NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS

Blue Growth – IoT
Smart Maritime Initiative – 5G+IoMT

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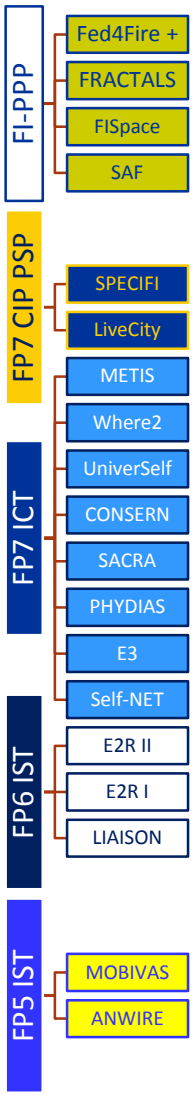
Our Profile

- SCAN is part of Dept. of Informatics & Telecommunications (DIT), National & Kapodistrian University of Athens
- We form a research unit in DIT: Software Centric & Autonomic Networking Lab
- Capacity: 25 researchers, engineers and support personnel
  - 17 R&D EU Funded Projects; 4 coordinated by SCAN
  - 10 Industry Contracts
  - More than 500 publications
  - More than 4000 citations
  - Support of BSc/MSc/PhD dissertation thesis: ~15 per year

Our Focus

- Mobile/Wireless Communications (5G, LTE, etc.)
  - M2M and D2D communications
  - Context-based Resource & Mobility Management
  - Big Data Analytics for User Profiling
- Software-Defined Networks (SDN) - Network Function Virtualization (NFV)
- Wireless SDN and Software-Defined Radio (SDR) using programmable radio hardware for flexible radio resources configuration
- Internet of Things and Future Internet applications and services
  - FI-WARE, Smart Cities/Farming/Tourism, Internet of Maritime Things
- Cloud computing (OpenStack, Ganeti, etc.) & Big Data Analytics

Our Involvement – EU Projects



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SCAN lab
Software Centric & Autonomic Networking

Areas of experience - EU Projects

- 5G, resource management, (cognitive) spectrum sharing etc.(METIS, Fed4Fire+, E2R I,II, SACRA, etc.)
- Cognitive network management (exploiting Machine Learning and/or Big Data Analytics) (METIS, Univerself, SELFNET, Specifi)
- SDN and NFV (Univerself trial, LiveCity trial, METIS, Fed4Fire+)
- MTC (METIS, SAF, FIspace)
- IoT, monitoring and data fusion, data aggregation, sensor connectivity to the Internet and the cloud (SAF, FIspace, FRACTALS)
- Development support and testing of FI-WARE IoT Generic Enablers (SAF, FIspace)
- FI application services development, deployment and externalization (LiveCity, SPECIFI, FIspace, etc.)
- Energy-efficient and spectrum efficient networking (SACRA, CONSERN)

Smart Maritime Initiative - Intro

- Following similar deployment framework as the “Smart City” projects, the deployment of the Smart Maritime initiative is announced. Main targets:

  - Provide an integrated test bed for the maritime domain, covering novel communications solutions (e.g., 5G), IoMT and data management,
  - Provide an open base platform for smart ports-smart vessels
  - Provide a test platform for Internet of Maritime things and respective communication solutions
  - Enable the fund raising for the sustainability of the platform

Smart Maritime Testbed Platform

- IoMT
- 5G etc., new networking concepts
- Maritime/ environmental and other apps
- Interworking with smart city and other projects

Smart Maritime initiative

- Initial discussions have already taken place with the European Parliament Committee of Industry, Research and Energy (ITRE)
- SMI's initial core consortium:
  - Angelicoussis Shipping Group "ASGL" (Maran Gas, etc.)
  - Dept. of Informatics and Telecommunications, University of Athens
  - Lloyd's Register - South Europe
  - Geosystems
  - Enthalpy
  - Collaborators / Sites:
    - Ports: Thessaloniki, Patras, Pireus
    - Operators: COSMOTE/OTE

Port of Thessaloniki

Port of Thessaloniki – infrastructure deployment for potential measurements/applications

One of the biggest Maritime companies in the world

Angelicoussis Shipping Group Ltd – The fleet

DRY CARGO

avg. age 8.5 yrs

	NO	DWT
Operating	29	5,063,000
On Order	19	3,110,000
Total	48	8,173,000

TANKERS

avg. age 6.9 yrs

	NO	DWT
Operating	36	7,633,000
On Order	7	2,235,000
Bareboat out	7	2,207,000
Total	50	12,075,000

LNG / LPG

avg. age 3.4 yrs

(897,000 cubic m.)

	NO	DWT
Operating	7	498,070
On Order	0	0
Total	7	498,070

SMI: 5G- new networking concepts

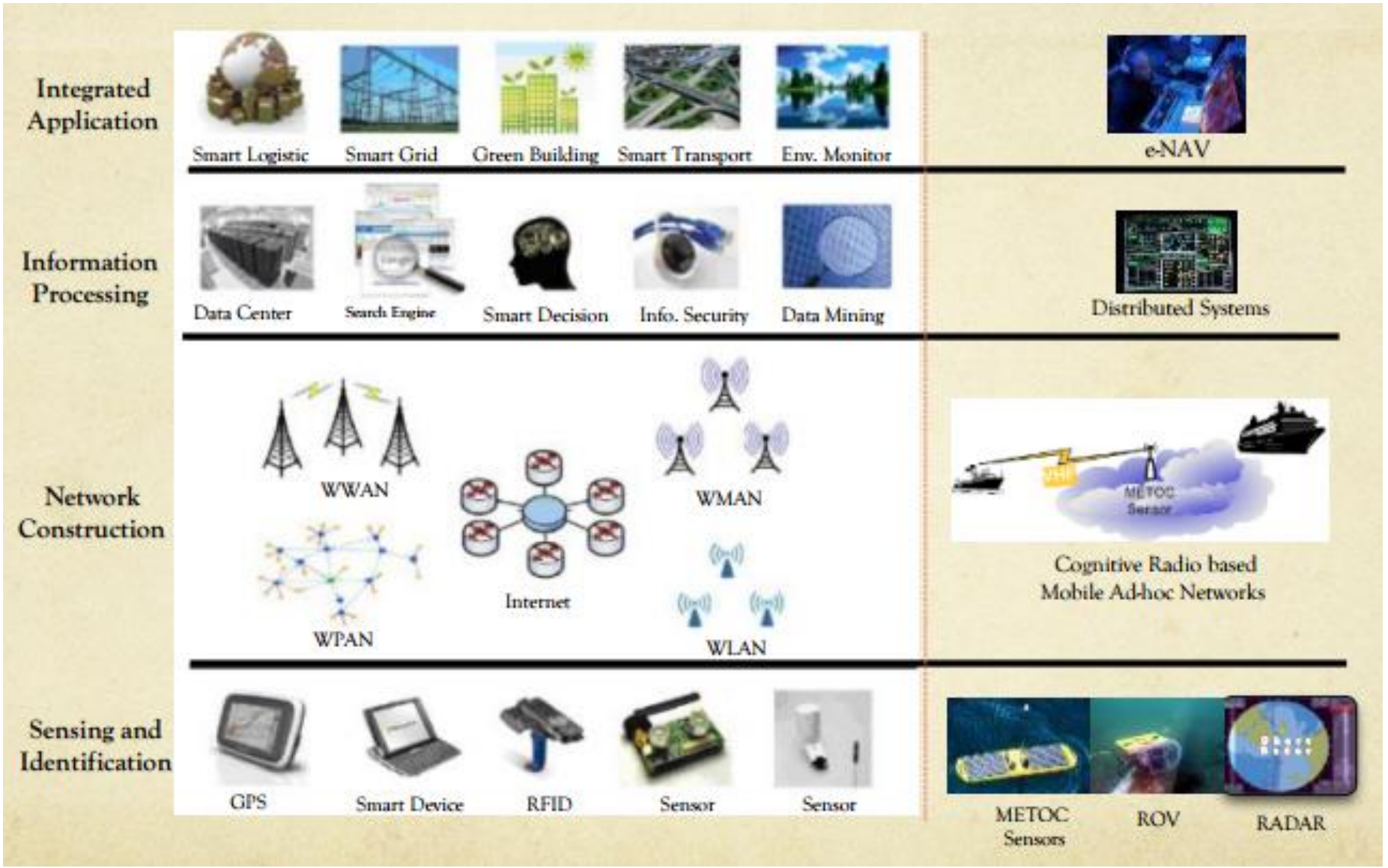
- 5G :
  - Delay intolerant apps (e.g., smart port/smart city assisted driving for transportation of cargo and people)
  - High volume communications (e.g., cruise tourism apps)
  - High number of connected devices

- SDN:
  - Smart routing(smart integration of edge sensors and mobile devices)
- NFV:
  - Virtualised network functions

SMI: IoMT

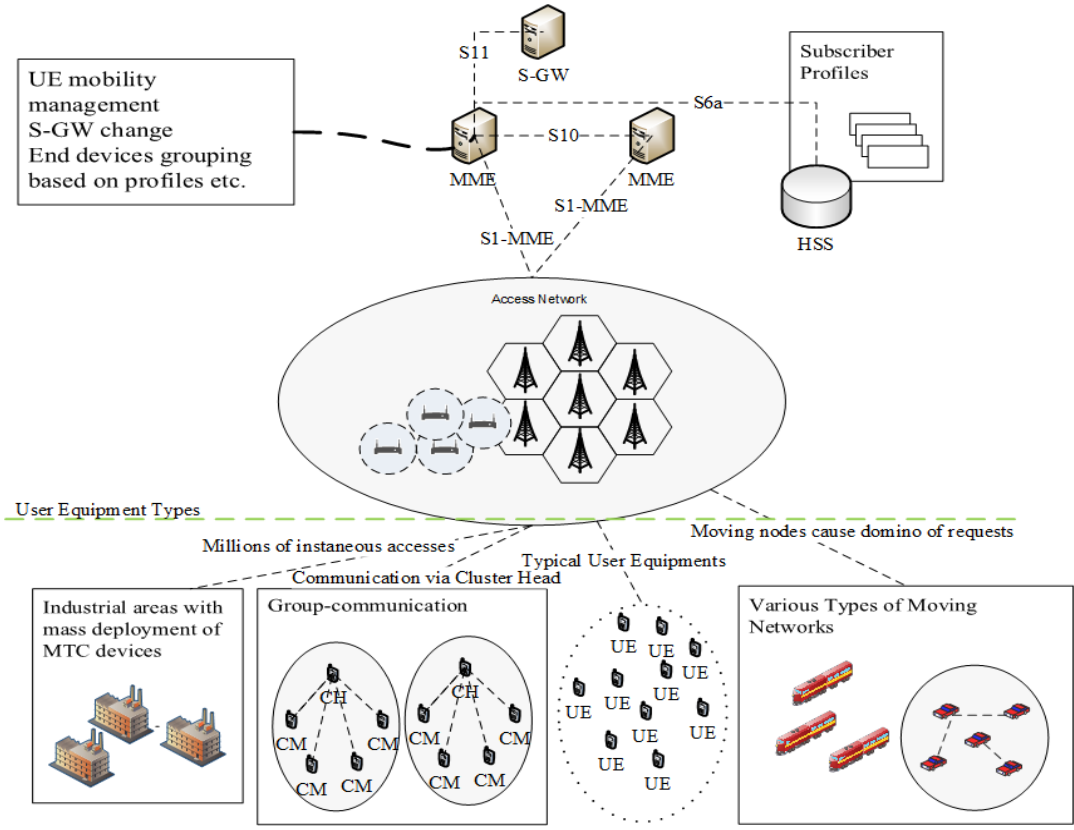
- Smart navigation and routing
  - Energy efficiency
  - Emissions
  - Collision avoidance
  - Unidentified vessel notification
  - Weather conditions
- Smart maintenance
- Smart Vessel management and performance
- Smart transportation
  - Smart logistics
  - Cargo status monitoring and tracing
  - Smart Port/Smart City road networks and transportation networks
- Smart business model
  - Data analytics for smart business development
  - New business models

Networking and IoT technologies



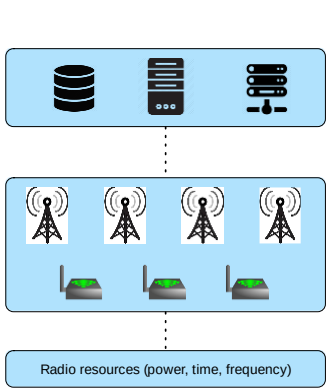
Mobile/Wireless Communications

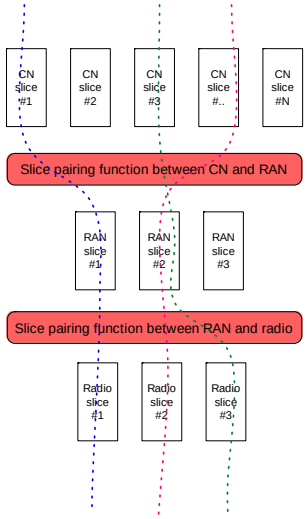
- 5G
  - Delay intolerant,
  - Large numbers of connected devices etc.
- SDN-enabled 5G system
  - Infrastructure sharing,
  - SDN/NFV,
  - OpenStack, etc.
- Support of Heterogeneous 5G Networks
  - Ultra Dense Networks,
  - Operation in unlicensed bands, etc.
- Large-Scale Test bed
  - Realistic experimentation



Example Deployment: Cross Layer Control (CLC) based on SDN and SDR towards 5G Heterogeneous Networks

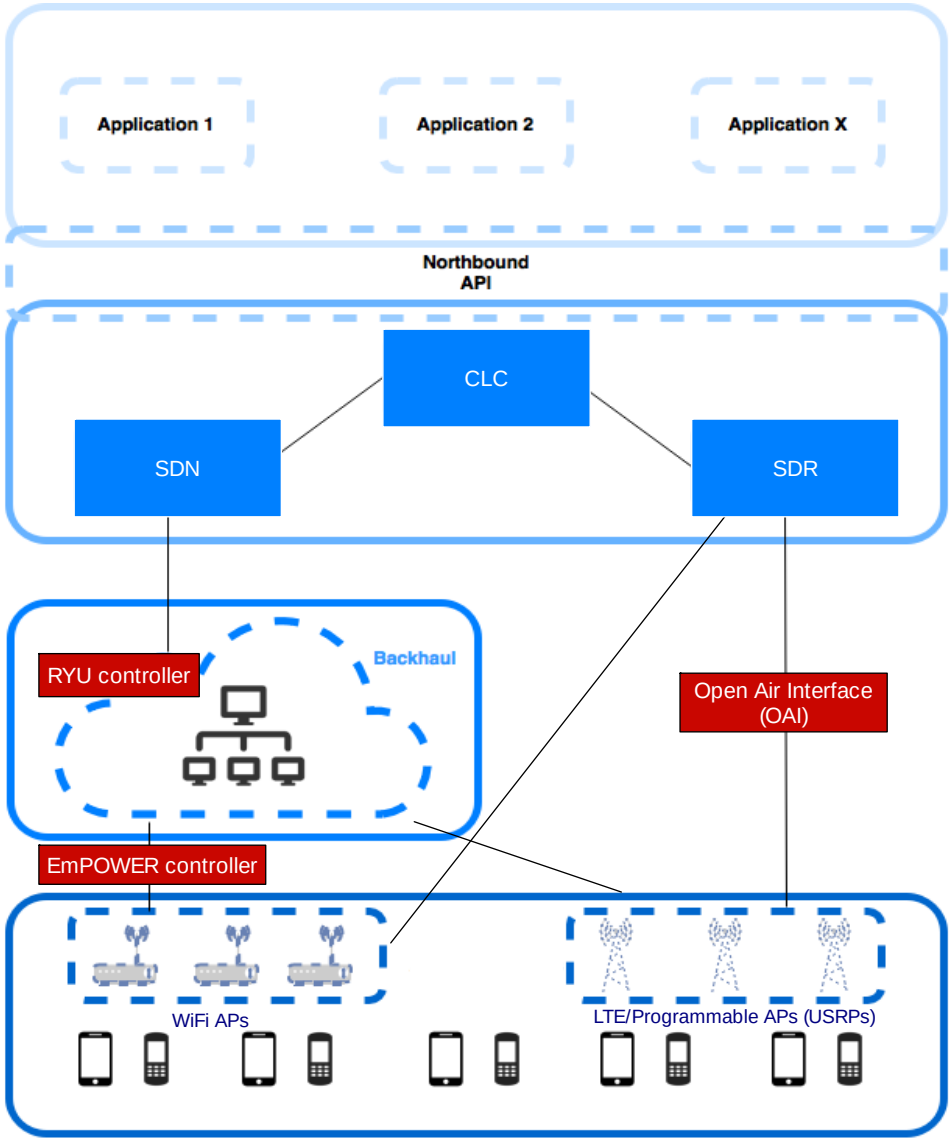
- Spectrum and network resources scarcity imposes a coordinated resource sharing scheme
- Besides resource scarcity, ultra dense wireless deployments result in critical interference challenges





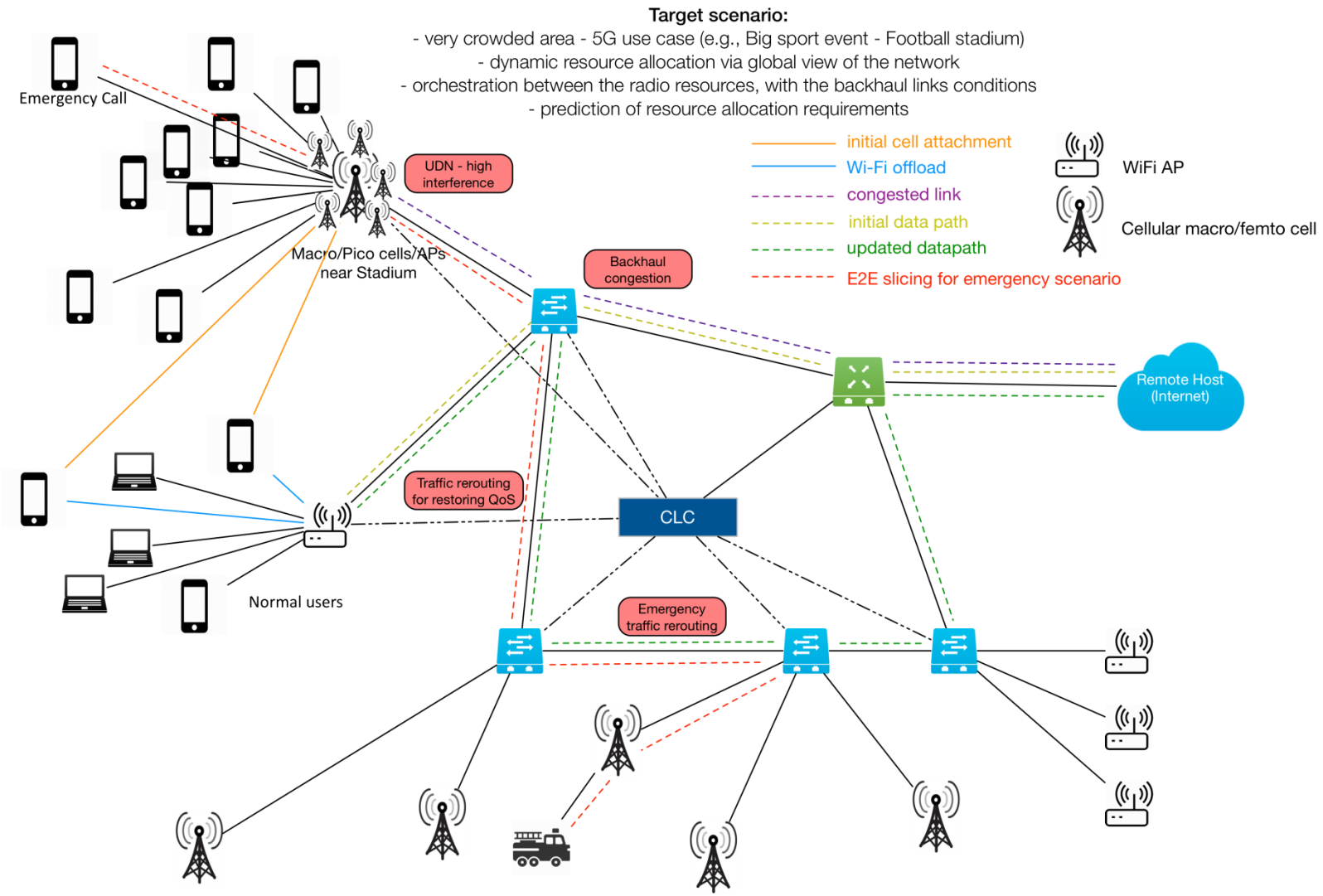
➢ By acquiring a global view of the network, via a cross layer controller, we attempt to orchestrate the resource allocation mechanisms in an end-to-end manner, i.e., in the Core Network, the backhaul of the RAN, as well as the Radio environment

Cross Layer Control (CLC) based on SDN and SDR towards 5G Heterogeneous Networks



- CLC operates in a controller-agnostic manner on top of various SDN and SDR controllers (Ryu, OpenDaylight , EmPOWER, OAI)
- CLC uses an abstraction layer, which aggregates:
  - the network and radio conditions (which are forwarded to CLC)
  - the network policies (which are being pushed from CLC to the network) are aggregated

Cross Layer Control (CLC) based on SDN and SDR towards 5G Heterogeneous Networks

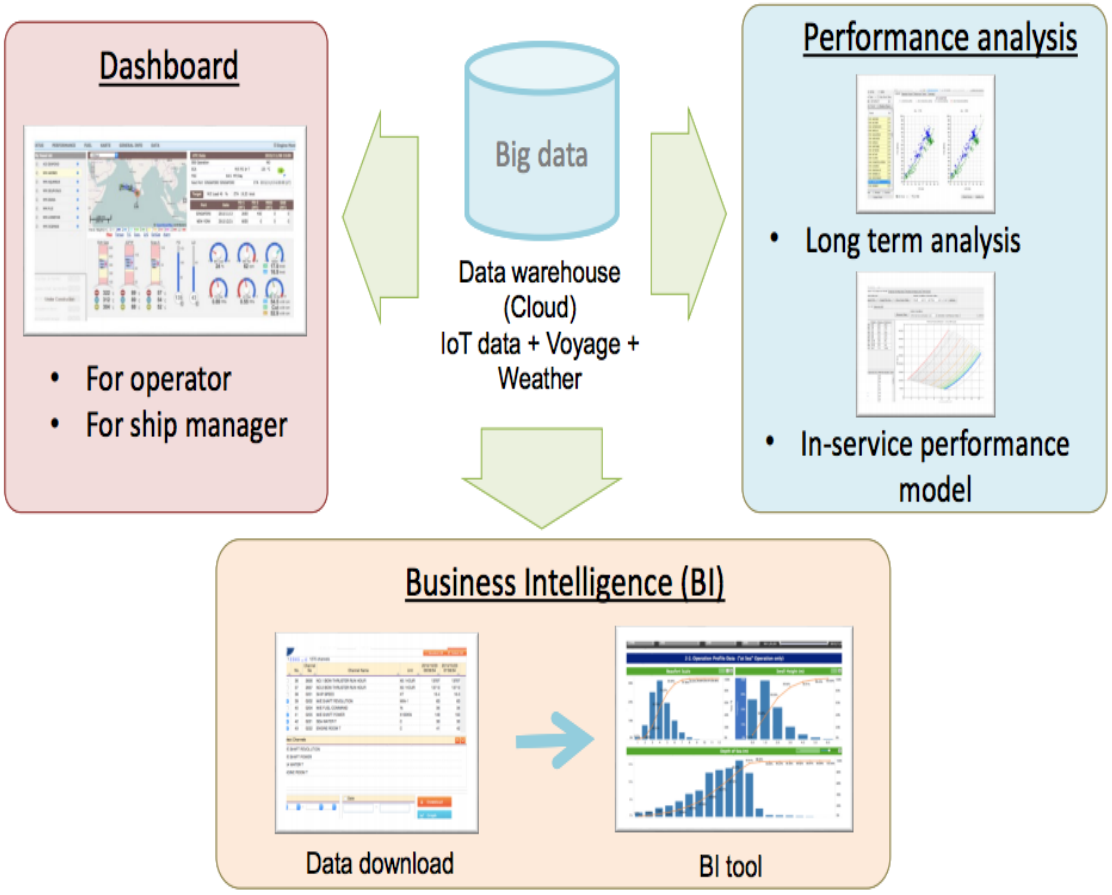


IoMT and Big Data application areas

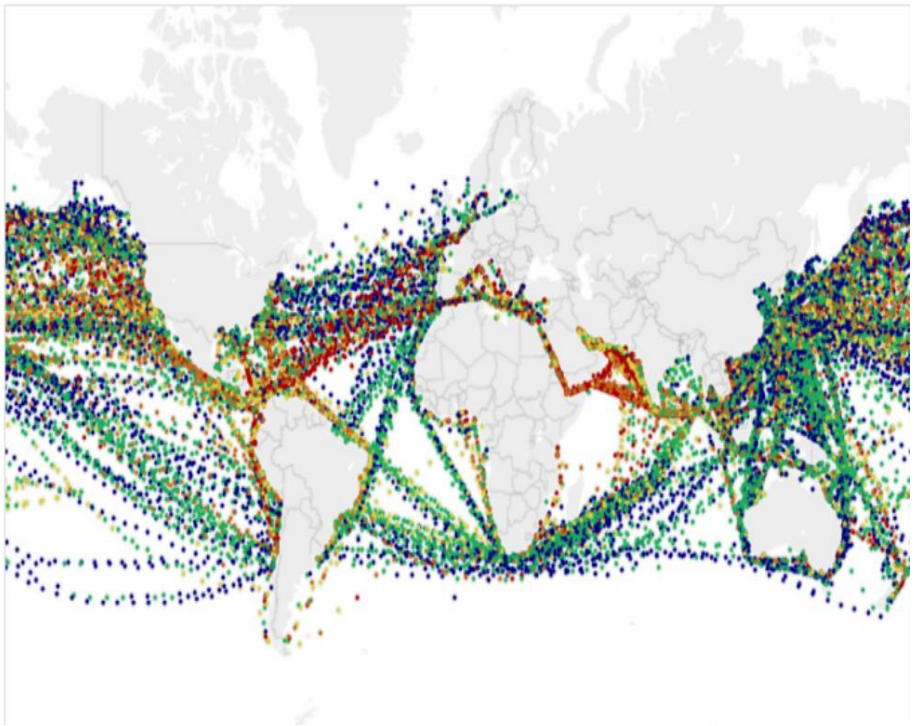
Role	Function	Example of Big data application
Ship operator	Operation	• Energy saving operation • Safe operation • Schedule management
	Fleet planning	• Fleet allocation • Service planning • Chartering
Ship owner	Technical management	• Safety operation • Condition monitoring & maintenance • Environmental regulation compliance • Hull & propeller cleaning • Retrofit & modification
	New building	• Design optimization

Other partners in value chains, such as cargo owners,
shipyards, equipment manufacturers, class societies and others, have also interests in ship Big data.

Big data management in IoMT



Smart networking and Big Data



Smart Networking for diverse needs in the maritime domain.

- Infrastructure slicing,
- Short range and long range connectivity for vessels, cargo, transportation

Big Data analytics towards:

- Creation of different operational profiles (characterized by consumption efficiency, cargo type, route length, ship speed, weather conditions, etc.)
- Short/long term performance analysis
- Performance visualization
- …

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