



COIN

Computing in the Network Update

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COIN

- Our goal:
Foster research in computing in the network to improve performance for networks and applications
- Focus:
 - Architectures
 - Protocols
 - Real-world use cases, applications, work in progress

Background

- Evolution towards COIN and common interests
 - Active Networking in the 1990s
 - Data Center orchestration (Paxos)
 - Tofino switches and P4
 - Edge computing
 - Information Centric Computing (ICN)
 - Named Function Networking (NFN)
 - Distributed networks
 - Compute –first-networking
 - Embedded AI/ML
 - And large body of research in new services and applications that cannot use the cloud alone (AR/VR, transportation, industrial control and automation, precision and vertical agriculture, tactile internet etc.)

Our History

- Our meetings
 - Montreal 2018, Infocom 2018 and Usenix NSDI 2019
 - Bangkok, Prague and Montreal 2019 – PRG meetings
 - 2 web-based interims
 - 2 hackatons (P4 and data filtering) in Montreal and Singapore
 - Meeting in Singapore – on Friday!
- Our collaborators:
 - A good mix of computer scientists, applications developers and implementors and industrial R&D

Our Work Matrix: The Cloud-to-Edge Computing Continuum

The need for a cloud-to-edge computing continuum goes hand in hand with the need to support computing-in-the-network (COIN)



More Implications/Questions

- Where in the HW/FW/SW stack will the Compute expect to be performed?
 - Not all “Network boxes” will perform Network-related functions
 - What does it mean to perform packet processing?
 - Compute may need to be optimized to handle packet content (vs just packet headers)?
 - What does programmability of these Network elements look like?
- For truly improved performance, Network functionality needs to be designed to “play well” not only with Compute, but also with Storage!
 - Networks are becoming more than “just” Networks
- Developers/users don’t want to have to specify where exactly COIN will run in the Cloud-to-Edge computing continuum
 - They just want the task requirements to be met
 - And something/somewhere to figure out the placement of the task components (for good-enough, improved, or optimal performance)
- If an abundance of Data originates at Edge devices and flows upstream, Edge aggregator nodes may need to perform Compute to reduce resource usage and/or to manage data implosion

Objectives

- Systematically look at different instantiations of COIN in the cloud-to-edge-to-device computing continuum:
 - Are there common principles, abstractions, assumptions and mechanisms that can be applied across this range of different types of computing/networking applications/approaches?
 - What are best practices and relevant considerations for computing/networking systems, in particular with respect to previous efforts in active networking?
 - For a network with non-forwarding functions, at what level of abstraction must the programmable data plane live?
 - What is the impact of in-network functions on end-to-end transport protocols and security?
 - What are the incentives for the network to add new computing capabilities and resources in an open eco-system?

What's the Commonality?

All Computing in the Network needs to...

- Select a programming paradigm to launch/orchestrate the process
- Marshal resources
 - Such as: Compute, Network, Storage, Data, Telemetry, Control, etc....
 - Each of which must be able to describe and expose their capabilities
- Meet requirements/constraints/policies
- Adapt to changing conditions
- Leverage telemetry
- Establish strong security/privacy/trust guarantee

Existing IDs

- draft-montpetit-coin-xr : In Network Computing Enablers for Extended Reality
- draft-mcbride-edge-data-discovery-overview: Edge Data Discovery for COIN
- draft-he-coin-managed-networks : In-Network Computing for Managed Networks: Use Cases and Research Challenges
- draft-sarathchandra-coin-appcentres: In-Network Computing for App-Centric Micro-Services
- draft-kunze-coin-industrial-use-cases: Industrial Use Cases for In-Network Computing
- draft-liu-coinrg-requirement: Requirement of Computing in network
- draft-kutscher-coinrg-dir: Directions for Computing in the Network
- draft-kunze-coinrg-transport-issues: Transport Protocol Issues of In-Network Computing Systems

Join us!
Friday November 22 10am-12pm
Sophia Room

J/E/M
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Co-chairs