
GSAW 2003

Challenges & Opportunities

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Admiring the Problems

- **Spectrum of space - ground balance – vertical balance**
 - **Simple space & complex ground**
 - **Robust space, autonomous operation, on-board processing and less complex ground (perhaps)**
 - **Driven by mission needs and robustness requirements**
- **Degree of system of systems integration - horizontal balance**
 - **Stand-alone R&D system**
 - **Integrated MGS for multiple missions**
 - **Integration capabilities into system-to-system architecture**
 - ✓ **Sensor-to-shooter**
 - ✓ **Transformation Communications System**
 - ✓ **Space as a component of a larger system**

Admiring the Problems (Con't)

- **Complexity of systems of systems problem not well understood**
- **Unable to define interactions at all the interfaces**
 - **Non-linear complexity growth**
 - **End to end system engineering vital**
 - **Testing must be robust**
- **Science and tools (e.g. M&S) need to be improved**

Centralization vs. Distributed

- **Peace-time efficiency drives centralization**
 - **In the extreme, totally centralized**
 - ✓ **One controls complex - many missions**
 - **AFSCN - TT&C for many missions – the history**
 - **Concentration of assets creates vulnerability**
- **Robust designs consider distributed and/or diverse ground nodes**
 - **One MGS - one mission - repeated**
 - **Distributed MGS, now enabled by technology**
 - ✓ **Distributed TT&C and/or distributed mission processing or mission control**
 - **Includes on-board processing and multiple user processing and/or control nodes**

Centralization vs. Distributed (Con't)

➤ **Balanced approach**

- **One MGS - several missions**
- **One MGS - one mission with backup**
- **Two MGS's - one primary plus backup mission at each**
- **Many combinations possible**
 - ✓ **MGS with factory backup and/or AFSCN**
 - **TT&C only (keep the birds alive)**
 - **Mission only**
 - **TT&C and Mission**

A Way Forward

- **Standards – Need some, but not too many**
- **Web-based architecture example**
 - **Presentation - HTML, WML, XML**
 - **Transport – TCP/IP, HTTP, WAP**
 - **Security – SSL, LDAP, WAP**
 - **Applications – JAVA, Servlets, JSP, EJB**
 - **Integration – XML, Messaging, SOAP, UDDI**
- **Front End Infrastructure – quick access to data**
 - **Edge servers connect to web services, intranet, extranet**
- **Mid-tier Infrastructure – flexible & dynamic**
 - **Edge servers connect to directory services, web presentation servers, web apps servers**
- **Back End Infrastructure – robust, stable, secure, scalable**
 - **Transportation servers, data servers**

Integration Ideas

- **Integrate only where needed, not at all interfaces**
 - **Integration is costly, effect must justify the \$**
 - **Challenge many on many requirement– everyone wants everything**
- **Integrating everything is like solving world hunger**
- **Integrating and fusing data for ISR - great place to start**
- **User doesn't care where data comes from - one terminal**
- **Space platforms need to be better integrated with other platforms**
 - **UAVs, A/C, Sea borne, land based**
- **Easy to say, hard to do affordably**
- **Lack of innovation and organization structure hinder progress**

Balanced Approaches

- **One MGS - several missions**
- **One MGS - one mission with remote backup**
- **MGS pair - one primary plus backup mission at each location**
- **Many technical combinations possible, organization limits combinations**
 - **MGS with factory backup and/or AFSCN**
 - ✓ **TT&C only (keep the birds alive)**
 - ✓ **Mission only**
 - ✓ **TT&C and Mission**

Security

- **Design in, adding later is expense**
- **Requires near continuous process for IA, etc**
 - **Determine what needs to be protected from what threat**
 - **Assess vulnerabilities**
 - **Fix what you can afford**
 - **Monitor the gaps – repeat the process**
- **Vulnerabilities combines likelihood of the threat w/ susceptibility**
 - **Susceptibility combines the ability to avoid attack and the ability to survive the attack**
- **Awareness- must be able to rapidly detect attack**
- **Response – must be able to rapidly defend against attack**
- **Any bullet can kill you world**

Robustness

- **Protection vs risk management- varies by system and mission**
- **Tailored minimum level of robustness for each system**
- **Independent check and/or test**
 - **At each acquisition milestone**
 - **Periodically during ops**
 - **Hold PM accountable for performance and robustness**
- **Train – organized – equip**
- **People, process, technology**
- **We can do better**

Flexibility

- **Future is unknowable**
 - **Design measurements & feedback into system**
- **COTS – Who's COTS?**
- **Loosely couple objects**

Summary

- **You have a tough challenge**
 - **More complex, not enough \$**
- **Technology is on your side**
- **Vertical and horizontal balance unique for each system**
- **Re-capitalization of systems - great opportunity**
- **Be open to innovation**
- **Ground is key to flexibility**

Discussion ?