



Spectrum Sharing

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Wireless Innovation 2013

- Spectrum Sharing
- President's Council of Advisers on Science and Technology (PCAST) 2012
 - 5G with Radar Integrated Networks (5GRINS)
- FirstNet – Progress, Plans, Trend Setting
- FCC 3550 MHz NPRM
 - Small cells and shared spectrum
- Conclusions

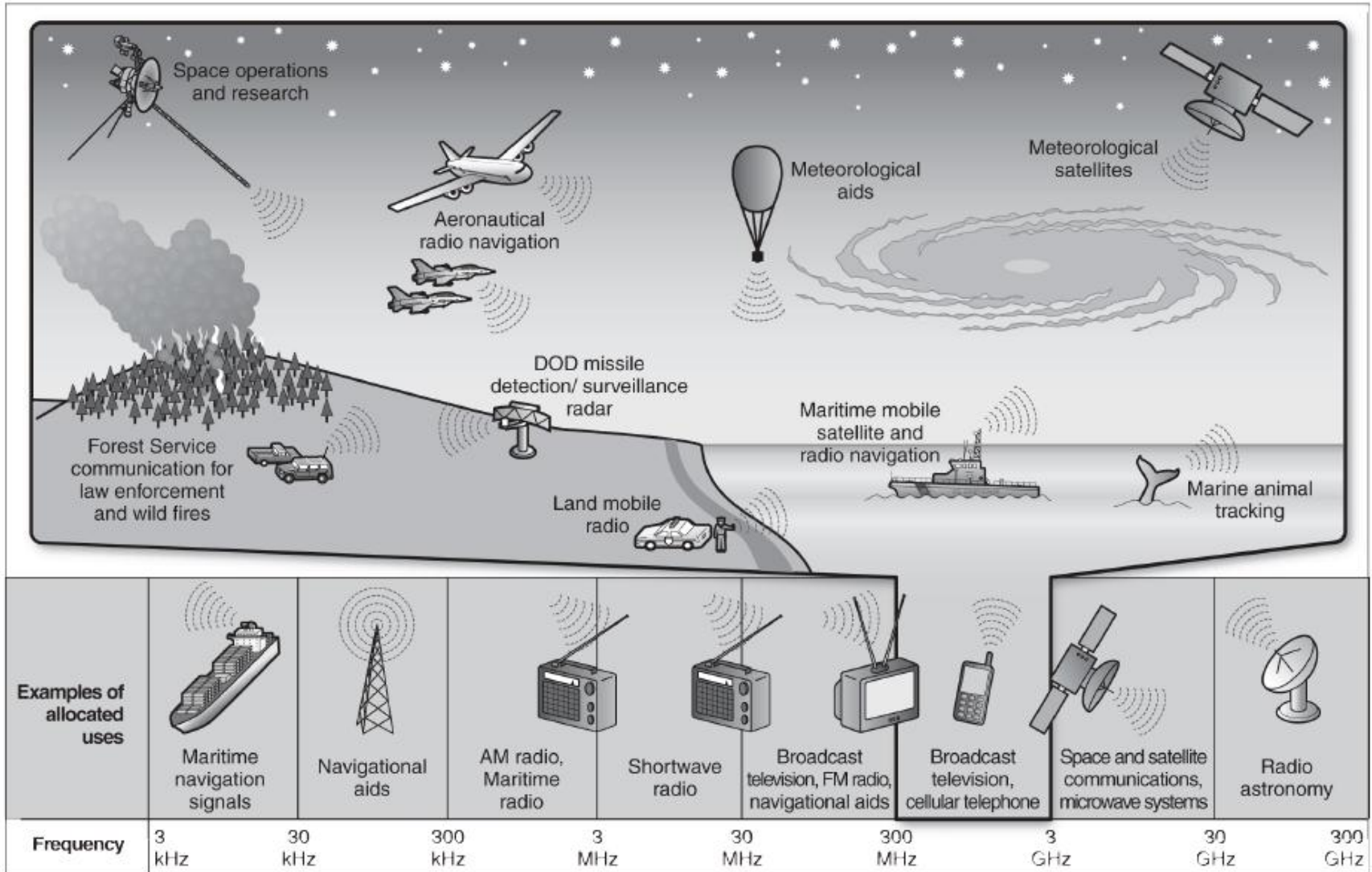
PCAST Applications

Table 1.1: Variety of Spectrum Applications

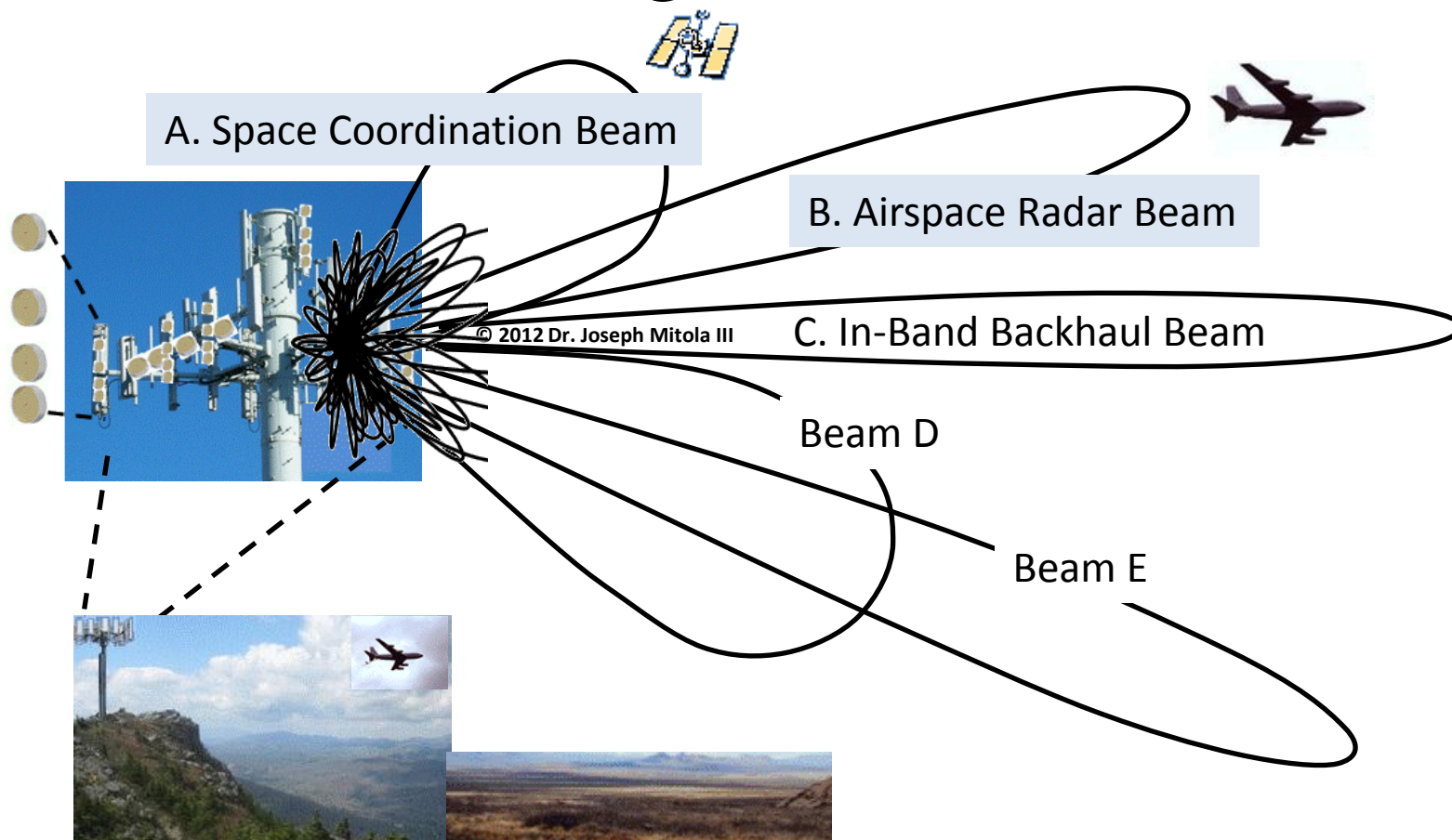
Cellular telephone systems	Wireless broadband	Civil and military radar
Wi-Fi Devices—Home and business networks: Hot-spots	Tank-level meters	Industrial automation controls
Community, urban & rural broadband	Traffic light controls	RFID systems
Bluetooth headsets & keyboards	Crane controls	Retail anti-theft systems
Automobile keyless entry	Lighting controls & dimmers	Security alarm systems
In-home video distribution	Wireless door bells	Wireless speakers
Remote control toys	Cordless phones	Satellite Radio-to-FM radio
Toy walkie-talkie	Garage door opener controls	Convergence w licensed devices
Utility meter readers & smart grid energy control	Sensors for automatic doors	Meat thermometers
Medical camera pills	Inventory control	Diaper wetness sensor
Medical panic alerts	Pool cover controllers	And the list goes on....

Source: Presentation by Julius Knapp, FCC, IDGA 2012 Conference.

PCAST Sweet Spot



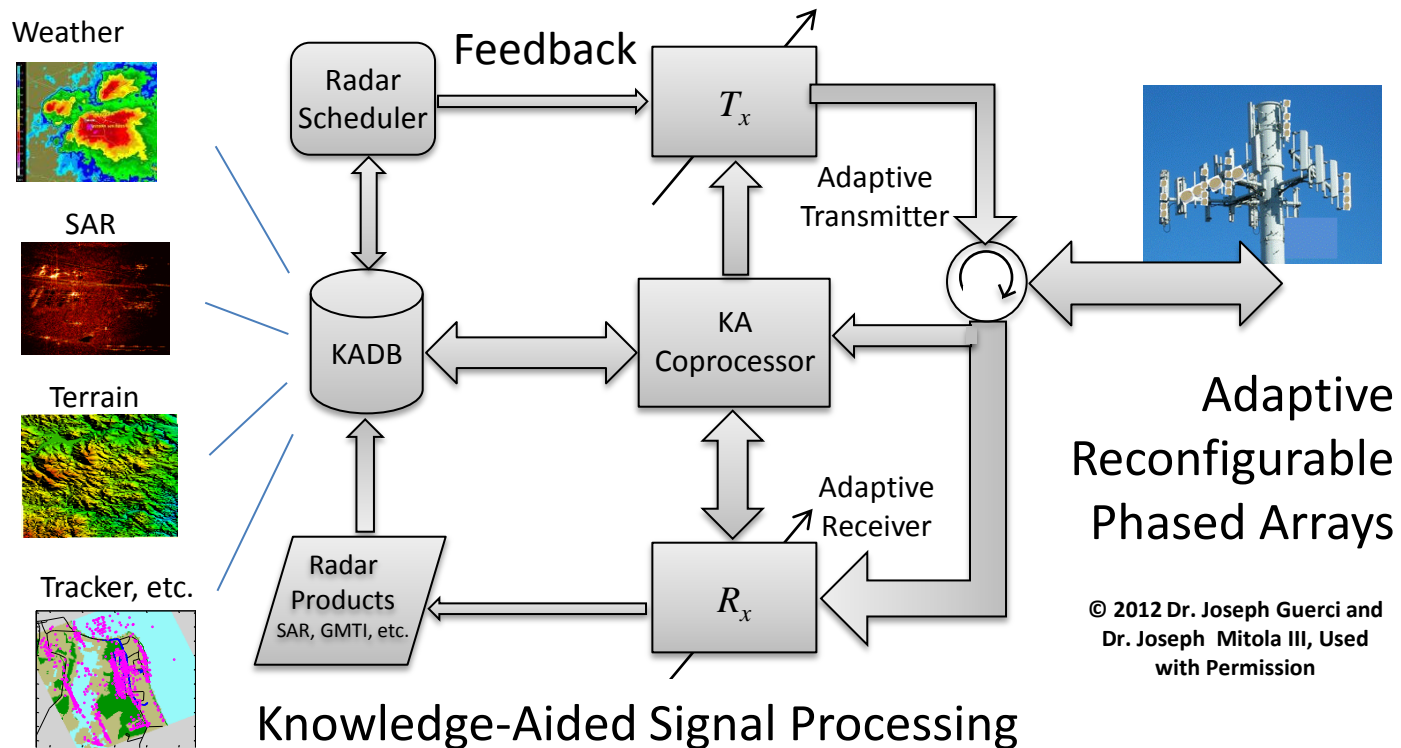
5G Radar Integrated Networks



Beam D. 2G GSM Wide Area Compatibility and Admissions Control

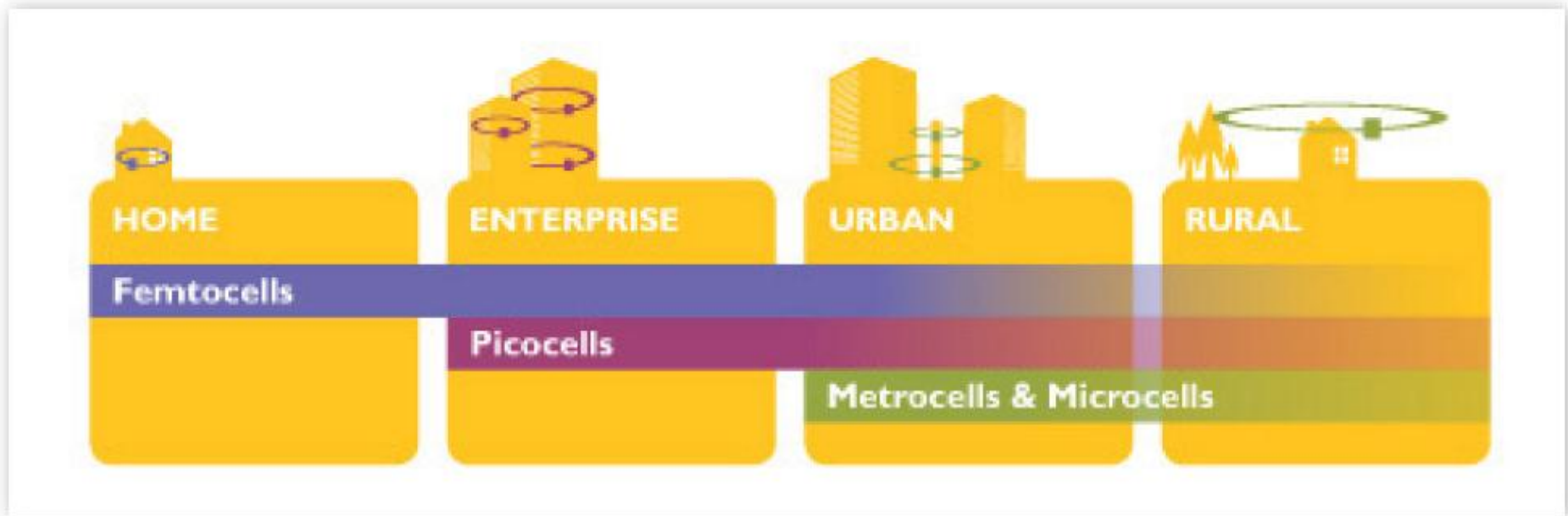
Beam E. Interstate 20 3G-5G Services MIMO Tracking Beams

5GRINS Signal Processing



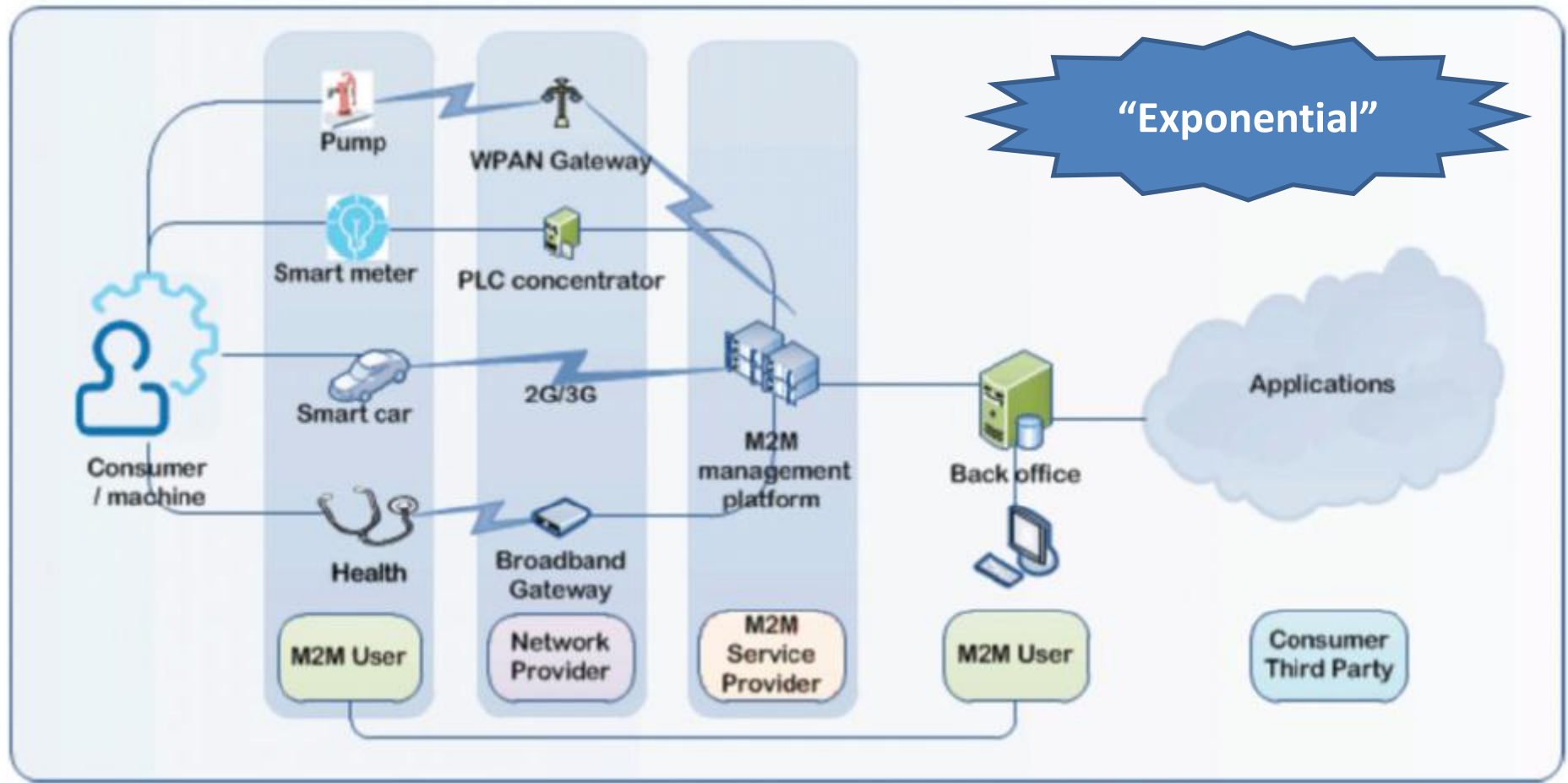
PCAST Small Cells

Figure 2.1: Small Cells Allow Greater Geographical Coverage. The smallest cells are used in home, enterprise, and urban areas, while metrocells cover larger regions, including rural areas.

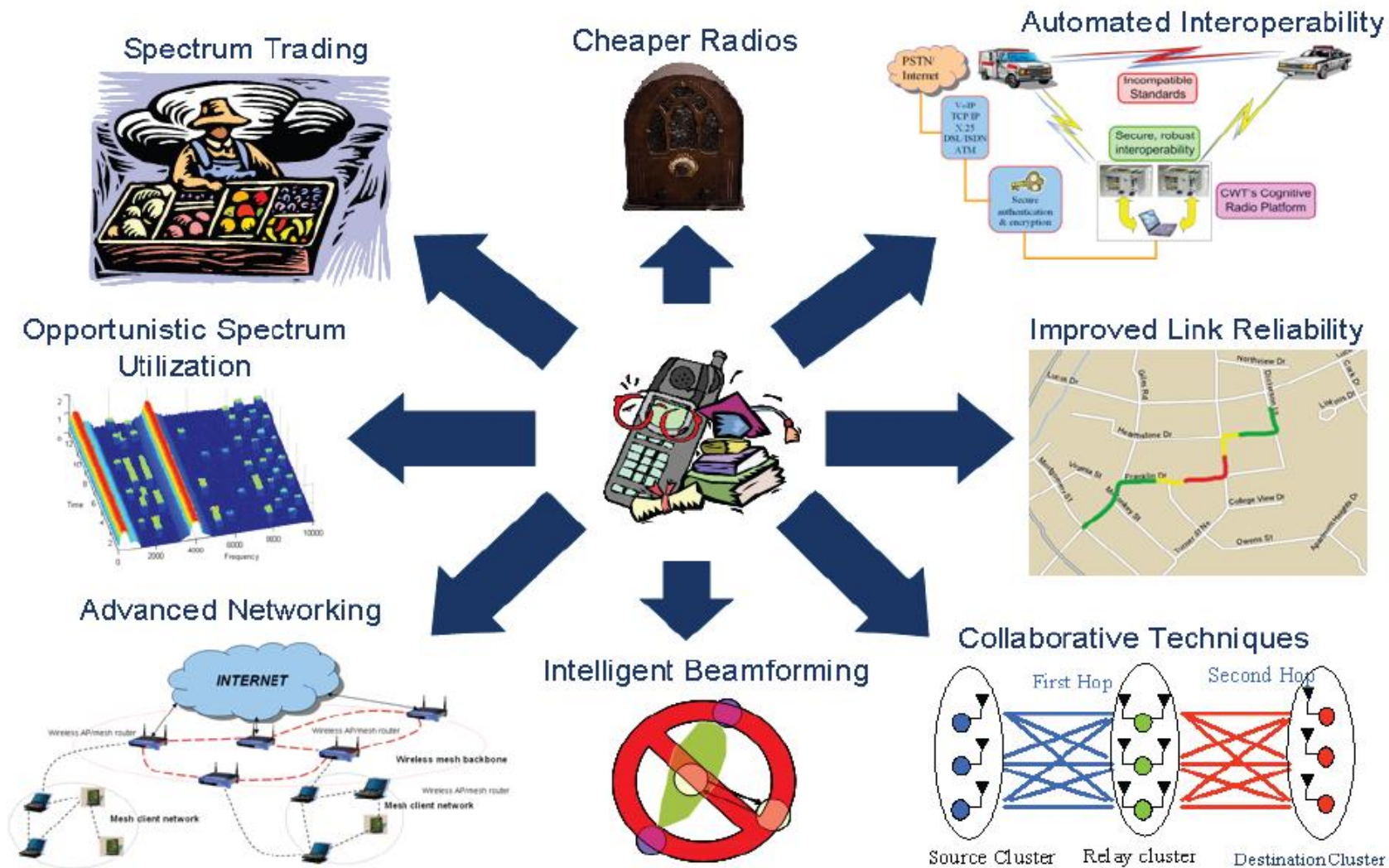


Source: "What is a Small Cell?" Small Cell Forum at www.smallcellforum.org/aboutsmallcells-small-cells-what-is-a-small-cell.

PCAST M2M



PCAST Technology Aspirations



PCAST Access Model

Requests for Access



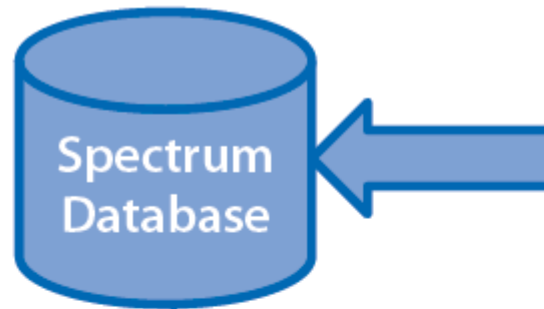
General
Authorized
Access



New Business
Models

Government
Service Providers

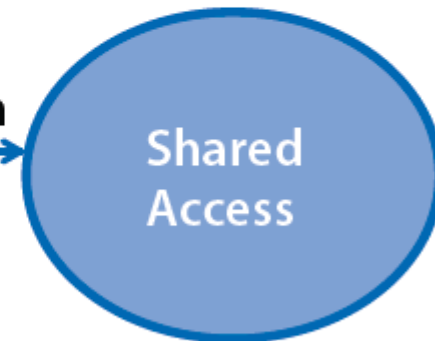
**Primary Access Control for
Incumbent Users**



**Spectrum Availability
Information** (sensing,
policy, pricing,
restrictions, legacy
requirements)



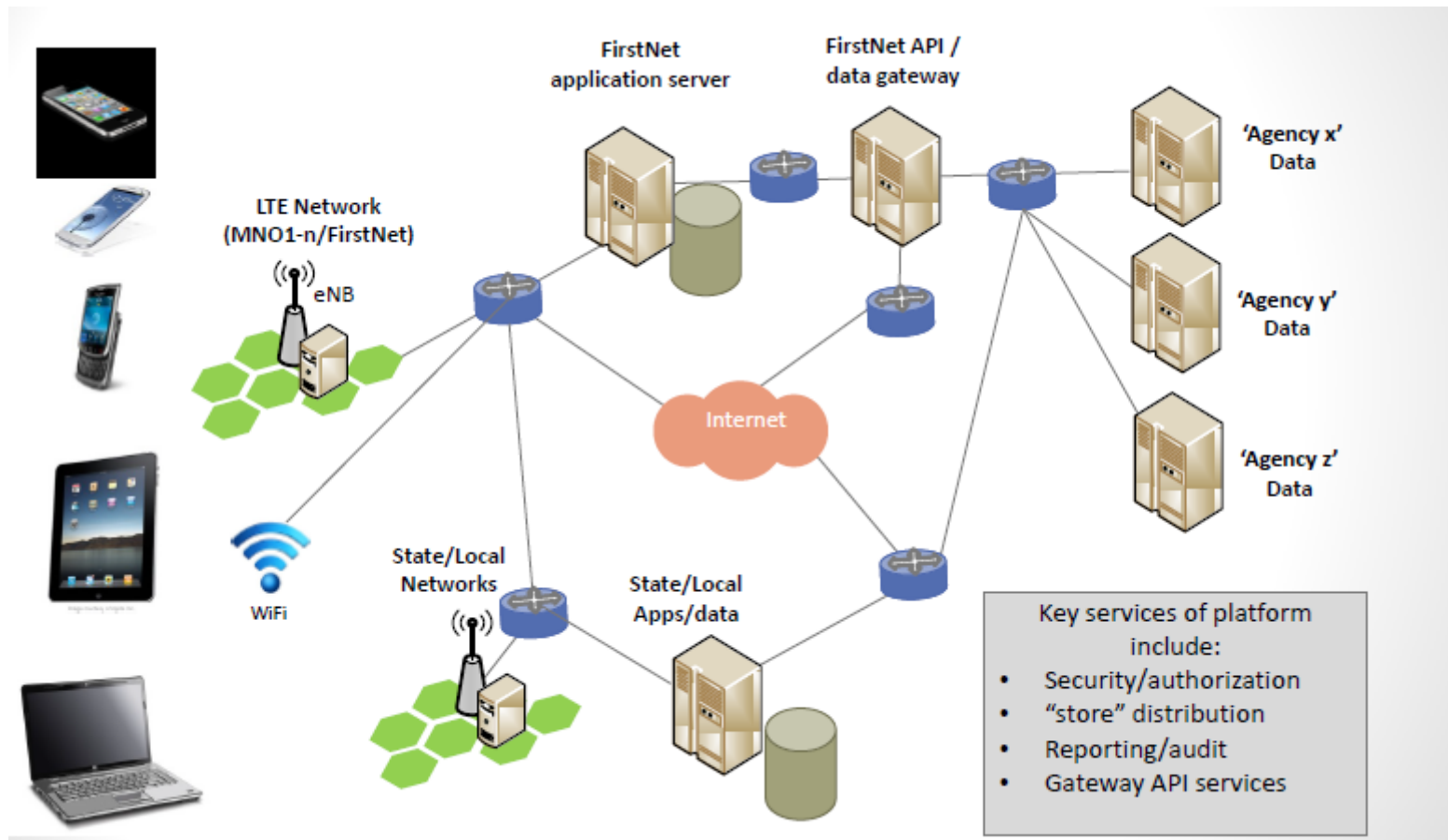
Allocation







Spectrum Sharing Issues

- AT&T's Joan Marsh, VP of federal regulatory
 - Concerns: Investment, technology and spectrum efficiency (5 Aug 2012)
 - “Ericsson studies have demonstrated that tight integration of low power nodes with the macro network provides substantial gains over the uncoordinated approach inherent in an unlicensed system”

FirstNet Architecture: “LTE”



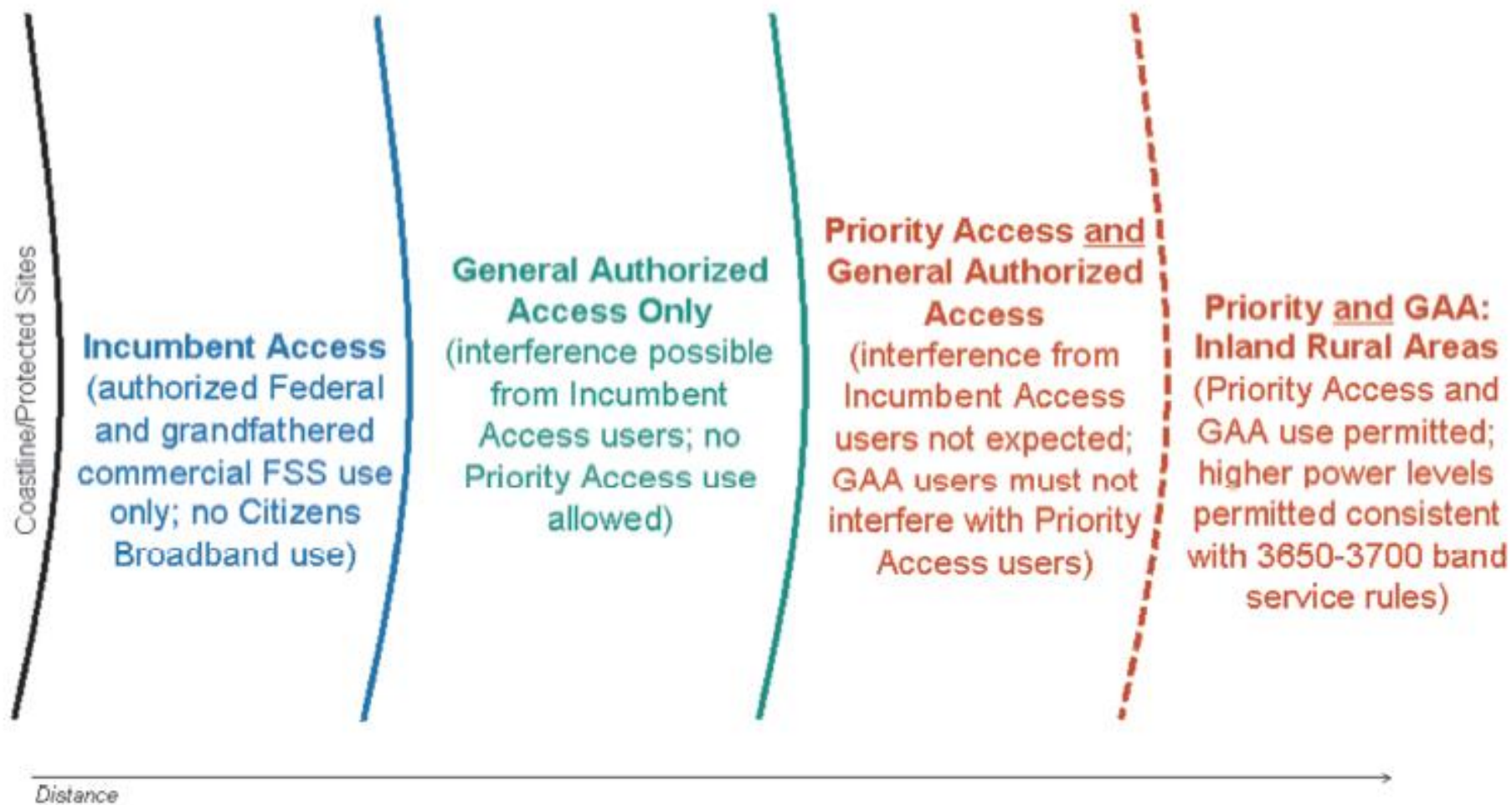
FirstNet Devices & Connectivity

	Commercial	Mainstream (Portable)	Mainstream (In-Vehicle)	Specialized/ customized
Device Types				
Category Driver	<ul style="list-style-type: none"> Broadband access 	<ul style="list-style-type: none"> Mission critical 		<ul style="list-style-type: none"> Special operational needs e.g. in-building, rural
Function	<ul style="list-style-type: none"> Smartphone Tablets 	<ul style="list-style-type: none"> Smartphone Tablets Modems 	<ul style="list-style-type: none"> Routers Hotspots Laptops 	<ul style="list-style-type: none"> SOWS, COWS, COLTS Low-profile sat. antennas Portable repeaters
Connectivity	<ul style="list-style-type: none"> LTE, CDMA, HSPA Wi-Fi, Bluetooth 	<ul style="list-style-type: none"> LTE, CDMA, HSPA Wi-Fi, Bluetooth USB Direct mode 	<ul style="list-style-type: none"> LTE, CDMA, HSPA Wi-Fi Ethernet 	<ul style="list-style-type: none"> LTE, CDMA, HSPA LMR/ P25 Satellite
Location	Yes	Yes	Yes	Yes
Band 14 Support	No	Some	Some	No

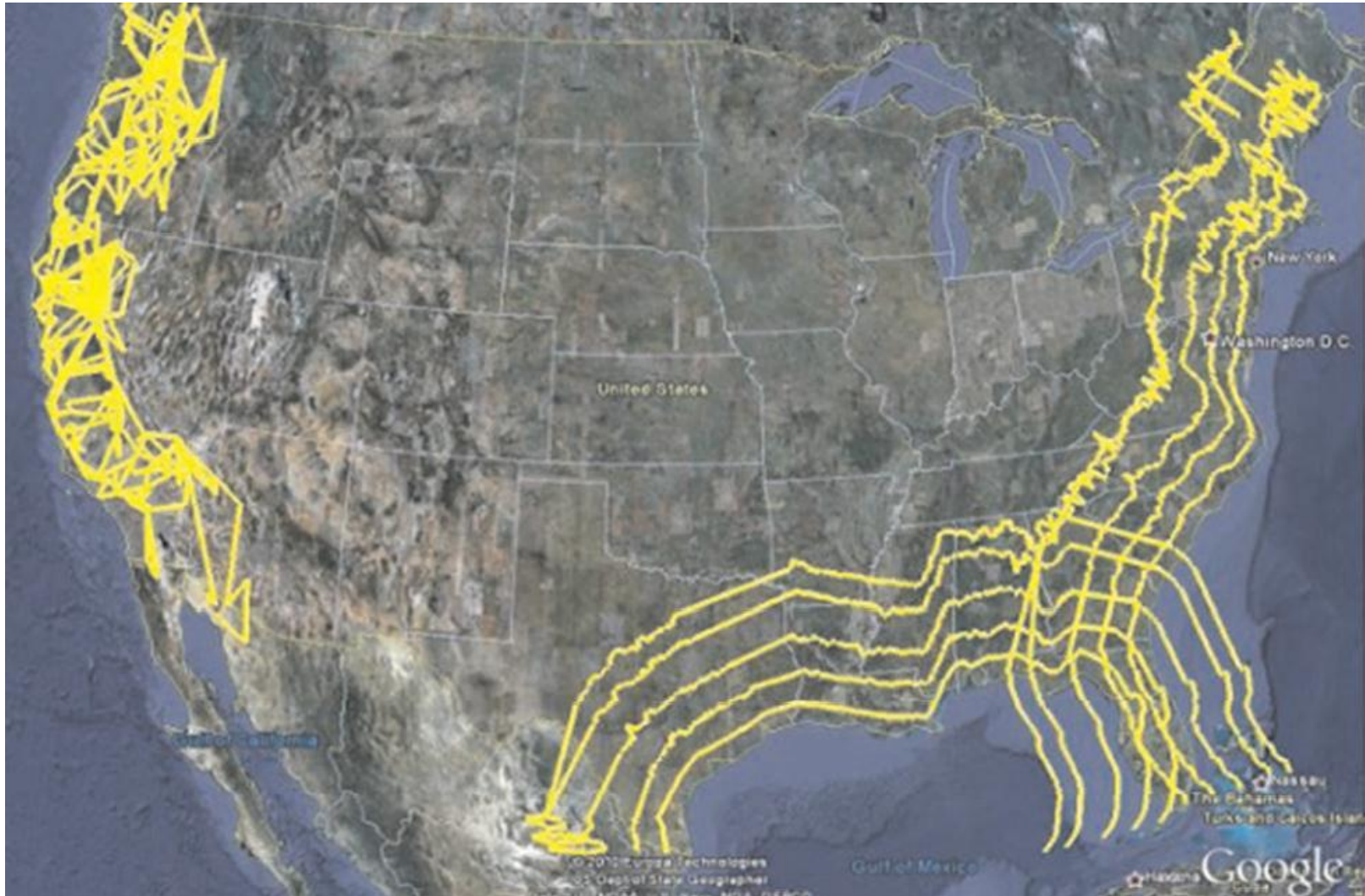
Citizens Broadband Service

- With this Notice of Proposed Rulemaking (Notice), we propose to create a new **Citizens Broadband Service** in the **3550-3650 MHz** band (3.5 GHz Band) currently utilized for military and satellite operations, which will promote two major advances that enable more efficient use of radio spectrum: small cells and spectrum sharing. The 3.5 GHz Band was identified by the National Telecommunications and Information Administration (NTIA) for shared federal and non-federal use in the 2010 Fast Track Report. Our proposal builds on our experience with spectrum sharing in the **television white spaces (TVWS)**, proposes ideas teed up in our recent Notice of Inquiry on **Dynamic Spectrum Access** technologies, and broadly reflects recommendations made in a recent report by the President's Council of Advisors on Science and Technology (**PCAST**)
- We also seek comment on whether to include under these proposed new, flexible rules the neighboring **3650-3700 MHz** band, which is already used for commercial broadband services

CBS-3.5 Spectrum Sharing Layers



CBS-3.5 Interference Zones



Conclusion

- Ubiquitous Wireless Architecture Evolution
 - LTE Clear Winner
 - M2M Thin on Use Cases and Security
 - Small Cells 60GHz or THz vs 3550?
 - Mixing Technologies into Services – FirstNet
 - Mixing Services into Technologies – 5GRINS
- CBS-3.5 NPRM Very Restrictive
 - Device Intelligence Under Estimated
 - Join Allied in Response?