

# Intelligent Reasoning on External Events for Network Management

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- AI solutions must work in symphony with other network management solutions:
  - Allow networks to grow in complexity.
  - Deliver faster decisions.
- Current ML solutions work only with performance data:
  - Other AI solutions require more information.
- Intelligent reasoning solutions:
  - Need to collaborate with the network to retrieve topology, real-time situation, etc.
  - Efficient semantic representation and exchange of network data are key challenges for the full adoption of AI in NM.

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Gather the necessary information (requirements) for getting the most benefits from the application of intelligent reasoning to network management, including, but not limited to, defining the **gaps** that must be covered for **reasoning** to be correctly **integrated** into network management solutions.

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- Virtual Computer and Network Systems:
  - Have high degree of flexibility and reliability.
- SDN and NFV:
  - (Conceptually) centralized control and function (software) reusing.
- Management and Control:
  - Increased the complexity of both underlying and overlying systems.
  - Must perform the dynamic adaptation of virtual resources to the specific needs of their operation environments.
- Slice Gateway (SLG):
  - Implement a flexible data plane for network slices (as infrastructure), offer interfaces to the control and management plane for network slices.
  - Form a robust data plane for services on network slices, offer interfaces for the control and management plane for services.

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- Moving beyond Machine Learning...
- Rationale begin AI adoption:  
We have moved from asking simple questions:  
**"Is there a problem in my system?"**  
to more complex questions:  
**"Where should I migrate this VM to accomplish my goals?"**.
- Intelligence emphasizes data gathering and management.
- The new functions and possibilities allow network devices to become autonomic (ANIMA).

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- Intelligent Network Management Process (INMP):
  - The amount of data that can be analyzed to **make decisions** on the network can be hugely increased.
  - The extension of management operation enabled by INMP encompasses different sub-processes for different functions:
    - **Retrieving** performance measurements.
    - **Reasoning** to infer new knowledge and rules.
    - **Solving** potential problems (finding solutions).
    - **Planning** the enforcement of the solutions.
  - All the sub-processes are executed in parallel.
- Closed Control Loop Management Approach (CCLMA):
  - Key approach for **achieving** proper network **management goals**.
  - INMP processes must be re-wired to connect their outputs to their inputs, so obtaining feedback...
  - The data plane elements (e.g. the SLG) must provide some capabilities to make them coherent to the closed control loop.

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- From Data to Wisdom:
  - AI solutions become more and more able to **take strategic decisions**.
  - AI solutions can be guided by the events or situations found in underlying networks in a **constantly evolving model**:
    - **Knowledge (and Intelligence) Driven Network.**
- External Event Detectors:
  - Notifications related to successes that **occur outside the boundaries of the controlled system** but that affect it.
- Network Requirement Anticipation:
  - The **time required** by the infrastructure to **make effective the adaptations** requested by the MANO mechanisms is longer than the time required by client requests to overload the system and make it **discard further client requests**.
  - Adaptations must be anticipated (**ARCA target**).

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- Research Challenges:
  - **Reason on network behavior** from performance measurements and external events to find out the situation of the network.
- Gaps and Standardization Issues:
  - Methods from different **providers** and **vendors** must be able to **coexist** and work together.
  - Information retrieval must be **assessed for quality** so that the outputs from AI reasoning.
  - **Ontological** concepts must be consistent.
  - The protocols used to “**publish**” the information must respond to the constraints of their target usage.

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# Thanks for Your Attention

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## Questions?

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- EOF -

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