D7.1
Initial dissemination and exploitation report

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<tr>
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<td>Editors:</td>
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Abstract:
Deliverable 7.1 defines an initial plan for usage and dissemination of knowledge, as well as develops a strategy to communicate project goals and results to the research and industrial community, and mass media. Moreover, D7.1 defines a standardization strategy, and an exploitation strategy, providing also the initial exploitation plan for SANSA industrial partners.
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<th>Description</th>
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<td>5th Generation</td>
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<tr>
<td>FP7</td>
<td>7th Framework Programme</td>
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<td>Horizon 2020</td>
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<tr>
<td>HTTP</td>
<td>Hyper-Text Transfer Protocol</td>
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<td>ICT</td>
<td>Information and Communications Technology</td>
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<td>IPTV</td>
<td>IP Television</td>
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<td>KPI</td>
<td>Key Performance Indicator</td>
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<td>MNO</td>
<td>Mobile Network Operator</td>
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<td>MVNO</td>
<td>Mobile Virtual Network Operator</td>
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<td>NoE</td>
<td>Network of Experts</td>
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<td>PPP</td>
<td>Public Private Partnership</td>
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<tr>
<td>SWOT</td>
<td>Strengths, Weaknesses, Opportunities, Threats</td>
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<tr>
<td>TRL</td>
<td>Technology Readiness Level</td>
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<td>VoD</td>
<td>Video on Demand</td>
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Executive Summary

Deliverable 7.1 (D7.1) is the first document that describes the dissemination, standardization and exploitation plan of the project after 12 months of operation. Precisely, this deliverable proposes an initial plan for dissemination and knowledge management.

The dissemination plan addresses the framework and the tools that will be employed in order to guarantee a proper and harmonized communication of project results during and after the SANSA lifespan. In the context of D7.1, we will also develop a strategy to spread the project goals and results to mass media. A special focus will be provided for dissemination of results and know-how exchange with activities where partners are already strongly involved, such as other H2020 ICT and 5GPP projects.

In addition, this document defines a standardization strategy, i.e., a plan for contribution of selected material derived out of the SANSA outcomes to standardization bodies, e.g., Concretely, the relevant standardization bodies and groups are identified.

Finally, D7.1 defines an exploitation strategy which provides the initial exploitation plan of SANSA industrial partners, i.e., TAS, AVA, and OTE. In particular, this document determines the roadmap for bringing SANSA solutions closer to commercial exploitation, considering market opportunities A SWOT analysis of the SANSA technology with respect to specific deployment scenarios and the individual exploitation plan of industrial partners is presented.
1 Introduction

The aim of the SANSA project is to boost the performance of mobile wireless backhaul networks in terms of capacity, cost and resilience while assuring an efficient use of the spectrum. Due to recent global traffic forecasts, predicting a significant mobile traffic increase within the next few years, novel solutions are required to avoid current backhaul limitations. The solution envisaged in SANSA is a spectrum efficient self-reconfigurable hybrid terrestrial-satellite backhaul network based in three key principles:

i. a seamless integration of the satellite segment into terrestrial backhaul networks;

ii. a terrestrial wireless network capable of reconfiguring its topology according to traffic demands;

iii. a shared spectrum between satellite and terrestrial segments.

Work Package 7 (WP7) of SANSA is devoted to the dissemination and exploitation of SANSA outcomes. In the context of WP7, this document, Deliverable 7.1, is the first document that describes the dissemination, standardization and exploitation plan of the project after 12 months of operation.

In particular, D7.1 aims to cover an initial plan for usage and dissemination of knowledge. This dissemination plan addresses the framework and the tools (website, press announcements, social networks, etc.) that are employed so as to guarantee a proper and harmonized dissemination of project results during and after the SANSA lifespan. In the context of D7.1, we also develop a strategy to communicate project goals and results to mass media, while special focus will be provided for dissemination of results and know-how exchange with activities where partners are already strongly involved, such as other H2020 ICT and 5GPP projects.

Moreover, D7.1 identifies relevant standardization bodies and activities w.r.t. SANSA foreground and activities, whose outcomes should be monitored throughout the SANSA project lifespan, while a plan for contribution of selected material derived out of the SANSA outcomes to such standardization bodies is developed, e.g., presentations to fora, authoring and contribution to drafts, networking with other key players, etc.

Finally, D7.1 provides the initial exploitation plan of SANSA foreground by industrial partners, i.e., TAS, AVA, and COSMOTE. In particular, we determine the roadmap for bringing SANSA solutions closer to commercial exploitation, considering wider market opportunities from new classes of applications taking advantage of SANSA approaches, especially when related to the demand for energy-efficient and spectrally efficient mobile communications, and accelerated uptake of the next generation of mobile networks and service infrastructures by achieving direct wireless links between mobile devices. In the context, of the roadmap definition for exploitation we perform a market research, we define relevant deployment scenarios and we will describe how the SANSA foreground is to be exploited in the context of these scenarios by each industrial partner.
The document is organized as follows: Section 2 summarizes the dissemination activities of SANSA in Year 1, and describes the dissemination plan for Year 2 and Year 3 addressing publications, organization of events and external liaisons with on-going projects. Section 3 defines a standardization plan in the context of SANSA, and describes standardization bodies of interest to SANSA and overview of their recent outcomes and activities. Section 4 defines an exploitation plan, provides a market research with respect to products and services of interest to SANSA, defines deployment scenarios for SANSA technology, perform a SWOT analysis with respect to the aforementioned scenarios and provides the individual exploitation plan of each industrial partners covering all three aspects: Satellite Equipment Manufacturer, Satellite Operator and Terrestrial Operator. Finally, Section 5 concludes this document and set the next steps towards future targets.
2 Dissemination

2.1 Dissemination activity in Year 1

2.1.1 Website
The SANSA website can be found under the link: http://sansa-h2020.eu/. It has been created and maintained by CTTC, while it is periodically and upon demand updated by COSMOTE. It comprises a public and private area.

The public site comprises the following eleven (11) areas:

- **Home**: The homepage includes a welcoming message to SANSA project, it provides a vertical and horizontal menu for navigation in the website, an area for accessing the private area by means of pre-assigned credentials, and a News area where recent posts with SANSA activities are shown. Moreover, the SANSA ID card is presented with compact information about the duration, funding, participants, etc. of SANSA.

- **Objectives**: Includes the SANSA objectives w.r.t. capacity, resiliency, coverage, spectral and energy efficiency, in a simplified and structure manner.

- **Vision**: Includes the SANSA vision on how it will address the aforementioned objectives, it explains the major key design axes of SANSA such as the integration of the satellite, the deployment of self-organizing terrestrial networks, and the spectrum co-existence of the two segments. Moreover, the technologies to be implemented by SANSA, as well as key enabling components of the SANSA architecture are presented, i.e., smart antennas and hybrid network manager.

- **Partners**: Presents the contributing members of SANSA, including their core business/main activities, expertise, interests and expected benefit due to SANSA technologies.

- **Project plan**: Presents the Work Packages of SANSA and the interactions among them. A brief description of each Work Package is given, including the main objectives per WP.

- **Deliverables**: Provides a table with the deliverables of SANSA as described in the DoW. Per deliverable, a deliverable number, name and delivery date is given. Moreover, a link to pdf is provided for those deliverables that have been concluded and are characterized as public.

- **Dissemination**: Presents the dissemination activities of SANSA until present. The webpage is organized into four (4) sections: Journals, Conferences, Workshops and Talks, and it is quarterly updated by COSMOTE with recent activities by all SANSA member. In Year 2 and Year 3, Dissemination will be enriched with information about events organized by SANSA, e.g. scientific workshop, industrial events, networking events, etc.

- **Innovation**: Describes innovation introduced by SANSA in various aspects and field. In particular, there are articles that briefly explain SANSA innovation in existing publications.
or other material by SANSA and the relevance of it to the SANSA goals.

- **News**: Provides a summary of recent events such as project meetings, reviews and their outcomes, new publications or presence of SANSA in various events, etc. The News area of the homepage is fed by this section.

- **Links**: Provides several important links to EC official websites and related research projects such as BATS, CORASAL, etc.

- **Contact us**: Provides a contact form for people outside the SANSA consortium to reach the SANSA coordinator and members.

Figure 1 depicts the homepage of SANSA website.

The private site provides to authorized users access to the SANSA repository, and enables users to edit their individual profile, e.g., username, password, email, language, etc.
Figure 1: The homepage of SANSA website.
2.1.2 Publications
During Year 1, the objectives of our scientific publications have been two-fold. First, to disseminate the SANSA general concept, objectives and foreseen benefits. This objective has been accomplished by a poster presentation at EUCNC 2015 and a paper submission to the ETSI Workshop on Future Radio Technologies focusing on Air Interfaces.

Second, to disseminate novel results related to SANSA enabling technologies. Since the task of defining use cases, scenarios and requirements was still on-going, these publications were focused on the technologies themselves. However their applicability to the SANSA scenarios will be properly addressed in the technical deliverables and in future publications. This second objective has been accomplished by the publication of 2 journals, and 6 conference/workshop papers, and the submission of 7 conference/workshop papers. The complete list of published and submitted papers during 2015 is detailed in next subsections, along with a short description of the relevance of the presented results for the SANSA solution.

2.1.2.1 Journals and Magazines

It is a power control to be carried out independently by each of the different pair links in an interference limited network. Its use prevents the saturation that interference may cause in each of the receivers and allows that each of the simultaneous transmission links achieves optimal Pareto rate. The exploitation of this technique in SANSA networks will be a new step towards the targeted ten-fold spectral efficiency improvement.


The lack of available unlicensed spectrum together with the increasing spectrum demand by multimedia applications has resulted in a spectrum scarcity problem, which affects Satellite Communications (SatCom) as well as terrestrial systems. The goal of this paper is to propose Resource Allocation (RA) techniques, i.e. carrier, power and bandwidth allocation, for a cognitive spectrum utilization scenario where the satellite system aims at exploiting the spectrum allocated to terrestrial networks as the incumbent users without imposing harmful interference to them. In particular, we focus on the microwave frequency bands 17.7 – 19.7 GHz for the cognitive satellite downlink and 27.5 -29.5 GHz for the cognitive satellite uplink, although the proposed techniques can be easily extended to other bands. In the first case, assuming that the satellite terminals are equipped with multiple Low Block Noise Converters (LNB), we propose a joint beamforming and carrier allocation scheme to enable cognitive Space-to-Earth communications in the shared spectrum where Fixed Service (FS) microwave links have priority of operation. In the second case, however, the cognitive satellite uplink should not cause harmful interference to the incumbent FS
system. For the latter, we propose a Joint Power and Carrier Allocation (JPCA) strategy followed by a bandwidth allocation scheme which guarantees protection of the terrestrial FS system while maximizing the satellite total throughput. The proposed cognitive satellite exploitation techniques are validated with numerical simulations considering realistic system parameters. It is shown that the proposed cognitive exploitation framework represents a promising approach for enhancing the throughput of conventional satellite systems.

### 2.1.2.2 Conferences and Workshops


In this poster, the general SANSA concept is introduced. In particular, it details the objectives and benefits of the proposed spectrum efficient self-organizing hybrid terrestrial-satellite backhaul network, and briefly describes the technologies that will make this solution possible.


Dense deployments of small cells (SC) will help satisfying the explosive growth of mobile data usage. However, the deployment of such networks implies several challenges where point-to-point (PTP) and point-to-multipoint (PMP) wireless technologies will be combined forming multipoint-to-multipoint (MP2MP) wireless mesh backhauls. In this initial work produced within the SANSA project, we propose Backpressure for Multi-Radio (BP-MR), a distributed dynamic routing and load balancing protocol designed for MP2MP wireless mesh backhauls where each node may embed a different number of multi-technology wireless interfaces.

In BP-MR, each SC maintains a data queue per interface and carries out the routing process in two stages. The first one distributes ingress packets with the goal of reducing the Head of Line (HoL) blocking effect in a multi-radio SC. The second stage determines the actual outgoing interface and the next-hop for each packet at the head of the queues. Simulation results show improvements in throughput and latency with respect to other state-of-the-art approaches as a consequence of an improved wireless link usage efficiency. Future work within SANSA project will consider the enhancement of this protocol in the proposed LTE hybrid backhaul network.


In this paper, we started evaluating the usage of reinforcement learning techniques for the management of energy harvesting SCs in heterogeneous networks. Our solution is based on Q-learning algorithm and it is designed to increase the system throughput, offload the macro BSs and
decrease the drop rate at the macro BS. The simulation results are promising and show that the proposed approach is viable, as the algorithm meets most of our design goals and also improves the energy efficiency of the system. Future work in SANSA will consider the integration with the backhaul model and the enhancement of the decisions made by the distributed small cells.

E. Lagunas, S.K. Sharma, S. Maleki, S. Chatzinotas, B. Ottersten, “Impact of Terrain Aware Interference Modeling on the Throughput of Cognitive Ka-Band Satellite Systems”, Ka and Broadband Communications Conference (KaConf), Bologna, Italy, Oct 2015. *(Published)*

The impact of including the diffraction loss in the interference modeling on the system throughput is assessed in the context of cognitive Ka-band satellite systems. In particular, we focus on the cognitive satellite downlink, where Geostationary (GEO) Fixed Satellite Service (FSS) terminals receive interference from the incumbent Fixed-Service (FS) microwave links. We present numerical results where we analyze the Signal-to-Interference plus Noise Ratio (SINR) and the throughput of the satellite terminals considering free-space propagation only and the free-space propagation plus the diffraction caused by the terrain data according to ITU-R P.526-13. We also compare the results achieved with and without smart resource allocation. The inclusion of the diffraction loss is shown to attenuate the interference caused by the terrestrial system and thus, to improve the SINR of the satellite terminals. However, its effect on the final throughput has little relevance due to the significant number of available and unaffected carriers.


A fundamental problem facing the next generation of Satellite Communications (SatComs) is the spectrum congestion and how the scarce spectral resources are allocated to meet the demand for higher rate and reliable broadband communications. In this context, this paper addresses the satellite uplink where satellite terminals reuse frequency bands of Fixed-Service (FS) terrestrial microwave links which are the incumbent users in the Ka band. In this scenario, the transmit power of the satellite terminals has to be controlled such that the aggregated interference caused at the FS system is kept below some acceptable threshold. In this paper, we review simple and efficient power allocation techniques available in the literature and, with slight adaptations, we evaluate them to the proposed satellite uplink and terrestrial FS co-existence scenario. The presented numerical results highlight the tradeoff between the level of channel state information and the rates that can be achieved at the satellite network.

Large in the number of transmit elements, multi-antenna arrays with per-element limitations are in the focus of the present work. In this context, physical layer multigroup multicasting under per-antenna power constrains, is investigated herein. To address this complex optimization problem low-complexity alternatives to semi-definite relaxation are proposed. The goal is to optimize the per-antenna power constrained transmitter in a maximum fairness sense, which is formulated as a non-convex quadratically constrained quadratic problem. Therefore, the recently developed tool of feasible point pursuit and successive convex approximation is extended to account for practical per-antenna power constraints. Interestingly, the novel iterative method exhibits not only superior performance in terms of approaching the relaxed upper bound but also a significant complexity reduction, as the dimensions of the optimization variables increase. Consequently, multicast multigroup beamforming for large-scale array transmitters with per-antenna dedicated amplifiers is rendered computationally efficient and accurate. A preliminary performance evaluation in large-scale systems for which the semi-definite relaxation constantly yields non rank-1 solutions is presented.


This is a joint positioning paper describing the SANSA concept and the innovation aspects addressed by each of the technical Work Packages of the project.

X. Artiga, Reflectarray Cell for Analog Row-Column Beam Scanning Control, submitted to the 10th European Conference on Antennas and Propagation (EuCAP 2016), 10-15 April 2016, Davos, Switzerland. (Submitted)

This paper proposes a reflectarray unit cell which enables beam scanning by controlling the reflectarray aperture in a row-column scheme. This technique allows reducing the number of ADCs and control lines, contributing to the low cost/low complexity antenna solutions targeted in SANSA.


This paper deals with the problem of phase-only beamforming optimization. Considering that the beamforming is done in the analog domain, we propose an efficient method to obtain the phase values in order to point to a certain direction while keeping the interference power levels below a certain threshold. This scheme is essential for low cost SANSA intelligent backhaul nodes since they will be equipped with a low cost antenna technology with a single radio frequency chain and a network of phase shifters and fixed transmit power amplifiers.

This paper presents our ns-3 framework developed for modeling next generation mobile networks with satellite-terrestrial wireless backhaul capabilities. We implemented LTE-EPC Network Simulator (LENA) extensions in order to connect the access and core network with a self-reconfigurable hybrid wireless backhaul. This paper also presents preliminary results that validate the proper operation of the resulting framework. On the one hand, these results indicate how the satellite can be a good complement to the wireless terrestrial backhaul not only for UDP traffic but also for TCP traffic without strict requirements on throughput and especially on delay. On the other hand, results also suggest that dynamic traffic management and load balancing algorithms are required to properly exploit additional and carefully planned backhaul resources.


This paper focuses on the optimization of uniform circular antenna array (UCA) structures equipped with analog combining networks for direction finding and beamforming applications. For such type of arrays, the specific choice of the combining matrix has a crucial impact on the effective radiation pattern and the sensitivity of beam steering and direction-of-arrival estimation. A design framework for constructing the combining network is proposed that improves the performance of the array. Cramer-Rao bound is used to find the optimal combining matrix and array aperture size for a given number of radiating elements and combiner output (baseband) channels. FRA provides design examples to demonstrate the effectiveness of their approach.


This paper considers a backhaul network for Ka band. In this band, large antenna arrays must be employed with appropriate beamforming and precoding techniques to combat the path loss. Recently, hybrid analog-digital solutions were suggested for millimeter wave multiple-input-multiple-output systems. They rely on two steps. The first step aims at analog only beamforming and exploitation of the large antenna gain offered by massive antenna arrays. The second step mitigates the multiuser interference by means of digital precoding. In this paper, FRA focuses on the second step of the hybrid precoding. FRA proposes a solution for interference mitigation in multi-base station scenario. Their solution is based on block diagonalization technique and requires full channel state information at each base station of a backhaul network. The performance of their algorithm is compared to a partial block diagonalization which was originally proposed for downlink scenario with a single base station and multiple users.

This paper presents a design of linear baseband precoding and combining techniques for mmWave MIMO backhaul networks. It considers a scenario known as MIMO multi-X channel with L transmitter base stations and K receiver base stations. Each transmitter base station communicates simultaneously with all receiver base stations. In this work, FRA proposed several low-complexity schemes suited for the digital part of hybrid precoders/combiners. These solutions are based on block diagonalization and MMSE techniques and assume partial knowledge of channel state information at each base station. The paper demonstrates a potential gain of the proposed algorithms. It studies their computational complexities and derives the minimum number of RF chains required at each base station.

2.2 Dissemination plan for Year 2 and Year 3

2.2.1 Dissemination tools

2.2.1.1 Website
Concerning Year 2 and Year 3, our goal is to continuously and periodically feed the project website with updates and news on dissemination activities and innovation introduced by SANSA. Moreover, the organization of events (scientific, industrial and networking) by SANSA, either stand-alone or jointly with other projects or external collaborators will be reported and promoted also via the official webpage of SANSA

2.2.1.2 Press releases
SANSA targets to perform at least two press releases in Year 2 and Year 3. In particular, a first press release is planned for the 1st semester of Year 2. The target of this first press release is to promote the scope and objectives of SANSA, to highlight its importance and expected impact, to describe its application scenarios (based on material of [2]), to set the next steps towards the materialization of its goals, and to emphasize the expertise of the SANSA consortium towards this direction. The text and media to be published are under consideration. Moreover, another press release is considered for the 2nd (and final) semester of Year 3 reporting on important outcomes and findings of SANSA, highlight its contributions to standardization bodies and fora, and to describe initial exploitation activities of the SANSA foreground by the industrial partners and not only. In the meantime, other press release could be published with respect to the outcomes and the organization of events in the context of SANSA.

2.2.2 Publications
In this section, we provide a list of journal and magazines, conferences and workshops, which are relevant to the scope of SANSA and may be considered by SANSA partners for publication of original
work produced within SANSA. Moreover, we briefly describe plans for white papers and provide a quantitative summary of publications targets within Year 2 and Year 3 of the project.

2.2.2.1 **Journals and Magazines**

*Table 1: Categorization of journals and magazines related to SANSA scope w.r.t. thematic area.*

<table>
<thead>
<tr>
<th>Magazine</th>
<th>Antennas</th>
<th>MAC / Resource allocation</th>
<th>Networking / Routing</th>
<th>Simulator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elsevier Digital Communications and Networks</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Eurasip Journal on Advances in Signal Processing</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eurasip Journal on Wireless Communications</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>IEEE Antennas and Propagation Magazine</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEEE Antennas and Wireless Propagation Letters</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEEE Communications Letters</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>IEEE Communications Magazine</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>IEEE Communications Society, Communications Surveys and Tutorials</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>IEEE Journal on Selected Areas in Communications</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>IEEE Network</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>IEEE Signal Processing Letters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEEE Transactions on Antennas and Propagation</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEEE Transactions on Cognitive Communications and Networking</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEEE Transactions on Communications</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>IEEE Transactions on Information Theory</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEEE Transactions on Mobile Computing</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>IEEE Transactions on Signal Processing</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEEE Transactions on Vehicular Technology</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>IEEE Transactions on Wireless Communications</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>IEEE Wireless Communications Letters</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>IEEE Wireless Communications Magazine</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>IEEE/ACM Transactions on Networking</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Conferences and Workshops

Table 2: Categorization of conferences and workshops related to SANSA scope w.r.t. thematic area.

<table>
<thead>
<tr>
<th>Conference</th>
<th>Important dates</th>
<th>Location</th>
<th>Applicable fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE Infocom 2016</td>
<td>10-15 Apr 2016</td>
<td>San Francisco, USA</td>
<td>✓</td>
</tr>
<tr>
<td>European Conference on Antennas and Propagation - EUCAP 2016 / 2017</td>
<td>12-17 Apr 2016</td>
<td>Davos, CH</td>
<td>✓</td>
</tr>
<tr>
<td>International Conference on Communications (ICC) 2016</td>
<td>23-27 May 2016</td>
<td>Kuala Lumpur, MY</td>
<td>✓</td>
</tr>
<tr>
<td>EuCNC 2016: European Conference on Networks and Communications</td>
<td>27-30 Jun 2016</td>
<td>Athens, GR</td>
<td>✓</td>
</tr>
<tr>
<td>Signal Processing Advances on Wireless Communications (SPAWC) 2016</td>
<td>03-06 Jul 2016</td>
<td>Edinburgh, UK</td>
<td>✓</td>
</tr>
<tr>
<td>IEEE VTC 2016 Fall</td>
<td>18-21 Sep 2016</td>
<td>Montreal, CA</td>
<td>✓</td>
</tr>
<tr>
<td>Mobicom 2016</td>
<td>03-07 Oct 2016</td>
<td>New York, USA</td>
<td>✓</td>
</tr>
<tr>
<td>Global Communications Conference (Globecom) 2016</td>
<td>04-08 Dec 2016</td>
<td>Washington DC, USA</td>
<td>✓</td>
</tr>
</tbody>
</table>
2.2.2.3 White Papers
The SANSA consortium plans to elaborate a white paper during Q2 of 2016. The objective of this paper is to target a broader audience than the classical scientific publications in order to maximize the SANSA dissemination in non-scientific circles. To this end, the paper will be focused on SANSA impact and the technical details will be kept to the minimum. The targeted audience could be composed by key personnel of interested companies with non-technical profiles, e.g., marketing and business professionals, but also by the European citizens. The main idea is to show them what SANSA is doing for them and how the SANSA solution can positively impact their business and lives. The paper will be available at the SANSA website.

2.2.2.4 Summary of publication achievements and targets
In Table 3, publication achievements and target achievements for Year 2 and Year 3 are set by the SANSA consortium.

Table 3: Summary of publication targets across the 3 years of operation of SANSA.

<table>
<thead>
<tr>
<th></th>
<th>Year 1 achievements</th>
<th>Year 2 targets</th>
<th>Year 3 targets</th>
<th>Total targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journals and Magazines</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Conferences and Workshops</td>
<td>6</td>
<td>10</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>White papers</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>15</td>
<td>16</td>
<td>31</td>
</tr>
</tbody>
</table>

2.2.3 Organization of Special Issue on Spectrum Sharing
The SANSA consortium is organizing a special issue on International Journal of Satellite Communications and Networking related to Cognitive Radio and Networks for Satellite and Space...
Communications. Spectrum sharing techniques play a key role in cognitive radio literature and thus this special issue is perfect for presenting the SANSA results and highlight gains in satellite and space communications. This special issue is co-organized with the CORASAT project which is described in sec 2.2.7. The call for papers can be found in the following link: http://onlinelibrary.wiley.com/store/10.1002/(ISSN)1542-0981/asset/homepages/CFP-SI-IJSCN-CogSat.pdf?v=1&s=e8c1c4a6fddbc55f1d163ea93a94cf7b19ae8df5&isAguDoi=false, and the submitted papers will follow the timetable presented in Table 4.

Table 4: Important deadlines for a Special Issue on Spectrum Sharing organized by SANSA.

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manuscript submission</td>
<td>January 15th, 2016</td>
</tr>
<tr>
<td>First review results</td>
<td>May 1st, 2016</td>
</tr>
<tr>
<td>Second review results</td>
<td>July 1st, 2016</td>
</tr>
<tr>
<td>Publication</td>
<td>December, 2016 (tentative)</td>
</tr>
</tbody>
</table>

2.2.4 Organization of Scientific Workshops

2.2.4.1 EuCNC 2016

The SANSA consortium is already in contact with VITAL-H2020 [8] project to organise a joint workshop during the EuCNC 2016 conference. VITAL (Virtualized hybrid satellite-Terrestrial systems for resilient and flexible future networks) is investigating the use of Network Functions Virtualization (NFV) and Software-Defined-Networking (SDN)-based architectures into the hybrid satellite-terrestrial networks domain, complementing the work of SANSA.

The joint plan is to organize and coordinate a joint workshop in the context of EuCNC 2016 so as to greatly attract the interest of the research and industrial community that are active in the fields of Satellite and Terrestrial Mobile backhaul links.

2.2.4.2 ICC 2017

The SANSA consortium plans to organize a workshop devoted to hybrid terrestrial/satellite backhaul networks collocated with the 2017 IEEE International Conference on Communications (ICC 2017), which will take place in Paris on 21-25th of May 2017. ICC is targeted since it is the flagship conference of the IEEE Communications Society. Every year ICC attracts more than 1500 attendees, and around 1000 research works are presented over its duration. In addition, ICC has become also an excellent networking event in which the leaders of the communication industry can link with their clients and with the scientific community for boosting the innovation. Therefore, ICC2017 is a perfect international showcase for presenting SANSA solutions and for pushing for Hybrid terrestrial/satellite backhaul networks.

The specific plan for organizing this workshop will be detailed in future deliverables, since at the time of writing; the deadline and instructions for submitting a workshop proposal are not publicly available.
available. In this plan we will consider to co-organize the workshop with one of the projects listed in Section 2.2.7.

2.2.5 Organization of Industrial Events

2.2.5.1 FITCE 2016

FITCE [4] (Forum for European ICT and Media Professionals) is a forum for the ICT & Media professionals’ community to exchange views and gain insights in new developments and challenges related to technical, regulatory, societal and economical aspects of ICT & media technologies and services. FITCE (headquartered in Belgium) has over 50 Years of experience in dealing with the needs of the ICT and Media Industry, while it has Members, mainly IT companies, ISPs and telecommunications operators in 11 European Countries, including Greece. The Hellenic Branch of FITCE [5] (also called Hellenic Union of Telecommunications Engineers) will organize the 55th FITCE Europe Congress [6] on September 1-3, 2016 in Athens, Greece. The FITCE Congress is entitled “Toward a Smart Interconnected Society”. The Congress will be organized in five sessions:

S1. Modern Telecommunication Technologies (5G, SDN, NFV, offloading, ...)
S2. IT Applications and Social Media
S3. Security ICT
S4. Contribution of Telecommunication in Energy and Transport
S5. Applications of ICT in Education, Environment and HR

while it will also accommodate three workshops:

W1. 5G architectures, innovations and advanced services
W2. Backhauling infrastructure (offloading, technologies convergence, abstractions, ...)

Due to the participation of COSMOTE in at least two more H2020 European projects, i.e., VITAL and 5G-XHAUL, both addressing mobile backhauling, COSMOTE as official member of FITCE Europe/Hellas plans to organize a session in the context of W2 – workshop on backhauling infrastructure – also for dissemination of SANSA vision, objectives and outcomes.

According to the program announcement, the workshop format will include presentations of up to 15 minutes and panel discussions on various topics. Moreover, the deadline for extended abstract (abstract of 300-500 words, key words, name, affiliation, short biography and postal/email addresses) submission is March 14, 2016, acceptance notification will come on April 4th, 2016, while camera-ready version should be submitted by June 6th, 2016.

Dr. George Agapiou (COSMOTE), WP7 leader of SANSA project will also serve as Technical Program Chair for the FITCE European Congress 2016.
2.2.5.2 NGMN Conference 2016 and /or 2017
The NGMN Alliance is an association of mobile operators, vendors, manufacturers and research centres develop with the following mission [3]:

- Expand and evolve the mobile broadband experience with a particular focus on 5G.
- Establish clear functionality and performance targets and requirements for deployment scenarios and network operations.
- Provide guidance to vendors and standardisation bodies, leading to the implementation of a cost-effective network evolution.
- Drive implementation of NGMN recommendations and to establish liaison statements and project agreements as needed with SDOs and industry organisations.
- Create an information exchange forum for discussion and sharing of experiences and lessons learnt.
- Address spectrum requirements and support the establishment of a transparent and predictable IPR regime.

The NGMN is currently focusing its work on 5G with the aim to develop and consolidate operator requirements to ensure end user satisfaction.

The 6th NGMN Industry Conference & Exhibition will take place in Frankfurt on 12-13 October 2016. SANSA is relevant to the NGMN because the hybrid solution it introduces is an interesting concept for operators who are looking to expand their networks in the light of 5G.

2.2.6 Organization of Networking Events

2.2.6.1 Events under consideration for 2016
Below, one candidate option identified for the organization of a Networking event by SANSA within 2016 is described:

SANSA information booth at the 26th International Conference RADIOELEKTRONIKA 2016 in Slovakia.

This conference is organized by the Association of Slovak Scientific and Technological Societies – Slovak Electrical Engineering Society in collaboration with the Technical University of Kosice. The scope of the conference is to create a discussion forum for researchers, academics, people in industry, and students who are interested in the latest development in the area of electronics, signal processing, information technologies, microwave technology, their applications and related disciplines. FRA has a good contact to organizers of RADIOELEKTORONIKA and may try to organize an information booth for SANSA project. This event would aim at networking with other research groups and promotion of SANSA especially in countries from Eastern Europe. The conference is mostly visited by participants from Czech Republic, Slovakia, Serbia, Latvia, Ukraine etc. The
presented papers will be submitted to the final conference proceedings on IEEE Xplore as well. Contributions/papers from SANSA would be welcomed as well. Dates: 19-20.4.2016.

2.2.6.2 Events under consideration for 2017

Below, candidate options for the organization of a Networking event by SANSA within 2017 are listed:

**Organization of a SANSA Workshop at a future COST meeting within Action CA15104 "Inclusive Radio Communication Networks for 5G and beyond (IRACON)" which was just recently approved by EU.**

COST is the longest-running European framework supporting transnational cooperation among researchers, engineers and scholars across Europe. The IRACON aims at scientific breakthroughs by introducing novel design and analysis methods for the 5th-generation (5G) and beyond-5G radio communication networks. Challenges include i) modelling the variety of radio channels that can be envisioned for future inclusive radio, ii) capacity, energy, mobility, latency, scalability at the physical layer and iii) network automation, moving nodes, cloud and virtualisation architectures at the network layer, as well as iv) experimental research addressing Over-the-Air testing, Internet of Things, localization and tracking and new radio access technologies. Since FRA has one representative within the IRACON management committee and one representative in its substitute management committee it could be possible to address organization of the SANSA workshop at one of IRACON meetings. The workshop would aim at promotion of the SANSA project, dissemination of its outcomes and networking with other projects, research groups, industry, etc. Participation of all SANSA partners would be welcomed. Assumed time plan: it should be planned for 2017.

**Organization of a convened session at the "European Conference on Antennas and Propagation" - EUCAP 2017.**

EuCAP is supported by top level world-wide associations on Antennas and Propagation, and provides a forum on the major challenges faced by these communities. Contributions from colleagues from European and non-European industries, universities, research centres and other institutions are most welcome. The conference provides an overview of the current state-of-the-art in Antennas, Propagation and Measurements topics, highlighting the latest developments and innovations required for future applications. Its topics such as array antennas, MIMO, diversity, and smart antennas, beamforming and signal processing, wireless networks, etc. are closely related to the objectives of the SANSA project. Since FRA has good contacts to EuCAP organizers it could be possible to initiate organization of a convened session at this conference in 2017. This event will aim at dissemination of SANSA outcomes and networking with other research groups. Papers from all SANSA partners would be welcomed. Assumed time plan: it should be planned for 2017.
2.2.7 Potential liaisons with other projects

In this section, we provide brief description of the scope and objectives of projects with whom SANSA consortium has liaisons, and with whom a bi-lateral collaboration may lead in mutual benefit for both SANSA and the project in terms of research, dissemination and/or exploitation.

2.2.7.1 FP7 BATS

The research project BATS (Broadband Access via integrated Terrestrial & Satellite systems), funded under the European Union 7th Framework Programme, addresses the delivery of BroadBand (BB) future services in Europe according to the EC Digital Agenda objective to reliably deliver >30Mbps to 100% of European households by 2020.

In order to accommodate the areas of Europe which are 'unserved' and 'underserved' in terms of BB availability, an Ultra High Throughput Satellite System is researched that provides order of magnitude cost/bit reductions and solutions to existing market barriers of bandwidth and latency limitations. BATS proposes a novel architecture which combines satellite and terrestrial service delivery via an Intelligent User Gateway (IUG), dynamically routing each traffic flow according to its service needs through the most appropriate delivery mechanism to optimise the Quality of Experience (QoE). The integration complies with emerging home network environment standards and provides resilience and reliability of service provision to the users by bonding diverse access networks. To cope with such integrated scenario, BATS will provide a unified network management framework.

The evaluation of concepts takes place via laboratory emulation with controlled objective and subjective testing and via field trials using prototype IUGs and capacity on in-orbit satellites to assess real user experiences.

BATS provides a unique opportunity for the European ICT and Satellite industries to take a lead in this novel integrated system which will have a worldwide market. Contributions to standardization groups will foster adoption of the concept and assist supporting the European Mandate 496: 'To Develop Standardization Regarding the Space Industry'.

SANSA like BATS are both projects dealing with hybrid satellite and terrestrial links. BATS is coming to an end on 31st of December 2015, but the outcome as well as many of the technical design findings can be a useful guide for SANSA. Moreover, in March 2016, the final review will take place concurrently with another event. An option for a SANSA presentation could be possible.

2.2.7.2 FP7 CORASAT

CoRaSat is an EU FP7 project which ran from October 2012 to October 2015 dealing with dynamic spectrum access in satellite communications, particularly in Ka band. It is shown that by applying cognitive resource allocation mechanisms in combination with REM, a significant gain in terms of spectral efficiency and availability can be obtained. The outcomes of CoRaSat particularly the cognitive satellite downlink scenario in the 18 GHz band, and cognitive uplink satellite scenario in 28GHz band in the presence of the terrestrial FS links have a direct impact on the scenario definition
in SANSA. To this aim, the results, outcomes and studies of CoRaSat has been investigated and referred thoroughly in the WP2 deliverables of SANSA, and they have been used for scenario definition in D2.3.

2.2.7.3 NoE SATNEX4
SatNex IV [7] activities aim to study medium/long term directions of satellite telecommunication systems for any of the commercial or institutional applications that can be considered appealing by key players but still not mature enough for attracting industry or initiating dedicated ESA R&D activities. The key objectives of the SatNex IV Network of Experts can be summarized as:

- Early identification, exploration and scientific assessment of promising new R&D avenues for satellite telecom networks for possible injection in ESA’s R&D programs.
- Detection and preliminary assessment of promising terrestrial telecommunication technology spinin into space telecom applications.
- Enhanced cooperation between the European/Canadian industry and research institutions on telecom satellite applied research subjects of common interest.

Currently SatNex IV has performed an activity devoted to future ICN traffic and in 2016 it will dedicate a working group to the role of satellite communications in terrestrial content delivery networks, which matches one of the SANSA use cases. SATNEX IV is being coordinated by CTTC what can simplify the collaboration among both initiatives.

2.2.7.4 H2020 ICT VITAL
VITAL [8] (VIrtualized hybrid satellite-TerrestriAl systems for resilient and f lexible future networks) is an H2020, 30-months, €2.9-millin project addressing the combination of terrestrial and satellite networks by pursuing two key innovation areas, by bringing Network Functions Virtualization (NFV) into the satellite domain and by enabling Software-Defined-Networking (SDN)-based, federated resources management in hybrid SatCom-terrestrial networks.

Enabling SDN-based, federated resource management paves way for a unified control plane that would allow operators to efficiently manage and optimise the operation of hybrid SatCom-Terrestrial networks. Enabling NFV into SatCom domain will provide the operators with appropriate tools and interfaces in order to establish end-to-end fully operable virtualised satellite networks to be offered to third-party operators/service providers. The project will primarily focus on developing the concepts in VITAL around three key application scenarios: Satellite Virtual Network Operator (SVNO) services, Satellite backhauling and hybrid telecom service delivery.

VITAL has almost identical design space with SANSA, though it employs a completely different approach to derive a solution for hybrid terrestrial-satellite network management and mobile backhauling. Due to the similar design space, as well as the participation of COSMOTE in both projects, there is very high potential for synergies in terms of common dissemination actions, and event organization.
2.2.7.5 5G-PPP 5G-Crosshaul

5G-Crosshaul [9], namely the integrated fronthaul/backhaul, is an H2020 PPP, 30 months, 8.3 million project which aims at developing a 5G integrated backhaul and fronthaul transport network enabling a flexible and software-defined reconfiguration of all networking elements in a multi-tenant and service-oriented unified management environment to satisfy the performance demands of upcoming 5G network deployments while bringing the CAPEX/OPEX investments to a reasonable return on investment (ROI) range.

The envisioned 5G-Crosshaul transport network will consist of high-capacity switches and heterogeneous transmission links (e.g., fibre or wireless optics, high-capacity copper, mmWave) interconnecting Remote Radio Heads, 5GPoAs (e.g., macro and small cells), cloud-processing units (mini data centres), and points-of-presence of the core networks of one or multiple service providers. This transport network will flexibly interconnect distributed 5G radio access and core network functions, hosted on in-network cloud nodes, through the implementation of: (i) a control infrastructure using a unified, abstract network model for control plane integration (Crosshaul Control Infrastructure, XCI); (ii) a unified data plane encompassing innovative high-capacity transmission technologies and novel deterministic-latency switch architectures (Crosshaul Packet Forwarding Element, XFE).

5G-Crosshaul shares with SANSA the vision on the necessity of evolving current backhaul techniques of mobile networks to meet the requirements of the upcoming and more demanding mobile network deployments. However, it uses a completely different approach to achieve a solution for the terrestrial mobile backhauling and does not consider the additional resources that satellite network could provide. As both projects share not only this vision about backhauling, but also the participation of CTTC, results within 5G-Crosshaul and SANSA project could be of interest to each other.

2.2.7.6 5G-PPP 5G-XHAUL

5G-XHaul [10] (Dynamically Reconfigurable Optical-Wireless Backhaul/Fronthaul with Cognitive Control Plane for Small Cells and Cloud-RANs) is a 36-months, €7.3-million project that proposes a converged optical and wireless network solution able to flexibly connect Small Cells to the core network. Exploiting user mobility, our solution allows the dynamic allocation of network resources to predicted and actual hotspots. To support these novel concepts, we will develop:

- Dynamically programmable, high capacity, low latency, point-to-multipoint mm-Wave transceivers, cooperating with sub-6-GHz systems;
- A Time Shared Optical Network offering elastic and fine granular bandwidth allocation, cooperating with advanced passive optical networks;
- A software-defined cognitive control plane, able to forecast traffic demand in time and space, and the ability to reconfigure network components.
In 5G-XHAUL, a multitude of industrial project partners are participating: Huawei, Telefonica I+D, i2CAT, Blu Wireless Technology, ADVA Optical Networking, Airrays, TES Electronic Solutions, including COSMOTE, who is also participating in SANSA, as well as academic partners University of Bristol, TU Dresden, University of Thessaly and IHP.

Due to the participation of COSMOTE in both projects, there is high potential for synergies in terms of common dissemination actions, and event organization.

2.2.7.7 5G-PPP COHERENT

COHERENT [11] (Coordinated control and spectrum management for 5G heterogeneous radio access networks) is an H2020 5GPP, 30-months project that aims to develop a control framework so as to deal with the insufficiency of current control solutions for inter-network coordination.

First, theories and methods to abstract the low layer network states and behaviors of different underlying mobile networks will be developed. This methodology will provide a simplified but sufficient abstracted network view for network-wide control and resource coordination. Moreover, network abstraction will significantly reduce the signaling overhead, making scalable network-wide control solutions feasible, and enable more flexible spectrum management, which are key for the success of 5G networks.

Second, based on the abstracted network view, common interfaces and software-development kits will be developed to enable programmability in controlling and coordinating heterogeneous mobile networks. The programmable control will provide operators a flexible and cost efficient way to implement new control functions and thus to support new services.

The COHERENT consortium is comprised of 14 partners from 9 countries, including well-known researcher institutes, universities, industry companies, and SMEs in Europe and Israel. Due to the participation of COSMOTE in both projects, there is high potential for synergies in terms of common dissemination actions, and event organization.

2.2.7.8 Clustering across EU funded projects

Clustering activities across EU-funded research project enables the collaboration among projects, the exploration of synergies, and the joint definition of frameworks, visions and objectives. The SANSA consortium has identified that it is crucial to be part of this clustering scheme in order to maximize the impact of our research activities. However, the appearance of the 5GPPP initiative, in which all project have to collaborate towards the same objectives, have changed the traditional vision of ICT related clusters. Therefore, the short-term plans of the SANSA consortium include the participation in the next “FP7 and H2020 network Technologies Concertation Day”, to be held in Brussels on March 1st 2016. In this concertation meeting, a new format for the clusters in H2020 will be debated. The aim of SANSA is to contribute to this discussion and to be part of the most suitable future cluster.
3 Standardization

3.1 Standardization plan

In this section we examine the possibility of disseminating the results through standardization bodies. The key action that should be taken at first is to identify the relevant standardization bodies. Then the activities of the selected standardization bodies should be monitored and interaction with them should be organized. It is noteworthy that some of the project partners, (AVA and CTTC) have already interaction with known standardization bodies and they monitor they activities. As it is described in the Section 3.2 and Section 3.3, identification of relevant standardization bodies is already done and some first actions towards the interaction with them were taken.

The second important part of this task is the evaluation of the outputs of WP3 and WP4 in order to identify which of the project outputs can be considered for standardization. To that end, the industrial partners (i.e., TAS, AVA, COSMOTE) and not only will continuous monitor the project outputs and based on the existing standards and the outputs of the standardization bodies will identify the most promising ones to pursue for standardization. To decide if a project output is eligible or not for standardization, the following aspects should be examined:

1. Does the project output rely on existings standards?
2. Is there a possibility of exploiting this output by organizations that are already using standards and their products or services?
3. Can the project output trigger the development of new products or services?
4. Is it possible for the output to be the basis for creating compatible technologies by other organizations?
5. Will the output complete an area partially covered by an existing standard?

For more information related to standardization planning please refer to [14] and [16].

Finally, Figure 2 summarizes the plan related to the standardization activities of SANSA.

3.2 Description of standardization bodies and task force groups

3.2.1 European Telecommunications Standards Institute (ETSI)

ETSI [12] is an independent, non-profit, standardization organization in the telecommunications industry (equipment makers and network operators) in Europe, with worldwide projection. ETSI was created by CEPT in 1988 and is officially recognized by the European Commission and the EFTA secretariat. Based in Sophia Antipolis (France), ETSI is officially responsible for standardization of Information and Communication Technologies (ICT) within Europe. ETSI structure is depicted in the following figure that is extracted from the ETSI website.
Among the ETSI working groups we have identified as the most relevant to our activities the one on Satellite Communications and Navigation (SCN). The aforementioned working group belongs to the
Technical Committee (TC) on Satellite Earth Stations and Systems (SES) of ETSI. SCN is the ETSI working group responsible for standards covering radio and transmission aspects related to Fixed, Mobile and Global Navigation Satellite Systems operating in any bands allocated to FSS, MSS or RDSS (See Terms of Reference at [13]). It gathers industry and research centers in the area of satellite communications and navigation from Europe and beyond.

3.2.2 5GPPP
The 5GPPP [15] is a Public-Private Partnership which aims to deliver solutions, architectures, technologies and standards for the ubiquitous 5G communication infrastructures of the next decade. It is a really ambitious program with very challenging KPIs in terms of capacity, energy efficiency, latency, number of connected devices, etc.

The Public part of the Partnership is the European Commission whereas the private is the 5G Infrastructure Association, which consist of a selected group of institutions representing the industry, research centers, SMEs and other organizations. The research activities of the 5GPPP are carried out through the 5GPPP projects which are granted by the EC under the H2020 work program. However, as shown in Figure 4, the 5G Infrastructure association is structured in several working groups focused in key issues such as spectrum, pre-standardization or 5G vision which aim to guide the work of the 5GPPP.

![5G Infrastructure Association structure](image-url)

*Figure 4: 5G Infrastructure Association structure [15].*
3.3 Monitoring of outcomes produced by standardization bodies and task forces

3.3.1 ETSI Working Group on Satellite Communications and Navigation (SCN)

Within SCN, a new Working Item is being created in order to develop a technical report that will:

- Identify the 5G use case which would benefit from satellite technologies (communication and/or navigation)
- Define the relevant integration scenarios of satellite technologies (communication and navigation) into 5G
- Identify and plan the necessary standardization activities in the appropriate standardisation bodies/groups

The technical report is expected to be finalized in Q2/Q3 2016. The contributions to this technical reports will be discussed in a “5G and Sat workshop” within the next SCN physical meeting in Sophia Antipolis, on 26th January 2016.

The integration of 5G and satellite technologies is totally relevant for SANSA. Therefore, the short-term plans of our consortium is to contribute to the preparation of this technical report. To this end, CTTC have been invited to present the SANSA concept, scenarios and use cases in the 5G and Sat workshop, along with other 5G projects. In a mid and long-term, the consortium will follow the activities of the SCN working group, monitoring the outcomes of this technical report and trying to contribute to the new standards to be developed.

3.3.2 5GPPP

As described in Section 3.2.2, the 5GPPP is not a standardization body but their goal is to have a big impact on all the standards related to the future 5G networks. It is envisaged that this impact will be achieved though the dedicated working groups of the 5G Infrastructure Association. Precisely, SANSA representatives will contribute to the satellite, architectural and spectrum working groups when possible. Indeed, some of these groups are only composed by active 5GPPP project participants. Despite this inconvenience, SANSA will try to promote its project outcome through the different 5GPPP working groups.

In view of this, the SANSA consortium plans to closely follow and contribute to the discussions not only on standardization but also on spectrum for 5G. Indeed, this activity has already started with offline discussions of 5G spectrum within the spectrum working group, and with the attendance of a CTTC representative to the “5G Workshop between Regional initiatives”, held in Lisbon on 20th October 2015, and organized in conjunction with the EU ICT Lisbon conference.
4 Exploitation

Chapter 4 defines an exploitation plan, provides a market research with respect to products and services of interest to SANSA, defines deployment scenarios for SANSA technology, perform a SWOT analysis w.r.t. the aforementioned scenarios and provides the individual exploitation plan of each industrial partners covering all three aspects: Satellite Equipment Manufacturer, Satellite Operator and Terrestrial Operator.

4.1 Strategy

The objective of the exploitation strategy is to ensure the sustainability of SANSA and its outcomes beyond the project duration. The exploitation strategy aims to provide guidelines for the continuous use of the project’s results beyond the project lifetime. Moreover, the exploitation strategy focuses on reaching a broader audience to ensure that relevant stakeholders at international level, are informed about the SANSA technologies, and use them.

As part of the exploitation strategy, SANSA will identify the landscape by monitoring competition such as existing commercial products, patents, and research activities, always with an eye on standardization efforts and their outcomes.

Concurrently, the SANSA consortium will capture exploitable items, i.e., identify items generated in the context of the project, and assess them with respect to:

- the technology readiness level (TRL) (e.g., basic research, basic invention, lab demo/proof of concept, working prototype/market acceptance, scale up, market ready, market deployment), and
- the opportunities they provide for exploitation, e.g., integration in the existing business portfolio of an industrial partner.

The most promising captured items will be protected by filling patents for IP protection, while appropriate business models for their exploitation must be defined (e.g., sale, license, license to spin-out, spin out, licensing joint venture, investment joint venture, venture fund /strategic alliance), including also definition of applicable deployment scenarios.

4.2 Market research

An extensive overview of backhauling technologies, both terrestrial and satellite, has been performed in [1]. Major finding of [1] is that the mobile backhauling services that exist currently are either satellite or terrestrial, not hybrid. Satellite backhauling services are usually deployed in rural and remote areas, where it is technically difficult to install terrestrial backhaul infrastructure or the population density is very low to justify the investment. Moreover, the satellite backhaul solutions that exist today are proprietary in the sense that they are designed to meet the MNO requirements for specific deployments. The opportunity with the SANSA solution is to combine the two
backhauling services into one standardized solution that will enable easier deployment across the network of an MNO even across countries, as well as to support cooperative backhauling business models.

For the purposes of SANSA, we overviewed a number of state-of-the-art equipment for wireless (microwave) terrestrial backhaul with a focus on Ka band, which are currently provided by large vendors such as Huawei, Ericsson, Alcatel Lucent, NEC, Ruckus, Intracom Telecom, CBNL, and CCSL. A detailed overview has been provided in Section 3.1.4 of [1], which summarizes the outcome of the overview providing information (where available) focusing on characteristics such as radio technology, frequency, channel space, RF direction, switch capacity, etc., for macro cells and small cells market, respectively.

Currently, depending on geography there exist either purely terrestrial backhauling, or satellite-based backhaul solutions. The market opportunity for SANSA is to combine both backhaul types in a hybrid solution. This can be achieved by extending the functionality of existing satellite NMS, by integrating the network management in a single solution (the HNM) that coordinates the network usage. The HNM product is necessary to avoid that there is too much difficulty in operating the SANSA system. The HNM application can be used by both the MNO and the SNO, who at the same time will possibly resell capacity resources to virtual operators (SVNO, MVNO).

4.3 Deployment scenarios

In this section, we identify the business stakeholders of SANSA and define three deployment scenarios of SANSA technology based on the application scenarios specified in D2.3 [2], describing the application requirements and industrialization needs, and we discuss business aspects.

4.3.1 Stakeholders of the SANSA ecosystem

SANSA solution can be attractive for the satellite and terrestrial industry, responding to the future increasing bandwidth demands without obliging virtual operators to stack on a certain technology/segment, i.e., they do not need choosing among either terrestrial or satellite infrastructure. Apart from manufacturers, the main potential actors are a combination of main infrastructure operators, customers (Service Providers) and end-users (Subscribers):

- Terrestrial and satellite operators. Those operators own the satellite access network, and the terrestrial backhauling networks, and are impacted when the network infrastructure needs changes to be able to deploy SANSA scenarios.
- Terrestrial and satellite virtual operators (MVNO, SVNO). As network re-sellers, they define the services that will be provided to their subscribers.
- End-users. These mobile terrestrial users enjoy data services delivered to the SANSA access interfaces. In the hybrid network, user coverage will be enhanced thanks to the satellite component and the dynamic link establishment, leveraging the load in the network topology.
SANSA operators. These consist on a “hybrid operator”, that manages both terrestrial and satellite resources, owning part of the terrestrial infrastructure (through topology-deployed iBNs) hired from the SNO and the TNO. The SANSA Operator is one of the possible operators of the HNM application.

4.3.2 Broadband coverage and services in urban areas
The first deployment scenario focuses on urban areas, where backbone infrastructure is very dense and superfast. The problems that mobile networks encounter are mainly caused by the high density of nodes concentrated on a small geographic area. These problems are the main business drivers and are posing a number of challenges that have already been expressed by SANSA use cases as they have been presented in [2].

The main challenges for the urban areas are summarized below:

- High traffic especially during rush hours. Network congestion is making services too slow or unavailable for users in urban areas as they are facing quality of service and quality of experience problems. SANSA aims at providing the additional capacity needed to improve capacity and enhance the way services are provided.
- Resilience where fiber doesn’t exist. The majority of urban deployments are supported by high speed broadband infrastructure, but this is not always the case. There are still plenty of urban areas that lack this type of infrastructure. SANSA with the use of satellite links and steerable beam antennas can be the answer to the needs of these areas.
- CDN caching for efficient content delivery (e.g., 4k video) as we have already mentioned the dominant traffic type within the next years will be video. The increasing quality of video streaming will keep increasing the traffic demands for users and network infrastructure will have to support these traffic needs. SANSA aims at improving the multicasting capabilities of the existing caching systems.

4.3.3 Broadband coverage and services in rural and remote areas
As a second deployment scenario, we consider the provisioning of broadband coverage in rural and remote areas, which has been specified also in [2]. For instance, in a country such as Greece, with geographical terrain consisting by 80% of mountains, and a demographical profile including also 227 inhabited islands with low- or very low-density population in most of the cases but increasingly high number of touristic arrivals for 3-6 months annually, the flexible and dynamic support of mobile backhauling employing both terrestrial and satellite links is crucial. Moreover, provision of adequate capacity is very important, not only for IPTV and VoD services, which usually are provided with a guaranteed QoS by the Operator, but also other types of traffic, as in different case, various traffic restrictions, data caps enforcement, etc. which constitute practices of mobile operators, lead to poor data rates and performance, especially for increasingly adopted multimedia services.

Thus, in this deployment scenario, we would consider rural divisions, namely areas with less than 100 inhabitants per km², whereas areas with less than 50 inhabitants per km² are characterized as
remote areas. Providing broadband access in such areas of low and very low population density is financially problematic. In particular, operators are not willing to invest in such areas, neither for access nor for backhauling, due to the high costs of investment and to the large period for the return of their investment.

In the meantime, broadband multimedia telecommunications is considered a great asset for these type of areas since it provides same access to worldwide services, information and commercial opportunities enjoyed in large urban communities. The importance of servicing rural areas is more evident in specific case as: a) students in remote communities attending high school and university classes in real time without leaving home, interacting face to face with peers and teachers, b) medical specialists diagnosing remote patients, c) small-medium enterpizes (SMEs) extending their visibility and delivering goods and services to an unlimited circle of potential, d) goverment agencies saving substantially cost on remotely providing governmental services, etc. The resulting gains in economic sustainability and cultural self-realization for remote communities are thus very significant. Hence, rural and remote areas are a significant target of OTE/COSMOTE in the context of SANSA.

4.3.4 Broadband coverage by means of moving base-station
The third deployment scenario reflects the moving base-station scenario defined in [2]. For instance, in cruise ships, typically, are installed one or more base stations / access points to provide radio access to the passengers. Traffic is backhauled by means of a satellite link. Such a setup can greatly benefit from the capabilities of the SANSA architecture.

In this scenario, we consider a cruise ship equipped with an iBN, according to the SANSA concept, so that both a terrestrial and a satellite link are available for mobile backhauling.

The main characteristics of the cruise ship scenario are:

- Stand alone cell while cruising, using the satellite link to backhaul data, and
- Hybrid node while near the coastline, selecting the optimal link according to the link selection rules that have already been set.

4.4 SWOT analysis
In this section, we perform a SWOT analysis for the SANSA hybrid backhauling technology.
Table 5: SWOT analysis for SANSA.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Important increase of capacity available to operators, thanks to frequency reuse schemes and interference mitigation techniques.</td>
<td>Revenues coming from low-density areas demanding occasional important traffic throughput.</td>
</tr>
<tr>
<td>Scalability. Thanks to the hybrid system nature, there are several options for deploying the coverage cells. For example, remote areas willing to start the service can always start with satellite-only nodes.</td>
<td>Important opportunity for industry (antennas manufacturers).</td>
</tr>
<tr>
<td>Great network configuration flexibility, adapting to sudden traffic loads in the topology.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weaknesses</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible dependency of legacy infrastructure, decreasing network dynamicity in parts of the topology.</td>
<td>SANSA Architecture re-definition caused by not sufficiently considering emerging 5G PHY/NET standards.</td>
</tr>
<tr>
<td>Difficulty for segregation of user traffic to the satellite interface.</td>
<td>High investment for iBN development</td>
</tr>
<tr>
<td></td>
<td>High Time To Market (TTM) for the iBN product</td>
</tr>
<tr>
<td></td>
<td>Radio resources regulations not flexible enough (for being attractive to hybrid operators).</td>
</tr>
</tbody>
</table>

4.5 Individual Exploitation Plans

The existing actors in mobile networks are increased with satellite actors, as the SO/SNO/SVNO (Satellite Operator, Satellite Network Operator, and Satellite Virtual Network Operator). For the commercial deployment scenario proposed in SANSA, it is needed to combine the SVNO (having satellite resources contracted through the SNO – SVNO SLA) with the MVNO (Mobile Virtual Network Operator).

4.5.1 Satellite Equipment Manufacturer – Thales

4.5.1.1 Organization profile

Thales Alenia Space España is devoted to satellite systems design and satellite infrastructure manufacturing. The SW development is a key activity in TASE, crucial to deliver the ground segment of end-to-end systems. TASE is also very active in innovation and research programs, as a means not only to further develop its product portfolio, but also to become a key player in the integration of the satellite component for future 5G systems.
4.5.1.2 Integration of project outcomes with existing portfolio

Evolution from current NMS product design to include the HNM extension for SANSA solution has strategic importance for TASE, since it represents a step further for the integration of 5G features in the current DVB satellite management system.

The TTM (time to market) depends not only on the HNM development, but also on the design of the iBN (Intelligent Backhaul Node) solution, which though is not fully covered in SANSA.

SANSA will probably mean other important strategic opportunities for TASE, related to Ground Segment SW products. These will consist on:

- OSS/BSS integration. Since the HNM will be part of a bigger Ground Segment infrastructure, it will need to integrate itself with existing OSS solutions. Similarly, the HNM must connect to an external BSS system that administrates and cares for the different SANSA customers. Integration with both systems (OSS/BSS) is crucial not only to sell the HNM product, but to access to an end-to-end solution.

- Definition of SVNO + MVNO operator models in the HNM. Existence and involvement of these two actors (apart from the main satellite and terrestrial resellers) will determine the success of SANSA. Therefore, their role and services must be carefully defined, and then supported by the HNM.

- Definition of CDN service and integration in the Network Manager. This service was already present in terrestrial networks, but it is expected to integrate and grow in satellite interactive networks (due to intrinsic satellite multicast advantages). In a hybrid network as SANSA, considering an ambitious variety of scenarios, the CDN service contents make even more sense and need to be managed by a HNM.

4.5.2 Satellite Operator – Avanti

4.5.2.1 Organization profile

Avanti Communications is a satellite operator that sells satellite data communications services to telecoms companies which use them to supply enterprise, institutional and consumer users. Avanti’s first satellite, called HYLAS 1, launched in November 2010 and was the first superfast Ka-band satellite launched in Europe. Avanti’s second satellite, called HYLAS 2, was launched in August 2012 and extends Avanti’s coverage to Africa, the Caucasus and the Middle East. Avanti also owns a multiband satellite called ARTEMIS, with a fourth and a fifth satellite under construction called HYLAS 3 and HYLAS 4.

4.5.2.2 Integration of project outcomes with existing portfolio

As the first satellite operator to develop and deliver 3G NodeB backhaul over Ka band, Avanti is interested in developing backhaul solutions that offer bandwidth flexibility, quick deployment, scalability and reliability across the whole network of an MNO. Avanti’s clients have deployed their bandwidth for multiple applications including:
Seasonal loading – providing backhaul to holiday locations during peak season,

Fixed backhaul back-up – 100% diverse routing of cell sites to overcome cable outages,

Fast response capacity – portable backhaul capacity for emergency situations,

Network extension – for dimensioning of un-served areas, and

Cell on wheels – coverage at events, conferences, festivals, concerts.

The SANSA project is relevant to Avanti in several different fields. In particular, the solution proposed aligns with one of the core Avanti products, i.e., satellite backhauling services for MNOs, while exploring new ways to collaborate with the MNOs, opens up new market opportunities for Avanti. Moreover, SANSA entails R&D activities for the development and operation of new hybrid networks. The building blocks that are investigated for the integration of satellite and terrestrial networks in the project might be used in future Avanti ground segment designs. Additionally, the exploitation of the shared Ka band is a challenging area and proving that it can be used effectively for backhaul service delivery is an outcome to take into consideration for future deployments. Furthermore, SANSA will contribute to the development of new service provider models which are essential to a service operator. The different service provider models can be analysed and feed into future business plans and product design. Finally, this project is well aligned with the current research activities around 5G. This provides Avanti with the opportunity to gain insight and knowledge relevant for participating in other R&D projects for 5G.

4.5.3 Terrestrial Operator – COSMOTE

4.5.3.1 Organization profile

The Hellenic Telecommunications Organisation S.A. (named COSMOTE since Oct 28, 2015), member of the Deutsche Telekom (DT) Group of Companies, is the incumbent telecommunications provider in Greece. COSMOTE’s vision is to rank among the largest telecommunications companies in Europe, and through its international investments (mainly in the area of South-Eastern Europe), now addresses a potential customer base of 60 million people, making OTE the largest telecommunications provider in SE Europe. COSMOTE is the dominant telecommunications operator in Greece, and along with its subsidiaries one of the largest telecom groups in Southeastern Europe. Moreover, COSMOTE offers broadband services, fixed and mobile telephony, high-speed data communications and leased lines services. In addition, the OTE Group in Greece is involved in a range of activities including satellite communications, and in particular satellite broadcast television.

4.5.3.2 Integration of project outcomes with existing portfolio

The SANSA project is expected to contribute significantly to the reinforcement of the research activities in hybrid network architectures based on coherent end-to-end transmission in the satellite and terrestrial domain. Moreover, as COSMOTE provides both fixed and mobile communications, the development of a hybrid satellite-terrestrial network infrastructure by sharing spectrum for
backhauling of mobile communications, e.g., in remote areas and rural areas, as well as islands, or for moving base stations installed in trains and ships, will enable COSMOTE to increase its coverage and capacity, provide extra redundancy (e.g., back-up satellite links), and offload, where applicable, the burden of the metro/core network to the satellite segment. Furthermore, COSMOTE will exploit the results of SANSA project by gaining technological experience and know-how on providing dynamically terrestrial network resources in coordination with satellite resources so as to meet traffic requirements imposed by capacity demanding applications.
5 Conclusions and Next Steps

D7.1 reported on the dissemination activities of the 1st year of operation of SANSA project, and has set an initial plan for usage and dissemination of knowledge, as well as a strategy to communicate project goals and results to the research and industrial community, and mass media, while special focus will be provided for dissemination of results and know-how exchange with activities where partners are already strongly involved, such as other H2020 ICT and 5GPP projects. Dissemination-wise SANSA has been very active in Year 1, and according to the plan set, SANSA aims to keep the rate in the forthcoming years as well. In particular, important venues for dissemination have been identified and categorized w.r.t. the thematic area, and quantitative publication goals have been set for the forthcoming Year 2 and Year 3 of SANSA. Next, SANSA will start organizing, in some cases jointly with other projects, scientific, industrial and networking events for disseminating its initial outcomes and for exchanging know-how and promoting its ideas to the research and industrial community.

Moreover, D7.1 defined a standardization strategy, identifies relevant standardization bodies and activities w.r.t. SANSA foreground and activities, whose outcomes should be monitored throughout the SANSA project lifespan, and overviewed recent activities and outcomes of those bodies. Next steps comprise the identification of a list of items which may be exploitable in the context of the standardization strategy of SANSA, such as algorithms, techniques, design schemes etc. and the definition of a criteria list for the assessment of the adoption possibility of these items by the community. Out of the initial list of exploitable items for standardization, one or two most promising ones will be selected and effort will be focused upon them.

Finally, D7.1 defined an exploitation strategy the initial exploitation plan of SANSA foreground by industrial partners. In particular, D7.1: updated the market research which had been performed in [1], defined deployment scenarios and performed a SWOT analysis, while it also described initial exploitation plans by SANSA industrial participants. As next steps, SANSA will determine the roadmap for bringing SANSA solutions closer to commercial exploitation, considering wider market opportunities from new classes of applications taking advantage of SANSA approaches, especially when related to the demand for energy-efficient and spectrally efficient mobile communications, and accelerated uptake of the next generation of mobile networks and service infrastructures by achieving direct wireless links between mobile devices.
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