



Goddard Mission Services Evolution Center “GMSEC”

GMSEC – A Ground System Framework

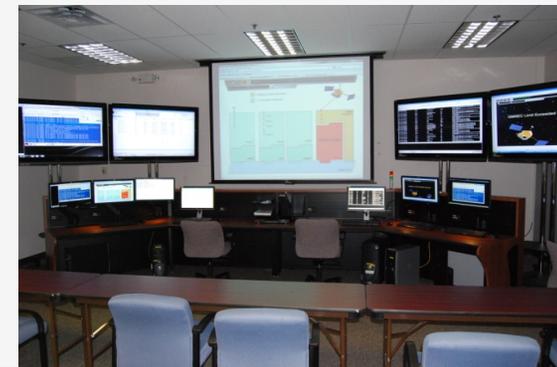
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Matt Handy

NASA Goddard Space Flight Center

Software Engineering Division

Matthew.handy@nasa.gov





Introduction and Background

Introduction



The Goddard Mission Services Evolution Center (GMSEC) is a proven satellite mission operations center software framework for use at the mission, fleet, or enterprise level.

We've had close collaboration with others to ensure its success and increase its value and broad use.

- Command and Control system product vendors
- Major integration contractors
- Other NASA Centers
- Other U.S. government space organizations

GMSEC is referred to as **CompatC2** across much of the DoD.

Current efforts focus on security and use of GMSEC across an enterprise.

GMSEC Background and Introduction



GMSEC was established in 2001 to coordinate ground and flight data systems development and services at GSFC. It has been operational since 2005.

- Goals
 - Simplify development, integration and testing
 - Facilitate technology infusion over time
 - Support evolving development and operational concepts
 - Allow for mix of heritage, COTS and new components while avoiding vendor lock-in

- Concepts
 - Standardize interfaces – not components
 - Provide a middleware infrastructure
 - Allow users to choose – GMSEC doesn't decide which components are best or dictate which components a mission must use. It's the mission/user's choice!

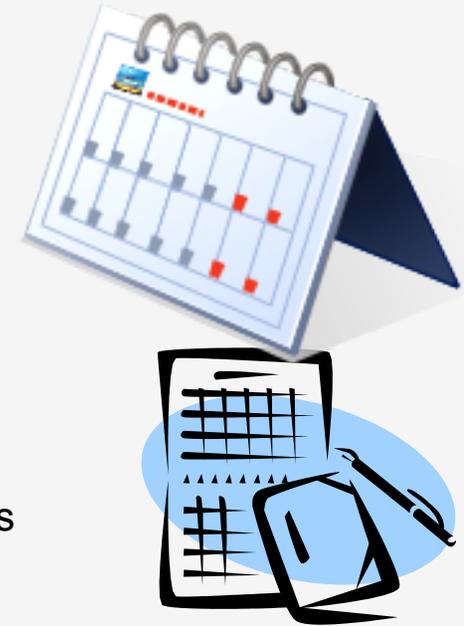
- Some say it is like what Apple has done – created a simple interface standard and communications approach and let others develop compatible tools beyond anyone's expectations.

Other NASA Centers and U.S. government space organizations are now recognizing the benefits of these simple concepts and are each working with NASA/GSFC's GMSEC Team.

Maturity and Readiness: Yearly Progress



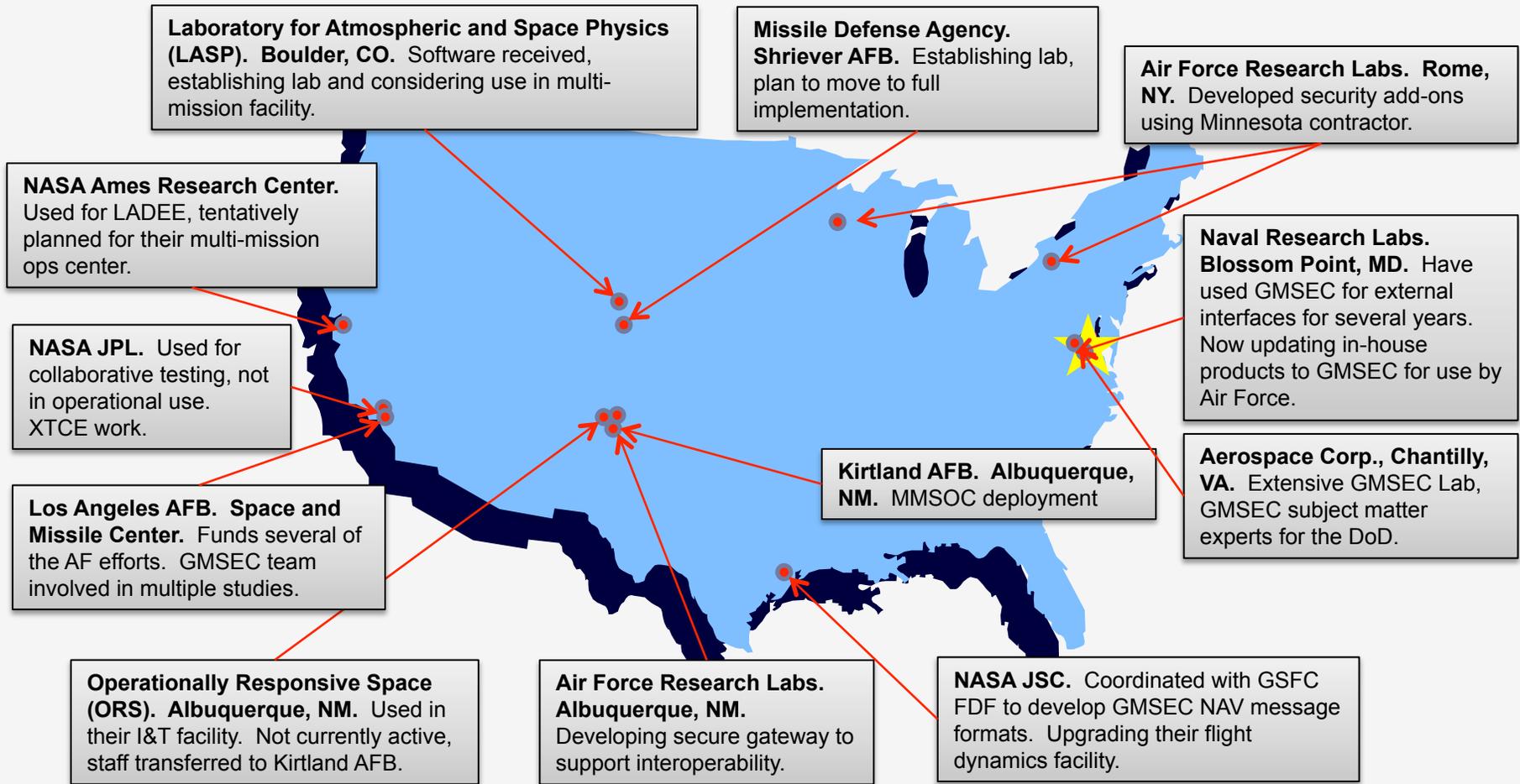
- FY02 – Architecture definition (paper studies)
- FY03 – Lab Created
 - Proof of concept prototypes; Initial message standards
- FY04 – Development of API, test environment & operational tools
- FY05 – First operational missions
 - Labs established at other NASA Centers
 - Exploration Initiative moves towards GMSEC concepts
- FY06 – Expanded operational use. First new mission launch
 - Exploration prototyping across other NASA Centers
 - Made available through NASA Open Source
- FY07 – Stable Operational Use
 - Spinoff initiatives started – FDF reengineering, Cx Labs/interfaces
- FY08 – New Maturity; CMMI Level 2 certification
 - Expansion to Other Government Agencies (OGA's)
- FY09 – Collaborations with government agencies, vendors, contractors
- FY10 – Cross-Agency demonstrations, involvement with Joint SatOPS Compatibility Committee
- FY11 – Security enhancements, vendor scenario demonstrations
- FY12 – Enterprise and Security work. AF begins development for operational use.
- FY13 – Increase support of AF work. Begin Space Geodesy Project Demonstration Development
- FY14 – Support increased number of AF projects
- FY15 – Begin technical refresh effort





GMSEC Community

GMSEC's Extended Community

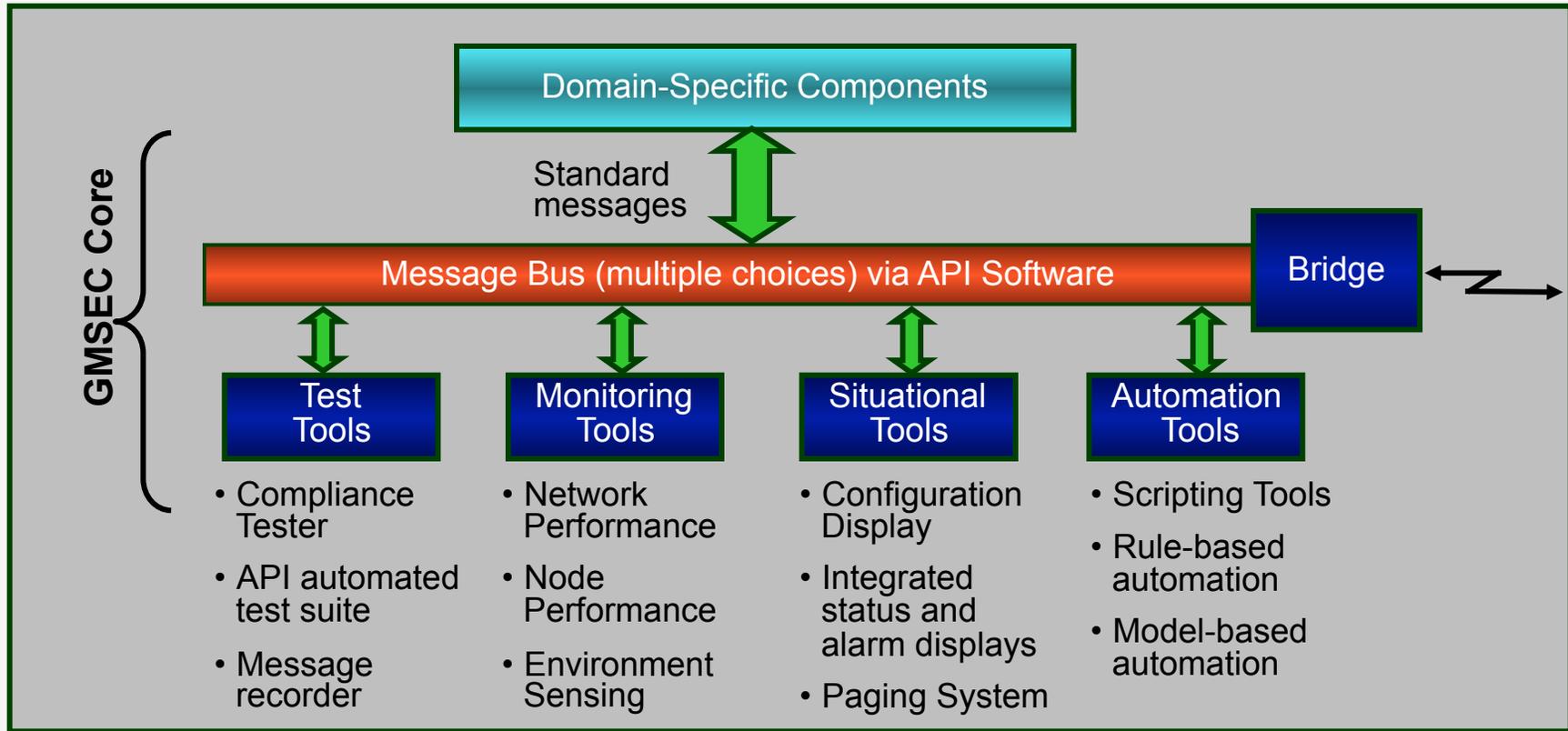


The GMSEC Team is also active with the multi-Agency Joint Ops Compatibility Committee (JSOC) and multiple conferences. Support is given for multiple external ground system studies. Interact regularly with industry's vendor community and standards committees.



GMSEC Architecture

Core GMSEC System Supports any Domain



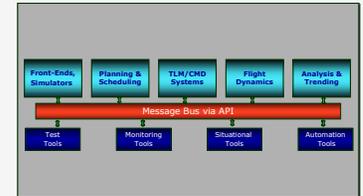
GMSEC's common service tools bring immediate value to any system.



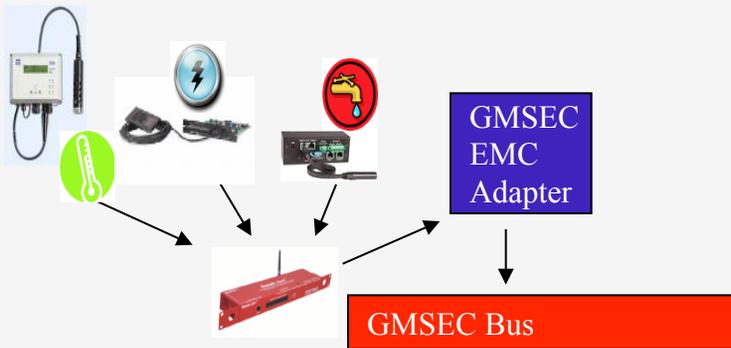
Why this Architecture?

The architecture enables new approach for automation

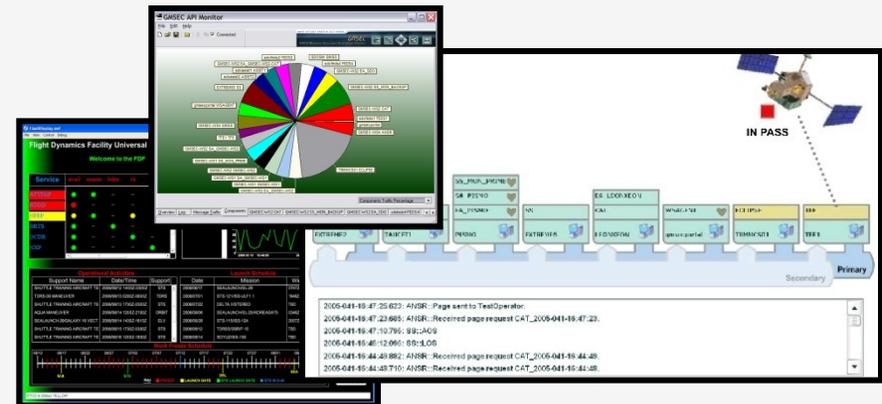
- Can “listen” for status from all components → situational awareness
- Can direct actions of component → system-wide control
- Recognize status and respond → event-driven automation



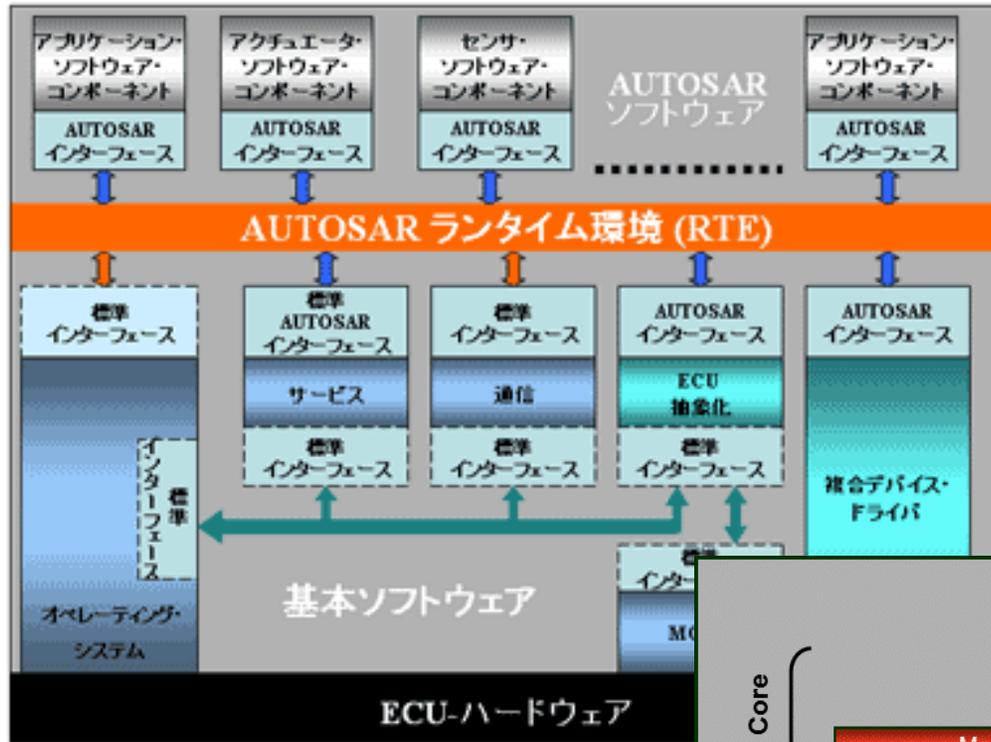
GMSEC allows for monitoring of temperature, humidity, disk usage, etc. for GSFC control centers.



New tools show network performance, system configuration, and processing status.

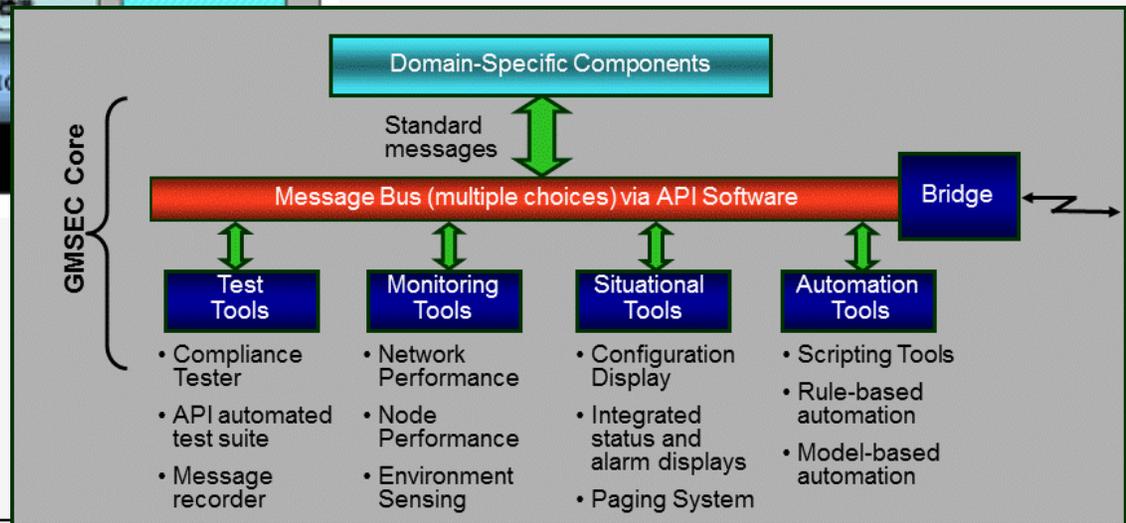


Others also see the value of GMSEC



JAXA has studied GMSEC and met with the GMSEC Team at GSFC to gather details. We limited discussion to generally available information.

See any similarities between the GMSEC chart below and JAXA's system now under development (left)?



GMSEC Framework



- The GMSEC Framework consists of the GMSEC API, standardized GMSEC messages, and an underlying middleware to interface with other components.
 - Standard API available as NASA Open Source.
 - “Secure API” available for government use.
 - GMSEC Architecture Document and Message Specifications available upon request.
- GMSEC supports a number of programming languages, COTS and GOTS middleware products, and operating systems.
 - **Programming languages:** C, C++, C#, Java, and Perl
 - **Middleware Products:** TIBCO SmartSockets, Apache ActiveMQ, IBM WebSphere MQ, GMSEC Bolt, JMS Capability, RabbitMQ, ZeroMQ
 - **Operating Systems:** Microsoft Windows 7 (32 & 64 bit), Microsoft Windows Server; Red Hat 5, 6, & 7 (32 bit & 64 bit); Solaris 10



Benefits

Top Reasons to Use GMSEC



1. Automation for cost reduction is the #1 selling point
2. Many commercial command and control products are now GMSEC compatible – increasing choices for the missions
3. Significant reduction in integration time
4. Components added/upgraded without impacting existing system; can support parallel testing
5. Ideal for using multiple small distributed development teams/vendors
6. New concepts emerging for small independent components that integrate with the bus and provide immediate benefits
7. Standard message approach provides collaboration possibilities with other organizations
8. Enables new approach for maintenance of very long-term systems