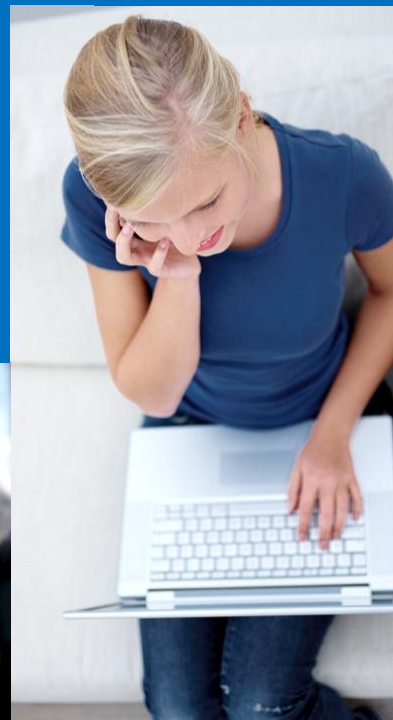




# Future Mobile Standardization

3 Dec 2012

Sungho Choi, Ph.D.  
Samsung Electronics  
3GP SA Plenary Vice Chairman



# Ongoing LTE Commercialization

- **351 Operators in 104 Countries** are investing in LTE
- **105 LTE Commercial LTE Networks Launched in 48 Countries**

## 351 operators in 104 countries are investing in LTE

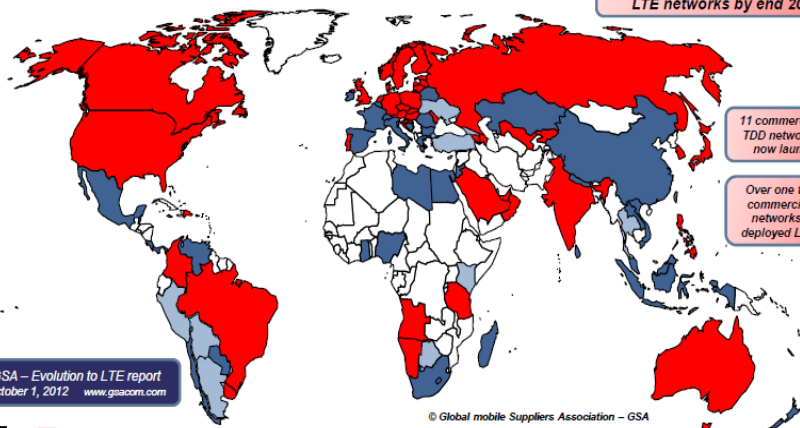
- 299 commercial LTE network commitments in 93 countries
- 52 pre-commitment trials in additional 11 countries
- 105 commercial LTE networks launched in 48 countries



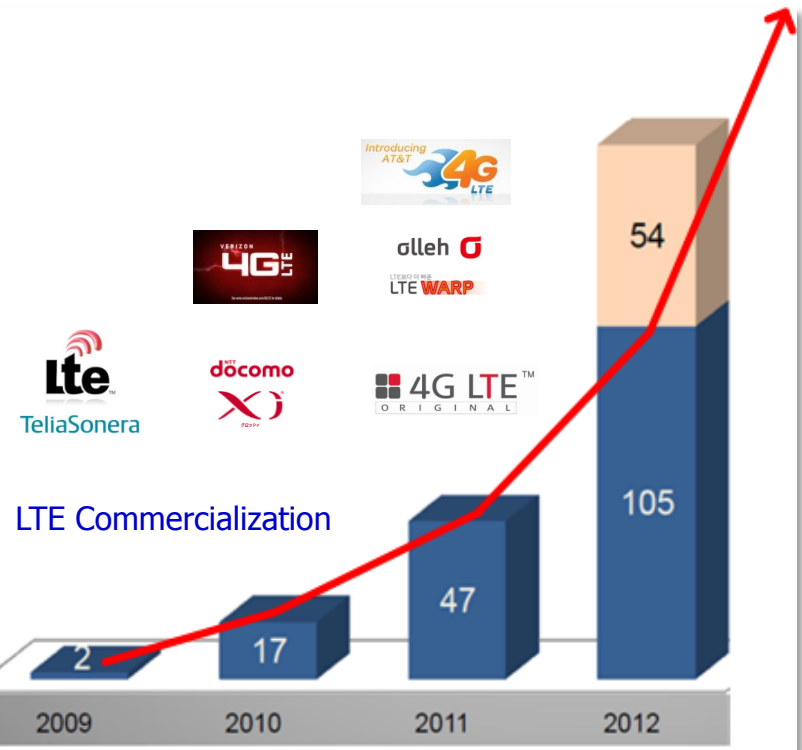
GSA forecasts 159 commercial LTE networks by end 2012

11 commercial LTE TDD networks are now launched

Over one third of commercial LTE networks have deployed LTE1800



GSA – Evolution to LTE report  
October 1, 2012 www.gsa.com

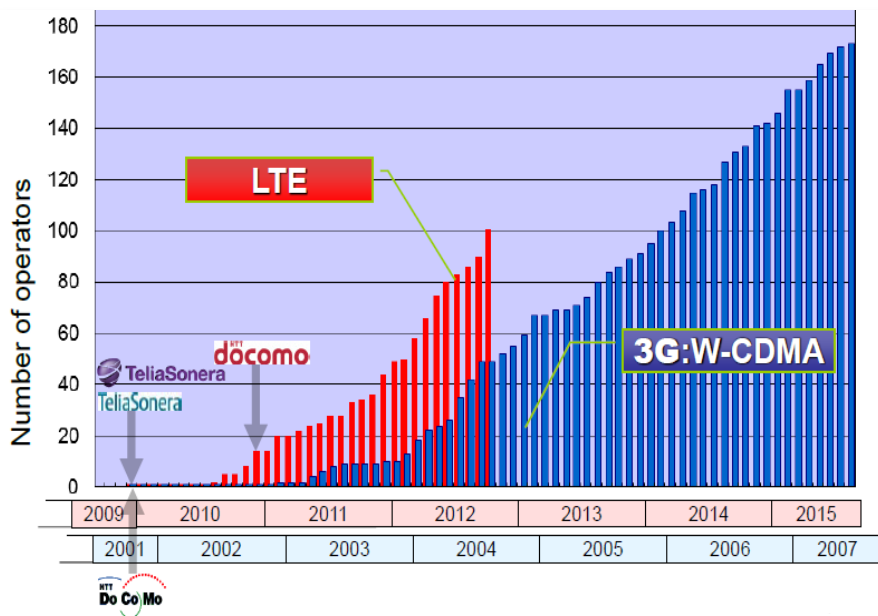


[Source: GSA, Global Mobile Suppliers Alliance, 2012.10]

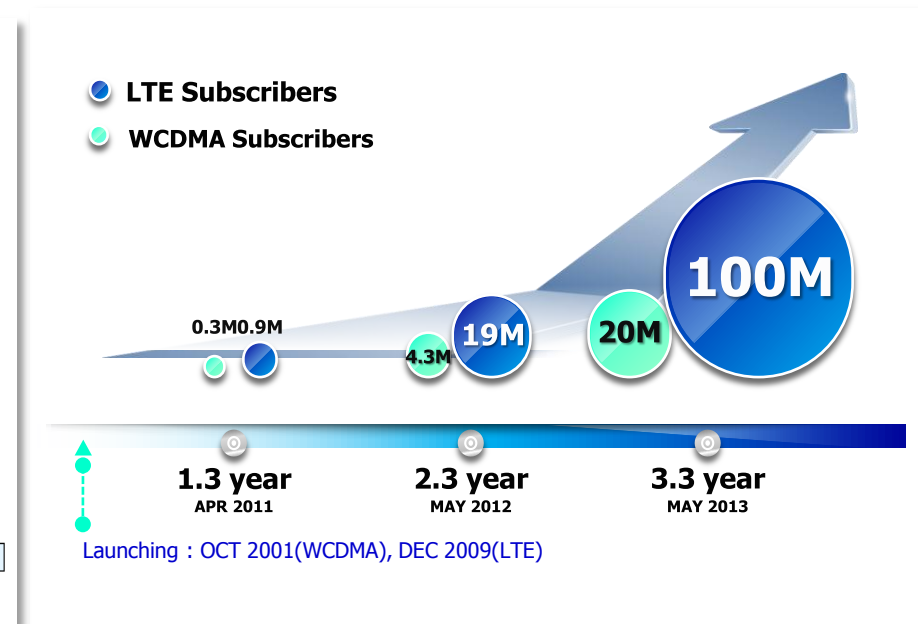
[Source: GSA, Global Mobile Suppliers Alliance, 2012.10]

# LTE: Fast Market Growth

- **100 LTE Commercial Launches within 3 years of the first launch**
  - WCDMA took longer than 4 year for 100 commercial launches
- **100M LTE Subscribers within 3.3 year expected**



[Source: DoCoMo, 2012.11]

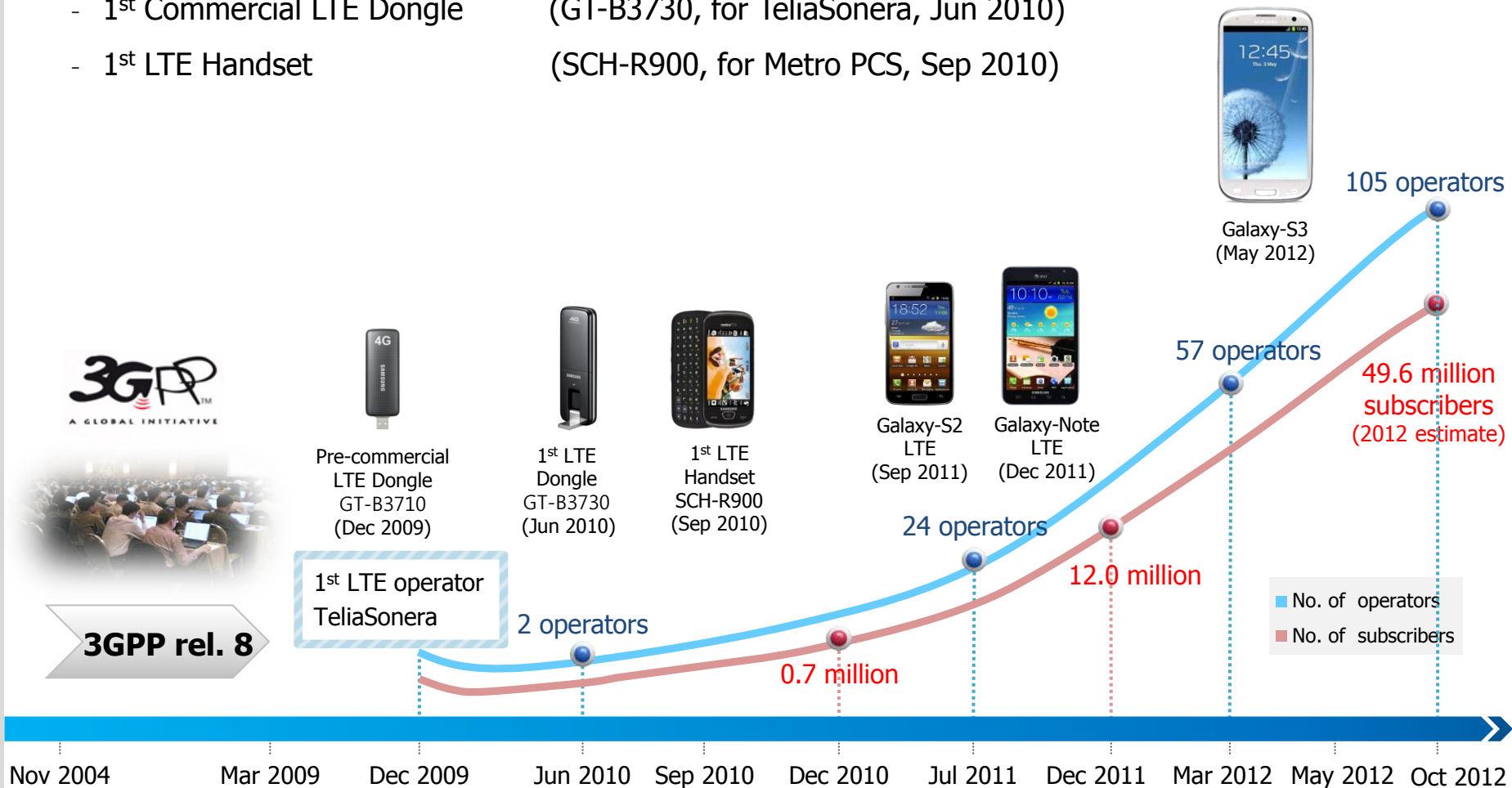


[Source: Samsung, 4G World Key Note Speech, 2012.10]

# Samsung's Contribution to LTE

## ▪ Timely LTE devices for early market development

- 1<sup>st</sup> Pre-Commercial LTE Dongle (GT-B3710, for TeliaSonera, Dec 2009)
- 1<sup>st</sup> Commercial LTE Dongle (GT-B3730, for TeliaSonera, Jun 2010)
- 1<sup>st</sup> LTE Handset (SCH-R900, for Metro PCS, Sep 2010)



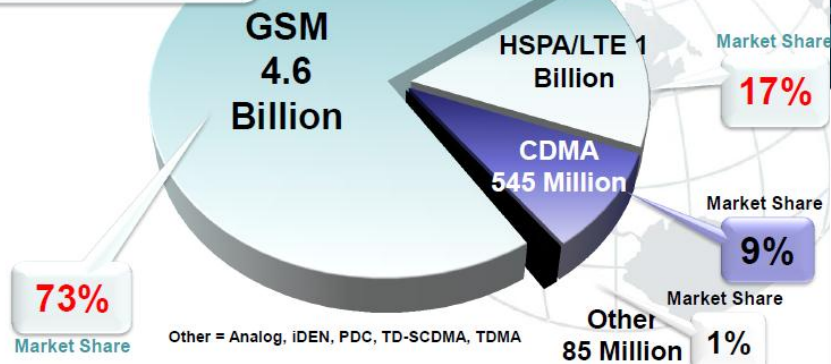
# 3GPP Technologies

- 3GPP has developed GSM, UMTS, HSPA and LTE standards
- WCDMA/HSPA is known as 3G, LTE/LTE-A is known as 4G mobile technologies

## Global Wireless Landscape Q2 2012

6.3 Billion Total Mobile Connections

3GPP Technologies  
5.6 Billion = 90%



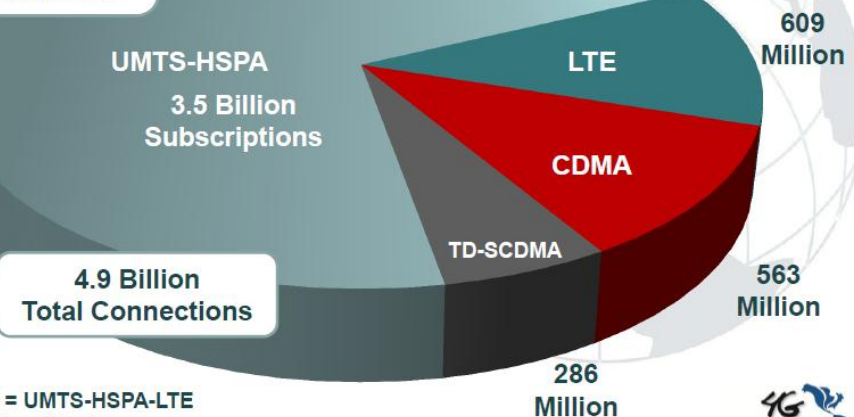
Source: Informa Telecoms & Media, WCIS+, June 2012

www.4gamericas.org

[Source: PCG29\_15, 4G America, 2012.10]

## Mobile Broadband Market Share 2016

3GPP = 84%  
3GPP2 = 11%  
TD-SCDMA = 5%  
WiMAX = <1%



3GPP = UMTS-HSPA-LTE  
3GPP2 = EV-DO

Source: Informa Telecoms & Media, Subscription Forecast Tool, Dec 2011

4G  
americas  
www.4GAmericas.org

[Source: PCG29\_15, 4G America, 2012.10]

# 3GPP as the global standards body

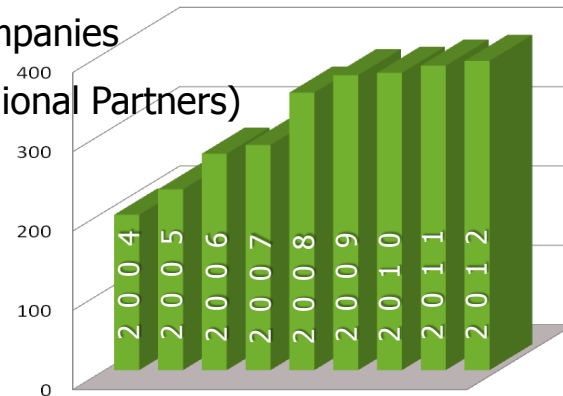
## ▪ 3GPP is a Partnership Project

- 6 Regional standards organizations and 13 Market representing partners
- 390 individual member companies from 39 countries



6 Organizational Partners

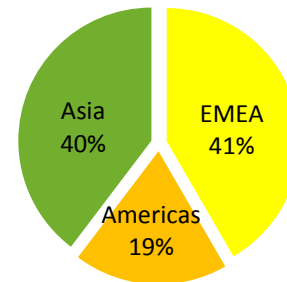
390 Companies  
(via Regional Partners)



13 Market Representative Partners

39 Countries

Participation by Region

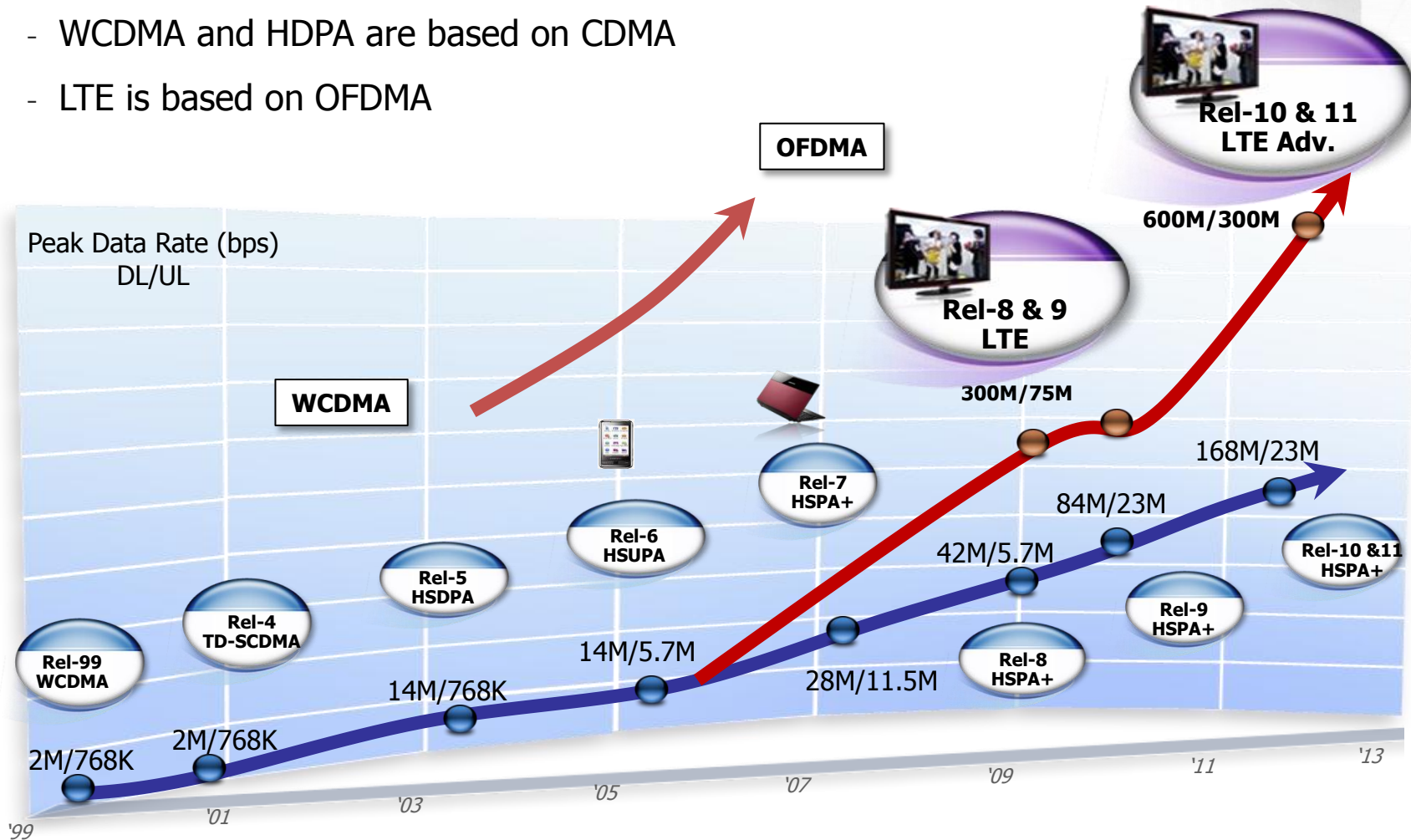


June 2012

# 3GPP Technology Roadmap

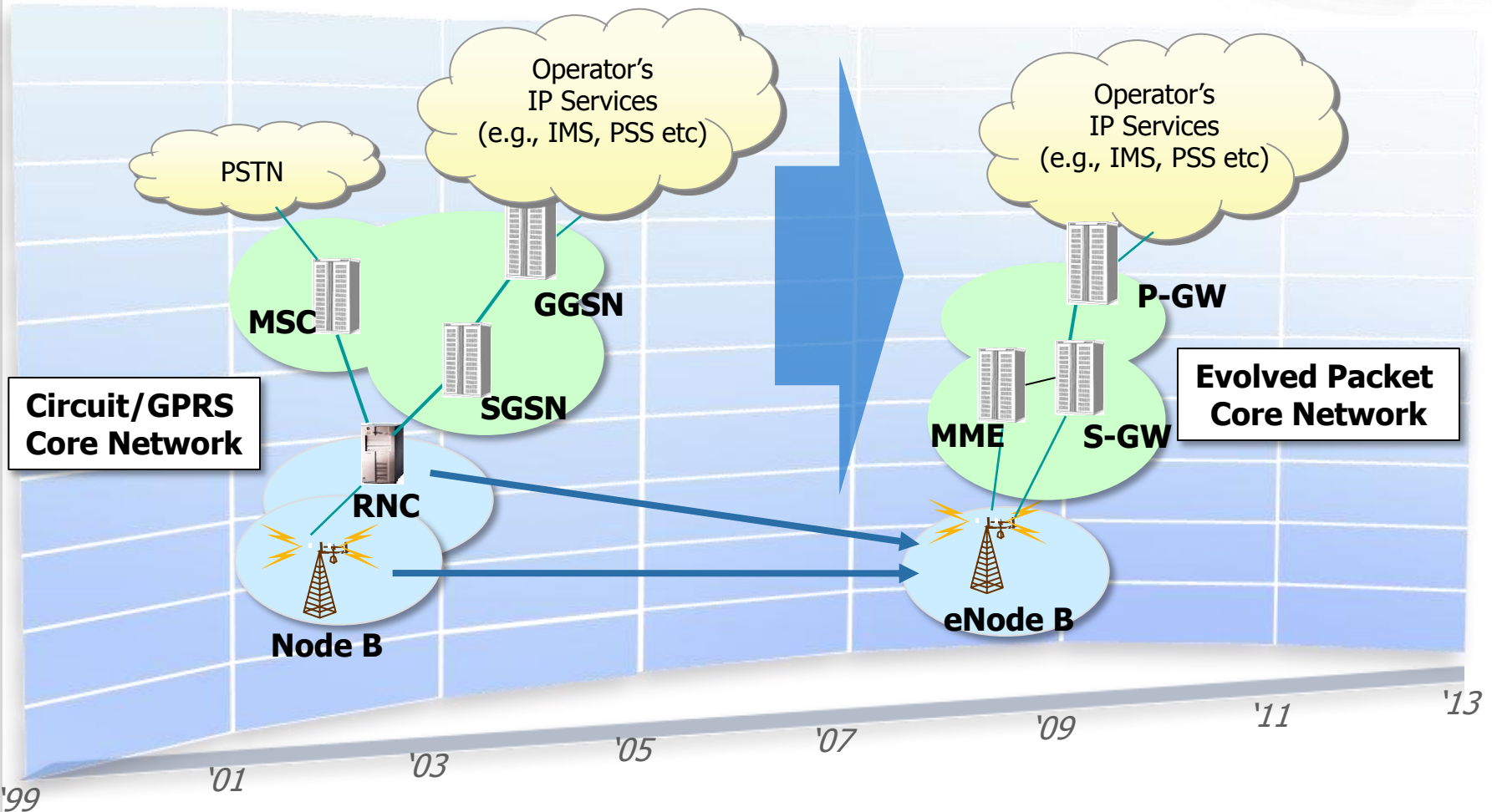
## 3GPP technologies are based on CDMA and OFDMA technologies

- WCDMA and HSPA are based on CDMA
- LTE is based on OFDMA



# 3GPP Core Network Evolution

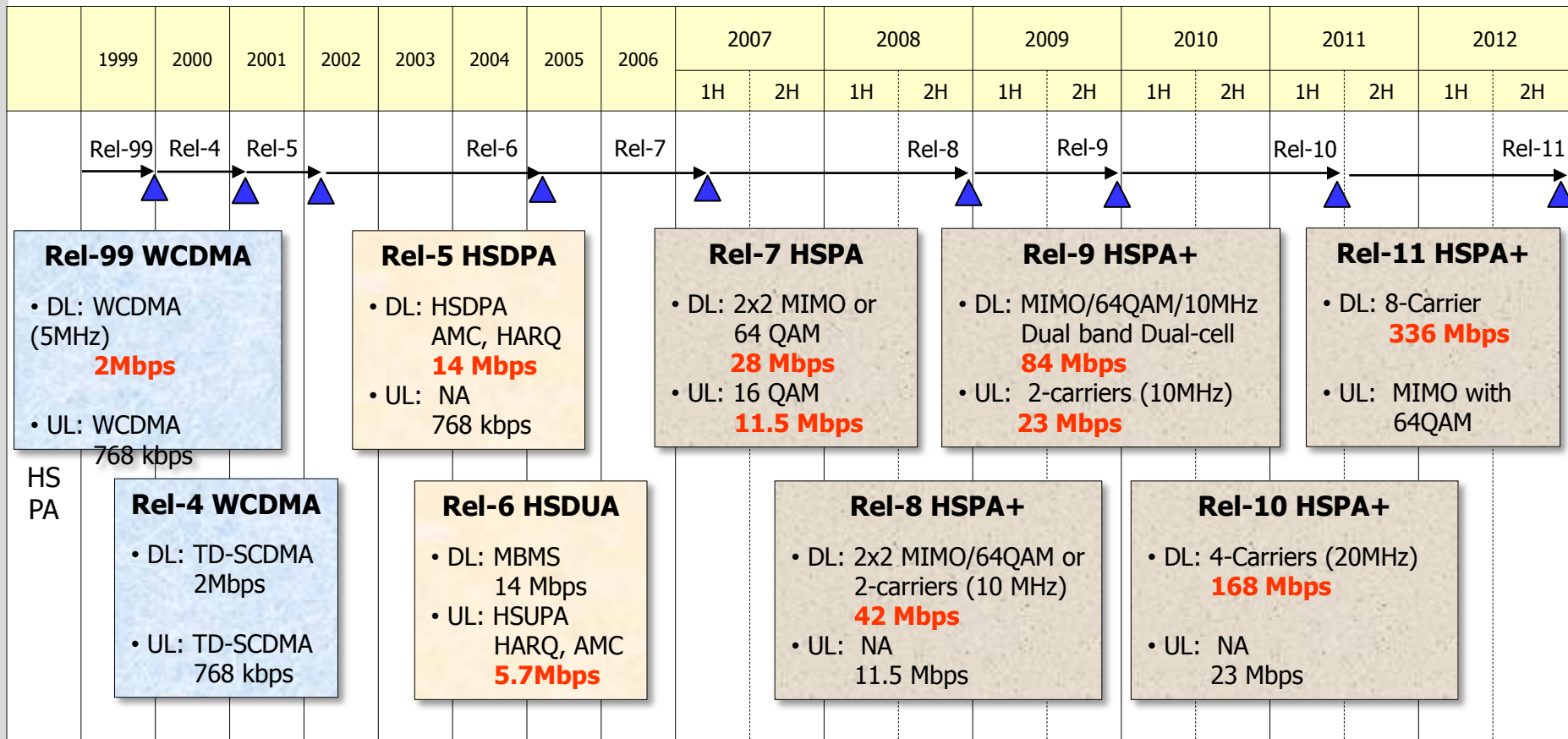
- 3GPP Network has evolved from 4 tier architecture to 3 tier architecture





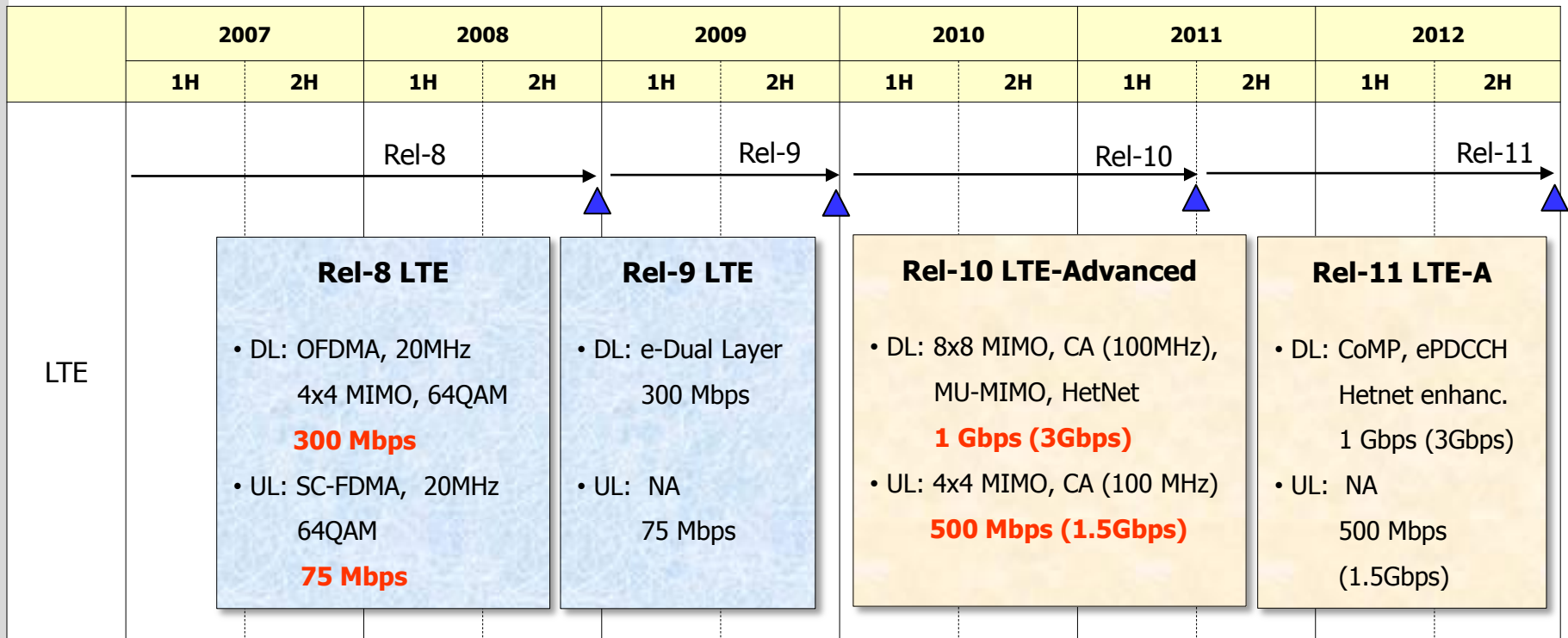
# 3GPP WCDMA/HSPA Evolution

- **AMC and HARQ are the key technologies for HSDPA & HSUPA**
- **MIMO, 64 QAM and multi-carrier are the key technologies for HSPA & HSPA+**



# 3GPP LTE Evolution

- For Rel-8/9 LTE, OFDMA and 4x4 MIMO/64 QAM enables high peak data rate
- For Rel-10 LTE-A, 8x8 MIMO and Carrier Aggregation are the key technologies
- For Rel-11 LTE-A, CoMP improves cell capacity rather than peak data rate



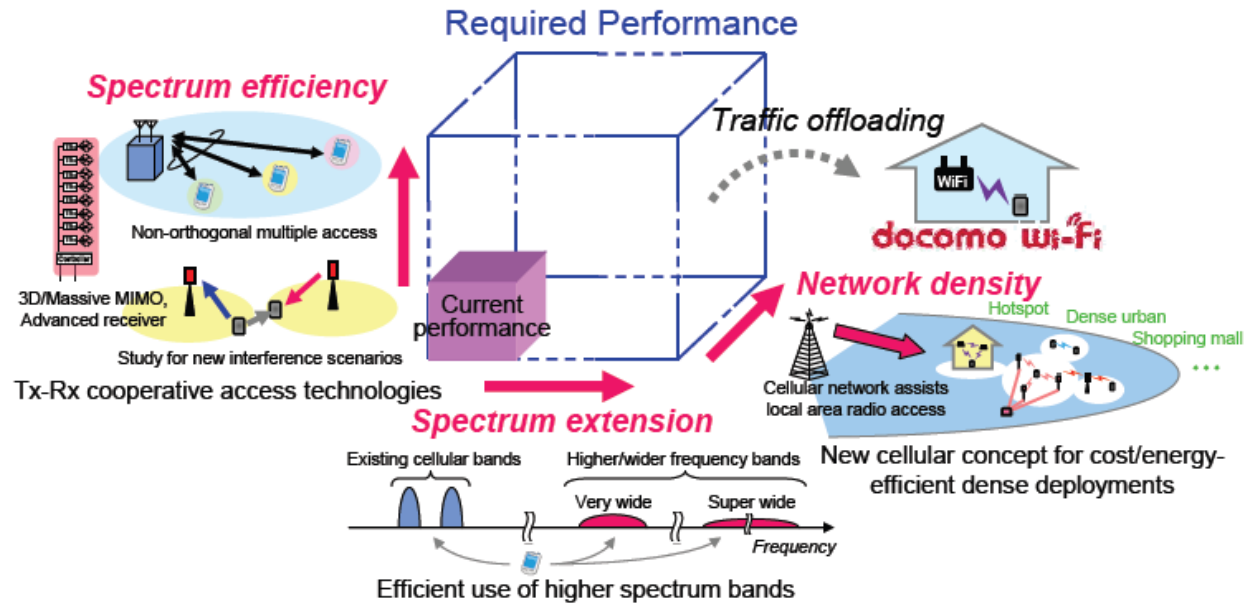
CA: Carrier Aggregation, CoMP: Coordinated Multi-Point Operation

# Direction of Evolution

- Peak data rate is not the main goal for the evolution

## Directions of evolution: "The Cube" <sup>NTT</sup> docomo

A set of radio access technologies is required to satisfy future requirements



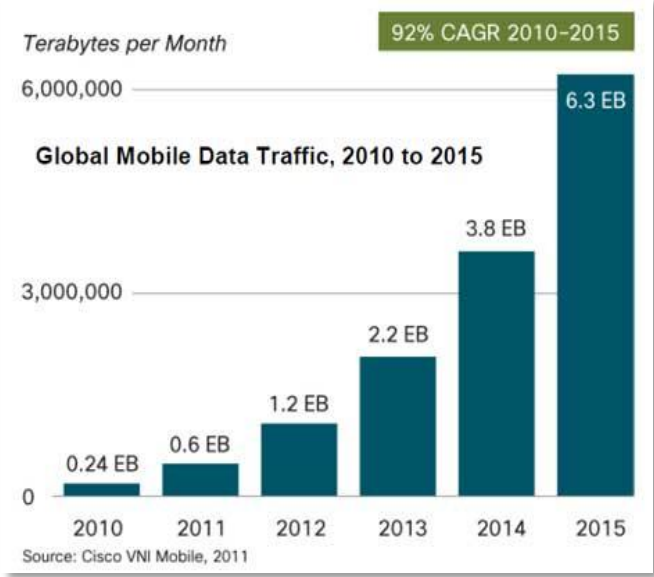
NTT DOCOMO, INC., Copyright 2012, All rights reserved.

12

[Source: DOCOMO, RWS-120010, 3GPP RAN Workshop, 2012.6

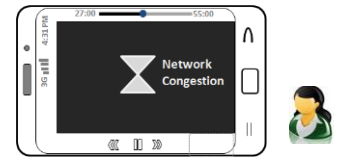
# Main Challenges for the Future

- **User QoE decrease and operator cost increase due to mobile traffic growth**
- **Operator revenue growth slows**



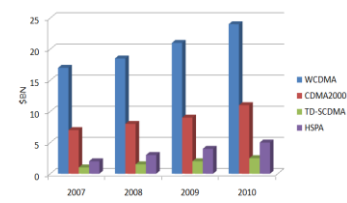
## 1 QoE Decrease

Users experience network congestions

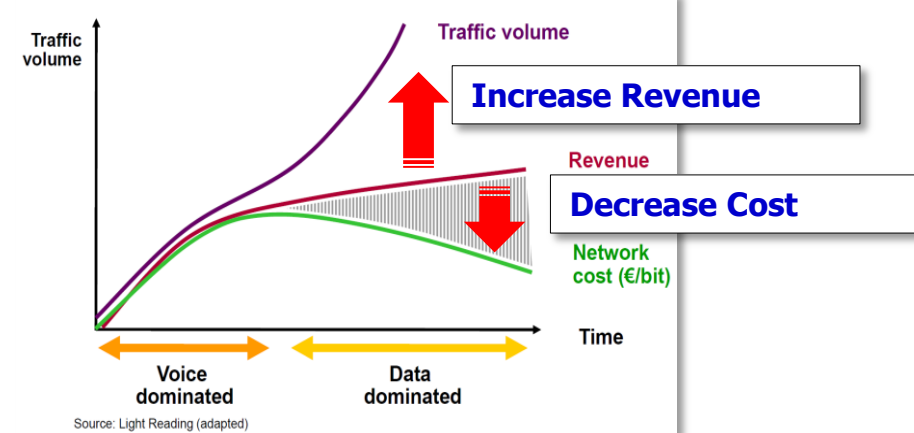


## 2 COST Increase

CAPEX Increase  
OPEX Increase



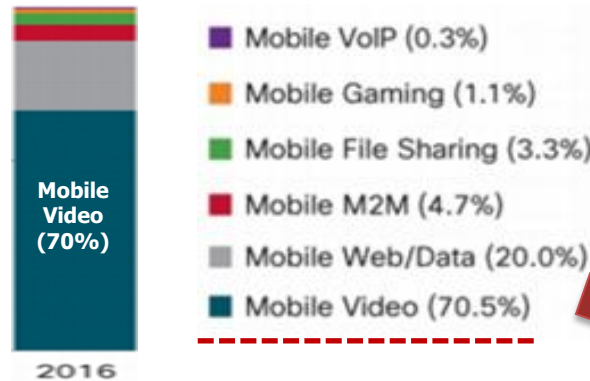
## 3 Revenue decoupling



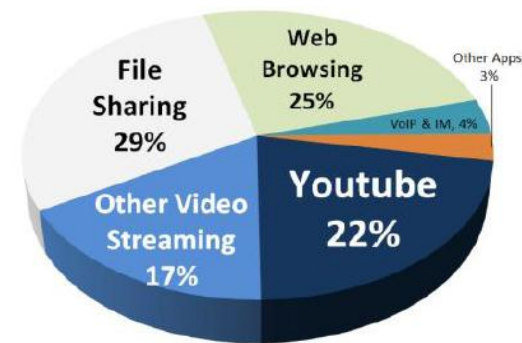
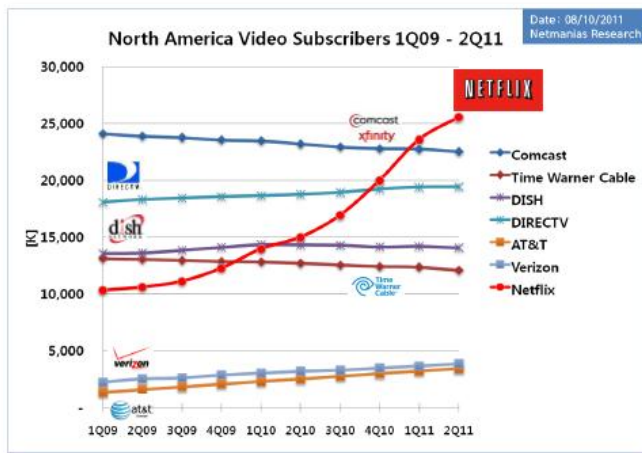
# Mobile Traffic

- Major contribution to Mobile Traffic is from Video contents
- OTT providers are consuming the mobile video

OTT: Over-The-Top



*Who is using this?*



2011 Global Mobile Data BW Usage [Source: Allot Communication 2011]

# 3GPP RAN Workshop in June

- **TSG-RAN WS on Release 12 Onward, June 11-12, 2012 in Ljubljana, Slovenia**
  - 250 participants, 43 presentations

**LTE-WLAN Interworking - RAN Enhancements**

Concept of Rel-12 onward evolution **docomo**

LTE Rel-12 onward should integrate technologies for enhanced Local Area (eLA)

**LOCAL-AREA ACCESS**

Stand-alone nodes necessary in coverage holes...

**Full Dimension MIMO (FD-MIMO) System**

Solution for capacity demand Full Dimension MIMO with 2D AAS (Active Antenna System)

- MU-MIMO with 10s of UEs
- 2D AAS array & 100 antennas
- 3D-SCM channel

Benefit

3-5x  
10x

Rel-10 Rel-12

3GPP Workshop on Release 12 Onward  
Ljubljana, Slovenia, June 11 - 12, 2012

RWS-120045

**3GPP**  
A GLOBAL INITIATIVE

## Summary of 3GPP TSG-RAN Workshop on Release 12 and Onward

TSG-RAN Chairman

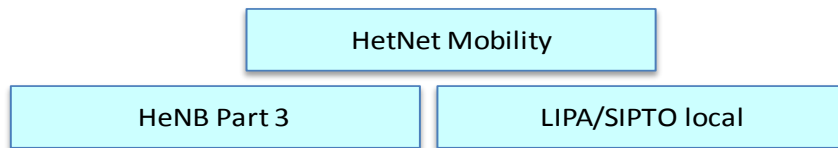


# Potential Rel-12/13 RAN WI/SI

## Rel-11 Enhancements (15)

## New Technologies (15)

### Small cells (7)



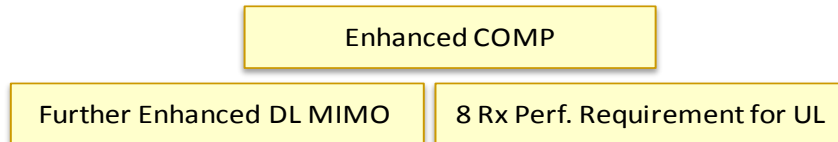
### Small cell requirements (Study Item)

Small cell enh: L1 (SI)

Small cell enh: higher layer (SI)

UL CA enhancements

### Enhanced antenna techniques (5)



### 3D-channel model (SI)

Elevation Beamforming (SI)

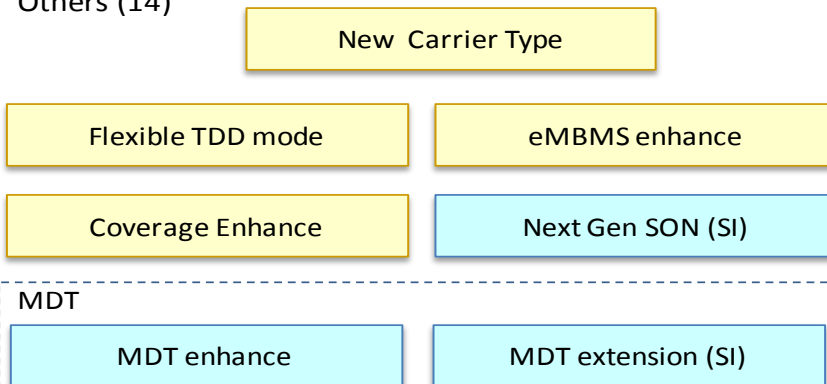
Full-Dimension MIMO (SI)

### Small data transport enhancements (3)



MTC enhancements

### Others (14)



D2D proximity discovery (SI)

### Enhanced rcv

Further Enhanced rcvrs (SI)

Enh Interference Suppression (SI)

### LTE+UMTS

UMTS/LTE Aggregate (SI)

LTE/UMTS lwk (SI)

3GPP/WIFI integration (SI)

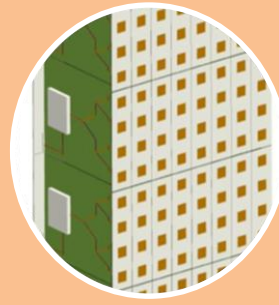
Push To Talk (SI)

# Three Categories Rel-12 & 13 Features



## Enhanced Small Cell

- ✓ Frequency separation btw macro and small cells with higher freq. band, **e.g. 3.5 GHz**
- ✓ **Inter site CA**
- ✓ Enhanced discovery / mobility
- ✓ Interference management
- ✓ Dynamic TDD



## Multi-antenna/site technologies

- ✓ **Inter-eNB CoMP**
- ✓ 3D channel model
- ✓ Vertical beamforming
- ✓ **FD-MIMO**
- ✓ Enhanced MU-MIMO



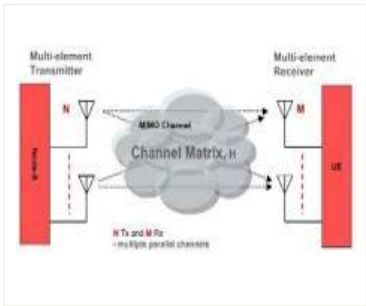
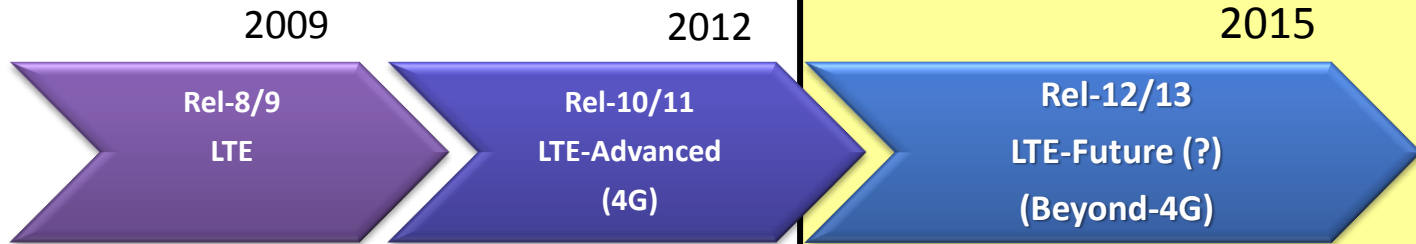
## Energy efficient communication

- ✓ **Diverse traffic type support**
- ✓ Machine Type Comm
- ✓ New Carrier Type
- ✓ VoLTE enhancement
- ✓ MDT/SON enhancement

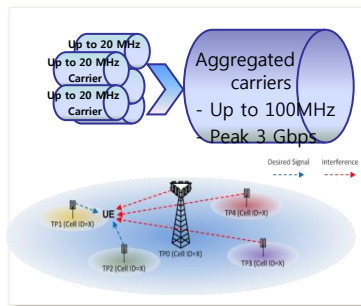
**Rel-12 & 13 (LTE-Beyond 4G)**



# Key Features of Rel-12 & 13



- 20MHz, OFDM
- SC-FDMA
- DL 4x4 MIMO
- SON, HeNB



- Carrier aggregation
- UL 4x4 MIMO
- DL/UL COMP
- HetNet

2015

**Rel-12/13**  
LTE-Future (?)  
(Beyond-4G)

1. Small Cell Enhancement
2. CoMP enhancement
3. FD-MIMO
4. Diverse Traffic support



# 1. Small Cell Enhancement

- High frequency band (> 3GHz) targeted for small cell enhancement
- Inter eNB Carrier Aggregation is a key solution



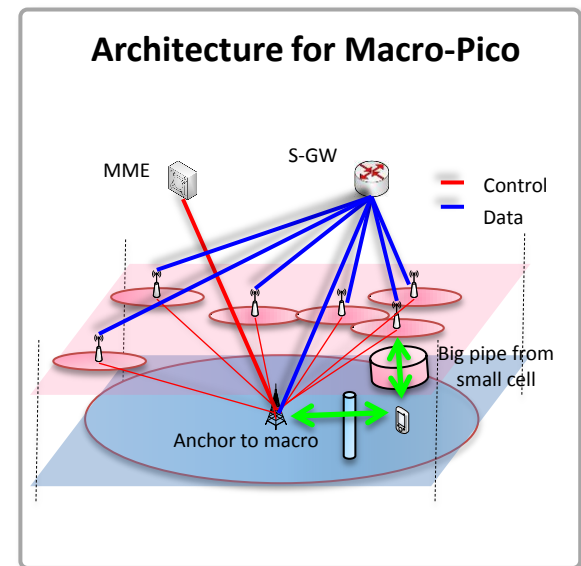
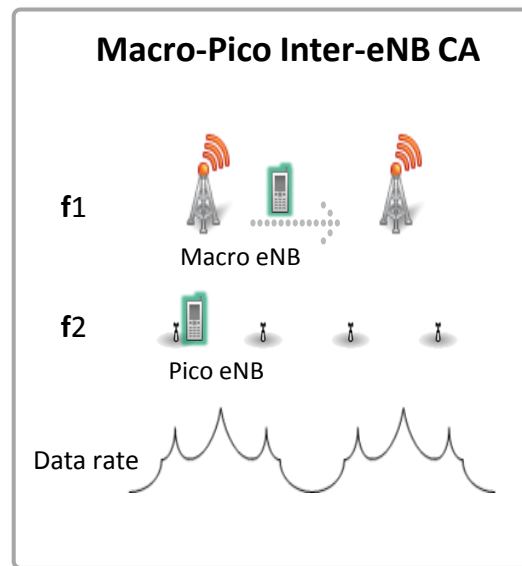
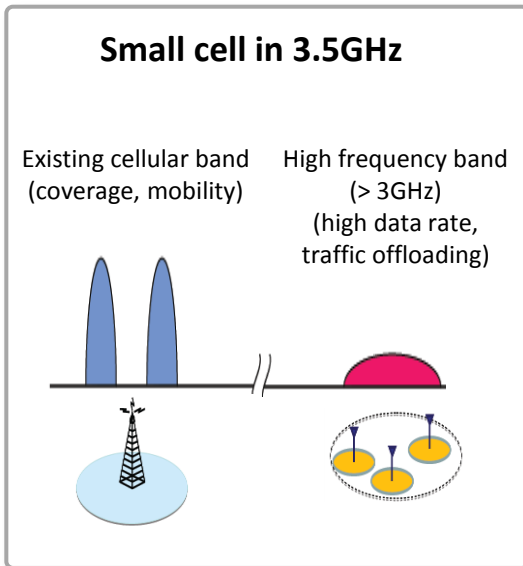
E-UTRA Band	UL (MHz)	DL (MHz)	Duplex Mode
22	3410 – 3490	3510 – 3590	FDD
42	3400 – 3600	3400 – 3600	TDD
43	3600 – 3800	3600 – 3800	TDD

➔

200MHz  
band width

## Issues in Small Cell Enhancement

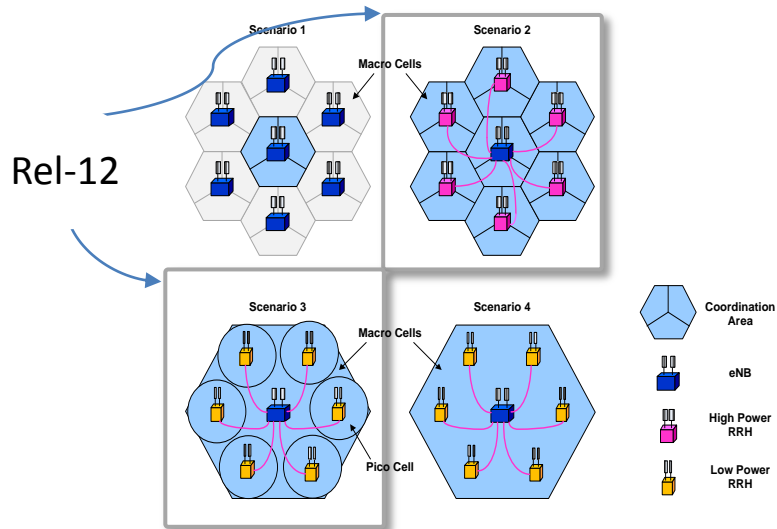
- Overhead due to frequent cell change
- Inter-frequency mobility
- Power consumption due to cell discovery
- Need to consider non-ideal backhaul



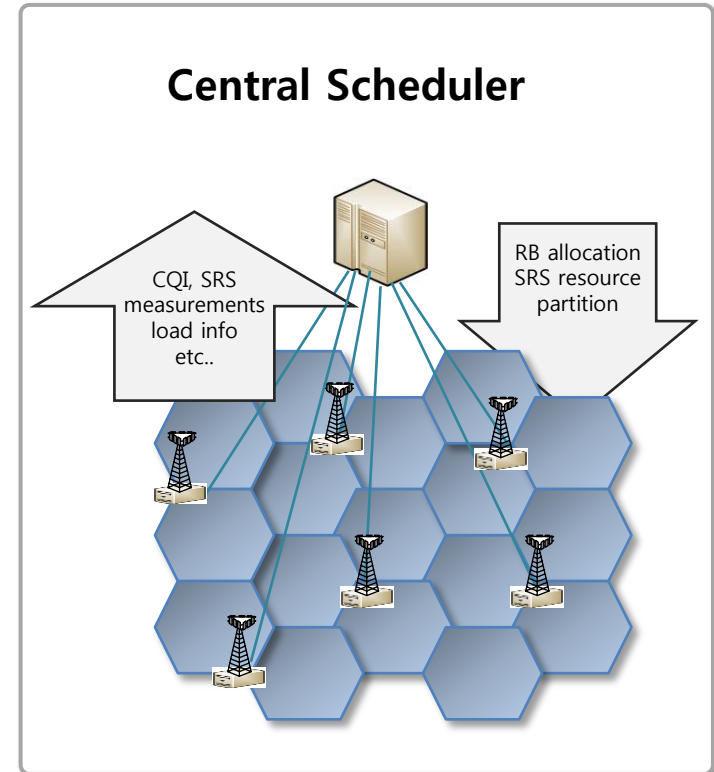
# 2. CoMP Enhancement



- **CoMP enhancement for Inter-eNB CoMP with non-ideal backhaul**
- **Centralized Scheduler is the key feature to enable Inter-eNB CoMP**



- Scenario1: Intra-eNB CoMP in homogeneous deployment
- **Scenario2: Inter-eNB CoMP in homogeneous deployment**
- **Scenario3: Inter-cell CoMP in heterogeneous deployment**
- Scenario4: Distributed antenna system with shared cell ID



# 3. Full Dimension MIMO (1/2)

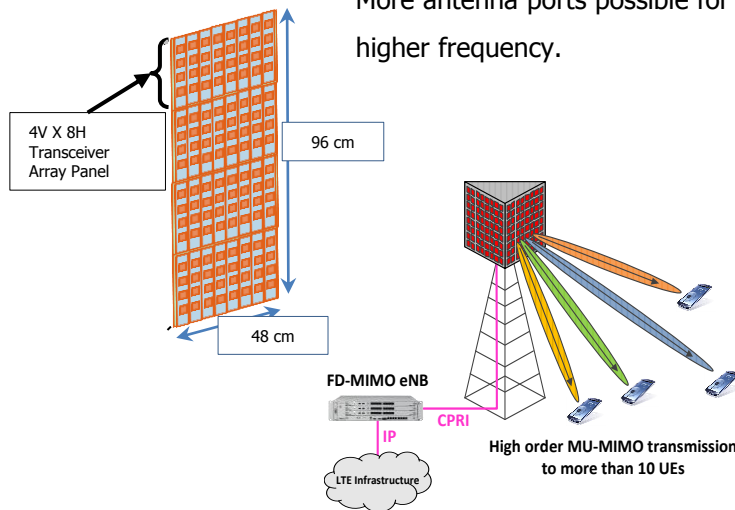
- **Full Dimension MIMO (FD-MIMO) is a promising technology for Macro cell capacity improvement**



## Full Dimension MIMO with 2D AAS

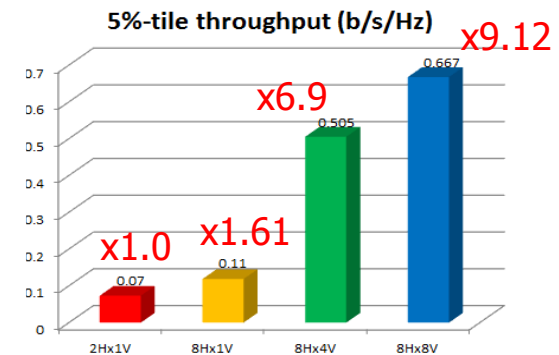
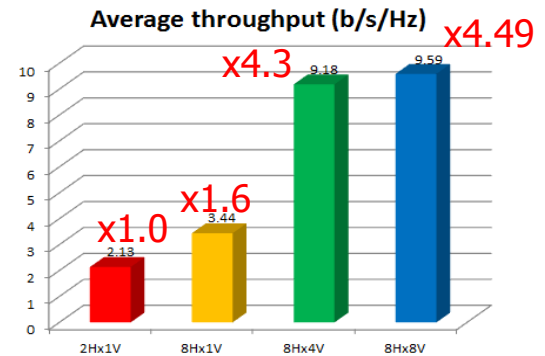
- 1) 2D Active Antenna Array (AAA) & up to 64\* Tx antenna ports at eNB
- 2) MU-MIMO with 10s of UEs

\* For 2.5GHz carrier frequency.  
More antenna ports possible for higher frequency.



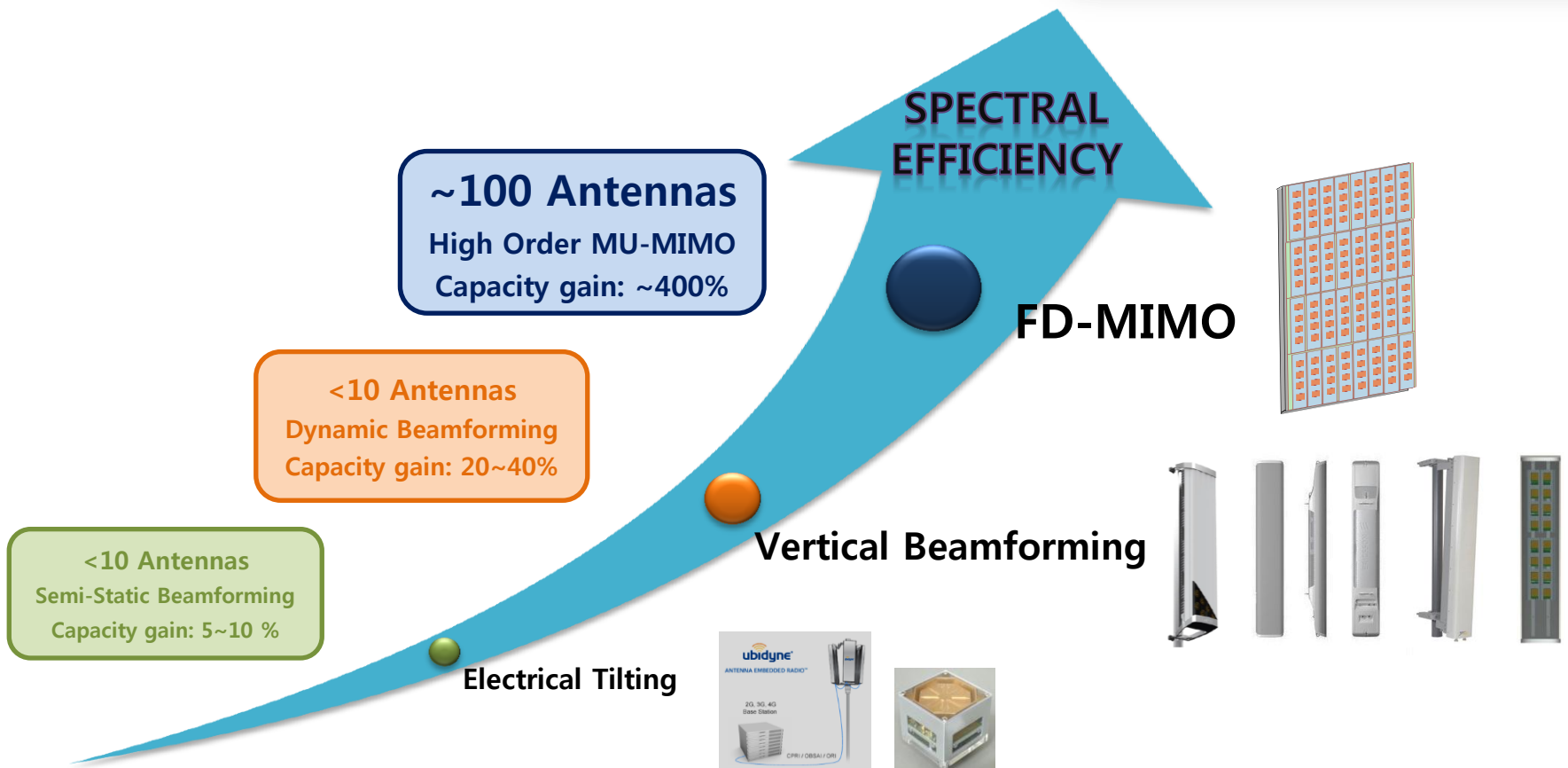
AAS: Active Antenna System

## Macro capacity gain



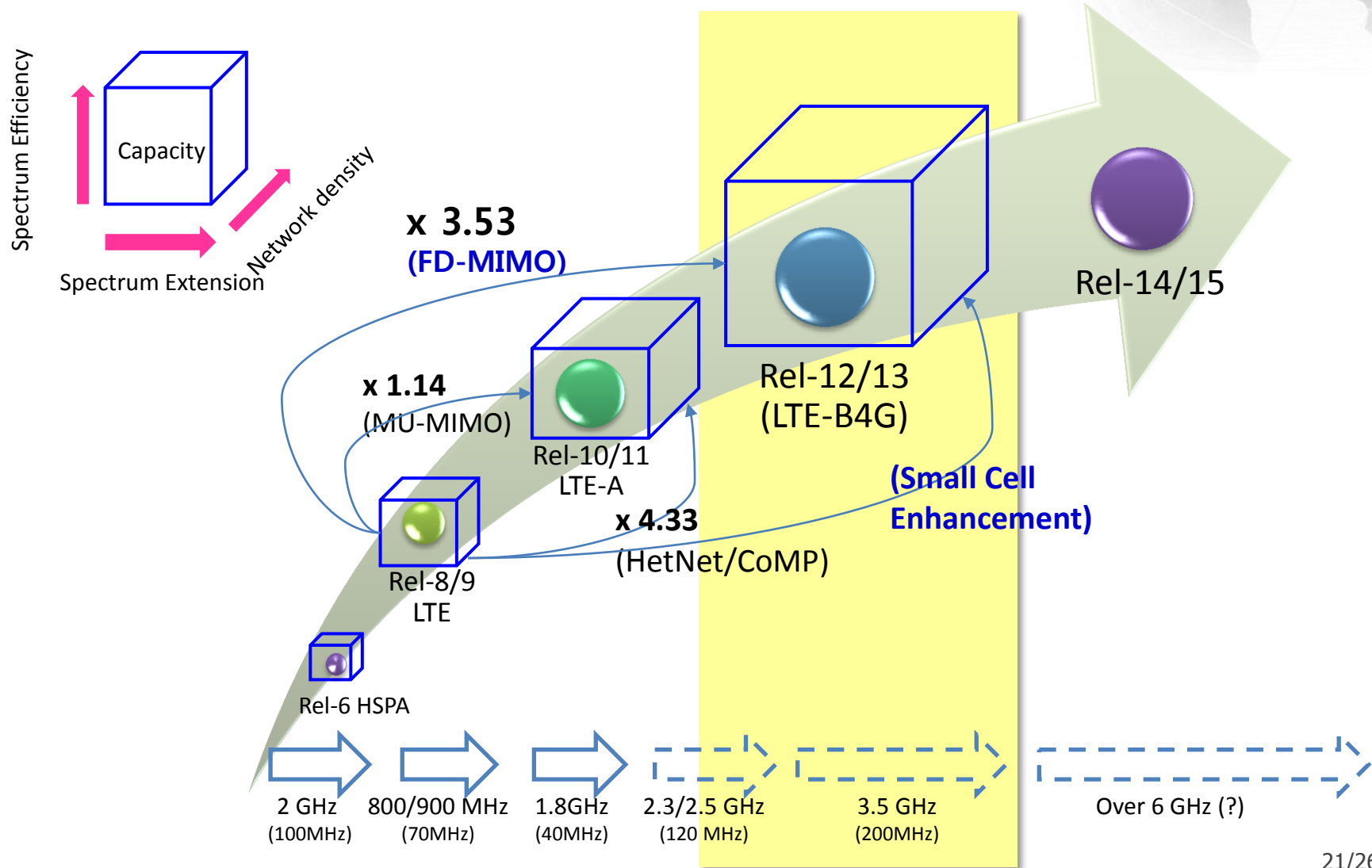
# 3. Full Dimension MIMO (2/2)

- Full Dimension MIMO (FD-MIMO) is the next step of Vertical Beamforming



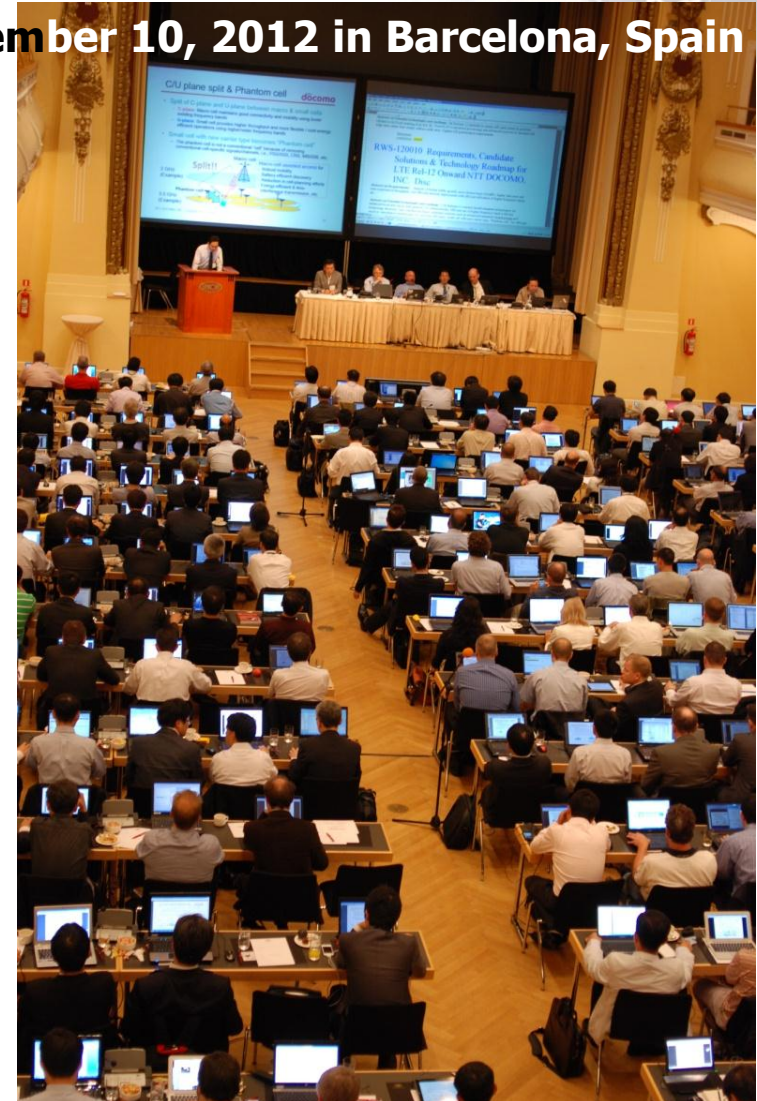
# Expected Performance gain from Rel-12 & 13

Key Features of Rel-12 & 13



# 3GPP SA Workshop in December

- **TSG-SA WS on Release 12 Prioritization, December 10, 2012 in Barcelona, Spain**
  - 26 presentations are submitted



**In Rel-12, SA should achieve:**

Communications Services

**Focus Areas for 3GPP Release 12 (SA and CT)**

**Focus Areas for Release 12**

**QoE Improvement**

**Cost Reduction / Revenue Increase**

**Improve for Delivery of Applications**  
Better understanding of application and network

**User Plane Congestion management (UPCON)**  
Application specific Congestion control for Data Communication (ACDC)  
ABC, CNO, PCP, ...

**Features for New Market Potential**  
New service enabler  
Machine Type and other mobile data applications  
Communications enhancements (MTCe)  
ProSe, GCSE\_LTE, PAC, ...

**Increase Available Bandwidth**  
Better offloading / Reduce backhaul usage  
WLAN Network Selection for 3GPP Terminals (WLAN\_NS)  
LIPA Mobility and SIPTO at the Local Network (LIMONET)  
SaMOG, WORM, NBIFOM...

Overview

Services

- Proximity
- DAGH
- Machine1
- Single Sig
- Study on
- UP Cong

Operation

- OSS Inter
- SON
- Security
- High Effic
- Enhance
- Core Net

SP-120885

Deutsche Telekom AG - Rel12 Prioritization in 3GPP

December 2012

NOKIA Connecting People

# 3GPP SA Workshop

- **Key Features for Network Evolution will be indentified**



**QoE Improvement**

**Improve for Delivery of Applications**  
(Better understanding of application and network)

1. **User Plane Congestion management (UPCON)**

**Cost Reduction /  
Revenue Increase**

**Features for New Market Potential**  
(New service enabler)

2. Machine Type and other mobile data applications Comm. Enhancements

**Increase Available Bandwidth**  
(Better offloading / Reduce backhaul usage)

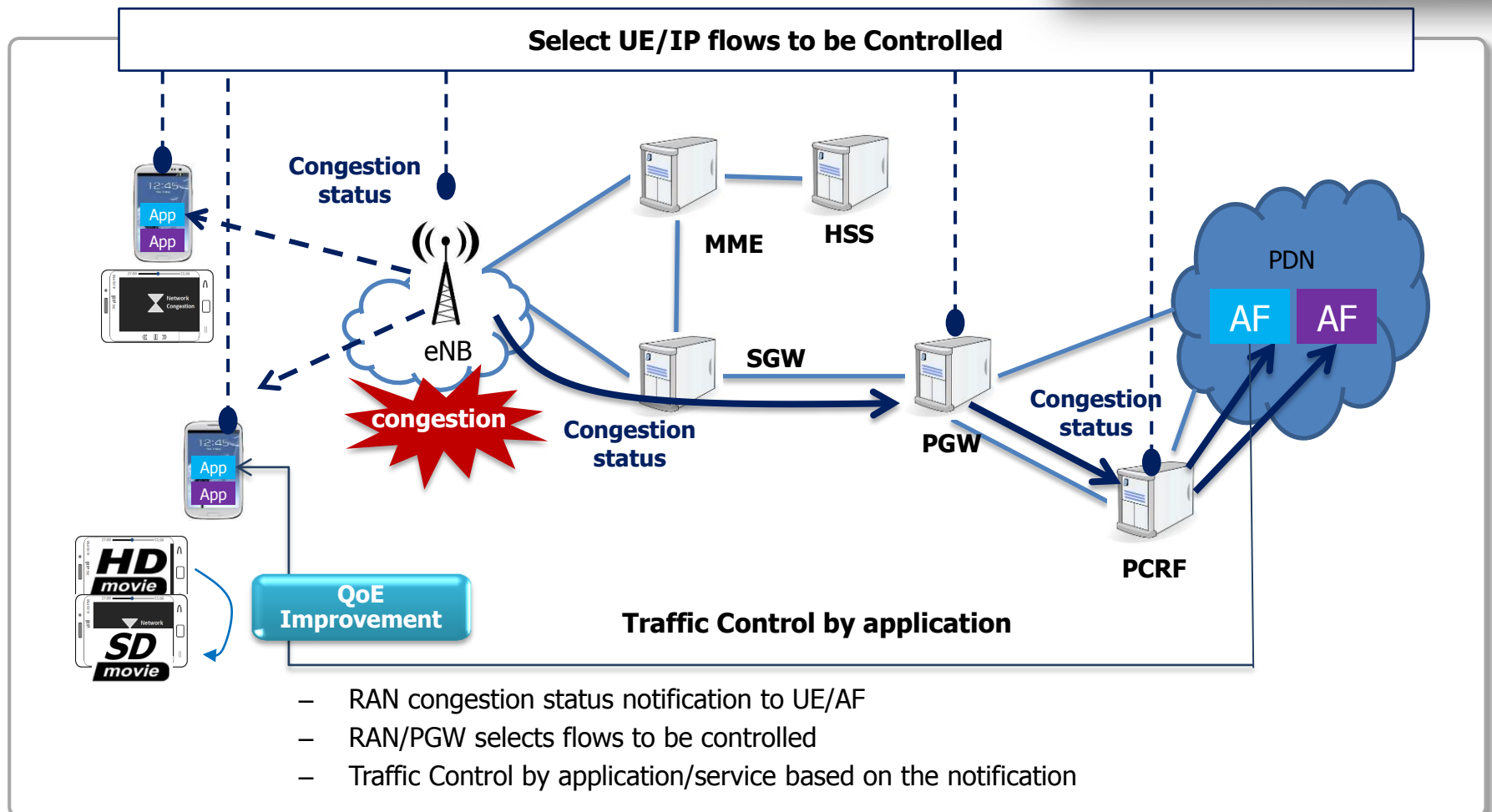
3. WLAN Network Selection for 3GPP Terminals
4. LIPA Mobility and SIPTO at the Local Network



# 3GPP SA Workshop

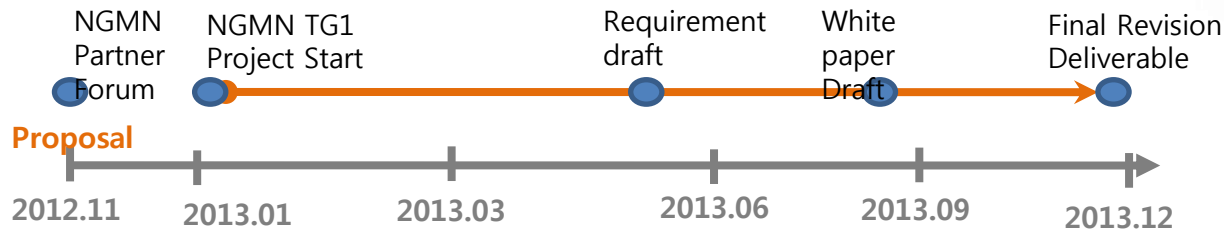


- QoE improvement by considering network status at application/service

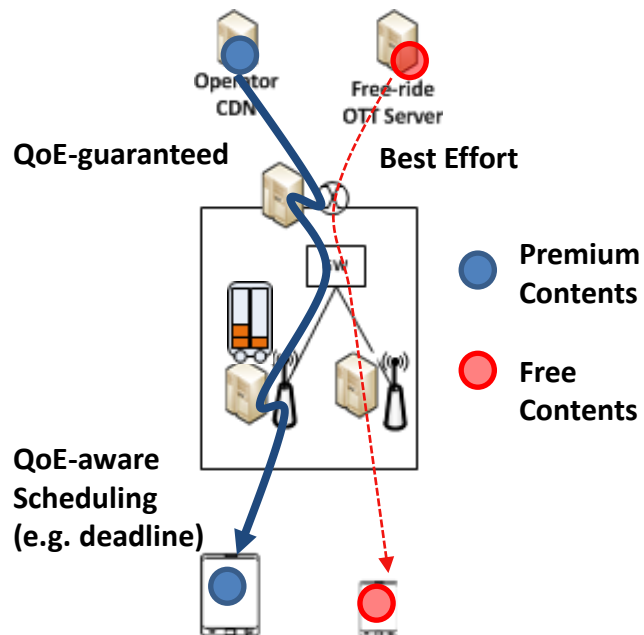


# A new NGMN Project for Network evolution

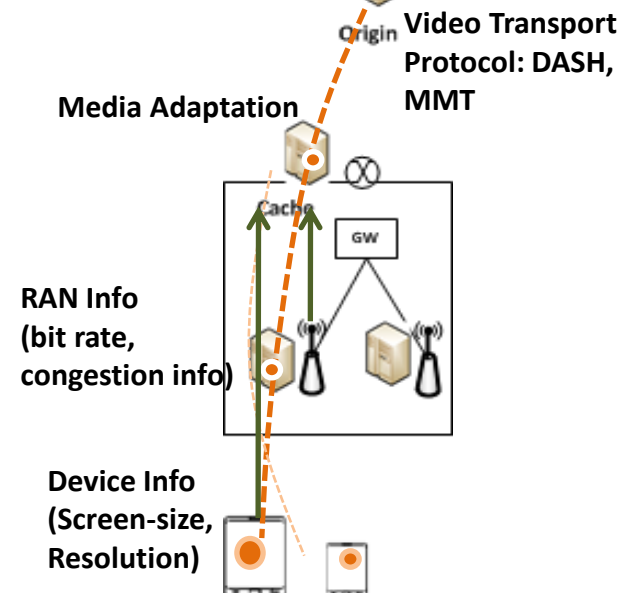
- Mobile Video Traffic Optimization is one of the most important projects in NGMN



## <EPS Video Traffic Optimization>



## <Video Delivery Protocol Enhancement>



# Summary

- Many promising technologies have been identified in 3GPP
- Operator and consumer benefit should be carefully considered when new technologies are introduced for Beyond 4G

