

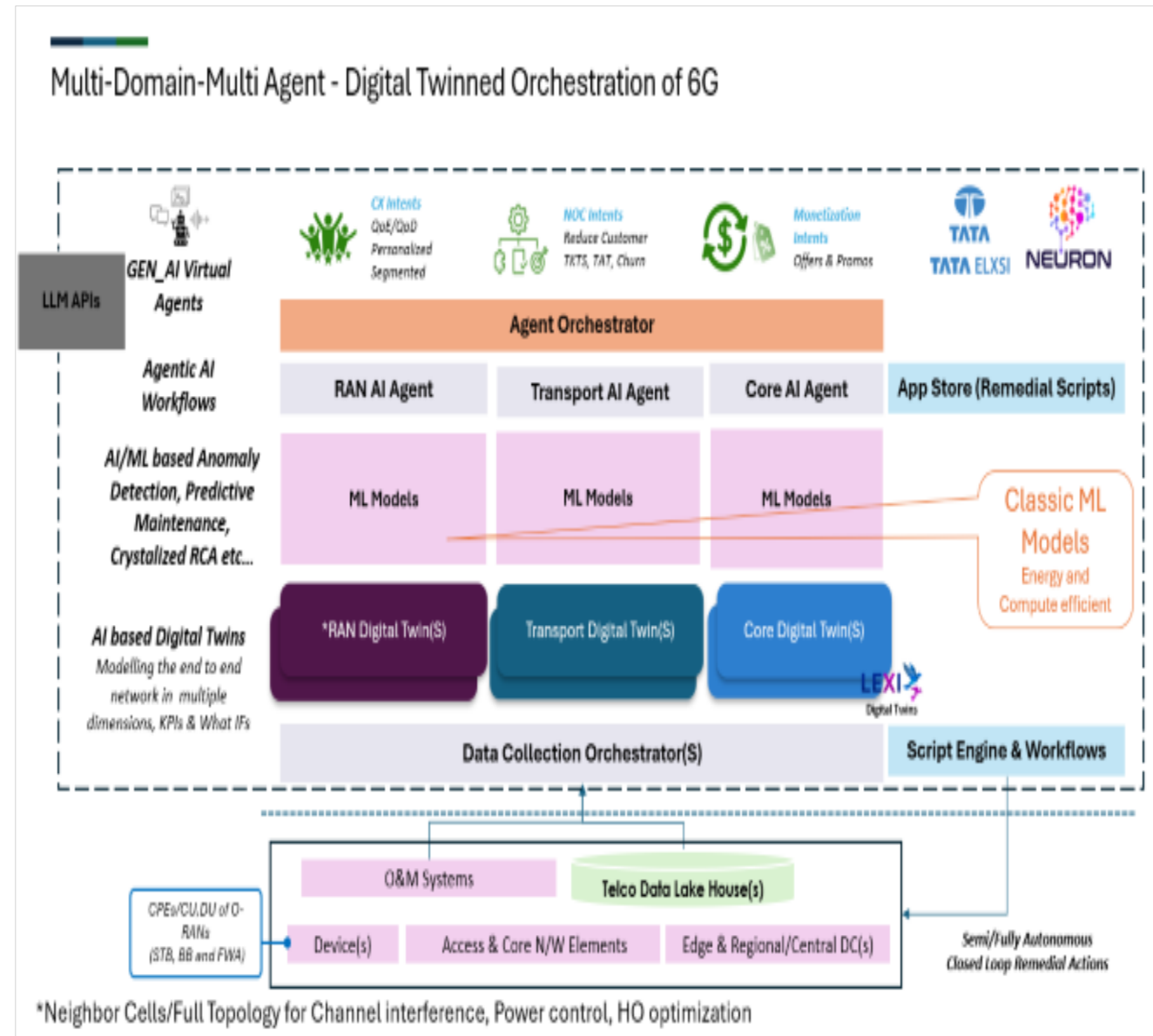
Agentic Digital Twin Orchestration for 6G Networks

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Agenda

- (R)Evolution to Agentic Digital Twin Orchestration
- 6G Digital Twin Universe
- Significance of RAN Digital Twin (Business and Energy Impact)
- Multi-domain multi-Agent Orchestrator for 6G N
- CI/CD/CL/CT Machine Learning Integration – **6G FlyWheel**
- Agentic Digital Twin – Challenges and probable Solutions
- Business model innovations



(r)Evolution - Agentic Digital Twin Orchestration for 6G



Cloud Native,
Service-Oriented Architecture,
Stand Alone Architecture
Automation & Orchestration

Agile CI/CD Telco cloud, RAN domain (CU, DU, x/rApps)

Traditional transport

O-RAN

((5G))



((6G))

4G

Packet-switched
E2E IP network
VoLTE, RCS !
CP/UP Split

AI Native E2E Architecture – **OPEN SYSTEMS**

OPEN AI-RAN (**O-AI-RAN**)

Data, Data Set, Data Model Driven (new paradigm) – **SHARED, Federated**

CI/CD **domain extending to O-AI-RAN PHY**

***Continuous Data | Continuous Cooperative Learning CI/CT_IN_DT/CD**

Intent Orchestration to Agentic Orchestration powered by Digital Twin

Lean Transport (**Flow Based**, Simple switching !)

Highly Energy Efficient thru **SON** and co-operative scheduling in RAN domain

*6G AI Flywheel

- An **Agent based on a Digital Twin** is a software or AI-based entity that leverages a **virtual replica of a physical system (the Digital Twin)** to perform real-time decision-making, predictions, control, or optimization. It combines **simulation, telemetry, and AI/ML algorithms** to **act/orchestrate** on behalf of the real-world system.

DIGITAL TWIN	SPIRAL TWIN
	
MIRRORED SYSTEM Static representation	EVOLVING SYSTEM Iterative learning
UPDATE FREQUENCY Periodic or on request	UPDATE FREQUENCY Continuous
ADAPTABILITY Limited and reactive	ADAPTABILITY High and proactive
COGNITION Minimal	COGNITION Embedded, AI-based

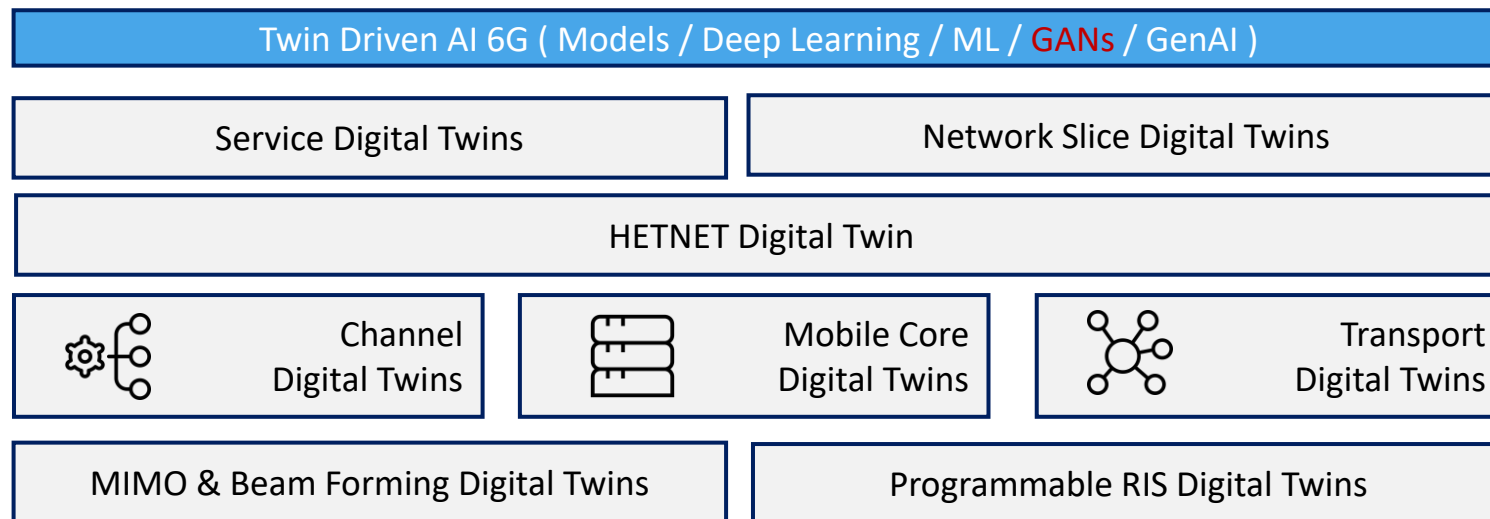
5G Network Digital Twin	6G Network Spiral Twin
	
Objective To accurately replicate the 5G network as it is	To replicate and evolve the 6G network over time
Approach Representational	Evolutionary
Nature Static	Dynamic

6G Digital Twin Universe - 6G Network Deploy/Innovate/Operate accelerator(many archetypes)

DISTRIBUTED | FEDERATED | CENTRALIZED

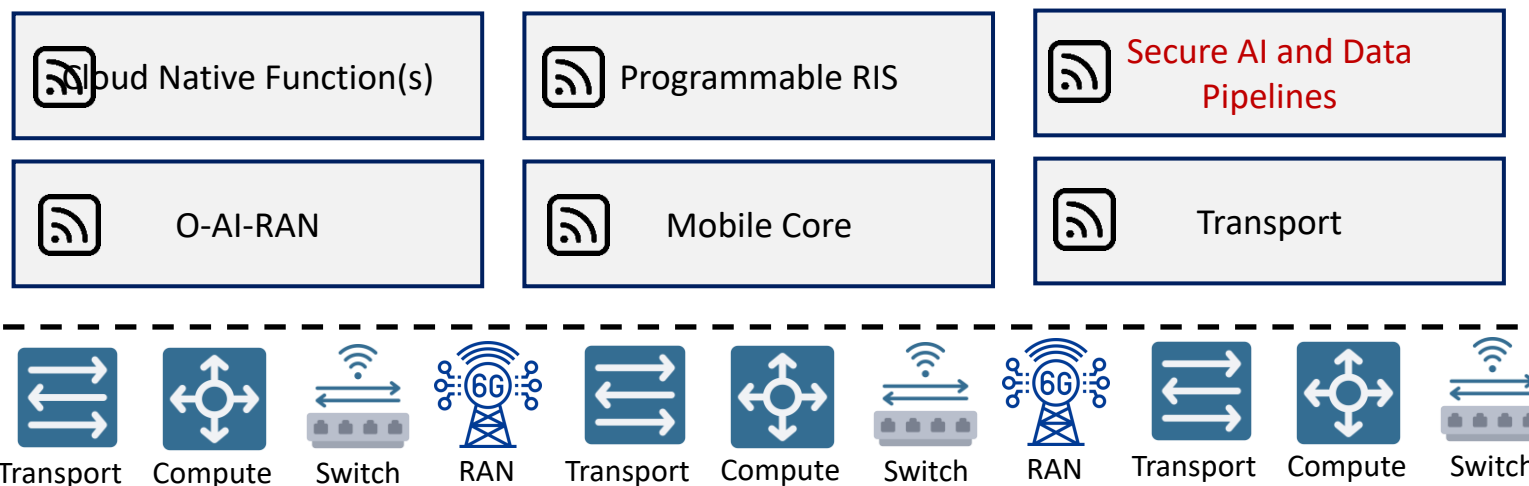
Security & Threat Model Digital twins

Digital Twin Layer



Secured Shared
Data Transport

Network Layers



Agentic Digital Twin Orchestration for 6G in RAN Domain (60-60-60) Opex-Capex-Energy consumption

MIMO and Beam Forming with Twins.

improve spectral efficiency, increase data rates, and enhance coverage

TWIN Driven Spectrum

Usage Efficiency *Neighbor Cells/Full Topology for Channel interference, Power control, HO optimization

Programmable RIS with Digital Twins.

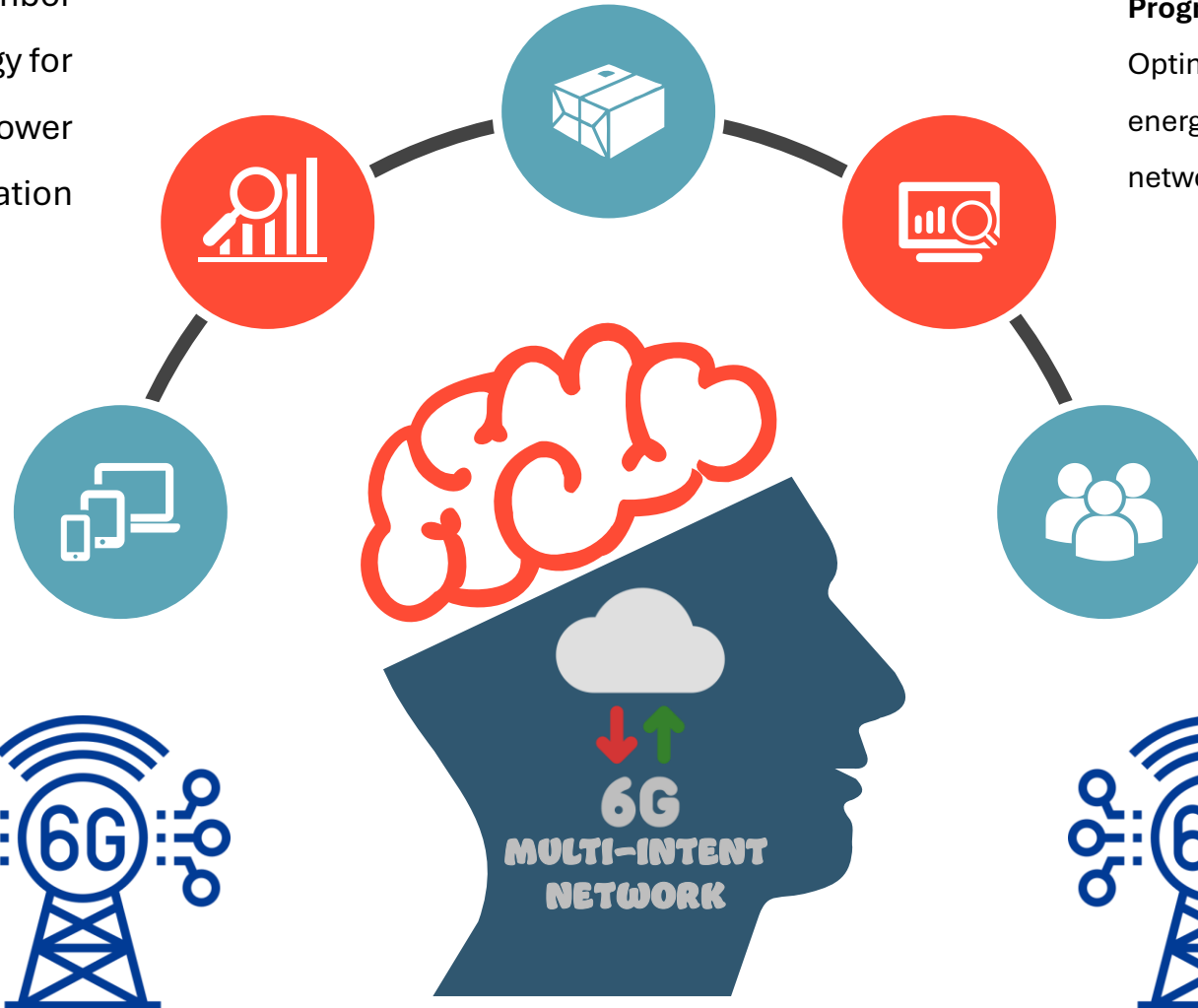
Optimizing signal propagation, enhancing energy efficiency, and improving overall network performance

Twin Driven HetNet & Channel Sensing

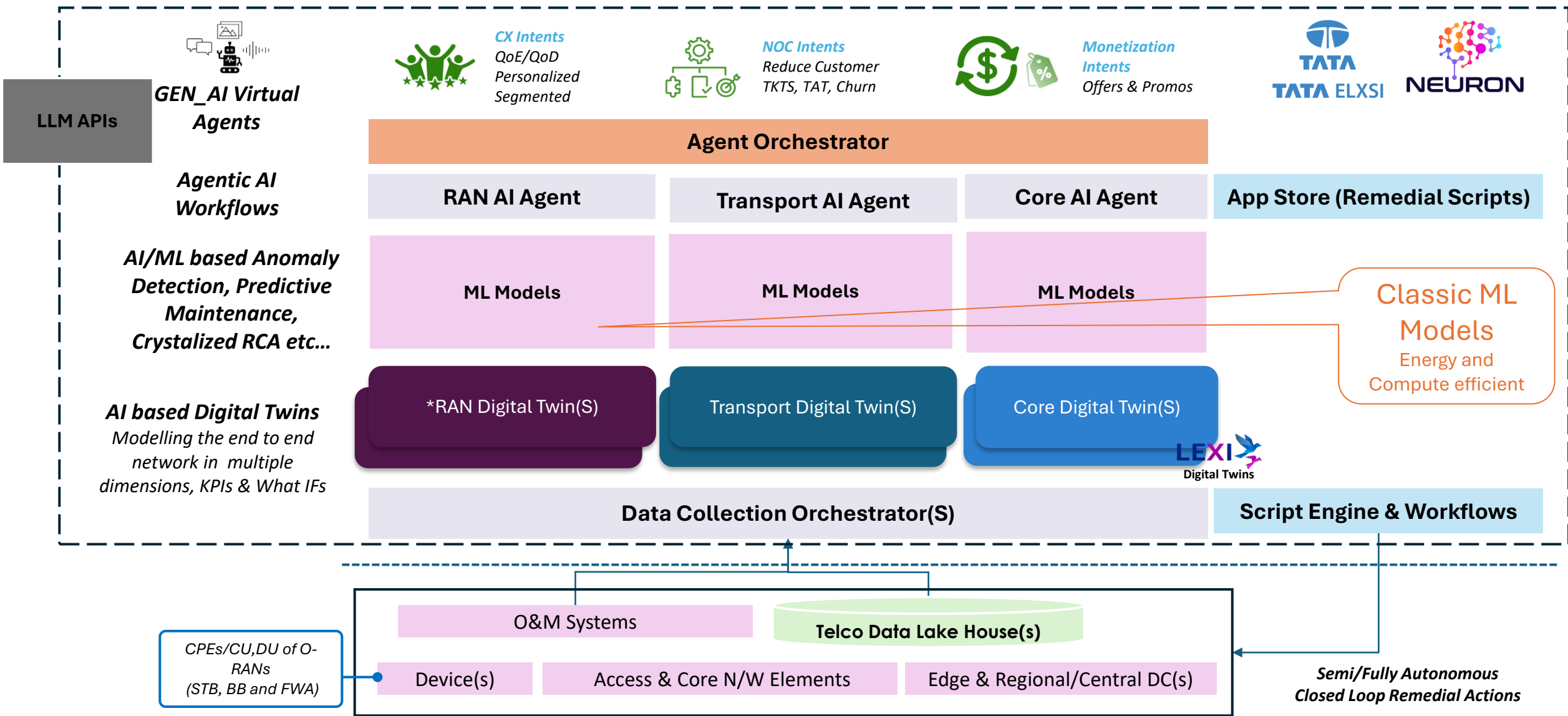
Optimizing Spectrum usage and Frequency planning

Channel Model through Digital Twins.

Empirical Channel model from Network behavior.

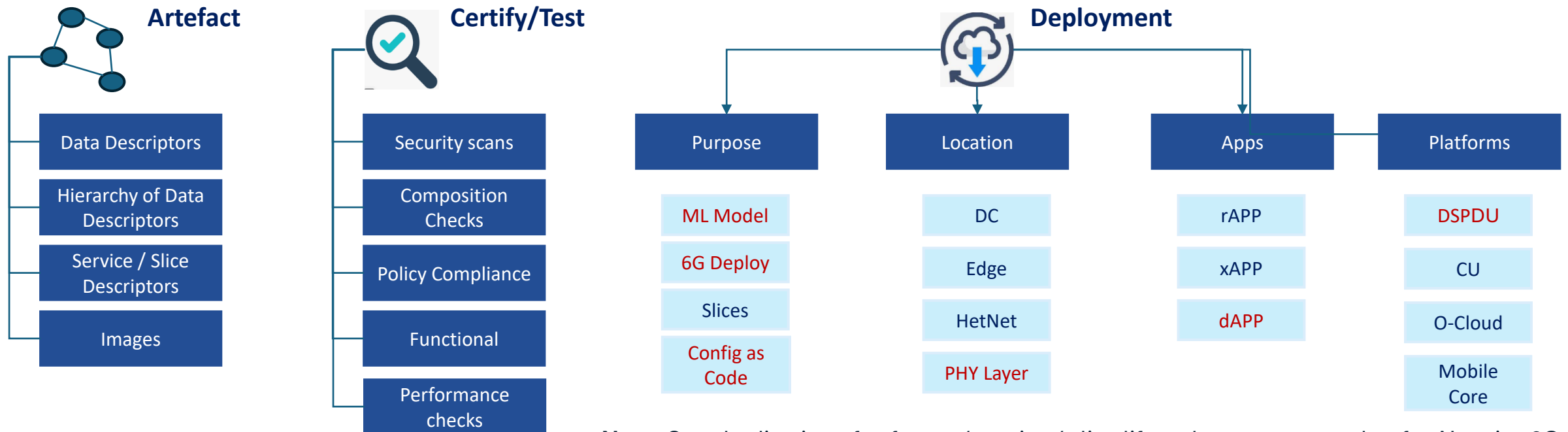
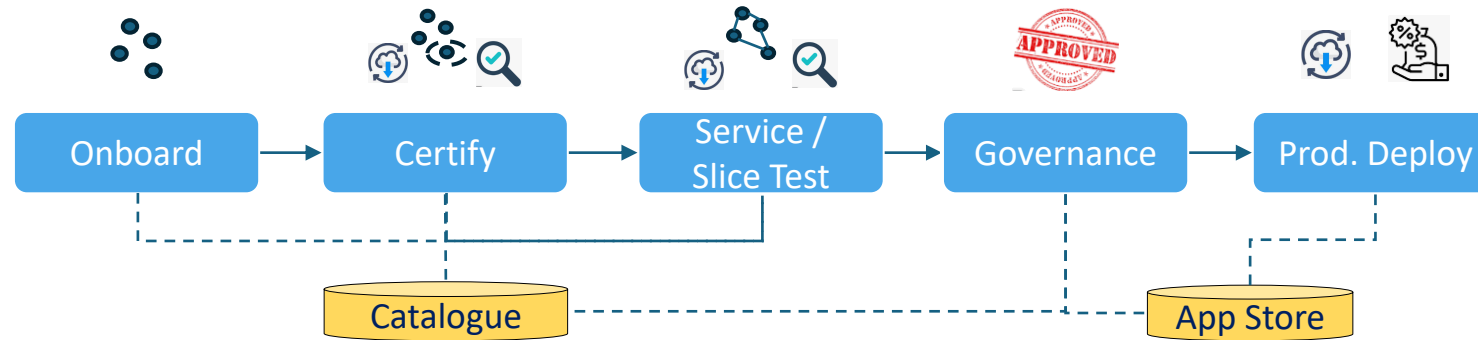


Multi-Domain-Multi Agent - Digital Twinned Orchestration of 6G



*Neighbor Cells/Full Topology for Channel interference, Power control, HO optimization

Automated Promotions and deployments of ML Models / Services / Slices using Digital Twins (6G Flywheel **Continuous Data** | Continuous **Co**operative **L**earning/ CI/CD / **C**ontinuous **T**esting)



Note: Standardization of software / service / slice lifecycle management key for AI native 6G

Agentic Digital Twin – Challenges and probable Solutions

CHALLENGES



Heterogenous data from multi-vendor and variety of sources



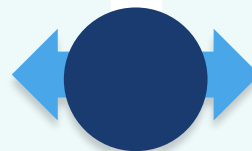
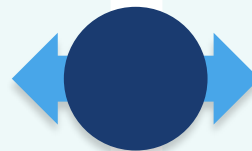
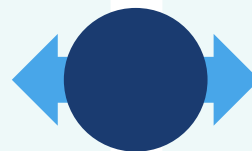
Ssynchronization between physical and digital counterparts
Consistency and scalability among multiple and hierarchical DTs.



Significant cost and energy requirements due to extensive compute, storage resource and transport requirements



Lifecycle management of software Services across RAN , Core and Transport



SOLUTIONS

Establishing a **standardized** data formats / semantics across containers/services/subsystems/systems/domains /hierarchical data



Determine the priority of parameters, frequency of data collection and hierarchical abstraction of parameters across the digital twins



Sharing of federated data, ML models, AI Infrastructure and Learnings across the Telcos and entire ecosystem



OTA Standardization, Lifecycle management and orchestration standardization to promote larger open community participation



Agentic Digital Twin Orchestration for 6G Network - new business and operating model

1

Data Sharing

- Licensing
- Data Federation
- ML Model Sharing
- LLM Sharing
- AI Infrastructure sharing

2

XaaS Model

- Spectrum
- RAN
- Slice
- Edge
- Data
- **End to End Open 6G Systems**

3

Spectrum for Purpose

- Spectrum Metering
- Meeting Social Objectives
- (Education, Health care, Upskilling, Rural empowerment)
- Welfare Schemes

Shared RAN Infrastructure model with O-RAN RU sharing architecture – art of possibilities with Agentic orchestration (Spectrum As A Service, RAN As A Service)

- Thank you