The Globus Toolkit
&
The Handle System

A Powerful Combination

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Content

- Handle System Overview
- Grid, Globus & Handles

CNRI & Handle System Background

- CNRI, a non-profit research organization
- R. Kahn, & R. Wilensky, "A Framework for Distributed Digital Object Services", 1995
- The National Information Infrastructure – Management layer for information sharing
- Handle System - Research project funded by US Government

Handle System Overview

- A global name service that provides unique identifier for digital objects over the Internet
- Maintains identifiers that may be persistent over location and attribute changes
- A distributed name service for both secured name resolution and administration
- An infrastructure service that facilitates resource registry, interface discovery, and secured name-attribute binding

Handle System Features

- Protect data integrity in name resolution, with standard mechanism for credential validation
- Distributed administration via handle system authentication protocol
- Ownership defined per handle, access control defined per handle value – independent from hosting environment
- International support via UTF-8 encoding
- Distributed service model that is both scalable and extendable

Security Aspects of the Handle System:

- Secure name resolution: Protocol option for data integrity and confidentiality.
- Credential reference for data trustworthy
- Handle administration by individual handle owner, via handle system authentication protocol.
- Distributed ownership model: Ownership defined per handle. Access control defined per handle value.
- Supports both public key and secret key

Syntax Definition:

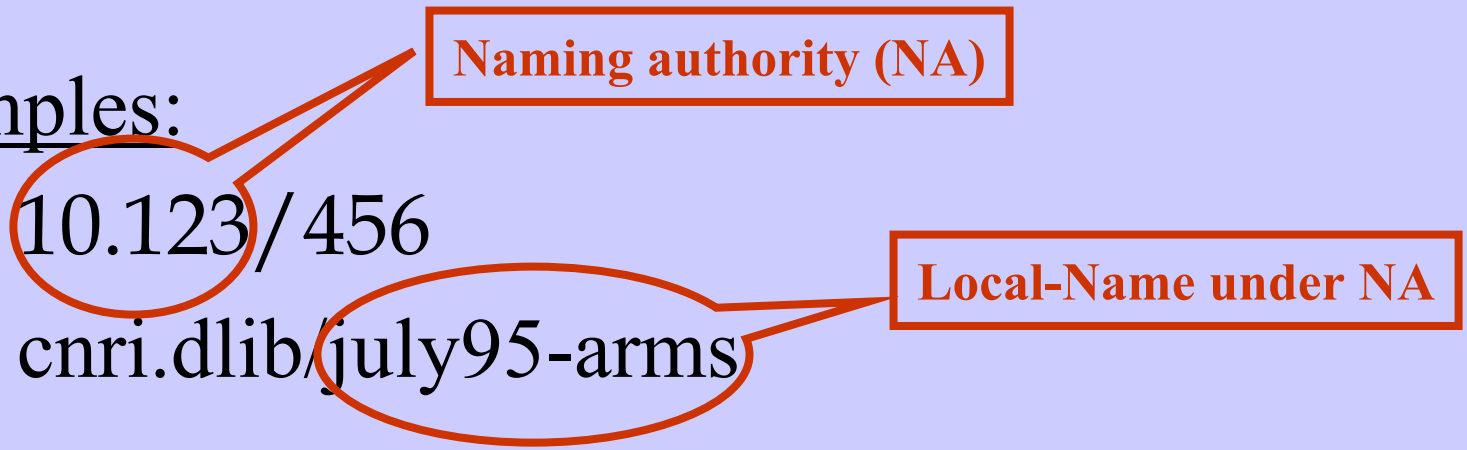
<handle> ::= <NA> / <Local-Name>

<NA> ::= *(<na_seg>) <na segment>

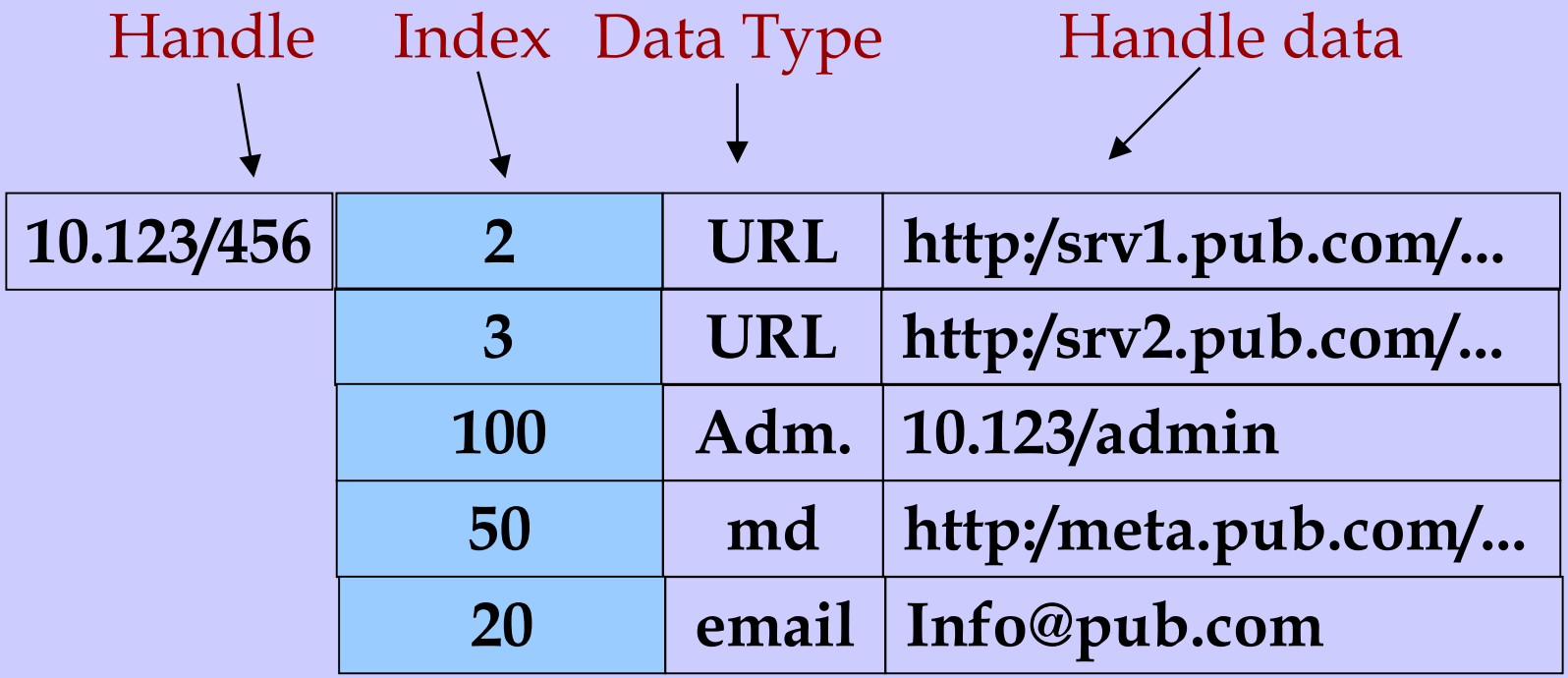
<na_seg> ::= Any Unicode 2.0 character encoded in UTF-8, except ‘/’ and ‘.’

<Local-Name> ::= Any Unicode 2.0 character

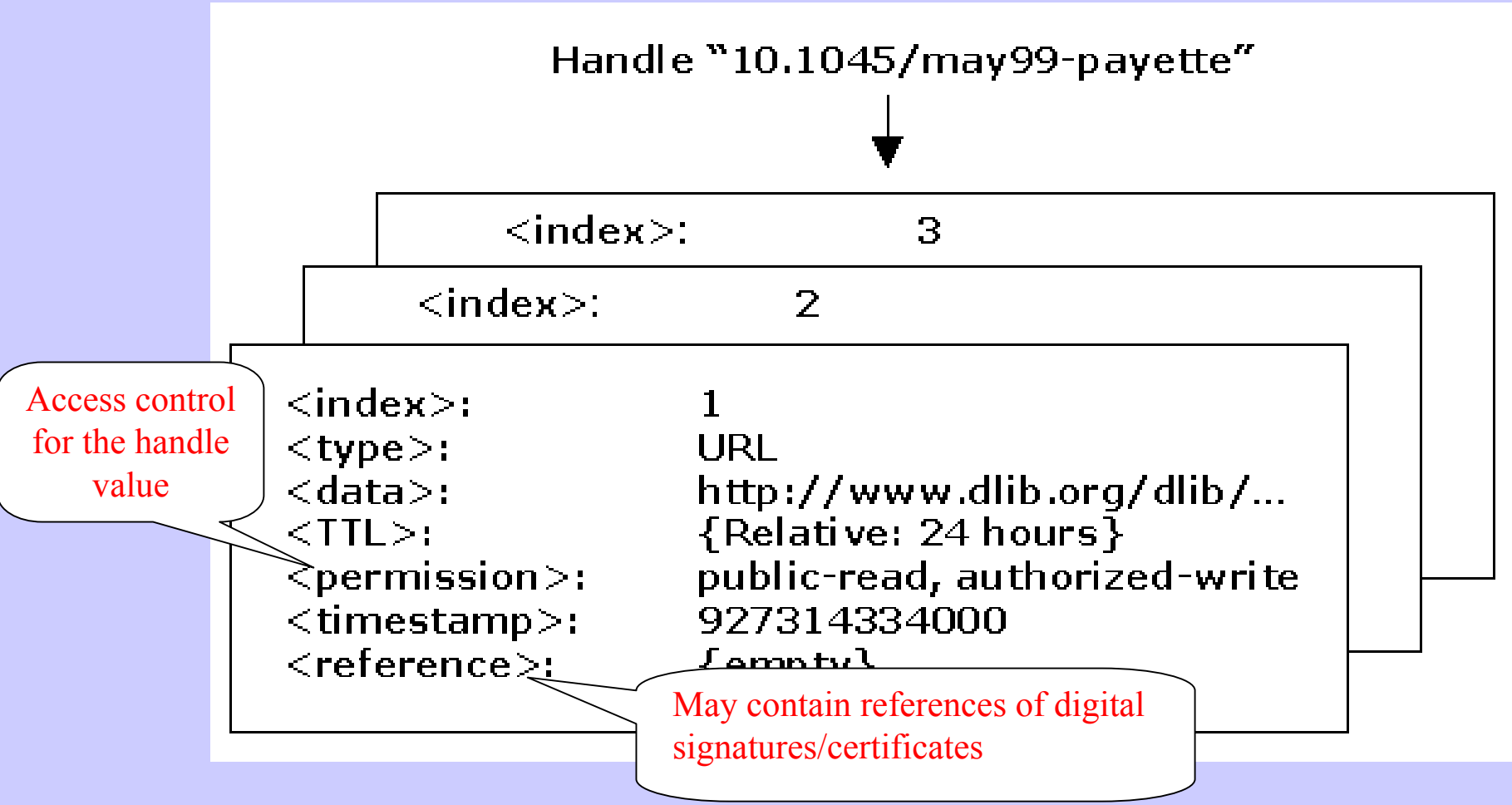
Examples:



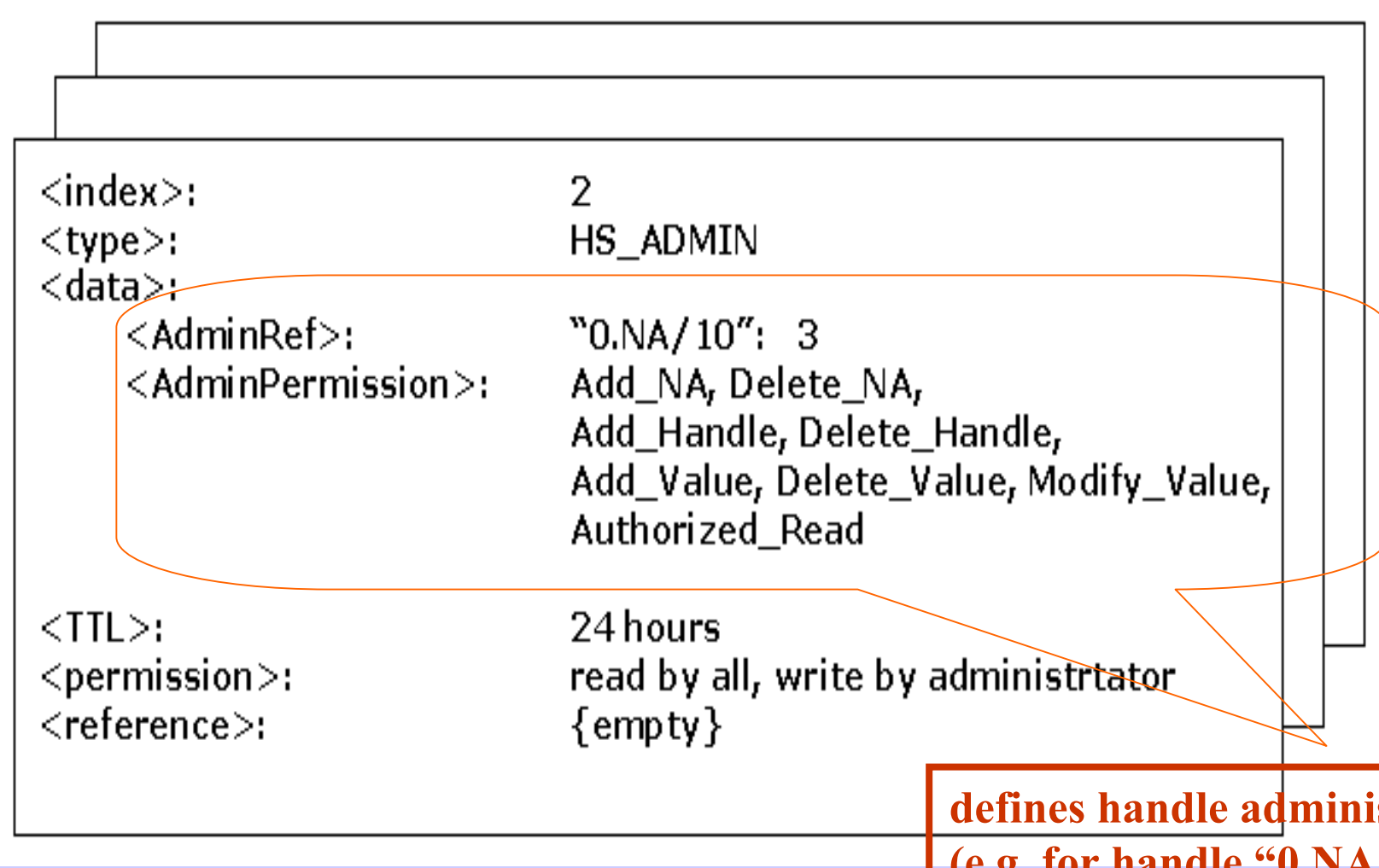
Example: Handle and Handle Values



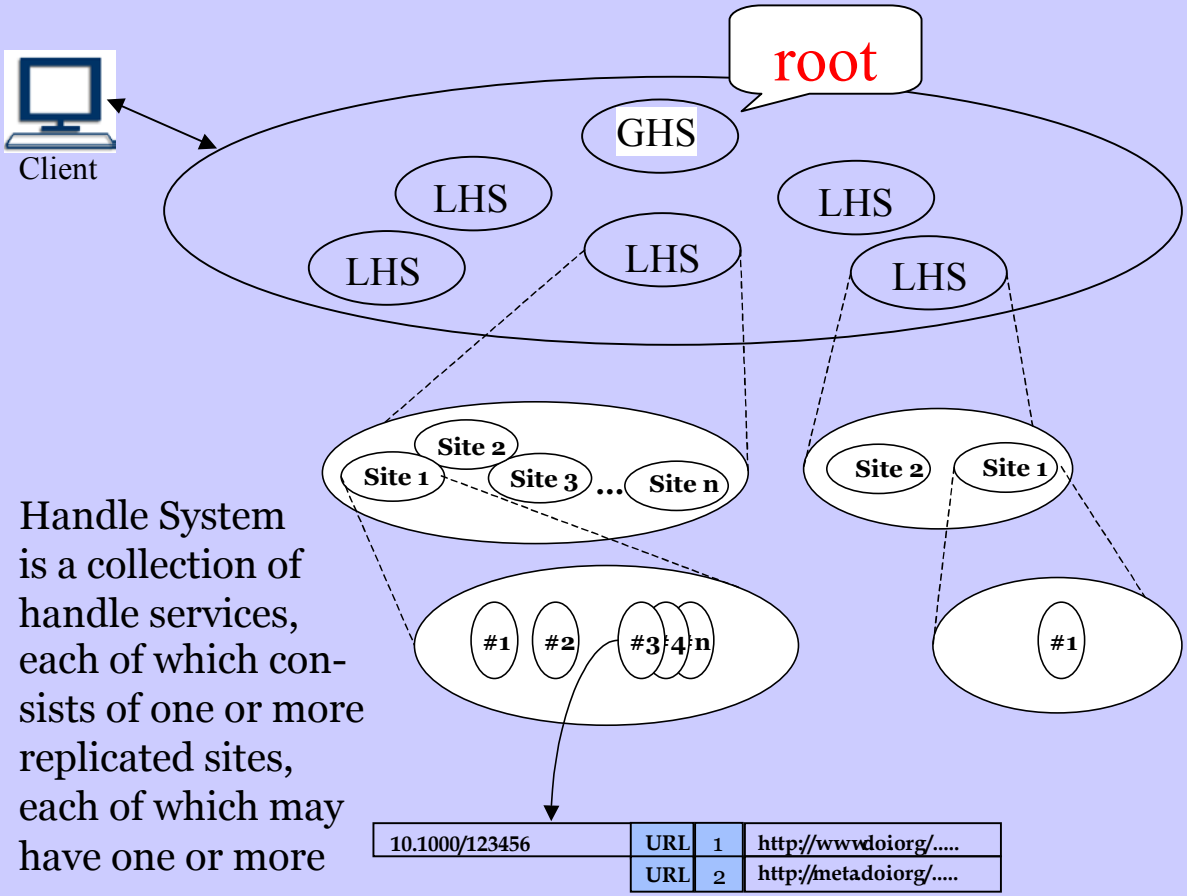
Handle System Data Model



Handle Administrator Record

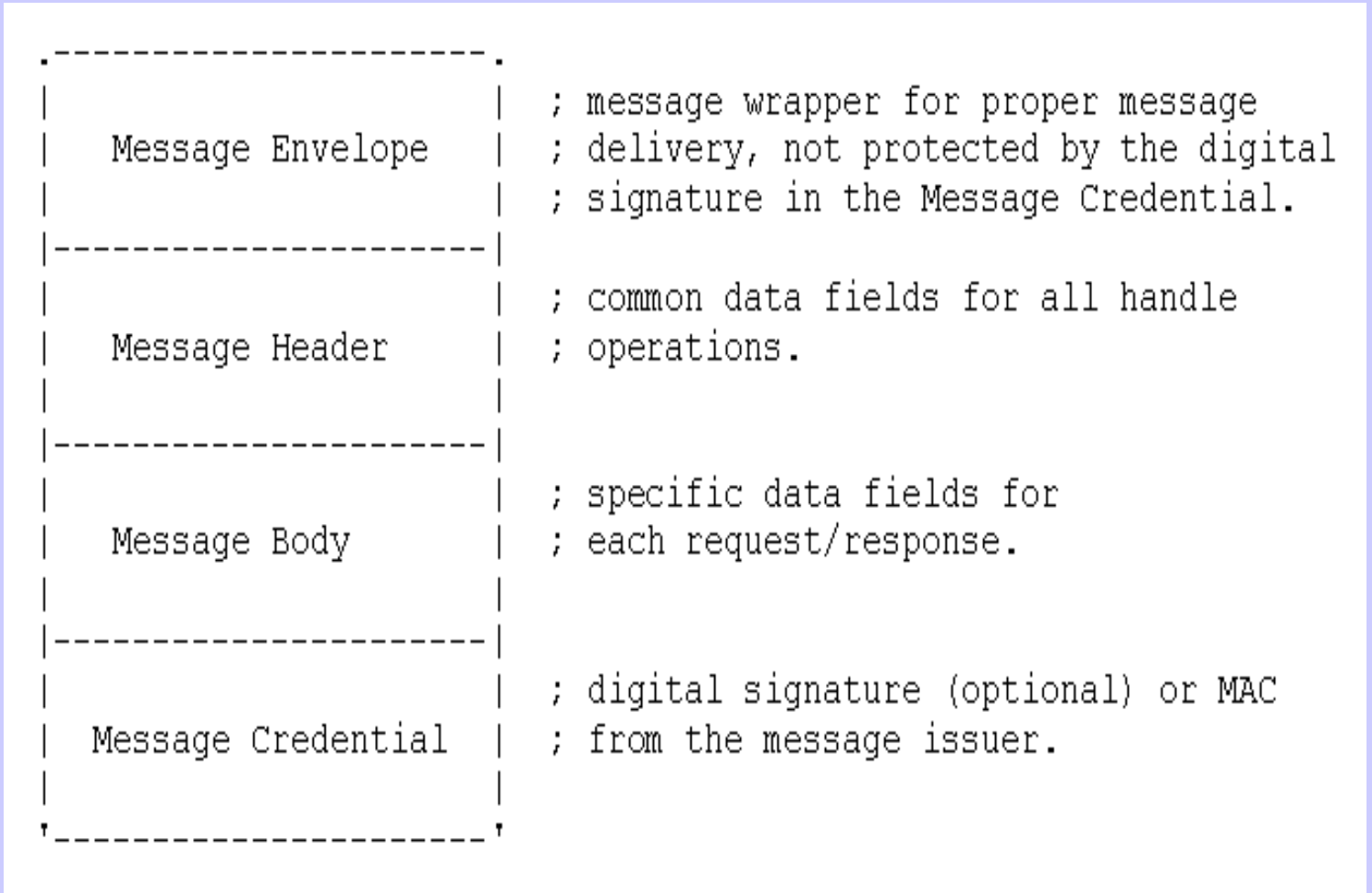


Handle System Service Architecture

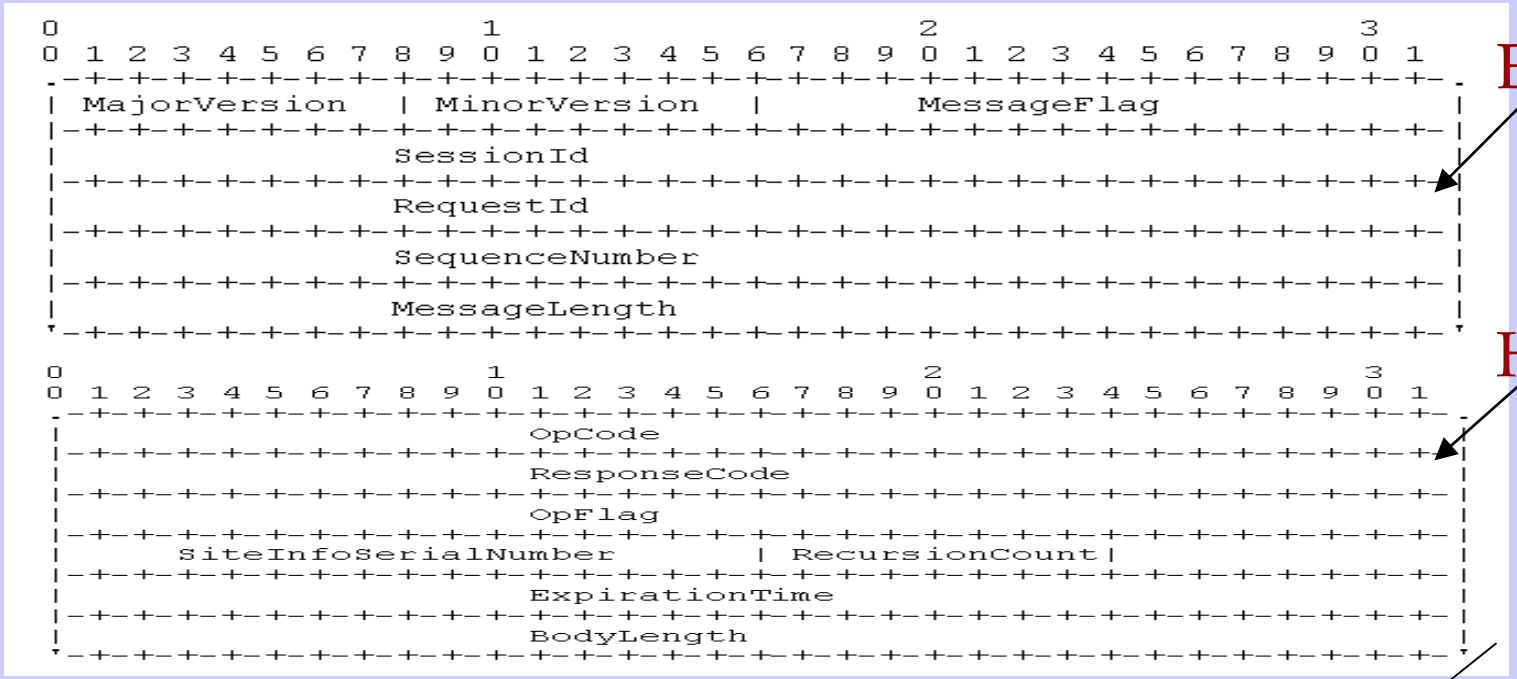


Handle System is a collection of handle services, each of which consists of one or more replicated sites, each of which may have one or more servers.

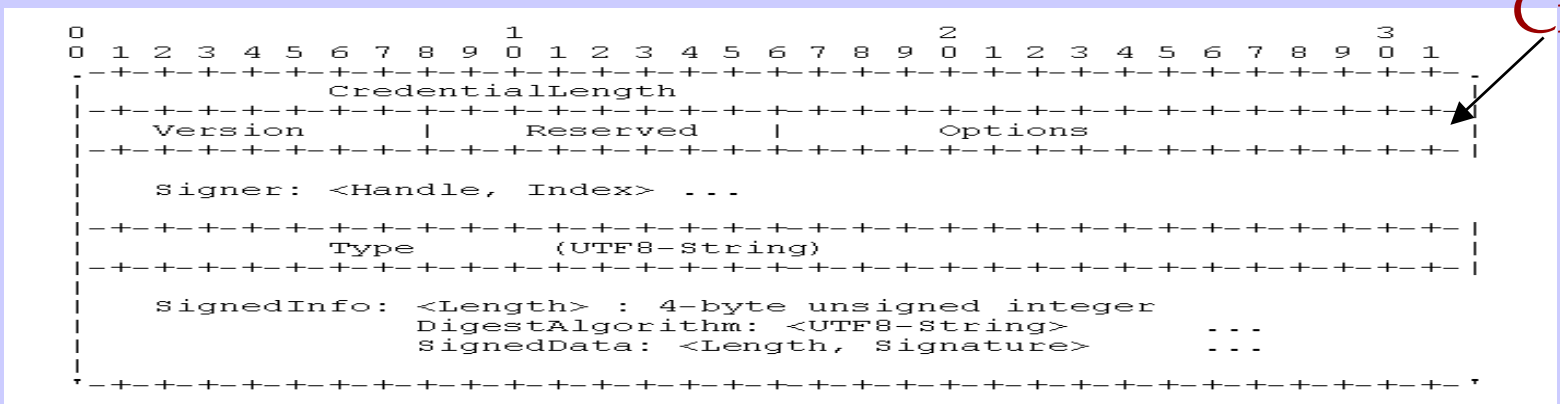
Handle System Protocol: Message Structure



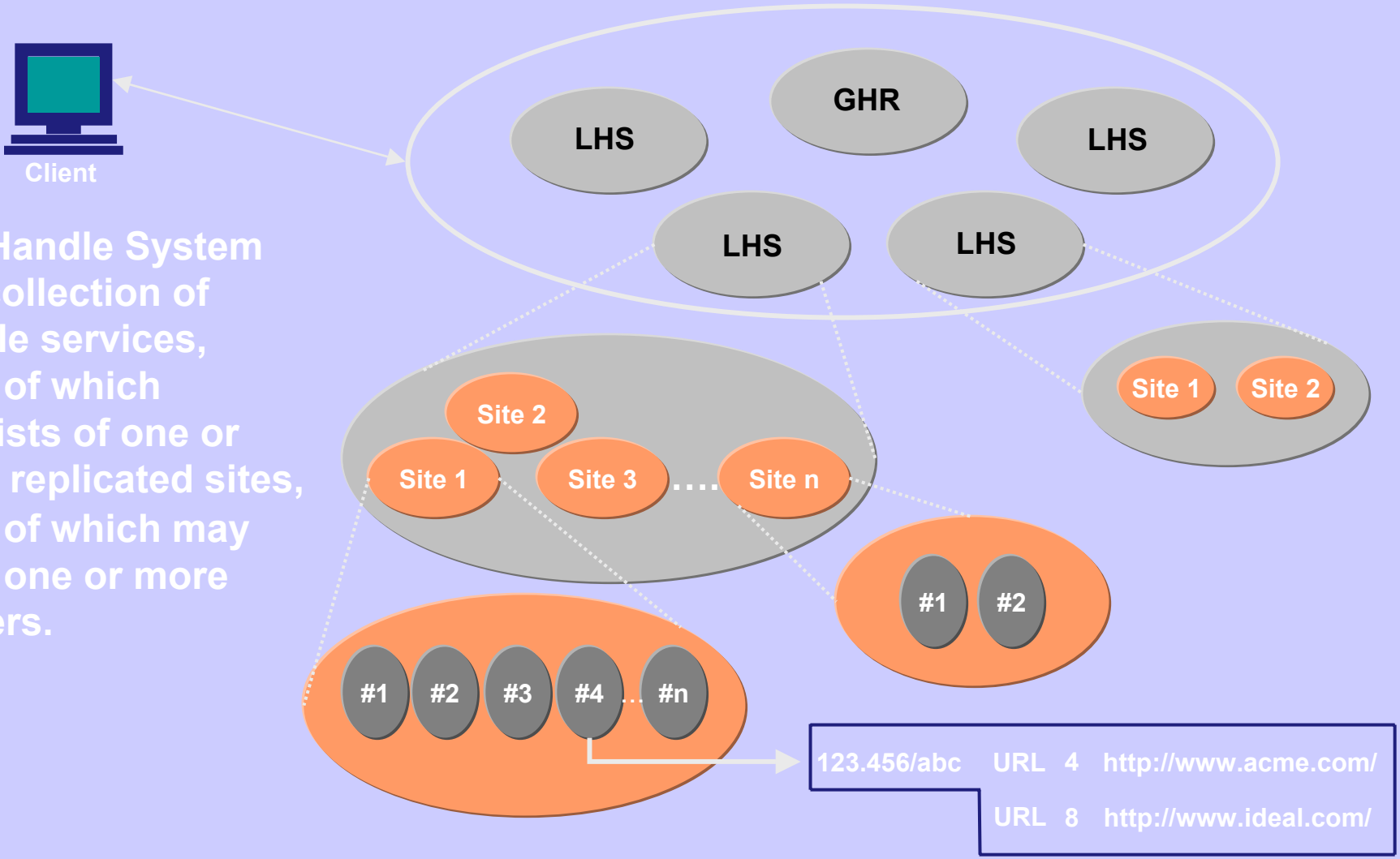
Handle System Protocol: Message Structure (continued)



[<message body>]



Handle Resolution



The Handle System is a collection of handle services, each of which consists of one or more replicated sites, each of which may have one or more servers.

Handle Clients

Request to Client:
Resolve hdl:10.1000/1

Client

1. Sends request to Global to resolve 0.NA/10.1000 (naming authority handle for 10.1000)

Global Handle Registry

Handle Clients

Request to Client:
Resolve hdl:10.1000/1

Client

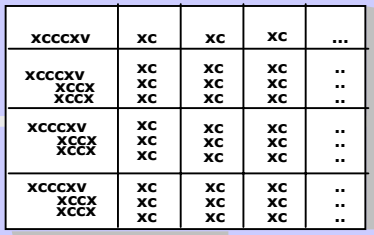
2. Global Responds with
Service Information for 10.1000

Global Handle Registry

xccccxv	xc	xc	xc	...
xccccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	.. .. ..
xccccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	.. .. ..
xccccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	.. .. ..

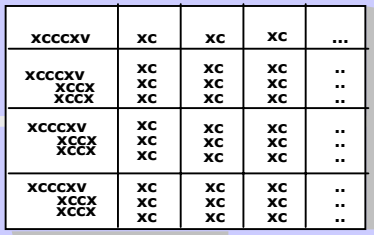
Service Information
Acme Local Handle Service

Handle Clients



	IP Address	Port #	Public Key	...
Primary Site				
Server 1	**123.45.67.8**	**2641**	**K03RLQ...**	**...**
Server 2	**123.52.67.9**	**2641**	**5&M#FG...**	**...**
Secondary Site A				
Server 1	**321.54.678.12**	**2641**	**F^*JLS...**	**...**
Server 2	**321.54.678.14**	**2641**	**3E$T%...**	**...**
Server 3	**762.34.1.1**	**2641**	**A2S4D...**	**...**
Secondary Site B				
Server 1	**123.45.67.4**	**2641**	**N0L8H7...**	**...**

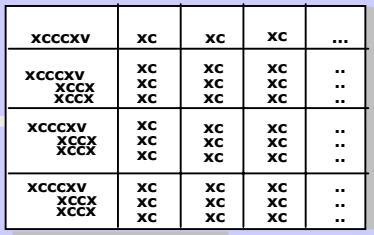
Service Information - Acme Local Handle Service



Handle Clients

	IP Address	Port #	Public Key	...
Primary Site				
Server 1	123.45.67.8	2641	K03RLQ...	...
Server 2	123.52.67.9	2641	5&M#FG...	...
Secondary Site A				
Server 1	321.54.678.12	2641	F^*JLS...	...
Server 2	321.54.678.14	2641	3E$T%...	...
Server 3	762.34.1.1	2641	A2S4D...	...
Secondary Site B				
Server 1	123.45.67.4	2641	N0L8H7...	...

Service Information - Acme Local Handle Service



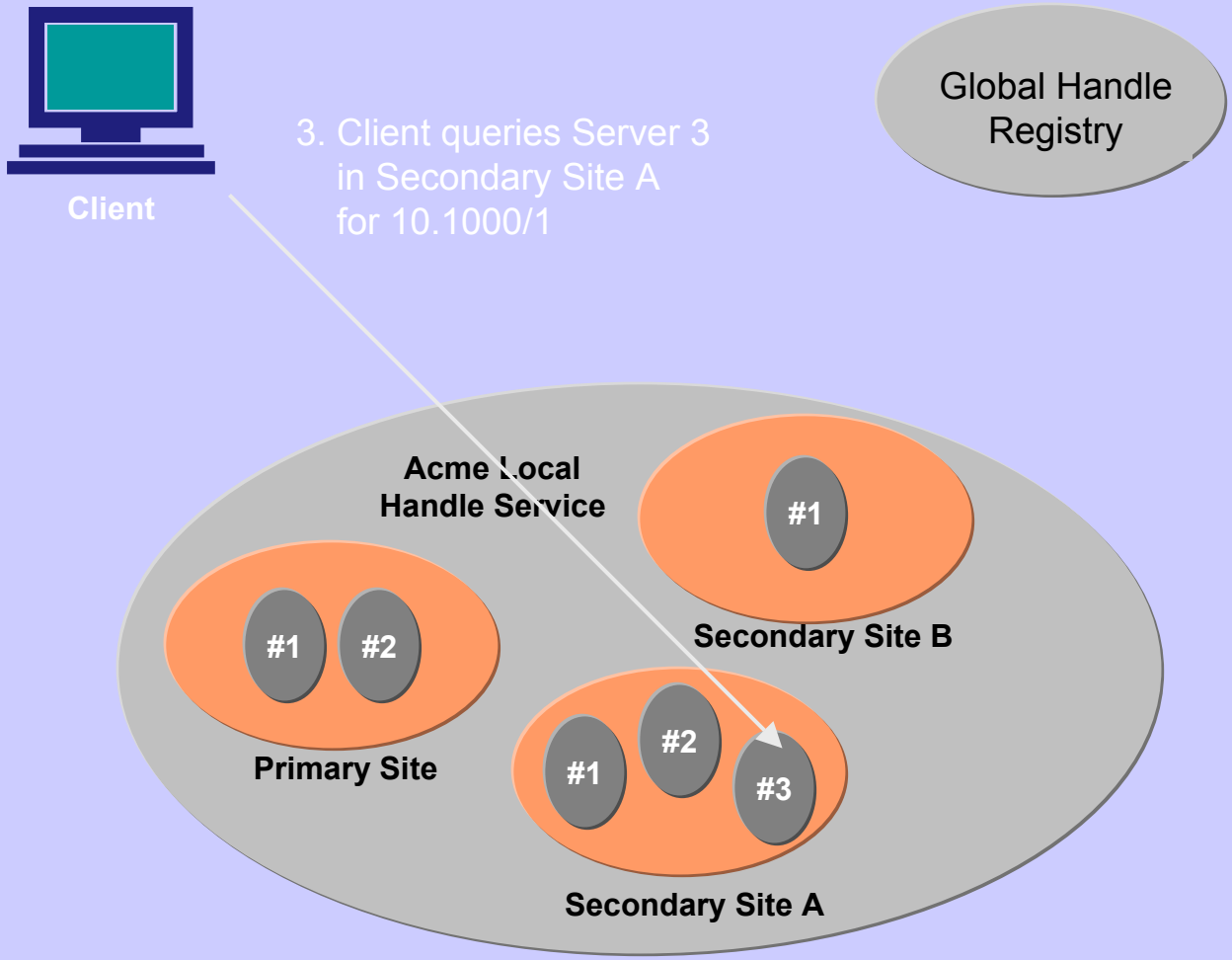
Handle Clients

	IP Address	Port #	Public Key	...
Primary Site				
Server 1	123.45.67.8	2641	K03RLQ...	...
Server 2	123.52.67.9	2641	5&M#FG...	...
Secondary Site A				
Server 1	321.54.678.12	2641	F^*JLS...	...
Server 2	321.54.678.14	2641	3E$T%...	...
Server 3	762.34.1.1	2641	A2S4D...	...
Secondary Site B				
Server 1	123.45.67.4	2641	N0L8H7...	...

Service Information - Acme Local Handle Service

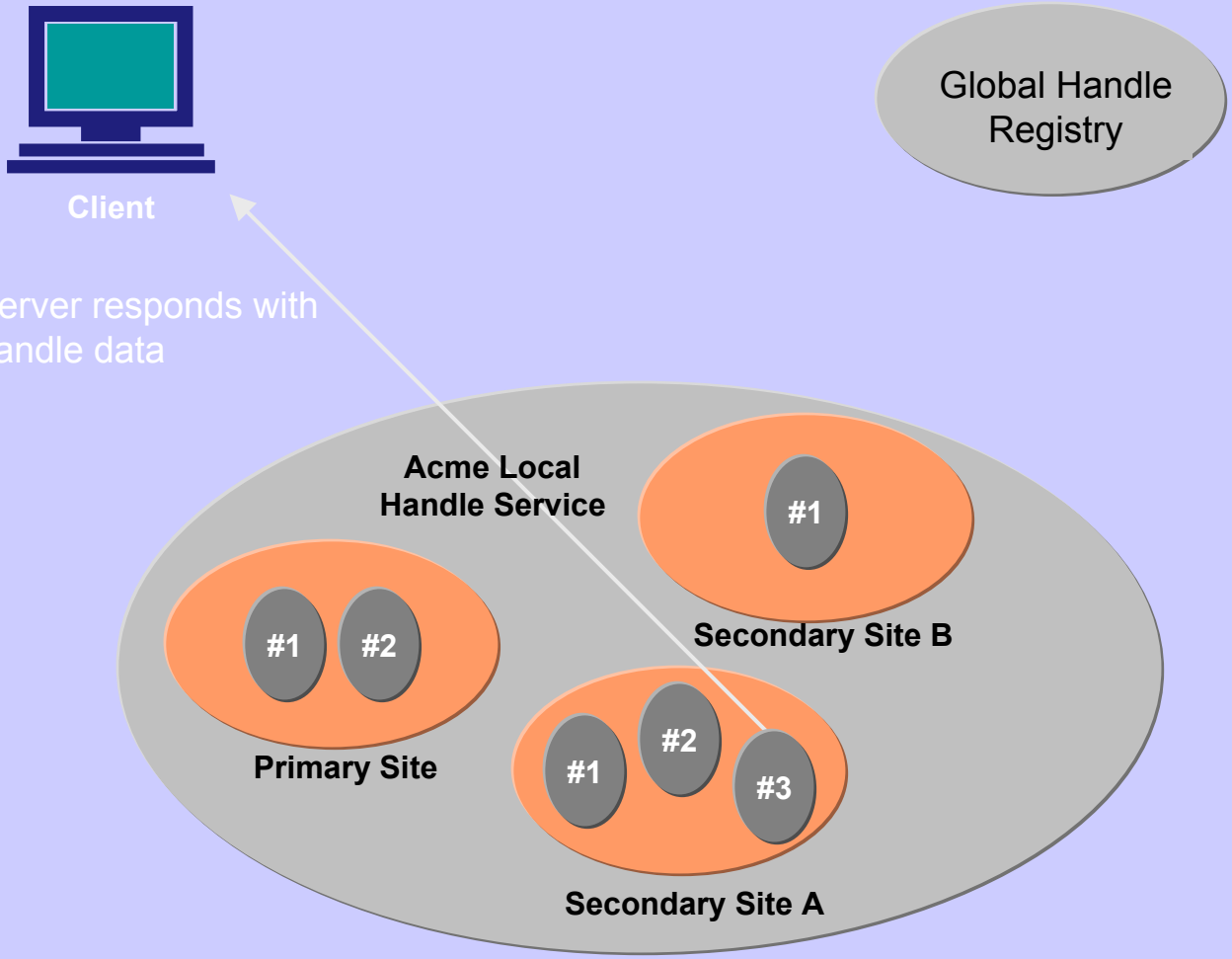
Handle Clients

Request to Client:
Resolve hdl:10.1000/1

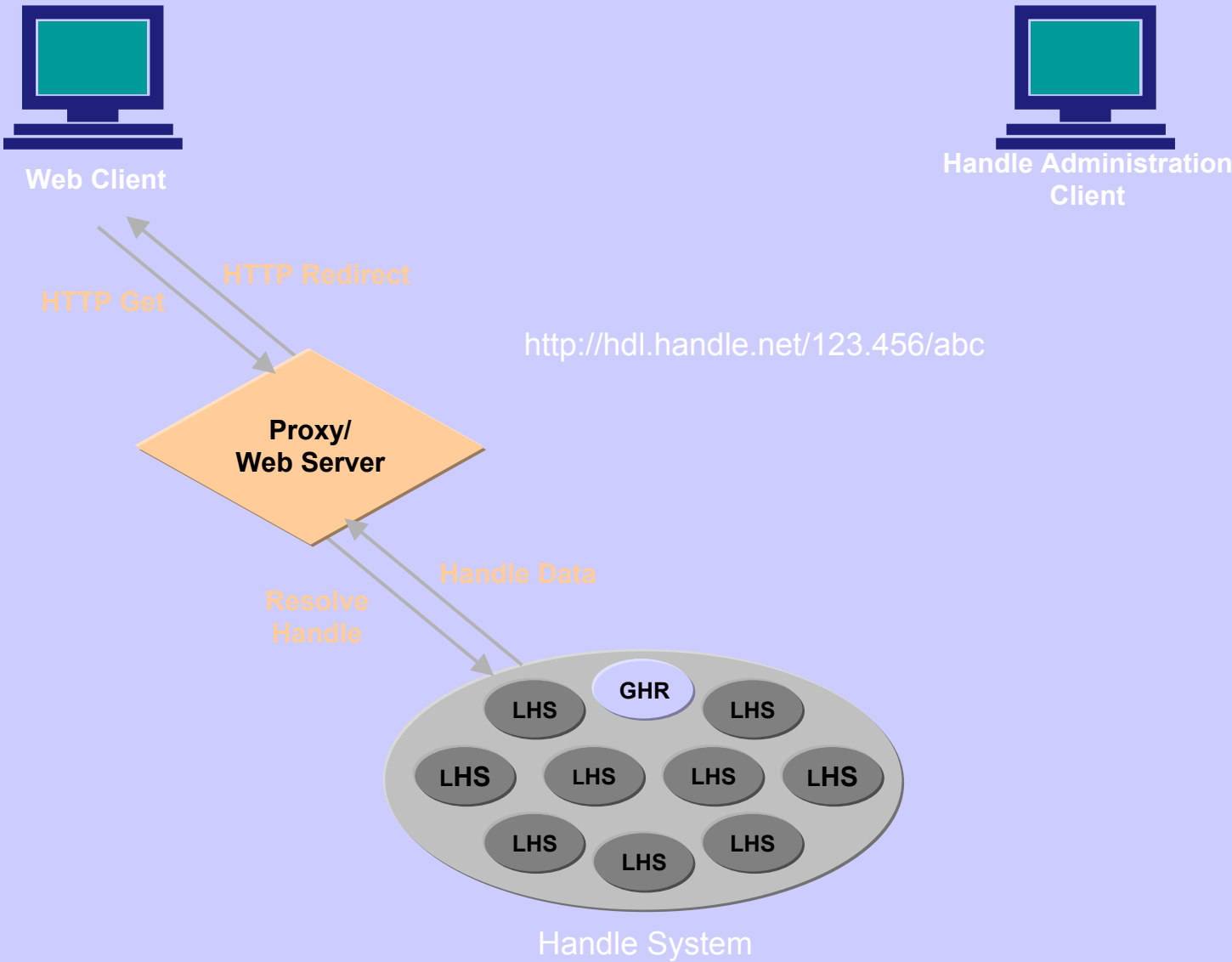


Handle Clients

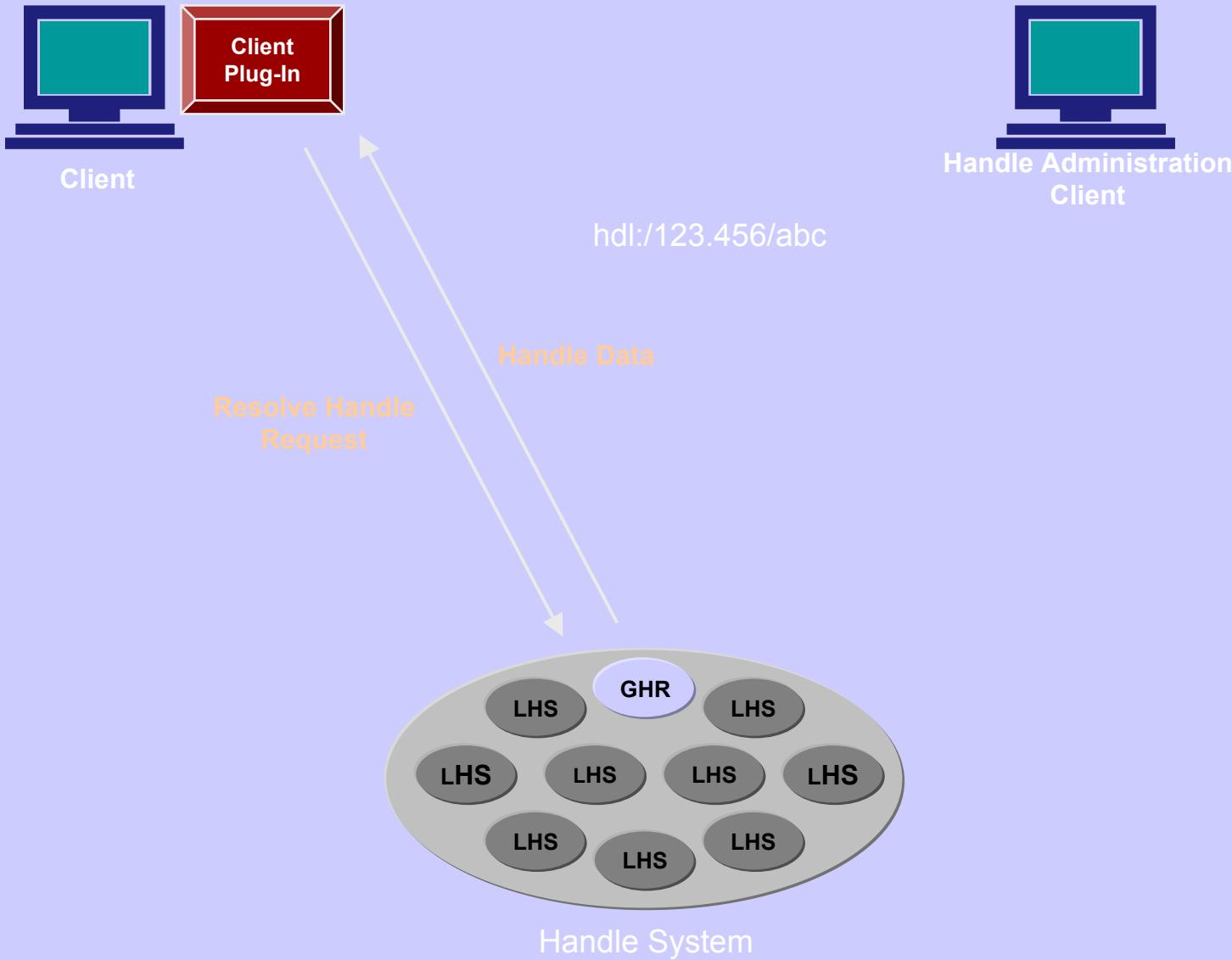
Request to Client:
Resolve hdl:10.1000/1



Handle Clients



Handle Clients



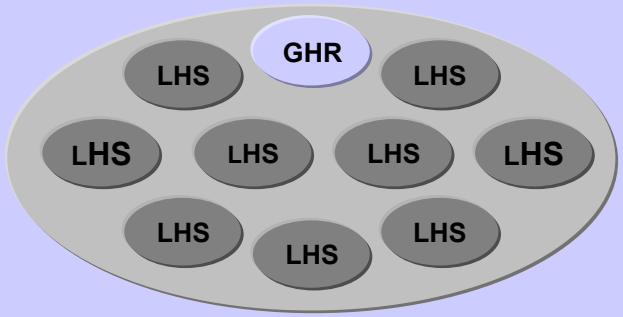
Handle Clients

Web

Handle Administration Client

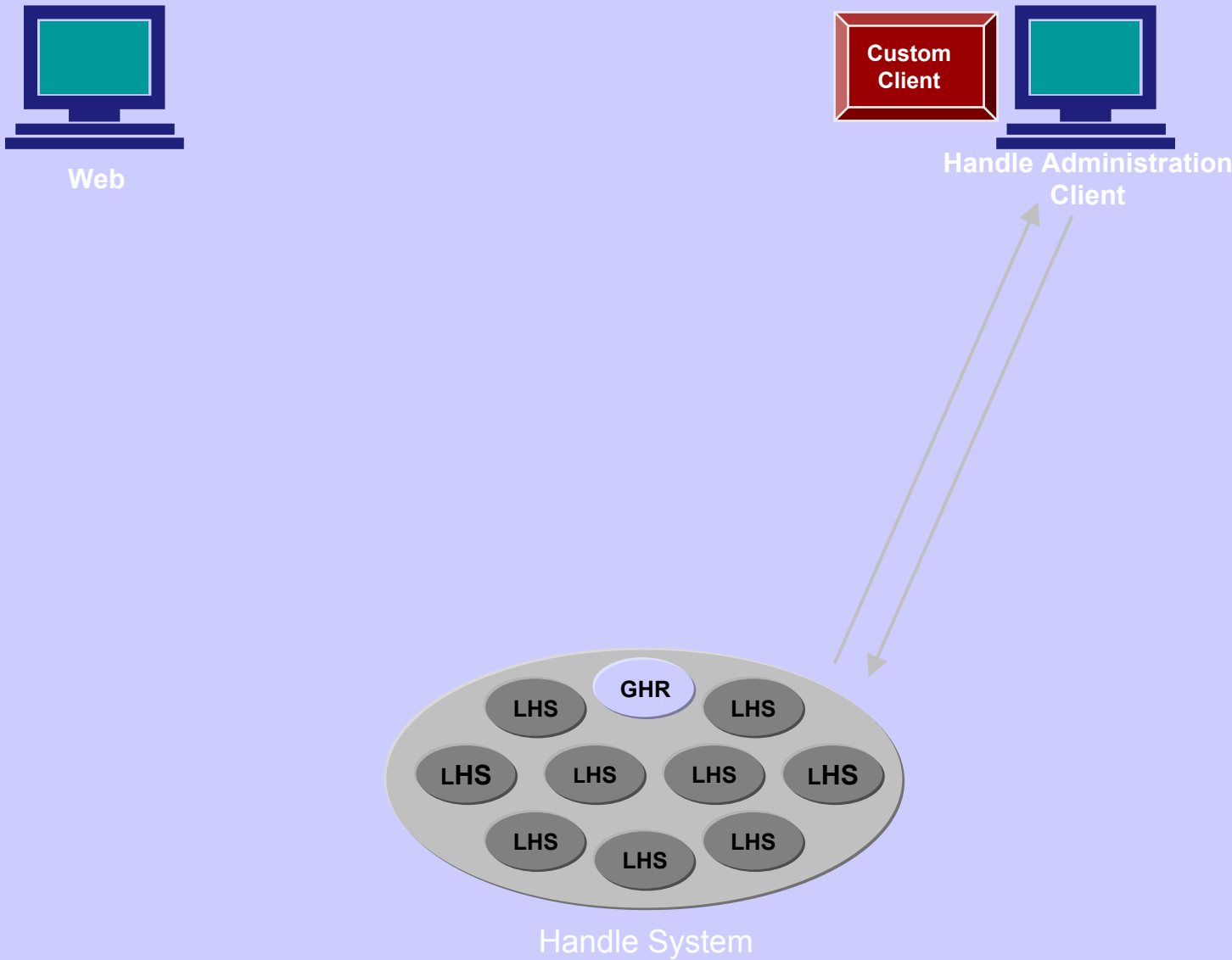
HTTP

Handle Admin API



Handle System

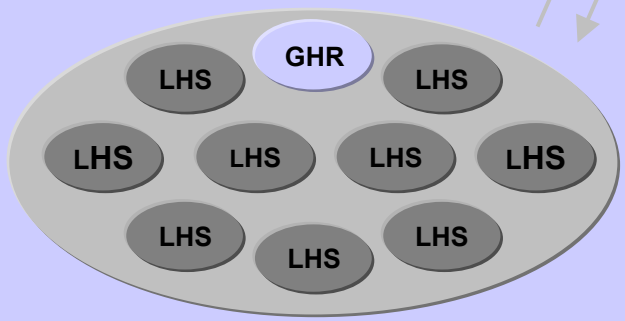
Handle Clients



Handle Clients

Web

Handle Administration embedded in another process

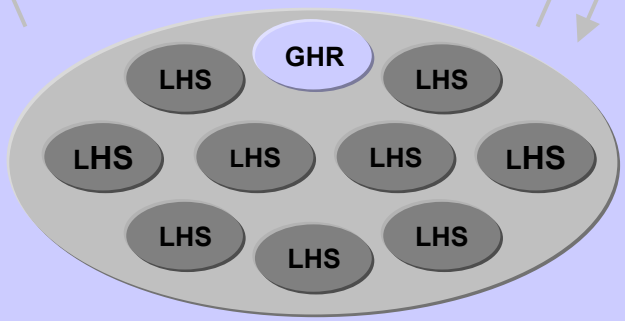


Handle System

Handle Clients

Handle Resolution embedded in another process

Handle Administration embedded in another process



Handle System

Handle System References:

- Handle System Overview (RFC3650)
- Handle System Namespace and Service Definition (RFC3651)
- Handle System Protocol Specification (RFC3652)
- Open Source Implementation

Development Resources:

- Open source license on handle server implementation and client libraries
- Client library available in Java, C, Python, and Perl
- Server implementation in Java. C-version server implementation in progress.
- Caching and Proxy server implementation in Java
- Handle Plug-in for Internet browser and Adobe Reader

Use of Handle System:

- Persistent naming and service reference
- Metadata registration and management
- Identity and Trust Management
- Grid Computing: WS-resource attribute
- Internet Digital Rights Management (IDRM)
- P2P computing and resource sharing

Handle System Initiatives

- Library of Congress
- DTIC (Defense Technical Information Center)
- IDF (International DOI Foundation)
  - CrossRef (scholarly journal consortium)
  - Enpia (Korean content management technology firm)
  - CDI (U.S. content management technology firm)
  - LON (U.S. learning object technology firm)
  - CAL (Copyright Agency Ltd - Australia)
  - TSO (U.K. publisher & info mgmt service provider)
  - MEDRA (Multilingual European DOI Registration Agency)
  - Nielsen BookData (bibliographic data - ISBN)
  - R.R. Bowker (bibliographic data - ISBN)
  - Office of Publications of the European Community (applied)
- NTIS (National Technical Information Service)
- DSpace (MIT + HP)
- Various digital library production and research projects

Handle System, OGSA and Globus

- Grid Resource, State & Handles
- Grid, Virtualization & Handles
- Resource's Endpoint Stability
- "External" Resource Properties

- Futures & Demo

The Grid Resource

- The Grid "Resource"
  - Application, Job, …
  - DB-record, disk drive, CPU-load
  - File, file-fragment, virtual piece of data
  - Contract, negotiation state, observed policy
- Resource is "state"…
- Very much like distributed "Objects"
- Grid Resource accessed through Web Service
  - Web Service is resource's "hosting environment"

The Grid: Virtualization

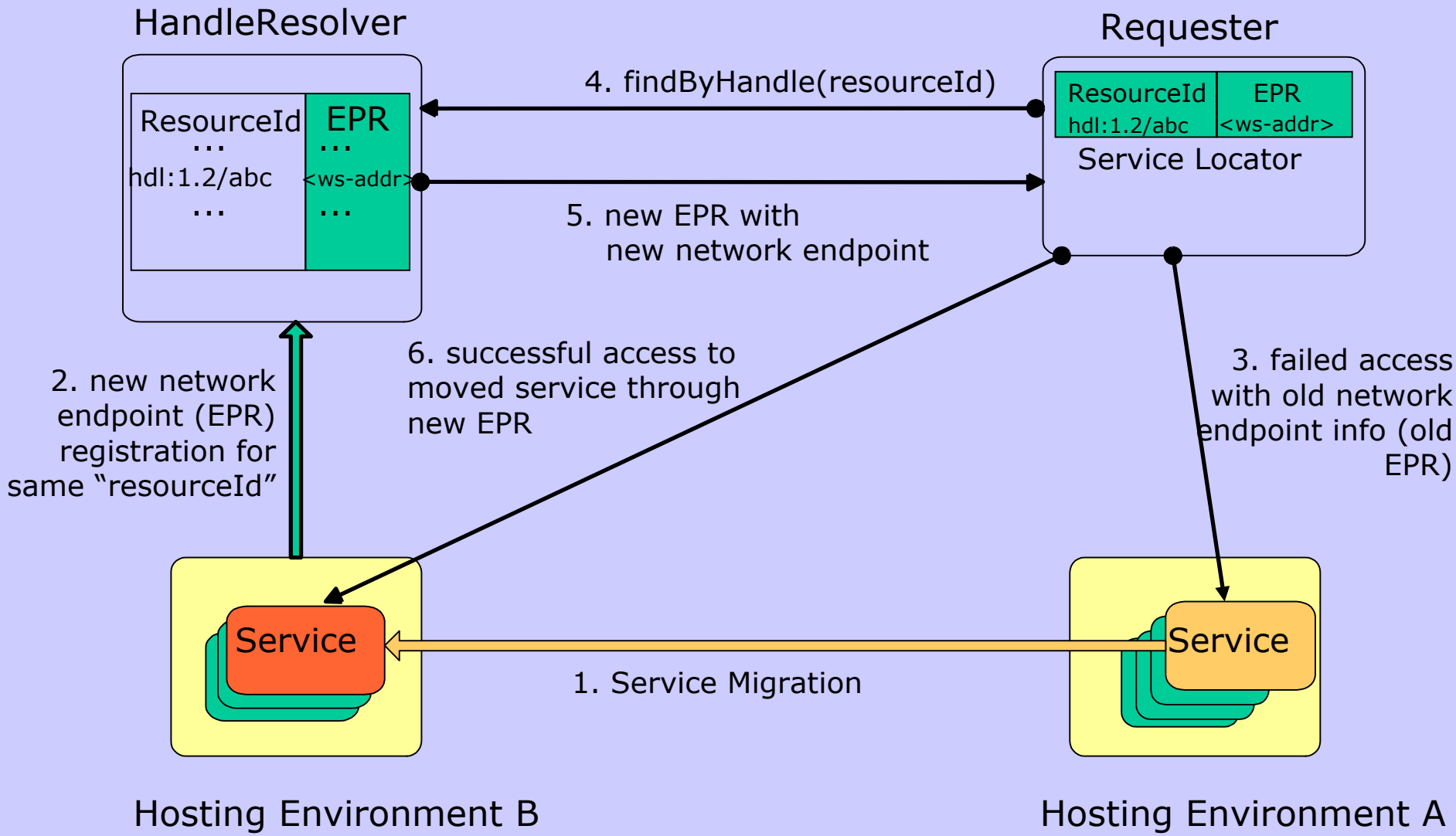
- Virtualization of Resources
  - Computers, applications, jobs, locations, files, file-fragments, ???
- Virtualization is about
  - Raising abstraction level
  - Transparently changing under the covers
  - Not caring what's under the cover
  - …
  - Adding levels of indirection

Virtualization = Handles

The Grid Resource "Stability"

- Web Service + Resource = "Network Pointer" to state
  - WebService Resource Framework: "Endpoint Reference"
- Web Service + Resource "instability"
  - multiple access methods
  - network address may change
  - resource may move
- Web Service + Resource: Unique Identifier
  - Stable "name" for policy, audit, comparison, "reasoning"
- Web Service + Resource: Network Pointer
  - Hosting environment recycling => different port number
  - Resource moves => new network pointer
  - Stable "handle" resolves to new network pointer
- Need Handle management for stability

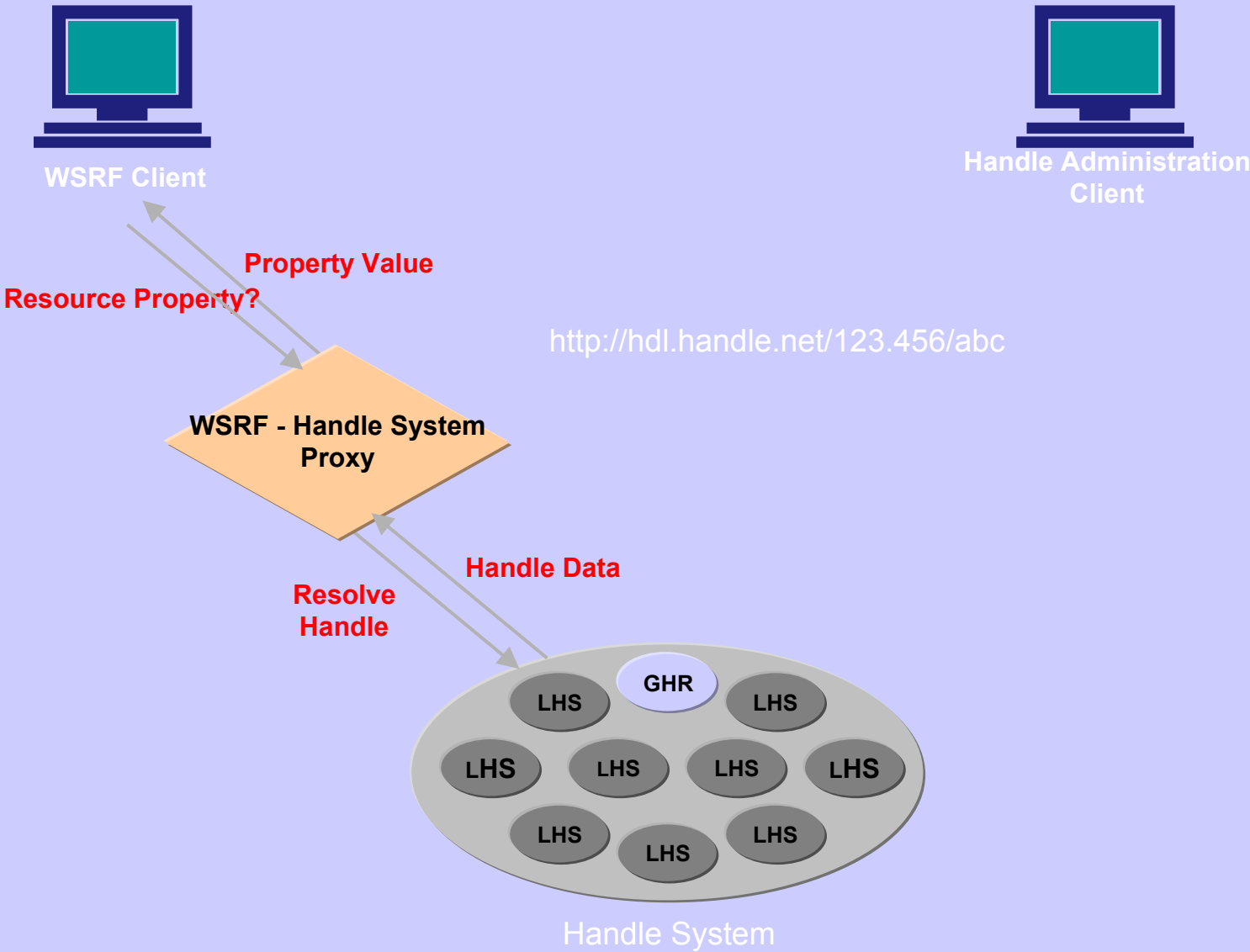
Service Migration



Service Instance Migration and Security

- Identity/Key “normally” associated with hosting environment and not with Instance
  - Moving instance => change of secure identity
- What about policies for that instance?
  - Users that were allowed to access, can they still access moved instance?
  - Hosting environment able to override (?)
- Where to maintain policy info?
  - Maybe in same naming/registry svc?
  - Move with instance state?
- Need more real-world requirements…
  - Learn from mobile agent systems…

WSRF Resource Properties & Handles



The Globus Toolkit & Handle System

- WSRF has "identified" need for EPR stability
- Clearly requirement for more sophistication
  - load-balancing, fail-over, resource migration
  - "external" resource properties
  - dynamic policy decoration
  - virtualization as a concept requires indirection
- Natural Synergy between GT and Handle System!
  - Recognized by both Globus Alliance and CNRI

We're working to make this vision a reality:
Come and see the DEMO!