Intelligent Reasoning on External Events for Network Management

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Context

- 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.

Objective

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.

Background

- 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.

Applying AI to Network Management

- 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).

Extended Management Operation

- 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.

Exploitation of AI in Net. Mgmt. (I)

- 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**).

Exploitation of AI in Net. Mgmt. (II)

- 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.

Thanks for Your Attention

Questions?

– EOF –