Cloud Computing Services and Architecture for Education

ICA CON 2012
April 19, 2012

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Abstract

• Cloud computing is a broad range of concepts and the distinction between “consumer of” and “provider of” cloud-based resources may be important in creating a larger ecosystem of cloud computing.

• Several IBM Cloud Academy members have outlined a definition and framework for cloud computing services and have drafted a cloud assessment survey for senior leadership planning cloud initiatives.

• Three case studies are presented on cloud solutions for K-12 and Higher Education along with survey results for the three case studies.
Outline

• IBM Cloud Academy
• Framework and standards
• Cloud Assessment Survey tool
• Case Studies
  – George Mason, Pike County Schools, Georgia State
• Preliminary Survey results for GMU, Pike, GSU
• Conclusions and next steps
IBM Cloud Academy (ICA)

• ICA mission is to “provide an organization for K-12 schools and higher education institutions that are actively integrating cloud technologies into their infrastructures to share best practices in the use of clouds and to collaborate with partners to create innovative cloud technologies and models.”

• Early discussions lead to Case Study profiles
• Profiles can be helpful
• Idea of SURVEY instrument as additional guide
NIST Cloud – Basic Service Model
ICA members positioned in the NIST Framework

| Framework: Cloud Computing Services X Cloud Computing Deployment Models |
|-----------------|-----------------|-----------------|-----------------|
| **SaaS**        | GMU; GSU; NCSU  |                  |                  |
| **PaaS**        | GMU; GSU; NCSU  | NCSU             | NCSU             |
| **IaaS**        | V2020/TTP; NCSU | Pike County; V2020/TTP; NCSU | V2020/TTP; NCSU |
| Private         | Community       | Public           | Hybrid           |
Multi-cloud education service – envisioned model

State education clouds...

SURA & HBCU clouds...

An eco-system of clouds supporting each other

Providers & Consumers

But which are you: Provider or Consumer?
Cloud Assessment Survey Tool

• Ramon Harris Director *Vision 2020* (previously *Technology Transfer Project*) devised 20 questions for CIO-level consideration

• Use Survey Tool to evaluate relevant elements of:
  – Institutional factors
  – Academic environment
  – Centralized IT structure
  – Student population

• Questions designed to gain insight into an institution’s
  – size, type
  – investment resources
  – culture and goals
  – innovative approaches to technology and its use
## Survey Questions

### Institutional Environment Questions (20% weighting)

1. Number of students (FTE)?
2. Percent of commuter students?
3. What is institutional openness to change in the IT arena?
4. What is institutional leadership’s commitment to improving the IT level of service to students and faculty?
5. What is your institution’s ability to invest $150K to $250K in infrastructure (initial facility and/or upgrades) for Cloud Computing?

### Academic Environment Questions (20% weighting)

<table>
<thead>
<tr>
<th>Question</th>
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<tbody>
<tr>
<td>1. What percent of the teaching faculty is Part-time/Adjunct?</td>
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<td>2. What is faculty’s openness to change in the use of IT?</td>
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<td>3. What percent of your labs is staffed?</td>
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<td>4. What is your lab workstation refresh cycle?</td>
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## Central IT Environment

<table>
<thead>
<tr>
<th>Central IT Environment Questions (50% weighting)</th>
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<tbody>
<tr>
<td>1. Rate your IT staff’s openness to change?</td>
</tr>
<tr>
<td>2. Rate your IT staff’s openness to collaboration and sharing?</td>
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<td>3. Rate your IT staff’s experience with open source software?</td>
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<td>4. Does central IT have a Cloud Computing initiative?</td>
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<td>5. Does central IT have a Virtualization initiative?</td>
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<tr>
<td>6. Rate the proficiency of your central IT staff?</td>
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<td>7. What is the yearly turnover of your IT staff?</td>
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<td>8. Rate how competitively your IT staff is compensated?</td>
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<table>
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<tr>
<th>Student IT Environment Questions (10% weighting)</th>
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<tbody>
<tr>
<td>1. Does your institution have a student PC ownership policy?</td>
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<tr>
<td>2. Does your institution have a standardized platform for student-owned PCs?</td>
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<tr>
<td>3. What percentage of students own PC?</td>
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Initial Observations

• Direct correlation between the size of the institution and economies of scale when deciding on a provider/consumer Cloud.

• Institutional culture is a critical determinant of success.

• Central IT mission, technical composition and flexibility of the IT staff are key drivers.
Case study: George Mason Univ.

• Private cloud benefits – George Mason
  – improved student access to professional software
  – capacity to teach more technical content in least expensive classrooms
  – improved services for distance learners
  – As well as…
    • fewer new physical computer labs
    • extend the replacement cycle of equipment

• Estimated annual recurring Lab costs: $1.06 Million

• Additional GMU facts FY2011 [http://irr.gmu.edu/FastFacts/index.htm]
  – Total enrollment 33,320
  – 124 graduate programs
  – $876.2 Million total operating budget
  – $107.3 Million research expenditures
GMU challenge

• 2009 survey of graduating seniors:
  – Frustration with limited lab hours, long lines
  – Limited access to professional software suites
• Campus space crunch – limits to lab space
• Capital funds don’t do maintenance, support or scheduled technology upgrades
• 5-year replacement cycle [in 2-yr world]... with estimated annual recurring Lab costs: $1.06Million
GMU VCL solution

- <Platform/Software>-as-a-Service
- Open source VCL
- IBM® BladeCenter® technology
- Complete solution involves:
  - systems and network security
  - high-speed network services
  - Web portal (end-user reservation interface)
  - database server (managing reservations... VCL code)
  - software image library (virtual images)
  - management nodes
  - LDAP integration with GMU PatriotPass credentials
VCL Login Interface, GMU
VCL Solution Benefits

• Students
  – Access from anywhere, anytime
  – Minimal requirements for their computer, network
  – Access to professional software suites
  – Distance education not disenfranchised (users have similar advantages)

• IT professionals
  – Reduced lab budget needs (5-yr refresh ok - even in 2-yr world)
  – Software management easier (monitored, secure)
  – Timely delivery of software (e.g. deploying new image)

• Software licensing aspects
  – No associated expense of maintaining high-end lab machines
  – VCL provides more granular tracking of software use (e.g. specific image vs. “might be anything installed on the lab machine...”)

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Some specifics on costs savings

• More lab hours:
  – Physical computer labs open 93 hrs. / week
  – VCL “computer lab” open 168 hrs. / week
• 43% increase in virtual seats (adjusted for maint.)
• VCL usage tracking is image (software) specific – allows for more targeted sw licensing costs
• $13,000 saved in FY2010 by reducing ONE physical lab’s hours during last week classes and exams
• Blade technology is greener:
  – $11,594 to power large computer lab
  – $ 3,944 to power equivalent seats using VCL Blade solution
GMU Lessons Learned

- **Step-by-step process**
- **Graduated roll-out** *(word of mouth announce)*
- **Culture shift addressed** *(“I want to touch it...”)*
- Technical **staff acclimatization** to new service, deployment model
- **NEED TO ADDRESS software licensing**
  - Outmoded models; complex pricing sheets
  - Assurance of adherence to license agreements
  - Higher value per VCL seat is partially offset by infrastructure cost
  - Need to work with sw industry for new licensing models
Case study: Pike County Schools

• Private cloud benefits – Pike County Schools
  – Improved student access to IT resources (rural/metropolitan equity)
  – Enabling successful learning experience for all students
  – Simplifying district-wide management of infrastructure (788 sq. miles)
  – As well as...
    • Access to up-to-date desktops from a wide variety of (often obsolete) PCs, desktop configurations, and locations

• Additional Pike facts
  – Total enrollment 10,000
  – Second largest (geographically) school system in Kentucky
  – 24 campuses, users across 788 square miles
  – Rural foothills of the Appalachian Mountains (“accessibility” is real issue)
Pike County challenge

• Primary goals:
  – Extend the life of existing computer hardware
  – Gain more functionality from existing computers
  – Keep user-to-computer ratio to a minimum

• Pike County needed to address many tech problems:
  – Providing IT resources to students, teachers, staff
  – Windows 98 systems!
  – Failing hard drives, CD drives
  – Staff supporting multiple sites – 60 miles apart!
  – Too many software versions, hardware models
  – Nearly impossible to get formative assessment & tracking
  – Network access very inconsistent...
  – AND 2008 IT budget cuts > 80%
Pike County DaaS solution

• **Initial attempts at solution:**
  – Encourage schools to upgrade systems/software (ended up with uneven, inconsistent results)
  – Use hosted application virtualization (failed to address some functionality like printing locally, saving to student’s home directory)
  – Replace Microsoft® Windows® operating systems with Linux® (unfamiliar interface and unable to integrate with authentication)

• **Successful solution, Desktop-as-a-Service:**
  – IBM virtualization services (2008 5-yr agreement)
  – IBM storage, System x® servers, and VMware virtualization technology
  – Aggregated through the Desktone Virtual-D Platform (now Desktone replaced by Zendesktop)
Desktop-as-a-Service Benefits

- Virtual desktops provided up-to-date hardware
- Desktops have extended lifetimes
- IBM data center leveraged, efficient operations
- Complexity of environment reduced for IT staff (achieved centralized, standard environment)
- Pike district maintains ownership and control of Windows OS® images, applications and all related licensing
- Outsource to IBM the physical data center powering the virtual desktops
Pike County Lessons Learned

• Cost savings of 64%
  – Over a five-year period, cost of ownership for virtual DaaS solution will be less than half of the cost of supporting them on-premise
  – Outsourcing servers also avoids cost of managing them
  – Speed of network is a reduced focus

• Dramatically simpler management
  – DaaS deployment took 2 months
  – Staff maintain only 1 image (not 40+)
  – Users save files in personalized directories (hosted, eases security)

• Equity (and transparency) of access to all
  – Performance improved, Consistent experience

• Having 1 DaaS image for students makes it possible to entertain adding some images (e.g. teachers’ image)

• 1,400 virtual DaaS “seats” results in low user-to-computer ratio
Case study: Georgia State Univ.

• Private cloud benefits – Georgia State
  – Meet demand of student computing labs in reduce budget era
  – Flexibility in platforms, software
  – Support for mobility

• Estimated annual recurring Lab costs $1.3-$2.4 Million

• Additional GSU facts FY2011 [http://www.gsu.edu/factsheet.html]
  – Total enrollment 32,000
  – 250 degree programs
  – $562.8 Million total operating expenses
  – $ 68.8 Million research revenue
GSU Challenge

Student Tech Fee HW/SW Cost Cycles: Requested vs. Funded
GSU VCL Solution

• IBM System x® iDataPlex
• Apache.org Virtual Computing Lab (VCL)
• JOINING the Apache VCL community
  – https://cwiki.apache.org/VCL/
  – Need to become committer
    https://cwiki.apache.org/VCL/becoming-a-committer.html

• Student tech fee funding source
  – Student from Computer Information Systems did analysis of
    various virtual options
  – VCL, being open source and “no-cost” per se, was a deciding
    factor in reducing base solution cost
Solution timeline

• Student Tech Fee Funding approved July 1, 2009
• “demo.vcl” instance in January 2010
• Pilot production “VCL” available August 2010
  – initial “time to deploy” (once funding approved): 14 months
• Computer Science Colloquium Aug 30, 2010 as kickoff
  – Dr. Andy Rindos, IBM RTP CAS, presenting VCL overview
  – Dr. Bill Robinson, GSU CIS, ran VCL image of IBM Rational products
• Tim Olsen, PhD student CIS, creates Windows XP base image with *BizAgi Process Modeler*
• VCL 2.2.1 available July 2011
  – Matlab, SAS, R, SPSS – images for high-demand courses
Testing – user perspective
(N. Xiong et al.)
Is VCL-based image as good as “my laptop”? 

Matlab 2010a, Windows XP.

**VCL image** –
Intel®Xeon® CPU
  2.33 GHz
  3.5 GB Memory

**Laptop** –
Lenovo Thinkpad
Intel Core 2 Duo
  1.9 GHz
  2.0 GB memory

Yes, VCL can be a performance boost.
GSU Lessons Learned

• VCL solution took a bit longer than thought
  – Technical staff getting up to speed
  – Implementation troubleshooting (e.g. performance for multiple reservations for class...)
  – Maybe 6 months (of 14) was acquire/install iDataPlex

• Contributing to Apache.org VCL WILL BE KEY!

• Establishing Cloud curriculum
  – Comp Science students are a critical success factor
  – Curriculum about VCL (and/or using VCL!) is key
  – Discussions with IBM re Academic Initiative options underway

• One way or the other – Clouds in GSU future
Cloud Computing Assessment Survey
GSU May 2011

<table>
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<th>Weighted Scores</th>
<th>Institutional Environment</th>
<th>Academic Environment</th>
<th>Centralized IT Environment</th>
<th>Student IT Environment</th>
<th>Total Weighted Score</th>
</tr>
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<tbody>
<tr>
<td>150</td>
<td>110</td>
<td>365</td>
<td>30</td>
<td>655</td>
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Cloud Computing Assessment Survey
PIKE March 2012

Weighted Scores

- Institutional Environment: 145
- Academic Environment: 120
- Centralized IT Environment: 435
- Student IT Environment: 40
- Total Weighted Score: 740
Scoring considerations

• 0-600 – institution likely Cloud consumer.
• 601-750 – institution consumer or provider.
• >750 – institution likely Cloud provider
• Interesting that PIKE (somewhat higher score than GMU or GSU) chose, effectively, to be consumer...

• Survey will gain “calibration” validity as more institutions complete survey (future research?)
  – Will YOU (ICA CON 2012 attendees) TAKE SURVEY?
Conclusion

• Cloud services for/by education are in progress
• IBM Cloud Academy (ICA) provides forum for collaboration, knowledge exchange
• ICA Case studies are informative (tell us your story)
• Cloud assessment survey unique ICA contribution – expect more in this area…
• ... Cloud provider/consumer ecosystem should be in our future!
Acknowledgments

• The authors thank the ICA CON 2012 reviewers who provided comments and valuable input on this paper.
More info...

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- IBM Cloud Academy
Thank you

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