Thoughts on QoS for the Constrained IoT

draft-gundogan-icnrg-iotqos-00
IETF 104, Prague

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March 29, 2019

Motivation for QoS in IoT

Constrained Devices
- ▶ Class 2 devices [RFC7228]: $\approx$ 50 *KiB RAM*, $\approx$ 250 *KiB ROM*
- ▶ Battery-operated with limited energy capacity

Low-power Link Layers
- ▶ Low bandwidth & high latency
- ▶ Restricted MTU sizes
- ▶ Wireless broadcast media $\rightarrow$ susceptible to cross-traffic

$\Rightarrow$ **available resources quickly exhaust, uneven network utilization**

Manageable Resources in an Information-centric IoT

- ▶ Link layer resources: Media access, buffer space
- ▶ PIT resources: Open request placement & replacement
- ▶ CS resources: Content object placement & replacement

Thoughts on Link Layer Resources

Link Layer Resource Management
- ▶ Media Access: Balance available resources + duty cycles
- ▶ Latency: Prioritize packets in forwarding buffers

Cooperative Management
- ▶ Pre-allocate resources for returning data
- ▶ Release resources when no traffic is expected

Thoughts on PIT Resources

PIT Resource Management

- ▶ Latency: Initial PIT entry placement based on priorities
- ▶ Reliability: PIT entry replacement based on priorities

Cooperative Management

- ▶ Notify last hop about evicted PIT entries (Interest NACK)?

Thoughts on CS Resources

Content Cache Resource Management

- ► Latency: Place content closer to consumer
- ► Reliability: Replicate content to multiple content stores

Cooperative Management

- ► Optimize local memory consumption by cooperative caching

Building Blocks for QoS in an Information-centric IoT

1. Lightweight traffic flow classification
2. Priority handling:
   - Link layer resource control mechanisms
   - Interest and Data message flows **(short term)**
   - Content objects in CS **(long term)**

Lightweight Traffic Flow Classification

- ▶ Each device maintains list of prefixes (flow classes)
- ▶ Longest prefix match defines flow class
- ▶ No flow class marker in packets to prevent message overhead

Trafic Classes

/org

/org/example$_A$

/org/example$_A$/site$_A$/temp

/org/example$_A$/site$_B$/humid

/org/example$_A$/site$_C$/alarm

Interest & Data Name TLV

/org/example$_B$/site$_A$/temp

/org/example$_A$/site$_A$/temp/yesterday

/org/example$_A$/site$_A$/temp/today

/org/example$_A$/site$_D$/humid/now

Priority Handling

Latency

- ▶ Priorities: regular, expedited
- ▶ Affects forwarding buffers, PIT entry placement **(short term)**
- ▶ Affects content object placement in CS **(long term)**

Reliability

- ▶ Priorities: regular, reliable
- ▶ Affects L2 corretive actions & PIT entry replacements **(short term)**
- ▶ Affects content availability in network **(long term)**

Outlook

- ▶ Initial draft -00 submitted: Quality of Service for ICN in the IoT
- ▶ Implementation in preparation: RIOT + CCN-lite and testbed measurements