Directory-enabling Your Application

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Dimensions of LDAP

- Information model
- Naming model
- Functional model
- Security model

Information Model

- Schema - structured
- Entry - record, has attributes
- Attribute - field, data about the entry
- Type - syntax, kind of data stored

Information Model (cont.)

- Schema
  - What data can be stored
    - Object classes – groups of attributes
    - Attributes in an entry
      - Name
      - Type
      - Value

Information Model (cont.)

- Entry (cont.)
  - Attributes
  - Types
  - Values

Naming Model

- How things are identified
- DN - distinguished name
  - unique name for an entry
    - uhUuid=1234, ou=People, dc=hawaii, dc=edu
- RDN - relative distinguished name
  - composed of one or more attributes of the entry
    - uhUuid=1234
Naming Model (cont.)

- **Namespace**
  - What do you call things
  - How things are grouped
  - Hierarchical DIT
    - Contains entries
    - Entries contain entries

Functional Model

- How information accessed
- Searching - area, filter, and scope, types of comparisons
- Update - add, delete, modify, modify RDN
- Connecting – bind, unbind, abandon

Searching

- **Search Attribute(s)**
  - Exact match
  - Approximate match
    - partial key
    - regular expression
  - Substring

Searching (cont.)

- **Search Attribute(s)**
  - Exact match
    - (sn= Doe)
  - Approximate match
    - (& (sn= Doe) (givenName=John) )

Searching (cont.)

- **Search Attribute(s)**
  - Approximate match
    - (sn~=road)
  - Substring
    - (sn=do*)
  - (& (sn~=Doe) (givenName=John) )
  - (& (sn=r*oa*) (givenName=sam*))
Searching (cont.)

- More examples

(& (sn=do*) (! (givenName=jo*)))

(& (givenName=Jo*n) ((sn=Do*) (sn=Sm*)))

Security Model

- Access control
- Who gets to see which attributes
- Who gets to change things
- Roles
- Views

Access Control

- FERPA (Federal Education Rights and Privacy Act)
- Students not visible anonymously
  - White pages
  - User authentication (requires special DN)

LDAP C API – RFC 1823

- ldap_bind() - authenticate to directory server
- ldap_result() - get result from previous operation
- ldap_search() - search for directory entries

LDAP C API (cont.)

- ldap_compare() - does entry contain attribute value?
- ldap_modify() - change entry
- ldap_unbind() - end session

LDAP C API (cont.)

- ldap_add() - new entry
- ldap_delete() - remove entry
- ldap_modrn() - rename entry
ldap_search - Lookups

- Host:port of LDAP server
- Search base (where to look)
- Scope (how much of tree)
- Search filter (what to look for)
- Attributes to return
- Attributes only

Using the LDAP C API

- Create session and open connection
- Set parameters, call LDAP function, and get results
- Process results
- End session

C Sample

```c
#include <ldap.h>

/* Create session and open connection */
ld = ldap_init(ldap_server, ldap_port);
rc = ldap_simple_bind_s(ld, BIND_DN, BIND_PW);

/* Set params, call LDAP function, & get results */
rc = ldap_search_s(ld, ldap_search_base,
    LDAP_SCOPE_SUBTREE,
    ldap_filter, NULL, 0, &results);

/* Process results */
entry = ldap_first_entry(ld, results);
for ( attr = ldap_first_attribute(ld, entry, &element);
    attr != NULL;
    attr = ldap_next_attribute(ld, entry, element) ) {
    if ((vals = ldap_get_values(ld, entry, attr)) !=NULL)
        for (i = 0; values[i] != NULL; i++)
            printf(" %s: %s\n", attr, values[i]);
}
```

C Sample (cont.)

```c
/* Process results */
entry = ldap_first_entry(ld, results);
for ( attr = ldap_first_attribute(ld, entry, &element);
    attr != NULL;
    attr = ldap_next_attribute(ld, entry, element) ) {
    if ((vals = ldap_get_values(ld, entry, attr)) !=NULL)
        for (i = 0; values[i] != NULL; i++)
            printf(" %s: %s\n", attr, values[i]);
}
```

Another way to search

- LDAP URL (RFC 2255)
  `/ou=people,dc=hawaii,dc=edu??one?(sn=Doe)`

What will I get back?

- Zero or more entries
- Attributes
- Value(s) for each attribute present
Anything but C

Java / JNDI
Perl
Visual BASIC
PHP
Cold Fusion
Python

Java / JNDI Sample (cont.)

```java
import javax.naming.*;
import javax.naming.directory.*;

// Create session and open connection
env.put(Context.INITIAL_CONTEXT_FACTORY,
        "com.sun.jndi.ldap.LdapCtxFactory");
env.put(Context.PROVIDER_URL, ldapUrl);
env.put(Context.SECURITY_AUTHENTICATION, "simple");
conn = new InitialDirContext(env);

// Set params, call LDAP function, & get results
searchCtls.setReturningAttributes(attributes);
searchCtls.setSearchScope((SearchControls.SUBTREE_SCOPE);
results =
        conn.search(ldapBaseDN,searchFilter.toString(),
searchCtls);
SearchResult entry = (SearchResult) results.next();

// Process results
Attributes attrs = entry.getAttributes();
for (int i=0; i < attributes.length; i++) {
    Attribute attrib = attrs.get(attributes[i]);
    for (vals = attrib.getAll();vals.hasMoreElements(); )
        value.append((String) val.nextElement());
    System.out.println(attributes[i] + " = " +
                    value.toString());
}
```

Results Returned:
uid = russ
givenName = Russell
sn = Tokuyama
cn = Russell C Tokuyama
eduPersonOrgDN = uhm
eduPersonAffiliation = staff, student
mail = russ@hawaii.edu
uhPreferredMail = russ@hawaii.edu

Perl Sample

```perl
# Sample by Bin Zhang of KCC Library
# Perl LDAP interface
use Net::LDAP;
use Net::LDAP::Util qw/ldap_error_text/;

# Create session and open connection
my $ldap = Net::LDAP -> new($server);
```
Perl Sample (cont.)

# Set params, call LDAP function, & get results
my $result = $ldap->search(base => 'ou=people, dc=hawaii,dc=edu', filter => "uid=$uid");

# Process results
my $entry = $result->entry(0);
foreach my $attr ($entry->attributes) {
    foreach my $value($entry->get_value($attr)) {
        print("$attr = $value\n");
    }
}

Perl Sample (cont.)

Results returned:
edupersonorgdn = uhm
uid = russ
mail = russ@hawaii.edu
uhpreferredmail = russ@hawaii.edu
cn = Russell C Tokuyama
sn = Tokuyama
givenname = Russell
edupersonaffiliation = staff
edupersonaffiliation = student

Visual BASIC Sample

Set reference to ActiveX Data Objects 2.5 Library

Create session and open connection
Dim con As New Connection
Dim ldap As New Command
con.Provider = "ADsDSOObject"
con.Open "Active Directory Provider", "", ""
Set ldap.ActiveConnection = con

Visual BASIC Sample (cont.)

Set params, call LDAP function, & get results
baseDN = "<LDAP://" & ldapHost & "/" & searchBase & ">
ldap.CommandText = baseDN & ";" & _
searchFilter & ";" & _
returnAttributes & ";" & _
searchScope
Set rs = ldap.Execute

Visual BASIC Sample (cont.)

Process results
While Not rs.EOF
    For i = 0 To rs.Fields.Count - 1
        Debug.Print rs.Fields(i).Name; " = ";_rs.Fields(i).Value
    Next i
    rs.MoveNext
Wend

PHP Sample

<%
<!-- Create session and open connection -->
$ds = ldap_connect("ldap1.its.hawaii.edu");
$rs = ldap_bind($ds);
<!-- Set params, call LDAP function, get results -->
$dn = "ou=People, dc=hawaii, dc=edu";
$filter = "(uid=$username)"
%>
PHP Sample (cont.)

```php
<!-- Set params, call LDAP function, get results -->
$justthese = array( "ou", "sn", "givenname",
    "eduPersonAffiliation", "title",
    "telephoneNumber",
    "facsimiletelephoneNumber",
    "physicalDeliveryOfficeName" );

$sr = ldap_search($ds, $dn, $filter, $justthese);
```

PHP Sample (cont.)

```php
<!-- Process results -->
$info = ldap_get_entries($ds, $sr);

echo "\n<table border="0">
<tr><td><b>Name:</b></td><td>" . $info[0]["cn"] . "</td></tr>
<tr><td><b>Affiliation:</b></td><td>" . $info[0]["eduPersonAffiliation"] . "</td></tr>
<tr><td><b>Email:</b></td><td>" . $info[0]["mail"] . "</td></tr>
```

Cold Fusion Sample

```coldfusion
<cfldap action="QUERY"
   name="result"
   server="ldap1.its.hawaii.edu"
   port="389"
   start="ou=people, dc=hawaii, dc=edu"
   attributes="uid, eduPersonAffiliation, uhSSN, eduPersonOrgDn, password, dn"
   filter="(uid=#trim(form.username)#)">
<cfset #accountType# = GetToken(#result2.eduPersonAffiliation#, 1, ",")>
```

Python Sample

```python
# Create session and open connection
conn = ldap.open(ldapHost, ldapPort)

# Set params, call LDAP function, & get results
filter = 'uid=' + itsUsername + ')
rc = conn.search(searchBase, searchScope, filter, attrList)
results = conn.result(rc)
resultData = results[1]
```

Python Sample (cont.)

```python
# Process results
attrs = resultAttrs.keys()
for i in range(len(attrs)):
    print attrs[i], ':'
    attrValues = resultAttrs.get(attrs[i])
    for j in range(len(attrValues)):
        print '    = %s' % attrValues[j]
```

Authenticating users

- Bind and lookup the uid
- Get the user’s DN
- Rebind as the user (DN and pw)
  - Blank pw = anonymous (caution)
- Search for anything in user’s entry
- Don’t need to lookup user’s pw
Programming hints

- KISS - Focus on just what you need
- Refactor for modularity
- Choose meaningful names
  - Use server Not svr (anybody’s guess)
- Test, test, test
- Re-read the documentation
- How do you know what went wrong?

Resources

- IETF RFC
  - 1823 – The LDAP Application Program Interface
  - 2251 - Lightweight Directory Access Protocol (v3)
  - 2255 - The LDAP URL Format

Resources (cont.)

- Implementing LDAP by Mark Wilcox, 1999, Wrox Press

Resources (cont.)


Resources (cont.)

- Java
- Perl - http://cpan.perl.org
- VB

Resources (cont.)

- Python - http://www.python.org/
- ITS Brown Bags
  - http://www.hawaii.edu/brownbags/ldap
- UH LDAP Directory Service
  - http://www.hawaii.edu/ldap/
Feedback

- ITS Systems Services
  - Russ Tokuyama <russ@hawaii.edu>