5G Networks in Support of Urban Mobility

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Cyprus MCM of COST ACTION CA15104

Outline

- Presentation of IRACON - COST CA15104 Inclusive Radio Communication Networks for 5G and beyond
- Smart Mobility
- 5G Networks in Support of Urban Mobility

COST CA15104 – Inclusive Radio Communication Networks for 5G and beyond

Inclusive Radio Communication Networks

- Supporting wireless connectivity for any rate/communication units/scenarios
- Key challenges: spectral and spatial efficiency + many constraints
- Goals: novel designs for 5G and beyond encompassing
  - ✓ Radio channel modeling for inclusive scenarios
  - ✓ Capacity, energy, mobility, latency and scalability at PHY and MAC
  - ✓ Network automation, moving nodes, cloud and virtual architectures at MAC and NET
  - ✓ Experimental research and demonstration covering OTA, IoT, localization and radio access techniques
  - ✓ A mix of traditional research + (re)new(ed) focus on experiments
    - 3rd phase of 5G research (2018-2020) should mainly rely on demonstrations and trials !

Presentation of the Action

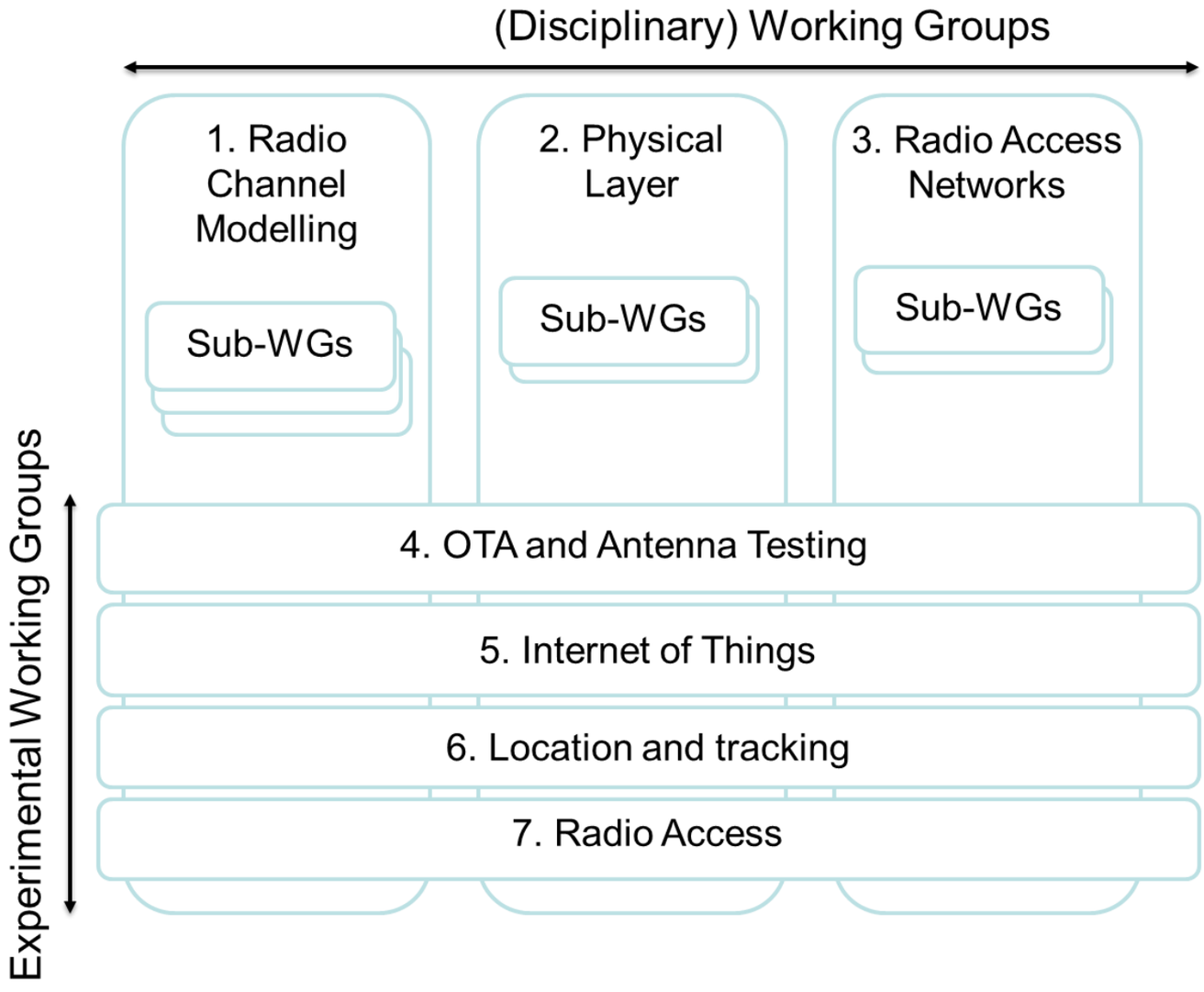
Research Coordination Objectives

- Agree on **models** for the variety of **radio channels** that can be envisaged for inclusive radios
- Share views and discussions on **Capacity, Energy, Mobility, Latency, Scalability** at the Physical (PHY) and Medium Access Control (MAC) layers
- Connect researchers in the area of **Radio Access Network automation**, moving nodes, cloud and **virtualization** architectures at the MAC and network (NET) layers
- Coordinate shared experimental research addressing **Over-the-Air** (OTA) testing, **IoT**, **localization/tracking** and **radio access**

Capacity Building Objectives

- Promoting **collaborative** research across different fields
- Creating a generation of researchers with competences on **both cellular and IoT-type** radio networking
- Fostering a generation of young researchers able to address wireless communication techniques relying on **joint theoretical and experimental** approaches
- Consolidating some initiatives aiming to establish **integrated pan-European** laboratory facilities for testing the development of 5G-and-beyond networks

Organization



- 7 Working Groups
  - ✓ 3 Disciplinary WGs
  - ✓ 4 Experimental WGs
- Each WG is coordinated by 2 co-Chairs

Partners

- Number of signatory countries : **35** (out of 36)
- Number of MC Members : **66** (+ Chair)
- Near Neighbour Country Institutions : 2 approved, **1** in submission

National Research Tomsk Polytechnic University	Russian Federation
YK State University of Grodno	Belarus
RUDN University	Russian Federation

- International Partner Country Institutions :

✓ **12** approved and activated

Beijing Jiaotong University	China
Tokyo Institute of Technology	Japan
Comsearch	United States of America
NIST	United States of America
Samsung Electronics Co.	Korea, Republic of
Japan Advanced Institute of Science and Technology	Japan
Motorola Mobility LLC	United States of America
Universidad Icesi	Colombia
Niigata University	Japan
Northeastern University	United States of America
University of Prishtina	Kosovo
CSIR	South Africa

Status of the Action

198 registered experts

132 MC Members (+chair)

105 participants per meeting (average)

38 research infrastructures

72 presented TD/workshop papers (average)

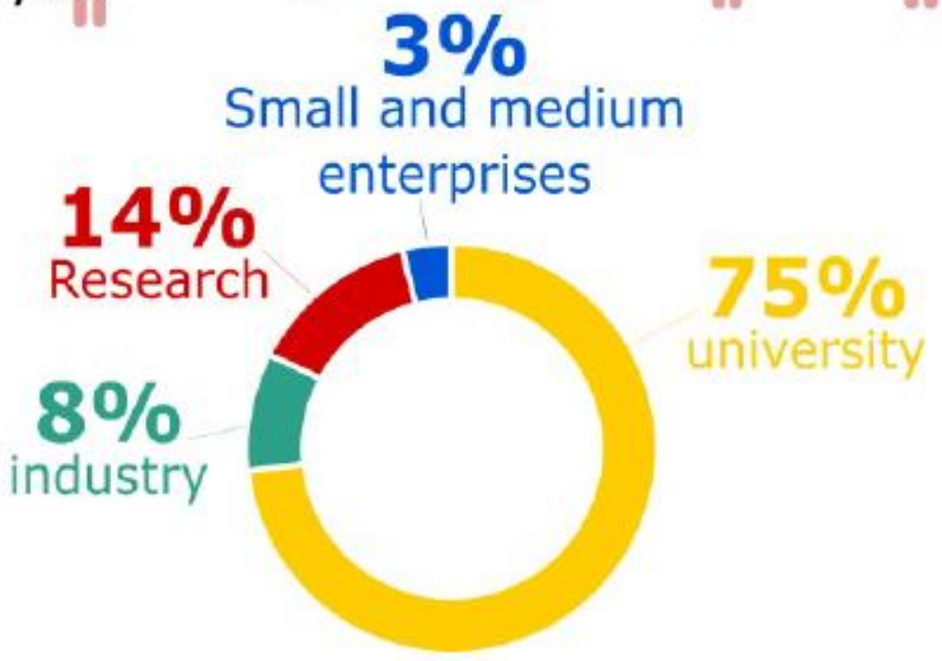
173 institutions (industry/university/ research/small) and medium enterprises) currently participating

458 participants registered

3 meetings per grant year

1 training school per grant year

11 STSM completed



Action Activities

March 2018

3rd IRACON Training School (Lisbon, 5-9 March 2018)

Beyond 5G Networks operating in the Millimetre Wavebands enabled by Joint Analogue-digital Signal Processing

April 2018

COST Connect on **"How to shape a Sustainable Urban Mobility for all?"** (Bucharest, 25-26 April 2018)

IRACON represented by Vasos Vassiliou (MC Cyprus)

May 2018

7th MCM (Cartagena, 30 May-1 Jun 2018)

Organized by Jose Molina-Garcia-Pardo

Training seminar on "RF Localisation Techniques" (jointly organized with ITN WIBEC)

Smart Mobility

Results of COST Connect event in Bucharest

Smart Mobility

Initial Question: **What is Smart (in) Mobility ?**

Quest Behind the Question:

Find out what is considered Smart in Urban Planning circles

Understand the components that make something smart

What is the Radius of smartness necessary?

Answers:

Not about technology but design approach

Solutions should be Efficient and Cost Effective

Should adapt to people's needs and relate to the problem's context

Open Systems – Open Source (not vendor-locked), Open Standards, Open Data

Move from Digital & Connected to Intelligent

Radius of "smartness" spans from individual to region

Smart Mobility

What is missing:

It is smart if people are smiling!

Global System Satisfaction

Rational use of environment and resources

Should be Responsive – meaning more proactive

Making people aware of the bigger issues

Bridging the digital divide – enable inclusion

Changing people's behavior

5G Networks in Support of Urban Mobility

What is 5G?

- 5G brings three new aspects to the table: greater speed (to move more data), lower latency (to be more responsive), and the ability to connect a lot more devices at once (for sensors and smart devices).

- **Faster speed**: Data transfer speeds are projected to be about 10 times higher with 5G than is possible with 4G. 5G promises to offer speeds in excess of 1Gb/s (1000Mbit/s), with many estimates placing it closer to 10Gb/s (10000Mbit/s).
- **Shorter delays:** Though it's not always noticeable, there is often a brief lag in time from when data is sent to when it's received. 5G reduce the latency of the last (radio) hop to 1ms, which is 100 times lower .
- **Increased connectivity**: 5G will also have **greater capacity**, meaning the networks will be able to cope better with many high-demand applications all at once – from connected cars and IoT (Internet of Things) devices to virtual reality experiences and simultaneous HD video streaming

What are the trends ?

1. Customer expectations
   - Today's consumers increasingly compare their experiences across different domains. They've become accustomed to intuitive, personalized and seamless experiences, especially when they interact with digital technologies.
   - 18- to 29-year-olds are more receptive to driverless vehicles. Same demographic that expects Virtual Reality to play a significant role in its digital experience!
2. Transportation-as-a-service
   - Consumer attitudes to vehicle ownership are undergoing a revolution. Ridesharing and transportation-as-a-service have disrupted traditional mobility service markets. AVs are ideally placed to capitalize on this ever-increasing preference for access rather than ownership.
3. Advances in technology
   - Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2X) technology is being developed to provide 360-degree, non-line-of-sight awareness
   - 5G wireless technology will transform AV communication – broadband multimedia streaming and high volume transmission of sensor data will be possible over the same medium.

How is 5G interacting with transportation and Mobility?

- **As 5G evolves** network services with mission-critical data traffic, such as instructions sent from a cloud service to a driver or to an automated vehicle, will coexist with other types of network services (e.g. web browsing and media streaming). The 5G network enabling the connectivity will guarantee QoS for the critical data traffic by prioritizing it over non-critical data traffic.
- Key technology trends driving the mobility revolution - autonomous driving, cooperative mobility, vehicle life-cycle maintenance and sensor data crowdsourcing require secure, reliable, low-latency and high-bandwidth connectivity. Only 5G can satisfy all of these rigorous connectivity requirements.
- 5G will provide enhanced situational awareness and high precision navigation through high bandwidth, low latency streams from other vehicles, and roadside infrastructure.

Usage Examples

- Maintenance Services
  - Dealership hubs will focus on software maintenance and hardware upgrades. Around 30 percent of connected vehicles (CVs) will have over-the-air (OTA) software updates by the end of this decade
- Public Transportation
  - Smarter public transport is possible through data analytics and connectivity
  - With increased wireless connectivity, communities with a public transit system can reduce rider wait times while also optimizing bus inventory. Smarter public transport is possible through data analytics and connectivity
- Teleoperated / Remote Driving
  - A vehicle is driven by someone in a remote location. The vehicle is still driven by aperson – it is not automated. This could potentially be used to deliver a premium concierge service to enable someone to participate in a conference or to work while on a journey, or to support a taxi service, or to help a person without a driving license, or when they are ill, intoxicated, or otherwise unfit to drive. Requires a high-reliability radio link with full round trip delay below 10 ms.

Usage Examples

- Traffic Management Systems
  - Thanks to 5G's ultra-fast speeds, cars will be able to "convoy" or "platoon" in groups, increasing road vehicle capacity, while providing substantial energy savings for vehicle owners.
  - If autonomous cars are supported by Smart Traffic Management systems, congestion could decrease and system could deliver additional productivity and quality-of-life improvements to residents.
- Public Parking.
  - Use of low-cost 5G IoT sensors. Reduce time to find parking benefits all commuters and encourages traffic to commercial areas, boosting economic activity.
  - Combined with the smart metering systems that are already deployed in some areas, advanced wireless connectivity could increase parking revenue by 27% while also helping reduce congestion and idling.
- Entertainment at High Speeds
  - High speed train is used in various regions for inter-city transport and will further evolve beyond 2020; these high speed trains can reach speeds greater than 500 km/h. While travelling, passengers will use high quality mobile Internet for information, interaction, entertainment or work. Examples are watching a HD movie, gaming online, accessing company systems, interacting with social clouds, or having a video conference.

Thank you!

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