



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**

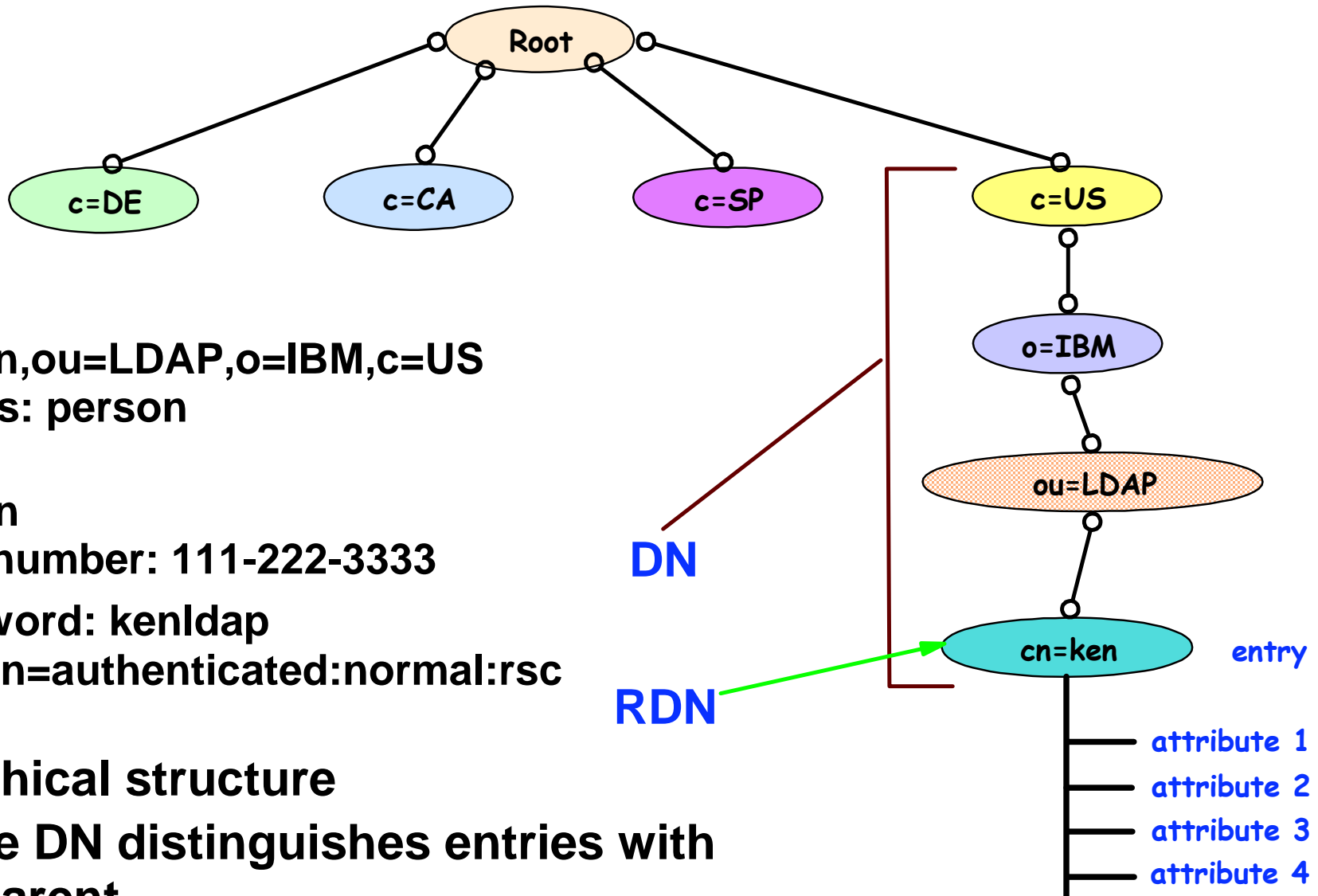
Overview of LDAP

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

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

acentry: 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: Idapadd, Idapmodify, Idapdelete, Idapmodrdn, Idapsearch**
- **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 "(&(telephonenumber=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
```

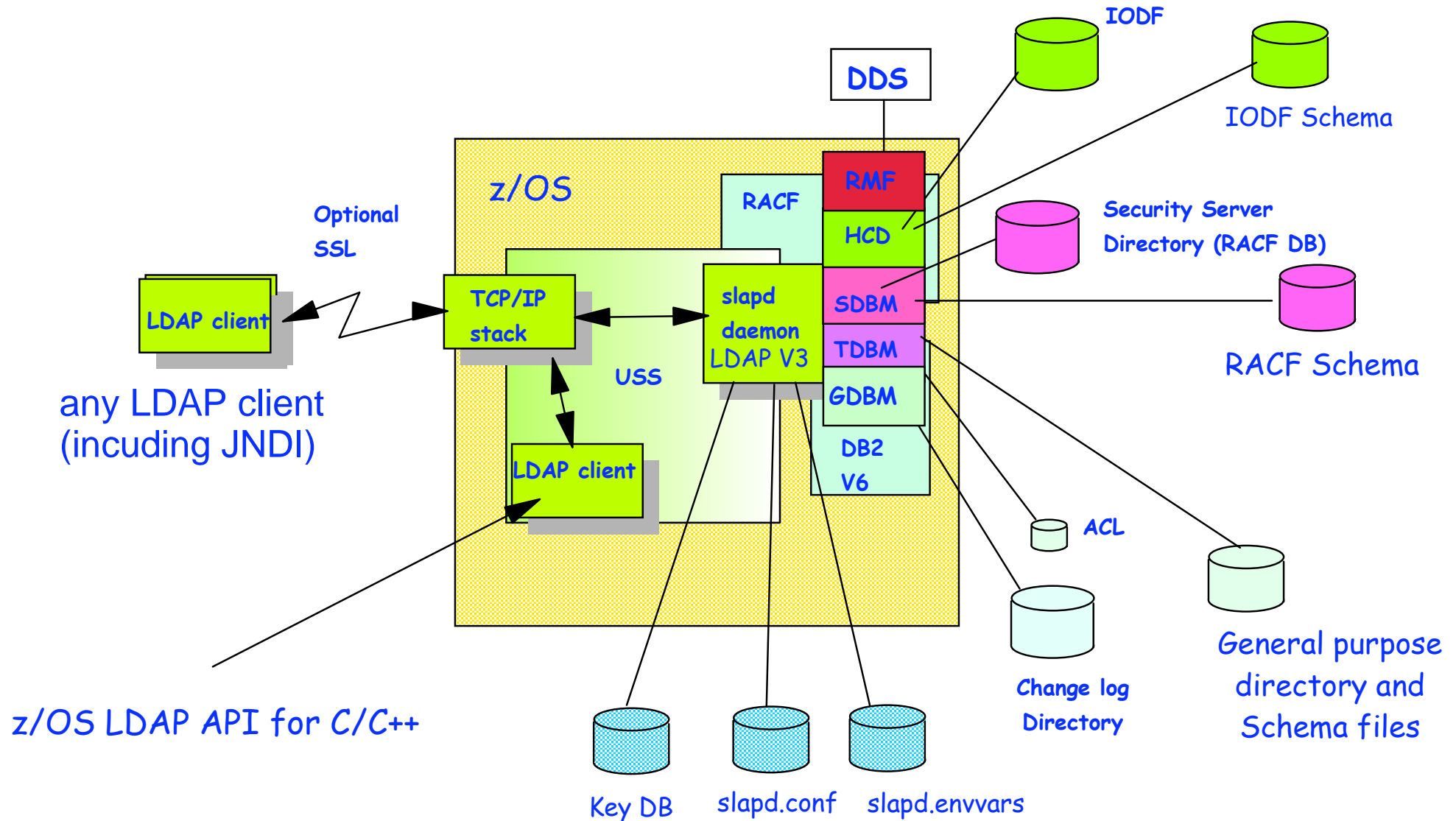
```
dn: o=IBM,c=US  
objectclass: organization  
o: IBM
```

```
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...

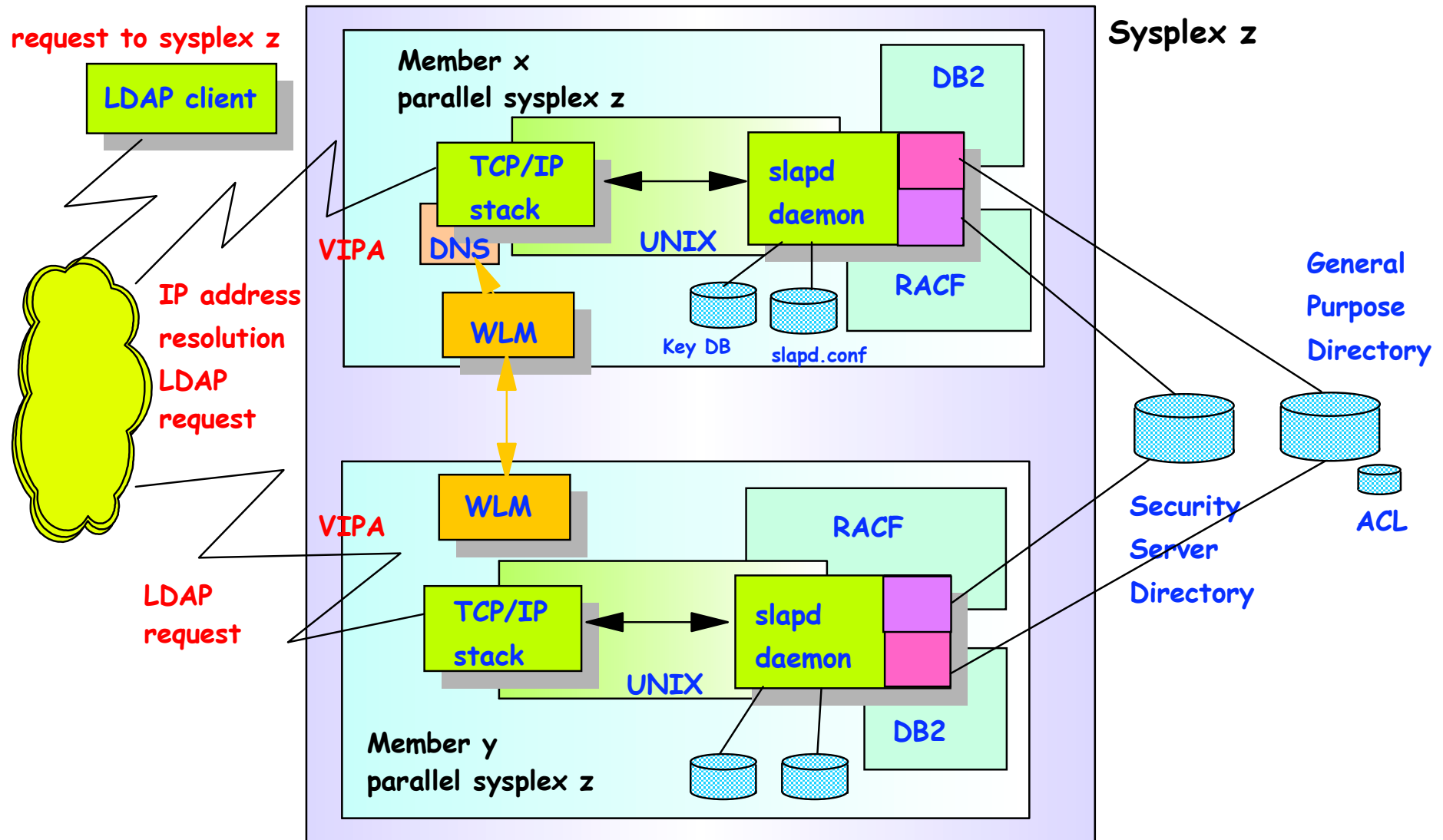
- **LDAP Server has multiple backends (data stores)**
 - ▶ **TDBM: General purpose directory**
 - Full LDAP V3 support, including modifiable schema
 - Data stored in DB2 database
 - Full scalability

 - ▶ **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

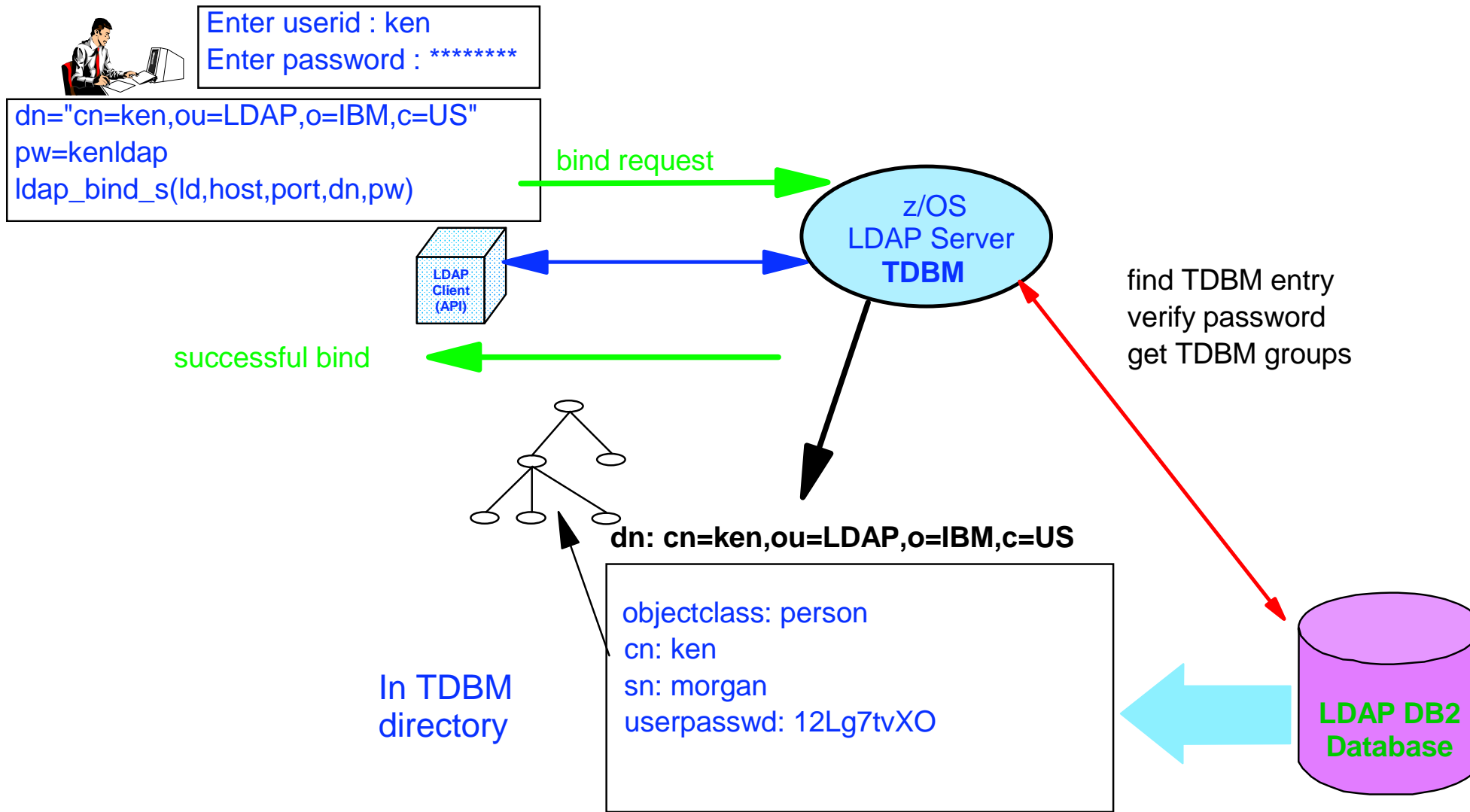


LDAP Authentication

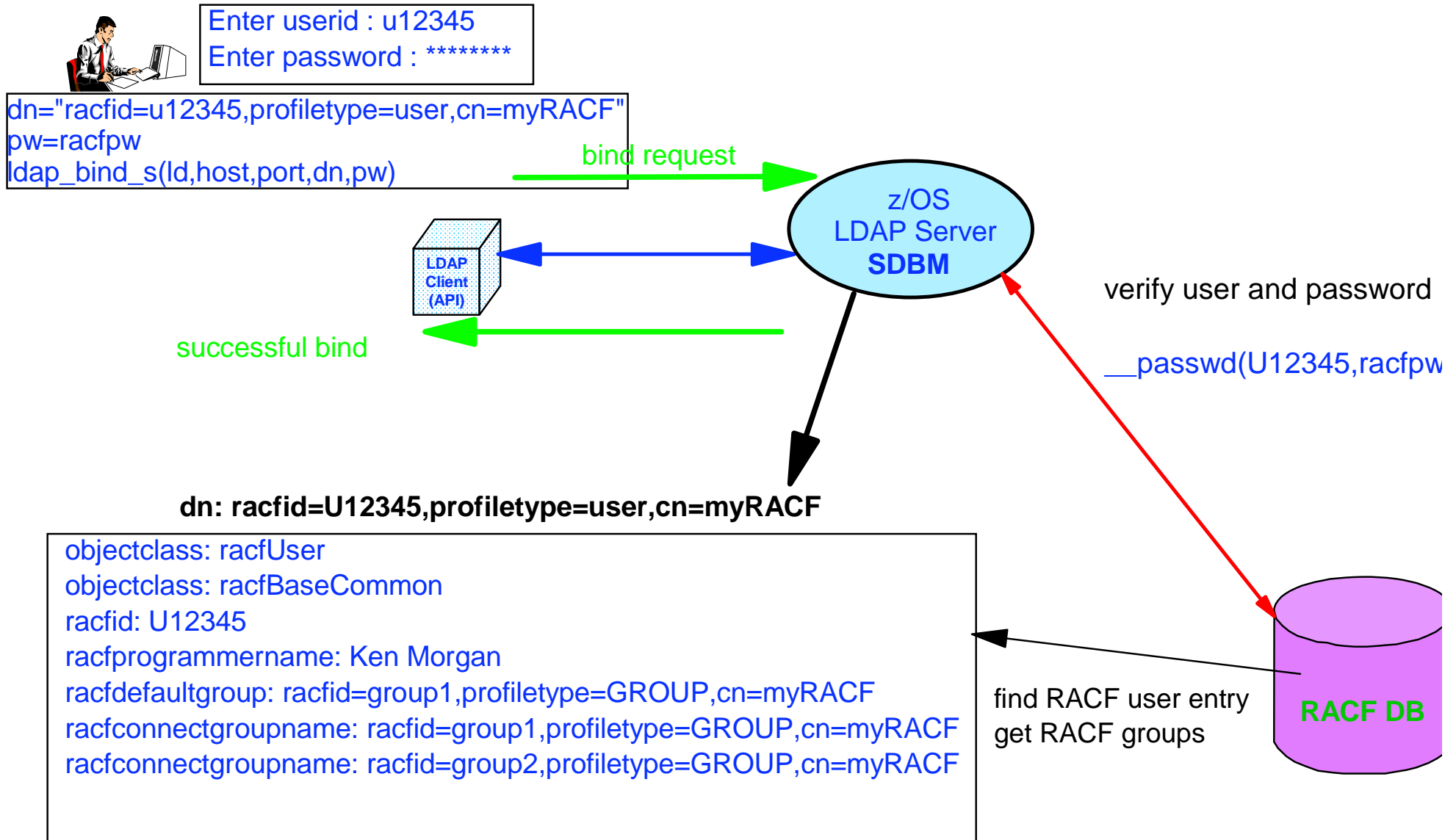
Authentication with an LDAP Server

- **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



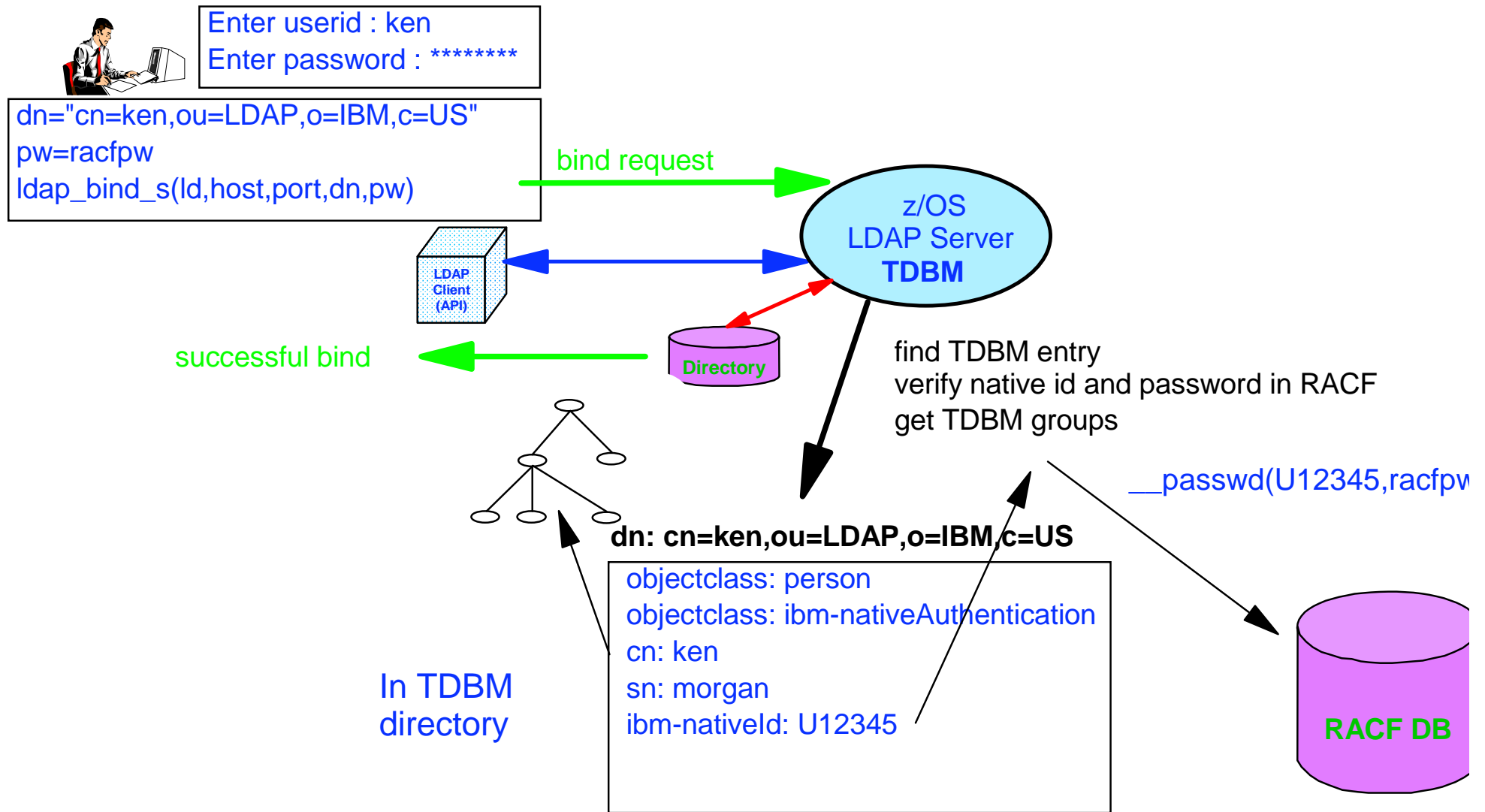
LDAP Authentication with SDBM (RACF)



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 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

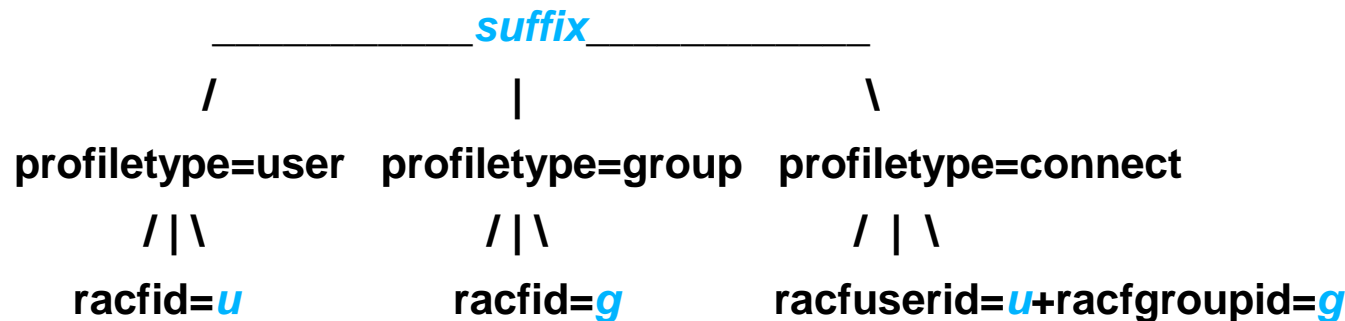
LDAP Native Authentication



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, ALTGROU, DELGROU, 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 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 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=admin,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

- **Idapmodify 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**

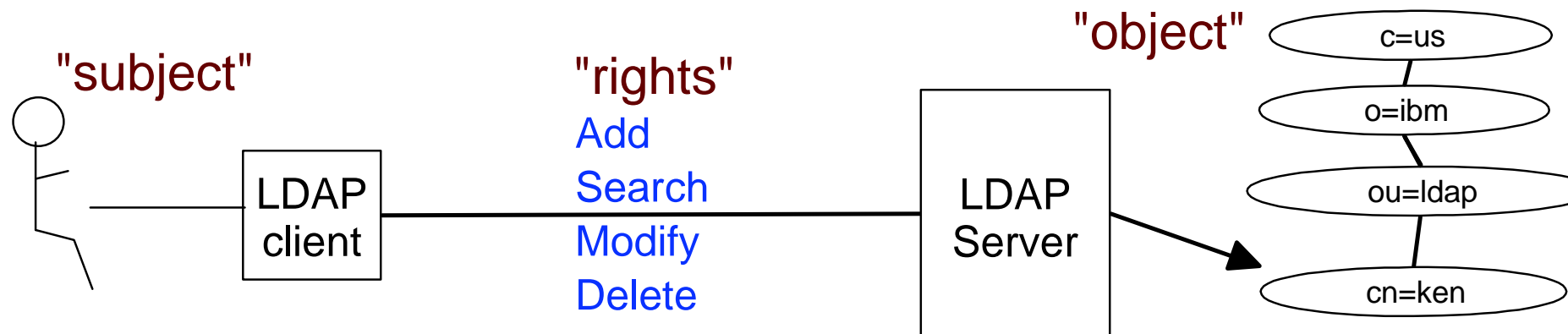
ldapsearch -D racfid=radmin,profiletype=user,cn=myRacf
-w radminpw -L -b racfid=U12345,profiletype=user,cn=myRacf
"objectclass=*" racfpasswordenvelope

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:**
 - `acentry: cn=jay,ou=LDAP,o=IBM,c=US:normal:rwsc:sensitive:rsc`
 - `acentry: racfid=morgankg,profiletype=user,cn=myRacf:object:ad`
 - `acentry: group:cn=mgrs,o=IBM,c=US:at:userpassword:rwsc`
 - `acentry: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:**

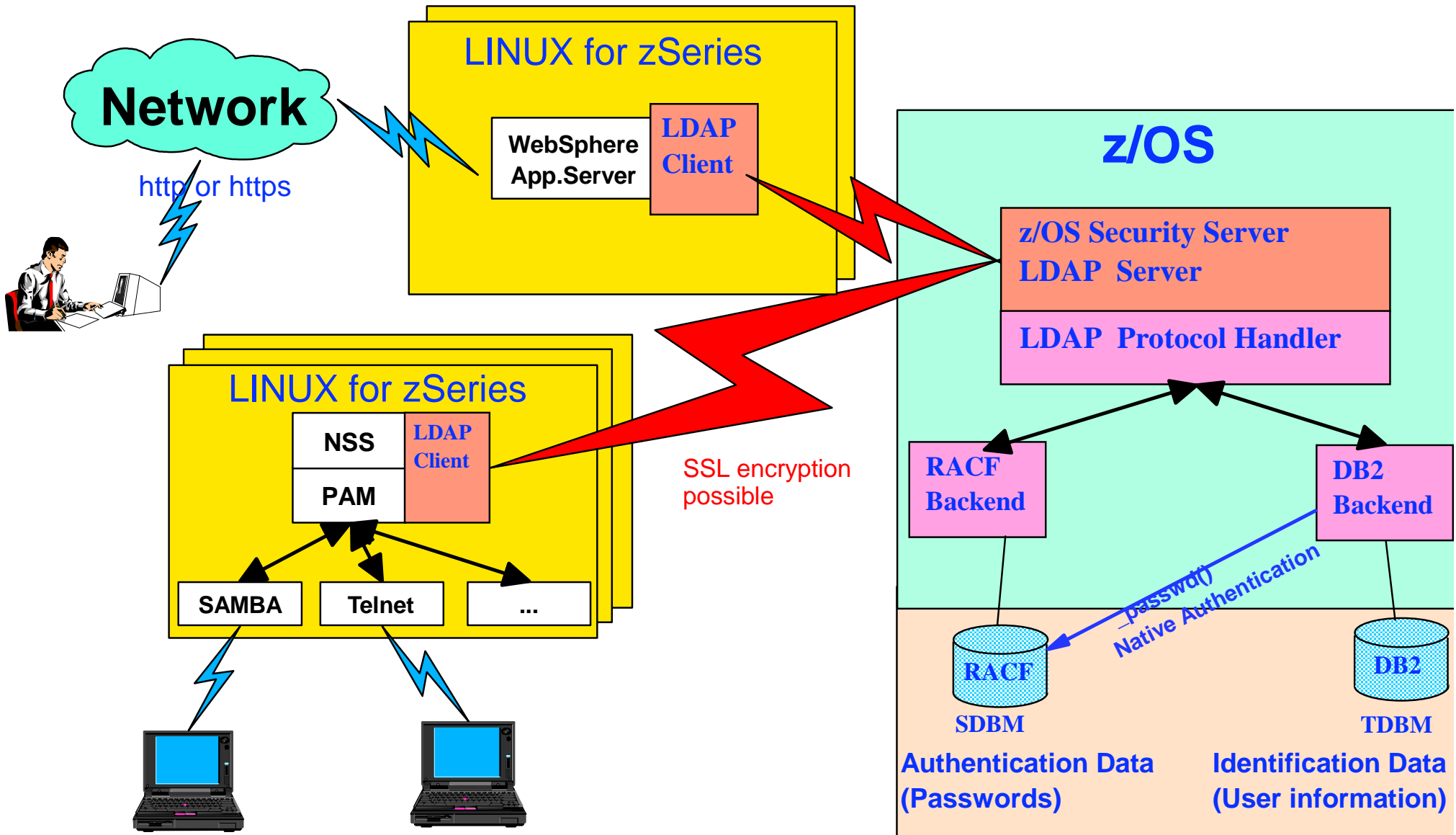
aclentry: cn=anybody:normal:rsc

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:

- **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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