

5G: VISION AND TECHNICAL ENABLERS

3GPP TSG RAN – 5G Workshop

Phoenix, USA, 17-18 Sept. 2015

RWS-150044

OVERVIEW

- Introduction
 - The 5G Ecosystem
 - Performance Objectives
- Vision and Enablers to Support:
 - Diversity of Services
 - Diversity of Environment
 - Diversity of Spectrum
- Summary

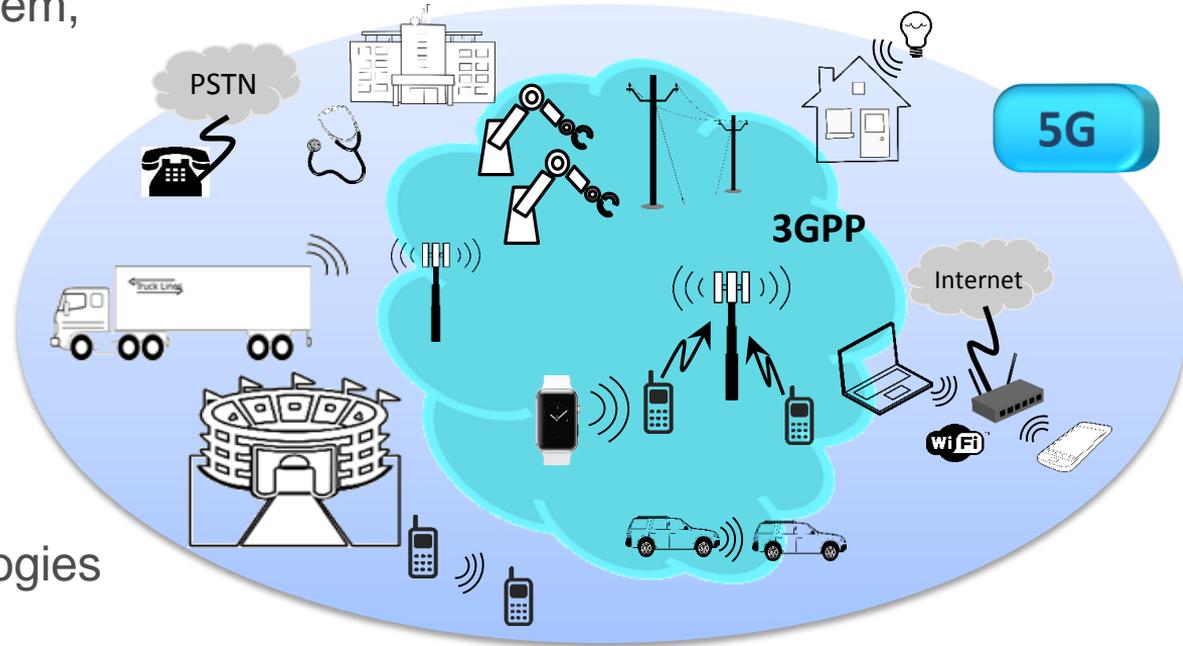


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THE 5G ECOSYSTEM

- 5G is a complete ecosystem, bringing together:
 - Multiple industries
 - Multiple technologies
 - Service Providers
- 3GPP should support seamless interoperability with other 5G ecosystem components and technologies



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PERFORMANCE OBJECTIVES

User Rates



- 10 Gbps with low mobility
- 100 Mbps everywhere

Super Real-Time Connections



- Sub-1ms Capable

Capacity



- 100 - 1000x vs. today
- e.g. 10Mb/s/m² for hotspots

Diversity of Radio Access



- Seamless integration of multiple networks and radio technologies

Support for Massive Machine Deployment

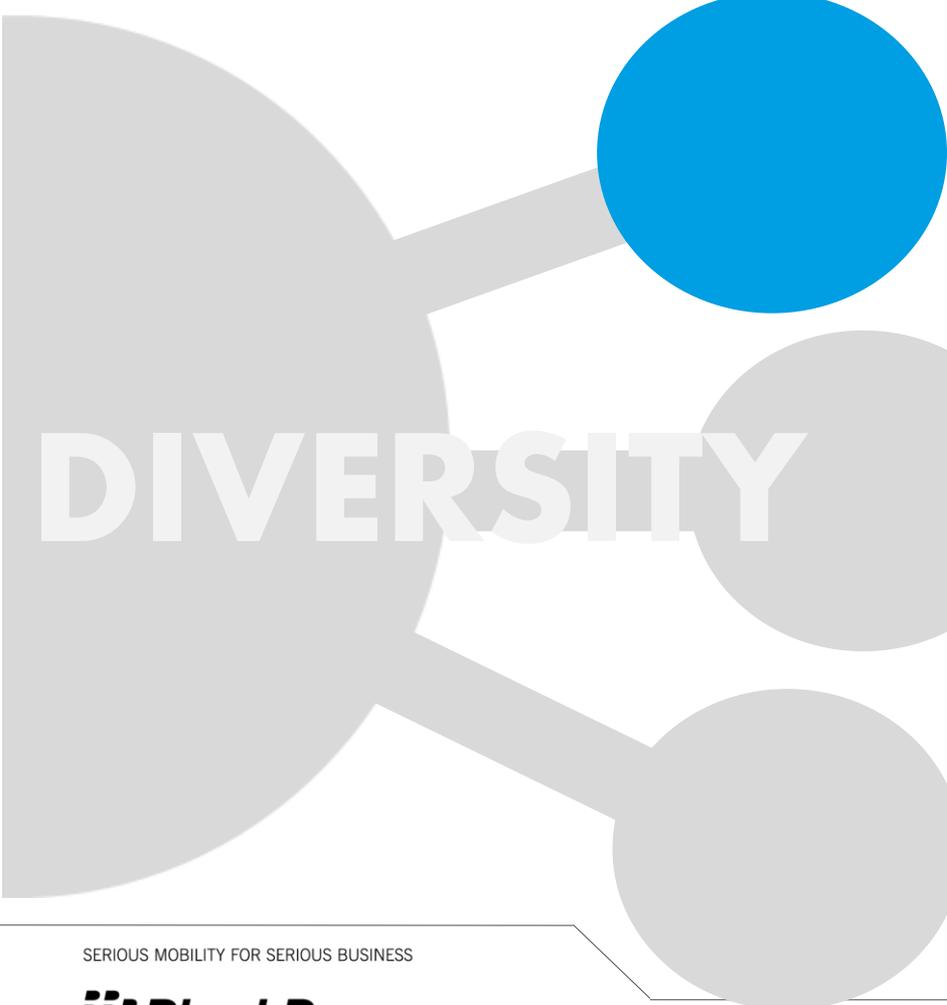


- e.g. 10⁶ machine devices per km²

Security



- Low overhead
- High resilience
- New paradigms and challenges



DIVERSITY

OF SERVICES

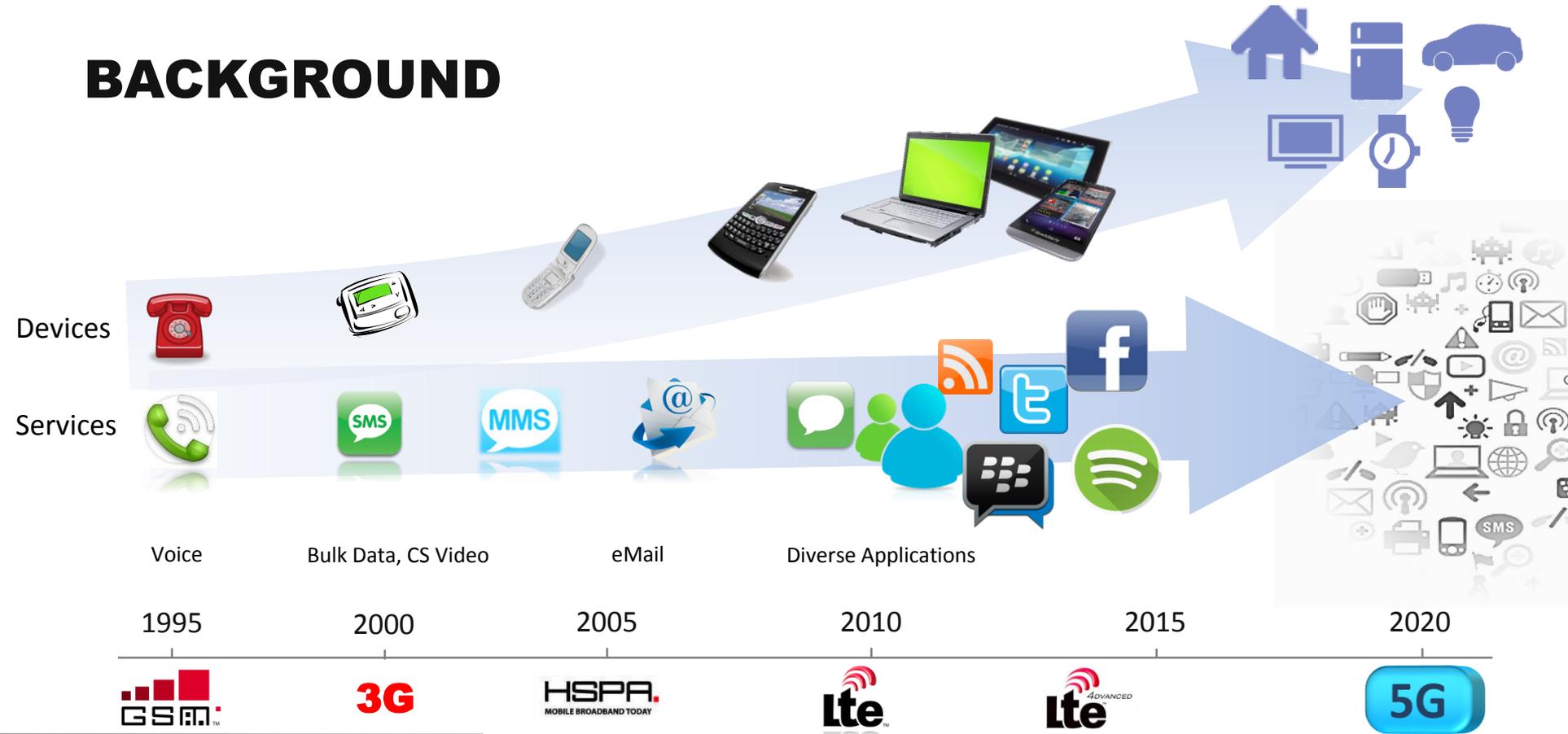
OF ENVIRONMENT

OF SPECTRUM

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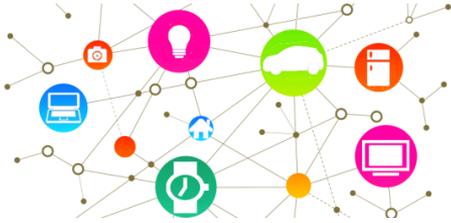
BACKGROUND



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EXPANDING OPPORTUNITIES



Internet of Things:

- Everything Connected
- Entirely New Vertical Markets & Industries
(transport, healthcare, energy/utilities, smart-homes & cities, ...)
- Security Challenges in new paradigm



Pervasive Ultra Broadband:

- Near-zero latencies
- Immersive Multimedia & Augmented Reality
- Agile and responsive cloud applications



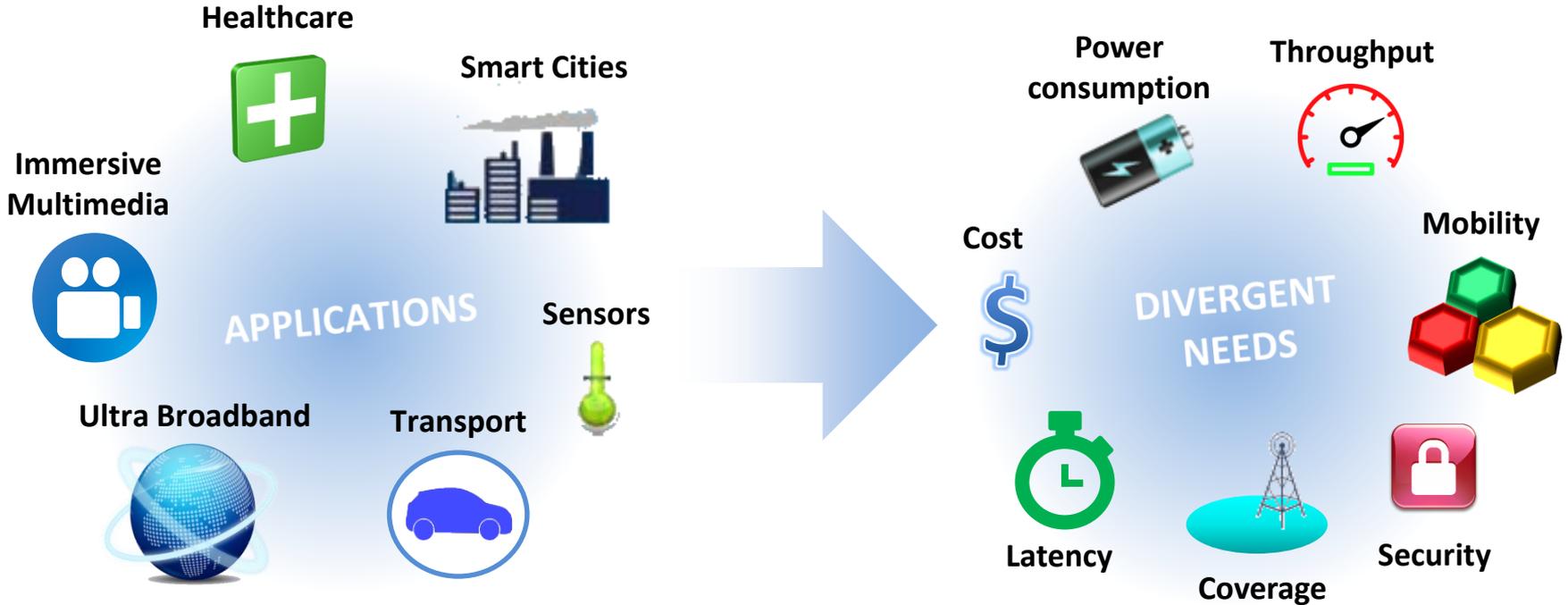
High Reliability & Security

- Public Safety / Mission Critical Communications
- Governmental and Regulated Industries
- Process Automation, Transport Systems

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RADIO REQUIREMENTS



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KEY REQUIREMENTS: DIVERSE SERVICES

- Service Awareness



- Smart edge nodes
- Highly flexible and optimised configurations for potential extremes of requirements

- Device and State Awareness

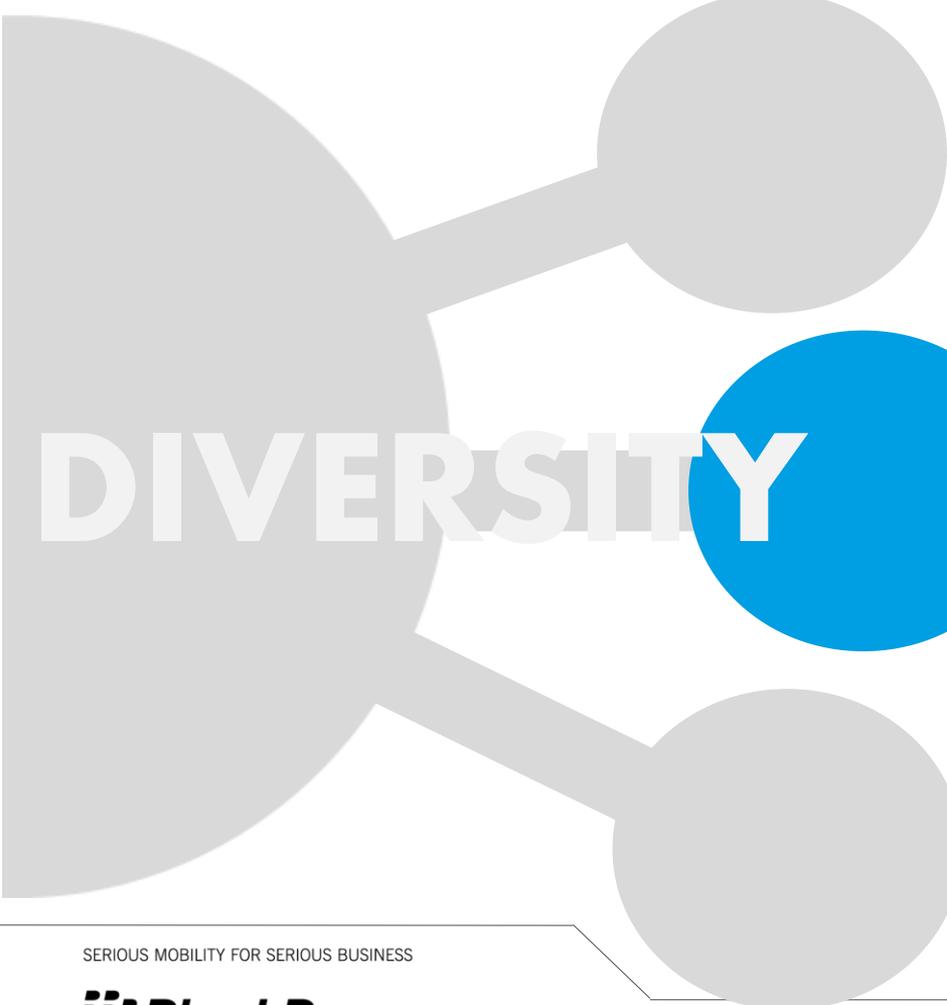


- Dedicated / specialised 'Single-Service' Devices
- Multi-Service 'Smart' Devices

- Security



- IoT 'everything connected' brings a host of new challenges
- Also paramount for public safety, regulated industries and industrial automation
- Secure node authentication for ad-hoc, P2P and mesh networking



DIVERSITY

OF SERVICES

OF ENVIRONMENT

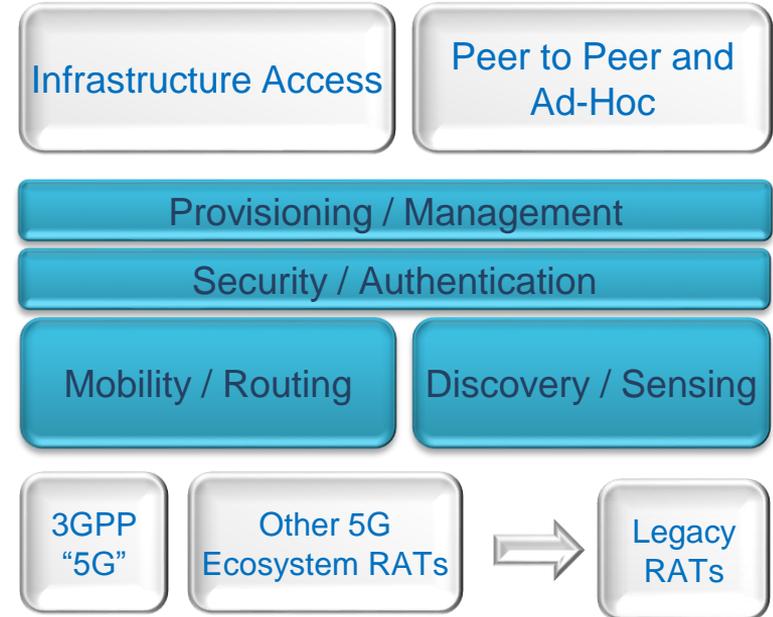
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DIVERSE CONNECTIVITY

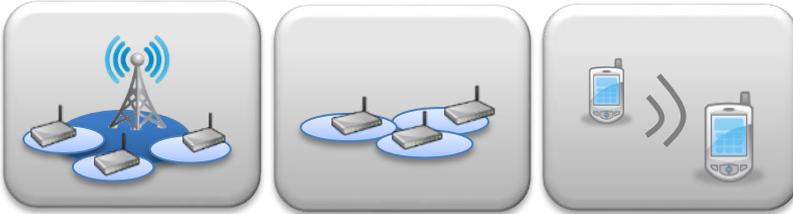
- Environment characterised by:
 - Heterogeneous deployments (wide area, short range, P2P)
 - Multiple connectivity options
 - Multiple radio technologies
- Radio Accesses
 - Flexible and adaptive new 3GPP 5G RAT(s)
 - Other 5G Ecosystem RATs
 - Legacy RATs
- Close integration / interworking with other accesses required via open interfaces
 - Convergence technologies will play a key role



DYNAMIC CONNECTIVITY SELECTION



Services



Connectivity



Devices

- Device-centric approach
 - Always best connected
- Connectivity selection based on:
 - Service needs
 - User requirements & preferences
 - Current environment
 - Network Availability
- Scenarios
 - D2D, Mesh, Small Cells, Macro, ...
 - 5G Ecosystem and legacy RATs

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KEY REQUIREMENTS: DIVERSE ENVIRONMENTS

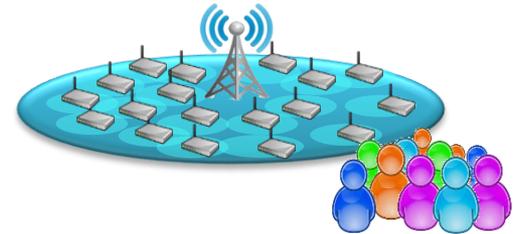
- **Dynamic Connectivity and Access Selection**

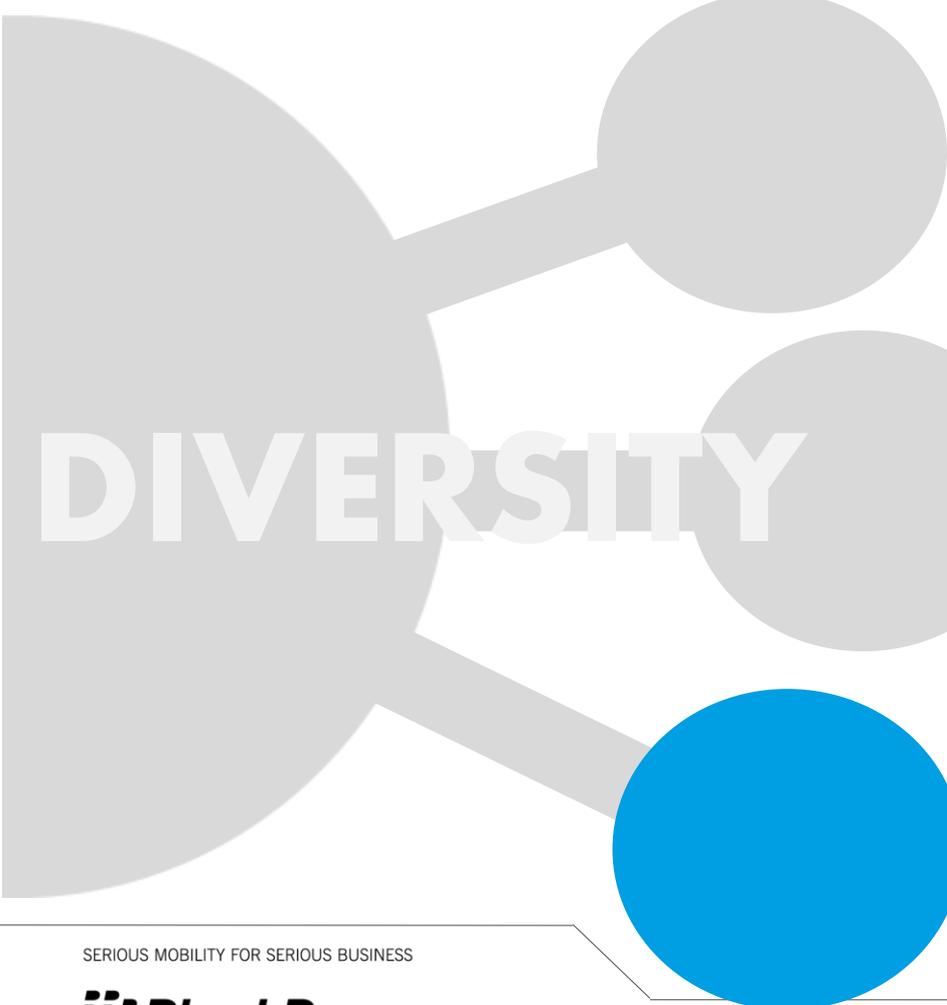
- Based on user needs, preferences, environment, network availability
- Convergent experience requires cross-network / cross-RAT QoE management



- **Self Configuration and Deployment**

- Support for large-scale / ad-hoc small-cell infrastructure
- Designed for high-density environments
- Operable over 3rd party backhaul / interconnect





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OF SERVICES

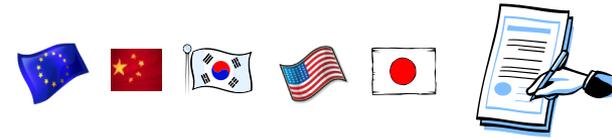
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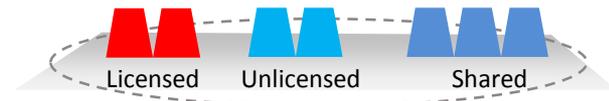
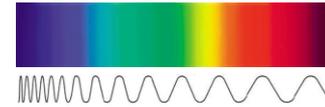
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REGULATORY ASPECTS

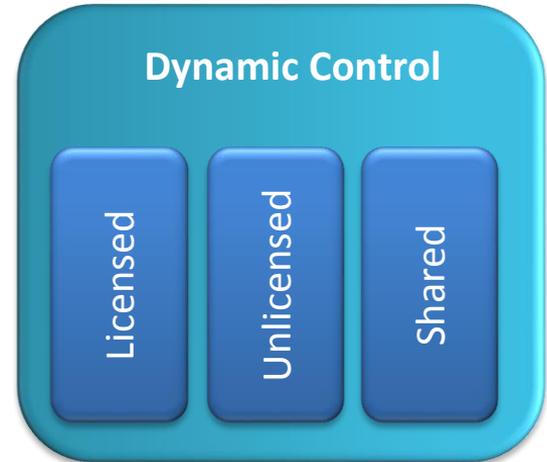


- Imperfect Global Harmonisation
 - Regional fragmentation will remain
- Use of higher frequencies
 - IMT beyond 6GHz, WRC-19
 - Candidate bands
 - 23/24GHz (TBD), 37-52GHz (TBD)
 - 60-76GHz (Unlicensed), 81-86GHz (TBD)
- Spectrum Types
 - From a Licensed to a Mixed regime...
(Shared spectrum, Whitespaces, Unlicensed)



DYNAMIC ACCESS TO SPECTRUM

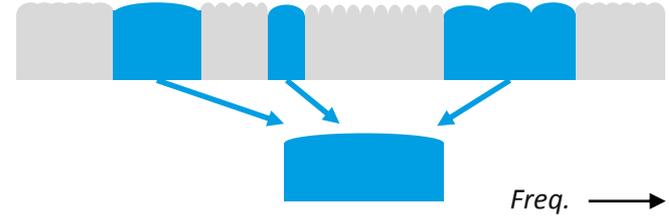
- Spectrum Sharing
 - Maximize efficiency and use of unused spectrum
 - Coexistence and coordination with other ecosystem technologies
- Coordination of resources
 - Intra-operator
 - Inter-operator
 - Between operator and P2P



FLEXIBLE SPECTRUM SUPPORT

Scalable aggregation

- Pooling of fragmented resources
- Improved scalability vs. LTE CA and DC
- Manageable complexity for devices supporting wide frequency ranges



Duplexing

- Agile solutions to address a variety of allocations
 - FDD, Adaptive/Dynamic TDD, Full Duplex
- Common waveforms for UL / DL
 - Symmetry eases path to Mesh, D2D, Relay



KEY REQUIREMENTS: DIVERSE SPECTRUM

- Support for mixed spectrum types
 - Licensed, Shared, Unlicensed
- Highly scalable framework (and waveform) for aggregation
 - High flexibility, manageable complexity
- Flexible duplex arrangement
 - To support wide variation of deployment scenarios

SUMMARY

- 5G will address new markets, connecting people, things and industries, characterised by:
 - Diverse Services
 - Diverse Environments
 - Diverse Spectrum Allocations
- 3GPP will play a key role in the 5G ecosystem
 - Defining new Radio Technologies
 - Integrating and coexisting with others

Services

- Service awareness
- Robust security for new paradigms

Environment

- Dynamic Connectivity Selection
- Self Configuration & Deployment

Spectrum

- Support for mixed spectrum types
- Scalable and flexible aggregation

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