



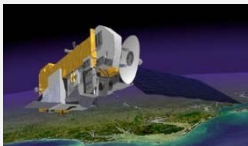
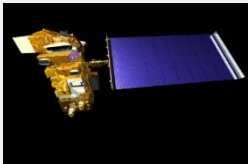
## Ground System Architectures Workshop

"Embracing the Rapid Rate of Change"

Renaissance Los Angeles Airport Hotel  
Feb. 29–March 3, 2016



Session 11F:  
Embracing Change via the Use of Service-Based Frameworks and Products in an Enterprise



Working Group 11F

# Opening Comments

# NASA

Planning for NASA's Future Ground Systems



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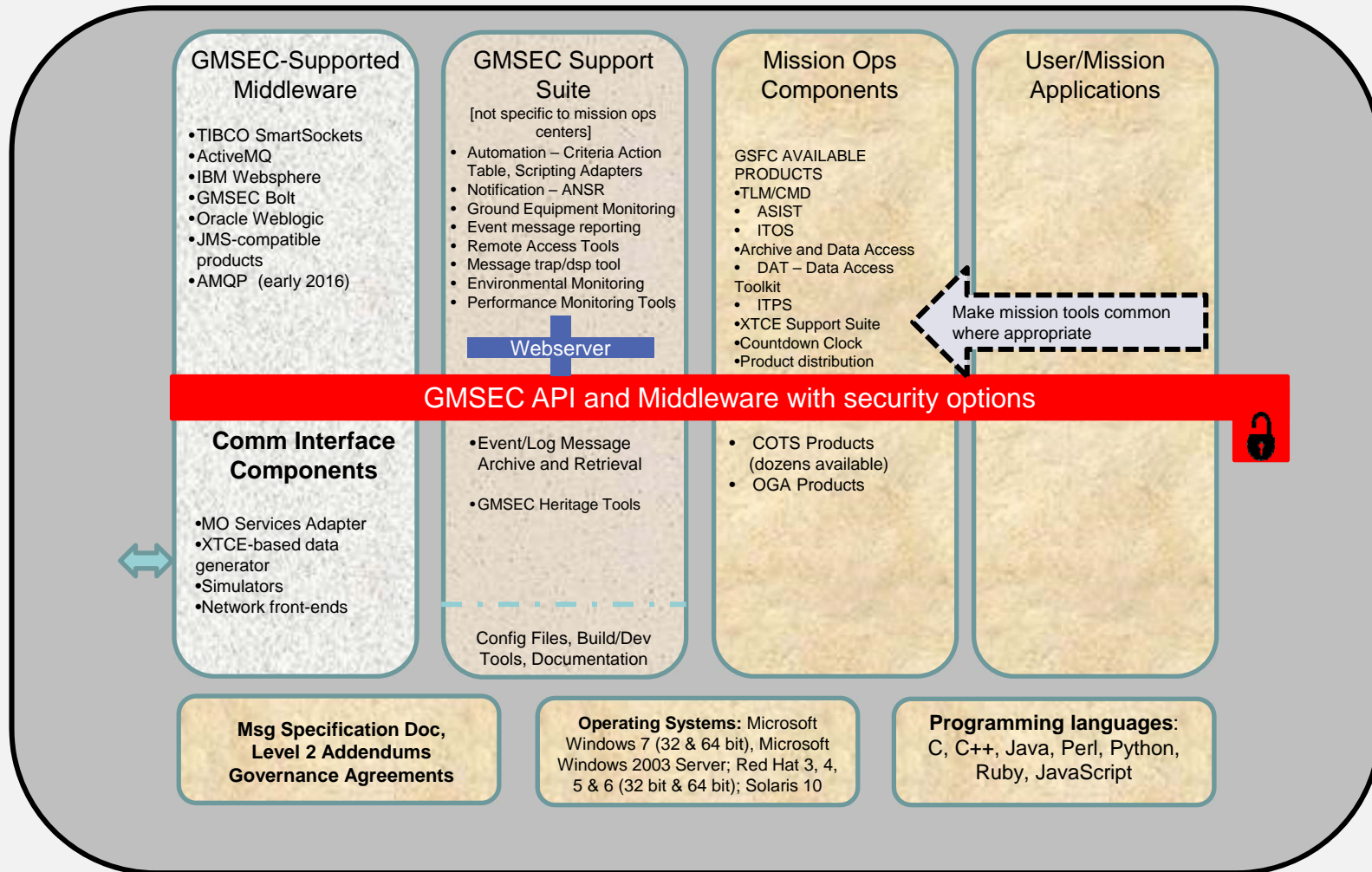
# NASA GSFC has extensive ground systems capabilities

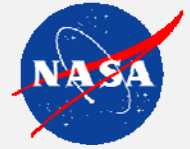


- We have moved mostly to multi-mission control center facilities and single-shift operations
- We are the home of GMSEC – an open architecture framework for mission operations
  - GMSEC is used on many GSFC programs and a numerous other NASA- and non-NASA facilities.
  - Many COTS vendor products are “GMSEC compatible”
  - GMSEC API 4.0 coming in April 2016, other capabilities being added in 2016
- We have existing low cost in-house telemetry and command systems and also use COTS products.
- We continue to invest in new technologies for mission operations
  - Cloud computing, web services, software-defined networking, rapid deployment concepts
  - Log message data mining and display, automation
  - Increased cyber threat mitigation
  - Use of XTCE for telemetry and command definitions
  - Cubesat/smallsat/constellation support



# GMSEC Architecture





But Goddard Space Flight Center is only 1 of 9 NASA Centers with successful mission OPS capabilities.

**So what should NASA do?**

Is a NASA-Wide common approach the answer?

# NASA is working to improve mission operations capabilities

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- New NASA Agency-wide initiative is focused on reducing duplication and increasing efficiency.
  - Identified 9 NASA Centers that perform mission operations
    - Each is successful, each has evolved an approach and set of common tools
    - Each has experience that can benefit the others
  - Determined that mission operations accounts for more than the 10% of a mission's budget that we had used as a rule-of-thumb
    - The old 10% number did not account for mission extensions and the full supporting cast (security, networks support, etc.)
    - Given the larger %, it became clear that mission ops is an area where new efficiencies really could make a difference in total mission cost – so let's pay more attention to it
  - Subteams formed to make recommendations on common software, standards, systems engineering, infrastructure, training, and more.

## Future NASA Direction – Let's first ask some questions



- As NASA plans its future mission operations strategy, we are first asking ourselves some basic questions.
  - What are our goals and objectives? [so we can assess the new ideas]
  - What are the factors/challenges that hinder change? [so related issues can be addressed]
  - What approaches are already in place or being tried elsewhere that we could leverage?
  - What does NASA's mission operations software inventory look like today?
  - NASA is not even the largest U.S. government space organization. Where should we look for commonality?
    - Within each Center? (some are better than others right now)
    - Across missions of a certain class? (planetary, orbiting, and manned flight have many unique requirements)
    - Across all of NASA? (this is the current study team assignment)
    - With the DoD? (they are working on similar objectives across multiple organizations)
    - With commercial product vendors? (there are common-practice ways to do things)
    - With commercial space and Universities? (rapid innovation is coming from these sectors)
    - With international partners or Agencies? (international standards are being developed for mission operations services, ESA has gone to "Common Core" software)
  - Transition will take years. Should we start with the basic model of each Center in charge of their own mission set using their own systems? Could instead jump to thinking about full enterprise model.

## 3 Questions for Working Group Discussion

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### 1. Do we think small or large?

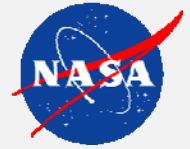
- a. Should we plan on a shared component catalog and common products?
- b. Should we develop a NASA-endorsed common system/architecture?
- c. Should we move towards a NASA shared enterprise with distributed services?

### 2. Push or pull?

- a. Should the common solutions be required? (PUSH)
  - Could be specified in RFPs; required for in-house efforts
- b. Should “golden nugget” capabilities from across NASA be made available to all Centers and missions so they can better create efficient systems? (PULL)

### 3. Technology and processes or people and awareness?

- a. Is the key component for success the ability to develop a flexible common-use system to meet the needs of many organizations?
- b. Is the need for policies and procedures for moving to the new paradigm the limiting factor?
- c. Is it really about changing culture, raising awareness, and encouraging collaboration and teamwork across organizations?
- d. Can we assign percentages to these 3 area to reflect the emphasis we should place on our strategy meetings and planning?



**BACKUP**



# Common Ground System Efforts to Watch . . .

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1. NASA's Agency-Wide Mission Operations Capability Team
2. NASA Center-level common ground system development efforts; web-based cloud services
3. Ball Aerospace has made their entire ground system available as open source!
4. ESA's common software model is deployed across many space agencies, manufacturers and parts suppliers
5. Air Force, Naval Research Lab, NASA, and others all working together to share components and match to a framework architecture. Referred to as EGS – Enterprise Ground System.
6. NOAA has reorganized to create the Office of Satellite Ground Systems (OSGS) to move towards an enterprise approach. Layers for infrastructure, common ground system capabilities, and mission-unique.
7. CCSDS has been working on a mission operations services (MO Services) set of standards for over 12 years.
8. COTS vendors moving forward with multi-mission and remote access capabilities and the idea of providing individual components for projects like EGS or GSFC's GMSEC.
9. Commercial Space industry is exploding with new ideas
10. Low-cost smallsat and cubesat innovations may change how we do larger missions

**We've been told that it looks like everyone has marching orders and are moving ahead,  
. . . but we are marching in a lot of different directions!**