3GPP R12 related research and standardization in china

CCSA

2012-11-27

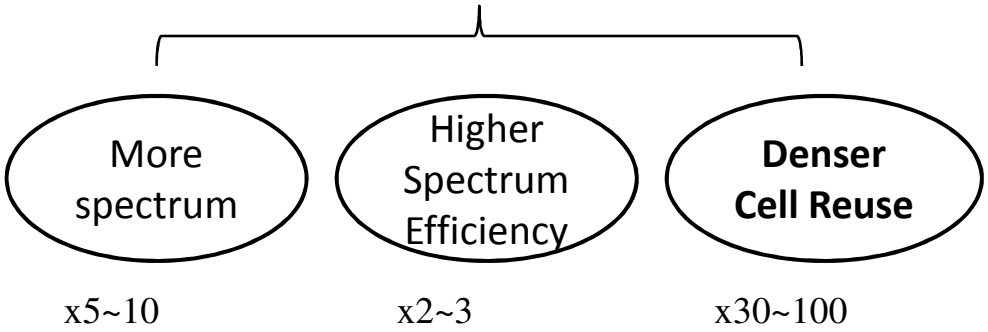
Outline

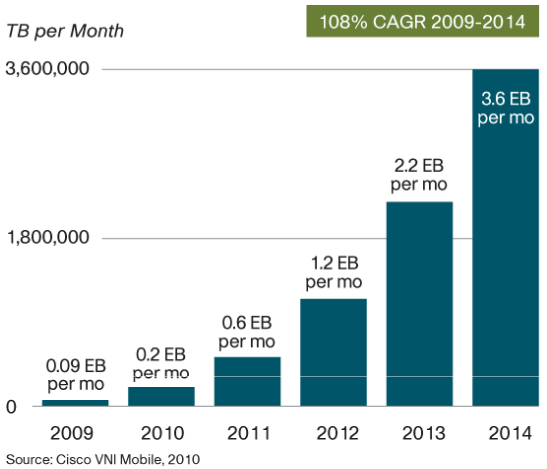
- Challenges and requirements for mobile broadband in the future
- Research in China on potential technologies for LTE R12 standard
- Summary

Mobile Data Traffic Grows Explosively in China

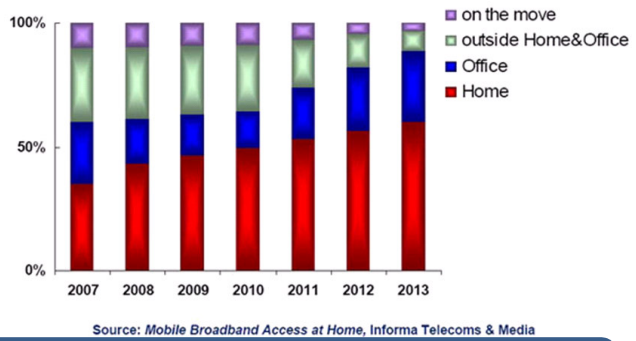
With the growth of mobile internet and smart phone, mobile traffic is increasing dramatically

- double per year
- 40 times in next 5 years
- 1000 times in 2020 compared to 2009





- Currently 70% traffic happens at **home or office**. In near future it will increase to 90% or even more.



Indoor/small cell solution will play an important role in the future

Challenges of LTE-Advanced beyond

Scarce of low spectrum resources

- Most of the spectrum suitable for mobile communications (e.g. <3.0GHz) has been allocated
- Necessity of utilizing higher frequency for future Mobile Broadband(MBB) communication

Machine type of communications

- MTC becomes an essential part of wireless communication systems
- Massive MTC terminal impacts network design and performance

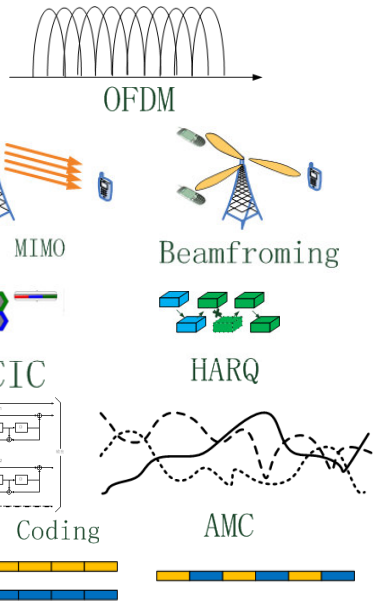
Green ICT

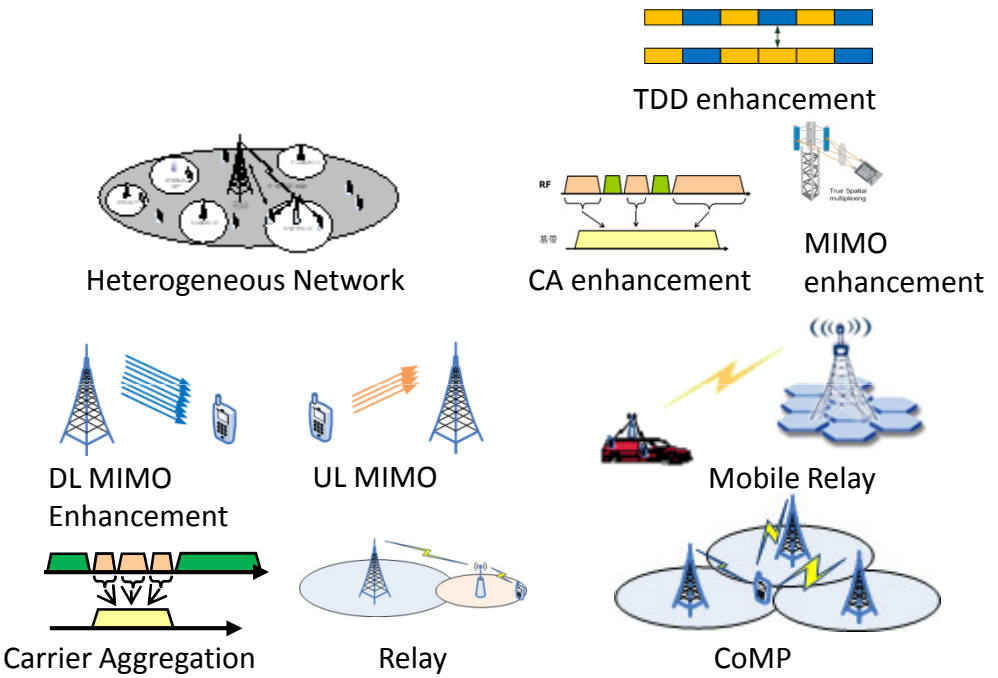
- Reduction of energy consumption for environmental protection and mitigating climate change
- Gaining more attention in various standard bodies

Complicated and high cost deployment scenarios

- Multi-RAT and multi-tier networks
- Advanced SON to reduce network OPEX and CAPEX

3GPP LTE Evolution in the previous version





LTE Rel-8	LTE Rel-9	LTE-A Rel-10	LTE-A Rel-11
LTE Basic Version	LTE Enhanced Version	LTE-A Basic Version	LTE-A Enhanced Version

Standardization targets for Rel-12

Higher capacity to cope with traffic explosion for Mobile Broadband

- Improved spectrum efficiency, in particular for hotspot and indoor scenarios
- Efficient support of Heterogeneous Networks with dense Low Power Node (LPN) deployments
- Exploit more spectrum resource in higher frequency band (e.g. 3.5GHz)

Further enhancements for general network

- Flexible, easy and cost-efficient network operation
- Further improvement on network and UE power efficiency for diverse devices, applications, and services (smart phones, MTC traffic, …)
- Support inter-RAT interworking enhancement for traffic offloading
- Further enhancement on multi-antenna techniques to improve coverage and capacity
- Improve the performance of LTE in high speed scenario
- Energy efficiency improvement

Standardization timeline for Rel-12

Rel-12 timeline

- ***06.2012: 3GPP RAN Plenary workshop***
- ***09.2012: initiate Study and Work item for R12***
- ***06.2014: Functional freeze***
- ***09.2014: ASN.1 freeze***

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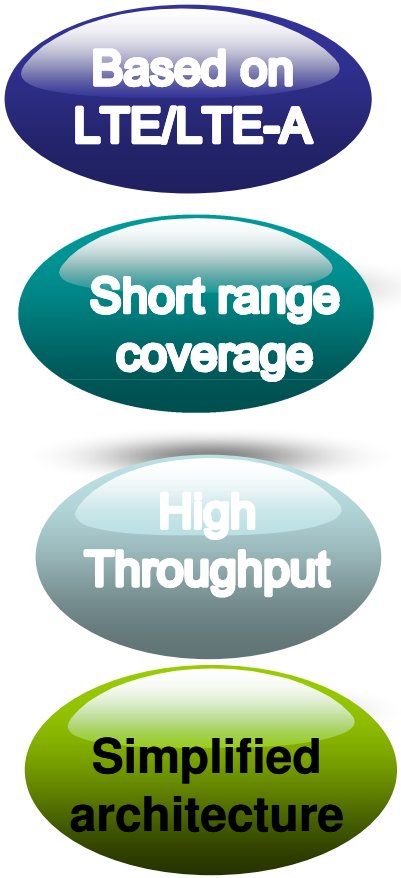
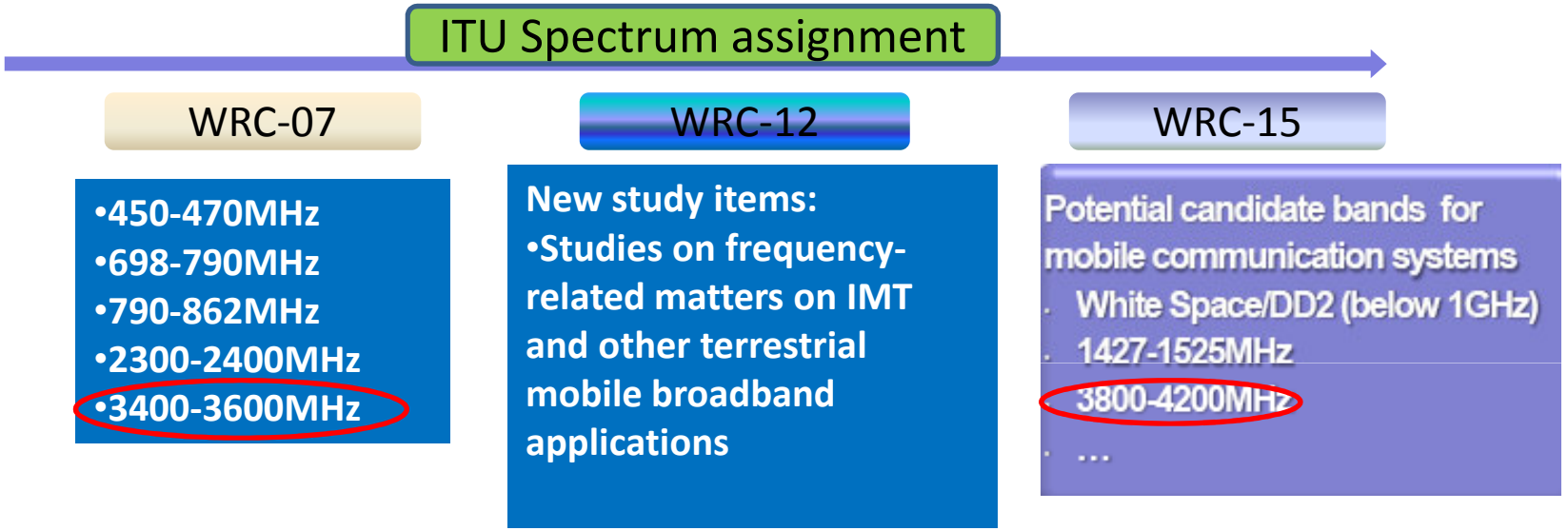
Hotspot and Indoor Enhancements(LTE-Hi)



- Hotspot and Indoor
- Higher frequency
- High bandwidth
- Higher performance
- Satisfying the need of indoor scenario better

Frequency for LTE-Hi



- Short coverage and low mobility in indoor scenario make higher frequency suitable for mobile broadband communication.
- Short coverage and isolation due to wall penetration make frequency reuse feasible.
- Different operating frequencies avoid interference from macro system and ensures QoS.
- The available bandwidth is over 200MHz.

Possible Enhancements for LTE-Hi

PHY Aspect

- New carrier type
- Adaptive TDD and interference management
- New multiple access mode
- Higher order modulation
- Overhead reduction
- Hotspot/indoor MIMO enhancement

Higher Layer Aspects

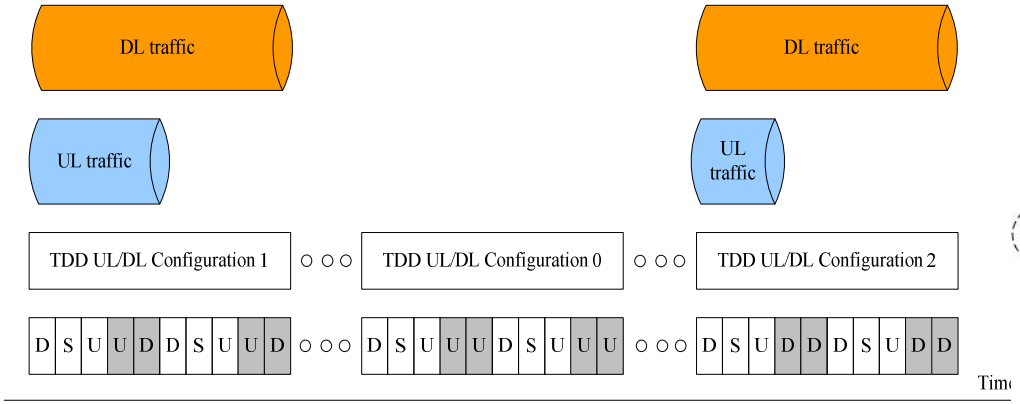
- Signaling and procedure optimization for small cell
- Hetnet mobility enhancement
- SON enhancement for LTE-Hi

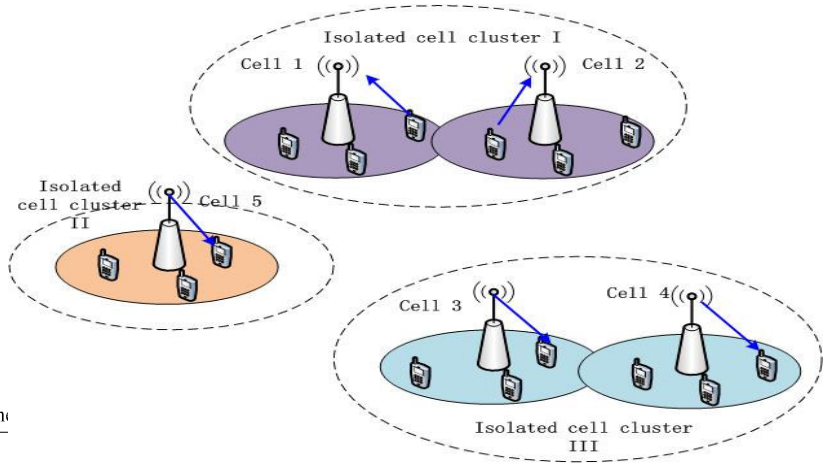
Architecture Aspects

- LIPA/SIPTO enhancement
- Local switch
- Network architecture enhancements

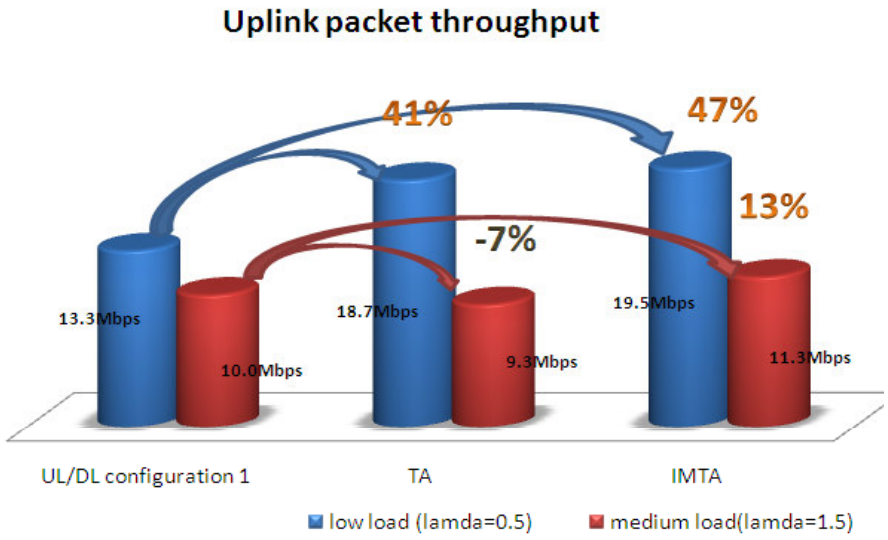
LTE-Hi: Flexible TD-LTE via interference mitigation

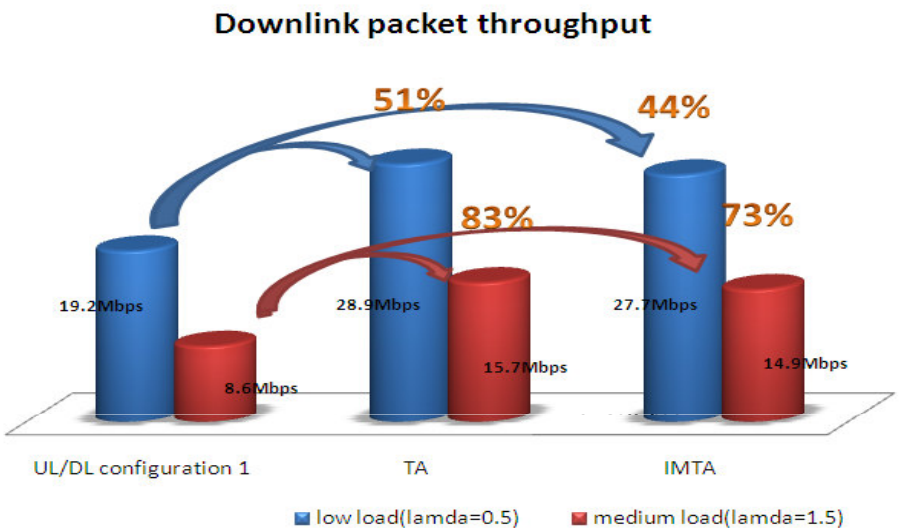
- **TDD UL-DL reconfiguration based on traffic adaptation**
  - More flexible usage of TDD spectrum and energy saving
  - Significant improvement on user packet throughput for hotspot/indoor scenario
- **Interference mitigation schemes in multi-cell TDD networks**
  - Mechanism for interference control
  - Necessary network/UE measurements
  - Necessary procedures and signalings

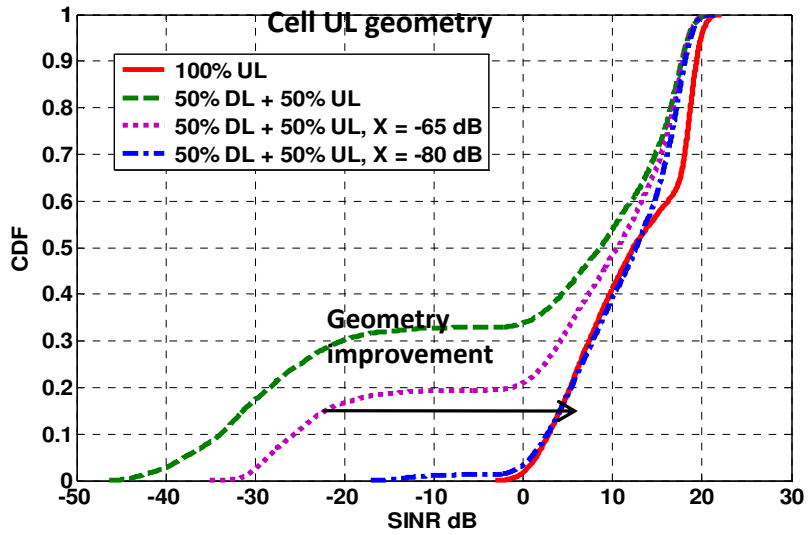




Performance evaluation on Flexible TD-LTE





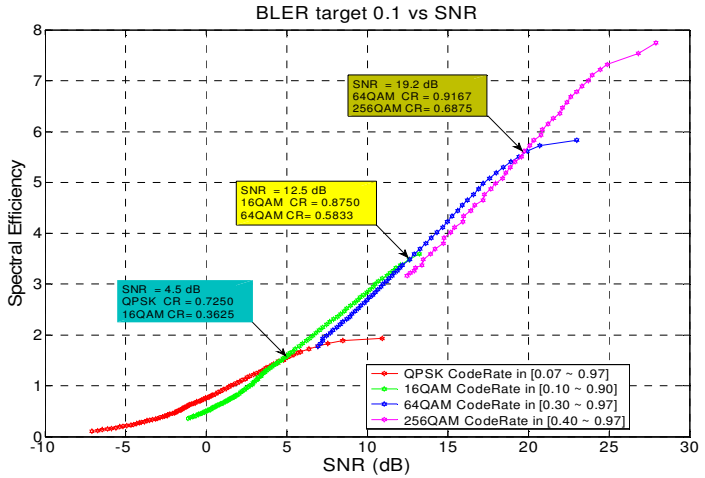


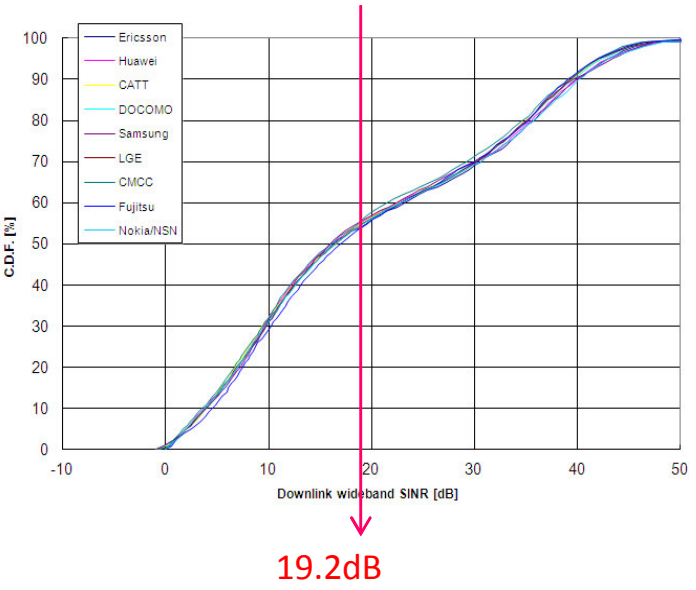
Observations

- Interference management (IM) effectively handles the co-existence interference in dynamic TDD system
- TDD UL-DL reconfiguration based on traffic adaptation (TA) significantly improves DL and UL packet throughput -> Better user experience
- Traffic adaptation with interference management (IMTA) further improves system performance in uplink, especially in medium cell traffic load region

LTE-Hi: Enhanced Spectrum Efficiency

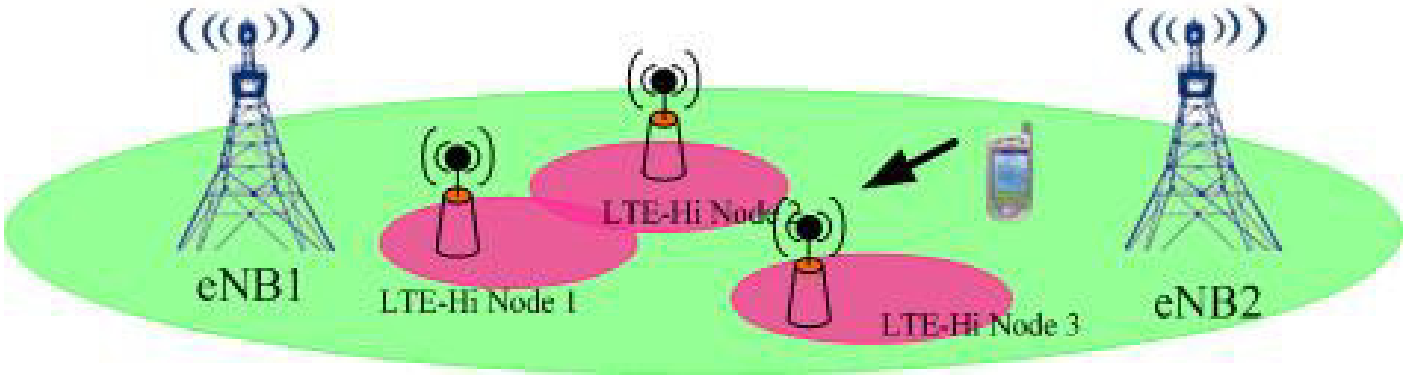
- **Support of higher order modulation up to 256 QAM**
  - Usable SINR range is roughly above 20 dB
  - Up to 40% of terminals may benefit from 256 QAM in indoor scenarios (ITU InHome scenario)
- **Overhead reduction**
  - RS overhead (CRS and DMRS) can be reduced due to low mobility and wider coherence bandwidth in hotspot and indoor environment
  - Control channel overhead can be reduced, e.g. by scheduling over multiple sub-frames
  - Maintain backward compatibility for legacy terminals
  - Expected savings are 10-15%





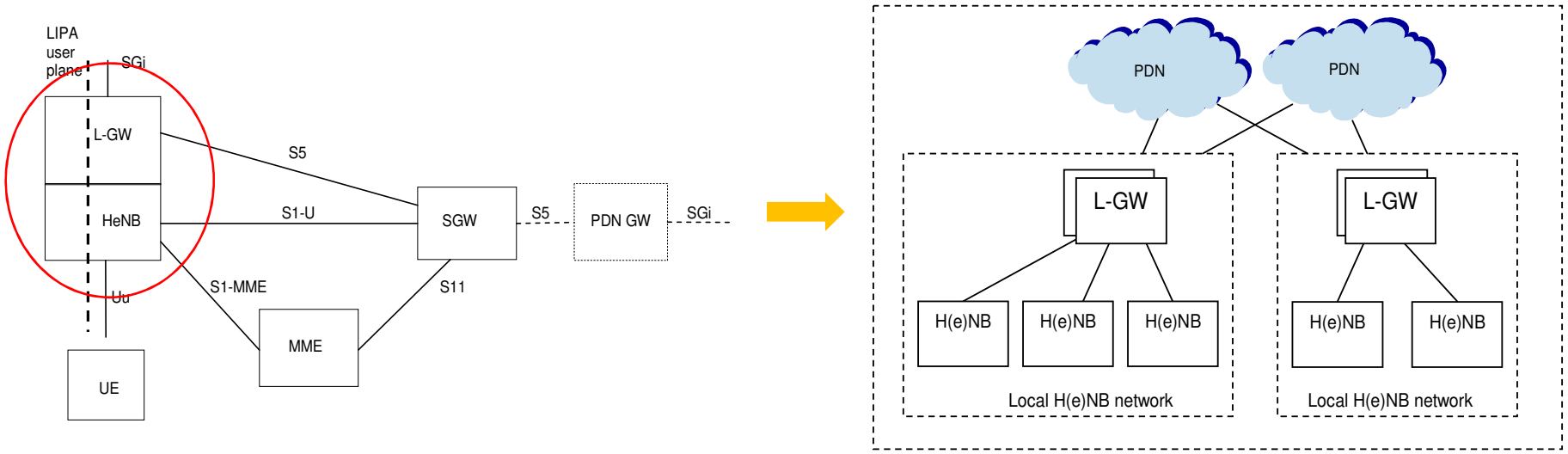
LTE-Hi: High Layer Signaling & Procedure

- **Access Point Discovery and Selection**
  - Small cell access point discovery mechanism
  - Selecting the most appropriate small cell point for UE camping or accessing
  - Discovery signals designing
- **Paging Optimization**
  - Paging optimization based on UE location information
  - Some information, e.g. Last serving cell, could be applied for UE location information



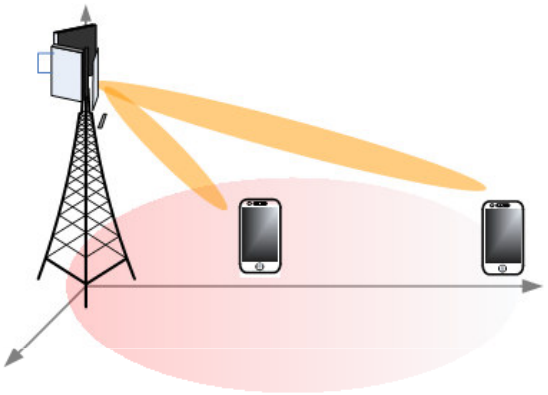
LTE-Hi: Network Architecture

- **LIPA mobility enhancement**
  - In current standard, LIPA only support coexistence of local GW(L-GW) and HeNB. Mobility between different HeNB has not been supported yet.
  - LIPA mobility could be realized by several HeNB sharing one L-GW.

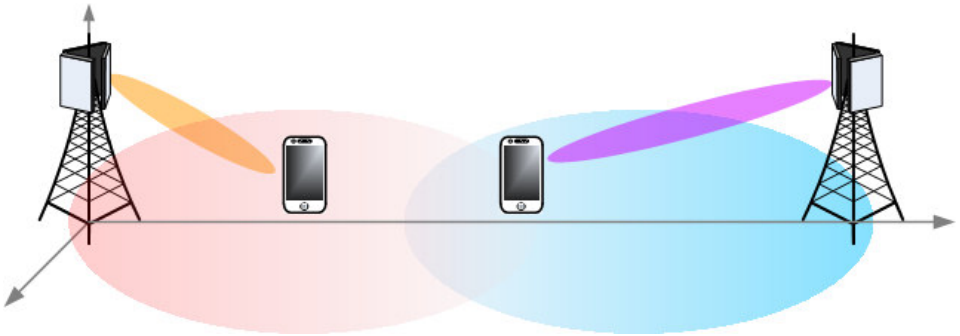


Support of Active Antenna Systems

- **Background**
  - Some initial discussion on 3D beamforming at the beginning of Rel-11 SI on DL MIMO enhancements
  - Rel-11 SI on Study of RF and EMC Requirements for Active Antenna Array System (AAS) Base Station in RAN4



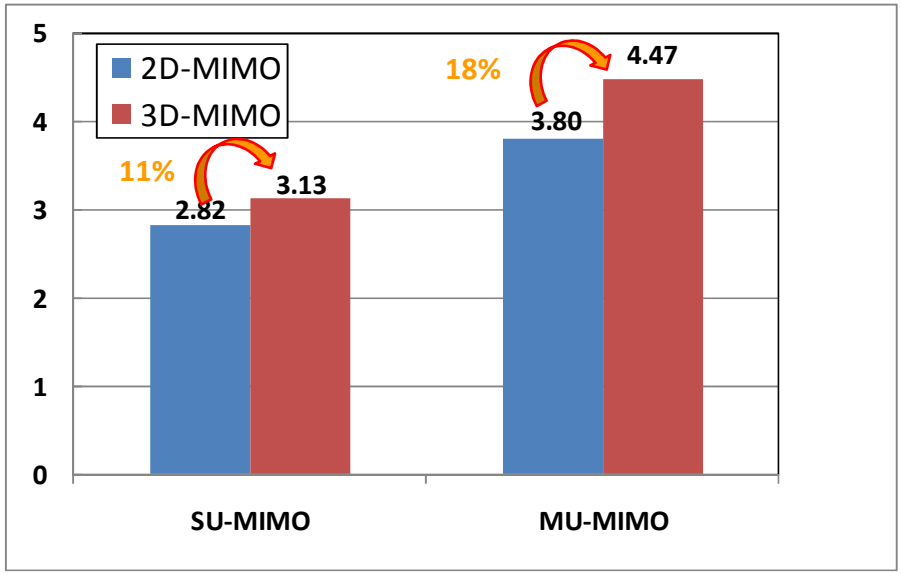
- **Benefits**
  - SNR improved by the UE specific tilt
  - Interference reduction



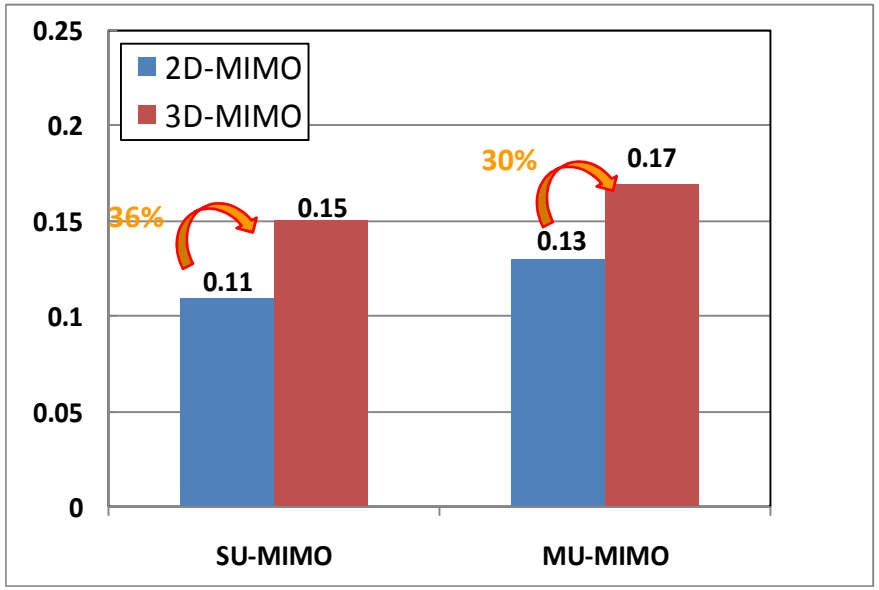
- **standard efforts**
  - 3D Channel modeling
  - 3D performance evaluation
  - 3D codebook design
  - 3D feedback design
  - Reference signals design
  - Control signaling design

Active Antenna Systems-Performance

Cell average SE



Cell edge SE



Initial simulation results of 3D Beamforming for TDD

Simulation assumptions:

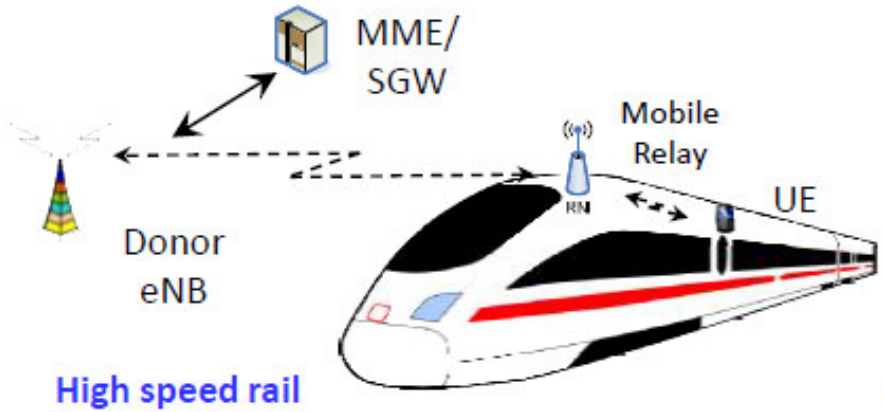
- Channel model:
  - 2D: ITU Uma
  - 3D: 3D-extension based on ITU model
- Precoding & CSI feedback: Ideal
- Antenna configuration (x-pol):
  - ENb: 4Tx for 2D-Beamforming / AAS array with16 ports for 3D-Beamforming
  - UE: 2Rx

Machine Type Communications enhancements

- **Low cost MTC UEs based on LTE**
  - Continuation of Rel-11 study on cost reduction
  - Low bit-rate UE category for MTC
  - Coverage enhancement for MTC UEs
- **Network optimization for MTC in R12**
  - Small Data and Device Triggering Enhancements
    - ✓ minimizing the RRC signalling overhead
    - ✓ Introducing the support of short-lived connections / connectionless approaches
  - UE Power Consumptions Optimizations
  - Support of group-based MTC application
  - Co-work with SA2 for MTC enhancements

Support of Mobile Relay

- **Scenario and background**
  - Fast development of high speed trains in some countries provides potential requirements for mobile relay deployment
  - Rel-10 WI on relay targeting for stationary relay
  - Rel-11 SI on mobile relay targeting for high speed environments
- **Challenges**
  - Seamless handover is important for user experience in high speed scenario

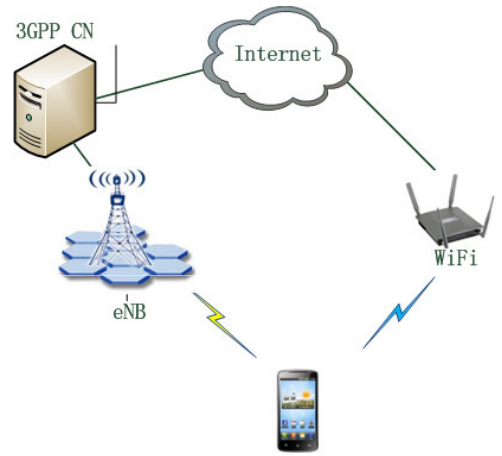


Standardization of Mobile Relay

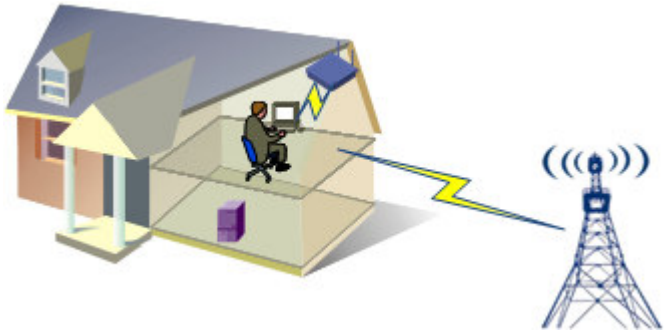
- **Mobile Relay enhancement**
  - Design of mobile relay architecture
  - Mobility optimization
  - Link re-establishment
  - Terminal access optimization
  - Carrier aggregation on Relay backhaul

LTE-WLAN interworking enhancement

- **Motivation**
  - RAN level enhancements for WLAN interworking
  - Cellular network traffic offloading for operator
  - efficient WLAN utilization
  - Improve user experience

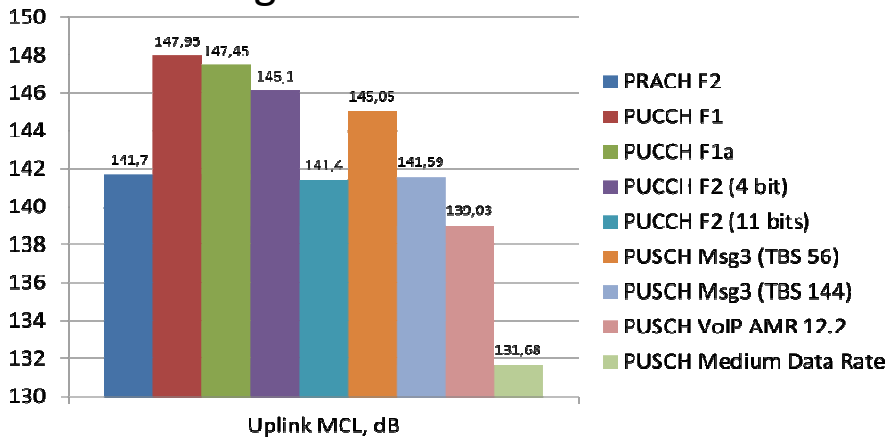


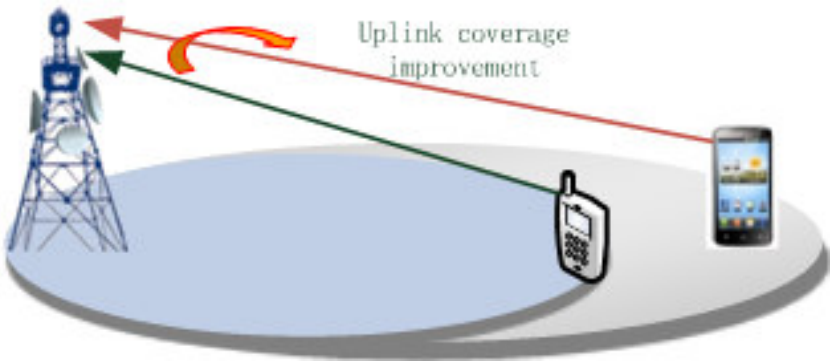
- **standard efforts**
  - Identification scenarios and mechanism of interworking
  - Appropriate WLAN AP discovery mechanism
  - Network selection strategy
  - Efficient RRM utilization of network
  - Signalling enhancements



Coverage enhancement for LTE

- **Motivation**
  - Coverage balance issues between control and data channels, link directions for LTE have been identified in R11
  - Several potential solutions have been provided to improve coverage for medium data rate PUSCH and uplink VoIP in R11
  - The continued work is expected in Rel-12 based on Rel-11 study
- **standard efforts**
  - Specify TTI bundling enhancements to improve coverage for medium data rate PUSCH and uplink VoIP
  - Investigating the possibility of TTI bundling extended to more TDD UL-DL configurations





Technical enhancement for simplifying network operation

- **Hetnet SON enhancement**
  - Extending current SON features to low power nodes, e.g. Pico/Relay/HeNB
- **MDT enhancement**
  - Continuation of QoS verification, e.g. Measurement of latency & Packet loss rate
  - Location information: improve availability and accuracy of location information
- **Energy saving**
  - Continuation of R11, e.g. non-overlapping energy saving scenario

Summary

- With the explosive growth of data services, performance optimization for hotspot/indoor deployment, particularly its application in higher frequency bands, becomes the core task of LTE Rel-12 and beyond

- Rel-12 shall focus on technical enhancements including LTE-Hi, 3D Beamforming, MTC, Mobile Relay, Coverage enhancement, MDT, SON, Energy saving, LTE and WLAN interworking.