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O-RAN Working Group 3

Near-Real-time RAN Intelligent Controller

E2 Service Model (E2SM)

KPM

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1 Foreword

2 This Technical Specification (TS) has been produced by O-RAN Alliance.

3 Modal verbs terminology

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

7 "**must**" and "**must not**" are **NOT** allowed in O-RAN deliverables except when used in direct citation.

8 1 Scope

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

12 version xx.yy.zz

13 where:

14 xx: the first digit-group is incremented for all changes of substance, i.e. technical enhancements, corrections,
15 updates, etc. (the initial approved document will have xx=01). Always 2 digits with leading zero if needed.

16 yy: the second digit-group is incremented when editorial only changes have been incorporated in the document.
17 Always 2 digits with leading zero if needed.

18 zz: the third digit-group included only in working versions of the document indicating incremental changes
19 during the editing process. External versions never include the third digit-group. Always 2 digits with
20 leading zero if needed.

21 The present document specifies the E2 Service Model (E2SM) "Key Performance Measurement" (KPM) for the RAN
22 function handling reporting of the cell-level performance measurements for 5G networks defined in TS 28.552 [4] and
23 for EPC networks defined in TS 32.425 [8], and their possible adaptation of UE-level or QoS flow-level measurements.

24 2 References

25 2.1 Normative references

26 References are either specific (identified by date of publication and/or edition number or version number) or non-
27 specific. For specific references, only the cited version applies. For non-specific references, the latest version of the
28 referenced document (including any amendments) applies.

29 NOTE: While any hyperlinks included in this clause were valid at the time of publication, O-RAN cannot
30 guarantee their long term validity.

31 The following referenced documents are necessary for the application of the present document.

32 [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

33 [2] O-RAN Working Group 3, Near-Real-time RAN Intelligent Controller, Architecture & E2 General
34 Aspects and Principles (E2GAP)

35 [3] O-RAN Working Group 3, Near-Real-time RAN Intelligent Controller, E2 Application Protocol
36 (E2AP).

- 1 [4] 3GPP TS 28.552: "Management and orchestration 5G performance measurements".
- 2 [5] ITU-T Recommendation X.680 (2002-07): "Information technology – Abstract Syntax Notation
3 One (ASN.1): Specification of basic notation".
- 4 [6] ITU-T Recommendation X.681 (2002-07): "Information technology – Abstract Syntax Notation
5 One (ASN.1): Information object specification".
- 6 [7] ITU-T Recommendation X.691 (2002-07): "Information technology - ASN.1 encoding rules -
7 Specification of Packed Encoding Rules (PER)".
- 8 [8] 3GPP TS 32.425: "Telecommunication management Performance Management Performance
9 managements".
- 10 [9] IETF RFC 5905 (2010-06): "Network Time Protocol Version 4: Protocol and Algorithms
11 Specification".
- 12 [10] 3GPP TS 32.404: "Telecommunication management; Performance Management (PM);
13 Performance measurements; Definitions and template".
- 14 [11] 3GPP TR 25.921: "Guidelines and principles for protocol description and error handling".
- 15 [12] O-RAN Working Group 3, Near-Real-time RAN Intelligent Controller, E2 Service Model (E2SM)
- 16 [13] 3GPP TS 36.413: "E-UTRAN; S1 Application Protocol (S1AP)"
- 17 [14] 3GPP TS 23.501: "System architecture for the 5G System (5GS); Stage 2"
- 18 [15] 3GPP TS 36.214: "E-UTRA; Physical layer; Measurements"
- 19 [16] 3GPP TS 38.215: "NR; Physical layer measurements"
- 20 [17] 3GPP TS 38.133: "NR; Requirements for support of radio resource management"
- 21 [18] 3GPP TS 38.214: "NR; Physical layer procedures for data"
- 22 [19] 3GPP TS 23.203: "Policy and charging control architecture"
- 23 [20] 3GPP TS 23.003: "Numbering, addressing and identification"
- 24 [21] O-RAN Working Group 3, Use Case Requirements (UCR)
- 25 [22] O-RAN Working Group 1, Massive MIMO Use Cases Technical Report

26 2.2 Informative references

27 References are either specific (identified by date of publication and/or edition number or version number) or non-
28 specific. For specific references, only the cited version applies. For non-specific references, the latest version of the
29 referenced document (including any amendments) applies.

30 NOTE: While any hyperlinks included in this clause were valid at the time of publication, O-RAN cannot
31 guarantee their long term validity.

32 The following referenced documents are not necessary for the application of the present document but they assist the
33 user with regard to a particular subject area.

34 [i.1] <Standard Organization acronym> <document number><version number/date of publication>: "<Title>".

1 3 Definition of terms, symbols and abbreviations

2 3.1 Terms

3 For the purposes of the present document, the following terms apply:

4 **E2 Node:** as defined in E2GAP [2].

5 **RAN Function:** as defined in E2GAP [2]

7 **E2 Service Model:** The description of the Services exposed by a specific RAN function within an E2 Node over the E2
8 interface towards the Near-RT RIC.

9 **KPM Report:** The performance measurements for 4G LTE and 5G NR Network Functions.

10 3.2 Symbols

11 For the purposes of the present document, the following symbols apply:

12 3.3 Abbreviations

13 For the purposes of the present document, the [following] abbreviations [given in ... and the following] apply:

14 O-CU	O-RAN Central Unit
15 O-CU-CP	O-RAN Central Unit – Control Plane
16 O-CU-UP	O-RAN Central Unit – User Plane
17 O-DU	O-RAN Distributed Unit
18 Near-RT RIC	Near-real-time RAN Intelligent Controller
19 Non-RT-RIC	Non-real-time RAN Intelligent Controller
20 EN-DC	E-UTRA-NR Dual Connectivity
21 MR-DC	Multi-Radio Dual Connectivity
22 SRS	Sounding Reference Signal
23 SRS-RSRP	Sounding Reference Signal based Reference Signal Received Power
24 SS-RSRP	Synchronization Signal based Reference Signal Received Power
25 SS-SINR	Synchronization Signal based Signal to Noise and Interference Ratio
26 SSB	Synchronization Signal Block

29 4 General

30 4.1 Forwards and Backwards Compatibility

31 The forwards and backwards compatibility of the protocol is assured by a mechanism where all current and future
32 messages, and IEs or groups of related IEs, include ID and criticality fields that are coded in a standard format that will
33 not be changed in the future. These parts can always be decoded regardless of the standard version.

34 4.2 Specification Notations

35 For the purposes of the present document, the following notations apply:

36 Service	When referring to a Service in the specification the SERVICE NAME is written with upper case 37 characters and in bold followed by the word "service", e.g. REPORT service.
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1	Procedure	When referring to an elementary procedure in the specification the Procedure Name is written with the first letters in each word in upper case characters followed by the word "procedure", e.g. Handover Preparation procedure.
4	Message	When referring to a message in the specification the MESSAGE NAME is written with all letters in upper case characters followed by the word "message", e.g. HANDOVER REQUEST message.
6	IE	When referring to an information element (IE) in the specification the <i>Information Element Name</i> is written with the first letters in each word in upper case characters and all letters in Italic font followed by the abbreviation "IE", e.g. <i>E-RAB ID</i> IE.
9	Value of an IE	When referring to the value of an information element (IE) in the specification the "Value" is written as it is specified in the specification enclosed by quotation marks, e.g. "Value".

4.3 Identifiers

For the purposes of the present document, the following identifiers are defined:

13	Style Type	The identifier used to nominate a specific approach or Style used to exposing a given RIC Service (REPORT, INSERT, CONTROL and POLICY). The same E2SM may support more than one Style for each RIC Service.
16	Format Type	The identifier used to nominate a specific formatting approach used to encode one of the E2AP IEs defined in this E2SM. The same E2SM may support more than one encoding Formats for each E2AP IE and each E2AP IE message encoding Format may be used by one or more RIC Service Styles.

5 E2SM Services

As defined in E2 General Aspects and Principles [2], a given RAN Function offers a set of services to be exposed over the E2 (**REPORT**, **INSERT**, **CONTROL**, **POLICY** and/or **QUERY**) using E2AP [3] defined procedures. Each of the E2AP Procedures listed in table 5-1 contains specific E2 Node RAN Function dependent Information Elements (IEs).

Table 5-1: Relationship between E2SM services and E2AP Information elements

RAN Function specific E2AP Information Elements	E2AP Information Element reference	Related E2AP Procedures
<i>RIC Event Trigger Definition IE</i>	E2AP [3] Section 9.2.9	RIC Subscription
<i>RIC Action Definition IE</i>	E2AP [3] Section 9.2.12	RIC Subscription
<i>RIC Indication Header IE</i>	E2AP [3] Section 9.2.17	RIC Indication
<i>RIC Indication Message IE</i>	E2AP [3] Section 9.2.16	RIC Indication
<i>RIC Call Process ID IE</i>	E2AP [3] Section 9.2.18	RIC Indication RIC Control
<i>RIC Control Header IE</i>	E2AP [3] Section 9.2.20	RIC Control
<i>RIC Control Message IE</i>	E2AP [3] Section 9.2.19	RIC Control
<i>RIC Control Outcome IE</i>	E2AP [3] Section 9.2.25	RIC Control
<i>RAN Function Definition IE</i>	E2AP [3] Section 9.2.23	E2 Setup RIC Service Update
<i>RIC Query Header IE</i>	E2AP [3] Section 9.2.36	RIC Query
<i>RIC Query Definition IE</i>	E2AP [3] Section 9.2.37	RIC Query
<i>RIC Query Outcome IE</i>	E2AP [3] Section 9.2.38	RIC Query

All of these RAN Function specific IEs are defined in E2AP [3] as “OCTET STRING”.

The purpose of this specification is to define the contents of these fields for the specific RAN Function “KPM Monitor”.

1 6 RAN Function Service Model Description

2 6.1 RAN Function Overview

3 E2 Service Model KPM (E2SM-KPM) supports O-CU-CP, O-CU-UP, and O-DU as part of NG-RAN connected to
4 5GC or as part of E-UTRAN connected to EPC.

5 The E2 Node shall host the RAN Function “KPM Monitor” which performs the following functionalities:

- 6 - Exposure of available measurements from O-DU, O-CU-CP, and/or O-CU-UP via the RAN Function Definition IE.
7 - Periodic reporting of measurements subscribed from Near-RT RIC.

8 This E2SM specification also exposes a set of services described in clause 6.2.

9 6.2 Supported RIC Services

10 6.2.1 REPORT

11 The “KPM Monitor” RAN Function provides the following **REPORT** services:

- 12 - E2 Node Measurement
13 - E2 Node Measurement for a single UE
14 - Condition-based, UE-level E2 Node Measurement
15 - Common Condition-based, UE-level E2 Node Measurement
16 - E2 Node Measurements for multiple UEs

17 These services may be initiated according to:

- 18 - Periodical event.

19 7 RAN Function Description

20 7.1 Description

21 The E2AP [3] procedures, E2 SETUP and RIC SERVICE UPDATE, are used to transport the RAN Function Definition
22 IE.

23 In this E2SM-KPM, the RAN Function Definition IE shall provide the following information:

- 24 - RAN Function name along with associated information on E2SM definition
25 - Event trigger styles list along with the corresponding encoding type for each associated E2AP IE.
26 - RIC REPORT Service styles list along with the corresponding encoding type for each associated E2AP IE.

27 7.2 RAN Function Name

28 RAN Function Short Name “ORAN-E2SM-KPM”

29 RAN Function Description “KPM Monitor”

1 RAN Function Instance, required when and if an E2 Node exposes more than one instance of a RAN Function based on
2 this E2SM.

3

4 7.3 Supported RIC Event Trigger Styles

5 7.3.1 Event Trigger Style Types

RIC Style Type	Style Name	Supported RIC Service Style			Style Description
		Report	Insert	Policy	
1	Periodic Report	1	-	-	<i>RIC Event Trigger Definition IE based on reporting period</i>

6

7 7.3.2 Event Trigger Style 1: Periodic Report

8 This Event Trigger style 1 is to set the KPM report period and uses the *RIC Event Trigger Definition IE Format 1*
9 (8.2.1.1.1)

10 7.4 Supported RIC REPORT Service Styles

11 7.4.1 REPORT Service Style Type

RIC Style Type	Style Name	Style Type Description
1	E2 Node Measurement	Used to carry measurement report from a target E2 Node
2	E2 Node Measurement for a single UE	Used to carry measurement report for a single UE of interest from a target E2 Node
3	Condition-based, UE-level E2 Node Measurement	Used to carry UE-level measurement report for a group of UEs per measurement type matching subscribed conditions from a target E2 Node
4	Common Condition-based, UE-level Measurement	Used to carry measurement report for a group of UEs across a set of measurement types satisfying common subscribed conditions from a target E2 Node
5	E2 Node Measurement for multiple UEs	Used to carry measurement report for multiple UE of interest from a target E2 Node

12

13 7.4.2 REPORT Service Style 1: E2 Node Measurement

14 7.4.2.1 REPORT Service Style description

15 The REPORT Service style 1 provides the performance measurement information collection from an E2 Node.

16 7.4.2.2 REPORT Service RIC Action Definition IE contents

17 This REPORT Service style aims to subscribe to the measurements defined in TS 28.552 [4] and TS 32.425 [8], and
18 uses the *RIC Action Definition IE Format 1* (8.2.1.2.1).

19 The REPORT Service *RIC Action Definition IE* contains measurement types that Near-RT RIC is requesting to
20 subscribe followed by a list of subcounters to be measured for each measurement type, and a granularity period
21 indicating collection interval of those measurements.

22 For the measurement types that belong to a measurement object class confined in a single cell (e.g. "EUtranCellFDD"
23 in TS 32.425 [8] or "NRCellIDU" in TS 28.552 [4]), the *Cell Global ID IE* shall be included in the IE to point to a

1 specific cell for collecting measurements within the E2 Node. The *Cell Global ID* IE may not be included if all the
2 subscribed measurement types are cell agnostic, i.e. belonging to measurement object classes not confined in a single
3 cell (e.g. "GNBCUUPFunction" in TS 28.552 [4]). In case that both single-cell-confined and cell agnostic measurement
4 types are subscribed together, the *Cell Global ID* IE shall be included in the IE and the E2 Node shall ignore the
5 included *Cell Global ID* IE for those cell agnostic measurement types.

6 A measurement ID can be used for subscription instead of a measurement type if an identifier of a certain measurement
7 type was exposed by an E2 Node via the *RAN Function Definition* IE.

8 7.4.2.3 REPORT Service *RIC Indication Header* IE contents

9 This REPORT Service style uses the *RIC Indication Header* IE Format 1 (8.2.1.3.1), which contains a measurement
10 collection start time as UTC format.

11 The REPORT Service *RIC Indication Header* IE may carry file format version, sender name, sender type, and vendor
12 name as printable strings.

13 7.4.2.4 REPORT Service *RIC Indication Message* IE contents

14 This REPORT Service style uses the *RIC Indication Message* IE Format 1 (8.2.1.4.1).

15 The REPORT Service *RIC Indication Message* IE carries a set of measurement data reported from an E2 Node. The
16 reported data contains a set of measurement records, each collected at every granularity period during the reporting
17 period. In case the E2 Node is not able to provide reliable data for a granularity period during the reporting period, it
18 may include the optional *Incomplete Flag* IE, which indicates that the corresponding measurements record in the
19 reported data is not reliable.

20 The REPORT Service *RIC Indication Message* IE optionally carry subscription information, i.e. *Measurement*
21 *Information List* IE that indicates the order of measured values for each measurement record in the reported data, or
22 their granularity period. If not present, the original subscription information shall apply.

23 7.4.3 REPORT Service Style 2: E2 Node Measurement for a single UE

24 7.4.3.1 REPORT Service Style description

25 The REPORT Service style 2 provides the performance measurement information collection for a single UE of interest
26 from an E2 Node.

27 7.4.3.2 REPORT Service *RIC Action Definition* IE contents

28 This REPORT Service style uses the *RIC Action Definition* IE Format 2 (8.2.1.2.2), where the included UE ID indicates
29 a specific UE of interest for measurement collection.

30 The rest of the subscription information follows the same as described in 7.4.2.2.

31 7.4.3.3 REPORT Service *RIC Indication Header* IE contents

32 This REPORT Service style uses the *RIC Indication Header* IE Format 1 (8.2.1.3.1) as described in 7.4.2.3.

33 7.4.3.4 REPORT Service *RIC Indication Message* IE contents

34 This REPORT Service style uses the *RIC Indication Message* IE Format 1 (8.2.1.4.1) as described in 7.4.2.4, where the
35 measurement data reported is associated only to a specific UE that was subscribed.

1 7.4.4 REPORT Service Style 3: Condition-based, UE-level E2 Node 2 Measurement

3 7.4.4.1 REPORT Service Style description

4 The REPORT Service style 3 provides the UE-level performance measurement information collection for a group of
5 UEs per measurement type matching subscribed conditions from an E2 Node.

6 7.4.4.2 REPORT Service RIC Action Definition IE contents

7 This REPORT Service style uses the *RIC Action Definition IE Format 3* (8.2.1.2.3), where, for each requested
8 measurement within the *Measurement Information Condition List IE*, the *Matching Condition IE* serves as a condition
9 to include the matched UEs' measurement values into the reporting. The *Matching Condition IE* can be expressed by a
10 list of subcounters to be measured (i.e. as a list of labels), or by a list of test conditions that need to be passed, or by a
11 combination of both.

12 The rest of the subscription information follows the same as described in 7.4.2.2.

13 7.4.4.3 REPORT Service RIC Indication Header IE contents

14 This REPORT Service style uses the *RIC Indication Header IE Format 1* (8.2.1.3.1) as described in 7.4.2.3.

15 7.4.4.4 REPORT Service RIC Indication Message IE contents

16 This REPORT Service style uses the *RIC Indication Message IE Format 2* (8.2.1.4.2).

17 The REPORT Service *RIC Indication Message IE* carries a set of UE-level measurement data matching subscribed
18 conditions. The included *Measurement Information Condition UE List IE* indicates the order of measured values for
19 each measurement record in the reported data – a list of all the UE ID(s) satisfying the subscribed *Matching Condition*
20 IE for each requested measurement within a Reporting Period.

21 In every granularity period during which a UE matching a subscribed condition stays in the E2 Node and maintains the
22 RRC_CONNECTED or RRC_INACTIVE state, the E2 Node collects the related data and reports it at the end of the
23 reporting period.

24 The *List of matched UE IDs IE* for a certain measurement type in the *Measurement Information Condition UE List IE*
25 indicates all the UE ID(s) that satisfied the subscribed *Matching Condition IE* for that measurement type and maintained
26 the RRC_CONNECTED or RRC_INACTIVE state at least for one granularity period during the reporting period. The
27 *List of matched UE IDs IE* can be omitted for a certain subscribed measurement type if none of the UEs were matched
28 during the reporting period. If the *List of matched UE IDs IE* is used for a measurement type, then the same IE shall be
29 used for all the measurement types in the *Measurement Information Condition UE List IE*.

30 If the *List of matched UE IDs IE* is used, in the granularity periods where the UE does not appear in the
31 RRC_CONNECTED or RRC_INACTIVE state (e.g. transitioned to RRC_IDLE or UE identity track is lost), the E2
32 Node does not collect the related data and NULL is reported for those granularity periods until the end of the Reporting
33 Period. In this case, the E2 Node stops reporting measurements related to this UE in the subsequent reporting periods. If
34 the *List of matched UE IDs IE* is used and a UE whose ID is included in the IE appeared in the middle of the reporting
35 period, then NULL should be reported for the granularity periods prior to the UE appearing in the E2 Node.

36 On the other hand, the *Sequence of Matched UE IDs for Granularity Periods IE* for a certain measurement type in the
37 *Measurement Information Condition UE List IE* can be used to indicate the UE ID(s) that satisfied the subscribed
38 *Matching Condition IE* for the corresponding measurement type and maintained the RRC_CONNECTED or
39 RRC_INACTIVE state, separately for each and every granularity period in chronological order. If the *Sequence of*
40 *Matched UE IDs for Granularity Periods IE* is used for a measurement type, then the same IE shall be used for all the
41 measurement types in the *Measurement Information Condition UE List IE*, and the *List of matched UE IDs IE*, if
42 included for any measurement type, shall be ignored.

43 The rest of the information follows the same as described in 7.4.2.4.

1 **7.4.5 REPORT Service Style 4: Common condition-based, UE-level**
2 **Measurement**

3 **7.4.5.1 REPORT Service Style description**

4 The REPORT Service style 4 provides the UE-level performance measurement information collection for a group of
5 UEs across a set of measurement types matching common subscribed conditions from an E2 Node.

6 **7.4.5.2 REPORT Service RIC Action Definition IE contents**

7 This REPORT Service style uses the *RIC Action Definition IE Format 4* (8.2.1.2.4), where a *Matching Condition IE*
8 serves as a condition to include the matched UEs' measurement values into the reporting, common for each requested
9 measurement within the *Measurement Information List IE*. The *Matching Condition IE* is expressed by a list of test
10 conditions to filter matching UEs.

11 The rest of the subscription information follows the same as described in 7.4.2.2.

12 **7.4.5.3 REPORT Service RIC Indication Header IE contents**

13 This REPORT Service style uses the *RIC Indication Header IE Format 1* (8.2.1.3.1) as described in 7.4.2.3.

14 **7.4.5.4 REPORT Service RIC Indication Message IE contents**

15 This REPORT Service style uses the *RIC Indication Message IE Format 3* (8.2.1.4.3).

16 The REPORT Service *RIC Indication Message IE Format 3* carries a list of measurement data for UE(s) matching
17 subscribed conditions.

18 In every granularity period during which a UE matching a subscribed condition stays in the E2 Node and maintains the
19 RRC_CONNECTED or RRC_INACTIVE state, the E2 Node collects the related data and reports it at the end of the
20 reporting period. In the granularity periods where the UE does not appear in the RRC_CONNECTED or
21 RRC_INACTIVE state (e.g. transitioned to RRC_IDLE or UE identity track is lost), the E2 Node does not collect the
22 related data and NULL is reported for those granularity periods until the end of the Reporting Period. In this case, the
23 E2 Node stops reporting measurements related to this UE in the subsequent reporting periods.

24 If none of the UEs were matched during the reporting period, then E2 Node does not report measurements for that
25 reporting period.

26 The rest of the information follows the same as described in 7.4.2.4.

27 **7.4.6 REPORT Service Style 5: E2 Node Measurement for Multiple UEs**

28 **7.4.6.1 REPORT Service Style description**

29 The REPORT Service style 5 provides the performance measurement information collection for multiple UEs of
30 interest from an E2 Node.

31 **7.4.6.2 REPORT Service RIC Action Definition IE contents**

32 This REPORT Service style uses the *RIC Action Definition IE Format 5* (8.2.1.2.5), where the included UE Identifiers
33 indicates UEs of interest for measurement collection.

34 The rest of the subscription information follows the same as described in 7.4.2.2.

35 **7.4.6.3 REPORT Service RIC Indication Header IE contents**

36 This REPORT Service style uses the *RIC Indication Header IE Format 1* (8.2.1.3.1) as described in 7.4.2.3.

1 7.4.6.4 REPORT Service *RIC Indication Message IE* contents

2 This REPORT Service style uses the *RIC Indication Message IE Format 3* (8.2.1.4.3) as described in 7.4.5.4, where the
3 measurement data reported is associated to multiple UEs that was subscribed and available in the system.

4 7.5 Supported RIC INSERT Service Styles

5 Note: Not used in this service model

6 7.6 Supported RIC CONTROL Service Styles

7 Note: Not used in this service model

8 7.7 Supported RIC POLICY Service Styles

9 Note: Not used in this service model

10 7.7A Supported RIC QUERY Service Styles

11 Note: Not used in this service model

12 7.8 Supported RIC Styles and E2SM IE Formats

13 Table 7.8-1 and 7.8-2 provide a summary of the E2SM IE Formats defined to support this E2SM specification.

14 **Table 7.8-1: Summary of the E2SM IE Formats defined to support RIC Event Trigger Styles**

RIC Event Trigger Style	Event Trigger Definition Format
Style 1	1

15

16 **Table 7.8-1: Summary of the E2SM IE Formats defined to support RIC Service Styles**

RIC Service Style	Action Definition Format	Indication Header Format	Indication Message Format	Call Process ID Format	Control Header Format	Control Message Format	Control Outcome Format
REPORT							
Style 1	1	1	1				
Style 2	2	1	1				
Style 3	3	1	2				
Style 4	4	1	3				
Style 5	5	1	3				
INSERT							
CONTROL							
POLICY							
QUERY							

17

7.9 Conversion for UE-level and QoS flow-level measurements derived from 3GPP defined measured values

The conversion of the measurements' definitions provided in TS 28.552 [4], TS 32.425 [8], and O-RAN specific measurement defined in Section 7.10 is performed according to the following rules:

The type of the original measurements	The corresponding per-UE and per-UE-per-slice measurements	The corresponding per-QoS flow and per-slice-per-QoS flow measurements	Notes
Throughput Delay Data volume In-session activity time	Measured per UE	Measured per QoS flow	For the Throughput and Data volume measurements, the formulas specified in 3GPP are used with restriction to the individual UE or individual QoS flow , and also based on Section 7.9.1.
PDCP drop rate IP latency	Measured per UE	Measured per QoS flow	For the Throughput and Data volume measurements, the formulas specified in 3GPP are used with restriction to the individual UE or individual QoS flow.
Radio resource utilization	Measured per UE	N/A	The formulas specified in 3GPP are used with restriction to the individual UE.
RRC connections related PDU sessions related DRBs related QoS flows related	Measured per UE	N/A	
Mobility management	Measured per UE	N/A	
CQI related MCS related	Measured per UE	N/A	
PEE related	N/A	N/A	
Distribution of Normally/Abnormally Released Calls	Measured per UE	N/A	

7.9.1 Changes in the units of measurements while adopting for E2SM-KPM

The units of the following measurements in TS 28.552 [4] and TS 32.425 [8] are replaced with newer units, as shown in the table below.

Measurement Type	Measurement Name	Data Type	Unit used in 3GPP	Unit used in E2SM-KPM
DL Cell PDCP SDU Data Volume, defined in TS 28.552 [4] clause 5.1.2.1.2.1.	DRB.PdcpSduVolumeDL_Filter	INTEGER	Mbit	Kbit
UL Cell PDCP SDU Data Volume, defined in TS 28.552 [4] clause 5.1.2.1.2.2.	DRB.PdcpSduVolumeUL_Filter	INTEGER	Mbit	Kbit
DL PDCP PDU Data Volume, defined in TS 28.552 [4] clause 5.1.3.6.1.1.	QosFlow.PdcpPduVolumeDL_Filter	INTEGER	Mbit	Kbit
UL PDCP PDU Data Volume, defined in TS 28.552 [4] clause 5.1.3.6.1.2.	QosFlow.PdcpPduVolumeUL_Filter	INTEGER	Mbit	Kbit
DL PDCP SDU Data Volume, defined in TS 28.552 [4] clause 5.1.3.6.2.1.	QosFlow.PdcpSduVolumeDI_Filter	INTEGER	Mbit	Kbit
UL PDCP SDU Data Volume, defined in TS 28.552 [4] clause 5.1.3.6.2.2.	QosFlow.PdcpSduVolumeUI_Filter	INTEGER	Mbit	Kbit
DL Cell PDCP SDU Data Volume on X2 interface, defined in TS 28.552 [4] clause 5.1.2.1.1.2.	DRB.PdcpSduVolumeX2DL_Filter	INTEGER	Mbit	Kbit
UL Cell PDCP SDU Data Volume on X2 interface, defined in TS 28.552 [4] clause 5.1.2.1.2.2.	DRB.PdcpSduVolumeX2UL_Filter	INTEGER	Mbit	Kbit
DL Cell PDCP SDU Data Volume on Xn interface, defined in TS 28.552 [4] clause 5.1.2.1.1.3.	DRB.PdcpSduVolumeXnDL_Filter	INTEGER	Mbit	Kbit
UL Cell PDCP PDU Data Volume on Xn interface, defined in TS 28.552 [4] clause 5.1.2.1.2.3.	DRB.PdcpSduVolumeXnUL_Filter	INTEGER	Mbit	Kbit
DL PDCP SDU Data Volume per interface, defined in TS 28.552 [4] clause 5.1.3.6.2.3.	DRB.F1uPdcpSduVolumeDI.QoS, DRB.X2uPdcpSduVolumeDI.QoS, DRB.XnuPdcpSduVolumeDI.QoS	INTEGER	Mbit	Kbit
UL PDCP SDU Data Volume per interface, defined in TS 28.552 [4] clause 5.1.3.6.2.4.	DRB.F1uPdcpSduVolumeUI.QoS, DRB.X2uPdcpSduVolumeUI.QoS, DRB.XnuPdcpSduVolumeUI.QoS	INTEGER	Mbit	Kbit
DL cell PDCP SDU Data Volume, defined in TS 32.425 [8] clause 4.4.7.1.	DRB.PdcpSduVolumeDI_Filter	INTEGER	Mbit	Kbit
UL cell PDCP SDU Data Volume, defined in TS 32.425 [8] clause 4.4.7.2.	DRB.PdcpSduVolumeUI_Filter	INTEGER	Mbit	Kbit
In-session activity time for UE, defined in TS 28.552 [4] clause 5.1.1.13.2.2.	QF.SessionTimeUE	INTEGER	s	ms
In-session activity time for DRB, defined in TS 28.552 [4] clause 5.1.1.10.4.	DRB.SessionTime.5QI, DRB.SessionTime.SNSSAI	INTEGER	s	ms
In-session activity time for QoS flow, defined in TS 28.552 [4] clause 5.1.1.13.2.1.	QF.SessionTimeQoS.QoS	INTEGER	s	ms
In-session activity time for UE, defined in TS 32.425 [8] clause 4.2.4.1.	ERAB.SessionTimeUE	INTEGER	s	ms
In-session activity time for E-RABs, defined in TS 32.425 [8] clause 4.2.4.2.	ERAB.SessionTimeQCI.QCI	INTEGER	s	ms
IP throughput in UL, defined in TS 32.425 [8] clause 4.4.6.2.	DRB.IPThpUI.QCI	REAL	Kbit	Kbit/s

1 The changes in the units of the measurements shown in the above table are to prevent the reported values from being
2 reported as 0 caused by rounding off the precision in the decimals to report them as INTEGER, except the last row of
3 “IP throughput in UL”, which is to fix the erroneous unit.

4 7.10 O-RAN specific Performance Measurement

5 7.10.1 DL Transmitted Data Volume

Measurement Name	DL Transmitted Data Volume
a) Description	This measurement provides the transmitted data volume in the downlink in a measurement time. The measurement is split into subcounters per QoS level (mapped 5QI or QCI in NR option 3), and subcounters per supported S-NSSAI. The unit is kbit.
b) Collection Method	CC
c) Condition	This measurement is obtained by counting the data volume counted on RLC SDU level, in kbit successfully transmitted (acknowledged by UE) in DL for one DRB during measurement time T. Separate counters are maintained for each mapped 5QI (or QCI for option 3) and for each supported S-NSSAI.
d) Measurement Result	Each measurement is an integer value representing the number of bits measured in kbits (1kbits=1000 bits). The number of measurements is equal to the number of PLMNs multiplied by the number of QoS levels multiplied by the number of S-NSSAIs.
e) Measurement Type	The measurement name has the form DRB.RlcSduTransmittedVolumeDL_Filter. Where filter is a combination of PLMN ID and QoS level and S-NSSAI. Where PLMN ID represents the PLMN ID, QoS represents the mapped 5QI or the QCI level, and SNSSAI represents S-NSSAI.
f) Measurement Object Class	NRCellDU
g) Switching Technology	Valid for packet switched traffic
h) Generation	5GS
i) Purpose	One usage of this measurement is for performance assurance within integrity area (user plane connection quality).

1 7.10.2 UL Transmitted Data Volume

Measurement Name	UL Transmitted Data Volume
a) Description	<p>This measurement provides the transmitted data volume in the uplink in a certain period. The measurement is split into subcounters per QoS level (mapped 5QI or QCI in NR option 3), and subcounters per supported S-NSSAI.</p> <p>The unit is kbit.</p>
b) Collection Method	CC
c) Condition	<p>This measurement is obtained by counting the data volume counted on RLC SDU level, in kbit successfully transmitted (acknowledged by E2 Node) in UL for one DRB during measurement time T. Separate counters are maintained for each mapped 5QI (or QCI for option 3) and for each supported S-NSSAI.</p>
d) Measurement Result	<p>Each measurement is an integer value representing the number of bits measured in kbits (1kbits=1000 bits). The number of measurements is equal to the number of PLMNs multiplied by the number of QoS levels multiplied by the number of S-NSSAIs.</p>
e) Measurement Type	<p>The measurement name has the form DRB.RlcSduTransmittedVolumeUL_Filter.</p> <p>Where filter is a combination of PLMN ID and QoS level and S-NSSAI.</p> <p>Where PLMN ID represents the PLMN ID, QoS represents the mapped 5QI or the QCI level, and SNSSAI represents S-NSSAI.</p>
f) Measurement Object Class	NRCellDU
g) Switching Technology	Valid for packet switched traffic
h) Generation	5GS
i) Purpose	One usage of this measurement is for performance assurance within integrity area (user plane connection quality).

2

1 **7.10.3 Distribution of Percentage of DL Transmitted Data Volume to Incoming
2 Data Volume**

Measurement Name	Distribution of Percentage of DL Transmitted Data Volume to Incoming Data Volume
a) Description	This measurement provides the distribution of the percentage of successfully transmitted data volume to incoming data volume in downlink for UEs. The measurement is split into subcounters per QoS level (mapped 5QI or QCI in NR option 3), and subcounters per supported S-NSSAI.
b) Collection Method	CC
c) Condition	<p>The Measurement is calculated by $100*x/y$ for each UE.</p> <p>x is incremented by counting the number of bits counted on RLC SDU level successfully transmitted (acknowledged by UE) in DL for one DRB during measurement time T.</p> <p>y is incremented by counting the number of bits entering the RLC layers in DL for one DRB during measurement time T.</p> <p>For each UE, the bin corresponding to the percentage of transmitted data volume to incoming data volume ($100*x/y$) experienced by the UE is incremented by one.</p> <p>Separate counters are maintained for each mapped 5QI (or QCI for option 3) and for each supported S-NSSAI.</p>
d) Measurement Result	A set of integers, each representing the (integer) number of samples with a percentage of DL transmitted data volume to incoming data volume in the range represented by that bin. If the optional QoS level subcounter and S-NSSAI subcounter and PLMN ID subcounter measurements are performed, the number of measurements is equal to the number of mapped 5QIs and the number of supported S-NSSAIs, and the number of PLMN IDs.
e) Measurement Type	The measurement name has the form DRB.PerDataVolumeDLDist.Bin where Bin represents the bin, or optionally DRB.PerDataVolumeDLDist.Bin.QOS, where QOS identifies the target quality of service class, and DRB.PerDataVolumeDLDist.Bin.SNSSAI, where SNSSAI identifies the S-NSSAI, and DRB.PerDataVolumeDLDist.Bin.PLMN, where PLMN identifies the PLMN ID.
f) Measurement Object Class	NRCellIDU
g) Switching Technology	Packet Switched
h) Generation	5GS
i) Purpose	Network Operator's Traffic Engineering Community

1 **7.10.4 Distribution of Percentage of UL Transmitted Data Volume to Incoming**
2 **Data Volume**

Measurement Name	Distribution of Percentage of UL Transmitted Data Volume to Incoming Data Volume
a) Description	This measurement provides the distribution of the percentage of successfully transmitted data volume to incoming data volume in uplink for UEs. The measurement is split into subcounters per QoS level (mapped 5QI or QCI in NR option 3), and subcounters per supported S-NSSAI.
b) Collection Method	CC
c) Condition	<p>The Measurement is calculated by $100*x/y$ for each UE.</p> <p>x is incremented by counting the number of bits counted on RLC SDU level successfully transmitted (acknowledged by E2 Node) in UL for one DRB during measurement time T.</p> <p>y is incremented by counting the number of bits entering the RLC layers in UL for one DRB during measurement time T. It is up to implementation how to measure y reliably during T.</p> <p>For each UE, the bin corresponding to the percentage of transmitted data volume to incoming data volume ($100*x/y$) experienced by the UE is incremented by one.</p> <p>Separate counters are maintained for each mapped 5QI (or QCI for option 3) and for each supported S-NSSAI.</p>
d) Measurement Result	A set of integers, each representing the (integer) number of samples with a percentage of UL transmitted data volume to incoming data volume in the range represented by that bin. If the optional QoS level subcounter and S-NSSAI subcounter and PLMN ID subcounter measurements are performed, the number of measurements is equal to the number of mapped 5QIs and the number of supported S-NSSAIs, and the number of PLMN IDs.
e) Measurement Type	The measurement name has the form DRB.PerDataVolumeULDist.Bin where Bin represents the bin, or optionally DRB.PerDataVolumeULDist.Bin.QOS, where QOS identifies the target quality of service class, and DRB.PerDataVolumeULDist.Bin.SNSSAI, where SNSSAI identifies the S-NSSAI, and DRB.PerDataVolumeULDist.Bin.PLMN, where PLMN identifies the PLMN ID.
f) Measurement Object Class	NRCellDU
g) Switching Technology	Packet Switched
h) Generation	5GS
i) Purpose	Network Operator's Traffic Engineering Community

1 7.10.5 Distribution of DL Packet Drop Rate

Measurement Name	Distribution of DL Packet Drop Rate
a) Description	This measurement provides the fraction of RLC SDU packets which are dropped on the downlink, due to high traffic load, traffic management etc in the gNB-DU. Only user-plane traffic (DTCH) is considered. A dropped packet is one without any part of it having been transmitted on the air interface. The measurement is optionally split into subcounters per QoS level (mapped 5QI or QCI in NR option 3), and subcounters per supported S-NSSAI.
b) Collection Method	SI
c) Condition	This attribute is created by counting the number of UEs experiencing a certain packet loss rate in each range.
d) Measurement Result	Each measurement is an integer value representing the drop rate multiplied by 1E6 of each UE within the range of the bin. The number of measurements is equal to one. If the optional QoS and S-NSSAI level measurement are performed, the measurements are equal to the number of mapped 5QIs and the number of supported S-NSSAIs.
e) Measurement Type	The measurement name has the form DRB.RlcPacketDropRateDLDist and optionally DRB.RlcPacketDropRateDLDist.QOS where QOS identifies the target quality of service class, and DRB.RlcPacketDropRateDLDist.SNSSAI where SNSSAI identifies the S-NSSAI.
f) Measurement Object Class	NRCellDU
g) Switching Technology	Valid for packet switched traffic
h) Generation	5GS
i) Purpose	One usage of this measurement is for performance assurance within integrity area (user plane connection quality).

2

1 7.10.6 Distribution of UL Packet Loss Rate

Measurement Name	Distribution of UL Packet Loss Rate
a) Description	This measurement provides the distribution of the fraction of PDCP SDU packets which are not successfully received at gNB-CU-UP. It is a measure of the UL packet loss including any packet losses in the air interface, in the gNB-CU and on the F1-U interface. Only user-plane traffic (DTCH) and only PDCP SDUs that have entered PDCP (and given a PDCP sequence number) are considered. The measurement is optionally split into subcounters per QoS level (mapped 5QI or QCI in NR option 3), and subcounters per supported S-NSSAI.
b) Collection Method	SI
c) Condition	This attribute is created by counting the number of UEs experiencing a certain packet loss rate in each range.
d) Measurement Result	Each measurement is an integer value representing the loss rate multiplied by 1E6 of each UE within the range of the bin. If the optional QoS and S-NSSAI level measurement are performed, the measurements are equal to the number of mapped 5QIs and the number of supported S-NSSAIs.
e) Measurement Type	The measurement name has the form DRB.PacketLossRateULDist and optionally DRB.PacketLossRateULDist.QOS where QOS identifies the target quality of service class, and DRB. PacketLossRateULDist.SNSSAI where SNSSAI identifies the S-NSSAI.
f) Measurement Object Class	GNBCUUPFunction. NRCellCU.
g) Switching Technology	Valid for packet switched traffic.
h) Generation	5GS.
i) Purpose	One usage of this measurement is for performance assurance within integrity area (user plane connection quality).

2

7.10.7 DL Synchronization Signal based Reference Signal Received Power (SS-RSRP)

Measurement Name	DL Synchronization Signal based Reference Signal Received Power (SS-RSRP)
a) Description	This measurement provides the average of the DL SS-RSRP (see TS 38.215 [16]) values reported from UEs in the cell when SS-RSRP is used for L1-RSRP as configured by reporting configurations as defined in TS 38.214 [18], in case the L1-RSRP report function is enabled. Separate counters are maintained for each SSB in the cell.
b) Collection Method	DER (N=1)
c) Condition	This measurement is obtained by taking the average of the reported DL SS-RSRP values (i.e. between RSRP_0 and RSRP_126, see Table 10.1.6.1-1 in TS 38.133 [17]) from UEs in the cell per SSB during a granularity period.
d) Measurement Result	Each counter is a real value representing the average of the reported DL SS-RSRP values (i.e. between RSRP_0 and RSRP_126, see Table 10.1.6.1-1 in TS 38.133 [17]) for each SSB. The number of measurements is equal to the number of SSB beams defined in the cell.
e) Measurement Type	The measurement name has the form L1M.DL-SS-RSRP.SSB, where SSB represents the counter associated with SSB.
f) Measurement Object Class	NRCellIDU
g) Switching Technology	Valid for packet switched traffic
h) Generation	5GS
i) Purpose	One usage of this measurement is for mMIMO Non-GoB optimization in [21].

7.10.8 DL Synchronization Signal based Signal to Noise and Interference Ratio (SS-SINR)

Measurement Name	DL Synchronization Signal based Signal to Noise and Interference Ratio (SS-SINR)
a) Description	This measurement provides the average of the DL SS-SINR (see TS 38.215 [16]) values reported from UEs in the cell when SS-SINR is used for L1-SINR as configured by reporting configurations as defined in TS 38.214 [18], in case the L1-SINR report function is enabled. Separate counters are maintained for each SSB in the cell.
b) Collection Method	DER (N=1)
c) Condition	This measurement is obtained by taking the average of the reported DL SS-SINR values (i.e. between SINR_0 and SINR_127, see Table 10.1.16.1-1 in TS 38.133 [17]) from UEs in the cell per SSB during a granularity period.
d) Measurement Result	Each counter is a real value representing the average of the reported DL SS-SINR values (i.e. between SINR_0 and SINR_127, see Table 10.1.16.1-1 in TS 38.133 [17]) for each SSB. The number of measurements is equal to the number of SSB beams defined in the cell.
e) Measurement Type	The measurement name has the form L1M.DL-SS-SINR.SSB, where SSB represents the counter associated with SSB.
f) Measurement Object Class	NRCellIDU
g) Switching Technology	Valid for packet switched traffic
h) Generation	5GS
i) Purpose	One usage of this measurement is for mMIMO Non-GoB optimization in [21].

1 **7.10.9 UL Sounding Reference Signal based Reference Signal Received
2 Power (SRS-RSRP)**

Measurement Name	UL Sounding Reference Signal based Reference Signal Received Power (SRS-RSRP)
a) Description	This measurement provides the average of the UL SRS-RSRP (see TS 38.215 [16]) values measured for UEs in the cell.
b) Collection Method	DER (N=1)
c) Condition	This measurement is obtained by taking the average of the measured UL SRS-RSRP values in [W] for UEs in the cell during a granularity period.
d) Measurement Result	The measurement is an real value representing the average of the measured UL SRS-RSRP values in [W].
e) Measurement Type	The measurement name has the form L1M.UL-SRS-RSRP.
f) Measurement Object Class	NRCellIDU
g) Switching Technology	Valid for packet switched traffic
h) Generation	5GS
i) Purpose	One usage of this measurement is for mMIMO Non-GoB optimization in [21].

3

4 **8 Elements for E2SM Service Model**

5 **8.1 General**

6 Sub-clause 8.2 describes the structure of the information elements as required for E2SM-KPM in tabular format. Sub-
7 clause 8.3 presents individual information elements. Sub-clause 8.4 provides the corresponding ASN.1 definition of
8 each information element.

9 The following attributes are used for the tabular description of the messages and information elements:

10 NOTE: The messages have been defined by the guidelines specified in 3GPP TR 25.921 [11].

11 **8.2 Message Functional Definition and Content**

12 **8.2.1 Messages for RIC Functional procedures**

13 **8.2.1.1 RIC EVENT TRIGGER DEFINITION IE**

14 This information element is part of the RIC SUBSCRIPTION REQUEST message sent by the Near-RT RIC to an E2
15 Node and is required for event triggers used to initiate REPORT actions.

16 Direction: NEAR-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE Event Trigger Format				
>E2SM-KPM Event Trigger Definition Format 1	M		8.2.1.1.1	

1

2 8.2.1.1.1 E2SM-KPM Event Trigger Definition Format 1

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Reporting Period	M		INTEGER (1..4294967295)	The reporting period is expressed in unit of 1 millisecond.

3

4 8.2.1.2 RIC ACTION DEFINITION IE

5 This information element is part of the RIC SUBSCRIPTION REQUEST message sent by the Near-RT RIC to an E2
6 Node. In this service model, this information element provides additional information for the nominated Action
7 (Report).

8 Direction: NEAR-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Style Type	M		8.3.3	
CHOICE Action Definition Format				
>E2SM-KPM Action Definition Format 1	M		8.2.1.2.1	
>E2SM-KPM Action Definition Format 2	M		8.2.1.2.2	
>E2SM-KPM Action Definition Format 3	M		8.2.1.2.3	
>E2SM-KPM Action Definition Format 4	M		8.2.1.2.4	
>E2SM-KPM Action Definition Format 5	M		8.2.1.2.5	

9

1 8.2.1.2.1 E2SM-KPM Action Definition Format 1

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Measurement Information List		1.. <maxnoofMeasurementInfo>		
>CHOICE Measurement Type				
>>Measurement Name	M		8.3.9 Measurement Type Name	
>>Measurement ID	M		8.3.10 Measurement Type ID	
>List of Labels		1.. <maxnoofLabelInfo>		
>>Label Information	M		8.3.11 Measurement Label	
Granularity Period	M		8.3.8 Granularity Period	Collection interval of measurements
Cell Global ID	O		8.3.20 Cell Global ID	Points to a specific cell for generating measurements subscribed by the <i>Measurement Information List IE</i>
Distribution Measurement Bin Range Info List		0.. <maxnoofMeasurementInfo>		
>CHOICE Measurement Type				
>>Measurement Name	M		8.3.9 Measurement Type Name	
>>Measurement ID	M		8.3.10 Measurement Type ID	
>Bin Range Definition	M		8.3.26	Indicates the value ranges of bins for distribution type measurement

2

Range bound	Explanation
maxnoofMeasurementInfo	Maximum no. of measurement types that can be reported by a single report. Value is <65535>.
maxnoofLabelInfo	Maximum no. of measurements values that can be reported for a single measurement type. Value is <2147483647>.

3

4 8.2.1.2.2 E2SM-KPM Action Definition Format 2

IE/Group Name	Presence	Range	IE type and reference	Semantics description
UE ID	M		8.3.24	Points to a specific UE of interest
Subscription Information	M		8.2.1.2.1 E2SM-KPM Action Definition Format 1	

5

1 8.2.1.2.3 E2SM-KPM Action Definition Format 3

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Measurement Information List		1.. <maxnoofMeasurementInfo>		
>CHOICE Measurement Type				
>>Measurement Name	M		8.3.9 Measurement Type Name	
>>Measurement ID	M		8.3.10 Measurement Type ID	
>Matching Condition		1.. <maxnoofConditionInfo>		The Matching Condition represents the Boolean expression, the logical connection to the next condition is AND if the <i>Logical OR</i> IE is not included
>>CHOICE Condition Type	M			
>>>Label Information			8.3.11 Measurement Label	
>>>Test Information			8.3.22 Test Condition Information	
>>Logical OR	O		8.3.25	If included, logical connection to the next condition is "or".
>Bin Range Definition	O		8.3.26	Indicates the value ranges of bins for distribution type measurement
Granularity Period	M		8.3.8 Granularity Period	Collection interval of measurements
Cell Global ID	O		8.3.20 Cell Global ID	Points to a specific cell for generating measurements subscribed by the <i>Measurement Information List</i> IE

2

Range bound	Explanation
maxnoofMeasurementInfo	Maximum no. of measurement types that can be reported by a single report. Value is <65535>.
maxnoofConditionInfo	Maximum no. of conditions that can be subscribed for a single measurement type. Value is <32768>.

3

1 8.2.1.2.4 E2SM-KPM Action Definition Format 4

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Matching Condition		1.. <maxnoofConditionInfoPerSub>		The Matching Condition represents the Boolean expression, the logical connection to the next condition is AND if the <i>Logical OR</i> IE is not included
>Test Information	M		8.3.22 Test Condition Information	Provides test condition to filter matching UEs
>Logical OR	O		8.3.25	If included, logical connection to the next condition is "or".
Subscription Information	M		8.2.1.2.1 E2SM-KPM Action Definition Format 1	

2

Range bound	Explanation
maxnoofConditionInfoPerSub	Maximum no. of conditions that can be subscribed for a single subscription. Value is <32768>.

3

4 8.2.1.2.5 E2SM-KPM Action Definition Format 5

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of Subscribed UE IDs		2.. <maxnoofUEIDPerSub>		Points to a list of UEs of interest
>UE ID	M		8.3.24	
Subscription Information	M		8.2.1.2.1 E2SM-KPM Action Definition Format 1	

5

Range bound	Explanation
maxnoofUEIDPerSub	Maximum no. of UE IDs that can be subscribed for a single subscription. Value is <65535>.

6

7 8.2.1.3 RIC INDICATION HEADER IE

8 This information element is part of the RIC INDICATION message sent by the E2 Node to the Near-RT RIC and is required for REPORT action.

9

10 Direction: E2 Node → NEAR-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE Indication Header Format				
>E2SM-KPM Indication Header Format 1	M		8.2.1.3.1	

11

1 8.2.1.3.1 E2SM-KPM Indication Header Format 1

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Collection Start Time	M		8.3.12 Time Stamp	
File Format Version	O		PrintableString (SIZE (0..15), ...)	
Sender Name	O		PrintableString (SIZE (0..400), ...)	
Sender Type	O		PrintableString (SIZE (0..8), ...)	
Vendor Name	O		PrintableString (SIZE (0..32), ...)	

2

3 8.2.1.4 RIC INDICATION MESSAGE IE

4 This information element is part of the RIC INDICATION message sent by the E2 Node to the Near-RT RIC and is
5 required for REPORT action.

6 Direction: E2 Node → NEAR-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE Indication Message Format				
>E2SM-KPM Indication Message Format 1	M		8.2.1.4.1	
>E2SM-KPM Indication Message Format 2	M		8.2.1.4.2	
>E2SM-KPM Indication Message Format 3	M		8.2.1.4.3	

7

1 8.2.1.4.1 E2SM-KPM Indication Message Format 1

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Measurements Data		1.. <maxnoofMeasurementRecord>		Contains a set of Measurement Records, each collected at each Granularity Period.
>Measurements Record		1.. <maxnoofMeasurementValue>		Contains measured values in same order as in the <i>Measurements Information List</i> IE if present, otherwise in the order defined in the subscription.
>>CHOICE Measured Value				
>>>Integer Value	M		INTEGER (0..4294967295)	
>>>Real Value	M		REAL	
>>>No Value	M		NULL	
>Incomplete Flag	O		ENUMERATED (true,...)	Indicates that the measurements record is not reliable.
Measurement Information List		0.. <maxnoofMeasurementInfo>		
>CHOICE Measurement Type				
>>Measurement Name	M		8.3.9 Measurement Type Name	
>>Measurement ID	M		8.3.10 Measurement Type ID	
>List of Labels		1.. <maxnoofLabelInfo>		
>>Label Information	M		8.3.11 Measurement Label	
Granularity Period	O		8.3.8 Granularity Period	Collection interval of measurements

2

Range bound	Explanation
maxnoofMeasurementInfo	Maximum no. of measurement types that can be reported by a single report. Value is <65535>.
maxnoofLabelInfo	Maximum no. of measurements values that can be reported for a single measurement type. Value is <2147483647>.
maxnoofMeasurementRecord	Maximum no. of measurement records that can be reported by a single report. Value is <65535>.
maxnoofMeasurementValue	Maximum no. of measurement values that can be carried by a single measurement record. Value is <2147483647>.

3

1 8.2.1.4.2 E2SM-KPM Indication Message Format 2

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Measurements Data		1.. <maxnoofMeasurementRecord>		Contains a set of Measurement Records, each collected at each Granularity Period.
>Measurements Record		1.. <maxnoofMeasurementValue>		Contains measured values in same order as in the Measurements Information Condition UE List IE.
>>CHOICE Measured Value				
>>>Integer Value	M		INTEGER (0..4294967295)	
>>>Real Value	M		REAL	
>>>No Value	M		NULL	
>Incomplete Flag	O		ENUMERATED (true,...)	Indicates that the measurements record is not reliable.
Measurement Information Condition UE List		1.. <maxnoofMeasurementInfo>		
>CHOICE Measurement Type				
>>Measurement Name	M		8.3.9 Measurement Type Name	
>>Measurement ID	M		8.3.10 Measurement Type ID	
>Matching Condition		1.. <maxnoofConditionInfo>		
>>CHOICE Condition Type	M			
>>>Label Information			8.3.11 Measurement Label	
>>>Test Information			8.3.22 Test Condition Information	
>>Logical OR	O		8.3.25	
>List of matched UE IDs		0.. <maxnoofUEID>		Indicates the UE ID(s) matched for the corresponding measurement type during the Reporting Period.
>>UE ID	M		8.3.24	
>Sequence of Matched UE IDs for Granularity Periods		0.. <maxnoofMeasurementRecord>		Indicates the UE ID(s) matched for the corresponding measurement type, separately for each and every Granularity Period in chronological order. If included, the List of matched UE IDs IE shall be ignored if received.
>>CHOICE Matched UE for Granularity Period	M			
>>>None				

>>>No UE matched for Granularity Period	M		ENUMERATED (true, ...)	Indicates that none of UEs were matched for the corresponding measurement type for the corresponding Granularity Period.
>>>One or more				
>>>List of UE IDs for Granularity Period		1.. <maxnoofUEID>		Indicates the UE ID(s) matched for the corresponding measurement type for the corresponding Granularity Period.
>>>>UE ID	M		8.3.24	
Granularity Period	O		8.3.8 Granularity Period	Collection interval of measurements

1

Range bound	Explanation
maxnoofMeasurementInfo	Maximum no. of measurement types that can be reported by a single report. Value is <65535>.
maxnoofConditionInfo	Maximum no. of conditions that can be subscribed for a single measurement type. Value is <32768>.
maxnoofUEID	Maximum no. of UE IDs that can be reported for a single condition. Value is <65535>.
maxnoofMeasurementRecord	Maximum no. of measurement records that can be reported by a single report. Value is <65535>.
maxnoofMeasurementValue	Maximum no. of measurement values that can be carried by a single measurement record. Value is <2147483647>.

2

8.2.1.4.3 E2SM-KPM Indication Message Format 3

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of UE Measurement Reports		1.. <maxnoofUEMeasReport>		
>UE ID	M		8.3.24	
>Measurements Report	M		8.2.1.4.1 E2SM-KPM Indication Message Format 1	Contains Measurement Data for a UE for a Reporting Period.

4

Range bound	Explanation
maxnoofUEMeasReport	Maximum no. of UE Measurement Reports that can be reported. Value is <65535>.

5

8.2.1.5 RIC CALL PROCESS ID

Note: Not used in this service model

8.2.1.6 RIC CONTROL HEADER IE

Note: Not used in this service model

8.2.1.7 RIC CONTROL MESSAGE IE

Note: Not used in this service model

8.2.1.8 RIC CONTROL OUTCOME IE

Note: Not used in this service model

8.2.2 Messages for RIC Global Procedures

8.2.2.1 RAN Function Definition IE

This information element is part of the E2 SETUP REQUEST, and RIC SERVICE UPDATE message sent by the E2 Node to the Near-RT RIC and is used to provide all required information for the Near-RT RIC to determine how a given E2 Node has been configured to support a given RAN Function specific E2SM.

Direction: E2 Node → NEAR-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RAN Function Name	M		8.3.2	
Sequence of Event Trigger styles		0.. <maxnoofRICStyles>		
>RIC Event Trigger Style Type	M		8.3.3	
>RIC Event Trigger Style Name	M		8.3.4	
>RIC Event Trigger Format Type	M		8.3.5	
Sequence of Report styles		0.. <maxnoofRICStyles>		
>RIC Report Style Type	M		8.3.3	
>RIC Report Style Name	M		8.3.4	
>RIC Report Action Format Type	M		8.3.5	
>Sequence of Measurement Info for Action		1.. <maxnoofMeasurementInfo>		
>>Measurement Type Name	M		8.3.9	
>>Measurement Type ID	O		8.3.10	
>>Bin Range Definition	O		8.3.26	Indicates the value ranges of bins for distribution type measurement
>RIC Indication Header Format Type	M		8.3.5	Indication header type used by Report style
>RIC Indication Message Format Type	M		8.3.5	Indication message type used by Report style

Range bound	Explanation
maxnoofCells	Maximum no. of cells supported by an E2 Node component. The value is <16384>.
maxnoofRICstyle	Maximum no. of Style of Report, Insert, Control or Policy actions supported by RAN Function. The value is <63>.
maxnoofMeasurementInfo	Maximum no. of measurement types that can be reported by a single report. The value is <65535>.

8.3 Information Element definitions

8.3.1 General

When specifying information elements which are to be represented by bit strings, if not otherwise specifically stated in the semantics description of the concerned IE or elsewhere, the following principle applies with regards to the ordering of bits:

- The first bit (leftmost bit) contains the most significant bit (MSB);

- 1 - The last bit (rightmost bit) contains the least significant bit (LSB);
- 2 - When importing bit strings from other specifications, the first bit of the bit string contains the first bit of the concerned information.

4 8.3.2 RAN Function Name

5 This IE is defined in [12] clause 6.2.2.1.

6 8.3.3 RIC Style Type

7 This IE is defined in [12] clause 6.2.2.2.

8 8.3.4 RIC Style Name

9 This IE is defined in [12] clause 6.2.2.3.

10 8.3.5 RIC Format Type

11 This IE is defined in [12] clause 6.2.2.4.

12 8.3.6 Void

13 8.3.7 Void

14 8.3.8 Granularity Period

15 This IE defines the measurement collection interval within a reporting period.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Granularity Period	M		INTEGER (1..4294967295)	Measurement collection interval expressed in unit of 1 millisecond.

16

1 8.3.9 Measurement Type Name

2 This IE defines the name of a given measurement type.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Measurement Name	M		PrintableString(SIZE(1.. 150, ...))	One of the measurement names specified in TS 28.552 [4], TS 32.425 [8], or Section 7.10. The subcounters are represented by the Measurement Labels defined in 8.3.11.

3

4 8.3.10 Measurement Type ID

5 This IE defines the identifier of a given measurement type.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Measurement ID	M		INTEGER (1.. 65535, ...)	

6

7 8.3.11 Measurement Label

8 This IE defines values of necessary subcounters applicable to an associated measurement type.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
No Label	O		ENUMERATED (true, ...)	Indicates the associated measurement type without any subcounter. If included, other IEs in 8.3.11 shall not be included in the same Measurement Label (and vice versa).
PLMN ID	O		8.3.15	Represents the PLMN subcounter
Slice ID	O		8.3.14	Represents the SNSSAI subcounter. OCTET STRING of length 1 octet shall be provided for matching the SST value only. OCTET STRING of length 4 octets shall be provided for matching the SST + SD value. OCTET STRING of length 4 octets with the last 3 octets as 0xFFFF shall be provided if a S-NSSAI without SD value has to be explicitly matched. See 3GPP TS 23.003 [20] clause 28.4.2.
5QI	O		8.3.17	Represents the 5QI subcounter
QFI	O		8.3.21	Represents the QFI subcounter
QCI	O		8.3.18	Represents the QCI subcounter
QCImax	O		8.3.18	Used only when the name of the associated measurement type ends with '_Filter'
QCImin	O		8.3.18	Used only when the name of the associated measurement type ends with '_Filter'

ARPmax	O		INTEGER (1.. 15, ...)	Used only when the name of the associated measurement type ends with '_Filter'
ARPmin	O		INTEGER (1.. 15, ...)	Used only when the name of the associated measurement type ends with '_Filter'
Bitrate Range	O		INTEGER (1.. 65535, ...)	Used only when the name of the associated measurement type ends with '_Filter'
Layer at MU-MIMO	O		INTEGER (1.. 65535, ...)	Represents the MIMO layer subcounter
Sum	O		ENUMERATED (true, ...)	Sum is calculated as cumulative sum from the start of the measurement.
Distribution Bin X	O		INTEGER (1.. 65535, ...)	An index of Bin X. Only applicable to distribution type measurement information.
Distribution Bin Y	O		INTEGER (1.. 65535, ...)	An index of Bin Y. Only applicable to distribution type measurement information. This IE may be present only when Distribution Bin X is present.
Distribution Bin Z	O		INTEGER (1.. 65535, ...)	An index of Bin Z. Only applicable to distribution type measurement information. This IE may be present only when Distribution Bin X and Distribution Bin Y are present.
Precedent Label Override Indication	O		ENUMERATED (true, ...)	Indicates that subcounters and their values of the precedent label applies in the same way except for the included subcounters. For included subcounters, new values shall apply.
Start End Indication	O		ENUMERATED (start, end, ...)	<p>Used to indicate a range of values. If "start" is used for a label, the subsequent label should include this IE with "end".</p> <p>If included together with Distribution Bin type subcounter(s), it can be used to indicate a range of multi-dimensional values in the ascending order of numbers from Bin Z (if included), then from Bin Y (if included), then from Bin X (if included). In this case, information of a label with "start" should be identical to that of the subsequent label with "end", except Distribution Bin type subcounter(s) used.</p> <p>Otherwise (included together with subcounter other than Distribution Bin type subcounter), it can be used to indicate one-dimensional range of values in the ascending order, and information of a label with "start" should be identical to that of the subsequent label with "end", except only one subcounter.</p>
Min	O		ENUMERATED (true, ...)	Minimum of the measured values over a granularity period.
Max	O		ENUMERATED (true, ...)	Maximum of the measured values over a granularity period.

Avg	O		ENUMERATED (true, ...)	Average of the measured values over a granularity period.
SSB Index	O		INTEGER (1.. 65535, ...)	Represents the SSB subcounter
Non-GoB Beamforming Mode Index	O		INTEGER (1.. 65535, ...)	Represents the Non- Grid of Beams (Non-GoB) beamforming mode subcounter [21]. The index is used for Non-GoB beamforming optimization for 5G mMIMO deployments. Each BF mode implies a vendor-specific proprietary Non-GoB BF algorithm that are not standardized [22], for which each E2 Node, who supports the Non-GoB beamforming optimization feature, provides the number of different Non-GoB BF mode(s) supported by its scheduler indexed from 1 to n. The AI/ML model for Non-GoB beamforming optimization is trained by data and measurements related to each BF mode and/or MIMO mode, for which the trained AI/ML model, based on collected data, configures the E2 Node with the best inferred Non-GoB BF mode index to be used for each UE, where such configuration could be done separately for the case of Single User- and/or Multi-user MIMO [21].
MIMO Mode Index	O		INTEGER (1..2, ...)	Represents the MIMO mode subcounter. Value = 1 means the SU (single-user) MIMO mode. Value 2 means the MU (multi-user) MIMO mode.

1

2 8.3.12 Time Stamp

3 This IE contains UTC time information in picosecond-level. In this version of specification, the value is rounded in
4 millisecond.

5

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Time Stamp	M		OCTET STRING (SIZE(8))	Encoded in the same format as the 64-bit timestamp format as defined in section 6 of IETF RFC 5905 [13].

6

7 8.3.13 Void

8 8.3.14 S-NSSAI

9 This IE is defined in [12] clause 6.2.3.12.

10 8.3.15 PLMN Identity

This IE is defined in [12] clause 6.2.3.1.

1 **8.3.16 Void**

2 **8.3.17 5QI**

3 This IE is defined in [12] clause 6.2.3.13.

4 **8.3.18 QCI**

5 This IE is defined in [12] clause 6.2.3.14.

6 **8.3.19 Void**

7 **8.3.20 Cell Global ID**

8 This IE is defined in [12] clause 6.2.2.5.

9 **8.3.21 QFI**

10 This IE is defined in [12] clause 6.2.3.15.

11 **8.3.22 Test Condition Information**

12 This IE defines a test condition for identifying UEs.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE Test Condition Type	M			
>GBR			ENUMERATED (true, ...)	Identifies UEs with the GBR QoS flows or within the specified bitrate range. The definition of GBR QoS flow is in TS 23.501 [14].
>AMBR			ENUMERATED (true, ...)	Identifies UEs with the Session-AMBR within the specified bitrate range. The definition of Session-AMBR is in TS 23.501 [14].
>IsStat			ENUMERATED (true, ...)	This IE is not used in this version of specification.
>IsCatM			ENUMERATED (true, ...)	This IE is not used in this version of specification.
>DL RSRP			ENUMERATED (true, ...)	Identifies UEs with the latest reported DL RSRP measurement for this cell within the specified range. For EUTRAN, the definition of DL RSRP is in TS 36.214 [15]. For NR, the definition of DL RSRP is in TS 38.215 [16].
>DL RSRQ			ENUMERATED (true, ...)	Identifies UEs with the latest reported DL RSRQ measurement for this cell within the specified range. For EUTRAN, the definition of DL RSRQ is in TS 36.214 [15]. For NR, the definition of DL RSRQ is in TS 38.215 [16].
>UL RSRP			ENUMERATED (true, ...)	Identifies UEs with the latest measured UL SRS-RSRP for this cell by the E2 Node within the specific range. The definition of UL SRS-RSRP is defined in TS 38.215 [16]. The mapping of measured quantity is described similarly to DL RSRP using the TS 38.133 [17] Table 10.1.6.1-1.
>CQI			ENUMERATED (true, ...)	Identifies UEs with the latest reported wideband CQI for this cell in the Layer 1 within the specific range. The definition of wideband CQI is defined in TS 38.214 [18].
>5QI			ENUMERATED (true, ...)	Identifies UEs with the 5QI of QoS flows within the specified range. The definition of 5QI is in TS 23.501 [14].
>QCI			ENUMERATED (true, ...)	Identifies UEs with the QCI of Service Data Flows within the specified range. The definition of QCI is in TS 23.203 [19].
>S-NSSAI			ENUMERATED (true, ...)	Identifies UEs with the S-NSSAI [12] within the specified range. OCTET STRING of length 1 octet shall be provided for matching the SST value only. OCTET STRING of length 4 octets shall be provided for matching the SST + SD value. OCTET STRING of length 4 octets with the last 3 octets as 0xFFFFFFF shall be provided if a S-NSSAI without SD value has to be explicitly matched. See 3GPP TS 23.003 [20] clause 28.4.2.
Test Condition	O		ENUMERATED (equal, greaterthan, lessthan, contains, present, ...)	
Test Condition Value	O		8.3.23	

1 8.3.23 Test Condition Value

2 This IE defines the target value for a particular Test Condition Type IE element.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE Test Value	M			
>INTEGER			INTEGER	
>ENUMERATED			INTEGER	
>BOOLEAN			BOOLEAN	
>BIT STRING			BIT STRING	
>OCTET STRING			OCTET STRING	
>PRINTABLE STRING			PrintableString	
>REAL			REAL	

3

4 8.3.24 UE ID

5 This IE is defined in [12] clause 6.2.2.6.

6 8.3.25 Logical OR

7 This IE indicates a logical “or” connection of the current condition to the next condition in a given sequence of conditions.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Logical OR	M		ENUMERATED (true, ...)	If set to “true”, logical connection to the next condition is “or”.

9

1 8.3.26 Bin Range Definition

2 This IE defines the value range of bins for distribution type measurements.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of Bins for Distribution Bin X		1.. <maxnoofBin n>		
>Bin Index	M		INTEGER (1.. 65535, ..)	Index of a bin to be used when subscribed
>Start Value	M		8.3.27	
>End Value	M		8.3.27	
List of Bins for Distribution Bin Y		0.. <maxnoofBin n>		Shall not be included for a distribution measurement type that doesn't use Distribution Bin Y.
>Bin Index	M		INTEGER (1.. 65535, ..)	Index of a bin to be used when subscribed
>Start Value	M		8.3.27	
>End Value	M		8.3.27	
List of Bins for Distribution Bin Z		0.. <maxnoofBin n>		Shall not be included for a distribution measurement type that doesn't use Distribution Bin Z.
>Bin Index	M		INTEGER (1.. 65535, ..)	Index of a bin to be used when subscribed
>Start Value	M		8.3.27	
>End Value	M		8.3.27	

3

Range bound	Explanation
maxnoofBin	Maximum no. of bins that can be defined for a distribution type measurement. Value is <65535>.

4

5 8.3.27 Bin Range Value

6 This IE defines either the start or end value of a bin for distribution type measurements.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE Bin Range Value	M			
>INTEGER			INTEGER	
>REAL			REAL	

7

1 8.4 Information Element Abstract Syntax (with ASN.1)

2 8.4.1 General

3 E2SM-KPM ASN.1 definition conforms to ITU-T Rec. X.680 [5] and ITU-T Rec. X.681 [6].

4 Sub clause 8.4.2 presents the Abstract Syntax of the E2SM information elements to be carried within the E2AP [3] protocol messages with ASN.1. In case there is contradiction
5 between the ASN.1 definition in this sub clause and the tabular format in sub clause 8.2 and 8.3, the ASN.1 shall take precedence, except for the definition of conditions for the
6 presence of conditional elements, in which the tabular format shall take precedence.

7 If an E2SM information element carried as an OCTET STRING in an E2AP [3] message that is not constructed as defined above is received, this shall be considered as Abstract
8 Syntax Error, and the message shall be handled as defined for Abstract Syntax Error in clause 9.

9 8.4.2 Information Element definitions

```

10 -- ASN1START
11 -- ****
12 -- E2SM-KPM Information Element Definitions
13 -- ****
14
15 E2SM-KPM-IEs {
16   iso(1) identified-organization(3) dod(6) internet(1) private(4) enterprise(1) oran(53148) e2(1) version3(3) e2sm(2) e2sm-KPMMON-IEs (2)
17
18 DEFINITIONS AUTOMATIC TAGS ::=

20 BEGIN
21
22 -- ****
23 -- IEs
24 -- ****
25
26 IMPORTS
27   CGI,
28   FiveQI,
29   PLMNIIdentity,
30   QCI,
31   QosFlowIdentifier,
32   RANfunction-Name,
33   RIC-Format-Type,
34   RIC-Style-Name,
35   RIC-Style-Type,
36   S-NSSAI,
```

```

1     UEID
2     FROM E2SM-COMMON-IES;
3
4     TimeStamp ::= OCTET STRING (SIZE(8))
5
6     BinIndex ::= INTEGER (1.. 65535, ...)
7
8     BinRangeValue ::= CHOICE {
9         valueInt      INTEGER,
10        valueReal     REAL,
11        ...
12    }
13
14    GranularityPeriod ::= INTEGER (1.. 4294967295)
15
16    LogicalOR ::= ENUMERATED {true, ...}
17
18    MeasurementType ::= CHOICE {
19        measName      MeasurementTypeName,
20        measID       MeasurementTypeID,
21        ...
22    }
23
24    MeasurementTypeName ::= PrintableString(SIZE(1.. 150, ...))
25
26    MeasurementTypeID ::= INTEGER (1.. 65536, ...)
27
28    MeasurementLabel ::= SEQUENCE {
29        noLabel        ENUMERATED {true, ...}          OPTIONAL,
30        plmnID        PLMNIIdentity                 OPTIONAL,
31        sliceID       S-NSSAI                      OPTIONAL,
32        fiveQI        FiveQI                       OPTIONAL,
33        qFI           QosFlowIdentifier            OPTIONAL,
34        qCI           QCI                          OPTIONAL,
35        qCImax        QCI                         OPTIONAL,
36        qCImin        QCI                         OPTIONAL,
37        aRPmax        INTEGER (1.. 15, ...)          OPTIONAL,
38        aRPmin        INTEGER (1.. 15, ...)          OPTIONAL,
39        bitrateRange  INTEGER (1.. 65535, ...)       OPTIONAL,
40        layerMU-MIMO INTEGER (1.. 65535, ...)       OPTIONAL,
41        sUM           ENUMERATED {true, ...}          OPTIONAL,
42        distBinX     INTEGER (1.. 65535, ...)       OPTIONAL,
43        distBinY     INTEGER (1.. 65535, ...)       OPTIONAL,
44        distBinZ     INTEGER (1.. 65535, ...)       OPTIONAL,
45        preLabelOverride ENUMERATED {true, ...}    OPTIONAL,
46        startEndInd  ENUMERATED {start, end, ...}   OPTIONAL,
47        min          ENUMERATED {true, ...}          OPTIONAL,
48        max          ENUMERATED {true, ...}          OPTIONAL,

```

```

1      avg          ENUMERATED {true, ...}           OPTIONAL,
2      ...,
3      ssbIndex     INTEGER (1.. 65535, ...)        OPTIONAL,
4      nonGoB-BFmode-Index  INTEGER (1.. 65535, ...)  OPTIONAL,
5      mIMO-mode-Index    INTEGER (1.. 2, ...)       OPTIONAL
6  }
7
8  TestCondInfo ::= SEQUENCE{
9      testType      TestCond-Type,
10     testExpr      TestCond-Expression           OPTIONAL,
11     testValue     TestCond-Value                OPTIONAL,
12     ...
13  }
14
15 TestCond-Type ::= CHOICE{
16     gBR          ENUMERATED {true, ...},
17     aMBR         ENUMERATED {true, ...},
18     isStat        ENUMERATED {true, ...},
19     isCatM       ENUMERATED {true, ...},
20     rSRP          ENUMERATED {true, ...},
21     rSRQ          ENUMERATED {true, ...},
22     ...,
23     ul-rSRP      ENUMERATED {true, ...},
24     cQI          ENUMERATED {true, ...},
25     fiveQI       ENUMERATED {true, ...},
26     qCI          ENUMERATED {true, ...},
27     sNSSAI       ENUMERATED {true, ...}
28  }
29
30 TestCond-Expression ::= ENUMERATED {
31     equal,
32     greaterthan,
33     lessthan,
34     contains,
35     present,
36     ...
37  }
38
39 TestCond-Value ::= CHOICE{
40     valueInt      INTEGER,
41     valueEnum     INTEGER,
42     valueBool     BOOLEAN,
43     valueBitsS   BIT STRING,
44     valueOctS    OCTET STRING,
45     valuePrtS    PrintableString,
46     ...
47     valueReal     REAL
48  }

```

```

1
2 -- ****
3 -- Lists
4 -- ****
5
6 maxnoofCells          INTEGER ::= 16384
7 maxnoofRICStyles      INTEGER ::= 63
8 maxnoofMeasurementInfo INTEGER ::= 65535
9 maxnoofLabelInfo       INTEGER ::= 2147483647
10 maxnoofMeasurementRecord INTEGER ::= 65535
11 maxnoofMeasurementValue INTEGER ::= 2147483647
12 maxnoofConditionInfo  INTEGER ::= 32768
13 maxnoofUEID            INTEGER ::= 65535
14 maxnoofConditionInfoPerSub INTEGER ::= 32768
15 maxnoofUEIDPerSub      INTEGER ::= 65535
16 maxnoofUEMeasReport    INTEGER ::= 65535
17 maxnoofBin              INTEGER ::= 65535
18
19 BinRangeDefinition ::= SEQUENCE {
20   binRangeListX     BinRangeList,
21   binRangeListY     BinRangeList        OPTIONAL -- This IE shall not be present for a distribution measurement type that doesn't use Distribution
22   Bin Y --,
23   binRangeListZ     BinRangeList        OPTIONAL -- This IE shall not be present for a distribution measurement type that doesn't use Distribution
24   Bin Z --,
25   ...
26 }
27
28 BinRangeList ::= SEQUENCE (SIZE(1..maxnoofBin)) OF BinRangeItem
29
30 BinRangeItem ::= SEQUENCE {
31   binIndex           BinIndex,
32   startValue         BinRangeValue,
33   endValue           BinRangeValue,
34   ...
35 }
36
37 DistMeasurementBinRangeList ::= SEQUENCE (SIZE(1..maxnoofMeasurementInfo)) OF DistMeasurementBinRangeItem
38
39 DistMeasurementBinRangeItem ::= SEQUENCE {
40   measType           MeasurementType,
41   binRangeDef        BinRangeDefinition,
42   ...
43 }
44
45 MeasurementInfoList ::= SEQUENCE (SIZE(1..maxnoofMeasurementInfo)) OF MeasurementInfoItem
46
47 MeasurementInfoItem ::= SEQUENCE {
48   measType           MeasurementType,

```

```

1      labelInfoList    LabelInfoList,
2      ...
3  }
4
5 LabelInfoList ::= SEQUENCE (SIZE(1..maxnoofLabelInfo)) OF LabelInfoItem
6
7 LabelInfoItem ::= SEQUENCE {
8     measLabel        MeasurementLabel,
9     ...
10 }
11
12 MeasurementData ::= SEQUENCE (SIZE(1..maxnoofMeasurementRecord)) OF MeasurementDataItem
13
14 MeasurementDataItem ::= SEQUENCE {
15     measRecord       MeasurementRecord,
16     incompleteFlag   ENUMERATED {true, ...}           OPTIONAL,
17     ...
18 }
19
20 MeasurementRecord ::= SEQUENCE (SIZE(1..maxnoofMeasurementValue)) OF MeasurementRecordItem
21
22 MeasurementRecordItem ::= CHOICE {
23     integer          INTEGER (0.. 4294967295),
24     real              REAL,
25     noValue          NULL,
26     ...
27 }
28
29 MeasurementInfo-Action-List ::= SEQUENCE (SIZE(1..maxnoofMeasurementInfo)) OF MeasurementInfo-Action-Item
30
31 MeasurementInfo-Action-Item ::= SEQUENCE {
32     measName         MeasurementTypeName,
33     measID          MeasurementTypeID           OPTIONAL,
34     ...
35     binRangeDef     BinRangeDefinition         OPTIONAL
36 }
37
38 MeasurementCondList ::= SEQUENCE (SIZE(1..maxnoofMeasurementInfo)) OF MeasurementCondItem
39
40 MeasurementCondItem ::= SEQUENCE {
41     measType         MeasurementType,
42     matchingCond    MatchingCondList,
43     ...
44     binRangeDef     BinRangeDefinition         OPTIONAL
45 }
46
47 MeasurementCondUEidList ::= SEQUENCE (SIZE(1..maxnoofMeasurementInfo)) OF MeasurementCondUEidItem
48

```

```

1 MeasurementCondUEidItem ::= SEQUENCE {
2     measType          MeasurementType,
3     matchingCond      MatchingCondList,
4     matchingUEidList  MatchingUEidList        OPTIONAL,
5     ...
6     matchingUEidPerGP MatchingUEidPerGP      OPTIONAL
7 }
8
9 MatchingCondList ::= SEQUENCE (SIZE(1..maxnoofConditionInfo)) OF MatchingCondItem
10
11 MatchingCondItem ::= SEQUENCE {
12     matchingCondChoice  MatchingCondItem-Choice,
13     logicalOR          LogicalOR            OPTIONAL,
14     ...
15 }
16
17 MatchingCondItem-Choice ::= CHOICE{
18     measLabel         MeasurementLabel,
19     testCondInfo      TestCondInfo,
20     ...
21 }
22
23 MatchingUEidList ::= SEQUENCE (SIZE(1..maxnoofUEID)) OF MatchingUEidItem
24
25 MatchingUEidItem ::= SEQUENCE{
26     ueID              UEID,
27     ...
28 }
29
30 MatchingUEidPerGP ::= SEQUENCE (SIZE(1..maxnoofMeasurementRecord)) OF MatchingUEidPerGP-Item
31
32 MatchingUEidPerGP-Item ::= SEQUENCE{
33     matchedPerGP      CHOICE{
34         noUEmatched    ENUMERATED {true, ...},
35         oneOrMoreUEmatched MatchingUEidList-PerGP,
36         ...
37     },
38     ...
39 }
40
41 MatchingUEidList-PerGP ::= SEQUENCE (SIZE(1..maxnoofUEID)) OF MatchingUEidItem-PerGP
42
43 MatchingUEidItem-PerGP ::= SEQUENCE{
44     ueID              UEID,
45     ...
46 }
47
48

```

```

1 MatchingUeCondPerSubList ::= SEQUENCE (SIZE(1..maxnoofConditionInfoPerSub)) OF MatchingUeCondPerSubItem
2
3 MatchingUeCondPerSubItem ::= SEQUENCE{
4     testCondInfo      TestCondInfo,
5     ...,
6     logicalOR        LogicalOR          OPTIONAL
7 }
8
9 MatchingUEidPerSubList ::= SEQUENCE (SIZE(2..maxnoofUEIDPerSub)) OF MatchingUEidPerSubItem
10
11 MatchingUEidPerSubItem ::= SEQUENCE{
12     ueID            UEID,
13     ...
14 }
15
16 UEMeasurementReportList ::= SEQUENCE (SIZE(1..maxnoofUEMeasReport)) OF UEMeasurementReportItem
17
18 UEMeasurementReportItem ::= SEQUENCE{
19     ueID            UEID,
20     measReport      E2SM-KPM-IndicationMessage-Format1,
21     ...
22 }
23
24
25
26 -- ****
27 -- E2SM-KPM Service Model IEs
28 -- ****
29
30 -- ****
31 -- Event Trigger Definition OCTET STRING contents
32 -- ****
33
34 E2SM-KPM-EventTriggerDefinition ::= SEQUENCE{
35     eventDefinition-formats   CHOICE{
36         eventDefinition-Format1    E2SM-KPM-EventTriggerDefinition-Format1,
37         ...
38     },
39     ...
40 }
41
42 E2SM-KPM-EventTriggerDefinition-Format1 ::= SEQUENCE{
43     reportingPeriod        INTEGER (1.. 4294967295),
44     ...
45 }
46
47 -- ****
48 -- Action Definition OCTET STRING contents

```

```

1  -- ****
2
3 E2SM-KPM-ActionDefinition ::= SEQUENCE{
4   ric-Style-Type      RIC-Style-Type,
5   actionDefinition-formats CHOICE{
6     actionDefinition-Format1    E2SM-KPM-ActionDefinition-Format1,
7     actionDefinition-Format2    E2SM-KPM-ActionDefinition-Format2,
8     actionDefinition-Format3    E2SM-KPM-ActionDefinition-Format3,
9     ...
10    actionDefinition-Format4   E2SM-KPM-ActionDefinition-Format4,
11    actionDefinition-Format5   E2SM-KPM-ActionDefinition-Format5
12  },
13  ...
14 }
15
16 E2SM-KPM-ActionDefinition-Format1 ::= SEQUENCE {
17   measInfoList          MeasurementInfoList,
18   granulPeriod          GranularityPeriod,
19   cellGlobalID          CGI           OPTIONAL,
20   ...
21   distMeasBinRangeInfo DistMeasurementBinRangeList   OPTIONAL
22 }
23
24 E2SM-KPM-ActionDefinition-Format2 ::= SEQUENCE {
25   ueID                  UEID,
26   subscriptInfo          E2SM-KPM-ActionDefinition-Format1,
27   ...
28 }
29
30 E2SM-KPM-ActionDefinition-Format3 ::= SEQUENCE {
31   measCondList          MeasurementCondList,
32   granulPeriod          GranularityPeriod,
33   cellGlobalID          CGI           OPTIONAL,
34   ...
35 }
36
37 E2SM-KPM-ActionDefinition-Format4 ::= SEQUENCE {
38   matchingUeCondList    MatchingUeCondPerSubList,
39   subscriptionInfo      E2SM-KPM-ActionDefinition-Format1,
40   ...
41 }
42
43 E2SM-KPM-ActionDefinition-Format5 ::= SEQUENCE {
44   matchingUEidList      MatchingUEidPerSubList,
45   subscriptionInfo      E2SM-KPM-ActionDefinition-Format1,
46   ...
47 }
48

```

```

1
2 -- ****
3 -- Indication Header OCTET STRING contents
4 -- ****
5
6 E2SM-KPM-IndicationHeader ::= SEQUENCE{
7     indicationHeader-formats      CHOICE{
8         indicationHeader-Format1    E2SM-KPM-IndicationHeader-Format1,
9         ...
10        },
11        ...
12    }
13
14 E2SM-KPM-IndicationHeader-Format1 ::= SEQUENCE{
15     collectStartTime            TimeStamp,
16     fileFormatversion          PrintableString (SIZE (0..15), ... ) OPTIONAL,
17     senderName                PrintableString (SIZE (0..400), ... ) OPTIONAL,
18     senderType                 PrintableString (SIZE (0..8), ... ) OPTIONAL,
19     vendorName                PrintableString (SIZE (0..32), ... ) OPTIONAL,
20     ...
21 }
22
23 -- ****
24 -- Indication Message OCTET STRING contents
25 -- ****
26
27 E2SM-KPM-IndicationMessage ::= SEQUENCE{
28     indicationMessage-formats   CHOICE{
29         indicationMessage-Format1  E2SM-KPM-IndicationMessage-Format1,
30         indicationMessage-Format2  E2SM-KPM-IndicationMessage-Format2,
31         ...
32         indicationMessage-Format3  E2SM-KPM-IndicationMessage-Format3
33     },
34     ...
35 }
36
37 E2SM-KPM-IndicationMessage-Format1 ::= SEQUENCE {
38     measData                  MeasurementData,
39     measInfoList              MeasurementInfoList
40     granulPeriod              GranularityPeriod
41     ...
42 }
43
44 E2SM-KPM-IndicationMessage-Format2 ::= SEQUENCE {
45     measData                  MeasurementData,
46     measCondUEidList          MeasurementCondUEidList,
47     granulPeriod              GranularityPeriod
48     ...

```

```

1   }
2
3 E2SM-KPM-IndicationMessage-Format3 ::= SEQUENCE {
4     ueMeasReportList          UEMeasurementReportList,
5     ...
6 }
7
8 -- ****
9 -- RAN Function Definition OCTET STRING contents
10 -- ****
11
12 E2SM-KPM-RANfunction-Description ::= SEQUENCE{
13   ranFunction-Name          RANfunction-Name,
14   ric-EventTriggerStyle-List SEQUENCE (SIZE(1..maxnoofRICStyles)) OF RIC-EventTriggerStyle-Item      OPTIONAL,
15   ric-ReportStyle-List       SEQUENCE (SIZE(1..maxnoofRICStyles)) OF RIC-ReportStyle-Item      OPTIONAL,
16   ...
17 }
18
19 RIC-EventTriggerStyle-Item ::= SEQUENCE{
20   ric-EventTriggerStyle-Type    RIC-Style-Type,
21   ric-EventTriggerStyle-Name    RIC-Style-Name,
22   ric-EventTriggerFormat-Type   RIC-Format-Type,
23   ...
24 }
25
26 RIC-ReportStyle-Item ::= SEQUENCE{
27   ric-ReportStyle-Type        RIC-Style-Type,
28   ric-ReportStyle-Name        RIC-Style-Name,
29   ric-ActionFormat-Type       RIC-Format-Type,
30   measInfo-Action-List        MeasurementInfo-Action-List,
31   ric-IndicationHeaderFormat-Type RIC-Format-Type,
32   ric-IndicationMessageFormat-Type RIC-Format-Type,
33   ...
34 }
35
36 END
37
38 -- ASN1STOP
39
40

```

1 9 Handling of Unknown, Unforeseen and Erroneous 2 Protocol Data

3 Section 10 of TS 36.413 [13] is applicable for the purposes of the present document.

Annex A (normative or informative): Further information on RAN Function Network KPM Monitor

A.1 Background Information

The RAN function “Key Performance Measurement” is used to provide RIC Service exposure of the performance measurement logical function of the E2 Nodes. Based on the O-RAN deployment architecture, available measurements could be different. Figure A.1-1 shows the target deployment architecture for E2SM-KPM.

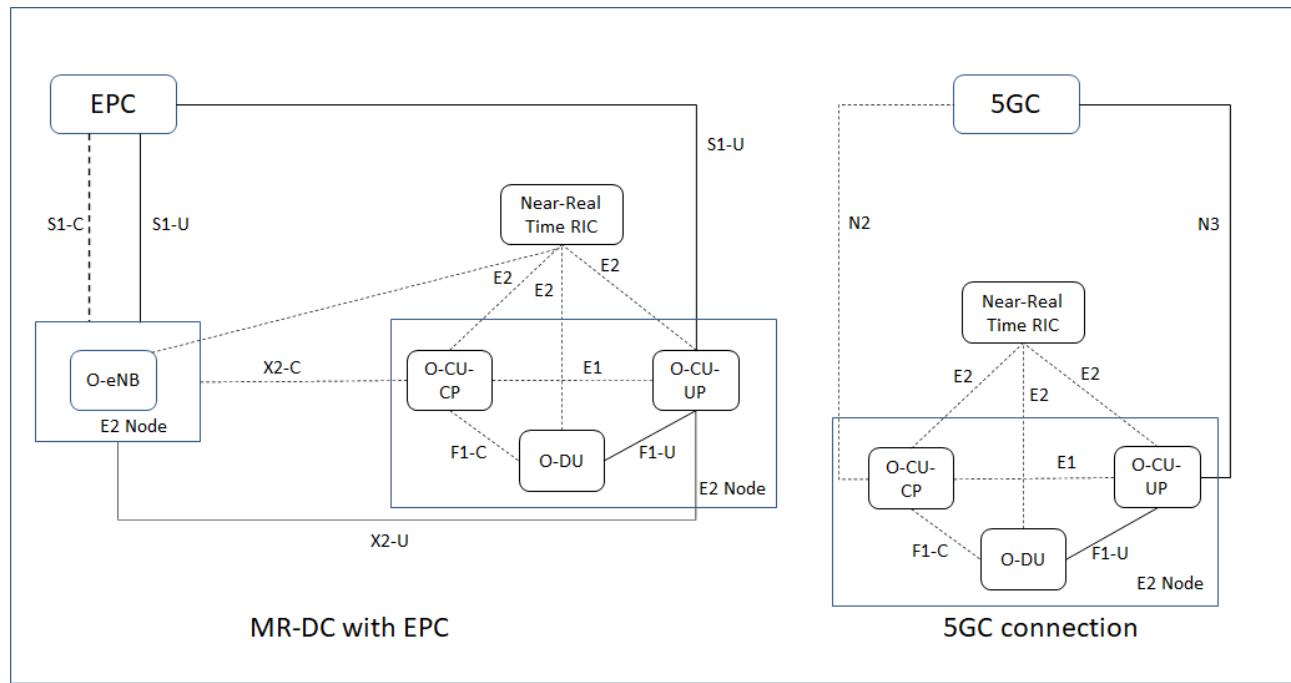


Figure A.1-1 E2SM-KPM Architecture

For each logical function the E2 Node shall use the RAN Function Definition IE to declare the list of available measurements and a set of supported RIC Services (**REPORT**).

1

Revision history

Date	Revision	Description
2018.11.25	00.00.0	Applied skeleton 00.01.04 to build KPM Monitor E2SM
2018.12.01	00.00.1	Applied change from E2SM-NI-v000.01.05
2018.12.09	00.00.2	Removed Policy section, specifies detail list of container IE
2018.12.11	00.00.3	Align with E2SM-NI as per comments from A. Urie
2018.12.12	00.00.4	Add E2 Node ID, O-CU-CP/O-CU-UP container as per comments from WG3
2018.12.18	00.00.5	Updated Style Type and Format Type definition aligned with Nokia E2SM-NI v00.01.08
2019.01.14	00.00.6	Change name from KPIMON to KPMMON, additional alignment with Nokia E2SM-NI v00.01.08 and ASN.1 message addition
2019.01.16	00.00.7	ASN.1 update
2019.01.17	00.00.8	Add RIC Style Type in RIC Indication message IE with a corresponding change to the ASN.1 encoding
2019.01.19	00.00.9	Change the name to E2SM-KPM, add Action Definition with RIC style list, made section 7.8 update for additional alignment with E2SM-NI, add Annex A.
2019.01.20	00.00.10	Update Scope, rename Slice ID to S-NSSAI, add Action Definition to each style definition, remove EPC and 5GC style, add CU-CP EPC style, fix the use of 5QI and QCI for E2 indication header, and correctly reference 28.552 for 5GC IEs
2019.01.20	00.00.11	Remove Report Period IE Test Condition and Report Period IE Value from trigger definition and ASN.1. Reference 28.552 for Active UE and PDCP DL/UL data volume
2019.01.22	00.00.11a	Removed en-gNB definition
2019.01.22	00.00.12	E2SM-KPM-IEs { iso(1) identified-organization(3) dod(6) internet(1) private(4) enterprise(1) 53148 e2(1) version1 (1) e2sm(2) e2sm-KPM-IEs (2)}
2019.01.22	00.00.13	Section 6.1 update, Change E2 Node ID to KPM Node ID
2019.01.22	00.00.13a	Change E2SM-NI-IndicationMessage to E2SM-KPM-IndicationMessage
2020.01.29	v01.00	Adopt Jio's comments, change the number of NR DL/UL PRB from 100 to 273.
2020.12.16	02.00.00	Adopt INTEL.AO's CR-0001 and CR-0002 for E2SM-KPM with cleaning up old texts and ASN.1 in v01.00
2021.02.24	02.00.01	Adopt ATT.AO's CR-0001 for UE-level measurements subscription and retrieval
2021.03.03	02.00.02	Adopt CSP.AO's CR-0001 for Incomplete Flag
2021.03.30	02.00.03	Adopt INTEL's CR-0003 for clean-up
2021.06.09	02.00.04	Adopt (1) INT's CR-0006; (2) INT's CR-0008; (3) RSYS's CR-0004
2021.07.09	02.00.05	Adopt (1) INT's CR-0009; (2) NEU.AO's CR-0001
2021.08.10	02.00	TSC Approved
2021.10.13	02.01.00	Adopt (1) INTEL.AO's CR-0011; (2) RSYS.AO's CR-0002
2021.10.27	02.01.01	Adopt KDDI's CR-0001.
2021.11.22	02.01.02	Editorial Updates based on review comments during WG3 approval process
2022.02.07	02.01	Version ready for Nov21 publication
2022.03.23	02.02.00	Adopt (1) TIM.AO's CR-0003; (2) CMCC.AO's CR-0001; (3) CMCC.AO's CR-0002
2022.04.14	02.02	Version ready for Mar22 publication
2022.05.11	02.02.01	Adopt (1) INT's CR-0015; (2) INT's CR-0016; (3) INT's CR-0017
2022.07.20	02.02.02	Adopt INT's CR-0022
2022.07.24	02.02.03	Aligned to new template
2022.08.09	02.03	TSC Approved
2022.11.09	02.03.01	Adopt (1) INT's CR-0024; (2) INT's CR-0027
2022.11.20	02.03.02	Editorial changes reflecting comments received during WG3 approval process

2

3

History

Date	Revision	Description
2020.01.29	v01.00	Published as Final version 01.00
2021.08.10	v02.00	Published as Final version 02.00
2022.02.07	v02.01	Published as Final version 02.01
2022.04.14	v02.02	Published as Final version 02.02
2022.08.09	v02.03	Published as Final version 02.03

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