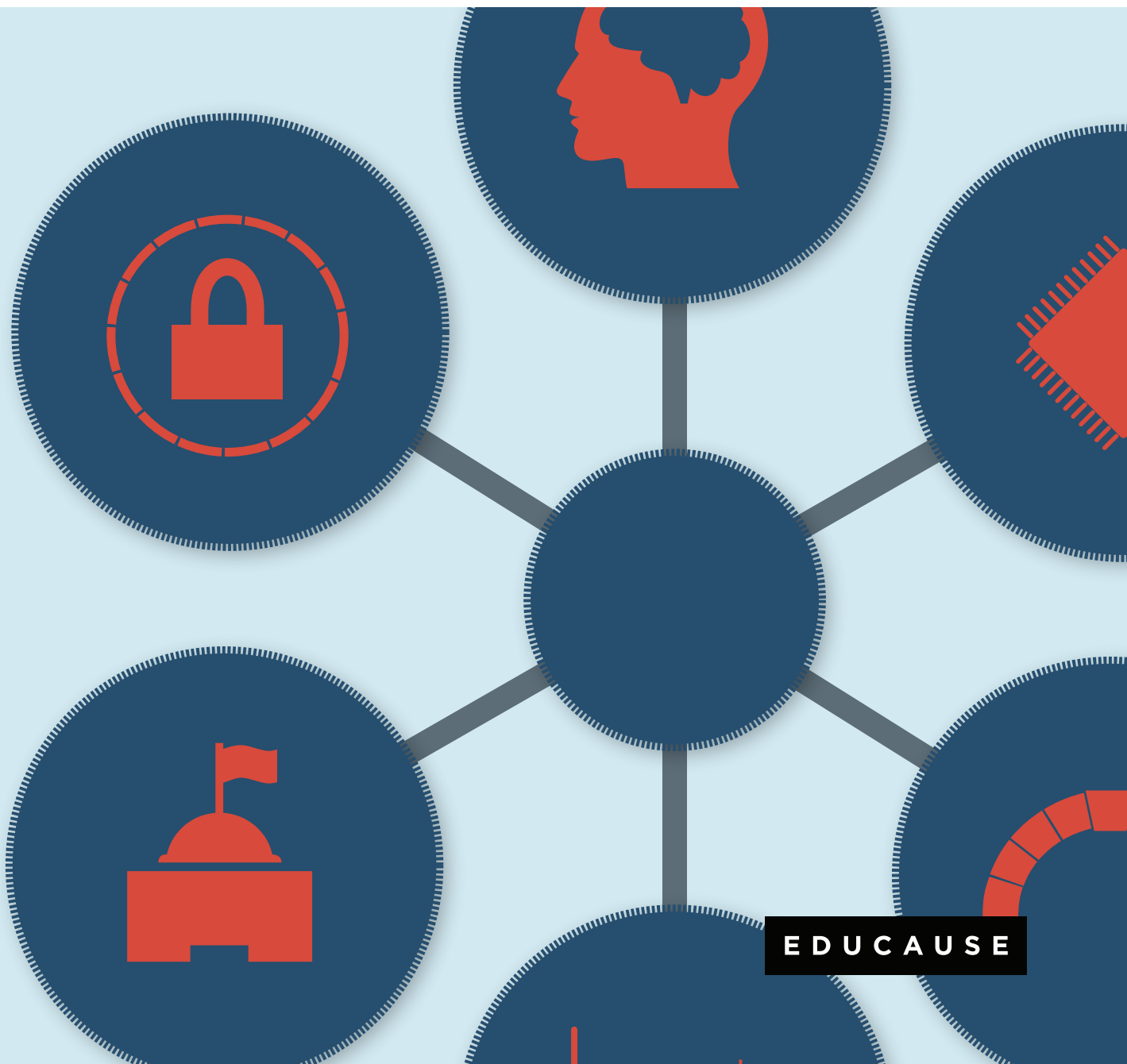


The Consumerization of Technology and the Bring-Your-Own-Everything (BYOE) Era of Higher Education



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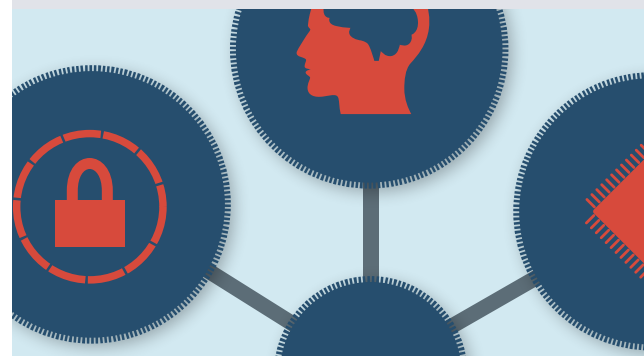
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Citation:

Eden Dahlstrom and Stephen diFilipo, with foreword by Mark Askren. *The Consumerization of Technology and the Bring-Your-Own-Everything (BYOE) Era of Higher Education* (Research Report). Louisville, CO: EDUCAUSE Center for Applied Research, March 25, 2013, available from <http://www.educause.edu/ecar>.



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Foreword

The time is right for ECAR to study the torrent of activity surrounding user-owned technology and the implications of this trend on higher education. The consumer market increasingly allows users to own and manage a long list of technologies. What began in the last decade as a faculty or staff member connecting a personal laptop to the campus network has exploded into an ever-growing ecosystem of personally owned smartphones, tablets, cloud storage, processing, and other individually owned technologies that are everywhere we are.

What we have seen to date demonstrates that faculty, staff, and students see tremendous value in the integration of these personally owned technologies with institutional systems and resources. Have we—as IT professionals—embraced the opportunities of this bring-your-own-everything (BYOE) movement while providing thoughtful guidance and support to manage related risks? How can we in the IT community best prioritize our efforts to provide leadership with security, privacy, end-user support, and other related areas?

The survey results in this report indicate that we are engaged and adding value and that we are moving forward. Specifically, the report points to one particularly reassuring finding: Best practices can be agile enough to cover this new terrain. If an IT organization currently provides effective and innovative services for university-owned technologies, it is likely well positioned to adapt to a bring-your-own culture.

BYOE is interesting not only because it compels us to focus on the impact of consumerization on our turf but also because it serves as tangible evidence of the future of IT in higher education. Institutional control of end-point technology decisions is fading, even as the opportunities to provide innovation and value to help meet our institutions' strategic priorities have never been greater.

At most colleges and universities, IT efforts undertaken heretofore have cultivated environments of ubiquitous connectivity (wired, wireless, and cellular) for campus communities. With BYOE, students are able to use personally selected and maintained technologies to leverage this connectivity for instructional opportunities, whether in the classroom or wherever they are, all of the time. The more recent BYOE trends involving faculty and staff will ultimately position institutions to have a more productive work force that has skin in the technology game.

With all of this promise within our grasp, are there many difficult challenges for our IT community to address? Absolutely. But we can do this—working together to drive and integrate change is what we do best.

Mark Askren

University of Nebraska–Lincoln

Executive Summary

We are living in an era when affordable, easy-to-use, and readily accessible technologies facilitate a bring-your-own-everything (BYOE) standard. This “consumerization of technology” is setting a new standard whereby students, faculty, and staff bring their own devices, software, apps, and cloud-based technology to create a personal computing environment. The furor over the consumerization of IT is part of the contemporary discourse of IT professionals in higher education and raises understandable concerns about IT infrastructure, planning and governance, security and compliance, support strategies, teaching and learning, and fiscal implications. This report addresses these topical issues by considering the following:







- Findings: What are the *most important* BYOE IT issues affecting higher education institutions?
- Recommendations: What are some *exemplary practices* for handling or managing BYOE IT issues?
- Considerations: What *strategic innovations* are here now and on the horizon because of the consumerization of IT?

ECAR conducted interviews, focus groups, and a survey to gather information about current BYOE practices in higher education. The results of these investigations provide insight about the scope of BYOE and the institutional culture surrounding BYO practices, as well as benchmarking metrics for the current state of policies, practices, and experiences of BYOE in higher education.

Key Findings

What excites IT leaders in higher education most about BYOE are opportunities to diversify and expand the teaching and learning environment; the greatest challenges are issues that pertain to faculty and staff use of their own devices for work-related purposes. Given that IT leaders estimate the portion of employees “BYOEing” for work-related purposes will increase from 20% in 2010 to 60% in 2014, the changes are imminent. Considering the challenges and opportunities BYOE brings to higher education institutions, this ECAR study presents the following key research findings:

1. **Device proliferation is manic**, and unmanaged growth could result in a “tragedy of the commons” situation, where too many devices find their way to campus networks too fast and institutions find more opportunities lost than taken.
2. **IT leaders express support for BYOE** in order to facilitate student engagement with learning, extend teaching and learning environments, and promote happy and productive faculty and staff.

-  3. **Planning doesn't have to precede action** when it comes to BYOE—doing before planning is actually the norm—yet policies are in place where they matter most, such as for security or end-user behaviors.
-  4. **A solid security presence and plan can adjust to most BYOE security challenges**, and managing risk and raising user awareness are two areas in which security practices are a wise investment.
-  5. **Cost savings from BYOE can be elusive**, with the cost to update/upgrade IT infrastructure outweighing cost savings for providing fewer institutionally provisioned devices and other technologies.
-  6. **Think of IT infrastructure as BYOE “middleware”**—the commodities that bridge users, their devices, and their consumer-level applications to the institution's data, services, systems, and enterprise-level applications. IT middleware should be robust yet nimble.
-  7. **Support strategies will need to adapt to BYOE environments**, as there is an apparent lag between BYOE ubiquity and DIY support.
-  8. **Utilizing mobile technologies for teaching and learning is a priority**, but providing guidance or institutional support to students and faculty for how best to do so remains uncommon.

These findings can be capped with the statement that there is a general sense that institutions are accommodating BYOE practices to the best of their abilities but not necessarily in a systematic way that is proactive or with the end in mind. As noted in an article about the top issues facing higher education, “Even the most strategic and flexible IT organization may, at times, need to be reactive. Institutions need to learn to adapt to and leverage personal computing environments, not proscribe them.”²¹

Introduction

According to Gartner estimates, 515 million smartphones and 131 million tablets had been sold by the end of 2012.² Smartphone ownership among undergraduate students increased from 55% in 2011 to 62% in 2012 (Figure 1), and nearly twice as many undergraduate smartphone owners in 2012 than in 2011 said they use these devices for academic purposes.³ These data confirm what IT professionals see as they tour their institutions.

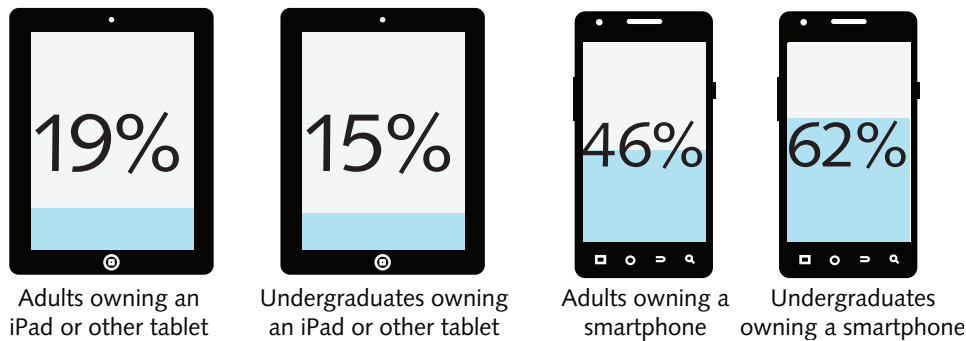


Figure 1. Tablet and Smartphone Ownership, 2012

ECAR conducted interviews, focus groups, and a survey to gather information about current BYOE practices in higher education. The results of these investigations provide insight about the scope of BYOE and the institutional culture surrounding BYO practices, as well as benchmarking metrics for the current state of policies, practices, and experiences of BYOE in higher education.

Figure 2 is a visualization of the most important issues that higher education institutions presently face regarding the consumerization of IT. This figure provides a framework for ECAR work on BYOE. Each of the six areas of investigation is partnered with a statement about the ideal BYOE environment in higher education and a brief description of an interrelated opportunity. This report explores these content areas in greater detail, with the purpose of providing actionable recommendations for higher education IT leaders to proactively address or accommodate BYOE.

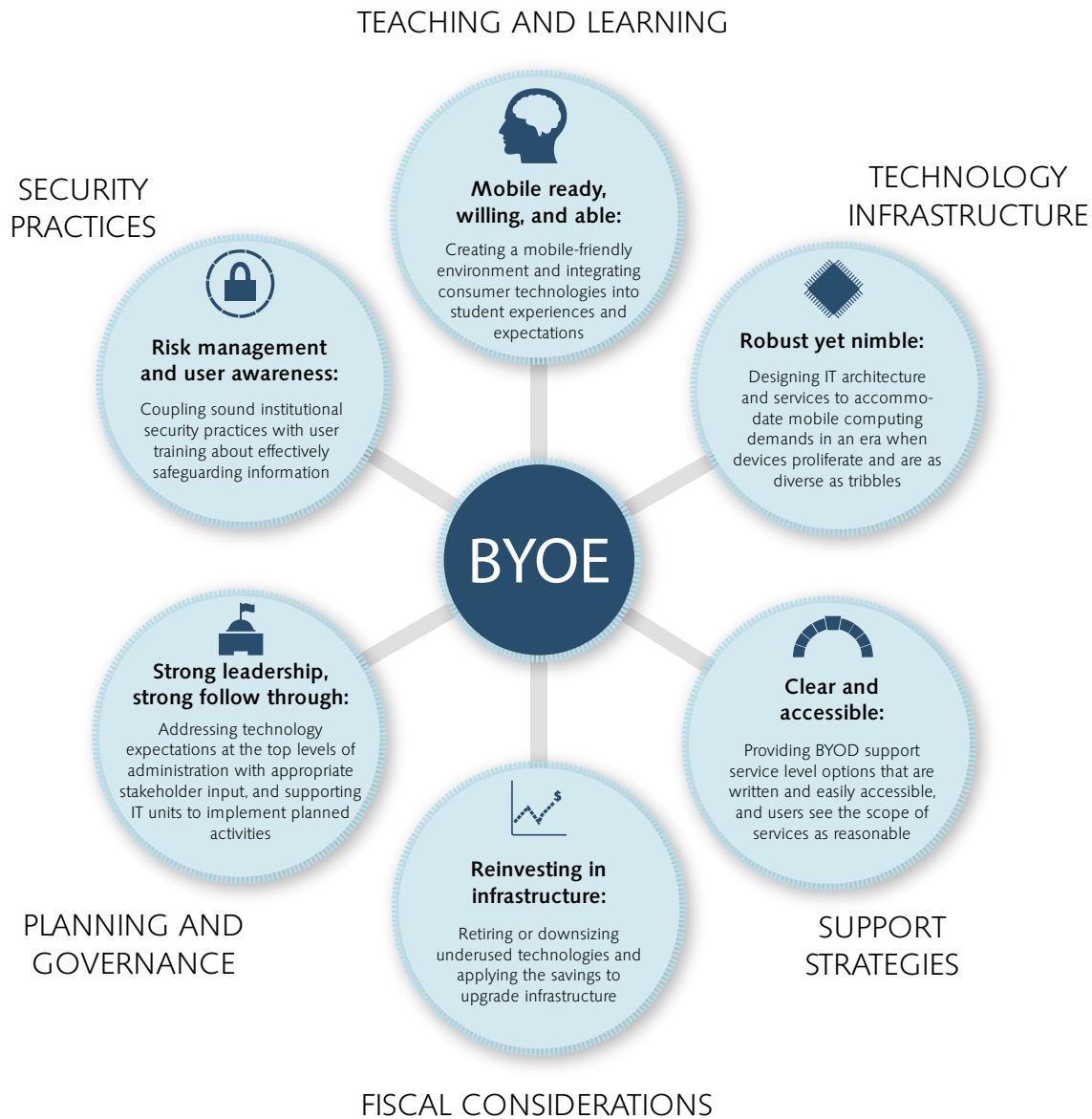


Figure 2. Most Important BYOE IT Issues to Higher Education Institutions

BYOE is here, it’s happening, and it will continue to happen at greater rates and with diversified technology (both services and devices) for the foreseeable future. This is true for all industries, education included. The prospect that most excites IT leaders in higher education about BYOE is the opportunity to diversify and expand the teaching and learning environment. This was the united message among participants of ECAR interviews and focus groups. The thematic recommendations that emerged include:

- Increasing student engagement with technology
- “Walking the talk” of extending “the classroom” to anytime, anywhere
- Making campuses desirable places to engage with technology and technology-enabled learning

Among the greatest challenges IT leaders identified in ECAR interviews and focus groups were issues that arise when faculty and staff use their own devices for work-related purposes. It is interesting that all of the challenges that emerged were one step removed from teaching and learning. Among these challenges were security, support strategies, and issues related to technology infrastructure:

- Securing institutional assets, intellectual property, and data; ensuring the integrity of the network(s)
- Standardizing and virtualizing desktop computing environments
- Providing service (even if simply best-effort support), or service alternatives, to faculty and staff who have been accustomed to contacting IT for technology-related issues
- Educating users about the risks and benefits of using their own technology, while knowing that enforcement of formal policies and practices is a luxury rather than common practice
- Maintaining and upgrading infrastructure to accommodate more devices and technologies that cross paths with IT domains; predicting what the next technology will be so as to be ready to accommodate it
- Transitioning or adapting technology infrastructure—or vendor products—so that enterprise systems work across a diverse array of user-provisioned devices

Looking past the challenges and opportunities BYOE brings to higher education institutions, ECAR interviews and focus groups revealed a culture of inquiry around exemplary practices and strategic innovations. Interviewees offered few examples of archetypal strategies for approaching the consumerization of IT in higher education. Instead there was keen interest in best practices around specific areas, including

- Supporting planning and governance
- Supporting faculty and staff in using their own devices for work-related purposes
- Securing data (and complying with institutional standards and in some cases FERPA and other laws)
- Providing appropriate and robust technology infrastructure
- Capitalizing on teaching and learning opportunities
- Proactively considering the fiscal implications (which ranged from optimistically positive to conservatively negative) that BYOE offers

The general sense was that BYOE is happening and institutions are accommodating to the best of their abilities. This report provides context for the current state of BYOE in higher education and provides insight about what to expect in the future.

Findings

Finding: Device Proliferation Is Manic

Device proliferation poses a “tragedy of the commons” situation.

By the end of 2012, there were 3.2 billion mobile plan subscribers, which is equivalent to about half of the world’s population.⁴ While exciting for the prospects of social, economic, and educational benefits, this level of mobile device proliferation conjures up cautionary imagery of economist Garrett Hardin’s “the tragedy of the commons.” Hardin’s observations of grazing cattle on common land resulted in the notion that although one more cow may be good for the individual farmer, one more cow may not be good for the land on which they graze.⁵ This analogy—as applied to networkable devices and the subsequent impact on bandwidth, network nodes, and IP addresses—provides a historical context to the challenges of unmanaged growth. Digital resources can be just as complicated and expensive to manage as natural resources, and this analogy should lead us to think about how an individual’s behaviors or habits of personal device usage impact the collective commons of shared networking space.

Networkable devices provide exciting opportunities for teaching and learning, especially when those devices are mobile. However, they also strain IT resources such as bandwidth and help desk support. Tracking device usage data and projecting future expansion of networkable device use can feed planning processes to prepare for increased IT resource allocation—or for implementing limitations on network access and usage.

Estimated growth in the number of Internet-capable devices is substantial.

According to ECAR BYOE survey respondents, the average number of Internet-capable devices per person on college and university campuses has grown substantially over the past two years and is projected to continue growing over the next two years (Figure 3). The greatest growth was in students’ use of networkable devices from 2010 to 2012 (from an average of 1.3 per student in 2010 to 2.4 in 2012), and growth is estimated at 47% over the next two years (from 2.4 in 2012 to 3.6 in 2014). Associate’s institutions are the outliers, with slower growth in student ownership of networkable device (and fewer overall devices) than all other Carnegie classes, but the biannual growth in networked devices is still significant for all Carnegie classes ($p < .0001$).⁶ ECAR per-person device data align with a 2012 mobile device subscriber industry study by Wireless Intelligence, the research arm of the Global System of Mobile Communications (GSM Association).⁷ They reported that the average American cellular and/or data plan subscriber has 1.57 connected devices, and 1.85 devices per subscriber were reported for the rest of the world.⁸

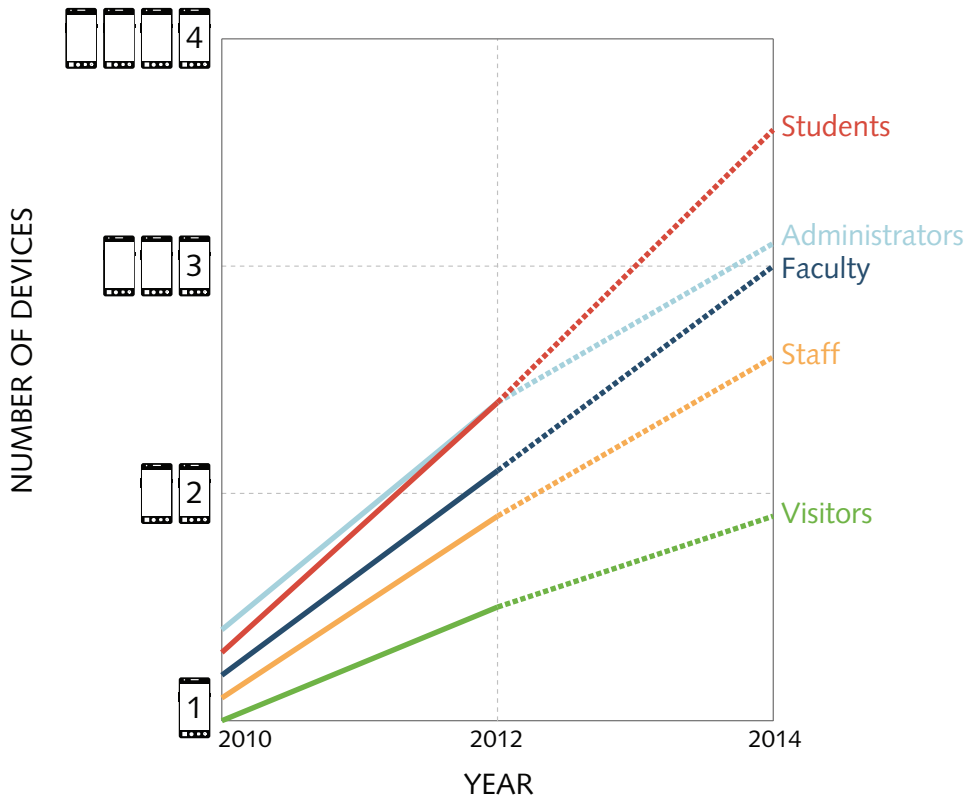


Figure 3. Average Number of Internet-Capable Devices Accessing Institutional Networks

About 75% of ECAR survey respondents have reliable data to estimate the number of per-person devices accessing institutional networks.⁹ ECAR is investigating opportunities to combine IT leaders’ per-person device estimates from this study, ECAR student study data, and generalizable industry trends to help project future network impact from user-provisioned devices.

IT leaders predict a substantial increase in faculty, staff, and administrators using their own technology options.

Having more devices on campus is one thing; accommodating faculty, staff, and administrator use of these devices for business enterprise activities is a related, but more complex, activity. For two in three institutions, central IT has primary responsibility for governing institutional strategies for user-provisioned technologies. Anticipating growth can inform the strategic decisions IT shops are making to best leverage opportunities and best accommodate challenges posed by this trend. Figure 4 shows that ECAR survey respondents estimated that about 20% of employees in 2010 and about 60% in 2014 will use their own provisioned devices for work-related purposes (equivalent numbers for those using their own cloud-based, collaboration, or other IT services were about 12% and 47%, respectively). There were no significant differences by Carnegie class, control, or institution size when it came to the 2010–2014 use trends.

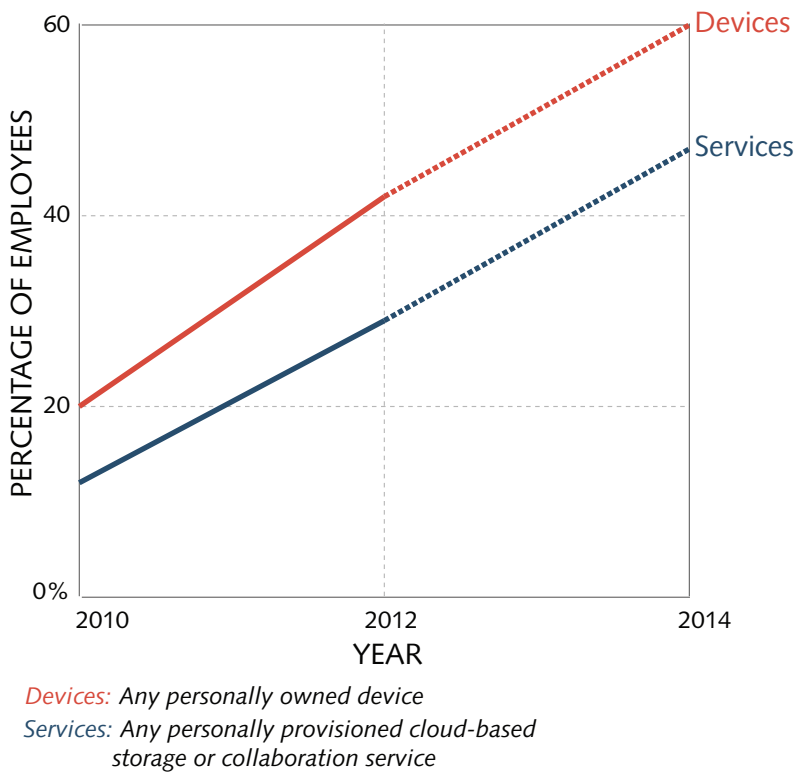


Figure 4. Extent of BYOEing for Faculty, Staff, and Administrators

Finding: IT Leaders Express Support for BYOE

IT leaders want students to use their own mobile devices to engage and extend their learning environments.

Having established that user-provisioned technologies are infiltrating campuses in unprecedented numbers, what do we really know about the institutions’ culture concerning acceptance of these devices? The vast majority of IT leaders agreed that their institutions have welcoming environments for students’ use of their own devices (82%), but one in five campuses didn’t agree. Though the figure “82%” can be classified as “the vast majority,” the 18% who didn’t agree is surprisingly high, considering that students have been bringing their own computing devices to campus since the early 1980s when the Commodore 64 hit the mass consumer market. However, ECAR sees these data as testimony to the complexities that consumerization of technology has brought to higher education: Too many devices, too fast, has led many IT professionals to be simply accommodating to BYO technologies rather than being able to strategically plan ahead, even though BYO has arguably been around for 30 years.

IT leaders want happy and productive faculty and staff.

Majorities of IT leaders also agree that their institutions have welcoming environments for faculty (66%) and staff (57%) user-provisioned technologies. These figures are not significantly different by Carnegie class, control, or institution size. IT leaders cited increasing faculty and staff satisfaction and productivity as the two greatest motivating factors for allowing employees permissive use of their own technologies (Figure 5). In addition, four in five (81%) cited a reduction in procurement costs of institutionally provisioned devices, and two in three (68%) cited recruitment as a motivating factor for permissive BYO cultures.

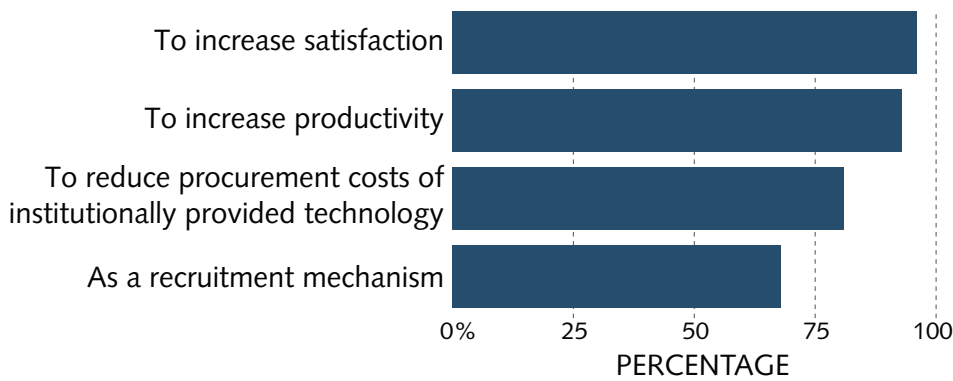


Figure 5. Institutional Motivation for Permissive BYOE Cultures for Faculty and Staff

Extending enterprise systems for mobile access is a high or essential priority for just over half of institutions surveyed (52%). Most (55%) have also deployed enterprise systems for mobile access, and another one out of four (25%) are in the planning stages of deploying mobile access to enterprise systems (Figure 6).

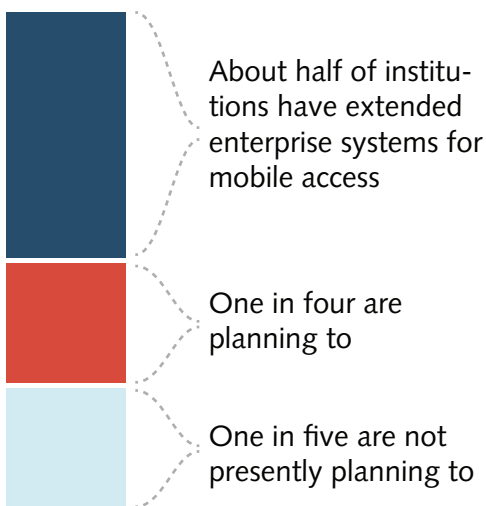
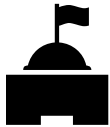


Figure 6. Extending Enterprise Systems for Mobile Access



PLANNING AND GOVERNANCE

Finding: Planning Doesn't Necessarily Precede Action for BYOE

Formal planning strategies are uncommon, yet action to accommodate BYOE is not lacking.

Ideally a campus would have a strong sense of how it will accommodate increasingly complex computing demands regarding information, devices, and users—and would have the resources to fulfill these plans. According to ECAR focus groups and interviews, planning of this nature is more often a luxury than a staple. ECAR survey data support this observation, with only 18% of respondents reporting that their institution has a formal planning strategy for user-provisioned technologies, and just 3% of all respondents saying both that they have a formal planning strategy and that it works well (Figure 7). Just over half of all institutions (52%) are engaged in planning activities for an overall BYO strategy.

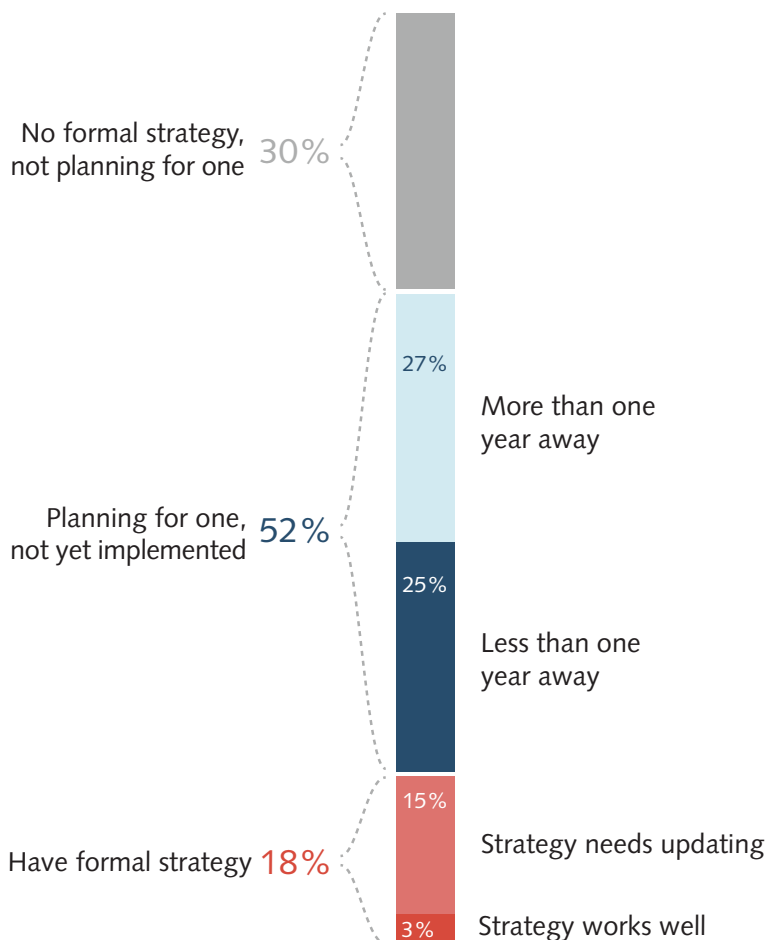


Figure 7. Formal Planning Strategies for BYO Technologies

Short- and long-term planning is a real challenge for BYO because of the continuously growing and diversified consumer-oriented market for technology products and services. Operationalizing specific infrastructure and support strategy needs for next month, let alone for next year, is nearly impossible when the available technologies are changing so rapidly. Using the metrics in this report to benchmark your institution's practices can inform your planning process. Considering device-proliferation projections, for example, provides some evidence about future network and support needs. About two in three survey respondents (68%) reported that their institution supports a culture of innovation (i.e., encourages new, pioneering technologies and activities), and innovation in IT is often coupled with a comfort level with ambiguity. True BYO leaders will combine available information with agile techniques in addressing BYO opportunities and challenges.

Formal policies for BYOE are scarce, yet they are common where they matter most.

BYOE issues are not heavily regulated by policies in most higher education institutions, yet policies tend to be common for issues that are within the purview of IT departments (e.g., topics of IT security and expected user behaviors). What types of topics should be covered in BYOE policy? Take a short [quiz](#) from SearchConsumerization to test your knowledge about this topic.¹⁰ If you are still not sure of where to start with assessing or drafting BYO policy, a great reference is the Digital Services Advisory Group and Federal Chief Information Officers Council BYOE policy toolkit to support federal agencies in implementing BYOE programs.¹¹ This toolkit offers contextual considerations about BYOE and policy, policy case studies, and example policies. To make BYO policies even more doable for higher education, the EDUCAUSE Higher Education Information Security Council (HEISC) is developing a step-by-step approach to support BYOE in higher education; it is modeled after the government's CIO toolkit for federal agencies.

Where are we today in terms of issues and topics covering user-provisioned technology? According to the ECAR BYOE survey, the three most common policies covering user-provisioned technology issues are for integrated acceptable use (89%), employee privacy (79%), and security requirements for data (75%). Least common are policies covering limitations of liability for devices or services (32%), permitted apps (allowed, recommended/not recommended, or banned) (40%), and ownership of software programs, services, or apps on user-provisioned technology (43%). These could be either stand-alone policies or integrated into another policy. The survey did not measure for policy function, such as efficacy or enforceability.

Three-quarters of institutions have policies about security requirements for data, and it is most common to find this policy language integrated into another policy rather than as a stand-alone policy (Figure 8). This tracks with institutional priorities for focusing efforts on securing access rather than assets (more on this later).

47%

of institutions say that developing a comprehensive institutional mobile strategy is a high or essential priority

Just over half of institutions have policies on security requirements for devices, services, or employee exit strategies. Least common among all the security policies are e-discovery rules.

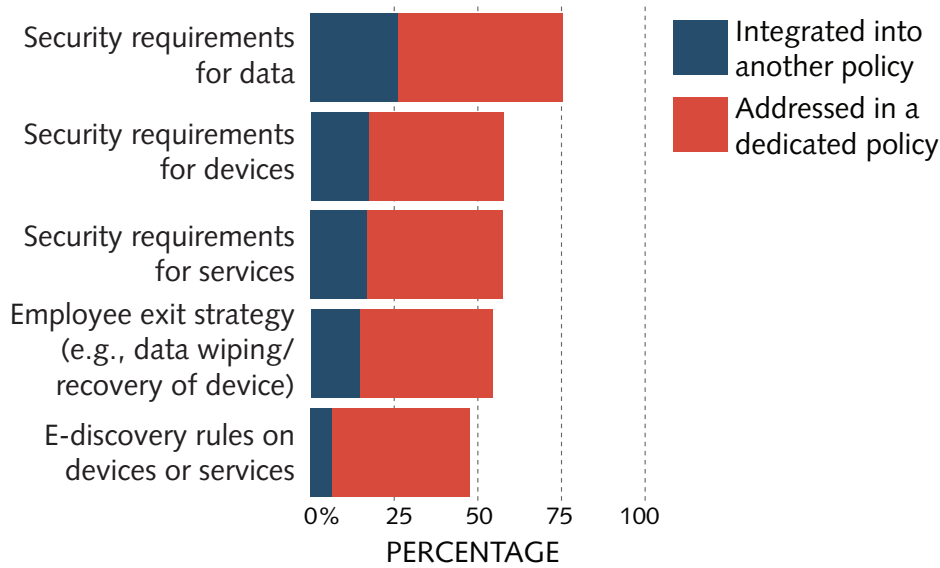


Figure 8. Policy Customs for Security Issues

Acceptable use policies are the norm, with nearly 89% of survey respondents reporting that their institution has an acceptable use policy (Figure 9). Policies on employee privacy expectations (79%) are also common, but policies are less common for ownership of software programs, services, or apps on user-provisioned technologies (43%) or limitations of liability (32%).

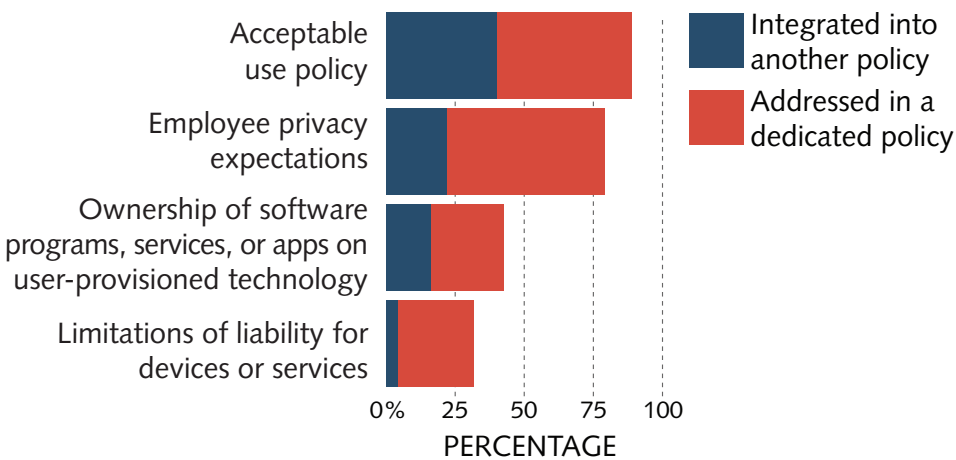


Figure 9. Policy Customs for Employee Behavior Issues

Policies about the types of services (50%), devices (44%), and apps (40%) that are permitted are not common (Figure 10). These data track with institutional motivation data for increasing faculty and staff satisfaction and having a welcoming BYOE environment for students.

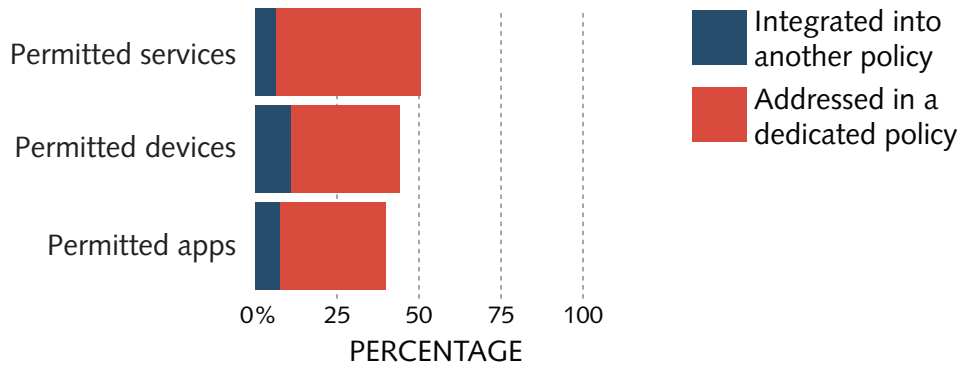


Figure 10. Policy Customs for Permitted Use Issues

The majority of institutions (60%) have a policy covering the scope of support services provided by the institution (Figure 11). But policies for reimbursement for user-provisioned technologies (49%) and accessibility issues (i.e., Section 504 compliance) (47%) are not as common.

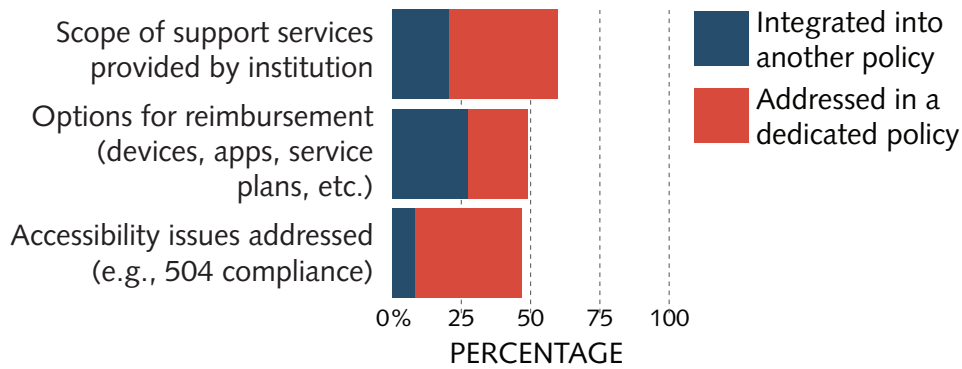


Figure 11. Policy Customs for Other Issues



SECURITY PRACTICES

Finding: A Solid Security Presence and Plan Can Adjust to Most BYOE Security Challenges

Managing risk and raising user awareness matter most for BYOE security.

The proliferation of user-provisioned technologies does little to change the basic best practices around security: a solid security presence and plan on campus can adjust to most BYOE challenges. The fears of BYOE being the cause of a virus spreading throughout a campus network or of sensitive data being stolen, corrupted, or lost are often misplaced. The real cause of such events is likely a straight-up security vulnerability that transcends BYO technologies. If institutional security practices are already porous, BYOE issues won't necessarily make things worse.

There is no silver bullet for ensuring IT security; there will always be risk to manage, and there will always be new user-awareness issues. Even the most vigilant CIOs can only practice due diligence to minimize and/or mitigate security breaches. User-provisioned technologies probably won't cause new or additional security issues beyond what IT units already take responsibility for; rather, the recent explosion of BYOE draws attention to such security issues and brings them into sharper focus. Implementing/improving mobile security for data was a high or essential priority for 55% of ECAR BYOE survey respondents (Figure 12).

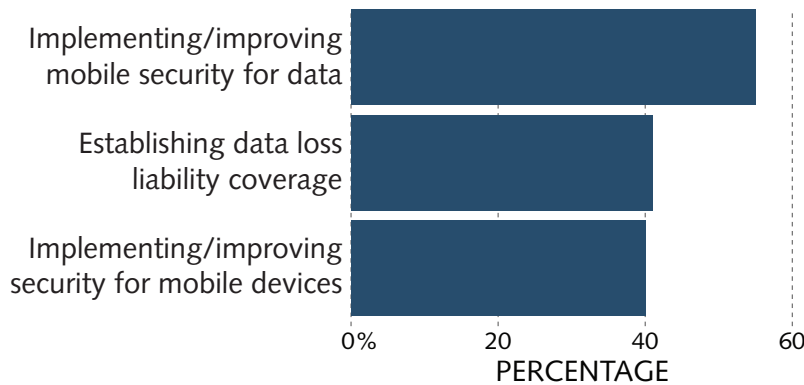


Figure 12. BYOE Security Issues Prioritized by Respondents

The most important security practices for higher education IT can be decoupled from BYO and pursued as stand-alone exemplary security practices. In fact, if sound security practices are in place, user-provisioned technology becomes a lot less scary.

54%
of institutions predict cost for data and security breaches will **increase** in the next two years

As noted in the January 2013 ECAR report on IT infrastructure for BYOE, a perfunctory approach to BYOE security issues is neither recommended nor prudent, yet security practices should not be so Draconian that they limit access to what is arguably the single greatest invention of the 20th century—the Internet. ECAR approaches BYOE security issues from the perspective that data are the paramount institutional asset and are therefore the most important consideration when discussing BYOE security issues. From this standpoint, the most important risk management issues for BYOE are securing data, carefully managing access to systems and services, using secure networks for enterprise-based activities, and authenticating identities. Dollars are better spent on these activities than on unique security concerns for user-provisioned devices and other technologies. An expansive overview of exemplary practices and strategic innovations for managing risk and raising user awareness (Figure 13) is published in a special ECAR report on BYOE IT security issues.¹²



Risk Management

- ✓ Securing Data
- ✓ Managing Access
- ✓ Securing Systems and Networks
- ✓ Managing Identity and Authentication



User Awareness

- ✓ Raising User Awareness
- ✓ Educating Users
- ✓ Enforcing Compliance

Figure 13. What Matters Most for BYOE Security Practices

For risk management, plan to focus on securing data rather than devices.

Because devices are more commonly mobile and more commonly provisioned by users than ever before, it is neither feasible nor sufficient to rely on device security to safeguard data. Figure 14 depicts the percentage of institutions that are focused on deploying technologies for securing data, the percentage focused on securing devices (physical assets), and the percentage focused on deploying technologies for preventing data loss. No significant differences were found by Carnegie class, institution size, or control, indicating that data security practices are universal in higher education.

“[D]ata are the paramount institutional asset and are therefore the most important consideration when discussing BYOE security issues.”

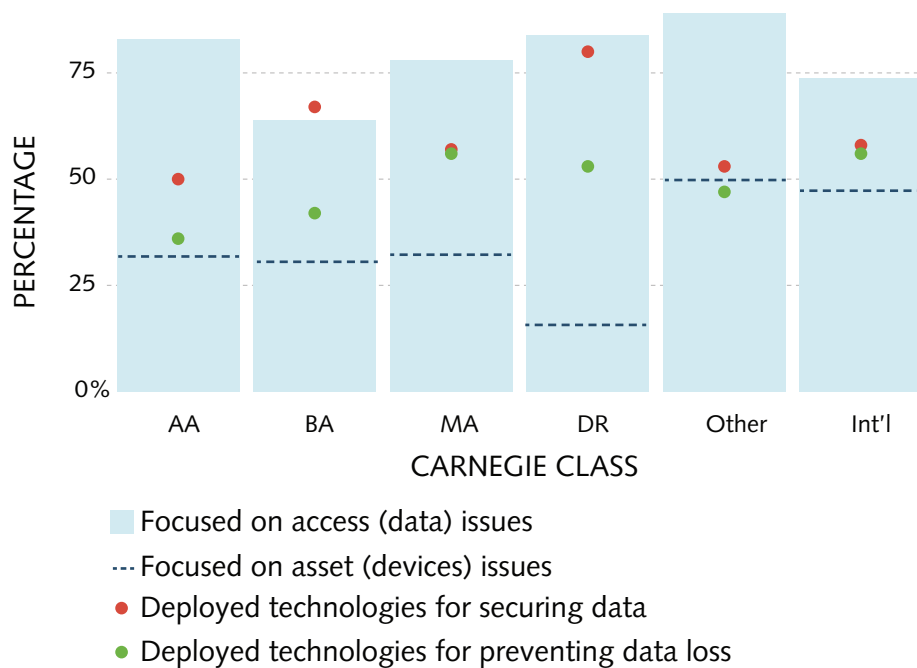


Figure 14. Focus on Securing Data, by Carnegie Class

Data should reside on secure servers, be encrypted at rest and in transit, and be accessed only through secure applications or https. These are exemplary practices regardless of BYO or institutional provisioning, and when coupled with user awareness about keeping data secure when accessed and viewed on “my screen,” they can mitigate most data security risks.

Educating users about sound security practices will raise their awareness of security risks.

IT leaders have more direct influence over risk management issues, such as securing data and managing access (discussed above), than they have over user awareness and behavior. User behavior is a wild card for BYOE, as even the most intelligent and thoughtful students, faculty, and staff can inadvertently compromise institutional security if they are not aware of the potential risks and threat vectors. In ECAR-hosted focus groups and interviews, the conversation about security generally started with, and circled back to, user behavior issues. The importance of raising user awareness, being an active stakeholder in educating users, and advocating for enforcement of compliance with security policies was a key finding from this research.

As the stewards for data and the systems that house them, IT leaders are in a strategic position—or may be obligated *by* their position—to make a case for educating users about the risks and benefits of using their own technology. ECAR found that more than one in three IT leaders (39%) did not know whether security

awareness training was mandatory at their institution. For those who do know about mandated security awareness training for BYO technology (Figure 15), ECAR found that it is common but not universal for faculty and staff knowledge workers in higher education to go through mandated security training regarding bringing/using their own technology (for school/work-related activities). Mandated security awareness training is focused on those who have access to data and systems, and the most important education needs concerning BYO were:

- User understanding of data exposure risks
- How users can avoid security breaches
- How users can separate work and personal usage

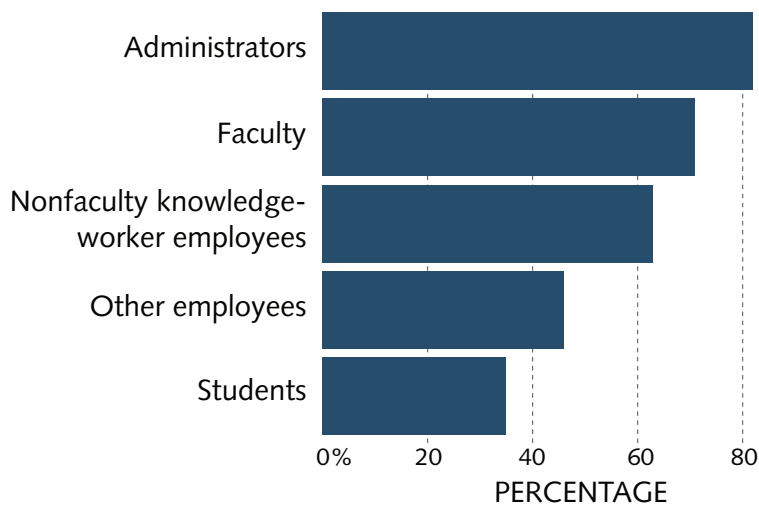


Figure 15. Mandated BYO Security Training Is Common for Most Faculty and Knowledge-Worker Staff



FISCAL CONSIDERATIONS

Finding: Cost Savings from BYO Can Be Elusive

BYOE can cost more than it saves.

The greatest promise for cost savings from BYOE lies in decreased expenditures for institutionally provisioned devices, but providing a robust infrastructure to accommodate increases in user-provisioned technologies has strained and will continue to strain IT budgets. Few IT leaders reported cost savings related to increased user-provisioned technology over the past two years, and the percentage of respondents expecting cost

increases for institutionally provisioned devices and services and increased/upgraded infrastructure far exceeds the percentage who expect cost savings (Figure 16). This was true for all types of institutions when Carnegie class, control, and institutional size were considered. Further analysis of these survey data tells us that past cost experience is believed to be indicative of future cost experience ($p < .0001$). Among survey respondents that experienced cost increases due to BYO technologies in the past two years (which represents the majority of institutions), most respondents also expect to continue to experience cost increases over the next two years.

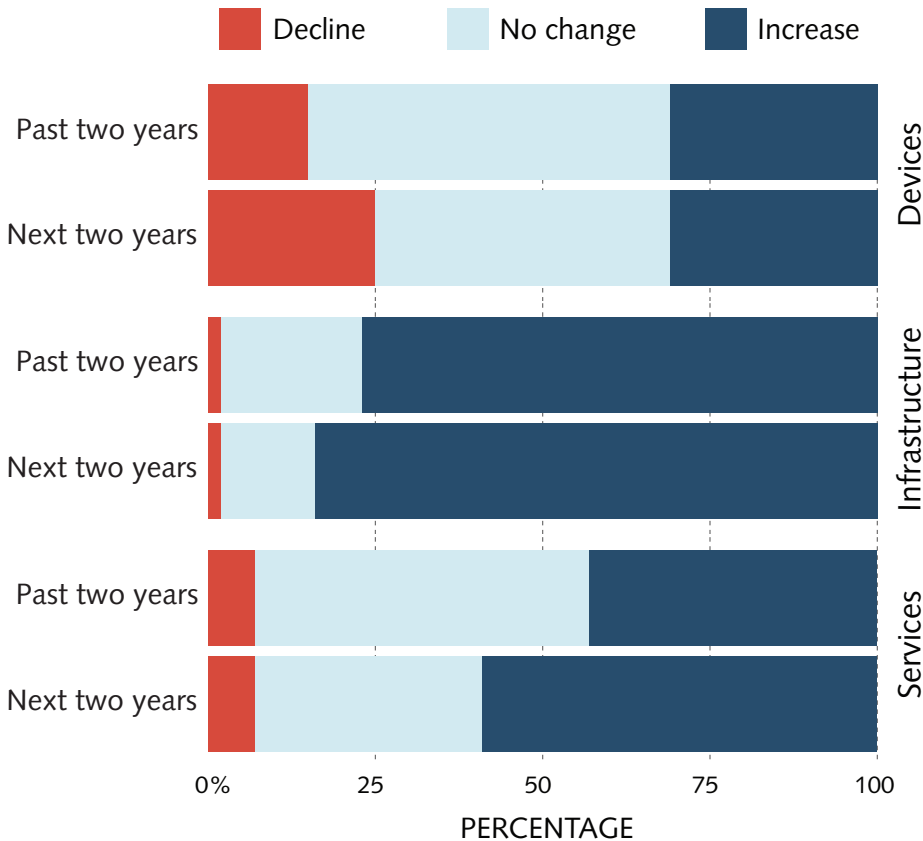


Figure 16. Financial Impact of BYO on IT Budgets

Reimbursements for BYO are not the norm in higher education.

Addressing reimbursement options in policy is neither common nor uncommon, with roughly half of respondents reporting that their institution has a reimbursement policy and half saying theirs does not (Figure 17). Among those that currently reimburse institutional employees for user-provisioned technologies, only a small percentage indicated that they would discontinue the practice (3% of BA institutions). Though there is variation by Carnegie class, control, and institution size, these differences are not significant. For reimbursements, policies tend to track with practices—four in five institutions that *did not* have a policy in place *did not* offer technology reimbursement to employees. Reimbursing for user-provisioned

81%
of institutions are
at least somewhat
motivated by BYOE
as a cost-savings
factor

technologies is not very common for higher education institutions in the United States (about two in four offer reimbursements) and is even more uncommon for institutions outside the United States.

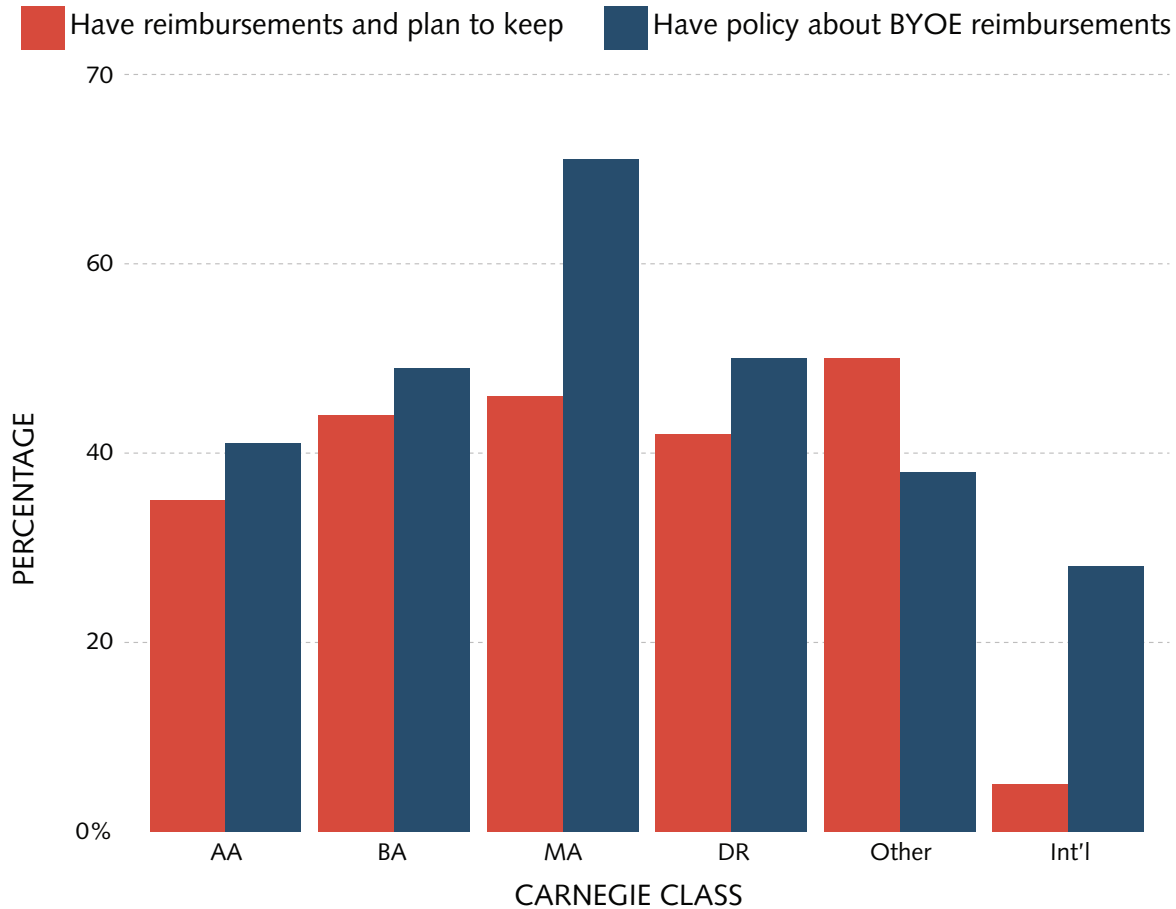


Figure 17. Prevalence of Employee Reimbursement Policies and Practices

Reimbursement practices were diverse, varying by amount, employee type, technology type (i.e., from cell phone only to an unregulated array of user-provisioned technologies), and duration (e.g., one time, monthly, triannual). These practices are clearly customized to an individual institution’s needs and capacity, and these data provide evidence that a one-size-fits-all model is not wise.

A robust yet nimble infrastructure is a wise investment.

Much of the increased costs IT leaders are facing can be traced to improving or expanding IT infrastructure to accommodate more—and more-sophisticated—user-provisioned technologies. Majorities of respondents said that extending enterprise systems for mobile access (52%) and updating/upgrading infrastructure to support device proliferation (70%) were high or essential priorities (Figure 18).

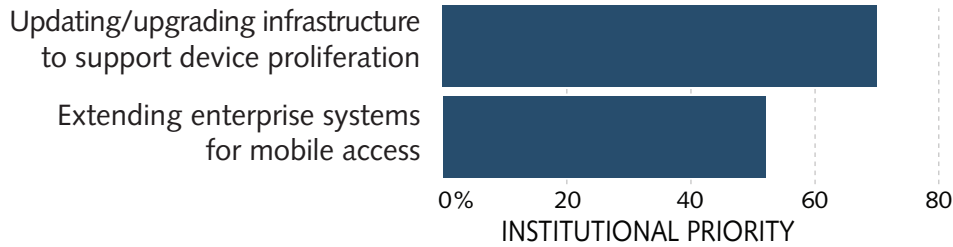


Figure 18. Respondent Priorities for Improving IT Infrastructure

Despite the fact that most students own a laptop and increasingly more own smartphones and tablets,¹³ most institutions have no plans to substantially reduce the number of student-accessible, institutionally provisioned devices (e.g., computers in general-purpose computer labs) (Figure 19). For those that do plan to reduce the number of computers, the spaces that once housed computer labs will most often be reconfigured as formal classroom lecture or lab space, collaborative or open and flexible learning spaces, and “hoteling” spaces for students to BYO (that is, spaces conducive to single or multiple occupants with flat surface areas, charging stations, and other amenities that enable users to walk up, plug in, and use personal devices in an institutionally provisioned workspace).

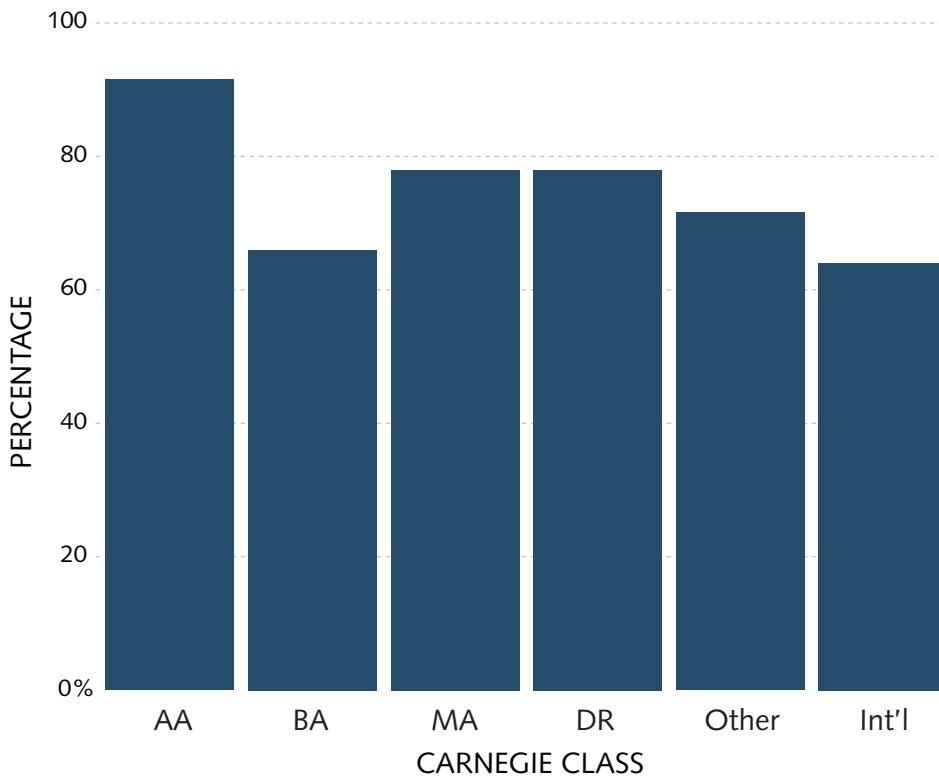
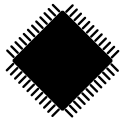


Figure 19. No Plans to Reduce Institutionally Provisioned Devices for Students

“[Former computer labs are being converted into] general collaboration spaces with power, Wi-Fi, printing stations, and free-moving furniture for ad hoc get-togethers, and of course coffee/fountain services.”

— ECAR BYOE Survey Respondent



TECHNOLOGY INFRASTRUCTURE

Finding: Think of IT Infrastructure as BYOE “Middleware”

Middleware that bridges users/devices and systems/services/data is an increasingly significant part of IT frameworks.

Traditional concepts of IT infrastructure include a combination of facilities, hardware, software, and networks that exist for the purposes of supporting, controlling, monitoring, developing, testing, and delivering information technology services.¹⁴ For BYOE, the most important aspects of IT infrastructure are the middleware components (Figure 20).

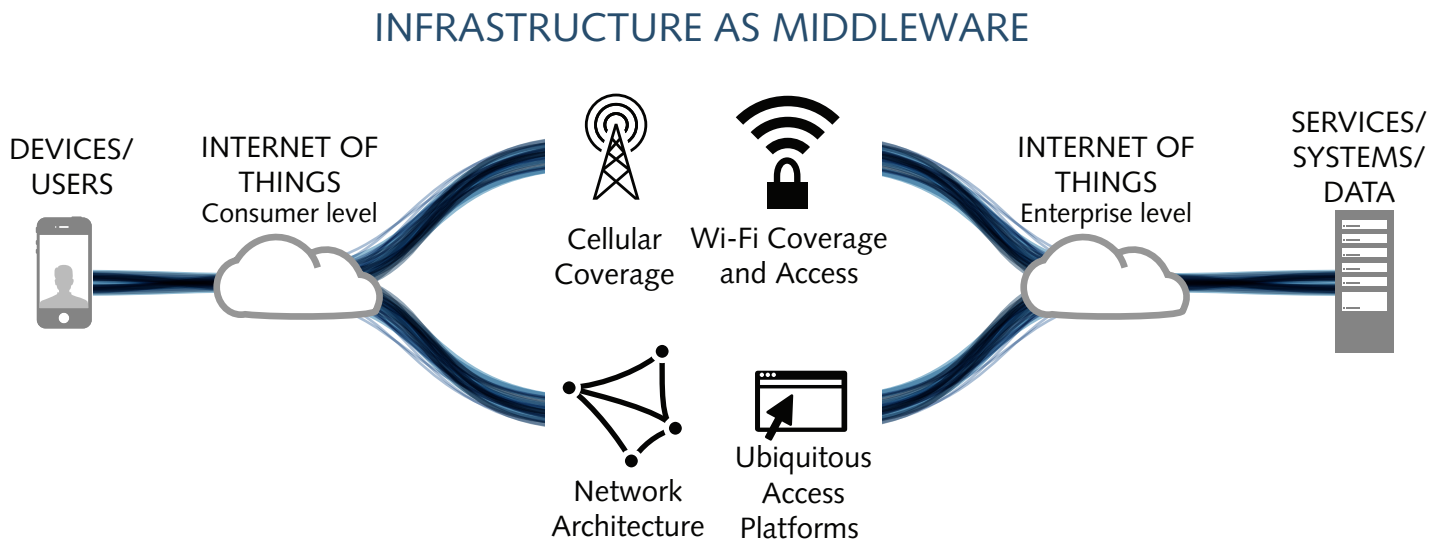


Figure 20. BYOE Middleware

Middleware components are the commodities that bridge users, their devices, and their consumer-level applications to the institution’s data, services, systems, and enterprise-level applications. IT infrastructure capable of supporting an emergent BYOE-heavy environment should provide frictionless access between any user device and any institutionally provided or managed services, systems, data, or apps that are accessed on these devices. If the important aspects of technology infrastructure for BYOE are in this “middleware,” then they are undeniably within the purview of IT professionals—and an increasingly significant part of their IT framework:

- **Cellular coverage**, including campus penetration of cellular coverage from major providers
- **Wi-Fi coverage and access**, including network Wi-Fi capabilities and open public Wi-Fi versus restricted network access

- **Network architecture**, including bandwidth and Wi-Fi density ratios (i.e., number of devices per user)
- **Ubiquitous access platforms**, including access capabilities through device applications, browsers, virtualized desktops, identify management tools, and cloud services

Current IT practice is captured in the EDUCAUSE Core Data Service.¹⁵ A sampling of these data are shown in Figure 21, and the CDS Reporting Tool can be used to further explore practices at peer institutions.

Percentage of institutions that say...

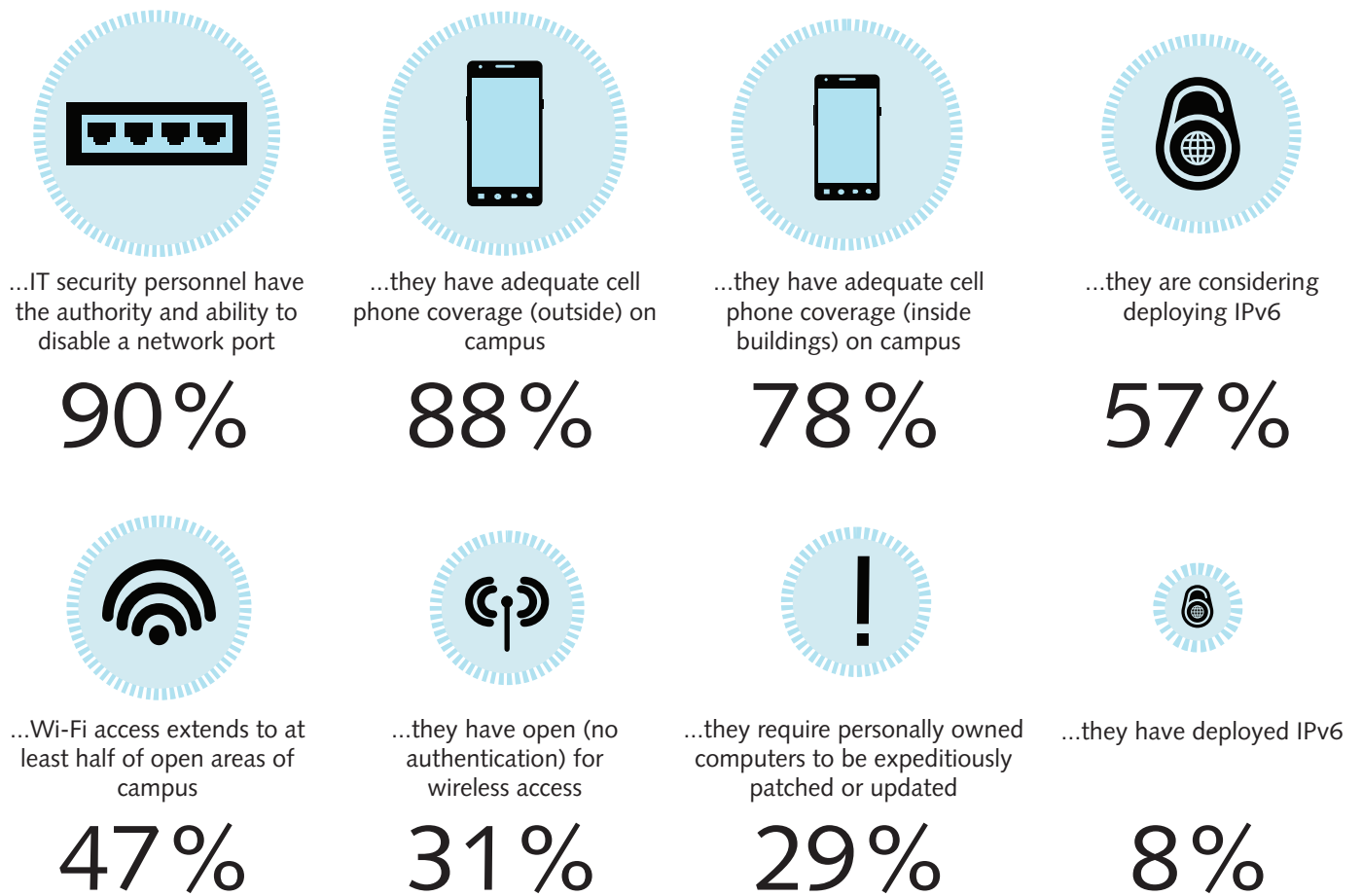


Figure 21. Current IT Practices That Relate to BYOE

An expansive overview of robust yet nimble exemplary practices and strategic innovations for each of the four IT middleware items was published in a special ECAR report on BYOE IT infrastructure.¹⁶

Moving toward a robust yet nimble IT infrastructure means finding balance between a strategically planned IT infrastructure and one that is reactive/ adaptable to new technologies.

Providing and maintaining IT infrastructure that serves a diverse array of user-provisioned and institutionally provisioned technology for students and employees is a major undertaking. The phrase “robust yet nimble” characterizes the need to have an infrastructure that is strong, well planned, large, and stable enough to accommodate BYOE needs now while preserving the ability to adapt to technology changes and growth. This is true for all aspects of IT infrastructure: hardware, software, “middleware,” and facilities.

The resounding message from the ECAR interviews and focus groups of IT leaders is that the driving force behind this seemingly contradictory way of managing IT infrastructure is the need to do whatever is necessary to meet users’ needs.¹⁷ Students, faculty, and staff expect to be able to access the Internet and institutionally maintained networks at any time and from any place (virtual or physical) using the device(s) of their choice. It is easier for an IT unit to meet this expectation if it plans well—rather than needing to continually accommodate more (or different) devices than anticipated, it can instead simply deploy the next round of projected upgrades or expansions to enable frictionless access between devices and institutionally maintained services, applications, websites, or data.

What are the characteristics of a robust yet nimble technology infrastructure? For hardware and software, this primarily means investment in quality equipment or packages with a predetermined life cycle and appropriate replacement/upgrade/expansion plans. For facilities, this primarily means abandoning the model in which new demands are continually placed on campus real estate to accommodate growing server racks (not to mention air conditioning and electricity to accommodate the equipment). Being robust yet nimble with facilities means updating (and likely upgrading) the “cloud strategy” to strike a balance between cloud and on-premise IT needs that represents fresh thinking about today’s needs and the more-demanding needs of tomorrow.¹⁸ For middleware, this means IT architecture and services have been designed—or, more likely, configured—to accommodate a large range of computing demands including an array of BYO devices, operating systems, browsers, and other technologies. Any sensitive data going to or through these BYOE technologies must be secure. In addition, plans must be made for increasing necessary elements, and funding for them should be planned or made a priority. Though the term “robust” communicates a strong, stout, and full-bodied infrastructure, it is imperative that this middle layer be transparent—if not completely invisible—to users.

Figure 22 shows the percentage of ECAR BYOE survey respondents that agreed or strongly agreed that their institution’s technology infrastructure can *presently*

Mobile Device Management

13% Deployed

Of those...

41% Systems in place for at least a year

Virtualized Desktop Integration

42% Deployed

Of those...

77% Systems in place for at least a year

accommodate widespread use of Internet-capable mobile devices. Most institutions are in pretty good shape for adequate network bandwidth, Wi-Fi coverage, and, to a lesser extent, cellular service coverage on campus. However, when asked if upgrades or expansions of these middleware services would be needed in the next two years to accommodate widespread use of Internet-capable mobile devices, the vast majority of respondents agreed or strongly agreed that infrastructure upgrades will be necessary for network bandwidth and Wi-Fi coverage (Figure 23). In comparing current adequacy of IT infrastructure to expectations for upgrades in the next two years, the relationships between present and future were significant but complex (Wi-Fi $p = .0022$, network $p < .0050$, cell coverage $p = .0001$). While agreement was high for both IT infrastructure adequacy at present and for the need for IT infrastructure upgrades in the future, institutions that reported they are adequately prepared now feel less strongly than their inadequately prepared counterparts that they will need to upgrade infrastructure in the future (a negative correlation). This means that though most institutions are expecting to upgrade IT infrastructure in the near future, this is less so for institutions that say they have an adequate IT infrastructure in place now.

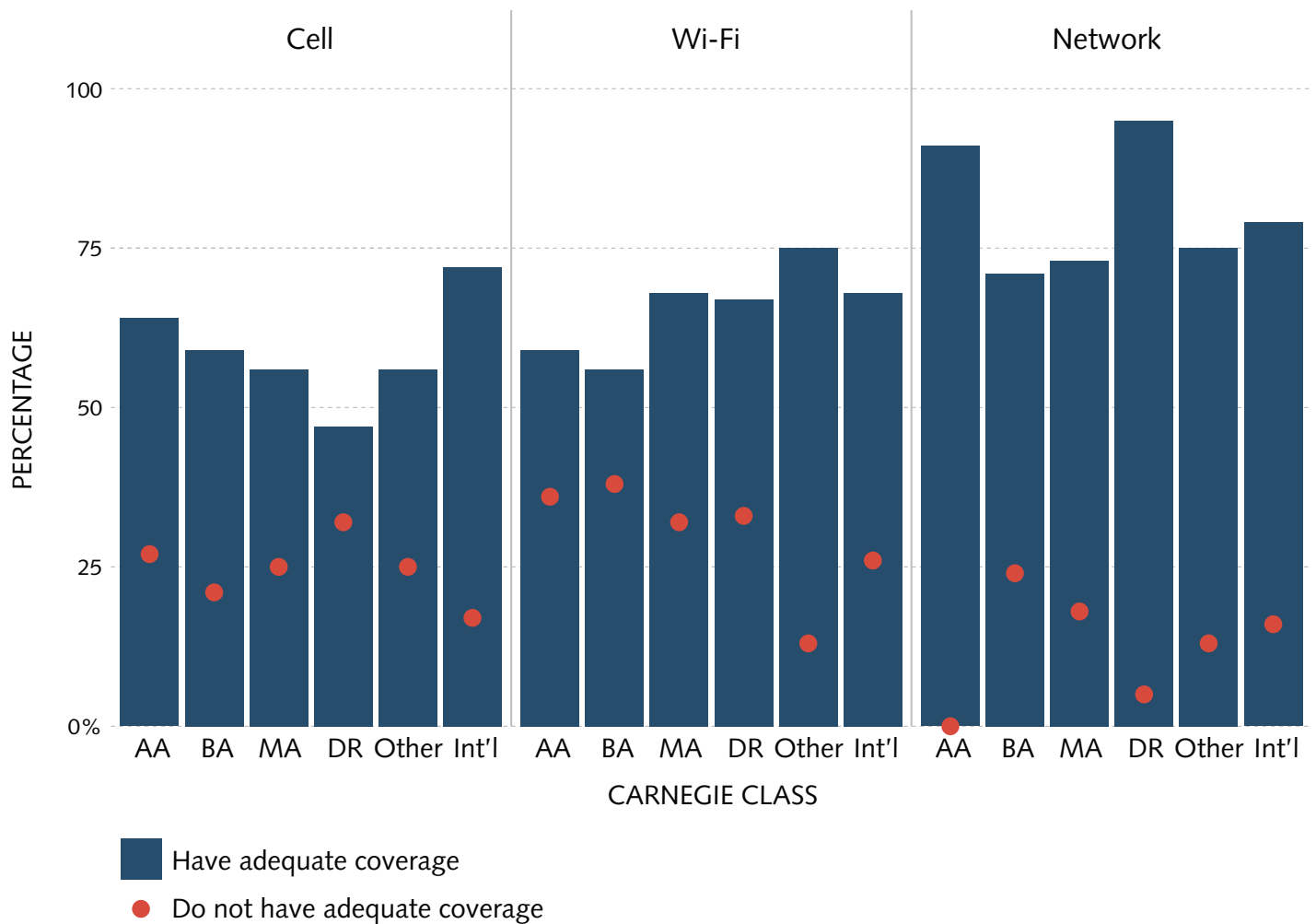


Figure 22. Adequacy of IT Infrastructure at Present Time

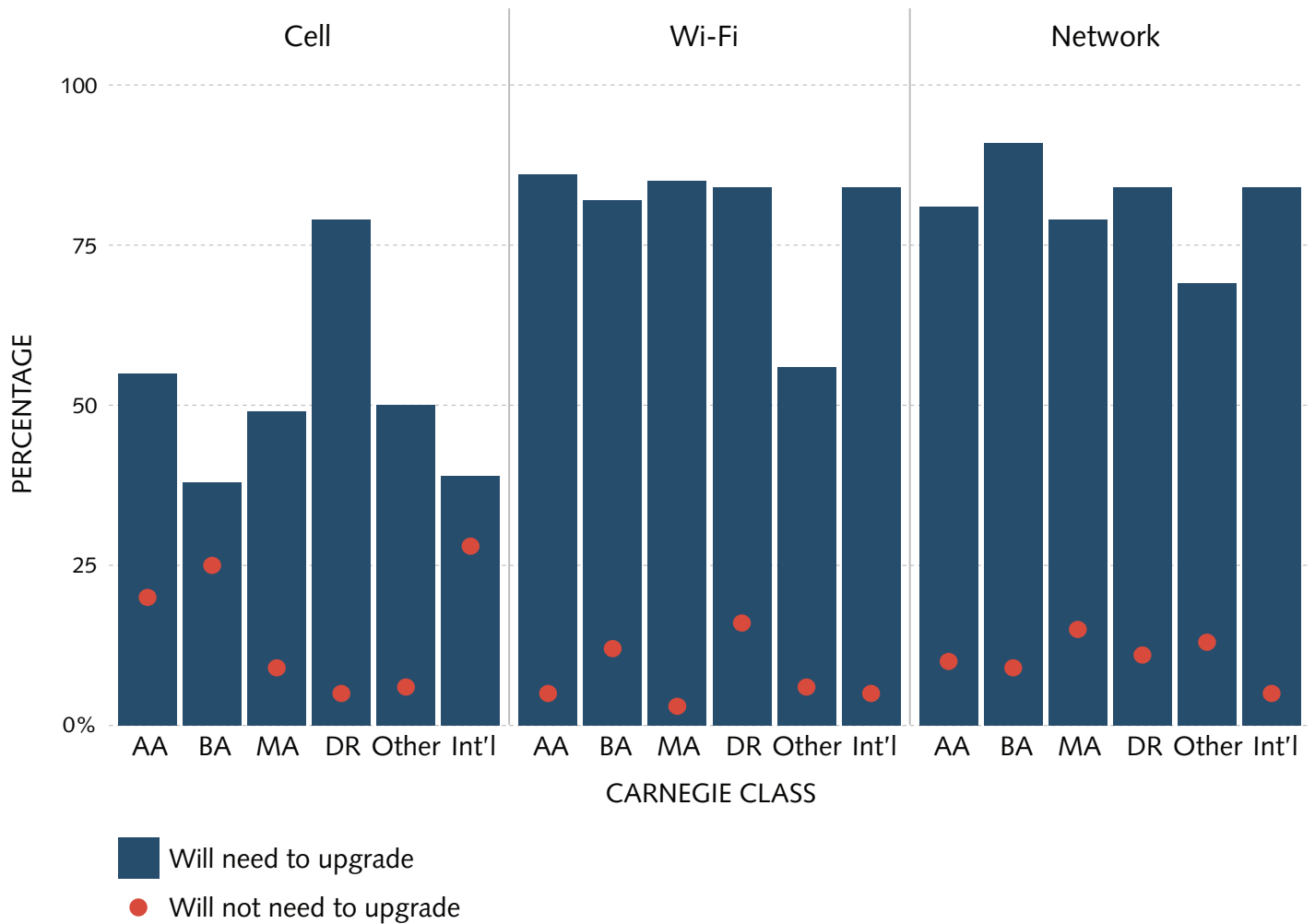


Figure 23. IT Infrastructure Upgrade Needs in the Next Two Years

SUPPORT STRATEGIES

Finding: Support Strategies Will Need to Adapt to BYOE Environments

Current help desk support efforts for employees are extensive.

There seems to be a lag between BYOE ubiquity and DIY (do-it-yourself) support. Higher education institutions’ IT shops were traditionally set up to support institutionally provisioned technologies for faculty and staff, and when BYO was relatively new (or at least not as widespread as it is today), providing some technical assistance for user-provisioned technologies seemed natural. The inundation of devices on campus, the

diverse nature of these devices, and the increasing sophistication that enables devices to be intuitive and have “plug and play” technology have changed the game for help desk support in higher education. According to ECAR focus groups and interviews, the expectations for full and even best-effort support are changing as users look to their product and service vendors first for support.

When focus group participants and interviewees were asked about the main challenges in providing support services to employees for user-provisioned devices, four themes surfaced:

- Diversity of devices, services, software, OS platforms, products, tools, and brands
- Insufficient staffing levels that can't keep up with the volume of requests
- Customization, nonstandard configurations, and user proficiency/education
- Managing expectations of users

Full support for faculty and staff laptops is common, and best-effort support is most common for smartphones, tablets, and cloud-based services (Figure 24). Despite support challenges, full-support services are focused on laptops, which have endured as the productivity standard.

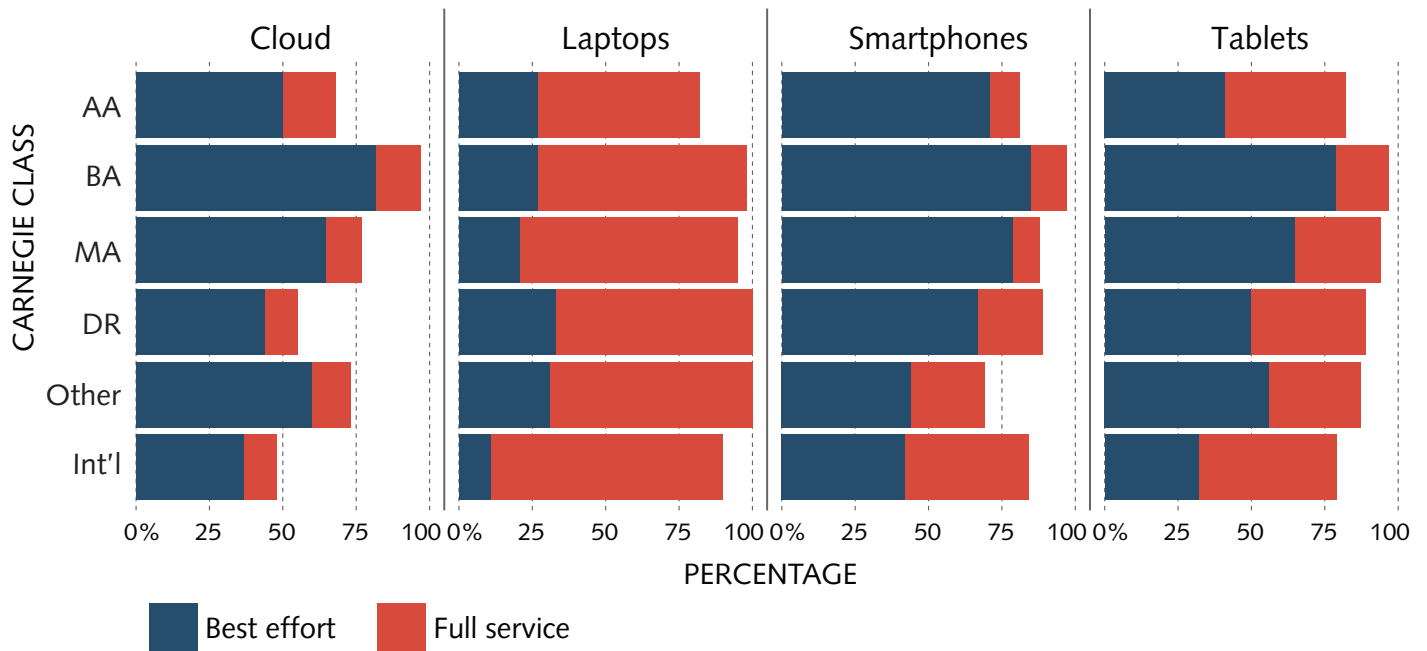


Figure 24. Full and Best-Effort Support Are Common for Employees

When employees use their own devices to increase their work productivity, it can be a public relations challenge for campus IT to deny support efforts. However, based on the challenges noted above, as more BYO technology infiltrates campuses, policies

and practices around user support will need to adapt to exclude most active, hands-on support efforts. Providing configuration information and general device-specific (or device-agnostic) instructions for access to institutionally owned or managed systems, services, and data may be prudent. That, combined with instructions about how to contact service providers, is not an unlikely “new normal” for IT help desk staff. If the increase in user-provisioned technologies does not translate into DIY support, IT help desks will face serious workload challenges.

Current help desk support for students is typically “best effort.”

Support for student devices is rather extensive, considering that most of these are, and have traditionally been, user-provisioned (Figure 25). Unlike faculty and staff, who are experiencing a cultural transition from “my institution should help me with this ...” to “my mobile device vendor/service provider should help me with this ...,” students have always been redirected to vendors/service providers for certain support issues. Assisting students with finding services, reminding them of user names, and troubleshooting with network connectivity are among the most common support efforts. Private institutions are more likely to offer support than public institutions for each of the four services/devices reported (cloud, $p = 0.0039$; smartphones, $p = 0.0099$; tablets, $p = 0.0103$; and laptops, $p = 0.0038$). International institutions are less likely to provide support for laptops ($p = 0.0034$) and tablets ($p = 0.0103$).

“Having the manpower to provide the support [is a challenge]. We will work on their devices if we have time.”

—ECAR BYOE Survey Respondent

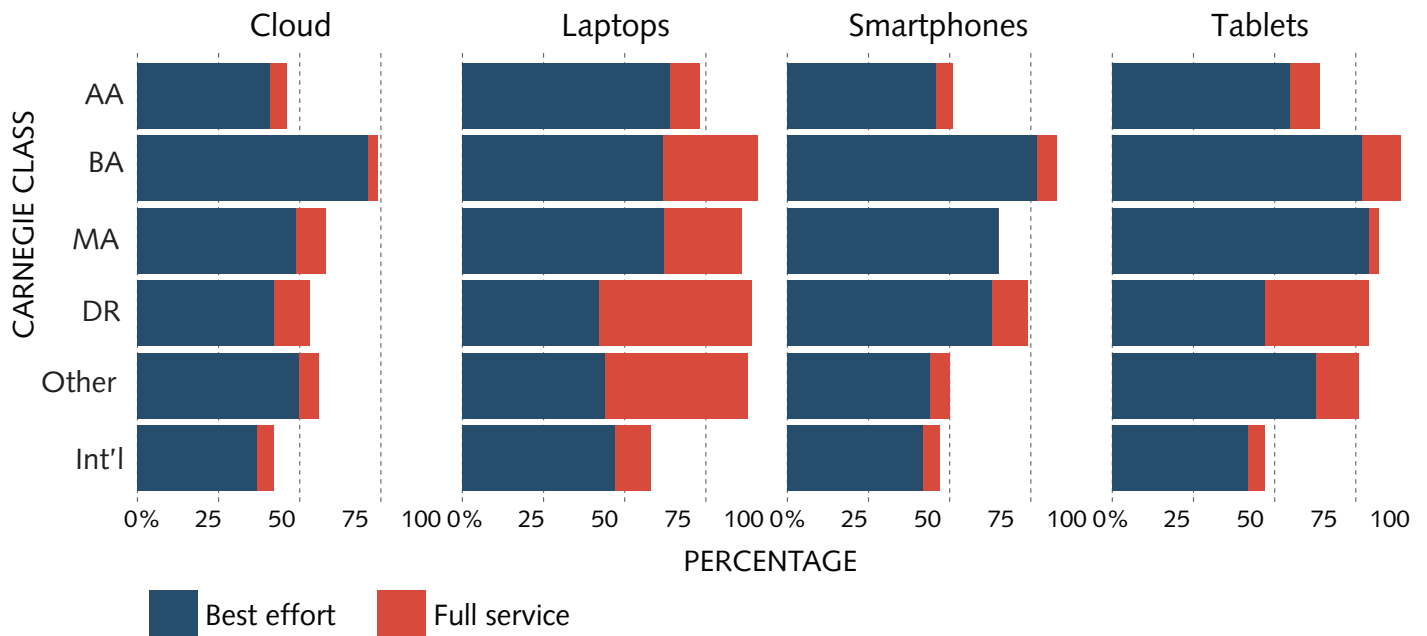


Figure 25. Best-Effort Support Is Most Common for Students

Support demands for user-provisioned technology are expected to increase over the next two years.

In estimating overall demand (inclusive of students, faculty, and staff) for support of user-provisioned technologies over the next two years, IT leaders predict notable increases (Figure 26). These data represent the percentage of institutions that expect to see an increase of 50% or more in support requests (e.g., help desk calls, support request tickets, etc.) between now and 2014. This means that an institution that currently addresses 1,000 support requests monthly is estimated to have 1,500 monthly support requests in two years.

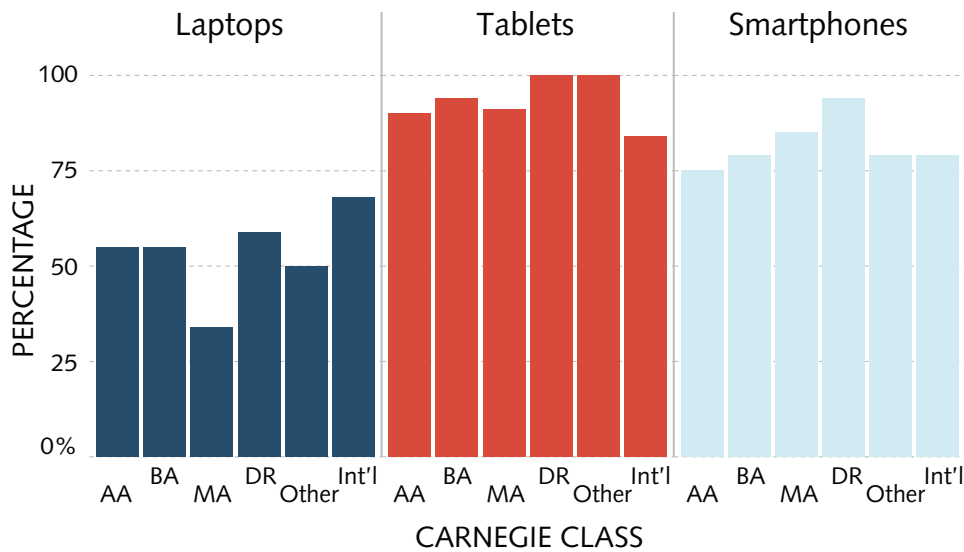


Figure 26. Increased Support Demand Estimates in Next Two Years

Improving end-user experiences and providing more support are among the top priorities of IT leaders.

IT leaders recognize simplifying (53%) and improving (44%) end-user experiences for those who use their own technology as top support priorities (Figure 27). These items were two of the top-three priorities when identifying high and essential institutional priorities. IT help desks are not coldly rerouting help seekers to third-party sources in response to the ever-increasing consumerized technology market; rather, higher education institutions are rethinking whether or how to best provide support. Figure 27 shows that about one in three institutions (36%) consider providing more user support for student-provisioned technologies—and more than one in four (28%) consider providing more user support for faculty-provisioned technologies—to be a high or essential priority. The nature of help desk support is changing, and the new IT help desk is less about being a technology plumber and more about being a technology consultant, which takes a different skill set. Routing help seekers to self-service portals and tutorials, providing links to vendor resources or direct customer support,

74%
of institutions predict costs to increase for providing IT services to support user-provisioned technology

and crowdsourcing solutions through blogs and wikis are all part of the new IT help desk paradigm. There is also an increasingly savvy end-user population that does its own Googling and crowdsourcing for technology solutions, according to Jarod Greene, a Gartner analyst who has been following the trend. “We call it ‘Hey, Joe!’ support. It’s not about opening a help ticket or closing the ticket. It’s ‘I just need to know how to use this better.’”¹⁹

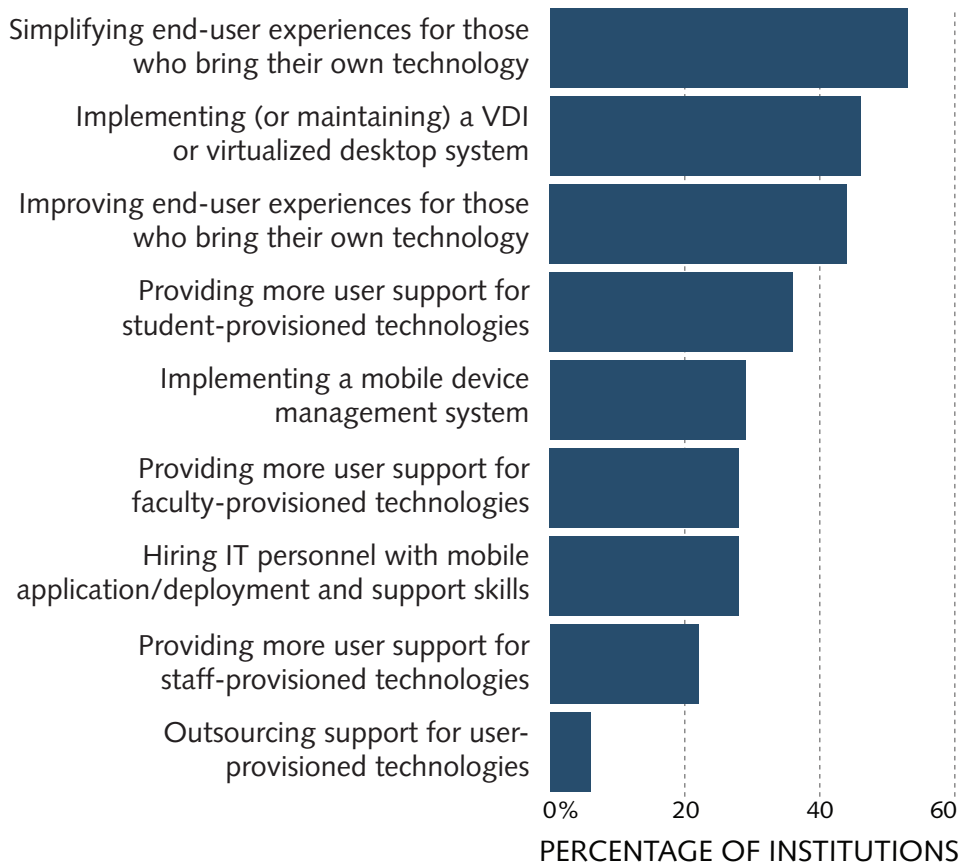


Figure 27. Institutional Rating of BYOE Support Priorities as High or Essential



TEACHING AND LEARNING

Finding: Implications for Teaching and Learning Excite IT Professionals the Most about BYO

Utilizing mobile technologies for teaching and learning is a priority, but providing students guidance for how to do so is still rare.

Facilitating anytime, anywhere access to course materials for students is a high or essential priority for the majority of institutions (Figure 28). ECAR focus group participants and interviewees discussed their support for and excitement about the teaching and learning opportunities that Internet-capable mobile devices offer to students. In addition to extending the learning environment, the use of technology to increase student engagement and to make campuses desirable places to engage with technology and technology-enabled learning are also aspirational prospects of the increased “BYOing” of students. We know from several years of data from the ECAR student study that technology literacy is not universal for undergraduate students. Though 66% said that they are prepared to use technology upon entering the college/university, nearly as many (64%) say that it is very or extremely important to be better skilled or trained at using technology.²⁰ Figure 28 also shows the percentages of institutions that provide guidelines to students about whether or how to incorporate their mobile technologies into the learning environment; clearly, such guidelines are relatively rare. Survey data revealed no significant differences by Carnegie class, control, or institution size for priority or student guidelines.

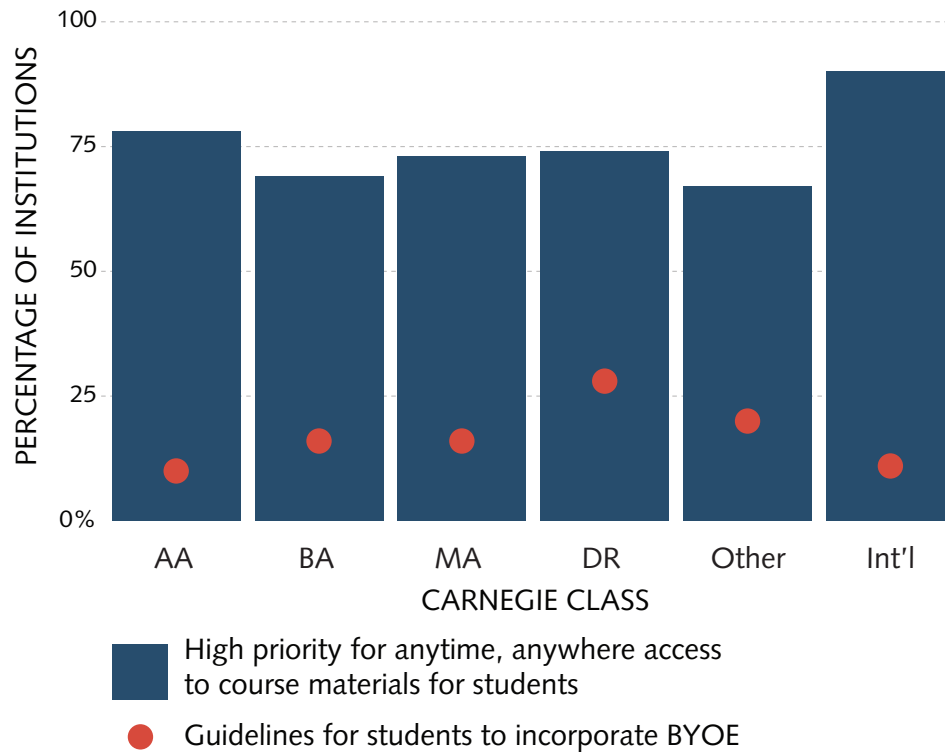


Figure 28. Priority for Facilitating Anytime, Anywhere Access to Course Materials and for Providing BYOE Guidelines for Students

Balancing academic freedom, professional development, and expectations for end-user experiences is important.

According to ECAR BYOE survey results, the vast majority of institutions consider the support of innovative teaching opportunities to be a high or essential priority (Figure 29). The figure also shows, however, that far fewer institutions provide guidelines for addressing whether or how faculty-provisioned technologies can be incorporated into the teaching and learning environment and that even fewer have formal programs or units in place to help faculty incorporate student-provisioned technologies into the learning environment. Survey data did not show significant differences by Carnegie class, control, or institution size for priority. College and university faculty were traditionally sought after for their content expertise, and though that is still of primary importance, the methods, modes, and techniques by which they connect and deliver content to students are becoming more important.

As students increasingly bring their own everything to campus, it is not enough to leave faculty to develop strategies that integrate mobile technology into their curricular or pedagogical practices. Offering professional development opportunities and

guidelines for BYO integration techniques that are couched in terms of institutional priorities and end-user experience goals is a way to avoid infringing on the academic freedom of individual faculty. The EDUCAUSE Learning Initiative (ELI) is the association's hotbed for information and resources for BYOE and mobile IT. ELI publishes resources, hosts online and face-to-face events, and offers targeted professional development opportunities that cover instructional technology and technology integration into the teaching and learning environment.

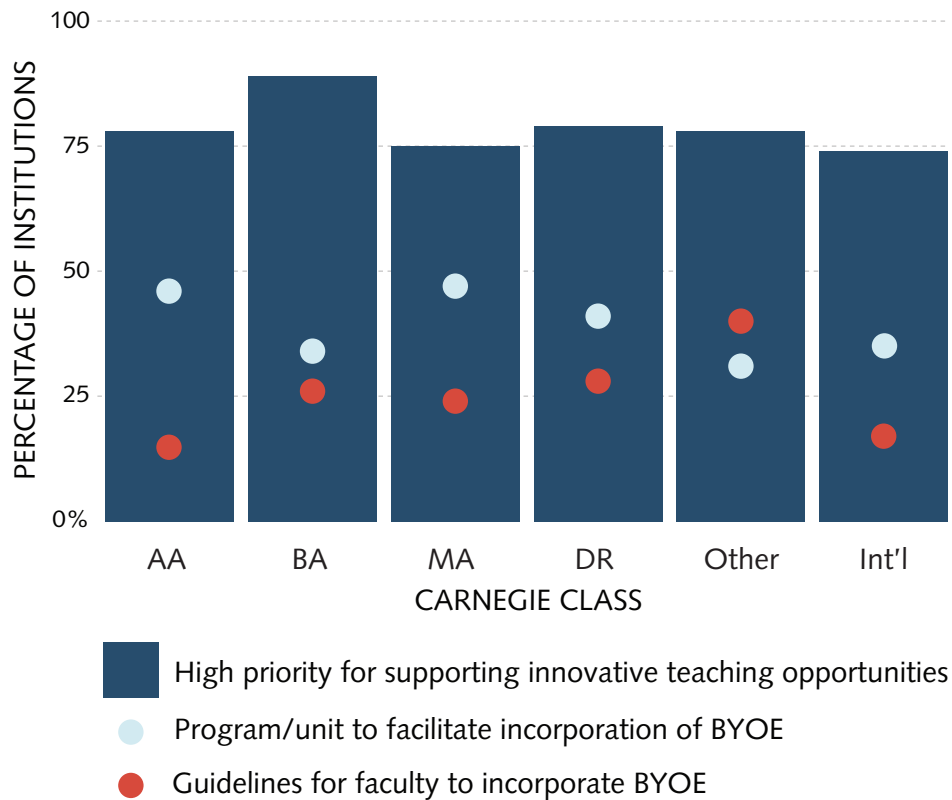


Figure 29. Priority for Supporting Innovative Teaching Opportunities, and Presence of Guidelines for Faculty- and Student-Provisioned Technologies

Nearly all institutions reported that it is up to individual faculty to allow or disallow mobile devices in class, and small percentages of IT leaders reported that divisions/units or the institution in general sets expectations to allow or disallow mobile devices in face-to-face classes (Figure 30).

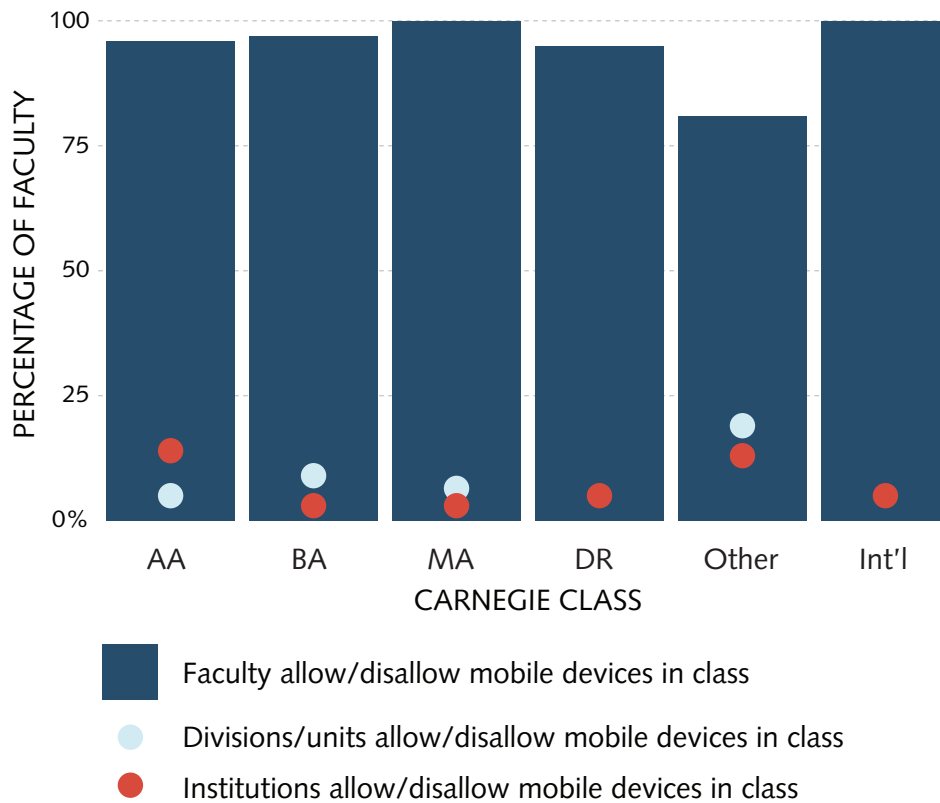


Figure 30. Authority for Allowing/Disallowing Mobile Devices in Face-to-Face Courses

Recommendations

IT professionals are facing considerable challenges and opportunities when it comes to adapting to a consumerized technology world. Tracking technology trends is an essential component for assessing today's capabilities to accommodate BYOE, leverage the best aspects of BYOE integration and use, and anticipate tomorrow's opportunities. The motivating factors behind embracing BYOE are to engage students and extend their learning environments and to have happy and productive faculty and staff. Doing this gracefully takes a little bit of planning and a lot of flexibility, and institutions that are most successful with BYOE will likely have an IT leader who is comfortable with ambiguity.



Planning, Governance, and Leadership

- Have strong leadership and strong follow-through that address technology expectations at the top levels and is supported throughout the institution.
- Establish a mobile vision, one that considers human behavioral traits as a significant variable.
- Focus on having policies for issues that are within the purview of IT, such as securing data, and only have policies that can and will be enforced.



Security Practices

- Balance rigorous security standards (managed risks) with user (in)conveniences.
- Accept that the proliferation of user-provisioned technologies does little to change the basic best practices around security—a solid security presence and plan on campus can adjust to most BYOE challenges.
- Manage risk through securing data (access) rather than devices (assets).
- Collaborate with other units, such as human resources, to establish user-awareness training and education programs that focus on the understanding of risks of data exposure, how users can avoid security breaches, and how users can separate work and personal usage.



Fiscal Considerations

- Don't count on cost savings, but when they arise, invest in infrastructure.
- Reconsider reimbursement plans for BYO and retain these services only if there is the right combination of political and financial investment for your institution.



IT Infrastructure

- Invest in IT infrastructure “middleware” that is invisible, frictionless, and robust yet nimble in order to bridge the connection of users/devices and systems/services/data.



Support Strategies

- Have clear and accessible support service-level options.
- Champion the paradigm shift so that BYOE means more DIY support.
- Strive to improve end-user experiences through empowering solutions such as “Hey, Joe” support crowdsourcing.



Teaching and Learning

- Be mobile ready, willing, and able with a mobile-friendly environment that meets student, faculty, and staff expectations.
- Collaborate with other units to formalize systems for guiding students and faculty in incorporating mobile, networkable devices into the curriculum and pedagogy.

Innovation Considerations

Seeking out strategic innovations for BYOE is a collective and ongoing responsibility. Innovations are happening daily, but instead of including today's comprehensive innovations that may not be applicable tomorrow, this report finds that the *most* strategic innovation recommendation is to pay attention to what is happening today and be forward-thinking about evolving and emerging technologies and how they will be adapted and used tomorrow. That said, here are a few strategic innovations that ECAR found too interesting to pass up and/or may have promise for BYOE in higher education.

Wearable devices will account for the next onslaught of BYO technologies.²¹ [Google glass](#), for example, offers hands-free, voice-activated, interactive networked experiences; with this product, you'll no longer need your smartphone to get directions, find a factoid, take a picture or video, send a message, or connect with others. [MYO](#) is a wearable gesture control device that can read the electrical activity in your muscles. A [GoPro](#) camera allows for sophisticated digital recordings by recognizing gesture-based control signals. You can track your sleep with [Jawbone](#), your physical activity with the [Nike Fuelband](#), or your general health and wellness activities with [FitBit](#). You can engage body movement and efficiency analytics with your connected [Under Armour](#) gear. Or maybe you just want a [CuteCircuit TshirtOS](#) as a wearable platform for self-expression. Are these just sophisticated toys, or will they have practical application in higher education?

Somewhat more practical innovations for higher education include strategies by which enterprise mobile apps can effectively be containerized.²² Another security innovation is the use of mobile devices to take "eye prints" to verify identity, as developed by [EyeVerify](#). If biometrics is not your thing, then perhaps [Passban](#) is of interest, a product that lets you use your mobile device to verify and access your personal mobile apps using your own voice and face, your location, or motion- or tokens-based verification. [Jumio](#) uses identification cards and a smartphone to authenticate identity; it can also scan and validate credit cards. While not a particularly new technology, [eduroam](#) is still on the innovation radar as a secure, worldwide roaming access service. Eduroam enables Internet connectivity across participating campuses, allowing frictionless network access to its users.

For IT infrastructure, the [Kurogo](#) Mobile Platform is an example of "open-source mobile optimized middleware" that bridges the custom-native mobile app opportunity without requiring substantial stand-alone native app investment. Following this approach could lead to a robust device-agnostic browser and app environment. [Connectify](#) Dispatch, for example, is software that acts as a meta-consolidator of existing network connections. For about \$50 per year, this software allows users to "combine all of [their] Internet connections to create one super-connection!" This

combination could include wireless and wired networks, as well as mobile broadband sources. In addition to these vendor-based innovations, Gigabit Wi-Fi is currently being considered by the FCC and is likely around the corner.²³

Innovations for teaching and learning include some exciting prospects. [Swivl](#), a lecture capture device, turns an iPhone into a personal cameraman with a wireless microphone. You can also use your smartphone as a document camera with [Scandock](#), which is touted as the “post-PC scanner.” With [Marvell Cloud Computer SMILE](#), you can bring your own network to the classroom. This device allows for cloud-based interactive digital learning. These are just a few new technologies that are available today, and more are being released each week.

As alluded to in the opening paragraph of this section, listing innovations is almost a moot point because the technology is changing so rapidly. Developing your own methodology for scouring news about new technologies is imperative. Finding metafeeders of innovative technology news (e.g., TechCrunch) and loyally scanning your sources for new, interesting, or better technologies is a feasible way to keep current on what types of technology are coming down the pike. Maintaining currency and keeping at least one step ahead of obsolescence is the burden and blessing of IT leadership.

Methodology

Survey: ECAR administered a BYOE survey to a sample of EDUCAUSE members (N = 976; 16% response rate), yielding 156 survey respondents (see Table A) and a $\pm 8\%$ margin of error. The online survey contained both quantitative and qualitative items. Data collection occurred December 2012 through January 2013.

Table A. Summary of Respondents, by Carnegie Classification and Control

Carnegie Classification	Public	Private	Total
AA	22	1	23
BA	6	31	37
MA	21	17	38
DR	13	8	21
Other	5	13	18
Non-U.S.	10	1	19 (8 missing control designations)
Total	77	71	156

Focus Groups: In addition to the survey, data were collected from five online groups (14 participants) and two face-to-face focus groups (12 participants). Participants for each focus group consisted of IT professionals, with an emphasis on IT leaders for the face-to-face focus groups. Focus groups were conducted in October and November 2012.

Interviews: One-on-one interviews were conducted with five IT professionals. Interviews were conducted in August, October, and November 2012 and March 2013.

Acknowledgments

This study resulted from the co-authorship collaboration between Eden Dahlstrom (ECAR) and Stephen diFilipo (Cecil College). Mark Askren (University of Nebraska–Lincoln) provided subject-matter expertise that helped focus the work on what aspects of BYOE matter most to IT professionals. Focus group participants and interviewees deserve special thanks for offering insights gained from their BYOE experiences. Survey respondents also deserve special recognition for sharing their institutional experiences with ECAR about BYOE. Kathryn Northcut (Missouri University of Science and Technology) provided help with the focus groups and resulting analysis. EDUCAUSE staff members Susan Grajek, Pam Arroway, Mike Roedema, Tyson Anderson, Rodney Petersen, Jackie Bichsel, Joanna Grama, Kate Hellweg, Gregory Dobbin, Lisa Gesner, and Ashlan Sarff contributed many insightful suggestions, additions, and changes to this report as well as operational support.

Notes

1. Susan Grajek, the 2011–2012 EDUCAUSE IT Issues Panel, and Judith A. Pirani, “Top-Ten IT Issues 2012,” *EDUCAUSE Review* 47, no. 3 (May/June 2012): 40, <http://net.educause.edu/ir/library/pdf/ERM1232.pdf>.
2. Lawrence Pingree, “Bring Your Own Device (BYOD): Mobile Trends and Securing the Transaction,” webinar hosted by Gartner, January 15, 2013, <http://www.gartner.com>.
3. Eden Dahlstrom, *ECAR Study of Undergraduate Students and Information Technology, 2012*, Research Report (Louisville, CO: EDUCAUSE Center for Applied Research, September 2012), available from <http://www.educause.edu/ecar>.
4. ATKearney, “The Mobile Economy 2013,” (p. 15), <http://www.gsamobileeconomy.com/read/>.
5. Garrett Hardin, “The Tragedy of the Commons,” *Science* 162, no. 3859 (December 13, 1968): 1243–1248.
6. Students at private institutions have significantly more networkable devices than students at public institutions (3.92 vs. 3.27; $p = 0.0104$), but there are no significant differences by Carnegie class or institution size.
7. ECAR counts are higher, as they also include Wi-Fi and Internet-only devices (no cellular data plan needed).
8. Kevin Fitchard, “The Average US Subscriber Owns 1.57 Mobile Devices,” October 22, 2012, <http://gigaom.com/2012/10/22/the-average-us-subscriber-owns-1-57-mobile-devices/>.
9. The exception was for visitors, where only 55% of respondents do have reliable data. Visitors are likely to use guest networks, and guest networks are least likely to have authentication requirements, so this makes sense. It does not account for the overlap of students, faculty, staff, and administrators using the guest network, however.
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