Service Location Protocol

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Introduction to Service Location Protocol (SLP)

SLP allows:

- Clients to find Servers by *type* and desired *attributes*
- Services to advertise themselves
- *Scopes* to organize services, using arbitrary policies
- Hierarchy of services not artificially imposed
- Support for internationalization

Introduction to SLP (cont.)

SLP is:

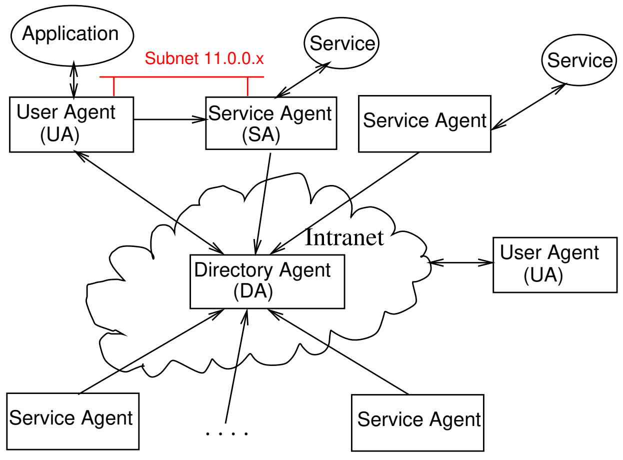
- Low-cost administration and effortless extension to new services
- Decentralized and (after creation) self-administered availability
- Compatible with browser, existing applications, and services (URLs)
- featherweight

Protocol Characteristics

- distributed and self-managing, with numerous service agents
- compatible with other administrative protocols and mobile networking protocols
- string-based (reduced parser complexity)
- easily implemented
- uses existing standards where possible
- expressive query grammar – LDAPv3 query syntax
- *Scalability* a prime motivation, given future explosion of network services and the crowded nature of of enterprise networks

Service Location Discovery Framework

- User Agents (UAs) intercede for applications
- Service Agents (SAs) intercede for services
- UAs and SAs on *nearby* networks can communicate
- Larger deployments use Directory Agents (DAs) (transparent)



URLs (Service Handles)

Standardized way to access a large variety of network resources

General form of URLs:

<scheme>:<scheme-specific-part>

often something like

```
scheme://host:port/opaque
```

Some examples of valid service replies are:

```
nfs://slag.eng.sun.com/src/slp

service:http://www.research.sun.com/

service:lpr://motels.eng.sun.com/MPK15-214
```

Service Requests

- A UA requests a service by *type*, possibly with a *naming_authority*
- from a particular *scope* (or, *default*)
- by *predicate* (a boolean query based on service attributes)

Example:

service type	=	service:printer:lpr
scope list	=	ENGINEERING,QA
predicate	=	(&(location-description=TD Fax/Printer Room)
		(duplex-mode=duplex))

This will be represented in examples as:

<`service-type`[.`na`],`scope`,[`query`]>

Service Request Examples

Some examples of valid Service Requests are:

`<nfs,default,(content=slp-src)>`

`<http.sun,research,homepage>`

`<lpr,local,postscript>`

- In the first example, the attribute *content* has value `slp-src`
- In the second example, the scope is `research`
- In the third example, the scope is the reserved value `local`, and only URLs for printers registered with the keyword `postscript` may be returned

Other SLP Features

- Service Type Request - Browsers can discover all service types
- Dynamic, decentralized registration and deregistration
- Attribute Request - enables (optional!) GUI based profiles and queries
  - Discover all (or subset) of a service's attributes
  - Discover attributes of a service type (to build queries)
- Service attributes can be updated dynamically or deregistered
- NO addresses need to be preconfigured with SLP agents
- GUI tools may provide users with a lot of feedback but are not required. SLP functions give a GUI designer plenty of functionality to support sophisticated interactive discovery.

Service Location Common Message Header

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Version (=2) |    Function   |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|O|Q|U|A|F|R|      reserved     |      Language Tag Length      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      Next option, offset      |              XID              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Language Tag (ASCII string) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Values of the function field (which define the message type):

1	Service Request	6	Attribute Request
2	Service Reply	7	Attribute Reply
3	Service Registration	8	Directory Agent Advertisement
4	Service Deregistration	9	Service Type Request
5	Service Acknowledgement	10	Service Type Reply

Service Request Packet Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        Service Location Header (function =    SrvRqst = 1)    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       length of <PRList>      |  <PRList> String (variable ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    length of <service-type>   |   <service-type> (variable ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     length of <scope-list>    |<scope-list> String (variable ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   length of SrvRqst predicate | SrvRqst predicate (variable ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    SrvRqst predicate string, continued (variable length) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

<`service-type`[.`na`],`scope`,[`query`]>

The <`PRList`> is the *Prev Responders Addr Spec List* for multicast convergence

The *predicate* is either:

- a list of attributes or keywords, OR
- a boolean predicate in prefix notation

Example:

(& (Pages-Per-Minute >= 12)(Unrestricted-Access)(Location = 12th floor))

Service Request for a Directory Agent

<`service:directory-agent,default,`>, which means:

- service scheme = "directory-agent"
- no *query* clause

Could instead have: <`directory-agent.SUN,math-dept,`>

Finding Directory Agents

There are four ways to find Directory Agents:

- Listening for Directory Agent Advertisements
- Multicast/broadcast request for small installations
- Request option 78 from DHCP
- Manual configuration

Note that even the last choice is *MUCH* better than having to configure each service manually time and again.

Option 78 should go through working group Last Call soon.

Service Reply Message Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Service Location Header (function =   SrvRply = 2)        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Error Code            |         URL Entry Count       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              URL Entry 1 (variable length ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              URL Entry 2 (variable length ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                              .....
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              URL Entry N (variable length ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

A URL entry has the form:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Reserved    |            Lifetime           | # of URL auths|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        Length of URL          |   URL (variable length) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  (if present) URL Authentication Block (variable length) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Service Registration Message Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       Service Location Header (function =    SrvReg = 3)      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                URL Entry (variable length) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   length of <service-type>    |<service-type> string (variable)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    length of <scope-list>     | <scope-list> string (variable)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     length of <attr-list>     |<attr-list> string (variable ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|# of AttrAuths |  (if present) Attribute Authentication Blocks
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Lifetime of registration is set in the common header.

The *attribute list* is a comma delimited list of

- (`attr` = `value`) , -OR-
- `keyword`

`URL entry` as discussed for the SrvRply

Incremental attribute registration

Service Deregistration

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       Service Location Header (function =    SrvDeReg = 5)     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      length of <scope-list>   |<scope-list> string (variable ..)|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Length of URL        |   URL (variable length ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| # auth blocks | (if present) Authentication Blocks (variable ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      length of <tag-list>     |<tag-list> string (variable ...) |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

A <**`tag-list`**> is a list of attribute tags or keywords. Attribute values are not needed in a deregistration.

If keywords and attributes are present in a deregistration, only those are removed from the service registration. Otherwise, the entire service registration is removed.

Service Acknowledge Message Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       Service Location Header (function =    SrvAck = 4)     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           Error Code          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

0	Success	1	LANGUAGE_NOT_SUPPORTED
2	PROTOCOL_PARSE_ERROR	3	INVALID_REGISTRATION
4	SCOPE_NOT_SUPPORTED	5	
6	AUTHENTICATION_ABSENT	7	AUTHENTICATION_FAILED
8		9	VER_NOT_SUPPORTED
10	INTERNAL_ERROR	11	DA_BUSY_NOW
12	OPTION_NOT_UNDERSTOOD	13	INVALID_UPDATE

Attribute Request Message Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      Service Location Header (function =   AttrRqst = 6)       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      length of <PRList>       | <PRList> string (variable ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Length of URL         |   URL (variable length ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    length of <scope-list>     |<scope-list> string (variable ..)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     length of <tag-list>      |<tag-list> string (variable ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- Can be used without DAs
- Can request substring matching for attributes

Attribute Reply Message Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       Service Location Header (function =    AttrRply = 7)     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           Error Code          |  length of <attr-list> string  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|               Attribute List (variable length) ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| # of AttrAuths |(if present) Attribute Authentication Blocks  ...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- Can be used without DAs
- Should be returned with original upper and lower-case

Service Type Request

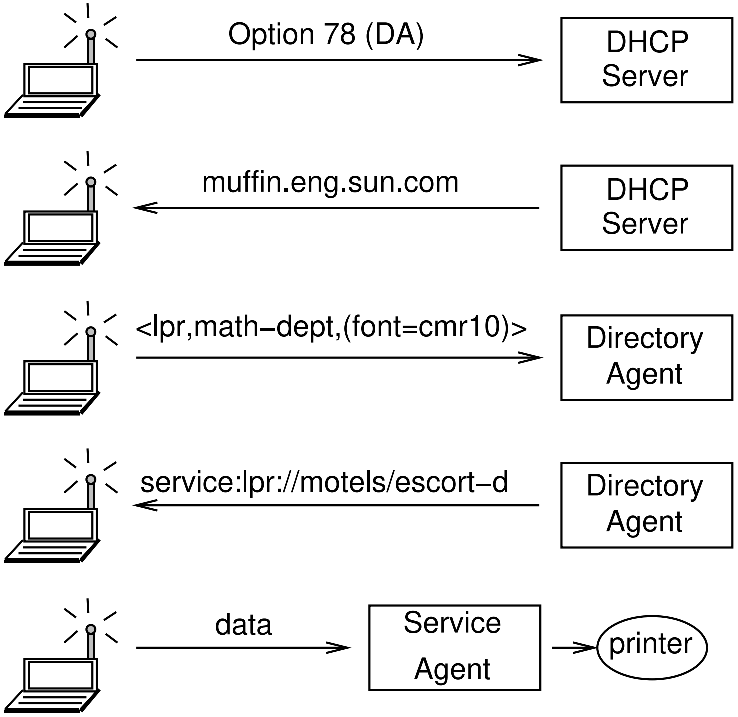
```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       Service Location Header (function =    SrvTypeRqst = 9) |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       length of <PRList>        | <PRList> string (variable ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  length of <naming authority>   |<naming authority> (variable ...)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     length of <scope-list>      |<scope-list> string (variable ..)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- Can be used without DAs
- Only entities loaded with schemes for the indicated Naming Authority may reply
- Likewise for scopes

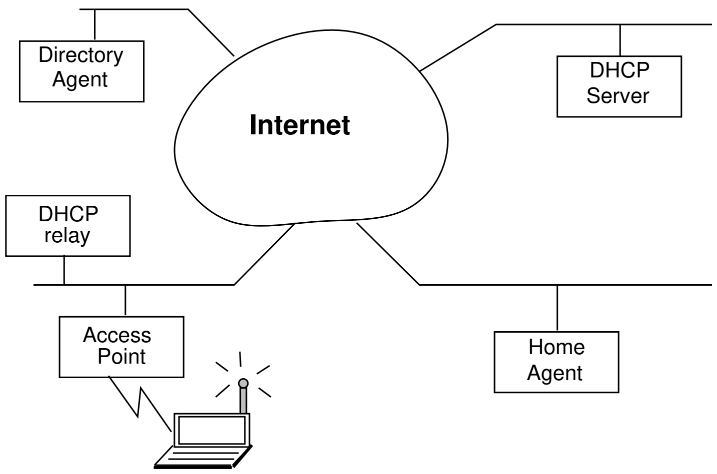
Service Type Reply Message Format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Service Location Header (function =    SrvTypeRply = 10)   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Error Code           |    Number of Service Types    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      length of <SrvType-list> | <SrvType-list> string (variable)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Discovering a Print Service



- Query *DHCP* for IP address of a Directory Agent
- get back *muffin.eng.sun.com*
- contact *muffin* for URL of printer
- receive *service:lpr://motels/queuename*
- send print jobs to IP address of printer service agent, *motels*



Mobile-IP and Service Location

- Mobile discovers that a cell switch is needed
- Mobile queries DHCP for a *Care-of Address*, and includes the Directory Agent (DA) option 78
- Mobile registers new Care-of Address with home agent
- Mobile queries Directory Agent for local resources

Observations about Mobile Networking and Service Location

- The growth of wireless communications is driving mobile networking
- Mobility is driving the need for automatic resource discovery
- Need to access local resources without preconfiguration
- Mobile users should not have to become system administrators
- While DHCP is useful, it is in no way required for use of SLP either in general or for mobile computers

JNDI Service Provider for SLP

- JNDI service provider for SLP implements the standard JNDI naming interface for SLP
- An SLP-based JNDI driver service allows dynamic registration of drivers for returning service objects
- Drivers are located from the network and linked on demand by the SLP service provider through JNDI
- Design supports legacy services (LPR) as well as newer service designs (IPP)
- Current version supports JNDI 1.1beta, plans are to roll forward to JNDI 1.1 FCS when available.

Scopes

- A *scope* is a set of services
- Services in *protected* scopes provide signed registrations
- Scopes are not hierarchical, and typically not user-selectable
- *default* scope enables smooth transitions, and ability to ignore scopes entirely when not used

Scope Design Points

- Users select services by *attribute*, not by *scope*
- Users can be assigned scopes by the administration in order to conveniently segregate expected access patterns.
- *access definition*, not *access control*
- *local* scope defines a set of services that depends upon the user, and needs interpretation by the DA
- initial deployments will use only *default* scope

Service Provision using Scopes

- User Agents and Service Agents are assigned scopes by administrators
  - Possibly by way of DHCP options 78 or 79
- Policy for set membership is completely determined by administration
- Scoped service agents don't answer service requests from unknown scopes
- Scoped directory agents don't register services from unknown scopes

Service Templates

- Standardized service: URLs to be tabulated by IANA
- Lists all attribute names and enumerations or allowable types for their values
- Service-type name, version number, language, description
- URL syntax
- Grammars (in ABNF) for template fields
- Flags
  - Literal
  - Optional in SrvReg
  - Required in every SrvRqst
  - Multi-valued
- Alternate address families (IPX, Appletalk)

SLP Administrative Tool

- For UAs, configure DA location, attribute selection for desired services, scopes
- For SAs, configure DA location, attribute values for service instance, registration intervals, scopes
- For DAs, configure proxy registrations, advertisement frequency, scopes
- Multicast parameters
- Security associations and key management

Critical: Allow use of Service Templates to simplify user input and perform error checking

LDAP

- Lightweight Directory Access Protocol
  - ⋆ But, ASN.1 is not a lightweight encoding
  - ⋆ SLP is more lightweight – we might say, *Java-weight*
- Derived from X.500 DAP Protocol
- Hierarchical naming scheme
- Centralized administration (one directory per enterprise)
- Pre-defined schemas for directory entries
- Services are statically registered into the directory
- Requires static association between driver and service definition

SLP compared with LDAP

	LDAP	**SLP**
Configuration	Static	Dynamic
Administration	Central	Distributed
Structure	Predefined	Arbitrary
Schemas	Static	Extensible
Language	Single	Internationalized

SLP & LDAP

- SLP can be used to dynamically populate LDAP with service entries
- SLP can be used by LDAP clients to find LDAP services
- SLPv2 queries = LDAP queries, so that LDAP can be SLP back end

SLP Standardization Efforts

- Passed IETF Last Call - May 1997
- Three interoperability workshops held, with a number of participants.
- IBM, Axis, Sun here at March Connectathon (other groups too busy implementing products!)

Differences between SLPv1 and SLPv2

- very much smaller implementations possible
- always UTF8
- no language id
- *Fresh* flag set by SA, not DA
- *MCAST* flag, *Attribute Required* flag
- scopes redefined, *default* scope defined
- DSA (not RSA) is default, multiple authenticators allowed
- better error codes
- <string-list> regularization
- LDAPv3 search filters
- Service-specific multicast attributes gone

IETF Documents

- RFC 2165
- SLP for IPv6
- DHCP options 78, 79
- Interoperation with DNS
- API
- Printer service template
- SLP version 2
- Template recipe format
- Converting LDAP Schemas <==> SLP Templates
- MIB
- *Wired for Management* Systems Management Service Type

Current Status: SLP in the Industry

- Products (beta) shipping from Novell (and Axis and IBM?). Work underway on SLP at Apple, Cisco, Axis, Intel (, HP?).
- Novell is using SLP as underlying basis of new NDS products
- Intel interested in SLPv2 as basis for their "*Wired for Management*" OEM initiative
- Specified as part of MNCRS
- Salutation consortium has adopted SLP for service device discovery

Conclusions

- Service Location Protocol is here now, and can become immediately useful.
- SLP is a natural and now standardized scheme for finding services
- Service Location is one of the next big problem areas for mobile computing
- Using Web technology is appropriate and synergistic for Service Location
- Implementation and deployment can be very simple or much more sophisticated
- For more information, contact cperkins@eng.sun.com,

  or check Service Location Protocol web pages at:

  http://www.srvloc.org

  http://www.ietf.org/html.charters/svrloc-charter.html

This presentation is available at:

http://www.srvloc.org/˜charliep/cthon-slp.ps