The Digital Object Architecture and the e-APP

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Motivations for the Digital Object Architecture

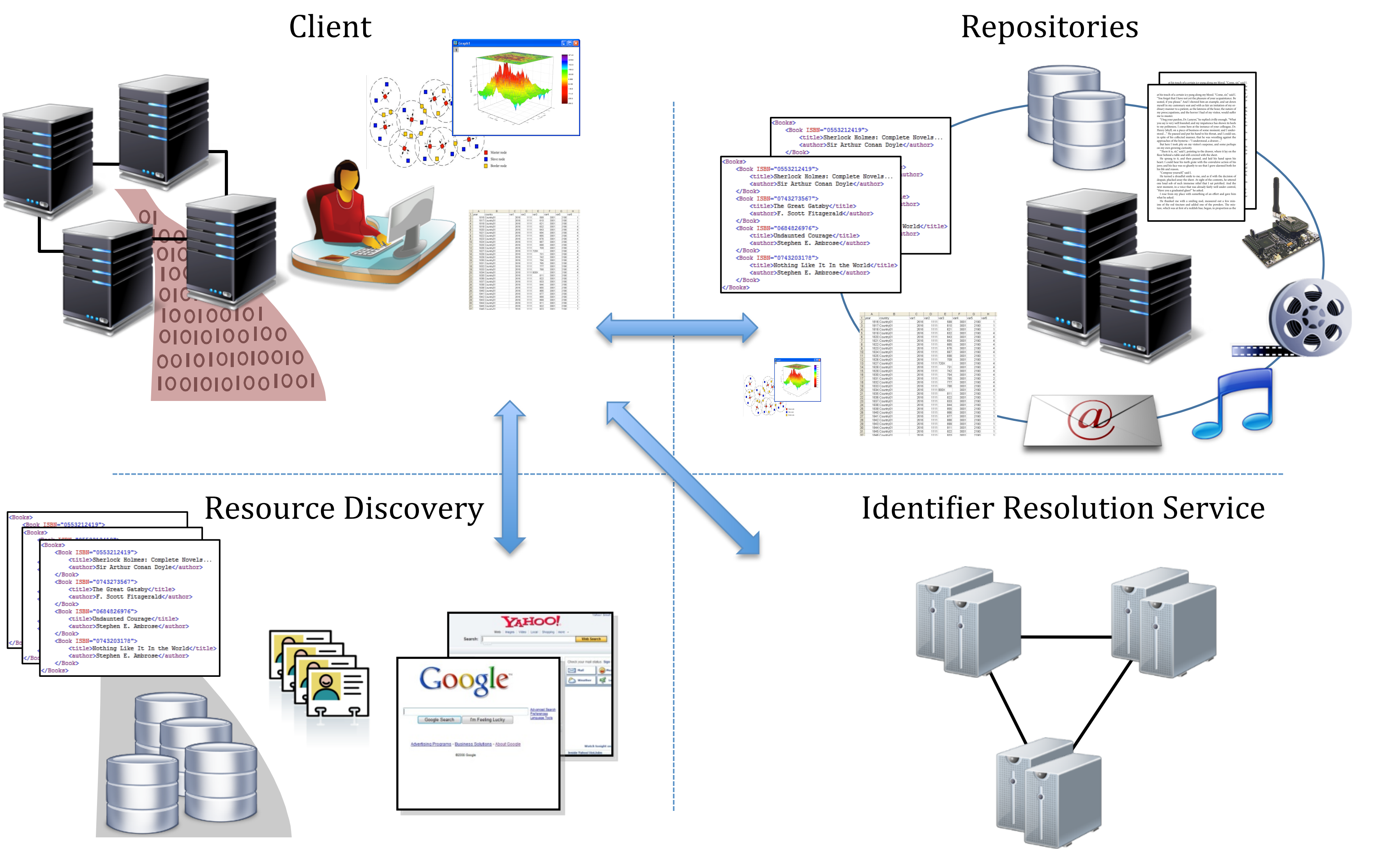
- The Internet is about sharing information represented in digital form.
- Information is more than packets.
- Information needs to be a “First Class Citizen” in the Internet.
  - Information is complex, it has context, uses, monetary value, etc…
  - Information needs to be locatable.
  - Information needs to be understandable and reusable.
  - Information needs to be protected, secured, authenticated, and trusted.
  - Information needs to be able to originate from many different types of sources and systems.
  - Information needs to persist over time.
- The Web enabled wider access to information in the Internet, but there are many issues that remain when dealing with information management.
  - Heterogeneous data and systems such as Big Data and IoT.

Digital Object Architecture Overview

The Digital Object Architecture addresses the following digital information management issues:

- Uniform and interoperable access to heterogeneous information and services.
  - Identification
  - Description, search and retrieval
  - Typing of data and services
- Interoperability across heterogeneous information systems.
  - Independent of the specific underlying technologies that host and provide the information.
  - Ability to deal with information that is not digital in nature.
- Integrated security.
- Very large level of scalability.
  - Distributed architecture
  - Open architecture framework
  - Standard protocols and procedures

Digital Object Architecture: Information Management on Networks



Client

Repositories

Resource Discovery

Identifier Resolution Service

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Search Engines, Metadata Databases, Catalogues, Registries, etc.

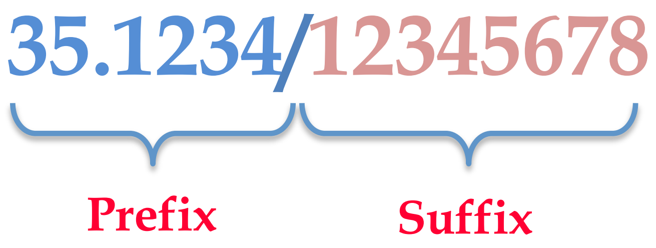
The Handle System ™

- A basic identifier/resolution system for the Internet.
  - Resolves a digital object's identifier to that object's current state information
  - Identifier persists when location and other attributes of the object changes.
- Logically a single system, but physically and organizationally distributed.
- Highly scalable.
- Associates one or more typed values, e.g., IP address, public key, URL, metadata, to each identifier.
- Secure resolution and administration.
- Optimized for speed and reliability.
- Open, well-defined protocol and data model, IPR free.
- Provides infrastructure for a wide application domain, e.g., digital libraries & publishing, e-research, id mgmt, and IoT, etc...

The Handle System Security Features

- Authentication
  - Using an optional PKI capability.
  - Handle server and client authentication.
- Authorization
  - Handles and associated handle records are administered by authenticated and authorized digital entities such as a handle service providers.
  - A handle service can restrict access to any of its values in a handle record.
- Confidentiality
  - All handle requests and responses can be encrypted.
- Non-Repudiation and Integrity
  - Handle record responses may be signed by the hosting server
  - Handle records may be signed by any authorized administrator.
- Audit logs
  - All Handle servers log all accesses.

What is a Handle?



35.1234/12345678

Prefix

Suffix

- Handles are globally unique and resolvable
  - Prefixes are allotted to local handle service providers and most prefix handle records are currently stored in the “Global Handle Registry” (GHR).
  - A **handle prefix** is typically resolvable by the GHR to an IP address for a handle resolution service such as a **Local Handle Service**.
  - The **full handle** is resolvable by the **handle resolution service** into a **handle record**.
- Character Set: Unicode 2.0
- Encoding: UTF-8
- Prefix: Currently allocating only numeric values.

Handle Record

Handle	Data Type	Handle Data
35.1525/b.2009.59.5.9	HS_ADMIN	handle=0.na/35.1525; index=200; [delete hdl,add val,read val,modify val,del admin,add admin,list]
	URL	http://www.caliber.net/abs/35.1525/2009.59.5.9
	35.TYPE/DEVICE	35.1/1.2.3
	10320/loc	<locations chooseby="locatt, country, weighted"> <location id="1" cr_type="MR-LIST" href="http://www.acme.org/iPage?doi=35.1525%2Fbio.20.5.9" weight="1" /> <location id="2" cr_src="unca" label="SECONDARY_BIOONE" cr_type="MR-LIST" href="http://www.bioone.org/doi/full/35.1525/ bio.2009.59.5.9" weight="0" /> </locations>
		⋮
	HS_PUBKEY	0000000B4453415F5055425F4B4559000000000015009760508F15230B....
	HS_SIGNATURE	eyJhbGciOiJSUzI1NiJ9.eyJkaWdlc3RzIjp7ImFsZyI6IlNIQS0yNTYiLCJkaWdlc....

Data Types are also resolvable handles and can be specific to:

- The Handle System (*)
  - **HS_ADMIN**
  - **HS_PUBKEY**
  - **HS_SIGNATURE**
  - **URL etc…**
- An application or service
  - **10320/loc**
- A group/community
- A device type

Types should be identified with a handle and resolve to a type description.

(*) Handle System types are registered as handles starting with the “0.TYPE/” prefix. (URL -> 0.TYPE/URL)

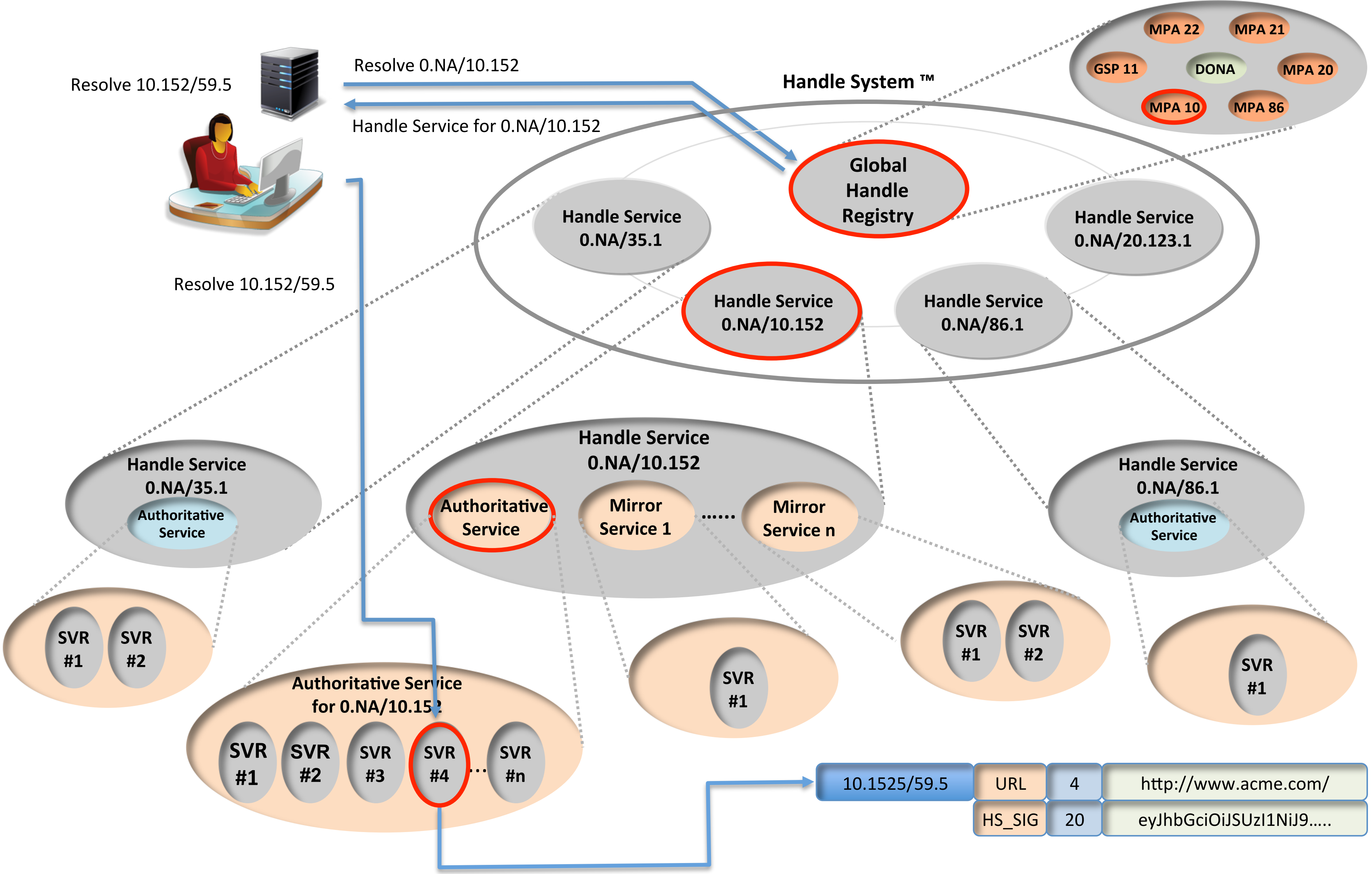
Handle Resolution - Overview

Resolving any handle such as 35.152/59.5 is a two step process:

1) Find the Handle Service associated with the handle prefix 35.152
   - Access the handle services provided by one of the GHR service providers.
   - Resolve 0.NA/35.152 into its service information.

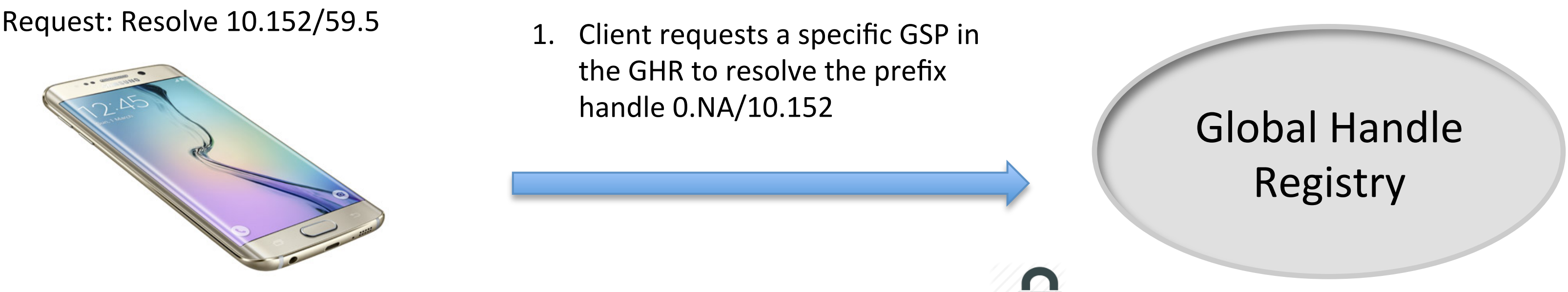
2) Resolve the 35.152/59.5 handle into its respective values
   - Access the handle services for that particular handle at that particular Handle Service provider.
   - Resolve 35.152/59.5 into its handle record.

Handle Resolution - Overview



10.1525/59.5	URL	4	http://www.acme.com/
	HS_SIG	20	eyJhbGciOiJSUzI1NiJ9.....

Handle Resolution - Service Info Request



Request: Resolve 10.152/59.5

1. Client requests a specific GSP in the GHR to resolve the prefix handle 0.NA/10.152

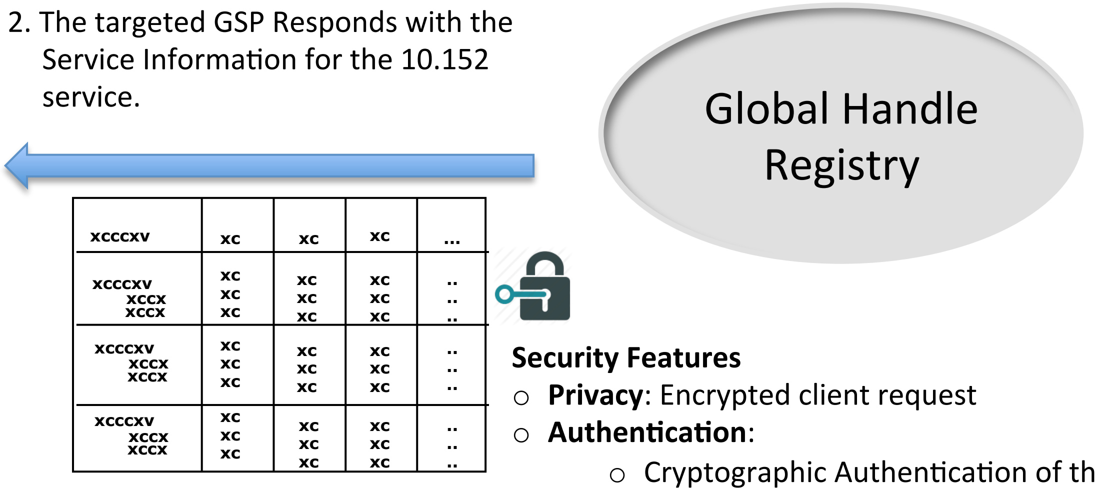
Global Handle Registry

Security Features:

- **Privacy**: Encrypted client request
- **Authentication**:
  - Cryptographic authentication of the target GSP service
  - Cryptographic authentication of the resolving client
- **Audit trail**: GSP logs the full client request

Handle Resolution - Service Info Request

Client receives the Service Information for the 10.152 Service.



2. The targeted GSP Responds with the Service Information for the 10.152 service.

xcccxv	xc	xc	xc	...
xcccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	.. .. ..
xcccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	.. .. ..
xcccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	.. .. ..

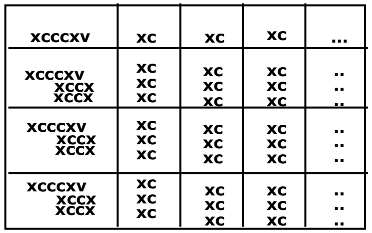
Handle Service Information

Security Features

- **Privacy**: Encrypted client request
- **Authentication**:
  - Cryptographic Authentication of the target GSP service
  - Cryptographic Authentication of the resolving client
- **Audit trail**: GSP logs the full client request

- **Privacy:** Response from GSP is encrypted
- **Authorization:** Response only provides what the authenticated client is allowed to see
- **Non-repudiation:** Service information is signed by the GSP service and it is verified by the client.

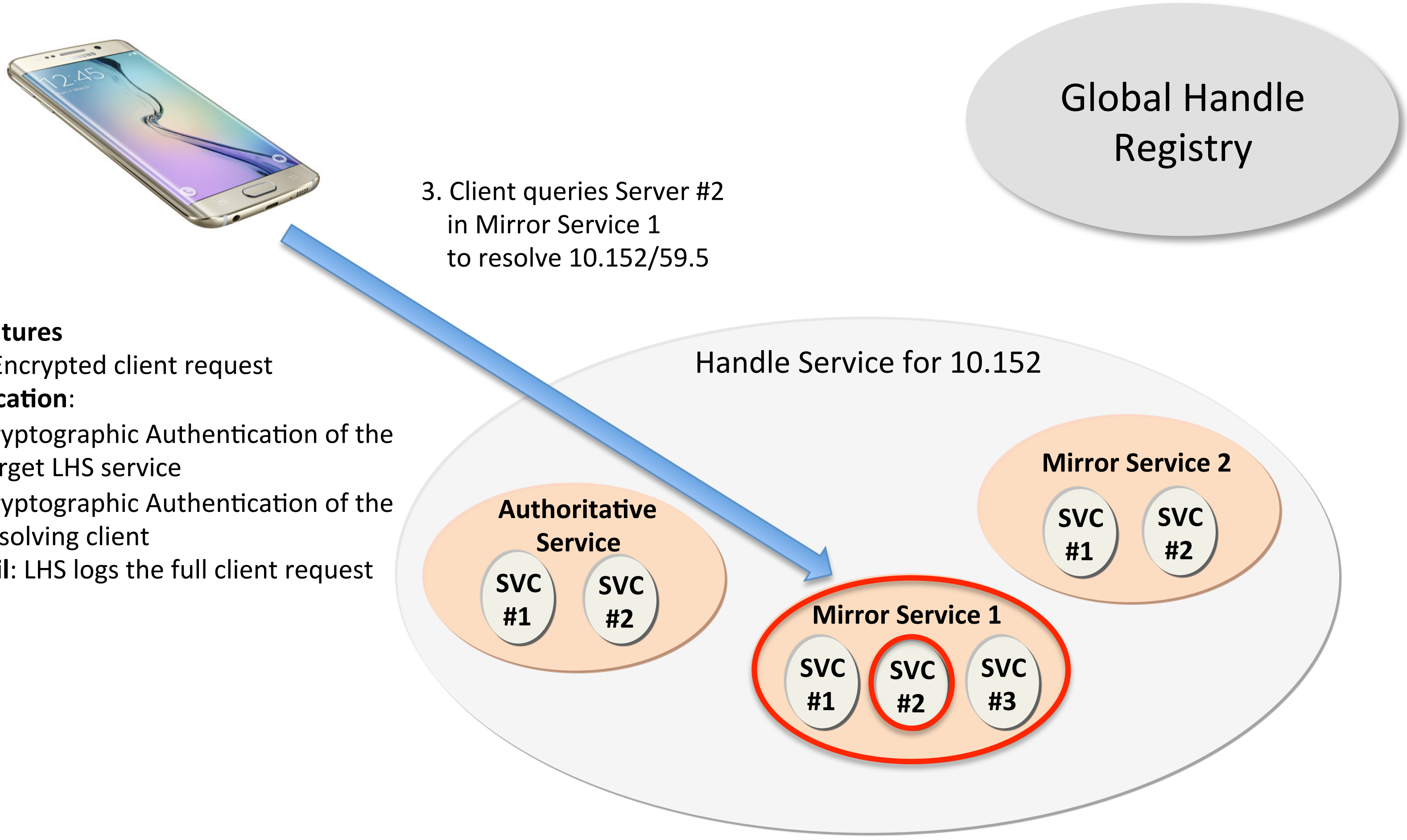
Handle Service Information



xcccxv	xc	xc	xc	...
xcccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	: : :
xcccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	: : :
xcccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	: : :

Handle Services	IP Addresses	Port Number	Public Key	...
Authoritative Service				
Service 1	12.34.45.67	2641	5ec6f944...	...
Service 2	12.34.56.68	2641	55fa26ca...	...
Mirror Service 1				
Service 1	12.45.67.71	2641	C77ee70...	...
Service 2	12.45.67.72	2641	22d81f1...	...
Service 3	12.45.67.73	2641	43a7a1f....	...
Mirror Service 2				
Service 1	32.23.23.12	2641	A80b56...	
Service 2	32.23.23.13	2641	b56757...	

Handle Resolution – Handle Service Request

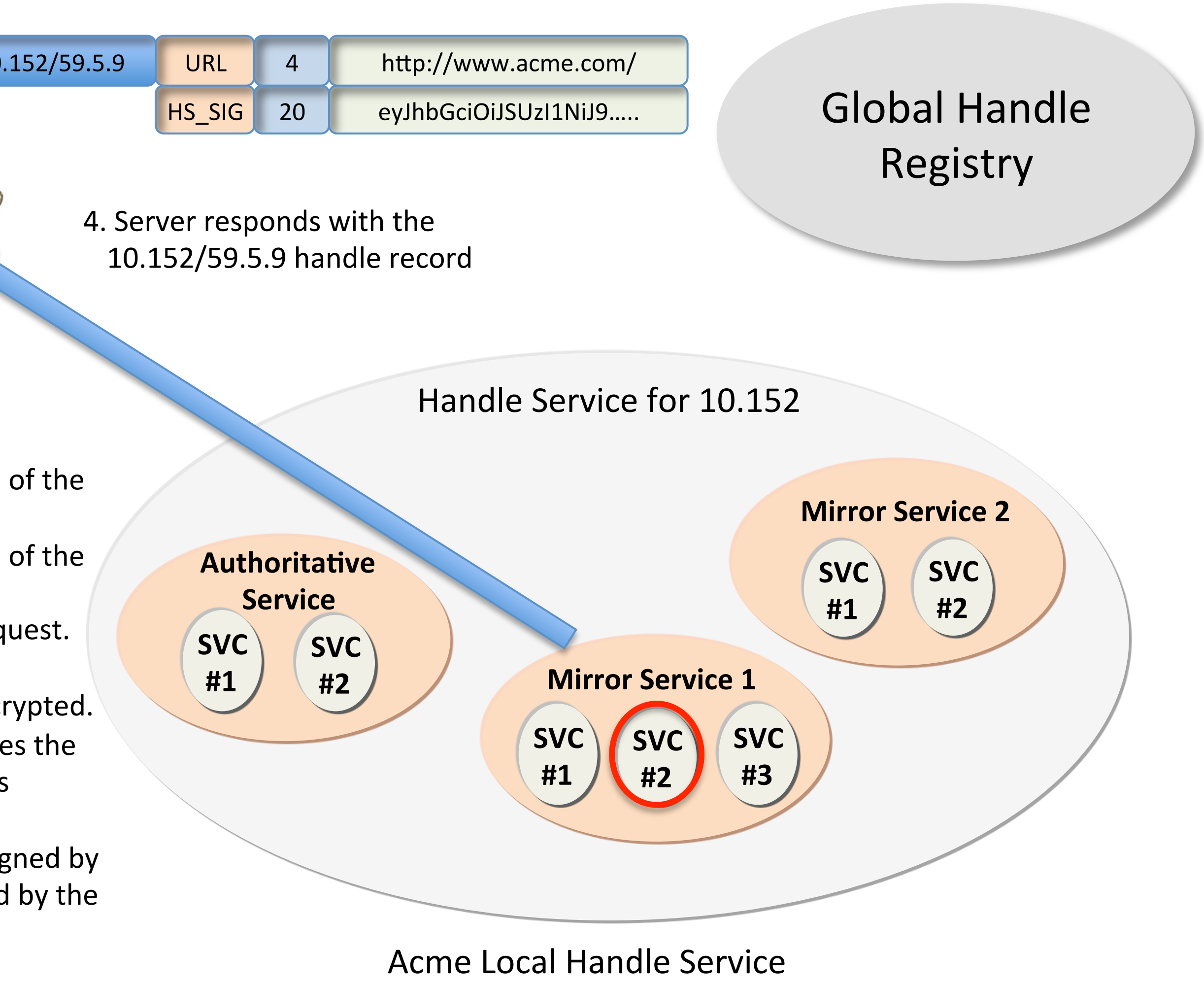


3. Client queries Server #2
in Mirror Service 1
to resolve 10.152/59.5

Security Features

- **Privacy**: Encrypted client request
- **Authentication**:
  - Cryptographic Authentication of the target LHS service
  - Cryptographic Authentication of the resolving client
- **Audit trail**: LHS logs the full client request

Handle Resolution – Handle Service Request



10.152/59.5.9	URL	4	http://www.acme.com/
	HS_SIG	20	eyJhbGciOiJSUzI1NiJ9…..

Security Features

- **Privacy**: Encrypted client request.
- **Authentication**:
  - Cryptographic Authentication of the target LHS service.
  - Cryptographic Authentication of the resolving client.
- **Audit trail**: LHS logs the full client request.

- **Privacy:** Response from Mirror is encrypted.
- **Authorization:** Response only provides the values that the authenticated client is allowed to see.
- **Non-repudiation:** Handle record is signed by the Mirror Service and can be verified by the client.

Handle and e-APP Synergy

- The need for authenticating digital resources is a basic requirement in many different information industries.
  - Journal articles, medical taxonomies, assets registries.
  - Internet of Things, Big Data.
- The policies and workflows that result in the signing and certifying of digital resources may differ but the intents and process for verifying signature(s) and the signer(s) are similar.
- The Handle System provides an open solution that offers
  - Security, scalability.
  - Interoperability.
  - Digital sovereignty.
  - Signer identification using handles.

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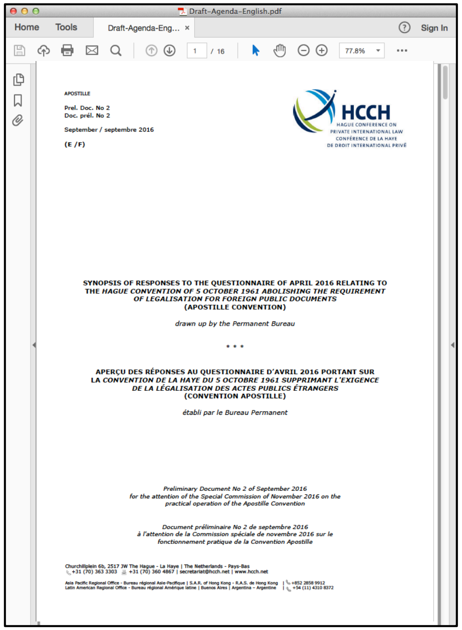
Document Registration



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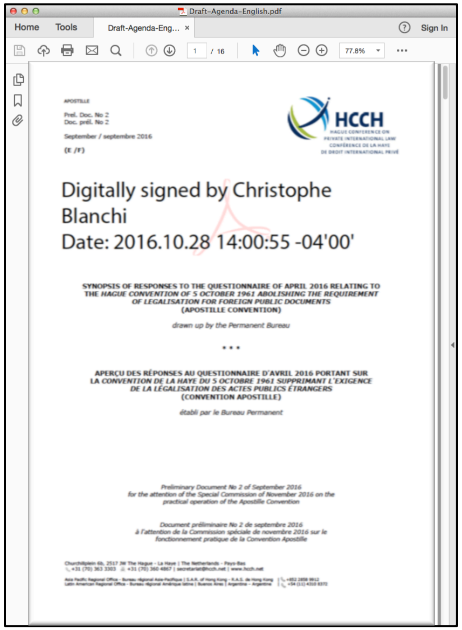

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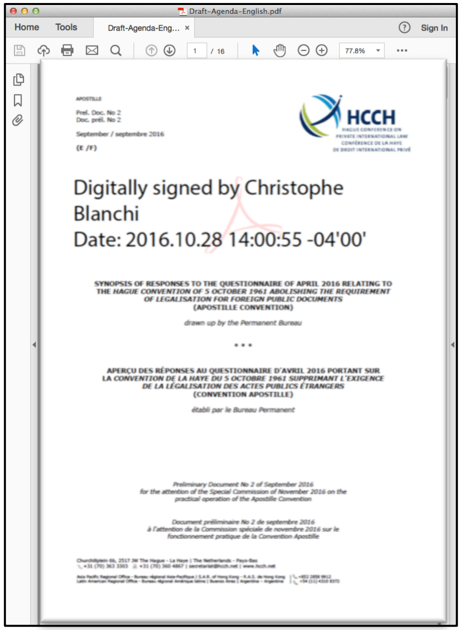

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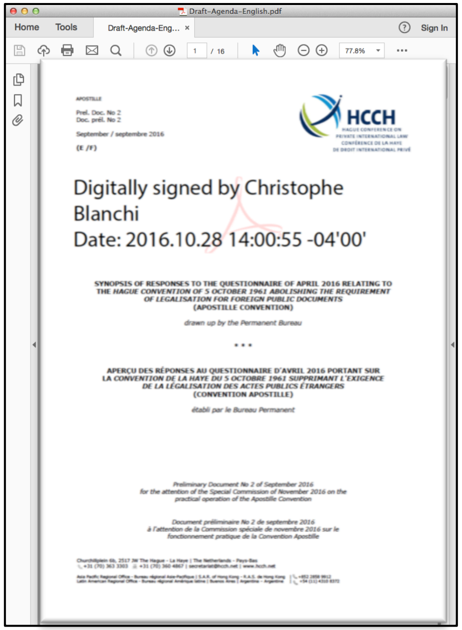

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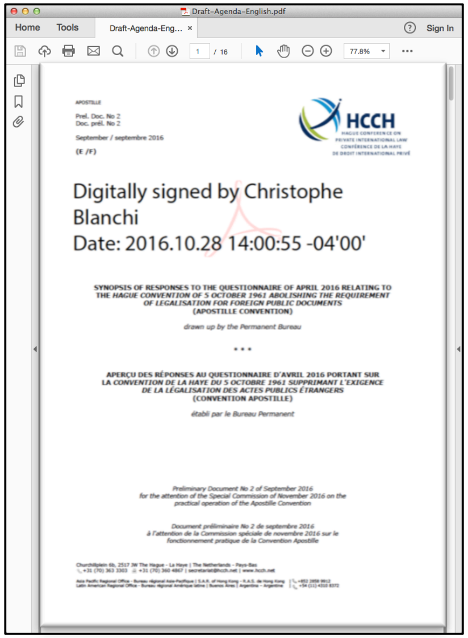

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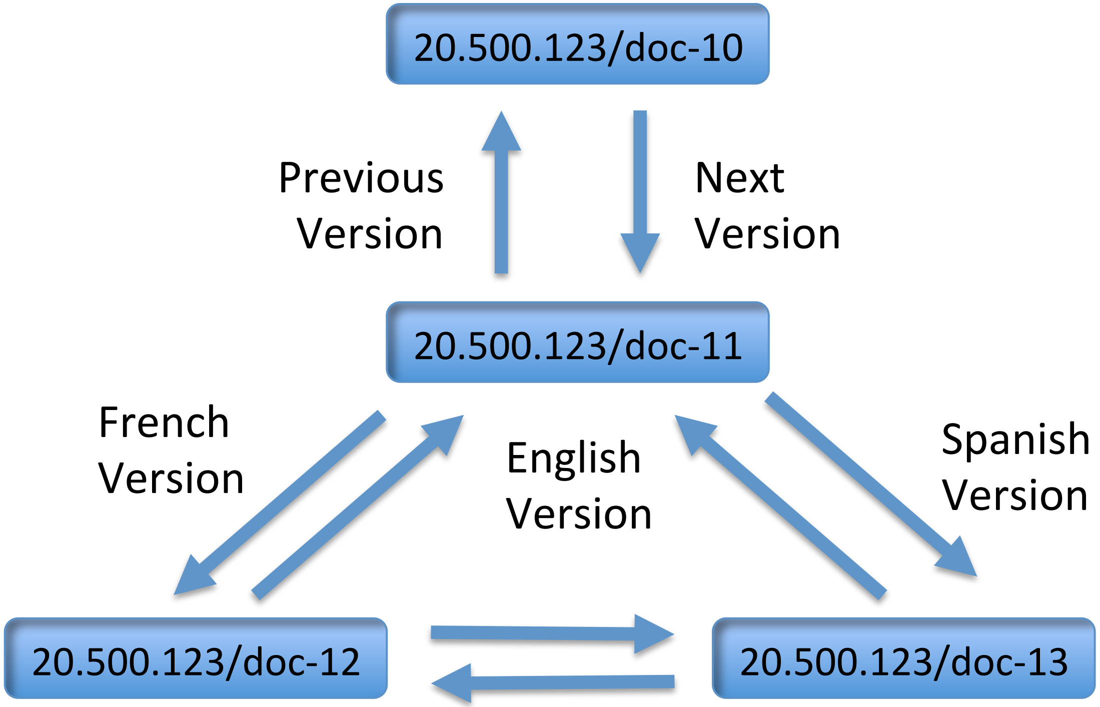

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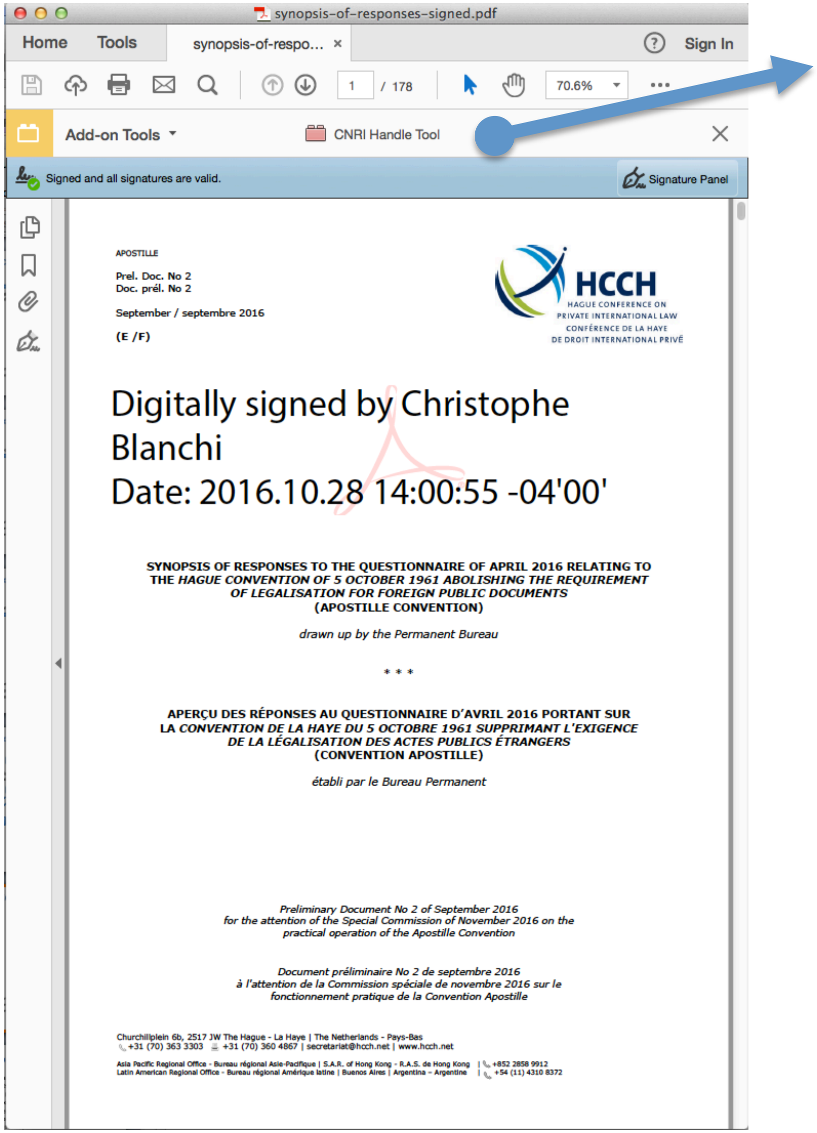

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APERÇU DES RÉPONSES AU QUESTIONNAIRE D'AVRIL 2016 PORTANT SUR LA *CONVENTION DE LA HAYE DU 5 OCTOBRE 1961 SUPPRIMANT L'EXIGENCE DE LA LÉGALISATION DES ACTES PUBLICS ÉTRANGERS* (CONVENTION APOSTILLE)

établi par le Bureau Permanent

Preliminary Document No 2 of September 2016 for the attention of the Special Commission of November 2016 on the practical operation of the Apostille Convention

Document préliminaire No 2 de septembre 2016 à l'attention de la Commission spéciale de novembre 2016 sur le fonctionnement pratique de la Convention Apostille

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1. Resolves the document's Handle from PDF metadata
2. Extracts the document's handle metadata.
3. Verifies the PDF's and Handle's signature:
   - Correlates the document to the handle.
   - Confirms the integrity of the document.
4. Validates the identity of the document signer.
   - Who endorsed the signer?
   - Is the signer's certificate valid?
   - Is the signer still recognized?
5. Provides a list of related documents:
   - Next – Previous.
   - References
   - Other languages etc…
6. Lists and verifies all additional cryptographic endorsements.
7. Each endorsement certificate chain can be explored.

Additional Benefits of the Handle Approach

1. PDF documents enhanced with a handle based verification solution can be used with any technology that can resolve handles such as:
   - An Adobe Reader plugin.
   - A web based solution.
   - Within a Digital Object based solution.

2. The handle based document validation solution can be used to authenticate documents that are not PDFs:
   - Web Pages, Word documents, data sets, etc…

3. Documents are assigned handles that are stored in a Local Handle Service (LHS)
   - The LHS is managed locally.
   - The LHS and registration can follow required local policies and procedures.
   - All handles are globally resolvable and interoperable.

4. Handle resolution provides an efficient solution for inspecting certificate chains
   - Provides a dynamic mechanism for inspecting and verifying certificates.
   - Resolves a signer's ID into its associated public key and metadata.
   - Equally verifies local, regional, and global certificates.

Who is responsible for operating the GHR?

- The original GHR was operated by CNRI in Reston VA in the US since the mid to late 1990s.
- Until recently, CNRI had the sole credential and authorization to create all new prefixes.
- CNRI decided further enhance and develop the GHR architecture to enable multiple organizations to coordinate and administer the GHR on a multi-primary basis under the overall administration of the DONA Foundation.
- The current GHR maintains backwards compatibility with all legacy handle clients.

Providers of GHR Services

- An organization that is credentialed and authorized by DONA to create derived prefixes from its allotted credential prefix is known as a Multi-Primary Administrator (MPA) or more generally as a Global Handle Service Provider (GSP).
- Each such organization is allotted a credential (e.g. 0.NA/21) by DONA and authorized to provide GHR services.
- Each such organization can create an unlimited number of derived prefixes from its credential prefix and allot them to organizations that wish to provide local handle services.
- All GHR Services verify and replicate any and all valid prefixes created/modified by other from all other MPAs and GSPs in accordance with DONA Foundation Policies and Procedures .

The Role of the DONA Foundation

- Based in Geneva Switzerland.
- Maintains the operations of the GHR, collaboratively with all MPAs.
- Provide coordination, software, and other strategic services for the technical development, evolution, application, and other uses in the public interest around the world of the Digital Object Architecture (DOA) with a mission to promote interoperability across heterogeneous information systems.
- DONA will promote the X.1255 standard and the use of the DOA across many different countries, domains, and industries.
- Make the developed DOA standards and/or software accessible to the community to further their development and adoption.
- Enables the development of relevant standards, and software for purposes of reference models and in connection with the GHR

DONA Foundation’s GHR Operations

- DONA coordinates with the GHR Service providers to maintain the stable and secure operation of the the GHR in the public interest.
- DONA credentials and authorizes new MPAs.
- The DONA Foundation will work in collaboration with the MPAs to improve the architectural, technical, and performance of the GHR.
- The Multi-Primary GHR Operations started on the 9th of December 2015.

Questions?

DONA