FLEX-SCALE

Flexibly Scalable Energy Efficient Networking

FLEX-SCALE - ENERGY CONSUMPTION AWARENESS IN TRANSPORT NETWORKS

TFS3 Ecosystem Day, 18th October 2023

Raul Muñoz, Lluis Gifre, Carlos Manso, Ricard Vilalta, *CTTC*

Panagiotis Famelis, *UBITECH*

Nicola Sambo, Andrea Sgambelluri, *Scuola Superiore Sant'Anna (Italy), CNIT (Italy)*

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INTRODUCTION TO FLEX-SCALE

FLEX-SCALE PROJECT CONSORTIUM

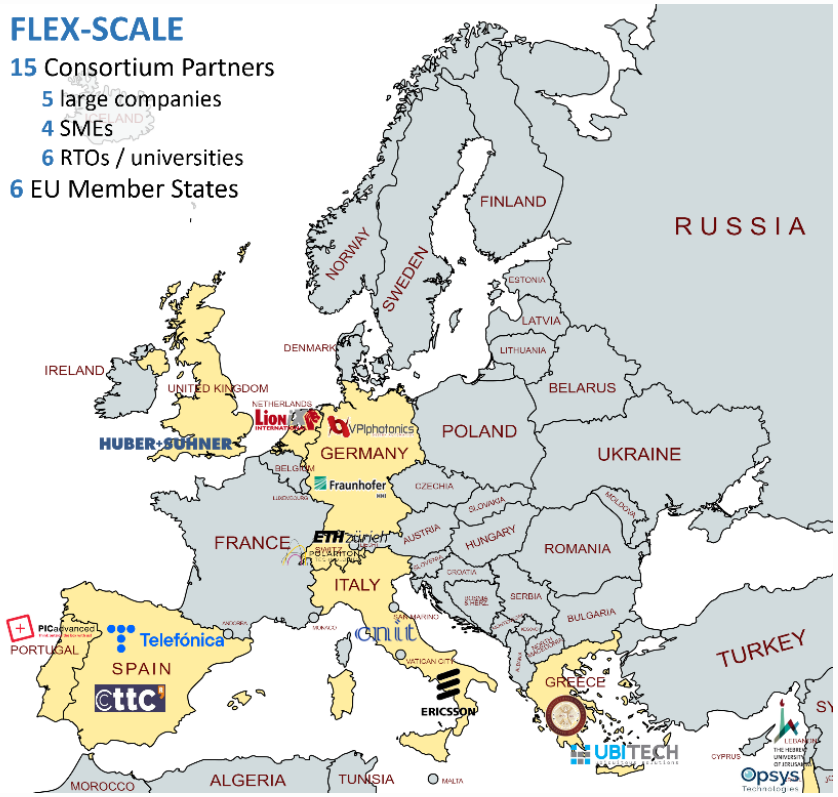
Work programme	HORIZON-JTI-SNS-2022
Programme Topic	STREAM-B-01-03
Type of action	HORIZON-JU-RIA
Project acronym:	FLEX-SCALE
Contact person:	Prof. Ioannis Tomkos (UPAT)
List of participants:	

UNIVERSITY OF PATRAS
CONSORZIO NAZIONALE INTERUNIVERSITARIO PER LE TELECOMUNICAZIONI
CENTRE TECNOLOGIC DE TELECOMUNICACIONS DE CATALUNYA
HUBER+SUHNER POLATIS LIMITED
FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.
THE HEBREW UNIVERSITY OF JERUSALEM
LIONIX INTERNATIONAL BV
OPSYS SENSING TECHNOLOGIES LTD
PICADVANCED, SA
ERICSSON TELECOMUNICAZIONI SPA
TELEFONICA INVESTIGACION Y DESARROLLO SA
UBITECH
VPIPHOTONICS GMBH
EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH
POLARITON TECHNOLOGIES AG

FLEX-SCALE

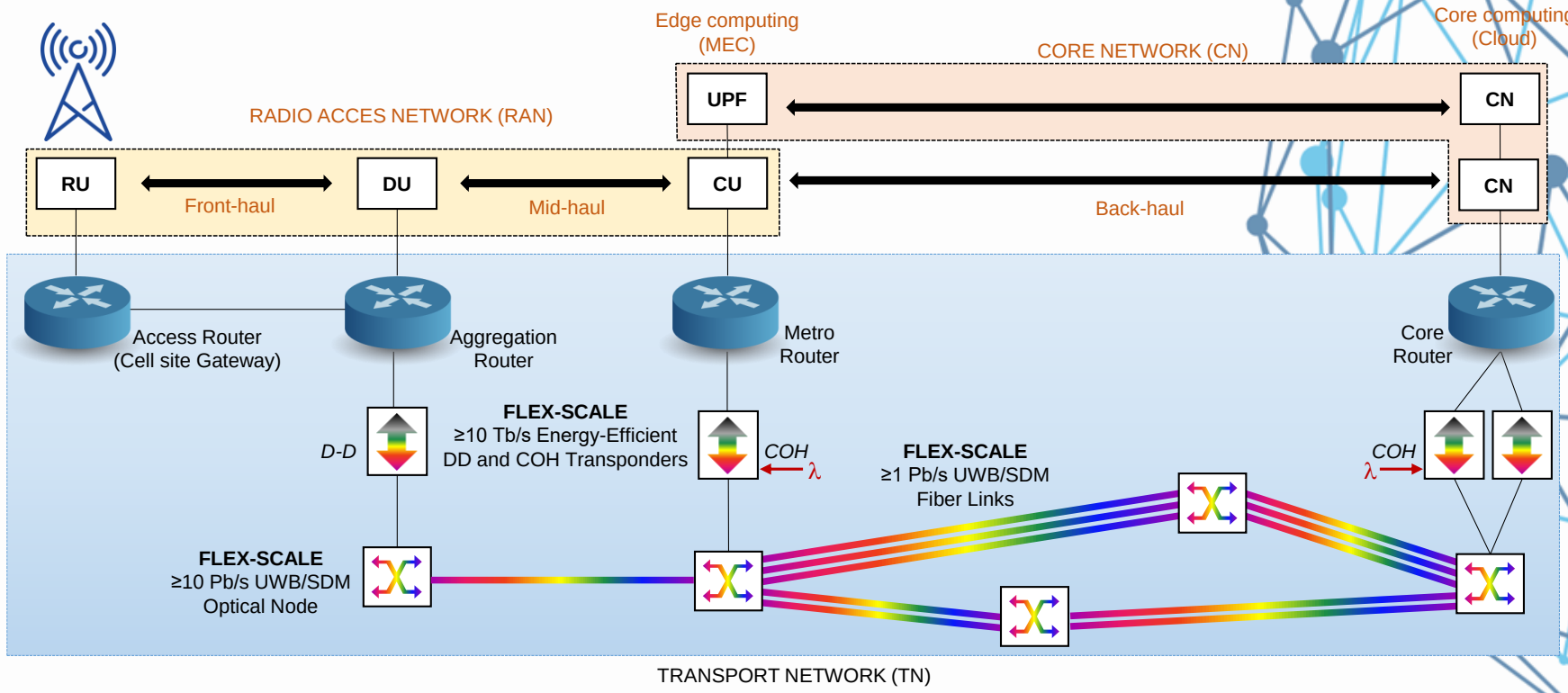
15 Consortium Partners
- **5** large companies
- **4** SMEs
- **6** RTOs / universities

6 EU Member States



FLEX-SCALE SCOPE: END-TO-END 6G NETWORKING RELYING ON ADVANCED OPTICAL NETWORKING

- FLEX-SCALE consortium develops innovations that will enable flexible capacity scaling of 6G x-haul networks, while ensuring security and reducing costs & energy consumption per packet-flows, by utilizing:
  - Optoelectronic interfaces of line-systems to scale to ≥10 Tb/s,
  - Network link capacities to scale ≥1 Pb/s by utilizing UWB/SDM multiplexing schemes
  - Optical switching node capacities to scale to ~tens Pb/s
  - Optical layer security solutions
  - SDN management of the packet-optical x-haul networks

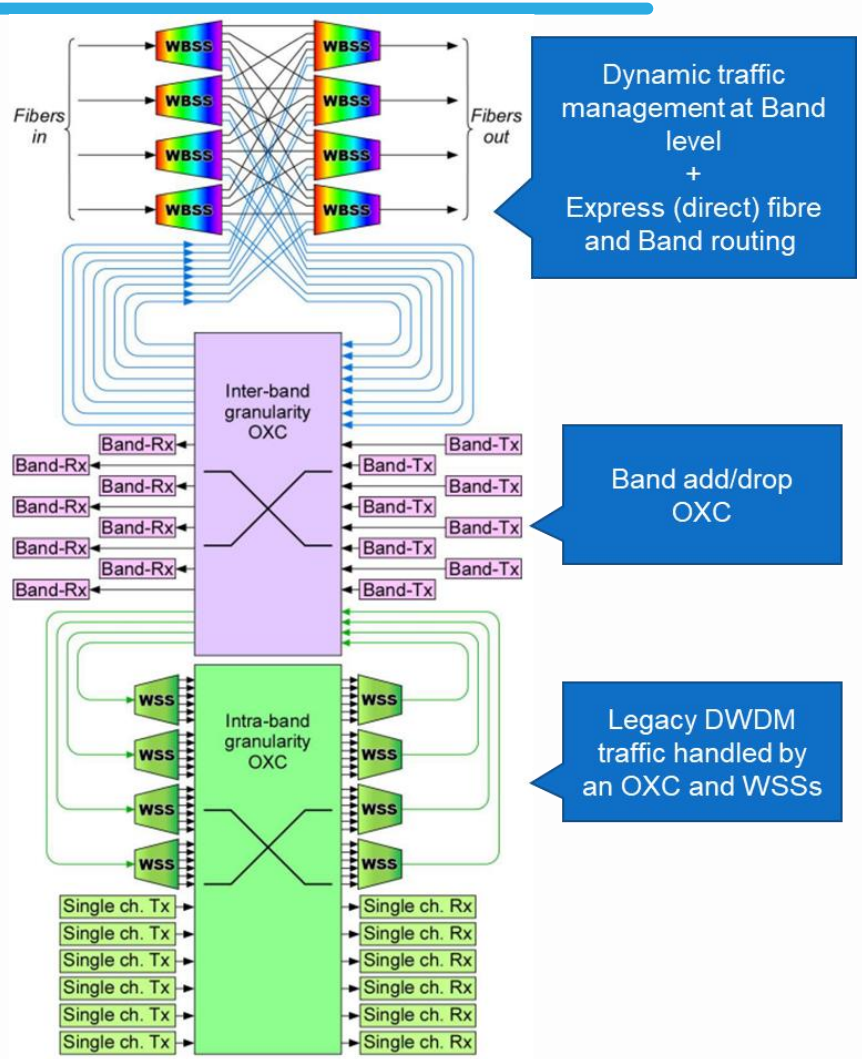


MULTI-GRANULAR OPTICAL NODE ARCHITECTURE AND WAVEBAND-SELECTIVE SWITCH

- The FLEX-SCALE Switching Node architecture is based on a novel Multi-Granular architecture (MG-ON) and a new switching subsystem that can realize reconfigurable WaveBand-Selective Switching (WBSS), in addition to Spatial and Spectral Lanes switching using enhanced Optical Xross Connects (OXCs) and conventional Wavelength Selective Switching (WSS)

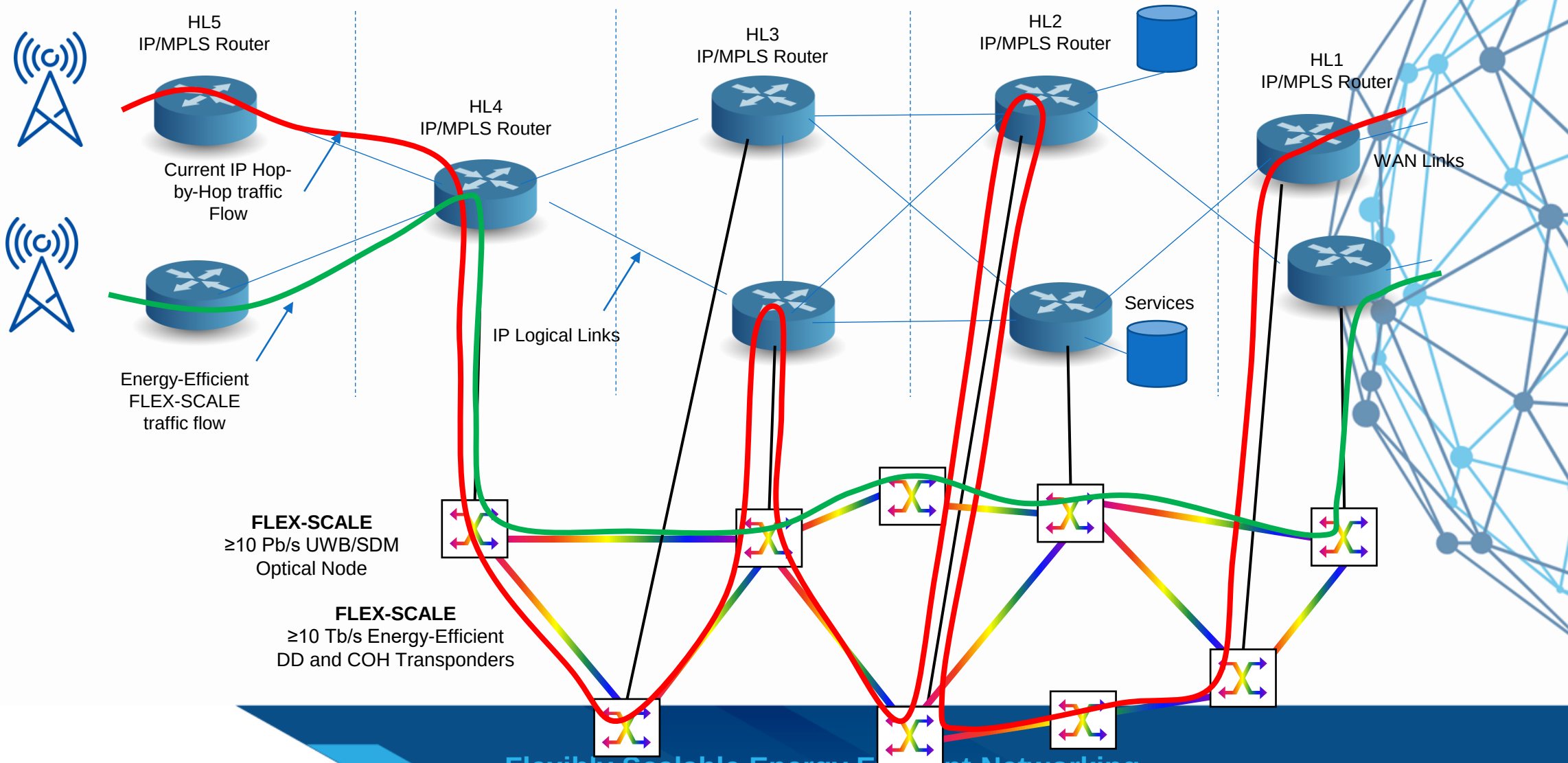
- The WBSS is implemented as a compact programmable and rapidly reconfigurable PIC that is capable of dynamically processing the entire UWDM optical spectrum and as demanded dynamically carve portions of the spectrum into flexibly-defined, continuous, and flat spectral bands, which are subsequently switched to multiple output ports.

- The FLEX-SCALE MG-ON is a hierarchical network node that offers fast, route-and-select architecture at the band and fibre levels at the top tier, with a secondary route-and-select architecture implemented with todays per Band WSSs ensuring backwards compatibility with legacy transport schemes.

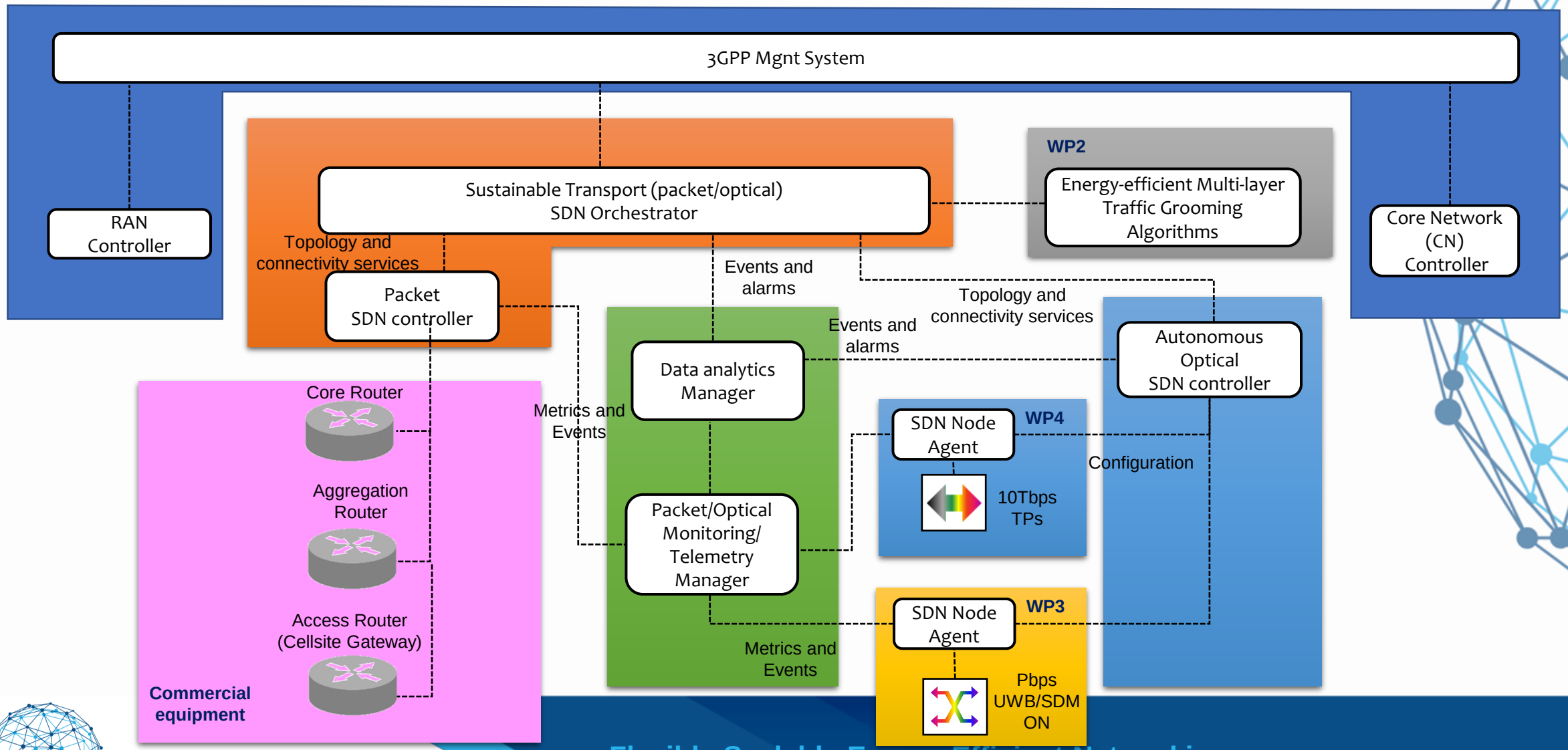


MULTI-GRANULAR PACKET-OPTICAL NODE CONTROL

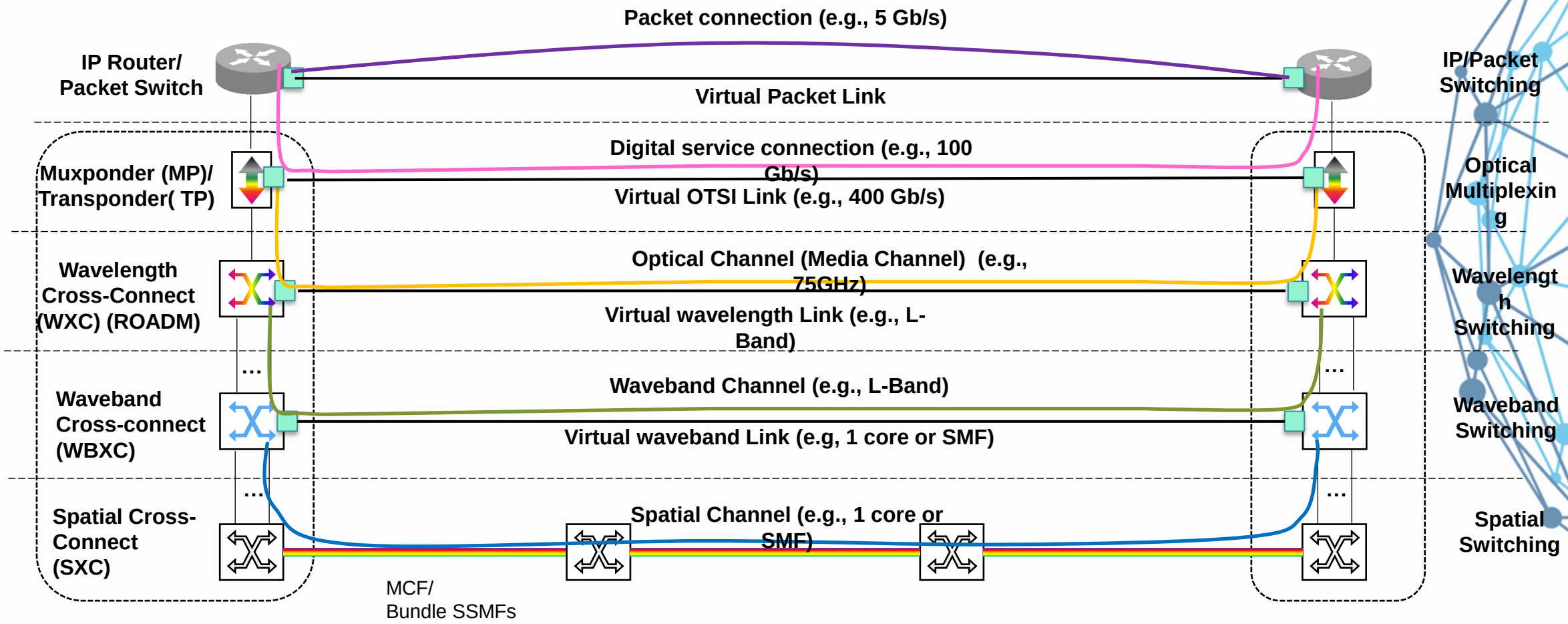
ENERGY-EFFICIENT AND LARGE-SCALE MANAGEMENT OF TRAFFIC FLOWS WITH DEDICATED QUALITY OF SERVICE (QOS)



FLEX-SCALE FUNCTIONAL TRANSPORT SDN CONTROL ARCHITECTURE



MULTI-GRANULAR OPTICAL NETWORK ARCHITECTURE: VIRTUAL NETWORK TOPOLOGY MANAGEMENT



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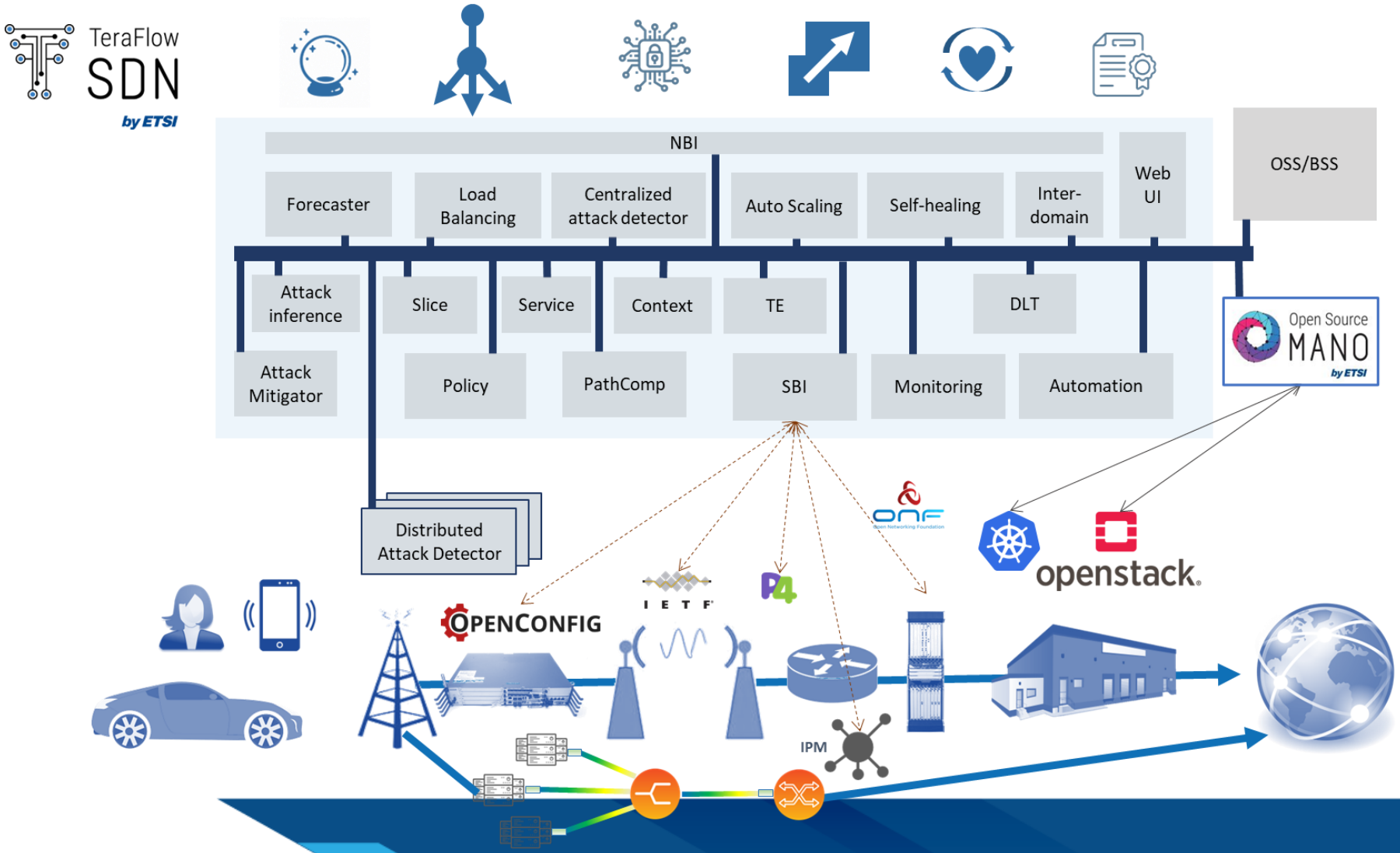
PROPOSED ADAPTATIONS FOR FLEX-SCALE

TFS ARCHITECTURE FOR RELEASE 2



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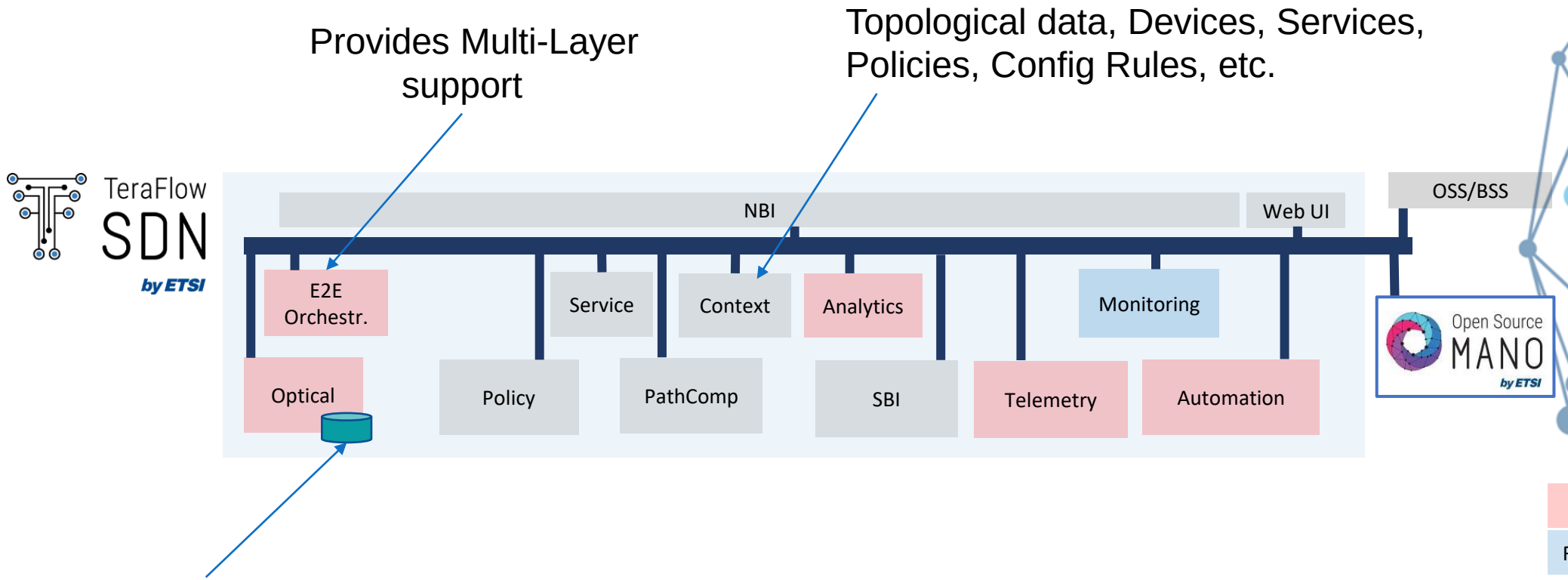
GENERIC ARCHITECTURE



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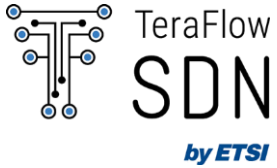
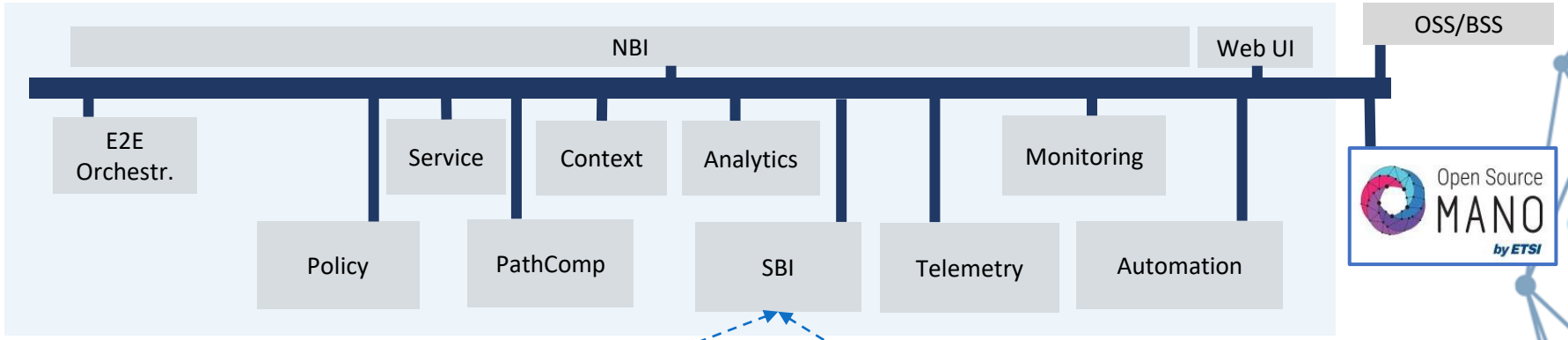
E2E ORCHESTRATION (IP + OPTICAL)



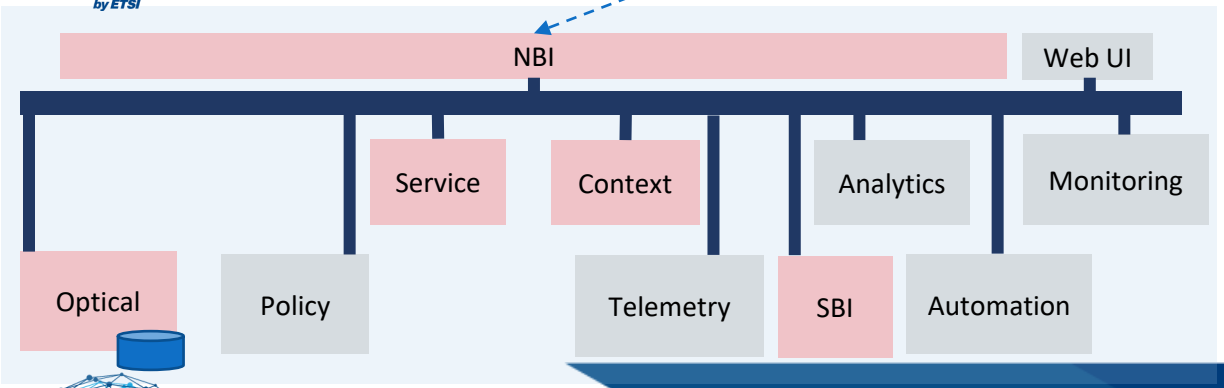
End-to-end Orchestrator



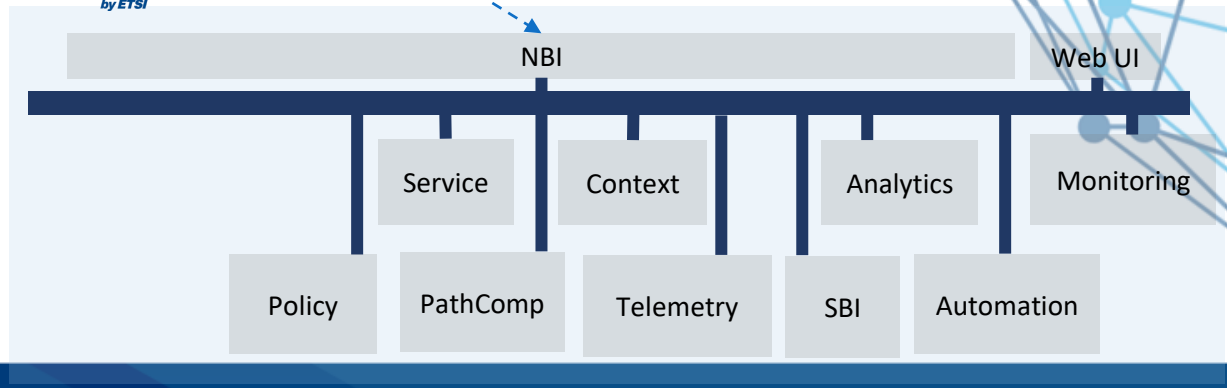
ONF Transport API
(or simple REST-API)

IETF L2SM (L2VPN)

Optical SDN Ctrl



IP SDN Ctrl



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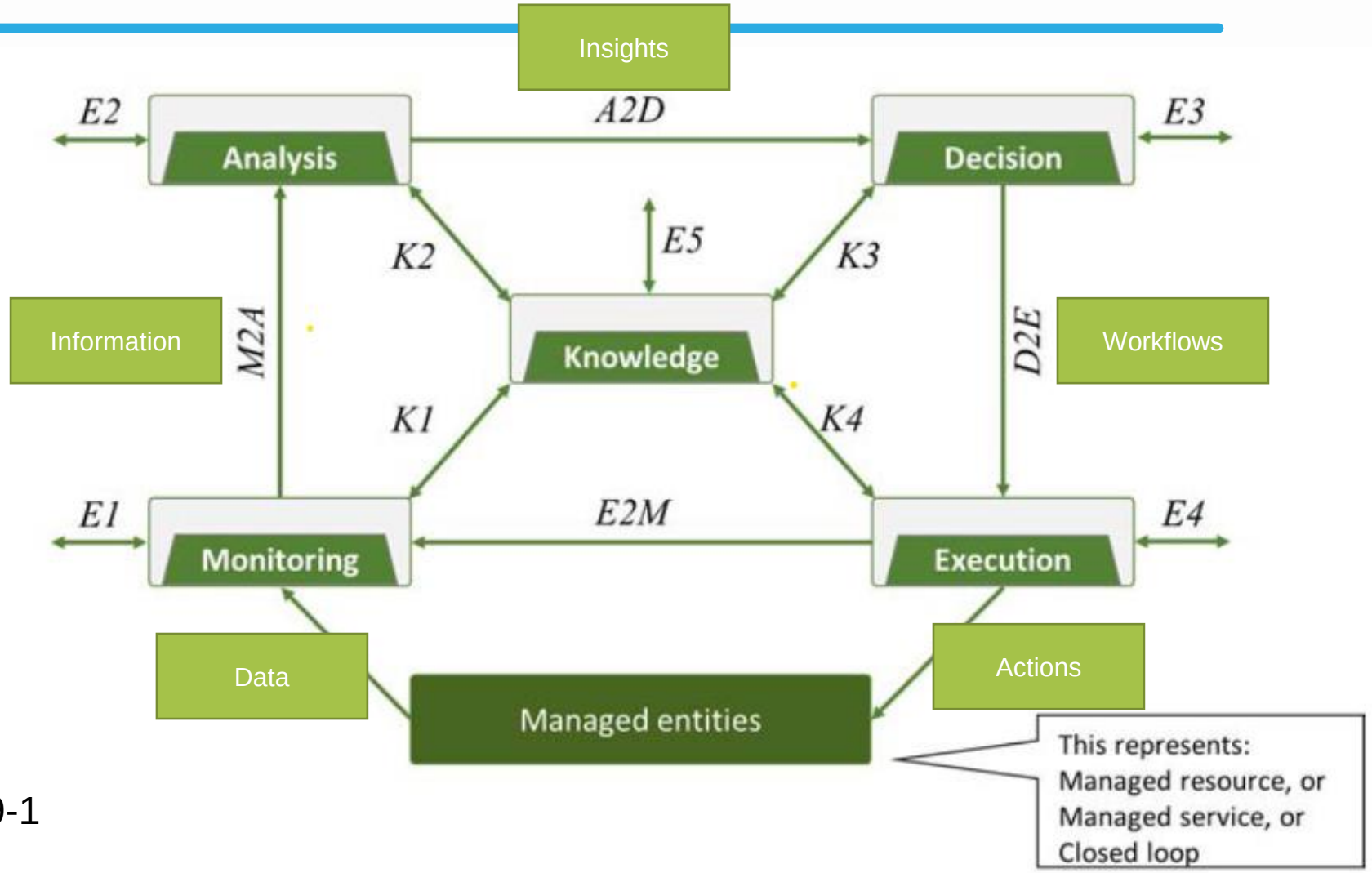
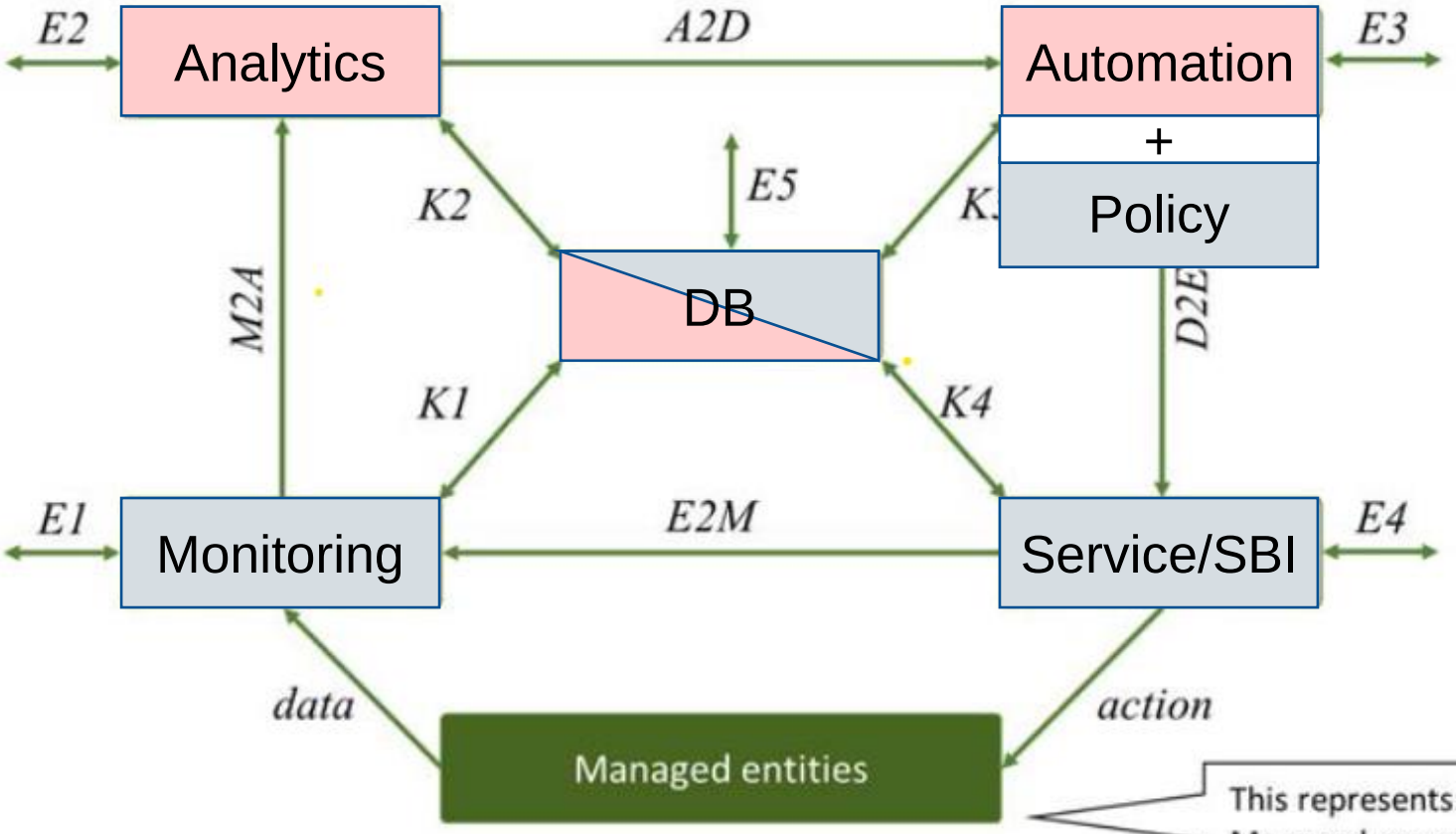
ZSM CLOSED LOOP



According to
ETSI GS ZSM 009-1

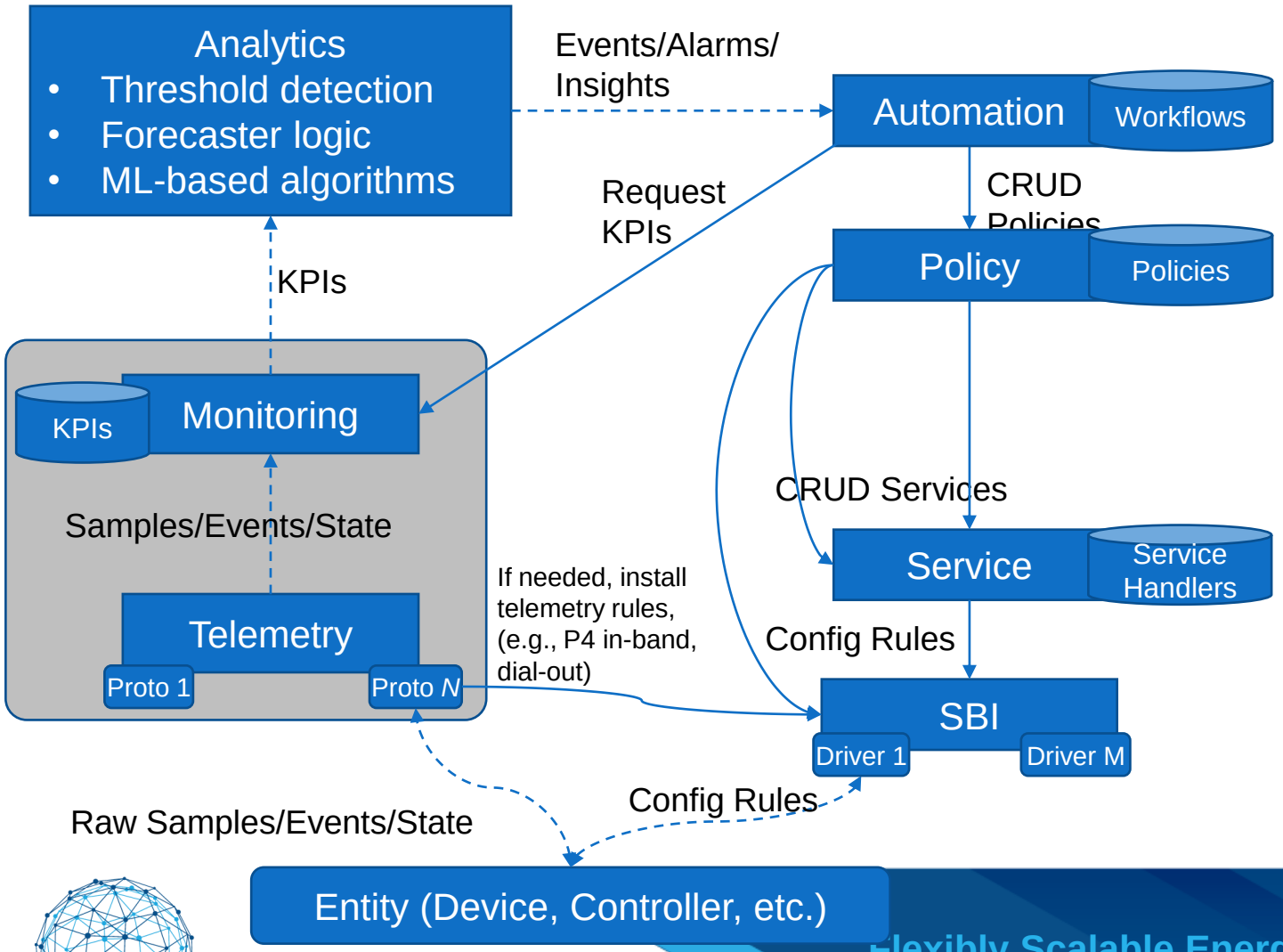
MAPPING TO TFS



New Component

Existing Component

MONITORING-ANALYTICS-AUTOMATION LOOP



TFS	ZSM
Telemetry	Data Collection (ingestion)
Monitoring	Data Collection (management)
Analytics	Analytics
Automation	Intelligence (decission engine)
Policy	Orchestration
Service	Control/Orchestration (services)
SBI	Control (devices/sub-domains)

Policy and Automation implement Event-Condition-Action (ECA) loops:

- Given a triggered ***<Event>***
- Check if ***<Condition>*** is met
- If so, perform the ***<Action>*** defined

CRUD: Create/Read/Update/Delete

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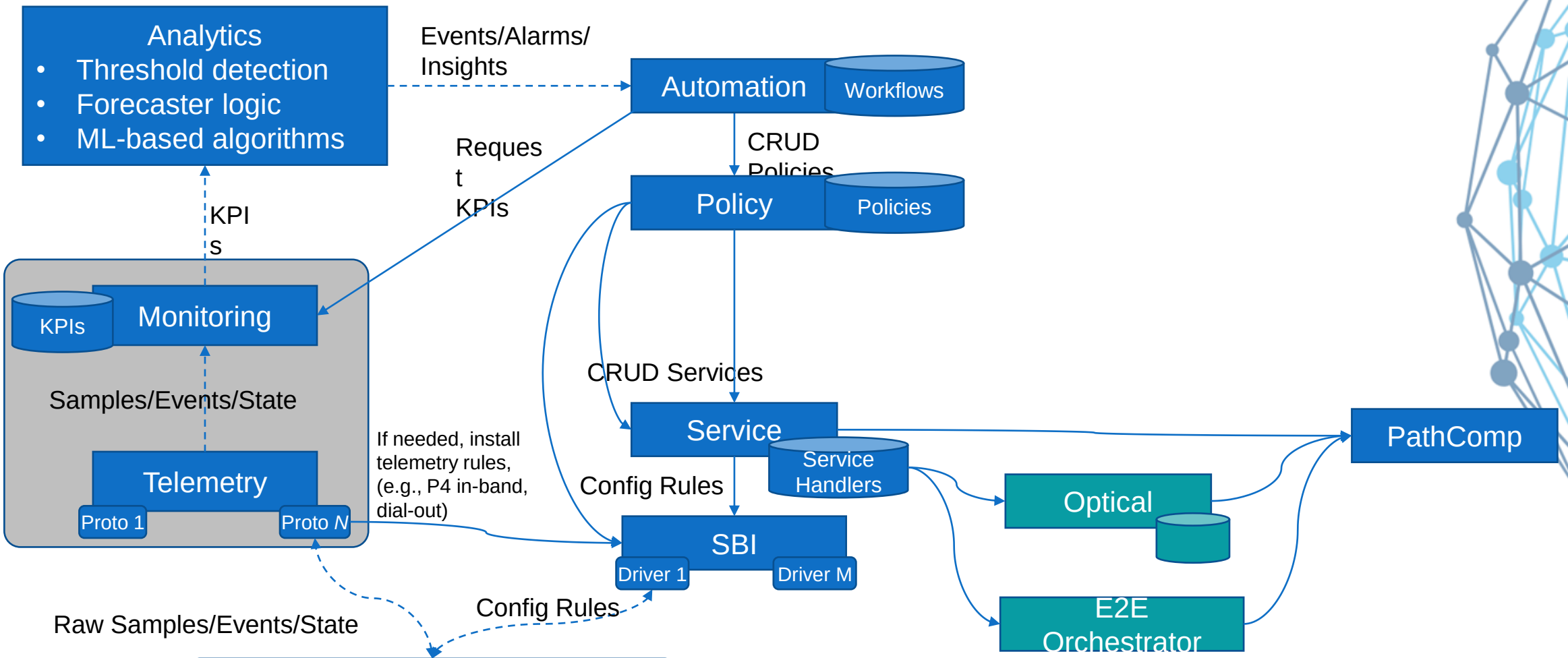
COMPONENT INTERACTIONS



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THANK YOU FOR YOUR ATTENTION

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www.6G-flexscale.eu

THANK YOU ON BEHALF OF THE ENTIRE FLEX-SCALE CONSORTIUM!