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UNIVERSIDAD
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URUGUAY

Trying to Leverage Third-Party DBA with AI

Luiz ANET NETO, Lucas INGLES, Michel MORVAN

luiz.anetneto@imt-atlantique.fr

FSAN and ITU-T SG15Q2 workshop Optical access evolution with AI towards ION-2030
Lannion, Sept. 16 2026

Introduction

01.

XTREM'IA
Platform

02.

Selected
Works

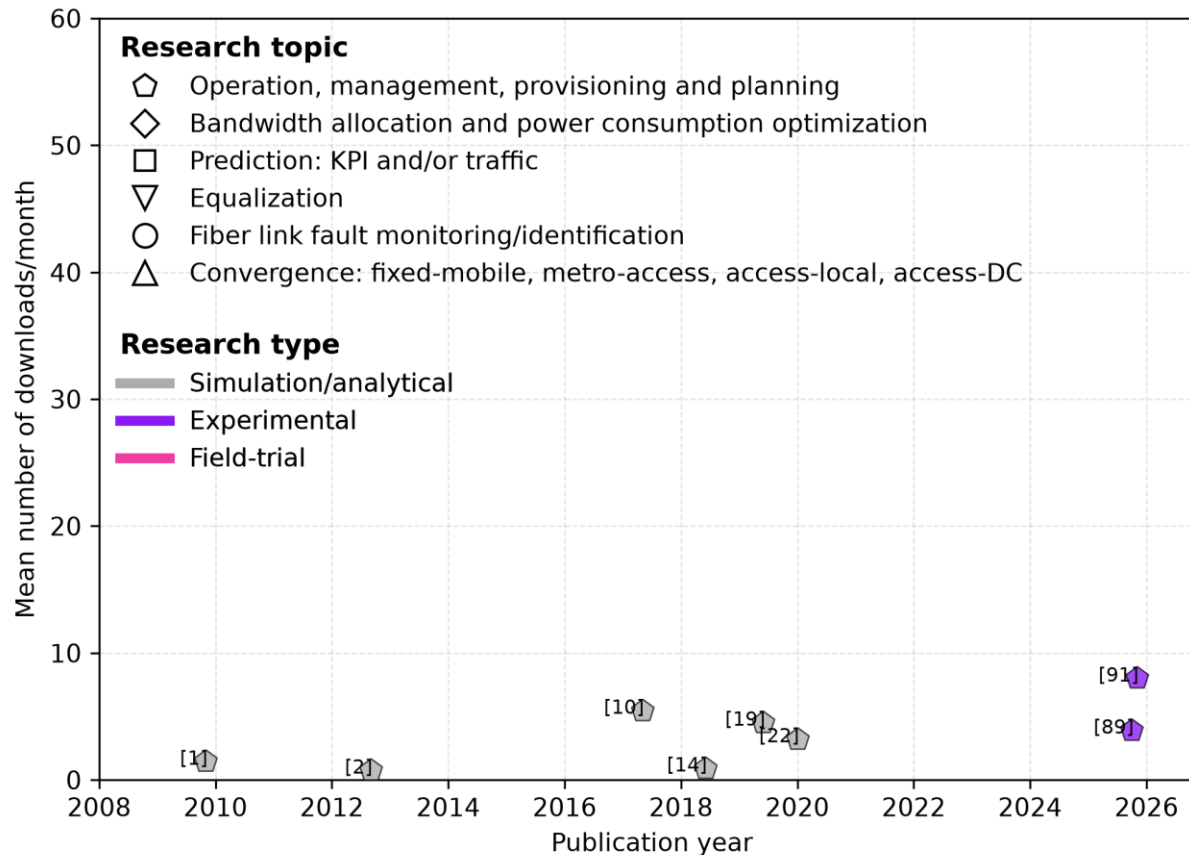
03.

Conclusions
&
Perspectives

04.

Introduction

State-of-the-art



IEEEXplore® “PON”, “learning”, “AI”

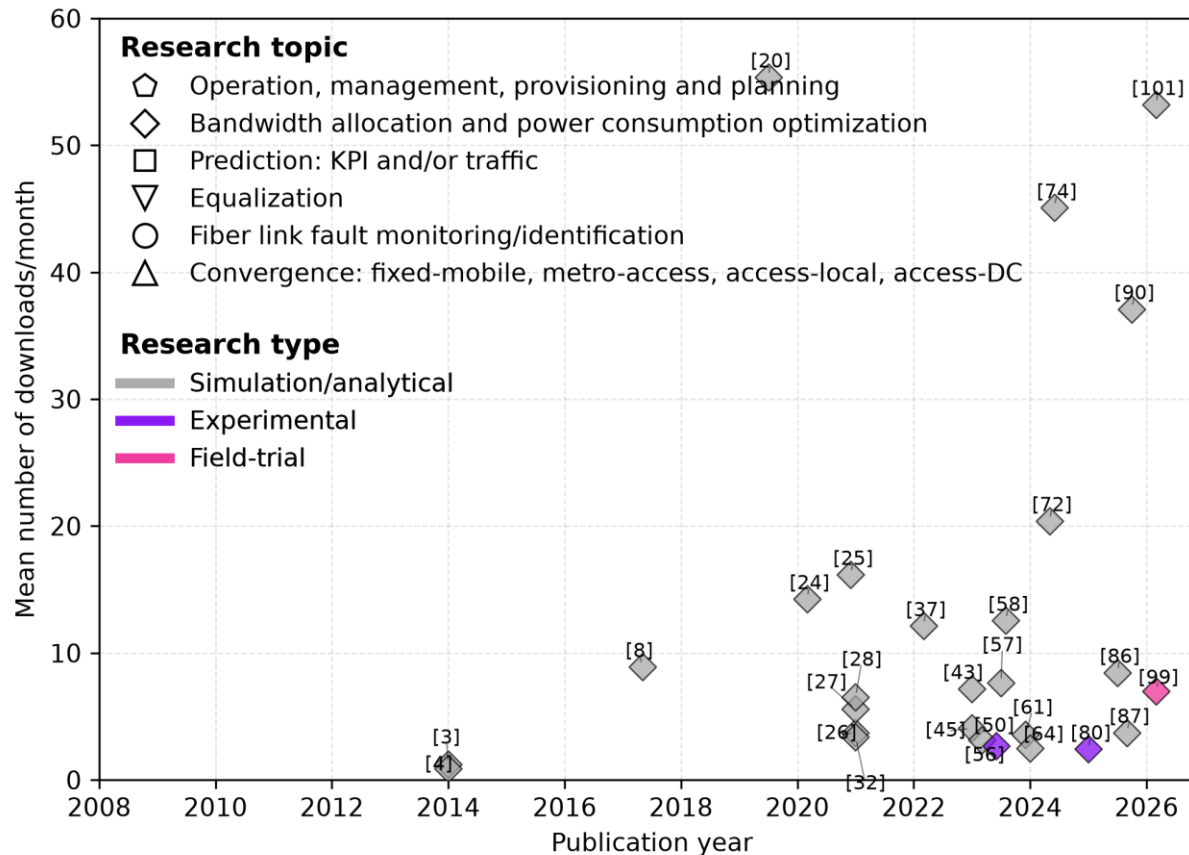
- ‘00s: operation & network provisioning
- ‘10s: bandwidth allocation optimization and prediction
- ’20’s: equalization; higher spectral efficiencies
- Link monitoring, self-diagnosis FTTH
- ‘20s: convergence (mobile, metro, datacenter)

Standardization

- ETSI Experiential Networked Intelligence, F5G mgmt., control & analytics
- ITU-T Y-series AI/ML IMT-2020, G.Sup84: rogue ONU, intelligent optical access operation., GSTR-ION-2030
- O-RAN Near/non-RT RIC architecture/interfaces
- IETF RFC 9232/9315 telemetry, intent-based nets.
- BBF: Automated Intelligence Management
- Emerging (industry): Model Context Protocol (MCP)

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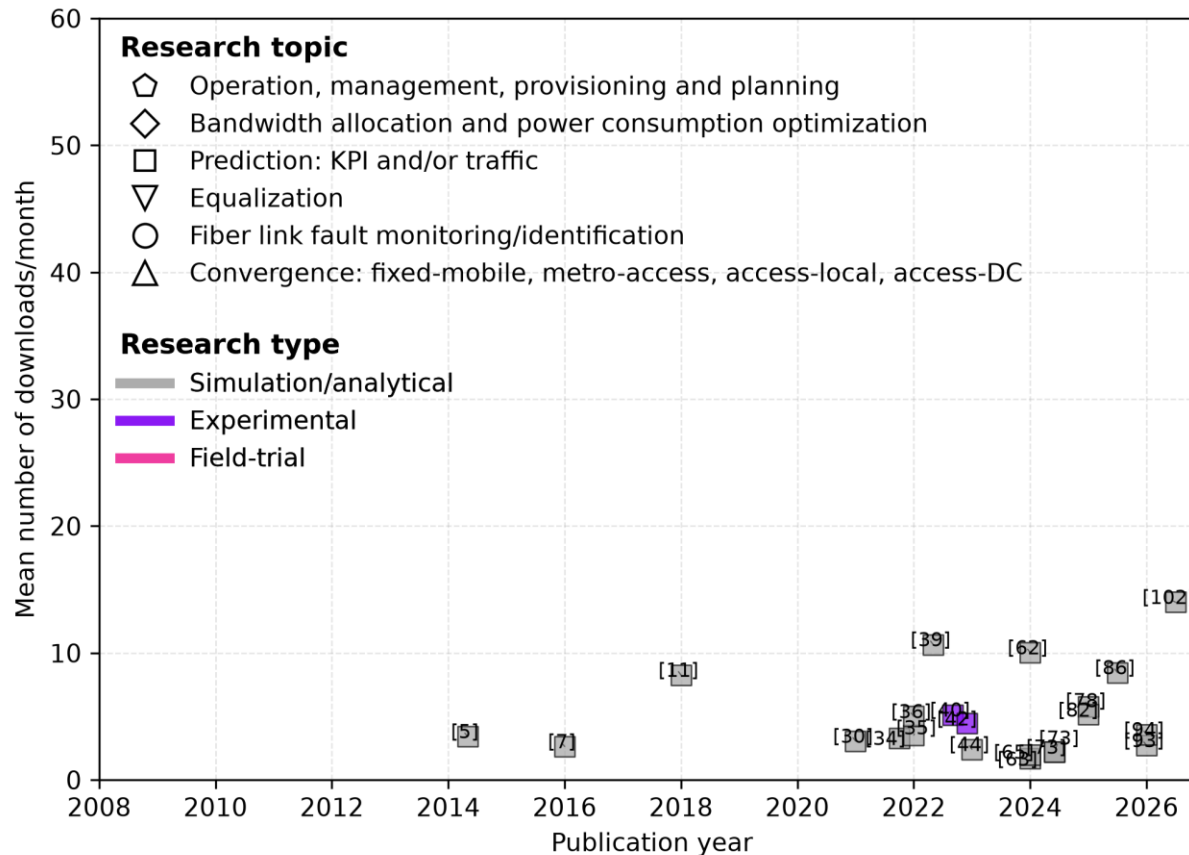
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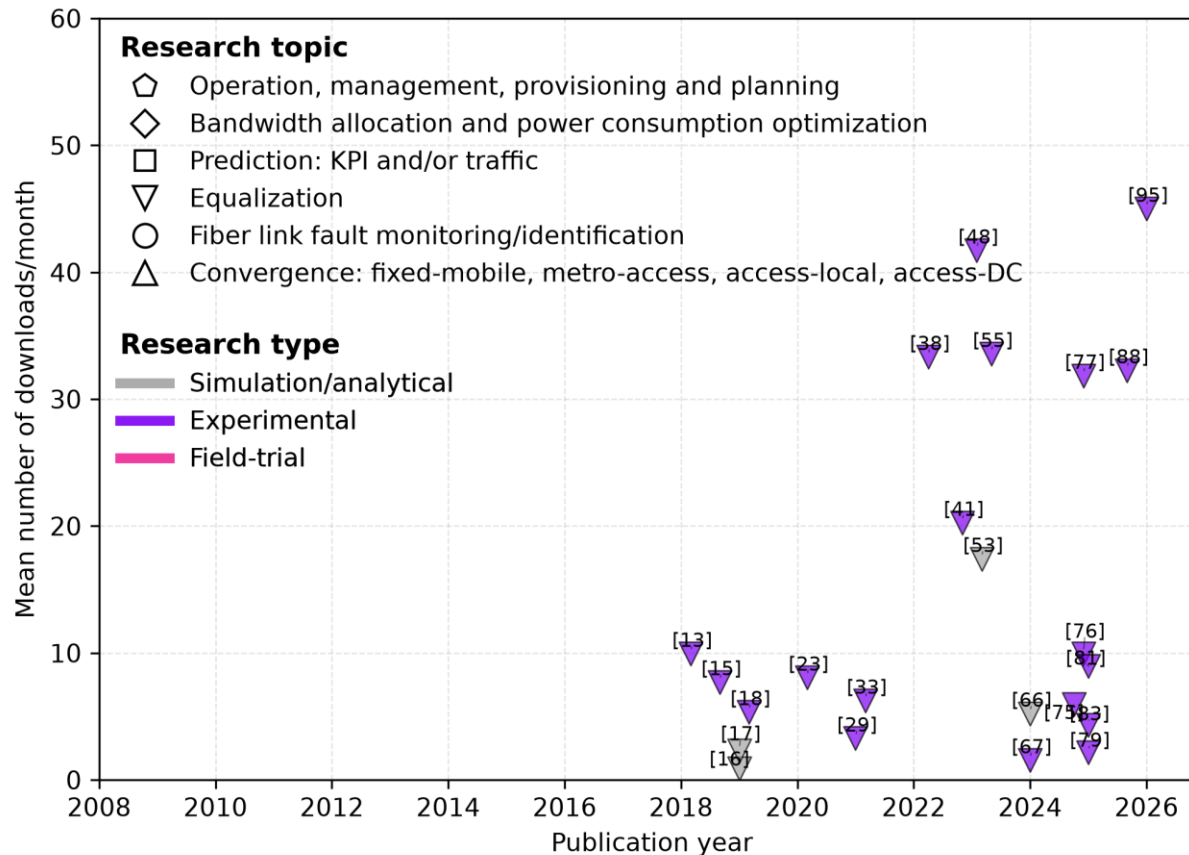
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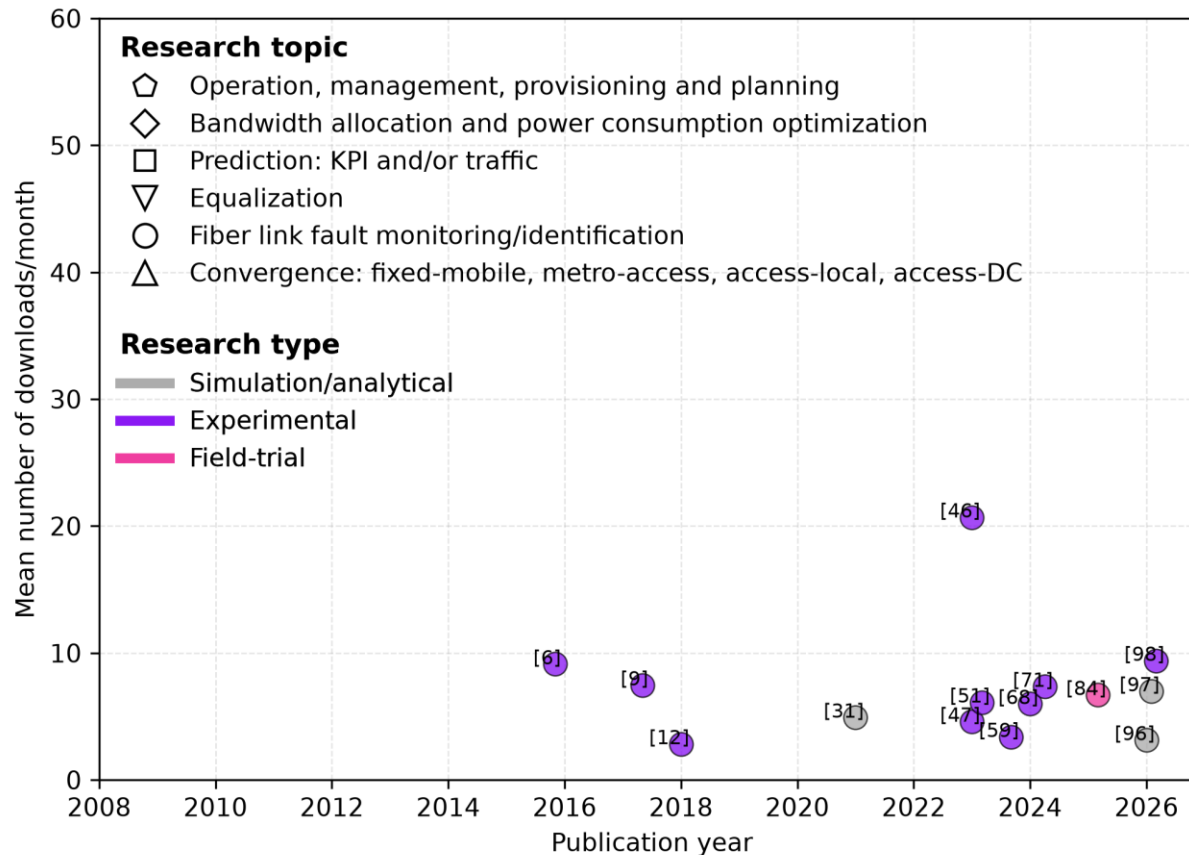
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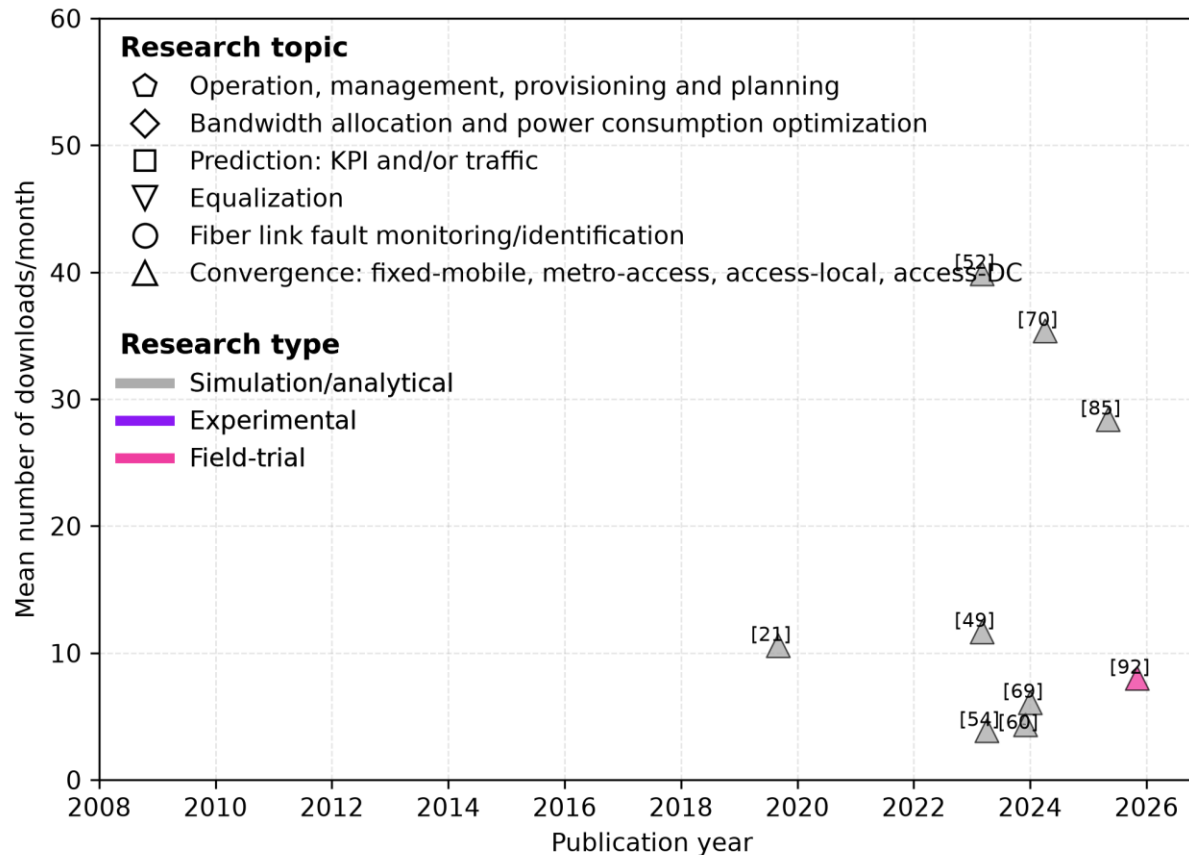
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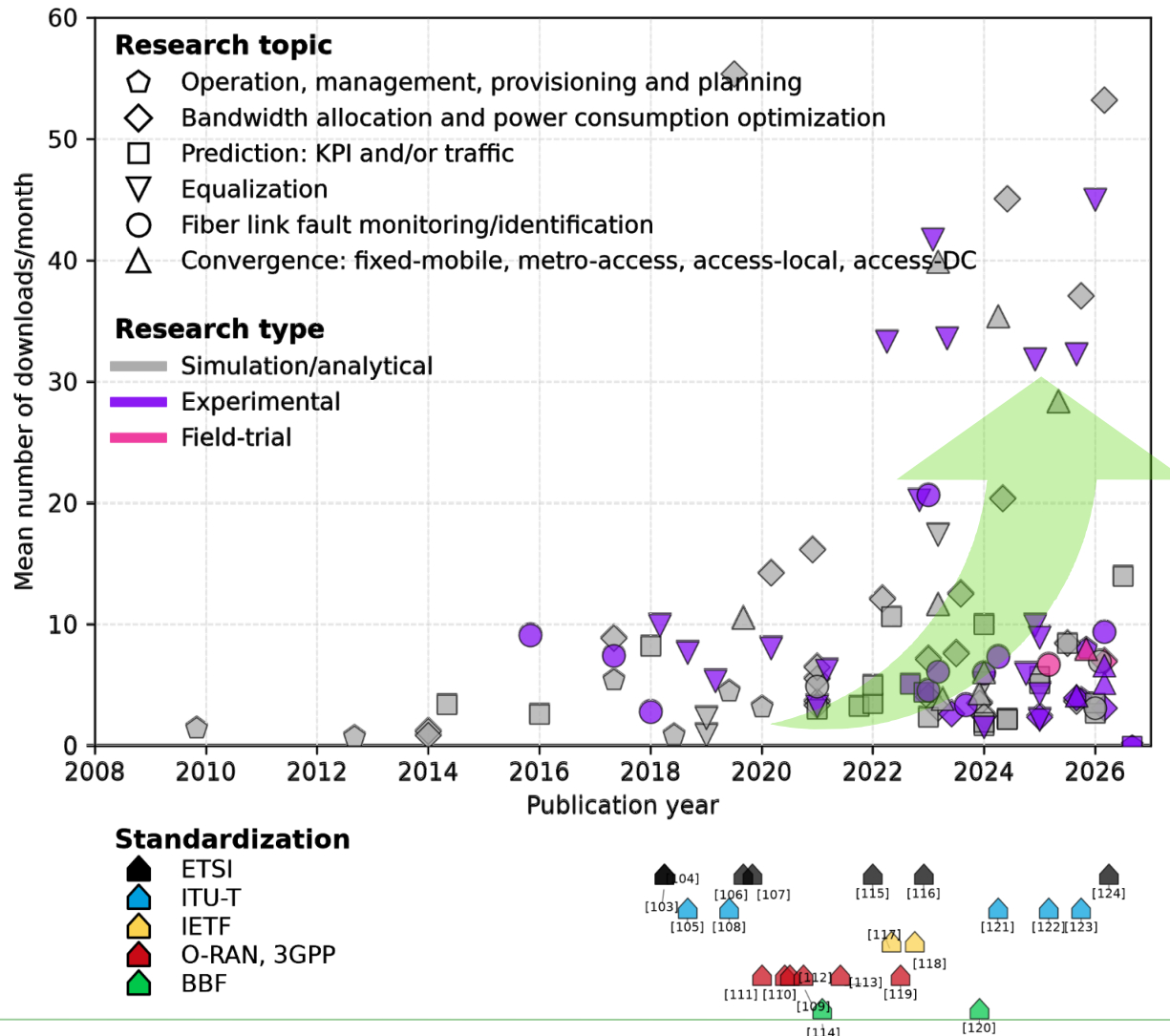
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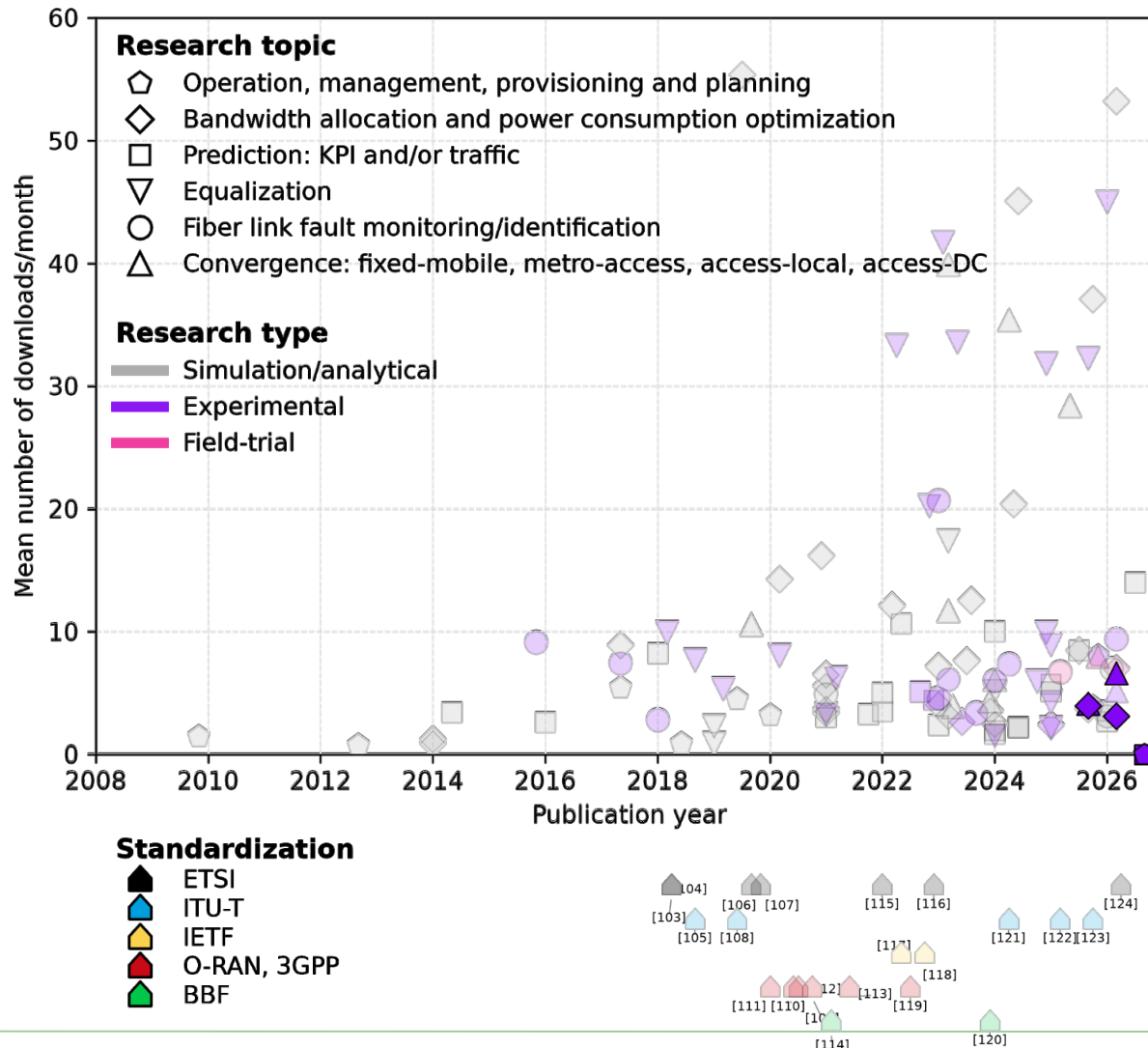
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Introduction

Scope and approaches

Positioning: Trying to Leverage Third-Party DBA with AI

- Why? Network bandwidth allocation optimization & prediction
- How? Add a **slow-timescale** optimization/control loop above vendor's DBA
- Who? operator side: do not change DBA (black-box); deal with it
- What? ML: supervised (SL), reinforcement (RL), deep (DL)
- Where? Focus on EMS (per OLT port), NMS in the future (multi-OLT)

Optimization

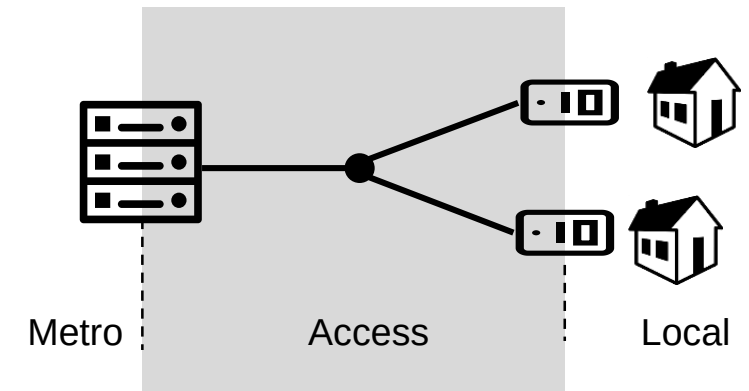
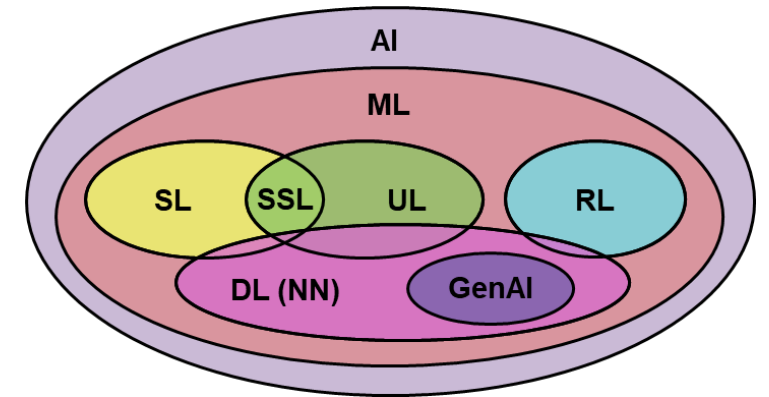
- Can AI optimize network operation on top of a vendor DBA and help operators reduce overprovisioning and/or allow forecasting?

Understanding

- Can AI learn/explain the behavior of a black-box DBA?

Interoperability

- Are we heading towards vendor lock-in?



Introduction

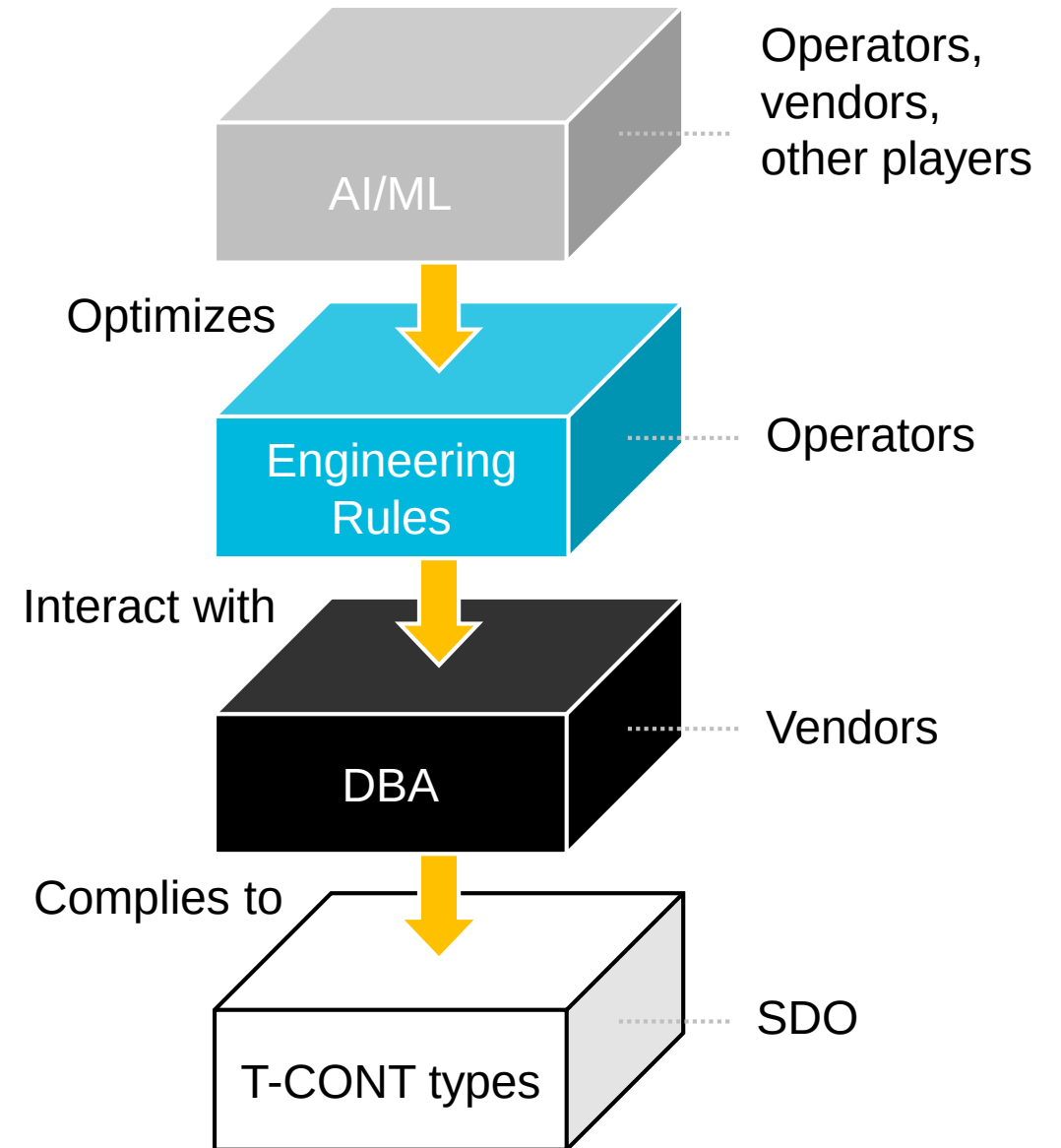
The irony: one grey box interacting with a black box

DBA: black box by circumstance

- Fast timescales bandwidth allocation
- Allows competition between vendors while enforcing interop. via T-CONT profiles; no access to source code
- Opaque but trusted, deterministic
- Does not ensure optimal engineering rules

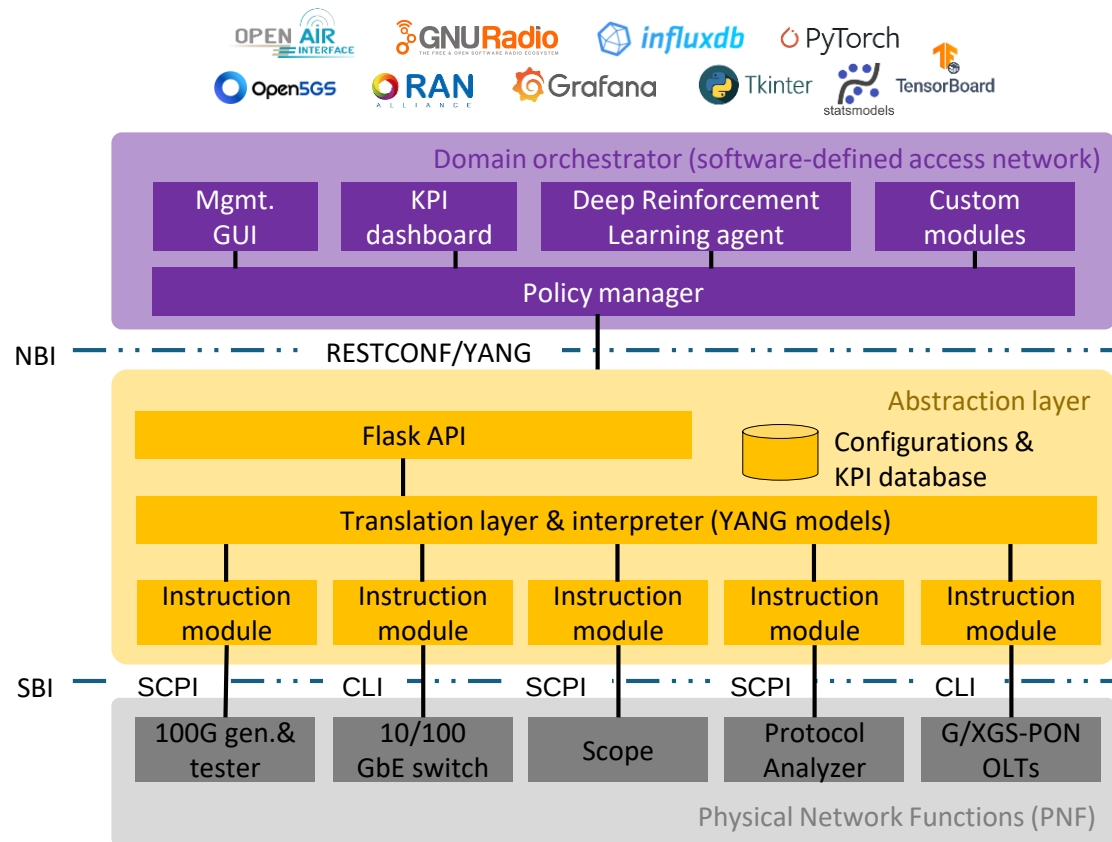
AI/ML: grey box by design

- Fine-tune engineering rules on a longer time scale
- Decisions can be based on stochastic solutions
- Controlled, observable and verifiable results
- Guardrails and external verification (human-in-the-loop)



eXperimental Twin for Resource-Efficient Management and traffic Intelligence in the optical Access

XTREM'IA Hardware and Software Capabilities



eXperimental Twin for Resource-Efficient Management and traffic Intelligence in the optical Access

The platform in a few key figures since 2020



French collaborative projects:

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- HAYDN
- STIC-AMSUD RAMONaaS
- BPI Beyond5G
- PIIEC ME/CT Part Orange
- PEPR 5G Photonique PLEIADES

~845 k€

Funding

- French collaborative projects
- ~50% personnel

>400 Go

Experimental datasets

- PON platforms
- PMD (physical media-dependent) layer
- TC (transmission convergence) layer



PhDs

5

- Virtualization (SDN/NFV) in Optical Access Networks: Contributions for Enhanced Fixed-mobile Convergence
- Block Turbo Codes for Next Generation Optical Communications
- Towards Flexible and More Efficient Optical Access Networks
- Fixed-Mobile Convergence in Future Optical Access Networks
- All-photonic Switching in Next-generation Optical Central Offices

Academic collaborations

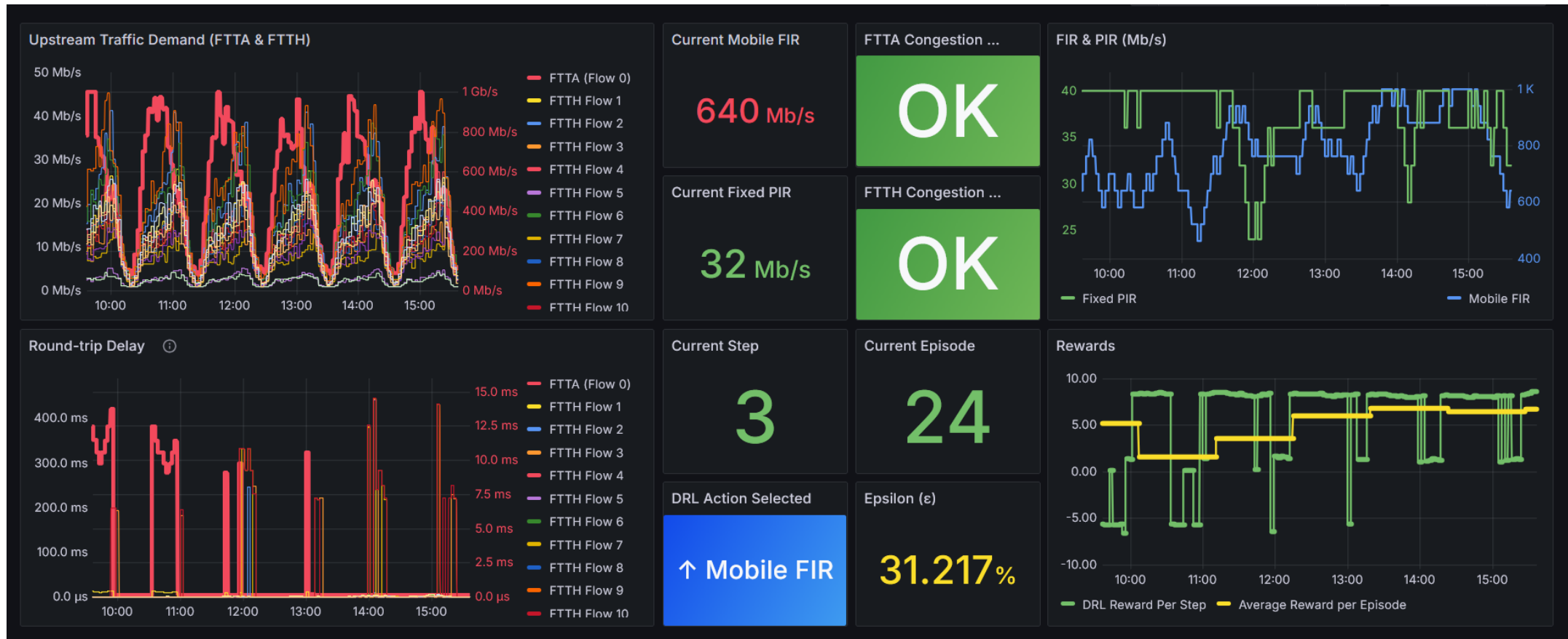
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- Univ. de la Republica (**URU**), cotutelle
- Univ. Rey Juan Carlos (**ESP**), datasets
- Univ. Carlos III (**ESP**), power over fiber

Selected Works

Fixed-mobile Convergence with Deep-Reinforcement Learning (DDQN)

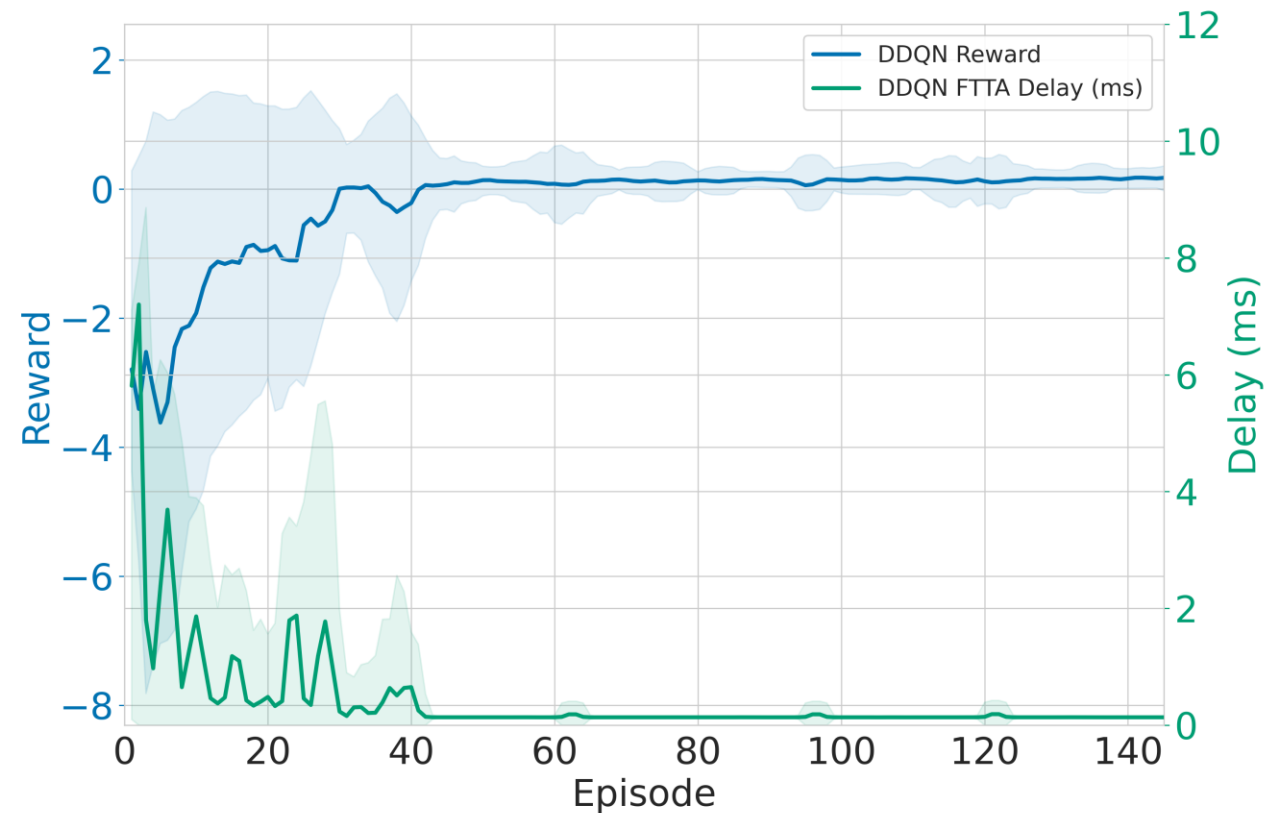
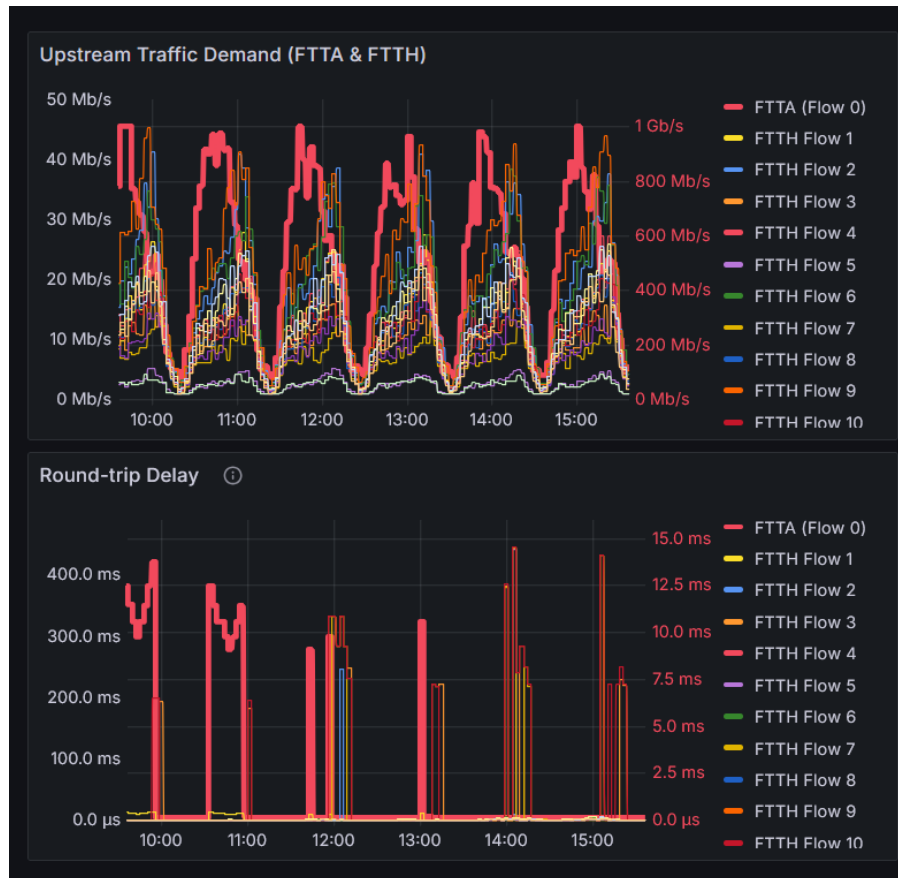
- 2 objectives: target latency < 1 ms for FTTH flows (supposing mid/backhaul) & minimum bandwidth
- Importance of guardrails during learning vs convergence time



Selected Works

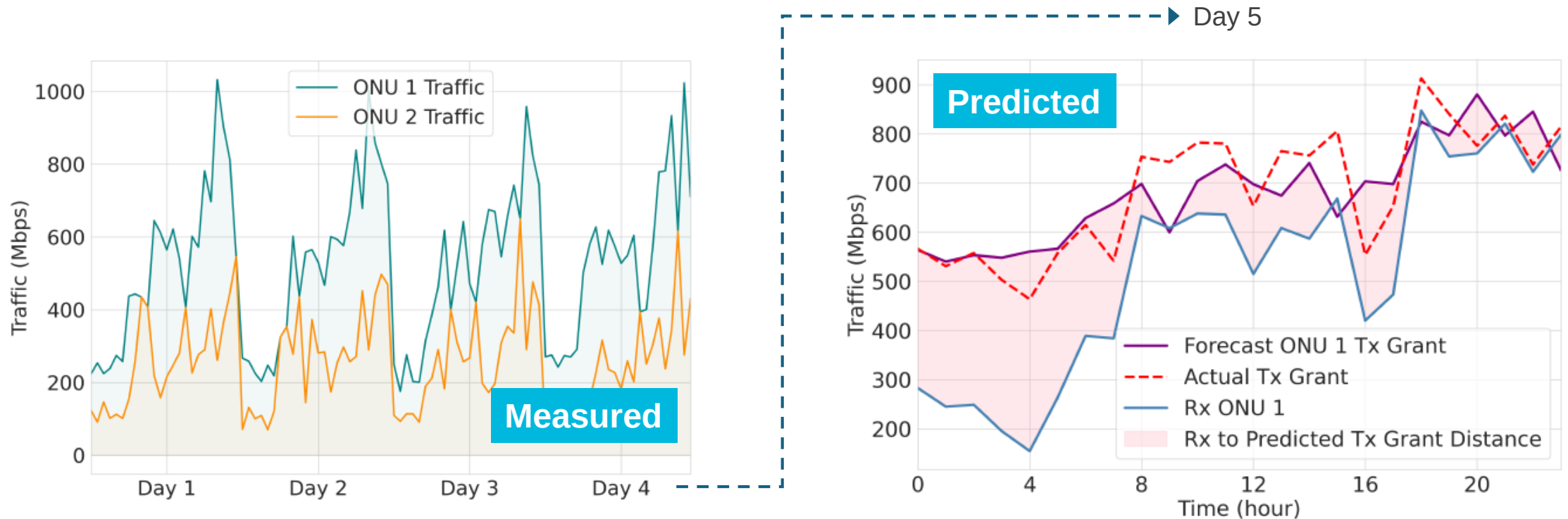
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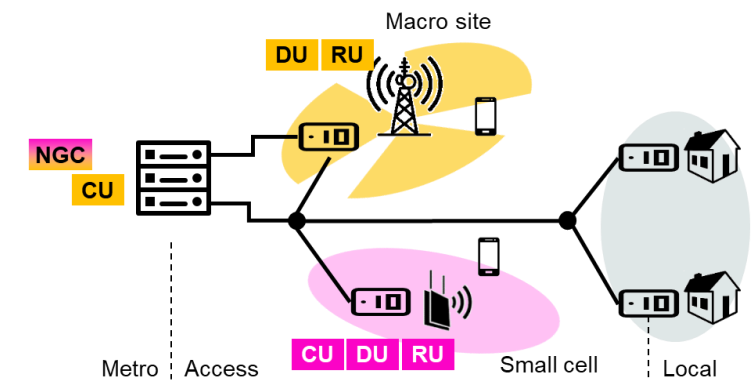
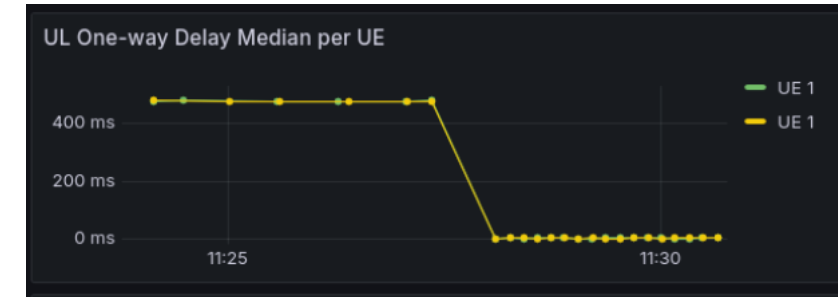
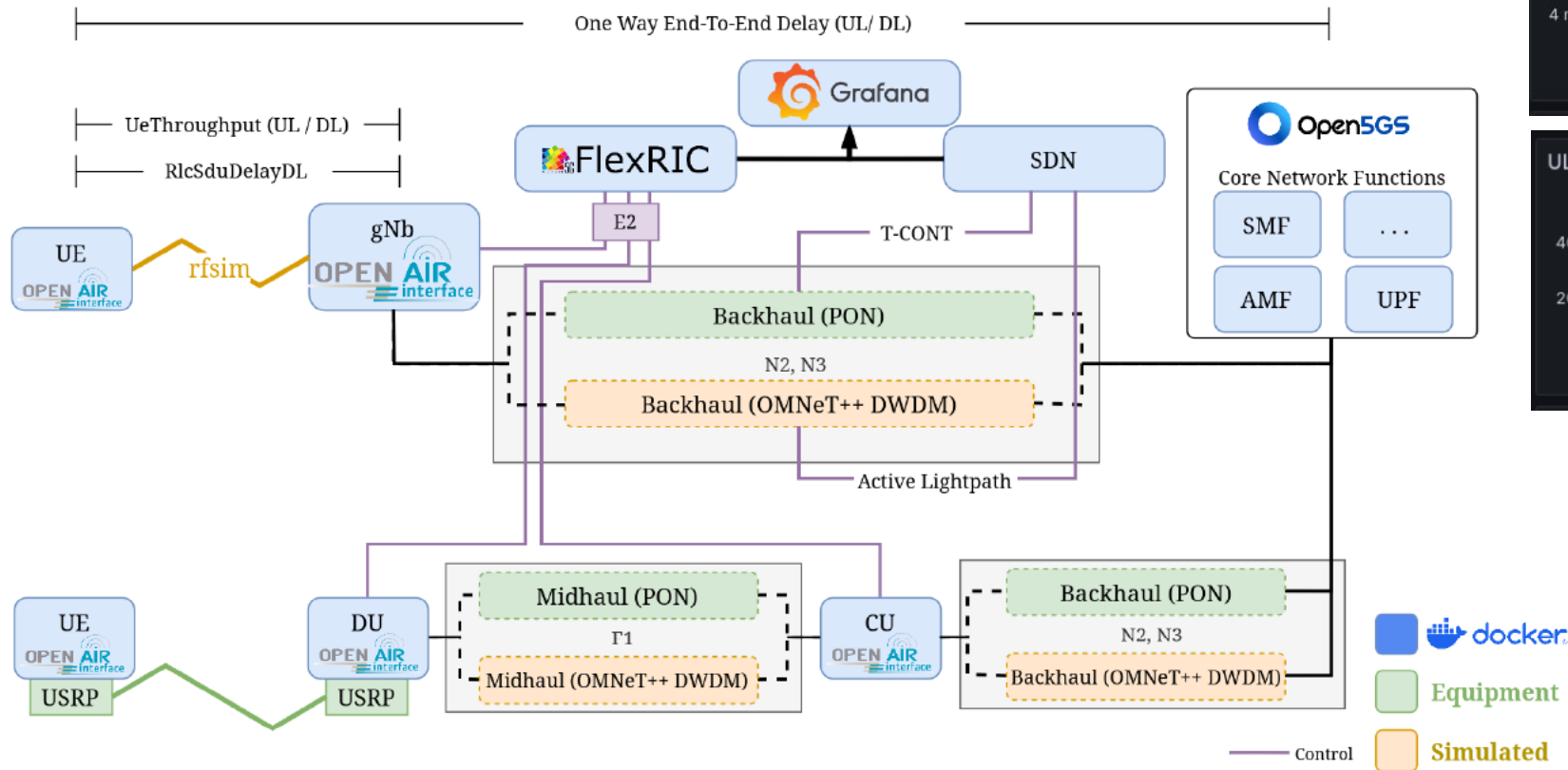
Monitoring and Traffic Forecasting with SARIMA – Network as a Probe

- DBA is also a probe into network demand and allocation policies
- Upstream BWmap sent in the downstream header exploited via GNURadio module
- Next TX grants can be predicted and allows us to infer DBA policy during low congestion



Integration of Mobile Virtual Network Functions

- Fixed-mobile convergence use-cases
- RAN metrology integration via O-RAN Near-RT RIC xApp



Conclusions & Perspectives

Conclusions

Bandwidth Allocation Optimization

- Vendor DBA remains untouched, AI optimizes the T-CONT/service configuration above it at slow scale
- Encouraging experiments for 16 ONUs, hourly reconfigurations, scalability needs to be validated
- DBA can be used as a proxy for bandwidth allocation forecasting
- If no gains in dynamic T-CONT configuration, detect sub-optimal engineering rules and concept drift

Understanding DBA

- Results suggest that behavioral inference may be sufficient; source code not necessarily required

Interoperability

- Vendor-specific solutions, but not exclusively: operators AI-mgmt., new AI/ML network management players (need data access)
- Industry-imposed solutions/protocols may play a role, common goal towards interop.

Conclusions & Perspectives

Perspectives

XTREM'IA scaling assessment

- TiBiT/Ciena XGS-PON with 75 ONUs/port currently, 128 ONUs next
- Multi-TCONT/ONU, multi-packet sizes
- Orthogonal to optimization: MCP as a tool for easier interaction with the platform? agent discovers and invokes capabilities, “Change T-CONT configs.”, “Get last 24h traffic”, “Retrieve KPI”, etc

More interaction with (human) AI experts

- Problem definition, dimensionality & features reduction; better dataset mgmt. (store and share)
- More ONUs/port: higher dimensional problem, ONU classification per traffic profile;
- RL compromise: convergence times vs guardrails vs traffic evolution speed vs solution optimality

Call for collaborations

- Datasets generation, convergence use-cases, traffic prediction tests, intent-based configuration

Thanks for your attention, see you in Malaga!
luiz.anetneto@imt-atlantique.fr

Tu1-F4, Tue 10h00, "Passive GPON Monitoring for Network Load Forecasting Using BWMap Information"

Tu2-Ex, Tue 11h00, "Modular & Hybrid Physical-Digital Twin for Optical-Mobile Networking"

We1-H1, Wed 9h00, "Equalization and FEC Evaluation Beyond D/E2 Class 50G-PON"

We1-H3, Wed 9h30, "An Exploratory Study of RS Decoding and Equalization in 50G-PON"



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