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Quotes of Note

James S. Cross, PhD
Longwood University, retired

"We will watch the campus technology landscape as it continues to evolve in exciting directions during this decade, driven by mobile, social, cloud, and big data technologies."

Mark Reynolds
IT Associate Director
University of New Mexico

"The trending challenges and opportunities with technology have created synergies for IT that we have never embraced before. What an exciting time for IT!"

The Year Ahead

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<td>March 3 – April 2, 2014</td>
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Core Purpose and Values

ACUTA's mission is to advance the capabilities of higher education communications and collaboration technology leaders.

ACUTA's core values are to:
- encourage and facilitate networking and sharing of resources
- exhibit respect for the expression of individual opinions and solutions
- fulfill a commitment to professional development and growth
- advocate the strategic value of information communications technologies in higher education
- encourage volunteerism and contributions by individual members
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From the ACUTA CEO
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by Corinne M. Hoch, PMP

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SDNs are not the slam dunk that other types of virtualization have been. Moving to an SDN can disrupt the university network infrastructure, be costly, and create management challenges.

Paul Korzeniowski

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Staff have a new expectation for the work of the future: not as silos, but as one community. The gains extend beyond the virtualization solution to include abundant opportunities for professional development, the creation of strong support networks, and a more unified IT community.

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Indiana University

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One thing is for certain: Technology is changing rapidly, and we must change with it. (I sometimes even wonder if the etymology of the word technology includes the concept of change.) In this issue of the Journal, we will be looking at this change in the form of “Emerging Trends in Campus Technology.” Topics include new library trends, localization services, virtualization, and gigabit networks (to name just a few).

Personally I enjoy these changes—especially the patterns I am now seeing. The walls between technology, business, education, and academia are coming down. Serious attention is being given to the presentation of information and not just data.

Additionally, much thought is being put into the usability of devices so that we can concentrate on our task. All of these trends are good but can be very unnerving to those who are unprepared and don’t keep up with the changing times.

This change creates some problems for us as the leaders of information technology on campuses. One problem we face is how to keep our staff informed and up-to-date on all this change. With decreasing travel budgets and people’s reluctance to travel and be out of the office, we have to find other methods to keep our staff informed about new technologies, emerging trends, and our students’ needs. One of the concepts that is emerging quickly and loudly to help us is that of a MOOC—massive open online courseware.

A MOOC is a Web-based information transfer environment where participants exchange ideas, facts, and other variations of knowledge with each other. It is a form of distance education that allows for collaboration, networking, and the exchange of information within the Web. One MOOC can be between tens, hundreds, or thousands of participants who can be taught by one trainer or instructor or multiple instructors within the group. The MOOC is a free, open service where instructors can give information to participants quickly, efficiently, and without physical presence. Opinions vary on the accuracy and efficiency of MOOCs and whether they are fit to replace other methods of information transfer, but surely MOOCs have their place.

MOOCs challenge the idea of what the typical learning process is. Generally, MOOCs do not provide college credit unless given permission by a university or college. When college credit is possible for participants, the university or college is normally the host of the MOOC, and an internal trainer or professor is leading the MOOC. New technology and trend discussion topics can be addressed in as much depth as the participants want as long as it fits the given timeline. This new-aged form of information transfer can reach larger audiences better than the typical learning environment, where time and space are much more confined. MOOCs also show a new direction for information transfer/education to a more student-centered learning rather than instructor-led learning.

We now live in a world where information is everywhere and much easier to get than ever before. MOOCs give people an opportunity to exchange information in an open forum with nothing more or less than an Internet connection. In a MOOC, the people participating are in control of how often they are online, how much they want to learn, how much they participate in discussions, and whether they have been successful in the learning process. MOOCs are fluid and can be based on any topic, technology, or trend.

Participants using a MOOC may face challenges. Technological inclination is necessary in order to find and use a MOOC properly. This can be problematic for those with disabilities, but not for those people on our staff who have the Internet and technology savvy. Due to the MOOC’s fluid nature, it can be difficult to stay on one specific topic or idea for a sufficient amount of time. Additional challenges are finding the MOOC with the proper validity and credibility and dealing with a fluid time position (you can miss an important topic when you sleep).

Despite the challenges, many benefits come from the use of MOOCs. One benefit is the increased development of technological skills and an understanding of the educational environment within our campuses. MOOCs also give participants flexibility of time and do
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not require travel or time away from the office. MOOCs give people a voice that provides the opportunity to learn more about one or many different topics.

A massive online course is a form of learning new skills, new technology, and emerging trends that reach beyond the boundaries of a normal conference, training session, or classroom. I encourage us, as leaders within this field, to do one of two things: (1) Look into the MOOCs already out there on the Web to assist our staff in keeping up with current technologies and trends. (2) If you consider yourself a leader in a technology or trend, host a MOOC to help others grow. The more we give, the more we get.

And, speaking of change, welcome to a new look for the ACUTA Journal, our flagship publication! We hope you enjoy our new image and that, as always, you find topics of interest in this issue. We always try to present information you can use for personal and professional growth, and we welcome your comments and suggestions at any time.

As ACUTA's president for the coming year, I encourage you to send me your ideas for ways we can help each other. If you see or hear about a concept that would turn challenges into successes, share that with others through ACUTA. I am always available at rkovac@bsu.edu.
Not so long ago I stood on the dais at the 42nd annual ACUTA Business Meeting at the Manchester Grand Hyatt in San Diego and listened to the electric buzz in the room as you shared so willingly your projects, budgetary status, cloud computing efforts, and impact of BYOD. That’s one of the core attributes of our organization—the networking, openness, sharing. That’s what makes us different from other organizations. We care, and we make connections.

And on that day I promised to let you all know what’s happening at other schools—a lot! The following will provide a snapshot of what you report is going on today at campuses large and small, public and private, with and without residence halls, which I thought was appropriate for the theme of the summer Journal, “Emerging Trends in Campus Technologies.”

The initiatives that you say are most important on your campuses are DAS campuswide, WiFi or ubiquitous wireless, wireless in the dorms, and VoIP.

1. The DAS Bootcamp was presented by Phil Ziegler, principal consultant, ECC; founder of the CIBET Training Initiative; and member of the Safer Buildings Coalition. It provided an introductory overview of topics in DAS science fundamentals, leading to more advanced training and certification for engineers and project managers.

2. The Internet2 Net+ SIP in the Cloud workshop was presented by Walt Magnusen, PhD, director for telecommunications at Texas A&M University, and assistant director Christopher Norton. This workshop offered an in-depth look at how to manage hosted VoIP services and SIP trunks from the contract to the operational phases. Participants learned to configure new lines, configure instruments, add features, turn up SIP trunks, and perform other daily operations.

Both of these workshops were offered in response to interest and demand, as part of the mission of ACUTA “to advance the capabilities of higher-education communications and collaboration technology leaders.” Your input is always valued and appreciated as we try to make things happen that will meet your needs.

What a difference a year can make. Last year unified messaging/uniﬁed communication was reported as the most important initiative. This year it moved to fourth place, which may indicate that many implementation efforts have been completed and/or that they are ongoing. Infrastructure upgrades took third place, as reported at the Business Meeting, perhaps to support the burgeoning connectivity requisites.

Other initiatives or challenges include the following:
• The issue of security (some research-DMZ) as more and more services are moving to the cloud (Google Apps, Office 365, etc.) and mobility device management demands it, transitioning from PRI to SIP trunking with one school using that for disaster recovery, identity management, and data center consolidation/restructuring.
• Voicemail and PBX upgrades, secondary disaster recovery and backup site, e-learning, and consolidation of services.
• Virtualized servers, videoconferencing, replacing two-way radio service, regional growth (the challenge of providing the same level of services and experiences offered at the main campus), rate structure, PeopleSoft implementation, new student ﬁnancial records system, MPLS, master database strategy, managed print services, Lync Online or On Premise, limited staff, IPv6 (who’s driving it and how to effectively deploy), forklift communications upgrade, business social network, and a Pinnacle implementation.

It is interesting to note that when asked how the economic recession of the past few years affected your IT department’s spending, the majority of schools responded that budgets are ﬂat with some project dollars available, followed by the schools that reported that their budgets are starting to increase, followed by the schools that reported no change. And then there are always the schools that continue to live with budgetary constraints.
When asked to what extent cloud services have come to your schools, the responses indicate much growth in areas other than just e-mail. Data storage and VoIP in the cloud prove that what you were exploring last year is becoming reality with such things as:

- Google Apps
- Microsoft Office 365
- Amazon/Dropbox
- Door locking
- Mass notification
- Video- and audioconferencing
- Fax
- Disaster recovery
- Data analysis
- High-speed computing
- Consolidated purchasing
- CMS

- Call accounting/telemanagement

It is not surprising to note that some schools look first to the possibility of cloud sourcing when faced with the need to implement new technologies. Some schools are looking into the development of providing internal cloud services. And some schools are not interested at all. Everyone shares concern about privacy and security with cloud management.

When asked what impact BYOD is having on your campus, your responses included the following:

- Security/risk management concerns
- Past it all; have dealt with it for years
- Mobile device management
- Struggling with support, straining networks, DAS investigations

As you know and as you will see in the following pages, there is much work going on behind the scenes, preparing each campus to support the ever-changing needs of higher education. We encourage you to continue to use ACUTA as a resource for benchmarking, pragmatic information technology sharing, to find out what will work in your environment. Let me know if there are questions for which you seek answers, and we will continue to connect you with the experts in your field. Reach me anytime at choch@acuta.org.

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Booking It—High Tech Style
The new James B. Hunt Jr. Library at NCSU is a futuristic model of technology at its best

North Carolina State University's new James B. Hunt Jr. Library lays claim to being "the academic library with the widest array of technologies in the country." If not number one, it certainly is in the top couple.

The library, named for former state governor Jim Hunt, is a working showcase of technology and design innovation. There is little doubt that NCSU will have a flood of both IT technology wonks and librarians stopping in to assess the applications the library supports. All of the most modern IT equipment imaginable is available to the NCSU faculty and student body on a first-come, first-serve basis. "This is a technology sandbox or incubator for the whole university," says Maurice York at NCSU, who has been the head of information technology for the libraries at the NCSU system since 2008.

What is almost as amazing as the technology there is the size of the support staff: just 11 IT people do everything from monitor systems to consult with faculty and students on uses for the technology.

"It's really difficult for people to understand until they actually come and see it," says York. Described by Scientific American magazine as "an amazing place" and recently showcased in Architectural Record, the 221,000-square foot library also houses more than 100 project/study rooms and multiple reception and event spaces.

"Many of the library's technologies will reach beyond our campus, and that is facilitated by our partnership with the North Carolina Research and Education Network [NCREN]," says ACUTA representative Greg Sparks, director of communications technologies for NCSU. "We have multiple 10 Gbs connections into NCREN, which in turn has multiple 10 Gbs connections to commodity providers, Internet2, and the National Lambda Rail."

This will complement NCREN's recent work to complete a $144 million expansion across North Carolina in an effort called the Golden LEAF Rural Broadband Initiative. "This effort combined significant Broadband Technology Opportunity Program funds with $40 million in private investment resulting in connectivity to each of the 115 K-12 school districts in North Carolina among a multitude of other connections," Sparks says.

According to the university, the library's IT and AV technology was made available thanks to the coming together of three technology trends:
1. Ever-greater bandwidth and cheaper computing that allows the library to offer computing-intensive applications such as large-scale visualization.
2. Intuitive, touch-based interfaces to computing devices that make it easier to interact with information and data.
3. Inexpensive mobile devices that combine computing and communications—and let library users constantly interact with information, spaces, and each other, wherever they are on the campus or in the building.

"The Hunt Library, while absolutely an innovative consumer of technology, is just an incremental add-on for us," Sparks says. In addition to the basics often found in current buildings—such as wireless connectivity and flexible, easy access to electrical power—the library offers virtual browsing, videoconferencing, online room scheduling, collaborative projection, video walls, and digital media production capabilities.

Big Backbone, Flat Design
"We're fortunate to have the support of our governance structure in our philosophy of maintaining a highly scalable, flexible, cost-effective architecture," Sparks says. "Our approach to this is in a fairly flat network design that has each building connecting to an aggregation layer that in turn connects to the core."

The backbone is gigantic. "Our backbone network is extremely robust with multiple 10 Gbs interconnections and can support individual client connectivity ranging from 100 Mbs to 10 Gbs," Sparks says. "As a world-class research university,
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4 KEYS TO CAMPUS CONNECTIVITY

1. **START STRONG**
   Focus on the campus backbone with options on Fiber, Ultra Broadband, and legacy TDM.

2. **EMBRACE BYOD**
   Virtualize the wireless network to provide scale and improve security and reliability.

3. **USE EXISTING CABLING**
   Leverage technology innovations to provide data connectivity to older facilities.

4. **WORK SMARTER**
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we balance the need for these extreme-use cases with the cost savings of not performing campuswide upgrades. We are very focused on network management and metrics allowing us to upgrade only as necessary at very granular levels.”

The library has 40 giga to the server room that is managed by the library IT staff. That steps down to a 10-giga backbone with one gig to the desktop, according to systems designer Scott Frey, CTS-D, of The Sextant Group. They served as a consultant to NCSU, helping them engineer the project and, according to York, are expected to continue in that role.

Frey says there are actually two networks within the library. One is managed by the NCSU library IT staff, and the other is managed by the campuswide NCSU Office of Information Technology.

“"All the essential tools to leverage emerging technologies in support of today’s learning models are here," says Frey. "State-of-the-art technologies have at last been placed directly into students’ hands. Some are saying it will prove to be one of the most innovative facilities in the United States, and a template for libraries well into the future.”

Everything specified by The Sextant Group was new, state-of-the-art equipment. That technology was just as new to the IT staff as it is to anyone else.

The People

When the library building was funded by the state, there was absolutely no money allocated for positions to fill out the IT department.

“We did not receive any additional funding or resources as a result of this building coming online," Sparks notes. “As with any new building, we spent time with the library staff understanding their needs and right-sizing the connection to the campus backbone.”

There certainly were challenges. “We were bringing online three or four major systems that we never ran before,” York recalls. “How were we going to scale the network without adding anyone to run it?”

Part of the answer was to focus heavily on virtualization and a cloud infrastructure. The idea was to get rid of the hassles of desktop management and free up time to focus on the audiovisual and display technology.

“[The library] finally did get two extra positions,” York says. One focuses on gaming and one on graphics. Those jobs came after all planning was completed.

“We do run a full-service operation,” York continues. The system is comparable to what one might see at a military command center or a corporate headquarters. His IT staff is responsible for consulting with students and faculty to translate a researcher’s vision to the technology and apply that vision to their research.

Today, there are four systems administrators/engineers in the direct-support group. There are four more positions to support the sound, display, and general operations. Three people focus on technical consulting. Some of those projects are esoteric since the school has people working on everything from agricultural methods to NSS grants. The IT staff works with everyone.

“We are really lean,” York understates, adding that they do go after grants for funding. “Our goal is to have all of this technology available to undergraduate, graduate, and faculty without restrictions.” He notes that programs like the school’s nuclear engineering major require enormous amounts of calculations and working in clusters. “A junior can access all of that,” he says. The array of technology is mind-boggling.

The Technology

Sometimes, York sounds like a kid on Christmas morning—a kid who got the bike and the trains and the football autographed by his hero—"The technology is awesome," he says.

If it was Christmas morning, the wish list was put together by Sextant’s Frey. “I specified Christie Digital projection in the Teaching and Visualization Lab as well as the Creativity Studio,” Frey says. There is an 80-cube Christie (www.christiedigital.com) MicroTile video wall in the Game Lab. The Game Lab is not an expensive version of Windows solitaire. It is for scholarly study of computer games. Northern Kentucky University, the School at the Art Institute of Chicago, and Texas Tech all have Christie products in place. Texas Tech’s Rawls College of Business wanted a digital media wall that instructors could use to display lecture materials to a room of 247 students. Their digital display wall has 108 Christie MicroTiles suspended on custom wall brackets fabricated by Custom Display Solutions. It was completed in October 2011.

The MicroTiles at NCSU and elsewhere have 70 times more pixels than the most popular 4 mm surface-mount display LEDs. They can reproduce 115 percent of the NTSC color gamut and exceed standard LCD flat panel color output by more than 50 percent. They are engineered to be configured in any size, shape, or orientation to form a digital canvas with barely visible, 1 mm seams.

For the budget-conscious, there are no bulbs to replace. The MicroTiles automatically self-calibrate for color and brightness. They have built-in sensors that monitor each LED’s performance. Each tile detects its neighbor and adjusts its image to optimize the overall display. This self-calibration happens at

Figure 2: Inside NCSU’s new library
setup and continuously over the life of the display. They are
easy to service, too. A simple suction cup on a handle removes
any individual tile. Tiles can be replaced or serviced in less
than 15 minutes, without having to turn off or bring down the
whole array.

An external control unit (ECU) is required for each wall.
The ECU delivers content to the array, and is compatible with
all standard graphic formats, playback devices, and main-
stream creative and digital signage software. The ECU is set up
using the company’s Web interface.

Extron XTP switching (www.extron.com) and AMX con-
trols (www.amx.com) were deployed in all of the audiovisual
spaces. XTP provides a completely integrated switching and
distribution solution for multiple digital and analog formats.
They support local connectivity as well as extended trans-
mision capability for sending high-resolution video, audio,
RS-232, Ethernet, and power up to 330 feet over a single CATx
cable. XTP Systems deliver extremely high switching and
transmission performance to support a wide range of video
formats, including the highest-resolution DVI and HDMI
signals. The high-data-rate digital backplane provides a future-
ready AV integration solution.

AMX targets scalable systems. Just in case NCSU’s system
becomes dated someday, their AMX controls allow the flex-
ibility and adaptability to change. AMX uses standards-based
technologies such as USB, HDMI, twisted pair, Linux, and
others to provide interoperability and future proofing.

Sennheiser K-array loudspeakers and amplification
(www.k-array.com) were specified to meet high-end audio
requirements. The K-array systems are deployed elsewhere in
a broad range of upper-end audio applications ranging from
tony nightclubs in London to Montreal’s Olympia Theatre.
NCSU’s components are designed by the K-array R&D depart-
ment and custom made under the K-array quality control
system in Italy.

The digital media production lab was outfitted with a 4K
camera as well as both Mac and PC editing stations.

As you might expect, all of this equipment cost a pretty
penny.

Paying the Bill
Although the North Carolina General Assembly budgeted $114
million for the library project as a whole—everything from
bricks to computers—that allocation will not pay for every-
thing.

“Everything was purchased new for this project,” Frey says.
The original AV budget was $1.7 million. “I believe the budget
has grown to over $8.5 million at this point for both AV and
IT,” he continues.

The Hunt Library raised more than $7 million from private
donors. “It was an amazing effort, in my opinion,” Frey says.
Some of those funds came in the form of technology that was
given to the college. Cisco (www.cisco.com) donated one of its
new immersive Telepresence TX9000 systems to the library, the
first installed in the county, Frey says.

The inaugural call was actually made by Cisco’s John Chamer-
bors to more than 6,000 sites worldwide. There are also 13 other
technology partners, including Dell, EMC, and Intel.

Cisco’s top-end Telepresence C90 codecs have been installed
in the main server room. The company calls the TelePresence
Codec C90 “the most powerful and flexible Cisco collaboration
engine, serving telepresence studios, boardrooms, auditoriums,
education, and telemedicine applications.” They offer 1080p
high-definition (HD) video and ultra-wideband audio.

“Both the Creativity labs and Teaching and Visualization
Labs can access the C90s from the installed AV fiber backbone,”
Frey says. The C90 has end-to-end HD video, HD collabora-
tion, and HD embedded-conference capability. The codecs are
two rack units high and rack mountable. They provide H.323/
SIP up to 6 Mbps point-to-point; and up to 10 Mbps total
multisite bandwidth. Each codec will connect up to 12 HD
sources and eight microphones directly into the interface. They
have full-duplex audio with high-quality stereo sound. Each is
backed by application programming interfaces. They require
Cisco Unified Communications Manager version 8.6 or later.

“Telepresence gives the library the ability to share content
and classes throughout the university as well as the world,”
Frey notes, taking the library’s services far beyond the Centen-
nial Campus.

“In North Carolina, we have a high-speed backbone that
links campuses,” York says. But now NCSU will link its tech-
tology to all of the campuses it works with around the state,
country, and world.

Susan K. Nutter, vice provost and director of the NCSU
Libraries, says, “We expect visitors from around the country, if
not the globe, not only because it will be a beautiful, inspiring
building, but because of what it will offer students.”

But Are There Books?

Yes. Lest traditionalists fear otherwise, the library is stacked
with books. However, access to the books is via a high-tech
bookBot system that fetches books for users upon request.

Part of the reason for the bookBot was to free up more
space for student study areas. The UNC system standard rec-
ommends library seating for 20 percent of the student popula-
tion; before the new library, NCSU had space for less than five
percent. Installation of the bookBot automated book-delivery
system will free up even more precious square footage that
would normally be occupied by book stacks, allowing for more
learning spaces—and more high-tech centers.

Reaching Beyond

Even with a state-of-the-art facility that is barely open, there
are things they would do differently. “There’s always hinds-
sight,” York chuckles. For one thing, they would look harder at
power. “We put more power into this building than anything
else in the state,” York says. But at one point, someone pointed
out that there was a wall without power.

York certainly would have liked a roadmap for the project;
some guidance from other colleges that had done similar
things. As first out of the gate, that benefit was denied him. However, he encourages others to give such projects a shot. The more different universities accomplish, the easier it will be for all schools to push the frontiers of technology.

“Spend as much time as you can thinking about the infrastructure,” he recommends. For a project that was years in the planning, that is saying a lot.

He challenges other schools to follow NCSU’s path. He points to their “black box” theatre, known as the IPearl Immersion Theatre, with open ceilings and drop-grids, open floors, and the rest. (See Figure 2.) It allows students and faculty to project their work. “Take it all the way!” he encourages. He says that the project is truly capturing the imagination of faculty working there.

Yet he regrets there were no models for him to consult when the project got going. “We need to start building more models and constructing this kind of space, and finding more best practices,” he says. “We need to find more ways to put all the pieces together.

“They add so much value to the infrastructure,” York continues.

To that end, he tells other college IT specialists they should think beyond just the computing infrastructure. “It’s not just a big display wall—but finding the service you are providing that nobody else does,” York says.

Lastly, he says IT people need to build the computing power, network, and systems that will make it intuitive and easy for anyone to use. “You want to build something that’s useful and is used every day,” York concludes. “Something that is so easy to use that people can just get to work on their research.”

Sparks, too, is thrilled with the results. “I don’t really have any do-overs, simply a few observations about why things worked so well,” he says. “We have a wonderful governance group made up of IT directors from across campus that advises me on both strategic and operational issues so our team is always ‘in touch’ not only with the current state of technology on campus but also future plans. The library involved us early in the process, and we remained in communication throughout the project; so we partnered in selecting the appropriate network hardware to meet their needs,” Sparks adds.

“This also allowed us to recognize the handful of instances in which a locally managed network made more sense as well as gave us time to architect integration of these networks into the overall campus network,” Sparks concludes.

Libraries will never be the same.

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Near Field Communication Brings Convenience to Campus

Coming soon to a device near you: NFC, the Enabling Technology

by Hugh Griffiths

Sensitivity to user location has always been a big part of what makes mobile devices irresistible. Even the earliest university mobile apps helped students on the move to navigate and interact with their environment more effectively, with features such as campus maps along with more sophisticated services that help students find everything they need on campus—from available computers and washing machines to their fellow students. From the outset, mobile developers in higher education have sought to create as much value around location as possible. With location-based features already making a significant difference to the daily lives of today’s students, new technologies are now coming that will transform mobile services.

Our BYOD World

Adoption of mobile devices by students and across the population at large has grown to the point that this is now indisputably the age of BYOD (bring your own device). The 2013 comScore Mobile Future in Focus survey reported that “the U.S. smartphone market finally surpassed 50 per cent market penetration,” and points out: “Smartphones have surpassed 125 million U.S. consumers, and tablets are now owned by more than 50 million. We have now crossed into the Brave New Digital World—a new paradigm of digital media fragmentation in which consumers are always connected.”

As Donald Clark, a learning technologist who has advised organizations from the World Bank and the United Nations to the Irish government, says, “BYOD isn’t a recommendation, it’s a reality. Everyone’s bought one and everyone uses one and everyone carries it around with them.” Today’s sophisticated mobile consumer tends to buy the very smartphones that the organization itself would want to provide, making it even easier for universities to exploit the very latest technologies when delivering mobile services.

Improvements in network infrastructure are playing their part in breaking down the barriers to more widespread use of smartphones on campuses. In the final semester of 2011, for example, almost 25,000 students at the University of Iowa used the campus wireless service from a tablet or smartphone, an increase of almost 10,000 compared with three years earlier.

With the use of GPS now mainstream in this heavily penetrated market, mobile innovators are introducing technologies that complement GPS to create a new generation of location-based services for mobile devices that will improve both accuracy and usability. As smartphones and tablets come onto the market with in-built near field communication (NFC) readers, it is time to start developing services that work with the impressive capabilities of this emerging technology.

What Is NFC?

Near field communication is a wireless proximity communication technology that can transmit data over short distances in either active mode, initiating communication, or passive mode, activated by a request. NFC chips are inexpensive and durable. (Actual NFC tags cost less than one dollar each. The core platform, of which the NFC component is a standard part, is under $40,000, which includes all implementation costs and covers use by all students. There is also an ongoing annual subscription based on the size of the institution.) The tags come in all shapes and sizes and are adhesive on one surface, so they can be easily fixed in locations across campus. Universities can add a design overlay and even cover them with plastic to prompt users in that location to interact with them in a certain way.

Universities can write data to the chips very easily; they are easy to set up and customize, and they require no power to run or effort to maintain. They are already available in a number of...
bands and key fobs for access to specific areas or events. In the first instance, universities can set up NFC touchpoints next to foyers and rooms and write location-specific data to these NFC tags. This is similar to the use of QR codes, but NFC is more user friendly; it doesn’t even require the use of a camera. We can then develop mobile app features that make use of the data. (See Figure 1.)

As researchers from the University of Córdoba, Spain, pointed out in the Journal of E-working, it is the simplicity of NFC that separates it from other wireless communication technologies. All it requires to initiate a transaction is proximity. “NFC technology can give additional functionality to a mobile device, like using it as a contactless credit card or as a contactless bus ticket.” As long as the phone or tablet is within range, NFC will work without any manual intervention.

NFC is already being used in facilities such as airports for contactless payments, identity, and access management. Instead of security mechanisms like passes and swipe cards to access certain areas, airport staff are increasingly using NFC-enabled devices that require no conscious intervention for identification.

The NFC-Enabled University

Today’s universities, like airports, present genuine challenges that NFC can useful-ly address. Many universities worldwide are looking at it seriously to enhance the experience of the student on campus, and a growing number of early adopters are emerging internationally.

Newham College of Further Education in London is using NFC for attendance monitoring, saving time that can be rechanneled into teaching and learning. When linked up to back-office systems, the data that NFC generates can trigger early warning signals about students in trouble, helping the college to take action and retain as many students as possible.

Spain’s Universidad Católica UCAM is piloting NFC for a range of functions, including physical access, payments, and attendance across all staff and its 20,000 students. Users will be able to use their mobile handsets to access university buildings (such as the gym and the library), check bus times, hire bicycles, access campus parking lots, and make payments using a stored-credit system, with users loading funds onto their phones via a network of payment points.

In the United States, those students at Villanova University who have an NFC-enabled mobile phone can enter dormitories and academic buildings securely. This development at Villanova is driven by an understanding that students want to use their phones, which they have in their possession at all times, for as many campus activities as possible.

NFC sits comfortably with the desire of today’s students for convenience. Students want to get on with their studies and conduct their business with the university with minimal interference, according to a recent survey of students at American colleges and universities.

NFC makes it easy for them to pay for the things they need across campus, from libraries and photocopying to cafes, shops, and even transportation.

Location-Sensitive Menu Options

Access management, attendance reporting, and contactless payments are great examples of NFC making life easier on today’s campuses, but they are only the beginning. With NFC, universities can offer menus of information and service options that are contextual to the geolocation of the touchpoint. As a user enters a room on campus, for example, a menu might pop up on the device with location-sensitive options such as “check availability” or “book the room.” It might also offer relevant information such as a floor plan, a room inventory, or even operating instructions for the equipment in the room. The mobile device would pick up a unique identifier for that location, such as a room number, and then back-end systems would provide the services and information needed. (See sample screens in Figure 2.)
Every area of campus service provision stands to benefit. If an NFC touchpoint is positioned outside a campus dining hall, the mobile menu may offer today’s specials or the dish of the day. A user checking into a computer room might see an option to book a PC or printer. By linking to the learning management system, students could even access materials for the next lecture in that room or slides from the previous session.

Location-sensitive alerting capabilities within today’s smartphones and tablets as well as banners within mobile apps themselves can play a proactive role in interacting with students. If a mobile app can sense that it is near the library, through proximity to an NFC tag, it can alert the user to any items ready for collection, report on current loans, or notify the student of any books that are due to be returned. Alternatively, it could alert the user to nearby friends.

Granular Navigability and Check-In

Many universities are concerned about the challenges of navigating today’s sprawling campuses, which can be baffling for newcomers. GPS has not wholly addressed this problem; it is not yet sufficiently accurate within buildings. It can help to navigate between campus facilities, but students, staff, and visitors may need help orienting themselves in buildings themselves, many of which are very large, are complicated, and can even merge into one other. To meet this need, NFC tags, which have their GPS position encoded within them, can be used as touchpoints across campus to help staff and students navigate. So for the first time, universities will be able to provide detailed and usable navigability within campus buildings by linking mobile devices to floor plans and other navigational aids. NFC can also help users find out what is nearby.

For universities wishing to incorporate check-in facilities into their mobile services, NFC offers an attractive option. Apps like Foursquare are popular with students, but one problem to date has been the same lack of granularity that GPS suffers from. This has held universities back from relying on Foursquare to deliver location-sensitive services; like GPS, it is not dependably accurate beyond the level of a building. With NFC, on the other hand, a mobile app can automatically check mobile users into a room as they walk in, and even update statuses on social networking tools on the university app or on the Web, on a permission basis. Once checked in, users can access location-sensitive information or see which of their friends are already there.

**A Seductive Blend of Attributes to Transform Mobile Services**

What sets NFC-enabled services apart from other location-based capabilities is a seductive blend of three attributes. First, NFC is consistently accurate in geolocational terms. Second, NFC can interact with back-end systems to provide information and services that are detailed, personalized, and relevant to the user in that location. Third, by using institutional data rather than relying on generic data from sources such as Google, universities can provide students with targeted services. And with NFC, this could not be an easier user experience, with little to no action required and using the device that we know students have with them at all times.

*Hugh Griffiths is the CEO and founder of Omniel, the leading mobile app supplier in UK higher education.*
Virtualization is sweeping through the data center: It started with servers, is working its way to storage systems, and now has taken aim at university networks. Theoretically, network virtualization, often lumped under the banner of software-defined networks (SDNs), provides communication departments with a single point of network control, which speeds up service deployment, eases administrative tasks, and reduces costs.

However, delivering such capabilities requires largely ripping out and replacing the current network infrastructure. This massive undertaking means significant investments in new network equipment, a long—perhaps painstaking—process of upgrading network nodes, and a dramatic retooling of network engineers’ skill sets. While the change offers many potential long-term benefits, significant angst is expected in the short term as this technology begins to take hold in university networks.

SDNs represent a natural step in the increasing use of virtualization for computing systems. “The network industry has learned from server virtualization that one way to reduce complexity, or at least hide it, is to create a new layer of abstraction,” stated Casey L. Quillin, senior analyst at Dell’Oro Group.

Decoupling Network Hardware and Software
In a nutshell, SDNs are expected to dramatically change how networks function. Currently, tedious, time-consuming administrative tasks (such as setting up addresses and routing traffic) are linked to and performed on expensive hardware. With SDNs, these tasks are decoupled from the network switch and instead become software functions running on commodity hardware.

This change presents schools with a number of potential benefits. Network intelligence—from directing traffic to minimizing latency to security—moves from closed, expensive switches and routers to open, inexpensive, software-based controllers. Because network control is implemented via software, network complexity is reduced and automation increases. In addition, communications technicians work one common interface for all devices rather than a variety of proprietary vendor-specific solutions.

Theoretically, network management becomes much simpler. “A majority of schools use ticket systems, followed by phone calls and then e-mails to communicate moves, adds, and changes to the network team,” explained Andre Kindness, principal analyst at Forrester Research. “This manually driven way of communicating infrastructure change drags out deployment and response times.” SDNs automate those functions, which speeds up the delivery of network services.

Reaching Deep into Vendors’ Pockets
As evidence of the market’s potential, VMware paid $1.26 billion in July 2012 for SDN start-up Nicira Inc. “The price that VMware paid was much more than anyone expected,” said Bob Laliberte, senior analyst for Enterprise Strategy Group (ESG).

The potential paradigm shift to network virtualization has certainly caught network equipment vendors’ attention. As a result, suppliers are outlining various plans to add such features to their product lines. Established vendors, such as Brocade Communications, Cisco Systems, Dell, Extreme Networks, Hewlett Packard, and Juniper Networks, want to ride the SDN wave. In addition, startups like Adara Networks, Big Switch Networks, ContaXtream, Embrane, Vello Systems, and Vyatta have entered the fray.

Vendors are responding with products offering a variety of SDN techniques. Traditionally, suppliers relied on proprietary protocols to support their networking functions, but...
now open-source solutions are emerging as a viable alternative. Consequently, vendor strategies range from an emphasis on proprietary solutions to those based largely on open-source initiatives, such as the industry’s OpenFlow initiative.

**Aiming at the Kingpin**

Cisco has been the networking industry’s dominant supplier. “Competitors view SDNs as a way to loosen Cisco’s grip on the network equipment market,” noted Zeus Kerravala, principal analyst with ZK Research.

Cisco’s approach is called the Open Network Environment, or Cisco ONE. It features a web of software agents, hardware controllers, and overlay network technologies designed to make each layer of a network—from the transport layer up through the management layers—programmable. “For several years, we have been trying to make our devices more programmable, and SDNs represent our latest step in that direction,” explained Kaustubh Das, senior director, product management, software-defined networking and programmability at Cisco.

Cisco ONE supports a variety of deployment models and a wide range of functions. The system features network flow management for massively scalable data centers and automated provisioning and programmable overlay networks for multitenancy cloud providers. The solution supports programmatic policy and analytics used by service providers.

**Extending Beyond the Control and Forwarding Planes**

To enable those functions, Cisco has opened up areas above and below the control and forwarding planes typically done by the new controllers. This approach allows customers to customize their networks using a variety of protocols according to their needs.

The Cisco One solution requires a number of interrelated components. It runs on the Nexus 1000V virtual switch, which the company says can be used as the basis of virtual overlay networks for multitenant cloud deployments. Nexus 1000V now supports OpenStack Quantum and REST application programming interfaces (APIs) for multitenant orchestration, open-source hypervisors, and a VXLAN gateway connecting physical VLAN and virtual networks.

VXLAN is a network encapsulation technique with segment identifiers for creating logical networks and for enabling workloads to move across data centers and cloud infrastructures. The networking segments support multitenant cloud infrastructures that require segmentation for security and compliance. The Nexus 1000V also now works with policy-based, per-tenant virtual security services on VXLAN-based overlay networks.

**Cisco Targets Universities**

Cisco has been less enthusiastic about supporting the OpenFlow open-source initiative than competitors. The vendor is limiting its support of the protocol to universities and research organizations, which can use OpenFlow agents and controllers for their network deployments.

Juniper Networks has developed QFabric, which includes a node (top-of-rack switch), an interconnect (core switch), and a director (controller). Similar to Cisco’s strategy, Juniper’s technique relies on upper-level APIs largely controlling the network devices and a management and orchestration layer that marginalizes the impact of open-source protocols.

Founded in 2006, Vyatta Inc. raised more than $40 million in venture capital and developed its own open-source router platform, the Vyatta Open Flexible Router. While the product line can work with the other open-source initiatives, the company’s approach is similar to those from Cisco and Juniper where much of the networking functions are controlled by its own equipment.

**Stanford Behind the OpenFlow Initiative**

In 2008, researchers at Stanford University created the OpenFlow switching specification. Since they did not have a commercial interest, they relied on an open-source model to spread their work, which has garnered a lot of attention. In 2012, vendors started to outline plans to deliver products based on OpenFlow, and the list of supporters has been growing.

OpenFlow has become a favorite among startups. Adara developed several SDN products (Horizon, Ecliptic, Axis, Echo, Sirius, Orion, and Comet) that are available individually and as modules in its Constellation Full Stack Engine.

Founded in 2010, Big Switch Networks Inc., whose management team comes from Stanford and Cisco, raised $39 million in venture capital. In November 2012, after two and a half years of development, Big Switch unveiled the first elements in its product suite, which are sold on a monthly subscription basis. The company developed four components: a network application development platform; an open-source core controller; support for industry standard, southbound data plane communication protocols; and open, northbound APIs that application developers can leverage.

The Big Network Controller, which scales to support more than 1,000 switches and 250,000 new host connections per second, creates and helps to manage enterprise networks. The device provides programmable interfaces for northbound applications so third parties can build software applications that automate network functions. The vendor delivered two such applications itself. Big Virtual Switch is a data center network virtualization application that dynamically provisions virtual network segments. Big Tap is a network monitoring application that outlines how well packets flow over network connections.

The supplier also developed a core controller named Floodlight. It supports both hypervisor-based virtual switches like Open vSwitch and physical OpenFlow switches. The controller, which is distributed under Apache License Version 2, functions with OpenFlow and non-OpenFlow devices.
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Nicira Inc.’s founders, Nick McKeown, Scott Shenker, and Martin Casado, also played key roles in the development of the OpenFlow specification. The company raised $40 million in venture capital and developed the Nicira Virtualization Platform networking products that create an intelligent abstraction layer between end hosts and existing networks. The products are now the linchpins in VMware’s network virtualization plans.

Vello Systems is a privately held, Silicon Valley network equipment supplier. The company’s VelloOS network operating system and Vello Data Center Gateway platform are built on OpenFlow SDN capabilities.

**Top Dogs Embrace OpenFlow**

Some established suppliers have also boarded the OpenFlow train. Hewlett-Packard is developing a new controller line: the Virtual Application Networks SDN Controller. The OpenFlow protocol has become a key element in its FlexNetwork SDN push and is supported on its switches, including the HP 3500, 5400, and 8200 series products.


Extreme Networks has plans to provide OpenFlow support across its ExtremeXOS-based Ethernet switch portfolio and will extend support to multiple OpenFlow controllers, including those from NEC and Big Switch. Extreme Networks has a plug-in for OpenFlow to manage network switches using the open-source APIs. Lastly, the company announced a new Web portal called xKT aimed at sharing SDN applications.

**Warming up the Pitcher**

While the SDN market has generated a lot of buzz, it has also produced virtually no deployments. “If the SDN market were a baseball game, the pitchers would still be warming up,” said ZK Research’s Kerravala. “We have a long way to go before universities start to realize the benefits that SDNs offer.”

One reason is the changes taking place are multifaceted, not one dimensional. To reap SDN benefits, colleges need to change three network elements: the physical controllers, their network software, and the APIs that enable applications to call network services.

Only one element, the physical controllers, largely the OpenFlow switching-compliant devices, has taken shape. The network protocol allows the path of data packets through the network of switches to be determined by software running on multiple routers. This separation of the control information from the forwarding data allows for more sophisticated traffic management than what is feasible using traditional approaches, like access control lists and routing protocols.

**Industry Heavyweights Back OpenFlow**

In March 2011, Deutsche Telekom, Facebook, Google, Microsoft, Verizon, and Yahoo! founded the Open Networking Foundation (ONF), a consortium designed to promote the use of OpenFlow. The group has released two iterations of OpenFlow; coordinated interoperability demonstrations at events, such as Interop; and worked with Indiana University to establish an interoperability testing laboratory. ONF membership has now passed the 80 mark and continues to grow steadily.

While OpenFlow has garnered support, many of the other needed elements are in the blueprint rather than the delivery phase. As vendor plans and new products take shape, possible hurdles could emerge, starting with scalability. Through the years, networks have evolved so they now support millions of nodes. SDNs have not yet proven they work outside the lab, let alone on such large networks.

Also, an SDN consolidates dispersed information in a central location, which introduces a single point of failure. Consequently, vendors need to add resiliency to their solutions and develop robust management tools in case problems arise.

**So Exactly How Much Does It Cost?**

Cost is an open question. Vendors have also been vague about product pricing. Analysts expect these solutions to cost about the same as traditional network gear but deliver much more functionality.

However, network virtualization will not be the “no brainer” decision that server virtualization has been. “With server virtualization, companies reduced costs by eliminating a lot of underused hardware,” noted ESG’s Laliberte. “That won’t be as likely with SDNs because network connections largely remain in place.”

Understanding how to deploy and manage these new devices could also create challenges. “The networks of tomorrow require new skill sets from the personnel, organization changes, and process standardization,” noted Forrester’s Kindness. “Otherwise IT will be installing solutions that won’t offer any benefits and could possibly cause more inefficiency.”

**Conclusion**

In sum, SDNs have tremendous potential and are garnering a great deal of ink. Vendors have been scurrying to add these features to their product lines and providing universities with a variety of migration paths as they build out their next-generation networks. However, SDNs are not the slam dunk that other types of virtualization have been. Moving to an SDN can disrupt the university network infrastructure, be costly, and create management challenges. As a result, schools may want to proceed cautiously as this emerging area matures.

And where does the virtual desktop fit into this picture? That could be a topic for another day!

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Preparation Union College's ResNet for the Post-PC Era

Updating the network means taking a careful look at what's new

When I first set foot on Schenectady, New York–based Union College as its chief information officer more than two years ago, revamping the college's network to meet the challenges of the post-PC era became a top priority. The ubiquitous PC of yesterday had morphed into laptops and tablets; e-readers and smartphones proliferated; gaming consoles went wireless; and smartphones and wireless printers kept trying to connect to an already overloaded system.

The device deluge created an automatic expectation of instant wireless access, and it became unthinkable for students to just plug into the wall for Internet access. As Union College expanded its efforts to integrate technology into teaching and learning, the lackluster network in our residence halls became a stumbling block to progress. Frustrated student residents found it difficult to access online resources and work collaboratively, leading to a barrage of complaints of inadequate wireless capacity.

We knew we had to overhaul the college's much-neglected network to create a robust network that supports academic activity.

Funding the Future

Like many of my peers, one of the biggest challenges I've faced is how best to acquire funding for a large infrastructure overhaul. Here are the lessons we've learned for building a business case for funding a ResNet upgrade:

1. Do your homework. We worked with an independent contractor to understand the current state of the network, forecast ongoing maintenance and life-cycle replacement costs, and learn what it would take to address resiliency and redundancy in the infrastructure. We then talked to vendors to understand what outsourcing would look like as we gathered and analyzed the costs of outsourcing versus implementing, maintaining, and supporting the ResNet in-house. Having all the information we needed on hand, we built our case and presented to Union's Planning and Priorities Committee to request the needed resources.

2. Focus on the added value, not just the dollar amount. A critical factor in our success was providing data in clear, focused tables and graphs that the Finance Department and senior administrators could easily understand. Important information included our current network spending trends over the last five years, peer comparison data, a concise prioritized project list, and full disclosure about advantages and disadvantages of each approach.

The whole approach to addressing this critical need was grounded by the concept of furthering the administration’s strategic goals. Upgrading the ResNet fell under “The Learning Environment” foundation of the school's three-pronged strategic plan and outlined a vision for infrastructure that would support student life and academic activity. As residence halls are an important part of the educational environment, an up-to-date ResNet will create living spaces that can facilitate student learning.

3. Advocate for the network. We had to be open to answering questions and describing specific scenarios with stakeholders. In one instance, our team had to convince senior administrators that maximizing the lifespan of some of the equipment may appear to save money, but would cause the network to lag behind demand. We had...
to persuade them to upgrade the entire ResNet infrastructure, and not just a portion of it.

The final decision became apparent when comparing the data. In contrast to what could be achieved in-house, outsourcing to Apogee provided better coverage and capacity, a stronger return on investment over a five-year period, 24/7 technical support, and a guaranteed level of service. In addition, outsourcing the ResNet freed up our network staff to concentrate on other campus needs. All these factors would further support our goal of using our resources wisely. In only 14 days, the network install team was able to connect 18 residence halls and 30 individual residences to Union College's new wired and wireless ResNet.

Safeguarding Reputations, Supporting Student Needs

Securing the network is a big challenge for higher-education institutions because so many different types of activities and environments have to be supported. And unlike our peers in the private sector, we don't have the luxury of limiting usage to just one type of data. Our team has dealt with a spectrum of security threats—from DMCA complaints to unauthorized access to student information. Our outsourcing arrangement allowed us to better protect the campus from these threats by separating the residential network traffic completely from the campus.

Offerings by our infrastructure providers and device manufacturers have continued to improve over the years. For example, smart firewall technology can restrict access on a more granular level than ever before, and now many networks, such as ours, scan student devices for malware before they can log on to the system. Although there is a certain level of security already in place, in the future we may enhance this further with a mobile device management system or policy. Another trend we have yet to investigate is virtual desktops that allow data to be stored away from the mobile device.

Education is a must. Students have to know what acceptable usage is if they're accessing college resources, and what rules they have to follow. To this end, we have implemented policies and procedures to manage inappropriate access to confidential data such as student records, coursework, and course schedules.

Another trend we have yet to investigate is virtual desktops that allow data to be stored away from the mobile device.

Enhancing the Learning Environment

The use of digital media heralds an exciting yet complex time for administrators. At Union College, we are continually trying to determine the right mix of technology for our type of school. As trends such as blended learning, lecture capture, and video usage in the classroom continue to blossom, we will see additional burdens on the network. At the same time, technology infrastructure vendors keep advancing with better, smaller, and faster ways to deliver services—such as wireless in the cloud. With innovations around every corner, administrators need to monitor, plan, and educate so that the appropriate infrastructure can be put in place to support further educational experimentation.

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Using Social Media During Times of Crisis

Ten ways social media can upgrade your emergency toolbox

by Joe Dysart

Given that most college students first reach for Twitter, Facebook, and other social media during times of crisis, scores of universities no longer consider the Internet an afterthought. Instead, it’s a critical communications component for every emergency.

“Universities must make social media not just a tool in the crisis communications toolbox, but a focal point of the entire strategy,” says Sara Estes Cohen, a social media strategist at G&H International Services.

Of course, college communications officials have no plans of abandoning more traditional methods of emergency communications. “The more tools that are available to reach the audiences, the better,” says Jeff Hanna, director of communications and public affairs at Washington and Lee University. But many believe the immediacy of social media—as well as the danger of allowing false rumors on social media to take over the emergency conversation—makes it imperative that the technology be part of every emergency outreach.

“Following the earthquake and tsunami in Japan in 2011, social media provided a critical means to determine the status of students and faculty in that country when other communication channels were not available,” says Paul Grantham, assistant vice president, communication services at Duke University. “In today’s world, it’s virtually impossible to get ahead of a story, especially in an emergency,” he adds. “But you do want to contribute to the story and give people a credible source of information. If not, other voices—perhaps less credible voices—will fill the void.”

College officials already using social media also say they were moved to do so after frustration with relatively slower media, like e-mail. “It sometimes would take several hours for an e-mail to cycle through our internal system,” says Alan Cubbage, vice president for university relations at Northwestern University, who uses Blackboard Connect to squire its social media emergency communications.

“To send an urgent e-mail and know it’s not going to reach your audience for another three hours means that system is not useful in a crisis situation.”

Plus, college communicators also say social media’s relative simplicity is also driving the trend. Given that most college communities already have some place on Facebook where college students congregate, getting access to the community—and getting information out quickly and accurately—often only takes a few key strokes.

“The focus of emergency communication should be in the social media community you have already developed,” says Eric Melcher, coordinator of communications and public relations, Volunteer State Community College. “That’s where everyone will expect to see emergency communication.”

How to Use Social Media

Key tactics recommended by communications specialists when implementing social media communications in college emergency preparedness include the following:

1. Make participation in emergency preparedness mandatory. “You can’t register for classes until you give us an emergency notification number” for texts and other forms of communication, says Northwestern’s Cubbage. “We’ve had zero pushback from students on this. We’ve found that students want to hear from us in a crisis.”

2. Preestablish a list of trusted sources. False rumors can be as dangerous as the emergency itself. Preestablish the authenticity of e-mail addresses, Twitter handles, and the like for professors and university officials who may or will play a major role in a campus outreach when a crisis occurs.

“I think the biggest mistake is not having any redundancy in the systems,” says Rhonda Weldon, director of communications at the University of Texas, Austin. “You cannot be effective if only one person can access the communications channel. All of your communications systems should be at least three deep in personnel who can activate and send messages.”

3. Preestablish predefined Twitter hashtags for emergencies: Hashtags are one of the easiest ways to unearth related posts on Twitter. Type in #campusshoot-Columbia, and you’ll be able to get any posts related to a shooting on that campus. Similar localized hashtags can
also be preestablished—and controlled by your university—such as #poweroutColumbia, #hailColumbia, #floodColumbia.

4. Preestablish standard emergency messages. "We have templates for text, tweets, web, e-mails, computer pop-up screens, and public service announcements that cover more than 40 emergency scenarios," Weldon says.

5. Use software that broadcasts in multiple social media formats: SchoolCast, Rave Alert, Blackboard Connect, e2Campus, described below, all broadcast emergency alerts and updates in multiple formats. "It's critical to have a tool that allows for mass communication along multiple formats such as e-mail, text, and voice calls/messages," says Jacque Montgomery, executive director of communications and media at University of Colorado, Denver.

6. Cross-train campus police in social media. Campus security needs to be conversant in Facebook, Twitter, and other social media, and be trained to use them during an emergency. Security officers at Volunteer State, for example, have social media communications training, according to Melcher.

"It is absolutely critical that universities and colleges integrate social media into exercise and training efforts, on an ongoing basis, in order to ensure those who are responsible for using these tools are familiar, comfortable, and able to use social media in a meaningful, safe, and appropriate way," says G&H's Cohen.

7. Use social media listening software: Software packages are available that allow college communications specialists to troll social media for talk about an institution, including any crisis afoot. The same software can be used to monitor social media to determine the kind of information a college campus is hungry for during an emergency.

"At the University of Texas, Austin, we use Hoot Suite Pro [http://hootsuite.com/] to follow hashtags and to post with multiple accounts at once," says Weldon. "We're also setting up Radian 6 [www.salesforcemarketingcloud.com/] right now, which will provide us a real-time social listening tool which should help us catch new issues as they happen."

8. Consider pasting a QR code on every dorm room door. QR codes are two-dimensional bar codes that can point a user to a specific, emergency information website when scanned with a smartphone. QR codes are already being used in some hotels to offer emergency information to guests on room doors.

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The same codes can be pasted to the back of every door room door for the same purpose.

9. Consider a Twitter town hall on emergency preparedness. Attending an in-person town hall on emergency training has all the allure of a root canal for many college students. You may get better attendance if you hold the town hall on Twitter—a fast, easy, efficient alternative.

10. Evaluate available social media communications suites: Here are a few to get you started.
   • CampusCast, HighGround Solutions (www.highgroundsolutions.com/campuscast.asp): This sends emergency alerts to multiple endpoints, including many social networks, via the Web and via mobile devices. It includes optional dissemination of weather info from the National Weather Service during a weather crisis.
   • Rave Alert, Rave Mobility Safety (www.ravemobilesafety.com/): Rave broadcasts to multiple endpoints, including many social networks. It also offers EyeWitness, which campus residents can use to tip campus police via text to suspicious activity.
   • Blackboard Connect (www.blackboard.com/Platforms/Connect/Products/Blackboard-Connect.aspx): The software broadcasts to multiple endpoints, including social media.
   • e2Campus 360 Safety Suite, e2Campus (www.e2campus.com/notification_services.htm): The package offers a multifaceted, interactive alert system. Features include broadcast alert, which sends custom or predefined messages via text, voice, Facebook, Twitter, iGoogle, website, and so on. It can also be used by campus community to tip off campus police via text message to suspicious activity.

Conclusion

"This demographic (college students) has grown up with the availability and overwhelming presence of high-tech media, smartphones, and 24/7 Internet connectivity," says Steven Charvat, director of emergency management, University of Washington. "We realized many years ago that we must both understand this new way of communicating and harness its power to quickly and effectively communicate with our campus residents."

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Business Model Innovation Examples in Education
Livemocha is an online social language learning platform that illustrates the potential role of IT in general and CIOs in particular in business model innovation in education.

Key Challenges

• New disruptive education competitors emerge at an increasing rate, disturbing the status quo of the education ecosystem. Phenomena such as Livemocha, Khan Academy, and the growing number of massive open online courses (MOOCs) show that information abundance and death of distance is changing the basis for the existence of many institutions.
• The disruptive innovation pressure is so great that many academic leaders of traditional institutions are reluctantly forced to accept a new language: the language of business.
• With the traditional funding streams withering away at such great speed, academic institutions have to think about not only how to cut cost, but, preferably, how to create new revenue that allows them to have sustained funding to deliver on their mission—they have to think about their business model.
• Real business-model innovation is often hard to do within existing institutions due to existing cost structures, estab-

Introduction
Education institutions of today face a pressure not seen before in their more than 1,000-year continuous history. New disruptive education competitors emerge at an increasing rate, disturbing the status quo of the education ecosystem. Phenomena, such as Livemocha, Khan Academy and, more recently, the many MOOCs, show that information abundance (as opposed to information scarcity) and death of distance (as opposed to geographical constraints), driven by information technology in general and the Internet in particular, are changing the basis for many institutions’ existence. This pressure is so great that many academic leaders of traditional institutions are reluctantly forced to accept a new language: the language of business.

With traditional funding streams withering away at such great speed, academic institutions have to think about not only how to cut cost, but, preferably, how to create new revenue that allows them to have sustained funding to deliver on their mission, or put in other words—they have to think about their business model. Gartner’s definition of a business model is “how your business creates value for its customers, and how it retains some of that value.”

Disruptive, and even substantial, business-model innovation is hard to do within existing institutions, as pointed out by many scholars, including Clayton Christensen. That is why we do not usually see traditional institutions (with a 1,000-year cultural legacy) being prominent in disruptive innovation in the education ecosystem. Instead, we see tenured professors, such as Sebastian Thrun, leaving Stanford to create startups like Udacity, with the aim of going from teaching 200 students to 200,000 per course.

Existing cost structures, established processes and a dominant status quo mindset are some key inhibitors of change. Frequently, the advice for succeeding in building on disruptive ideas is to start a new organization, separate from the mother institution to a varying degree. In order to explore that path, we examine a nontraditional education venture that nonetheless is impacting how language education is done in traditional education institutions.

The example we use is Livemocha’s online social language learning platform, which has followed a classic disruptive innovation path through business model innovation, based on going beyond mere digitization and into digitalization. This research is meant to inspire education CIOs of traditional education institutions to take a more active part in changing the business model of the institution so that it becomes more competitive and can sustainably deliver on its mission. The important caveat is that most existing research and advice points to the fact that real disruptive business model innovation is extremely hard to do from within an institution and most likely requires a new organization with its own cost structure,
processes and people. We have deliberately used a business-oriented language, where we use "business executives" as a term, rather than "dean," "provost" or just "academic leader." This is to provoke more thinking around each leader's role in the evolution/revolution of the institution or its offspring. Figure 1 shows the six phases of the Gartner Business Model Framework.

Case Study
Livemocha is an online social language learning platform that was launched in September 2007. It is based on the simple idea that a good way to learn a new language is together with native speakers of that language.

Livemocha Business Model Innovation
- Step 1. Establish a social website with some simple tools to facilitate language learning, such as basic flashcard-based language lessons; quiz tools; recording tools; text, audio and video chat tools; crowd-sourcing of translations; and content.

The social environment allows native speakers to provide ratings or other feedback on how the language learner is doing. The language learner can provide reciprocal feedback on the quality of the reviewer. All ratings and feedback are measured by "Mochapoints," which spur community members to perform and engage. The primary funding mechanism at this stage is advertising. The calculated level for a sustainable community/business was 700,000 recurring users, and the result was 1.85 million users in 15 months.

- Step 2. Introduce brand quality content in five languages by teaming up with publishers of language textbooks. Mash up the textbook content with the social learning environment, and charge either a yearly flat fee or a monthly subscription fee to access the premier content modules.

The first collaboration was with Pearson on conversational English for $19.95 per month or $149 per year. This led to higher quality content that appealed to a slightly higher customer segment, boosting the size of the community and giving an additional revenue stream that eventually replaced the advertising revenue stream. Livemocha continued to offer free, flashcard-based language lessons in over 30 languages, combined with free access to the community of native speakers. This "freemium" model helped grow the community to 5 million users by January 2010.

- Step 3. Introduce accredited teachers for a fee to engage in both asynchronous (for example, correcting homework) and synchronous (i.e., live virtual class) language learning.

Here, the original idea of hiring teachers upfront did not scale with the needs for availability of the global community, nor did it make sense to tie up salary costs upfront. The solution was to build a "reversed micropayment" system, where registered accredited teachers got paid for every interaction they had with a student. This solution scaled both from a teacher availability and financial aspect. When this was introduced, the community was about 3 million users, of which about 300,000 answered to a call for accredited teachers. Additionally, the freemium model evolved into an "earn or buy" ecosystem, which allowed learners to purchase premier content as a whole, purchase bite-sized pieces using a virtual currency (tokens), or unlock premier content through rewarded activity within the community.

The results were another increase in quality of the language learning experience, a diversification of revenue streams, increased community activity, and an even tighter relationship with key sponsors of the community: the language teachers. Language teachers did not only use Livemocha in their own classrooms as a complement to traditional teaching, they also had the choice to make money by simply living out their passion for language learning, together with students all over the world. Today, Livemocha has more than 15 million users.

Continuous Incremental Business Model Innovation
The classical journey of applying disruptive innovation to language learning—starting in competition against non-consumption (see Note 2) outside the traditional classrooms—has resulted in Livemocha becoming a language learning player that both competes with and enhances traditional players, including universities. Incremental business model innovation/improvement has continued to strengthen Livemocha's competitiveness. Examples include:
- Collaborating with other business model innovators, such as Urban Planet Mobile, which delivers language learning over low-tech/high-availability SMS/ringtone functionality in mobile phones. The collaboration has expanded the reach and functionality of Livemocha.
- Introducing products and services for schools and corporate language learning, based on its learning platform and 15-million-strong community that now has about 1 million teachers and linguists. (The latter refers to people who are not accredited teachers but can show documented special language proficiency.) Livemocha can now hire teachers based on these contracts, as revenue streams and workload are predictable. A common denominator is the strength of the language learning community that Livemocha has built, which enables it to draw new collaborators, content providers and customers.

In the following section, we outline some best practices learned from the Livemocha case study, and some additional education examples in all six phases of the Gartner Business Model Framework.

Analysis

Ideate: Combine Old Practices With New Technology for a New Business Model

- Business Model Phase Definition—
Ideate: Where ideas come from, how decisions are made, and how enterprise leadership becomes informed and uses this information to make decisions.

Livemocha was born from the idea of the old master/apprentice learning model expanded through social software. The idea was formed by professionals already steeped in IT startup ventures and well-versed in technology. In this case, the learning idea was old, but the technology made it new and scalable. This is a common trait in the Internet era, where simple, old ideas get new life through new technological capabilities. There is no certain way of finding these new combinations. However, it is possible to increase the success rate by allowing strong industry professionals and IT professionals to mix and providing them with innovation tools that enable them to quickly sift through and analyze new combinations of capabilities.

Key Take-Away for a Traditional Education Institution

The implication for traditional education institutions and their leadership is that having IT-savvy executives at the senior management table is a key way to be informed about trends, bring in technology early, and find new combinations of old education practices (pedagogy) and new technology. Give the education CIO a seat at the table.

Other examples of business model innovation ideation include:

- MOOCs (such as Udacity and Coursera) that use such IT tools as podcasts and social software to massively scale courses to several hundred thousand.
- Key elements are automation and social learning.
- Urban Planet Mobile, which delivers language learning over low-tech/high-availability SMS/ ringtone functionality in mobile phones.
- P2PU, which crowdsources content and relies on individual people who need to learn or want to teach.

Create: Leverage Others’ Strengths

Business Model Phase Definition—Create: How the product or service is produced and how internal operations are run.

A key part of Livemocha’s business model is partnering with other players, both inside and outside the education ecosystem, and leveraging their strengths. For high-quality content and teaching experiences, it has collaborated with publishers Pearson and HarperCollins, and, more recently, with many freelance teachers and content authors who are experts in their fields. On the distribution side, Livemocha has partnered with representatives of different media, such as Urban Planet Mobile, which distributes language lessons via SMS, and of different distribution methods, such as daily deals (for example, Groupon) that market Livemocha’s products to new audiences.

Key Take-Away for a Traditional Education Institution

The implication for traditional education institutions and their leadership is that the traditional integrated business model is breaking up. The institutional leadership should seek partners who are more efficient or have a brand or special capability that can be leveraged to gain competitive advantage. The education CIO will evaluate and execute IT integration with business partners, as well as plan and execute an IT sourcing strategy. The twist in this case is that Livemocha can change from a language learning competitor to an excellent partner for lead generation in recruiting new students for online and on-campus education. Marketing to the right community is a key capability in the new digitalized education ecosystem.

Other examples of business model innovation creation include the following:

- 2U (formerly 2tor), which helps institutions go online by using institution curriculum and professors, while providing everything else, such as marketing, student administration, and learning platforms.
- Pearson, which provides proctored physical test sites to Udacity students who want certificates for passing courses.
- Community colleges that are introducing flipped classrooms—for example, based on iTunes U or MOOC courses—to increase the focus on teacher/student mentoring.

Engage: Engaging Is the Business Model

Business Model Phase Definition

Engage: How the customer interacts with the business, including push and pull marketing and logistics

The core of Livemocha’s business model is to engage. In many respects, the community is Livemocha, and the key is to constantly retain individuals and grow the community (farm and hunt). The key marketing tool is word of mouth, which is the very essence of a vibrant community and also the main key to recruit new students. However, Livemocha is constantly analyzing how the community interacts and how the language learners achieve their goals. It is then using this data to personalize the experience of the individual and facilitate social exchange using more of the social software “tools” available on the net in order to retain individuals.

A critical success factor was that, beforehand, Livemocha estimated the critical mass of its community and worked hard to get to the point where there would be a self-sustaining community by designing social structures (such as the submission/review loop, in which students help each other learn) that keep the community engaged with their learning and with each other.

Key Take-Away for a Traditional Education Institution

The main implication for traditional education institutions and their leadership is that engaging the student (and teacher) and keeping them engaged are critical competitive capabilities for traditional education institutions. This means that social software is playing an increasing role for both traditional and continuous learning, recruiting and alumni engagement. The implication for the education CIO is a need to master the social software “toolbox.” Other examples of business model innovation engagement include:

- P2PU is a good example of an
engaged social community that is the business model.
• A more traditional example of an engagement model that is adapted to the
death-of-distance online-learning market is the emphasis of for-profit institutions
on marketing and ease of access. Many U.S. for-profit institutions spend four
times more on marketing than not-for-profit institutions. They also allow enrollment as often as every second week to provide timely education and to improve admission rates.

Offer: The "Topic" Community Is the Service

Business Model Phase Definition
Offer: The products, services, communities and customer experience

At the heart of Livemocha's offer is the community, particularly the access to
native speakers of a language or accredited teachers engaging in personal learning. The sheer size of this language-focused community is the key asset that guarantees individual learners, traditional school students and corporate learners quick access to the appropriate support.

To increase the value of its offer and provide more reasons to join the community, Livemocha is seeking and adding components such as crowdsourced "flashcards," branded content from publishers, and new distribution channels/pedagogical models, such as SMS/ringtones, all focused on language learning. A particularly good value-add was introducing the ability for accredited-language teachers to get micropaid for engaging with learners, which further motivated loyalty of this key constituency of the community.

Key Take-Away for a Traditional Education Institution

The implication for traditional education institutions and their leadership is the necessity of a keen understanding of the key constituents of the offer. Where does the topic learning value come from? Professors/teachers, "native" masters in the workforce, traditional publishers, Open Educational Resources or even crowdsourcing. The heaviest burden in this business model innovation phase clearly falls on the business executives. The general implication for the education CIO is to build the digitized business infrastructure that enables the digitalized offers and enables the institution to stay flexible for the future. The more specific implication is that the education CIO of the future must learn the "business" to be able to better contribute at the executive table.

Other examples of business model innovation offerings include:
• Statistics.com is an excellent example of how death of distance allows a very
specialized education institution, which could not exist if there were geographical constraints on its enrollment and hiring, to exist. Its value proposition is that many
ordinary institutions deliver statistics education with non-specialized mathematics professors while Statistics.com delivers it with statistics specialists from renowned universities or the workplace. Statistics.com would not be able to achieve critical mass in students nor have access to the specialized talent in the pre-Internet world. Yet, it is basically modeled on an old idea: the correspondence university.
• The Stanford Peace Innovation Course in the spring of 2008 was another
good example where social learning was achieved through open Web tools, such as Google Docs, Facebook, SurveyMonkey, and wikis. Anyone could join the course, but the key intention was to involve active peace workers from the field, injecting real-world experience in the class and thereby making the class more valuable.
• Udemy and StraighterLine are examples of for-profit companies that have
provided professors and other topic experts with a convenient platform to teach
online and charge for it, should they want to. With StraighterLine, instructors can pick their own tuition premiums, an amount that will be added on top of the base fee of $49 per course and $99 per month for enrolling. Udemy takes a 30 percent cut of what the professor makes on the courses. This model aims to ensure a steady content flow to these online learning sites.

Monetize: Create Many Revenue Streams With Low Thresholds

Business Model Phase Definition
Monetize: How value is exchanged and transferred among customers, companies and others, including funding, pricing and payment

The Livemocha business model is clearly focused on a low barrier of entry with a freemium model at its core. The initial business model depended on advertising but has gradually evolved to focus more on selling tokens and subscriptions and rewarding community activity to gain access to premium content. Constant evolution of the pricing models helps lower the entry barrier. Decreasing the price as the community grows and introducing "free" tokens on joining and for specific community activities help grow the community even more while maintaining the overall sustainability. A key enabler in this pricing model is the ability to cost-effectively handle micropayments.

A special innovative twist in the Livemocha case is the inverted use of micropayments to remunerate accredited teachers for engaging with learners. On the basis of the sustainable community and pricing model, Livemocha has been able to enter more traditional B2B contracts with schools and corporations, adding yet another revenue stream.

Key Take-Away for a Traditional Education Institution

The implication for traditional education institutions and their leadership is that the pricing model is the key part of the sustainability of the business model. Careful choices need to be made to fit the institution's business model, and those choices can have a big impact on IT. For example, the more the institution model relies on volume, the more important IT will become. The important role of the education CIO is then to help keep the cost per transaction low and constantly
look at convenient—yet secure—ways of exchanging money.

Other examples of business model innovation monetization include:

- 2U uses a clear-cut revenue-sharing model that makes it very easy for institutions to enter a joint venture, as no upfront investments are needed.
- Urban Planet Mobile's approach to monetizing is to use very low-cost subscriptions (less than US$2.00 a month in Indonesia), collaborating with telcos for marketing and charging mechanisms.
- MOOCs are struggling to find a sustainable monetizing model, but innovative suggestions are plenty. Currently, the most promising innovation is in recruitment or referral. For example, Coursera is experimenting with "Coursera Career Services," an opt-in schema for selling information about students matching certain criteria in certain geographies to companies. Udacity has indicated that social and teamwork skills can be predicted by a student's involvement in helping other students, as documented by the MOOCs' social environment.

Adapt: Adapt Often and Quickly, Never Losing Sight of the Job to Get Done

**Business Model Phase Definition**
Adapt: How the enterprise learns and executes change

At the heart of Livemocha's success lies the ability to adapt. The best example is the case where Livemocha realized that the original business model calling for hiring accredited teachers in a more conventional way did not scale. Their quick response, which did not lose sight of the job to get done, was to devise the reverse micropayment schema and "advertise" for accredited teachers in their own community. In addition, they have a constant adaptation process building on the large social community that generates large datasets that can be harvested to continuously improve the learning and socialization offer. Furthermore, they have partnered with universities to do comparative research on the Livemocha language learning versus traditional language learning, using the results to adapt and build brand.

Key Take-Away for a Traditional Education Institution
The implication for traditional education institutions and their leadership is first and foremost that the leadership needs to fully understand their chosen business model in general and "the job to get done" in particular. Then they have to develop a fast decision process that enables quick course correction if a chosen strategy does not work. The education CIO must master capabilities such as big data, which becomes key to attaining faster data-driven decision processes that can generate digitized competitiveness in the education ecosystem.

Other examples of business model innovation adaptation include:

- Pearson, a publisher, is an interesting player in the education ecosystem that has realized, over time, that it needs to provide its content (textbooks) in a context to get closer to its consumers and add more value. Pearson has, therefore, over the years, added more and more context capabilities through acquisitions, such as Fronter (a learning management system), and collaboration with Livemocha. Eventually, Pearson went all the way to deliver education directly to 40,000 high school students through the acquisition of Connections Education, which gives Pearson total control of the context.
- Arizona State University (ASU) represents a case of taming potentially disruptive technology for sustaining innovation and adaption. ASU bought the Knewton Adaptive Learning Platform to offer low-cost remedial training that will help in driving retention up and, thereby, increasing tuition in the long run.

Bottom Line
In the past decades (even centuries), a handful of higher education business models have dominated the market, leaving few choices for prospective students. Our Livemocha case story, together with the case examples in this research, shows that the education ecosystem is ripe for disruptive innovation, with a proliferation of education business models as a consequence.

The key advice to traditional institutions trying to come up with a disruptive business model innovation is to try the business model out in a self-sufficient organization (subsidiary) to decouple it from existing cost structures and mindsets. However, the general intention of this case study is to inspire and add several new perspectives, tools, and potential revenue streams — in short innovative business models — that can help traditional institutional players reform and stay competitive in the expanding education ecosystem.

To put things in perspective, Livemocha can be seen as a sustainable business model evolution for MOOCs (it certainly has the size), where students come and learn a topic at their own pace from masters of that topic, instead of centering it on a company and separate courses (or even geographical sites, such as campuses in the case of traditional institutions). It is interesting to note that Livemocha existed before the MOOCs entered the stage.

"The future is already here. It's just not very evenly distributed." — William Gibson

"Disruptive Innovation" and the "Job to Get Done": In several places, this research makes use of language introduced by professor Clayton Christensen in several of his books regarding "disruptive innovation." For a generic overview of the disruptive innovation framework, see "The Innovator’s Solution: Creating and Sustaining Successful Growth," by C.M. Christensen and M.E. Raynor, Harvard Business School Press, September 2003. For a specific application on higher education, see "The Innovative University: Changing the DNA of Higher Education from the Inside Out," by C.M. Christensen and H.J. Eyring, Jossey-Bass, July 2011.

For an excellent public domain compendium on the topic of disruptive innovation in higher education, see "Disrupting College," by C.M. Christensen, M.B. Horn, L. Soares and L. Caldera, Center for American Progress, February 2011.

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Institutional Excellence Award 2013
IUanyWare at Indiana University
Innovative model allows education to thrive for all by removing barriers of cost, timing, and location.

IUanyWare is an enterprise cloud-based service that provides Indiana University’s students, faculty, and staff with on-demand access to hundreds of software applications. IU began developing IUanyWare in March 2010, and moved the service into production in the fall of 2012. With IUanyWare, IU enables its 110,000+ students plus all faculty and staff to access critical software, cloud storage (50 Gb on Box at IU), and printing tools on any personal device (including PCs, Macs, tablets, and smartphones).

IUanyWare runs on virtual technology from IU’s primary Data Center in Bloomington, using Indiana’s I-Light network to reach all eight campuses across the state. This means the IU community has on-demand access to more than 200 applications, including Adobe Creative Suite, Microsoft Office, various stat/math packages like SPSS, and specialized departmental apps, through the IUanyWare portal (iuanyware.iu.edu).

IU’s purchase of enterprise licenses sets the university apart from its peers, allowing all students, staff, and faculty members to make IUanyWare their customary computing environment on any device. By offering a level of choice and access that few institutions can match, this innovative and proven model allows education to thrive for all by removing barriers of cost, timing, and location.

Unlike other higher-education initiatives of this scope, many of the resources needed for IUanyWare came through reallocating, restructuring, and retooling existing staff, processes, and resources. For example, a University Information Technology Services (UITS) senior support adviser developed sufficient skills to serve as the project’s principal enterprise systems engineer. Many other staff have sought professional development opportunities in the new environment, so the university does not have to seek outside talent.

None of these achievements would have been possible without edge, leverage, and trust (ELT)—an evolving model of support that grew out of IU’s strategic plan for IT, Empowering People (EP), which proposed collaboration as an efficient and economical way to develop IT resources. IUanyWare is IU’s first ELT project, involving 118 members, only 15 of whom were from UITS, IU’s central IT organization. Instead of UITS doing research, negotiating products, planning implementation, and selling it to the community, the community was already involved and pushing the project to completion.

In July 2012, IU received a 2012 Campus Technology Innovators Award (http://campustechnology.com/articles/2012/06/27/2012-innovators-indiana-university.aspx) for the development of IUanyWare. The Innovators Award recognizes universities that deploy extraordinary technology solutions to meet campus challenges. IUanyWare was also featured on an in-flight video for Delta Air Lines’ flights during two months of 2012.

Planning, Leadership, and Management Support
When founded, UITS served IU top-down as the central and sole provider of enterprise IT resources and solutions. In the 1990s, the organization seeded a program that encouraged schools and departments to hire their own IT staff to augment UITS resources and provide on-site, hands-on help to their own end users (mainly by loading software, handling security, and providing training). In this distributed computing model, these “edge” IT staff were a culture separate from UITS, with minimal interaction.

After two decades of provisioning campus desktops via a high-touch, distributed model, IU sought a more efficient mechanism that would scale to meet demand, provide agility and flexibility, and free IT staff from the...
repetitive maintenance and update cycle to focus on innovation. In keeping with EP principles, a culture of collaboration took shape in the IT Managers Council, an advisory committee of IT leaders from all campuses, various schools and departments, and a few ex officio UITS teams. The council was created to help operationalize the values of partnership embodied in ELT. Trust, the least tangible and most fragile element in ELT, is a prerequisite to introducing change in an organization or a culture. The concept of One IU IT, developed by the IT Managers Council, helped IT staff across IU view themselves as one community with shared goals and, over time, build relationships of trust.

The council soon recognized that the time was right to investigate an enterprise system for provisioning desktops and applications across the university. Some edge IT staff had created successful single-use virtualization solutions for their departments, which led them to suggest that the council look into virtualization technologies as a desktop management solution. A group then formed the Client Endpoint Virtualization (CEV) Committee to evaluate virtualization as a possible enterprise solution.

Some 118 IT staff (only 15 representing UITS) made up the project team. Given their majority and ability to gain trust, edge staff were the natural choice to lead the project. The committee’s loose internal structure looked nothing like the traditional bureaucratic development process, where each role is defined and assigned. The project lead was a persuasive virtualization advocate who recruited many committee members and built support beyond the committee. Three subcommittees—software, product evaluation, and licensing—were each led by an edge staff member with expertise in the area. The project lead and two other edge staff, also known technical experts who believed virtualization could effectively serve the university’s mission, led the subcommittees.

The fact that only a few staff members were assigned full-time to the project could have hindered progress, but the committee’s size became an advantage. As some staff stepped back, others came forward. When new skills or roles were needed, motivated staff eager to learn or assume more responsibility found opportunities for professional development. Additional gains include:

- Professional development opportunities for committee participants
- Creation of strong support networks across departments, schools, and campuses
- A more unified IT team, feeding into the One IU IT initiative
- A conviction that virtualization technology can effectively serve the university’s teaching and research missions

A dedicated 14-person core of leaders from the edge and from UITS also emerged to make decisions, write summaries, and give progress reports, while the subcommittee leaders provided momentum and inspiration.

To manage decision making, the committee adapted a successful model from the collaborative process used in developing EP:

- Parameters were set for discussion.
- Open channels were established for input and feedback from all committee members and interested IT staff.
- Decisions were in the hands of the few—the project lead and the chairs of the other two subcommittees.

IAnyWare teaches us two things: ELT is not a "one-size-fits-all" solution, and there is no playbook for collaboration.
Evaluating virtualization technologies for use across the enterprise was high stakes and high risk for a variety of reasons.

- A project of this significance, led by edge staff, was unprecedented and presented an alternative to the typical UITS top-down development model.
- The edge and UITS had never collaborated at this scale.
- The committee combined two different cultures: the structured center and the independent edge.
- Virtualization was uncharted, so the long-familiar development model with its clear-cut roles and responsibilities did not apply.

- Virtualization technology was now viable.
- IU's IT infrastructure of networks, supercomputers, storage, and support was aligned.
- Edge staff had been successful in single-use instances of virtualization.
- Early adopters of virtualization were enthusiastic, and other departments were waiting in line.
- IT center and edge staff had built sufficient trust that IU could now consider a unified technology for managing personal computing.
- Economic realities supported a leveraged environment across IU.

The initiative also addressed action items 7, 22b, 27, and 29 in Empowering People, meaning it would likely gain the backing of university and IT leadership.

- Action 7: IU should maintain and refresh its IT infrastructure by consolidating enterprise-scale (multicampus) services for software systems, server and data hosting, networks, backup, messaging, support services, and training, while also enabling innovative departmental-scale technology services provided at the edge.
- Action 22b: Technologies such as desktop virtualization should be explored to help reduce the costs and extend the life cycles of personal computing devices.
- Action 27: IU should continue to pioneer and provision effective means of user support through advanced tools for self-service and connection to IU experts to help faculty, staff, and students effectively use IT. IU should continue its work as a support infrastructure provider for national research projects and services.
- Action 29: UITS should expand its formal and informal engagements with the IU community to ensure continuous, timely dialogue, and flow of information to effectively adapt IT services to user needs.

To move from theory to practice, the committee needed to test virtualization at an enterprise scale. The single-use cases the edge had created did not prepare IT to develop, install, and configure an enterprise prototype. The CEV Committee turned to a consulting source for help defining the basic criteria for an RFP seeking vendors who would build prototypes on-site. Committee members tested and compared three vendor prototypes in actual use cases to find the best fit for IU's needs, fiscal reality, and IT infrastructure.

The chosen vendor then spent an initial 12 weeks on-site refining the prototype in preparation for installation. Engineers from IU sat alongside vendor engineers as they designed and rolled out the prototype, observing and recording the steps and the decisions behind them. Today IU engineers can handle much of the engineering and architecture themselves. Hands-on learning alongside the experts in IU’s own environment presented a rare professional development opportunity.

**Promotion of Technology and Maturity of Effort**

Indiana University has long prided itself in offering world-class, award-winning technology to our community. Broad-based collaboration and leveraging of technologies has helped IU stay current with industry and market technologies. It has also allowed the university to become a leader in virtualization technology for higher education. In fact, IUanyware’s availability to more than 130,000 students, faculty, and staff across eight campuses makes it the first virtualization initiative to succeed at an institution of IU’s size and scope.

Most large research universities still maintain a very decentralized approach to managing personal computers. This made sense in the 1990s when university staff had to be experts about the entire PC life cycle (from ordering to maintenance). Even at IU, close to 100 separate IT shops emerged to handle all of this for their departments. Where IU separates itself from other universities is the recognition that, after two decades, these duties (duplicated across departments and cam-
One of the most difficult parts of IT change is selling it to users. Rolling out a new technology can entail hosting focus groups and town halls and developing communication plans, announcements, and other publicity, all in service of preparing the audience. Thanks to the edge, the solution is selling itself via the peer network of early adopters who vouch for virtualization. In the words of one edge staff member, “Instead of asking ourselves how we can build interest, we’re now wondering how we can meet demand.”

From this experience, team members have learned the advantages of collaboration. Between edge and center lies a deeper understanding of each other’s priorities, audiences, and challenges. In tackling technical challenges, people made connections and formed networks of expertise to leverage in the future. Many gained a new appreciation for the caliber of professionals across IT and pride in the IT community. This enlarged collective perspective blurs the boundaries between center and edge. Staff have a new expectation for the work of the future: not as silos, but as one community. The gains extend beyond the virtualization solution to include abundant opportunities for professional development, the creation of strong support networks, and a more unified IT community.

Today’s students expect to be able to download and use apps on demand from any location on any device, from smartphones and tablets to laptops and desktops. IU’s virtualized application delivery to all faculty, staff, and students via an enterprise cloud service has met those expectations. IUanyWare is designed to provide this freedom, while ensuring the...
security of user applications and access to storage and printing resources. Furthermore, the initiative improves operational efficiencies without insisting on a uniform IT environment. Instead, the service targets a bring-your-own-device (BYOD) model defined by the user community itself instead of university technology staff.

**Quality, Performance, and Productivity Measurements**

IU technologists designed IUanyWare in three phases to ensure that it could deliver applications to any consumer device anytime, anywhere.

<table>
<thead>
<tr>
<th>System/Measures (as of January 2013)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Concurrent users (daily average)</td>
<td>350</td>
</tr>
<tr>
<td><strong>Software</strong></td>
<td></td>
</tr>
<tr>
<td>Total packages available</td>
<td>178</td>
</tr>
<tr>
<td>Average application startup time</td>
<td>53.77 seconds</td>
</tr>
<tr>
<td><strong>Active users</strong></td>
<td></td>
</tr>
<tr>
<td>Current active users</td>
<td>11,569</td>
</tr>
<tr>
<td>New users added per week</td>
<td>1,000 (approx.)</td>
</tr>
<tr>
<td><strong>Device access</strong></td>
<td></td>
</tr>
<tr>
<td>Desktop</td>
<td>45%</td>
</tr>
<tr>
<td>Mobile</td>
<td>37%</td>
</tr>
<tr>
<td>Unknown</td>
<td>18%</td>
</tr>
</tbody>
</table>

Phase I ([http://uits.iu.edu/page/bcuy](http://uits.iu.edu/page/bcuy)) focused on the analysis, design, and build of the system’s core infrastructure. Beginning August 2011, phase II ([http://uits.iu.edu/page/azor](http://uits.iu.edu/page/azor)) shifted attention to scalability testing and preproduction beta to determine the appropriate hypervisor and hardware platform. In socket server tests, XenServer 6.0 provided the best scalability, offering a 37.5 percent increase over XenServer 5.6.2 and a 10 percent increase over VMware vSphere 4.1.

Phase II results also showed that the XenServer and vSphere hypervisors were unable to effectively use additional resources from the new generation of four-socket servers. With only 40 percent of the CPU resources of the four-socket Dell PowerEdge R810, the two-socket R810 was able to host approximately 75 percent of the maximum users of its four-socket counterpart. IU technologists used this analysis to make the following adjustments to IUanyWare’s core infrastructure:

- Upgrade to XenServer 6.0.
- Use two-socket servers for XenApp.
- Replace and repurpose the existing four-socket Dell PowerEdge R810s with two-socket R810s for hosting the XenApp Resource Pool.
- Keep the Infrastructure Resource Pool on the existing four-socket R810s.

These modifications provided the most effective use of server hardware resources, and helped maximize the density of IUanyWare’s XenApp 6 environment.

In August 2012, IUanyWare started phase III, the production mode. The team found that pinpointing system stability issues was key to maintaining a high-performance virtual environment. IU purchased SysTrack software to analyze system performance, event log entries, application performance, system changes, and memory leaks (including the “per-process” Blackbox Data Recorder for root cause). This software allows for continuous performance adjustments.

Since entering production, IUanyWare’s use has risen steadily across the IU community. Currently, the service is adding approximately 1,000 new users per week. Current performance metrics include the information in Figure 1.

IUanyWare will be included in a range of surveys in 2013 to help determine the future direction of feature and hardware updates. The most important will be the UITS annual satisfaction survey, which gauges the opinions of students, faculty, and staff on all eight IU campuses. Other surveys currently under way include:

- Thin-client adoption in student technology labs as a replacement to standard computers.
- Thin-client adoption for public infostations.
- UITS also created the Mobile Technology Showcase for exploration and evaluation of new technologies. The UITS Student IT Ambassadors, an undergraduate organization that promotes IT at IU and collects peer feedback, demonstrates the IUanyWare environment in high-traffic areas such as campus libraries. The ambassadors encourage fellow students to check out technology that was previously available only in physical student labs. Since IUanyWare went into production in fall 2012, the response from participants has been overwhelmingly positive.

**Cost, Benefit, and Risk Analysis**

IUanyWare enhances the productivity of faculty, staff, and students, giving them access to required resources anytime using a device of their choosing. By reducing its investment in end-point technology, IU is:

- Reallocating IT professional support for higher-priority tasks.
- Leveraging discipline-specific software licensing (such as SPSS, SAS, etc.) for courses to lower installation costs.
- Analyzing software use by departments and individuals to determine how many licenses are actually used.
- Improving life-cycle funding through user segmentation, helping IU evolve away from the “one device fits all” approach (i.e., data entry workers may only need a $200 thin-client device instead of a $1,500 machine).
- Reducing administrative overhead (no-touch management): New model computing simply requires powering up an on-desk thin client. The box is self-configuring for patches and security, and it provides more than 100 software applications, unified printing, and enterprise storage with no need for IT support.
- Reducing tech restrictions: More courses are embracing a BYOD environment, especially now that students can
access discipline-specific software on any operating system.
- Guaranteeing HIPAA compliance for medical applications (such as Axiom) by storing data in a closed, secure environment.

Benefits: Students
On IU's two core campuses in Bloomington and Indianapolis, there are more than 70,000 students and only 2,800 computers available in labs. With IUanyWare, students can take their lab to go, freeing them to study and collaborate from home, the library, a coffee shop, or wherever they choose. This mobility eliminates the need to visit campus labs that are often filled to capacity, or purchase specific hardware to run the software required for their studies. It is also a great benefit to nontraditional students—particularly those on regional campuses—who face timing and logistical challenges related to travel, child care, and employment.

IU students can also access IUanyWare applications using consumer devices they already own, including Macs, PCs, iOS and Android devices, and tablets such as the Kindle Fire. With a BYOD environment, IU students are able to save money while gaining a more convenient and productive educational experience— which in turn helps IU compete for, retain, and better prepare more students than ever.

IUanyWare will also have a positive impact on visually disabled students, who use campus computer labs to browse the Web, research, and study. In the past, IT staff had to load software such as JAWS—a comprehensive screen-reading program for low-vision and blind users—individually on each computer. They then had to monitor the effect of operating system patches on the software. IUanyWare plans will allow students to access this software anytime, anywhere, and with ease.

Benefits: Faculty
In courses requiring specialty software, professors often spend the first two days of class walking students through installation. IUanyWare restores valuable class time by allowing professors and students to access applications virtually. The service also features convenient options for storage and collaboration—including Box at IU (50GB), SharePoint My Site, IU file shares, Dropbox, Google Drive, and SkyDrive. The cloud storage service ensures that our educators have access to all the files they need, when and where they need them.

Additionally, IUanyWare boosts flexibility. Faculty can teach from an iPhone using a projection screen, access the service via thin clients, and run multiple versions of the same software even after upgrades are issued. For instance, IUanyWare allows users to choose between both Windows 7 and 8 environments, which meets students' desires for the latest and greatest while eliminating disruptive changes for faculty.

Benefits: Staff
It is vital that IU staff have the tools to keep the university running in any situation. IUanyWare provides staff with the resources they need to be productive in times of campus closure or other events that disrupt work—from flu pandemics and weather emergencies to telecommuting and travel. IUanyWare also helps IU lower hardware and support costs while redeploying IT resources through more efficient management. This frees the IU technology staff for new innovations, such as the recent development of a nursing simulation lab on the Indianapolis campus.

Customer Satisfaction and Results to Date
IUanyWare will be part of the 2013 UITS annual satisfaction survey, which collects feedback from students, faculty, and staff on all eight IU campuses. However, the initiative has already received positive feedback from a number of schools and departments across the university:
- The Kelley School of Business has lifted technology restrictions for K201 (The Computer in Business), a required course that enrolls nearly 2,000 students each semester. The course uses Windows-only software such as SPSS and JMP to help students solve complex business problems. With IUanyWare, students can access this software on any device with almost any operating system.
- IU's School of Public and Environmental Affairs (SPEA) has one computer lab with 12 computers loaded with discipline-specific software unavailable for fee-free download. SPEA's 650 graduate students frequently endure long waits to use these machines. IUanyWare allows them to access these resources they need anywhere, any time.
- Now that IU Kokomo's 3,700 undergraduate and graduate students have virtual access to lab software through IUanyWare, its laptop software installation service is no longer necessary.
- Mac users (with OSX and iOS devices) can now use IUanyWare to gain real-time access to Windows applications using their preferred technologies, rather than seeking out PCs to run course software.
- IU's self-service storage configurator (cloudstorage.iu.edu) allows each IUanyWare user to choose on-premises or public storage customized to their preference. The application, developed in-house at Indiana University, is one of the primary drivers to IUanyWare adoption.

For more information about this project, contact Sue Workman at sbworkma@iu.edu.
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