Government Cloud Computing

Governments around the world are actively looking into cloud computing as a means of increasing efficiency and reducing cost. The following outline will help you better understand the value and risk associated with this new concept. For further information please contact:

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I. What is Cloud Computing?
   a. Definition: 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.[1]
   b. Three delivery models
      i. Software as a Service (SaaS): The consumer uses an application, but does not control the operating system, hardware or network infrastructure on which it's running.
      ii. Platform as a Service (PaaS): The consumer uses a hosting environment for their applications. The consumer controls the applications that run in the environment (and possibly has some control over the hosting environment), but does not control the operating system, hardware or network infrastructure on which they are running. The platform is typically an application framework.
      iii. Infrastructure as a Service (IaaS): The consumer uses "fundamental computing resources" such as processing power, storage, networking

[1] National Institute of Standards and Technology (NIST) Definition of Cloud Computing, http://csrc.nist.gov/groups/SNS/cloud-computing/

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components or middleware. The consumer can control the operating system, storage, deployed applications and possibly networking components such as firewalls and load balancers, but not the cloud infrastructure beneath them.

c. Four deployment models
    i. Public Cloud: In simple terms, public cloud services are characterized as being available to clients from a third party service provider via the Internet. The term "public" does not always mean free, even though it can be free or fairly inexpensive to use. A public cloud does not mean that a user's data is publically visible; public cloud vendors typically provide an access control mechanism for their users. Public clouds provide an elastic, cost effective means to deploy solutions.
    ii. Private Cloud: A private cloud offers many of the benefits of a public cloud computing environment, such as being elastic and service based. The difference between a private cloud and a public cloud is that in a private cloud-based service, data and processes are managed within the organization without the restrictions of network bandwidth, security exposures and legal requirements that using public cloud services might entail. In addition, private cloud services offer the provider and the user greater control of the cloud infrastructure, improving security and resiliency because user access and the networks used are restricted and designated.
    iii. Community Cloud: A community cloud is controlled and used by a group of organizations that have shared interests, such as specific security requirements or a common mission. The members of the community share access to the data and applications in the cloud.
    iv. Hybrid Cloud: A hybrid cloud is a combination of a public and private cloud that interoperates. In this model users typically outsource nonbusiness- critical information and processing to the public cloud, while keeping business-critical services and data in their control.
d. Five essential characteristics
    i. Rapid Elasticity: Elasticity is defined as the ability to scale resources both up and down as needed. To the consumer, the cloud appears to be infinite, and the consumer can purchase as much or as little computing power as they need. This is one of the essential characteristics of cloud computing in the NIST definition.
    ii. Measured Service: In a measured service, aspects of the cloud service are controlled and monitored by the cloud provider. This is crucial for billing, access control, resource optimization, capacity planning and other tasks.

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iii. On-Demand Self-Service: The on-demand and self-service aspects of cloud computing mean that a consumer can use cloud services as needed without any human interaction with the cloud provider.
iv. Ubiquitous Network Access: Ubiquitous network access means that the cloud provider's capabilities are available over the network and can be accessed through standard mechanisms by both thick and thin clients.
v. Resource Pooling: Resource pooling allows a cloud provider to serve its consumers via a multi-tenant model. Physical and virtual resources are 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).

e. For the govenrment, two domains should also be considered
   i. Enterprise (i.e. NGEN)
   ii. Tactical (i.e. CANES)

II. Key discussion points around cloud computing
   a. Benefits[2]
      i. **Significant Cost Reduction:** Available at a fraction of the cost of traditional IT services; upfront capital expenditures eliminated; dramatically reduced IT administrative burden
      ii. **Increased Flexibility:** On-demand computing across technologies, business solutions and large ecosystems of providers; reduced new solution implementation times.
      iii. **Access anywhere:** Un-tethered from a single computer or network. Use different computer or move to portable devices, and applications and documents follow.
      iv. **Elastic scalability and pay-as-you-go:** Add and subtract capacity as your needs change. Pay for only what you use.
      v. **Easy to implement:** No need to purchase hardware, software licenses or implementation services.
      vi. **Service quality:** Reliable services, large storage and computing capacity, and 24/7 service and up-time.

[2] General Services Administration, Federal Cloud Computing Services, Cloud FAQ, https://apps.gov/cloud/advantage/information/page.do?BV_SessionID=@@@@0890768492.1257006923@@@@&BV_EngineID=ccccadeijljllhecflgcefmdgfhdgjn.0&keyName=CLOUD_FAQ

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vii. **Delegate non-critical applications:** Outsource non-critical applications to service providers and focus agency IT resources on business-critical applications.
viii. **Always the latest software:** Updates are automatic
ix. **Sharing documents and group collaboration:** Applications and documents accessible from anywhere in the world, facilitating group collaboration on documents and projects.

b. Concerns[3]
   i. Security
   ii. Performance
   iii. Availability
   iv. Hard to integrate
   v. Ability to customize
   vi. Higher cost
   vii. Regulatory requirements
   viii. Not enough major suppliers

III. Enterprise cloud computing first order economic analysis[4]
   a. Simplifying assumptions
      i. There is an existing data center(s) currently operational that is a baseline for economic comparison of migrating to a cloud environment.
      ii. Status Quo (SQ) data center containing 1,000 servers with no virtualization is already operational
      iii. One-time investment phase costs as well as the recurring O&S phase costs for each scenario with a 13-year life cycle (3-year investment phase and 10-year steady-state O&S phase) from FY10 through FY22.
      iv. Existing application software will migrated with the infrastructure to the cloud. Application software support costs remain out of scope.
      v. Migration decisions will be made at the department or agency (rather than bureau) level in order to aggregate demand and drive scale efficiencies.
      vi. We assume the perceived sensitivity of an agency's mission and data will be a primary factor (though by no means the only factor) driving its decisions on which path to follow.

[3] Frank Gens, SVP & Chief Analyst, IDC, "Clouds and Beyond: Positioning for the Next 20 Years of Enterprise IT", http://www.slideshare.net/innoforum09/gens

[4] Booz, Allan, Hamilton, "The Economics of Cloud Computing", http://www.boozallen.com/media/file/Economics-of-Cloud-Computing.pdf

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b. Key Metrics
    i. **Net Present Value (NPV)** is calculated as each cloud scenario's discounted net benefits (i.e., the cloud scenario's reduced operations and support [O&S] costs relative to the SQ environment's O&S costs) minus the cloud's discounted one-time investment costs. A positive dollar figure indicates a positive economic benefit versus the SQ environment. NPV is an *absolute* economic metric.
    ii. **Benefit-to-Cost Ratio (BCR)** is calculated as each cloud scenario's discounted net benefits divided by its discounted investment costs. A number greater than 1.0 indicates a positive economic benefit versus the SQ environment. BCR is a *relative* economic metric.
    iii. **Discounted Payback Period (DPP)** reflects the number of years (from FY10) it takes for each scenario's accumulated annual benefits to equal its total investment costs.

c. Analysis scenarios
    i. Use public clouds
        1. *Key Agency Characteristic:* Migrates low-sensitivity data to an existing public cloud.
        2. *Assumptions:* Transition to the new cloud environment will occur steadily over 3 years; workload remains constant (i.e., no increase in capacity demand).
    ii. Build private clouds
        1. *Key Agency Characteristic:* Builds its own private cloud solution or participates in an interagency cloud solution (i.e., community cloud). Broad mission sensitivity results in the need to maintain control of infrastructure and data.
        2. *Assumptions:* Transition to the new cloud environment will occur steadily over 3 years; existing facilities will be used (i.e., no new investment is required in physical facilities); workload remains constant (i.e., no increase in capacity demand).
    iii. Adopt a hybrid approach
        1. *Key Agency Characteristic:* Uses a private cloud solution to handle the majority of its IT workload; also uses a public cloud solution to provide "surge" support and/or support for low-sensitivity data.
        2. *Assumptions:* Seventy-five percent of the IT server workload will migrate to a private cloud, and the remaining 25 percent will transition to a public cloud; transition to the new cloud environments will occur steadily over 3 years; existing facilities will be used (i.e., no new investment is required in physical

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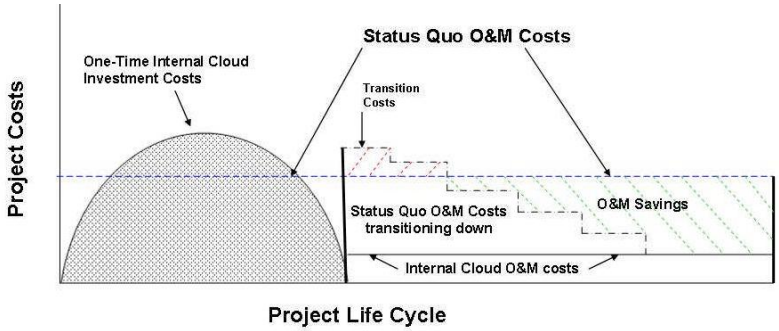
facilities); workload remains constant (i.e., no increase in capacity demand).

d. Economic Benefit Summary

Costs/Economic Metrics	Status Quo: 1,000 Server (Non-Virtualized) Environment	Scenario 1: Public Cloud	Scenario 2: Hybrid Cloud	Scenario 3: Private Cloud
Investment Phase Costs FY10–12 (BY09 M$)	$0	$3.0	$6.1	$7.0
O& S Phase Costs FY10–22 (BY09 M$)	$77.3	$22.5	$28.9	$31.1
Total LCCs (BY09 M$)	$77.3	$25.5	$35.0	$38.1
Economic Metrics:				
NPV (BY09 M$)	N/A	$41.8	$33.7	$31.1
BCR	N/A	15.4	6.8	5.7
DPP (Years)	N/A	2.7	3.5	3.7

e. Economic Model[5]



f. Conclusions and recommendations

i. It will take, on average, 18-24 months for most agencies to redirect funding to support a transition to cloud computing

ii. Some up-front investment will be required, even for agencies seeking to take advantage of public cloud options

iii. Implementations may take several years, depending on the size of the agency and the complexity of the cloud model it selects (i.e., public, private, or hybrid).

iv. It could take as long as 4 years for the accumulated savings from agency investments in cloud computing to offset the initial investment costs; this timeframe could be longer if implementations are improperly planned or inefficiently executed.

v. Agencies should consider which of the high-level scenarios described in this article best suits their needs, with the understanding that regardless of

[5] Booz, Allen,Hamilton, "Government Cloud Computing Community", CCC-Economic Forum Baseline-v101-020409.pdf http://sites.google.com/a/bah.com/government-cloud-computing/files

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scenario chosen, proper planning and efficient execution are critical success factors from an economic perspective.

vi. Given the significant impact of scale efficiencies, agencies selecting a private cloud approach should fully explore the potential for interdepartmental and interagency collaboration and investment

vii. Agencies should identify the aspects of their current IT workload that can be transitioned to the cloud in the near term to yield "early wins" to help build momentum and support for their migration to cloud computing.

viii. Cloud computing has received executive backing and offers clear opportunities for agencies to significantly reduce their growing data center and IT hardware expenditures

IV. Representative cloud computing activity

a. Global Governments

i. United Kingdom: G-Cloud[6]

ii. European Union: EuroCloud[7]

iii. Canada: Canada Cloud Computing[8]

iv. Japan: Kasumigaseki Cloud[9]

b. US Government

i. Federal Chief Information Officer's Council: Data.gov [10]& IT Dashboard[11]

ii. GSA : Federal Cloud Computing Initiative – Apps.gov[12]

iii. NASA: Nebula[13]

iv. Energy: Magellan[14]

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[6] Green Telecom Live, "UK Government Unveils G-cloud", http://www.greentelecomlive.com/?p=831

[7] http://www.eurocloud.org/

[8] Global Government Cloud Computing Roundtable,"Cloud Computing and the Canadian Environment", http://www.scribd.com/doc/20818613/Cloud-Computing-and-the-Canadian-Environment

[9] Green Telecom Live, "Japan to build massive cloud infrastructure for e-government", http://www.greentelecomlive.com/?p=831

[10] http://www.data.gov/

[11] http://usaspending.gov/

[12] https://apps.gov/cloud/advantage/main/start_page.do

[13] http://nebula.nasa.gov/

[14] http://www.sc.doe.gov/News_Information/News_Room/2009/Oct%2014_ComplexQuestions.html

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v. Interior: National Business Center (NBC) Cloud Computing[15]
vi. Intelligence Community - "Develop a common "cloud" based on a single backbone network and clusters of servers in scalable, distributed centers where data is stored, processed and managed[16]
vii. CIA – "…If I look back at CIA's technology strategy for the past few years, we were headed to an Enterprise Cloud all along…"[17]

c. Defense Department
   i. NSA – In pilots with MapReduce cloud computing proven as an effective method to address enterprise large data problems.[18]
   ii. NGA - NGA using "cloud computing technology" for imagery processing[19]
   iii. DISA
      1. Rapid Access Computing Environment -RACE (Compute/Store)[20]
         a. Support faster application development/deployment
         b. Reduce hardware provisioning from months to hours
         c. Provide standard platforms to encourage standardization
         d. Developing under security guidelines reduces implementation delays to retrofit security
         e. Reduce development and operating cost
         f. Self-service model reduces costs
         g. Standardization reduces support costs
         h. Centralizing resources in the cloud
         i. Improve overall security posture
         j. No servers under desks
         k. Secure facilities
         l. Uniform application of security guidelines

[15] http://cloud.nbc.gov/

[16] Director of National Intelligence, "Vision 2015: A Globally Networked and Integrated Intelligence Enterprise",p24

[17] Jill Tummler Singer, Deputy Chief Information Officer, Central Intelligence Agency speaking at the GovIT Expo, Washington, DC, http://cloudcomputing.sys-con.com/node/1102230

[18] "NSA Using Cloud Model for Intelligence Sharing", J. Nicholas Hoover, InformationWeek, http://www.informationweek.com/news/government/cloud-saas/showArticle.jhtml?articleID=218501405

[19] Computing Clouds Cast Geospatial Vision", Cheryl Gerber, Military Information Technology Magazine, http://www.geospatial-intelligence-forum.com/mgt-archives/94-mgt-2009-volume-7-issue-1/716-computing-clouds-cast-geospatial-vision.html

[20] http://www.disa.mil/race/

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2. GIG Content Delivery Service (GCDS)[21] - Reliability enhancements from cloud computing helped the US Central Command (CENTCOM) mitigate the impact of an unplanned cessation of data transport. (PaaS)
    a. DoD designated content delivery service
    b. Managed by the Defense Information System Agency (DISA's) Computing Services Directorate (CSD).
    c. Uses Akamai™ technology, that provides intelligent routing and caching of web-based content.
    d. Interfaces with web-based applications and portals.
    e. Requires the local system be configured to allow GCDS to handle communications between it and the Defense Information Systems Network (DISN).
    f. Infrastructure as a Service (IaaS) in the DISN Cloud
3. Forge.mil [22]- global application lifecycle management solution and software development collaboration (SaaS)
    a. Agile software development and testing
    b. Cross-program sharing: software and services
    c. Early and continuous collaboration
    d. Integrated approach to development life cycle
    e. Extensible platform to support delivery of partner capabilities
    f. Uses Collabnet
4. InRelief.org [23]
    a. A US Navy effort, managed by San Diego State University (Registered NGO) , to promote better interactions and results when disasters strike.
    b. Built on Google platform
    c. Collaborative environment used to promote information sharing between International Organizations, Non-Governmental Organizations, Government Organizations, and Military groups responding to a natural or man-made disaster.

[21] http://www.disa.mil/conferences/2009/briefings/cs/2009-DISA-Conference-GCDS-090417.pdf

[22] https://www.forge.mil/

[23] http://partnerpage.google.com/inrelief.org

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V. Candidate Enterprise cloud use cases[24]
   a. End User to Cloud - Applications running on the cloud and accessed by end users
   b. Enterprise to Cloud to End User - Applications running in the public cloud and accessed by employees and customers
   c. Enterprise to Cloud - Cloud applications integrated with internal IT capabilities
   d. Enterprise to Cloud to Enterprise - Cloud applications running in the public cloud and interoperating with partner applications (supply chain)
   e. Changing Cloud Vendors - An organization using cloud services decides to switch cloud providers or work with additional providers
   f. Cloud Brokering - Multiple clouds work together, coordinated by a cloud broker that federates data, applications, user identity, security and other details.

VI. Candidate Tactical cloud use cases[25]
   a. "Cloudbursting" to support cyclic data processing requirements
   b. Joint/allied/interagency cloud-based collaboration environment
   c. Virtually binding IT infrastructures (shipboard and/or land vehicle) to create a strike force infrastructure-as-a-service platform
   d. Provisioning of cloud-based compute and storage resources to support processing, exploitation and dissemination of unmanned air vehicle (UAV) intelligence products
   e. Unit (vehicle, ship, etc.) software maintenance
   f. Unit (vehicle, ship, etc) IT casualty response
   g. Exercise and contingency planning support

VII. Cloud capabilities to be addressed in all use cases based on mission needs and requirements
   a. Identity management
   b. Identity federation
   c. Security and privacy
   d. Service level agreements and benchmarks
   e. Location awareness
   f. Metering and monitoring
   g. Management and governance
   h. Common virtual machine (VM) file format
   i. Common cloud storage and middleware APIs
   j. Data and application federation

[24] http://www.scribd.com/doc/18172802/Cloud-Computing-Use-Cases-Whitepaper

[25] "Trident Warrior '10:Dataline Secure Cloud Computing" http://www.slideshare.net/kvjacksn/trident-warrior-10-dataline-secure-cloud-computing

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k. Lifecycle management
l. VM deployment and termination
m. DoD specific standards and protocols
n. Transactions and concurrency
o. Cloud interoperability
p. Cloud portability

VIII. Recommended next steps
a. Validate relevance and value of candidate use cases
i. Enterprise
ii. Tactical
b. Complete System, Capabilities, Operations, Programs and Enterprises (SCOPE) analysis of validated use cases[26]
i. Capability/Domain-Independent Scope - The range of scope or context supported
ii. Capability/Domain-Dependent Scope - The nature, quantity, quality, speed, etc., of capability provided to meet operational needs.
iii. Net-Readiness: Ability to deliver capability within a maritime network context
iv. Technical/Economic Feasibility: The feasibility or risk associated with providing capability.
c. Feasibility experiments on selected use cases

IX. Dataline Cloud Computing Services

Dataline Capabilities			
	SaaS	PaaS	IaaS
Cloud Storage			X
Virtual Appliance			X
Geographic Information Services	X		
Software Configuration Management	X	X	
Tracking and Monitoring Tools	X	X	
Collaboration/Communications	X		
Security			X
Professional Services	X	X	X

[26] https://www.ncoic.org/apps/group_public/download.php/8504/SCOPE_MODEL_VER1.0.pdf

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