Accelerating Digital Transformation through Emerging Technologies

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Note: The views expressed in this presentation are those of the author and may not necessarily represent the views of the Federal Communications Commission

"The promise of 5G means new and improved services and applications for consumers and businesses alike. This means not only faster download speeds, but also enabling digital tools we can't even imagine yet. We need to deliver the 5G that the American people were promised. That means a 5G that is fast, secure, resilient, and—most importantly—available across the country."

- Acting Chairwoman Rosenworcel, February 23, 2021

Accelerating the Digital Transformation Requires An Integrated Multi-Dimensional, Multi-Faceted All-Encompassing Approach

- Radiofrequency Spectrum Access
- Technology and Experimentation
- Equipment Compliance and Security

Spectrum Breadth and Depth in the U.S.

High-band:	28 GHz band auction (27.5 GHz – 28.35 GHz; 2 x 425) Completed January 2019 24 GHz band auction (24.25 – 24.45; 25.25 -25.75 GHz; 7 x100) Completed May 2019 37 GHz, 39 GHz, and 47 GHz (34 x 100 for total of 3,400 megahertz of spectrum released into the commercial marketplace) Completed March 2020. Potential to free up another 2.75 gigahertz of High-band spectrum in the 26 and 42 GHz bands
Mid-band:	3.5 GHz auction completed August 25, 2020, (7x10) 3.7-3.98 GHz "C-Band" auction completed February 17, 2021 (14x20) 3.45 – 3.55 GHz auction scheduled to begin in early October 2021 (10x10) 2.5 GHz Rural Tribal Priority Window, future auction TBA
Low-band:	600 MHz transition from 2016 Broadcast Incentive Auction completed; 5G mobile service rolling-out Targeted changes to 800 MHz and 900 MHz bands to improve use of low band spectrum for 5G services

Emphasis on Mid-Band Spectrum
3.55-3.7 GHz CBRS

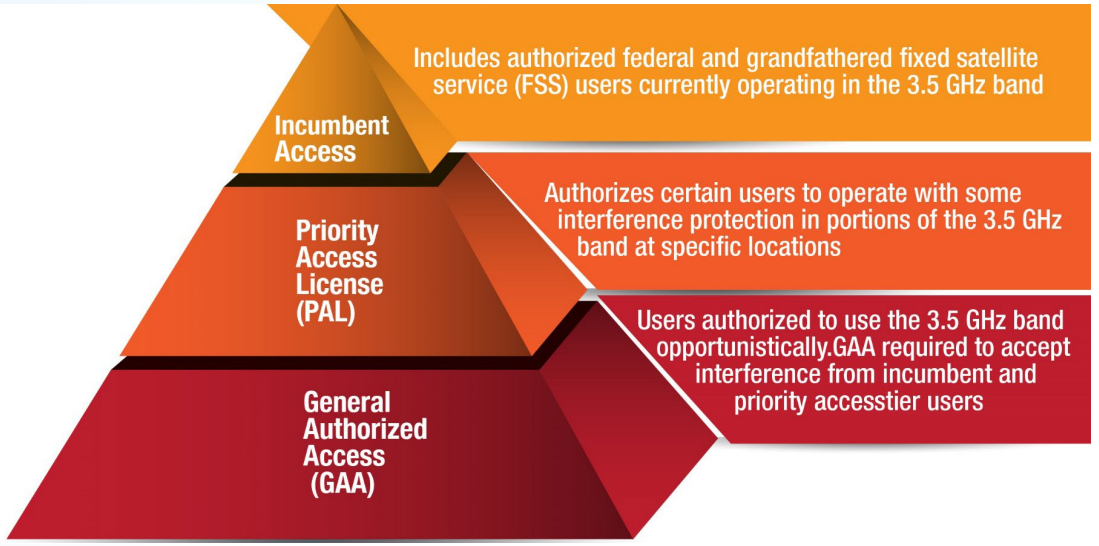
In October 2018, the FCC adopted updated rules for the shared use of the 3.5 GHz (3.55-3.7 GHz) band, known as the Citizens Broadband Radio Service (CBRS).

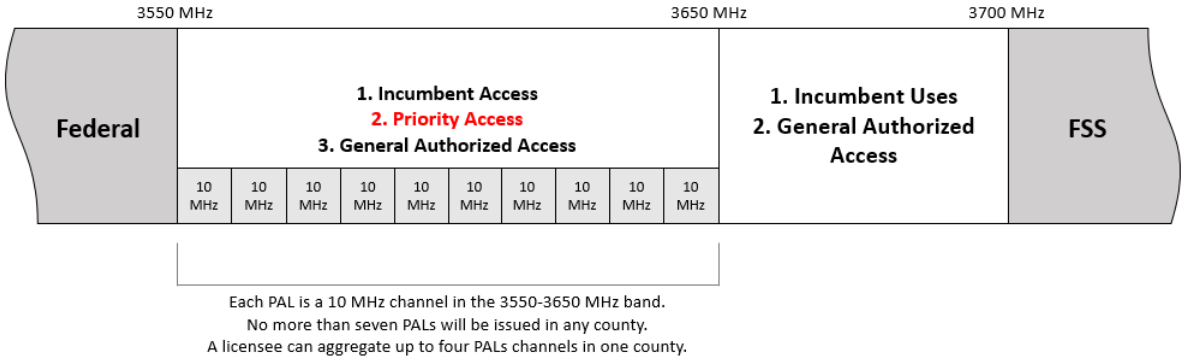
The CBRS band uses a dynamic sharing model to enable sharing between naval radars, satellite users, PAL users and GAA users.

CBRS dynamic sharing relies on a Spectrum Access System (SAS) database linked to sensors providing Environmental Sensing Capability (ESC).

Auction 105 offered 22,631 Priority Access Licenses (PALs) in the 3550-3650 MHz band. The auction completed August 25, 2020, with gross proceeds totaling $4.543b

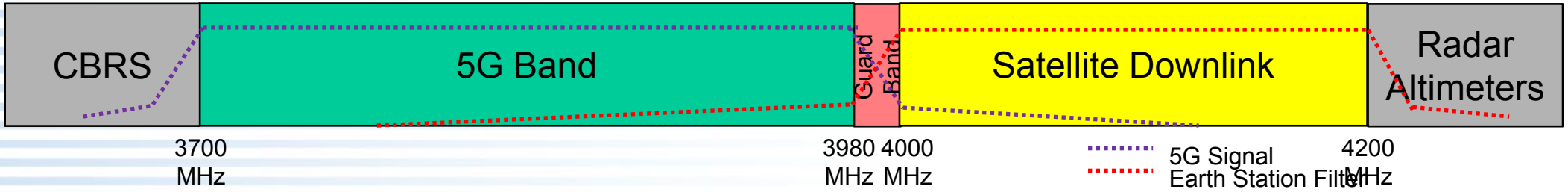
Priority Access Licenses are being issued; GAA access since January 2020



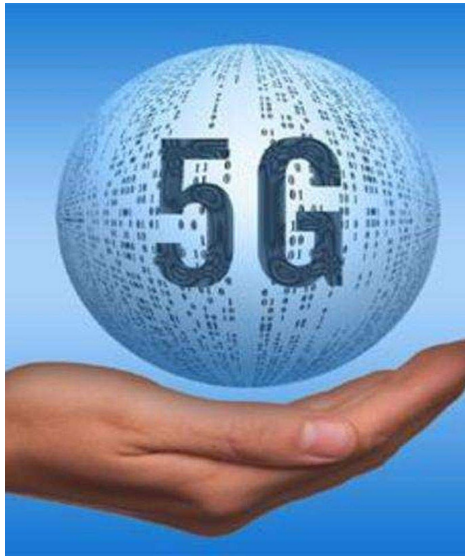


Emphasis on Mid-Band Spectrum
3.7-4.2 GHz C-Band

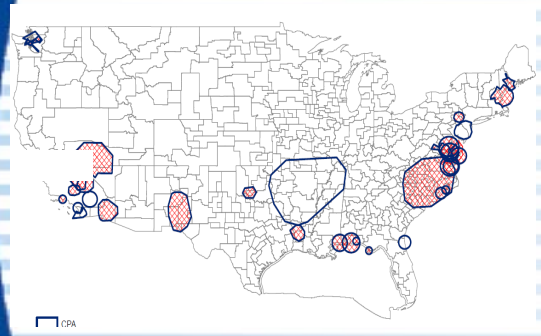
- Auction completed February 17, 2021
- *3.7 GHz Report and Order (adopted* March 2020)
  - Spectrum made available for new wireless uses while also accommodating incumbent Fixed Satellite Service (FSS) and Fixed Service (FS) operations in the band.
  - 280 megahertz (3.7-3.98 GHz) available for mobile use.
  - 20 megahertz (3.98-4.0 GHz) will serve as a guard band.
  - 200 megahertz (4.0-4.2 GHz) to accommodate existing satellite operations.
- Accelerated relocation option selected by all satellite operators
  - Lowest 100-megahertz in 46 of top 50 markets to transition by December 5, 2021
  - Remaining markets and spectrum to transition by December 5, 2023
- Technical rules adopted to protect satellite operations
  - In-band and out-of-band PFD limits
  - Filters required for all earth stations



Emphasis on Mid-Band Spectrum 3.1-3.55 GHz Band



- 2nd Report and Order (March 17, 2021)
  - Makes 3450-3550 MHz band available for flexible use throughout the contiguous United States;
  - Creates coordinate regime for non-federal and federal users by adopting Cooperative Planning Areas and Periodic Use Areas and establishing coordination procedures;
  - Adopts a band plan and technical, licensing, and competitive bidding rules;
    - Ten 10-megahertz blocks available within PEAs in contiguous United States
  - Requires non-federal radiolocation operators to sunset operations within 180 days after the grant of new flexible-use licenses and provide for reimbursement of reasonable relocation costs; and

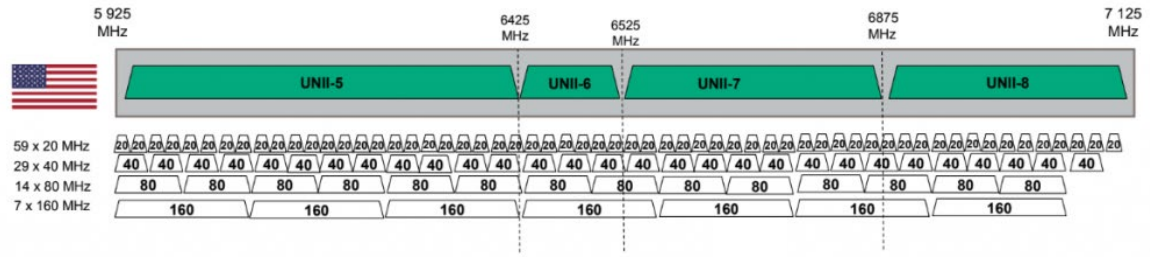


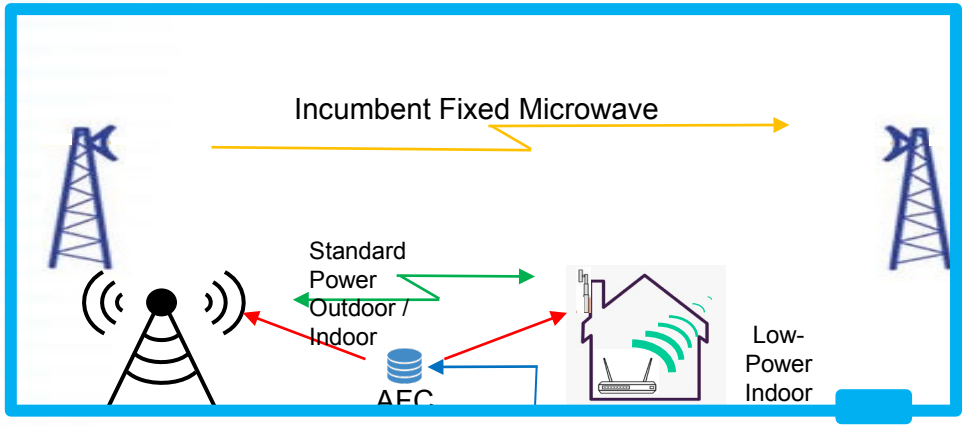
  Requires amateur operators to cease operations in the 3.45 GHz band within 90 days of the public notice announcing the close of the auction; allows those operations to continue in the 3.3-3.45 GHz band pending future Commission action in that spectrum.

- Beat CHINA for 5G Act of 2020 requires the Commission to start an auction for flexible use licenses in the 3450-3550 MHz band by December 31, 2021

Emphasis on Mid-Band Spectrum Unlicensed Operations in the 6 GHz Band

- Report & Order (April 2020)
- 1200 megahertz in four sub-bands
  - Up to 7 160-megahertz wide channels
  - Standard access points in U-NII-5, 7 only
    - No usage on cars, trains, boats, aircraft
  - Low-power indoor access points in all bands
  - Contention-based protocol required
- Further Notice of Proposed Rulemaking
  - Very low power use across full band
    - Virtual / augmented reality use cases
  - Additional power for low-power indoor
  - Mobile standard power
  - Higher power/antenna directivity for AFC
- Public Notice
  - Comment on client-to-client communications

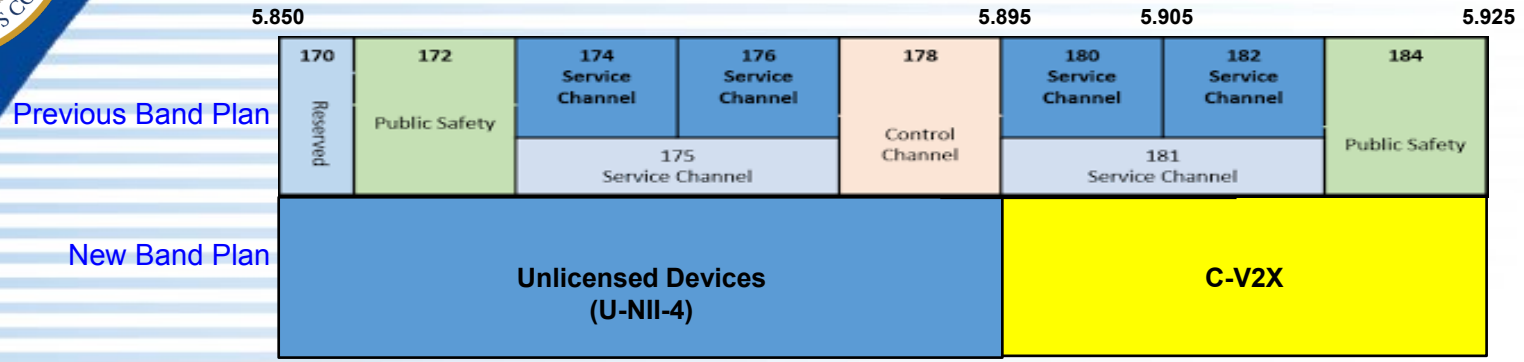




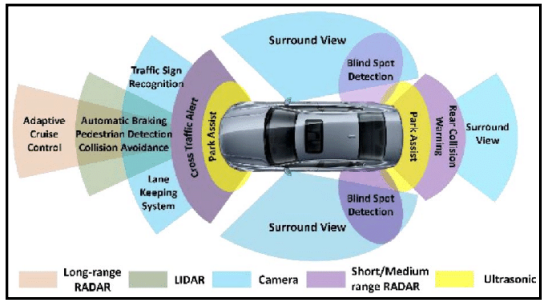
6 GHz Unlicensed Use

Device Class	Operating Bands	Maximum EIRP	Maximum EIRP Power Spectral Density
Standard-Power Access Point (AFC Controlled)	U-NII-5 (5.925-6.425 GHz) U-NII-7 (6.525-6.875 GHz)	36 dBm	23 dBm/MHz
Client Connected to Standard-Power Access Point		30 dBm	17 dBm/MHz
Low-Power Access Point (indoor only)	U-NII-5 (5.925-6.425 GHz) U-NII-6 (6.425-6.525 GHz) U-NII-7 (6.525-6.875 GHz) U-NII-8 (6.875-7.125 GHz)	30 dBm	5 dBm/MHz
Client Connected to Low-Power Access Point		24 dBm	-1 dBm/MHz

Emphasis on Mid-Band Spectrum Unlicensed Operations in 5.9 GHz



Sensors & Comm. Equipment on Cars Today



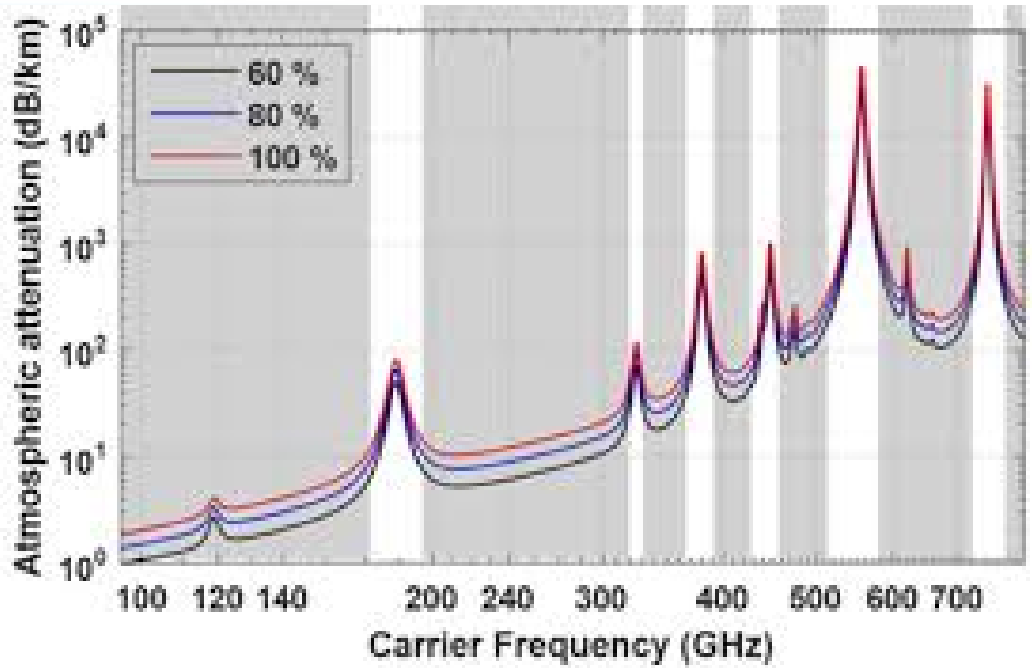
- Report & Order (Rules effective July 2, 2021):
  - Recognizes evolving and changed automotive and telecommunications landscape since 1999
  - Recognizes continuing need for ITS applications - But many applications being delivered through other technologies
- Dedicated spectrum for transportation/vehicle safety use while repurposing remaining spectrum for high throughput unlicensed broadband operations
  - Expands top of U-NII-3 band into new U-NII-4 band to provide an additional 160-megahertz channel for unlicensed use – not subject to DFS requirements
  - Full-power (up to 36 dBm) indoor use permitted
- Requires Intelligent Transportation Services to transition to C-V2X technology
  - One year to vacate lower 45-megahertz
- Further Notice
  - Technical rules and transition timeline for C-V2X
  - How to protect incumbent federal radiolocation sites

Unlicensed Operations and Experimentation Above 95 GHz

- **The FCC has created a new class of experimental licenses for use of frequencies between 95 GHz and 3 THz.**
  - These licenses will give innovators the flexibility to conduct experiments lasting up to 10 years, and to more easily market equipment during the experimental period.

- **The FCC has also freed up 21.2 gigahertz of the Spectrum Horizons bands for unlicensed use:**
  - 116-123 GHz band,
  - 174.8-182 GHz band,
  - 185-190 GHz band, and
  - 244-246 GHz band

- **Unlicensed use above 95 GHz is authorized similar to unlicensed use in the 57-71 GHz band.**



Innovation in Research & Development

Experimental Licenses and Innovation Zones

- The Commissions rules create opportunities for expanded experimentation through Program experimental licenses and Innovation Zones.

- Under a Program experimental license, qualified institutions may conduct testing for multiple non-related experiments under a single authorization within a defined geographic area under control of the licensee and where the licensee has institutional processes to manage and oversee experiments.

- The Innovation Zone takes this concept a step further by effectively providing an extension of a Program Experimental License's authorized area of operation. Such licensees are permitted to operate within an Innovation Zone, under the parameters set for that particular Zone, without having to modify their licenses to cover the new location. Innovation Zones can be created in response to a particular request or on the Commission's own motion.

FCC/NTIA/NSF Collaboration on Spectrum Innovation Initiative

- Key research areas include spectrum flexibility and agility, working towards near real-time spectrum awareness, and improved spectrum efficiency and effectiveness through secure and autonomous spectrum decision-making.

Allowing Earlier Equipment Marketing Opportunities

- Report and Order (June 17, 2021) sets forth the conditions under which RF devices may be marketed in the U.S.
- RF devices cannot be marketed unless they have obtained the applicable equipment authorization—certification or SDoC—or are exempt from those requirements
  - with exception for conditional sales limited to contracts between manufacturers and wholesalers or retailers.
- Now allows conditional sales contracts with other entities, including consumers provided:
  - prospective buyers advised at the time of marketing, through prominent disclosure, that the RF devices are subject to FCC rules and delivery to the end user is conditional upon successful completion of the applicable equipment authorization process
  - physical possession of RF devices subject to Certification are transferred prior to obtaining certification for the sole purpose of “pre-sale activities

Allowing Earlier Equipment Importation Opportunities

Report and Order sets forth the conditions under which RF devices may be imported into the U.S.

- 12,000 RF devices subject to certification could be imported for specific “pre-sale activities”
  - packaging and transferring physical possession of RF devices to distribution centers and retailers
  - devices must not be delivered to end users, displayed, operated, or sold until the device receives certification
- Devices must prominently display a visible temporary removable label
  - noting that the device can be used only for the specified “pre-sale activities” until equipment certification has been obtained
  - disclosure notification of any responsibility of the initiating party to the buyer in the event that the applicable equipment authorization process is not successfully completed, including information regarding any applicable refund policy
- Devices shall remain under legal ownership of the manufacturer, developer, importer or ultimate consignee, or their designated customs broker
  - retrieval immediately after a determination is made that equipment certification cannot be successfully completed

Supply Chain and Network Security

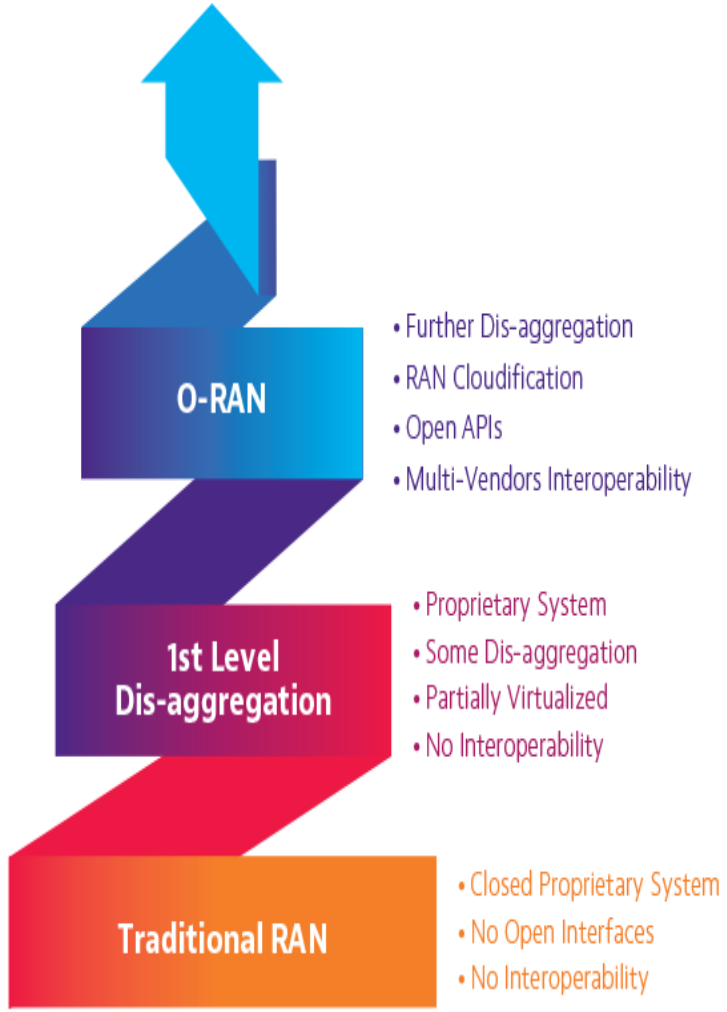
In the United States, many agencies have important responsibilities when it comes to ensuring the safety of our networks, and the FCC is playing its part:

- ✓ **Supply chain integrity:** The FCC prohibits the use of universal service funding to purchase equipment or services from any company that poses a national security threat to the integrity of U.S. communications networks or the communications supply chain.

- ✓ **Open Radio Access Networks (Open RAN):** Software-centric approach drives innovation, supply-chain diversity and increased security.

Open Radio Access Networks (Open RAN)

- Notice of Inquiry (March 17, 2021):
  - Seeks comment on potential public interest benefits in promoting Open RAN development and deployment, including increased competition, network vendor diversity, affordability for consumers, network security and public safety, and other potential benefits.
  - Seeks comment on potential considerations, risks, and barriers to Open RAN development and deployment, like software vulnerabilities, the risks of a virtualized operating environment, and barriers to adoption, among other considerations.
  - Seeks comment on whether and what Commission efforts could be undertaken to promote Open RAN development and deployment.
  - Discusses and seeks comment on the costs and benefits of Open RAN deployment.



Protecting the Communications Supply Chain through Equipment Authorization

- Proposed Rulemaking and Inquiry (June 17, 2021) seeks to take additional steps to further protect the nation's communications equipment and services supply chain, proposes to:
  - prohibit filings for certification of covered equipment and Telecommunications Certification Bodies (TCB) authorizations of any covered equipment
  - require that responsible parties that receive a grant be located within the U.S., seeks comment on whether applications should be required to designate a U.S. agent
  - preclude use of the SDoC process for authorization of any equipment produced or provided by an entity that has produced or provided equipment on the Covered List
  - Seeks comment on revising rules for equipment currently exempted from authorization requirements to no longer permit exemption for equipment on the Covered List
  - Seeks comment on revoking prior authorizations for any equipment on the Covered List
  - Seeks comment on possible education and outreach opportunities

Protecting the Communications Supply Chain through Equipment Authorization

- The Inquiry explores opportunities to spur trustworthy innovation in the development of more secure communications equipment, seeks comment on :
  - addressing security risks associated with Internet-of-Things (IoT) devices, asks whether Commission should utilize the equipment authorization process to incentivize better cybersecurity practices
  - additional ways that the Commission could encourage manufacturers that develop devices that connect to U.S. networks consider cybersecurity standards and guidelines and adopt better cybersecurity practices
    - identifies multiple sources of potential cybersecurity guidance
    - status of supply chain security discussions by international standards bodies and how to encourage American companies to participate
  - best practices and standards, including voluntary standards, as well as other incentives or considerations that could encourage manufacturers to build better security in their products
  - role of retailers in limiting the sale of equipment lacking adequate security protections and educating consumers on security protections

Thank You