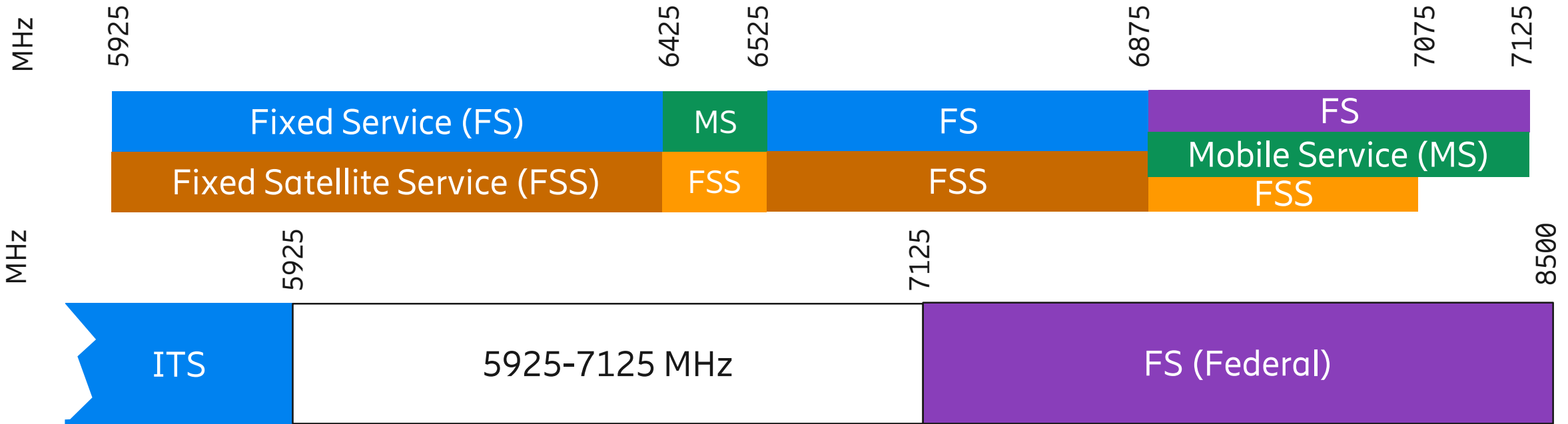




# Balanced Approach to Spectrum Policy and Sharing at 6 GHz

Kumar Balachandran  
Ericsson Research  
July 17, 2019

# Incumbent situation in 5925-7125 GHz band



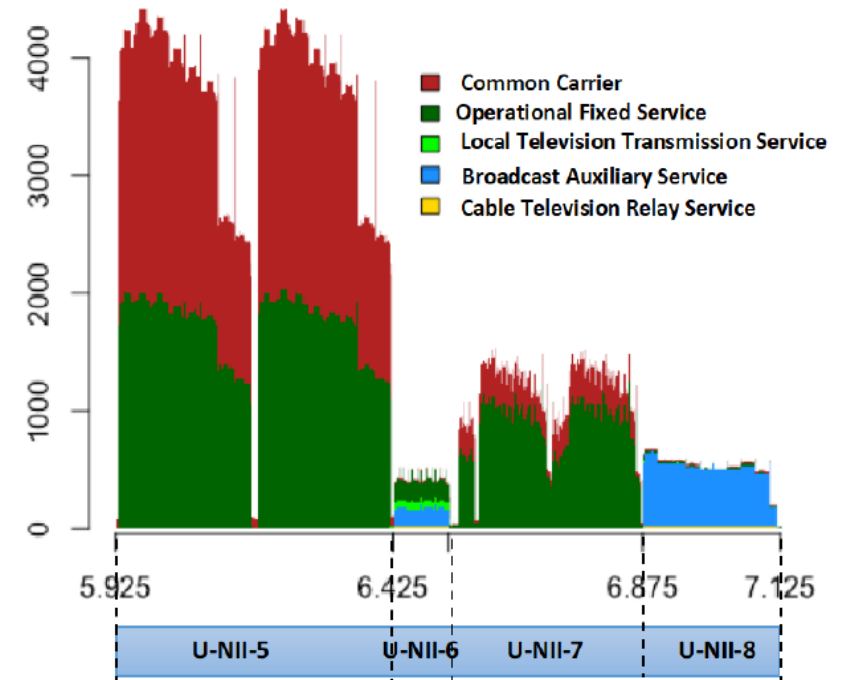
Incumbents divided between

- Broadcast Auxiliary Service (BAS)
- Cable TV Relay Service (CARS)
- FSS uplink

# FCC NPRM

- FCC Proposes unlicensed operation over 5925-7125 MHz
  - Expansion of 5 GHz U-NII into four new segments
- Questions on Automatic Frequency coordination (AFC) requirement
  - Registration of access points
    - Similar to White Space databases or SAS?
  - Uses, e.g. I/N or C/I, to protect incumbents
  - Mobile incumbents and high power operations
  - Should indoor be subject to AFC?
  - No adjacent channel protection
  - What is the appropriate fade margin? 25-40 dB
  - Propagation models?
  - Modeling of access points?

Assignment Density (from NPRM)



Band U-NII-	Access Point(AP)				Client Device			
	W*	P (dBm)	S (dBm/ MHz)	Max. Gain G (dBi)	mW*	P	S	G
5 & 7	1	30	17	6	63	18	5	6
6 & 8	0.25	24	11	6				

\* Conducted power in Watts (W) or milliwatts (mW)

# Part 101.5 Interference criteria for FS



- Part 101 assumes interferers are also FS terminals
  - Cochannel carrier signal to interfering signal protection ratio of 90 dB
  - Adjacent carrier signal to interfering signal protection ratio of at least 56 dB
- Part 101 requires an engineering analysis showing coordination between fixed service installations
  - Specification of the interference criteria and system parameters
  - Nominal service areas or modified service areas
  - Statement from affected parties agreeing to the analysis
- Part 101 does not consider sharing with the Mobile Service
  - Interference criteria have to change to an aggregate interference level
  - FCC NPRM does not offer adjacent channel protection, while Part 101 does; this is a problem

# FS Protection Requirements



- FS protection criteria should consider aggregate effects from indoor users with appropriate loss models
  - Difficult to differentiate between indoor and outdoor for small devices; enforcement impractical
  - Indoor access points in high rises can affect incumbent protection
- FS links are line-of-sight FS receivers are designed with industry margin levels for atmospheric effects, precipitation, shadowing and multipath fading
  - margins are a critical component of system availability and reliability requirements
- High availability links require aggregate I/N protection into boresight of FS receiver antenna; e.g..  $I/N = -6$  dB
  - Margin of  $-6$  dB may be acceptable for mutual interference between FS deployments; aggregate mobile service allotments to interference margins cannot steal from accepted dimensioning unless incumbents accept certainty of degradation
- Detection of source of interference is very difficult; what are the tools available to the AFC to correct problems?
  - Need knowledge of used frequencies of individual devices at the AFC

# AFC Operation



- The AFC should be able to estimate aggregate interference or noise rise at the front end of an incumbent
  - AFC operation should address indoor and outdoor RLAN devices
- Prior to any operation, access points (APs) access the AFC system to determine authorized frequencies at their geographic coordinates
- APs may transmit only on frequencies indicated as being available by an AFC system
  - AFC must likewise know channels in use by RLAN; this implies positive control of spectrum use by RLAN devices

# WAS/RLAN modeling



- WAS/RLAN deployments can be indoor or outdoor
  - Outdoor and indoor installations should register actual height of installation of antenna above ground level
  - Self-reporting of height above ground level is prone to error and inaccuracy
- Professional installation requirements for indoor and outdoor access points
  - Definitely needed for outdoor emplacements
  - CBRS approach to relaxation for automatic geolocation capabilities may be an option
  - Possibly needed for most indoor installations
    - Difficult to guarantee accuracy of indoor geolocation
    - Indoor devices not professionally installed can be moved outdoors
  - Should professional installation requirements be relaxed for lower power devices?

# Propagation models to be used by the AFC



- ITU-R P.452 is a convenient and modern option
  - Available in area and P-t-P terrain mode: terrain mode should be used.
  - NTIA participating in standards
- Clutter model in Section 4.5 of P.452 should be replaced with model in ITU-R P.2108
  - Clutter refers to objects, such as buildings or vegetation, which are on the surface of the Earth but not actually terrain: includes water, open/rural, suburban, urban/foilage, dense urban.
  - Model relevant to terminal type and operational frequency (within clutter for 6 GHz)
    - Addresses RLAN and FS characteristics in modelling parameters
- Building entry loss model in ITU-R P.2109
  - Valid from 80 MHz to 100 GHz
  - Also ITU-R P.2040: Guidance on effect of building materials and structure on electromagnetic waves
  - ITU-R P.2346: Empirical data on building entry loss such as classification into modern thermally isolated vs. traditional



# Technology neutrality for RLAN



- Unlicensed does not mean WiFi
  - There will be multiple RLAN technologies operating in 6 GHz unlicensed spectrum when it is available, e.g., Wi-Fi, LTE-LAA, NR-U
- Regulations for unlicensed spectrum should be common to all technologies
  - No special provisions for any technology
- NR-U will be deployed in the 6 GHz unlicensed band
  - 3GPP is developing specifications to operate 5G NR in 5 and 6 GHz unlicensed spectrum
- Technology neutrality does not mean interference coordination between RLAN users by the AFC
  - Regulations generally protect against willful or harmful interference as in ISM bands

# Summary



1. The 6 GHz band can support unlicensed and licensed use
  - This is a regulatory and legislative matter
  - Broad cellular industry support for a balanced approach
2. Part 101.5 has no support for aggregate interference protection
3. Ericsson supports the use of an AFC for fixed service protection; this requires
  - RLAN access points to register with the AFC with professional installation and registration of geolocation coordinates
  - AFC to actively track and approve of spectrum that a particular RLAN station is authorized to use
  - AFC is needed for indoor and outdoor operation
4. Propagation models used by the AFC for incumbent protection need modernization: ITU-R P.452/P.2108/P.2109 is appropriate
5. FCC should adhere to technology neutrality principles in US regulations and also when interacting in international fora such as ETSI or CEPT

