Unofficial Notes:

Forum Global's 12th America's Spectrum Management Conference

October 10-11, 2023
Washington, D.C.

SUMMIT RIDGE GROUP

Financial, Valuation, and Industry Consulting

NOTICE: These notes were taken live at the 2023 Forum Global 12th America's Conference in Washington, D.C. from October 10th to 11th 2023. They are a good-faith representation of our impressions of the events and what was said by participants. However, we cannot guarantee the accuracy of any specific comment. These notes are not endorsed by Forum Global in any way. This document is not a recommendation to buy or sell any security. Please consult with appropriate professional advisors before making significant business decisions. Comments and corrections are welcome.

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Executive Summary

The 12th Annual Americas Spectrum conference revolved around several major topics:

1) WRC 23, including fierce debates around the future of the 6 GHz band (How much should be licensed vs. unlicensed?, Should the FCC revisit its 6GHz decision?, etc.) as well as the NTIA's upcoming National Spectrum Strategy (since released)
2) The slowdown of 5G deployment.
3) Increasing potential role of satellite communications, including direct to device applications.

Other trends were apparent, including:

1) Multiple acknowledgments that mmWave business models were not yet ripe as the technology is not really ready for mobile use.
2) Discussions of shared spectrum
    a. Predictably, established incumbents favor exclusive licensed spectrum that makes it harder for new entrants, while new entrants favor sharing models that allow for accelerated market access.
3) The battle between satellite operators and wireless operators is becoming fierce.
4) CBRS and LEO satellite operators are eager to get higher power limits.

As usual, the Forum Global team did an excellent job running a first-rate event.

Contents

I. Day One: Tuesday, October 10, 2023

A. 09:30 – 10:10 AM Session 1: Roadmaps to Meet Current and Future Connectivity Needs Across US and Canada – The National Spectrum Strategy and The Spectrum Outlook

- **Moderator: Johanne Lemay** *Co-President, LYA*

SESSION 1 DISCUSSION NOTES

Chantal David *Senior Director, Regulatory Policy, Innovation, Science and Economic Development Canada (ISED) (via video)*

- Canada has a five-year spectrum outlook plan released this summer.
  - Sets priorities for 2023-2027.
- Spectrum is an economic driver.
  - Lots of demand for private networks, often where there is no current coverage.
  - Need for rural and remote connectivity as well as indigenous connectivity.
  - How to use spectrum to impact climate change and prevent more climate change.
- Need to use the right tools, including sharing/dynamic spectrum access.
- Need the right balance between existing services and new services.
  - Have bands in three priorities: low, mid, and high-band.
  - Canada's 3800 MHz auction to start on October 24th.
- *Note: some items are missing since the audio on Chantal's video feed cut out.*

Scott Blake Harris *Senior Spectrum Advisor, Office of the Assistant Secretary, NTIA*

- There are very few jokes about spectrum other than the one about the marriage of two antennas – the wedding was OK but the reception was great.
- Relentless demand for additional spectrum access needs to be addressed with a national spectrum strategy.
  - NTIA is supposed to be an unbiased advisor to the President on spectrum issues.
- Not an NTIA strategy but a national strategy
  - Release date before year-end and possibly before WRC (stretch goal).
  - Aimed to study 1500 MHz of spectrum for repurposing; likely to significantly exceed this amount.
  - Look for mobile broadband and other uses as well.
  - Identified weakness in the current system because there is no good mechanism for the executive branch and industry to discuss.
    - Want industry and government to be able to discuss and exchange data regularly.

  - Past experience shows that the best spectrum access technologies are ahead of use and NTIA wants to use them.
- National spectrum strategy will be a strategic document and include some implementation strategies as well.
  - Hope it will be more of a living document that can be updated, but no guarantees it will be a regular five-year event. [AM Comment: The NTIA's Spectrum Strategy has since been released]
- Q&A
  - Spectrum bands to study will include lots of mid-band spectrum.
  - The report will be readable – not too long.
  - If there can be more engagement between the public and private sectors, it will be clear that the concern that government spectrum use is inefficient is not really the case.
  - Won't have recommendations about changing the FCC.
  - Looking at spectrum transfer policy framework and improving mobile coverage of roads and satellite usage of mobile bands.

B. 10:35 – 11:45 Session 2: The New Spectrum Pipeline – What Are The Candidate Bands That Can Help To Meet Current And Future Spectrum Needs

- **Moderator: Amit Nagpal** *Partner, Aetha Consulting*
- **Tom Stroup** *President, SIA*
- **Michael Calabrese** *Board Member, Dynamic Spectrum Alliance*
- **Umair Javed** *Senior Vice President, Spectrum, CTIA*
- **Becky Tangren** *Vice President & Associate General Counsel, NCTA*
- **Amit Mukhopadhyay** *Senior Spectrum Standardization Leader, Nokia Bell Labs*

SESSION 2 DISCUSSION NOTES

Amid Nagpal *Partner, Aetha*

- Battleground is midband.
  - Definition of midband is evolving, formerly up to 3 GHz, now is sometimes goes as high as 15 GHz.

Tom Stroup *President, SIA*

- New space agency acknowledges the growth of the satellite industry.
  - 1,000 satellites in orbit ten years ago, so far launched 2,000 this year alone, and will soon have 10,000 with plans for many more.
  - Launch costs are down 76% on a per kilogram and more flexible options, including ride share.
  - The cost of new capacity is 1/10 of 2013.

  - Huge increase in broadband and also in earth observation which can refresh as much as 7x a day.
  - Loss of GPS would cost $1 billion a day and more if during critical agricultural seasons.
  - IOT and Broadband are growing fastest.
- Direct-to-device will be the largest opportunity for the satellite industry.
  - Lots of different approaches are being taken to this service. Its already saving lives with 911 connectivity.

Michael Calabrese *Board Member, Dynamic Spectrum Alliance (also at New America Assn)*

- Should adopt a policy of "Use It or Share It," which is working in CBRS.
  - Effectively what FCC adopted in 6 GHz and can be adopted in almost any band if the primary incumbent can share.
  - FCC and NTIA should have an inventory of spectrum usage (geography, bands, time, and power usage). *[AM Comment: this seems pretty basic.]*
- Suggest expanding 6 MHz unlicensed by another 400 MHz.
  - Possible add another 300 MHz channel above 7250 MHz.
  - Propose more dynamic spectrum sharing below 3450 MHz.
- It may take a long time to figure out moving or coordinating commercial and federal spectrum usage – as a result long-term planning is needed.
- At higher frequencies, the capital intensity of the industry increases due to the need for small cells. *[AM Comment: This is a big reason mmWave deployment has been so slow.]*
- Coverage is largely accomplished but capacity and indoors is not – this is where unlicensed needs to keep up with cellular to manage offloading.

Umair Javed *Senior Vicie President, CTIA*

- Technology can help disabled people (gave an example of sending football game plans to deaf quarterback via a small screen in helmet).
  - 60 million disabled Americans. *[AM Comment: 60 million America is almost 1 in 5.]*
- Largest private sector investment in technology is happening now in wireless.
  - U.S. wireless ecosystem is the envy of the world. *[AM Comment: This is arguable and not an undisputed fact. Many countries have much lower cost wireless service.]*
- To maintain, we need 1500 MHz of wireless broadband spectrum, Ericsson studies show a huge increase in demand. *[AM Comment: Sounds like the assumptions in the*

2010 Broadband plan that ended-up being inaccurate.]

- Need to look at 3 and 4 GHz bands.
- Lots of movement to the 6 GHz band for 5G internationally, if we can get to 7 GHz and 8 GHz, it is in the same tuning range.
- FCC needs auction authority restored, and US needs to build global leadership.
- Advanced planning is important to avoid friction points.
- Lots of disagreement over the amount of spectrum needed and the value, but it is always safe to overestimate than underestimate. We can look at estimates and what other countries are doing? *[AM Comment: Is it really always best to overestimate?].*
- Have not found a sharing mechanism optimized to get benefits of 6G to as many people as possible. *[AM Comment: Not sure what this means]*

Becky Tangren *Vice President & Associate General Counsel, NCTA*

- Clients use wireless in rural areas where wire is not viable, offer mobile voice (now 4th largest provider).
- License-free creates low barriers to entry, shared spectrum is great.
  - Lots of bands can be made more efficient with sharing.
  - More focus on coexistence technologies and policies is more important than identifying new bands.
- Sometimes, we need to wait and see consumer demands. Demands also evolve and can't be measured via a drive test. Also, need to resolve tensions about the value of government use such as DoD.
- 80% of mobile traffic goes over Wi-Fi.

Amit Mukhopadhyay *Senior Spectrum Standardization Leader, Nokia Bell Labs*

- Evolution of usage to 6G (Immersive XR, Mobile hologram, and Communication + Sensing).
  - Need 1.5 – 2 GHz of spectrum, especially below 15 GHz.
- When new technology arrives, new spectrum is needed. 5G was hard to deploy until C-band became available – don't want this problem in the future.
  - WRC has a mess with 6G, as Region 1 is uncertain as to what they want
    - We want to study 1.5 to 2.0 GHz in the 7 GHz to 15 GHz range for WRC – 27. *[AM Comment: This will be a challenge to find]*
    - Want global agreement to get economies of scale and lower prices to bridge the digital divide.
- At higher bandwidths, can use better compression technologies to be more efficient – don't necessarily need more power.
- High-value remote surgery won't drive 6G demand. Need to consider economics will be

driven by wide area outdoor usage.

C. 11:45 AM -12:55 PM Session 3: Spectrum Sharing – Maximizing The Potential And Finding The Right Balance

- **Moderator: Paul Kirby** *Senior Editor, Wolters Kluwer's TR Daily*
- **Derek Khlopin** *Deputy Associate Administrator, Office of Spectrum Management, NTIA*
- **Arthur DeLeon** *Director, Strategic Spectrum Policy, Department of the Navy*
- **Justin Markle** *Head of Wireless Partnerships & Development, Comcast*
- **Jeff Stewart** *Assistant Vice President, Global Public Policy, AT&T*
- **Mark Gibson** *President and Chair of the Forum, WInnForum*
- **Tim Harrington** *Chairman, UWB Alliance*

SESSION 3 DISCUSSION NOTES

Derek Khlopin *Deputy Associate Administrator, Office of Spectrum Management, NTIA*

- As a regulator, need to listen to industry and government users and figure out how to innovate.
- All spectrum users have a responsibility to be efficient users – incumbent and new users have rights, but they are not unlimited. Federal users are being pushed to be more efficient. Sharing arrangements are also complicated as federal users' needs will evolve.
- We are digesting the DoD spectrum sharing report.

Arthur DeLeon *Director, Strategic Spectrum Policy, Department of the Navy*

- Manpower is an issue with spectrum sharing as people are working on operational issues. We need to add people to manage sharing.
- The foundation of sharing is that the priority use case can get access when needed.

Justin Markle *Head of Wireless Partnerships & Development, Comcast*

- Lots of new uses and private networks.
- Shared spectrum is really good. CBRS had a broader base of users which allows more ideas to come to bear.
- Comcast has 830 PAL licenses with coverage of 80% of Comcast coverage area.
- Specialized equipment and roadmaps make spectrum change a multi-year process.

Jeff Stewart *Assistant Vice President, Global Public Policy, AT&T*

- Must make spectrum sharing work; need the following:
    - Close coordination and planning including detailed exchange of information, including proprietary and potentially classified information and technical details.

    - Need good data to calibrate models, test, and iterate.
    - All parties need to come to the table to discuss.
- Shared spectrum is a long process of building trust.
- Sharing time depends on the regime and what is needed.
    - It's good to have predictability.
    - Real-time is still a ways off.
- Licensing schemes for sharing depends on who you are sharing with; works better if the uses are similar.
- Need real world data on sharing (in response to FCC NPRM).

Mark Gibson *President and Chair of the Forum, WinnForum*

- AWS-1 was sharing, but not dynamic, but dynamic is sharing is growing and evolving.
- Many bands being considered.
- Dynamic spectrum coordination is not instantaneous; want it to be working in the milliseconds.
- Should be an alignment of interests and boundaries so people know what they are getting with sharing.
- Don't want too many requirements on sharing or we may be pricing ourselves out of the market.

Tim Harrington *Chairman, UWB Alliance*

- UWB use allowed in 2002 in the U.S. and adopted in Europe in 2005.
    - Now available everywhere.
    - Enabled in over 100 million devices to make sharing better.
    - UWB helps with smartphone data sharing from 3.1 to 10.6 GHz – so by design we share all the time, but don't interfere. Goes over wide band and small power +17 dbm vs (41 dbm), also no transmission between pulses.
- No measurable effect on WiFi. Also does not aggregate interference is multiple are used. Low latency, lossless audio, and low battery consumption. Bluetooth has compression with audio.
- FCC NOI went out about receivers – puts people on notice that they may be sharing in the future and should consider that in your planning.

D. 1:55 PM - 3:05 PM Session 4: CBRS 3 Years In – What Has Worked, What Has Not, And What Comes Next?

- **Moderator: Andy Hudson** *CEO, Spectrivity*
- **Jessica Greffenius** *Assistant Chief, Wireless Telecommunications Bureau, FCC*
- **Scott Patrick** *Executive Director, Office of Spectrum Management, NTIA*

- **Andy Clegg** *Spectrum Engineering Lead, Google & Representative, OnGo Alliance*
- **Patrick Welsh** *Vice President of Federal Regulatory and Legal Affairs, Verizon*
- **Manish Jindal** *Group Vice President, Wireless, Charter*

SESSION 4 DISCUSSION NOTES

Jessica Greffenius *Assistant Chief, Wireless Telecommunications Bureau, FCC*

- Designed to be iterative and collaborative with industry and government on sharing mechanics.
- Consistent growth and utilization.
- People are using the band and reexamination is possible, but it may require a rule-making process from the FCC.

Scott Patrick *Executive Director, Office of Spectrum Management, NTIA*

- Want to get unused time into use due to the incumbent's episodic use.
- 12% growth/quarter.
- Going well, main object is to protect incumbents.

Andy Clegg *Spectrum Engineering Lead, Google & Representative, OnGo Alliance*

- 1,000 GAA operators and 744 CBSD models have been certified by the FCC.
- 400,000 CBSDs deployed.
- Now only need to check in with the SAS every 24 hours; no loss of connectivity if the internet goes down.
- Hard to preplan federal usage as we don't know what frequencies they will pop-up on.
- Now static assignments are listed on website.
- Lots of super conservative assumptions on CBRS interference that suggest system is over designed to protect incumbents.
- Some interference between GAA users with some plans to address this.
  Federal usage in Navy areas (Norfolk, VA and San Diego, CA) are 13-15% and fractional percentage in other areas.
- WIPS can get 5-6 miles of coverage with proper configuration.

Patrick Welsh *Vice President of Federal Regulatory and Legal Affairs, Verizon*

- Verizon was largest CBRS license winner.
- Working on iterative improvement.
- Low power is what prevents CBRS from being used more widely.
  - Power limits were based on early work.
  - Now we can do dynamic protection zones, so power limits may be raised.
  - May increase OOBE limits as FSS sites have been relocated.

- Low power and sharing is not a substitute for flexible exclusive use licenses.
    - Need a balance of the type of spectrum.
    - Over 50% of the use cases are along the coast that would have previously been excluded.
    - Can't just export CBRS rules to other bands with different incumbent uses.
- With higher power levels, uses might change.

Manish Jindal *Group Vice President, Wireless, Charter*

- Wireless network overs 87% of our customers.
    - Small cells work well in our network.
    - Participated in CBRS and won 210 licensed in 106 counties.
- Structure of CBRS with innovation allowed Charter to enter the market.
    - Democratization of spectrum has given rise to new players.
- Want to introduce new propagation models to adjust models.
    - Would like more rules about co-existence including parity between the SASs.
    - Can take up to two hours to get spectrum back after the government use has stopped.
- We like lower power. Smaller players can't coexist with high power.

E. 3:05 PM - 3:55 PM Session 5: Unleashing The Potential Of The 6 GHz Band – Has The Right Balance Been Struck With The Power Limits And Sharing Framework That Is In Place?

- **Moderator: Stephan Sloan** *Director, Like Spectrum*
- **Ira Keltz** *Deputy Chief, Office of Engineering and Technology, FCC*
- **David Willis** *Group Director, Spectrum, Ofcom*
- **Stuart Strickland** *Vice President & Wireless CTO, HPE*

SESSION 5 DISCUSSION NOTES

Ira Keltz - Deputy Chief, Office of Engineering and Technology, FCC

- The Commission realizes there are a lot of different needs for different spectrum options that need to be balanced.
    - and other countries have harmonized with us.
- 1200 MHz band low-power indoor use:
    - Well into testing phase for AFC devices.
- Have a second report and order and NPRM on providing more spectrum access options.
- Hard to predict where unlicensed will be sued.
- We've had a lot of experience with databases (white spaces and now the more complex

CBRS). AFC is much easier:
    - Working rules now.
    - Indoor usage with some commercial licensed use. Need enough power for indoor use. Outdoor power levels should be the same as other wi-fi bands 36 dbm.
- Some waiver requests have been filed (e.g., building entry loss to allow a bit more power, weatherizing for operations in arenas, etc.).

David Willis *Group Director, Spectrum, Ofcom*

- UK can't go it along. Need to follow international standards.
    - UK is not homogonous, so not a one size fits all (indoor, outdoor, licenses, unlicensed). *[AM Comment: The U.S. is even less homogenous.]*
    - MNOs want upper 6 GHz made available for mobile broadband.
    - Some countries are unwilling to look above the upper 6 GHz.
    - So we focused on 6 GHz to add a capacity layer.
- Want to encourage hybrid use coexistence without needing to clear incumbents nationwide.
- 6 GHz likely to be used in places like stadiums or certain corporate applications.

Stuart Strickland *Vice President & Wireless CTO, HPE*

- Part of HPE that makes wi-fi.
- Role for both wi-fi and mobile broadband in 6 GHz:
    - Large take-up of 6 GHz wi-fi in public areas like stadiums – deployments planned to maximize the number of individual users. At Chase Arena has fourteen 80 MHz channels.
- Did a lot of work on wi-fi test vectors and provided to FCC.
    - Doing more with wi-fi today than in the past.
- 3GPP seems to have lost enthusiasm for unlicensed spectrum.
- Most incumbents in 7 GHz are DoD.

F. 4:20 PM - 5:30 PM Session 6: Delivering Rural Connectivity – Policy and Technological Solutions to Connect Unserved and Underserved Areas

- **Hector Lopez,** NERA Consulting
- **Campbell Massie,** Advocacy Director, North America, GSMA
- **Gonzalo deDios,** Head of Global Licensing, Project Kuiper at Amazon
- **Mark Gibson,** President and Chair of the Forum, Winnforum

SESSION 6 DISCUSSION NOTES

Hector Lopez, NERA Consulting

- Lots of tradeoffs with rural connectivity – speed vs coverage.
- Need reliable service, or customers will leave quickly.
- Countries are leveraging auction revenue being used to networks or trade-offs between auction revenue and coverage.
- Some countries try to put effort into updating coverage maps entirely on the operators.
- There needs to be a balanced approach.
- There is some resistance to reverse auctions that do not make sense. Weights and deciding which entities can participate is difficult. Want to avoid the "winners curse" of paying money to an entity that can't complete it.

Campbell Massie *Advocacy Director, North America, GSMA*

- Challenges are in socio-economic and socio-political issues.
- 5% of the world is in coverage gap.
- 40% is usage gap – there may be coverage but it's unaffordable.
- U.S. is good with public-private partnerships.
- Try not to see auction revenue as a critical revenue source, or it creates distortions.
- Future-proofing is hard, especially with environmental factors (fire, flood, etc.).
- RDOF is risk for the government. It's also risky for service providers putting a lot of money into a small service area.

Gonzalo de Dios *Head of Global Licensing, Project Kuiper at Amazon*

- The two profile satellites that were launched will be the basis for the production satellites.
- Have affordable terminals.
    - 11" x 11" x 1" terminal and hope to have available at $400/terminal.
    - 7" x 7" terminal up to 100 Mbps.
    - A larger enterprise terminal that can have 1 Gbps.
    - Users are very sensitive to price.
- Announced a deal with Verizon – wireless carriers can extend reach with limited capital expenditures.

- Want technology to be easy to use.
- Countries need appropriate regulatory framework in countries – such as blanket-type approval for terminals so each one does not need to be approved.
- Government policies should be technology neutral as government can't know all the local and technology issues.
    - Fiber to the home is not the way to serve everyone.
    - In some areas legacy technologies are very important to them.
- Lots of uncertainties about NGSO growth and bringing Starlink to 80 counties.
    - Need to reflect the affordability's of different countries.
- Need to look at how to get coverage with as small a subsidy as possible.
    - We [Kuiper] expects to have an ongoing business with a second generation that has an improved offering.
    - May add different service operations (e.g., narrowband) to be sustainable as needs change. *[AM Comment: Not sure the size of the narrowband market (e.g. IoT). Also there are a lot of competitors.]*
- U.S. has good broadband maps *[AM Comment: Really? All I see is complaints*

DAY TWO: WEDNESDAY, OCTOBER 11, 2023

A. 09:00 – 09:20 *Keynote Presentation*

- **Moderator, Amit Nagpal** *Partner, Aetha Consulting*
- **Steve Lang** *Department of State*

KEYNOTE SESSION NOTES

- Prepping US delegation for WRC, replacing Anna Gomez who was confirmed at FCC Commissioner.
    - Lots of travel to preparatory meetings, got allies on board with a lot of things.
- Former foreign service officer – career diplomat.
    - WRC goals improve national security for the US and its allies.
    - Relationships are critical to accomplish goals.
- Working on 5G, 6G as well as unlicensed. Want to get international coordination for C-band.
- Support CTEL proposal for no change in the 6 GHz band, which already has a primarily global allocation for mobile broadband.
- Need to figure out which spectrum is best for global harmonization.
- Prepping for long-term lunar presence that will need spectrum.
    - Updating policies around orbital tolerances.
    - Proposing future study of bands and a framework for the moon – need short-term solutions and long-term framework.
- *[AM Comment: They are working on everything. I asked about top priorities and got this – no controversial response].*
    - Spectrum for innovate new services.
    - New opportunities for space economy and exploration.
    - Protect national security.

B. 09:20 – 09:35 Introductory Presentation

- **Oscar Leon-Suares** *CITEL*

KEYNOTE SESSION NOTES

Oscar Leon-Suares *CITEL*

- Chair of the delegation is Victor Martinez, Mexico.
- Summary of CITL positions on the WRC items.
- Want a study about sharing GSO and non-GSO systems.

C. **09:35-10:45** ***Session 7: Final Preparation And Positions Ahead Of WRC-23 – What Should Be The Key Goals For The Region And How Can It Be Ensured That These Are Achieved?***

- **Nese Guendelsberger** *Deputy Chief, Office of International Affairs, FCC*
- **Veena Rawat** *Senior Policy Advisor, GSMA*
- **Alan Norman** *Public Policy Director, Meta*
- **Prakash Moorut** *Global Head, Spectrum and Regulatory Affairs, Shure*
- **Hazem Moakkit** *Global Spectrum & Regulatory Affairs, GSOA*

SESSION 7 DISCUSSION NOTES

Nese Guendelsberger *Deputy Chief, Office of International Affairs, FCC*

- Lots of diverse interests; WRC advisory committee received over 70 recommendations.
    - Ended-up with several proposals for CITA.
    - C-band harmonization is a big deal.
    - No changes to 6 GHz.
    - No agreement on 10-10.5 GHz due to competing CITEL proposals.
    - Lots of satellite items, including global recognition of inter-satellite links in Ka-band, and items to facilitate communication on the moon's surface.
- Want a fair, open, and transparent process that leads to good outcomes.

Veena Rawat *Senior Policy Advisor, GSMA*

- Focus on Agenda Items 1.2 (IMT) and 10 (future IMT item).
- 6 GHz has a primary allocation for mobile; countries can differ.
    - Want harmonization to get economies of scale, especially for developing countries.
    - Many small countries follow ITU allocations.
- The CPM [Conference Preparatory Meeting] report does not even touch on EIRP mask.
    - It's an engineering process end-up being political.
    - Different countries have different needs, so we have multiple allocations, and countries can do their own thing. In the end, the marketplace will decide.

Alan Norman *Public Policy Director, Meta*

- No change in upper 6 GHz but a lot of work to do.
    - Intense lobbying by China.
- 90% of U.S. traffic goes over fixed.
    - Mostly Wi-Fi and a lot of mobile traffic goes over fixed.
    - 6 GHz is the workhouse of the internet.
- Engineering studies depend on assumptions that go into them, so it ends up being a political process.

Prakash Moorut *Global Head, Spectrum and Regulatory Affairs, Shure*

- Support multi-billion-dollar wireless microphone industry.
    - Typically 50 mw transmission 470-806 MHz, now down to 470 MHz – 698 MHz as TV gets squeezed and there are fewer white spaces.
        - Need long-term planning to ensure we aren't squeezed out.
        - Need to get special authorization to use unapproved equipment/bands at the Super Bowl. Also difficult in Paris.
    - ITU agenda item 1.5 to consider regulatory action in 470-694 MHz in Region 1.
    - Need close to 1 GHz for major events – spectrum sharing is critical.
- Maybe other bands that can be used, but it is a very important one, and we want to use the same equipment around the world.

Hazem Moakkit *Global Spectrum & Regulatory Affairs, GSOA*

- Space is the only way to provide ubiquitous communication globally.
- Two items:
    - Ensure the integrity of the ecosystem.
    - Enhance the productivity of existing allocations.
- Harmonization is good but needs to respect the sovereignty of different administrations.
- Can live with 3.6-3.8 GHz plans.
- Strongly oppose additional IMT allocation in 7-24 GHz
    - Hard to get much space there, much less 2 GHz. *[AM Comment: Stopping additional spectrum allocation in 7-24 GHz will likely be an uphill battle.]*
    - Range being looked at for mobile goes too high for it to be well-used.
- Lots of money in spectrum, so politics get involved. It's inevitable.
- As you go higher in frequencies, there is likely to be more open spots, so perhaps licensing needs to be rethought?

D. 11:10 – 11:30 Keynote Presentation

- **Moderator: Johanne Lemay**
- **Austin Bonner** *Deputy U.S. Technology Officer for Policy, White House Office of Science and Technology Policy*

KEYNOTE SESSION NOTES

Austin Bonner *Deputy US Technology Officer for Policy, White House Office of Science and Technology Policy*

- OSTP was founded 20 years ago to give the President the best advice on technology.
- Access to high-speed internet.
    - Access to high-speed internet is a necessity, but over 8 million Americans have

little or problematic access.
    - Approximately $90 billion is being spent on Internet access.
- Trying to set-up a new framework for spectrum strategy.
- NTIA public engagement has been good.
    - Will identify at least 1500 MHz for repurposing for IMT.
    - Call for long-term planning and spectrum management using new technology.
- Already seeing impacts of governments agencies working together in the C-band but need the FCC to have auction authority.
- U.S. is well prepared going into WRC but needs to continue to work with international partners.
- Automated systems have made advances, and AI may be able to supercharge this, but needs to be done responsibly. May be able to use AI to facilitate sharing.

E. 11:30 – 11:50 Shaping the Evolution of 5G and the Development of 6G – Spectrum Policy to Meet Economic and Security Goals

Matthew Pearl *Director of Emerging Technology, White House National Security Council*

- Multiple entities in the White House dealing with spectrum: NSC, OSTP and National Economic Council.
- Spectrum policy is an important tool to stay ahead of other countries.
- Spectrum convergence
    - AI, machine learning, and other technologies converge on spectrum.
    - Also, many of the networks are converging (e.g., satellite to terrestrial).
    - 5G & 6G are the future of the internet and also the physical world (e.g., connected cameras, robots, etc.).
- China is the only country with the technology and economic power to dominate change in the technology world order.
    - This potential dominance creates significant security risks.
    - Don’t want a geo-political competitor that could control the internet, communication networks, and ultimately the physical world to a competitor that does not share our values; the U.S. could lose control.
    - Need to make more spectrum available as part of the strategy, but we are out of greenfield spectrum. Dynamics sharing and other sharing is possible, also flexible use frequencies.
    - Need all this to come together to compete against China.
- Development of 6G
    - Need to apply lessons from past communication breakthroughs.
    - Need to apply lessons of security, reliability, openness, and interoperability. and other factors that may not have been thought through – need to do that with 6G.

    - O-RAN will help lower prices. Appreciate the situation of US Carriers, but it is coming along in Europe and in Japan (NTT Docomo). Hope US carriers will start to look at it. Working on a consolidated statement on 6G that US partner companies will sign on to. CHIPS act to invest in US chips and prove out O-RAN.
- Need to advance capabilities on dynamic spectrum sharing – working on standardized platform IIC. [*AM Comment: For more information on IIC see: https://www.ntia.gov/blog/2020/ntia-pursues-innovative-spectrum-sharing-plan-could-deliver-boost-5g*]
- US is looking to work with partners internationally via multiple avenues – want to work with companies and not just government-to-government agreements.
- Need to work on standard setting to forward development. Want lots of companies to participate and help lower the price of equipment. Many US companies don't want to speak publicly about concerns about China, and US Government only learns about it in private conversations.

F. 11:50 – 12:40 Session 8: Where Are We At Now? What Progress And Trends Are Being Seen With 5G Rollout And Use Cases?

- **Moderator: J. Armand Musey** *President and Founder, Summit Ridge Group*
- **John Hunter** *Director of Spectrum Policy, T-Mobile*
- **Rachel Bender** *Vice President & Associate General Council, Federal Regulatory & Legal Affairs, Verizon*
- **Jennifer Manner** *Global Spectrum & Regulatory Policy, GSOA*

SESSION 8 DISCUSSION NOTES

John Hunter *Director of Spectrum Policy, T-Mobile*

- mmWave often cuts off when UPS truck drives by.
- 5G buildout has slowed because we have built it out in most places. *[AM Comment: T-Mobile covers my midtown NYC office well, but not my Upper East Side apartment – so I think there are still some big gaps to fill]*

Rachael Bender *Vice President & Associate General Council, Federal Regulatory & Legal Affairs, Verizon*

- Fixed wireless is a significant 5G use case.

Jennifer Manner *Global Spectrum & Regulatory Policy, GSOA*

- 5G release 18 will use higher bands.

[AM Comment: I was so busy moderating this panel, I did not take good notes

G. 12:40 – 13:30 Session 9: The Long-Term Future Of FWA In North America – Continued Growth Or Has A Peak Been Reached?

- **Natalie Modesto** *Customer Service Manager, Ericsson*
- **Chris Wieczorek** *Senior Director Spectrum Policy, T-Mobile*
- **Darrin Mylet** *Wialan Technologies – Telosa Network*

SESSION 9 DISCUSSION NOTES

Natalie Modesto *Customer Service Manager, Ericsson*

- FWA is the biggest use case – it is here to stay.
    - Lots of fixed wireless CPEs are self-installable.
    - Can also use it in agriculture.
- Need to plan number of users per site, provisioning, indoor and outdoor mix.
- Fixed wireless is happening all over the world.
    - In Norway, they are replacing DLS with fixed wireless.
    - Fixed wireless is a tool in the toolbox and is developing technologically.
    - FWA offers a lot of bandwidth.
    - In Oman, FWA replaced home 4G with 5G.
- Want to protect mobile broadband users from FWA.
- The more spectrum is given, the more it is used.
    - Advances in hardware and software will help.
- Lots of microwave deployed and some technology is available to advance coverage capabilities.
    - FWA has good separation of devices and can use massive MIMO efficiently.
    - Outdoor CPE can give better spectrum efficiency, but it sometimes makes the sale a bit harder as it's more work for the consumer.
- 2-4% of network traffic is from FWA, but each user consumes 20x-30x more data than mobile wireless, partly because whole family is using it.
- The future of FWA depends on technology, regulations, etc.

Chris Wieczorek *Senior Director Spectrum Policy, T-Mobile*

- Cable competition.
    - Comcast and Charter are now big competitors of T-Mobile for wireless.
    - T-Mobile is a big competitor for them for fixed wireless.
- FWA is a good tool in the toolbox but fiber is in everyone's diet.
    - Use all bands available for FWA.
    - 2.4 GHz is an ultra-capacity band.
- Municipalities make it hard to build cell sites in certain areas.
- Millimeter wave should work, but it is hard to get them to propagate well.

    - Verizon had 30,000 mmWave sites a few years ago, but it has not increased.
- One town sets max height to 75 feet because the tree line is 110-140 ft, so it's hard to get a cell site with good coverage area.
- Hundreds of gigabits per month are used by FWA.
- In 10 years, there will be lots more FWA

Darrin Mylet *Wialan Technologies – Telesa Network*

- Telecom operators and cable companies trading at 1990s levels despite increased demand.
    - Lots of new applications are emerging; new infrastructure will allow additional spectrum to be identified.
    - Will 100 MHz of additional spectrum make any difference?
- Spectrum reuse is becoming a requirement by technologies such as massive MIMO.
- Need to densify the networks.
    - Extra capacity for FWA may run out in 2025, so they will need to densify their network.
    - Won't be able to do densification nationwide.
- Can throw spectrum at the problem, but will need to reuse spectrum as there is no more [spectrum] available.
- Maybe spectrum sharing or "use it or lose it" may free up spectrum.
- South Korea and Japan have very dense networks; it's not easy to site in parts of the U.S.
    - Need to be more creative in the U.S. - there is no other choice.
- In 10 years, most consumer connections will be FWA and fewer wired connections.

H. 14:20-15:30 ***Session 10: Where Are We Going Next? Identifying The Required Spectrum To Power The 6G Evolution***

- **Moderator: Brlow Keener** *Special Counsel, Womble Bond Dickinson*
- **Arpan Sura** *Senior Counsel, Wireless Telecommunications Bureau, FCC*
- **Aspasia Paroutsas** VP *Regulatory Affairs, Qualcomm*
- **Hazem Moakkit** *Vice President, Spectrum Strategy, Intelsat*
- **Jose Ayala** *Chairman, Spectrum Group for CITEL Region, GAA*
- **Carl Povelites** *AVP Global Policy, AT&T*

SESSION 10 DISCUSSION NOTES

Barlow Keener *Womble Bond Dickstein*

- In S. Korea, the government took back the mmWave spectrum.
- How do we know the industry knows what spectrum is needed for 6G?

- Korea plans to have a commercial 6G by 2028.

Aran Sura *Senior Counsel, Wireless Telecommunications Bureau, FCC*

- Layers to 5G and 6G.
    - Use cases (AR).
    - Performance benchmarks (peak data rate, latency, etc.).
    - Enabling technologies (spectrum sharing and sensing capabilities, artificial intelligence.
    - Critical Inputs (spectrum, infrastructure, compute power).
    - Standards (#GPP, ITU, etc.).
- Policy
    - Flexible use, technology neutrality.
    - Must act in the public interest to promote government objectives.
- 6G
    - Trust and national security, resiliency, affordability, sustainability, and affordability and standards in international collaboration.
- Midband is table stakes in telecom now.
- Looking at terahertz bands with 10-year licenses.

Aspasia Paroutsas *VP Regulatory Affairs, Qualcomm*

- After 10 years you get a new generation.
- Will need more spectrum, ideally greenfield.
    - Not interested in terahertz spectrum, but 7 GHz to 15 GHz range.
    - Need more frequencies under study for 6G.
- GigaMIMO [an order of magnitude more than massive MIMO] antenna will allow coverage in bands that otherwise would not work – for 6G, not 5G.
    - Give 10 db gain.
- WRC is just to study the new bands. If we want a certain amount of spectrum, we need to study more of it.
    - As we see more standardization and integration of networks, spectrum might be shareable as opposed to being “mine” and “yours.”
    - mmWave allocation may have made mistakes.
- Would prefer spectrum below 10 GHz but will need to make do with what we have.

Hazem Moakkit *Vice President, Spectrum Strategy, Intelsat*

- Spectrum is allocated at all WRC, but we need to have confidence it will be used.
- Lots of cellular traffic goes to cellular, so do they need the spectrum?
    - Lots of higher frequency spectrum will be used for fixed services, so is it really

mobile?

- Seems there is a lot of talk about coexistence by mobile operators who then evict the incumbents when they get in.
- Lots of satellites use the Ku-band.
    - Taking spectrum from satellites is undermining the U.S. position in the space race.
    - Can't put high-power mobile broadband in the same band as satellite as it will overwhelm the sensitive satellite receivers.
- Should not do mobile at the expense of terrestrial and harm U.S. ability to compete in the space race.
    - Industry should look at refarming.
        - Why is greenfield necessary?
        - Why can't the industry Innovate within its existing spectrum?
    - U.S. frequency bands need to be available.
- 12.6 GHz as "midband" is a misnomer
    - Has rain fade and problems with indoor usage similar to mmWave.
- Paradigm is mostly exclusive use, but the wireless industry wants to share with the ultimate goal of eviction that is not helpful.

Jose Ayala, *Chairman Spectrum Group for CITEL Region, GAA*

- More than 500 companies invested in 5G; now working on 5G Advanced.
    - Over 1 billion 5G subscribers.
    - Industry has delivered.
- Usage scenarios – immersive, sensing connectivity, and communications empowered by AI.
    - U.S. can take a leadership position.
    - IMT standard for 6G by 2030.
    - U.S. frequency bands need to be available by 2028 in three areas.
        - 7 GHz – 15 GHz.
            - Need 500 to 750 MHz per network.
        - Above 92 GHz that will complement 7-15 GHz.
        - 4G Spectrum below 7 GH and above 24 GHz.
        - How much is needed?
- Just want some bands for consideration of new spectrum bands.
    - Want the U.S. to join the Mexico position.

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Carl Povelites *AVP Global Policy, AT&T*

- No U.S. spectrum pipeline, so any spectrum will likely take until at least 2027, which

makes it 5G Advance or 6G spectrum.

- Terrestrial race going on for 30 years.
    - 38% increase in traffic from 2021 to 2022.
    - Growth is not slowing.
- We do re-farm spectrum but still need more.
- Hope for more progress from lower 3 GHz band.
    - Want some part of 4.4 to 4.9 GHz.
    - Also 7 GHz band should be explored.
- An unbalance between licensed and unlicensed (1,920 MHz unlicensed – 3x licensed)
    - Puts us at risk of losing our place.
- Industry always underestimates the amount of spectrum needed. *[AM Comment: Not true IMHO.].*
    - Need more spectrum somehow.
- Need to consider indoor and outdoor use for a variety of reasons, including interference.

I. 15:30-15:40 Introductory Presentation

- **Julie Kearney** *Chief, Space Bureau, FCC*

PRESENTATION NOTES

Julie Kearney *Chief, Space Bureau*

- New FCC space agency due to growth.
    - Satellite broadband growth for internet (91% of 2022 launches).
    - Satellite broadband revenue is up 18% year over year.
    - The [Space] Bureau is to improve policy coordination in space.
    - Huge increase in number of launches.
- 6G will combine satellite and earth-based communication.
- Already have double the number of earth station applications in 2017.
- Satellites are now a viable connectivity option in many cases.
    - Still need resilient internet coverage.
- Need to streamline processes for satellite.

J. Session 12: Space Panel Discussion

- **Julie Kearney** *Chief, Space Bureau*
- **Alexander Kuehn** *Head of International Spectrum Affairs, Spectrum Planning and Innovative Spectrum Usage, BNetz Germany*
- **Margo Deckard** *Co-Founder and COO Lynk*
- **Patrick Wilson** *Vice President, Government Relations, Project Kuiper at Amazon*
- **Julie Zoller** *Head of Global Regulatory Affairs, Project Kuiper at Amazon*

SESSION 12: DISCUSSION NOTES

Julie Kearney *Chief, Space Bureau*

- See notes above from the Introductory Presentation.

Alexander Kuehn *Head of International Spectrum Affairs, Spectrum Planning and Innovative Spectrum Usage, BNetz Germany*

- Convergence between terrestrial and space is important.
    - We have identified use cases.
        - Communications on the move.
        - Hybrids multiplying.
        - Trunking and head-end feed.
        - Backhaul and tower feed.
- Looking at advances in data rates, density, and latency.
- Need to deal with OOBE[1] or spectrum placement and power limits to maximize utility.
    - Satellites may be able to use mobile frequencies on a nation-by-nation decision but is it open to all providers?
    - Also need a transition plan.
- Need an international dialog to move forward.

Margo Deckard *Co-Founder and COO Lynk*

- Lync partners with mobile operators to fill coverage gaps, extend networks, etc.
    - Lync will be a weak signal with terrestrial coverage but becomes the most powerful one when out of cellular coverage, so there is a seamless shift.
    - Three commercial-ready cell towers in space.
- Have beta service in the Bahamas, Cook Island, Palau, and Soloman Islands.
    - Many regulators in developing countries with telecom challenges (e.g., prone to natural disasters) have or are rewriting their rules to allow satellite to phone
    - 80% of humanity lives on $10 or less a day.

[1] OOBE is the acronym for out-of-box experience.

Patrick Wilson *Vice President, Government Relations, Mediatek*

- Founded in Taiwan but operates around the world with 20,000 employees in 50 countries.
    - Powers 2 billion devices.
    - Half of the revenue ($20 billion) in the smartphone business.
- Looking at who has connectivity (60% have cell phone), but only 40% of land mass is connected by cell phone.
    - Spent $4 billion last year in R&D.
    - Launched 1st commercially available phone service and can turn any cell phone operate via satellite L-band/S-band. *[AM Comment: Likely Globalstar.]*
    - Want more LEO satellites.
- Massive MIMO beamforming and adaptation to really increase throughput.

Julie Zoller *Head of Global Regulatory Affairs, Project Kuiper at Amazon*

- Progress.
    - 1st launch on October 6th on an Atlas 5.
    - Filed application with FCC to blanket license customer terminals.
- Will have 3,200 satellites in LEO
    - Manufactured and designed by Amazon.
    - Designed to be affordable to customers.
    - Smaller terminal is 7” x 7” and can handle 100 Mbps.
- Can connect to microwave backhaul.
- Need safe and sustainable access to space, access to Ka-band globally.
    - More spectrum in 17 GHz band would be helpful.
- 2023 WRC is important.
    - Outdated technical rules limit transmit power.
        - A lot of changes technically in 25 years but not the rules.
        - Updated rules would provide tens of billions of benefits to people around the world.
    - 10 countries support plan to put this on the agenda in WRC 27.

[AM Comment: I did not see the whole final session as I need to catch a train back to NYC]