2nd 5G Workshop with Verticals

Brussels, 9 November 2015

Organised by European Commission and 5G Infrastructure Association

Workshop Report

Table of Content

About the workshop

Whilst earlier network generations have been designed as general purpose connectivity platforms with limited differentiation capabilities across use cases, the situation is changing for the definition of 5G networks. 5G will create an ecosystem for technical and business innovation involving vertical markets such as automotive, energy, food and agriculture, city management, government, healthcare, manufacturing, public transportation, and many more. It will serve a larger portfolio of applications with a corresponding multiplicity of requirements ranging from high reliability to ultra-low latency going through high bandwidth and mobility.

This workshop targeted the presentation and discussion of white papers elaborated by vertical sectors in partnership with the ICT industry to identify how future innovative digital business models in various industries may impact future 5G networks. It also aimed at building constituency for 5G PPP Phase 2 between vertical industries and the ICT community.

It followed from the 1st 5G for Verticals Workshop, co-organised by the European Commission and the 5G Infrastructure Association in Brussels on June 18, 2015 with the automotive, energy, factories of the future / manufacturing, health, media / entertainment and ICT sectors.

The agenda was the following:

	Agenda item	Chair
10h00-10h30	Welcome coffee	
10h30-11h30	Panel on business and regulatory aspects to identify commonalities (based on verticals whitepapers)	Jean-Sébastien Bedo
11h30-12h30	Panel on use cases and technical requirements to identify commonalities (based on verticals whitepapers)	Emilio Calvanese
12h30-13h30	Networking lunch	
13h30-14h30	Pre-standards: discussion on the priority / phasing of vertical use cases	Hugo Tullberg
14h30-15h00	5G PPP Phase 2 pre structuring model	Didier Bourse
15h00-15h30	Coffee break	
15h30-16h30	Project ideas and competencies from verticals and discussion on what is missing in the pre-structuring	Jean-Sébastien Bedo
16h30-17h00	Key messages from the day and next steps	Jean-Sébastien Bedo

1st panel: business models and regulatory aspects

a) New business models

Introduction by METIS II – Frédéric Pujol (iDate)

The vision for 5G is new network architecture building on programmable hardware network elements controlled by software that is separated from the physical element itself. The resultant telecommunication network will continue to provide connectivity among people and things, provide access to wanted services, but will as well be able to provide specialised services and offer complete competitive networks for vertical sectors. By about 2020 5G infrastructure technology will provide extreme broadband capabilities, connect a vast number of sensors or things, and serve individuals and machines with reliable and secure communication networks. In a way 5G is one flexible and adaptive single network infrastructure that can be programmed or sliced to serve the various type of stand-alone solutions of today.

The coming network infrastructure technology will enable changes of the current telecommunication ecosystem comprising network operators and service providers, equipment vendors, software providers, and system integrators. There will be new players and ways to provide value added services to various vertical sector industries such as health care, energy, utility, transport, retail, media, entertainment, finance, and public safety.

Healthcare - Christophe Thuemmler (TUM)

The industry providing healthcare is very fast growing. New types of personalised and precise medicine are becoming available.

The society is challenged on how to spend the available, but limited, resources and know that they are well used. Tools are needed to take the decision at the correct time and also to evaluate the quality of the resource utilisation such as through big data analyses.

A model must be developed to aid the personalised and precise medicine decision process and the evaluation of the health care result.

Factory of the future - Wouter Haerick (iMinds)

Profound changes will take place in the manufacturing sector. It is expected that by 2016 a majority of manufacturers will offer connected products and that by 2025 there will be more revenue from services than from products.

In the future both production and products will be dominated by data-driven technologies.

New business models will be required for the data-driven production for roles dealing with factory management and ownership, machines and tools, robots, and smart clothing. For example providing tools-as-a-service may well be one of the new value propositions, or hiring of robots.

New business models will also be required for the data-driven product-related services. An example is product design based on efficiency of collected data during the lifetime of the connected good including the cost of their transport and processing. It will require a unified experience across several wireless access technologies.

Energy - Linus Thrybom (ABB)

New connectivity business models will be needed supporting longevity, virtualization and network slicing, cost efficiency, and dedicated machine profiles. Power utilities will take more ownership of the telecom network management. There will be a need for storage to provide big data services.

Automotive – Maxime Flament (ERTICO)

The automotive industry is controlled by a relatively few number of players, but must integrate more communication. The automation is growing in the vehicles themselves.

Fleet learning enables sending information to the environment so that the next car can take advantage of the learnings. Cooperative driving enables sending information directly between vehicles being close to each other in order to improve the security (avoid collision, detect an obstacle earlier). There will be a huge demand on exchanging information.

New business models are needed along with the integration of connectivity in cars. These include car manufacturers, network and technology providers, and services providers such as insurance, driver assistance, security or content delivery. We also need to take into account the whole transportation sector including rail and multi-modality.

Media and entertainment – Jean-Sébastien Bedo (Orange)

User habits with regards to media consumption are profoundly changing with respect to types of services, user environments, and devices. There is for example a move from linear media to on-demand content and the consumption takes place at home as well as on the move.

Under the changed regime new business models will be needed for network operators as well as for application and service providers. Since media and entertainment traffic will continue to grow dramatically and drive the required data rates for 5G, operators and service providers will require scalable and sustainable technologies.

With 5G and simple APIs to access to infrastructure capabilities, new players will enter in the entertainment innovative ecosystem consisting of developers, service providers, and network operators.

b) Regulation and policy aspects

Healthcare - Christophe Thuemmler (TUM)

The regulation is needed concerning healthcare services and payment. Legislators should take steps to ensure that new services can satisfactory be billed and be reimbursable to the health care providers.

Energy - Linus Thrybom (ABB)

Regulations have a high impact and should deal with the integration of electrical vehicles, energy storage, and demand-response tariffing schemes.

Specialized services with guaranteed performance for critical infrastructure systems should be enabled.

Automotive - Maxime Flament (ERTICO)

Policies that promote innovation and reward investment in communication networks and innovative standards are needed, together with preserving a technology-neutral approach on use of spectrum.

Specialized services are needed to prioritize security services related to cooperative intelligent transport systems (C-ITS) over media consumption for entertainment.

Regulators need to address security, integrity, data protection, and privacy in the data economy in a holistic manner from a user's point of view, in particular by setting rules that apply to all providers offering equivalent services.

c) Q&A

We are talking about tele-medicine for years. What will really change with 5G?

- 5G will bring new capabilities especially a better coverage in all situations, the possibility to connect far more sensors, and new ways to ensure data security and privacy.

How to kick-start car-to-car communication? Is there a critical mass under which the service is of no use?

- Car-to-car communication modules will be embarked by default in new cars very soon. It will immediately give more communication facilities into the car. Then progressively more and more convenience services will be activated. Ultimately, the vehicle will be a part of a package, a global solution.

How to build a transition to 5G that makes commercial sense for all sectors?

- For media and entertainment, 4G can already carry a lot of traffic. 5G will offer complementary traffic volume capabilities on top of that for example in very dense areas like stadiums.
- For energy, 4G will enable smart metering. New requirements e.g. on guaranteed latency for the integration of renewables in the grid control system will require 5G.
- For healthcare, 4G is not very developed because everyone needs to have access to the service, also in rural areas. If 5G can be made available in the rural areas, it might be a game changer.
- For the automotive / transportation industry, a lot of applications can today use 4G. 5G is needed for security, assisted driving and cooperative driving services because it embeds a strong reliability, low latency to deal with real time constraints, and the capacity to work under high load.

Smart grid owners may prefer to own their own connectivity infrastructure due to trust issues. Is regulation needed to make sure sharing is possible?

- Smart grids will be very distributed systems with a large number of databases at many locations. All will have their own infrastructure. But deploying dedicated connectivity networks for aggregated services would be counterproductive. Sharing will be needed to ensure cost efficiency.
- Strong regulation for sharing may not be the best idea because it would hinder infrastructure deployment. We need to find agreements and focus on the standards.

How the data coming from the users is affecting the verticals?

- Personal information can be exploited to customize services in all sectors. But there is a need to get the agreement from end users and control the flow of data to avoid social acceptance issues. Healthcare is a very good example because it is in the standardised way of a distributed system for personal information.

2nd panel: use cases and technical requirements

a) METIS-II project - Salah El Ayoubi (Orange)

Mr El Ayoubi presented the main objective of the METIS-II project: develop the overall 5G radio access network design. He then detailed the specific objectives of Work Package 1: refine the scenarios and perform a qualitative and quantitative techno-eco analysis.

5G services and use cases in METIS-II were presented. The selection process of the five METIS-II use cases (Dense Urban information society, virtual reality office, broadband access everywhere, massive distribution of sensors and actuators, connected cars) was explained. Next step in this process is 5GPPP use case harmonisation. Mr El Ayoubi indicated that inputs from vertical sectors are expected.

b) Energy - Linus Thrybom (ABB)

In the energy sector, the needs are for metering and control & monitoring of the energy networks. Three use cases have been developed in the energy white paper:

1. Metering for billing
2. Power grid protection, control and monitoring
3. 3a Transmission and distribution grid with demand side management (existing use cases); 3b Micro-grids, renewables and storage (emerging use case)

Mr Thrybom presented a table of use cases and associated KPIs. From traditional grid to new grid, the new elements will be micro grids, renewables and storage.

c) Health - Christophe Thuemmler (TUM)

A huge variety of use cases exists today in the health sector. Low latency is important for robotics: today 150 ms or 250 ms latency will affect quality of performance for surgery. With 500 ms, the surgeon will not be able to perform surgery with high quality standards, so very low latency will be necessary. In the future, it will be necessary to connect far more objects than today.

A second family of use cases is about tracking objects. It is necessary to connect far more objects in the hospitals (Implants, wheel chairs…).

Smart pharmaceutical represents a huge market and is building up. It can be controlled and monitored.

The health sector will need a scalable (guaranteed) quality of service. There is also a need for better methods to measure QoS, e.g., for insurance companies. Thuemmler also insisted that reliability is a very important parameter for the health sector.

d) Factory of the future - Wouter Haerick (iMinds)

An opportunity exists for 5G technologies to become part of globally connected value chains. Within the working group, five use case families have been identified for the factory of the future:

1. Time-critical process optimisation inside factory
2. Non time-critical in-factory communication
3. Remote control
4. Intra/inter enterprise communication
5. Connected goods

In terms of requirements, it was expressed that coverage is an issue for use case 5 and that the most challenging requirement is 1 ms latency for use case 1. In general, security and heterogeneity will have to be supported.

Recommendations from the white paper 5G and factory of the future include the "Plug-and-play" factor which is very important according to Mr Haerick. It should also be noted that a lot of SMEs are involved in the sector.

e) Automotive - Marcus Dillinger (Huawei)

Mr Dillinger started by recalling that cars now have a multitude of sensors and actuators and that roads are more "packed". The use cases defined for the automotive sector are the following:

- Automated driving: overtaking, cooperative collision avoidance, high density platooning
- Road safety and traffic efficiency services: see-through, Vulnerable Road User (VRU) Discovery, Bird's Eye View
- Digitization of transport and logistics: remote sensing and control, Remote processing for vehicles
- Information society on the road
- Nomadic nodes

The focus for research and innovation is on reliable communications in conjunction with low latency and security.

Business models should also be an area for research and innovation. Requirements for the use cases and services described above are in the range of 1 to 10 Mbps and 5 to 100 ms latency depending on the use case.

f) Media and entertainment - J.S. Bedo (Orange)

Jean Sébastien Bedo replaced Alexander Geurtz (SES) who was not able to come to the workshop.

The work on the white paper is still on-going and 10-15 companies and institutions are actively collaborating on this work. Use cases under consideration for the media and entertainment sector are the following:

- Ultra-high fidelity media
- Live event coverage
- User generated content & machine generated content
- Immersive and interactive media
- Cooperative production
- Collaborative gaming

Key requirements on 5G are still under consideration by the working group. One is to integrate the need to support any device, anywhere and at any time. In terms of volume of information and speed,

there is a need for higher downlink bandwidth with video quality requirements evolving to the highest audiovisual standards like Ultra HD. Demand for higher upload bandwidth for User Generated Content has been identified as well.

Quality of service requirements are expressed as low error rates for video or low latency for gaming. The ability to seamlessly switch from sources (e.g. unicast/multicast, adaptive streaming, etc) and to allow service personalization (e.g. dynamic/personal advertisements and user context awareness) was also highlighted.

Security is also seen as a key requirement both for end-users as well as for protecting content-owners and associated content rights.

g) Q&A

Which are the common use cases for which vertical sectors target to include 5G functionalities?

- Two extremes should be considered: mission critical & massive IoT
- Three 5G services are common (xMBB, uMTC, mMTC)
- Low latency should be guaranteed and wide coverage should be offered

Why vertical industries should consider 5G as a technical enabler for the vertical sectors?

- Low Frequency bands necessary but business models need to be established
- Energy sector: optical fibre is used today. More control and protection needed. There are big benefits to have it wireless as other nodes need to be accessed.
- The question of licensed/unlicensed frequency bands was raised as were concerns about reliability and latency. It was answered that 5G will be adapted to these requirements.
- Health sector: no construction work wanted. Users do not care if the connection is 4G or 5G but want plug and play solutions. The health sector wants to bring the hospital to people which mean more virtualisation of care. If 5G delivers these advantages, then it will be adopted by the health sector. The question of business models associated with 5G is open.
- Industry: managed network is a common functionality. Convenient, plug and play, easy to manage and easy to create new services are necessary. Simplicity also has to be delivered.
- Werner Mohr (5G-IA) indicated that 5G will also include 4G capabilities and will add new capabilities.
- S. El Ayoubi (Orange) mentioned that new radio interfaces will be integrated in 5G and that service will be offered seamlessly to the user.
- 5G will have to show what it brings on top of existing technologies. The basic difference will be the quality of service.
- Basic difference with 5G promises is QoS. QoS everywhere should be the focus as 4G is not fulfilling the needs of many verticals today.

Is it possible to identify commonalities between verticals? How will commercial outcome (cost efficiency) be addressed?

- There is a need for scalability. Not only a question of technology. Also a question of SLA (Service Level Agreement) and deployment.

- J.S. Bedo noticed that 4G was targeting mobile broadband but not IoT and verticals at the beginning. Meters and machines are still using 2G networks today. 5G has to start directly with verticals.

Will backward compatibility be available? Is there any blocking point?

- Cost is important.
- For the health sector, coverage is the most important requirement ("post code lottery" in the UK has to be avoided in the future).

Is there any problem with certification?

- Not a long term problem for the health industry.

What else if 3GPP does not succeed in meeting verticals requirements?

- There is no concurrent standard today.
- Only one flavour of 5G will be available to answer all needs & requirements? Dynamic and interactive process is necessary as new requirements might emerge
- Can vertical complement very cheap technologies?

Are 5G and verticals technologies roadmaps aligned?

- There are commonalities on coverage and latency. These two aspects can drive alignment
- Factory: No alignment between the roadmaps
- Energy: good match as grids are currently evolving
- Health: alignment not very strong. A lot of work need to be done

CTTC asked a question about energy efficiency requirements.

- For the energy sector, energy efficiency is taken into account.
- Health sector indicates ("human is a living battery") that new power sources will be available.
- Automotive: consumption of sensors has to be taken into account; autonomy is a key question.
- 5G will also focus on energy saving on network side (zero energy at base station if no traffic).

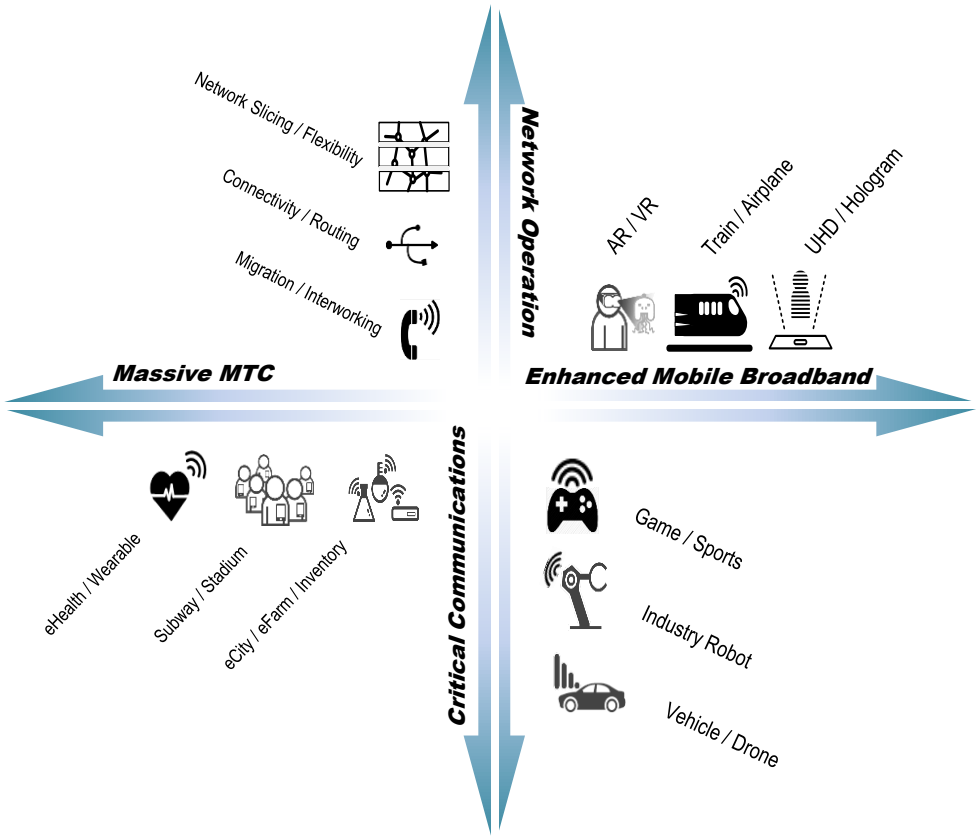
3rd panel: pre-standards

a) Introduction – Toon Norp (TNO)

Toon Norp presented 3GPP SA (Service & Architecture) structure, roles and activities related to verticals (MTC, Public Safety, V2X, Mobile TV and TV broadcast).

A specific study on 5G (SMARTER) started in May 2015 in order to develop requirements for 5G. More than 70 use cases were captured under the reference 3GPP TR 22.891. These use cases are grouped into four groups which will be studied until June 2016. The four groups are eMBB (Enhanced Mobile Broadband), mIoT (massive Internet of Things), CriC (Critical Communications) and NEO (Network Operation).

Figure 1: Use cases groups by SMARTER



Source: SMARTER

Consolidated requirements for these use cases will provide input for technical work in 3GPP Release 15.

Time is now if verticals want to be involved in 3GPP 5G activities. Indeed, use cases studies will be over mid-2016.

Q&A

Will there be joint activities between 3GPP SA and other SDOs (Standardization organisations) like ISO ICE for example in the factory domain?

- Not that much, people have to go to 3GPP meetings to influence the standard.

How often is this process of defining use cases and requirements carried out?

- Requirements are maintained each quarter in 3GPP SA. But a new generation is happening only once every 10 years.

Isn't there a risk of duplicating work between Europe and ITU on use cases?

- It is true that Europe is still discussing use cases while other bodies have already published documents. There is a lot of pressure from Asia to introduce 5G quickly. But this may result in missing some business opportunities.

Who is involved from the automotive sector?

- Only General Motors from car manufacturers is involved in 3GPP today. Other car manufacturers need to participate. There is a concern that a new standard is derived without enough involvement from the vertical industries. It was mentioned that a lot of work is being done at ETSI (ITS).

Railways & connected trains: are they part of use cases?

- Not in V2X but they are part of public safety work.

Will priority services be selected for early standardisation (5G Phase 1)?

- There is currently no prioritization in SA group. But there is a pressure from some 3GPP members to prioritize eMBB.

What is 3GPP time-line?

- Phase 1 should be completed by 2H2018 for commercial deployment in 2020. Phase 2 will follow 2 years later.

b) Energy sector – Linus Thrybom (ABB)

The most important requirements for the energy sector are:

1. Secure and reliable communication
2. Low latency

Timelines associated to those requirements are 2020 for the first one and +2020 for the second (lower latency).

SDOs for the energy sector include IEC, CEN, CENELEC, IETF and IEEE (CIGRE).

Research topics needed to provide timely input to the standardization process include improved latency, reliability, business models, security, unlicensed spectrum, massive machine communication, massive MIMO, time synchronisation.

Q&A

Do discrepancies exist between commercial offers and technology capabilities?

- MNOs only deploy a new technology if a business case is here. In particular, the Total Cost of Ownership has to be taken into account (including maintenance and operations). A trade-off between technical performances and costs has to be made.

c) Automotive sector – Maxime Flament (ERTICO)

The speaker described relevant SDOs in the automotive sector: ETSI TC ITS, CEN TC278-WG16 / ISO TC204-WG18 as well as ISO TC204-WG16 (CALM), IEEE 802.11 as well as IEEE 1609.x, SAE J2735, ITU C-ITS, DATEXII, TISA;

The speaker indicated that there is a need to have a scalable 5G standard to handle millions of cars and insisted that lifetime of a car is ten years.

Q&A

What about the respective time lines for 5G and specific automotive wireless solution?

- Technical solutions will have to be available in 5 years otherwise the automotive sector will choose other solutions than 5G. In the USA, deployment of 802.11p modules in new cars is already decided so we must integrate this fact in 5G design.
- Time line: in the next 18 months, solutions will be there for low cost low range solutions

d) Factories of the future – Wouter Haerick (iMinds)

SDOs for the factories of the future include ODVA, IEC, IEEE for IoT protocol stack.

Communications need is also outside of the factory when the product has been manufactured, so hybrid connectivity is needed.

Q&A:

What could bring new technologies to the factories of the future?

- Factory automation uses proven technologies. New ones have to prove they can bring something new and last to 15 years. They also have to fit into an existing infrastructure. As a result, independence from the radio layer would be a plus.

What are the requirements from the industry in terms of latency, coverage…?

- The white paper analyses if 5G can fill the gap.

5G PPP Phase 2 preparation

Didier Bourse presented the Pre-structuring model for 5G PPP Phase 2 which has been developed within the 5G Infrastructure Association. The model is available on 5G PPP website and an open consultation will be conducted before January to improve this first version.

Bernard Barani recalled that the European Commission is expecting from Phase 2 projects more testing and experimentations as well as the demonstration of impact for vertical sectors. For the European Commission, the PPP is industry-driven. Projects are not independent projects, they have to inter link with each other and Phase 2 projects have to piggy-back on Phase 1 results.

After that, eight project ideas for 5G PPP Phase 2 were presented by:

- Markus Dillinger (Huawei)
- Patrick Svedman (ZTE)
- Wouter Haerick (iMinds)
- David Lund (PSCE & HW Communications)
- Paulo Mendes (Copelabs)
- Ralf Neudel (IRT)
- Jorma Hintikka (Centria)
- Maxime Flament (ERTICO)

Slides are available on 5G PPP website.

Q&A

Is there any strategy for a European test bed?

- There is a need to go further on testing and experimentation in Phases 2 & 3. Demonstrations with vertical applications could be a good example. There is a work ongoing in the 5G Infrastructure Association to define what will not be done. Projects may be built in silos in Phase 3 (one manufacturer only with MNOs and verticals).

Are trains and the related sector included in the 5G PPP?

- Trains are mentioned in the 5G PPP vision paper.
- Trains are included in the running project 5G-XHAUL.
- There will be a dedicated call with Taiwan for Phase 2. Taiwan has offered test bed facilities with high speed trains.

Will there be funding for verticals in Phase 2?

- Yes. It is part of the expected impact by the European Commission. Verticals are expected to get involved.
- Two open TAs are available in the Pre-structuring model for Phase 2.

Annex

List of registered participants

First name	Last name	Organisation
Andrew	Murphy	BBC
Rui	Aguiar	Instituto de Telecomunicacoes
Ashraf	Ahmed	KTH
Ben	Allen	Network Rail
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André	Bourdoux	IMEC
Didier	BOURSE	Alcatel-Lucent
Jan	Bouwen	Alcatel-Lucent
Nadia	Brahmi	Bosch
rudi	broos	Alcatel-Lucent
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Emilio	Calvanese Strinati	CEA-LETI
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Wojciech	Dymowski	ITTI / MedStar
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Giovanni	Frattini	Engineering Ingegneria Informatica
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Isabelle	Korthals	Deutsche Telekom Laboratories
Vivek	Kulkarni	Siemens AG
Timo	Lahnalampi	InterInnov
oscar	lazaro	Innovalia
Ming	Lei	WWRF (Wireless World Research Forum)
David	Lund	PSCE Forum / HW Communications
Toktam	Mahmoodi	King's College London
Jaime	Mancebo	A-CING
Laurent	Manteau	GEMALTO
Carolien	Martens	imec
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Daniel	Medina	Huawei Technologies
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Frederic	Pujol	IDATE
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Alberto	Rabbachin	EC- DG CONNECT
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Pedro A.	Ruiz	Integrasys SA
Stephan	Saur	Alcatel-Lucent, Bell Labs
Hans	Schotten	Univ of Kaiserslautern / DFKI GmbH
Alain	SERVEL	PSA
INdran	Sivarajah	Avanti Communications Ltd
Rute	Sofia	COPELABS/ULHT
Spiros	Spirou	Intracom Telecom
Patrick	Svedman	ZTE
Luigi	Telesca	CREATE-NET
Linus	Thrybom	ABB AB, Corporate Research
Terje	Tjelta	Telenor
Hugo	Tullberg	Ericsson
Juanjo	Unzilla	UPV/EHU - University of the Basque Country
Paulo	Valente	Cable Europe
Ingrid	Van de Voorde	ALU
Colin	Willcock	Nokia
Martin	Wollschlaeger	TU Dresden
Oguzhan	Yavuz	Netas Telecommunications Inc.