The 5G Infrastructure Public-Private Partnership

5G research in Europe

Werner Mohr
Chair of the board of 5G Infrastructure Association

http://5g-ppp.eu/
Outline

- 5G PPP in Horizon 2020 of the European Union
- 5G Vision and Requirements
- 5G PPP research projects
  - Radio-related cluster
  - Fronthaul/backhaul
  - Hardware implementation
  - Network automation
  - SDN, NFV, Cloud and Virtualisation
  - Security
- Conclusions
Major milestones towards the 5G PPP implementation

- Commissioner Kroes asked Industry in Europe to cooperate on 5G PPP at Mobile World Congress 2013 in Barcelona
- First Call for Proposals published on December 11, 2013
- 5G PPP Contractual Arrangement signed between EU Commission and private side on December 17, 2013
- Budget for 2014 – 2020 time frame
  - Up to 700 million € public funding
  - Matched by private side including leveraging factor 5 of additional private investment results in private value of about 3.5 billion €
- 5G PPP industry launch at Mobile World Congress on February 24, 2014
- Submission deadline of proposals on November 25, 2014
- Project start on July 1, 2015
- 5G Infrastructure Association vision paper published

From left to right:
- Marcus Weldon, Chief Technology Officer and President Bell Labs, Alcatel-Lucent
- Li Yingtao, President of 2012 Laboratories, Huawei
- Kyungwhoon Cheun, Executive Vice President, Samsung Electronics
- Hermann Eul, Corporate Vice President General Manager, Mobile and Communications Group, Intel
- Mari-Noëlle Jego-Laveissière, Senior Executive Vice President of Innovation, Marketing and Technologies, Orange
- Günther H. Oettinger, Commissioner for Digital Economy and Society
- Mr Seizo Onoe, Executive Vice President, Chief Technical Officer, and Member of the Board of Directors, Docomo
- Ulf Ewaldsson, Chief Technology Officer, Ericsson

Source: 5G Infrastructure Association.
Key challenges

• PPP Program that will deliver solutions, architectures, technologies and standards for the ubiquitous 5G communication infrastructures of the next decade

• Program Ambitions: Key Challenges / High level KPIs
  – Providing 1000 times higher wireless area capacity and more varied service capabilities compared to 2010
  – Saving up to 90% of energy per service provided. The main focus will be in mobile communication networks where the dominating energy consumption comes from the radio access network
  – Reducing the average service creation time cycle from 90 hours to 90 minutes
  – Creating a secure, reliable and dependable Internet with a “zero perceived” downtime for services provision
  – Facilitating very dense deployments of wireless communication links to connect over 7 trillion wireless devices serving over 7 billion people
  – Enabling advanced User controlled privacy

Source: 5G Infrastructure Association.
5G PPP Vision and Requirements

5G new service capabilities

• 5G needs to support efficiently three different types of traffic profiles
  – high throughput for e.g. video services
  – low energy for e.g. long–living sensors
  – low latency for mission critical services

• 5G covers network needs and contributes to digitalization of vertical markets
  – automotive, transportation, manufacturing, banking, finance, insurance, food and agriculture
  – education, media
  – city management, energy, utilities, real estate, retail
  – government
  – healthcare

• Sustainable and scalable technology to handle
  – anticipated dramatic growth in number of terminal devices
  – continuous growth of traffic (at a 50-60% CAGR)
  – heterogeneous network layouts
  – without causing dramatic increase of power consumption and management complexity within networks

5G PPP Vision and Requirements
5G will have disruptive capabilities

- 5G will provide an order of magnitude improvement in performance in the areas of more capacity, lower latency, more mobility, increased reliability and availability
- 5G infrastructures will be also much more efficient in terms of
  - energy consumption
  - service creation time
  - hardware flexibility
5G PPP Vision and Requirements

Key requirements

- 1,000 X in mobile data volume per geographical area reaching a target ≥ 10 Tb/s/km²
- 1,000 X in number of connected devices reaching a density ≥ 1M terminals/km²
- 100 X in user data rate reaching a peak terminal data rate ≥ 10Gb/s
- Guaranteed user data rate >50Mb/s
- 1/10 X in energy consumption compared to 2010
- 1/5 X in end-to-end latency reaching 5 ms for e.g. tactile Internet and radio link latency reaching a target ≤ 1 ms for e.g. Vehicle to Vehicle communication
- 1/5 X in network management OPEX
- 1/1,000 X in service deployment time reaching a complete deployment in ≤ 90 minutes
- Mobility support at speed ≥ 500km/h for ground transportation
- Accuracy of outdoor terminal location ≤ 1m

5G PPP Vision and Requirements

Key technological components

- 5G wireless will support a heterogeneous set of integrated air interfaces
  - from evolutions of current access schemes
  - to brand new technologies
- 5G networks will encompass cellular and satellite solutions
- Seamless handover between heterogeneous wireless access technologies
- Simultaneous radio access technologies to increase reliability and availability
- Deployment of ultra-dense networks with numerous small cells requires new interference mitigation, backhauling and installation techniques
- 5G will be driven by software and will heavily rely on emerging technologies
  - Software Defined Networking (SDN)
  - Network Functions Virtualization (NFV)
  - Mobile Edge Computing (MEC)
  - Fog Computing (FC)
  to achieve required performance, scalability and agility
- Easier and optimised network management by means of exploitation of Data Analytics and Big Data techniques
  - to monitor users Quality of Experience
  - while guaranteeing privacy

5G PPP Vision and Requirements
5G networks and services vision

5G PPP Vision and Requirements

5G roadmap

Radio-related cluster

Objectives

• Radio interface below 6 GHz
• Radio interface above 6 GHz
• Overall RAN design
• Heterogeneous radio access networks (RAN)
• Novel adaptive 5G mobile network architecture
• Spectrum access

Source: COHERENT, FANTASTC-5G, Metis-II, mmMAGIC, 5G-NORMA, SPEED-5G.
Objectives

- **5G integrated backhaul and fronthaul transport network**
- Fronthaul and backhaul solutions between RAN and packet core
- Demonstration and validation of xHaul technology components will be integrated into a software-defined flexible and reconfigurable 5G Test-bed

- **Flexible backhaul/fronthaul network** for serving current and future RAN deployments in a dynamic, service oriented, and cost-effective way

- **Seamless integration of future-proof technologies** in the optical and wireless (Sub-6 GHz, mm-Wave) metro/access domains, through a converged software-based control plane

Source: xHaul, 5G-xHaul.
Hardware implementation

Objectives
• Increasing the HW versatility and reconfigurability
• Providing HW-agnostic, flexible and cost-effective SW platforms
• Increasing the overall capacity of 5G communication platforms
• Decreasing the energy consumed by 5G communication platforms
• Identifying and prototyping key building blocks

Areas to be addressed
• RF front-ends and antennas (versatility, TRX > 6 GHz, antennas, …)
• Mixed-signal technology (broadband DAC/ADC, full duplex, …)
• Digital front-end + HW/SW split (HW for new waveforms, MIMO …)
• SW modules and functions (SW re-configurability, energy savings)

19/06/2015
Source: Flex5Gware.
Network automation

Objectives

- **Automated and fast provisioning** of infrastructure services in a multi-domain/multi-operator 5G environment
- Innovative framework for the **automated management** and rapid deployment of **self-configuring next-generation networks and services**
- Extending the state-of-the-art network management within the Software-Defined Networking and Network Function Virtualization (SDN/NFV) arena
- Network Management at the **5G/IOT** scale

Source: CogNet, SELFNET, 5GEx.
Objectives

- **Network Functions Virtualisation (NFV) and Edge Cloud Computing**;
- Substantial evolution of the Small Cell concept
- Consolidation of multi-tenancy in communications infrastructures, allowing several operators/service providers to engage in new sharing models of both access capacity and edge computing capabilities.
- **Reduce time to market for networked services** by shortening service development (Programming model and SDK)
- Optimizing resource utilization and reduce cost of service deployment and operation
- Converged cloud-based 5G concept that will enable innovative use cases in the mobile edge, empower new business models, and reduce investment and operational costs
- To develop a **SDN & NFV ecosystem for industrial domains**, based on open, modular, and secure communication framework, leading to a prototype demonstration for intra-domain and inter-domain scenarios in real wind parks as a representative use case of industrial networks, and quantify the economic benefits of the solution
Security

Objectives

- End-to-end security across all layers of the converged and virtualised open access network
- Physical layer low-latency security for both wireless and optical, in open, dynamic, multi-user, highly connected and decentralized 5G networks
- Build two secure end-to-end pilot demonstrators
Conclusions

- 5G research started already in EU Framework Program 7
- 5G research is getting momentum globally
- In Europe 5G PPP launched in December 2013 as part of new research program Horizon 2020
- 5G PPP is addressing the complete future communication network including support of vertical sectors
- 5G PPP published its Vision and Requirements White Paper in Barcelona at MWC 2015
- Horizon 2020 Call 1 projects will start on July 1, 2015 and will address major components of future communication network

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Thank you for your attention!

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