Cross-track Infrared Sounder (CrIS) SDR Calibration/Validation Plan Status

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Sounder Science Team Meeting

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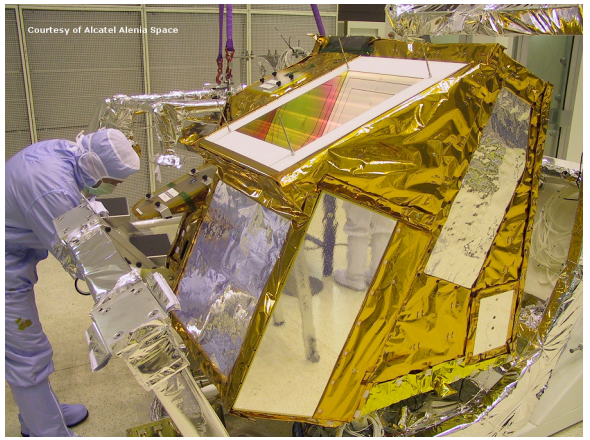
You may be tempted to ask, "Just which plan are we talking about? Haven't we done this about 15 times already?"

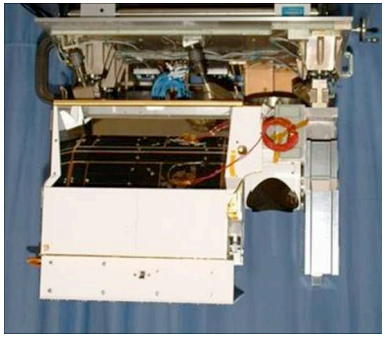
CrIS is 3rd Hyperspectral Sounder

AIRS

IASI



CrIS



CrIS follows two great, well calibrated instruments to orbit
SDR Cal/Val will utilize similar procedures
Co-existence allow direct comparison-good comparisons from GSCICS
Cal/Val team brings direct AIRS/IASI experience
Hence, today's Cal/Val plan is significantly different than the first one

NPP CrIS SDR Cal/Val Plan

Objectives

- **Develop up-to-date plan to guide the cal/val process implementation**
  - **Resource allocation, architecture development and communications**
  - **Coordinate previous planning, foster team building,**
  - **Optimize task assignments, resource utilization**
- **Unify cal/val planning, describe the joint government/ industry effort**
  - **IPO-industry team consolidating and optimizing previous versions**
  - **Allocating anticipated resources, developing functional approaches**
  - **Preparing document section for near term SME and community review**
- **Incorporate heritage lessons (AIRS, IASI, TES calibration)**
  - **Cross calibration assets**
  - **Tools and techniques developed by team members**
- **Guide pre-launch SDR development using bench and TVAC tests**
  - **Guided by experienced industry, government and academic SMEs**
  - **Open process, with near real time data sharing, process guidance**
- **Provide detailed planning for post-launch activities**

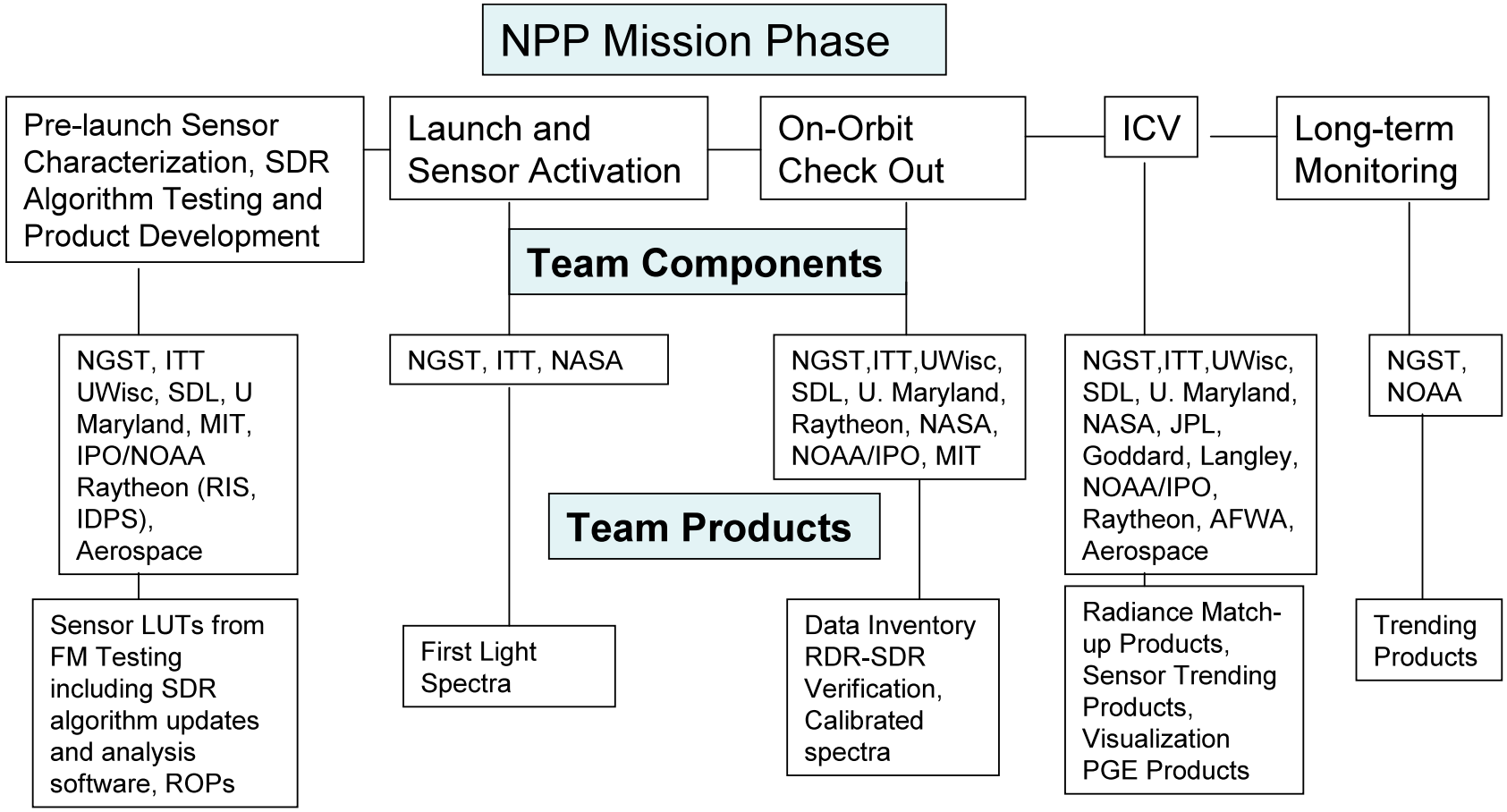
NPP CrIS SDR Calibration Strategy (1)

- **Build a team of SMEs from government, industry and science communities with heritage knowledge and tools to assure mission success.**
  - **Provide the basis for resource allocation and justification**
- **Utilize two pronged pre-launch effort :**
  - **Development of formal software and instrument response functions utilizing ground test data to verify SDR accuracy and completeness**
  - **Develop post flight plan, team, support facilities and communications**
- **Pre-launch effort**
  - **Analysis of TVAC data**
  - **Evolve TVAC findings into improved operational algorithm**
  - **Verification of RDRs and ITT supplied engineering parameters (LUTs)**
  - **Test the SDR conversion from C++ into the IDPS system**
  - **Test the post launch software, tools and communication systems**

NPP CrIS SDR Calibration Strategy (2)

- **Post-launch effort lead by NGST, supported by government resources**
  - **IPO provided computer support, personnel resources**
  - **IPO contracted SMEs from government and academic associated laboratories**
  - **Distributed design utilizing teleconferencing, internet, distributed software**
  - **System exercised extensively pre-launch using proxy data**
- **Post-launch effort divided into three phases**
  - **Sensor activation and checkout**
    - > **Lead by NGST and ITT**
    - > **Data available to SME team for information and communication checkout**
  - **Intensive Calibration Period**
    - > **Combined effort by NGST/ITT and government SME teams**
    - > **Effort coordinated through IPO "Issue Tracker" and "DR Tracker" software**
    - > **Linux based SDR software at SME and government team locations to process RDRs and make data available to local tools**
    - > **IPO Linux and NGST's IBM ADA system provide change suggestion verification**
- **Long term monitoring and trending**
  - **NGST and SME participation**
  - **Note: I do not see any Sounding Science funding included in the cal/val effort**

Cal/Val Effort Summary

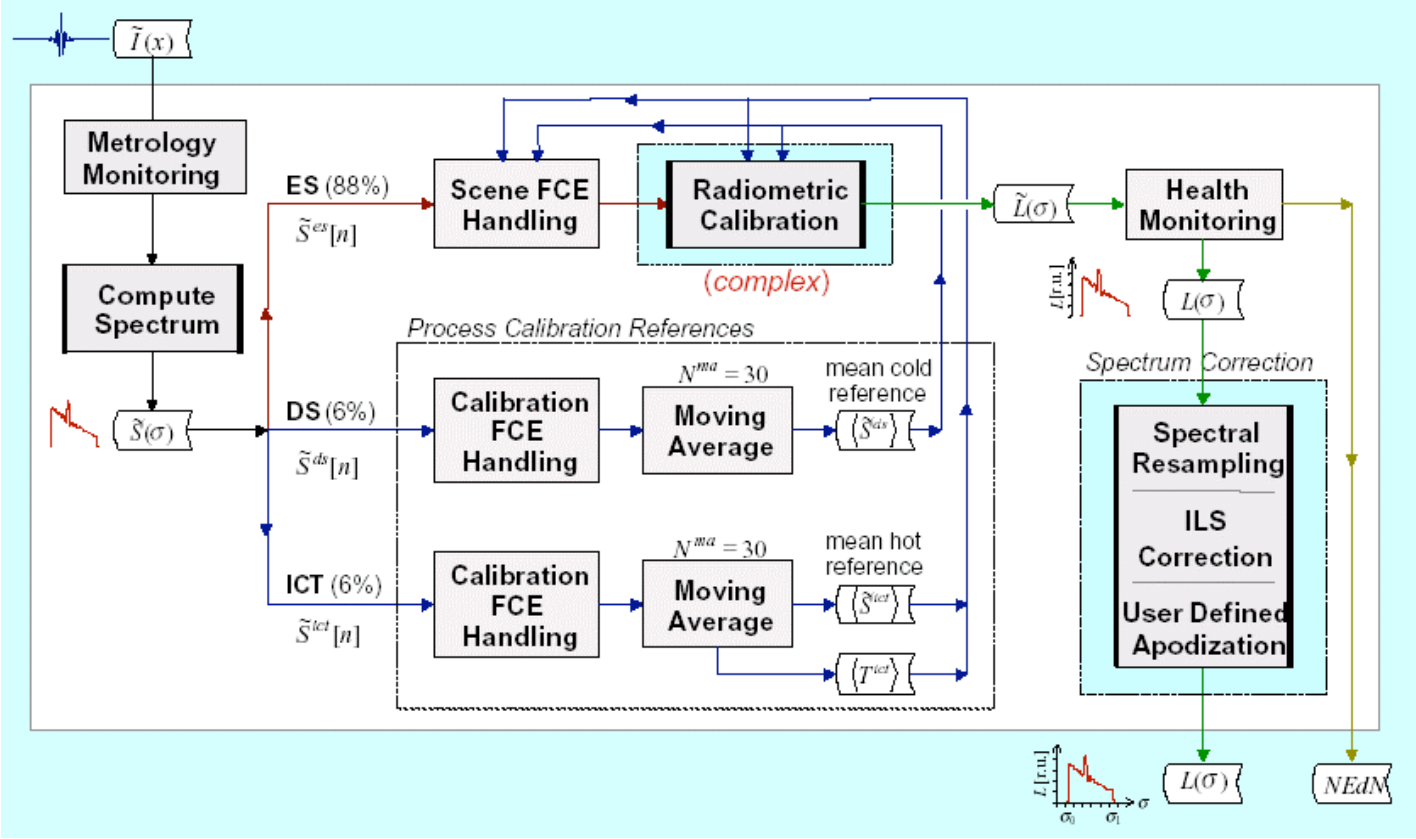


NPP CrIS SDR C/V Team

	NGST/Raytheon/ITT	IPO/Govt
Function / Leads	**Denise Hagan (NGST)**	**Gail Bingham (SDL)**
Instrument Verification Radiometric Cal SST Comparisons Radiosonde Comparisons Cross-Platform Comparison Model-to-Instrument Geolocation	Denis Tremblay Chunming Wang Denise Hagan Gene Kratz Giovanni De Amici	**SMEs** Dan Mooney (Lincoln Labs) Hank Revercomb, Dave Tobin and Bob Knuetson (UW SSEC) George Aumann and Tom Pagano (JPL) Larrabee Strow (UMBC) M. Esplin, C. Fish, G. Cantwell, V. Zavyalov, N. Pougatchev (SDL) Chris Barnet (NESDIS/STAR)
ATMS Interface	Giovanni De Amici	Bill Blackwell (Lincoln Labs) Edward J. Kim (GSFC) Lynn Chidister (SDL)
Sensor Support	Joe Predina, Glenn White, Dave.Jordan, Lawrence Suwinski, Ron Glumb, Steve Wells and Nathan Funk (ITT) Farhang Sabet-Peyman,	Mark Esplin, Greg Cantwell (SDL)
SDR Operational Algorithm Change Support SDR ILS Updates	Denis Tremblay and AM&S (Degui Gu, Xia-Lin Ma) AER (Post-launch POC TBD)	Larrabee Strow (UMBC) Dean Ferguson, Mark Greenman (SDL)

SDR Design

- **SDR is maturing as the instrument develops**
  - **Three EDUs proceeded FM1, but still learning things!**
  - **New releases of the SDR have accompanied the learning process.**
  - **Newest version will include non-linearity correction and improved ICT environment model. (Beta release imminent)**



Prelaunch SDR Tuning

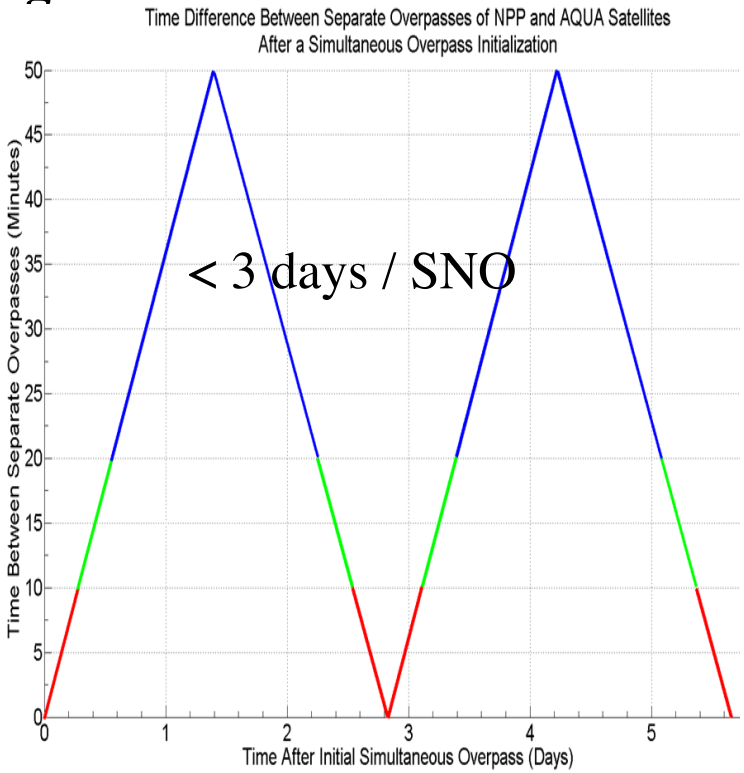
SDR Algorithm Parameter Specified in 4 min Engineering Data Packet	Populated Pre-launch	Post-launch Update	Task Network ID	On-Orbit Procedure/Method
Effective Neon wavelength	ITT	Cal-Val	855, 1333	Set Neon Lamp Calibration (ROP #8216134)
ILS Fit Parameters	ITT	Cal-Val	910, 913, 926	DA Tilt Offset Determination (ROP #8216139) Likely requires adjustments
Cal Target Geometric factor	ITT	Cal-Val	914, 927, 1341, 1374	May require tuning
Cal Target Emissivities (Wavelength-dependent)	ITT	Cal-Val	914, 927, 1341, 1374	May require tuning
Polarization Change (%) (Detector/FOV dependent)	ITT	Cal-Val	927	May require tuning
Polarization Wavenumber	ITT	Cal-Val		Determined pre-launch
Ext Env ICT Model Parameters	ITT	Cal-Val	927, 1341, 1374	May require tuning
Science TLM Coefficients	ITT	Cal-Val		Determined pre-launch for ICT Radiance Model; may require tuning
TLM Limits	ITT	Cal-Val		Temp Drift limits determined pre-launch; may require tuning
Mapping Parameters	ITT	Cal-Val	911, 925	May require tuning
Bit Trim Masks	ITT	Cal-Val	911	Bit Trim and Impulse Mask Checks (ROP #8216136)
OPD SampleJitter Correction Parameters	ITT	Cal-Val		ITT Procedure TBD
Spectral Calibration Data	ITT	Cal-Val	833	Tuning

Post Launch Cal/Val Task Summary

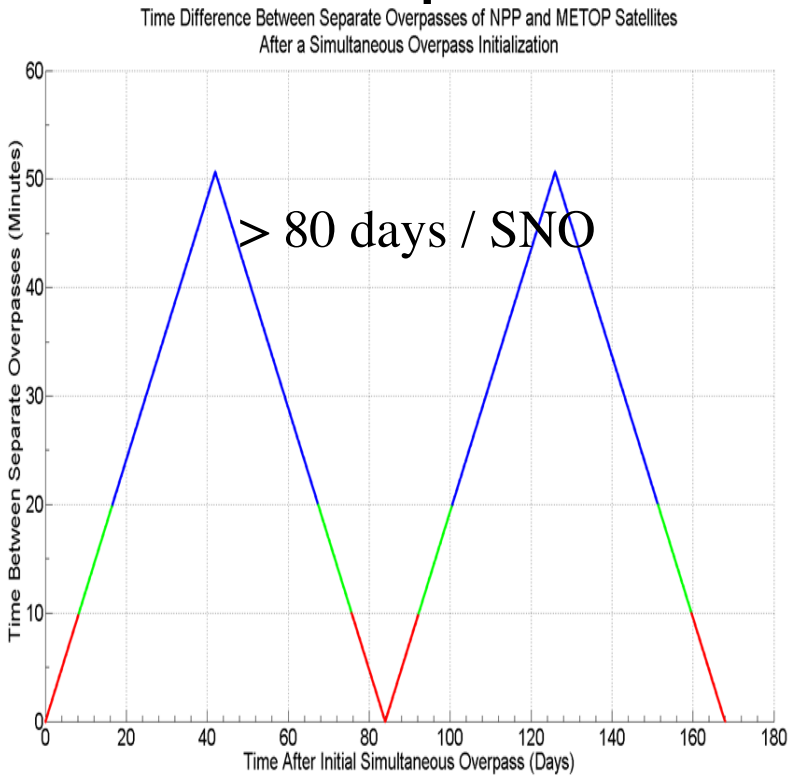
Principal Category	Sub-Category	Task Network ID#(s)	Related Sensor Performance Requirement #s	Cal/Val Phase				Benefit from Air Campaign	Requires Sea &/or Ground Campaign	**Lead / Backup**
				Sensor Activation	Sensor Checkout	SDR Baseline	Long Term Monitoring			
Functional Performance	CrIS Diagnostic Mode	1329, 1330, 905		X	X	X	X	No	No	**ITT / NGC**
	Sensor Checkout Status and Trending	857, 911, 913, 914, 910, 907, 1327, 1569, New Task 1, New Task 2		X	X	X	X	No	No	**ITT / NGC**
	CrIS Activation	1322, 900, 901, 902, 903, 904, 1324, 1325, 1326, 1328, 974		X				No	No	**ITT / NGC**
	CrIS Telemetry Parameters and RDR Status and Trending	1549, 1550, 870, 912, 927		X	X	X	X	No	No	**ITT / NGC**
Radiometric Accuracy	Absolute Radiometric Uncertainty	1552, 870, 871, 935, 936, 1341	SDRP 3481, CSS 4589		X	X	X	Yes	TBD	**SDL / SSEC / NASA**
	Radiometric linearity	867, 870	CSS 835		X	X	X	No	No	**SSEC / ITT**
	Cross Comparisons	1334, 1335, 1339, 1344, 1557, 1553				X	X	Yes	Yes	**NGC / SSEC / STAR / NASA**
	ICT Temperature Stability	864, 975, 1550, 1551, 1552, 1332, 870, 908, New Task		X	X	X	X	No	No	**ITT / NGC SDL / UMBC**
Spectral Accuracy	Laser Wavelength	855, 862, 875, 1333, 1342			X	X	X	No	No	**ITT / UMBC**
	Spectral Calibration	868, 870, 924, 926, 933, 935, 1341	SDRP 7043, 884, 940, 944		X	X	X	Yes	TBD	**ITT / SSEC**
Spatial Performance	Geolocation	925, 934, 929, 1373, 1552	SDRP 3731, 882, 7019, CSS 1762		X	X	X	No	No	**NASA/SDL**
	CrIS FOV Coregistration	869, 871, New Task	SDRP 3695, 3714, CSS 1721, 1736, 1740	X	X	X	X	No	No	**NGC / SDL**

Government IV&V SDR Activities

- **Government supported effort is designed to provide industry team capability gap filling and independent review**
- **Significant support to NGST/ITT from IPO supported SME's with aircraft and space FTS sensor experience (GIFTS, MSX, NAST-I, S-HIS)**
- **Significant use of WMO GSICS and CEOS calibration procedures**

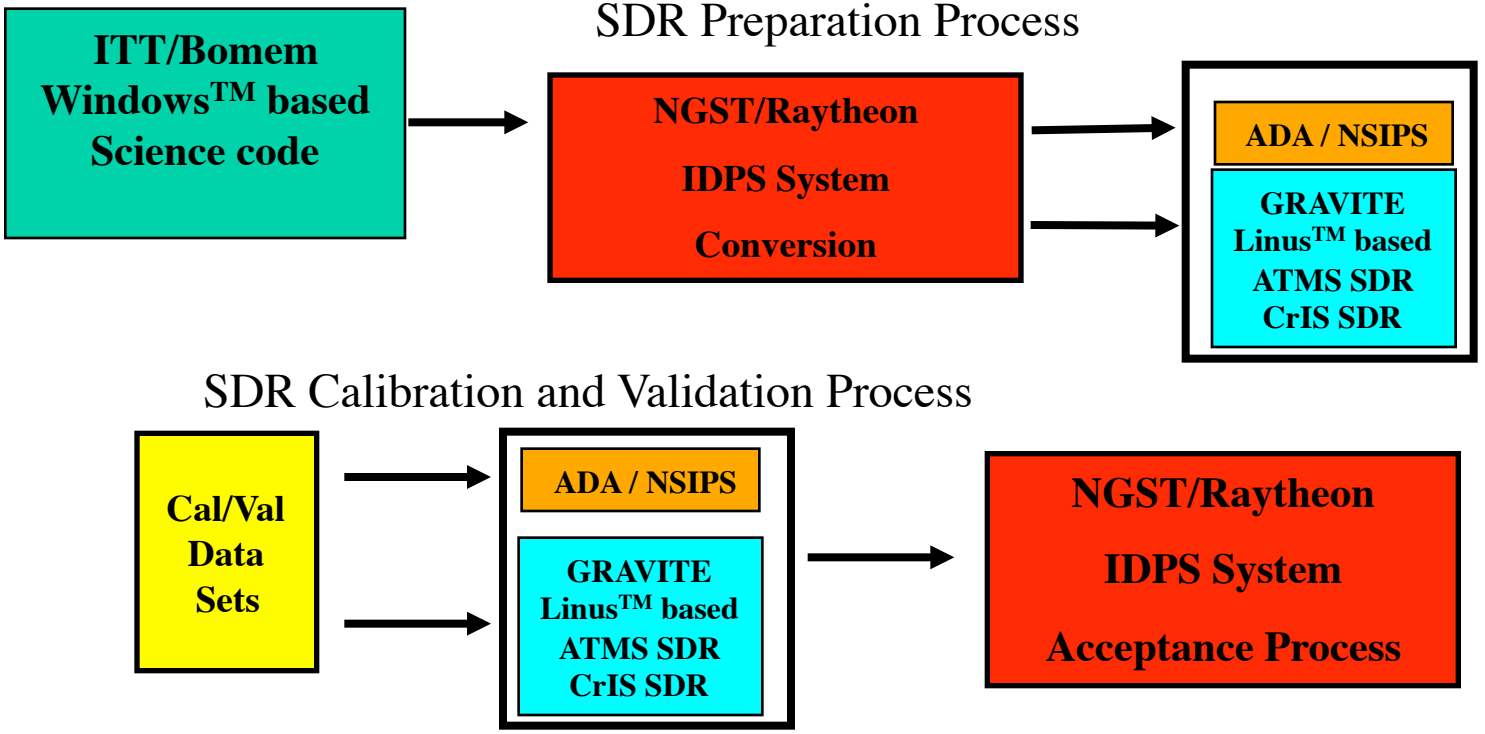


AIRS to NPP SNO time delta



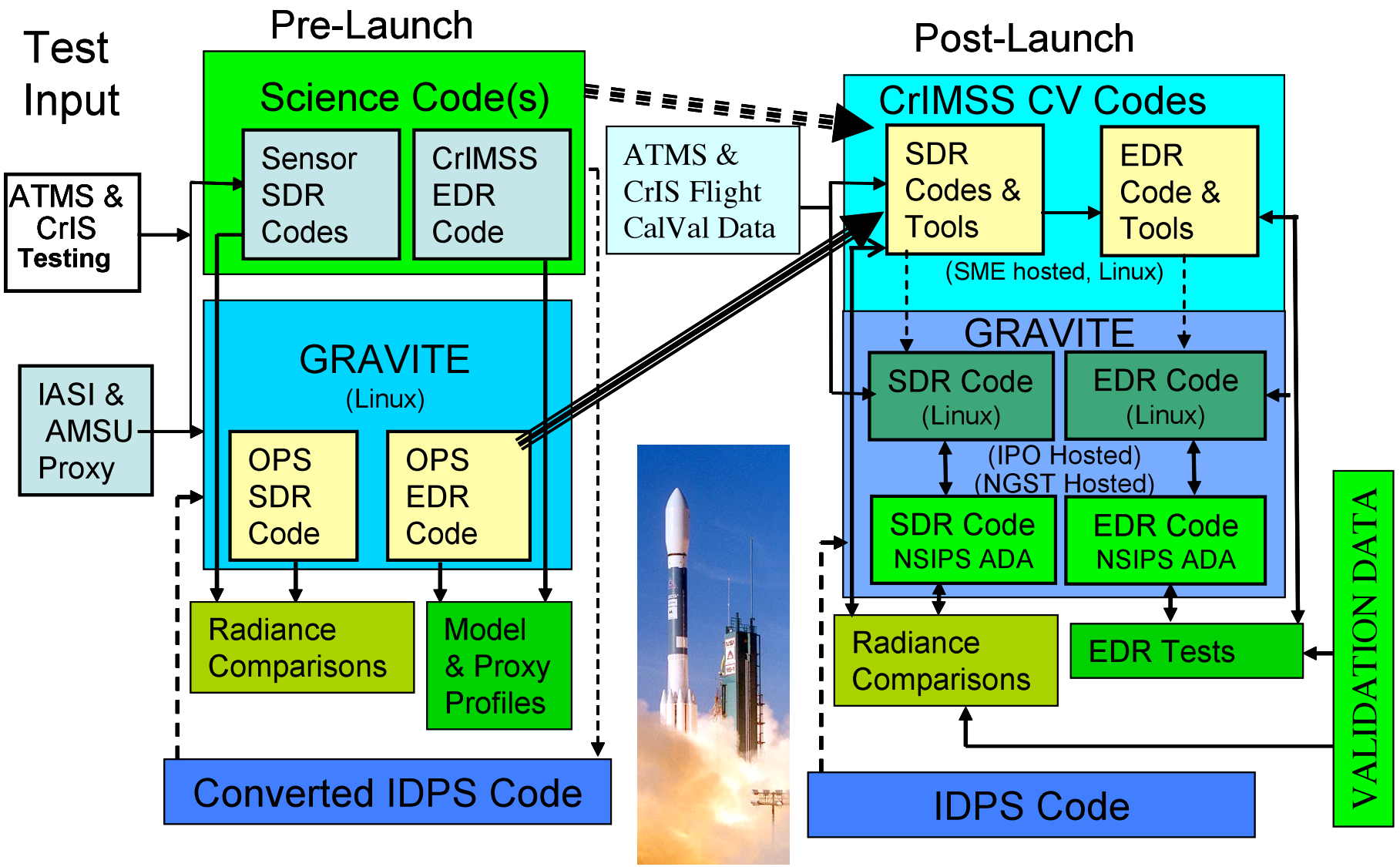
CrIS to IASA SNO time delta

SDR Development System Flow

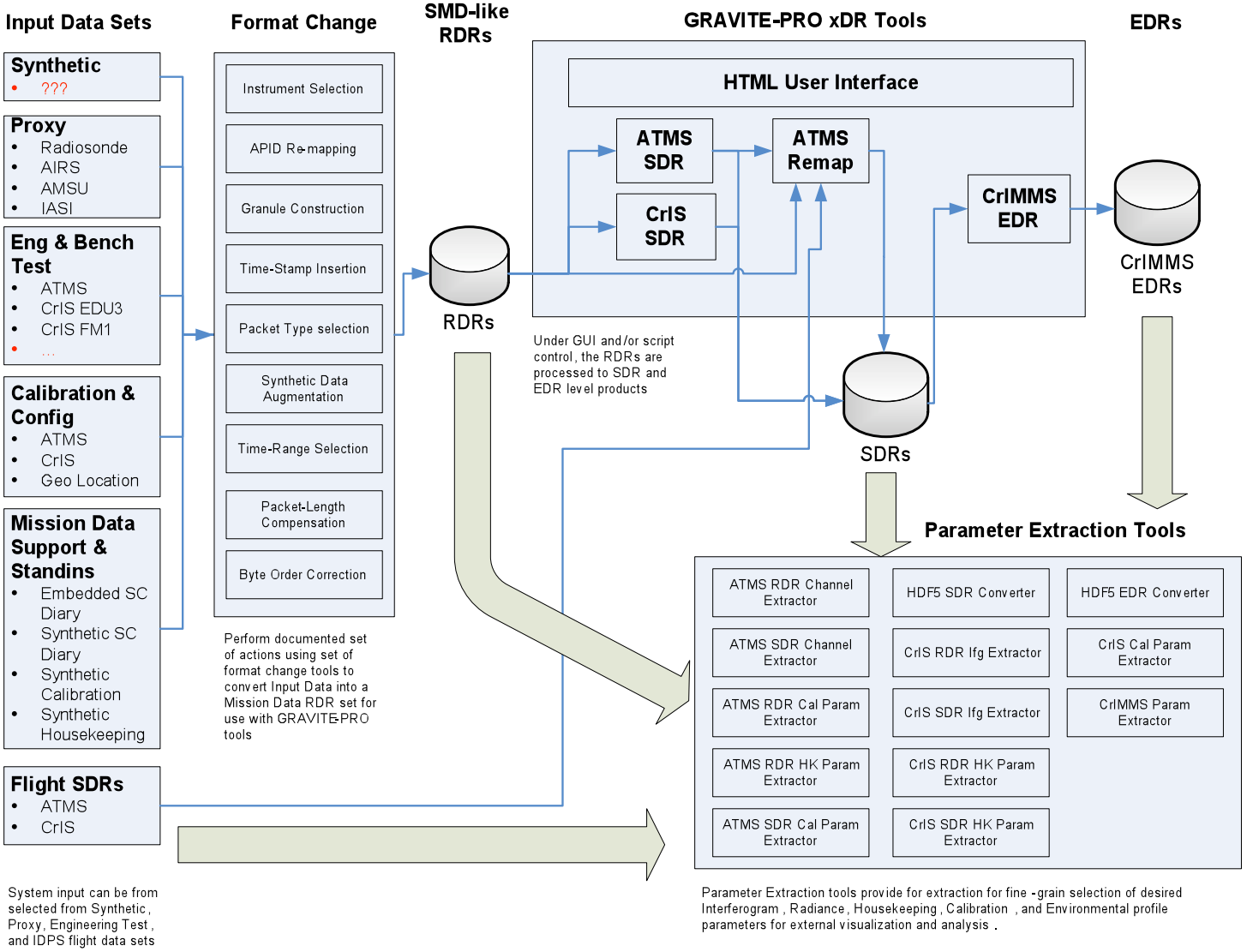


- **ITT developed Science Code is the basis for IDPS development – provides preflight SDR**
- **Our effort will validate the science and IDPS codes, before launch, using AIRS/AMSU and IASI/AMSU proxy data.**
- **A controlled, user friendly version of the SDR will be provided to the Cal/ Val team to allow a distributed CrIMSS Cal/Val network.**

Cal/Val Data Processing Support

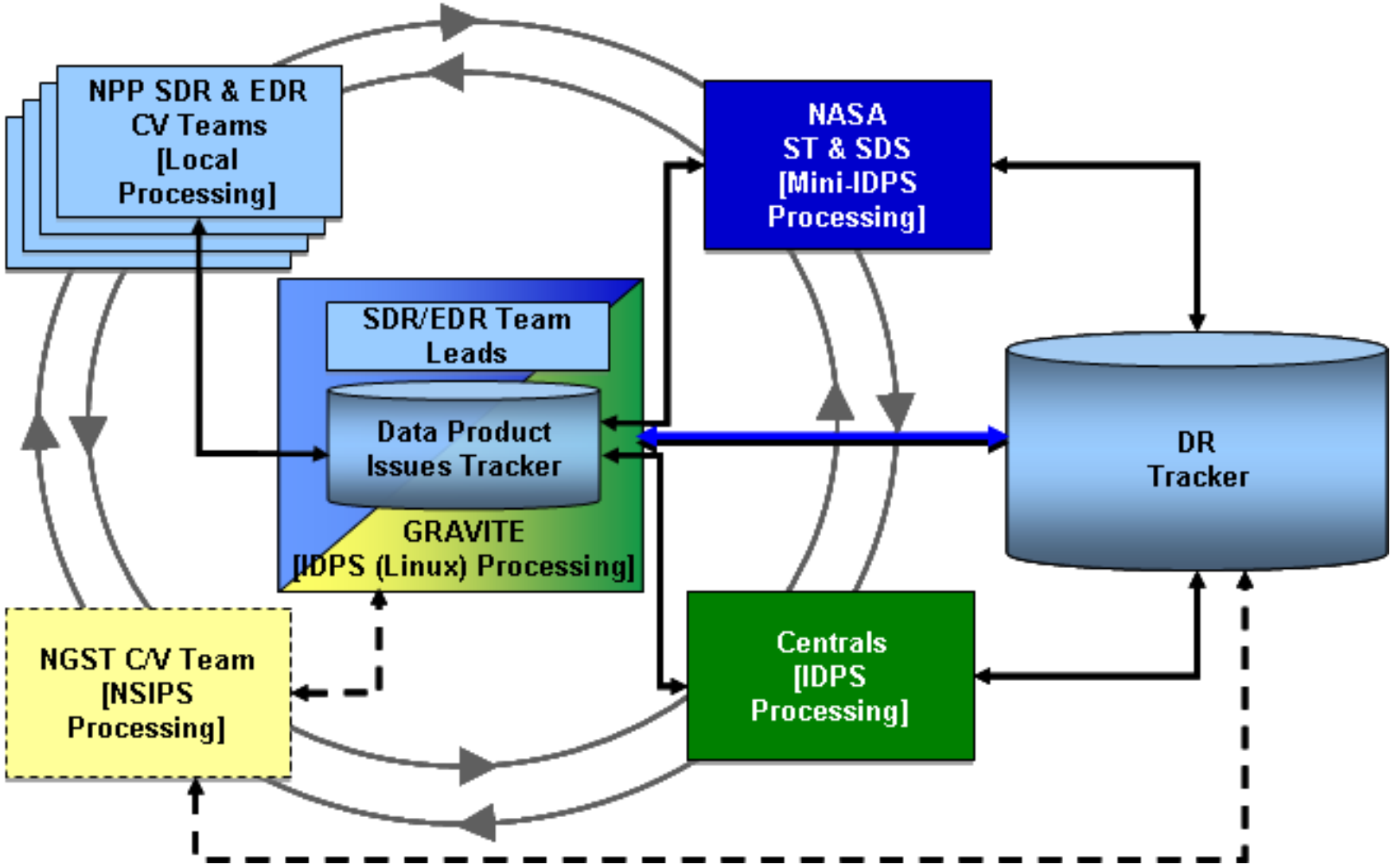


GRAVITE Linux SDR Validation Tool



Sophisticated, flexible package available for team member use

Cal/Val Communications/Coordination



Team members linked by internet and teleconferencing links

Cal/Val Preflight Exercises

- **The data and software interfaces required for Cal/Val effort are complex and cross many boundaries.**
- **Critical prelaunch steps to implement this plan include:**
  - **Completion of tool development and validation**
  - **Definition and EXERCISE of data interfaces and products**
  - **Specific cal/val tasks linked to specific SDR coefficients**
  - **EXERCISE the cal/val data to coefficient update procedure**
- **Pre-launch cal/val exercise plan is under consideration that would use proxy data collection to allow end-to-end verification of SDR performance and the EDR interface.**
  - **Use real time AIRS & IASI data collection as proxy data source**
  - **Utilize an aircraft campaign to provide benchmark absolute calibration of existing (heritage) assets.**
  - **Aircraft role has probably changed with AIR/IASI existence and GSICS efforts**
  - **Verify tools and ancillary data collection, access – utilization.**

Plan Implementation Summary

- **CrIS SDR Cal/Val effort has 4 branches:**
  - **Thermal Vacuum performance assessment and SDR validation**
    - > **Team wide, biweekly data analysis telecom and result progress reviews**
    - > **Exercise science SDR code with independent TV results**
  - **Detailed "Task Network" item update and optimization**
    - > **Coefficient identification and CV task link assignment**
    - > **Effort error and resource analysis**
  - **CV system exercise plan development, budgeting and schedule**
    - > **Coordination and buy-in across agencies and sensors**
    - > **Resource availability verification and schedule development**
  - **CV personnel interfaces and network development / validation**
    - > **Completion of IDPS to Linux code conversion for GRAVITE**
    - > **GRAVITE operations plan development and user team review**
- **Careful, in depth coordination of CrIS SDR and CrIMSS EDR planning and development teams is critical to smooth function.**