

Introduce outcome of Research work in 3GPP SA1

Overview of SA1 WoW and how Research work is
adopted to standardization

Outline

Introduction of SA1

Example use case form Hexa-X-II

Take aways

Introduction of SA1

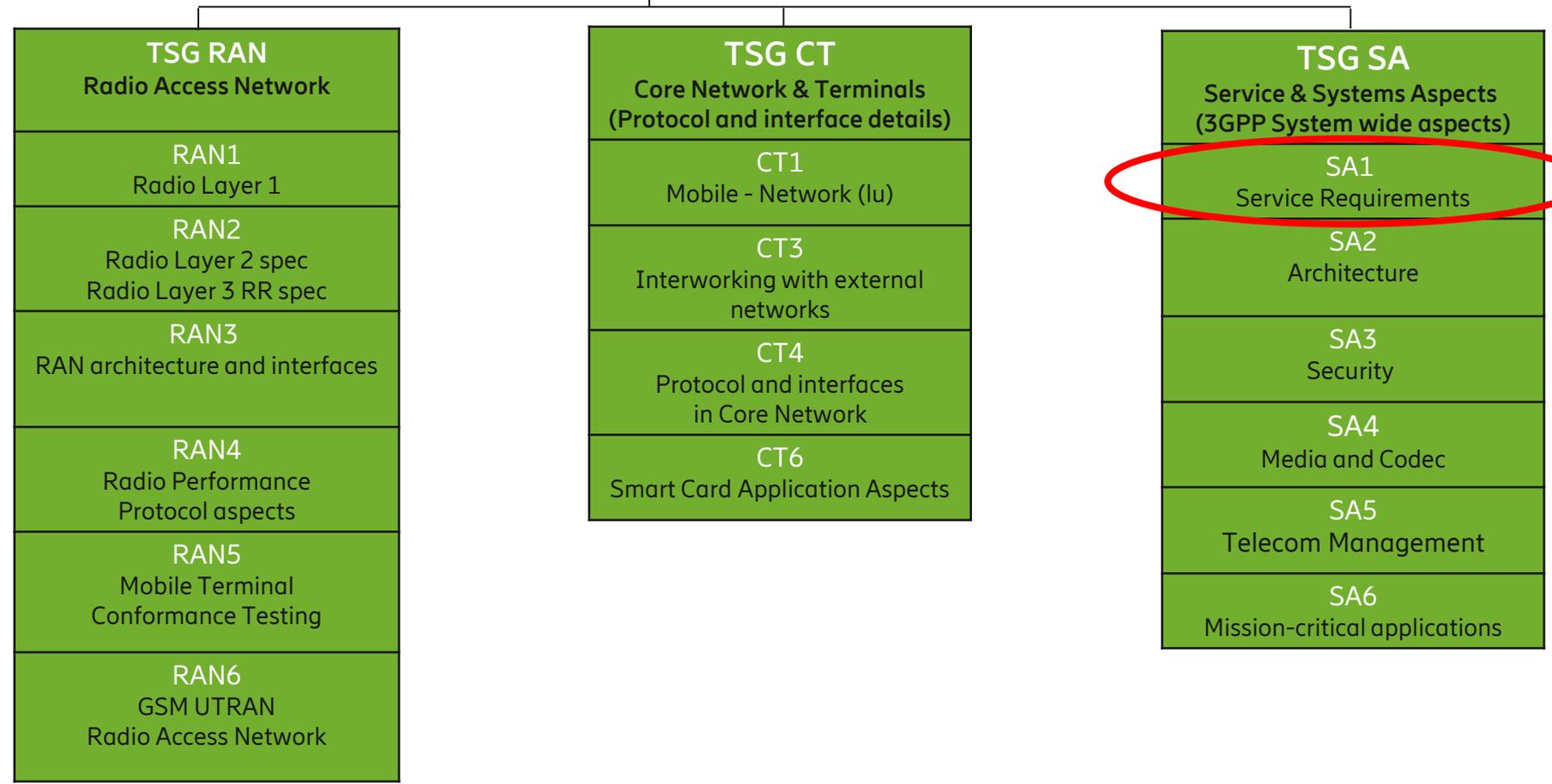
Background

Project Coordination Group (PCG)

TSG RAN, CT and SA plenary meet four times a year

Each TSG has a number of working groups and...

3GPP SA1 is one of the working groups in TSG SA with responsibility for service requirements for the whole 3GPP system



3GPP SA1 + new verticals = TRUE

Background

- 3GPP SA1 creates **service requirements**, often derived from use cases.
- The SA1 group focuses on new services and enhancing existing services.
 - SA1 is always one release ahead of all the other 3GPP working groups, including RAN WGs!
 - SA1 is the appointed entry point for new verticals
 - SA1 changes “vertical” requirements into “3GPP language” so they can be (re-)used in 3GPP by other verticals.
 - The SA1 service requirements cover the whole network, including both **core** and **radio**!
- SA1 has traditionally worked with operator services and are now also getting input from verticals.

SA1 WoW: Use case->Potential requirement -> Requirement

- SA1 studies are structured around identifying service requirement through jointly agreed use cases
- Potential new requirements needed to support the use case in a TR (Technical Report)
 - Typically, enablers and KPI's



- Consolidated potential requirement (consolidated with similar requirements and made more general) in the same TR



- In a Work item these consolidated requirement are considered and the agreed ones goes to Requirements in a TS (Technical Specification)

Example use case from Hexa-X-II

PHYSICAL AWARENESS

Physical Awareness use cases build on beyond-communication capabilities in networks: sensing, positioning, compute, and AI. By gathering 3D data about physical scenarios and situations, efficiency and safety can be improved.

Use Cases

Network Assisted 3D Mobility | Network Physical Data Exposure | Wide-area surveillance/Smart Crowd Monitoring | Environmental Radio Sensing

Functional Requirements



Reliability



Sensing



Positioning



**Privacy &
Security**



AI/ML/Compute

KPIs



1-10

Depends on service type



1m

Reliable 3D positioning with high availability



Up to 300

Speed of vehicles (cars, drones, trains) in urban areas



1-20

Similar to V2X services.



99.99%

Fraction of packets within latency bound E2E



99.9%

Fraction of defined 3D service space



99.99%

Probability to get communication service when requested

SA1 WoW: Hexa-X-II -> 3GPP SA1

Hexa-X-II

3.7 Physical Awareness Use Case Family

3.7.1 Network-Assisted Mobility (Representative Use Case)

3.7.1.1 Use Case Description

In this use case, illustrated in Figure 3-4, vehicles (cars, AGVs, drones, etc.) rely on devices for localization of connected and unconnected objects and for determining such as size and velocity, contextual info, trajectories etc. Vehicles have a reliable cost with services available in a well-defined service area. Networks measure the physical scenarios and analyze to detect objects, and aggregate data of device positions and extract information to relay to vehicles. Position data shared with vehicles can include (VRUs), such as pedestrians and cyclists.

This can be done on several levels; networks can provide raw or processed environment navigational support ranging from collecting and sharing of data, over navigation assistance leveraging on beyond-communication capabilities. The network can thereby support levels of autonomy and different modes of operation and enable smart transport in urban environments. Furthermore, there is a possibility to use the physical environment understanding area to improve communication to vehicles by tailoring beams, avoid blockers, etc.

Some examples of the services provided by networks are: *network assistance info* (object locations), *network assistance map* (digital 3D map data), *network navigation* (e.g. full operation (remote control of vehicles) and *context-aware communication* (beam scheduling).

Problem(s) to be solved/challenges

- Risk of accidents with intense and automated transport scenarios.** The use of vehicles to avoid collisions and see around corners. Network support is a reliable solution for vehicles.
- Energy consumption and generated emissions from transport.** Urban transport from an energy perspective and lean, unmanned, electrical transport can appropriate guidance. Network support also allows the reduction of weight on-board sensors are needed, thereby reducing their energy consumption.
- Cost of transportation of goods and people.** The use case supports increasing operation of transport, reducing operational costs. Network support also allows vehicles, reducing their cost.

Hexa-X-II

The performance of network-based positioning in wide area scenarios is clearly not sufficient horizontal accuracy for 80% of devices and 30s E2E latency [38,855].

3.7.1.2 Sustainability Analysis

	Sustainability Handprints (benefits)	Sustainability Footprints (costs)
Environmental	<ul style="list-style-type: none"> Reduction of GHG emissions by improving the traffic flow at the intersections thus requiring fewer traffic lanes and freeing up space for pedestrians and green spaces next to the roads Reduction in accidents would help reduce automotive waste generated by repairs and scrapping of irreparable vehicles and the GHG generated in the process Supported driving, including network-assisted small driverless electric vehicles, made more efficient will reduce fuels and thereby reduce related emissions 	<ul style="list-style-type: none"> Increased energy consumption sensing activities, including collection, processing, and communication within the sensing devices operation real-time requirements To enable the positioning low power devices would consume additional energy footprint compute needed at the core Materials and energy need lifecycle emissions for AI/ML
Social	<ul style="list-style-type: none"> Enhanced safety and well-being through reduced transport-related accidents Increased availability of transportation: automated/self-driving vehicles would decrease the need for human drivers' availability and could be available any time in any area Preserved/uncompromised privacy (compared to video-based perception) Enhanced continuity of transportation service even in rural areas (digital inclusion) 	<ul style="list-style-type: none"> Potential risks for privacy localization data Potential risks for trustworthiness of hacking (e.g., lead accidents) Potential risks for wrong by AI/ML Decreased job opportunities
Economic	<ul style="list-style-type: none"> Reduced costs for stakeholders for improved profitability from using the network for the monitoring tasks instead of additional sensors by freeing resources for other tasks 	<ul style="list-style-type: none"> Safety/predictability risks economic impact Expenses of network infrastructure meet the requirements for autonomous driving

Hexa-X-II

Deliverable D1.2

humans' need for rest), the availability of professional drivers to conduct the route (especially in rural areas), etc. Additionally, replacing cameras with sensing capabilities from the network, can also help to decrease any privacy risks involved. However, some questions remain unanswered such as 'how to deliver a sensing system, when there are people who don't want to be sensed'. Also, how to ensure the system is resilient to any cyber-attacks, as well as resolving accountability issues for AI/ML decisions. Therefore, providing trustworthy networks is essential.

Economic

There can be reduced costs for stakeholders leading to improved profitability from using the network for the monitoring instead of separate systems. There can also be improved efficiency by freeing resources for other use that can bring profits. On the cost side, there can be safety and predictability-related risks. Building network infrastructure to meet the requirements for high reliability of services can be costly.

3.7.1.3 Example Service Scenarios



Figure 3-4: Network-Assisted Mobility Example Scenario

Autonomous Drone Transport

In autonomous drone transport, flying drones are carrying goods in urban areas. The drones are equipped with some sensors (camera, GPS, etc.) and a processor. Through the onboard 6G device they get a reliable network. Over the communication channel the drone can and activities and get recommended actions for fastest led position as well as map data from the network. It can process from the camera feed and share the resulting deliverers of the drone transport service can count on a saked at any time, and people in the streets can trust that over their heads.

Hexa-X-II

Deliverable D1.2

- Connectivity:** Reliable communication is a critical aspect of this use case. For safety reasons, the link to the network should not be allowed to go down other than during very short periods within the service area. This may be difficult to achieve in practice considering 3D mobility within a city where links may be blocked at times. But the network should have the capability to predict and notify the connected vehicles such that they can take preventive action (e.g. stop or switch to a local operation mode). The network should also be able to timely activate adjacent links to ensure connectivity, e.g. to other devices and networks.
 - High resilience, availability, and reliability for connectivity in 3D; preferably without requiring excessive deployment of network nodes.
- Compute:** Offload from the vehicles to the network of heavy processing tasks and training of models should be supported, as well as in-network real-time processing of sensor data. This means that the networks should have the capability of reliable compute and AI/ML-related functionality that can be accessed at all times from any point in the network.
 - Availability of reliable compute capabilities offered by the network.

KPIs

	KPI	Target Range	Comments / Justification
Communication	Peak Data Rate [Gbit/s]	-	Not expected to be a challenge
	User-Experienced Data Rate [Mbit/s]	1-10 (<100)	Depends on service type: lower for warnings and assistance, higher for digital maps. (For sensor fusion exchange of data may be higher.)
	Spectrum Efficiency	-	Same as for communication services
	Area Traffic Capacity [Mbit/s/m ²]	-	Not expected to be a challenge
	End-to-end latency [ms]	20	Similar to V2X services.
	Reliability [%]	99.99	Fraction of packets within latency bound E2E
	Coverage [%]	99.9	Fraction of defined service space (in 3D) within latency bound.
Positioning & New	Service availability [%]	99.99	Probability to get communication service (as defined with E2E latency) within service space when requested. (Can replace coverage and reliability)
	Connection density [devices/km ²]	10 ⁶	Not expected to be a challenge
	Mobility [km/h]	Up to 300 seamless handover	Speed of vehicles (cars, drones, trains) in urban areas. Handover within latency bound
	Location accuracy [m]	1 (3D) precision with 99.9% reliability within 99.9% of service space (0.1)	Reliable positioning with high availability important for use case, but likely multiple sources (e.g. from on-board sensors) can be combined to achieve more precise positioning. (Sensor fusion)
Positioning & New	Sensing-related capabilities [Y/N]	Y	Object detection probability, Object location accuracy/resolution, Object velocity accuracy/resolution, Object size accuracy/resolution.
	AI/ML-related capabilities [Y/N]	Y	Probability of a response time of compute/AI capabilities within a latency limit.

Table 3-10: Network-Assisted Mobility KPIs

Hexa-X-II

Deliverable D1.2

or picture would be used. Finally, sharing the sensed real-time data with traffic control centres can help to improve traffic flow management in smart cities.

Assisted Vehicles

Vehicles today have many on-board sensors to support applications such as cruise control, pedestrian detection etc. In the 6G era, the enabling of advanced automotive features such as autonomous driving and autonomous coordinated manoeuvring is envisioned through leveraging the wide area sensors from the network, in addition to on-board vehicle sensors. Autonomous driving would allow vehicles to be navigated through challenging traffic situations and terrains with no human interaction.

In addition, autonomous coordinated manoeuvring feature would allow multiple vehicles to autonomously navigate through roads and highways in a coordinated fashion to ease traffic congestion and improve the traffic flow. These advanced automotive features would require a comprehensive detailed knowledge of the environment surrounding the vehicles as well as high precision localization and positioning. This would be enabled by the fusion of the wide-area sensor information provided by the network, vehicle on-board sensors and/or even sensors embedded in the transport infrastructure.

3.7.1.4 Deployment Aspects

Environment & Type of Deployment	Transport services relying on network perception should be available outdoors in wide-area scenarios, primarily in urban areas but also in suburban and rural areas with more limited functionality. Many blockers in the form of buildings, vehicles, and fixed objects are expected in the main scenario.
User Devices	Several types of devices may be involved: <ul style="list-style-type: none"> UEs will be mounted in moving vehicles that move along streets (on or above). These should be capable of high reliability, high availability, and low latency communication, as well as positioning capabilities. UEs belonging to pedestrians and bikers etc. may also be temporarily stationary or slowly moving along streets. These can be expected to be standard smartphones. Finally, UE roadside units may be mounted along streets to assist in measurements, e.g., bi-static sensing and positioning, and should have capabilities for this.
Constraints and Challenges	Likely need to deploy for Line-of-Sight (LoS) coverage in all of service area, if not non-LoS methods can be used for positioning and sensing

Table 3-9: Network-Assisted Mobility Deployment Aspects

3.7.1.5 Requirements and KPIs

Requirements

- Privacy:** personal identities in public spaces must be handled in such a way that privacy is not jeopardized.
- Localization:** Network nodes need to be able to perform radar-like measurements using the radio interface, to detect unconnected objects, which is delivered by JCAS functionality. In conjunction with this capability, precise device positioning is required. For both these capabilities, it is expected that networks will only be able to deliver part of the required precision and coverage. A sensor fusion functionality would therefore be needed, where networks collect data from multiple sources, e.g. on-board camera and GPS, and fuse it with the network measurements to create an enhanced dataset that is shared with the device and other devices.
 - High wide-area coverage for positioning and sensing services, also in 3D.
 - High detection probability of unconnected objects.

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S1-25xxxx
(revision of S1-25xxxx)

Source: <Your COMPANY NAME>
New use case title: New use case on <Document TITLE>
Draft TS/TR: 3GPP TS / TR <TS/TR number and version>
Agenda item: x.x
Document for: Approval
Contact: <name and email address>

Abstract: <provide a short description of the content>

..... Use Case template

x.1 Use case on ...

x.1.1 Description

<Describe what the use case intends to achieve>

x.1.2 Pre-conditions

<List any pre-conditions that need to exist for this use case, preferably as a bulleted list, e.g. UE is registered to the network>

x.1.3 Service Flows

<Describe the sequence of events that explain what needs to happen, preferably as a numbered list, e.g. 1. User makes a voice call, 2. Called party receives alerting message>

x.1.4 Post-conditions

<Describe the end result e.g. Called party can decide whether to accept call based on information displayed on UE screen>

x.1.5 Existing features partly or fully covering the use case functionality

<Highlight existing features in the existing set of normative specifications that partly or fully cover this use case>

x.1.6 Potential New Requirements needed to support the use case

<Provide draft new requirements that are needed to realize the use case, and that are not yet covered in any normative specifications>

Example: Network assisted 3D mobility

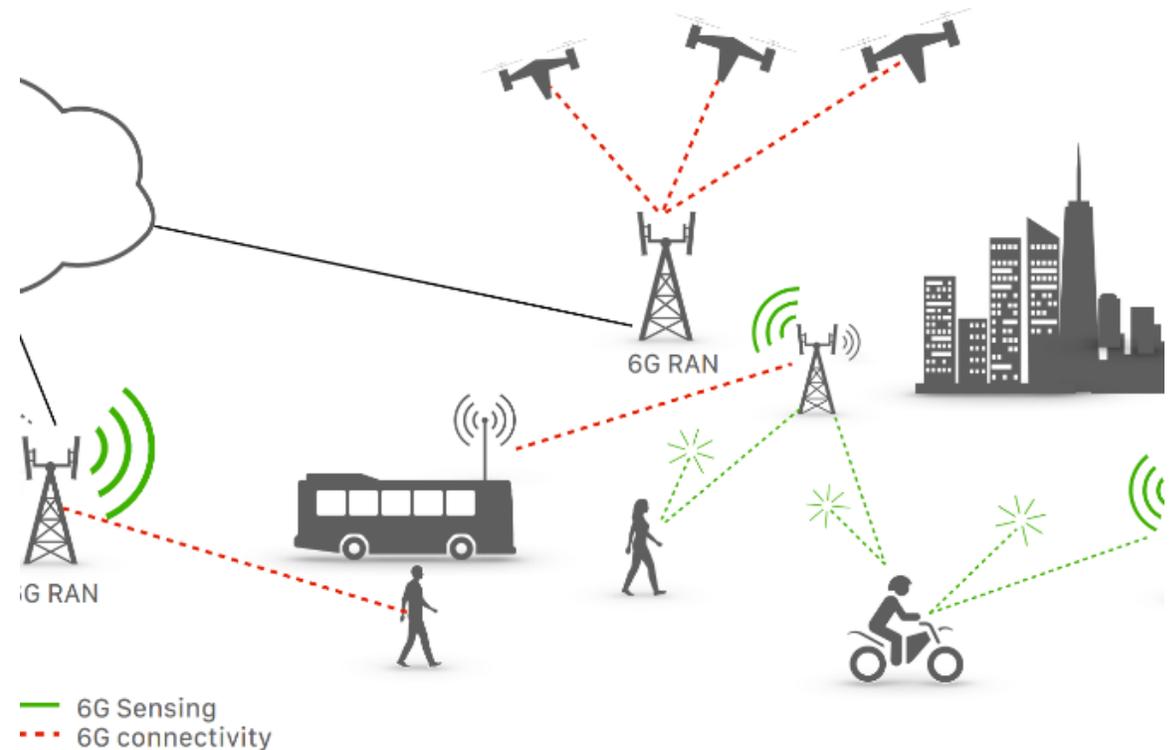
Still under discussion



x.y.6 Potential new requirements needed to support the use case

Based on national/ regional regulation and operator policy and the 6G system shall support Network assisted 3D mobility service by ensuring the following KPIs for communication, location and sensing are **fulfilled simultaneously**.

- For the communication part:
 - User experienced data rate in the range of [1-10Mb/s], depending on use case. Lower for sending warnings and assistance and higher for digital maps.
 - Round trip latency in the range of [40ms].
 - Service availability for communication 99.99% within service volume.
 - Connection density in the range of 10^4 devices/km² (all served vehicles on ground and in the air).
- For the spatial data part:
 - Location accuracy in 3D, [1m] with 90% probability and within 99% of the service volume
 - Sensing of objects in line with category 2 or 3 in Table 6.2-1 in 3GPP TS 22.137 [6], within 99% of the service volume.



Take aways

Take aways

- Research work are important as it lays the foundation for the standardization work
 - SNS JU research projects like Hexa-X-II is used as **input** and as **motivation** for the 3GPP work
 - Alignment between companies is important, co sourcing will make the difference.
- 3GPP definitions and Ways of Working needs to be understood
- Gap analysis is very important in the standard work
- New enablers and KPI's are the important part in use cases for SA1



ERICSSON