HEXA-X-II

A holistic flagship towards the 6G network platform and system, to inspire digital transformation, for the world to act together in meeting needs in society and ecosystems with novel 6G services

Deliverable D7.8
Impact to industry activities, standardisation and regulation – Final release

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Abstract

This document presents the activities of Hexa-X-II project on standardization impact during the second and final year activity of the project. It provides the final project progress towards the fulfilment of its objectives and complete list of standardization contributions on various standardization bodies and industry fora.

Keywords

Hexa-X-II, Standardization, Industry fora

Disclaimer

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Executive Summary

This document, Hexa-X-II Deliverable D7.8, presents the final standardization contributions of the Hexa-X-II project, a comprehensive initiative aimed at shaping and influencing the evolution of next-generation (6G) mobile communication systems. The primary objective of this report is to document the project's conclusive input to global standardization bodies, reflecting the completion of research, technical innovation, and industry alignment over the project's duration.

The document details the strategic coordination with industrial and academic stakeholders, the alignment with global 6G roadmaps, and the impact of these contributions on shaping early 6G standards. It highlights collaboration outcomes and provides recommendations for ongoing engagement in standardization efforts. The primary goal of this document is to inform the project's audience about key areas of research, achievements, results, and their impact on the various standardization forums and Standard Developing Organizations (SDOs).

The document outlines the project's contributions to various SDOs and industry fora, including 3GPP RAN, 3GPP SA, ITU, GSMA, ETSI, IETF, and IRTF. It highlights the project's engagement with key Technical Specification Groups within 3GPP, such as SA (Services and Systems), RAN (Radio Access Networks), and CT (Core Network & Terminals), as well as its involvement in relevant study groups within ITU-R and ITU-T. The document also details the project's contributions to Industry Specification Groups within ETSI, such as ZSM (zero-touch management), MEC (edge computing), THz (terahertz communications), NFV (network function virtualization), and SAI (securing AI).

The document emphasizes the project's contributions to shaping the future of 6G by influencing the evolution of mobile standards, ensuring that research results feed directly into the technologies and architectures underpinning future 6G systems. It also highlights the project's efforts to foster collaboration among SNS-JU Stream B projects, with a particular focus on identifying converging points for standardization across technological domains.

Table of Contents

1 Introduction 8
1.1 Project and Work package 7 set-up 8
1.2 Structure and main objective of WP7/Task 7.3 8
1.3 Work plan and deliverables 9
1.4 Structure of the document 9

2 Standardisation and industry group activities 10
2.1 6G standardisation timeline 10
2.2 Hexa-X-II planned contributions toward standardisation groups 11
2.2.1 Hexa-X-II standards engagement summary 13

3 Standard contributions of technical WPs of Hexa-X-II 15
3.1 WP1 key standard contributions 15
3.2 WP2 key standard contributions 17
3.3 WP3 key standard contributions 21
3.4 WP4 key standard contributions 22
3.5 WP5 key standard contributions 24
3.6 WP6 key standard contributions 25

4 Workshops 29
4.1 Joint SNS-JU stream B workshops 29
4.2 3GPP standards and SNS-JU impact Webinar 31
4.3 3GPP SA1 workshops 31
4.4 ETSI/ITU-T SG5 workshop on sustainability 32
4.5 Radio Spectrum Policy Group (RSPG) sub-group on the 6G strategic vision 33
4.6 Workshop on 3GPP and O-RAN Alliance 33

5 6G-IA pre-standardisation working group 34

6 Conclusion 35

Appendix A: Hexa-X-II partner abbreviations 36

References 38

List of Tables

Table 1: Hexa-X-II standard contributions to various SDOs and industry groups. 11
Table 2: Hexa-X-II standardisation and industrial impact during the lifetime of the project. 15
Table 3: WP1 standard and industrial impact contributions. 16
Table 4: WP2 standard and industrial impact contributions. 18
Table 5: WP3 standard and industrial impact contributions. 21
Table 6: WP4 standard and industrial impact contributions. 22
Table 7: WP5 standard and industrial impact contributions. 24
Table 9: WP6 standard and industrial impact contributions. 25

List of Figures

Figure 1: Hexa-X-II structure. 8

Figure 2: 6G standardisation timeline estimates for 3GPP and ITU/IMT (6GWS-250240, 3GPP workshop on 6G, Incheon, Korea, 10 - 11 Mar 2025) 11

Figure 3: 3GPP working groups (WGs) where Hexa-X-II has contributed. 13

Figure 4: Hexa-X-II Use cases work vs European input to the 3GPP SA1 use cases workshop in SWS-240018.zip [3gpp-s1-sns] 32

Acronyms and abbreviations

Term	Description
3GPP	The 3rd Generation Partnership Project
6G-IA	6G Smart Networks and Services Industry Association
BEREC	Body of European Regulators for Electronic Communications
DetNet	Deterministic Networking
ETSI	European Telecommunications Standards Institute
GSMA	Global system for Mobile Communications Association
ICT	Information and Communication Technologies
IETF	Internet Engineering Task Force
IRTF	Internet Research Task Force
ISG	Industry Specification Groups
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union Radiocommunication Sector
KPI	Key Performance Indicators
KVI	Key Value Indicators
NGMN	Next Generation Mobile Networks
nGRG	next Generation Research Group
RAW	Reliable and Available Wireless
SDO	Standards Developing Organisation
SNS JU	Smart Network and Services Joint Undertaking
URLLC	Ultra-Reliable, and Low-Latency Communications
WRC	World Radiocommunication Conference
ZSM	Zero touch network and Service Management

1 Introduction

Hexa-X-II is the 6G Flagship project under the European Union's Horizon Europe research and innovation program Smart Network and Services Joint Undertaking (SNS JU). The project is a holistic flagship towards the 6G platform and system to inspire digital transformation for the world to act together in meeting needs in society and ecosystems with novel 6G services.

This document is the last deliverable of Work Package 7 (WP7) – "Impact to industry activities, standardisation and regulation" and the 3rd deliverable on the series of the Hexa-X-II impact report on the standardisation and regulation. This report includes an update on the planned contributions as well as the final impact results of the Hexa-X-II project on the various standardisation bodies.

1.1 Project and Work package 7 set-up

Hexa-X-II is structured in 8 work packages, spanning a timeframe of 30 months: WP1 and WP2 are the main technical hubs of the project, where the first outputs are produced, and the results are collected and validated in the context of an end-to-end 6G system; WP3-WP6 are core technical work packages focused on the architecture and design of the technical enablers and components for 6G. WP7 and WP8 cover horizontal activities related to impact creation (with a special focus on clustering with other European Smart Networks and Services Joint Undertaking (SNS JU) projects) and project management, respectively.

Each WP has clearly defined objectives, each with a precise relationship with the overall project objectives. Furthermore, each task in each WP has a scope clearly related to one or more of the WP objectives. This structure ensures a tight and well-defined coherence across the whole project, from the overall goal to the specific objectives, research methodology, workplan objectives, single tasks, right up until the tangible results (deliverables).

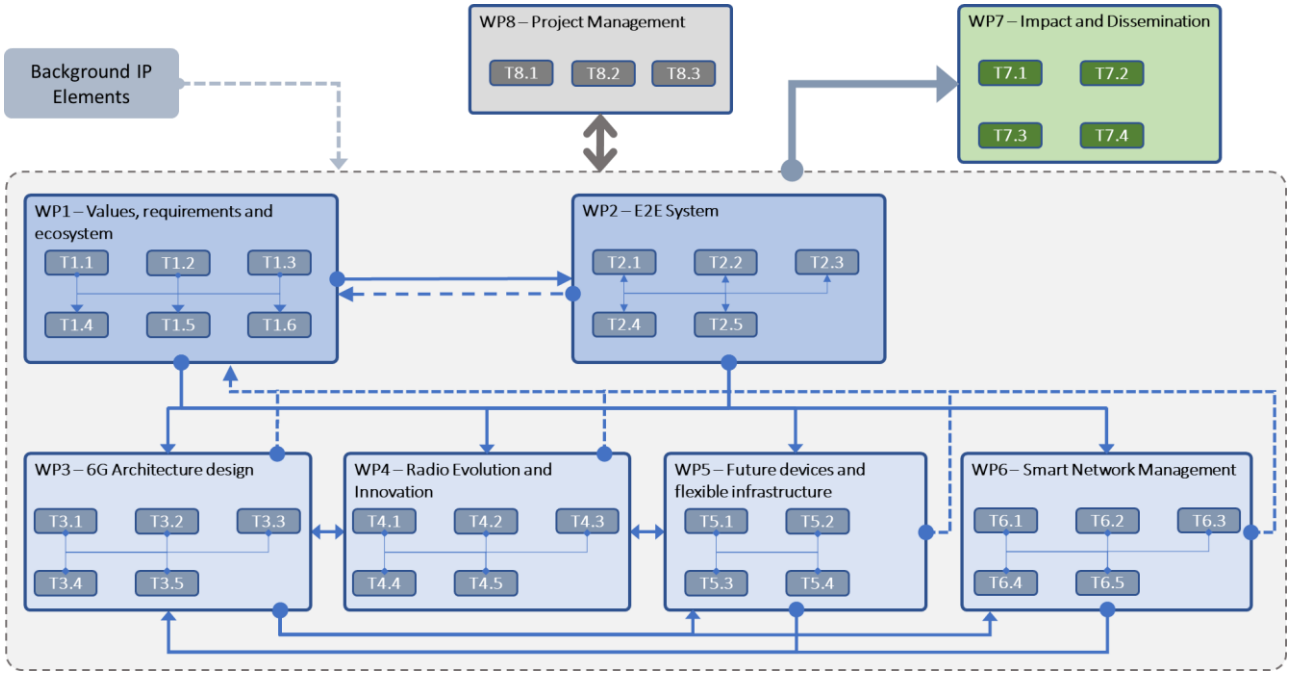

Figure 1: Hexa-X-II structure.

1.2 Structure and main objective of WP7/Task 7.3

WP7 is dedicated to collect project outcomes and promote them through dissemination, standardisation, and exploitation channels, to facilitate technology and know-how transfer to all stakeholders. The work package is also aiming to further enhance the collaboration with other EU and non-EU projects. WP7 aims to increase and facilitate the impact of the project and create awareness of the activities and its objectives. Research results developed in Hexa-X-II will be disseminated and exploited via WP7. To ensure the relevance and maximize impact, WP7 will provide a top-down standardisation plan to guide the work in WP1–6 and then identify

promising technologies provided by WP1–6 to promote in prominent standardisation development organisations.

Task 7.3 is dedicated to activities within industry, standardisation and regulation. This will be organized as 2 joint European SNS JU stream B workshops so as to communicate its results and support harmonisation across projects in assessing the performance of various concepts at the e2e system level. Stream B is about research for technology advancement toward 6G. The focus is on novel technologies that are expected to be adopted in commercial networks in a mid and/or long-term time period. Research topics considered in the 19 retained projects include, among others, novel 6G system architectures, advanced wireless and optical communication technologies, advances in Non-Terrestrial Networks, secure development of ultra-reliable, and low-latency communications (URLLC) applications. Moreover, Hexa-X-II will contribute to standardisation to exploit the impact of the project results and to justify the investments of the public funding of this project. This is approached in two ways: Firstly, Task 7.3 will strongly influence the activity of the relevant standardisation bodies and regulatory bodies. Secondly, through the 6G IA pre-standardisation working group and contributing to the 6G standardisation efforts, Hexa-X-II will analyse the standardisation gaps with respect to the SNS JU vision so that such gaps can be adequately addressed.

1.3 Work plan and deliverables

WP7 will provide the following deliverables:

- *D7.1: Online project presence* (delivered in M1). Project's website and social media channels developed from M1 and regularly updated.
- ***D7.2 Planning for dissemination, exploitation, standardisation, and clustering* (delivered in M4). Plan for dissemination (including scheduling of system-PoC demonstrations in M12, M21 and M30), exploitation (how key results can be identified, evaluated, exploited, and disseminated) and standardisation.**
- *D7.3: Dissemination, communication, and clustering - Intermediate release* (delivered in M12). It reports on dissemination and system-PoC demonstration results up to M12 and updated plan.
- *D7.4 Exploitation of key results - Intermediate release* (hdelivered in M12). It reports on key exploitable results up to M12 and updated exploitation plan.
- ***D7.5: Impact to Industry activities standardisation and regulation - Intermediate release* (delivered in M12) D7.5 report on results up to M12 and updated plan.**
- *D7.6: Dissemination, communication, and clustering – Final release* (will be delivered in M30). D7.6 provides the overview of the dissemination and demonstration results obtained.
- *D7.7: Exploitation of key results -Final release* (will be delivered in M30). D7.7 report on exploitation up to M30 and further plans.
- ***D7.8: Impact to Industry activities standardisation and regulation – Final release* (will be delivered in M30). It provides the overview of the results obtained**.

1.4 Structure of the document

The document is structured in the following way: Chapter 2 is dedicated to the 6G standardisation timeline as well as a demonstration of the updated plans for contributions from Hexa-X-II to various standardisation organizations. Chapter 3 describes the main topic from each of the Hexa-X-II technical work packages which contributed to standardisation and/or regulation bodies. Chapter 4 will go into details of the workshops Hexa-X-II organized and/or participated and contributed. In Chapter 5, the relationship and contributions of Hexa-X-II project toward 6G-IA pre-standadization working group will be drawn. The document concludes with the description of the planned next steps in Chapter 6.

2 Standardisation and industry group activities

In this section, planned contributions toward the different standardisation and regulation bodys will be detailed.

2.1 6G standardisation timeline

The 3GPP roadmap toward 6G is built on a phased and strategic evolution through its release cycle, with coordination across global stakeholders and alignment with ITU-R's IMT-2030 initiative. The timeline spans from early exploratory studies to the full normative specification and eventual commercialization of 6G technologies.

Following the momentum gained from the 3GPP 6G Workshop in March 2025, the trajectory toward 6G standardization has taken on clearer structure and alignment within the global telecommunications community. The workshop, which gathered operators, vendors, researchers, and regional standards bodies, reaffirmed the intent to approach 6G through a phased strategy, rooted in the established 3GPP release cycle. While 6G development is still in its early stages, the consensus is that its standardization will be built progressively, beginning with foundational studies and leading to full normative work by the end of the decade.

Currently, 3GPP is working on Release 19, which, while primarily focused on extending 5G-Advanced capabilities, is also laying the technical groundwork for 6G. Topics such as AI/ML-native network functions, integrated sensing, energy efficiency, and expanded support for non-terrestrial networks are being explored, providing critical insights that will form the next generation. However, the real shift toward 6G begins with Release 20, which will start in mid-2025. This release is seen as the key pre-6G phase, where broad and structured studies will be carried out to examine the feasibility of emerging technologies like sub-terahertz communication, native intelligence embedded in network architecture, new waveform candidates, and integration of communication with sensing. It is during this phase that 3GPP, in close coordination with ITU-R, will refine the technical requirements and architectural directions that 6G will ultimately take.

Between 2025 and 2027, according to Figure 2, 3GPP's focus will center on understanding the fundamental building blocks of 6G. The process begun in December 2024 (3GPP plenaries #106) with the start of the SA1 6G Study, which focuses on identifying use cases and service requirements. Around the same time, the ITU Study also begins, aiming to align 3GPP's contributions with ITU-R's IMT-2030 framework. This ITU Study continues until mid-2025, followed by the initiation of the broader RP 6G Study, which runs from mid-2025 through mid-2026.

In parallel, as the RP study progresses, additional 6G study items are launched within the 3GPP RAN and SA groups in late 2025. SA2 is tasked with exploring the system architecture needed to support 6G capabilities, and its study continues through the end of 2026. At the same time, the RAN1 6G Study starts in late 2025 and extends into early 2027, focusing on the physical layer and radio performance of 6G technologies.

By the end of 2025, the RAN2/3/4 6G Studies also begin. These cover protocol layers and further technical aspects related to the radio access network, continuing into mid-2027. Finally, Stage 3 6G studies starts around the end of 2025 and run through early 2027.

The timeline also marks two critical ITU milestones: the publication of IMT-2030 Technical Performance Requirements by the ITU-R, and the setup of evaluation criteria and templates for submissions, both occurring in late 2025. Following this, a workshop on technology proposals is held in early 2026, and actual submissions of 6G technology proposals are expected throughout 2026 and into 2027.

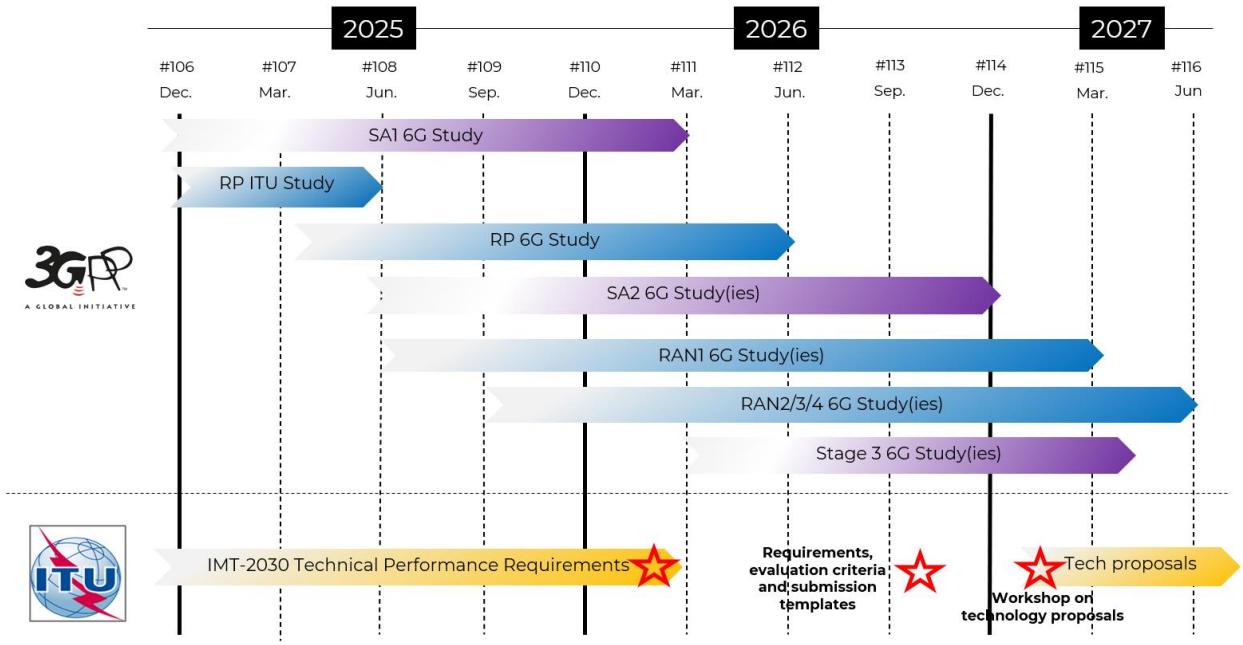

Figure 2: 6G standardisation timeline estimates for 3GPP and ITU/IMT (6GWS-250240, 3GPP workshop on 6G, Incheon, Korea, 10 - 11 Mar 2025)

2.2 Hexa-X-II planned contributions toward standardisation groups

The overall goal of Hexa-X-II is to enable a 6G platform for setting up new value creation opportunities while being trustworthy, inclusive, and sustainable. To achieve this, Hexa-X-II has defined six main objectives. As part of objective number 6: "*Impact creation towards a global and holistic 6G era*", Hexa-X-II will contribute to a holistic European view of 6G development and align with key stakeholders, with the aim of achieving globally harmonized standards. This will lead to paving the way for 6G systemisation and standardisation, through industry consensus and interactions with the scientific community. The activities of the project members toward achieving this goal will be measured in terms of the following metrics: the number of standardisation groups and European SNS JU working groups [6GSNS] addressed and contributions made, as well as the number of scientific publications, the number of contributions to whitepapers and position papers, etc. Table 2-1 represents the updated (from Deliverable D7.2 and D7.5) planned contributions from Hexa-X-II partners toward Standards Developing Organisations (SDOs) and similar organisations. The total number of submitted contributions as well as their details can be found in Section 3. The further details about those SDOs as well as key topic contributions from each technical work package can be found in the previous deliverable D7.5.

Table 1: Hexa-X-II standard contributions to various SDOs and industry groups.

SDOs	Responsible Hexa-X-II WPs	Topic scope
3GPP SA1	WP1	Use cases, corresponding requirements and key performance/value indicators
3GPP SA2	WP2, WP3	Develop the overall 3GPP system architecture and services including access network, core network

		Architecture modularisation, AI/ML usage, RAN-CN interface, UE-CN and CN-Application (e.g., network exposure) interfaces.
3GPP SA3	WP2	Security and privacy aspects, and their impact on system resilience, and the techniques to address threats. Distributed and trustworthy AI, Quantum-safe crypto Distributed ledgers, Remote attestation, Context-awareness, etc.
3GPP SA5	WP2, WP3, WP6	Intent reporting Intent conflict administration, 3rd party services. Trustworthy AI/ML-based control ML training and analysis Trustworthy management, zero-touch multiple closed loop coordination.
3GPP SA6	WP3	AI/ML model life cycle AI/ML performance degredation detection
3GPP RAN (1,2,3,4)	WP2, WP3, WP4, WP5	Radio interface architecture and protocols (e.g., MAC, RLC, PDCP, SDAP), the specification of the radio resource control protocol and the radio resource management procedures. Intelligent radio air interface design, flexible spectrum access solutions, Non-Terrestrial Networks solutions, joint communication and sensing, radio performance. Integrated sensing and communications. Evolution of cellular IoT, enhancement of RedCap devices (eRedCap), Ambient IoT (potential future topic)
ITU-R WP 5D	WP1	IMT-2030 (6G) vision and requirements.
ETSI ZSM	WP2, WP6	Security and privacy threats Intent based management, digital twins, service management automation, smart contract based closed loop governance, closed loop governance. Programmability, zero-touch automation, AI-based network management and orchestration, trustworthy management and integration fabric, interdomain network and service management. Integration fabric (reference implementation), smart contract based closed loop governance.
ETSI THz ISG	WP4, WP5	Channel modelling, sub-THz radio RF impairment modeling / sub-THz radio aspects
ETSI ISG SAI	WP2	Understanding of the risks associated to widespread use and support to AI by networks, including the realisation of relevant proofs of concept
GSMA	WP1	Use cases and requirements

IETF DetNet	WP6	Deterministic network (data plane) and orchestration (control plane)
IETF RAW	WP6	Deterministic network (data plane) and orchestration (control plane)
IETF dmm	WP6	Mobility management
IETF Security Area	WP2	On the application of attestation techniques, quantum-safe technologies, and automated certificate and key management procedures to improve security and privacy in next-generation networks.
IRTF NMRG	WP6	AI-based orchestration

2.2.1 Hexa-X-II standards engagement summary

Hexa-X-II actively contributes to various international and regional standardization bodies to help shape the future of 6G. Within **3GPP**, which is composed of seven regional standardization organizations from Europe, Asia, and North America, the project engages with key Technical Specification Groups: SA (Services and Systems), RAN (Radio Access Networks), and CT (Core Network & Terminals). Contributions span across working groups addressing service requirements, architecture, security, orchestration, and radio innovation, drawing on results from Hexa-X-II's work packages on system design, architecture, and smart management.

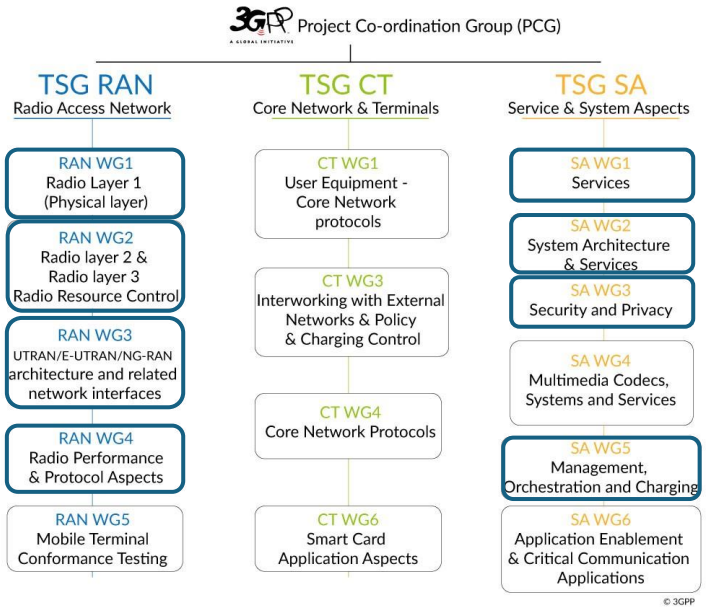

Figure 3: 3GPP working groups (WGs) where Hexa-X-II has contributed.

In the **International Telecommunication Union (ITU)**, particularly ITU-R and ITU-T, Hexa-X-II continues its involvement from the earlier Hexa-X project, influencing 6G / IMT-2030 vision,

spectrum management, and sustainability efforts. Relevant study groups include those focused on spectrum (SG1), terrestrial services (SG5), and sustainable digital transformation (ITU-T SG5).

ETSI, a foundational partner in 3GPP, is another focus area, where Hexa-X-II contributes to Industry Specification Groups such as ZSM (zero-touch management), MEC (edge computing), THz (terahertz communications), NFV (network function virtualization), and SAI (securing AI). Contributions target automation, privacy, sustainability, and cloud evolution, aligning with ETSI's open-source and environmental initiatives.

Beyond SDOs, Hexa-X-II interacts with broader alliances such as **NGMN**, contributing to its 6G vision and use cases; the **GSMA**, monitoring developments and potentially shaping discussions around industry innovation and societal impact, and 5G-ACIA on a key vertical-relevant use cases and definition of their technical requirements.

Hexa-X-II also plans to influence **IETF** and **IRTF** through targeted input to working and research groups on deterministic networking, distributed mobility, security, and AI-enhanced network management. Finally, contributions to **BEREC** aim to support EU regulatory efforts, particularly around environmental sustainability in telecoms.

3 Standard contributions of technical WPs of Hexa-X-II[1]

3GPP is one of the most important targets for standardization contributions in the Hexa-X-II project, as it defines the specifications that shape the global mobile communications ecosystem. Contributions to 3GPP are a way for the project to influence the evolution of mobile standards, ensuring that research results feed directly into the technologies and architectures underpinning future 6G systems.

To grasp better understanding of counting Hexa-X-II partner's contributions toward 3GPP, here we explain shortly how the 3GPP works and how the contributions will be evaluated.

3GPP is contribution driven and consensus driven. The acceptance process within 3GPP is rigorous and collaborative: submitted documents—such as Change Requests (CRs) or discussion papers—are first reviewed by relevant working groups and then discussed in meetings attended by member delegates. Contributions may receive various statuses based on consensus: "noted" means the content was acknowledged but not included in the specification (often used for informative or non-normative material, or non-agreed material); "approved" or "agreed" means the group accepts the contribution for inclusion; "rejected" indicates disagreement or lack of support; and "postponed" means the discussion is deferred to a future meeting, typically due to time constraints or the need for further clarification. For the counting of the 3GPP contributions, Hexa-X-II reported all including the "rejected" and "postponed" ones since they show the technical effort of the Hexa-X-II partners. These contributions are further enhanced and/or submitted to the next meeting.

The overall achievements of Hexa-X-II during the lifetime of the project are listed below in Table 2.

Table 2: Hexa-X-II standardisation and industrial impact during the lifetime of the project.

Type	Targeted by the project	Contributed to
Standards and industry groups impacted	3GPP RAN, 3GPP SA, ITU, NGMN, ORAN Alliance, nGRG, GSMA, BEREC, ETSI, TMForum, IETF, IRTF	3GPP RAN, 3GPP SA, ITU, GSMA, ETSI, IETF, IRTF
Total number of standards contributions by participants based on work in Hexa-X-II	More than 120	151

3.1 WP1 key standard contributions

WP1 aims to develop use cases, functional requirements, Key Performance Indicators (KPIs) and Key Value Indicators (KVIs).

This work can be provided as input for the 6G requirements work in 3GPP SA1 (working group in charge of use cases and service requirements within 3GPP). WP1 have made several contributions to 3GPP SA1 during the project timeline targeting the 3GPP SA1 Workshop on IMT2030 Use Cases in May 2024 (section 4.2) and the 3GPP Technical Report 22.870 "Study on 6G Use Cases and Service Requirements".

Furthermore, WP1 contributed to the requirements discussion in ITU-R WP 5D.

[1] The method of contribution to SDOs and industry groups is purely through Hexa-X-II partners. Since Hexa-X-II, as an entity is not a member of such arenas, the active partners will contribute their results which they have developed in the project as a form of contribution and in some cases also cite the Hexa-X-II project.

Table 3: WP1 standard and industrial impact contributions.

Standard contributions title	SDO	Hexa-X-II partners involved	Meeting date (DD-MM-YY)
S1-250954 / S1-250688 / S1-250666 / S1-250265 Network assisted 3D-mobility	3GPP SA1	EAB, NFR	17-02-25
S1-250970 / S1-250881 / S1-250812 / S1-250312 New use case on Cooperating Mobile Robots	3GPP SA1	SAG, TNO	17-02-25
S1-250971 / S1-250882 / S1-25838 / S1-250031 New use case on Realtime Digital Twins	3GPP SA1	NFR, TNO, TID, ORA, SAG, VOD	17-02-25
ITU-R Minimum Technical Requirements for IMT-2030	ITU-R WP5D	EAB, OUL	Jan 2025
S1-244819 / S1-244616 / S1-244602 / S1-244017 New use case on Ubiquitous and Resilient Network	3GPP SA1	ORA, NFR, TNO, TID	18-11-24
S1-244921 / S1-244906 / S1-244841 / S1-244502 / S1-244416 / S1-244030 Seamless Immersive Reality in Education	3GPP SA1	TNO, TID, ORA	18-11-24
S1-244681 / S1-244412 / S1-244018 New use case on Realtime Digital Twins	3GPP SA1	NFR, TNO, TID, ORA	18-11-24
S1-244815 / S1-244589 / S1-244435 / S1-244024 Network assisted 3D-mobility	3GPP SA1	EAB, TNO, NFR, TID	18-11-24
S1-242500 / S1-242344 / S1-242032 Proposed way forward on Key Values for SA1 6G Rel-20 / KV Manifesto for SA1 6G Rel-20	3GPP SA1	NFR	19-08-24
S1-242031 Considerations on defining Key Values for SA1 6G study	3GPP SA1	NFR	19-08-24
S1-241254 / S1-241020 Considerations on implementing Key Values for 6G study in SA1	3GPP SA1	NFR	27-05-24
S1-241237 / S1-241040 Discussion paper Key Value (KVs) and Key Value Indicators (KVIs)	3GPP SA1	ORA	27-05-24
S1-241160 Key values for SA1	3GPP SA1	EAB	27-05-24
S1-241385 / S1-241383 / S1-241288 Proposed way forward on Key Values for 6G study in SA1	3GPP SA1	NFR	27-05-24
SWS-240018 The European view on 6G use cases	3GPP SA1	EAB	08-05-24
S1-240100 An initial proposal to address key societal values in 6G in SA1	3GPP SA1	NFR	26-02-24

S1-240025 - Thoughts on the Introduction of (Key) Values in SA1	3GPP SA1	SON	26-02-24
S1-240104 Consideration for KV	3GPP SA1	EAB	26-02-24
S1-240139 Discussion on Key Values (KVs) and Key Value Indicators (KVIs)	3GPP -- SA1	VOD	26-02-24
S1-240144 Discussion on KVs and KVIs	3GPP SA1	TNO	26-02-24
S1-233584 / S1-233194Addressing KVIs in SA1 Rel-20	3GPP SA1	NFR	13-11-23
R19-WP5D-C-17588Orange-multicompany!!MSW-E(002)	ITU WP5D	ORA, TIM, TID	05-06-23

3.2 WP2 key standard contributions

WP2 aims to design a End-to-End (E2E) system blueprint aiming at a sustainable 6G platform by consolidating the enablers developed in other WPs and determining the set of concepts to be integrated in the system. It also conducts studies on the design of the radio interface and protocols, on an intent-based E2E service management automation framework and on enhancing a security, privacy, and resilience (SPR) framework, based on SPR controls to ensure the reliability and trustworthiness of the overall system.

WP2 participants have made several contributions to the 3GPP 6G workshop organized in March 2025 to elaborate on 6G system architecture relevant to the work done on the Hexa-X-II E2E system blueprint, including RAN and Core aspects, and highlighting the guiding principle that the 6G standard should be lean and ensure a smooth cooperation with 5G.

To support the solutions explored in this project, 3GPP 6G specifications will impact the specifications defining the radio protocol layers such as SDAP, PDCP, RRC, RLC, MAC, and overall RAN aspects. During the 3GPP 6G workshop, submissions include aspects relevant to lean and implementation friendly 6G radio design, native support of different 6G device types, modular protocol design (for user plane and control plane), robust and resource efficient mobility, new QoS operation in 6G based on soft QoS guarantees, multi-radio spectrum sharing with 5G, etc.

Related to intent-based management, several contributions addressed 3GPP SA5 in particular on intent-generic model and solutions in TS 28.312, such the work item on intent-driven management services for mobile network phase 2, the addition of an intent utility function overview, or adding a solution for intent report and intent handling capability obtaining. WP2 also contributed to ETSI-ZSM016 on the intent life-cycle and on the use of smart contracts for supporting the governance of intent-driven closed loops.

The aspect related to capabilities exposure is of paramount importance for the 6G platform and several contributions have been issued to 3GPP SA5, related to NaaS and management services exposure.

Related to security and privacy enablers, WP2 also made several contributions to 3GPP SA5 (TS 28.908) in the scope of AI/ML trustworthiness, including the introduction of AI/ML trustworthiness indicators, or enabling to request and report on the trustworthiness of training data used for AI/ML model deployment. Multiple contributions addressed 3GPP SA3, related to the security aspect of AI/ML for the NG-RAN and of enablers for network automation such as solutions to support authorization of participant NWDAFs in federated learning.

Table 4: WP2 standard and industrial impact contributions.

Standard contributions title	SDO	Hexa-X-II partners involved	Meeting date (DD-MM-YY)
6GWS-250006 Lean and Streamlined 6G Standards	3GPP SA/CT, RAN	APP, EAB, EBY, LMF, NDK, NFI, NFR, NGE, QLC, VGS	10-03-25
6GWS-250083 Overall vision & priorities for 6G	3GPP SA/CT, RAN	EAB, EBY, LMF	10-03-25
6GWS-250084 Overall vision & priorities for RAN in 6G	3GPP RAN	EAB, LMF, EBY	10-03-25
6GWS-250232 Ericsson`s view on Core Network for 6G	3GPP SA/CT	EAB, LMF, EBY	10-03-25
6GWS-250004 6G Radio and RAN	3GPP RAN	NDK, NFI, NGE, NFR	10-03-25
6GWS-250005 6G System and Services	3GPP SA/CT, RAN	NDK, NFI, NGE, NFR	10-03-25
6GWS-25003 6G Architecting Tomorrow	3GPP 6G WS	NDK, NFI, NGE, NFR	10-03-25
6GWS-250110 Apple’s Vision and Priorities for Next Generation Wireless Communications	3GPP 6G WS	APP	10-03-25
6GWS-250111 Apple’s Vision and Priorities for 6G RAN	3GPP 6G WS	APP	10-03-25
6GWS-250112 Apple’s Vision and Priorities for 6G SA/CT	3GPP 6G WS	APP	10-03-25
S3-234814: "Resolution of one EN (storage request update) in Security for AI/ML model storage and sharing"	3GPP SA3	EBY	06-11-23
S3-234818: "Clarify ADRF usage to be optional"	3GPP SA3	EBY	06-11-23
S3-234960: "Resolution of one Editor's Note (Interoperability ID) for Security for AI/ML model storage and sharing"	3GPP SA3	EBY	06-11-23

S3-235034: "Conveying the CCA of the source NF service consumer"	3GPP SA3	EBY	06-11-23
S3-235037: "Update flow of Nnwdaf_MLModelProvision"	3GPP SA3	EBY	06-11-23
S5-236485: "Rel-18 CR 28.312 Intent Conflict Resolution Procedure"	3GPP SA5	TID	13-10-23
ZSM(23)000181r2 - Intent LCM	ETSI ZSM	EAB, EBY	22-09-23
URSPWI_04 Doc004 "pCR on traffic category publication by app store"	GSMA URSPWI	TID	13-09-23
ZSM(23)000162r3: "ZSM016 Using smart contracts to support the governance of intent-driven closed loops"	ETSI ZSM	TID	01-09-23
S5-236013: "Rel-17 CR TS 28.312 Correct use case for delivering a service at the edge"	3GPP SA5	EAB, TID	25-08-23
S5-235851: "Rel-18 CR TS 28.312 Add solutionn for intent driven approach for intent report and intent handling capability obtaining"	3GPP SA5	TID, EAB	25-08-23
S3-233011: "AIML_NGRAN KI3 conclusion"	3GPP SA3	EBY	22-05-23
S3-233251: "Resolution of EN in the conclusion for KI#3 "Security for AI/ML model storage and sharing""	3GPP SA3	EBY	22-05-23
S3-233268: "Security for AI/ML model storage and sharing"	3GPP SA3	EBY	22-05-23
S3-232151: "Resolution of EN related to encryption in KI#3 conclusion in eNA_SEC_Ph3"	3GPP SA3	EBY	17-04-23

pCR TR28.908Potential Solution on AIML trustworthiness indicators	3GPP SA5	NGE	27-02-23
Potential Solution on AIML data trustworthiness	3GPP SA5	NGE	27-02-23
S3-231497: "Conclusions to KI#2 "Authorization of selection of participant NWDAF instances in the Federated Learning group""	3GPP SA3	EBY	20-02-23
S3-230409:"New Key issue on the security of the information transfer of the RAN AI/ML framework"	3GPP SA3	EBY	16-01-23
S3-230443:"New solution for KI#2 to support authorization of participant NWDAFs in FL"	3GPP SA3	EBY	16-01-23
S3-230510:"Adding conclusion on KI#3"	3GPP SA3	EBY	16-01-23
S5-234565 / S5-234068 "pCR TR 28.824 Modify conclusions and recommendations for management capability exposure in normative work"	3GPP SA5	TID	22-05-23
S5-234566 / S5-234069 "pCR TR 28.824 Add conclusions and recommendations for NaaS ecosystem"	3GPP SA5	TID	22-05-23
S5-232537 "NaaS ecosystem and 3GPP SA5 work on capability exposure"	3GPP SA5	TID	27-02-23
S5-232893 / S5-232538 "SA5 way forward on capability exposure topic"	3GPP SA5	TID	27-02-23
S5-232767 / S5-232417 / S5-231200 "New WID on intent-driven management service for mobile network Phase 2"	3GPP SA5	EBY	27-02-23

S5-232790 / S5-232208 pCR TR 28.912 “Add conclusion and recommendations for issues related to collaboration with other SDOs"	3GPP SA5	TID, EAB	27-02-23

3.3 WP3 key standard contributions

The main standard contributions from WP3 are mainly to the SA group for AI (SA5) and the RAN groups for NTN in two different areas: The NTN work in Hexa-X-II relates to TN-NTN multi-connectivity and NTN architecture. However, the Rel-19 work in 3GPP is currently under development so it is still unclear exactly which Hexa-X-II topic will be included here, but it is believed that at least some of the Hexa-X-II topics will be considered. There is also one WP3 activity related to the ETSI AI activity.

Table 5: WP3 standard and industrial impact contributions.

Standard contributions title	SDO	Hexa-X-II partners involved	Meeting date
Integrated Sensing and Communications (ISAC) use case for CATS (draft-bernardos-cats-isac-uc-00)	IETF CATS WG	UC3	27-02-25
Integrated Sensing and Communications (ISAC) use case for GREEN (draft-bernardos-green-isac-uc-00)	IETF GREEN WG	UC3	27-02-25
S6-245674 ML Model Performance Degradation Detection	3GPP SA6	TNO	18-11-24
S6-245672 AI/ML model information update	3GPP SA6	TNO	18-11-24
S6-245673 AI/ML model lifecycle management	3GPP SA6	TNO	18-11-24
S6-241512 - Solution #12 Update	3GPP SA6	TNO	15-04-24
S6-240771 - New Solution: AI/ML model lifecycle management	3GPP SA6	TNO	26-02-24
S6-240039 - Solution #5 update	3GPP SA6	TNO	26-02-24
ETSI Artificial Intelligence (AI) Conference - Status, Implementation and Way Forward of AI Standardization	ETSI AI	EAB, NXW, TNO, APP, ICC	05-02-24

NG_18 Doc018 "E2E Slicing user story support [E2E-S]"	GSMA NG	TID	26-10-23
TR28.908 Potential Solution and evaluation on Measurement data correlation analytics for ML training	3GPP SA5	NGE	27-02-23
TR28.908 Potential Solution and evaluation on Training data effectiveness analytics	3GPP SA5	NGE	27-02-23
TR28.908 Potential Solution and evaluation on Training data effectiveness reporting	3GPP SA5	NGE	27-02-23

3.4 WP4 key standard contributions

In Release 18 of 3GPP, specification work on NTN has been taking place to define various enhancements towards 5G-Advanced. This work includes enhancements on topics such as coverage, deployment in above 10 GHz bands, network verified UE location, mobility and service continuity, and NTN-IoT. The NTN related specifications within 5G-oriented releases of 3GPP will become an important baseline for the design of TN-NTN integrated operation in early 6G systems. Our goal within WP4 for ubiquitous connectivity and seamless TN-NTN integration has driven us to focus especially on the topic of mobility and service continuity wherein we have been providing several proposals to help RAN2 specify low-overhead and forward compatible mechanisms that will enhance NTN-NTN and NTN-TN handover procedures.

Table 6: WP4 standard and industrial impact contributions.

Standard contributions title	SDO	Hexa-X-II partners involved	Meeting date
Proposal to add "RF-EMF exposure assessment of a 6G D-MIMO deployment" as a case study to ITU-T K Supp. 32 (10/2022)	ITU-T SG5	EAB	19-05-2025
R2-2407532 Downlink coverage enhancement SMTC impacts	3GPP RAN2	SEQ	19-08-24
R2-2407537 Support of Store & Forward	3GPP RAN2	SEQ	19-08-24
R2-2405680 Soft satellite switch SSB time offset and SMTC impact	3GPP RAN2	SEQ	20-05-24
R2-2405672 [H010][H115] and skipping MIB acquisition	3GPP RAN2	SEQ	20-05-24
R2-2405757 Report of Soft satellite switch SSB time offset and SMTC impact	3GPP RAN2	SEQ	20-05-24

THz(24)000039: Terahertz molecular absorption loss based on HITRAN database	ETSI THz (WI3)	OUL	27-02-24
R2-2401393 Remaining issues on NR NTN Enhancements	3GPP RAN2	SEQ	26-02-24
ECC PT1(24)054 Additional sharing studies between WBS LMP base stations and FSS earth stations in the band 3.8-4.2 GHz	CEPT ECC PT1	EAB	18-01-24
R2-2313475 - Unchanged PCI satellite switch considerations	3GPP RAN2	SEQ	13-11-23
R2-2313481 - Support of NTN neighbor cell info in TN cell	3GPP RAN2	SEQ	13-11-23
R2-2313554 - RP of epoch time for neighbor and target cells / RP of t-Service	3GPP RAN2	SEQ	13-11-23
THz(24)000039: A channel model modification for large arrays, large bandwidth, and near-field effects	ETSI THz (WI3)	OUL	26-10-23
R2-2311212 - Common signalling of HO common information	3GPP RAN2	SEQ	09-10-23
R2-2311223 - “Unchanged PCI” solution vs “PCI change only” solution	3GPP RAN2	SEQ	09-10-23
R2-2308753 “Unchanged PCI” solution vs “PCI change only” solution	3GPP RAN2	SEQ	21-08-23
R2-2308755 Common signalling of HO common information	3GPP RAN2	SEQ	21-08-23
R19-WP5D-C-1740!!MSW-E 100GHz Ericsson	ITU WP5D	EAB	05-06-23
R2-2306453 NTN-NTN handover enhancements	3GPP RAN2	SEQ	22-05-23
R2-2306663 Correction on MIB configuration for NR NTN	3GPP RAN2	SEQ	22-05-23
R2-2306517 “Unchanged PCI” solution vs “PCI change only” solution	3GPP RAN2	SEQ	22-05-23
R2-2304134 NTN-NTN handover enhancements	3GPP RAN2	SEQ	17-04-23
R2-2304137 HO/CHO Signaling Overhead Reduction by NTN-config omission	3GPP RAN2	SEQ	17-04-23

R2-2304147 Considerations on unchanged PCI solution	3GPP RAN2	SEQ	17-04-23
R2-2301864 NTN-NTN handover enhancements	3GPP RAN2	SEQ	27-02-23
R2-2301866 HO/CHO Signaling Overhead Reduction by NTN-config omission	3GPP RAN2	SEQ	27-02-23

3.5 WP5 key standard contributions

WP5 studies, designs, and prototypes technological hardware and software enablers for future 6G devices and infrastructure. Starting from the characterisation of device classes derived from 6G use cases identified in WP1 (Work Package Objective (WPO) 5.1), we study hardware and RF transceivers (WPO5.2), specialized SoC connectivity solutions (WPO5.3), and energy- and cost-aware design methodologies (WPO5.4). Specifically, related to WPO5.4, WP5 studies how to integrate ultra-low-power (e.g., enhanced reduced capability (eRedCap), zero energy, or ambient IoT) devices into the 6G network architecture. This requires specific protocol and network architecture adaptations which are under consideration in 3GPP standardisation. WP5 participants have made several contributions to 3GPP standardisation related to both eRedCap (Rel-18), and Ambient IoT (Rel-19). For eRedCap specifically, we have been contributing to the Rel-18 work item "Enhanced support of reduced capability NR devices" (eRedCap) which targeted to cover the capability and cost gap between Rel-17 RedCap and LTE-based IoT device solutions, becoming fitted for the lower-end broadband IoT applications. We envisage RedCap/eRedCap UE overall specification design becoming an important baseline for future early 6G UE solutions to address cellular IoT.

Table 7: WP5 standard and industrial impact contributions.

Standard contributions title	SDO	Hexa-X-II partners involved	Meeting date (DD-MM-YY)
R2-2500863 UL multiple access for Ambient IoT	3GPP RAN2	LMF	07-02-25
R1-2500035 Timing acquisition and synchronization for Ambient IoT	3GPP RAN1	LMF	07-02-25
R2-2410152 UL multiple access for Ambient IoT	3GPP RAN2	LMF	08-11-24
R1-2409389 Frame structure and timing aspects for Ambient IoT	3GPP RAN1	LMF	08-11-24
R2-2408688 UL multiple access for Ambient IoT	3GPP RAN2	LMF	04-10-24
R1-2407639 Frame structure and timing aspects for Ambient IoT	3GPP RAN1	LMF	04-10-24
R2-2406786 UL multiple access for Ambient IoT	3GPP RAN2	LMF	09-08-24
R1-2405827 Frame structure and timing aspects for Ambient IoT	3GPP RAN1	LMF	09-08-24

S2-2407739 KI#1, #2, #3, New Solution: UP Solution using AIOTF for Topology 1	3GPP SA2	LMF	09-08-24
S2-2406133 KI#1, #2, #3, New Solution: UP Solution using AIOTF for Topology 1	3GPP SA2	LMF	17-05-24
R1-2403843 Frame structure and timing aspects for Ambient IoT	3GPP RAN1	LMF	10-05-24
R2-2404499 UL multiple access for Ambient IoT	3GPP RAN2	LMF	03-05-24
R2-2402951 On UL multiple access for Ambient IoT	3GPP RAN2	LMF	05-04-24
R1-2401973 Frame structure and timing aspects for Ambient IoT	3GPP RAN1	LMF	05-04-24
R1-2401401 Discussion on DL and UL channel/signal aspects for Ambient IoT	3GPP RAN1	SEQ	26-02-24
R1-2401402 Discussion on frame structure and timing aspects for Ambient IoT	3GPP RAN1	SEQ	26-02-24
R1-2400078 Frame structure and timing aspects for Ambient IoT	3GPP RAN1	LMF	16-02-24
R2-2311197 - Msg1 Early Indication for eRedcap	3GPP RAN2	SEQ	09-10-23
R1-2305868 Considerations for Rel-18 eRedCap UE complexity reduction	3GPP RAN1	SEQ	22-05-23
R1-2303847 Considerations for Rel-18 eRedCap UE complexity reduction	3GPP RAN1	SEQ	17-04-23

3.6 WP6 key standard contributions

WP6 is in charge of designing and implementing smart network management and orchestration enablers for 6G. One of the key works performed in WP6 is related with the evolution of so-called software networks technologies, this is related to the virtualisation of networks and how cloud technologies play a key role on 6G more that it was even in 5G, as well as Software Defined Networking (SDN). In this regard several contributions have been made to IETF on different aspects, e.g., new architectural SDN control plane with data awareness improvements as well as involving deterministic networking. Besides, several contributions have been performed to ETSI ZSM group which is a key reference regarding zero-touch management and one of the main objectives in WP6. Those contributions are related to intent-based management and the close loop governance specification to improve network automation.

Table 8: WP6 standard and industrial impact contributions.

Standard contributions title	SDO	Hexa-X-II partners involved	Meeting date (DD-MM-YY)

An Evolution of Cooperating Layered Architecture for SDN (CLAS) for Compute and Data Awareness (draft-contreras-coinrg-clas-evolution-02)	IRTF COINRG	TID, UC3	03-11-23
S5-235170: "Rel-18 CR TS 28.541 Add NRM for network slice isolation"	3GPP SA5	NFI, TID	03-11-23
S5-234586: "Add NetworkSliceController and NetworkSliceSubnetController IOCs to support asynchronous LCM operations"	3GPP SA5	NFI, TID, EAB	25-08-23
S5-234587: "Update Procedure of Network Slice Instance Allocation to support asynchronous operations"	3GPP SA5	NFI, TID, EAB	25-08-23
S5-234588: "Update Procedure of Network Slice Instance deallocation to support asynchronous operations"	3GPP SA5	NFI, TID, EAB	25-08-23
S5-234589: "Update Procedure of Network Slice Instance Modification to support asynchronous operations"	3GPP SA5	NFI, TID, EAB	25-08-23
S5-234590: "Update Procedure of Network Slice Subnet Instance Allocation to support asynchronous operations"	3GPP SA5	NFI, TID, EAB	25-08-23
S5-234591: "Update Procedure of network slice subnet instance deallocation to support asynchronous operations	3GPP SA5	NFI, TID, EAB	25-08-23
S5-234592: "Update Procedure of Network Slice Subnet Instance Modification to support asynchronous operations"	3GPP SA5	NFI, TID, EAB	25-08-23
S5-234716: "InputToDraftCR Rel-18 28.533 on Access control for management service"	3GPP SA5	NFI, TID	25-08-23
S5-234742: "Rel18 CR TS 28.541 Improve EP_Transport model to clarify connection point info"	3GPP SA5	NFI, EAB, TID	25-08-23
S5-236015 (Rel-17) / S5-236016 (Rel-18): " CR TS 28.312 Add missing stage 3"	3GPP SA5	EAB, TID	21-08-23
MIPv6 RAW mobility (draft-bernardos-detnet-raw-mobility-02)	IETF DetNet WG	UC3	26-05-23
Intent-driven Closed Loops Introduction	ETSI ZSM	EBY, EAB	26-05-23

Governing intent-driven closed loop and additional services	ETSI ZSM	EBY, EAB	26-05-23
ETSI ZSM: Additional Services and Capabilities	ETSI ZSM	EBY, EAB	26-05-23
Intent-driven Closed Loop Governance Service	ETSI ZSM	EBY, EAB	26-05-23
S5-232907: "Rel-18 CR 28.541 Fix vague issues in EP_Transport with Federated network Modelling"	3GPP SA5	NFI, TID	26-05-23
S5-232948: "pCR TR 28.836 Add solutions for expresing service and slice profile requirements as intent expectations"	3GPP SA5	TID	26-05-23
S5-233058: "Proposed way forward for NSRULE isolation topic"	3GPP SA5	TID	26-05-23
S5-233092: "DP on relationship between NEST, URSP and ServiceProfile"	3GPP SA5	TID	26-05-23
S5-233896: "Add stage 3 for data type AvailabilityStatus"	3GPP SA5	NFI, TID, EAB	26-05-23
S5-234698: "Discussion paper on isolation and sharing"	3GPP SA5	EAB, TID	26-05-23
S5-235946: "InputToDraftCR Rel-18 28.533 on Access control related to ConditionForMOIs"	3GPP SA5	NFI, TID	26-05-23
S5-235947: "InputToDraftCR Rel-18 28.533 on Access control related to PermissionsForMnSs"	3GPP SA5	NFI, TID, EAB	26-05-23
S5-237203: "DP on Service Management in SA5"	3GPP SA5	TID, EAB	26-05-23
S5-237047: "Rel-18 CR TS 28.533 Add example of RAN domain management capabilities mapped with ZSM"	3GPP SA5	TID	26-05-23
S5-237082: "Rel-18 CR TS 28.541 Add NRM for network slice isolation"	3GPP SA5	NFI, TID	26-05-23
S5-237174: "pCR 28.836 Enhance benefit description in 4.6"	3GPP SA5	EAB, TID	26-05-23
Network resource allocation for Gaming using MEC BandWidth Management service and TeraFlowSDN	ETSI ZSM	CTT, TID	26-05-23
Deterministic Networking (DetNet) Controller Plane Framework (draft-	IETF DetNet WG	UC3	03-03-23

ietf-detnet-controller-plane-framework-09)			
S5-235344: "pCR TR 28.836 Remove figure of how ServiceProfile can be represented by intent expectation components"	3GPP SA5	TID	03-03-23

4 Workshops

4.1 Joint SNS-JU stream B workshops

This section highlights the critical role of standardization in the consolidation of research efforts across projects. It examines how contributions from various SNS-JU Stream B (B01, B02, B03, B04) projects can be synthesized into cohesive, widely accepted standards. As a flagship initiative, **Hexa-X-II** has taken the lead in fostering this collaboration by organizing two dedicated workshops aimed at aligning architectural and standardization efforts across the ecosystem. These workshops were co-organized with Work Package 2 (WP2).

1st Workshop – Jan 2024:

In close coordination with WP2, Hexa-X-II selected eight projects—two from each of the four strands—based on their architectural enablers and standardization activities, ensuring meaningful alignment with Hexa-X-II's objectives. Below is a summary of their contributions to SDOs presented during the workshop. Due to different timeline and scope of participating projects, some of them did not report any standardization activity at the time of the workshop:

B01: System Architecture

- DETERMINISTIC6G
    - No standard contribution reported
- DESIRE6G
    - No standard contribution reported

B02: Wireless Communication Technologies and Signal Processing

- TERRAMETA:
    - Contributed 2 submissions to IEEE 802.15 SC THz
    - Submitted 5 contributions to ETSI ISG THz under WI#1 (Use Case Identification for THz Communication Systems)
- TIMES:
    - ETSI ISG THz
        - 4 use cases included in final ISG THz Group Report
        - Industrial THz channel measurements contributed
    - COST INTERACT
        - Joint Technical Documents on channel measurements and modelling

B03: Communication Infrastructure Technologies and Devices

- FLEX-SCALE
    - No standard contribution reported
- 6G-NTN:
    - Active contributions to 3GPP SA1 and SA2
    - Engagement with ITU-R, particularly in WP5D and WP4B

B04 Secure Service development and Smart Security

- RIGOUROUS
    - No standard contribution reported

- HORSE:
    - Contributed to ETSI ENI GR 035 introducing the concept of Digital Twinning for enhanced autonomicity
    - Active involvement in:
        - IRTF NMRG
        - ETSI ETI, ENI, SAI, ZSM
        - 3GPP SA3
        - IETF / IRTF

2nd Workshop – October 2024:

Building on the momentum of the first workshop, the second Hexa-X-II (WP2/WP7) workshop further deepened collaboration among SNS-JU Stream B projects, with a particular focus on identifying converging points for standardization across technological domains. A total of **nine projects** participated, each selected for their relevance to the architectural vision and their active engagement in standardization initiatives.

- ADROIT-6G
    - Contributions to ETSI ENI WG on crowdsourcing AI solutions to reduce AI/ML carbon footprint
    - Engagement with ETSI ZSM and ETSI MEC WGs
    - Introduction of the UE–VBS computing continuum concept to 3GPP SA1
    - Contributions to 3GPP SA2 on NTN/6G integration solutions
- PREDICT-6G
    - Contribution to IEEE 802.1 regarding TSN-related switching
    - Engagement with 3GPP on integration with TSN and DetNet
    - Active participation in IETF DetNet and discussions on Service Access Point and Provider Edge
    - Input to IRTF on Network Digital Twins
- DESIRE-6G
    - Continued alignment on architectural principles and standardization direction (details to be updated as project progresses)
- ETHER
    - Contributions to ETSI OSM via the ETHER MANO framework
    - Engagement with ETSI MEC to support edge-related advancements
- 6G-SHINE
    - Innovation in subnetwork architecture, with potential impact on 3GPP Release 20/21
    - Contributions to 3GPP SA1 on use cases and requirements related to subnetworks for 6G
- TERA6G
    - Actively exploring sub-THz technologies; contributions to standardization to be tracked and expanded in future phases
- 6GTandem
    - Participation in ETSI workshops
    - Engaged in 3GPP, though facing challenges in identifying clear standardization paths for sub-THz systems

- CENTRIC
  - Monitoring key standardization bodies focused on 6G and AI-driven design
  - Aiming to promote impactful, novel, and IPR-protected AI-based telecom enablers
  - Strategic intent to shape specifications through contributions at the right time
- CONFIDENTIAL6G
  - Participation in the ETSI Security Conference
  - Contributions to ISO WG2 and WG11
  - Coordinated efforts to propose standards to 3GPP, ETSI, and IETF on topics such as:
    - Privacy preservation
    - Confidential computing
    - Confidential networking in the context of 6G architecture

4.2 3GPP standards and SNS-JU impact Webinar

The "3GPP Standards and SNS-JU Impact: Best Practices and Success Stories" webinar, held on March 27, 2025, focused on the significance of standardization in European research projects, particularly within the SNS-JU ecosystem. The event highlighted the role of 3GPP as a pivotal standards body influencing SNS-JU project outcomes.

Key Highlights:

- **Overview of 3GPP Standardization:** Jose Luis Almodovar Chico, Chair of 3GPP SA1 and Hexa-X-II partner and task lead, provided insights into the current activities and structure of 3GPP, emphasizing its relevance to European research initiatives.
- **Best Practices and Success Stories:** Experts from leading organizations shared their experiences:
  - Mikko Uusitalo, coordinator of Hexa-X-II from Nokia discussed contributions from the Hexa-X-II flagship project.
  - Daniel Lönnblad (Ericsson) and Devaki Chandramouli (Nokia) shared their perspectives as SA1 and SA2 delegates, respectively.
- **Round Table Discussion:** The webinar concluded with a panel discussion focusing on effective strategies for translating research outcomes into impactful standard contributions.

This webinar served as a platform for researchers and industry professionals to understand the importance of standardization, gain insights into 3GPP processes, and learn how to enhance the impact of their projects through active participation in standardization efforts.

4.3 3GPP SA1 workshops

In May 2024, 3GPP organized in the city of Rotterdam the “3GPP SA1 Workshop on IMT2030 Use Cases” [3GPP-ws1]. Chaired by the SA Chair (Puneet Jain) and the SA1 Chair (Jose Luis Almodovar Chico), the workshop gathered for the first time operator associations (e.g., GSMA, NGMN), vertical associations (e.g., 5GAA, 5G-ACIA, 5G MAG, Broadband Forum), and six important Research Alliances worldwide (B5GPC– Japan, 6G Forum– S. Korea, IMT2030 Promotion Group – China, Bharat 6G Alliance – India, NextG Alliance – North America and 6G SNS – Europe). The mission of the workshop was to bring 3GPP closer to the ongoing initiatives of various global/regional research organizations and Market Representation Partners related to 6G use cases.

3GPP asked the six research alliances to present their views in 6G and in 6G use cases. For the European context, 3GPP contacted the SNS-JU who assigned the task of the presentation to the project SNS-ICE. As time was limited, SNS-ICE decided to build on the work done on 6G use cases by the flagship project Hexa-

X-II as the basis for the contribution. All the SNS-JU phase 1 research projects and also the different national initiatives were asked to review and provide feedback on the 6G use cases provided by Hexa-X-II, but also to suggest the inclusion of new use cases which had not been considered initially by Hexa-X-II. This process, with a duration of 3 weeks, allowed to strengthen this initial set of use cases, but also complement it with other relevant identified applications. Once all inputs were gathered, they were thoroughly discussed and merged to build the final input for the workshop.

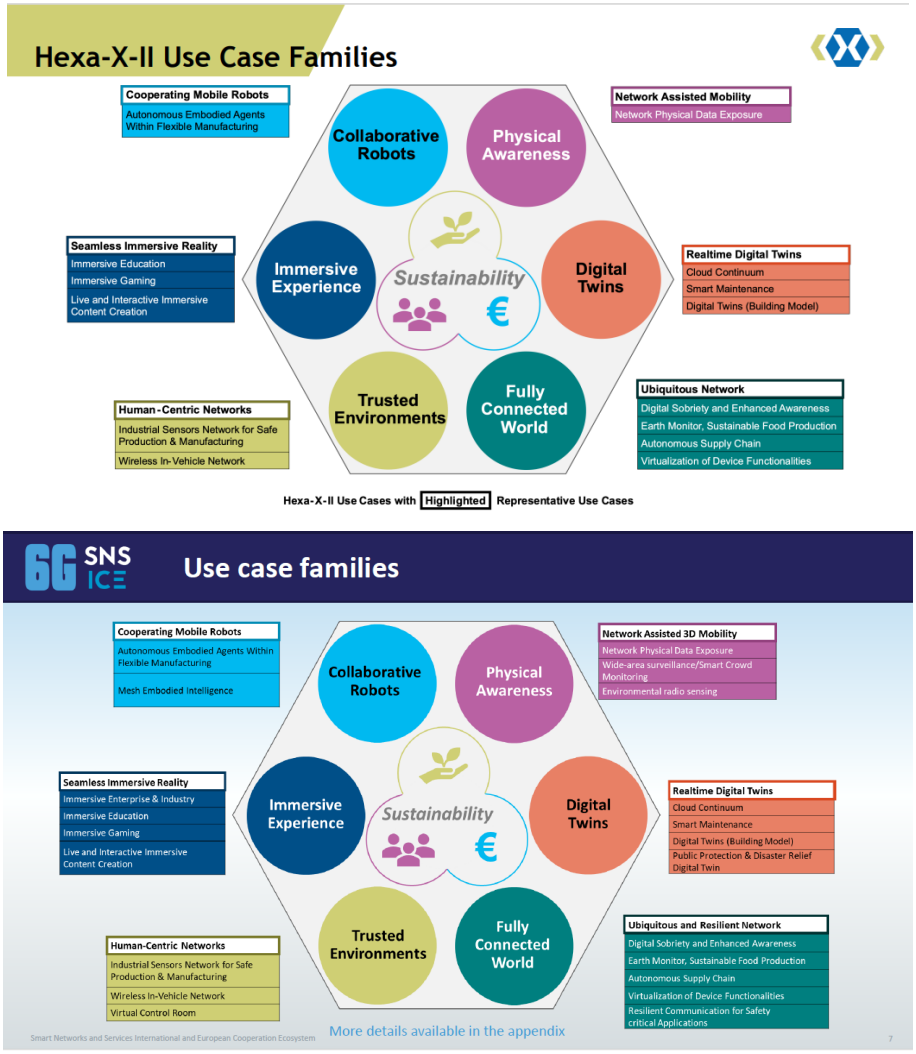

Figure 4: Hexa-X-II Use cases work vs European input to the 3GPP SA1 use cases workshop in SWS-240018.zip [3gpp-s1-sns]

The presentation was given by the Dr. Gustav Wikström (member of Hexa-X-II) and can be found at the 3GPP website of the seminar [3GPP-ws1]. The organization of the process and meetings, the collection of input, processing and the production of the final set of use cases presented at the workshop were all led by SNS ICE with critical contributions from Hexa-X-II, 6G-IA and SNS JU personnel.

4.4 ETSI/ITU-T SG5 workshop on sustainability

In December 2024, a workshop on sustainability for telecommunications networks took place at the ITU Headquarters in Geneva. This event was jointly organized by ITU-T SG5 and ETSI EE (Environmental Engineering). These workshops are periodically held by the two SDOs, which are highly active in sustainability topics, often producing corresponding specifications and recommendations. Numerous liaisons link the work of ITU-T SG5 and ETSI EE, particularly between Question 6/5 in ITU-T SG5 and the EEPS technical committee in ETSI EE. These groups are responsible for, among other topics, the energy efficiency of mobile networks and equipment. Most of the metrics and thresholds in the European Code of Conduct, supported by the European Commission, originate from these organizations.

At the December 2024 workshop, Hexa-X-II was represented by several delegates, particularly those working in Work Package 1. Stefan Wendt from Orange, the WP1 leader, gave a presentation on the work performed on terminology and the discussions and outcomes related to handprints and footprints in the project. Mauro Boldi, the WP7 leader, contributed to the organization of the workshop being also the vice-chairman of the ETSI EE-EEPS committee and the Rapporteur for recommendations and specifications on network-level energy efficiency metrics and measurement methods in both SDOs.

The event was widely attended at an international level, and the proposals presented by Hexa-X-II on the highly discussed topic of 6G sustainability were positively received. This paved the way for updating the specifications towards the forthcoming standardization of 6G.

4.5 Radio Spectrum Policy Group (RSPG) sub-group on the 6G strategic vision

Radio Spectrum Policy Group (RSPG) hearing on 6G took place on September 27th, 2024. Hexa-X-II had been invited to present. Project lead Mikko Uusitalo presented an overview of the status of Hexa-X-II as well as material on several pre-set question areas. Answers were given related to use cases for future spectrum needs, role of private networks in 6G, role of license exempt spectrum, sustainability and security and view on non-terrestrial networks.

4.6 Workshop on 3GPP and O-RAN Alliance

A joint workshop between 3GPP and O-RAN Alliance was conducted in the ETSI headquarter in Sofia Antipolis, France, April 24th and 25th 2025. The workshop had 104 physical attendees, and 289 attendees registered online.

The 3GPP SA Chair, Puneet Jain chaired the workshop with support from the 3GPP RAN vice chair, Axel Klatt and the O-RAN co-chairs, Doug Knisely and Kai Ando.

Both organizations presented themselves.

Several input documents were provided, proposing how the two organizations could interact, collaborate and split the work between them. Some of the Hexa-X-II partners had been active in providing conscious input to prepare some middle-ground for cooperation between the two organizations. However, as the workshop had no decision power, no conclusion was reached. All the input documents were noted.

The Summary slides from the workshop were provided in 3ORW-250035. This was contributed to the 3GPP PCG meeting in May and the 3GPP plenary meetings in June by the chairs. The O-RAN leadership will contribute this summary to the upcoming O-RAN meeting.

The workshop was a first important step to pave the way for an open disaggregated 6G radio access network to emerge.

5 6G-IA pre-standardisation working group

The 6G Smart Networks and Services Industry Association (6G SNS-IA) is the voice of European industry and research for next generation networks and services. Its primary objective is to contribute to Europe's leadership on 5G, 5G evolution and SNS/6G research. The 6G-IA represents the private side in both the 5G Public Private Partnership (5G-PPP) and the SNS JU. In the 5G-PPP and SNS JU, the European Commission represents the public side. The 6G-IA brings together a global industry community of telecoms and digital actors, such as operators, manufacturers, research institutes, universities, verticals, SMEs and ICT associations. The 6G-IA carries out a wide range of activities in strategic areas including standardisation, frequency spectrum, R&D projects, technology skills, collaboration with key vertical industry sectors, notably for the development of trials, and international cooperation.

In particular the 6G-IA pre-standardisation working group has the following main goals:

- To identify standardisation and regulatory bodies to align with e.g., ETSI, 3GPP, IEEE and other relevant standards bodies, ITU-R (incl. WPs) and WRC (including e.g., ECC PT1).
- To develop a roadmap of relevant standardisation and regulatory topics for 6G: Evaluate existing roadmaps at the international level; Propose own roadmap for 6G being aligned at the international level.
- To influencinge 6G pre-standardisation and related R&D: Potentially propose where topics should be standardised; Influence timing on R&D work programs (e.g., EC WPs)

Hexa-X-II seeks to use standardisation as a means to exploit the impact of the project results and to justify the investments of the public funding of this project. This is approached in two ways: Firstly, it will endeavour to strongly influence the activity of the relevant standardisation bodies and secondly, through the 6G IA pre-standardisation working group and contributing to its 6G standardisation efforts.

6 Conclusion

In conclusion, the Hexa-X-II project has made significant contributions to the standardization landscape for 6G mobile communication systems. Through its collaborative efforts with industry and academia, the project has successfully aligned its research and innovation with global 6G roadmaps, influencing the development of early 6G standards. The project's deliverables, documented in this report, provide a comprehensive overview of its contributions to various standardization bodies, including 3GPP, ITU, GSMA, ETSI, IETF, and IRTF.

The project's impact extends beyond technical contributions, fostering collaboration among SNS-JU Stream B projects and identifying converging points for standardization across technological domains. This collaborative approach has ensured that research results are effectively translated into practical applications, shaping the future of 6G and driving the evolution of mobile communication technologies.

As the project concludes, its legacy will continue to influence the development of 6G standards. The project's commitment to ongoing engagement in post-project standardization efforts ensures that its insights and expertise will remain valuable resources for the global 6G community. The Hexa-X-II project serves as a testament to the power of collaborative research and innovation in shaping the future of mobile communication, paving the way for a more connected and digitally transformed world.

Appendix A: Hexa-X-II partner abbreviations

Part. No.	Participant organisation name	Part. Short name	Country
1	NOKIA SOLUTIONS AND NETWORKS OY	NFI	FI
2	ERICSSON AB	EAB	SE
3	AALTO KORKEAKOULUSAATIO	AAU	FI
4	ALCATEL-LUCENT INTERNATIONAL	NFR	FR
5	APPLE TECHNOLOGY ENGINEERING B.V. & CO. KG	APP	DE
6	ATOS IT SOLUTIONS AND SERVICES IBERIA SL	ATO	ES
7	ATOS SPAIN SA ES	ASA	ES
8	CENTRE TECNOLOGIC DE TELECOMUNICACIONS DE CATALUNYA	CTT	ES
9	CHALMERS TEKNISKA HOGSKOLA AB	CHA	SE
10	ERICSSON ARASTIRMA GELISTIRME VE BILISIM HIZMETLERI ANONIM SIRKETI	EBY	TR
11	INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS	ICC	EL
12	INTERUNIVERSITAIR MICRO-ELECTRONICA CENTRUM	IMEC	BE
13	LULEA TEKNISKA UNIVERSITET	LTU	SE
14	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO	TNO	NL
15	NEXTWORKS	NXW	IT
16	NOKIA SOLUTIONS AND NETWORKS DANMARK AS	NDK	DK
17	NOKIA SOLUTIONS AND NETWORKS GMBH &CO KG	NGE	DE
18	ONE REALITY	ONR	SE
19	OPTARE SOLUTIONS SL	OPT	ES
20	ORANGE POLSKA SPOLKA AKCYJNA	OPL	PL
21	ORANGE SA	ORA	FR
22	OULUN YLIOPISTO	OUL	FI
23	OY L M ERICSSON AB	LMF	FI
24	PROMOZIONE PER L INNOVAZIONE FRA INDUSTRIA E UNIVERSITA ASSOCIAZIONE	PIU	IT
25	QAMCOM RESEARCH AND TECHNOLOGY AB	QRT	SE
26	QUALCOMM COMMUNICATIONS SARL	QLC	FR
27	SAS IDATE	IDA	FR
28	SEQUANS COMMUNICATIONS SA	SEQ	FR

29	SIEMENS AKTIENGESELLSCHAFT	SAG	DE
30	SIEMENS AKTIENGESELLSCHAFT OESTERREICH	SAT	AT
31	SIEMENS INDUSTRY SOFTWARE OY	SIS	FI
32	SONY NORDIC (SWEDEN), BRANCH OF SONY EUROPE B.V. (NL)	SON	SE
33	TECHNISCHE UNIVERSITAET DRESDEN	TUD	DE
34	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY	VTT	FI
35	TELECOM ITALIA SPA	TIM	IT
36	TELEFONICA INVESTIGACION Y DESARROLLO SA	TID	ES
37	TELENOR ASA	TNR	NO
38	UBIWHERE LDA	UBW	PT
39	UNIVERSIDAD CARLOS III DE MADRID	UC3	ES
40	VODAFONE GROUP SERVICES GMBH	VGS	DE
41	WINGS ICT SOLUTIONS INFORMATION & COMMUNICATION TECHNOLOGIES IKE	WIN	EL
42	BARKHAUSEN INSTITUT GGMBH	BI	DE
43	NXP SEMICONDUCTORS GERMANY GMBH	NXP	DE
44	TECHNISCHE UNIVERSITAET KAISERSLAUTERN	TUK	DE

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