

# 3GPP RAN: Ran Evolution Rel-12 and Beyond

3GPP TSG-RAN WG3 Chairman  
Philippe Reininger

# 3GPP



📶 GSM, GPRS, EDGE, W-CDMA, HSPA and LTE are all [RAN] Technologies specified by 3GPP

📶 Core network and Systems architecture evolution have kept pace

📶 The 3GPP Organizational Partners are Regional and National Standards Bodies

📶 Companies participate through their membership of one of these 6 7 Partners

📶 [www.3gpp.org](http://www.3gpp.org)



# Introduction



- 📶 3GPP RAN has started a new innovation cycle which will be shaping next generation cellular systems
- 📶 A variety of radio technologies are being studied and may be standardized in Rel-13 or future releases\*
- 📶 This presentation provides a brief overview of the main technology areas 3GPP RAN is working on for Rel-12 and beyond

*\* At this time it is difficult to anticipate which feature will be standardized and in which release. In the following we will indicate with '+' the features that are **in study phase** for rel-13*

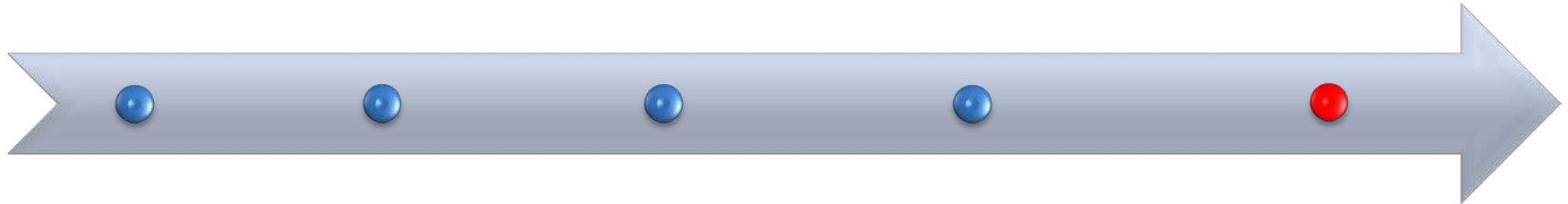
# LTE: continual evolution

## Rel-9 (Dec. '09)

- eMBMS
- Dual stream beamforming
- Positioning
- Enhanced HeNB/CSG support
- Emergency services

## Rel-11 (Sep. '12)

- DL and UL CoMP
- In-device coexistence
- Enhanced Physical Downlink Control Channel (ePDCCH)
- Further eICIC



## Rel-8 (Dec. '08)

- FDD and TDD mode
- Flexible bandwidth (1.4MHz to 20MHz)
- DL SU-MIMO (4 layers) and SDMA
- UL TX diversity and SDMA
- Inter-cell power control and interference management
- Inter-eNB and Inter-RAT mobility
- HeNB/CSG & SON support

## Rel-10 (Mar. '11)

- CA (up to 5 CCs)
- Enhanced MIMO (8 DL and 4 UL layers)
- eICIC
- Relays
- Enhanced SON & MDT

## Rel-12 (Dec. '14)

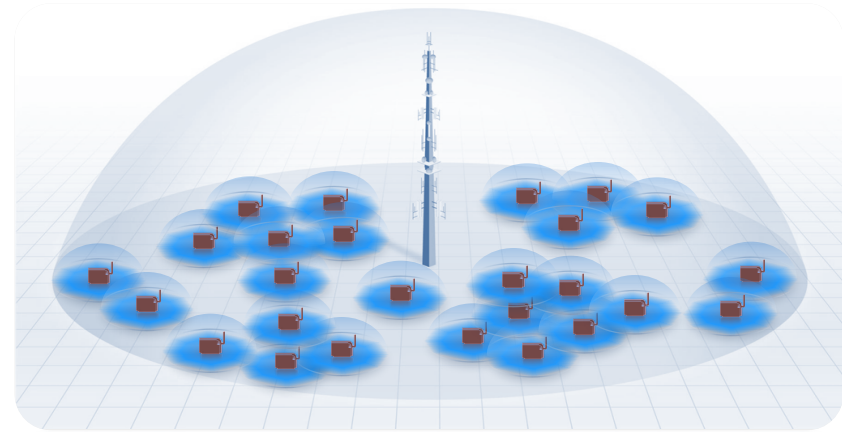
## *LTE Rel-12 and Beyond*

 *Technologies that improve network capacity  
and cell-edge performance*

# Small Cells

## New physical layer/RF solutions

- Higher order modulation e.g. 256QAM for downlink
- Small cell discovery and support of small cell on/off mechanisms
- Radio interface based inter-cell synchronization
- Interference management when neighbor LTE TDD cells with different UL/DL ratio



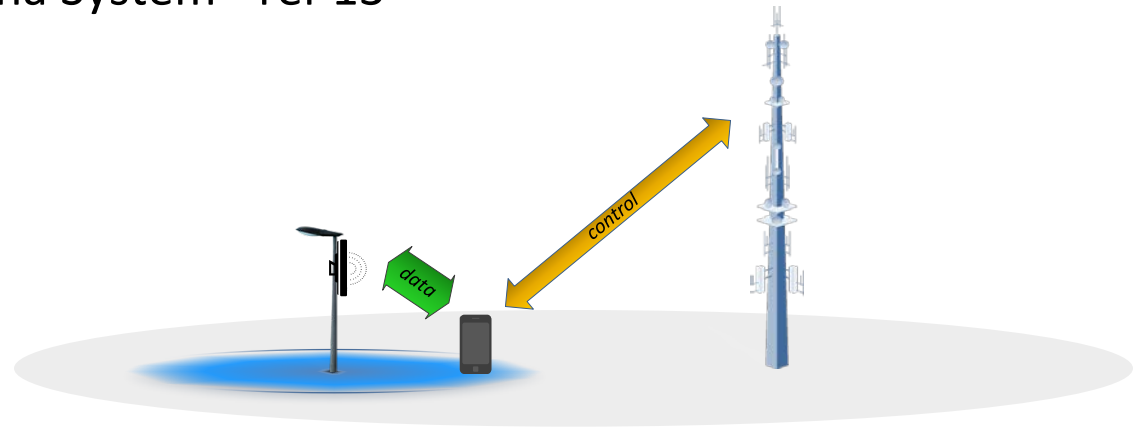
*Towards hyper-dense networks*



# Small Cells (cont'd)

## New protocol/architectural solutions

- **Dual Connectivity**
- SON for Active Antenna System - rel-13



*Example of Dual Connectivity: anchoring connections to macro cells while boosting datarate via small cells*

# Multi-antenna technology advancements

 3D channel modeling study to enable future work on **†** :

- Terminal-specific **elevation beamforming**
- Full-dimension MIMO
  - MIMO systems with large number of antennas, e.g. 64 x 4
  - To become relevant with the use of higher frequencies



# Other technologies



- 📶 Coordinated Multi-Point (CoMP) operation with non ideal-backhaul
  
- 📶 Advanced interference suppression techniques at the terminal
  - Including support of interference suppression on the data channel, with and without network assistance
  
- 📶 Resource usage (quantification and monitoring) by any operator participating in a single E-UTRA RAN network - rel-13
  
- 📶 Evaluation of multi-Radio Access Technology joint network operation for better user experience, traffic steering, joint radio resource management

## *LTE Rel-12 and Beyond*

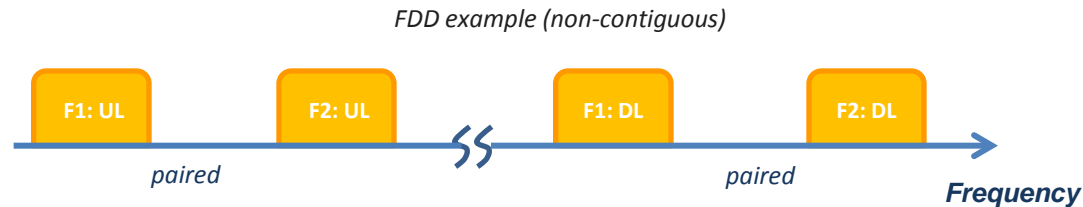
 *Technologies that make more spectrum available at the terminal*

# Carrier Aggregation advancements (1)

RF requirements definition for CA combinations with:

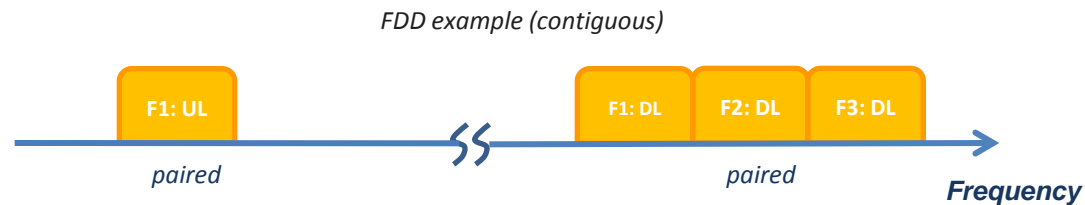
## 2 uplink carriers

- Non-contiguous for intra-band and inter-band



## 3 downlink carriers (with 1 uplink)

- Contiguous and non contiguous for intra-band and inter-band



# Carrier Aggregation advancements (2)

## 📶 FDD/TDD carrier aggregation framework

- Further integration between the two modes allowing operators to fully utilize their spectrum
- Connections to be anchored either to the FDD or to the TDD carrier
- (Legacy) Terminals to be able to camp on or connect to the FDD or TDD carrier individually

## 📶 RF requirements definition for actual CA band combinations to follow

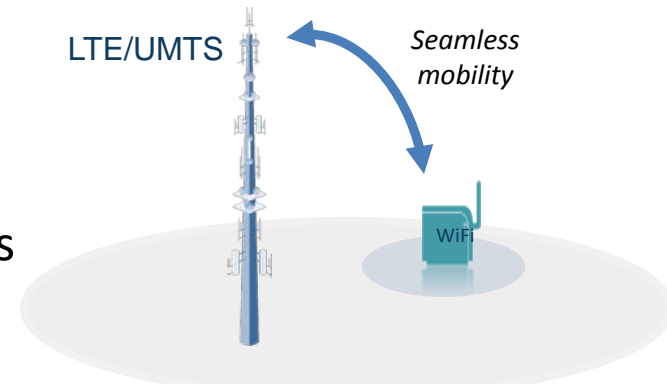


## 📶 Study the Licensed-Assisted Access by un-licensed spectrum usage†

# Inter-Radio Access Technology interworking

## LTE/UMTS-WiFi radio interworking

- Radio solutions for steering terminals between LTE/UMTS and WiFi, in idle and connected mode
- Improve mobility and **load balancing** capabilities between the two systems



*Seamless mobility improvement between LTE/UMTS and WiFi*


## Increasing the minimum **number of carriers** for UE monitoring in LTE/UMTS

- Number of deployed bands and frequencies has increased significantly
- Existing minimum requirements are seen to be significant limitations in future

# Low-cost and long-range for MTC

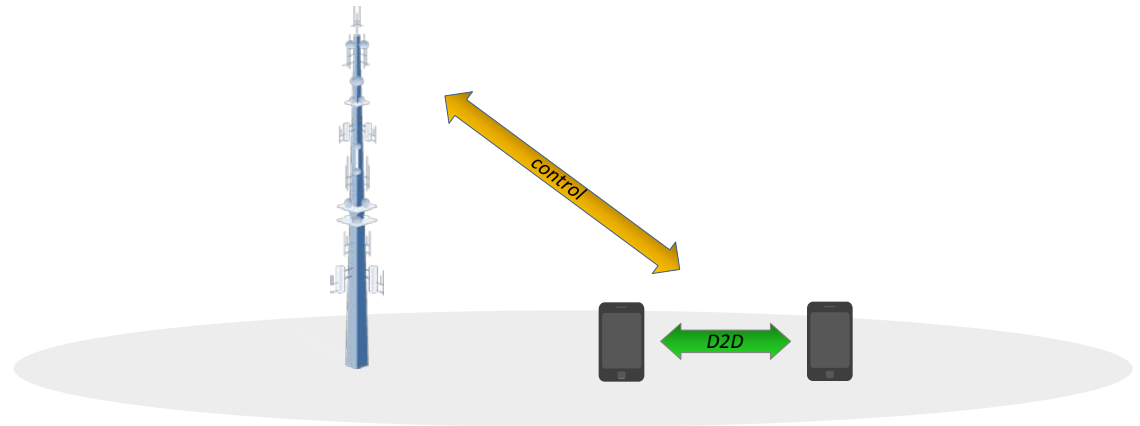
- 📶 Goal is to reduce modem cost and improve range for low datarate, delay tolerant, Machine-Type Communications (MTC)
  
- 📶 Low cost enablers
  - New low datarate UE category (~1Mbps max throughput)
  - 1 RX antenna operation
  - Narrowband data channel operation (with wideband control channel)
  - Half-duplex operation
  
- 📶 Coverage enhancements – rel-13
  - Receiver, repetition and bundling techniques to extend coverage of control and data channel
  
- 📶 Enhancements for MTC and other mobile data applications communications
  - Power consumption optimization and signaling reduction to handle traffic profiles comprising transfers of small amounts of data

## *LTE Rel-12 and Beyond*

 *Technologies that enable new services or enhance existing ones*

# Device-to-device (D2D)

- Goal is to enable proximity services for **Public Safety (PS)** and **Consumer** usecases
- **D2D** discovery and communications, covering:
  - D2D discovery under network coverage
  - D2D communication under network coverage, with focus on PS applications
  - D2D discovery & communication outside network coverage, solely for PS





# Others

## Group Communication for **Public Safety**

- Support of LTE unicast and eMBMS capabilities for Group Communications
- Including support of Group Call with eMBMS congestion management

## eMBMS measurements

- Definition of eMBMS-related measurements to be used for planning purposes e.g. to optimize the quality of MBMS services being delivered
- New measurements to be collected using the MDT functionality

## **Voice & Emergency** related enhancements

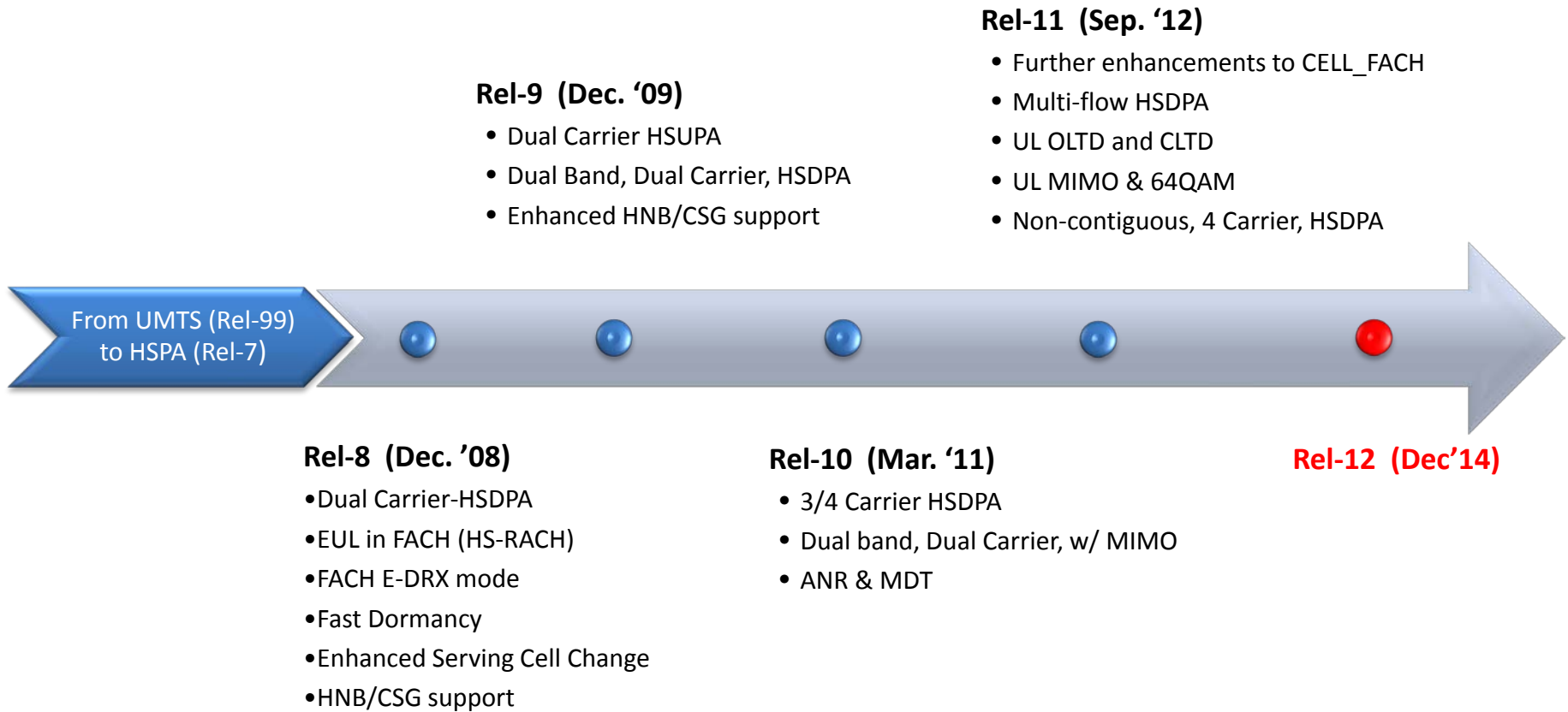
- Specification of uplink bundling to increase coverage of voice services
- Evaluation of further radio mechanisms to prioritize voice or emergency services during congestion situations

## **Positioning** related enhancements

- Positioning Enhancements for RF Pattern Matching in E-UTRA
- Study in indoor positioning Enhancements for UTRA and LTE<sup>+</sup>

## *UMTS/HSPA: Rel-12 and beyond*





# UMTS/HSPA evolution



# UMTS/HSPA: Rel-12 and beyond



## Improvement to system capacity and user experience

-  DCH enhancements for CS voice
  - Removal of pilot overhead; Support of Early Frame Termination
  
-  Heterogeneous networks support
  - Mobility enhancements, evaluation of techniques to deal with UL/DL imbalance and interference issues, multi-flow enhancements
  
-  Uplink and study Downlink<sup>+</sup> enhancements
  - Evaluation of various techniques to improve uplink operation, including overhead reduction, uplink compression, datarate boosting on secondary carrier, enhancements to access control, power and rate control, UE power headroom signaling and load balancing between carriers
  - Evaluation of various techniques to improve downlink operation, DL control channel performance, signaling performance on overhead and latency, investigate mechanisms to enhance SRB
  
-  Small data transmission enhancements study<sup>+</sup>
  - Evaluation of various techniques to improve MTC operation, including signalling optimizations, device power saving enhancements, optimization of delay tolerant transmissions and Investigate mechanisms to enhance coverage

# UMTS/HSPA: Rel-12 and beyond (cont'd)

## Carrier Aggregation advancements

- RF requirements definition for Supplemental Downlink CA combination



## Utility enhancements

- Broadcast enhancements
  - To address present and future signaling load of the broadcast channel coming from the large number of features supported by the UMTS system

*Thank you!*