

# “Top Three Challenges” For DoD Cloud Computing

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# Challenge 1: Portability and Interoperability

# Portability And Interoperability (P&I)

Why are P & I important for DoD cloud services?

- Improves the end-to-end survival of IT capabilities through compatible failover across providers
  - Enables continuity of operations (COOP)
- Mitigates cloud service provider (CSP) lock-in
  - Enables alternatives for unsatisfactory performance
  - Supports changing mission needs and requirements
  - Enabling competition – potential cost savings
- Improves consumer confidence in providers
  - Many sources - consistent interfaces across providers
  - Requires official standards or de facto Industry standards

# Multiple Clouds / Multiple Acquisitions

- Number of independent cloud efforts underway
  - Many deployment models under consideration
- Majority of these efforts focus on acquiring and constructing internal private clouds
  - Marketplace: Currently no common group of mature standards for building these independent clouds
  - Technical solutions not likely to be interoperable in many key facets of their design or operation
  - Joint Information Environment (JIE) effort intends to address a portion of this challenge in defining some common data center and services characteristics

# What Needs to be Portable?

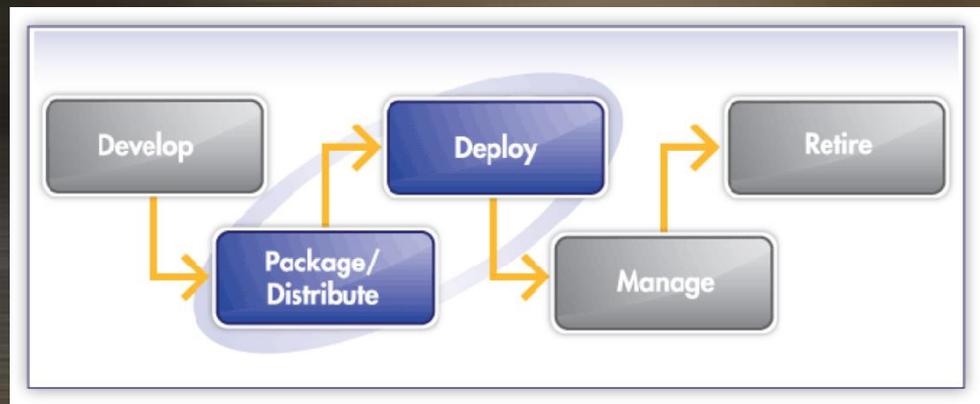
| Cloud Service Type   | Cloud Service Model | Content that could be <u>portable</u> between comparable DoD service providers |
|--|---------------------|--|
| VMs on demand (e.g., public Amazon EC2 or a private VMware stack)  | IaaS                | A Virtual Machine (VM) image   |
| File Storage (e.g., Amazon S3)   | IaaS                | File content   |
| Block Storage (e.g., Amazon EBS)   | IaaS                | Binary disk images   |
| Identity   | IaaS                | Credentials  |
| Source code repository - check in / check out  | PaaS                | Source code files  |
| JVM runtime environment  | PaaS                | Java source code or JAR files  |
| Microsoft OS (a Windows run-time environment) – (e.g., EC2 or Rackspace with Windows Server 2008 selected) | PaaS                | Compiled COTS Windows-compliant applications                                   |
| Email  | SaaS                | Email content, contacts, global address list (GAL)                             |
| CRM application (e.g., Salesforce.com)   | SaaS                | Customer data  |
| Office productivity tools (e.g., MS Office 365, Google Apps)   | SaaS                | Office files – e.g., documents, briefings, spreadsheets...                     |
| Vertical SaaS (e.g., Payroll, HR apps)   | SaaS                | Employee data, tax history   |
| Language translation   | SaaS                | Language text file   |
| Image manipulation   | SaaS                | Image file   |

# Portability Example: Virtual Machines

- Example of infrastructure interoperability
- Defense Business Board (DBB) - estimated 70K DoD servers
  - Suggests the need to failover between private DoD cloud providers
- Individual DoD private clouds could become VM 'islands' if different technical solutions are implemented
- Movement of VMs must be timely and repeatable – on the scale of thousands of machines
- Current data center *consolidation* efforts makes large-scale portability even more important

# Example: Open Virtualization Format

- Open Virtualization Format (OVF) - open standard for packaging and distributing virtual machines
- Often used to exchange VMs between different hypervisors
- Published by the Distributed Management Task Force (DMTF)
- Distribution packages (Appliances) - composed of one or more VMs
- OVF meta-data descriptors are described in XML - Descriptions support extensions
- Support for package integrity checking based on PKI
  - Includes basic functions for management of software licensing



# OVF - Tradeoffs

- OVF XML metadata is naturally portable
  - Includes virtual machine's name, configured memory, CPU, network, and storage settings
  - However...
- OVF does not adequately describe a virtual disk
  - File conversions needed between some hypervisor formats
  - File conversion availability tends to be case by case today
- Guest OS device drivers may not operate when ported
  - Source and destination environments may have different hardware devices, and hence different drivers in their machine images
- Installed guest OS may not support the CPU architecture
  - Example: Guest OS may use processor opcodes or floating point not available in the target environment

# VM Portability

- Bottom line: VM portability remains a tough problem in current marketplace
- Specialty administrator VM porting tools exist, often one-way tools
- Could require every DoD cloud to use the same products – unlikely approach
- Could wait for vendor's use of standards to mature – not a current solution
- Could utilize third party commercial tools that port VMs between environments

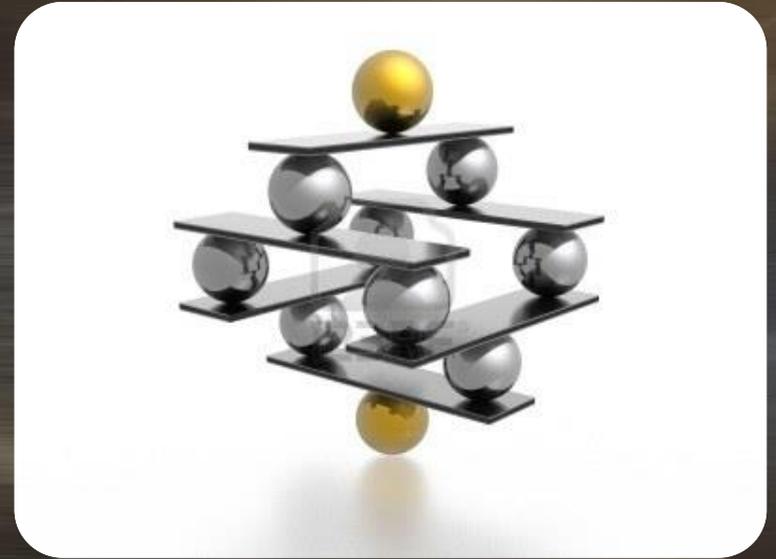
# Challenge 2: Consolidation Risks

# Consolidation Risks

- *“Virtually every DoD mission depends on the Department’s information infrastructure”* – Ms. Takai, 2012 Congressional testimony
- Data center consolidation places the information infrastructure in far fewer locations
- Optimizing operations costs and physical diversity can be conflicting goals
- *“It is the part of a wise man...not to venture all his eggs in one basket.”* – Miguel de Cervantes

# Consolidation - Engineering

- Presents interesting engineering issues – maintain the positives of previous geographic diversity, while benefiting from consolidation and virtualization
- Objectives
  - Create uncertainty as to where IT functions are occurring
  - Agile migration of IT capability among sites
  - Maintain high availability for collections of IT capability in the face of a variety of adverse conditions



# Challenge 3: Cost Expectations

# Cost Expectations

- Commercial market creating new price floors with commodity cloud providers
- ‘Commoditization’ of infrastructure layer ongoing
  - E.g., See [SpotCloud.com](http://SpotCloud.com)
- Many DoD missions are driven to custom private clouds
- Leadership’s cost expectations are based on commercial commodity providers



3-year Rental of AWS Resources

# Cost Expectations

- DoD unlikely to match contemporary commercial price floors
- Commodity providers are different:
  - Larger scale operations
  - Do not operate with DoD security controls
  - DoD-required staff clearances have additional labor expense
  - DoD admin-to-server ratio not as beneficial
  - Commercial service provider acquisition process more agile
- Commodity exchanges and spot pricing will create new price floors
  - Continuous pressure on government operations to compare