



*Finding Services on IP Networks
with SLP*

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What is SLP?

- **Service Location Protocol is a new IETF standards track protocol for discovering services on IP intranets.**
- ***A service* is any network accessible hardware device or software server.**
 - **Examples: printers, file servers, video cameras, HTTP servers, etc.**
- ***Discovery* is the process by which potential clients of the service obtain enough information to access the service.**
- **Replaces or supplements proprietary service discovery protocols such as:**
 - **Appletalk NDS**
 - **NetWare SAP**
 - **Microsoft CIFS Browsing Protocol.**

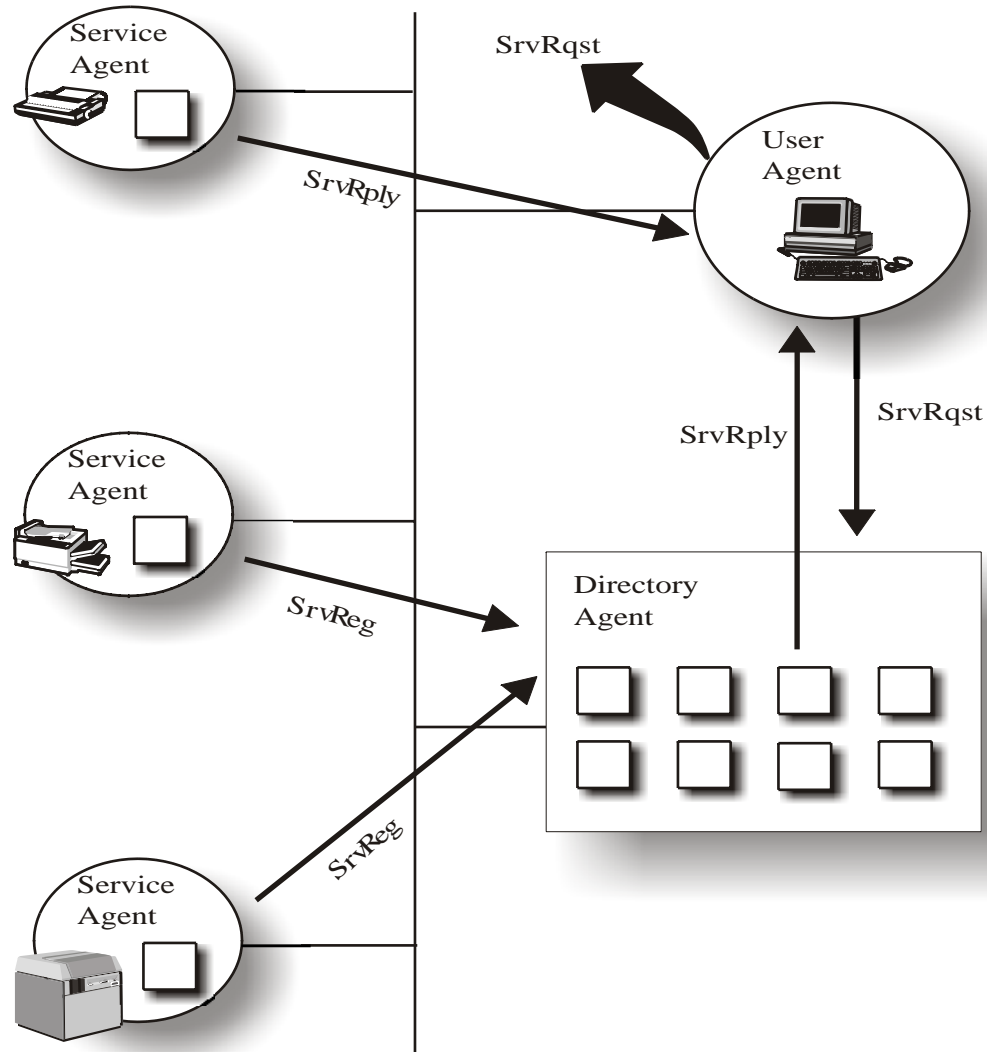
Characteristics of SLP

- **Clients find services by type and desired attributes rather than by name.**
- **Services can be organized into administrative, logical, or physical groupings called scopes.**
 - **Scopes provide upward scalability.**
- **No preconfiguration needed for bootstrapping.**
 - **SLP has been designated a bootstrapping protocol by the IETF.**
- **Operates in the absence of a directory server.**
- **Object-based security using public key cryptography assures that discovered information came from a secure server.**

SLP Entities

- ***Service Agents (SAs)*** advertise services on behalf of a client offering them.
- ***User Agents (UAs)*** look for services on behalf of a client requiring them.
- ***Directory Agents (DAs)*** act as a cache of service advertisements, reducing multicast network traffic in large installations.
- **UAs communicate requests to SAs via IP multicast.**
- **UAs communicate requests to DAs via TCP or UDP.**
- **SAs communicate requests to DAs via TCP or UDP.**

SLP Architecture



Service Advertisements

- **SAs register service advertisements with DAs using SrvReg or manage the advertisements themselves if no DA.**
- **A service advertisement in SLP consists of the following components:**
 - **A service URL, including the service type, and an advertisement lifetime.**
 - **A collection of attributes.**
- **The advertisement is characterized by *service type*.**
- **Service type template documents define service types.**
 - **Templates include definitions of attributes and the service URL syntax.**
- **Templates can be registered with IANA for maximum interoperability.**

Service Types

- **Three kinds of service types:**
 - **Protocol types - name corresponds to networking protocol.**
 - **Example: service:ldap**
 - **Abstract types - name corresponds to a common function shared by several protocols (SLPv2 only).**
 - **Examples: service:printing:lpr, service:printing:ipp**
 - **URL scheme types - name corresponds to a standard URL scheme (SLPv2 only).**
 - **Example: http**
- **If the service type is not registered with IANA, an optional naming authority can be included in the type name (protocol and abstract types only).**
 - **Examples: service:video.sun:mpeg4, service:file-printer.demo**

Service URL

- **Service URLs bundle the service type with the service access point and other information needed to access the service.**
- **Examples:**
 - `nfs://slag.eng.sun.com/src/slp`
 - `service:ldap://www.research.sun.com`
 - `service:printer:lpr://motels.eng.sun.com:4242/MPK15-214`
 - `service:sap.novell/ipx/0ffab724:badbaddade44:4242`
- **A SrvRqst from a UA is answered with a SrvRply containing the service URLs of services whose attributes match the client query.**
- **Service URLs are registered with a 16 bit positive integer lifetime, which indicates how long the information is valid.**

Attributes

- **Attributes consist of an LDAPv3 compatible tag and zero or more values.**
- **Attributes having no values are called *keyword* attributes.**
- **Attribute values are transmitted as UTF8 strings but types are determined when the strings are decoded.**
- **Four attribute types:**
 - **Integer - ranges over signed 32 bit integers. Any number outside that range is a string.**
 - **Boolean - value is "true" or "false" (case insensitive). Single valued only.**
 - **String - all valid UTF8 characters. Some characters important to protocol must be escaped.**
 - **Opagues - arbitrary sequence of bytes. Transmitted as UTF8 strings in escaped format.**

Service Requests

- **Service requests consist of:**
 - A service type
 - The scopes in which the service should appear.
 - A query consisting of boolean expressions comparing attributes and values.
- **Query syntax is base LDAPv3**
 - Extensible queries are not supported.
- **Example:**

Service Type - **service:printing:lpr**
Scopes: **default,td,mpk15**
Query: **(&(location-description=TD Fax/Printer Room)(duplex-mode=duplex))**

Optional Protocol Messages

- **SrvReg/fresh** - updates an advertisement with new attribute information or a new service URL lifetime.
- **SrvDereg** - delete an advertisement.
- **SrvDereg/attr** - delete some attributes from an advertisement.
- **AttrRqst/URL** - return attribute values for a particular registered URL matching a set of tags.
- **AttrRqst/type** - return all attribute values matching a set of tags for a particular service type.
- **SrvTypeRqst** - return all service types in a particular naming authority or all without regard to naming authority.

How Agents Discover a DA

- **Static configuration (discouraged).**
- **DHCP options 78 and 79.**
- **Active discovery.**
- **Passive discovery.**

If no DAs are discovered, then UAs and SAs use multicast to communicate.

Active DA Discovery

- **When a UA or SA comes up, it multicasts an active DA discovery message.**
- **An active discovery message is a SrvRqst with service type "directory-agent" and an optional list of scopes required by the client agent.**
- **Reply from DA is a DAAdvert message with URL for directory agent.**
 - **Example: service:directory-agent://142.142.42.42**
- **If no scopes are included in the request, all DAs reply.**
- **If scopes are included in the request, only DAs supporting those scopes reply.**

Passive DA Discovery

- **When a DA comes up and periodically after, the DA multicasts a DAAdvert message.**
 - **Recommended multicast period is 3 hours to avoid excessive network traffic.**
- **SAs must and UAs should listen for unsolicited DAAdvert messages on the SLP port (427) and multicast address.**
- **When an SA discovers a new DA, it must register all its service advertisements with the DA if the DA supports the same scopes as the SA.**
- **UAs may use the new DA if they require services from the scopes that the new DA supports.**

Scope Configuration

- **Initial configuration of scopes requires human intervention.**
- **Two configurations:**
 - **User selectable scopes**
 - **Administrative scopes**
- **User selectable scopes**
 - **DAs and also possibly SAs get their scopes from DHCP or static configuration file.**
 - **UAs and also possibly SAs get their scopes from passive or active DA discovery.**
 - **Users select scopes in UAs when they want to find something.**
- **Administrative scopes**
 - **DAs, UAs, and SAs get their scopes from DHCP or static configuration file.**
 - **Scope of UA requests is predetermined by administrative fiat.**

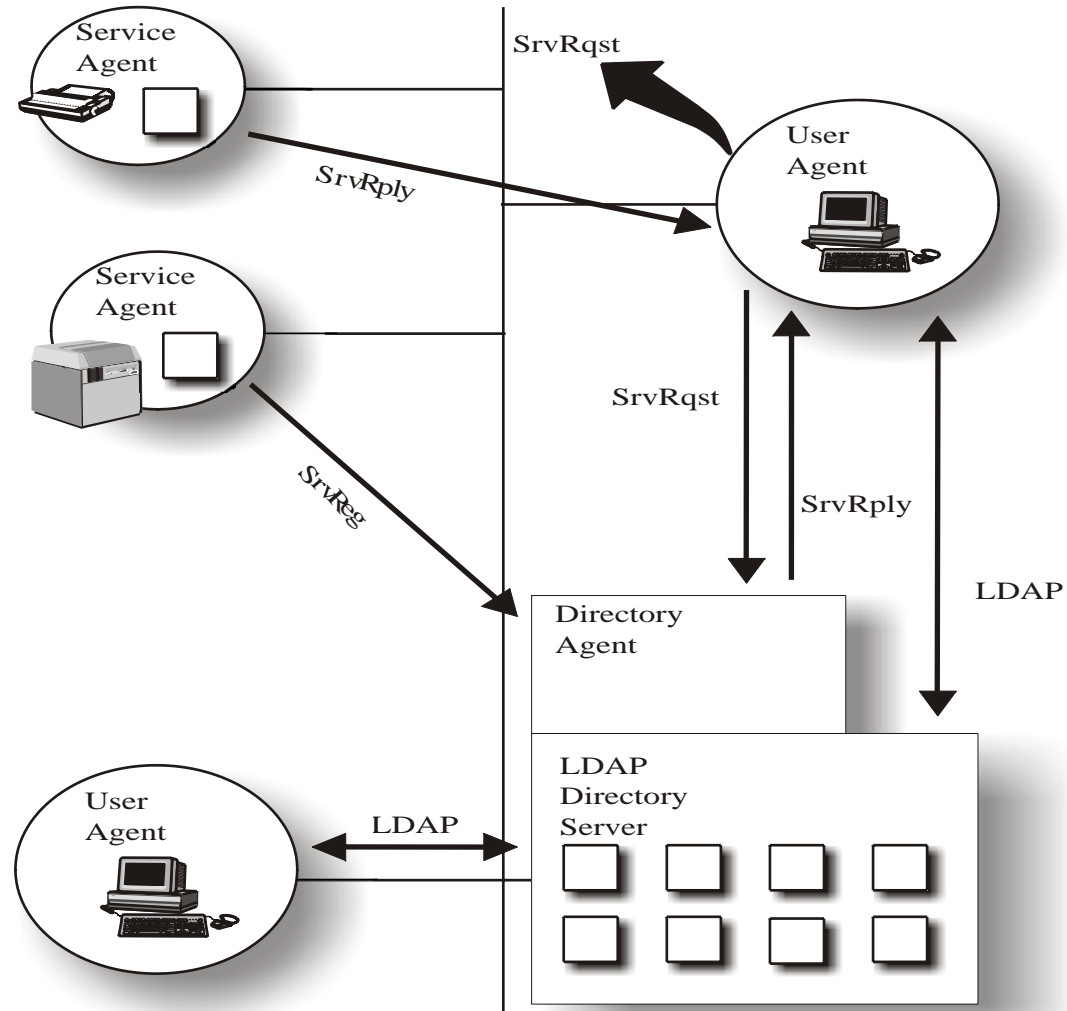
Security

- **SLP *Security Parameters Index* (SPI) is a string transmitted with registrations indicating keying material and cryptoalgorithm parameters.**
- **SAs sign registrations using private key.**
- **DAs check signature using public key to ensure authenticity.**
- **DAs pass signature along to UAs when answering queries, and UAs check signature to be sure DAs haven't tampered with it.**
- **To sign DAAdverts, DAs manage their own private keys, UAs and SAs have DA public key.**

SLP and LDAP

- **Discovery of LDAP server not possible within LDAP protocol.**
 - DHCP and DNS naming convention alternatives are not dynamic.
- **Every system vendor is implementing a different way for clients to find their LDAP server.**
 - Microsoft uses DNS (ldap.microsoft.com) or DHCP, Novell uses SLP or DHCP, Linux is considering using SLP.
- **Building LDAP into devices problematic because:**
 - Server discovery will require a separate, system dependent protocol (DHCP, naming convention, SLP) hindering autoconfiguration.
 - DHCP and naming convention solutions don't allow autorollover if the primary server goes down.
- **Solution: use SLP for service discovery and insert SLP service advertisements into the LDAP directory server.**

Integrating SLP and LDAP



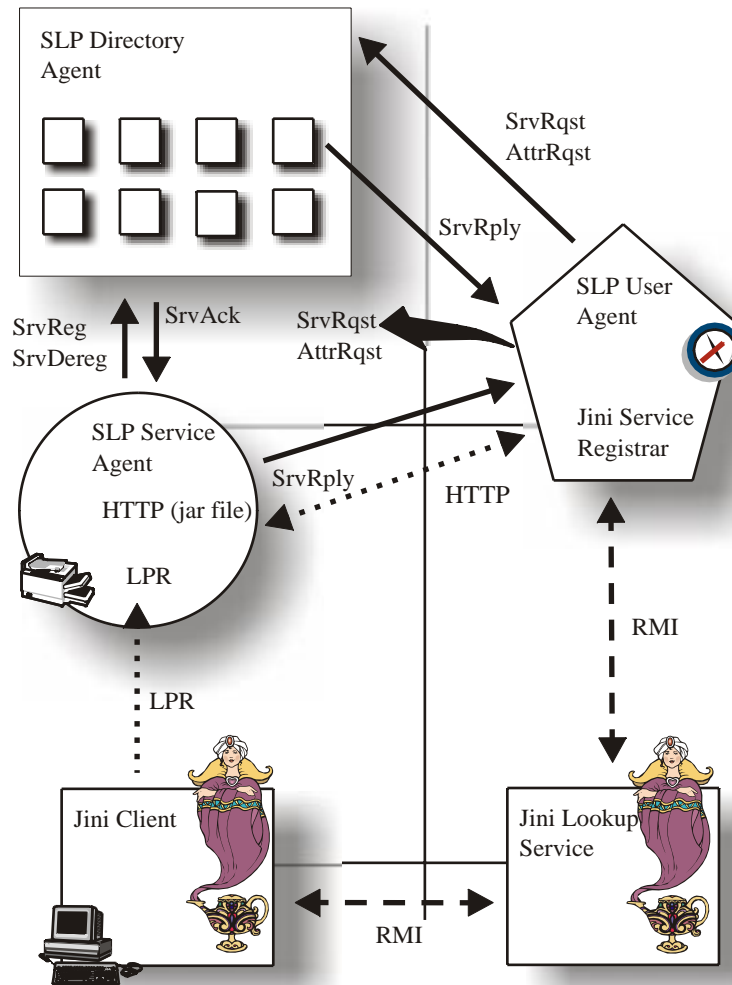
Progress in LDAP and SLP Integration

- **Prototype of SLP DA with LDAP backend developed as proof of concept.**
- **SrvLoc Working Group draft on translating SLP service templates into LDAP schema.**
 - <http://www.ietf.org/internet-drafts/draft-ietf-srvloc-template-conversion-03.txt>
- **Contact with Common Information Model (CIM) about integrating SLP template definitions into LDAP schema via CIM.**
- **Translation draft needs work and involvement of LDAP schema standardization groups.**

SLP and JINI

- **Service discovery is a small part of what JINI provides.**
- **Service discovery in JINI returns a *service object*.**
 - **Service object interface available for object-oriented client access.**
- **JINI's object query semantics, transactions, and event notification are superior to LDAP or SLP for describing complex distributed object operations.**
- **JINI uses RMI, restricting it to JVM-based clients only.**
- **For small embedded systems and enterprise C clients, a JVM may be unavailable.**
- **An SLP/JINI bridge allows JINI networks to access industry standard SLP-enabled devices.**

Integrating SLP and JINI

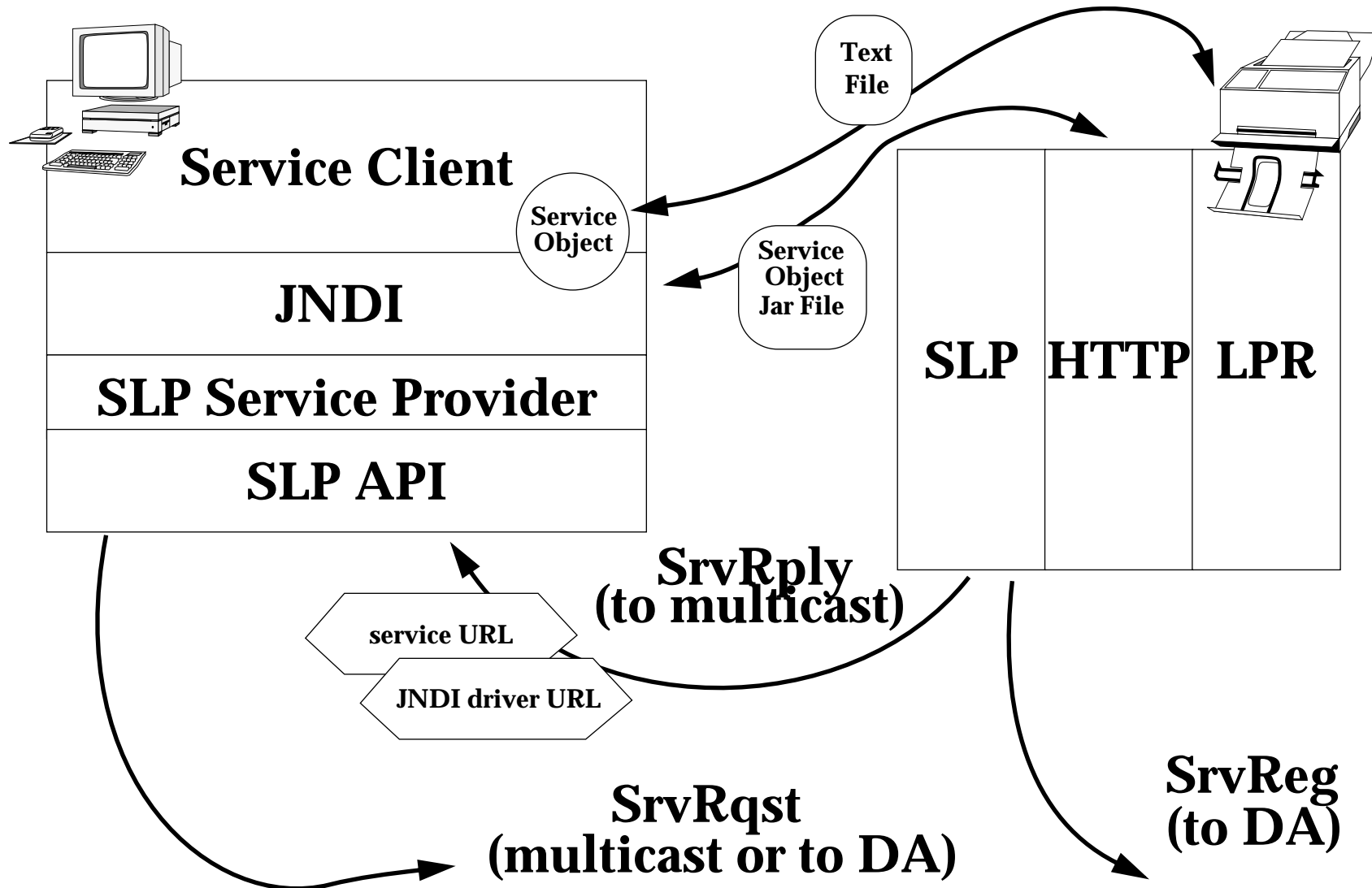


Note: Unicast UA/SA contact also possible

SLP and JNDI

- **Java Naming and Directory Interface (JNDI) is a standard Java extension (javax package):**
 - For obtaining objects from directory services.
 - JNDI API is independent of directory service provider.
 - Naming is dependent on the directory service provider.
- **An SLP service provider for JNDI uses SLP to deliver service objects for network services to clients:**
 - SLPv1 service provider is available at:
<http://www.javasoft.com/products/jndi/serviceproviders.html>
 - Service object delivered by JNDI can be the same as for JINI.
- **Widespread deployment of JNDI:**
 - Seven service providers available from website, others as commercial products.
 - Many enterprise client products under development use JNDI, several already delivered.

SLP/JNDI Architecture



Industry Momentum for SLP

- **Axis has a network printing product with SLP built in.**
- **HP's latest network enabled printer line and WebJet administration product have SLP built in.**
- **Novell Netware 5.0 has integrated LDAP directory services with SLP as a replacement for their proprietary SAP protocol.**
- **Salutation Consortium, MNCRS, and the Intel Wired for Management initiative have adopted SLP.**
- **Apple is implementing SLP as a replacement for Appletalk NBP.**
- **IBM has a load sharing terminal client and server using SLP.**

Summary

- **SLP provides a way for network services to autoconfigure without much human intervention.**
- **SLP is attractive to device manufacturers because it is a bootstrapping protocol.**
- **SLP complements LDAP directory services.**
- **SLP provides a window into the world of standard, IETF protocols and nonJava clients for JINI.**
- **SLP with JNDI provides service objects for enterprise clients.**
- **Please talk to your customers and system vendors about SLP!**
- **For more information: <http://www.srvloc.org>.**