



5G PAN-EUROPEAN TRIALS ROADMAP VERSION 1.0

The 5G Pan-European Trials Roadmap has been elaborated and reviewed by the Trials Working Group (WG) Members organizations as listed in Page 6.

1. Introduction

Ambitious 5G trials and pilots are currently being implemented in various regions of the world. This document addresses the high-level 5G Pan-European Trials Roadmap and the related actions towards implementation. It is made available in view of public release at the 3rd 5G Global Event taking place on 24-25.05.17 in Tokyo. The Trials Roadmap has been worked out by the European Trials WG¹ coordinated by the 5G Infrastructure Association (5G-IA), expanding the work initiated by the Industry and EC in the context of respectively the 5G Manifesto (http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=16579) and the 5G Action Plan (http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=17131) and following the definition of the Roadmap Strategy introduced in MWC 2017 (<https://5g-ppp.eu/wp-content/uploads/2017/01/5G-IA-Action-Plan-Event-Press-Release--MWC2017.pdf>).

A solid and comprehensive strategy to develop Pan-European coordinated trials is proposed as well as international trials with non-EU partner countries, addressing several key elements of the 5G Action Plan (5GAP). The main objectives of the Roadmap are to:

- Support global European leadership in 5G technology, 5G networks deployment and profitable 5G business.
- Validate benefits of 5G to vertical sectors, public sector, businesses and consumers.
- Initiate a clear path to successful and timely 5G deployment.
- Expand commercial trials and demonstrations as well as national initiatives.

Most of the Roadmap implementation is and will be covered by the Industry on a private basis, with part of this implementation supported by the EC through the 5GAP, EC 5G Infrastructure PPP Phase 3, EC 5G Investment Fund and by Member States through specific National programmes.

This document addresses the current four main pillars of the Roadmap (1) 5G Private Trials, (2) 5G Vertical Pilots, (3) 5G for UEFA EURO 2020 and (4) 5G Trials Cities. The release of the Roadmap Version 2.0 is planned for end 2017.

¹ Open participation / membership.

2. Building Europe 5G readiness through 5G Private Trials

Europe is home of an increasing number of 5G private experimentation and trials (pre-commercial and commercial) involving a multiplicity of stakeholders and notably network operators, manufacturers/vendors and some vertical actors. Several major network operators in Europe have already announced first demonstrations and experimentations results achieved and planned on specific 5G features, bilaterally with one single manufacturer/vendor or bilaterally with multiple manufacturers/vendors. The main target of the current trials is to demonstrate the high data rates and low latency communications, which are key features for 5G technology. In 2017 there are only a few 5G Private trials including vertical stakeholders. Trials in 2016-2017 have been and will be focused on enabling technologies related to the radio interface (high throughput, millimetre-waves and other new large spectrum bands, antenna technologies...), the network architecture (virtualization, cloudification, network slicing, edge computing...) and the introduction of new technologies dedicated to specific use cases (technologies for IoT, for automotive...). It is foreseen, that when the maturity level of 5G features increases, more direct vertical stakeholders will be included for trials. Some of the 5G trials announced include joint work on experimentation platforms that could become open to new ecosystems, in order to develop 5G applications and services in the context of the digital transformation of vertical industries.

Before 2018, when the first 5G standard release will be delivered by the 3rd Generation Partnership Project (3GPP), the technology demonstrations and trials are implemented in different countries, driven by the location of the different Network Operators. These demonstrations and trials are done partly independently of the status of standardization (though network operators may prioritize features well advanced in standardization), to early demonstrate and validate the new 5G capabilities as well as foster an ecosystem around these new 5G capabilities. Consequently, the running trials and demonstrations are already today building concrete know-how and readiness of the European industry to benefit from early 5G launch when the standards will be fully stable, by the end of 2019.

The 5G readiness will be further consolidated during and after 2018, when European stakeholders will move to agree on detailed trials specifications (use-cases, scenarios, interfaces, agreement to transfer use-cases across trial networks) valid for Pan-European trials, largely based on standard-compliant systems. These trials will take advantage of the first 5G release of the 3GPP Standard (Rel-15 Stage 3 - June 2018) and use some of the additional frequency spectrum proposed for identification in WRC 2019, enabling the full performance capabilities of 5G in terms of capacity and speed. These trials will aim to demonstrate wider interoperability and support for vertical use-cases in order to validate new business models.

The 5G-IA Trials WG targets a tight connection with the NGMN 5G Trial & Testing Initiative (TTI), launched in June 2016. TTI enables a global collaboration on testing activities, consolidating contributions and report on industry progress, and testing future 5G use-cases with industry stakeholders (in particular from vertical industries). It involves testing technology building blocks, proofs of concept, testing of key interfaces for ensuring interoperability, and pre-commercial networks trials to visualize 5G capabilities and advantages on a system close to real network operation.

At the international level, multiple standalone 5G network trials will be in progress by 2018. It is hence targeted to run interoperability trials in coordination with other main regions. In order to

enforce the coordination with other regions the bi- and multi-lateral agreements with other 5G initiatives in China, Japan, Korea, the United States and Brazil will be leveraged.

3. 5G for Vertical Industries - Building the case through Pilots

After 5G technologies have reached a maturity level beyond pure laboratories experiments, trials and pilots at local as well as Pan-European levels will be targeted to accelerate the deployment of these new technologies. The main goals of such trials are the validation of 5G technologies in multi-vendor and multi-user environments. Verifying the stability and advantages in the environments will be an important step in moving 5G technologies from the R&D laboratories into the market. In addition such trials will serve to validate the technology as well as to identify further features to serve the needs of specific industry segments and use groups. A secondary and equally important goal is to increase the understanding of the new possibilities 5G technologies offer in industry segments which are less ICT focused and thereby, help to jump start 5G adoption across a broad range of industries.

Following the 5G Manifesto, eleven different industry segments are considered by the 5G-IA Trials WG with some common and various different functional characteristics. Common and new functions utilized by almost all vertical industries are Targeted Virtual Networks, enhanced Privacy and Security and IoT Enabler Functions. Beyond these, different verticals require function such as Localization Techniques, Cloud and Edge Computing support or Heterogeneous Network Access, all provided by 5G. While the understanding of the benefits of 5G for different industries is a crucial point for a successful deployment, the 5G-IA will assure that an umbrella perspective across all verticals will be developed to avoid siloes and a harmful segmentation of the 5G trials.

The ambition and the reality of demonstration coming from vertical trials have a strong dependency on the underlying platform capabilities. The platform interoperability issues are considered from at least two different angles:

- Verticals should benefit from meaningful (representing 5G services offer) common and standard interfaces such as APIs. This will allow discovering, triggering, negotiating and controlling the platform capabilities.
- Since many Verticals should involve several platforms to demonstrate end-to-end capabilities, interoperability between platforms is becoming a must. Last but not least platforms should serve to KPI validation, benchmarking including vertical mission. Platforms should also be replicable and deployed where the vertical stands.

Beyond functional aspects, different verticals have different levels of 5G readiness. In some verticals large industry alliances or consortia exist, e.g. the EATA and 5GAA in the automotive sector or the IIC in the manufacturing industry, which are well positioned to partner with the 5G Industry to establish, drive and shape 5G adoption within their verticals. From that perspective, the Connected Cars is considered as one of the verticals priorities for a strategic 5G European roadmap targeting vertical use cases.

There are several other vertical segments such as eHealth, the various Smart X areas (X= Cities, buildings, transport, agriculture, energy) and the Public Safety, where a coordinated approach will be addressed. Relevant sector organizations e.g. the Personal Connected Health Alliance for the eHealth sector or other organizations as far as available and relevant will be invited to participate to this initiative. Planned 5G pilots at high visibility public events such as Media and Entertainment services for the EURO 2020 or 5G services for lighthouse Smart City (including various other Smart

X sectors) will deliver awareness for end users and get them interested in these new services. An important part of such trials will be the understanding of business aspects to support the set-up of the 5G infrastructure. In some sectors like Public Safety or eHealth business models may be of secondary importance, as the value to society is the focus.

4. 5G for UEFA EURO 2020 – An opportunity for a Pan-European Showcase Event

In order for 5G to be truly successful high profile trial(s), accessible to large public audiences are planned. The target flagship event has to get widespread media attention and serve as a milestone for industry, governments and the general public that 5G is coming now and is beneficial for individuals and society.

The UEFA EURO 2020 football championships will be played in 13 different cities in Europe (Glasgow, Dublin, Copenhagen, Budapest, Bucharest, Brussels, Bilbao, Amsterdam, Saint Petersburg, Rome, Munich, Baku and London). This makes the EURO 2020 an excellent opportunity for a 5G Pan-European trial, also because of the media attention it will get. The timing of EURO 2020, summer 2020, just before the 2020 Olympics in Japan, fits well with the EC 5GAP.

The proposal is that the EURO 2020 acts as the “launching event” for 5G in Europe with a number of 5G services that will be trialed around the EURO 2020 football cup. Three different types of trial services are proposed, the triple A trials:

- A. For the stadiums, around the stadiums and in fan zones, 5G Augmented and virtual reality applications related to EURO 2020 or football in general can provide ways to entertain fans before, during and after the game, including through immersive experiences around the competition. These services could be available in hosting cities but also in other cities.
- A. The EURO 2020 will be the opportunity to demonstrate services in Automated transportation around the stadiums and relevant transport routes. Scenarios include transportation to and from the airports and automated vehicles for the transport of officials, staff and supporters.
- A. Public safety authorities present for security around the stadiums could benefit from Advanced public safety services. For example augmented reality can be used to visually mark persons of interest based on facial recognition. Tailored services (e.g. access security, persons localization) will create a significant improvement in safety and security.

Content and services will be shared across the different sites, which will be connected by different means towards the provision of services beyond the capabilities of current technologies. In each of the cities a consortium is needed of local governments, playing stadiums, operators, infrastructure vendors and application providers. The City of Amsterdam, with the Amsterdam Arena as EURO 2020 host stadium publicly announced at the MWC 2017 in Barcelona that they are committed to participate in 5G trials and to get as many playing cities on board. For each playing city, an agreement with (at least one) operator is targeted to ensure there will be a 5G coverage on which the intended 5G services can be trialed. Sufficient spectrum (at least 100 MHz per operator across the 3.4-3.8 GHz band, several hundreds of MHz in the 26 GHz band) is targeted for availability from the related Member States, in order to allow demonstrating the full performance capabilities of 5G. The trial services will be developed together with the local partners, e.g. public safety trials will need collaboration with local governments. Where possible replication of 5G trial services across multiple cities should be aimed for. A Pan-European steering committee will ensure a

consistent coordination of trial objectives and implementation, including also the marketing and communications aspects of this profile event across Europe and the world.

Many of the trial services are not only relevant for EURO 2020, but are also related to Smart City type applications. A relation with UEFA will be established in order to investigate the rights and constraints associated with using EURO 2020 as a flagship event and to ensure the trials add to the success of UEFA as well. A win-win-win perspective between 5G Infrastructure PPP, EC and MSs (and related Cities) and other stakeholders is sought. Specific actions may be partly funded by EC in the context of PPP Phase 3 and by MSs at National level.

5. 5G Trials Cities

In complement to the 5G private trials under development and the 5G for UEFA EURO 2020 flagship event definition, specific cities in Europe already announced their plans to become 5G Trials Cities, at the forefront of 5G experimentation and trials. The different involved stakeholders come together to enable societal infrastructure benefits to the public. 5G will clearly be part of future cities, and to conduct relevant trials is a way to ensure the development of the best feasible 5G solutions. A non-exhaustive list of 5G Trials cities is: Amsterdam, Bari, Berlin, Espoo, L'Aquila, London, Madrid, Malaga, Matera, Milan, Oulu, Prato, Stockholm, Tallinn and Turin. In addition there are also 5G Research & Innovation Programs running in several Members States, including the development of specific labs and experimentation and trials platforms. These platforms being generally anchored in specific labs / cities (before their replication), contribute to the 5G momentum in specific countries / cities. Some of the 13 cities where the EURO 2020 competition will be organized already work on the possible 5G demonstrations and showcase. It is also anticipated that Members States will communicate before end 2017, in the context of the 5GAP the information on their 5G Pioneering city (or multiple cities) where 5G will be deployed in 2020. These different actions clearly create a strong momentum on 5G from cities and countries perspectives.

Under the 5G Infrastructure PPP initiative, a "5G City Challenge" will be organized as a call for interest towards interested cities prepared to sign a 5G charter and aiming at supporting cooperation among the cities involved in 5G experimentation and trials, e.g. for the possible development of best practices and sharing of lessons learnt. The number of collaborations are foreseen to grow as the various trial activities in the cities are maturing. In connection to the current European Smart Cities developments, a Charter/Alliance of 5G Trial Cities can be developed in that context.

Here again, the availability of sufficient amounts of spectrum (see section 4) will be sought to deliver the full benefits of the 5G city trials.

Trials WG Members organizations contributing to the Trials Roadmap Strategy

ABB, ADVA Optical Networking, Ahlers, Airbus, Altice Labs, Atos, BMW, BT, Deutsche Telekom, DOCOMO Communications Laboratories Europe, Ericsson, Eutelsat, Huawei Technologies, IBM Research, Indra Sistemas, Inmarsat, Intel Mobile Communications, KPN, Leonardo, Mitsubishi Electric R&D Centre Europe, NEC Laboratories Europe, Netaş Telecommunication, Nokia, Orange, Philips, Proximus, QinetiQ, Samsung Electronics Research Institute, SES, Siemens, Telecom Italia, Telefónica I+D, Telenor, Tele2, Telespazio, Telia Company, Thales Alenia Space, Thales Communications & Security, Trenitalia, Turk Telekomünikasyon, Vodafone, ZTE Wistron Telecom, European Broadcasting Union (EBU), ECTA, ETNO, T-REGS, AICO Software, AMBEENT WIRELESS YAZILIM, CityPassenger, Ingeniería y Soluciones Informáticas, Integrasys, InterInnov, M.B.I., Nextworks, Quobis, Sequans Communications, CEA-LETI, Centre Tecnologic de Telecomunicacions de Catalunya (CTTC), Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT), DLR (German Aerospace Center), Fundacion IMDEA Networks, IMEC, Institut Mines-Télécom, Instituto de Telecomunicações, TNO, Universidad de Málaga, Universitat Politècnica de Catalunya, University of Bologna, VTT Technical Research Centre of Finland, Universidad Carlos III de Madrid.

Note: Specific comments / questions can be communicated to the 5G-IA Trials WG @ TrialsRoadmap@5g-ppp.eu.