Quality of Service for ICN in the IoT

draft-gundogan-icnrg-iotqos-01
IETF 105, Montreal

Cenk Gündoğan[1] Thomas Schmidt[1] Matthias Wählisch[2]

Michael Frey[3] Felix Shzu-Juraschek[3] Jakob Pfender[4]

[1]HAW Hamburg

[2]Freie Universität Berlin

[3]Safety IO

[4]VUW

July 21, 2019

Draft Positioning & Update

Positioning

- `draft-moiseenko-icnrg-flowclass-03`
  - Proposes two methods for flow classification based on names
  - Uses indicators (additional TLV / name components) to map prefix to class
- `draft-anilj-icnrg-dnc-qos-icn-00`
  - Uses name components to indicate routable part of name
  - Consumer adds QoS markers to non-routable part
  - Prefix matching of *PIT*, *CS*, *FIB* is adjusted accordingly
- `draft-gundogan-icnrg-iotqos-01`
  - Uses longest prefix match against preconfigured list for flow classification
  - **Focus:** Balance resources (link-layer buffer, CS, PIT) using correlations

Update: 00 $\Rightarrow$ 01

- Elaborate on *Distributed QoS Management*

Distributed QoS Management

1. Locally Isolated Decisions
2. Local Resource Correlations
3. Distributed Resource Coordination

Locally Isolated Decisions

Decisions that have no interactions with other mechanisms (local, remote)

- Prioritized forwarding
  - Prompt vs. regular forwarding queues
  - Delay regular traffic for prompt traffic
- PIT Management
  - Prompt vs. regular priorities
  - Evict regular traffic for prompt traffic, if saturated
- Caching decisions
  - Reliable vs. regular priorities
  - Evict regular content for reliable content, if saturated

Local Resource Correlations

Decisions that entail interaction between mechanisms on the same device

- Arriving Data meets valid PIT entry
  - Reliable Data is cached with priority
- Arriving Data meets no valid PIT entry
  - Prompt Data is cached with priority (Interest retransmissions are likely)
- Forwarding Data is dropped intra-stack (L2 error, buffer overflows, ...)
  - Prompt Data is cached with priority (Interest retransmissions are likely)

Distributed Resource Coordination

Decisions that affect resources across multiple devices

- PIT coherence
  - Same PIT eviction strategy at all nodes
  - regular $<$ reliable $<$ prompt
- Cache efficiency
  - Same caching decision parameters at all nodes
  - regular $<$ reliable
  - Probabilistic caching: coordinated equal weights

Experimental Evaluation

Setup

- Multi-hop topology with 31 nodes (IoT-Lab testbed)
- RIOT & CCN-lite

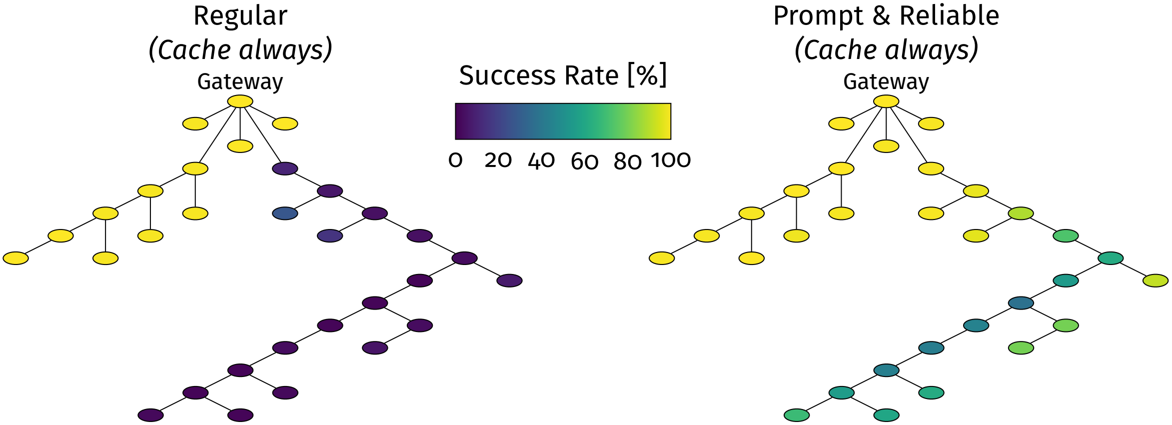
Scenario 1: Mixed Sensors and Actuators

- Gateway requests **device-specific** temperature readings every 10 s $\pm$ 2 s
- Actuators request **device-specific** state from gateway every 5 s $\pm$ 1 s

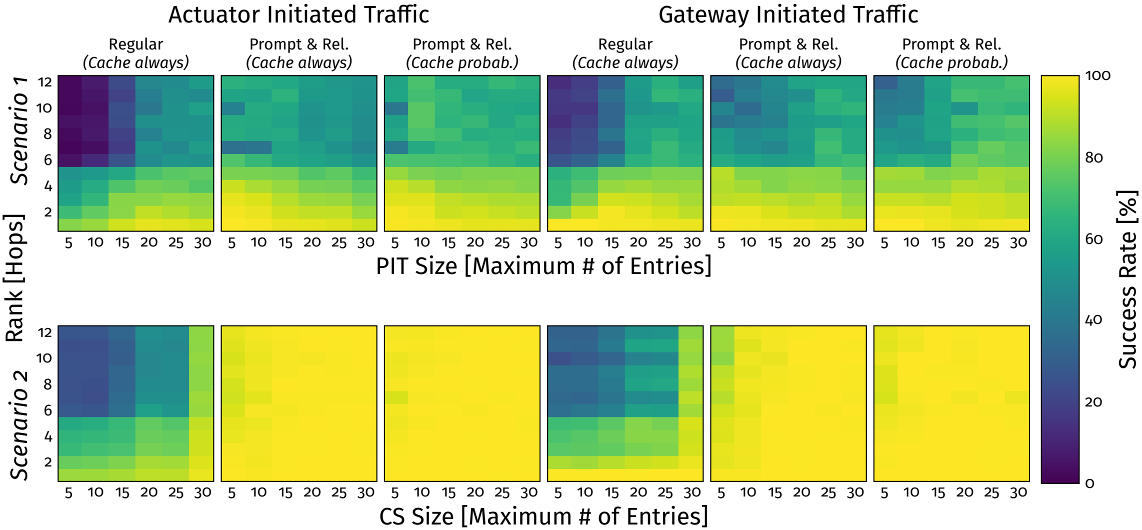
Scenario 2: Sensing and Lighting Control

- Gateway requests **device-specific** temperature readings every 10 s $\pm$ 2 s
- Actuators request **group-specific** instructions from gateway every 5 s $\pm$ 1 s

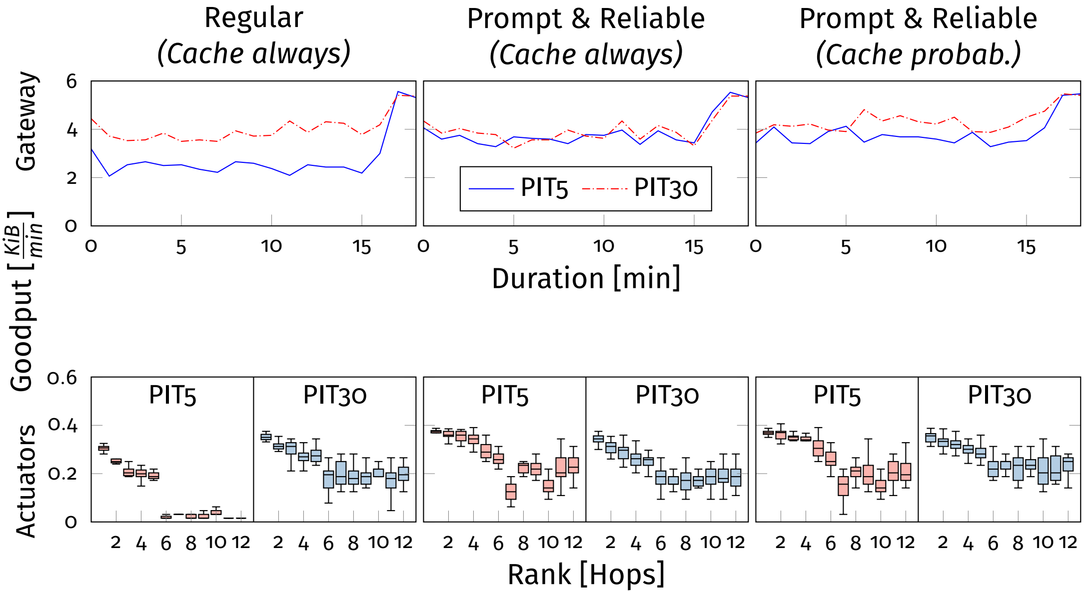
Scenario 1: Nodal Success Rates (PIT5, CS5)



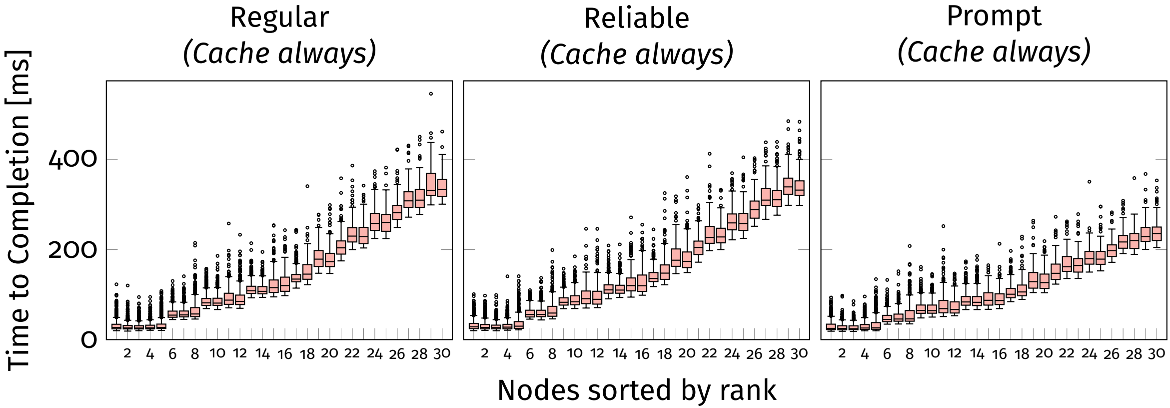
Scenario 1 & 2: Success Rates for Varying PIT & CS Sizes



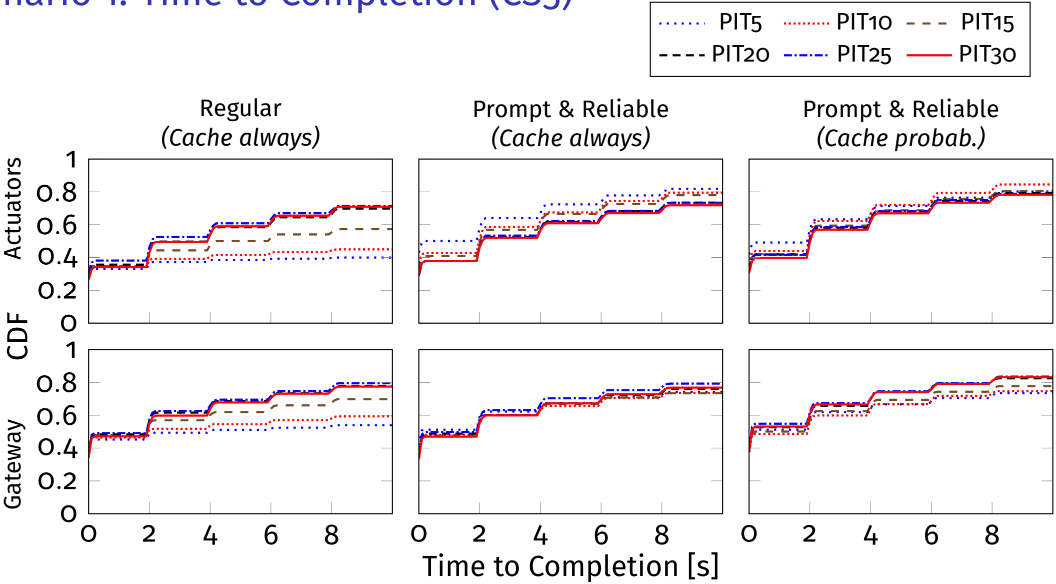
Scenario 1: Goodput Evolution



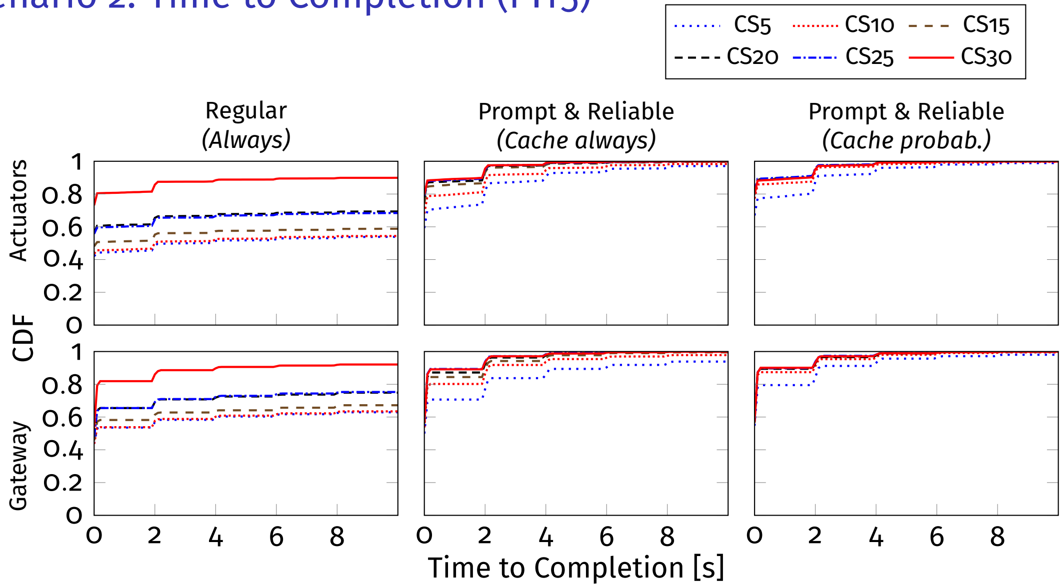
Scenario 1: Time to Completion per Node (PIT30, CS5)



Scenario 1: Time to Completion (CS5)



Scenario 2: Time to Completion (PIT5)



Conclusion & Outlook

- QoS in NDN is not confined to simple resource trading
- PIT and cache space have prevailing effects on overall network performance
- Treating Interest as well as Data messages is vital for resource coordination

Next Steps

- Elaborate on correlations between caching decision and cache replacement