ETSI World Class Standards

Indo-European dialogue on
ICT standards & Emerging Technologies
(Growth, Profitability & Nation Building)
13-14th March 2014 - New Delhi, INDIA

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Project
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Mobile Developments

Presented by Philippe Reininger, Chairman of 3GPP RAN WG3

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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-12 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 (this will be clearer mid of the year). Also, new features may be proposed in the coming months. In the following we will indicate with '†' the features that are already in normative phase for Rel-12*

LTE: continual evolution

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
- Basic HeNB/CSG & SON support

Rel-9 (Dec. '09)
- eMBMS
- Dual stream beamforming
- Positioning
- Enhanced HeNB/CSG support
- Emergency services

Rel-10 (Mar. '11)
- CA (up to 5 CCs)
- Enhanced MIMO (8 DL and 4 UL layers)
- eICIC
- Relays
- Enhanced SON & MDT

Rel-11 (Sep. '12)
- DL and UL CoMP
- In-device coexistence
- Enhanced Physical Downlink Control Channel (ePDCCH)
- Further eICIC

Rel-12 (Jun. '14)

Technologies that improve network capacity and cell-edge performance

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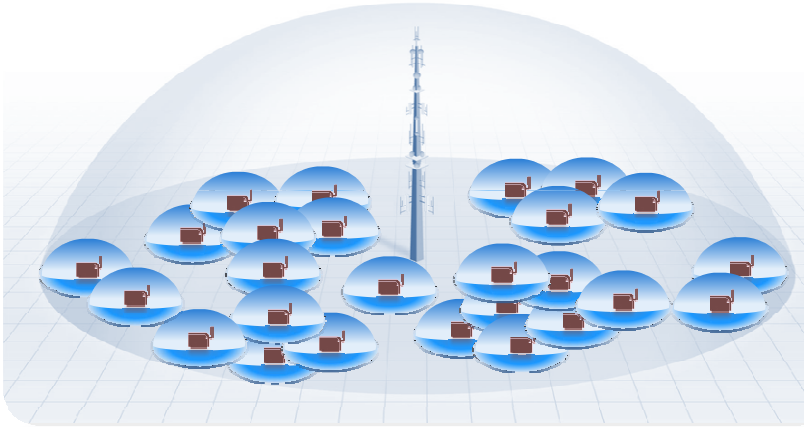
Small Cells (1)

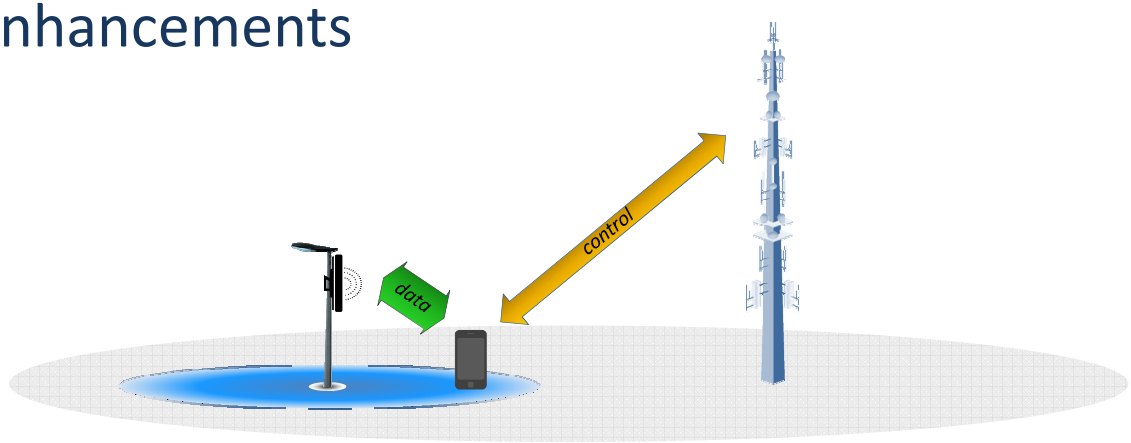
- Evaluation of new physical layer/RF solutions†
  - Evaluation of higher order modulation e.g. **256QAM** for downlink
  - Small cell discovery and support of semi-static small cell on/off mechanisms
  - Radio interface based inter-cell synchronization
  - Interference management when neighbor LTE TDD cells with different UL/DL ratio



Towards hyper-dense networks

Small Cells (2)

- New protocol/architectural solutions†
  - **Dual connectivity**
  - Mobility and SON enhancements



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
- Evaluation of the resource usage (quantification and monitoring) by any operator participating in a single E-UTRA RAN network
- Evaluation of multi-Radio Access Technology joint network operation for better user experience, traffic steering, joint radio resource management

Technologies that make more spectrum available at the terminal

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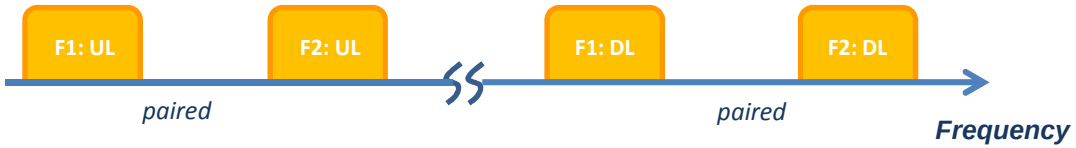
Carrier Aggregation advancements (1)

- Performance requirements definition for CA combinations with:

2 uplink carriers†

- Non-contiguous, intra-band and inter-band

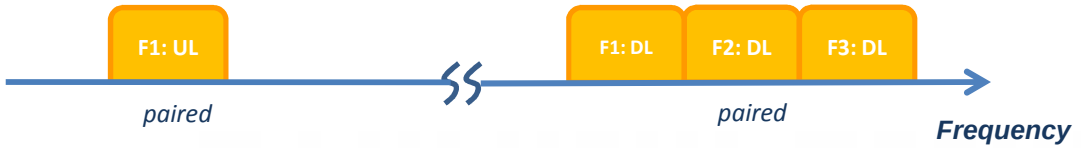
FDD example (non-contiguous)



3 downlink carriers (with 1 uplink) †

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

FDD example (contiguous)

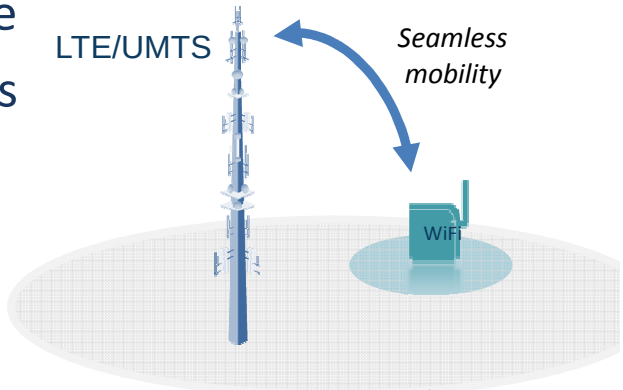


Carrier Aggregation advancements (2)

- 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

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

Technologies that enable new services or enhance existing ones

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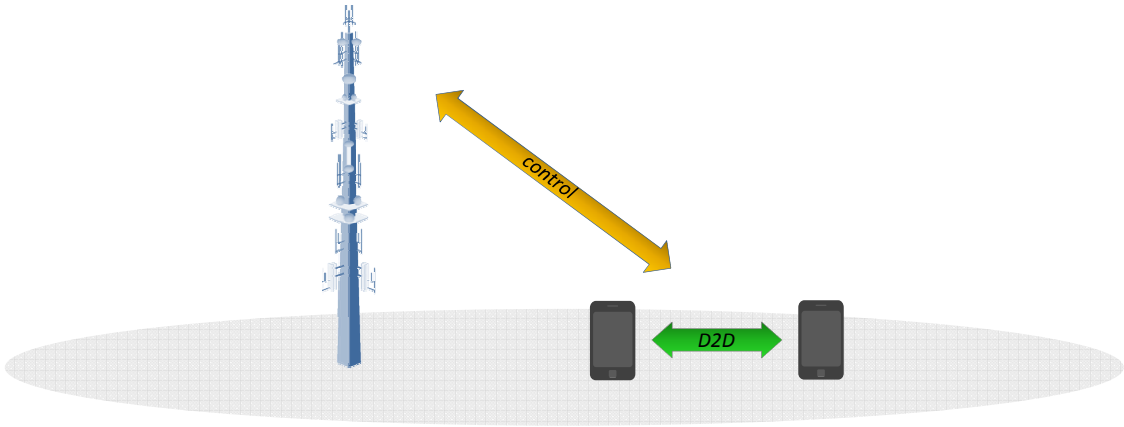
Low-cost and long-range for MTC

- 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†
  - 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

Device-to-device (D2D)

- Goal is to enable proximity services for **Public Safety** (PS) and **Consumer** usecases

- Evaluation of solutions for 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



***D2D** communication under network coverage*

Others

- Group Communication for **Public Safety**†
  - Evaluation of LTE radio interface's suitability for Group Communications, including LTE unicast and eMBMS capabilities
- **eMBMS** measurements†
  - Definition of eMBMS-related measurements to be used for planning purposes and 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

UMTS/HSPA: Rel-12 and beyond

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UMTS/HSPA evolution

From UMTS (Rel-99) to HSPA (Rel-7)

Rel-8 (Dec. '08)
- Dual Carrier-HSDPA
- EUL in FACH (HS-RACH)
- FACH E-DRX mode
- Fast Dormancy
- Enhanced Serving Cell Change
- Basic HNB/CSG support

Rel-9 (Dec. '09)
- Dual Carrier HSUPA
- Dual Band, Dual Carrier, HSDPA
- Enhanced HNB/CSG support

Rel-10 (Mar. '11)
- 3/4 Carrier HSDPA
- Dual band, Dual Carrier, w/ MIMO
- ANR & MDT

Rel-11 (Sep. '12)
- Further enhancements to CELL_FACH
- Multi-flow HSDPA
- UL OLTD and CLTD
- UL MIMO & 64QAM
- Non-contiguous, 4 Carrier, HSDPA

Rel-12 (Jun. '14)

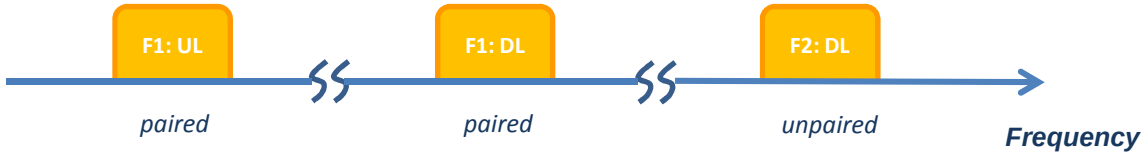
UMTS/HSPA: Rel-12 and beyond (1)

- 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†
    - Combined Cell operations
  - Uplink 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

UMTS/HSPA: Rel-12 and beyond (2)

- Carrier Aggregation advancements
  - Performance requirements definition for Supplemental **DL CA combination**†

FDD example (non-contiguous)



- Utility enhancements
  - Scalable UMTS
    - To enable UMTS operations in channel bandwidths smaller than 5 MHz, e.g. 2.5 MHz
  - 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!

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