



3GPP IMT technology development and spectrum aspects

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Outline

Small cell Enhancements

Carrier aggregation, including FDD/TDD aggregation

MIMO and 3D-beamforming enhancements

Interference suppression by interference cancellation
and coordination

Radio level interworking with WLAN

New market segments: M2M & Public Safety

HSPA Release 12 items

3GPP Release schedule

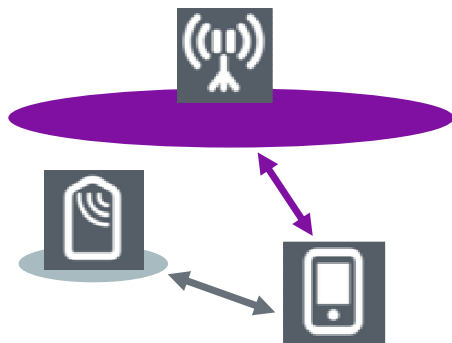
Small Cell Enhancement in Release 12

Drivers

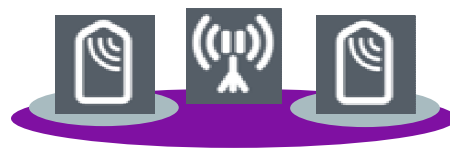
Offload of 1000x traffic increase, cost effective dense small cell deployments and improved mobility management in dense small cell deployments

Key Technologies in 3GPP Release 12

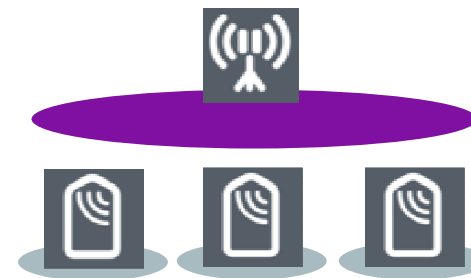
Dual connectivity, small cell on/off and 256QAM, network based eNodeB synchronization enhancements also being considered



Dual Connectivity



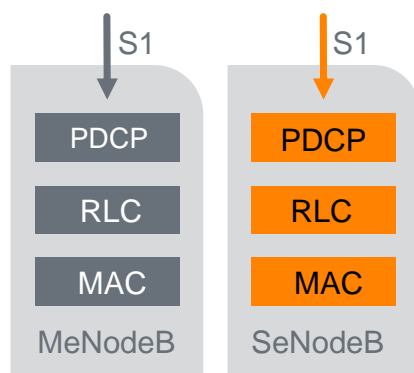
Scenario 1
co-channel deployment,
outdoor



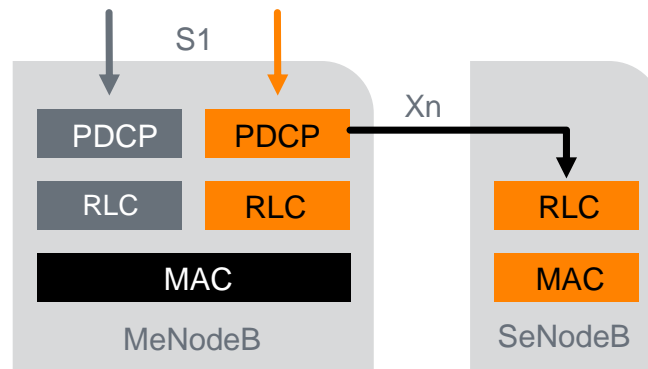
Scenario 2
macro overlay outdoor, small
cells a) outdoor or b) indoor

User Plane Architecture Options with Small Cells

- New work item approved in 3GPP recently, covering two architectures:
- Alternative 1A: Small cell connected to core network via S1, bearer split option.
- Alternative 3C: Small cell connected to macro eNodeB via Xn-interface.
- PDCP layer located in macro eNodeB - > security handled by macro eNodeB.



Alternative 1A



Alternative 3C



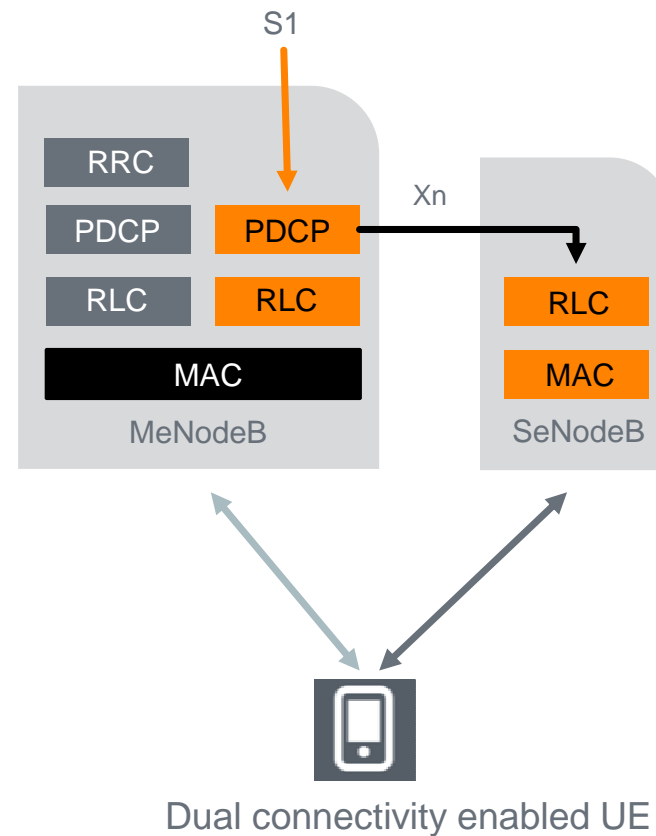
Small Cell Enhancements

Control Plane

RRC signaling is always in the macro eNodeB

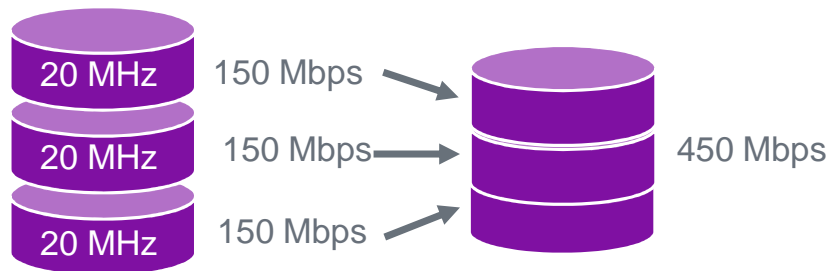
Ensures connection reliability even if connection to small eNodeB is lost

Small eNodeB does not send own RRC messages to the UE



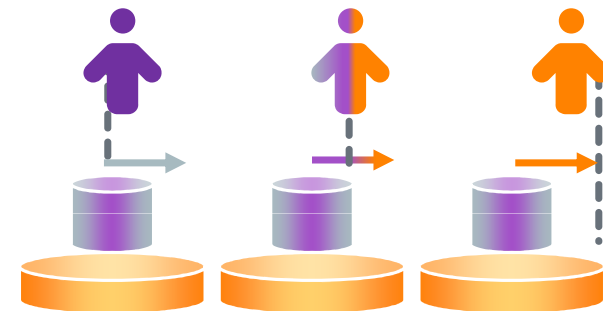
LTE Carrier Aggregation: Boosting LTE capabilities further

Higher peak data rate



- Higher peak and average data rates, especially in the downlink
- Uplink carrier aggregation more range limited (UE total TX power 23 dBm)
- Release 12 defining up to 3-carrier downlink band combinations RF requirements (signaling since Rel-10)

Inter-band load balancing

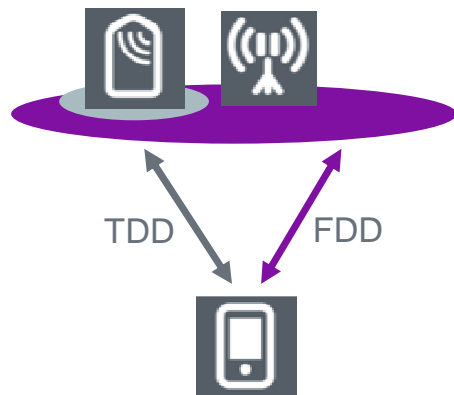


- Ultrafast (1 ms) resource allocation by scheduler instead of handover
- Users dynamically get the best resources of aggregated carrier

LTE Carrier Aggregation

FDD/TDD aggregation

FDD/TDD Aggregation (Intra-site)



- Aggregation between FDD and TDD bands being enabled in Release 12
- Specific FDD-TDD band combinations to follow in the next phase

- Either FDD or TDD can be the Primary Cell (Pcell)
- Allows an operator to aggregate FDD and TDD bands
- Release 12 small cell enhancements to enable further inter-site carrier aggregation

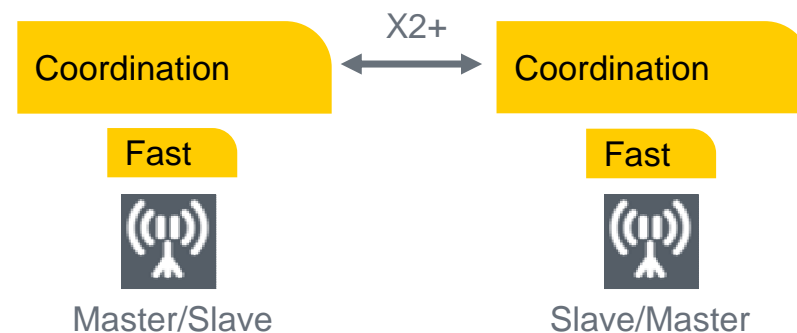
Scheduler coordination

3GPP concluded the study for enhanced CoMP

The gains in macro-macro case were low (less than 5% cell edge gain). More benefit for macro-small cell environment

Specification work focuses on macro-small cell environment

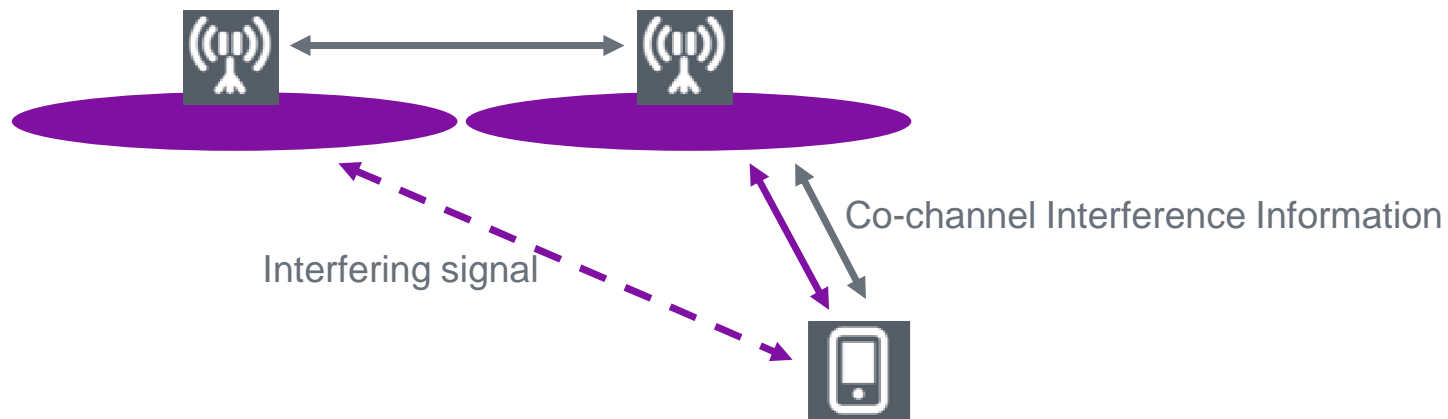
Distributed coordination over X2 with non-ideal backhaul



- Fast scheduler in each eNB
- Coordination over X2+
- Low transport delay requirements

Interference Suppression by Cancellation and Coordination

- 3GPP study on-going on, work item(s) expected to be started from March onwards
- Network Assisted Interference Cancellation and Suppression (NAICS)
- Such a receiver considers all the data signals from interfering cell, not only the Common Reference Symbols (CRS)



3D beamforming

3GPP working to finalize the enabler for the work – 3D- channel model

- Existing channel models assume 2 dimensional (2D) UE distribution -> not suited for evaluation of features like vertical sectorization

Next steps

- 3D-beamforming, to look for possible enhancements to the specifications following the studies up to 8 antenna ports

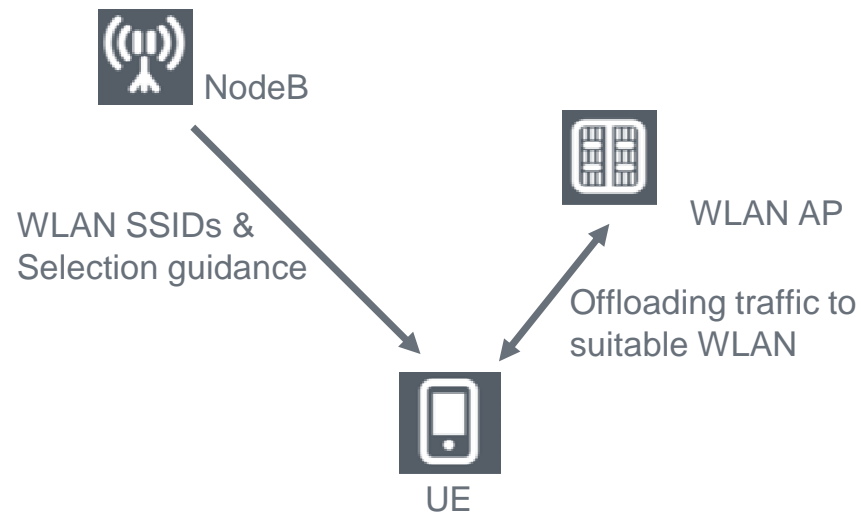
Then to look for beyond 8 antenna ports

- Massive MIMO / Full Dimension MIMO to consider 16 or 32 antenna ports even
- This is a foreseen for Release 13



WLAN - 3GPP Radio Interworking

- WLAN/3GPP radio level interworking (also for HSPA)
- UE is provided more assistance at the RAN level (in addition to ANDSF)
- Allows UE to decide the right time to go to WLAN (and when to come back if QoS is poor)



Machine-type communications (M2M)

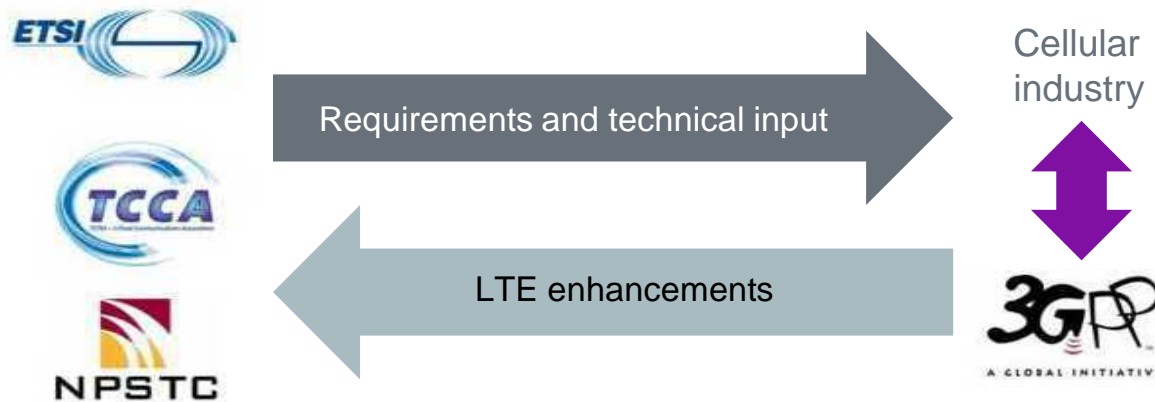
High number of devices with low data throughput

- Initial 3GPP efforts have focused on the ability to differentiate machine-type devices
 - This allows the operator to selectively handle such devices in overload situations (both RAN and Core overload protection solutions included)
- Radio-level optimizations on-going enable implementation of low-cost LTE M2M devices and consider range improvements
 - Single RX, smaller bandwidth & lower data rate etc. to reduce cost
- Work moving towards generic solutions due to divergence of M2M traffic patterns
 - UE Power consumption optimization
 - Optimization for small data transmission

Public Safety

A global effort leveraging the LTE footprint

- LTE has been chosen as a single nationwide public safety broadband network in the USA beyond the current P25 system
 - TCCA/TETRA community has also settled on LTE as the next step beyond the current TETRA system
- **Unprecedented opportunity to unify the global public safety footprint**



Public Safety

3GPP scope

System features

Proximity services (ProSE) (Device to Device)
Group call on LTE enablers (GCSE_LTE)

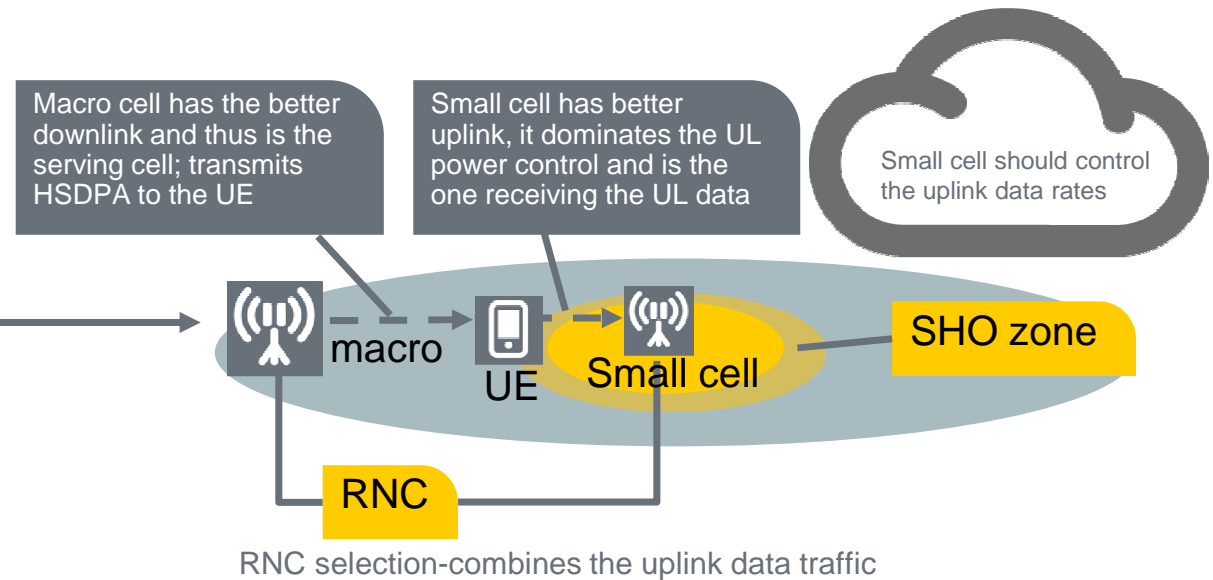


Radio layer features

Frequency band support
Power level support
Radio enablers for system features

HSPA Evolution

- HSPA evolution includes further work on HetNet for HSPA, items such as:
- E-DCH decoupling
- Network Assisted Interference Cancellation
- Work is being done also with HSUPA improvements (Further EUL Enhancements)
- Study also on-going for Scalable UMTS by filtering
 - Use only filtering without changing the chip rate
 - Interest coming from some re-farming scenarios



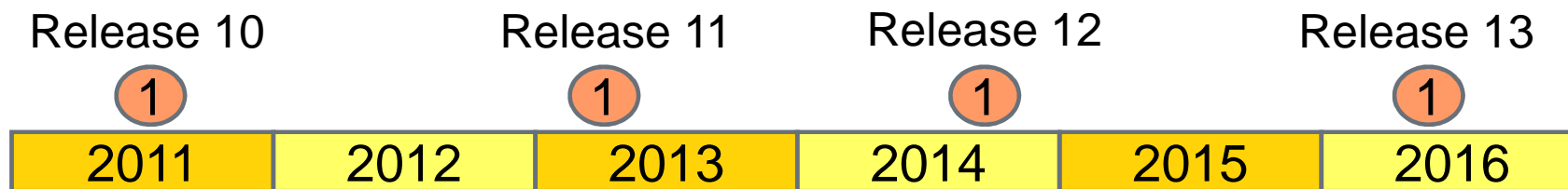
New Frequency Variants

Addressing new spectrum opportunities

- 3GPP makes always new frequency band as Release independent
- Thus a new band introduced in Release 12 does not have to wait for Release 12 or 13 features to be ready, but can be implement for example on top of LTE Release 8 (taking only the band specific RF requirements into account in the later Release)
 - Facilitates fast time-to-market for support for new bands
 - Lately added band, such as APAC 700 MHz or Brazil 450 MHz, can be supported on top of for example Release 8 LTE

3GPP Release Schedule

Currently 3GPP is focusing on Release 12 finalization
Specifications scheduled to be frozen (ASN.1) September 2014
Release 13 specification freeze scheduled for March 2016



① = 3GPP specs ready (ASN.1 freeze)

Release 13 content to be still decided. Potential items being raised in 3GPP include:
3D-beamforming/full dimension MIMO, LTE-Unlicensed, dedicated carrier eMBMS

Summary

Rich toolbox available for operators to address traffic explosion

LTE entering segments never before available to operators

Band aggregation and small cells address traffic growth

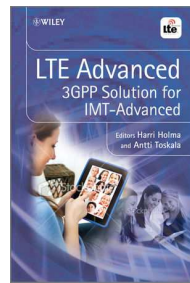
Release 12 to be completed during 2014, then new Release 13 items to start

Thank you

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The NSN logo consists of the letters 'n', 's', and 'n' in a stylized, lowercase font. The 'n' on the left is yellow, the 's' in the middle is orange, and the 'n' on the right is purple.

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A large, white NSN logo is positioned in the bottom right corner of the slide. The letters are in a bold, lowercase, sans-serif font.