Goddard Ground System Environment
March 12, 2009

2009 IEEE Aerospace Conference
Big Sky, MT
Session 12.09
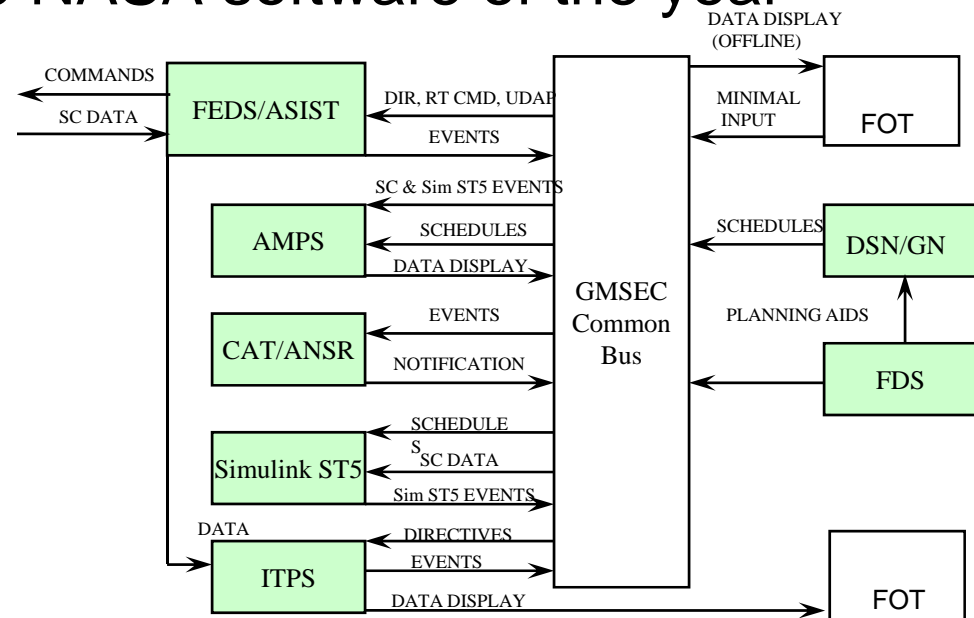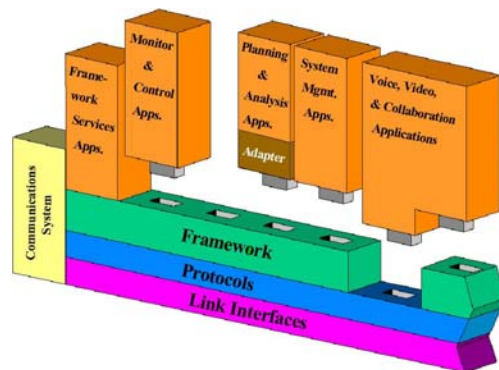
Ben Lui
Goddard Space Flight Center
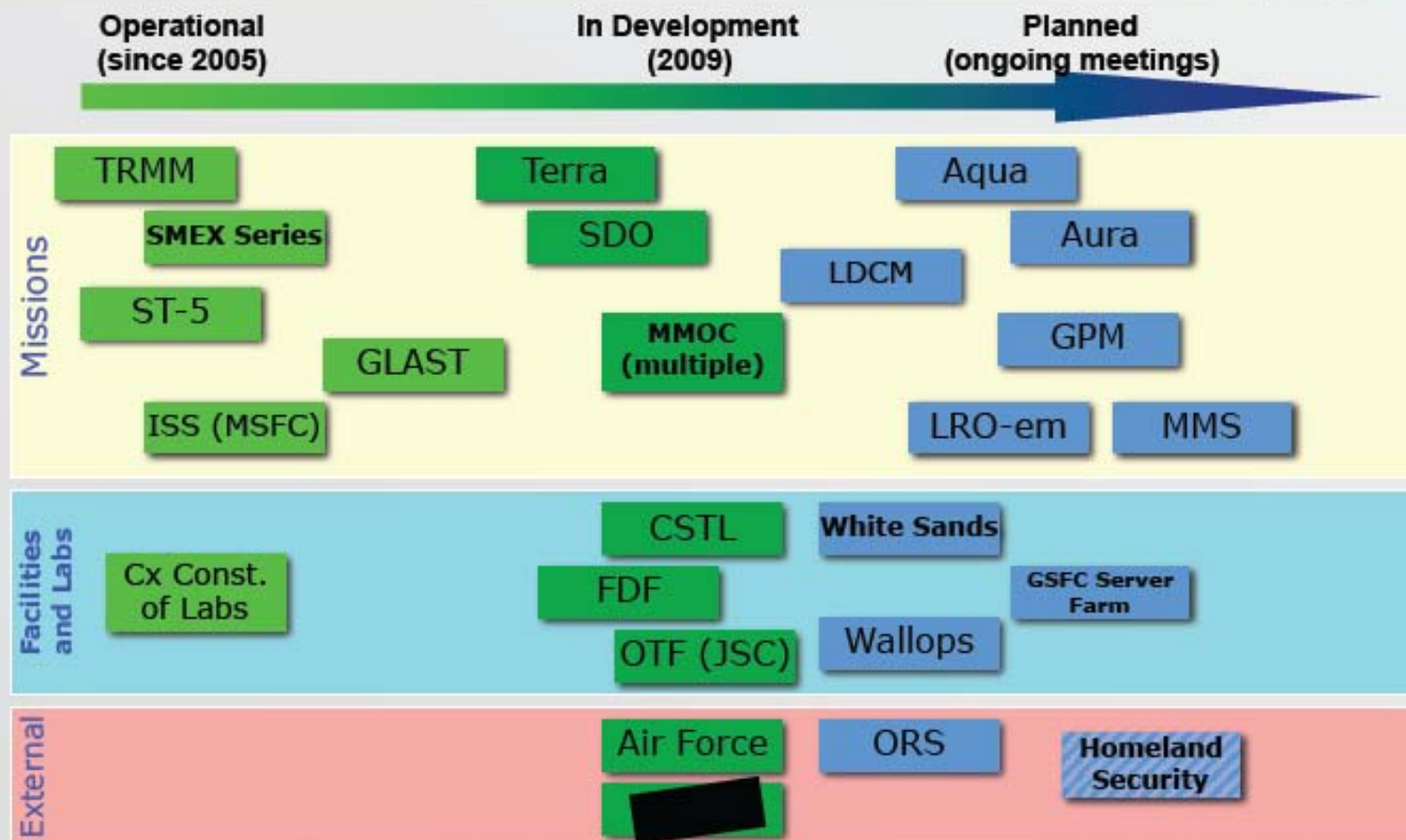
NASA Goddard Space Flight Center *Software Engineering Division*

- Goddard Ground System Environment
- Mission Utilization of Ground Systems
- Observations
- Lessons Learned

- # Ground System Infrastructure
  - Provides component plug-and-play capability over a software bus
  - Calls for standard interfaces, not components
  - Allows for mix of heritage and new components
  - Facilitates scalability, extensibility, and technology infusion
- # Named runner-up in 2008 NASA software of the year
 - Used by many Goddard missions, Air Force and other fed agencies

NASA and Other Government Users

Operational (since 2005)	In Development (2009)	Planned (ongoing meetings)

Missions
- TRMM
- SMEX Series
- ST-5
- GLAST
- ISS (MSFC)
- Terra
- SDO
- MMOC (multiple)
- Aqua
- Aura
- LDCM
- GPM
- LRO-em
- MMS

Facilities and Labs
- Cx Const. of Labs
- CSTL
- FDF
- OTF (JSC)
- White Sands
- Wallops
- GSFC Server Farm

External
- Air Force
- ORS
- Homeland Security

- ASIST (Advanced Spacecraft Integration and System Test)
  - Originally developed to support Medium Explorer (MIDEX) missions in the early 1990's

- ITOS (Integrated Test and Operation System)
  - Originally developed to support Small Explorer (SMEX) missions in the early 1990's

- Both systems have supported
  - Board and box level development
  - Spacecraft and instrument development
  - Flight software development
  - Integration and test (I&T)
  - Missions operations
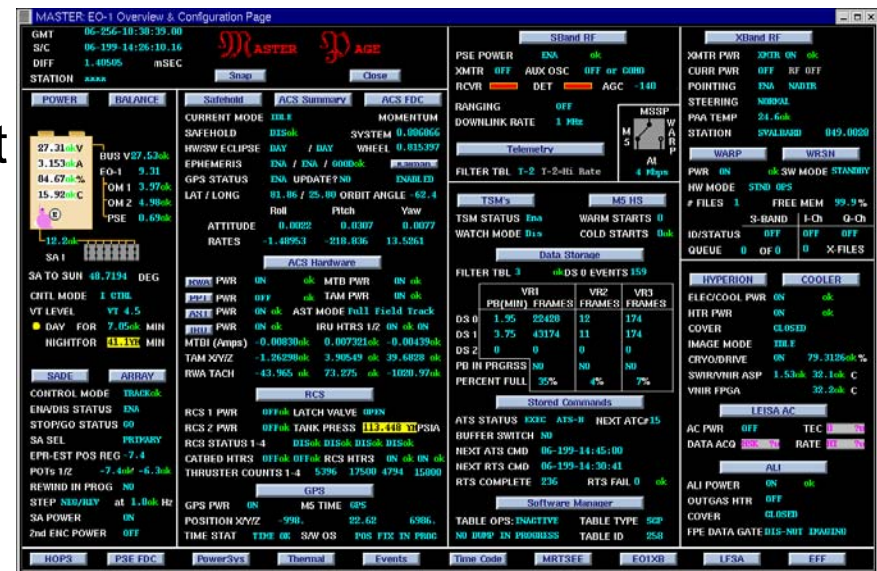
- MOPSS (Mission Operations Planning and Scheduling System)
  - Originally developed in the 90's for SOHO and WIND/POLAR
  - Has been expanded to support several other Goddard missions
- AMPS (Automated Mission Planning and Scheduling System)
  - Designed to support constellation missions
- FlexPlan
  - Acquisition from GMV Space Systems Inc. to support LRO
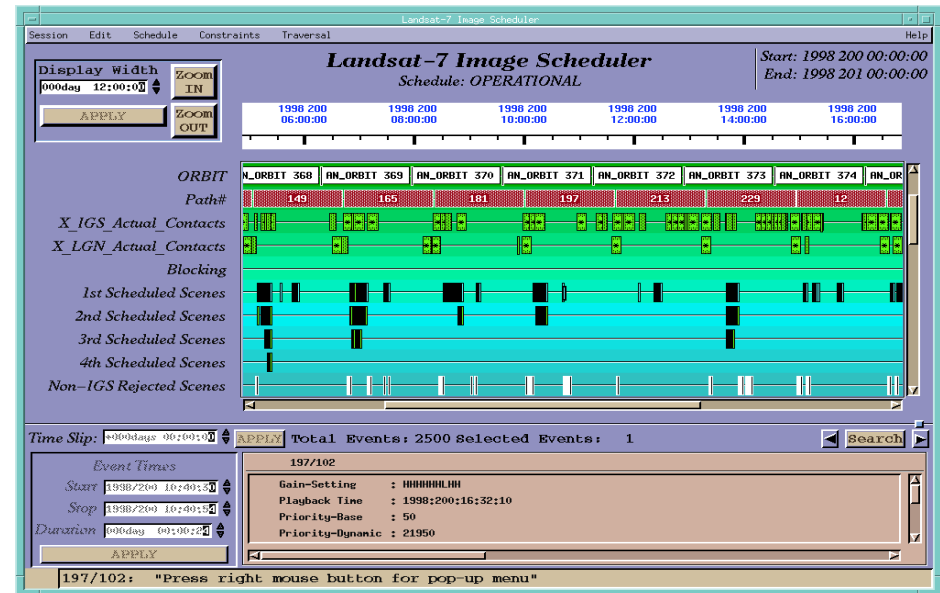
- GTAS (Generic Trending and Analysis System)
  - Originally developed for SOHO and WIND/POLAR Missions
- DTAS (Data Trending and Analysis System)
  - Designed in the mid 90's for SMEX missions
- ITPS (Integrated Trending and Plotting System)
  - Provide access to full-resolution mission telemetry data archive
  - Unlimited data point plot
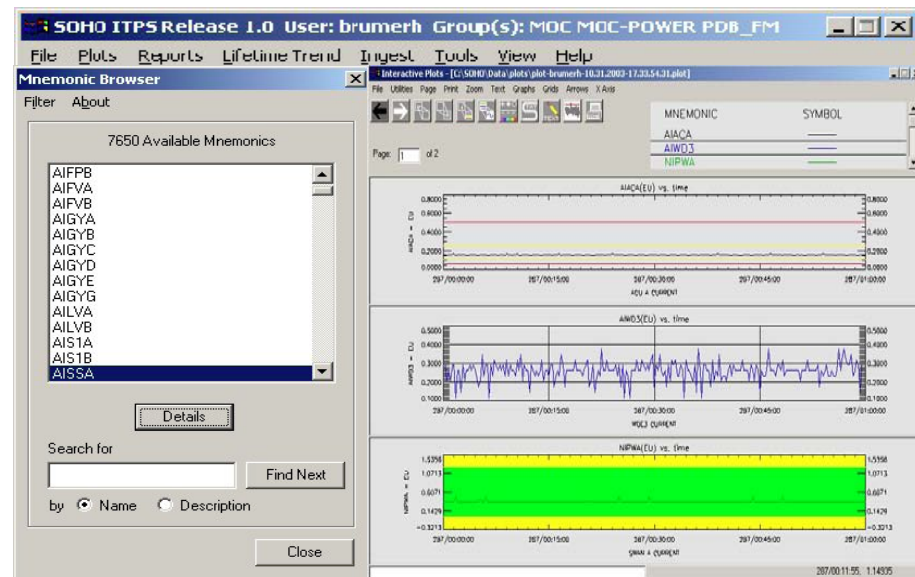
- DMS (Data Management System)
  - Designed to handle and distribute a large volume of science data
  - Using FedEx approach where data distribution can be tracked in realtime
  - Designed for LRO, can be used by other missions

	HST - 1990	SAMPEX - 1993	WIND - 1994	XTE - 1995	SOHO - 1995	POLAR - 1996	FAST - 1996	TRMM - 1997	SWAS - 1998	TRACE - 1998	WIRE - 1999	Landsat 7 - 1999	EO-1 - 2000	IMAGE - 2000	WMAP - 2001	Rhessi - 2002	Swift - 2004	Cream-1 - 2004	Cream-2 - 2005	ST-5 - 2006	Themis - 2006	GLAST - 2007	Cream-3 - 2007	Cream-4 - 2008
GMSEC		X						X	X	X	X									X		X		
ASIST				X				X					X	X	X					X				
ITOS		X					X		X	X	X					X	X	X	X		X	X	X	X
ITPS			X		X	X		X		X			X							X		X		
DTAS		X							X	X	X		X											
MOPSS	X			X	X			X				X	X		X									
AMPS																				X				

Past and Current Missions

Non Inclusive

Mission Utilization of Ground Systems

	LRO - 2009	SDO - 2009	LWS SET-1 - 2011	LDCM - 2011	JWST - 2013	JWST ISIM - 2013	GPM - 2013	MMS - 2014
GMSEC		X					X	
ASIST	X	X				X	X	
ITOS	X		X	X				
ECLIPSE					X			
ITPS	X	X	X					
FlexPlan	X							
DMS	X							

Upcoming Missions

- Goddard has used various ground components to support a variety of missions over the last 20 years
- Like the industry, old components are replaced by newer/better components
- Some newly developed components last for many missions, some don't

- Avoid system lock-in
- Provide an open environment that allows interoperability
- There is no one size fits all solution. Most missions have unique requirements and demand unique solutions
- Succession planning for both people and systems

- AETD – Applied Engineering and Technology Directorate
- AMPS – Automated Mission Planning and Scheduling System
- ASIST – Advanced Spacecraft Integration and System Test
- COTS – Commercial Off-The-Shelf
- DMS – Data Management System
- DTAS – Data Trending and Analysis System
- FedEx – Federal Express
- GMSEC – Goddard Mission Services Evolution Center
- GTAS – Generic Trending and Analysis System
- I&T – Integration and Test
- ITOS – Integrated Test and Operation System
- ITPS – Integrated Trending and Plotting System
- MOPSS – Mission Operations Planning and Scheduling System
- NASA – National Aeronautics and Space Adminstration
- SED – Software Engineering Division

Missions

- CREAM – Cosmic Ray Energetics and Mass
- EO-1 – Earth Observing - 1
- FAST – Fast Auroral Snapshot Explorer
- GLAST – Gamma-Ray Large Area Space Telescope
- GPM – Global Precipitation Mission
- HST – Hubble Space Telescope
- IMAGE – Imager for Magnetopause-to-Aurora Global Exploration
- JWST – James Webb Space Telescope
- Landsat 7
- LDCM – Landsat Data Continuity Mission
- LRO – Lunar Reconnaissance Orbiter
- LWS SET-1 – Living With a Star Space Environment Testbeds - 1
- MMS – Magnetospheric Multiscale Mission
- POLAR
- Rhessi
- SAMPEX – Solar Anomalous and Magnetospheric Particle Explorer
- SDO – Solar Dynamics Observatory
- ST-5 – Space Technology - 5
- SWAS – Submillimeter Wave Astronomy Satellite
- Swift
- Themis – Time History of Events and Macroscale Interactions durijng Substorms
- TRACE – Transition Region and Coronal Explorer
- TRMM – Tropical Rainfall Measuring Mission
- WMAP – Wilkinson Microwave Anisotropy Probe
- WIND
- WIRE – Wide-Field Infrared Explorer
- XTE – X-Ray Timing Explorer

Backup

- AMPS – CSC
- ASIST – Design America Inc. (DAI)
- DMS – the Hammers Company
- DTAS – GSFC
- ECLIPSE – Raytheon
- FlexPlan – GMV Space Systems Inc.
- ITOS – the Hammers Company
- ITPS – Honeywell
- MOPSS - CSC