, `gss_accept_sec_context` will indicate this by setting the length field of the `output_token` argument to zero. To complete the context establishment, one or more reply tokens may be required from the peer application; if so, `gss_accept_sec_context` will return a status flag of GSS_S_CONTINUE_NEEDED, in which case it should be called again when the reply token is received from the peer application, passing the token to `gss_accept_sec_context` via the `input_token` arguments.

Portable applications should be constructed to use the token length and return status to determine whether a token needs to be sent or waited for. A typical portable caller should always invoke `gss_accept_sec_context` within a loop. For example:

```
gss_ctx_id_t context_hdl = GSS_C_NO_CONTEXT;

do {
    receive_token_from_peer(input_token);

    maj_stat = gss_accept_sec_context(  &min_stat,
                                                        &context_hdl,
                                                        cred_hdl,
                                                        input_token,
                                                        input_bindings,
                                                        &client_name,
                                                        &mech_type,
                                                        output_token,
                                                        &ret_flags,
                                                        &time_rec,
                                                        &deleg_cred);
    if (GSS_ERROR(maj_stat)) {
        report_error(maj_stat, min_stat);
    };
    if (output_token->length != 0) {
        send_token_to_peer(output_token);
        gss_release_buffer(&min_stat, output_token);
    };
    if (GSS_ERROR(maj_stat)) {
        if (context_hdl != GSS_C_NO_CONTEXT)
```

```
            gss_delete_sec_context(     &min_stat,
                                               &context_hdl,
                                               GSS_C_NO_BUFFER);
        break;
    };
} while (maj_stat & GSS_S_CONTINUE_NEEDED);
```

Whenever the routine returns a status that includes the value GSS_S_CONTINUE_NEEDED, the context is not fully established and the following restrictions apply to the output arguments:

- The value returned via the `time_rec` argument is undefined unless the accompanying `ret_flags` argument contains the bit GSS_C_PROT_READY_FLAG, indicating that per-message services may be applied in advance of a successful completion status. The value returned via the `mech_type` argument may be undefined until the routine returns a status of GSS_S_COMPLETE.
- The value of the GSS_C_DELEG_FLAG, GSS_C_MUTUAL_FLAG, GSS_C_REPLAY_FLAG, GSS_C_SEQUENCE_FLAG, GSS_C_CONF_FLAG, GSS_C_INTEG_FLAG, and GSS_C_ANON_FLAG bits returned via the `ret_flags` argument contain the values that the implementation expects would be valid if context establishment were to succeed.
- The values of the GSS_C_PROT_READY_FLAG and GSS_C_TRANS_FLAG bits within `ret_flags` indicate the actual state at the time `gss_accept_sec_context` returns, whether or not the context is fully established.

  Although this requires that GSSAPI implementations set the GSS_C_PROT_READY_FLAG in the final `ret_flags` returned to a caller (that is, when accompanied by a GSS_S_COMPLETE status code), applications should not reply on this behavior as the flag was not defined in Version 1 of the GSSAPI. Instead, applications should be prepared to use per-message services after a successful context establishment, according to the GSS_C_INTEG_FLAG and GSS_C_CONF_FLAG values.
- All other bits within the `ret_flags` argument will be set to zero. While the routine returns GSS_S_CONTINUE_NEEDED, the values returned via the `ret_flags` argument indicate the services that the implementation expects to be available from the established context.
- During context establishment, the information status bits GSS_S_OLD_TOKEN and GSS_S_DUPLICATE_TOKEN indicate fatal errors, and GSSAPI mechanisms return them in association with a routine error of GSS_S_FAILURE. This requirement for pairing did not exist in Version 1 of the GSSAPI specification, so applications that wish to run over Version 1 implementations must special-case these codes.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_CONTINUE_NEEDED	The service completed successfully and synchronously (returned only if the DDTM$M_SYNCH flag is set).
GSS_S_DEFECTIVE_TOKEN	Indicates that consistency checks performed on the `input_token` failed.
GSS_S_DEFECTIVE_CREDENTIAL	The options flags were invalid or the TID argument was omitted and the bid argument was not 0.
GSS_S_NO_CRED	The supplied credentials were not valid for context acceptance, or the credential handle did not reference any credentials.

GSS_S_CREDENTIALS_EXPIRED	The referenced credentials have expired.
GSS_S_BAD_BINDINGS	The `input_token` contains different channel bindings to those specified via the `input_chan_bindings` argument.
GSS_S_NO_CONTEXT	Indicates that the supplied context handle did not refer to a valid context.
GSS_S_BAD_SIG	The `input_token` contains an invalid MIC.
GSS_S_OLD_TOKEN	The `input_token` was too old. This is a fatal error during context establishment.
GSS_S_DUPLICATE_TOKEN	The `input_token` is valid, but is a duplicate of a token already processed. This is a fatal error during context establishment.
GSS_S_BAD_MECH	The received token specified a mechanism that is not supported by the implementation or the provided credential.

gss_acquire_cred — Acquire credential handle

C Prototype

```
OM_uint32 gss_acquire_cred(
OM_uint32                minor_status,
      gss_name_t         desired_name,
      OM_uint32          time_req,
      gss_OID_set        desired_mechs,
      gss_cred_usage_t   cred_usage,
      gss_cred_id_t      output_cred_handle,
      gss_OID_set        actual_mechs,
      OM_uint32          time_rec );
```

Arguments

minor_status (output)	The mechanism-specific status code.
desired_name (input)	The name of the principal whose credential should be acquired.
time_req (input)	The number of seconds that credentials should remain valid. Specify GSS_C_INDIFINITE to request that the credentials have the maximum permitted lifetime.
desired_mechs (input)	The set of underlying security mechanisms that may be used. GSS_C_NULL_OID_SET may be used to obtain an implementation-specific default.
cred_usage (input)	One of the following values: **GSS_C_BOTH** — Credentials may be used either to initiate or accept security contexts. **GSS_C_INITIATE** — Credentials will only be used to initiate security contexts. **GSS_C_ACCEPT** — Credentials will only be used to accept security contexts.
output_cred_handle (output)	The returned credential handle. Resources associated with this credential handle must be released by the application after use with a call to `gss_release_cred`.
actual_mechs (output)	The set of mechanisms for which the credential is valid. Storage associated with the returned OID-set must be released by the application after use with a call to `gss_release_oid_set`. Specify NULL if not required.
time_rec (output)	The actual number of seconds for which the returned credentials will remain valid. If the implementation does not support expiration of credentials, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.

Description

This routine allows an application to acquire a handle for a pre-existing credential by name. GSSAPI implementations must impose a local access-control policy on callers of this routine to prevent unauthorized callers from acquiring credentials to which they are not entitled. This routine is not intended to provide a "login to the network" function, as such a function would result in the creation of new credentials rather than merely acquiring a handle to existing credentials.

If desired_name is GSS_C_NO_NAME, the call is interpreted as a request for a credential handle that will invoke default behavior when passed to `gss_init_sec_context` (if cred_usage is GSS_C_INITIATE or GSS_C_BOTH) or `gss_accept_sec_context` (if cred_usage is GSS_C_ACCEPT or GSS_C_BOTH).

This routine is expected to be used primarily by context acceptors.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_BAD_MECH	Unavailable mechanism requested.
GSS_S_BAD_NAMETYPE	The type contained within the `desired_name` argument is not supported.
GSS_S_BAD_NAME	The value supplied for the `desired_name` argument is ill formed.
GSS_S_NO_CRED	The supplied credentials were not valid for context acceptance, or the credential handle did not reference any credentials.
GSS_S_CREDENTIALS_EXPIRED	The referenced credentials have expired.

gss_add_cred — Construct credentials incrementally

C Prototype

```
OM_uint32 gss_add_cred(
        OM_uint32          minor_status,
        gss_cred_id_t      input_cred_handle,
        gss_name_t         desired_name,
        gss_OID            desired_mech,
        gss_cred_usage_t   cred_usage,
        OM_uint32          initiator_time_req,
        OM_uint32          acceptor_time_req,
        gss_cred_id_t      output_cred_handle,
        gss_OID_set        actual_mechs,
        OM_uint32          initiator_time_rec,
        OM_uint32          acceptor_time_rec );
```

Arguments

minor_status (output)	An implementation-specific status code.
input_cred_handle (input)	The credential to which a credential-element will be added. If GSS_C_NO_CREDENTIAL is specified, the routine will compose the new credential based on default behavior. (See description). Note that, while the credential handle is not modified by `gss_add_cred`, the underlying credential will be modified if `output_cred_handle` is NULL.
desired_name (input)	The name of the principal whose credential should be acquired.
desired_mech (input)	The underlying security mechanism with which the credential may be used.
cred_usage (input)	How the credential may be used. Valid values are as follows: **GSS_C_INITIATE** — Credential will only be used to initiate security contexts. **GSS_C_ACCEPT** — Credential will only be used to accept security contexts.
initiator_time_req (input)	The number of seconds that the credential should remain valid for initiating security contexts. This argument is ignored if the composed credentials are of type GSS_C_ACCEPT. Specify GSS_C_INDEFINITE to request that the credentials have the maximum permitted initiator lifetime.
acceptor_time_req (input)	The number of seconds that the credential should remain valid for accepting security contexts. This argument is ignored if the composed credentials are of type GSS_C_INITIATE. Specify GSS_C_INDEFINITE to request that the credentials have the maximum permitted initiator lifetime.
output_cred_handle (output)	The returned credential handle, containing the new credential-element and all the credential-elements from `input_cred_handle`. If a valid pointer to a `gss_cred_id_t` is supplied for this argument, `gss_add_cred` creates a new credential handle containing all credential-elements from

	the input_cred_handle and the newly acquired credential-element; if NULL is specified for this argument, the newly acquired credential-element will be added to the credential identified by input_cred_handle. The resources associated with any credential handle returned via this argument must be released by the application after use with a call to gss_release_cred.
actual_mechs (output)	The complete set of mechanisms for which the new credential is valid. Storage for the returned OID-set must be freed by the application after use with a call to gss_release_oid_set. Specify NULL if not required.
initiator_time_rec (output)	The actual number of seconds for which the returned credentials will remain valid for initiating contexts using the specified mechanism. If the implementation or mechanism does not support expiration of credentials, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.
acceptor_time_rec (output)	The actual number of seconds for which the returned credentials will remain valid for accepting security contexts using the specified mechanism. If the implementation or mechanism does not support expiration of credentials, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.

Description

This routine adds a credential-element to a credential. The credential-element is identified by the name of the principal to which it refers. This routine is not intended to provide a "login to the network" function, as such a function would involve the creation of new mechanism-specific authentication data, rather than merely acquiring a GSSAPI handle to existing data.

If desired_name is GSS_C_NO_NAME, the call is interpreted as a request to add a credential element that will invoke default behavior when passed to gss_init_sec_context (if cred_usage is GSS_C_INITIATE or GSS_C_BOTH) or gss_accept_sec_context (if cred_usage is GSS_C_ACCEPT or GSS_C_BOTH).

This routine is expected to be used primarily by context acceptors, since implementations are likely to provide mechanism-specific ways of obtaining GSSAPI initiator credentials from the system login process. Some implementations may therefore not support the acquisition of GSS_C_INITIATE or GSS_C_BOTH credentials via gss_acquire_cred for any name other than GSS_C_NO_NAME, or a name produced by applying either gss_inquire_cred to a valid credential, or gss_inquire_context to an active context.

This routine can be used to either compose a new credential containing all credential-elements of the original in addition to the newly acquired credential element, or to add the new credential-element to an existing credential. If NULL is specified for the output_cred_handle argument, the new credential-element will be added to the credential identified by input_cred_handle; if a valid pointer is specified for the output_cred_handle argument, a new credential handle will be created.

If GSS_C_NO_CREDENTIAL is specified as the input_cred_handle, gss_add_cred will compose a credential (and set the output_cred_handle argument accordingly) based on default behavior. That is, the call will have the same effect as if the application had first made a call to gss_acquire_cred, specifying the same usage and passing GSS_C_NO_NAME as the desired_name argument to obtain an explicit credential handle embodying default behavior, passed this credential handle to gss_add_cred, and finally called gss_release_cred on the first credential handle.

If GSS_C_NO_CREDENTIAL is specified as the input_cred_handle argument, a nonNULL output_cred_handle must be supplied.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_BAD_MECH	Unavailable mechanism requested.
GSS_S_BAD_NAMETYPE	The type contained within the `desired_name` argument is not supported.
GSS_S_BAD_NAME	The value supplied for the `desired_name` argument is ill formed.
GSS_S_DUPLICATE_ELEMENT	The credential already contains an element for the requested mechanism with overlapping usage and validity period.
GSS_S_CREDENTIALS_EXPIRED	The required credentials could not be added because they have expired.
GSS_S_NO_CRED	No credentials were found for the specified name.

gss_add_oid_set_member — Add an object identifier to a set

C Prototype

```
OM_uint32 gss_add_oid_set_member(
          OM_uint32            minor_status,
          gss_OID              member_oid,
          gss_OID_set          oid_set );
```

Arguments

minor_status (output)	An implementation-specific status code.
member_oid (input)	The object identifier to be copied into the set.
oid_set (input/output)	The set in which the object identifier should be inserted.

Description

This routine adds an object identifier to an object identifier set. It is intended for use in conjunction with `gss_create_empty_oid_set` when constructing a set of mechanism OIDs for input to `gss_acquire_cred`. The `oid_set` argument must refer to an OID-set that was created by GSSAPI (for example, a set returned by `gss_create_empty_oid_set`). GSSAPI creates a copy of the `member_oid` and inserts this copy into the set, expanding the storage allocated to the OID-set's elements array if necessary. The routine may add the new member OID anywhere within the elements array; if the `member_oid` is already present, the `oid_set` remains unchanged.

Return Values

This routine returns the following GSS status code:

GSS_S_COMPLETE	Successful completion.

gss_canonicalize_name — Convert internal name to internal mechanism name

C Prototype

```
OM_uint32 gss_canonicalize_name(
       OM_uint32               minor_status,
       const gss_name_t        input_name,
       const gss_OID           mech_type,
       gss_name_t              output_name );
```

Arguments

minor_status (output)	An implementation-specific status code.
input_name (input)	The name for which a canonical form is desired.
mech_type (input)	The authentication mechanism for which the canonical form of the name is desired. The desired mechanism must be specified explicitly; no default is provided.
output_name (output)	The resultant canonical name. Storage associated with this name must be freed by the application after use by a call to `gss_release_name`.

Description

This routine generates a canonical mechanism name (MN) from an arbitrary internal name. The mechanism name is the name that would be returned to a context acceptor on successful authentication of a context where the initiator used the `input_name` in a successful call to `gss_acquire_cred`, specifying an OID set containing `mech_type` as its only member, followed by a call to `gss_init_sec_context`, specifying `mech_type` as the authentication mechanism.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_BAD_MECH	The identified mechanism is not supported.
GSS_S_BAD_NAMETYPE	The provided internal name contains no elements that could be processed by the specified mechanism.
GSS_S_BAD_NAME	The `input_name` argument was ill formed.

gss_compare_name — Allow application to compare two internal names

C Prototype

```
OM_uint32 gss_compare_name(
      OM_uint32         minor_status,
      gss_name_t        name1,
      gss_name_t        name2,
      int               name_equal );
```

Arguments

minor_status (output)	An implementation-specific status code.
name1 (input)	Internal-form name 1.
name2 (input)	Internal-form name 2.
name_equal (output)	A Boolean value. TRUE — Names refer to the same entity. FALSE — Names refer to different entities (strictly, the names are not known to refer to the same identity).

Description

This routine allows an application to compare two internal-form names to determine whether they refer to the same entity. If either name presented to `gss_compare_name` denotes an anonymous principal, the routine will indicate that the two names do not refer to the same identity.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_BAD_NAMETYPE	The type contained within either name1 or name2 was unrecognized, or the names were of incomparable types.
GSS_S_BAD_NAME	One or both of name1 or name2 was ill formed.

gss_context_time — Check how much longer context is valid

C Prototype

```
OM_uint32 gss_context_time(
      OM_uint32         minor_status,
      gss_ctx_id_t      context_handle,
      OM_uint32         time_rec );
```

Arguments

minor_status (output)	An implementation-specific status code.
context_handle (input)	Identifies the context to be interrogated.
time_rec (output)	The number of seconds that the context will remain valid. If the context has already expired, zero will be returned.

Description

Determines the number of seconds for which the specified context will remain valid.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_CONTEXT_EXPIRED	The context has already expired.
GSS_S_NO_CONTEXT	The `context_handle` argument did not identify a valid context.

gss_create_empty_oid_set — Create a set containing no object identifiers

C Prototype

```
OM_uint32 gss_create_empty_oid_set(
        OM_uint32             minor_status,
        gss_OID_set           oid_set );
```

Arguments

minor_status (output)	An implementation-specific status code.
oid_set (output)	The empty object identifier set. The routine will allocate the `gss_OID_set_desc` object, which the application must free after use with a call to `gss_release_oid_set`.

Description

This routine creates an object identifier set containing no object identifiers, to which members may be subsequently added using the `gss_add_oid_set_member` routine. These routines are intended to be used to construct sets of mechanism object identifiers, for input to `gss_acquire_cred`.

Return Values

This routine returns the following GSS status code:

GSS_S_COMPLETE	Successful completion.

gss_delete_sec_context — Delete a security context

C Prototype

```
OM_uint32 gss_delete_sec_context(
      OM_uint32              minor_status,
      gss_ctx_id_t           context_handle,
      gss_buffer_t           output_token );
```

Arguments

minor_status (output)	A mechanism-specific status code.
context_handle (input/output)	A context handle identifying the context to delete. After deleting the context, the GSSAPI will set this context handle to GSS_C_NO_CONTEXT.
output_token (output)	A token to be sent to the remote application to instruct it to also delete the context. It is recommended that applications specify GSS_C_NO_BUFFER for this argument, requesting local deletion only. If a buffer argument is provided by the application, the mechanism will either return a token in it, or set the length field of this token to zero to indicate to the application that no token is to be sent to the peer.

Description

This routine deletes a security context. The `gss_delete_sec_context` routine deletes the local data structures associated with the specified security context, and may generate an `output_token`, which when passed to the peer `gss_process_context_token` will instruct it to do likewise. No further security services may be obtained using the context specified by context_handle.

The `output_token` argument is retained for compatibility with Version 1 of the GSSAPI. It is recommended that both peer applications invoke `gss_delete_sec_context` passing the value GSS_C_NO_BUFFER for the `output_token` argument, indicating that no token is required, and that `gss_delete_sec_context` should simply delete local context data structures.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_FAILURE	Failure. See `minor_status` for more information.
GSS_S_NO_CONTEXT	No valid context was supplied.

gss_display_name — Provide textual representation of opaque internal name

C Prototype

```
OM_uint32 gss_display_name(
      OM_uint32         minor_status,
      gss_name_t        input_name,
      gss_buffer_t      output_name_buffer,
      gss_OID           output_name_type );
```

Arguments

minor_status (output)	An implementation-specific status code.
input_name (input)	The name to be displayed.
output_name_buffer (output)	A buffer to receive the textual name string. The application must free storage associated with this name after use with a call to `gss_release_buffer`.
output_name_type (output)	The type of the returned name. The returned `gss_OID` will be a pointer into static storage, and should be treated as read-only by the caller. (In particular, the application should not attempt to free it). Specify NULL if not required.

Description

This routine allows an application to obtain a textual representation of an opaque internal-form name for display purposes. The syntax of a printable name is defined by the GSSAPI implementation.

If `input_name` denotes an anonymous principal, the routine will return the `gss_OID` value GSS_C_NT_ANONYMOUS as the `output_name_type`, and a textual name that is syntactically distinct from all valid supported printable names in the `output_name_buffer`.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_BAD_NAMETYPE	The type of `input_name` was not recognized.
GSS_S_BAD_NAME	The `input_name` was ill formed.

gss_display_status — Convert GSSAPI status code to text for user display

C Prototype

```
OM_uint32 gss_display_status(
      OM_uint32         minor_status,
      OM_uint32         status_value,
      int               status_type
      gss_OID           mech_type,
      OM_uint32         message_context,
      gss_buffer_t      status_string );
```

Arguments

minor_status (output)	An implementation-specific status code.
status_value (input)	The status value to be converted.
status_type (input)	One of the following values: **GSS_C_GSS_CODE** — The `status_value` is a GSS status code. **GSS_C_MECH_CODE** — The `status_value` is a mechanism status code.
mech_type (input)	The underlying mechanism (used to interpret a `minor_status` value). Supply GSS_C_NO_OID to obtain the system default.
message_context (input/output)	This argument should be initialized to zero by the caller on the first call. If further messages are contained in the `status_value` argument, `message_context` will be nonzero on return, and this value should be passed back to subsequent calls, along with the same `status_value`, `status_type`, and `mech_type` arguments.
status_string (output)	The textual interpretation of the `status_value`. Storage associated with this argument must be freed by the application after use with a call to `gss_release_buffer`.

Description

This routine allows an application to obtain a textual representation of a GSSAPI status code, for display to the user or for logging purposes. Since some status values may indicate multiple conditions, applications may need to call `gss_display_status` multiple times, each call generating a single text string. The `message_context` argument is used to store state information about which error messages have already been extracted from a given `status_value`; `message_context` must be initialized to zero by the application prior to the first call, and `gss_display_status` will return a nonzero value in this argument if there are further messages to extract.

The `message_context` argument contains all state information required by `gss_display_status` in order to extract further messages from the `status_value`; even when a nonzero value is returned in this argument, the application is not required to call `gss_display_status` again unless subsequent messages are desired. The following code extracts all messages from a given status code and prints them to SYS$ERROR.

```
OM_uint32 message_context;
OM_uint32 status_code;
OM_uint32 maj_status;
OM_uint32 min_status;
gss_buffer_desc status_string;
 .
 .
 .
message_context = 0;

do {
    maj_status = gss_display_status(&min_status
                                                status_code,
                                                GSS_C_GSS_CODE,
                                                GSS_C_NO_OID,
                                                &message_context,
                                                &status_string);
    fprintf(stderr,
                "%.*s\n",
                (int)status_string.length,
                (char *)status_string.value);
    gss_release_buffer(&min_status, &status_string);
} while (message_context != 0);
```

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_BAD_MECH	Indicates that translation in accordance with an unsupported mechanism type was requested.
GSS_S_BAD_STATUS	The `status_value` was not recognized, or the `status_type` was neither GSS_C_GSS_CODE nor GSS_C_MECH_CODE.

gss_duplicate_name — Create a copy of an internal name

C Prototype

```
OM_uint32 gss_duplicate_name(
        OM_uint32               minor_status,
        const gss_name_t        input_name,
        gss_name_t              dest_name );
```

Arguments

minor_status (output)	An implementation-specific status code.
input_name (input)	The internal name to be duplicated.
dest_name (output)	The resultant copy of `input_name`. Storage associated with this name must be freed by the application after use by a call to `gss_release_name`.

Description

This routine creates a duplicate of the existing internal name `input_name`. The new `dest_name` will be independent of `input_name` (that is, `input_name` and `dest_name` must both be released, and the release of one will not affect the validity of the other).

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_BAD_NAME	The `input_name` argument was ill formed.

gss_export_name — Convert an internal mechanism name to export form

C Prototype

```
OM_uint32 gss_export_name(
        (OM_uint32          minor_status,
        const gss_na        input_name,
        gss_buffer_t        exported_name );
```

Arguments

minor_status (output)	An implementation-specific status code.
input_name (input)	The mechanism name to be exported.
exported_name (output)	The canonical contiguous string form of `input_name`. Storage associated with this string must be freed by the application after use by a call to `gss_release_buffer`.

Description

This routine produces a canonical contiguous string representation of a mechanism name (MN), suitable for direct comparison (for example, with `memcmp`) for use in authorization functions (for example, matching entries in an access-control list). The `input_name` argument must specify a valid MN (that is, an internal name generated by `gss_accept_sec_context` or by `gss_canonicalize_name`).

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_NAME_NOT_MN	The provided internal name was not a mechanism name.
GSS_S_BAD_NAME	The provided internal name was ill formed.
GSS_S_BAD_NAMETYPE	The internal name was of a type not supported by the GSSAPI implementation.

gss_export_sec_context — Transfer a security context to another process

C Prototype

```
OM_uint32 gss_export_sec_context(
       OM_uint32             *minor_status,
       gss_ctx_id_t          *context_handle,
       gss_buffer_t          interprocess_token );
```

Arguments

minor_status (output)	An implementation-specific status code.
context_handle (input/output)	The context handle identifying the context to transfer.
interprocess_token (output)	The token to be transferred to the target process. Storage associated with this token must be freed by the application after use with a call to `gss_release_buffer`.

Description

This routine is provided to support the sharing of work between multiple processes. It will typically be used by the context acceptor, in an application where a single process receives incoming connection requests and accepts security contexts over them, then passes the established context to one or more other processes for message exchange. The `gss_export_sec_context` routine deactivates the security context for the calling process and creates an interprocess token which, when passed to `gss_import_sec_context` in another process, will re-activate the context in the second process. Only a single instantiation of a given context may be active at any one time; a subsequent attempt by a context exporter to access the exported security context will fail.

The implementation may constrain the set of processes by which the interprocess token may be imported, either as a function of local security policy, or as a result of implementation decisions. For example, some implementations may constrain contexts to be passed only between processes that run under the same account, or which are part of the same process group.

The interprocess token may contain security-sensitive information (for example, cryptographic keys).

If the creation of the interprocess token is successful, all process-wide resources associated with the security context will be deallocated, and the `context_handle` will be set to GSS_C_NO_CONTEXT.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_CONTEXT_EXPIRED	The context has expired.
GSS_S_NO_CONTEXT	The context was invalid.
GSS_S_UNAVAILABLE	The operation is not supported.

gss_get_mic — Generate a cryptographic MIC for a message

C Prototype

```
OM_uint32 gss_get_mic(
        OM_uint32         minor_status,
        gss_ctx_id_t      context_handle,
        gss_qop_t         qop_req,
        gss_buffer_t      message_buffer,
        gss_buffer_t      message_token );
```

Arguments

minor_status (output)	An implementation-specific status code.
context_handle (input)	Identifies the context on which the message will be sent.
qop_req (input)	Specifies the requested quality of protection. Callers are encouraged, on portability grounds, to accept the default quality of protection offered by the chosen mechanism, which may be requested by specifying GSS_C_QOP_DEFAULT for this argument. If an unsupported protection strength is requested, `gss_get_mic` will return a status of GSS_S_BAD_QOP.
message_buffer (input)	The message to be protected.
message_token (output)	A buffer to receive the token. The application must free storage associated with this buffer after use with a call to `gss_release_buffer`.

Description

This routine supports data origin authentication and data integrity services. When `gss_get_mic` is invoked on an input message, it generates a cryptographic MIC, and places the MIC in a per-message token containing data items that allow underlying mechanisms to provide the specified security services. The original message, along with the generated per-message token, is passed to the remote peer; these two data elements are processed by `gss_verify_mic`, which validates the message in conjunction with the separate token. The `qop_req` argument allows a choice between several cryptographic algorithms.

This routine is functionally equivalent to the `gss_sign` routine. New code should use `gss_get_mic` instead of `gss_sign`. Although both routines are supported, `gss_sign` has been deprecated in the GSSAPI Version 2 specification.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Indicates that an integrity check, suitable for an established security context, was successfully applied and that the message and corresponding `per_msg_token` are ready for transmission.
GSS_S_CONTEXT_EXPIRED	Indicates that context-related data items have expired, so that the requested operation cannot be performed.

GSS_S_NO_CONTEXT	Indicates that the `context_handle` argument did not identify a valid context.
GSS_S_BAD_QOP	Indicates that the provided QOP value is not recognized or supported for the context.

gss_import_name — Convert a printable string to an internal form

C Prototype

```
OM_uint32 gss_import_name(
      OM_uint32         minor_status,
      gss_buffer_t      input_name_buffer,
      gss_OID           input_name_type,
      gss_name_t        output_name );
```

Arguments

minor_status (output)	An implementation-specific status code.
input_name_buffer (input)	A buffer containing the contiguous string name to convert.
input_name_type (input)	The object ID specifying the type of printable name. Applications may specify either GSS_C_NO_OID to use a local system-specific printable syntax, or an OID recognized by the GSSAPI implementation to name a specific namespace.
output_name (output)	The returned name in internal form. Storage associated with this name must be freed by the application after use with a call to `gss_release_name`.

Description

This routine converts a contiguous string name to internal form. In general, the internal name returned (via the output_name argument) will not be an internal mechanism name; the exception to this is if the input_name_type indicates that the contiguous string provided via the `input_name_buffer` argument is of type GSS_C_NT_EXPORT_NAME, in which case the returned internal name will be a mechanism name for the mechanism that exported the name.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_BAD_NAMETYPE	The `input_name_type` was unrecognized.
GSS_S_BAD_NAME	The `input_name_buffer` argument could not be interpreted as a name of the specified type.
GSS_S_BAD_MECH	The input name type was GSS_C_NT_EXPORT_NAME, but the mechanism contained within the input name is not supported.

gss_import_sec_context — Import a transferred context

C Prototype

```
OM_uint32 gss_import_sec_context(
        OM_uint32           minor_status,
        gss_buffer_t        interprocess_token,
        gss_ctx_id_t        context_handle );
```

Arguments

minor_status (output)	An implementation-specific status code.
interprocess_token (input/output)	The token received from the exporting process.
context_handle (output)	The context handle of the newly reactivated context. Resources associated with this context handle must be released by the application after use with a call to `gss_delete_sec_context`.

Description

This routine allows a process to import a security context established by another process. A given interprocess token may be imported only once. See `gss_export_sec_context` for additional information.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_NO_CONTEXT	The token did not contain a valid context reference.
GSS_S_DEFECTIVE_TOKEN	The token was invalid.
GSS_S_UNAVAILABLE	The operation is unavailable.
GSS_S_UNAUTHORIZED	Local policy prevents the import of this context by the current process.

gss_indicate_mechs — Allow an application to determine which security mechanisms are available

C Prototype

```
OM_uint32 gss_indicate_mechs(
      OM_uint32           minor_status,
      gss_OID_set         mech_set );
```

Arguments

minor_status (output)	An implementation-specific status code.
mech_set (output)	A set of implementation-supported mechanisms. The returned `gss_OID_set` value will be a dynamically allocated OID set that should be released by the caller after use with a call to `gss_release_oid_set`.

Description

This routine allows an application to determine which underlying security mechanisms are available.

Return Values

This routine returns the following GSS status code:

GSS_S_COMPLETE	Successful completion.

gss_init_sec_context — Establish a security context

C Prototype

```
OM_uint32 gss_init_sec_context(
      OM_uint32                 minor_status,
      gss_cred_id_t             claimant_cred_handle,
      gss_ctx_id_t              context_handle,
      gss_name_t                target_name,
      gss_OID                   mech_type,
      OM_uint32                 req_flags,
      OM_uint32                 time_req,
      gss_channel_bindings_t    input_chan_bindings,
      gss_buffer_t              input_token,
      gss_OID                   actual_mech_type,
      gss_buffer_t              output_token,
      OM_uint32                 ret_flags,
      OM_uint32                 time_rec );
```

Arguments

minor_status (output)	An implementation-specific status code.
claimant_cred_handle (input)	A handle for credentials claimed. Supply GSS_C_NO_CREDENTIAL to act as a default initiator principal. If no default initiator is defined, the routine will return GSS_S_NO_CRED.
context_handle (input/output)	The context handle for the new context. Supply GSS_C_NO_CONTEXT for the first call; use the value returned by the first call in continuation calls. Resources associated with this context handle must be released by the application after use with a call to `gss_delete_sec_context`.
target_name (input)	The name of the target.
mech_type (input)	The object ID of the desired mechanism. Supply GSS_C_NOOID to obtain A mechanism-specific default.
req_flags (input)	Contains various independent flags, each of which requests that the context support a specific service option. Symbolic names are provided for each flag, and the symbolic names corresponding to the required flags should be logically ORed together to form the bit-mask value. Valid values are: **GSS_C_DELEG_FLAG** TRUE — Delegate credentials to the remote peer. FALSE — Do not delegate. **GSS_C_MUTUAL_FLAG** TRUE — Request that the remote peer authenticate itself. FALSE — Authenticate self to the remote peer only. **GSS_C_REPLAY_FLAG**

	TRUE — Enable replay detection for messages protected with `gss_wrap` or `gss_get_mic`. FALSE — Do not attempt to detect replayed messages. **GSS_C_SEQUENCE_FLAG** TRUE — Enable detection of out-of-sequence protected messages. FALSE — Do not attempt to detect out-of-sequence messages. **GSS_C_CONF_FLAG** TRUE — Request that confidentiality service be made available (by calling `gss_wrap`). FALSE — No per-message confidentiality service is required. **GSS_C_INTEG_FLAG** TRUE — Request that integrity service be made available (by calling either `gss_get_mic` or `gss_wrap`). FALSE — No per-message integrity service is required. **GSS_C_ANON_FLAG** TRUE — Do not reveal the initiator's identity to the acceptor. FALSE — Authenticate normally.
time_req (input)	The desired number of seconds for which the context should remain valid. Supply zero to request a default validity period.
input_chan_bindings (input)	Application-specified bindings. Allows the application to securely bind channel identification information to the security context. Specify GSS_C_NO_CHANNEL_BINDINGS if channel bindings are not used.
input_token (input)	The token received from the peer application. Supply GSS_C_NO_BUFFER, or a pointer to a buffer containing the value GSS_C_EMPTY_BUFFER on the initial call.
actual_mech_type (output)	The actual mechanism used. The OID returned via this argument will be a pointer to static storage that should be treated as read only; in particular the application should not attempt to free it. Specify NULL if not required.
output_token (output)	The token to be sent to the peer application. If the length field of the returned buffer is zero, no token need be sent to the peer application. Storage associated with this buffer must be freed by the application after use with a call to `gss_release_buffer`.
ret_flags (output)	Contains various independent flags, each of which indicates that the context supports a specific service option. Specify NULL if not required. Symbolic names are provided for each flag, and the symbolic names corresponding to the required flags should be logically ANDed with the `ret_flags` value to test whether a given option is supported by the context. The flags are: **GSS_C_DELEG_FLAG** TRUE — Credentials were delegated to the remote peer. FALSE — No credentials were delegated.

GSS_C_MUTUAL_FLAG

TRUE — The remote peer has authenticated itself.

FALSE — The remote peer has not authenticated itself.

GSS_C_REPLAY_FLAG

TRUE — Replay of protected messages will be detected.

FALSE — Replayed messages will not be detected.

GSS_C_SEQUENCE_FLAG

TRUE — Out-of-sequence protected messages will be detected.

FALSE — Out-of-sequence messages will not be detected.

GSS_C_CONF_FLAG

TRUE — Confidentiality service may be invoked by calling the `gss_wrap` routine.

FALSE — No confidentiality service (via `gss_wrap`) is available. The `gss_wrap` routine will provide message encapsulation, data-origin authentication, and integrity services only.

GSS_C_INTEG_FLAG

TRUE — Integrity service may be invoked by calling either `gss_get_mic` or `gss_wrap` routines.

FALSE — Per-message integrity service is unavailable.

GSS_C_ANON_FLAG

TRUE — The initiator's identity has not been revealed, and will not be revealed if any emitted token is passed to the acceptor.

FALSE — The initiator's identity has been or will be authenticated normally.

GSS_C_PROT_READY_FLAG

TRUE — Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available for use if the accompanying status return value is either GSS_S_COMPLETE or GSS_S_CONTINUE_NEEDED.

FALSE — Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available only if the accompanying major status return value is GSS_S_COMPLETE.

GSS_S_TRANS_FLAG

TRUE — The resultant security context may be transferred to other processes via a call to `gss_export_sec_context`.

FALSE — The security context is not transferable.

All other bits should be set to zero.

time_rec (output) — The number of seconds for which the context will remain valid. If the implementation does not support credential expiration, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.

Description

This routine indicates the establishment of a security context between the application and a remote peer. Initially, the `input_token` argument should be specified either as GSS_C_NO_BUFFER, or as a pointer to a `gss_buffer_desc` object whose length field contains the value zero. The routine may return an `output_token` that should be transferred to the peer application, where the peer application will present it to `gss_accept_sec_context`. If no token need be sent, `gss_init_sec_context` will indicate this by setting the length field of the `output_token` argument to zero. To complete the context establishment, one or more reply tokens may be required from the peer application; if so, `gss_init_sec_context` will return a status containing the supplementary information bit GSS_S_CONTINUE_NEEDED. In this case, `gss_init_sec_context` should be called again when the reply token is received from the peer application, passing the token to `gss_init_sec_context` via the `input_token` arguments.

Portable applications should be constructed to use the token length and return status to determine whether a token needs to be sent or waited for. Thus a typical portable caller should always invoke `gss_init_sec_context` within a loop:

```
int context_established = 0;
gss_ctx_id_t context_hdl = GSS_C_NO_CONTEXT;

input_token->length = 0;

while (!context_established) {
    maj_stat = gss_init_sec_context(&min_stat,
                                                cred_hdl,
                                                &context_hdl,
                                                target_name,
                                                desired_mech,
                                                desired_services,
                                                desired_time,
                                                input_bindings,
                                                input_token,
                                                &actual_mech,
                                                output_token,
                                                &actual_services,
                                                &actual_time);
  if (GSS_ERROR(maj_stat)) {
      report_error(maj_stat, min_stat);
  };

  if (output_token->length != 0) {
      send_token_to_peer(output_token);
      gss_release_buffer(&min_stat, output_token)
  };
  if (GSS_ERROR(maj_stat)) {

      if (context_hdl != GSS_C_NO_CONTEXT)
          gss_delete_sec_context(       &min_stat,
                                                &context_hdl,
                                                GSS_C_NO_BUFFER);
      break;
  };
  if (maj_stat & GSS_S_CONTINUE_NEEDED) {
      receive_token_from_peer(input_token);
  } else {
        context_established = 1;
```

```
    };
};
```

Whenever the routine returns a status that indicates the value GSS_S_CONTINUE_NEEDED, the context is not fully established and the following restrictions apply to the output arguments:

- The value returned via the time_rec argument is undefined unless the accompanying `ret_flags` argument contains the bit GSS_C_PROT_READY_FLAG, indicating that per-message services may be applied in advance of a successful completion status, the value returned via the `actual_mech_type` argument is undefined until the routine returns a status value of GSS_S_COMPLETE.
- The values of the GSS_C_DELEG_FLAG, GSS_C_MUTUAL_FLAG, GSS_C_REPLAY_FLAG, GSS_C_SEQUENCE_FLAG, GSS_C_CONF_GLAG, GSS_C_INTEG_FLAG and GSS_C_ANON_FLAG bits returned via the `ret_flags` argument contain the values that the implementation expects would be valid if context establishment were to succeed. In particular, if the application has requested a service such as delegation or anonymous authentication via the `req_flags` argument, and such a service is unavailable from the underlying mechanism, `gss_init_sec_context` generates a token that will not provide the service, and indicates via the `ret_flags` argument that the service will not be supported. The application may choose to abort the context establishment by calling `gss_delete_sec_context` (if it cannot continue in the absence of the service), or it may choose to transmit the token and continue context establishment (if the service was merely desired but not mandatory).
- The values of the GSS_C_PROT_READY_FLAG and GSS_C_TRANS_FLAG bits within `ret_flags` indicate the actual state at the time `gss_init_sec_context` returns, whether or not the context is fully established.
- GSSAPI implementations that support per-message protection are encouraged to set the GSS_C_PROT_READY_FLAG in the final `ret_flags` returned to a caller (that is, when accompanied by a GSS_S_COMPLETE status code). However, applications should not rely on this behavior, as the flag was not defined in Version 1 of the GSSAPI. Instead, applications should determine what per-message services are available after a successful context establishment according to the GSS_C_INTEG_FLAG and GSS_C_CONF_FLAG values.

If the initial call of `gss_init_sec_context` fails, a context object is not created, and the value of the `context_handle` argument is set to GSS_C_NO_CONTEXT to indicate this.

During context establishment, the informational status bits GSS_OLD_TOKEN and GSS_S_DUPLICATE_TOKEN indicate fatal errors, and GSSAPI mechanisms return them in association with a routine error of GSS_S_FAILURE. This requirement for pairing did not exist in Version 1 of the GSSAPI specification, so applications that wish to run over Version 1 implementations must special-case these codes.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_CONTINUE_NEEDED	Indicates that a token from the peer application is required to complete the context and that `gss_init_sec_context` must be called again with that token.
GSS_S_DEFECTIVE_TOKEN	Indicates that consistency checks performed on the `input_token` failed.

GSS_S_DEFECTIVE_CREDENTIAL	Indicates that consistency checks performed on the credential failed.
GSS_S_NO_CRED	The supplied credentials were not valid for context initiation, or the credential handle did not reference any credentials.
GSS_S_CREDENTIALS_EXPIRED	The referenced credentials have expired.
GSS_S_BAD_BINDINGS	The `input_token` contains different channel bindings to those specified via the `input_chan_bindings` argument.
GSS_S_BAD_SIG	The `input_token` contains an invalid MIC, or a MIC that could not be verified.
GSS_S_OLD_TOKEN	The `input_token` was too old. This is a fatal error during context establishment.
GSS_S_DUPLICATE_TOKEN	The `input_token` is valid, but is a duplicate of a token already processed. This is a fatal error during context establishment.
GSS_S_NO_CONTEXT	Indicates that the supplied context handle did not refer to a valid context.
GSS_S_BAD_NAMETYPE	The provided `target_name` argument contained an invalid or unsupported type of name.
GSS_S_BAD_NAME	The provided `target_name` argument was ill formed.
GSS_S_BAD_MECH	The specified mechanism is not supported by the provided credential, or is unrecognized by the implementation.

gss_inquire_context — Extract security context information

C Prototype

```
OM_uint32 gss_inquire_context(
        OM_uint32          minor_status,
        gss_ctx_id_t       context_handle,
        gss_name_t         src_name,
        gss_name_t         targ_name,
        OM_uint32          lifetime_rec,
        gss_OID            mech_type,
        OM_uint32          ctx_flags,
        int                locally_initiated,
        int                open );
```

Arguments

minor_status (output)	An implementation-specific status code.
context_handle (input)	A context handle identifying the context for which information is to be returned.
src_name (output)	The name of the context initiator. If the context was established using anonymous authentication, and if the application invoking `gss_inquire_context` is the context acceptor, an anonymous name will be returned. Storage associated with this name must be freed by the application after use with a call to `gss_release_name`.
targ_name (output)	The name of the context target. Storage associated with this name must be freed by the application after use with a call to `gss_release_name`. If the context acceptor did not authenticate itself, and if the initiator did not specify a target name in its call to `gss_init_sec_context`, the value GSS_C_NO_NAME will be returned. Specify NULL if not required.
lifetime_rec (output)	The number of seconds for which the context will remain valid. If the context has expired, this argument will be set to zero. If the implementation does not support credential expiration, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.
mech_type (output)	The security mechanism providing the context. The returned OID will be a pointer to static storage that should be treated as read only by the application; in particular the application should not attempt to free it. Specify NULL if not required.
ctx_flags (output)	Contains several independent flags, each of which indicates that the context supports (or is expected to support, if open is FALSE), a specific service option. If not needed, specify NULL. Symbolic names are provided for each flag, and the symbolic names corresponding to the required flags should be logically ANDed with the `ret_flags` value to test whether a given option is supported by the context. The flags are: **GSS_C_DELEG_FLAG** TRUE — Credentials were delegated from the initiator to the acceptor. FALSE — No credentials were delegated.

GSS_C_MUTUAL_FLAG

TRUE — The acceptor was authenticated to the initiator.

FALSE — The acceptor did not authenticate itself.

GSS_C_REPLAY_FLAG

TRUE — Replay of protected messages will be detected.

FALSE — Replay messages will not be detected.

GSS_C_SEQUENCE_FLAG

TRUE — Out-of-sequence protected messages will be detected.

FALSE — Out-of-sequence messages will not be detected.

GSS_C_CONF_FLAG

TRUE — Confidentiality service may be invoked by calling the `gss_wrap` routine.

FALSE — No confidentiality service (via `gss_wrap`) is available. The `gss_wrap` routine provides message encapsulation, data-origin authentication, and integrity services only.

GSS_C_INTEG_FLAG

TRUE — Integrity service may be invoked by calling either the `gss_get_mic` or `gss_wrap` routine.

FALSE — Per-message integrity service is unavailable.

GSS_C_ANON_FLAG

TRUE — The initiator's identity will not be revealed to the acceptor. The `src_name` argument (if requested) contains an anonymous internal name.

FALSE — The initiator has been authenticated normally.

GSS_C_PROT_READY_FLAG

TRUE — Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available for use.

FALSE — Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available only if the context is fully established (that is, if the open argument is nonzero).

GSS_C_TRANS_FLAG

TRUE — The resultant security context may be transferred to other processes via a call to `gss_export_sec_context`.

FALSE — The security context is not transferable.

locally_initiated (output) — A Boolean value. Specify NULL if not required.

TRUE if the caller is the context initiator.

FALSE if the caller is the acceptor.

open (output) — A Boolean value. Specify NULL if not required.

TRUE if the context is fully established

FALSE if a context-establishment token is expected from the peer application.

Description

This routine is used to extract information describing characteristics of a security context. The caller must already have obtained a handle that refers to the context, although the context need not be fully established.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Indicates that the referenced context is valid and that `ctx_flags`, `locally_initiated`, and `open` return values describe the corresponding characteristics of the context. If `open` is TRUE, `lifetime_rec` is also returned; if `open` is TRUE and the context peer's name is known, `src_name` and `targ_name` are valid in addition to the values listed previously. The `mech_type` value must be returned for contexts where `open` is TRUE and may be returned for contexts where `open` is FALSE.
GSS_S_NO_CONTEXT	Indicates that no valid context was recognized for the input `context_handle` provided. Return values other than `minor_status` are undefined.

gss_inquire_cred — Provide calling application with information about a credential

C Prototype

```
OM_uint32 gss_inquire_cred(
      OM_uint32           minor_status,
      gss_cred_id_t       cred_handle,
      gss_name_t          name,
      OM_uint32           lifetime,
      gss_cred_usage_t    cred_usage,
      gss_OID_set         mechanisms );
```

Arguments

minor_status (output)	An implementation-specific status code.
cred_handle (input)	A handle that refers to the target credential. Specify GSS_C_NO_CREDENTIAL to inquire about the default initiator principal.
name (output)	The name whose identity the credential asserts. Storage associated with this name should be freed by the application after use with a call to `gss_release_name`. Specify NULL if not required.
lifetime (output)	The number of seconds for which the credential will remain valid. If the credential has expired, this argument will be set to zero. If the implementation does not support credential expiration, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.
cred_usage (output)	How the credential may be used. Specify NULL if not required. Valid values are as follows: **GSS_C_INITIATE** **GSS_C_ACCEPT** **GSS_C_BOTH**
mechanisms (output)	The set of mechanisms supported by the credential. Storage associated with this OID set must be freed by the application after use with a call to `gss_release_oid_set`. Specify NULL if not required.

Description

This routine obtains information about a credential. The caller must already have obtained a handle that refers to the credential.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.

GSS_S_NO_CRED	The referenced credentials could not be accessed.
GSS_S_DEFECTIVE_CREDENTIAL	The referenced credentials were invalid.
GSS_S_CREDENTIALS_EXPIRED	The referenced credentials have expired. If the lifetime argument was not passed as NULL, it will be set to zero.

gss_inquire_cred_by_mech — Obtain per-mechanism information about a credential

C Prototype

```
OM_uint32 gss_inquire_cred_by_mech(
        OM_uint32               minor_status,
        gss_cred_id_t           cred_handle,
        gss_OID                 mech_type,
        gss_name_t              name,
        OM_uint32               initiator_lifetime,
        OM_uint32               acceptor_lifetime,
        gss_cred_usage_t        cred_usage );
```

Arguments

minor_status (output)	A handle that refers to the target credential. Specify GSS_C_NO_CREDENTIAL to inquire about the default initiator principal.
mech_type (input)	The mechanism for which information should be returned.
name (output)	The name whose identity the credential asserts.
initiator_lifetime (output)	The number of seconds for which the credential will remain capable of initiating security contexts under the specified mechanism. If the credential can no longer be used to initiate contexts, or if the credential usage for this mechanism is GSS_C_ACCEPT, this argument will be set to zero. If the implementation does not support expiration of initiator credentials, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.
acceptor_lifetime (output)	The number of seconds for which the credential will remain capable of accepting security contexts under the specified mechanism. If the credential can no longer be used to accept contexts, or if the credential usage for this mechanism is GSS_C_INITIATE, this argument will be set to zero. If the implementation does not support expiration of acceptor credentials, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.
cred_usage (output)	How the credential may be used with the specified mechanism. Specify NULL if not required. Valid values are as follows: **GSS_C_INITIATE** **GSS_C_ACCEPT** **GSS_C_BOTH**

Description

This routine obtains per-mechanism information about a credential.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_NO_CRED	The referenced credentials could not be accessed.
GSS_S_DEFECTIVE_CREDENTIAL	The referenced credentials were invalid.

gss_inquire_names_for_mech — Return set of supported nametypes

C Prototype

```
OM_uint32 gss_inquire_names_for_mech(
        OM_uint32               minor_status,
        gss_OID                 mechanism,
        gss_OID_set             name_types );
```

Arguments

minor_status (output)	An implementation-specific status code.
mechanism (input)	The mechanism to be interrogated.
name_types (output)	The set of `name-types` supported by the specified mechanism. The returned OID set must be freed by the application after use with a call to `gss_release_oid_set`.

Description

This routine returns the set of nametypes supported by the specified mechanism.

Return Values

This routine returns the following GSS status code:

GSS_S_COMPLETE	Successful completion.

gss_process_context_token — Pass a security context to the security service

C Prototype

```
OM_uint32 gss_process_context_token(
      OM_uint32                minor_status,
      gss_ctx_id_t             context_handle,
      gss_buffer_t             token_buffer );
```

Arguments

minor_status (output)	An implementation-specific status code.
context_handle (input)	The context handle of the context on which the token is to be processed.
token_buffer (input)	A pointer to the token to process.

Description

This routine provides a way to pass an asynchronous token to the security service. Most context-level tokens are emitted and processed synchronously by `gss_init_sec_context` and `gss_accept_sec_context`, and the application is informed as to whether further tokens are expected by the GSS_C_CONTINUE_NEEDED status return. Occasionally, a mechanism may need to emit a context-level token at a point when the peer entity is not expecting a token. For example, the initiator's final call to `gss_init_sec_context` may emit a token and return a status of GSS_S_COMPLETE, but the acceptor's call to `gss_accept_sec_context` may fail. The acceptor's mechanism may wish to send a token containing an error indication to the initiator, but the initiator is not expecting a token at this point, believing that the context is fully established. The `gss_process_context_token` routine provides a way to pass such a token to the mechanism at any time.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_DEFECTIVE_TOKEN	Indicates that consistency checks performed on the token failed.
GSS_S_FAILURE	Failure. See `minor_status` for more information.
GSS_S_NO_CONTEXT	The `context_handle` did not refer to a valid context.

gss_release_buffer — Free storage associated with a buffer

C Prototype

```
OM_uint32 gss_release_buffer(
      OM_uint32           minor_status,
      gss_buffer_t        buffer );
```

Arguments

minor_status (output)	An implementation-specific status code.
buffer (input/output)	The storage associated with the buffer will be deleted. The gss_buffer_desc object will not be freed, but its length field will be zeroed.

Description

This routine frees storage associated with a buffer. The storage must have been allocated by a GSSAPI routine. In addition to freeing the associated storage, the routine will zero the length field in the descriptor to which the `buffer` argument refers. Any `buffer` object returned by a GSSAPI routine may be passed to `gss_release_buffer` (even if there is no storage associated with the buffer).

Return Values

This routine returns the following GSS status code:

GSS_S_COMPLETE	Successful completion.

gss_release_cred — Mark a credential for deletion

C Prototype

```
OM_uint32 gss_release_cred(
      OM_uint32          minor_status,
      gss_cred_id_t      cred_handle );
```

Arguments

minor_status (output)	A mechanism-specific status code.
cred_handle (input/output)	A buffer containing an opaque credential handle identifying the credential to be released. If GSS_C_NO_CREDENTIAL is supplied, the routine will complete successfully, but will do nothing.

Description

This routine informs GSSAPI that the specified credential handle is no longer required by the application, and frees associated resources. When all processes have released a credential, it will be deleted.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_NO_CRED	The credentials could not be accessed.

gss_release_name — Free storage associated with an internal name that was allocated by a GSSAPI routine

C Prototype

```
OM_uint32 gss_release_name(
      OM_uint32          minor_status,
      gss_name_t         input_name );
```

Arguments

minor_status (output)	An implementation-specific status code.
input_name (input/output)	The name to be deleted.

Description

This routine frees GSSAPI allocated storage associated with an internal form name.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Successful completion.
GSS_S_BAD_NAME	The `input_name` argument did not contain a valid name.

gss_release_oid_set — Free storage associated with a gss_OID_set object

C Prototype

```
OM_uint32 gss_release_oid_set(
      OM_uint32           minor_status,
      gss_OID_set         set );
```

Arguments

minor_status (output)	An implementation-specific status code.
set (input)	The `gss_OID_set` whose storage is to be deleted.

Description

This routine frees storage associated with a GSSAPI generated `gss_OID_set` object. The `set` argument must refer to an `OID-set` that was returned from a GSSAPI routine. The `gss_release_oid_set` routine frees the storage associated with each individual member OID, the OID set's elements array, and the `gss_OID_set_desc`.

Return Values

This routine returns the following GSS status code:

GSS_S_COMPLETE	Successful completion.

gss_test_oid_set_member — Determine whether an object identifier is a member of the set

C Prototype

```
OM_uint32 gss_test_oid_set_member(
        OM_uint32          minor_status,
        gss_OID            member,
        gss_OID_set        set,
        int                present );
```

Arguments

minor_status (output)	An implementation-specific status code.
member (input)	The object identifier whose presence is to be tested.
set (input)	The object identifier set.
present (output)	A Boolean value:
	TRUE — The specified OID is a member of the set.
	FALSE — The specified OID is not a member of the set.

Description

This routine interrogates an object identifier set to determine whether a specified object identifier is a member. It is intended to be used with OID sets returned by `gss_indicate_mechs`, `gss_acquire_cred`, and `gss_inquire_cred`, but will also work with user-generated sets.

Return Values

This routine returns the following GSS status code:

GSS_S_COMPLETE	Successful completion.

gss_unwrap — Verify a message with attached MIC and decrypt message content

C Prototype

```
OM_uint32 gss_unwrap(
        OM_uint32          minor_status,
        gss_ctx_id_t       context_handle,
        gss_buffer_t       input_message_buffer,
        gss_buffer_t       output_message_buffer,
        int                conf_state,
        gss_qop_t          qop_state );
```

Arguments

minor_status (output)	An implementation-specific status code.
context_handle (input)	Identifies the context in which the message arrived.
input_message_buffer (input)	The protected message.
output_message_buffer (output)	A buffer to receive the unwrapped message. Storage associated with this buffer must be freed by the application after use with a call to `gss_release_buffer`.
conf_state (output)	A Boolean value indicating which services have been applied. Specify NULL if not required. TRUE — Confidentiality and integrity protection services have been applied. FALSE — Only integrity service has been applied.
qop_state (output)	The quality of protection provided. Specify NULL if not required.

Description

This routine converts a message previously protected by `gss_wrap` back to a usable form, verifying the embedded Message Integrity Code (MIC). The `conf_state` argument indicates whether the message was encrypted; the `qop_state` argument indicates the strength of the protection that was used to provide the confidentiality and integrity services.

This routine is functionally equivalent to the `gss_unseal` routine. New code should use `gss_unwrap` instead of `gss_unseal`. Although both routines are supported, `gss_unseal` has been deprecated in the GSSAPI Version 2 specification.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Indicates that the `input_message_buffer` was successfully processed and that the `output_message_buffer` is ready for transmission.

GSS_S_DEFECTIVE_TOKEN	Indicates that the `input_message_buffer` was successfully processed and that the `output_message_buffer` is ready for transmission.
GSS_S_BAD_SIG	Indicates that consistency checks performed on the token extracted from the `input_message_buffer` failed, preventing further processing from being performed with that token.
GSS_S_DUPLICATE_TOKEN	Indicates that the MIC extracted from the `input_message_buffer` contains an incorrect integrity check for the message.
GSS_S_OLD_TOKEN	The token extracted from the `input_message_buffer` is valid, and contained a correct MIC for the message, but is a duplicate of a token already processed. This is a fatal error during context establishment.
GSS_S_UNSEQ_TOKE	Indicates that the token was valid, and contained a correct MIC for the message, but has been verified out of sequence; a later token has already been received.
GSS_S_GAP_TOKEN	Indicates that the token was valid, and contained a correct MIC for the message, but has been verified out of sequence; an earlier expected token has not yet been received.
GSS_S_CONTEXT_EXPIRED	Indicates that context-related data items have expired, so that the requested operation cannot be performed
GSS_S_NO_CONTEXT	Indicates that no valid context was recognized for the input `context_handle` provided.

gss_verify_mic — Check that a cryptographic MIC fits the applied message

C Prototype

```
OM_uint32 gss_verify_mic(
        OM_uint32         minor_status,
        gss_ctx_id_t      context_handle,
        gss_buffer_t      message_buffer,
        gss_buffer_t      message_token,
        gss_qop_t         qop_state );
```

Arguments

minor_status (output)	An implementation-specific status code.
context_handle (input)	Specifies the context on which the message arrived.
message_buffer (input)	Specifies the message to be verified.
message_token (input)	Specifies the token to be associated with the message.
qop_state (output)	Returns the quality of protection gained from the MIC. Specify NULL if not required.

Description

This routine checks that a cryptographic MIC, contained in the `message_token` argument, fits the message in the `message_buffer` argument. The `qop_state` argument allows a message recipient to determine the strength of protection that was applied to the message.

This routine is functionally equivalent to the `gss_verify` routine. New code should use `gss_verify_mic` instead of `gss_verify`. Although both routines are supported, `gss_verify` has been deprecated in the GSSAPI Version 2 specification.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Indicates that the message was successfully verified.
GSS_S_DEFECTIVE_TOKEN	Indicates that consistency checks performed on the received `message_token` failed, preventing further processing from being performed with that token.
GSS_S_BAD_SIG	Indicates that the received `message_token` contains an incorrect MIC for the message.
GSS_S_DUPLICATE_TOKEN	The `message_token` was valid, and contained a correct MIC for the message, but is a duplicate of a token already processed. This is a fatal error during context establishment.

GSS_S_OLD_TOKEN	The `message_token` was valid, and contained a correct MIC for the message, but the `message_token` was too old to check for duplication. This is a fatal error during context establishment.
GSS_S_UNSEQ_TOKEN	Indicates that the cryptographic check value on the received message was correct, and the `message_token` contained a correct MIC, but the token has been verified out of sequence; a later token has already been received.
GSS_S_GAP_TOKEN	Indicates that the cryptographic check value on the received message was correct, and the `message_token` contained a correct MIC, but the token has been verified out of sequence; an earlier expected token has not yet been received.
GSS_S_CONTEXT_EXPIRED	Indicates that context-related data items have expired, so that the requested operation cannot be performed
GSS_S_NO_CONTEXT	Indicates that no valid context was recognized for the input `context_handle` provided.

gss_wrap — Attach a MIC to a message and encrypt the message

C Prototype

```
OM_uint32 gss_wrap(
        OM_uint32          minor_status,
        gss_ctx_id_t       context_handle,
        int                conf_req_flag,
        gss_qop_t          qop_req,
        gss_buffer_t       input_message_buffer,
        int                conf_state,
        gss_buffer_t       output_message_buffer );
```

Arguments

minor_status (output)	An implementation-specific status code.
context_handle (input)	Identifies the context on which the message will be sent.
conf_req_flag (input)	A Boolean value indicating which services are to be used. TRUE — Both confidentiality and integrity services are requested. FALSE — Only integrity service is requested.
qop_req (input)	Specifies the required quality of protection. A mechanism-specific default may be requested by setting `qop_req` to GSS_C_QOP_DEFAULT. If an unsupported protection strength is requested, `gss_wrap` will return a status of GSS_S_BAD_QOP.
input_message_buffer (input)	The message to be protected.
conf_state (output)	A Boolean value indicating which services have been applied. Specify NULL if not required. TRUE — Confidentiality, data origin authentication and integrity services have been applied. FALSE — Only integrity and data origin services have been applied.
output_message_buffer (output)	The buffer to receive the protected message. Storage associated with this message must be freed by the application after use with a call to `gss_release_buffer`.

Description

This routine attaches a cryptographic MIC and optionally encrypts the specified `input_message_buffer`. The `output_message_buffer` contains both the MIC and the message. The `qop_req` argument allows a choice between several cryptographic algorithms.

This routine is functionally equivalent to the `gss_seal` routine. New code should use `gss_wrap` instead of `gss_seal`. Although both routines are supported, `gss_seal` has been deprecated in the GSSAPI Version 2 specification.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Indicates that the `input_message_buffer` was successfully processed and that the `output_message_buffer` is ready for transmission.
GSS_S_CONTEXT_EXPIRED	Indicates that context-related data items have expired, so that the requested operation cannot be performed.
GSS_S_NO_CONTEXT	Indicates that the `context_handle` argument did not identify a valid context.
GSS_S_BAD_QOP	Indicates that the provided QOP value is not recognized or supported for the context.

gss_wrap_size_limit — Check expected size of wrapped output

C Prototype

```
OM_uint32 gss_wrap_size_limit(
        OM_uint32          minor_status,
        gss_ctx_id_t       context_handle,
        int                conf_req_flag,
        gss_qop_t          qop_req,
        OM_uint32          req_output_size,
        OM_uint32          max_input_size );
```

Arguments

minor_status (output)	An implementation-specific status code.
context_handle (input)	A handle that refers to the security over which the messages will be sent..
conf_req_flag (input)	A Boolean value indicating whether `gss_wrap` will be asked to apply confidentiality protection in addition to integrity protection. TRUE — Both confidentiality and integrity services are requested. FALSE — Only integrity service is requested.
qop_req (input)	Specifies the requested quality of protection that `gss_wrap` will be asked to provide. Callers are encouraged, on portability grounds, to accept the default quality of protection offered by the chosen mechanism, which may be requested by specifying GSS_C_QOP_DEFAULT for this argument.
req_output_size (input)	The desired maximum size for tokens emitted by `gss_wrap`.
max_input_size (output)	The maximum input message size that may be presented to `gss_wrap` in order to guarantee that the emitted token shall be no larger than `req_output_size` bytes.

Description

This routine allows an application to determine the maximum message size that, if presented to `gss_wrap` with the same `conf_req_flag` and `qop_req` arguments, will result in an output token containing no more than `req_output_size` bytes.

This call is intended for use by applications that communicate over protocols that impose a maximum message size. It enables the application to fragment messages prior to applying protection.

This call is intended for use by applications that communicate over protocols that impose a maximum message size. It enables the application to fragment messages prior to applying protection.

Successful completion of this call does not guarantee that `gss_wrap` will be able to protect a message of length `max_input_size` bytes, since this ability may depend on the availability of system resources at the time that `gss_wrap` is called.

Return Values

This routine returns one of the following GSS status codes:

GSS_S_COMPLETE	Indicates a successful token size determination: an input message with a length in octets equal to the returned `max_input_size` value will, when passed to `gss_wrap` for processing on the context identified by the `context_handle` argument with the confidentiality request state as provided in conf_req_flag and with the quality of protection specifier provided in the `qop_req` argument, yield an output token no larger than the value of the provided `req_output_size` argument.
GSS_S_CONTEXT_EXPIRED	Indicates that the provided input `context_handle` is recognized, but that the referenced context has expired. Return values other than `minor_status` are undefined.
GSS_S_NO_CONTEXT	Indicates that no valid context was recognized for the input `context_handle` provided. Return values other than `minor_status` are undefined.
GSS_S_BAD_QOP	Indicates that the provided QOP value is not recognized or supported for the context.

6 KRB5 (Kerberos V5) Application Programming Interface

This chapter describes the C language bindings for the routines that make up the KRB5 Application Programming Interface.

NOTE Additional Kerberos KRB5 APIs are not documented in this manual. The APIs themselves are included in the Kerberos for OpenVMS library (KRB$RTL.EXE for 64 bit interfaces, or KRB$RTL32.EXE for 32 bit interfaces) in SYS$LIBRARY.

krb5_425_conv_principal — Convert a Kerberos V4 principal name to V5 format

C Prototype

```
krb5_error_code krb5_425_conv_principal(
         krb5_context       context,
         const char         *name,
         const char         *instance,
         const char         *realm,
         krb5_principal     *princ );
```

Arguments

context (input/output)	The context structure.
name (input)	Kerberos V4 name.
instance (input)	Kerberos V4 instance.
realm (input)	Kerberos V4 realm.
principal (output)	Kerberos V5 principal name.

Description

This routine builds a principal `princ` from a V4 specification made up of `name.instance@realm`. The routine is site customized to convert the V4 naming scheme to a V5 scheme. For instance, the V4 `rcmd` is changed to `host`.

The returned principal should be freed with `krb5_free_principal`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_address_compare — Compare two addresses

C Prototype

```
krb5_boolean krb5_address_compare(
         krb5_context           context,
         const krb5_address     *addr1,
         const krb5_address     *addr2 );
```

Arguments

context (input/output)	The context structure.
addr1 (input)	The first address to compare.
addr2 (input)	The second address to compare.

Description

This routine compares two Kerberos addresses.

Return Values

This routine returns one of the following KRB5 status codes:

TRUE	The two addresses are the same.
FALSE	The two addresses are different.

krb5_address_order — Return an ordering of two addresses

C Prototype

```
int krb5_address_order(
         krb5_context           context,
         const krb5_address     *addr1,
         const krb5_address     *addr2 );
```

Arguments

context (input/output)	The context structure.
addr1 (input)	The first address to compare.
addr2 (input)	The second address to compare.

Description

This routine returns an ordering on the two addresses.

Return Values

This routine returns one of the following KRB5 status codes:

= 0	The two addresses are the same.
< 0	First address is less than second.
> 0	First address is greater than second.

krb5_address_search — Search for address in address list

C Prototype

```
krb5_boolean krb5_address_search(
         krb5_context               context,
         const krb5_address         *addr,
         krb5_address * krb5_const  *addrlist );
```

Arguments

context (input/output)	The context structure.
addr (input)	The address to search for.
addrlist (input)	The address list to search, as an array of addresses. The last entry in the array must be a NULL pointer. Specify NULL for this argument if no address list is present.

Description

This routine searches `addrlist` for the address in `addr`.

Return Values

This routine returns one of the following KRB5 status codes:

TRUE	`addr` is listed in `addrlist`, or `addrlist` is NULL.
FALSE	`addr` is not listed in `addrlist`.

krb5_aname_to_localname — Convert a principal name to a local name

C Prototype

```
krb5_error_code krb5_aname_to_localname(
         krb5_context             context,
         krb5_const_principal     aname,
         int                      lnsize,
         char                     *lname );
```

Arguments

context (input)	The context structure.
aname (input)	A principal name.
lnsize (input)	Specifies the maximum length name that is to be filled into `lname`.
lname (output)	The local name.

Description

This routine converts a principal name `aname` to a local name suitable for use by programs wishing a translation to an environment-specific name (for example, user account name).

The translation will be NULL terminated in all nonerror returns.

Return Values

This routine returns the following KRB5 status code:

System errors.

krb5_auth_con_free — Free auth_context

C Prototype

```
krb5_error_code krb5_auth_con_free(
        krb5_context         context,
        krb5_auth_context    auth_context );
```

Arguments

context (input/output)	The context structure.
auth_context (output)	A per connection context.

Description

This routine frees the `auth_context` returned by `krb5_auth_con_init`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_init — Initialize the auth_context

C Prototype

```
krb5_error_code krb5_auth_con_init(
        krb5_context        context,
        krb5_auth_context   *auth_context );
```

Arguments

context (input/output)	The context structure.
auth_context (output)	A per connection context.

Description

This routine initializes the `auth_context`. The `auth_context` contains all data pertinent to the various authentication routines.

The default flags for the context are set to enable the use of the replay cache (`krb5_auth_context_do_time`) but no sequence numbers. The function `krb5_auth_con_setflags` allows the flags to be changed.

The default checksum type is set to CKSUMTYPE_RSA_MD4_DES. This may be changed with `krb5_auth_con_setcksumtype`.

The `auth_context` structure should be freed with `krb5_auth_con_free`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_getaddrs — Retrieve address fields from the auth_context

C Prototype

```
krb5_error_code krb5_auth_con_getaddrs(
         krb5_context            context,
         krb5_auth_context       auth_context,
         krb5_address           **local_addr,
         krb5_address           **remote_addr );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	A per-connection context.
local_addr (output)	Local address.
remote_addr (output)	Remote address.

Description

This routine retrieves `local_addr` and `remote_addr` from `auth_context`. If `local_addr` or `remote_addr` is not NULL, the memory is first freed with `krb5_free_address` and then newly allocated. It is the caller's responsibility to free the returned addresses in this way.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_getauthenticator — Retrieve authenticator used during mutual authentication

C Prototype

```
krb5_error_code krb5_auth_con_getauthenticator(
         krb5_context            context,
         krb5_auth_context       auth_context,
         krb5_authenticator      **authenticator );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	A per-connection context.
authenticator (output)	The authenticator used during mutual authentication.

Description

This routine retrieves the authenticator that was used during mutual authentication. It is the caller's responsibility to free the memory allocated to authenticator by calling `krb5_free_authenticator`.

Return Values

This routine returns the following KRB5 status codes:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_getflags — Retrieve the flags in auth_context

C Prototype

```
krb5_error_code krb5_auth_con_getflags(
         krb5_context           context,
         krb5_auth_context      auth_context,
         krb5_int32             *flags );
```

Arguments

context (input/output)	The context structure.
auth_context (input)	A per connection context.
flags (input)	A bit mask representing the flags to set in the `auth_context`. Valid flags are: KRB5_AUTH_CONTEXT_DO_TIME — Use timestamps. KRB5_AUTH_CONTEXT_RET_TIME — Save timestamps to output structure. KRB5_AUTH_CONTEXT_DO_SEQUENCE — Use sequence numbers. KRB5_AUTH_RET_SEQUENCE — Copy sequence numbers to output structure.

Description

This routine retrieves the flags from `auth_context`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_getkey — Retrieve keyblock from auth_context

C Prototype

```
krb5_error_code krb5_auth_con_getkey(
         krb5_context          context,
         krb5_auth_context     auth_context,
         krb5_keyblock         **keyblock );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	A per-connection context.
keyblock (output)	Key stored in `auth_context`.

Description

This routine retrieves the keyblock stored in `auth_context`. The memory allocated in this function should be freed with a call to `krb5_free_keyblock`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_getlocalseqnumber — Retrieve and store the local sequence number

C Prototype

```
krb5_error_code krb5_auth_con_getlocalseqnumber(
         krb5_context           context,
         krb5_auth_context      auth_context,
         krb5_int32             *seqnumber );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	A per-connection context.
seqnumber (input)	The address of the location to store the local sequence number.

Description

This routine retrieves the local sequence number that was used during authentication and stores it in `seqnumber`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_getlocalsubkey — Retrieve the local_subkey keyblock from auth_context

C Prototype

```
krb5_error_code krb5_auth_con_getlocalsubkey(
         krb5_context           context,
         krb5_auth_context      auth_context,
         krb5_keyblock          **keyblock );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	A per-connection context.
keyblock (output)	`local_subkey` keyblock stored in `auth_context`.

Description

This routine retrieves the `local_subkey` keyblock stored in `auth_context`. The memory allocated in this function should be freed with a call to `krb5_free_keyblock`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_getremoteseqnumber — Retrieve and store the remote sequence number

C Prototype

```
krb5_error_code krb5_auth_con_getremoteseqnumber(
         krb5_context             context,
         krb5_auth_context        auth_context,
         krb5_int32               *seqnumber );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	A per-connection context.
seqnumber (input)	The address of the location to store the remote sequence number.

Description

This routine retrieves the remote sequence number that was used during authentication and stores it in `seqnumber`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_getremotesubkey — Retrieve the remote_subkey keyblock from auth_context

C Prototype

```
krb5_error_code krb5_auth_con_getremotesubkey(
         krb5_context               context,
         krb5_auth_context          auth_context,
         krb5_keyblock              **keyblock );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	A per-connection context.
keyblock (output)	`remote_subkey` keyblock stored in `auth_context`.

Description

This routine retrieves the `remote_subkey` keyblock stored in `auth_context`. The memory allocated in this function should be freed with a call to `krb5_free_keyblock`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_setaddrs — Set address fields in auth_context

C Prototype

```
krb5_error_code krb5_auth_con_setaddrs(
         krb5_context           context,
         krb5_auth_context      auth_context,
         krb5_address           *local_addr,
         krb5_address           *remote_addr );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	A per-connection context.
local_addr (input)	Local address.
remote_addr (input)	Remote address.

Description

This routine copies the `local_addr` and `remote_addr` into `auth_context`. If either address is NULL, the previous address remains in place.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_setflags — Set the flags in auth_context

C Prototype

```
krb5_error_code krb5_auth_con_setflags(
        krb5_context       context,
        krb5_auth_context  auth_context,
        krb5_int32         flags );
```

Arguments

context (input/output)	The context structure.
auth_context (output)	A per-connection context.
flags (input)	A bit mask representing the flags to set in `auth_context`. Valid values are: **KRB5_AUTH_CONTEXT_DO_TIME** — Use timestamps. **KRB5_AUTH_CONTEXT_RET_TIME** — Save timestamps to output structure. **KRB5_AUTH_CONTEXT_DO_SEQUENCE** — Use sequence numbers. **KRB5_AUTH_RET_SEQUENCE** — Copy sequence numbers to output structure.

Description

This routine sets the flags of `auth_context` to the `flags` argument.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_setports — Set port fields in the auth_context

C Prototype

```
krb5_error_code krb5_auth_con_setports(
         krb5_context           context,
         krb5_auth_context      auth_context,
         krb5_address           *local_port,
         krb5_address           *remote_port );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	A per-connection context.
local_addr (input)	Local address.
remote_addr (input)	Remote address.

Description

This routine copies the `local_port` and `remote_port` addresses into `auth_context`. If either address is NULL, the previous address remains in place. These addresses are set by `krb5_auth_con_genaddrs`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_setrcache — Set the replay cache

C Prototype

```
krb5_error_code krb5_auth_con_setrcache(
         krb5_context           context,
         krb5_auth_context      auth_context,
         krb5_rcache            rcache );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	A per-connection context.
rcache (input)	The replay cache to be set.

Description

This routine sets the replay cache that is used by the authentication routines to `rcache`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_auth_con_setuseruserkey — Set keyblock field in auth_context to temporary key

C Prototype

```
krb5_error_code krb5_auth_con_setuseruserkey(
         krb5_context           context,
         krb5_auth_context      auth_context,
         krb5_keyblock          *keyblock );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	A per-connection context.
keyblock (input)	Server key for incoming request.

Description

This routine overloads the keyblock field. It is only useful prior to a `krb5_rd_req_decode` call for user-to-user authentication where the server has the key and needs to use it to decrypt the incoming request. Once decrypted, this key is no longer necessary. It is then overwritten with the session key sent by the client.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_build_principal — Build a principal name

C Prototype

```
krb5_error_code krb5_build_principal(
         krb5_context       context,
         krb5_principal     *principal,
         int                rlen,
         const char         *realm,
         char               *s1, ... )
```

Arguments

context (input/output)	The context structure.
principal (output)	Principal name.
rlen (input)	Realm name length.
realm (input)	Realm name.
... (input)	A variable-length argument list. These arguments are added to the principal data.

Description

`This routine` and `krb5_build_principal_va` perform the same function. `krb5_build_principal` takes a variable-length argument list, which is added to the principal data being built.

Both functions take a realm name `realm`, realm name length `rlen`, and a list of null-terminated strings, and fill in a pointer to a principal structure principal, making it point to a structure representing the named principal. The last string must be followed in the argument list by a NULL pointer.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_build_principal_ext — Build a principal name extension

C Prototype

```
krb5_error_code krb5_build_principal_ext(
         krb5_context           context,
         krb5_principal         *principal,
         int                    rlen,
         const char             *realm,
         int len1, char         *s1, ... )
```

Arguments

context (input/output)	The context structure.
principal (output)	Principal name.
rlen (input)	Realm name length.
realm (input)	Realm name.
... (input)	A list of (list, contents) pairs to be added to the principal data.

Description

This routine is similar to `krb5_build_principal` but it takes its components as a list of (length, contents) pairs rather than a list of null-terminated strings. A length of zero indicates the end of the list.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_cc_close — Close the credentials cache

C Prototype

```
krb5_error_code krb5_cc_close(
         krb5_context      context,
         krb5_ccache       id );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A credentials cache identifier.

Description

This routine closes the credentials cache id, invalidates `id`, and releases `id` and any other resources acquired during use of the credentials cache. It requires that `id` identifies a valid credentials cache. After return, `id` must not be used unless it is first reinitialized using `krb5_cc_resolve` or `krb5_cc_gen_new`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_cc_default — Resolve the default credentials cache name

C Prototype

```
krb5_error_code krb5_cc_default(
         krb5_context   context,
         krb5_ccache    *ccache );
```

Arguments

context (input/output)	The context structure.
ccache (output)	The default credentials cache name.

Description

This routine is equivalent to `krb5_cc_resolve(context, krb5_cc_default_name, ccache)`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_cc_default_name — Return the name of the default credentials cache

C Prototype

```
char * krb5_cc_default_name(
         krb5_context   context );
```

Arguments

context (input/output)	The context structure.

Description

This routine returns the name of the default credentials cache; this may be equivalent to `getenv("KRB5CCACHE")` with an appropriate fallback.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_cc_destroy — Destroy a credentials cache

C Prototype

```
krb5_error_code krb5_cc_destroy(
         krb5_context   context,
         krb5_ccache    id );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A credentials cache identifier.

Description

This routine destroys the credentials cache identified by `id`, invalidates `id`, and releases any other resources acquired during use of the credentials cache. This routine requires that `id` identifies a valid credentials cache. After return, `id` must not be used unless it is first reinitialized using `krb5_cc_resolve` or `krb5_cc_gen_new`.

Return Values

This routine returns the following KRB5 status code:

Permission errors.

krb5_cc_end_seq_get — Finish processing credentials cache entries

C Prototype

```
krb5_error_code krb5_cc_end_seq_get(
         krb5_context     context,
         krb5_ccache      id,
         krb5_cc_cursor   *cursor );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A credentials cache identifier.
cursor (input/output)	The cursor created by `krb5_cc_start_seq_get`.

Description

This routine finishes sequential processing mode and invalidates `*cursor`. `*cursor` must never be reused after this call.

It requires that `id` identifies a valid credentials cache and `*cursor` be a cursor returned by `krb5_cc_start_seq_get` or a subsequent call to `krb5_cc_next_cred`.

Return Values

This routine returns the following KRB5 status code:

Error code if `*cursor` is invalid.

krb5_cc_gen_new — Generate a new credentials cache identifier

C Prototype

```
krb5_error_code krb5_cc_gen_new(
         krb5_context          context,
         krb5_ccache           *id );
```

Arguments

context (input/output)	The context structure.
id (output)	A new, unique credentials cache identifier.

Description

This routine fills in `id` with a unique `ccache` identifier. The cache is left unopened.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_cc_get_name — Return the name of the credentials cache

C Prototype

```
char * krb5_cc_get_name(
         krb5_context    context,
         krb5_ccache     id );
```

Arguments

context (input/output)	The context structure.
id (output)	A credentials cache identifier.

Description

This routine returns the name of the credentials cache denoted by `id`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_cc_get_principal — Retrieve the primary principal of the credentials cache

C Prototype

```
krb5_error_code krb5_cc_get_principal(
         krb5_context     context,
         krb5_ccache      id,
         krb5_principal   *principal );
```

Arguments

context (input/output)	The context structure.
id (input)	A credentials cache identifier.
principal (output)	The returned primary principal.

Description

This routine retrieves the primary principal of the credentials cache (as set by `krb5_cc_initialize request`). The primary principal is set to `*principal`; the caller should release this memory by calling `krb5_free_principal` on `*principal` when finished.

It requires that `id` identifies a valid credentials cache.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_cc_initialize — Create/refresh a credentials cache

C Prototype

```
krb5_error_code krb5_cc_initialize(
         krb5_context     context,
         krb5_ccache      id,
         krb5_principal   primary_principal );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A credentials cache identifier.
primary_principal (input)	The primary principal for the credentials cache.

Description

This routine creates or refreshes a credentials cache identified by `id` with the primary principal set to `primary_principal`. If the credentials cache already exists, its contents are destroyed.

This routine also modifies cache identified by `id`.

Return Values

This routine returns one of the following KRB5 status codes:

System errors.

Permission errors.

krb5_cc_next_cred — Fetch the next credentials entry

C Prototype

```
krb5_error_code krb5_cc_next_cred(
         krb5_context     context,
         krb5_ccache      id,
         krb5_creds       *creds,
         krb5_cc_cursor   *cursor );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A credentials cache identifier.
creds (output)	The returned credentials cache entry.
cursor (input/output)	The cursor created by `krb5_cc_start_seq_get`. This value is updated upon return to be used in subsequent calls to `krb5_cc_next_cred`. The returned credentials cache entry.

Description

This routine fetches the next entry from `id`, returning its values in `*creds`, and updates `*cursor` for the next request. It requires that `id` identifies a valid credentials cache and `*cursor` is a cursor returned by `krb5_cc_start_seq_get` or a subsequent call to `krb5_cc_next_cred`. The `krb5_end_seq_get` routine is called when no more entries are to be read.

Return Values

This routine returns the following KRB5 status code:

Error code if there are no more cache entries.

krb5_cc_remove_cred — Remove credentials from the credentials cache

C Prototype

```
krb5_error_code krb5_cc_remove_cred(
         krb5_context     context,
         krb5_ccache      id,
         krb5_flags       which,
         krb5_creds       *cred );
```

Arguments

context (input/output)	The context structure.
id (input)	A credentials cache identifier.
which (input)	A bit mask representing the search flags to use. The values should be logically ORed together. Valid values are: **KRB5_TC_MATCH_TIMES** – The requested lifetime is required to be at least as great as that specified. **KRB5_TC_MATCH_IS_SKEY** – The `is_skey` field much match exactly. **KRB5_TC_MATCH_FLAGS** – The set bits in `mcreds` must match in `creds`. **KRB5_TC_MATCH_TIMES_EXACT** – The requested lifetime must match exactly. **KRB5_TC_MATCH_FLAGS_EXACT** – All bits in `mcreds` must match exactly. **KRB5_TC_MATCH_AUTHDATA** – The authorization data must match. **KRB5_TC_MATCH_SRV_NAMEONLY** – Only the name portion of the principal name must match. The realm portion may be different. If this flag is not set, the entire principal name must match. **KRB5_TC_MATCH_2ND_TKT** – The second tickets must match. **KRB5_TC_MATCH_KTYPE** – The encryption key types must match. **KRB5_TC_MATCH_SUPPORTED_KTYPES** – Check all matching entries that have any supported encryption type and return the one with the encryption type listed earliest. Return CC_NOT_KTYPE if a match is found except for having a supported encryption type.
cred (input)	The credentials to match.

Description

This routine removes any credentials from `id` which match the principal name (`cred->server`) and the fields in `cred` masked by `which`. It requires that `id` identifies a valid credentials cache.

Return Values

This routine returns one of the following KRB5 status codes:

Error code if nothing matches.

Error code if could not delete.

krb5_cc_resolve — Resolve a credentials cache name

C Prototype

```
krb5_error_code krb5_cc_resolve(
         krb5_context   context,
         char           *string_name,
         krb5_ccache    *id );
```

Arguments

context (input/output)	The context structure.
string_name (input)	The credentials cache name to resolve.
id (output)	The credentials cache identifier that corresponds to the name in `string_name`.

Description

This routine fills in `id` with a `ccache` identifier that corresponds to the name in `string_name`.

It requires that `string_name` be of the form `type:residual` and `type` is a type known to the library.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_cc_retrieve_cred — Search the cache for a credential and return it if found

C Prototype

```
krb5_error_code krb5_cc_retrieve_cred(
         krb5_context       context,
         krb5_ccache        id,
         krb5_flags         whichfields,
         krb5_creds         *mcreds,
         krb5_creds         *creds );
```

Arguments

context (input/output)	The context structure.
id (input)	A credentials cache identifier.
whichfields (input)	A bit mask representing the search flags to use. The values should be logically ORed together. Valid values are: **KRB5_TC_MATCH_TIMES** – The requested lifetime is required to be at least as great as that specified. **KRB5_TC_MATCH_IS_SKEY** – The `is_skey` field much match exactly. **KRB5_TC_MATCH_FLAGS** – The set bits in `mcreds` must match in `creds`. **KRB5_TC_MATCH_TIMES_EXACT** – The requested lifetime must match exactly. **KRB5_TC_MATCH_FLAGS_EXACT** – All bits in `mcreds` must match exactly. **KRB5_TC_MATCH_AUTHDATA** – The authorization data must match. **KRB5_TC_MATCH_SRV_NAMEONLY** – Only the name portion of the principal name must match. The realm portion may be different. If this flag is not set, the entire principal name must match. **KRB5_TC_MATCH_2ND_TKT** – The second tickets must match. **KRB5_TC_MATCH_KTYPE** – The encryption key types must match. **KRB5_TC_MATCH_SUPPORTED_KTYPES** – Check all matching entries that have any supported encryption type and return the one with the encryption type listed earliest. Return CC_NOT_KTYPE if a match is found except for having a supported encryption type.
mcreds (input)	The credentials to match.
creds (output)	The credentials found in the cache that match the requested value.

Description

This routine searches the cache id for credentials matching `mcreds`. The fields which are to be matched are specified by set bits in `whichfields`, and always include the principal name `mcreds->server`. This routine requires that `id` identifies a valid credentials cache.

If at least one match is found, one of the matching credentials is returned in `*creds`. The credentials should be freed using `krb5_free_credentials`.

Return Values

This routine returns the following KRB5 status code:

Error code if no matches found.

krb5_cc_set_flags — Set the flags on the credentials cache

C Prototype

```
krb5_error_code krb5_cc_set_flags(
         krb5_context     context,
         krb5_ccache      id,
         krb5_flags       flags );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A credentials cache identifier.
flags (input)	A bit mask representing the flags to set. The values should be logically ORed together. Valid values are: **KRB5_TC_OPENCLOSE** – Turn on OPENCLOSE mode (open and close the cache each time a credentials cache routine is called). The default, if this flag is not set, is to have the cache stay open until `krb5_cc_close` is called.

Description

This routine sets the flags on the credentials cache `id` to `flags`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_cc_start_seq_get — Start sequential read of cached credentials

C Prototype

```
krb5_error_code krb5_cc_start_seq_get(
         krb5_context     context,
         krb5_ccache      id,
         krb5_cc_curso    *cursor );
```

Arguments

context (input/output)	The context structure.
id (input)	A credentials cache identifier.
cursor (output)	A cursor to be used in calls to `krb5_cc_next_cred`.

Description

This routine prepares to sequentially read every set of cached credentials.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_cc_store_cred — Store a credential in the credentials cache

C Prototype

```
krb5_error_code krb5_cc_store_cred(
         krb5_context     context,
         krb5_ccache      id,
         krb5_creds       *creds );
```

Arguments

context (input/output)	The context structure.
id (input)	A credentials cache identifier.
creds (input)	The credentials to store in the cache.

Description

This routine stores creds in the cache `id`, tagged with `creds->client`. It requires that `id` identifies a valid credentials cache.

Return Values

This routine returns one of the following KRB5 status codes:

Permission error.

Storage failure error.

krb5_copy_addresses — Copy Kerberos addresses

C Prototype

```
krb5_error_code krb5_copy_addresses(
         krb5_context           context,
         krb5_address * const   *inaddr,
         krb5_address           ***outaddr );
```

Arguments

context (input/output)	The context structure.
inaddr (input)	An array of addresses.
outaddr (output)	A pointer to a copy of the array of addresses.

Description

This routine copies addresses in `inaddr` to `*outaddr`, which is allocated memory and should be freed with `krb5_free_addresses`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_copy_authdata — Copy a Kerberos authdata structure

C Prototype

```
krb5_error_code krb5_copy_authdata(
         krb5_context           context,
         krb5_authdata * const  *inauthdat,
         krb5_authdata          ***outauthdat );
```

Arguments

context (input/output)	The context structure.
inauthdat (input)	An array of `krb5_authdata` structures. The last element must be NULL.
outauthdat (output)	A copy of the array of `krb5_authdata` structures.

Description

This routine copies an `authdata` structure, filling in `*outauthdat` to point to the newly allocated copy, which should be freed with `krb5_free_authdata`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_copy_authenticator — Copy an authenticator structure

C Prototype

```
krb5_error_code krb5_copy_authenticator(
         krb5_context                  context,
         const krb5_authenticator      *authfrom,
         krb5_authenticator            **authto );
```

Arguments

context (input/output)	The context structure.
authfrom (input)	The authenticator to be copied.
authto (output)	A copy of the authenticator.

Description

This routine copies an authenticator structure, filling in `*outauthdat` to point to the newly allocated copy, which should be freed with `krb5_free_authenticator`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_copy_checksum — Copy a checksum structure

C Prototype

```
krb5_error_code krb5_copy_checksum(
         krb5_context           context,
         const krb5_checksum    *ckfrom,
         krb5_checksum          **ckto );
```

Arguments

context (input/output)	The context structure.
ckfrom (input)	The checksum to be copied.
ckto (output)	A pointer to a copy of the checksum.

Description

This routine copies a checksum structure, filling in `*ckto` to point to the newly allocated copy, which should be freed with `krb5_free_checksum`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_copy_creds — Copy a credentials structure

C Prototype

```
krb5_error_code krb5_copy_creds(
         krb5_context           context,
         const krb5_creds       *incred,
         krb5_creds             **outcred );
```

Arguments

context (input/output)	The context structure.
incred (input)	The credentials structure to be copied.
outcred (output)	A pointer to a copy of the credentials structure.

Description

This routine copies a credentials structure, filling in `*outcred` to point to the newly allocated copy, which should be freed with `krb5_free_creds`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_copy_data — Copy a Kerberos data structure

C Prototype

```
krb5_error_code krb5_copy_data(
         krb5_context      context,
         const krb5_data   *indata,
         krb5_data         **outdata );
```

Arguments

context (input/output)	The context structure.
indata (input)	The data structure to be copied.
outdata (output)	A pointer to a copy of the data structure.

Description

This routine copies a data structure, filling in `*outdata` to point to the newly allocated copy, which should be freed with `krb5_free_data`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_copy_keyblock — Copy a keyblock

C Prototype

```
krb5_error_code krb5_copy_keyblock(
         krb5_context           context,
         const krb5_key lock    *from,
         krb5_keyblock          **to );
```

Arguments

context (input/output)	The context structure.
from (input)	The keyblock to copy.
to (output)	A pointer to a copy of the keyblock.

Description

This routine copies a keyblock, and sets the `*to` argument to point to the newly allocated copy, which should be freed with `krb5_free_keyblock`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_copy_keyblock_contents — Copy a keyblock's contents

C Prototype

```
krb5_error_code krb5_copy_keyblock_contents(
         krb5_context           context,
         const krb5_keyblock    *from,
         krb5_keyblock          *to );
```

Arguments

context (input/output)	The context structure.
from (input)	The keyblock to copy the contents of.
to (output)	A pointer to a copy of the keyblock contents.

Description

This routine copies keyblock contents from `from` to `to`, including allocated storage. The allocated storage should be freed by using `free(to->contents)`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_copy_principal — Copy a principal structure

C Prototype

```
krb5_error_code krb5_copy_principal(
         krb5_context             context,
         krb5_const_principal     inprinc,
         krb5_principal           *outprinc );
```

Arguments

context (input/output)	The context structure.
inprinc (input)	Principal name to be copied.
outprinc (output)	Copy of input principal name.

Description

This routine copies a principal structure, setting `*outprinc` to point to the newly allocated copy, which should be freed with `krb5_free_principal`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_copy_ticket — Copy a Kerberos ticket structure

C Prototype

```
krb5_error_code krb5_copy_ticket(
         krb5_context             context,
         const krb5_ticket        *from,
         krb5_ticket              **pto );
```

Arguments

context (input/output)	The context structure.
from (input)	The ticket structure to be copied.
pto (output)	A pointer to a copy of the ticket structure.

Description

This routine copies a ticket structure, setting `*pto` to point to the newly allocated copy, which should be freed with `krb5_free_ticket`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_free_addresses — Free addresses allocated by krb5_copy_addresses

C Prototype

```
void krb5_free_addresses(
         krb5_context     context,
         krb5_address     **val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine frees the series of addresses `*val` that have been allocated from `krb5_copy_addresses`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_ap_rep_enc_part — Free subkey and other data allocated by krb5_rd_rep or krb5_send_auth

C Prototype

```
void krb5_free_ap_rep_enc_part(
         krb5_context           context,
         krb5_ap_rep_enc_part   *val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine frees the subkey keyblock (if set) as well as `val` that has been allocated from `krb5_rd_rep` or `krb5_send_auth`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_authdata — Free an authdata structure

C Prototype

```
void krb5_free_authdata(
         krb5_context     context,
         krb5_authdata    **val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine frees the authdata structure pointed to by `val` that has been allocated from `krb5_copy_authdata`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_authenticator — Free authenticator storage

C Prototype

```
void krb5_free_authenticator(
         krb5_context           context,
         krb5_authenticator     *val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine frees the authenticator `val`, including the pointer `val`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_checksum — Free a checksum

C Prototype

```
void krb5_free_checksum(
         krb5_context     context,
         krb5_checksum    *val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine frees checksum and the pointer `val`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_context — Free a context structure

C Prototype

```
Void krb5_free_context(
        krb5_context    context );
```

Arguments

context (input)	Context structure to be freed.

Description

This routine frees the context returned by `krb5_init_context`. Internally calls `krb5_os_free_context`.

Return Values

None.

krb5_free_cred_contents — Free credential structures

C Prototype

```
void krb5_free_cred_contents(
         krb5_context         context,
         krb5_creds           *val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine zeros out the session key stored in the credential and then frees the credentials structures. The argument `val` is not freed.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_creds — Free credentials

C Prototype

```
void krb5_free_creds(
         krb5_context    context,
         krb5_creds      *val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine calls `krb5_free_cred_contents` with `val` as the argument. `val` is freed as well.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_data — Free storage associated with a krb5_data object

C Prototype

```
void krb5_free_data(
         krb5_context    context,
         krb5_data       *val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine frees the data structure `val`, including the pointer `val`, which has been allocated by any of numerous routines.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_error — Free error information

C Prototype

```
void krb5_free_error(
         krb5_context   context,
         krb5_error     *val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine frees the error `val` that has been allocated from `krb5_read_error` or `krb5_sendauth`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_host_realm — Free storage allocated by krb5_get_host_realm

C Prototype

```
krb5_error_code krb5_free_host_realm(
         krb5_context     context,
         char * const     *realmlist );
```

Arguments

context (input)	The context structure.
realmlist (output)	A pointer to a list of realm names.

Description

This routine frees the storage taken by a `realmlist` returned by `krb5_get_host_realm`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_keyblock — Free keyblock memory

C Prototype

```
void krb5_free_keyblock(
         krb5_context     context,
         krb5_keyblock    *val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine frees the pointer `val` and memory, and zeroes the keyblock contents of `val`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_principal — Free the pwd_data allocated by krb5_copy_principal

C Prototype

```
void krb5_free_principal(
         krb5_context     context,
         krb5_principal   val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine frees the `pwd_data` `val` that has been allocated from `krb5_copy_principal`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_tgt_creds — Free TGT credentials

C Prototype

```
void krb5_free_tgt_creds(
         krb5_context     context,
         krb5_creds       **tgts );
```

Arguments

context (input/output)	The context structure.
tgts (input/output)	A pointer to the credentials to be freed.

Description

This routine frees the TGT credentials `tgts` returned by `krb5_get_cred_from_kdc`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_free_ticket — Free ticket allocated by krb5_copy_ticket

C Prototype

```
void krb5_free_ticket(
         krb5_context     context,
         krb5_ticket      *val );
```

Arguments

context (input/output)	The context structure.
val (input/output)	A pointer to the data structure to be freed.

Description

This routine frees the ticket `val` that has been allocated from `krb5_copy_ticket` and other routines.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_get_credentials — Get an additional ticket for the client

C Prototype

```
krb5_error_code krb5_get_credentials(
         krb5_context           context,
         const krb5_flags       options,
         krb5_ccache            ccache,
         krb5_creds             *in_creds,
         krb5_creds             *out_creds );
```

Arguments

context (input/output)	The context structure.
options (input)	Valid values are as follows: **KRB5_GC_USER_USER** — Return a full user to user authentication ticket **KRB5_GC_GC_CACHED** — Only search credentials cache for the ticket.
ccache (input)	The credentials cache.
in_creds (input)	Input credentials.
out_creds (output)	Output credentials.

Description

This routine attempts to use the credentials cache `ccache` or a TGS exchange to get an additional ticket for the client identified by `in_creds->client`, with the following information:

- The server identified by i`n_creds->server`.
- The options in options. Valid choices are `KRB5_GC_USER_USER` and `KRB5_GC_GC_CACHED`.
- The expiration date specified in `in_creds->times.endtime`.
- The session key type specified in `in_creds->keyblock.keytype` if it is nonzero.

If options specifies `KRB5_GC_CACHED`, then `krb5_get_credentials` will only search the credentials cache for a ticket.

If options specifies `KRB5_GC_USER_USER`, then `krb5_get_credentials` will get credentials for a user-to-user authentication. In a user-to-user authentication, the secret key for the server is the session key from the server's ticket granting ticket (TGT). The TGT is passed from the server to the client over the network; this is safe since the TGT is encrypted in a key known only by the Kerberos server. The client must pass this TGT to `krb5_get_credentials` in `in_creds->second_ticket`. The Kerberos server will use this TGT to construct a user-to-user ticket that can be verified by the server, by using the session key from its TGT.

The effective expiration date is the minimum of the following:

- The expiration date as specified in `in_creds->times.endtime`.
- The requested start time plus the maximum lifetime of the server as specified by the server's entry in the Kerberos database.

- The requested start time plus the maximum lifetime of tickets allowed in the local site, as specified by the KDC. This is a compile-time option, `KRB5_KDB_MAX_LIFE` in `config.h`, and is by default one day.

If any special authorization data needs to be included in the ticket for example, restrictions on how the ticket can be used, they should be specified in `in_creds->authdata`. If there is no special authorization data to be passed, `in_creds->authdata` should be NULL.

Any returned ticket and intermediate ticket-granting tickets are stored in `ccache`.

Return Values

This routine returns one of the following KRB5 status codes:

System errors.

Errors from encryption routines.

krb5_get_default_realm— Retrieve the default realm

C Prototype

```
krb5_error_code krb5_get_default_realm(
         krb5_context      context,
         char              **lrealm );
```

Arguments

context (input)	The context structure.
lrealm (output)	A pointer to the default realm.

Description

This routine retrieves the default realm to be used if no user-specified realm is available (for example, to interpret a user-typed principal name with the realm omitted for convenience), setting `lrealm` with a pointer to the default realm in allocated storage.

It is the caller's responsibility for freeing the allocated storage pointed to be `lrealm` when it is finished with it.

Return Values

This routine returns the following KRB5 status code:

System errors.

krb5_get_host_realm — Get the Kerberos realm names for a host

C Prototype

```
krb5_error_code krb5_get_host_realm(
         krb5_context      context,
         const char        *host,
         char              ***realmlist );
```

Arguments

context (input)	The context structure.
host (input)	The host name.
realmlist (output)	A pointer to a list of realm names.

Description

This routine determines the Kerberos realm names for `host`, filling in `realmlist` with a pointer to an argv[ ] style list of names, terminated with a NULL pointer.

If `host` is NULL, the local host's realms are determined.

If there are no known realms for the host, the filled-in pointer is set to NULL.

The pointer array and strings pointed to are all in allocated storage, and should be freed by the caller when finished.

Return Values

This routine returns the following KRB5 status code:

System errors.

krb5_get_message — Convert an error code into the string representation

C Prototype

```
char * krb5_get_message(
        long code );
```

Arguments

code (input)	The Kerberos numeric error code.

Description

This routine is supported on the OpenVMS platform only. It converts a Kerberos numeric error code into the string that describes the error.

Return Values

A pointer to an ASCII string describing the error indicated by code. The storage allocated at this pointer location should not be freed; it is part of an internal table of error messages.

krb5_get_server_rcache — Create a replay cache for server use

C Prototype

```
krb5_error_code krb5_get_server_rcache(
         krb5_context           context,
         const krb5_data        *piece,
         krb5_rcache            *ret_rcache );
```

Arguments

context (input/output)	The context structure.
piece (input)	Used to distinguish this replay cache from others in use on the system. Typically, `piece` is the first component of the principal name for the client or server that is calling `krb5_get_server_rcache`.
ret_rcache (output)	A handle to an open `rcache`.

Description

This routine generates a replay cache name, allocates space for its handle, and opens it.

Upon successful return, `ret_rcache` is filled in to contain a handle to an open `rcache`, which should be closed with `krb5_rc_close`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_init_context — Initialize a Kerberos context structure

C Prototype

```
krb5_error_code krb5_init_context(
        krb5_context   *context );
```

Arguments

context (output)	A pointer to the context structure that has been initialized.

Description

This routine initializes the context for the application. The context contains the encryption types, a pointer to operating specific data and the default realm. In the future, the context may also contain thread specific data. The data in the context should be freed with `krb5_free_context`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_kt_add_entry — Add an entry to a key table

C Prototype

```
krb5_error_code krb5_kt_add_entry(
         krb5_context         context,
         krb5_keytab          id,
         krb5_keytab_entry    *entry );
```

Arguments

context (input/output)	The context structure.
id (input)	A key table handle.
entry (input)	The new entry to add to the key table.

Description

This routine adds a new entry to a key table. If the table is not writeable, then KRB5_KT_NOWRITE is returned.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_kt_close — Close a key table

C Prototype

```
krb5_error_code krb5_kt_close(
         krb5_context      context,
         krb5_keytab       id );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A key table handle.

Description

This routine closes the keytab identified by `id` and invalidates `id`, and releases any other resources acquired during use of the key table.

It requires that `id` identifies a keytab.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_kt_default — Return a handle to the default keytab

C Prototype

```
krb5_error_code krb5_kt_default(
         krb5_context     context
         krb5_keytab      *id );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A key table handle.

Description

This routine fills `id` with a handle identifying the default keytab.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_kt_default_name — Get default key table name

C Prototype

```
krb5_error_code krb5_kt_default_name(
         krb5_context     context
         char             *name,
         int               namesize );
```

Arguments

context (input/output)	The context structure.
name (input/output)	Key table name to resolve.
namesize (input)	The size of the name to return. Anything more than `namesize` will be zeroed in `name` upon completion.

Description

This routine fills `name` with the first `namesize` bytes of the name of the default keytab. If the name is shorter than `namesize`, then the remainder of name will be zeroed.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_kt_end_seq_get — Complete a series of sequential key table entry retrievals

C Prototype

```
krb5_error_code krb5_kt_end_seq_get(
         krb5_context      context,
         krb5_keytab       id,
         krb5_kt_cursor    *cursor );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A key table handle.
cursor (input/output)	The cursor to be invalidated.

Description

This routine finishes sequential processing mode and invalidates `cursor`, which must never be reused after this routine call.

This routine requires that `id` identifies a valid keytab and `*cursor` be a cursor returned by `krb5_kt_start_seq_get` or a subsequent call to `krb5_kt_next_entry`.

Return Values

This routine returns the following KRB5 status code:

Error code if cursor is invalid.

krb5_kt_get_entry — Retrieve an entry from the key table

C Prototype

```
krb5_error_code krb5_kt_get_entry(
         krb5_context         context,
         krb5_keytab          id,
         krb5_principal       principal,
         krb5_kvno            vno,
         krb5_keytype         keytype,
         krb5_keytab_entry    *entry );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A key table handle.
principal (input)	A principal name.
vno (input)	Key version number. If `vno` is zero, the first entry whose principal matches is returned.
keytype (input)	The key encryption type. Use a `keytype` of zero if an encryption type does not matter.
entry (output)	The returned key table entry.

Description

This routine searches the keytab identified by `id` for an entry whose principal matches `principal`, whose keytype matches `keytype`, and whose key version number matches `vno`. It returns an error code if no suitable entry is found. If an entry is found, the entry is returned in `*entry`; its contents should be deallocated by calling `krb5_kt_free_entry` when no longer needed.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_kt_get_name — Get key table name

C Prototype

```
krb5_error_code krb5_kt_get_name(
         krb5_context      context,
         krb5_keytab       id,
         char              *name,
         int                namesize );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A key table handle.
name (output)	The key table name.
namesize (input)	The maximum length to fill in name.

Description

This routine fills `name` with the first `namesize` bytes of the name of the keytab identified by `id`. If the name is shorter than `namesize`, then `name` will be NULL terminated.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_kt_next_entry — Retrieve the next entry from the key table

C Prototype

```
krb5_error_code krb5_kt_next_entry(
         krb5_context        context,
         krb5_keytab         id,
         krb5_keytab_entry   *entry,
         krb5_kt_cursor      *cursor );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A key table handle.
entry (output)	The returned key table entry.
cursor (input/output)	A cursor to be used in subsequent calls to `krb5_kt_next_entry`.

Description

This routine fetches the next entry in the keytab, returning it in `*entry`, and updates `*cursor` for the next request. If the keytab changes during the sequential get, an error is guaranteed. The argument `*entry` should be freed after use by calling `krb5_kt_free_entry`.

This routine requires that `id` identifies a valid keytab, and `*cursor` be a cursor returned by `krb5_kt_start_seq_get` or a subsequent call to `krb5_kt_next_entry`.

Return Values

This routine returns the following KRB5 status code:

Error code if no more cache entries or if the keytab changes.

krb5_kt_read_service_key — Retrieve a service key from the key table

C Prototype

```
krb5_error_code krb5_kt_read_service_key( \funcinout
         krb5_context     context,
\funcin
         krb5_pointer     keyprocarg,
         krb5_principal   principal,
         krb5_kvno        vno,
         krb5_keytype     keytype,
\funcout
         krb5_keyblock    **key );
```

Arguments

context (input/output)	The context structure.
keyprocarg (input)	The name of a keytab, or NULL to use the default keytab.
principal (input)	The service principal.
vno (input)	Key version number. Use a `vno` of zero to specify the key with the highest version number.
keytype (input)	The key encryption type. Use a `keytype` of zero if an encryption type does not matter.
key (output)	The returned service key.

Description

The routine opens and searches keytab for the entry identified by principal, `keytype`, and `vno`, returning the resulting key in `*key` or returning an error code if it is not found. If `keyprocarg` is not NULL, it is taken to be a `char*` denoting the name of a keytab. Otherwise, the default keytab will be used.

`krb5_free_keyblock` should be called on `*key` when the caller is finished with the key.

Return Values

This routine returns the following KRB5 status code:

Error code if the entry is not found.

krb5_kt_remove_entry — Remove an entry from a key table

C Prototype

```
krb5_error_code krb5_kt_remove_entry(
         krb5_context         context,
         krb5_keytab          id,
         krb5_keytab_entry    *entry );
```

Arguments

context (input/output)	The context structure.
id (input)	A key table handle.
entry (input)	The entry to remove from the key table.

Description

This routine removes an `entry` from a key table. If this routine is not available, then KRB5_KT_NOWRITE is returned.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_kt_start_seq_get — Start a sequential retrieve of key table entries

C Prototype

```
krb5_error_code krb5_kt_start_seq_get(
         krb5_context       context,
         krb5_keytab        id,
         krb5_kt_cursor     *cursor );
```

Arguments

context (input/output)	The context structure.
id (input/output)	A key table handle.
cursor (output)	A cursor to be used in calls to `krb5_kt_next_entry`.

Description

This routine prepares to read sequentially every key in the keytab identified by `id`. The `cursor` argument is filled in with a cursor to be used in calls to `krb5_kt_next_entry`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_kuserok — Determine whether the local user is authorized to log in

C Prototype

```
krb5_boolean krb5_kuserok(
         krb5_context      context,
         krb5_principal    principal,
         const char        *luser );
```

Arguments

context (input)	The context structure.
principal (input)	A Kerberos principal name.
luser (input)	A local username.

Description

This routine determines whether user is authorized to log in to the account `luser`, given a Kerberos principal `principal` and a local username `luser`.

Return Values

This routine returns one of the following KRB5 status codes:

TRUE	User is authorized to log in.
FALSE	User is not authorized to log in.

krb5_mk_error — Format an error message

C Prototype

```
krb5_error_code krb5_mk_error(
         krb5_context         context,
         const krb5_error     *dec_err,
         krb5_data            *enc_err );
```

Arguments

context (input/output)	The context structure.
dec_err (input)	The error structure to format.
enc_err (output)	The formatted error buffer.

Description

This routine formats the error structure `*dec_err` into an error buffer `*enc_err`.

The error buffer storage (`enc_err->data`) is allocated, and should be freed by the caller when finished.

Return Values

This routine returns the following KRB5 status code:

System errors.

krb5_mk_priv — Format a KRB_PRIV message

C Prototype

```
krb5_error_code krb5_mk_priv(
         krb5_context          context,
         krb5_auth_context     auth_context,
         const krb5_data       *userdata,
         krb5_data             *outbuf,
         krb5_replay_data      *outdata );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	Authentication context. The flags from `auth_context` select whether sequence numbers or timestamps should be used to identify the message. Valid values are: **KRB5_AUTH_CONTEXT_DO_TIME** — Use timestamps and replay cache. **KRB5_AUTH_CONTEXT_RET_TIME** — Copy timestamp to `*outdata`. **KRB5_AUTH_CONTEXT_DO_SEQUENCE** — Use sequence numbers in replay cache. **KRB5_AUTH_CONTEXT_RET_SEQUENCE** — Use sequence numbers in replay cache and output data.
userdata (input)	The user data in the message.
outbuf (output)	The formatted KRB_PRIV buffer.
outdata (input/output)	Contains the sequence numbers if KRB5_AUTH_CONTEXT_RET_SEQUENCE was specified in `auth_context`.

Description

This routine formats a KRB_PRIV message into `outbuf`. Behaves similarly to `krb5_mk_safe`, but the message is encrypted and integrity protected rather than just integrity-protected.

The `inbuf, auth_context, outdata` and `outbuf` arguments function as in `krb5_mk_safe`.

As in `krb5_mk_safe`, the `remote_addr` and `remote_port` part of the `auth_context` is optional; if the receiver's address is not known, it may be replaced by NULL. The `local_addr`, however, is mandatory.

The encryption type is taken from the `auth_context keyblock` portion. If the `i_vector` portion of the `auth_context` is nonNULL, it is used as an initialization vector for the encryption (if the chosen encryption type supports initialization vectors), and its contents are replaced with the last block of encrypted data upon return.

Return Values

This routine returns one of the following KRB5 status codes:

System errors.

Encryption errors.

krb5_mk_rep — Format and encrypt an AP_REP message

C Prototype

```
krb5_error_code krb5_mk_rep(
         krb5_context          context,
         krb5_auth_context     auth_context,
         krb5_data             *outbuf );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	Authentication context.
outbuf (output)	AP_REQ message information.

Description

This routine formats and encrypts an AP_REP message, including in it the data in the `authentp` portion of `auth_context`, encrypted using the keyblock portion of `auth_context`.

When successful, `outbuf->length` and `outbuf->data` are filled in with the length of the AP_REQ message and allocated data holding it. The `outbuf->data` argument should be freed by the caller when it is no longer needed.

If the flags in `auth_context` indicate that a sequence number should be used (either KRB5_AUTH_CONTEXT_DO_SEQUENCE or KRB5_AUTH_CONTEXT_RET_SEQUENCE) and the local sequence number in the `auth_context` is 0, a new number will be generated with `krb5_generate_seq_number`.

Return Values

This routine returns the following KRB5 status code:

System errors.

krb5_mk_req — Format a KRB_AP_REQ message

C Prototype

```
krb5_error_code krb5_mk_req(
         krb5_context           context,
         krb5_auth_context      *auth_context,
         const krb5_flags       ap_req_options,
         char                   *service,
         char                   *hostname,
         krb5_data              *in_data,
         krb5_ccache            ccache,
         krb5_data              *outbuf );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	Authentication context. Contains the checksum method to be used. A new authentication context will be returned if NULL is specified.
ap_req_options (input)	Specifies the `KRB_AP_REQ` options desired. Valid options are: **AP_OPTS_USE_SESSION_KEY** **AP_OPTS_MUTUAL_REQUIRED** **AP_OPTS_USE_SUBKEY**
service (input)	Used to specify the principal name, in conjunction with `hostname`.
hostname (input)	The server to receive the message.
in_data (input)	Application data whose checksum should be included in the authenticator. Specify NULL if no checksum is to be included.
ccache (input/output)	The credentials cache.
outbuf (output)	A pointer to an existing `krb5_data` structure to be filled. Returns the generated AP_REQ message.

Description

This routine formats a `KRB_AP_REQ` message into `outbuf`.

The principal of the server to receive the message is specified by `hostname` and `service`. If credentials are not present in the credentials cache `ccache` for this server, the TGS request with default arguments is used in an attempt to obtain such credentials, and they are stored in `ccache`.

The checksum method to be used is as specified in `auth_context`.

The `outbuf` argument should point to an existing `krb5_data` structure. `outbuf->length` and `outbuf->data` will be filled in on success, and the latter should be freed by the caller when it is no longer needed; if an error is returned, however, no storage is allocated and `outbuf->data` does not need to be freed.

Return Values

This routine returns one of the following KRB5 status codes:

System errors.

Error getting credentials for server.

krb5_mk_req_extended — Format a KRB_AP_REQ message with additional options

C Prototype

```
krb5_error_code krb5_mk_req_extended(
         krb5_context           context,
         krb5_auth_context      *auth_context,
         const krb5_flags       ap_req_options,
         krb5_data              *in_data,
         krb5_creds             *in_creds,
         krb5_data              *outbuf );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	Authentication context. Contains the checksum method to be used. A new authentication context will be returned if NULL is specified.
ap_req_options (input)	Specifies the KRB_AP_REQ options desired. Valid options are: **AP_OPTS_USE_SESSION_KEY** **AP_OPTS_MUTUAL_REQUIRED**
in_data (input)	Application data whose checksum should be included in the authenticator. Specify NULL if no checksum is to be included.
in_creds (input)	Specifies the credentials for the service.
outbuf (output)	A pointer to an existing krb5_data structure to be filled. Returns the generated AP_REQ message.

Description

This routine formats a KRB_AP_REQ message into outbuf, with more complete options than krb5_mk_req.

The outbuf, ap_req_options, auth_context, and ccache arguments are used in the same fashion as for krb5_mk_req.

The in_creds argument is used to supply the credentials (ticket and session key) needed to form the request.

If in_creds->ticket has no data (length == 0), then an error is returned.

During a call to this routine, the structure elements in in_creds may be freed and reallocated. Hence all of the structure elements which are pointers should point to allocated memory, and there should be no other pointers aliased to the same memory, since it may be deallocated during this routine call.

If ap_req_options specifies AP_OPTS_USE_SUBKEY, then a subkey will be generated if need be by krb5_generate_subkey.

A copy of the authenticator will be stored in the auth_context, with the principal and checksum fields nulled out, unless an error is returned. (This is to prevent pointer-sharing problems; the caller should not need these fields anyway, since the caller supplied them.)

Return Values

This routine returns one of the following KRB5 status codes:

System errors.

Error getting credentials for server.

krb5_mk_safe — Format a KRB_SAFE message

C Prototype

```
krb5_error_code krb5_mk_safe(
         krb5_context          context,
         krb5_auth_context     *auth_context,
         const krb5_data       *userdata,
         krb5_data             *outbuf,
         krb5_replay_data      *outdata );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	Authentication context. The `auth_context->auth_context_flags` select whether sequence numbers or timestamps should be used to identify the message. Valid flags are: **KRB5_AUTH_CONTEXT_DO_TIME** — Use timestamps and replay cache. **KRB5_AUTH_CONTEXT_RET_TIME** — Copy timestamp to `*outdata`. **KRB5_AUTH_CONTEXT_DO_SEQUENCE** — Use sequence numbers. **KRB5_AUTH_CONTEXT_RET_SEQUENCE** — Copy sequence numbers to `*outdata`.
userdata (input)	The user data in the message.
outbuf (output)	The formatted KRB_SAFE buffer.
outdata (input/output)	Contains the sequence numbers if KRB5_AUTH_CONTEXT_RET_SEQUENCE was specified in `auth_context`.

Description

This routine formats a KRB_SAFE message into `outbuf`.

The `userdata` argument is formatted as the user data in the message. Portions of `auth_context` specify the checksum type, the keyblock that might be used to seed the checksum, and full addresses (host and port) for the sender and receiver. The `local_addr` portion of `*auth_context` is used to form the addresses used in the KRB_SAFE message. The `remote_addr` is optional; if the receiver's address is not known, it may be replaced by NULL. The `local_addr` argument, however, is mandatory.

If timestamps are to be used (that is, if KRB5_AUTH_CONTEXT_DO_TIME is set), an entry describing the message will be entered in the replay cache so that the caller may detect if this message is sent back by an attacker. If KRB5_AUTH_CONTEXT_DO_TIME is not set, the `auth_context` replay cache is not used.

If sequence numbers are to be used (if either KRB5_AUTH_CONTEXT_DO_SEQUENCE or KRB5_AUTH_CONTEXT_RET_SEQUENCE is set), then `auth_context` local sequence number will be placed in the protected message as its sequence number.

The outbuf buffer storage (`outbuf->data`) is allocated, and should be freed by the caller when finished.

Return Values

This routine returns one of the following KRB5 status codes:

System errors.

Encryption errors.

krb5_os_localaddr — Return all protocol addresses of this host

C Prototype

```
krb5_error_code krb5_os_localaddr(
         krb5_context       context,
         krb5_address       ***addr );
```

Arguments

context (input)	The context structure.
addr (output)	A pointer to an array of address pointers.

Description

This routine returns all of the protocol addresses of this host.

Compile-time configuration flags will indicate which protocol family addresses might be returned. The `*addr` argument is filled in to point to an array of address pointers, terminated by a NULL pointer. All the storage pointed to is allocated and should be freed by the caller with `krb5_free_address` when no longer needed.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_parse_name — Convert string principal name to protocol format

C Prototype

```
krb5_error_code krb5_parse_name(
         krb5_context           context,
         const char             *name,
         krb5_principal         *principal );
```

Arguments

context (input/output)	The context structure.
name (input)	Single string representation of a Kerberos principal name.
principal (output)	Multipart principal format used in the protocols.

Description

This routine converts a single-string representation name of the principal name to the multi-part principal format used in the protocols.

A single-string representation of a Kerberos name consists of one or more principal name components, separated by slashes, optionally followed by the @ character and a realm name. If the realm name is not specified, the local realm is used.

The slash and @ characters can be quoted (included as part of a component rather than as a component separator or realm prefix) by preceding them with a backslash (\) character. Similarly, newline, tab, backspace, and NULL characters can be included in a component by using \n, \t,\b or \0, respectively.

The realm in a Kerberos name cannot contain the slash, colon, or NULL characters.

The *principal argument points to allocated storage that should be freed by the caller (using krb5_free_principal) after use.

Return Values

This routine returns one of the following KRB5 status codes:

KRB5_PARSE_MALFORMED	The name string is badly formatted.
ENOMEM	Space for the return value cannot be allocated.

krb5_principal_compare — Compare two principals

C Prototype

```
krb5_boolean krb5_principal_compare(
         krb5_context              context,
         krb5_const_principal      princ1,
         krb5_const_principal      princ2 );
```

Arguments

context (input/output)	The context structure.
princ1 (input)	First principal name.
princ2 (input)	Second principal name.

Description

This routine compares two principal names.

Return Values

This routine returns one of the following KRB5 status codes:

TRUE	Principals are the same.
FALSE	Principals are different.

krb5_read_password — Read a password from the keyboard

C Prototype

```
krb5_error_code krb5_read_password(
         krb5_context     context,
         const char       *prompt,
         const char       *prompt2,
         char             *return_pwd,
         int              *size_return );
```

Arguments

context (input)	The context structure.
prompt (input)	First user prompt when reading password.
prompt2 (input)	Second user prompt, or NULL to read the password only once.
return_pwd (output)	The returned password.
size_return (input/output)	On input, the maximum size of the password to be returned. On output, the total number of bytes returned in `return_pwd`.

Description

This routine reads a password from the keyboard. The first `*size_return` bytes of the password entered are returned in `return_pwd`. If fewer than `*size_return` bytes are typed as a password, the remainder of `return_pwd` is zeroed. Upon success, the total number of bytes filled in is stored in `*size_return`.

The `prompt` argument is used as the prompt for the first reading of a password. It is printed to the terminal, and then a password is read from the keyboard. No newline or spaces are emitted between the prompt and the cursor, unless the newline/space is included in the prompt.

If `prompt2` is a NULL pointer, then the password is read once.

If `prompt2` is set, then it is used as a prompt to read another password in the same manner as described for `prompt`. After the second password is read, the two passwords are compared, and an error is returned if they are not identical.

Echoing is turned off when the password is read.

Return Values

This routine returns one of the following KRB5 status codes:

0

Error in reading or verifying the password.

krb5_rd_priv — Parse a KRB_PRIV message

C Prototype

```
krb5_error_code krb5_rd_priv(
         krb5_context           context,
         krb5_auth_context      auth_context,
         const krb5_data        *inbuf,
         krb5_data              *outbuf,
         krb5_data              *outdata );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	Authentication context.
inbuf (input)	The KRB_PRIV message to be parsed.
outbuf (output)	The data parsed from the KRB_PRIV message.
outdata (input/output)	Contains the sequence numbers if KRB5_AUTH_CONTEXT_RET_SEQUENCE was specified in `auth_context`.

Description

This routine parses a KRB_PRIV message from `inbuf`, placing the data in `*outbuf` after decrypting it. It behaves similarly to `krb5_rd_safe`, but the message is decrypted rather than integrity checked.

`The inbuf, auth_context, outdata` and `outbuf` arguments function as in `krb5_rd_safe`.

The `remote_addr` part of the `auth_context` as set by `krb5_auth_con_setaddrs` is mandatory; it specifies the address of the sender. If the address of the sender in the message does not match the `remote_addr`, the error KRB5KRB_AP_ERR_BADADDR will be returned.

If `local_addr` portion of the `auth_context` is nonNULL, then the address of the receiver in the message must match it.If it is NULL, the receiver address in the message will be checked against the list of local addresses as returned by `krb5_os_localaddr`.

The `keyblock` portion of `auth_context` specifies the key to be used for decryption of the message. If the `i_vector` element is nonNULL, it is used as an initialization vector for the decryption (if the encryption type of the message supports initialization vectors) and its contents are replaced with the last block of encrypted data in the message.

The `auth_context` flags specify whether timestamps (KRB5_AUTH_CONTEXT_DO_TIME) and sequence numbers (KRB5_AUTH_CONTEXT_DO_SEQUENCE) are to be used.

Return Values

This routine returns one of the following KRB5 status codes:

System errors.

Integrity errors.

krb5_rd_rep — Parse and decrypt an AP_REP message

C Prototype

```
krb5_error_code krb5_rd_rep(
         krb5_context           context,
         krb5_auth_context      auth_context,
         const krb5_data        *inbuf,
         krb5_ap_rep_enc_part   **repl );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	Authentication context.
inbuf (input)	The AP_REP message to parse and decrypt.
repl (output)	The parsed message.

Description

This routine parses and decrypts an AP_REP message from `*inbuf`, filling in *repl with a pointer to allocated storage containing the values from the message. The caller is responsible for freeing this structure with `krb5_free_ap_rep_enc_part`.

The keyblock stored in `auth_context` is used to decrypt the message after establishing any key preprocessing with `krb5_process_key`.

Return Values

This routine returns one of the following KRB5 status codes:

System errors.

Encryption errors.

Replay errors.

krb5_rd_req — Parse a KRB_AP_REQ message

C Prototype

```
krb5_error_code krb5_rd_req(
         krb5_context              context,
         krb5_auth_context         *auth_context,
         const krb5_data           *inbuf,
         krb5_const_principal      server,
         krb5_keytab               keytab,
         krb5_flags                *ap_req_options,
         krb5_ticket               **ticket );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	Authentication context. A new authentication context will be returned if NULL is specified.
inbuf (input)	Contains the KRB_AP_REQ message to be parsed.
server (input)	Specifies the expected server's principal name for the ticket.
keytab (input)	Specifies a keytab containing a decryption key. If NULL, `krb5_kt_default` will be used to find the default keytab and the key taken from there.
ap_req_options (input/output)	If nonNULL on input, this field will be set to contain the application request flags on output.
ticket (output)	Returns the ticket from the AP_REQ message. The caller is responsible for deallocating this space by using `krb5_free_ticket`. If no ticket is desired, specify NULL.

Description

This routine parses a KRB_AP_REQ message, returning its contents. Upon successful return, if ticket is nonNULL, `*ticket` will be modified to point to allocated storage containing the ticket information.

If `auth_context` is NULL, one will be generated and freed internally by the function.

The `server` argument specifies the expected server's name for the ticket.

If `server` is NULL, then any server name will be accepted if the appropriate key can be found, and the caller should verify that the server principal matches some trust criterion.

If server is not NULL, and a replay detection cache has not been established with `auth_context`, one will be generated.

If a keyblock is present in the `auth_context`, it will be used to decrypt the ticket request and the keyblock freed with `krb5_free_keyblock`. This is useful for user-to-user authentication.

If no keyblock is specified, the `keytab` is consulted for an entry matching the requested keytype, server, and version number and used instead.

The authenticator in the request is decrypted and stored in `auth_context`. The client specified in the decrypted authenticator is compared to the client specified in the decoded ticket to ensure that the compare was performed.

If the `remote_addr` portion of the `auth_context` is set, then this routine checks if the request came from the right client.

The replay cache is checked to see if the ticket and authenticator have been seen and, if so, returns an error. If not, the ticket and authenticator are entered into the cache.

Various other checks are made of the decoded data, including cross-realm policy, clockskew, and ticket validation times.

The keyblock, subkey, and sequence number of the request are all stored in the `auth_context` for future use.

If the request has the AP_OPTS_MUTUAL_REQUIRED bit set, the local sequence number, which is stored in the `auth_context`, is XORed with the remote sequence number in the request.

Return Values

This routine returns one of the following KRB5 status codes:

System errors.

Encryption errors.

Replay errors.

krb5_rd_safe — Parse a KRB_SAFE message

C Prototype

```
krb5_error_code krb5_rd_safe(
         krb5_context           context,
         krb5_auth_context      *auth_context,
         const krb5_data        *inbuf,
         krb5_data              *outbuf,
         krb5_replay_data       *outdata );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	Authentication context.
inbuf (input)	The KRB_SAFE message to be parsed.
outbuf (output)	The data parsed from the KRB_SAFE message.
outdata (input/output)	Contains the sequence numbers if KRB5_AUTH_CONTEXT_RET_SEQUENCE was specified in `auth_context`.

Description

This routine parses a KRB_SAFE message from `inbuf`, placing the data in `outbuf` after verifying its integrity.

The keyblock used for verifying the integrity of the message is taken from the `auth_context` `local_subkey`, `remote_subkey`, or `keyblock`. The keyblock is chosen in the preceding order by the first one that is not NULL.

The `remote_addr` and `localaddr` portions of the `*auth_context` specify the full addresses (host and port) of the sender and receiver, and must be of type ADDRTYPE_ADDRPORT.

The `remote_addr` argument is mandatory; it specifies the address of the sender. If the address of the sender in the message does not match `remote_addr`, the error KRB5KRB_AP_ERR_BADADDR will be returned.

If `local_addr` is nonNULL, then the address of the receiver in the message much match it. If it is NULL, the receiver address in the message will be checked against the list of local addresses as returned by `krb5_os_localaddr`. If the check fails, KRB5KRB_AP_ERR_BADARRD is returned.

The `outbuf` buffer storage (`outbuf->data`) is allocated storage which the caller should free when it is no longer needed.

If `auth_context_flags` portion of `auth_context` indicates that sequence numbers are to be used (if KRB5_AUTH_CONTEXT_DOSEQUENCE is set in it), the `remote_seq_number` portion of `auth_context` is compared to the sequence number for the message, and KRB5_KRB_AP_ERR_BADORDER is returned if it does not match. Otherwise, the sequence number is not used.

If timestamps are to be used (if KRB5_AUTH_CONTEXT_DO_TIME is set in `auth_context`), then two additional checks are performed:

- The timestamp in the message must be within the permitted clock skew (which is usually five minutes), or KRB5KRB_AP_ERR_SKEW is returned.
- The message must not be a replayed message, according to `rcache`.

Return Values

This routine returns one of the following KRB5 status codes:

System errors.

Integrity errors.

krb5_recvauth — Receive authenticated message

C Prototype

```
krb5_error_code krb5_recvauth(
         krb5_context           context,
         krb5_auth_context      *auth_context,
         krb5_pointer           fd,
         char                   *appl_version,
         krb5_principal         server,
         krb5_int32             flags,
         krb5_keytab            keytab,
         krb5_ticket            **ticket );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	Authentication context.
fd (input)	A pointer to a file descriptor describing the network socket.
appl_version (input)	A string describing the application protocol version that the client is expecting to use for this exchange. If the client is using a different application protocol, an error will be returned, and the authentication exchange will be aborted.
server (input)	If server is nonNULL, then `krb5_recvauth` verifies that the server principal requested by the client matches server. If not, an error will be returned and the authentication exchange will be aborted.
flags (input)	The flags argument allows the caller to modify the behavior of `krb5_recvauth`. For nonlibrary callers, flags should be 0.
keytab (input)	Specifies a keytab containing a decryption key.
ticket (output)	Ticket is optional and is only filled in if nonNULL. It is filled with the data from the ticket sent by the client, and should be freed with `krb5_free_ticket` when it is no longer needed.

Description

This routine provides a convenient means for client and server programs to send authenticated messages to one another through network connections. The `krb5_sendauth` routine is the matching routine to `krb5_recvauth` for the server. The `krb5_recvauth` routine will engage in an authentication dialog with the client program running `krb5_sendauth` to authenticate the client to the server. In addition, if requested by the client, `krb5_recvauth` will provide mutual authentication to prove to the client that the server represented by `krb5_recvauth` is legitimate.

The `fd` argument is a pointer to the network connection. As in `krb5_sendauth`, in the MIT UNIX and OpenVMS implementations, `fd` is a pointer to a file descriptor.

The arguments `server`, `auth_context`, and `keytab` are used by `krb5_rd_req` to obtain the server's private key.

If `server` is nonNULL, the principal component of it is used to determine the replay cache to use. Otherwise, `krb5_recvauth` will use a default replay cache.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_sendauth — Send authenticated message

C Prototype

```
krb5_error_code krb5_sendauth(
         krb5_context           context,
         krb5_auth_context      *auth_context,
         krb5_pointer           fd,
         char                   *appl_version,
         krb5_principal         client,
         krb5_principal         server,
         krb5_flags             ap_req_options,
         krb5_data              *in_data,
         krb5_creds             *in_creds,
         krb5_ccache            ccache,
         krb5_error             **error,
         krb5_ap_rep_enc_part   **rep_result,
         krb5_creds             **out_creds );
```

Arguments

context (input/output)	The context structure.
auth_context (input/output)	Authentication context.
fd (input)	A pointer to a file descriptor describing the network socket.
appl_version (input)	A string describing the application protocol version that the client is expecting to use for this exchange. If the server is using a different application protocol, an error will be returned.
client (input)	The Kerberos principal for the client. Ignored if `in_creds` is nonNULL.
server (input)	The Kerberos principal for the server. Ignored if `in_creds` is nonNULL.
ap_req_options (input)	Specifies the KRB_AP_REQ flags that should be passed to `krb5_mk_req`. Valid flags are: **AP_OPTS_USE_SESSION_KEY** **AP_OPTS_MUTUAL_REQUIRED** **AP_OPTS_USE_SUBKEY**
in_data (input	The data to be sent to the server.
in_creds (input)	Input credentials, or NULL.
ccache (input/output)	The credentials cache.
error (output)	If nonNULL, contains the error packet returned from the server. This error should be freed with `krb5_free_error`.
rep_result (output)	If nonNULL, contains the result of the mutual authentication exchange. The `*rep_result` argument should be freed with `krb5_free_ap_rep_enc_part` when the caller is done with it.
out_creds (output)	If nonNULL, the retrieved credentials.

Description

This routine provides a convenient means for client and server programs to send authenticated messages to one another through network connections. The `krb5_sendauth` routine sends an authenticated ticket from the client program to the server program using the network connection specified by `fd`. In the MIT UNIX and OpenVMS implementations, `fd` should be a pointer to a file descriptor describing the network socket.

The arguments `client` and `server` specify the Kerberos principals for the client and the server. They are ignored if `in_creds` is nonNULL. Otherwise, `server` must be nonNULL, but `client` may be NULL, in which case the client principal used is the one in the credential cache's default principal.

The `ap_req_options` argument specifies the options that should be passed to `krb5_mk_req`. If `ap_req_options` specifies MUTUAL_REQUIRED, then `krb5_sendauth` will perform a mutual authentication exchange, and if `rep_result` is nonNULLl, it will be filled in with the result of the mutual authentication exchange; the caller should free `*rep_result` with `krb5_free_ap_rep_enc_part` when done with it.

If `in_creds` is nonNULL, then `in_creds->client` and `in_creds->server` must be filled in, and either the other structure fields should be filled in with valid credentials, or `in_creds->ticket.length` should be zero. If `in_creds->ticket.length` is nonzero, then `in_creds` will be used as-is as the credentials to send to the server, and `ccache` is ignored; otherwise, `ccache` is used as described later, and `out_creds`, if not NULL, is filled in with the retrieved credentials.

The `ccache` argument specifies the credential cache to use when one is needed (that is, when `in_creds` is NULL or `in_creds->ticket.length` is zero). When a credential cache is not needed, `ccache` is ignored. When a credential cache is needed and `ccache` is NULL, the default credential cache is used. Note that if the credential cache is needed and does not contain the needed credentials, they will be retrieved from the KDC and stored in the credential cache.

If mutual authentication is used and `rep_result` is nonNULL, the sequence number for the server is available to the caller in `*rep_result->seq_number`. (If mutual authentication is not used, there is no way to negotiate a sequence number for the server.)

If an error occurs during the authenticated ticket exchange and error is nonNULL, the error packet (if any) that was sent from the server will be placed in it. This error should be freed with `krb5_free_error`.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_set_default_realm — Sets the default realm

C Prototype

```
krb5_error_code krb5_set_default_realm(
         krb5_context       context,
         char               *realm );
```

Arguments

context (input)	The context structure.
realm (output)	The default realm to be set. If realm is NULL, then the operating system default value will used.

Description

This routine sets the default realm to be used if no user-specified realm is available (for example, to interpret a user-typed principal name with the realm omitted for convenience).

Return Values

This routine returns the following KRB5 status code:

System errors.

krb5_sname_to_principal — Generate a full principal name from a service name

C Prototype

```
krb5_error_code krb5_sname_to_principal(
         krb5_context     context,
         const char       *hostname,
         const char       *sname,
         krb5_int32       type,
         krb5_principal   *ret_princ );
```

Arguments

context (input)	The context structure.
hostname (input)	The host name, or NULL to use the local host..
sname (input)	The service name.
type (input)	A principal type. The type argument controls how `krb5_sname_to_principal` generates the principal name, `ret_princ`, for the named service, `sname`. Valid values are: **KRB5_NT_SRV_HST** — The `hostname` will be canonicalized (a fully qualified lowercase hostname using the primary name and the domain name), before `ret_princ` is generated in the form `sname/hostname@LOCAL.REALM`. Most applications should use KRB5_NT_SRV_HST. **KRB5_NT_UNKNOWN** — While the generated principal name will have the form `sname/hostname@LOCAL.REALM`, the `hostname` will not be canonicalized first. It will appear exactly as it was passed in `hostname`.
ret_princ (output)	The returned full principal name.

Description

This routine generates a full principal name to be used when authenticating with the named service on the host., given a hostname `hostname` and a generic service name `sname`. The full principal name is returned in `ret_princ`.

The realm of the principal is determined internally by calling `krb5_get_host_realm`.

The caller should release the storage in `ret_princ` by calling `krb5_free_principal` when it is finished with the principal.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_timeofday — Retrieves the system time of day (in seconds) since local system's epoch

C Prototype

```
krb5_error_code krb5_timeofday(
         krb5_context     context,
         krb5_int32       *timeret );
```

Arguments

context (input/output)	The context structure.
timeret (output)	The system time of day, in seconds, since the local system's epoch.

Description

This routine retrieves the system time of day, in seconds since the local system's epoch.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

krb5_unparse_name — Convert protocol format principal name to string format

C Prototype

```
krb5_error_code krb5_unparse_name (
         krb5_context             context,
         krb5_const_principal     principal,
         char                     **name );
```

Arguments

context (input/output)	The context structure.
principal (input)	Multipart principal format used in the protocols.
name (output)	Single string representation of a Kerberos principal name.

Description

This routine converts the multipart principal name principal from the format used in the protocols to a single-string representation of the name. The resulting single-string representation will use the format and quoting conventions described for `krb_parse_name`.

The `*name` argument points to allocated storage and should be freed by the caller when finished.

Return Values

This routine returns one of the following KRB5 status codes:

KRB5_PARSE_MALFORMED	The principal does not contain at least two components.
ENOMEM	Unable to allocate memory.

krb5_unparse_name_ext — Convert multiple protocol format principal names to string format

C Prototype

```
krb5_error_code krb5_unparse_name_ext(
         krb5_context            context,
         krb5_const_principal    principal,
         char                    **name,
         int                     *size );
```

Arguments

context (input/output)	The context structure.
principal (input)	Multipart principal format used in the protocols.
name (output)	Single string representation of a Kerberos principal name.
size (output)	Size of the unparsed name buffer.

Description

`This routine` is designed for applications which must unparse a large number of principals, and are concerned about the speed impact of needing to do a lot of memory allocations and deallocations. It functions similarly to `krb5_unparse_name` except if `*name` is nonNULL, in which case, it is assumed to contain an allocated buffer of size `*size` and this buffer will be resized with `realloc` to hold the unparsed name. Note that in this case, `*size` must not be NULL.

The `*name` argument points to allocated storage and should be freed by the caller when finished.

Return Values

This routine returns the following KRB5 status code:

KRB5_S_COMPLETE	Successful completion.

krb5_us_timeofday — Retrieves the system time of day (in seconds and microseconds)

C Prototype

```
krb5_error_code krb5_us_timeofday(
         krb5_context     context,
         krb5_int32       *seconds,
         krb5_int32       *microseconds );
```

Arguments

context (input)	The context structure.
seconds (output)	The system time of day, in seconds, since the local system's epoch.
microseconds (output)	The microseconds portion of the system time of day.

Description

This routine retrieves the system time of day, in seconds, since the local system's epoch.

The seconds portion is returned in `*seconds`, the microseconds portion in `*microseconds`.

Return Values

This routine returns the following KRB5 status code:

Successful completion.

A Open Source Notices

Acknowledgements

The Kerberos model is based in part on Needham and Schroeder's trusted third-party authentication protocol and on modifications suggested by Denning and Sacco. The original design and implementation of Kerberos Versions 1 through 4 was the work of Steve Miller of the former Digital Equipment Corporation (now Hewlett-Packard Company) and Clifford Neuman (now at the Information Sciences Institute of the University of Southern California), along with Jerome Saltzer, Technical Director of Project Athena, and Jeffrey Schiller, MIT Campus Network Manager. Many other members of Project Athena have also contributed to the work on Kerberos. Version 4 is publicly available, and has seen wide use across the Internet.

Version 5 (described in this document) has evolved from Version 4 based on new requirements and desires for features not available in Version 4.

Kerberos Copyright Notice

OpenVision Technologies Copyright Notice

```
The following copyright and permission notice applies to the
OpenVision Kerberos Administration system located in kadmin/create,
kadmin/dbutil, kadmin/passwd, kadmin/server, lib/kadm5, and
portions of lib/rpc:


WARNING:  Retrieving the OpenVision Kerberos Administration system
source code, as described below, indicates your acceptance of the
following terms.  If you do not agree to the following terms, do not
retrieve the OpenVision Kerberos administration system.
You may freely use and distribute the Source Code and Object Code
compiled from it, with or without modification, but this Source Code
is provided to you 'AS IS' EXCLUSIVE OF ANY WARRANTY, INCLUDING,
WITHOUT LIMITATION, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS
FOR A PARTICULAR PURPOSE, OR ANY OTHER WARRANTY, WHETHER EXPRESS
OR IMPLIED.  IN NO EVENT WILL OPENVISION HAVE ANY LIABILITY FOR ANY
LOST PROFITS, LOSS OF DATA OR COSTS OF PROCUREMENT OF SUBSTITUTE GOODS
OR SERVICES, OR FOR ANY SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES
ARISING OUT OF THIS AGREEMENT, INCLUDING, WITHOUT LIMITATION, THOSE
RESULTING FROM THE USE OF THE SOURCE CODE, OR THE FAILURE OF THE SOURCE
CODE TO PERFORM, OR FOR ANY OTHER REASON.


OpenVision retains all copyrights in the donated Source Code.
OpenVision also retains copyright to derivative works of the Source
Code, whether created by OpenVision or by a third party. The OpenVision
copyright notice must be preserved if derivative works are made based
on the donated Source Code.


OpenVision Technologies, Inc. has donated this Kerberos Administration
system to MIT for inclusion in the standard Kerberos 5 distribution.
This donation underscores our commitment to continuing Kerberos technology
development and our gratitude for the valuable work which has been
performed by MIT and the Kerberos community
```

University of California Copyright Notice

```
Copyright Notice, University of California at Berkeley © 1983 Regents of the University of
California.

MIT Kerberos includes documentation and software developed at the
University of California at Berkeley, which includes this copyright notice:


All rights reserved.
Redistribution and use in source and binary forms, with or without
modification, are permitted provided that the following conditions are met:


• Redistributions of source code must retain the above copyright notice,
this list of conditions and the following disclaimer.


• Redistributions in binary form must reproduce the above copyright
notice, this list of conditions and the following disclaimer in the
documentation and/or other materials provided with the distribution.
```

• All advertising materials mentioning features or use of this software must display the following acknowledgement: "This product includes software developed by the University of California, Berkeley and its contributors."

• Neither the name of the University nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

Permission is granted to make and distribute verbatim copies of this manual provided the copyright notices and this permission notice are preserved on all copies.
Permission is granted to copy and distribute modified versions of this manual under the conditions for verbatim copying, provided also that the entire resulting derived work is distributed under the terms of a permission notice identical to this one.
Permission is granted to copy and distribute translations of this manual into another language, under the above conditions for modified versions.

Glossary

A-Z

Authentication Verification of the claimed identity of a principal.

Authentication header A record containing a ticket and an authenticator to be presented to a server as part of the authentication process.

Authentication path A sequence of intermediate realms transited in the authentication process when communicating from one realm to another.

Authenticator A record containing information that can be shown to have been recently generated using the session key known only by the client and server.

Authorization The process of determining whether a client may use a service, the objects the client is allowed to access, and the type of access allowed.

Ciphertext The output of an encryption function. Encryption transforms plaintext into ciphertext.

Client A process that uses a network service on behalf of a user. In some cases a server may itself be a client of some other server. (For example, a print server may be a client of a file server.)

Credentials A ticket plus the secret session key necessary to successfully use that ticket in an authentication exchange.

KDC (Key Distribution Center) A network service that supplies tickets and temporary session keys, or an instance of that service or the host on which it runs. The KDC services both initial ticket and ticket-granting ticket requests.

The initial ticket portion is sometimes referred to as the authentication server (or service). The ticket-granting ticket portion is sometimes referred to as the ticket-granting server (or service).

Kerberos 1. In ancient mythology, the three-headed dog guarding Hades. 2. The name given to Project Athena's authentication service, the protocol used by that service, or the code used to implement the authentication service.

Plaintext The input to an encryption function or the output of a decryption function. Decryption transforms ciphertext into plaintext.

Principal A uniquely named client or server instance that participates in a network communication.

Principal identifier The name used to uniquely identify each different principal.

Realm The administrative domain that encompasses Kerberos clients and servers.

Seal To encipher a record containing several fields in such a way that the fields cannot be individually replaced without either knowledge of the encryption key or leaving evidence of tampering.

Secret key An encryption key shared by a principal and the KDC, distributed outside the bounds of the system, with a long lifetime. In the case of a human user's principal, the secret key is derived from a password.

Server A particular principal that provides a resource to network clients.

Service A resource provided to network clients; often provided by more than one server (for example, remote file service).

Session key A temporary encryption key used between two principals, with a lifetime limited to the duration of a single login session.

Sub-session key A temporary encryption key used between two principals, selected and exchanged by the principals using the session key, and with a lifetime limited to the duration of a single association.

Ticket A record that helps a client authenticate itself to a server; it contains the client's identity, a session key, a timestamp, and other information, all sealed using the server's secret key. It only serves to authenticate a client when presented along with a fresh authenticator.

A

Administrative utilities, 49
Authentication path, 27
Authentication service, 29

C

Cerberus, 25
Client programs, 45
Compiling Kerberos application, 57
Configuration logs, 32

D

Database, 29
Denial of service attacks, 27

E

Example programs, 58
  GSSAPI, 58
  KRB5 API, 59

G

GSSAPI example program, 58

I

Installation logs, 39
Inter-realm key, 27

K

kadmin, 29, 49
kdb5_util, 30, 50
KDC, 25, 28
kdestroy, 30, 48
Kerberos
  compiling application, 57
  linking application, 57
Kerberos database, 29
Kerberos for OpenVMS website, 31
Key Distribution Center, 25
kinit, 29, 45
klist, 30, 47
kpasswd, 30, 48
kprop
  using to propagate database, 53
KRB5 API example program, 59

L

Linking Kerberos application, 57

M

Massachusetts Institute of Technology, 25
Master KDC server
  propagation of, 53
MultiNet, 31

P

Principal name, 25
Private key, 26

R

Realm, 25, 27

S

Secret key, 26
Secret key cryptography, 26
Service key, 26
Session key, 26

T

TCP/IP Services for OpenVMS, 31
TCPware, 31
TGT, 26
Ticket, 26
Ticket-granting service, 29
Ticket-granting ticket, 26

U

Utilities
  administrative, 49
  user, 45
Utility programs, 29