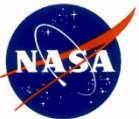


Intelligent Payload Module Overview

Daniel Mandl et al - NASA/GSFC
Steve Chien et al - JPL

8/11/09

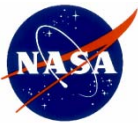
HysplRI Workshop
Pasadena, CA



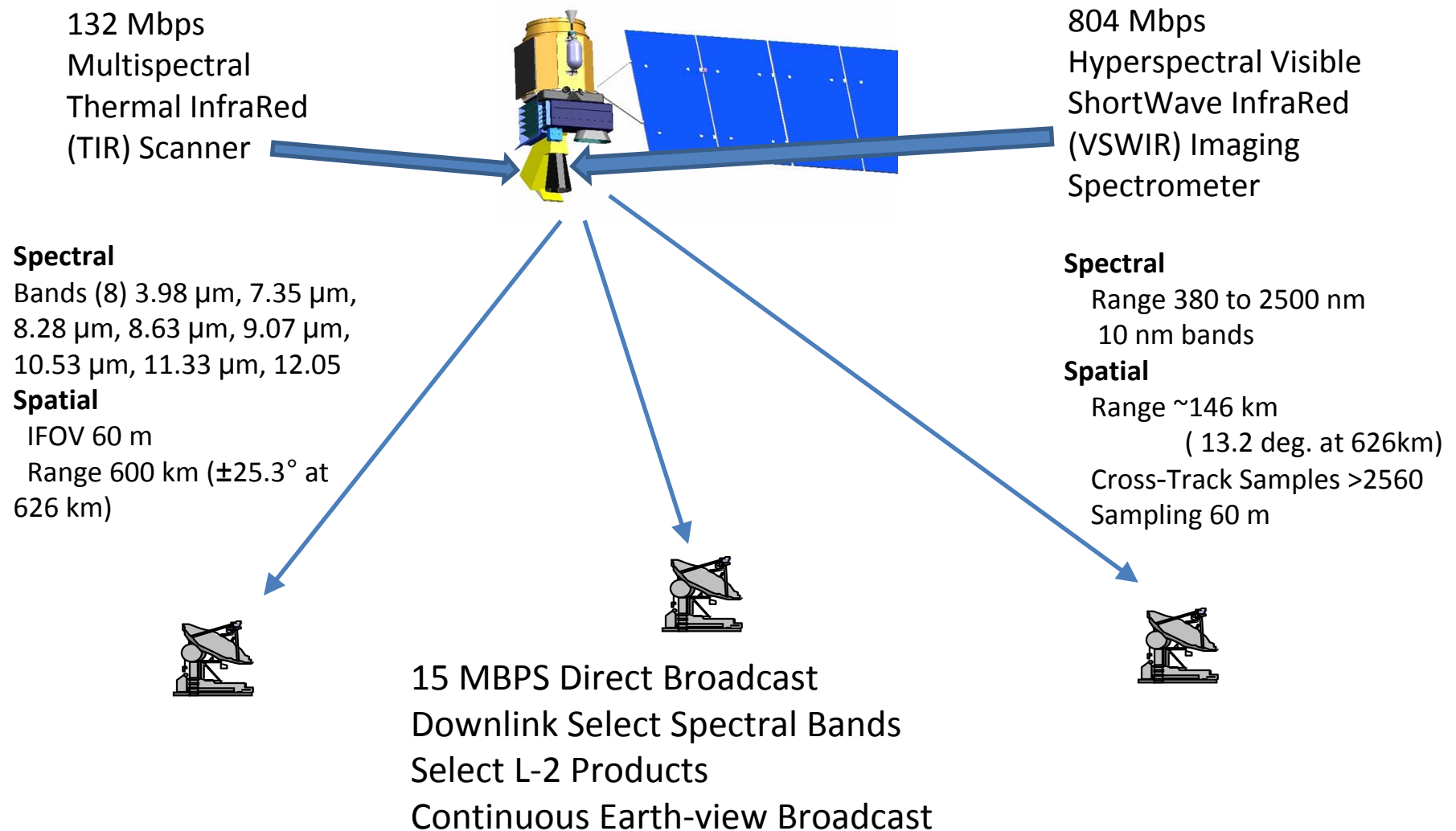


Overview

- Purpose
 - Supply subset of HypsIRI data to low latency community
 - Enable users to specify algorithms to operate on the subset of data onboard
 - Supply data via direct broadcast
- Potential users
 - Emergency response (fires, floods etc.)
 - Other science applications to be covered in presentation by Steve Chien on Wednesday

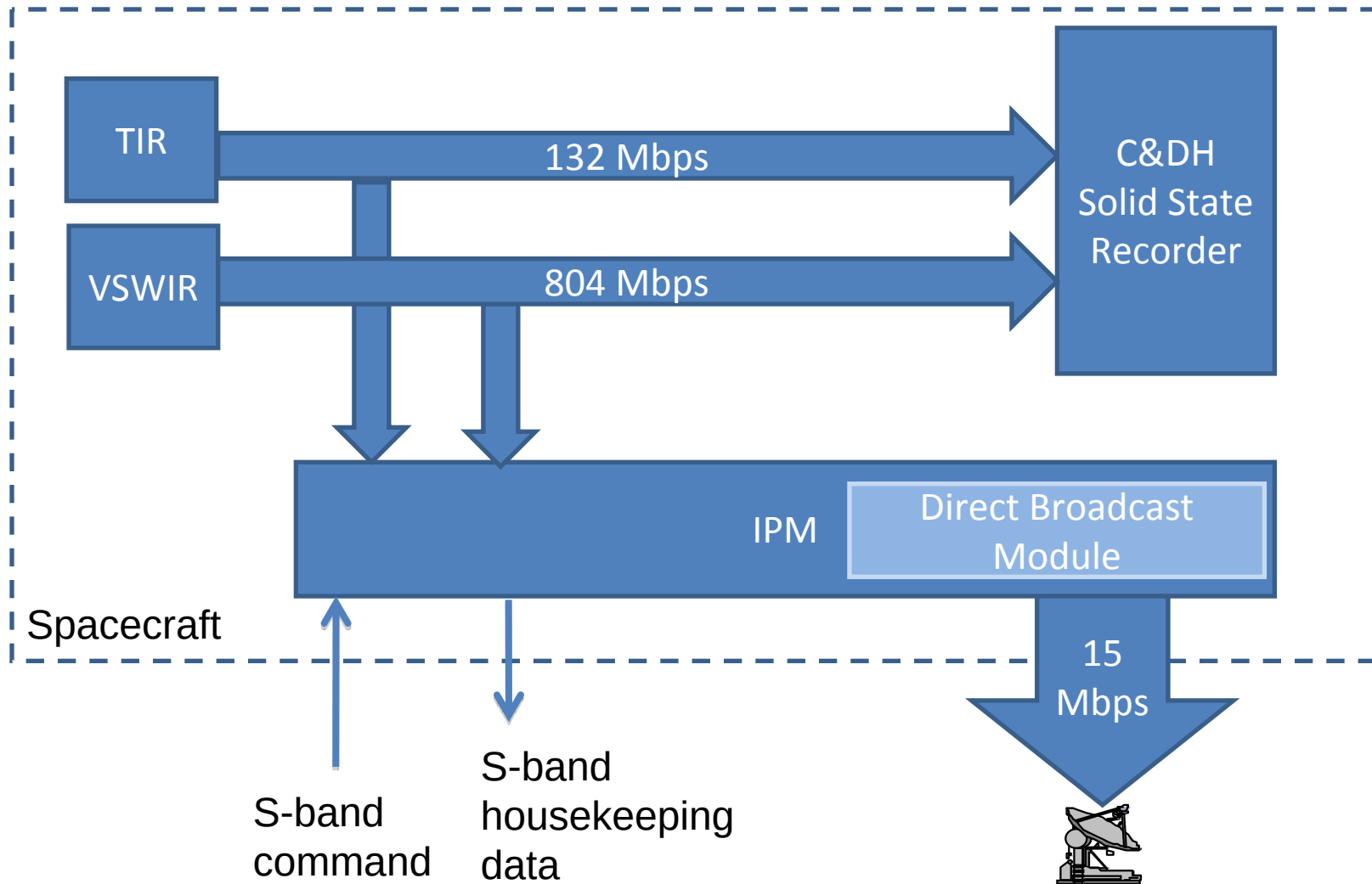


HyspIRI Low Latency Data Product Concept



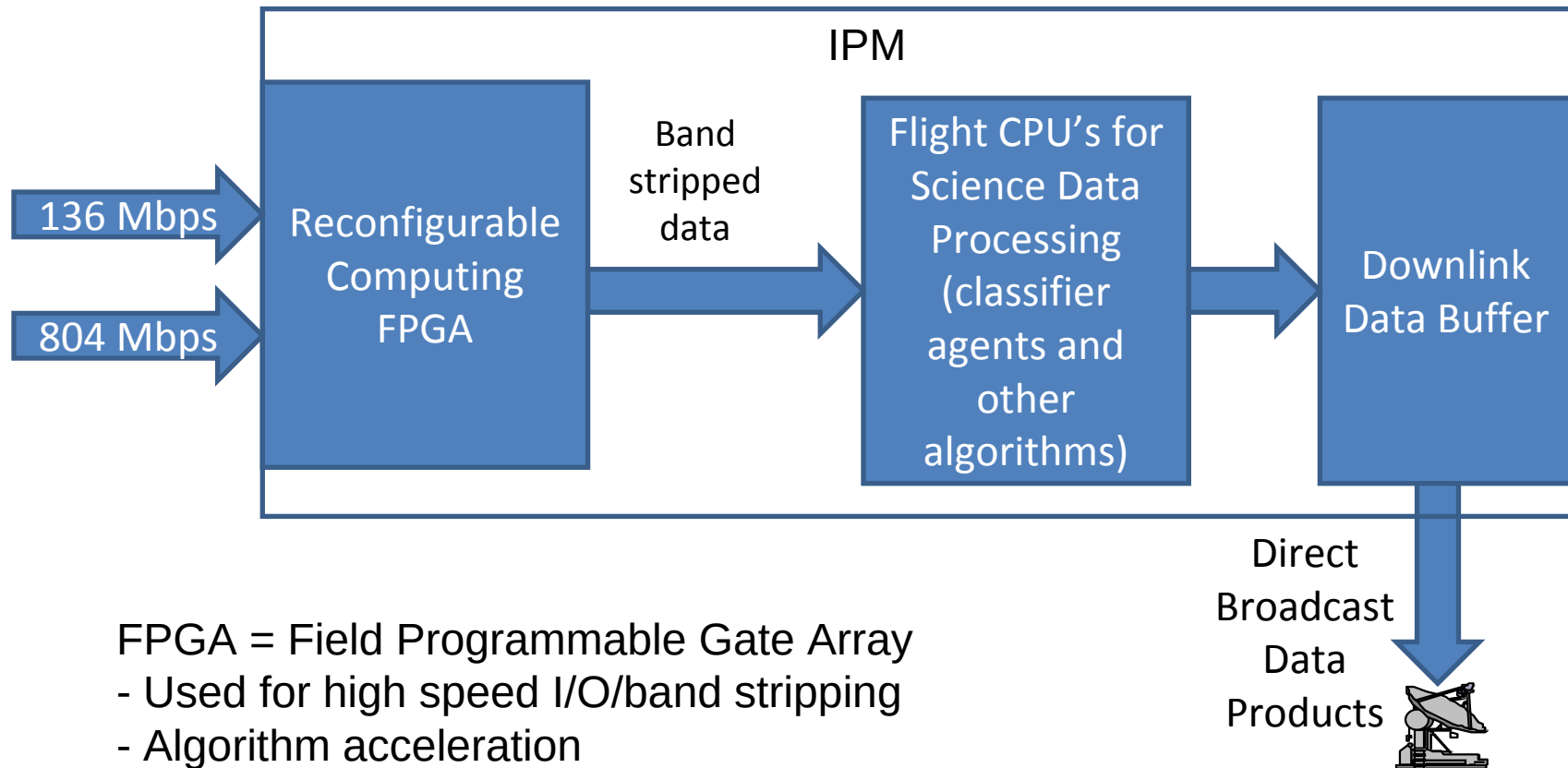


HyspIRI Data Flow





IPM Data Flow





Direct Broadcast – Direct Readout Overview

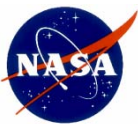


What is Direct Broadcast (DB)?

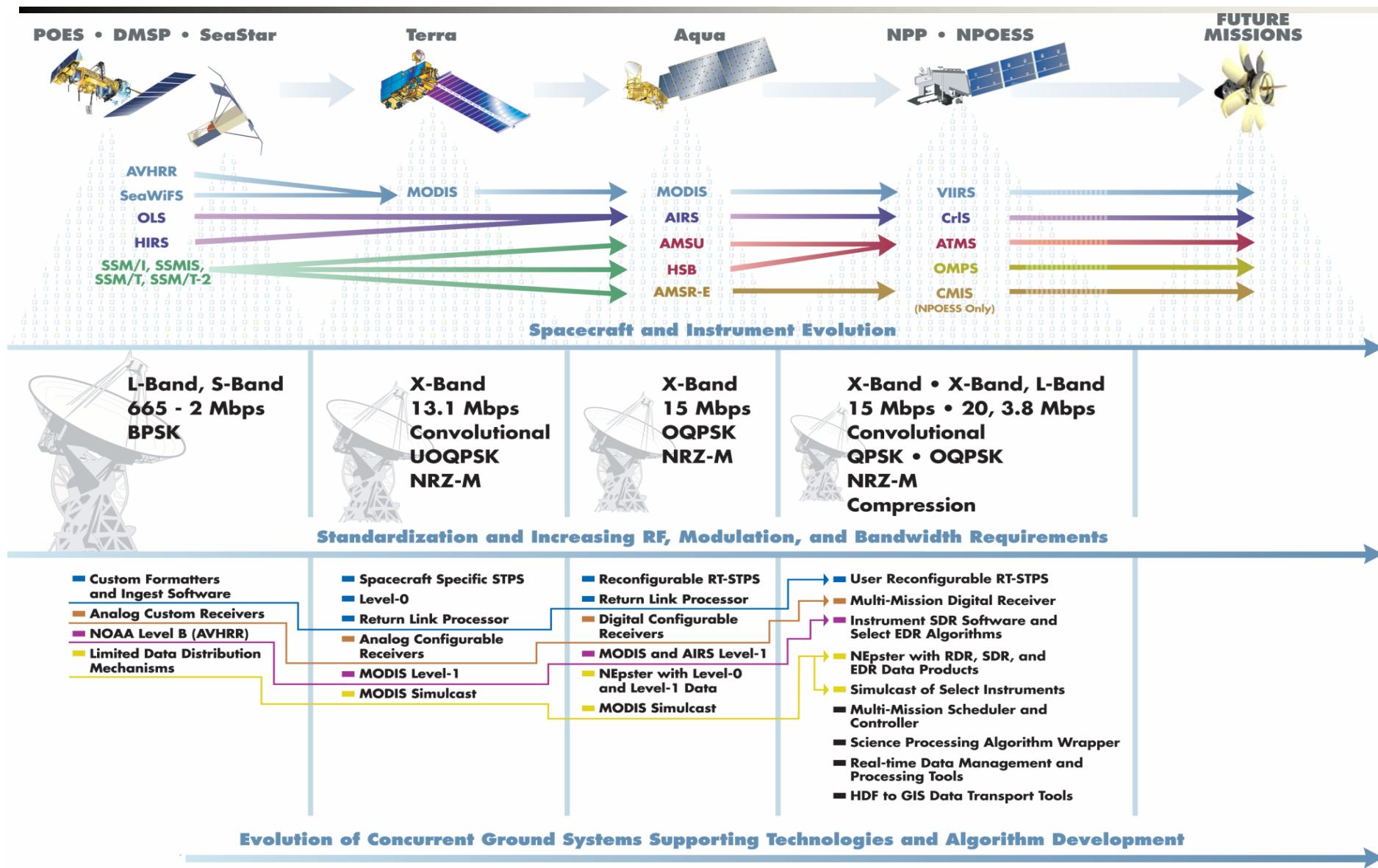
Real-time hemi-directional transmission of satellite data to the ground. As the Earth is being observed, instruments data are formatted and transmitted to any user below in real-time. Users who have compatible ground receiving equipment and are in direct line of sight to the satellite may receive these transmissions.

Direct Readout (DR):

The process of acquiring freely transmitted live direct broadcast satellite data and processing it for real-time applications.



Direct Broadcast/Readout Heritage





Direct Broadcast – S/C RF Data Path



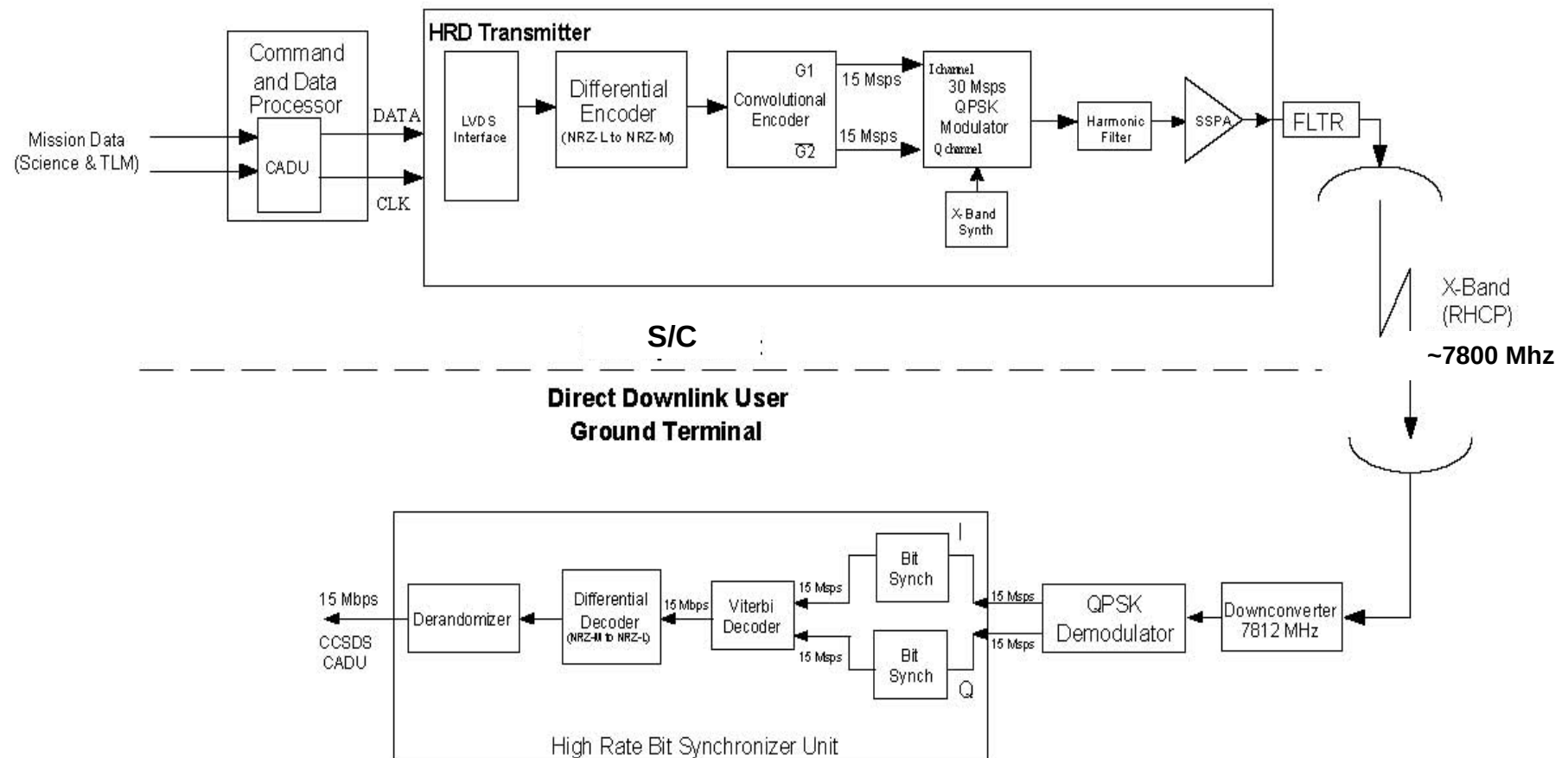
Transmitter-Modulator-Encoder (single unit)

Mass: 4Kg

Volume: 17.3 cm x 17.8 cm x 11.5 cm

Power: 75 Watts max consumption for 8 Watt output

Rad Hard: 20Krad total dose





HyspIRI IPM Highlights

2009 HyspIRI version of Intelligent Payload Module (IPM)

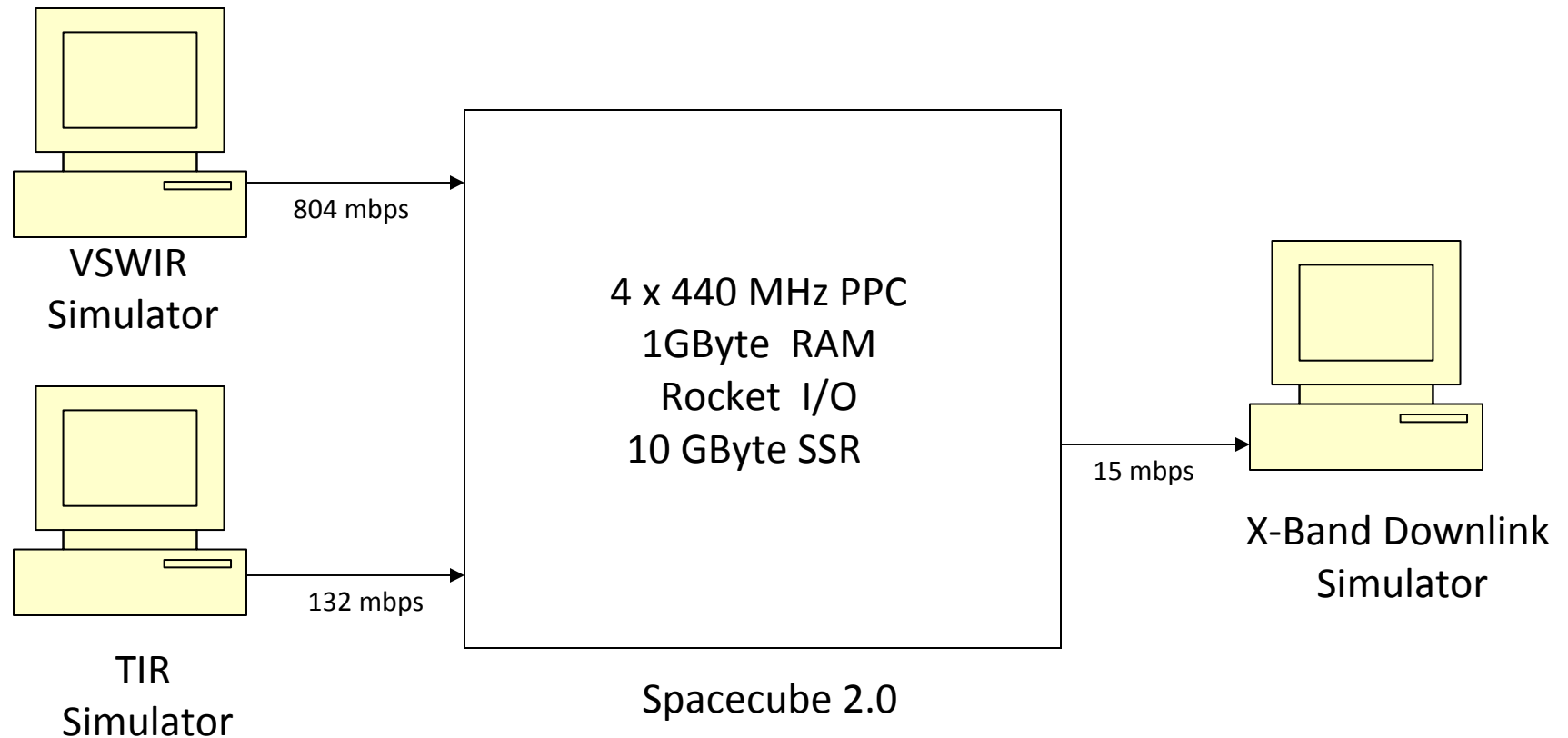
- Each instrument has microprocessor
- Add high performance computer as user driven intelligent processor

Functionality

- Real time receipt of VSWIR and TIRS data
- Direct Broadcast Downlink at 15 MBPS
- Uploadable user developed classification algorithms via S-band
- Automated onboard workflows execute algorithms
- Onboard planner functionality to enable downlink of messages and data subsets via direct broadcast or S-band for rapid turnaround
- Onboard science data processing (i.e. cloud screening, thermal summary) other onboard data reduction functionality
- Related ground software to enable desktop data delivery, loadable classifiers
- Basic architecture, ground and flight software being developed under 2 ea 3 year ESTO awards (Mandl, Flatley)
- Based on already existing EO-1 S/W, upgraded for HyspIRI flight computer



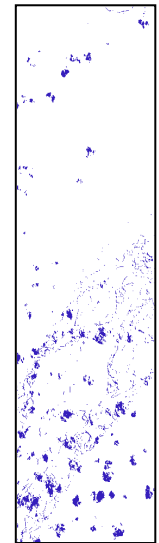
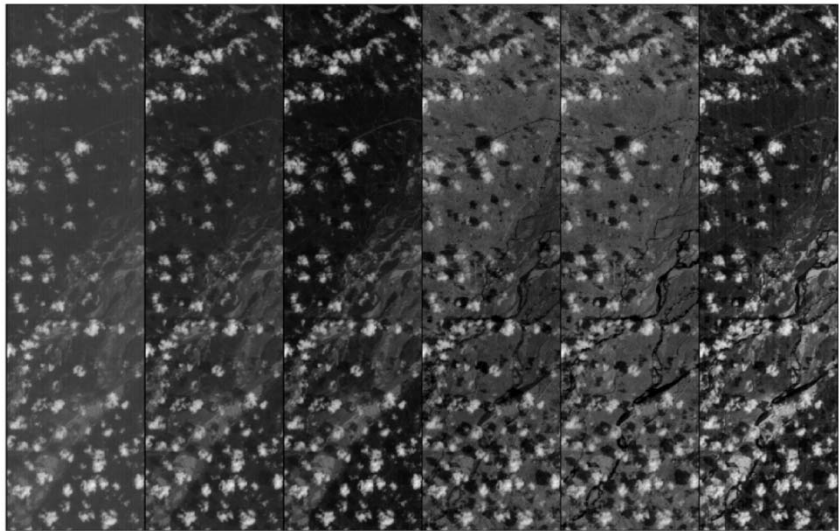
HyspIRI IPM Testbed at GSFC



Note: Similar testbed operating at JPL



IPM Processor Benchmarks



Cloud benchmark
pixels detected
as a cloud in blue

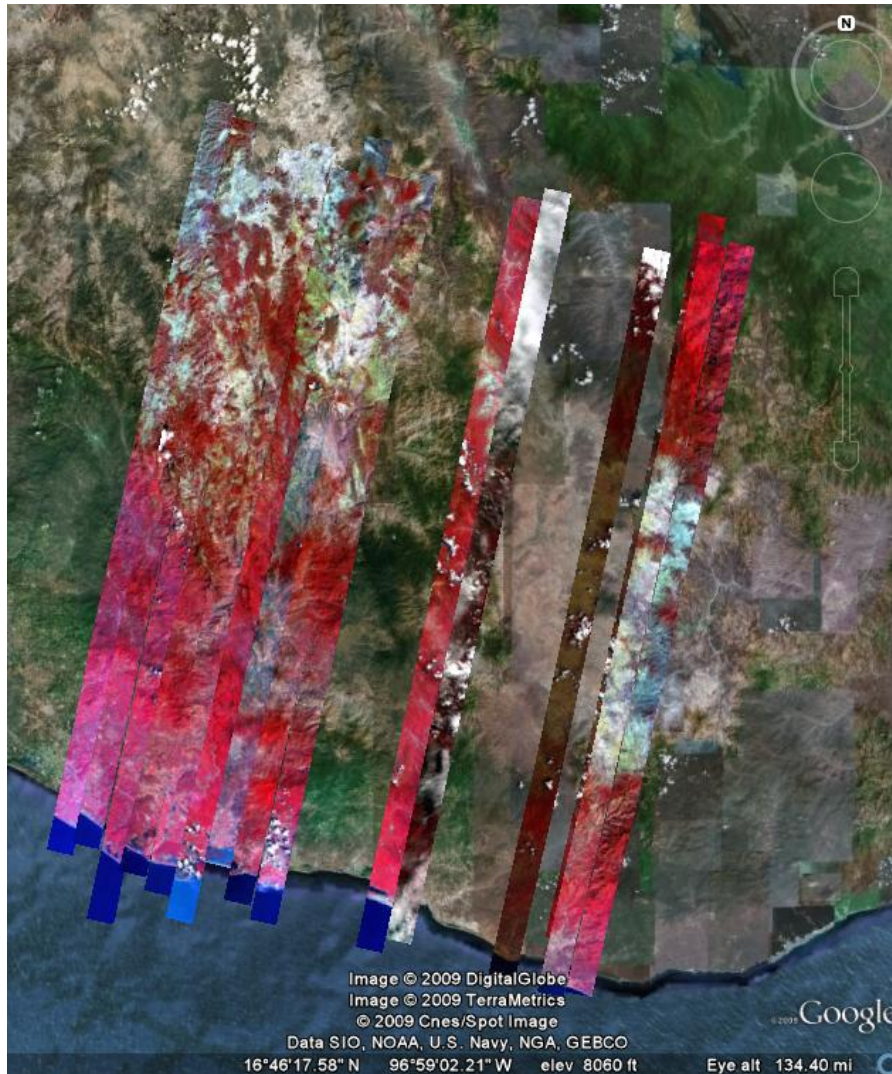
bands (21, 31, 51, 110, 123, 150 }

GSFC Benchmark	MHz	Thermal CPU%	Cloud CPU%
Aeroflex LEON3	75	80	110
BAE RAD750	133	50	80
Xilinx PPC 440	440	20	30

JPL Benchmark	MHz	Thermal CPU%	Cloud CPU%	Flood CPU%	SWIL SVM CPU%	SULPHUR SVM CPU%
Mongoose V	12	tbd				
Atmel LEON2	100	597	684	823	1784	14935
RAD750	200	294	383	441	1030	4856
GESPEC	150	166	190	230	520	2202
PPC 440	440	156	181	299	966	23223
GESPEC	500	120	156	180	421	1985

- Benchmark numbers need reconciliation to understand differences
- More sophisticated algorithms will clearly require FPGA acceleration

HyspIRI Test Image



Location

- Oaxaca New Mexico

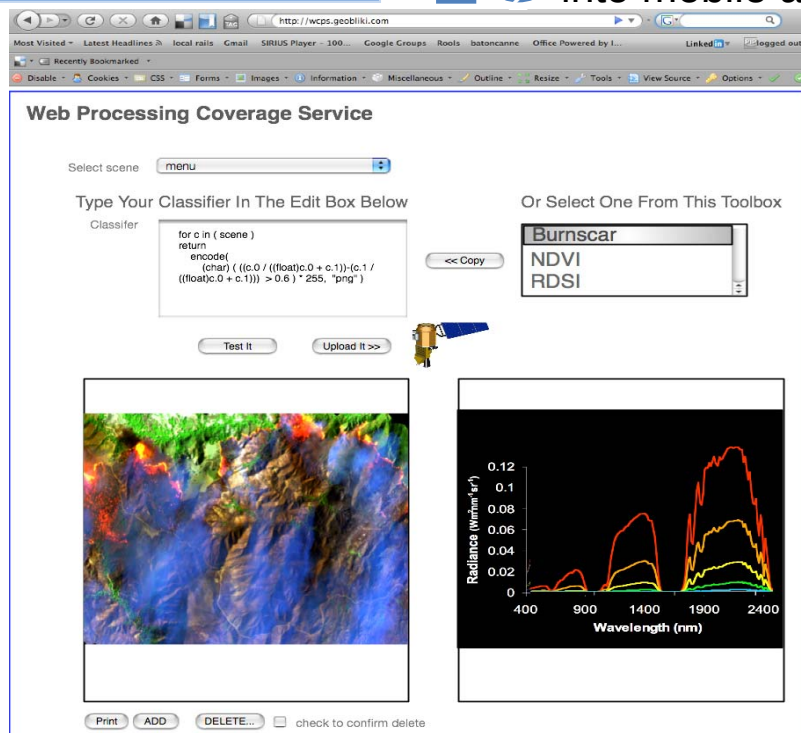
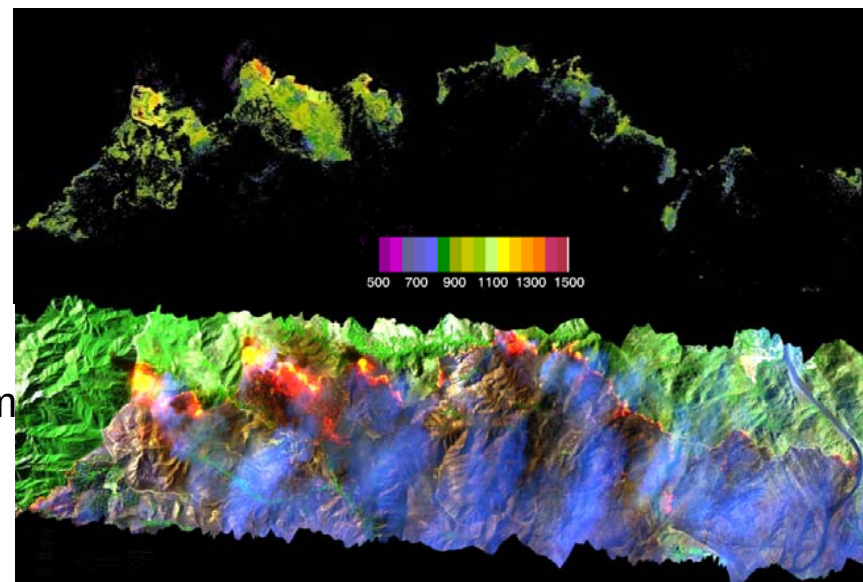
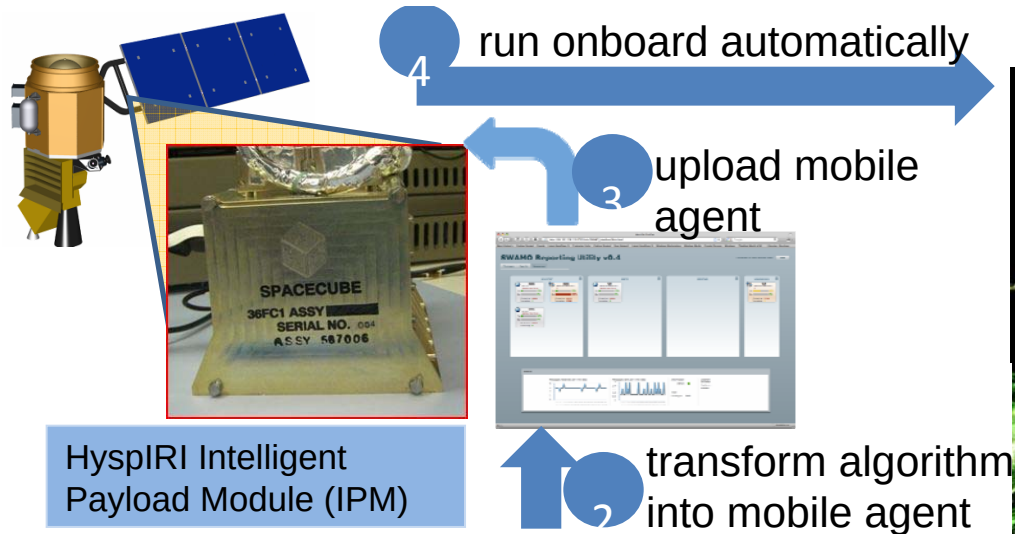
Process

- Combine 21 Hyperion data takes
- EO-1 tasked to get missing scenes
- 30 M Hyperion pixels will be combined
- 4 Hyperion pixels averaged = 1 HyspIRI
- Scene size ~146km x~146km

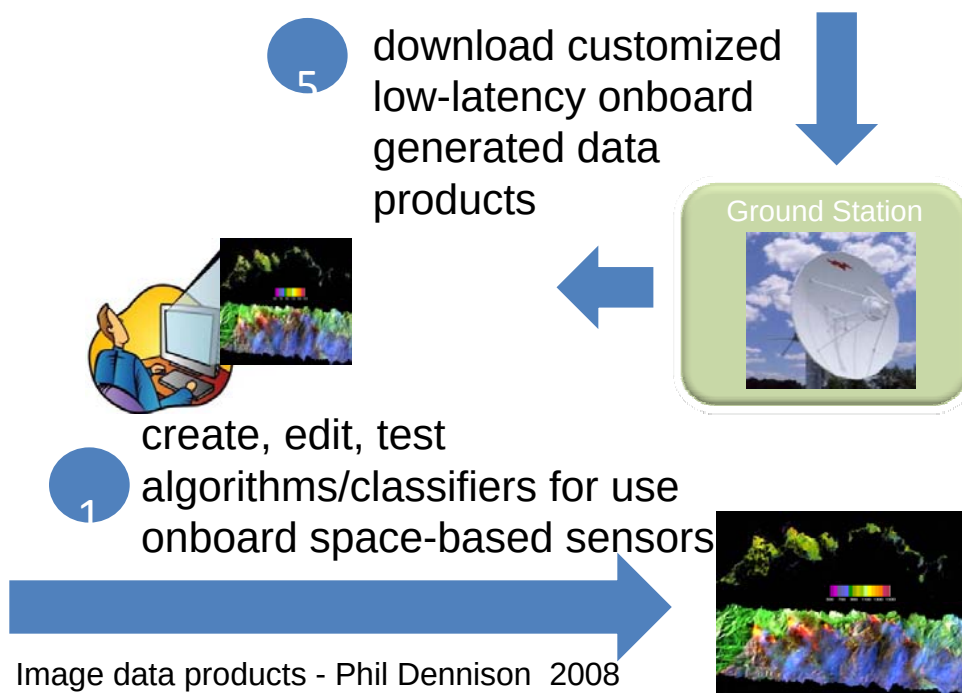
Function

- Performance: I/O, band strip, alg. cpu%
- Functional tests of classifiers





HypsIRI IPM Operations Concept





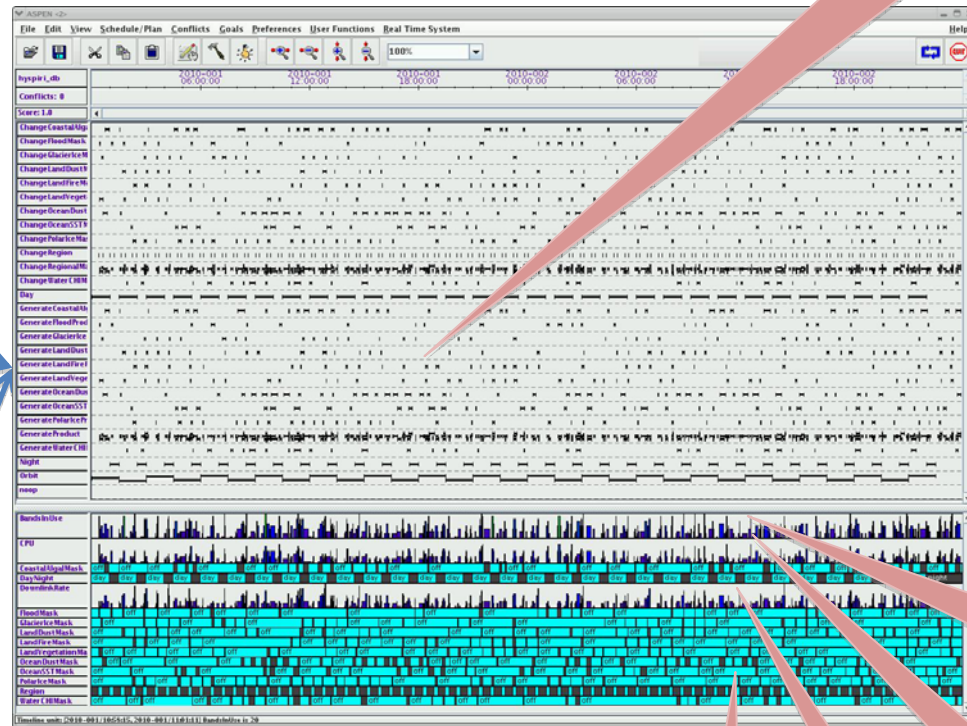
Direct Broadcast Operations

Product Generation activities

Orbit and masks



Product generation policies and priorities



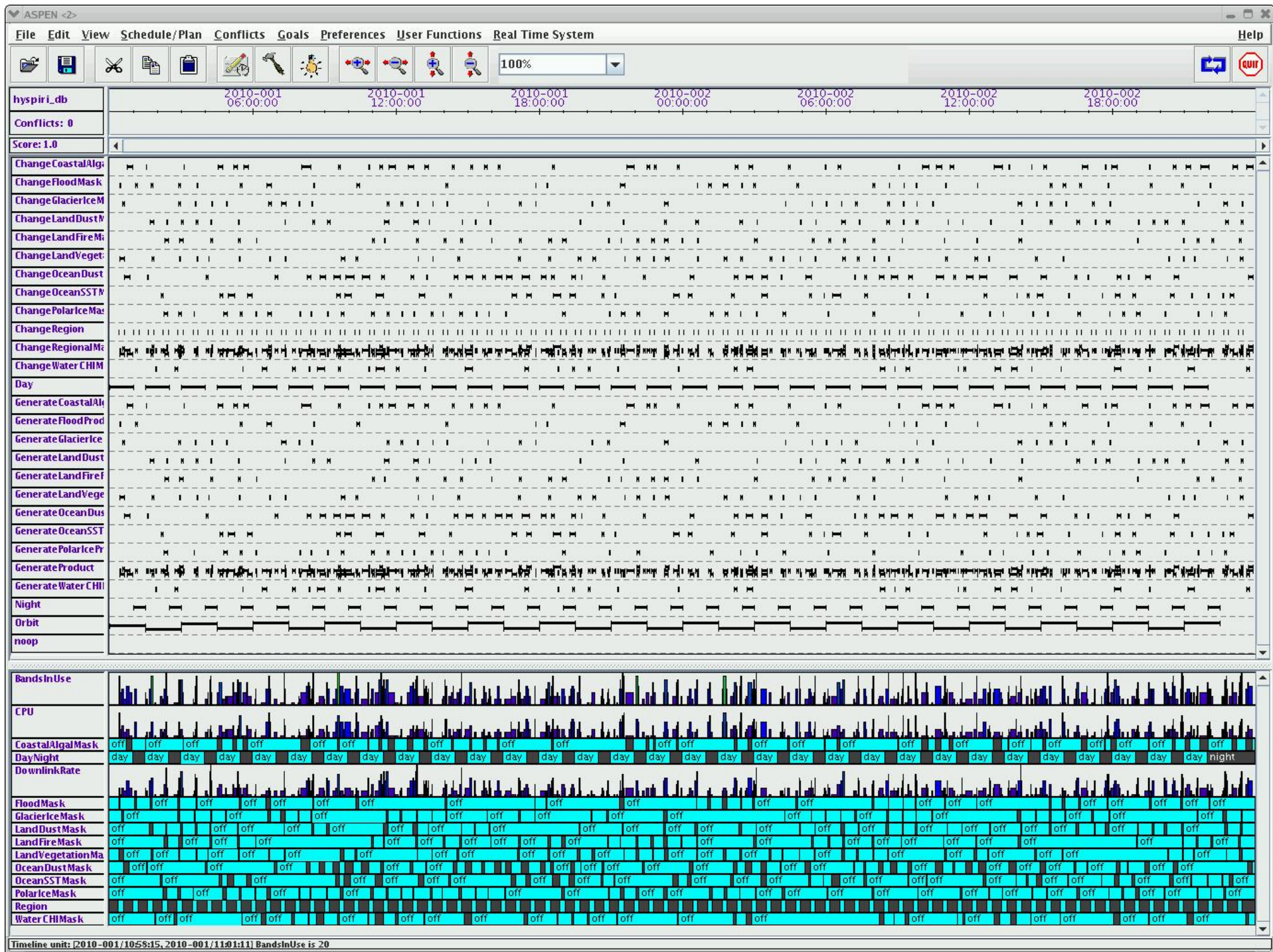
Bands in use

CPU Utilization

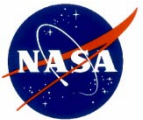
Overflight t Masks

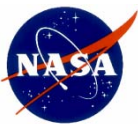
Downlink Rate

Product generation plan

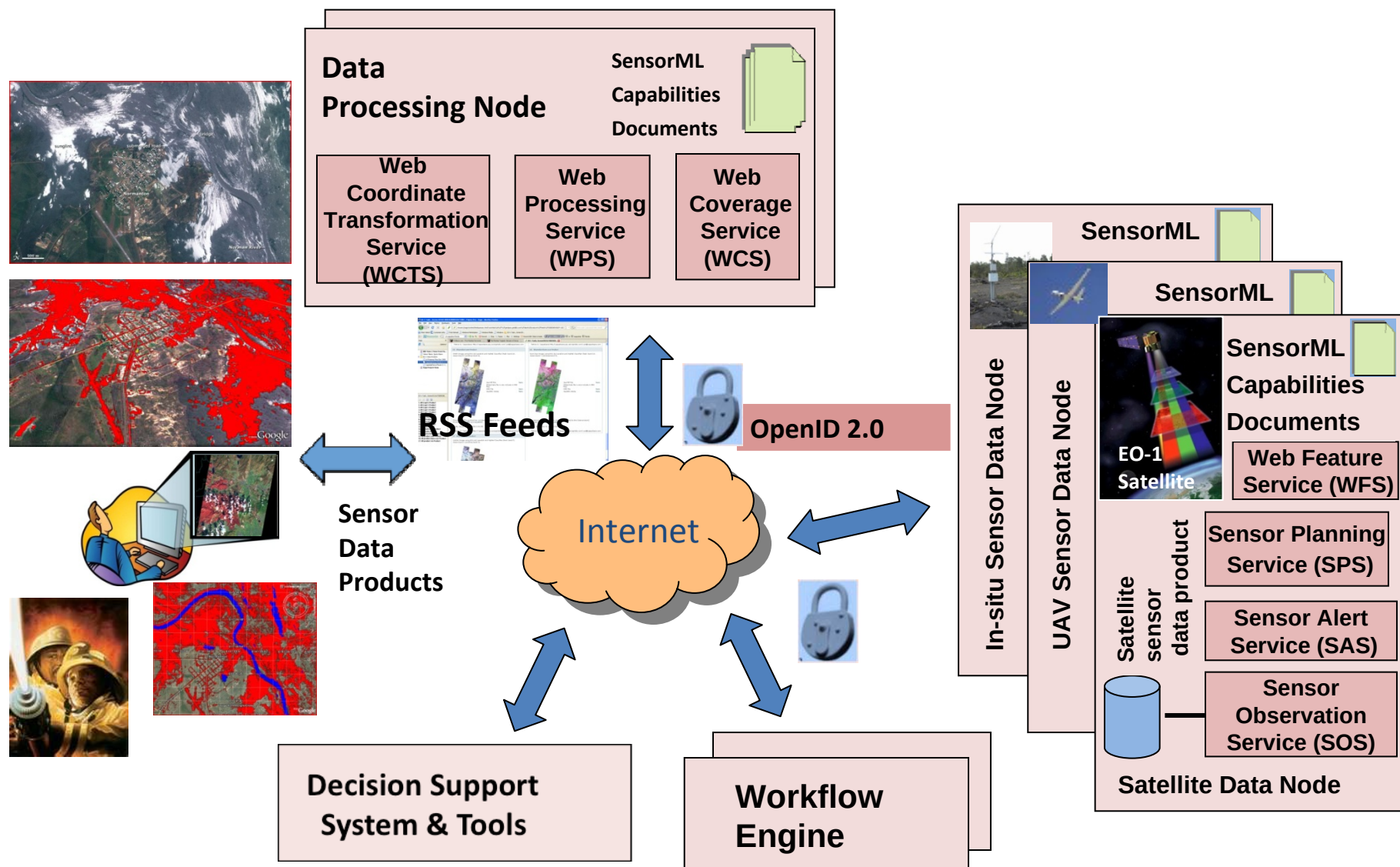


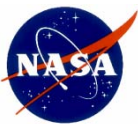
Backup Slides





Basic SensorWeb Components





Campaign Manager Tasking Request Page

Visualize request using Google Map

Tasking Request:

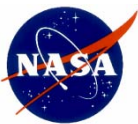
Title: Lake Liambezi test1
Description: Namibia flood campaign requested by Guido Van Langenhove
Category:
Latitude: -17.9108028411865
Longitude: 24.21120262146
Day/Night: day time
Country Code:
Country Name:
Zone Number: 576
Zone Name: Zambia
Region Number: 37
Region Name: Africa
Admin Code:
Admin Name:
Nearby:
Created At: Thu, 23 Apr 2009 02:37:14 -0000
Updated At: 2009-04-23

[Show Map](#)

Feasibilities

Potential Feasibility Asset: EO-1, Date: 2009-04-24T08:09:00Z
Potential Feasibility Asset: ALOS, Date: 2009-04-24T23:24:50Z
Potential Feasibility Asset: FORMOSAT-2, Date: 2009-04-25T00:45:28Z
Potential Feasibility Asset: QB-2, Date: 2009-04-25T08:00:21Z
Potential Feasibility Asset: SPOT-5, Date: 2009-04-25T21:15:14Z
Potential Feasibility Asset: EO-1, Date: 2009-04-27T08:25:00Z
Potential Feasibility Asset: FORMOSAT-2, Date: 2009-04-27T12:24:02Z
Potential Feasibility Asset: SPOT-5, Date: 2009-04-28T06:24:02Z
Potential Feasibility Asset: QB-2, Date: 2009-04-28T19:10:07Z
Potential Feasibility Asset: ALOS, Date: 2009-04-29T00:35:33Z
Potential Feasibility Asset: EO-1, Date: 2009-04-29T08:04:00Z
Potential Feasibility Asset: ALOS, Date: 2009-04-29T20:38:33Z
Potential Feasibility Asset: FORMOSAT-2, Date: 2009-04-29T23:19:50Z
Potential Feasibility Asset: QB-2, Date: 2009-04-30T02:52:57Z
Potential Feasibility Asset: SPOT-5, Date: 2009-04-30T11:02:33Z
Potential Feasibility Asset: EO-1, Date: 2009-05-02T08:21:00Z
Potential Feasibility Asset: ALOS, Date: 2009-05-02T14:09:28Z
Potential Feasibility Asset: QB-2, Date: 2009-05-02T14:38:16Z
Potential Feasibility Asset: SPOT-5, Date: 2009-05-03T01:43:33Z
Potential Feasibility Asset: FORMOSAT-2, Date: 2009-05-03T09:47:24Z





Deliver Level 2 Products via News Feeds to Users Along with Links to GeoTiff, KML and information about Image

EO-1 Task, Scene:EO1A1700592008326110KF, Theme:fire - Sage - Mozilla Firefox

chrome://sage/content/feedssummary.html?uri=http%3A%2F%2Fgeobpms.geobliki.com%2Fdata%2Fproducts%2Ffeeds%2F830B3080-B829-11DC

Freeorder Customized Web Search

Most Visited Customize Links Free Hotmail Windows Marketplace Windows Media Windows EO-1 Task, Scene:EO...

Freeorder st augustine florida Record Stop Pause Play Settings Record ANY Video & Audio WFU... st augustine florida

Sage Options

BBC News | News Front Pa...
Yahoo! News: Sports News
EO-1 Data Products
LA Freeway Fires Nov 2008
Uganda/Kenya Floods 11-1...
Uganda/Kenya Floods 11-1...
Sage Project News

EO-1 Task, Scene:EO1A170059200...

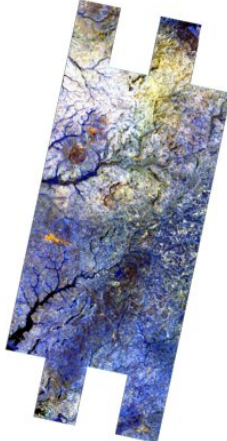
1. Ali tcapt 6 Product
2. Ali tcapt 5 Product
3. Ali tcapt 4 Product
4. Ali tcapt 3 Product
5. Ali tcapt 2 Product
6. Ali tcapt 1 Product
7. Ali br 1 Product
8. Ali rdi Product
9. Ali rvi Product
10. Ali gndvi Product
11. Ali ndvi Product
12. Ali cloud mask Product
13. Ali smoke Product
14. Ali active fires Product
15. Ali product swir Product
16. Ali product burn scar Product
17. Ali product vis Product

FOXNews.com - Five Mumbai Terrorists...
The Mumbai Tragedy: Beware of Innue...
EO-1 Task, Scene:EO1A17005920...

Patrice G. Cappelaere http://cappelaere.pip.verisignlabs.com/ pat@cappelaere.com

15. Ali product swir Product

SWIR Image using EO1 ALI Level1G and Vighetl Classifier (Red: band 10, Green:band 9 and Blue:band 8).



GeoTiff File [here](#)
[Note:Data file is also include in KMZ file]
KMZ File [here](#)
GeoBliki Article [here](#)

[Disclaimer: This product has not been validated by the Science team]
Provided by GeoBliki and GeoBPMS

Friday, November 21, 2008 2:04 PM

Patrice G. Cappelaere http://cappelaere.pip.verisignlabs.com/ pat@cappelaere.com

16. Ali product burn scar Product

Burn Scar Image using EO1 ALI Level1G and Vighetl Classifier (Red: band 10, Green:band 7 and Blue:band 5).



GeoTiff File [here](#)
[Note:Data file is also include in KMZ file]
KMZ File [here](#)
GeoBliki Article [here](#)

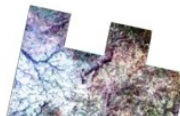
[Disclaimer: This product has not been validated by the Science team]
Provided by GeoBliki and GeoBPMS

Friday, November 21, 2008 2:04 PM

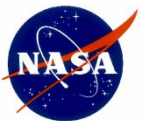
Patrice G. Cappelaere http://cappelaere.pip.verisignlabs.com/ pat@cappelaere.com

17. Ali product vis Product

Visible Image using EO1 ALI Level1G and Vighetl Classifier (Red: band 5, Green:band 4 and Blue:band 3).



SpaceCube Overview



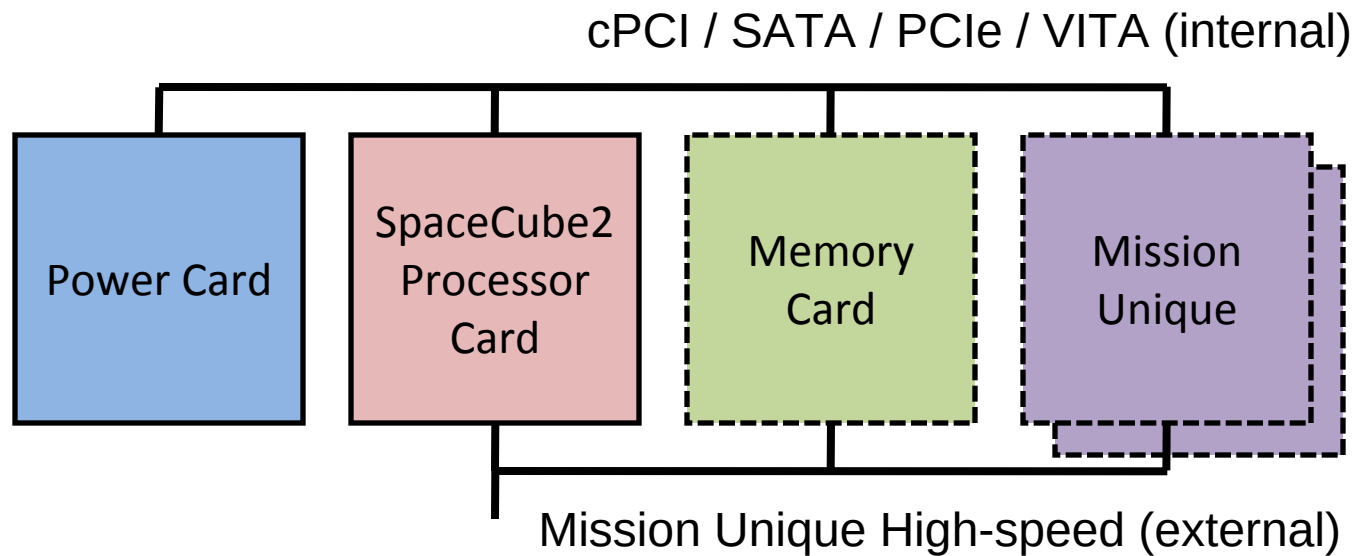


SpaceCube Info and Heritage

- SpaceCube is a powerful hybrid on-board science data processor, based on Xilinx Virtex FPGA technology (integrated CPU, FPGA logic and DSP slices)
- SpaceCube 1.0a flew as part of the Relative Navigation Sensors (RNS) experiment on the recent Hubble Servicing Mission
- SpaceCube 1.0b will be installed on the International Space Station in Nov/Dec 2009 as part of the Naval Research Lab MISSE7 experiment palette
- SpaceCube 1.5 will serve as science data processing avionics on sounding rocket technology demonstration flight in June/July 2010 (in collaboration with NASA/Exploration and DoD/ORS)
- ESTO recently funded (Dec 2008) the development of SpaceCube 2.0 to support the Earth Science Decadal Survey missions, delivery of environmentally tested flight prototype scheduled for April 2012
- SpaceCube 1.0a/b uses the Virtex 4 series FPGA (rad-tolerant)
- SpaceCube 2.0 uses the Virtex 5 S1RF FPGA (rad-hardened via AFRL funding)



SpaceCube 2.0 Block Diagram



SpaceCube 2.0 unit (estimated, 4 cards): 7 lbs, 15-20 watts, 7"L x 7"W x 5"H



Flight Processor Comparison

	MIPS	Cost	Power	MIPS/W
MIL-STD-1750A	3	-	15W	0.2
RAD6000	35	\$250K	10-20W	2.33 ¹
RAD750	<500	\$200K	10-20W	30 ²
SPARC V8	86	\$???K	1W ³	86 ³
LEON 3FT	60	\$???K	3-5W ³	15 ³
SpaceCube 1.0	3000	\$60K	5-15W	400 ⁴
SpaceCube 2.0	5000	\$60K	10-20W	500 ⁵

Notes:

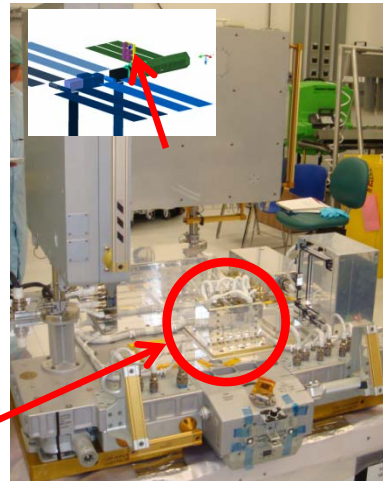
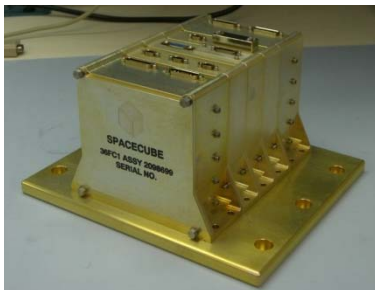
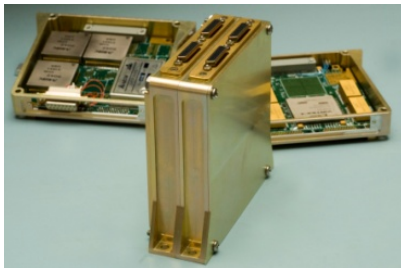
1 – typical, 35 MIPS at 15 watts

2 – typical, 450 MIPS at 15 watts

3 – processor device only ... total board power TBD

4 – 3000 MIPS at 7.5 watts (measured)

5 – 5000 MIPS at 10 watts (calculated)



SpaceCube 1.0b on NRL MISSE7 palette at KSC



SpaceCube 1.0a in STS-125 Payload Bay