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Technologies and policies to promote advanced mobile communications

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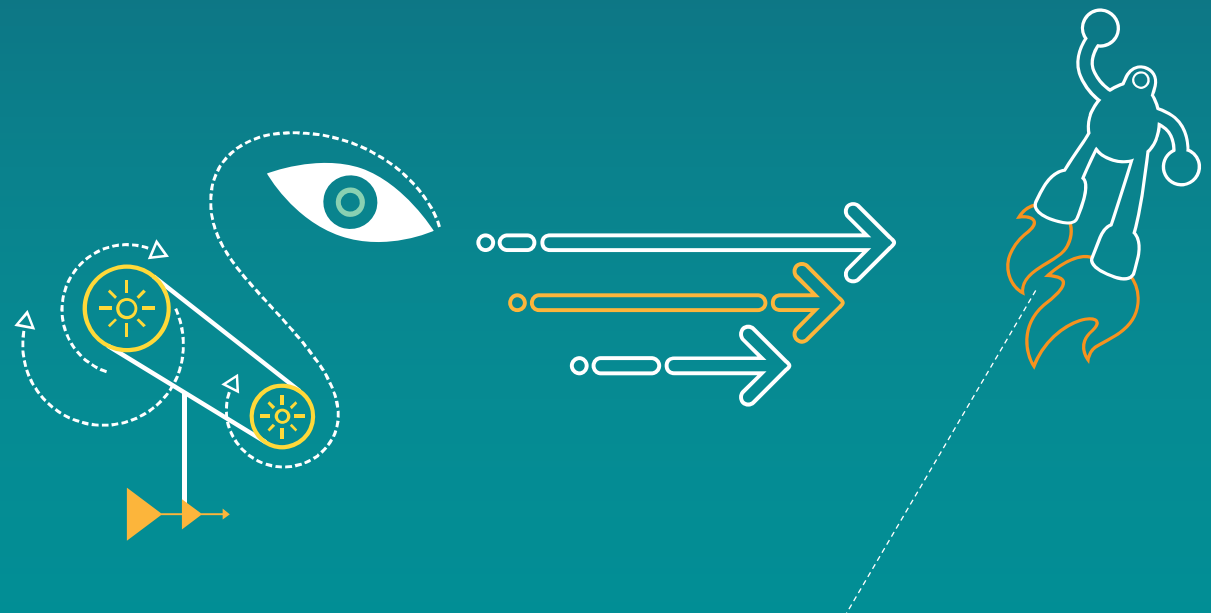
APT PRF August 2015

Technologies and policies to promote advanced mobile communications

QUALCOMM®



QUALCOMM®

Born Mobile™

- 30 years of driving the evolution of wireless communications
- Making wireless more personal, affordable and accessible
- World’s largest fabless semiconductor company
- S&P 100/ S&P 500/ Fortune 500





Agenda

1. Mobile Economics
2. Mobile Technology
3. Mobile Spectrum

Mobile is the fastest-adopted technology of all time

3 billion 3G and 4G connections

~3 billion 3G and 4G connections today expected to grow to ~8B by 2020

12,000x faster speeds

Data transmissions speeds provided by 4G are 12,000x faster than 2G

99% lower costs

Connectivity costs per MB have fallen 99% in less than 10 years

Source: Boston Consulting Group, “The Mobile Revolution: How Mobile Technologies Drive a Trillion-Dollar Impact” January 2015.

Why It’s All So Important

Mobile Technology is an Engine for Socio-Economic Development

$1.8 trillion
invested past 5 years

R&D and infrastructure investments from 2009-2013

$3.3 trillion
in revenue

Revenues of the global mobile value chain in 2014

$11 million
jobs

Jobs in the global mobile value chain

Another
$4 trillion
investment coming

Additional R&D and infrastructure investments needed by 2020

2x faster
revenue growth

Revenue growth of SME Mobile Leaders versus Mobile Laggards

8x faster
jobs growth

Jobs growth of SME Mobile Leaders versus Mobile Laggards

7 million
added jobs

Jobs added by closing SMEs' mobile divide in the six countries

Source: Boston Consulting Group, “The Mobile Revolution: How Mobile Technologies Drive a Trillion-Dollar Impact” January 2015.

Mobile trends creating challenges for industry and government

Rapid growth of mobile broadband data traffic

Connectivity expanding into new device categories

New applications and services

Mobile data traffic growth—industry preparing for 1000x

Industry preparing for

1000x

data traffic growth*

Richer Content

more video

~2/3 of mobile traffic will be video by 2017[3]

Bestseller example, richer content:

- 5.93 GB Movie (High Definition)
- 2.49 GB Movie (Standard Definition)
- 1.8 GB Game for Android
- 0.14 GB Soundtrack
- 0.00091 GB Book

More devices

everything connected

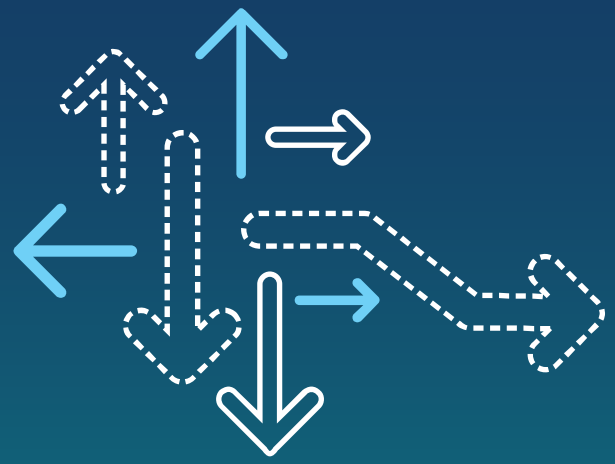
~25 Billion Interconnected device forecast in 2020[2]

~8 Billion Cumulative smartphon forecast between 2014-2018[1]

[1]Gartner,; Mar'14 [2]Machina Research/GSMA, Dec. '12. [3]Cisco, Feb. '13

*1000x would be e.g. reached if mobile data traffic doubled ten times, but Qualcomm does not make predictions when 1000x will happen, Qualcomm and its subsidiaries work on the solutions to enable 1000x

Mobile Technology



Mobile has made a leap every ~10 years

1G

Analog voice

AMPS, NMT, TACS

1980s

2G

Digital voice

D-AMPS, GSM, IS-95 (CDMA)

1990s

3G

Mobile broadband

WCDMA/HSPA+, CDMA2000/EV-DO

2000s

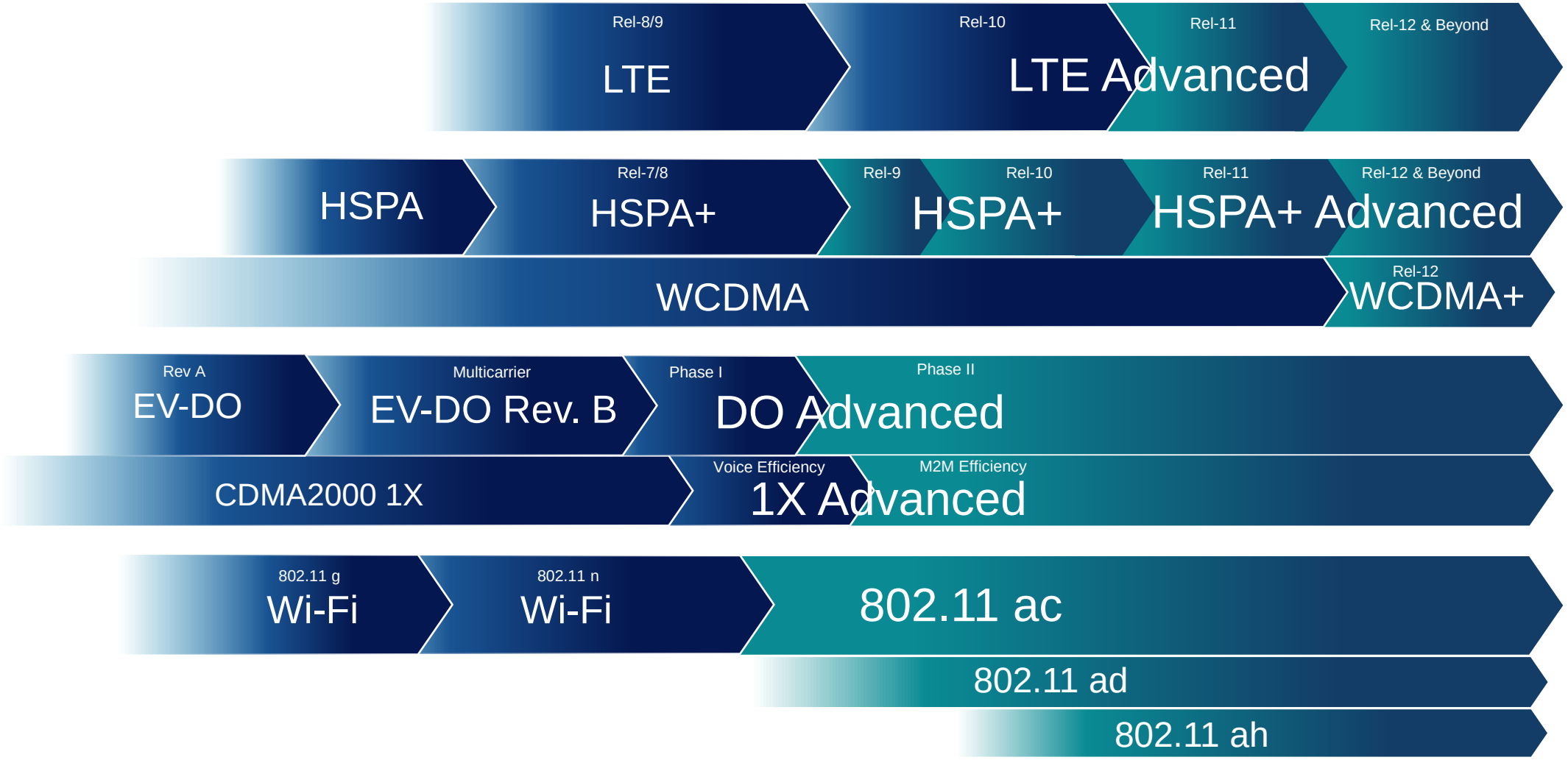
4G

Faster and better MBB

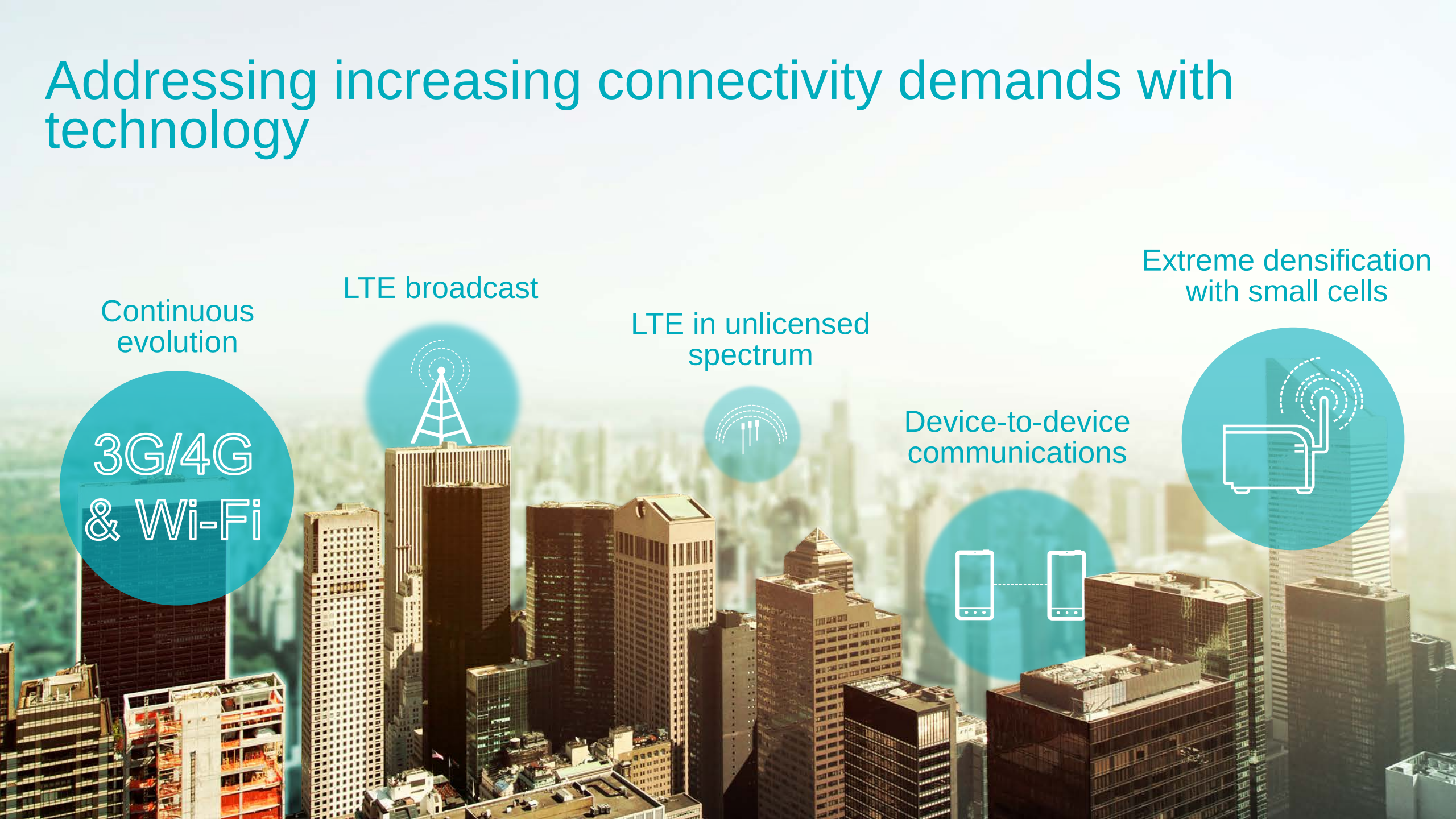
LTE, LTE Advanced

2010s

Wireless Broadband Standards keep evolving



Addressing increasing connectivity demands with technology



Mobile 4G LTE complements 3G to boost data capacity

Multimode 3G/LTE is the foundation for successful 4G LTE

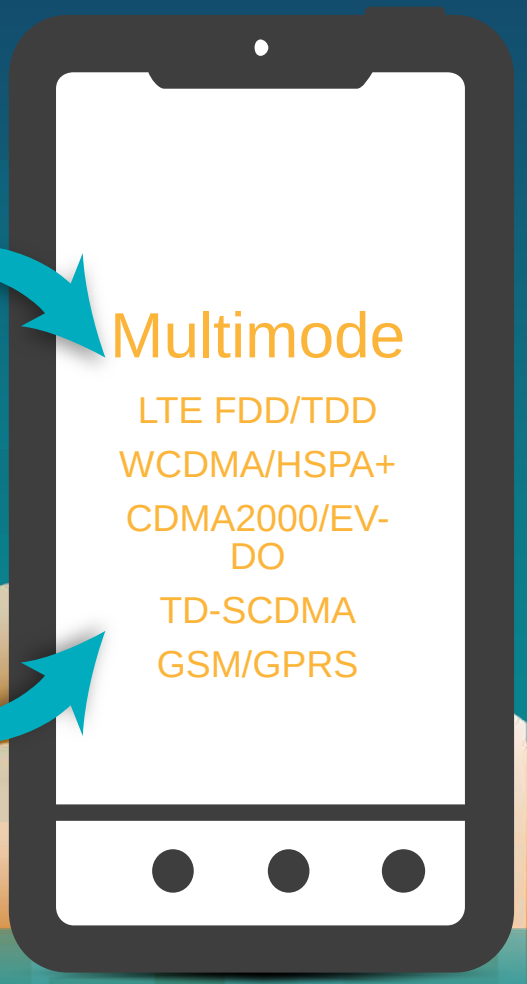
4G LTE

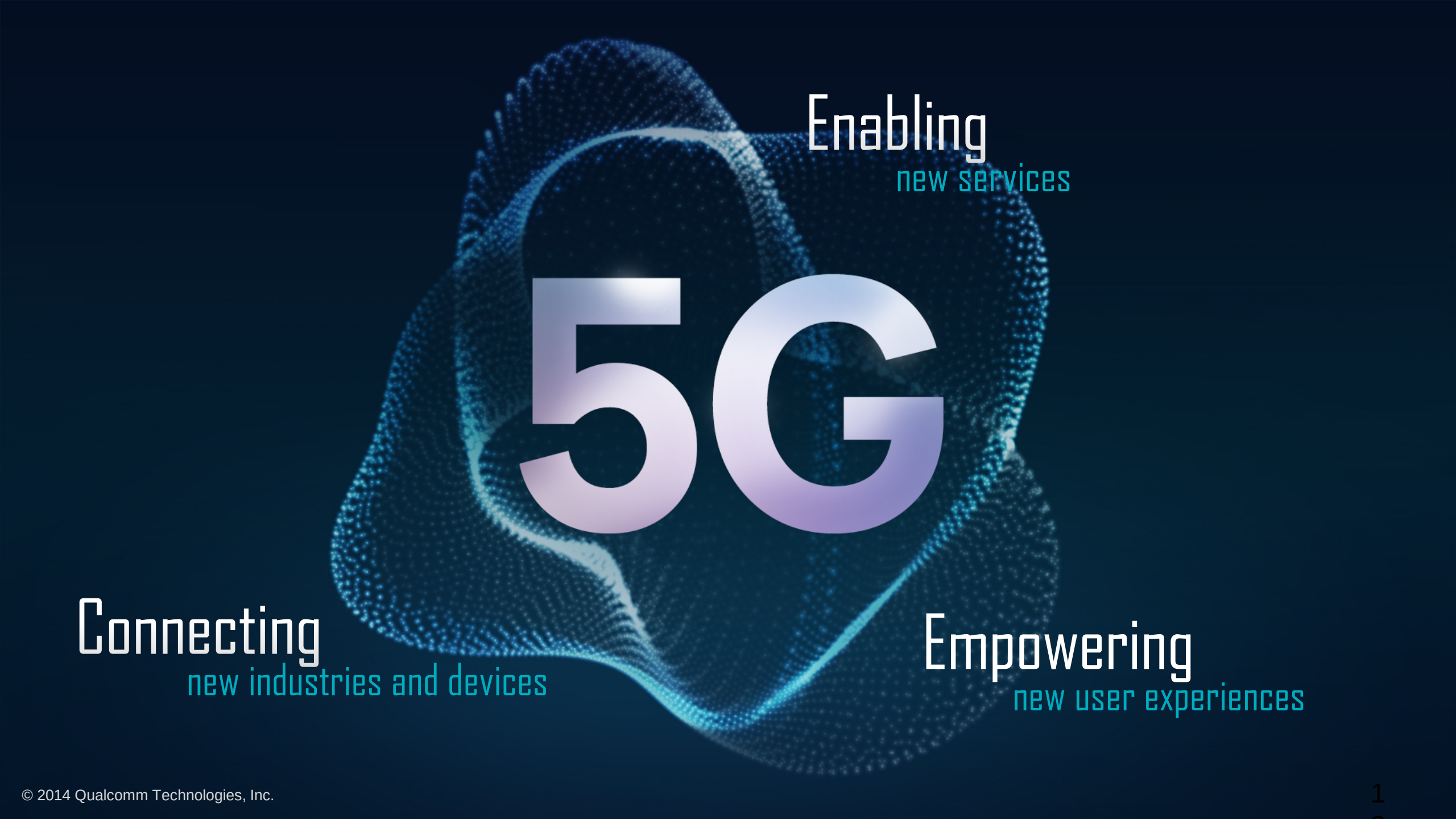
Providing more data capacity for richer content and more connections

3G

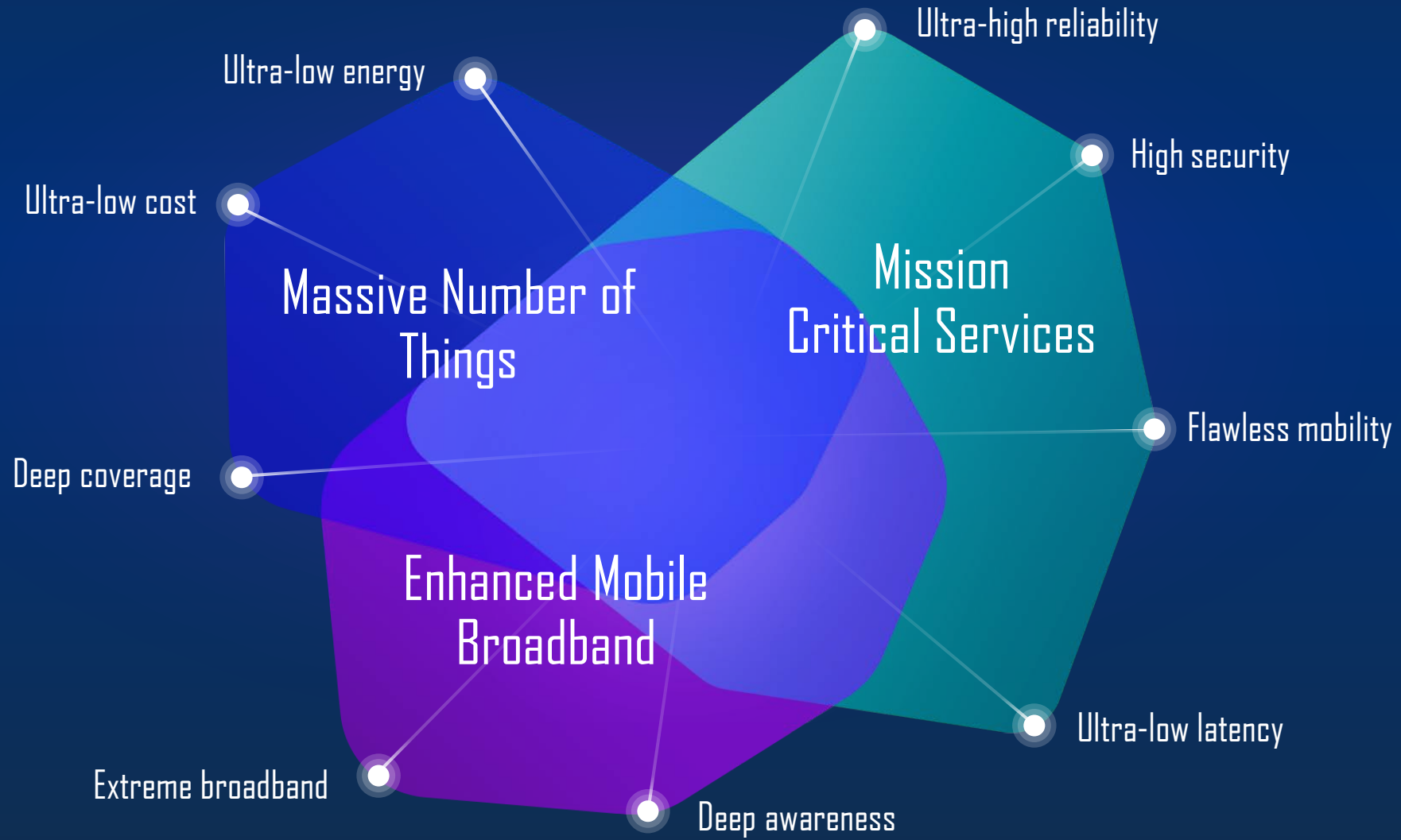
Enabling a consistent broadband experience outside 4G LTE coverage

Delivering ubiquitous voice services and global roaming



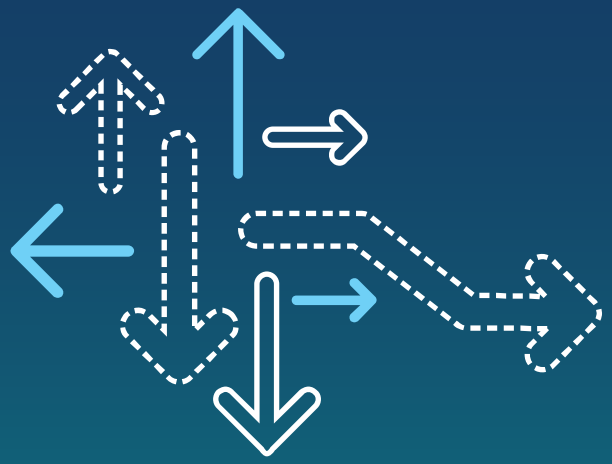


Support extreme variation in requirements



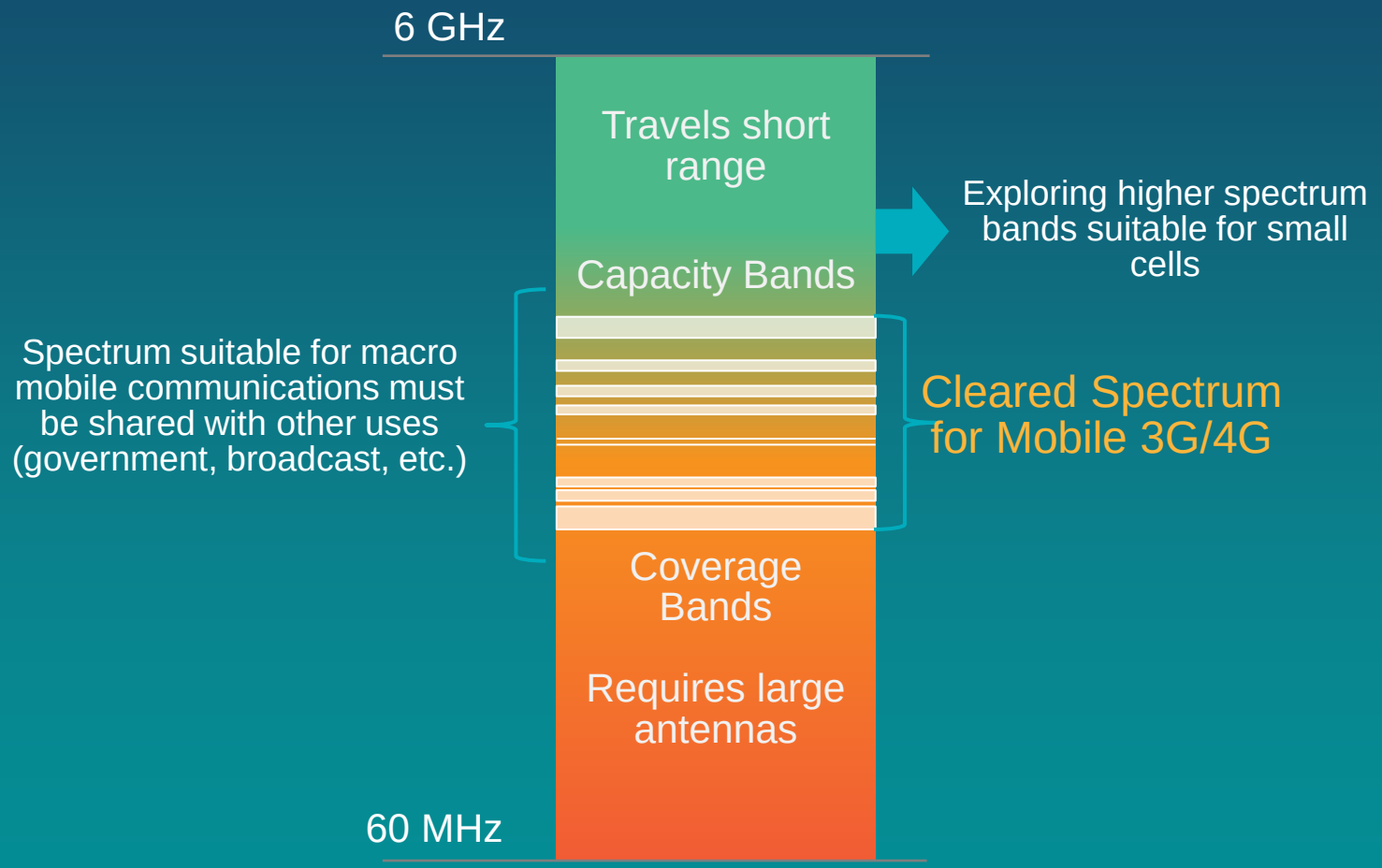
In parallel: driving 4G and 5G to their fullest potential

Mobile Spectrum



Spectrum is the lifeblood of mobile connectivity

airwaves that all wireless communications travel on



Mobile uses different spectrum for different types of access

Unlicensed Spectrum

Spectrum shared by multiple technologies
(Wi-Fi, LTE, BT & others)

Foundation of Local Area Broadband

License-free, Simple Deployment

Short Range, Local Coverage

Residential, Enterprise, Connected Home

Licensed Spectrum

Cleared spectrum for exclusive use
(Mobile 3G/4G technologies)

Foundation of Mobile Broadband

Predictable Performance, Subscription-based

Ubiquitous Coverage

Seamless Mobility

Spectrum Harmonization

- Brings down the cost of mobile devices
- Enables international roaming
- Reduces cross border interference

INCREASED CHOICE
competition

2919 LTE devices
2595 are 3G multi-mode
Source: www.gsacom.com

ROAMING
harmonised bands

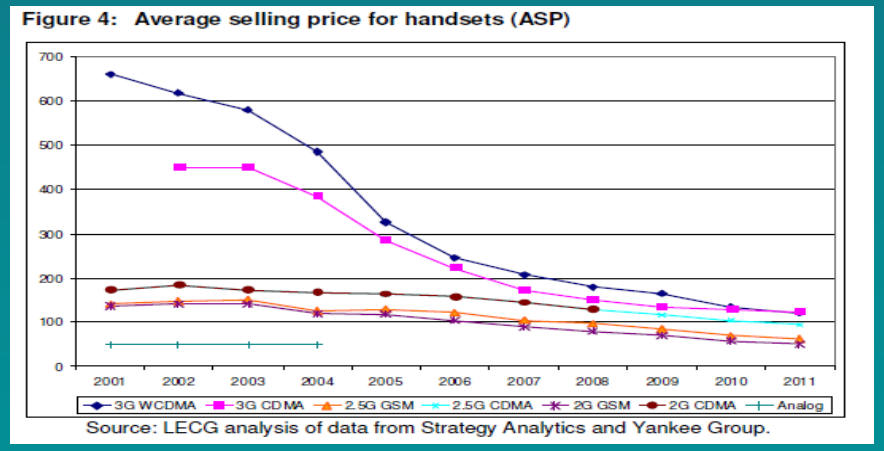
591 3GPP band 1 (2100 MHz) networks worldwide
Source: Ovum WCIS

SCALE
billions of subscribers

~7.5Bilion mobile connections
Source: GSMA Intielligence

LOWER COST
economies of scale

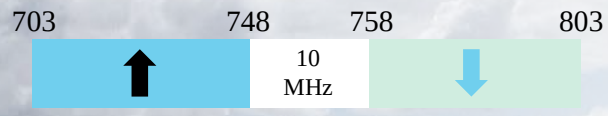
Average Subscriber cost per Mb decreased 99% from 2005 – 2013
Source: “The Mobile revolution” Boston Consulting Group



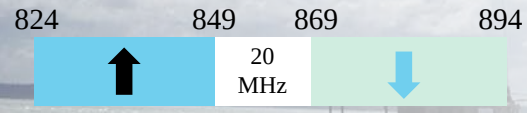
Identified Mobile Broadband Spectrum Resources

Asia Pacific Region

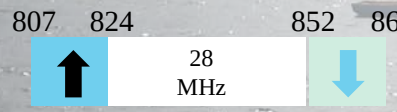
Coverage Bands (<1GHz)



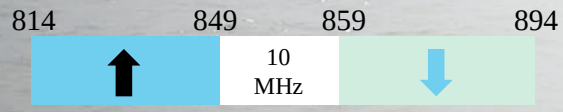
B28: 700 band: 2x45 MHz



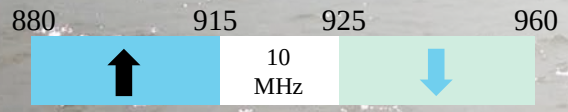
B5: 850 band: 2x25 MHz



B27: extended 850 band: 2x17 MHz

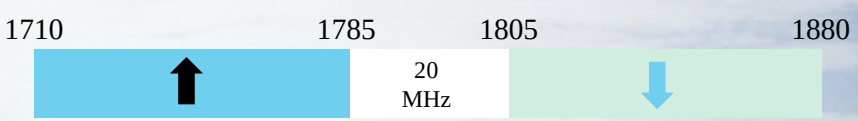


B26: extended 850 band: 2x35 MHz



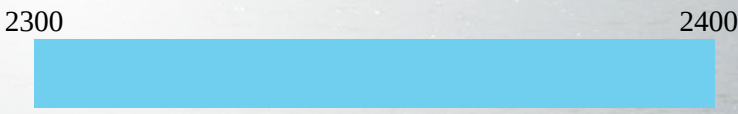
B8: 900 band: 2x35 MHz

Capacity Bands (>1GHz)



B3: band: 2x75 MHz

B1: 2100 band: 2x60 MHz



B40: 2300 band: 100 MHz

B7: 2600 band: 2x70 MHz with 50 MHz unpaired TDD

APT700 2x45 MHz FDD band plan (Band 28)

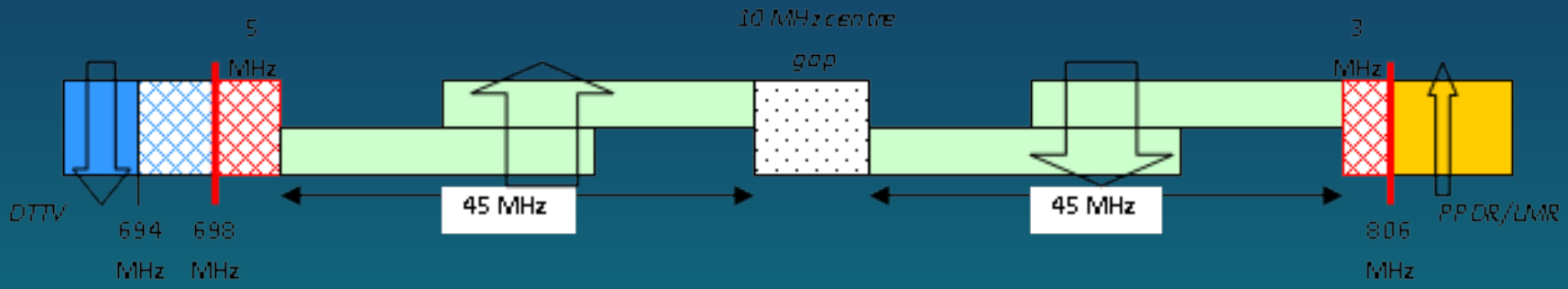
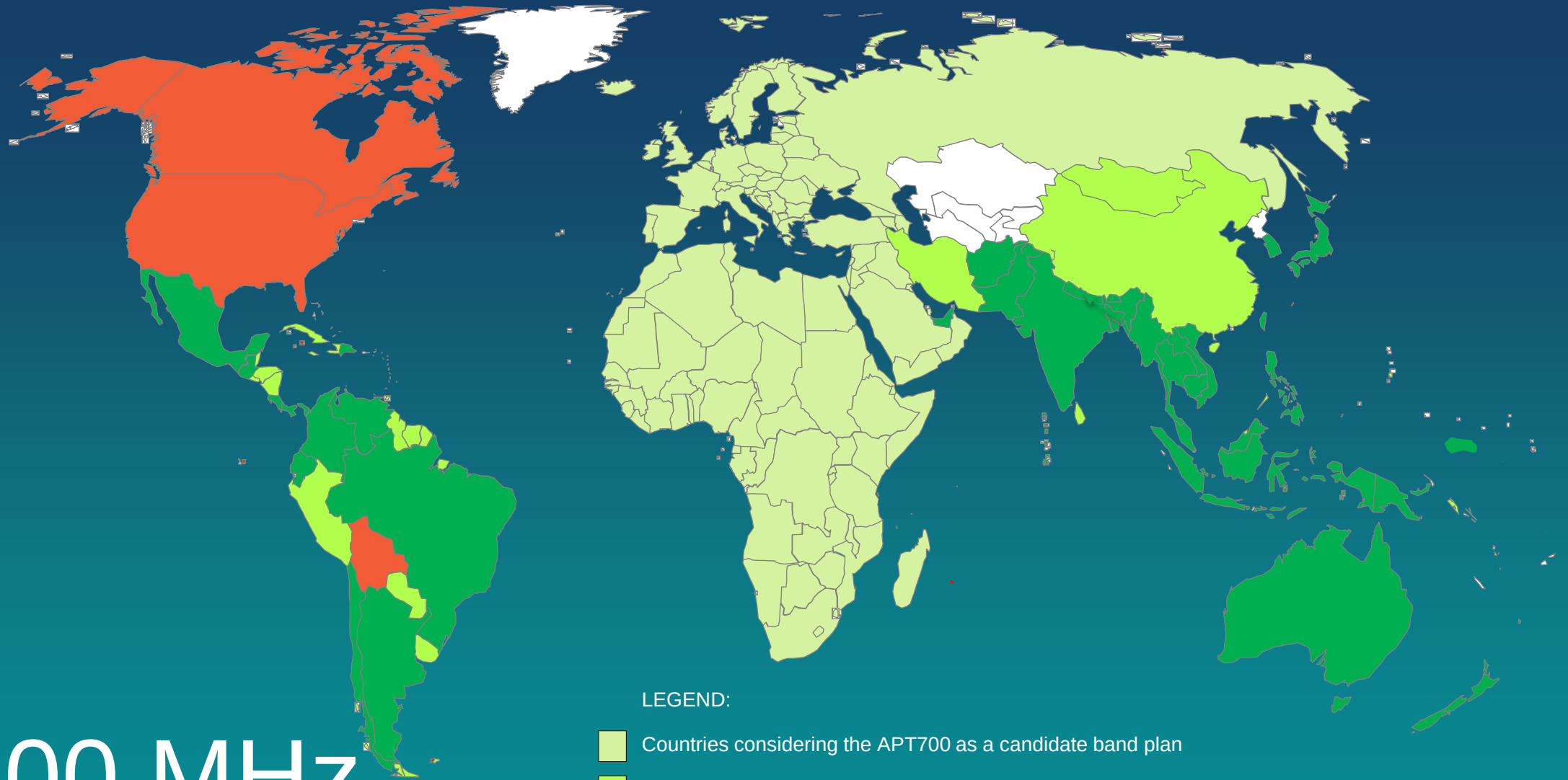


Figure 1: Harmonised FDD Arrangement of 698-806 MHz band

- Assigned to mobile operators: Argentina, Australia, Brazil, Chile, Ecuador, Fiji, Japan, Mexico, New Zealand, Panama, Papua New Guinea, Taiwan
- 8 commercial networks launched: Optus, Telstra, Vodafone NZ, Spark NZ, FarEasTone, Taiwan Mobile, Asia Pacific Telecom, Digicel
- Robust and growing ecosystem: 76 devices available from Apple, HTC, LG, Samsung, Sony, Alcatel, ZTE, Huawei, Motorola



700 MHz

Global Status

LEGEND:

- Countries considering the APT700 as a candidate band plan
- Countries covered by a regional recommendation for APT700
- Countries that have taken action towards adoption of partial or full APT700
- Countries that have taken action towards adoption of US 700 MHz band plan

Source: Qualcomm, Jan. 2014.

Medium Term Licensed Mobile Broadband Spectrum Resource

ITU World Radio Conference 2015 : Agenda Item 1.1

*"to consider additional spectrum allocations to the mobile service on a primary basis and identification of additional frequency bands for International Mobile Telecommunications (IMT) and related regulatory provisions, to facilitate the development of terrestrial mobile broadband applications, in accordance with Resolution **233 (WRC-12)**;"*

Report ITU-R M.2290 estimates **1340 – 1960 MHz to meet demand in 2020**
Mobile proponents favor consideration of **sub-700 MHz, 1.5 GHz, 2.7 – 2.9 GHz** and **3.5 GHz**

APG2015 Outcomes

PACP for IMT identification:	1427-1452 and 1492-1518 MHz - ONLY 51 MHz
No PACP:	1452-1492 MHz
PACP for No Change:	470-694 MHz and 2.7-2.9, 3.4-3.6, 3.6-3.8 and 3.8-4.2 GHz*
	* Countries can add their name to footnote 5.432A & 5.433A

Recommendation

Allow nations the flexibility to provide IMT spectrum access to meet future needs

Support frequency identifications for IMT by PACP or mutli-country proposals

Longer Term Licensed Mobile Broadband Spectrum Resource

ITU World Radio Conference 2015 – Agenda for WRC-19

ITU-R Developments

- Recommendation ITU-R M.[IMT.VISION]
- Report ITU-R M.[IMT.ABOVE 6 GHz]
- work plan, timeline, process and required deliverables for the IMT-2020 development
- Resolution ITU R [IMT.PRINCIPLES]

APG2015 Outcome

1.1 to consider identification of frequency bands for IMT including possible additional allocations to the mobile service on a primary basis in accordance with Resolution **[ASP-B10- IMT_ABOVE_6GHz]**

Recommendation

Support the development of advanced mobile solutions

Enable suitable spectrum access when it is needed

Support the APT PACP for a WRC-19 agenda item

Summary of Actions

- Harmonize spectrum usage on a regional basis to drive down device cost.
- Leverage established 3G and 4G LTE technology ecosystems
- Establish a spectrum release roadmap for the immediate, medium and long term by:
  - **Releasing spectrum to support 3G and 4G LTE technology**
    - **especially: 1800 MHz, 2300 MHz, 2600 MHz, 700 MHz**
  - **Support for the identification of new bands for IMT at WRC-15**
  - **Support a agenda item for IMT spectrum at WRC-19**
- Continue to seek industry stakeholder views

Thank you

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