Comparison of Fiber-to-the-Premises and 5G Wireless Technologies for Long Island

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Summary

Several people have raised the issue of whether 5G Wireless would be a better choice than fiber for broadband service on Long Island. While the major U.S. wireless carriers are in the process of deploying 5G, they are focusing on high-population areas where they can sign up more subscribers. Long Island will be a low priority for them. Furthermore, wireless systems have never proven to be a better option for indoor applications (residential and business) since they depend on the user getting a good signal from the base station. Even if 5G were to become available on Long Island in 5-10 years, a direct connection to a fiber or cable broadband system would still be a much more predictable, reliable, and robust solution. We do not cable or fiber-to-the-premises available on the island today, but we may have a path to getting one or the other within the next year or so.

What is 5G Wireless?

The first-generation, or "1G", cellphones used analog technology. Despite poor voice quality, frequent dropped calls, and no capability for data transmission or Internet connection, they enabled individuals to make and receive telephone calls from their cars or walking around.

When digital cellular systems emerged ("2G"), voice quality improved and it became possible to do very simple data-based tasks such as e-mail and text messaging from handheld devices. Data rates up to about 56 kb/s (or 0.056 Mb/s) were possible. This was comparable to dial-up Internet speeds using analog modems.

When cellphones advanced to the next level, including color screens, cameras, and stereo audio capability, the 2G data rates were too slow and new standards ("3G") were developed that provided up to 1 or 2 Mb/s data speeds. This enabled music downloads, video calling (Facetime, Skype, etc.), and access to video content for display on the small cellphone screen. This is similar to the speeds available on early ADSL systems using the telephone wires such as the initial system installed by Verizon (later Fairpoint, and now Consolidated) on Long Island.

Things became blurry about this point in the wireless industry. Some companies promoted their enhanced 3G systems as being "4G" when they really were not. Ultimately, they all began playing by the same rules and agreed that only systems using "LTE" technology could be called "4G". This system provides tens of Mb/s speeds (even up to 100 Mb/s in some areas). For example, if you have a 4G phone and visit the Falmouth-facing side of Long Island (along Island Ave. between the Fire Station and Boston Sand & Gravel) there are spots where you can consistently get 20-30 Mb/s speeds. However, if you take the same phone to the East End or South Beach you will get much slower speeds. More about this later.

Now we are in the early days of 5G. The goal is to provide speeds on the order of 1000 Mb/s (1 Gigabit/second) or more to mobile/portable devices, and as an afterthought, to residences. This will

enable faster transfers of big files, excellent quality for streaming video content, connectivity for autonomous (self-driving) vehicles, and more…if you can get a good signal.

Now we need to get technical for a little bit.

All these wireless systems work by using radio waves. Your cellphone or tablet computer sends its signal to (and receives a signal back from) a base station. The base stations for 1-4G systems are usually located on tall buildings or big towers because they use radio signals on frequencies that can cover a wide area. There are no cell towers on Long Island, which is why cell phones work OK on the mainland-facing side of the island, but don't work very well on the back shore, East End, or by the beach.

Cellular base stations make the connection between your cellphone and the rest of the world's telephone network. If your cellphone can get a good signal from a base station (3-4 bars on your phone display), you can make a call and connect to the Internet. If you have only one bar (or none), you have a poor connection to the base station, and probably won't be happy with the service.

Radio waves have some strange properties. They don't go through walls very well, and dense foliage is also a problem. If you have satellite TV, you have probably noticed that it stops working in the summertime when there are heavy rains or in the winter during mixed snow/rain storms. This is because the precipitation blocks the radio waves carrying the TV pictures coming to your dish from the satellite.

And one more little technical thing…radio waves at higher frequencies don't carry as far, and are impaired by rain, foliage, and building materials than lower frequencies. This is important in 5G because different operators are using different frequencies.

In quick summary, the frequency bands work as follows in the real world. One low-band (600-700MHz) base station can cover hundreds of square miles with 5G service that ranges in speed from 30 to 250Mb/s. A mid-band (2.5/3.5 GHz) base station covers a several-mile radius with 5G speed that currently ranges from 100 to 900 Mb/s. Lastly, a high-band ("millimeter wave", or 24-39 GHz) base station covers a one-mile (some sources say much lower) radius while delivering roughly (1000-3000 Mb/s (1-3 Gb/s) speeds. Each of these tiers will improve in performance over time, and local terrain and obstacles will lower the range.

The high-band frequencies that can provide the higher data speeds don't carry as well as lower frequencies, so instead of installing a high-power base station on a big tower (or on a big building) to cover many square miles, high-band 5G systems usually use small base stations every few hundred feet and mounted on existing utility poles. They all need to be connected together by a fiber-optic link to carry the high-speed data between the nearby users and eventually to the rest of the world. If the users are indoors, the pole-mounted base stations need to be fairly close to get a good signal.

At one point, some carriers suggested that high-band 5G would be the only "true 5G" solution, but the past year has demonstrated that high-band "small cells" are not going to be deployed as widely as was originally hoped. This article: https://venturebeat.com/2019/03/22/report-verizon-5g-home-service-

too-expensive-to-scale-attracts-few-users/ tells the story of Verizon Wireless trying to launch high-band "5G Home" wireless broadband system for residential users in Sacramento, CA. It was a failure.

I spoke with Stephanie Lee, Verizon's Director of State Government Affairs for Maine on February 6, 2020. She said that Verizon's 5G rollout (and AT&T is doing much the same) is focused on big cities and aimed at mobile users. Competing with fiber and cable for residential applications is not a priority.

There is no 5G in Maine and it is not clear when there will be. When 5G comes to Maine, it will be in the cities first. "5G Home" might be installed in some Portland neighborhoods where there are a lot of close-spaced residences and businesses, but for example, more-suburban South Portland would not be a candidate. Ms. Lee described 5G as an "an urban play". There is currently no timetable for 5G in Maine.

Verizon's strategy for Maine is to expand their existing 4G coverage (not 5G) to rural areas. That doesn't help Long Island much…even if we got a base station or two on the island, the maximum speeds would be in the 10-50 Mb/s range (and lower indoors).

Ms. Lee understood our situation, and encouraged us to look at all our options (which was a nice way of saying that Verizon is not really an option for us). As far as funding a system, she mentioned the ConnectME, USDA, and new FCC Rural broadband funding programs. Unfortunately, Long Island does not qualify for any of these because we currently have broadband service that the government programs consider "adequate". Many rural communities are still on dial-up service or basic ADSL at 15/1 maximum.

System		Data speed	Base station coverage radius*	Services possible	Comparable wired connection
1G		None	10+ miles	Voice	Voice telephone
2G		Typ 56kb/s (0.056Mb/s)	10+ miles	Voice, email	Dial-up modem
3G		1-10 Mb/s	10+ miles	Video calls, music download	ADSL modem
4G ("LTE")		10-50 Mb/s	10+ miles	Streaming HD video	VDSL modem
5G	**Low-band**	30-250 Mb/s	10+ miles	Streaming HD video, work-from-home	Cable TV
	Mid-band	100-900 Mb/s	2-3 miles	Streaming HD video to multiple devices, work-from home	Cable TV, fiber
	High-band	1000-3000Mb/s (1-3 Gb/s)	<1 mile	Streaming HD video to multiple devices, work-from-home	Fiber

* coverage radius assume no obstructions; radius is reduced by buildings, hills, foliage, etc.

Comparison of Data Speeds Available on Various Cellular Systems

Indoor vs. outdoor wireless coverage

One big problem with all wireless system is indoor coverage. But you already know this…if you watch over-the-air TV, you know you always get a better signal with an outside antenna than with an inside antenna. If you use your cellphone outside your house, you may see 3-4 bars of signal. Go inside, and it will probably drop to 1-2 bars. Radio waves have trouble going through wood, concrete, and other solid materials. This problem is worse with higher frequencies.

The cellular industry has struggled for years with complaints from customers who ask "Why does my cellphone stop working when I go indoors?". This is just a consequence of the problem radio waves (especially high-frequency waves) have penetrating walls. Most new cellphones have a feature called "Wi-Fi Calling" which lets you make calls through the Internet via your home Wi-Fi system if you have poor indoor cell coverage.

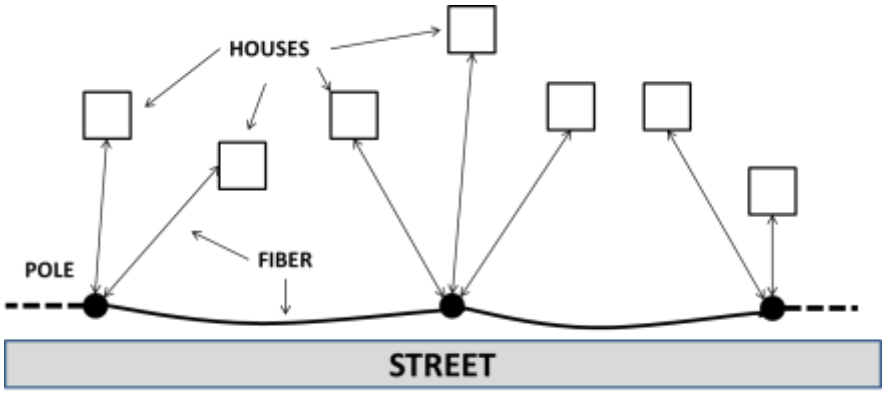
You can test this yourself with your 3G or 4G cellphone or tablet. Use your browser (Safari, Chrome, etc.) to go to the Web site "**Speakeasy.net**" and click on the red box that says "Go to Speed Test". Try it inside your house. Then go outside and try again. Then drive along Island Ave, especially in the area between the Fire Department and Boston Sand & Gravel.

Can 5G provide broadband (high-speed Internet) inside my house?

Today, no. There is no 5G service available anywhere in Maine.

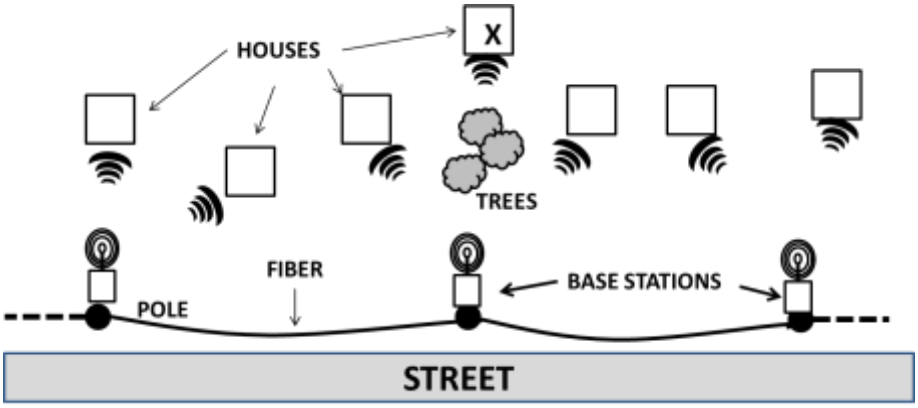
But let's assume that Verizon or AT&T Wireless decides to do us a big favor and install a system. In order to provide speeds comparable to cable TV or fiber systems, they would have to install small base stations on utility poles every 200-500 feet on the island and have Consolidated string fiber on all the poles to connect all the base stations together and then connect via Consolidated's underwater fiber to the mainland.

Compare the two diagrams below. The first one shows what a fiber-to-the-home system would look like. A big fiber runs along all the roads in town, and is tapped at the closest pole to each house. From there, a smaller fiber runs to each individual house or business either up in the air or buried underground, just like the telephone and power lines run now.



Fiber-to-the Home system

Now let's look at a 5G-to-the-home system. It looks very similar, with fiber strung along every street, except that the houses connected by radio waves to small base stations mounted on the poles. These base stations need to be installed every 200-500 feet and are connected to each other (and off to the mainland) by fiber. Note also that the house labeled "X" has some trees in the front yard. They would likely block the wireless signal and would have to be removed to provide service. If the house is behind a hill and does not have a clear line of sight to the pole-mounted base station, service is not possible.



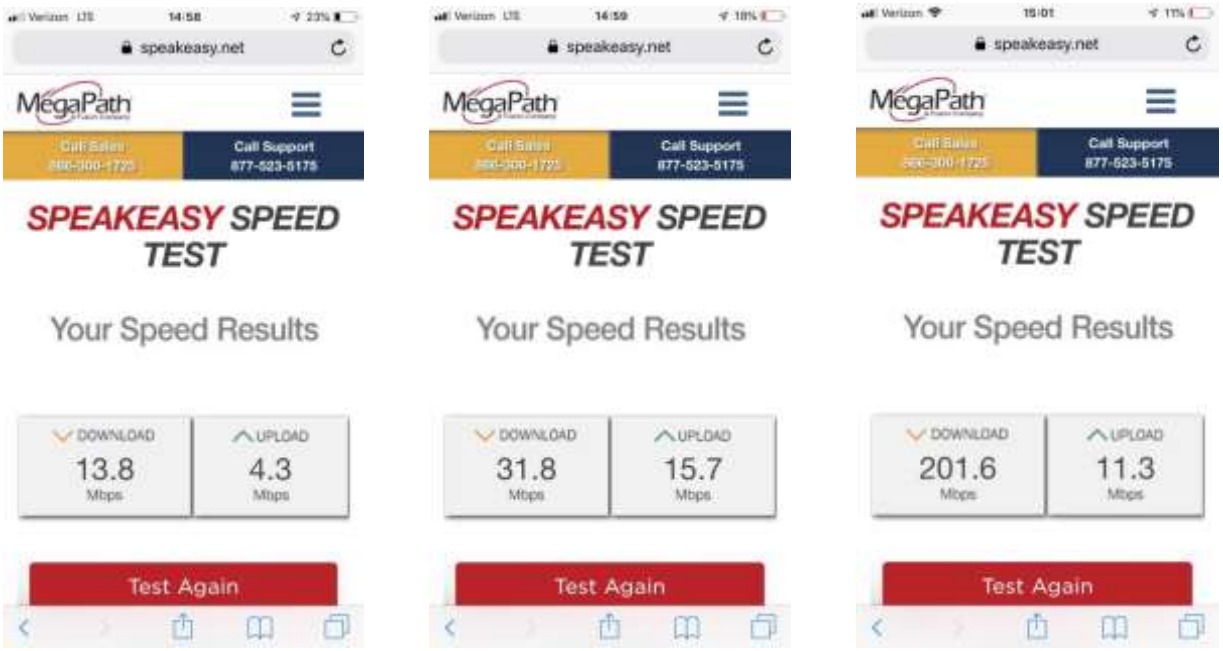
5G Residential Broadband System

Residential 5G systems require a box in the house with an antenna mounted on a window facing the base station. You can see Verizon's self-install instruction video here:
www.verizonwireless.com/support/5g-home-setup/

By comparison, the equivalent box for a fiber system can be mounted anywhere…usually in a garage or basement. This box is similar to the DSL modem you may already have. Your devices (computers, TVs, iPads, etc.) connect to this box using radio waves (Wi-Fi at 2.4 or 5.8 GHz). The DSL modem line provided by Consolidated Communications that uses the existing telephone wires that come to your house to connect your router box to the Internet. In a fiber-to-the-home system, the DSL modem/Wi-Fi box is replaced by a fiber modem (technically called an "ONT" – Optical Network Terminal").

Comparison of Data Speeds: Indoor vs. outdoor cellular coverage vs. Wi-Fi/Cable

I am writing this from my house in New Hampshire. I can connect to the Internet on my cellphone either through the Verizon Wireless LTE network (the tower is fairly close - about two miles away with no obstructions – I can see the tower from my house) or via the Wi-Fi in my house that uses Comcast/Xfinity for the wide-area connection. I get about 14 Mb/s through the LTE network indoors but it jumps to about 32 Mb/s if I step outside. For comparison, the same phone gets 200 Mb/s if I use the Wi-Fi connection via the cable system.



Internet Speeds in Derry, NH

(left: using Verizon 4G indoors; center: Verizon 4G outdoors;, right: Xfinity Cable)

Conclusion

5G cellular technology can provide mobile, outdoor users with much faster data rates than current 4G cellular technology. However, poor indoor coverage and the uncertainty that it will ever be available on Long Island make it an unattractive option and either cable or fiber is a much better choice.