March 5, 2012

WTC 2012

Challenges and Innovations in LTE Deployment

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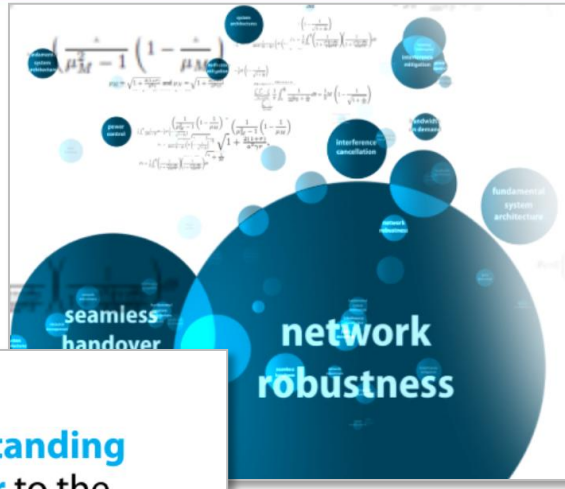
CTO, InterDigital

Agenda

- InterDigital Overview
- Key Trends
- Key Challenges in LTE
- Innovative Solutions for LTE Deployment
- Summary

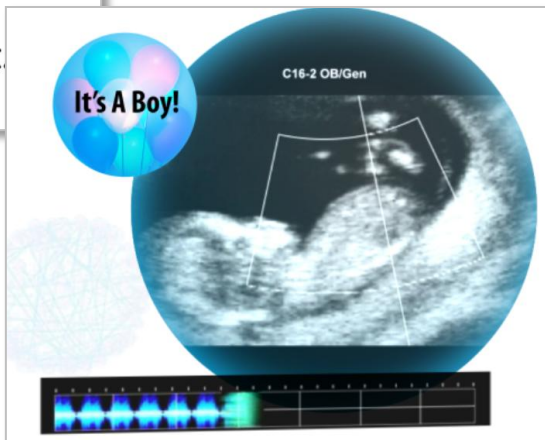
About InterDigital



InterDigital develops **fundamental** wireless technologies that are at the **core** of **mobile devices**, **networks**, and **services worldwide**.

HSPA+
LTE
LTE-A
802.16
802.21

As a **long-standing contributor** to the wireless industry, we solve many of the most **critical** and **complex technical challenges years ahead** of market deployment.



Our advanced solutions support **more efficient wireless networks**, a **richer multimedia experience**, and **new mobile broadband capabilities**.

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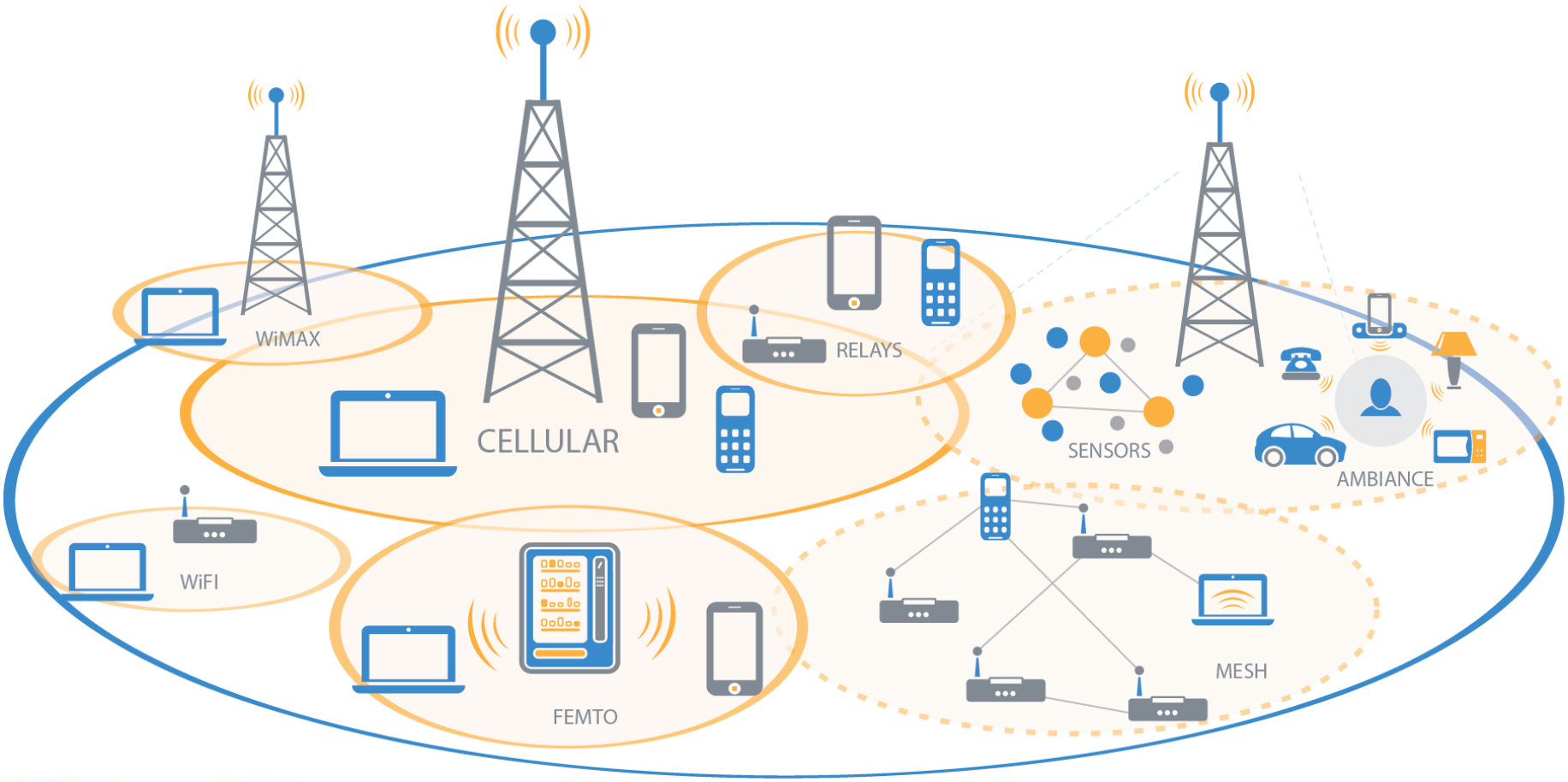
InterDigital Snapshot

- ~ 180 engineers developing technology used in every cellular wireless device
- Portfolio of 18,500 issued patents and applications at year-end 2010
  - Covering a wide range of technologies, including 2G, 3G, 4G / LTE and IEEE 802
  - 50% of 3G market under license at year-end 2010; 80% of 2G market licensed historically
  - Strong 4G / LTE portfolio
- Cash and short-term investments of $690 million[1]; third quarter 2011 revenues $76.5 million
- Approximately $2 billion market cap[2]

1. As of September 30, 2011
2. As of November 22, 2011

Tomorrow's Network of Networks

Billions of subscribers ● Trillions of connections ● Seamlessly connected and fully integrated



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KEY TRENDS

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Key Trends

- Mobile ecosystem exists to drive LTE Adoption:
  - Applications drivers: Web access, HD video streaming, TV Everywhere
  - LTE lowers the cost/bit compared to previous generations
  - Consumers are willing to pay
  - Availability of devices (Smartphones, Tablets, PCs and CE)
  - Device & application ease of use for consumer

- LTE adoption ramp is faster than 3G
- Several networks have been deployed
- LTE offers cost and spectrum efficiencies

Mobile Ecosystem will Fuel LTE Growth

Mobile video traffic will exceed 50% of the total for the first time in 2011.

Last year's mobile data traffic was 3x the size of the entire global Internet in 2000.

Global mobile data traffic grew 2.6-fold in 2010, nearly tripling for 3rd year in a row.

In 2010, 3 million tablets and 94 million laptops were connected to the mobile network

Each tablet generated 5x and each laptop generated 22x more traffic than the average smartphone

Growing availability of easy-to-use tablet, e-reader and smartphone devices

Lower backhaul costs and increased spectral efficiency means LTE has significant cost savings over prior technologies

	2G	3G	3.5G	4G (LTE)
Backhaul Cost per GB	**$12.00**	**$4.00**	**$3.00**	**~$2.50**
Cost Savings (vs. previous iteration)	-	*3.0x*	*1.3x*	*1.2x*
Max Link Spectral Efficiency (bit/s/Hz)	**0.52**	**2.50**	**8.44**	**16.32**
Efficiency Gain (vs. previous iteration)	-	*4.8x*	*3.4x*	*1.9x*

Source: Company data, Goldman Sachs Research estimates.

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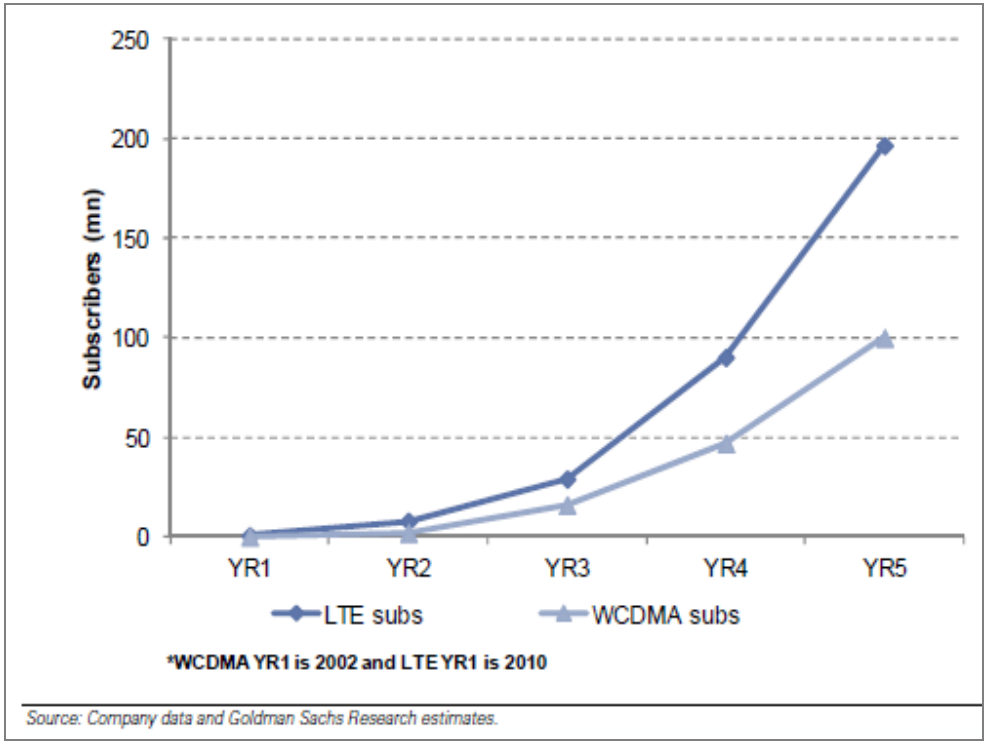
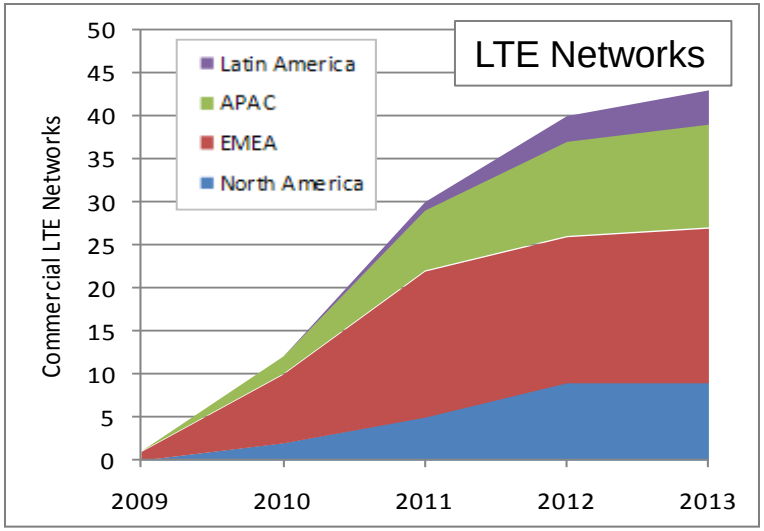
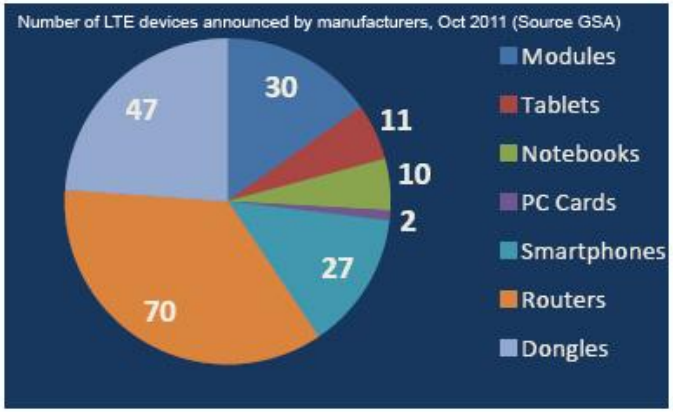
LTE Adoption Happening Faster than 3G





40 Operators have launched LTE

- In its 1st 5 years, LTE adoption is expected to grow at 2x the rate of 3G in it's first 5 years
- Deployments are happening across the globe at a rapid rate



Source: http://www.3gpp.org/X3-increase-in-LTE-device

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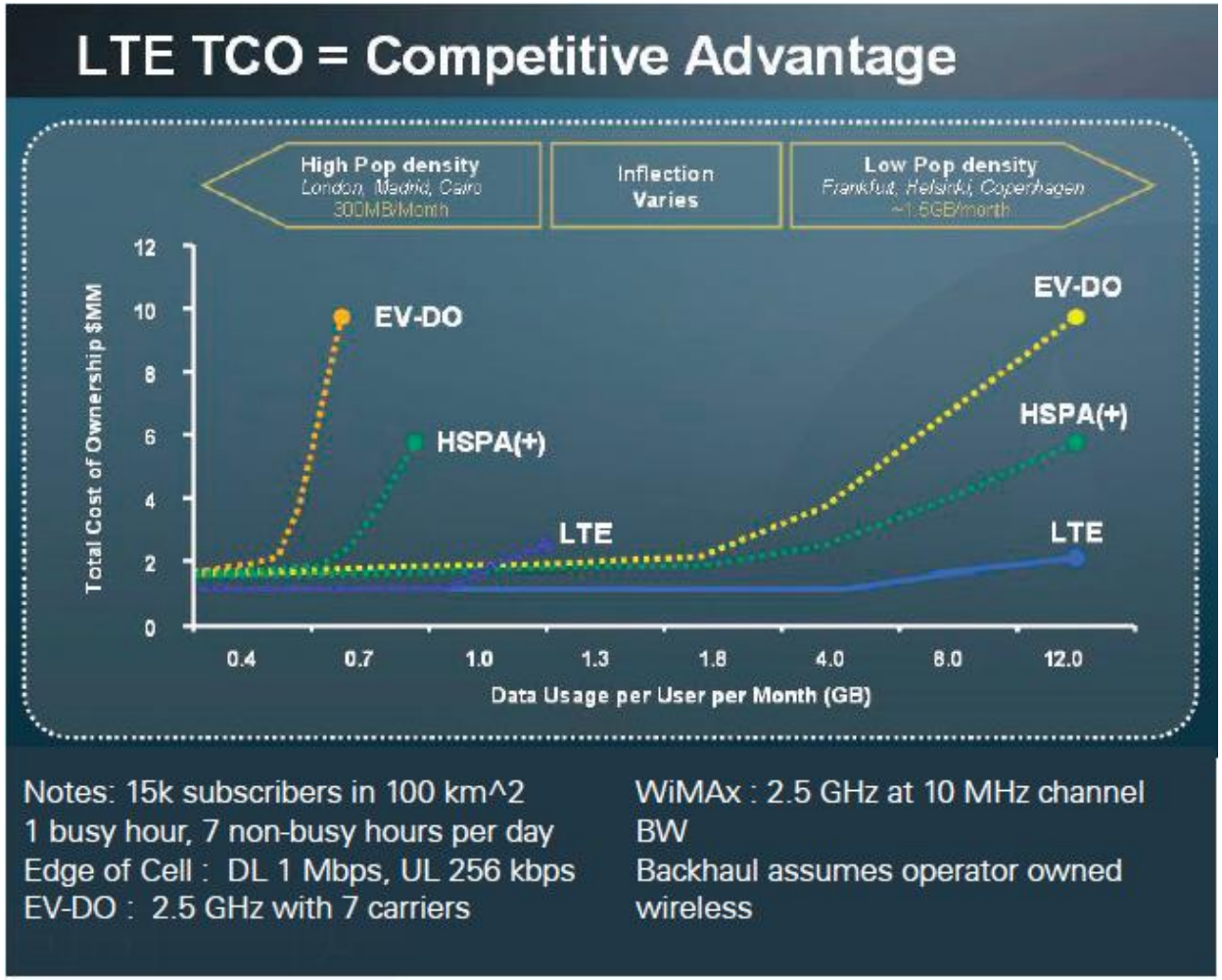
LTE Total Cost of Ownership – Less Than 3G Technologies

LTE cost-per-bit represents a 4-10x improvement compared to 3.5G technologies

Source: Motorola Whitepaper, "Motorola LTE, Beyond Mobile Broadband"



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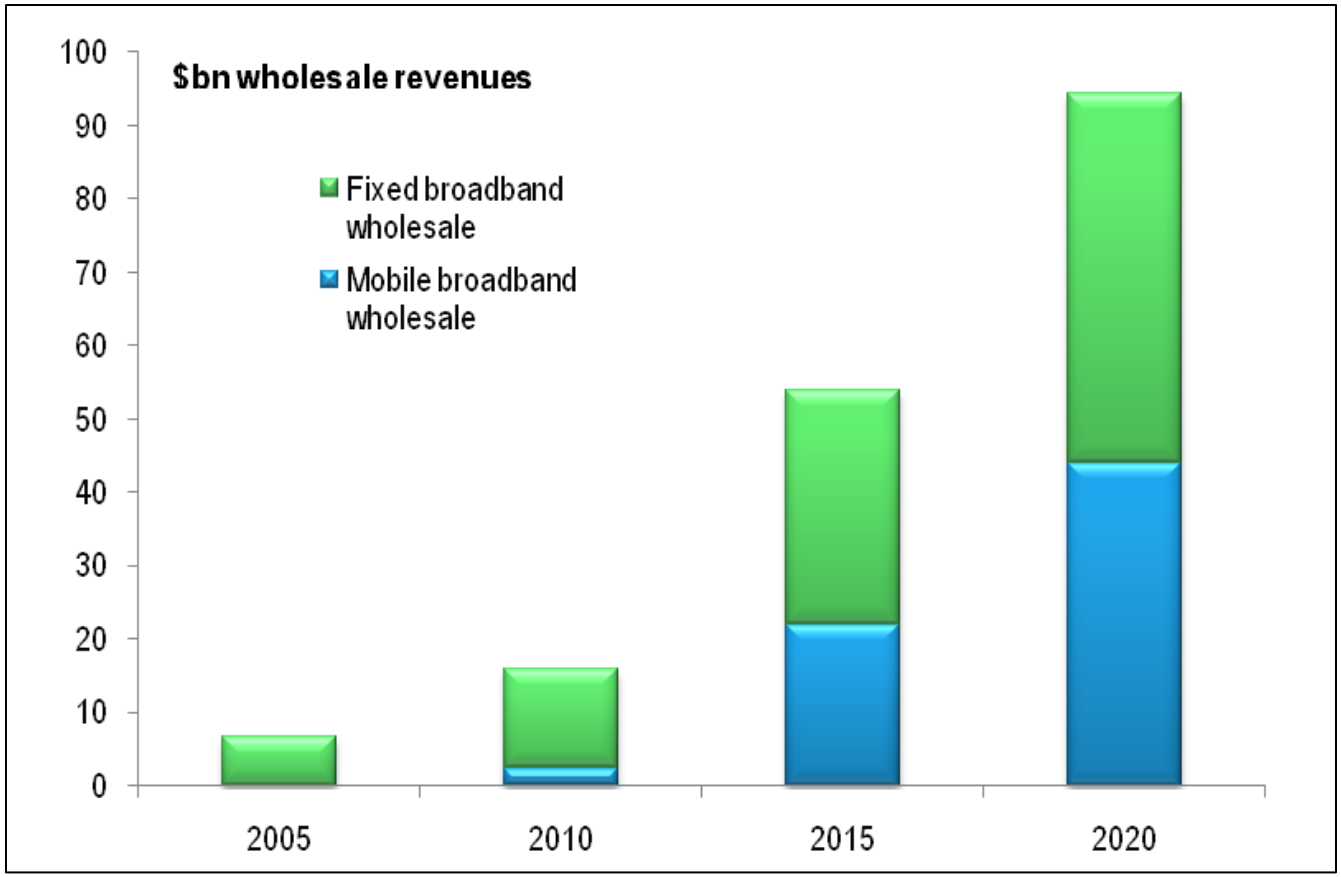
Convergence of mobile and fixed broadband

LTE Will Enable Larger Broadband Adoption

Source: Telco 2.0 New Mobile, Fixed and Wholesale Broadband Business Models Report



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CHALLENGES STILL REMAIN…

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Key Challenges

- Bandwidth crunch
  - Existing bands will not be enough for IMT services after year 2015
  - Video will be the dominant traffic source
- CAPEX/OPEX Crunch
  - Mobile voice era business model does not work anymore in face of Declining voice revenue, Exponential data growth, OTT service competition and New regulations
- Support of emerging cloud architectures
- Asymmetric networks cannot support two-way communications.
- Non uniform coverage and user experience
- Spectrum fragmentation – High number of LTE bands

FRAGMENTED AND COSTLY SPECTRUM

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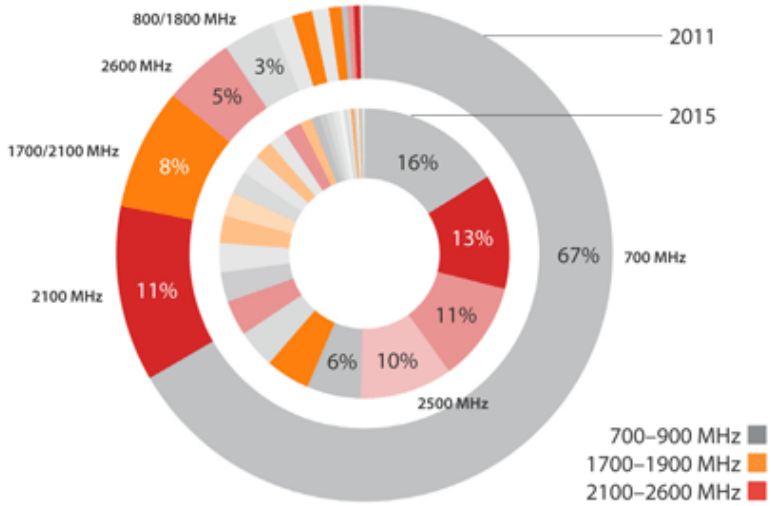
LTE Spectrum Situation

*ITU is a United Nations agency which coordinates the shared global use of the radio spectrum and establishes worldwide standards.

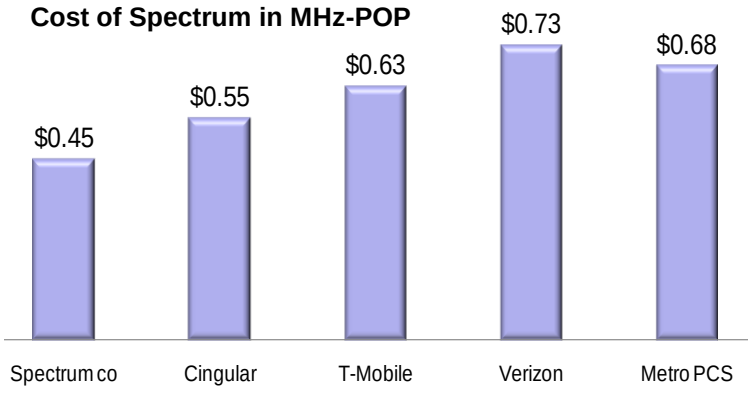
Source: ITU, company data and Goldman Sachs Research estimates.



Source: GSMA

"Spectrum fragmentation has the potential to hinder global LTE roaming…"

*"The **lack of spectrum harmonization** represents a key challenge for the emerging LTE ecosystem…"*



Source: Forbes (Dec 2011)

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OUR TECHNOLOGY SOLUTIONS TO THE CHALLENGE

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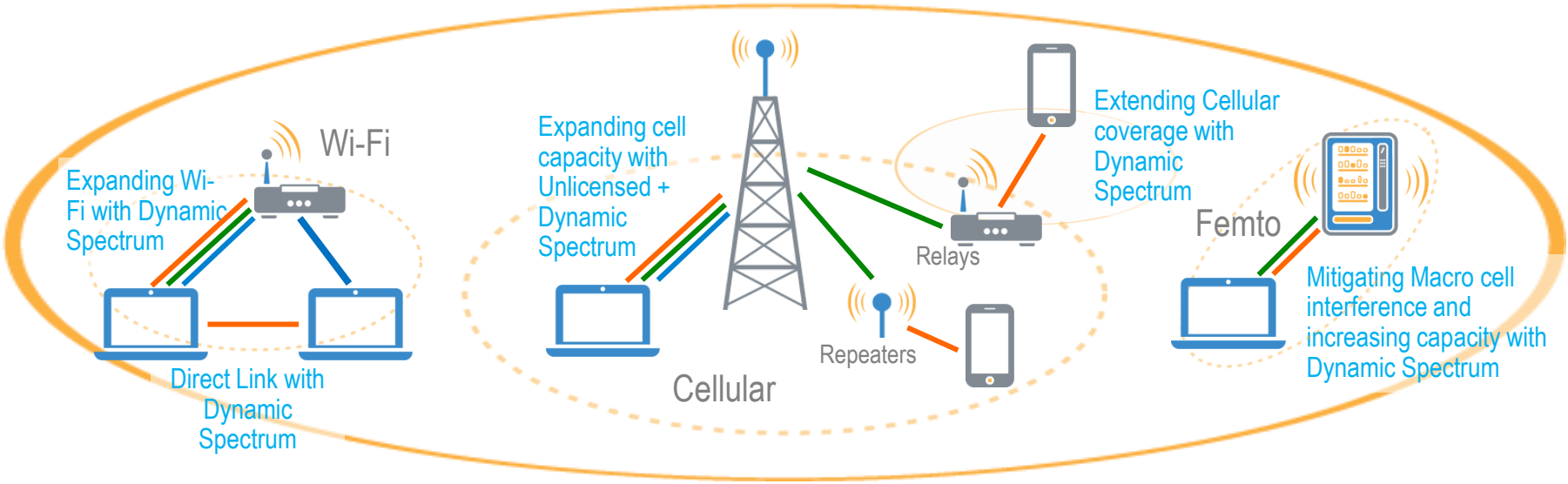
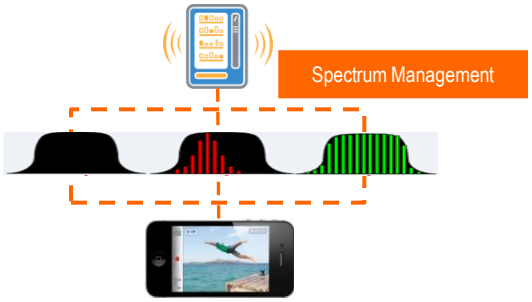
Bandwidth Management and Dynamic Spectrum Management

Addresses BW Crunch, Reduces CAPEX/OPEX, Improves Coverage & User Experience

Licensed spectrum — Dynamic Spectrum (DS) — Unlicensed Spectrum

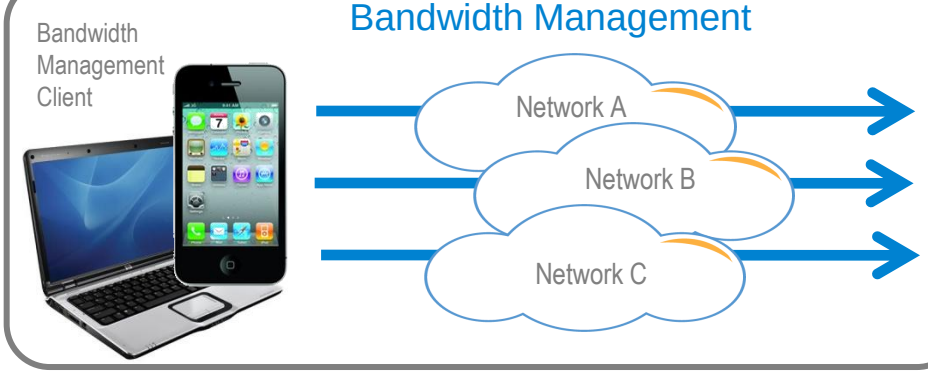


Dynamic Spectrum Management



PHY & MAC level aggregation across licensed, unlicensed, and white space in one radio technology

Bandwidth Management



Bandwidth switching, aggregation, segregation, and mobility across networks at the IP level

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VIDEO AWARE WIRELESS NETWORK AND WIRELESS AWARE VIDEO NETWORKS IMPROVES POWER, COST AND QOE

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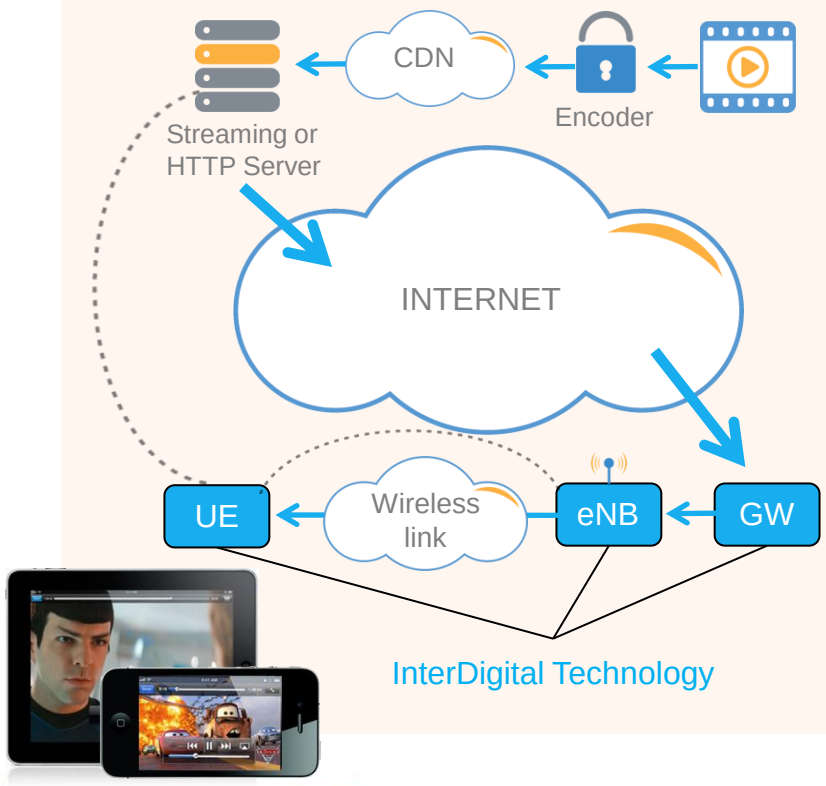
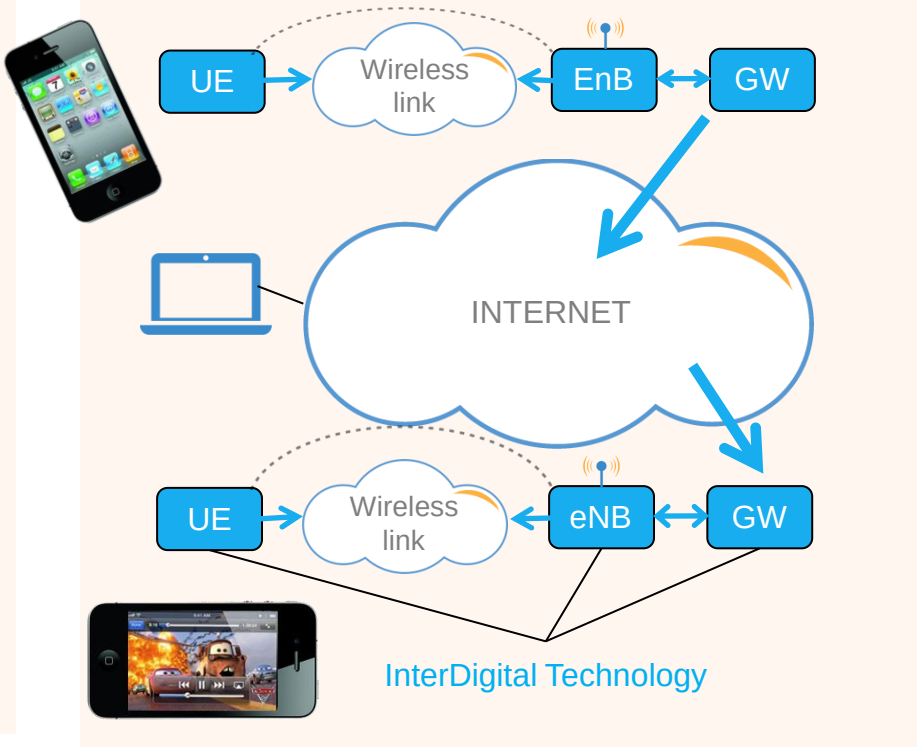
Cross-layer optimization for video over wireless

Addresses Bandwidth Crunch, Improves User Experience and Reduces Terminal Power Consumption - >3X

Mobile Video Streaming



Mobile Video Telephony



NETWORK VIRTUALIZATION REDUCES OPEX AND CAPEX

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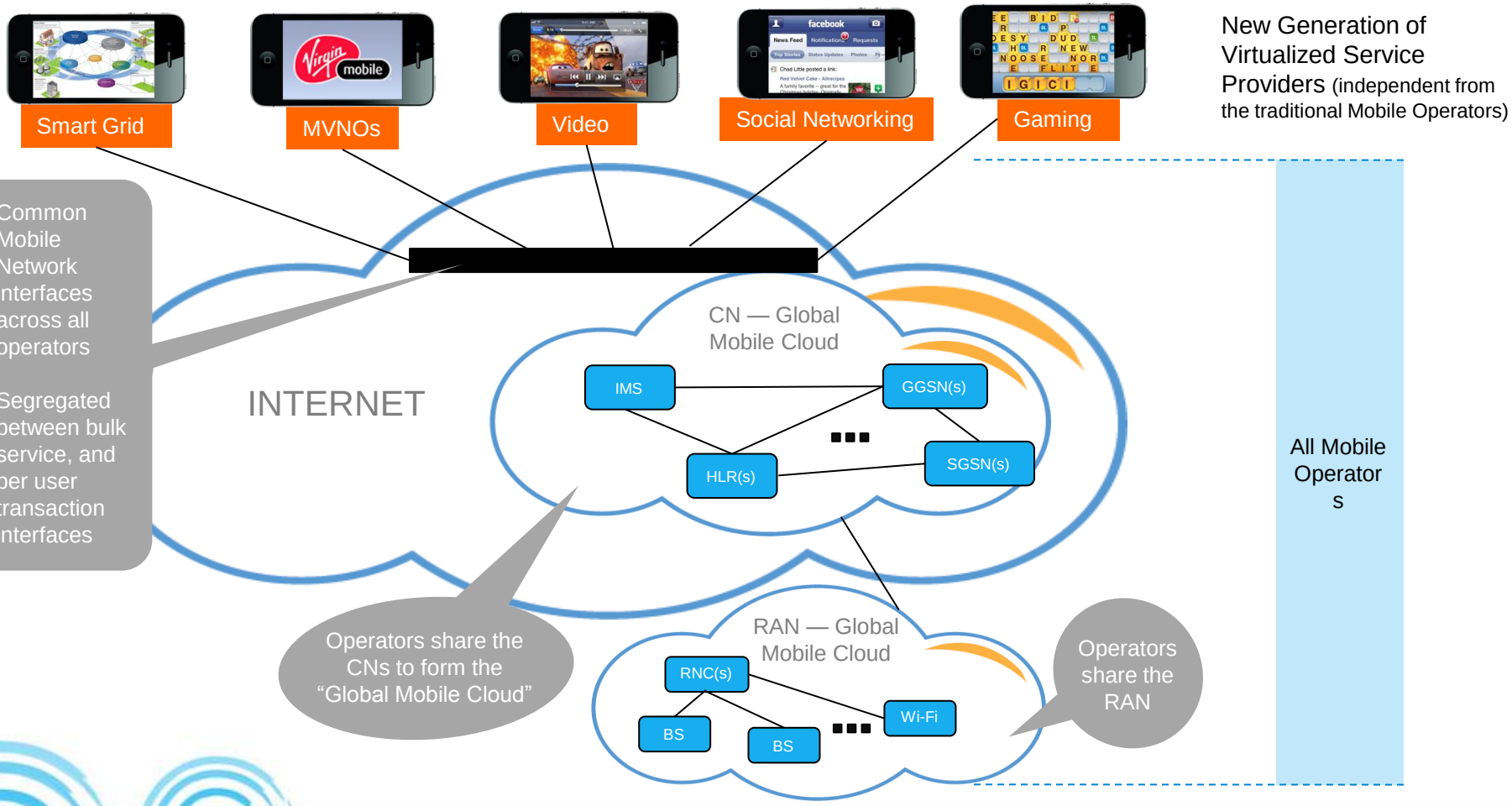
Network Virtualization - Move the Mobile Network into the Cloud

Significantly reduce deployment and operation costs by virtualizing the physical wireless network infrastructure and creating a customizable virtual network slice abstraction (75% CAPEX cost reduction).



COVERAGE AND CAPACITY ENHANCEMENTS

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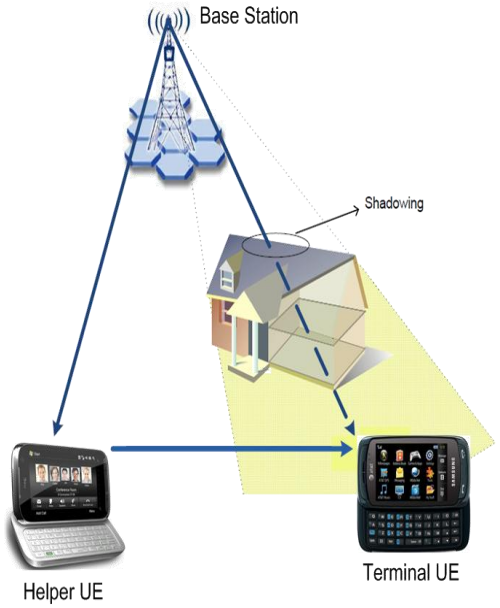
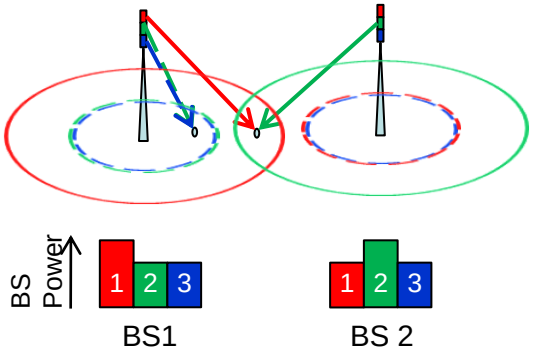
Coverage and Capacity Improvements

Cellular Controlled Device to Device

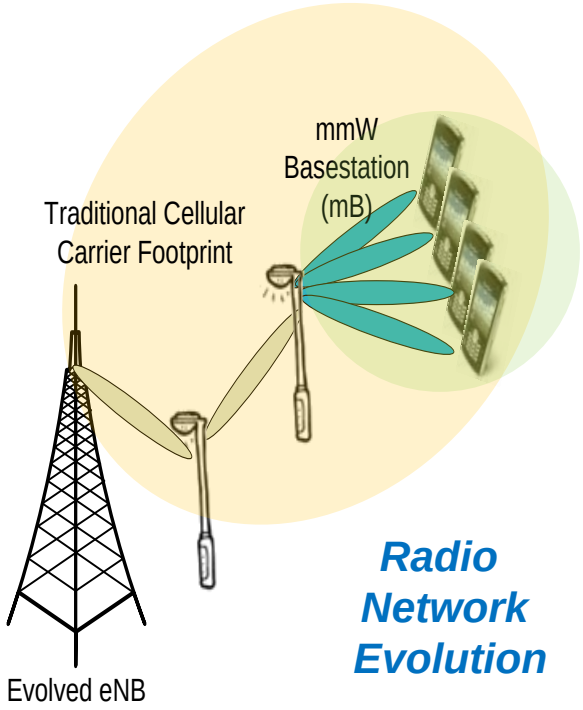


2X Cell Edge Capacity Gains for both Uplink and Downlink
5X Reduction in required Base station density for 95% coverage

Advanced Multi-Site Carrier Aggregation



45% cell edge gain*
35% cell average gain*



Radio Network Evolution

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Summary

- LTE Ecosystem of devices, networks and services are thriving, but challenges still remain.
- Key challenges: Opex, Capex, power consumption, business model and growing demand for bandwidth.
- We have developed solutions to these challenges and are taking it to standards body for mass market deployment.
- We are open for collaboration

THANK YOU

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