



NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

Slicing and Self-management of Future network resources for the support of concurrent vertical domain use cases



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Our Profile and Focus

General Profile

- National & Kapodistrian University of Athens (UoA, uoa.gr) – the oldest and 1st ranking among all Greek Universities:
 - students: 105,000 people
 - academic stuff: 1,964 people
 - administrative stuff: 1,316 people
- Research and innovation group in Department of Informatics & Telecommunications (DIT, di.uoa.gr), *Networks: Software Centric & Autonomic Networking Lab* (SCAN, scan.di.uoa.gr)
 - 20 **researchers, engineers** and support personnel
 - **More than 20 EU Funded Projects** (since FP6)
 - SCAN-NKUA coordination (both PM and TM) in several of them
 - **More than 10 Industry Contracts**
 - Several **patents** filed in European/World Patent Office,
 - More than 500 **publications**,
 - More than 4000 **citations**,
 - Support of BSc/MSc/PhD dissertation thesis: ~15 per year.

Focus Areas

- Mobile/Wireless Communications (5G, LTE)
- MEC - Cloud
- Internet of Things – Smart Cities – Connected Cars
- Software-Defined Networks (SDN) - Network Function Virtualisation (NFV)
- Big Data (Data Analytics, Predictive Analytics, Data Economy)
- Future Internet (FI-WARE Advanced Apps and Services)



EU & Industry Projects



Patents from Industry Contracts related to Automotive domain

- WO2016184492A1: Method for efficient Location Management in Wireless Networks
 - Take advantage of forthcoming, automotive industry V2V killer-apps, such as **Car Platooning** in order to improve Location Management for 5G devices and minimize signaling burden
- WO2017137089A1: User equipment profiling for network administration
 - A context extraction and profiling engine based on advanced analytics, capable of **5G Connected Vehicle Profiling** for traffic and mobility patterns prediction and optimal network resource allocation
- WO2017211415A1: Context Information Processor, Profile Distribution Unit and Method for a Communication Network
 - A distributed network solution, which is able to operate on top of Connected Vehicles OBUs and pre-process the **Vehicle Context Information** towards efficient Vehicle Profiling



Open issues for slicing and management of concurrent vertical flows

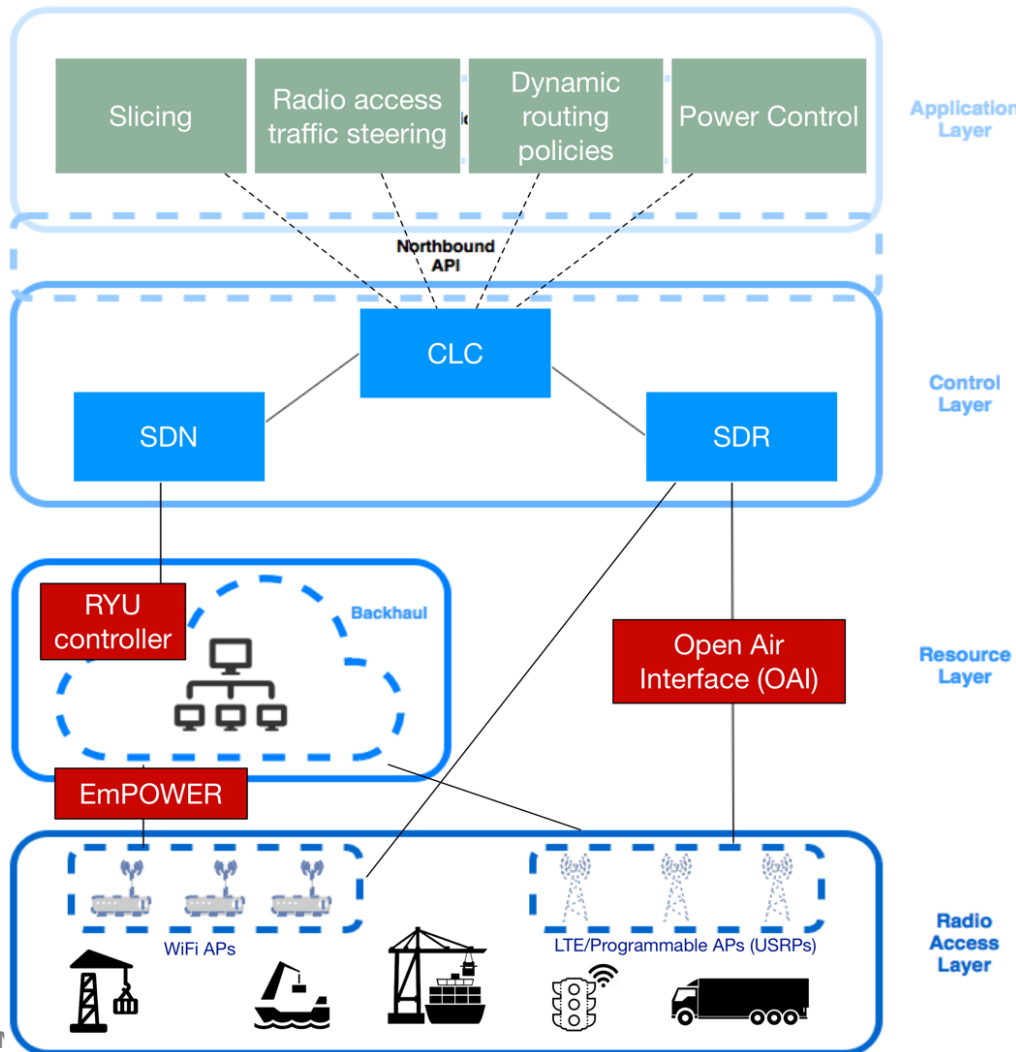
- Agile management and configuration
- Orchestration of flow prioritization across vertical domains
- Multioperator – multivendor harmonization
- SDN/SDR resource control at the edge
- Use cases: automotive , maritime



Scenarios and Architectures under consideration



CLC: Cross Layer Controller for 5G architecture based on SDN and SDR approaches for (massive) Internet of Things RANs and M2M



- Multi-layer, flexible, SDN-based network architecture: an elastic distributed controller architecture that allows different number and type of controllers
- Operates on top of both standard radio devices (e.g. Wi-Fi APs) as well as custom, programmable radio infrastructure (e.g., USRP-based LTE eNBs)
- Almost real-time policies and rules enforcement based on real-time monitoring of network and radio conditions
- Capable of applying E2E slicing for specific types of devices, traffic, etc.
- Evaluated in the context of Fed4Fire+ testbed



ScanNSM-IoT:

SCAN NS3/SDN-enabled & Massive IoT RAN Simulator Platform



- SDN and SDR based Cross Layer Controller for E2E slicing (CLC)
- Context Extraction and Profiling Engine for Internet of Things
- Ultra Dense Environment scenarios with coexisting WiFi and LTE access technologies
- Connected cars 5G use case evaluation using V2X (Vehicle-to-Vehicle, Vehicle-to-Infrastructure, etc.) technologies
- Context-Aware UE-based Traffic Steering scheme



ScanNSM-IoT :

SCAN NS3/SDN-enabled & Massive IoT RAN Simulator Platform



- Platform developments:
 - SDN-enabled backhaul for Ultra Dense 5G deployments using OpenFlow-enabled EPC in NS-3
 - NB-IoT NS-3 module for Massive IoT RAN implementation
 - LoRaWAN NS-3 module
 - Low Power Wide Area Network (LPWAN) specification intended for wireless battery operated Things in a regional, national or global network.
 - LoRaWAN targets key requirements of IoT such as secure bi-directional communication, mobility and localization services
 - seamless interoperability among smart Things without the need of complex local installations operates in unlicensed radio spectrum (similarly with Wi-Fi)
 - uses lower radio frequencies with a longer range (EU 863-870 MHz, US 902-928 MHz, etc.)



CLC: enhance SDN/SDR integration and slicing in multioperator domains

- Orchestration policies for harmonized edge network resource slicing and operation
- Facilitate cross domain flow prioritization and control
- Enhanced capabilities for cross-operator end-to-end slicing
- Provision of SDR/SDN capabilities at the edge
- Enhanced MEC capabilities



Conclusions

- Multioperator end-to-end slicing for prioritized flows
- Intelligent orchestration for fixed/wireless resources
- Vertical cross-domain flow priority identification
- Cross-domain SDR/SDN resource allocation at the edge
- Enabler for new approaches for the support of dynamic radio/fixed resource allocation and slicing supporting fine-grained QoS classes



Thank you!

