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#1 ARCHITECTURAL ENHANCEMENTS FOR 6G PROGRAMMABLE AND DETERMINISTIC NETWORKS

6G Programmable Deterministic Webinar Series

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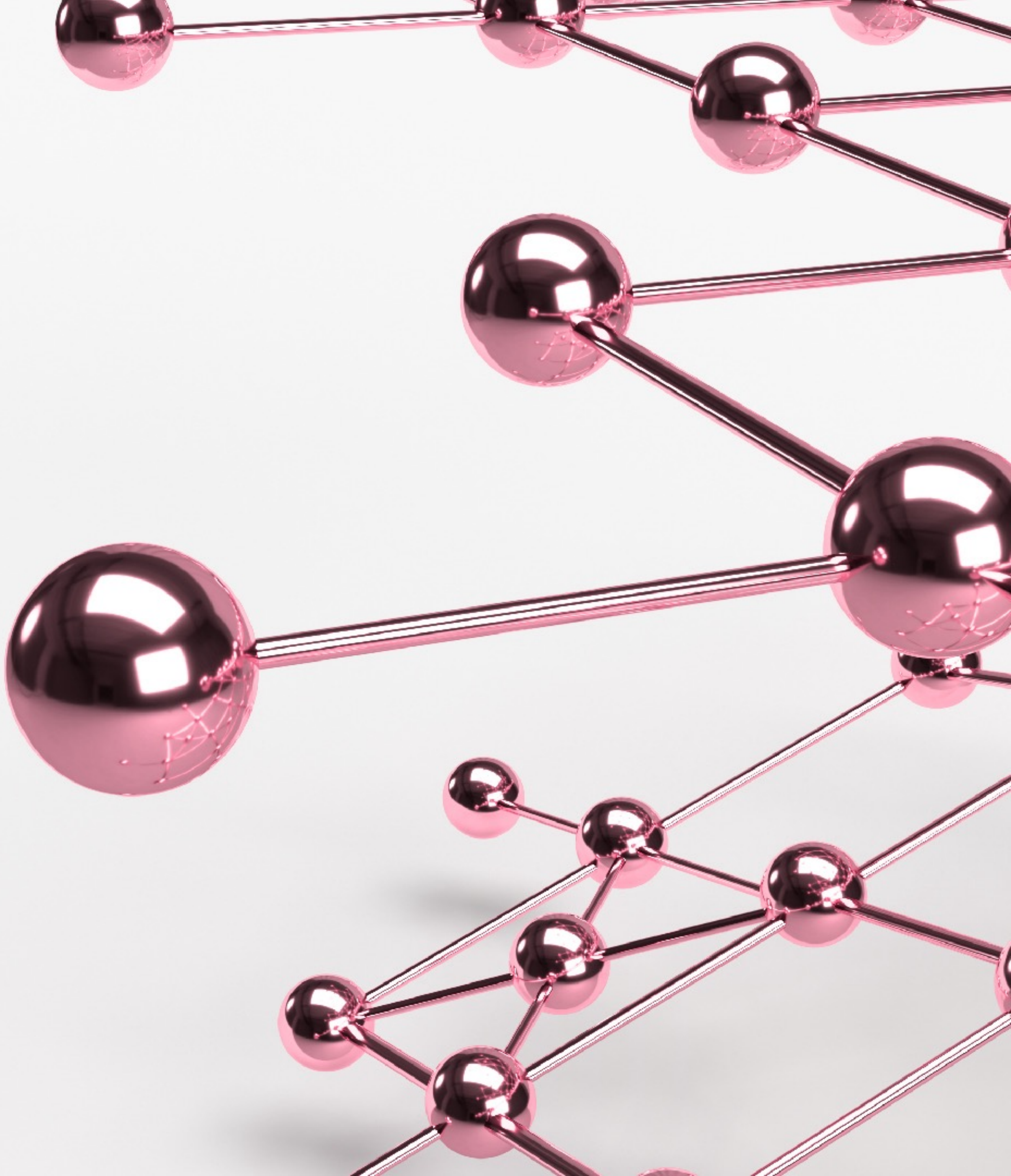
2024-06-14



SESSION RECORDING

THIS SESSION IS GOING TO BE RECORDED

WELCOME

6G PROGRAMMABLE DETERMINISTIC WEBINAR SERIES
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ARCHITECTURAL ENHANCEMENTS FOR 6G PROGRAMMABLE AND DETERMINISTIC NETWORKS
PETER SZILAGYI (NOKIA)
Multi-domain deterministic service management architecture
CHRYSA PAPAGIANNI (UNIVERSITY OF AMSTERDAM)
Towards extreme network KPIs with deep programmability in 6G
JOACHIM SACHS (ERICSSON)
GOURAV PRATEEK SHARMA (KTH)
5G latency analysis and possible improvements
Date
14 June, 2024
Time
10:00 am - 12:45 Am
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AGENDA

- 10-10:10: INTRO BY CARLOS J. BERNARDOS (UC3M)
- 10:10-10:50: PETER SZILAGYI (NOKIA): “MULTI-DOMAIN DETERMINISTIC SERVICE MANAGEMENT ARCHITECTURE”
- 10:50-11:30: CHRYSA PAPAGIANNI (UNIVERSITY OF AMSTERDAM): “TOWARDS EXTREME NETWORK KPIS WITH DEEP PROGRAMMABILITY IN 6G”
- 11:30-12:10: JOACHIM SACHS (ERICSSON) AND GOURAV PRATEEK SHARMA (KTH): “5G LATENCY ANALYSIS AND POSSIBLE IMPROVEMENTS”
- 12:10-12:40: PANEL: “ARCHITECTURAL ENHANCEMENTS FOR 6G PROGRAMMABLE AND DETERMINISTIC NETWORKS”
- 12:40-12:45: CLOSURE

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PANEL: "ARCHITECTURAL ENHANCEMENTS FOR 6G PROGRAMMABLE AND DETERMINISTIC NETWORKS"

- WHAT ARE THE MAIN ARCHITECTURAL CHANGES/ENHANCEMENTS YOU FORESEE REQUIRED IN 6G TO ENABLE THE EXPECTED HYPER RELIABLE AND LOW LATENCY COMMUNICATIONS FORESEEN IN IMT-2030?

PANEL: "ARCHITECTURAL ENHANCEMENTS FOR 6G PROGRAMMABLE AND DETERMINISTIC NETWORKS"

- HOW DO YOU SEE THE ROLE THAT AI MIGHT PLAY IN FUTURE 6G ARCHITECTURES TO ENABLE LOWER LATENCIES AND IMPROVE RELIABILITY?

PANEL: “ARCHITECTURAL ENHANCEMENTS FOR 6G PROGRAMMABLE AND DETERMINISTIC NETWORKS”

- THERE SEEM TO BE TWO DIFFERENT APPROACHES TO URLLC/HRLLC: THE IETF DETNET (ALSO EMBRACED SOMEHOW BY 3GPP IN REL17) AND GOING FOR DEEP PROGRAMMABILITY SOLUTIONS. HOW DO YOU SEE FUTURE 6G SOLUTIONS GO?

PANEL: "ARCHITECTURAL ENHANCEMENTS FOR 6G PROGRAMMABLE AND DETERMINISTIC NETWORKS"

- THE ACTUAL STANDARDIZATION OF 6G HAS JUST STARTED IN 3GPP. DO YOU EXPECT MAJOR CHANGES IN THE ARCHITECTURE?

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THANKS!

Carlos J. Bernardos

cjbc@it.uc3m.es

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SATISFACTION SURVEY

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Multi-domain deterministic service management architecture

Péter Szilágyi | Nokia Bell Labs, Hungary | PREDICT-6G Technical Manager
2024-06-14

Funded by
the European Union

This project was awarded funding by the European Union's Horizon Europe Research and Innovation programme under grant agreement N° 1101095890.

OUTLINE

1. Introduction and technical overview
2. Multi-domain deterministic services
3. Cross-domain data plane
4. AI based control and management plane
5. Discussion

1. Introduction and technical overview

The vision of PREDICT-6G

PREDICT-6G

Deterministic services over multiple networks with different technologies (3GPP, TSN, Wi-Fi)

E2E RELIABILE

High availability
Low (zero) packet loss
Failure resilient

E2E TIME SENSITIVE

Time-aware
Bounded latency
Low jitter

PREDICTABLE

Use of AI to predict events, states, demands, resources;
Autonomous proactive actions

Three technical pillars

Extend the reliability and time sensitiveness features of IEEE 802.11 and 3GPP networks, including APIs for the monitoring and control of such capabilities, enabling predictability.

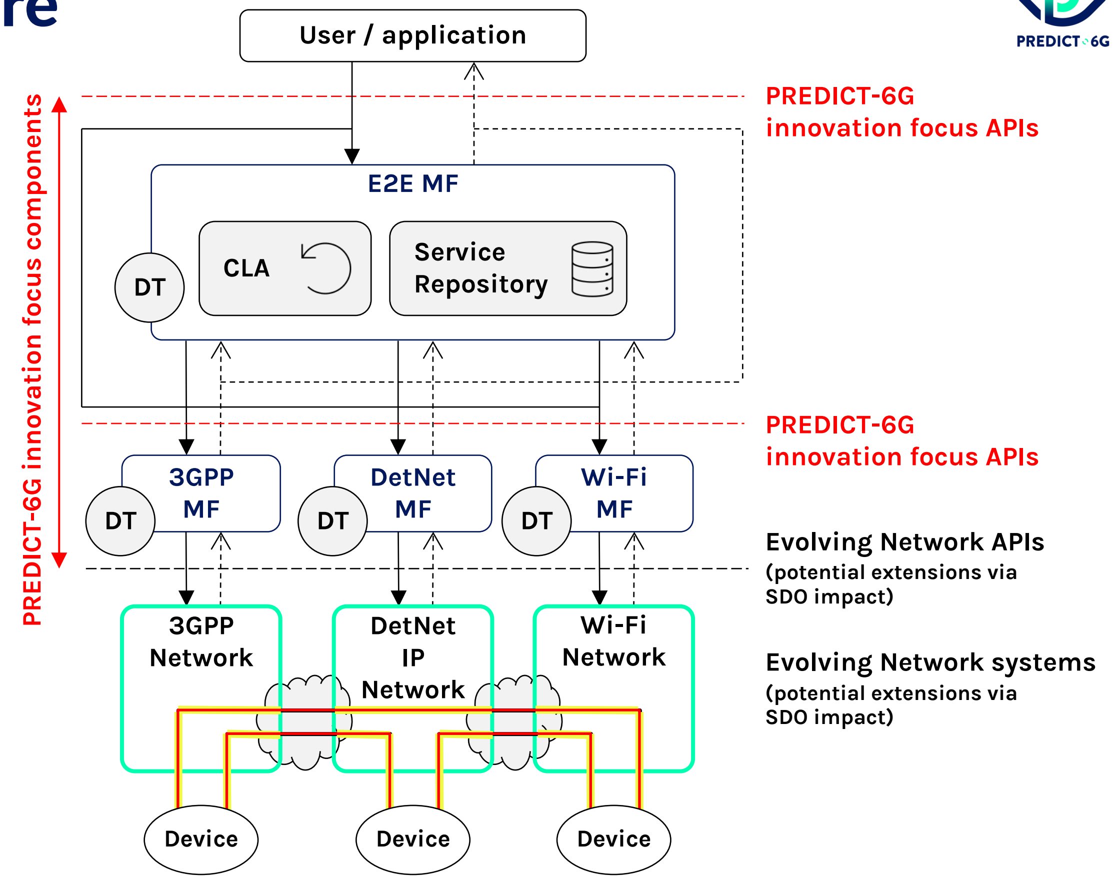
Develop a **Multi-technology multi-domain Data-Plane (MDP)** jointly with an **AI-driven multi-stakeholder inter-domain Control-Plane (AICP)** capable of autonomous service assurance

Enhance the predictability of the network via DT and AI, predicting the network load and the impact of admitting a new service into the network

Reference architecture

PREDICT-6G management scope

- Networks
- Services within one network
- E2E services composed over multiple networks



- E2E deterministic flow (MDP)
- Request / config (AICP)
- Measurement / status / insight (AICP)

2. Multi-domain deterministic services

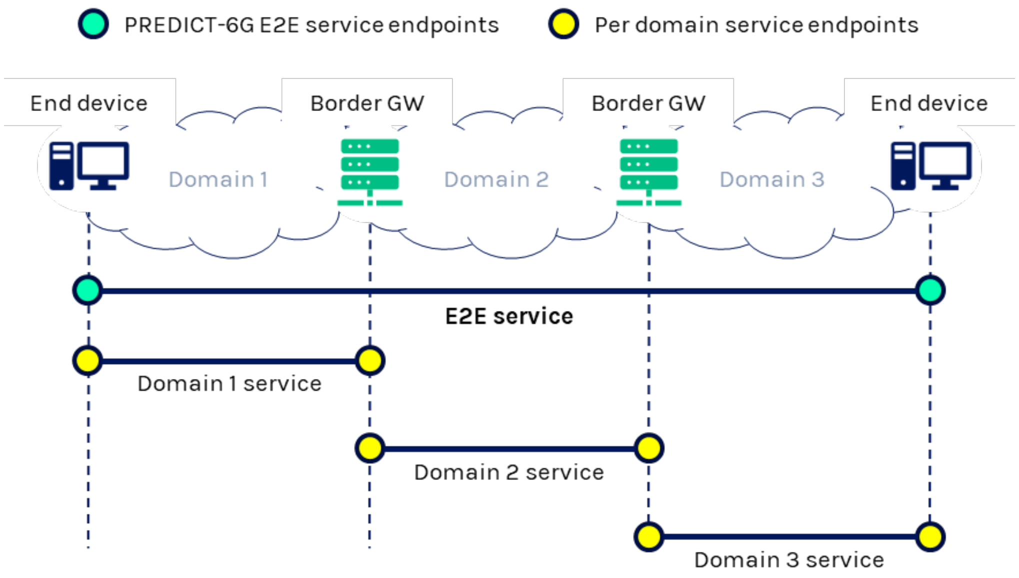
E2E services

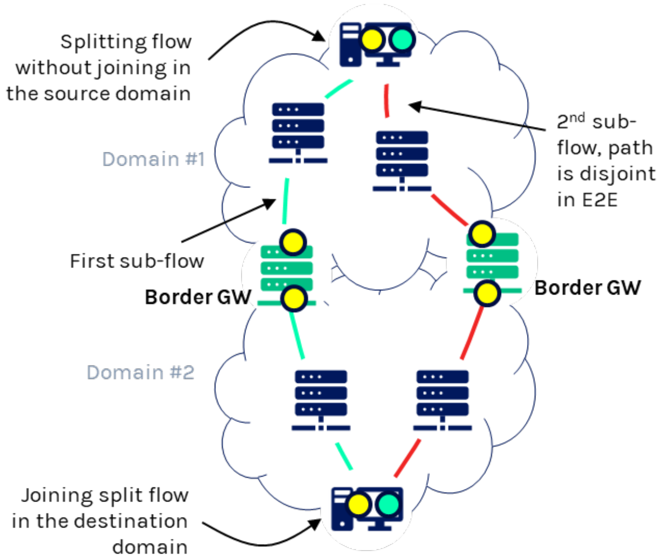
Services may be requested by operators (provision services to be used by end users) or by end users (i.e., self-service – asking a service for themselves).

Components of a deterministic service definition:

1. Service endpoints (where should the service to be provided?)
2. QoS characteristics (packet forwarding treatment between service endpoints)
3. Traffic characteristics (what is the pattern of the traffic to be carried by the service?)
4. Traffic flow template (how to select the traffic that is subject of the service?)
5. Service lifetime (when should the service start/end?)

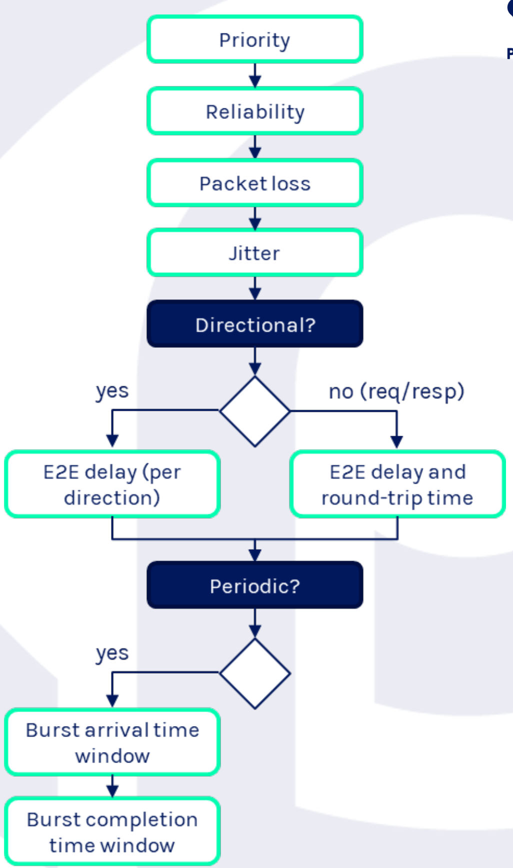
Multi-domain deterministic service flows





Service request – QoS characteristics

- Priority
- Reliability
- Packet loss (including late and out of order packets)
- Jitter (per packet)
- E2e latency (per direction)
- E2e round-trip time
- Burst Arrival Time Window: the acceptable earliest and latest arrival time of the first packet of the data burst (relative to the start of the period)
- Burst Completion Time Window: the acceptable earliest and latest arrival time of the last packet of the data burst (relative to the start of the period)



Service lifecycle

1. Service Ingestion

- Receive service request → Accept/Reject

2. Service Fulfillment

- Initial configuration (e2e and per domain) to fulfil the service request → service is ready to use

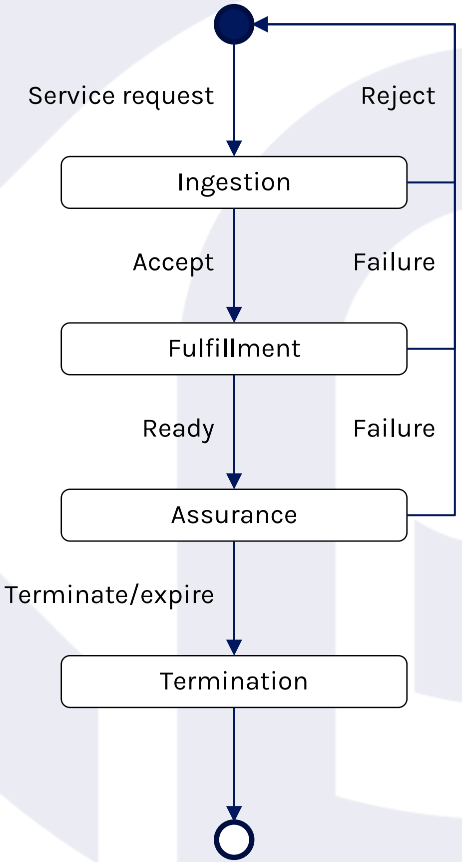
3. Service Assurance

- Continuous closed-loop self-configuration to maintain the SLA of the service

4. Service Termination

- End of the service (at explicit request, or at service lifetime expiry)

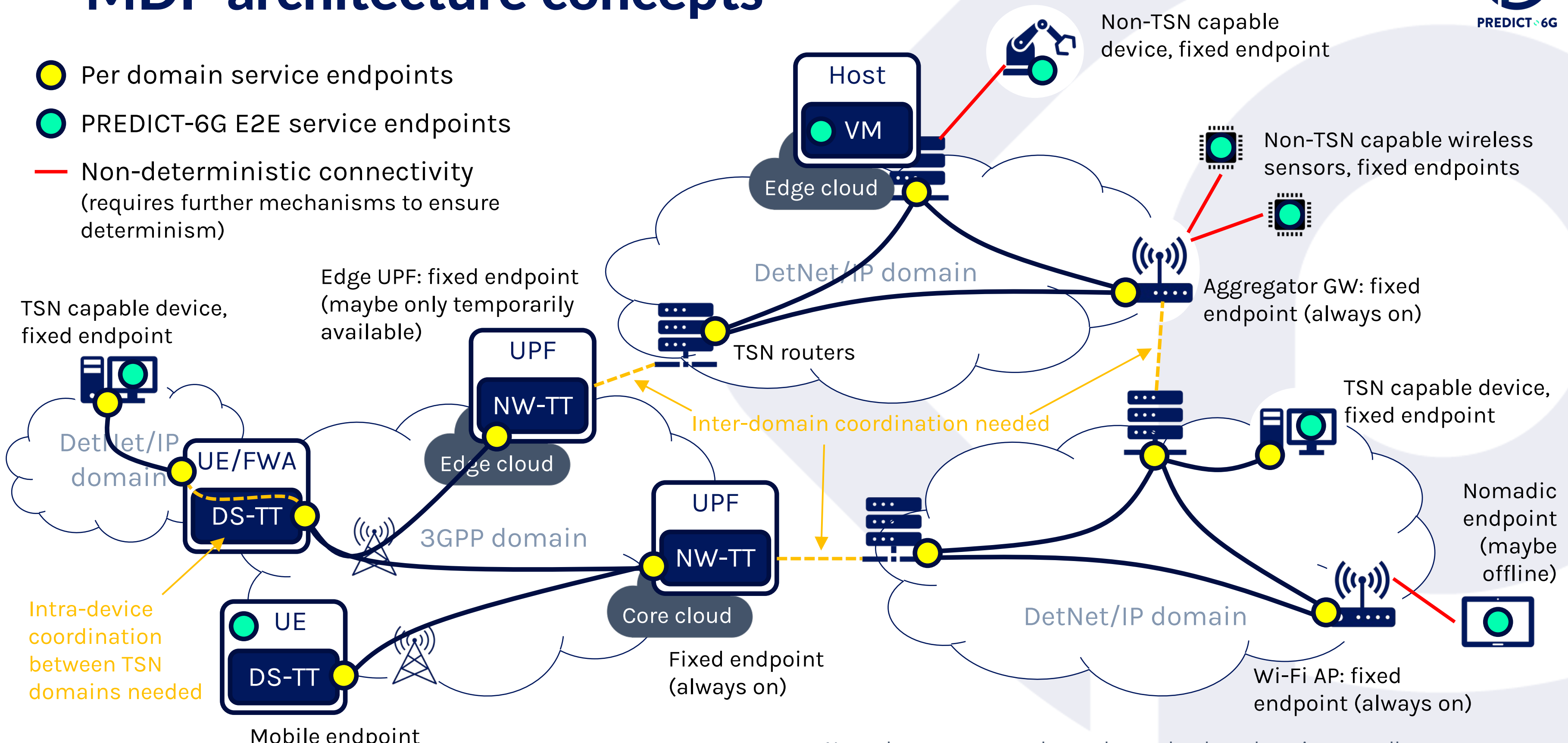
Failures are raised only if they cannot be autonomously resolved.



3. Cross-domain data plane

MDP architecture concepts

- Per domain service endpoints
- PREDICT-6G E2E service endpoints
- Non-deterministic connectivity (requires further mechanisms to ensure determinism)



Note: the concepts apply to other technology domains as well.

'Architectural enhancements for 6G programmable and deterministic networks'

MDP enablers for determinism in E2E

Deterministic data generation at the device (including application, kernel, NIC, virtualization layers, etc., for the entire data path from program code to TX on wire/waveform)

Deterministic schedulers at each hop (with proper per-hop behavior configured to support the E2E service parameters): providing deterministic and predictable

- transmission opportunity,
- bandwidth,
- buffering delay,
- propagation delay,
- zero congestion loss

Cross-domain interworking for harmonized E2E path selection, data plane configuration and multi-domain splitting of deterministic mechanisms

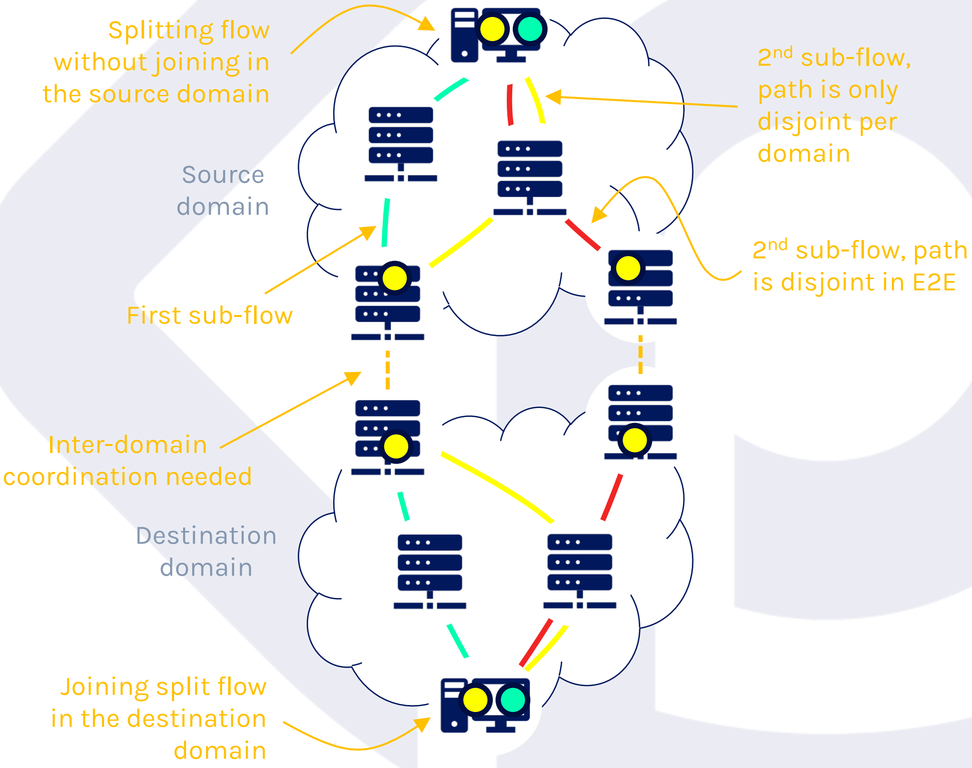
Deterministic schedulers and PREOF

Deterministic scheduler capabilities:

- Credit based shaper (IEEE 802.1Qav)
- Preemption of lower priority packet transmission by higher priority)
- Per flow filtering, buffering, policing and shaping
- Delay compensation (hold and forward) is needed for links with variable propagation characteristics (e.g., wireless).

Reliability enablers:

- PREOF: packet replication, elimination and ordering (using disjoint transmission paths)
- Path control and reservation (with admission control)



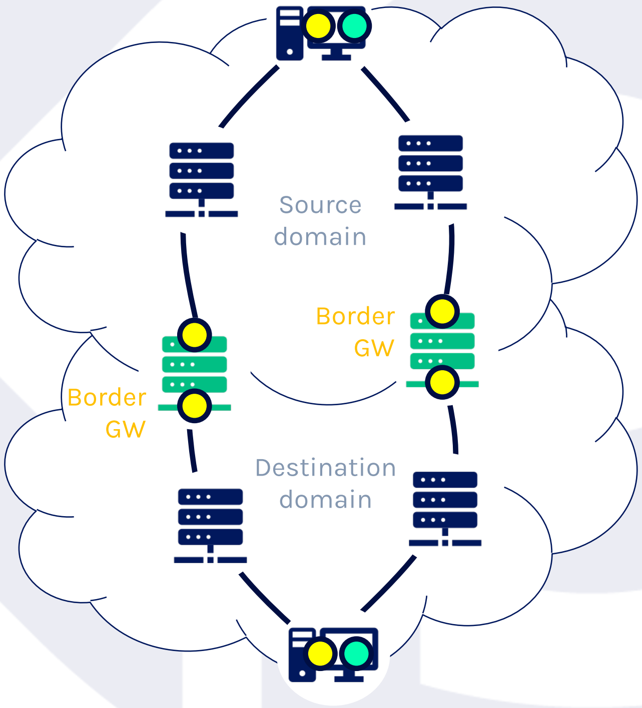
Cross-domain determinism

Requirements:

- Harmonization of intra-domain service configuration (e.g., scheduler parameters; bandwidth allocations; delay budgets; etc.)
- Cross-domain path selection and with path capabilities matching with E2E service requirements
- Cross-domain PREOF inter-working (source domain performs packet replication, destination domain performs packet elimination – if the domains are implemented with different technology,)

Potential enablers:

- Domain border GWs having NICs in both domains
- Cross-domain flow splitting and joining with per packet/flow replication/elimination context transferred between domains



4. AI based control and management plane

Key design principles

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Service centric approach

- Define management services that can be implemented by management functions and produced/consumed via interfaces.
- A reference architecture with logical entities aggregating management services is provided as an implementation guideline.

Modularity and separation of concerns

- The management services are self-contained with well-defined scope and clearly defined interfaces.

Extensibility

- Management services (as well as new management domains) can be added without impact on existing ones.

Flexibility and scalability

- An implementation of the architecture may selectively include only a subset of management services adapted to the domains existing in a specific deployment.
- Allow (self-)adaptation to the configuration, capabilities, size, resources, topology and other aspects of specific deployments.

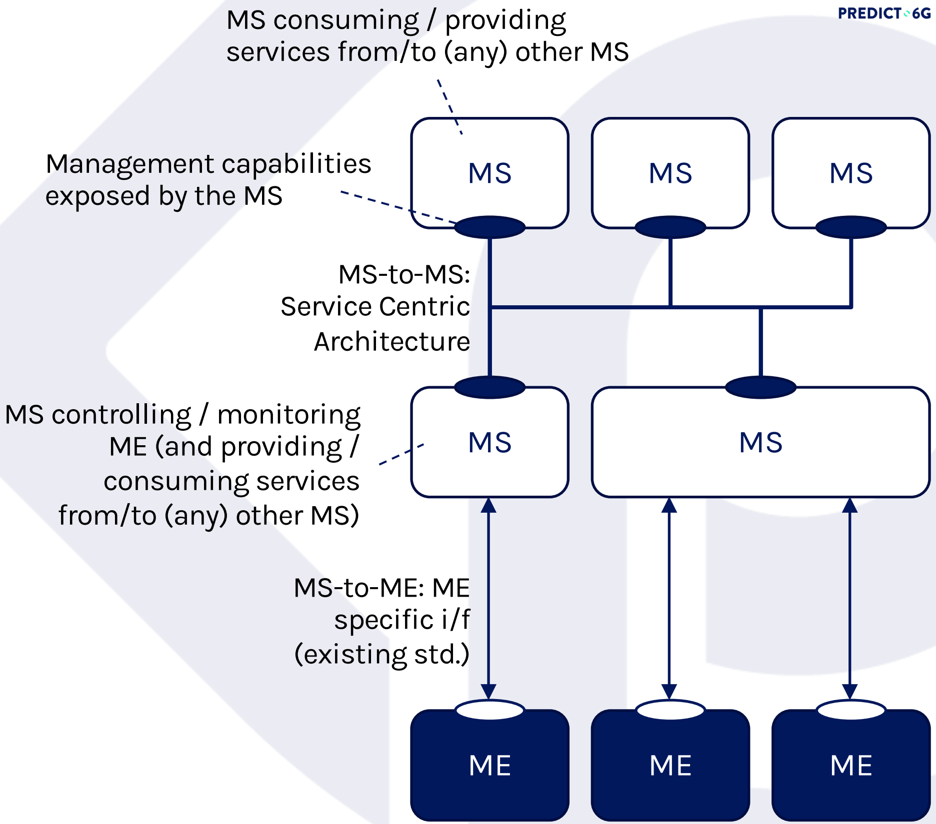
Management Services (MS)

Definition:

One or more management capabilities (configuration, data, measurement, performance, analytics, control, etc.) with a scope (e.g., to control one or more MEs, or to provide services to other MSs).

Examples:

- An MS provides deterministic service provisioning capability for a 3GPP network.
- An MS provides performance measurement services over a DetNet IP network (which is then consumed by an analytics MS that evaluates the service quality).



Management Domains (MD)

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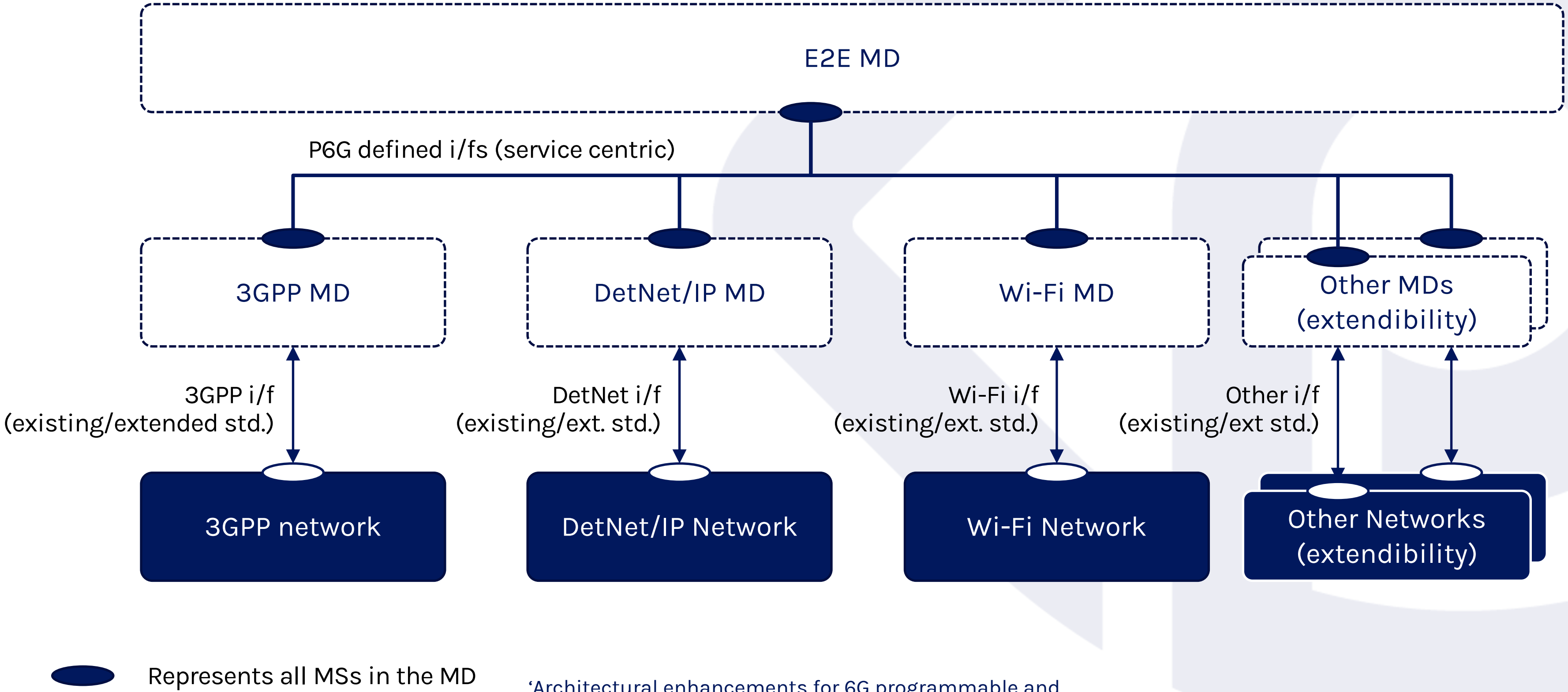

Full AICP architecture (for illustration)

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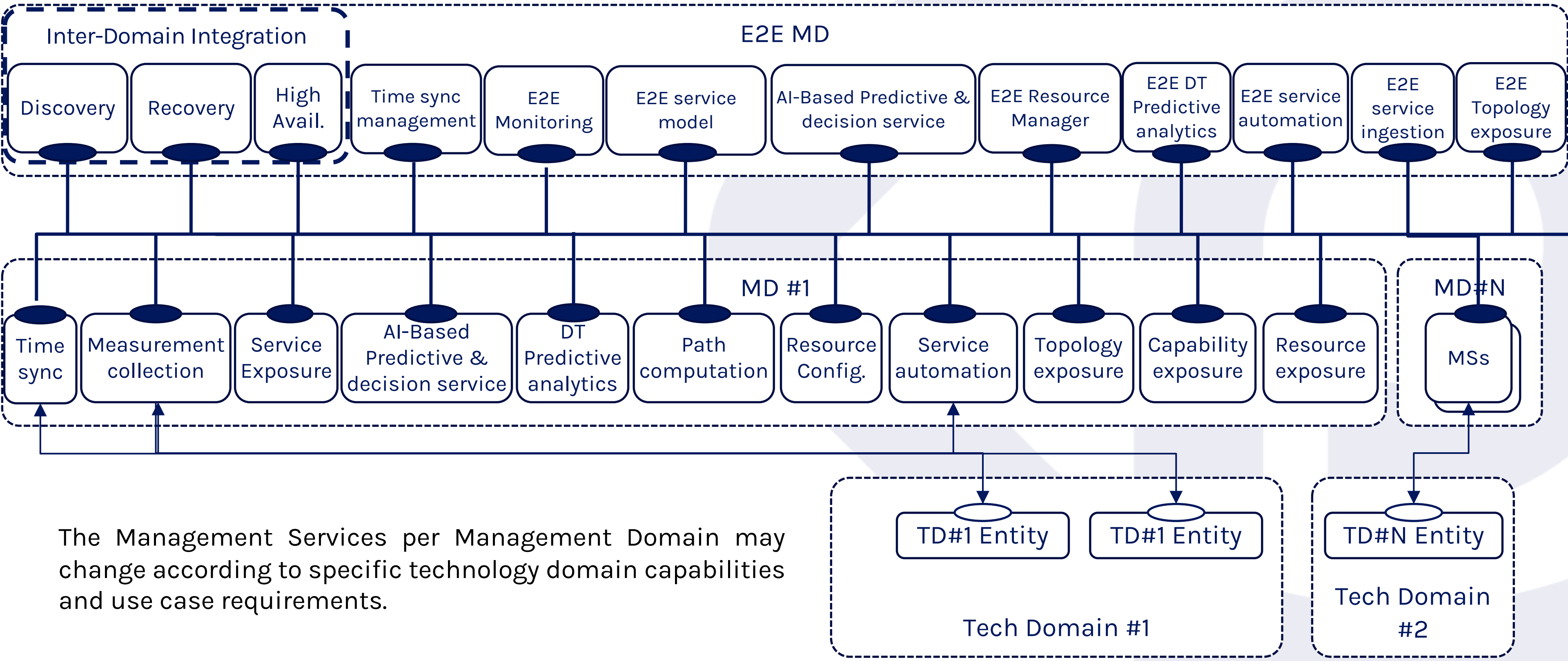

The Management Services per Management Domain may change according to specific technology domain capabilities and use case requirements.

5. Discussions

Thank you!

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TOWARDS EXTREME NETWORK KPIS WITH PROGRAMMABILITY IN 6G

Chrysa Papagianni, University of Amsterdam (Project Coordinator)

Gergely Pongrácz, Ericsson Research (Technical Coordinator)

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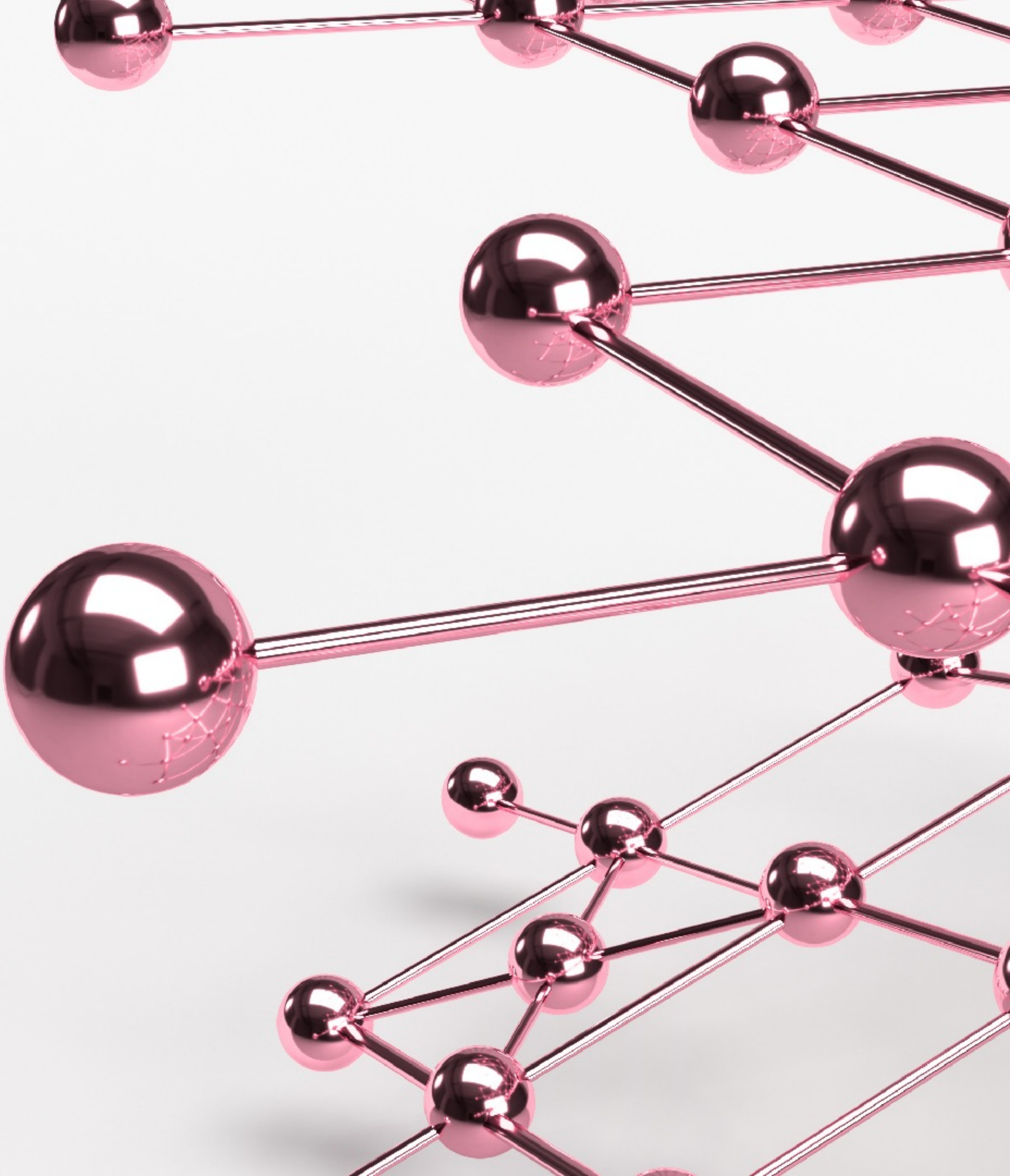

DESIRE6G GENERICS

DEEP PROGRAMMABILITY & SECURE DISTRIBUTED INTELLIGENCE FOR REAL-TIME END-TO-END 6G NETWORKS

DESIRE6G

Project coordination:
University of Amsterdam

Technical coordination:
Ericsson Hungary

Duration:
01/01/2023 - 31/12/2025

Total Cost:
6.227.919€

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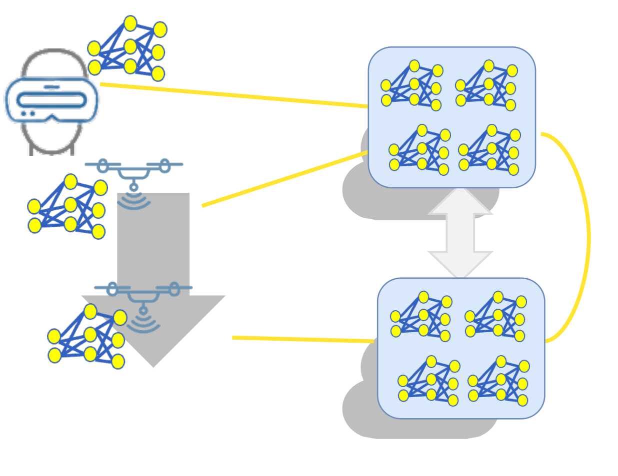
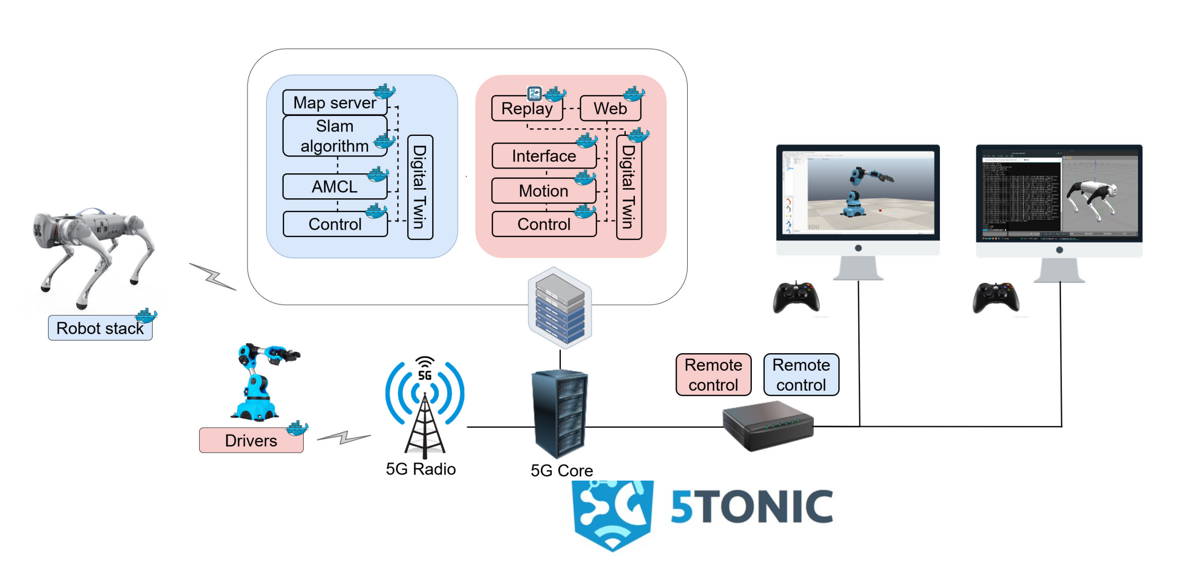
PROJECT SCOPE

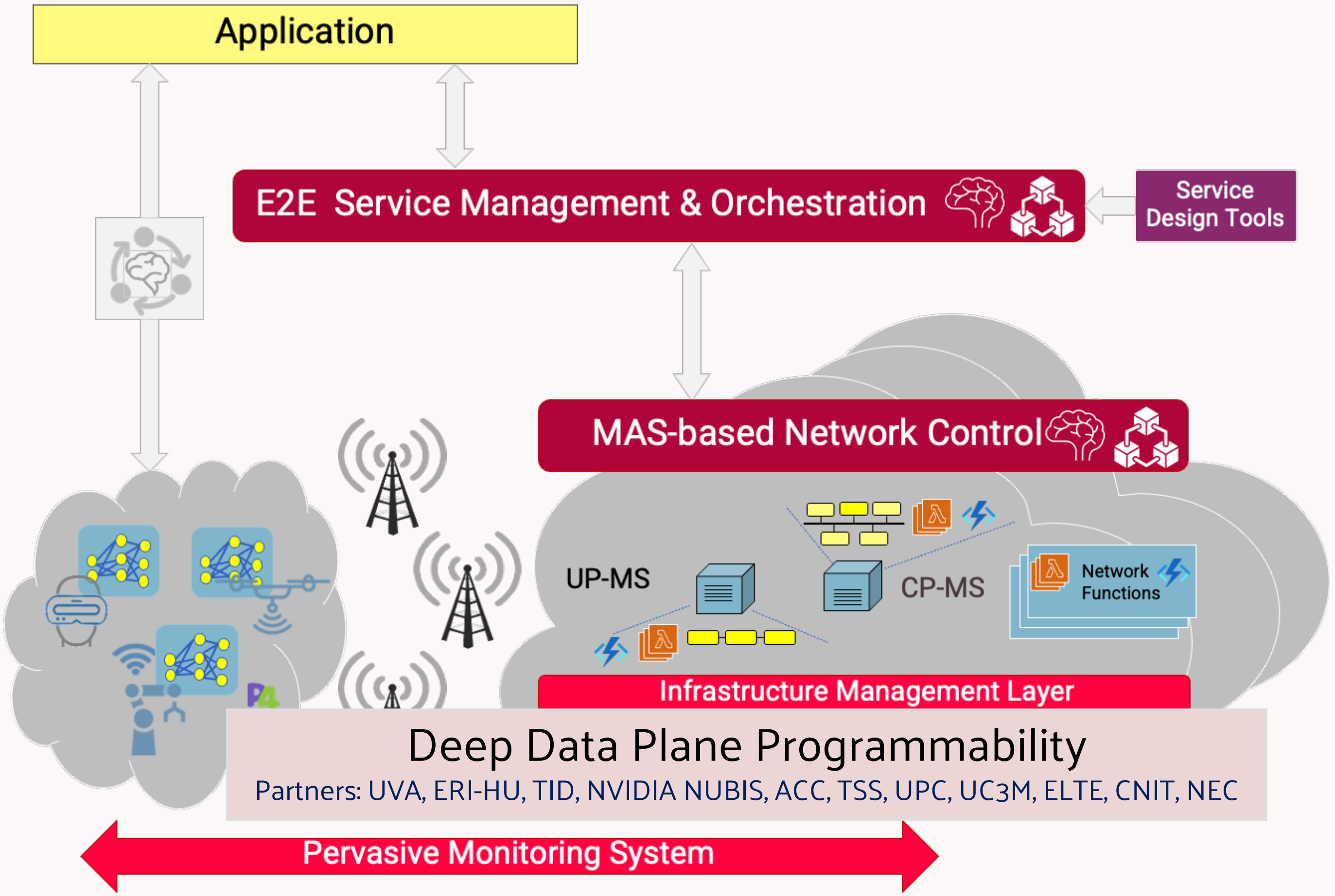
- **Zero-touch control, management & orchestration platform, with native integration of AI, to support eXtreme URLLC requirements over a performant, measurable & programable data plane.**

- Use cases: AR and a Digital Twin application at two distinct experimental infrastructures.


ARNO testbed



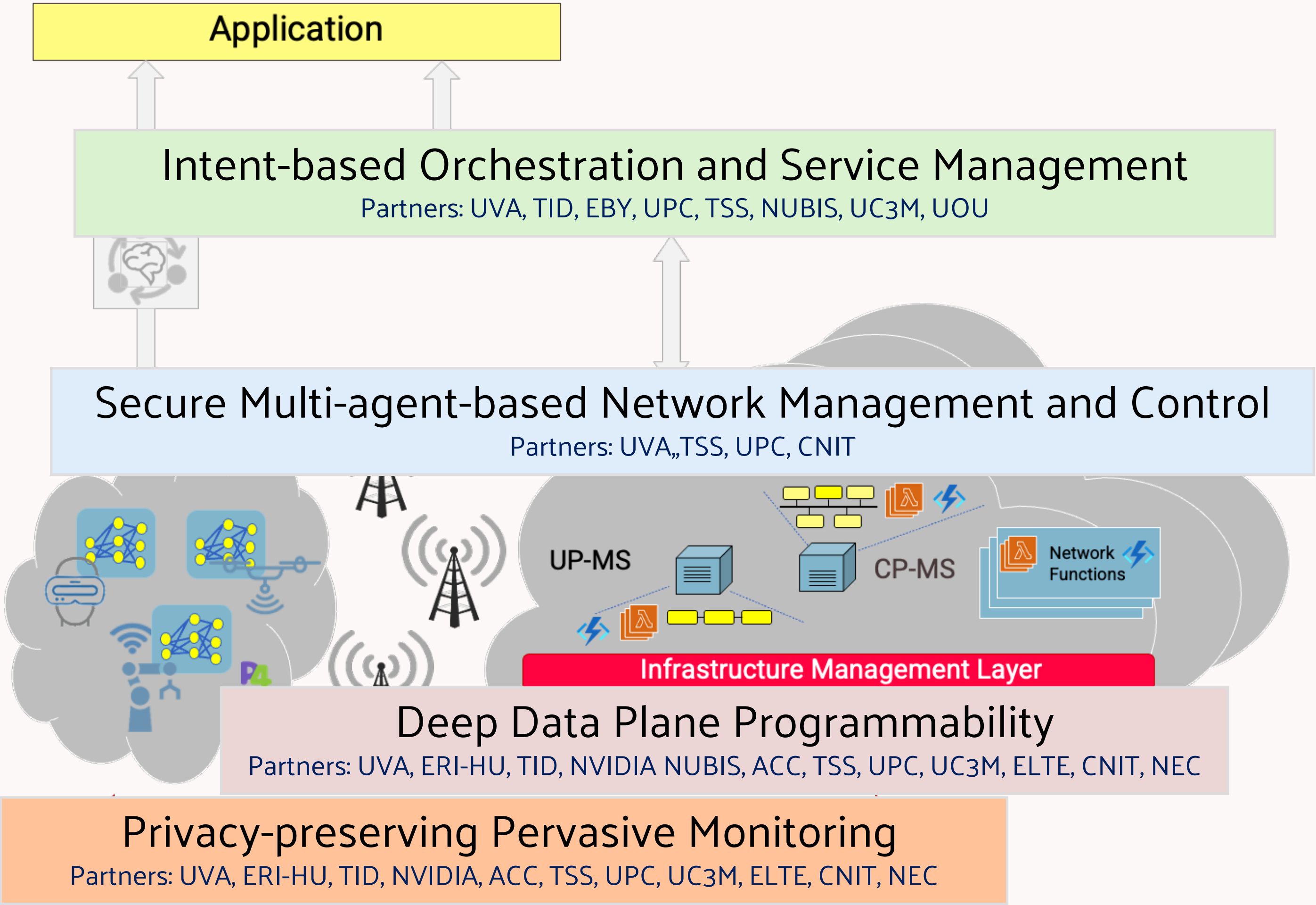
D6G KEY INNOVATIONS



Innovation

- xURLLC services
- Edge Intelligence
- Intent-based orchestration
- Blockchain-based federation
- Secure distributed intelligence
- RAN-core convergence
- Edge-to-Cloud continuum
- Serverless architecture
- E2E programmable data plane
- Multi HW acceleration
- E2E network telemetry

D6G KEY INNOVATIONS



Innovation

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- Multi HW acceleration
- E2E network telemetry

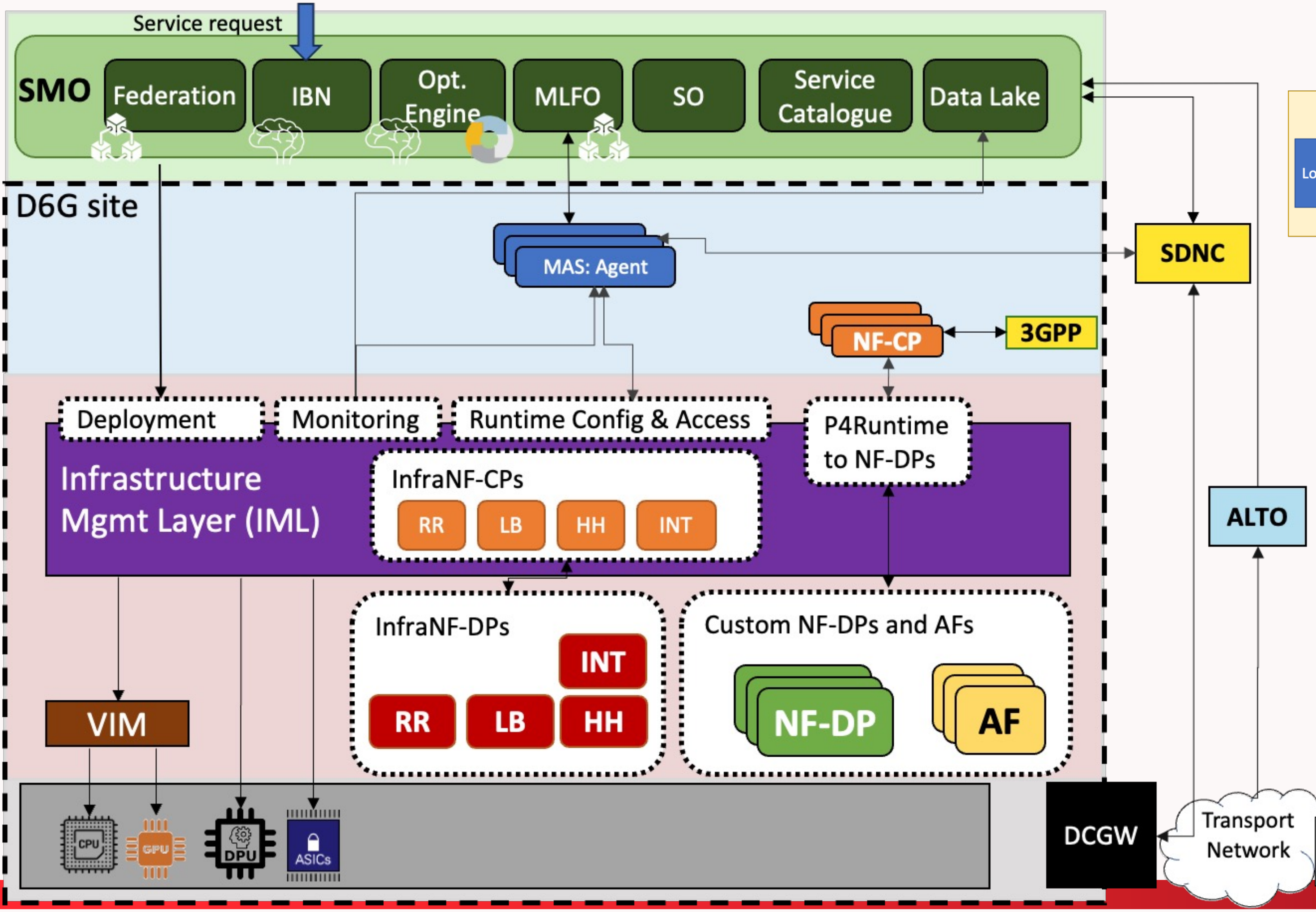
WHY DESIRE6G?

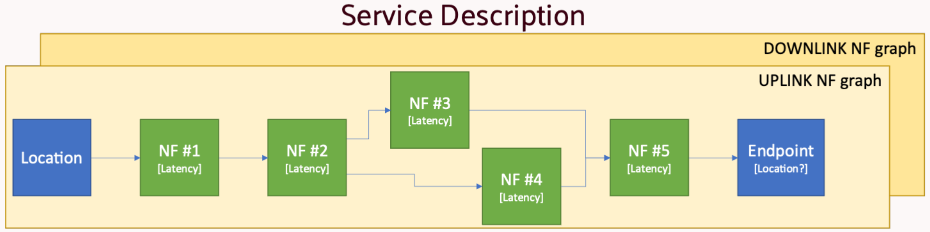
What is the difference between D6G and the other 6G projects?

We study:

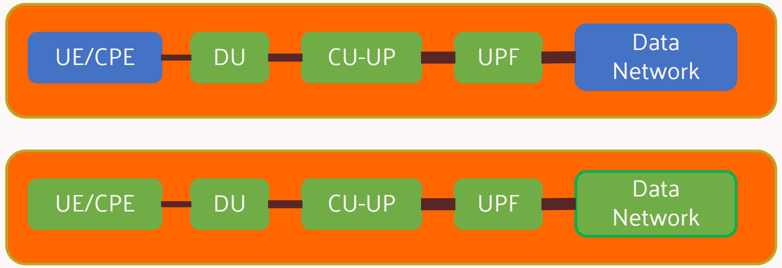
- ✓ how **E2E deep network programmability** aids in addressing challenging use cases / KPIs (such as sub msec latency) in a multi-service network, looking into on the flexibility - performance trade-off
- ✓ **Cloud-native** deployment of network services & components, conforming to the Serverless/FaaS concept
- ✓ Explore how a **multi agent-based system** can address scalability issues of centralized control and optimization
- And how can we put this together as simply as possible with other innovative methods, like **AI-driven telemetry**, **blockchain-based federation** and a **DLT-backed software security framework**
- So D6G has a **bottom-up** view and focuses on proof-of-concept **demos** to validate the value proposition

D6G ARCHITECTURE AND SERVICES

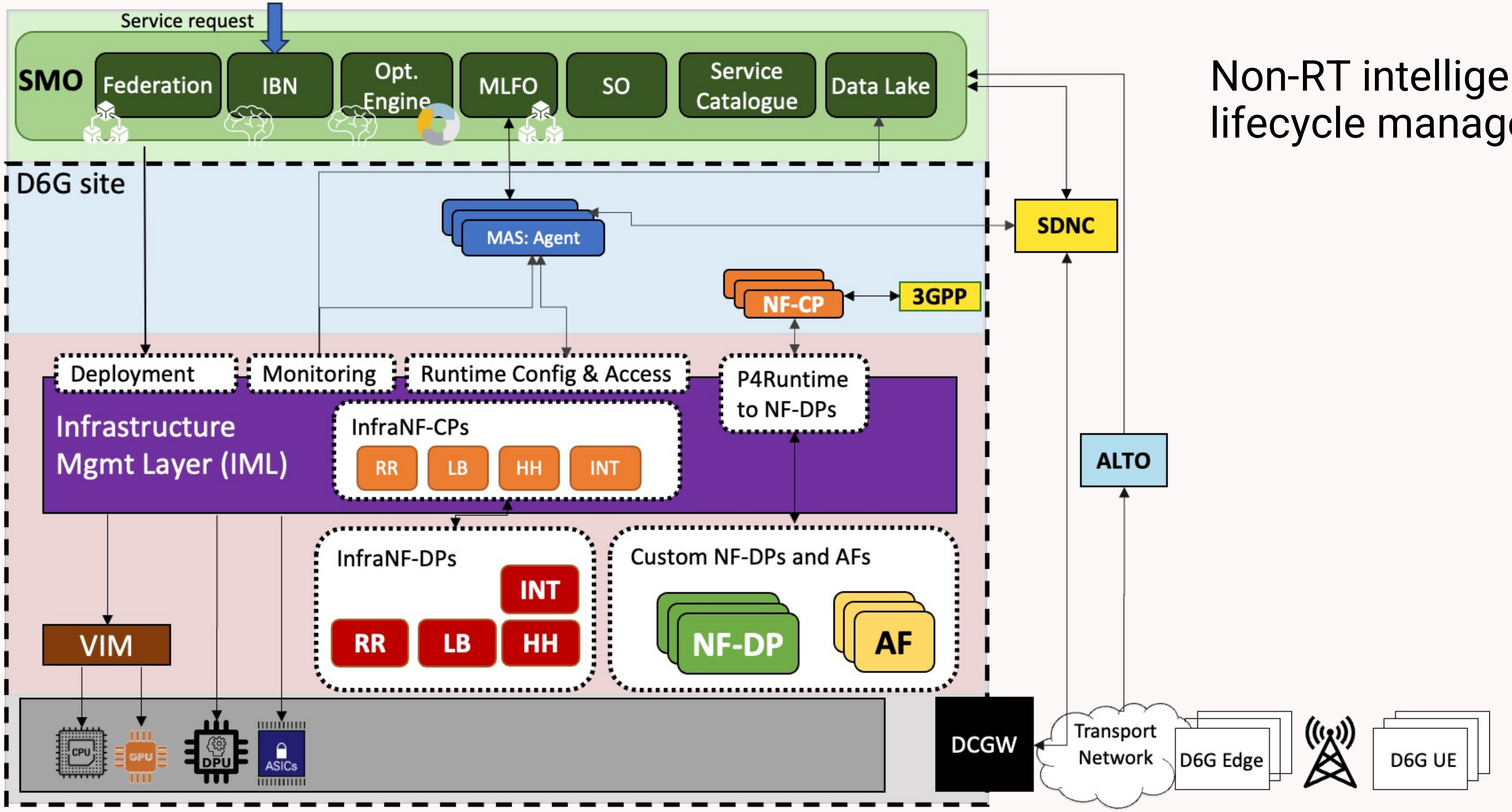




D6G: Edge-to-edge vs End-to-end services

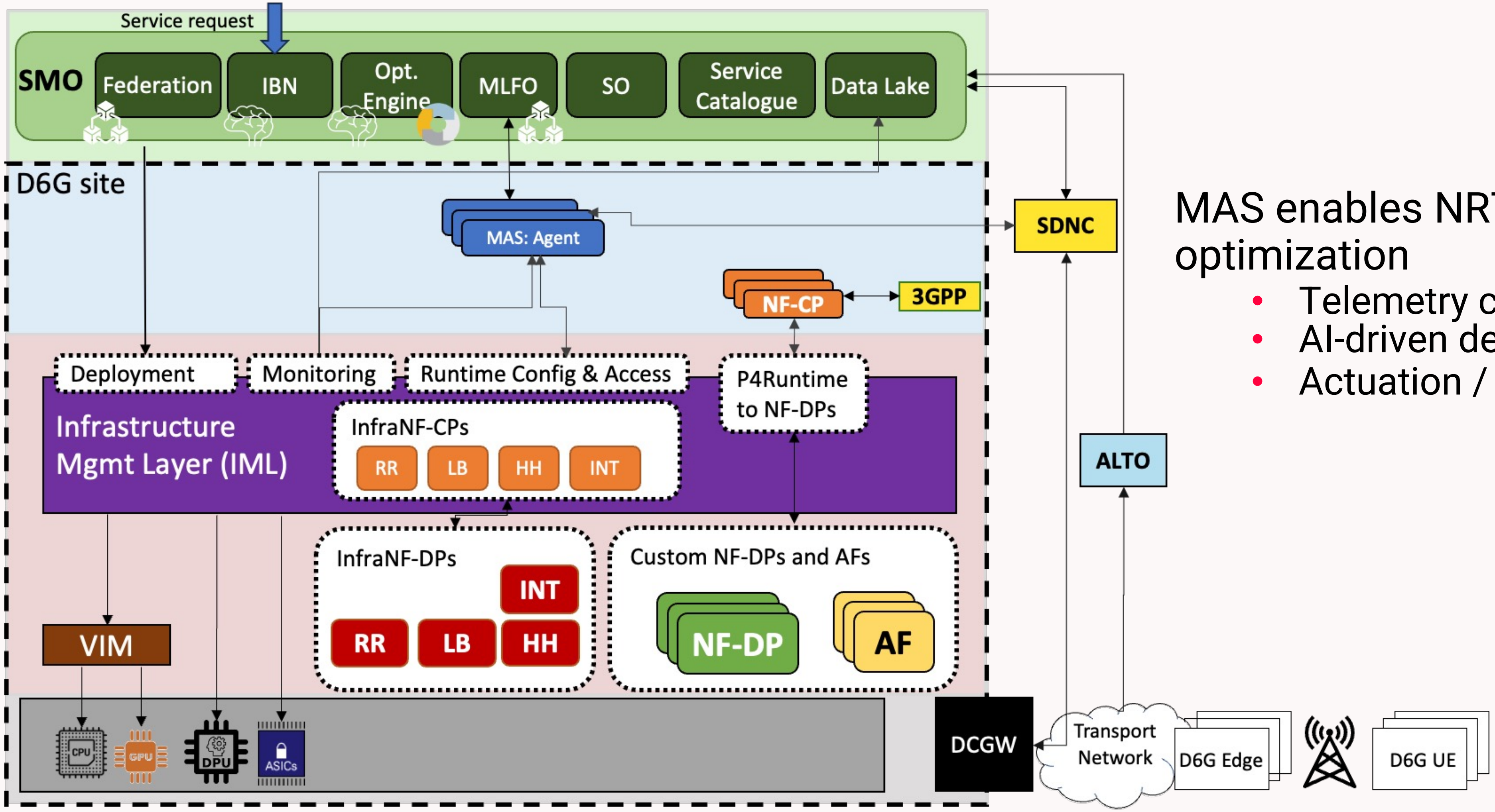


D6G ARCHITECTURE OVERVIEW



Non-RT intelligent E2E service lifecycle management

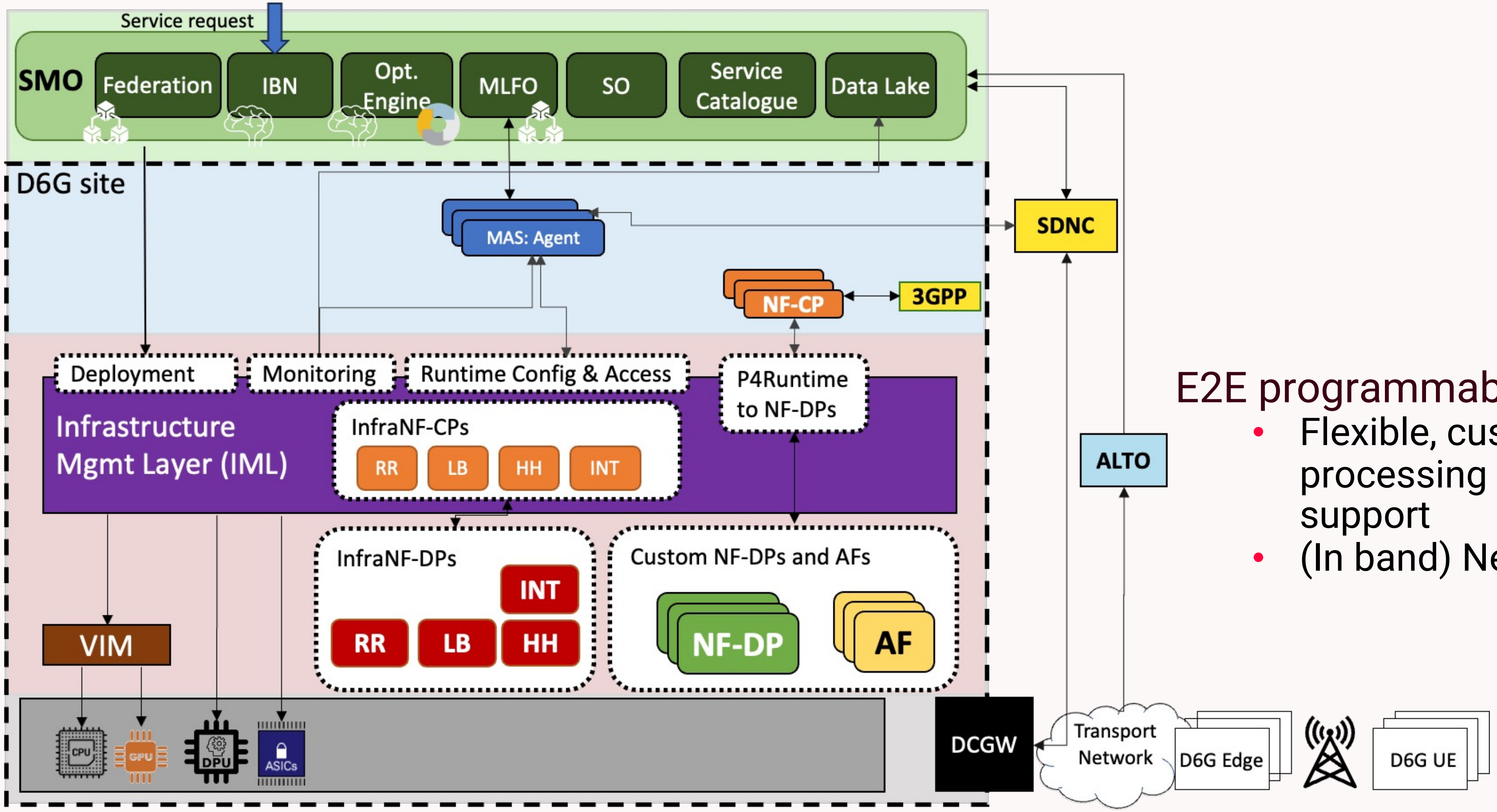
D6G ARCHITECTURE OVERVIEW



MAS enables NRT service optimization

- Telemetry collection
- AI-driven decision making
- Actuation / reconfiguration

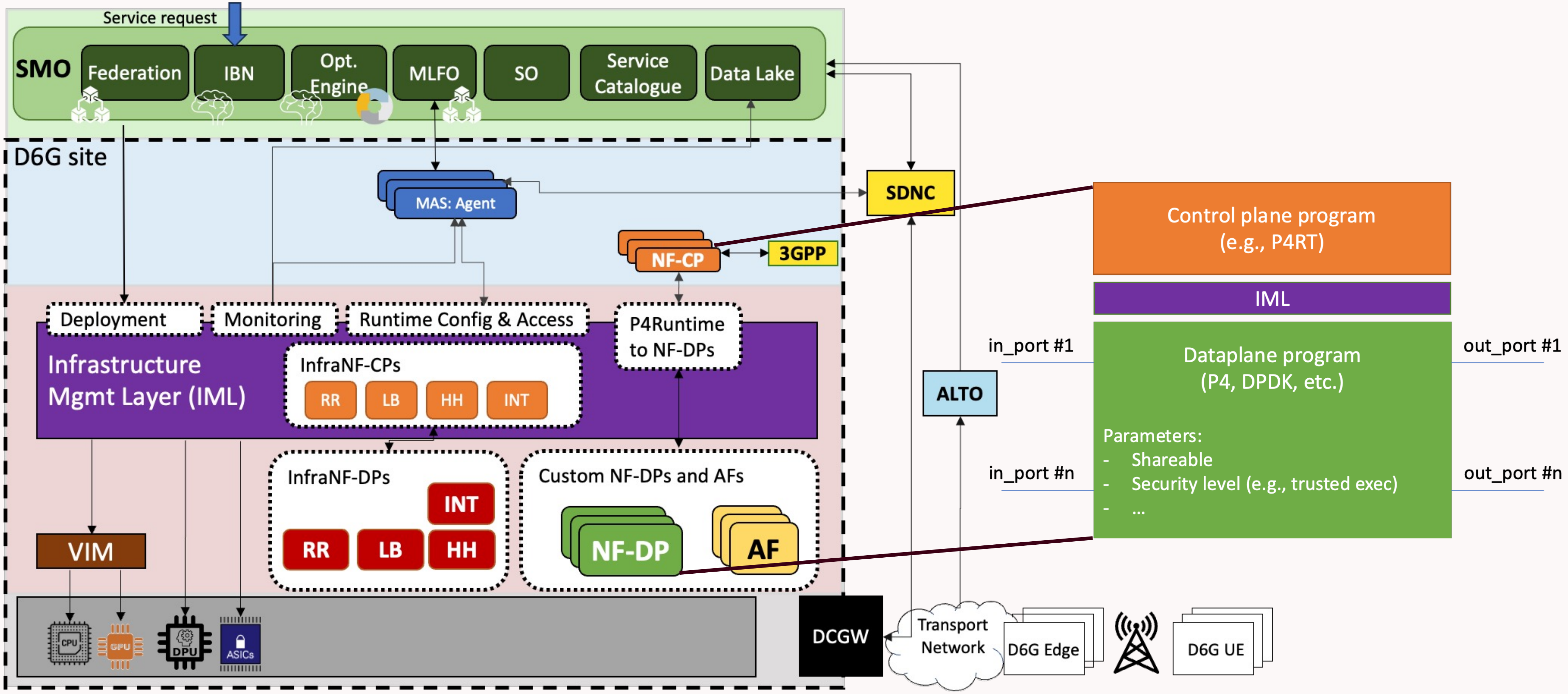
D6G ARCHITECTURE OVERVIEW



E2E programmable data plane

- Flexible, customized packet processing operations and protocol support
- (In band) Network Telemetry

D6G ARCHITECTURE OVERVIEW



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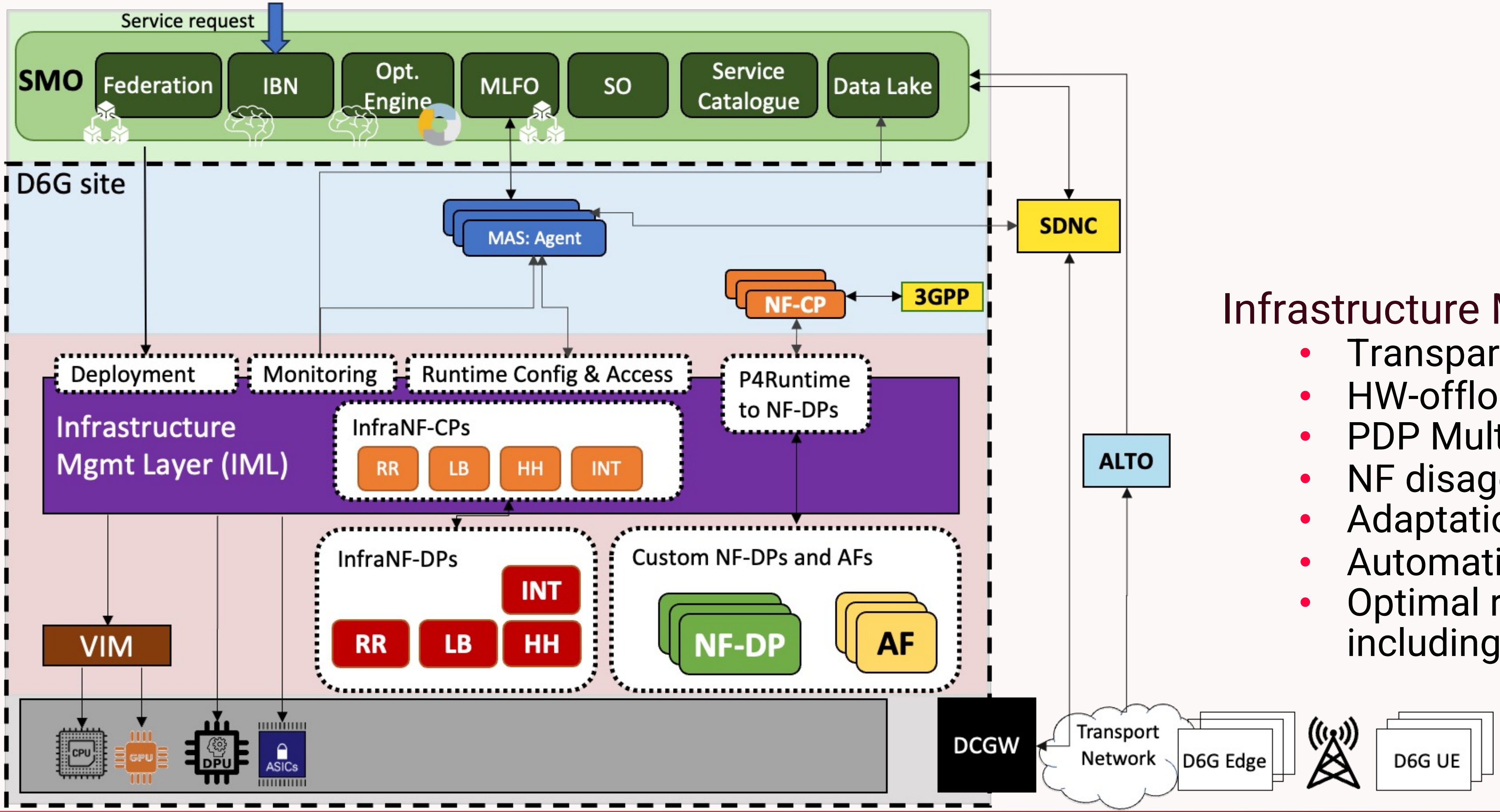
D6G ARCHITECTURE OVERVIEW



Infrastructure Management Layer

- Transparent scaling
- HW-offload in CP-agnostic way
- PDP Multitenancy
- NF disaggregation
- Adaptation to non-PDP domains
- Automatic heavy-hitter offload
- Optimal routing between NF-DPs, including collocation optimization:

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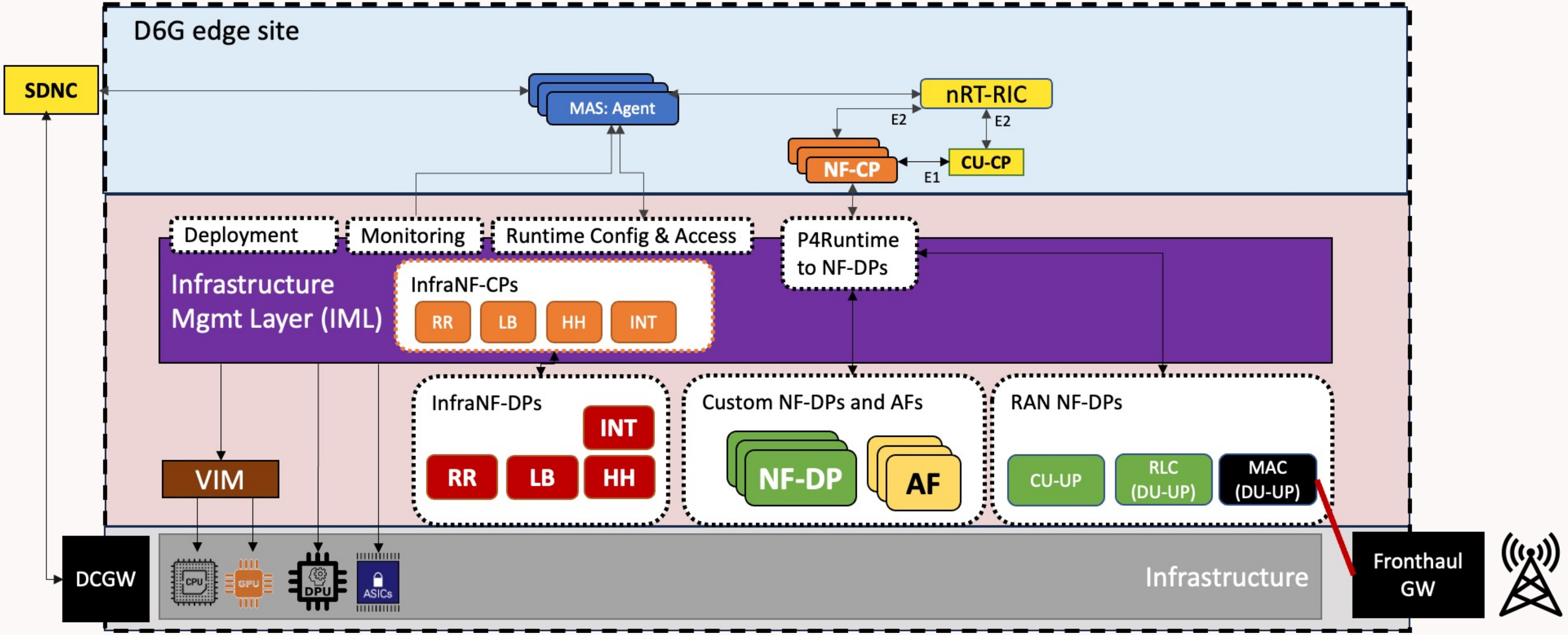
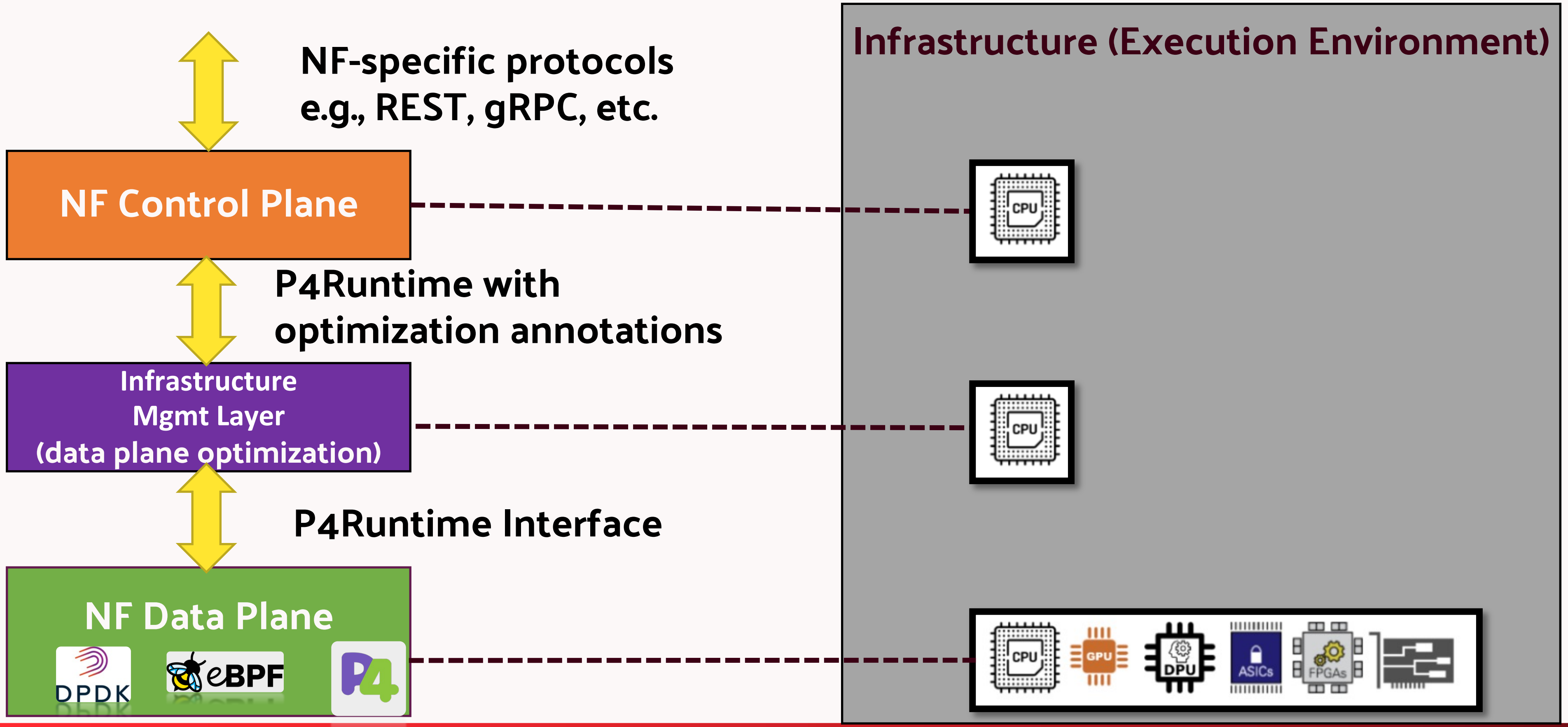
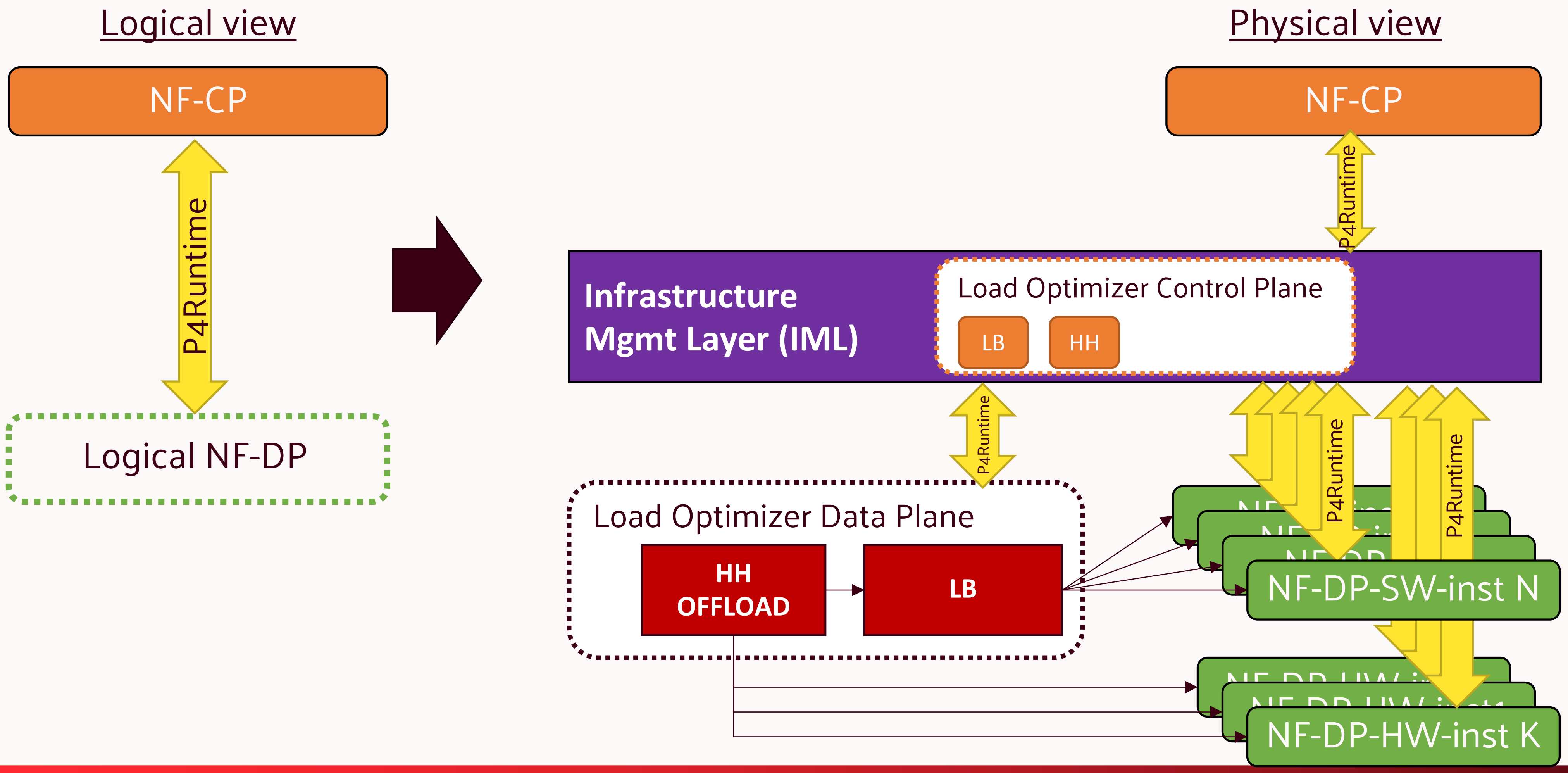
D6G ARCHITECTURE – EDGE SITE



PROGRAMMABLE DATA PLANE TRANSPARENCY



CLOUD NATIVE NETWORK SERVICES



MAS: NEAR-REAL-TIME CONTROL LOOPS

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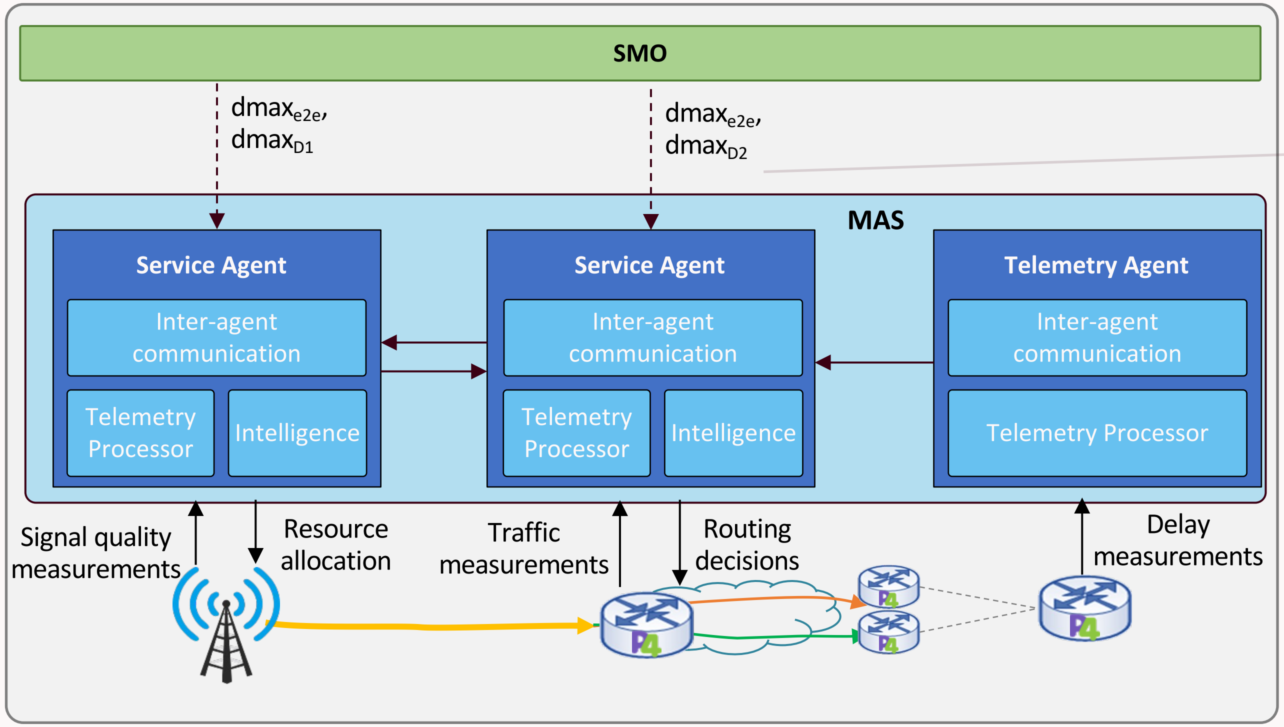
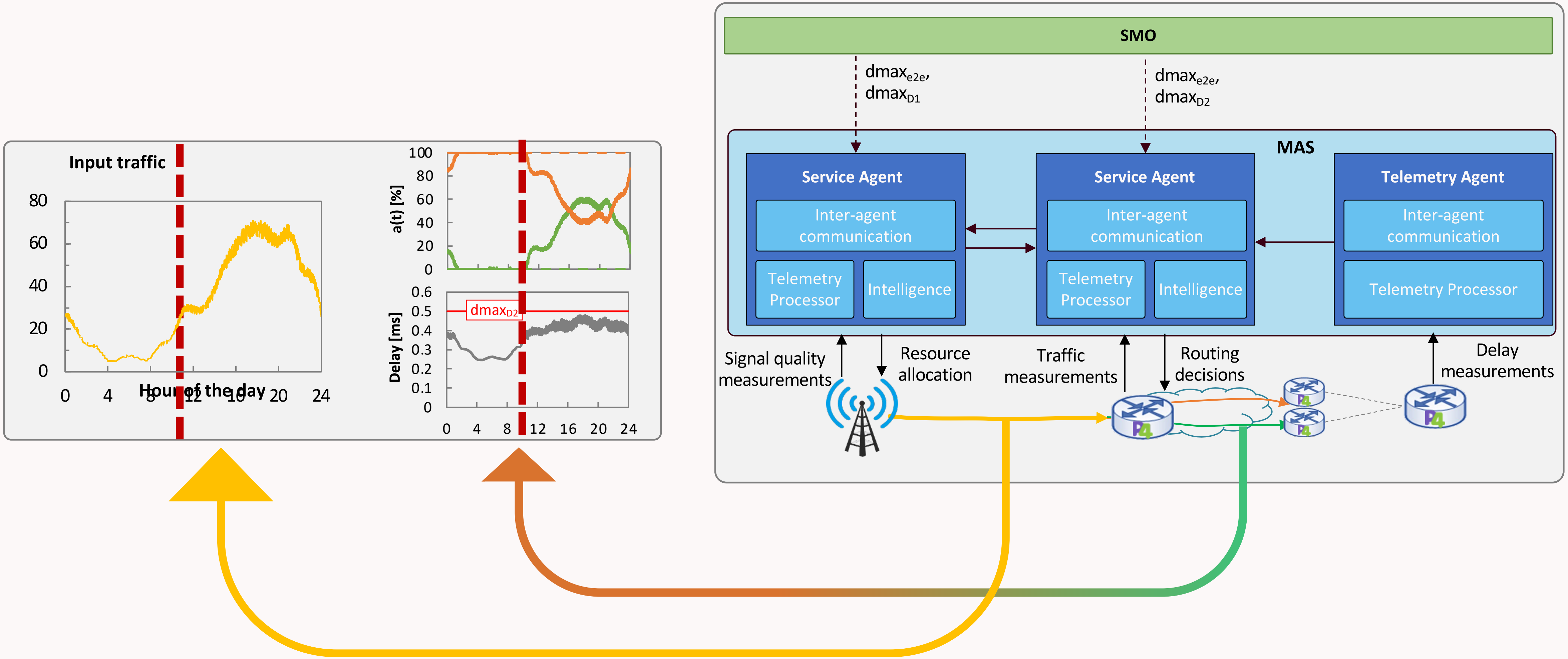


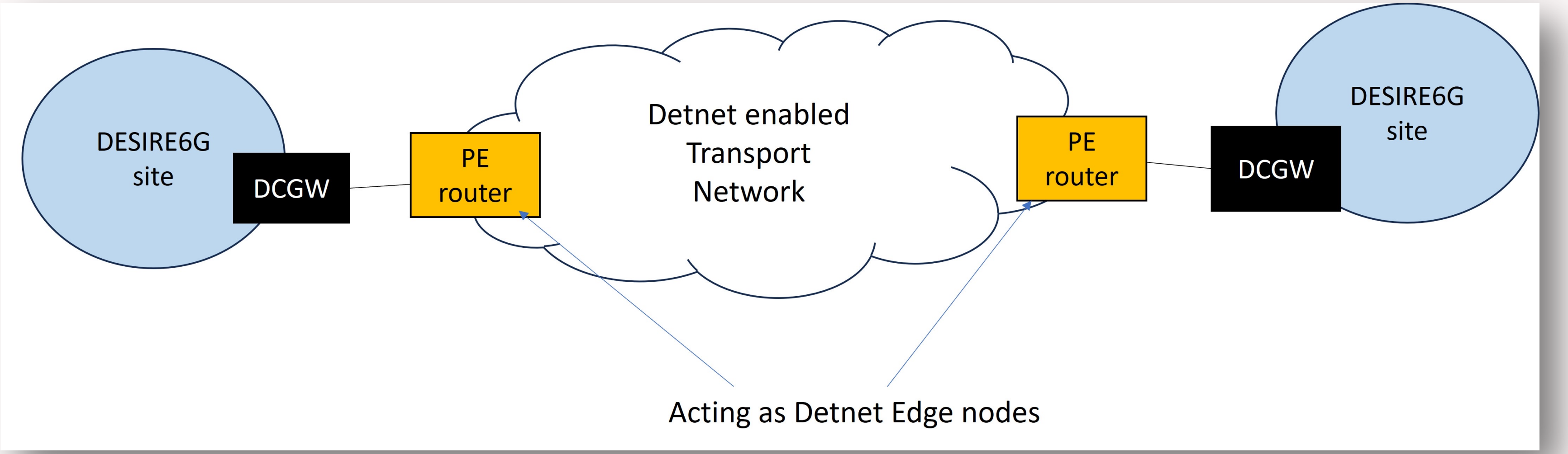
The service agents receive from the SMO:

- the max e2e delay that needs to be ensured
- the budget delay from the SLA decomposition process
- A set of routes adhering to the budget delay as guidelines that can be used for the connectivity service and corresponding policy

MAS: NEAR-REAL-TIME CONTROL LOOPS

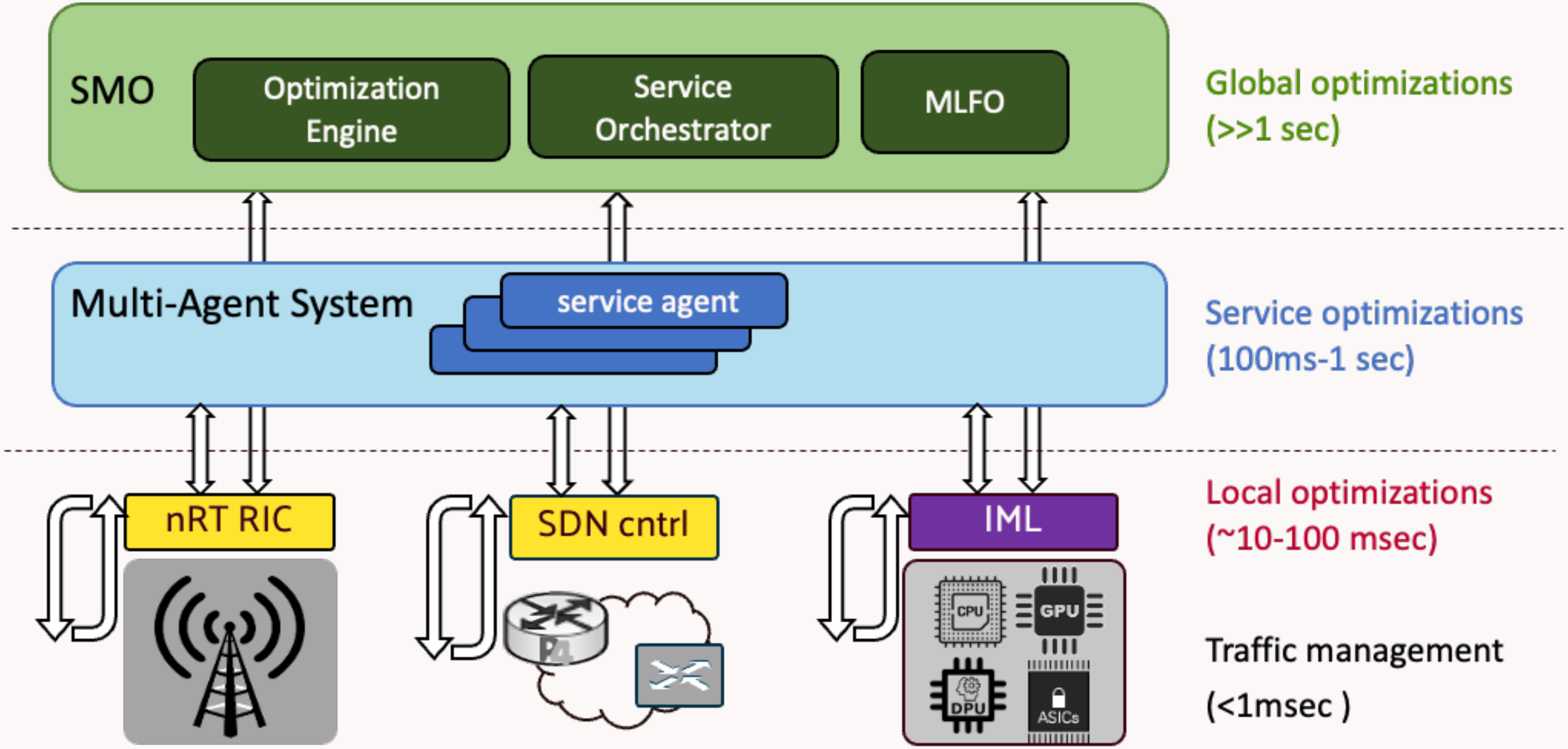


DETNET EXTENSION FOR D6G



Provide connectivity services between DESIRE6G sites, according to the KPIs of very low latency or high reliability applications.

TAKE AWAY - SERVICE ASSURANCE IN D6G



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QUESTIONS?

Chrysa Papagianni

email: c.papagianni@uva.nl

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DETERMINISTIC6G

5G latency analysis and possible improvements

Dr. Joachim Sachs (Ericsson)
Dr. Gourav Prateek Sharma (KTH)

Webinar on Architectural enhancements for 6G programmable and deterministic networks

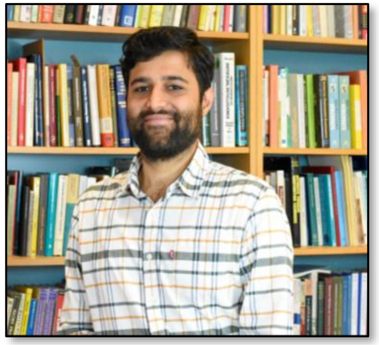
DETERMINISTIC6G has received funding from the European Union's Horizon Europe programme under grant agreement No 101096504.

Speakers

DR. JOACHIM SACHS

Senior Expert at Ericsson Research

>25 years experience in 2G to 6G



DR. GOURAV PRATEEK SHARMA

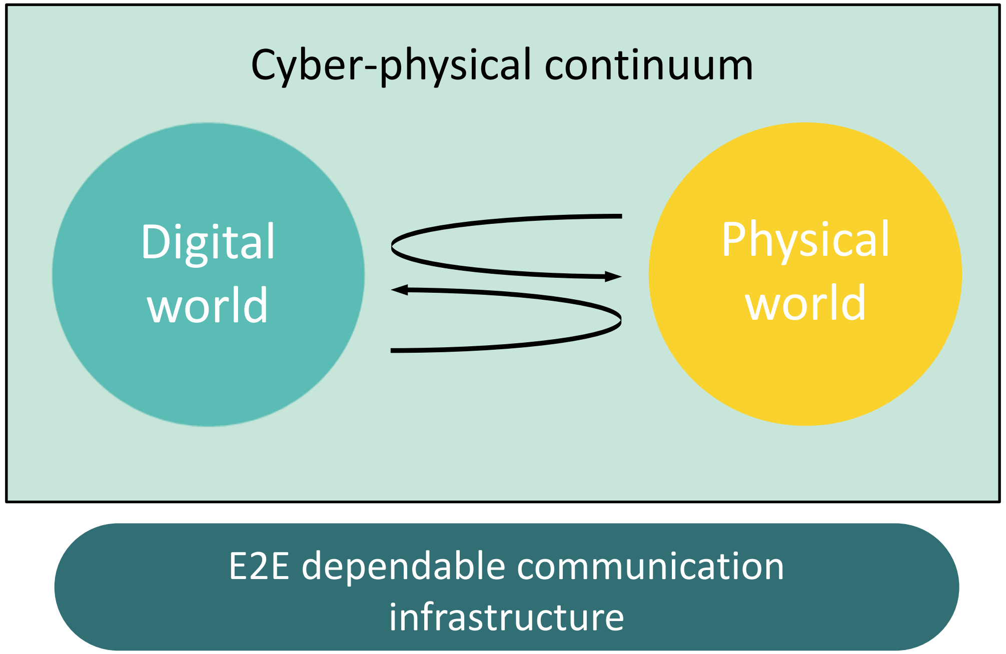
Postdoc at KTH Royal Institute of Technology

Outline

- Introduction
- Latencies in 5G Networks
- DETERMINISTIC6G Approach
- Summary

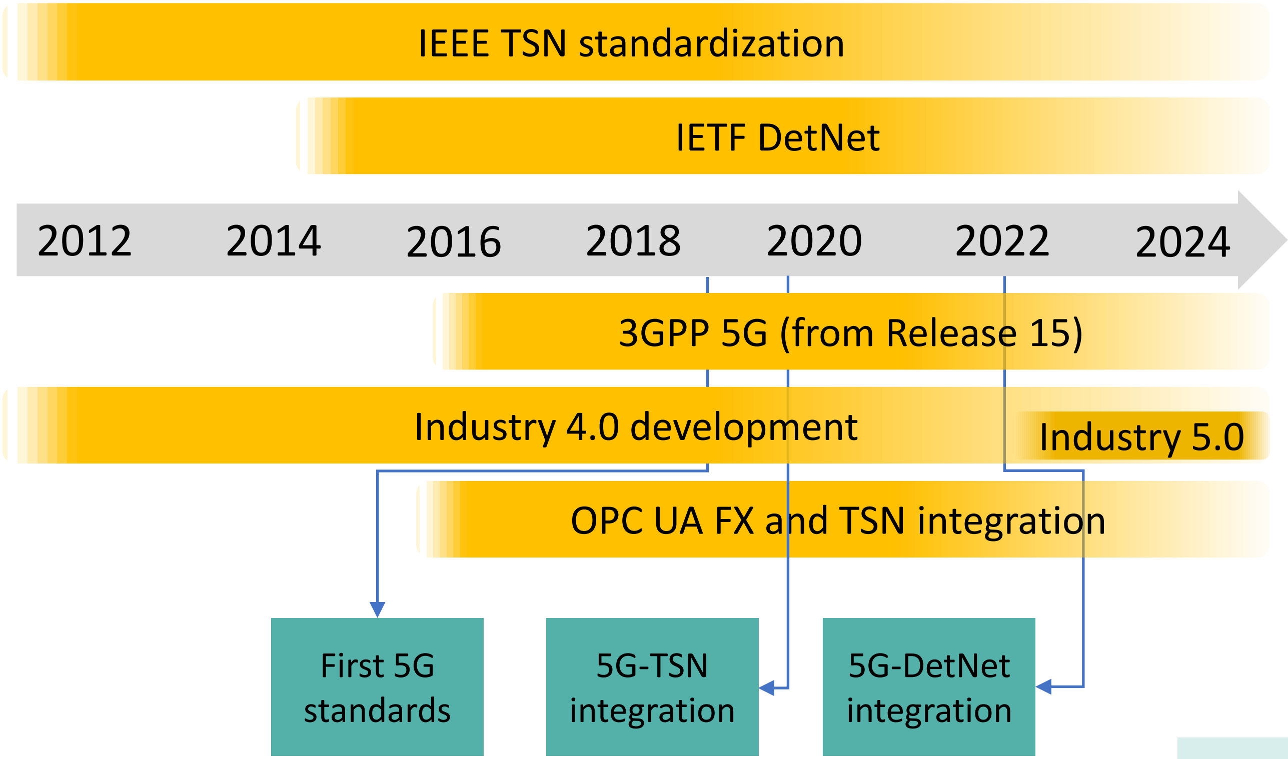
Moving towards a Cyber-Physical Continuum

- The digitalization is driving the transformation of the society and industries
- New forms of interactions will lead to a converged cyber-physical continuum spanning different communication technologies
- End-to-End (E2E) dependable communication infrastructure is a necessary requirement to support such interactions



Today's Dependable Communications Arena

- ❑ Over the last decade, the major pivot of the communications community has been towards low-latency and reliability
  - ❑ Digitalization of automation systems as a main driver
- ❑ Several communication technologies (TSN, DetNet, 5G, OPC UA) are independently evolving towards the support for wired/wireless dependable communication
  - ❑ So far only limited interworking (e.g., recent 5G-TSN integration architecture)

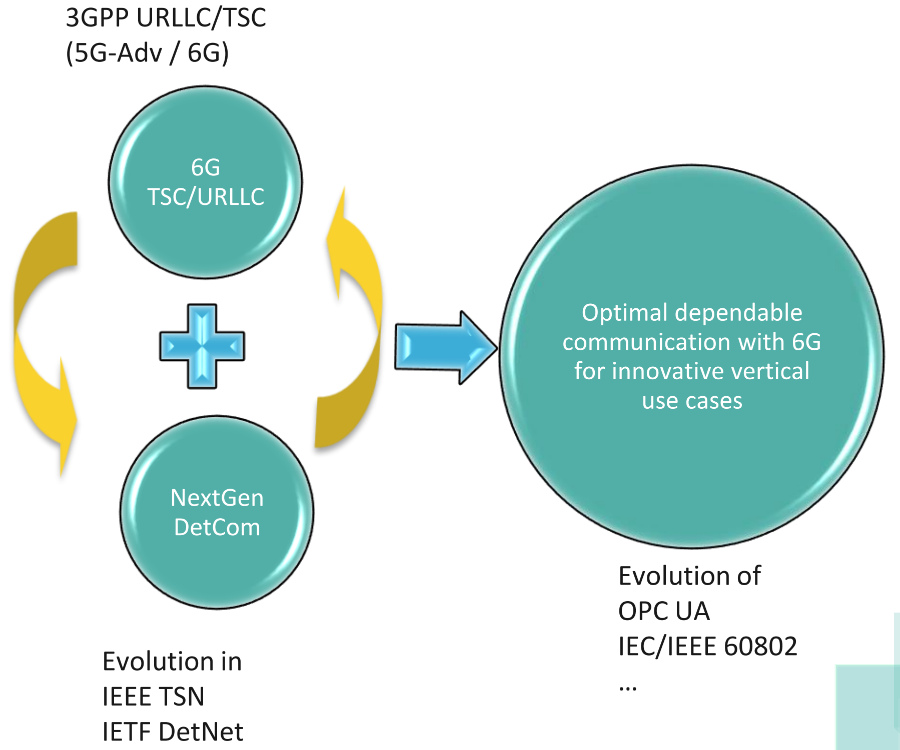


TSN : Time-Sensitive Networking
OPC UA : OPC Unified Architecture
DetNet: Deterministic Networking

DETERMINISTIC6G Vision

The DETERMINISTIC6G vision is to set the foundation for future global communication standards enabling 6G dependable communication for visionary use cases

- New concepts, features and solutions to
  - Evolve TSN & DetNet to become more wireless-friendly
  - Improve 5G-Advanced/6G to be better suited for dependable communication
  - Align with the main application middleware for dependable communication: OPC UA (with its features on OPC UA FX (Field eXchange) and the usage of TSN)



URLLC: Ultra-reliable and low-latency communications
5G-Adv: 5G-Advanced
TSN : Time Sensitive Networking
TSC: Time Sensitive Communication
DetNet: Deterministic Networking

DETERMINISTIC6G Consortium

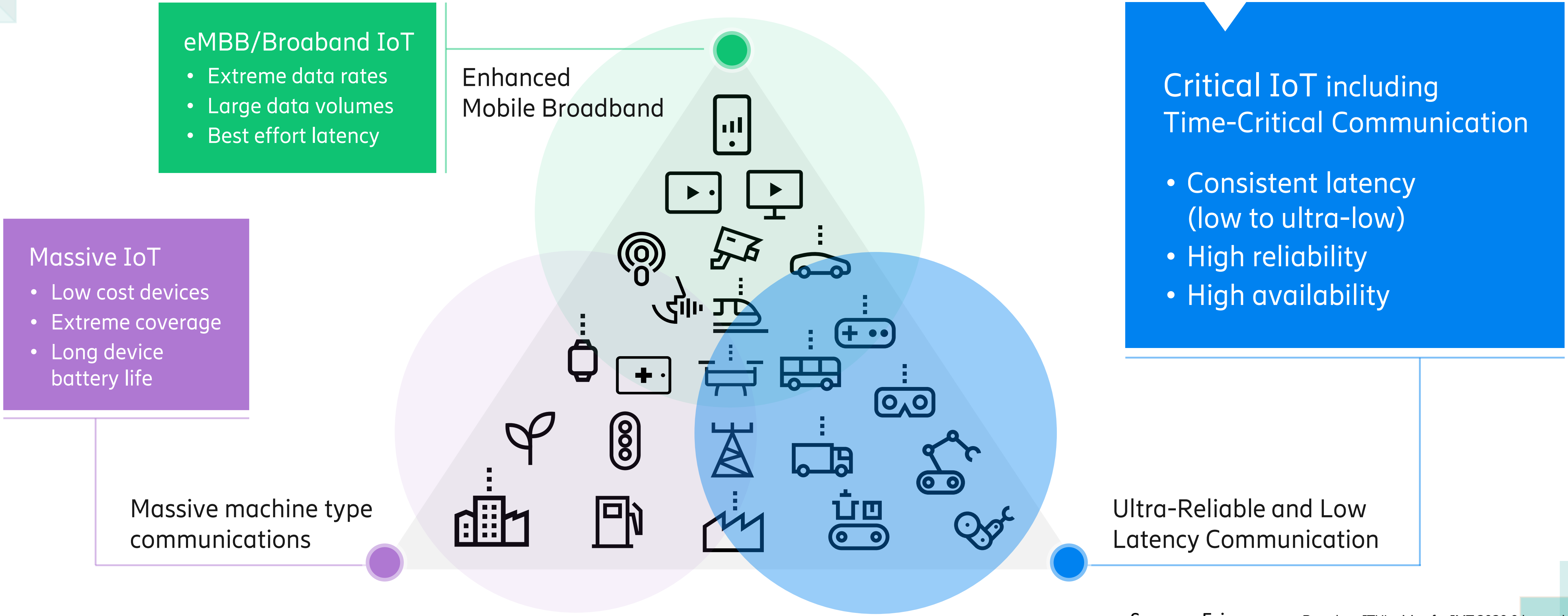
Industrial application players bringing 6G visionary use cases

Key industrial players in 6G research and development

Key university and research institutes at the forefront for 6G fundamental research

- 12 partners (Coordinator: Ericsson GmbH)
- Jan 2023 – Jun 2025 (30 months)
- 5.8 M€

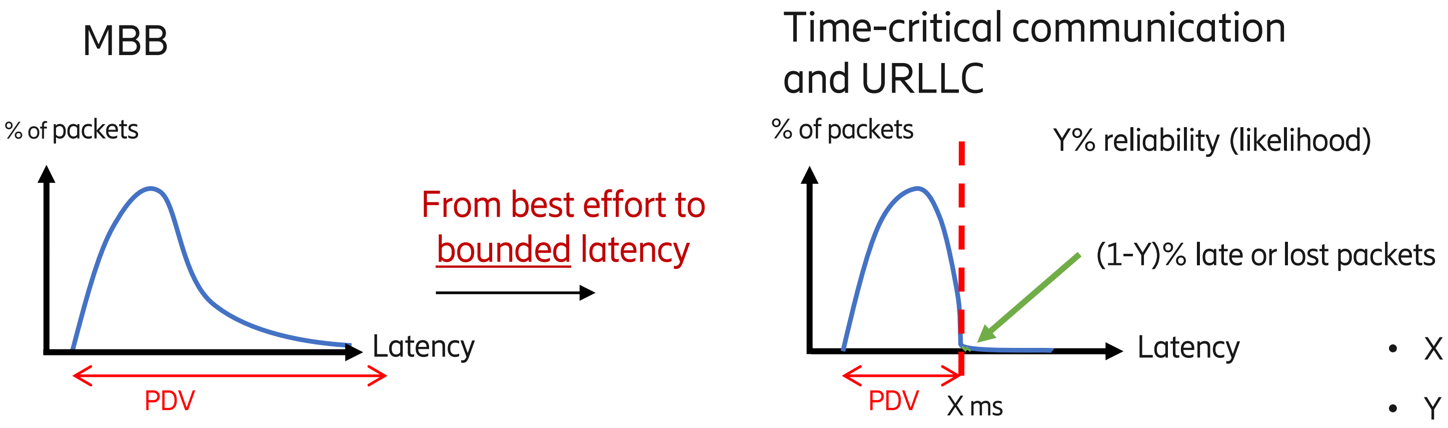
5G Ambitions



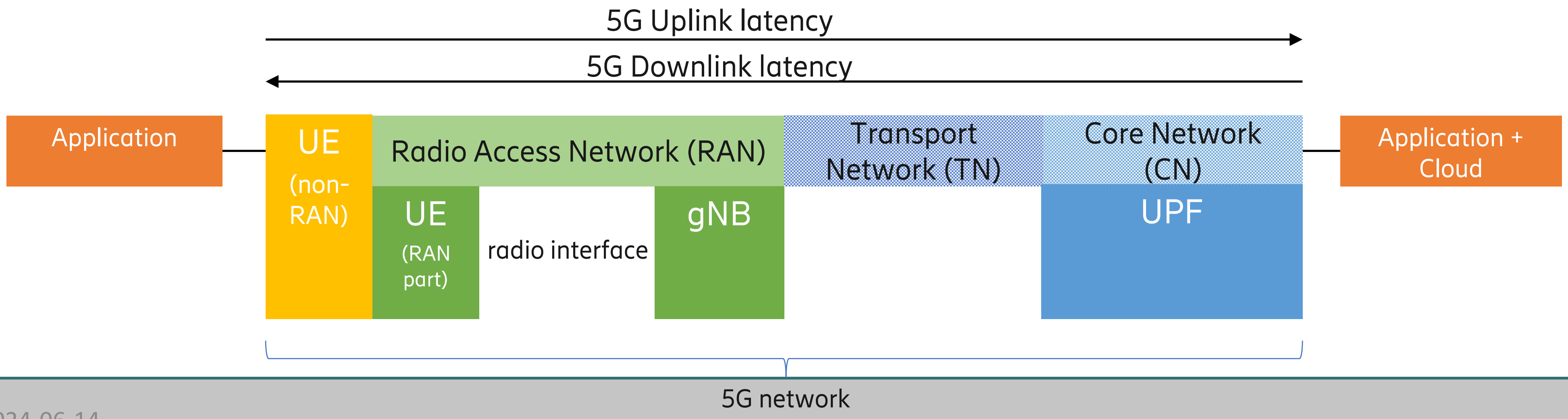
Source: Ericsson

Based on: ITU's vision for IMT 2020 & beyond

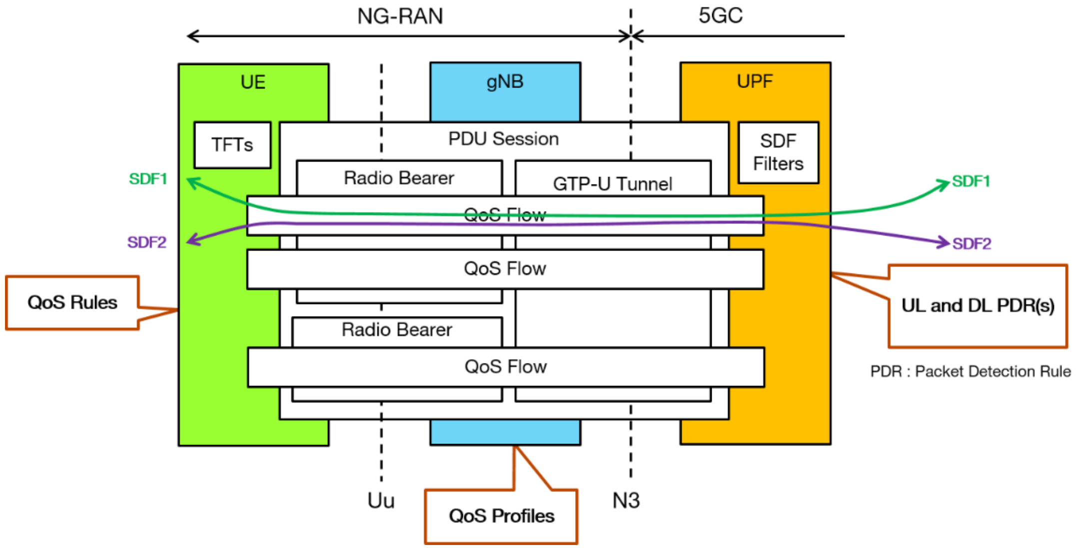
Time-critical Communication

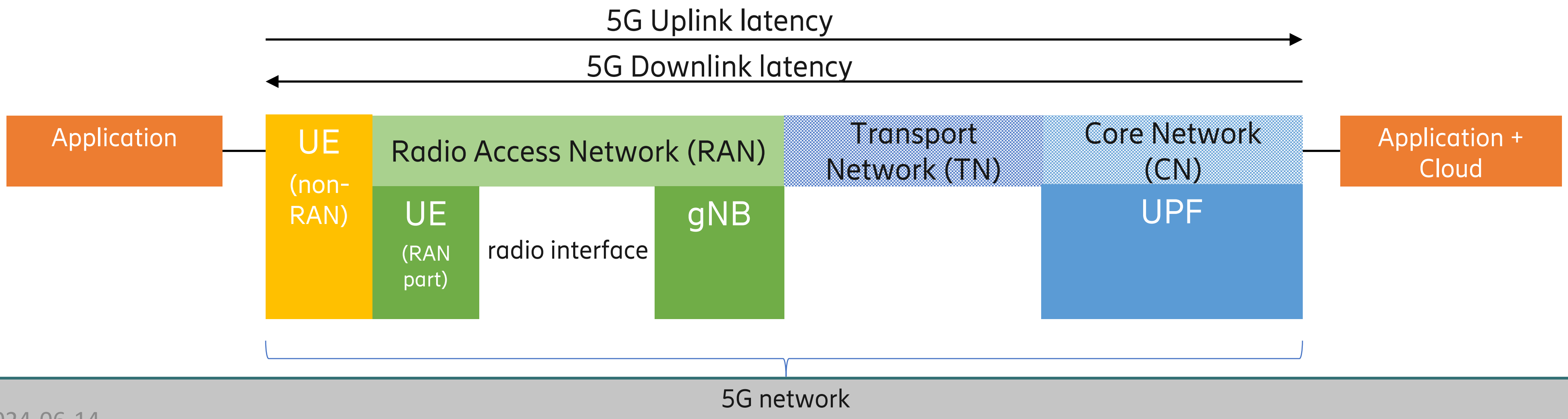


- X ranges from tens of ms to 1ms latency
- Y ranges from 99% to 99,999% reliability

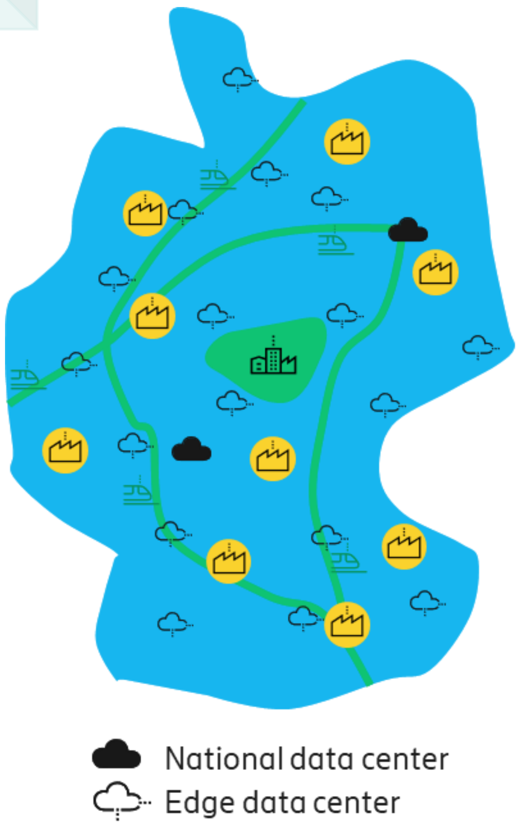


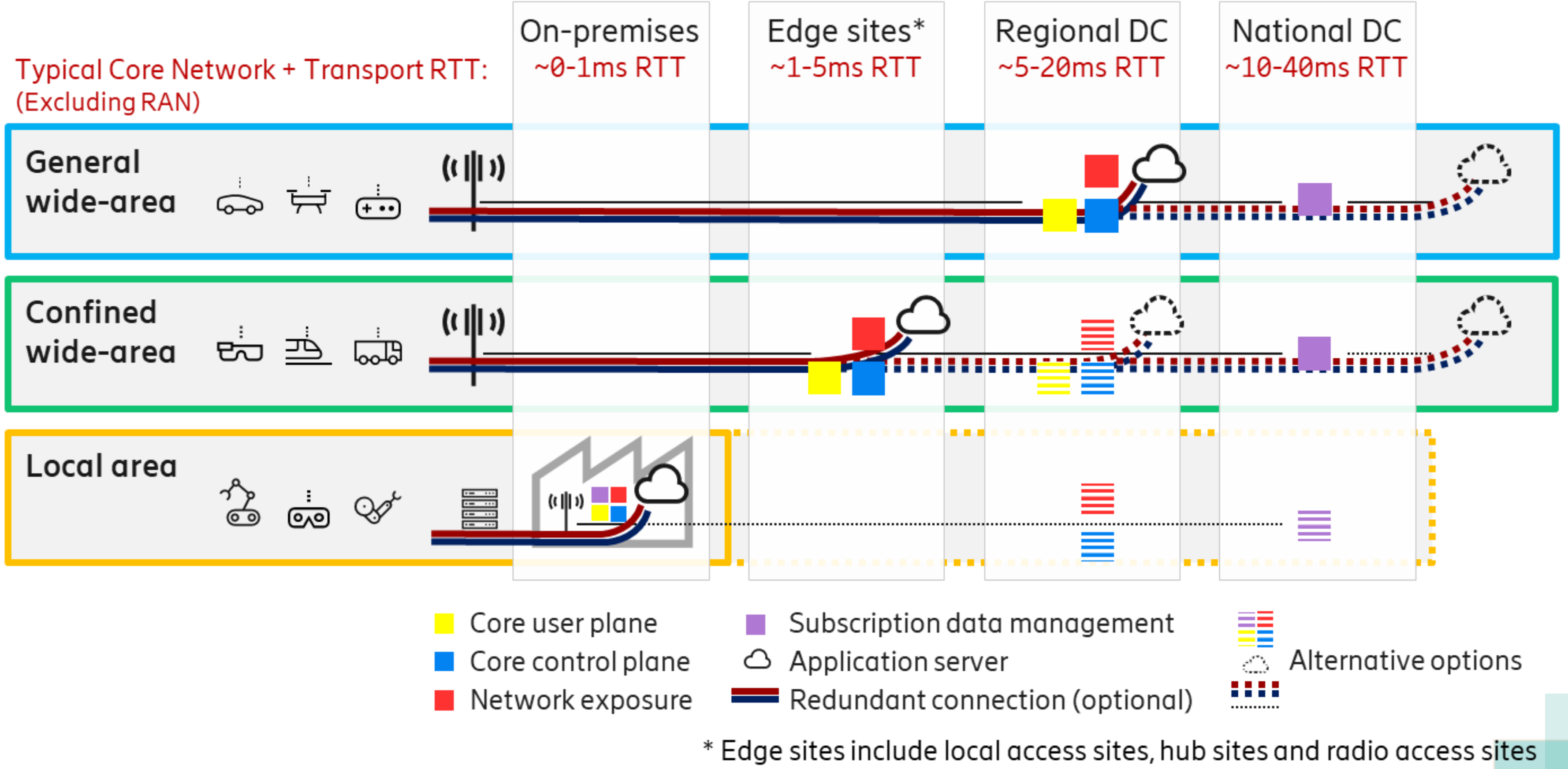
Time-critical Applications





Latency Induced by Distance





F. Alriksson, L. Boström, J. Sachs, Y. . -P. E. Wang and A. Zaidi, "Critical IoT connectivity Ideal for Time-Critical Communications," in Ericsson Technology Review, vol. 2020, no. 6, pp. 2-13, June 2020, doi: 10.23919/ETR.2020.9905508

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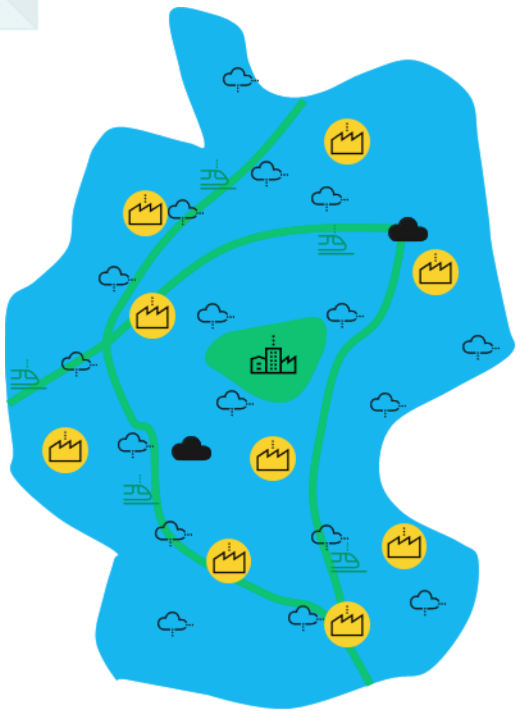
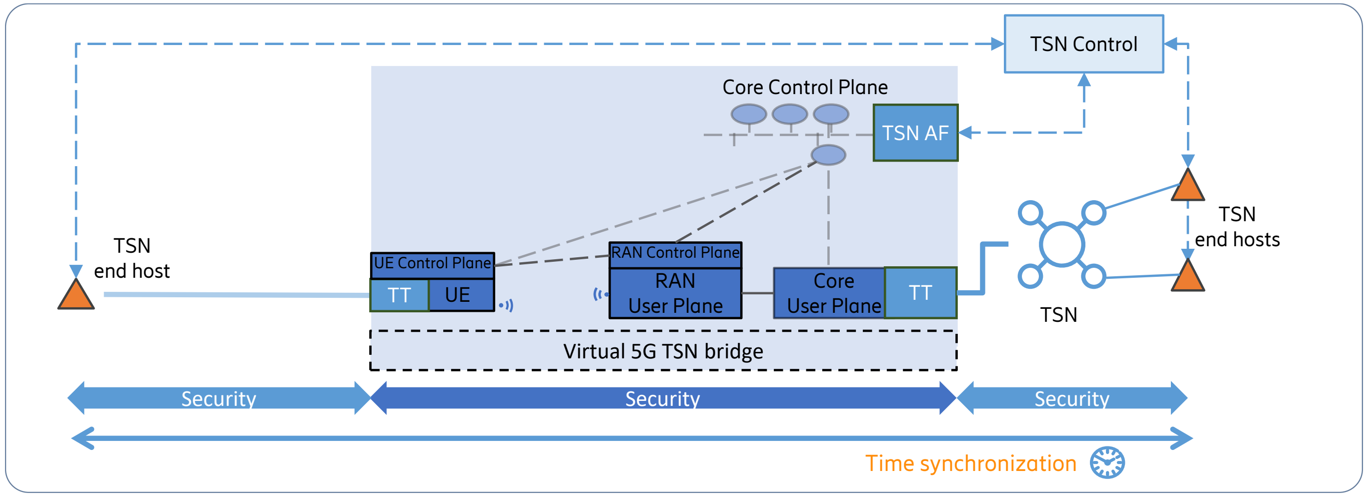
5G Non-public (private) Networks



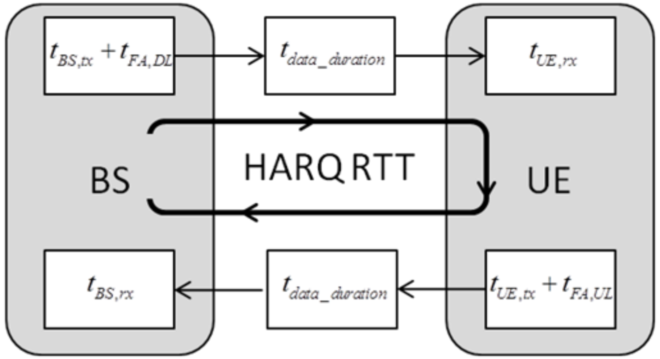


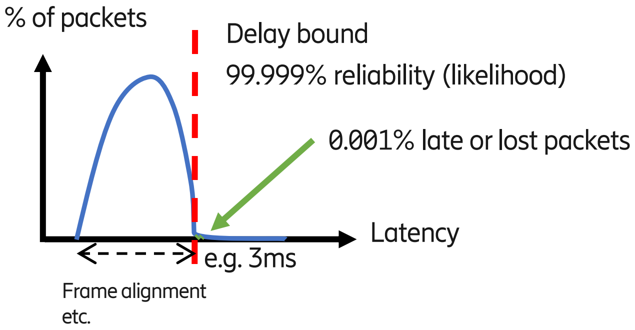
National data center
Edge data center

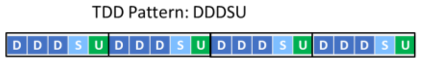
Core user plane
Core control plane
Network exposure
Subscription data management
Application server
Redundant connection (optional)
Alternative options

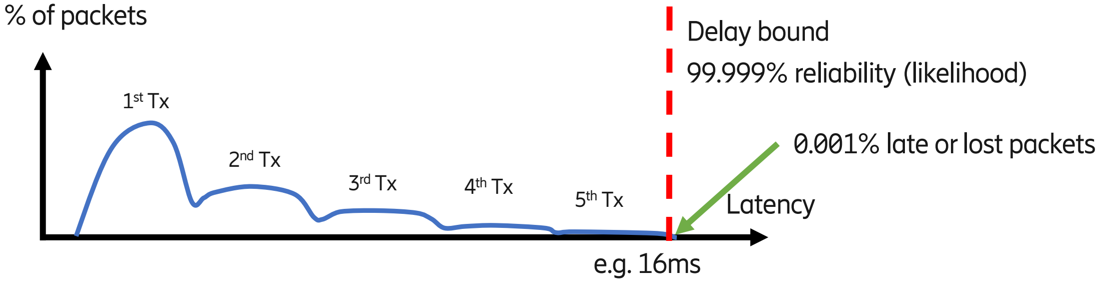
* Edge sites include local access sites, hub sites and radio access sites

Reliability vs. Latency



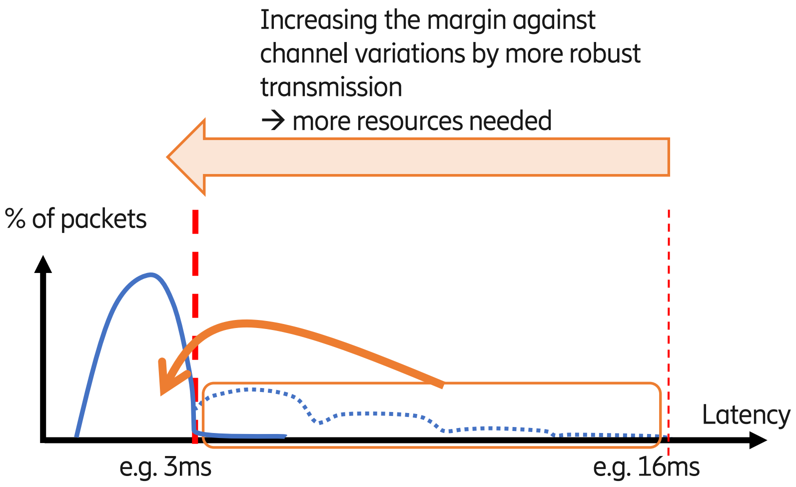


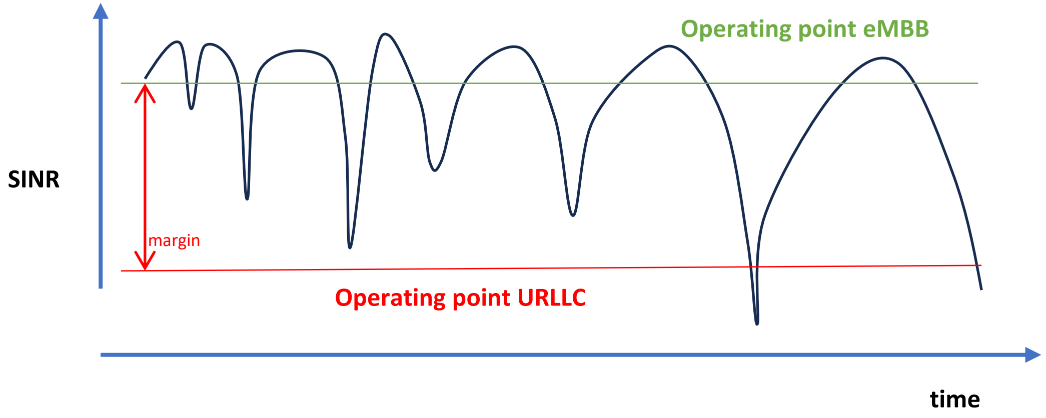




DETERMINISTIC6G, Deliverable 2.1, “First report on 6G centric enablers,” Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables

Reliability vs. Spectral Efficiency



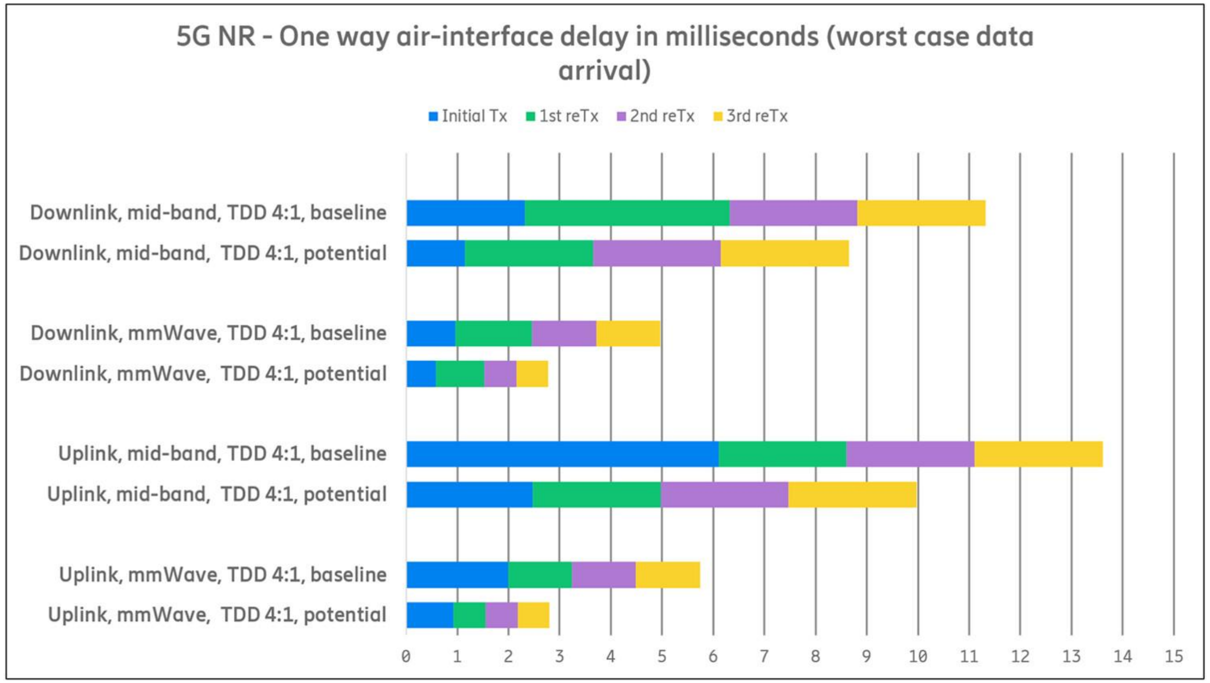


DETERMINISTIC6G, Deliverable 2.1, "First report on 6G centric enablers," Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables

URLLC with 5G

URLLC toolbox

- ❑ Pre-scheduling and configured grant
- ❑ Mini-slots and flexible numerology
- ❑ Fast HARQ
- ❑ Preemptive transmission
- ❑ Robust control and data channels
- ❑ Redundant connectivity
- ❑ Multi-antenna diversity



5G-SMART deliverable D1.5, “Evaluation of radio network deployment options”, Dec. 2021, https://5gsmart.eu/deliverables/

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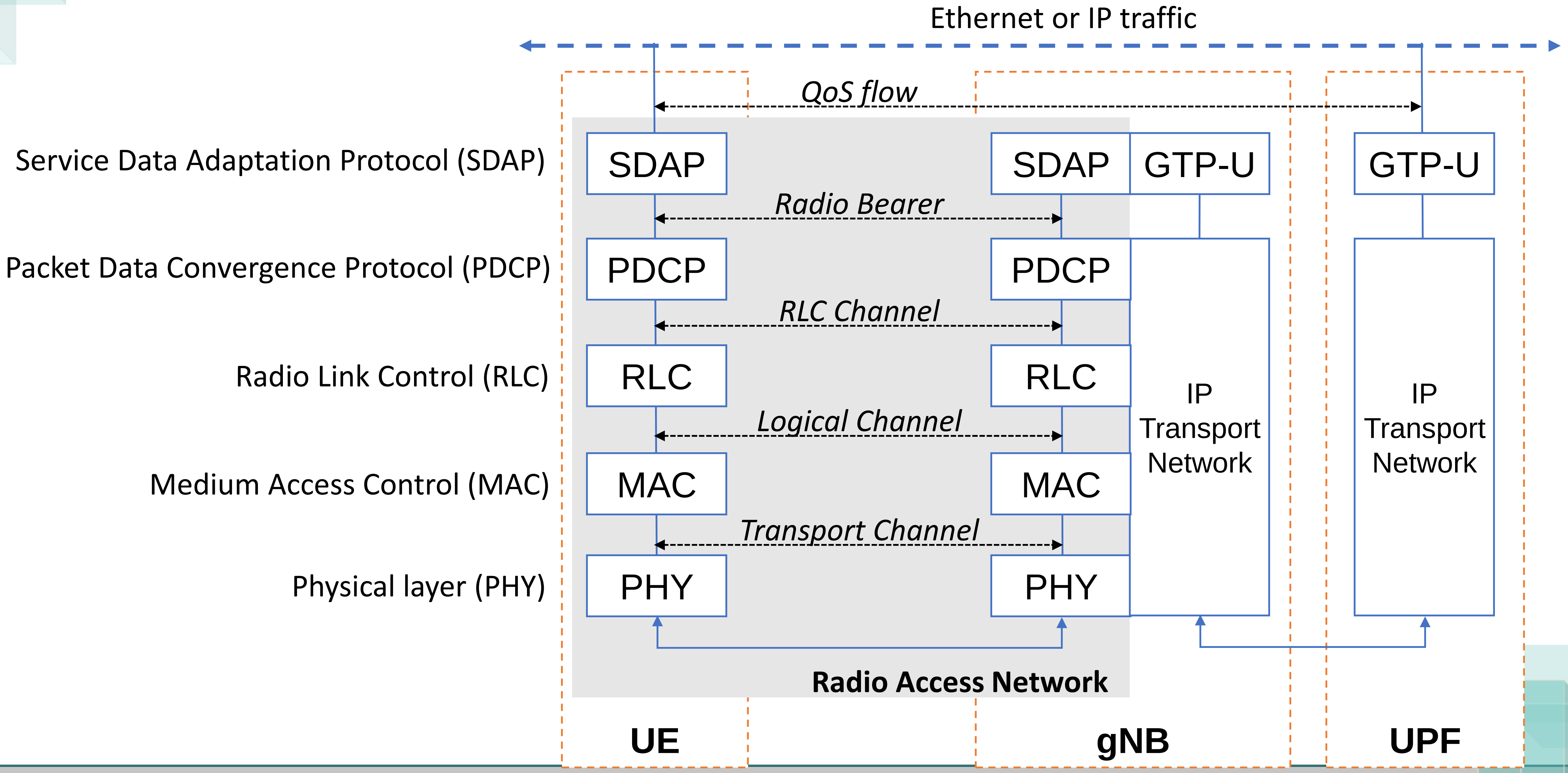
- O. Liberg, M. Sundberg, Y.-P. E. Wang, J. Bergman, J. Sachs, G. Wikström, *Cellular Internet of Things - From Massive Deployments to Critical 5G Applications*, Academic Press, second edition, ISBN: 9780081029022, October 2019.

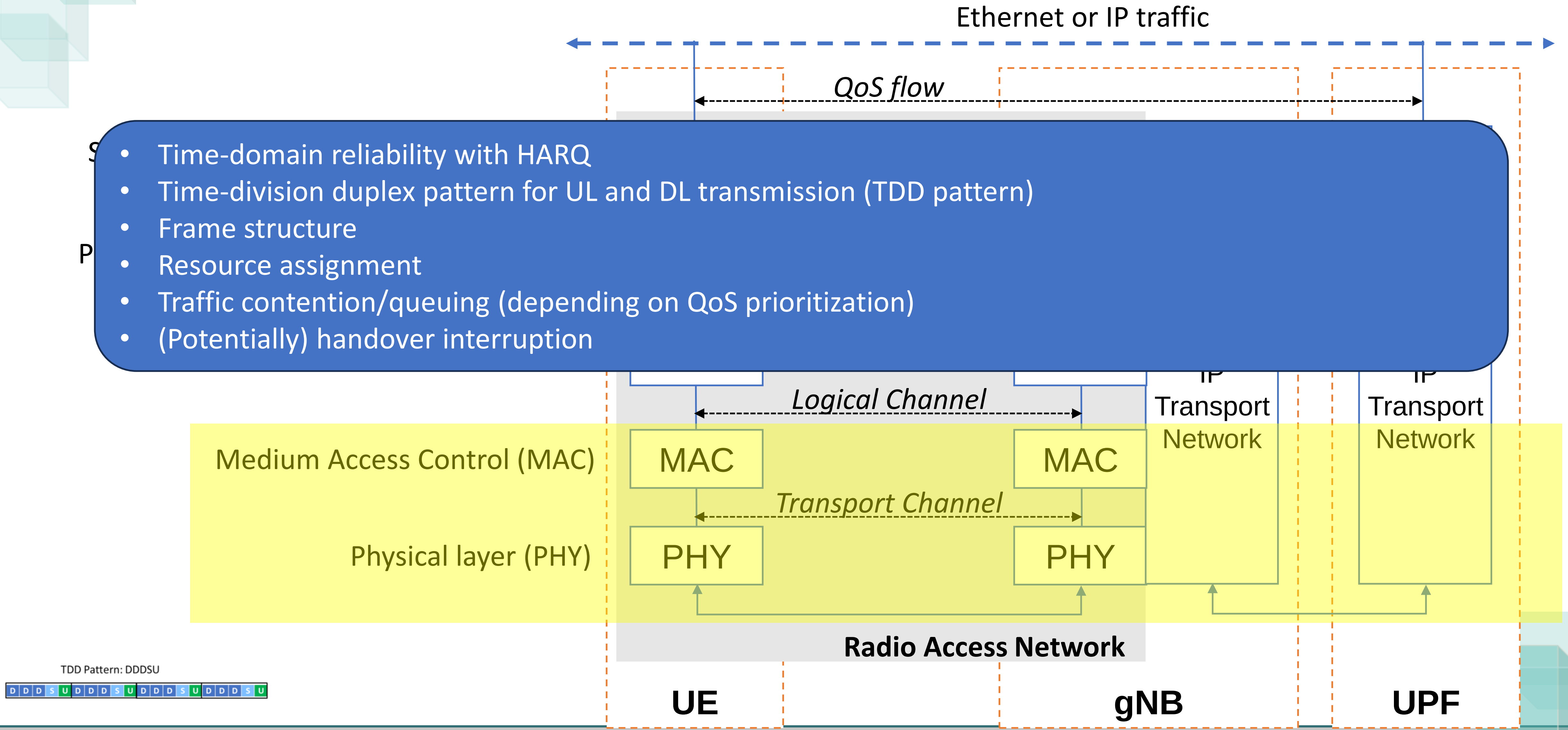
5G RAN Latency Contributors



DETERMINISTIC6G, Deliverable 2.1, "First report on 6G centric enablers," Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables

5G RAN Latency Contributors

- Time-domain reliability with HARQ
- Time-division duplex pattern for UL and DL transmission (TDD pattern)
- Frame structure
- Resource assignment
- Traffic contention/queuing (depending on QoS prioritization)
- (Potentially) handover interruption



DETERMINISTIC6G, Deliverable 2.1, "First report on 6G centric enablers," Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables

5G RAN Latency Contributors

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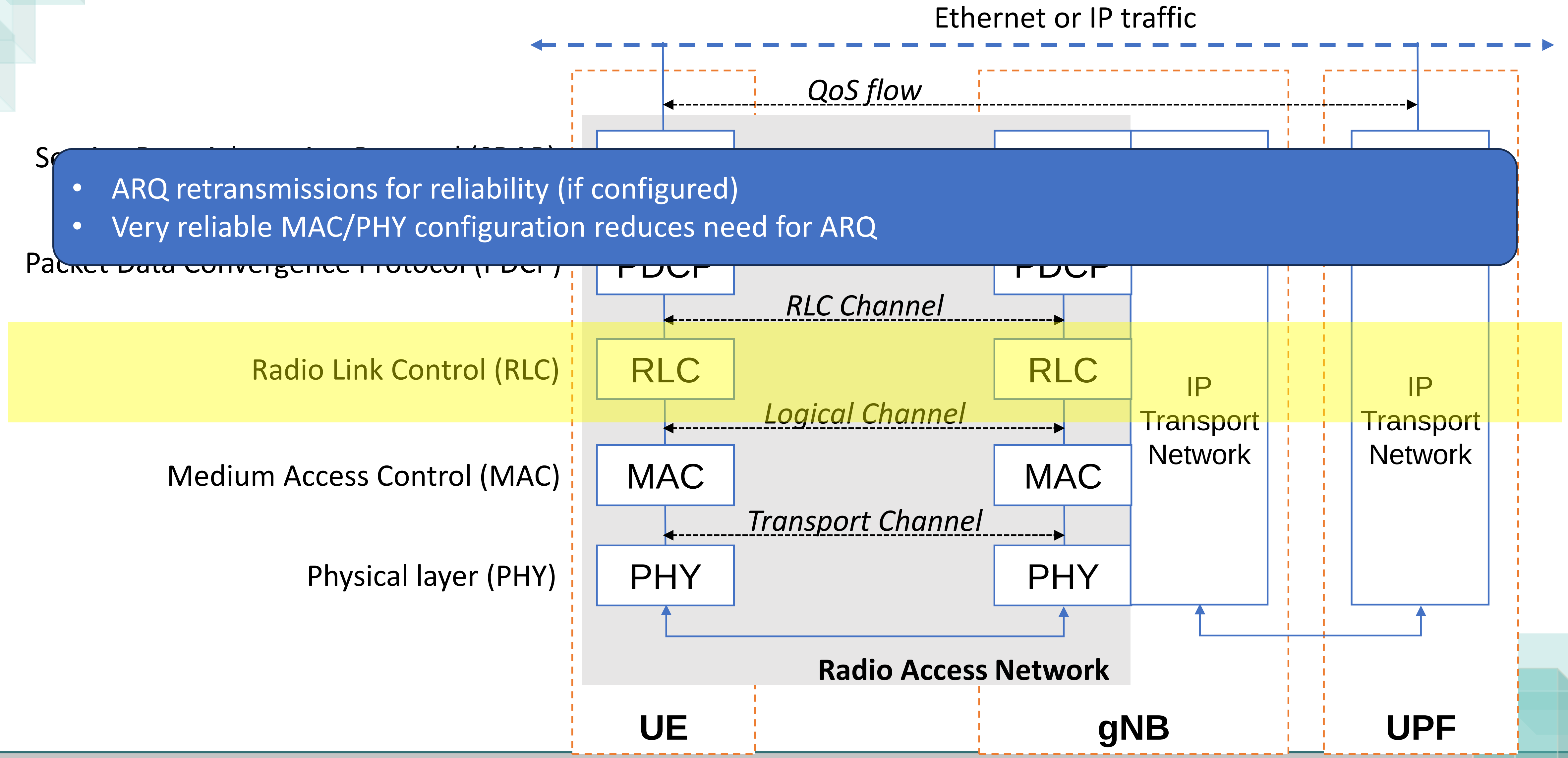
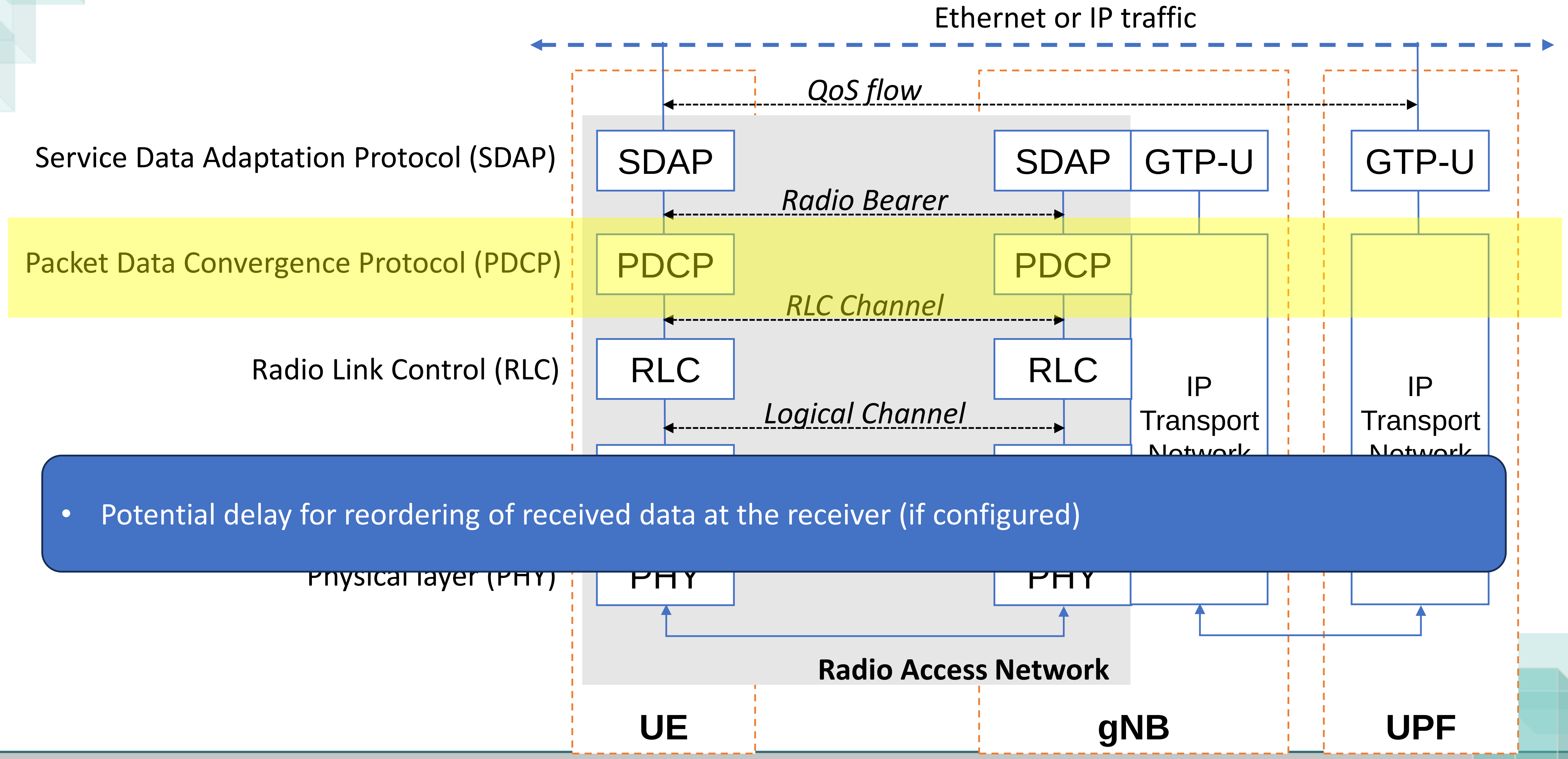
- ARQ retransmissions for reliability (if configured)
- Very reliable MAC/PHY configuration reduces need for ARQ



DETERMINISTIC6G, Deliverable 2.1, "First report on 6G centric enablers," Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables

5G RAN Latency Contributors

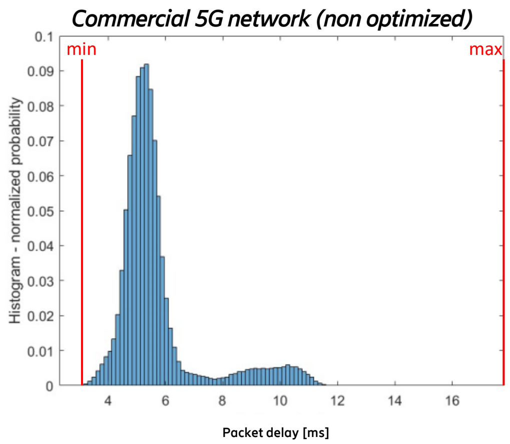


- Potential delay for reordering of received data at the receiver (if configured)

DETERMINISTIC6G, Deliverable 2.1, “First report on 6G centric enablers,” Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables

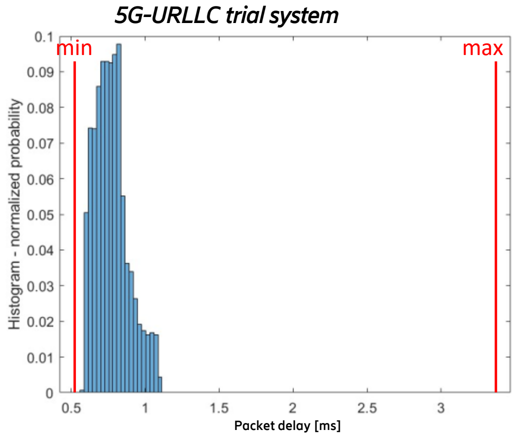
5G Networks: From Trials to Reality

- 5G networks show comparatively large packet delay variation (PDV), even with URLLC



(a)

Ansari et al. Electronics 2022



(b)

Ansari et al., TSNA 2022
Kehl et al. Electronics 2022

[1] J. Ansari, C. Andersson, P. de Bruin, J. Farkas, L. Grosjean, J. Sachs, J. Torsner, B. Varga, D. Harutyunyan, N. König, R. H. Schmitt, "Performance of 5G Trials for Industrial Automation. Electronics", 2022; 11(3):412. https://doi.org/10.3390/electronics11030412

[2] P. Kehl, J. Ansari, M. H. Jafari, P. Becker, J. Sachs, N. König, A. Göppert, R. H. Schmitt, "A Prototype of 5G Integrated with TSN for Edge-Controlled Mobile Robotics" Electronics 11, no. 11: 1666, 2022. https://doi.org/10.3390/electronics11111666

[3] DETERMINISTIC6G, "Digest on First DetCom Simulator Framework Release", deliverable D4.1, Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables

[4] DETERMINISTIC6G, "Report on 6G convergence enablers towards deterministic communication standards", deliverable D3.1, Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables

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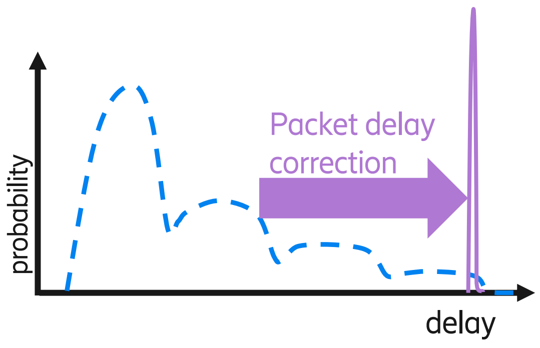
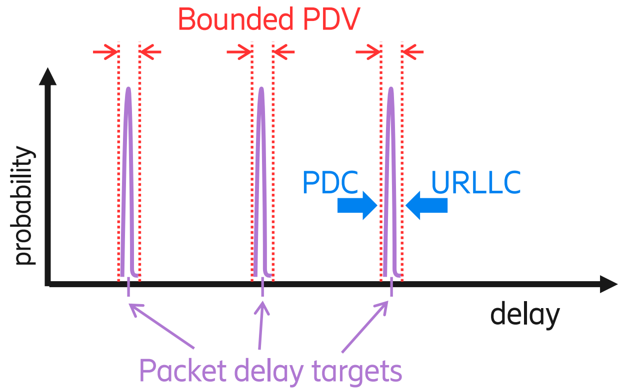
Packet Delay Variation (PDV)

- Time-sensitive / deterministic transmission
  - Receiving the right packet at the right time
- Packet-delay variation creates uncertainty on packet arrivals
  - Can be problematic for e.g. Time-Sensitive Networking (TSN) time-scheduled transmission [D3.1]
- Correction of PDV via packet delay correction (PDC) in 6G can remove uncertainty of packet delays [D2.1]

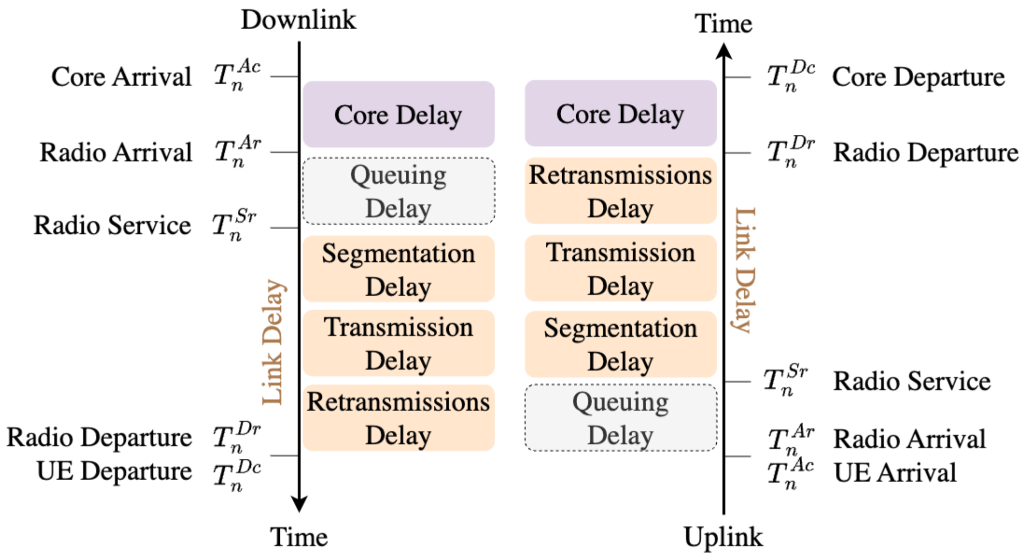




[D2.1] DETERMINISTIC6G, Deliverable 2.1, "First report on 6G centric enablers," Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables
[D3.1] DETERMINISTIC6G, Deliverable 3.1, "Report on 6G convergence enablers towards deterministic communication standards," Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables

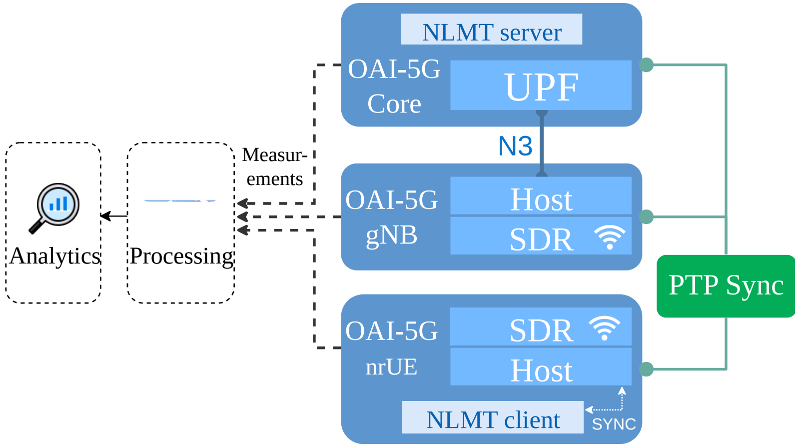
5G Delay Decomposition Model

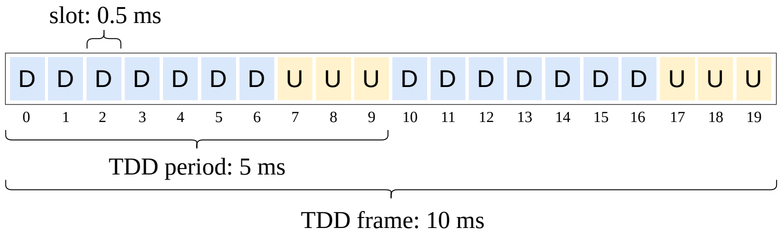
- High-level components: Core delay and RAN delay
- Core delay
  - N3 interface (between RAN and UPF)
  - Industrial scenarios: small and fixed
- RAN delay
  - Dominates in end-to-end delay variations
  - Further split: Queuing Model
    1. Queuing delay (RLC buffer)
       - previous packets, frame-alignment + scheduling
    2. Link delay
       - Segmentation delay
       - Transmission delay
       - Retransmission delay



Experimental Setup

- Implementation on Openairinterface5G with SDRs; hosts were synced with PTP
- Measurement points inserted in the OAI user plane in both UE and gNB for the UL path
- NMLT packet generator that can align send time offset wrt 5G frame boundaries
- Each packet journey is reconstructed using recorded timestamps and stored in a DB





Parameters	Value/Ranges
OAI config	Band 78, TDD, 106 RBs, 40 MHz, SCS of 30kHz (slot size=0.5ms)
Traffic	500B UDP @ 100 Hz

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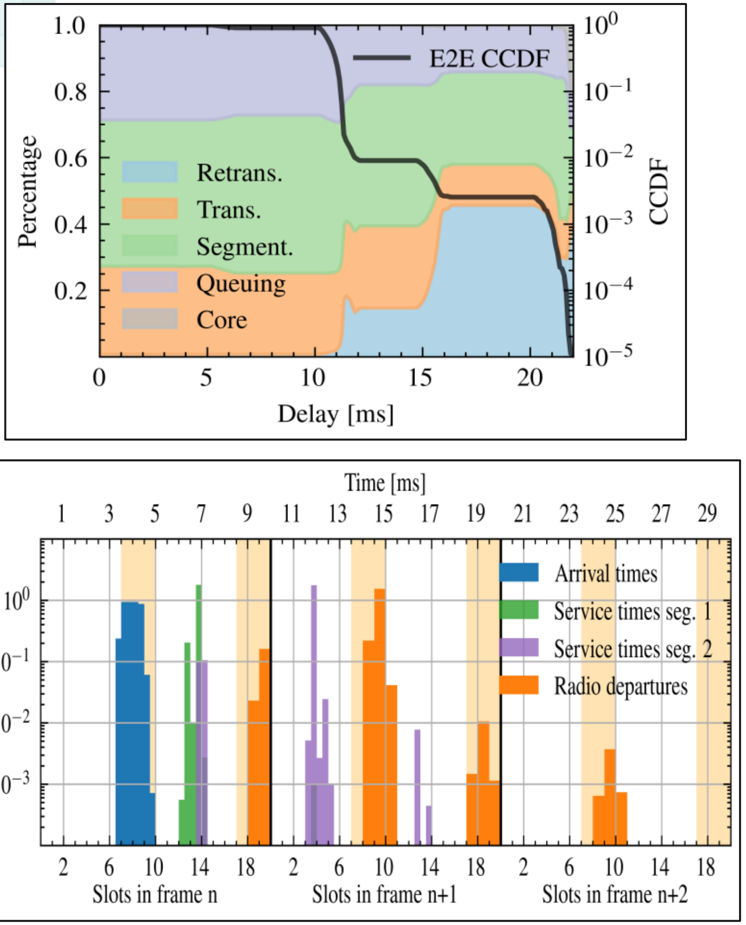
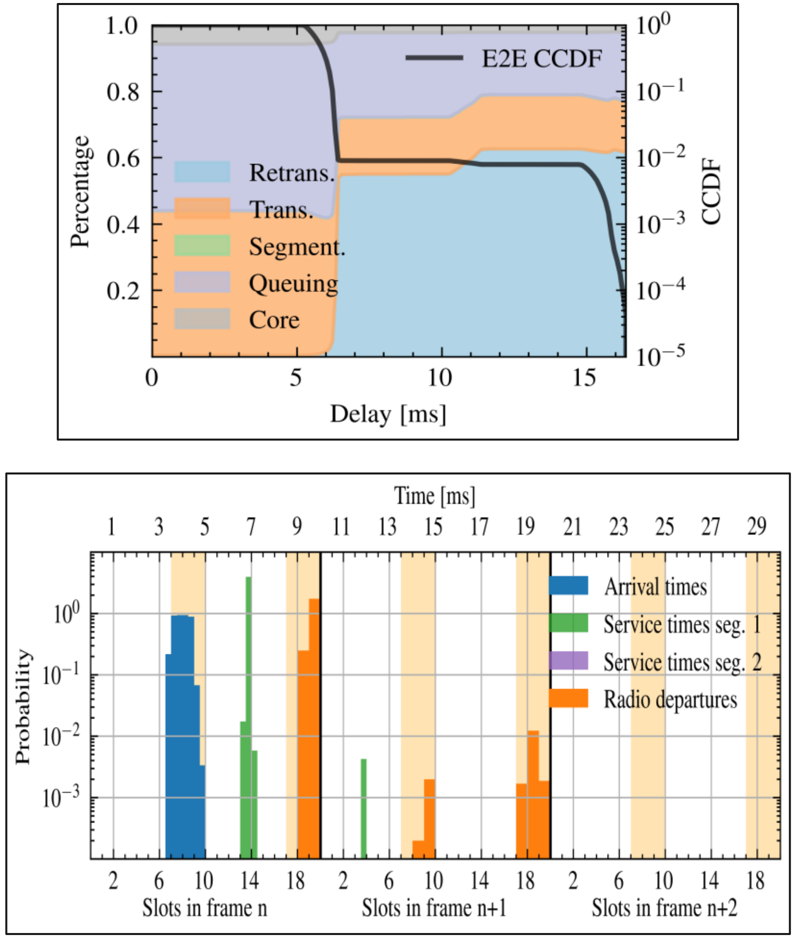
5G Delay Decomposition

5G Delay Decomposition

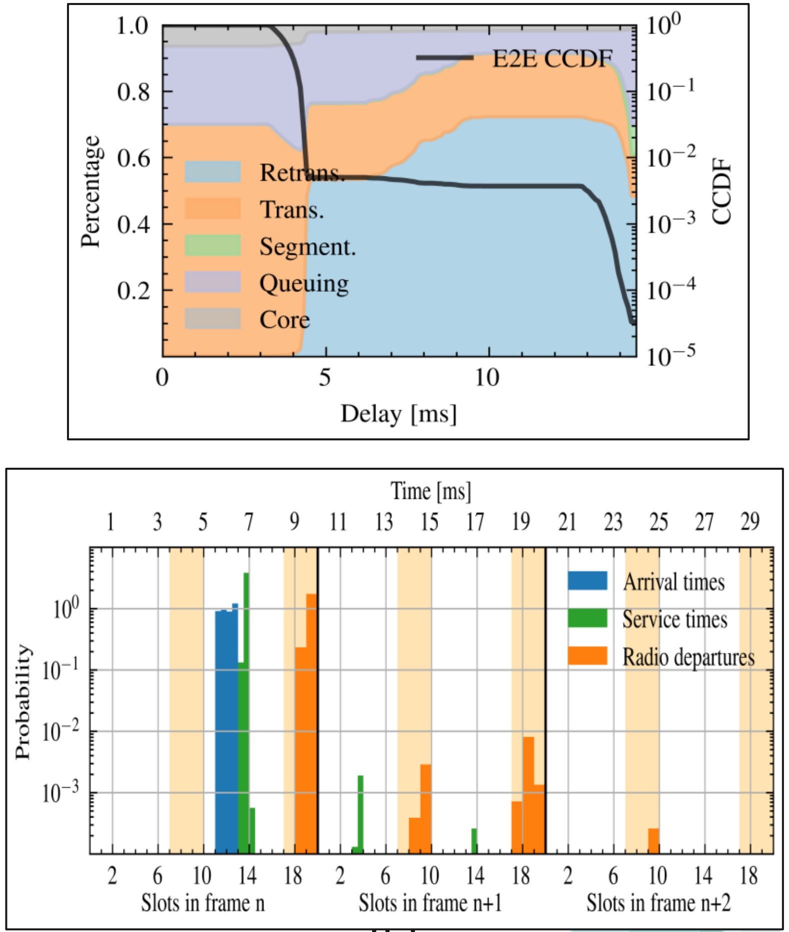
Data-driven Delay Optimization



Baseline



Addressing segmentation delay



Addressing frame-alignment delay

Requirements of Time-critical Applications

- Time-sensitive applications typically have critical (lower and upper) delay bounds
  - Avoid failure or degradation of experienced application quality

- Deterministic network and application characteristics (claimed to be) a necessity
  - But challenging in several digitalization enablers
    - Cloud computing
    - wireless communication
    - (adaptive) applications
  - Include stochastic variations

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From Deterministic Communication to Dependable Communication

- Strict review of *determinism:*
  - a system without or with negligible stochastic variations
  - a system behaves in a pre-determined way from a certain state with a given input
- Eliminating stochastic elements not always feasible,
  - ➔ Embrace stochastic elements that are not pre-determined
  - ➔ … make them predictable and plannable,
  - ➔ … manage them to fullfill the requirements of the applications and utilize flexibility and adaptability
  - Provide *dependable communication* for time-critical services (➔ the service can rely on the communication)

[1] DETERMINISTIC6G, "DETERMINISTIC6G use cases and architecture principles", deliverable D1.1, Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables

[2] DETERMINISTIC6G, "Report on 6G convergence enablers towards deterministic communication standards", deliverable D3.1, Dec. 2023, https://deterministic6g.eu/index.php/library-m/deliverables

Dependable Mobile Networks for Time-Critical Applications

Dependable communication :

Be able to quantitatively ascertain the delivery of required service performance for the communication as it has been agreed.

- ❑Builds on time-critical communication enabled with Ultra-reliable and low latency communication capabilities
- ❑Requires service specification with application requirements via network exposure
- ❑Requires observability for service performance monitoring and prediction
- ❑Potential for feedback to the application domain and enabling application-network coordination

Summary

- Convergence of digital and physical worlds will requires support for time-critical communications
- Data-driven latency assesement provides an oppurtunity for designing enablers for end-to-end delay optimization
- DETERMINISTIC6G aims to realize end-to-end dependable time-critical communication with 6G

Further References

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All DETERMINISTIC6G deliverables available at https://deterministic6g.eu/index.php/library-m/deliverables

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