

SPECTRUM SHARING FOR CAPACITY AND BUSINESS GROWTH

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Outline



Business and Use Cases



Comparative Overview of European and U.S. Solutions



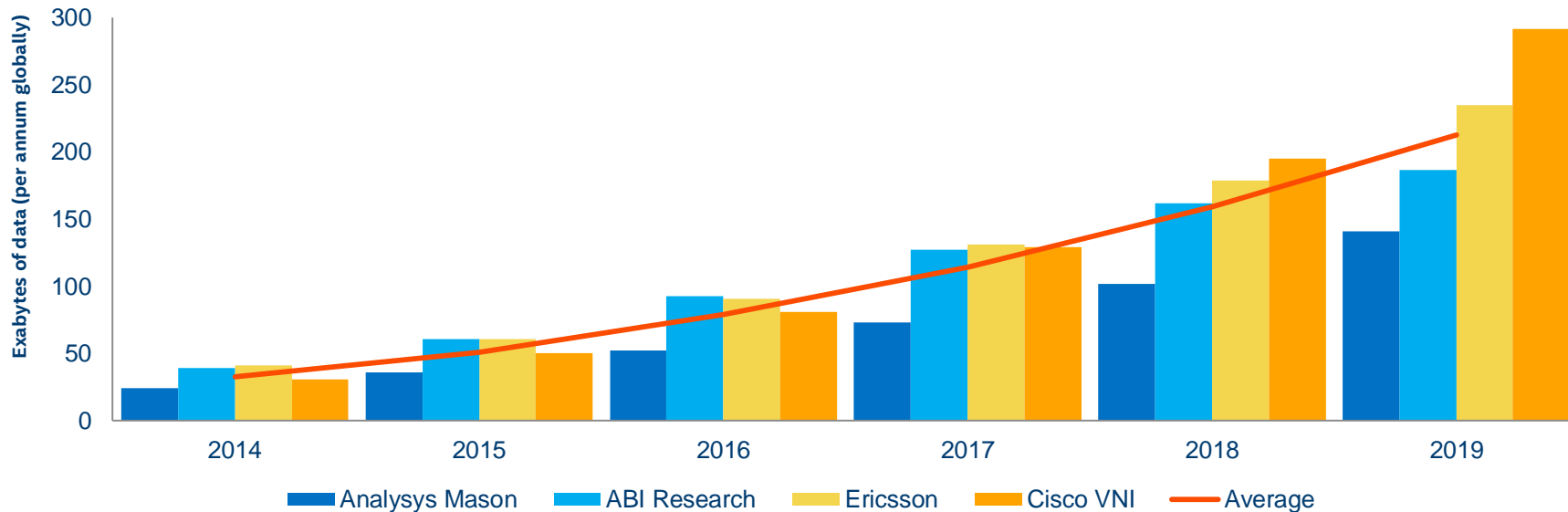
Key Challenges and Status



Future Outlook

Data Demand

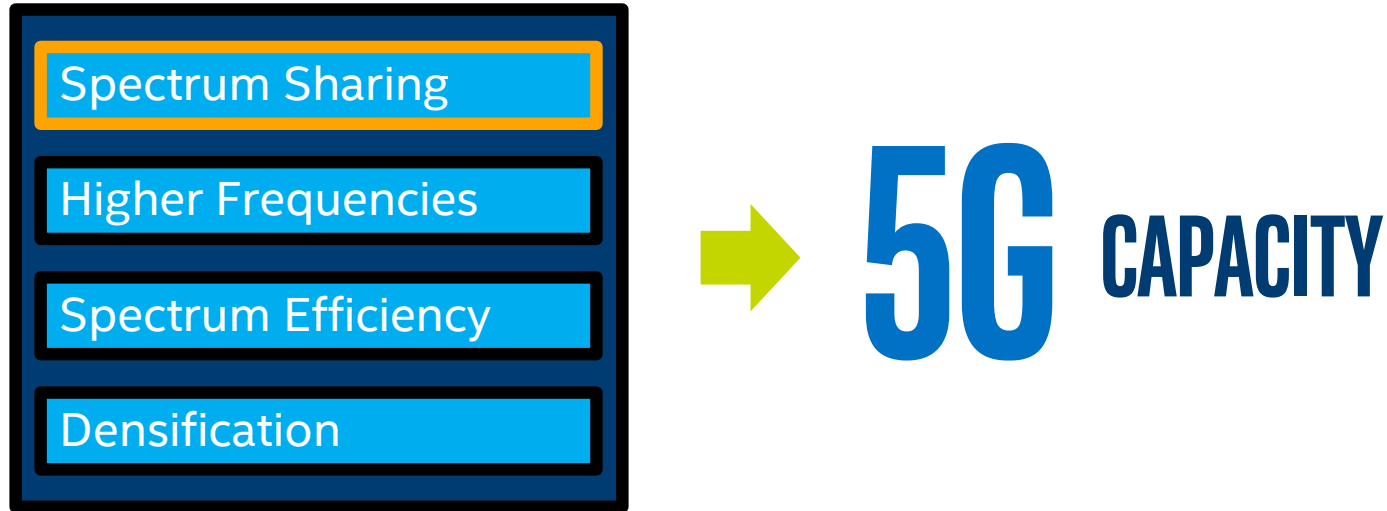
Growth from 2014-2019 expected to be 6-10X



5G IS EXPECTED TO PROVIDE 1,000 – 10,000X CAPACITY GAINS

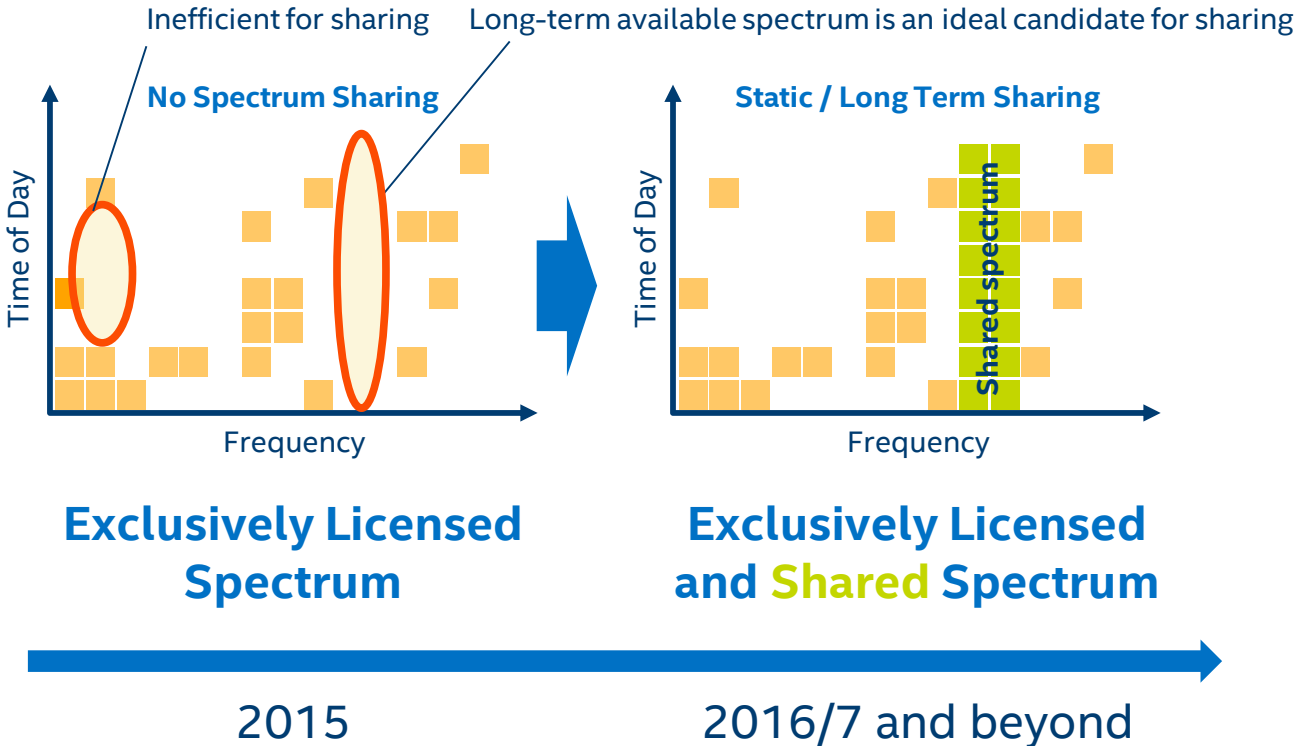
Source: FUTURE MOBILE SPECTRUM REQUIREMENTS, GSMA, 2015

Spectrum Sharing is an Enabling Technology for 5G









EFFECTS OF COMPLEMENTARY VECTORS ARE MULTIPLICATIVE

Spectrum Sharing Monetizes Available Spectrum



Different Sharing Business Models in Europe and US

Provide capacity extension to carriers on co-primary basis (quasi-licensed)

LSA	SAS
	
	
	

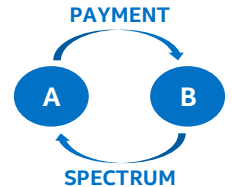
Enable new business cases, e.g. local businesses owning spectrum in a small geographic area

Enable license-by-rule usage of spectrum, e.g. for cellular off-loading

OTHER REGIONS ARE CURRENTLY INVESTIGATING THE TECHNOLOGY AND ARE EXPECTED TO FOLLOW

Three Design Guidelines Built into Sharing Technology

A clear business model is required – who sells what to whom?



Investment certainty is required

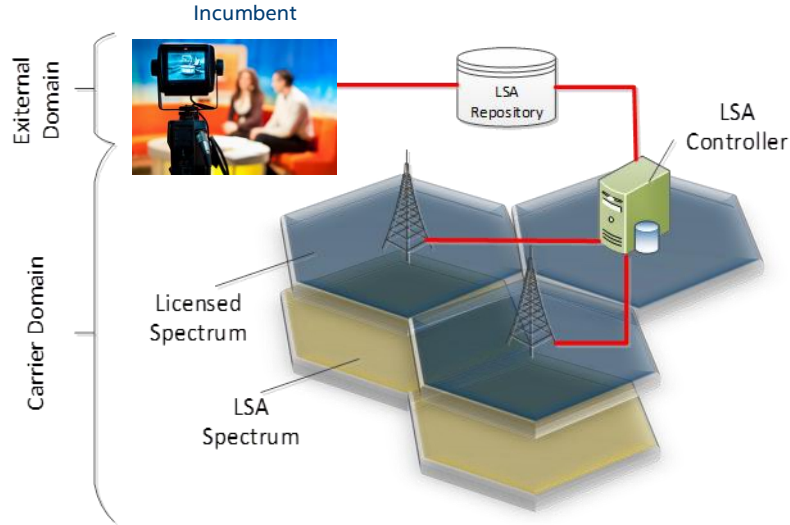
- Guaranteed Service Quality
- Guaranteed Availability over Space, Time, Frequency



Protection of assets is required – sharing of equipment, information, etc.



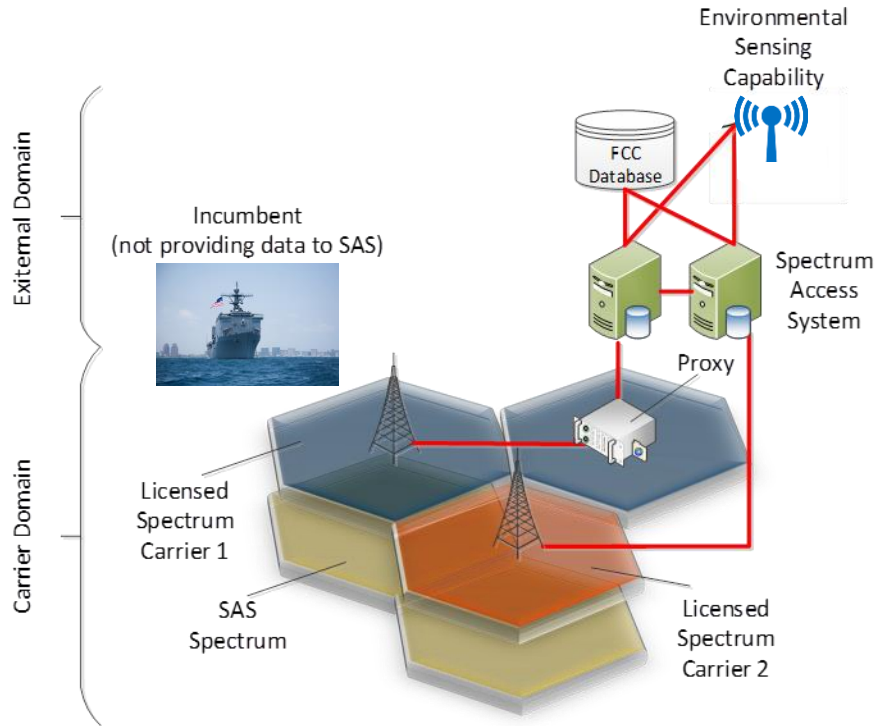
European Licensed Shared Access (LSA) Provides Additional Spectrum to Carriers



- LSA supports:
 - 1st tier: Incumbent User
 - 2nd tier: (Co-primary) Licensee
- Operates in 2.3-2.4 GHz (LTE Band 40)
- Incumbent protection through database

- ✓ A clear business model
- ✓ Investment certainty
- ✓ Protection of assets

U.S. Spectrum Access System (SAS) Provides Additional Spectrum to Carriers and Enables New Business Cases



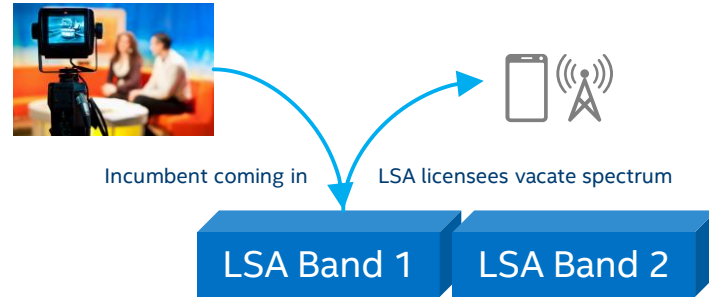
- SAS supports:
 - 1st tier: Incumbent User
 - 2nd tier: Primary Access License
 - 3rd tier: General Authorized Access
- Operates in 3.55-3.7 GHz (LTE Bands 42/3)
- Incumbent protection through sensing

- ✓ A clear business model (tbd for Tier-3)
- ✓ Investment certainty
- ✓ Protection of assets (under definition)

Protection Mechanisms for Incumbent Systems

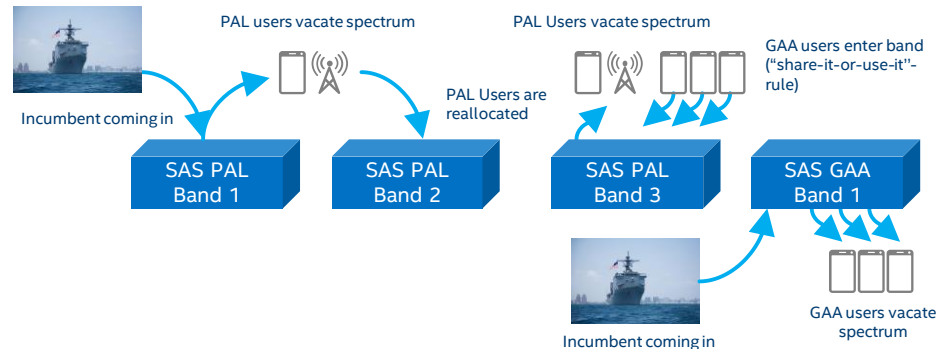
Licensed Shared Access (LSA)

- LSA Licensee (tier-2)



Spectrum Access System (SAS)

- Priority Access License (PAL, tier-2)
- General Authorized Access (GAA, tier-3)



SAS and LSA Incumbents Differ Substantially

Naval Shipborne Radar Systems



Satellite System



SAS
3.55-3.7 GHz

Dedicated Spectrum

LSA/SAS Spectrum



Amateur Radio



Mobile Video Link



Unmanned Aeronautical Vehicles



Civil/Military Fixed/Mobile Aircraft Telemetry Systems





PMSE/Professional Wireless Camera Systems

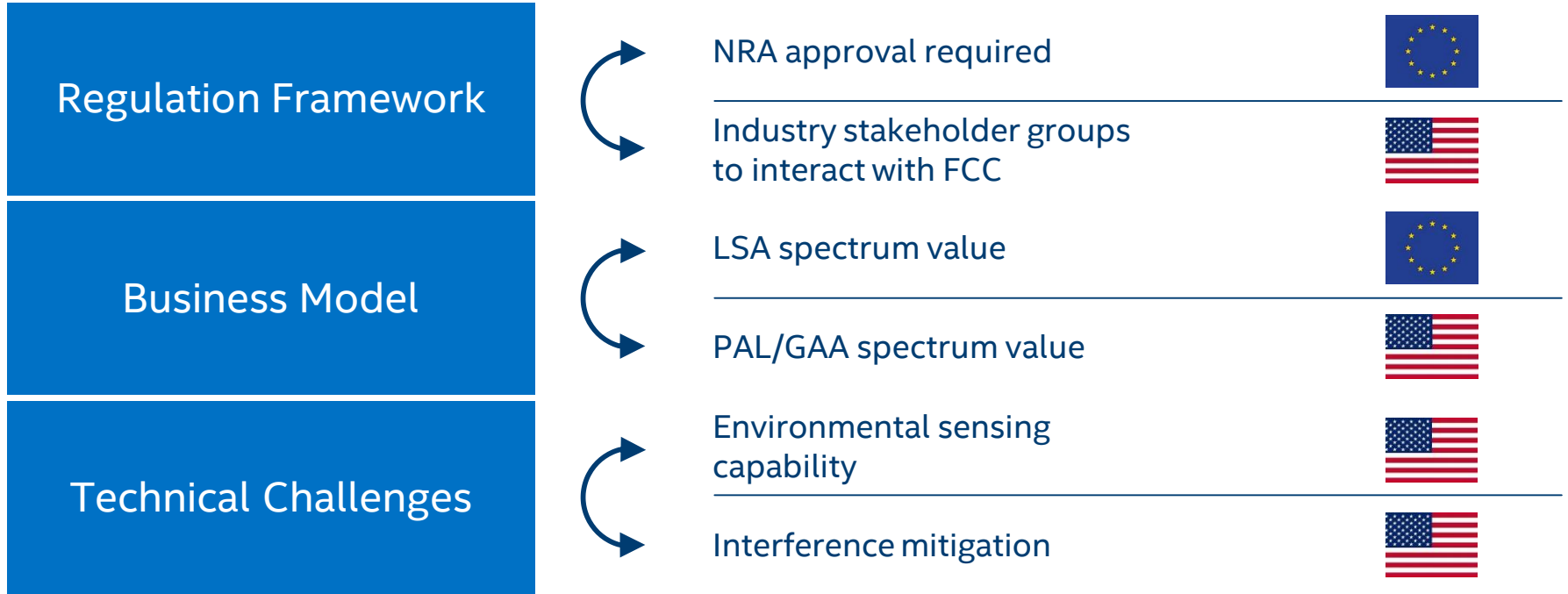
LSA
2.3-2.4 GHz

Aircraft Telemetry Systems photo: SNC, <http://www.sncorp.com/AboutUs/NewsDetails/537>

SAS Offers New Business Models at Higher Complexity

	LSA 	SAS 
Incumbent Protection	Incumbent protection through database	Sensing-based protection of incumbents
Interference Mitigation	Not required	Interference mitigation across census tracts
Protection of Licensee Information Assets	Full protection	Interference mitigation requires licensee's configuration data
Licensing period	To be negotiated (target: >10 yrs)	3 yrs (first license: 6 yrs)

Challenges for Implementation



Standards Groups Paving the Way to Mass Adoption



Licensed Shared Access (LSA)
2.3-2.4 GHz



Spectrum Access System (SAS)
3.55-3.7 GHz



World Class Standards

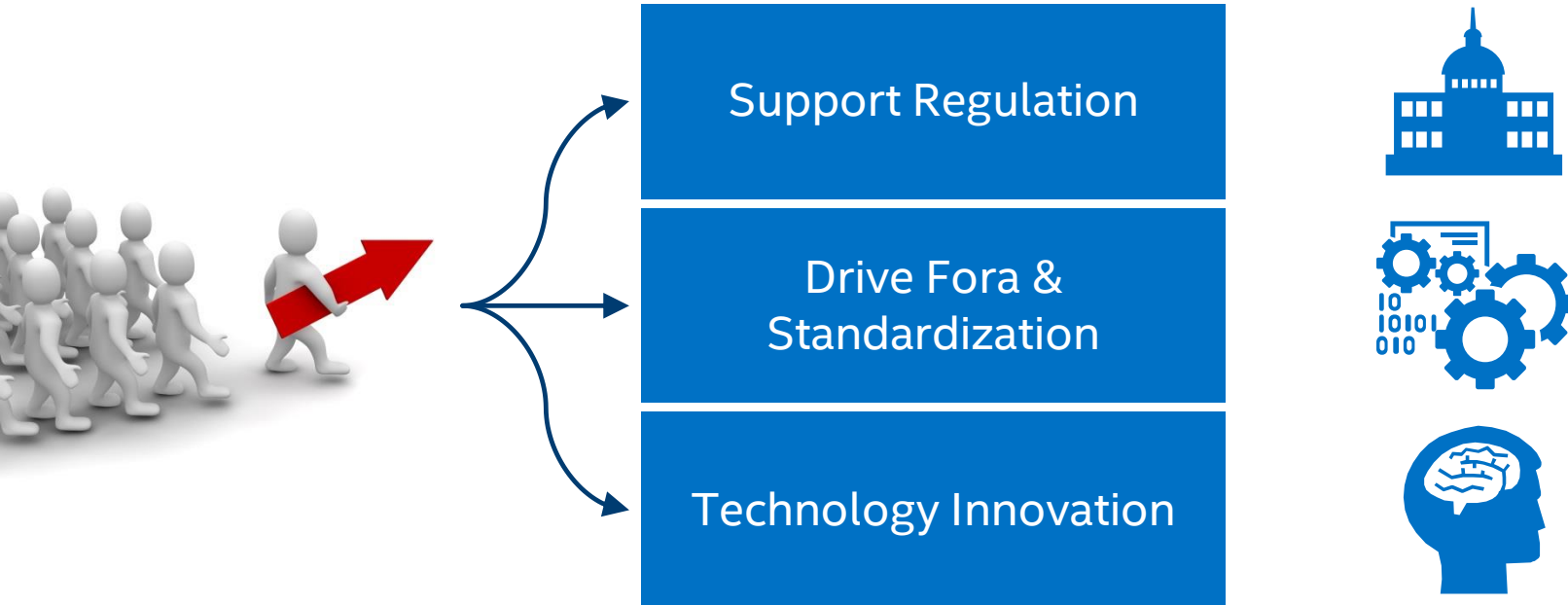


A GLOBAL INITIATIVE



SDR FORUM VERSION 2.0 WIRELESSINNOVATION.ORG

Leadership Must Drive Across Multiple Areas



5G Capabilities Enabled by Spectrum Sharing



Changing the World with Technology

- New applications
- QoS through optimum resource usage

Next Steps for Technology

- Convergence
- Further bands
- Higher flexibility / shorter-term sharing



5G Capacity Enablers

SPECTRUM SHARING

Licensed Shared Access
Spectrum Access System

SPECTRUM EFFICIENCY

Multiple Opportunities

5G CAPACITY

HIGHER FREQUENCIES

cmWave / mmWave

DENSIFICATION

Small Cells

FUTURE WEBINARS WILL DISCUSS OTHER METHODS TO INCREASE CAPACITY

Download Intel's Spectrum Sharing white paper for more information on sharing schemes, business cases and implementation strategies

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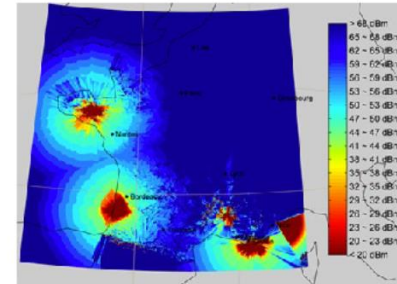
Intel Corporation

<http://www.intel.com/content/www/us/en/wireless-network/spectrum-sharing-lsa-sas-paper.html>



Spectrum Sharing: Licensed Shared Access (LSA) and Spectrum Access System (SAS)

Markus Dominik Mueck, Srikathyayani Srikanteswara, Biljana Badic



White paper

Spectrum sharing technology is steadily gaining both attention and momentum within various regulatory bodies (European CEPT, US FCC), standards groups (ETSI, 3GPP) and industry fora (Wireless Innovation Forum). It is expected to be a key tool that will enable regulators to provide the capacity required for 5th Generation (5G) mobile applications. This white paper provides a detailed and comparative overview of shared spectrum technologies currently deployed in Europe (Licensed Shared Access – LSA) and the U.S. (Spectrum Access System – SAS).

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Q&A

BACKUP

5G Unleashes Enhanced & New Capabilities



SERVICES

Social Gaming
Automotive Entertainment
3D Video & Hologram Calls
Enhanced Position-location



INDUSTRIAL APPLICATIONS

Smart Cities
Energy
Safety & Security
Health & Wellness



IMMERSIVE USER EXPERIENCES

Augmented & Virtual Reality
Interactive HD TV
Context-aware Devices
Multi-user Telepresence

ENABLED BY HIGH-SPEED & CAPACITY, LOW-LATENCY CLOUD COMPUTING

5G Landscape: Focus on User

MMI¹ Communications

- Virtual remote communications
- Telepresence



Transportation Systems

- Navigation and infotainment
- Autonomous vehicles



Connected Health

- Remote healthcare
- Continuous diagnostics



Tactile Real-time Control

- Remote tactile experience
- Critical real-time machine type communications (MTC)



Augmented Reality

- Perception at a distance
- Embedded multi-view



Ultra High Definition

- Video and audio
- Multi-angle viewing



THE COOLEST USES FOR 5G...NOT YET INVENTED.