ICN Packet Format Design Requirements

presented by Alex Afanasyev

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Why The Requirements?

• This draft is not about any specific packet format designs
  – ICN is still in active research stage
• Our goal is to identify general requirements for ICN packet format
  – what are the requirements of the format
  – how these requirements should be ordered
  – what are the tradeoffs between various designs
• Learn and apply lessons from the past
Identified Requirements for ICN Packet Format

1. Universality / elasticity
2. Flexibility and extensibility
3. Processing efficiency
4. Auditability / robustness
1. Universality / Elasticity

• Packet format should be able to support a wide diversity of usage scenarios and underlying network technologies
  – constrained IoT environments
  – ultra high speed network channels

• Lessons from the past
  – shortage of IPv4 called for IPv6
  – overhead of IPv6 in IoT called for 6LoWPAN
2. Flexibility and Extensibility

• ICN is in research stage
  – experimental nature
  – not all required functions are identified yet
• Packet format should stay flexible
  – allow addition of new elements
  – allow removal of elements no longer necessary
  – minimize the number of required fields

• TLV encoding offers these properties
  – emerged from many years of IETF protocol development experience
3. Packet Processing Efficiency

- Packet format should support efficient processing
- However processing efficiency has conflict with other requirements
  - variable length fields $\rightarrow$ higher processing cost
  - fixed header can help reduce processing cost $\rightarrow$ reduced universality and flexibility

- We are designing ICN for the future
  - new applications will come over time
  - technologies will move forward with time
  - new approaches to hard problems will be discovered over time
4. Auditability / Robust Design

- Unique type code for all network level TLVs facilitates packet audit without tracking the semantics of each nested TLV level

- Tradeoffs between
  - reduction of implementation errors
  - implementation complexity of network debugging tools (tcpdump and wireshark)
  - required coordination
    - coordination can be separate (and not required) for app- and vendor-specific TLVs
5. ICN Packet Format elements (Classes Of Information in the Packet)

- Information-centric elements
- Transport elements to assist multi-hop information retrieval
Information-Centric Functions

• ICN uses application-level data units at network level
• ICN packet format: representation of data and request for the data
  – name
  – name constraints
  – payload
  – security context
  – security context constraints
• These are the only elements that producers and consumers need to communicate in terms of data
Information Retrieval Over Wide Area

• Additional information may be necessary to aid the retrieval
  – kill requests traveling “indefinitely” in the network
  – Problem reporting between neighbor nodes (e.g., NACK)
    • trigger exploration of alternative path
  – AS-level traffic engineering/QoS support
  – Fragmentation/reassembly

• Note that the elements not directly related to the information itself
ICN Packet Format Functions
(Classes Of Information in the Packet)

• How to encode these elements in ICN packet?
  – single spec
  – two separate complementary standard specs

• Tradeoffs
  – Single spec easier to implement → may require inclusion of unnecessary elements
  – Separate specs give maximum flexibility and allow separate evolution of ICN and transport functions → require separate standardization
History of IP Address Space Design

IEN 28
(February 1978)

DAL: destination address length; SAL: source address length
History of IP Address Space Design

IEN 28
(February 1978)

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IEN44
(June 1978)

DAL: destination address length; SAL: source address length

03/22/2015  ICNRG
According to David Clark:

• “Back then we knew that a 4 byte address would be too short in the long run, and proposed a variable length address.”
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• “Back then we knew that a 4 byte address would be too short in the long run, and proposed a variable length address.

• “The guys doing the coding protested that it would be too complex to parse the variable length header (too slow to process the packet) and demanded a fixed length header so they did not have to work their way through the header…”
Thanks