3GPP/SA5 support of ETSI TC EE (Mobile Network Energy Efficiency)

Discussion Paper

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3GPP/SA5 No.100
April 13-17, 2015

Dubrovnik, Croatia

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References

- ETSI ES 203 228 V<1.0.0> (<2015-01>): Environmental Engineering (EE); Assessment of mobile network energy efficiency

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ETSI ES 203 228 / Section 4
Network under test definition

- ETSI ES 203 228 / Section 4 ("Network under test definition") enumerates equipment in scope:
  - **Base Stations** (Wide area BS, Medium range BS, Local Area BS).

    Note: **Home BS (and WiFi access points) are not dealt with in this standard version**, being possibly considered for future versions
  - Site equipment (air conditioners, rectifiers/ batteries, fixed network equipment,…)
  - Backhaul equipment required to interconnect the BS used in the assessment with the core network
  - **Radio controller** (RC)

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Analysis

⇒ In terms of scope, ETSI ES 203 228 and 3GPP TS 28.xxx / 32.xx series have in common ONLY Radio Access Networks

⇒ In ETSI ES 203 228 , covered technologies are GSM, UMTS and LTE (incl. LTE-A).

⇒ Mobile CS / PS Core Networks (, IMS, ASs) are out of scope of ETSI ES 203 228 .

⇒ Mobile backhaul and site equipment are out of scope of 3GPP.

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ETSI ES 203 228 / Section 4
Network under test definition

- Methodology:
  - As a complete and detailed energy consumption measurement of the complete network of a country or MNO is in most cases impossible or economically not viable, **the total network is split into a small number of networks with limited size ("sub-networks")**.
  - Size and scale of the sub-networks are defined by topologic, geographic or demographic boundaries.
  - Extrapolation methods to be used to estimate energy efficiency for large networks of one MNO or within an entire country, based on these sub-networks

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Analysis

⇒ ETSI ES 203 228 sub-networks are kind of groupings of equipment

⇒ The MNO is responsible for designing these sub-networks (based on topologic, geographic or demographic boundaries) on which it wants to conduct energy efficiency measurement campaigns – possibly multiple small sub-networks across the country

⇒ ETSI ES 203 228 sub-networks do NOT necessarily match with 3GPP TS 28.622 (Generic NRM IRP) SubNetwork IOC instances

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ETSI ES 203 228 / Section 4.3
Network classification

- Sub-network demography classes:
  - Dense Urban / Urban / Sub-urban / Rural / Unpopulated
- Sub-network topography classes
  - Flat / Rolling / Mountainous
- Sub-network climate classes
  - Tropical / Dry / Temperate / Cold / Polar
- Sub-network penetration classes
  - Dominant Penetration / Non-Dominant Penetration / Minor Penetration
- Sub-network data volume classes
  - CS dominating / PS – small packages dominating / PS – large packages dominating

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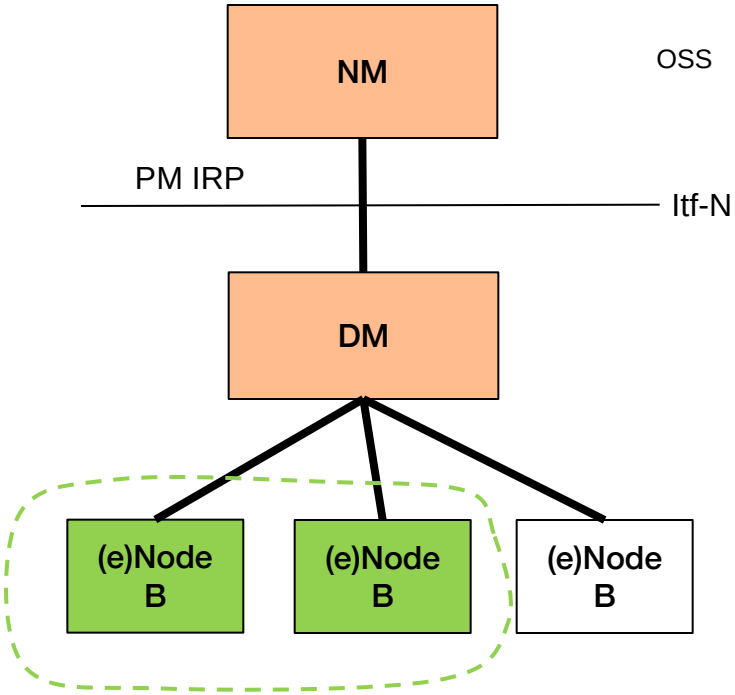
Analysis (cont'd)

Example #1:



⇒ 3GPP PM IRP can be used to manage measurement jobs for EE purposes

⇒ It would be beneficial for Operators that:

- ⇒ Such EE sub-networks are visible over Itf-N -> Potential need for updating some NRM(s)
- ⇒ PM measurements jobs can be launched on a per EE sub-network basis, and not only on a per BTS / (e)NodeB basis

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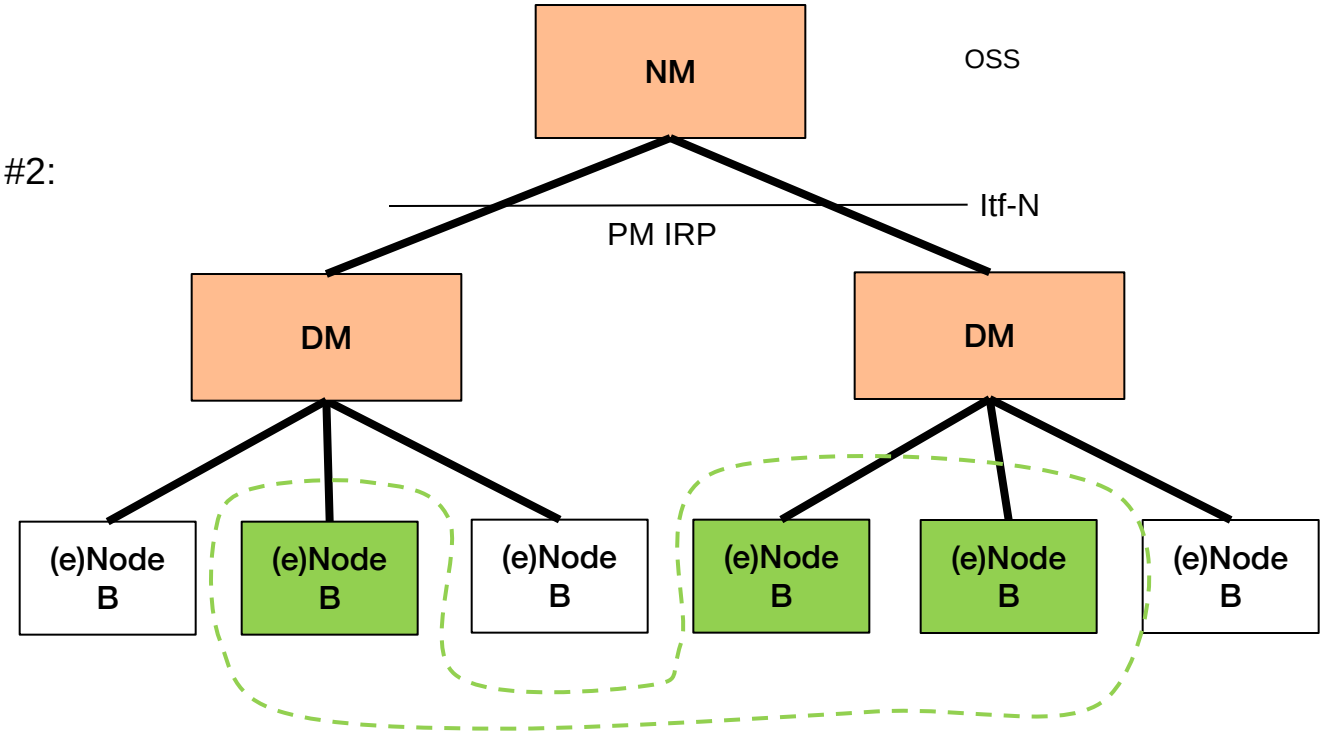
Analysis (cont'd)

Example #2:



⇒ It may be needed that the NM layer manages a end-to-end view of EE sub-networks, by doing the union of several DM-specific EE sub-networks

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ETSI ES 203 228 / Section 6.1
Time duration of the measurement

- The time duration of the measurement, denoted as T, shall be one of the alternatives:
  - Weekly measurement: T equal to 7 days.
  - Monthly measurement: T equal to 30 days.
  - Yearly measurement: T equal to 365 days.

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Analysis

- Question: to which of the following TS 32.412 (PM IRP IS) attributes, ETSI EE time duration of the measurement (7 days / 30 days / 365 days) correspond to?
  - jobGranularityPeriod (The value can be 5 minutes, 15 minutes, 30 minutes, 1 hours, 12 hours and 24 hours.) – from IOC MeasurementJob
  - jobReportingPeriod (Its value should be one or multiple of jobGranularityPeriod.) – from IOC MeasurementJob
  - (jobStopTime – jobStartTime) – from IOC JobMeasurementSchedule

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ETSI ES 203 228 / Section 5
Metrics for energy efficiency assessment

Mobile network efficiency metrics

= Performance metrics / Energy consumption metrics

Energy consumption metrics

- metering information provided by utility suppliers , or …

Means to collect energy consumption metrics are not defined by 3GPP

Performance metrics

See next slides.

- Data Volume

$$DV_{MN} = DV_{MN-PS} + DV_{MN-CS} \quad (4)$$

- Coverage

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ETSI ES 203 228 / Sections 5.2 (Performance metrics) & 6.2.2 (Measurement of capacity)

Data Volume

$$DV_{MN} = DV_{MN-PS} + DV_{MN-CS}$$

- Packet Switched traffic

For PS traffic, the data volume is considered as the overall amount of data transferred to and from the users present in the MN under test. Data volume shall be measured in an aggregated way per each RAT present in the MN and shall be measured referring to counters derived from vendor O&M systems.

- Circuit Switched traffic

For CS traffic (e.g. CS voice or VoLTE), the data volume is considered as the **number of minutes of communications** during the observation **period multiplied by the data rate of the corresponding service and the call success rate**. The call success rate is equal to 1 minus the sum of blocking and dropping rates, i.e.

$$Call\ Sucsess\ Rate = (1 - blocking\ and\ dropping\ rates) \times 100\ [\%]$$

DV_{MN} can be derived from standard counters defined in ETSI TS 132 425 [3] and ETSI TS 132 412 [4] for LTE or equivalent used for 2G and 3G, multiplying by the measurement duration T.

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Analysis

Data Volume

$$DV_{MN} = DV_{MN-PS} + DV_{MN-CS}$$

- To be done by 3GPP/SA5

⇒ Identification of candidate measurements for DV_{MN-PS} , per RAT

Candidate measurements for LTE (from TS 32.425 - Section 4.4.1.1 and 4.4.1.2):

– Average DL cell PDCP SDU bit-rate* X measurement period

– Average UL cell PDCP SDU bit-rate* X measurement period

with possibility to collect them per QCI (DRB.PdcpSduBitrateDl.QCI where QCI identifies the E-RAB level quality of service class)

⇒Identification of candidate measurements for $DV_{MN-CS,}$ per RAT

⇒Identification of relevant measurements for calculating (for CS traffic)

⇒blocking rate (TCH blocking rate, SCH blocking rate)

⇒dropping rate

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Analysis (cont'd)

- Data Volume:
  - Alternative measurements provided by Trace functionality (cf. TS 32.422 – Section 5.10.3 – List of Measurements)
    - For UTRAN -> M6: Data Volume measurement, separately for DL and UL, by RNC.

M6	UL volumes	List of measured UL volumes in bytes per RAB. One value per RAB.	TS 32.422 TS 37.320
	DL volumes	List of measured DL volumes in bytes per RAB. One value per RAB.	TS 32.422 TS 37.320
	Traffic classes	List of Traffic class parameters (conversational, streaming, interactive, background) of the RABs for which the volume and throughput measurements apply. The order of Traffic class values in the list should be the same as the corresponding measured values in the UL volumes and DL volumes attributes.	TS 25.331

*

    - For E-UTRAN -> M4: Data Volume measurement separately for DL and UL by eNB

M4	UL volumes	List of measured UL volumes in bytes per E-RAB. One value per E-RAB.	TS 32.422 TS 37.320
	DL volumes	List of measured DL volumes in bytes per E-RAB. One value per E-RAB.	TS 32.422 TS 37.320
	QCIs	List of QCIs of the E-RABs for which the volume and throughput measurements apply. The order of QCI values in the list should be the same as the corresponding measured values in the UL volumes and DL volumes attributes.	TS 32.422 TS 37.320

**

* See also TS 32.423 – Sections 4.17.1
** See also TS 32.423 – Section 4.16.1

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ETSI ES 203 228 / Section 6.2.3
Determination of coverage area

Coverage

The coverage area shall be described by two distinct methods:

1. Calculated coverage area derived from network design, planned service and geographical data
2. Measured network coverage based on UE reporting

- Geographic coverage area defined by an MNO defined network service plans
- Coverage ratio / effective coverage area

The actual coverage area might differ from the originally planned coverage area (i.e. coverage holes within the considered area). The coverage ratio is a measure to estimate the actually covered fraction of the planned total coverage area. User equipment reports such as signal strength and failed call attempts shall be used to more accurately determine the covered fraction.

The effective coverage shall be measured based on coverage failures reported by the appropriate network counters:

Coverage ratio = 1 - (1 - RRC setup failure ratio) (1 - RAB setup failure ratio) (1 - RAB release failure ratio)

The following indicators shall be used to calculate the coverage failure:

- RRC setup failure ratio = Failed RRC connection establishments/Attempted RRC connection establishments.
- RAB setup failure ratio = RAB setup failure/RAB setup attempted.
- RAB release failure ratio = RAB release failure/RAB release attempted.

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ETSI ES 203 228 / Section 6.2.3
Determination of coverage area

Coverage

Table 7: Measurement parameters required for coverage ratio calculation (refer to [7], [8] and [3] for 2G, 3G and 4G definition/source reference respectively)

Parameter	Function	Counter name
Failed RRC connection establishments	Radio resource control	RRC.ConnEstabFail.sum
Attempted RRC connection establishments	Radio resource control	RRC.ConnEstabAtt.sum
RAB setup failure	Initial context setup attempt	RAB.EstabInitFailNbr.sum
RAB setup attempted	Initial context setup attempt	ERAB.EstabInitAttNbr.sum
RAB release failure	RAB release	RAB.RelFailNbr.sum
RAB release attempted	RAB release	ERAB.RelAttNbr.sum

- [3] ETSI TS 132 425 (V12.0.0): "LTE; Telecommunication management; Performance Management (PM); Performance measurements Evolved Universal Terrestrial Radio Access Network (E-UTRAN) (3GPP TS 32.425 version 12.0.0 Release 12)".
- [7] ETSI TS 152 402 (V11.0.0): "Digital cellular telecommunications system (Phase 2+); Telecommunication management; Performance Management (PM); Performance measurements - GSM (3GPP TS 52.402 version 11.0.0 Release 11)".
- [8] ETSI TS 132 405 (V11.1.1): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Performance Management (PM); Performance measurements; Universal Terrestrial Radio Access Network (UTRAN) (3GPP TS 32.405 version 11.1.1 Release 11)".

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Analysis

- Coverage

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Parameter	Function	Counter name
Failed RRC connection establishments	Radio resource control	RRC.ConnEstabFail.sum
Attempted RRC connection establishments	Radio resource control	RRC.ConnEstabAtt.sum
RAB setup failure	Initial context setup attempt	RAB.EstabInitFailNbr.sum
RAB setup attempted	Initial context setup attempt	ERAB.EstabInitAttNbr.sum
RAB release failure	RAB release	RAB.RelFailNbr.sum
RAB release attempted	RAB release	ERAB.RelAttNbr.sum

- To be done within SA5
  - Check the above table
  - Complete the list of measurements per RAT
  - Liaise back to ETSI EE

  - Check whether « geographic coverage area » could be retrieved thru RPTA IRP (TS 28.667/8/9)

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Analysis (cont'd)

RAN sharing

- Is addressed in ETSI ES 203 228 / Section 6.2.1 (Measurement of Energy Consumption)

In case of shared infrastructure the EC_{MN} of the shared sites shall be computed per each MNO sharing those sites in a proportional ratio. In case of separate metering per MNO the respective part of the ECMN shall be assigned to each MNO.

- Is NOT addressed in performance metrics (Section 5.2), in particular Data Volume: DV_{MN}
  - A per Participating Operator DV_{MN} is needed, or
  - Energy Efficiency metrics will be wrong

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Proposal

- SA5 to discuss remarks / proposals made in previous slides
- Create and maintain list of action items for each accepted proposal
- Liaise with ETSI EE to inform them of our work plan and progress
- Discuss whether the current WID needs being updated
  - Make it explicit that 2G, 3G and LTE are in scope
  - Extend scope to not only performance measurements (usage of PM IRP, RPTA IRP, etc.)
  - Potential need for a new TS (in order to provide a global answer to ETSI EE)

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Thank you

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