GOES-R – Preparing for Operations

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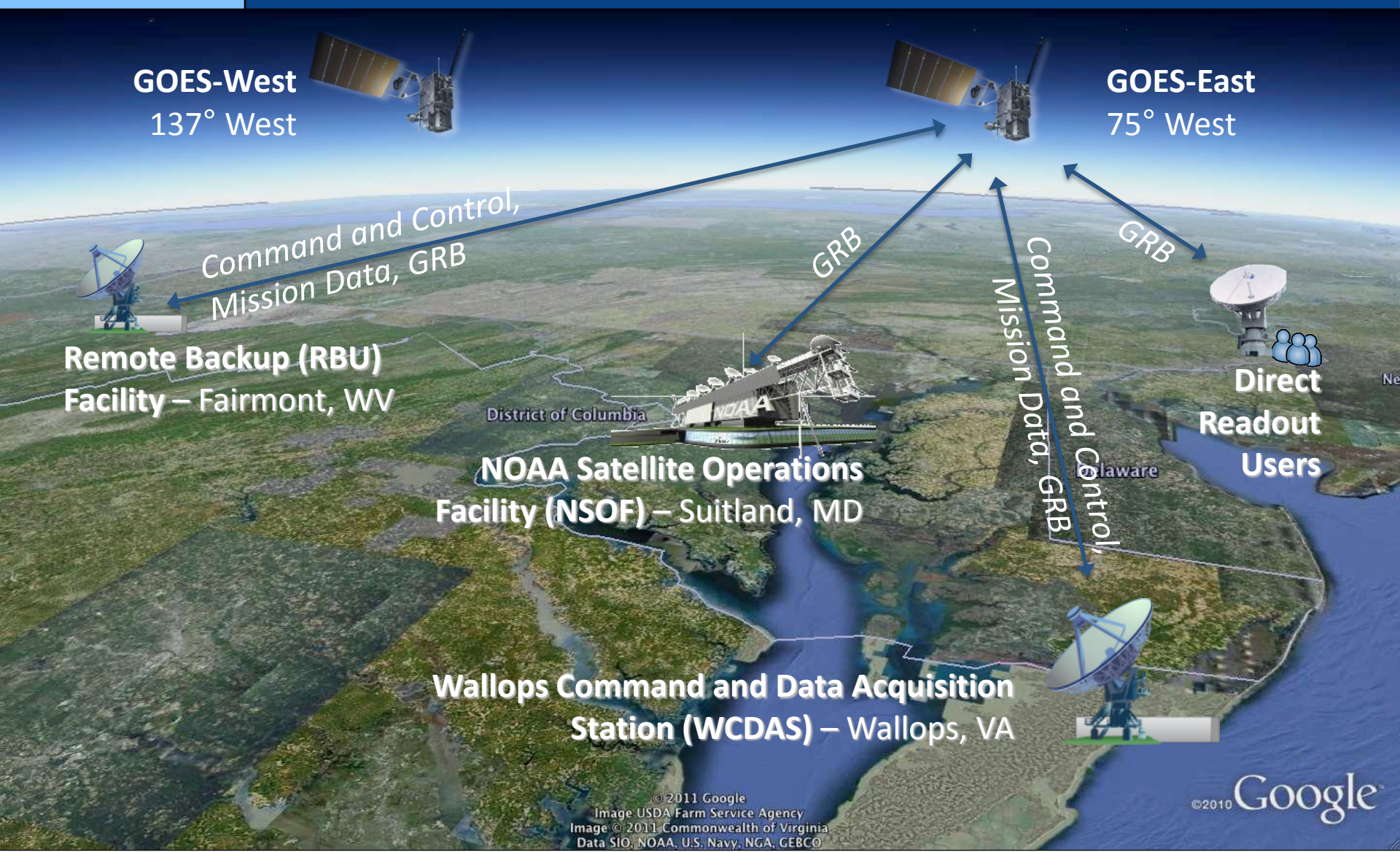
# GOES-R Operational System Configuration

GOES-West
137° West

GOES-East
75° West

Command and Control, Mission Data, GRB

GRB

GRB

Command and Control, Mission Data, GRB

Remote Backup (RBU) Facility – Fairmont, WV

Direct Readout Users

NOAA Satellite Operations Facility (NSOF) – Suitland, MD

Wallops Command and Data Acquisition Station (WCDAS) – Wallops, VA

District of Columbia

Delaware

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Continuity of NOAA's Geostationary Operational Satellite Programs
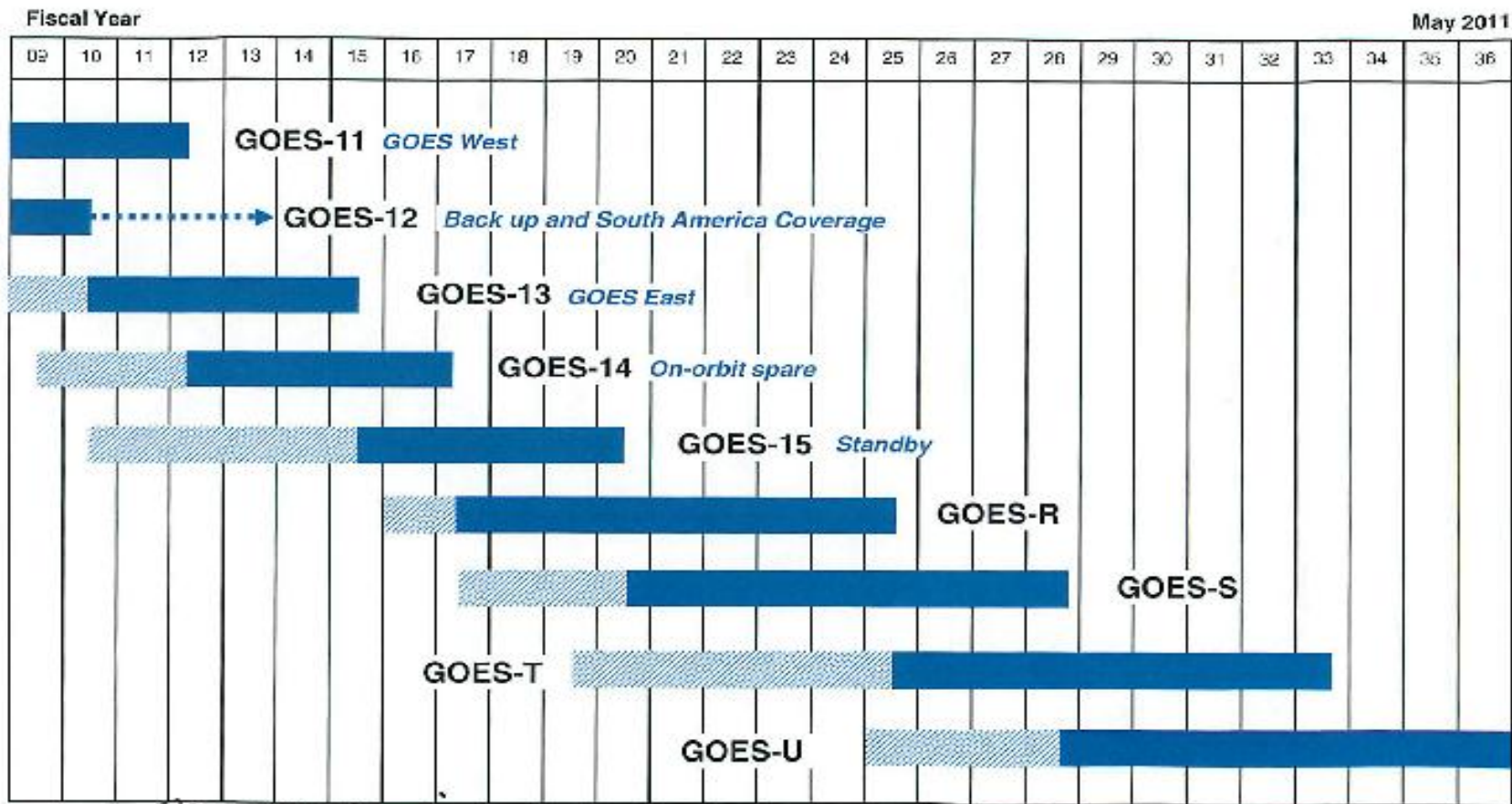
GOES-R Preparing for Operations

- Prepare for
  - Transition to *GOES Rebroadcast (GRB)* that will replace GVAR and be tested during PLT

  - New *Product Distribution and Access* capabilities

  - *Post Launch Test* of the first in-orbit GOES-R Series Satellites and Ground Segment

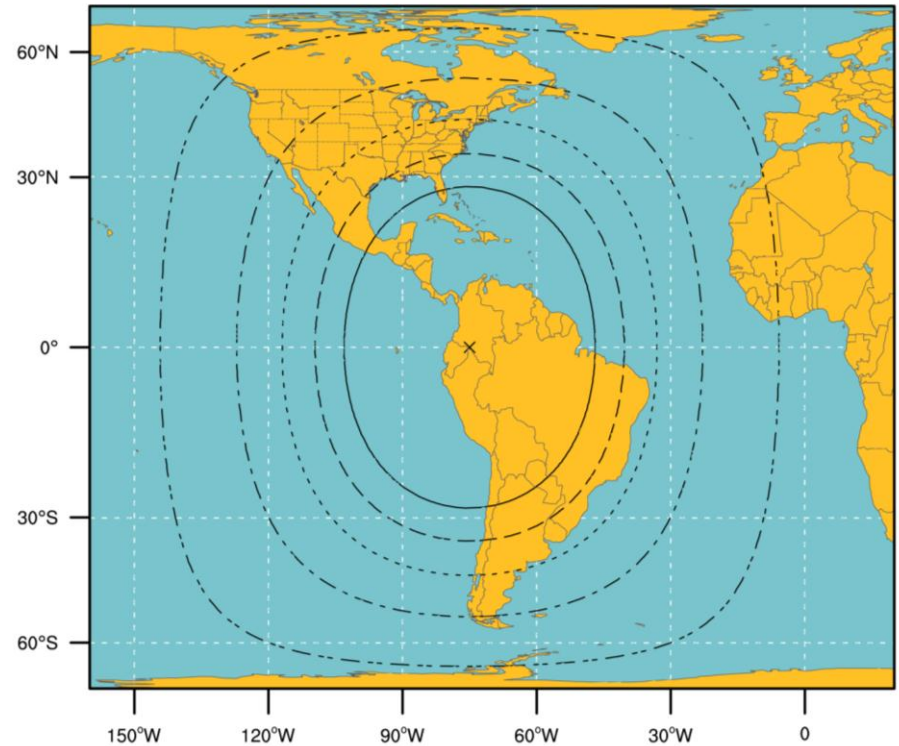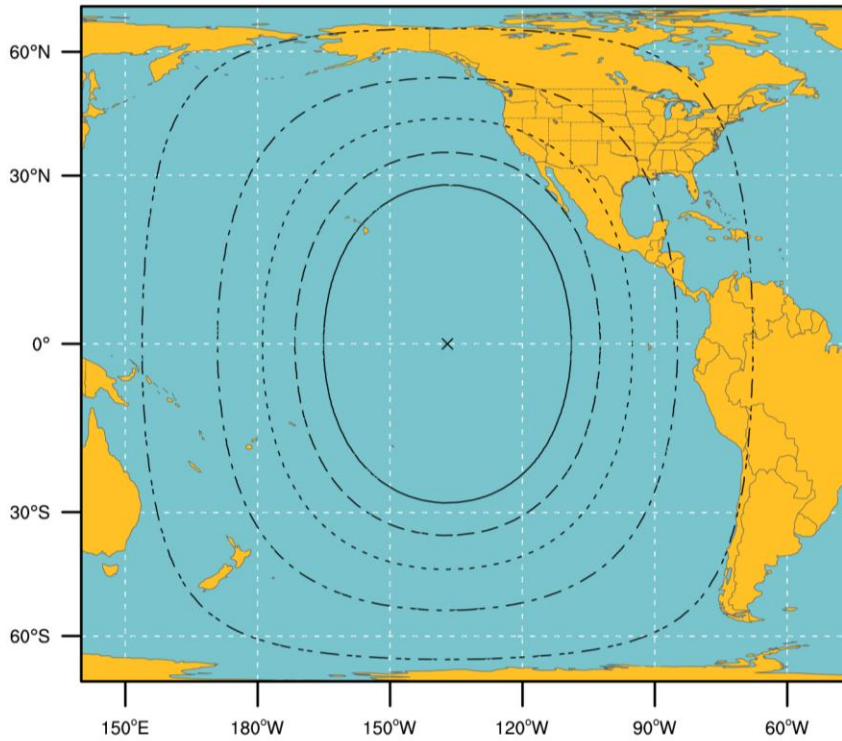 - *Algorithm improvements* and the *addition of new data products*

Transition from GVAR to GRB

	GVAR	GOES Rebroadcast (GRB)
Full Disk Image	30 minutes	5 minutes (Mode 4)
		15 min (Mode 3)
Other modes	Rapid Scan, Super Rapid Scan	3000 km x 5000 km CONUS: 5 min
		1000 km x 1000 km Mesoscale: 30 sec
Polarization	None	Dual circular polarized
Receive Center Frequency	1685.7 MHz (L-band)	1686.6 MHz (L-band)
Data Rate	2.11 Mbps	~30 Mbps
Antenna Coverage	Earth coverage to 5°	Earth coverage to 5°
Data Sources	Imager and Sounder	ABI (16 bands), GLM, SEISS, EXIS, SUVI, MAG
Space Weather	None	~2 Mbps
Lightning Data	None	~0.5 Mbps

GRB Ground Antenna Sizes

NOTES:
1. Calculations based on available data as of May 2011
2. Each antenna size is usable within the indicated contour
3. Rain attenuations included are:
   1.3/1.6/2.0/2.2/2.5 dB (3.8 to 6 m)
4. An operating margin of 2.5 dB is included as the dual polarization isolation is likely to vary within each antenna size area

Antenna Diameters
— - - — - - — - -	6.0 m
— - — - — - — -	5.0 m
- - - - - - - - -	4.5 m
— — — — —	4.2 m
——————	3.8 m

GRB Downlink Characteristics

- Input Center Frequency: 1690.0 MHz
- Content (specified for each of two polarization channels: LHCP, RHCP)
  - L1b data, QC data and metadata: ABI, SUVI, EXIS, SEISS, MAG
  - L2 data, QC data, metadata: GLM
  - GRB Information Packets
- Data rate
  - 31 Mbps maximum data rate
  - 15.5 Mbps instantaneous maximum for each polarization channel
  - Down link margin: 2.5 db
- Compression - Lossless compression required
  - JPEG2000 and SZIP are candidates that are being considered/studies
- Format
  - Inner Frame Format: CCSDS Space Packet
  - Outer Frame Format: DVB-S2
- Coding
  - BCH + LDPC (2/3) for 8-PSK and LDPC (9/10) for QPSK
- Modem Required C/No (dB-Hz): 78.6
- Maximum Demodulator Required Eb/No (dB) for 1×10^{-10} BER: 4.8 dB/Hz
- Minimum Antenna System G/T (dB/K) : 15.2

These specs should be considered preliminary and will be finalized in 2012

GRB Simulators

- Purpose
  - On-site testing of user ingest and data handling systems, aka GRB field terminal sites
  - Simulates GRB downlink functionality by generating Consultative Committee for Space Data Systems (CCSDS) formatted GRB output data based on user-defined scenarios, test patterns, and proxy data files.
  - Available in 2013
- Key Capabilities and Features
  - Transportable
    - Fully self contained
    - Configurable hardware units
  - Outputs simulated GRB
  - "Off-line Mode" to create and setup configurations and scenarios
    - Also, create test patterns and input proxy data
  - "On-line Mode" to continuously output GRB data stream at IF or baseband levels
    - Includes monitoring and logging of events

GRB Simulator Concept

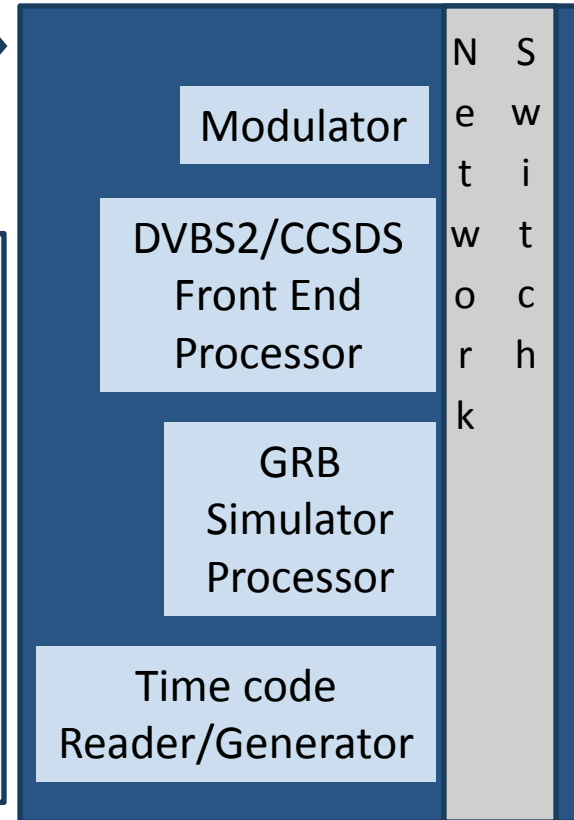**Simulated data/test patterns**

Binary/PNG/JPEG
Proxy Data

GRB signal in Baseband and IF Frequencies

- CCSDS packets in LHCP and RHCP streams
- Lossless compression
- DVBS2 framing
- BCH/LDCP encoding
- 8-PSK or QSPK modulation

	Network	Switch
Modulator		
DVBS2/CCSDS Front End Processor		
GRB Simulator Processor		
Time code Reader/Generator		

GOES-R Data Distribution

GRB

Direct Broadcast Community

Sectorized Cloud and Moisture Imagery

AWIPS NCFs

NOAA Port

NOAAPort Community

GRB

Mission Data

GRB

L1B and L2+ Derived Products

GOES-R GS

PDA

NSOF

L2+

WCDAS

GOES-R GS

RBU

L0, L1B

CLASS

L0, L1B and L2+ Derived Products

Fastest

Access Speed

Slowest

Operational User Community (NOAA Centers, DOD, NCEP, Int'l Partners)

Climate Research & Academia

Digital Data Access

- ## AWIPS
  - Imagery Products for Full Disk, CONUS, Hawaii, Alaska, Puerto Rico, and Mesoscale
  - Delivered in NetCDF-4 formatted "Sub-Image Tiles"
  - Format described in PUG Volume 5
  - NWS is planning NOAAPort Capacity Expansion

- ## ESPDS/PDA – Product Distribution and Access
  - Operational Data Access Portal being acquired by NOAA/NESDIS/OSD
  - Time-sensitive distribution of L1B and L2+ data sets
  - Seven Day revolving store
  - Project Information and Status:
    http://www.osd.noaa.gov/Spacecraft Systems/Ground_Systems/GAS/gas.html
  - Access requires authorization per NESDIS Policy for Access and Distribution of Environmental Satellite Data and Products, dated Feb 17,2011
    http://www.ospo.noaa.gov/Organization/Documents/PDFs/NESDIS_Data_Access_Distribution_Policy.pdf

Data Access for Retrospective Use

- ## CLASS

  – Archived data will include :

    - L0, L1B, and L2+ Mission Data Products and associated Metadata

    - Calibration and Processing Parameters

    - Algorithm Software and Test Data

    - Instrument Calibration Data

    - Ancillary Data used to generate Mission Data Products

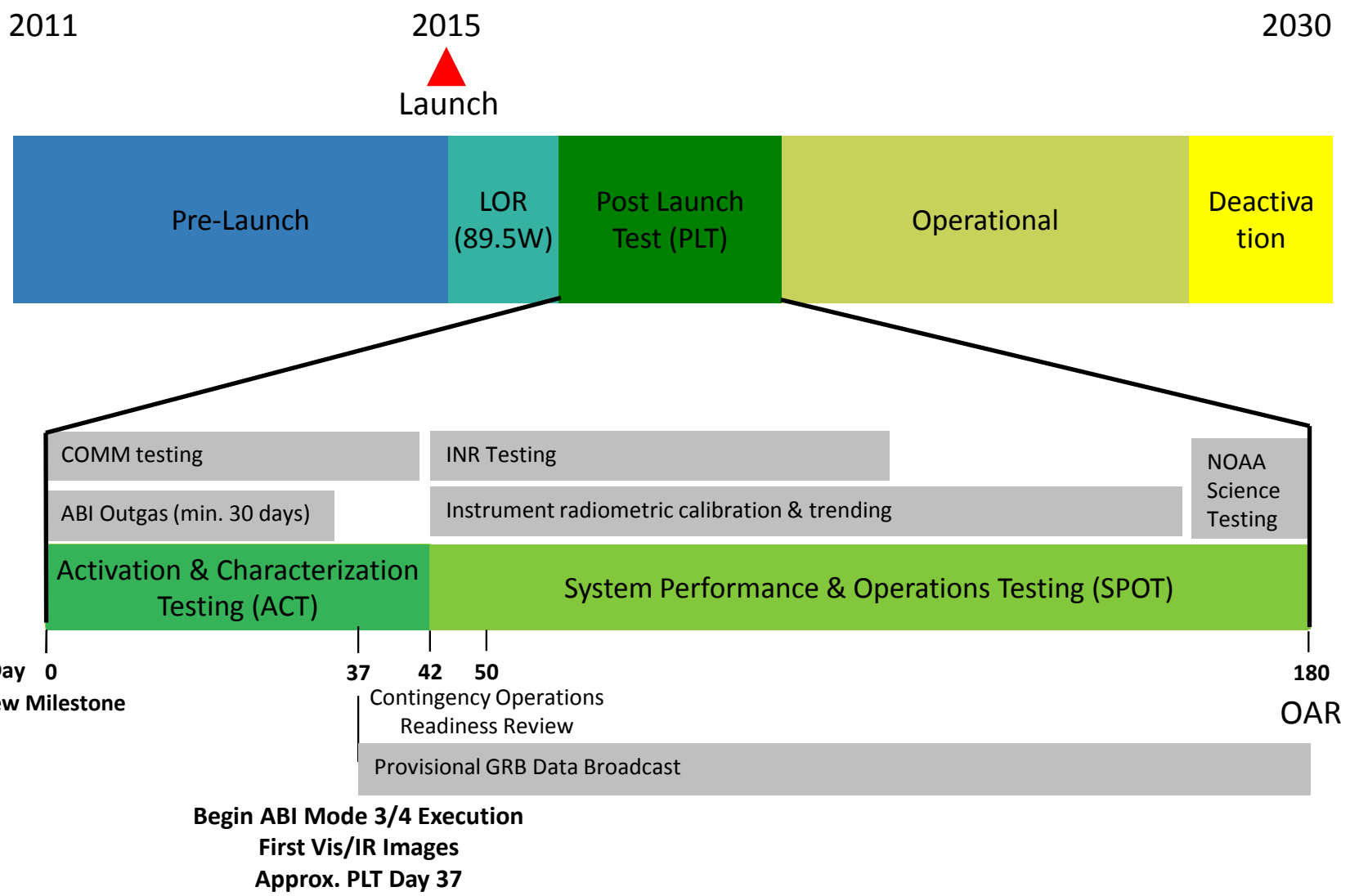 – Data formatting

    - Generally netCDF-4 with CF conventions

    - Documented in the Product User Guide

  – Availability

    - CLASS and the GOES-R GSP are discussing the availability

Post Launch Testing

2011   2015   2030

▲
Launch

| Pre-Launch | LOR (89.5W) | Post Launch Test (PLT) | Operational | Deactivation |

COMM testing

INR Testing

NOAA Science Testing

ABI Outgas (min. 30 days)

Instrument radiometric calibration & trending

Activation & Characterization Testing (ACT)

System Performance & Operations Testing (SPOT)

PLT Day   0   37   42   50   180
Review Milestone

Contingency Operations
Readiness Review

OAR

Provisional GRB Data Broadcast

Begin ABI Mode 3/4 Execution
First Vis/IR Images
Approx. PLT Day 37

Planning for Post Launch Level 2+ Algorithm Improvements

- Validate the scientific accuracy of all L2+ products
  - Conduct during PLT science data collection phases
    - Developing the L2+ product validation plan
    - Compare new data with legacy products, in-situ measurements, and other satellite products
    - AWG is developing 'deep dive tools' for validation
    - Algorithm updates via revised ATBDs
- Long term algorithm (science) maintenance

Summary

- GRB allows GOES data product users access to new instrument data

  – Realtime distribution of all Level-1b data

- GOES-R data products will be available using new product distribution and access technologies

- Capabilities will be fully verified during Post Launch Test

- Product improvements and adjustments can be made continually after launch and into operations
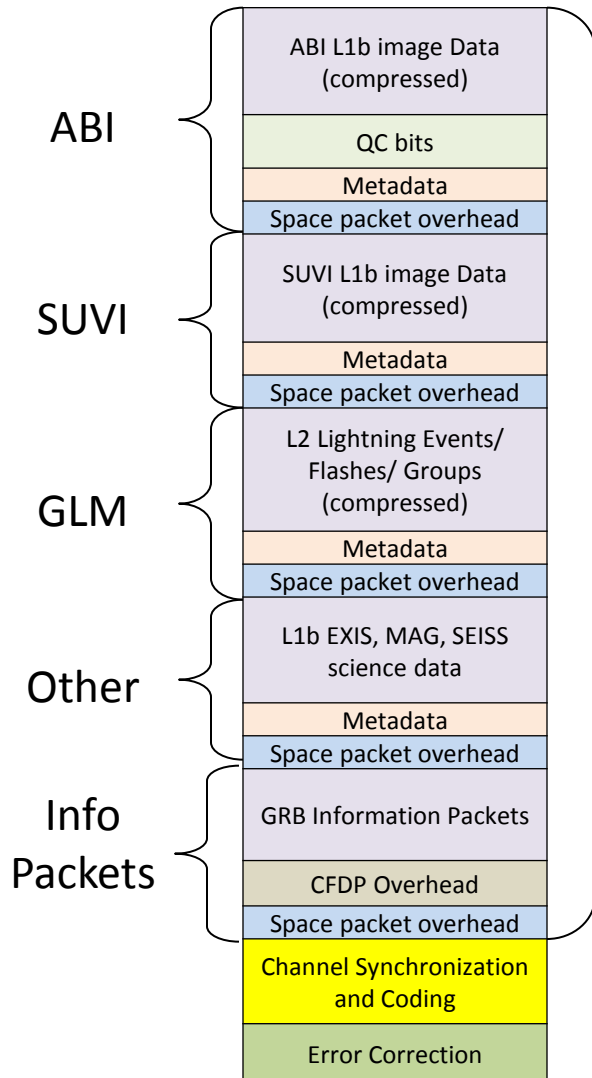
Background Charts

Details of the Dual Polarized Signal

- GRB
  - LHCP: L1b products from ABI 0.64 um band and 6 IR bands (3.9, 6.185, 7.34, 11.2, 12.3, and 13.3 um)
  - RHCP: L1b products from ABI bands 0.47, 0.865, 1.378, 1.61, 2.25, 6.95, 8.5, 9.6 and 10.35um, L2+ GLM, L1b SUVI, L1b EXIS, L1b SEISS, and L1b Magnetometer products
- Ensures load balanced utilization of the two circular polarizations, allowing users to receive all GRB products with a dual-polarized system (both LHCP and RHCP), and allowing users flexibility to receive GOES Imager legacy channels with a single polarized system (LHCP only).

GRB Channel Content Summary

ABI	ABI L1b image Data (compressed)
	QC bits
	Metadata
	Space packet overhead
SUVI	SUVI L1b image Data (compressed)
	Metadata
	Space packet overhead
GLM	L2 Lightning Events/ Flashes/ Groups (compressed)
	Metadata
	Space packet overhead
Other	L1b EXIS, MAG, SEISS science data
	Metadata
	Space packet overhead
Info Packets	GRB Information Packets
	CFDP Overhead
	Space packet overhead
	Channel Synchronization and Coding
	Error Correction

Note: This is a catalog of the contents and not a sequential organization of the stream

Included in 15.5 Mbps Bandwidth allocation per channel

- For each instrument: image data + metadata + CCSDS Space Packet overhead
- ABI has per pixel QC bits, coded separately
- ABI, SUVI, GLM compressed
- GRB Info packets via CCSDS File Delivery Protocol (CFDP)
- Channel synchronization and coding (link layer) for DVB-S2 or other
- Error correction (LDPC)

Data Formats will be Provided

- Data Formats will be described in the Product User Guide (PUG)
  - Five Volume Set
    - Volume 1: General Information
    - Volume 2: Level 0 Data Formats
    - Volume 3: Level 1 Data Formats
    - Volume 4: GRB Data Formats
    - Volume 5: Level 2 Data Formats
  - Includes Sample Data Sets
  - Preliminary Version available to the Public on/about Q3 2012
    Access via GOES-R website: http://www.goes-r.gov/

- Specific queries should be addressed to the GOES-R Data Operations Manager
    goesrdom@noaa.gov

Planned GRB Resources for Users

- 5 GRB Simulators available in 2013
- GOES-R Product Users Guide
  - Draft available now; final in 2012
  - Describes the format and content of GRB data
- GRB Downlink Specification Document for Users available in 2012
  - Provides GOES Rebroadcast radio frequency downlink characteristics, to enable the user community to develop GRB receivers