Kent State University’s Cloud Strategy

June 2017
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The adoption of cloud computing at Kent State University has been accepted as a way to enhance operations within the university. The division looks at cloud computing not as an isolated technology, but as a large, ever expanding pool of available technologies and services providing a new way to deliver services. Cloud computing is helping the division to become a more service oriented organization. The Information Services division will become a service provider for the university’s various information technology needs. An overall understanding of the cloud, its offerings, capabilities, and how it is being integrated into our operations is integral for all who are involved with the university.

This cloud strategy has been developed to explore the cloud model, identify benefits, use cases, and successful implementations. The alignment of the Cloud Strategy with Information Services’ strategic goals enables the division to successfully accomplish and maintain those goals. Along with furthering the overall IS mission, the division will continue to refine its cloud strategy, and, as the cloud model matures, evolves, and innovates, the division will do the same. The tactical actions taken thus far by the division to implement our cloud strategy are as follows:

- June 2017

[Diagram showing timeline from 2012 to 2017 with various cloud-related tasks and milestones]
Strategic Direction for Cloud Computing at Kent State University

1) Many of our existing applications will not be cloud ready in the near to midterm future (3-5 years) or do not have strong business drivers to move to a cloud model. To prepare these applications for a future cloud migration, KSU has moved these applications to a standard virtualized environment in the data center. The virtualized environment will allow us to more quickly introduce solutions into our computing environment.
   a) Goals:
      i) Reach an 80% utilization of our IT assets.
      ii) Ensure zero business impact from IT infrastructure changes.
   b) Accomplishments:
      i) The Banner ERP was migrated to a standard virtualized environment.
      ii) The Blackboard Learn CMS was migrated to a standard virtualized environment.

2) New and replacement applications should be cloud based; assuming the functionality and costs are similar to non-cloud based alternatives.
   a) Accomplishments:
      i) The KSU public website is now in a cloud environment utilizing a PaaS web content management system.
      ii) The Empower timekeeping application was implemented in AWS IaaS.
      iii) The KSU DropBox application was rewritten using AWS OpsWorks.
      iv) The student and employee portal was rewritten on a PaaS platform.
      v) Both Student and Faculty/Staff email is run from a SaaS

3) While most applications will reside either in the cloud or at the data center, there are specific circumstances where it may be advantageous for an application to run in a hybrid model where some resources are in the data center while others are in the cloud.
   a) Accomplishments:
      i) A tiered storage system has been implemented that includes both data center storage and cloud based storage. This design leverages the low cost and massive scale of cloud storage, while utilizing a small footprint of cache storage on-premises for better performance.
      ii) We have implemented a cloud-based data management solution that consists of a SaaS-based management engine along with on-premises agent devices that perform the intensive bulk data load and data transformation work.
4) In selecting which type of cloud computing should be used for a specific application, consideration must be given to the amount of control that the university needs to maintain over that particular application. Generally the university has less control over a SaaS application and greater control over an application running in an IaaS model, with Paas falling in the middle. Based on the objectives and value propositions, our approach to a new application is based on the following priorities:
   a) SaaS, when feasible
   b) Public IaaS (AWS)
   c) Private Cloud (datacenter)
   d) Physical Hardware

5) Cloud computing is similar to current application hosting models in that the university data no longer resides on university owned systems. This makes the evaluation of vendor security a key component of any decision to move applications to the cloud.
   a) Goals:
      i) Data Stewardship in the Cloud
         (1) Define groups and rules as well as policies and procedures for assigning access to data and processes in the Cloud
         (2) Review current list of Data Stewards and drawing alignment between cloud data ownership and the appropriate Data Steward(s)
      ii) Sensitive Data Management in the Cloud
          (1) Inventory and track sensitive data with regards to:
              (a) Where sensitive data is stored
              (b) What applications provide access to or process sensitive data
              (c) Who has access to sensitive data
      iii) Cloud Application Access Controls
           (1) Define and implement access control processes that achieve:
              (a) Centralized - Security and Access Management assigns and removes access to cloud applications and data
              (b) Audited - Logs are maintained within the cloud application systems that are reviewed to ensure access is assigned and removed appropriately and follow established procedures
              (c) Verified - Access controls are tested to ensure they effectively provide the necessary access to data and processes while preventing unauthorized access
              (d) Automated - Access controls conform to established processes and get triggered through standard identity lifecycle events
      iv) Cloud Application Security Monitoring
          (1) Ensure cloud applications are monitored in order to:
              (a) Identify and prevent unauthorized access
              (b) Improper modification of data or processes
              (c) Availability of the cloud application systems
b) Accomplishments:
   i) Developed a security checklist to be used in evaluating the security of the cloud providers.
   ii) Administered the security checklist to existing cloud providers.
   iii) Established a recurring review of vendor checklist materials.

6) With critical systems currently virtualized in the on premise private data center, we will convert our disaster recovery services to a cloud integrated recovery solution. Backing up virtual workloads and performing recovery with assisted services will improve our reliability and reduce management of the processes. Additionally, this model is substantially more flexible due to its ability to track environment configuration changes and replicating those to the recovery environment along with the applications and data. Traditional DR models require manual recovery site configuration and contract changes in order to ensure recoverability.

7) Test and development workloads consume large amounts of on premise resources with irregular usage that often goes underutilized. To improve resource utilization, some tier 1 test and development systems will be migrated to AWS IaaS services to recover on premise resources that can be allocated to production utilization.
Cloud Computing at Kent State University

The mission of Kent State University’s Information Services Division (IS) is to maintain institutional systems, deliver services, and innovate based on user needs and current trends. Much of the department’s efforts are spent keeping systems running and delivering services, leaving little time for innovation. To ensure the division embraces innovation and keeps pace with institutional demands, a Systems Development department, an Infrastructure Engineering team, and a Cloud Strategy and Services team have been established with a focus on innovation. To accomplish this mission, Systems Development will utilize cloud based platforms to enable a simplified approach to developing responsive, stateless solutions that scale seamlessly and upgrade automatically. The Infrastructure Engineering team is responsible for developing a self-service, fully automated method for deploying both premise and cloud resources. The Cloud Services and Strategy team is responsible for fostering the secure, responsible adoption of cloud technology.

Due to the nature of running an IT department at a university, the habits of IS have historically been characterized by purchasing for peak demands (when KSU experiences small short peak times, such as registration, etc.), rapidly growing storage demands, managing complex systems and having less than desired automation. Although IS had been effective in managing these activities, we are now adopting new cloud-centric technologies such as auto scaling, microservices, and serverless computing that will help to achieve greater efficiency throughout the department.

As we continue to move our systems into a cloud service delivery model, we will have the ability to purchase on-demand resources to balance our daily need and peak requirements. Having these on-demand resources available gives us flexibility to increase our innovation and automation for new projects. With these cloud tools, we plan to have a greater depth and breadth of available services to our customers.
A Service Provider to the University

Extending IT Services Through a Brokered Model
The division views each activity as a service. This focuses our awareness on the effort and cost of all activities. Our activities are seen not as what infrastructure we own, but what services we provide. The cloud allows to expand our portfolio of services, and provide them faster to our users alongside our traditional on-premise services.

Software as a Service
Applications and services offered in the cloud continue to expand rapidly and Information Services is positioned to assist the university departments in acquisition and integration of these services. This brokering service will allow Information Services to help departments in the following ways

- Properly evaluate the security and reliability of services
- Ensure secure integration into the university architecture
- Provide additional layers of support for solutions
- Document and inventory university services

Infrastructure as a Service
Information Services has implemented a hybrid cloud infrastructure with Amazon Web Services. This architecture allows for subscribing to AWS services and incorporating it properly into the Kent State University network. The AWS integrated environment also provides consolidation of accounts and simplified account billing.

Example of IS as a Service Provider

User Productivity Tools (Google Docs)
Kent State University has harnessed the power of SaaS productivity tools such as those offered from Google to enable employees and students to work cohesively and interactively despite location or device. Productivity tools have given employees and students the ability to produce quality work more quickly and efficiently together by allowing users to easily share and collaborate on the same documents in real-time.

Email (Office 365 Exchange and GMail)
Kent State University has harnessed the power of two SaaS email providers to enable employees and students to communicate electronically regardless of location or device.
Kent State IT Support Page
Kent State University has leveraged a SaaS ticketing and knowledge base system to enable employees and students to search for IT support information, submit a IT support ticket or interactively chat with a help desk agent.

Kent State Survey Application
Kent State University has implemented of a SaaS survey application from Qualtrics to enable employees and students to easily design, carry out and analyze a survey.

Empower Timekeeping
Kent State University recently migrated to a new timekeeping system. Given the demands of this new system, we chose to implement this in the cloud. This is one of our first examples of converting an on-premise application to run in the cloud and have it scale based on demand.

Research Server Backups
Kent State University researchers have begun utilizing cloud backed storage to backup large datasets. This has reduced traditional backup costs substantially, as well as allowed the individual researchers a greater amount of control over their backup strategy.

Lessons Learned So Far
● Recurring costs can grow quickly as cloud services are easy to consume. These costs can be difficult to predict and manage. Strong oversight and cost management tools are required to keep them under control.
● Cloud technology can fail. Being in the cloud does not prevent service disruption or data loss. Building resiliency into the application design must be considered, and often adds to the overall cost.
● Cloud is not always a good option. Sound goals and decision criteria are necessary to determine if public, private, or hybrid cloud is the best solution.
● Value and cost efficiency are attained only by developing or redeveloping applications to take advantage of cloud capabilities (bursting, object storage, DBaaS, automation, etc). Lift and shift of traditional apps usually results in higher cost with little or no additional value in the cloud.
● Despite initial hesitancy towards hosting applications in the cloud, time has shown that when implemented properly, users rarely know or even care where their their applications live.

As we look back at what this team has accomplished over the past few years by utilizing AWS, we find that we have come a long way. We have been able to convert several applications to scale and run better through these tools. Beyond continuing down this path, we are taking a more structured approach at designing new systems in the cloud. This involves utilizing more configuration
management and infrastructure as code. Having these controls will allow us to run a more standardized and efficient environment.

An Efficient, Agile Provider of Innovation

Integration Management
Adoption of the cloud highlights the importance of maintaining timely, accurate data integration between on-premise to SaaS, SaaS to SaaS, and even on-premise to on-premise applications. We have identified a cloud based Integration Platform (iPaaS) to meet the following objectives:

- Simplify the approach to the vast number of integrations that we maintain
- Provide a standard solution for on-premise application to application, and on-premise to cloud (SaaS) integrations
- Remove integration dependencies from within applications
- Enable rapid deployment of new integration requirements (reduce resource development time)
- Scale seamlessly for increases in volume and types of data (social, mobile, big data)
- Gain full visibility and monitoring of integration collection

Innovative Application Development
We maintain a strategic information and applications architecture for applications, services, and solutions, as well as an agile, flexible approach that allows us to keep pace with the rapidly changing and advancing educational and technology environment. A key component of our approach is a cloud based Development Platform (aPaaS) that meets the following objectives:

- Enable rapid deployment of custom applications (visual development and data modeling)
- Empower building of component libraries (reusable components) for efficient development methodologies
- Access to a marketplace of integrated third party applications
- Provide responsive design, supporting web, mobile, and social capabilities out-of-the-box
- Produce applications that can be run stateless so that they are scalable both vertically and horizontally
- Serve as a single point for all major development lifecycle activities (e.g. authentication, scheduling, event logging, caching, exception tracing, analytics, etc.)
- Automate hardware and software upgrades
- Scale seamlessly for increases in transaction volumes
Focus on User Experience and Features

We strive to provide easy to use applications that are accessible anytime anywhere, with the features and functionality that users desire. SaaS applications that have been born in the cloud provide a superior user experience, innovate more rapidly, and encompass features and functionality that we have historically had to bolt together with multiple applications. We are committed to pursuing the adoption of pure SaaS applications to realize the following value proposition:

- **Cost effectiveness**
  - More functionality in baseline product
  - Reduce bolt-on footprint
- **Flexibility**
  - Integrations
  - Configuration
- **Ease of Use**
  - Modern user interface
  - Mobility
- **Pace of Innovation**
  - Efforts dedicated to one version
- **Delivery Model**
  - Eliminate purchase, implementation, and maintenance of hardware
  - Eliminate software upgrades and patches
  - Quick time-to-value
Approach To Cloud Adoption

Using a structured approach to determine which applications can and should be moved to the cloud is essential. The approach can be used to build new applications and services in the cloud or to move pre-existing applications and services to the cloud.

Choosing the proper cloud providers for the university

The rapid evolution of the cloud continues to bring new, innovative products and offerings to the table. Each provider is at a different level of maturity regarding individual products and services. Each use case involves applying what is known about the cost and benefits of each provider against the requested implementation. Security, exit strategy, ease of use and method of implementation must be extensively researched for each cloud provider to ensure appropriate vendor selection.

Software-as-a-Service (SaaS) First

As mentioned earlier, Kent State University’s approach to cloud adoption begins with the preference for Software-as-a-Service. SaaS often provides a trade-off of features, usability, and control. While the benefits of flexibility, ease of use, and rapid delivery are desirable, one must perform due diligence to understand the limitations of integrations, customization, and access to your data. Assuming any limitations are acceptable or workarounds are available, SaaS is the preferred platform for any new application at Kent State University. As of Spring 2017, Information Services supports nearly seventy SaaS applications for the university. By deploying these applications as SaaS, we are able to use resources that would otherwise have been dedicated to supporting these application and infrastructure for higher-value, customer-focused activities.

Ensuring a secure, trustworthy environment (Security)

At Kent State University, we strive to maintain a secure environment. Information Services has an Information Security Checklist which is followed to ensure our technology assets are protected. The checklist specifies security requirements in the following categories based on the reference standards and best practices contained in Attachment 3:
A trustworthy cloud provider follows strict compliance audits and provides security information controls just as well, if not better, than we do. However, just like with on-premise security measures, poor implementation and code will cause security issues. Because of these risks, it is important that code and implementation are constantly reviewed both on-premise and in the cloud.

**Assuring an Exit Strategy**
It is important to have an exit strategy for each cloud implementation. Remember, if a provider can no longer provide services, etc., there must be a method in place to eliminate our dependence upon that provider and remove our information from their cloud. Proper strategic planning will result in multiple options for implementation.

**Determining Ease of Use and Implementation**
Ease of use and implementation for cloud implementations is important. A cloud solution should not be more difficult in the long run to implement. It should improve efficiency and agility, not hinder it.

**Partnering with Expert Talent**
Cloud technology changes at a pace that far surpasses traditional enterprise technology. Hiring and maintaining the expertise necessary to successfully implement and support cloud technology is difficult. Partnering with the both the cloud providers and third-party professional services organizations specializing in cloud adoption gives us the expertise necessary for successful cloud deployments, and shortens the initial learning curve for our staff.
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<td>Marketplace Review</td>
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<td>Staff Engagement</td>
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<td>Cloud Architecture and Governance Team</td>
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General Order of Departmental Cloud Transition
The division has developed a general order to the cloud transition and has completed an assortment of project transitions. We continue to work towards completing others.

Application Architecture
The following diagram demonstrates how cloud services have been incorporated into the Kent State information and applications architecture.
Cloud Service Types
The following diagram demonstrates the capabilities of the IaaS, PaaS, and SaaS cloud delivery services and our adoption of each.
Conclusion

Kent State University Information Services is leveraging the cloud to make best practice decisions for university services. The approach today is a hybrid solution which allows the university to combine on-premise and cloud solutions, with an emphasis on SaaS and infrastructure automation. As the cloud continues to mature, our strategy for utilizing it will mature as well. Looking forward, our Division is excited by the potential the cloud holds, not only in efficiency and agility it offers, but also the breadth and speed of services we can offer our customers.
Attachment 1
What is Cloud Computing?

Cloud computing relies on *sharing computing resources* rather than purchasing application specific servers and storage to run computer applications. The National Institute of Standards and Technology (NIST) defines cloud computing as “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.”¹

NIST states the cloud model is composed of five essential characteristics, three service models, and four deployment models.

**Essential Characteristics:**

**On-demand self-service** - A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

**Broad network access** - Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

**Resource pooling** - The provider’s computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

**Rapid elasticity** - Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

**Measured service** - Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

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¹ csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf
Service Models:

**Software as a Service (SaaS)** - The capability provided to the consumer is to use the provider’s applications running on a cloud infrastructure.

**Platform as a Service (PaaS)** - The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the cloud provider.

**Infrastructure as a Service (IaaS)** - The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications.

Deployment Models:

**Private cloud** - The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

**Community cloud** - The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.

**Public cloud** - The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

**Hybrid cloud** - The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).²

Attachment 2

Benefits of Cloud Computing

How Cloud Computing Can Lead to Growth in Capabilities

Cloud computing can help the department grow in capabilities by providing consumption based scalability and elasticity that was previously unavailable. These abilities grow our efficiency, agility, innovation, and help us provide increasing services to the university, as demonstrated in the following:

**Efficiency**
- On-demand resources allow the department to cut costs by only paying for capacity used.
- Unlimited computing resources are available for university consumption on-demand.
- More options are available to recommend and provide services that will control the technological growth at the university (storage demands, capacity demands, etc.)

**Agility**
- The constant availability and ease of deploying cloud services allows the division to respond quickly to the needs of the university as a service provider.
- Quicker access to new features allows for easier and faster deployment of production services.
- Testing, Development, and Quality Assurance are on-demand and can be used when needed.

**Innovation**
- The availability of cloud services allows us to tap into and build on the innovations of others and will increase opportunity cost by freeing up time for IS to spend innovating.

Cloud Computing enhances our ability to support our Strategic Goals

Our cloud strategy is aligned with the strategic goals of Information Services (IS) and helps IS to successfully accomplish and maintain these goals. Alignment is as follows:

**Strategic Goal #1: Enable Student Success**

Our cloud strategy enables student success by allowing us to more easily create and support technology services that increase information availability and improve customer service.
**Strategic Goal #2: Empower Teaching and Improve Learning**
Our cloud strategy empowers teaching and improves learning through increasing the availability of technology solutions.

**Strategic Goal #3: Ensure Reliable, Secure and Accessible Systems**
Our cloud strategy allows us to provide and maintain systems that are reliable, secure and accessible anytime, anywhere; thereby providing an information technology infrastructure that enhances productivity and enables global access.

**Strategic Goal #4: Manage Costs and Improve Business Processes**
Our cloud strategy helps to lower the cost of service, Total Cost of Ownership (TCO), and improves administrative and organizational efficiencies (resulting in reduced cost) through process improvement and organizational alignment.

**Strategic Goal #5: Plan and Manage Information Services**
Critical to the efficient execution of the university IS mission are the organization, its people and processes. We must have fully engaged and visionary teams in order to facilitate university-wide information technology strategies, priorities and decisions. Equally, we must deploy processes and disciplines that enhance organizational efficiency, as well as deliver reliable systems and environments. Our cloud strategy has increased our ability to plan and manage information services.
Attachment 3

Security Reference Standards and Best Practices

- Family Educational Rights and Privacy Act (FERPA)
- Center for Internet Security - Critical Security Controls for Effective Cyber Defense
- Cloud Security Alliance - Security Guidance on Critical Areas of Focus in Cloud Computing
- ISO 27001 - Information Security Management Systems
- ISO 27002 - Code of Practice for Security Information Management
- ISO 27017 - Code of practice for information security controls based on ISO/IEC 27002 for cloud services
- Control Objectives for Information Technology (COBIT)
- Gartner - Effective Security Assessment of Public Cloud Services
- Payment Card Industry Data Security Standards (PCI-DSS)
- Health Insurance Portability and Accountability Act (HIPAA)
- Health Information Technology for Economic and Clinical Health Act (HITECH)
- Service Organization Control Type 2 (SOC2)