

Title: 5G Edge Computing Use Cases & Requirements

Source: 5G Alliance for Connected Industries and Automation (5G-ACIA)

To: 3GPP TSG SA, 3GPP TSG CT, 3GPP TSG RAN

CC: 3GPP TSG SA WG1

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1. Overall Description

5G-ACIA has produced an internal report on edge computing use cases and requirements for industrial 5G networks and it is now working on a whitepaper about the various edge deployment options and architectural considerations for the edge components.

This 5G-ACIA internal technical report aims at identifying and understanding industrial edge use-cases, their requirements concerning the edge computing infrastructure, and the related communication requirements. The service requirements are analyzed in 3GPP TS 22.104 which is consulted for comparison and gap analysis for edge related requirements.

The following use-cases that attribute to the gaps with existing 3GPP Standards documents are described below in a nutshell. The first table describes use case title and the corresponding KPI/parameters that might be modified/added. The second table identifies 3GPP document section that might require modifications.

Manufacturing Workers' safety via XR: *This use case investigates different approaches to ensure the safety of humans that interacts with machineries involved in an industrial process. Different machineries can lead to distinct levels of interaction and then specific safety strategies can be employed in each case. To deal with the heterogeneity of industrial environment, a closed loop safety strategy is considered. Edge computing benefit: fast*

response required for XR based applications, fast computation on site for the human and machine safety

Fleet of Robots Routing: *Flexible route adaptation for the rest of the fleet is required if one AGV declares a blocked route or other problems and stops moving. The control of robots is expected to be achieved by a Guided Control System (sitting at the Edge cloud). In this use case, tracking each robot is required. Robot position information and control messages should be communicated securely. Edge Computing Benefit: Onsite compute to meet the latency, bandwidth, positioning requirements.*

AR based Product Quality & Field Procedures using digital twin: *A digital twin is a digital and virtual model of aspects of a functional system combined with real-time aspects of how the system operates. In this use case product quality control or field procedures (debugging, training, data capture) can be achieved via an AR assisted feedback control with varying degree of service KPI. Edge computing benefit: Meeting latency and reliability/availability required for the Industrial application*

The goal of this liaison statement is to make the SDO aware about the identified gaps in performance KPI (3GPP TS 22.104), use cases and to propose new service requirements for edge networks for Industrial manufacturing.

<i>Gap ID</i>	<i>Use case Description</i>	<i>Corresponding KPI identified in the Industrial Edge (5G-ACIA)</i>
G.1	Manufacturing workers' safety through XR	Higher data rate, Higher Message size Influence parameters: data aggregation (sensors, camera, LIDR etc.)
G.2	Fleet of robots routing and control of robots.	Timing accuracy, device speed Influence parameters: Real time motion, control coordination, communication service reliability
G.3	AR based product quality & Field procedures with digital twin	Communication availability > 99.999%, Timing accuracy Influence quantity- Session continuity, quality production
G.4	Edge Services aspects for Industrial IoT	Describe a chapter on Industrial Edge services

Gap ID	Use case Description	Corresponding KPI identified in the Industrial Edge (5G-ACIA)
G.5	Mobile Robots and AGV additional use cases related to security & privacy	Needs to consider additional requirements such as security, privacy, positioning, and state-recovery of robots in a case of connectivity loss in industrial use cases

5G-ACIA also identified the following limitations of 3GPP specifications.

Limitation ID	Description	Corresponding requirement in the 5G-ACIA
L.1	3GPP TS22.104 A.2.2.3	3GPP addresses a similar use case where robots are controlled by a central unit. <ul style="list-style-type: none"> - Provide edge cloud as an example - Additional service performance requirements for increased data rate from video and LIDAR and receiving aggregated sensor data from multiple sources - Modify the influence quantity for Message size in usecase #4 (1 Mbyte – 10MB) or add use case #5 considering higher data message size for processing
L.2	3GPP TS 22.261 3GPP TS 22.104	<ul style="list-style-type: none"> - A new service at the Industrial Edge - The use case for fleet of robots guidance in 5G-ACIA study covers A.2.2.3 (UC#2, #3, #4) - Update communication service reliability value up to ~ 1 year (A.2.2.3-1, for use case #4) for increased reliability
L.3	3GPP TS 22.261 3GPP TS22.104,	<ul style="list-style-type: none"> - New service examples at the Industrial edge - Addition use-case in A 2.4.2 and KPI for communication availability, timing accuracy, security - Latency could be < 20ms for Field procedure use case
L.4	3GPP TS 22.261	<ul style="list-style-type: none"> - TS 22.261 Talks about Service Hosting Environment, however an appendix can be added to describe several use cases and operation scenarios of Edge Services as an example of Service hosting environment clarifying IIoT usage
L.5	3GPP TS 22.104 Possible input to SA1	Introduce new use cases in TS 22.104 A 2.2.3 for Mobile Robots and AGV as mentioned in G.5

2. Actions

5G-ACIA kindly asks 3GPP to take note of the identified gaps and limitations in Rel-18 specifications for considerations and inform if there are any related activities to address these issues in the ongoing or future 3GPP studies to cover.

3. Date of Next 5G-ACIA Plenary Meetings

- December 7th-8th 2022, Plenary Meeting in Frankfurt, Germany

4. References

- [1] 3GPP TS 22.104, v18.3.0, [Service Requirements for Cyber Physical Control Communications](#), 2021.
- [2] 3GPP TS 22.261, v18.6.1 [Service Requirements for 5G System](#), 2022