Brecksville - Broadview Heights City School District

Technology Plan
2013 - 2018

BRECKSVILLE-BROADVIEW HTS.
CITY SCHOOL DISTRICT

"where fine education is a heritage"

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Executive Summary

The last few years have seen a transformational shift that is having a substantial impact on how schools educate students. The rise of mobile computing devices and ubiquitous Internet access has made access to information trivial. In this environment, the focus of education is on helping students effectively find, filter, and select appropriate information resources. Then, students synthesize, analyze, and evaluate that information, using innovative thinking and problem solving skills to collaboratively create new ideas and new solutions to authentic problems. These solutions are communicated, debated, justified, and defended in a variety of formats and contexts.

The district's technology model has traditionally focused on computer labs for student use, with minimal computer access in classrooms. Desktop computers have maximized available computing resources while minimizing costs. Investments in network infrastructure have kept pace with the district's needs, and long-range upgrade projects are underway or have been recently completed.

Current trends in educational technology are leading toward an environment where computers are tied to people, not to places. Every student and staff member has ubiquitous access to technology that is used to connect with online learning resources and networks of people who interact and learn from one another on a regular basis. At the same time, instruction is hyper-personalized, with students participating in activities and using resources uniquely suited to their needs.

To meet the needs of its students, staff, and school community over the next five years, the district has identified three major technology goals. These goals acknowledge the existing technology resources that are available while planning to meet the challenges and demands that are likely to come within the next few years.

> **Goal 1: Provide the necessary infrastructure to support the instructional and operational goals of the school district.**
>
> **Goal 2: Provide ubiquitous access to technology for students and staff.**
>
> **Goal 3: Provide appropriate levels of support to encourage the productive and efficient use of technology.**

The cost of these initiatives is expected to be $4.3 million over the next five years, with $1.3 million in the first two years, and approximately $1 million per year thereafter. In many cases, these numbers include expenditures that are already in the budget. It is expected that currently available funding for textbooks and technology will offset the hardware costs. While the personnel costs are substantial, they are relatively modest considering the magnitude of the planned resources.

This plan outlines technology needs designed to meet the challenges of next generation learning. It is not an overly ambitious plan, but simply acknowledges the technology needs of the district moving forward, and outlines a reasonable plan to meet those needs.

Updates

The March 2014 Technology Plan Status Update summarizes progress on the technology plan in its first year. It is available on the district's web site at **www.bbhcsd.org/technology**.

The April 2015 Technology Plan Status Update provides details on the implementation of the technology plan in its second year. It is also available online at **www.bbhcsd.org/technology**.

The March 2016 Technology Plan Status Update provides details on the implementation of the technology plan in its third year. It is also available online at **www.bbhcsd.org/technology**.

Introduction & Objectives

The Brecksville-Broadview Heights City School district provides an outstanding comprehensive public education to approximately 4,100 students in the Brecksville and Broadview Heights communities. The school district has a long-established tradition of excellence in academic, extra-curricular, co-curricular, and athletic areas, and is consistently ranked among the best in the state of Ohio. The community is generally affluent and supportive of the schools. Parents place a high value on education, and student performance reflects the shared responsibility of education among schools, families, and the community at large.

The schools have been successful by embracing a traditional, conservative approach to education. Proven teaching methods, quality educational resources, and traditional styles of school management have been very effective. Over the last fifteen years, technology has been used to support delivery of instruction, select instructional resources, and target intervention for struggling students, especially in the areas of reading and math.

The growth of technology use in the schools has been measured and frugal. In the 1990's, the district took advantage of grants from the Ohio SchoolNet Commission to wire the school buildings for network access, and to introduce computers to the elementary school classrooms In 2001, the district standardized on the Windows platform to reduce support costs and simplify the district's network infrastructure and professional development needs. An upgrade of the district telephone system in 2002 allowed the schools to build a wide-area network, connecting all of the school buildings with high-speed fiber links while still saving money over the previous phone system. Leveraging the cable franchise agreements in place in the cities of Brecksville and Broadview Heights, the district maintained this network at a minimal cost for more than a decade. The addition of a permanent improvement levy in 2005 allowed the district to adopt a formal replacement schedule for technology equipment, ensuring that technology acquisition and support is sustainable through the long term.

Appendix 3 includes additional strategies that the district has employed to save money on technology.

The last few years have seen a transformational shift in the information economy that is having a substantial impact on how schools educate students and how they use technology. The rise of mobile computing devices and ubiquitous Internet access has changed the traditional roles of teacher and school as providers of information. Students now have instant access to far greater resources than a classroom, textbook, or school library can provide. Additionally, the rise of social networking tools allows students to connect to one another as well as experts in nearly every academic field. In this environment, the focus of education shifts from simply providing content for students to helping students effectively find, filter, and select appropriate information resources. Then, once the information is found, students synthesize, analyze, and evaluate that information, using innovative thinking and problem solving skills to collaboratively create new ideas and new solutions to authentic problems. These solutions are communicated, debated, justified, and

defended in a variety of formats and contexts, including traditional and technological media.

To support this type of learning, a new approach to technology in schools is needed. Technology resources must be available to students and staff as needed. Computers no longer have to be a precious, limited resource, confined to computer labs and media centers. Networks must allow students to access information and learning resources from anywhere. Proper support structures must acknowledge the critical role that these technologies now play in teaching and learning. The district technology vision must clearly articulate the technology needs and the plan for meeting those needs, but it must also remain flexible enough to adapt as those needs and technologies change.

Current State of Technology

For the most part, the school district uses a computer lab model for student technology use. Twenty computer labs throughout the district provide 663 computers for students. Additionally, one computer is provided in each classroom for teacher and student use, and computers in offices and administrative areas are used by district staff members. All of these computers are replaced on a six-year schedule. When computers are removed from these primary-use environments, they are generally made available to teachers for classroom use and supported on a best-effort basis. A total of 240 computers are currently deployed in this fashion throughout the district.

Over the last few years, the district has begun using more portable computing devices. Netbooks were first introduced in pilot programs in 2008, and in 2012 a large-scale adoption of netbooks provided classroom sets to each K-3 media center and 23 science classrooms. Tablet computers have been used successfully in many places, especially at Hilton Elementary, where 85 iPads are available for teacher and student use. In total, 1,020 netbooks and 273 iPads are employed throughout the district. In addition, many teachers are also encouraging students to use their own portable devices in class, further improving student access to information resources.

The distribution of computing resources among the district's six schools is roughly proportional to the number of students served in each school. In all, 2,734 networked computing devices are deployed throughout the district. The middle school has a slightly higher proportion of these devices, primarily due to the science adoption of netbooks which targeted middle school classrooms. The high school has a slightly higher proportion of computers in labs. This is due to the need for special-purpose computer labs to accommodate classes in graphic arts, computer aided design, and business. Chippewa and Highland have a slightly higher level of deployment of repurposed computers in classrooms, while Chippewa and Hilton have more iPads in use, proportionally, than the other schools. Overall, the inequities among the schools are minor, with access to technology essentially equivalent among all six schools.

Device Distribution

	High School	Middle School	Central	Chip-pewa	High-land	Hilton	District	TOTAL
Students	1504	1046	592	330	337	375		4184
Current Desktops*	387	317	205	86	94	82	30	1201
Per Student	.257	.303	.346	.261	.279	.219		.287
Old Desktops†	79	35	30	37	37	17	5	240
Per Student	.053	.033	.051	.112	.110	.045		.057
Current Laptops‡	6	6	1	0	0	1	5	19
Per Student	.004	.006	.002	.000	.000	.003		.005
Old Laptops§	22	3	27	12	8	3	6	81
Per Student	.015	.003	.046	.036	.024	.008		.019
Netbooks‖	313	480	75	46	54	52	0	1020
Per Student	.208	.459	.127	.139	.160	.139		.244
iPads¶	36	46	34	41	25	85	6	273
Per Student	.024	.044	.057	.124	.074	.227		.065
TOTAL DEVICES	843	887	372	222	218	240	52	2734
Per Student	.561	.848	.628	.673	.647	.640		.653
CURRENT DEVICES	742	849	315	173	173	220	41	2513
Per Student	.493	.812	.532	.524	.513	.587		.601

** Current Desktops are desktop computers that are less than six years old.*
† Old Desktops are desktop computers that are more than six years old.
‡ Current Laptops are laptop computers that are less than four years old.
§ Old Laptops are laptop computers that are more than four years old.
‖ Netbooks include all netbooks purchased since 2008.
¶ iPads include all iPad models purchased since 2009.
Green text indicates a per-student level more than 1 standard deviation above the district mean.
Red text indicates a per-student level more than 1 standard deviation below the district mean.

From an infrastructure perspective, the district has kept pace with technology needs. The 22 wiring closets throughout the district house 87 network switches and associated equipment. In the spring of 2013, a five-year wired network upgrade is being completed, bringing managed gigabit network

access to each network port throughout the district. It is anticipated that this wired network infrastructure will continue to meet the district's needs through 2018.

In the wireless realm, the district deployed a wireless network in 2010 to provide a basic level of wireless network coverage to most academic areas in the six schools and the education center. This network initially included 120 wireless access points to allow up to 6,000 devices to simultaneously use the network. In 2012, a five-year expansion project was begun to allow for up to 60 wireless devices per classroom, district-wide. The completed network will comprise more than 500 access points, including one in every classroom. This network will be capable of supporting up to 25,000 wireless devices in simultaneous use. The completion of this network is being coordinated with curricular goals and mobile device adoption plans to ensure that appropriate levels of access are available as they are needed.

On the server side, the district maintains 20 physical servers along with an additional 21 virtual servers. These provide basic network functions such as DHCP, domain logons, file sharing, and printing. Additionally, application servers are maintained for the district web site, teacher websites and blogs, the Moodle learning management system, PDExpress for managing teacher licensure and professional development, the cafeteria point of sale systems, and a host of instructional applications, including Read 180, Fastt Math, System 44, Accelerated Reader, Successmaker, Orchard, Ultrakey, Type to Learn, and Fitnessgram.

From 2001-2010, the district's need for local server capacity increased at an exponential rate, with the demand for storage and server resources doubling every year. Since 2010, that rate of growth has slowed somewhat, primarily due to the increased use of cloud computing. In June, 2010, the district moved from a locally hosted email server to Gmail. This allowed the offloading of email processing, spam filtering, web access to email, and email archiving to the Google cloud service. As a result, the district saved thousands of dollars in cost avoidance, because new servers did not need to be purchased for these tasks. At the same time, the district was able to offer email access to students for the first time. Currently, email accounts are assigned to students in fifth grade, and they keep them as long as they are students in the Brecksville-Broadview Heights schools. In the fall of 2013, this program is being expanded to third grade. The increased use of cloud-based applications, such as Google Apps for Education, is expected to offset the increased demand for server capacity, resulting in a minimal increase in capacity demand over the next five years.

The district's Internet access is provided through a 100 MB fiber connection to North Coast Council (NCC). This link will be upgraded to 150 MB beginning with the 2013-14 school year. Currently, this connection is meeting the district's data access needs. The limiting bandwidth factor is not the district's connection to NCC, but rather NCC's connection to Oarnet, and, subsequently, the Internet. It is anticipated that the district will need to upgrade its Internet bandwidth to 1 GB within the next five years to accommodate increased use of online resources and applications, including the online PARCC assessments that are scheduled to begin in 2015. This upgrade must be done in conjunction with NCC's upgrade of its own bandwidth. If NCC fails to keep up with the demand for bandwidth by upgrading its own connection to the Internet, the district will need to pursue the possibility of

obtaining a secondary Internet connection from another provider to handle the additional load.

Technology support in the district has been stagnant over the last ten years. The district employs two full-time computer technicians in addition to the technology coordinator. In the four elementary schools, supplemental positions provide first-line support in an attempt to resolve minor problems quickly. These positions are typically filled by teachers or support staff members with an interest in technology and a willingness to help others.

PARCC assessments represent a significant technological challenge for public schools. Significant investment in hardware and infrastructure will be needed to accommodate online testing. This is discussed in more detail in Appendix 4.

Since adding support staff in 2003, the district has more than doubled the number of computing devices in use, added Smartboards and projectors to nearly every classroom, tripled the network infrastructure that must be supported, added a wireless network, greatly expanded the use of mobile devices, and dramatically increased the number of instructional and intervention applications that must be supported. More importantly, technology has taken a much more critical role in the operation of the school district and the education of its students. In 2003, a loss of Internet access or an interruption in email delivery was a minor inconvenience. In 2013, instruction frequently stops when technology fails, and the need for effective, timely support is more critical than ever.

On the instructional side, the district has struggled with professional development and instructional integration of technology. Resources to help teachers make productive use of technology in their teaching are limited. While some progress has been made in recent years with the addition of a part-time integration specialist at the middle school and the re-definition of the role of media specialists district-wide, the district still lacks the instructional support resources to effectively meet the needs of its 21st century learners.

Overall, the district has a solid technology infrastructure. The capacity exists or is planned to meet its needs for the foreseeable future. While the traditional computer lab model of technology availability may be obsolete, the schools should be able to make the transition to increased use of mobile technologies with a minimum of disruption. Technology and instructional support are much more precarious, and steps should be taken to ensure the technology resources are reliably supported and effectively used by staff members and students throughout the district.

Current Trends in Educational Technology

At the state and national levels, educational technology has taken a progressively more prominent role as governments, education officials, researchers, and experts have struggled to maintain relevance and reduce costs. The Partnership for 21st Century Skills, a coalition of business leaders, policy makers, and education officials, was formed in 2002 as a catalyst for conversations centered on the promotion of information literacy, communication, critical thinking, creativity, and collaboration skills. In an information-rich society, the critical skills are those which teach students what to do with information once they find it. In many cases, technology is highlighted as a tool to foster the development of these skills.

Since 2001, Educause has teamed up with the New Media Consortium to produce the Horizon Report, which annually details emerging technologies for teaching, learning, research, creative inquiry, and information management. The report tracks educational technology trends in three time frames: 0-1 years, 2-3 years, and 4-5 years. Past reports have correctly predicted the rise of ubiquitous wireless networks, the use of social media, data-driven decision making, and the adoption of open content resources in education. More recent reports predict an increase in the adoption of massive open online courses (MOOCs), tablet computing, the use of learning analytics, and the use of game-based approaches to teaching and learning. These trends suggest a transition toward blended approaches, where technology is used in conjunction with classroom teaching to address the individual, specific needs of each student while fostering the collaborative, communication, creativity, and critical thinking skills highlighted by the Partnership for 21st Century Skills.

These trends are echoed by the National Educational Technology Plan, released by the U.S. Department of Education in 2010. This plan focuses on a need for increased student engagement in their own learning, leveraging technology to build their own learning networks and collaborative environments. The plan also encourages teachers and school administrators to embrace a similar culture of connectivism, in which they work together with other educators both inside and outside their school environments to improve their professional practice. Schools must support this model by providing a comprehensive infrastructure that allows ubiquitous access to computing and network resources for teaching and learning.

The results of district conversations from 2012 on next generation schools are described in Appendix 2.

In late 2012, the National Association of State Boards of Education released a report titled “Born in Another Time: Ensuring Educational Technology Meets the Needs of Students Today -- and Tomorrow.” That report calls on state school boards to reduce impediments to the use of devices and technologies that allow students and teachers to connect, collaborate, share resources, and create content online. It recommends ensuring that students and teachers have reliable, ubiquitous access to devices that allow them to connect with online learning networks, and that the use of digital and online learning resources be embraced. The report also highlights the need for data-driven decision making, as well as professional development programs to make these

initiatives successful.

While policymakers and researchers are advocating for a dramatic increase in collaboration, an emphasis on Common Core standards is making it easier for teachers in most states to find common ground on which to collaborate. With a curriculum that is essentially standardized throughout most of the United States, teachers are no longer limited to collaboration within their schools or within their states. The potential for collaboration is higher than it has ever been, and the technical resources to facilitate that collaboration are better than ever. Additionally, the increased adoption of blended learning technologies is combining the benefits of online learning and traditional face-to-face classes. The rise in the use of mobile computing devices and ubiquitous Internet access, increased individualization of education to best meet the needs of each student, and the use of learning networks, where both students and teachers connect with and learn from others online, is resulting in an educational experience that is uniquely tailored to the specific needs of each student.

To summarize, current trends in educational technology are leading toward an environment where computers are tied to people, not to places. Every student and staff member has ubiquitous access to technology, which is used to connect with online learning resources and networks of people who interact and learn from one another on a regular basis. At the same time, instruction is becoming hyper-personalized, with students participating in activities and using resources uniquely suited to their needs.

Technology Vision

The Brecksville-Broadview Heights School District provides and supports the necessary technological resources to foster student growth in academic areas, develop next generation skills in students and faculty, and operate the school district in an efficient and effective manner.

Technology Goals

To meet the needs of its students, staff, and school community over the next five years, the district has identified three major technology goals. These goals acknowledge the existing technology resources that are available while planning to meet the challenges and demands that are likely to come within the next few years.

Goal 1: Provide the necessary infrastructure to support the instructional and operational goals of the school district.

Most technologies rely on an infrastructure to work reliably and effectively. As the district increases the number of computing devices, it must ensure that the underlying infrastructure can support the additional devices. This includes wired and wireless networks, servers, technology security measures, and Internet bandwidth. Additionally, care must be taken to ensure resilience against interruptions and spikes in electrical power, provide adequate environmental conditions for servers and network equipment, and accommodate future needs as they arise.

Goal 2: Provide ubiquitous access to technology for students and staff.

As computing technologies have become increasingly mobile and affordable, it no longer makes sense to separate technology from the classroom through the use of computer labs and environments where many students share the same computers. As connected, next-generation learners, our students rely on technology to be there when they need it, just as previous generations relied on notebooks, pencils, and chalk. Technology must support learning by being seamlessly available as needed.

Goal 3: Provide appropriate levels of support to encourage the productive and efficient use of technology.

In an environment where technology plays an integrated role in the operation of the school district and the education of its students, the technology must work efficiently and reliably. Technology plays a critical role in routing school busses, serving lunch, taking attendance, and teaching students. When it doesn't work, the losses in productivity can be enormous. It is no longer practical or cost-effective for schools to treat technology support as an afterthought. The district must work to adopt best-practice measures to provide technology support to all students, teachers, and school employees that is reflective of the critical nature of the technology systems in use.

Goal 1: Provide Necessary Infrastructure

In order for an automobile to be a convenient form of transportation, certain things must be in place. There have to be sufficient roads on which to drive. There have to be gas stations strategically located over a wide geographic area, so the cars can refuel. There have to be mechanics and service stations to perform maintenance on the cars. Without this type of infrastructure in place, a car quickly becomes useless.

Similarly, technology needs an infrastructure in place to realize its full potential. Sufficient network capacity must be provided, including access to the Internet. Shared resources such as file servers and printers must be available and reliable. Provisions must be made for security and disaster recovery. This goal includes a number of strategies to meet these needs.

Strategy 1-1: Wireless Network Expansion

In 2010, the district installed a wireless network covering 90% of the instructional areas of the district. This network provides coverage that allows both district-owned and guest devices to access appropriate network services, including the Internet. Initially, this network comprised 120 wireless access points, and it can accommodate 3,000 - 6,000 devices in simultaneous use.

As the demand for individual technology devices increases, the need for a more robust wireless network is becoming clear. The day is rapidly approaching when every student and every staff member will carry some sort of network-connected device. The reality is that many of them already have two or more devices, when tablets, laptops, netbooks, e-readers, and mobile phones are included. This appetite for wireless network capacity shows no signs of slowing anytime soon.

Appendix 6 includes an analysis of best practices for school wireless networks.

The Ohio Schools Facilities Commission guidelines for wireless network suggest having a wireless access point for every 1,100 square feet of building space. Generally speaking, that means a wireless access point in every classroom, with additional capacity in common areas. Each access point can accommodate up to 50 devices, and from most places in the schools, at least two access points should be available. This model, when implemented, will accommodate up to 25,000 wireless devices in simultaneous use. The expansion makes use of the existing wireless infrastructure, and increases the number of access points from the original 120 to more than 500 by 2017.

Year	New APs	Total APs	Projected Cost
2013	80	240*	$75,000
2014	80	320	$75,000
2015	80	400	$75,000
2016	80	480	$75,000
2017	50	530	$50,000
TOTAL	370	530	$350,000

** The total includes 40 access points that were added in 2012 in addition to the 120 installed in 2010.*

The prioritization of these expansion efforts is tied to instructional needs. For example, a large netbook deployment was part of the 2012 science curriculum revision. To meet this need, the wireless improvements in 2012 focused on science classrooms at the middle school and high school. Similarly, expansion efforts in 2013-2017 are expected to be completed as needed in each area, with the entire project finished by 2017.

This plan assumes that there will be no significant changes to school facilities within the next five years. Facility planning is currently underway to determine the needs for instructional and non-instructional space moving forward. If these plans result in a major reconfiguration of grade levels, closure of buildings, or expansion of current facilities, the corresponding wireless plan will need to be adjusted accordingly. This may result in lower equipment costs if fewer devices are needed and higher labor costs if equipment must be removed from one location and reinstalled in another.

Strategy 1-2: Maintain Wired Network

In 2013, the district is completing a five-year wired network upgrade project. This project has substantially improved the capacity and reliability of the local area networks in each building as well as the wide-area network that connects the district's facilities. Most of the district's network is now gigabit ethernet, and most of the network switches are fully managed, allowing a great deal of flexibility in the deployment of virtual networks in nearly any location district-wide. It is expected that this network will continue to meet the district's needs for the next five years.

As the number of devices on the network grows, and as the network equipment in place ages, it will be necessary to replace failing equipment and make minor adjustments to the network to accommodate additional devices. For the most part, this involves adding additional network switches without major configuration changes.

Year	Replacement Switches	Additional Switches	Projected Cost
2013	2	4	$12,000
2014	6	5	$22,000
2015	8	5	$26,000
2016	10	4	$28,000
2017	12	3	$30,000
TOTAL	38	21	$118,000

As the need for bandwidth increases, and the network infrastructure ages, the district will have to re-visit the wired network configuration beginning in 2018. Despite the tremendous expansion in wireless services, the wired network will continue to be the foundation for the district's network infrastructure for the foreseeable future.

Strategy 1-3: Provide Adequate Server and Storage Capacity

One area in which the demand for technology services is not growing exponentially is server and storage capacity. From 2001-2010, the district's need for local server capacity increased at an astounding rate, with the demand for storage and server resources doubling every year. Since 2010, that rate of growth has slowed somewhat, due to the increased use of cloud computing and the more aggressive application of storage quotas.

While the district is expected to see an increase in the need for server capacity and storage space over the next five years, that growth is much smaller than it would have been without the adoption of cloud computing technologies.

Most servers in the district have a life of 6-9 years. In general, servers are replaced when they no longer have the capacity to provide the required services. In practice, this usually means that hardware is repurposed and used for less demanding work. In many cases, server tasks are broken down into smaller pieces and distributed over more servers. The use of virtualization technologies has allowed the district to keep older servers in use longer as their tasks are divided among multiple physical devices.

Year	Server Replacements	Projected Cost
2013	Middle school file server, hard drive imaging server	$6,000
2014	Chippewa, Highland, Hilton file servers, authentication / directory server, virtual server for hal, delta, omega, and PD	$20,000
2015	Central file server, Print server, kappa server for backups & redundancy, virtual for food, sam, radius, mailer, ldap	$16,000
2016	District firewall	$4,000
2017	BOE server, virtual servers for www, staff web server, Moodle	$19,000
TOTAL		$65,000

This plan does not include all of the district's servers because some are not scheduled for replacement within the scope of this plan. This includes the maintenance / transportation facility server, the high school file server, and the shared storage server that houses home directories and shared network drives.

Strategy 1-4: Increase Internet Bandwidth to Meet Demand

For 2013-2014, the district is upgrading its Internet connection to 150 mbps from the current 100 mbps. Due to renegotiated contracts with service providers, this upgrade is occurring at no cost to the district.

The Management Council of the Ohio Educational Computing Network (MCOECN) provides Internet access to most Ohio schools (including Brecksville-Broadview Heights) through their Information Technology Centers (ITCs). According to the MCOECN, the bandwidth demands in Ohio schools have increased by an average of 56% each year since 2007. At the same time, though, the average cost of bandwidth on a per-megabit basis has decreased by an average of 32% each year since 2007. Overall, since 2007, bandwidth consumption in Ohio schools has increased 11-fold, while the cost per megabit has decreased by 92 percent. The result has been a steady increase in available bandwidth for Ohio schools while the cost has remained constant.

If this trend continues, the district should be able to continue to increase bandwidth without a substantial increase in cost. Based on current growth, the district should plan to increase Internet bandwidth to 1 gigabit per second by the beginning of 2017. The practicality of improving Internet access to this extent will depend on the ITC's connection to the state as well as the availability and affordability of high-speed Internet access from private carriers.

If gigabit Internet access is not available through the state by 2016, the district will have to pursue

alternatives to procure that access, possibly combining connections from two or more companies or organizations to ensure that the necessary connectivity will be available for the district's students and staff.

Strategy 1-5: Improve Backup and Disaster Recovery Plans

One of the changes in school technology use over the last decade has been the extent to which schools rely on technology services for day-to-day operations. Technology is often a critical component of instruction, with students regularly using online tools to retrieve information, complete projects, produce content in a variety of formats, and share resources, insights, and products with one another and with a wider audience. At the same time, technology is indispensable in the practical operations of the school district, from routing busses and serving lunch to managing attendance, student records, personnel, and security.

Because the schools rely on technology so heavily, a technology failure can have a significant negative impact on the schools' ability to operate normally. Mitigating this risk is always a balance between a robust, redundant technology infrastructure and an affordable one. Currently, the district manages backups of critical data and server configurations, and leverages its geographic diversity to back up that data elsewhere in the district. For example, most of the large servers in use in the district are located at the high school. The backups for these servers are housed at Chippewa, which is more than two miles away.

As the school's reliance on technology increases, it should investigate other ways to improve the reliability of its systems. These may include more robust battery backup or generators for critical systems, increased use of virtualization to provide greater service redundancy, and the use of off-campus backup solutions for disaster recovery. Because these plans have not been made, it is impossible to predict the cost of any needed improvements.

Goal 2: Provide Ubiquitous Access to Technology

For years, the school district has used a technology deployment model that favors desktop computers in fixed locations (usually computer labs), one computer in each classroom, and computers in office locations where needed. The use of mobile technologies, such as laptops, has been extremely limited.

This model has the advantage of being very affordable and relatively easy to support. The computers are replaced on a six-year schedule. There's little accidental damage because they stay in one place all the time. All of the software configurations are identical. Economically, this is the best way to ensure the technology is used as much as possible, and the most practical way for many students to share a single computer.

The world is changing, though. Mobile devices are personalized. A cell phone is not easily shared among multiple people. The same is true with tablet computers. They are designed to be used by a single person, not shared among many. Issues of user authentication, privacy, and accountability quickly arise when IOS or Android devices are shared. At the same time, the cost difference between desktops and more mobile devices like laptops, netbooks, and tablets is narrowing.

Today's students are accustomed to being connected. They regularly move back and forth between physical and virtual worlds, and rely on their mobile devices to augment their experience in the real world. Society is shifting from a world where technology was assigned to places into one in which technology is assigned to people. This "places to people" transition has already happened with the telephone. It's also occurring now with computers.

To help them meet the challenges of the next generation, our students must have ubiquitous access to technology. The devices are not the subject of learning. They are simply the tools of learning. Providing a learning environment where mobile technologies are available for each student all the time is quite a challenge. This goal includes several strategies to meet that challenge.

Strategy 2-1: Maintain Desktop Replacement Schedule in Offices

Despite the trend toward mobile computing, there will always be some cases where desktop computers are the most practical solution to the district's technology needs. School secretaries and administrative assistants, for example, generally work from a single location. They usually don't have a need for mobile technologies. Similarly, desktop computers are needed in areas like library circulation and food service point of sale, where they are dedicated to a particular purpose. In these cases, maintaining the current six-year replacement cycle for desktop computers makes sense.

Year	Desktop Replacements	Projected Cost
2013	25	$15,000
2014	39	$23,400
2015	22	$13,200
2016	28	$16,800
2017	9	$5,400
TOTAL	103	$73,800

This plan also includes the replacement of the high school CAD lab in 2014, which is expected to remain a special-purpose computer lab. Additionally, the high school graphic arts computer lab will remain as a special purpose lab. That computer lab is being replaced in the spring of 2013, and will not need to be replaced again during the scope of this plan.

All of the other computer labs in the district, including the desktop computers located in the school media centers, will be phased out as the district shifts focus to individually assigned computing devices. This process will take several years, as computers purchased between 2007 and 2012 age, become less reliable and less productive, and are ultimately decommissioned.

Strategy 2-2: Provide Mobile Devices for Teachers

The mission of the school district is to educate its students. Student learning is of paramount importance. From a practical perspective, though, it is unreasonable to expect students to adapt to a learner-driven, always-connected, inquiry-focused model of lifelong learning without also equipping their teachers to do the same thing. The models of personal learning networks, online collaboration, and a culture of lifelong learning are the teachers and school administrators working in the buildings. Any initiative that moves technology from places to people, then, needs to include the teachers and school administrators.

The current deployment of classroom computers is scheduled to be replaced beginning in 2014. The district will take advantage of this timing to shift to a model where mobile devices are assigned to teachers to replace the computers in the classrooms. This initiative will be completed in phases beginning in 2014 and ending in 2016.

Year	Teacher Laptops	Projected Cost
2013	20	$20,000
2014	100	$100,000
2015	100	$100,000
2016	100	$100,000
2017	10	$10,000
TOTAL	320	$330,000

The 20 devices allocated for 2013 will be used for a pilot project that will allow the district to identify and resolve issues related to the deployment, configuration, and operation of these devices. Thereafter, three phases are planned, though these may be broken down further into multiple deployments per year. By taking this initiative in smaller pieces, more time is available for professional development, troubleshooting issues, and supporting users as they complete this transition.

It is anticipated that more devices will be needed than the number of teachers in the district. Without computers in the classrooms, it will be necessary to have additional devices available for substitute teachers. It is also important to have immediate spares available to teachers when problems occur, so productivity is not lost while waiting for repairs. Additionally, in the case of job shares and part time employees, the number of devices needed is one per person, not necessarily one per full time position.

In 2017, it is expected that a few devices will be needed to accommodate new employees. Thereafter, teacher devices will be replaced on a five-year rotation, with approximately 60 new devices needed each year.

Strategy 2-3: Move to One Device per Student

No technology initiative has a greater potential to transform student learning than the assignment of an always-available, Internet-connected computing device to every learner. Technology no longer needs to be a scarce resource in schools. The availability of affordable devices, robust infrastructure, and changes in teaching pedagogy make this the right time to move in this direction.

The connected learner does not rely on the textbook or the teacher as the sole authority on the subject being studied. Instead, she uses online resources to access multiple perspectives on any topic, and assesses credibility and reliability of information in real time. The connected learner collaborates with peers and experts both within the school and around the world. The connected

learner uses technology when needed to organize and synthesize information. She uses that information to make connections, draw conclusions, and defend arguments. She applies her learning from different disciplines in new ways to develop innovative solutions to complex problems. Then, she uses the technology to articulate that learning in a variety of formats, from traditional essays to web sites, videos, and interactive media.

This model of student learning cannot happen in an environment where there are only a few computers available in the classroom, or where classes have to move to a shared computer lab where time and resources are limited. Instead, every student in grades K-12 must have access to a networked device to support his or her learning.

An analysis of 1:1 programs vs. a BYOD approach is provided in Appendix 5.

This is an enormous paradigm shift that cannot be undertaken lightly. Clearly, significant investments in professional development, policy revision, technical and technology integration support, and communication among all district stakeholders will be needed for a successful implementation.

At the K-3 level, the one-to-one (1:1) initiative will be accomplished through the use of classroom sets of devices. Each classroom will have a set of devices that are used by the students at school. They will not be taken home by students.

In fourth grade, the same model will be used, with each classroom having a set of devices for students to use. The difference in fourth grade is that it is anticipated that students will be permitted to sign out the devices from their teachers to take home for the completion of assignments. The devices are still managed at the classroom level, and primarily used at school, but they will also be available for occasional home use as needed.

Beginning in fifth grade, the devices are assigned to individual students. It then becomes the student's responsibility to care for the device and to make sure it is brought to school each day. The devices will be collected at the end of each school year, re-loaded with current software and configuration settings, and re-assigned to students the following year. Students will use the same device in grades 5-8. Ninth graders will receive new devices, which they will then use until they graduate.

Accomplishing this goal will require a significant amount of planning. Policies regarding support, acceptable use, liability, and maintenance will need to be established. Plans for the transition from computer labs to individual devices will have to be finalized. Funding will have to be coordinated between the technology and curriculum departments, as savings from reduced textbook expenditures are used to pay for the devices. Additionally, the specific devices to be used will have to be identified. While this document uses the term "device" when referring to this technology, the actual laptop, netbook, tablet, or other technology will have to be identified, tested, and procured. It is anticipated that this evaluation of devices will be necessary every year as the availability of new technology products changes.

It is expected that the move to a 1:1 program for students will begin in 2015, one year after teachers begin to transition to mobile devices. Beginning at that point, new devices will be needed each year for all ninth graders and all fifth graders. Additionally, classroom sets of devices will be needed for 25% of the K-4 classrooms. Like the teacher devices, additional units will be used as replacements and loaners to be provided to students as needed.

Year	Student Devices*	Projected Cost
2013	600	$300,000
2014	600	$300,000
2015	1,020	$510,000
2016	990	$495,000
2017	990	$495,000
TOTAL	4,200	$2,100,000

** Student Devices based on projected enrollment in grades 5 and 9, plus 25% of K-3, + 10%, rounded to the nearest 10.*

Strategy 2-4 Minimize Use of Computer Labs

As the district moves toward a 1:1 environment, the need for computer labs diminishes considerably. It is not necessary for students to visit a computer lab to access technology when they carry that technology around with them. Accordingly, it will be feasible to retire the majority of the computer labs in the district, repurposing those spaces for other uses.

As computer labs are scheduled for replacement, their use will be re-evaluated. While some may remain in operation beyond their normal six-year lifespan as the district transitions to a student-centered model of technology deployment, it is anticipated that most labs will not be replaced, and that they will eventually be removed as the computers in them cease to meet the current needs of the district.

Two exceptions to this strategy are the high school graphic arts and CAD computer labs. In those cases, the technology needs and the software costs make it unfeasible for students to use their personally assigned devices. The district will maintain those existing labs in their current state. Those costs are reflected in Strategy 2-1.

Strategy 2-5 Employ Special Purpose Devices and Resources

While the focus of the district's technology strategy is to assign devices to individual students and staff members, there are some cases where special-purpose technologies may be employed outside this paradigm. Speech and language teachers, for example, may use adaptive devices with

specialized software to assist their students. Special education teachers may employ technology that is different from that which is assigned to all students to meet the individual needs of the special education students being serviced.

While standardization of technology is critical to providing reasonable support, there will have to be exceptions made in circumstances where student needs justify deviation from these standards. Consistent with current practice, funding for these devices is anticipated to come from outside agencies, grant funding, and the pupil services department.

Strategy 2-6 Continue to Explore & Evaluate Innovative Technologies

One of the exciting -- and exasperating -- aspects of educational technology is the constant state of change. New technologies, new teaching strategies, new applications, and new approaches are being developed all the time. Technologies that are currently cost-prohibitive or unreasonably complex may be practical applications for classroom use in just a few years.

The district must continue to explore and evaluate new technologies as they become available to assess their feasibility in addressing the district's mission. Ongoing innovation is critical for a school district to remain relevant to its stakeholders. A portion of the technology budget, up to $15,000 per year, must be allocated to evaluating and piloting new technologies and looking for more efficient, effective, and affordable solutions to district challenges.

This is also an area in which partner organizations can help. The Parent-School Organization and the Schools Foundation have been enthusiastic about funding technology initiatives in our schools, but are often unsure how to support programs that have a lasting, positive effect on students. One way in which these organizations can help is to fund some of these innovative pilots that explore new technologies, investigate their effectiveness in enhancing student learning, and making recommendations regarding wider-scale adoption.

Goal 3: Provide Appropriate Levels of Support

Technology has permeated most aspects of everyday life in the 21st century, and schools are no exception. In the last fifteen years, schools have come to rely on technology to provide both operational and instructional efficiency. Most of the things that the school district does involve some form of technology at some level, and the reliable operation of that technology is critical.

It is no longer acceptable to provide "best effort" support, with response times to technology problems measured in days. Increasingly, technology incidents are urgent, and down time significantly impacts the ability of the school district to carry out critical tasks. A failed classroom projector usually means lost instruction time until it is fixed. The inability to print keeps administrative and administrative support personnel from being able to do their jobs. An interruption in network service or a failure of a critical server can have an immediate and devastating effect on the ability for school staff and students to get their work done.

As the district moves toward a ubiquitous computing environment, where the use of technology is fully embedded in instructional and operational practice, it will be necessary to resolve most technology problems within minutes instead of within days. This requires a re-examination of the support infrastructure currently in place.

Strategy 3-1: Establish a Network Support Position

The complexity of the data network used in the schools has grown beyond the expertise of the district's technical staff. Multiple outside consultants have pointed out that the network infrastructure is more complex than those in use in most medium-sized business. School networks have unique challenges of scale (up to 10 devices per employee) and security (the need to protect the network from internal users as well as outside threats). Burst capacity is important, because the cyclical nature of class periods means hundreds of logins, file saves, and print jobs within very short time windows. Web filtering policies make it necessary to firewall both inbound and outbound network traffic, which is unusual for most organizations. The use of virtual networks, storage area networks, and server virtualization adds a great deal of flexibility in how network resources are used, and can dramatically reduce costs. But these approaches also increase the complexity of these systems and the expertise needed to maintain them.

The addition of a network support specialist to oversee the district's data network and servers is long overdue. While these tasks have been traditionally handled by the technology coordinator, having someone on staff to manage the network would allow the district to capitalize on the technical expertise such a person would bring to the table. It would also allow the district to proactively take steps to improve performance and reliability, instead of operating in a constant reactive state, with workarounds and quick fixes becoming permanent solutions due to a lack of time and focus on network issues.

Many schools, including Brecksville-Broadview Heights, use outside network consultants to provide

some of this technical expertise. A 2013 survey of Ohio schools found that a third of respondents outside contractors to provide network or server support. Such services are especially useful to plan and implement special projects, such as network upgrades, server virtualization, and wireless improvements. Where practical, the district should take advantage of these types of opportunities to provide needed expertise without increasing headcount. A network manager would be invaluable in coordinating these types of services and projects, and ensuring that they all work together.

Strategy 3-2: Align Tech Support Levels with Industry Standards

In the area of end-user technology support, the district is currently understaffed. Since 2003, no additional resources have been allocated to technical support. In that time, the district has doubled the number of file servers in use throughout the district, doubled the number of computers in use, and added more than 200 Smartboards and projectors. Six computer labs have been added to the fourteen previously installed, along with 27 classroom sets of netbooks and nearly 300 tablets.

At the same time, the demand for immediate tech support has exploded. Technology problems are rarely an annoyance now, to be remedied when time and resources permit. In most cases, student and staff productivity are significantly impaired when a technology problem occurs. While the district continues to provide the highest level of support practical given the available resources, the experience is often frustrating for both the end user and the technology staff.

There are frequent efforts to operate schools more like businesses. The industry recommendations for proactive technology support levels typically specify an IT person for every 75-150 devices. This level of staffing would allow technology personnel to anticipate needs and address them quickly, provide preventative maintenance services, and respond quickly and efficiently to problems as they arise.

An analysis of standard IT staffing levels for industry, non-profits, and education is provided in Appendix 7.

The industry recommendation for IT staffing in a reactive environment is one IT person for every 200 devices. At this level, technology personnel cannot anticipate problems and provide the level of preventative maintenance recommended, but they can still respond to problems and take corrective measures in a reasonable time frame.

Currently, the district has 2,734 devices and three staff members, including the technology coordinator. Additionally, supplemental positions are provided in five buildings, where staff members provide best-effort support. Combined, these supplemental positions provide approximately 400 hours of support per year, or 20% of a full-time employee. With a total technology staff of 3.2 people, then, the current staffing level is one IT person per 854 devices. This is less than 1/4 of the minimum level recommended by industry, with a shortage of 10.5 people to maintain the current technology deployment with a reactive technology support structure. Following best practice recommendations, there is a shortage in IT staff of 15-33 people. This does not include the planned expansion of technology use in the district, which is expected to increase the number of devices in use by 65% over the next five years.

While it may be impossible to provide even a minimal level of IT support that is up to industry standards, it is equally impractical to expect that the school district will be able to support its current technology and provide for future expansion without a significant increase in support staff. A reasonable compromise would be to work toward a staffing level that provides one IT person per 500 devices. This is still half the industry standard minimum, but nearly double current levels.

Given the current fiscal climate in public schools, even this level of staffing is probably out of reach. From 2003-2012, the district maintained a support level of approximately one technology staff person per 600 devices. While the technology program at that time was far from proactive, it was possible to provide a minimum, basic level of support with that staffing level. The goal for this plan is to return to that level of support staffing. Transitioning from support levels that are 23% of industry minimums to ones that are 36% of industry minimums will allow the district to provide a minimum level of support to keep critical systems working most of the time.

Year	Devices	IT Staff	Ratio	Staff Changes	Additional Cost*
2013	3,600	4.2	1:857	Add Technician (1.0)	$60,000
2014	4,100	6.2	1:661	Add Network (1.0), Technician (1.0)	$185,000
2015	4,300	8.0	1:537	Add Technicians (2.0), Eliminate supplementals (-0.2)	$305,000
2016	4,500	8.0	1:562	Maintain staffing level	$305,000
2017	4,500	8.0	1:562	Maintain staffing level	$305,000

** Assumes hourly rate of $17 for technicians, $23 per hour for network manager. Benefits and retirement are included. Additional costs are compared with 2012 levels and include prior year additions.*

By 2015, this plan will include a total of eight people in the technology department, including the technology coordinator and network manager. At that staffing level, the district will be capable of providing at least a minimal level of support to every building nearly every day. At that point, it will be possible to transition the certificated staff members holding the building supplemental tech support positions into roles that focus more on instruction and pedagogy. This model is a more appropriate -- and more efficient -- use of their time and expertise.

It may be possible to supplement some of the district's support needs to outside contractors. Nearly a quarter of Ohio schools use outside contractors to provide some technology support, with half of them relying on outside companies to provide day-to-day support for technology systems. While there are significant concerns about the costs of these services and the ability of an outside company to provide timely support, the use of such resources should be explored by the district as an alternative to additional support staff..

Strategy 3-3 Institute a Student Technology Support Program

Schools are in the business of teaching students and preparing them for their future. Some students have an interest in technology, and would benefit greatly from a program that provides focused training in technology, networking, and support. Traditionally, the district has met these needs by partnering with the Cuyahoga Valley Career Center. Within the Brecksville-Broadview Heights Schools, opportunities for students to explore careers in information technology related fields have been severely limited.

At the same time, the district has a growing need to provide support to staff and students needing immediate, but generally basic, assistance. A student technology program could provide a symbiotic solution, giving students real-world technical support experience while providing support coverage in the schools at a lower cost than additional technology staff.

The costs of a student technology support program are real and significant. A quality program that benefits both students and the school requires a significant amount of oversight, training, and management. In general, managing a student technology program will reduce the technology staff's ability to address technology issues in the schools by one person. This loss in productivity can be offset by productivity gains from the student technicians. Because multiple students are used during peak times, a student tech program can increase the presence of basic support, to provide on-site support coverage during most school hours.

When technology staffing reaches a level that allows full time support staff to be assigned to the high school and middle school buildings, the district will embark on a student technology program. Students in grades 7-12 will volunteer to participate in the program, generally giving up a study hall in order to do so. During this time, they will staff a technology help center that is available for students and staff members to visit to get technology help. The students will be taught troubleshooting and basic maintenance tasks by the computer technician assigned to the building, and the entire program will be overseen by the technology coordinator.

In grades 11-12, students who have successfully participated in the program for two years or more will be eligible for student employment as such positions are needed and become available. These students would work after school and during school breaks performing maintenance tasks, upgrading equipment, and configuring and installing new hardware. Students will leave the program with significant experience troubleshooting and supporting information technology systems in complex environments.

The costs of such a program primarily come from the lost productivity of the computer technicians who oversee it. Initially, this cost will be relatively high, because much time will be spent training and coaching the students in the program. As time goes on, the students' productivity contributions will offset this cost. If students are ultimately employed as part of this program, the costs will vary depending on the current student assistant hourly rate and the number of hours worked. These costs are not expected to exceed $3,000 per student per year. It is anticipated that no more than four

students would be employed in any one year.

Other Staffing Needs

This plan covers technology deployment and use within the schools, but it does not focus on professional development and instructional integration. Investments in technology are futile if sufficient support is not provided in the areas of professional development, instructional integration, and the related pedagogical shift that results from the transition to an information-rich society. These very real needs are acknowledged as crucial, but are beyond the scope of this plan.

Cost Estimates and Conclusions

The following table summarizes the costs outlined in the goals and strategies articulated throughout this plan.

Area	2013	2014	2015	2016	2017	Total
Wireless Upgrades	$75,000	$75,000	$75,000	$75,000	$50,000	$350,000
Network Upgrades	$12,000	$22,000	$26,000	$28,000	$30,000	$118,000
Server Upgrades	$6,000	$20,000	$16,000	$4,000	$19,000	$65,000
Desktop Replacement	$15,000	$23,400	$13,200	$16,800	$5,400	$73,800
Teacher Devices	$20,000	$100,000	$100,000	$100,000	$10,000	$330,000
Student Devices	$300,000	$300,000	$510,000	$495,000	$495,000	$2,100,000
Innovative Technologies	$15,000	$15,000	$15,000	$15,000	$15,000	$75,000
Technology Staff	$60,000	$185,000	$305,000	$305,000	$305,000	$1,160,000
Student Tech Program	$0	$12,000	$12,000	$12,000	$12,000	$48,000
Totals	$503,000	$752,400	$1,072,200	$1,050,800	$941,400	$4,319,800

While these costs are significant, it is important to note that most of these figures are not in excess of current funding levels. In many cases, they include expenditures currently in the budget. It is expected that currently available funding through the permanent improvement fund for textbooks and technology will offset the hardware costs, to the tune of approximately $600,000 per year.

Indeed, if this funding is available, the non-staffing deficit for this plan is minimal. While the staffing cost is certainly not an insignificant amount of money, it is relatively modest considering the magnitude of the planned expansion of technology services and availability for students and staff.

The strategies outlined in this plan are complex, challenging, time consuming, and expensive. Since the advent of technology use in the schools, the Brecksville-Broadview Heights school district has undervalued, underfunded, and understaffed its technology program. The district has worked hard to provide the best resources possible for students and staff, but the cost of meeting student and staff technology needs has always prohibited a robust technology adoption. As the needs of 21st century learners make the traditional models of schooling increasingly irrelevant, the district must adapt to retain its status as one of the premier public schools in Ohio. Fundamental changes in the structure of school, the content and methods of instruction, and the strategies for intervention, remediation, and extension of learning are necessary and imminent.

This plan outlines technology needs designed to meet the challenges of next generation learning. It is not an overly ambitious plan, and it does not include the adoption of gratuitous technology for its own sake. It simply acknowledges the technology needs of the district moving forward, and outlines a reasonable plan for meeting those needs.

Appendix 1: Technology Plan Directive

On December 3, 2012, the 2012-2013 Board Work Plan was amended to include this statement:

By May 2013 the District's Technology Coordinator shall provide the Superintendent and BOE a five year technology plan that includes projected needs, costs and anticipated transition timelines inclusive of: a. opportunities to reduce program costs, b. an educational component for parents to better understand the district's technology vision and c. an analysis of school provided resources vs. Bring Your Own Device BYOD.

This plan is the result of that directive.

Appendix 2: Characteristics of Next Generation Schools

In the spring of 2012, the district conducted a series of conversations and surveys about next generation learning. District administrators, teachers, and parents were asked to identify characteristics of next generation schools. Many of these conversations centered around the work of Will Richardson, Michael Wesch, Ken Robinson, David Wiley, Dan Pink, Chris Lehmann, and others.

Once the characteristics were identified, they were divided into categories suggestive of the expected time needed for the characteristic to become prevalent in our schools. These characteristics are summarized below:

Imminent Characteristics

- Teachers and school officials are no longer "gatekeepers" of information.
- Parents have online access to student progress.
- Technology informs and provides intervention
- Teachers, parents, and students communicate in multiple ways.
- Parents, students, and the community participate in the process of defining "learning" and "school"
- Assessment measures what students have learned, not what they have done

Short Term Characteristics

- "Best practice" teaching methodologies are modeled in professional development.
- Teachers model problem solving teams
- Students complete fewer worksheets
- Staff members respect and value their learning communities
- Teachers are "flipping" their classrooms to provide more in-class time for analysis, discussion, synthesis, and application
- We take risks as teachers and learners
- Administration encourages risk taking by supporting unorthodox methodologies and projects
- Students collaborate on projects within their classes and school
- Students solve real world problems
- Students regularly apply information literacy skills
- A BYOD or 1:1 program encourages students to use the technology available to them to enhance the learning process
- Students create things that demonstrate learning
- Students publish their work online for an authentic public audience
- Students "learn how to learn" by reflecting on their own learning
- Our students and staff feel that they are valued members of the school community
- Students are excited about learning

Long Term Characteristics

- Staff collaboration is ubiquitous and natural
- Critical thinking is the model of instruction.
- Classes regularly engage in project based learning activities
- Instruction is hyper-individualized, addressing the specific needs of each student
- All classes have an online component
- Understanding by Design is used as a common framework for planning instruction
- Inquiry plays a critical role in academic work
- Professional development is ongoing and embedded in teachers' daily work
- Students evaluate, analyze, and apply knowledge to build wisdom
- Students collaborate on projects with people outside the school
- Students build and curate their own personal learning networks
- A 1:1 program provides a consistent set of technology tools for each learner
- Students respect their schools as communities of learning
- Students take ownership of their learning spaces
- Teachers and students do not rely on commercial textbooks as the primary source of curricular content
- Teachers and students do not rely on printed books as the primary method for delivering content
- Most work is completed, shared, and accessed online. Printing is rare.
- Technology is like oxygen: ubiquitous, necessary, and invisible
- "School within a school" programs highlight STEM / performing arts / arts & letters / technology focUs areas to meet the interests and diverse needs of students

Appendix 3: Cost Saving Measures

Traditionally, the district has employed a number of strategies to reduce technology costs, and it continues to search for new ways to save money and improve available technology offerings. This appendix summarizes ways in which the district is currently saving money, and suggests areas in which further savings may be realized.

Current Cost-Saving Strategies

- **Platform Standardization:** In 2001, the district standardized on the Windows platform for all computer purchases. This move eliminated the need to support a dual-platform infrastructure, and has significantly reduced the complexity of network services, hardware and software support, hardware acquisition costs, and professional development needs.
- **Hardware Standardization:** The district employs standards for most technology devices, including desktop and laptop computers, printers, interactive whiteboards, projectors, and other peripherals. By standardizing models and configurations, reduced costs are realized in support, maintenance, configuration, and professional development.
- **Open Source Server Software:** The district uses open source software on Linux servers throughout the school district, resulting in hundreds of thousands of dollars' worth of savings annually on software licensing costs. Network tasks such as domain logins, print management, network file sharing, web services, database services, firewall and filtering tasks are all handled by free, open source software. Additionally, the school's learning management system and teacher website/blog server are powered entirely with free, open-source software.
- **Free Desktop Software:** The use of free software on desktop computers has saved thousands of dollars on software licensing costs, and made software applications available to staff and students that would otherwise be cost prohibitive. These have included applications for audio recording, video editing, mind mapping, PDF creation, and a host of other tools tied to specific curricular areas.
- **Use of Off-Lease Hardware:** In many cases, the district uses off-lease hardware for network infrastructure and desktop computer deployments. These decisions have allowed the district to provide more robust network services at a lower cost, and has saved significant money on desktop computers compared to the cost of repairing and maintaining older equipment.
- **Self Maintenance of Network Equipment:** The district maintains replacement equipment for most of its network infrastructure. Because maintenance agreements are not kept on these devices, the district saves approximately 20% per year on network maintenance costs. This is practical, in part, because of the hardware standards that limit the number of hardware models for which spares must be maintained.
- **Volume Purchasing:** The district has taken advantage of consortium pricing for computers, network equipment, and consulting services by bunding purchases with other schools to obtain higher discounts. In some cases, this has resulted in savings of more than 20% over previously negotiated state term educational pricing for the same equipment and services.

- **Use of Cloud Technologies:** The transition to cloud services, specifically the adoption of Google Docs and Gmail, has saved the district thousands of dollars in hardware and support time because it no longer maintains its own email, spam, and email archive servers. Additionally, productivity gains have been realized through the collaborative features of Google's tools, and these resources have been extended for student use at no additional cost.

Potential Areas for Additional Savings

- **Microsoft Office:** As cloud tools become more prevalent and feature-rich, the need for Desktop productivity software, such as Microsoft Office, lessens. If the district were to stop licensing Microsoft Office entirely, it would realize nearly $15,000 in annual software licensing savings.
- **Larger Consortia Purchasing:** Current efforts coordinated by the Cuyahoga County Educational Service Center may realize consortium pricing from a larger pool of education and government entities throughout Ohio. While this program is in its early planning stages, cost savings on significant technology purchases could be significant.
- **Energy Costs:** The transition to a primarily mobile computing environment has the side-benefit of saving on energy costs. The reduction of 18 computer labs will mean there are 600 fewer desktop computers in use throughout the district. Even when taking into account the need for additional energy for the expanded wireless network and the charging of mobile devices, the energy consumption reduction should be around 500 kilowatt hours per school day once these plans are fully implemented.
- **Use of Consulting Services:** The expansion of the use of consulting services, such as network design, server support, computer repair, and other specialized services may allow the district to avoid additional costs associated with hiring full time employees to meet these new needs.

Appendix 4: Technology Needs for PARCC Assessments

The Partnership for Assessment of Readiness for College and Careers (PARCC) is a consortium of states working to develop a common set of student assessments to assess student readiness for college and career. This consortium encompasses 22 states and the U.S. Virgin Islands, with more than 24 million students affected. PARCC is one of two state consortia developing assessments aligned to the Common Core State Standards through the federal Race to the Top program. In Ohio, PARCC Performance-Based Assessments and End of Year Assessments will replace the Ohio Achievement Assessments and Ohio Graduation Tests beginning with the 2014-2015 school year.

Because PARCC tests are administered online and are taken by all students in grades 3-11, their introduction represents a significant technical challenge. The Brecksville-Broadview Heights School District is working to ensure that the needed resources are available for this testing prior to its implementation in the spring of 2015.

Hardware Requirements

According to version 2.1 of the PARCC Technology Guidelines (February, 2013), computers must meet the following recommended requirements to successfully administer PARCC tests beginning in 2015:

- 1 GB of RAM or more
- 9.5 inch screen or larger capable of 1024 x 768 resolution
- Physical keyboard and mouse/touchpad
- Headphones and microphone
- Windows 7, Chrome OS 19, Mac OS 10.7, Ubuntu 11.10, Fedora 16, or newer operating system.

Beginning in 2012, district technology purchases are being made with these requirements in mind. Most of the computers purchased since 2007 meet these requirements, except for the operating system version. A transition from Windows XP to Windows 7 is currently underway, which will make these computers compatible with PARCC assessments.

Tablet devices, however, are problematic. An iPad or Android tablet may only be used if it meets the minimum screen size and has a physical keyboard and mouse or touchpad. Additionally, it is unclear whether a wireless Bluetooth connection, common for tablet keyboards, is sufficient. PARCC guidelines have been inconsistent on this point, with some requirements stating that wireless keyboards are not acceptable. Due to the ambiguity of the requirements, along with the practical considerations of managing the devices, the district does not intend to use tablets for PARCC testing.

Capacity Requirements

Current plans specify that each student will require nine testing periods, and that two of these testing periods may be scheduled per day using the same equipment. One computer, then, in use over nine school days, will meet the needs of two students taking both the Performance-Based

(PBA) and End-of-Year (EOY) assessments.

Each of these tests (PBA and EOY) may be administered in a 5-20 day testing window. In most cases, schools will want this window to be as small as possible in order to minimize the disruption of testing on the school schedule and to maximize the number of instructional days the students have prior to testing.

At a bare minimum, the school must provide one computer for every eight students to be tested. This model assumes that two students will be tested on each device per day, and that the maximum testing window is used. The ideal scenario is to minimize the testing window, in which one computer will be needed for every two students tested.

Currently, sufficient capacity exists in all of the buildings to meet this need except for Central School. At Central, 180 computers will need to be added prior to the spring of 2015 to meet this need. This need will be met with currently planned expansions in technology availability as part of the curriculum review and adoption process. In all buildings, it is assumed that all computer labs and mobile classroom sets of computers will be available for testing.

Bandwidth Requirements

Final bandwidth requirements have not yet been released by PARCC. The Ohio Department of Education, along with the Management Council of the Ohio Educational Computing Network (MCOECN), recommends that schools have at least 100 kilobytes per second of bandwidth per simultaneous test taker. District-wide, it is expected that 1,350 students will be taking the test simultaneously. That means the district will need 135 megabits per second of bandwidth to accommodate testing. Currently, the district has 100 megabits per second of bandwidth, but that capacity is scheduled to increase to 150 in the summer of 2013. These numbers assume that no one else in the school district will be using the Internet for any purpose while testing is underway. While this assumption is impractical, it is also likely that the 100 kilobit requirement will be reduced prior to the implementation of this program.

The real challenge for bandwidth is upstream. The school district connects to North Coast Council (NCC), which, in turn, connects to OARNet. This link is currently 600 megabits per second, indicating that they have the capacity for 6,000 students to test simultaneously. Since NCC serves nearly 40 school districts, this capacity is grossly insufficient. The leadership of NCC and the MCOECN are aware of these issues and are working to provide sufficient capacity for the successful administration of these assessments.

Appendix 5: Analysis of 1:1 vs Bring Your Own Device (BYOD)

One of the current trends in educational technology is a move toward individual computing devices for each learner. The citizens of the 21st century are hyper-connected. It is rare for an adult in the developed world to be away from mobile phones, Internet access, and social networks for extended lengths of time. These networks provide instant communication, updates on traffic, weather, and news, location-based information on services and places of interest, routing and navigation tools, and access to much of the world's knowledge.

The 21st century learner needs access to similar tools. In addition to being able to access information, she must be able to create new information, share resources and ideas, and publish to a global audience. Next generation students are creative collaborators who use technology to find innovative solutions to complex problems, and share those solutions in dynamic ways online.

For this type of learning to be practical, technology must be ubiquitous. It's no longer sufficient to have a couple computers in the back of the classroom that are shared by 25 students. It isn't practical for classes to move down to a computer lab when technology is needed for learning. Every student needs access to technology all the time.

Most schools who are addressing this need are using either a 1:1 model or a Bring Your Own Device approach. In a 1:1 program, the technology is provided by the school. Parents may be responsible for accidental damage insurance or extended warranties. There may also be a technology fee that must be paid for the student to use the technology outside of school. A standard device is selected by the school. Software licenses are handled by the school. Computer configuration, setup, and maintenance are all the responsibility of the school, and fall under the district's policy for maintaining its own computer equipment.

The advantages to a 1:1 program are significant. Within a particular grade, every student has the same technology. Their devices all have the same capabilities and the same software. Teachers can rely on all students being able to edit documents online, or use the integrated cameras to record a video, or connect the device to a projector to make a presentation. Less time has to be spent figuring out the capabilities of each student's personally selected device. More time can be focused on the learning that's taking place with the technology rather than the technology itself.

From a financial perspective, though, a 1:1 program is expensive. Purchasing and maintaining devices for each student significantly increases the scope and complexity of the district's technology program. More resources must be allocated to acquiring and maintaining these devices.

A Bring Your Own Device (BYOD) approach sidesteps these costs by requiring students to acquire their own devices and use them at school. In a BYOD environment, families purchase technology equipment on their own, and students use that technology at school to augment their learning. From a pedagogical perspective, this approach has the advantage of moving the center of learning from the school to the student. Rather than bringing her learning to the technology provided by the

school, the student brings her own technology to the learning. This approach better prepares her for life-long learning because it better integrates learning with her existing use of technology.

On the negative side, a BYOD approach removes the benefits of standardization. Different students will have different types of devices, each with its own set of capabilities. More time and expertise will be needed at the teacher and student levels to help ascertain how the student's technology can be used effectively to complete a given task, and with more focus on the technology, less time will be available to concentrate on the instructional objectives of the activity.

A BYOD model can also magnify the socioeconomic inequity prevalent in the school population. Students in the school district come from widely varied economic backgrounds, and these means will be reflected in the devices they select, purchase, and bring to school. Schools implementing a BYOD program must be aware of this problem, and take steps to bridge this digital divide.

Additionally, maintenance becomes a problem with BYOD devices. Because they're not owned by the school, the district cannot install software, configure settings, and provide repairs. Instead, the student (and student's family) becomes responsible for keeping the technology in good working order. This can result in longer delays and greater frustration when things don't go well, because the district cannot provide the needed support.

This last point also makes BYOD devices impractical for PARCC testing. Beginning in the spring of 2015, all students in grades 3-11 will take achievement tests and end-of-course exams electronically. The technology requirements for these tests indicate that certain features must be disabled on all computers used for testing. These features include the ability to print, run programs other than the test, access the Internet, use the camera on the computer, and access resources like calculators and word processors. While it is technically possible to disable these features, installing and configuring the software to do so on a device that is not owned or controlled by the school district would be illegal and immoral. Because of this, BYOD devices cannot be used for PARCC testing.

Given this reality, BYOD schools will have to maintain computer labs and classroom computers specifically for testing. Depending on the testing model used, one computer would need to be available for every 2-6 students in grades 3-11. For the Brecksville-Broadview Heights schools, this would mean that 500-1500 computers would have to be maintained just for standardized testing.

In a 1:1 program, these computers would not be needed. Because the devices assigned to students are owned and maintained by the school district, they could also be used for testing. This model results in a much more efficient use of technology, and also follows the PARCC recommendation that students use computers for testing that they are already familiar with and comfortable using.

For these reasons, it is recommended that the school district pursue a 1:1 model whereby each student is provided with a mobile computing device as described in Strategy 2-3.

Appendix 6: Wireless Recommendations for Schools

School environments present some unique challenges for wireless networking. Typically, schools encompass a large geographic area, through which hundreds of students and staff members are regularly moving with their technology devices. In addition to the devices owned and managed by the schools, most people have additional wireless devices in the form of mobile phones, tablets, e-readers, and other technology. While it is tempting to attempt to replicate the simplicity of a home wireless network in a school setting, the reality is that the limitations in range, wireless spectrum, and client capacity do not allow home solutions to scale well to a school environment.

A number of white papers have been issued in recent years focusing on school wireless networks. In general, they emphasize a need for centralized management, dual-band performance covering both the 802.11g and 802.11n network specifications, and operation in both the 2.4 ghz and 5 ghz wireless spectra. From a density perspective, the Ohio School Facilities Commission recommends a wireless access point per 1,100 square feet. Schools should plan for a reality in which most of the staff and students in the school facilities are carrying multiple network-enabled devices. Instructional areas should be covered by a minimum of two devices, each capable of handling a minimum of 60 devices.

The six academic buildings in the Brecksville-Broadview Heights Schools encompass 662,000 square feet of space. Following OSFC recommendations, the district should install a total of 602 access points in these schools.

Building	Square Feet	Recommended APs	Planned APs
High School	299,000	272	234
Middle School	155,000	141	122
Central	78,000	71	61
Chippewa	43,000	39	34
Highland Drive	43,000	39	34
Hilton	44,000	40	34
Other Areas*			11
TOTAL	662,000	602	503

** Other areas include the education center, maintenance/transportation facility, and athletic facility. As non-instructional buildings, these facilities must support significantly fewer devices.*

In reality, the OSFC guidelines are impractical in common areas. In large open spaces, such as gymnasiums, auditoriums, and cafeterias, it is impossible to install a wireless network with the

recommended level of density without causing wireless interference problems. The planned wireless deployment includes the recommended levels in all instructional areas, with slightly lower density in common areas. The result is a plan that reduces the number of access points needed by approximately 100, and which saves more than $100,000.

The plans for wireless expansion assume that the district will maintain the current buildings in their current configurations. If major facilities changes are made, adjustments to this plan will be necessary. Depending on timing, this may involve removing and re-deploying wireless hardware, which will save on hardware costs but increase labor costs. Such changes may also impact the timeline and cost for the final year of wireless improvements and the ultimate completion of the upgrade project.

Appendix 7: Technology Staffing Levels

In a school environment, it is often difficult to ascertain the appropriate level of technology support. While a robust information technology staff can anticipate problems and prevent many of them before they affect the productivity of staff and students, limited resources often make this level of staffing impractical. Instead, the goal is to provide the minimum level of staffing necessary to ensure a reasonable level of support to instill confidence in the reliability of the school's technology systems, and to avoid major productivity losses due to technological failures.

One of the often-cited goals among school boards, civic leaders, and politicians is to run schools more like businesses. To that end, it may be helpful to take a look at the information technology infrastructures and support systems used in business. Generally, organizations that take a proactive approach to technical support employ a model of one support person per 50-150 devices. This level can vary widely, depending on a number of factors. High tech industries, for example, may have ratios as low as 1:10. Energy and manufacturing companies, on the other hand, may have smaller technology departments, with one staff member per 150 devices. Additionally, some organizations require their support personnel to manage networks, servers, and other infrastructure in addition to computer hardware and software. Others separate these tasks to reduce support burdens.

Beyond 150 devices per support person, analysts observe that information technology departments become reactive rather than proactive. They spend the majority of their time responding to problems and working to correct them rather than focusing on prevention. Again, levels vary widely, but most organizations stay below the one technician per 200 devices threshold in their reactive environments.

Looking at the non-profit side, a 2011 report conducted by the Non Profit Technology Network concludes that non-profit organizations typically have one support person per 60 staff members. This support level varies based on the size of the organization. Overall, technology expenditures in the non-profit sector average $3,747 per staff member, or about 5% of each organization's budget. Surprisingly, this is higher than the level of support provided in most for-profit businesses.

Industry analyst Gartner has also examined technology staffing levels. Its numbers are particularly useful because they break the data down by industry segment. As a percent of revenue, for example, technology funding ranges from 0.7 % in the energy sector to 6.0% in the financial services sector. In education, technology funding is typically 4.7% of the organization's revenue. On a per-staff-member basis, schools spend $5,078 per employee per year on technology as a whole, and IT staff generally comprises 4.8% of the total employee headcount.

A less scientific survey of 56 Ohio schools in the spring of 2013 found that IT staffing levels vary widely, with one parochial school reporting as few as 20 devices per technician, while a public school district in northeast Ohio reports 1,800 devices per technician. Overall, the median number of devices per technician is 500.

Looking at technology staff as a percent of total staff, the same survey found the median to be 1.0% in Ohio schools, which is significantly lower than the levels cited by Gartner.

	Industry Norm	Non-Profit Norm	Education Norm	Current Level	Planned Level
Devices per Tech Staff	50-150	24-116	200-300	854	500
Tech Staff as Percent of Employees	5.4%	1.7%	1.0 - 4.8%	0.6%	2.2%
Tech Budget as Percent of Revenue	3.5%	5%	4.7%	1.5%	2.5%
Tech Budget per employee	$12,350	$3,747	$5,078	$1,450*	$2,450

** Assumes a current technology budget of $725,000 including general fund, permanent improvement, salaries, and benefits, along with a current staffing level of 500 employees.*

Looking at the norms, the district should currently have 13.7 staff members in the technology department to maintain a minimum level of support for its 2,734 devices. With the expected increase in technology to 4,500 devices over the next few years, that support level should climb to 22.5 staff members. With a current staffing level of 3.2 people, this represents an astounding support deficit.

From a budget perspective, both the non-profit and the education analyses indicate technology budgets to be 4.7% - 5% of total revenue. If the lower value were used, a target funding level for all technology would be about $2.3 million per year. That is more than three times the current funding level.

As a percent of total employees, the Gartner research indicates a typical technology staff level of 4.8% in the education sector, and the Ohio survey puts this level at 0.3% to 16.7%, with a median of 1.0%. If we average the Ohio numbers with the Gartner nationwide average, 2.9% seems a reasonable target. In a district with 500 employees, this would mean 14.5 staff members in the technology department, nearly five times the current staffing level.

All of these metrics indicate that the district is grossly under-staffed in technology support. While the recommendations in this plan call for a substantial increase in technology staffing, the level to be attained is still only a third of the industry standard recommendations for a minimum level of support. This staffing level is also less than the median level of support in other Ohio schools, which typically have a technology support person for every 500 devices.

It may be possible to meet some of this support gap through the use of outside service providers. Several companies in the area provide technology support services. These services can range from special projects like installation and configuration of new equipment to day-to-day troubleshooting

and support of technology in the schools. The use of such services may reduce the burden on district employees and ultimately result in a slower expansion of needed support staff.
Despite the potential of outside service providers, the district will still need to employ additional technicians and network support personnel to address the immediate, on-site needs of our student, teachers, and support personnel.

Additionally, the district intends to address the support gap by employing the same cost saving measures of efficiency, standardization, and automation that it has used up to this point. It is impractical, however, to expect that a reasonable level of support can be provided to the district staff and students without a substantial increase in technical staff.

Appendix 8: Sources and Further Information

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