z/OS LDAP: Overview and New Function Update

Valid thru z/OS 1.6
Session W16

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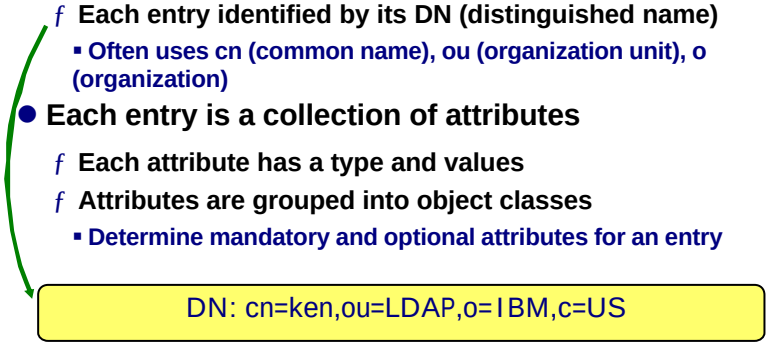
Agenda

- **LDAP Overview**
- **LDAP Authentication**
  - **Using RACF**
  - **Using TDBM**
  - **Native Authentication**
- **LDAP Authorization/Access Control**
  - **Under RACF**
  - **TDBM ACLs**
- **LDAP Change Log SPE**
- **z/OS V1R6 LDAP New Function**

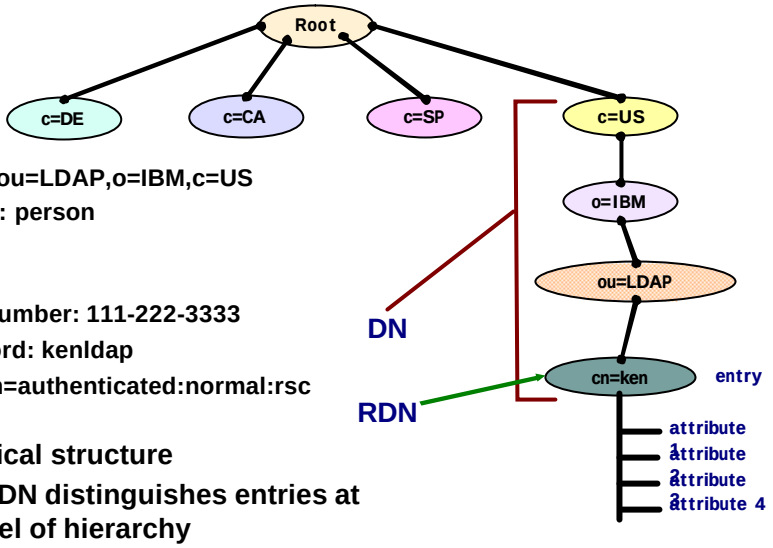
Overview of LDAP

What is LDAP?

- Lightweight Directory Access Protocol (LDAP) is a global directory model
- Originally developed as front-end of X.500 (DAP)
- The LDAP protocol runs over TCP
- Global directory model is based on entries
  - Each entry identified by its DN (distinguished name)
    - Often uses cn (common name), ou (organization unit), o (organization)
- Each entry is a collection of attributes
  - Each attribute has a type and values
  - Attributes are grouped into object classes
    - Determine mandatory and optional attributes for an entry



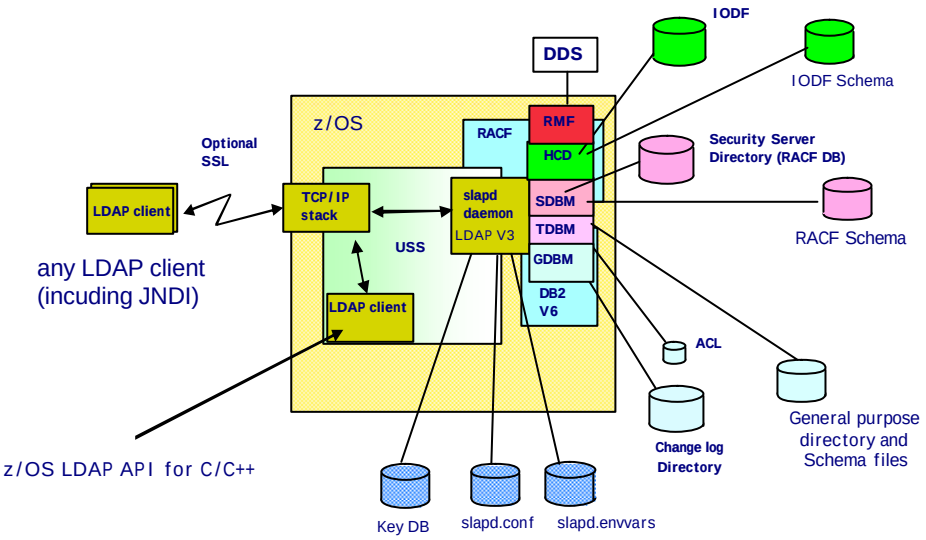
LDAP Directory Structure



dn: cn=ken,ou=LDAP,o=IBM,c=US
objectclass: person
cn: ken
sn: morgan
telephonenumber: 111-222-3333
userpassword: kenldap
aclentry: cn=authenticated:normal:rsc

- **Hierarchical structure**
- **Relative DN distinguishes entries at same level of hierarchy**
- **Attributes are protected by Access Control Lists (ACL)**

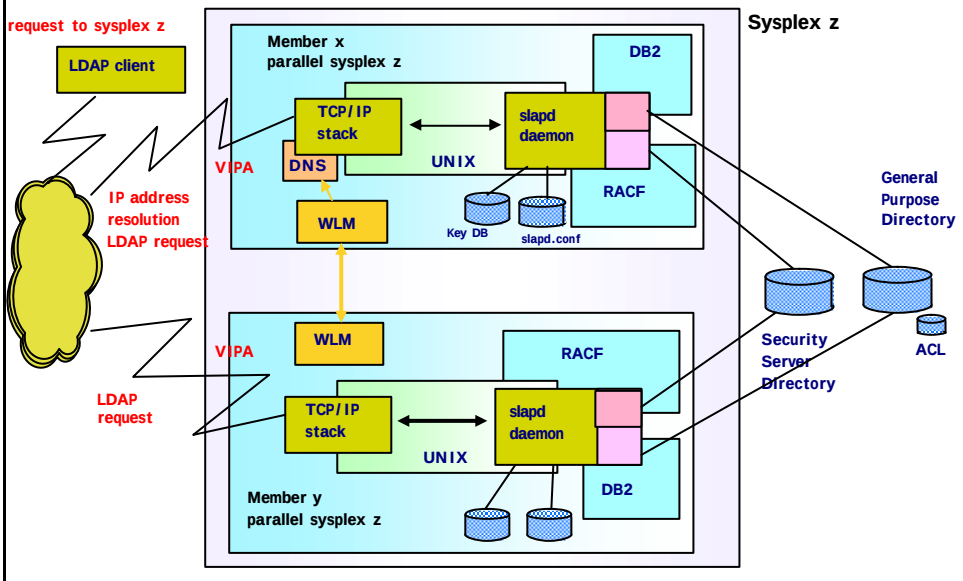
LDAP Server on z/OS

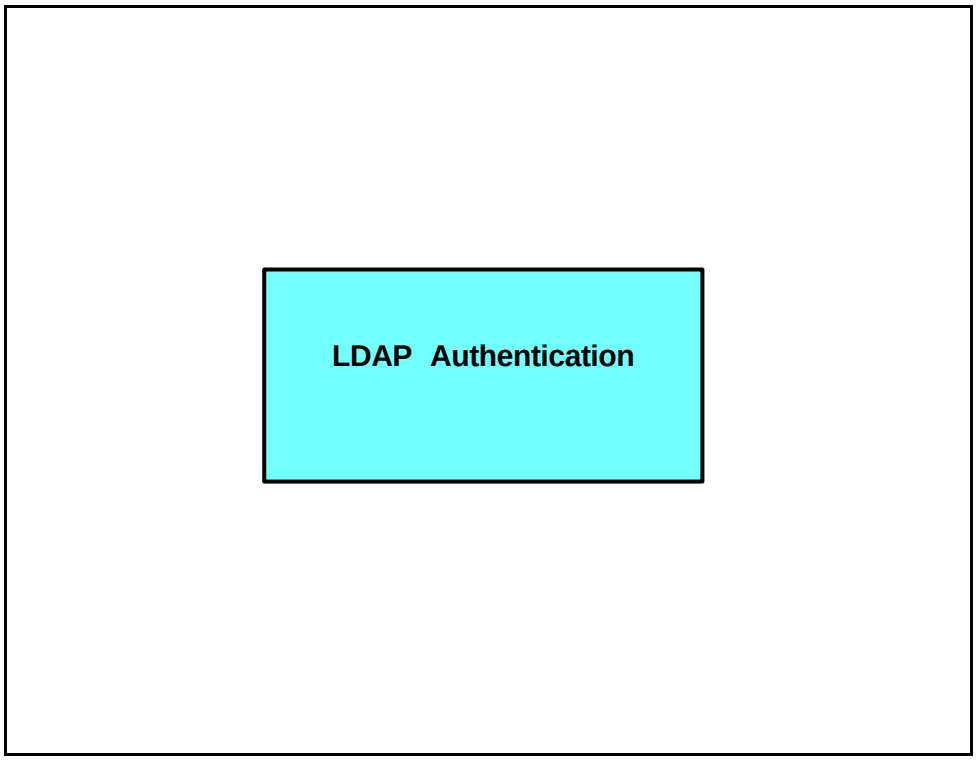


LDAP Server on z/OS...

- **LDAP Server has multiple backends (data stores)**
  - **TDBM: General purpose directory**
    - **Full LDAP V3 support, including modifiable schema**
    - **Data stored in DB2 database**
    - **Full scalability**
  - **SDBM: RACF users, groups, and user-group connections**
    - **Provides remote RACF administration and authentication**
    - **Fixed schema**
    - **Data stored in RACF database**
    - **Limited search capability**
  - **GDBM: change log directory**
    - **Similar to TDBM (DB2 based) but restricted operations**
  - **Limited function special backends**
    - **HCD: IODF definitions, data in IODF - shipped with HCD**
    - **RMF: RMF data, stored in RMF DDS server - shipped with RMF**

LDAP for z/OS Parallel Sysplex Support

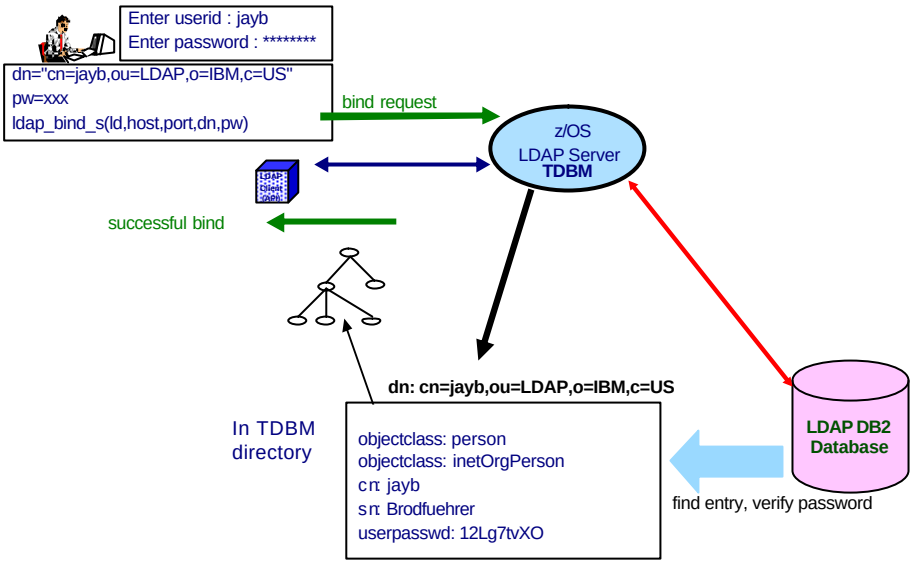




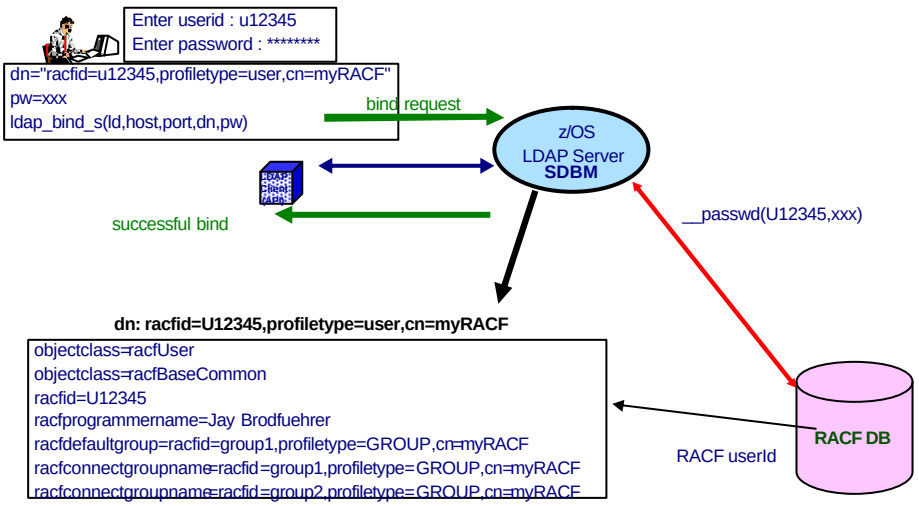
Authentication with an LDAP Server

- **LDAP is a stateful protocol**
  - **Session starts when client "binds" to server**
  - **Session can be unauthenticated (anonymous bind)**
  - **Authentication is performed during bind**
    - **Check password or certificate**
    - **Determine groups to which user belongs (for authorization checking)**
- **LDAP supports different authentication protocols**
  - **Simple bind: Distinguished Name and password**
    - **Session can optionally be protected with SSL**
    - **Passwords can be stored in LDAP directory, optionally one-way (MD5, SHA-1, crypt) or two-way (TDES) encrypted, or stored in RACF**
  - **Certificate bind: X.509 digital certificate over SSL**
    - **Distinguished name in certificate must conform with distinguished name of person authenticating**
  - **Kerberos bind: Kerberos principal sends ticket for LDAP server**
    - **Attribute: ibm-kn = principal @ realm**
  - **CRAM-MD5, DIGEST-MD5 binds: DN/userid and password**
    - **Client hashes password using MD5 encryption**

LDAP TDBM Authentication



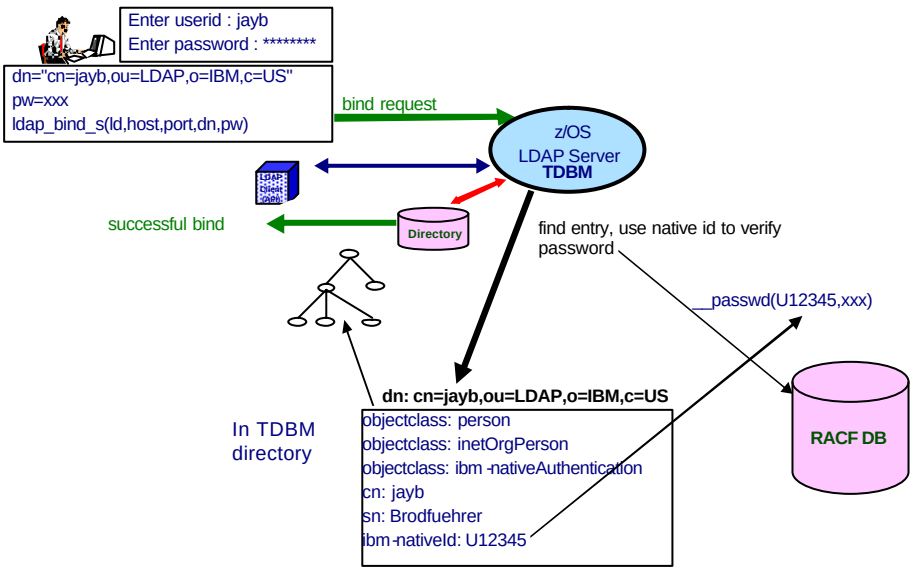
LDAP Authentication with SDBM (RACF)



z/OS LDAP Server Native Authentication

- **Disadvantage of Authentication in RACF:**
  - **SDBM backend required**
  - **Nonstandard Distinguished Name (racfid, profiletype)**
  - **Fixed schema: only RACF information is available, cannot add attributes to contain additional information**
- **Native Authentication uses TDBM backend**
  - **Standard Distinguished Name (e.g. cn, ou, o)**
  - **Any schema supported by LDAP V3 for person entry can be used**
    - **Any information supported by the schema can be retrieved**
    - **Use TDBM groups and group membership in ACLs**
  - **Authentication (password verification) performed by RACF**
    - **Password for entry is in security server (not in TDBM)**
    - **No need for administration or synchronization of multiple password registries**
    - **RACF authentication triggered by attribute ibm-nativeId in TDBM entry**
  - **Can limit native authentication to specific TDBM subtrees or entries - some entries use RACF, others have passwords in entry**

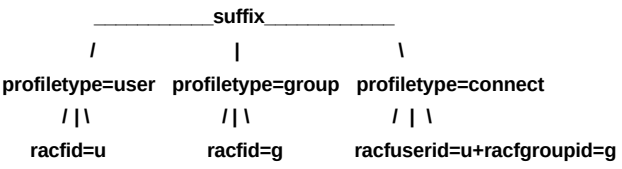
LDAP Native Authentication



Accessing RACF via LDAP

SDBM Support of RACF

- **Use LDAP to add, modify, delete, display RACF users, groups, and user-group connection - remote admin**
  - **Equivalent to RACF commands: ADDUSER, ALTUSER, DELUSER, LISTUSER, ADDGROUP, ALTGROUP, DELGROUP, LISTGRP, CONNECT, REMOVE**
- **SDBM directory structure**



example DN: racfid=kmorgan,profiletype=user,cn=myRacf

- **Hard coded schema definitions**
- **Limited search capabilities - predefined by SDBM**
- **All data accessed via RACF**
  - **No RACF Data in LDAP**
  - **Authorization controled by RACF, based on bound userid**

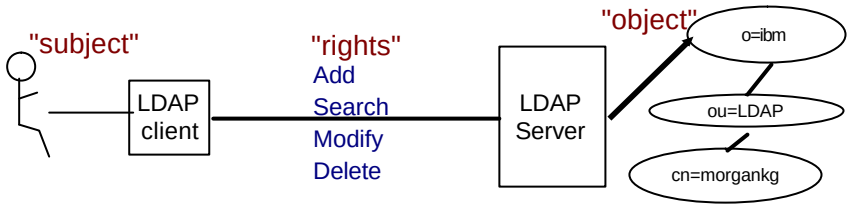
Changing the RACF Password

- **ldapmodify can be used to change RACF password**
  - **Via SDBM:**
    - **dn: racfid=G12345,profiletype=user,cn=myRACF**
      changetype: modify
      replace: racfPassword
      racfPassword: *new_password*
  - **Via TDBM with native authentication**
    - **dn: cn=jayb,ou=LDAP,o=ibm,c=us**
      changetype: modify
      delete: userPassword
      userPassword: *old_password*
      -
      add: userPassword
      userPassword: *new_password*
      -
    - **Note:** replace: userPassword **cannot be used - not supported**
- **LDAP SDBM or native authentication bind can be used to change a password (even if expired)**
  - **Specify *old_password*| *new_password***

Access Control in TDBM

Access Control Checking

- **Does subject have the right to perform the requested operation on an object?**
  - **"subject" - the "bound" LDAP client identity: DN of requestor + DNs of groups to which requestor belongs**
  - **"object" - the entries or the attributes of the entries involved in the operation**
  - **"rights" - the access required to perform the requested operation (add/delete entry, read/write/search/compare attribute)**



Access Control Implementation

- **TDBM uses an Access Control List (ACL) to control access to an entry**
  - **Specifies DNs of bound users and groups that can access the entry**
- **Can control access to individual attributes or to classes of attributes (normal, sensitive, critical, restricted and system)**
  - **Attribute's access class defined in the schema**
- **Use LDAP modify operation to set ACL and search operation to display ACL info**
  - **examples:**

```
aclentry: cn=Jayb,o=Your Company:normal:rwsc:sensitive:rsc
aclentry: racfid=morgankg,profiletype=user,cn=myRacf:object:ad
aclentry: group:cn=mgrs,o=Your Company:at:userpassword:rwsc
 aclentry:group:racfid=g1,profiletype=group,cn=myRacf:normal:rwsc
```

- **Can propagate an entry's ACL to the subtree below it**

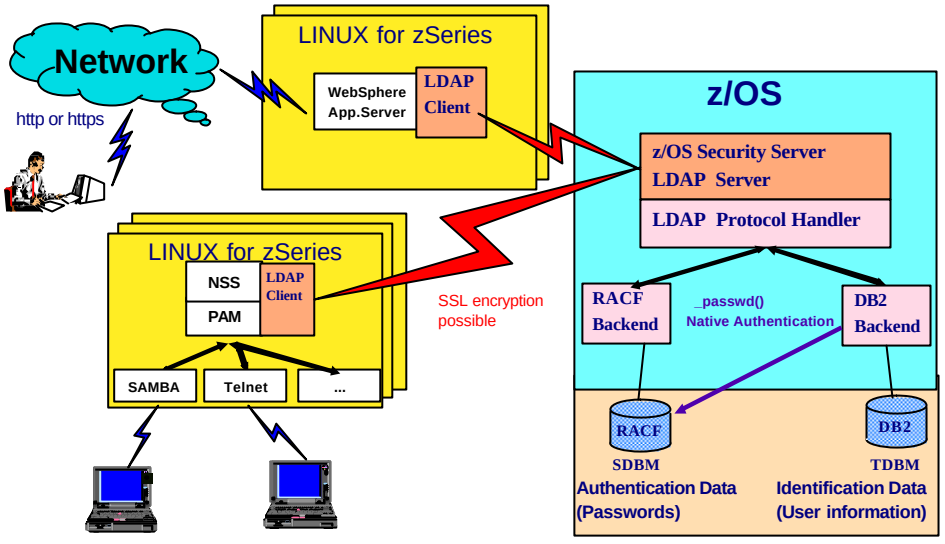
Special aclEntry "pseudo-DNs"

- **cn=anybody**
  - **Applies when no other specific ACL value applies**
- **cn=authenticated**
  - **Applies when the requestor has authenticated to the directory bu t no other specific ACL value applies**
  - **Meant to allow more access than cn=anybody ACL value**
- **cn=this**
  - **Applies when the requestor has authenticated with the same DN as the entry being accessed**
  - **Used to grant individuals access to their own entry**
- **Example:**

aclentry: cn=anybody:normal:rsc
aclentry: cn=authenticated:normal:rsc:sensitive:rs
aclentry: cn=this:normal:rscw:sensitive:rscw:critical:rsc

The Big Picture

User Information and Authentication in LDAP



Change Log SPE

LDAP-RACF Change Log SPE

- **Provides way to propagate RACF user changes (including password changes) to other systems**
- **RACF part:**
  - **Notifies LDAP when a change to a user occurs**
  - **Creates PKCS7 envelope containing clear password**
- **LDAP part:**
  - **Creates an entry containing the RACF info in the changelog directory (in new change log backend - GDBM)**
    - **Can be accessed using normal LDAP operations from any LDAP client**
  - **Supports retrieval of RACF password envelope via LDAP search**
- **Used by IBM Tivoli Directory Integrator to synchronize passwords:**
  - **Periodically does LDAP search of change log for new entries**
  - **If password changed, performs LDAP search of RACF user to retrieve enveloped password**
  - **Decrypts envelope and sets password on other systems**

Change Log SPE - continued

- **Searching the change log**

> ldapsearch … -b cn=changelog changenumber>=1023
CHANGENUMBER=1023,CN=CHANGELOG

```
objectclass: CHANGELOGENTRY
objectclass: IBM-CHANGELOG
changenumber: 1023
targetdn: racfid=U12345,profiletype=user,CN=MYRACF
changetime: 20030611161820.374472Z
changetype: MODIFY
changes: replace: racfpassword
racfpassword: *ComeAndGetIt*
-
ibm-changeinitiatorsname: racfid=RADM,profiletype=user,CN=MYRACF
```

- **Retrieving RACF envelope containing new password**

> ldapsearch –D racfid=cladmin,profiletype=user,cn=myRacf –w passwd –L -b racfid=U12345,profiletype=user,cn=myRacf "objectclass=*" racfpasswordenvelope

```
racfid=U12345,profiletype=USER,cn=myRacf
racfpasswordenvelope:: base-64_encoded_password_envelope
```

New Function in z/OS V1R6
LDAP

V1R6 Function Availability on Previous z/OS Releases

- **Late-breaking news: "IBM z/OS V1.6: Integrating new applications" announcement (#204-180, Aug 10, 2004)**
- **z/OS V1R6 LDAP fuctions will be made available on z/OS V1R4 and z/OS V1R5**
  - **In "LDAP Enhancements for z/OS V1R4/R5 and z/OS.e V1R4/R5" Web deliverable**
- **Will not support WebSphere Application Server for z/OS and OS/390, V4.0.1**
- **Planned availability: Nov 19, 2004**

Change Logging Enhancements

- **Problem: Have change log entries for RACF user changes but no indication of changes to TDBM entries**
- **Solution:**
  - **Create change log entry for each change to any TDBM entry**
    - **Including schema entry**
- **Same change log as for RACF changes**
  - **Change log entries from RACF and TDBM intermixed**
- **Complete changes attribute**
  - **userpassword value replaced with *ComeAndGetIt***
- **No suppport for enveloping TDBM password**
  - **Can already retrieve password (depending on encryption in use)**
- **Configuration options to turn on/off TDBM change logging**
  - **Default is ON**

Change Logging Enhancements - continued

- **Example of change log entry for add of a TDBM entry:**

CHANGENUMBER=1024,CN=CHANGELOG
objectclass: CHANGELOGENTRY
objectclass: IBM -CHANGELOG
changenumber: 1024
targetdn: cn=ken,o=Your Company
changetime: 20030611161820.374472Z
changetype: ADD
changes: objectclass: inetorgperson
cn: ken34
userpassword: *ComeAndGetIt*
sn: Morgan
telephonenumber: 123-456-7890
ibm-entryuuid: 59290000-73D7-1F7B-94ED-40206404095
-

ibm-changeinitiatorsname: racfid=dept68mgr,o=Your Company

Persistent Search (Event Notification)

- **Problem: Integrator products not notified when change to RACF user or TDBM entry occurs**
  - **Needed to continually poll change log**
- **Solution: Allow a search to persist**
  - **Optionally first return existing entries matching search criteria**
  - **Continue to return an entry each time it is changed and matches search criteria (base, scope, and filter)**
- **New control on search request to indicate persistent**
  - **LDAP Server config option to allow/reject persistent searches**
  - **Control can specify types of change to monitor (add, modify, delete, rename)**
- **Persistent search continues until client issues abandon or unbind**
- **Example: typical Integrator product persistent search**

base: cn=changelog scope: subtree filter: objectclass=*

types of change: add

Alias Support

- **Problem: need a simple, well-known name for an entry**
  - **Application shouldn't fail if entry containing information is moved**
- **Solution: allow creation of an alias entry that points to the 'real' entry**
  - **Alias DN can be much simpler than DN of real entry**
  - **Application uses alias entry**
  - **If real entry moves, just change pointer in alias entry**
- **Alias support involves**
  - **Creating an alias entry which points to another DN**
  - **Supporting dereferencing during search**
    - **When find alias entry, continue search using DN pointed to**
      - Must be within same backend
      - Can contain an alias (dereference it!)
  - **Alias support in TDBM only (not SDBM)**
- **Dereferencing is only done during search operation**
  - **Client specifies level of dereferencing on search request**

Alias Support - continued

- **Example:**
  - **If create alias entry**

    ou=LDAPZOS,o=IBM

    to point to 'real' entry

    ou=DEPTC8NG,o=Pok,o=IBM_US,o=IBM

  - **And do a dereferenced search with base DN**

    cn=morgankg,ou=LDAPZOS,o=IBM

  - **Search dereferences alias within base DN and processes entry**

    cn=morgankg,ou=DEPTC8NG,o=Pok,o=IBM_US,o=IBM

  - **Normal (non-dereferenced) search would return LDAP_NO_SUCH_OBJECT**

- **Warning:**
  - **Alias dereferencing degrades search performance**
  - **Some clients (e.g. JNDI client) set dereferencing on by default**

Enhanced Access Groups

- **Problem: limited ways to create large access groups**
  - **Used in determining group membership for ACL checking**
- **Solution: provide more ways to create TDBM groups**
- **Static groups: added ways to specify members**
- **Additional types of groups**
  - **Dynamic groups**
    - **Membership defined by a search expression: base, scope, and filter**
    - **Membership re-evaluated each time dynamic group is used**
  - **Nested groups**
    - **Group of groups - create hierarchy of groups**
    - **Contains names of other static, dynamic, and nested groups**
- **New attributes to determine group membership**
  - **ibm-allMembers - returns all members of a group**
  - **ibm-allGroups - returns all groups to which a user belongs**
  - **Supported on search and compare operations**
  - **Resolves nested group hierarchy and dynamic membership**

Peer to Peer Replication

- **Problem: if master (read-write) server fails, difficult to reset a read-only replica to become a master**
- **Solution: support multiple read-write master servers**
  - **If one fails, direct updates to another one**
- **Peer replicas**
  - **All read/write**
  - **Replicate update operations to one another**
- **Replica network can contain peer replicas and read-only replicas**
  - **Each peer must replicate updates to all other replica servers**
  - **Each read-only replica must refer update requests to a peer server**
    - **Can set up list of peer servers to contact until get response**

DB2 Restart and Recovery

- **Problem: LDAP server doesn't react if DB2 terminates**
  - **Client requests fail, LDAP administrator unaware of problem**
- **Solution: monitor DB2 and react accordingly**
- **If DB2 fails, LDAP server can optionally**
  - **Terminate**
    - **Useful in SYSPLEX - requests get routed to other LDAP servers**
  - **Or sever DB2 connections and reconnnect to DB2 when DB2 restarts**
    - **Client requests to DB2- based backends refused while DB2 is down**
    - **Other backends (e.g. SDBM) can continue to be used**
- **Configuraton option to set reaction mode**

Schema Migration

- **Problem: large number of complaints about schema migration**
  - **Updating schema between releases or for service is not a trivial task for customers**
  - **Cannot just modify using latest schema file**
    - **modify 'add' fails due to duplicate values**
    - **modify 'replace' removes all extra values added by customer**
- **Solution: enhance schema modification to support replacing specific schema values for modify 'replace'**
  - **If 'replace' value**
    - **is in schema - replace existing value with new value**
    - **is not in schema - add new value to schema**
  - **All other attribute values remain unchanged**
- **Config option and modify operation control to use new or old schema replace behavior**
  - **New behavior is the default**

Additional Schema Enhancements

- **Problem: no easy way to fix a schema attribute with an incorrect OID**
  - **All entries using this attribute lose access to the attribute**
- **Solution: allow special OID change schema modify**
  - **Entries using the attribute do not have to be changed**
- **Problem: Over 20 small schema files shipped by LDAP**
  - **Made service harder to apply**
  - **Too difficult to keep up to date**
- **Solution: only ship 2 combined schema files**
  - **schema.user.ldif and schema.IBM.ldif contain all contents of the small files**
  - **Schema philosphy:**
    - **z/OS LDAP ships general base schema**
    - **Applications need to ship their specific schema**

Cache Monitoring

- **Problem:**
  - **No way to determine if caches are effective or to change cache sizes**
  - **Improve search performance in TDBM (continual goal)**
- **Solution**
  - **Improve cache usage monitoring**
    - **Detailed performance info now kept in cn=monitor entry**
    - **Can view by ldapsearch or by operator MODIFY command**
  - **Configuration options to set size of each cache**
  - **Add TDBM search filter and entry caches**
    - **Contains search results**
    - **Another search for same base, scope, filter, dereference can retrieve results from cache**
    - **Search filter cache cleared whenever any entry is changed**

Cache Monitoring - continued

- **Example of monitor output:**

```
>ldapsearch  ...  -b cn=monitor   "objectclass=*"

...
cn=backendtdbm1,cn=monitor
...
entry_cache_size=5000
entry_cache_current=11
entry_cache_hit=11
entry_cache_miss=0
entry_cache_percent_hit=100.00%
entry_cache_refresh=0
entry_cache_refresh_avgsize=0
filter_cache_size=5000
filter_cache_current=2
filter_cache_hit=1
filter_cache_miss=2
filter_cache_percent_hit=33.33%
filter_cache_refresh=0
filter_cache_refresh_avgsize=0
filter_cache_bypass_limit=100
```

Miscellaneous Enhancements

- **ldapcnf (LDAP configuration tool) enhancements**
  - **Can now use ldapcnf to configure GDBM (change log backend)**
  - **Can now configure any combination of backends**
    - **TDBM, GDBM, SDBM, and PC interface**
- **LDAP executable code now installed in SYS1.SIEALNKE (was *GLD*.SGLDLNK)**
  - **Easier to use since already APF authorized and in LINKLST**
    - **STEPLIB removed from JCL and shell scripts shipped by LDAP**
  - **Other LDAP datasets not moved**
    - ***GLD*.SGLDEXEC, *GLD*.SGLDEXPC, *GLD*.SGLDHDRC, *GLD*.SGLDSAMP**

Miscellaneous Enhancements - continued

- **Enhanced z/OS LDAP client**
  - **SOCKS Version 5 support**
  - **64-bit support**
- **Added support for IPv6 addressing (in client and server)**
- **Capabilities attributes added to rootDSE entry**
  - **Indicate capabilities of the z/OS LDAP server**
    - **Allows an application to determine what functions it can use**
  - **ibm-supportedCapabilities - functions supported by z/OS LDAP**
  - **ibm-enabledCapabilities - supported functions that can be currently used**
  - **Example:**

```
> ldapsearch ...  -s base   -b ""   "objectclass=*“
...
ibm-supportedcapabilities=1.3.18.0.2.32.3
ibm-enabledcapabilities=1.3.18.0.2.32.3
```

References:

- **z/OS LDAP Documentation**
  - **SC24-5923 z/OS Integrated Security Services LDAP Server Administration and Usage Guide**
    - **http://publibz.boulder.ibm.com/cgi-bin/bookmgr_OS390/Shelves/ICHZBK42**
  - **SC24-5924 z/OS Integrated Security Services LDAP Client Programming**
    - **http://publibz.boulder.ibm.com/cgi-bin/bookmgr_OS390/Shelves/ICHZBK42**
- **Redpaper: Linux on IBM zSeries and S/390: Securing Linux for zSeries with a Central z/OS LDAP Server (RACF)**
  - **http://www.redbooks.ibm.com/redpapers/abstracts/redp0221.html**
- **PAM Documentation:**
  - **http://www.kernel.org/pub/linux/libs/pam/Linux-PAM-html/pam-4.html**
- **NIS Schema for z/OS LDAP Server:**
  - **ftp://www.redbooks.ibm.com/redbooks/REDP0221**
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