AI-NET-PROTECT – Streaming Telemetry
SEASON - Network Digital Twin

Achim Autenrieth, Vignesh Karunakaran
Adtran Networks SE

18/10/2023, TFS#3 Ecosystem Day

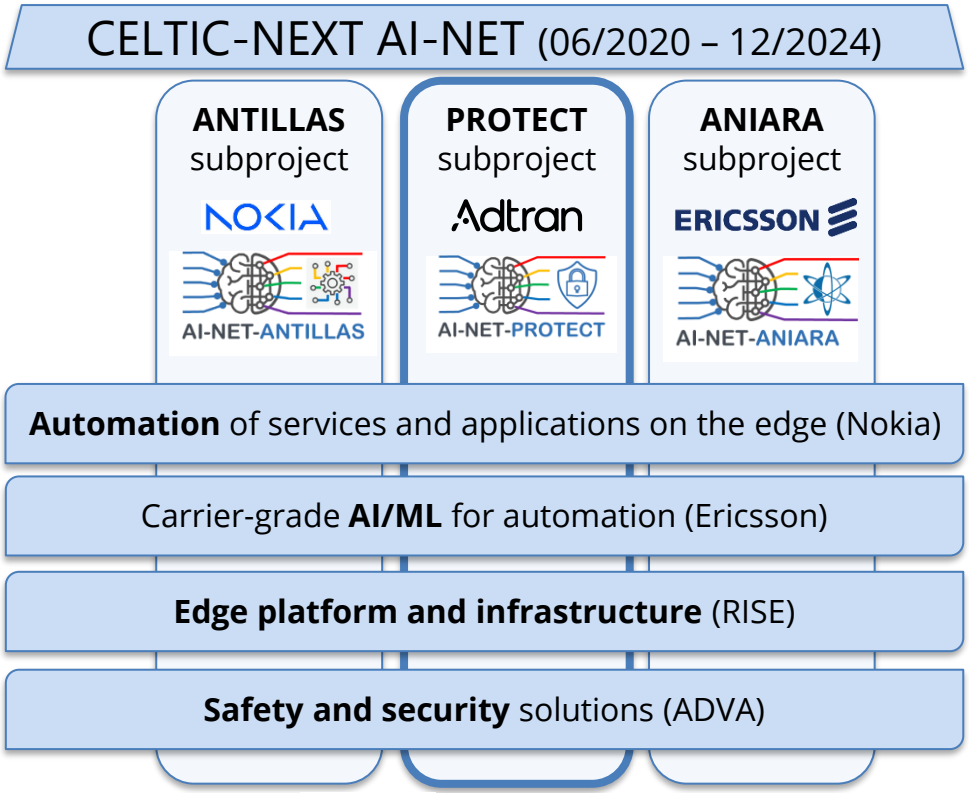
Presentation outline

- Projects introduction
  - AI-NET-PROTECT
  - SEASON
- Our TFS related current and planned activities
  - Optical network controller for disaggregated optical networks
  - Streaming Telemetry
  - Digital Twin

2023 © ADTRAN

EUREKA CLUSTER CELTIC-NEXT FLAGSHIP PROJECT

AI-NET



Accelerating digital transformation in Europe by Intelligent NETwork automation

7	98
Countries	Participants
68.3 M€	**507 PJ**
Total budget	Total effort

SPONSORED BY THE

Federal Ministry of Education and Research · VINNOVA Sweden's Innovation Agency · UKRI Innovate UK · BUSINESS FINLAND · bpifrance · Ministerie van Economische Zaken en Klimaat · Narodowe Centrum Badań i Rozwoju · Adtran

2023 © ADTRAN

AI-NET-PROTECT

Automated resilience and secure networks for enterprises and society

- **Network telemetry and intelligent control**
- Scalable network & node architecture
- **Artificial Intelligence (AI) based network automation**
- Strong automated and quantum-safe security
- **Demonstrators and testbeds**

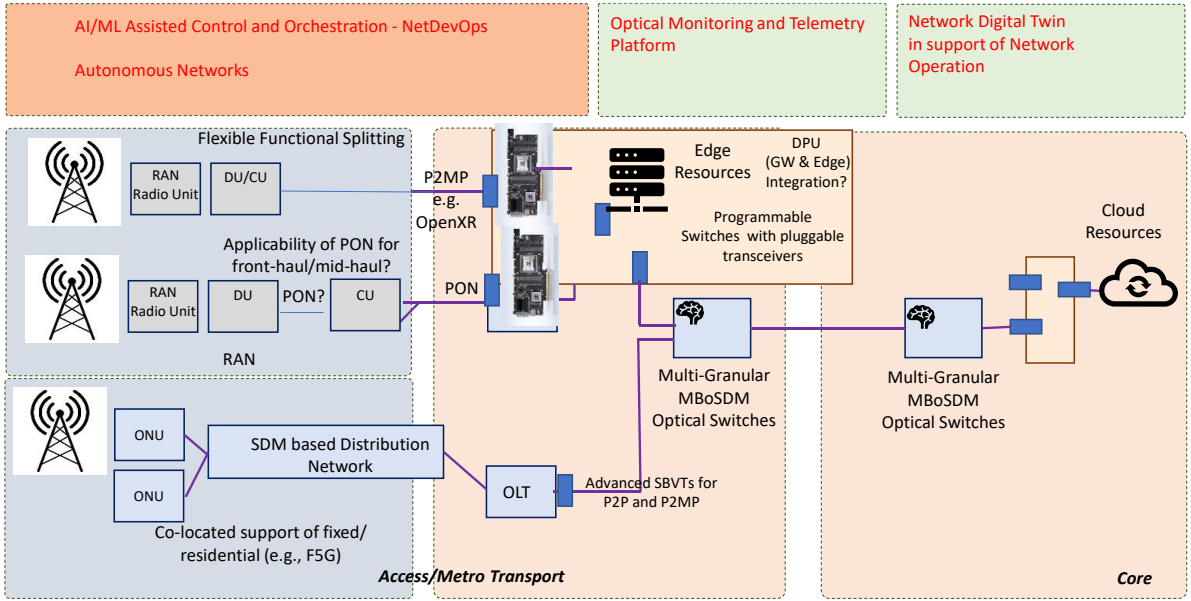
4	39
Countries	Partners (incl. 12 SMEs) ICT & medical
26.6 M€	**176 PY**
Total budget	Total effort

01.01.2021 – 30.6.2024

Project duration

2023 © ADTRAN

Horizon Europe SEASON



Duration	01/2023 – 12/2025 (36 months)
Total budget	6.4 M€
Coordinator	CNIT

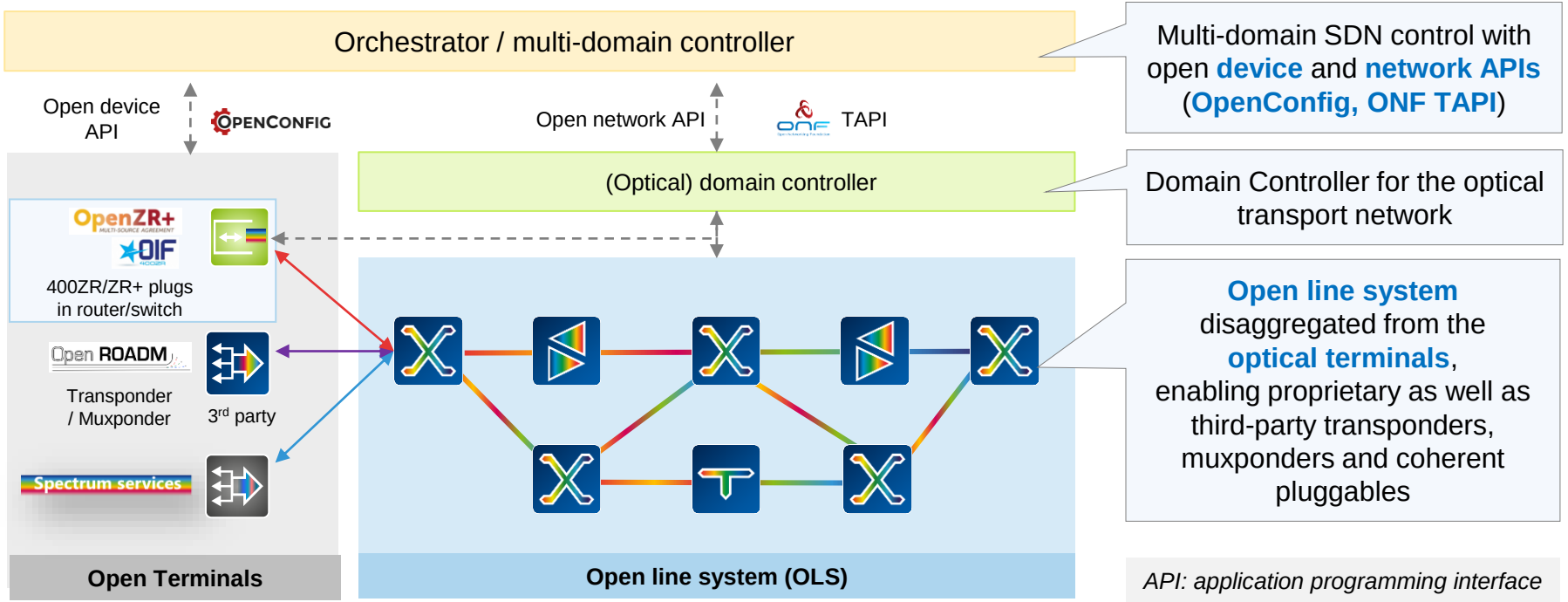
Objectives:

Design and validate a transport network for 5G and emerging technologies.

- Architecture considers access, aggregation, and the metro/long-haul segments .
- Efficient solutions in terms of capacity and energy efficiency.

2023 © ADTRAN

Disaggregated open optical networking



Multi-domain SDN control with open **device** and **network APIs** (**OpenConfig, ONF TAPI**)

Domain Controller for the optical transport network

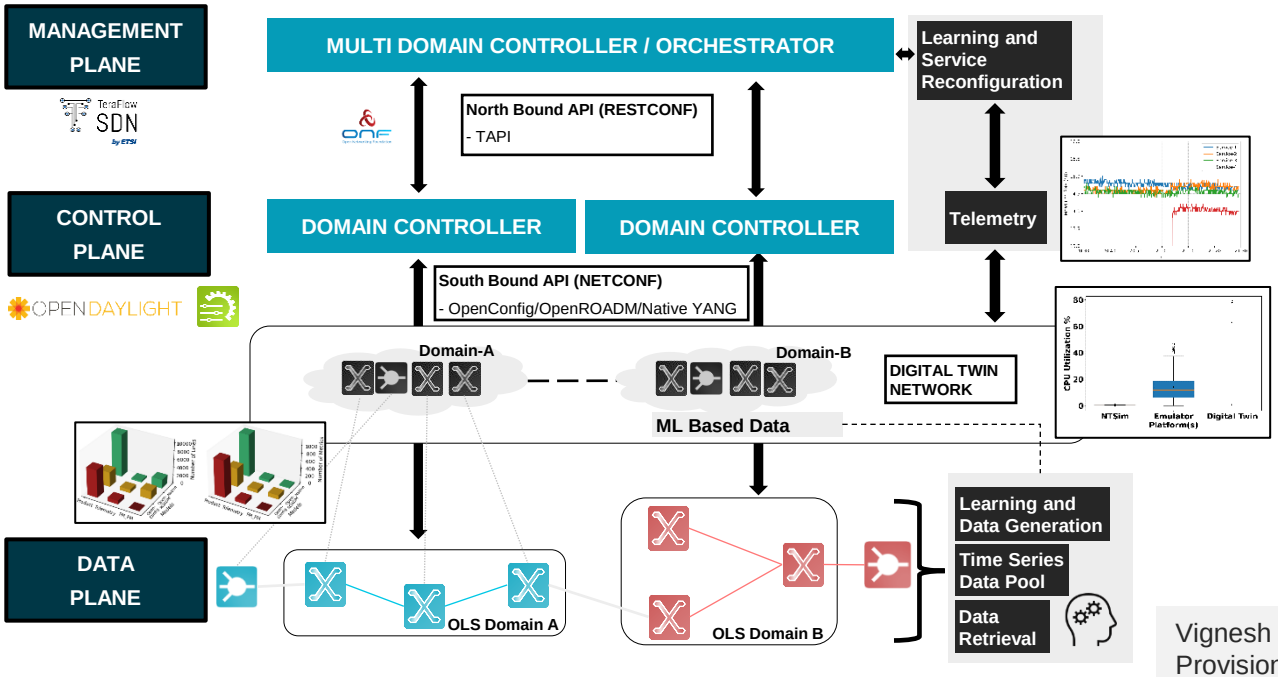
Open line system disaggregated from the **optical terminals**, enabling proprietary as well as third-party transponders, muxponders and coherent pluggables

API: application programming interface

Moving away from integrated systems to open control and programmability

2023 © ADTRAN
Adtran

Digital Twin for Optical Transport Network



Use-Cases:

- Closed-Loop Automation
- Assessment of YANG models
- Forecast network behavior

AI-NET-PROTECT

Federal Ministry of Education and Research

SEASON

Publications:

- ITG 2023, APC 2023
- **ECOC 2023, P73**

Vignesh Karunakaran, et al., Model-based Service Provisioning in Optical Networks, **ECOC 2023**, P73

Test and evaluate network applications in simulated environment

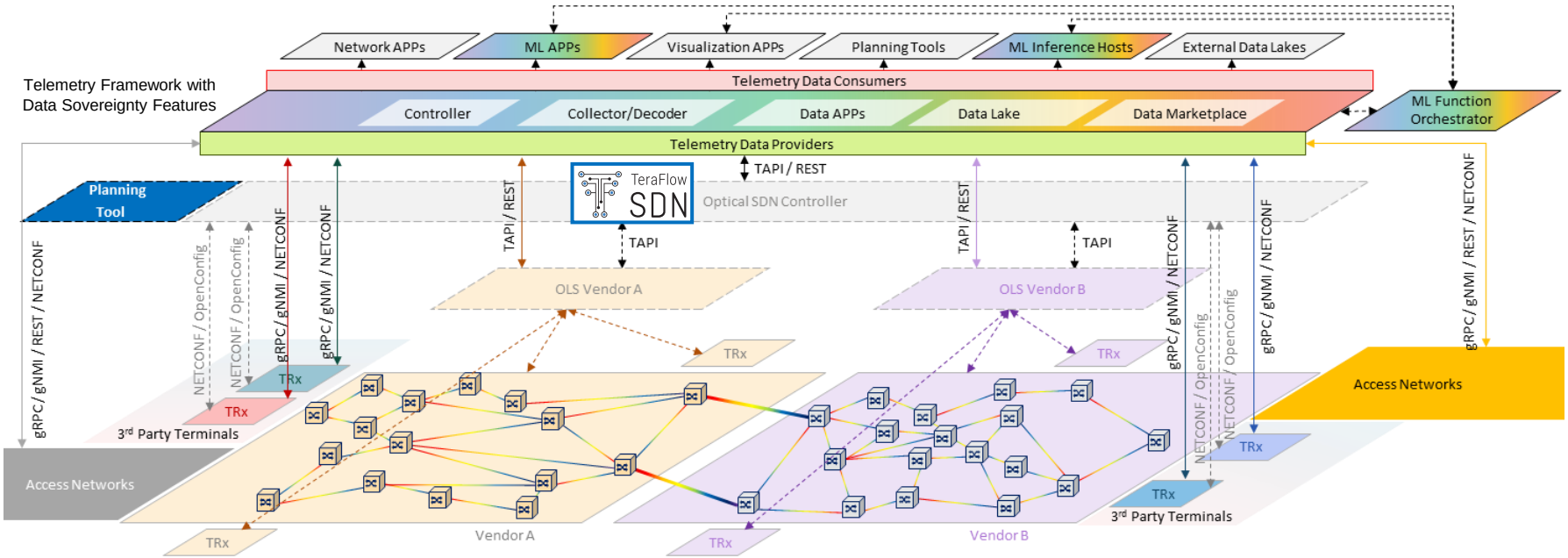
2023 © ADTRAN
Adtran

Our interest in and activities with TFS

- Network slicing
- TIP MUST reference architecture
- Disaggregated optical network control
- Multidomain orchestrator / optical network controller
- Transceiver configuration
- Evaluation of data models
  - ONF TAPI
  - OpenConfig
  - OpenROADM
- Streaming Telemetry
  - Evaluation of protocols: NETCONF, gRPC, gNMI

2023 © ADTRAN

AI-NET-PROTECT reference architecture



Intelligent telemetry & control, AI-based automation, secure communication

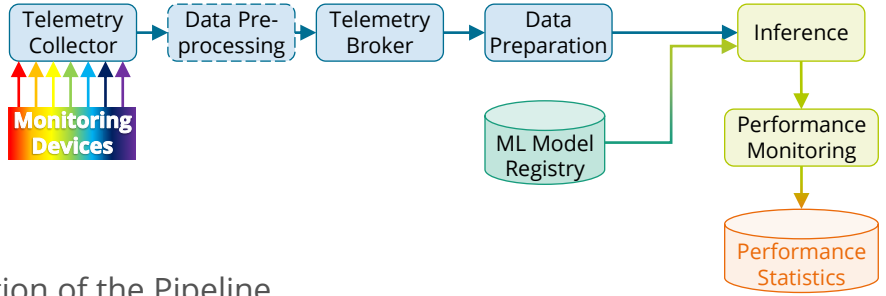
2023 © ADTRAN

SDN: SDN Controller | TRx: Transponder | OLS: Open Line System | ML: Machine Learning

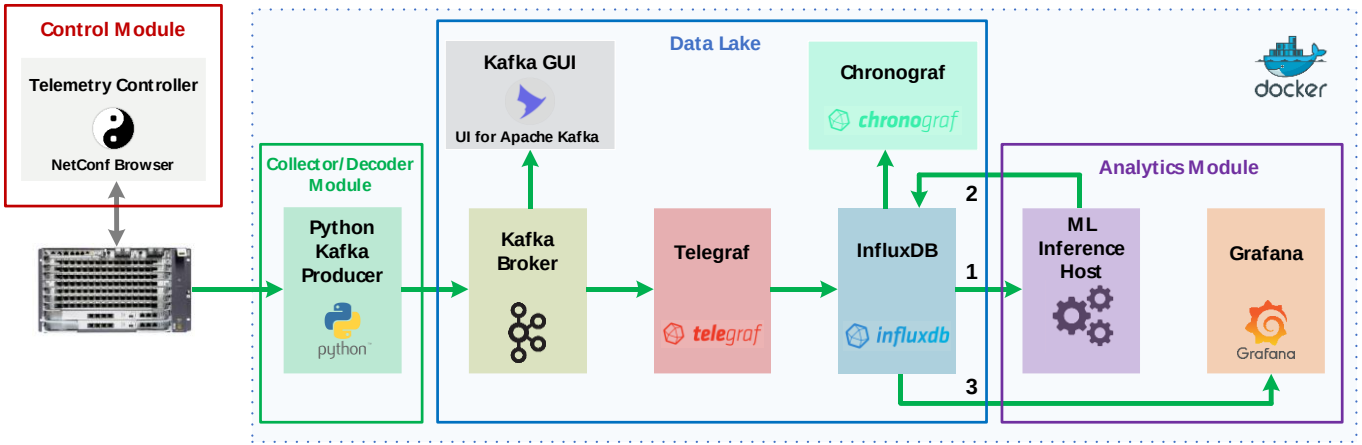
Telemetry Framework and Pipeline for Network Automation

Identified Requirements

- Support for Various Telemetry Retrieval Granularities
- Optimized Storage for the Telemetry Data
- Computation Resources for Data Analysis
- Telemetry Collectors, Brokers, and Time-Series Databases
- Cross-interface and Cross-terminal Telemetry Sharing



Example Implementation of the Pipeline



[HHI] M. Balanici, et al., "Demonstration of a Real-Time ML Pipeline for Traffic Forecasting in AI-Assisted F5G Optical Access Networks," in Proc. ECOC 2022.

2023 © ADTRAN

Telemetry Streaming in Partially Disaggregated Optical Networks

Motivation

- Automation of partially disaggregated optical networks
- systematic approach to telemetry collection and streaming
- allow different data consumers access the data when, where , and how needed

Usecases

- E2e ligthpath performance monitoring
- Impairment validation
  - E.g. terminal and OLS parameters
- Network health monitoring

Goals

- Multi-protocol telemetry streaming of a partially disaggregated network
- Compare different approaches for telemetry collection
  - streaming directly from the devices
  - streaming from the OLS controller

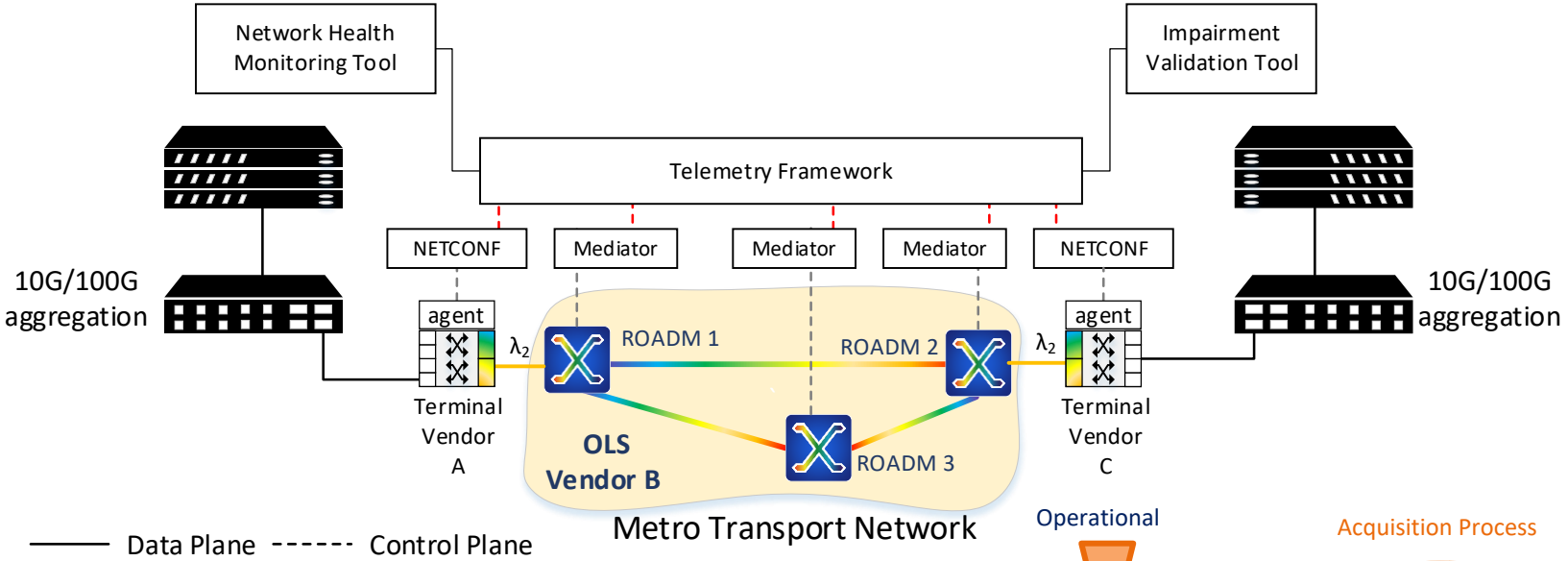
Goal: develop and demonstrate a telemetry framework that complies with the requirements of MUST for monitoring of partially disaggregated optical networks

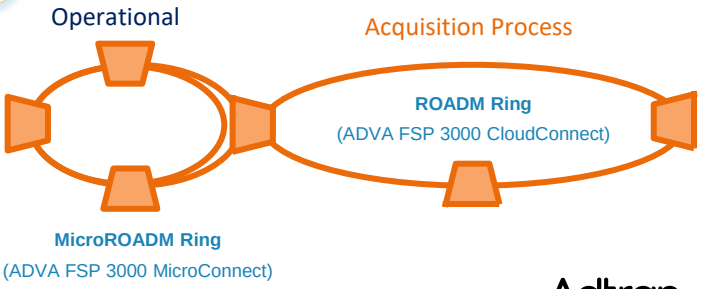
2023 © ADTRAN

Open Test Infrastructure for Network Automation

Integration of Telemetry Framework for the Demonstration - **Current**

AI-NET-PROTECT



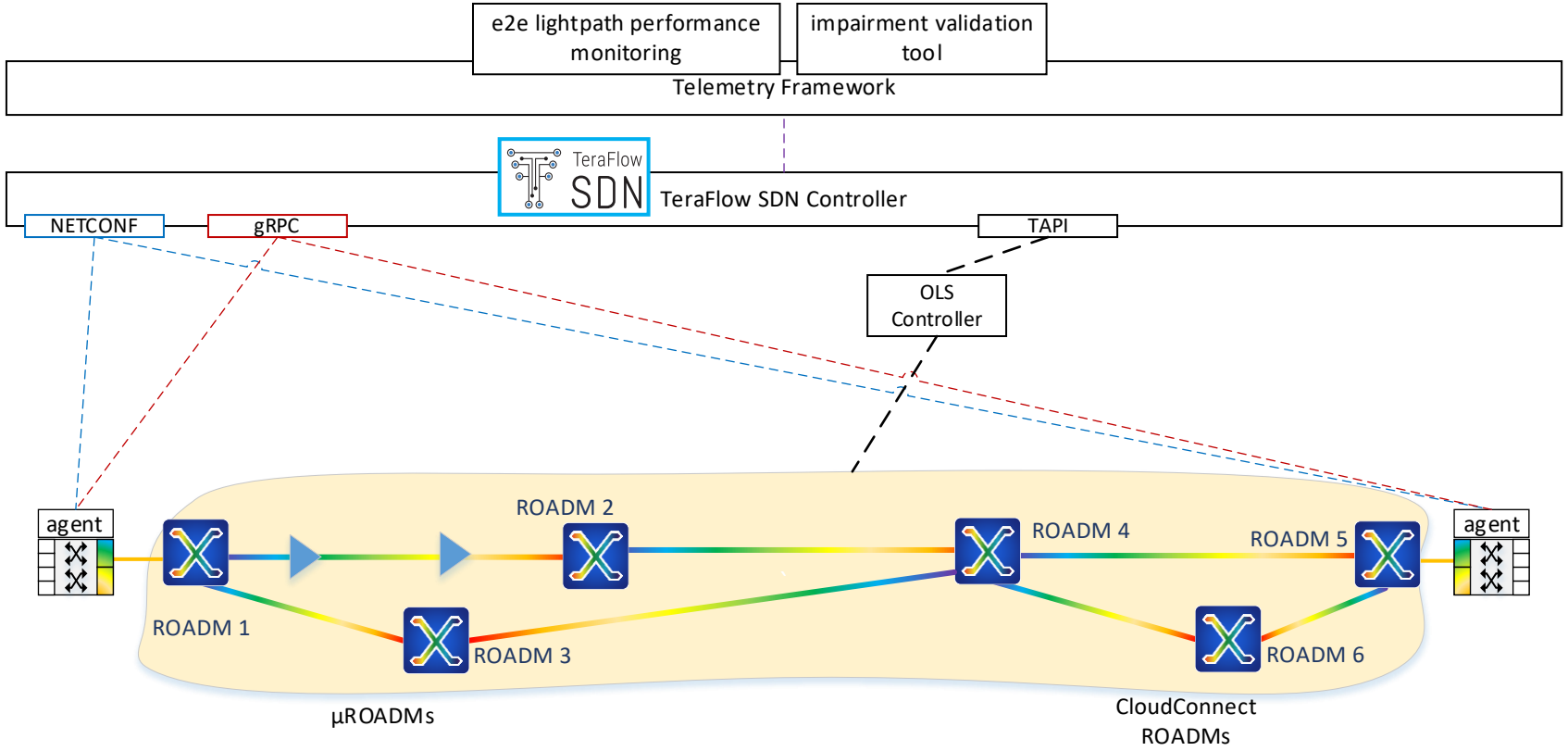


Fraunhofer HHI · Telia Company · Adtran · CHALMERS UNIVERSITY OF TECHNOLOGY

2023 © ADTRAN

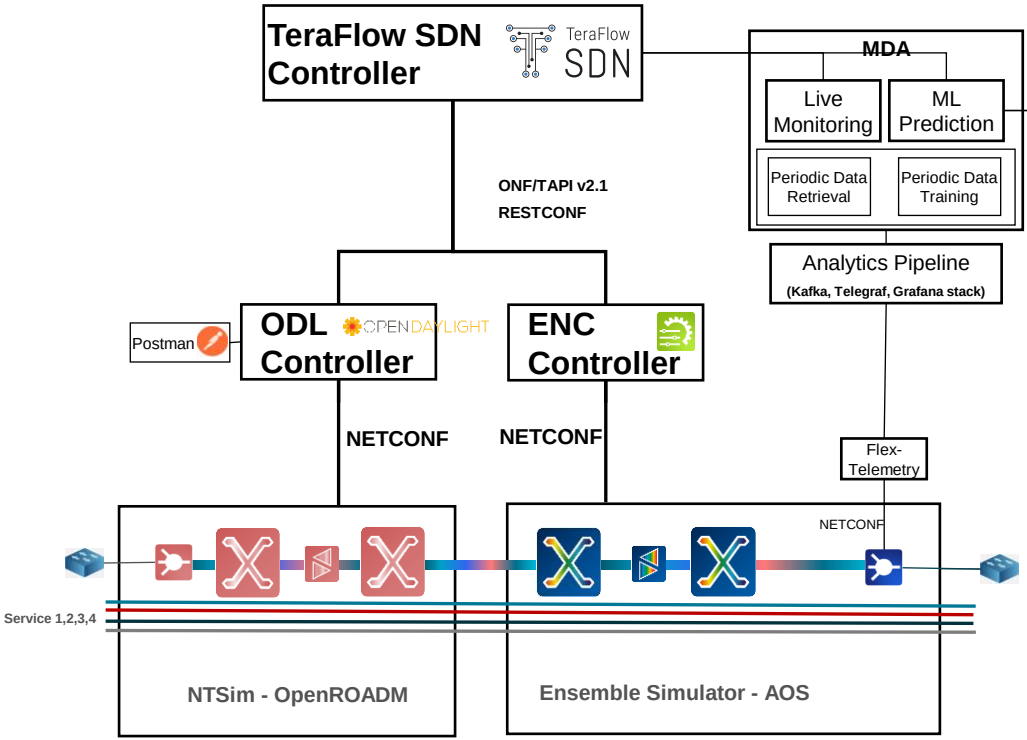
Adtran

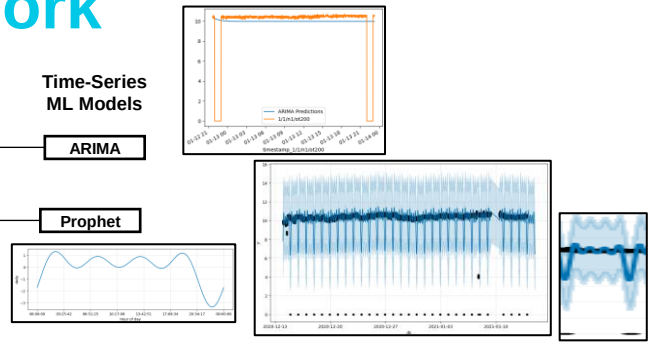
Planned Telemetry Streaming POC Architecture



2023 © ADTRAN

Digital Twin: Optical Transport Network





USE CASES FOCUSSED:

1. **Multi-Domain Optical Network Simulation.**
   1. Architecture.
   2. Protocol and Standards maintenance.
2. **Multi-Domain Orchestration.**
   1. Optical Service Creation along different domains.
      1. Main Service.
      2. Sub service creation for each domains.
   2. Modification and Deletion of service.
3. **MDA - Modeling and Data Analytics.**
   1. Closed Loop Automation.
      1. Using Live monitoring (with WINDOW-ing).
   2. Predictive Maintenance.
      1. ML Based Automation (ARIMA and Prophet).
4. **gRPC vs REST.**
   1. Client-Server Implementation.
   2. Protocol Analysis.
   3. Latency, Network Traffic, Payload size are analyzed.

2023 © ADTRAN

Key take-aways

- TFS will be used as multidomain controller for AI-NET-PROTECT TIP Streaming Telementry POC and SEASON Digital Twin closed loop automation
- Extensions planned on ONF TAPI implementation, optical network and device data models, and Streaming Telemetry protocols
- Close alignment with TIP MUST
- **Interest in alignment and collaboration with other TFS activities on optical network controller, SDN API and streaming telemetry**

2023 © ADTRAN

This work has been performed in the framework of the CELTIC-NEXT project AI-NET-PROTECT (Project ID C2019/3-4), and it is partly funded by the German Federal Ministry of Education and Research (FKZ16KIS1279K).

Thank you!

Achim Autenrieth, Adtran
achim.autenrieth@adtran.com

Acknowledgements: AI-NET-PROTECT & SEASON project partners & funding agencies