

Sustainable ICT through verifiable slicing techniques

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EPSRC

Engineering and Physical Sciences
Research Council



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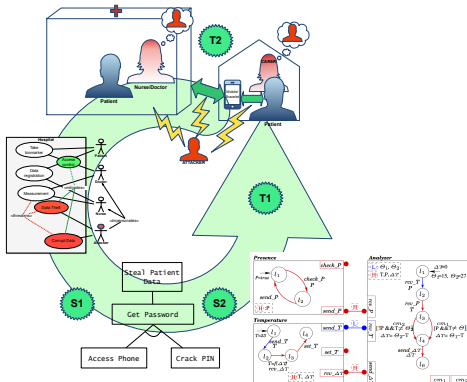
Line of Research, Institutes and Expertise

- Middlesex University London: Verification, Security Engineering, Florian Kammüller
- Université Gustave Eiffel UGE: LIGM - Head of SNR/LRT Research Team, Rami Langar
- IMDEA Networks Institute, Marco Fiore
- Potential industrial partner: Nokia Bell Labs Paris

Middlesex Recent Project for Security and Privacy for IoT

CHIST-ERA (EU) project SUCCESS:

<http://www.iot-success.eu>



- Formal design of privacy-critical IoT scenarios
- Risk visualisation by **attack tree analysis**
- Security refinement in Isabelle
- Certified implementation for IoT component architectures

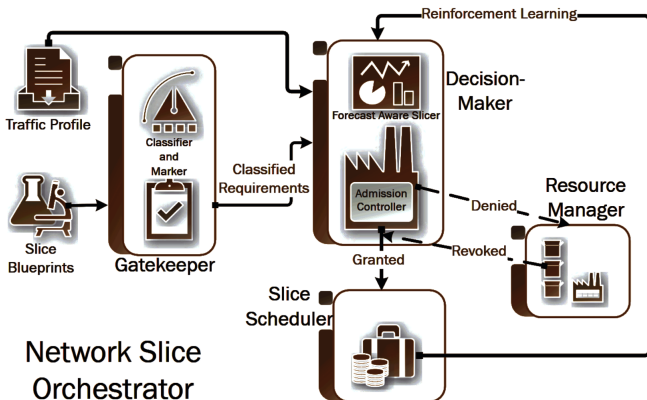
Use Case: Network Slicing

- Network slicing is an emerging paradigm in 5G and beyond-5G architectures
 - ⇒ **Multiple logical instances of the physical network** so-called **network slices**, ensuring strict traffic isolation among them, and tailoring the network resources of each slice to a specific (class of) application
 - ⇒ Network slicing paradigm enables coexistence of a range of mobile services in the same network infrastructure
- But technical challenges: **Resource management**
 - ⇒ Isolation of resources across slices inherently increases network capacity requirements
 - ⇒ Dynamic, preemptive and efficient allocation of resources to slices is key instrument to keep capital expenditure (CAPEX) and operating expenses (OPEX) under control in sliced networks.

Capacity allocation in sliced 5G networks

Prominent difficulty is **network resource management**: the infrastructure provider must allocate in advance resources to each slice at all network nodes, avoiding underprovisioning (which determines service disruption) and limiting overprovisioning (which yields inefficient waste of resources)

Network Slice Orchestrator



Network Slice Orchestrator

Project proposal and related topics/themes 1

- Data traffic in modern mobile networks is increasingly heterogeneous and complex
- ⇒ Dynamic resource allocation with attention of life-cycle analysis for understanding reusability, reparability and recycling in the presence of human factors
- Enable network managers and Operations Support Systems (OSS) to control service disruption and bad performance
- ⇒ We need verifiable operation of the mobile communication architecture

Project proposal and related topics/themes 2

Our project aims at providing novel design and analysis methods for designing and building systems for verifiable sliced network management

Key challenges for protocols and software:

- Evaluate network traffic data
 - Modeling, verification, and certification of resource requirements on system models
- ⇒ For example, using automated reasoning to ascertain frugality aspects, like energy consumption, material or carbon footprint

Challenges related to topics

Addressed target outcomes:

- integration of energy consumption
- life-cycle analysis
- environment aware usage
- Integrate sustainability into new design and analysis methods

Summary of challenges of the topic

The successful execution of the project will generate

- first-of-their-kind reusable and recyclable models for mobile network management under a slicing paradigm:
 - ⇒ mobile network operators can benefit from the efficiency of zero-touch data-driven slice resource orchestration
- Design, analysis, and verification methods to ascertain energy consumption, life-cycle analysis, environment aware usage:
 - ⇒ mobile network operators keep full control over their infrastructure.