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Extensions to wireless DetNet

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OUTLINE

- Introduction
- Exemplary use case: wireless for industrial applications
- IETF DetNet/RAW: wireless DetNet
- RAW Challenges Ahead
  1. Multi-domain extension
  2. RAW and MEC integration
  3. Mobility in RAW
- Conclusions

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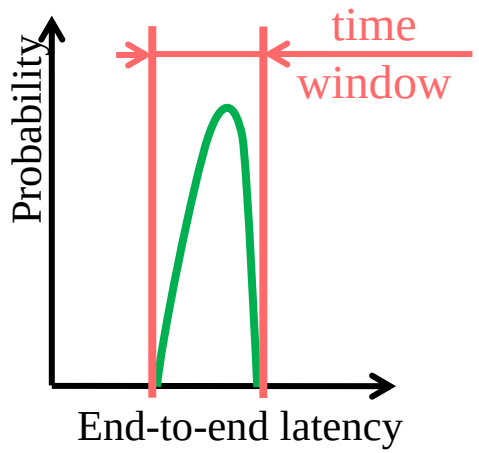
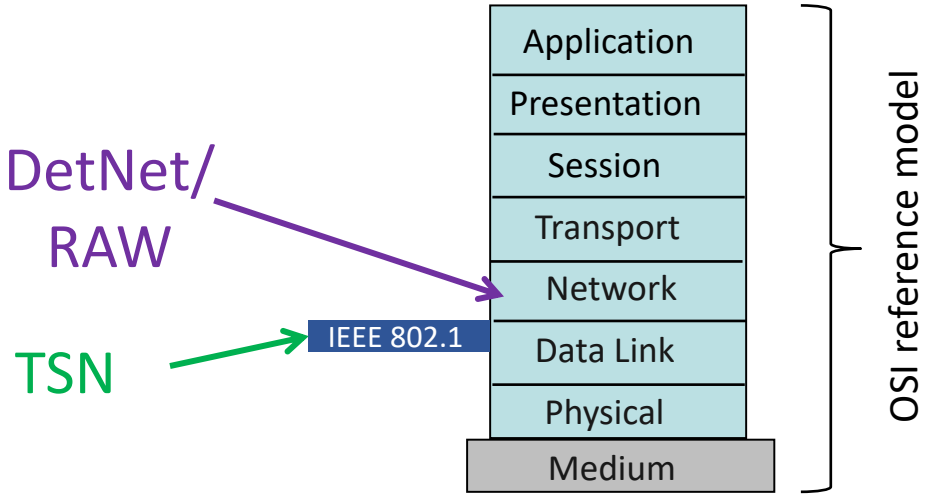
DETERMINISTIC COMMUNICATIONS

- The Right Packet at The Right Time
  - Deterministic data packet delivery
  - Packet delivery within a time window without loss or delay due to congestion or errors



- IEEE 802.1 Time-Sensitive Networking (TSN) at Layer 2 (bridging)
- IETF Deterministic Networking (DetNet) at Layer 3 (IP/MPLS routing)



IETF DetNet WG

The Deterministic Networking (DetNet) Working Group focuses on deterministic data paths that operate over Layer 2 bridged and Layer 3 routed segments, where such paths can **provide bounds on latency, loss, and packet delay variation (jitter), and high reliability**. DetNet solutions **apply to both wireless and wired networks**. The Working Group addresses **Layer 3 aspects in support of applications requiring deterministic networking**. The Working Group collaborates with IEEE802.1 Time-Sensitive Networking (TSN), which is responsible for Layer 2 operations, to define a **common architecture for both Layer 2 and Layer 3**. Example applications for deterministic networks include professional and home audio/video, multimedia in transportation, engine control systems, and other general industrial and vehicular applications being considered by the IEEE 802.1 TSN Task Group.

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https://datatracker.ietf.org/wg/detnet/about

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Exemplary use case: wireless for industrial applications

Ethernet backbone

IEEE 802.15.4

IEEE 802.11

3GPP 5G

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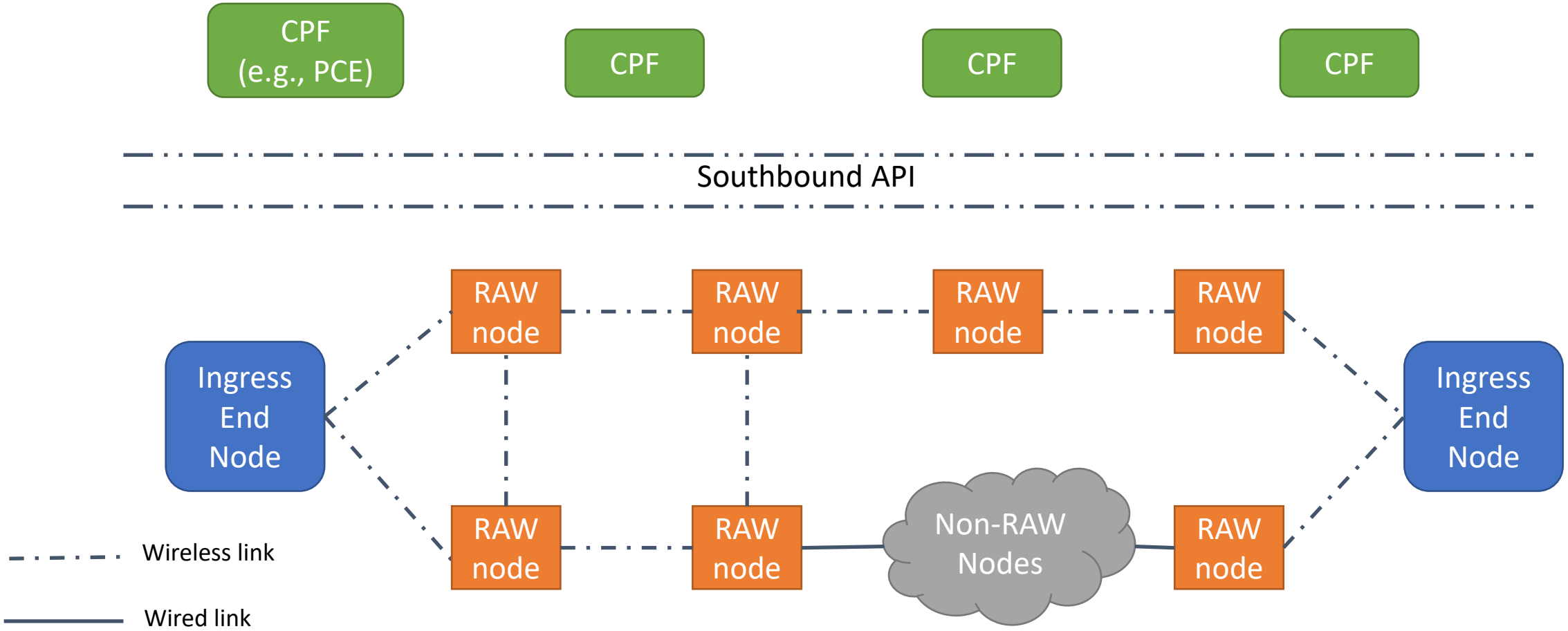
RAW architecture: conceptual model

CPF: Control Plane Function
PCE: Path Computation Element



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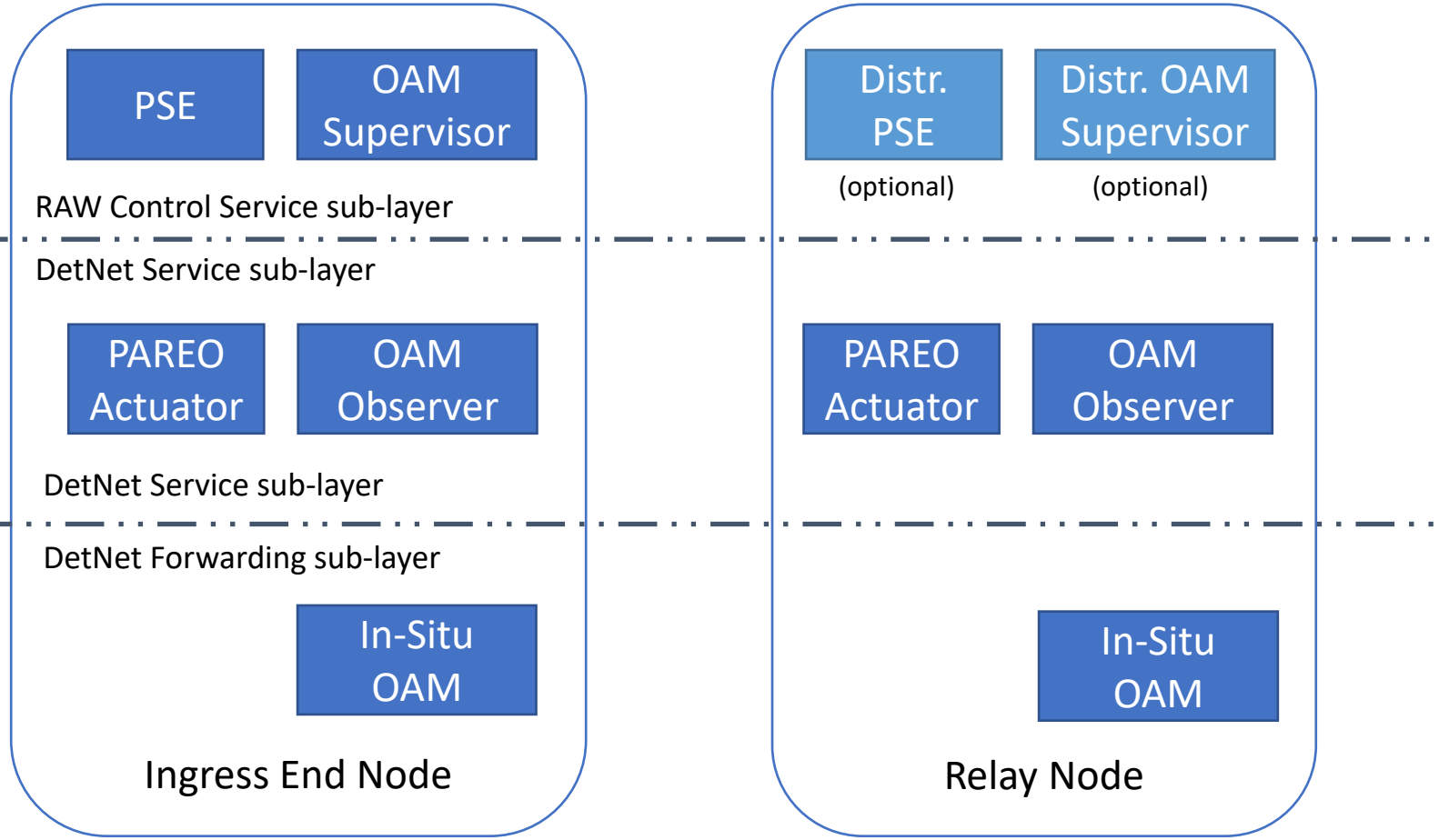
RAW architecture: RAW and DetNet



PSE: Path Selection Engine
OAM: Operations, Administration and Maintenance
PAREO: Packet (hybrid) ARQ, Replication, Elimination and Ordering

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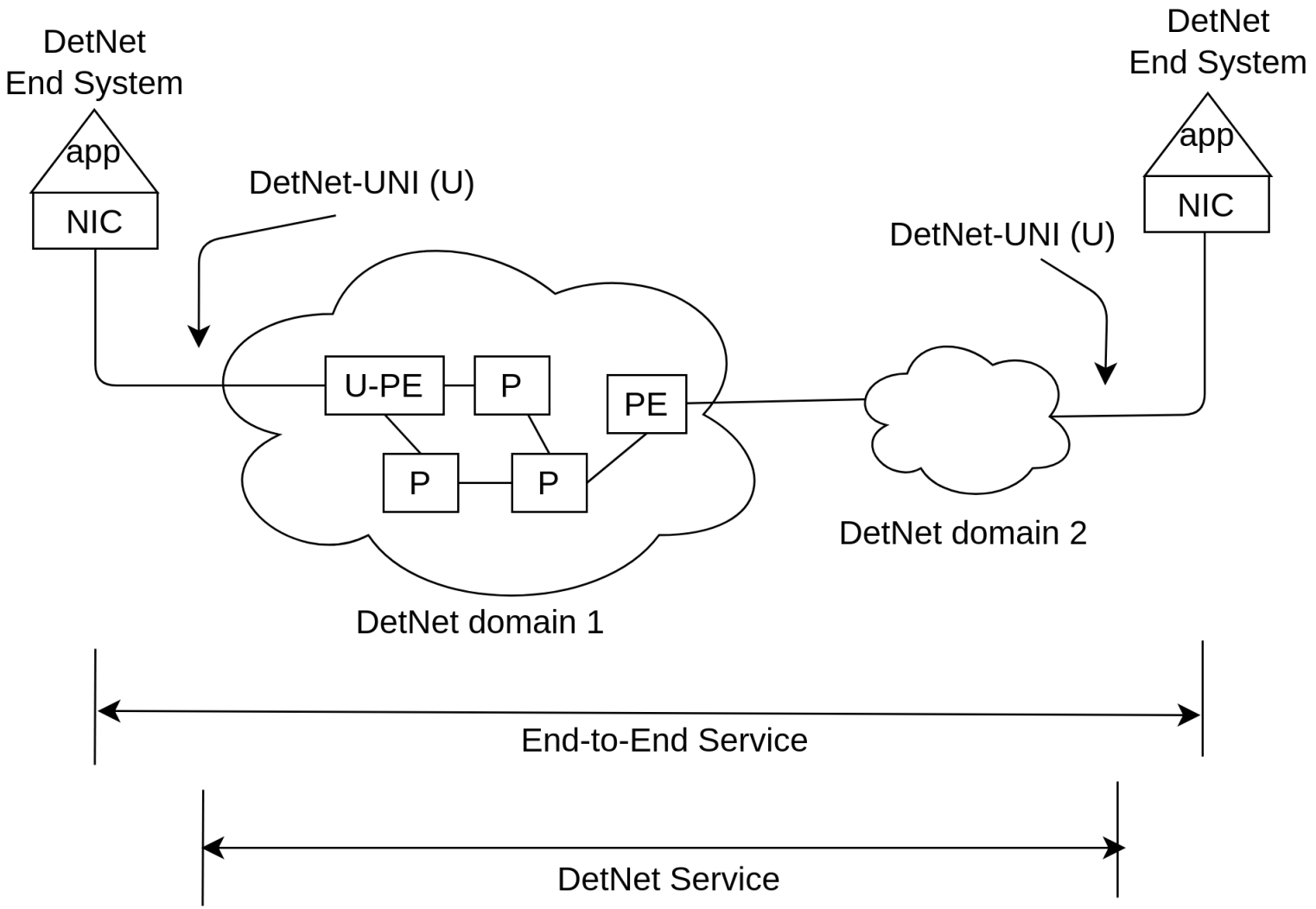
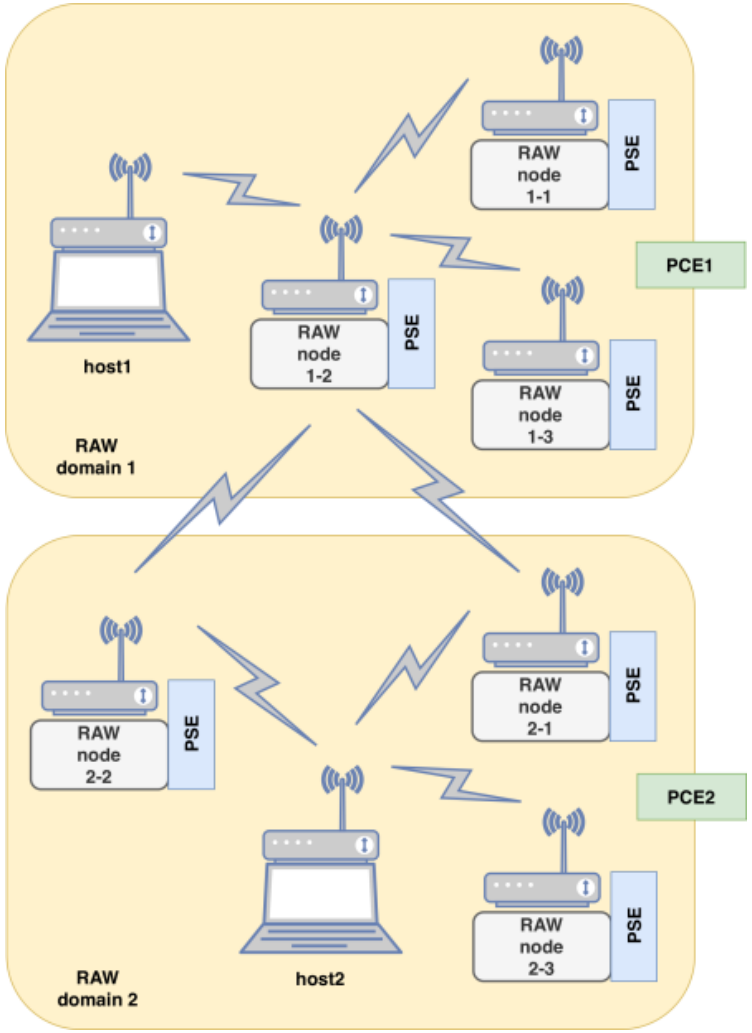
DetNet Service Reference Model (Multidomain)



Scenario showing multiple RAW domains

- PSE of one domain can not act on the other domains (e.g., no multi-domain OAM solutions yet)
- Running uncoordinatedly RAW solutions in each domain is not an effective solution.
- PSEs need to have global E2E information as well as be capable of running OAM mechanism to monitor the quality of the selected multi-domain paths.



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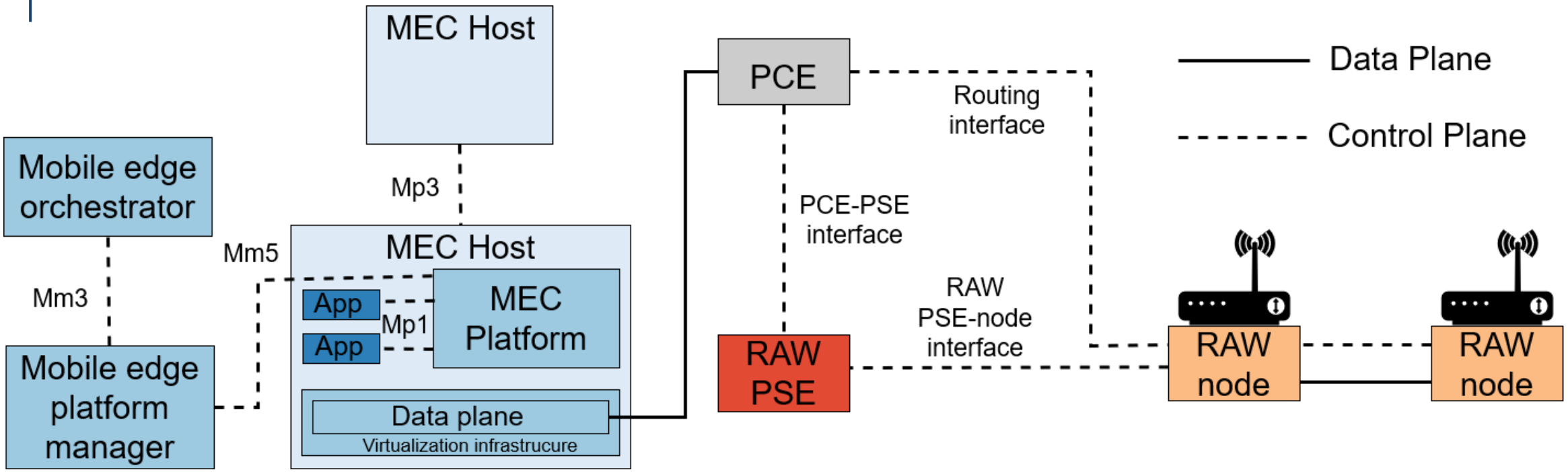
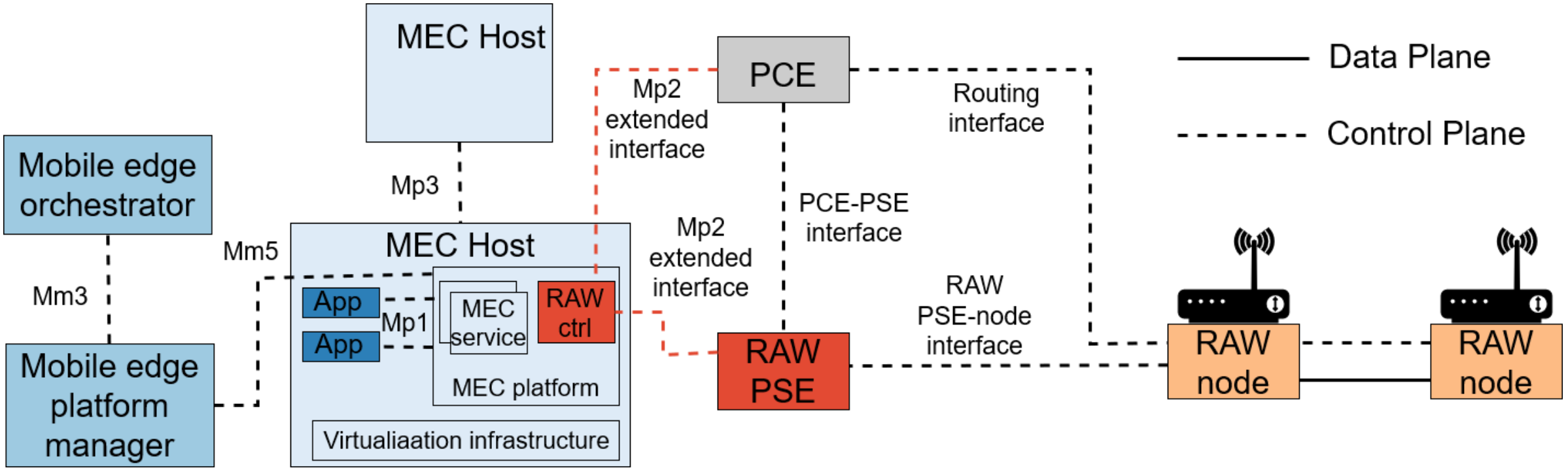
RAW in Multi-Access Edge Deployments



In the MEC reference architecture the Virtualisation infrastructure in the MEC host includes a **data plane that executes the traffic rules** received by the MEC platform, and routes the traffic among applications, services, DNS server/proxy, 3GPP network, **local networks and external networks**

RAW and MEC integration



The Mp2 reference point between the MEC platform and the data plane of the Virtualisation infrastructure is used to instruct the data plane on how to route traffic among applications, networks, services, etc. **This reference point is not further specified by ETSI MEC**

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Mobility in RAW Scenarios

Exiting challenges

- As opposed to static scenarios, where possible “tracks” do not change due to mobility, mobility scenarios pose additional complexity
- Current solutions DetNet and RAW solutions are limited to static scenarios
- Control plane solutions need to cope with mobility by proactively preparing the network for change of point of attachment of the mobile node. And the impact that this has in terms of new tracks used for the traffic

Way forward

- Inter-PSE coordination will be needed
- Mechanisms that will allow for a terminal to signal an imminent handover and convey its QoS requirements
- The signaling messages among RAW nodes (PSEs) need to be specified to prepare and coordinate an imminent handover

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CONCLUSIONS

- Significant contributions made (some adopted) to IETF:

Adopted by the IETF

  - RFC 9450: Reliable and Available Wireless (RAW) Use Cases, https://www.rfc-editor.org/rfc/rfc9450.txt, January 2024
  - RFC 9551: Framework of Operations, Administration, and Maintenance (OAM) for Deterministic Networking (DetNet), https://www.rfc-editor.org/rfc/rfc9551.txt, March 2024
  - draft-ietf-detnet-controller-plane-framework: Deterministic Networking (DetNet) Controller Plane Framework, https://www.ietf.org/archive/id/draft-ietf-detnet-controller-plane-framework-05.txt, September 2023
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  - draft-bernardos-detnet-raw-multidomain: RAW multidomain extensions, https://www.ietf.org/archive/id/draft-bernardos-detnet-raw-multidomain-00.txt, April 2024
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PREDICT-6G

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