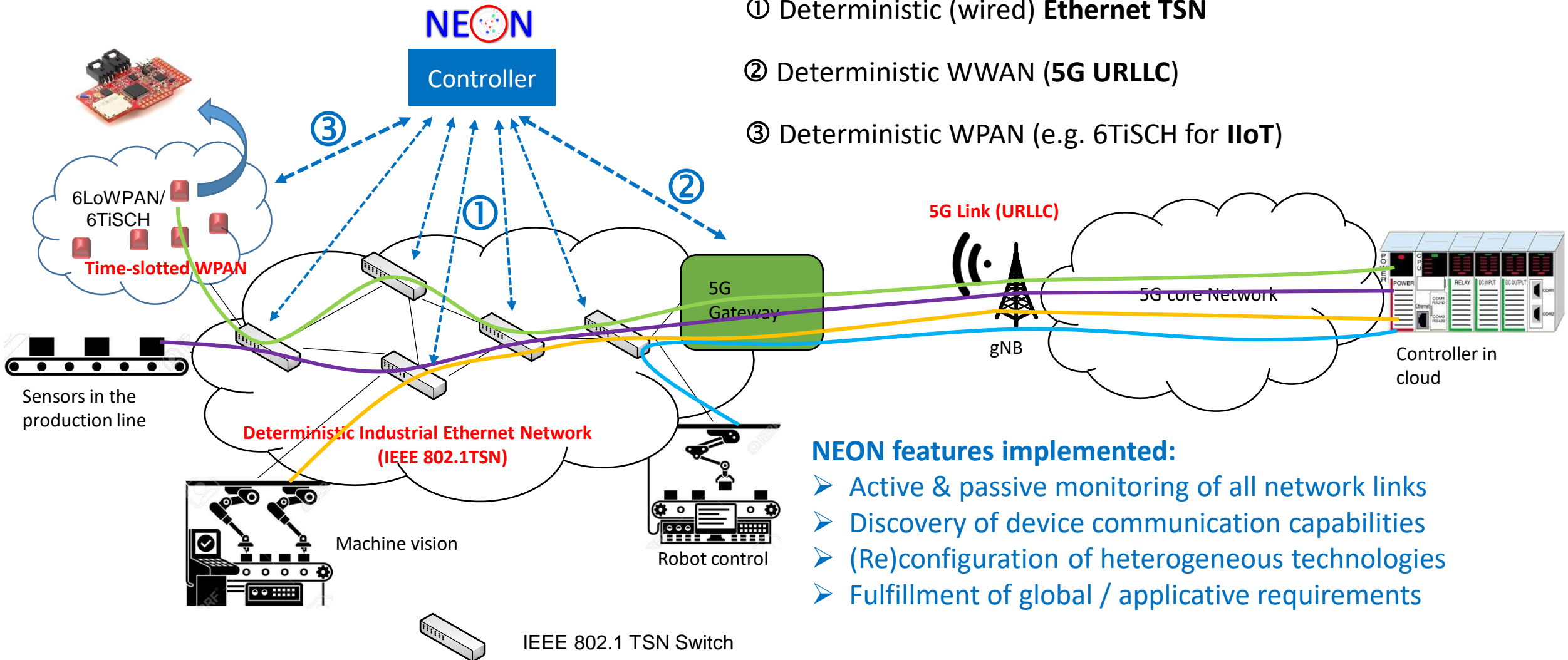# CEA LIST, LSC –

Laboratory of Communication Systems interest in SNS call for projects

- HORIZON-JU-SNS-2024-STREAM-B-01-01 "System Architecture - Standardisation and Follow-up/PoCs"
  - "New design approaches for 6G system architecture systems":
    - ➔ Propose the use of Intelligent, multi-technology, network management tool NEON, designed at CEA:
      - Supports Time-Sensitive Networking features and allows deterministic end-to-end communication through 6G networks.
  - "Mechanisms, leading to partial or complete Digital network twinning, applied in 6G"
    - ➔ Propose enhancements to the design of Digital Twin for 6G Networks, using mechanisms and tools designed at CEA.
  - "Dissemination of solutions for international consensus building, which can be exploited in standardisation activities."
    - ➔Tracking of 6G pre-standardization groups and potential contributions to IETF and 3GPP.
- ➔Contact:
  - ➔Mr. Alexis OLIVEREAU alexis.olivereau@cea.fr Head of Laboratory
  - ➔Mr. Alexandre PETRESCU alexandre.petrescu@cea.fr EU Affairs at Laboratory

NEON managing End-to-end Deterministic Communications

☑ **Objective: End-to-end bounded latency for multiple heterogeneous flows, in a complex multi-hop environment**

① Deterministic (wired) **Ethernet TSN**

② Deterministic WWAN (**5G URLLC**)

③ Deterministic WPAN (e.g. 6TiSCH for **IIoT**)

NEON Controller

6LoWPAN/6TiSCH

Time-slotted WPAN

Sensors in the production line

Deterministic Industrial Ethernet Network (IEEE 802.1TSN)

Machine vision

Robot control

5G Gateway

5G Link (URLLC)

gNB

5G core Network

Controller in cloud

IEEE 802.1 TSN Switch

NEON features implemented:
- Active & passive monitoring of all network links
- Discovery of device communication capabilities
- (Re)configuration of heterogeneous technologies
- Fulfillment of global / applicative requirements

NE●N+: Towards a Network Digital Twin (NDT)

- NEON: SDN-based smart and dynamic network management

    - Multi-tehnology framework

    - Network routing, flow control, bandwidth aggregation, TSN

- NEON+ : extend NEON with Network Digital Twin (NDT) functionnalities

    - Real-time and fine-grained virtualization of the real communication network

    - ML-based network modeling (network traffic, link quality, topology dynamics)

        - DRL, GANs, GNNs,

- Use cases:

    - Online network optimization, what-if analysis, troubleshooting, plan network upgrades

- Current work : NDT for NEON-based TSN configuration, dynamic NDT generation (real-to-virtual interface, dynamic network resource discovery/inference)

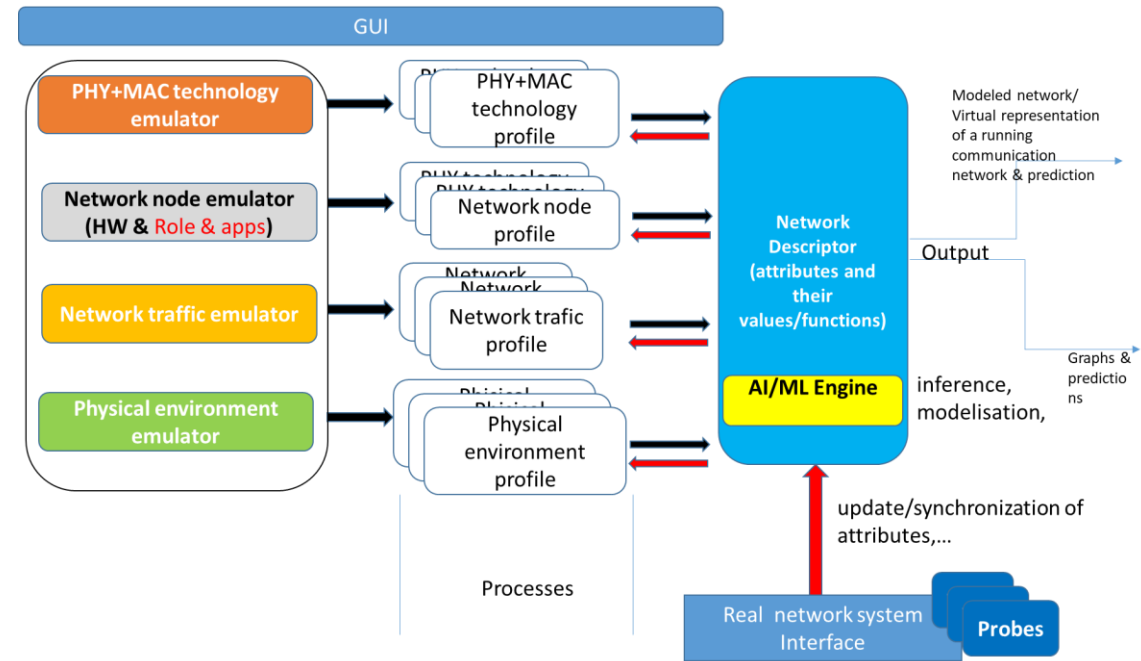- Open issues : scalability, accuracy, model generalization

Fig. NDT functional architecture

Cybersecurity interest

- HORIZON-JU-SNS-2024-STREAM-B-01-04 "Reliable Services and Smart Security–Standardisation and Follow-up/PoCs", RIA, 16MEur

SIGMO-IDS: ANOMALY-BASED NETWORK INTRUSION DETECTION & RESPONSE

Detect cyber attacks and Reconfigure the network automatically in reaction

Cognitive System (AI) for Network Intrusion Detection & Reaction (IDS)
- Neural-network –based "protocol-aware" intrusion detection at each probe
- Orchestration of the overall (multi-probe) detection function, always fitted to the current context
- Dynamic reconfiguration of the network to counter the detected threats

Implementations targeting multiple applications
- **Legacy**: Wi-Fi, Ethernet
- **Wireless IoT**: 6LoWPAN, ZigBee, Thread, LoRA, BLE
- **Automotive**: CAN, cloud-based V2I data reporting
- **Smart Grid**: IEC 60870
- **Industry 4.0**: OPC-UA

Distributed Raspberry Pi detection probes

STM32 detection probe

FIC demonstration of OPC-UA link protection