What is LDPA?

- Lightweight Document Printing Application (LDPA) protocol for the Internet.

- Smallest, functional subset of the semantic operations and attributes defined in ISO/IEC 10175 Document Printing Application (DPA) parts 1 & 3.

- LDPA is defined as a set of abstract data types and operations
  - Operations are RPCs (RFC 1831(RPC: Remote Procedure Call Specification Version 2)
  - Abstract data types: RPC/XDR (ftp://ftp.pwg.org/pub/pwg/netprint/ldpa) or ASN.1/BER (ftp://ftp.pwg.org/pub/pwg/snmpmib/dpa)

- Only User operations on basic print service objects.
- No new Authentication, Access Control, Device or Service Management

- Obsoletes RFC 1179 “Line Printer Daemon Protocol”
  - Designed with line printers in mind
  - Does not fit with current page oriented printing technologies
  - Vendors have made their own proprietary, uncoordinated extensions (mutually incompatible)

- Improvements over RFC 1179:
  - It uses Object Identifiers (OIDs) for interoperability and extensibility; new attributes or features can be added without forcing a redefinition of the basic protocol.
  - It models the more complex, multiple content object page oriented languages and printers.
  - It is based on a well known and well tested ISO standard.
  - Supports multiple printing models (desktop, distributed)

- Assumes a distributed computing environment
  - Clients (print service users: applications, redirectors, drivers, etc.)
  - Printers (print service providers: servers, printers, gateways, etc.)

- Operations are client/server based
  - Client accesses the service by invoking one or more operations
  - Each operation has associated arguments and results.
  - The server performs the operations with arguments as the parameters to the oepration
  - The results return the status and outcome back to the client from the server.

What are the LDPA Components?

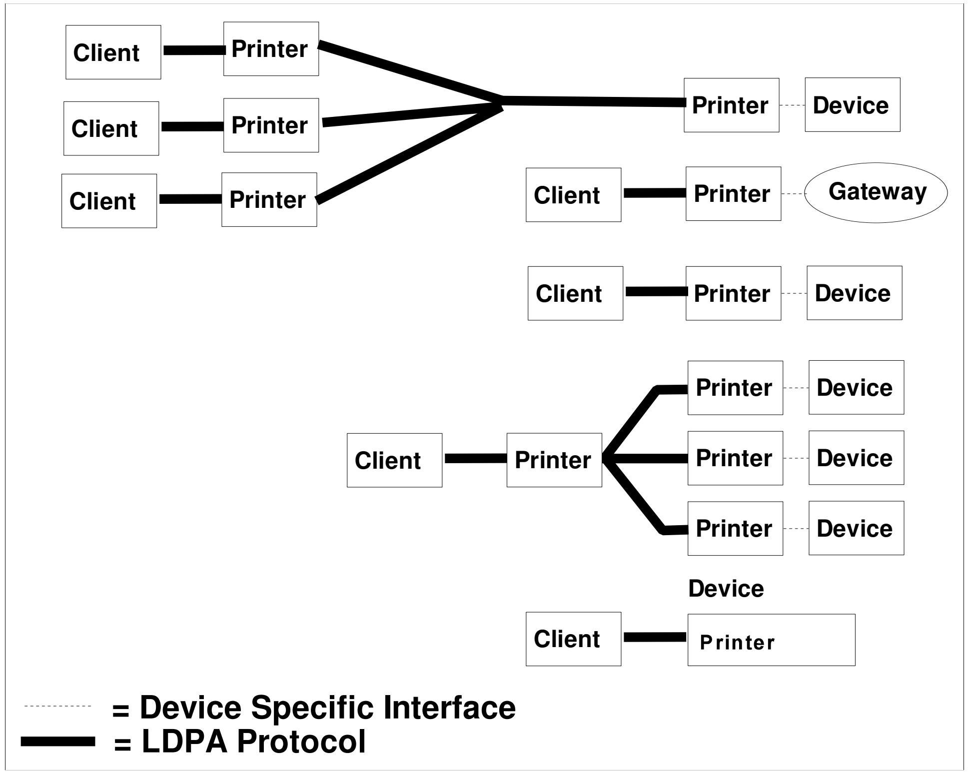
- One or more humans (or agents acting on behalf of humans) acting in the role(s) of Users, Operators, Managers, or Administrators.
- One or more clients (computer nodes) implementing the LDPA protocol.
- One or more print service providers - Printers
- A Printer implements the LDPA protocol and performs and responds to LDPA operations
  - Can be a “client” of yet another Printer
  - “Physical” if it represents a physical printer or some other document production device
  - “Logical” if it represents one or more Printers each of which may be logical or physical

- Only User operations
- No Operator, Manager, and Administrator operations

- Objects
  - Not encapsulations of both data and behavior (just data, no methods as in other object oriented models)
  - Simple collections of attribute/value pairs.
  - What are the Objects?
    - Printer
    - Job
    - Document
    - Initial Value Job
    - Initial Value Document

What is a Printer?

- Logical or Physical
- Optional spooling
- Job management
- Device management
- Server
- Two Modes
  Public Access Mode (no authentication, no authorization)
  Controlled Access Mode (authentication, authorization)
- Represents an instance of a print service provider implementing the LDPA protocol
- Common interface for all types of disparate and diverse physical devices as well as gateways
- Types
  - Physical Printer = represents and controls a print device possibly embedded
  - Gateway = interface to some other printing system
  - The Printer can be a Logical Printer which feeds other Printers



Questions about the model?
1. How can I submit a job to a queue and have that job be routed to any available physical printer?

In the LDPA model, the Logical Printer implements both the client and the server side of the LDPA protocol. The logical printer submits the job to another printer.

2. How can I achieve both “fan out” and “fan in” of client to Printers and from Printers to physical print devices?

For “fan in”, set up one or more non-spooling Logical Printers. These Logical Printers are used to define different defaults, capabilities, and access rights. For “fan out”, set up a spooling Logical Printer which can fan out to one or more downstream Printers for load balancing and reliability.

3. How can a Printer be configured to service multiple spooling Logical Printers?

Do not set up multiple spooling Logical Printers which are used to feed the same Printer, their schedulers are not coordinated. Although this configuration is possible, it is not recommended.

Job Objects

- Contain one or more documents
- Job attributes
  - Execution and Scheduling
  - Job description
  - Job production

Document Objects

- Document attributes
  - Document description
  - Document production

Initial Value Job

- Job defaults

Initial Value Document

- Document defaults

Object Relationships

- “Document object D1 belongs to Job object J1”, or
- “Job object J1 belongs to Printer object P1”.

LDAP Schema

- An LDAP entry representing the printer
- Redundant with Printer object info
- Used for filtered directory lookups.
- Attributes
    - Fully Distinguished Name - the name/URL
    - Description - Simple text
    - Location - Simple text
    - Owner - Simple text
    - Address - URL
    - Status - Simple state/status
    - Resolution - Single valued, maximum resolution in dpi

Color Supported - Boolean yes if any color printing supported
Maximum Speed - Maximum speed in Maximum Speed Units
Maximum Speed Units - ppm, sheets, characters, etc.
Plug and Play Device Id - Useful for driver location and association
Model - Simple text string
Manufacturer - Simple text string
Type - Simple text string from list (laser, ink jet, thermal, etc.)
PDLs Supported - List of all supported
Sides Supported - 1 or a 2 (the maximum)

- Rationalize with PSIS?

OIDs

- OIDs are OBJECT IDENTIFIERs
- ASN.1/BER
- Rules
  - Use DPA OIDs
  - If extentions are made and it involves DPA semantics, use DPA OIDs
  - If extentions are made beyond DPA semantics, create new LDPA OIDs
  - Vendor specific extensions, use OIDs from the appropriate enterprise arcs

Object Identification

- Printer = printer-name (Simple Text String)
- Job = job-identifier (Printer name, Unique value for that Printer)
- Document = document-sequence-number (Cardinal)
- Initial Value Job = TBD

- Initial Value Document = TBD

LDPA Operations
- Bind
- Unbind
- Print
- Cancel Job
- List Object Attributes
- Modify Job
- Resubmit Job
- Common Operation Attributes
  - Errors (DPA, Printer MIB)

- Why Binding and Unbinding?
  - Establishes a “session” (do not take down and rebuild the connection)
  - Application authentication
  - RPC authentication

Bind Argument:

Printer Name	The name of the instance of the Print Service Provider (Printer object) to which the bind is being done.
Credentials	These can simple (name of the client perfoming the Bind) or the actual opaque Credential from some security/authorization service. All LDPA implemenations must support at least the simple option.
Other Security Info	Optional additional opaque security information if needed for a given security/authorization service.

Bind Result:

Results	The authentication attributes
Errors	Optional Error information
Session Handle	Session Handle

Unbind Argument:

Session Handle	Session Handle

Unbind Result:

Errors	Optional Error Information

Print Argument:

Session Handle	The handle for this session.
Create Job	One of the three modes for the Print Arguments (Create Job, Add Document, Close Job). If it is a Create Job, the Job Id is returned in the Print Results.
Printer Name	
Job Submission Complete	
Job Attributes	
First Document Description	Transfer method, content, type, and Document Attributes
Add Document	
Job Id	The job to which this document is added.

Job Submission Complete	
First Document Description	Transfer method, content, type, and Document Attributes
Close Job	
Job Id	The job to close (no more documents can be added)
Common Arguments	Common to all three forms of Print Argument

Print Result:

Job Id	Used for all other operations on this Job.
Server State	Optional state information about the Print Service Provider
Message	Optional message
Document Status	Optional document status information
Job Status	Job state information
Errors	Optional Error Information

Cancel Job Argument:

Session Handle	The handle for this session.
Job Id	The identifier of the job to be canceled.
Document Number	Optional document number of the document to cancel within a given job.
Message	Optional message to the operator.
Retention Period	Optional period for retaining the cancelled job.
Common Arguments	

Cancel Job Result:

Job Status	Optional Job status information
Errors	Optional Error Information

List Object Attributes Argument:

Session Handle	Handle for this session.
Operation	CONTINUE or SPECIFICATION
SPECIFICATION	
Class	The class type for which this operation is being performed (Printer, Job, Document, etc.)
Scope	Levels of object containment to report
Selector	A set of object identifiers (possibly wild carded), optional filter information, time limits, and count limits.
Requested Attributes	A set of attributes in which the requestor is interested
Operation	ATTRIBUTES or ORDERED_JOBS if requesting Jobs contained by a given Printer.
CONTINUATION	
Context	Context for continuing
Abort	Should the operation be aborted? (boolean)

Common Arguments	

List Object Attributes Result:

Time	The operation can take an indeterminate amount of time to process. The results to a single Argument can be returned in multiple phases. This Result of for one of those phases. This processing time element is the time required for this phase of the opration.
Continuation Context	Optional opaque context information for performing another argument request on the next phase of the same operation.
Limit Encountered	Information on the type of limit that was encountered which forces the end of the operation even if there is a potential for more results. Values include TIME, COUNT, ERRORS.
Result Attributes	Attribute set containing the returned results.
Errors	Optional Error Information

Modify Job Argument:

Session Handle	Handle for this session.
Job Id	Which job to modify.
Document Number	Optionally the document to modify if not modifying a job attribute.
Job Attributes	Attribute set for Job attributes. Values can be modified in any of the following ways: ADD_ATTRIBUTE, REPLACE, ADD_VALUES, REMOVE_VALUES, SET_TO_DEFAULT, or REMOVE_ATTRIBUTE
Document Attributes	Attribute set for Document attributes.
Message	Optional Message.
Common Arguments	

Modify Job Result

Modify Status	Modify result attributes.
Errors	Optional Error Information

Resubmit Job Argument

Session Handle	Handle for this session.
Destination Printer Name	Optional name of the destination printer.
Destination Printer Address	The address of the destination printer (can be used instead of the name).
Operation	MOVE or COPY
Job Set	A set of jobs to move or copy. Each entry in the set has: Job Id, Document Number, Job attributes, and Document attributes.
Message	Optional Message
Common Arguments	

Resubmit Job Result:

Resubmit Job Set	A set of jobs that were resubmitted. Each element in the set has: Old Job Id, New Job Id, and an attribute set with info about the results of the move or copy.
Errors	Optional Error Information

Object Attributes (DPA Level 2M)

- Job Attributes
  - Job Informational Attributes
    - job-identifier
    - job-owner
    - job-name
  - Printer Selection Attributes
    - printer-name-requested
  - Job Status Attributes
    - current-job-state
    - printers-assigned
    - submission-time
    - print-checkpoint
    - job-message-from-administrator
    - completion-time
    - job-state-reasons
    - number-of-documents
    - job-submission-complete
  - Job Results Handling Attributes
    - job-sheets
    - document-sheets
  - Job Event Handling Attributes
    - notification-profile
  - Job Scheduling Instructions Attributes
    - job-hold

- job-priority
- job-print-after
- job-retention-period

Documenet Attributes

- Document Description Attributes
  - document-format
  - document-content
  - transfer-method
- Document Production Instruction Attributes
  - default-font
  - sefault-medium
  - number-up
  - finishing
  - sides
  - copy-count
  - reset-printer
- Document Characteristics Attributes
  - fonts-used
  - media-used
- Document Status Attributes
  - document-sequence-number

Printer Attributes

- printer-name
- printer-state
- message
- printer-initial-value-job
- printer-initial-value-document

- fonts-supported
- fonts-ready
- media-supported
- media-ready
- printer-associated-printers
- document-formats-supported
- numbers-up-supported
- finishings-supported
- sides-supported
- job-sheets-supported
- document-sheets-supported
- maximum-copies-supported
- notification-delivery-methods-supported
- server-name
- server-state
- physical-printers-supported
- logical-printers-supported
- events-supported
- transfer-methods-supported
- locales-supported
- multiple-documents-supported
- cancel-individual-document-supported
- modify-individual-document-supported

Initial Value Job Attributes
Initial Value Document Attributes