z/OS LDAP Overview and Security Function Update

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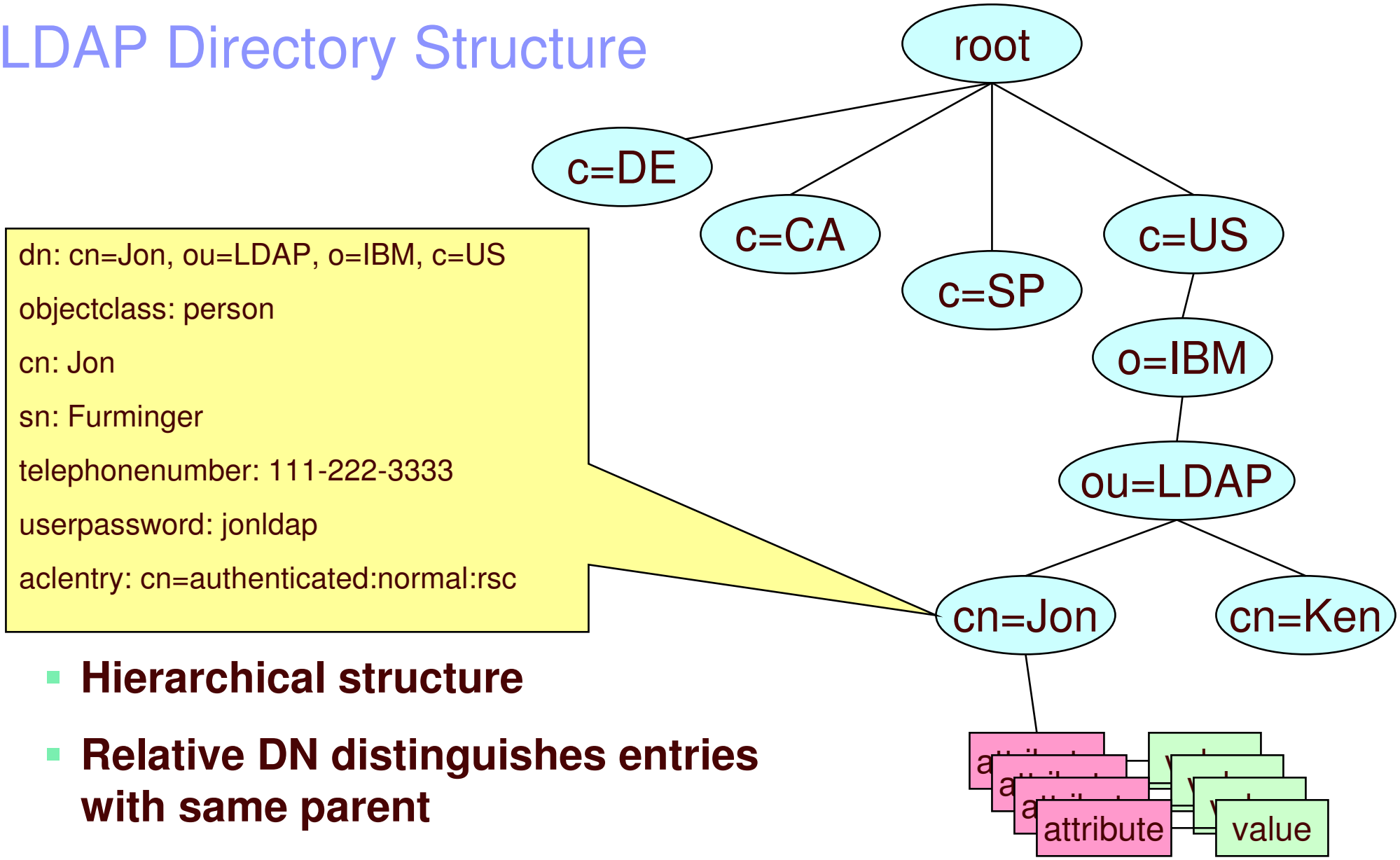
Abstract

- This presentation explains:
  - What is LDAP
  - Why a customer would want to use LDAP
  - Special features of z/OS 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)
    - Example: DN: cn=jon,ou=LDAP,o=IBM,c=US
- **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
  - Schema defines attributes and object classes

LDAP Directory Structure



- **Hierarchical structure**
- **Relative DN distinguishes entries with same parent**
- **Attributes are protected by Access Control Lists (ACL)**

What is it used for?

- **Storing information**
  - Information that is mostly read
  - Application configuration
    - Centrally located for easy administration, i.e. you don`t have to go to each workstation
  - Authorization checking
  - Identity checking (authentication)
  - User information
    - Phone numbers, address, etc

LDAP Parts

- **z/OS LDAP provides**
  - LDAP server: manages directory entries
  - LDAP client: C APIs to add, delete, modify, rename, compare and search entries
  - Command line client utilities: ldapadd, ldapdelete, ldapmodify, ldapmodrdn, and ldapsearch
- **Any Version 3 LDAP client can be used with z/OS LDAP server**
- **z/OS LDAP client and utilities can be used with any V3 LDAP server**

Using LDAP - Examples

- **Example : add an entry**
  - Create a file, jay.add, containing entry to be added:

```
dn: cn=jay,ou=LDAP,o=IBM,c=US
objectclass: person
cn: Jay
sn: smith
userpassword: jaypw
```

  - Invoke ldapadd utility:

```
ldapadd –h dceset3.ibm.com –p 389 –D cn=jon,ou=ldap,o=ibm,c=us
  –w jonldap –f jay.add
```

Using LDAP – Examples cont.

- **Example : modify an entry**
  - Create a file, jay.mod, containing changes:

```
dn: cn=jay,ou=LDAP,o=IBM,c=US
add: telephonenumber
telephonenumber: 222-333-4444
-
replace: sn
sn: smithson
```

  - Invoke ldapmodify utility:

```
ldapmodify –h ceset.ibm.com –D cn=jon,ou=ldap,o=ibm,c=us –w jonldap
  –f jay.mod
```

Using LDAP – Examples cont.

- **Example : search for an entry**
  - Display specific entry
    - ldapsearch –h dceset3.ibm.com –p 389 –D cn=jon,ou=ldap,o=ibm,c=us –w jonldap –s base –b cn=jay,ou=ldap,o=ibm,c=us objectclass=*

      dn: cn=jay,ou=LDAP,o=IBM,c=US

      objectclass: person

      cn: Jay

      sn: smithson

      telephonenumber: 222-333-4444
  - Display entries with telephonenumber in 222 area code and surname starting with smith:
    - ldapsearch –h dceset3.ibm.com –p 389 –D cn=jon,ou=ldap,o=ibm,c=us –w jonldap –s sub –b o=ibm,c=us "(&(telephonenumber=222*)(sn=smith*))"

Jsing LDAP – Examples cont.

- **Example : display all entries in the c=US directory tree**
  - ldapsearch –h dceset3.ibm.com –p 389 –D cn=jon,ou=ldap,o=ibm,c=us –w jonldap –b c=us objectclass=*

dn: c=US
objectclass: country
c: US

dn: o=IBM,c=US
objectclass: organization
o: IBM

dn: ou=LDAP,o=IBM,c=US
objectclass: organizationalunit
ou: LDAP

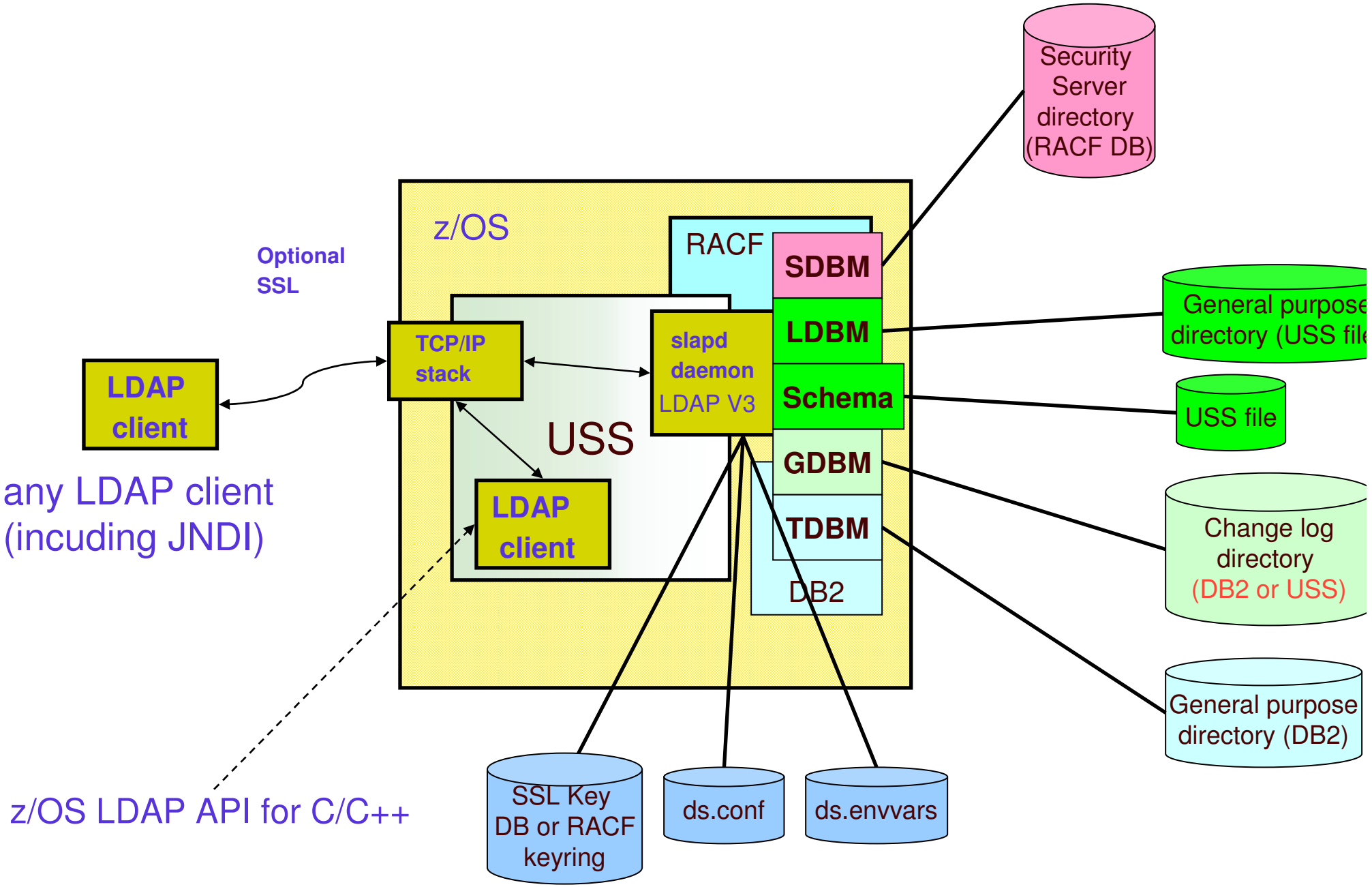
cn=ken,ou=LDAP,o=IBM,c=US
objectclass: person
cn: ken
...

Using LDAP – Examples cont.

- **Example : delete an entry**

```
ldapdelete –h dceset3.ibm.com –p 389 –D cn=jon,ou=ldap,o=ibm,c=us
  –w jonldap cn=jay,ou=ldap,o=ibm,c=us
```

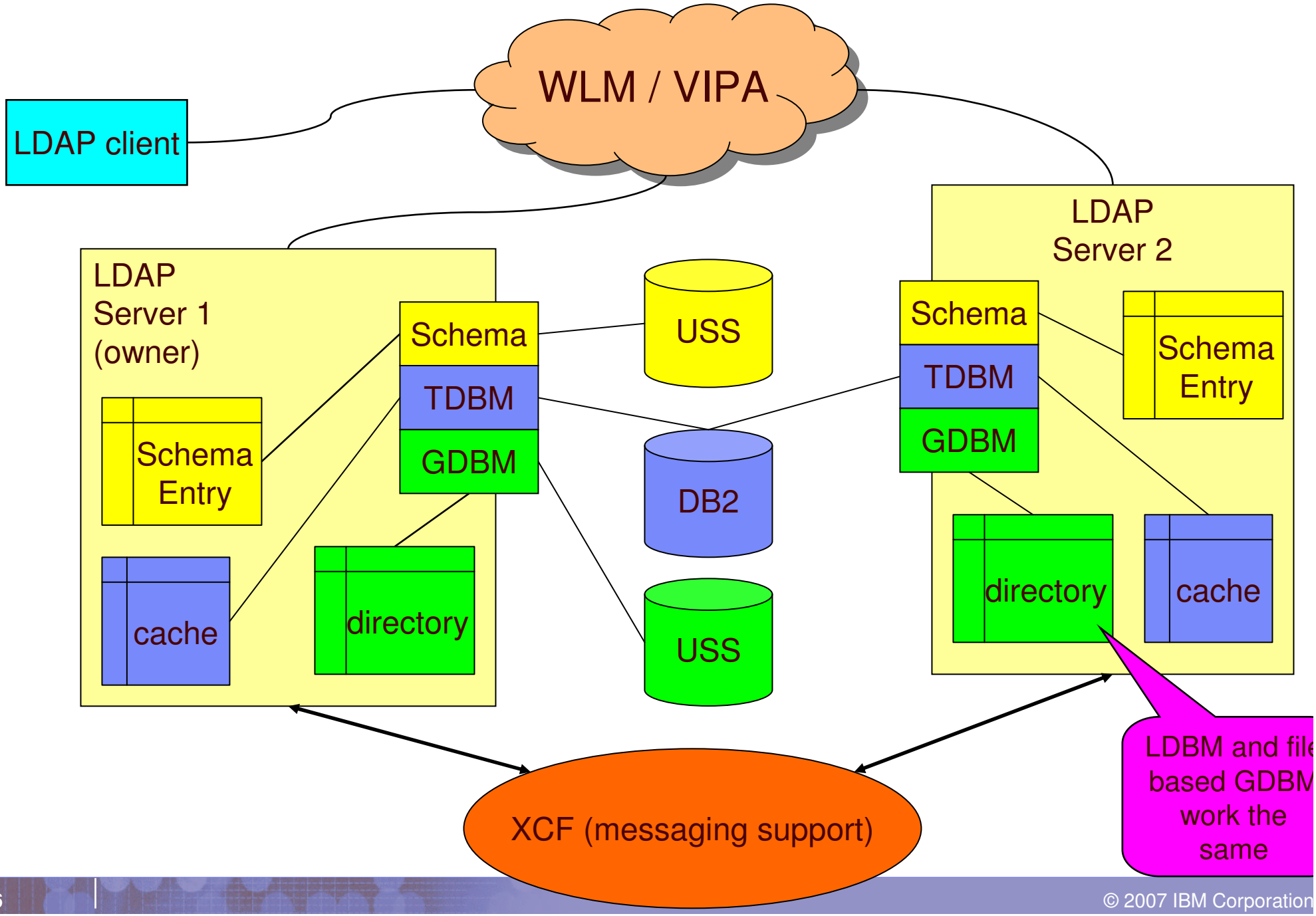
LDAP server on z/OS



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
  - **LDBM:** General purpose file-based directory
    - Full LDAP V3 support, including modifiable schema
    - Uses USS file system to store directory entries
    - Useful for small to medium sized directories
  - **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
    - Can be file-based or DB2-based
    - Similar to LDBM/TDBM but restricted operations
    - Contains records of changes to other backends and RACF
  - **Schema**
    - Single server-wide schema used by all backends, simplifies administration of server

IBM TDS Sysplex Support



Authentication with an LDAP Server

- **LDAP is a stateful protocol**
  - Session starts when client “binds” to server
  - Authentication is performed during bind
    - Check password or certificate
    - Determine groups to which user belongs (for authorization checking)
  - Session can be unauthenticated (anonymous bind)
- **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 – use RACF keyring or key database fileb
  - 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 LDBM/TDBM Authentication

Enter userid : jon

Enter password : ********

dn="cn=jon,ou=LDAP,o=IBM,c=US"

pw=jonldap

ldap_bind_s(ld,host,port,dn,pw)

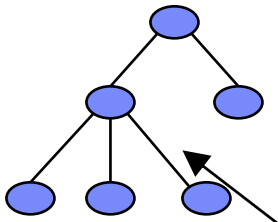
Bind request

LDAP Client (API)

z/OS LDAP Server LDBM or TDBM

Successful bind

dn: cn=jon,ou=LDAP,o=IBM,c=US



In LDBM or TDBM directory

objectclass: person

cn: jon

sn: furminger

userpassword: jonldap

LDAP Database

LDAP Authentication with SDBM (RACF)

Enter userid : u12345

Enter password : ********

dn="racfid=u12345,profiletype=user,cn=myRACF"

pw=racfpw

ldap_bind_s(ld,host,port,dn,pw)

Bind request

LDAP Client (API)

z/OS LDAP Server LDBM or TDBM

Successful bind

Verify user and passwor

__passwd(U12345,racfpw

dn: racfid=u12345,profiletype=user,cn=myRACF

objectclass: racfUser

objectclass: racfBaseCommon

racfid: U12345

racfprogrammername: Jon Furminger

racfdefaultgroup: racfid=group1,profiletype=group,cn=myRACF

racfconnectgroupname: racfid=group1,profiletype=GROUP,cn=myRACF

racfconnectgroupname: racfid=group2,profiletype=GROUP,cn=myRACF

RACF Database

z/OS LDAP Server Native Authentication

- **Disadvantages of authentication in LDBM/TDBM:**
  - Password in LDBM/TDBM directory entry
  - Another password repository to manage
- **Disadvantages of authentication in RACF:**
  - SDBM backend required with its funny DN (racfid,profiletype)
  - Fixed schema: only RACF info, cannot add attributes
- **Native Authentication – LDBM/TDBM with RACF authentication**
  - Standard Distinguished Name (e.g. cn, ou, o)
  - Any schema supported by LDAP V3 for an entry can be used
    - Any information supported by the schema can be retrieved
    - Use LDBM/TDBM groups and group membership in ACLs
  - Authentication (password verification) performed by RACF
    - Password for entry is in Security Server, not in LDAP
    - No need for administration or synchronization of multiple password registries
    - RACF authentication triggered by attribute ibm-nativeId in LDBM/TDBM entry
  - Can configure which entries use which sort of authentication

LDAP Native Authentication

Enter userid : jon

Enter password : ********

dn="cn=jon,ou=LDAP,o=IBM,c=US"

pw=jonldap

ldap_bind_s(ld,host,port,dn,pw)

LDAP Client (API)

Bind request

z/OS LDAP Server LDBM or TDBM

RACF Database

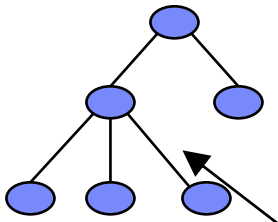
Successful bind

Find LDBM/TDBM entry

Verify native id and password in RACF

__passwd(U12345,racfpw)

Get LDBM/TDBM groups



In LDBM or TDBM directory

dn: cn=jon,ou=LDAP,o=IBM,c=US

objectclass: person

cn: jon

sn: furminger

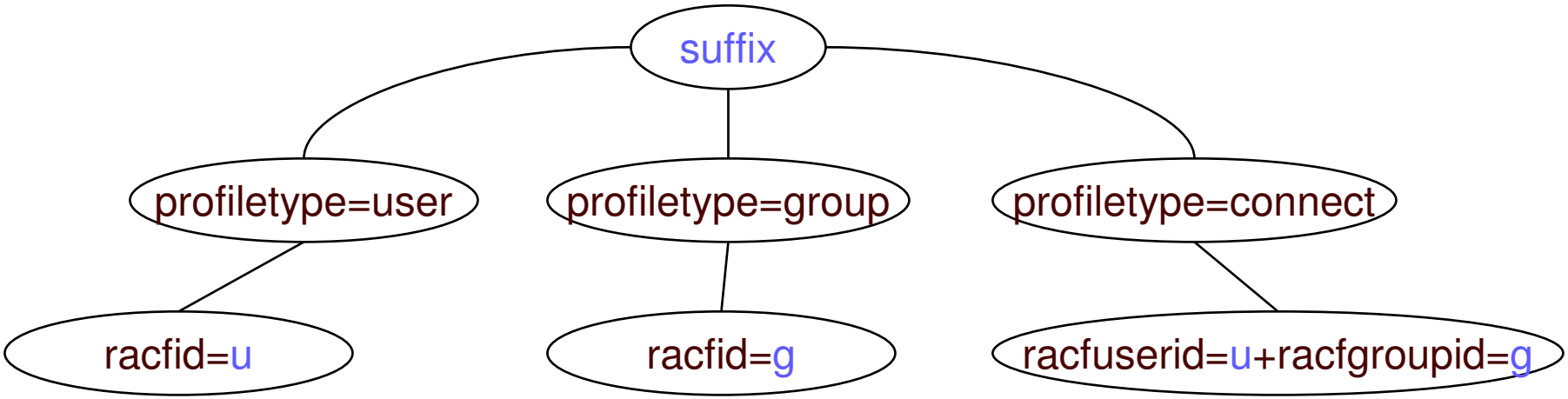
userpassword: jonldap

Ibm-nativeId: U12345

LDBM TDBM database

SDBM Support for RACF

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



  - Limited search capabilities – predefined by SDBM
  - All data accessed via RACF
    - No RACF data in LDAP
    - Authorization controlled by RACF, based on bound userid

SDBM Support of RACF - cont

- **Hard coded schema definitions**
  - Each RACF user/group/connect profile segment mapped to an LDAP object class
  - Example:

    User OMVS segment ← → racfUserOmvsSegment object class
    - Object class contains all the attributes in that segment
  - Each RACF add/alt/listuser, add/alt/listgrp, connect keyword mapped to an LDAP attribute
    - Example: OMVS UID keyword ←→ racfOmvsUid attribute

Using SDBM - Examples

- **Example: add a RACF user entry**
  - Create a file, u1234.add, containing entry to be added:

```
dn: racfid=U1234,profiletype=user,cn=myRACF
objectclass: racfUser
objectclass: racfUserOmvsSegment
racfid: u1234
racfdefaultgroup: dce1
racfowner: radmin
racfattributes: special
racfomvsuid: 321
racfomvshome: /home/u1234
```

  - Invoke ldapadd utility:

```
ldapadd –h dceset3.ibm.com –p 389 –D
  racfid=radmin,profiletype=user,cn=myRACF –w radminpw –f u1234.add
```

  - SDBM executes:

```
ADDUSER u1234 OWNER(radmin) DFLTGRP(dce1) special OMVS(UID(321)
  HOME(/home/u1234)
```

Using SDBM – Examples cont.

- **Example: display a RACF user-group connection**
  - Invoke ldapsearch utility

    ldapsearch –h dceset3.ibm.com –p389
    –D racfid=radmin,profiletype=user,cn=myRacf -w radminpw
    –b racfuserid=u1234+racfgroupid=dce1,profiletype=connect,cn=myracf
    objectclass=*

  - SDBM executes LISTUSER u1234 and returns connection info for group dce1

    dn: racfuserid=u1234+racfgroupid=dce1,profiletype=connect,cn=myracf
    objectclass: racfConnect
    racfuserid: u1234
    racfgroupid: dce1
    racfconnectowner: racfid=RADMIN,profiletype=user,cn=myRacf
    racfconnectgroupauthority=USE
    racfconnectauthdate=04.279
    ...

Changing the RACF Password

- **ldapmodify can be used to change RACF password**
  - Via SDBM:

    dn: racfid=u1234,profiletype=user,cn=myRACF
    replace: racfpassword
    racfpassword: mynewpw
    racfattributes: noexpired

  - Via TDBM with native authentication

    dn: cn=jon,ou=LDAP,o=IBM,c=US
    delete: userpassword
    userpassword: jonldap
    -
    add: userpassword
    userpassword: mynewpw
    -

    - Note: replace: userpassword cannot be used by SDBM - not supported

  - LDAP SDBM or native authentication bind can be used to change a password (even if it is expired)
    - Specify old_password/new_password when binding

LDAP-RACF Change Logging

- **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 (GDBM backend)
    - Can access entry using normal LDAP operations from any LDAP client
  - Retrieves RACF password envelop via LDAP SDBM search
- **Used by IBM Tivoli Directory Integrator to synchronize passwords:**
  - Periodically does LDAP search of change log for new entries
    - Persistent search can also be used
  - If password changed, performs LDAP search of RACF user to retrieve enveloped password
  - Decrypts envelop and sets password on other systems

Change logging continued

- **Search the change log**
  - ldapsearch ….. –b cn=changelog changenumber>=1023

```
dn: CHANGENUMBER=1023,CN=CHANGELOG
objectclass: CHANGELOGENTRY
objectclass: IBM-CHANGELOG
changenumber: 1023
targetdn: racfid=U1234,profiletype=user,CN=MYRACF
changetime: 20030611161820.374472Z
changetype: MODIFY
changes: replace: racfpassword
racfpassword: *ComeAndGetIt*
-

ibm-changeinitiatorsname: racfid=radmin,profiletype=user,cn=myRACF
```

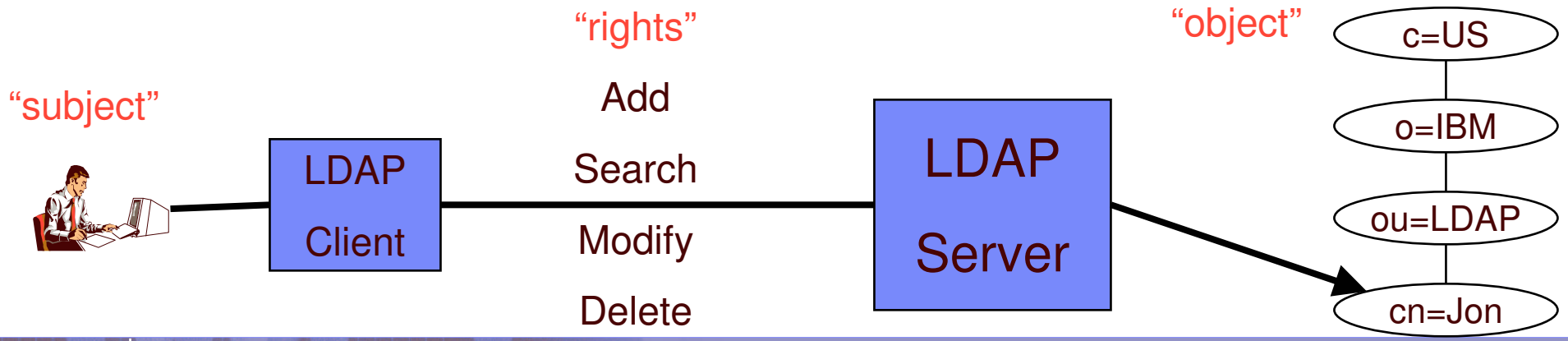
  - Retrieving RACF envelope containing new password

```
ldapsearch –D racfid=radmin,profiletype=user,cn=myRacf –w radminpw –L
–b racfid=U1234,profiletype=user,cn=myRacf objectclass=* racfpasswordenvelope

racfid=U1234,profiletype=USER,cn=myRacf
racfpasswordenvelope:: <base64 encoded password envelope>
```

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, read/write/search/compare attribute)



Access Control Implementation

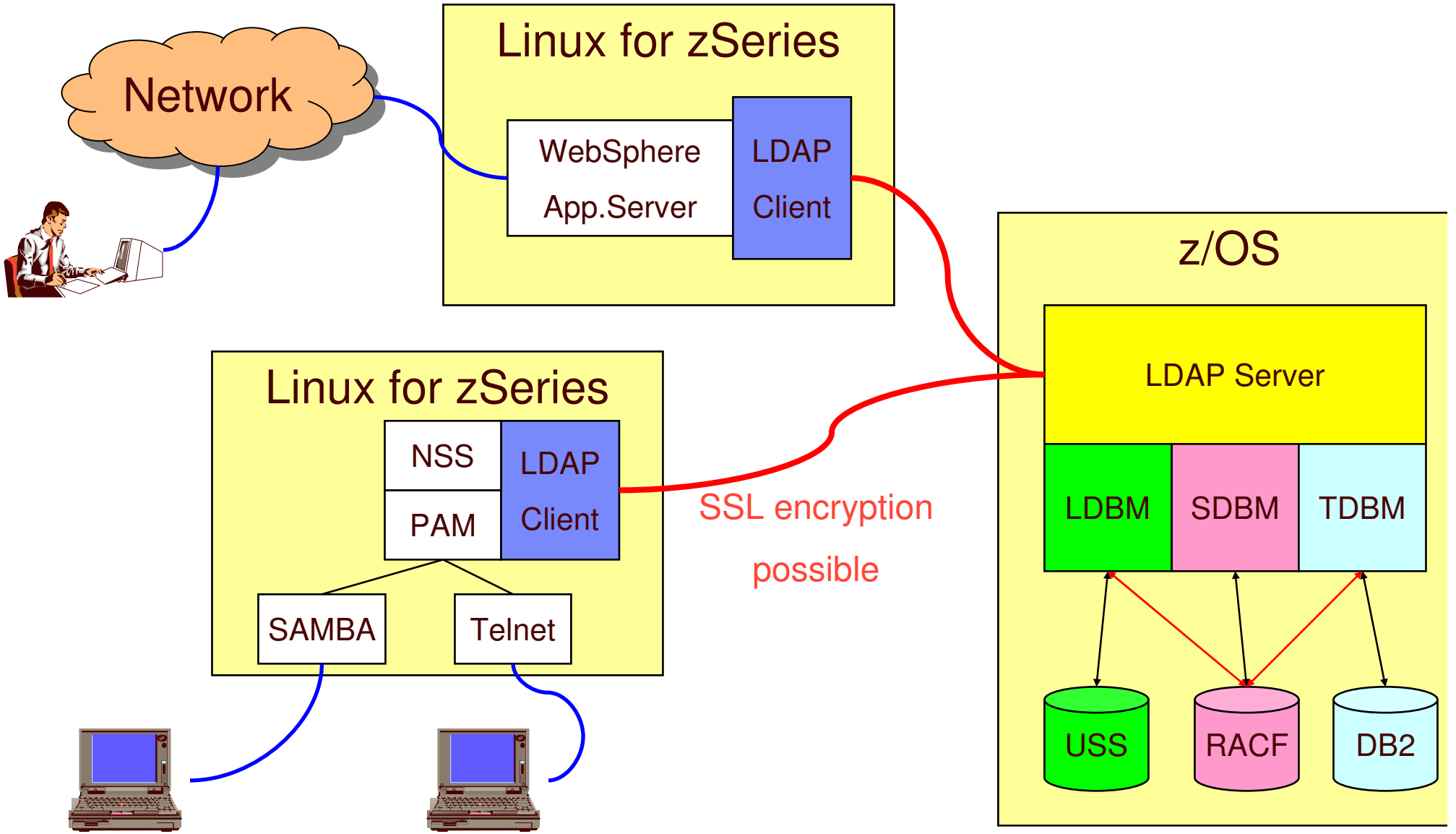
- **LDBM/TDBM uses an Access Control List (ACL) to control access to an entry**
- **Can specify LDBM, TDBM and SDBM (RACF) users and groups in ACL**
- **Can control access to individual attributes or to classes of attributes (normal, sensitive, critical, restricted and system)**
  - Attribute's access class defined in the schema
- **Use LDAP modify operation to set ACL and search operation to display ACL info**
  - Examples:

    aclentry: cn=jay,ou=LDAP,o=IBM,c=US:normal:rwsc:sensitive:rsc
    aclentry: racfid=u1234,profiletype=user,cn=myRacf:object:ad
    aclentry: group:cn=mgrs,o=IBM,c=US:at:userpassword:rwsc
    aclentry: grpu: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
  - Server can be configured to prevent anonymous binds
- **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:normalize:rsc
  - aclentry: cn=authenticated:normal:rsc:sensitive:rs
  - aclentry: cn=this:normal:rscw:sensitive:rscw:critical:rsc

User Information and Authentication in LDAP



BM TDS RAS

- **Can be configured to:**
  - Monitor resources
    - DB2
      - TDBM
    - File system
      - LDBM and GDBM use HFS or zFS
    - Network
    - Client connections
      - Warning message when number of connections reach a level
      - Usage
        - SMF 83 audit records
        - Activity log
  - Automatically restart in the case of failure

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- Contacting me
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