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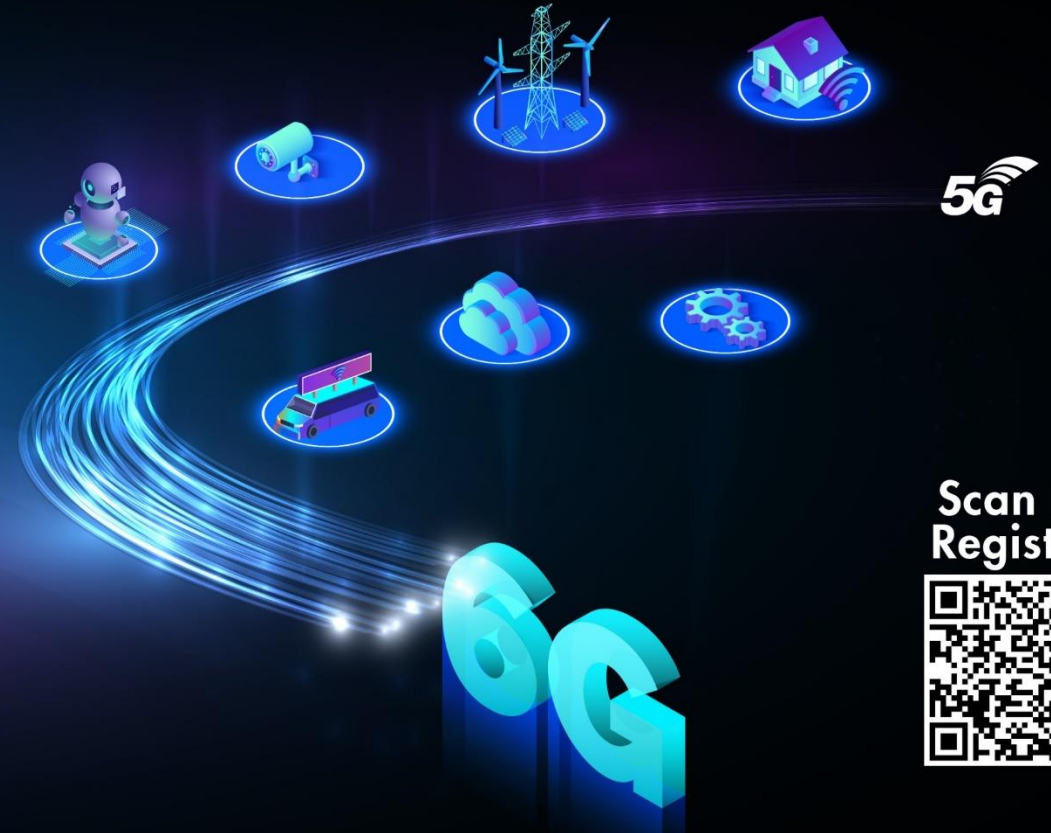
DoT-TSDSI Micro Workshop Series Advancing 5G Towards 6G

#Workshop 2

Studies related to **'Technology and Systems'**

 **January 20, 2023**

 11:00 AM to 12:30 PM IST



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DoT-TSDSI Micro Workshop Series on Advancing 5G towards 6G #Workshop 2: Studies related to 'Technology & Systems'

3GPP Study on Network of Service Robots with Ambient Intelligence
(FS_SOBOT)

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Disclaimer: The information included in this presentation is mostly based on the 3GPP contributions and other published materials.



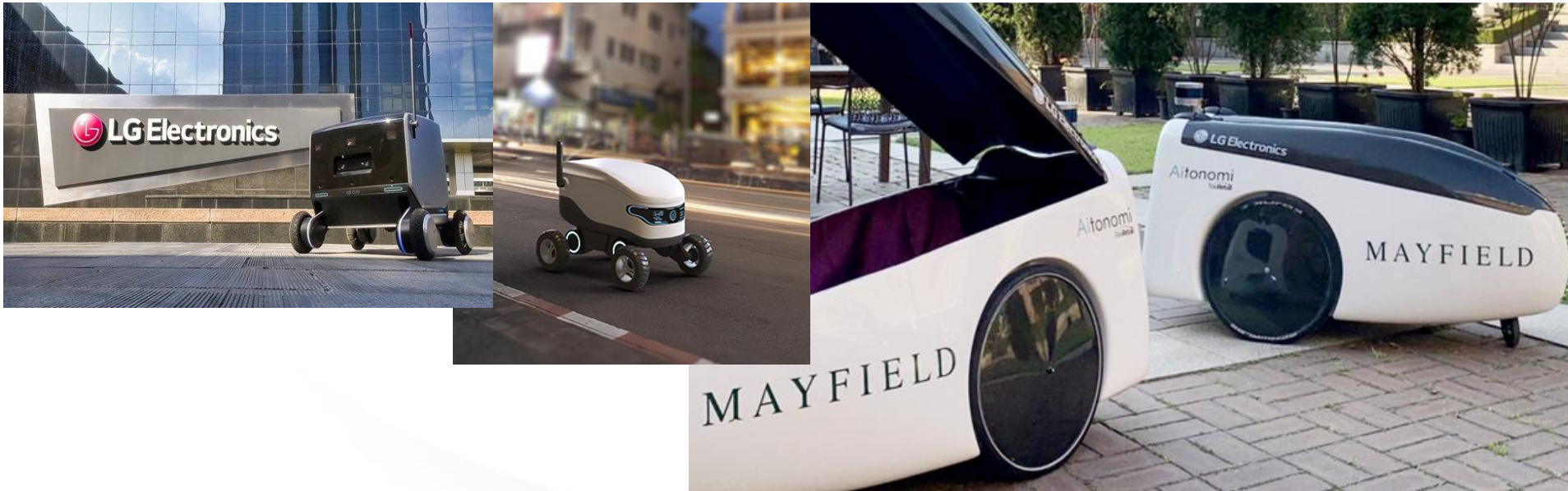
Agenda

1. Service Robots: Definition, Business Aspects
2. 3GPP Activities on “Network of Robots”
3. FS_SOBOT: Objectives and Progress



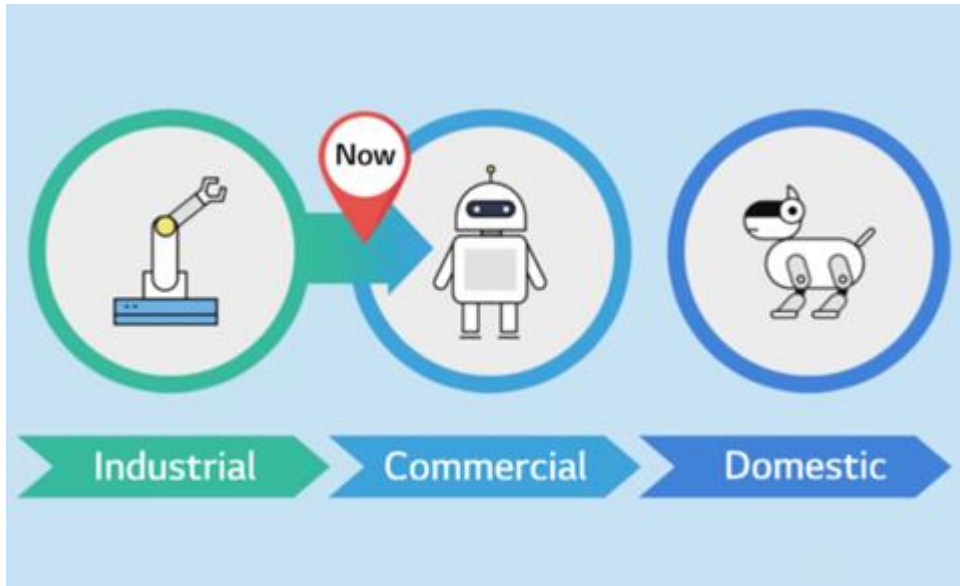
1. Service Robots – Definition/Examples

- Industrial robot [ISO]: automatically controlled, reprogrammable, multipurpose manipulator, programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications
- Service robot [ISO]: robot that performs useful tasks for humans or equipment excluding industrial automation applications
 - Examples: Delivery robots (e.g., restaurant, shopping mall, library, CCRC, hospital), robots that are intended for use in unstructured settings (hazardous control, search & rescue, public safety)





1. Service Robots – Business Aspects



Today, robots are not so much ready to go outside. There are many more advance considerations/features that service robots should have for their automated maneuvering and decision-making. For them to have such capability, the simple measure of ROI for robot service provider and virtually the entire stakeholders as cost matters. Along this line, it is very important how communication technology can help avoid and minimize service disruption (preventive or post-response).



- “Akin to how computers and automobiles were implemented in industry and commerce before they made their way to consumers, service robots are following a similar path. Already widely found in industries, service robots are now entering the commercial phase. When consumers will be able to purchase a delivery robot of their own is still unknown but if LG has anything to say about it, it won’t be too far away.” (source: LG Group News)



1. Service Robots – Business Aspects

- how SOBOTs help improve humans' living in the society

Table 1. Various Aspects of Service Robots that have Capability of Ambient Intelligence (usage scenarios associated with unstructured settings)

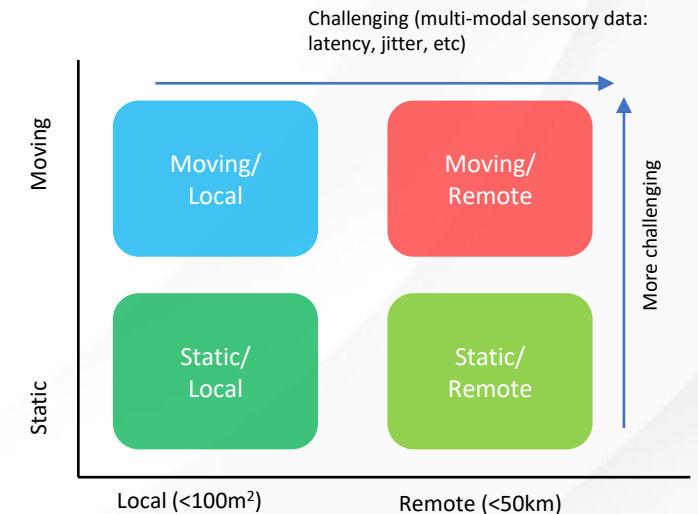
Aspects	Industry	Service features	Goals
Daily Living	Healthcare, Education, Logistics (indoor/local)	Preventive care/monitoring/therapy; education assistance; indoor deliver (food, medicine, cart); local delivery	Communication support of ultra-fast, reliable and effective interactions with human (gesture, language) with edge intelligence
Experience	Healthcare, Retail	Physical therapy assistance, physical motion training assistance (golf, aerobic, Pilates, etc.)	Congestion avoidance/management (ISAC) for True physical experience (digital replica)
Critical	Agriculture, Landscaping, light-duty constructions, search-and-rescue/public-safety	Smart and efficient harvest assistance, Local construction (skillset)	Network fabric-assisted environmental recognition and object detections, zero-touch network operation/management
Societal		Contributions to societal development goals, such as sustainability, the “aging population” (e.g., United Nations Report), etc.	



2. 3GPP Activities on Network of Robots

“Network of Robots” – cyber-physical systems with the focus on “connected things” but not just “connected”

- Vehicle-to-Everything (V2X):
 - Examples: Vehicle platooning
- EAV/ID_UAS: UAV (Uncrewed Aerial Vehicle)
 - Examples: swarm of flying bots that do something over cellular transport
- Industrial robots:
 - Examples: robot arms; mobile robots in a structured setting
- Medical robots
 - Examples: tele-surgeon robot
- Communication-layer aspects:
 - Haptic and multi-modality support
 - High accuracy positioning, ranging, sensing (to come)





3. FS_SOBOT (1/)

Study on Network of Service Robots with Ambient Intelligence (SP-220447)

Some background for [considerations](#):

- (1) Application area: service robots are intended to assist humans in various settings (as described in ISO 8373:2012) whereas industrial robots are to replacing human workforce in structured settings, such as manufacturing
- (2) Interacting points: service robots have interactions with human, capable of understanding natural forms of human input (e.g., natural language, gestures, facial expressions) whereas industrial robots have more standardized and structured way of interactions with human workers in job site
- (3) Business opportunity: service robots are designed for different usage scenarios than industrial robots, such as shopping assistance, care-giving, and indoor and local outdoor delivery
- (4) Technology readiness: apart from some basic roles that service robots can play, there exist challenging and promising areas that technology will need to catch up, in order to improve the service quality that service robots can provide, such as AI-native operation, zero-touch operation so that ideally human customers do not need to anything even when disruption happens in service robot operations



3. FS_SOBOT (2/) – The Objectives

Endogenous factors: “efficient communications service and cooperative operation for a group of service robots ”

- exposure of information between application layer and communications layer (e.g., capability to handle on-demand high priority events)
- support of on-demand high priority communications, to help avoid or minimize disruptions of service robot operation
- support of time bounded communication to help timely delivery of information/data between multiple service robots (including KPIs related to access delay, communication re-establishment, etc.), especially for large-scale group operation scenarios, e.g., due to robot’s communication failures or other event triggers
- support of scalable and efficient use of communication resources needed for stable operation of multiple service robots especially when a large number of service robots are present
- requirements related to media applications specific for service robots (e.g. speech, haptics, multiple simultaneous media types)
- aspects related to security, privacy and charging.

(next...)



3. FS_SOBOT (3/) – The Objectives (cont.)

Exogenous factors:

- collecting the existing functional and performance requirements that are relevant to support particular use cases of service robots that have human-machine and machine-machine interactions
 - E.g., V2X (.186), UAS (.125), CAV (.104), VIAPA/positioning/ranging (.261)
- identifying potential correlation with some of stage-1 studies, e.g., Sensing, Metaverse.

Note:

High-level spectrum usage scenarios related to implementation, deployment and operation of a group of service robots that are relevant to external audience



3. FS_SOBOT (4/) – Progress

3GPP TR 22.916 v0.2.0

Terminology: TBA

Overview: TBA

Use cases:

- Online cooperative high-resolution 3D map building
- Real-time cooperative safety protection

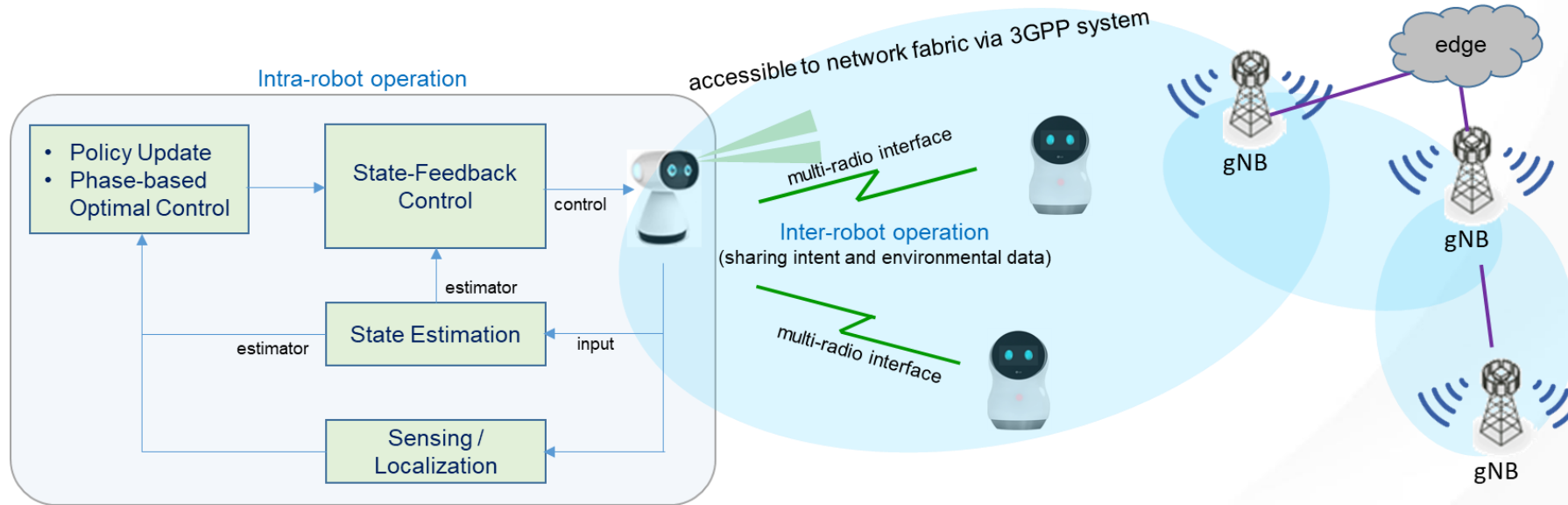
Other Considerations: TBA



3. FS_SOBOT (5/) – Progress (cont.)

3GPP TR 22.916 v0.2.0

- UC#1: Online cooperative high-resolution 3D map building

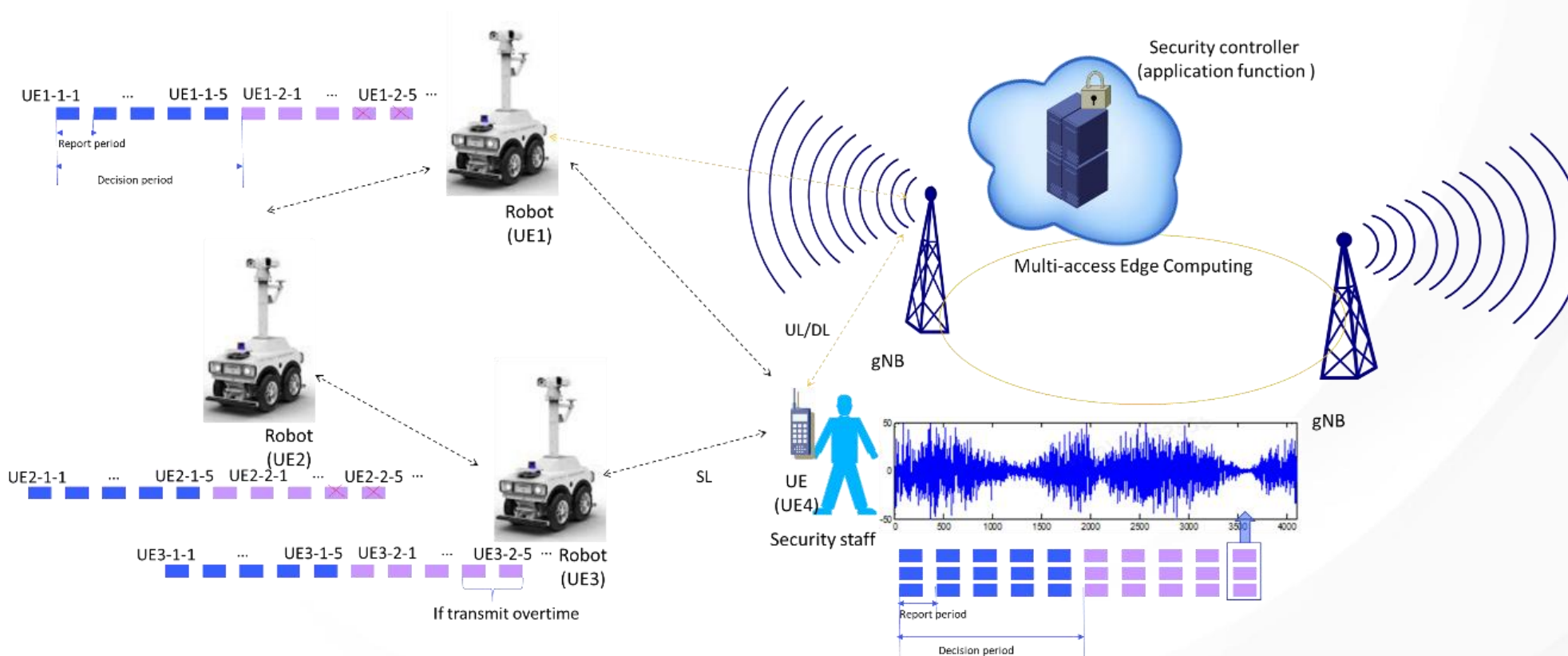




3. FS_SOBOT (6/) – Progress (cont.)

3GPP TR 22.916 v0.2.0

- UC#2: Real-time cooperative safety protection





3. FS_SOBOT (7/) – Plan Next

TSG#:

- SA1#101 (Feb 2023): 70%
Remarks: add necessary terminology, add new use cases relating to (representative) application fields /scenarios with focus on collaborative operations of multiple robots (e.g., unstructured job site env., media communication for robotic applications, aerial/underwater and safety-critical env.)
- SA1#102 (May 2023): 90%
Remarks: last meeting for new use cases, input on relations between existing and ongoing studies/features;
last meeting for new questions to be opened which needs to be indicated as Editor's Note
- SA1#103 (Aug 2023): 100%
Remarks: clean-up, resolution of already identified issues only
- SA1#104 (Nov 2023): 100%
Remarks: corrections if necessary



Thank You

< Presenter Co-ordinates >