Canadian neighborhood 5G antenna, ca. 2018
(URL: https://cdn.mobilesyrup.com/wp-content/uploads/2017/07/huawei-5g-antenna-live-mas.jpg)

Updated Presentation:

5G Fixed Wireless for Home Internet

The Rollout Continues

by Bob Primak

For Lexington Computers and Technology Group (LCTG)

Wed., June 19, 2024

Old slides and references are not much use, as the articles are long-since expired. The best reference for group members would be to review my original presentation to LCTG on July 8, 2020 (URL: https://www.youtube.com/watch?v=MBohKDbCVr4 **).**

I had also done at least one previous talk about 5G networks, before the COVID Pandemic, which was given to both LCTG and BNUG (Boston Network User Group). (Sometime in 2019, if memory serves.)

So, here's my June, 2024 5G Wireless Networks Update. *– Bob Primak* --

Verizon FWA Gateway. (Modem and Router)

This is the first Verizon FWA device that offers Wi-Fi 6E Tri-Band. (Verizon)
(URL: https://qtxasset.com/cdn-cgi/image/w=850,h=478,f=auto,fit=crop,g=0.5x0.5/https://qtxasset.com/quartz/qcloud4/media/image/Screen%20Shot%202023-08-22%20at%203.45.06%20PM.png?VersionId=9YUguEY.YmjQKFlBBl___qhtt920HAD7)

Among its standout features are WiFi 6E and tri-band capabilities, providing users with superior coverage, faster upload speeds, and an exceptional WiFi range throughout their homes.

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Main Features of a Typical 5G FWA Gateway (Modem and Router))

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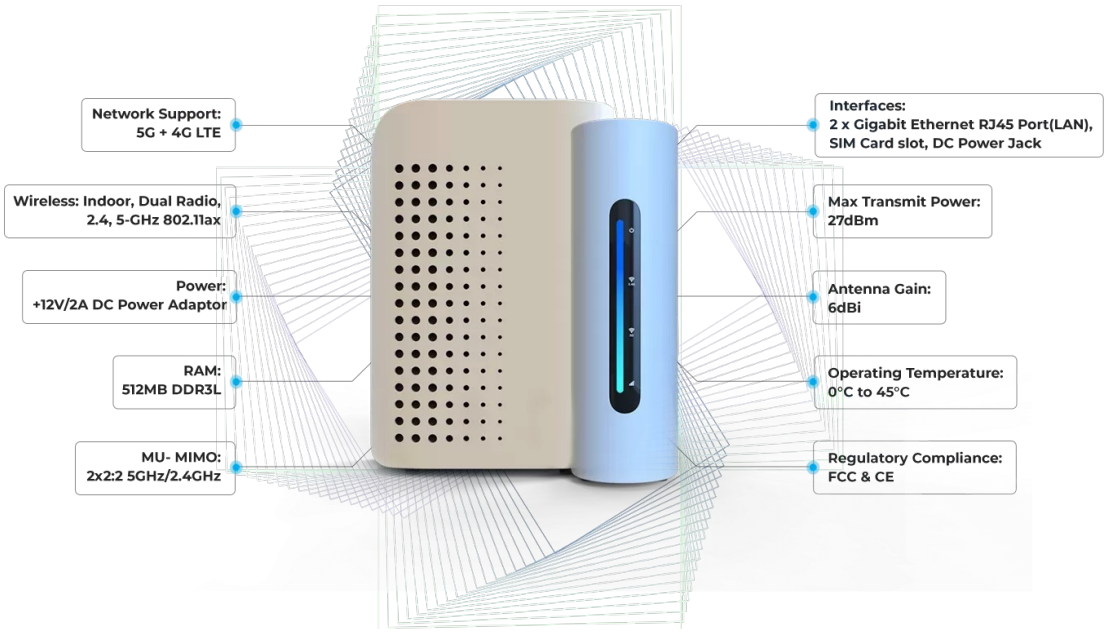

Home 5G FWA Gateway Characteristics.
(URL: https://www.vvdntech.com/en-us/images/fwa_cpe_highlights_img.png)

To efficiently use the millimeter wave FWA spectrum (High Band FWA) a differnet type of antenna is needed.

Nokia mm-wave receiver. Offers Non Line of Sight (NLOS) service. (Can use reflected waves in addition to direct waves.
(URL:
https://b432460.smushcdn.com/432460/wp-content/uploads/2024/02/Nokia_5G_mmWave_FWA_1_702_370.jpeg?lossy=1&strip=1&webp=1)

Resource Article about mm-wave 5G FWA:
The Myths of mmWave Fixed Wireless Access—Busted!
(Sponsored Content from Nokia)
https://www.rcrwireless.com/20240222/5g/the-myths-of-mmwave-fixed-wireless-access-busted)

Overview: What Are We Talking About Here?

Per Verizon:
Verizon Blog

(URL: https://www.verizon.com/about/blog/fixed-wireless-access)

What Is Fixed Wireless Access?

Fixed wireless access, or FWA, is a type of 5G or 4G LTE wireless technology that enables fixed broadband access using radio frequencies instead of cables. FWA can be used to connect homes and businesses to the internet.

Fixed wireless access, or FWA, is a type of technology that uses radio waves to send high-speed signals that offer data transfer to and from consumer devices.

FWA systems typically consist of a base station connected to a fixed network and a number of subscriber units spread out over a wide area. The base station then uses radio waves to communicate with the subscriber units, making it possible for consumers to connect to the fixed network and access high-speed data services. These transmitters are strategically attached to stationary structures such as poles, buildings or towers.

How does fixed wireless access differ from wired broadband?

Fixed wireless access, which can support 5G technology, is the next generation of wireless connectivity, offering the potential for ultra-high speeds, low latency and massive capacity.

Wired, fixed-line broadband works through fiber-optic cables, telephone lines (DSL), coaxial cables (cable modem), or powerlines (BPL); this includes DSL services through POTS wired connections.

With fiber-optic internet, your internet service provider runs the cable all the way to your house, or to a location nearby, in which case you tap in via phone line running to a switching box (or “cabinet”). With FWA, your device is receiving a radio signal from the internet provider’s transmission tower. This doesn’t require any cables or wires to go to your home.

FWA may be able to bring high-speed internet to areas where cables cannot reach, which is why it’s likely to play a role in the future of wireless internet connectivity, especially in digital deserts.

Digital Deserts

Due to pricing and relatively slower speeds, FWA finds its best use cases in two different types of scenarios: Thinly populated rural areas where it’s not economical to lay out cable or fiber optic lines,

and thickly packed urban areas where it’s expensive to keep tearing up streets or stringing wires to individual apartments or homes.

In both scenarios, true broadband Internet access is limited or non-existent. Or, simply expensive.

Previous solutions, like Hughes Satellite, Starry and StarLink, have proven to be technically challenging, not really great performance, and expensive for the consumer.

(See my previous talks for more about Starry and StarLink.)

Definition of Broadband Internet, per Biden Administration FCC:

(URL: https://broadbandusa.ntia.gov/about-us/frequently-asked-questions/how-fast-broadband)

In a 2024 report examining the state of broadband deployment in the United States, the Federal Communications Commission (FCC) determined that fixed broadband services meeting the definition of ‘advanced telecommunications capability’ had download speeds of at least 100 Mbps and upload speeds of at least 20 Mbps.

A Tale of Two Towers – And Three Main Frequency Bands
https://www.thefastmode.com/media/k2/items/src/5cb04386bb1893c12350a67d79cbb96e.jpg

What Frequency Bands Does 5G Use?

(URL:
https://lh3.googleusercontent.com/B9nCLlCbUijpWwJhhTDKWPzdV_eiFhf3BOm6CfMUlpIMV5nFFmaTcS9lI1o71reodOruO3Rk68E6font1TVtfKQh_VZa7RqKCZnNmnVmP9lU6JWIFrKFK7DfRcxkcHUkiMQhKXneru-XTRwYDAdakpE_)

5G Frequency Bands

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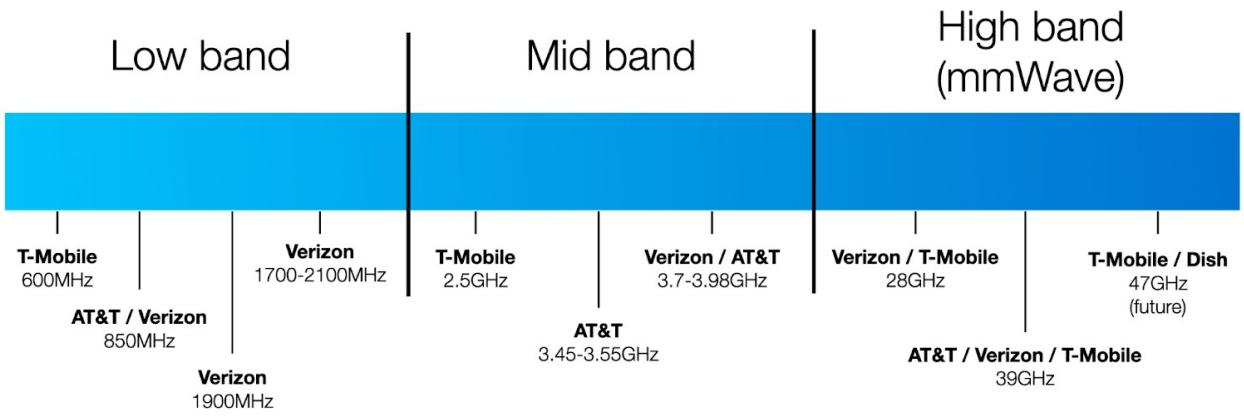


5G Rural Towers

Rural 5G Cell Tower example.
(URL: https://www.thefastmode.com/media/k2/items/src/5cb04386bb1893c12350a67d79cbb96e.jpg?t=20230126_090019)

Note that if the terrain is not flat with good sight lines, this method won't work well.

Also, weather conditions, more wooded areas and strong solar activity (solar flares) and building materials or hills/mountains – all can make this type of 5G access difficult to impossible.

This is where Satellite solutions like StarLink start to look good, though StarLink itself has drawbacks.

(Satellite Internet is beyond the scope of this talk.)

5G Urban Neighborhood Antennas (Exact configurations and appearance differ from this photo.)

Urban neighborhood 5G antenna example.

(URL: https://www.verizon.com/about/privacy/sites/default/files/2022-10/what-is-fixed-wireless-access.png)

My Own Photos: Actual 5G FWA Infrastructure in Waltham, MA, 2024. (Bob Primak)
Some Controversy, Much Misinformation. And Some Optimism.

Placement and Public Safety issues have swirled around the rollout of urban neighborhood 5G antennas.

New York Times on Urban Neighborhood Antennas *(Free article)***:**

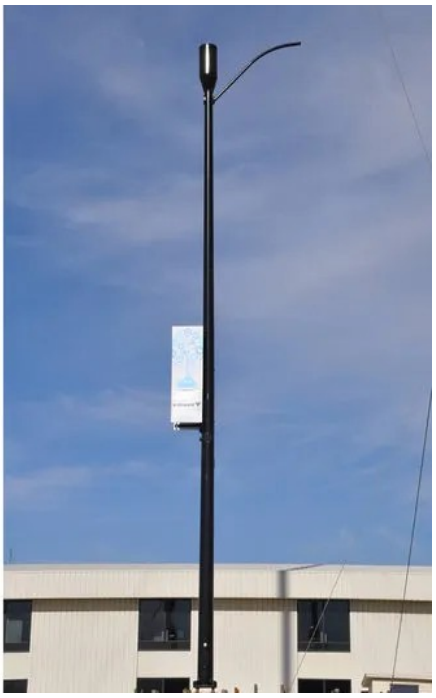
5G Cell Service Is Coming. Who Decides Where It Goes?
(URL: https://www.nytimes.com/2018/03/02/technology/5g-cellular-service.html)

White Paper on 5G FWA Applications:
Potential Applications of 5G FWA
(URL: (PDF) https://www.ijsr.net/archive/v12i1/SR23126111026.pdf)

I will not be covering StarLink or Starry, as these are not making big inroads into residential Internet Services.)

Examples of Urban Neighborhoood Antennas





Urban 5G FWA antenna and service box examples.

Growth of 5G FWA: 2023-2025

2023 in review: FWA in growth mode
https://www.lightreading.com/fixed-wireless-access/2023-in-review-fwa-in-growth-mode-

Growth of Users 2017-2023
(URL: https://img.lightreading.com/2023/05/784871/5618.jpg) Modified to show trend lines better.

FWA in the USA: Getting ready for Phase 2
https://www.lightreading.com/fixed-wireless-access/fwa-in-the-usa-getting-ready-for-phase-2

The Rise of 5G FWA & The Battle for Fixed Broadband Customers (Ookla Article 2023)
https://www.ookla.com/articles/fixed-wireless-access-us-q3-2023

Key Takeaways: (from the Ookla Article)

T-Mobile & Verizon 5G FWA performance holding up well nationally. Despite strong customer growth, both T-Mobile and Verizon have maintained performance levels over the past year according to Speedtest data. Both ISPs recorded similar median download speeds in Q3 2023, although T-Mobile maintains an edge on median upload performance. Despite this, there are significant differences in performance at a State-level, and for urban versus rural locations.

Cable & DSL providers bear the brunt of user churn. The FWA value proposition is clearly resonating most with existing cable and DSL customers, which make up the vast bulk of churners to both T-Mobile's and Verizon's FWA services. It's not one-way traffic however, with T-Mobile's larger user base in particular showing some attrition to cable providers. In rural locations where options are more limited, FWA services are increasingly going head to head, with over 10% of users joining Verizon's FWA service coming from T-Mobile.

Clear signs that download performance could be a key contributor to churn in the market. Our analysis of the customers of major ISPs in the US that have churned to T-Mobile's FWA service shows that their median download performance before churning was below the median performance of all customers of these ISPs, indicating a performance short-fall that is likely contributing towards churn.

Further C-band spectrum will serve to strengthen FWA's case. The release and deployment of additional C-band spectrum for all three national cellular carriers, and AT&T's new FWA service will drive further performance gains, and further competitive pressure in 2024.

(***I would like to add:*** As far as I know, the release of new spectrum is still in the realm of 5G protocols, not solely dependent upon the adoption of more advanced protocols, like the proposed 6G standards.)

Growth of FWA Adoption in the US: (OpenSignal Article)

5G Fixed Wireless Access (FWA) Success in the US: A Roadmap for Broadband Success Elsewhere?
https://www.opensignal.com/2024/06/06/5g-fixed-wireless-access-fwa-success-in-the-us-a-roadmap-for-broadband-success-elsewhere

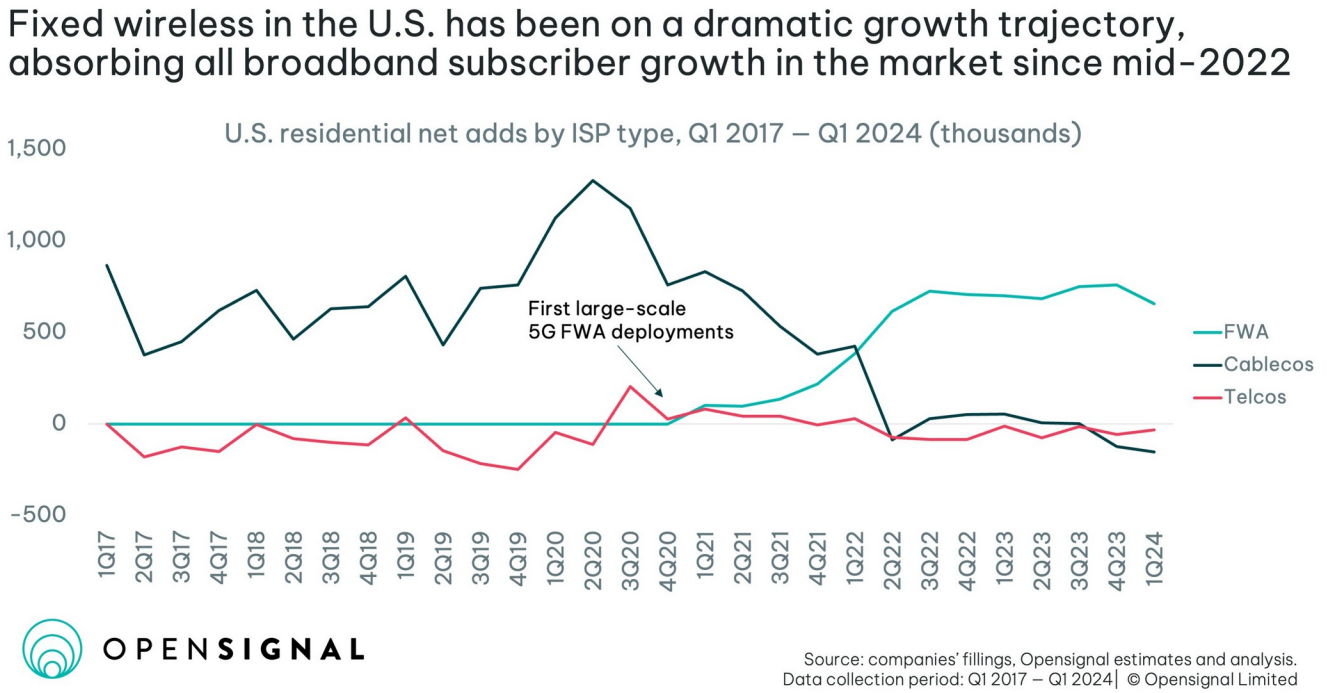
Key Findings: (from the OpenSignal Article)

5G FWA has reshaped the US broadband market. It has allowed U.S. mobile operators to rapidly expand their broadband footprints for minimal incremental network investment. This has seen 5G FWA absorb all broadband subscriber growth in the market since mid-2022.

FWA is the secret sauce for 5G monetization. FWA benefits from lower prices compared to wireline competition, access to existing mobile retail channels and subscribers, and the ability to deliver a "good enough" broadband service.

U.S. mobile networks have proven to be resilient. Despite adding millions of 5G FWA subs since 2021, 5G speeds on T-Mobile and Verizon's mobile networks have continued to improve. Their success in managing FWA traffic is due to a variety of factors, including plentiful access to mid-band spectrum, localized load management, and differences in peak usage time of day patterns between mobile and FBB usage.

Elsewhere, there are mixed results. In India, Jio is seeing no discernible impact from FWA on the mobile experience of its users, while in Saudi Arabia Zain is seeing the additional load on its network from FWA having a greater influence on mobile users' experience, depending on the time of day or the level of FWA penetration.

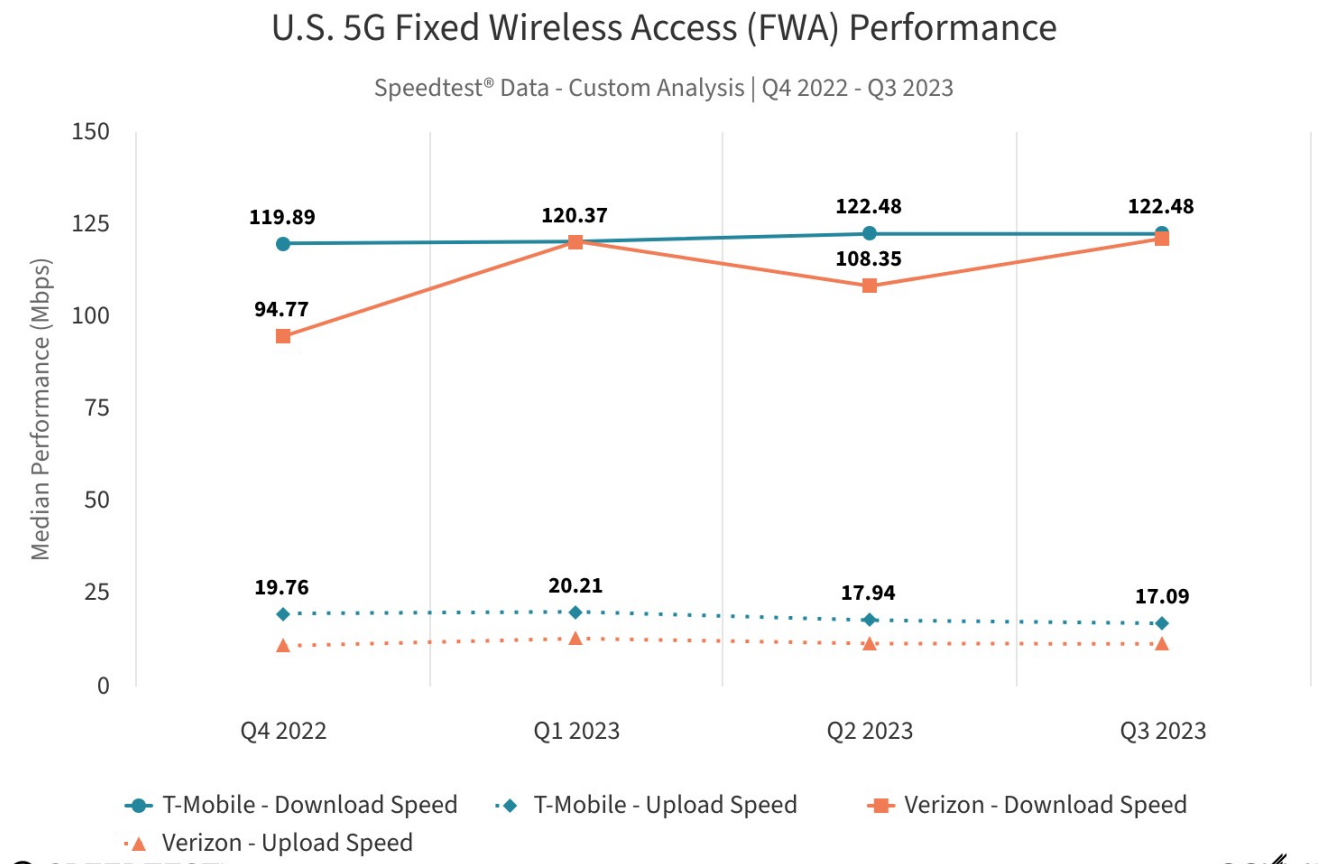


Growth of FWA Subscriber Base vs. Teleco and Cable Co. 2017-2024
(URL: https://cdn.opensignal.com/public/202406_TL_5G_FWA_02.jpeg)
(*This graph is not from the same Article as the text.*)

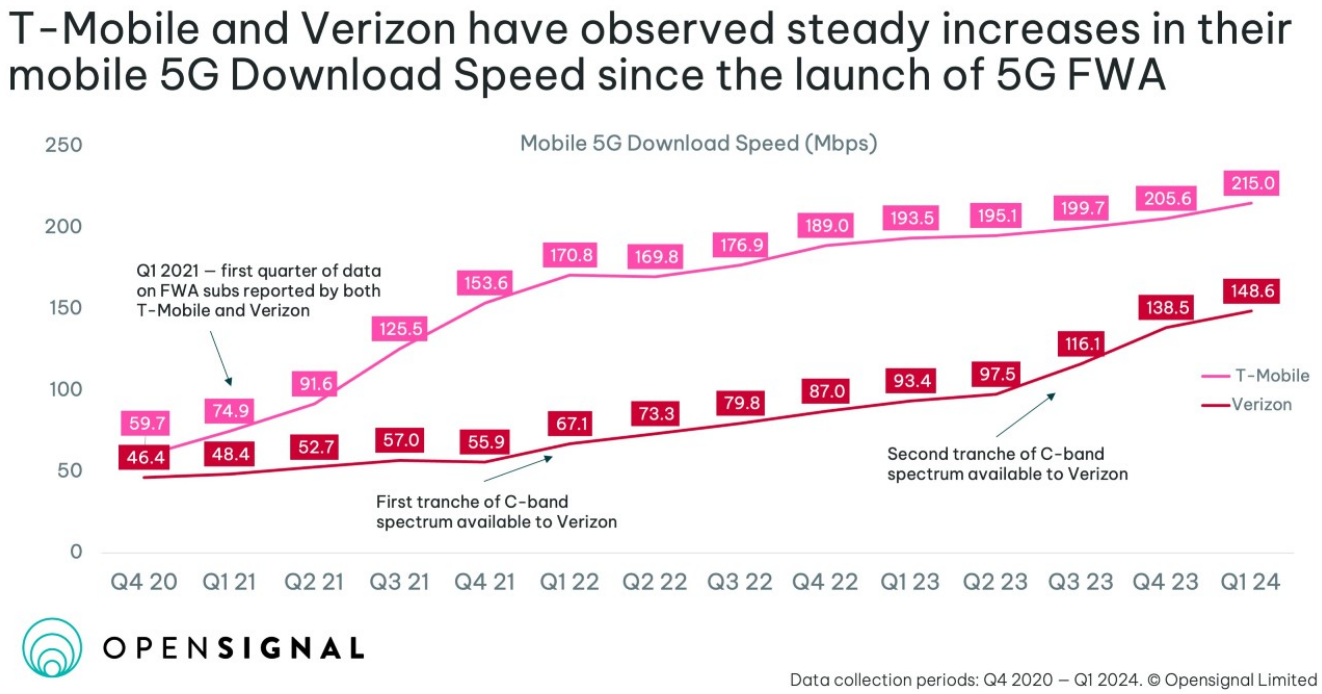
So What's Available Now, and How Does It Perform?

Performance: T-Mobile and Verizon

(continues, with speed graphs)



(Graphic from: https://www.ookla.com/articles/fixed-wireless-access-us-q3-2023)



T-Mobile and Verizon 5G FWA Download Speeds (optimal conditions)
(URL:
https://eu-images.contentstack.com/v3/assets/blt23eb5bbc4124baa6/bltabecfdb7d11745b8/6661d882aa3681db85163c7a/opensignal-fixed-wireless-fwa.png)

Available Carriers and Plans – Examples

I don't have anything specific about local Lexington, MA 5G FWA options. (And I also don't have specifics for Waltham.)

But there are two carriers with significant investments in 5G FWA, and they have indicated their plans and pricing.

The Rise of 5G FWA & The Battle for Fixed Broadband Customers (Ookla, end of 2023)
https://www.ookla.com/articles/fixed-wireless-access-us-q3-2023

(Article written in 2023.) T-Mobile's current FWA plan retails for $50/month, but that falls to $30/month for customers subscribing to its Magenta MAX mobile plan.

Verizon prices at a slight premium to T-Mobile, with its FWA service currently retailing for $60/month, but falling to $35/month with select 5G mobile plans.

The median download speed across the US for all fixed providers combined in Q3 2023 was 207.42 Mbps.

T-Mobile has recorded consistent median download speed over the past four quarters, reaching 122.48 Mbps in Q3 2023 based on Speedtest data, but saw its median upload performance erode slightly, down from 19.76 Mbps in Q4 2022, to 17.09 Mbps in Q3 2023.

Verizon on the other hand improved its median download performance when compared to Q4 2022, reaching a similar level to T-Mobile, of 121.23 Mbps in Q3 2023. However, its upload performance remained lower than T-Mobile's, at 11.53 Mbps. .

So in urban areas, neither carrier's FWA can rival the performance and reliability of wired options (Fiber Optic and Cable Internet). And neither carrier reports much market penetration into rural areas.

T-Mobile's rollout strategy has included using its cell towers for rural 5G FWA Internet service. This uses the lowest band of the 5G spectrum, and limits speeds even further.

So, maybe a future Internet Service possibility, but needs more work, I would conclude. Maybe also useful in niche markets which are currently "broadband deserts".

Where I live, we have underground cable (Xfinity by Comcast) and fiber optic (Verizon by Verizon) options. Other nearby places also have Astound (by RCN). Nothing messes those up, except for "network issues", which usually originate somewhere else in the systems. Pricing for Internet-only can be higher than expected for some "unbundled" customers. Speeds and reliability are good for the price, whatever option we choose.

So, not much incentive to move over to FWA in Windsor Village Waltham. But other areas of our City, and some areas of Lexington, have reliability issues, which might make FWA look like a good option to some people, especially “cord cutters” and customers with limited bandwidth and usage needs.

And finally,
Maintaining Quality of Services -- Network Slicing

(I think we’ll leave this for another time, possibly as a Potpourri topic.)

-- Bob Primak
for Lexington Computers and Technology Group (LCTG)
Wed., June 19, 2024 --

(This presentation has not been fully finished and polished, due to other obligations I’ve had to attend to, and a little illness.)

Wed, Jun 12, 24 05:19:23 PM EDT

Updated Mon, June 17, 2024 10:30:08 PM EDT