CCN/NDN Protocol Wire Format and Functionality Considerations

G.Q.Wang[1], Christian Tschudin[2],
Ravi Ravindran[1]
(ICN-RG, Hawaii, IETF-91)
[1] Huawei, Santa Clara, USA
[2] University of Basel, Switzerland

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Agenda

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- Elastic TLVs
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- Caching as a service
- Context Handling
- Summary

Motivation

- TLV discussions are primarily considering performance requirements.
- Future Internet Architecture has to accommodate other requirements too.
  - Flexibility
  - Scalability
  - Expressiveness

  which needs support at the wire format level
- Following are some of these requirements for future considerations.

Flexible TLV Schema(s)

- "One TLV to rule them all" is bad. Need support for a multiplicity of TLV schemas:
  - one (or few) TLV format for the fixed header
  - potentially many TLV flavors in the option fields and payload
    (policies might restrict what a net accepts, but the functionality is very useful)
- Examples:
  - To support Backward Compatibility and Service Expressiveness
  - forward a CCNx2.0 payload through a CCNx1.0 net
  - forward a NFN thunk [1] representation through CCNx1.0
  - Service composition [2]
- Relies on a generalized "name-to-forward-on" schema, see the "forwarding target pointer" slide later on

[1]Minolakis Sifalakis, Basil Kohler et al, "An Information Centric Network for Computing the Distribution of Computations", ICN, Siggcomm, 2014.
[2] Peyman Talebifard, Ravi Ravindran et al "Towards a Context Adaptive ICN based Service Centric Framework", Qshine, Q-ICN, 2014.

Elastic TLV for CCN

Variable “Length” definition to accommodate heterogeneous application/device/interface-capability contexts e.g. Optical, IoT

- One possibility to support *large* PDUs

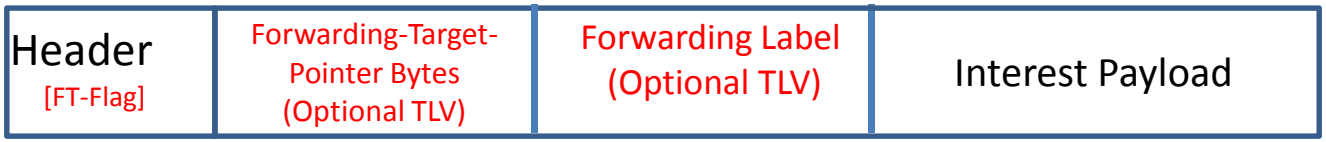
(00) B/Unit-Size
(01) KB/Unit-Size
(10) MB/Unit-Size
(11) GB/Unit-Size

• The proposal keeps it simple, in terms of limiting over head to 2/2 Type and Length, while using two bits to determine granularity of the payload.

• The selection of the *per-unit* resolution can be chosen by the application, based on the feedback from ICN forwarding layer, based on strategic path level feedback.

Forwarding Target Pointer (a.k.a Locator)

- Allow **Interest forwarding** to operate on something other than the Interest name proper (which nevertheless stays in the packet)
- ICN Name, or Flat Label, or …
  - /huawei/g.q/phone → /att/sc/ap-x [1]
  - alternate name or flat label for mobility mechanisms like Kite [2]
- Supports mobility, late-binding, or other application-centric requirements.
- **Proposal** (examplified for CCNx1.0):
  store the name bits, as well as the pointer, as optional hdr TLVs



- An **FT-flag** indicates the presence of a Forwarding Target Pointer.
  The first optional hdr- field MUST be the FTP (quick access at fixed pos.)
  `T={Forwarding-Target-Pointer} L=sizeof(offset) V={offset-of-"FT-Bytes"}`

- The name or label bits can be anywhere in the optional header field area:
  `T={Name-or-Label-Type} L=sizeof(name-or-label] V={name-or-label bytes}`

- **Hdr-Len field is still used to access the payload (and its Name-TLV)**

[1] Aytac Azgin, Ravi Ravindran, G.Q.Wang, "Scalable Mobility-Centric Architecture for Named data Networking", IEEE, CCNC (SCENE Workshop), 2014

[2] Yu Zhang, Hongli Zhang, Lixia Zhang , "Kite: A Mobility Scheme for NDN", ICN Siggcomm, 2014

Header Compression

- Hooks for header compression, especially for names. But *encoding context switching* could also be used for type dictionaries as in ccnb.
- **Others do it too:**
  Remember MNP5 from old modem times[1], TCP header compression, UDP ROHC [2], and 6LoWPAN?

- Examples:
  - Ask downstream node to accept “name abbreviations”. The name mappings would be stored in a “context”, hence the need for a “contextID” field in the fixed header.
  - IoT setting: use a 1+1 TLV schema internally, the gateway will expand it to 2+2 for the rest of the world.

[1] http://en.wikipedia.org/wiki/Microcom_Networking_Protocol
[2] RFC 1144, RFC 2058, RFC 4019 (Robust Header Cmopression)

Caching as a Service

- CCN/NDN domains may not have any caching at all.
- Or domains could enable caching/storage only at the edges.
- Recent PARC document [1] on distributing PIT/CS and FIB functionality.
- Introduce packet processing complexity where it is more useful.

[1]http://www.ccnx.org/pubs/hhg/5.1%20CCNx%201.0%20Implications%20for%20Router%20Design.pdf

Shareable versus Non-Shareable

- Non-Shareable content (e.g. coversational, transactional) can be on fast path without PIT/CS processing.
  - As communication is bi-directional, optional source-ID can be included.
- **As Optional Header TLV**

Ravi Ravindran, Asit Chakraborti, Xinwen Zhang, G.Q.Wang, “Supporting Dual Mode Forwarding in Content Centric Networking” IEEE, ANTS, 2011

Using Selectors

- Selectors as a Optional feature.
  - Implication on the PIT design
- Selectors can be avoided in the network infrastructure with authoritative sources exist.
- Selectors are useful where authoritative source doesn’t exist, and learning from cache or source is the only option.
  - Discovery Services, Inventory in Home, Campus etc.
  - Ad hoc V2V, IoT scenarios
- Should be a Protocol Feature that can be optionally enabled

Context Handling

- Provision to include context metadata that can be processed in the Network Layer.
  - Contexts includes Identity/Location/Device etc.
  - Attachment to a Service Instance
  - Discovering Content/Services
  - Policy based Routing/Forwarding
  - **Optional Interest TLVs**

Summary

- CCN/NDN Protocol design not just on performance, but also on flexibility, scalability, and expressiveness.
- Several considerations laid out to be accounted for current design and future enhancements.
- Eventual consensus between CCN and NDN, do not desire two versions of the same protocol.