



Perspectives on Cloud Computing

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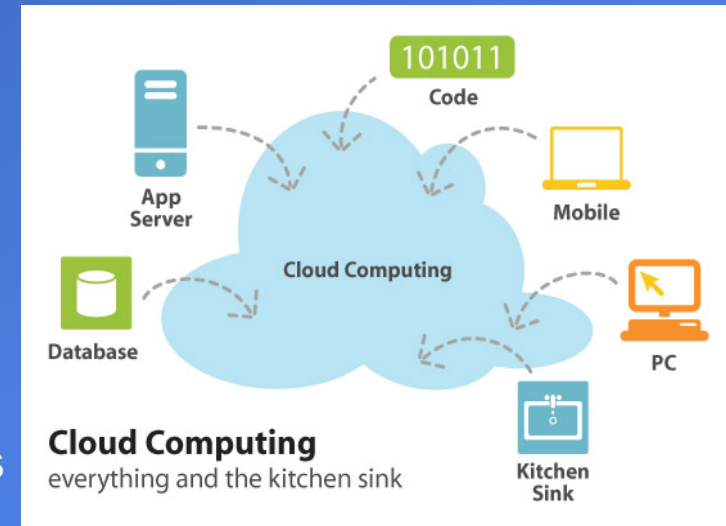




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The Cloud Must ...

- **Meet the mission requirements**
- Provide a modern processing environment
 - Modular, partitioned, scalable, portable, extendable, secure
 - Responsive, quick
- Provide a method to deliver key capabilities quicker to airmen
- Have the least impact on structure/governance
- Cause minimal risks and impact to AF Network, systems, and infrastructure





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NIST Essential Cloud Characteristics

- **On Demand Self Service**
 - **Automatically provision**
- **Broad Network Access**
 - **Heterogeneous thin/thick client platforms**
- **Resource Pooling**
 - **Includes storage, processing, memory, bandwidth**
- **Rapid Elasticity**
 - **Capabilities rapidly and elastically provisioned**
- **Measured Service**
 - **Metering capability relating to resource usage**

- **Distinguish “Cloud” from Virtualization**

Support Efficiency Efforts -- Data Center Consolidation



Internal “Cloud” Computing Experience

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Using Hill AFB Computing Center as an example:

- **On Demand self-service -- on demand but not self-service**
- **Broad network Access – yes**
- **Resource Pooling – yes**
- **Rapid elasticity – yes**
- **Measured Service – somewhat but not a true charge back model**

- **Provides PaaS only -- determined most efficient and cost effective**



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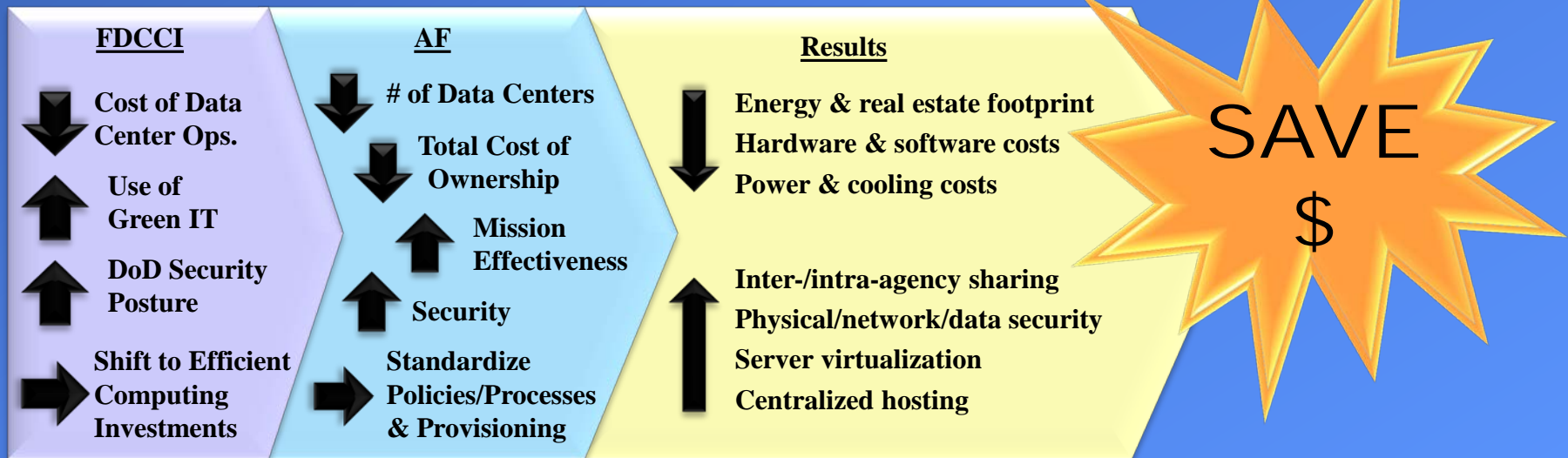
AF Infrastructure Initiatives

–Cloud Prep

- **Establishment of an enterprise infrastructure PEO (C3I&N) that will provide infrastructure capabilities to business and mission systems**
- **Development of an Implementation Baseline PaaS used for cloud service provisioning/procurement – based on target IT baseline capabilities**
- **Identification of authoritative information assets and the use of web services to extract, manipulate and display the asset.**
- **Development of an Enterprise Level Security concept that supports ABAC claims-based authentication and authorization between requester and supplier.**
- **Meta-data labeled information assets for eDiscovery and Information Management**



- Align AF strategy w/ DoD/JIE vision and FDCCI goals
- Optimize use of DoD/JIE computing centers and commercial providers in the data center consolidation initiative
- Maintain critical mission applications at most effective data center location





Cloud Application Selection Considerations

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- **Current Asset/Application Inventory**
 - Hardware and Software specifications/licenses
 - Applications that reside on the hardware/software
 - CPU & Storage Utilization
 - Number of users/user locations
 - Security and other special requirements
 - Surge requirements
 - External system interfaces (inbound and outbound) – batch and on-line
- **Selection criteria**
 - **Business Case Analysis (migrate, sunset, or move)**
 - Duplicative across bases – move to AF Enterprise level
 - **Mission Analysis**
 - Critical missions
 - Special SLAs – may have additional comm requirements
 - Connections to aerial/space layer systems
 - Unique for base mission operations
 - Special community (e.g., medical, Air Operations Center)
 - Disconnected operations requirement
 - **Outward facing (aka White List Applications)**
 - **Programmed funding; cost avoidance amount**



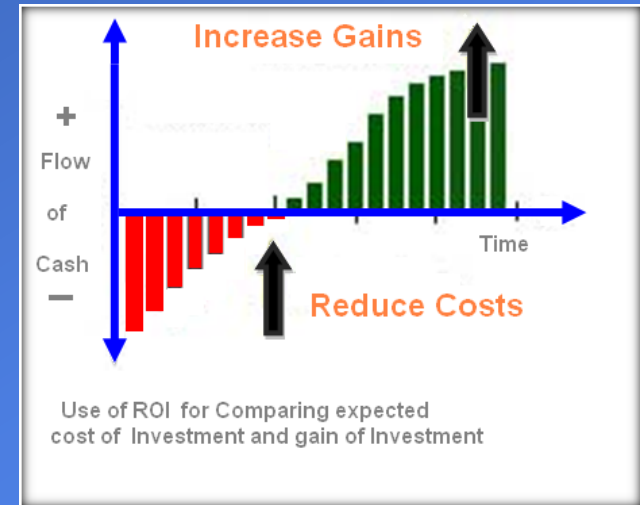


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Business Case ROI Calculations

Migration/Movement ROI:

- Investment Costs =
 - Migration \$ (if necessary) +
 - Testing \$ +
 - Dual operations \$+
 - Retraining \$ (products/people) +
 - Old data center repurposing/refurbish \$ +
 - Addition communication lines \$+
 - Contract change costs \$ for my O&M provider +
 - For commercial provider, security/business add on costs \$
- Savings=
 - Data center space release \$ +
 - Data center staff reduction \$ +
 - Data center HVAC/electrical reduction \$ +
 - COOP site space/staff elimination \$ +
 - Low “usage/storage” cost \$ +
 - Intangibles – resiliency, availability, scalability,...





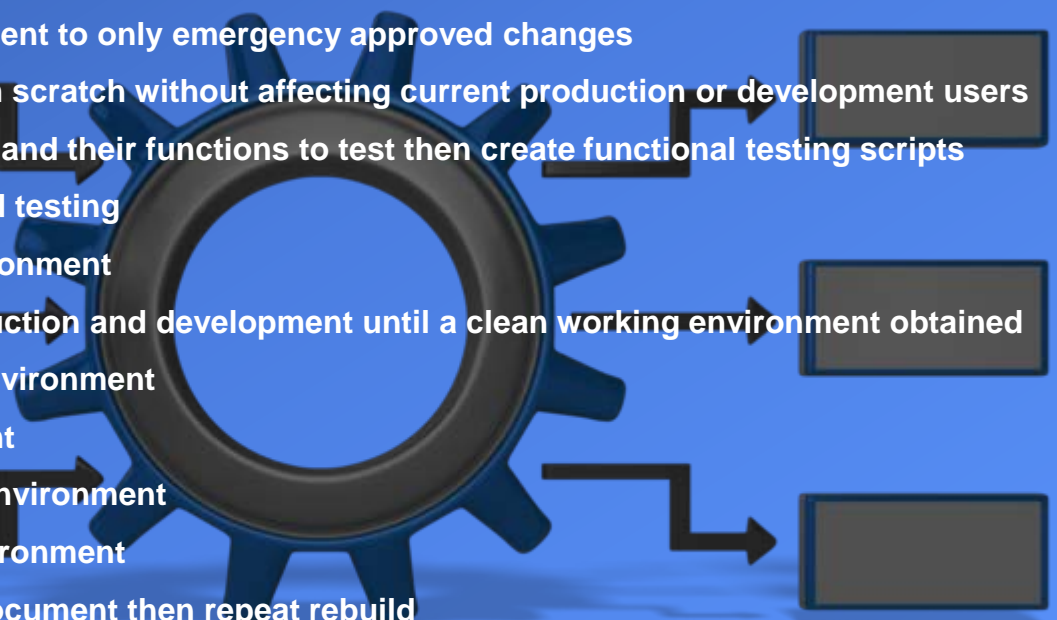
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Process: Migrating applications to a virtualized environment

Application Owners in many cases do not know how the applications actually work

- **Changes and updates have been applied**
- **Documentation is outdated**
- **Input/output data feeds are unknown**
- **Personnel changes**

Developed 11 step process to resolve application unknowns

1. Freeze production environment to only emergency approved changes
 2. Build new environment from scratch without affecting current production or development users
 3. Identify critical applications and their functions to test then create functional testing scripts
 4. Perform regression and load testing
 5. Have key users review environment
 6. Iterate load tests from production and development until a clean working environment obtained
 7. Deploy new development environment
 8. Deploy new test environment
 9. Deploy new coop standby environment
 10. Deploy new production environment
 11. Identify, analyze, resolve, document then repeat rebuild
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Cloud Challenges

- **Security**
 - Encrypted Data at Rest
 - Capability to Isolate/cleanse security breaches
 - PKI key escrow location
 - Meet NIST security controls based on application's criticality
 - Capability for AF/CYBERCOM to defend
 - Effectively suppresses cyber attacks (e.g., DDOS at the network and application levels)
 - Secure hypervisor (type 1 bare metal)

- **Supports AF IB-compliant PaaS including AF Enterprise Level Security/ABAC**
 - Requires End-to-End 2-way encrypted authentication/authorization from sender to provider
 - Sender Access authorization claims are enclosed in encrypted SAML token
 - User Access authorization based on sender's attributes including role, location , rank, etc.
 - For external cloud providers, need to assess how to securely acquire and pass the requester's claims (in a SAML token) to the cloud-based application which will evaluate the claims and allow/deny access.



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Cloud Challenges

- **External Interface Connections** - Effectively supports a large number (>100) of two-way asynchronous external interfaces per application system
- **SLA Availability at the application level rather than at the server/database level**
 - **Meaningful reward/penalty clauses**
 - **Linkage to iNOSC/Help Desk for application situational awareness**
- **COOP/DR to alternative data center – essential for 24/7 mission systems**
- **Dynamic elasticity (auto up/down scaling of both processing/storage/bandwidth) and associated charging**
- **Contract clauses with complete flow down to subcontractors (e.g., indemnification, Insurance, personnel, inspections, data extraction, etc.)**



Moving to (internal) “Cloud” Results

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- **400 VM’s hosted on 55 ESX Servers (~9:1 Consolidation)**
 - **Without virtualization**
 - Average cost per server and infrastructure software stacks = \$32k
 - Multiplied by 400 hosts = \$12.8M
 - **With VMware virtual infrastructure**
 - Average cost per server and VI3 = \$44k
 - Multiplied by 55 hosts = \$2.4M
 - **The current hardware savings alone = \$10.4M**
 - **Reduce energy consumption savings of \$457k annually**
 - **Reduced physical foot print in data centers**
- **93% virtualization**
 - **Admin cost decreased: 50/1 for Windows and 250/1 for Linux environments**





Evolving Operational Environment

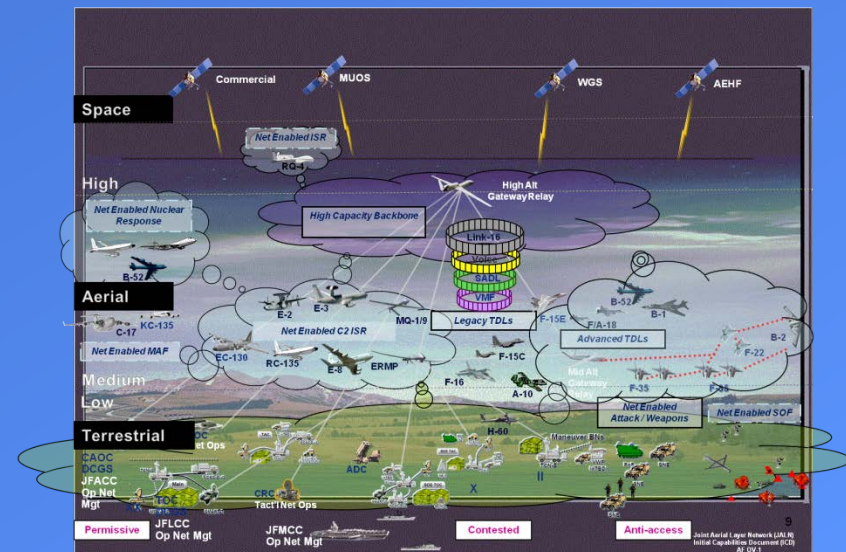
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RESILIENCY

- Under cyber “attack” conditions, maintain system/data connectivity
- When a data center goes down, all operations (with up-to-date data) transfers seamlessly
- Prioritization of work cascading through cloud data centers

CLOUD Computing at all layers

- Aerial layer
- Space layer
- Single Integrated Network Environment (SINE) Mesh Connectivity/ Resiliency





How Do We Get There?

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- Leverage the lessons learned from application migration/virtualization efforts
- Utilize a library of cloud capability-based services (DoD Cloud Broker)
- Update selection strategy for determining the best application candidates for cloud computing
- Develop an investment strategy/business case analysis to transition current mission applications to cloud computing
- Ensure cloud computing solutions meeting all appropriate NIST controls and is AF Implementation Baseline compliant
- Guaranteed information assurance and SLA
- Assess any impacts on the AF Network and situational awareness.





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Our Shared Operational Goal

- **Mission assurance by providing joint force commanders network enabled operational capability to...**
 - **See with clarity**
 - **Navigate with accuracy**
 - **Communicate with certainty**
 - **Strike with precision**
 - **Network with assurance**



Improve Capabilities, Flexibility & Robustness of Forces Across the Domain



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Questions - Discussions



Integrity - Service - Excellence