Outline

I. ICN-Ping
   I. draft-mastorakis-icnrg-icnping-00

II. ICN-Traceroute: additions/changes vs. ICN-Ping
   I. draft-mastorakis-icnrg-icntraceroute-00

III. Security Considerations
I. ICN Ping

draft-mastorakis-icnrg-icnping-00
Functionality (by analogy with ip ping)

• Target Flavors
  – Is an ICN forwarder reachable?
  – Is a producer application reachable?
  – Is a cached object reachable?

• RTT measurements
  – Run several pings and provide times for each response
Reachability

• Is an ICN forwarder reachable?
  – Forwarders need names
  – Forwarder names must be routable
  – Forwarder names must be well-known

• Is a producer application reachable? Where?
  – What does it mean for an application to be reachable?
  – What name(s) would be used to determine if an application is reachable

• Is a cached object reachable? Where?
  – What does it mean for a cached object to be reachable?
  – What name(s) would be used to determine if a cached object is reachable?
Multipath

• E.g. RTT measurements in presence of multipath?
  – Path Identification
    • PathId TLV in Data Message packet header
  – Path Steering
    • PathId TLV in Interest Message packet header causes Interest to follow the reverse path of the Data Message that returned the PathId
  – Path Discovery
    • For Interests sent without PathIds, forwarders will switch Interests, making a probabilistic choice among next hops.
Echo Request/Reply Contents/Purpose

• Echo request
  1. Target Name
  2. PathId
  3. CS bypass

• Echo reply
  – Responding forwarder name
  – Return code (type of reachability, 1-3)
  – Is reply signed or unsigned?
Packet Formats and Processing Procedures

• Re-use Interest/Data/IntReturn Message Types
  – Largely match Int/Data forwarding semantics
    • Avoid aggregation with other pings or with Interests: Include random nonce in name
    • Avoid CS caching of response: ExpiryTime TLV=0
    • Header PathId for identification/steering (not restricted to echo)

• Echo Request/Reply Packet types
  – Quick identification of ping messages
  – Allows forwarding semantic differences
    • Application node response from forwarder, i.e. Interest not passed to locally attached target application
    • Transit node CS bypass, e.g. using Hash restriction

• Matching can optionally be FIB LPM-based (e.g. add entry for local router name to FIB, with internal next-hop)
II. ICN Traceroute
draft-mastorakis-icnrg-icntraceroute-00
Functionality (by analogy with ip traceroute)

• **Target Flavors**
  – What is the path to an ICN forwarder?
  – What is the path to a producer application?
  – What is the path to a cached object?

• **Path hop-by-hop RTT measurements**
  – Run several protocol exchanges for each hop and provide times for each response

• **High overlap with ping functionality/mechanisms/procedures**
Differences with Ping Proposal

• Two packet types: TracerouteRequest, TracerouteReply
• Core mechanism based on HopLimit Expiry (as with ip traceroute)
  – Additional reply code from responding forwarder: HopLimitExpired
III. Security Considerations
Security Considerations

• Threat Model Choices:
  – On-path/Off-path
  – Reflection attacks

• Response messages: Signed or Unsigned?
A. Backup Slides
Packet Formats: Echo Request

<p>|     | Version | EchoRequest | PacketLength |</p>
<table>
<thead>
<tr>
<th></th>
<th>HopLimit</th>
<th>Reserved</th>
<th>Flags</th>
<th>HeaderLength</th>
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<td>PathSteering TLV</td>
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<td>Echo Request Message TLVs</td>
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</table>
Packet Formats: Echo Reply

0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1

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|               |               |               |
|    Version    |    EchoReply  |    PacketLength|
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|               |               |               |
|             Reserved             |     Flags     |  HeaderLength |
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|                    Echo Reply Message TLVs                     |
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Packet Formats: Traceroute Request

0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1

+---------------+---------------+---------------+---------------+
|     Version   | TrRequest     | PacketLength  |
|               |               |               |
+---------------+---------------+---------------+---------------+
| HopLimit      | Reserved      | Flags         | HeaderLength  |
+---------------+---------------+---------------+---------------+
/                                                               /
/                                                               /
| PathSteering TLV |
/                                                               /
/                                                               /
+---------------+---------------+---------------+---------------+
| Traceroute Request Message TLVs |
+---------------+---------------+---------------+---------------+
Packet Formats: Traceroute Reply

|     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1  |
| +---------------+---------------+---------------+---------------+---------------+--------------- |
|               |               |               |               |               |
|    Version    | TrReply       | PacketLength  |
|               |               |               |               |               |
|               |               |               | Reserved      |
|               |               |               | Flags         |
|               |               |               | HeaderLength  |
|               |               |               | PathSteering TLV |
|               |               |               | Traceroute Reply Message TLVs |

Diagram:

- Version
- TrReply
- PacketLength
- Reserved
- Flags
- HeaderLength
- PathSteering TLV
- Traceroute Reply Message TLVs
Path Identification and Steering

A flow consists of multiple subflows. Each subflow’s path reports its own $R_{sf}(t)$

- What entity tracks a flow’s multiple subflows and their current $R_{sf}(t)$?
  - Consumer endpoint (application/application-library), the only entity given stated goals and assumptions
  - Significant extra responsibility for consumer vs. single-path situation

- How does consumer endpoint identify subflows and per-subflow $R_{sf}(t)$?
  - Path identifier, reported in Data message

- How are consumer endpoint’s decisions about per-subflow rates honored for the consumer’s Interests?
  - Path identifier, reflected back in Interest

- How are subflows discovered?
  - Interests without path identifiers must be sent initially/periodically
  - Forwarders with multiple next hops choose probabilistically

- Path Identification mechanisms have other possible uses, e.g. for ICN ping performance measurement.