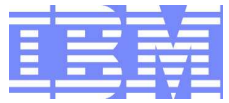

z/OS LDAP Overview and Security Function Update

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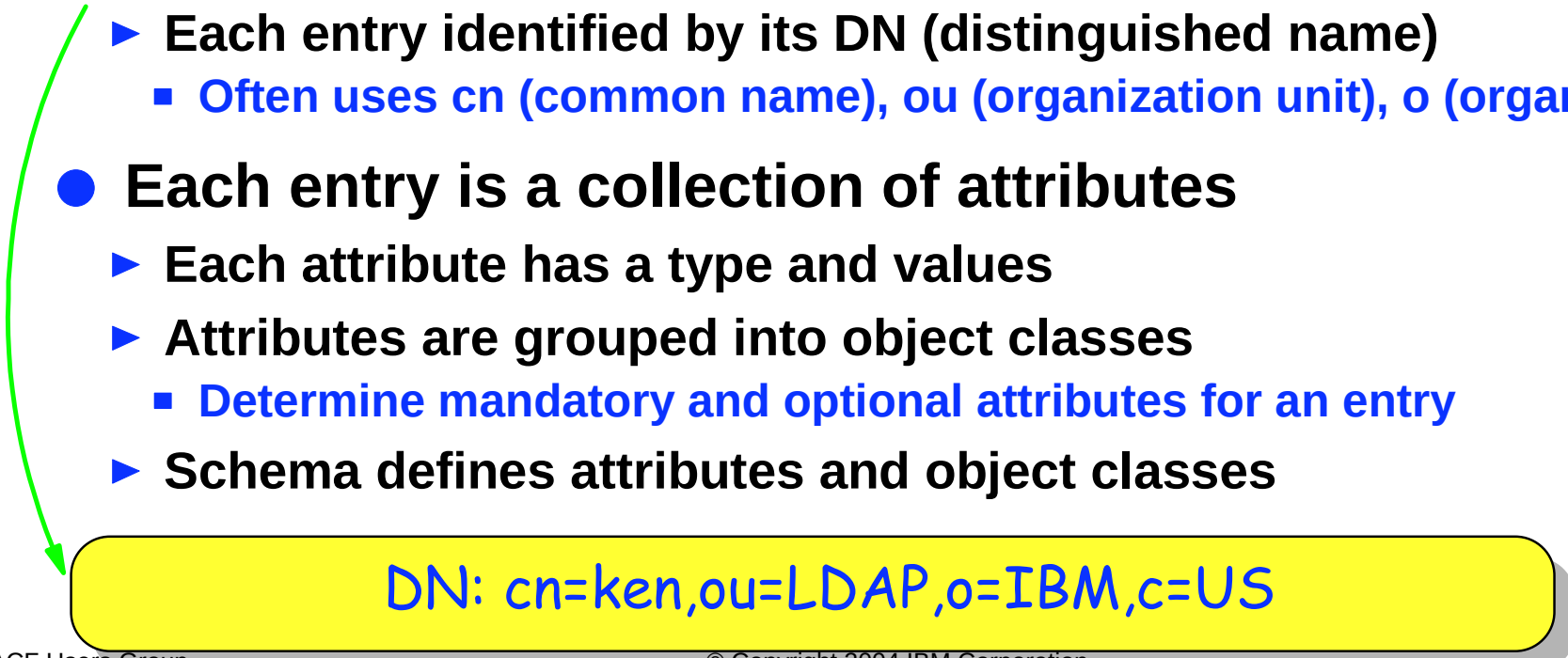
Agenda

- **LDAP Overview**
- **LDAP Authentication**
  - **Using RACF**
  - **Using TDBM**
  - **Using Native Authentication (TDBM and RACF)**
- **Accessing RACF via LDAP**
- **RACF Change Logging**
- **Access Control in TDBM**
- **The Big Picture**

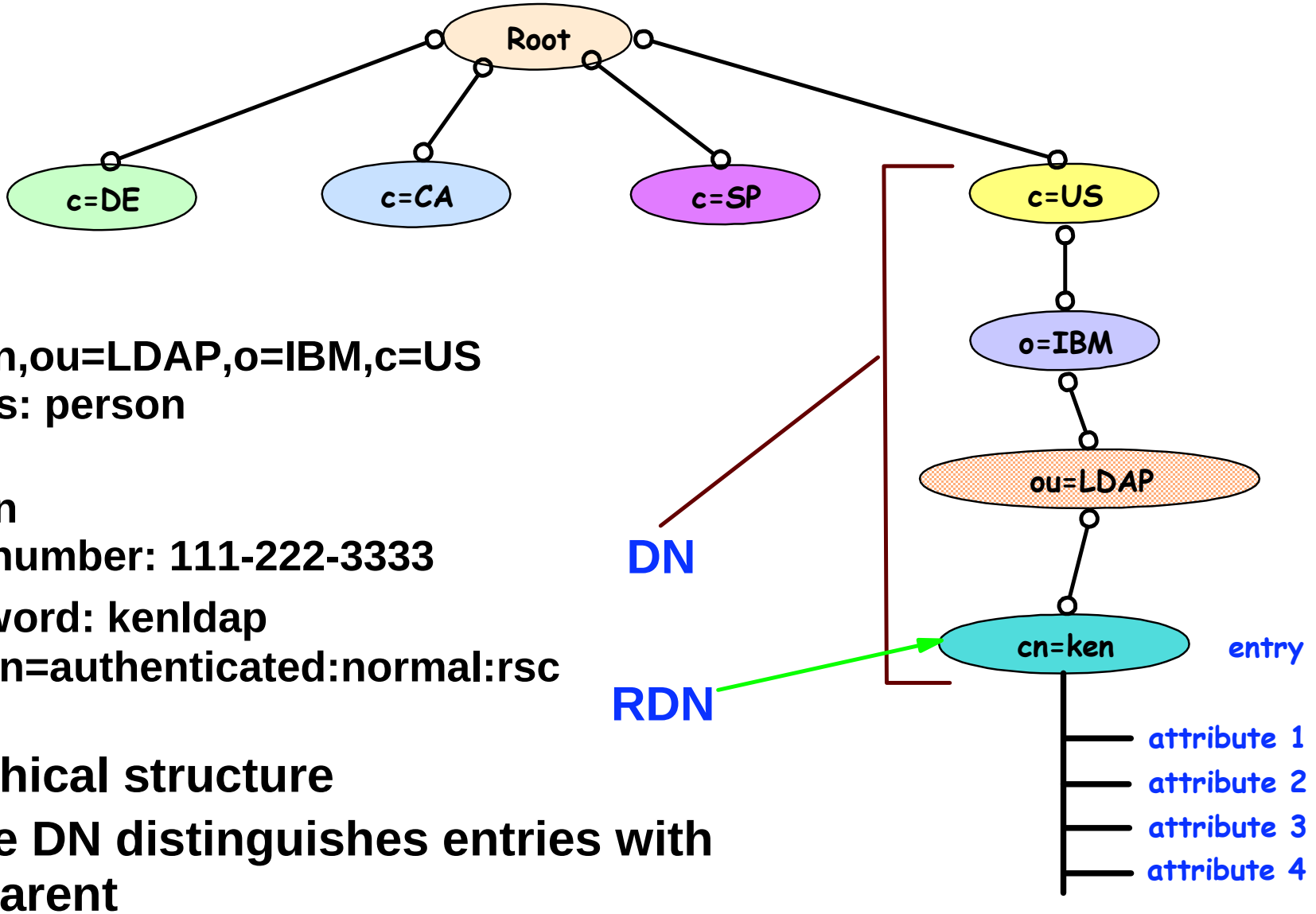
Overview of LDAP

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**
  - **Schema defines attributes and object classes**



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 with same parent**
- **Attributes are protected by Access Control Lists (ACL)**

LDAP Parts

- **z/OS LDAP provides**
  - **LDAP server - manages the directory entries**
  - **LDAP client - C APIs to add, modify, delete, rename, compare, and search entries**
  - **Command line client utilities: ldapadd, ldapmodify, ldapdelete, ldapmodrdn, 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
cn: jay
sn: smith
userpassword: jaypw
```

  - **Invoke ldapadd utility:**

```
ldapadd   -h dceset3.ibm.com   -p 2803
   -D cn=ken,ou=LDAP,o=IBM,c=US   -w kenldap   -f jay.add
```

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

```
dn: cn=jay,ou=LDAP,o=IBM,c=US
add: telephonenumber
telephonenumber: 555-666-7777
-
replace: sn
sn: smithson
```

  - **Invoke ldapmodify utility:**

```
ldapmodify   -h dceset3.ibm.com   -p 2803
   -D cn=ken,ou=LDAP,o=IBM,c=US   -w kenldap   -f jay.mod
```

Using LDAP - Examples cont.

- **Example: search for an entry**
  - **Display specific entry**

```
ldapsearch -h dceset3.ibm.com  -p 2803  -D cn=ken,ou=LDAP,o=IBM,c=US
 -w kenldap   -L   -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: 111-666-7777
```

  - **Display entries with telephonenumber in 111 area code and surname starting with smith:**

```
ldapsearch  -h dceset3.ibm.com  -p 2803   -D cn=ken,ou=LDAP,o=IBM,c=US
 -w kenldap  -L  -s sub   -b c=US   "(&(telephonumber=111*)(sn=smith*))"
```

- **Example: delete an entry**

```
ldapdelete  -h dceset3.ibm.com  -p 2803   -D cn=ken,ou=LDAP,o=IBM,c=US
    -w kenldap   cn=jay,ou=LDAP,o=IBM,c=US
```

Using LDAP - Examples cont.

- **Example: display all entries in c=US directory tree**

```
ldapsearch   -h dceset3.ibm.com   -p 2803    -D cn=ken,ou=LDAP,o=IBM,c=US
    -w kenldap   -L   -s sub   -b c=US   objectclass=*
```

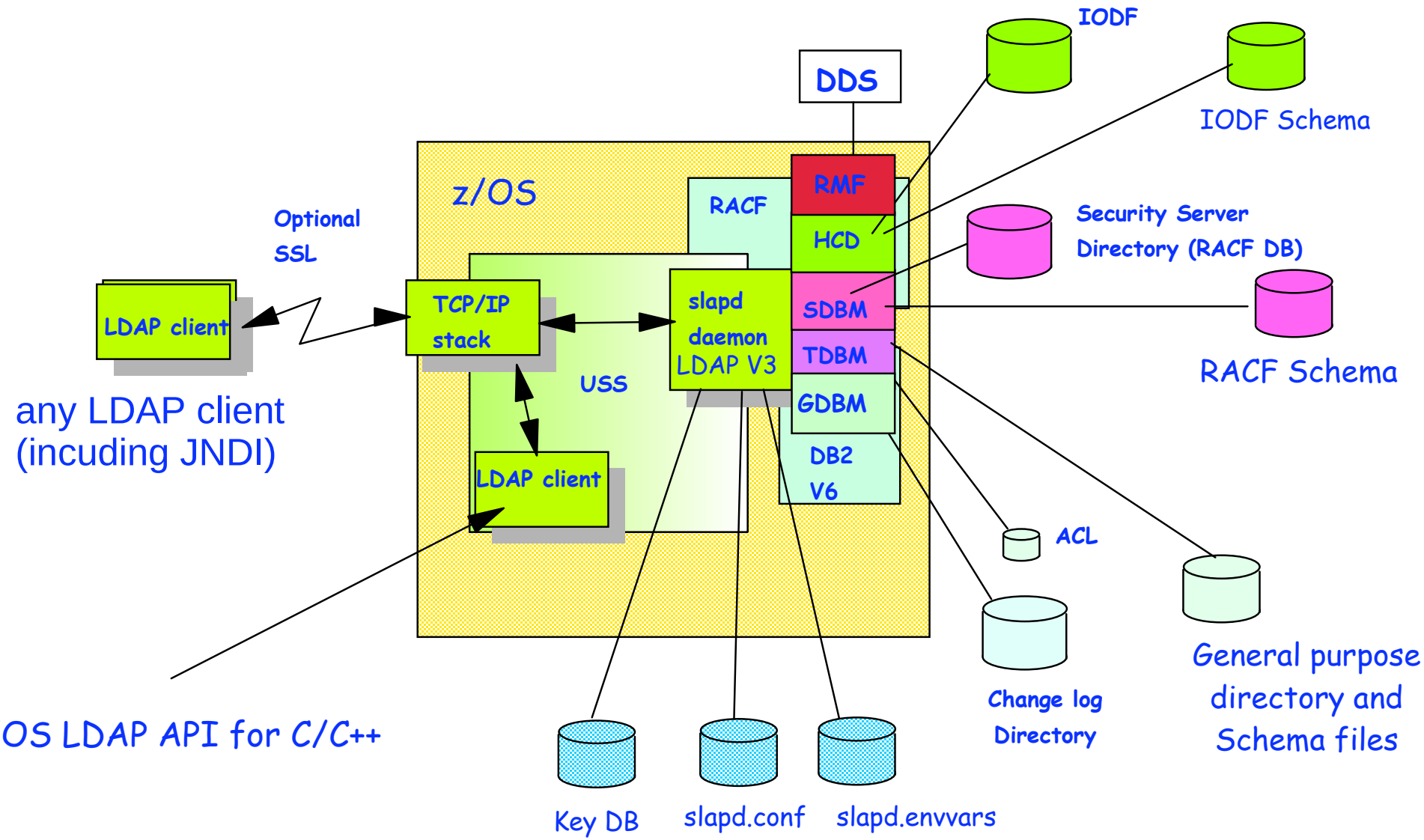
```
dn: c=US
objectclass: country
c: US

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
...
```

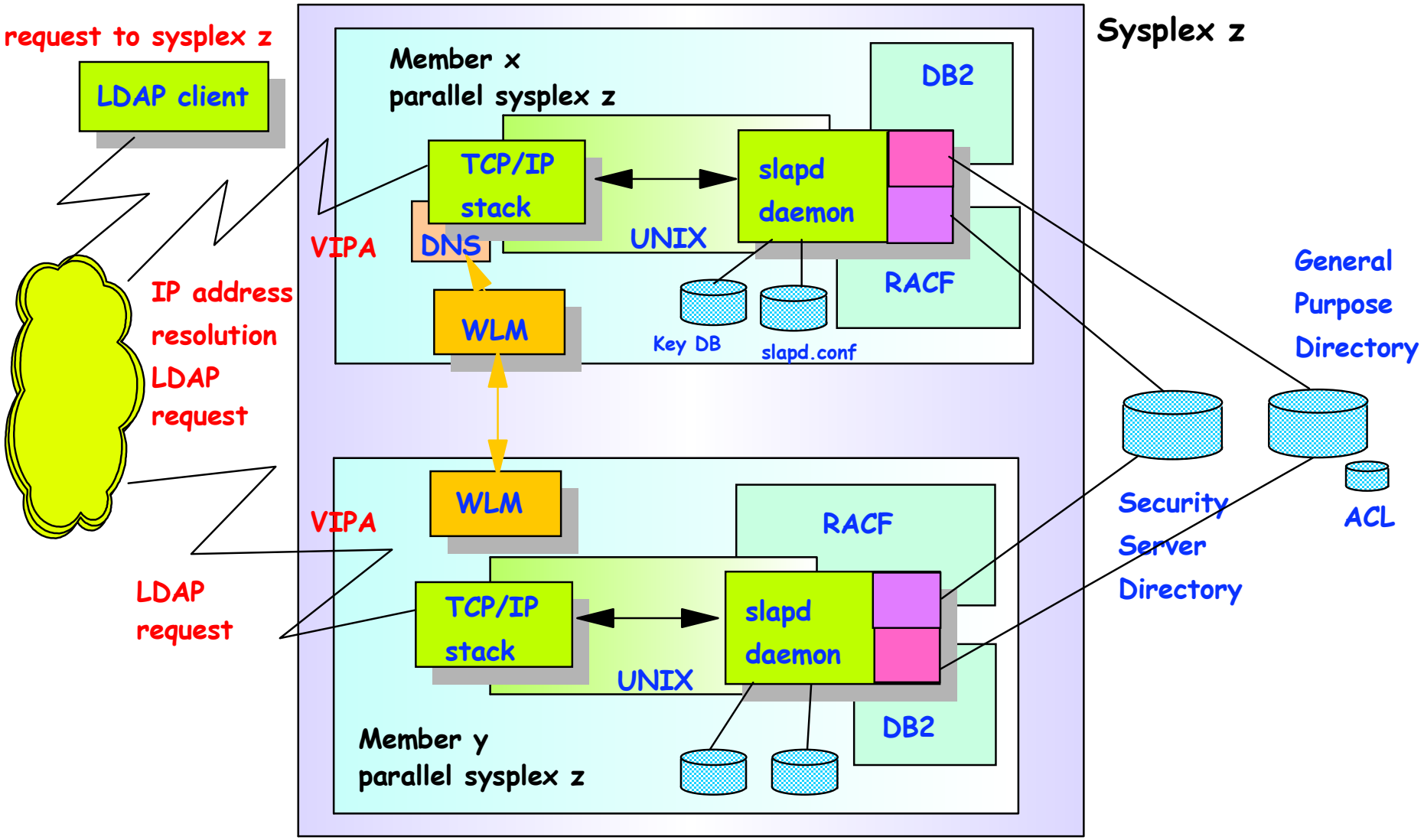
LDAP Server on z/OS



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



LDAP Authentication

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 HFS keydb**
  - **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

Enter userid : ken
Enter password : ********

dn="cn=ken,ou=LDAP,o=IBM,c=US"
pw=kenldap
ldap_bind_s(ld,host,port,dn,pw)

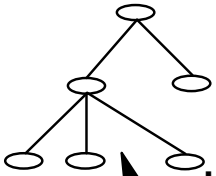
bind request

LDAP Client (API)

z/OS LDAP Server **TDBM**

find TDBM entry
verify password
get TDBM groups

successful bind



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

objectclass: person
cn: ken
sn: morgan
userpasswd: 12Lg7tvXO

In TDBM directory

LDAP DB2 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 **SDBM**

verify user and password

__passwd(U12345,racfpw

successful bind

dn: racfid=U12345,profiletype=user,cn=myRACF

objectclass: racfUser
objectclass: racfBaseCommon
racfid: U12345
racfprogrammername: Ken Morgan
racfdefaultgroup: racfid=group1,profiletype=GROUP,cn=myRACF
racfconnectgroupname: racfid=group1,profiletype=GROUP,cn=myRACF
racfconnectgroupname: racfid=group2,profiletype=GROUP,cn=myRACF

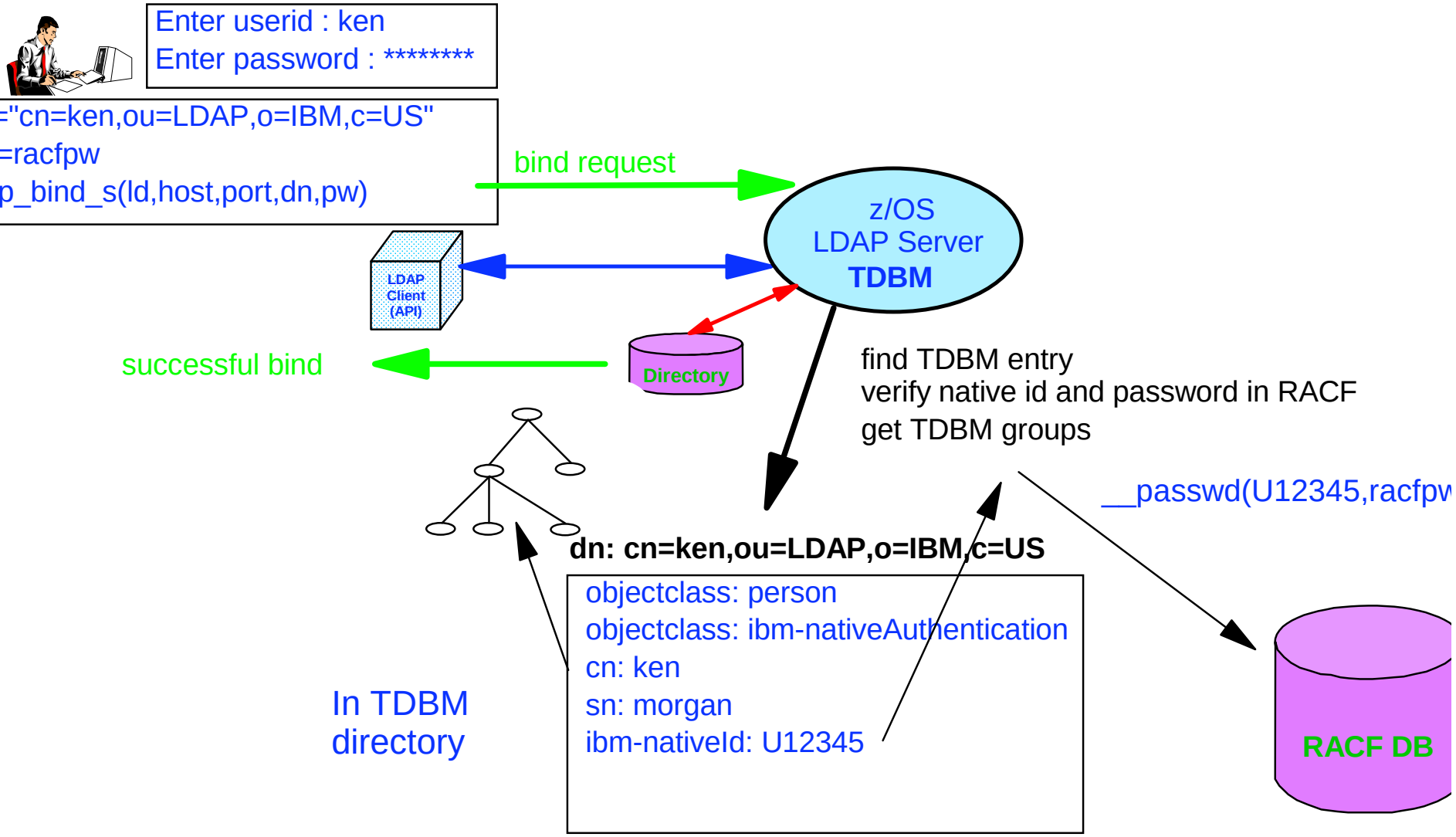
find RACF user entry
get RACF groups

RACF DB

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 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

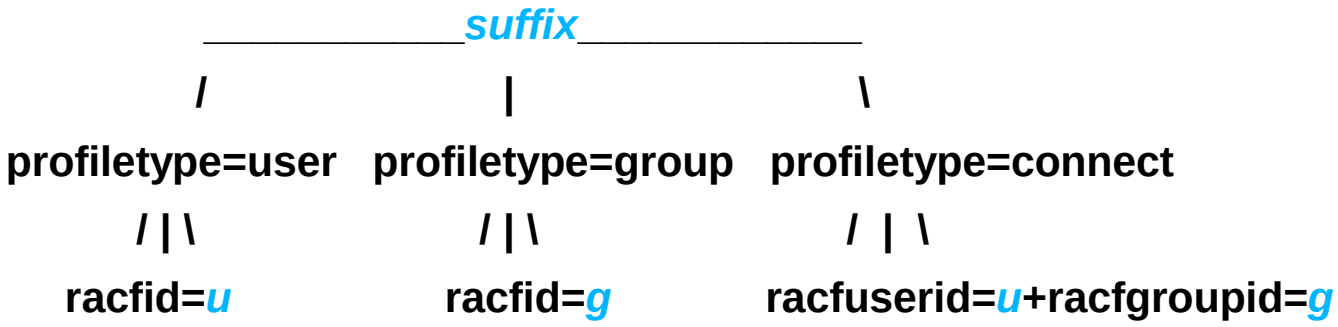


Accessing RACF via LDAP

SDBM Support of RACF

- **Use LDAP to add, modify, delete, display RACF users, groups, and user-group connections - 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

- **Limited search capabilities - predefined by SDBM**
- **All data accessed via RACF**
  - **No RACF Data in LDAP**
  - **Authorization controled 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 2803
 -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  -p 2803
  -D racfid=radmin,profiletype=user,cn=myRacf   -p radminpw    -L
  -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=ken,ou=LDAP,o=ibm,c=us
delete: userPassword
userPassword: kenldap
-
add: userPassword
userPassword: mynewpw
-
```

    - 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*** when binding

RACF Change Logging

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 (in change log backend - GDBM)**
    - **Can access entry using normal LDAP operations from any LDAP client**
  - **Retrieves RACF password envelope via LDAP SDBM 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

  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**

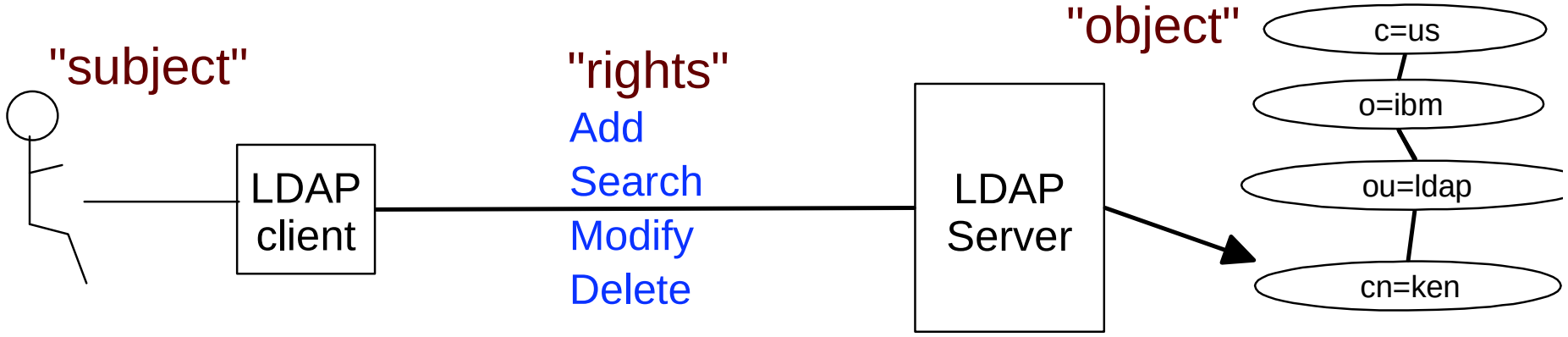
  ldapsearch –D racfid=radmin,profiletype=user,cn=myRacf
  –w radminpw –L -b racfid=U12345,profiletype=user,cn=myRacf
  “objectclass=*” racfpasswordenvelope

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

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**
- **Can specify TDBM and SDBM (RACF) users and groups**
- **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=morgankg,profiletype=user,cn=myRacf:object:ad
    aclentry: group:cn=mgrs,o=IBM,c=US:at:userpassword:rwsc
    aclentry:group:racfid=g1,profiletype=group,cn=myRacf:normal:rwsc
- **Can propagate an entry's ACL to the subtree below it**

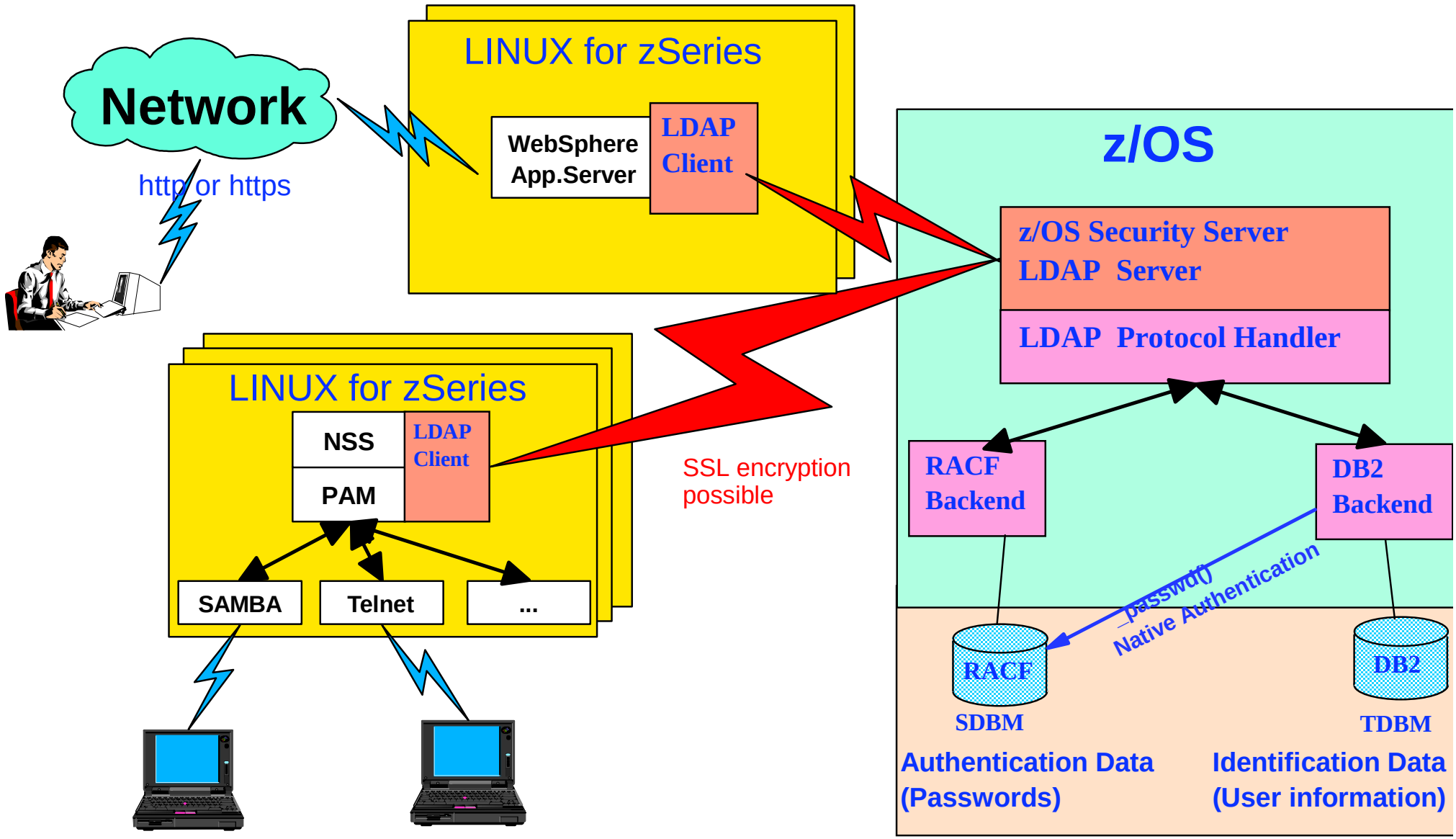
Special aclEntry "pseudo-DNs"

- **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
```

The Big Picture

User Information and Authentication in LDAP



References:

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  - **SC24-5924 z/OS Integrated Security Services LDAP Client Programming**
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  - **http://www.redbooks.ibm.com/redpapers/abstracts/redp0221.html**
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- **NIS Schema for z/OS LDAP Server:**
  - **ftp://www.redbooks.ibm.com/redbooks/REDP0221**
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