Unofficial Notes:

Center for Strategic and International Studies (CSIS) Strategic Technologies Program
The Invisible Shield: Wireless Spectrum and U.S. National Security

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***NOTICE**: These notes were taken live at The Invisible Shield: Wireless Spectrum and U.S. National Security event in Washington, D.C., on November 12, 2025. 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 the Center for Strategic and International Studies (CSIS) Strategic Technologies Program or participants 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 CSIS Spectrum & National Security event brought together senior leadership from the FCC, NTIA, major wireless operators, equipment vendors, and AI/RAN technology providers to examine how U.S. spectrum policy intersects with national security, next-generation wireless deployments, and the emerging AI-native 6G ecosystem. Across three panels, participants emphasized that the United States is entering a new competitive phase in which wireless leadership, AI leadership, and national security are linked, with mid-band spectrum emerging as the central constraint. While the One Big Beautiful Bill ("O3B") provides the first structured federal spectrum pipeline in years, panelists agreed that the decisive factor is execution: faster band studies, coordinated federal relocation, credible auction timelines, and international harmonization ahead of WRC-27.

Key Takeaways

1. **National Security Convergence: Spectrum = AI = Strategic Competition**

The panels underscored that spectrum policy has effectively merged with national security strategy. Officials and industry leaders emphasized that U.S. competitiveness in AI, autonomous systems, robotics, and precision sensing relies on a reliable, low-latency mid-band spectrum. The U.S.-China race is no longer abstract: China holds approximately four times more mid-band spectrum than the U.S., and the values embedded in future global standards (open vs. authoritarian models) depend on who leads 5G/6G deployment. The O3B's 800 MHz pipeline (500 MHz for shared or non-Federal use; 300 MHz for exclusive non-Federal use) is viewed as necessary but not sufficient. Panelists warned against multi-year studies, procedural drag, and misaligned federal incentives.

2. **Mid-Band Capacity Shortfall: Fixed Wireless, Uplink Demand, and 6G Readiness**

Industry speakers noted that current mid-band allocations are insufficient to support emerging traffic patterns. Fixed wireless access (FWA) now consumes 20–25 times the traffic of smartphones and has made the U.S. a global testbed due to unique competitive dynamics and mid-band availability. Uplink-heavy applications, such as XR glasses, vehicle telemetry, drone feeds, and video sensors, are accelerating faster than current spectrum regulations anticipate. Equipment vendors (Qualcomm, Nokia) and operators (Verizon, T-Mobile) have stated clearly that 6G requires 200–400 MHz of contiguous channels, which the U.S. does not yet have designated. Priority mid-band candidates include the 4 GHz, 7 GHz, upper 6 GHz, and restructured 3 GHz bands, but none are fully committed to date. [**AM Comment**: The push for several 200 - 400 MHz channels assume U.S. political feasibility to consolidate federal C-band assets 3.45 GHz to 4.1 GHz, but there will be significant challenges from innovative CBRS licensees.]

3. **Interagency Constraints: Legacy Systems and the "Default No" Problem**

NTIA and FCC leadership acknowledged that federal incumbents often default to "no" because objecting carries no cost. The result: delayed studies, outdated radar/altimeter systems, and slow progress on relocation or coexistence. NTIA highlighted the need for federal modernization funding and early engineering transparency rather than late-stage conflict (e.g., the 5G altimeter issue). Agencies are aligned at the leadership level for the first time in a decade; however,

burdensome Spectrum Relocation Fund rules, incomplete interference data, and slow system upgrade cycles remain major obstacles. [**AM Comment**: The discussion highlights process delays but sidesteps the core issue: the Spectrum Relocation Fund is structurally misaligned with DoD/FAA upgrade cycles. Without a redesigned funding mechanism, "faster studies" will not translate into "faster relocations.]

4. **Satellite, Direct-to-Device, and Hybrid Models Introduce New Complexities**

Direct-to-device (D2D) satellite connectivity is transitioning from concept to operation (T-Mobile + Starlink; Verizon + AS; Apple + Globalstar). However, panelists noted that it is a complement to terrestrial, not a replacement, and creates new regulatory questions regarding MSS use, hybrid sharing, and the protection of terrestrial networks. Satellite experts have warned of emerging conflicts as operators blend satellite spectrum with terrestrial partnerships, and highlighted the EU's draft space law, which could impose cost increases of 3–30% on U.S. firms through duplicative requirements and non-tariff trade barriers.

5. **AI-Native RAN and 6G: Uplink-Centric, Sensing-Integrated, Compute Everywhere**

NVIDIA and Ericsson emphasized that 6G will be AI-native, not "AI-enabled." This includes integrated sensing (where the RAN behaves like radar), real-time dynamic spectrum allocation, and the use of distributed computing across devices, the RAN, the edge, and the core. AI will fundamentally reshape network traffic, making the uplink as important as the downlink; as a result, networks will require dynamic, real-time prioritization models rather than static QoS rules. These requirements intensify the need for wide mid-band channels and predictable interference environments. [**AM Comment**: AI-driven uplink demand represents a significant departure from traditional traffic assumptions, underscoring the need for larger contiguous mid-band allocations.]

6. **International Harmonization and WRC-27 Strategy**

Panelists stressed that WRC-27 will be decisive for 6G mid-band harmonization. U.S. agencies are pushing early Americas-wide coordination to strengthen CITEL positions in Shanghai. Harmonized 4 GHz and 7 GHz ranges are seen as essential to global equipment scale and cost reductions. Without alignment, the U.S. risks fragmentation and higher device/network costs, undermining competitiveness just as 6G standards are being finalized.

7. **Core Message: The U.S. Must Move Faster**

The shared conclusion across all panels was direct: the United States must accelerate spectrum governance, federal–commercial coordination, and mid-band availability. Leadership in 5G, 6G, and AI will be determined less by legislation and more by how quickly spectrum is cleared, how reliably federal users modernize, and how consistently the U.S. aligns with global allocations. Delays risk ceding ecosystem leadership to China and Europe at the exact moment when AI-native wireless systems become globally standardized.

[**AM Comment**: Elephant in the Room! More spectrum could boost U.S. 6G leadership, but without advances in wireless equipment, it is ineffective. U.S. telecom operators mainly use European gear, which often trails Chinese equipment in cost and technology development.]

PANEL I (10:05–10:35 AM): WIRELESS LEADERSHIP AND NATIONAL SECURITY

MODERATOR: Matt Pearl, Director – Strategic Technologies Program, CSIS.

PANELISTS:

- Brooke Donilon, Chief of Staff, NTIA.
- Arpan Sura, Senior Counsel and Chief AI Officer, Office of Chairman Carr, FCC.
- Umair Javed, Senior Vice President & General Counsel, CTIA.
- Giulia McHenry, Senior Vice President, Public Policy, AT&T.

SESSION:

Matt Pearl, Director – Strategic Technologies Program, CSIS.

- **AI Race & National Security Stakes.**
  - Spectrum policy is fundamentally a national security issue, not just a commercial matter.
  - The U.S. and People's Republic of China ("PRC") are in a high-stakes AI leadership race.
  - Winning AI = decisive, enduring economic and national security advantages.
  - If the U.S. loses the AI race, then "nothing else the national security community does will matter."
- **Why Edge Networks Matter.**
  - Historically, policy focus has been on data centers, chips, energy, talent, and data.
  - The next battleground = the edge.
    - The edge is where AI systems interact with the physical world, including robots, drones, precision agriculture, and autonomous vehicles.
    - Inference workloads will be edge-based, requiring fast, low-latency wireless.
    - This (i.e., AI systems interacting with the physical world, with edge-based inference workloads[1]) cannot happen without large, new mid-band spectrum blocks.
- **Momentum & Policy Environment.**
  - Congress provided a mandate via O3B.
  - 800 MHz of spectrum to be made available.
  - 500 MHz must be federal spectrum.
  - Strong leadership at White House, FCC, and NTIA, with aligned staff and advisers.
- **Execution Challenge.**
  - Political and technical challenges remain significant.
  - Success requires deep interagency coordination + industry collaboration.

[1] An "inference workload" is the operational deployment of a trained AI model, optimized to provide real-time or batch predictions efficiently and reliably, with careful attention to hardware, latency, and throughput requirements.

- Panel goal: understand the threat, understand the solution, and map execution paths.

Umair Javed, Senior Vice President & General Counsel, CTIA.

- "If We Fail on Spectrum, We Fail on AI" [**AM Comment**: If we fail on wireless hardware, we fail on wireless. So far, aside from chips, the U.S. is failing in telecom hardware.]
  - AI use cases to drive wireless demand.
  - AI will determine U.S. competitiveness across various sectors, including manufacturing, transportation, and healthcare.
- **Survey Data.**
  - 83% of executives already see AI increasing 5G connectivity needs (Dell).[2]
  - Accenture: The U.S. will be unable to meet ⅓ of peak-hour AI traffic without more spectrum.[3]
  - Spectrum = Bottleneck.
    - Need a large block of contiguous mid-band spectrum, the U.S. does not have an answer for that.
  - Without mid-band spectrum, AI use cases cannot scale.
  - "AI needs more spectrum just like it needs more energy."
- **Geopolitical Factors.**
  - The U.S. and China run "side-by-side" in the AI race.
  - The outcome will determine whether the system is authoritarian or democratic, and shape future tech ecosystems.
  - Consequences will span generations.
- **Execution Requirements.**
  - O3B provides the U.S. with a path to victory, but implementation must be swift and efficient.
- **Key Problems in the Current Spectrum-Study Processes.**
  - A one-year start to a study is unacceptable in an AI race.
  - Federal incumbents controlling study inputs/outputs create conflicts of interest.
  - Past studies repeatedly conclude: "needs more study."
  - The 6GHz band presents an opportunity for the U.S., especially since it is unlicensed in the country.
  - Agencies must deliver trustworthy, evidence-based, actionable outputs, not stall.

Giulia McHenry, Senior Vice President, Public Policy, AT&T.

- **Spectrum, Economies of Scale & Strategic Risk.**

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[2] Gabe Knuth, AI at the Endpoint: The Impact of AI on End Users and Endpoint Devices, Enterprise Strategy Group (January 2025), https://www.delltechnologies.com/asset/en-us/products/laptops-and-2-in-1s/industry-market/ebook-dell-verizon-at-at-the-endpoint.pdf.external.

[3] Securing the Future of U.S. Wireless Networks: The Looming Spectrum Crisis (March 27, 2025), https://api.ctia.org/wp-content/uploads/2025/03/Looming-Spectrum-Crisis-Accenture.pdf.

  - Why is losing the spectrum race irrecoverable?
  - Without sufficient spectrum, U.S. carriers cannot build networks at a cost-effective scale.
- **Losing global leadership undermines the following:**
  - Vendor ecosystems.
  - Cost efficiencies.
  - Global interoperability.
  - Where innovation is built and deployed.
- **Once the U.S. loses ecosystem leadership, clawing back is extremely difficult.**
- **Economic & Security Risks.**
  - Lack of harmonized spectrum prevents carriers from leveraging global economies of scale.
  - Want a harmonized spectrum so it won't be underutilized.
  - Losing wireless leadership means that fewer global services and applications will be built on U.S. platforms.
  - Even if Chinese equipment is absent from U.S. networks, global proliferation of PRC gear complicates U.S. offensive/defensive security posture.
- **Implementation & Coordination Insights.**
  - Agencies and industries often misunderstand each other; they need early, frequent, and structured communication. [**AM Comment**: How do we make this happen?]
  - Transparency must be balanced with the protection of the mission and national security.
  - FCC Auctions Division = model for disciplined project management.
  - Every auction is unique; it requires bespoke rules, incentives, and sequencing.
- **Industry Spectrum Priorities.**
  - Harmonized global bands.
  - Contiguous blocks
  - Ecosystem-ready frequencies
- **Excited about the following:**
  - C-band expansion.
  - Improving CBRS usability.
  - 4 GHz long-term potential.
    - 7 GHz: equipment ecosystem further out.
- Holding a spectrum idle is costly, given the current economic environment.

Arpan Sura, Senior Counsel and Chief AI Officer, Office of Chairman Carr, FCC.

- **Geopolitical Threat from the PRC.**
  - The geopolitical threat is clear in the PRC's behavior.
  - Examples

        - Huawei promotion in Latin America/Africa. [**AM Comment:** Of course. However, Huawei is often considered better and cheaper than western wireless equipment providers, and developing countries can't afford to pay twice as much. What is the strategy?]
        - Cyber events targeting U.S. networks.
        - Attempts to exploit U.S. equipment authorization.
        - Aggressive posture at WRC and 3GPP.
    - These behaviors show that the spectrum is a geopolitically strategic asset.
- **From "Spectrum Malaise" to Momentum.**
    - Early 2025:
        - No auction authority.
        - Stalled band studies.
        - No political commitment to release federal spectrum.
    - Now:
        - O3B created a clear spectrum pipeline.
        - White House, NTIA, and FCC are aligned and energized.
        - Mandates provide clarity → easier coordination.
- **Execution Challenges & Timelines.**
    - FCC must complete Upper C-band auction by July 2027:
    - Steps for Upper C-band auction:
        - Completion steps:
            - Propose rules.
            - Adopt rules.
            - Finalize procedures.
        - Run and finish the auction.
- Some bands have historically taken around 10 years to develop.
- Aggressive timelines require tight project management and agency collaboration.
- Fixing Excessive Proceduralism.
    - Prior rules (BEAD, NEPA, siting) showed how the process can overwhelm outcomes.
    - FCC goal: maintain procedures while eliminating proceduralism.
- Every day of delay → real economic loss.
- **WRC-27 Preparation (Shanghai).**
    - Framework of Four Ps:
        - Personnel: choose U.S. delegation leaders early.
        - Policies: unify U.S. positions on all agenda items (heavy space focus).
        - Place: the Shanghai venue has unique security/operational considerations.
        - Partnerships: build partnerships with allies to advance the U.S. vision.

Brooke Donilon, Chief of Staff, NTIA.

- **NTIA's Expanding Role.**
  - NTIA facilitates IRAC and interagency coordination prior to FCC rulemakings.
  - During the shutdown, NTIA continued IRAC[4] operations.
- **Coordination on C-band.**
  - Band study prep for 2.7 GHz and 4.4 GHz.
  - Study Process & Pace.
  - Administrator Roth will move quickly and will not allow 1-year delays to start studies. [**AM Comment**: That's good]
- **Constraints are often tied to the requirements of the Spectrum Relocation Fund.**
  - Federal agencies need to fund impact assessments.
  - This bureaucratic layer explains historic delays.
  - NTIA is pushing teams aggressively.
- **Changing Incentives for Federal Agencies.**
  - NTIA pushing agencies to see band changes as "opportunity, not loss."
  - FAA is particularly engaged in viewing the spectrum transition as a path to next-gen radar upgrades.
  - Shift from zero-sum mentality to win-win modernization.
  - Strong top-down mandates from the White House and Congress are improving cooperation.
- **Meeting the 800 MHz / 500 MHz Mandate.**
  - NTIA views the mandate as a minimum standard, not a maximum limit.
  - Goal = maximize federal spectrum made available as fast as possible.
- **Priority: Focus on 4 GHz.**
  - 15 federal agencies are currently using it. [**AM Comment:** That will be a mess to sort out]
  - Minimal prior study.
  - Close alignment with DoD and DoJ.
  - Ambition to meet (or beat) deadlines.
- **WRC-27 Strategy.**
  - Learn from WRC-23; avoid fragmented U.S. positions.
  - Set U.S. positions early and build an allied bloc ahead of C-fills.
  - Push for IMT identification as early as possible.[5]

[4] IRAC stands for Interdepartment Radio Advisory Committee, NTIA https://www.ntia.gov/page/interdepartment-radio-advisory-committee-irac.
[5] IMT refers to International Mobile Telecommunications, a set of global standards for mobile broadband systems. IMT-2000 is commonly associated with 3G technology, IMT-2020 with 5G, and IMT-2030 with 6G. See Richard Hass, *IMT*, Policy Tracker (July 30, 2024), https://www.policytracker.com/glossary/imt/.

PANEL II (10:40–11:10 AM): SPECTRUM FOR NEXT-GENERATION TERRESTRIAL USE

MODERATOR: Kelcee Griffis, Telecom Reporter, Bloomberg News.

PANELISTS:

- Becky Tangren, Vice President, Nokia.
- John Kuzin, Senior Vice President – Spectrum Policy, Qualcomm.
- Rachael Bender, Senior Vice President – Public Policy, Verizon.

SESSION:

Kelcee Griffis, Telecom Reporter, Bloomberg News.

- Shift focus from federal spectrum management to commercial wireless, equipment vendors, and deployment implications.
- Begin with a foundational question for non-experts: What is wireless spectrum, and why does it matter?
- Explore how carriers and vendors coordinate, requirements of the O3B, tradeoffs in repurposing, direct-to-device satellite use, and 6G outlook.

Becky Tangren, Vice President, Nokia.

- Spectrum is like an "invisible rainbow": different frequencies behave like different colors; each suited for specific communication needs.
- The mid-band spectrum offers ideal propagation, enabling signals to travel long distances and at high speeds through buildings and trees.
- Higher frequencies face distance, blockage, and penetration limits.
- **Why Spectrum Matters.**
    - Spectrum enables connectivity, allowing consumers, enterprises, and industries to participate in the global economy.
    - Driving economic growth supports broader social needs.
- **Vendor–Carrier Coordination.**
    - Nokia builds global equipment and must navigate varying international allocations.
    - Example: Globally, 6 GHz is trending toward licensed use; in the U.S., it remains unlicensed.
    - Vendors coordinate continuously with carriers to understand use cases, preferred bands, and roadmaps.
    - Final equipment design depends on FCC rules and technical specifications.
- **Upper C-Band NPRM.**
    - Nokia strongly supports opening the band for licensed mobile use.
    - Provides wider contiguous bandwidth required for 5G Advanced and 6G-class channels.
    - Encouraging improvement: FAA, FCC, and NTIA began coordination much earlier than for the lower C-band.

- **Tradeoffs in Repurposing Federal Bands.**
  - Advances in commercial 5G/6G technologies can benefit federal and defense users.
  - Nokia Federal Solutions focuses on defense-grade applications of commercial tech.
  - Key 6G feature: Integrated Sensing and Communications (ISAC), enabling detection of drones, vehicles, and people.
  - [**AM Comment:** Defense sector is now relying more on commercial technology solutions, which may make finding solutions easier.]
- **Direct-to-Device (D2D).**
  - Nokia participates in D2D via a partnership with AST SpaceMobile.
  - Supports satellite expansion but urges the FCC to rely on strong engineering before increasing satellite power limits.
  - Important to protect existing terrestrial operations.
- **6G Outlook.**
  - 6G will be AI-native rather than AI-enabled.
  - Every part of the network, including access, core, and sensing, must be capable of handling massive AI workloads.
  - Use cases such as gaming, industrial automation, and telehealth require large bandwidth, high reliability, and rapid response times.
  - CBRS needs to get full power.

John Kuzin, Senior Vice President – Spectrum Policy, Qualcomm.

- Spectrum is a unique natural resource; highway lanes offer a useful analogy.
- Each mobile generation requires wider lanes.
  - 4G uses 5–20 MHz.
  - 5G expands to 100 MHz.
  - 6G requires 200–400 MHz channels.
- Wide channels limit viable bands for next-gen mobile, reinforcing the need for large mid-band blocks.
- **Spectrum Pipeline Requirements.**
  - The U.S. must identify at least 600 MHz of spectrum by 2029 to keep pace with China, the EU, and India.
  - Global peers plan 6G deployments in the upper 6 GHz.
  - The U.S. currently has no designated 6G band, creating urgency for planning.
- **Vendor–Carrier Standards Coordination.**
  - Spectrum planning involves developing multi-year standards and designing equipment to optimize the utilization of spectrum.
  - Early communications with vendors are needed.

  - Bands do not require perfect global alignment; equipment can span adjacent frequencies, such as the upper 6 GHz and 7 GHz.
  - New 6G bands must allow full-power mobile operations, not medium-power or unlicensed sharing schemes. Most calls start or end indoors.
- **Upper C-Band NPRM.**
  - Early industry–government collaboration is key.
  - Lessons from the lower C-band transition should accelerate upper C-band work.
  - The Upper C-band will serve 5G and 5G Advanced, while 4 GHz and 7 GHz must be prepared for end-of-decade 6G deployment.
- **Repurposing Tradeoffs.**
  - Well-known tools include relocation, equipment upgrades, Federal-only sharing, and geographic protection zones.
  - All tools need to be on the table.
    - It is important to consider the ability of equipment upgrades to utilize less spectrum.
    - Relocation is important, but the end goal is to achieve the full power spectrum.
  - Incumbents may be able to operate more efficiently with modernized systems.
- **NDAA Concerns.**
  - Proposals removing 3.1–3.45 GHz and 7.4–8.4 GHz from consideration delay full-power mobile until 2040.
  - The U.S. should now examine the spectrum below 10 GHz.
- **Direct-to-Device (D2D).**
  - Qualcomm chipsets support mobile, Wi-Fi, and satellite connectivity.
  - Satellite is complementary and beneficial for rural and remote areas.
  - Terrestrial full-power mobile remains essential for metro-area economic activity.
- **6G Applications and Architecture**
  - Four largest data drivers:
    - Mobile gaming.
    - Video.
    - AI.
    - XR.
  - XR glasses, such as Meta's Ray-Bans and Oakley's (Qualcomm-powered) models, are uplink-intensive.
  - AI workloads also increase uplink requirements.
  - 6G networks must transition from downlink-heavy to symmetric, low-latency, high-capacity architectures.[**AM Comment**: Interesting, but little evidence so far that this will happen. How much spectrum will it really require?]

Rachael Bender, Senior Vice President – Public Policy, Verizon.

- Spectrum is the lifeblood of wireless and core to the digital economy.
- 6G will require large contiguous blocks of spectrum (200 - 400 MHz channels).
- **Carrier–Vendor Collaboration.**
  - Verizon works constantly with equipment vendors to align technical, regulatory, and deployment timelines.
  - The goal is to ensure equipment is ready when the spectrum becomes available.
  - Must balance desired performance with what FCC and NTIA can deliver.
- **Upper C-Band NPRM.**
  - The Pipeline Act requires at least 100 MHz, but the NPRM proposes up to 180 MHz; Verizon supports increasing this further. This timeline is tight.
  - Challenges include FSS transitions, earth-station migration, and aviation altimeter upgrades.
  - Auction completion is only one step; deployment must follow without decade-long delays.
  - Early engagement among the FCC, NTIA, and FAA is a positive development.
- **Tradeoffs in Repurposing.**
  - The Upper C-band contributes toward the 300 MHz that the FCC must allocate for commercial use within 7 years.
  - CBRS is a key candidate for full-power licensed use, enabling a unified 3 GHz ecosystem from Ambit (i.e., 3.45 GHz to 3.55 GHz), CBRS, C-band, and upper C-band. [**AM Comment:** This is very interesting. CBRS was recently auctioned and has successfully attracted new entrants. There will be a lot of resistance to change.]
  - Verizon supports either incremental CBRS reforms (higher power) or a full re-examination of the band.
- **Direct-to-Device (D2D).**
  - Two models today.
  - MSS model: Verizon–Skylo partnership using MSS spectrum.
  - Supplemental Coverage from Space: Verizon–AST partnership using Verizon's 850 MHz to close dead zones.
  - FCC rules wisely keep satellite operations secondary and require terrestrial partnerships.
  - Guardrails are crucial for protecting terrestrial networks.
- **NDAA Concerns.**
  - NDAA spectrum carve-outs create unnecessary veto points.
  - Senator Cruz and the White House oppose restrictions that reduce executive flexibility.
  - Flexibility is necessary to meet the goals of the Pipeline Act.

- **6G Outlook.**
  - 6G is expected to be AI-native with AI embedded throughout the network.
  - AI will create new consumer use cases and drive network resource demands.
  - Integrated sensing is likely to shift network architecture and spectrum planning.
  - Strong spectrum policy today determines whether the U.S. can scale to 6G.

PANEL III (11:15–11:45 AM): TECHNOLOGICAL DEVELOPMENTS (FIXED WIRELESS, DIRECT-TO-DEVICE, 6G) AND POLICY IMPLICATIONS

MODERATOR: Drew FitzGerald, Reporter – The Wall Street Journal.

PANELISTS:

- Peter Linder, Head of Thought Leadership Americas, Ericsson.
- Chris Wieczorek, Head of Spectrum Policy, T-Mobile.
- Flynn Rico-Johnson, Director of Government Affairs – Telecom, NVIDIA.
- Mike French, Senior Advisor – Boston Consulting Group (BCG); Founder, Space Policy Group; former Chief of Staff at NASA.

SESSION:

Drew FitzGerald, Reporter – Wall Street Journal.

- The final session focuses on emerging technologies (6G, fixed wireless, and direct-to-device) and their associated policy implications.
- The goal is to build on prior panels and explore the new capabilities and challenges that arise with next-generation wireless technology.

Peter Linder, Head of Thought Leadership – Americas, Ericsson.

- **6G Capabilities and Differences from 5G.**
  - Historically, each wireless generation has a "pivot moment":
    - 3G → iPhone.
    - 4G → IoT.
    - 5G → first time wireless can match wired broadband (fixed wireless).
  - 6G will extend 5G capabilities: lower latency, higher capacity, and broader uplink functionality.
  - Key new capability: Integrated Sensing and Communication (ISAC) mobile beams, functioning like radar, detect objects not directly connected to the network (humans, animals, devices on other networks). [**AM Comment**: I am too old to even imagine this.]
  - Wearables and next-generation devices will depend heavily on cloud-assisted connectivity.
- **AI's Role in 6G.**
  - AI integrates across device → edge → cloud; reliability and trust become more critical in distributed AI architectures.
  - 6G networks will need to function securely and consistently as workloads move dynamically across computing layers.
- **Fixed Wireless Access (Global Perspective).**
  - Fixed wireless was once considered inferior in earlier generations; however, 5G has changed that.

  - U.S. success driven by unique market dynamics: cable competition, uneven fiber deployment, and shift toward dual play (mobile + home broadband).
  - India is emerging as a major FWA testbed due to extremely low wired penetration; success there will drive global scale and adoption.
  - Fixed wireless can often solve the "last mile" more efficiently than trenching fiber.
- **AI and Traffic Growth Outlook.**
  - Even with deceleration, mobile traffic continues to double every 5–6 years.
  - Fixed wireless customers generate 20–25× more monthly data than smartphone users [**AM Comment**: But FWA is deployed in areas where there is generally more spectrum available.]
  - AI traffic today is primarily "text-in/text-out," but multimodal AI (encompassing video, sensors, and continuous real-time input) will drive massive uplink growth.
  - Network management will evolve toward dynamic priority models (ambulance-lane behavior) rather than static configurations.
  - Uplink capacity, latency, and service-specific resource guarantees will matter more than raw downlink throughput.
- **Direct-to-Device (International Perspective).**
  - The satellite will play a complementary role in extending coverage where fiber and cellular networks break down.
  - D2D is especially useful in remote areas, disaster zones, and wide spaces (e.g., wildfires).
  - Business models vary (primary access vs complementary use), but satellite will remain an essential tool in the connectivity toolbox.

Chris Wieczorek, Head of Spectrum Policy, T-Mobile.

- **5G Learnings Informing 6G.**
  - 6G predictions are difficult; 5G is still actively evolving.
  - 5G fixed wireless access (FWA) has been a major and somewhat unexpected commercial success. [**AM Comment**: 5G worked out well for T-Mobile, but not for most others.]
  - Increasing need for uplink-heavy applications: smart glasses, autonomous vehicles, drones, live VR, and real-time video streams.
  - Networks will need to rebalance uplink vs downlink resources.
- **Why the U.S. Leads in Fixed Wireless Access.**
  - T-Mobile's 2020 merger enabled control of large, contiguous mid-band holdings required for competitive FWA.
  - The U.S. market structure differs from those of other countries.
    - Cable industry dynamics are unique.
    - Many countries have deeper fiber penetration, which reduces the need for FWA.

    - FWA success is driven by competition and giving consumers new choices.
- **Direct-to-Device (Starlink–T-Mobile Partnership Learnings).**
    - Consumers clearly value satellite messaging and coverage; usage is increasing.
    - T-Mobile recently enabled nationwide 911 texting via satellite for all users, including non-subscribers.
    - D2D still has physical limits (e.g., heavy tree cover limiting line-of-sight).
    - Future models may include both T-Mobile's licensed spectrum + MSS arrangements, depending on market evolution.
    - Operator Flexibility for Dynamic Prioritization.
- U.S. regulatory posture (light-touch approach) enables innovation in traffic management.
- T-Mobile's T-Priority system enables the prioritization of critical streams (e.g., autonomous vehicle camera feed over in-car entertainment).
- Operators currently have adequate flexibility without needing additional policy changes.

Flynn Rico-Johnson, Director, Government Affairs Telecom, NVIDIA.

- **Early 6G Development and Standards.**
    - Standards work is underway, with debate surrounding whether traditional OFDM waveforms[6] are ambitious enough for 6G.
    - NVIDIA's position: 6G standards must fully leverage modern compute capabilities to achieve a fully AI-native architecture.
    - If standards are not ambitious, the U.S. risks missing the technological moment.
- **AI RAN vs Open RAN.**
    - Open RAN defines interoperability of RAN components; it does not inherently define intelligence. [**AM Comment:** Will ORAN die because of Echostar network decommissioning? If so, how does the wireless equipment market open for small innovative companies?]
    - AI-RAN integrates AI into the RAN itself and can be implemented using Open RAN standards.
    - NVIDIA leads AI-WIN, an American coalition (Nokia, ODC, MITRE, Cisco, Booz Allen) building a U.S. 6G AI-native stack.
    - NVIDIA–Nokia partnership will deploy NVIDIA hardware/software globally within Nokia's AirScale systems.
- **AI Policy and Deployment.**
    - Unlike spectrum, compute does not face public-policy bottlenecks determining where they can be deployed.

[6] An OFDM (Orthogonal Frequency-Division Multiplexing) waveform transmits a high-speed data stream by splitting it into multiple lower-speed streams sent in parallel using orthogonal subcarriers, ensuring efficient spectrum use, robustness against multipath interference, and high data rates for modern wireless systems .

  - Carriers are independently rolling compute toward the edge based on performance needs.
  - Innovation is happening organically, without regulatory gating.
- **How AI Changes Traffic and Networks.**
  - Today's LLMs tokenize human language; future network AI will tokenize radio environments.
  - Propagation and ray-tracing data.[7]
    - Power levels.
    - Cell-site distribution.
    - Population density during large events.
  - AI will allow networks to behave as adaptive, "living" systems adjusting to dynamic conditions.
- **Where Compute Will Live (NVIDIA's View of the Edge).**
  - Compute will exist across the entire chain: device → RAN → edge → core.
  - Location depends on use case latency, mobility, and workload intensity.
  - NVIDIA products (e.g., Aerial RAN Computer Pro/ARC Pro) are deployed inside base stations; SIONNA toolkits enable 6G research on desktops with NVIDIA systems.

Mike French, Senior Advisor – BCG; Founder, Space Policy Group.

- **Satellite Policy Landscape.**
  - Policy debates are still largely tied to 5G-era sharing models, rather than emerging hybrid architectures.
  - New satellite coordination models are needed as satellite–terrestrial hybrids expand.
- **National Security and Interagency Tensions.**
  - Aviation and defense communities carry "scar tissue" from prior conflicts (e.g., altimeters).
  - Their missions prioritize safety and long hardware replacement cycles.
  - Government systems (especially space-based) cannot pivot or upgrade quickly.
  - Financial incentives often fail to align with commercial upgrade cycles.
  - Need for a new interagency default.
- Current federal spectrum coordination defaults to "no," since agencies bear no cost for blocking requests.
  - Industry advocating a default "yes, but…" approach.
  - Agencies should be more transparent about conflicts so the industry can propose early solutions. [**AM Comment**: Yes, but the problem is with some confidential DoD applications where information sharing is difficult.]

[7] Ray tracing is a rendering technique that simulates the path of light rays to produce highly realistic images by accurately modeling reflections, refractions, and shadows..

- **EU–U.S. Spectrum and Space Law Tensions.**
  - EU's draft space law creates concerns for U.S. companies.
    - Duplicative regulatory burdens add 3-30% in costs.
    - Requirements that appear technically infeasible.
    - Potential non-tariff trade barriers (e.g., favoring European launch).
  - "Giga-constellation" category (>1,000 satellites) affects Starlink, Amazon Kuiper, and Chinese systems, raising questions about intent and market impact.
- **Next Spectrum Conflict.**
  - Likely to center on hybrid direct-to-device models that mix satellite and terrestrial spectrum.
  - The SpaceX/EchoStar deal has accelerated regulatory scrutiny of hybrid architectures and business models.
  - What satellite connectivity matters most?
  - The true breakthrough is LEO broadband, not SMS-style D2D mobile messaging. [**AM Comment:** SMS style D2D market has expanded, emergency communications globally without taxpayer support is certainly a significant development.]
- **National Security Value.**
  - Dual-use technologies.
  - New defense procurement pathways.
  - Enhanced resilience and sovereignty.

Matt Pearl, Director – Strategic Technologies Program, CSIS.

- Key Takeaways.
  - Spectrum availability is crucial for both commercial innovation and national security.
  - Agencies like FAA and DoD can upgrade systems to more interference-resilient modern architectures.
  - Integrated sensing could enable 6G networks to function as distributed radars, critical for counter-drone missions.
  - International harmonization expands market scale for technologies like fixed wireless and improves global competitiveness.
- CSIS will continue analysis, publishing, and multi-stakeholder engagement to advance U.S. leadership.

End of Event.