

Spectrum Bands,
Auctions Policies,
and Connectivity
Programs
to Advance 5G
Services



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

The Promise of Advanced Services, The Tools to Promote Them



Spectrum



Technology



Security



Infrastructure



Funding

Lessons Learned in Spectrum Policy

01

The right “mix”
of licensed and
unlicensed

02

Structure
auctions to
promote
competition.

03

Set clear rules
for license use
and build out.

The Promise of 5G Starts with Spectrum

- **Connectivity** (nearly universal reach, all the time)
- **Capacity** (more data, to more places, more easily)
- **Mobility** (a unique and valuable characteristic)

With advances in technology, we can use more spectrum frequencies than ever, and deploy more valuable services than ever.

Why the Mix of Spectrum Bands Matters

Low-band: Especially useful because it enables wider geographic coverage, which is valuable when deploying 5G in rural areas.

Mid-band: A target for 5G buildout given its balanced coverage and capacity characteristics (with more spectrum than low-band, better geographic coverage than high-band).

High-band: Especially useful for wireless backhaul, fixed wireless access, large capacity: a key component of 5G expansion (with large blocks of spectrum creating capacity).

Unlicensed: The FCC has recognized that providing opportunities for expanded unlicensed use is important for 5G and therefore is creating new opportunities for the next generation of Wi-Fi, in particular, the 6 GHz band.

Spectrum for 5G: Flexible-Use Licenses to Meet “Changing Needs” – Low Band

600 MHz (Auction 1002)

- First Incentive Auction
- Reverse and Forward auctions repurposed 70 megahertz of TV spectrum in wake of digital TV transition

600 MHz Band Plan																			
UHF Band		RAS/ WMTS	G. B.	600 MHz Band Downlink							Duplex Gap	600 MHz Band Uplink							700 MHz UL
35	36	37	3	A	B	C	D	E	F	G	11	A	B	C	D	E	F	G	
			614 MHz	617 MHz							652 MHz	663 MHz							696 MHz

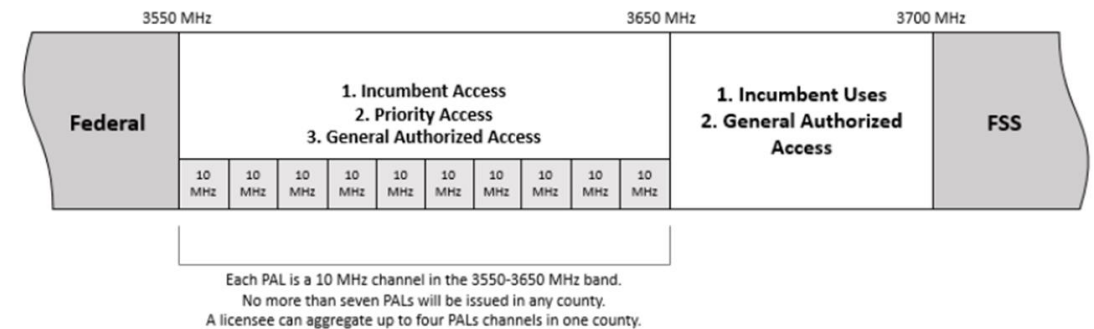
Spectrum for 5G: Flexible-Use Licenses to Balance Capacity and Coverage – Mid Band

3.5 GHz (Auction 105)

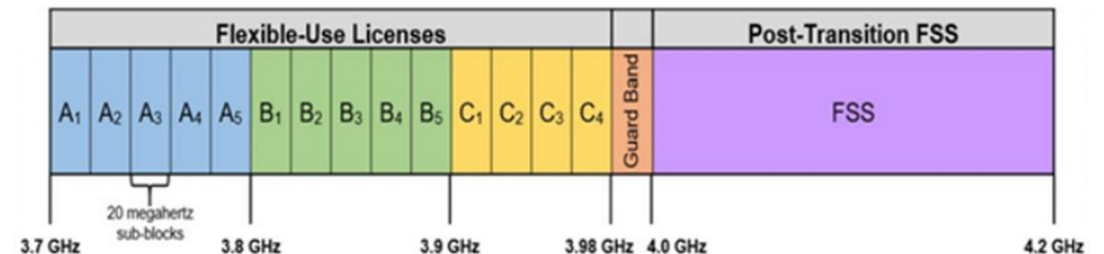
- Licenses grant priority access to shared spectrum, with dynamic frequency assignment by an administrator
- Aggregation limit of four 10-mhz blocks per area

3.7 GHz (Auction 107)

- Repurposed from satellite providers, winning bidders to make payments to fund relocation
- Two-phase clearing plan allowed early access to certain blocks/areas, early payments to incumbents
- Highest grossing auction ever, raising over \$81 Billion



3.7 GHz Service Band Plan



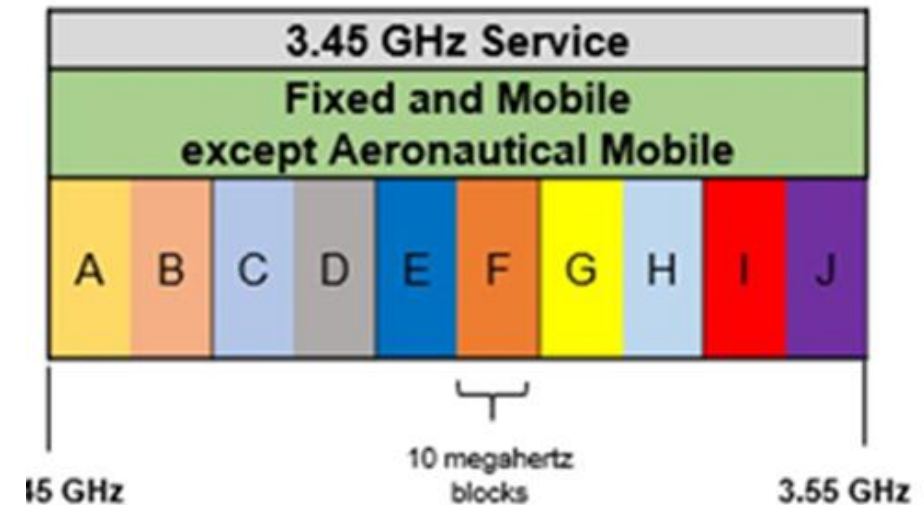
Spectrum for 5G: Flexible-Use Licenses to Balance Capacity and Coverage – Mid Band

2.5 GHz (Auction 108)

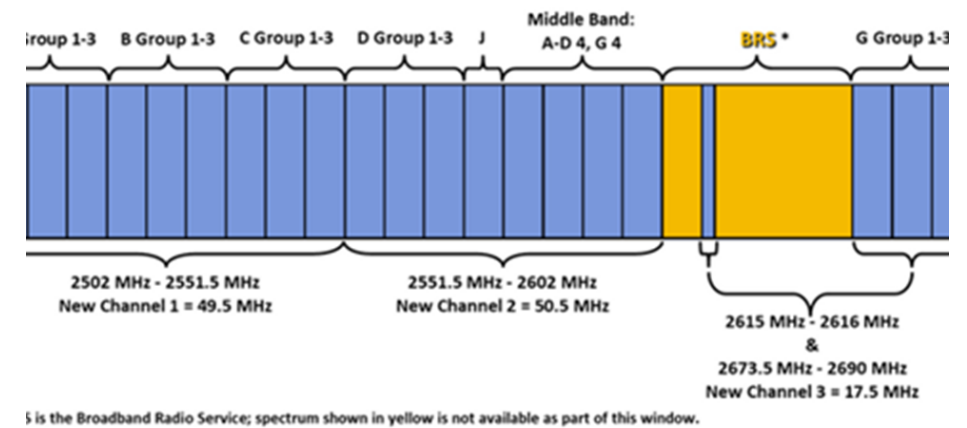
- Auction of overlay licenses in counties circumvented need to clear numerous small incumbents
- Licenses originally assigned to non-commercial and educational institutions
- Significant existing leases, in particular to one mobile provider

3.45 GHz (Auction 110) (the federal use and non-federal use are co-primary with geographic sharing and priority given in different areas)

- Some licenses required sharing/coordination with Defense Department
- Other federal and non-federal incumbents relocated with payments from auction proceeds
- Aggregation limit of 4 blocks per area



2.5 GHz Band Plan



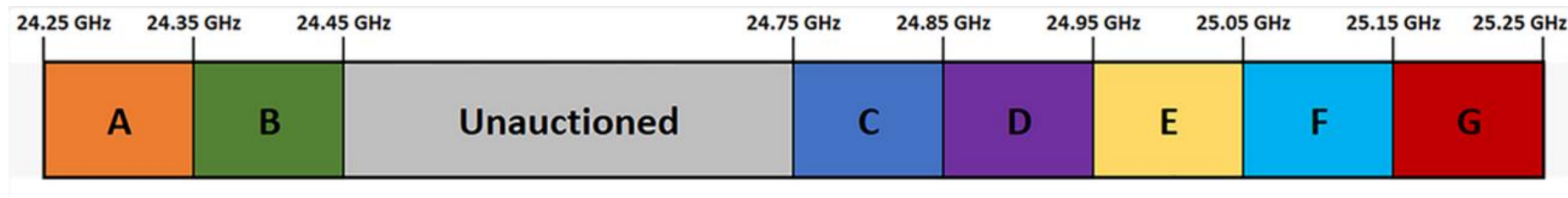
Spectrum for 5G: Flexible-Use Licenses for High-Capacity and Low-Latency Use Cases – High Band

Total of almost 5000 megahertz offered in three auctions

28 GHz (Auction 101)



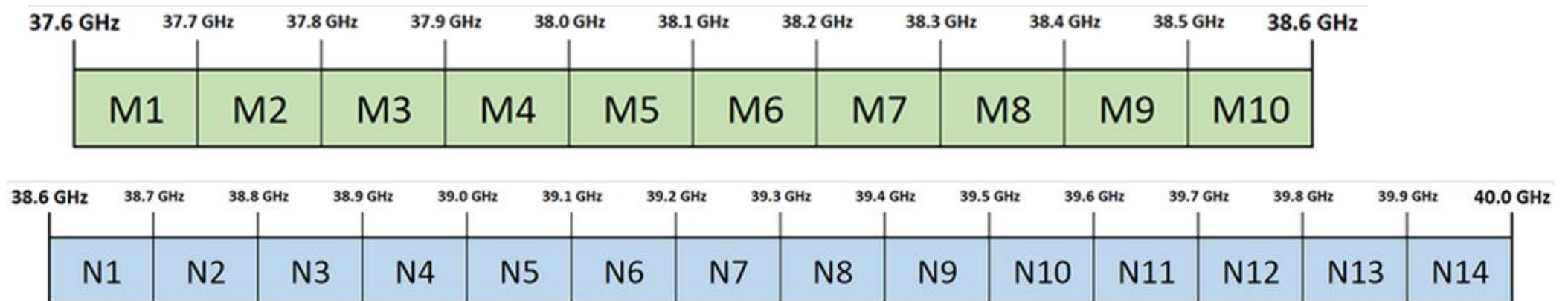
24 GHz (Auction 102)



Spectrum for 5G: Flexible-Use Licenses for High-Capacity and Low-Latency Use Cases – High Band, Continued

Upper 37, 39, 47 GHz (Auction 103)

- An incentive auction
- Incumbent licensees in 39 GHz could relinquish their rights in exchange for a pro-rated share of auction proceeds or keep equivalent licenses



Expanded Opportunities for Unlicensed Use

Because applications and services delivered by unlicensed devices will be important for 5G, the FCC is creating new opportunities for the next generation of unlicensed devices, including Wi-Fi (e.g., 6 GHz, 57 - 71 GHz, and above 95 GHz).

- *Example:* In April 2020, the FCC adopted rules that expanded unlicensed use across 1,200 megahertz of spectrum in the 6 GHz band (5.925–7.125 GHz).

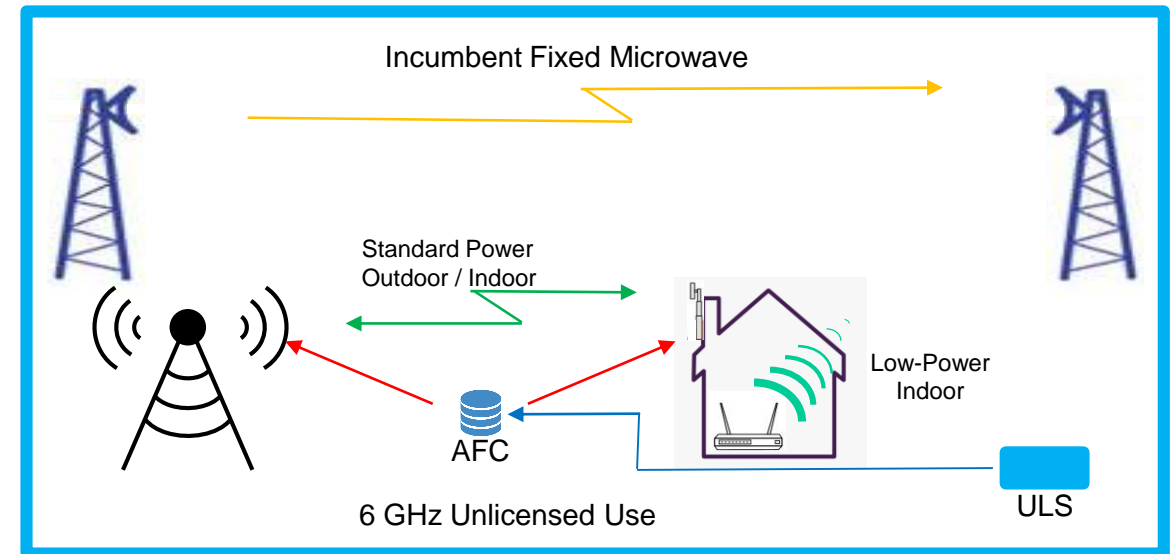
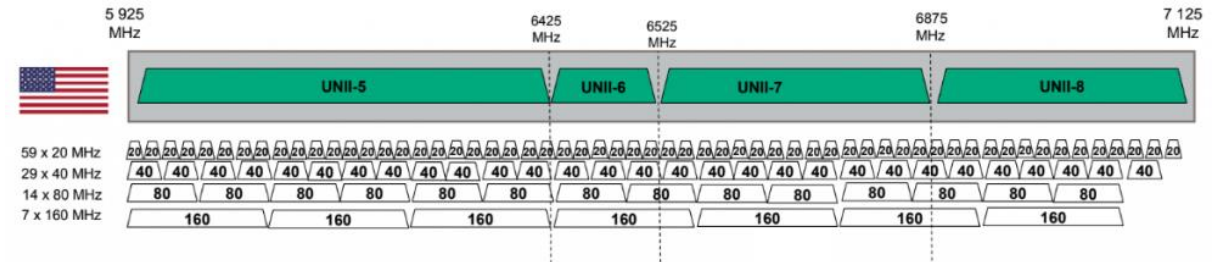


Image source: Cisco

6 GHz Band


Unlicensed Sharing with Fixed Microwave Links

- Report & Order adopted April 2020
- 1200 megahertz for unlicensed use in four sub-bands
 - Up to seven 160-megahertz wide channels and three 320-megahertz wide channels
 - Standard access points in U-NII-5, 7 only
 - Low-power indoor access points across band
 - Contention-based protocol required
- Unlicensed access to full band
 - Significant economic value of unlicensed operations
 - Only spectrum where new Wi-Fi 6E with larger channels/higher throughput can operate
 - Plans for Wi-Fi 7; even higher data rates
 - Other mid-band spectrum available (or soon to be available) for licensed operations



Why 1,200 Megahertz for Unlicensed? A Balanced Approach

- More spectrum for unlicensed operations was identified as a priority and in the public interest to pave the way for consumers and enterprises to benefit from higher speeds to premises
- Consistent with an approach that recognizes the need and the role for all technologies (e.g., 5G, FWA, Fiber, Satellite, Wi-Fi, etc.) to continue to evolve
- Future-proof the spectrum for the wider channels of Wi-Fi 7
- Protects satellite operations; satellite up-links in band are compatible with lower powered unlicensed device operation; high powered base stations and consumer equipment could pose an interference risk
- No relocation needed for incumbent fixed service
- Wi-Fi capacity needs to keep pace with expanded commercial network capacity; most data carried by wi-fi (e.g., off-load). This is increasing and keeps network loading to manageable levels while still ensuring consumers have access to the applications and services they need.



The 6 GHz Band: Estimating the Value of Unlicensed Operations

According to a study, “The Economic Value of Wi-Fi: A Global View (2018 and 2023)”

Wi-Fi total **global economic value**,
including worldwide availability of
Wi-Fi 6 devices operating in 6 GHz, **to
reach \$4.9 Trillion by 2025**

Next Generation Broadband Satellites



FCC also is making sure there is sufficient spectrum for next generation space-based services.



Next Generation Geostationary Satellite Orbit (GSO)–

Licensed GSO “High-throughput” satellites FSS to provide new high-speed broadband applications for consumers.



Next Generation Non-Geostationary Orbit (NGSO) Constellations



On March 17, 2023, the FCC adopted a Notice of Proposed Rulemaking (NPRM)

Single Network Future: Supplemental Coverage From Space

- The NPRM proposes a way forward for Supplemental Coverage from Space.
The proposed rules would allow a satellite operator to partner with a terrestrial mobile licensee to get access to their terrestrial spectrum. If approved, the satellite system can provide service directly to the subscribers of the wireless carrier in areas where the carrier lacks coverage.
- The proposal is designed to make it easier for satellite operators collaborating with terrestrial providers to obtain authorization for converged services. Such an approach can expand service coverage in remote, unserved, and underserved areas.



Principles to Manage Spectrum and Receiver Performance

In April 2022, the FCC adopted a Notice of Inquiry (NOI) to explore options for **promoting improvements in radio frequency (RF) receiver performance**, including through use of incentives, industry-led voluntary approaches, Commission policy and guidance, or regulatory requirements.

On April 20, 2023, the Commission established a **set of high-level principles** on how the Commission intends to manage spectrum going forward.

The Policy Statement will help inform potential future Commission considerations and actions concerning harmful interference issues, **the responsibilities of both transmitters and receivers to mitigate interference**, and the further regulatory steps to ensure coexistence among services in increasingly congested spectrum bands.

Ensuring Next Generation Services Are Widely Deployed

Promote deployment of service through:

- **competition**
- **strict yet reasonable rules for build out**
- **universal service support where market forces are not sufficient**



What Is the FCC Doing to Promote Advanced Services in Rural and High-Cost Areas?



**Increasing the amount of spectrum
available for 5G services**



**Increasing support for deployment
in rural and high-cost areas**



**Decreasing unnecessary regulatory
burdens to deployment**

New Support Programs

Since December 2020, Congress has authorized several programs that affect Universal Service Fund beneficiaries.

- **Emergency Broadband Benefit:** Provides up to \$50 per month for services and a one-time benefit of \$100 for a qualifying computer, laptop or tablet for **low-income consumers during the pandemic.**
- **Affordable Connectivity Program:** \$14.2 billion successor program to the Emergency Broadband Benefit which helped almost nine million users afford Internet access during the pandemic.
 - Up to \$30 per month discount toward Internet service, up to \$75 per month discount for households on qualifying Tribal lands.
 - Eligible households can also receive a one-time discount of up to \$100 to purchase a laptop, desktop computer, or tablet.

New Support Programs, Continued

- **Emergency Connectivity Fund:** \$7 billion for educational devices and connections.
- The Consolidated Appropriations Act (“CAA”): Congress authorized a **second Telehealth Fund** to provide reimbursement for services and equipment used to provide **telehealth services during the COVID pandemic**.

The **Telehealth II** fund provides \$249.95 million in new funding for this program.

Rural Digital Opportunity Fund (RDOF)

In 2020, the FCC established a new Rural Digital Opportunity Fund (RDOF) to efficiently fund the deployment of high-speed broadband networks in rural America

- Two-phases of a **reverse auction** mechanism
- Up to \$20.4 billion over ten years to finance up to gigabit speed broadband

Auction 904 (RDOF)

- Targeted areas that are wholly unserved with fixed broadband at speeds of at least 25/3 Mbps
- Phase I auction (2020) awarded support to bring broadband to over five million homes and businesses in areas that were entirely unserved by voice and broadband

Universal Service Fund (USF) Report

In August 2022, the FCC issued a **Report on the Future of the Universal Service Fund** (under Section 60104(c) of the Infrastructure Investment and Jobs Act).

<https://www.fcc.gov/document/fcc-reports-congress-future-universal-service-fund>

The Report adopts the following goals for broadband:

- **universal deployment,**
- **affordability, adoption, availability, and**
- **equitable access to broadband throughout the United States**

A Brief Message on NTIA Connectivity Programs



National Telecommunications and Information Administration

www.ntia.gov

Office of International Affairs

NTIA Connectivity Grant Programs

Consolidated Appropriations Act, 2021

- ▶ Broadband Infrastructure Program- \$288M
 - Funds partnerships between State & local governments and private broadband providers to expand coverage, especially in rural areas.
- ▶ Tribal Broadband Connectivity Program - \$980M
 - Funds Native American Tribal governments to deploy broadband on tribal lands and for broadband-related topics such as telehealth, distance learning, broadband affordability, etc.
- ▶ Connecting Minority Communities Program - \$268M
 - Funds for Historically Black Colleges and Universities (HBCUs), Tribal Colleges and Universities (TCUs), and Minority Serving Institutions (MSIs) to acquire broadband services or to hire and train IT personnel

Infrastructure Investment and Jobs Act

- ▶ Broadband Equity, Access, and Deployment (BEAD) Program - \$42B
 - Funds to states and territories for broadband deployment, mapping, and adoption projects.
- ▶ Middle Mile Broadband Infrastructure - \$1B
 - Funds for construction, improvement, and acquisition of middle mile infrastructure.
- ▶ Tribal Broadband Connectivity Program - \$2B
- ▶ Digital Equity Act Programs - \$2.75B
 - Three grant programs that promote digital inclusion and equity, ensuring that all individuals have the skills, technology, and capacity to reap the full benefits of the digital economy.



National Telecommunications and Information Administration

www.ntia.gov

Office of International Affairs

Broadband Mapping

The FCC has created the Broadband Data Collection (BDC) and has taken recent steps to create a reliable data resource to **evaluate the status of broadband availability throughout the United States.**

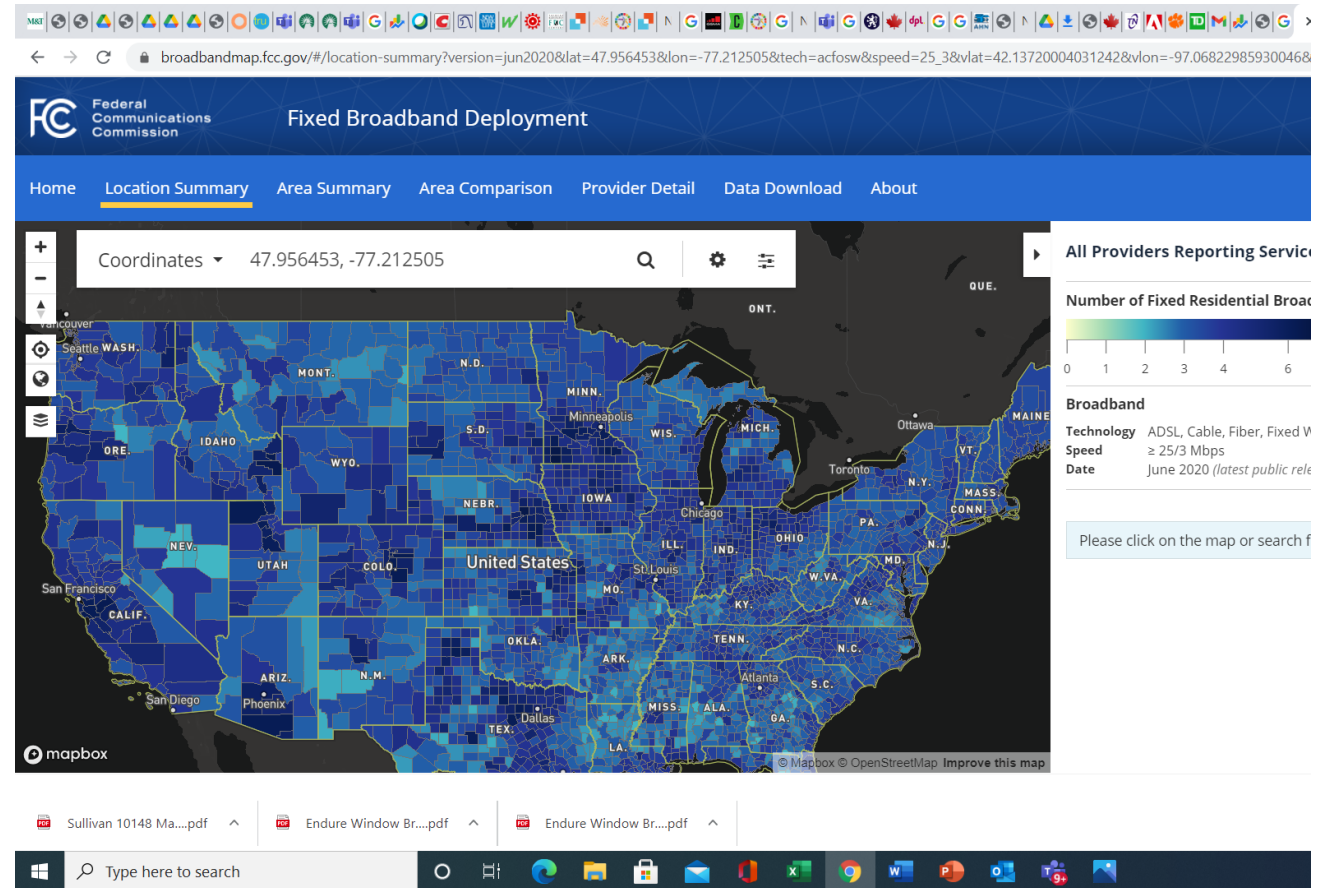
<https://www.fcc.gov/BroadbandData>

- **The Fixed Broadband Map shows the fiber, cable, DSL, satellite, or fixed wireless internet services available at each home or small business on the map** (along with the types of service or technologies and the maximum advertised download and upload speeds they offer).
- **The Mobile Broadband Map shows the 3G, 4G, and 5G coverage of each mobile provider for the area displayed.** The coverage areas represent where mobile users can get a connection when outdoors or in a moving vehicle, but not indoors.



Broadband Mapping, Illustrated

- Broadband Data Act
- Broadband Data Taskforce
- Broadband Data Collection
- Tools for Consumers

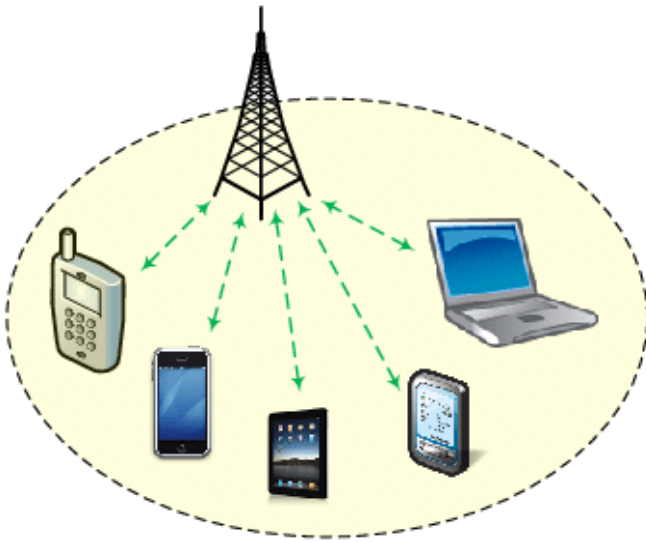


Facilitating Infrastructure Deployment: Rethinking the Rules

- 5G isn't just about wireless; we also need strong wired networks to carry all this traffic as well once it's offloaded from the airwaves.
- The FCC is modernizing regulatory rules to encourage the deployment of optical fiber for backhaul to promote the wired backbone of next generation networks.
- The FCC is removing unnecessary regulatory barriers to facilitate rapid deployment of small cells.



Facilitating Infrastructure Deployment: Rules for Siting Wireless Infrastructure



The FCC is modernizing regulatory rules to remove impediments to rapidly deploy wireless infrastructure (including small cells).

State and local governments have authority over zoning and land use decisions, but for wireless infrastructure, they have specific limitations on that authority.

For example, a state or local government:

- may not unreasonably discriminate among providers of functionally equivalent services,
- may not regulate in a manner that prohibits or has the effect of prohibiting the provision of wireless services,
- must act on applications within a reasonable period of time,
- must make any denial of an application in writing supported by substantial evidence in a written record.

Thank You!

