

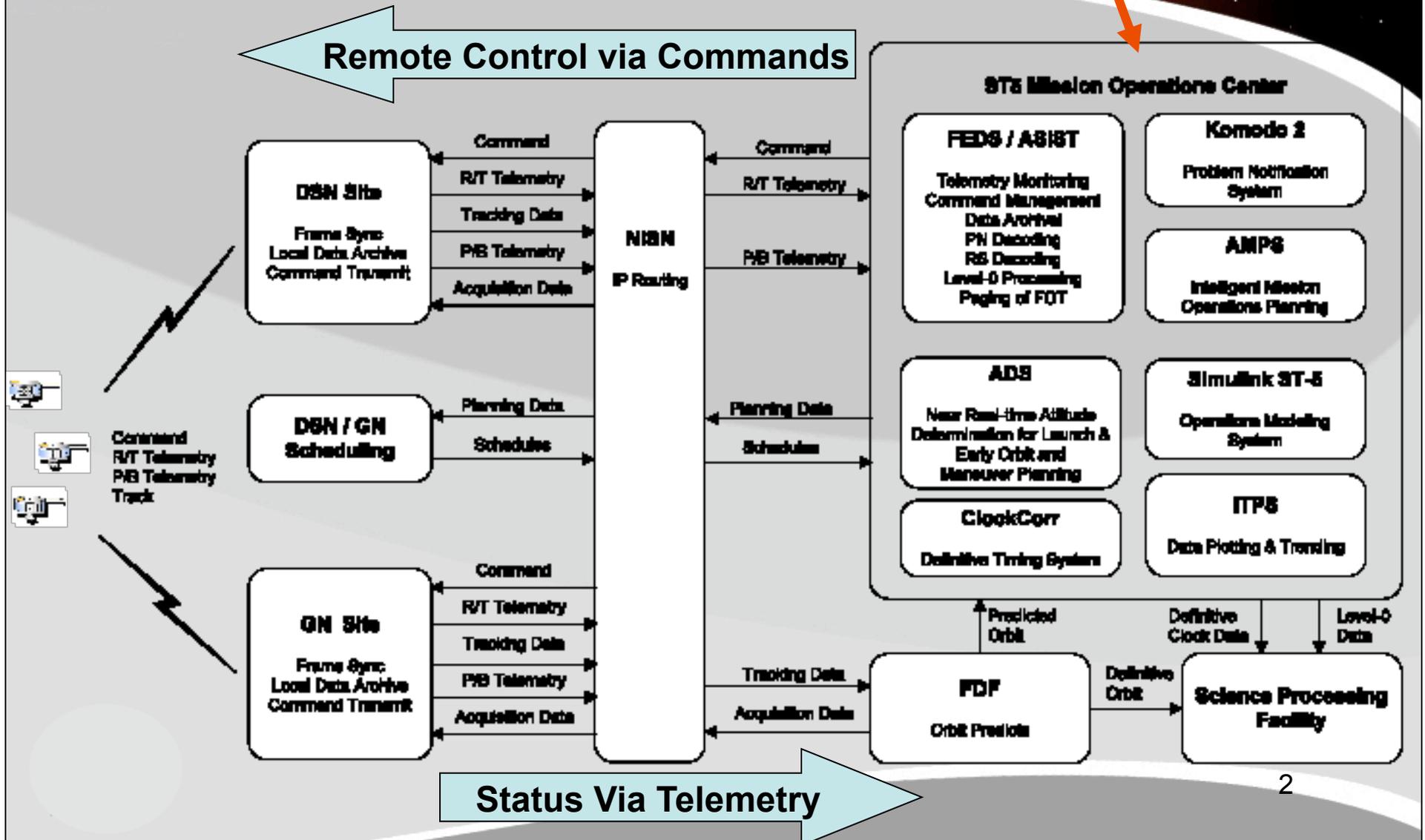
Evolving Command and Control Paradigms for Science and Exploration Missions

presented by Dan Mandl

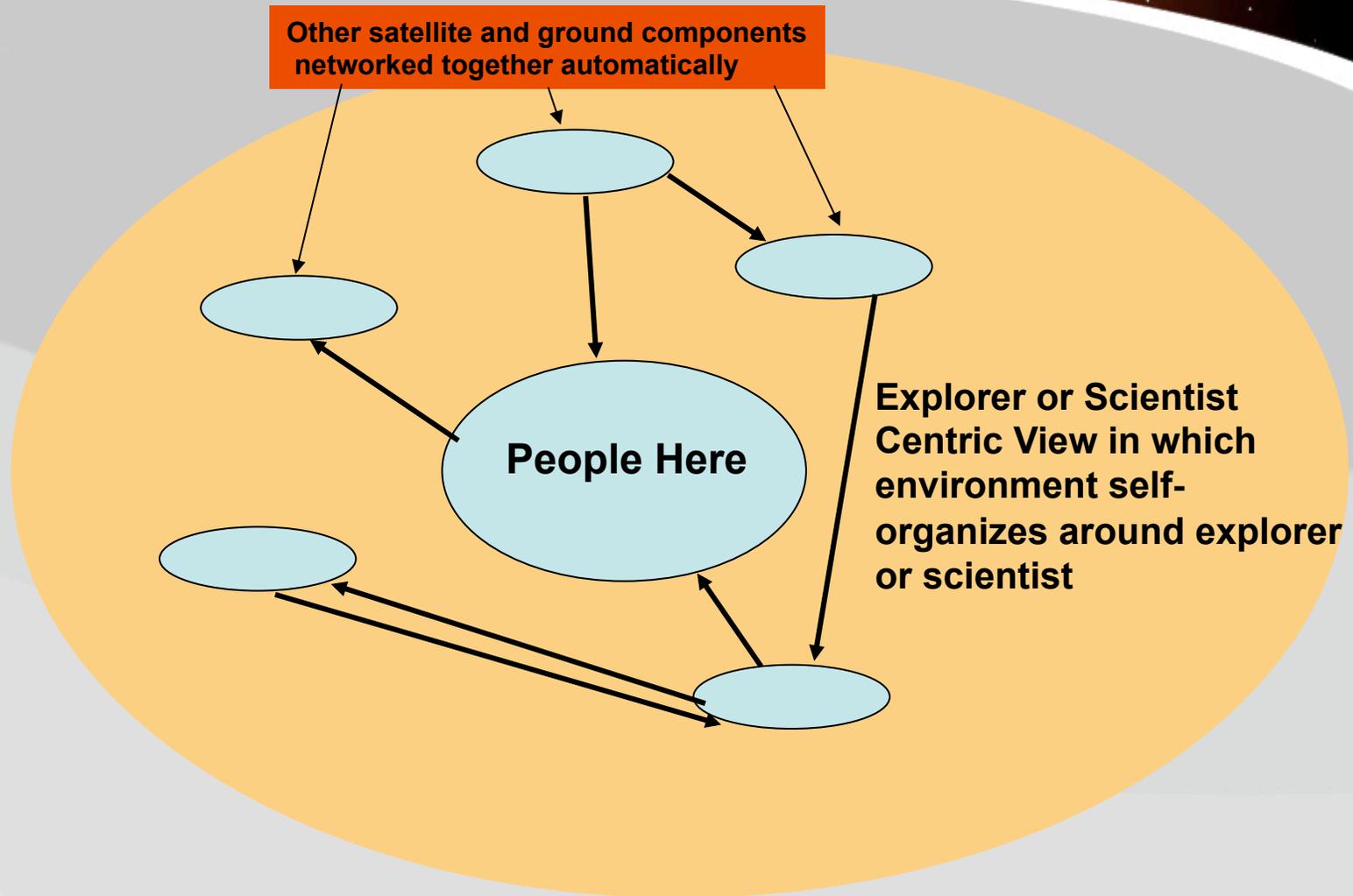
IS&T Colloquium
September 14, 2005

Traditional Command and Control Architecture

People Here



Future Command and Control Architecture





RED RIDGE MOUNTAINS

UNKNOWN/UNUSUAL OBJECT

- MAPS
- FEATURE OVERLAY
- TOPOGRAPHY
- LINE OF SIGHT PROFILE
- CONTOUR PROFILE
- AERIAL
- SURFACE DATA
- SUB-SURFACE DATA
- GRAPHICAL FEATURE (AERIAL)



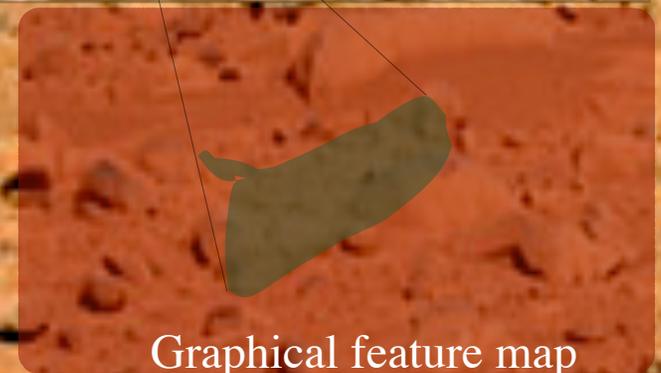
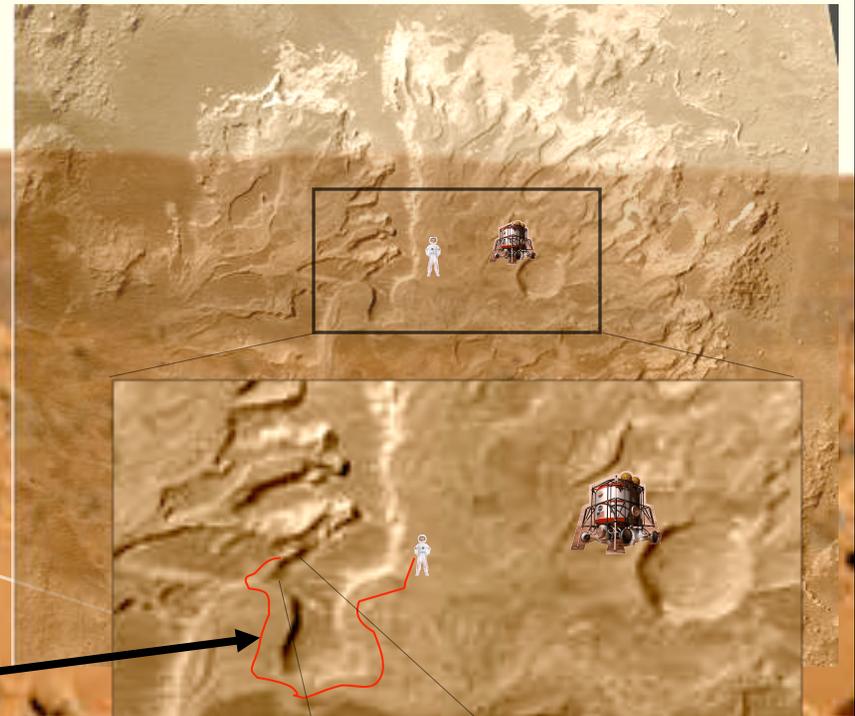
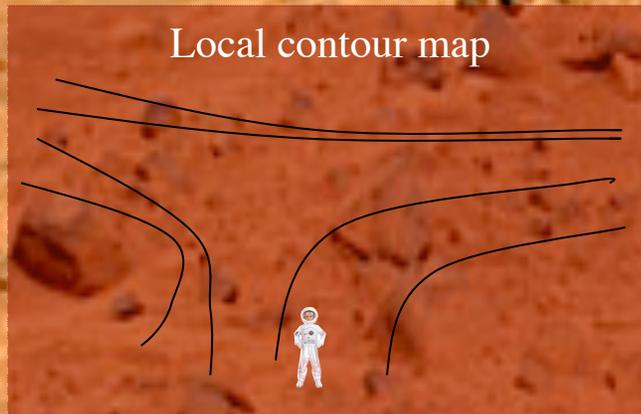
POTENTIAL HAZARD:

- Loose dirt, **deposited last 24 hrs**
- Walking possible
- No vehicle
- Searching for alternative path...

Line of sight topographic profile

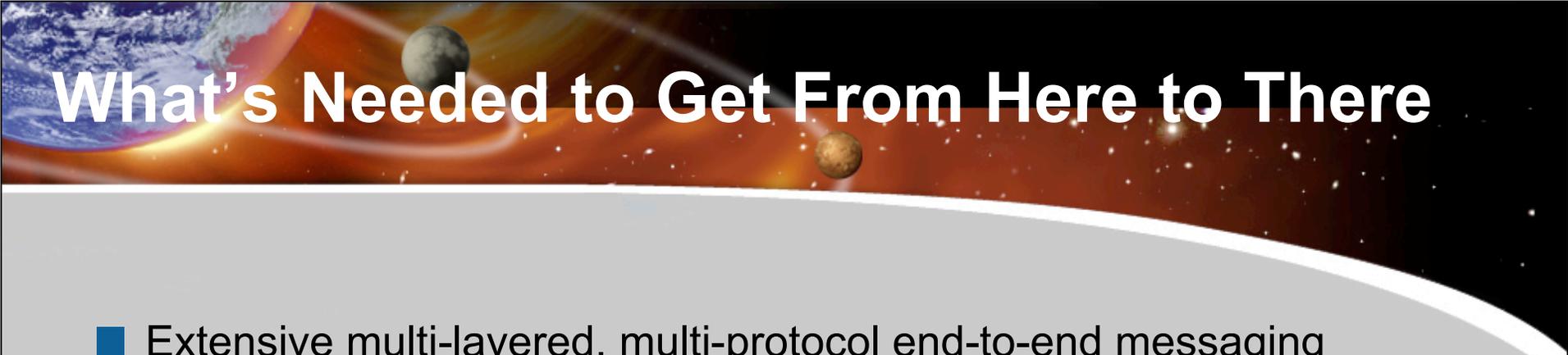


Local contour map



Graphical feature map

Explorer's Visor Heads-Up Display

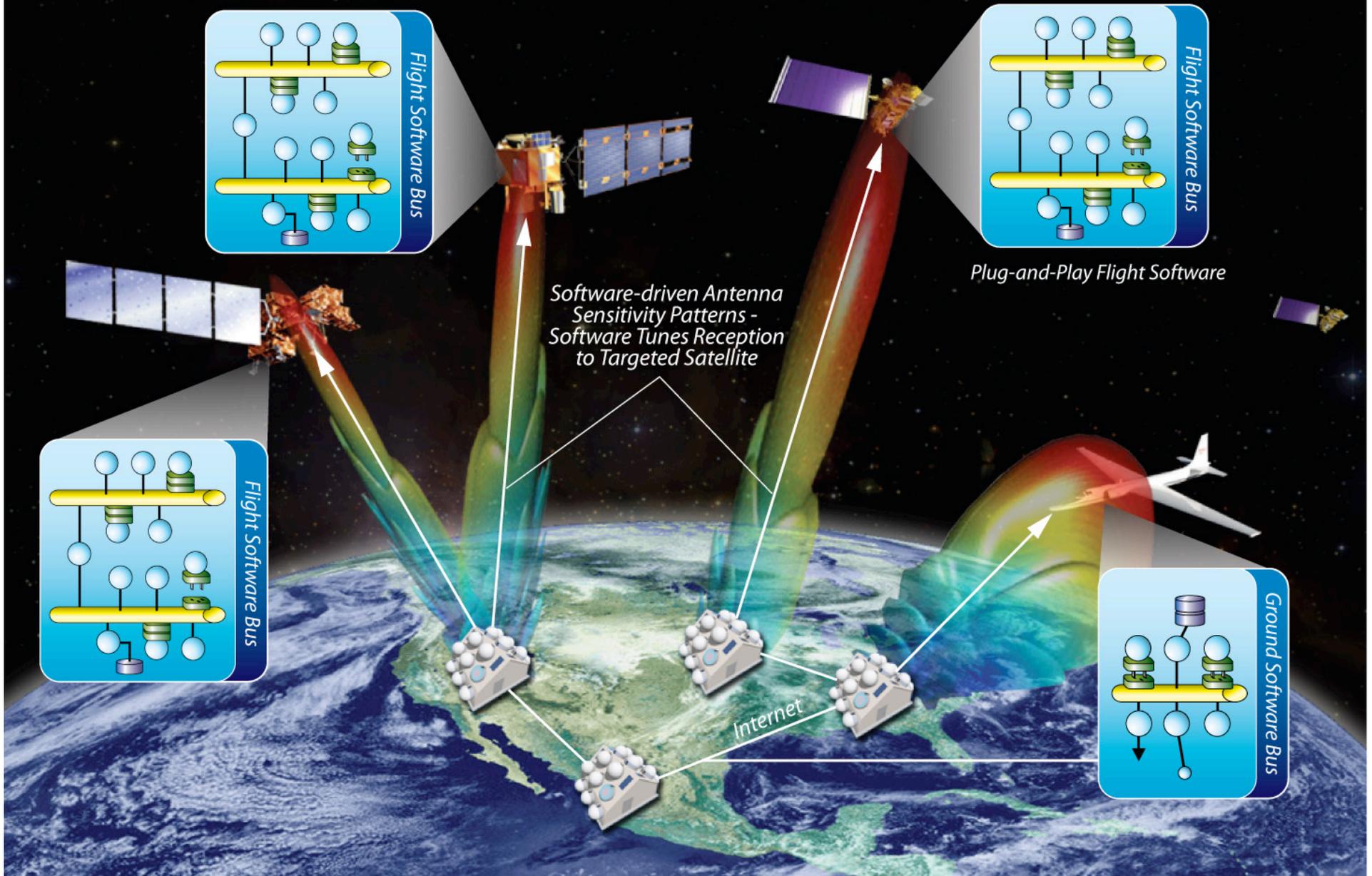


What's Needed to Get From Here to There

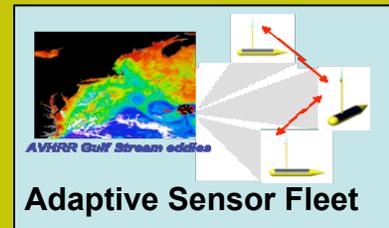
- Extensive multi-layered, multi-protocol end-to-end messaging communication architecture
- Autonomy software
- Inexpensive technology infusion approach to infuse new capabilities
- Next slides show some ongoing efforts to evolve towards these goals

Vision to Enable Sensor Webs with "Hot Spots"

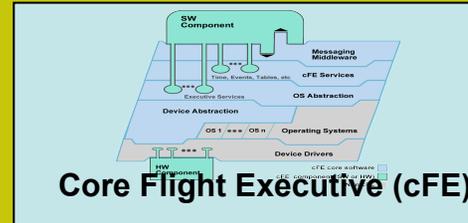
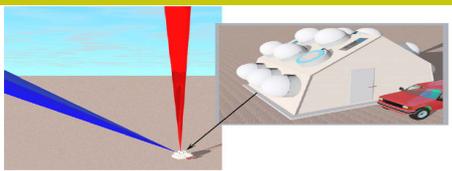
Sensor Web Experiments, Event-driven Observations, Onboard Autonomy



A Technology Pipeline for Sensor Webs as a Pre-cursor to the Interactive Explorer

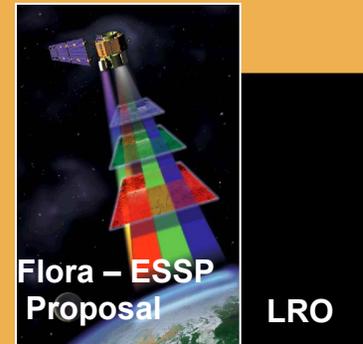
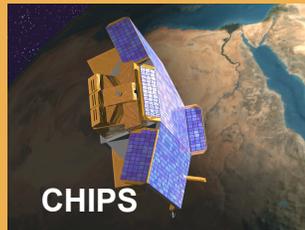


Pathfinder Activities

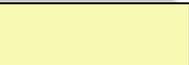


Communications Infusion

Autonomy Testbed



Sensor Web Capability Infusion Path



Funded

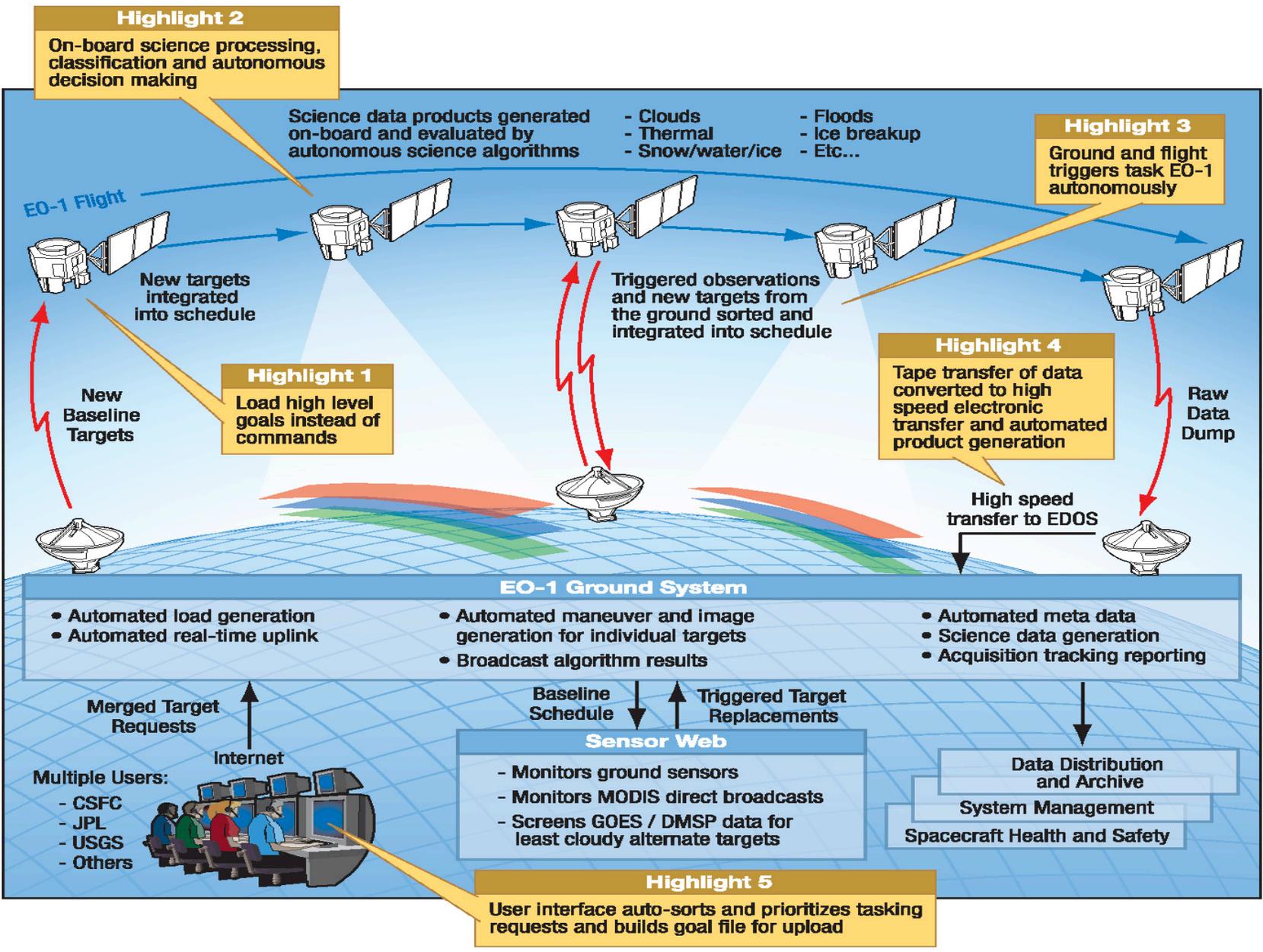


Partially
Funded

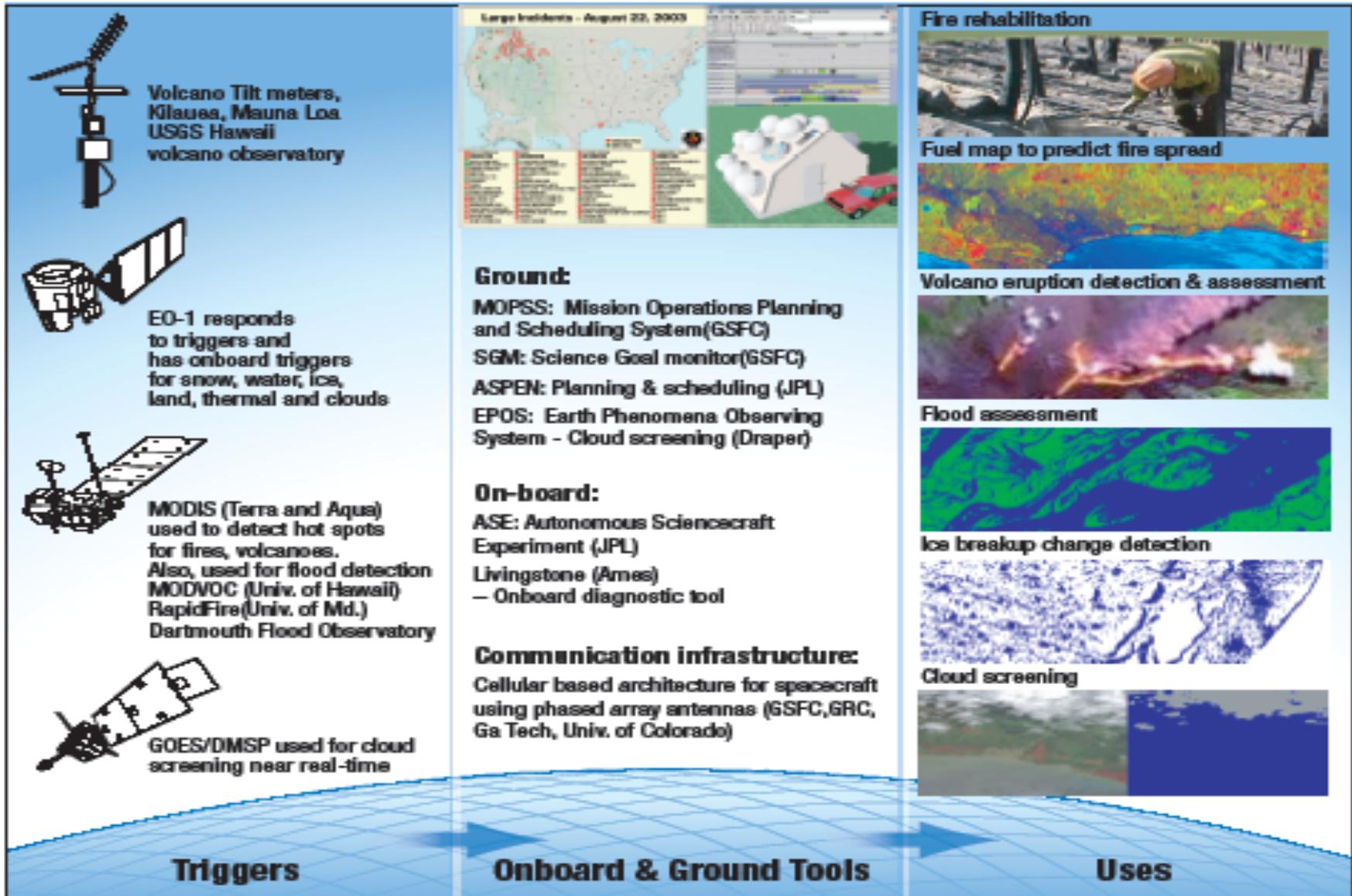


Proposed

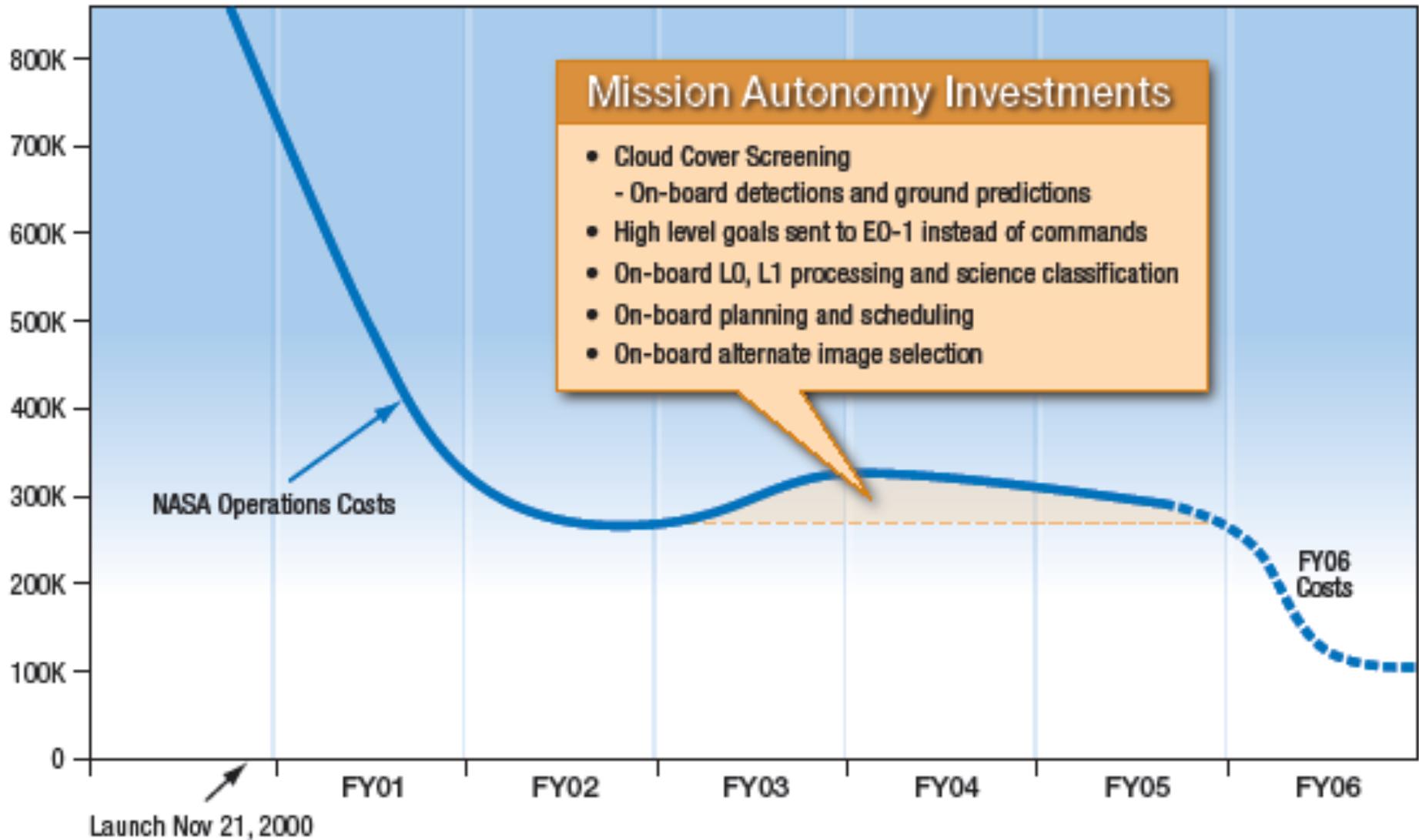
EO-1 Autonomy



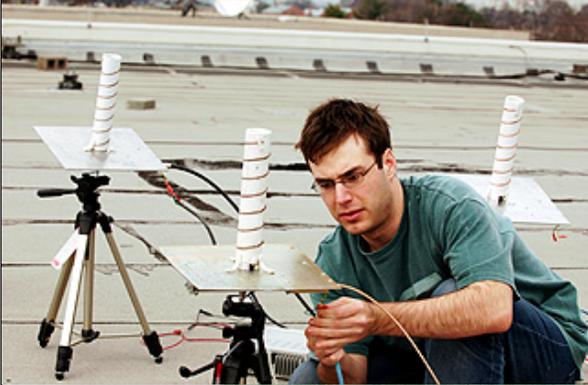
EO-1 Sensor Web Experiments Conducted



Real Benefits From EO-1 Autonomy and Automation

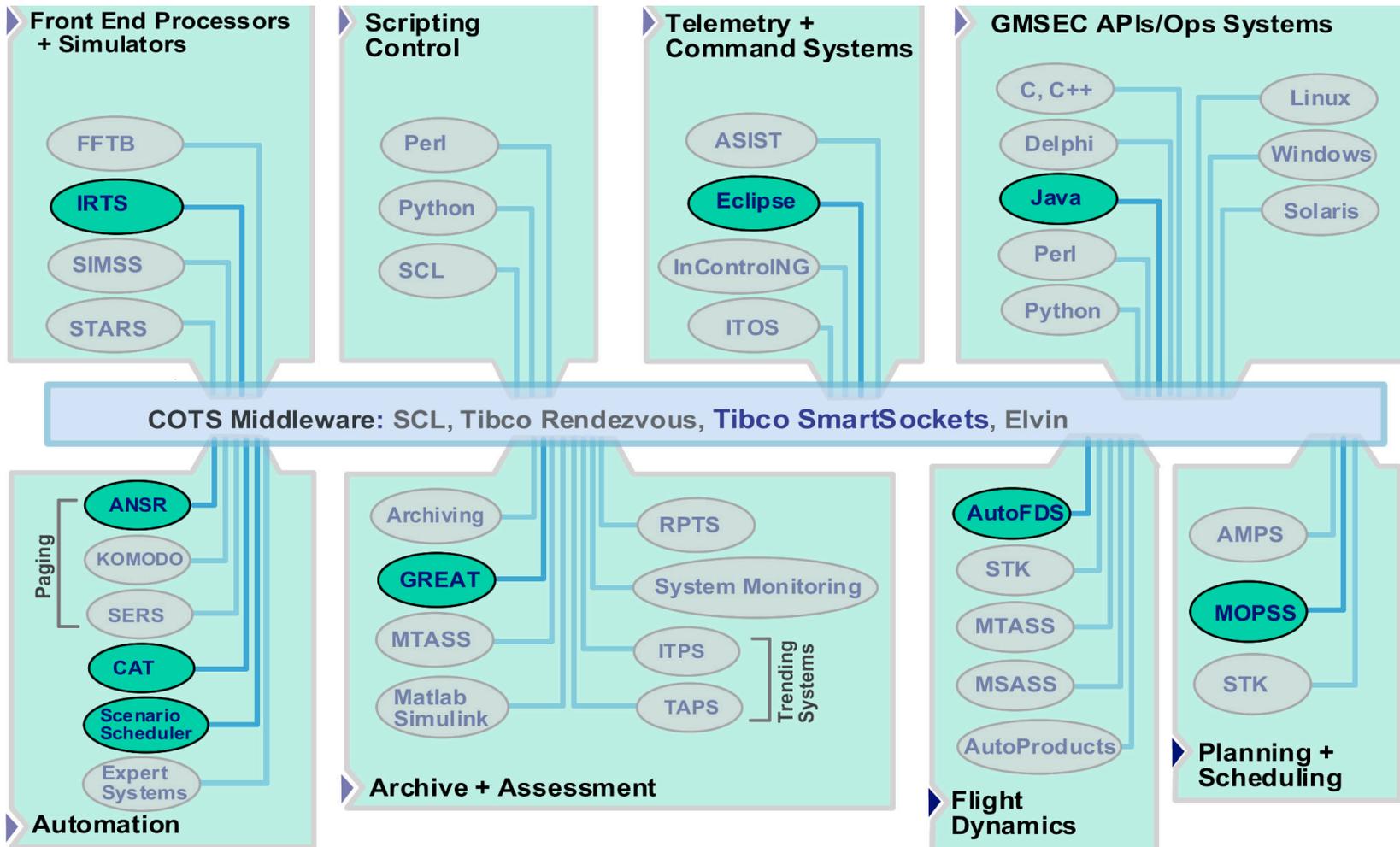


Adaptive Antenna Array Experiments



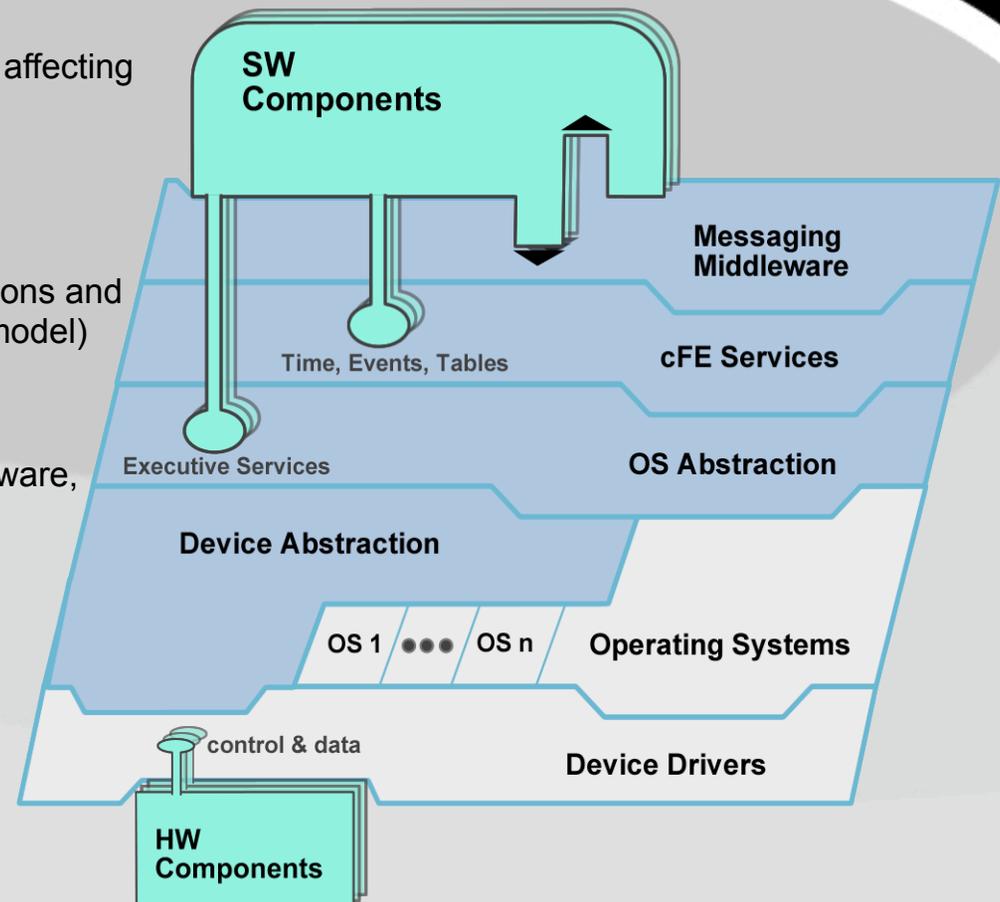
GMSEC Component Catalog/ Message Bus

GMSEC approach gives users choices for the components in their system and a way to plug them into a generic message bus. The TRMM mission has selected key components from the GMSEC catalog.

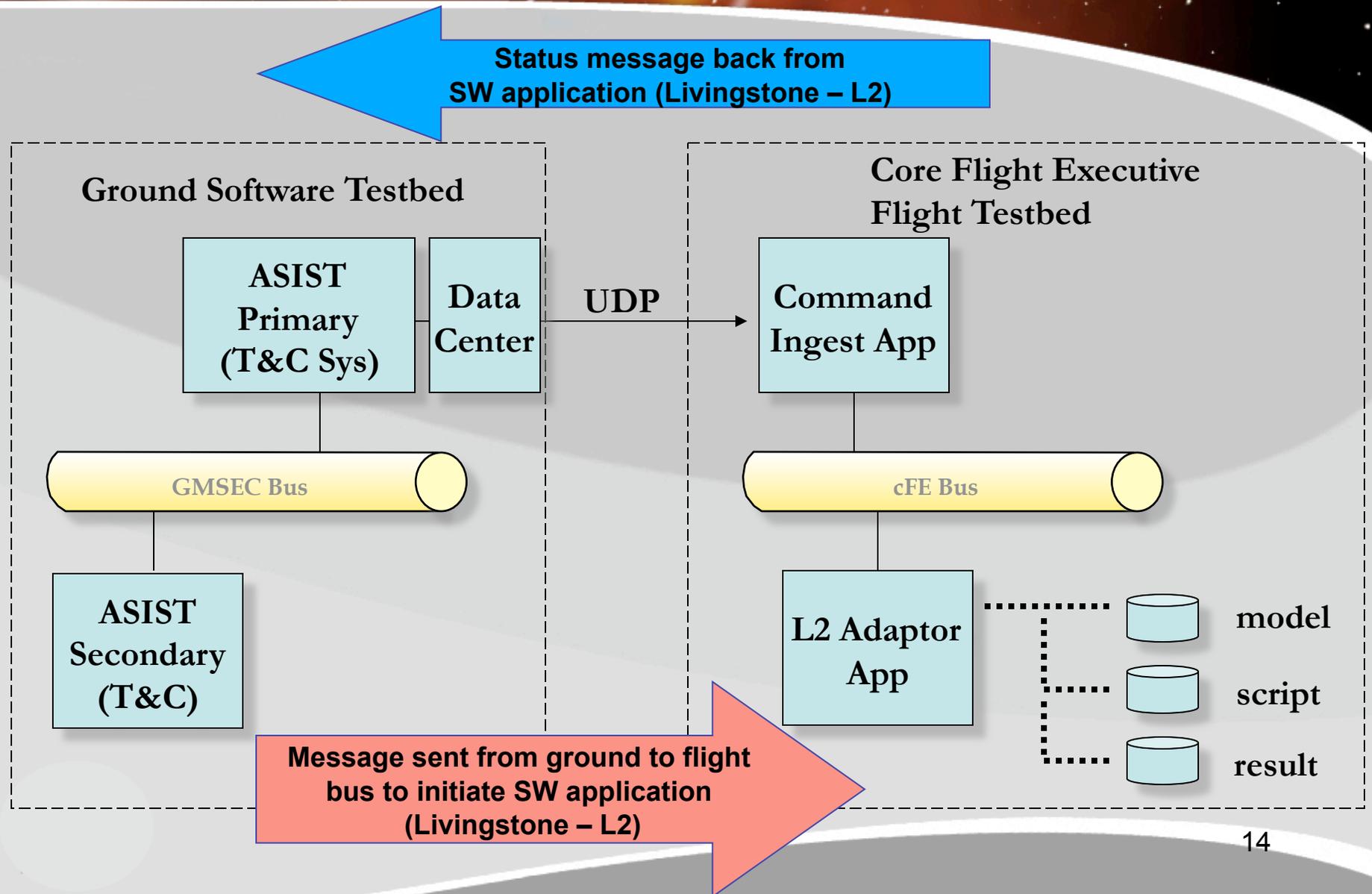


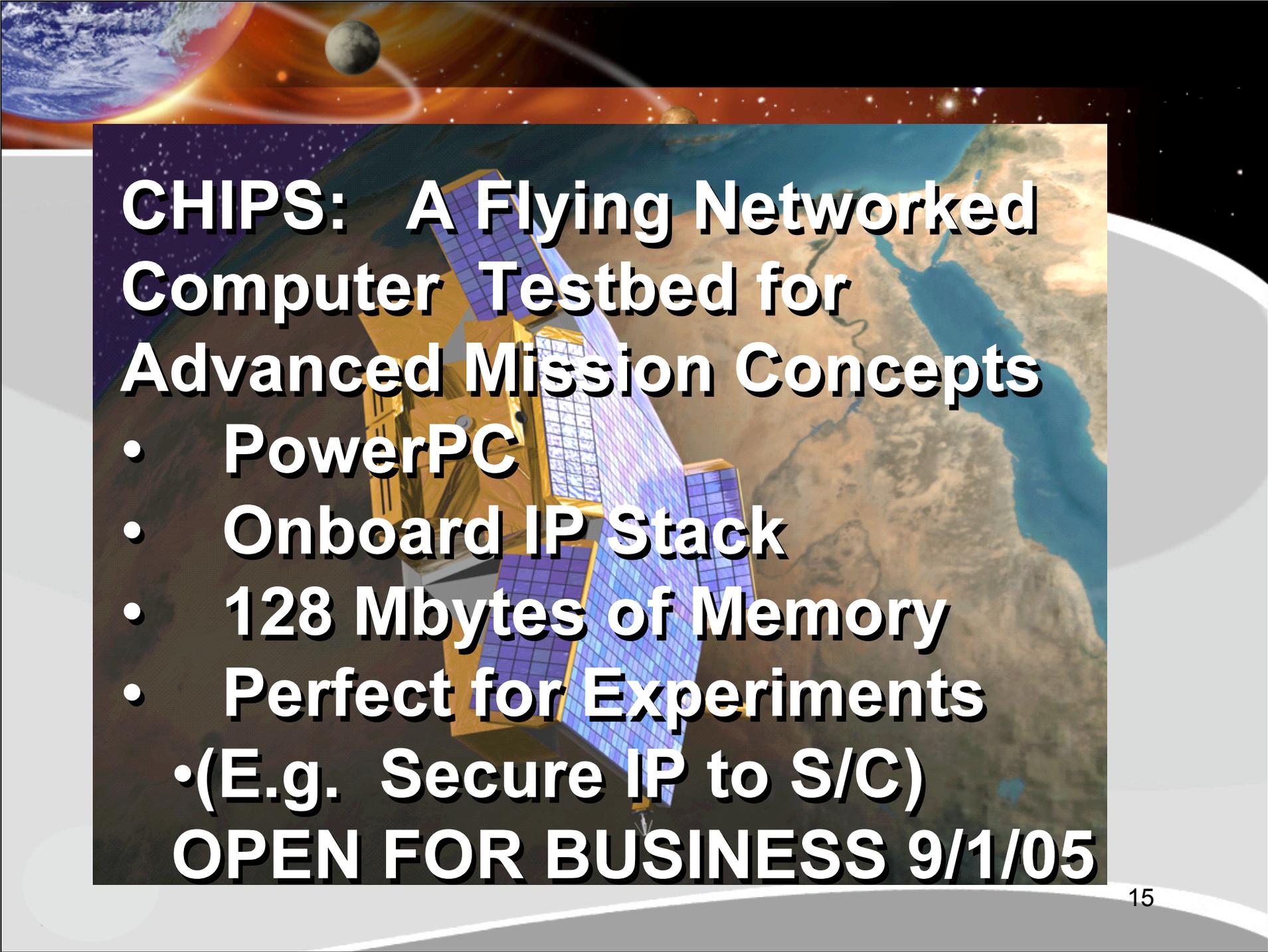
Core Flight System (cFS) and Core Flight Executive (cFE)

- **Strategic Software Layering**
 - Software of a layer can be changed without affecting the software of other layers
- **Advanced Message Handling**
 - Eliminates manual configuration of FSW
 - Automates integration of FSW with applications and hardware components (Publish/Subscribe model)
- **Standardized, Abstracted Interfaces**
 - Minimizes software impacts from flight hardware, RTOS, and application changes



Autonomy Testbed Demo 9-19-05





CHIPS: A Flying Networked Computer Testbed for Advanced Mission Concepts

- **PowerPC**
- **Onboard IP Stack**
- **128 Mbytes of Memory**
- **Perfect for Experiments**
 - **(E.g. Secure IP to S/C)**

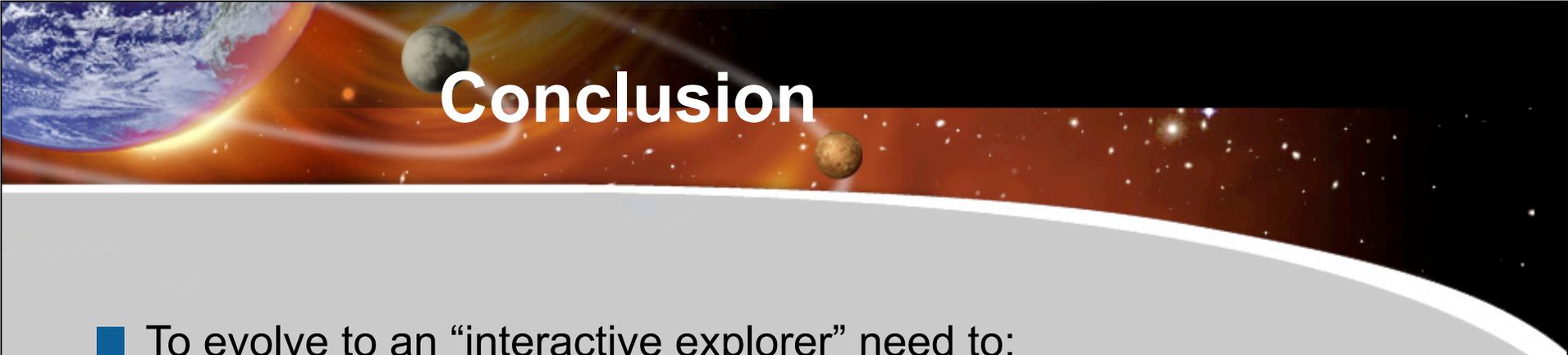
OPEN FOR BUSINESS 9/1/05

Flora Related Technology Work

■ Onboard Adaptive compression

- IRAD proposal for onboard intelligent data reduction to manage high data volumes
 - CCSDS Compression algorithm will be put on ASIC for future use by Pen-Shu Yeh/567
- Extend EO-1 Onboard pixel classification and autonomous decision making capability(Use FPGA processors)
 - Onboard L0 processing
 - Onboard L1 processing
 - Onboard Science processing
 - Onboard Feature detection
 - Autonomous decision making – categorizing sets of pixels in interest level
 - Use lossy compression on pixels of lower interest
 - Manage downlink volume to fit available downlink capacity on each orbit
 - Keep track to image data not needed and either delete or use very high compression

■ Use Autonomy Testbed to prototype approach



Conclusion

- To evolve to an “interactive explorer” need to:
 - Build cost-effective technology pipeline
 - Build scalable cost-effective communications
 - Wireless access points for satellites
 - Software bus
 - Continue to evolve autonomy software