MRP Report

Chris Pearson
President, 5G Americas

April 25-26
West Palm Beach, FL

www.5GAmericas.org

5G Americas Mission

5G Americas will advocate for and foster the advancement and full capabilities of LTE wireless technologies and their evolution to 5G, throughout the ecosystem's networks, services, applications and connected devices in the Americas.

Market Update

Global Mobile Subscriptions and Market Share
by Technology

GSM	*3 B Subscriptions* *41% Market Share*
HSPA	*2.3 B Subscriptions* *30% Market Share*
LTE	*1.9 B Subscriptions* *25% Market Share*
CDMA	*234 M Subscriptions* *3% Market Share*
TC-SCDMA	*100 M Subscriptions* *1% Market Share*

Source: Ovum, Dec 2016

LTE Technology Share of Market
by World Region
December 2016

North America leads the world in LTE market share
298 million LTE subscriptions
2/3 of all cellular connections!

Source: Ovum, Dec 2016

Mobile Connections and Market Share

by Technology

US and Canada | Year-End 2016

Source: Ovum, Dec 2016

Annual Technology Forecast

North America

2017 - 2021

Source: Ovum, Dec 2016

www.5gamericas.org

Mobile Connections and Market Share
by Technology
Latin America & Caribbean | Year-End 2016

Source: Ovum, Dec 2016

Annual Technology Growth
Latin America & Caribbean
4Q 2015 – 4Q 2016

Source: Ovum, Dec 2016

Annual Technology Forecast
Latin America & the Caribbean
2017-2021

Source: Ovum, Dec 2016

LTE Connections and Subscription Growth
Global

LTE Global Connections

LTE Global Subscription Growth

53% global market share by 2021

Source: Ovum, Dec 2016

LTE’s Innovation of Technical Progress

LTE to LTE-Advanced Pro Migration

2010 to 2012

Initial Deployments
- 5 or 10 MHz Radio Channels
- 2X2 Multiple Input Multiple Output (MIMO) Antennas
- Initial Self-Optimization/Organization for Auto Configuration

2013 to 2018

Higher Capacity/Throughput and/or Efficiency
- Wider Radio Channels: 20 MHz
- Carrier Aggregation: up to 640 MHz
- Advanced Antenna Configurations
- Coordinated Multipoint Transmission
- Het-nets (Microcells/Picocells/Femtocells)
- Het-net Self-Optimization/Organization
- More Intelligent and Seamless Offload
- Dual Connectivity

Greater Capabilities
- Voice Widely Handled in the Packet Domain (VoLTE)
- Policy-Based Quality of Service
- Integration with Unlicensed Spectrum

Enables more users, more applications, and a better experience

Source: Rysavy Research 2016

Successive Gains in Peak LTE Downlink Throughput

Source: Rysavy Research 2016

LTE – The Mobile Wireless Foundation for 5G

5G™

Toward the 5G Opportunity

ENERGY: smart grid adoption enabled by wireless connectivity could create 1.8 Trillion in added revenue in the U.S. [1]

HEALTH: connected devices could create $305 Billion in annual health system savings [2]

TRANSPORTATION: self driving cars reduce emissions by 40-90%, travel times by nearly 40% and delays by 20% [4]

Self driving cars could save 21,700 lives and $447 billion per year [5]

PUBLIC SAFETY: a one minute improvement in response time translates to a reduction of 8% in mortality [3]

[1] Electric Power Research Institute, January 2017
[2] Goldman Sachs, January 2017
[3] Journal of Health Economics, January 2017
[4] Deloitte, January 2017
[5] Eno Center for Transportation, January 2017

Forecasts

Monthly Mobile Data Traffic

- 2016 = 8M TB
- 2021 = 76M TB

iGR Feb 2017

5G Forecast

- 2021 subs = 25M
- 2021 NA Region =11M
- 2021 NA Region = 44% Market Share

Ovum (WCIS) Mar 2017

5G in 2022

- 550M 5G subscribers,
- 10% coverage
- 25% of North America subscriptions

Ericsson Mobility Report, November 2016

5G Traffic

- By 2021 5G connections will generate 4.7 times more traffic than the average 4G connection.
- 5G connections will appear in 2020 and grow more than 1000% by 2021

Cisco VNI Feb 2017

Network Technology Transformation

Wireless Network of the Present

Insufficient Spectrum
Capacity Constrained
Competitive Alternative to Wireline for Some

Wireless Network of the Future

Balanced Portfolio of Licensed and Unlicensed Spectrum
Significantly Greater Capacity
Competitive Alternative to Wireline for Many

Network Design:

- Larger cells on average
- Some small cells
- Some advanced radio methods
- Wi-Fi and cellular mostly operate independently
- Limited sharing of spectrum with government
- Frequencies: current cellular (600 MHz to 2.5 GHz)
- Total spectrum used: approximately 1 GHz

Network Design:

- Smaller cells on average
- Many small cells
- Many advanced radio methods (smart antennas, etc.)
- Unlicensed- and licensed-spectrum technologies work together in integrated network
- Selective sharing of spectrum with government
- Frequencies: current cellular bands and higher frequencies, including mmWave
- Total spectrum used: many GHz

Rysavy Research

TIA/Tolaga Research Operator Survey
5G Industry Concerns

Lack of diversity in 5G network densification

Uncertainties around backhaul technology

Disparate data offload strategies

Limited deployment partner groups identified for necessary cellular nodes

Less than 50% in telecommunications industry expected to make 5G investments in their CAPEX budgets by end of 2020

Source: TIA / Tolaga Research, Operator Survey, March 2017

5G Americas Technology Recommendations and White Papers

Global Organizations Forge New Frontier of 5G

Mobile Broadband Transformation LTE to 5G

The Evolution of 3GPP Communications Services

Network Slicing for 5G Networks & Services

V2X Cellular Solutions

Download free whitepapers at www.5GAmericas.org

5G Americas Technology Recommendations and White Papers

Small cell siting: regulatory and deployment considerations

Understanding the Standards for LTE-Advanced Enhancements

Optimizing Mobile Media Delivery and the Impact of Encryption

Understanding Information Centric Networking and Mobile Edge Computing

LTE and 5G Technologies Enabling The Internet Of Things

Multi-operator and neutral host small cells

Download free whitepapers at www.5GAmericas.org

Spectrum Considerations

Spectrum and the Evolution to 5G

Existing bands <6GHz	**Licensed** Exclusive rights granted to an operator by regulator	**Licensed** Provides reliable, secured spectrum for predictable quality/capacity	**Licensed** Provides reliable, secured spectrum for predictable quality/capacity
cmWaves 6-30GHz	**Shared** Shared with incumbents	**Shared** Coordinated access when/where not used by incumbents	**Shared** Facilitates timely access to spectrum in shared bands
mmWaves >30GHz	**Unlicensed** No registration or individual permission	**Unlicensed** Rules established to avoid interference	**Unlicensed** Complement for LTE & 5G e.g. in small cell deployment

Additional harmonized spectrum needed in existing and new bands

High frequencies for ultra-dense 5G small cell deployments

Both licensed, unlicensed exclusive and shared spectrum

U.S. Broadcast Television Spectrum Incentive Auction

- Over $19.6 Billion raised
- Expect 70MHz Spectrum (plus 14 MHz of guard band)
- 39 Month repacking plan to reshuffle TV spectrum

U.S. Citizens Broadband Radio Service
3.5 GHz Spectrum

- **3550-3700 MHz**
- **The Citizens Broadband Radio Service is governed by a three-tiered spectrum authorization framework to accommodate a variety of commercial uses on a shared basis with incumbent federal and non-federal users of the band.**
- **Access and operations will be managed by a dynamic spectrum access system.**
- **The three tiers are: Incumbent Access, Priority Access, and General Authorized Access.**

U.S. CBRS Spectrum Framework

Tier 1 (Incumbents)
- Primarily in coastal areas, some inland
- Wireless ISPs to transition to Tier 2/3

Tier 2 (PAL)
- Up to seven 10MHz channels
- 3-year term by census tract

Tier 3 (GAA)
- At least 80MHz of commercial use

2016 CBRS Alliance

U.S. 5G Decision
FCC Rules on Spectrum Frontiers

mmWave Spectrum

28 GHz

37 GHz

39 GHz

FCC Spectrum Frontiers

FNPRM: Additional Bands for Consideration

Spectrum	
24 – 25	GHz
32	GHz
42	GHz
48	GHz
51	GHz
70	GHz
80	GHz

Next Generation Considerations:
The End-to End 5G Ecosystem

REGULATORY
Spectrum Resiliency
Lawful Intercept
Spectrum Sharing
Emergency Services

RADIO
Advanced Interference Management
Massive MIMO
Security
Modulation
Millimeter Wave

CORE
NFV
Security
M2M/IoT
Ubiquitous
Storage & Computing

APPLICATIONS
Security
Context Aware Networking
M2M/IoT
D2D Apps

DEVICES
Mesh Networks
D2D
Modulation
Context Aware Networking

Thank you

www.5GAmericas.org