Ground System Architectures Workshop
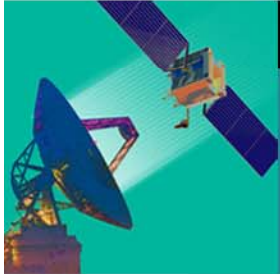
Session 16

Harmonization: Challenges and Opportunities

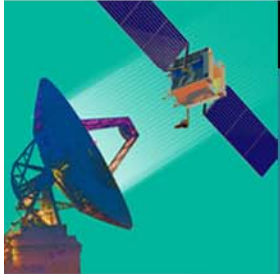## Plenary Session Summary

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# A Decadal Survey: … GSAW 2001

- Success stories
  - Product lines, Java and associated technologies
- Progress being made
  - Quantifying cost-benefit of COTS
  - Interoperability standards
  - Exploring "commercialization"
- New themes
  - Web is changing the space business
  - Security and vulnerability, down-side of interoperability
  - People challenges: how to make space/ground systems "cool" and hire/retain talent?
- Connections to explore
  - Architecture and CMM-i, role of open source
- Terms and quotes
  - Just-in-Time everything
  - Nobody ever thinks about security
  - _Everyone_ is special (get over it!)

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Harmonization / Harmonisation

- Musical notes in tune

- Traffic in Cambodia

- Dissimilar systems serving a common purpose

- Harmonization of people, organizations as well as architectures, data and operations

- Harmonization + connectivity / seamlessness = how ground stations need to work

- Spelled 11 different ways (ESA only!)

- Need to _discover_ commonality first then work towards it

- What's your goal?

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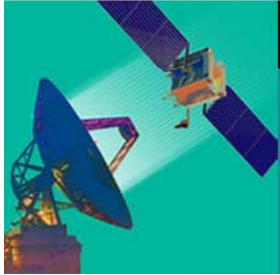
Successes

- GSAW (15th Year)
- CCSDS standards definition, evolution, adoption
- Multi-mission ground systems, and using multiple ground systems
  - ISS Ground System, CubeSats
- AF Space (GPS, MILSATCOM, AFSCN, others)
- JSCC – Joint SATOPS Compatibility Committee, GMSEC
- Eurospace and E2E Technology Processes

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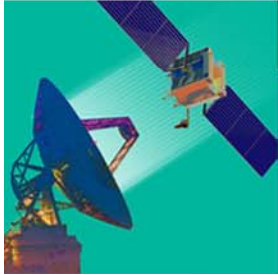
Themes

- Success creates new challenges
  - Flood of data, information
  - Cross-domain security

  … new opportunities
  - Need to fuse information into knowledge
  - How to harness surplus ground system capacity

- Applied Standards, Technologies
  - Successful web-based architectures, SOA appropriately applied
  - Standards (OSGi, WS-*, CCSDS, XTCE, DTN, …)
  - Commercial, IT solutions (secure cloud, virtualization)
 - Careful use of Open Source

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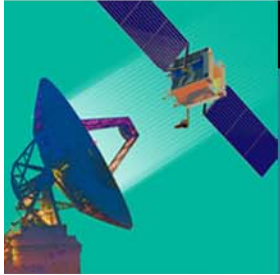
Downticks

- Budgets
  - …and no relief on expectations
  - Total cost at completion heavily driven by ground (challenge)
  - Driving efficiencies (upticks)
    - Cost-sharing, federation, automation, test / operations synergies

- Science, Technology, Engineering, Math –> the next generation
 - Not new issue, but vigilance and investment needed (e.g., NASA)

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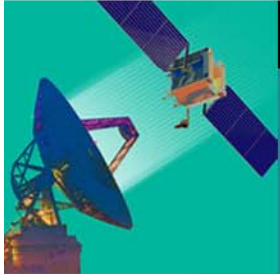
Upticks

- Government / civil / international collaboration
- Small Sats
  - Launching now, accelerating numbers
  - Creative ground system, network solutions
- Situational Awareness
  - <u>Space</u>: Growing # of objects. Need shared and more accurate orbit data
  - <u>Ground</u>: Multiple missions, fewer operators, support increased availability, timely notifications (e.g., conjunctions)
- Blurred space-ground architectures
  - Common processing platforms, operating systems, interfaces
  - SPA extended to ground, IP (GIG) extended to space, HAIPE
- Cyber Security
  - Not new, but sharper focus on space systems
 - C&A of spacecraft, so ground system can protect it

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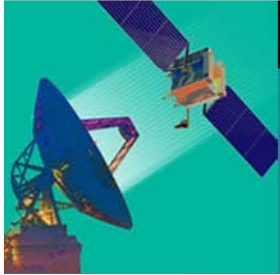
…the more they stay the same

- Effective communication of architectures
  - Layered views / architectures, DODAF
  - Defining common set of elements, service domains
  - The importance of the right architecture tool
  - Cautious use of bridges (edge-connectors) to legacy systems

- KISS !

- Standards
  - Addressing all layers up the stack (CCSDS)
  - Better understanding of trade-space choices (Frameworks, MOM, W*, CORBA)

- SOAs, Net-Centricity
  - Not new, nor universal
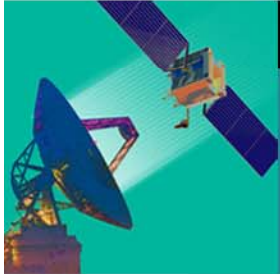 - We're learning how/where to use, balance latency/trust/access

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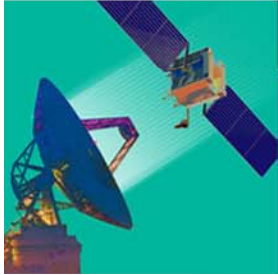
Game-changers

- Considering a biological model approach to the problem
  - Processing volumes, with speed (is metadata kept with information?)
  - Establishing trust, cooperation, interconnectedness
  - Ground System therapist?

- Plug-and-Play
  - Ground architecture development
    - Vision 2016 Mission Ops App Store example
  - Adapters for capability extension, evolution
  - Extended SPA standards to ground

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Quotable Quotes

"..the Built-by-Pharaoh Model, Built-by-Democracy Model (extremes)
GSAW brings the Ground Systems community together."

"Flexibility in Space Systems is on the Ground"

"We live in a world of Excessiveness. Have we over-complicated missions?"

"Developers weren't distracted by Facebook." (when legacy systems were built)

"CCSDS is not just packet TLM anymore"

""Don't bet against IT"

(Legacy systems) "Cylinders of Excellence"

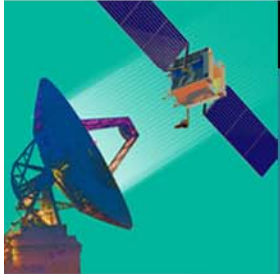"We need to challenge each other all the time. When we become complacent, we start to decay."

"Let Mission Ops Services do the boring part of the job, so you can focus on the smart part"

"Space Systems are disadvantaged IT systems"

"Lemonade stand at $210 a cup, and we'll name a TR module after you."

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Take-aways

- What resonated with you?   Did anything strike a tune?

- Once in harmony, what do we do with the information?
  - Tune in next year Feb 27-Mar 1 for GSAW 2012:

> ***"Expanding Access to Information."***

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