Merged draft on Requirements for NRS in ICN

ICNRG Interim meeting in Chicago

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Requirements for Name Resolution Service in ICN

- draft-jhong-icnrg-nrs-requirements-00
  - Two drafts are merged
    - draft-hong-icnrg-nrs-requirements-00
    - draft-dong-icnrg-nrs-requirement-00
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Purpose of this draft

- First, we try to achieve a consensus that NRS is the most essential service provided by the ICN infrastructure
  - Regardless of name resolution approaches
  - Regardless of NRS mechanisms
- Thus, in this document, we give the definition of NRS in ICN and discuss the motivation
- Then, we discuss the requirements in designing the NRS for ICN

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Name Resolution Service in ICN

- Name resolution is the first step of ICN routing in RFC 7927
  - ICN routing may comprise three steps:
    (1) name resolution : translates the name of the requested NDO into its locator
    (2) discovery : routes the request to the data object based on its name or locator
    (3) delivery : routes the data object back to the requestor

- The Name Resolution Service (NRS) is defined as the service that shall be provided by ICN infrastructure to help a requestor to reach a specific piece of content, service, or host using a persistent name

Three approaches on name resolution

- Standalone name resolution approach
  - The name resolution step in ICN routing is separated from the discovery step
    - Ex. DONA, PURSUIT, SAIL, MobilityFirst
- Name based routing approach
  - The two steps are integrated
    - Ex. CCN, NDN
- Hybrid approach
  - Name based routing approach can be performed from the beginning
    - When it fails at certain router, the router can go back to the standalone name resolution approach
  - Standalone name resolution approach can be performed to find locators of routers which can carry out the name based routing of the client's request

Comparisons of two approaches

	Standalone name resolution approach	Name based routing approach
Update overhead	- Updates propagation in part of the name resolution system	- Floods part of the network for update propagation - In the worst case, may flood the whole network
Resolution capability	- Guarantees the resolution if it is registered to the name resolution system	- Can only promise content resolution with a high probability, depending on the flooding scope
Node failure impact	- Node : name resolution system server - May cause some content resolution fail even though the content is available	- Node : routers maintaining name based routing tables - Does not exist because other alternative paths can be discovered to bypass the failed routers
Maintained databases	- Name to locator mapping in the name resolution system - Routing tables in the routers on the data forwarding plane	- Name routing table - Breadcrumbs for reverse routing of content back to the requester

Again,

- NRS is the most essential service which shall be provided by the ICN infrastructure
  - Regardless of name resolution approaches

- The comparisons of the two name resolution approaches are provided to motivate the requirements for NRS

Motivation of NRS

- Handling heterogeneous names in ICN
  - Hierarchical name such as URLs
  - Flat name such as self-certifying IDs
  - Human readable name
  - Non-readable name

- Handing Dynamism in ICN
  - Mobility
  - Multi-homing
  - Migration
  - Replication

Requirements for NRS

Use cases of NRS

- Flat name routing support in PURSUIT, SAIL, MobilityFirst
- Publisher mobility support in various projects in literatures
- Scalable routing support in NDNS (DNS for NDN)
- Manifest support for Nameless Objects in CCNx's

Use case 1 : Flat name routing support

- Flat name routing is not easy since flat names cannot be aggregated, which would cause more the scalability problem in routing system
- In literature, to address such problem, a flat name is resolved to some information which is routable through NRS
- PURSUIT
  - Names are flat and the rendezvous functions are defined for NRS, which is implemented by a set of Rendezvous Nodes (RNs), the Rendezvous Network (RENE)
  - NRS is performed by the RENE
- MobilityFirst
  - A name called a global unique Identifier (GUID) is flat typed 160-bits strings with self-certifying function
  - A global name resolution service (GNRS) resolves GUIDs to network addresses

Use case 2 : Publisher mobility support (1/2)

- Mobility in ICN
  - Consumer mobility
    - How to return requested data to a moving consumer
    - Supported naturally in ICN
      - Mobile consumer can always re-express interests after moving
  - Publisher mobility
    - How to forward Interest towards the data created by a moving publisher
    - More difficult to support since the routing tables need to be updated according to the publisher movement
      - Even more difficult in CCN/NDN due to the hierarchical name

Use case 2 : Publisher mobility support (2/2)

- Various ICN literatures adopt NRS to support the publisher mobility
  - NDN [ICNRG interim meeting, January 2016]
    - Design rendezvous mechanisms for interests to meet data generated by the moving publisher
  - Forwarding-label draft in CCN
    - Proposed based on separation between ID and Locator Names
      - The Mobility Service Controller (MSC) controls the Forwarding-Label Cache Table (FLT)
        - Caches the mapping between the name to the locator
  - MibilityFirst
    - Both consumer and publisher motilities can be primarily handled by the global name resolution service (GNRS) which resolves GUIDs to network addresses

Use case 3 : Scalable routing support

- Routing scalability issue in the DFZ of a ICN network

- Map-and-Encap system for NDN routing [TR, 2015]
  - Data whose name prefixes do not exist in the DFZ forwarding table can be retrieved by a distributed mapping system called NDNS (DNS for NDN)
    - NDNS maintains and lookups the mapping information from a name to its globally routed prefixes

Use case 4 : Nameless Objects support

- Nameless objects in CCNx
  - Content Object without a name may be retrieved by an Interest with a name and a Content Object Hash restriction
    - The name in the Interest is used for routing
    - ContentObjectHash is used to identify the content

- To publish a Nameless Content Object, one would first create a signed Manifest with an authoritative name in it
  - The Manifest would need to enumerate the possible content distribution names and the Nameless object's Content Object hashes
  - A specified method for Manifest lookup is needed, which is a kind of NRS

Questions?

Adoption as ICNRG work item?