



# **SIIA Trends Report for Education Technology 2010**

## **EXCERPT: MOBILE COMPUTING**



A PUBLICATION OF THE  
SOFTWARE & INFORMATION INDUSTRY ASSOCIATION (SIIA)  
EDUCATION DIVISION

## About SIIA

The Software & Information Industry Association (SIIA) is the principal trade association for the software and digital content industry. SIIA provides global services in government relations, business development, corporate education and intellectual property protection to the leading companies that are setting the pace for the digital age.

## About SIIA's Education Division

SIIA's Education Division serves and represents over 150 member companies that provide software, digital content and other technologies that address educational needs. The Division shapes and supports the industry by providing leadership, advocacy, business development opportunities and critical market information. SIIA provides a neutral business forum for its members to understand business models, technological advancements, market trends, and best practices. With the leadership of the Division Board and collaborative efforts with educators and other stakeholders, the Division undertakes initiatives to enhance the use of educational technology and the success of SIIA members.

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# **SIIA Trends Report for Education Technology**

## **FREE EXCERPT: MOBILE COMPUTING**

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Richard Milewski, The Greaves Group



**Software & Information  
Industry Association**

**A Publication of the SIIA Education Division**

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The full 144 page SIIA Trends Report for Education Technology is a comprehensive look at recent trends for the key topics within education technology: Mobile Devices, Online Learning, K-12 Learning Management Systems, Postsecondary Learning Management Systems and the States of the States.

## **HIGHLIGHTS INCLUDE:**

### **K-12 Learning Management Systems**

- ♦ Cool technology tools that enable teaching and learning
- ♦ Open Content Development Communities

### **Postsecondary Learning Management Systems**

- ♦ The evolution of learning management systems in postsecondary markets
- ♦ Increasing use of social media and web 2.0

### **Online Learning**

- ♦ Growing opportunities with blended learning
- ♦ The changing landscape of online enrollment

### **State of the States**

- ♦ Summary and analysis of the governors' State of the States
- ♦ The movement to common academic standards

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## **2010 SIIA TRENDS REPORT FOR EDUCATION TECHNOLOGY**

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Mr. Greaves is recognized as a visionary in the K-12 Mobile Computing space. He has published widely and is currently the editor of the SIIA Mobile Computing Trends report. He holds multiple patents and patent disclosures for student computing technologies and has been involved in hundreds of 1:1 computing projects at district, state and federal levels. Mr. Greaves' recent work includes, most notably, the 2006 and 2008 America's Digital Schools surveys, which are among the most widely read and quoted educational technology reports ever produced.

Mr. Greaves has 40 years experience in the computer industry, including 26 years at IBM. He co-founded NetSchools in 1996 which focused on comprehensive curriculum integrated 1:1 laptop solutions. He founded The Greaves Group, a strategic education consulting organization, in 2003 and continues his work there as Chairman. Mr. Greaves was a recipient of the 2010 Ed Tech Impact Award from SIIA's Education Division.

### **Richard A. Milewski, Chief Technology Officer, The Greaves Group**

Mr. Milewski has more than 30 years of experience applying technology in Silicon Valley. He wrote the first third-party software application marketed by Apple Computer under the Apple name, was a columnist for Creative Computing Magazine and served as Editor-in-Chief at InfoWorld. Richard has been involved in the development and marketing of technologies for non-contact temperature measurement using infrared radiometry, infant hearing screening using brainwave analysis, passive infrared intrusion detection systems, and systems for facsimile and Internet telepublishing, wireless networking, and wireless aviation weather delivery.

Mr. Milewski also developed and operated the first comprehensive medical market research survey system on the Internet. In the area of K-12 educational technology, he served as the Chief Technology Officer for NetSchools Corporation and holds three educational network technology patents.

## MOBILE COMPUTING

Tom Greaves and Richard Milewski  
The Greaves Group, LLC

*Netbook sales are growing at a rate of 200% year over year.*

### THE AGE OF MOBILE

In 2006, the responding school districts in the *America's Digital Schools* research study reported that more than half the computers in their schools would be mobile by 2011. Four years later, it appears that this prediction may not be too far off the mark. There are several factors driving this forward:

- ♦ Netbook sales are growing at a rate of 200% year over year. Over the last two years netbooks have become much more robust. Screen sizes are growing and processors are getting faster.
- ♦ Smartphones have dramatically improved in functionality and ease of use.
- ♦ Connectivity has improved inside schools and districts and in the community.
- ♦ Software applications are just starting to catch up to the opportunities (and challenges) presented by mobile devices.

This rapid change from desktop to various types of academic mobile computing represents both a concern and an opportunity for educational software publishers. Marketing and development budgets could be strained as companies seek out new markets while maintaining momentum in existing core areas.

This report will address the following areas:

- ♦ Mobile computing devices
- ♦ Operating systems and system software
- ♦ Connectivity
- ♦ Applications
- ♦ Business models
- ♦ What's in it for you, the software publisher
- ♦ Futures and a five-year forecast

While much of this document applies to both K-12 and higher education, where appropriate, distinctions between the two will be discussed. Please note: This market segment is evolving rapidly in almost every facet. Please check for the latest information before making decisions based on the information contained herein.

## MOBILE COMPUTING DEVICES

The mobile computing landscape continues to change rapidly. Netbooks have surfaced only in the last two years. Up and coming categories are the MID, or Mobile Internet Device, and smartbooks. Of particular note is the disappearing CD/DVD drive. Following in the footsteps of the floppy drive and the parallel port, the CD/DVD drive is gone in most of the thin and light models. It is probably only a matter of time before it disappears altogether.

### Netbooks – The growth leader

The netbook category is blossoming, and every notebook manufacturer of consequence has an offering in this category. Sales are growing at more than 200% per year. Netbooks are getting less traction in postsecondary circles where students generally provide their own hardware than in the K-12 world where the burden of hardware costs fall mainly on the institution. Trends in netbooks include:

- ♦ Screen sizes of 10 inches, versus the initial 7-9 inch versions
- ♦ Faster processors, led by the new generation of low-power Intel Atom processors
- ♦ Longer battery life, attributed to larger batteries, better power management, LED display backlights, and lower power processors
- ♦ Built in wide area wireless LAN (WWAN) connectivity on a variety of networks
- ♦ Evolving business models, such as carriers subsidizing the cost of the netbook when they are purchased with a data plan
- ♦ Specialized devices, such as the Dell Latitude 2100, with classroom features including increased ruggedness and a teacher observable wireless activity light
- ♦ The original netbooks featured Linux as well as Windows, but Linux versions were not well received by the market. Netbook users welcome Windows 7, as Vista was not supported on netbooks.

### The venerable laptop

Netbooks growth has impacted the sales of laptops to some extent. Laptop sales are increasing, but not at the previous rate. Laptops have steadily increased in capacity and functionality to the point where the differences between high-end laptops and typical desktop machines are declining.

Trends in the laptop segment include:

- ♦ LED backlights, which improve battery life
- ♦ Backlit keyboards, a universally popular feature
- ♦ More rugged mechanical designs, which contribute to fewer failures
- ♦ Special features such as USB ports that remain powered when the machine is in suspend mode, allowing users to recharge their cell phones

*The netbook category is blossoming, and every notebook manufacturer of consequence has an offering in this category.*



*Tablet computers have made great headway in postsecondary education and have some strong support in K-12.*

- ♦ Increased availability of 3G/4G WWAN support, including WiMAX in the newer models
- ♦ Larger hard drives and solid state drives, giving the user options for more storage or reliability
- ♦ Newer processor designs that lower power requirements and provide modest speed improvements. The new Intel chipset, code-named Capella, is reported to incorporate integrated graphics and 3G/4G communications support, including WiMAX. This increase in functionality is accompanied by lower power consumption. This trend will continue for the foreseeable future.

### Tablet computers

Tablet computers have made great headway in postsecondary education and have some strong support in K-12. Electronic ink and touch screens clearly provide a number of advantages.[specify?] Looking forward, we see the price of tablet computers dropping and the reliability and battery life improving. Prime examples of lower-cost tablets include the ASUS T91 and the Intel Classmate. While surveys indicate that tablets will not overtake ordinary laptops in the next five years at least, certainly the tablet install rate will increase.

Tablet computers provide a tremendous opportunity for software publishers to bring interesting and powerful functionality to K-12 and make more headway in postsecondary. A growing installed base will make more of these products financially viable.

### Smartbooks

Several players are now announcing smartbooks. A prime driver is Qualcomm and its Snapdragon processor. A key differentiator between netbooks and smartbooks is the “always on” capability. The chipsets, with cell phone roots, are designed to work while the device is supposedly powered down. Thus, when users open the lid of the device, their mail and messages are already delivered. Another proposed advantage of smartbooks, again based on their heritage, is long battery life. Users can expect at least two days of use without recharging.

### Cell phones and smartphones

Smartphones have really taken off in the last few years. The addition of better browsers and faster data communications has meant that, worldwide, more web pages are viewed via smartphones and cell phones than by computers. Cell phones with browsing capabilities are taken for granted in the postsecondary education market, where virtually every student has a cell phone. In the K-12 market, however, the situation is quite different and in some places[specify?] a contentious issue.

A few K-12 districts are beginning to relax their bans on students bringing cell phones to school, mostly at the insistence of working parents who now see the technology as a way to keep tabs on school-age children after class. However, there is still widespread reluctance to permit any use of cell phones in K-12 schools during school hours. According to the Yankee Group<sup>1</sup>, cell phone penetration in the 13-17 age group is approaching 80% today, with 90% penetration expected by 2012. In the 8-12 age group, more than 40% have cell phones, with growth to 70% expected by 2012.

While it used to be the case that only smartphones came with Internet browsing capability, over the last few years, the average phone has become smarter and the cost of even the smartest phones has declined. With most carriers and handset manufacturers under intense pressure to duplicate the success of the Apple iPhone, the smartphone segment is booming.

According to Gartner Research, worldwide smartphone sales are up 27% from last year.<sup>2</sup> Today, virtually all cell phones are capable of browsing the Internet, and many in the smartphone category have WiFi capability, which could allow direct connection to school or college campus networks.

### Smartphones – On the horizon

The smartphone platforms and their non-phone counterparts are expected to continue to evolve rapidly. This is driven in part by volume. The number of cell phones and smartphones sold each year far exceeds the number of computers of all varieties.

- ♦ Smartphones and cell phones are becoming more powerful and less expensive.
- ♦ Cellular data connections are becoming faster and ubiquitous.
- ♦ Browsers are improving functionality, and website content is automatically reformatted for mobile users with more frequency.
- ♦ Manufacturers are providing Software Development Kits (SDKs) and opening up the cell phone to other applications.

Dr. Gerry Purdy, a Frost and Sullivan mobile computing analyst, reports that smartphones have a 20% penetration today, expected to climb to 80% by 2013. Two examples of this new trend are the Apple iPhone 3GS and the HTC Touch Pro2. The iPhone has set new standards in phone user interfaces (UIs). Developers have flocked to the iPhone SDK. The HTC Touch Pro2 is a noteworthy example of a next-generation smartphone with a slide out keyboard, an 800x480 graphical touch screen interface, and a browser (Opera 9.5) optimized to that screen size. With this much screen real estate and an excellent browser, the devices look better from an educational standpoint.

### The transition from handhelds to phoneless smartphones

The strong market acceptance of phones with the ability to browse and run stand-alone software has led manufacturers to abandon what used to be called

*Of key significance in the K-12 market is the fact that both the “phoneless-phones” and networked gaming devices can operate on school networks without the purchase of a wireless data plan from a cellular carrier.*

*For many years, higher education institutions from community colleges to major universities have supported student-owned devices on their networks. K-12 schools mostly do not.*

PDA's, or, in the education world, handhelds. But a new class of devices with some similarities to the old handhelds is emerging. Led by the "phoneless iPhone," the iPod Touch, these portable media players and game playing devices feature WiFi and Bluetooth networking capability.

Last fall, Microsoft introduced its ZuneHD, a touchscreen media player with WiFi and Internet browsing capability. Clearly targeting the iPod Touch, the device curiously appears to lack the ability to run stand-alone applications. There are, however, reports<sup>3</sup> that Microsoft has been approaching independent developers of successful iPhone applications to develop for the ZuneHD platform. Microsoft has announced that the ZuneHD will work with their Xbox Live Marketplace, which is likely the platform Microsoft will use to compete with the iTunes Store. Initial pricing for the ZuneHD is quite aggressive, with a ZuneHD costing \$75 to \$100 less than an iPod Touch of similar capability.

The other "not-a-phone" is the portable gaming device. The leader in this category from an education perspective is Sony's Play-Station-Portable (PSP). In the UK, more than 60 schools make use of the PSP as a connected student device for delivery of curriculum content.<sup>4</sup> In the US, PLATO Learning supports the PSP with PLATO Achieve, supporting skills taught in grades K-7. The company has case studies available for schools in Virginia,<sup>5</sup> Mississippi<sup>6</sup>, and New Jersey.<sup>7</sup>

Of key significance in the K-12 market is the fact that both the "phoneless-phones" and networked gaming devices can operate on school networks without the purchase of a wireless data plan from a cellular carrier. Cellular data plans are relatively expensive, and student use is not E-rate eligible.

In addition, carriers generally focus on sales to individual consumers and large corporate clients, creating a significant barrier to the adoption of cell phones in US K-12 schools. An exception is Sprint, which is the leading carrier selling wireless to schools, with a very active education marketing presence.

Because the media players and gaming machines tend to have larger screens, faster processors, and better browsing capabilities than all but the highest-end cell phones, we suspect that schools will begin integrating these devices into the curriculum. These new devices neatly solve the equity issue of providing loaner devices to students who do not have cell phones.

### **Student-owned devices and the school network**

For many years, higher education institutions from community colleges to major universities have supported student-owned devices on their networks. K-12 schools mostly do not. While we see signs that this is beginning to change, we expect that access to the school network will be the single greatest factor limiting the inclusion of student-owned devices in the K-12 curriculum.

K-12 schools should not ignore the benefits of supporting a broad array of devices, some of which will inevitably be student-owned. Two of the leading Learning Management Systems (LMS), Blackboard and Moodle, are now beginning to support handheld mobile devices.

Blackboard offers Blackboard Learn<sup>8</sup> for the iPhone and iPod Touch. This application lets users receive notifications of changes and updates to their courses, including updates on new assignments, course content, study group updates, community discussions, and grades. It works in conjunction with Blackboard Sync, which also supports the Blackboard Learn Facebook application. Blackboard, Inc. recently acquired Terriblyclever. Their MobilEdu<sup>9</sup> product line is aimed at bringing campus services to users via mobile devices. In the open source world, Moodle has options for supporting a broad set of mobile devices. Because the format of the information presented to users by Moodle is controlled by format definitions called “themes,” it is possible to define alternate themes that present the same information in different formats. The University of Bath in the UK has defined a mobile theme<sup>10</sup> for Moodle that permits users to access much of their Moodle content on mobile devices. Other projects go somewhat beyond a simple theme, such as Moodle on a Mobile,<sup>11</sup> which is still in the early stages.

Another effort, the MoMo (Mobile Moodle) Project, appears further along. MoMo consists of two components, an extension to the Moodle open source LMS<sup>12</sup> and a Java client for mobile devices.<sup>13</sup> Note that Java J2ME applications do not run on the iPhone, iPod Touch, or most Verizon phones, so a universal solution still appears elusive. However, in theory, all three of the approaches could be used in parallel on a single Moodle installation.

## Other mobile devices

For the sake of completeness, while there are many forms of mobile devices, this report is limited to those with color screens, connectivity, a general-purpose operating system, and support by a developer community. Examples of fine products that address specific niches but are unlikely to break into widespread use in education include:

- ♦ eBook readers such as the Kindle and the Sony readers
- ♦ Closed, fixed purpose devices such as the Leapfrog products
- ♦ Specialty products such as the various pen computing products

## THE OS PERSPECTIVE

### Windows

Microsoft Windows is by far the leading operating system (OS) on desktop and laptop systems in education. Many schools using Windows XP resisted Microsoft's push to move users to Windows Vista, and waited for Windows 7.

## Mac OS X

Apple's outstanding mobile products are well received in the education marketplace. A large portion of their success can be credited to Mac OS X. The newest release of Mac OS X is code-named Snow Leopard. This release of Apple's flagship operating system is focused less on new features and more on improving performance and reducing the overall footprint.<sup>14</sup> Snow Leopard takes 6GB less space than the current version of Mac OS.

Changes include a completely rewritten Finder; faster backup; speedier wake-up, shut-down, and wireless connections; and automatic updates of printer drivers.

Snow Leopard offers improved text selection in PDF documents, allowing users to select text in PDFs on a column-by-column basis. For world language students, the new OS supports mixing left-to-right and right-to-left languages in the same document, and on Mac notebooks, users will be able to enter Chinese characters by drawing them on the touchpad.

As a note, Snow Leopard will not run on legacy Macintosh hardware with non-Intel processors.<sup>15</sup>

## Windows Mobile

Windows Mobile 6.5 is Windows' latest version for use in cell phones. In addition to freshening up the Windows 6.1 interface, a new feature such as inertial on-list scrolling goes a long way towards reducing the need for a stylus. Catering to the importance of the browser in mobile devices, the new IE browser supports a zoom function, improves HTML handling, and comes with a new JavaScript engine.

According to Mobile and Social Media consultant Lisa Whelan, Windows Mobile 6.5 supports touchscreen gestures,<sup>16</sup> and the browser supports Flash. Search queries can be entered in the address bar, a feature pioneered by Mozilla in its Firefox desktop browser.

While little information is available about Windows Mobile 7, sources<sup>17</sup> indicate that it will have a redesigned user interface, multi-touch screen support, and motion-related features. These last two features clearly indicate that the success of the iPhone OS is putting pressure on Microsoft to add features made popular by the Apple iPhone. Multi-touch will require a capacitive touchscreen, which means that most current Windows Mobile phones will not be able to upgrade past Windows Mobile 6.5.

## iPhone OS

Apple's much-hyped iPhone runs a small-footprint version of Mac OS X known as iPhone OS. Like Windows Mobile, iPhone OS lacks the multi-tasking capabilities of its parent operating system. Only a single application can run at one time. Background tasks are limited to tasks like core phone monitoring

and playing music in iPod mode if the foreground application does not use the sound system.

The 3.0 release of iPhone OS added working push notification capabilities. While the phone still cannot run more than one application at a time, push notification enables the system to pop-up notifications on receipt of a notification packet over the network. These notifications are registered to specific applications. One example of this is the AOL Instant Messenger application, which can now notify users of incoming instant messages when they are running other applications.<sup>18</sup>

The 3.1 release of iPhone OS includes support for a class of “augmented reality” applications that turn on the camera, use the position sensors and electronic compass (new in the iPhone 3Gs) to determine where the camera is pointing, and then superimpose information, such as the location of nearby subway stations, on the camera image.<sup>19 20</sup>

## Symbian

Symbian is an operating system designed for mobile devices that started life as Psion’s EPOC operating system for handheld devices. It runs only on ARM (Advanced RISC Machine) processors and is produced by the Symbian Foundation.

Until 2008, the Symbian OS was developed by Symbian Ltd., a joint venture of Ericsson, Sony Ericsson, Nokia, Motorola, Panasonic, and Samsung. Nokia bought out the other partners, formed the Symbian Foundation, and turned the OS over to the Foundation, to “provide royalty-free software and accelerate innovation.” Symbian is not yet an open-source operating system, however. The foundation’s goal is to have the entire Symbian OS available as open source in 2010.

The Symbian OS requires that applications be digitally signed. For basic capabilities, such as saving a file, which users control, developers may use self-signed security certificates. Advanced capabilities, such as using multimedia device drivers, require certification, signing via the Symbian Signed program, and security certificates issued by independent testing companies or phone manufacturers.

This allows phone manufacturers (and indirectly, wireless carriers) to control what applications can run on the device and whether or not customers must pay to use a particular application separately. We expect that the success of the more open iPhone OS approach will put pressure on phone manufacturers and wireless carriers to open up this process to a greater extent in the future.

## Linux

A number of mobile devices are now available running various versions of the Linux open-source operating system. The Asus Eee PC runs a fairly standard desktop Linux, but Linux runs on handhelds also. The Nokia 770, N800, and

N810 devices run Linux and an open-source graphical user interface (GUI) called Hildon. Sharp makes a series of Zaurus handhelds running Linux, and Samsung and Slacker use Linux as the OS in their portable media players. Noah Education Holdings uses Linux and the Trolltech Qt GUI to make educational handhelds intended primarily for use in China. However, the company offered a travel-oriented version of the handheld for visitors to the Beijing Olympics. It included road maps, travel guides and an English/Chinese translation program, in addition to more standard features such as a calculator, calendar, and an eBook reader. The first Linux-based mobile phone offered for sale in the US was the Wildseed fashion phone offered by Dobson/Cellular One in 2004. While not a significant platform for educational content, Wildseed led the way for devices such as the recently available OpenMoko NeoFreerunner, a completely open-source phone robust enough to be of significant use as a mobile education platform. Other Linux-based mobile phones include Motorola's MotoZine, Rokr E8, and RAZR2 models.

### Adroid

The Linux-based Android operating system for mobile devices, was developed by Google and the Open Handset Alliance. Unlike most other mobile device operating systems, Android does not support programs written in native code. Android programs must be written in a Java-like language that executes in a virtual machine implemented in native code rather than directly on the device's CPU. Google has pledged to make most of Android available under an open-source license.

Android does not differentiate between the phone's basic applications and those of third-party developers. Even the dialer or the phone's home screen can be replaced. The fall of 2009 saw a flurry of activity for the Android platform, with version 2 of the OS being released and new phones from HTC, Motorola and Samsung becoming available.

The Android platform is arguably the most open of all the mobile platforms for mobile development, but it is too early to tell if that openness will translate to the avalanche of applications that have filled the iTunes App Store. In October 2009 there were only 200 applications, both free and paid, in the Android Market.<sup>21</sup> As carriers add more models of Android-based phones to their inventories, it's likely we will see many more applications emerge; but it will take a phone as compelling as the iPhone to attract developers and trigger the avalanche.

### Widgets and web runtimes

While all the operating systems mentioned here will continue to be important to the future of mobile computing, a different approach probably represents the current best hope for cross-platform application development in the mobile space, and perhaps in the desktop world as well.

Widgets are essentially websites that have been bundled and loaded onto the local file system. They are built with well-standardized web technologies such



as AJAX, HTML, CSS, and Javascript. When running from local file systems, these easy to implement applications can provide all the functionality of an application coded using more conventional languages. The approach enables technical staff with web skills to deploy applications across platforms without having to master the disparate programming environments required by the other operating systems.

While widgets do not provide write-once, run-anywhere capability, they do make it relatively easy to deploy an application across different platforms. On desktops, JetPack, a Mozilla Labs project,<sup>22</sup> lets users use widgets as plug-ins to the Firefox browser. Apple's desktop widgets live in the desktop, not the browser, so a Mac running Firefox can have both kinds of widgets. Apple's Dashcode<sup>23</sup> tools can be used to create widgets.

On mobile platforms, the implementation details for widgets vary from platform to platform, but they are implementable on virtually any platform. The Palm Pre employing the Palm WebOS essentially uses widgets as its primary programming paradigm.<sup>24</sup> For iPhone, Android, and Blackberry, the PhoneGap framework<sup>25</sup> provides a way to bundle widgets into packages that look like native applications on the phone.

For phones running the Symbian OS, there is Symbian's Web Runtime.<sup>26</sup> Motorola offers WebUI,<sup>27</sup> which runs across several operating systems on Motorola phones. NetFront Widgets<sup>28</sup> run on phones using the Access NetFront browser, and Windows Mobile 6.5 will have widget support.<sup>29</sup> The important thing to remember is that an application implemented as a widget can be moved to any of these platforms with relative ease. The World Wide Web Consortium (W3C) is working on standards for widgets,<sup>30</sup> and as these evolve we expect "wigeitized apps" to become even more portable. Widgets certainly represent an attractive implementation strategy for software publishers wanting to bring content to an array of disparate mobile platforms.

## Dynamic Virtual Computing

As schools and postsecondary institutions transition to mobile computing, the number and diversity of client computers will grow dramatically. Unfortunately the support staff in these institutions does not grow commensurately. A relatively new concept called Dynamic Virtual Computing<sup>31</sup> may prove to be one of the answers to this dilemma. Dynamic Virtual Computing (DVC) enables the delivery of applications across a range of platforms in a very cost effective manner[not clear how this solves problem of small support staff]

## CONNECTIVITY: CAN WE GET ENOUGH?

Connectivity is a one-way street. Once we experience a faster connection, we cannot go back. Connectivity is a major issue for

*The important thing to remember is that an application implemented as a widget can be moved to any of these platforms with relative ease.*



*Connectivity is a one-way street. Once we experience a faster connection, we cannot go back. Connectivity is a major issue for software publishers.*

software publishers. As illustrated in the *America's Digital Schools* reports, the Consortium for School Networking (CoSN) web site, and the recent State Education Technology Directors Association (SETDA) Bandwidth Report, schools face a crisis as bandwidth demand outstrips their ability to get or pay for the bandwidth they need.

Publishers are reacting to the challenge by offering hybrid solutions that provide local caching and caching appliances [such as?] to reduce total bandwidth requirements.

As education technology increasingly goes mobile and the number of mobile computing devices surpasses desktop varieties, connectivity needs increase and new options become available. Here is an overview of the current options.

### WiFi

WiFi has been around for more than ten years and is widespread. Recently the 802.11n standard was finally approved, enabling much higher bandwidth per access point. Most postsecondary campuses are well covered with robust WiFi. However, it is estimated that less than 30% of K-12 classrooms have robust WiFi access.

WiFi is more involved than just putting up an access point. Security, bandwidth capacity, and many other factors come into play. Classroom management applications often require industrial grade access points if 250 students in a university lecture hall must be successfully controlled wirelessly. Software publishers will increasingly consider WiFi network capability as part of pre-sales or pre-installation checklists. It can make or break a software implementation.

### WiMAX

WiMAX is a relatively new 4G wide area data service in the US. Already in use in more than a hundred countries around the world, it is now coming to the US in substantial volume. Contrasted to WiFi's relatively short range, WiMAX can go several miles in open terrain, comparable to a cell phone signal. WiMAX range and speed are subject to many variables, but as a rule of thumb the signal can reach a three-mile radius around a tower. In the open country and with a tall tower, the range could reach up to 30 miles. A number of major players are shipping laptops and netbooks with built-in WiMAX support. Older devices can use USB dongles or Express Cards. We expect a wide range of WiMAX enabled devices to emerge over the next few years.

WiMAX occupies a unique position with regard to education. The spectrum used for WiMAX is the same as the venerable education TV broadcast spectrum, commonly known as EBS. The FCC requires EBS spectrum licensees to provide "substantial education use."

In a model worth noting, recently Northern Michigan University (NMU) implemented WiMAX across the entire town of Marquette, covering 25 square miles. The 10,000 plus students, faculty and staff can access the Internet wherever they are in the city—a service provided at no additional charge. This may be the first system of its kind in the US where an institution installed and operates its own WiMAX network for students and for government offices.<sup>32</sup>

### Cellular data services — 3G/4G

Major cell phone providers all have cellular data networks, which are required for proper smartphone operation. They go by names, such as UMTS and EVDO. Generally these networks are optimized as companions to carrier cell phone operations, as opposed to WiMAX, which is a type of 3G/4G network, but optimized more toward a pure data network. On the horizon you will hear about LTE, a new cellular data standard that promises much higher data rates, and could be deployed in 2011.

Sprint employs a novel approach to the 3G/4G opportunity. They are marketing devices that run on the Clearwire 4G network when available (Sprint is the majority owner of Clearwire and a MVNO through Sprint 4) and then switch to the Sprint 3G EVDO Rev A network when the 4G network is not available. We expect a range of devices that support this dual network approach.

## APPLICATIONS AND USAGE MODELS

As exciting as devices and operating systems are, they are only the enablers of education applications. Fortunately, almost all current desktop applications work just fine on a laptop, and most work well on a netbook (the issue of screen resolution being a key issue). Some of the web-based applications work on a smartphone, but different processors, operating systems and screen sizes are major impediments.

We expect a continued flow of applications aimed at desktops, laptops and netbooks. Of all software publishing opportunities, this is perhaps the area of greatest new growth and the potential for disruptive change. Three major value-added factors enabled by mobile devices will drive this growth:

- ♦ The change-in-use paradigm from desktop to laptop to handheld. The physical logistics of desktop computers, including space, power, etc., preclude their ubiquitous presence. Laptops, netbooks, and smartphones do not have this constraint. Every student can have a mobile device, creating a real game changer.
- ♦ Connectivity everywhere. Students, faculty, and administrators are more mobile than ever, requiring connectivity wherever they go—creating a need for new types of applications.

*As previously mentioned, most students and faculty in postsecondary institutions have a cell phone or smartphone.*

*Institutions are going to want to use the technology students bring in their pocket to school every day.*

- ♦ Special features like GPS, accelerometers, compasses, and presence indicators. These also enable completely new and educationally valuable software applications.

The question is often asked: “How can we rationalize the use of different types of devices?” One way is by the expected length of time the device is used, per interaction:

- ♦ Cell phone/smartphone – Quick access, and short interactions.
- ♦ Smartbooks – Quick access, similar to a smartphone. Larger screen and keyboard make them suitable for sustained interactions.
- ♦ Netbooks – start up time is longer. Sessions are much longer than smartphones.
- ♦ Large screen laptop – Startup times longer than netbooks. Screen size and other features make these suitable for all day use.

Additional differentiation scenarios exist.<sup>33</sup> Here are a few examples of applications and usage models enabled by mobile devices.

### **Cell phones in the classroom: The next big thing**

As previously mentioned, most students and faculty in postsecondary institutions have a cell phone or smartphone. Many college students no longer have a landline—a phenomenon that has occurred quite rapidly. Colleges and universities are leading the way in implementing applications that exploit the use of the student-owned device. The K-12 world lags behind, hobbled by archaic laws and the perceived need to be in control of all devices and content in the classroom.

We believe there will soon be a sea change in the use of cell phones (and media players) in the classroom. Our logic is:

- ♦ While it may be inevitable, it will be a long time before 1:1 laptop programs reach every student.
- ♦ Almost every high school and college student, and soon almost every middle school student, will have a cell phone or smart music player capable of browsing the web and running applications.
- ♦ Phones are getting better, faster, and more connected, as described earlier.
- ♦ Carriers are moving to improve service, including focusing on coverage and back end usage inhibitors such as latency and backhaul bandwidth.
- ♦ Web site operators are increasingly building mobile friendly web sites.
- ♦ Institutions are going to want to use the technology students bring in their pocket to school every day. So while institutions are unlikely to buy cell phones and data plans, they will find a way to use student-provided technology as a supplement to the print world and other technology already available. Twitter, Facebook, Friendfeed,

and a host of other social networking technologies have taken root and captured the imagination of America's school age population. Educators ignore them or try to suppress them at their peril. While school administrators may see Twitter as the most advanced in-class note passing technology, the student body has embraced social networking to a degree that provides opportunities for both teachers and administrators. A good industry description of this opportunity accompanies the FAQ for Blackboard's Facebook Application:

*"A very large percentage of students are spending lots of time on Facebook but their academic life is not represented there, thus distancing students from their education. Faculty/administrators were looking for a way to help students bridge their social and academic lives, as well as to leverage those social interactions that are already occurring for social learning. But they were also concerned about aligning themselves with 'fad' technology and the safety and security of doing so. They needed a solution that helps them integrate without compromising the integrity of their systems and data"*<sup>34</sup>

*Institutions are going to want to use the technology students bring in their pocket to school every day.*

## New application areas enabled by mobile

Here are just a few examples of potential student cell phone usage in the future:

- ♦ Student response systems - Software exists today to allow teachers to use their cell phone as a student response unit. To try this, go to [www.poll Everywhere.com](http://www.poll Everywhere.com).
- ♦ Notification systems - Products like School Tipline ([www.schooltipline.com](http://www.schooltipline.com)) enable authenticated anonymous reporting of safety issues to school authorities, as well as mass outbound notifications of users for events such as weather problems or worse.
- ♦ Podcast playback – Lecture podcasts can be replayed at a student's convenience. If students are absent (excused, of course), this tool can help keep them up to speed. The capability to watch and listen to podcasts from multiple teachers and students on the same topic allows a student to select the one which best matches their learning style.
- ♦ Mini quizzes – This would allow students to receive a one-question quiz for each subject and the data to be fed into the learning management system.
- ♦ Real world data observations – If a class assignment requires data observations, the data—along with pictures, sound recordings movies, and GPS locations—can be recorded and provided to a central database.
- ♦ Social media - While not strictly a mobile topic, the explosion of both social networking and mobile device technology in the last year are inextricably intertwined.

*In other parts of the iTunes Store, Apple hosts iTunes U, which contains podcasts of a broad range of university courses, many of them free, from more than 200 colleges and universities worldwide.*

- ♦ **Augmented Reality** – Imagine an application that beeps when a student is close to an object with educational significance such as a historic site or geographic feature. The student has the option of listening to and watching related information. This only works for mobile devices with a GPS.

As is frequently the case, postsecondary institutions lead the way in experimenting with new technologies. One interesting presentation on this subject is located at: [net.educause.edu/ir/library/powerpoint/MAC08050.pps](http://net.educause.edu/ir/library/powerpoint/MAC08050.pps). The key takeaway is that cell phones in themselves are not particularly valuable in schools. They become valuable after significant planning and usage modeling.

## BUSINESS MODELS

### The mobile app and media stores

One of the spectacular successes in the mobile industry has been Apple's iTunes App Store. Two years ago, there were approximately 1,500 applications in all categories. Today, the iTunes App Store offers more than 150,000 applications for the iPhone and iPod Touch — more than (author's note: couldn't find a reliable number for this) of which are in the education category.

In other parts of the iTunes Store, Apple hosts iTunes U, which contains podcasts of a broad range of university courses, many of them free, from more than 200 colleges and universities worldwide. Institutions including Stanford, Harvard, Yale, Duke, UC Berkeley, MIT, Missouri State University, and Johns Hopkins University, as well as community colleges such Harrisburg Area Community College, offer content on iTunes U. Overseas, Oxford, Cambridge, Edinburgh, and Warwick universities in the UK in addition to universities in Canada, Ireland, France, Australia, New Zealand, Germany, and Norway offer a wide range of courseware in podcast form.

In K-12 education, some districts such as the Montclair Public Schools in New Jersey offer content ranging from elementary school courses,<sup>35</sup> through middle school foreign language course supplements,<sup>36</sup> to content aimed at district staff professional development.<sup>37</sup>

### The app store rush

The success of Apple's iTunes App Store has caused a flurry of activity from other players in the mobile market. While each of the wireless carriers has offered an online applications store for some time, many are refocusing their efforts in an attempt to emulate Apple's success. Today, most carriers' mobile apps stores are buried deep in their website, usually under a topic like Games.<sup>38</sup> In many cases, the download stores are managed by Handango, which also operates its own online downloads store.<sup>39</sup>

Nokia, the largest handset manufacturer, has recently opened its OVI app store.<sup>40</sup> It is difficult to tell how many applications are available, because not all applications will run on all models of Nokia phones. But for popular models, the count of available applications ranged from 100 for the Nokia 6300 to 485 for the E71.

OVI considers games to be a separate category, and the number of available games for the Nokia 630 was 241 and 288 for the E71. These numbers are a tiny fraction of the tens of thousands of applications and games available for the iPhone and iPod Touch. Like the iTunes store, Nokia offers music sales online but only in some parts of the world, and not in North America. The OVI store has no equivalent to iTunes U and its podcasts. The OVI store has only been open for a few weeks, and we will be watching closely to see if Nokia can duplicate the explosive growth that Apple achieved during its first year. The Symbian Foundation maintains the Symbian operating system used on roughly half of all mobile phones in the world, including most Nokia phones. Rather than add yet another app store to the scene, they have announced a plan called Symbian Horizon.<sup>41</sup> Modeled after book publishing, Horizon looks to provide mobile app developers a single entry point into all of the stores that sell applications for the Symbian OS, whether run by carriers, handset manufacturers, or others.

Microsoft launched a Windows Mobile application store in October of 2009 called Windows Marketplace for Mobile.

## WIIFY – WHAT’S IN IT FOR YOU, THE SOFTWARE PUBLISHER?

The evidence strongly suggests that the world of educational technology is moving rapidly from fixed to mobile. It is likely there will be several flavors of mobile computing, and some will be winners. The good news is that as publishers gain more competency in defining and developing mobile computing applications it will matter less which device or which platform is used. The more important intellectual property will be in the application itself.

- ♦ K-12 laptop-netbook market
- ♦ About 55 million students.
- ♦ About five million laptops, netbooks, or tablet computers. For the most part the software purchaser is the school. Today there are very few applications that exploit mobility—most just accommodate it.
- ♦ In five years we expect the number to grow to 15 million machines. Given this growth, the incremental software sales will be about \$1B.
- ♦ We believe there will be substantial sales directed at students and parents as consumers. These sales could also top \$1B.

*The success of Apple’s iTunes App Store has caused a flurry of activity from other players in the mobile market.*

*The evidence strongly suggests that the world of educational technology is moving rapidly from fixed to mobile.*

## K-12 smartphone market

- ♦ In the US there are about 10 million students with cell phones.
- ♦ The estimated average education application spending level of about \$30 per student computer per year could be extended to cell phones. This would yield an incremental \$300M to software publishers.
- ♦ Student/parent spending for educational applications could yield an additional \$300M a year. Note that students are purchasing that amount in ringtones already.

## Higher ed laptop-netbook-smartphone market

- ♦ About 18 million college students<sup>42</sup>
- ♦ About 10 million have laptops or netbooks
- ♦ About six million have smartphones
- ♦ In five years we predict that the total number of smartphones and laptops will exceed 25 million, as many students will have both
- ♦ Generally the student is the consumer. Total sales could top \$1B annually

We believe the market for software optimized for the mobile education market is poised to grow rapidly. To be successful, publishers will:

- ♦ Focus on ease of use
- ♦ Recognize and exploit new functionality enabled by mobile
- ♦ Find new ways to reach new consumers

## A FIVE-YEAR FORECAST

Five years out is just on the edge of where a forecast can be based on data and not science fiction. Five years is also the approximate timeframe for a company to identify a new market, launch a new product, refine and then enhance it to create substantial value.

### Forecast 1: Cloud computing becomes a big thing in education

Today, schools are embracing web-hosted applications in increasing numbers, paving the way for much larger-scale cloud computing initiatives. According to Google searches, in 2008 there were 3,540 hits for “cloud computing” and “K-12.” There was only one hit for “cloud computing” and “K-12” and “technology plan.” In 2009, the numbers grew from 3,540 to more than 30,000 and from one to 511. We expect that these numbers will continue to grow dramatically in the coming years.

Some cloud computing implementations offer powerful opportunities to both large and small institutions. As applications become more sophisticated, it becomes more difficult for thinly staffed technology departments to implement them. Cloud computing offers all institutions the opportunity to participate.



Very powerful and costly-to-run applications can run in the cloud and provide services at a reasonable cost to institutions. Another advantage is simplicity. One example is the home-school connection. Student-generated files (pictures, music, word processing docs, etc.) can all be stored in the cloud and accessible to stakeholders in a secure and monitored way.

Cloud computing will open up the opportunity for new applications and new hardware that do not exist today.

### **Forecast 2: A cell phone in every pocket**

We expect that schools will soon begin to embrace the technology already in the hands of students in a major way, with an explosion in the number of conference and professional development sessions on how to use student-owned devices effectively in academic settings.

### **Forecast 3: 3G and 4G Take Off**

Industry experts are projecting 3G data usage to grow at 19% compounded, across all industries. We believe the growth rate in education will be even faster. Students are demographically very data-hungry. Student access to digital instructional materials anywhere they can currently read a book, with 99.9% uptime, will allow educators to move rapidly from print to electronic media. A key driver will be personalization. Personalized learning is difficult or impossible without digital materials, and it is difficult to implement digital materials without 3G or better connectivity.

At the university level, WiMAX has been on the radar for a long time. See:

<http://www.newsdesk.umd.edu/scitech/release.cfm?ArticleID=1652> and

<http://cms.bsu.edu/Features/Global/MakinganImpact/WiMAXPioneers.aspx>.

K-12 has been very slow in catching up. With the upcoming deployments by Sprint and the availability of a wide range of WiMAX infrastructure and devices coming to market, we expect to see very rapid growth for this market segment.

### **Forecast 4: Student devices grow in specialization and differentiation**

We are beginning to see specialized student hardware from the big-name OEMs, and these machines are expected to sell in large volumes. In addition, the rapid growth of the mini laptop market will likely prove to be the basis for specialized K-12 versions.

Between smartphones of all varieties, non-phone devices like the iPod touch or other rich media players, tablets and mini-tablets, laptops and mini-laptops, the choices will be numerous. The growth in K-12 volumes should entice big-name manufacturers to consider targeting these devices for the K-12 market.

*Today, schools are embracing web-hosted applications in increasing numbers, paving the way for much larger-scale cloud computing initiatives.*



*The plethora of devices is both a threat and an opportunity for K-12 publishers.*

The plethora of devices is both a threat and an opportunity for K-12 publishers. Which will find success in the demanding K-12 market? Which will offer hype that exceeds reality? Publishers should hedge their bets by facilitating multi-platform operation of their products.

### **Forecast 5: New business models will emerge**

New business models always emerge. The trick is to ascertain which will survive. A few candidates appear to offer potential:

- ♦ Hardware bundled with an application software suite. As hardware prices drop, education may follow the cell phone model where the hardware is included. This could be coupled with a cellular data plan.
- ♦ “All you can eat” aggregator plans. Schools would sign up for a fixed per-student fee, have access to a variety of products, and receive a substantial discount versus separate purchases. Vendors receive revenue as their product is used.
- ♦ iTunes U or similar. Distribution is a challenge for software publishers. iTunes U offers much more efficient marketplace, particularly for smaller publishers.

## **A BRIGHT FUTURE AWAITS**

The nexus of powerful, low-cost mobile computing, blazing fast connectivity, robust operating systems, and cloud computing has the potential to transform our industry at an unprecedented rate. As education publishers consider the opportunities afforded by this convergence, they should see a bright future.

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Thanks again

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