



## 5G Communication with a Heterogeneous, Agile Mobile network in the Pyeongchang Winter Olympic competition

Grant agreement n. 723247

# Deliverable D7.1 Plan for Standardization and Dissemination

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### Abstract

The present document outlines the 5G CHAMPION strategy and agreed actions in order to drive standardization, regulation and dissemination activities. An emphasis is laid on joint European-Korean efforts in order to maximize the project synergies and foster collaborations between the partners. The intention is indeed to exploit a cross-region consensus among the project partners in order to be in the position to efficiently influence the identified bodies and fora.

For this purpose, the technical direction addressed in the project are analyzed with respect to their potential for Standards Contributions, Regulation Contributions, Scientific Publications, Workshops/Tutorials and Interaction with Media. Based on this analysis, a contribution plan for selected and relevant bodies and fora is proposed and detailed. Furthermore, specific actions for contributing to top level conferences, scientific journals and high visibility events are presented. Finally, media interactions are addressed which help to raise awareness of the project among a broader, non-technical audience.

### Index terms

5G, 5G CHAMPION, Dissemination, Regulation, Standardization.



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## 1 Introduction

The present document outlines the strategy and planned actions of the 5G CHAMPION consortium in order to

- Influence Standards discussions,
- Influence Regulation discussions,
- Contribute to key and best-in-class Conferences and Journal papers,
- Organize and contribute to workshops, conference tracks, tutorials, special sessions, summer/winter schools and other dissemination events,
- Contribute to key exhibitions and
- Influence media perception of 5G technology.

Concerning standards discussions, the 5G CHAMPION consortium has identified key bodies of immediate relevance to the technical research directions of the project. It is expected that the joint European/Korean framework and the close collaboration between corresponding industrial and academic partners will help to strengthen the influence in standards discussions. Joint contributions will underline a close cross-region alignment and are expected to further increase the relevance and acceptance of corresponding submissions.

In terms of regulation discussions, there are currently key opportunities to influence CEPT, TCAM and European Commission regulation discussions – in particular related to mmWave and Software Reconfiguration technology. The consortium will drive corresponding discussions either directly or indirectly through other bodies (such as ETSI) which will consult the Government Administrations on the suitable way forward.

5G CHAMPION partners are furthermore committed to produce best-in-class technical results and to provide thought leadership in the field of 5G technology and its further evolution. Key international scientific conferences and high-profile Journal Papers are identified within this document as candidates for contributions by the 5G CHAMPION consortium. The objective is again to exploit cross European/Korean synergies in order to maximize the visibility and impact in the scientific community and beyond.

Beyond contributing to scientific conference through paper presentations, the 5G CHAMPION consortium will furthermore organize Workshops, Conference Tracks (such as the *Industry Track on “5G and Wireless Communications” at IEEE VTC’2017 in Sydney, Australia*), Tutorials, Special Sessions and other dissemination events.

A key milestone of the project is the showcasing of key enabling technologies for a proof-of-concept environment at the 2018 Winter Olympics in PyeongChang, Korea. This event in combination with the European/Korean partnership is expected to attract a high level of attention by the scientific, industrial and media community. It will help to maximize the visibility of 5G CHAMPION results and hardware/software solutions.

Finally, the consortium interacts with media representatives in order to disseminate results beyond the scientific and industrial community. The objective is to educate the public on the potential of 5G technology and to facilitate the acceptance of this technology leap.



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## 2 Technology Directions and related Dissemination Strategy

Table 1 summarizes the 5G CHAMPION strategy for contribution to standards bodies and regulation bodies, to influence and educate the scientific community and to interact with media representatives in order to maximize the impact and visibility of the project. The key technological directions of the 5G CHAMPION project are identified and mapped with respect to specific actions that are candidates over the lifetime of the project.

**Table 1: Dissemination Strategy.**

	<b>Standards Contributions</b>	<b>Regulation Contributions</b>	<b>Scientific Publications</b>	<b>Workshops/ Tutorials/ Tracks</b>	<b>Interaction with Media</b>
complex 5G set-up			Conference/ Journal contributions		TV interview, press releases
mmWave high capacity backhaul in 24-28 GHz using novel antenna arrays	IEEE & 3GPP	CEPT	Conference/ Journal contributions	Educational events	
virtualization through NFV/SDN in a secure backhaul architecture as well as a novel SDN-based IPsec tunnel architecture	ETSI		Conference/ Journal contributions	Educational events	
novel accurate positioning solutions (<1m accuracy) using mmWave combined with GNSS PPP	ETSI		Conference/ Journal contributions	Educational events	
direct UL/DL communication between satellites and 5G User Equipment			Conference/ Journal contributions	Educational events	
Software Reconfiguration	ETSI	TCAM SDR Working Group	Conference/ Journal contributions	Educational events	

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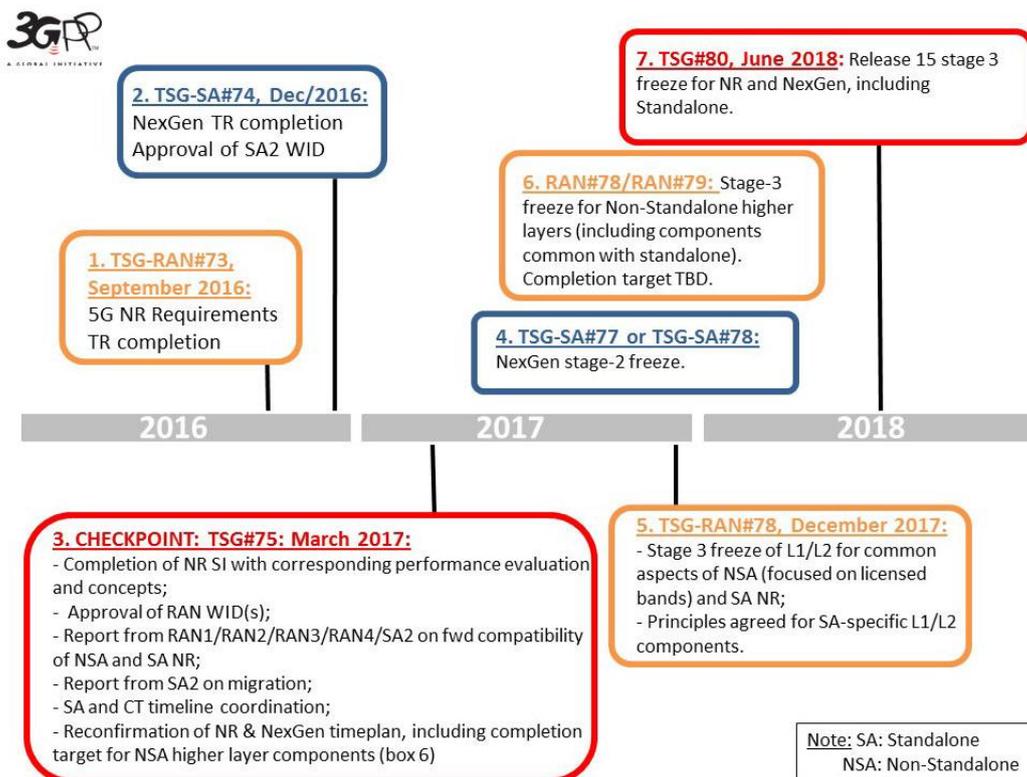
### 3 Standards & Fora Strategy

It is a key objective of the 5G CHAMPION consortium to influence most relevant standards and fora with the object to drive thought leadership and the 5G technology evolution across the entire eco-system. This section outlines the consortium strategy for the most relevant bodies that are identified.

#### 3.1 3rd Generation Partnership Project (3GPP)

The 3rd Generation Partnership Project (3GPP) is identified to be one of the key bodies for the definition of future 5G technology. The checkpoints to be met by the 5G CHAMPION consortium with respect to the 3GPP planning are indicated in Table 2.

**Table 2: 3GPP 5G activities during 5G CHAMPION project**  
([http://www.3gpp.org/images/articleimages/5g\\_timeline.jpg](http://www.3gpp.org/images/articleimages/5g_timeline.jpg)).





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In order to cope with the 5G requirements, 3GPP initiated studies on use cases and new radio (NR) technologies for the 5G network in a 3GPP RAN Workshop held in Phoenix, AZ in Sep. 2015 [1]. At the workshop, there was a consensus that the new radio will cover three high level use cases:

- Enhanced Mobile Broadband;
- Massive Machine Type Communications;
- Ultra-reliable and Low Latency Communications.

3GPP has started the 5G standardization effort for developing the “New Radio” access technology in TSG RAN and the “Next Generation” core network in TSG SA. The New Radio will be non-backward compatible to the legacy LTE-Advanced technology, and will meet all the 5G requirements and use cases defined by the IMT-2020 [2]. The Next Generation core network will define new architecture to support diverse use cases and scenarios, and enable tight multi-RAT interworking. There are also under planning Standalone and Non-Standalone NR operations, where the latter one would have LTE as control plane anchor.

The study item (SI) on New Radio access technology approved in Mar. 2016 will cover initial evaluation of various new physical-layer techniques such as modulation, waveform, multiple access, channel coding, and MIMO for different deployment scenarios [3]. Among those various 5G deployment scenarios, the high speed scenario focuses on providing continuous coverage along high speed train tracks using either 4 or 30 GHz frequency band [2]. The access link to the UE in the train is directly established for the 4 GHz band. For the 30 GHz band, the access link for the UE is established through a relay which is deployed outside of the train. During the project time frame, new Study and Work Items could be expected, especially one could target for items regarding physical layer measurements and procedures related to beamsteering and beamforming.

Indeed, 5G CHAMPION partners have already been contributing to the scenario and evaluation assumption descriptions for the 5G NR high speed scenario in 3GPP RAN1#84bis, RAN1#85, and RAN1#86 meetings. In addition, there have been partner contributions on the study of new radio technology standardization especially on the numerology, frame structure, channel structure, and MIMO-related topics. 5G CHAMPION partners are thus recognized by the community as key contributors and thought leaders and are perfectly positioned to further drive the technology evolution. 5G CHAMPION will keep seeking worldwide for solid partnership and support for better dissemination and great promotion of 5G CHAMPION standardization activities in 3GPP standard body by actively participating technical discussions and jointly generating contributions.

Hence, the technical solutions developed during the 5G CHAMPION project will significantly impact on the development of the NR access technology SI, especially on high speed scenario and beamforming related items.

The relevant 3GPP working groups for possible contribution from 5GCHAMPION are:

- SA1: Service aspects;
- SA2 : Architecture aspects;
- SA3: Security aspects;
- SA5 : Network management aspects;
- RAN1: Radio Layer 1;
- RAN2: Radio Layer 2 and Radio Layer 3.



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In the framework of 5G CHAMPION, we have furthermore set the objective to determine the feasibility of **seamlessly integrating satellite communication in the 5G network infrastructure** to meet selected 5G Key Performance Indicators. In particular to define the technical enablers and configurations allowing operation of a 5G User Equipment via satellite for global service continuity beyond terrestrial network coverage.

In terms of standardisation activity, this translates into the following ambitions:

- Ensure that the 3GPP Next Gen architecture will support satellite Radio Access Network as any other 3GPP defined RAN technologies;
- Define a future Uu interface which is satellite “friendly” for example in terms of latency and Doppler characteristics associated to the proposed space segment (whether NGSO or GSO);
- Define the high level architecture of the Satellite Radio Access Network.

Similar to the upper statements, 5G CHAMPION consortium partners have been actively contributing to 3GPP standardization in the field of satellite communication and have thus created a fruitful basis for future work to be performed in the framework of the consortium. Examples of specific past and planned future contributions contributions are indicated in Table 3. The 5G CHAMPION consortium will be able to build on this basis and benefit from an established channel into the community.

**Table 3: Examples of contributions to 3GPP by 5G CHAMPION consortium members.**

Reference	Document Title	Impact	Status
3GPP TR 22.891	Feasibility Study on New Services and Markets Technology Enablers; Stage 1 (Release 14)	Adding a use case “5G Connectivity Using Satellites” (clause 5.72)	Done in SA1
3GPP TS 22.261	Service requirements for next generation new services and markets [TBD]; Stage 1 (Release 15)	Add a new basic capability “Satellite Access” (Clause 6.3.2.3): <i>The 3GPP system shall be able to provide services using satellite access.</i> <i>The 3GPP system shall support service continuity between land based and satellite based access networks owned by the same operator or by an agreement between operators</i>	SA1#75 decision (August 2016)
3GPP TR 38.913	Study on Scenarios and Requirements for Next Generation Access Technologies; (Release 14)	Adding of a new deployment scenario “Satellite extension to Terrestrial” (Clause 6.1.12)	RAN#72 decision (June 2016)

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3GPP TR 23.799	Study on Architecture for Next Generation System (Release 14)	Add an architectural requirement (Clause 4.1): <i>Satellite radio access network (3GPP and non 3GPP defined) shall be supported (for phase 2)</i>  Add a new key issue 22: Support of "5G connectivity via satellite" use case	SA2#116bis decision (September 2016)
3GPP TR 38.912	Study on New Radio Access Technology (Release 14)	Add relevant information and parameters that would be needed to model a NextGen (5G) system with satellite access in order to evaluate the performance of 5G technologies over such a system	To be submitted in future RAN1 meetings

As a specific next step, 5GCHAMPION is expected to be an input for several 3GPP SA and RAN WG preparation meetings for the possible contributions for actual SA and RAN WG Study or Work items, especially related to mmWave beamforming and/or steering and Satellite Technology. Gained hands-on experiences from 5GCHAMPION demonstration will be exploited internally for the future product releases in the 5G CHAMPION partner organizations.

### 3.2 European Telecommunications Standards Institute (ETSI)

ETSI is an independent, not-for-profit organization which provides a platform for all those who need to be involved in the standardization of telecommunications: ETSI creates standards via consensus and through the direct input of our members.

ETSI is working on key technologies which enable the future 5G Eco-System, including for example Mobile Edge Computing, Network Function Virtualization, Security solutions, Reconfigurable Radio Systems, Satellite Systems, etc.

In the context of the 5G CHAMPION project, the focus of the ETSI work will be on the ETSI Satellite Earth Stations and Systems (ETSI TC SES) and ETSI Reconfigurable Radio Committee (ETSI TC RRS). The latter is currently chaired by Dr. Markus Mueck of INTEL. As a key enabler of future 5G systems, TC RRS develops solutions for software reconfigurability in alignment to article 3(3)(i) and 4 of the novel Radio Equipment Directive (RED) and thus supports related European Commission activities in the TCAM SDR (Software Defined Radio) WG (Working Group) which is currently in an early phase – the timing is thus perfect for 5G CHAMPION to influence the corresponding work of TC RRS and TCAM.

Furthermore, ETSI RRS recently started to develop a Radio Interface Engine. The committee is currently working on a corresponding Feasibility Study. With context information management being a key enabler in the future 5G eco-system, 5G CHAMPION will contribute to this activity and influence corresponding discussions.

In the field of virtualization, contributions will be prepared to standards bodies in the field of MANO (Management and Orchestration) as it is for example ongoing in ETSI. To give a specific example, 5G CHAMPION partner KT plans to test a variety of 5G VNF solutions from

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global vendors. From the view point of service provider, KT will produce the requirements for 5G MANO.

In the context of Satellite systems handled in ETSI TC SES, a new work item referenced DTR/SES-00405 has been initiated. Entitled "Satellite Earth Stations and Systems (SES); Seamless integration of satellite and/or HAPS (High Altitude Platform Station) systems into 5G system;," it aims at identifying 5G systems architecture integrating satellite and/or HAPS systems (communication and/or navigation) for relevant use cases. The intent is to identify the necessary standardisation activity in relation to relevant satellite (communication and/or navigation) technologies.

### 3.3 Institute of Electrical and Electronics Engineers (IEEE)

Within IEEE standards activities, the center of interest for 5G CHAMPION lies in the IEEE 802 family. It relates to IEEE standards, which deals with local area networks (LANs) and metropolitan area networks (MANs) and is maintained by the IEEE 802 LAN/MAN Standards Committee (LMSC). In the IEEE 802, there are several individual Working Groups (WGs) providing the focus for each area. Among them, ETRI has been participating in the IEEE 802.11, IEEE 802.15 and IEEE 802.16 WGs, and brief descriptions of which are given as follows:

- IEEE 802.11 WG: Wireless LAN WG developing a set of media access control (MAC) and physical layer (PHY) specifications for implementing wireless local area network (WLAN) communication in the 900 MHz and 2.4, 3.6, 5, and 60 GHz frequency bands
- IEEE 802.15 WG: Wireless Personal Area Network (WPAN) WG focusing on the development of consensus standards for Personal Area Networks (PANs) or short distance wireless networks
- IEEE 802.16 WG: Broadband Wireless Access WG currently focusing on developing standards and recommended practices to support the development and deployment of broadband Wireless Metropolitan Area Networks

Recently, in order to offer a better mobile Internet service in high-speed environments, IEEE 802.15, a working group (WG) of the IEEE 802 standards committee, created an Interest Group High Rate Rail Communications (IG HRRC) in November 2014 [4], based on the proposal made by 5G CHAMPION partners [5]. The main objective of this group is to focus on standardization of a mobile wireless backhaul for user groups located in the fast moving vehicles, especially for high-speed railway. Before the proposal was approved by IEEE 802.15 WG, the proposal was initially presented in the IEEE 802.16 WGs. However due to lack of participants in the 16 WG, 5G CHAMPION PARTNERS realized that it is difficult to keep standardization activities in the group. That was the main reason why 5G CHAMPION PARTNERS and delegates from the 16 WG finally decided to propose it to the IEEE 802.15 WG.



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The IEEE 802.15 IG HRRC currently chaired by ETRI holds a joint meeting with the 802.16 WG. The group usually organizes the meeting during IEEE 802 plenary session, so there will be 3 meetings of IG HRRC in March, July and November each year. The main participants of the group include ETRI, IEEE 802.16 WG delegates as well as Beijing Jiaotong University (BJTU), China. They have already had 8 meetings so far and during the previous meetings, a wide range of frequency bands including millimeter-wave have been studied as a candidate for the broadband wireless backhaul links for the fast moving vehicles through ray-tracing channel modeling and system demonstration, showing its infinite feasibility and potentiality [6][7][8]. Besides, various technical challenges and key technologies have been discussed as well [9].

Recently, our main concern is considering the transition from the IG to Study Group (SG) when enough interest has been identified. Since the group is completely led by ETRI, as long as both Korean and European consortiums could be able to collaborate on driving on the IEEE 802.15 IG HRRC standardization activities, there would be a high possibility of the transition to the SG, even to Task Group (TG) that is responsible for developing the specification. At the stage of either SG or TG, it is would be a great chance for both Korean and European partners to closely work on specification development and include their key technologies to the specification, which will not only highly be beneficial to the project, but also create a long lasting synergy for 5G research, innovation and commercialization. Therefore, the main strategies for the IEEE 802.15 IG HRRC standardization activities are to invigorate the group with collaboration from European and other Korean partners, which will finally paved the way for transition to SG and TG. As a first step, 5G CHAMPION PARTNERS will distribute the call for participation document in order to give a comprehensive understanding of the IG status and to encourage European partners and other companies to participate in upcoming meetings scheduled as follows:

- IEEE 802 plenary session on November 6-11, 2016 (Grand Hyatt San Antonio, San Antonio, TX, USA);
- IEEE 802 plenary session on March 12-17, 2017 (Hyatt Regency Vancouver, 802 Plenary Session);
- IEEE 802 plenary session on July 9-14, 2017 (Estrel Hotel and Convention Center, Berlin, Germany);
- IEEE 802 plenary session on November 5-10, 2017 (Caribe Hotel and Convention Center, Orlando, FL, USA).

### 3.4 Internet Engineering Task Force (IETF)

The Internet Engineering Task Force (IETF) is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet.

5GCHAMPION will monitor the IETF SFC working group, IRTF SDNRG and IRTF NFVRG as well as Operation & Maintenance activities (Transport Network Control and Management related solutions) which are expected to play a key role in future 5G systems.

### 3.5 Next Generation Mobile Networks (NGMN)

The Next Generation Mobile Networks NGMN Alliance is an open forum to evaluate candidate technologies to develop a common view of solutions for the next evolution of wireless networks. It was founded by major telecommunication corporates in 2006, and it is regarded as an association of mobile operators, vendors, manufacturers, and research institutes.

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The main objective of NGMN is to provide a platform that facilitates the successful commercial launch of future mobile broadband technologies, thereafter, providing affordable broadband mobile services to the end-user. In more details the objectives are:

- expansion and evolution of mobile broad band with an especial focus on 5G
- setting clear goals and functionalities as well as basic requirements for deployment scenarios
- recommendations to equipment providers and standardization bodies, leading to cost-effective network evolution
- to facilitate the information flow among the industry partners on critical and immediate concerns and to share experiences, and
- stating and dealing with the spectrum necessities and supporting the foundation of a transparent and clear IPR regime.

The NGMN envisions 5G is an end-to-end platform that enables a fully mobile and connected world, which empowers value creation towards customers and partners.

5G CHAMPION partners are actively involved in NGMN activities on various levels. The consortium will be able to showcase the outputs of 5G CHAMPION within the NGMN exhibitions and forums to broaden to projects impact. In addition to showcasing, 5G CHAMPION will provide and contribute to talks held at NGMN workshops which advance the 5G CHAMPION's influence.

### 3.6 Small-cell/ Femto Forum

The Small-Cell /Femto Forum works to ensure the adoption of industry wide standards, a positive regulatory environment, common architectures and interoperability.

Small-cell network management will be a key component of future 5G systems. The activities in the forum will be monitored.

### 3.7 ITU-T IMT-2020 Focus Group

In early 2012, ITU embarked on a programme on “International Mobile Telecommunications (IMT) for 2020 and beyond”, setting the stage for IMT-2020 research, development, and marketing activities around the world. ITU-T Study Group 13 is mandated to study the requirements, architectures, capabilities and mechanisms of future networks including mobile. There is a desire to establish an open platform for experts representing ITU members and non-members in order to gain deep understanding of the IMT-2020 agenda, from non-radio transmission related network perspective. Recognizing activities being undertaken around the world, it is necessary to identify the specific areas for ITU-T Study Group 13, in order for ITU-T Study Group 13 to make constructive contributions to IMT-2020, together with other standardization bodies. The outcomes of this Focus Group will consist of continuing to define the visions and objectives related to IMT-2020, in order to help progress and promote standardization by ITU-T Study Group 13 and other SDOs on IMT-2020. With regard to specific tasks, the following areas have been identified as areas of study/activity:

- Explore demonstrations or prototyping with other groups, notably the open source community - this task investigates demonstration or prototyping various aspects of IMT-2020 networks;
- Enhance aspects related to Networks softwarization and ICN.



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This work refines aspects related to network softwarization, building on, or refining the output from the first Focus Group. Softwarization of the network has been studied in academia, this work will help identify issues that may exist in translating this from theory to application. It also investigates the use of ICN approaches within the IMT-2020 goals. There is much academic and industrial work around ICN in the 5G context at this time. We will suggest experiments aimed at guiding the broader community in next steps that can help bridge the gap between the research and practical use of ICN in IMT-2020. The output of this work will be a document that describes those experiments and provides recommendations on how ICN can be adopted in IMT-2020.

- Continue to refine and develop the IMT-2020 network architecture;

The work produces base material for the development of draft Recommendations to be approved by SG13, based on the architecture work produced during the identification of standardization gaps as reported in the report of FG IMT-2020. The output of this work will be a document that describes in depth the network architecture needed to address identified architectural gaps.

- Continue the study of fixed mobile convergence aspects;

Recognizing that a connected society in the years beyond 2020 will need to accommodate a similar user experience for end-users regardless of whether they are on the move or stationary, the new 5G standards aim at maintaining high quality service at high mobility, enabling the successful deployment of applications on a moving platform, such as in cars or high-speed trains.

- Continue to study network slicing for the front haul/back haul network;

This work studies and defines the use of network slicing in the context of control of the front haul/back haul network. Note, that it is expected that the transport and equipment aspects of front haul and back haul networks will be performed by Study Group 15. The work of the Focus Group is limited to dealing only with control aspects.

- Continue to define new traffic models and associated QoS and OAM aspects applicable to IMT-2020 network

IMT-2020 is seen as enabling new applications not limited to requiring high bandwidth, low latency and diverse service requirements. This item will define new network management aspects for the IMT-2020 network, including any QoS or OAM aspects. The work will produce base material for the development of draft Recommendations to be approved by SG13.

Based on the objectives of this group, 5G CHAMPION will evaluate the possibility for contributing to items 1, 2, 3, and 6. Among these items, we need a phased approach starting from architecture to demonstration & prototyping contributions. Especially, due to the objective of our project, demonstration & prototyping related contribution has higher priority than other working items.



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## 4 Regulation Strategy

Government administrations and regulation bodies are currently in the process of defining the regulation framework of future 5G systems. 5G CHAMPION will identify key opportunities in this field and evaluate the possibility for contribution such that the project impact is maximized.

### 4.1 International Telecommunication Union (ITU)

ITU is a specialized agency of the United Nations (UN) that is responsible for issues that concern information and communication technologies.

5G CHAMPION is in particular interested in influencing parathion discussions for WRC (World Radio Conference) 2019 on Agenda Item 13, which relates to future usage of mmWave bands:

*“This agenda item relates to consideration of identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 238 [COM6/20] (WRC-15). It calls for studies on frequency-related matters for IMT identification including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency range between 24.25 and 86 GHz.”*

5G CHAMPION will in particular liaise with CEPT in order to influence the European position on the corresponding WRC'2019 discussions.

### 4.2 European Conference of Postal and Telecommunications Administrations (CEPT)

As indicated in section 4.1, 5G CHAMPION has specific interests in influence preparatory discussions of WRC'2019 on agenda item 13 related to future usage of mmWave frequency bands. 5G CHAMPION will interact and liaise with CEPT in order to influence the European position for the upcoming WRC'2019 negotiations.

### 4.3 Telecommunications Conformity Assessment and Market Surveillance Committee (TCAM)

The Telecommunications Conformity Assessment and Market Surveillance Committee (TCAM) is an advisory and regulatory committee that assist the European Commission in matters regarding conformity assessment and market surveillance. TCAM recently created a Software Defined Radio (SDR) Working Group (WG) in order to discuss the implementation of software reconfiguration related articles 3(3)(i) and 4 of the Radio Equipment Directive (RED).

5G CHAMPION will influence the corresponding discussions through its activities in ETSI TC RRS (Reconfigurable Radio Systems) on technology solutions in the field of software reconfigurations.



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## 5 Scientific Publication and Education Strategy

### 5.1 Scientific Conferences

The 5GCHAMPION partners have the ambition to generate a highly visible and impacting footprint of their research outcomes in the scientific community. The main KPI that the project is using to measure this impact are in the form of publications in journals and at best-in-class conferences, as well as through speeches, tutorials, etc. Concerning scientific publications, the consortium has the target to publish at least 20 conference papers, in the most suitable venues.

While there are no conferences and explicitly excluded from the consortiums publication targets list, there are a number of venues that are particularly targeted to disseminate the scientific findings of the project, which are listed below.

**Table 4: Identified key conference candidates for contribution by 5G CHAMPION.**

Event name	Main topics
SPAWC – Signal Processing Advances in Wireless Communications	Signal Processing in Wireless Communication Systems.
WCNC – Wireless Communications and Networking Conference	New approaches in wireless communications and networking technology.
GLOBECOM	IEEE flagship conference covering all aspects of networking and communications.
ICC - International Conference on Communications	IEEE flagship conference covering all aspects of networking and communications.
EuCNC – European Communications and Networking Conference	Communication and networking.
IEEE VTC – Vehicular Technologies Conference	Networking and vehicular aspects.
IEEE Antennas and Propagation International Symposium	Electromagnetics, antennas and propagation
Europe Conference on Antennas and Propagation	Electromagnetics, antennas and propagation
European Microwave Week	Radiofrequency, electromagnetics, and antennas
Train Communications Systems conference in 2017 – 2018	Railroad related communication conference



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5G CHAMPION has identified specific contributions in order to ensure that key project results will have maximum visibility and impact. Priority paper submissions are planned on

- Adaptive hybrid beamforming, algorithm and implementation aspects. At this stage of the project, the target conferences are EuCNC 2017 (submission deadline 06 February 2017) and PIMRC 2017.
- An overview of MHN system to the session on “Propagation Channels for Wide-Sense Vehicle-to-X Communications” in EuCAP 2017.
- Train Communications Systems conference in 2017 – 2018, since the event is the only conference to focus directly on the problems and opportunities of putting Wi-Fi services onto trains. Customer services will be presented on mobile internet in Seoul subway and promote the outcomes as relentless efforts to improve the service qualities.
- Massive machine-type communication and special purpose modems for large capacity wireless backhubs in addition to the existing designs. These high-tech modems will be promoted at flagship conferences or events in wireless communications. A paper related to the mobile MODEM based on 3GPP LTE system will be submitted to a conference of KICS (January 2017).
- A signal transmission schemes for high speed railway (HSR). The target conference is IEEE VTS APWCS 2017 or IEEE VTC 2017-Fall (deadline: 2017).
- Implementation of MU-MIMO system supporting a dynamic precoding. Results will be submitted to the IEEE VTC 2017 (submission deadline: 30 September 2016). Second, a research paper on ETSI TC RRS standardization activities will be submitted to the ICEIC 2017 (submission deadline: 23 September 2016).
- Distributed mobile core system architecture and its mobility management technology supporting ultra-high speed mobility.
- ITS (Intelligent Transport Systems), Smart Cities, and IoT results will be disseminated towards the relevant User communities. To this end, papers will be submitted to the future ITS Europe, and ITS world congresses, and various Smart Cities Conferences.



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## 5.2 Scientific Journals

Contributions to Scientific Journal are a suitable means to disseminate mature and substantial results of the 5G CHAMPION consortium with great visibility in the scientific community. A list of target Journal Paper candidates is indicated in the sequel.

*Table 5: Identified key Journal Paper candidates for contribution by 5G CHAMPION.*

Publication name	Main topics
EURASIP Journal on Wireless Communications and Networking	General wireless and access network topics, covering PHY to System level.
EURASIP Journal on Advances in Signal Processing	Algorithms and Signal Processing approaches in general.
IEEE Communications letters	Communication technologies.
IEEE Communication and signal processing magazines	Communication technologies and systems in more tutorial style.
IEEE Transactions on Signal Processing	Algorithms and Signal Processing approaches in general.
IEEE Wireless Transactions	Communication technologies – scientific evaluation of approaches and techniques.
IEEE Vehicular Technology Magazine	Networking and vehicular aspects.
IEEE Access	Communication and networking aspects.
IEEE Communications Magazine	Communications and networking aspects.
IEEE Transaction on Antennas and Propagation	Electromagnetics, antennas and propagation
IEEE Antenna and Wireless Propagation Letters	Electromagnetics, antennas and propagation

Table 6: Indicative list of targeted journals for 5GCHAMPION results.

5G CHAMPION has identified specific contributions in order to ensure that key project results will have maximum visibility and impact. Priority paper submissions are planned on

- Signal transmission schemes for high speed railway (HSR) to a major journal. The target journal is IEEE Transactions on Vehicular Technology or IEEE Communications Letters (deadline: 2018).
- Concept of RVM (Radio Virtual Machine) which is being standardized in ETSI TC RRS to the Journal of Korean Institute of Electromagnetic Engineering and Science (submission deadline: 31 December 2016).



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### 5.3 Education – Teaching, Tutorials, Workshops, etc.

**Education and teaching** is an important target for the exploitation of 5G CHAMPION results. It is indeed of key importance to feed latest findings and progress beyond the state of the art into University programs in order to ensure teaching at the edge of the technology:

5G CHAMPION strategic directions will be implemented by consortium partner Universities into selected University programs. Key targets are master and high-quality PhD programs.

To give a specific example, 5G CHAMPION will establish new teaching directions in the field of Software-Defined Networks, Service Orchestration and Programmable networks & service. The 5G CHAMPION related research in these fields is fully embedded, for example, in the different Flemish universities allowing a very efficient exploitation of knowledge by embedding this in the more advanced University courses. In this specific project, the research group IBCN (Internet Based Communication Networks and Services), part of Ghent University, is involved which will assimilate 5G CHAMPION results into advanced master courses on Future Internet and related high-quality PhD.

As part of the 5G CHAMPION platform development, selected contributions will be open-sourced and as such available for the European research community. This involves 5G CHAMPION developments in orchestration components, monitoring components, and/or network functions.

**Tutorials** are useful tools to disseminate and share project results among a professional community. Typically, tutorials are organized in conjunction with major scientific conferences. Participants typically include academic, governmental and industrial representatives who wish to acquire knowledge in new field.

5G CHAMPION will thus not only promote the project and its results through press releases and joint workshops, but also tutorials are a key target to address many of the major industrial stakeholders.

**Workshop** contributions will help to disseminate 5G CHAMPION results and findings through Face-to-Face interactions with experts and interested scientists. The following actions are planned for the immediate future:

- As a joint and cross-regional effort, 5G CHAMPION will drive the preparation of a workshop and demonstration at the EuCNC 2017, in Oulu, Finland. The target is to provide a comprehensive vision of the 5G technologies developed in the project as well as a preliminary demonstration of the 5GCHAMPION testbed.
- 5G CHAMPION consortium partners have a longstanding successful experience in holding workshops related to mm-wave in well-known conferences and symposiums. Among the most recent ones we can mention EUCAP2016 and RWS15. In the future, the consortium will organize similar event. Furthermore, some of the 5G CHAMPION partners are participating to several collaborative projects and thus joint workshops between 5G CHAMPION and other related EU projects are planned to be organized.
- 5G CHAMPION will bring mobile technology stakeholders such as manufacturers and mobile operators together in order to promote 5G technology and in particular project results. Domestic and international workshops will be used in order to promote 5G CHAMPION technology and foster the adoption across the industry.



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- 5G CHAMPION will be demonstrating the outcomes of this project in domestic/international 5G-enriched SDI workshops. With the open collaboration under ONK (Open Networking Korea, <http://opennetworking.kr>), key R&D results and open-source software can be presented at Korean and European open-source networking events. Also, it is under discussion to extend it with EU-Korea scope by leveraging newly-formed IEEE OSSN (Open-Source Software Networking) workshop (<http://opennetworking.kr/ossn/>).

In order to further educate the industry on key developments in the 5G field, 5G CHAMPION is leading the Industry track on “Wireless Communications and 5G” at VTC Spring 2017, Sydney, Australia. The program is currently under preparation, but the following high-profile speaker program is available for the time being:

<b>VTC'17 Industry Track Chair - Wireless Communications and 5G</b>
<b>Chairman: Dr. Markus Mueck / INTEL &amp; 5G CHAMPION</b>
<b>Keynotes:</b>
<u>Prof. Dr. Cheun (Samsung, SVP)</u>
David Cooper (ERICSSON, CTO)
<u>Adrian Scrase (ETSI, CTO)</u>
Takehiro Nakamura (NTT DoCoMo, VP)
<u>Dr. Chung (ETRI, VP)</u>
-
<b>Technical Vision:</b>
<u>Dr. David Soldani (NOKIA, VP)</u>
<u>Dr. Emilio Calvanese Strinati (CEA)</u>
<u>Prof. Dr. Merouane Debbah (Huawei, VP) - invitation pending</u>
<u>Sanyogita Shamsunder (Verizon) - invitation pending</u>
<u>Dr. Jamshid Khun-Jush (Qualcomm) - invitation pending</u>



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## 6 Collaboration with other research projects

5G CHAMPION has already started to prepare the background for collaboration with other projects in order to extend 5G CHAMPION consortium collaboration to other European Commission projects in H2020. More precisely 5G CHAMPION has organized jointly with MiEdge project two major events in 2016 and 2017:

- ‘10th International Workshop on Evolutional Technologies & Ecosystems for 5G and Beyond (WDN-5G ICC2017)’ that will be held in Mai 2017 at IEEE ICC conference, Paris (<http://icc2017.ieee-icc.org/>); (ii) The special session at 5G Berlin Summit 2016 on ‘Joint 5G Projects and Trials’ (<http://www.5gsummit.org/berlin/>).
- 5G CHAMPION has planned on 10-11/10/2016 a joint workshop (<http://zzzdana.wixsite.com/ict-techday>) in Seoul with WiseloT and Basamati EU-KR projects.

5G CHAMPION has already started discussing with mmMagic 5G PPP phase 1 project on network prototyping. A joint participation to the IP9 industrial panel held at IEEE Globecom 2016 with title “5G Networks Prototyping: Entering the Next Phase of Experimentation for Future Radio Access Technologies” on 7<sup>th</sup> of December 2016.

Furthermore in order to maximize the European momentum towards, and benefits from, the future 5G integrated, ubiquitous and ultra-high capacity networks, 5G CHAMPION is paving the way for collaborating with ongoing 5G PPP phase 1 projects and with the 5G-Infrastructure Association and the NetWorld2020 European Technology Platform.

5G CHAMPION foreseen active collaboration and exchanges with 5G PPP phase 2 project in the wireless strand.

Furthermore, 5G CHAMPION has already started discussing with GK-5G project (Project Name: 5G mobile communication system development based on mmWave) and QK-5G project (Project Name: Development of 5G Mobile Communication Technologies for Hyper-connected smart services) in Korea. Technical discussions for the related issues and joint contributions for the IEEE and 3GPP standardizations have been done.



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## 7 Cross Korean / European Collaboration Benefits

5G is a **global** revolution and it requires cross-national validation and **cross-continental** interoperability and economical sustainability validation. Regulation on 5G spectrum is already globally discussed and indication on potential '**5G new bands**' has been indicated by the WRC'15 [10]. Final decision is expected by 2019 during the WRC'19. WRC'19 decision will be based on several parameters: political, economic and technical. Therefore 5G ecosystem cannot wait 2020 for a full scale validation of 5G technology and related services.

Industry, SMEs, Operators and academia from two of most active areas of the world on 5G revolutions - Korea and Europe - decided to federate in order to anticipate the validation of **potentials of on 5G** key enabling technologies in 2018, delivering a joint an unprecedented proof-of-concept show cased at the **2018 Winter Olympics** in PyeongChang, Korea.

5G CHAMPION started in July 2016, few months ago, but already bilateral benefits of Korean-European collaboration are clear for 5G CHAMPION partners, Korean and European ecosystems. In a global scale, the worldwide 5G community already benefits from active 5G CHAMPION dissemination activities.

At this stage of the project, we experience the benefit of **jointly validating potentials of on 5G** key enabling technologies 5G CHAMPION. Benefits are for:

- **Korean and European Consortium members** which can drive the development of a holistic and global fully integrated 5G system definition and solutions. This creates momentum for strengthening the cooperation between Europe and Korea for **future research projects** not only at the consortium scale but also between Korean and European future collaborations frameworks under discussion. Today, 5G partners experience that joining forces in such unique collaborative ecosystem give them an edge in the attempt to get ahead of the game in developing ultra-fast 5G wireless communications networks and preparing global standardization for it.  
**Industry, service providers and operators** which will enable practical feedback to improve reliability and performance of the newly developed products and related services from both Europe and Korean market players. Moreover, working together towards global standards for 5G, in support of ongoing standardization in relevant fora, such as 3GPP and ITU and indeed developing common interest in research activities and products ensuring global 5G interoperability. Specifically from satellite perspective and related service provisioning, Cooperation between Korea and Europe will spread the usage of Galileo in Asia with win-win benefits.
- **5G Global Community** which benefits from a very vivid and active dissemination activity from 5G CHAMPION. Moreover, 5G CHAMPION has already started producing common interest and forge a consensus on key 5G functionalities that can be proved in 2018. Europe, Korea and in a global scale many other countries in the world have demonstrated strong interest on 5G CHAMPION activities. For instance 5G CHAMPION has already today, few months after its start, a large community that follows actively 5G CHAMPION news and achievement. Today the 5G CHAMPION LinkedIn group accounts for about 350 members.



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## 8 Exhibitions

The key target exhibition event for the 5G CHAMPION project is the 2018 Winter Olympics in PyeongChang, Korea. This event in combination with the European/Korean partnership is expected to maximize the visibility of 5G CHAMPION results and hardware/software solutions. The highest level of attention is ensured by the scientific community and the public audience which will be introduced to benefits and advantages of 5G technology.

For this purpose, a communication flyer was developed as indicated below.

### 5G CHAMPION PyeongChang Olympic Venue Demonstration Proposal

#### Objective

Providing various high-speed/high-quality Internet multi-media 5G services for visitors to PyeongChang through the achievements of the Korea-Europe joint research project (5G CHAMPION) deployed in the Olympic venue will contribute to,

- Success in the ICT Olympic that is the Korean government's goal
- Promotion of joint research and development results through a interworking service based on the 5G access and high-speed core networks
- Escalation of National brand value through promotion of 5G-based ICT technologies

#### PoC Scenario

※Need to check with the Olympic organizing committee to see if both scenarios are possible (including mmWave backhaul frequency)

**(Scenario 1)** Provide demonstrations of various service scenarios through interworking between Europe and Korea PoC testbeds deployed in the PyeongChang Olympic Venue and EU counterpart (Finland)



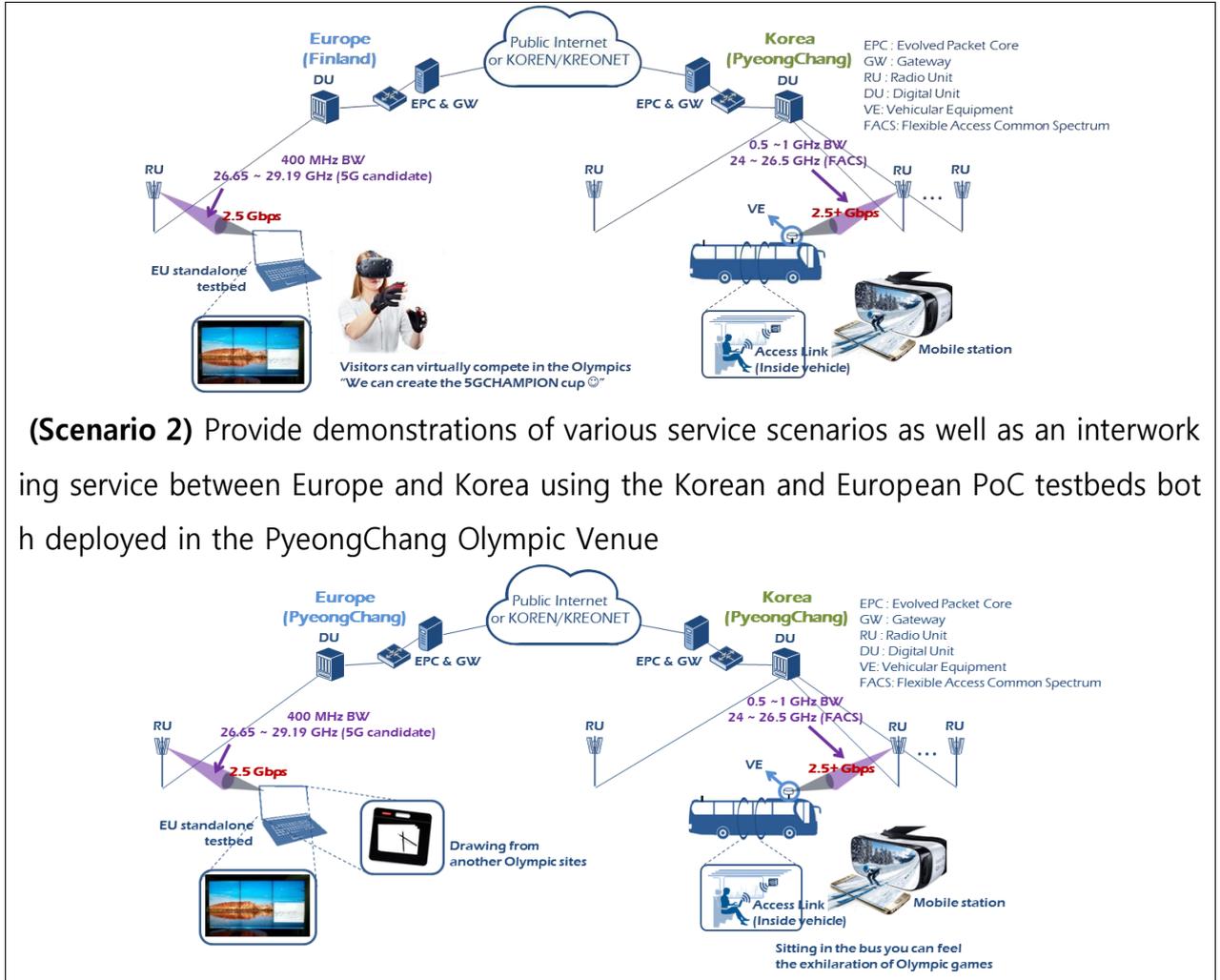
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**(Technology demonstration)** A millimeter-wave mobile wireless backhaul technology supporting data rate of 2.5 Gbps and A SDN/NFV-based mobile core technology

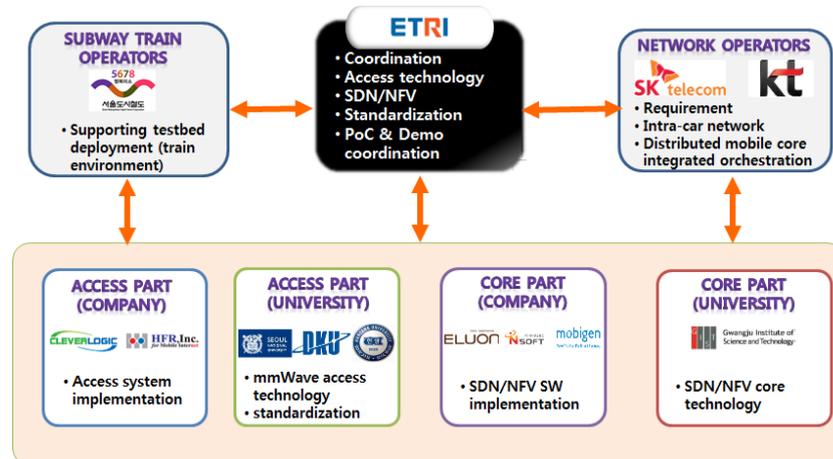
**(Service demonstration for scenario 1)** Demonstrations of virtual reality, hologramas and high-definition video from Korea to Europe through the stationary EU testbed and Korean moving testbed (in bus)

**(Service demonstration for scenario 2)** Demonstrations of drawing board and virtual gaming services using the stationary EU testbed and a virtual reality service using the Korean moving testbed (in bus)

**(Service demonstration target)** Tourists and officials of the PyeongChang Winter Olympics Games

### Participants and Roles

**(Korean participants)** ETRI, KT, SKT, SMRT, Cleverlogic, HFR, Eluon, InSoft, Mobigen, Seoul National University, Dankook University, Hanyang University, GIST



**(European participants)** CEA-LETI(France), Nokia(Finland), iMinds(Belgium), Fraunhofer(Germany), Intel(Germany), ThalesAlenia(France), Telespazio(France), UOULU(Finland)



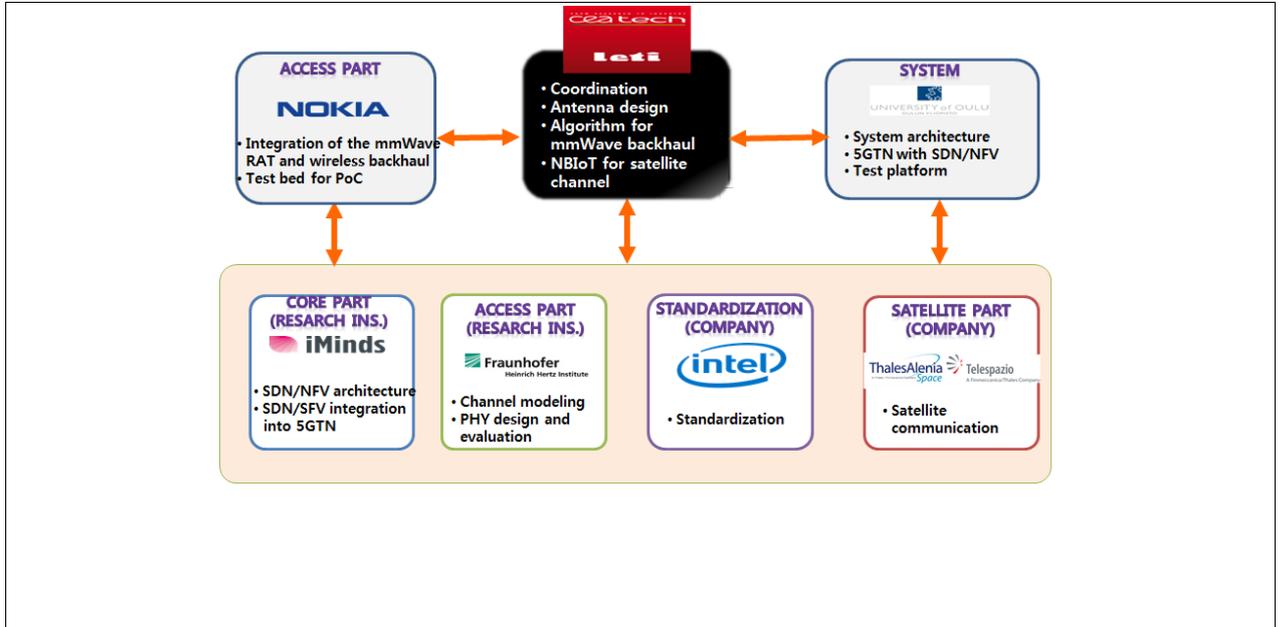
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Beyond the 2018 Winter Olympics in PyeongChang, Korea, the project evaluates contributions to further key events, such as

- Mobile World Congress, Barcelona, Spain, 2017/18;
- Mobile World Congress, Shanghai, China, 2017/18;
- Consumer Electronics Show (CES), 2017/18;
- ITS World Congress, rotating between Europe, the Asia Pacific region and the Americas, returning to Europe every three years:

Year	World congress	European congress
2017	ITS World Congress, Montréal, Canada, 29 October – 2 November	ITS European Congress, Strasbourg, France, 19-22 June
2018	ITS World Congress, Copenhagen, Denmark, 17-21 September	No congress



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- Smart cities related exhibitions
  - Regarding the smart cities, there are many European cities working on the technologies that will enable smarter cities. However, most of them are concentrated on their own problems and only a few of them organize more global events where stakeholders from several countries are invited. Among these can be found: Smart city expo which takes place every year in Barcelona; Smart countries & cities congress in Paris; Future of cities forum in Ljubljana;
  - Other local events have as well visibility because the cities in which they take place have decided to support the smart city development: Copenhagen; Amsterdam; Vienna; Ljubljana; Barcelona;
- IoT related congresses, including topics on the smart cities and intelligent transport systems.

## 9 Interaction with press and media

On the 28.08.2016, the UOULU team was invited by the MBC Korean TV to present the 5GCHAMPION project and cooperation with Korean partners. In this context, the consortium was able to provide thought leadership to a large public community, to educate and prepare a public audience for future 5G technology and to illustrate the benefits of a cross-regional collaboration between Europe and Korea.

The broadcasting event will be scheduled in the near future.



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## 10 Conclusion

The present document is a sound basis for the 5G CHAMPION consortium. It introduces a clear strategy on how to address the exploitation and dissemination of project results with the objective to

- Drive the 5G technology development forward and show thought leadership in the scientific, industrial and media community,
- Influence key standards and regulation bodies in order to contribute the suitability of future product standards and the related regulation framework,
- Exploit key events to showcase the 5G CHAMPION consortium results, in particular proof-of-concept equipment and to thus maximize the project visibility and overall impact.

The strategy and plan outlined throughout this document in combination with the efficient cross-region collaboration between Europe and Korea is expected to manifest in the highest level of visibility and impact of the project results and outcomes.



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