5G smarT mObility, media and e-health for toURists and citizenS

Deliverable D8.1
First Report on Innovation Management, Dissemination, Standards and Exploitation Plans

Project Details

Call	H2020-ICT-19-2019
Type of Action	RIA
Project start date	01/06/2019
Duration	36 months
GA No	856950

Deliverable Details

Deliverable WP:	WP8
Deliverable Task:	Task T8.1-T8.4
Deliverable Identifier:	5G-Tours_D8.1
Deliverable Title:	First Report on Innovation Management Dissemination Standards exploitation Plans
Editor(s):	Cédric Thiénot (Exp)
Author(s):	Simon Fletcher (RW), Anthony Dunne (RW), Eleni Rigani (NOK-GR), Cédric Thiénot (EXP), Carlos Barjau Estevan (UPV), Eric Gatel (BCOM), Mathieu Lagrange (BCOM), Guillaume Pasquier (BCOM), Giovanni Nassi (TIM), Panayiotis Verrios (ACTA), Simos Symeonidis (ACTA), Efstathios Katranaras (SEQ), Baruch Altman (LIV), Marco Gramaglia (UC3M), Ana Hernandez Llor (UC3M), Albert Branchs (UC3M), Belkacem Mouhouche (SRUK), Vignaroli Luca (RAI), Yevgeniya Sulema (BLB), Roman Odarchenko (BLB), Nelly (Eleni) Giannopoulou (WINGS), Fons de Lange (PRE), Nikolaos Papagiannopoulos (AIA)
Reviewer(s):	Fons de Lange (PRE), Nikolaos Papagiannopoulos (AIA), Nelly Besnard (CHU), Eric Gatel (BCOM), Mathieu Lagrange (BCOM)
Contractual Date of Delivery:	31 May 2020
Submission Date:	29 May 2020
Dissemination Level:	PU
Status:	Completed
Version:	1.0
File Name:	5G-TOURS_D8.1_First_Report_on_innovation_management_dissemination_standards_exploitation_plans_v1.0.docx

Disclaimer
The information and views set out in this deliverable are those of the author(s) and do not necessarily reflect the official opinion of the European Union. Neither the European Union institutions and bodies nor any person acting on their behalf may be held responsible for the use which may be made of the information contained therein.

Version	Date	Modification
V1.0	*29/05/2020*	*Initial version, submitted to EC through SyGMa.*

Table of Content

List of Acronyms and Abbreviations

3GPP	3rd Generation Partnership Project
5G-EVE	European 5G validation platform for extensive trials
5G-MoNarch	5G Mobile Network Architecture for diverse services, use cases, and applications in 5G and beyond
ABM	Account Based Marketing
ABR	Adaptive Bite Rate
AR	Augmented Reality
AIA	Athens International Airport
ATSC	Advanced Television Systems Committee
B2B	Business to Business
BMC	Business Model Canvases
BMSB	Broadband Multimedia Systems and Broadcasting
BSS	Business Support System
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CARS	Computer Assisted Radiology and Surgery
CDN	Content Delivery Network
CHU	centre hospitalier universitaire (French)
CMUT	Capacitive micromachined ultrasonic transducers
COVID	Coronavirus disease
CPNF	Control Plane Network Function
CSP	Communication Service Provider
DICOM	Digital Imaging and Communications in Medicine
DSL	Digital Subscriber Line
DVB	Digital Video Broadcasting
ECG	Electrocardiography
EDEN	European Distance and E-Learning Network
ENI	Experiential Network Intelligence
EPC	Evolved Packet Core
ESEA	European Science Education Academy
ESHA	European School Heads Association
ETSI	European Telecommunications Standards Institute
EUCNC	European Conference on Networks and Communications
FOBTV	Future of Broadcast Television
GIANT	Global Innovation And New Technology
GPCI	Global Power City Index
IATA	International Air Transport Association
IBC	International Broadcasting Convention
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICT	Information and Communications Technology
ICU	intensive care unit

IEEE	Institute of Electrical and Electronics Engineers
IEEE JSAC	IEEE Journal on Selected Areas in Communications
IFE	In-Flight Entertainment
IMD	International Institute for Management Development
IMT	International Mobile Telecommunications
IPR	Intellectual Property Right
IPWC	International Wireless Industry Consortium
IVR	Interactive Voice Response
KPI	key performance indicators
LTE	Long-Term Evolution
MBMS	Multimedia Broadcast Multicast Service
MBS	Multicast/Broadcast Service
MEC	Mobile Edge Computing
MNO	Mobile Network Operator
MSP	Mobile Service Provider
MVNO	Mobile Virtual Network Operators
MWC	Mobile World Congress
NEMO	Network of European Museum Organizations
NFV	Network Functions Virtualisation
NGMN	Next Generation Mobile Networks
NR NSA	5G new Radio non-Standalone Mode
OPEX	operational expenditure
OSS	Operational Support System
OTT	over-the-top
POC	Proof Of Concept
PON	Passive optical network
RAN	Radio Access Network
RAT	Radio Access Technology
ROI	Return on Investment
SDK	Software Development Kit
SEM	Search Engine Marketing
SEO	Search Engine Optimization
SID	Study Item Description
SLA	Service-Level Agreement
SME	Small and Medium-sized Enterprise
STARLIT	cloud baSed ioT smARt LIving platform
STD	Standardisation
TETRA	Trans-European Trunked Radio
TSG	Technical Specification Group
UHD	Ultra High Definition
URLLC	Ultra-Reliable Low-Latency Communication
USSD	Unstructured Supplementary Service Data
UTRAN	Universal Terrestrial Radio Access Network
VR	Virtual Reality
WG	Working Group
XR	eXtended Reality

List of Figures

List of Tables

Executive Summary

The European Vision of "**5G empowering vertical industries**" well describes the motivation of the 5G-TOURS project. 5G-TOURS is defined by the diversity of its project partners; drawn from the wireless industry and importantly from the vertical sectors that in fact provide the focus for value creation activities. The vertical sectors are broadly defined by the themes of three European City located testbeds that form the basis of use case trials and demonstrators. The three themes and their host Cities of the Touristic City (Turin, Italy), the Safe City (Rennes, France) and the Mobility Efficient City (Athens, Greece) encompass not only technical platforms and solutions that are under development, but a wider socio-economic and business context.

Work Package 8 (WP8) of 5G-TOURS manages the processes necessary to fulfil the projects objectives of **Business validation and exploitation**. To this end, task areas manage independent processes to deliver Business Case Analysis, Exploitation and Innovation Management, Standardisation and Industrial Communications and Dissemination. This report provides a summary of the outcomes to date towards dissemination, standardisation and impact assessment during the first year. It also provides an opportunity for the project partners to review their exploitation planning and refine their strategic intentions for exploitation of the outcomes of the project. The refreshing of the strategic thinking of the project partners is essential and exactly maps the approach that would be taken in agile technology sectors where strategic marketing, technology and business model insights will necessitate strategic pivots.

Business Case Analysis has focussed in this first year of gaining a solid understanding of the 5G specific business models that are state of the art in academia and industry research. There has been a noticeable increase in publications on 5G business models during the period leading to the conclusion that this is a highly topical area. To enable scoping of the themes and business narratives of 5G-TOURS a survey of City Indexes has created a clearer strategic framework within which the socio-economic value propositions can emerge. The validation process is aided in this first year by surveys to obtain qualitative data on the perspectives of the project partners and their positions in value chains.

Exploitation and Innovation Management has established a project approach to innovation management which whilst defining a broadly common overall method allows for each of the vertical themes to take an independent view based on the emphasis of use cases and ecosystems. 5G-TOURS recognises that whilst aspects of 5G platforms and services will be common, the way in which each of the vertical industries will benefit will be different and can only be fully understood by expertise from within the vertical industries; this has led to the approach of having an independent Innovation Manager for each of the three City themes. The Innovation Managers have established perspectives on opportunities for market expansion based on trends that are seen from vertical industries, this creates a business model archetype within which the innovations can emerge. The well-established 4Ps [25] of innovation provide one of the analysis frameworks at this stage of the project.

Standardisation capabilities of the 5G-TOURS project partners have been well positioned in this first year of the project as evidenced by a significant number of contributions and significant Rapporteur positions for a number of the project partners. These outcomes have been principally focussed towards the core telecoms standards but vertically oriented standards bodies are within reach of the 5G-TOURS project partners and can be expected to be impacted in the following year of activity.

Industrial Communication and Dissemination activities have established all necessary social media channels along with the project website. Content for social media and the website has come from the deliverables as well as blogs from partners and video content.

During the development of this report we have seen the emergence of the COVID-19 crisis. This creates substantial challenges for this area of the project. Assessment and re-planning are ongoing in the face of significant uncertainty with respect to the length of the period of disruption, the nature of disruption, and the capacity of partners to engage in the Research and Innovation of this project. Nevertheless, despite the challenges 5G-TOURS partners are committed to finding approaches that use more online facilities and outreach in the face of substantial reduction and cancellations of conferences and events. All inter-5G-PPP project working groups have resource from 5G-TOURS allocated. Chair, vice-Chair and founder member positions are credited to various partners of 5G-TOURS, providing substantial evidence of engagement in the wider community.

1 Introduction

This report is the first statement from Work Package 8 (WP8) of 5G-TOURS at the end of the first year. The Business validation and exploitation objectives of WP8 are structured around four key process areas.

Task8.1 carries out Business Case Analysis on behalf of the project. This amounts to applying business analyst thinking to establish credible commercial cases. By strategic market studies in the vertical sectors, exploring evolving value chains and commercial models. This report highlights initial findings on the state of the art of business models emerging in the 5G domain and the insights gained from a project partner survey. To frame the potential relevance of commercial models in the context of a City environment a survey of City Indexes enables analysts to determine City level motivations.

Task8.2 co-ordinates Exploitation and Innovation Management focussed activities. All partners have been given the opportunity to review and refresh their view on their strategic thoughts regarding exploitation of the outcomes of the project. The Innovation Managers (one for each of the testbed themed areas) have developed an initial view on the value propositions of the use cases and the wider market expansion models that could be relevant as the project progresses.

Task8.3 co-ordinates the Standardisation activities of the 5G-TOURS partners. Standards bodies such as 3GPP and ETSI are a principle beneficiary of the contributions from partners but other Standard Development Organizations (SDOs) such as DICOM (Digital Imaging and Communications in Medicine) are also relevant 5G-TOURS tracks developments with respect to slicing from Next Generation Mobile Networks (NGMN) and is exploring the limitation of the templates published by them in regard to the requirements of the vertical industries addressed in the project (mobility, tourism, health). This may lead to influence and shaping of those templates over time.

Task8.4 co-ordinates Industrial Communication and Dissemination for the project. A marketing plan is provided that seeks to identify major targets of the project. The report also highlights achievements to date with respect to event contributions and the creation of assets for the project; social media channels, website, video and brochure and flyer templates that can be exploited over the coming two year of the project.

1.1 Structure of this report

This report is structure around the key process areas:

- **Chapter2:** Provides a summary of the Business Model context for the project
- **Chapter3:** The Exploitation plans of the project partners are individually presented, and then further analysis is carried out to determine synergies and patterns with respect to the vertical and value chain structures inherent in the 5G-TOURS project consortium
- **Chapter4:** The approach to Innovation is identified and findings from the preliminary analysis of the Innovation Managers with respect to the use case driven opportunities and the market expansion trends that will frame emergent innovations into the vertical.
- **Chapter5:** Standardisation outcomes to date and expectations with respect to Intellectual Property that may be generated in the project are captured in this chapter.
- **Chapter6:** Identifies achievements to date for dissemination and sets out focus for the next period.
- **Chapter7:** Conclusions for the first year of the project from the perspective of WP8.

2 Business Model context

An important aim of 5G-TOURS is to establish a commercial case for investment by studying the market dynamics in the vertical sectors that are the focus of the 5G-TOURS innovations. This contrasts with the traditional commercial drivers for Communications Service Providers (CSPs) which was the focus of previous projects.

Work Package 8 (WP8) is entitled "Business validation and exploitation" and focuses on the business, social and economic validation of the project together with the dissemination, exploitation, and standardization activities.

Business validation is a process to assess whether a certain system design is appropriate for the purpose and meets the business requirements within given constraints. The requirements in question are the characteristics of the system from the customer's point of view and expressed in the customer's "language" and the constraints are the external factors that impact and limit system design. These can be technical, financial or regulatory in nature. In 5G-TOURS the system design is represented by the 13 use cases and the customers, the corresponding end-users or vertical customers of the use case. Each 5G-TOURS partner will look to maximise the economic and commercial impact of the project in their respective vertical market and this will be defined in their respective exploitation plans. WP8 will consider these individual exploitation plans and analyse business opportunities for the individual partners.

Business validation is not exclusively the responsibility of WP8 as it spreads across WP8, WP2 and to some extent, the other work-packages. WP8 will draw upon the key findings from T8.1, T8.3, WP2, stakeholder engagement, business model idea discovery, etc, to validate the business opportunity claims of the project.

WP2 will define the use cases for technical and commercial analysis across the entire project. WP2 will provide the "big picture" economic impact of the use cases and will establish which uses cases have the most significant commercial impact. WP8 will take specific scenario inputs from WP2 to carry out a more detailed business assessment of the prioritised use cases. The information from WP2 will include service definitions and demand profiles. WP2 will also provide a high-level, qualitative evaluation of the value generated by each use case within each vertical and hence the willingness to pay. WP8 will use the WP2 qualitative evaluation to develop a more detailed quantitative analysis.

Analytical tools, such the business model canvas (BMC) [1] will be used in WP8 as appropriate. These tools will show the stakeholders and industry actors for each uses case and their role in the value chain which will in turn establish directions for the exploitation, industrial communication and dissemination activities. Blue Ocean Strategy tools such as Strategy canvas, Four Actions Framework and others may be considered where the market readiness is immature.

2.1 Business model framework applicable to 5G-TOURS

WP8 will develop and validate a framework of business models, a minimum of one for each of the markets addressed by 5G-TOURS (i.e., touristic, media and entertainment, e-Health, safety, transportation) using contributions from the other work-packages.

The 5G-TOURS business model framework will include both business case analysis and identification of appropriate business models.

The business case analysis will first quantify the use cases. This will then be used to develop vertical market focused business models for the 5G-TOURS use cases. The business case analysis will focus on investment decisions by asking which use case investments will generate the most value. The business models will then describe how the associated vertical organisations can create, deliver, and capture this value in economic, social, cultural and other contexts.

2.1.1 5G-TOURS Business Models

The business model development will establish which use cases have the potential for the greatest value creation in the verticals. This will utilise the business case work previously developed in 5G-MoNArch. However, unlike

5G-MoNArch, the WP8 business case analysis will focus on actual value creation across the vertical market stakeholders rather than just value creation for the Communication Service Providers (CSPs).

The business models explored in 5G-TOURS need to be applied to clearly defined and realistic scenarios capturing the physical setting, infrastructure assumptions, services in use and user distributions (both temporally and physically). For any given scenario being evaluated, there must be a set of target Key Performance Indicators (KPIs) defined. These KPIs should reflect the user experience that is expected in this scenario, which networks can be dimensioned against these and, which technical and economic evaluations to be performed. Figure 1 presents the proposed 5G-TOURS verification process and the relation between key elements.

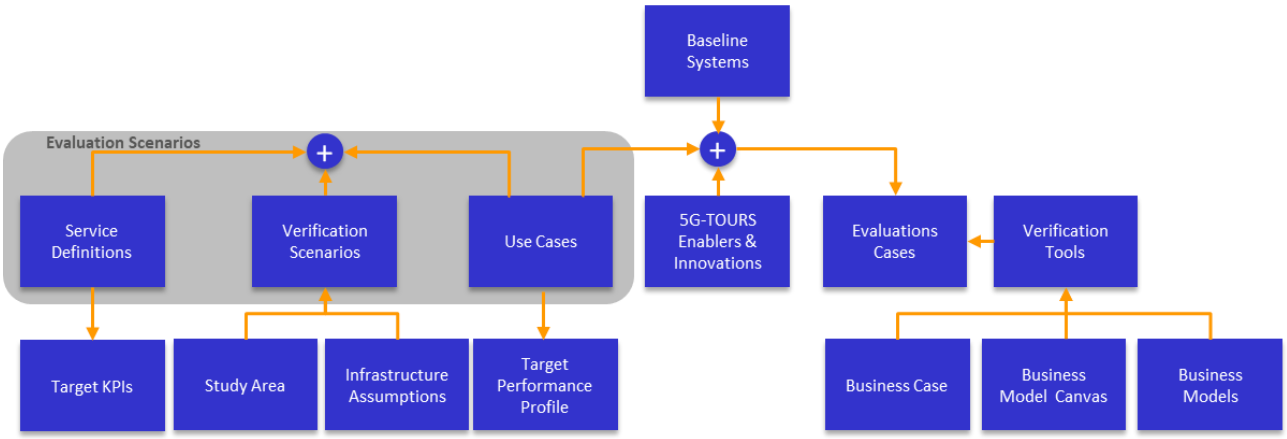


Figure 1. Relations between elements in the 5G-TOURS verification process

The key elements of this verification process are described as follows:

Service definitions. The individual wireless services being demonstrated in the trials and being targeted by the technical and commercial verification need to be defined. These *service definitions* set the target KPIs from an individual user's perspective i.e. minimum acceptable user throughput, required end to end latency, coverage area, etc.

Verification scenario. The verification scenario adds to the description of the problem space by adding the geographical physical location information (known as the study area) and infrastructure characteristics.

Use cases. With the previous 5G-MoNArch model, the use cases were described by the combination of users and services that the CSPs were trying to serve in a specific verification scenario. 5G-TOURS will now consider how the use cases are also developed and exploited by the vertical stakeholders. In some instances, the vertical stakeholders may themselves be both the user and provider of the service platform, e.g. neutral host networks. While the service definitions describe the range of individual services that can be evaluated, use cases select the set of services being considered in a verification scenario for evaluation. They also add an extra level of detail to the service definitions by providing the *traffic profiles* i.e. density of users, where users are located and when, anticipated traffic growth, etc. These use cases have a target *performance profile* to achieve which will be a combination of ensuring that all individual services considered are delivered in line with user experience expectations, as per the *target KPIs*, and that these are achievable with the volume of contending users and services envisaged in the use case.

Baseline system. This is a baseline network without the enhancements proposed by 5G-TOURS. This will include existing vertical market networks e.g. airport neutral host networks.

5G-TOURS enablers and innovations. 5G-TOURS enablers and innovations are modules, algorithms or schemes being developed by the project contributing to improvements which are not part of non 5G-TOURS baseline 5G networks. They represent the enhancements to networks proposed by 5G-TOURS.

Evaluation cases. Evaluation cases assess a given mobile network approach and business model for a given set of use cases. These evaluation cases should include evaluation against a baseline system so that the incremental benefits of ideas for 5G-TOURS can be evaluated against this baseline.

Verification tools. These are the various technical, commercial and economic tools that will be used during the verification process. Ideally these will be aligned in terms of assessing the same set of evaluation cases.

Business Model. The business model will describe how a vertical related organisation creates, delivers, and captures value, in economic, social, cultural and other contexts. The Business Model analysis includes business model innovation through the development of new, or modification to, established business models.

Business Case. The business case will provide the justification for investment, by the wireless solution providers serving the verticals, or for verticals themselves to invest in their own wireless infrastructure, depending on the specific business model. It will evaluate the benefit, cost and risk and provides a rationale for the particular solution. The Business Case will include a range of elements including, but not limited to, the case for change, economic analysis (ROI), commercial approach and management approach (roles, governance, life cycle choice, etc.).

Business Model Canvas. This is a template for developing new or documenting existing business models. It is a visual chart with elements describing an organisation or product's value proposition, infrastructure, customers, and finances. It is explained in greater detailed in Section 2.1.2.

Value Chain. The value chain describes the processes or activities through which a company adds value to a product or service.

2.1.2 Business Model Canvases (BMC) for 5G-TOURS use cases

The use of the Business Model Canvas (BMC) [1] was recommended in the original proposal as the primary tool for understanding an organsiations “money earning logic” and as a means of analysing the following four aspects of the business process and determining the value proposition for each vertical:

1. How to make the business happen (based on existing assets such as partners, existing activities and resources);
2. What to propose to the customer (the value proposition);
3. With whom (i.e., the customers);
4. The financial structure (including inflows and outflows).

So far the BMC models have relied on the customisation of network slices as a foundation value proposition for Mobile Service Providers (MSPs) (as explored in 5G-MoNArch). Within WP8 we will use the BMC approach to analyse the vertical market stakeholders utilisation of the 5G-TOURS specific use cases and the value creation that the use cases bring to the stakeholders and their markets.

The BMC was developed by Alexander Osterwalder [1] and is a visual chart with elements describing an organisation’s or product's value proposition, infrastructure, customers, and finances. An example BMC template is shown in Figure 2.

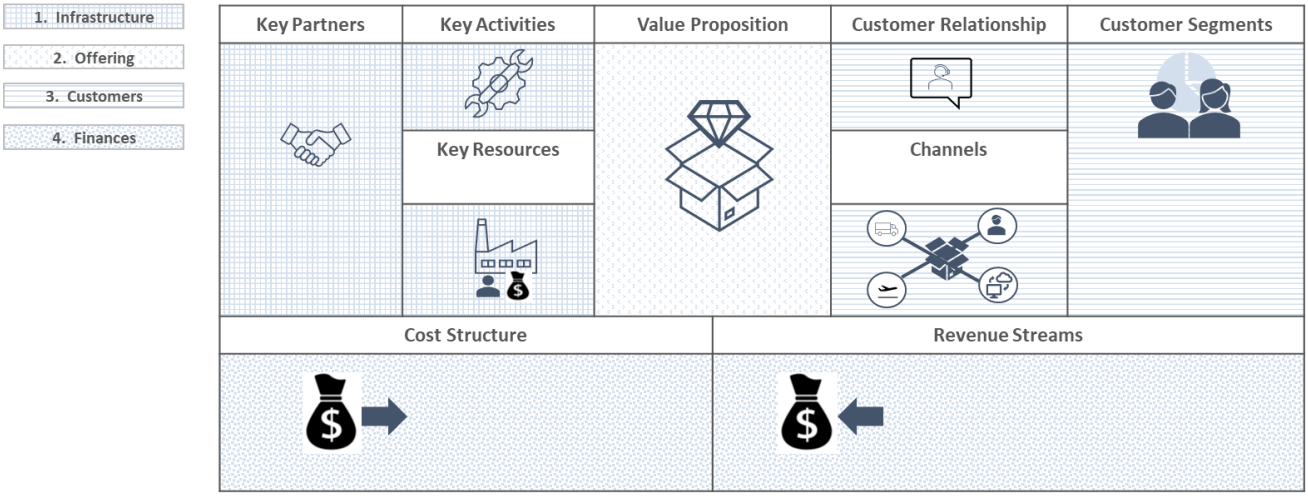


Figure 2. BMC Template

The BMC template comprises of nine "building blocks" grouped by an organisation’s or product's value proposition (the offering), infrastructure, customers, and finances (cost and revenue):

1. Offering
    - Value Proposition: The collection of products and services a business offers to meet the needs of its customers.
2. Infrastructure
    - Key Activities: The most important activities in executing a company's value proposition.
    - Key Resources: The resources that are necessary to create value for the customer.
    - Key Partners: The other organisations required to optimise operations and reduce risks of a business model. They can be joint ventures or strategic alliances between competitors or non-competitors.
2. Customers
    - Customer Segments: This considers the customers that are to be served. They can be classified according to their different needs and attributes.
    - Channels: An organisation can deliver its value proposition to its targeted customers through different channels such as distributors, resellers, integrators or infrastructure companies.
    - Customer Relationships: Organisations must identify the type of relationship they want to create and maintain with their customer segments.
3. Finances
    - Cost Structure: This describes the most important monetary consequences while operating under different business models. It addresses the class of business structure e.g. cost-driven versus value drive and the cost structure characteristics e.g. fixed costs, variable costs, economies of scale and economies of scope.
    - Revenue Streams: This describes the way the organisation generates income from each customer segment. It includes asset sale, subscription fees, licensing, etc.

2.1.2.1 5G-TOURS Use Cases BMC

BMCs have been developed for the 13 5G-TOURS uses cases. The full set can be found in Annex A. Below summarises the use case value proposition parameters. The BMC are all based upon the CSP as the traditional deliverer of the primary, bearer service.

The BMC use case analysis will be reviewed with the WP2 use case owners to confirm new value creation opportunities within the specific vertical markets. These new opportunities will be reflected in the respective exploitation plans. The new value creation opportunities will be further analysed using the business case / business model approach described above.

The initial observations of the 13, CSP focused 13 uses cases are as follows:

- Key partners including the CSPs, suppliers, infrastructure providers and equipment and device vendors are generally consistent for the CSPs with the exception of the need for different terminal-equipment and device partners specific to the target vertical;
- Key activities including marketing, customer service and support, deployment and maintenance of infrastructure, network operations, traffic management slicing and billing are generally consistent for the CSPs. This highlights the lack of vertical value differentiation between the services being offered by CSP to each vertical.

The Value Proposition parameters vary between each use case (see Table 1). Whilst there is some commonality it does demonstrate the need for bespoke services to each vertical use case. However, for further, more detailed business case analysis it can be seen that not all 13 use cases need to be analysed and a sub-set, encompassing the range of service specific features, can be developed.

The Channels component indicates a number of additional channels, some established, such as Neutral Hosts but also scopes for new channels via vertical specific integrators such as those in the medical devices industry or 5G private networks.

The use of a Neutral Host Network e.g. an airport, would see the vertical as the landlord. In the case of the Mobility Efficient City trial, the use of a Neutral Host Network at Athens Airport, might see AIA as the landlord and service provider and CSPs as the primary tenants with Airport specific operations and services as secondary tenants. Alternatively, the Neutral Host Network might be delivered by a 3rd party Infrastructure provider with the MSPs still being as primary tenants and AIA as the landlord and a secondary tenant. The Neutral Host model would analyse the role of the other players including the vendors and secondary tenants.

The 5G private networks model will focus on the vertical stakeholder developing and operating a private network to deliver the key use cases. This would see the vertical stakeholder as both the landlord, service provider and primary tenant with scope for the onward provision of services to secondary tenants. This model will be evaluated for the Rennes hospital use cases.

Table 1. Summary of Use Case Value Proposition Parameters

	Data Rates	Latency	User / Device Density	Reliability	Mobility Speeds	Location accuracy
(1) Augmented Tourism Experience	500 Mb/s	< 10 ms				
(2) Telepresence		< 10 ms				
(3) Robot Assisted Museum Guide		< 10 ms				
(4) H.Qual Video Services Distrib	25 Mb/s		several users /m2			
(5) Distributred Video Production	25 Mb/s	< 5 ms		99.99%		
(6) Remote health monitoring & emergency mgmt			several users /m2	99.99%		
(7) Teleguidance for diagnostics and intervention support	2 Gb/s	< 10 ms		99.9999%	> 100 Km/h	
(8) Wireless Operating Room	10 Gb/s	< 5 ms		99.99999%		
(9) Optimal Ambulance Routing			1000's sensors / km2		> 100 Km/h	
(10) Smart Parking Management			50, 000's sensors / km2			
(11) Video Enhanced Ground Vehicles	25 Mb/s				≤ 100 Km/h	
(12) Emergency Evacuation			several users /m2	99.99%		≤ 1m
(13) ARVR Educational Bus	500 Mb/s	< 10 ms			≤ 100 Km/h	

Each of the use cases requires that the associated value proposition describes why the vertical user would want the associated service and the value (proposed benefits or improvements), relative to an existing service. For example, in the case of the Augmented Tourism Experience, the value proposition requirements for 500Mbps and <10ms latency is to support the use of Extended Reality (XR) technology in enriching the tourism experience, making it more attractive to younger, more tech-savvy audiences and to compete with other attractions. This descriptive development of the use case value proposition is currently in development.

2.1.3 Review of business model options

This section details the initial review of business models and their potential suitability to the vertical markets addressed by 5G-TOURS.

2.1.3.1 Literature review

Recognising that WP 8 requires identification of business models based on the 5G-TOURS use case requirements, an initial literature review has been carried out to identify current and emerging business models that might be considered suitable. The literature review has been based upon an extensive literature search as detailed in Figure 3. The initial literature search has identified an extensive set of publications, reports and articles. These have been recorded and stored in a literature database. The literature search will continue throughout the project and the Mendeley database updated with any new findings. The literature database is available on request and will be archived with the project documentation at the end of the project.

The literature review is looking for novel material coming from academia. This will be critically reviewed against what we are developing within WP8. WP8 will continually listening the research ecosystem to look for business model innovation and where found will be assed for its revelation to the 5G-TOURS project objectives. This search for business model innovation will continue for the length of the 5G-TOUR project.

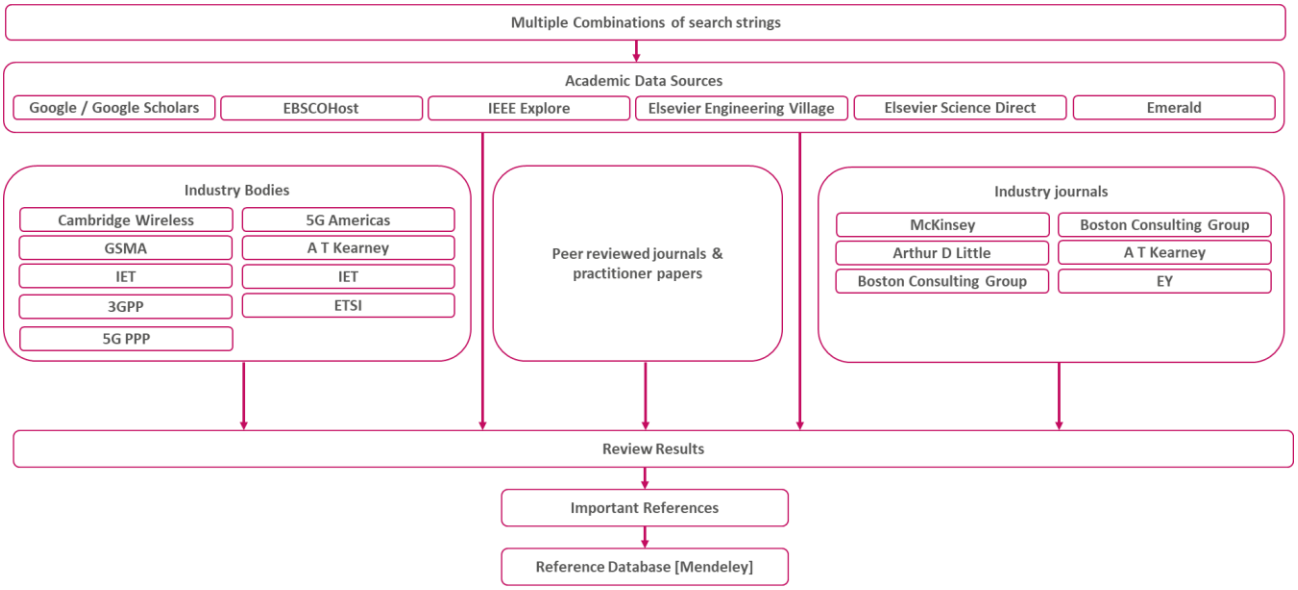


Figure 3. Business Model Literature Search Process

2.1.3.2 Existing business models for mobile

The literature search identified a wide range of established business models. The following list details the ones initially considered:

1. Business Model Canvas [1];
2. Value Chain [2];
3. V^4 Business Model [3].

Business Model Canvas

The Business Model Canvas has already been addressed in Section 2.1.2.1. Several BMCs had been devised based upon their applicability to the mobile wireless industry. These models looked at the "5G Operators Business (the CSPs) that considered a value proposition based on a 5G network service that includes customized slices that can be adapted to specific customer requirements and a "provider of vertical services" that considered a value proposition based on an offer of an enhanced service relying on 5G technology to improve the experience of the customers of the service.

However, for the Business Model Canvas model to work for 5G verticals it must be able to model both the existing Business to Consumer (B2C) model and new Business to Business (B2B) models as required for each new vertical. The CSP will continue to operate one network, but it will support multiple, differentiated services in multiple markets.

Value Chain

The Value Chain model should also be considered because it describes the way that a company fits its products and services to meet the specific needs of current and prospective customers. While a Business Model (BM) shows the way a business returns profit from the activities, resources, channels and partnerships that deliver the product, a Value Chain identifies the sequence of activities, from sourcing to marketing and sales, that deliver the product while returning a "Margin" to the company. Any Business Model could be best evaluated or built on the Value Chain that realises it.

Figure 4. 2016 value chain for the mobile sector (Source: (Frederic Pujol et al., 2016 [4])

(Pujol, Elayoubi, Markendhal, & Salahaldin, 2016 [4]) proposes that the **2016 mobile sector value chain** needs to evolve to reflect a range of further stakeholders emerging in 4G markets:

- Access providers including CSPs, MVNOs[1] and Wi-Fi providers;
- RAN Outsourcers including tower companies, facility managers, urban furniture (lampposts) managers and Equipment manufacturers;
- IoT/mMTC players including Integrators, IT companies and Vertical market players;
- Content owners, OTTs[2].

They propose further new players will emerge in 5G including:

- Connectivity providers offering differentiated services;
- Asset providers who will provide a range of XaaS (anything as a service models);
- New RAN players such as CDN (Content Delivery Network) providers or data centre players;

Having identified the above new stakeholders (Pujol et al., 2016 [4]) proposes a range of new 5G service specific value chains to support the new stakeholders delivering the new services to the new verticals:

- The Private Virtual Network Operator value chain;
- Enhanced connectivity provider value chain;
- The Small Cell as a Service value chain;
- The partner service provider value chain.

V^4 Business Model

The **V^4 Business Model** [3] has been developed for specific use in mobile and ICT industries. The developers of this model argue that it is more comprehensive and suitable for CSPs in an environment that is characterised by continuous change. The V^4 model for CSPs is based upon value proposition, value architecture, value network and value finance dimensions. The value proposition describes either the way in which an organisation along with its suppliers and partners (business actors) creates value for its customers or the ways in which an organisation along with its stakeholders create values for each party involved. With the V^4 model the value proposition requires that the business model includes a description of the products/services a digital organisation offers, along with their related information. Furthermore, the business model also needs to describe the value elements incorporated within the offering, as well as the nature of targeted market segment(s) along with their preferences. The value architecture is a resource-based viewpoint describing the structural design of an organisation, including its technological architecture, organisational infrastructure, and their configurations. This comprises tangible and intangible organizational assets, resources and core competencies. The value network refers the multi-party stakeholder network in which the "actors" (organizational actors and customers), roles, relationships, channels, flows and communications, and governance are treated as design concepts to be addressed within the business model. Finally, the value finance provides information relating to costing, pricing methods, and revenue structure.

The authors suggest that the business model of CSPs needs to be considered at the operator level, from which a more detailed departmental or even service business models can be identified.

[1] A mobile virtual network operator (MVNO) is a reseller of mobile services. An MVNO leases wireless capacity (minutes) from an MNO at wholesale prices and resells it to subscribers at reduced retail prices under its own business brand.

[2] An Over the top (OTT) media service is a streaming media service offered directly to viewers over the mobile internet. OTT bypasses cable, broadcast and satellite television platforms that traditionally act as a controller or distributor of such content.

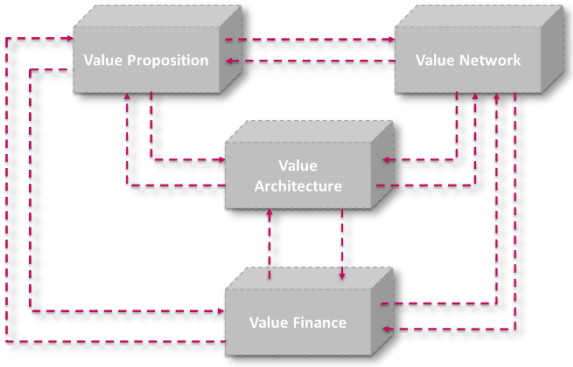


Figure 5. V4 model for mobile network operators (Source: (Al-Debei et al, 205 [3])

Even before the advent of 5G technology (Ghezzi, Cortimiglia, & Frank, 2015) [4] had already recognised that new business models would be required to cope with the dynamic mobile wireless environment and continuous technological change.

Having confirmed that there are established business model frameworks, business models and value chains for current mobile services we now need to establish the broad differences between the current 2G, 3G and 4G services and future 5G services and confirm if these differences can be supported by the existing models and value chains or new ones are required.

(Yrjola, Ahokangas, & Matinmikko-Blue, 2018 [5]) suggests the current, pre-5G mobile market is characterised by the CSPs using business models developed to offer relatively unsophisticated voice and data services to the mass subscriber market with high upfront infrastructure investments (the radio network and associated radio sites) and long-term exclusive licenses granted by the regulators.

Current business models and value chains, on which CSPs built their separate national networks become inefficient in supporting the development of various verticals and services and to respond to use case specific requirements (Yrjola et al., 2018 [5]).

Furthermore, local service demand is expected to grow to enable the digitalisation of different verticals in constrained locations such as campuses, factories, hospitals, sports arenas, and shopping malls. This will give rise to the emergence of so called "micro-operators[3]" (Yrjola et al., 2018 [5]).

The new stakeholders identified by (Pujol et al., 2016 [4]) in the delivery of the new 5G services will also need to be accommodated in new 5G business model and value chains.

Network slicing is currently unaddressed by existing business models and value chains but will play a significant role in addressing the vertical requirements. Finally, it is worth considering that the traditional approach towards business model research focuses largely only on the supply side of value creation, not considering the demand (subscriber or device) side (Ahokangas et al., 2019 [6]). With the anticipated connection densities[4] of 5G combined with shared resource aspects of network slicing it will be important to reflect the specific demand side requirements of each vertical sector.

In conclusion, there is strong evidence to suggest that there are established business models and value chain instances suitable or even developed specifically for the mobile market. However, given the radically different functionality of 5G and proposed use in hitherto undeveloped mobile markets it is clear that these existing business model and value chains will not work for the proposed new 5G vertical markets.

[3] Micro operators will build and operate indoor 5G communication infrastructure to complement the existing mobile connectivity offering. Local 5G micro operators can operate a closed network for its own customers, act as neutral host for mobile network operators' (MNO) customers, or serve both.

[4] Connection density is the ability to deliver a message of a certain size within a certain time, even in space-constrained locations with a high density of mobile end users such as is the case for a football stadium during a match. Connection density is key to IOT and the use of mMTC

2.1.3.3 Emerging business models for 5G

A number of recent 5G based business models have been identified and are potentially suitable for use across multiple 5G vertical markets. The models reviewed have been selected because they initially appear to address gaps in the pre-5G models reviewed in the previous section.

These recent 5G business model include:

1. Scenario-based business modelling (Moqaddamerad, Ahokangas, Matinmikko, & Rohrbeck, 2017 [7]);
2. Micro Operators Business model wheel (Ahokangas et al., 2019 [6]);
3. The (Thuemmler et al., 2015) business modelling concept [9].

Scenario-based business modelling

The **scenario-based business modelling** of potential 5G Markets developed by (Moqaddamerad et al., 2017 [7]) uses 4 scenarios to represent different futures and reflect how the situation with 5G networks and related services unfolds.

1. Scenario 1, "Eternal Today". Assumes CSPs will continue to provide mobile broadband services by acting as traditional "bit pipes" (Maitland, Bauer, & Westerveld, 2002).
2. Scenario 2, "Wild West". This assumes 5G evolves to deliver a portfolio of highly fragmented services.
3. Scenario 3, "Utopia". This scenario describes the characteristics of a dynamic mobile market in a sharing economy society where resources are shared.
4. Scenario 4, "CSPs' Law and Order". It is characterised by a static market situation without new entrants, but necessary resources are shared between the stakeholders.

	5G Ecosystem				
4C MBs Scenarios	Connection	Content	Context	Commerce	Key actors in each scenario
Scenario 1: *Eternal Today* Technology-oriented MNOs dominant	• Mobile broadband as offered today		• Data & usesr density monetized	• Subscription based • Advertisements • Bonus	• Device manufacturers • Network equipment • Spectrum & infrastructure owners
Scenario 2: *Wild West* Service-oriented Micro-operators dominant	• Enabling mobile broadband offering in fragmented markets / environments	• Vertical technological solutions • Customized services			• Content owners & aggregators • Application providers • System integrators
Scenario 3: *Utopia* Service & technology oriented Micro-operators dominant	• Guaranteeing mobile broadband offering through sharing	• Multiple apps • Local content services	• Profiling of users • Context defined content services		• Combination of scenario 1 & 2 actors, i.e. professional service providers
Scenario 4: *MNOs' Law & Order* Regulatory & service oriented MNOs dominant	• Full coverage (by MNOs) throught spectrum provisioning	• IoT devices • Superior QoS • Customer specific services		• License prices • Suctioning of spectrum • Cloud-based B2B	• Government, regulation authorities & standardization groups
	5G specific value creation & capture				

Figure 6. Overview of scenarios and the 4C layers

To model these scenarios, 4 business models are proposed, referred to as the 4C's and describing the specific 5G value creation and capture aspects of the model.

1. Connectivity business model -monetises connectivity-services related to network infrastructure and spectrum provisioning.
2. Content-oriented business model - builds on providing all types of online content-related services.

3. Context-related business model- monetises the structured and aggregated information related to the network, application, user's profile, location, time, history data, equipment, operating systems, and required bandwidth etc.
4. Commerce business model - builds on a platform for buying and selling connection and content.

The "4C's" are then cross-referenced with specific CSP service delivery scenarios to identify their particular value creation and capture features as shown in Figure 6.

Micro Operators Business Model Wheel

The vertical specific **Micro Operators** approach (Ahokangas et al., 2019 [6]) considers a new 5G vertical not previously discussed in this document, namely "micro-operators". The traditional CSP delivery of mobile services to end users is based on centralised infrastructure and using CSP owned radio spectrum. From the local perspective, especially in indoor environments, the new 5G ecosystem may see entirely new players to build and maintain the required infrastructures locally. This will open up new roles for mobile operators, mobile network vendors and local micro operators.

(Ahokangas et al., 2019 [6]) developed the business model wheel concept which puts the business opportunity at the centre of a business model. The business model comprises "what" (customers, offering, value proposition, differentiation), "how" (selling and marketing, delivery, key operations, basis of advantage), "why" (basis of pricing, way of charging, cost drivers, cost elements) and "where" (internal or external to a focal firm) elements. (Ahokangas et al., 2019 [6]) use this generic model to develop three 5G specific model variants: Vertical, Horizontal, and Oblique.

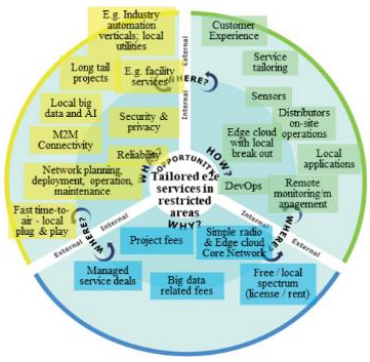


Figure 7. Vertical business model

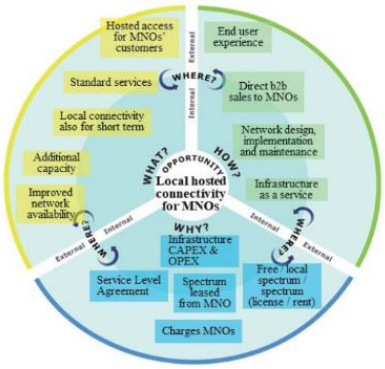


Figure 8. Horizontal business model

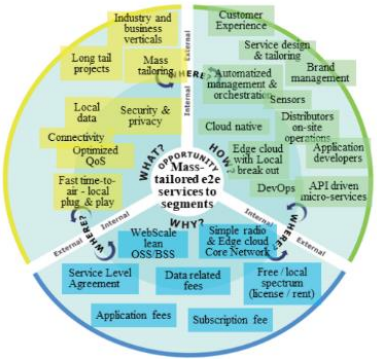


Figure 9. Oblique business model

Source: (Ahokangas et al., 2019)

Firstly, the micro operator model provides the opportunity to provide tailored end-to-end services in restricted areas. Typical customers in the Vertical model include industry automation verticals that may be segmented based e.g. on production type or industry, local utilities such as companies focusing on smart grid management, or local facilities from infrastructures to operational arenas.

Secondly, the Horizontal business model is markedly different to the Vertical business model in that it provides local hosted connectivity for CSPs. This is very close to current neutral host business models.

Thirdly, there is the Oblique business model. This is based on an opportunity to provide mass-tailored end-to-end services to various segments but also offers connectivity with guaranteed security and privacy, local data and optimized quality of service.

(Ahokangas et al., 2019) concludes that the Oblique business model is the most interesting and has the promise to include the best characteristics of the other two models. It represents a more elaborate approach that accommodates opening the supply side to partners (new stakeholders) and ensures that the demand side (downstream customer side) is kept in their own hands. This is interesting because the demand side aspect of current business models is largely unexplored.

Thuemmler Business Modelling Concept

Finally, the model developed by (Thuemmler et al., 2015 [9]) in the report "5G and e-Health" is also vertical specific but does suggest broader use in the 5G infrastructure services context and provides a means to model services in a multi stakeholder environment that offers future 5G infrastructures services. This is a critical aspect of the 5G "network slicing feature".

Thuemmler et al [9] propose that future business models and value chains need to be flexible and adaptable to allow each stakeholder group to focus on its core competencies, such as delivery of care, sector application development, platform, infrastructure or network service provisioning. Identified interfaces must be specified, between all potential business roles that could be performed by stakeholders within the same of different administrative domains. In Figure 10 the areas in scope or potentially in scope of the 5G network are detailed.

The business modelling concepts provide the means to model services in a multi stakeholder environment that offers future 5G infrastructures services. The business modelling concepts specify a common framework for all stakeholders in a service ecosystems and services market. A business model which is constructed using the business modelling concepts of this framework uses the identified business roles and business relationships.

The instantiation of the abstract business model for a particular service enables:

- the identification of the business roles needed to provide a particular service;
- the association of the business roles with the involved stakeholders;
- the identification of the business relationships between the business roles and the business administrative domains owned by the stakeholders involved;
- the specification of the reference points implementing the business relationships.

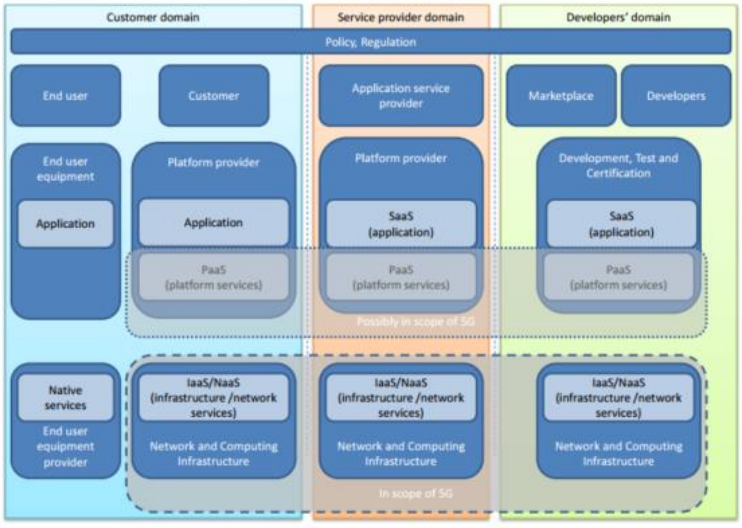


Figure 10. e-Health business modelling concept (Source: (Thuemmler et al., 2015))

The 5G infrastructure service level models developed in the report (Thuemmler et al., 2015) seem also useful for the modelling of the use of the 5G infrastructure by the different verticals.

2.1.4 Conclusions and next steps 5G-TOURS business model framework

Following the initial review of current business models, it can be seen that there are a number of emerging models that attempt to address the innovations brought by 5G. However, these models have not yet been assessed against the specifics of the 5G-TOURS uses cases.

The assessment of the models against the use case design will also need to address the demand side specifics of each vertical and reflect the additional stakeholders and the potential emergence of new vertical specific operators such as neutral host providers and self-managed private networks.

We will first take use cases defined in WP2 and establish the most appropriate business case modelling to apply to these use cases. This will be done in partnership with WP2 establishing the value generation potential of the

use cases and will accommodate the "willingness to pay". The selected business cases will then be developed for each vertical use case to quantify their specific value.

Once the value generation potential of the use cases has been established, WP8 will develop appropriate business models to describe how the vertical organisations can create, capture and deliver this value in economic, social, cultural and other contexts. The development of the business models will recognise both established and emerging models as detailed in the proceeding section and establish their suitability to the 5G-TOURS verticals.

These business models can then be used by the project partners and other stakeholders clarify their role in the vertical use case value chain which and how this can drive strategies for the commercial exploitation of project results.

2.2 Stakeholder engagement

5G-TOURS has a requirement to engage with, and disseminate to, a wide range stakeholders across the vertical industries. So far, we have researched influencing factors with the assistance of the innovation managers and have monitored industry press and announcement to develop and the stakeholder classes detailed in Figure 1.

The 5G-TOURS Advisory Board will also provide support for Stakeholder development. The stakeholder engagement will be an ongoing activity with contributions and suggestions from all 5G-TOURS partner based upon their vertical or subject matter expertise. Potential external stakeholders will be recorded and tracked in a stakeholder tracker for later engagement aligned with the trial workshops.

The purpose of the 5G-TOURS stakeholder engagement activities is twofold. Firstly, WP2 will use strategic market research methods to quantify market size and key parameters such as willingness to pay. WP8 will leverage the WP2 strategic market research to develop a coordinated stakeholder engagement strategy. This will ensure that the project identifies the opportunities for commercialisation of its results and takes the necessary steps to realise these opportunities. It will also promote the visibility of 5G-TOURS for the dissemination of results. This dissemination requirement includes the delivery of business model and technical workshops at, as a minimum, the three proposed major industrial workshops at the trial sites.

Through the workshops the project will investigate how 5G technology and architectures are aligned with creating stakeholder value within the industry verticals and how they might contribute to the long-term goals of an enterprise by:

(i) creating superior performance;

(ii) complimenting internal resources; and

(iii) exploiting external opportunities.

The aim of these workshops will be to gather technology stakeholders and vertical industries beyond those in the 5G-TOURS consortium and communicate to them the project concept and results in a direct and effective way. The expected outcome is to raise awareness of 5G-TOURS technology and deployments in the European stakeholders. Particular efforts will be devoted to reach vertical industries outside the consortium and make them aware of the advantages that 5G can potentially bring to their businesses. A strong emphasis will be given to the use cases demonstrations, to show the advantages and benefits of 5G technology to address real problems and provide practical solutions.

Specific dates for the workshops have not yet been assigned although they will be scheduled to take place once the trials are fully operational. The baseline project plan anticipates the trials to be operational at MS3, "infrastructure handover" in M24. At this milestone, the first integrated 5G-TOURS ecosystem with infrastructure is scheduled to be up and running. However, COVID 19 lock-downs in the partner countries is currently impacting trials set-up and dates.

The stakeholder engagement described in this document, details the first of the two phases of business model focused stakeholder engagement, to gain a project partner perspective on business models and business case analysis. The analysis will be used to refine the approach for a phase 2 questionnaire (and possible interviews). The second phase will utilise the proposed business model and technical workshops intended to focus on the

verticals promoting their engagement with a wider audience. This first phase analysis uses an initial questionnaire to understand the project partner views on business models as guided prompted through a generic Business Model Canvases.

The workshops will provide a valuable platform for wider stakeholder engagement which is particularly important given the expectation for the creation of wider business opportunities. The questionnaire and interviews data collected in phase 2 will be used to confirm and test the WP8 developed business case and business models.

In summary, the phasing of the stakeholder engagement will be as follows:

- Phase 1 (completed): Internal stakeholder engagement using phase 1 questionnaire;
- Phase 2: Internal and external stakeholder engagement using phase 2 questionnaire (applying lessons learned from phase 1) supplemented to strategic interviews with key external vertical stakeholders.

2.2.1 Internal stakeholder engagement

The initial stakeholder, first phase stakeholder engagement has focused on the internal consortium partners. It provides a first pass, with friendly audience. The second phase will use the learnings from the first phase to inform the developed of the second phase question including the questions types, question structure and order and nesting of questions Consortium survey.

The objective of the consortium survey is to collect data from project stakeholders using questionnaires. This is the first of two phases of questionnaires. The second phase will take place in conjunction with the proposed workshops and will seek to survey a larger stakeholder set, including those external to the consortium. The second questionnaire will expand on the first and will look to validate and test the business and economic model developed as part of WP8.

The larger stakeholder set will be researched and developed in the period up to the trial commencement and will be recorded in a Stakeholder Engagement Plan. A set of "Elevator Pitch" documents (see Section 2.2.2.3) have been developed to engage with, and generate interest from, this wider stakeholder group.

Regarding this first phase consortium survey, the partners were assumed to have different "views" on the perceived benefits of 5G, the value delivered by the use cases and the need for new business models. The questionnaire was used to poll opinions corresponding to these aspects of the business model analysis.

The questionnaire comprised 8 sections (see Annex B).

1. Section 1. The primary purpose of this section is the classification of stakeholders into different sub-groups. The classification is necessary as different categories are expected to have different contributions to the value chains.
2. Section 2 of the questionnaire measures the usability of Wireless Technology in each vertical sector. Stakeholders were asked to express their opinion regarding their current use of Wireless Technology and potential use of 5G technology as demonstrated by the use cases.
3. Section 3 of the questionnaire consisted of both closed (quantitative) and open questions (qualitative) questions. Stakeholders were asked about existing business models in their particular sector and their views on new business models for 5G verticals.
4. Sections 4 to 7 of the questionnaire asked each stakeholder to consider each of the sectors. Stakeholders were asked how they perceive the benefits from each 5G use case specific to both vertical sector customers and employees.
5. Section 8 comprises a number of open-ended questions intended to enrich the results obtained from Stakeholders. Based on Stakeholder's answers, the expectation is to derive new information and expressed needs that may not have been captured in the proceeding closed questions.

2.2.1.1 Key Findings

The following information provides the key findings of the questionnaire response relating to the adoption of 5G and aspects of 5G Value chains and Business models. The full results can be found in Annex B. The summary also includes the results from the cross-tabulation analysis of the questionnaires closed questions although the related pivot tables have not been included.

- Do you currently use wireless technology in the daily operation of your business (Question 7 & associated sub-questions)?
    - These questions were used to establish the perceived value of wireless technology in the partner organisations, if current wireless technology met their requirements and how new 5G services might be paid for.
    - The responses to Question 7 (all parts) were unexpected and imply that no further wireless features and functionality are needed (as would be available from a 5G service). The questions need to be reworded to improve clarity including further sub-questions used to qualify the responses.
- If 5G services were used to improve your daily operations, who would you expect to pay for the network equipment to support these (Question 8)?
    - The responses to Question 8 corroborate Question 7 by showing the majority of partners are expecting to pay more for 5G services.
    - Question 8 also shows that the partners (and their respective vertical markets) are expecting the CSPs to fund the 5G network development.
- Would you willing to pay more than what you are currently investing in wireless solution to enjoy 5G enabled services (Question 9)?
    - The responses to this question clearly show that partners (and by implication their verticals) are willing to pay more for 5G services.
- What is your customers general understanding of 5G? (Question 14):
    - Customers understanding of 5G shows that there is an understanding of 5G across all three vertical markets. However, this requires further clarification to understand if the "perceived understanding "is anecdotal or possibly related to health concerns.
    - There continues to be extensive research into the potential health effects of 5G and all wireless communications systems. There have been two recent UK government publications, (OFCOM, 2020) and (ICNIRP, 2020) that both conclude 5G currently presents no risk to health. Despite this the public concern persists (Hern, 2020).
- What is your company / organisation primary function and how important is the existing wireless technology to the daily operations of your business (Question 2 & 7a1)?
    - The response to this cross-referenced question shows that all project partners, regardless of role, place high importance on wireless technology. This is valuable given that a significant number of the partners are not from the mobile industry.
- What is your company / organisation primary function and what are the current and future needs of wireless technology in your business (Question 2 & 7.a iii.1)
    - The response to this cross-referenced question gives a confused picture regarding the potential value of 5G. This is because the largest proportion of the responses indicate that the current and future needs of wireless technology in the particular business areas meet all current requirements. This implies that the partners are anticipating that existing 4G and future 5G systems will meet all future requirements. The Phase 2 questionnaire needs to simply the question so that there is a clear correlation between the clarify the question structure to ensure that the question is correct answered.
- If 5G services were used to improve your daily operations, who would you expect to pay for the network equipment to support these (Question 2 & 8)?
    - The responses to this cross-referenced question indicates that the verticals expect the CSP to fund 5G network improvement annual subscription.
    - This needs to be developed in the phase 2 questionnaire to also capture the views relating to alternative network provision such as self-funded private networks and neutral host networks.
    - The responses also had business model implications with respect to the traditional CSP delivered service model.
- What is your company / organisation primary function and do you believe that the generic value chain provide in the questionnaire accurately reflects your understanding of the current mobile market (Question 2 & 20 a/b)?
    - Almost half of the responses expressed a need for changes to the generic value chain.
    - A number of the response also proposed a range of specific changes including:

        - *The integrator role is not explicit.*
        - *Several parts are missing. The manufacturing of vertical equipment and applications. End users can be vertical players. Private networks are not covered.*
        - *The end user section does not fully address the new 5G vertical markets each with different needs.*
    - This feedback needs to be accommodated in the phase 2 questionnaire.
- Do you believe that 5G solutions & services will require new business models to address industry segments/verticals not effectively served by existing wireless technologies (Question 16)?
    - The responses to this cross-referenced question gives a clear indication that new 5G business models are needed (16 from 18 responses confirmed the need for new models).
- How would you describe your company's current Business Model (Question 17)?
    - There was a good number of responses to Question 17 but the responses gave a wide range of messages.
    - This indicates either, the question was not understood, or the partners understanding of a business model is not clear.
    - The phase 2 questionnaire will therefore need to give greater clarity to the question and provide supplementary background information on Business Models.
- Do you believe that 5G solutions & services will require new stakeholders e.g. service providers, integrators, solutions providers, etc for 5G to address new industry segments/verticals (Question 19)?
    - 12 of the 17 responses to Question 19 said they believed 5G solutions and services would require new stakeholders. This needs to be reflected in the development of any new business models.
- Do you believe that this generic value chain accurately reflects your understanding of the current mobile market? If no, how might it be changed (Question 20).
    - 14 of the 18 responses to Question 20 said that the generic value chain accurately reflected the partners understanding of the current mobile market.
    - However, this conflicts with Question 20 in which half of the responses made suggestions for a range of 5G related changes to the value chain model thus implying a need new business models are required.
- Do you believe that further BMC are required to better model the potential 5G market (Question 21)?
    - The responses to this question included interesting suggestions for further 5G BMC models including a "dedicated BMC for dedicated vertical services", "infrastructure sharing", and BMCs for Neutral Host. These suggestions need to be reflected in the assessment and development of new business models.

The questionnaire responses provide strong evidence supporting the need for new 5G business models. In addition to incorporating the new 5G business model feedback there are also a range of lessons learned that should be applied to the Phase 2 questionnaire.

- The question numbering needs to be simplified and avoid titles that imply an open question.
- The numbering of nested sub-questions needs to be simplified in line with a traditional document heading hierarchy.
- The section headings need to be simplified to give a clear guidance to the responder.
- The questions need to have "jumps" so that vertical specific responders do not need to scroll through questions that are not relevant. This will reduce the time taken to complete the questionnaire.
- The combining of closed and open questions under a common question heading made analysis difficult. For the Phase 2 questionnaire the closed and open questions need to be separated, with closed question only being used for responder information e.g. company name, size, function, etc.
- The structure and wording of Q7 needs to be changed with further sub-questions asking what 5G advances, new features and services stakeholders would like to see in addition to their current services and why?
- Question 8 needs a further sub-question to explore the use of alternative network delivery, e.g. private networks and MVNO's.
- Question 11 needs to be expanded to further explore "willingness to pay" and specifically demands side versus supply side implications and the use of alternative supply models e.g. neutral host and MVNO.

2.2.2 External stakeholder engagement

In parallel to the internal stakeholder engagement we are developing a plan to engage with a wider set of external stakeholders, outside the consortium but relevant to the 5G-TOURS vertical market and the use cases that are being demonstrated. The impact of COVID 19 lock-downs in the partner countries is yet to be fully understood but direct external stakeholder engagement via the proposed trial workshops may prove challenging.

The external stakeholder engagement will also promote the proposed trial workshops and generate a potential list of potential attendees.

2.2.2.1 Stakeholder map: Background & purpose

Figure 11 details the 5G-TOURS stakeholder map. This has been developed to capture the stakeholders associated with the 5G-TOURS project and the wider vertical industries.

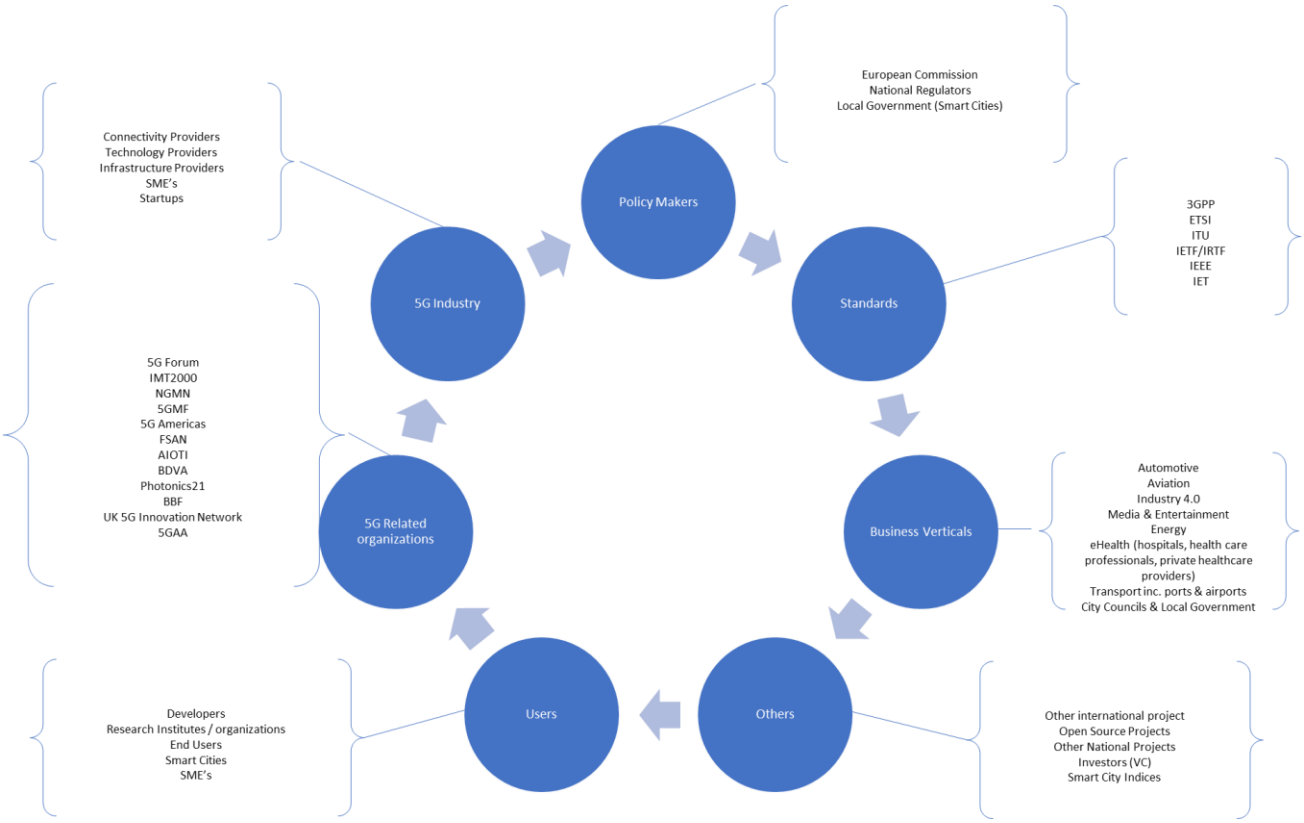


Figure 11. Stakeholder map

Associated with the Stakeholder map is the Stakeholder Engagement Plan. This plan is used to capture, track and record stakeholders and industry players across the vertical markets. The Stakeholder Engagement Plan is updated and maintained using a similar approach to that used for the Literature Review (Section 2.1.3.1). Potential new stakeholders and industry players are added to the Stakeholder Engagement Plan and will ultimately form the target market for the future workshops and the second survey.

The following list provides examples of the current organisations listed on the non-5G-TOURS Stakeholders part of the Stakeholder Engagement Plan:

- 2 hospitals;
- 2 ports;
- 3 healthcare industry bodies;
- 4 manufacturers / vendors;

- 2 network operators.

The initial stakeholder plan indicates a strong eHealth presence which reflects considerable activity relating to the potential use of 5G in the health industry.

2.2.2.2 City Index Research

During the stakeholder engagement research, a number of "City Index" systems were found to have strong technology and innovation criteria including wireless communications and hence might provide valuable in the wider business validation. We therefore carried out a review of a number of these index systems to establish how relevant their specific assessments were for the 5G-TOURS trial cities.

The City indexes evaluate and rank the major cities of the world by the assessment of a range of indicators. These indicators address a wide range of criteria including Business, Culture, Economy, Infrastructure, Education, etc. Many of the indexes include specific assessment of broadband data services and wireless technologies as these are seen to be a key component in the ranking. An overview of the Indexes has is detailed in Annex C. One or more the index datasets will be made available to the project and these will be used to further evaluate the assessment criteria and indicators and their suitability to the 5G-TOURS trial cities.

Table 2. Comparison of City Indexes

Index	No. of Index Indicators	Relevance to 5G-TOURS
IMD Smart City Index [10]	46 Indicators	7 direct indicator synergies with 5G-TOURS
Innovation Cities Index [11]	165 Indicators	12 direct indicator synergies with 5G-TOURS
A.T. Kearney, Global Cities Report [12]	40 Indicators	4 direct indicator synergies with 5G-TOURS
Global Power City Index (GPCI) [13]	76 Indicators	8 direct indicator synergies with 5G-TOURS
Mott Macdonald Smart Infrastructure Index [14]	42 Indicators	4 direct indicator synergies with 5G-TOURS
ARUP City Resilience Index [15]	53 Indicators	7 direct indicator synergies with 5G-TOURS
Arcadis Sustainable Cities Index [16]	31 Indicators	7 direct indicator synergies with 5G-TOURS

2.2.2.3 Elevator Pitch: Background & purpose

A set of Elevator Pitch document have been developed for initial engagement with external stakeholders. These documents attempt to distil the 5G-TOURS vision and goal into a quick, persuasive overview that will create interest in a project and promote a willingness to engage and contribute. At this point three Elevator Pitch documents have been developed, one each for the three trial locations.

2.2.3 Conclusions and next steps on stakeholder engagement

The stakeholder engagement will continue throughout the life of the project.

To date, the bulk of the engagement has been with the internal stakeholders, but we are now progressing to engaging with the wider, non-partner, vertical industries.

A second, phase 2 questionnaire will be developed taking on board the lessons learned from the first internal questionnaire. This questionnaire, which will coincide with the trial workshops will be used to gain a more detailed understanding on the wider stakeholder community and seek to again a more detailed understanding of vertical industry innovation, market size, scaling, costs, revenues and willingness to pay.

All of the City indexes reviewed contain indicators that reflect many of the features of the 5G-TOURS use cases. Whilst the Innovation Cities Index has the most synergy it is also the most complex index.

The IMD, GPCI, ARUP and Arcadis indexes all capture many of the features of the 5G-TOURS uses cases including health, emergency services, traffic congestion, video and film production, tourist attractions and air freight.

Whilst these indexes are an interesting perspective on a city's infrastructure and the support for wireless communications services they have only been reviewed as a possible mechanism for the trial cities to compare their city resources and potentially enhance their respective cities world status. The Index Indicators will not be used as a specific element of the business model analysis.

3 Exploitation

This section describes the exploitation plans regarding the needed functionality linked to business cases to be developed by 5G-TOURS, considering both dimensions of vertical ecosystems and transversal network infrastructures.

This is the first publish of the exploitation plan statements that, starting from the proposal, have been completed and upgraded on the base of first phase of project's life.

In the following, the individual exploitation plans of 5G-TOURS partners are reported, subdividing partners on the base of their role in the project ecosystem: network operators, network equipment providers, the three vertical ecosystems (Media & entertainment, Healthcare and Mobility) and the Transversal activities.

3.1 Mobile network operators

The role of the mobile network operators in the 5G ecosystem involves the deployment of the mobile network and the provision of network slices for the vertical customers:

Telecom Italia (TIM) is the incumbent operator in Italy. TIM is implementing, and it will continue in the next years, the so called "Operations TIMe" plan, which significantly impacts the business of the company. In the context of this multi-year plan, 5G is a fundamental corner-stone, enlarging the type and number of markets where the new digital company will be committed and promoting the full deployment of the "native cloud" approach. The business with the so-called "verticals" is central in the 5G deployment. Therefore, TIM started already in the previous years with R&D projects and state-owned initiatives, such as the "Bari Matera" trial supported by the Italian Ministry of Economic Development. 5G-TOURS, which is running on top of the 5G-EVE platform coordinated by TIM, is a very important element in this strategy. Most of the innovative initiatives are centred in Turin, where TIM is planning to run the "Innovation Mile" platform, aiming to implement the most innovative features of 5G beyond those that are going to be implemented in already foreseen commercial deployment. The involvement of players such as RAI, Comune di Torino and Fondazione Torino Musei provides TIM with the opportunity to create new businesses with these players in the field of broadcasting, smart city applications, education and tourism.

Orange uses the results of the 5G-TOURS project to understand the advances in healthcare provision that can be made when implementing the innovative features of 5G in terms of high bandwidth, low latency and ultra-reliability connectivity between all actors in the care pathway, ensuring secure connectivity of novel devices that can be used both outside and inside of a hospital to better treat patients.
Orange is helping to design the hospital of the future and exploits the outcomes of the eHealth use cases with our partners to further define this vision. In addition, Orange uses 5G-TOURS to enhance and optimise the network deployment, control and management of the 5G-EVE platform across the various verticals through the development of the eHealth and safe city use cases designed for the Rennes trial, thereby gaining experience in running a 5G network for specific vertical needs.

OTE is the dominant telecommunications operator in Greece, and along with its subsidiaries one of the largest telecom groups in South-eastern Europe. OTE has being very much involved in wireless (e.g. WiFi, WiMAX, LTE, TETRA) and wireline (e.g., xDSL, fibre optic, FTTx, etc.) broadband technologies. As of that, OTE has long ago identified the growing need for investing in 5G technology since this has been proven one of the fields which is very promising for OPEX and CAPEX reduction while at the same time offering demanding and advanced services to the end users. Based upon technical and market-led priorities, OTE is expected to gain several advantages by the project results, so that to further increase its market profile.

OTE aims to exploit the expected 5G-TOURS concept by initially verifying the proposed platform and then coming with a plan of "how to promote it" into its existing and/or future solutions, thus strengthening customers' confidence and enhancing its competence in the field of telecommunication networks. Moreover, 5G-TOURS exploitable assets will be demonstrated to the exhibitions that OTE representatives will participate and anticipated customers will be further engaged with 5G-TOURS developments and products. The innovative features of the expected 5G-TOURS findings also help to design and promote new business models. Finally, the promo-

tion of the project's results to biannual Deutsche Telecom Group workshops, international workshops and congresses greatly enhance and strengthen the exploitation opportunities for their wide adoption, as well as conformation to current standards is of crucial importance for their wide adoption and deployment.

3.2 Mobile network equipment providers

The manufacturers of network equipment:

(i) provide the mobile network operators with the infrastructure to deploy their networks;

(ii) supply the providers of the vertical solutions with the communication devices or components needed within their solutions.

Mobile network equipment providers exploitation plans include:

Ericsson Italy is part of one of world's leader provider of communications technology (ICT) and services that enable the full value of connectivity by creating game-changing technology and services that are easy to use, adopt and scale, making its customers successful in a fully connected world. Its comprehensive portfolio ranges across Networks, Digital Services, Managed Services and Emerging Business; powered by 5G and IoT platforms. Ericsson Italy exploits 5G-TOURS results as part of its main goal to support operators and other "vertical" customers to leverage new business opportunities that rely on technologies enabled by 5G. Ericsson builds on the improvements on the state of the art brought by 5G-TOURS to strengthen its market position and to improve the product portfolio.

Samsung is the world's highest-selling mobile phone company and number one in global and European smart phone markets. Shortly after the beginning of the project, Samsung started producing 3GPP Release 15 phones. Samsung started providing project partners with these phones (Galaxy S10 model) and will continue throughput the project possibly with later releases (Rel-16). Samsung plans to exploit the project's results to strengthen its position in the smart phone market, improving their capabilities and reaching the verticals' markets. 5G-TOURS further provides an important opportunity for Samsung to enhance the global R&D in future 5G systems by cooperation with key vendors and operators, relevant verticals that can benefit from 5G, and leading research centres and universities across Europe. Samsung Electronics UK (SRUK) plans to utilise 5G-TOURS results and output for future development of Samsung 5G devices and networking products. Key innovative ideas included in the proposal are the suitability of 5G terminals for the diverse verticals covered in the project (i.e., media, e-health, mobility), terminal-based data analytics to help the management and orchestration of networks, as well as knowledge on 5G mobile network architecture, end-to-end network slicing and orchestration in 5G mobile networks that have expanded the company's competence towards mobile product developments in the near future. These innovations will be protected through international patents, whenever applicable. Samsung also builds on the project in order to continue improving the 3GPPP standard for future releases (16, 17 and beyond) including concepts studied in 5G-TOURS such as AI, Broadcast and network slicing.
Note: Samsung exploitation plans regarding media related activities are included within the media & entertainment segment.

Nokia Greece participates in 5G-TOURS with Nokia France. Nokia is interested in exploiting the results of the projects to improve existing business solutions, reduce capital and operational expenses of production labs, and provide potential for more economically efficient solutions and superior 5G products to customers. In addition, the results of the project are expected to be used to improve the design of the exposed interfaces, as well as the configuration parameters and options of the provided network equipment. Finally, the project results from the 5G testbed facilities are planned to be used to identify innovation opportunities in terms of solutions, products, and services for its customers. Within 5GTOURS, Nokia leverages its network slicing products to deploy slices for medical and mobility applications. This gives insights about new business opportunities around these two vertical markets and provide valuable feedback on the resulting performance requirements and issues, which can be leveraged to improve the network equipment capabilities.

Expway Enensys plans to use the results of the 5G-TOURS project to enrich its portfolio to offer improved products to the broadcast market. First, Expway Enensys keeps its leading position in the current LTE-Broadcast market as Expway Enensys is the only end-to-end LTE-Broadcast provider to offer the solutions for both network and terminal. The outcomes of the 5G-TOURS project will strengthen Expway Enensys's position on 5G broadcast technologies to offer the solutions for the use cases targeted in the 5G-TOURS project and beyond.

Expway Enensys provides the products and solutions that enable broadcast in 5G system in both core network and terminal. For example, the BM-SC product in LTE could be evolved and become network function(s) in 5G core network. Expway Enensys plans to provide the point-to-multipoint solutions for the convergence of fixed broadband (e.g., multicast ABR) and mobile networks (e.g. LTE-Broadcast) in 5G. Expway Enensys also intends to increase its standard exposure by actively participating in 3GPP SA4, SA6 working groups and occasionally other 3GPP working groups such as CT1 and CT3. Indeed, 5G-Xcast partners including Expway Enensys managed to introduce a study item on terrestrial broadcast in 3GPP Release 16. Expway Enensys plans to bring broadcast as a part of standard specifications in the upcoming 3GPP Releases.

Sequans leverages the project outcome to develop its knowledge of vertical markets, especially in the context of machine type communications. The improved knowledge on use case can help Sequans to improve and add functionalities to its Cat-M and NB-IoT solutions, enrich its product offering by including custom development made within the project, in order to adapt to the specific needs met in the various vertical deployments of 5G-TOURS. Technical activity undergone in the project helps us to continue promoting enhancements to Cat-M and NB-IoT as well as scope development of IoT relevant study and work items into 3GPP. Sequans exploits the project outcome to consolidate its transition from 4G to 5G, with a particular focus to the on-going trend in 3GPP of "Industrial IoT" or other evolution of eMTC and NB-IoT within Rel.16 and beyond.

Atos Telecom is an international information technology company, leading the transformation of digital services and telecoms operators to generate more business value from their networks. The involvement in 5G-TOURS project plays a vital role to enhance the current portfolio of products and technologies offered to its customers. Atos telecom portfolio is adapted for network virtualization and diversification of services. Atos uses the knowledge and the expertise acquired during the 5G-TOURS project to strategically position the telco portfolio in an environment in which NFV is transforming the telecom landscape, strengthening its NFV Program. This project provides Atos with the opportunity to be prepared for new customer demands and enable new business offerings. Building on the expertise gained during 5G-TOURS project, Atos will analyse the return of investments of its customers that are willing to acquire 5G services.
As a member of the OSM, Atos provides the knowledge, experience and contributions acquired in other EU funded projects such as SONATA or 5G-TANGO. Atos Telecom facilitates the use of 5G-EVE through the 5G-TOURS service layer for the pilots that are being developed in the project, as well as extending the intelligent orchestration capabilities for the use cases of 5G-TOURS that are not offered from the 5G-EVE architecture.
Note: Atos exploitation for media related activities is included within the media & entertainment segment.

3.3 Media & entertainment ecosystem

The media & entertainment ecosystem brings together partners that are providing the media solutions (Samsung media and ATOS media for Augmented Reality (AR)/Virtual Reality (VR) applications and LiveU for media production solutions) along with the users of those solutions (a museum and a school for the AR/VR solutions and a broadcaster for the media production):

Samsung media contributes to 5G-TOURS by members of the Samsung Internet Web Advocacy team. Among its main tasks is to spread the word about web technologies, with a strong focus on immersive AR/VR technologies. To do this, the Samsung Internet team engages in standards, contributes to open source projects and interacts directly with the developer community. Focusing on a more inclusive and diverse web, the Samsung Internet team treats topics related to the modern web, leading conversations in areas of Progressive Web Apps, Immersive Web, and new upcoming Web APIs. Samsung plays an active role in the Web and is committed to enhance the reach of these technologies. Through its involvement in 5G-TOURS, Samsung media expects to leverage the technologies developed within the project to greatly enhance the massively used Samsung Internet for Android, namely the web browser that is pre-installed on all Samsung Galaxy phones and tablets, so that it can be optimized to support immersive applications using underlying 5G technologies. That will be achieved through the open source Chromium project, to which Samsung is a major contributor. Also, Samsung expects to develop a better understanding of the use of AR/VR in use cases based on 5G infrastructure such as the transport of the touristic use cases in order to enhance the AR/VR products and improve the user experience in products such as the Gear VR.

Atos media is a leading European provider of Managed Services and a major player in the area of IT services for large media companies and Olympic IT services provider. It plans to incorporate 5G-TOURS highlights into

the media portfolio. In the media market, Atos has customers in the Broadcast, Entertainment and New Media areas. The current portfolio of services includes: Media Operations Outsourcing, Process focused Digital Media Supply Chain Modernisation, OTT TV Services & Interactive TV Services, Sports Management Systems. The aforementioned services are consumed by a large number of media players such as BBC where Atos manages 151 international sites led by the BBC Network and over 1PB of web data distributed daily. Atos explores the integration of 5GTOURS results into its media offering portfolio enriching the already successful Olympic Video Player (a turnkey online multiplatform service providing a customizable digital Olympic experience) and into the Atos Media Cloud services (with partnership with EMC2 and VMware).

LiveU leverages the 5G-TOURS project to tune and improve its video delivery algorithms and products for 5G networks. This is based on the knowledge it gains about new features offered by 5G technology in the areas of interest of a media company, including 5G network KPIs, QoS guarantee mechanisms and the impact of slicing, as well as the 5G ecosystem deployment preferences and priorities for media video contribution applications.
LiveU exploits the project results for its cellular-based video contribution products serving the professional and semi-professional EU and global media customers in News coverage, Sports and Entertainment coverage etc. Further, LiveU remote production suite currently called “At home” for synchronized multi-camera production remotely from the cameras themselves, shall also be enhanced according to the 5G-TOURS tests.
LiveU uplink single and multi-link bonding video encoders-transmitters will be tuned for the performance we will experience in the 5G-TOURS testbed trials, such as in bandwidth, latency and error rate in the sub 6 GHz band. These products include the upcoming LU800, the existing LU600 and future products. Also, our LU-Smart SW for smartphones shall be similarly tuned for the 5G uplink performance. And as mentioned, so will the LiveU “At Home” remote production and future variations. LiveU will also be able to consider the impact of having its cloud-based video server receiver near the edge, for applications such as production using 5G Private Networks in venues.
In particular, LiveU collaborated with other partners of the project for the creation of state-of-the-art television products in order to exploit 5G TOURS technologies in the area of the television production, taking into account UHD content, multi-camera synchronized production, low latency via edge server and additional collaborative production features such as multi-party return audio (later in the project).

RAI Radiotelevisione Italiana leverages the 5G-TOURS project to gain knowledge about new features offered by 5G technology in the areas of interest of a media company. RAI exploits the project results in two different areas: (i) the content distribution to the final user, enriching the television experience on different types of terminals, and (ii) the television production, using the 5G network and features to implement remote and distributed production, facilitating the covering of events and exploiting 5G features by providing new services: from high quality audio/video streaming up to the mixed reality immersive services. In particular:

- Knowledge in IP-end-to-end highly distributed broadcast production workflow, cloud/edge-based video and audio encoding, mixed reality for improved TV entertainment;
- New TV formats enabled by new features offered by the 5G TOURS technologies;
- Integration of the media company production workflow with new distributed edge network and computing technologies.

In particular RAI collaborated with other partners of the project for the creation of state-of-the-art television products in order to exploit 5G TOURS technologies in the area of the television production and in the area of distribution, taking into account UHD content and Immersive experiences in relevant cities. In this environment a particular focus of exploitation activities for RAI is about:

- Content creation and OTT services in the 5G era;
- Cultural heritage for touristic and museums services.

In particular, for the first point, for RAI the 5G technology is expected to build on and integrate the previous generations of wireless networks. 5G supports the expected broadcasters' mobile data growth, and at the same time allows new services for final users and advertisement. 5G brings network performance enhancements and agility in the network characteristics, and with that, plays an important role in supporting the growth and development of many industries, the broadcasting and media factories included.
For the second point about Cultural Heritage, RAI collaborated with the other Italian partners of the project in the production of new content specifically studied for the city of Turin in the context of 5G TOURS trials.

In general, RAI will leverage the 5G-TOURS project to gain as knowledge about 5G service layer that will be valuable also for future works (research and industrial) in the environment of new generation networks.

Comune di Torino & Fondazione Torino Musei are interested in leveraging 5G technology to improve local services in the city. As stated within "Torino 5G Agreement", signed between the City and Telecom Italia, the City is particularly interested in exploiting the 5G infrastructure to evaluate future suitable applications. For 5G-TOURS the City is working on touristic, as well as on cultural and educational sectors, thanks to the collaboration with Fondazione Torino Musei: the five use cases provided in WP4 (Touristic city use cases implementation) have, as main locations, museums. The objectives, to whom to turn to, are mainly: increase the cultural and tourist offer of the city, diversify the cultural offer of museums in order to reach the widest and most diverse audience, engage students by stimulating their learning through innovative and participatory technological solutions, foster social inclusion, ameliorate the surveillance and safety system in museums, improve the communication system for citizens and tourist providing more information (e.g. weather conditions, density of people in different areas).

Ellinogermaniki Agogi (EA) is an innovative school which systematically takes advantage of emerging new technological opportunities in order to offer enhanced teaching and learning experiences, including the use of advanced telecommunications infrastructure and high-speed connectivity. The potential offered by 5G technologies for richer educational content and experiences everywhere, both within and outside the classroom, will be exploited by EA to realize its aim to turn the school environment into a smart campus, and enable richer learning experiences whenever students visit sites of educational interest outside the school premises. To this end, EA offers its school environment for the co-design and testing of future 5G applications for education, leveraging the user-centred approach of the 5G-TOURS project to produce AR/VR solutions for travelling students which will be exploited in real-life educational settings both during and after the funded period of the project.

3.4 Healthcare and safety ecosystem

The healthcare and safety ecosystem includes partners across the full value chain, including clinical parties (hospitals, emergency care services), equipment and health service providers (ultrasound systems, smart glasses, remote collaboration services), mobile network operators and network equipment vendors (described above). Their detailed exploitation plans are as follows:

Philips plans to use the results and experiences of the 5G-TOURS project to improve its range of connected care solutions across the full health continuum [32], see Figure 12.

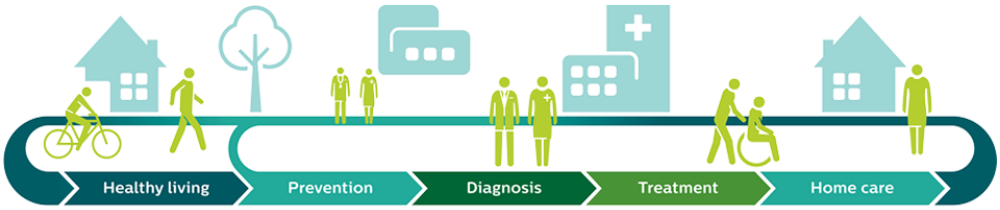


Figure 12. Health continuum

A wide variety of connected medical devices are currently being used in the different phases of the health-continuum. These devices include mobile communication devices such as smartphones, patient monitoring devices such as respiratory and pulse rate measurement patches, vital signs sensing cameras, mobile point-of-care equipment such as ultrasound machines, data access / entry devices, such as tablets for use by nurses and techs in the ward, ICU and, radiology department. Finally, there may be IoT devices for the monitoring of environmental conditions (temperature, light, motion) of patients, medication adherence, etc. 5G communication technology offers huge opportunities to create more reliable, performant and effective connected care solutions.
In particular, the use case that is addressed in 5G TOURS is expected to provide valuable insights to Philips on how to effectively use 5G communication technology to improve and expand its business in Ultra Mobile ultrasound devices and solutions, in particular into the ambulance and the hospital emergency department. The combination of reliable real-time ultrasound streaming with low-latency remotely-controlled image acquisition, associated AR/VR applications, high resolution video communication and smart glasses will provide Philips the opportunity to create breakthrough product propositions for emergency care and diagnostics services for rural areas.

AMA plans to use all the experience gathered around 5G-TOURS to prepare the next big challenge that 5G represents on smart glasses business and tele-assistance. Today, AMA is leading this emerging market world-wide because it has the most robust solution working at its best even in low bandwidth conditions (3G, Satellite, etc.). Mastering its environment and being able to offer the best experience in any case, either low or very high bandwidth, is a key factor of success for any player in the smart glass business. This is why getting into this project helps AMA to be one step ahead than anyone else on 5G by bringing the best user experience and new features. This helps AMA to expand outside Europe too.

Hospital of Rennes (CHU) plans to use 5G-TOURS results to influence its project on the new hospital of the future. With more than 50 operating rooms, the interventional platform must have the most modern and efficient technologies. Augmented reality becomes a standard in OR and with the 5G-TOURS project, we expect 5G to provide the performances needed to actually combine two or more live sources of high-resolution image data in real-time. The synchronization needs to be perfect as in these situations time is distance and distance errors could be a matter of life and death during surgical minimally invasive interventions.
Our hospital plays a major role in emergency and remote care with medical regulation teams and mobile emergency care teams. As part of the 5G-TOURS project, we will assess the performance of 5G to help transform an ambulance dispatched on an incident site into a real emergency room. All the expertise of the CHU will thus be used to assist and guide the intervention team to stabilize the patient on site and then during transfer to the hospital. The benefits of 5G are also evaluated in the context of patient monitoring after or between hospital stays. Positive evaluations lead directly to changes in medical practices and care pathways. Physicians involved in 5G-TOURS will disseminate the results in clinical and scientific conferences.

3.5 Mobility and transportation ecosystem

The mobility ecosystem includes two solutions providers which develop the sensor deployments that gather information related to mobility and safety as well as other mobility-related systems and applications. It also includes the end-users of such solutions: an airport, a school and a security agency for the safety inside the airport. The detailed exploitation plans are as follows:

WINGS plans to exploit the outcomes of the project, especially the ones related to health, wellbeing and transportation, towards enhancing the company's software solutions (such as STARLIT, a smart cities and assisted living platform but also other solutions in different vertical domains) so as to extend the supported set of connectivity options and to be able to offer the platform's services over a wide area connectivity, offering, at the same time, certain quality guarantees. WINGS develops systems (software and hardware) for serving diverse verticals (e.g., smart cities, assisted living – health, water, energy, environment monitoring, etc.). Through 5G technologies, WINGS will expand its portfolio and become more efficient in its offerings. For example, it is anticipated that WINGS will be enabled to deliver content and assisted living and smart cities services (currently, in the portfolio or new ones), by negotiating slices that will ensure the appropriate performance and quality levels in challenging environments, as the one of e-health, safety and transportation. In addition, data management and ingestion, predictive analysis and, in general, ML-based services and tools developed in the context of various use cases being deployed in the Athens and Rennes nodes are expected to increase the functionality of WINGS commercial platforms, particularly with respect to domains such as smart cities, assisted living and environmental monitoring. Towards the above, WINGS will pursue valuable synergies with vendors, Telecom Operators and OEMs, so as to set up a collaborative infrastructure that will enable the delivery of the previously described advanced services.

ACTA is an integrating, distributing and software-implementing company. As an integrator of software for OTE, the project's solutions are valuable to be exploited through its products. In particular, ACTA adapts the outcomes of the project into its products line. In particular, some of the solutions produced in the project will be used to improve ACTA's product offerings and extend the current portfolio of the company.

Athens International Airport (AIA) is particularly interested in addressing the challenge to protect and safeguard the lives and the safety of the tens of thousands of passengers using the airport every day. In order to cope with potential risks, the Airport needs to have in place those processes and framework that enable their mitigation. The solutions developed within the 5G-TOURS project enable the gathering of the information that will signal the early detection of alarming events raised at the Airport and then fuse and convey this information to the authorities responsible for the decision making. The solutions employed will also allow the responsible

authorities to assess the effectiveness and the progress of the execution of these plans. In the case of the parking scenario, the Airport is keen on developing a solution that will enable the airport car parking users to quickly identify a suitable parking place, saving time and energy, reducing emissions and increasing passenger satisfaction. The third use case which comprises of live video feeds from multiple mobile Airport vehicles will result to a dramatic increase of the situational awareness of the stakeholders responsible for the operation of the Airport operation. Upon the execution of the validation tests, AIA will consider and decide upon the integration and use of the solutions developed within the 5GTOURS project.

KEMEA works very closely with all security stakeholders in Greece to uptake innovative actions, and the expected outcomes from the project are promptly considered by Hellenic Police, Civil protection, Ambulance, Fire and Rescue services for validation and exploitation. KEMEA leverages the project outcomes to improve the existing collaboration between various first responder agencies and minimise the fragmentation experienced when various actors operate in the same incident scene. These synergies with European networks will be used to promote a better level of technology and independence for European strategic autonomy and to support the development of European reference solutions.

3.6 Transversal activities

In addition to the network operators, network equipment providers and the three ecosystems, the 5G-TOURS consortium also includes a number of partners who are playing a more transversal role such as economic analysis of use cases (Real Wireless), introduction of non-commercial solutions into the ecosystems (B-COM, IIT) or innovations from Phase 2 projects (UC3M for 5G-MoNArch and UPV for 5G-Xcast). These are their exploitation plans:

Real Wireless (RW) deepens its business model and economic analysis services capability through analysis of a socio-economic environment in the context of the nodes and identification of drivers and barriers for the adoption of 5G-TOURS concepts in a commercial context. Where appropriate RW's unique in-house developed tools will be enhanced to enable analytic dimensioning of systems based on wireless data traffic and linked revenues. By application of the RW Techno-Economic assessment framework, which shall be validated and enhanced through 5G-TOURS we will strengthen our ability to rapidly determine the optimal opportunity to assess Total Cost of Ownership of infrastructure and assessment of the business case for investment to enhance our Digital Infrastructure investment advisory services. Systems analysis currently takes into account scope and scale across spectrum, compute, storage and networking resources. RW develops a refined vertical driven use case analysis approach, establishing key stakeholders, service value chain positioning and critical functional and techno-economic performance KPIs within the architecture framework. We shall also increase our technology value assessment of AI and Automation based approaches. This shall enable a Connected City practice which utilises our synthesis and analysis tools to accelerate investment and business case evaluation and decision making. RW develops a new business model broker service concept designed to accelerate adoption of innovations in vertical industries.

B-COM contributes to the project both with its telecommunications and its health departments. As to results obtained on the telecom infrastructure, B-COM promotes VNFs that are rolled out as part of 5G-TOURS' Rennes node, which include both open-source building blocks and B-COM ingredients. B-COM is particularly cautious with open-source licenses to prevent hurdles in licensing these VNFs within the scope of 5G-TOURS but also to industries outside the consortium in the private network solutions sector. Additionally, B-COM has already built a marketing plan for a testbed service built on top of a 5G end-to-end facility. B-COM is willing to enhance this service offering with the results of 5G-TOURS project, in particular 5G connectivity in millimetre spectrum. Finally, B-COM is building ingredients to support real-time medical video over IP, based on the upcoming standard DICOM-RTV, as well as software components enabling easier development of medical AR applications. B-COM is willing to enhance these ingredients to support 5G, including wireless communications.

IIT is currently collaborating with various companies and end-users to develop service applications on its R1 robot and is investigating potential economic exploitation of these technologies for retail, surveillance and healthcare. Such results are to a large extent a public asset, which can be applied for society's use and benefit. IIT has created a network of companies that has resulted in more than 400 sponsored research agreements, a portfolio of more than 570 filed patents, 12 joint laboratories with national and international companies and

research institutions, and 17 start-up companies. IIT plans to leverage 5G-TOURS in order to build more powerful robots that rely on 5G for remote control and to provide telepresence servers. The ultimate aim is to transfer the prototypes developed within 5G-TOURS to the productive sector, either by means of a start-up or leveraging the IIT network of industrial collaborations.

UC3M plans to use the results of the 5G-TOURS project mainly along three lines. First, to strengthen the academic leadership: the leading role of UC3M in this area has been recognised by the research community, and the participation of UC3M in the 5G-TOURS allows to publish research results in top-rated conferences and journals, which helps to further strengthen UC3M's position and increase its visibility as one of the top academic institutions active in the field of 5G. In particular, UC3M has already published some of the results in top venues such as ACM MOBICOM, IEEE INFOCOM AND IEEE JSAC, among others. Second, to foster the technology transfers to enterprises: technology transfer to enterprises is one of the key activities of UC3M. This is being achieved through the standardisation and opensource software development, among other activities. 5G-TOURS will reinforce this kind of activities. In particular, UC3M is very active at ETSI ENI standards group, where it is collaborating with some companies. Third, to consolidate the academic courses portfolio: according to several national rankings, UC3M is classified among the top universities in Spain for computer science and telecommunication network studies. The knowledge achieved from the participation in 5G-TOURS provides innovative content to the courses being taught. In particular, UC3M is teaching three master's degrees closely related to 5G-TOURS which are being fed with the knowledge gained from the project: the Big Data MSc, the 5G MSc and the MSc in Telematics Engineering.

UPV has an important role in 5G-TOURS by (i) expanding the knowledge, teaching and training future engineers working in the fields of telecommunications, and (ii) contributing to standardization and dissemination activities, publishing research in scientific venues such as journals, magazines and major international conferences.

UPV is currently exploiting not only the project results but also the experience gained in further expanding its knowledge in the 5G field. UPV also enhances its teaching scope and quality by introducing new project findings and cutting-edge technologies into the teaching and research syllabus at undergraduate, postgraduate teaching and research. UPV focuses on the design and performance evaluation of 5G Broadcast and the correct integration in the use cases considered within the project for trials and demonstrations in Turin. In particular, UPV will closely collaborate with TIM and other partners in the demonstration of joint multicast eMBMS transmissions and work on the development of an enTV Rel-16 receiver to carry out High-Power High-Tower broadcast trials with RAI. They will additionally integrate some of the multicast/broadcast results of the phase-2 5G-Xcast project, where UPV was coordinator, in the 5G core and provide their expertise in digital broadcast standardization (e.g. DVB-T2, DVB-NGH, ATSC 3.0).

3.7 Exploitation Tables

This section consists of five tables summarising exploitation features related to the ecosystems defined in the project: Network operators & network equipment providers, the three vertical ecosystems, corresponding to the three trials (Media and entertainment, Healthcare and safety, Mobility and transportation), and a final one covering transversal activities. Every table includes collections of inputs provided by every partner involved in every ecosystem, for an easy reading.

Data collected by partners relate only to the first phase of project activity, but some interesting indications emerge. All the sectors of application of project partners are involved in a time-frame already starting from the first year of project towards its end and, for some areas, continuing also after the project will be completed.

The most relevant outcomes are highlighted below:

- Network operators & network equipment providers:
    - Specific knowledge about specific use cases is remarkable for improving and adding functionalities to already available solutions to adapt to the specific needs of verticals;
    - Performance characterization (e.g. throughput, latency) of different use cases;
    - Collection of "from-the-filed" requirements for Network Slice applications;
    - Relevant feedback in standardisation activities;

- Media and entertainment:
  - Improving research on educational innovation and innovative educational practice;
  - Content distribution for Broadcasters and Media Companies;
  - Innovative educational practice based on 5g functionality offer for enhanced teaching and learning both at school and outside the classroom;
- Healthcare and safety:
  - Tele-guided diagnosis and connected care solutions in case of emergency care, hospital and ambulance;
  - Patient monitoring and low-cost solutions;
  - Validation of the synchronization of live sources of image data for AR;
- Mobility and transportation:
  - Smart & digitized Airport services in the Airport management sector;
  - New Products and / or Assisted living and smart cities services;
  - Use of Data analytics services and tools to evaluate the effectiveness of the use cases and identify areas of improvement;
- Transversal activities:
  - Application of trials data to the enhancement and validation of the techno-economic models;
  - Increased awareness of AI and AI algorithms that leverage data analytics;
  - Investment opportunity assessment framework.

3.7.1 Network operators & network equipment providers

Description of exploitable result / knowledge	**Exploitable product(s) or measure(s) in which the result / knowledge will be used**	**Sector(s) of application**	**Time-plan for use**	**Deliverable(s) to which 5G-Tours deliverables / results does the topic relate to**	**Owner and other beneficiaries involved**
Improved knowledge on Use Case definition	Define Use Case associated requirements on 5G Mobile System CPNF(s) and 5G-RAN For Use Case 2 and 3, specific knowledge on Docker application, Video compression management and Packet Management For UC10-13, specific knowledge on user and network requirements and network infrastructure Cat-M and / or NB-IoT product. The improved knowledge on use case will help us to improve and add functionalities to our catM / Nb-IoT solutions, to adapt to the specific need of verticals Research activities on Smart Tourism use case Build understanding on use case that will be used to improve Phone's support of these use cases. Improve the AR/VR experience Improved understanding of verticals use case requirements will aid in testbed implementation and feed future work on local network projects including contributions to 5G-EVE Specific spectrum requirements dictate certain equipment, the use and integration of which will aid in future developments	Vendors and Operators: • R&D Development Environment and Telco Labs • Network Management • Other 5G projects • New products or/and Services to offer towards end users • Chipset and module providers • Mobile Vendors increase phone's support for use cases • AR/VR vendors and application creators Primarily the health sector with specific focus on the use cases around AR/VR, remote triage and improving the efficiency of delivery of care in a Smart City environment; other 5G projects and research on OpenRAN to support use cases	Now and throughout the lifecycle of the project For Chipset and module at the end of the project Starting with integration of WP5 testbed in Rennes approx. September 2020 through to end of project and beyond	D2.x D4.x (Turin trial) D5.x (Rennes trial) D6.x (Athens trial) D5.x (Rennes trial) Direct and indirect Scientific publications in conferences	all stakeholders for use cases where they are involved in WP4, WP5 and WP6: • mobile network operators • mobile network equipment providers WP5 participants and related partners from WP3 on network side and WP7 on testing
Knowledge on 5G mobile network architecture	Specific knowledge on antennas, BBUs, and network infrastructure Study of Broadcast application of 5G Network Deep study of Outdoor/Indoor 5G coverage for specific historical areas Performance characterization in term of throughput, latency of different use cases especially in the communication user/server Server positioning for data elaboration needed to implement the use case.	OTE Labs, other 5G projects and Greek site of the 5G-EVE Sharing of practical Use Case experiences within Ericsson/ within Nokia Experience can be applied in R&D development and E2E System Verification	Now and throughout the lifecycle of the project	D3.1 D6.x D7.x D3.x D4.x D7.x D3.x D6.x D7.x	OTE NOKIA GR WP4 involved partners WP6 involved partners

	UE positioning for 5G Networks Define Use Case associated requirements on 5G Mobile System CPNF(s) and 5G-RAN Build new architecture compliant mobile phones OSM / RFQ / RFI Integration work with specific network equipment from multiple vendors. Work on Open Source implementations to support use case requirements. Network coverage planning to support use case locations. Modelling bandwidth expectations against specifications of networking equipment	Mobile Vendors and Operators Vendors and Operators Rennes testbed based on 5G-EVE extended from Paris Saclay Sharing of use case experiences between network vendors and use case verticals on testbed implementation side Feeding back outcomes to R&D based in Rennes supporting the 5G-EVE networks	First half of second year of the project Starting with planning of WP5 testbed in Rennes Q2 through to end of project and beyond	D3.x D5.x Internal reports and scientific dissemination	Operators and Equipment Providers ATOS WP5 participants and related partners from WP3 on network side and WP7 on testing
Knowledge on 5G network slicing	Dynamic Slice allocation and Network Slice characterization in terms of associated KPI values to manage and fulfil the requirements of different Use Cases Specific knowledge on antennas, BBUs, and network infrastructure Orchestration definition in Turin use cases implementation OSM / RFQ / RFI Proposing the use of standardised industry methods as described in GSMA Network Slicing Taskforce (NEST) to collate all use case slicing requirements Study of availability of slicing technology as applicable to the project based on 3GPP and OpenRAN initiatives	Requirement collection for real applications Feedback to R&D OTE Labs, other 5G projects and Greek site of the 5G-EVE Vendors and Operators Ensuring all use case requirements are collected in a manner that allows for orchestration and slicing design to be handled efficiently Sharing with R&D on Open Source side and delegate to GSMA Nest	Requirement collection as for now; Implementation last year of the project Now and throughout the lifecycle of the project 1st half of the project First half of second year of the project Starting in Q2 through to end of project	D3.x D7.x D3.1 D6.x D7.x D4.x D5.x	NOKIA GR OTE ERI-IT TIM OTE NOKIA GR TIM ATOS ORANGE NOKIA FR B-COM
Knowledge on orchestration in 5G mobile networks	Dynamic Slice allocation and to manage different use case requirements, UC10-13 Application of theoretical requirement to the real use-cases: expected tuning of current products based on real use case application results Automate deployment and service assurance by performing automated healing and scaling OSM / RFQ / RFI Gaining insight to the level of granularity required in slicing to support multiple simultaneous use case requirements Use of ONAP in the context of 5G use cases over multi-region IaaS deployments with Openstack and Kubernetes	Feedback to Greek Site orchestration development in 5G EVE Feedback to Ericsson orchestration development in 5G EVE NOKIA Service automation and dynamic Orchestration solution Feedback to NOKIA orchestration development in 5G EVE Vendors and Operators Iterative process with R&D on sharing the orchestration design and implementation results	Last year of the project First half of second year of the project Starting after successful integration of WP5 testbed in Rennes to end of project	D3.x D5.x	OTE ERI NOKIA GR ORANGE NOKIA FR B-COM
Knowledge on data analytics in 5G mobile networks	OTE's KPIs Measurements and Validation Build experience from the relevant use case on data analytics Defining the metrics and test practices to meet requirements from WP7; developing better understanding of key metrics on a multi vertical use case network	OTE labs 5G Tours results to be monitored and identify opportunities Operators/infrastructure providers Rennes Testbed and partners Sharing results and learnings with R&D	Now and throughout the lifecycle of the project	D6.x D7.x D3.x D5.x	OTE Operators and Equipment Providers ORANGE NOKIA FR B-COM
Knowledge and industry insights on the business drivers for and wider socio-economic value of 5G networks	5G Tours feedback to OTE/Ericsson/TIM/NOKIA Product & Strategy Management Build Knowledge on market trends in terms of adopting 5G for various use cases Dissemination of project results to Orange SA departments focusing on healthcare verticals	New Products or/and Services to offer towards end users Vertical providers, operators Developing better 5G related offers to relevant verticals partners	Now and throughout the lifecycle of the project	D8.3 D5.x	OTE ERI IT TIM NOKIA GR Verticals and operators WP5 partners

Experience on the implementation of network slicing in a testbed	OSM / RFQ / RFI Learning from the actual implementation of slicing templates to evaluation of practicality, meeting of KPI and validation of efficiencies brought about	Vendors and Operators Refining of slicing definition and impact on orchestration methodology based on results from testbed	First half of second year of the project	D5.x	ATOS ORANGE NOKIA FR B-COM
Standardisation impact	Relations of the performed activities in the Turin testbed towards the definition of the Release 16 3GPP specs Technical activity undergone in the project helped us to promote enhancements to cat-M and NB-IoT into 3GPP Results from slicing and orchestration implementation feedback via delegates to 3GPP and OpenRAN, and others where applicable 5G Tours feedback to stakeholder's representatives in standardisation committees Improve the standard quality from the research and test bed results feedback	Vendors, operators and wherever the standardisation is implemented/used, including MNO and vertical partners	Now and throughout the lifecycle of the project	D8.1 D8.2 D8.4 D5.x	Project stakeholders and 5G Eco System All partners, especially those that are members of 3GPP
IPR for standardisation essential topics	5G Tours feedback to stakeholder's representatives in standardisation committees	Vendors, operators and wherever the standardisation is implemented/used, including MNO and vertical partners	Now and throughout the lifecycle of the project	D8.1 D8.2 D8.4 D5.x	Project stakeholders and 5G Eco System

3.7.2 Media and entertainment ecosystem

Description of exploitable result / knowledge	Exploitable product(s) or measure(s) in which the result / knowledge will be used	Sector(s) of application	Time-plan for use	Deliverable(s) to which 5G-Tours deliverables / results does the topic relate to	Owner and other beneficiaries involved
Improved knowledge on Use Case definition	Research on educational innovation and innovative educational practice leveraging the potential offered by 5G for enhanced teaching and learning at school and outside the classroom Content distribution, enriching television experience and remote television production Media contents enriching touristic and cultural experiences (e.g. promotional video)	Education and educational innovation, including education-related research and development, educational services, educational content, teacher training Broadcasters and Media Companies	During the project as well as after the end End of project	D2.1, D6.1, D6.2, D6.3 D2.x D4.x (Turin Trials)	EA RAI, LIVU, FTM, TOR
Knowledge on 5G mobile network architecture	Research and service development	Broadcasters and Media Companies	End of project	D3.x D4.x	RAI, LIVU, TIM, ERI
Knowledge on 5G network slicing	Improving the remote television production work flow	Broadcasters and Media Companies	One year after end of project	D3.x D4.x	RAI, LIVU, TIM, ERI
Knowledge on orchestration in 5G mobile networks	Research and knowhow	Broadcasters and Media Companies	End of project	D3.x	RAI
Knowledge on data analytics in 5G mobile networks	Content distribution, and enriching television experience	Broadcasters and Media Companies	One year after end of project	D4.x	RAI, TOR, FTM
Knowledge and industry insights on the business drivers for and wider socio-economic value of 5G networks	Research on educational innovation and innovative educational practice leveraging the potential offered by 5G for enhanced teaching and learning at school and outside the classroom Content distribution, enriching television experience and remote television production	Education and educational innovation, including education-related research and development, educational services, educational content, teacher training Broadcasters and Media Companies	Continually during the 5G-TOURS project as well as after the funded project period End of project	D2.1, D6.1, D6.2, D6.3 D4.x D8.x (Turin trials)	EA RAI, All

Experience on the implementation of network slicing in a testbed	Content distribution, enriching television experience and remote television production	Broadcasters and Media Companies	End of project	D4.x (Turin trials)	RAI, LIVU, FTM, TOR, TIM, ERI
Standardisation impact	Content distribution, in particular Broadcast TV services (it depends also on standard implementation on devices)	Broadcasters and Media Companies	One year after end of project	D4.x D7.x D8.x	RAI, TIM, ERI

3.7.3 Healthcare and safety ecosystem

Description of exploitable result / knowledge	**Exploitable product(s) or measure(s) in which the result / knowledge will be used**	**Sector(s) of application**	**Time-plan for use**	**Deliverable(s) to which 5G-Tours deliverables / results does the topic relate to**	**Owner and other beneficiaries involved**
Improved knowledge on Use Case definition	Tele-guided diagnosis and intervention solutions for emergency cases	Emergency care, hospital and ambulance.	End of project	D2.X D3.X D5.X	CHU, PRE, PFC, AMA, ORA, B-COM, NOKIA
Knowledge on 5G mobile network architecture	Improved connected care solutions, in particular Ultra Mobile Ultrasound	Emergency care, hospital and ambulance Patient monitoring. Interventional healthcare applications	End of project	D2.X D3.X D5.X	CHU, PRE, PFC, AMA, ORA, B-COM, NOKIA
Knowledge on 5G network slicing	Improved connected care solutions	Emergency care, hospital and ambulance. Patient monitoring. Interventional healthcare applications	End of project	D2.X D3.X D5.X	CHU, PRE, PFC, AMA, ORA, B-COM, NOKIA
Knowledge on orchestration in 5G mobile networks	Low-cost multi data type and real time streaming connected care applications: network-based orchestration iso application level orchestration of data streams	Emergency care, hospital and ambulance. Patient monitoring. Interventional healthcare applications	End of project	D2.X D3.X D5.X	CHU, PRE, PFC, AMA, ORA, B-COM, NOKIA
Knowledge on data analytics in 5G mobile networks	Medical grade audit trails to proof SLA and medical claims wrt reliability and latency	Emergency care, hospital and ambulance. Patient monitoring. Interventional healthcare applications	End of project	D2.X D3.X D5.X	CHU, PRE, PFC, AMA, ORA, B-COM, NOKIA
Knowledge and industry insights on the business drivers for and wider socio-economic value of 5G networks	Healthcare of the future: small hospitals, diagnosing and treating patients at home	Healthcare as a whole	End of project	D2.X D3.X D5.X	CHU, PRE, PFC, AMA, ORA, B-COM, NOKIA
Experience on the implementation of network slicing in a testbed	validation of the prioritization of information flows (sound, ultrasound, video, ...) for tele-assistance (health emergencies)	health emergency services	applicable at the end of project	D5.x (Rennes Trials)	CHU, PRE, PFC, AMA, ORA, B-COM, NOKIA
Standardisation impact	Critical medical care				
OTHER: experience on the implementation of network latency and reliability and of data rate in a testbed	validation of the synchronization of live sources of image data (ultrasound, fluoroscopy, video, …) for AR (operating room)	health emergency services	applicable at the end of project	D5.x (Rennes Trials)	CHU, B-COM, AMA, ORA

3.7.4 Mobility and transportation ecosystem

Description of exploitable result / knowledge	Exploitable product(s) or measure(s) in which the result / knowledge will be used	Sector(s) of application	Time-plan for use	Deliverable(s) to which 5G-Tours deliverables / results does the topic relate to	Owner and other beneficiaries involved
Improved knowledge on Use Case definition	e-Health, safety and transportation Products development Situational awareness, safety and transportation Products and services development	Assisted living and smart cities services Smart & digitized Airport services in the Airport management sector in terms of Aircraft operations and safety management	During the project lifecycle and beyond in future research initiatives and Airport operational management initiatives	D2.X, D5.X and D6.X	WINGS AIA
Knowledge on 5G mobile network architecture	Smart Parking and Health Products development Required 5g network architecture and infrastructure deployment at Airport premises	Assisted living and smart cities services Smart & digitized Airport services in the Airport management sector in terms of Aircraft operations and safety management	During the project lifecycle and beyond, in future research initiatives and in future investments of the airport regarding 5G implementation	D2.X, D3,X, D5.X and D6.X	WINGS AIA
Knowledge on 5G network slicing	Network Slice characterization in terms of associated KPI values to manage and fulfil the requirements of Use Cases 6, 9 and 10. WINGS KPIs Measurements and Diagnostics tool Identifications of Network Slice requirements in order to fulfil the requirements of use Cases 10,11 and 12.	WINGS R&D activities Slicing for Airport management in terms of simultaneous, transmission of high-speed mobile, high definition video & building evacuation operations & safety management	During the project lifecycle and beyond in future research initiatives and in future investments of the airport regarding 5G implementation	D3.X, D7.x	WINGS AIA
Knowledge on orchestration in 5G mobile networks	Dynamic Slice allocation to manage different use case requirements	Feedback to Greek Site orchestration development in 5G EVE Knowledge on 5G mobile network orchestration in terms of simultaneous, transmission of high-speed mobile, high definition video & building evacuation operations & safety management	During the project lifecycle and beyond in future research initiatives and in future investments of the airport regarding 5G implementation	D3.X, D6.x, D7.x	WINGS AIA
Knowledge on data analytics in 5G mobile networks	Data management and ingestion, predictive analysis and, in general, ML-based services and tools developed in the context of various use cases being deployed in the Athens and Rennes. WINGS KPIs Measurements and Diagnostics tool Use of Data analytics services and tools in order to evaluate the effectiveness of the use cases and identify areas of improvement ACTA's KPI Validation Platform (KVaP)	Assisted living and smart cities services Use of Data analytics services and tools in order to evaluate the effectiveness of simultaneous, transmission of high-speed mobile, high definition video & building evacuation operations & safety management Telecom	During the project lifecycle and beyond in future research initiatives End of project	D3.X, D7.X D6.3 D7.3	WINGS AIA ACTA
Knowledge and industry insights on the business drivers for and wider socio-economic value of 5G networks	5G-TOURS feedback to WINGS commercial department for monitoring diagnosing and treating patients at home as well as smart parking management Efficient and effective Airport apron monitoring, coordination between Airport stakeholders control centres	New Products and / or Assisted living and smart cities services to offer towards end users New Products and services for the sectors of simultaneous, transmission of high-speed mobile, high definition video & building evacuation operations & safety management	During the project lifecycle and beyond, in future research initiatives and in future investments of the airport regarding 5G implementation	D2.X, D5.X, D6.X, D8.3	WINGS AIA

3.7.5 Transversal activities

Description of exploitable result / knowledge	Exploitable product(s) or measure(s) in which the result / knowledge will be used	Sector(s) of application	Time-plan for use	Deliverable(s) to which 5G-Tours deliverables / results does the topic relate to	Owner and other beneficiaries involved
Improved knowledge on Use Case definition	For UC4, UPV will obtain knowledge in broadcast applications to mobile networks New research directions, novel potential applications Further enhancements to the RW extensive database of 5G use cases and KPIs	R&D, vendors, operators, broadcasters Research, service robotics All verticals infrastructure investment types	Now and future 3GPP releases Expecting a better understanding of the difficulties in the use case after starting experiment in the field, therefore exploitation of such knowledge may start towards the end of the project End of the project	D2.x D4.x D4.2, D4.3 D8.3 D2.3	TIM, RAI, EXP, ERI IIT, TOR, ERI-IT
Knowledge on 5G mobile network architecture	5GC multicast product development, IPR development Increased knowledge on 5G mobile networking in general may help us improve middleware software for robotics Integration of 5G-NR RAN precommercial equipment with BCOM Core network Knowledge on Data Plane deployment at the EDGE to achieve low latency communications Investment opportunity assessment framework	R&D, vendors, operators, Broadcasters Research, service robotics Private networks, PoC All verticals infrastructure investment types	By the end of the project Knowledge on 5G mobile networking will be gained after initial tests with 5G networks (Jan 2021) Along the project End of the project	D3.x D4.x D7.x D4.2 D3.x D5.x (Rennes trials) D8.3 D2.3	TIM, EXP, ERI IIT, ERI-IT BCOM, WP3/WP5 Stakeholders BCOM sponsors
Knowledge on 5G network slicing	Slicing Manager to assign high priority to critical user data traffic Dimensioning of slices for allocation of resource for CAPisce tooling Algorithm for allocation of resources for network slicing	Private networks, PoC All verticals infrastructure investment types Equipment manufacturing	Along the project End of the project Future standard releases	D3.x D5.x (Rennes trials) D8.3 D2.3 D3.1	BCOM, WP3/WP5 Stakeholders BCOM sponsors UC3M

Knowledge on orchestration in 5G mobile networks	Orchestration through 5G EVE platform Linked to dimensioning of slices but depends on nature of slices Algorithm for orchestration of resources based on AI	All verticals infrastructure investment types Equipment manufacturing	Along the project Future standard releases	D3.1	WP3/WP5 Stakeholders BCOM sponsors UC3M
Knowledge on data analytics in 5G mobile networks	Increased awareness of AI and automation-based implications and value propositions AI algorithms that leverage data analytics	All verticals infrastructure investment types Equipment manufacturing	End of the project Future standard releases	D3.1	UC3M
Knowledge and industry insights on the business drivers for and wider socio-economic value of 5G networks	Enhancements to the RW techno-economic value creation and capture assessment framework are anticipated	All verticals infrastructure investment types	End of the project	D8.3 D2.3	
Experience on the implementation of network slicing in a testbed	Prioritization for the data flows through the service layer Application of trials data to the enhancement and validation of the techno-economic models	b<>com experimental platform and associated service offering All verticals infrastructure investment types	Along the project End of the project	D3.x D5.x (Rennes trials) D7.3	WP3/WP5 Stakeholders
Standardisation impact	Broadcast and multicast SI/WIs in 3GPP Use of DICOM-RTV in a real Operating Room setup and to show benefits of such standard Feedback from physicians/surgeons on real life communication requirements for medical use cases allowing to refine 3GPP specifications Framework for data analytics based on ENI standard	Vendors, operators, Broadcasters E-Health and Operating Room equipment and integration TR 22.826 TS 22.104 TS 22.261 TS 22.263 Equipment manufacturers& network operators	Now and future 3GPP releases Along the project Future standard releases	D4.x D7.x D8.x D5.x (Rennes trials) D3.1	TIM, RAI, EXP, ERI CHU UC3M
OTHER	Improve the ingredient "DICOM-RTV Converter" software	e-Health	Along the project		BCOM, CHU

4 Innovation

Main objective 5G-TOURS is to incubate innovation that results in novel Products and Services. 5G-TOURS develops also advanced prototypes that can provide the basis for future commercial Products and Services. These aspects provide very substantial technological advances, also have a very high commercial value as well as a very strong potential market impact.

The project, considering that the so-called "vertical areas" belong to three different markets, has appointed an Innovation Manager for each area and the Innovation Management of the project is also split according the three areas: Touristic, Health and Transportation sectors.

5G-TOURS has a common process following the 4Ps of innovation [25] (Product, Position, Process, Paradigm) focused, in the initial stages, on **Product/Service** and **Position in the market**, as highlighted in Figure 13.

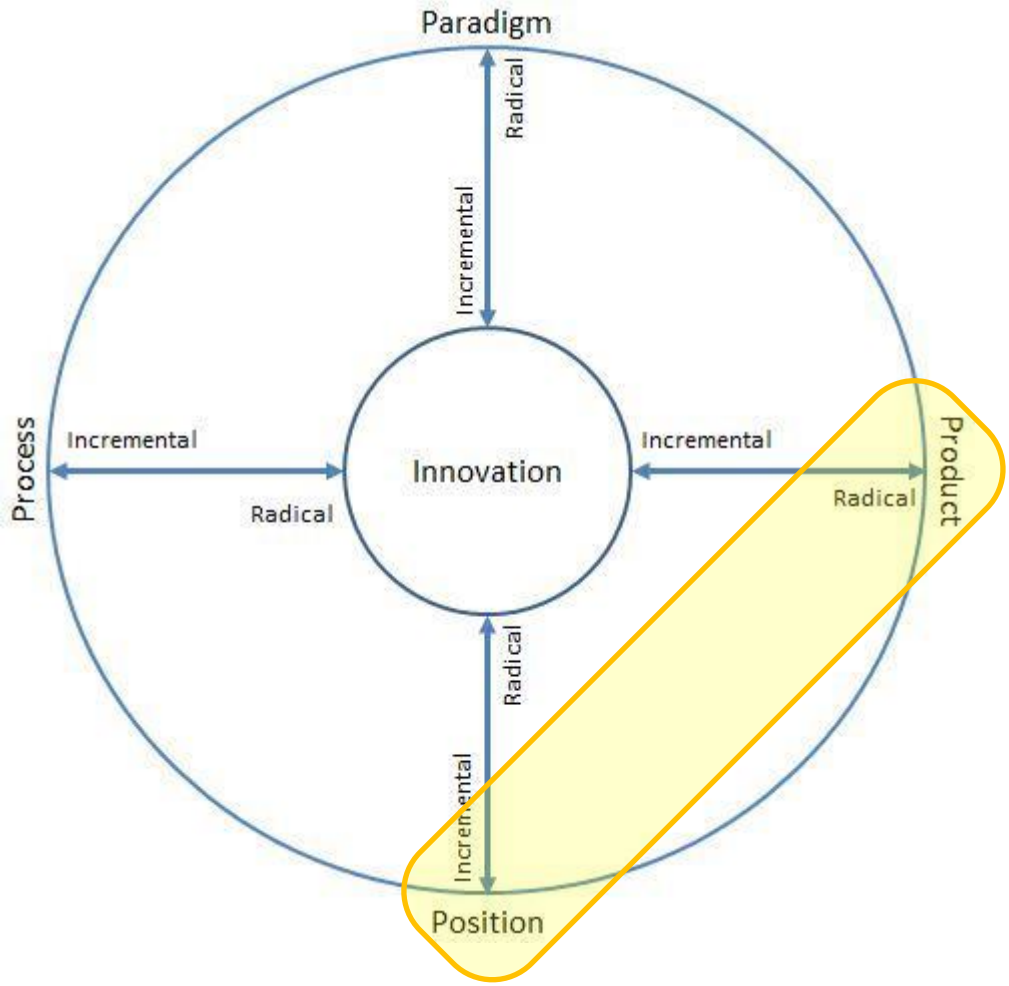


Figure 13. The 4P of Innovation (Tidd & Bessant 2013) [25]

There are many forms of innovation: the 4P's of Innovation as described by Tidd and Bessant in [25] are product, process, position, and paradigm and defined as following:

- *Product innovation* is the first thing that comes to mind when talking about innovation and conveys the changes in the things (products/services) which an organisation offers;
- *Process innovation*, on the other hand, refers to changes in the way things are created and delivered;
- *Position innovation* is the change in the context in which the products/services are introduced or in other words where the target of the offering lies and what the story told about it is;

- *Paradigm innovation*, in particular, is the change in the underlying mental models which frame what the organisation does (e.g. Cirque du Soleil: redefining the circus experience) or alternatively how the company frames what it does (e.g. Bausch & Lomb: moving from eye-wear to eye-care).

The dividing line between these is often blurred and innovation in one dimension often bring changes to the others.

Incremental innovation, or improvement, is related to the notion of doing the same thing better, instead of doing something completely different. Radical innovation is instead the use of a better or novel idea or method or product which achieves a significant impact in the market. Many times, disruptive innovations are not seen as such until the market responds, they may also start as incremental parts.

Products/Services are directed to have commercial impact. In the following, sector per sector, it is described the improvements that can be provided thanks to the introduction of 5G. In particular, the introduction of 5G-TOURS technologies takes into account a general vision based on today's market segments, what the potential market could be addressed by these technologies and, therefore, the opportunities from the point of view of the European industry.

Innovation management is conducted to ensure that the project identifies the opportunities for commercialisation of its results and takes the necessary steps to realise these opportunities.

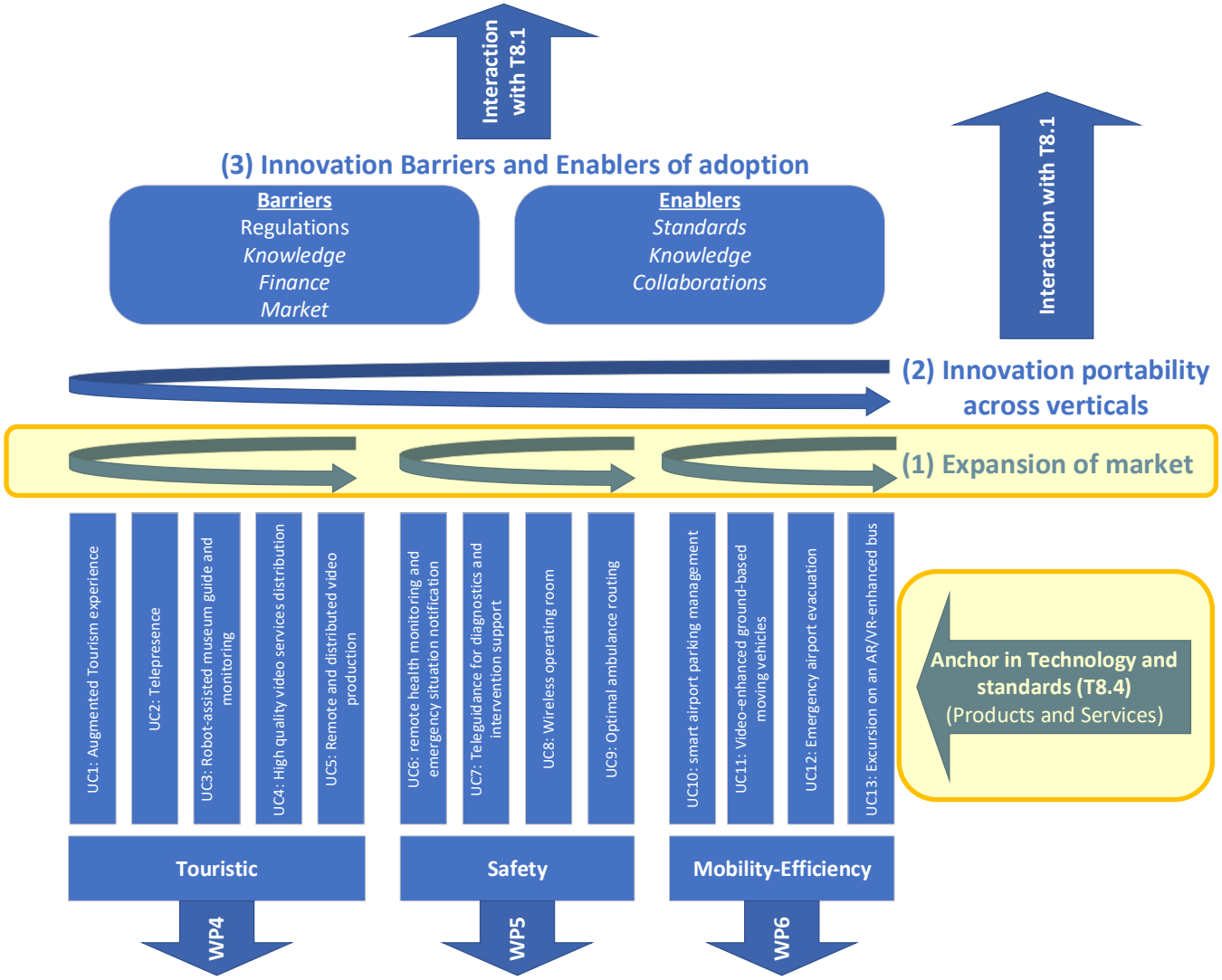


Figure 14. Key project touchpoints and processes

The project's key touchpoints and processes are represented in Figure 14. This shows a focus of the innovation managers in their verticals and over time moving to cross vertical discussions and also exploring innovation

barriers and enablers. This document, covering first part of the project, is focused on the parts highlighted in Figure 14.

The outcomes of this task are (i) contributions to the most relevant standardisation activities (results of which are described in section 5 of this deliverable), (ii) identification of the business opportunities for the individual partners, and (iii) IPR that is co-incident with Standards (Standards Essential) or proprietary in nature that emerges as a consequence of the 5G-TOURS activities shall be recorded as part of the important outcomes when considering exploitation.

Finally, considering the aspects directly related to the operation of the 5G network, the activities performed in 5G-TOURS are functional to the evaluation and the subsequent deployment of the innovative solutions of 5G beyond the NR NSA that is being implemented in these days. This helps both in the direction of the future network roll-out and of the validation of the new features being standardised in Release 16 and beyond in the framework of 3GPP.

4.1 Touristic Sector

4.1.1 Product/service Characteristics

What is Tourism? Tourism involves the activities of people travelling and staying in a place away from their home environment for leisure, business or other purposes. Mathieson and Wall in [21]define tourism as "the temporary movement of people to destinations outside their usual places of work and residence, the activities undertaken during their stay in those destinations, and the facilities created to cater to their needs." Tourism is travelling with an objective. There are many factors that influence the running of the tourism industry: among others, the environment, the economy and technology, the historical, cultural, scientific, religious importance of the destination.

Apart from the marketing strategy, the 5 A's of tourism offer a valuable means to define the tourist needs and demands. These are:

1. **Attraction**: It includes all those factors which attract a tourist. It could be a place, nature, lakes, beach, monuments etc.
2. **Accessibility**: It is how to access or reach to that place of attraction. Ways to reach.
3. **Accommodation**: Place to stay or accommodate while travelling for rest or overnight stays.
4. **Amenities**: All the other services which we require while travelling for good and comfortable living while travel such as food, drinking water, sanitary, etc.
5. **Activities**: It includes activities which a place or attraction holds such as nature walks, history & architecture, boating, views, health, etc.

But what makes the tourism smart? According to [20], Smart Tourism is "tourism supported by integrated efforts at a destination to collect and aggregate/harness data derived from physical infrastructure, social connections, government/organizational sources and human bodies/minds in combination with the use of advanced technologies to transform that data into on-site experiences and business value-propositions with a clear focus on efficiency, sustainability and experience enrichment."In short, the 5 A's listed above, empowered by the use of the most advanced technology, are major components that are to be taken into account in setting the engagement strategy for the services and products of tourism.

Which is the value of Smart Tourism? Smart tourism responds to new challenges and demands in a fast-changing sector, including the evolution of digital tools, products and services; equal opportunity and access for all visitors; sustainable development of the local area; and support to creative industries, local talent and heritage.

The keywords to define the value of smart tourism are being defined by excellence of tourist destinations across the EU in the four categories:

1. accessibility: does not only entail being a barrier-free destination, it also encompasses services that are multilingual and, for example, digitally available to all travelers or visitors – regardless of age, cultural background or any physical disability;
2. sustainability: does not only mean to manage and protect your natural resources as a city, but to reduce seasonality and include the local community;

3. digitalization: city uses digital technologies to enhance all aspects of the tourism experience, as well as to help local businesses to grow;
4. cultural heritage and creativity: means to protect and capitalize on the local heritage as well as cultural and creative assets for the benefit of the destination, the industry and tourists.

4.1.2 Market position and innovation potential

The "Touristic city node" built by 5G-TOURS in the city of Turin exploit the potential of Media & Entertainment, to develop an innovative tourism concept based on complementary and linked trials for different use cases, according to the following general principles:

- Offer an overall integrated indoor and outdoor immersive experience to the visitor/citizen;
- Assure the possibility to enjoy these immersive experiences through any possible device, device that fits the different context and final users;
- Promote the use of "technology for all" making touristic visits easy to experience and accessible, with particular attention to disadvantaged people and disabled people;
- Provide sustainable conditions for testing and scaling;
- Develop use cases able to challenge the performances of future 5G networks as well as blend functions (e.g. learning and culture, surveillance and tourist services);

The Touristic City of 5G-TOURS is a place where visitors of museums and outdoor attractions are provided with 5G-based applications to enhance their experience while visiting the city. The touristic city comprises a set of use cases that aim at improving the touristic experience at a city by providing visitors with (i) added value services within the visited touristic attractions, and (ii) media applications to complement their visit.

This includes VR/AR applications to complement the physical visit of the museum with additional content, involving interactive tactile communications. The visitors' experience is further enhanced with robot-assisted services, telepresence to allow for remote visits. Media distribution and production is also addressed, providing visitors with digital content that can further improve the visitors' experience as well as live events enabled by mobile communications such as multi-party concerts.

The touristic city use cases are implemented to demonstrate the 5G technology benefits to citizens and tourists by providing visitors added value services within the visited touristic attractions and media applications to complement their visit. But how these use cases could impact new markets in the 5G era?

4.1.2.1 The Municipality and the Museum Foundation

The city of Turin as Smart City is working, since 2011, on new model of development, both social and economic, prioritizing interventions capable of affecting citizens and the life of the city.

The City has developed processes and paths aimed at responding creatively to the main territorial problems in the following areas: energy, environment, mobility, accessibility, inclusion and social cohesion, culture and lifestyles. To this end, the City has participated in European and national calls and is still involved in projects useful for launching research, technological development and innovation and linked to the themes of the "intelligent city".

Smart cities are described as "Cities using technological solutions to improve the management and efficiency of the urban environment." in [24]. Smart cities are those centers capable of developing innovation processes by using digital technologies in a widespread manner in order to encourage businesses, improve the quality of life of citizens and pursue objectives of economic and environmental sustainability.

Innovation towards tourism and culture is one segment of the entire mosaic that forms the process and it is considered particularly important by the City. It is in this context that Turin's participation in the 5G-TOURS project fits.

Another element that strength the concept of smart city is the enhancement of cultural and artistic heritage through digital - multimedia, virtual museums, augmented reality, cultural communities on the web, e-commerce - leading the innovation process, especially in this thematic area, with systematic coordination between institutions. For this reason, the City of Turin works in close synergy with Torino Fondazione Musei, third part of the City, on the development and implementation of Use Cases related to Touristic City.

Here some expected returns that have been taken into consideration.

Tourism is one of the largest industries and tourist business is always trying to keep pace with time and to step up the game with new technology. Augmented reality in tourism has a great potential to enhance travellers' experiences. It serves to grab people's attention acting as mainstream technological tool that will alter the way people interact with technology and content. During the last decade, museums all over the world witnessed a decrease in visitors. Augmented reality can help in reversing this trend, acting as a flying and motivating even the youngest users/visitors to visit a museum through technologies they are familiar with. The same for the gamification experience, which in addition to involving the youngest in the discovery and comprehension of an artist and museum, generates an educational and social benefit by promoting connections and social inclusiveness.

Socio-economic drivers for the decision of promoting the Telepresence activities can be resumed as: reduction of travel spend, reduction of carbon footprint and environmental impact, improve employee's work/life balance and productivity (e.g. Surveillance of the museum(s). Telepresence favours, among others, the inclusiveness and accessibility of disadvantaged groups from a geographical or economic point of view, providing everyone with the opportunity to visit a specific museum and promoting the connection between national and international schools. (e.g. in Palazzo Madama exclusive exhibitions for all).

Robot assisted museum guide improves employee's work/life balance and productivity. The robot will not replace employees, of course, but will offer them a lightning on some activities on one hand. On the other, will allow visitors to get more information about museum locations and additional details.

High quality video service distribution and remote and distributed video production allow the users, through the use of smartphones, tablets, AR devices and monitors to receive educational and informative content during their visits to the city and its museums. One expected result has to be considered in terms of education. A specific professional 4K-HDR video will be produced for both testing and promotional activities about the city and its culture. The expected return in this sense is more related to the use of innovation technology to improve the strategy market for the touristic promotion.

4.1.2.2 Mass Media Companies

Broadcasters, in the last years, have encompassed a profound transformation, to become media companies and offer, in addition to traditional linear radio and TV programmes, a great variety of different services, including also nonlinear offers, such as streaming, downloads, podcasts, catch-up, etc., and employment of many social media platforms. Linear services are generally still the core business: they are highly used, but it is undoubtable that demand for them is slowly declining. In particular, there is a generation gap for linear services: while live "linear" viewing still represents the mainstay for people over 50, Gen Z and millennials are devoting significantly longer periods of their day watching online forms of TV.

The total consumption of nonlinear services is still small in terms of downloaded data volumes and the time spent with them compared to linear services. However, consumption is strongly increasing primarily among the younger generation. But also, the elder audiences start to appreciate the flexibility that comes with nonlinear services and this opens the field for the market expansion framework enabled by the 5G-TOURS Use Cases context.

4.1.2.2.1. Media delivery and OTT services

OTT video is video transmitted via the Internet that bypasses traditional cable/linear distribution. While it can either be ad-supported or subscription-based, we consider true OTT to be long-form and live streaming content such as network programming, TV shows and movies.

The digital disruption that is transforming the broadcaster industry is accelerating: the growth in IP-delivered TV content is reshaping distribution models, consumer viewing habits and advertising. Every major TV operator has launched their streaming offerings. Consumers now have more choice than ever to access video content. With so many broadcasters and content companies entering on the streaming TV market, the marketplace is becoming fragmented, and it is creating more competition for high-quality content to keep viewers hooked to the video service.

At the same time 5G technology is expected to build on and integrate with the previous generations of wireless networks. 5G will support the expected broadcasters' mobile data growth, and at the same time will allow new services for final users and advertisement. With the previously listed technologies, 5G will bring network performance enhancements and agility in the network characteristics, and with that, will play an important role in supporting the growth and development of many industries, the broadcasting and content creator included.

This has an impact also on the economic aspect. Experts in advertising are following the exponential OTT audience growth, personalization, measurement and engagement are the keys of this type of market. Today, OTT delivers the best of television content with the capability to precisely target viewers, and use is able to exploit demographics factors like, lifestyle and interests. Analytics tools are enabling advertisers to target the right audience, buy the highest quality inventory and measure OTT campaign results more effectively.

Raiplay [33], the Rai OTT platform, offers a multitude of streaming and VoD contents. Thanks to 5G technology enablers put in place in 5G-TOURS new opportunities for a market expansion framework could be envisaged.

VR/AR can represent an added value opportunity for a Travel documentary to be consumed on demand, either independent, present in the internet platform of the media company, or linked to a linear program. The TV program describes the travel opportunity, and the VR visit of a remote location is offered to the audience.

Narrative of the VR TV program: the user access RaiPlay and select the Travel documentary program episode dedicated to the city of Turin. A selection of different cultural sites is presented, and the user selects the Visit of the Chinaware Collection in the Palazzo Madama Museum of Torino.

This impacts in particular 2 P’s of Innovation: mainly the Product, since it is a new type of TV program. For this it can be considered as a radical innovation, because this changes completely the normal concept of Television, where the immersivity is limited and there is generally no possibility of interacting with the program. It is to be considered more similar to online gaming. Also, Position is impacted, definitively incremental, since its context is no longer linear TV, but pure Content on Demand.

New content creation and new paradigms on content consumption are the basis for new markets, Media companies can react to these new incoming opportunities to invent new business coming from new needed contents.

4.1.2.2.2. Media content production in the OTT era

In the era of the "giants" the media companies are called to an epochal challenge, the new actors competing for the television screen are based on very aggressive and world-wide business models.

This challenge is not only based on new technologies but is based on offering attractive content to attract the end user. The challenge between the various actors is marked by huge investments in the creation of cinematographic content.

For this reason, the television world knows how to try in every way to optimize the production processes of television content that can compete on the current market. In this direction the use case 5 (Remote and distributed video production) tries to exploit the new network technologies to obtain a new elastic and efficient production model.

The cultural heritage context is a very interesting field in term of possible video content that could be exploited in term of business opportunities if a very strong partnerships could be done between municipalities, museum foundations and media companies.

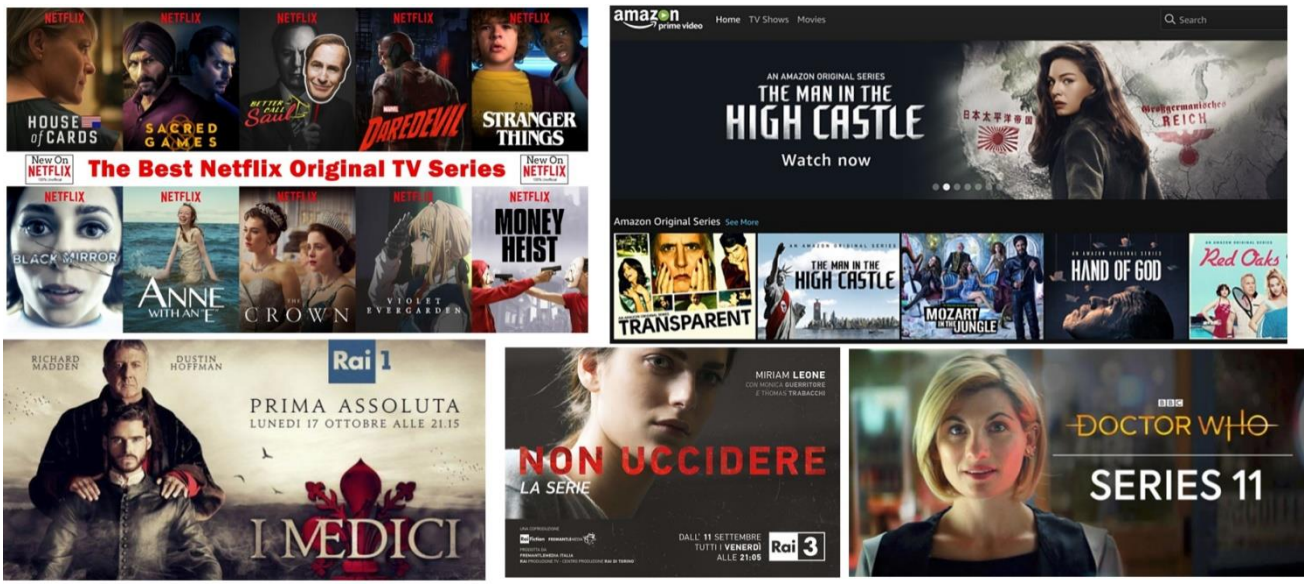


Figure 15. Media content production in the OTT era

In general, the production of high-quality content that can be video but also models to be used in the context of new services in XR can give market opportunities in a lot of environment, in particular for the tourism, it could be the key to attract tourists to explore a new destination. For example, using 360-degree videos to provide an immersive real-world experience to help tourists choose a destination, adventure or accommodation. Or again using XR content to give a new way to visit a museum.

In a typical TV production environment, video contents are delivered from cameras located in places where an event is taking place to a TV studio in the broadcasting center or to a remote studio facility on the event location itself. Such video contents could be used both for immediate live broadcasting of the event or recorded to be further edited and used in TV programs later on.

In distributed TV video production, the content needs to be produced by mixing local and remote audio and video contributions in the TV studio. The remote contributions are thus delivered to the main editing site via the 5G network in real time. The challenge in this scenario is the end-to-end delay between the local and the remote site, which must be kept very low and constant. Furthermore, each AV flow at the remote site can be only mildly compressed before transmission to preserve sufficient headroom for editing and distribution coding, so the content size needs to be large. On the other end, the number of required remote flows is planned in advance and kept fixed during the program production. The final program can then be distributed to the users either live or at a later time.

Introducing remote production over 5G networks for television content can revolutionize the typical work flow of broadcaster and media companies. Remote and distributed production is extremely challenging, and requires very low and stable delays, an ultra-reliable capability and a very large bandwidth capacity in order to reach a good final result. However, its introduction can contribute to the valorization of cultural events taking place within the territory of the city introducing a new way to cover live events, while at the same time building a more efficient and cost-effective way to produce television content. This aspect will also improve local, national and international tourism with social and economic utility for cities.

4.1.3 Business opportunities

The objective is to create a harmonious and interdependent environment that benefits both the inhabitants of the city and the visitors. The media & entertainment applications enabled by 5G-TOURS along with the improved services in terms of mobility and safety will greatly contribute to enhance the attractiveness of European cities for tourists and establish a vision for enablement of emergent ecosystems in Cities.

5G-TOURS, with its use cases, aims to create the framework for innovative tourism, with benefits for all the main stakeholders:

- Tourists;

- Local residents;
- (Local) Government (e.g. Municipality);
- Tourist organisations and service providers (e.g. Museum,);
- Accommodation/service providers;
- Technology infrastructures.

In the WP4 of 5G-TOURS project three main verticals are involved in the touristic city trial, in order to obtain a mapping between developed services and relevant business case and emerging markets a punctual analysis is needed.

The Touristic market context is a very interesting field in term of possible services that could be exploited in term of business opportunities, if a very strong partnerships could be done between municipalities, museum foundations and media companies.

In the 5G TOURS project, services deployed in the context of WP4 from verticals could be summarized as:

- Tele-presence;
- Robot assistance;
- XR in museum and in city walks;
- Media content production and distribution.

In this way municipalities, museum foundations and media companies could be the protagonist in the exploitation of main tourism market activities, in which the new 5G network technologies will enable the partnership of involved actors in the value chain.

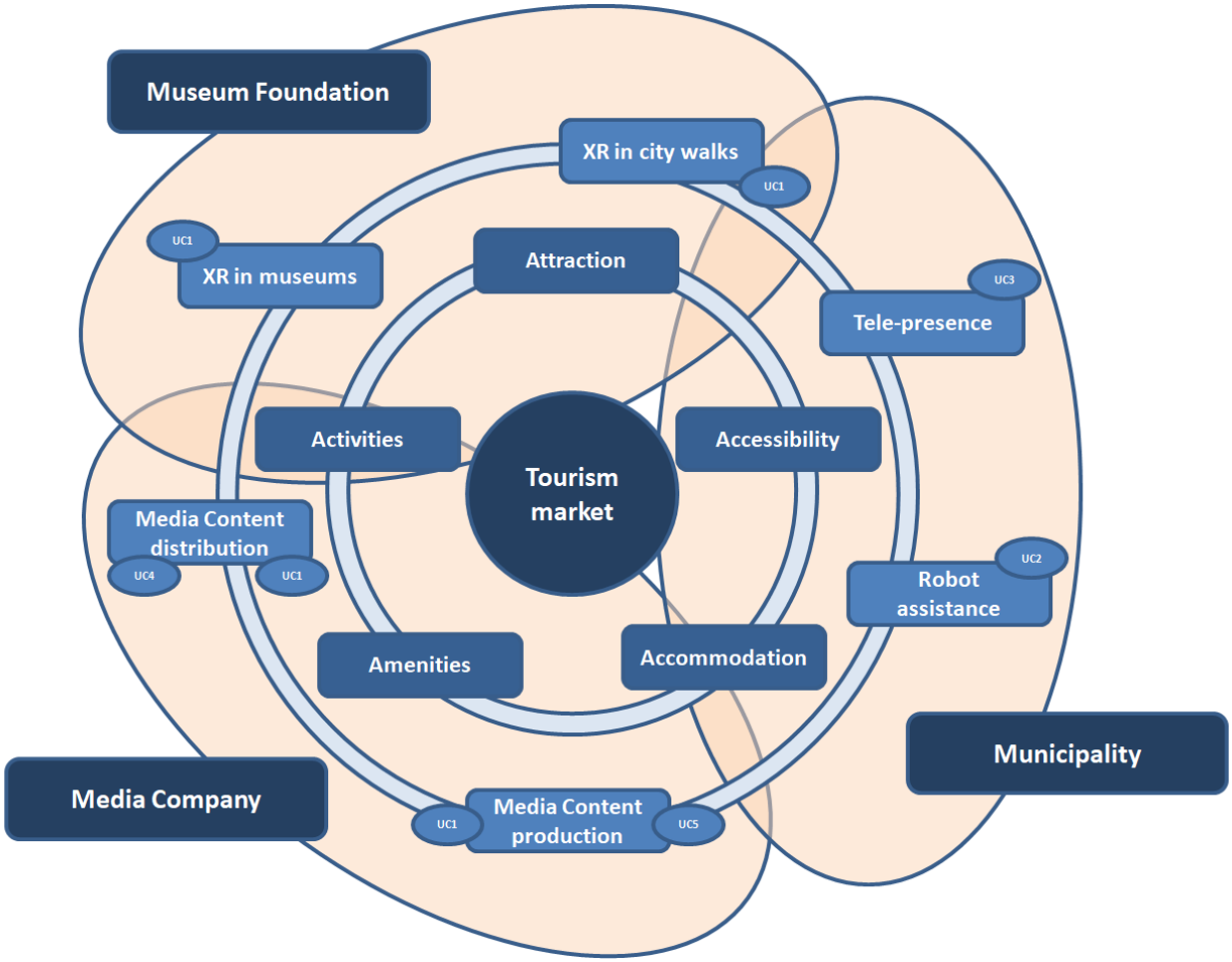


Figure 16. 5G TOURS Tourism market map

In the context of tourism market these partnerships could give a significant increment in terms of:

- **Attraction**: new XR techniques applied to museums and also to the smart city facilities will increment this topic in the same time Media content can advertise Museum, nature, lakes, beach, monuments etc. given to the tourist a preview of what are possible attractions and attract them to the city.
- **Accessibility**: more of this context is covered by transport facilities but the increment of tourists in a given city rises the issues in terms of accessibility, in particular the municipality vertical is leading this important market for tourist.
- **Accommodation**: any action in ads attractions has impact also in accommodation enlarging the market of hotels and hospitality. Adding new services enabled by the innovation exploitation of all topics will be also the key to improve accommodation facilities for tourist.
- **Amenities**: thinking about museum shops and souvenir products, in this context the increment of tourists given by a good advertisement of attractions and new services in the museum can significantly increase the market.
- **Activities**: Video and XR content production to add new services in the museum can improve the experience and give new fascinating activities for tourists. Partnership between main verticals combined with digitalization, cultural heritage and creativity to protect and capitalize cultural assets could benefit all aspect of tourism market.

All of the considered UCs in the context of the touristic city of 5G TOURS project lay their foundation on the key characteristic of smart tourism given by the EU to define the excellence of touristic destination, in terms of accessibility, sustainability, digitalization and cultural heritage and creativity.

4.2 Health Sector

4.2.1 Product/Service Characteristics

Today's healthcare solutions require patients to pay visits to their general practitioner or a specialist at the hospital where chronically ill patients need to do this on a regular basis. With respect to emergency care, involving an ambulance and skilled emergency doctors and nurses, the focus is on bringing the patient to a hospital as quickly as possible for precision diagnosis and treatment. In case of chronic patients who require monitoring, the current practice is to apply daily measurement of biometric data and vitals, e.g. weight, heart rate, blood pressure and blood oxygenation. Here, measurements are done with wired devices and data is uploaded to a patient management system, where a care professional will analyse the data once every day. Products, targeting frail elderly people, will enable calling for help and contain sensors that can detect if a person is falling down.

Existing connectivity solutions are limited and cannot seamlessly support and adapt according to every aspect of the health continuum. For example, connectivity requirements of the connected medical devices that are used in homecare are very different from the devices that are used for the diagnosis and treatment process in a hospital.

4.2.2 Market potential and innovation potential

Chronic illnesses - such as cancer, heart disease and diabetes - now account for 38 million worldwide deaths each year according to the World Health Organization (WHO). They are placing enormous financial strains on healthcare systems. For example, the American Diabetes Association estimates the total costs of diagnosed diabetes cases in the US increased from $174 billion in 2007 to $245 billion in 2017 [27].

Over recent years, the Healthcare sector in general and Philips in particular has been evolving into a digital health and well-being industry, empowering people to live healthier lives across what we call the health continuum: from Healthy Living to Disease Prevention, Diagnosis, Treatment and Home Care.

5G enabled connected care solutions will impact the existing healthcare solutions. Some examples are listed below:

- Highly adaptive connected medical devices to seamlessly monitor health condition of the patients. This will impact the long-term medical cost-to-care efficiency and will reduce the hospitalization costs.
- Lower burn-out of medical professionals by automating health condition monitoring in lower-acuity patients, thereby also lowering the human-error in clinical decision making.

- Extending remote monitoring to remote diagnostics, to improve first responder accuracy in emergency situations.
- Screening, examination and monitoring of patients and pregnant women in remote areas with teleguided ultrasound for a large variety of pathologies and diseases, e.g. stroke, internal bleedings, liver fibrosis, bone fractures and COVID19 pneumonia.
- Remote consultations replacing face to face consultations to prevent the spreading of contagious diseases such as COVID19.Increase the accuracy of clinical data and prevent inconsistencies in critical medical data communication.

The remote monitoring of patients who do not absolutely require hospitalization is implemented on a large scale at this very moment to manage patients with COVID 19. The situation is changing the perceptions and the acceptability of the society at an incredible speed. Technological infrastructures and mobile devices will have to be there to meet these new expectations.

In today's professional healthcare, the value chain includes among other things the manufacturers of medical equipment, system solution integrators, medical professionals, insurance companies and payers (health consumers). By introduction of advanced telemedicine solutions, also network equipment providers and mobile network operators become part of the value chain, but now in a larger market. Note that this value chain should serve the true value of Healthcare, represented by the quadruple aim [26].

1. Provide high quality of care to assure the best possible outcomes for patients. This means that care should be given effectively to actually cure patients.
2. Make sure that medical professionals can do their work properly with minimal physical and mental stress, e.g. by providing them with the right tools and equipment.
3. Provide maximum wellbeing to patients, despite of their illness and the medical procedures they have to endure.
4. Reduce the overall costs of care as much as possible. This means that all care given should be useful and waste of time and materials should be minimized.

All can be improved by applying smart and adaptive connected solutions across the health continuum for improved outcomes and efficient care delivery in healthcare. As explained before (Section 3.4), the health continuum covers the major phases in healthcare that apply for healthy individuals and patients, i.e. prevention, diagnosis, treatment and homecare.

Realization of these four goals translates into financial benefits for all parties involved in the value chain. Moreover, a cured patient will be able to participate again in society, reducing the financial burden on the healthcare system as a whole.

Modern and upcoming cellular technologies, e.g. 5G, will enable anywhere / anytime smart and adaptive connected healthcare propositions for the full care continuum. Examples are:

1. Low power solutions for continuous patient monitoring, including wearable patches that communicate directly with medical AI services in edge devices and the cloud. Fully automated, always connected "Diagnosis as a Service" (DxaS) will be able to predict and detect critical medical conditions and are essential to enable timely intervention.
   Benefits are the improved medical outcome and the general population health as well as the reduced cost of care and improved patient and physician experience. For, a critical health condition is detected in time, the patient will have more freedom of movement and the physician needs not to check the patient's vitals data every day.
2. High bandwidth solutions for advanced remote diagnostics applications will enable virtual patient visits / remote consultation from the patient's home or a virtual examination room, e.g. a "clinic on wheels" built into a van.
   Benefits are the improved experience for patient and physician as well as the reduced cost of care, since there is no need to travel as much anymore.
3. Ultra-reliable and low latency solutions for mission critical medical interventions and emergency care procedures, e.g. from an ambulance. In case of a patient with a critical health condition, fast diagnosis

is essential to take the right measures for stabilizing the patient. If not stabilized directly, the patient's health may deteriorate irreversibly or will not make it alive to the hospital. In emergency care, ultrasound is very well suited for diagnosis such as internal bleeding detection and image guided intervention such precise needle insertion. Because the ambulance nurse is typically not an expert sonographer, guidance by a remote expert would increase the survival rate for the patient.

4.2.3 Business opportunities

Philips has a dominant position in medical ultrasound equipment, where the ultra-mobile ultrasound market is growing strongly. Furthermore, Philips has a big market share in patient monitoring equipment. Wearable wireless monitoring is an important new area with a lot of market potential. With the acquisition of RDT [32] in 2018, a provider of ambulance equipment for vitals monitoring such as ECG, blood pressure, blood oxygenation, etc., new solutions for mission critical care have become eminent for Philips. Finally, the inclusion of high bandwidth tele presence technology, e.g. hi-res video, ultrasound and 3D environment to improve remote diagnosis and intervention, will bring big opportunities for new Philips business.

Ultra Mobile Ultrasound (uMUS) technologies provide opportunities to disrupt the Point of Care (PoC) market. Already today, uMUS devices provide point of care options to patients in hospitals, clinics, homecare and critical care ambulatory settings, more precisely, for the evaluation and handling of patients during diagnosis, monitoring, and therapy.

The global PoC ultrasound device market is expected to grow at a CAGR (Compound Annual Growth Rate) of 7% during 2015 – 2025 as depicted in the following figure.

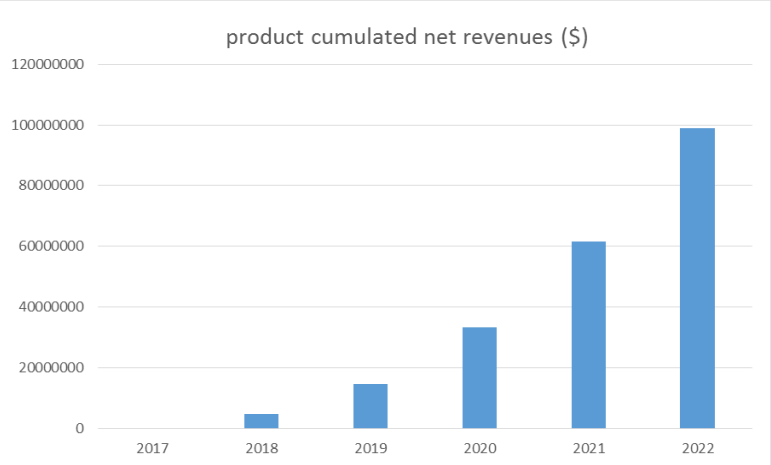


Figure 17. Point of Care Ultrasound market growth forecast

Major players are Hitachi Ltd., Toshiba Medical Systems Corporation, Siemens AG, Koninklijke Philips N.V., Esaote SpA, General Electric Company, Samsung, Mindray Medical International Limited, FUJIFILM Holdings Corporation, and Analogic Corporation. Reflecting the growing demand for PoC ultrasound technology, emerging clinical applications contributed to more than one-fifth of the $3.66 billion U.S. (3.25 billion euro) of the global ultrasound market in 2014. AR / VR solutions for Ultrasound are still mostly experimental: not a market yet. However, Butterfly Inc. claims to have cloud-based AR/VR and AI solutions that enable non-experts to perform high quality ultrasound diagnostics with their CMUT (Capacitive micromachined ultrasonic transducers) probe.

4.2.4 5G healthcare vision and IPR opportunities

Healthcare products and services of the future will be based on advanced network communication technology. Particularly, 5G technologies will enable healthcare to take place everywhere and anytime inside and outside the hospital with or without expert doctors physically attending a patient. This becomes possible with 5G, since it can provide guarantees for network performance KPIs that are needed for the monitoring, diagnosing and treatment of patients. Data acquired by medical sensors and diagnostic equipment can be transferred from a patient to remote medical experts and/or an AI based diagnostic service. Also, medical interventions could be

controlled by a remote expert or converted into instructions to a local nurse, provided the network can provide guarantees for the Quality of Service. Furthermore, direct audio-visual communication for assessing a patient and/or performing a consultation, will become more and more important with the spread of contagious diseases such as COVI19. In April 2020, the number of remote consultation par day has increased by a factor of about 100 in the main European countries. However, the overall quality of today's network communication is not sufficient to consider this as a replacement for face to face consultations.

In short, 5G communication technology is expected to:

- Enable the timely involvement of best medical experts for fast remote diagnostics & treatment for medical emergencies;
- Enable 24/7 access from anywhere to artificial medical intelligence in the cloud for continuous monitoring of patients: for analyzing their health condition and generating automatic alerts to care providers in case of detected problems. Moreover, low-cost reliable diagnostics services could be provided for follow-up (ultrasound) exams;
- Enable optimal connected care solutions that are cost effective and realize the best outcome at minimal costs. In particular, 5G will enable care providers, care facilities and patients to be always connected, even when patients and care providers are on the move. Up-to-date patient status and decision support will become possible at all time. Examples are up-to-date patient dashboards to have the full patient status to take the right decisions at all time from medical command centers.

It is expected that 5G will create ample possibilities for innovation and IPR creation.

4.3 Transportation Sector

The Transportation Sector is driven by many socio-economic factors, in the new economy 4.0 era, where elements of the service economy are also affecting the industry growth. Digital transformation, API economy and passenger experiences are key growth factors for the mobility/transportation business model. The introduction of 5G mobile networks is expected to provide not only a platform, channel or a medium that will facilitate the transportation industry, but will also enable the creation of new and innovative products and services, that would not be feasible without the technological capabilities that the 5G networks introduce.

4.3.1 Product/Service characteristics

The airport business model consists of two main elements: a) the aeronautical activities, where airline and airport processes - required for the handling and travel of passengers, baggage and cargo - take place, and b) non-aeronautical ones, where all other commercial activities that are either required (e.g. car park, food and beverage etc.) or compliment the Airport offering (e.g. Airport lounges, concessionaires, retail parks, expo centres etc.).

As the aviation industry is continuously growing during the latest years, there is a big pressure for airports to increase capacity, to be able to grow their revenues and enhance their business model. The required investments in the industry's infrastructure are significant, as large and capital-intensive infrastructure projects are required, in order to increase capacity. These investment requirements are heavily dependent on the revenues from both Aeronautical and Non-Aeronautical activities.

Aeronautical activities though, are regulated by governments and therefore the revenues growth that can be achieved is either from the increase of the flights and passengers' volumes traveling through the airport – which it is also dependent on the capacity of the airport – and the optimisation of costs for the aeronautical activities.

The non-aeronautical revenues though, are not regulated and is the prime activity for airport managers and planners to provide a value proposition (e.g. floorspace, layout, crowd management, terminal positioning, incentives and loyalty schemes, contractual schemes etc.) that creates and promotes a business-friendly environment so as to attract concessionaires to introduce and grow their business at the airport premises. The aim is to maximize non-aeronautical revenues, which are expected in a large extent to finance capacity increase investments at the airport, so that also aeronautical revenues can grow.

The non-aeronautical revenues sector is a prime airport area for airport profit maximisation. This is the area, where primarily the Airport's marketing, business development and finance dept. and all other Airport's units and depts are targeting, in order to enhance the airport value proposition to concessionaires and build those products and services that will maximize the potential income from non-aeronautical revenues.

4.3.2 Market position and Innovation potential

Mobility and travel are going to dominate the experience economy and will be on the prime focus for the research and development of new products and services. 5G mobile networks in the transportation sector can be used to facilitate operational efficiency, create new revenue models and enhance passenger experience. How these products will be positioned in the market is of great importance, as it will have a detrimental effect on how they will be exploited and marketed after their introduction to service.

The two main categories of market positioning are cost leadership and differentiation. As the services and products developed utilising 5G mobile networks introduce unique and innovative features - such as ultra-high bandwidth, massive machine to machine communication and ultra-low latency wireless connection- the most appropriate market positioning is the differentiation one.

In a differentiation marketing positioning strategy, a product or service provides unique characteristics that consumers will pay more for, because they cannot find comparable products or product features anywhere else in the marketplace. Products and services developed under the 5G mobile network have indeed the potential to provide premium upscale features, that are unique and cannot be found in other products or services, due to the innovative characteristics that they introduce. Consumers then are willing to pay a premium for a differentiated product and profit margins are higher than average, recovering the high research and development costs that these products and services require.

The differentiated market positioning will be maintained for the duration that these unique features of the 5G mobile network derived product, continue to add value, whether this is a functional feature or an aspect of image/prestige or an enriched experience that enhances the perception of the product.

The products and services developed under the airport vertical, that provide functional features of image/prestige or an enhanced experience that adds to the perception of the product and will be developed during the course of 5G-TOURS project are described in chapter 4.3.1 Mobility Product/Service characteristics.

Technology has a pivotal role, both for the optimization of the aeronautical processes and the creation of innovative products and services for the non-aeronautical area. This is more evident when it comes to the orchestration of activities and content between multiple airport stakeholders and creation of state-of-the-art services that enhance passenger experience. The unique characteristics and pioneering capabilities of 5G mobile networks are seen by many as enablers for a new round of innovative technological solutions that will further enable the digital transformation of airports.

The mobility solutions that are developed within the context of the 5G-TOURS project for the transportation sector, are the following:

- a solution of indoor navigation that will be used guide passenger to safety during and emergency evacuation of the Airport Terminal.
- a solution that will enable the airport's car parking users to quickly identify a suitable parking place, saving time and energy, reducing emission and increasing passenger satisfaction.
- a solution with live video feed scenario from multiple mobile Airport vehicles that result in a dramatic increase of the situational awareness of the stakeholders responsible for the running of the Airport operation, decision making and mitigation actions of airport related incidents.
- a solution that will enable streaming of online content that can be utilized to generate good quality digital learning experiences during the transportation.

It looks more likely than ever that in the future all "things" will be connected – e.g. from airport assets to IFE (In-flight Entertainment) systems and sensors integrated into seating – providing the industry with a constant stream of data which, if used correctly, could deliver new levels of operational efficiency and enable personalization like never before.

4.3.3 Business opportunities

The potential of new business opportunities, that the introduction of the 5G mobile networks will bring, is significant and the business landscape is still under formulation, as more and more features are turning from concept to reality, as the new versions of the 5G standards are being released. As described in chapter 2 of this

document, for the business model definition, the new business models emerging foster the synergies of content and service providers and 5G mobile network operators.

For the aviation vertical sector, the business opportunities are focused both in the aeronautical activities and more specifically in the operational excellence area and the non-aeronautical activities in the areas of eXtended Reality, commercial and marketing campaigns, multimedia content delivery etc.

4.3.3.1 Aeronautical Business opportunities

The business opportunities resulting from the introduction of 5G will derive from operational efficiency, increase of airport ancillary services revenues and costs optimisation. The Non-Aeronautical Business opportunities are mainly the following:

- Airports, and especially international ones, cover larger areas of land with multiple buildings - some of them of massive proportions such as passenger terminals, aircraft hangars etc.- and have several airport infrastructure equipment scattered in the whole airport area and even at remote places, such as perimeter security fences, runway lights, navigation aids etc. All this infrastructure has significant data connectivity requirements, so as to be feasible for the Airport operators to monitor their operational status, transmit readings and alert for incidents arising in a reliable and efficient manner. 5G mobile networks can be used to provide connectivity for the whole airport vicinity, without the need of installing thousands of meters of data network and fiber optic cables. The installation and maintenance of airport's data cabling infrastructure is a significant cost both for the initial investment to install the infrastructure, as well as to maintain it.

5G mobile network operators using the network slicing and quality of service capabilities can provide connectivity services to the airport operators or other airport stakeholders by sharing bandwidth capacity from the 5G infrastructure that they plan to install for their subscribers. In this way, airports introduce considerable savings for data connectivity as they do not have to build their own 5G infrastructure and at the same time mobile operators can recover a lot of the required investments costs required for the installation of a 5G mobile network infrastructure, which would be required anyhow in order to provision for their subscribers 5G mobile connectivity needs at airports.

- Aviation stakeholders such as airlines and ground handlers have also large connectivity needs while operating at airport premises as they utilise large numbers of ground handling equipment, hundreds of personnel, thousands of pieces of baggage and baggage containers and tons of cargo. The management of all these require a resilient wireless network, with the capacity to connect thousands of devices and sensors and available throughout the airport premises.
- Currently, many international airports face capacity constraints both in terms of passenger and flight/aircraft handling. For airports operators to handle the increasing numbers of passengers and flights, they make intense use of available airport fixed (buildings, hangars, terminals aircraft parking positions etc.), and mobile infrastructure, such as ground handling equipment. Due to the intensive use of resources, an incident or abnormality during airport processes can potentially impact airport operations and thus impair passenger and aircraft capacity of the Airport.

The early identification and mitigation of incidents and/or abnormalities in airport operations, is paramount for the execution of all required mitigation measures from Airport stakeholders, such as the Airport management company, Police, fire fighting services, Civil aviation authorities, Airlines etc. In cases where their combined intervention is required there is an increased effort for coordination and communication between the airport stakeholders in order to resolve these incidents.

The 5G mobile networks can help with the effective coordination of airport stakeholders by transmitting real-time, high-quality video of the areas that the incident is taking place, especially if the respective area is not covered by fixed CCTV surveillance system. Multiple mobile cameras fixed on vehicles or on the clothes of first responders, can transmit in real time, reliably, high quality video streaming, which results to the provision of a common situational awareness to all involved stakeholders and their operational centres responsible for the mitigation of the incident. The increased bandwidth that the 5G eMBB protocol provides, allows for the seamless transmission of multiple video streams that can then be distributed to the operation centres and decision makers instantly, without any delay, resulting to the timely mitigation of incident before becoming critical for the airport operations.

4.3.3.2 Non-Aeronautical Business opportunities

The non-aeronautical business opportunities that the 5G mobile networks are introducing are revolutionary, as the new bandwidth characteristics allow for rich content delivery, such as video or eXtended reality applications to multiple devices, paving the way to immersive experiences through the development of pioneering services and products. More restrictively:

- The airport passenger experience is one of the key metrics for the performance and efficiency of an airport and is a key differentiation factor for airports in their effort to become the airport of choice of travellers, especially frequent and business ones. This is very important for cities with multiple airports, such as London, Paris, Milan, New York, Beijing etc.

The provision of real time flight, way finding, time-to-gate, waiting and variable queuing times related information, are only a fraction of the value proposition that airports can offer to their passengers, based on the characteristics of the 5G cellular networks. By combining all data exchanged from the various applications and interactions the airport will provide passengers with relevant, contextualized information and services to assist and entertain them.

Many airlines offer sophisticated IFE services to their passengers especially for long haul flights. For short haul flights though and when flying with low cost customers, IFE services are not available at most of the times. As almost all passengers carry at least one smart device, by utilizing 5G mobile networks, they can download in seconds, ultra-high definition movies, the whole season of TV series or multiple music albums, that will be available to watch offline, during their flight, or while waiting at gate. Due to the large bandwidth characteristics of 5G networks, this can take place almost instantly irrespectively of the number of simultaneous connections. Additionally, passengers will be able to watch live events, such as concerts, stream sports events, or live TV shows in ultra-high (4K) quality, while waiting at the Airport, no matter how busy or congested it is at any given time.

- Most of the non-aeronautical revenues at the airport derive from concessionaires, such as retail, food & beverages shops. The most common business model for non-aeronautical revenues at airports, is when the airport leases the commercial spaces within the airport terminals and employs a business scheme of revenue sharing, based on the sales of every concessionaire.

Therefore, it is in the best interest of all stakeholder that the airport provides a business environment that is business friendly and allows concessionaires to maximize their sales, through the provision of advanced technological services. 5G mobile networks can deliver personalised sophisticated marketing campaigns directly to the passenger's smart devices, utilising the high bandwidth capabilities of the 5G, combined with several passenger data sources, such as shopping patterns, geolocation, basket analysis etc.

- For many airports, the revenues of the Car Parking at the airport premises represents the single most lucrative revenue stream, as multiples of thousands of parking spaces are available at the airport' s premises and operate on a 24x7 basis. As airport car parks face strong competition from car parks near the airports, they must be not only economical, but also practical, so they can achieve differentiation and a competitive advantage from other car parks.

The way to achieve this is to provide car space availability and guidance information to car drivers, so they manage to park their car and reach the airport terminal in the minimum possible time. 5G mobile networks can help achieve this by utilising occupancy sensors in every car park space to identify the occupancy of every space and guide the drivers to the first available one. The guidance service will also take into consideration the preferences or the respective flight characteristics, such as terminal or Check-in area, to assign the most suitable car space and guide the driver to this space through the most efficient route. As many airports have tens of thousands of car spaces the occupancy sensors will be connected by utilising 5Gs mMTC protocol, which allows for hundreds of thousands of sensors to be connected.

4.3.4 IPR opportunities

The introduction of new products and services that are based on the unique characteristics of 5G mobile networks, create a new ecosystem of methods, software applications and platforms. Furthermore, this ecosystem will be used to deliver content and information intended to either passengers or airport stakeholders. Airport concessioners will also use this ecosystem for marketing campaigns and personalisation services.

The above described landscape, including 5G mobile operators, is a field, where several IPR aspects have to be considered and defined. IPRs provide ownership of product and services to their creator, allowing a monetisation model to be introduced, so that the products and services create value for their creator. So, the entity that holds these IPRs, could invest part or all of the value created to the further development and evolution of the respective products and services, thus creating additional value for the passengers and airport stakeholders.

Although IPRs are a fine framework to produce and maintain products and services, in the new digital and service economy, IPRs of products and service developed under the 5G mobile networks must be drafted in such a manner, that encourages synergies with other stakeholders or information sources and allow for the creation of shared revenue models.

A major characteristic of the service economy in the aviation industry is the orchestration of the activities of many stakeholders and the sharing and integration of multiple data sources and content providers, especially for the commercial services, the integration of airport and concessionaire's information sources in order to produce personalized marketing campaigns is critical.

Part of the service economy is the so-called API economy, where every data source exposes its data through web services, so that they can be effortlessly integrated and produce products and services such as eXtended Reality ones, to be delivered over the 5G mobile networks. In this context the IPR framework must have provisions for data sharing contracts that allow for the provision of data and allow for flexible charging models, such as charging as per number of calls or volume of data exchanged.

4.4 The Mobile network Sector

While 5G-TOURS puts a strong emphasis on leveraging 5G technology to develop innovations across several sectors and vertical industries, as described in the previous section, another very relevant sector for 5G-TOURS innovations is the mobile network technology and industry itself. As a matter of fact, 5G-TOURS does not only use the existing 5G technology but rather evolves it with novel functionality, creating opportunities for innovation and exploitation within the mobile networking sector with 5G products and services.

To support the project innovation within the mobile network sector, 5G-TOURS Innovation Management is addressing the following aspects:

- The assessment of the different innovations within the project to identify the ones that have the highest potential for real market impact. In this context, the technical work packages of the project (especially WP2 and WP3) play a major role, by providing the novel ideas and solutions that could generate commercial value.
- Provide guidelines and take necessary steps to ensure that the market will leverage the potential of these innovations. In this context, WP8 plays a decisive part by coordinating the standardisation and patent work and orchestrating the dissemination activities.

In the following, we report on the progress of Innovation Management in this context, describing (i) the envisaged mobile network products and services resulting from 5G-TOURS, (ii) the key innovations upon which these products and services will rely, (iii) the market position to exploit these innovations, and (iv) the activities that are being taken by the project to realize the exploitation potential of these innovations.

Note that this section has a different structure from the previous subsections of this section, as it does not cover innovation in terms of products or services but in terms of technology employed. As such, the business models and stakeholders are the ones traditional for the mobile network ecosystem (involving mainly manufacturers and operators) in contrast to the previous subsections which were dealing with emerging markets. Beyond the key 5G characteristics such as eMBB, URLLC and mMTC or network slicing, which are part of the state of the art in 5G technology, 5G-TOURS fosters novel innovations that strengthen Mobile network products. The main focus of this subsection is the efforts to pave the path towards the commercialization of these innovations.

4.4.1 Products/Service Characteristics

5G-TOURS innovations aim not only using 5G technology but also at developing novel 5G network solutions. These solutions will build on the equipment provided by the manufacturers of the consortium, compliant with the latest 3GPP releases, comprising network infrastructure equipment, mobile terminals and chipsets, and will

incorporate the enhanced functions on top of baseline products. In particular, these are the products being addressed by 5G-TOURS:

- ***Network equipment***: Deployment and implementation of network equipment conforming to the latest 3GPP release including novel 5G-TOURS functions;
- ***mMTC sensors***: Implementation and integration within vertical solutions of chipsets for mMTC communication conforming to the latest releases;
- ***Mobile terminals***: Deployment and integration with vertical solutions of mobile terminals conforming to the latest releases.

In addition to the above products, another major target addressed by 5G-TOURS are the novel network services that can be provided with network slicing, one of the key technologies addressed by the project. In addition, 5G-TOURS aims to provide new and customized mobile communications services, reaching new application domains with specific requirements. Hence, a major innovation of 5G-TOURS in the mobile network involves the provisioning of novel services by network operators.

4.4.2 Key mobile network innovations

The project is working towards incorporating novel enhanced functions to the mobile network architecture on top of the existing baseline products. By adding this novel functionality into the network equipment, 5G-TOURS aims to improve the performance and operation of 5G equipment. The ultimate goal of 5G-TOURS is to bring these innovations on network technology to commercial exploitation. In the following we explain the novel technology ideas that the project is working on. In the next subsections, we further explain the market position and business opportunities to commercially exploit these innovations and the steps taken by the project to foster the adoption of these innovations in the market.

In particular, these are the key innovations that the project is working on:

- ***Novel service layer***: A new layer is being developed in order to provide vertical industries and other potential tenants with an easy-to-operate interface offering them the required interface to request for a slice that meets their requirements, instantiate and operate it. This interface are translated by this layer to commands that are supported by the different network components;
- ***Novel AI/ML based algorithms for the management of the mobile network***: 5G-TOURS is developing novel AI/ML based algorithms to manage the mobile network. Such algorithms are necessary in order to ensure that such a complex and large-scale network system operates optimally. Indeed, in large deployments, without AI/ML it would be very difficult to devise algorithms that optimize the overall performance of such a complex system;
- ***Novel orchestration and elasticity solutions***: 5G-TOURS is working on novel orchestration and management techniques. These techniques exploit the orchestration and management interfaces provided by standard-compliant network devices;
- ***Novel broadcast solutions***: 5G-TOURS is working on novel broadcast techniques adapted to the constraints of standard-compliant network devices.

The above innovations will particularly impact 5G core network products, which will be able to provide enhanced interfaces to the network slice tenants (such as verticals) and rely on novel techniques to provide an improved management and orchestration of the whole network.

4.4.3 Market position and business opportunities

In the following we review the context and market positioning of Europe in general and 5G-TOURS partners in particular, to leverage the project innovations to exploit potential business opportunities.

Europe has traditionally been very strong in the development of mobile networks technology, in contrast to other technologies such as the Internet which have been largely led by other world regions, mainly the US. As a matter of fact, Europe has largely dominated the mobile network market since the development of the GSMA technology, and even today Europe plays a leading role in the development of mobile network infrastructure equipment. Yet, there are some areas within the mobile communications market where Europe's position is

much weaker. And there are also new areas that will emerge with 5G technology and it is yet to be seen who will take the leadership in these emerging markets.

5G-TOURS aims to (i) reinforce European leadership in those areas where Europe retains a strong position, (ii) strengthen its position in those areas that are currently dominated by other world regions, and (iii) contribute to Europe's positioning in the new opportunities and ecosystem that will be created around 5G technology. In the development of 5G technology, 5G-TOURS aims to strengthen European leadership in the following areas:

- ***Mobile network infrastructure***: This market is largely dominated by European manufacturers nowadays, namely Ericsson and Nokia which jointly account for a substantial fraction of the market share. 5G-TOURS involves both Ericsson and Nokia, and aims to provide them with novel technological solutions, valuable trial experiences as well as the exposure to new vertical solutions and ecosystems, contributing to strengthen the European leadership in this area;
- ***Baseband processors***: This market is largely dominated by non-European players, Qualcomm being the market leader with a share above 50%. While Europe's position in this market is rather weak, the 5G-TOURS consortium includes the most important European player in this market, Sequans, which supplies the IoT market. 5G-TOURS can provide Sequans with the opportunity to enter vertical markets of high potential, teaming up with partners as strong as Philips;
- ***Mobile phones***: This market is also dominated by non-European players. The consortium includes however one of the largest worldwide manufacturers in this area, Samsung, which despite being a non-European company has an important presence in Europe and plays a leading role in many European initiatives such as ETSI. Samsung's participation in 5G-TOURS can strengthen its European profile and its collaboration with the main European players;
- ***Mobile network operators***: The consortium includes three of the largest mobile network operators in Europe: Orange, Telecom Italia and OTE (part of the Deutsche Telekom group). 5G-TOURS focuses on new markets and revenue streams for operators and is providing the operators of the consortium with valuable trial experiences as well as exposure to ecosystems around the new markets, thus strengthening the position of the European operators.

4.4.4 Promoting the adoption project innovations

One of the main goals of 5G-TOURS is to promote the technology innovations of the project and foster their adoption in the market. While the project innovations themselves have been described in Section 4.4.2, in the following we explain the actions that are being taken by the project in order to promote the commercialization of these innovations and foster their adoption in future mobile network products.

In order to promote the project innovations in this sector and exploit the potential business, 5G-TOURS is pursuing the following goals:

- *Attracting vertical industries* to use 5G-TOURS technology; indeed, verticals are the end customers of the technology and the success of the technology ultimately depends on reaching a critical mass of customers;
- *Fostering the widespread adoption of the technology* beyond manufacturers and operators of the consortium; as a matter of fact, in a global market such as the mobile telecom one, a technology can only succeed if it is widely adopted by the majority of the players in the market.

In particular, the measures taken by the project to achieve these goals include the following:

- Carrying out market analyses that highlight the business opportunities enabled by the solutions developed in 5G-TOURS and stimulate a widespread adoption of the technology;
- Building an ecosystem in line with the exploitation plans of the partners involved in the project, so as to foster the rapid commercial utilisation of the 5G-TOURS technology;
- Promoting the standardisation of the key interfaces into the relevant standards bodies and groups, in order to facilitate the use of the technology and to stimulate its adoption by other market players beyond those actively involved in the consortium;
- Providing an open source Software Development Kit that simplifies the development of vertical applications that use the interfaces provided by 5G-TOURS.

In terms of open-source software, over the last years, we have observed a paradigm shift in the telecom industry towards open source software, which is particularly visible in the SDN and NFV technologies. The key advantages of products based on open source are as follows: (i) open source can gather a critical mass of effort that allows pursuing projects that would be too large and effort-consuming for a single manufacturer; (ii) by relying on open source based products, mobile operators are not bound to a single manufacturer and can easily change to other manufacturers using the same open source software. Following these trends in the mobile network industry, 5G-TOURS is working on open source software for some of its solutions.

In the following table, we describe the various activities that are being carried out to promote the future market adoption of the key 5G-TOURS innovations around the mobile network technology.

Table 3. Activities to promote market adoption

Key 5G-TOURS innovation	Activities conducted to promote the commercial adoption of the project innovation
Novel service layer	• Interaction with vertical partners to design of a novel interface that meets their requirements • Development of a prototype that may eventually become a Software Development Kit that can be shared with vertical players.
Novel AI/ML based algorithms	• Proposal of the project solutions to ETSI standards, in particular to ENI ISG. • Development of a prototype which is an official Proof of Concept of ETSI ENI.
Novel orchestration solutions	• Contribution to 3GPP standardisation. • Development of a prototype that may become Open Source. • Demonstrator to show the functionality provided.
Novel broadcast solutions	• Contribution to 3GPP standardisation. • Development of a prototype.

As a conclusion, Innovation Management will closely monitor the mobile network innovations addressed by 5G-TOURS, will guide the various activities to strengthen the commercial value of these innovations and will ultimately promote the adoption of these innovations in the market.

5 Standardization and Intellectual property

The objective of this task is to promote the project outcomes to targeted standards bodies, and industry fora that influence the development of standards, to facilitate the future exploitation of these results. This task is designed to ensure collaboration and consensus building occurs at an early stage when high potential outcomes are identified prior to the dissemination action towards SDOs. 5G-TOURS partners who are members of different standardisation bodies have been actively contributing to the standardisation to promote the project's results.

5G-TOURS is contributing to standardisation bodies and to facilitate the exploitation of 5G-TOURS innovations in commercial products and their usage by the verticals. In particular, 5G-TOURS is contributing to standards by (i) reporting on its trial experiences and the requirements collected from those experiences into standards bodies so that they can be addressed in future releases of the standards; (ii) bringing its design on novel functionalities including orchestration, broadcast and AI-based algorithms so that they can be incorporated into the current release being developed by the standard; and (iii) proposing interfaces with external stakeholders, including the verticals, which satisfy their requirements and simplify their usage of the underlying network services.

The following **Table 4** give a global view of what was the targeted KPIs and activity and the current status. The subsections give more details.

Table 4. Standardisation: initial KPI and results

	Current status
	31 March 2020
3GPP	Active participation to : SA, SA1, SA2, SA4, RAN, RAN1, RAN2
ETSI ENI	Contribution to the Proof of Concept (PoC) called "Autonomous Network Slice Management for 5G Vertical Services"
DVB	Target participation to the on-going work on harmonisation between DVB-I and 5G
DICOM	Currently no new WG has been set up to focus on the evolution of DICOM-RTV to 5G. However, BCOM is actively investigating the impact of 5G for DICOM-RTV and will propose a new WG to the standard committee depending on its both investigation and priority"
PCHA	PCHA released the 2019 version of the Continua Design Guidelines [28]. PCHA established a collaboration with IHE and launched the Personal Connected Health (PCH) subdomain within the IHE Patient Care Device Domain (news release [29]) The new IHE DEV Personal Connected Health (PCH) subdomain produced and published the Personal Health Device Observation Upload (POU) Profile [30]
Total number of standards contributions	48 – (the initial objective is more than 50)

5.1 Contributions in 3GPP Technical Specification Groups (TSGs) and Working Groups (WGs)

5G-TOURS partners have been actively participating in TSGs SA (System and service Aspect) and RAN (Radio Access Network), and their affiliated WGs on project topics.

The topics of contributions include the following:

- Multicast/Broadcast (related 5G-TOURS task 3.2): Multicast/Broadcast is one of top priority topics that are included in 3GPP Release 17 specification as agreed in the 3GPP RAN and SA plenary in December 2019. The 5G architecture supporting multicast/broadcast has been being studied and specified by the 3GPP SA2 WG since October 2019. For example, the scope of SA2 work in the study phase is to support both multicast requirements/use cases for CIoT, Public Safety, V2X etc., and broadcasting requirements/use cases. The goal is to identify and evaluate potential enhancements to the 5G system architecture to provide multicast-broadcast services which might be used for different vertical businesses. The radio aspect will be studied and specified by the RAN WGs in 2020;
- 5G Media Streaming Architecture (related 5G-TOURS task 3.2): The 5G System offers many features (e.g. Local Break Out, Distributed Compute) and many deployment options for 5G Media Streaming Services. This work creates a new 5G media streaming architecture for both uplink and downlink streaming services. The new 5G Media Streaming architecture aims at being decomposed into independent components enabling different deployments with various degrees of integration between 5G Mobile Network Operators and Content Providers. This work is conducted by 3GPP SA2 SA4 WG. It will integrate the multicast/broadcast aspect in Release 17;
- Service requirements for medical sector (related 5G-TOURS Work Package 5): 3GPP has been tackling service requirements for the medical sector especially in the area of remote patient monitoring in various specifications. More recently, considering that the adoption of wireless technologies has increased across most hospital functions (patient monitoring, nurse call systems, etc.) but that critical medical services, such as surgical operations and remote diagnosis are lagging behind, 3GPP decided to extend its Rel17 specifications to cover additional use cases. Therefore, a new technical report (TR22.826) has been created and now gathers requirements attached to two main use case categories:
    - the delivery of critical care in the context of a hospital or a medical facility where the medical team and the patients are collocated. In this context, devices and people consume indoor communication services delivered by 5G non-public networks that provide communication services with similar functionalities to Local Area Networks (5GLANs) to medical equipment;
    - the delivery of critical care where medical specialists and patients are located at different places. This, in particular, covers medical services delivered by first rescuers. In this context, devices and people consume communication services delivered by PLMNs where a mobile network operator can use network slicing as a means to provide a virtual private network, or a private slice.

  Then, normative requirements have been extracted from the technical report, reworded and inserted in normative specifications, covering the following aspects:

    - 5G system performances required to enable use cases involving high quality and augmented imaging systems in hybrid ORs. Associated requirements have been included in 3GPP TS 22.263;
    - 5G system performances (KPIs) required to enable use cases with tele-diagnosis. Associated requirements have been included in 3GPP TS 22.261;
    - 5G system performances (KPIs) required to enable use cases with tele or robotic-aided operations. Associated requirements have been included in 3GPP TS 22.104;
    - Security management in 5G systems for the sharing of medical data between care providers or with patients while still fulfilling national and European regulatory requirements. Associated requirements have been included in 3GPP TS 22.261.
- mMTC evolution: The 3GPP study on “self-evaluation towards IMT-2020 submission” confirmed that the existing E-UTRAN LTE-based solutions of NB-IoT and LTE-M fulfil the IMT-2020 requirements for mMTC and thus can be certified as 5G technologies and it is assumed that no new RAT will be

defined for 5G mMTC by RAN WGs. LTE-M and NB-IoT have been designed in RAN WGs essentially from Rel-13 and enhanced in every following Release to support their ongoing commercial and deployment growth. In that direction, Rel-16 enhances NB-IoT [RP-192986] and LTE-M [RP-191356] to further improve their respective network operation and efficiency in a range of areas including coexistence with NR, connection to 5GC, improved UL/DL transmission and/or UE power consumption, scheduling and mobility enhancements, etc. Furthermore, several mMTC relevant studies and standardization work is ongoing (e.g. URLLC support, Industrial IoT) and/or have been under discussion to include in 3GPP Rel-17 (e.g. further NB-IoT and LTE-M enhancements, NB-IoT/eMTC over Non-Terrestrial Networks (NRN), reduced capability NR devices). Main part of aforementioned work is conducted by 3GPP RAN WGs.

The contributions that have been agreed or accepted up to the publication date of the present document are listed in Annex D.

5.2 Contributions in DICOM

In order to demonstrate the impact and the interest of 5G in the operating room, new AR applications need to be developed. Such applications may require several video streams as input, together with additional metadata, such as positioning information of ultrasound probe for example. To provide surgeons a really precise feedback, these applications also require a strong synchronization mechanism between all incoming streams. A solution was then necessary to allow the transfer of theses streams in such conditions and in the context of the operating room, handling patient information. Thus, the new DICOM-RTV standard was a mandatory prerequisite before demonstrating the impact of 5G.

The DICOM-RTV supplement has been finalized on the 16/09/2019 with the support of B-COM (see contribution in Annex D). It defines a new IP-based DICOM Service for the broadcasting of real-time video to subscribers with a quality of service which is compatible with the communication inside the operating room (OR). The new Real-Time Video Service supports interoperable devices inside the OR and beyond, enabling a better management of imaging information, impacts directly the quality of care. It is based on the SMPTE ST2110 suite, elaborated on the basis of Technical Recommendation TR03 originated by the VSF (Video Services Forum).

Following the publication of this supplement, a demonstration of a DICOM-RTV use case and implementation has been showcased in MEDICA, the world's largest medical trade fair for medical technology and electromedical equipment, in Dusseldorf in November 2019. Before demonstrating the transfer of DICOM-RTV flows over 5G a network, this implementation was a very important step to conceive and develop necessary elements to enable these transfers. These developments will be the base of the 5G-TOURS future works.

Being conscious that for the interest of the 5G-TOURS project, it is important to use future-proof and widely used technologies. Some contacts have also been established with several companies at Arab Health, a healthcare conference and trade show in Dubai, in January, to help promoting the standard. 5G-TOURS use case for the OR (use case 8) will be also used to demonstrate the usage of this standard.

5.3 Contributions in ETSI ENI

One of the key innovations of the project is the introduction of AI, which is needed to support large-scale deployments such as the ones envisaged in 5G-TOURS. To this end, the project has been working on AI-based management of the network [19] and pushing them to these relevant standardization fora, in order to promote the wide commercial adoption of the project solutions.

5G TOURS is actively participating to the ETSI ENI ISG, in particular Marco Gramaglia from UC3M is regularly attending virtual and physical meetings, disseminating the advances attained in the project. In particular 5G TOURS partners (UC3M, WINGS, TIM and SRUK) have proposed a Proof of Concept (PoC) called “Autonomous Network Slice Management for 5G Vertical Services” (see Annex D) whose goals are the validation of the ETSI ENI interfaces through the AI management of some of the UCs proposed in the project. This PoC has been accepted during the ETSI#12 meeting held in December 2019 and the work already started (see the upcoming WP3 deliverables). The intermediate milestone (i.e., the PoC final architecture) has been presented during ETSI#13 meeting. Finally, 5G TOURS members will contribute to the upcoming ETSI ENI White Paper.

5.4 Contributions in ITU

The ITU-R Working Party (WP) 5D is responsible for the overall radio system aspects of IMT systems. WP 5D launched an evaluation process for Radio Interface Technologies (RIT) in the context of IMT-2020, to be submitted by SDOs and independent Working Groups (WG). The 5G-PPP WG, which belongs to the 5G Infrastructure Association, is one of the eleven globally registered groups.

UPV, as part of this group and representing 5G-TOURS, completed the following objectives:

- To perform and independent evaluation of IMT-2020 proposals to support ITU-R WP5D for the finalization of the IMT-2020 recommendation;
- To complete evaluation report by February 2020, from the European perspective in the global context of other evaluation groups;
- To demonstrate the importance and global presence of communication technology industry and the research community in Europe.

The final evaluation report, sent in February 2020, evaluates the use of 5G NR and LTE as potential IMT-2020 technologies. All KPIs are therein evaluated. Examples are bandwidth, throughput, spectral efficiency, latency or mobility. The evaluation report concludes that 5G NR fulfils all considered requirements in the context of IMT-2020 scenarios (see Annex D).

Another activity of the 5G -TOURS Partner is related to the definition of Business model in ITU.

As part of the WP8 business model research we considered business model developments within the ITU. The ITU Business Models Working Group was part of the ITU m-Powering Development Initiative.

The purpose of this Working Group was “to carry out the background work on business models to foster private-public partnerships and facilitate mobile technologies to be part of the development process. The working group would provide input to the work of the m-Powering Development Initiative Advisory Board”.

The m-Powering Development Initiative Ran from 2011 to 2018 and is now closed. It produced a final report entitled “m-Powering Development Initiative: 2011 – 2018” [31].

This report has lots of Business Model Content including “Section 8, Innovative business models for sustainable connectivity”, which proposed models for Infrastructure sharing and Aggregation of small Wi-Fi networks both of which may have some 5G-TOURS relevance. The report has a strong Africa continent focus using mainly African country examples and references but is worthy of a more detailed review with respect to possible input to 5G-TOURS.

5.5 Patents

The project is actively pursuing the application of patents in order to promote the exploitation of the project results and protect the commercial interests of the involved patents. As 5G-TOURS puts a strong focus on the deployment and use of the mobile network technology to provide different applications and use cases, there not may be as much emphasis on the creation of IPR as compared to other projects that strictly focus on the creation of mobile network technology. In spite of this, there have already been some results in terms of IPR (Intellectual Property Right), and additional results are expected by the end of the project.

To capture the project impact in terms of IPR, 5G-TOURS monitors the results in terms of patents related to the project. These correspond to patents that have been authors by researchers working on the project, during the lifetime of the project and in technologies that are closely related to the topics addressed by 5G-TOURS. Up to now, there have been the following results in terms of patents related to the project:

- Ericsson Italy has already issued a patent application related to the project. Ericsson is a large manufacturer producing network equipment and thus it is expected that it will greatly benefit from the project results to develop more competitive and innovative products;
- Samsung UK has a strong activity in innovation. Up to now, the people involved in 5G-TOURS have been independently involved in 2 patents whose topics are related to the topics addressed in 5G-TOURS.

6 Industrial Communication and Dissemination

The goal of dissemination activity is to promote the visibility of 5G-TOURS, disseminating its results into multiple fora that are oriented towards industry. The main target audience for this dissemination was identified as verticals, industry, Mobile Network Operators (MNOs), research institutes, universities etc.

In the project proposal were determined two main phases of the dissemination activity:

- Elaboration of the initial dissemination plan;
- Implementation of the dissemination plan.

To achieve the main goal of the dissemination partners are planning to use the next main directions:

Earned Media and PR. Earned media (or "free media") is publicity that's created through efforts other than paid advertising. It can take a variety of forms – a social media testimonial, word of mouth, a television or radio mention, a newspaper article or editorial – but one thing is constant: earned media is unsolicited and can only be gained organically. It cannot be bought or owned like traditional advertising.

Networking Events. Tradeshows remain a top B2B networking tool (especially when inbound tactics support event efforts), as they gather companies within a specific industry into one location for demonstrating their latest products and services. Rarely open to the public, trade shows give companies the chance to establish or strengthen relationships with key industry partners, customers and prospects; identify market trends and opportunities; and, gain an understanding of what their competition is offering in the market.

Search Engine Marketing. Search engine marketing, or SEM, is a tool that companies use to grow their website traffic through paid online advertising.

Account Based Marketing (ABM) and Retargeting. Account Based Marketing (ABM) is a B2B strategy that focuses on a targeted set of accounts using highly personalized campaigns. It provides marketing and sales teams with a number of advantages, including a faster sales process, cost effectiveness, and a more efficient use of marketing resources. With all of the things ABM is, though, it's important to remember that ABM is not the same as targeted outbound marketing. It's much more considered and strategic, using methods like online retargeting to personalize marketing efforts.

Social Media Marketing. Social media marketing focuses on providing users with content they find valuable and want to share across their social networks, resulting in increased visibility and traffic. Social media shares of content, videos and images also influence SEO efforts in that they often increase relevancy in search results within social media networks like Facebook, Twitter, LinkedIn, YouTube and Instagram and search engines like Google and Yahoo.

Search Engine Optimization. Search engine optimization, or SEO, is the process of increasing awareness about – and traffic to – a particular website by making sure it appears among the top unpaid (or "natural") search results on search engines like Google, Bing! and Yahoo. While there is a common misperception that it is a stand-alone marketing tactic, SEO is accomplished by many tactics working together and is central to an effective inbound marketing strategy.

Content Marketing. Content marketing emphasizes education over selling to influence buying behaviour. This strategic marketing approach focuses on creating and distributing information relevant to prospects' needs in order to attract those best aligned with – and most likely to purchase – your product or service.

Inbound Marketing. Inbound is far and away the most effective B2B marketing strategy because it leverages the strengths of the majority of the other nine strategies to attract, convert, close and delight customers. Unlike traditional marketing methods – or even those of the other strategies listed here – inbound earns the attention of customers and pulls them to company website by producing meaningful content.

Webinars. A webinar is an online meeting or presentation held via the Internet in real-time. To put it simply, it is an online event, which connects individuals with viewers across the world. The main feature of live webinars is interactivity, or the ability to discuss, send and receive information in real-time.

At the current stage of the project the project has already achieved a substantial impact in terms of dissemination activities. The number of dissemination activities related to international journals and conference papers has reached the target of 10 contributions. Regarding the number of keynotes and panels together with the participation in 5G events, dissemination has already reached the number of 16.

The project has immediately reacted to the live events cancellation and restriction measurement due to COVID-19 outbreak by adopting / reinforcing the following dissemination channels: blog post, newsletter, press releases, webinars.

On the contrary, the COVID-19 outbreak has been impacting some promotion events where 5G-TOURS have been planned to attend. 5G-TOURS planned to participate on MWC 2020 (later cancelled): presentation materials were anyway sent to the organisers of MWC for promotion. Small-scale demonstrations were planned during the EuCNC 2020 (later downsized and in an online format): current plan is to promote the above demos by the end of the year. If no further COVID-19 impact a scientific workshop in a major IEEE conference will be organised during the next year. At the moment three industrial workshops organising by the 5G-TOURS are planned for the next year in Turin, Rennes and Athens.

Finally, all the targeted public deliverables were submitted as scheduled, and made available in the project website http://5gtours.eu/.

These dissemination activities have helped to reach a large number of people from academia, industry, civil society, media, etc: in particular, 1200 people from the scientific community, 871 people from the industry, 91 people from the civil society, 890 people from the general public, 254 policy makers, 409 people from media, 512 customers and 1174 people from others sectors. In total, 5401 people have been reached with the 5G-TOURS dissemination activities. These estimates were obtained based on the analysis of the involvement of the audience in social media, website traffic, the number of participants in various events where partners participated.

6.1 Journal Articles and Magazines

5G-TOURS partners are targeting and have been publishing at the most prestigious journals and magazines in the field. The main results of 5G-TOURS have been published in 3 journal papers and 1 book chapter. The full text can be found in (http://5gtours.eu/journal-papers-books-and-chapters/). 5G-TOURS is also planning a number of Journal papers in special issue of an IEEE Journals. The joint work between partners is also highlighted.

Table 5. Journal Articles and Magazines

#	Authors	Title	Journal / book information
1.	Albert Banchs, David M. Gutierrez-Estevez, Manuel Fuentes, Mauro Boldi, Silvia Provvedi	A 5G Mobile Network Architecture to Support Vertical Industrie	IEEE Communications Magazine, Dec 2019
2.	David Gomez-Barquero, Jordi Joan Gimenez, Roland Beutler	3GPP Enhancements for Television Ser-vices: LTE-based 5G Terrestrial Broadcast	Wiley Encyclopedia on Electical and Electronics Engineering, 2020
3.	D. Bega, M. Gramaglia, M. Fiore, A. Banchs, X. Costa-Perez	DeepCog: Optimizing Resource Provision-ing in Network Slicing with AI-based CapacityForecasting	IEEE JSAC
4.	G. Garcia-Aviles, M. Gramaglia, P. Serrano, F. Gringoli, S. Fuente-Pascual, I. Labrador-Pavon	Experi-menting with open source tools to deploy a multi-service and multi-slice mobile network	Elsevier Computer communications

6.2 Conference papers

5G-TOURS partners have published up to 5 conference papers. All the conference papers are also available on our public website (http://5gtours.eu/conference-papers/). The full list of conference papers, either published or accepted, are listed below. The joint work between partners is also highlighted.

Table 6. Conference papers

#	Authors	Title	Conference information
1.	.A. Ayala Romero, Andres Garcia Saavedra, Marco Gramaglia, Xavier Costa Perez, Albert Banchs, Juan José Alcaraz Vrain	A Deep Learning Approach Tailoring Computing and Radio Resources in Virtualized RANs	ACM Mobicom
2.	J.A. Ayala Romero, Andres Garcia Saavedra, Marco Gramaglia, Xavier Costa Perez, Albert Banchs, Juan José Alcaraz	Demo: vrAIn Proof-of-Concept — A Deep Learning Approach for Virtualized RAN Resource Control	ACM Mobicom
3.	Alvaro Ibañez, Manuel Fuentes, Borja Iñesta, David Gomez-Barquero, Diarmuid Collins	5G Broadcast implementation and demonstration in an SDR laboratory experiment	IEEE BMSB
4.	Jiaxiao Zheng, Gustavo de Veciana, Albert Banchs	Constrained Network Slicing Games: Achieving service guarantees and network efficiency	WiOpt
5.	Saad El Jaouhari	Introduction to DICOM-RTV: a new standard for real-time video communication in hospitals	IEEE Healthcom

6.3 Presentations, keynote speeches, invited talks

The main results of 5G-TOURS in the first phase of the project have been presented in 15 talks and presentations.

Table 7. Presentations, keynote speeches, invited talks

	Main Author	Title	Event	Date	Place	Type of Audience
1	Bel Mouhouche	5GTOURS EuCNC Presentation Video	EuCNC2019	21/07/2019	Valencia Spain	Industry/ Academia
2	Marco Gramaglia	Presentation to the 5G-EVE project plenary	5G-EVE project plenary	02/09/2019	Pisa, Italy	5G EVE consortium
3	Eduardo Garro	5G-Broadcast Trials in 5G-TOURS	IBC 2019 FOBTV meeting	15/09/2019	Amsterdam, The Netherlands	Broadcasting Industry

4	Panagiotis Demestichas	Vertical Sector Transformations through Advanced Wireless Technologies and A.I. (The role of MEC)	IEEE 5G World Forum (WF-5G)	30/09/2019 - 02/10/2019	Dresden, Germany	Industry/ Academia
5	Panagiotis Demestichas	5G InfraPPP Trials Roadmap	IEEE 5G World Forum (WF-5G)	30/09/2019 - 02/10/2019	Dresden, Germany	Industry/ Academia
6	Emmanuel Cordonnier	*DICOM®Real-time Video*	DICOM Conference	4/10/2019	Bangkok Thailand	Industry/Hospitals/academia
7	Simon Fletcher	5G Future of Healthcare	GIANT Health 2019	16/10/2019	London, UK	Health Sector
8	Anthony Dunne	5G-TOURS: An Overview including Business Modelling of new 5G Verticals	10th FOKUS FUSECO Forum	07/11/2019	Berlin, Germany	Industrial 5G
9	Simos Symeonidis	Measuring Key Performance Indicators of 5G Networks	InfoCom World 2019	26/11/2019	Athens, Greece	Technical/ Industry
10	Albert Banchs	Data analytics based orchestration	5G PhD School Italy	04/12/2019	Rome, Italy	PhD students and researchers
11	Simon Fletcher	The techno-economic case for road connectivity for a 5G-TOURS Safe City and Rural environment	WWRF Health VIP workshop	31/01/2020	Thesoliniki, Greece	Industry/ Academia
12	Anthony Dunne	5G-TOURS: Emerging New 5G Ecosystems In Different Industry Verticals	FOKUS FUSECO Forums Event	05/11/2020	Berlin, Germany	Emerging New 5G Ecosystems In Different Industry Verticals
13	Roman Odarchenko	Cellular Networks: New Challenges	Kyiv house of scientists	05/02/2020	Kyiv, Ukraine	Industry/ Academia
14	Velissarios Gezerlis, Tilemachos Doukoglou	Infocom 2019 - 5th Generation Network Applications in Transport and Tourism	Infocom 2019	26/11/2019	Athens, Greece	Industry / Academia
15	Velissarios Gezerlis, Tilemachos Doukoglou	5G-Event - 5th Generation Network Applications in Transport and Tourism	5G Event in Stavros Niarchos	18/10/2019	Athens, Greece	Industry/ Academia

6.4 Industrial workshops

5G-TOURS consortium involves a number of partners whose activity has a strong social emphasis, such as a hospital, a school, a museum, a municipality, an airport and a security agency. Driven by these actors, many of the use cases addressed by the project have a strong societal impact. In order to assess the resulting benefits for

society, 5G-TOURS will conduct the subjective evaluation which will be fed with the feedback received from the verticals participating in the project workshops.

Thus, 5G-TOURS is planning to implement a comprehensive dissemination strategy towards the verticals with the organisation of industrial workshops. This dissemination strategy is of prime importance to let project's results and findings percolate among industrial stakeholders.

5G-TOURS has already organized the workshop on 5G and emergency services. This workshop was organized by University Carlos III of Madrid and was held in Madrid to address one of the key use cases of 5G-TOURS: the use of 5G technology for emergency services.

The workshop gathered the main players in Spain in this area:

- Telefonica, the main operator in Spain;
- Ericsson, one of the main 5G equipment providers;
- SAMUR, the national agency for emergency services;
- UC3M, one of the leading academic institutions on 5G.

The workshop counted also with wide attendance from the other stakeholders in the Spanish 5G ecosystem, including vertical players. This was a very successful project to debate and show the usefulness of 5G technology for this purpose. A demo was provided in addition to several talks. It is worth highlighting that demo on 5G and emergency services had previously been broadcasted on the regional TV channel.

Also, the project will further organise at least three industrial workshops devoting particular efforts to reach vertical industries outside the consortium and make them aware of the advantages that 5G can potentially bring to their businesses. These workshops are planned to be organised in three cities: Turin, Rennes and Athens.

Through this series of workshops, each focusing on a specific study node, project partners aim to investigate how 5G technology & architectures are aligned with creating stakeholder value within the industry verticals and how they might contribute to the long-term goals of an enterprise by creating superior performance, complimenting internal resources, and exploiting external opportunities.

The aim of these workshops will be to gather technology stakeholders and vertical industries beyond those in the 5G-TOURS consortium and communicate to them the project concept and results in a direct and effective way. A strong emphasis will be given to the use cases demonstrations, to show the advantages and benefits of 5G technology to address real problems and provide practical solutions.

6.5 Website and social media

So far, the main dissemination activities have been shared via the project website and twitter. In order to ensure the largest possible exposure of the project, other social media and networking tools have also been activated.

A public website (http://5gtours.eu/) presents the news, events, description, consortium and public deliverables of the project. The public website is the central hub for the dissemination activities. 5G-TOURS website is reachable via 5G PPP projects page https://5g-ppp.eu/5g-tours/. Open access to scientific publications is being ensured by publishing submitted papers in compliance with IEEE rules.

The following figure shows as an example part of the documents section, where public deliverables are shared.

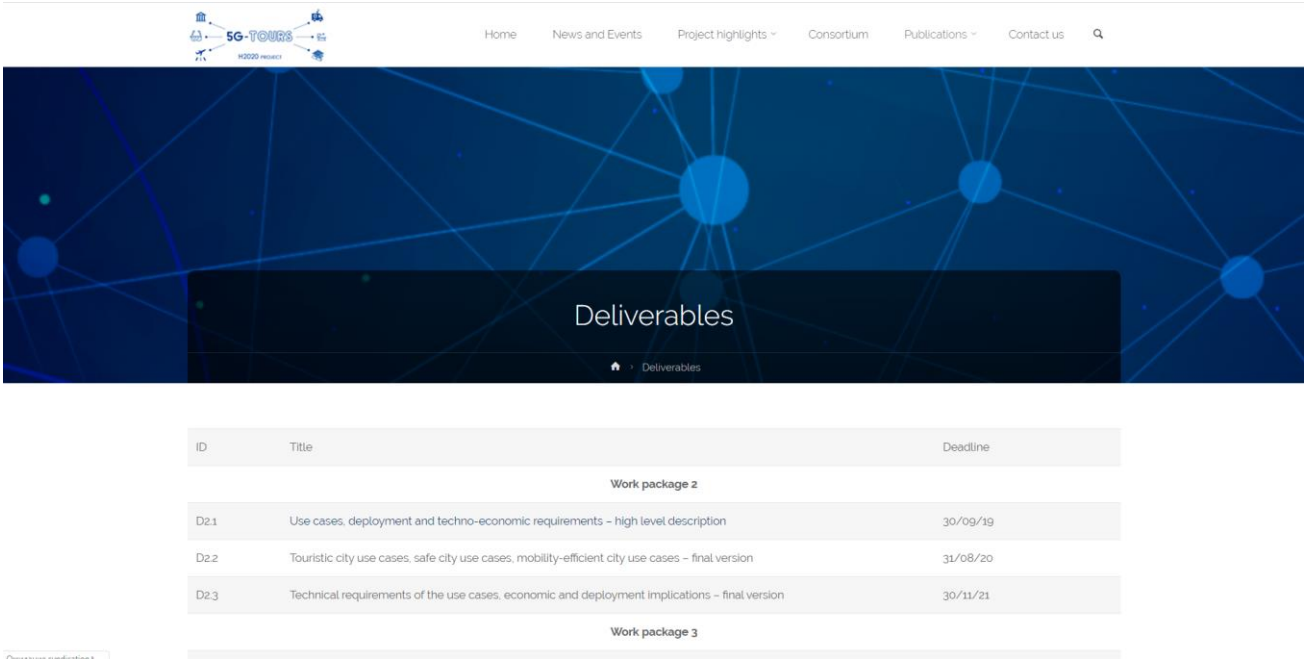


Figure 18. Official website of 5G-TOURS project

Website visits analysis using Google Analytics tool is shown on the following figure:

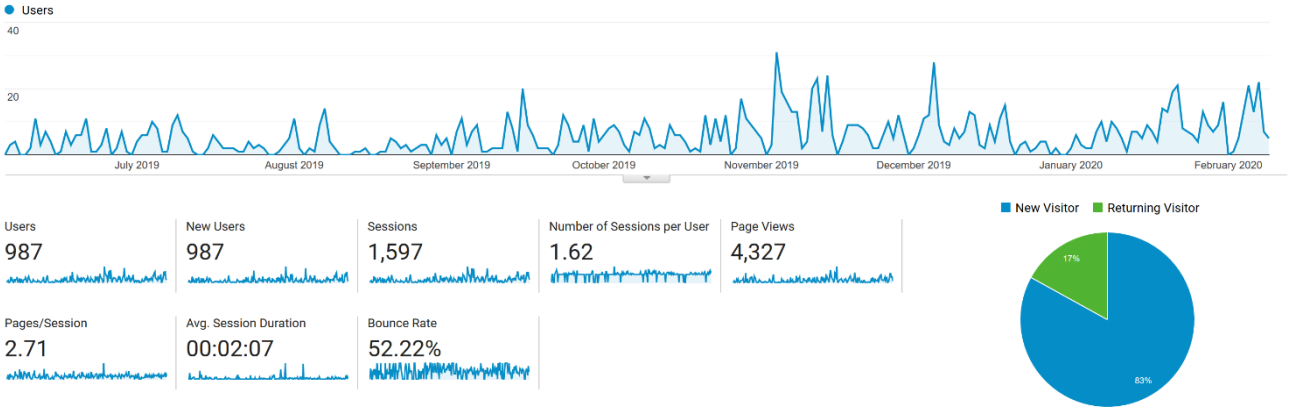


Figure 19. Website visits analysis

Currently, the website contains the following pages:

- Home: General information about the project;
- News and events: Information regarding the last news and future events;
- Project highlights: This page consists of three subpages “Objectives”, “Approach” and “Architecture”;
- Consortium: Information about project partners;
- Publications: This page contains the following subpages: “Blog”, “Deliverables”, “Dissemination materials”, “Videos” and constantly updated, in accordance with the progress in publishing activity, video production, preparation of presentation materials, etc;
- Contact us: Feedback form for the website visitors.

The website is updating continuously. For instance, recently was decided to add several pages:

- Blog: Blog posts are planned to be published according to the developed plan;
- Dissemination materials (press releases, brochure, project presentation): These materials will be posted (up-dated) as they are produced;
- Newsletters: A specific template will soon be developed. Newsletter issues will be periodically published on the website and social media, also emailed to stakeholders (a contact list to be updated on a regular basis).

The project is using Twitter (https://twitter.com/5gtours) as a key tool for dissemination. Not only news related to the project or published in the website, but also the main activities related to 5G-PPP or 3GPP are continuously shared through this platform. Currently, the project has shared 76 tweets reaching more than 600 impressions in total. This impact has led our Twitter account to have 175 followers and more than 1000 profile visits. The current number of tweets, followers and links on twitter are also observed in Figure 20.

LinkedIn is another social media tool used to promote the 5G-TOURS work. The possibility to share posts and news with longer extension than on Twitter makes of Linkedin an attractive social network to share the project progress with a higher level of detail. The release of new project deliverables, news articles related to project meetings and the participation in 5G-PPP or other events are continuously shared through this platform. 5G-TOURS is present on Linkedin under the name of '5G-TOURS' (https://www.linkedin.com/company/30118784). 5G-TOURS profile visitors come from different professional sectors, showing the project impact on different fields. 5G-TOURS LinkedIn profile page is shown in Figure 21.

Figure 20. Official 5G-TOURS twitter account

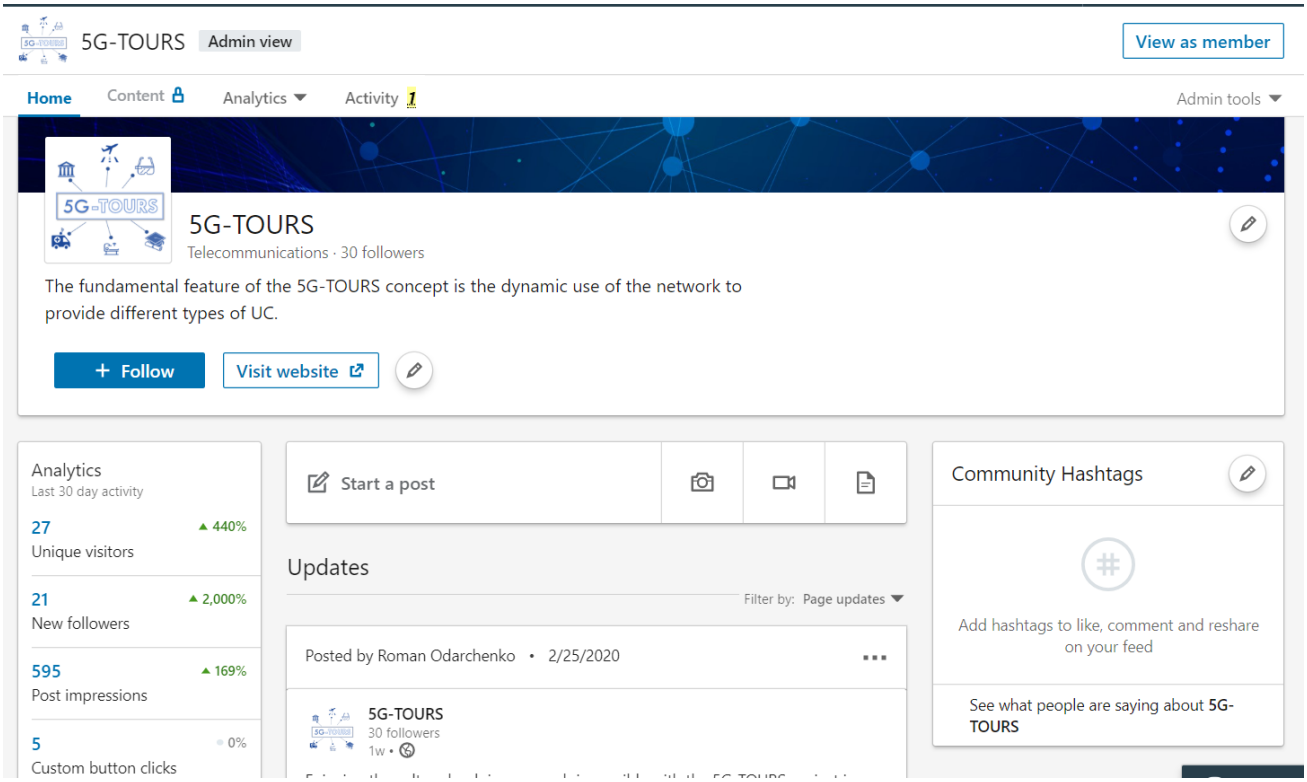


Figure 21. LinkedIn profile

A YouTube channel has been created to capture presentations from e.g. industry forum demonstrations, workshops, and test-bed trials. The following figure presents the project profile.

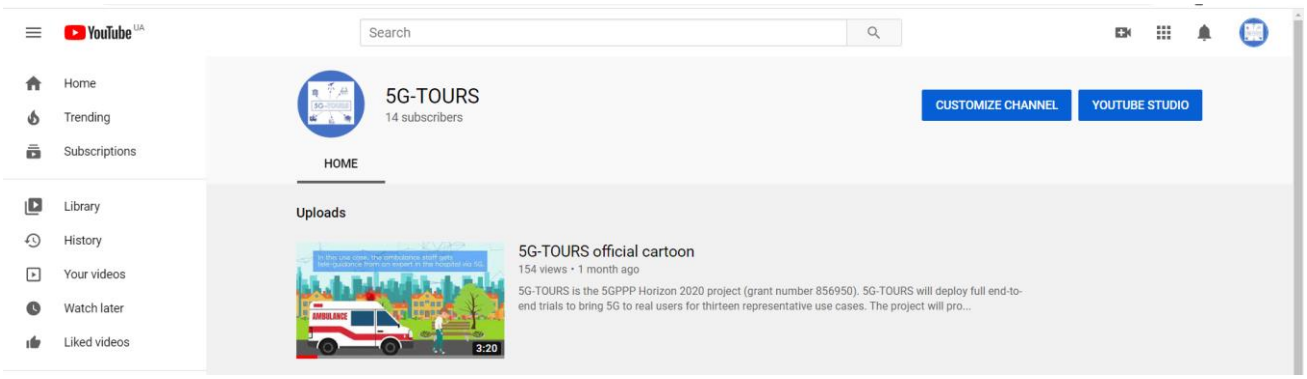


Figure 22. 5G-TOURS profile on YouTube

Some channel statistics you can find on Figure 23.

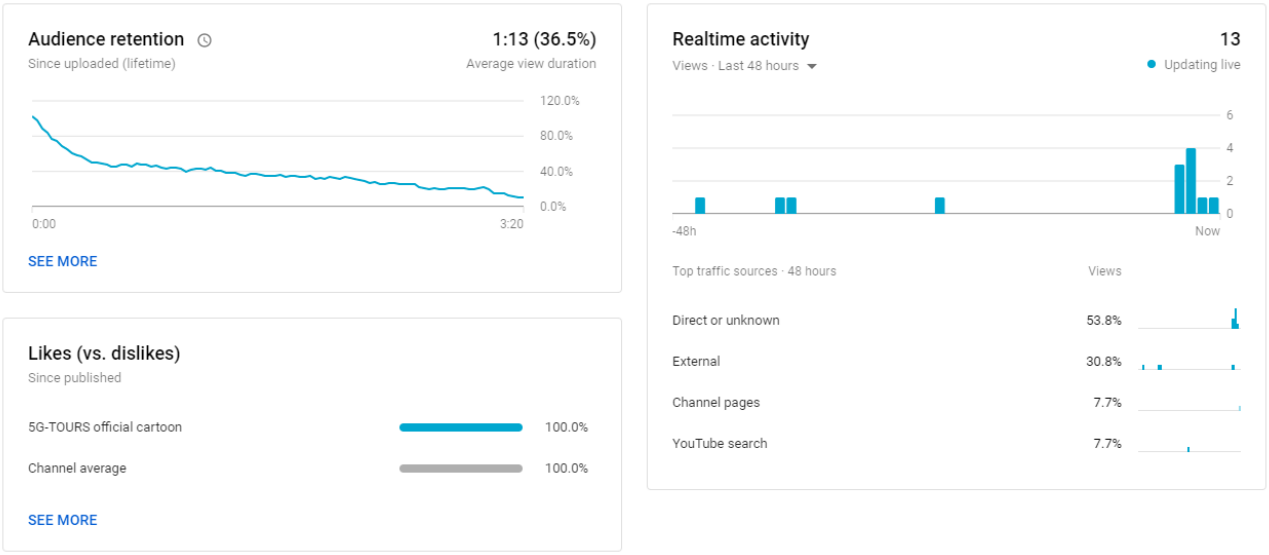


Figure 23. 5G-TOURS YouTube channel statistics

The plan for video producing is to be readjusted in terms of dates due to COVID-19 impacts. However, the scope of the video is still confirmed. (Table 8).

Table 8. List of video producing

The idea of the video	Responsible person(s)	Location
Cartoon about the project	Roman Odarchenko	All the cities
Use cases description (Turin)	WP4 leader and innovation manager	Turin
Use cases description (Rennes)	WP5 leader and innovation manager	Rennes
Use cases description (Athens)	WP6 leader and innovation manager	Athens
Project achievements	Roman Odarchenko, Silvia Povvedi	
EuCNC	Demonstrators	EuCNC
Videos for the demonstrators	Demonstrations owners	Events
Final video	Roman Odarchenko, Simon Fletcher	Turin, Rennes, Athens

Also, it is planned to produce at least one video for each testbed (Turin, Rennes, Athens), using the next template:

Location:	**Turin city center, Palazzo Madama,.....**
Expected duration:	3-5 min
Deadline for the video producing:	
Responsible person(s):	
Involved partners:	
Description of the issues covered, emphasizing	

Location:	**Turin city center, Palazzo Madama,.....**
the timeliness of the proposed video:	
The main idea of the video:	The idea is to show the benefits for the verticals from 5G usage from the point of view of the subscribers. We can show few scenes from the city of Turin, then show short scenes from testbeds (gNb, core etc.), video from Palazza Madama regarding use cases. During the video, we can compare KPIs from previous generations and 5G. At the end of the video, we can make a conclusion regarding the most valuable benefits for the touristic city.

Currently 5G-TOURS has its own official cartoon (Figure 24): https://youtu.be/OIKJBMyd02o.

Figure 24. Official 5G-TOURS cartoon

6.6 Flyers and posters

A flyer was chosen as a form of paper advertisement intended for wide distribution and typically posted or distributed in a public place by 5G-TOURS.
The first huge event where 5G-TOURS aimed to participate was MWC 2020.The overall vision and architecture of the project were presented. (see below Figure 25).

Figure 25. Official 5G-TOURS flyer

Also, 5G-TOURS partners aim to participate in different events. For the EuCNC 2020, a poster template was designed (Figure 26) which can be used for further events as well.

Figure 26. Poster template

6.7 Webinars

Because of COVID-19, it was decided to use webinars as one of the dissemination channels. Interested consortium members started to plan their webinars using the next table:

Table 9. Webinars

Event title	Event dates	Responsible participants	Leading partner	Deadline for deciding	Deadline for material	What material	Status	Published? (social media + website)	Comments

The project partners have identified the first webinars that will take since June 2020 onwards. The organization of these webinars is just started. After each event, a report will be published on social media and the website.

6.8 PRs and articles

LiveU published a PR (Feb 4th, 2020) which achieved a very high exposure. The PR potential exposure was > 1,000,000 as it was picked up in numerous online outlets and publications. The social media mentioning of the PR saw > 10,000 viewers. See below:

https://www.tvbeurope.com/technology/liveu-extends-collaboration-in-5g-test-projects

http://tmbroadcast.com/index.php/liveu-increases-collaboration-pan-european-eu-5g-initiatives/

https://www.tvtechnology.com/the-wire-blog/5g-hevc-eu

https://www.panoramaaudiovisual.com/2020/02/04/liveu-participa-nuevos-proyectos-paneuropeos-5g/ (Spanish)

https://www.broadcastbeat.com/liveu-collaborates-on-two-additional-pan-european-eu-5g-projects/

https://www.4rfv.com/ARD713PMBDNE/601/liveu-collaborates-on-two-additional-paneuropean-eu-5g-projects.htm

https://markets.businessinsider.com/news/stocks/liveu-collaborates-on-two-additional-pan-european-eu-5g-projects-1028875648 (Business Insider)

Table 10. Pickup by PR Newswire Media Partner Websites - Top Outlets

Outlet Name		Location	Source Type	Industry	Potential Audience
finanzen.net	finanzen.net	Germany	Financial News Service	Financial	6,189,084
FinanzNachrichten.de	FinanzNachrichten.de	Germany	Trade Publications	Financial	1,318,439
PR Newswire a CISION company	PR Newswire UK	United Kingdom	PR Newswire	Media & Information	991,079
TMCnet.com	TMCnet	United States	Trade Publications	Tech	830,312

	One News Page Global Edition	Global	Online News Sites & Other Influencers	Media & Information	433,131
	IT News Africa	South Africa	Blog	Tech	257,773
	One News Page United Kingdom Edition	United Kingdom	News & Information Service	Media & Information	106,556
	InvestorPoint.com	United States	Trade Publications	Financial	82,761
	CEO.CA	Canada	Online News Sites & Other Influencers	Financial	64,752
	New Delhi Times	India	Newspaper	Media & Information	52,848
	TechFruit	United Kingdom	Blog	Tech	31,009
	OEMSecrets.com	United Kingdom	News & Information Service	Industrial	24,862
	MarketingTools 365	France	Online News Sites & Other Influencers	Business Services	16,210
	Loup Dargent	United Kingdom	Blog	Entertainment	12,361
	The Tech Portal	India	Trade Publications	Tech	9,508
	Newstage	Nigeria	Online News Sites & Other Influencers	Media & Information	9,025

	Xpert	United Kingdom	News & Information Service	Business Services	1,085
	EMSF-Lisbon	Portugal	News & Information Service	Media & Information	752
	Tech Blog Writer	United Kingdom	Blog	Tech	
	FOG Computing	United States	Online News Sites & Other Influencers	Tech	
	PICANTE	Romania	Online News Sites & Other Influencers	Media & Information	

Visitors-per-month is provided by Cision Digital Reach, a proprietary methodology created by Cision to measure the reach of online media outlets which post our news.

7 Conclusion

Each activity area of WP8 has progressed well. Business Case analysis has established a high-level framework for looking at the City context through the eyes of strategic planning utilizing City Indexes. The survey of project members has established a view of the project partners on the prospects for the use cases and a bibliography of business analyst terms has been established to promote a common understanding amongst 5G-TOURS project partners about the commercial analysis. Interactions with WP2 and the economic and technical touchpoints are well underway. An approach to mapping of stakeholders and cataloguing engagements has been implemented. This asset will be used for the purpose of focus groups, questionnaire respondents, invitees to events both at the trial's locations and at wider dissemination events.

Each 5G-TOURS partner has refreshed their view on the exploitation opportunities, i.e. several have advanced their thinking of particular business strategy areas of the first 12 months on the project which provides good evidence of an ongoing evaluation of prospects at a business level.

Whilst defining a 5G-TOURS standard approach to the innovation management process, the Innovation Managers have focused on their sectorial expertise to refine a view on the value of the innovations of the project towards the vertical sectors and how these innovations may emerge through market expansion opportunities. The innovations that emerge in the networking technology domain have also been captured in this report as they are important enabling innovations to realize the value of the project not only for the vertical sectors but also for the wireless industry (including telecoms operators) sector.

The project has so far catalogued 48 patented contributions across various standards bodies over the past year. This quantity has exceeded expectations. The project also has standards Rapporteur level participants amongst its numbers evidencing influence in shaping the standards. Partners are also working on patents applications and open software development which would be soon available in a synthetic presentation.

The number of dissemination activities related to international journals and conference papers has reached the target of 10 contributions. Regarding the number of keynotes and panels together with the participation in 5G events, dissemination has already reached the number of 16. 5G-TOURS planned to participate on MWC 2020, but unfortunately it was cancelled. At the moment three industrial workshops organising by the 5G-TOURS are planning for the next year. 5G-TOURS has an important presence in 5G PPP WGs and activities. Because of coronavirus COVID-19 5G-TOURS partners have to start searching for the new dissemination channels: blog posts, press releases, webinars. All the targeted public deliverables were submitted and made available in the project website. These dissemination activities have helped to reach a large number of people from academia, industry, civil society, media, etc.

The dissemination of project results has been challenged in recent months by the emergence of the COVID-19 virus. However, the project is broadly on target time to meet initial targets and in some areas as 5G-TOURS moves towards use case delivery and demonstrations the greatest opportunities for engagement and dissemination lay ahead for this project.

Acknowledgment

This project has received funding from the EU H2020 research and innovation programme under Grant Agreement No. 856950.

References

[1] Osterwalder, A. and Pignneur, Y., *Business Model Generation. A Handbook for Visionaries, Game Changers, and Challengers*. New Jersey: John Wiley & Sons, 2010

[2] Porter, M. E, *Competitive strategy : techniques for analyzing industries and competitors*. Free Press, 1980

[3] Al-Debei, Mutaz M., Al-Lozi, Enas, Al-Hujran, Omar, *Critical design and evaluation factors of mobile business models: "Road block" eradicators for mobile networks operators*, Journal of Enterprise Information Management, 2015

[4] Pujol, F, Elayoubi, S., Markendhal, J., Salahaldin, L., *Mobile telecommunications ecosystem evolutions with 5G*, DigiWorld Economic Journal Communications & Strategies, 2016

[5] Yrjola, S., Ahokangas, P., Matinmikko-Blue, M., *Novel Context and Platform Driven Business Models via 5G Networks*, IEEE International Symposium on Personal, Indoor and Mobile Radio Communications, 2018

[6] Ahokangas, P. et al, *Business Models for Local 5G Micro Operators*, IEEE International Symposium on Dynamic Spectrum Access Networks, 2018

[7] Moqaddamerad, S., Ahokangas, P., Matinmikko, M., Rohrbeck, R., *Using scenario-based business modelling to explore the 5G telecommunication market*, Journal of Futures Studies, 2017

[8] Ghezzi, A, Cortimiglia, M, Frank, A, *Strategy and business model design in dynamic telecommunications industries: A study on Italian mobile network operators*, Technological Forecasting and Social Change, 2015

[9] Thuemmler, C. et al, *5G and e-Health*, 5g Infrastructure Association, 2015

[10] Smart City Index, https://www.imd.org/smart-city-observatory/smart-city-index/

[11] Innovation Cities™ Index, https://www.innovation-cities.com/

[12] A.T. Kearney, Global Cities Report -2018

[13] Institute for Urban Strategies, Global Power City Index,

[14] Mott MacDonald, Smart Infrastructure

[15] ARUP, City Resilience Index

[16] Arcadis, Citizen Centric Cities, 2018

[17] Maguire, Martin and Bevan, Nigel, User Requirements Analysis: A Review of Supporting Methods. Proceedings of IFIP 17th World Computer Congress, January 2002

[18] Olphert & Damodaran (2002) Getting what you want, or wanting what you get? - beyond user centred design, Proceedings of the Third International Conference on Design and Emotion, Loughborough, UK, 1-3 July 2002

[19] 5G-Tours: Deliverable D3.1Baseline architecture and deployment objectives (http://5gtours.eu/documents/deliverables/D3.1.pdf)

[20] U. Gretzel, M. Sigala, Z. Xiang, C. Koo, Smart Tourism: foundations and developments, Electron Markets (2015) 25:179–188 (https://link.springer.com/content/pdf/10.1007/s12525-015-0196-8.pdf)

[21] A. Mathieson, G. Wall, Tourism: economic, physical and social impacts, Longman, 1982

[22] Ofcom Media nations report (https://www.ofcom.org.uk/research-and-data/tv-radio-and-on-demand/media-nations-2019)

[23] GlobalWebIndex 2018

[24] European innovation partnership on smart cities and communities (EIP-SCC), - ec.europa.eu - "https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en".

[25] Tidd, J., & Bessant, J. R. (2013). Managing innovation: Integrating technological, market and organizational change (5th ed.) Chichester, UK: John Wiley & Sons.

[26] https://www.philips.com/a-w/about/news/archive/blogs/innovation-matters/20191217-patience-and-patients-how-radical-empathy-will-transform-healthcare-design.html

[27] https://www.diabetes.org/resources/statistics/cost-diabetes

[28] https://www.pchalliance.org/continua-design-guidelines

[29] https://www.pchalliance.org/news/pcha-and-ihe-establish-joint-task-force-simplify-collection-personal-health-data-health-record

[30] https://www.ihe.net/uploadedFiles/Documents/PCD/IHE_PCD_Suppl_POU.pdf

[31] https://www.itu.int/en/ITU-D/Initiatives/m-Powering/Pages/default.aspx

[32] https://www.rdtltd.com/rdt-acquired-by-philips-healthcare
[33] https://www.raiplay.it/

Annex A, Use Case BMC's

	Augmented Tourism Experience	**Telepresence**	**Robot Assisted Museum Guide**	**H. Quality Video Services Distribution**	**Distributed Video Production**
Key Partners	CSPs	CSPs	CSPs	CSPs	CSPs
	Regulators	Regulators	Regulators	Regulators	Regulators
	Suppliers	Suppliers	Suppliers	Suppliers	Suppliers
	Other Telco's (fixed)	Other Telco's (fixed)	Other Telco's (fixed)	Other Telco's (fixed)	Other Telco's (fixed)
	Infrastructure providers / Neutral Host	Infrastructure providers / Neutral Host	Infrastructure providers / Neutral Host	Infrastructure providers / Neutral Host	Infrastructure providers / Neutral Host
	Content Providers	Content Providers	Content Providers	Content Providers	Content Providers
	Equipment & Device vendors (XR Application)	Equipment & Device vendors (Robot & remote interfaces)	Equipment & Device vendors (Robot)	Equipment & Device vendors (app for content / video distribution)	Equipment & Device vendors (media production backpack)
	Developers	Developers	Developers	Developers	Developers
	ICNIRP	ICNIRP	ICNIRP	ICNIRP	ICNIRP
Key Activities	Marketing	Marketing	Marketing	Marketing	Marketing
	Customer Service & Support	Customer Service & Support	Customer Service & Support	Customer Service & Support	Customer Service & Support
	Content acquisition	Content acquisition	Content acquisition	Content acquisition	Content acquisition
	Creation & distribution of content	Creation & distribution of content	Creation & distribution of content	Creation & distribution of content	Creation & distribution of content
	Deployment & maintenance of infrastructure	Deployment & maintenance of infrastructure	Deployment & maintenance of infrastructure	Deployment & maintenance of infrastructure	Deployment & maintenance of infrastructure
	Network Operations	Network Operations	Network Operations	Network Operations	Network Operations
	Traffic Management Inc. slicing	Traffic Management Inc. slicing	Traffic Management Inc. slicing	Traffic Management Inc. slicing	Traffic Management Inc. slicing
	Billing	Billing	Billing	Billing	Billing
	R&D	R&D	R&D	R&D	R&D
	Innovations	Innovations	Innovations	Innovations	Innovations
	Product Development	Product Development	Product Development	Product Development	Product Development
Value Proposition	Using CSP network to deliver an Augmented Tourism Experience	Using CSP network to deliver an Telepresence Service	Using CSP network to deliver an Robot Assisted Museum Guide Service	Using CSP network to deliver an High Quality Video Services Distribution	Using CSP network to deliver an High Quality Video Services Distribution
	• per user data rate up to 500 Mb/s	• latency < 10 ms	• latency < 10 ms	• Per user data rate of 25 Mb/s , several users /m2	• Per user data rate of 25 Mb/s , several users /m2

	• Latency < 10 ms	Reliable E2E telco service (fixed & mobile) Inc. indoor	Reliable E2E telco service (fixed & mobile) Inc. indoor	Reliable E2E telco service (fixed & mobile) Inc. indoor	• Latency < 5 ms
	Reliable E2E telco service (fixed & mobile) Inc. indoor	Bespoke Service - service specific SLA/QoS	Bespoke Service - service specific SLA/QoS	Bespoke Service - service specific SLA/QoS	• Reliability > 99.99%
	Bespoke Service - service specific SLA/QoS	Converged comms: voice & data	Converged comms: voice & data	Converged comms: voice & data	Reliable E2E telco service (fixed & mobile) Inc. indoor
	Converged comms: voice & data				Bespoke Service - service specific SLA/QoS
					Converged comms: voice & data
Customer Relationships	Product / Service Innovation & leadership	Product / Service Innovation & leadership	Product / Service Innovation & leadership	Product / Service Innovation & leadership	Product / Service Innovation & leadership
	Operational Excellence - SLA/QoS/indoor coverage	Operational Excellence - SLA/QoS/indoor coverage	Operational Excellence - SLA/QoS/indoor coverage	Operational Excellence - SLA/QoS/indoor coverage	Operational Excellence - SLA/QoS/indoor coverage
	Vertical specific service	Vertical specific service	Vertical specific service	Vertical specific service	Vertical specific service
Customer Segments	Tourism	Tourism	Tourism	News reporting	News reporting
	Venues (museum)	Venues (museum)	Venues (museum)	Media Distribution	Media Distribution
	Transport	Transport	Transport	TV Broadcast	TV Broadcast
	Municipal / Local Gov authorities	Municipal / Local Gov authorities	Municipal / Local Gov authorities	Social Media	Social Media
Key Resources	RAN Inc. in-building	RAN Inc. in-building	RAN Inc. in-building	RAN Inc. in-building	RAN Inc. in-building
	Core: OSS & BSS	Core: OSS & BSS	Core: OSS & BSS	Core: OSS & BSS	Core: OSS & BSS
	Network Quality (URLLC, mMTC)	Network Quality (URLLC)	Network Quality (URLLC)	Network Quality	Network Quality (Reliability, latency)
	Network Capacity (eMBB)	Network Capacity (eMBB)	Network Capacity	Network Capacity (eMBB)	Network Capacity (eMBB, subscriber density)
	IT Services (HR, finance, etc.)	IT Services (HR, finance, etc.)	IT Services (HR, finance, etc.)	IT Services (HR, finance, etc.)	IT Services (HR, finance, etc.)
Channels	Direct	Direct	Direct	Direct	Direct
	Indirect: Tour operators, venues	Indirect: Tour operators, venues	Indirect: Tour operators, venues	Integrators: Neutral Host / MVNO	Integrators: Neutral Host / MVNO
	Integrators: Neutral Host / MVNO	Integrators: Neutral Host / MVNO	Integrators: Neutral Host / MVNO	MVNO	MVNO
	Thin MVNO	Thin MVNO	Thin MVNO	Terrestrial Broadcast	Terrestrial Broadcast

				Streaming Services	Streaming Services
Cost Structure	Spectrum	Spectrum	Spectrum	Spectrum	Spectrum
	Network Costs (capex & opex) Inc. indoor systems	Network Costs (capex & opex) Inc. indoor systems	Network Costs (capex & opex) Inc. indoor systems	Network Costs (capex & opex) Inc. indoor systems	Network Costs (capex & opex) Inc. indoor systems
	Staff & overheads	Staff & overheads	Staff & overheads	Staff & overheads	Staff & overheads
	Customers costs (acquisition & retention)	Customers costs (acquisition & retention)	Customers costs (acquisition & retention)	Customers costs (acquisition & retention)	Customers costs (acquisition & retention)
	Licensing & royalties	Licensing & royalties	Licensing & royalties	Licensing & royalties	Licensing & royalties
	End device integration	End device integration	End device integration	End device integration	End device integration
Revenue Streams	Subscription	Subscription	Subscription	Subscription	Subscription
	Data volume	Data volume	Data volume	Data volume	Data volume
	Value Added Services	Value Added Services	Value Added Services	Value Added Services	Value Added Services
	Data & voice roaming	Data & voice roaming	Data & voice roaming	Data & voice roaming	Data & voice roaming
	Remote Health & Emergency Mgmt	**Teleguidance**	**Wireless Operating Room**	**Ambulance Routing**	**Smart Parking**
Key Partners	CSPs	CSPs	CSPs	CSPs	CSPs
	Regulators	Regulators	Regulators	Regulators	Regulators
	Suppliers	Suppliers	Suppliers	Suppliers	Suppliers
	Other Telco's (fixed)	Other Telco's (fixed)	Other Telco's (fixed)	Other Telco's (fixed)	Other Telco's (fixed)
	Infrastructure providers / Neutral Host	Infrastructure providers / Neutral Host	Infrastructure providers / Neutral Host	Infrastructure providers / Neutral Host	Infrastructure providers / Neutral Host
	Clinical partners: Hospital chronic diseases department	Clinical partners: Hospital Emergency departments, SAMU	Content Providers	Content Providers (road traffic data), Clinical partners: Hospital Emergency departments, SAMU, private ambulance companies	Content Providers
	Equipment & Device vendors (wearable devices/patches) and AI driven Platforms	Equipment & Device vendors (teleguidance systems)	Equipment & Device vendors (Operating Theatre Medical Systems)	Equipment & Device vendors (Sensor Systems)	Equipment & Device vendors (Parking Sensor Systems & apps)
	Developers	Developers	Developers	Developers	Developers
	ICNIRP	ICNIRP	ICNIRP	ICNIRP	ICNIRP
Key Activities	Marketing	Marketing	Marketing	Marketing	Marketing
	Customer Service & Support	Customer Service & Support	Customer Service & Support	Customer Service & Support	Customer Service & Support
	Content acquisition	Content acquisition	Content acquisition	Content acquisition	Content acquisition

	Creation & distribution of content	Creation & distribution of content	Creation & distribution of content	Creation & distribution of content	Creation & distribution of content
	Deployment & maintenance of infrastructure	Deployment & maintenance of infrastructure	Deployment & maintenance of infrastructure	Deployment & maintenance of infrastructure	Deployment & maintenance of infrastructure
	Network Operations	Network Operations	Network Operations	Network Operations	Network Operations
	Traffic Management Inc. slicing	Traffic Management Inc. slicing	Traffic Management Inc. slicing	Traffic Management Inc. slicing	Traffic Management Inc. slicing
	Billing	Billing	Billing	Billing	Billing
	R&D	R&D	R&D	R&D	R&D
	Innovations	Innovations	Innovations	Innovations	Innovations
	Product Development	Product Development	Product Development	Product Development	Product Development
Value Proposition	The remote monitoring program for physiological symptoms for the earlier detection of health exacerbations, improving diagnostics and enabling earlier intervention. This will be achieved through the use of a highly available, low latency, 5G service, capable of providing end - to-end support for teleguided diagnostics	Extending patient care into remote communities brings the clinician to where the patient lives, works, or wherever they have an appropriate connection. It returns the patient the centre of the healthcare delivery model. It will remove the patient travel costs & reduce medica provider overheads compared with a traditional visit. This will be achieved through the use of a highly available, low latency, high bandwidth 5G service capable of providing end -to-end support for highly mobile teleguided diagnostics and intervention solutions for emergency care.	Wireless connectivity in the Operating Room will deliver improved efficiency particularly with cases of an unplanned procedures. Further efficiency gains will also be supported with the introduction of surgical procedures using AR/VR assisted Cobotic-aided surgery and remote assistance This will be achieved through the use of a very highly available, low latency, high bandwidth 5G service.	The use of city sources and vehicle navigation systems for optimal ambulance routing will minimise response times and improve emergency incident handling leading to improved patient prognosis and more efficient use of emergency response resources. This will be achieved through the use of a reliable, sensor based 5G service capable of providing optimal routing and resource availability information from a range of sources.	Passenger parking is a key contributor in establish high Passenger satisfaction as well as contributing to optimised passenger and vehicle movements and efficient use of airport resources and facilities. This will be achieved through the use of a reliable, sensor based 5G service capable of providing optimal routing and resource availability information.
	• Several users /m2	• Speeds > 130 Km/h	• 10 data rates > 10 Gb/s	• Speeds > 100 km/h	• 50, 000's sensors / km2
	• Reliability > 99.99%	• 1 Gb/s	• Latency < 5 ms	• 1000's sensors / km2	Reliable E2E telco service (fixed & mobile)
	Reliable E2E telco service (fixed & mobile) Inc. indoor	• Latency < 10 ms	• Reliability > 99.99999%	Reliable E2E telco service (fixed & mobile)	Bespoke Service - service specific SLA/QoS

	Bespoke Service - service specific SLA/QoS	• Reliability > 99.99%	Reliable E2E telco service (fixed & mobile) Inc. indoor	Bespoke Service - service specific SLA/QoS	Converged comms: voice & data
	Converged comms: voice & data	Reliable E2E telco service (fixed & mobile) Inc. indoor	Bespoke Service - service specific SLA/QoS	Converged comms: voice & data	
		Bespoke Service - service specific SLA/QoS	Converged comms: voice & data		
		Converged comms: voice & data			
Customer Relationships	Product / Service Innovation & leadership	Product / Service Innovation & leadership	Product / Service Innovation & leadership	Product / Service Innovation & leadership	Product / Service Innovation & leadership
	Operational Excellence - SLA/QoS/indoor coverage	Operational Excellence - SLA/QoS/indoor coverage	Operational Excellence - SLA/QoS/indoor coverage	Operational Excellence - SLA/QoS/indoor coverage	Operational Excellence - SLA/QoS/indoor coverage
	Vertical specific service	Vertical specific service	Vertical specific service	Vertical specific service	Vertical specific service
Customer Segments	Hospitals	Hospitals	Hospitals	Local Health Authorities	Airport Authorities
	Local Health Authorities	Local Health Authorities	Local Health Authorities	National Health Authorities	Car Park Companies
	National Health Authorities	National Health Authorities	National Health Authorities	Private Health	Transport Operators / Regulators
	Private Health	Private Health	Private Health	Insurance Companies	Vehicle Hire Companies
	Insurance Companies	Insurance Companies	Insurance Companies	Transport Operators / Regulators	
		Emergency Health Services		Emergency Health Services	
				Local Authorities	
Key Resources	RAN Inc. in-building	RAN Inc. in-building	RAN Inc. in-building	RAN Inc. in-building	RAN Inc. in-building
	Core: OSS & BSS	Core: OSS & BSS	Core: OSS & BSS	Core: OSS & BSS	Core: OSS & BSS
	Network Quality	Network Quality (URLLC, high reliability)	Network Quality (URLLC, very high reliability)	Network Quality (URLLC, very high reliability)	Network Quality
	Network Capacity (eMBB, mMTC, subscriber density	Network Capacity (eMBB)	Network Capacity (eMBB)	Network Capacity (eMBB)	Network Capacity (mMTC)
	IT Services (HR, finance, etc.)	IT Services (HR, finance, etc.)	IT Services (HR, finance, etc.)	IT Services (HR, finance, etc.)	IT Services (HR, finance, etc.)
Channels	Direct	Direct	Direct	Direct	Direct
	Integrators: Neutral Host / Thick MVNO	Integrators: Neutral Host / Thick MVNO	Indirect: Operating Theatre Medical System vendors		Indirect: Airport Authorities, Car Park Companies, Vehicle Hire Companies

	Thin MVNO	Thin MVNO	Integrators: Neutral Host / Thick MVNO	Integrators: Neutral Host / Thick MVNO	Integrators: Neutral Host / Thick MVNO
	Health Authorities	Health Authorities	Thin MVNO	Thin MVNO	Thin MVNO
	Insurance Companies	Insurance Companies	Health Authorities	Health Authorities	Transport Operators / Regulators
			Insurance Companies	Insurance Companies	
Cost Structure	Spectrum	Spectrum	Spectrum	Spectrum	Spectrum
	Network Costs (capex & opex) Inc. indoor systems	Network Costs (capex & opex) Inc. indoor systems	Network Costs (capex & opex) Inc. indoor systems	Network Costs (capex & opex) Inc. indoor systems	Network Costs (capex & opex) Inc. indoor systems
	Staff & overheads	Staff & overheads	Staff & overheads	Staff & overheads	Staff & overheads
	Customers costs (acquisition & retention)	Customers costs (acquisition & retention)	Customers costs (acquisition & retention)	Customers costs (acquisition & retention)	Customers costs (acquisition & retention)
	Licensing	Licensing	Licensing	Licensing	Licensing
	End device integration	Teleguidance Systems integration	Operating Theatre Medical Systems integration	Sensor Systems integration	Sensor Systems integration
		Teleguidance Systems capex & opex inc. Vehicle Installations	Operating Theatre Medical Systems	Sensor Systems	Sensor Systems
			Systems Medical / Health approvals	Sensor Systems approvals	Sensor Systems approvals
				Sensor Systems (capex & opex)	Sensor Systems (capex & opex)
Revenue Streams	Subscription	Subscription	Subscription	Subscription	Subscription
	Data volume	Data volume	Data volume	Data volume	Data volume
	Value Added Services	Value Added Services	Value Added Services	Value Added Services	Value Added Services
			Operating Theatre Medical System vendors managed service		Integrated Parking / Hire Fee

	Video Enhanced Ground Vehicles	**Emergency Evacuation**	**ARVR Educational Bus**
Key Partners	CSPs	CSPs	CSPs
	Regulators	Regulators	Regulators
	Suppliers	Suppliers	Suppliers
	Other Telco's (fixed)	Other Telco's (fixed)	Other Telco's (fixed)
	Infrastructure providers / Neutral Host	Infrastructure providers / Neutral Host	Infrastructure providers / Neutral Host
	Content Providers	Content Providers	Content Providers
	Equipment & Device vendors (Parking Sensor Systems & apps)	Equipment & Device vendors (Emergency Signage Systems & mobile app)	Equipment & Device vendors (AR/VR Systems & apps)
	Developers	Developers	Developers

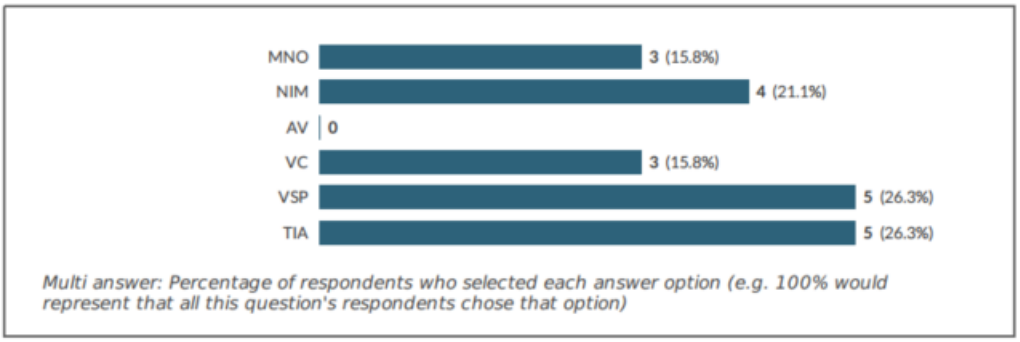
	ICNIRP	ICNIRP	ICNIRP
Key Activities	Marketing	Marketing	Marketing
	Customer Service & Support	Customer Service & Support	Customer Service & Support
	Content acquisition	Content acquisition	Content acquisition
	Creation & distribution of content	Creation & distribution of content	Creation & distribution of content
	Deployment & maintenance of infrastructure	Deployment & maintenance of infrastructure	Deployment & maintenance of infrastructure
	Network Operations	Network Operations	Network Operations
	Traffic Management Inc. slicing	Traffic Management Inc. slicing	Traffic Management Inc. slicing
	Billing	Billing	Billing
	R&D	R&D	R&D
	Innovations	Innovations	Innovations
	Product Development	Product Development	Product Development
Value Proposition	Using CSP network to deliver High Quality Video Services Distribution	Using CSP network to deliver High Quality Video Services Distribution	Using CSP network to deliver High Quality Video Services Distribution
	• per user data rates > 25 Mb/s	• Reliability > 99.99%	• per user data rates > 500 Mb/s
	• speeds up to 100 km/h	• Location accuracy </= 1m	• latency < 10 ms
	Reliable E2E telco service (fixed & mobile)	• several devices / m2	• speeds up to 100 km/h
	Bespoke Service - service specific SLA/QoS	Reliable E2E telco service (fixed & mobile) Inc. indoor	Reliable E2E telco service (fixed & mobile)
	Converged comms: voice & data	Bespoke Service - service specific SLA/QoS	Bespoke Service - service specific SLA/QoS
		Converged comms: voice & data	Converged comms: voice & data
Customer Relationships	Product / Service Innovation & leadership	Product / Service Innovation & leadership	Product / Service Innovation & leadership
	Operational Excellence - SLA/QoS/indoor coverage	Operational Excellence - SLA/QoS/indoor coverage	Operational Excellence - SLA/QoS/indoor coverage
	Vertical specific service	Vertical specific service	Vertical specific service
Customer Segments	Airport Authorities	Airport Authorities	Education Authorities
	Car Park Companies	Emergency Services	Private Schools
	Transport Operators / Regulators	Neutral Hosts	Transport Operators
	Vehicle Hire Companies		Vehicle Hire Companies
	Emergency Services		
Key Resources	RAN Inc. in-building	RAN Inc. in-building	RAN Inc. in-building
	Core: OSS & BSS	Core: OSS & BSS	Core: OSS & BSS
	Network Quality	Network Quality (URLLC, mMTC)	Network Quality
	Network Capacity (eMBB)	Network Capacity (eMBB)	Network Capacity (eMBB)
	IT Services (HR, finance, etc.)	IT Services (HR, finance, etc.)	IT Services (HR, finance, etc.)
Channels	Direct		Direct

	Indirect: Airport Authorities, Car Park Companies, Vehicle Hire Companies	Direct	Indirect: Transport Operators
	Integrators: Neutral Host / Thick MVNO	Integrators: Neutral Host / Thick MVNO	Integrators: vehicle build
	MVNO	MVNO	MVNO
	Transport Operators / Regulators		Transport Operators
Cost Structure	Spectrum	Spectrum	Spectrum
	Network Costs (capex & opex) Inc. indoor systems	Network Costs (capex & opex) Inc. indoor systems	Network Costs (capex & opex) Inc. indoor systems
	Staff & overheads	Staff & overheads	Staff & overheads
	Customers costs (acquisition & retention)	Customers costs (acquisition & retention)	Customers costs (acquisition & retention)
	Licensing	Licensing	Licensing
	Video Systems integration	Emergency Signage Systems & mobile app integration	AR/VR Systems integration
	Video Systems capex & opex inc. Vehicle Installations	Emergency Signage Systems & mobile app	AR/VR capex & opex inc. Vehicle Installations
	Vehicle systems approvals	Emergency Signage Systems approvals	Vehicle systems approvals
Revenue Streams	Subscription	Subscription	Subscription
	Data volume	Data volume	Data volume
	Value Added Services	Value Added Services	Value Added Services

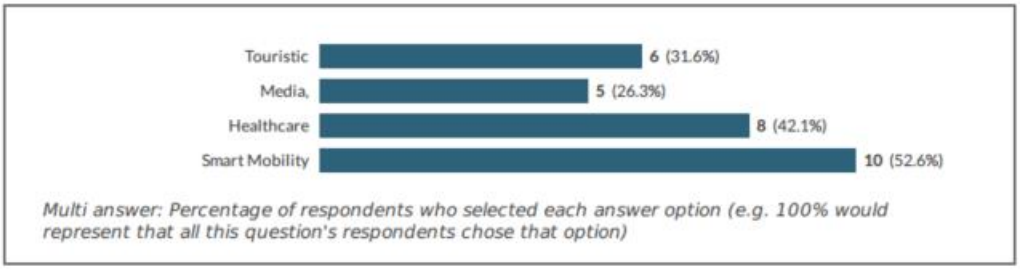
Annex B, Consortium survey Example Responses

Error! Not a valid link.

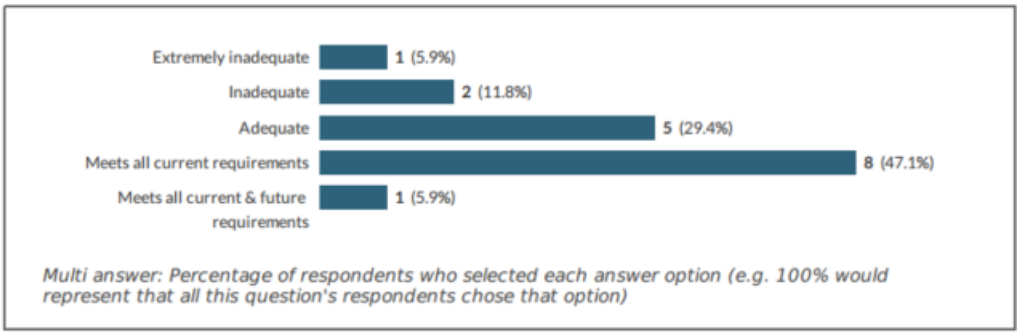
2 What is your company / organisation primary function (MNO, NIM, AV, VC, VSP, TIA)



4 With which 5G industrial sector is your company / organisation associated (Touristic , Media, Healthcare, Smart Mobility)



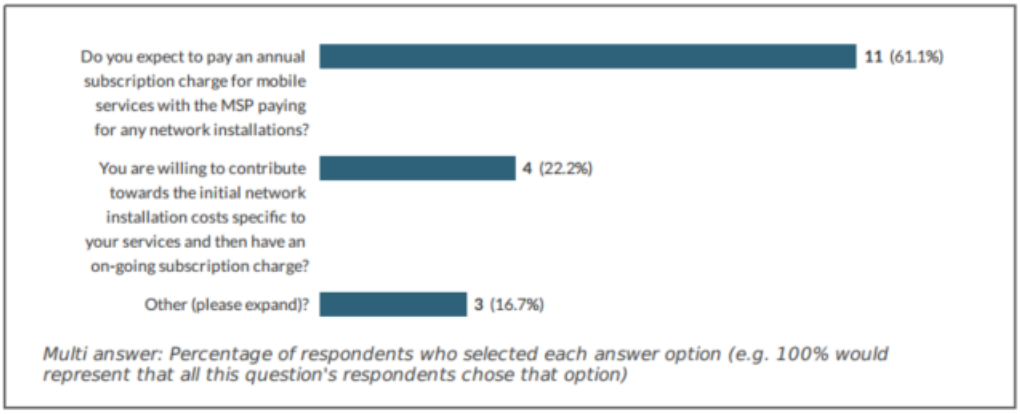
7.a.iii.1 Current and future needs of wireless technology in your business



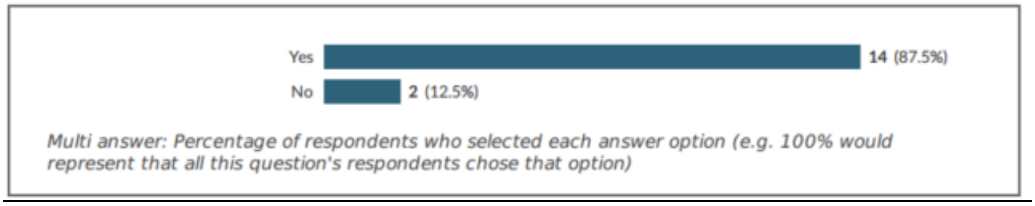
7.a.iv Are there any new features or functions that you would like to see with your current wireless solution?

Showing all 14 responses	
Priority QoS for medical related calls	545208-545199-53116748
Coverage	545208-545199-53217854
Guaranteed UL QoS, anywhere and on-demand; low cost global roaming;	545208-545199-53323983
Better support for lowa latency use cases	545208-545199-53322358
yes	545208-545199-53330266
Yes, Single unified wireless access	545208-545199-53657581
No	545208-545199-53666243
Higher bandwidth, low latency	545208-545199-53689664
I can not think of any	545208-545199-53728106
Outdoor coverage	545208-545199-53798088
Lower delay. Higher mobility	545208-545199-53818134
Yes sure. We would need more computing capacity, higher bandwidth, lower latency, lower service creation time, etc.	545208-545199-54117955
yes	545208-545199-56011300
Slicing	545208-545199-56825477

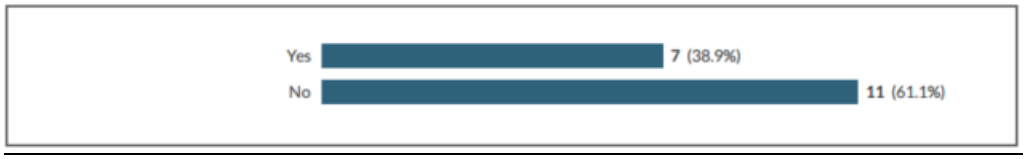
8 If 5G services were used to improve your daily operations, who would you expect to pay for the network equipment to support these?



9 Would you willing to pay more than what you are currently investing in wireless solution to enjoy 5G enabled services?



15 Do your customers have any concerns re: 5G?



15.a If the answer is yes, what concerns have been expressed?

Showing all 8 responses	
Is it more Dangerous for your health than 4G?	545208-545199-53116748
unfortunately many of them do not have concerns, or have little. Some of them expect it to be the cure for all their relevant needs, per the 5G propaganda. The problem is that such thinking is of course the gap between expectations and reality and since we are the middlemen, we have to explain these gaps.	545208-545199-53323983
safety	545208-545199-53330266
Radiation due to higher number of base stations. Availability and price of terminals.	545208-545199-53657581
concerns on radiation effects to the human body	545208-545199-53689664
impact on health	545208-545199-53850078
Mainly when the technology will be available and how they can benefit from it.	545208-545199-54117955
Cost, Safety (ICNIRP), timescales, Spectrum	545208-545199-56825477

18 What aspects of potential 5G technology/services are not addressed by your current Business Model?

Showing all 12 responses	
I don't how to answer that question	545208-545199-53116748
edge computing - if we'll need it/use it at all; guaranteed UL QoS, if will be provided at all.	545208-545199-53323983
The better parts of slicing. Needs a radical transformation of our business to harvest the best of its potential	545208-545199-53322358
slicing, low latency	545208-545199-53330266
do not know	545208-545199-53657581
Primarily network slicing customers and private networks. Potentially infrastructure owners as well.	545208-545199-53664245
It is not clear	545208-545199-53666243
BCOM is 5G Technology providers not end users	545208-545199-53727173
All aspects are addressed	545208-545199-53798088
They will appear new actors, new opportunities, new ways of doing things, etc that are not currently covered and that will have to be taken into account.	545208-545199-54117955
Full network automation, slicing, MEC, Dynamic scalability	545208-545199-56011300
N/A	545208-545199-56825477

19. Do you believe that 5G solutions & services will require new stakeholders e.g. service providers, integrators, solutions providers, etc for 5G to address new industry segments/verticals?

Showing all 17 responses	
Yes and No. I am not sure a lot od new ones will arrive but the current ones will have to evolve	545208-545199-53116748
no,	545208-545199-53323983
Yes definitely. It's just not in the operator's genes to handle the IT infrastructure as efficiently as a cloud operator.	545208-545199-53322358
not necessarly	545208-545199-53330266
depents on the industry and/or application	545208-545199-53657581
Yes. From the network slicing side, new vertical equipment will be required makin use of the network.	545208-545199-53664245
Yes	545208-545199-53666243
no	545208-545199-53689664
yes	545208-545199-53701604
Yes, news stakeholders will enter this market and we believe that IT Technology companies will progressively enter the 5G market.	545208-545199-53727173
yes	545208-545199-53798088
Yes	545208-545199-53818134
no	545208-545199-53850078
Yes	545208-545199-54107853
Absolutely	545208-545199-54117955
Yes	545208-545199-56011300
Yes	545208-545199-56825477

20.b Do you believe that this generic value chain needs to change to accommodate new 5G solutions & services & any new industry segments/verticals? If yes, please describe.

Showing all 15 responses	
no	545208-545199-53116748
maybe	545208-545199-53217854
open architecture if 3rd parties SW vendors and service providers are seen as drivers of 5G adoption in new markets.	545208-545199-53323983
The value chain is correct until it isn't. Some new actors with new business models might shake the status quo of the traditional actors. One example might be traditional industrial clients (Rolls Roys, Siemens, Philips) acquiring radio spectrum and starting to operate their industry/supply chain with independent networks managed by small scale actors in the current chain (Altiostar, AWS/GCP/Azure, Others).	545208-545199-53322358
no	545208-545199-53330266
No	545208-545199-53657581
Yes. See above.	545208-545199-53664245
No	545208-545199-53666243
no	545208-545199-53689664
no	545208-545199-53701604
yes, New players such as compute ressources providers for instance AWS (between Facility and network op) should be added/indicated in this value chain.	545208-545199-53727173
no	545208-545199-53798088
Yes	545208-545199-53818134
For sure. A new scenario with new stakeholders requires an evolution of the value chain.	545208-545199-54117955
Yes, the MVNO & Neutral Host players need to be addressed. 5G slicing functionality needs to be somehow addressed.	545208-545199-56825477

Annex C, City Indexes Indicators with synergy to 5G-TOURS

IMD Smart City Index [46 Indicators]	Innovation Cities™ Index [165 Indicators]	A.T. Kearney, Global Cities Report [40 Indicators]	Global Power City Index (GPCI) [76 Indicators]	Mott Macdonald Smart Infrastructure Index [42 Indicators]	ARUP City Resilience Index[53 Indicators]	Arcadis Sustainable Cities Index [31 Indicators]
Health & Safety	Video & Film Production	Air Freight	Number of Cultural Events	Digital Transformation	Robust public health systems	Health
Traffic congestion is not a problem.	Visitor Entry	Broadband Subscribers	Tourist Attractions	Business model	Emergency Medical Care	Access to public transport services
Cultural activities (shows, bars, and museums) are satisfactory.	Visitor Information	Museums	ICT Readiness	Investment	Effective Emergency Response services	Digital Services (property tax)
Health & Safety	TV & Radio Networks	Healthcare evolution	International Freight Flows	Information management	**Effective Provision of Critical Services**	Wi-Fi Availability
Free public wifi has improved access to services	Tourist Entry	**4 Direct synergies with 5G-TOURS**	Number of Air Passengers	**4 Direct synergies with 5G-TOURS**	Diverse & affordable transport networks	Tourism
Mobility	Transport Coverage		Public Transportation Use		Reliable communications technology	Connectivity
Apps that direct you to an available parking space have reduced journey time.	Broadband Internet		Travel Time to Airports		Secure technology networks	**6 Direct synergies with 5G-TOURS**
7 Direct synergies with 5G-TOURS	Fixed Phone Network		Traffic Congestion		**7 Direct synergies with 5G-TOURS**	
	Mobile Phone Network		**8 Direct synergies with 5G-TOURS**			
	Wireless Internet					
	Smart Devices					
	11 Direct synergies with 5G-TOURS					

Annex D, Contribution to standard

Number	Date	Source Partner	STD Body	Title	Reference	Status
1	06/06/2019	EXP	3GPP TSG SA	Revised SID: Architectural enhancements for 5G multicast-broadcast services	SP-190442	Agreed
2	16/08/2019	EXP	3GPP SA4	pCR 26.512 Consumption Reporting API	S4-191013	Agreed
3	16/08/2019	EXP	3GPP SA4	CR 26.501-0002 rev 3 Correction of Architecture, Unicast Streaming Procedure, QoE metrics reporting, Consumption reporting and Session Handling for 5GMS (Release 16)	S4-191075	Agreed
4	23/08/2019	BCOM	3GPP SA1	CR on Addition of robotic aided surgery and diagnosis performance requirements in TS 22.104	S1-192751.zip	Agreed
5	23/08/2019	BCOM	3GPP SA1	CR Addition of section 4.2 on key parameters for critical medical applications in TS 22.263	S1-192747	Agreed
5	23/08/2019	BCOM	3GPP SA1	CR Addition of section 4.2 on key parameters for critical medical applications in TS 22.263	S1-192747.zip	Agreed
7	23/08/2019	BCOM	3GPP SA1	CR Addition of medical telemetry requirements in TS 22.261	S1-192511	Agreed
6	23/08/2019	BCOM	3GPP SA1	CR Addition of security requirements for critical medical applications in TS 22.261	S1-192510.zip	Agreed
7	23/08/2019	BCOM	3GPP SA1	CR Addition of medical telemetry requirements in TS 22.261	S1-192511.zip	Agreed
8	23/08/2019	BCOM	3GPP SA1	CR Addition of a new synchronisation performance requirement	S1-192513.zip	Agreed
9	23/08/2019	BCOM	3GPP SA1	Addition of Abbreviations section in TR 22.826	S1-192053.zip	Agreed
10	23/08/2019	BCOM	3GPP SA1	Addition of a synchronisation requirement in use case 5.3.3 (Communication QoS requirement for robotic telesurgery)	S1-192476.zip	Agreed
11	23/08/2019	BCOM	3GPP SA1	TR 22.826 final clean up	S1-192475.zip	Agreed

12	23/08/2019	BCOM	3GPP SA1	Addition of Conclusion and recommendations section in TR 22.826	S1-192479.zip	Agreed
13	23/08/2019	BCOM	3GPP SA1	Alignment of use case description text and Survival Time requirements in TR 22.826	S1-192131.zip	Agreed
14	23/08/2019	BCOM	3GPP SA1	Consolidation for clock synchronization in TR 22.826	S1-192477.zip	Agreed
15	23/08/2019	BCOM	3GPP SA1	FS_CMED_Updates related to cardiac telemetry monitoring	S1-192746.zip	Agreed
16	23/08/2019	BCOM	3GPP SA1	TR 22.826 Study on Communication Services for Critical Medical Applications v1.1.0	S1-192349.zip	Agreed
18	19/09/2019	BCOM	3GPP SA1	Study on Communication Services for Critical Medical Applications	22826-h00.zip	Last 3GPP approved version
19	16/10/2019	SEQ	3GPP RAN	Rel-17 NR-Light scoping discussions	RAN#85: RP-192160.zip	Sequans contributed to NR-Light WID scoping including use cases of e.g. wearables. Discussions concluded with a Rel-17 WI on NR-Light.
20	18/10/2019	EXP	3GPP SA2	Key issue for levels of service	S2-1910830.zip	Agreed
21	25/10/2019	EXP	3GPP SA4	CR TS 26.501 on Consumption Reporting API	S4-191250.zip	Agreed
22	14/11/2019	SEQ	3GPP RAN2	NB-IoT UE specific DRX – Backward Compatibility	R2-1916235.zip	RAN2 didn't agree on proposals breaking backward compatibility. Sequans contributed to save that.
23	18/11/2019	SEQ	3GPP RAN1	Consideration for scheduling multiple UL/DL TBs	R1-1912702.zip	Rel-16 WI [LTE_eMTC5] had objective for "Scheduling enhancements". Sequans was a lively participant in the discussions for NB-IoT and Cat-M with RAN1 contributions from RAN1#98 (August'19). For Cat-M, some Sequans ideas regarding the method to conserve bits when transmitting the DCI scheduling multiple TBs were received as part of the standard.
24	19/11/2019	BCOM	3GPP SA1	Addition of missing "5.1 Introduction" section in TR 22.826	S1-193572.zip	Agreed
25	19/11/2019	BCOM	3GPP SA1	Addition of missing 5.5.1 section in TR 22.826	S1-193573.zip	Agreed

26	19/11/2019	BCOM	3GPP SA1	Removal of brackets and correction on required bitrates in TR 22.826	S1-193064.zip	Agreed
27	19/11/2019	BCOM	3GPP SA1	Correction on #UE density for use cases using services delivered by PLMNsin TR 22.826	S1-193286.zip	Agreed
28	19/11/2019	BCOM	3GPP SA1	Correction of network dependability figures in 22.826 KPI tables	S1-193574.zip	Agreed
29	19/11/2019	BCOM	3GPP SA1	Addition of general section 6.x for CMED in TS 22.261	S1-193289.zip	Agreed
30	19/11/2019	BCOM	3GPP SA1	Correction of CMED KPIs tables in TS 22.104	S1-193290.zip	Agreed
31	19/11/2019	BCOM	3GPP SA1	Correction of CMED KPIs tables in TS 22.263	S1-193287.zip	Agreed
32	19/11/2019	BCOM	3GPP SA1	Update of text in section 4.4 of TS 22.263	S1-193115.zip	Agreed
33	22/11/2019	SRUK, EXP	3GPP SA2	Key Issue: unicast multicast delivery mode switch	S2-1912444.zip	Agreed
34	22/11/2019	SRUK, EXP	3GPP SA2	Key Issue: unicast broadcast delivery mode switch	S2-1912696.zip	Agreed
35	09/12/2019	SEQ	3GPP RAN	Rel-17 NWI Non Terrestrial Networks scoping discussions	RAN#85: RP-192238.zip RAN#86: RP-192500.zip	Sequans contributed in WID scoping. NTN discussion concluded with a SI on NTN for IoT which Sequans had supported.
36	09/12/2019	SEQ	3GPP RAN	Rel-17 NB-IoT and LTE-MTC enhancements, Phase 1 and 2 discussions	RAN#85: RP-192291.zip RAN#86: RP-192877.zip	Sequans contributed in WID [NB_IoT_eMTC_enh] scoping, including proposals for specific enhancements.
37	17/01/2020	EXP	3GPP SA2	Key issue on transition from E-UTRAN/EPC MBMS service to 5G MBS and vice versa	S2-2001699.zip	Agreed
38	17/01/2020	EXP	3GPP SA2	Additional components for 5MBS Architecture	S2-2001702.zip	Agreed
40	18/11/2019	SRUK	3GPP SA2	Key Issue: Unicast – multicast delivery mode switch	S2-1912444	Approved
41	18/11/2019	SRUK	3GPP SA2	Key Issue: Unicast – broadcast delivery mode switch	S2-1912696	Approved
42	24/02/2020	SRUK	3GPP SA2	Slice service experience data collection corrections	S2-2002454	Approved
43	14/10/2019	SRUK	3GPP SA2	Miscellaneous corrections/updates to TS 23.288	S2-1912319	Approved

44	14/10/2019	SRUK	3GPP SA2	New Key Issue on Slice SLA Guarantee	S2-1910812	Approved
45	17/01/2020	SRUK	3GPP SA2	Solution to support slice SLA guarantee	S2-2001244	Approved
46	16/09/2019	BCOM	DICOM	Finalization of DICOM-RTV (sup202)	sup202_ft_RealTimeVideo	Final Text
47	11/02/2020	UC3M, WINGS, TIM, SRUK	ETSI ENI	PoC#9 Autonomous Network Slice Management for 5G Vertical Services"	ENI(19)012_026	Agreed
48	11/02/2020	UPV	ITU	Final Evaluation Report from the 5G IA on IMT-2020 proposals	5G-IA-Final-Evaluation-Report-3GPP-1.pdf	Final