QoS in Information-Centric Networks

Disaggregated Name Component Approach

https://www.ietf.org/id/draft-anilj-icnrg-dnc-qos-icn-02.txt

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Update Summary

- Discussion on network resources to be controlled
  - Link, Content Store, Forwarder Memory, Compute
- QoS treatment types and the network resource they influence
- Encoding of QoS marker in the hop-by-hop header
- Improved PIT state design for the QoS marker
- Improved QoS remarking scheme
- Editorial improvements

QoS Treatment and the Network Resources

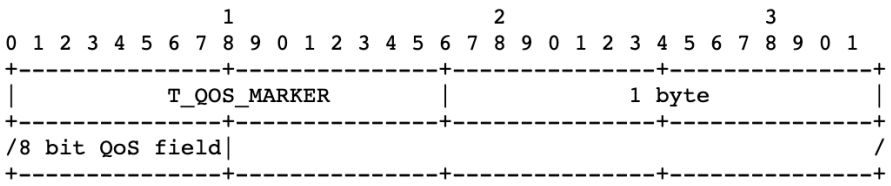
Resource Type	Use in ICN
Link Capacity	Packet priority queues
Content Store Capacity	Cache the content data chunks
Forwarder Memory	Pending Interest Table (PIT) storage
Compute Capacity	CPU cycles for FIB, PIT, and CS lookups

QoS Treatment Type	Type of Resource and Influence
Reliable delivery	++ CPU - utilization to handle errors ++ Queues - for multi-path forwarding ++ Cache - utilization for short term
Low Latency delivery	++ CPU - utilization to handle errors ++ Queues - for multi-path forwarding ++ Cache - replace cache entries ++ PIT - replace low priority PIT entries in saturated PIT
Mobility event	++ Cache - update cache at next forwarder
Bursty data	++ Queues - allocation of link capacity
Search data	++ Queues - for multi-path forwarding ++ CPU - utilization to handle errors

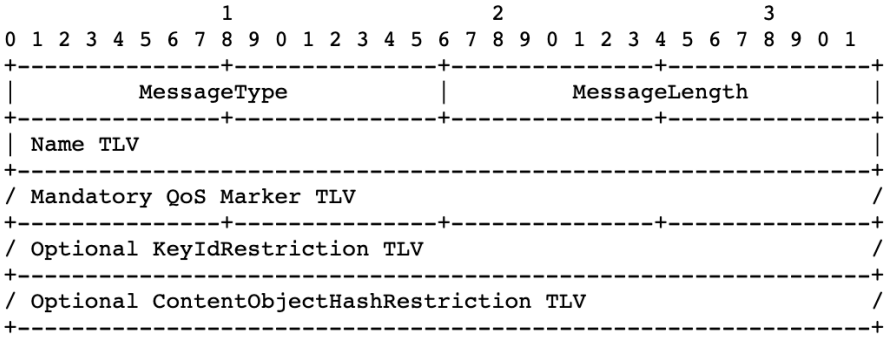
- ICN network resources to be managed

- QoS treatment types and the network resource they influence
- ++ indicates an increased resource use
- Trade-offs in modelling of QoS treatment
  - The number of traffic classes given the memory and processing capacity
  - The expressiveness of the QoS treatment to the protocol encoding and algorithmic implementation

QoS Marker Inside Hop-by-Hop Header

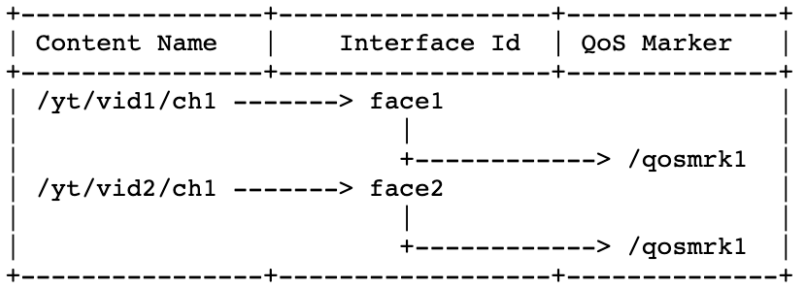


- Bit-wise structure of the QoS Marker
- Lower 1 byte of the TLV is used to encode the QoS marker information



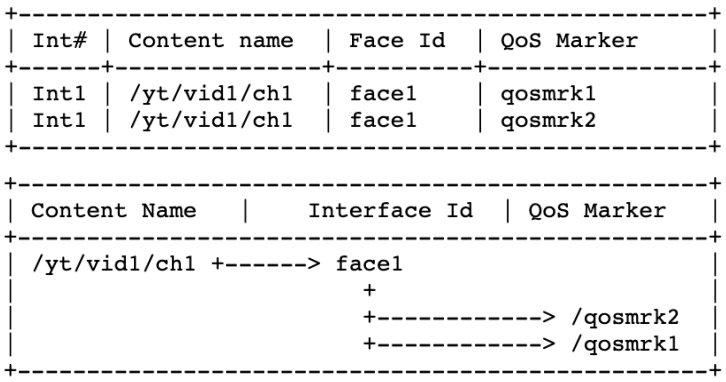
- Interest Message with QoS Marker TLV
- QoS Marker encoding as a mandatory hop-by-hop header

QoS-Aware Forwarder/PIT Design

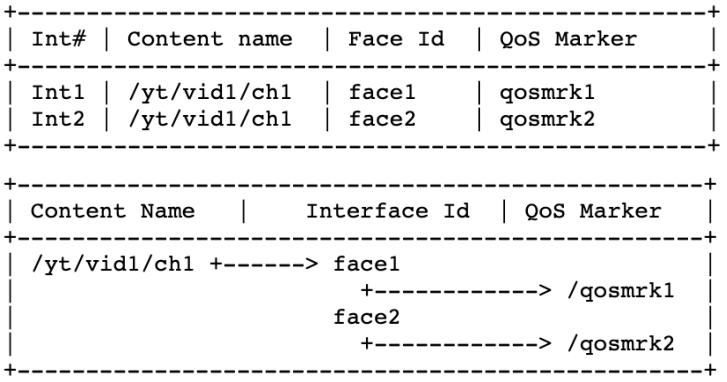


- QoS attribute is preserved and mapped as an interface property on which the Interest is received
- The interface data structure (in PIT) can be enhanced to save the QoS marker state

QoS-Aware Interest Aggregation in PIT



Case-1: A duplicate Interest with higher QoS markers is received on the *same* interface



Case-2: A duplicate Interest with higher QoS markers is received on the *different* interface

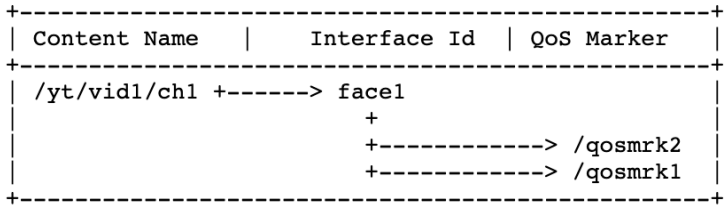
Forwarder forwards the (duplicate) Interest with a higher QoS marking and updates the interface entry in PIT with the higher QoS marking

PIT aggregation is relaxed in this case

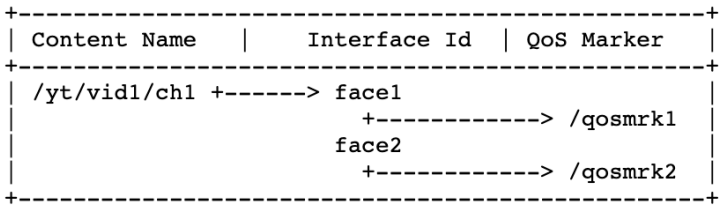
Only Interests with lower QoS marking are aggregated

QoS-Aware Data Delivery at PIT

- Data delivery at PIT does not change with the addition of the QoS marker



- In case-1, data packet is forwarded on downstream interface with the higher QoS marking recorded at the interface



- In case-2, data packet is forwarded on downstream interface with the actual QoS marking recorded at the interface

Summary & Future Work

- Propose concrete QoS markers and the definitions
- Discuss the QoS remarking and related protocol encoding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