Overview of Digital Object Architecture (DOA)

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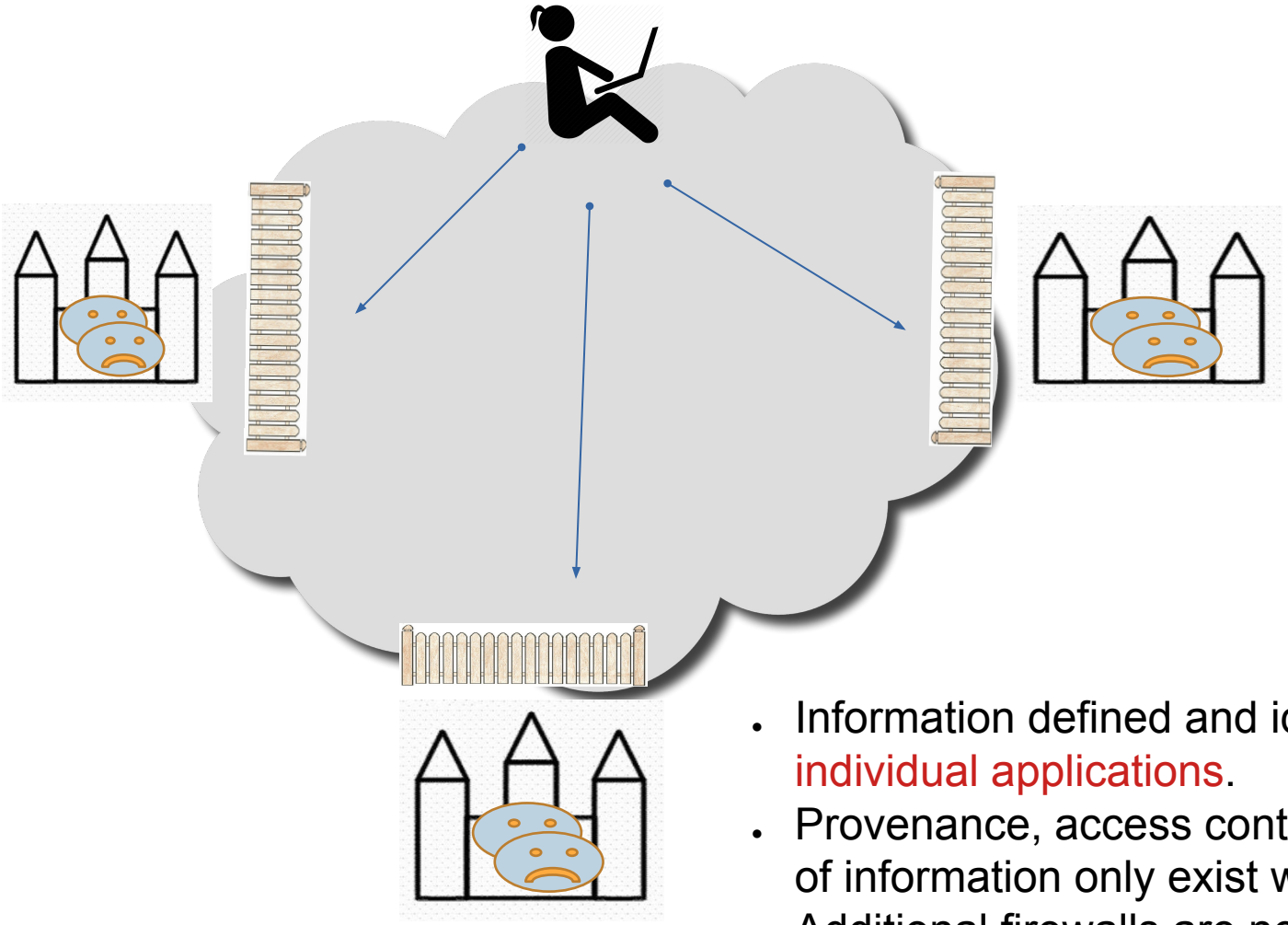
Introduction

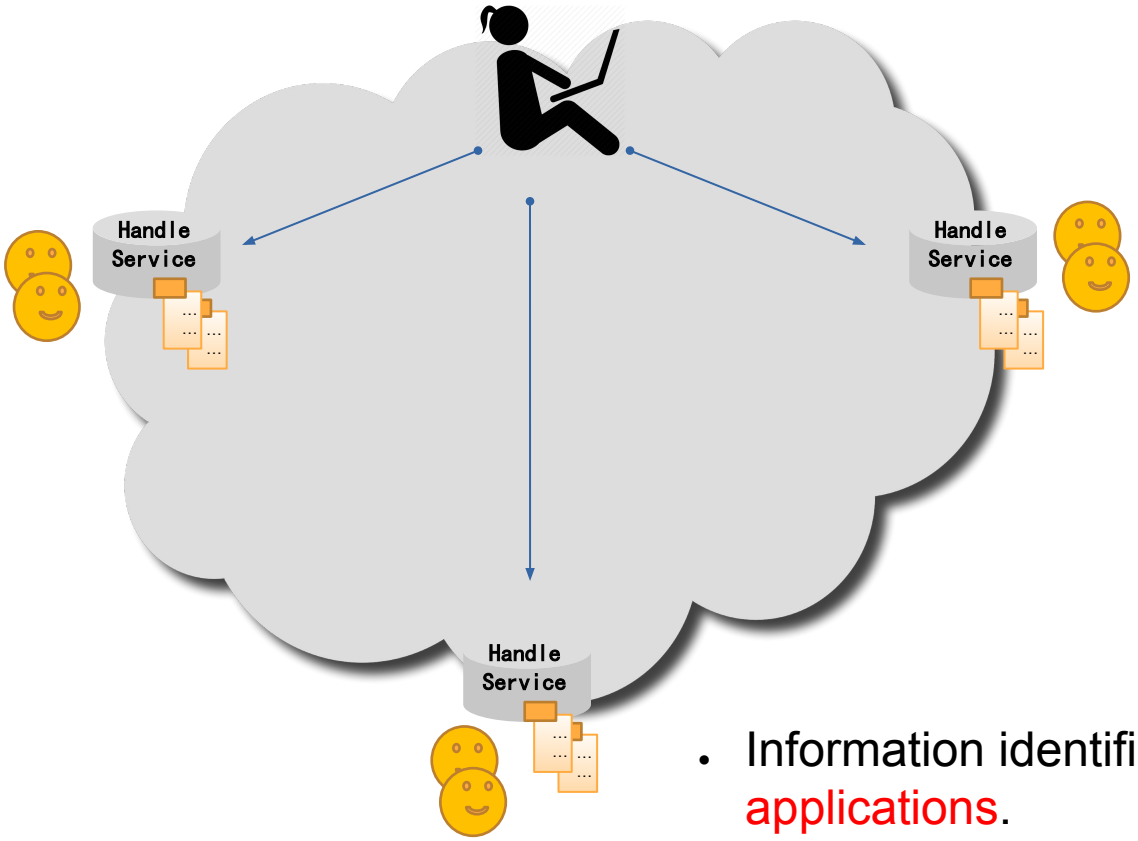
- CNRI: a research institute
  - Mission: Internet infrastructure research
  - Dr. Bob Kahn, co-inventor of TCP/IP
- Initial Internet Infrastructure Services
  - IP Address/DNS
  - TCP/IP for data transmission
- Initial motivation
  - INTER-connect computers over heterogeneous networks

Internet without DOA – many information silos



- Information defined and identified within individual applications.
- Provenance, access control, and protection of information only exist within applications.
- Additional firewalls are needed due to lack of information protection.

DOA – Information oriented Internet Infrastructure

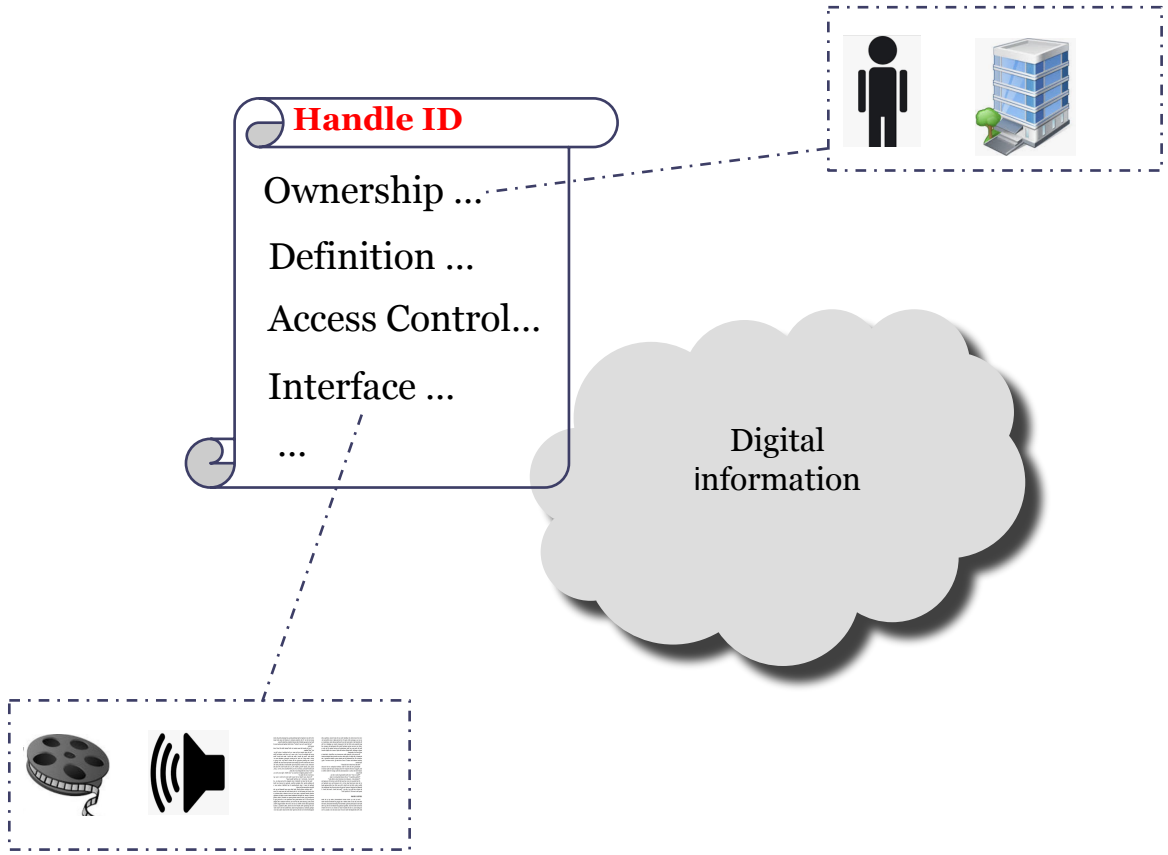


- Information identified independent from applications.
- Provenance, access control, and protection
- of information independent from applications
- Information can be shared among trusted applications without firewalls.

DOA Motivations

- From machine inter-connection to information system interoperability
- From host-oriented/application-centric architecture to information-centric architecture
- Diminish network, application, and organizational boundaries for information sharing and management

What is Digital Object



DOA/Handle System

- A logical extension of the Internet architecture for the information age, with build-in security, to facilitate:
  - Information identification/discovery
  - Information definition/management
  - Information dissemination/interaction
  - All with build-in Security
- All these to facilitate secure and managed information sharing across applications

Digital Object Architecture

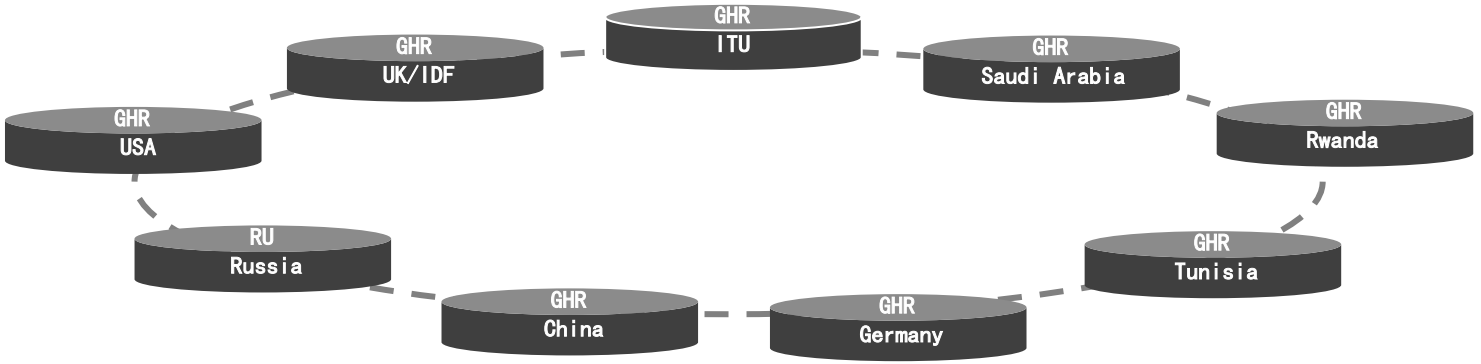
- Governance Perspective
- Technical Perspective
- Application Perspective
- Standard Perspective

DOA: Governance perspective

- Parallel root services that allows sovereignty at the infrastructure level
- Mutual collaborations among all countries
- DONA Foundation for all intellectual property and international management
- ITU support and oversight

Global Handle Registry (GHR)

- Multi-Primary Root Service
- Sovereignty at the infrastructure level



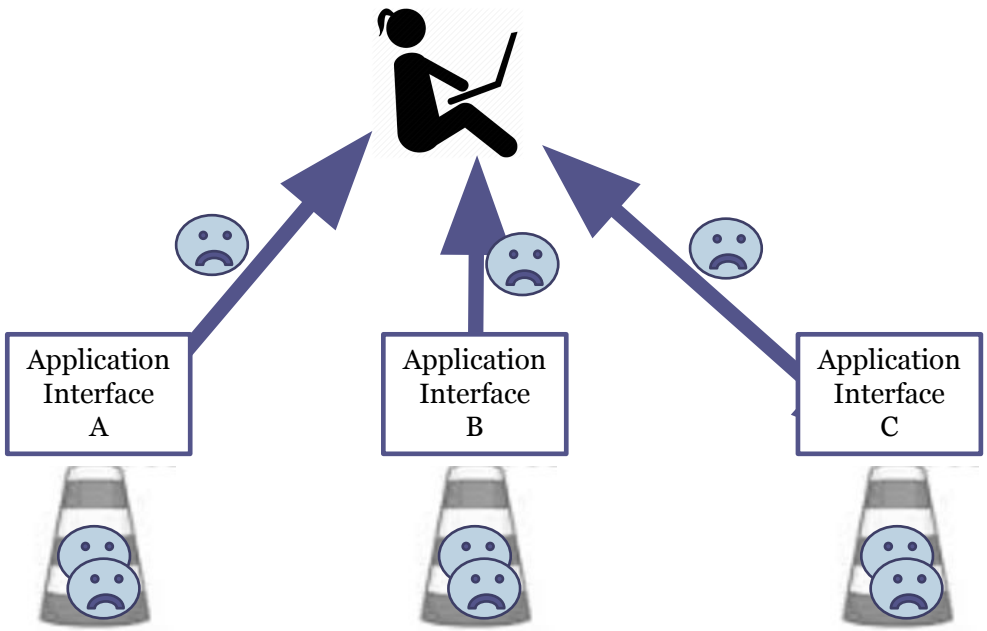
DOA: Technical perspective

- Global identifier service: identification, definition, resolution, & management, all independent from applications
- Security service at the infrastructure level
- Scalability and extendibility
- Build-in multi-lingual support
- Efficiency and reliability

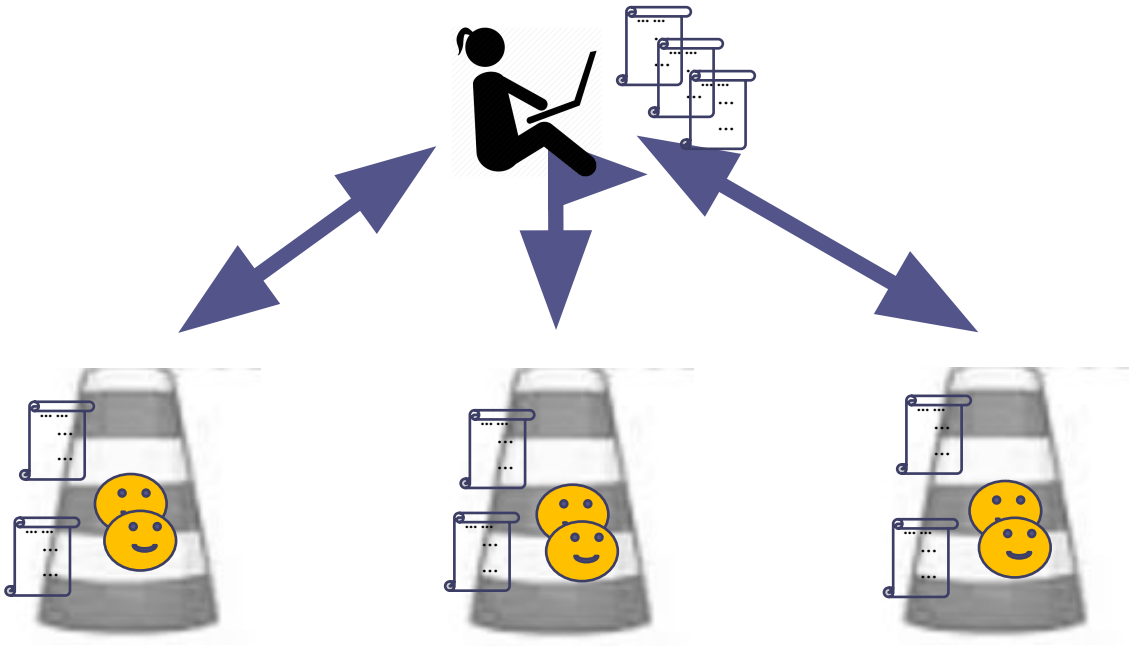
DOA: Application perspective

- Application oriented – definition and management of information are confined within each individual applications
- Information oriented – definition and management of information can be discovered by any applications and shared among them host oriented application

Information Silos under application-oriented infrastructure



DOA for **Information-Centric** Internet Infrastructure



DOA: Standards perspective

- ITU-T X.1255 on DOA framework
- IETF RFC3650, RFC3651, RFC3652
- ITU-T Y.4805 on IoT Identifier Service Requirements
- ITU Y.4459 on IoT interoperability using DOA
- DOIP spec. from DONA Foundation
- ATSD on DOA Application standards

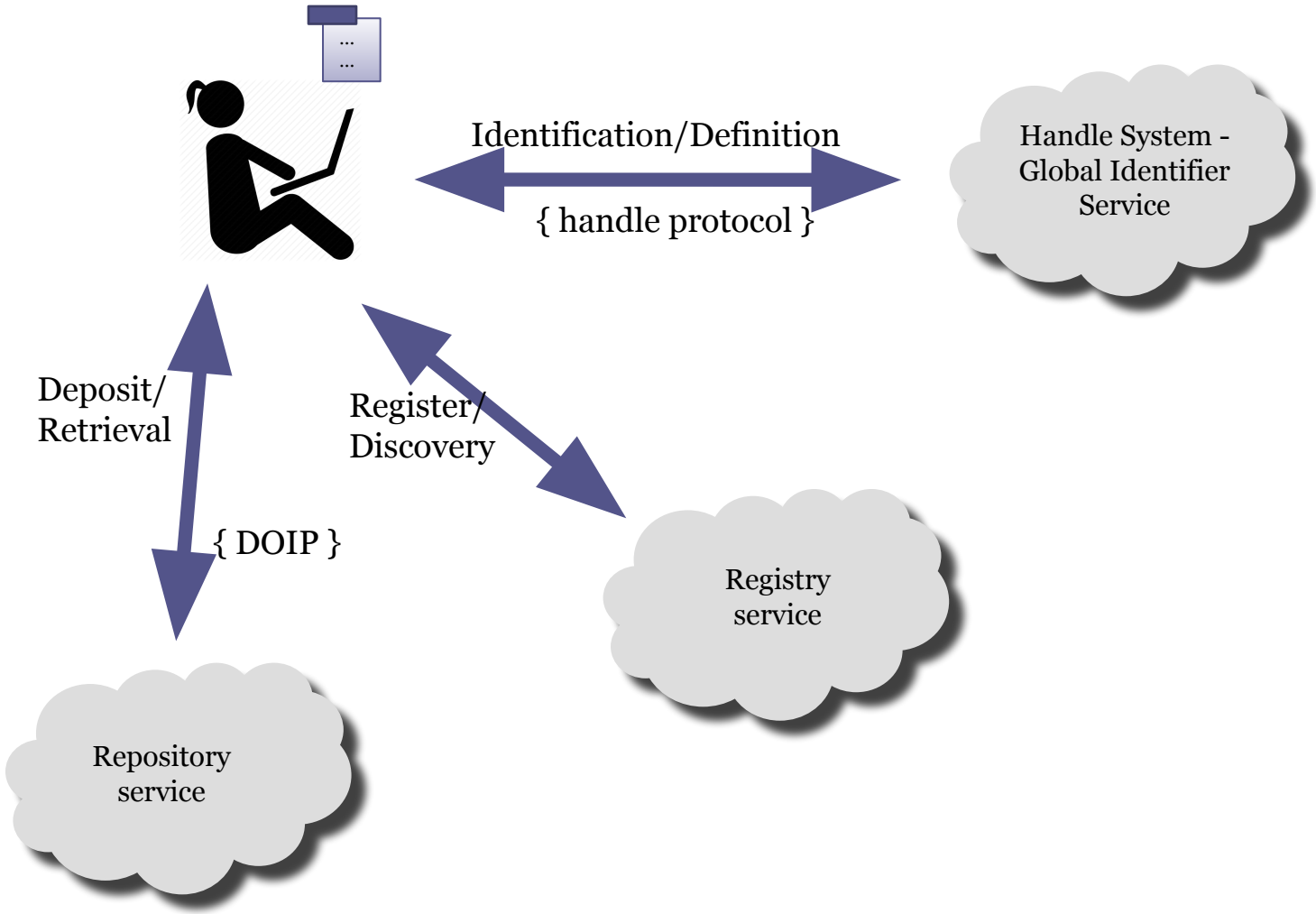
DOA Protocol Components

- DOA protocol components
  - DOIRP - Handle System protocol
  - DOIP protocol
- Handle System protocol – identification, resolution, definition and management of information
- DOIP protocol – Interaction among digital objects (e.g. deposit/retrieval of DO content)

DOA Infrastructure Services

- DO Identifier Services provides global unique identifiers for every digital object over the Internet, along with resolution, management, and access control interface.
- DO Registry Services facilitates lookup and discovery of digital object based on metadata information associated with the digital objects.
- DO Repository Services allow deposit, retrieval, and consumption of information encapsulated with the digital object, regardless of the underlying storage technology or location of the storage service.

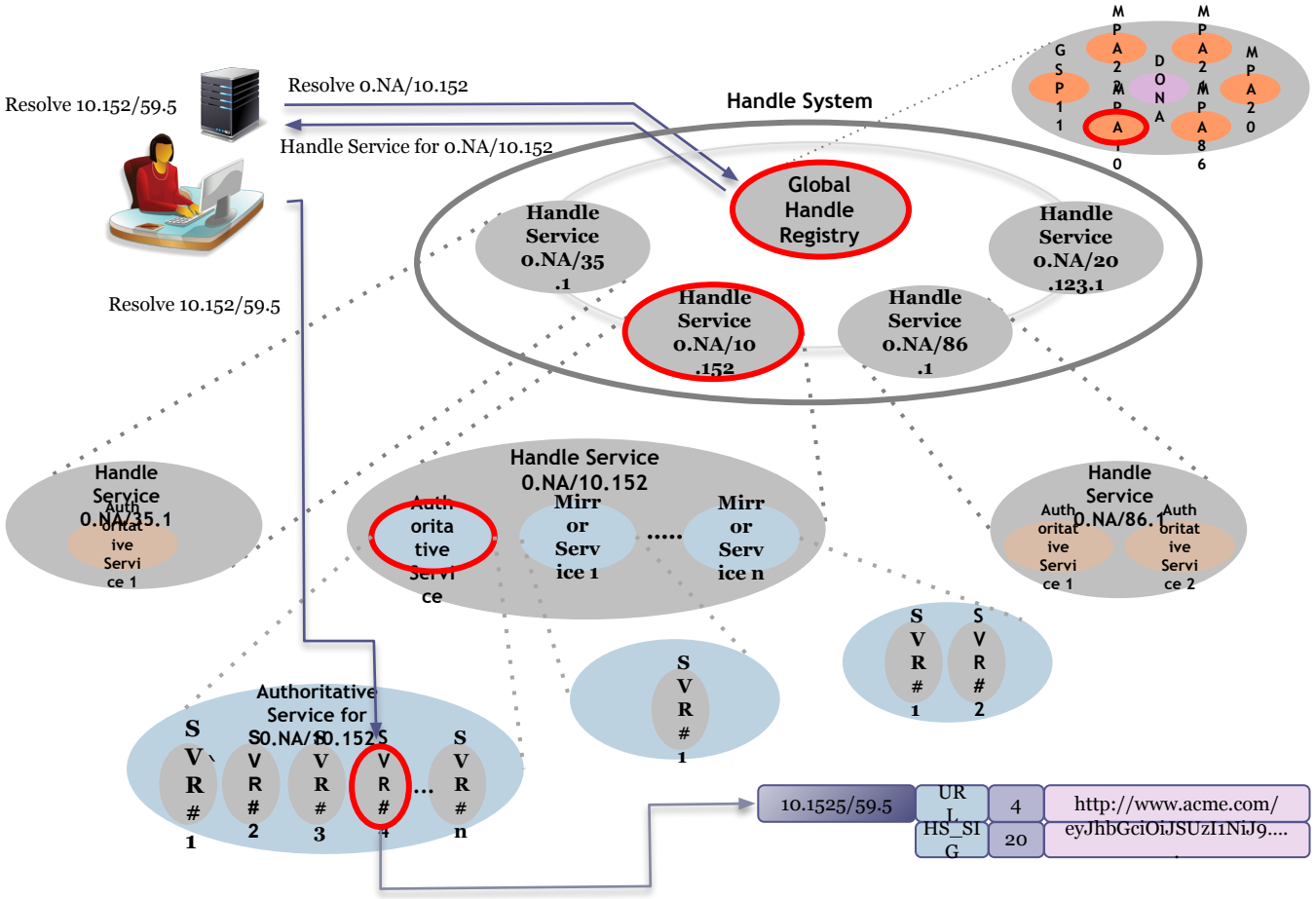
DOA Service Components



DOA: Handle System Overview

- A full-service protocol for both resolution and identifier administration
- Allows identification, definition, and management of information independent of applications.
- Secure identifier service for both identifier resolution and management

Handle System Overview



DOA: Handle Security Services

- Communication/transport security
  - Service integrity
  - Data confidentiality
  - Non-repudiation
- Distributed access control on information object
  - Authentication and authorization
  - Role-based/group-based access control
  - Discretionary ownership and information management
- Validation of credentials and trustworthy
  - Credentials and Block-chain

DOA is NOT:

- Intended to replace existing Internet architecture, but adds capabilities for service integrity, data confidentiality, and access control at the Internet infrastructure level.
- Proprietary technology, but rather supports an open framework consisting of a set of conceptual infrastructure services for secure information sharing
- Confined to specific implementations. Instead, it's a framework that supports interoperability among different implementations and information systems.

Government Roles in DOA/Handle:

- Support for infrastructure development
- Policies and guidelines for critical industry and government sectors
- Incentives for advancement of technology, security, and interoperability
- Education and promotion of new technology

DOA/Handle Applications & Application Platforms

IoT and Smart city

UK/China Smart building management
Smart automobile and smart parking
Real time traffic control and emergency response
Industrial supply chain management
Consumer industry – tracking and counterfeiting
Pharmaceutical/medicine industry

Cloud service and big data

DaaS integration and big data application
Integration with cloud service
E-government applications

(See conference proceedings on DOA Forum for details).

Real-Time Customs Information Exchange: AEO information exchange

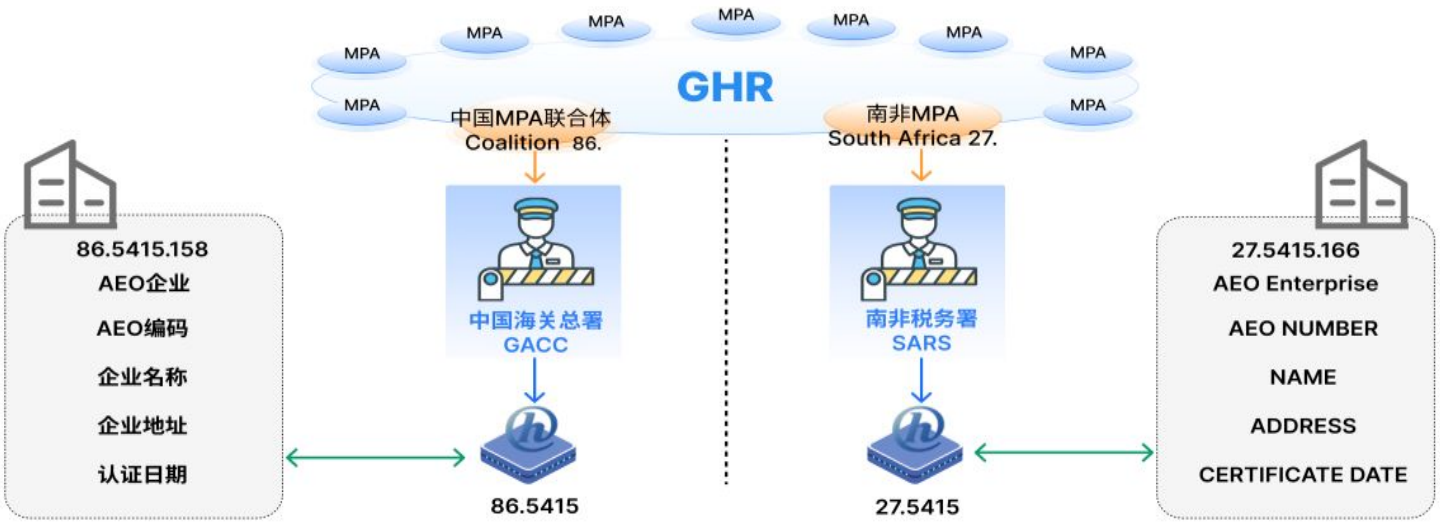
In 9/1/2023, SARS and GACC signed agreement on information exchange of

Authorized Economic Operator (AEO)

to promote trusted international commerce between the two counties.

A DOA based real-time information exchange system is developed to support such effort.

Real-Time Customs Information Exchange: AEO information exchange



Real-Time Customs Information Exchange: AEO information exchange

Handle based Information Router

- Distributed information management. Information ownership remains in each organization, in each country
- Secured information exchange (service integrity, data confidentiality, non-repudiation)
- Role based and location-based access control, multi-factor/multi-channel authentication.
- Customized management interface for AEO information registration and update.
- Plug and play solution – easy to deploy and low maintenance.

Real-Time Customs Information Exchange: AEO information exchange

Handle Barcode Scanner

- Automatic handle and DO pairing with existing barcode
- Secured data sharing made easy
- DO data collection on the spot (time,
- location, status, etc.)
- Full integration with handle-based information router

Real-Time Customs Information Exchange: AEO information exchange

Handle Camera

- Handle ID and DO for the digital camera
- Ownership and access control of video data defined via Handle System and Digital Object
- Real time video dissemination and control automation
- Full integration with handle-based information router

Redundant IoT devices at a traffic light

IoT device sharing in terms of a Digital Object

Description:
Bluetooth printer…

Print Service Request

Configuration Request

Enter service-token:

… ….

Submit

Conclusions:

- DOA provides a set of information-centric, rather than host-centric, Internet infrastructure services for Digital Objects.
- DOA is about interoperability between heterogeneous information systems, over different host boundaries, application boundaries, and organizational boundaries.
- DOA enables better security in information sharing and management.
- DOA promotes an public service architecture that allows every individual/organization to publish and manage their own information.

Thank you!