

PREDICT 6G

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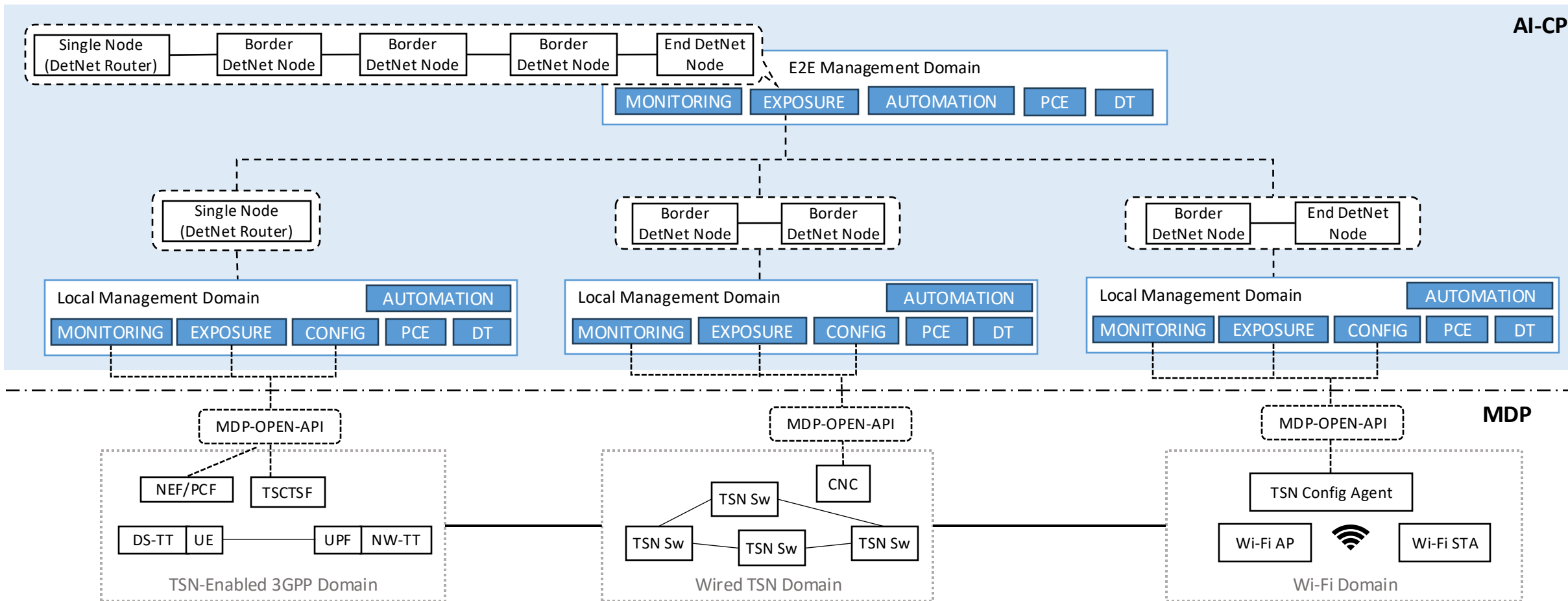
# Artificial Intelligence Control Plane (AICP) for Deterministic Networks

## PoC

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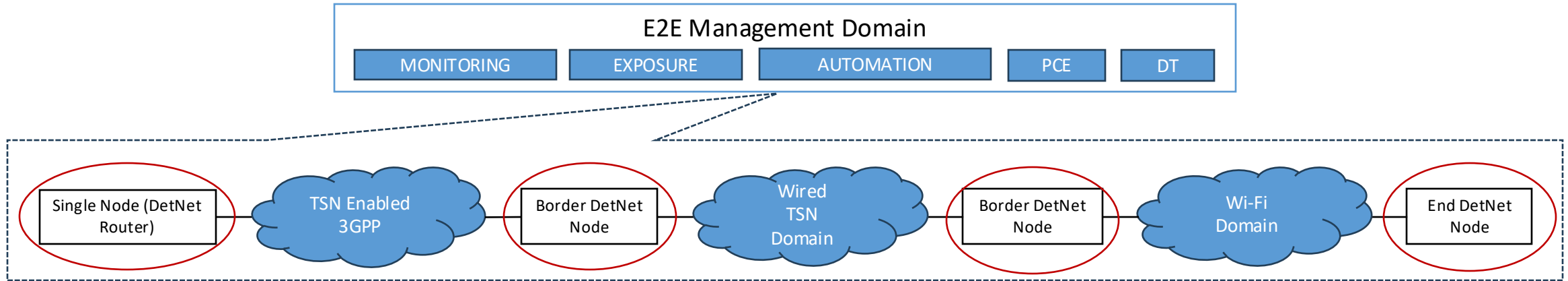


# High-level control architecture





# E2E Domain Abstraction



- **Objective:** Unify control across different technology domains (3GPP, WiFi, wired TSN) to provide deterministic E2E service.
- **IETF DetNet:** Ensures the encapsulation at domain entry points (DetNet Nodes) maintains data integrity
- **Layer-3 Overlay:** Creates a unified E2E path across multiple network domains. MPLS serves as a “glue” to maintain deterministic behaviour through different network segments.
- **Service & Forwarding Sub-Layers:**
  - Service Sub-layer: Assigns S-labels and uses a DetNet Control Word (d-CW) to identify and sequence flows, ensuring packets are managed predictably.
  - Forwarding Sub-layer: Manages explicit paths and resources for QoS.





# Service Automation

Local Management Domain

AUTOMATION

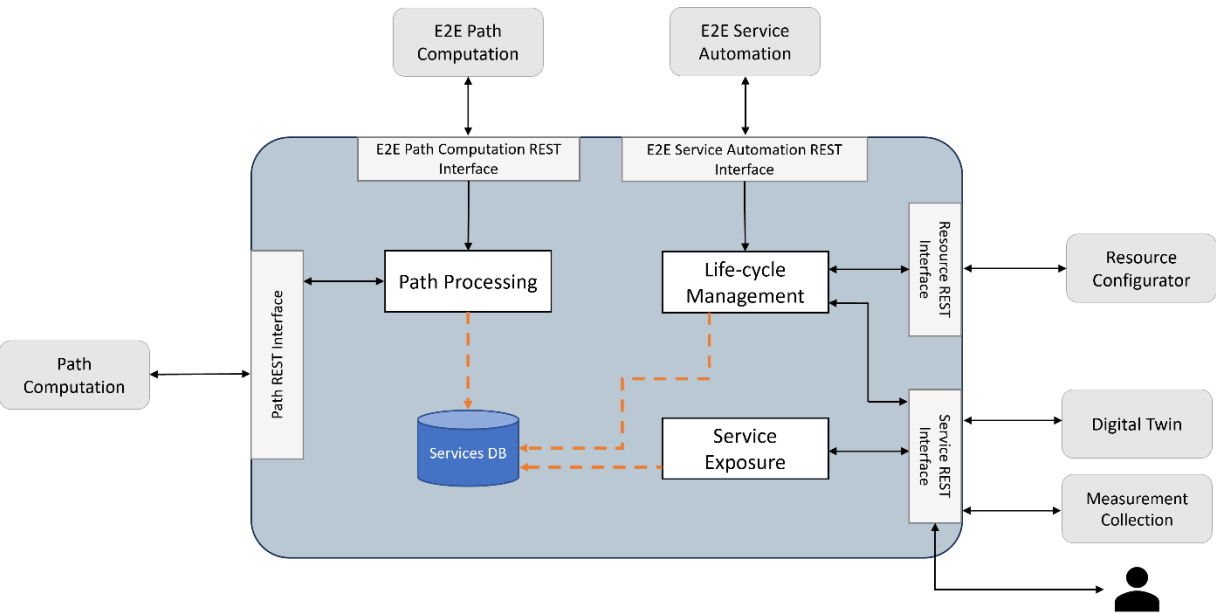
MONITORING

EXPOSURE

CONFIG

PCE

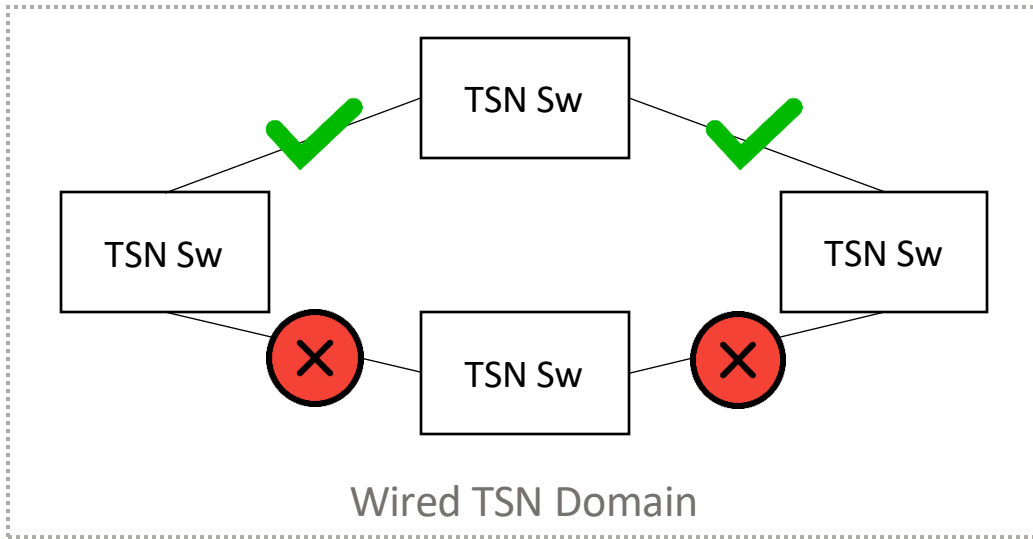
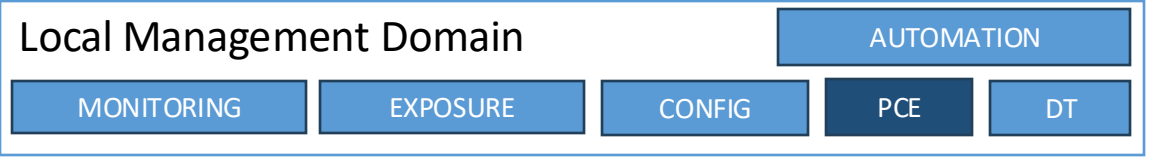
DT



- **Objective:** Provides automated, closed-loop management of deterministic services across diverse network domains, ensuring they meet performance requirements throughout their lifecycle.
- Three Key Lifecycle Stages:
  1. **Service Provisioning:** Configures each domain to meet service-specific QoS and determinism requirements.
  2. **Service Assurance:** Adjusts service parameters in real-time to maintain QoS
  3. **Service Termination:** Safely decommissions services when no longer needed.



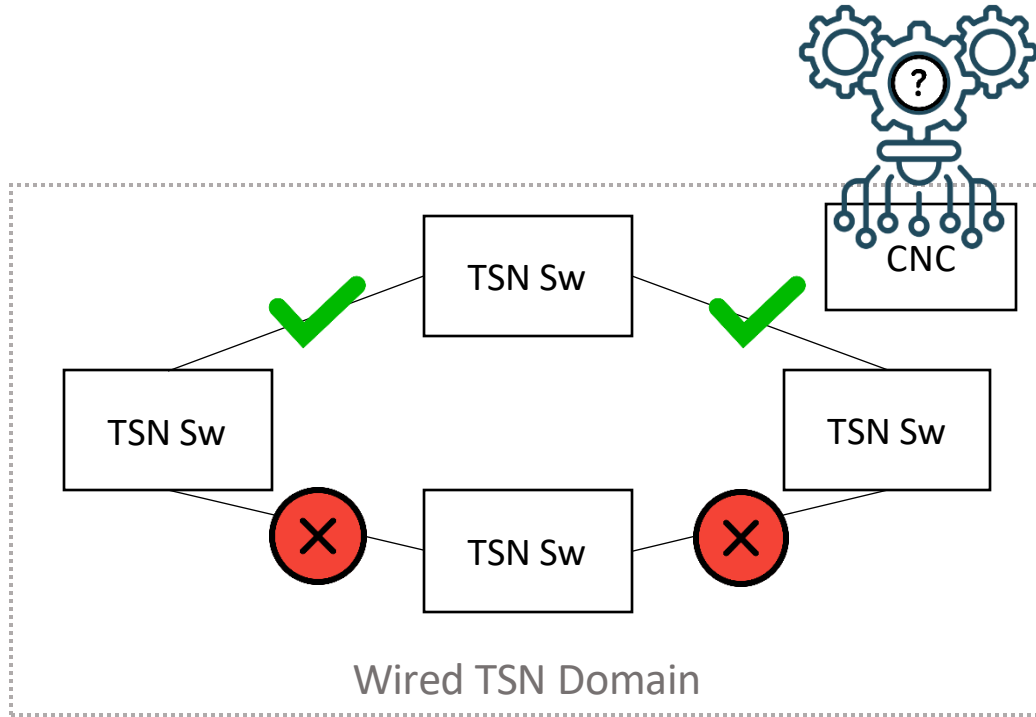
# Path Computation



- **Objective:** Establishes deterministic paths that meet strict performance requirements across multi-domain networks.
- Two-Level Path Computation
  1. **E2E Path Computation:** Calculates the high-level path across domains, integrating abstracted topologies of each domain as a connected graph. This path meets overall service KPIs.
  2. **Domain-level Path Computation:** Calculates a more detailed path within each domain, considering local topology, technology specifics, and current resource usage.



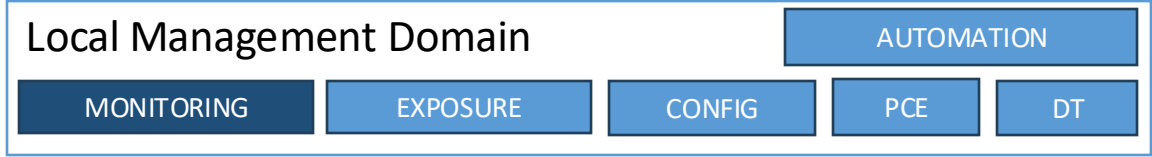
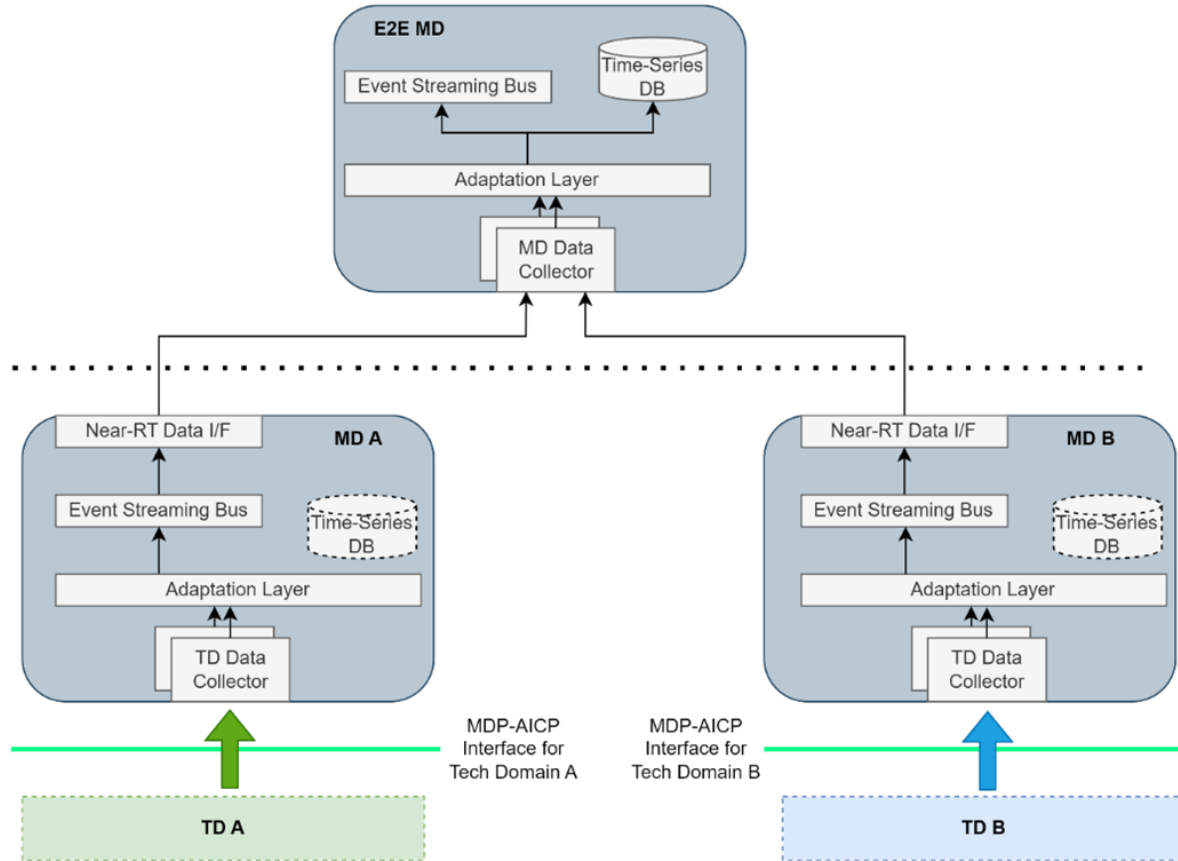
# Resource Configuration



- **Objective:** Manages and allocates network resources dynamically to meet the performance requirements.
- **Multi-Domain Resource Management:**
  - Configures resources individually within each domain (e.g., Ethernet, WiFi, 3GPP) using dedicated Resource Configurators tailored to each technology's requirements.
  - Ensures deterministic behavior by handling VLANs, traffic classifications, and scheduling configurations specific to each domain.
- **Worst-Case Traversal Time (WCTT) Analysis.**



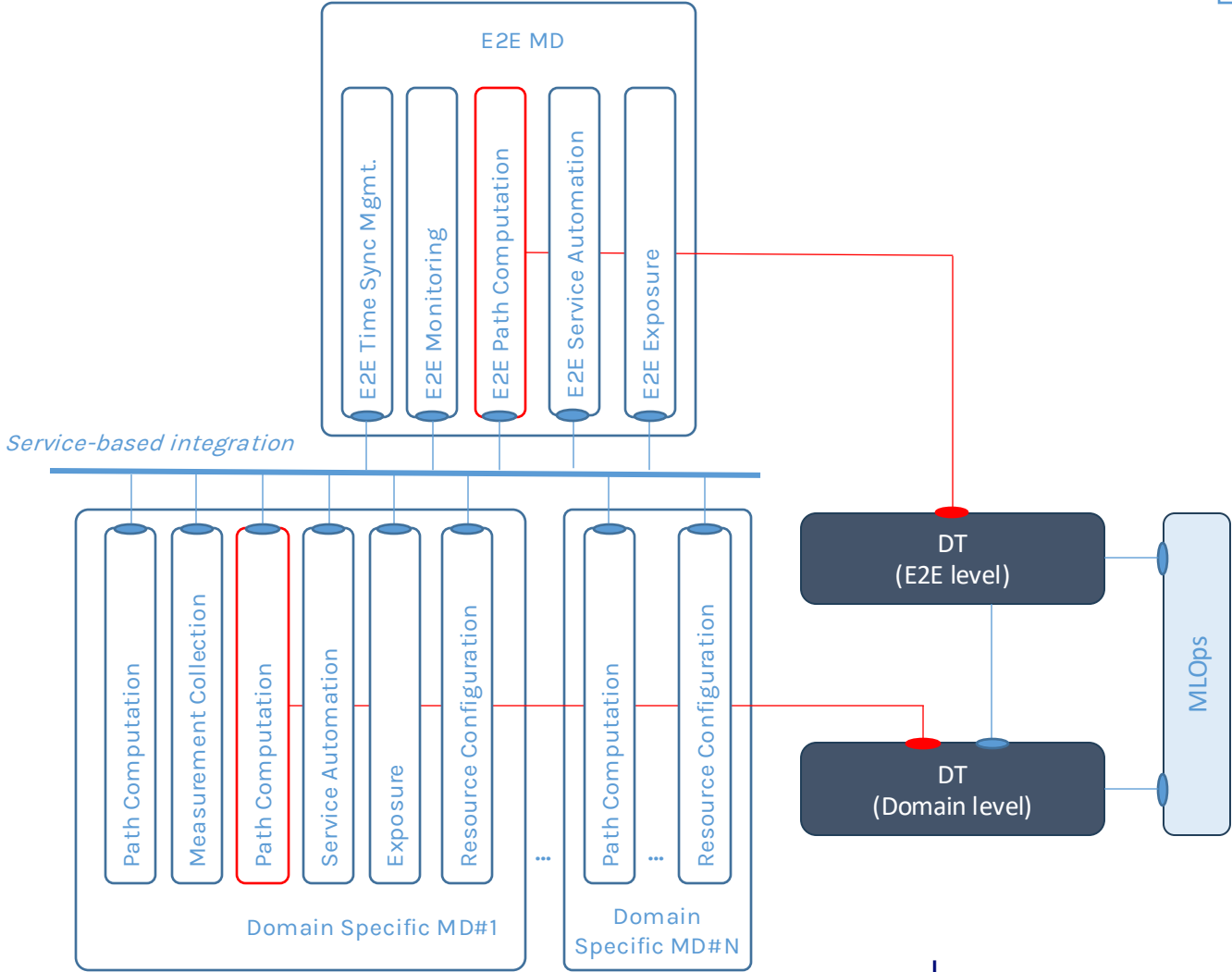
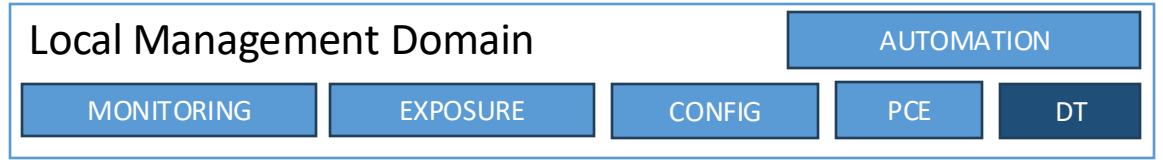
# Monitoring



- **Objective:** Provides continuous, real-time data collection and analysis across domains to ensure predictable performance.
- **Data Collection and Management Platform:**
  - Collects metrics from diverse data sources, normalizes them, and provides near real-time Access via an Event Streaming Bus.
  - Aggregate key metrics, such as minimum, mean, maximum values, and standard deviation, supporting KPI tracking.
- **Plugin-Based Architecture**
- **Hierarchical Data Aggregation**



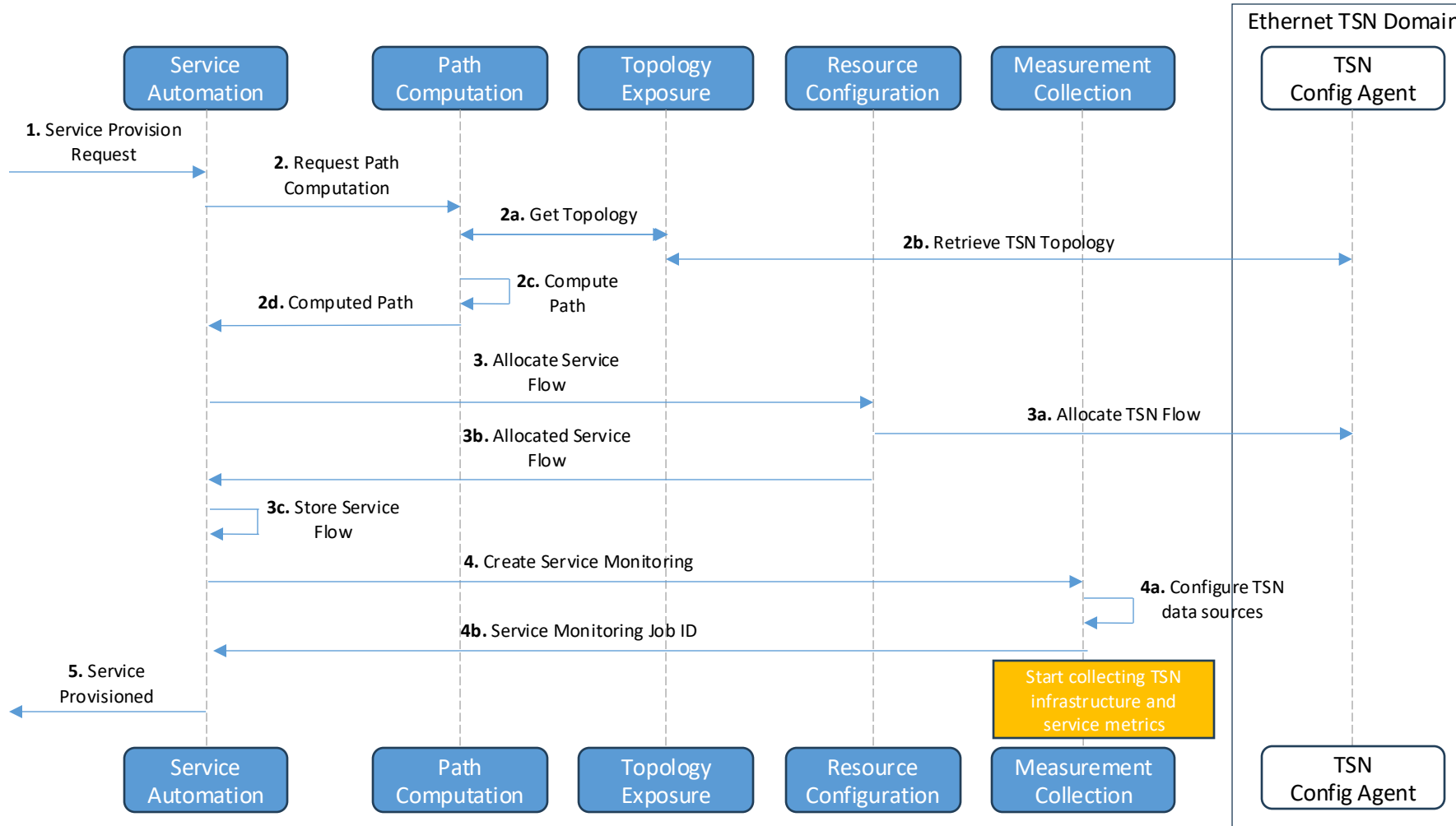
# The Digital Twin



- **Objective:** Emulates network conditions to estimate KPIs for deterministic services, supporting real-time adjustments and proactive service management.
- Network Scenario Emulation:
  - **Components:** The DT models traffic and network behavior with fine-grained accuracy, using four main components: generators, queues, links, and sinks.
  - **Traffic Generation:** Synthetic traffic is generated at both macroscopic (e.g., hourly load) and microscopic (e.g., microsecond packet bursts) levels, reflecting real-world network dynamics.
- Queue and Link Modeling
- KPI Estimation



# PoC Workflow



1. Service Provisioning Request.
2. Path Computation.
3. Resource Allocation.
4. Monitoring Configuration.
5. Service Activation.

# Thank You

