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

<table>
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<tr>
<th></th>
<th>Standalone name resolution approach</th>
<th>Name based routing approach</th>
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| **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  
                          | - Node: routers maintaining name based routing tables  
                          | - May cause some content resolution fail even though the content is available  
                          | - 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  
                          | - Name routing table  
                          | - Routing tables in the routers on the data forwarding plane  
                          | - 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

• Handling Dynamism in ICN
  • Mobility
  • Multi-homing
  • Migration
  • Replication
Requirements for NRS

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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 an 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?