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TECHNICAL SPECIFICATION

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Stage 2
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In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

shall indicates a mandatory requirement to do something

shall not indicates an interdiction (prohibition) to do something

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The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

can indicates that something is possible

cannot indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

will indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

will not indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

might indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

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might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

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1 Scope

The present document specifies architectural enhancements to the 5G system to support Ambient power-enabled Internet of Things, complying to the requirements in TS 22.369 [2] applicable to the AIoT Device types, traffic types, use cases and connectivity topologies defined in TS 38.300 [5].

In this Release, the AIoT system is defined as an isolated private network, such as SNPN, that does not interact with a public network.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 22.369: "Service requirements for Ambient power-enabled IoT".

[3] 3GPP TS 23.501: "System Architecture for the 5G System (5GS); Stage 2".

[4] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[5] 3GPP TS 38.300: "NR; Overall description; Stage-2".

[6] 3GPP TS 23.003: "Numbering, Addressing and Identification".

[7] GS1 TDS Release 2.1: "EPC Tag Data Standard".

[8] 3GPP TS 33.501: "Security architecture and procedures for 5G system".

[9] 3GPP TS 33.369: "Security aspects of Ambient Internet of Things (AIoT) services for isolated private networks".

[10] 3GPP TS 38.413: "NG Application Protocol (NGAP)".

[11] 3GPP TS 38.391: "Ambient IoT Medium Access Control Protocol specification".

[12] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".

[13] 3GPP TS 24.369: "Ambient IoT Non-Access-Stratum (AIoT NAS) protocol for 5G System (5GS); Stage 3".

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3 Definitions of terms and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

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AIoT Area: An area in which NG-RAN can perform Ambient IoT operations, see TS 38.300 [5], represented by an AIoT Area identifier. There can be multiple NG-RAN nodes and multiple RAN Readers in a single AIoT Area. NG-RAN nodes and RAN Readers can be part of multiple AIoT Areas.

AIoT Device: An Ambient IoT device is an IoT device powered by energy harvesting, with limited energy storage capability.

External Area Identifier: An identifier for an AIoT service area used by the AF when requesting AIoT Service Operations.

External Target Area: An area used between the NEF and AF in AIoT service operations, identified by a pre-configured External Area Identifier or geographic location (e.g. a civic address or GAD shapes, see TS 23.032 [12]).

Target Area: An area in which a service operation request towards an AIOTF is intended to operate, identified by a list of AIoT Areas.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

ADM	AIoT Data Management
AIoT	Ambient IoT
AIOTF	Ambient IoT Function
EPC	Electronic Product Code

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4 Architecture model and concepts

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4.1 General concept

AIoT is a service that can be provided by the 5GS system to support Ambient power-enabled IoT devices that are powered by energy harvesting, being either battery-less or with limited energy storage capability (e.g. using a capacitor) and the energy is provided through the harvesting of radio waves, light, motion, heat, or any other suitable power source.

The 5GS System architecture for AIoT include the following functions and procedures for:

- AIoT Device identification;
- AIoT Device inventory;
- Providing to, and obtaining from, an AIoT Device application data.
- Disabling AIoT Devices.

4.2 Architecture

4.2.1 General

The 5GS System architecture for AIoT includes core network functions, different AIoT Reader architectures and AIoT Devices. The different AIoT Reader architectures allow for different deployment options. The following AIoT Reader architectures are defined:

- NG- RAN (which supports AIoT Reader), which includes either a direct connectivity between NG-RAN and the AIOTF or an indirect connectivity between NG-RAN and the AIOTF via an AMF.

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The NG-RAN in this specification refers to the gNB which supports AIoT related functionalities, as specified in TS 38.300 [5]. The gNB may only support communication with AIoT Devices.

The architecture for Network Exposure Function, using reference point representation, defined in clause 4.2.3 of TS 23.501 [3] is applicable for AIoT, with a southbound interface from the NEF to AIOTF.

4.2.2 Architecture for NG-RAN connectivity

4.2.2.1 General

5GS system architecture for AIoT supports the following connectivity to access an NG-RAN:

- Direct Connectivity: AIOTF communicates with NG-RAN directly.
- Indirect Connectivity via AMF: NG-RAN and the AIOTF communicate indirectly via an AMF.

Figure 4.2.2.1-1 depicts the complete non-roaming architecture showing the overall 5GS architecture for support of AIoT, including both the Indirect Connectivity and Direct Connectivity.

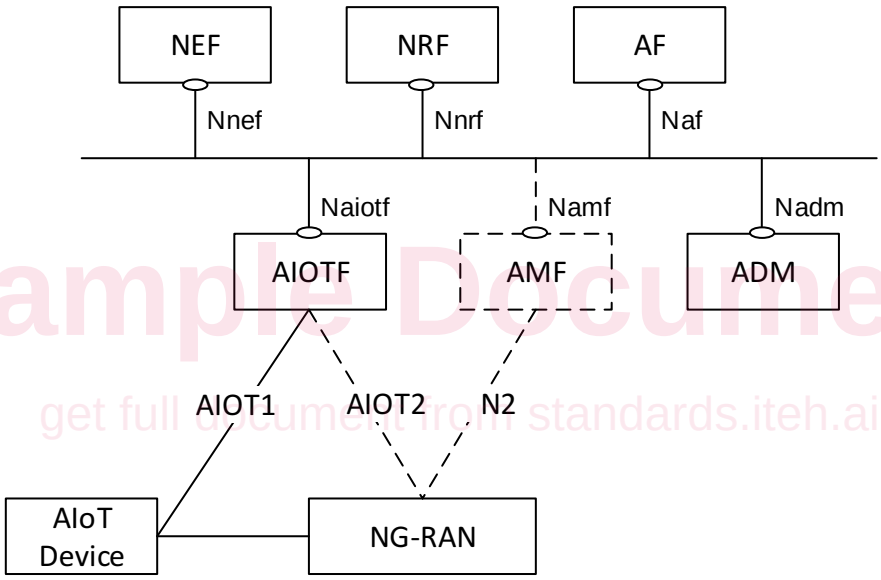

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Figure 4.2.2.1-1: Non-roaming AIoT System Architecture

NOTE 1: For the sake of clarity and to depict the complete reference point architecture, the AMF, AIOT2 and N2 as depicted using dashed lines, as all deployments might not use them.

Figure 4.2.2.1-2 depicts the complete non-roaming AIoT system architecture, using the reference point representation.

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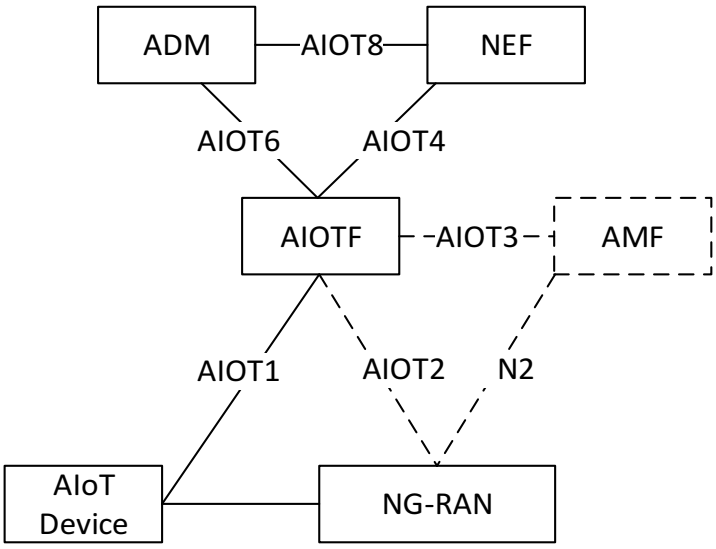

Figure 4.2.2.1-2: Non-roaming AIoT System Architecture (RAN Readers) in reference point representation

NOTE 2: For the sake of clarity of the point-to-point diagrams, the AF and NRF have not been depicted. However, all depicted Network Functions can interact with the NRF as necessary.

NOTE 3: For clarity, the UDR and its connections with ADM, are not depicted in the point-to-point and service-based architecture diagrams. For more information on the ADM data storage architectures refer to clause 4.5.8.

NOTE 4: For the sake of clarity and to depict the complete reference point architecture, the AMF, AIOT3, N2 and AIOT2 as depicted using dashed lines, as all deployments might not use them.

The architectures in the following clauses showing parts of the overall AIoT architecture specific to each connectivity option:

- Direct Connectivity: the AIOTF uses AIOT2 to access NG-RAN, and is described in clause 4.2.2.2.
- Indirect Connectivity via AMF: the AIOTF uses an AMF which uses N2 to access NG-RAN, and is described in clause 4.2.2.3.

NOTE 5: A deployment that only uses, e.g. the Direct Connectivity only does not need to deploy the NFs, reference points and service-based interfaces associated with the Indirect Connectivity, and vice-versa.

4.2.2.2 Direct Connectivity between AIOTF and NG-RAN

In the Direct Connectivity architecture, the AIOTF uses AIOT2 to communicate directly with NG-RAN.

Figure 4.2.2.2-1 depicts the AIoT architecture, using the service-based interfaces, showing only the parts of the AIoT architecture for an AIOTF connecting to NG-RAN directly. The remaining parts of the AIoT architecture shown in Figure 4.2.2.1-1 remain unchanged.

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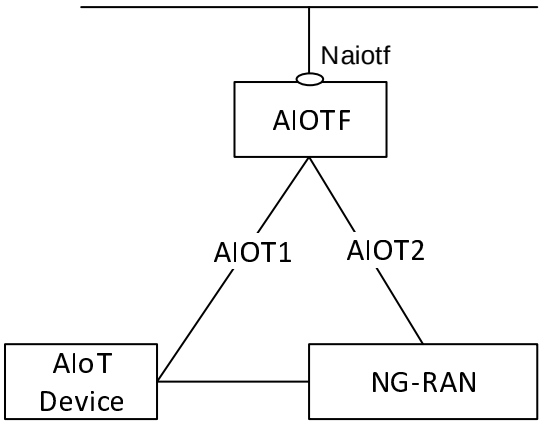

Figure 4.2.2.2-1: NG-RAN - AIOTF Direct Connectivity Architecture

Figure 4.2.2.2-2 depicts the AIoT architecture, using the reference point representation, showing only the parts of the AIoT architecture for an AIOTF access NG-RAN. The remaining parts of the AIoT architecture shown in Figure 4.2.2.1-2 remain unchanged.

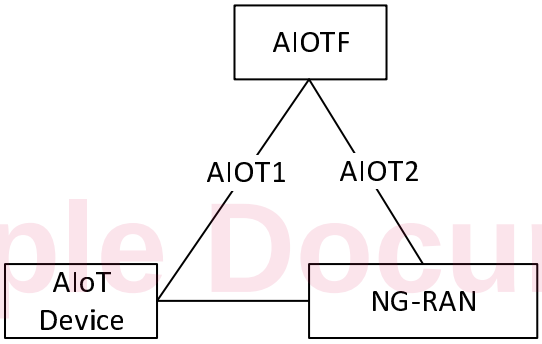

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Figure 4.2.2.2-2: NG-RAN - AIOTF Direct Connectivity Architecture in reference point representation

4.2.2.3 Indirect Connectivity between AIOTF and NG-RAN via an AMF

Figure 4.2.2.3-1 depicts the AIoT architecture, using the service-based interfaces showing only the parts of the AIoT architecture for an AIOTF connects indirectly to NG-RAN via an AMF. The remaining parts of the AIoT Architecture shown in Figure 4.2.2.1-1 remain unchanged.

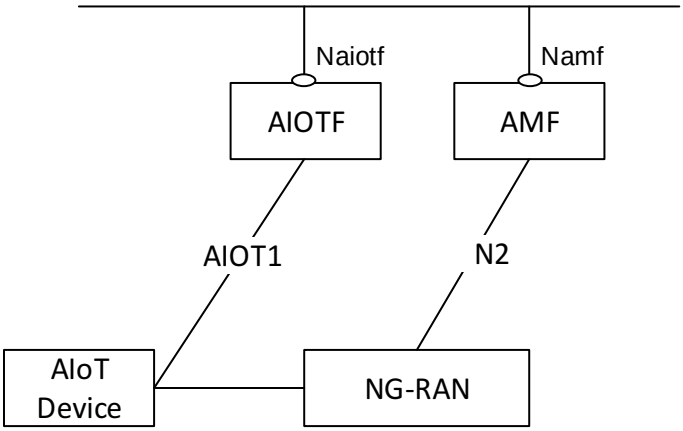

Figure 4.2.2.3-1: NG-RAN - AIOTF Indirect Connectivity Architecture

Figure 4.2.2.3-2 depicts the AIoT architecture, using the reference point representation showing only the parts of the AIoT architecture for an AIOTF connects to NG-RAN via an AMF. The remaining parts of the AIoT architecture shown in Figure 4.2.2.1-2 remain unchanged.

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