Latency Requirements in M2M Application Scenarios

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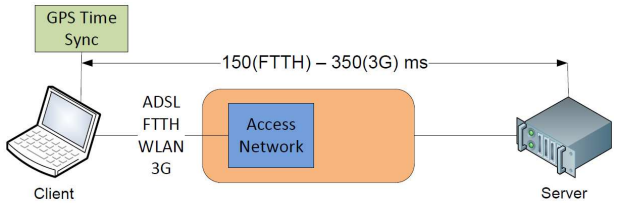
I. About Lola Project

- **Low latency M2M communication in LTE/LTE-Advanced**
  - Reduce energy consumption for M2M devices
  - Co-existence of M2M/Gaming traffics with conventional services
- **Public-safety / professional rapidly deployable networks***
  - Convergence (air-interface) with LTE/LTE-A
  - Low-latency is crucial and hard to achieve in multihop networks
- **Three Objectives**
  - **Fundamental:** Low latency communication and traffic characteristics
  - **Experimental:** Two validation platforms and one filed trial
  - **Standardization:** Inputs to 3GPP and M2M Working Groups

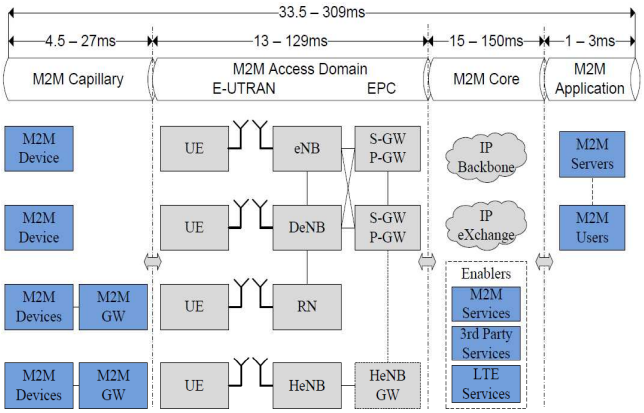
* Not considered in this poster

II. Delay Analysis in MTS Network (Operator in Serbia)



- **Latency can be improved by providing services locally**
  - The client is directly attached via the access networks to the gaming server itself

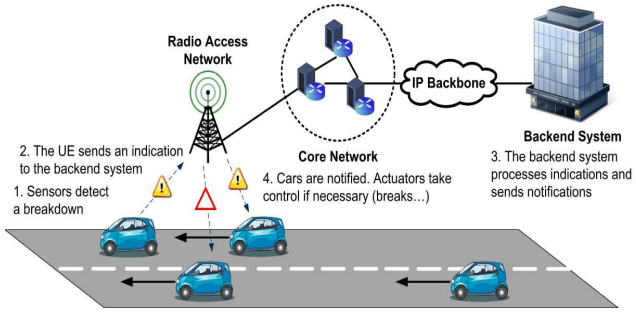
III. M2M System Architecture Based on LTE/LTE-A



- **M2M Capillary** incorporating smart devices and their gateways using a number of short or wide range communication technologies, reusable across a number of application domains
- **M2M Access** giving adequate support for M2M services
- **M2M Core** providing interconnectivity and extendable by relevant M2M services (registry, request analyzer, control), 3rd party services (e.g. location, charging, processing of data) and LTE services (e.g. AAA, IMS)
- **M2M Application** including domain specific processing and visualization of information, and the end user applications interacting with the smart devices through a common platform

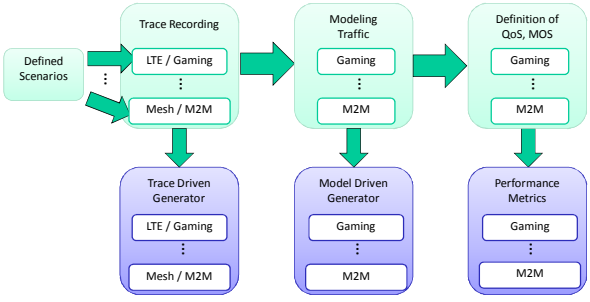
IV. Realtime M2M Application Scenarios and Analysis

- **Auto-Pilot for Intelligent Transport System**



  - M2M Capillary : 4.5 – 25 ms
  - M2M Access : 57 – 378 ms
  - M2M Application : 1 – 3 ms
  - M2M core : 15 – 150 ms
- **Virtual Race in Machine Gaming**
  - M2M Capillary : 6 – 10 ms
  - M2M Access : 112 – 748 ms
  - M2M Application : NA
  - M2M core : 42 – 122 ms
- **Smart Environment in Ambient Assisted Living**
  - M2M Capillary : 9 – 54 ms
  - M2M Access : 180 – 1290 ms
  - M2M Application : 1 – 3ms
  - M2M core : 15 – 150 ms
- **Sensor-based Alarm and Event-Detection**
- **Mobile Surveillance System for Security**
- **Life support system for health monitoring**

V. Traffic Characteristics



- **Collision avoidance system for Intelligent Transport System**
  - All the sensors (car, road sensors) send the information to the M2M backend system within the predefined period
  - Event-driven, short bursts emergency signals from the M2M backend to the M2M devices (warning and actuation commands)
- **Traffic pattern varies depending on application scenarios but the general traffic trends follows the ON-OFF traffic model**

VI. L1/L2 Latency Improvements

- **Contention-based random access on the LTE/LTE-A in uplink**
  - UL latency in FDD mode is 7-11ms (SR periodicity 5ms) => 7-11 times latency reduction for M2M/sensor applications with 1ms contention-based random access
  - Further 2x reduction for small packets with 500us TTI duration
- **Protection and transmission of more detailed HARQ feedback**
  - A 10% latency reduction is foreseen
  - Estimation of missing mutual information (SNR/statistical models)
- **Adaptive Modulation and Coding Scheme/Transmission Power**
  - Increase power of delayed flows
  - Use more robust MCS for HARQ retransmissions
  - Send more redundancy in unloaded conditions
  - Up to 10% latency gain can be achieved with these techniques
- **Coordinated Multi-Point Joint Processing/Joint Transmission**
  - Improves throughput → improves latency for non-sparse traffic sources (e.g. video surveillance cameras)
  - Reduces nº retransmissions for cell-edge users → improves latency
- **Carrier Aggregation aware scheduling**
  - Unloaded carrier components can be scheduled for delayed users

The research leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement n° 248993.