ETSI TR 136 932 V15.0.0 (2018-09)

TECHNICAL REPORT

LTE;
Scenarios and requirements for small cell enhancements for E-UTRA and E-UTRAN
(3GPP TR 36.932 version 15.0.0 Release 15)

A GLOBAL INITIATIVE

Reference
RTR/TSGR-0036932vf00

Keywords
LTE

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

Copyright Notification

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

This Technical Report (TR) has been produced by ETSI 3rd Generation Partnership Project (3GPP).

The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp.

Modal verbs terminology

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

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Foreword

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

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

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document contains scenarios and requirements for the small cell enhancement for E-UTRA and E-UTRAN.

2 References

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

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

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

[2] 3GPP TS 36.839: "Evolved Universal Terrestrial Radio Access (E-UTRA); Mobility enhancements in heterogeneous networks".

[3] 3GPP TR 36.913: "Requirements for further advancements for Evolved Universal Terrestrial Radio Access (E-UTRA) (LTE-Advanced)".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

3.2 Symbols

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

<symbol> <Explanation>

3.3 Abbreviations

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

CDF: Cumulative Distribution Function
VoLTE Voice over LTE

4 Introduction

Small cells using low power nodes are considered promising to cope with mobile traffic explosion, especially for hotspot deployments in indoor and outdoor scenarios. A low-power node generally means a node whose Tx power is lower than macro node and BS classes, for example Pico and Femto eNB are both applicable. Small cell enhancements for E-UTRA and E-UTRAN will focus on additional functionalities for enhanced performance in hotspot areas for indoor and outdoor using low power nodes.

This document captures the scenarios and requirements for small cell enhancements. 3GPP TR 36.913 [3] should be used as reference whenever applicable in order to avoid duplication of the requirements.

5 Objective

The objectives of this document are as follows:

A) Define target scenarios for small cell enhancement considering:

- Deployment scenarios of small cell nodes
- Spectrum usage for small cell scenarios
- Traffic characteristics in small cell scenarios

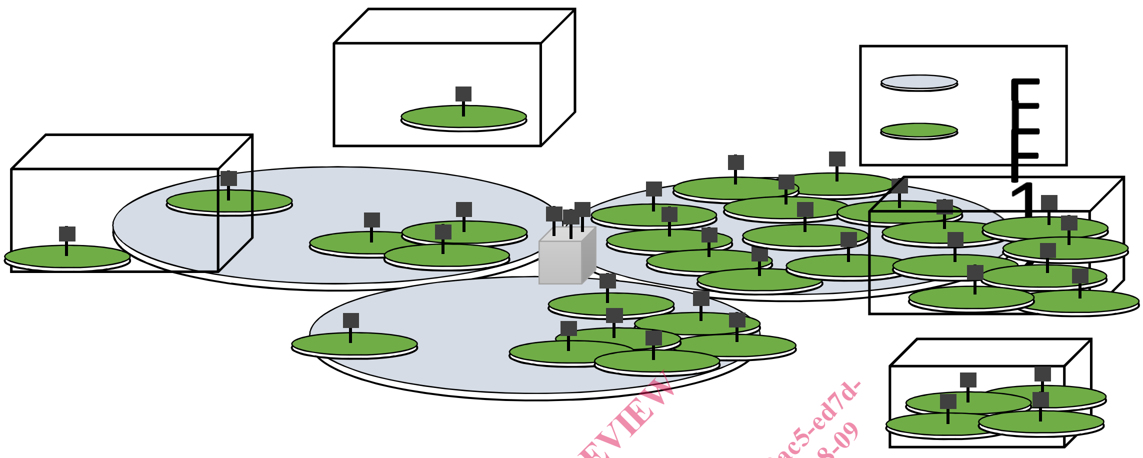
B) Define requirements for small cell enhancement scenarios considering:

- System, mobility and coverage performance
- Core network related aspects
- Cost and energy efficiency aspects
- Security aspects

6 Target scenarios

6.1 Deployment

Small cell enhancement should target both with and without macro coverage, both outdoor and indoor small cell deployments and both ideal and non-ideal backhaul. Both sparse and dense small cell deployments should be considered. (See Fig. 6.1-1)



NOTE 1: F1 and F2 are the carrier frequency for macro layer and local-node layer, respectively

Figure 6.1-1: Deployment scenarios of small cell with/without macro coverage

6.1.1 With and without macro coverage

As shown in Fig. 6.1-1, small cell enhancement should target the deployment scenario in which small cell nodes are deployed under the coverage of one or more than one overlaid E-UTRAN macro-cell layer(s) in order to boost the capacity of already deployed cellular network. Two scenarios can be considered:

1. Where the UE is in coverage of both the macro cell and the small cell simultaneously

2. Where the UE is not in coverage of both the macro cell and the small cell simultaneously

Figure 6.1-1 also shows the scenario where small cell nodes are not deployed under the coverage of one or more overlaid E-UTRAN macro-cell layer(s). This scenario is also the target of the small cell enhancement Study Item.

6.1.2 Outdoor and indoor

Small cell enhancement should target both outdoor and indoor small cell deployments. The small cell nodes could be deployed indoors or outdoors, and in either case could provide service to indoor or outdoor UEs.

For indoor UE, only low UE speed (0 – 3 km/h) is targeted. For outdoor, not only low UE speed, but also medium UE speed (up to 30km/h and potentially higher speeds) is targeted.

Both throughput and mobility/connectivity shall be used as performance metric for both low and medium mobility. Cell edge performance (e.g. 5%-tile CDF point for user throughput) and power efficiency (of both network and UE) are also used as metrics for further study.

6.1.3 Ideal and non-ideal backhaul

Both ideal backhaul (i.e., very high throughput and very low latency backhaul such as dedicated point-to-point connection using optical fiber) and non-ideal backhaul (i.e., typical backhaul widely used in the market such as xDSL, microwave, and other backhauls like relaying) should be studied. The performance-cost trade-off should be taken into account.

A categorization of non-ideal backhaul based on operator inputs is listed in Table 6.1-1:

Table 6.1-1: Categorization of non-ideal backhaul

Backhaul Technology	Latency (One way)	Throughput	Priority (1 is the highest)
Fiber Access 1	10-30ms	10M-10Gbps	1
Fiber Access 2	5-10ms	100-1000Mbps	2
Fiber Access 3	2-5ms	50M-10Gbps	1
DSL Access	15-60ms	10-100 Mbps	1
Cable	25-35ms	10-100 Mbps	2
Wireless Backhaul	5-35ms	10Mbps – 100Mbps typical, maybe up to Gbps range	1

A categorization of ideal backhaul based on operator inputs is listed in Table 6.1-2:

Table 6.1-2: Categorization of ideal backhaul

Backhaul Technology	Latency (One way)	Throughput	Priority (1 is the highest)
Fiber Access 4 (NOTE 1)	less than 2.5 us (NOTE2)	Up to 10Gbps	1

NOTE 1: This can be applied between the eNB and the remote radio head.

NOTE 2: propagation delay in the fiber/cable is not included.

For interfaces between macro and small cell, as well as between small cells, the studies should first identify which kind of information is needed or beneficial to be exchanged between nodes in order to get the desired improvements before the actual type of interface is determined. And if direct interface should be assumed between macro and small cell, as well as between small cell and small cell, X2 interface can be used as a starting point.

6.1.4 Sparse and dense

Small cell enhancement should consider sparse and dense small cell deployments. In some scenarios (e.g., hotspot indoor/outdoor places, etc.), single or a few small cell node(s) are sparsely deployed, e.g. to cover the hotspot(s). Meanwhile, in some scenarios (e.g., dense urban, large shopping mall, etc.), a lot of small cell nodes are densely deployed to support huge traffic over a relatively wide area covered by the small cell nodes. The coverage of the small cell layer is generally discontinuous between different hotspot areas. Each hotspot area can be covered by a group of small cells, i.e. a small cell cluster.

Furthermore, smooth future extension/scalability (e.g.: from sparse to dense, from small-area dense to large-area dense, or from normal-dense to super-dense) should be considered. For mobility/ connectivity performance, both sparse and dense deployments should be considered with equal priority.

6.1.5 Synchronization

Both synchronized and un-synchronized scenarios should be considered between small cells as well as between small cells and macro cell(s). For specific operations e.g. interference coordination, carrier aggregation and inter-eNB COMP, small cell enhancement can benefit from synchronized deployments with respect to small cell search/measurements and interference/resource management. Therefore time synchronized deployments of small cell clusters are prioritized in the study and new means to achieve such synchronization shall be considered.

6.2 Spectrum

Small cell enhancement should address the deployment scenario in which different frequency bands are separately assigned to macro layer and small cell layer, respectively, where F1 and F2 in Fig. 6.1-1 correspond to different carriers in different frequency bands.

Small cell enhancement should be applicable to all existing and as well as future cellular bands, with special focus on higher frequency bands, e.g., the 3.5 GHz band, to enjoy the more available spectrum and wider bandwidth.

Small cell enhancement should also take into account the possibility for frequency bands that, at least locally, are only used for small cell deployments.