HRIT/EMWIN

Seth Clevenstine
Direct Broadcast Manager
NOAA/NESDIS/OSPO/SPSD

GOES Data Collection System

Technical Working Group (TWG) Training

Denver, CO

April 2019

HRIT/EMWIN Training Topics

-HRIT/EMWIN Background Information

-HRIT/EMWIN Production & Ground System Overview

-GOES Constellation and DCS VCID Status

-DCS VCID 31 Versus 32 Performance Stats

-DCS VCID 31 Termination Date

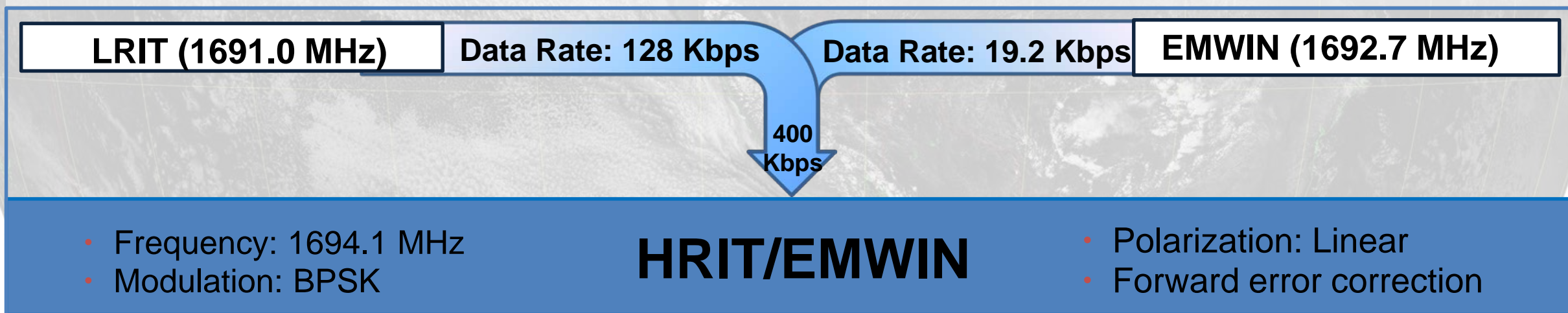-PDA DCS Specific HRIT/EMWIN Release Schedule

High Rate Information Transmission (HRIT)

What is HRIT/EMWIN?

➢ The High Rate Information Transmission/Emergency Manager Weather Information Network's (HRIT/EMWIN) is available only on the GOES-R series satellites and is the follow up to both the separate LRIT and EMWIN broadcasts onboard the GOES-NOP satellites.

➢ HRIT/EMWIN's objective is to continue the previous broadcast services of LRIT and EMWIN at a significantly higher data capacity. This is accomplished by combining the two services into a single service with a data relay capacity of 400Kbps.

➢ HRIT/EMWIN provides more imagery channel selection with greater resolution at a more frequent rate than previous LRIT broadcasts.

| LRIT (1691.0 MHz) | Data Rate: 128 Kbps | Data Rate: 19.2 Kbps | EMWIN (1692.7 MHz) |

400 Kbps

HRIT/EMWIN

- Frequency: 1694.1 MHz
- Modulation: BPSK
- Polarization: Linear
- Forward error correction

Description of the Broadcast

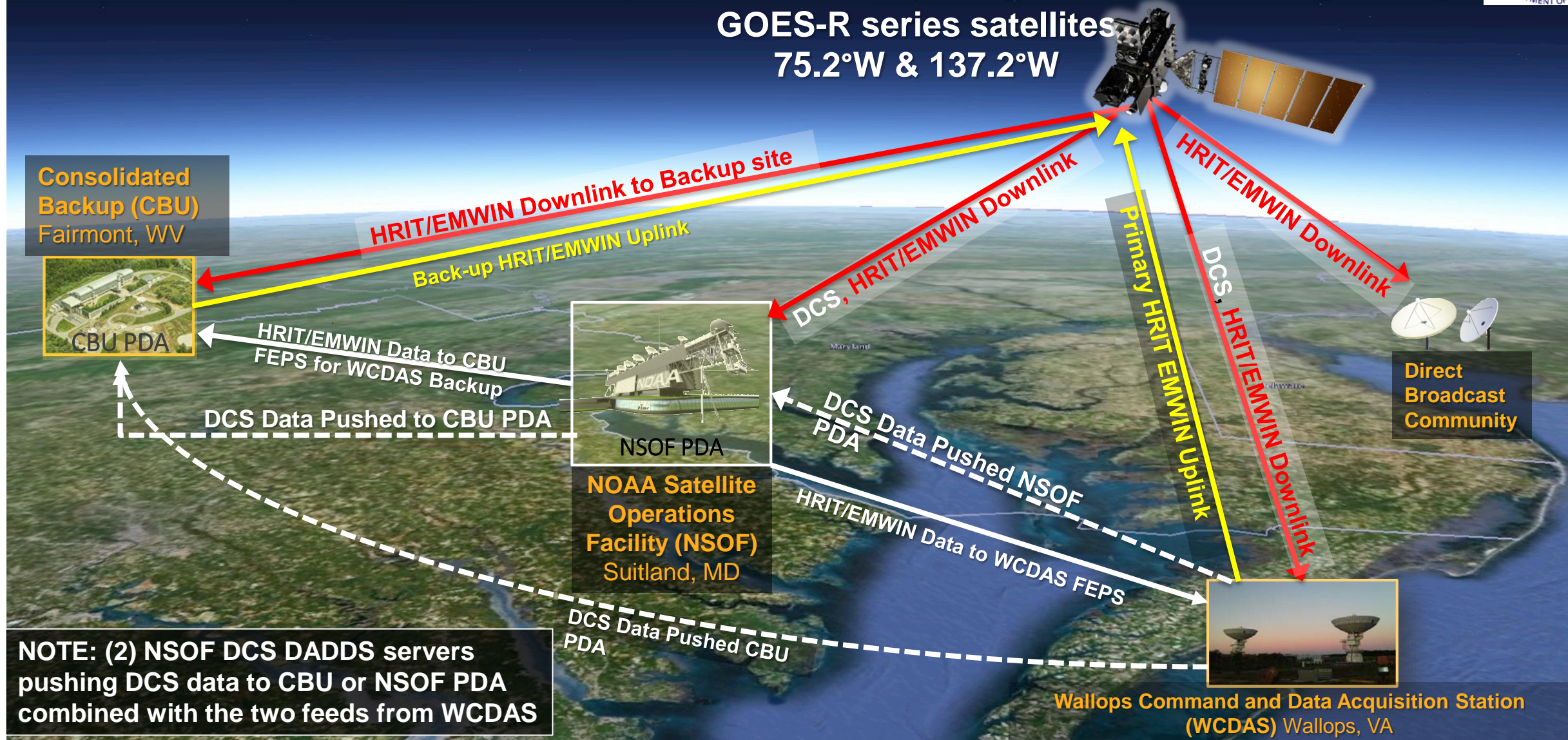| Characteristic	HRIT/EMWIN Broadcast Specifications
Platform	Operational East and West GOES-R Series Satellites
Operating Frequency Range	L-band
Center Frequency	1694.1 MHz
Data Rate	400 kilobits per second (Kbps)
Symbol Rate	927,000 symbols per second (sps)
Modulation	BPSK
Polarization	Linear – Vertical offset
Antenna System	At 5 degree elevation, the minimum antenna is 1.2 meter. At 10 degrees or more, the minimum size is 1.0 meter

Production and Uplink Systems

Characteristic	HRIT/EMWIN System Configuration
Input Streams All Go Through the Product Dissemination & Access (PDA) Systems	1. Imagery – PDA NSOF, Suitland, MD or WBU Fairmont, WV 2. EMWIN – NWS "Gateway" College Park, MD or Boulder, CO **3. DCS – DADDS NSOF, Suitland, MD or DADDS Wallops, VA** 4. NHC Products – Acquired over the internet at this time
PDA / HRIT-EMWIN Broadcast Stream Production	**Primary – Satellite Operations Facility (NSOF) in Suitland, MD** **Backup – Consolidated Backup Facility (CBU) in Fairmont, WV** **-Both can feed uplink antenna systems at Wallops, WV and the CBU**

Uplink Antenna Systems	**Primary – Command & Data Acquisition Station (WCDAS)**
	   Wallops Island, VA
	Backup – Consolidated Backup Facility (CBU) in Fairmont, WV
	   -Both can uplink HRIT/EMWIN to GOES-R Series Satellites

Downlink and Data Monitoring	**-Front End Processors linked to GOES-R antennas at WCDAS/CBU have both transmit and receive capability. Received files are relayed back to PDA's for transmit-receipt & checksum validation** **-Anomaly warning messages are generated to help desk & operators** **-VSAT stations are online at the NSOF for troubleshooting**
User Input on Broadcast Quality	-Input from users/manufacturers in the field is highly desired

GOES DCS to HRIT/EMWIN Operations

GOES-R series satellites
75.2°W & 137.2°W

Consolidated Backup (CBU)
Fairmont, WV

HRIT/EMWIN Downlink to Backup site

Back-up HRIT/EMWIN Uplink

DCS, HRIT/EMWIN Downlink

HRIT/EMWIN Downlink

Primary HRIT EMWIN Uplink

DCS, HRIT/EMWIN Downlink

CBU PDA

HRIT/EMWIN Data to CBU FEPS for WCDAS Backup

DCS Data Pushed to CBU PDA

NSOF PDA

DCS Data Pushed NSOF PDA

NOAA Satellite Operations Facility (NSOF)
Suitland, MD

Direct Broadcast Community

HRIT/EMWIN Data to WCDAS FEPS

DCS Data Pushed CBU PDA

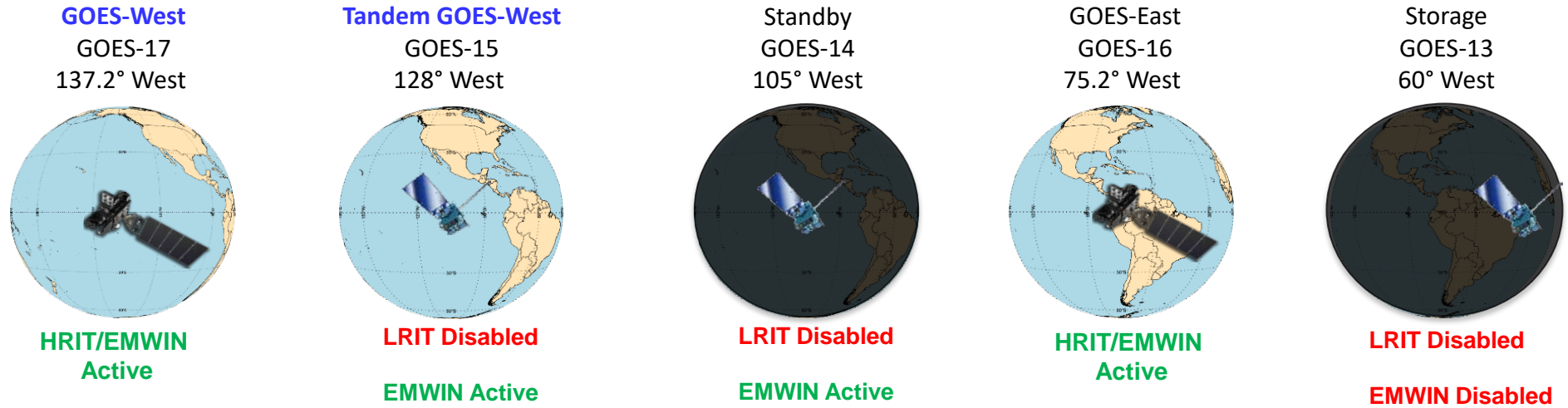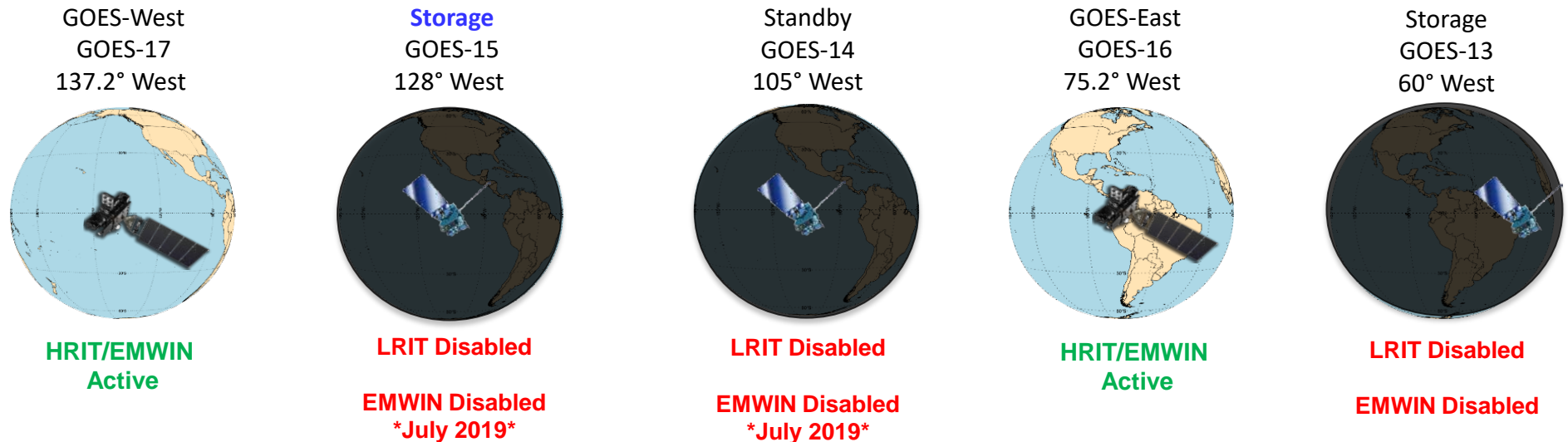NOTE: (2) NSOF DCS DADDS servers pushing DCS data to CBU or NSOF PDA combined with the two feeds from WCDAS

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

GOES Constellation Current and Future Status

	GOES-West GOES-17 137.2° West	Tandem GOES-West GOES-15 128° West	Standby GOES-14 105° West	GOES-East GOES-16 75.2° West	Storage GOES-13 60° West
Current – July 2019	HRIT/EMWIN Active	LRIT Disabled EMWIN Active	LRIT Disabled EMWIN Active	HRIT/EMWIN Active	LRIT Disabled EMWIN Disabled

	GOES-West GOES-17 137.2° West	Storage GOES-15 128° West	Standby GOES-14 105° West	GOES-East GOES-16 75.2° West	Storage GOES-13 60° West
Plan for July 2019	HRIT/EMWIN Active	LRIT Disabled EMWIN Disabled *July 2019*	LRIT Disabled EMWIN Disabled *July 2019*	HRIT/EMWIN Active	LRIT Disabled EMWIN Disabled

HRIT/EMWIN Bandwidth Management

PDA Product Group Name	Guaranteed Bandwidth	Maximum Bandwidth	Group Order Rank
EMWIN	8%	15%	1
DCS	**5%**	**10%**	**2**
Imagery	75%	100%	3

- HRIT has "subscriptions" to various products within the Product Distribution and Access (PDA) system
- When each of the subscriptions gets pulled for HRIT dissemination based on their availability or when they're scheduled, they move over to HRIT's Broadcast Management system where the subscriptions get labeled under a group listing and pushed to the dissemination queue for FEP uplink.
- HRIT separates subscriptions into three different groups and prioritizes each product on how its configured into the system.
  - DCS data is the second highest priority behind EMWIN data

HRIT/EMWIN Virtual Channel ID and Group Listing

VCID #	Product Name	GOES-16 Availability	GOES-17 Availability	Period -Min	Format	Resolution	Product Source Information
0	Admin Text	X	X	60	Text Messages	N/A	Active and available
1	Mesoscale Imagery	X	X	15	HRIT/LRIT	0.5km Band 2, 2km for bands 7 and 13	Active and available
2	Cloud Moisture Imagery Band 2	X	X	30	HRIT/LRIT	2 km	Active and available
5	GOES-15 WV Imagery		X	30 - 180	LRIT	4 km	Active and available
6	GOES-15 IR Imagery		X	30 - 180	LRIT	4 km	Active and available
7	Cloud Moisture Imagery Band 7	X	X	30	HRIT/LRIT	2 km	Active and available
8	Cloud Moisture Imagery Band 8	X	X	30	HRIT/LRIT	2 km	Active and available
9	Cloud Moisture Imagery Band 9	X	X	30	HRIT/LRIT	2 km	Active and available
13	CMI Band 13	X	X	30	HRIT/LRIT	2 km	Active and available
14	CMI Band 14	X	X	30	HRIT/LRIT	2 km	Active and available
15	CMI Band 15	X	X	30	HRIT/LRIT	2 km	Active and available
16	G16 CMI Band 13		X	60	HRIT/LRIT	4 km	Active and available
17	G17 CMI Band 13	X		60	HRIT/LRIT	4 km	Inactive. availble in 2km on VCID 13
20	EMWIN - Priority	X	X	Variable	Text	N/A	Available, non-operational
21	EMWIN - Graphics	X	X	Variable	Graphic (e.g. GIF, JPEG)	N/A	Available, non-operational
22	EMWIN - Other	X	X	Variable	Text and Graphic	N/A	Available, non-operational
23	NWS Products	X	X	Variable	Graphic	N/A	Active and available
24	NHC Maritime Graphics Products	X	X	Variable	Graphic (e.g. GIF, JPEG)	N/A	Active and available
25	GOES-R/S Level II Products	Not Available	Not Available	Variable	HRIT/LRIT	2-4 km	Not Available, HRIT Release 3.3
30	**DCS Admin**	**X**	**X**	**Continuous**	**Text**	**N/A**	**Active and available**
31	**DCS Data Old Format**	**X**	**X**	**Continuous**	**Formatted Text**	**N/A**	***Active and available until June 2019***
32	**DCS Data New Format**	**X**	**X**	**Continuous**	**Formatted Text**	**N/A**	**Active and available**
60	Himawari-8		X	60	LRIT	4 km	Active and available

Group Legend
- ☐ EMWIN
- ☐ DCS
- ☐ Imagery

VCID 31 vs 32 Efficiency Comparison

March 28th, 2019 VC31 Average File Size		March 28th, 2019 VC32 Average File Size	
Mean (bytes)	8238.45	Mean (bytes)	8238.59
Median (bytes)	8174	Median (bytes)	8162
Mode (bytes)	8084	Mode (bytes)	8080
Standard Deviation	239.70	Standard Deviation	260.94
Range (bytes)	2623	Range (bytes)	2599
Minimum (bytes)	8077	Minimum (bytes)	8077
Maximum (bytes)	10700	Maximum (bytes)	10676
Sum (bytes)	165971771 ➡	Sum (bytes)	140698636
Count	20146 ➡	Count	17078

- VCID 32 (New file format) shows a reduction of file counts by over 3,068 messages in comparison to VCID 31 (old file format). This reduces the file content size by ~15.23% over a 24-hour period.
- This equates out to an additional ~0.60% of extra bandwidth every hour
- Note that there minimal difference in the average file size distribution between old and new file formats
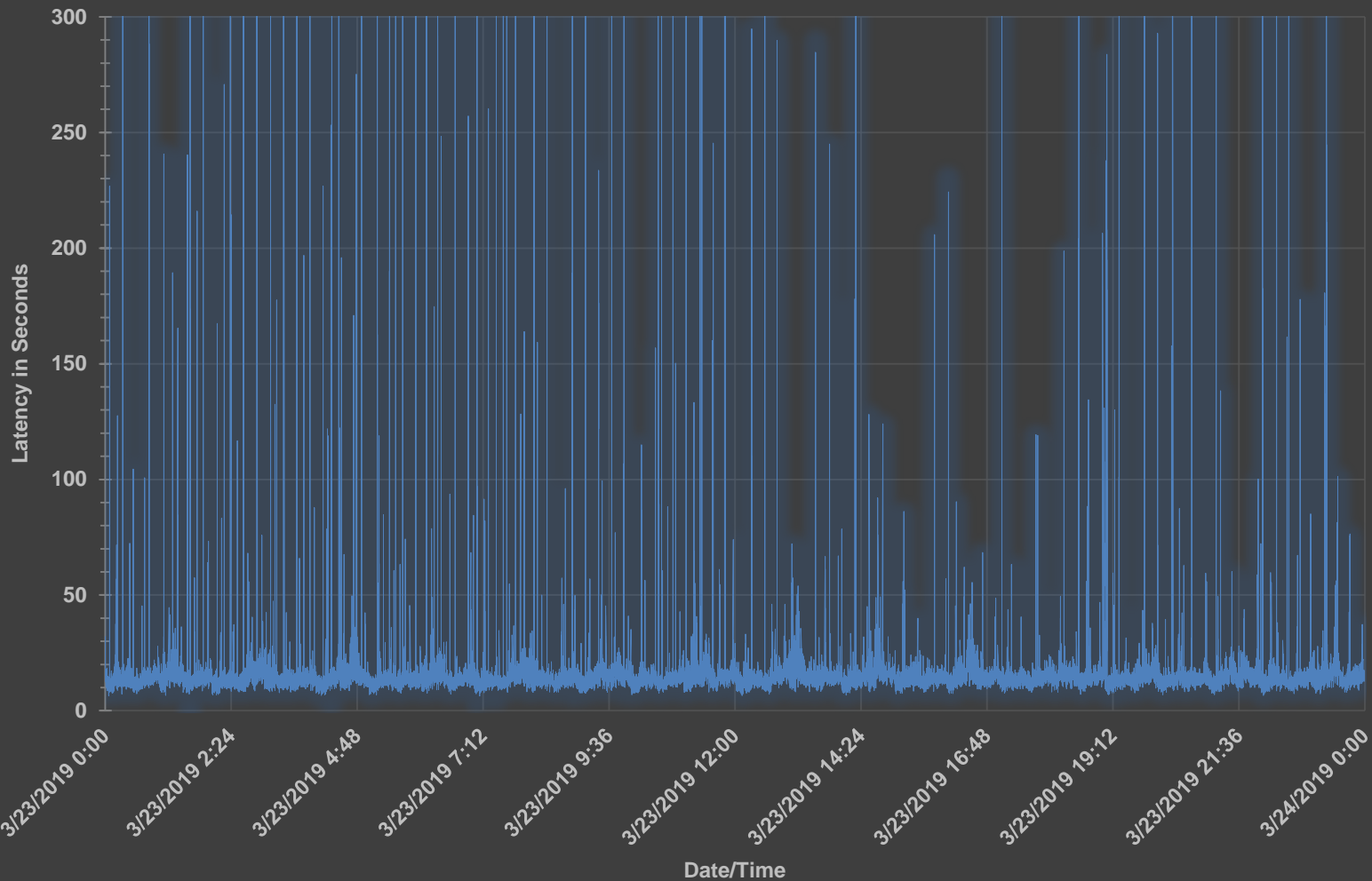
March 28th 24-hour Bandwidth Usage	
VCID 31 Bandwidth %	3.84%
VCID 32 Bandwidth %	⬇ 3.26%

DCS Latency Performance

March 23rd, 2019 VCID 31 DCS File Latencies

23rd March 00-06Z		23rd March 06-12Z	
Mean (seconds)	18.29	Mean (seconds)	18.74
Median	13.51	Median	13.84
Mode	11.94	Mode	13.89
Standard Deviation	41.42	Standard Deviation	40.26
Minimum	6.46	Minimum	6.37
Maximum	813.23	Maximum	900.11
Count	5044	Count	5031
Count 60-120 (sec)	26	Count 60-120 (sec)	28
Count 120-300 (sec)	32	Count 120-300 (sec)	27
Count >300 (sec)	27	Count >300 (sec)	33
Count	1.69%	Count	1.75%
23rd March 12-18Z		**23rd March 18-00Z**	
Mean (seconds)	15.72	Mean (seconds)	16.82
Median	14.07	Median	14.04
Mode	13.29	Mode	13.36
Standard Deviation	14.82	Standard Deviation	21.95
Minimum	6.58	Minimum	6.63
Maximum	420.07	Maximum	540.27
Count	5043	Count	5057
Count 60-120 (sec)	18	Count 60-120 (sec)	30
Count 120-300 (sec)	11	Count 120-300 (sec)	29
Count >300 (sec)	4	Count >300 (sec)	11
Count	0.65%	Count	1.38%

Virtual Channel 31 Old DCS File Format Termination Date

- The 6-month long parallel time period of HRIT streaming both Virtual Channels 31 & 32 on GOES East/West is set to <u>expire at the end of May 2019</u>.
- Flexibility to extend VCID 31 varies on several future HRIT product inclusions
  - PDA Release 3.3 (planned to be in operations in mid-May 2019) is providing HRIT/EMWIN the capability of putting Level II imagery products on the broadcast.
  - EMWIN's operational date of early July
  - Possible Mode 6 imagery frequency update to 3 of the 7 bands
- Any inquiries on VCID 31 extension must be provided to the NOAA DCS or HRIT Program Managers as soon as possible.

- Once VCID 31 is terminated, VCID 32 will be the only DCS data channel on HRIT/EMWIN

HRIT/EMWIN DCS Specific PDA Updates

PDA Release 3.2

- <u>ENTR 4105</u> – HRIT/EMWIN periodically broadcasts duplicate files
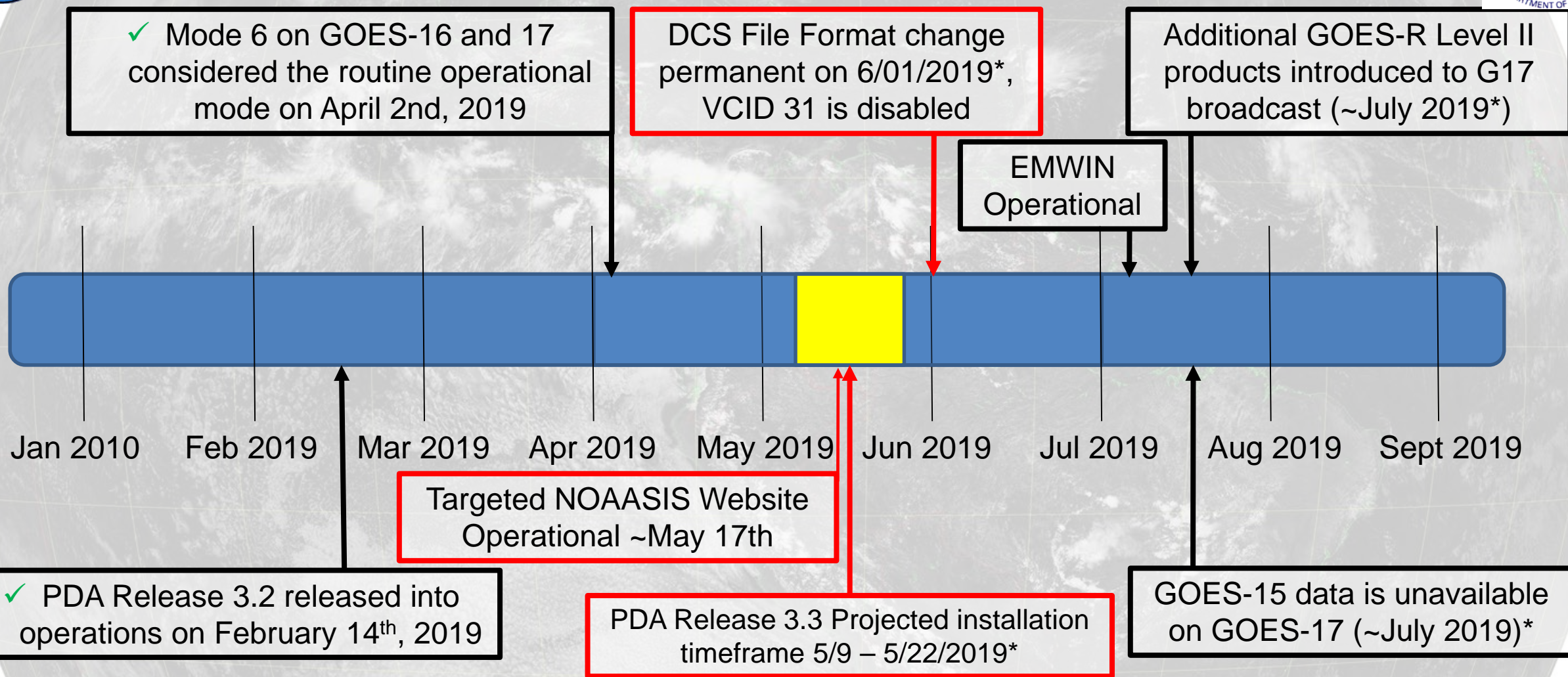   - The fix was implemented into HRIT operations on February 14th, 2019.

PDA Release 3.3

- <u>ENTR 4263</u> – "Fast Track" data.
    - This fix is specific to the "spikes" observed in latencies with both DCS and EMWIN files on the HRIT broadcast. This fix will give HRIT data the highest priority within the PDA system, ultimately reducing latency times.
- <u>ENTR 4155</u> – HRIT Packet Format Error reported by Microcom. This fix is specific to the HRIT file packetization in regards to fill packets.

HRIT/EMWIN Event Timeline

✓ Mode 6 on GOES-16 and 17 considered the routine operational mode on April 2nd, 2019

DCS File Format change permanent on 6/01/2019*, VCID 31 is disabled

Additional GOES-R Level II products introduced to G17 broadcast (~July 2019*)

EMWIN Operational

Jan 2010   Feb 2019   Mar 2019   Apr 2019   May 2019   Jun 2019   Jul 2019   Aug 2019   Sept 2019

Targeted NOAASIS Website Operational ~May 17th

✓ PDA Release 3.2 released into operations on February 14th, 2019

PDA Release 3.3 Projected installation timeframe 5/9 – 5/22/2019*

GOES-15 data is unavailable on GOES-17 (~July 2019)*

Dates are subject to change, these are just projections from the current ongoing development work taking place in April 2019

Contact Information

High Rate Information Transmission Broadcast

Seth Clevenstine
NOAA/NESDIS/OSPO/DSB
Seth.Clevenstine@noaa.gov
301-817-4558
www.noaasis.noaa.gov/LRIT

Emergency Managers Weather Information Network

Robert Gillespie
Bob.Gillespie@noaa.gov
301-427-9693

http://www.weather.gov/emwin