HRIT/EMWIN

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GOES Data Collection System
Technical Working Group (TWG) Training
Denver, CO
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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
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.

**HRIT/EMWIN**
- Frequency: 1694.1 MHz
- Modulation: BPSK
- Polarization: Linear
- Forward error correction

<table>
<thead>
<tr>
<th>LRIT (1691.0 MHz)</th>
<th>Data Rate: 128 Kbps</th>
<th>Data Rate: 19.2 Kbps</th>
<th>EMWIN (1692.7 MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>400 Kbps</td>
<td></td>
</tr>
</tbody>
</table>

**LRIT (1691.0 MHz)**
- Frequency: 1694.1 MHz
- Modulation: BPSK

**EMWIN (1692.7 MHz)**
- Frequency: 1694.1 MHz
- Modulation: BPSK

*OFFICE OF SATELLITE AND PRODUCT OPERATIONS*
Description of the Broadcast

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

## Characteristic

### 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
- Wallops Command and Data Acquisition Station (WCDAS) Wallops, VA
- Direct Broadcast Community
- NOAA Satellite Operations Facility (NSOF) Suitland, MD
- CBU PDA
- NSOF PDA

NOTE: (2) NSOF DCS DADDS servers pushing DCS data to CBU or NSOF PDA combined with the two feeds from WCDAS
GOES Constellation Current and Future Status

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

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

*July 2019*
HRIT/EMWIN Bandwidth Management

<table>
<thead>
<tr>
<th>PDA Product Group Name</th>
<th>Guaranteed Bandwidth</th>
<th>Maximum Bandwidth</th>
<th>Group Order Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMWIN</td>
<td>8%</td>
<td>15%</td>
<td>1</td>
</tr>
<tr>
<td>DCS</td>
<td>5%</td>
<td>10%</td>
<td>2</td>
</tr>
<tr>
<td>Imagery</td>
<td>75%</td>
<td>100%</td>
<td>3</td>
</tr>
</tbody>
</table>

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

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

- 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

<table>
<thead>
<tr>
<th></th>
<th>VCID 31</th>
<th>VCID 32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandwidth %</td>
<td>3.84%</td>
<td>3.26%</td>
</tr>
</tbody>
</table>
### DCS Latency Performance

#### March 23rd, 2019 VCID 31 DCS File Latencies

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Mean (seconds)</th>
<th>Median</th>
<th>Mode</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Count</th>
<th>Count 60 (sec)</th>
<th>Count 120 (sec)</th>
<th>Count &gt;300 (sec)</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>23rd March 00-06Z</td>
<td>18.29</td>
<td>13.51</td>
<td>11.94</td>
<td>41.42</td>
<td>6.46</td>
<td>813.23</td>
<td>5044</td>
<td>26</td>
<td>32</td>
<td>27</td>
<td>1.69%</td>
</tr>
<tr>
<td>23rd March 06-12Z</td>
<td>18.74</td>
<td>13.84</td>
<td>13.89</td>
<td>40.26</td>
<td>6.37</td>
<td>900.11</td>
<td>5031</td>
<td>28</td>
<td>27</td>
<td>33</td>
<td>1.75%</td>
</tr>
<tr>
<td>23rd March 12-18Z</td>
<td>15.72</td>
<td>14.07</td>
<td>13.29</td>
<td>14.82</td>
<td>6.58</td>
<td>420.07</td>
<td>5043</td>
<td>18</td>
<td>11</td>
<td>4</td>
<td>0.65%</td>
</tr>
<tr>
<td>23rd March 18-00Z</td>
<td>16.82</td>
<td>14.04</td>
<td>13.36</td>
<td>21.95</td>
<td>6.63</td>
<td>540.27</td>
<td>5057</td>
<td>30</td>
<td>29</td>
<td>11</td>
<td>1.38%</td>
</tr>
</tbody>
</table>
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 expire at the end of May 2019.
- 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**

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

**PDA Release 3.3**

- **ENTR 4263** – “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.
- **ENTR 4155** – 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**

- **Jan 2010**
- **Feb 2019**: PDA Release 3.2 released into operations on February 14th, 2019
- **Mar 2019**: Mode 6 on GOES-16 and 17 considered the routine operational mode on April 2nd, 2019
- **Apr 2019**: PDA Release 3.3 Projected installation timeframe 5/9 – 5/22/2019*
- **May 2019**: DCS File Format change permanent on 6/01/2019*, VCID 31 is disabled
- **Jun 2019**: EMWIN Operational
- **Jul 2019**: Targeted NOAAIS Website Operational ~May 17th
- **Aug 2019**: Additional GOES-R Level II products introduced to G17 broadcast (~July 2019*)
- **Sept 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

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