5G Networks in Support of Urban Mobility

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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!
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
Presentation of the Action

Organization

- 7 Working Groups
  ✓ 3 Disciplinary WGs
  ✓ 4 Experimental WGs

- Each WG is coordinated by 2 co-Chairs
Status of the Action

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  
  YK State University of Grodno  
  RUDN University  

- International Partner Country Institutions :
  
  ✓ **12** approved and activated
  
  Beijing Jiaotong University  
  Tokyo Institute of Technology  
  Comsearch  
  NIST  
  Samsung Electronics Co.  
  Japan Advanced Institute of Science and Technology  
  Motorola Mobility LLC  
  Universidad Icesi  
  Niigata University  
  Northeastern University  
  University of Prishtina  
  CSIR  
  China  
  Japan  
  United States of America  
  Korea, Republic of  
  Japan  
  United States of America  
  Colombia  
  Japan  
  United States of America  
  Kosovo  
  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

14% women
36% ECI
8% industry
14% Research
75% university
3% Small and medium enterprises
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 reduces 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 a person – 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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