ICN Packet Format Design Requirements

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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 → higher processing cost
  - fixed header can help reduce processing cost → 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

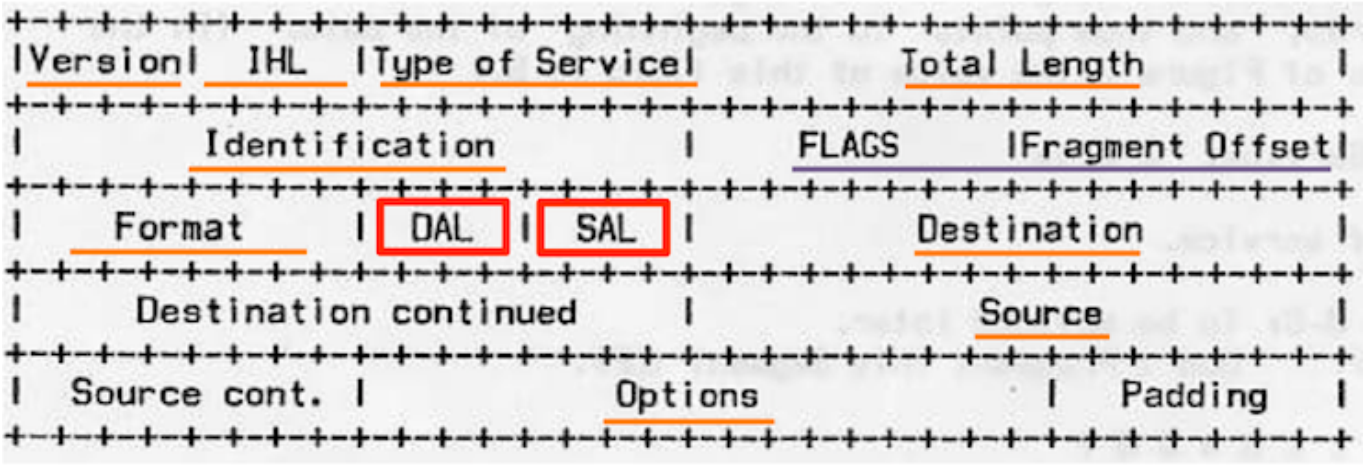
ICN Packet Format Functions (Classes Of Information in the Packet)

- 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

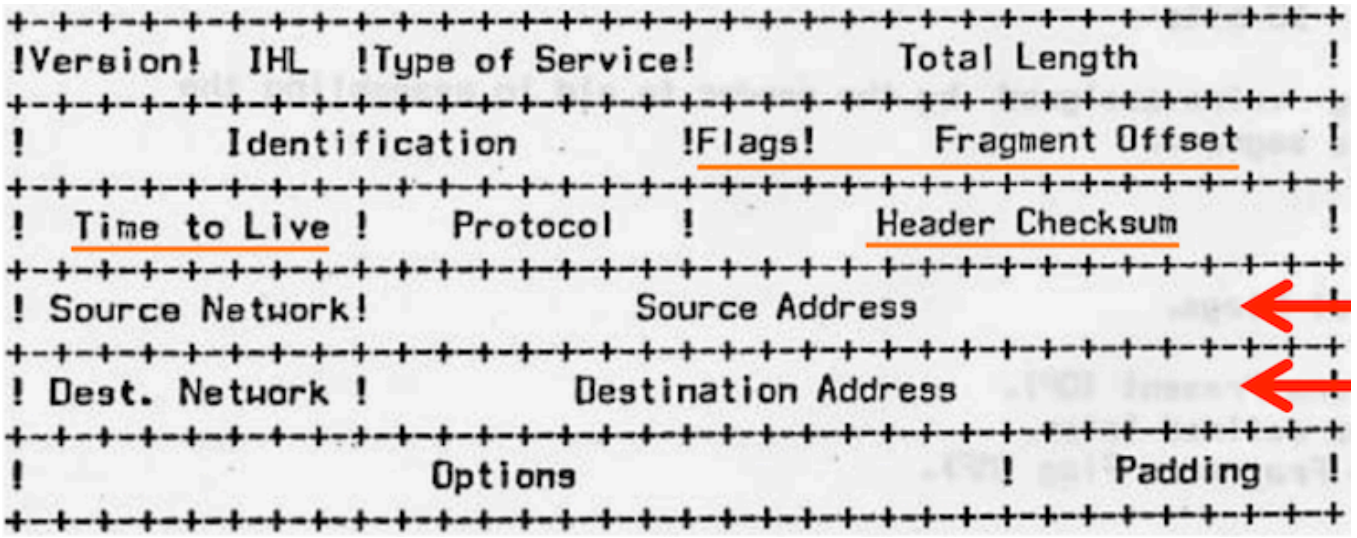
History of IP Address Space Design

IEN 28
(February 1978)



DAL: destination address length; SAL: source address length

IEN44
(June 1978)



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.
- "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