Tivoli Directory Server (TDS) for z/OS 1.12: LDAP Update for 2011

Vanguard Security Conference

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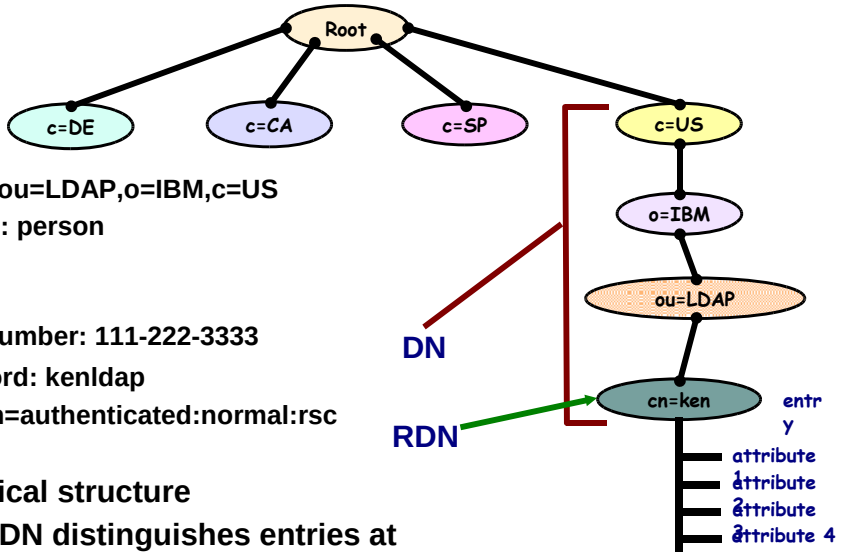
Table of Contents

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**

DN: cn=ken,ou=LDAP,o=IBM,c=US

LDAP Directory Structure



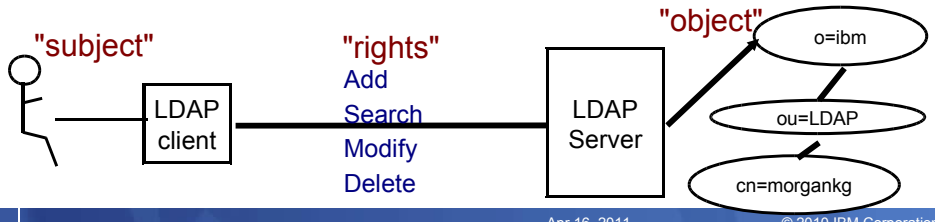
dn: cn=ken,ou=LDAP,o=IBM,c=US
objectclass: person
cn: ken
sn: morgan
telephonenumber: 111-222-3333
userpassword: kenldap
aclentry: cn=authenticated:normal:rsc

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

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)**

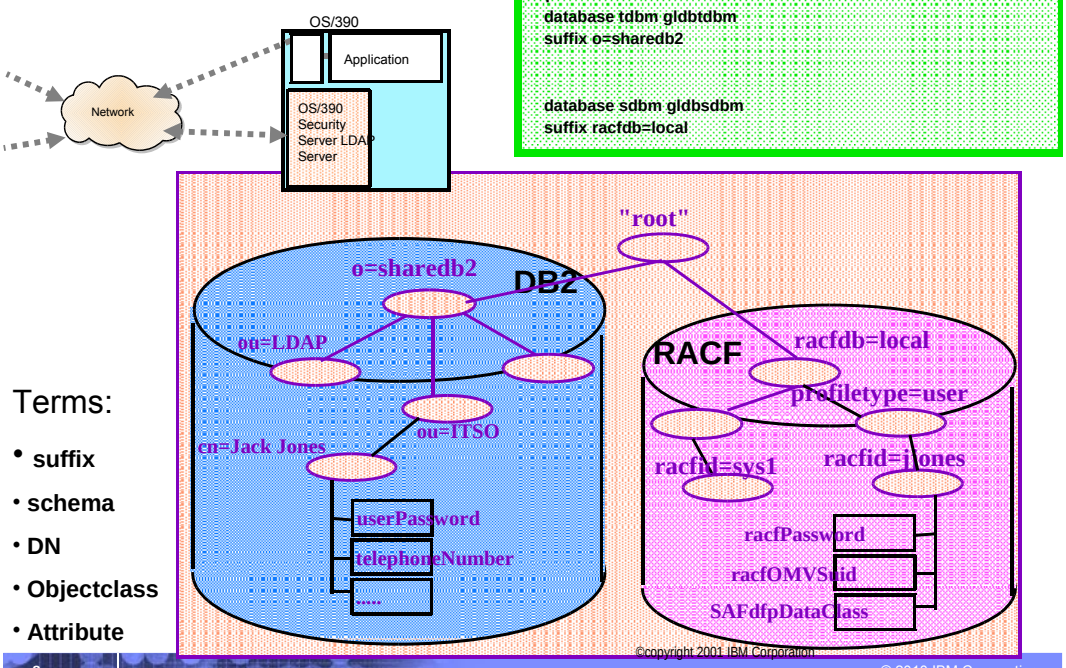


Overview

- **IBM Tivoli Directory Server (IBM TDS) for z/OS V1R11**
  - Integrated Security Services (ISS) Not Supported
  - Must migrate to TDS prior to z/OS R11

- Two LDAP components in z/OS V1R10 base:
  - **IBM Tivoli Directory Server (IBM TDS) for z/OS**
    - LDAP server enhanced in v1R10
    - LDAP client and utilities
  - **Integrated Security Services (ISS)**
    - z/OS V1R6 version of LDAP server
    - Withdrawn in V1R11
  - Both servers installed as part of z/OS V1R10
  - All enhancements to IBM TDS only

SDBM & TDBM Backends



Terms:

- **suffix**
- **schema**
- **DN**
- **Objectclass**
- **Attribute**

Access Control Implementation

- **TDBM/LDBM 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

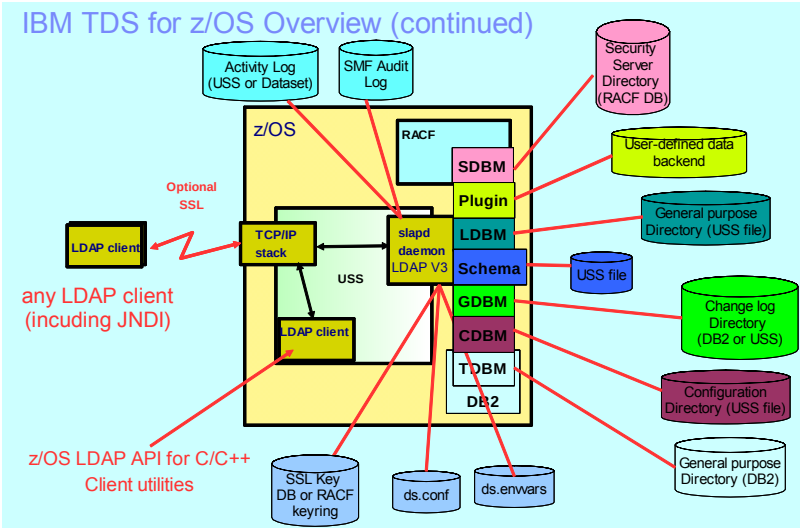
- **Can propagate an entry's ACL to the subtree below it**

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 but 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

LDAP Component Overview



Unique z/OS Features

- **Sysplex Support**
  - DB2 data sharing
  - XCF message support
  - Failover in multi-servermode
- **WLM workload classification and Vipa health**
- **SMF 83 Security Audit Records**
- **LDAP access to RACF**

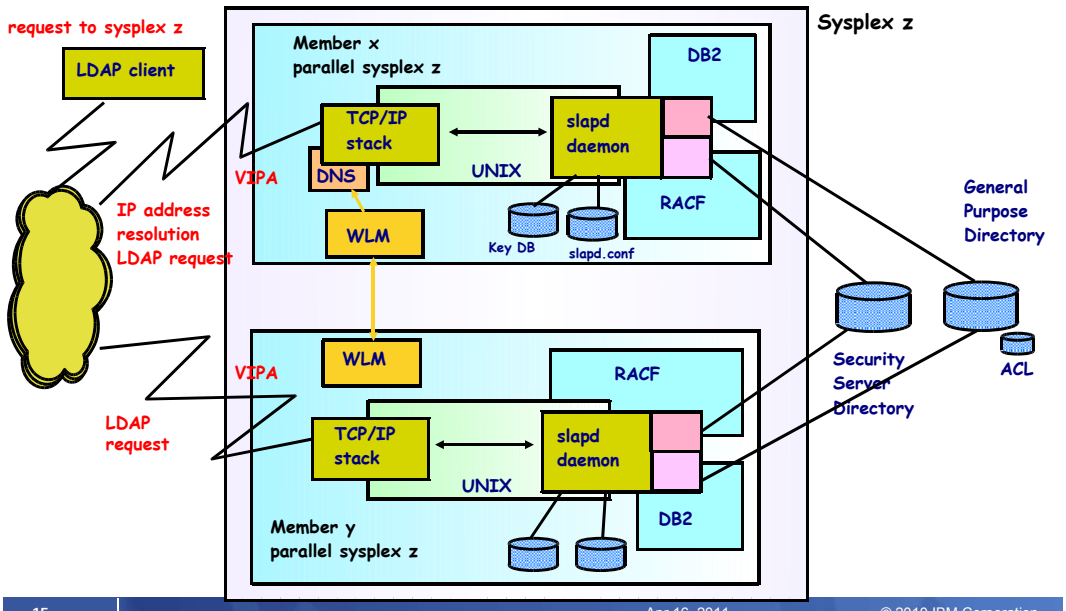
z/OS R11 TDS Features (Current)

- **Advanced Replication Support**
  - Replication of subtrees of the Directory Information Tree (DIT) to a specific server
  - multi-tier topology referred to as cascading replication
  - assignment of server role (master or replica) by a subtree
  - filtered replication
  - support of gateway replication
  - enhanced conflict resolution
- **WLM and VIPA Health support**
  - Supports classification of LDAP work by client IP or binddn
- **Accessing RACF Resource Profiles via TDS**
  - Define ldap schema for RACF resource profile and access via SDBM

z/OS R12 TDS (GA 9/2010)

- Password Policy
  - Password policy is a set of rules that controls how passwords are used and administered in the IBM Tivoli Directory Server for z/OS.
- ACL by IP
  - An extension to ACLs which clarifies a BIND DN by IP address or subnet
- Salted SHA
  - This is a salted version of the SHA-1 Secure Hash Algorithm.
- Schema Updates
  - Support for 21 new schema syntaxes matching rules which will make z/OS TDS compatible with those supported by TDS .
- Activity Log Management
  - Additional support for auto roll of activity log including operator commands to roll it by size/count.

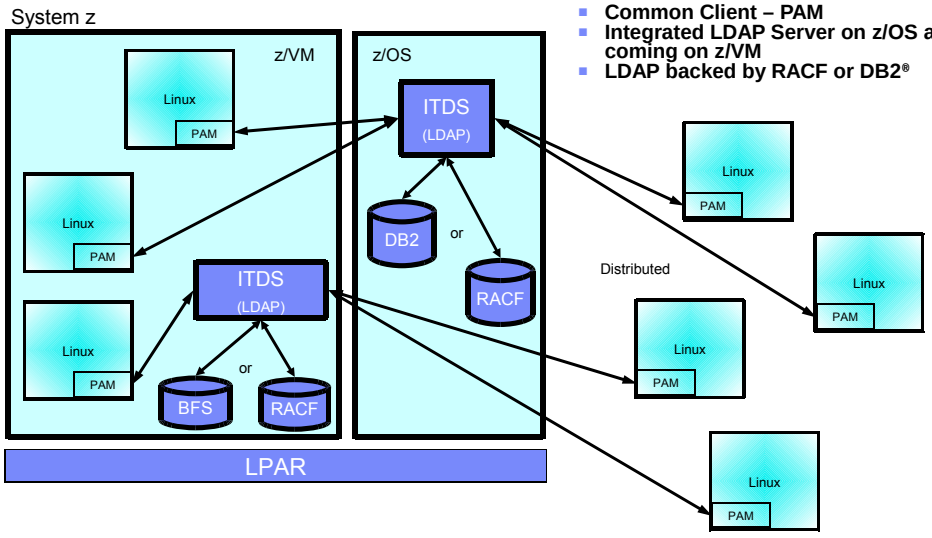
LDAP for z/OS Parallel Sysplex Support



IBM TDS has Multiple Backends

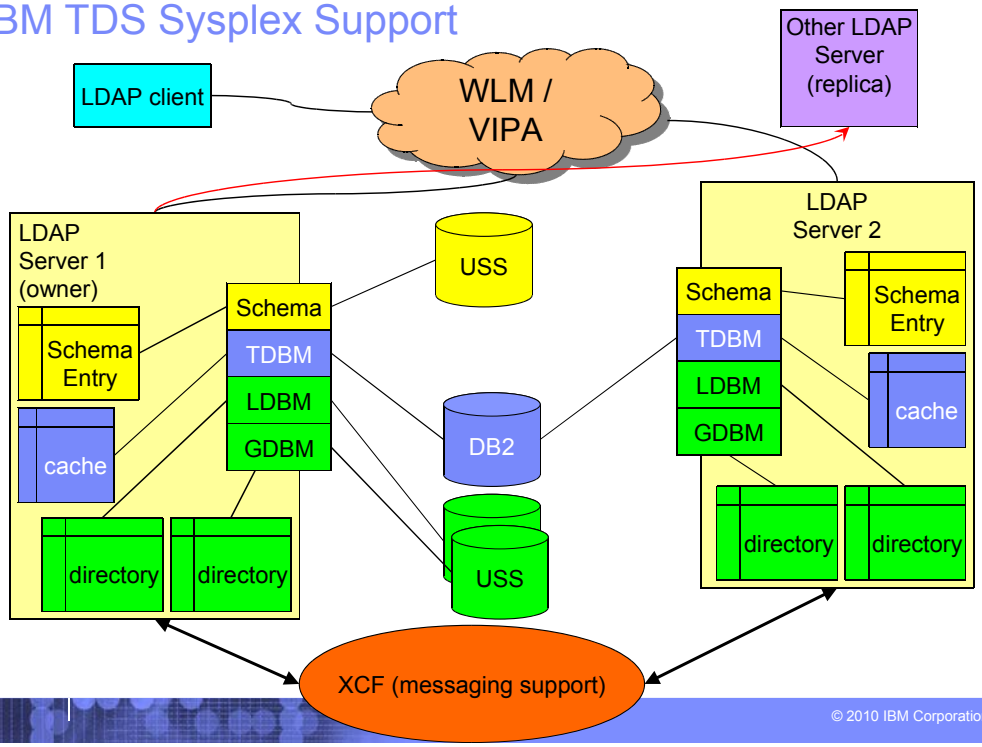
- **LDBM, TDBM**: General purpose directories
  - Full LDAP V3 support
  - Data stored in USS files (LDBM) or DB2 database (TDBM)
  - More Speed (LDBM) or More Room (TDBM)
- **SDBM**: RACF users, groups, and user-group connections
  - Provides remote RACF administration and authentication
  - Fixed schema
  - Data stored in RACF database
  - Limited search capability
- **GDBM**: Change log directory
  - Similar to LDBM or TDBM but restricted operations
  - Contains records of changes to other backends and RACF
  - User configurable to be stored in USS files or DB2

Centralized Authentication & User Management

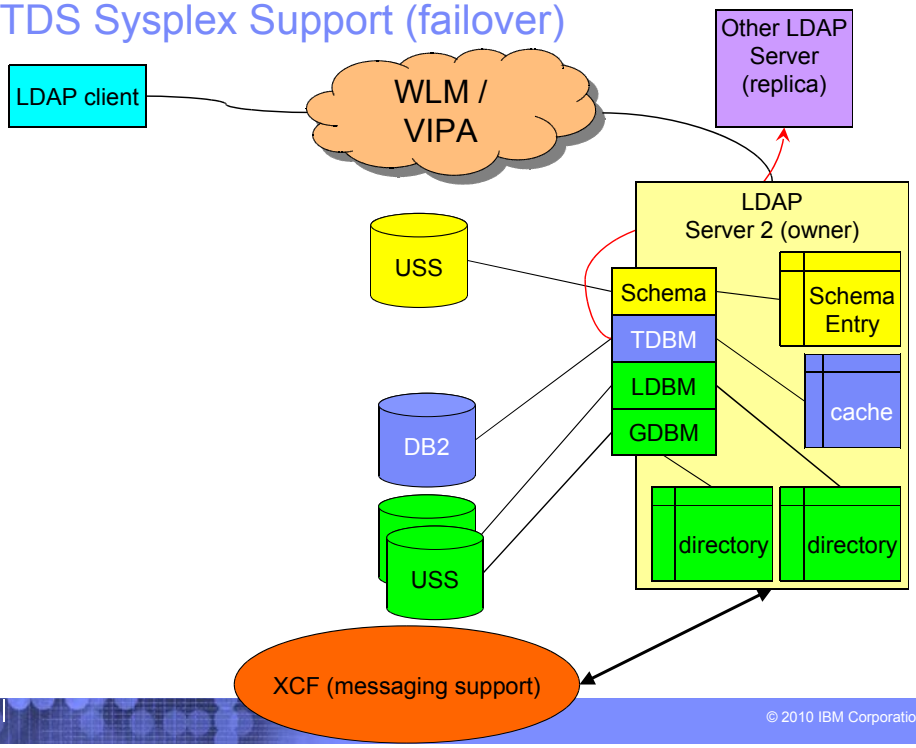


- **Common Client – PAM**
- **Integrated LDAP Server on z/OS and coming on z/VM**
- **LDAP backed by RACF or DB2®**

IBM TDS Sysplex Support



IBM TDS Sysplex Support (failover)



IBM TDS Sysplex Support - Continued

- First server in sysplex is the owner - Owns the resources
  - USS files (Schema, LDBM, and file-based GDBM)
    - Performs update and sends change to sysplex replicas
    - USS files must be in either zFS or shared HFS and available to all servers in the sysplex
  - Owns LDAP replication out of the sysplex

- Other servers are sysplex replicas
  - USS file based backends request directory from owner at startup
  - Applies changes from owner
  - Passes modification requests to owner

IBM TDS Sysplex Support - Continued

- TDBM and GDBM (DB2-based) backends are shared between all sysplex replicas
  - Uses DB2 data sharing
  - Notifies other LDAP servers of changes
  - Invalidates internal caches when notified of changes
- When owning server terminates
  - Oldest sysplex replica becomes owner
  - Owns resources
  - Replicates

IBM TDS Overview - Continued

- Runs in 31 or 64 bit mode (if using DB2-based backends only 31 bit)
- RAS enhancements
  - Enhanced error messages when processing configuration file
  - Create SMF 83 audit records for server events
    - **audit** *audit_option*
  - Automatic restart management (ARM) support
    - **armName** *name*
  - Server startup error monitoring
    - **srvStartUpError** [IGNORE | TERMINATE]
  - TCPIP error monitoring
    - **tcpTerminate** [TERMINATE | RECOVER]
  - File system error monitoring
    - **fileTerminate** [TERMINATE | RECOVER]
  - DB2 error monitoring
    - **db2Terminate** [TERMINATE | RECOVER | RESTORE]
      - Available previously
  - Creation of CTRACE records for server errors

New server utilities

- **ds2ldif** – Used to unload TDBM, LDBM, and schema backends
- **ldif2ds** – Used to load TDBM backend
- **dsconfig** – Used to configure IBM TDS

IBM TDS Schema

- Single server-wide schema used by all backends
  - Simplified name: **cn=schema**
- Stored as a file in USS file system - does not use DB2
  - Can change path with **schemaPath** configuration option
- Initial schema sufficient for SDBM and GDBM backends
  - Probably need to add schema for LDBM or TDBM
- Supports non-numeric OIDs for attribute and objectclass
  - Cannot use if sharing TDBM with ISS LDAP server
- Cannot change schema definition for existing data

IBM TDS LDBM Backend

- General purpose backend – stores any data
- Entries stored in USS files (DB2 not used)
  - Can change directory where LDBM files are stored with **databaseDirectory** configuration option
- Runs in 31 and 64 bit mode
- LDBM backend can be shared in a sysplex
- Can configure multiple LDBM backends
- Entries stored in memory while server is running
  - Advantage: fast access
  - Trade off: large directory requires a lot of memory and server start-up and shutdown is slow (reads in all those entries)
- Intended for small to medium size directory
  - About 250K entries in 31 bit, or 500K entries in 64 bit
- LDBM supports TDBM level of functionality
  - Aliasing, Native Authentication, Replication, change logging…

IBM TDS TDBM Backend

- Similar to TDBM in ISS LDAP server
- Uses a new set of replication tables
  - **DIR_REPLICA**, **DIR_REPENTRY**, **DIR_LONGREPENTRY**
  - Old replication tables are ignored if present
  - Replication on a backend level
- **DB_VERSION** set to ‘4.0’ for full function
  - Leave at ‘3.0’ if sharing TDBM with ISS LDAP server
    - Enhanced sysplex support and replication disabled
    - Schema updates that contain Non-numeric OID rejected
- Schema entry no longer stored in TDBM – now using LDAP server global schema

IBM TDS GDBM Backend

- GDBM can now be DB2-based or file-based:
  - GDBM is file-based unless the **dbuserid** configuration option is specified
  - File-based can run in 31 or 64 bit mode
    - Change path with **databaseDirectory** configuration option
  - DB2-based can run in 31 bit mode only
- logs changes to LDBM,TDBM,SDBM and schema entries
  - unless **changeLoggingParticipant** configuration option is set to **no**
  - RACF changelogging require RACF configuration

IBM TDS SDBM Backend

- Uses R_admin profile extract interface for obtaining user, group, connection entry
  - No limitations on amount of data returned
    - Complete list of groups to which user belongs and of members in a group
- RACF still limits output on search when using the RACF SEARCH command
- All data stored in RACF

New R10 Function

- **z/OS LDAP Password phrase**
- **RACF Custom User Field Support**
- **Certificate validation (map to RACF user ID)**
- **LDAP wait for DB2 during startup**
- **TDS Compatibility – SHA/MD5 encrypted passwords**
- **TDS Compatibility - Plug-in Support**
- **Operations monitor for gathering search statistics**
  - Will also be available on z/OS R8 and R9 via SPE

Note: NO functional enhancements to 'old' ISS LDAP server

z/OS LDAP Password Phrase

- **Used by SDBM or Native Authentication in LDBM or TDBM backends to bind**
  - Specified the same as a password
  - Anything longer than 8 characters is a Password Phrase

```
ldapsearch -D racfid=x,profiletype=user,cn=racf1 -w
  this1PhraseIsOk4Me …
```

- **RACF determines min and max length allowed**
- **Changed just like an SDBM/Native Auth password**
  - *<oldpwd>/<newpwd> during bind*
  - Via LDAP modify
- **Use SDBM to retrieve via Password Phrase PKCS 7 envelope**
  - racfPassPhraseEnvelope attribute
- **RACF can log Password Phrase changes in changelog**

RACF Custom User Fields

- Attributes can be added to Schema that map to a RACF custom field.
  - Specify RACF custom field info in new RACFFIELD keyword in ibmAttributeTypes definition
    RACFFIELD ('*racfFieldName*') or RACFFIELD ('*racfFieldName*' '*racfFieldType*')

attributeTypes: (SSN-oid NAME ('SSN') DESC 'Social Security Number' EQUALITY caseIgnoreIA5Match SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE USAGE userApplications)

ibmAttributeTypes: (SSN-oid RACFFIELD ('USER-CSDATA-SSN' 'char') ACCESS-CLASS sensitive)

- Use field via normal SDBM operations (add/modify/compare/search)
  - ldapsearch …. –b racfid=x,profiletype=user,cn=racf1 "objectclass=*"

    racfid=x,profiletype=user,cn=racf1
    …
    ssn=000-11-2222

Certificate Validation

- Can fail certificate bind if not associated with a RACF user
  - New config option
    - sslMapCertificate {off | check | add | replace} {fail | ignore}
      - Default: **off fail**
- Now able to perform SDBM operations after Certificate, Kerberos or Native Authentication bind
  - RACF ID associated with bind identity is stored in bind info
  - SDBM operations after binding use RACF ID from bind info

LDAP Wait for DB2 During Startup

- LDAP server can now be started before DB2.
  - LDAP will wait for DB2.
  - No requests will be processed while waiting.
- Two new configuration options
  - **db2StartUpRetryLimit** ***num-retries***
    - Maximum number of times to retry connecting to DB2
      - Default is 0 (no retries)
  - **db2StartUpRetryInterval** ***num-seconds***
    - Number of seconds to wait between each retry attempt
      - Default is 45
- **srvStartUpError** config option determines LDAP behavior if no DB2 connection after retries
  - **ignore** – LDAP server initialization continues but DB2-based backends not available
  - **terminate** – LDAP server ends
- **db2Terminate** specifies LDAP behavior if DB2 goes down after DB2-based backends successfully start

TDS Compatibility – SHA/MD5 encrypted passwords

- Encryption tag can be either within the encrypted data or in the clear before the encrypted data.
- z/OS LDAP previously only allowed the tag within the encrypted data.
  - userPassword:: *base64encodedValue*
    where *base64encodedValue* is a base64 encoding of {*tag*}encryptedValue and *tag* is SHA or MD5
- Other LDAP server`s tag is before the encrypted data.
  - userPassword: {*tag*}*base64encoded_and_encryptedValue*
    where *tag* is SHA or MD5
- z/OS LDAP now supports both formats
  - Search optionally returns the new format.
    - New config option **pwSearchOutput** [binary | base64]

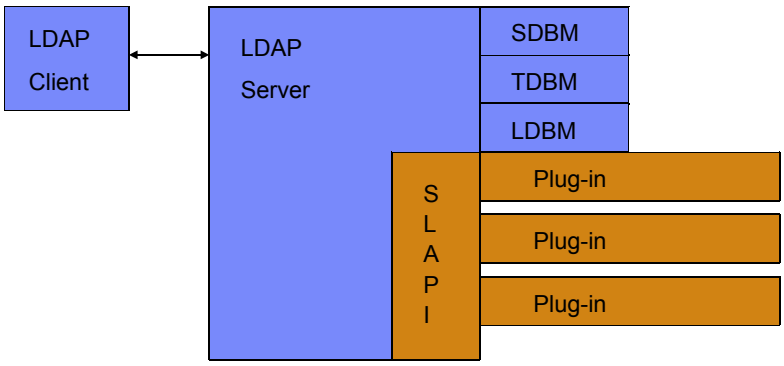
AES Encryption with ICSF

- Can use an AES key stored in the ICSF CKDS on **pwEncryption** and **secretEncryption** configuration options
  - Examples:
    pwEncryption AES:ICSFKEY
    secretEncryption AES:ICSFKEY
- AES encryption and decryption now occurs in ICSF if the AES key resides in the CKDS

TDS Compatibility - Plug-in Support

- **Customers and applications can add function to LDAP**
- **Plug-in is insulated against changes to LDAP internals**
- **Plug-in may be compatible with multiple LDAP platforms**
- **ICTX and HCD now exploit the Plug-in interface**

Plug-in Picture



Plug-in Overview

- New configuration option (plugin) to define a Plug-in
- 3 Plug-in types supported
  - **Pre-operation** – Plug–in called before each client request is processed (regardless of suffix)
  - **Client-operation** – Plug-in called to process a client request if
    - Target DN of operation is under a Plug-in suffix
    - Extended operation OID is registered for the Plug-in
  - **Post-operation** – Plug-in called after each client request is processed (regardless of suffix)
- Plug-in DLL is loaded by the LDAP server during startup
- Plug-in registers function pointers for LDAP server front-end calls
  - Only called for registered functions
- Also registers any suffixes it controls and extended operations it supports (client-operation only)
- LDAP server calls Plug-in when appropriate during client request processing

Building Plug-ins

- **slapi-plugin.h** – defines the data structures and service routine prototypes
- GLDSLP31.x and GLDSLP64.x provide LDAP server DLL entry points for 31-bit and 64-bit load modules
- New book to describe APIs and how to create a Plug-in
  - IBM Tivoli Directory Server Plug-in Reference for z/OS (SA76-0418)

Operations Monitor

- **Allows monitoring of search performance**
  - Detect SPAM and slow search performance
  - New subentry **cn=operations,cn=monitor** to hold search statistics
    - Use ldap_search to view statistics
  - Results show Client IP address, search request, and performance.
  - New global configuration options:
    - operationsMonitor
      - Specifies the granularity of the search operations monitored by the LDAP server
    - operationsMonitorSize
      - Maximum number of different search patterns to store in operations monitor (least recently used pattern is trimmed)

Sysplex Considerations

- All servers must be TDS servers at V1R10 level to get consistent results when using new functions in TDS V1R10
  - ISS LDAP server and older levels of TDS servers do not support the various new functions
  - V1R8 does not support Custom Fields
    - If RACF field added to v1R10 server, v1R8 servers in the sysplex group will not provide access
- Problem with older levels of TDS server in sysplex – cannot share schema due to extra fields (for RACFFIELD info)
  - APAR OA22022 - PTFs UA38112 and UA38113
    - RACFFIELD data could be lost
  - Not a problem in ISS LDAP servers - already ignore extra info

ISS to TDS Migration Considerations

- Utilities to migrate are available now
  - ISS is withdrawn in v1R11
- Configuration file changed
  - Example: DLL names and sysplex configuration options
  - Can use **dsconfig** to create new files and server proc
- TDBM schema migration
  - Done automatically by IBM TDS during initialization
  - Problem if multiple TDBM backends in ISS server with conflicting schema definitions

New R11 Function

- **LDAP Support for RACF Resource Profile**
  - New subtrees added to SDBM for for classes and for setropts
- **Advanced Replication Support**
  - New server plugin to support advanced replication configurations
  - Migration steps required to convert old replication to new support
  - Can continue to use old replication support
- **WLM Support**
  - LDAP worker threads assigned to WLM enclaves
  - Multiple enclaves supported

LDAP/SDBM Support for RACF Resources

- Extend SDBM hierarchy with new entries:
  - A class entry to represent each RACF class
  - A resource entry for each RACF resource profile
  - A setropts entry to represent RACF system values
- Use LDAP search to display RACF resource profiles and setropts settings
- Use LDAP add, modify, delete to manage RACF resource profile
  - RACF RDEFINE, RALTER, RDELETE, PERMIT, SETROPTS commands
- Log changes to RACF resource profiles in LDAP changelog
- Does not support DATASET resource profiles
- Limited RACF SETROPTS support

Advanced Replication Support

- **Supports the following replication configurations**
  - Peer-to-Peer, Master-to-Replica
  - Subtree replication
  - Cascade
  - Forwarding
  - Gateway
- **Additional Capabilities**
  - Replication filtering
  - Conflict Resolution
  - Additional Logging, Replication Error Log, Conflict Resolution Log
  - Queue Management
  - New Extended Operations (LDAPEXOP utility)
  - Interoperability with TDS Distributive platforms
  - Compare subtrees on different servers (LDAPDIFF utility)

WLM Support

- Directs ldap operations to run under WLM enclaves
- Work can be classified by client IP address and/or Bind DN
- Support dynamic reclassification of work via LDAP WLMEXCEPT operator modify command
- WLM health service used to update TCP/IP sysplex distributor load balancing

z/OS Security R12 – ITDS for z/OS

- Password Policy Support
  - Provided LDAP password quality, expiry, account lockout, warning of pending LDAP password expiry
- Dynamic LDAP ACLs using LDAP filters
  - Authority can be define based on:
    - IP address, Time of day and Day of week, clear or encrypted connection
      - SSL or non-SSL protected connections, Filters used wth aclEntry and entryOwner attributes
      - New LDAP operators to control ACLS: UNION, INTERSECT, REPLACE
  - Intended to provide capabilities similar to other LDAP implementations to help directory consolidation on z/OS
- Activity Log Manangement
  - Controls size of ITDS activity Log – new log file creaded when limits are readched:
    - Time of day, size in bytes or Console command
    - New single record format
    - Filter records by Clinet IP addres
- Salted SHA – Compatible with distributed ITDS, OpenLDAP
  - userPassword LDAP attribute in CDBM, LDBM and TDBM backends
- Schema Updates
  - Supports syntax and matching rules – supported by distributed ITDS, openLDAP and sunOne LDAP directory Severs
  - Improves migration and LDAP replication between ITDS distributed and ITDS for z/OS
    - 22 new Syntaxes, 14 new Matching rules

Improves the interoperability of z/OS ITDS and ITDS Distributed

Session Summary

- Overview of the IBM TDS for z/OS server
- Defined the functional content and benefits of IBM TDS
- Identified migration considerations
- ISS will NOT be shipped in v1R11

Publications References

- IBM TDS for z/OS server
  - SC23-5191 IBM Tivoli Directory Server Server Administration and Use for z/OS
  - SA76-0418 IBM Tivoli Directory Server Plug-in Reference for z/OS
- IBM TDS LDAP for z/OS client
  - SA23-2214 IBM Tivoli Directory Server Client Programming for z/OS
- Integrated Security Services LDAP server
  - SC24-5923 z/OS Integrated Security Services LDAP Server Administration and Use