Decision Superiority

In a Cyber Driven World!

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Do You Recognize These Images?
Information Dominance is a Transformation!

The Opportunity

- The U.S. Navy today has the rare opportunity to truly revolutionize its warfighting capability

- Similar to the transformations that occurred when the Navy introduced steam power, dreadnoughts, aircraft carriers, and nuclear power into the Fleet.
10x Growth of UAV Expenditures since 2000

Decision Superiority in Cyberspace

*Applications for NAVY UNMANNED AIRCRAFT SYSTEMS*

BRIEN ALKIRE, JAMES G. KALLIMAN, PETER A. WILSO, LOUIS R. MOORE

RAND 2010
Sensor Data Rates*

Typical Data Rates Associated with IMINT Sensors

* Applications for NAVY UNMANNED AIRCRAFT SYSTEMS  BRIEN ALKIRE, JAMES G. KALLIMAN, PE  TER A. WILSO, LOUIS R. MOORE  RAND 2010

RAND MG957-3.3

8/25/10  Decision Superiority in Cyberspace
"The greatest shortcoming of the human race is our inability to understand the exponential function."

Professor Emeritus Albert Bartlett, University of Colorado http://www.albartlett.org/
• Wideband Global Satellite carries 2.1-3.6 Gbps over 39 channels
• Max of 50 Mbps per channel

• If we fill up the chess board analogy with bits square 64 would represent 8 Exabits (10E18 bits)

• Unity undersea cable carries 4.8 Tbps on five cable pairs
• Current single mode (long distance) fiber carries 960 Gpbs
Growing Data Generation Capability

*Petabytes in use* - examples of the use of "petabyte" to describe data sizes in different use domains:

**Internet:** Google processes about 24 petabytes of data per day; they think in exabytes

**Telecoms:** AT&T has about 19 petabytes of data transferred through their networks each day

**Physics:** The 4 experiments in the Large Hadron Collider will produce about 15 petabytes of data per year, which will be distributed over the LHC Computing Grid

**P2P networks:** As of October 2009, Isohunt has about 9.76 petabytes of files contained in torrents indexed globally

**Archives:** The Internet Archive contains about 3 petabytes of data, and is growing at the rate of about 100 terabytes per month as of March, 2009

**Games:** World of Warcraft utilizes 1.3 petabytes of storage to maintain its game

**Film:** The 2009 movie Avatar is reported to have taken over 1 petabyte of local storage at Weta Digital for the rendering of the 3D CGI effects

**Navy** will soon generate 5 - 10 Petabytes of data per year!! Other Services and Agencies will generate similar amounts!!
Navy ISR Roadmap... Data Challenges

- EP3 and SPA
- Global Hawk Maritime Demo
- Saber Focus
- Scan Eagle
- Fire Scout
- STUAS
- Cobra Judy
- Cobra Judy Replacement
- SURTASS
- SSEE E/F Surface
- Intel Gear on SSNs
- Sea Maverick UUV Demo
- Sea Stalker UUV Demo
- SHARC or Glider UUV
- MSN Reconfigurable UUV
- Large Diameter UUV Demo

Decision Superiority in Cyberspace
Exponential Data Growth: Enabler & Challenge!

Theater Data Stream (2006):
~270 TB of NTM data / year

Max of 50 Mbps per channel

Current single mode fiber carries 960 Gpbs

Time to transfer one terabyte of data = 8,796,093,022,208 or 8.8E+12 bits

Max Transfer (bits/sec) | Seconds | Minutes | Hours | Days
---|---|---|---|---
50 megabit bps WGS Channel | 40,000,000 | 219,902 | 3,665 | 61 | 3
155 megabit bps service | 62,000,000 | 141,872 | 2,365 | 39 | 2
10 gigabit bps service | 4,000,000,000 | 2,199 | 37 | 1
Large Data 10 Gbps JCTD | 8,500,000,000 | 1,035 | 17
40 gigabit bps service | 16,000,000,000 | 550 | 9
100 gigabit bps service | 40,000,000,000 | 220 | 4
In a world of infoglut, for bits to have value, they must find their consumers.
And their Consumers Must be Ready, Willing & Able to Consume

Professor Rick Hayes-Roth, Naval Postgraduate School
Valuable Information at the Right Time (VIRT)
Push MUCH BETTER than Pull

99.999% less data for the operator to consider

5 orders of magnitude more efficient

Professor Rick Hayes-Roth, Naval Postgraduate School; Valuable Information at the Right Time (VIRT)
**Unimaginable Info Tech Growth**

The red button in a IBM 3380 cabinet is as big as three MicroSD cards.

- **1980**
  - Eight 2.5GB IBM 3380 Disk Systems: 20GB
  - Estimated value: $648,000 - $1,137,600
  - Weight: 2,000,000 grams (4,400 pounds)

- **2010**
  - One MicroSD Card: 32GB
  - Estimated value: $100 - $150
  - Weight: 0.5 grams (0.001 pounds)

**Terabyte Hard Drive**

**$1B NORAD Computer Complex**
### Current Cost of a Petabyte of Storage

#### COST OF A PETABYTE

<table>
<thead>
<tr>
<th>Drive Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAW Drives</td>
<td>$81,000</td>
</tr>
<tr>
<td>BACKBLAZE</td>
<td>$117,000</td>
</tr>
<tr>
<td>DELL MD1000</td>
<td>$826,000</td>
</tr>
<tr>
<td>Sun X4550</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>NetApp FAS-6000</td>
<td>$1,714,000</td>
</tr>
<tr>
<td>Amazon S3</td>
<td>$2,806,000</td>
</tr>
<tr>
<td>EMC NS-960</td>
<td>$2,860,000</td>
</tr>
</tbody>
</table>

*Amazon S3 Storage over three years (minus electricity, co-location, and administration).

As of 2009, today the cost will be less, next year even less!!
Exponential Growth of Computing

The exponential growth of computing is a marvelous quantitative example of the exponentially growing returns from an evolutionary process. We can express the exponential growth of computing in terms of its accelerating pace: it took 90 years to achieve the first MIPS per 1000 dollars; now we add 1.2 MIPS per 1000 dollars every hour.

Source: Ray Kurzweil and KurzweilAI.net
2029: An intimate merger

- $1,000 of computation = 1,000 times the human brain
- Reverse engineering of the human brain completed
- Computers pass the Turing test
- Nonbiological intelligence combines
  - the subtlety and pattern recognition strength of human intelligence, with
  - the speed, memory, and knowledge sharing of machine intelligence

- Nonbiological intelligence will continue to grow exponentially whereas biological intelligence is effectively fixed

Source: Ray Kurzweil; www.kurzweil.net
Information Dominance Opportunity Dilemma

1. Centralized - Mainframe
   - Central computer center
   - Software in computer center only
   - Work brought to the computer center

2. Networked - Decentralized
   - PC enabled and network
   - Software distributed in both server and client computers
   - Work from the user location

3. Internet - Cloud
   - Virtualized compute; global network enabled
   - Software decoupled from hardware
   - Work from anywhere

- We are in early stages of Wave 3 information technology
- Mainframe and Client-Server waves remain in place
- Waves represent many co-dependent technologies, matured over time
- Adding functional capability has become easier with each new wave
- But enterprise infrastructure gaps & vulnerabilities have become more critical

Adding functional capability has become easier with each new wave.

Waves represent many co-dependent technologies, matured over time.

Adding functional capability has become easier with each new wave.

The greatest danger in times of turbulence is not the turbulence; it is to act with yesterday’s logic.” Peter Drucker

Navy is using Wave 2 acquisition & budget processes; but requires Wave 3 capability.
GIG Content Delivery Service (GCDS)
DISA’s First Cloud Service

Globally Distributed Enterprise Computing Infrastructure
“Type Accredited”
Saving Millions in IT Expansion Costs
50 Regions, 25 cities, 12 Countries (SWA)

Accelerating Collaborative Applications to Warfighters
2X to 30X Performances Improvements
85% DISN Bandwidth Offload

Adjusting to Changes in Network Conditions

Excellent Customer Feedback & Reputation

GCDS is Designated as DoD Enterprise Service
Akamai Deployments for GCDS

- 50+ regions
- Hundreds of servers
- 60 apps live
### Examples of Applications on GIG CDS

<table>
<thead>
<tr>
<th>Customer</th>
<th>Total BW</th>
<th>BW from Origin</th>
<th>BW Offload Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAVY NKO</td>
<td>160 GB</td>
<td>62 GB</td>
<td>61%</td>
</tr>
<tr>
<td>NEL (5)</td>
<td>450 GB</td>
<td>45 GB</td>
<td>96%</td>
</tr>
<tr>
<td>GDS CRL</td>
<td>7129 GB</td>
<td>5 GB</td>
<td>99.9%</td>
</tr>
<tr>
<td>GCSS-AF</td>
<td>150 GB</td>
<td>60 GB</td>
<td>60%</td>
</tr>
<tr>
<td>AKO</td>
<td>154 GB</td>
<td>7.6 GB</td>
<td>95%</td>
</tr>
<tr>
<td>ADLS</td>
<td>338 GB</td>
<td>30 GB</td>
<td>91%</td>
</tr>
</tbody>
</table>

#### Both NIPRet & SIPRNet

<table>
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<th>BW Offload Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>symantec DoD Symantec</td>
<td>8.74 GB</td>
<td>2.48 GB</td>
<td>72%</td>
</tr>
<tr>
<td>McAfee DoD McAfee</td>
<td>2.9 GB</td>
<td>0.12 GB</td>
<td>96%</td>
</tr>
</tbody>
</table>

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<th>BW Offload Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>CJTF (2)</td>
<td>40.85 GB</td>
<td>16.92 GB</td>
<td>59%</td>
</tr>
<tr>
<td>MNFI</td>
<td>956 MB</td>
<td>0.05 MB</td>
<td>99.98%</td>
</tr>
<tr>
<td>MARCENT (2)</td>
<td>24.56 GB</td>
<td>6.37 GB</td>
<td>74%</td>
</tr>
<tr>
<td>NGA (6)</td>
<td>12.1 GB</td>
<td>5.9 GB</td>
<td>51%</td>
</tr>
<tr>
<td>Intelink</td>
<td>238.5 GB</td>
<td>102 GB</td>
<td>57%</td>
</tr>
<tr>
<td>TEC</td>
<td>20.4 GB</td>
<td>13.2 GB</td>
<td>35%</td>
</tr>
</tbody>
</table>
Transfer rates:

- **99.2 MB File**
  - Langley: 19 Min, 40 Sec
  - Net Storage: 2 Min, 44 Sec
- **380 MB File**
  - Langley: 1 Hr, 18 Min
  - Net Storage: 8 Min, 43 Sec
- **1 GB File**
  - Langley: Timed out after 2 Hrs
  - Net Storage: 23 Min, 5 Sec

Usage:

1 Week usage before Akamai:
3,879 requests

1 Week usage after Akamai:
208,703 requests

GeoBase, an AF GIS system, deployed to GCSS-AF as a Reduced Sign-On application.

GeoBase Data became readily available and quickly downloaded world-wide, multiplying usage by nearly 54 times.
Information Dominance Requires a Transformation!

...157 worldwide coaling stations

...168 Air Stations; 250 outlying airfields
  At the end of WWII:
  • 100 aircraft carriers
  • 41000 aircraft
  • 431000 personnel
  • 6768 ships

... Naval Reactors Facilities; Nuclear Power Schools

... Google’s Infrastructure
  • 450,000 + servers
  • Require 20 Megawatts
  • $2M/mo electric cost
  • 50 + Petaflops
The U.S. Navy today has the rare opportunity to truly revolutionize its warfighting capability.

Similar to the transformations that occurred when the Navy introduced steam power, dreadnoughts, aircraft carriers, and nuclear power into the Fleet.

• Just as in previous Naval transformation... Information Dominance requires ashore infrastructure to support successful at sea operations!!
The Solutions Are Not This Simple!!
Questions

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