Cloud and Mobile Computing
A Higher Education Perspective

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Cloud
What is Cloud Computing?

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.
What is Cloud Computing?

This cloud model is composed of five essential characteristics, three service models, and four deployment models.
5 Essential Cloud Computing Characteristics

Ref: The NIST Definition of Cloud Computing
http://csrc.nist.gov/groups/SNS/cloud-computing/cloud-def-v15.doc

- On-demand self-service
- Ubiquitous network access
- Location transparent resource pooling
- Rapid elasticity
- Measured service with pay per use
Cloud Computing as Gartner Sees It

SaaS
- Google Apps, Salesforce.com, Netsuite, Lotus, WebFilings, Zoho, Yahoo!Mail, Hotmail, ...

PaaS
- Google App Engine, Force.com, Windows Azure, LongJump, Rollbase, Amazon Elastic Beanstalk, VMware CloudFoundry, ...

IaaS
- Amazon EC2, Rackspace, VMware, Joyent, Google Cloud Storage, ....

Source: Gartner AADI Summit Dec 2009
Figure 3 Cloud Computing: The Latest Evolution Of Hosting

Source: Forrester Research, Inc.
Figure 1. Hype Cycle for Cloud Computing, 2012

- **Expectations**
  - Hybrid Cloud Computing
  - Cloud BPM
  - Cloud Management Platforms
  - Big Data
  - Cloud Application Development Services
  - Cloud Security and Risk Standards
  - MDM Solutions in the Cloud
  - DevOps

- **Technology Trigger**
- **Peak of Inflated Expectations**
  - Cloud Email
  - Platform as a Service
  - Cloud Collaboration Services
  - Cloud Parallel Processing
  - Private Cloud Computing
  - Application PaaS
  - Database Platform as a Service (dbPaaS)
  - Elastic Multitenancy

- **Trough of Disillusionment**
  - Hybrid IT
  - Cloud Services Brokerage
  - Cloudbursting
  - Personal Cloud
  - Private Platform as a Service
  - Cloud-Optimized Application Design

- **Slope of Enlightenment**
  - Cloud Computing
  - Real-Time Infrastructure
  - Public Cloud Storage
  - Cloud/Web Platforms

- **Plateau of Productivity**
  - Infrastructure as a Service (IaaS)
  - Enhanced Network Delivery
  - Software as a Service (SaaS)
  - Cloud Advertising
  - Sales Force Automation SaaS
  - Virtualization
  - Dedicated Email Services

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**Time**

- Plateau will be reached in:
  - ○ less than 2 years
  - ● 2 to 5 years
  - ● 5 to 10 years
  - ▲ more than 10 years
  - ◆ obsolete
  - ○ before plateau

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Source: Gartner (August 2012)
Cloud Control

Separation of Responsibilities

Cloud Computing

On-Premises
- Applications
- Data
- Runtime
- Middleware
- O/S
- Virtualization
- Servers
- Storage
- Networking

Resource owner’s
Subsciber

Infrastructure
- (as a Service)
  - Applications
  - Data
  - Runtime
  - Middleware
  - O/S
  - Virtualization
  - Servers
  - Storage
  - Networking

Platform
- (as a Service)
  - Applications
  - Data
  - Runtime
  - Middleware
  - O/S
  - Virtualization
  - Servers
  - Storage
  - Networking

Software
- (as a Service)
  - Applications
  - Data
  - Runtime
  - Middleware
  - O/S
  - Virtualization
  - Servers
  - Storage
  - Networking

Service provider
Cloud Usage

Forms of Alternative Sourcing Currently in Use (N=309)

(Source: ECAR)

Form Percent Adopted (N=309)

- SaaS 49.8%
- ERP project management 19.1%
- Third party to design network 18.8%
- Third party–operated call center/help desk 14.2%
- Third party to manage network 9.4%
- Cloud-based servers 9.1%
- Cloud-based storage 7.8%
- Primary data center provided by a third party 7.4%
- Third party–provided desktop/computing support 7.1%
- Cloud-based security applications 4.5%
- Cloud-based development environments 3.6%
Cloud computing’s greatest wins in the enterprise continue to be in non-mission critical areas of the business.

Source: [2013 Cloud Computing](http://example.com) Planning Guide: Rising Expectations Published: 1 November 2012 Analysts: Drue Reeves, Kyle Hilgendorf
Cloud Sweet Spot

Source: Gartner (October 2012)
Potential Cloud/Shared Services

- Business availability/disaster recovery
- Computer labs for students
- Computing cycles
- Cooperative (library) collection development
- Desktop support
- Data storage
- E-mail
- ERP
- Identity services
- IT help desk (Tier 1)
- Telephony

Trends in IT Sourcing

Change in percentage of colleges and universities using external suppliers for selected IT functions

In 2009

- 22.0% Web Development/Hosting
- 21.1% Transaction Systems Operation
- 20.8% Learning/Course Management Systems

7-Year Change

- +86.4%
- +129.3%
- +66.4%

In 2003

- 12.5% Print Services
- 11.8% Application Development
- 9.2% Help Desk

7-Year Change

- +122.2%
- +70.6%
- +147.2%

Institutions Using No External Suppliers:

- 51.0%
- 47.0%
- 43.0%
- 38.7%
- 34.3%
- 29.8%
- 25.7%

Source: EDUCAUSE Core Data Service © 2011 EDUCAUSE ZMGraphics.com
Alberta’s Learning Cloud

BC Campus Shared Service Inventory
Cloud Decision Framework

Step 1: Prework
- Create cloud computing core team
- Define business objectives
- Scope the effort
- Establish cloud adoption principles

Repeat Steps 2 through 4 as necessary, on an application-by-application basis.

Step 2: Business and Application Assessment
- Conduct a BIA
- Determine application requirements and dependencies
- Construct an internal cost model
- Consider changes to organizational procedures
- App external cloud ready?
- No
- Yes

- Keep application internal
- Yes
- Re-evaluate app?
- No
- Send RFO and kick off migration planning
- No
- Yes

Step 3: Vendor Selection Process
- Create and submit the RFI
- Review vendor response
- Suitable vendor?
- No
- Yes

Step 4: Mitigate Risk and Liability
- Devise an exit strategy
- Explore other risk mitigation options
- Risk acceptable?
- No
- Yes

Step 5: Steady State
- Manage vendors
- Govern internally
- Review regularly

Source: Gartner (October 2012)

Cloud Benefits

• Driving down the capital and total costs of IT in higher education
• Facilitating the transparent matching of IT demand, costs, and funding
• Scaling IT
• Fostering further IT standardization
• Accelerating time to market by reducing IT supply bottlenecks
• Countering or channeling the ad hoc consumerization of enterprise IT services
• Increasing access to scarce IT talent
• Creating a pathway to a five nines and 24 × 7 × 365 environment
• Enabling the sourcing of cycles and storage powered by renewable energy
• Increasing interoperability between disjointed technologies between and within institutions
Cloud Considerations

• Security, data ownership, confidentiality, integrity, regulations, audit requirements
• Total cost isn’t always lower
• Reliability of performance doesn’t match promise
• Bandwidth requirements may be a limiting factor
• Poor or nonexistent service level agreements
• Inadequate risk management
• ROI justification, management of change orders, and vendor lock-in
• Market immaturity of contract and legal obligations
• Management issues of integrated systems

http://www.informationweek.com/higher-eds-cloud-computing-forecast-stormy/d/d-id/1111544?
Cloud Considerations

Don't ...

-- Move to the cloud simply because it is easier to obtain budget for recurring expenses than it is for a capital expense and permanent staff positions.

-- Move to the cloud simply for the expediency of shorter project timelines. This is tempting but can have a long-term negative impact on your university.

-- Move to the cloud without an ironclad service level agreement guaranteeing uptime with penalties for downtime.

-- Commit to long-term contracts for cloud services.

Do ...

-- Investigate private cloud and community cloud offerings.

-- Evaluate all of your options, using a method that considers Total Cost of Ownership (TCO) and return on investment along with institutional risks and business continuity.

-- Investigate costs and complexities of integrating the cloud service into your existing environment.

http://www.informationweek.com/higher-eds-cloud-computing-forecast-stormy/d/d-id/1111544?
Cloud Security

• http://www.youtube.com/watch?v=q9Mu1INm6KA
Mobile
What is Mobile Computing

**Mobile computing** is human-computer interaction by which a computer is expected to be transported during normal usage.

http://en.wikipedia.org/wiki/Mobile_computing
Mobile is everywhere

<table>
<thead>
<tr>
<th>RANK</th>
<th>COUNTRY</th>
<th>MOBILE PHONES (MN)</th>
<th>% OF POPULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>1,170</td>
<td>85.21</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>864</td>
<td>68.72</td>
</tr>
<tr>
<td>3</td>
<td>United States</td>
<td>327</td>
<td>103.9</td>
</tr>
<tr>
<td>4</td>
<td>Indonesia</td>
<td>281</td>
<td>118.6</td>
</tr>
<tr>
<td>5</td>
<td>Brazil</td>
<td>263</td>
<td>136.7</td>
</tr>
<tr>
<td>6</td>
<td>Russia</td>
<td>261</td>
<td>183.0</td>
</tr>
<tr>
<td>7</td>
<td>Japan</td>
<td>138</td>
<td>108.0</td>
</tr>
<tr>
<td>8</td>
<td>Vietnam</td>
<td>134</td>
<td>146.5</td>
</tr>
<tr>
<td>9</td>
<td>Pakistan</td>
<td>122</td>
<td>68.83</td>
</tr>
<tr>
<td>10</td>
<td>Nigeria</td>
<td>114</td>
<td>69.0</td>
</tr>
</tbody>
</table>

Source: ITU, National Telecommunication Ministries and Regulatory Authorities, June 2013

http://www.cn-c114.net/578/a778409.html
Mobile Network growth in Africa

http://blog.aviatnetworks.com/2012/06/15/mobile-network-modernization-in-africa
What Cell Phones are used for

Trends in Enterprise Mobile Computing for 2013

• **Mobile App Developers Are Popular:** As businesses find new ways to harness mobility in 2013, the demands for specialized apps and support will only increase.

• **HTML5 comes on board:** Android and iOS have the market for the moment, but developers are also interested in HTML5

• **Consumerization:** BYOD is here to stay….and Consumerization leads to other related BYOs (personal cloud, app stores, Windows 8, etc.)

• **Mobile Device Management:** Growth in BYOD programs will lead to increased popularity of MDM solutions and services

• **Mobile Collaboration:** Social Business trend drives need for new mobile collaboration capability

• **Video Streaming:** Live and recorded videos embedded into mobile business processes

• **Mobile Assistants:** Workers demand enterprise versions of Watson/Siri for mobile search and productivity apps
Trends in Enterprise Mobile Computing for 2013

- **Mobile Assistants:** Workers demand enterprise versions of Watson/Siri for mobile search and productivity apps.

- **Mobile Analytics and Visualization Apps:** New analytical and visualization solutions will be developed and deployed for remote and mobile workers.

- **Mobile Clouds:** Enterprises will develop and deploy mobile clouds for specific apps.

- **Mobile Payments:** Employee expenses paid via mobile. Business accepting payments for products solutions and services via mobile.

- **Increased Need for Speed:** Big data, analytics, social, and mobile video will drive demand for faster mobile networks.

- **CIO Leadership:** CIOs take lead in managing the enterprise mobile strategy, including developing new business models, embedding mobile technology innovations into processes, and protecting mobile data.
Expectations

http://livinteractive.com/business/expectations-rewards-innovation/
What is mobile learning

Mobile learning is considered to be the ability to use mobile devices to support teaching and learning. It is the ‘mobile' aspect of mobile learning that makes it stand apart from other types of learning, specifically designing learning experiences that exploit the opportunities that ‘mobility' can offer us.

http://www.jiscdigitalmedia.ac.uk/guide/mobile-learning-for-education
### A Majority of Students Own Mobile Devices

<table>
<thead>
<tr>
<th>Technology</th>
<th>Students Own</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laptop</td>
<td>87%</td>
</tr>
<tr>
<td>Printer</td>
<td>81%</td>
</tr>
<tr>
<td>DVD Player</td>
<td>75%</td>
</tr>
<tr>
<td>USB Thumbdrive</td>
<td>70%</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>67%</td>
</tr>
<tr>
<td>Stationary Gaming Device</td>
<td>66%</td>
</tr>
<tr>
<td>iPod</td>
<td>62%</td>
</tr>
<tr>
<td>HDTV</td>
<td>56%</td>
</tr>
<tr>
<td>Smartphone</td>
<td>55%</td>
</tr>
<tr>
<td>Digital Camera</td>
<td>55%</td>
</tr>
<tr>
<td>Webcam</td>
<td>55%</td>
</tr>
<tr>
<td>Desktop Computer</td>
<td>53%</td>
</tr>
<tr>
<td>Handheld Gaming Device</td>
<td>38%</td>
</tr>
<tr>
<td>Netbook</td>
<td>11%</td>
</tr>
<tr>
<td>iPad</td>
<td>8%</td>
</tr>
<tr>
<td>Other tablet</td>
<td>2%</td>
</tr>
</tbody>
</table>

Source: ECAR National Study of Undergraduate Students and Information Technology, 2011. N=3,000 college students from 1,179 colleges and universities. http://www.educause.edu/Resources/ECARNationalStudyofUndergraduate/238012
Mobile Devices Provide Access and Tools

<table>
<thead>
<tr>
<th>Mobile Device Activity</th>
<th>Smartphone Owners (n = 688)</th>
<th>Other Cell Owners (n = 1,226)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send or receive text messages</td>
<td>92%</td>
<td>59%</td>
</tr>
<tr>
<td>Take a picture</td>
<td>92%</td>
<td>59%</td>
</tr>
<tr>
<td>Access the Internet</td>
<td>84%</td>
<td>15%</td>
</tr>
<tr>
<td>Send a photo or video to someone</td>
<td>80%</td>
<td>36%</td>
</tr>
<tr>
<td>Send or receive e-mail</td>
<td>76%</td>
<td>10%</td>
</tr>
<tr>
<td>Download an app</td>
<td>69%</td>
<td>4%</td>
</tr>
<tr>
<td>Play a game</td>
<td>64%</td>
<td>14%</td>
</tr>
<tr>
<td>Play music</td>
<td>64%</td>
<td>12%</td>
</tr>
<tr>
<td>Record a video</td>
<td>59%</td>
<td>15%</td>
</tr>
<tr>
<td>Access a social networking site</td>
<td>59%</td>
<td>8%</td>
</tr>
<tr>
<td>Watch a video</td>
<td>54%</td>
<td>5%</td>
</tr>
<tr>
<td>Post a photo or video online</td>
<td>45%</td>
<td>5%</td>
</tr>
<tr>
<td>Check your bank balance or do any online banking</td>
<td>37%</td>
<td>5%</td>
</tr>
<tr>
<td>Access Twitter</td>
<td>15%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Participate in a video call or video chat</td>
<td>13%</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Mean Number of Activities (out of 15)</strong></td>
<td><strong>9</strong></td>
<td><strong>2.5</strong></td>
</tr>
</tbody>
</table>

Quoted in the Pew Research Center report, *Americans and their cell phones*, Aaron Smith, 8/15/2011, p. 3
Presidents Use Mobile Devices

- Many college and university presidents use mobile devices.
- Just under half of respondents indicated that their president uses more than one mobile device.

Types of Mobile Device Used by Respondent Institution Presidents
(Multiple Responses Allowed)

- iPhone: 51%
- iPad: 43%
- BlackBerry smartphone: 29%
- Android smartphone: 15%
- Other tablet: 2%
- Don't know: 7%
What’s the “Killer Mobile App” for Higher Education?

<table>
<thead>
<tr>
<th>Percentage of responses that say…</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Student services</td>
<td>25%</td>
</tr>
<tr>
<td>LMS</td>
<td>25%</td>
</tr>
<tr>
<td>Messaging and calendaring</td>
<td>14%</td>
</tr>
<tr>
<td>Social network</td>
<td>6%</td>
</tr>
<tr>
<td>Personal productivity</td>
<td>6%</td>
</tr>
<tr>
<td>Classroom technology</td>
<td>6%</td>
</tr>
<tr>
<td>Portal</td>
<td>4%</td>
</tr>
<tr>
<td>Collaboration</td>
<td>2%</td>
</tr>
<tr>
<td>E-learning</td>
<td>2%</td>
</tr>
<tr>
<td>ERP</td>
<td>2%</td>
</tr>
<tr>
<td>Other</td>
<td>19%</td>
</tr>
</tbody>
</table>
Students are the Focus of Current Demand

- Institutions are meeting the mobile demand for students at more than twice the rate at which they meet them for faculty and nearly three times the rate for staff.
Most Activity is in Generic Mobile Web

Institutions Reporting Use of Mobile Strategies, by Carnegie Class (Multiple Responses Allowed)

- Generic mobile web: 63% DR, 41% MA, 33% BA GEN, 38% BA LA, 39% AA
- Semi-custom mobile web: 37% DR, 23% MA, 21% BA GEN, 13% BA LA, 13% AA
- Build native applications: 41% DR, 15% MA, 13% BA GEN, 12% BA LA, 4% AA
- Buy native applications: 34% DR, 19% MA, 18% BA GEN, 13% BA LA, 4% AA
- Standardized mobile web: 22% DR, 7% MA, 12% BA GEN, 9% BA LA, 5% AA
- Full-custom mobile web 1: 4% DR, 7% MA, 13% BA GEN, 12% BA LA, 5% AA
- Full-custom mobile web 2: 15% DR, 7% MA, 13% BA GEN, 12% BA LA, 5% AA

Percentage of Respondents Reporting Deployment of Mobile Services Using Each Strategy

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Mobile enablement

A true hallmark of an application designed for a mobile device is that it allows people to **click** on data elements and have **something useful happen** (e.g., you click on a phone number and your device dials that number; you click on a location and a map comes up that displays the location).

Mobile Planning Resources

Mobile Decision Framework

Mobile Decision Framework
Risk based tailoring
Mobile Decision Framework

Mission Requirements
How would mobile support the mission?

1. Does mobile support my mission? (MT)
2. Users (U)
3. Information (I)
4. Location (L)

What is the mission impact? (MS)

Mobile Decision Framework

Results
Selecting the right solution

- Application (R1)
- Device (R2)
- Infrastructure (R3)

Mobile Planning Resources

Higher Educational Institution Audiences

University Audiences

• Students
• Faculty
• Prospective students
• Staff
• Campus visitors
• Donors
• Community
• Alumni
• Parents
• Corporate research collaborators
• Patients (clinical)

Mobile Audiences

University User Categories

Audience 1: Internal Users
• Students
• Faculty
• Staff
• Lifelong Learners

Audience 2: External Users
• Prospective students
• Campus visitors
• Donors
• Community
• Alumni
• Parents

Four Strategies

High Potential for Outsourced Strategy
• Our institution does not have staff dedicated to writing mobile applications, so it is important to leverage standard modules that have been developed and are in use by others. We would be potentially interested in a commercial SaaS solution.

High Potential for In-House Strategy
• Our institution develops and manages many applications and already works with technologies that can be utilized for mobile development (SOA, web services, HTML5, JavaScript, CSS3, and native platforms).

High Potential for Native Strategy
• We have a strong relationship with a specific vendor. We are willing to focus on a single-vendor native strategy

High Potential for Web Framework or Responsive Design Strategy
• Our institution has a strong web standards development culture.
Three Phase Implementation

- Phase I: Engaging Institutional Stakeholders
- Phase II: Building a Mobile-Enabled Web Community
- Phase III: Defining a Mobile Governance Process
Mobile Learning Case Study

- University of Leeds are using mobiles to access their e-portfolios and submit assessments

- http://www.youtube.com/watch?v=c0WkCFIpg9k
Thank you

Questions