**3GPP TSG-SA WG1 Meeting #100e S1-22XXXX**

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**pCR Title: [Discussion] Consolidation on Functional Requirement of Ambient IoT**

**Draft Spec: 3GPP TR 22.40**

**Agenda item: 7.7**

**Document for: Approval**

**Contact:**

### 1. The requirements in TR 22.840v0.2.0 are put into 7 categories

**- Category-A: RAN (5GS) communicates with Ambient IoT (identifier of Ambient IoT);**

**- Category-A1/B: UE communicate with Ambient IoT**

**- Category-C: Ambient IoT positioning/location**

**- Category-D: On-demand capability/information exposure to 3rd party**

**- Category E: Management of AIoT (active/deactivate)**

**- Category-F: Charging**

**- Category-G: Security**

### 2. The per-category analysis below is with Conslidated Potential Requirements (CPR) followed by the specific PRs in each use cases

#### Category-A: RAN (5GS) communicates with Ambient IoT;

**[CPR-A1] The 5G system shall support communication with Ambient IoT device to collect the information stored in an Ambient IoT device which is battery-less or with limited energy storage (e.g., capacitor).**

**[CPR-A2] The 5G system shall support energy efficient communication mechanisms (i.e. minimizing the overall and peak device communication power consumption) for Ambient IoT devices. (PR.5.3.6.2-1)**

**[CPR-A3] Based on 3rd party’s request, the 5G system shall support to communication with a specific Ambient IoT device or a group of Ambient IoT devices. (PR 5.2.6-2)**

[P.R.5.1.6-001] The 5G system shall be able to support communication with Ambient IoT device which is battery-less or with limited energy storage (e.g., capacitor).

[PR 5.2.6-1] The 5G system shall be able to communicate with an Ambient-IoT device

[PR 5.2.6-2] The 5G system shall be able to provide group communication for a group of Ambient-IoT devices

[PR 5.2.6-3] The 5G system shall be able to provide a mechanism to collect the information stored in an Ambient-IoT device.

[PR.5.3.6.2-1] The 5G system shall support energy efficient communication mechanisms (i.e. minimizing the overall and peak device communication power consumption) for Ambient IoT devices.

[PR.5.4.6-001] 5G system shall support network access for Ambient IoT devices while considering the constraint power consumption.

Note: The above requirement applies to both NPN and PLMN.

[PR 5.5.6.1-001] The 5G system shall support communication for an Ambient IoT device which is battery-less or with limited energy storage capability.

[PR.5.6-001] The 5G system shall be able to support communication services for ambient power-enabled IoT devices.

[PR 5.11.6-1] The 5G system shall be able to communicate with an Ambient-IoT device.

[P.R.5.12.6.1-002] The 5G system shall be able to collect information from a specific Ambient IoT device.

[P.R.5.13.6-001] The 5G system shall be able to support communication with Ambient IoT devices.

[P.R.5.13.6-004] The 5G system shall support energy efficient communication mechanisms for Ambient IoT devices (i.e., minimizing the device communication power consumption).

[PR.5.15.6.2-1] The 5G system shall support communication for Ambient\_IoT devices.

Editor’s Note: It is FFS enhancement of specific 5GS efficiency required to support this use case.

#### Category-A1/B: UE communicate with Ambient IoT

**[CPR-A4] The 5G system shall be able to assist an Ambient IoT device with discovery and communication with UEs/RAN entities that can provide location related information (PR 5.8.6-1)**

**[CPR-A5] The 5G system shall support an authorized UE to communicate with specific Ambient IoT devices.**

**[CPR-A6] The 5G system shall support an authorized UE to transfer the Ambient IoT related information to other 5G system entities (e.g. core network)/servers.**

[PR.5.8.6-1] The 5G system shall be able to assist an Ambient IoT device with discovery and communication with UEs/RAN entities that can provide location related information

Editor’s note: "UEs/RAN entities” terminology needs to be clarified.

[PR 5.8.6-2] Based on operator policy, the 5G system shall be able to support authorization of UEs communicating with an Ambient IoT device.

[PR.5.8.6-3] The 5G system shall be able to support means to support RAN entities and authorized UEs to communicate with Ambient IoT devices and transfer related information to other 5G system entities (e.g., core network) / servers.

[PR.5.12.6.1-001] The 5G system shall support to authorize a UE to obtain device information of an Ambient IoT device.

[PR.5.14.6.1-001] The 5G system shall support be able to authorize a UE to perform Ambient IoT communication services with specific Ambient IoT devices

#### Category-C: Ambient IoT positioning/location

**[CPR-C1] Based on user consent, operator policy and 3rd party request, the 5G system shall support means to discover and locate Ambient IoT devices in a certain geographical area, e.g. at cell level (PR. 5.7.6-1)**

**[CPR-C2] Based on user consent, operator policy and 3rd party request, the 5G system shall support to determine the location information of a specific Ambien IoT device including the information of absolute positioning, relative positioning (Ranging), indoor positioning and outdoor positioning.**

[PR 5.7.6-1] The 5G system shall be able to support means to discover and locate Ambient-IoT devices in a certain geographical area, e.g. at cell level.

[PR 5.9.6.1-002] 5G system shall be able to determine the location of Ambient IoT device, when it becomes active as triggered by the 5G network.

[PR 5.10.6.1-001] 5G system shall be able to support the ranging operation between UE and Ambient IoT device.

[PR 5.12.6.1-004] The 5G system shall be able to support indoor and outdoor positioning for Ambient IoT devices.

[PR.5.14.6.1-002] The 5G system shall be able to support authorizing a UE to perform Ambient IoT positioning services with specific Ambient IoT devices.

#### Category-D: On-demand capability/information exposure information to 3rd party

**[CPR-D1] The 5G system shall support to provide a suitable and secure means to expose the collected information of Ambient IoT devices to the 3rd party. The collected information includes the requested Ambient IoT device identity, and positioning result.**

**[CPR-D2] The 5G system shall support an authorized user or authorized 3rd party to enable and disable an Ambient IoT device capability for Ambient IoT communication. (PR 5.17.6-1)**

[P.R.5.1.6-002] The 5G system shall support to provide collected information from Ambient\_IoT devices to the trusted 3rd party.

[PR 5.3.6.2-3] The 5G system shall support a mechanism to interface a 3rd party application to manage and operate on the Ambient IoT devices.

[P.R.5.12.6.1-003] The 5G system shall be able to provide information of a specific Ambient IoT device to the trusted 3rd party.

NOTE: The request from 3rd party can include the requested Ambient IoT device identity, the requested service area to find the Ambient IoT device, the requested information of an Ambient IoT device includes position information.

[P.R 5.13.6-005] The 5G system shall support transferring data collected from Ambient IoT devices to a trusted 3rd party.

[PR.5.14.6.1-003] Subject to user consent and operator’s policy, the 5G system shall be able to expose the identities and positions of Ambient IoT devices to a 3rd party.

[PR 5.16.6.1-004] The 5G System shall be able to provide suitable and secure means to report to an authorized third-party the location of Ambient\_IoT devices.

[PR 5.17.6-1] Based on operator policy, the 5G system shall provide means for an authorised user or authorised third parties to request enable and disable an Ambient IoT device capability to transmit RF signals.

#### Category E-Management of AIoT (5GS active/deactivate)

**[CPR-E1] The 5G system shall support mobility management for specific Ambient IoT devices (e.g. not stationary and unable to initiate communication towards the network). (PR 5.9.6.1-001, PR 5.16.6.1-003)**

**[CPR-E2] The 5G system shall support to manage one or multiple Ambient IoT devices, including provisioning parameters, activate, deactivate an Ambient IoT devices. (PR 5.1.6-005, PR 5.16.6.1-003) in bulk**

[PR 5.9.6.1-001] 5G system shall optimize mobility management support for mobile Ambient-enabled IoT devices that are unable to constantly stay active.

[P.R.5.1.6-005] The 5G system shall be able to manage (e.g. provide service parameters, activate, deactivate) multiple Ambient\_IoT devices in bulk.

[PR 5.16.6.1-002] The 5G system shall optimize mobility management support for non-stationary Ambient\_IoT devices that are unable to initiate communication towards the network.

[PR 5.16.6.1-003] The 5G System shall allow an operator to manage (e.g. provision, authenticate, authorise, etc.) Ambient\_IoT devices that have limited or no power source.

[PR 5.11.6-2] The 5G system shall be able to provide a mechanism for a trusted 3rd party to modify the information stored on an Ambient-IoT device.

Editor’s Note: This requirement need to be revisited to clarify how the device can store and modify information without application and what kind of data that can be stored.

#### Category-F: Charging

**[CPR-F1] The 5G system shall support to collect changing information for using Ambient IoT services including total number of Ambient IoT devices, communications, data payload per charging period.**

[PR.5.3.6.2-4] The 5G system shall be able to collect charging information for using Ambient IoT services on per Ambient IoT device basis (e.g., total number of communication per charging period).

[PR 5.3.6.2-5] The 5G system shall be able to collect charging information per application for using Ambient IoT services (e.g., total number of Ambient IoT devices per charging period).

[PR 5.5.6.1-002] The 5G system shall support collection of charging information based on different charging policies for Ambient-IoT type of communication, i.e., total number of communication (e.g. data payload) per charging period, or total number of Ambient IoT devices per charging period.

#### Category-G: Security

**[CPR-G1] The 5G system shall support suitable security mechanisms for Ambient\_IoT devices, including encryption and data integrity.**

**[CPR-G2] The 5G system shall support to authenticate a UE for performing communication or positioning service with a Ambient IoT device;**

**[CPR-G3] The 5G system shall support a UE to authenticate an Ambient IoT device;**

**[CPR-G4] The 5G system shall support an Ambient IoT device to verify/validate UE/RAN node which communicates with the device;**

**[CPR-G5] The 5G system shall support to provide a mechanism to protect the privacy of information (e.g., location and identity) exchanged during communication with an Ambient IoT device.**

**NOTE 1: This requirement refers to communication between Ambient IoT devices and 5G System entities (e.g., core network, RAN entities), application servers or authorized UEs.**

[P.R.5.1.6-003] The 5G system shall support suitable security mechanisms for Ambient\_IoT devices, including encryption and data integrity.

[P.R.5.1.6-004] The 5G system shall be able to support the authentication and authorization mechanisms of Ambient\_IoT devices.

[PR 5.3.6.2-2] The 5G system shall be able to support energy efficient security mechanisms for Ambient IoT devices, including authentication, encryption and data integrity.

[PR.5.6-002] The 5G system shall support suitable security mechanisms for Ambient IoT devices, including authentication, encryption and data integrity.

[PR.5.8.6-4] The 5G system shall be able to provide a mechanism to protect the privacy of information (e.g., location and identity) exchanged during communication with an Ambient IoT device.

NOTE 1: This requirement refers to communication between Ambient IoT devices and 5G System entities (e.g., core network, RAN entities), application servers or authorized UEs.

[PR 5.8.6-5] The 5G system shall be able to support a UE to authenticate an Ambient IoT device

[PR. 5.12.6.1-005] The 5G system shall be able to support an Ambient IoT device to validate a UE which communicates with the device.

[PR. 5.12.6.1-006] The 5G system shall support to validate an Ambient IoT device

[P.R.5.13.6-002] The 5G system shall be able to support suitable security mechanisms for Ambient IoT devices, including encryption and data integrity.

[P.R.5.13.6-003] The 5G system shall be able to support suitable mechanisms to authenticate and authorize Ambient IoT devices.

[PR. 5.14.6.1-005] The 5G system shall be able to support a UE to verify an Ambient IoT device’s identity.

[PR 5.16.6.1-001] The 5G system shall be able to support a mechanism to authenticate and authorize Ambient\_IoT devices.

[PR. 5.14.6.1-004] The 5G system shall be able to support an Ambient IoT device to authenticate a UE triggering Ambient IoT services.

### Annex: List of all requirements in TR 22.840v0.2.0

**5.1 Use case on Ambient IoT for automated warehousing**

[P.R.5.1.6-001] The 5G system shall be able to support communication with Ambient IoT device which is battery-less or with limited energy storage (e.g., capacitor).

[P.R.5.1.6-002] The 5G system shall support to provide collected information from Ambient\_IoT devices to the trusted 3rd party.

[P.R.5.1.6-003] The 5G system shall support suitable security mechanisms for Ambient\_IoT devices, including encryption and data integrity.

[P.R.5.1.6-004] The 5G system shall be able to support the authentication and authorization mechanisms of Ambient\_IoT devices.

[P.R.5.1.6-005] The 5G system shall be able to manage (e.g. provide service parameters, activate, deactivate) multiple Ambient\_IoT devices in bulk.

**5.2 Medical instruments inventory management and positioning**

[PR 5.2.6-1] The 5G system shall be able to communicate with an Ambient-IoT device.

[PR 5.2.6-2] The 5G system shall be able to provide group communication for a group of Ambient-IoT devices.

[PR 5.2.6-3] The 5G system shall be able to provide a mechanism to collect the information stored in an Ambient-IoT device.

**5.3 Use Case on Ambient IoT devices in substations in smart grids**

[PR.5.3.6.2-1] The 5G system shall support energy efficient communication mechanisms (i.e. minimizing the overall and peak device communication power consumption) for Ambient IoT devices.

[PR 5.3.6.2-2] The 5G system shall be able to support energy efficient security mechanisms for Ambient IoT devices, including authentication, encryption and data integrity.

[PR 5.3.6.2-3] The 5G system shall support a mechanism to interface a 3rd party application to manage and operate on the Ambient IoT devices.

[PR.5.3.6.2-4] The 5G system shall be able to collect charging information for using Ambient IoT services on per Ambient IoT device basis (e.g., total number of communication per charging period).

[PR 5.3.6.2-5] The 5G system shall be able to collect charging information per application for using Ambient IoT services (e.g., total number of Ambient IoT devices per charging period).

**5.4 Use case for supporting Ambient power-enabled IoT in non-public network for logistics**

[PR.5.4.6-001] 5G system shall support network access for Ambient IoT devices while considering the constraint power consumption.

Note: The above requirement applies to both NPN and PLMN.

**5.5 Intralogistics in automobile manufacturing**

[PR 5.5.6.1-001] The 5G system shall support communication for an Ambient IoT device which is battery-less or with limited energy storage capability.

[PR 5.5.6.1-002] The 5G system shall support collection of charging information based on different charging policies for Ambient-IoT type of communication, i.e., total number of communication (e.g. data payload) per charging period, or total number of Ambient IoT devices per charging period.

**5.6 Ambient power-enabled IoT sensors in smart homes**

[PR.5.6-001] The 5G system shall be able to support communication services for ambient power-enabled IoT devices.

Editor’s Note: The definition of ‘ambient power-enabled IoT devices’ will align to final TR.

[PR.5.6-002] The 5G system shall support suitable security mechanisms for Ambient IoT devices, including authentication, encryption and data integrity.

[PR.5.6-003] The 5G system shall be able to provide the required communication service according to KPI given in table 5.6.6-1.

**5.7 Use Case on Ambient IoT for airport terminal / shipping port**

[PR 5.7.6-1] The 5G system shall be able to support means to discover and locate Ambient-IoT devices in a certain geographical area, e.g. at cell level.

**5.8 Use case on Finding Remote Lost Item**

[PR.5.8.6-1] The 5G system shall be able to assist an Ambient IoT device with discovery and communication with UEs/RAN entities that can provide location related information.

Editor’s note: "UEs/RAN entities” terminology needs to be clarified.

[PR 5.8.6-2] Based on operator policy, the 5G system shall be able to support authorization of UEs communicating with an Ambient IoT device.

[PR.5.8.6-3] The 5G system shall be able to support means to support RAN entities and authorized UEs to communicate with Ambient IoT devices and transfer related information to other 5G system entities (e.g., core network) / servers.

[PR.5.8.6-4] The 5G system shall be able to provide a mechanism to protect the privacy of information (e.g., location and identity) exchanged during communication with an Ambient IoT device.

NOTE 1: This requirement refers to communication between Ambient IoT devices and 5G System entities (e.g., core network, RAN entities), application servers or authorized UEs.

[PR 5.8.6-5] The 5G system shall be able to support a UE to authenticate an Ambient IoT device

**5.9 LCS for Ambient IoT**

[PR 5.9.6.1-001] 5G system shall optimize mobility management support for mobile Ambient-enabled IoT devices that are unable to constantly stay active.

[PR 5.9.6.1-002] 5G system shall be able to determine the location of Ambient IoT device, when it becomes active as triggered by the 5G network.

**5.10 Ranging for Ambient IoT**

[PR 5.10.6.1-001] 5G system shall be able to support the ranging operation between UE and Ambient IoT device.

**5.11 Use case on Online modification of medical instruments status**

[PR 5.11.6-1] The 5G system shall be able to communicate with an Ambient-IoT device.

[PR 5.11.6-2] The 5G system shall be able to provide a mechanism for a trusted 3rd party to modify the information stored on an Ambient-IoT device.

Editor’s Note: This requirement need to be revisited to clarify how the device can store and modify information without application and what kind of data that can be stored.

**5.12 Use Ambient IoT service for personal belongings finding**

[PR.5.12.6.1-001] The 5G system shall support to authorize a UE to obtain device information of an Ambient IoT device.

[P.R.5.12.6.1-002] The 5G system shall be able to collect information from a specific Ambient IoT device.

[P.R.5.12.6.1-003] The 5G system shall be able to provide information of a specific Ambient IoT device to the trusted 3rd party.

NOTE: The request from 3rd party can include the requested Ambient IoT device identity, the requested service area to find the Ambient IoT device, the requested information of an Ambient IoT device includes position information.

[PR 5.12.6.1-004] The 5G system shall be able to support indoor and outdoor positioning for Ambient IoT devices.

[PR. 5.12.6.1-005] The 5G system shall be able to support an Ambient IoT device to validate a UE which communicates with the device.

[PR. 5.12.6.1-006] The 5G system shall support to validate an Ambient IoT device

**5.13 Use case on Ambient IoT for Base Station Machine Room Environmental Supervision**

[P.R.5.13.6-001] The 5G system shall be able to support communication with Ambient IoT devices.

[P.R.5.13.6-002] The 5G system shall be able to support suitable security mechanisms for Ambient IoT devices, including encryption and data integrity.

[P.R.5.13.6-003] The 5G system shall be able to support suitable mechanisms to authenticate and authorize Ambient IoT devices.

[P.R.5.13.6-004] The 5G system shall support energy efficient communication mechanisms for Ambient IoT devices (i.e., minimizing the device communication power consumption).

[P.R 5.13.6-005] The 5G system shall support transferring data collected from Ambient IoT devices to a trusted 3rd party.

**5.14 Indoor positioning in shopping centre using Ambient IoT**

[PR.5.14.6.1-001] The 5G system shall support be able to authorize a UE to perform Ambient IoT communication services with specific Ambient IoT devices.

[PR.5.14.6.1-002] The 5G system shall be able to support authorizing a UE to perform Ambient IoT positioning services with specific Ambient IoT devices.

[PR.5.14.6.1-003] Subject to user consent and operator’s policy, the 5G system shall be able to expose the identities and positions of Ambient IoT devices to a 3rd party.

[PR. 5.14.6.1-004] The 5G system shall be able to support an Ambient IoT device to authenticate a UE triggering Ambient IoT services.

[PR. 5.14.6.1-005] The 5G system shall be able to support a UE to verify an Ambient IoT device’s identity.

**5.15 Use Case of Ambient\_IoT enablement of smart laundry**

[PR.5.15.6.2-1] The 5G system shall support communication for Ambient\_IoT devices.

Editor’s Note: It is FFS enhancement of specific 5GS efficiency required to support this use case.

**5.16 Use case of Ambient\_IoT service for automated supply distribution**

[PR 5.16.6.1-001] The 5G system shall be able to support a mechanism to authenticate and authorize Ambient\_IoT devices.

[PR 5.16.6.1-002] The 5G system shall optimize mobility management support for non-stationary Ambient\_IoT devices that are unable to initiate communication towards the network.

[PR 5.16.6.1-003] The 5G System shall allow an operator to manage (e.g. provision, authenticate, authorise, etc.) Ambient\_IoT devices that have limited or no power source.

[PR 5.16.6.1-004] The 5G System shall be able to provide suitable and secure means to report to an authorized third-party the location of Ambient\_IoT devices.

**5.17 Use case on Device Activation and Deactivation**

[PR 5.17.6-1] Based on operator policy, the 5G system shall provide means for an authorised user or authorised third parties to request enable and disable an Ambient IoT device capability to transmit RF signals.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*End of Change\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*