
Lightweight Directory Access Protocol

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What is a directory?

- A directory is a publishing service
- Kind of like a database...
 - enhanced search capabilities
 - client / server implementation for access
 - ...but....
- highly optimized for reads
 - loosely consistent replication
 - possesses an extensible schema

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What is LDAP good for?

- Providing a standard means of accessing data over a network
- Fast searches and retrieval of data
- What kind of data?
 - read-only data
 - data that is seldom modified

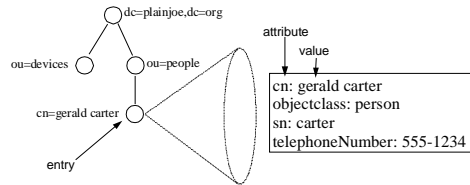
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LDAP Overview

- Connection oriented (tcp/389)
 - LDAP over SSL (tcp/636)
 - ◆ deprecated in favor of StartTLS
 - connectionless LDAP over UDP in an I-D
- Client / Server
- Messaged based
- asynchronous
 - client libraries often provide blocking versions of calls

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An LDAP Directory



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LDAP Building Blocks

- An LDAP Directory is a tree-like structure composed of
 - Entries
- An Entry is composed of
 - Attributetypes
 - Attribute Values
- The 'objectClass' attribute values define which attributes are valid

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LDAP Schema (Syntax)

- Analogous to a type in a programming language
 - e.g. int, char, real, char*
- Example : 'Directory String' is a UTF-8 form of ISO 10646 (a superset of Unicode).

(1.3.6.1.4.1.1466.115.121.1)15 DESC 'Directory String')

OID

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LDAP Schema (Matching Rules)

- Applies to a syntax
- Used by server during
- search and compare attribute values
 - addition and deletion of attributes
 - comparing distinguished names (DN)

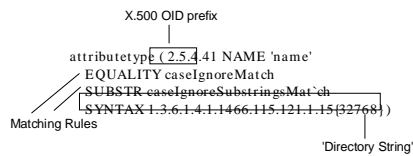
(2.5.13.2 NAME 'caseIgnoreMatch'
SYNTAX 1.3.6.1.4.1.1466.115.121.1.15)

(2.5.13.4 NAME 'caseIgnoreSubstringsMatch'
SYNTAX 1.3.6.1.4.1.1466.115.121.1.58)

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LDAP Schema (Attribute Type)

- analogous to a variable instance
- flat namespace in schema for attribute names



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LDAP Schema (Object Class)

- Defines an entity composed
 - required attributes (MUST)
 - optional attributes (MAY)
- Object classes can be derived
 - single inheritance only (is-a)
 - multiple 'has-a' occurrences

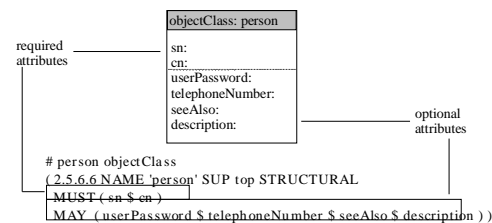
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LDAP Schema (Object Class)

- Class type is either
 - structural
 - ◆ can be instantiated (e.g. person)
 - auxiliary
 - ◆ cannot stand on its own (e.g. mail)
 - abstract
 - ◆ only derive classes from this one (e.g. top)

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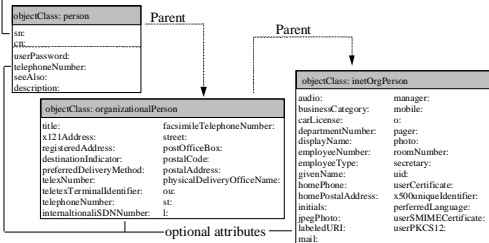
objectClass: person



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Objectclass Inheritance

required attributes

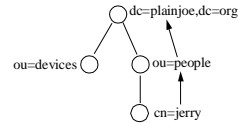


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Distinguished Names

dn: cn=jerry,ou=people,dc=plainjoe,dc=org

Relative Distinguished Name (RDN) - must be unique among all siblings



An RDN can contain multiple attribute values. This is generally confusing. Use a better namespace design.

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LDAP Searches

- 8 parameters

- base
 - scope
 - derefAliases
 - size limit
 - time limit
 - attrsOnly
 - search filter
 - attribute list to return
- Most common options

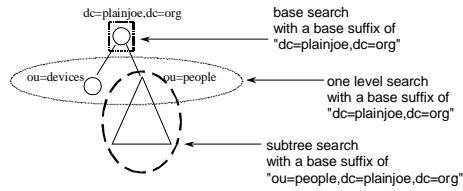
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LDAP Searches

- search base
 - the top level of the directory tree from which to begin the search
- scope
 - base
 - ◆ search base entry only
 - onelevel
 - ◆ depth of 1 (excluding parent)
 - subtree
 - ◆ entire directory tree beneath search base

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Base search suffix & scope



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rootDSE

- Contains attributes
 - altServer
 - namingContexts
 - supportedControl
 - supportedExtension
 - supportLDAPVersion
 - supportSASLMechanisms
 - supportSASLMechanisms

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subschemaSubentry

- Contains the published schema for the server
 - objectClasses
 - attributeTypes
 - dITStructureRules
 - nameForms
 - dITContentRules
 - matchingRules
 - matchingRuleUse

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Using LDAP Correctly

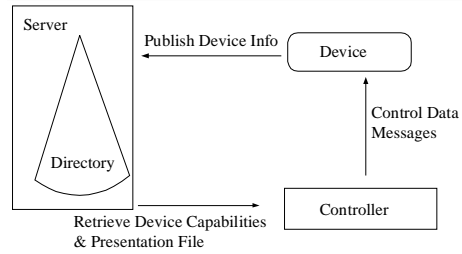
- LDAP is not designed as
 - a generalized replacement to specialized directories such as DNS
 - ◆ schemas do exist for storing DNS zone information in LDAP
 - a generalized storage for BLOB's (Binary Lumps of Bits) as is the case with a filesystem
 - ◆ binary data can be stored in LDAP such as the jpegPhoto attributetype

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Network Architecture Proposal

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Overview



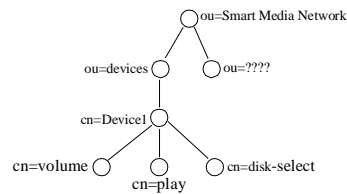
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Publishing a Device

- When booting onto the network, a device publishes information about it's
 - capabilities
 - ◆ smnFunction: [player|recorder]
 - ◆ smnName: Phillips CD Player
 - controls
 - ◆ smnControlName: volume
 - ◆ smnControlDefaultValue: 100
 - ◆ smnControlType: slider
- Done via LDAP
 - DSML

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Directory Namespace



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Device Entry

```
dn: smnName=cdl,ou=devices,ou=Smart Media Network
objectclass: smnDevice
objectclass: player
smnName: Phillips CD-Player
smnName: cdl
supportedMedia: mp3
supportedMedia: audio cd
supportedMedia: DVD
ipAddr: 192.168.1.100
supportedStreams: <stream name>
```

```
dn: controlName=volume,ou=devices,ou=Smart Media Network
objectclass: smnControl
controlName: volume
controlType: slider
controlDefault: 60
controlMinValue: 0
controlMaxValue: 100
```

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Locating Devices & Controls

- one level search on ou=Devices
 - "(objectclass=smnDevice)"
- one level search on cn=<devicename>
 - "(objectclass=smnControl)"
 - Controller downloads presentation/layout file from
 - ◆ server, or
 - ◆ device
 - ◆ HTML ? XML ?

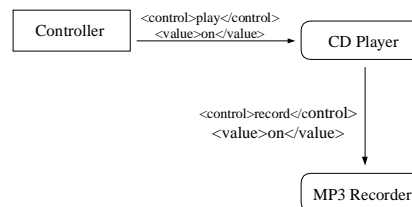
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Device Communication

- Communication is based on common UI event programming models
 - control sends message to application
 - ◆ control ID
 - ◆ current value
- In this example,
 - control == object on presentation file
 - application == media device on network
- SOAP used for wire encoding
- Query State - is media loaded?

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Control Message Examples



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LDAP/XML vs. JINI

- Inheritance
 - JINI uses true OO technology
 - LDAP provides derived objectclasses
 - "Is a?" really needed?
- Communication
 - JINI clients download stub code
 - LDAP solution provides controls published by devices
 - ◆ Mimics front panel control methodology

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Advantages of LDAP Solution

- Standard technologies
 - DSML, XML, SOAP
 - LDAP
 - HTTP (or other file transfer protocol)
- Not tied to
 - specific language
 - hardware
 - vendor (e.g. Sun & JINI)

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Future Proof

- Defined set of functions
 - [video|audio] player
 - [video|audio] recorder
- New Devices?
 - new functions? Does this make sense?
- New controls?
 - Must be understood by the presentation file
 - ◆ published by device

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Miscellaneous Details

- run-time schema updates
 - is this really necessary?
- keepalives
 - What if a device does not gracefully deregister itself?
 - cleanup process on server?

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Project Links

- IRC channel on irc.openprojects.net
 - [#au-comp7970](http://irc.openprojects.net/#au-comp7970)
- Mailing list
 - <http://mailman.eng.auburn.edu/mailman/listinfo/comp7970>
- CVS server
 - details forthcoming