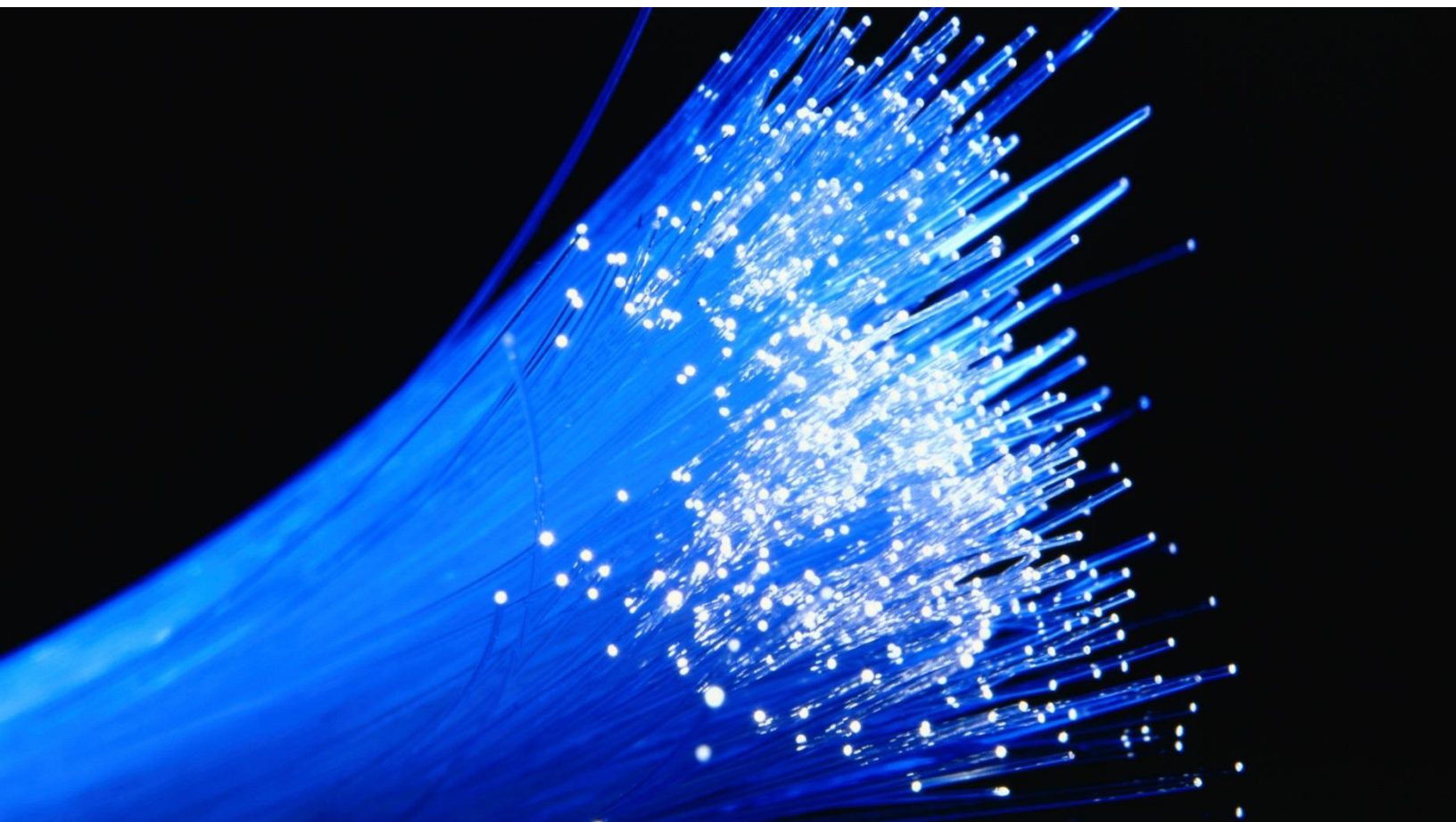


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A Brief Overview of Broadband Deficiencies in Connecticut

**Prepared for the State of Connecticut
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Columbia Telecommunications Corporation

10613 Concord Street • Kensington, MD 20895 • Tel: 301-933-1488 • Fax: 301-933-3340 • www.ctcnet.us

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1 Executive Summary

1.1 Overview

Although Connecticut is a prosperous state¹ with large areas of urban and suburban densities, Connecticut businesses, institutions, and residents have significant challenges obtaining broadband services.

In its most recent State of the Internet report, Akamai² noted that Connecticut had the largest decline in average connection speed, down 8.9 percent to 13.9 Mbps. By comparison, the District of Columbia had the largest increase—up 34 percent, to 19.5 Mbps. Connecticut’s decline could be due to a variety of factors, but it is likely that the quality of Internet service provider (ISP) performance and the quantity of ISP infrastructure played a significant role.

In Connecticut, Internet service is provided statewide by Frontier Communications over copper DSL lines and dial-up telephone lines. In urban and suburban areas and in towns across Connecticut, cable broadband also exists, usually provided by Comcast—but these services are frequently limited to residential areas. In the southwestern corner of the state, there is a small area with Verizon fiber-to-the-premises (FTTP) services. In the District of Columbia, by contrast there are three competing facilities-based broadband providers—Comcast, RCN, and Verizon—and Verizon offers FTTP service to most of the District.

Akamai also noted that Connecticut was the only state with a drop in peak speeds, which declined by 8 percent to 65.3 Mbps.³ The decline in the peak speeds may indicate that service providers are not improving the quality of their higher speed services for Connecticut businesses and residents, relative to service providers in other states—and it is at the higher speeds where FTTP and high-quality cable broadband make a significant difference, and where customers served by DSL encounter limits. Most DSL connections cannot exceed 65 Mbps.

As the State’s independent broadband consultant, CTC Technology & Energy (CTC) conducted site visits at business locations selected by the State’s Office of the Consumer Counsel to investigate a small sample of broadband customer experiences. We visited representative urban areas of the State on December 14, 2015 and rural areas on January 6, 2016. We met with a range

¹ Indeed, Connecticut had the highest per capita personal income among all states in 2014. See: “Personal Income for Connecticut,” Bureau of Economic Analysis, U.S. Department of Commerce, September 2015, <http://www.bea.gov/REGIONAL/bearfacts/action.cfm?geoType=3&fips=09000&areatype=09000>

² Akamai, one of the largest operators of Web hosting and Internet content delivery in the world, measures key parameters of internet service for all countries and all U.S. states.

³ “Akamai’s State of the Internet, Q3 2015 Report,” <https://www.akamai.com/us/en/multimedia/documents/report/q3-2015-soti-connectivity-final.pdf>, accessed January 6, 2016.

of users and institutions, discussed broadband capabilities and challenges, performed speed tests, and surveyed broadband physical plant.

This preliminary report presents representative illustrations (not a comprehensive list or a systematic analysis) of the challenges facing the State; we will complement this overview with additional reports in the coming months.

1.2 Findings

From our urban surveys in Hartford, Connecticut we found evidence of higher-quality fiber and cable broadband services in proximity to the poorly served locations. However, the individuals at those locations reported that service providers decline to connect users to those services, or will do so only at a prohibitively high cost—approximately \$10,000 to \$30,000 for a short street crossing. Also, services are costly—from \$1,000 to \$2,000 per month.

We found based on our field survey in rural areas that most areas had copper telephone service, areas in proximity to towns have cable TV, and there is frequently a third fiber telecommunications provider on major routes between towns and in in proximity to State buildings, fire stations, and libraries. However, these services were not readily available to many institutions and businesses—requiring significant effort by the institutions to understand their options and to be connected.

We found that most utilities in the rural areas were on aerial utility poles. The pole condition and amount of pole space for new attachers varied dramatically. We found that current attachers used highly flexible ways of attaching cables to utility poles, including “boxing” poles with cables on both sides. If pole owners continue to be flexible about attachment, there are acceptable strategies for adding new fiber to poles, quickly and at reasonable expense.

We found many rural areas where cellular mobile broadband service was poor or nonexistent. In areas between towns, and even in towns—inside buildings and in basements—service would diminish or cut out.

2 Broadband Experiences of Sample Businesses in Connecticut

2.1 Hartford

We chose Hartford as our first sample location because it is the State capital. We anticipated that the concentration of governmental operations and the density of businesses (as in many urban communities) would create the level of demand for broadband services that would incent incumbent service providers to deliver relatively high quality, high-speed options. However, prior to our sampling, we received reports from city officials that many businesses and institutions within the city were limited to only low levels of service.

2.1.1 Conference of Churches

The Conference of Churches is located on the site of a former Aetna insurance facility (224 Farmington St, Hartford). It is now a loft-style facility segmented into offices and meeting rooms, classrooms, and auditoriums for training, business incubator co-work, and educational purposes (Figure 1). We met with Rev. Shelley Best.

Figure 1: Conference of Churches – Incubator Facility



Broadband is critically important to the Conference because the incubator companies and workers need to connect to operate their businesses and to interact with clients. The building is designed for up to 200 individuals in the incubator or other meeting and office spaces who may need to simultaneously connect. Based on our experience, this environment would require 50 to 100 Mbps to serve adequately. In addition, the service would need to be consistent, and with relatively low latency to support video conferencing and other business needs.

Currently the only company serving the building is Frontier. Frontier provides a copper-based DSL service for \$69 per month. We tested it and found download speeds of 10.5 Mbps and upload speeds of 0.89 Mbps, at a quiet time in the building (no other users). By comparison, the average residential broadband speed in the U.S. is around 31 Mbps (download).⁴ Rev. Best reports that the service runs much more slowly during busy times and often fails, including the previous night, when the participants in the building could not connect to the Internet.

Comcast has service 100 feet from the property, directly across Farmington Street, including fiber optic cables stored in slack storage and a splice enclosure (Figure 2). Rev. Best identified a conduit that she reported was installed from the network room (Figure 3) to a manhole near the front of the lot (Figure 4). She reports that Comcast would only provide broadband service for a \$30,000 installation charge and for a service costing \$1,000 to \$2,000 per month.

Despite reporting numerous efforts to develop better options through Frontier and Comcast, Rev. Best's solution was to work with the State to purchase wireless equipment to establish a connection from the building to a rooftop at the Hartford Building, one-half mile away, where the State has broadband capacity.

Figure 2: Conference of Churches – Comcast Fiber Stored Directly Across Street



⁴ "2015 Measuring Broadband America Fixed Broadband Report," Federal Communications Commission, Dec. 30, 2015. See "Actual download speeds," <https://www.fcc.gov/reports-research/reports/measuring-broadband-america/measuring-broadband-america-2015#block-menu-block-4>.

Figure 3: Conference of Churches – Conduit to Street from Inside Facility



Figure 4: Conference of Churches – Manhole Where Conduit Terminates at Side of Street



2.1.2 Scotts' Jamaican Bakery

Scotts' Jamaican Bakery (801 Windsor St., Hartford) is in a former manufacturing facility. Scotts' has multiple locations in Hartford for food preparation and retail sales. In addition to typical business Internet communications, Scotts' needs broadband for its telephone system, to update its website, and for USDA inspectors to connect. Scotts' cannot operate a unified telephone system or an interconnected point-of-sale system across its locations. The owner, Gordon Scott, reports he has had serious problems with broadband since 2008 and needs to do all but the most rudimentary Internet tasks from his house.

Scotts' is served by AT&T through Frontier Communications copper lines. Scotts' uses a 1.54 Mbps T1 service that is segmented between the voice lines and the data broadband. If a phone line is in use, the data slows drastically. Mr. Scott stated that it is frequently impossible to send or receive e-mail if the phones are in use.

We tested the connection and found a download speed of 1.44 Mbps, an upload speed of 1.00 Mbps, a round-trip latency of 340 ms, and jitter of 364 ms. In addition to the low speed, the latency and jitter makes it difficult or impossible to use media applications such as voice or video over IP.

Scotts' pays \$290 per month for its current service at this location. Frontier proposed an upgraded DSL service at the location with a committed rate of 6 Mbps for \$364, as well as 2 Mbps service for \$310 at each of Scotts' three other locations in Hartford.

Mr. Scott informed the State that Comcast has fiber and a node on Windsor Street, but that the company quoted him a connection cost of \$600,000. Utilities are underground, so upgrading to fiber or adding cable TV service would require new underground construction (although if Comcast is present on the street, this may only be a short distance).

Figure 5: Scotts' Jamaican Bakery – Fiber Terminated at Warehouse Across Street



Figure 6: Scotts' Jamaican Bakery – Cell Site on Warehouse Across Street



Figure 7: Scotts' Jamaican Bakery – All Underground Utilities in Vicinity



2.1.3 Express Kitchens

Max Kothari, the owner of Express Kitchens (3080 Main St, Hartford), reports that he is satisfied with his broadband service from Comcast, but that he was only able to obtain the service by constructing conduit at his own expense across a parking lot to a pedestal at an adjacent residential lot he owns (the location of a house that had burned down) (Figure 8).

Mr. Kothari is able to obtain business-grade Internet service through the Comcast connection for \$180 per month. He reported that, other than his own constructed Comcast service, the only alternative is a low-speed DSL service from Frontier.

Figure 8: Express Kitchens – Pedestal on Adjacent Vacant Residential Lot



The photo below shows the view from Express Kitchens across the parking lot to the pedestal (at the far corner, next to street). Express Kitchens constructed underground conduit across this parking lot to reach the pedestal.

Figure 9: Express Kitchens – View Across Lot Where the Business Constructed Conduit



2.1.4 Star Hardware

Star Hardware (2995 Main St, Hartford) is located across the street from Express Kitchens and is connected over a Frontier DSL connection. At the time of our visit, we conducted a test and found a download speed of 1.27 Mbps, an upload speed of 0.33 Mbps, latency of 340 ms, and jitter of 364 ms. Again, in addition to the low speed, this level of service precludes use of media such as voice over IP and video conferencing.

2.1.5 Action Audio

Action Audio (2814 Main St, Hartford) is located a few blocks from Express Kitchens and Star Hardware. We conducted a test and found a download speed of 2.66 Mbps, an upload speed of 0.39 Mbps, and 75 ms latency. The owner reports that this connection, over a Frontier DSL connection, is the only available service.

The low speed creates significant problems for Action. The business needs to download upgrades for stereo systems and car navigator systems. The files can be 500 MB and require more than half an hour to download. The business needs to upload breathalyzer calibration photos, which can require 20 minutes. The owner reported he either risks losing customers or needs to use a costly mobile broadband service to connect. He also reported numerous unsuccessful efforts to work with Frontier to increase his available speeds.

2.2 Northwestern Connecticut

We also conducted sampling in less populated areas in the northwest corner of Connecticut, where local officials reported that area residents and businesses faced significant challenges in obtaining even a basic level of broadband service in some locations. A group of local leaders, composed of both town officials and residents, has formed a coalition known as “NWConnect” that is meeting with incumbent providers in an effort to increase options for local residents; the coalition reports that it not seen any increase in service or speed to date.

2.2.1 Sharon Hospital

We spoke with Carlos Neto, the IT director of Sharon Hospital (50 Hospital Hill Road, Sharon). Sharon Hospital is located close to the center of Sharon. It was recently connected by way of a new fiber optic connection to a symmetrical 100 Mbps service. The service is provided by ChimeNet using a fiber optic connection constructed by Fibertech (now Lightower). The service costs \$1,800 per month, with no installation or construction cost assessed.

According to Mr. Neto, it took one year for Fibertech to obtain the rights to attach to the handful of poles to extend the fiber from its connection at the Sharon Fire Station to the hospital.

The service replaces a 10 Mbps Frontier connection costing \$1,375 per month and requiring a \$5,000 payment to Frontier for early termination. According to Mr. Neto, the actual speed of the service was between 3 Mbps and 5 Mbps.

We tested the new connection and found the download speed to be 555 Mbps and the upload speed to be 96.8 Mbps, with round-trip latency of 4 ms. Mr. Neto reports that typical speeds are at least 300 Mbps to 400 Mbps.

The photo below shows a Lightower cable installed from the former demarcation point at Sharon Fire Station to Sharon Hospital a few blocks away. The Lightower attachment is the lowest one, with a splice enclosure on the pole.

Figure 10: Sharon Hospital – Lighttower Cable and Splice Enclosure



Sharon Hospital obtained a connection to the Medical Arts Center across the street, also using ChimeNet and Fibertech fiber. Mr. Neto reports that this connection is satisfactory. Sharon Hospital also connects to other medical facilities in Kent and New Milford. The Kent connection is through Charter and operates at 30 Mbps, which Mr. Neto reports is satisfactory. The New Milford connection is through Comcast or Charter and operates at 65 Mbps, also satisfactory.

One significant problem for the hospital is the poor cell phone and mobile data service in the areas surrounding Sharon. Doctors must rely on landlines at their houses if on call. There is a long-range pager service by American Messaging that provides coverage in some areas.

The need for broadband will increase for the hospital due to the mandatory requirements for use of electronic medical records and the need to share those records with other medical institutions and the state healthcare exchange.

A new offsite storage area network is being set up for radiology images, which will need to be accessed in the hospital and by doctors at home and at remote practices. There is a need for faster connectivity to specialists in other institutions, such as the stroke specialists at Yale.

2.2.2 Geer Village

We met with the IT staff and leadership at Geer Village, a nonprofit senior living community outside Canaan. Geer has extensive medical facilities, an assisted living facility with 120 apartments, an adult day center, a pharmacy, a YMCA, and a restaurant. About 275 residents live

on the Geer campus, 100 people visit each day for outpatient services, and as many as 200 more people might be on campus each day (e.g., at the YMCA or restaurant, or attending a public event or class). Geer Village has 350 employees, about half of whom are actively using the Internet or e-mail at any given time.

Geer is served by Comcast over a combination of coaxial and fiber optic services. It has a 100 Mbps symmetrical fiber Ethernet service for \$1,750 per month on a three-year contract and a 100/10 Mbps cable modem service for \$100 per month. The connections go from the campus to the main road over conduit owned by Geer. The fiber connection is new; service began in November 2015. Prior to the Comcast fiber connection, Comcast had provided an estimate of \$46,000 for the fiber connection, but it changed its pricing.

The two services are meant to provide a backup for each other so that communications continue in the event of an outage, but Geer is concerned that, since the two services are from the same provider and traverse the same route, this provides only limited backup. According to Geer, Frontier serves the area with DSL but not fiber. When Geer contacted other providers such as Windstream for fiber services, they found that the services would be over the Comcast fiber and again provide no redundancy. Geer also connects its PBX switch to telephone service over the Comcast connection. There are a handful of POTS telephone lines used by fax machines, provided by Frontier.

According to Geer, there was a phone service outage of five hours the day prior to our visit, in which no one could dial out, including to 911. Cell coverage in the building is very limited.

We tested the connection at the main network switch and found download speeds of 90.5 Mbps and upload speeds of 104 Mbps, latency of 26 ms, and jitter of 157 ms. We note that the speeds are close to the promised speeds but that the latency and jitter are higher than what would be expected in a symmetrical business-grade fiber connection and may pose problems if Geer increases its use of two-way video and other latency-sensitive applications.

Geer reported that Comcast could not provide a gigabit service without running a new connection. Based on the survey, the single mode fiber connection installed by Comcast probably can support gigabit speeds, but Comcast would need to replace its interface device and potentially also modify the electronics at its hub and network facilities. Geer requires the ability to scale its service to accommodate future needs.

The photo below shows conduit installed by Geer from one of its buildings to the street. Comcast is using the top right conduit; two spare conduit are at the bottom.

Figure 11: Geer Village – Self-Installed Conduit from Building to Street



Geer has rapidly growing network and broadband needs. It is at the beginning of its introduction of electronic health records. It is seeking better connectivity so that physicians can serve patients at Geer from other locations—this being necessary in attracting doctors, who would want to keep the rest of their practice and not need to travel to Geer for all consultations. Electronic health records are expanding. Many of these are hosted in the cloud in remote data centers. Records will include high-resolution images. Geer is also seeking to better secure the campus, which currently has 46 cameras.

Members of the Northwestern Connecticut Council of Governments (NWCOG) who are focused on broadband issues attended the meeting at Geer and provided information about service to surrounding areas. They reported it is difficult for residents in the surrounding areas to get quality broadband. Outside of the town, service is only available through Frontier and only dial-up connections are available in some areas, lower speed DSL in others. Individuals have received quotes as high as \$60,000 from Comcast and Frontier for fiber connections to their residences.

Cell service is poor, as well. Geer understands that Verizon Wireless is evaluating constructing a “mini-tower” in Canaan to improve service in the surrounding 1.5 miles. Terrain is a factor in making it difficult to get quality wireless service.

Geer is planning a facility expansion of 24,000 square feet and will need more broadband to serve clients and attend to the growing medical needs.

3 Field Survey Findings

On January 6, 2016 we performed a field survey of suburban and rural areas in the NWCOG region. Most communications utilities in rural areas and in the small towns are on aerial utility poles. We found a wide range of pole conditions, ranging from new tall utility poles being installed in the Sharon region to address damage from recent storms, to poles with communications utilities installed in a “boxed” manner on both sides of the utility poles in order to fit them in with the required clearances. We also observed some poles where communications and power utilities were visibly too close and out of compliance with code.

In the rural areas the poles had power and Frontier telephone lines (a combination of fiber backbone in some areas, plus large-diameter copper phone cables). In many areas there were multiple Frontier attachments, sometimes four or five. On some major roads there was another separate fiber cable. Cable TV cables (coaxial cable, with fiber cable “overlashed” on backbone routes) existed in towns and for short distances outside towns.

Figure 12: Congested Utility Pole in Sharon with Boxing on Both Sides of Pole



Given the pole conditions, it was generally feasible to add an additional communications utility without pole replacement or extensive make ready (i.e., movement of existing cables), especially in the areas between towns. First, a fiber optic cable is a small addition, generally lightweight and about 0.75-inches or less in diameter. Second, on the newer poles there is generally space for a new attachment. Third, if boxing is permitted, there is almost always space for an additional attachment, although this position may change from pole to pole. Fourth, space can be created by consolidating the existing attachments. The power company can create space by placing all three conductors in a tighter configuration. Where the phone company has many attachments, these may potentially be consolidated.

4 Conclusions

CTC found a range of serious broadband challenges in the State, including:

- 1) Maximum speeds are often far less than what businesses need for their current operations
- 2) There are limited or no affordable competitive options for broadband services for businesses in urban areas
- 3) Businesses' growing needs for broadband will further exceed the available broadband services
- 4) Businesses face long delays in obtaining services, or are unable to obtain service even when infrastructure is relatively nearby

Our findings at representative businesses in the Hartford area are illustrative of the types of issues likely faced in other urban parts of the State. Small and medium-sized businesses are being constrained by lack of broadband infrastructure and, where infrastructure is available, lack of competitive options (leading to higher prices and limited service). The poor service at the sampling locations in Hartford was surprising, given that the city is the State capital, a major city in the State, and a densely populated community.

All of the businesses we visited in Hartford reported that they are hampered by the low speed and quality of their existing services from Frontier or Comcast. The business owners also identified the cost of those services as an area of concern. In the sample locations, the price for service that is adequate at best is high, especially in comparison to services in many other urban areas, not to mention the gigabit services available in other parts of the country at \$70 to \$100 per month (e.g., Google Fiber markets and cities with municipal fiber networks).

Anecdotally, the incumbent providers (Comcast and Frontier) are also not acting on requests to expand service availability or speeds to businesses that are specifically requesting new and better service (often over a period of months or years). Rev. Best at the Conference of Churches had to resort to "self-help" with CCAT and CEN, because she could not get served by incumbent providers.

In addition to the potential economic impact, this lack of broadband service and competition also has potentially severe consequences for healthcare in the State; as our visit to Sharon Hospital revealed, insufficient broadband at hospitals and clinics will be a major hurdle in the adoption of electronic health records, and will curtail or prevent the use of telemedicine and the latest advances in remote medical care.