Big Data on Clouds (BDOC) – The Soft Stuff is the Hard Stuff

The Human Perspective - Striking the Balance between Human and Machine

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The Aerospace Corporation

Opening Keynote Speech

Asia Pacific Network Operations and Management Symposium (APNOMS 2014)*

Hsinchu, Taiwan, 17-19 September 2014

* Sponsored by EICE & KICS, supported by IEEE & IFIP

Thank You Very Much!

- I am very honored to be invited to give the opening keynote speech of the 16th APNOMS!

- Chunghwa Telecom, which heads the Cloud Computing Association of Taiwan (CCAT) said in 2011:
  - **"The Cloud Valley will play a key role in transforming Taiwan into a true international information technology (IT) powerhouse.“***

* Dr Yuan-Kuang TU, President, Northern Taiwan Business Group, Chunghwa Telecom, during his keynote speech at IEEE/IFIP NOMS 2012

Big Data on Clouds* - The Soft Stuff is the Hard Stuff

- **Call to action – Develop the management methodologies and metrics for the human & machine TEAM**
- Leadership Perspective – IFIP/IEEE IM 1993 Vendor Program
- Scale, complexity, and diversity of BDoC make management very challenging
- The Space Enterprise
- The Cyber Challenge
- From Ops to DevOps to PostOps
- How to Develop outstanding people and STEM talent
- Leadership and Enterprise Management
- **Call to action – Develop the management methodologies and metrics for the human & machine TEAM**
- Leadership Perspective – IFIP/IEEE IM 1993 Vendor Program

* Betser, J., Hecht, M., “Big Data on Clouds, Success Drivers - Business, Reliability, and Legal Insights”, Chapter 16 of “Cloud Services, Networking, and Management”, Fonseca, N., & Boutaba, R., (Editors), IEEE Wiley Press, 2015

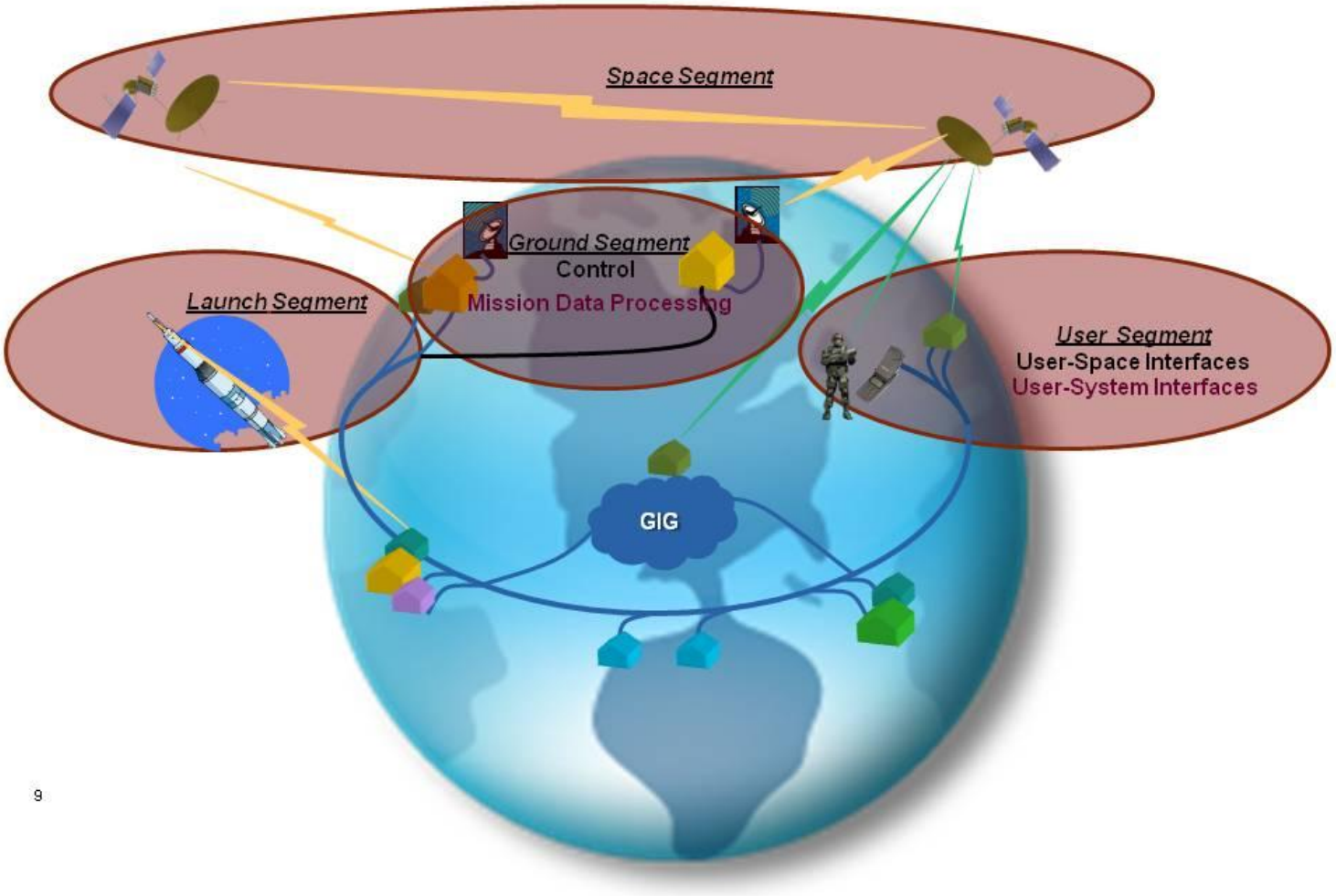
Call to Action – The Challenge to Our Community

- Develop the methodologies, metrics, and foundation to continually enhance human-machine systems of BDoC
  - ***New research needed on new metrics and methodologies***
  - *Outstanding STEM and general education*
  - *Develop strong organizations for Software Defined ++ Everything*
- Continue to recruit the very best talent to our community
  - *Enterprise management*
  - *PostOps, Site Reliability Engineering*
- Leadership Perspective – IFIP/IEEE International Symposium on Integrated Network Management (IM) 1993, San Francisco, CA
- Vendor program chair – Joe Betser
  - *Vendor program included 5 strong Technology Centers*
    - SNMPv2, OSI, Applications, RMON MIB, OMNIPoint
    - Strong leaders for each technology center
  - *Raving Success, over 1,500 attendees highest ever!*
- It is all about the people!
- Big Data on Clouds, The Soft Stuff is the Hard Stuff

Joe Betser, Vendor Program Chair, IFIP/IEEE IM 1993, SF, CA

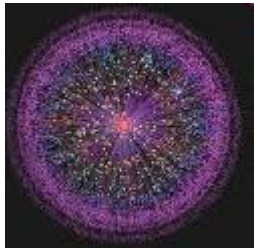
The Soft Stuff is the Hard Stuff!

The Space System Enterprise - 4 Segments



9

Computing Waves



Arpanet

amazon web services

Azure

IBM

+Mobile

+Social

+Big Data

+IoT

+Cyber-physical Sys

Cloud

Web

PC & Client Server

Mainframe

1960 1970 1980 1990 2000

BILLIONS (10^9)
OF USERS

100s OF BILLIONS
OF THINGS

MILLIONS OF
OF APPS

Mobile Cloud Big Data Social IoT

Mobile Devices

~½ GB/day/human

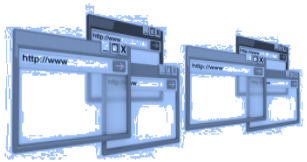
2.5 exabytes/day (= billion gigabytes = 10^18 bytes) of data (2012)

HUNDREDS OF MILLIONS
OF USERS

LAN/Internet Client/Server

PC

TENS OF THOUSANDS
OF APPS



MILLIONS
OF USERS

Mainframe, Minicomputer

Terminals

THOUSANDS
OF APPS

Based on IDC 2012

“Automate the Human Operator out of the Job”

- It is the goal of any enterprise management system to seek the highest level of automation, consistent with resilient operation
- Automation can achieve faster response times
- Humans add a level of human judgment, and a higher semantic cognition than some machines, but the cost is substantial
  - *Response time slower than automated management (in most cases)*
  - *Need human capital investments – training, salaries, benefits, office space*
  - *Humans can make errors, and can be a challenge to manage*

The Cyber Environment – More Complex

- Outages and faults can be the result of malicious activities
- Asymmetric challenge – attack can proceed at the speed of light
  - *Very little time to defend, usually not enough time for human response*
- Opposed System Design [Albert Wohlstetter 1967, RAND]
- Observe-Orient-Decide-Act (OODA) Loop [John Boyd 1976, USAF]
  - *Goal - Getting "inside the OODA loop" of the adversary*
- Immunological approaches [Stephanie Forrest 1996, U New Mexico]
- Triage responses – quickly determining what family of malware [Bit-Shred, David Brumley, 2006, CMU]

The Cyber Environment – Trade-Offs

- Other approaches combining Operations Research and System Engineering in order to design cyber systems
- Must automate as much as possible, but human oversight is ultimately required
  - *Automated detection & responses are limited in scope*
  - *Much new malware is continually developed, and capable humans must always oversee cyber systems*
  - *Deep understanding of attacks is needed*
  - *Innovative new strategies must continually be generated*
- So it is all about striking the right balance
  - *Human and machine must work together in complementary roles*

The Cyber Environment - Convergence

- Ultimately, cyber-physical systems will become more and more capable
- Increased level of autonomy and automation must be developed
- The human leader will always be required in order to
  - *Understand, counter, and design complex attacks*
  - *Make operational decisions at critical decision points*
  - *Keep systems under control*
- We will be able to do “More with Less” via automation
- However, the good news is
  - *We will fail to “automate the Human leader out of the job”*

Management Evolution: Operations, DevOps, PostOps*

- 1980s-2000s: System and Network Administrators
  - *Fancy switches (Telecoms)*
  - *Network Operations Center (NOC)*
  - *More recently - Web enabled Services*
- Late 2000s: DevOps
  - *Increased automation and semantic sophistication*
  - *Better coordination between development and operations*
  - *Autonomics and application centric management*
- 2010s Post Ops: Site Reliability Engineering
  - *Address huge growing scale and applications*
  - *"Big Data and Business Analytics"***
  - *Redefined roles and responsibilities*

* Underwood, T. "Google: PostOps, A Non-Surgical Personal Tale of Software, Fragility, and Reliability, Usenix 2013

** Betser, J., Belanger, D., "Architecting the Enterprise via Big Data Analytics", Chapter 1 of "Big Data and Business Analytics", Liebowitz, J. (Editor), CRC Press 2013

PostOps – Site Reliability Engineering (SRE) *

- SRE is a ROLE
  - *SRE team responsible for web SITE applications*
  - *Independent of Development organizations*
  - *Automated SRE software addresses most alerts*
  - *Some escalation to human SRE team members*
  - *If further escalation necessary, engage Dev organization*
- SRE Team performance critical to enterprise success **
  - *Strong team participation and interaction across the enterprise*
  - *Excellent production ethics and problem solving skills*
  - *Building automation and performance monitoring*
  - *Superb Release engineering, capacity planning, SLA execution*

* Underwood, T., "Google: PostOps, A Non-Surgical Personal Tale of Software, Fragility, and Reliability, Usenix 2013

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Cloud and Apps Activity In 60 Seconds…*

11k searches on LinkedIn, 2000k searches on Google. And....

278k Tweets, 104k Snapchat photos shared, 20k new Tumblr photos, 72 hours of YouTube uploads

$83k in amazon sales, 17k transactions on Walmart.com

SREs needed by these enterprises, thousands of job openings on LinkedIn

* Avinash Kaushik https://plus.google.com/+avinash/posts/MGyATu6mBhD

STEM Talent - Science Technology, Engineering, and Mathematics

- How do we cultivate outstanding STEM and SRE talent?
  - *Must get high performance outstanding people*
  - *Solid performers, ethical, reliable, and trustworthy*
- "The Triple Package"* Some groups consistently over achieve, Yale University Law School, Prof Chua and Prof Rubenfeld (in the US):
  1. *A sense of being "special"*
  2. *Continual self improvement*
  3. *Impulse control, delayed gratification – "It's not a dash, it's a Marathon"*
- The above traits are common to members of very different groups who do very well within the United States
- Must capture and retain STEM talent early in grade school in the US
  - *4th grade lose females to STEM, 7th grade lose males to STEM***
  - *Must elevate social status of STEM*
  - *Must insure sufficient supply of qualified talent entering college*
- The soft stuff is the hard stuff!

* Chua, A., & Rubenfeld, J. (2014). *The Triple Package: How Three Unlikely Traits Explain the Rise and Fall of Cultural Groups in America*. Penguin.

** Muller, Carol B., Sally M. Ride, Janie Fouke, Telle Whitney, Denice D. Denton, Nancy Cantor, Donna J. Nelson et al. "Gender differences and performance in science." *Science (New York, NY)* 307, no. 5712 (2005): 1043.

STEM Talent and Cloud Computing in Taiwan

- Dr Yuan-Kuang TU, President, Northern Taiwan Business Group, Chunghwa Telecom, said during his keynote speech in IEEE/IFIP NOMS 2012:

  – *"Chunghwa Telecom is supporting the research of Medical, Streaming, Mobile application, Security, Social Network, settlement and etc. for **47 professors** with 1850 VMs over cloud platforms in 2011"*

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