Future Naval Use of COTS Networking Infrastructure

Briefing to

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Panel Membership

- **Panel**
- TOR
- Fact Finding
- Naval IT Programs
- Why This Matters
- Network Evolution
- Resource Sharing
- Cloud Computing
- Impact
- Technical Issues
- Findings
- Action Items
- Take-Aways

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Terms of Reference

- Study the Navy's use of commercial architectures, software, and hardware.
- Examine the related emerging networking approaches under development in the commercial world.
- Examine the development and operational practices associated with the emerging approaches.
- Suggest strategies for leveraging ongoing COTS investment in future Naval networks:
  - In light of dramatically changing Naval bandwidth availability, uncertain connectivity, and large latencies
  - Within a global supply chain
- Recommend S&T investments to adapt the emerging networking approaches to Naval requirements.

Fact Finding

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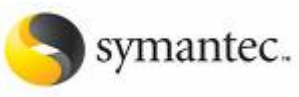

Current Naval IT Programs

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Why This Briefing Matters to the Navy

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Bechtel CTO Geir Ramleth compared his internal network costs to the costs of best-in-class providers

	Bechtel	Best in Class	Cost of Bechtel's Inefficiencies
Bandwidth Capacity	$500/Mbps per month	$10-$15/Mbps per month YouTube	x33 – x50
IT Efficiency	One administrator per 100 servers	One administrator per 20,000 servers Google	x200
Storage Cost	$3.75/GB per month	$0.15/GB per month amazon.com	x25

Potential Savings are Compelling

Why This Briefing Matters to the Navy

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"Our S&T investments must address Warfighting gaps and improve our effectiveness and efficiency."
– 2009 CNO's Guidance

- Information dominance is central to **National Military Strategy**
- Information dominance **requires** being near the leading edge of technology
- Being **near the leading edge** today can increase network efficiency 10s to 100s of times
- **Societal transformations** are being driven by advances in Information Technology (e.g. social networking is changing how people interact with people)
- The **new networking architectures** enable the NNE objectives as well as operational commander priorities well beyond what the current architecture can provide

Translates to greater effect at lower cost

Evolution of Networking Architectures

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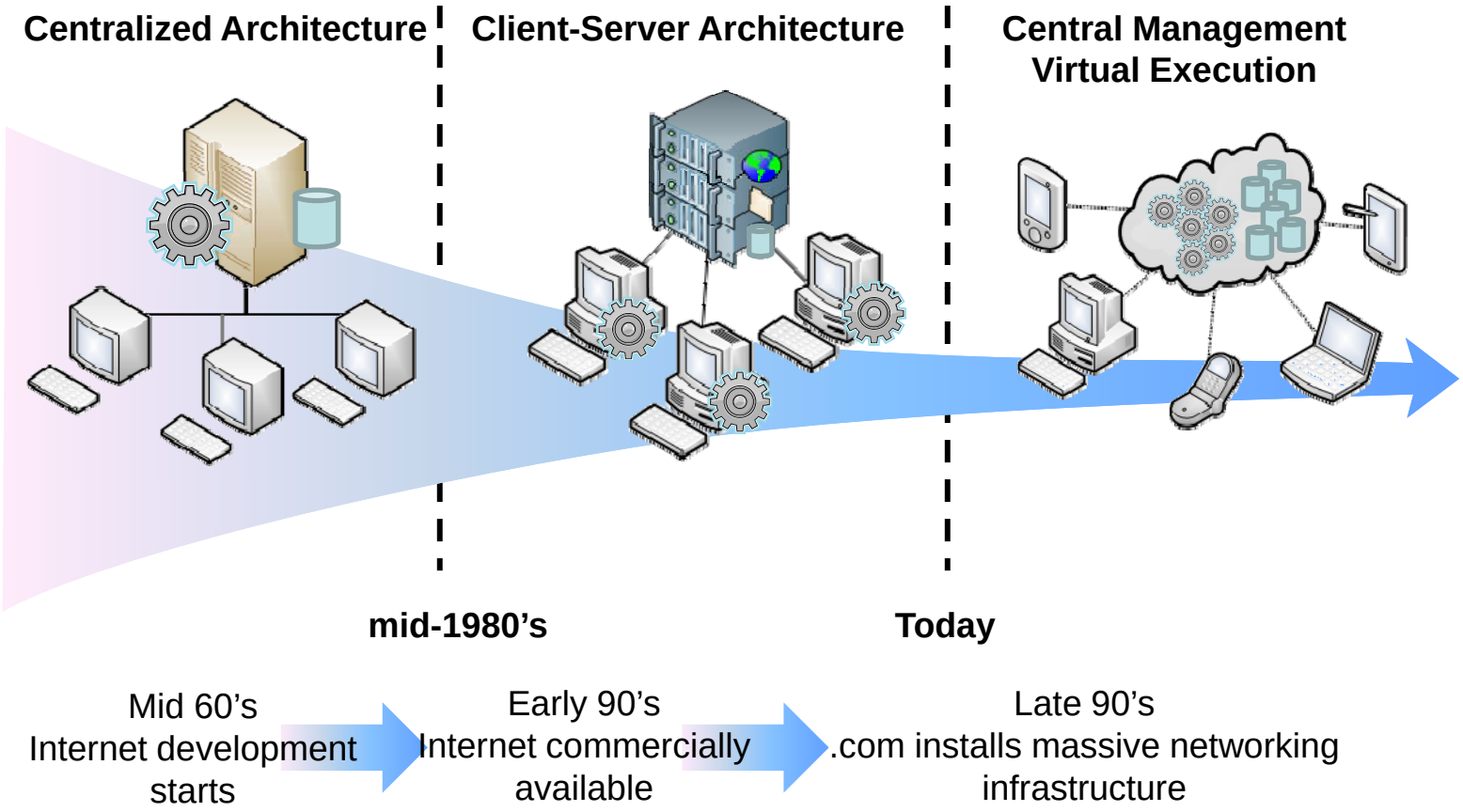

Evolution of Resource Sharing

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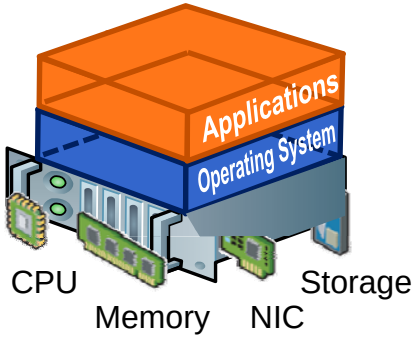

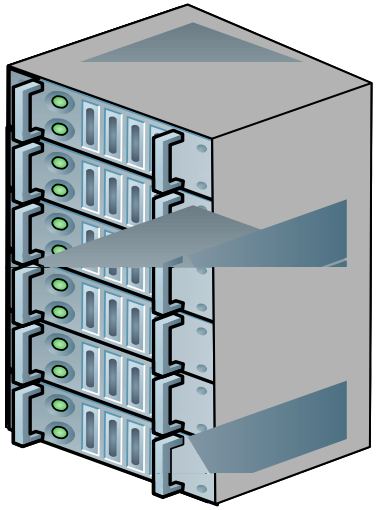

- 1-to-1 Server/OS Ratio: Operating system and applications installed on each machine.
- Configuration Management: OS and applications updated periodically, creating diversity of versions across the network.
- Security Patches: IT must support ALL of the versions!

Evolution of Resource Sharing

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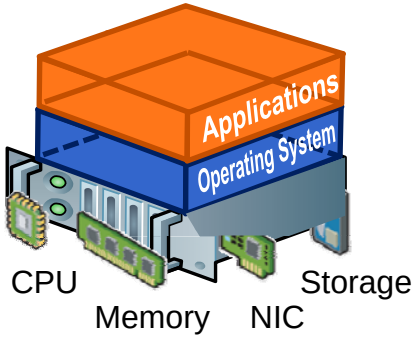

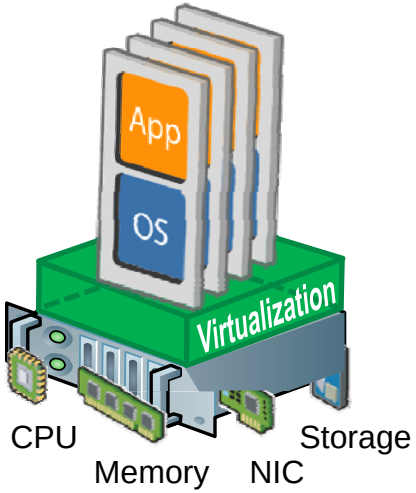

- Flexibility: Virtualization layer allows multiple OS on an individual server.
- Standardized Configuration: Provides a uniform server environment – easier for IT to support!
- Efficiency: Allows each server to be used more efficiently, and therefore, requires fewer physical servers.

Evolution of Resource Sharing

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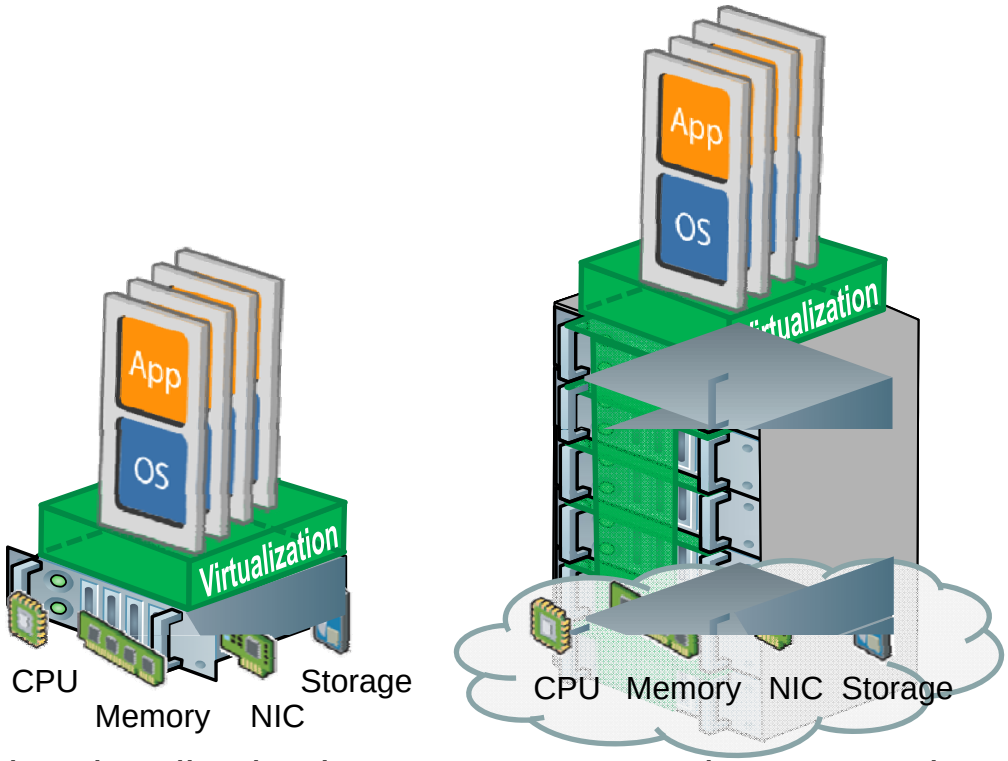

- Scalable: Virtualization layer supports seamless expansion of computing and storage capacity on demand.
- Pools Resources: Permits creation of large, shared server and storage capacity serving large and diverse user community.
- Availability: Load leveling virtual machines across servers provides instant recovery from failure of physical servers.

What is Cloud Computing?

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Cloud computing is a style of computing that enables

- available, convenient, on-demand network access to
- a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, services) that can be
- rapidly provisioned and released with
- minimal management effort or service provider interaction.

Adapted from the NIST Working Definition

Cloud Impact

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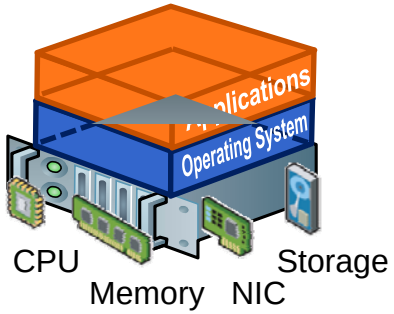
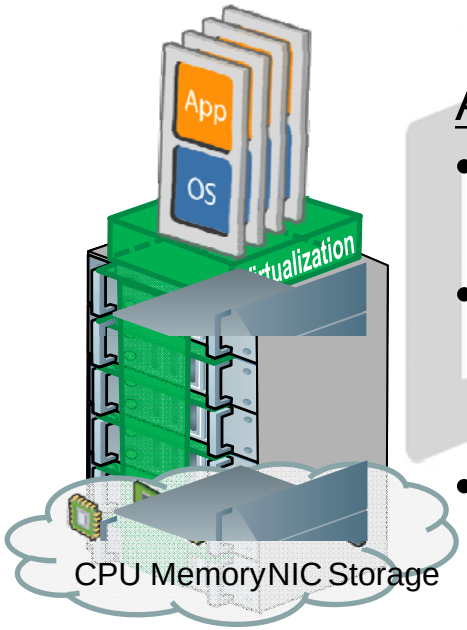


Before:

- **7 data centers** and **35,000 sq ft** of datacenter capacity across a distributed footprint.
- **5 versions** each of **230 applications**. Upgrades and training were constant.
- **No version management.**



After:

- **3 data centers** with less than **1,000 sq ft** of datacenter space.
- **1 version** of each of the **50** most heavily used applications converted to run from a Google-like portal.
- **Centralized version management**.

Cloud Revolution = Think Scalable

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Cloud Revolution = Think Innovation

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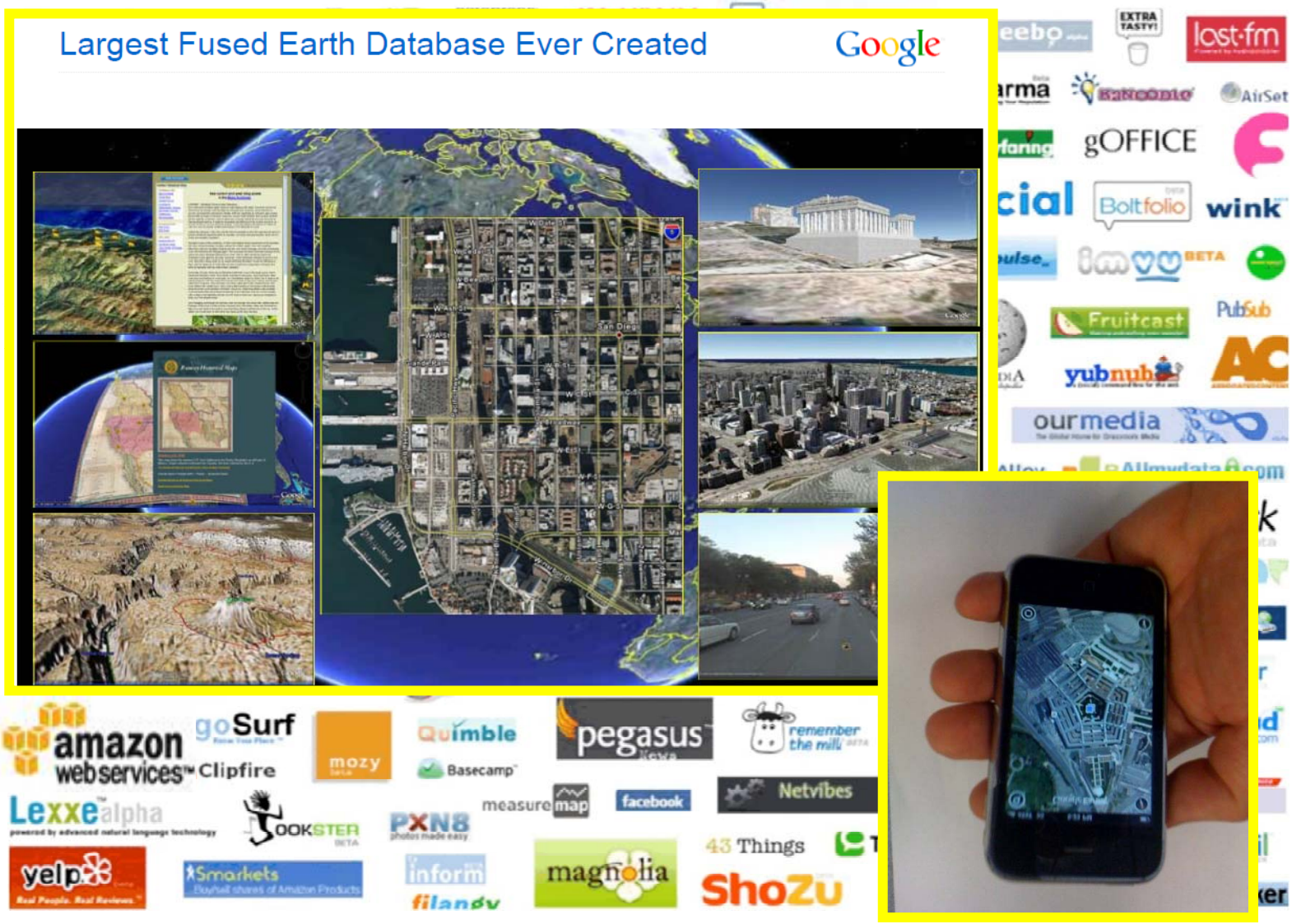

Technical Issues for Naval Implementation

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Security in the Cloud

- **Uniform, efficient enforcement of security standards**

but

- **It opens up some new and different security concerns**
  - **In the Virtualization Layer**
  - **In Software**
  - **In data at rest**

Bandwidth & Connectivity to the Cloud

- **.com implementations assume ubiquitous, high-bandwidth, continuous connectivity**

but

- **The Navy must deal with limited bandwidth and intermittent connectivity**

Finding I: Transformational

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Finding:

1. Cloud computing technology has the potential for transformational benefits to Naval networks (not a fad).

Recommendations:

1-A. Acquisitions: Ensure future DoN acquisitions consider and, as appropriate, leverage the benefits of cloud computing.

1-B. Pay-as-you-go: Develop long-term procurement strategies for purchasing on demand computing capacity.

1-C. Metrics: Standard cloud computing models and performance metrics should be developed to assist in the design, monitoring and contracting of systems.

1-D. Pilot: Establish cloud computing pilot program(s) to explore the key metrics, benefits and issues.

1-E. Standards: Must enter the standards conversation with the commercial community to represent unique Naval needs.

Finding II: Security

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Finding:

2. Trust in the security of cloud technologies; i.e., confidentiality and integrity, is the greatest challenge to cloud utilization.

Recommendations:

2-A. Research Areas: Track research and fund activities to fill Navy specific gaps:
- Trusted (formally verified) virtualization layer
- Data-at-Rest in the cloud
- Secure cloud applications

2-B. Confidentiality/Integrity: Develop strategies, technologies, and protocols to enable Naval forces to fight through loss-of-trust events and to rapidly restore trust and integrity of cloud operation. Future Naval war games should test these strategies, technologies, and protocols.

Finding III: Intermittent Operations

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Finding:

3. Naval forces afloat will remain disadvantaged by intermittent links with large latency and marginal bandwidth. This may affect the capabilities of cloud computing-based systems that depend upon more reliable links.

Recommendations:

3-A. Continuity: Develop technologies to ensure continuity of cloud operations in the face of failed communication links (e.g. between shore and afloat components).

3-B. Synchronization: Research ways for cloud synchronization over intermittent/low-bandwidth/mobile channels

3-C. Redundancy: Research and develop high bandwidth and multiple redundancy links (e.g., the DARPA ORCA program).

Bandwidth Challenge to DoN Use of Cloud Architecture

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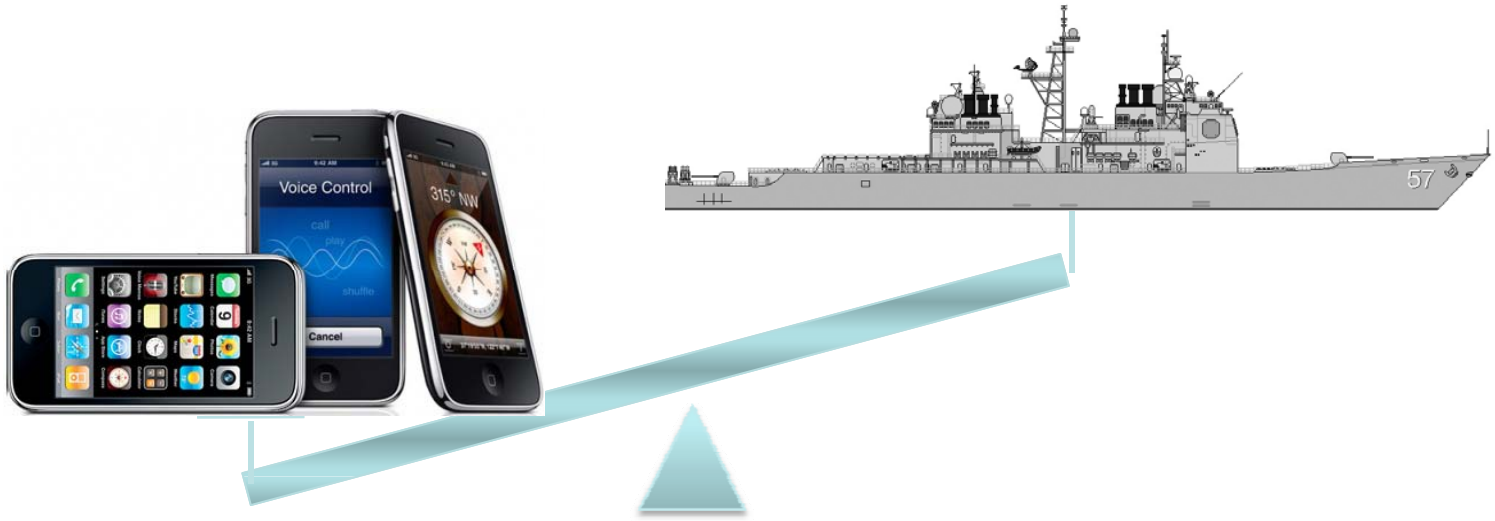

Connectivity pervasive for .com applications
Achieving this for disadvantaged user nontrivial

Actions

- **ASN RDA**
  - 1-A. Acquisitions: Ensure future DoN acquisitions consider and, as appropriate, leverage the benefits of cloud computing.
- **DON CIO**
  - 1-E. Standards: Must enter the standards conversation with the commercial community to represent unique Naval needs.
- **N6**
  - 1-D. Pilot: Establish cloud computing pilot program(s) to explore the key metrics, benefits and issues.
- **NNWC**
  - 1-C. Metrics: Standard cloud computing models and performance metrics should be developed to assist in the design, monitoring and contracting of systems.
  - 2-B. Strategy: Develop strategies to enable Naval forces to fight through loss-of-trust events and to rapidly restore trust and integrity of cloud operation. Future Naval war games should test these strategies.
- **PEO EIS**
  - 1-B. Pay-as-you-go: Develop long-term procurement strategies for purchasing on-demand computing capacity .

Actions

- **PEO C4I**
  - 2-B. Technologies & Protocols: Develop technologies and protocols to enable Naval forces to fight through loss-of-trust events and to rapidly restore trust and integrity of cloud operation.
  - 3-A. Continuity: Develop technologies to ensure continuity of cloud operations in the face of failed communication links (e.g., between shore and afloat components).
- **CNR**
  - 2-A. Research areas: Track research and fund activities to fill Navy specific gaps:
    - Trust (formally verified) virtualization layer
    - Data-at-rest in the cloud
    - Secure cloud applications
  - 3-B. Synchronization: Research ways for cloud synchronization over intermittent/low-bandwidth/mobile channels.
  - 3-C. Redundancy: Research and develop high bandwidth and multiple redundancy links (e.g. the DARPA ORCA program).

Take-Aways

- Cloud Computing: the next big step in networking architecture
- Engage the cloud community to ensure Navy needs are incorporated into evolving standards.
- Establish cloud pilot project(s) for non-combat services.
- Focus research and development efforts on:
  - Securing the virtualization layer
  - Develop data links that enable cloud architectures
  - Cloud performance models to analyze network performance in various conditions

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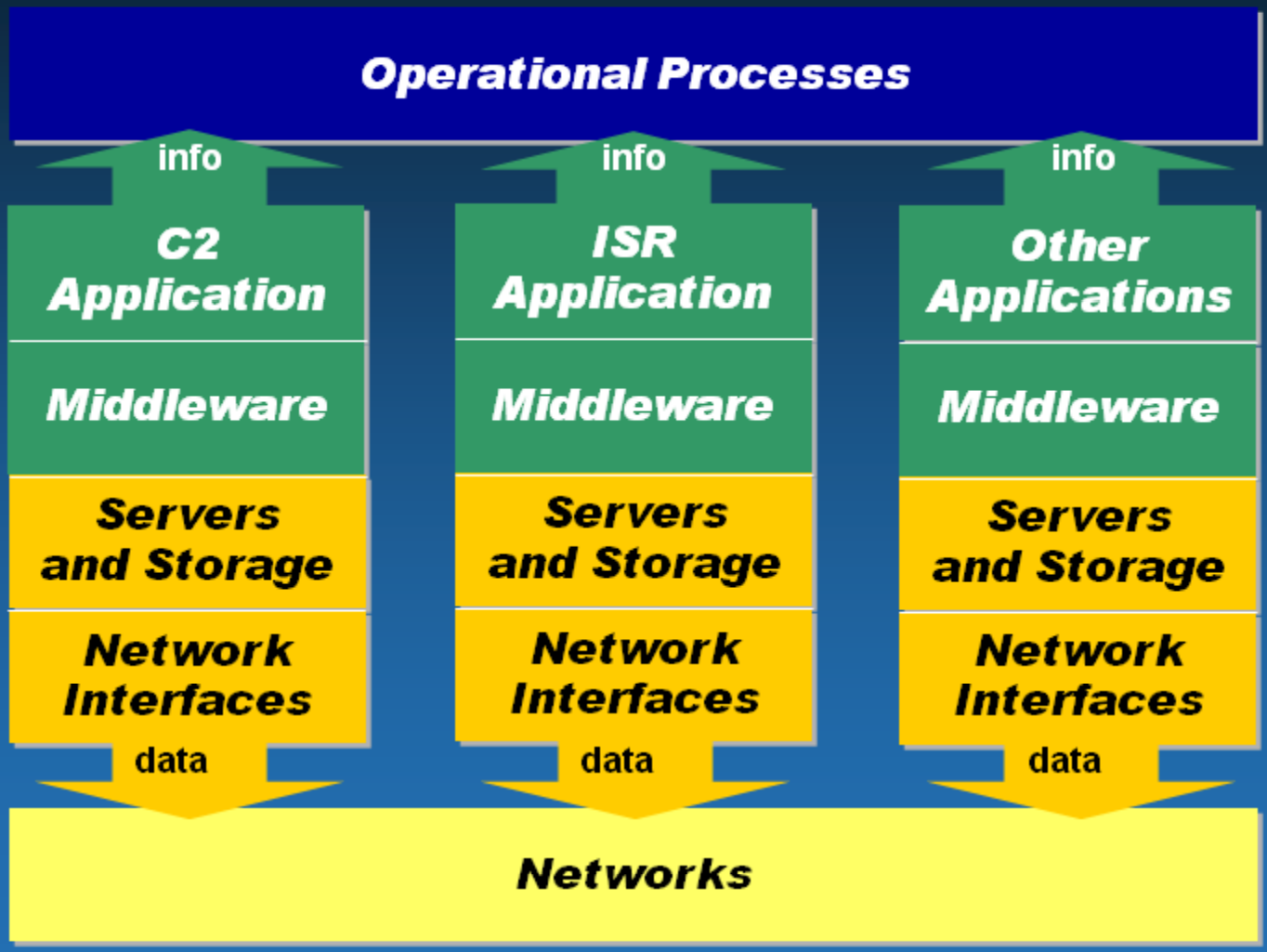
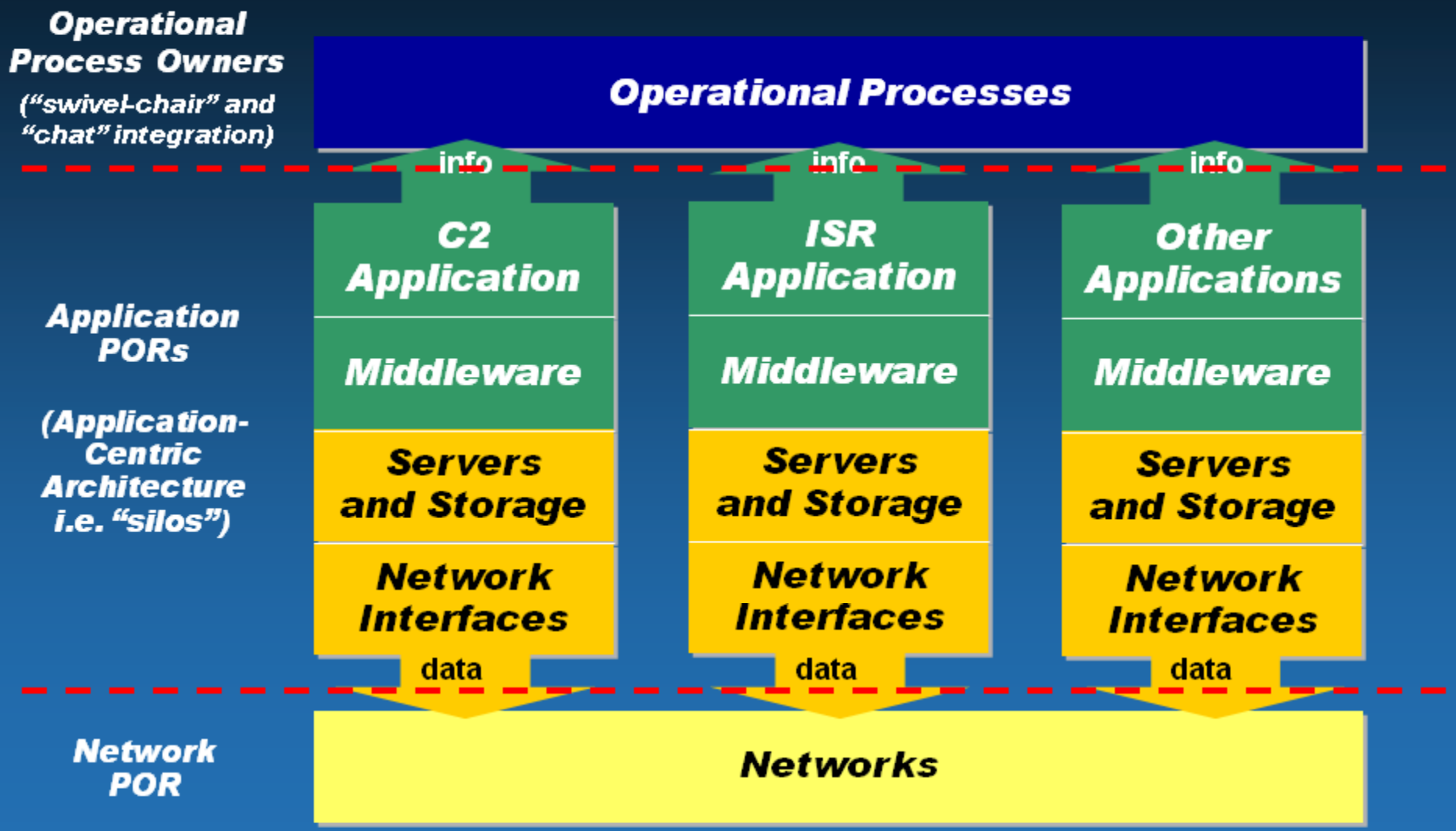
Backup

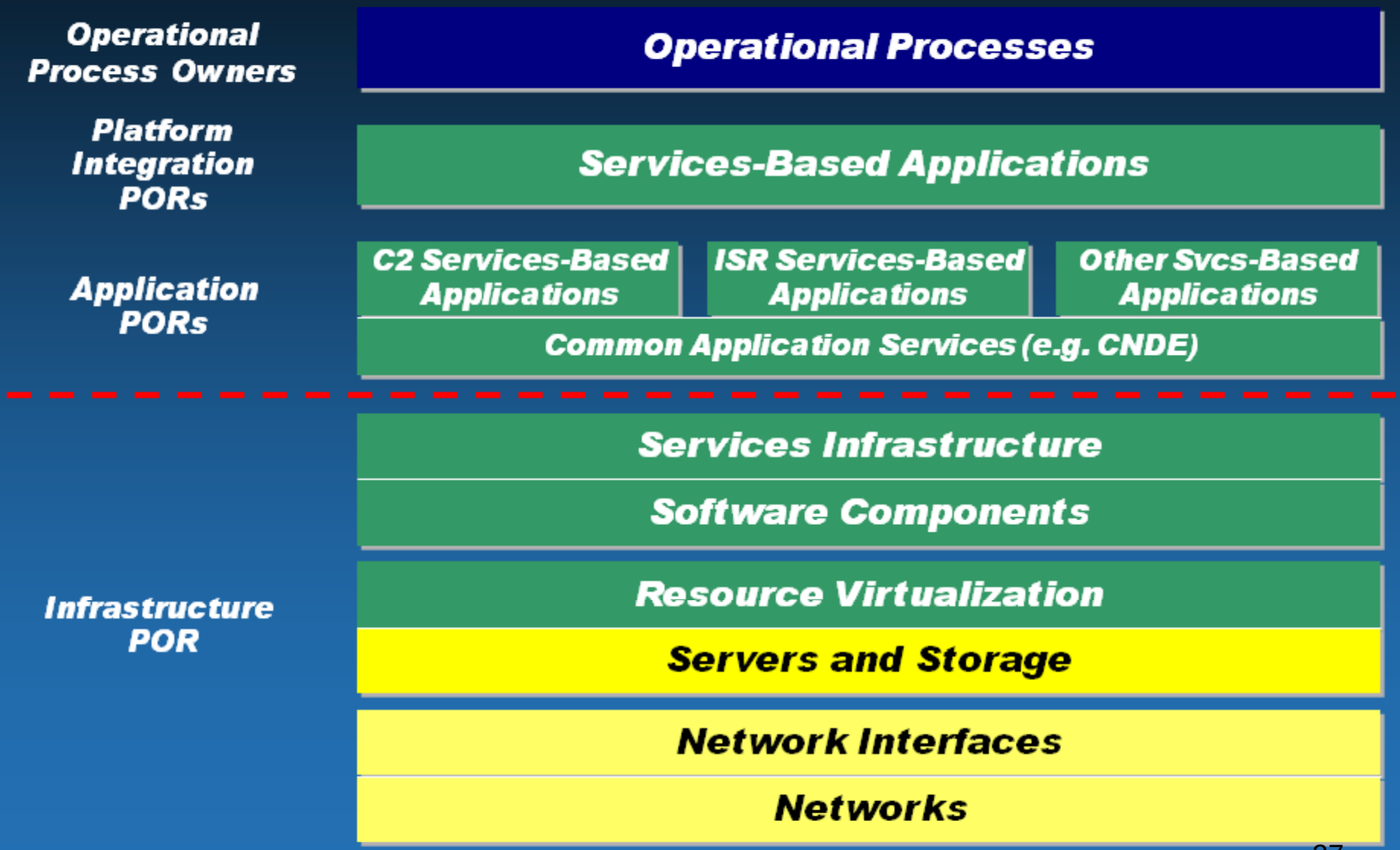
Current Afloat Architecture



Current Afloat Architecture



Future Service-Oriented Afloat Architecture



What is Virtualization

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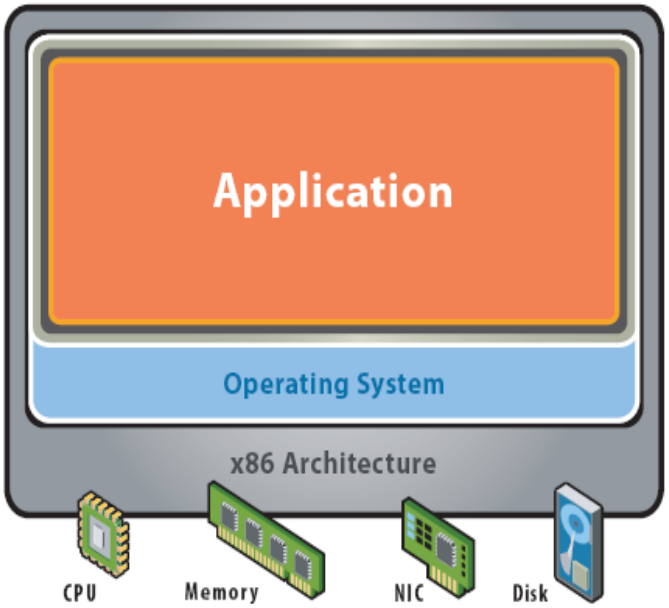
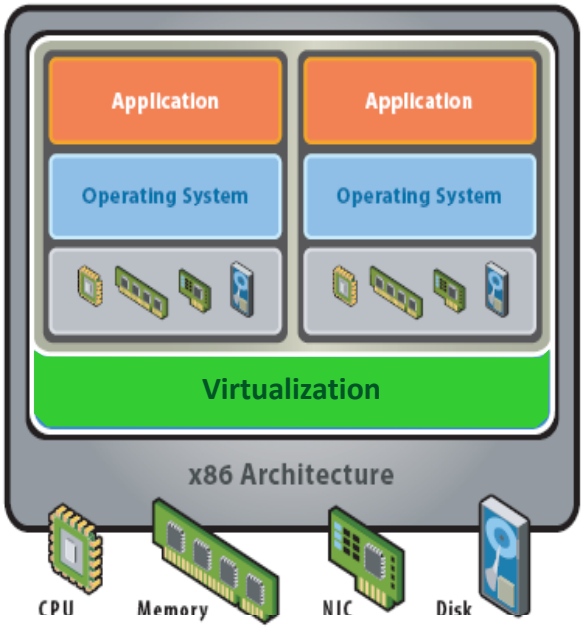


- **1-to-1 Server/App Ratio**: Operating system and applications installed on each machine.
- **Large Configuration Management**: 1-to1 OS and applications updated periodically, creating diversity of versions across the network.
- **Security Patches**: IT must physically support ALL of the versions!



- **Flexibility**: Virtualization layer allows multiple OS on an individual server.
- **Standardize Configuration**: Provides a uniform server environment – easier for IT to support!
- **Efficiency**: Allows each server to be used more efficiently, and therefore, requires fewer physical servers.

DJC2 Data Center

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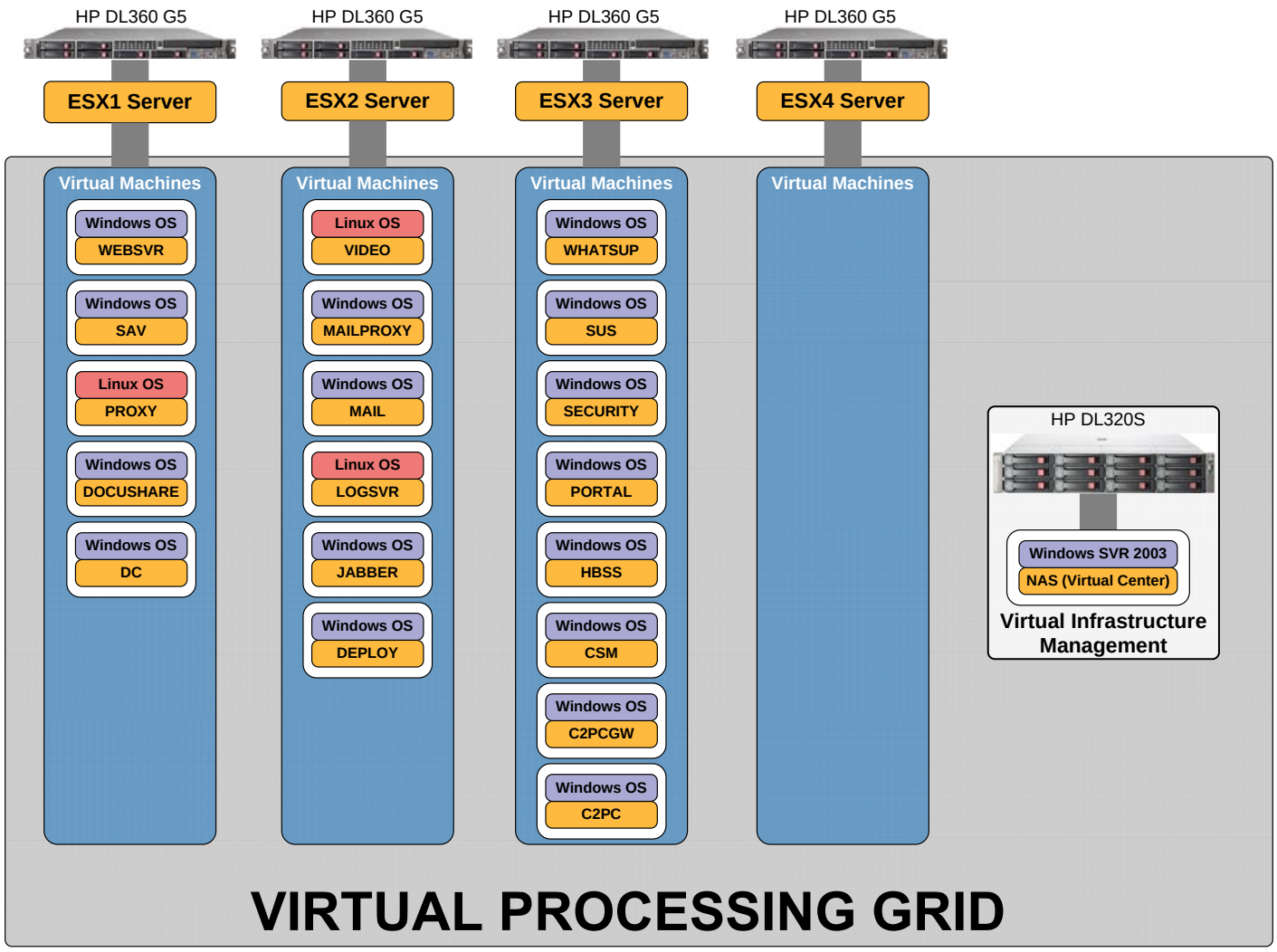
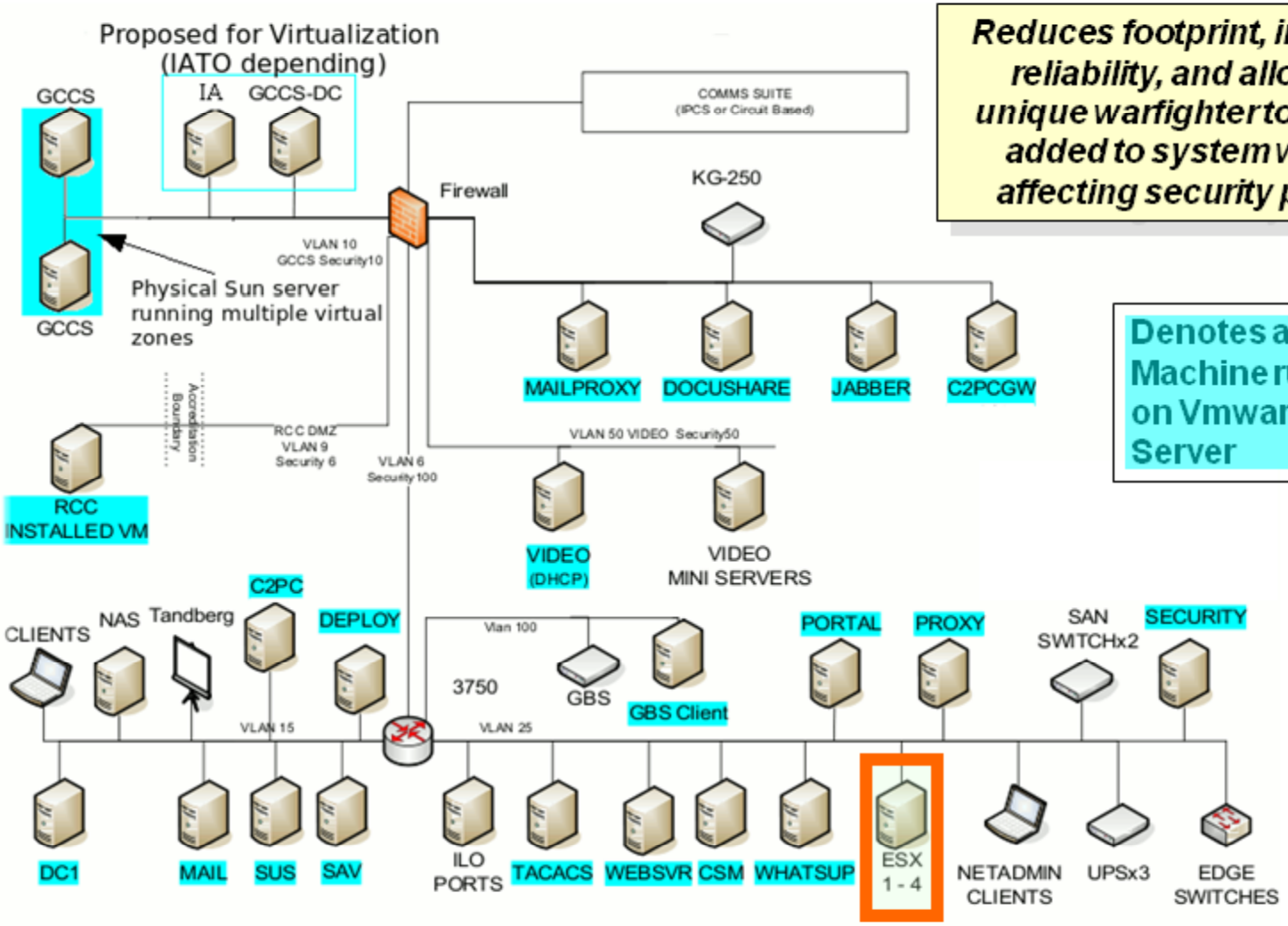


DJC2 Spiral 1.2
Virtual Environment

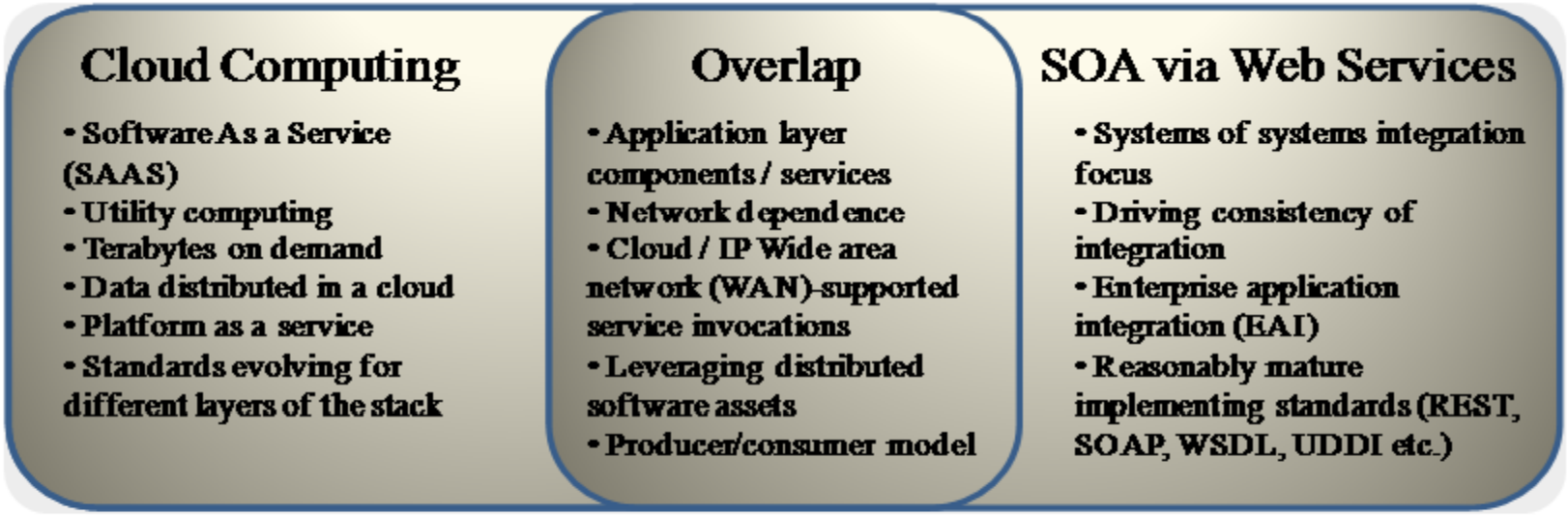


Reduces footprint, increases reliability, and allows for unique warfighter tools to be added to system without affecting security posture

Denotes a Virtual Machine running on Vmware ESX Server

Only 3 physical servers and 1 spare

Comparing Clouds and SOA



- SOA and cloud computing concepts are complementary - important overlap occurs near the top of the cloud computing stack, in the area of *Cloud Services*
- Both cloud computing and SOA share concepts of service orientation
- Cloud computing focuses on turning aspects of the IT computing stack into commodities that can be purchased incrementally from the cloud-based providers
- Both are forms of outsourcing, sharing network dependence

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Mr. Justin Burks, Amazon Web Services Alliance Manager, Amazon
Mr. Mike Culver, Web Services Evangelist, Amazon
Mr. Paul Horvath, Solutions Architect, Amazon
Mr. Stephen Schmidt, General Manager, Enterprise & Federal AWS, Amazon
Mr. Matt Tavis, Solutions Architect, Amazon
Mr. Tim Dowd, CISCO
Mr. Stephen Orr, CISCO
Mr. Bruce McConnell, Group Chair, Cybersecurity for the 44th Presidency, CSIS
Mr. Eric Gundersen, President, Development Seed
Mr. Richard Hale, Chief, Information Assurance Executive, DISA
Mr. Dave Mihelcic, CTO, DISA
Mr. Dave Baciocco, CTO, Ericsson
Mr. Kevin LaMontagne, Gartner
Mr. Robert Mason, Gartner
Mr. Jason Cain, Google Earth Enterprise Sales Engineer, Google
Mr. Dylan Lorimer, Strategic Partner Mgr - Geo Content Partnerships, Google
Mr. Rajen Sheth, Senior Product Manager- Google Apps, Google
Mr. Graham Spencer, App Engine, Google
Mr. Mark Wheeler, Google Earth/Maps Enterprise, Google
Mr. Jim Young, DoD Sales Manager, Google
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Dr. Marv Langston, Former DoN CIO
Mr. Bryan Atwood, Product Manager, Google Earth Enterprise
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