Autonomous Cars, 5G Mobile Networks and Smart Cities: Beyond the Hype

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Target Nodes/Networks for Provisioning are Getting More and More Distributed, Dynamic, and Heterogeneous

How to experiment such applications and services in these environments?
Research Scope (Cont.)

- **Application-level**
  - Applications topology: Component-based applications, service-based applications, business processes
  - Taking into account applications structures and applications lifecycle management
  - Models/Languages: SCA, BPEL, BPMN, Petri nets

- **Platform-level (Cloud, IoT, fog, mobile edge)**
  - Unified cloud resources description model, scalable and elastic micro-containers, generic provisioning operations
  - Standards: OCCI, TOSCA, REST

- **Network-level (3GPP 4G, 5G, CDN)**
  - Decompose the network into micro-domains, the use of overlay networks and gateways, virtualize the network functions, extend the ecosystem to the edge of the network
  - Technologies: NFV, SDN
5G Building Blocks (ETSI perspective)

- Network Functions Virtualization (NFV)
- Multi-access Edge Computing (MEC)
- Millimetre Wave Transmission (mWT)
- Next Generation Protocols (NGP)
Autonomous Cars in 5G Networks

1. Data Stream
   - MEC
   - NPG

2. Internet core processing
   - NFV

3. Control action
   - mWT

1. Data Stream
   - MEC
Experimentation Objective:
• Evaluating the gain in terms of latency.

Experimentation Metric:
• End to End Delay.

Experimentation Scenario:
• Comparing delays while varying placement domain.

Lesson learned:
• The first lesson learned is that placing components at the edge considerably reduce latency with regard of a placement in core network.
Experimentation (Mobility support)

**Experimentation Objective:**
- Evaluate the migration cost in terms of delay.

**Experimentation Metric:**
- The Migration duration \((M_d)\): the necessary time to (i) instantiate and start the hosting container in the target edge \((t_i)\) and (ii) shut down the first container in the source edge node \((t_s)\)

**Experimentation Scenario:**
- The car, while cruising, it sends a migration order to the Collecting-data module that needs to move from one edge node to another while still communicating with the Navigation module.

**Lesson learned:**
- Migration duration does not affect the good functioning of the autonomous car application under certain circumstances…
Experimentation Objective:
• Investigate the suitability and the robustness of SIP as a signaling protocol for such highly dynamic environment.

Experimentation Metric:
• SIP packets per second

Experimentation Scenarios:
• Four scenarios were considered with various number of cars (one to five) making simultaneous SUBSCRIBE requests to the same OpenSips instance within a given PoP.

Lesson learned:
• SIP messaging is not suitable signaling protocol for such system.
• SIP 5G specification expects to support dynamicity and mobility of end devices which is not feasible using SIP as a signaling protocol.