Spreading Computing along the Network Path

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- Need for computing offloading

- Challenges in computing offloading

- Enabling technologies

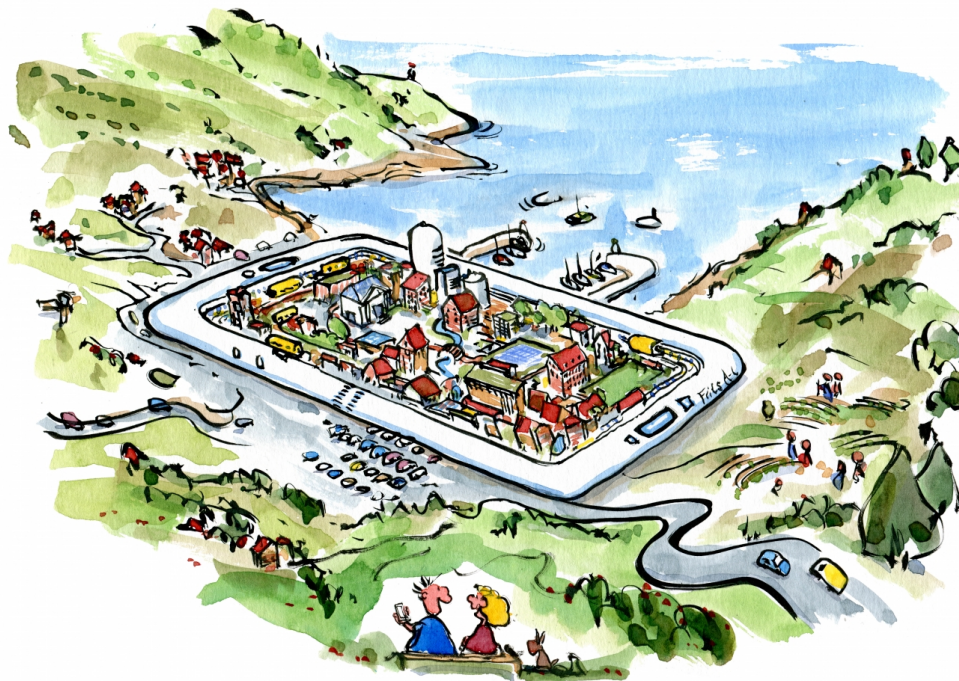- On-the-way solutions in the area

Need for computing offloading

- Current networked scenarios have high demands of data processing…

Source: Frits Ahlefeldt

- … and new scenarios are challenging…

- … however, data processing cannot be done solely on data clouds

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- Lower and upper edges of the network need computing offloading:

  - **End devices** with energy constraints: IoT hardware, smart phones, sensors…

  - **Cloud data centres** can suffer from scalability issues

- Current **computing paradigms**:

  - Cloud computing

  - Fog computing

  - Edge computing

  - Cloudlets
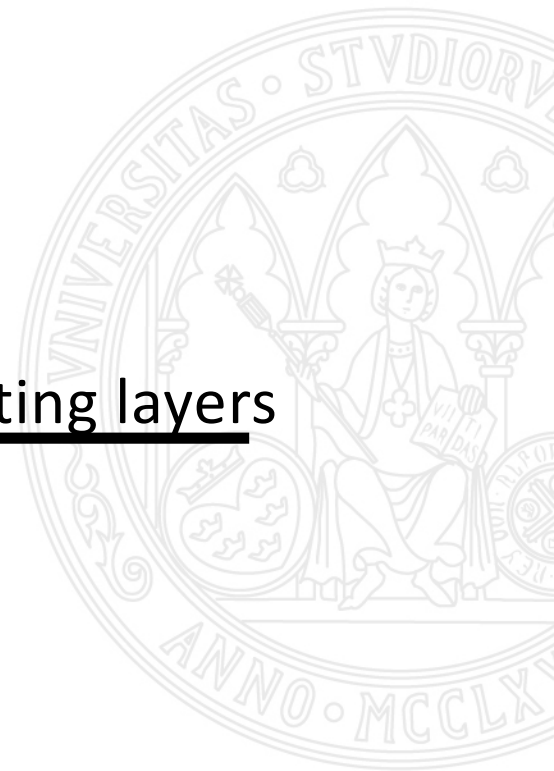
  - Mobile edge computing (MEC)

  - … and more to come

- **Issue**:
  - Stratified and static computing layers

- **Risks** if no solutions are given:
  - Static distribution of computing hardware
  - Non-scalable solutions
  - Waste of money in stratified architectures

- It is needed a coordination among computing layers

- **Sectors** to be involved in such solutions:
  - Intelligent Data Processing
  - Smart Cities and Spaces
  - Connected and Green Transportation
  - Software Engineering
  - Software-Defined Networks
  - Information-Centric Networks
  - Fog, Edge and Cloud Computing
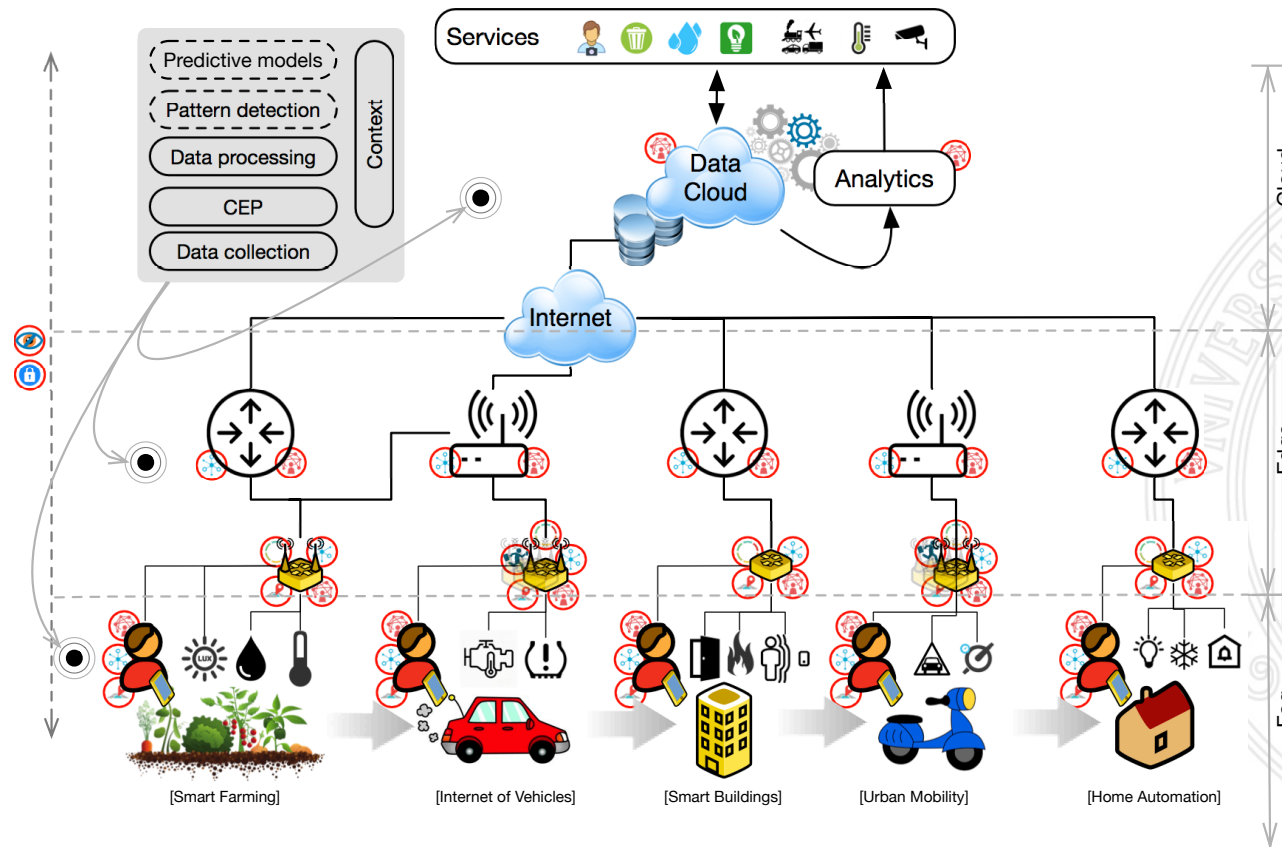 - ... -> **multidisciplinary field**

Challenges in computing offloading

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- ## Overall frame

National project PERSEIDES

- **Exploit MEC** for delay-sensitive services, instead of cloud computing: one of the main focus of 5G
  - MEC reduce delay when accessing telematic services
  - Processing in the access network
  - Intermediate solution between edge and cloud schemes
  - Under standardization (ETSI, 3GPP)
- **Context-awareness** in processing distribution
  - Use of contextual data to adapt processing
  - Adaptation of the networked system according to the user/network context
- Exploitation of **pre-processing** in MEC/fog/edge computing
  - Filtering, aggregation, event extraction
  - Offloading high levels of fine-grain data analysis

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- Application of **AI techniques** for dynamic distribution of computing
  - Machine learning to extract computation patterns in the network
  - Predictive adaptation of the processing resources
  - Distributed AI for network adaptation: agents
- **Migration of computing nodes**
  - Movement of virtualized resources to accommodate computing needs
  - Computing nodes "follow" physical devices in the network topology
- **Vertical and horizontal coordination**
  - Vertical: from the end-node to the cloud
  - Horizontal: across a network level (end-nodes, network gateways, access networks, data clouds, etc.)

Enabling technologies

- Software-defined networks (SDN)

- Information-Centric Networking (ICN)

- Machine learning

- Network function virtualization (NFV)

- Network slicing

- Distributed file systems

- Distributed caching

- Network mobility management

- New communication technologies: LP-WAN, 5G NR

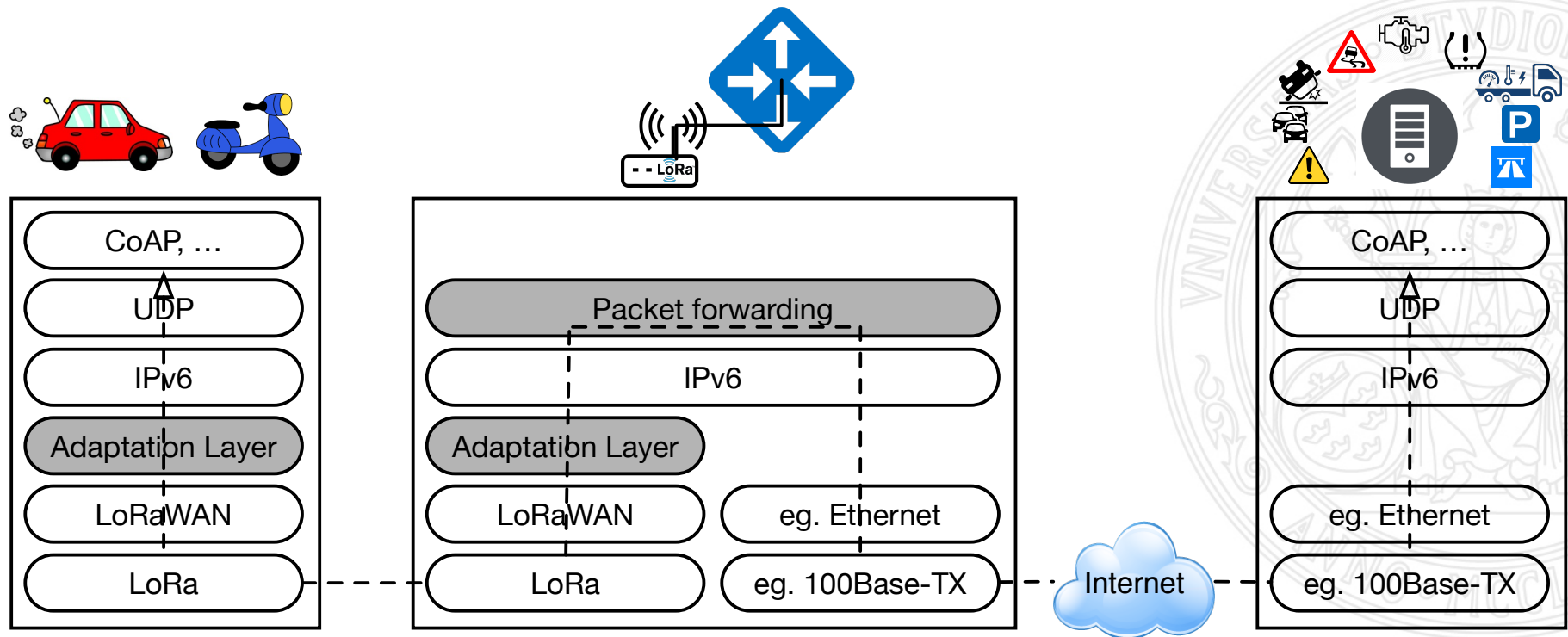- Distributed computing

- …

On the way solutions in this area

- Packet adaptation in the network

- ## Virtualization of vehicular OBU duties
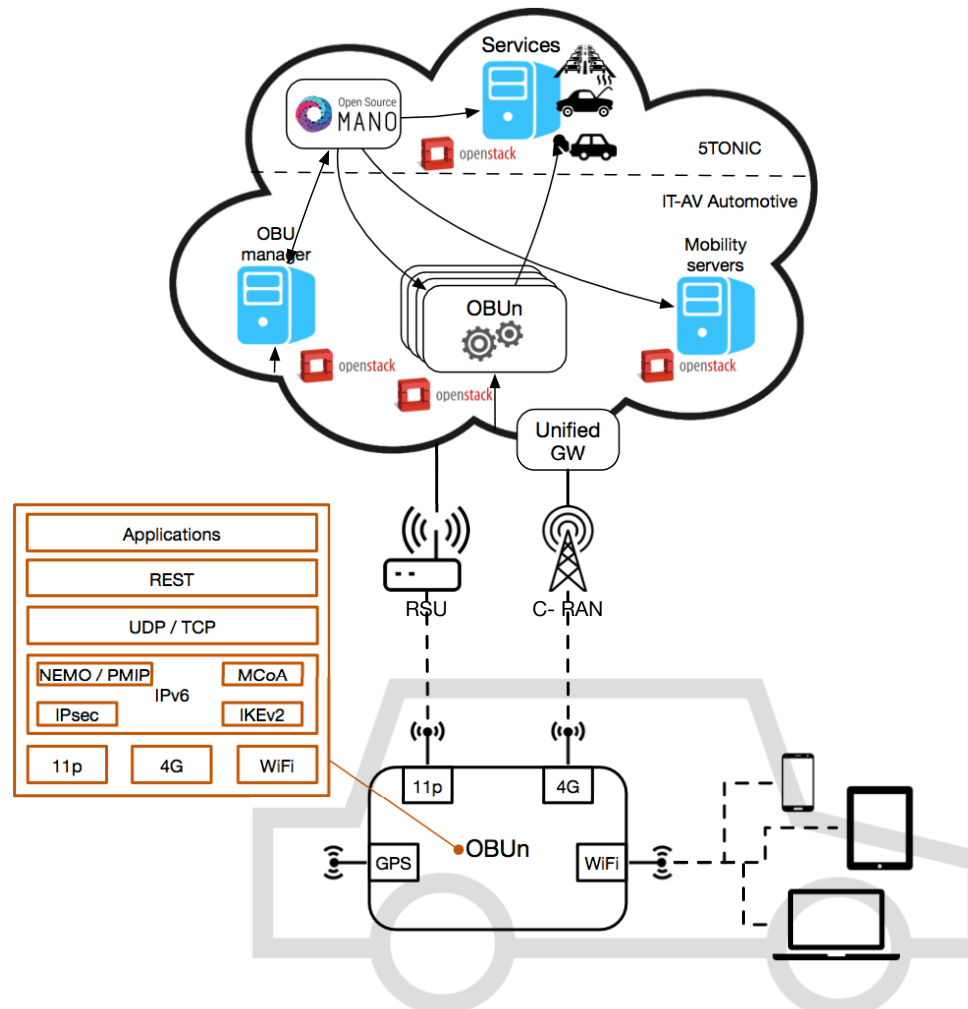
H2020 project 5GINFIRE

- Abstract processing platform with offloading coordination
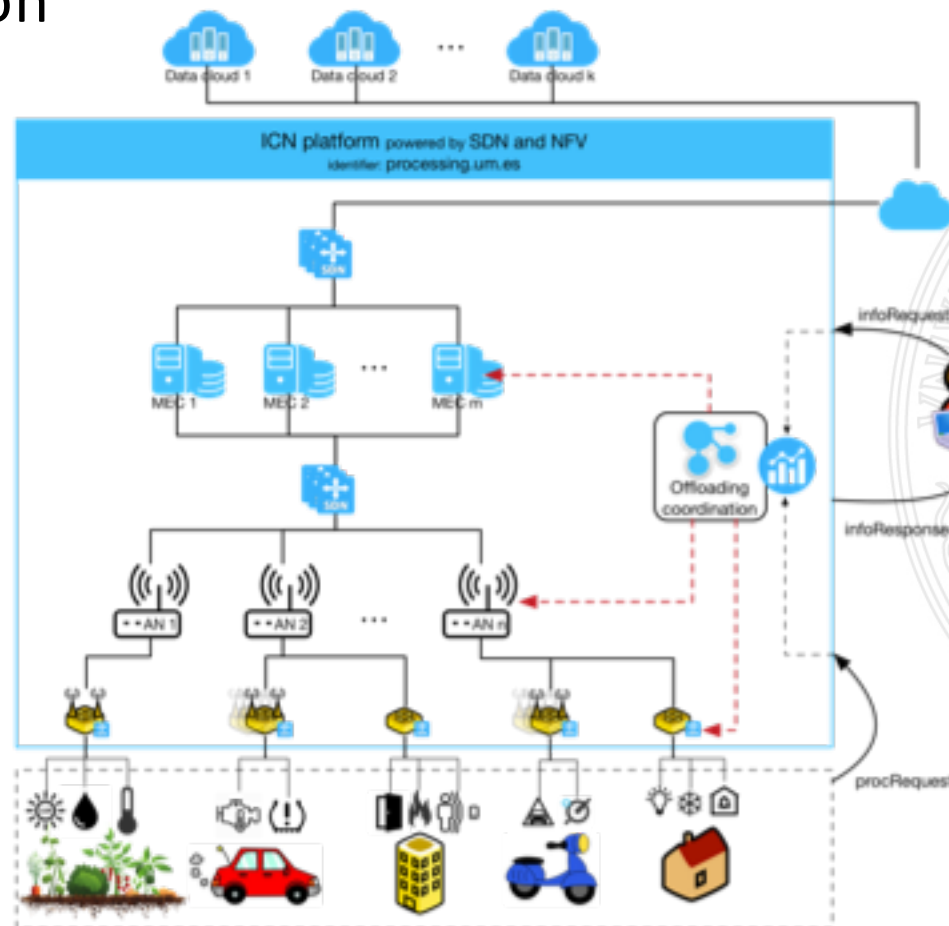
- Moving smart spaces
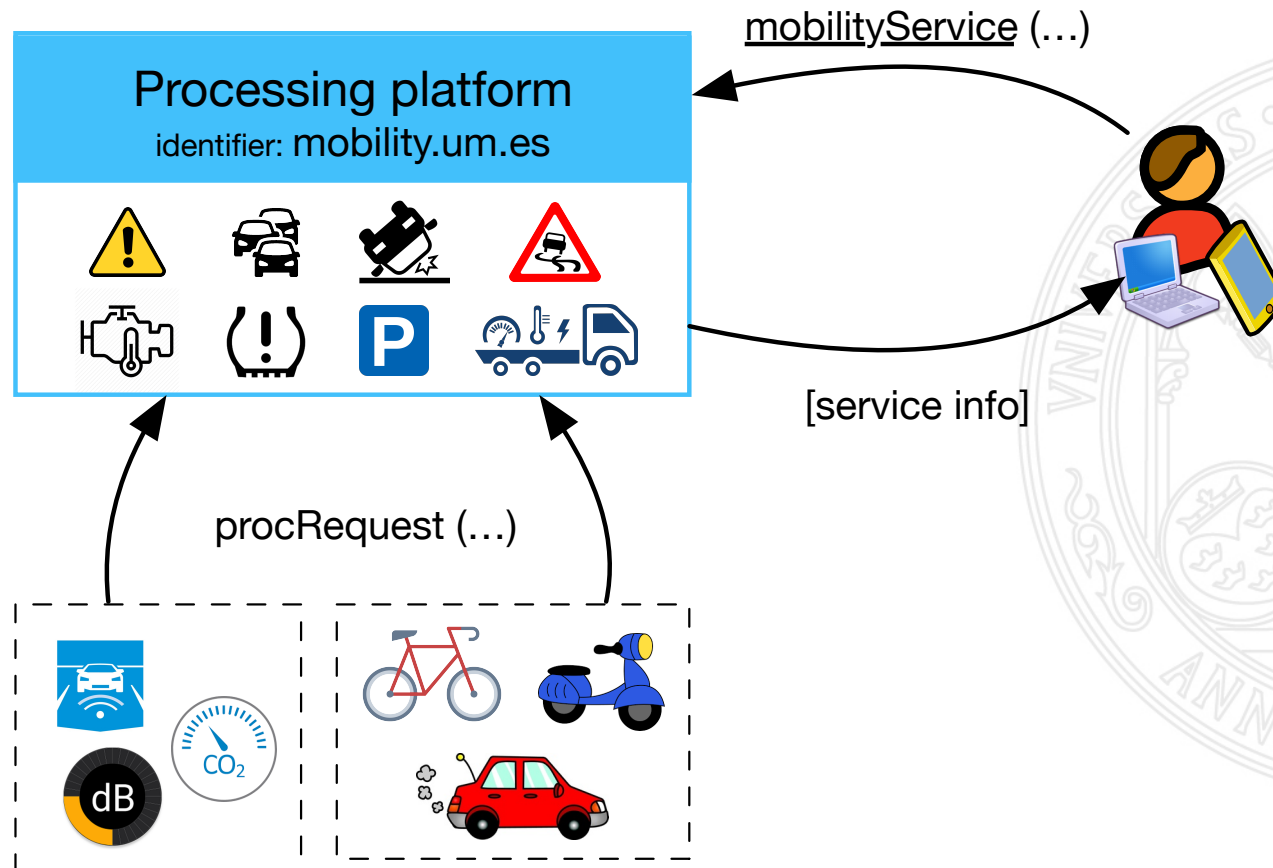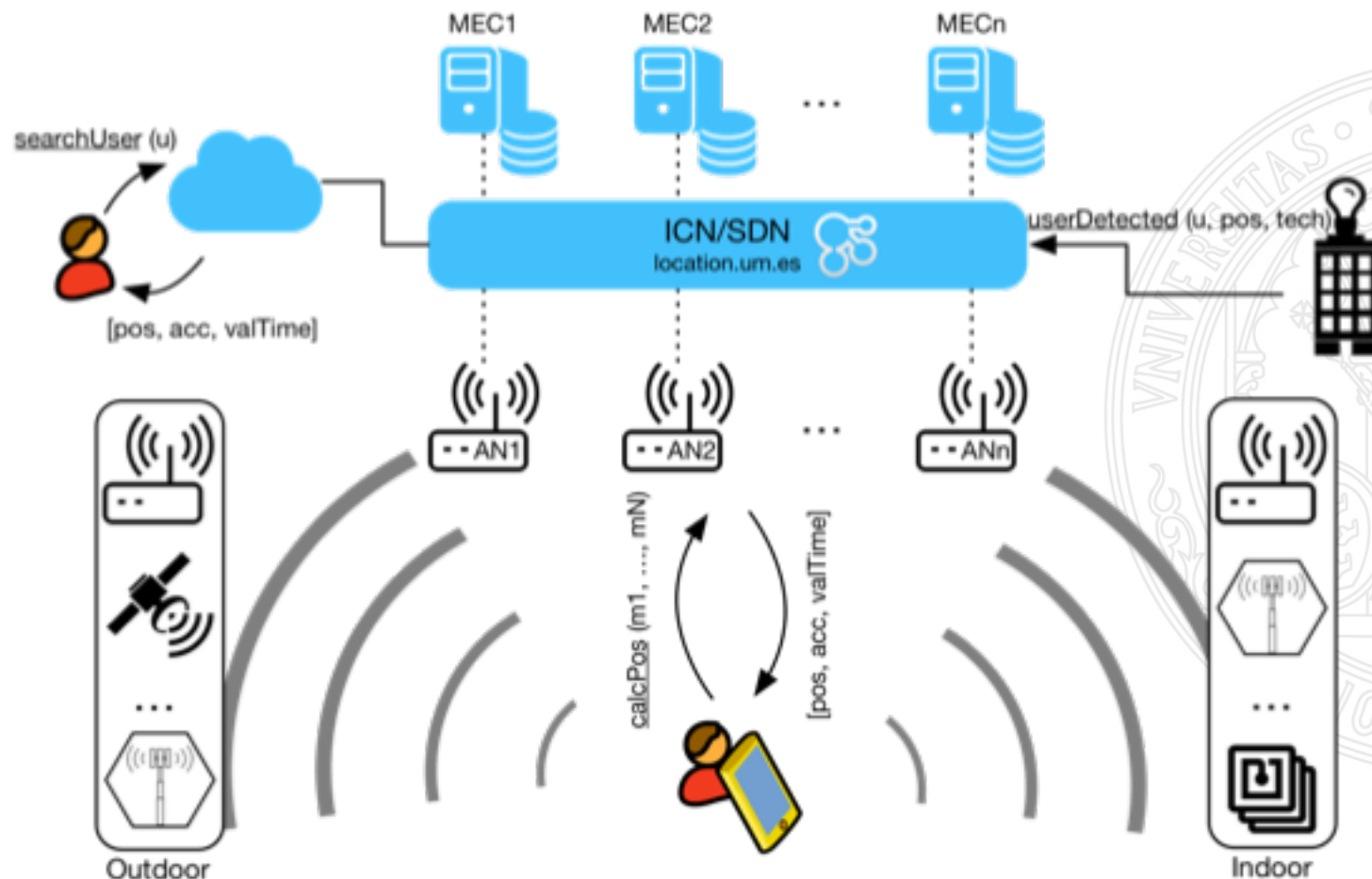
- Positioning offloading
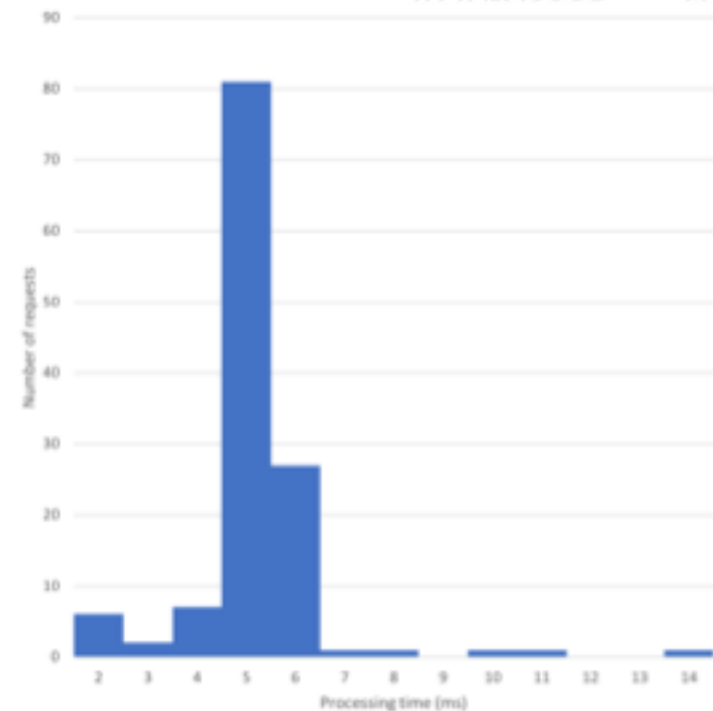
- Positioning offloading: some results

Smartphone position calculation time
(Samsung Galaxy S7)
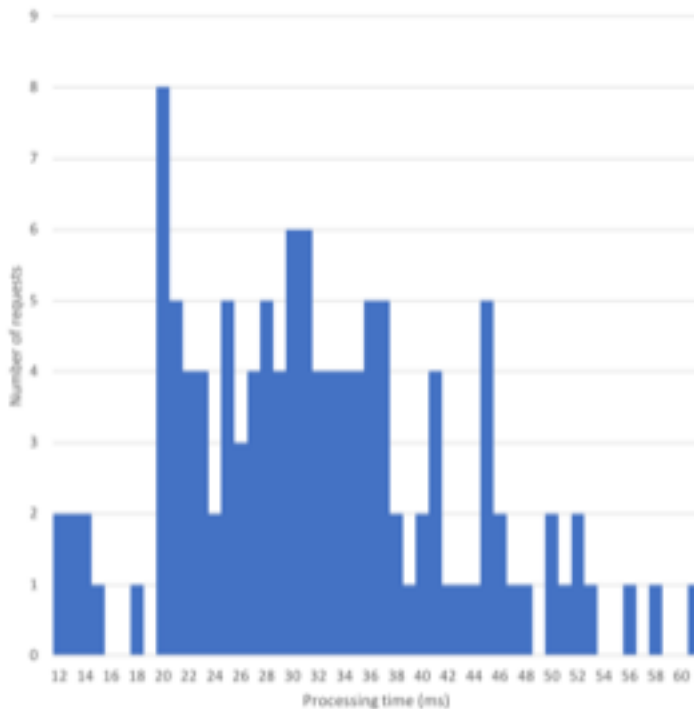
MEC-assisted position calculation time
(Regular PC in the access network)

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Thanks!

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