





# Motivations of integrating sensing and communications

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- Expected native feature in 5G-A and 6G:
  - The integrated sensing and communication can utilize the current communication network (deployment site resources and spectrum resources) to provide low-cost, high-precision, seamless and ubiquitous sensing capability through joint design of the system architecture.
- Consolidated SA1 study work:
  - Integrated Sensing and Communication has been studied in SA1 on including the use cases, the requirements and the KPIs. It is specified in TR 22.837 with various typical scenarios and use cases.
- Preexistent Feature in SA2:
  - UE positioning is already supported in 5GS. Current study on LCS in TS 23.273 can be used for reference since positioning can be regarded as one specific type of sensing service.

# Commercial Use Cases of Sensing

## Valuable Use Cases:

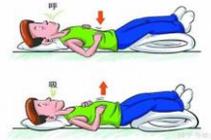
- The Use Cases from SA1 are classified into 5 categories according to the commercial aspects including Target Users, Products and Quality Requirements

### A. Smart Home:

- Use cases: Intruder Detection, Health monitoring
- Target User: Smart home consumers
- Products: Cell phone, Smart IoT Devices.
- Quality Requirements: Low/Normal



Intruder Detection



Health Monitoring

### B. Interactive Entertainment:

- Use cases: Gestures/expressions/movements capturing
- Target User: AR/VR consumers, Gamers
- Products: Cell phone, CPE, Smart IoT Devices.
- Quality Requirements: High



Gestures/expressions/movements capturing

### C. Assistance in Vehicle Driving:

- Use cases: Parking space determination, sensing assisted automotive maneuvering and navigation
- Target User: Vehicle drivers
- Products: RAN, Vehicle Mounted IoT devices, Integrated Automotive components
- Quality Requirements: Normal/High



Parking space determination



Automotive maneuvering

### D. Smart Factory:

- Use cases: Plant monitoring and accident avoidance, AGV detection and tracking
- Target User: Industries
- Products: RAN, IoT Devices, AGV devices.
- Quality Requirements: High



Plant monitoring and accident avoidance



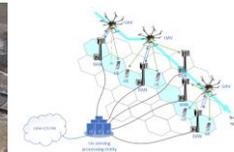
AGV detection and tracking

### E. Public regulation and safety :

- Use cases: Intruder detection in highway/train station, UAV regulation, Disaster Detection
- Target User: Governments, Industries
- Products: RAN, IoT Devices.
- Quality Requirements: Low



Intruder Detection



UAV regulation



Disaster Detection

# Sensing Methods

## Sensing method and scenario:

	<b>UE-gNB sensing</b> UE-gNB bistatic sensing (Uu DL/UL)	<b>UE sensing</b> UE-UE bistatic sensing (SL) and UE monostatic sensing	<b>gNB sensing</b> gNB-gNB bistatic sensing and gNB monostatic sensing
A(Smart Home)	✓	✓	
B(Interactive Entertainment)	✓	✓	
C(Vehicle Driving)	✓	✓	✓
D(Smart Factory)	✓	✓	✓
E(Public regulation and safety)	✓		✓

- UE-gNB sensing can be used in most use cases and scenarios.
- UE sensing is important in toC Use Cases and mainly utilized for indoor scenarios with limited sensing area.
- gNB sensing is the main method in toB Use Cases and mainly utilized in outdoor scenarios with large sensing area.
- Non-3GPP sensing data can be used to improve the sensing results in each scenario.

# Sensing Requirements Compared to LCS

## Specific Requirements Compared to Current Positioning Service:

	Sensing	LCS
Data Volume	Large	Small
Radio Bandwidth Requirement	High	Low
Target Object	UE, non-UE object, proximal environments	UE
Service Types	Multiple Use Cases	Only positioning
Data Types	Multiple	Single
Processing Complexity	Complex (ML model may be used)	Simple (limited positioning algorithms)
Involved Nodes	Object centric, RAN and UE involved	UE centric, RAN involved
Privacy	More private data collected	Only UE location collected
Charging	Related to target object	Related to Target UE

Compared to current positioning service, the following aspects should be studied:

- 1. UP sensing and related enhancements compared to LCS.
- 2. Quality management of sensing.
- 3. Node discovery and selection procedure.
- 4. New authorization mechanism.
- 5. UE configuration and charging.

Different deployment compared to LMF:

- Different kinds of sensing functions may be deployed due to multiple service types and data types.
- Multiple sensing function instances may be deployed due to high processing complexity.

# Standardization Plan

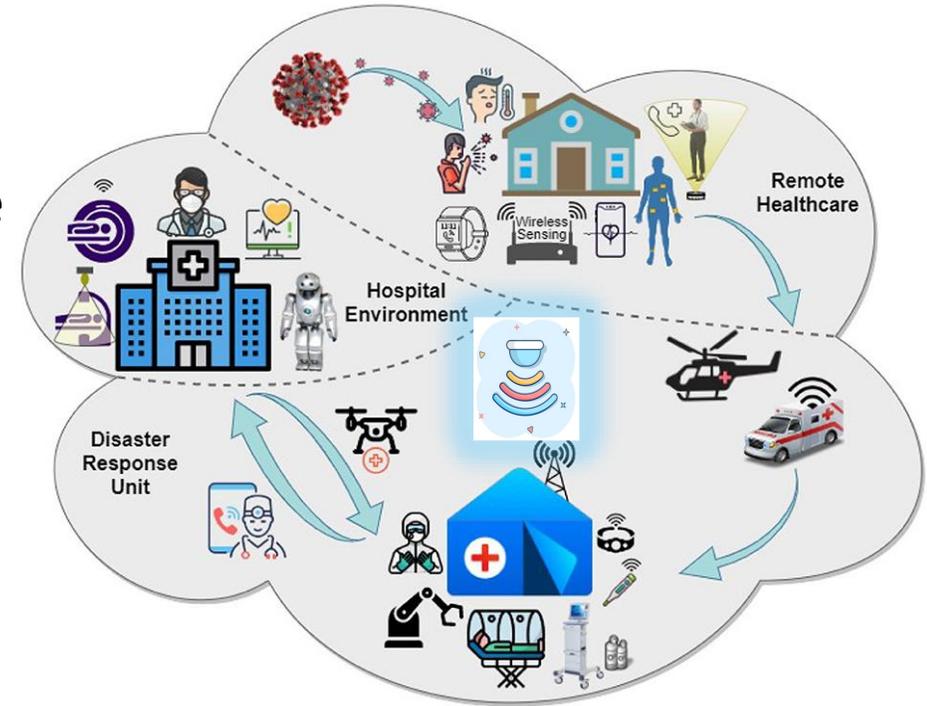
Potential working plan for Sensing:

Potential scope	R19 Base	Potential R19 Feature	R20+ and 6G Feature
UP sensing	✓		
Quality management	✓		
Node discovery and selection	✓		
Authorization for privacy protection	✓		
UE configuration	✓		
Charging	✓		
Power Saving		✓	
Non-3GPP sensing assistance		✓	
Multi-node co-ordination		✓	
Non-coverage scenario sensing		✓	
Service continuity		✓	
Inter-operator issue			✓
Edge processing for sensing data			✓
Co-ordination with AIML			✓

- Basic architecture and functionalities of Sensing should be studied in Rel-19, including UP sensing, Sensing quality management, Sensing node discovery and selection, authorization mechanism etc.
- Important features may be studied. Such as multi-node assistance, power saving, etc.
- Additional features to improve Sensing service can be studied in future Releases e.g. Rel 20+ and 6G.

# Conclusions

High capacity, massive connectivity, low latency 5G Advanced System supports broad range of devices and applications. Such 5G devices and applications could take advantage of their real-time data collecting using 5GS as real-time sensors (e.g. environmental sensors, health sensors and industrial sensors etc.) and then communicate with the backend server for timely analysis to enable variety type of sensing applications such as smart homes, smart cities, autonomous driving and industrial automation etc.



*Therefore, 5G advanced mobile system is best suited for integrating sensing and communications to bring in new revenue opportunity for mobile operators and its vertical service providers.*

