

FS_Sensing KPI consolidation and CPR grouping proposal

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Outline

KPI aspect

- General KPI table status
- KPI categorization #1: Level KPIs based on positioning service
- KPI categorization #2: from scenario's perspective
- KPI categorization #3: from application's perspective

CPR aspect

- Life cycle management perspective to order the requirements

Summary and proposal

General status on KPI table

5.1 intruder detection at home	Yes
5.2 intruder detection at highway	Yes
5.3 rainfall monitoring	Yes
5.4 transparent sensing	No
5.5 flood monitoring	Yes
5.6 intruder detection at yard	Yes
5.7 intruder detection at railway	Yes
5.8 Automotive Maneuvering	No

5.9 AGV tracking	No
5.10 UAV trajectory tracing	Yes
5.11 collision avoidance at crossroad	Yes
5.12 UAV collision avoidance	Yes
5.13 UAV intruder detection	Yes
5.14 tourist spot monitoring	Yes
5.15 sleep monitoring	Yes
5.16 intruder detection – security part	No

5.17 health monitoring by coordinate sensing	No
5.18 health monitoring with service continuity	No
5.19 sensor group	No
5.20 parking lot detection	Yes
5.21 seamless XR streaming	No
5.22 collision avoidance at smart grid	Yes
5.23 AMR collision avoidance	Yes
5.24 sport monitoring	Yes

5.25 human trajectory tracking	Yes
5.26 Accurate sensing	No
5.27 positioning for public safety	Yes
5.28 ADAS	Yes
5.29 Gesture recognition	Yes
5.30 Automotive maneuvering out of coverage	No
5.31 Blind spot detection	No
5.32 positioning for smart factory	Yes

- There are 32 use cases until SA2#101. It is agreed that no new use case will be added to TR22.837 after SA2#101, but KPI table can be updated.
- 29 use cases relate to 3GPP wireless sensing, where 21 use cases having KPI table, 8 use cases having no KPI table,
- 3 use cases relate to non-3GPP sensors, and it is agreed that KPI table is only valid for 3GPP wireless sensing.
- It is observed that several scenarios share similarities, such as intruder detection, health monitoring, UAV and autonomous driving.

Categorization #1: Level KPIs based on positioning service

Table 7.3.2.2-1 Performance requirements for Horizontal and Vertical positioning service levels

Positioning service level	Absolute(A) or Relative(R) positioning	Accuracy (95 % confidence level)		Positioning service availability	Positioning service latency	Coverage, environment of use and UE velocity		
		Horizontal Accuracy	Vertical Accuracy (note 1)			5G positioning service area	5G enhanced positioning service area (note 2)	
							Outdoor and tunnels	Indoor
1	A	10 m	3 m	95 %	1 s	Indoor - up to 30 km/h Outdoor (rural and urban) up to 250 km/h	NA	Indoor - up to 30 km/h
2	A	3 m	3 m	99 %	1 s	Outdoor (rural and urban) up to 500 km/h for trains and up to 250 km/h for other vehicles	Outdoor (dense urban) up to 60 km/h Along roads up to 250 km/h and along railways up to 500 km/h	Indoor - up to 30 km/h
3	A	1 m	2 m	99 %	1 s	Outdoor (rural and urban) up to 500 km/h for trains and up to 250 km/h for other vehicles	Outdoor (dense urban) up to 60 km/h Along roads up to 250 km/h and along railways up to 500 km/h	Indoor - up to 30 km/h

- Positioning service KPI is divided into 6 levels as defined in Table 7.3.3.3-1 in TS22.261.
- The level depends on the **accuracy of positioning**. 10m, 3m, 1m, 0.3m, 0.2m.
- Positioning service's objective is to have an accurate position of UE, the **target** is always **UE**. Therefore, leveling them based on KPI **accuracy of positioning** is reasonable.
- However, for sensing service, there are **2 variables to control**, **sensing target**, **sensing objective** (i.e. most relevant KPI)

Example use case	Sensing target	Sensing objective
Intruder detection at home	Human	There is intruder or not
UAV intruder detection	UAV	There is UAV or not
UAV trajectory	UAV	UAV position

- With different sensing target and sensing objective, it is impossible to level sensing scenario with similar ideas taken from positioning service.
- To level sensing KPIs, it is proposed to control one variable firstly:
 - Categorization #2: control sensing target**
 - Categorization #3: control sensing objective**

Categorization #2: from scenario's perspective 1/2

Smart city		Smart home		Smart factory		Public safety	
UC 5.3 rainfall monitoring	Rainfall	UC 5.1 home intruder detection UC 5.6 yard intruder detection	Human /animal	UC 5.9 AGV collision avoidance with human (holding UE) UC 5.23 AMR collision avoidance UC 5.32 AGV positioning and tracking	AGV	UC 5.5 flood monitoring	water
UC 5.2 highway human/animal detection UC 5.7 railway human/animal detection UC 5.14 traffic monitoring in tourist spot	Human	UC 5.15 sleep monitoring UC 5.17 human health UC 5.18 human health	Human - respiration			UC 5.22 UAV/car/human collision avoidance to smart grid	UAV/CAR/ HUMAN
UC 5.13 restricted area UAV intrusion detection UC 5.10 track UAV's trajectory UC 5.12 UAV (UE onboard) collision avoidance with building/tree	UAV	UC 5.24 sports monitoring UC 5.25 track human's trajectory in room to improve sounding system	Human – body gesture			UC 5.27 people rescue positioning for public safety	Human
UC 5.20 parking lot detection UC 5.11 track motorcycle's location, direction and velocity to improve real-time map UC 5.8 Autonomous driving UC 5.28 ADAS UC 5.30 out of coverage UC 5.31 Blind spot detection	Car	UC 5.29 gesture detection	Human – hand gesture				

Different scenario shares similar affecting factors, e.g. in smart home the affecting factor is mainly human, in smart factory the affecting factor is mainly AGV, in smart city affecting factor can be car, UAV and Human which can be easily grouped.

Categorization #2: from scenario's perspective 2/2

Smart city

5.3 rainfall monitoring	5.20 parking lot detection
5.2 intruder detection at highway	5.8 Automotive Maneuvering
5.7 intruder detection at railway	5.26 Accurate sensing
5.10 UAV trajectory tracing	5.28 ADAS
5.13 UAV intruder detection	5.30 Automotive maneuvering out of coverage
5.12 UAV collision avoidance	5.31 Blind spot detection
5.14 tourist spot monitoring	5.11 collision avoidance at crossroad

14 → 6 left

Smart factory

5.9 AGV tracking in smart factory
5.32 AGV positioning in smart factory
5.23 AMR collision avoidance

3 → 1 left

Smart home

5.1 intruder detection at home
5.6 intruder detection at yard
5.16 intruder detection – security part
5.15 sleep monitoring
5.17 health monitoring by coordinate sensing
5.18 health monitoring with service continuity
5.24 sport monitoring
5.25 human trajectory tracking
5.29 Gesture recognition

9 → 5 left

Public safety

5.5 flood monitoring
5.22 collision avoidance at smart grid
5.27 positioning for public safety

3 left

- 4 kinds of applied scenarios that 3GPP wireless sensing can offer: smart city, smart factory, smart home and public safety.
- Colored highlighted are merging suggestions. After merging, there will be **15** KPI sub-scenarios left.

Categorization #3: from the application's perspective 1/2

Intruder detection	Monitoring	Collision avoidance	Positioning/Tracking
UC 5.1 home intruder detection UC 5.2 highway human/animal detection UC 5.6 yard intruder detection UC 5.7 railway human/animal detection UC 5.13 restricted area UAV intrusion UC 5.20 parking lot detection UC 5.29 gesture detection	UC 5.3 rainfall monitoring UC 5.5 flood monitoring UC 5.14 traffic monitoring in tourist spot UC 5.15 sleep monitoring UC 5.17 human health UC 5.18 human health UC 5.24 sports monitoring	UC 5.8 Autonomous driving UC 5.9 AGV collision avoidance with human (holding UE) UC 5.12 UAV (UE onboard) collision avoidance with building/tree UC 5.22 UAV/car/human collision avoidance to smart grid UC 5.23 AMR collision avoidance UC 5.28 ADAS UC 5.30 out of coverage UC 5.31 Blind spot detection	UC 5.10 track UAV's trajectory UC 5.11 track motorcycle's location, direction and velocity to improve real-time map UC 5.25 track human's trajectory in room to improve sounding system UC 5.27 people rescue positioning for public safety UC 5.32 AGV positioning and tracking
The main sensing objective is to detect whether there is intrusion occurs in an area. 0-1 sensing objective, e.g.: - 0 stands for there is NO intruder - 1 stands for there is intruder	The main sensing objective is to detect some specific index based on use cases, e.g.: - Density of rain - Density of water on the road - Density of human in tourist spot - Respiration rate of human - Sit-ups rate of human	The main sensing objective can be 2 kinds: - to detect the distance to the obstacle(s), or - to detect the velocity of the obstacle if the obstacle can move - It needs sensing assistance information from a trusted 3 rd party, such as the map of the environment, the route and direction of the moving object	The main sensing objective is similar to positioning service, to detect the location, velocity of the object.
General KPI table satisfies, where missed detection and false alarm are main KPIs	General KPI table cannot fully satisfy such application, where each monitoring case needs specific KPI based on what it monitoring	General KPI table satisfies, where position accuracy, velocity accuracy, resolution are main KPIs	General KPI table satisfies, where position accuracy, velocity accuracy, resolution are main KPIs

Categorization #3: from the application's perspective 2/2

Detection application

5.1 intruder detection at home
5.2 intruder detection at highway
5.6 intruder detection at yard
5.7 intruder detection at railway
5.13 UAV intruder detection
5.16 intruder detection – security part
5.20 parking lot detection
5.29 Gesture recognition

Reduced from 8 to 3

Monitoring application

5.3 rainfall monitoring
5.5 flood monitoring
5.14 tourist spot monitoring
5.15 sleep monitoring
5.17 health monitoring by coordinate sensing
5.18 health monitoring with service continuity
5.24 sport monitoring

Reduced from 7 to 5

Collision avoidance

5.8 Automotive Maneuvering
5.26 Accurate sensing
5.28 ADAS
5.30 Automotive maneuvering out of coverage
5.31 Blind spot detection
5.11 collision avoidance at crossroad
5.22 collision avoidance at smart grid
5.12 UAV collision avoidance
5.23 AMR collision avoidance

Reduced from 9 to 4

Positioning/tracking

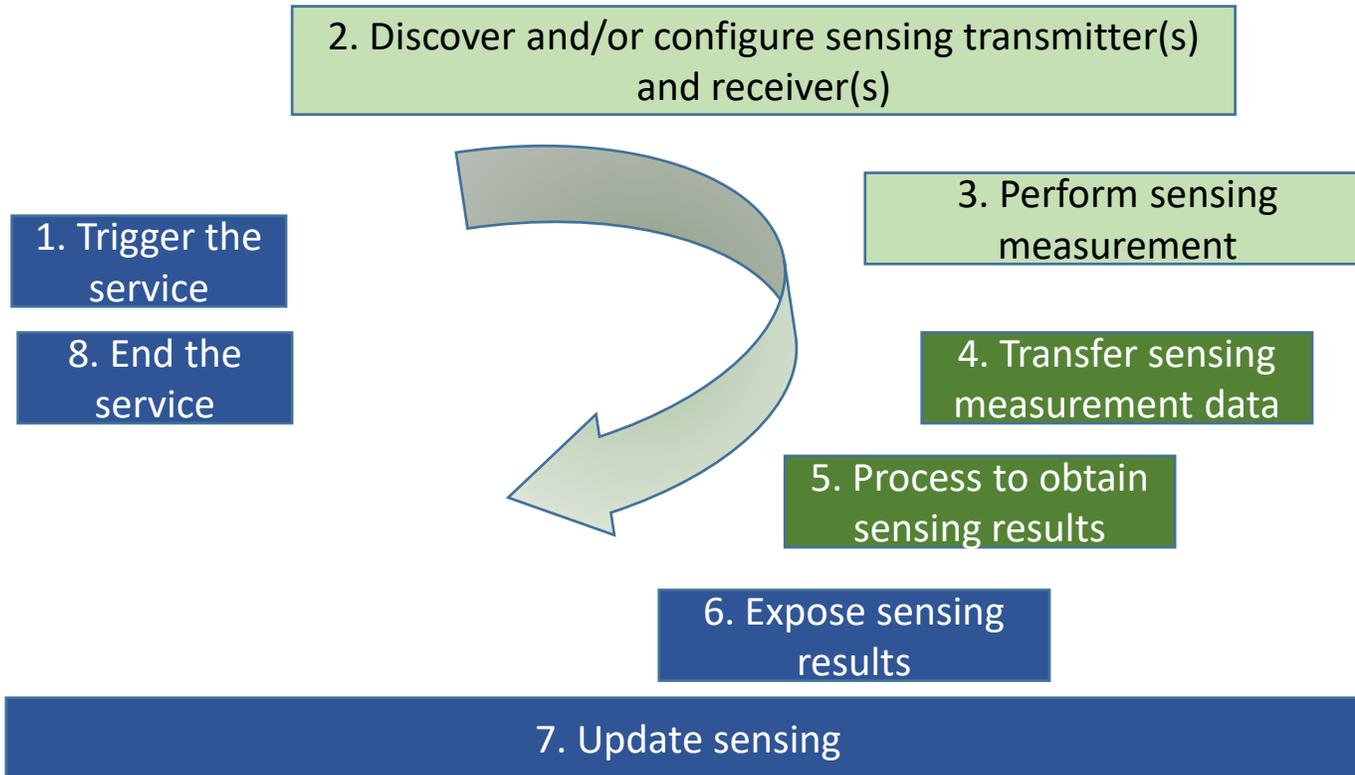
5.10 UAV trajectory tracing
5.25 human trajectory tracking
5.27 positioning for public safety
5.9 AGV tracking in smart factory
5.32 AGV positioning in smart factory

Reduced from 5 to 3

☞ 4 kinds of applications that 3GPP wireless sensing can offer: detection, monitoring, collision avoidance and positioning.

☞ Colored highlighted are merging suggestions. After merging, there may be **15** KPI sub-scenarios left.

From life cycle management's perspective



Sensing operation and configuration

- 2. Discover and/or configure sensing transmitter(s) and receiver(s)
- 3. Perform sensing measurement
- 4. Transfer sensing measurement data
- 5. Process to obtain sensing results

Better to be split into 2 categories.

Exposure → interaction with 3rd party

- Trigger and End
- 6. Expose sensing result
- 7. Update sensing result

security

charging

🌿 Nearly all drafted potential requirements in each use case are based on the life cycle management, with some of the above-mentioned steps.

🌿 It is proposed to draft CPR based on the above main steps to make CPR easier to understand.

Summary

KPI categorization #1: Level KPIs based on positioning service	With different sensing target and sensing objective, it is impossible to level sensing scenario with similar ideas taken from positioning service.
KPI categorization #2: from scenario's perspective	To control sensing target (main affecting factor) After merging, there may be 15 KPI sub-scenarios left, if categorizing them by grouping them with affecting factors
KPI categorization #3: from application's perspective	To control sensing objective (main KPI) After merging, there will be 15 KPI sub-scenarios left, if categorizing them by grouping them with different applications
Life cycle management	Nearly all drafted potential requirements in each use case are based on the life cycle management, with some of the above-mentioned steps
<p>Proposal 1: If merging is necessary, it is suggested to group KPIs based on categorization #2, and encourage use case proposers to merge the KPI, as similar affecting factor shares similar characteristics, e.g, velocity, and position. With "sensing target" as the controlled variable, it is easier to level them.</p> <p>Proposal 2: Divide sensing operation and configuration into 2 parts, one focuses on sensing operation before getting sensing measurement data, and the other focuses on sensing operation after getting sensing measurement data</p>	