An ADTRAN White Paper

Adding a “G” to the Three “Rs” - The Necessity of Gigabit Broadband for Education

Building the 21st Century Network

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Rena Anderson, Director of Community Relations, Huntsville City Schools

Introduction

Schools need high-speed broadband connectivity for delivering effective education in the information-centric 21st Century. Still, too few have seen the necessity to provide sufficient student and faculty access outside the classroom, be it a humble elementary school in a rural town or a bustling university in a large city. The backstop/complement to in-school access for underserved/unserved areas has been a combination of public library and public access. Still, few were open on a 24-hour, 7-day-a-week basis, even before the events of the last year.

COVID-19 cut the public broadband lifeline for students and families, indiscriminately closing libraries and schools alike, moving traditional K-12 and colleges away from in-person classroom models to learn- from-home (LFH) practices in a matter of weeks. In this transformed world, high-speed broadband became a vital utility for all, counted on to support one or more school-age children via distance education and one or both parents working from home (WFH) at the same time.

School districts, university administrators, and service providers were all forced to step up in a matter of weeks to provide a suddenly indispensable resource for delivering education. Numerous districts struggled with the number of unconnected families without any means of broadband access, according to The Verge. In addition to printing and mailing assignment packs as needed, these educational systems were forced to resort to distributing cellular hotspots or setting up Wi-Fi hotspots in public places so students could download and upload assignments and participate in Zoom calls inside cars parked next to hotspots. Others used school buses outfitted with Wi-Fi as mobile hotspots for unserved areas, providing economic larger-area coverage within a geographic region.

Many broadband extension projects were stop-gap measures balancing limited fiscal resources, unique demographics of individual school districts, and the

In an unprecedented wave, COVID-19 forced traditional K-12 and college learning away from in-person classrooms to remote learning models that demanded new approaches and technological foundations.

need to provide as many unserved K-12 students broadband as rapidly as possible to deliver education for the school year. However, connectivity challenges were not solely limited to neighborhood K-12 facilities. Higher education institutions, from local community colleges to award-winning universities, had to adapt and expand their in-house infrastructure from a classroom-based way of life into a massively scaled distance-learning model.

To be clear, online learning is no substitute for an in-person classroom environment, especially for younger and at-risk populations. However, the need to provide gigabit-speed broadband within and outside of the classroom will continue, even after society moves past the impact of the global pandemic. Educators continue to assess, learn, and improve the digital classroom experience by necessity.

Wi-Fi on the Fly: Huntsville City Schools

Huntsville City Schools is the fourth-largest employer in Madison County, Alabama, serving 24,000 students in 42 schools. Based on estimates from free and reduced-cost lunches, 42 percent of the enrolled students do not have broadband access at home.

Eight years ago, the district adopted a digital one-to-one educational model, providing devices to students for learning. Everyone in the third through

During the initial shutdown from COVID-19, Huntsville City Schools, ADTRAN, and Huntsville Utilities joined together to turn-up external Wi-Fi hotspots at all 42 schools in the district..

the 12th grade receives a laptop, providing a solid base for delivering an learn-from-home (LFH) environment. As COVID-19 made its presence felt in early 2020, Huntsville expanded its device distribution policy for the fall, distributing laptops to first and second graders and Apple iPads to kindergarten students.

Huntsville's main challenge to delivering education in a socially distanced environment was broadband access. More specifically, finding the best way to deliver broadband to the largest number of unserved students in a cost-effective fashion in a drastically short timeframe. The last full day of school before a statewide lockdown was Friday, March 13, 2020, with classrooms to be shut down for a minimum of six weeks.

"The quick and easy answer is always cellular Wi-Fi hotspots," said Rena Anderson, Director of Community Relations, Huntsville City Schools. "There are pros and cons. They are easy to set up, but it's hard to monitor what they're used for. When COVID hit, the price of tech devices went up, and hotspots became quite expensive."

Large-scale Wi-Fi network deployments covering the city had been discussed in the past as a part of a more comprehensive long-term plan to transform Huntsville into a "Gig city." Still, the school district needed an immediate solution. Local business ADTRAN and Huntsville Utilities came together with the school district on a March 26 conference call, with the utility able to assist in deploying fiber and other cabling support within buildings while ADTRAN provided the Wi-Fi hardware.

"We needed to provide high-density Wi-Fi at each school, from the exterior of the school building, so students could walk or drive up to any one of our 42 schools to get access," Anderson said. "Using an ADTRAN Wi-Fi hotspot, we could extend Wi-Fi up to 300 yards, three football fields of Wi-Fi coverage outside of the school building."

The ad-hoc partnership between ADTRAN, Huntsville Utilities, and the school system turned up external Wi-Fi hotspots at all 42 schools in the district and later added service at a local football stadium in the center of the district. Seven buses were also equipped with Wi-Fi hotspots to provide additional coverage including public housing areas.

Accelerated upgrades in the Midwest: Dickson Public Schools

Dickson Public Schools is a modest organization, with two elementary, one middle, and one high school. Serving over 1,300 students in Oklahoma, the school district planned to move to a one-to-one ratio of digital devices to students in the classroom, using ADTRAN Wi-Fi Access Points (APs) within the buildings to provide seamless connectivity. ADTRAN has managed the Wi-Fi as a cloud service offering without incident for nearly five years, but the shift to a one-to-one digital device model required upgrading APs for higher speed and throughput as well as adding additional APs to provide full-building coverage.

> "Teachers conduct remote instruction from their physical classrooms, requiring in-building gigabit-class connectivity to support multi-user video conferencing."

Cindy Stinson, Tech Director, Dickson Public Schools

The pandemic accelerated Dickson's upgrades, making one-to-one a priority in March 2020, with full implementation happening before the first day of school in the fall. Student remote broadband access was provided on an as-needed basis by issuing T-Mobile hotspots to any families that required them, with around 500 hotspots distributed.

Dickson went fully virtual in mid-November as COVID rates increased. The combination of one-to-one and remote learning also accelerated the need to improve the school system's core network. "We needed to upgrade and add new switches," said Cindy Stinson, Tech Director for Dickson Public Schools. "Our connectivity between buildings is between 1.2 Gbps and 2.5 Gbps. It's going to 10 Gig throughout. Teachers conduct remote instruction from their physical classrooms, requiring in-building gigabit-class connectivity to support multi-user video conferencing."

Upgrading from cable to fiber: Stanford University

Founded in 1885, Stanford University's campus covers 8,180 contiguous acres with 700 major buildings. With nearly 7,000 undergraduates and 9,400 graduate students, classes are taught by 2,276 faculty members, giving the campus a five-to-one student-to-faculty ratio.

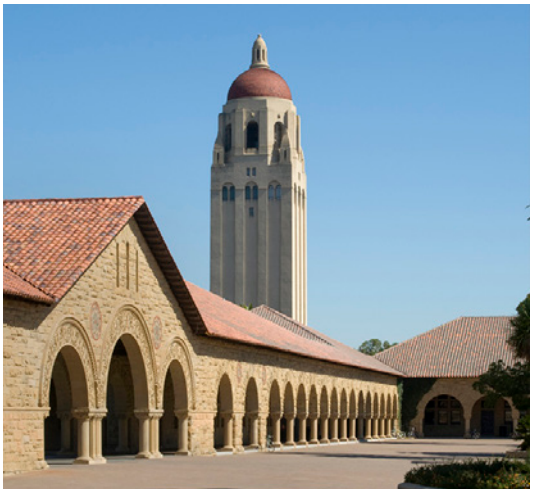
Unlike many universities, Stanford University operates as a broadband service provider both for its campus research and teaching facilities as well as faculty housing, including on- and off-campus locations.

Being an elite university didn't spare Stanford from the impact of COVID-19. The network engineering staff had been working on plans to replace an aging cable modem infrastructure and deploy GPON-based fiber connectivity to faculty and staff residences owned by the university, including an apartment complex with over 600 residents.

Fiber had already been pulled into each of the buildings. Still, the need to enable gigabit connectivity for remote teaching, research, and staff work was sorely needed by mid-March as the campus implemented a lockdown and planned to deliver almost all undergraduate instruction remotely. Networking staff had to wear protective gear to install GPON equipment on campus for 600 single-family homes and at a new housing complex in Palo Alto, CA.

The existing cable infrastructure was heavily stressed, providing only 20 to 30 Mbps of connectivity at a time when faculty and staff were conducting all of their daily meetings using videoconferencing and providing instruction on-campus and around the globe using video collaboration tools. It was impractical to spend money to speed up the aging cable plant. Instead, university officials decided to accelerate the deployment of GPON leveraging the existing fiber.

By the end of August, Stanford's network team had successfully completed over 1,000 fiber installations as part of the upgrade. Physical fiber deployments leveraged existing conduit for the most part, with very little digging. Deployment for the apartment complex ran fiber into the buildings and then used standard Ethernet delivered service to individual residences.



Stanford University successfully completed a widescale fiber network upgrade during the impact of COVID-19, enabling gigabit connectivity for remote teaching, research, staff, and residents.

Single-family homes typically had a residential gateway connected to an optical network terminal (ONT) at the end of a fiber strand. This future-proofed PON architecture can comfortably provide the higher symmetrical capacities of XGS-PON via the introduction of Combo PON OLT aggregation line cards, without requiring any of the existing outside plant or in-home ONTs to be changed.

Planning for tomorrow's education network today

The COVID-driven push toward distance education and the resulting exposure of broadband gaps has resulted in a political consensus for more national investments into infrastructure, extending fiber to unserved areas, and increasing the speeds of existing networks to satisfy real-time, multiperson video applications requiring symmetrical bandwidth.

Service providers and educational institutions alike need to prepare to enhance their existing infrastructure, expand coverage, and upgrade core networks while raising delivery speeds to gigabit levels.

Educational organizations will need more symmetrical bandwidth from their service providers and should consider moving to 10Gig connectivity in their internal networks to support multi-person video conferening in all classrooms. Combo PON technologies can ensure limited school budgets can achieve the connectivity required without over-investing in locations where more modest capacities are sufficient.

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