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Prepared by NOAA  
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## **The Current Status and Short Term Plans (2011-2015) of the GOES LRIT Service**

NOAA-WP-30 provides the status of the Low Rate Information Transmission (LRIT) on the GOES I-M and N-P spacecraft. The LRIT broadcast is operational on both the GOES-east and GOES-west spacecrafts. NOAA is also in design stage of the HRIT/EMWIN broadcast service for the GOES-R Series of spacecraft.

Our short range plans include the expansion of the product suite and completion of the back-up LRIT system at the Continuity of Operations site in Wallops, Virginia.

NOAA will also continue its outreach efforts with an increased focus on the upcoming HRIT/EMWIN system for GOES-R series of satellites that includes briefings and live demonstrations of a prototype receiver system that is compatible with all current and planned GOES LRIT broadcasts.

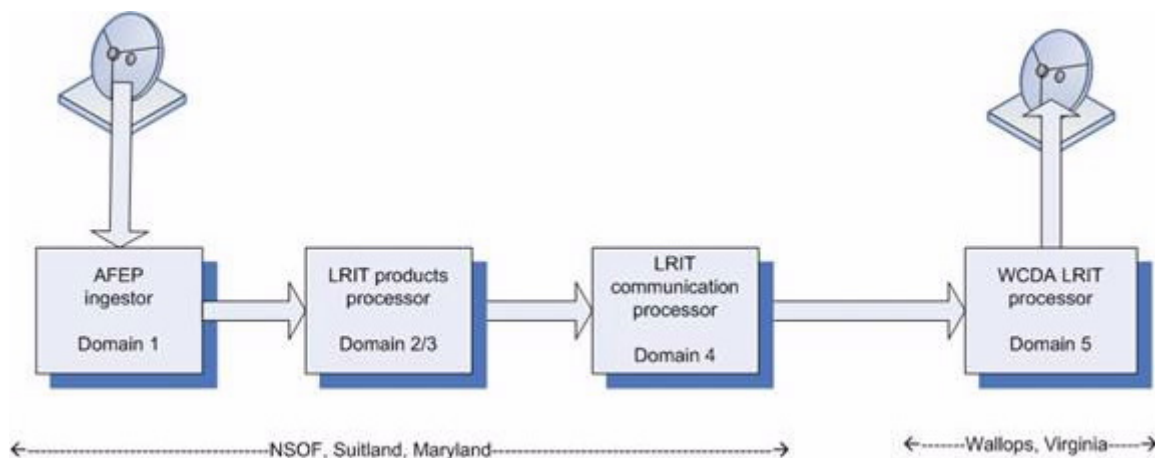
## The Current Status and Short Term Plans (2011-2015) of the GOES LRIT Service

### 1. Introduction

The United States operates a Low Rate Information Transition (LRIT) broadcast from both the East and West Geostationary Operational Environmental Satellites (GOES). Currently GOES-13 is the GOES East operational satellite and GOES-11 is the GOES West operational satellite. GOES-15 will become the GOES West operational satellite in late 2011. LRIT services will be operational from the GOES-15 spacecraft when it is put into service. On the future GOES-R series of satellites, the LRIT service will be combined with the US National Weather Service’s Emergency Manager’s Weather Information Network (EMWIN) service into a High Rate Information Transmission call HRIT/EMWIN with a data rate of 400 Kilobits per second.

### 2. Current System Configuration

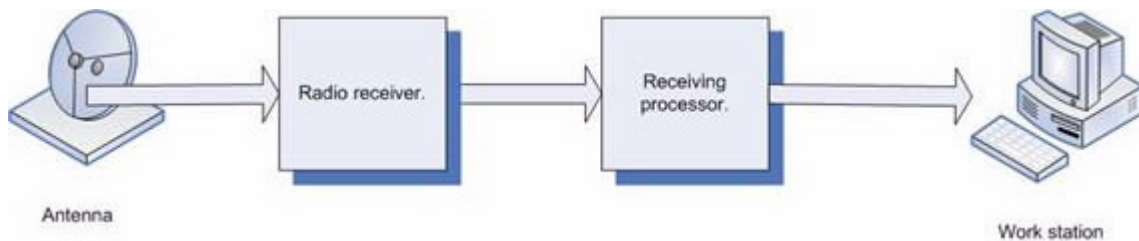
The NOAA LRIT system is deployed in two geographic sites; Suitland, Maryland and Wallops, Virginia. The primary production system of LRIT Domains 1-4 is located at the NOAA Satellite Operations Facility in Suitland, Maryland. The LRIT product packet stream is then sent over redundant telecommunications paths to the LRIT Uplink Processors at the Command and Data Acquisition Station at Wallops, Virginia. The LRIT stream is then sent to the uplink antenna system for uploading to the GOES satellites. This system is pictured in Figure 1. A. Each Domain is comprised of primary and back-up servers. A back-up LRIT system comprised of primary servers only has been deployed to the Continuity of Operations site that is co-located with the CDA in Wallops, VA providing an added layer of reliability. This system, while not 100% completed, is connected to the Domain 5 Uplink Processors in the Wallops CDA and is lacking only the connection to the primary EMWIN uplink stream at this time. Further technical information can be found at <http://noaasis.noaa.gov/LRIT/>.



**Figure 1 High Level Functional Flows for LRIT Domains 1 through 5.**

The LRIT Domain 6 user terminal is implemented using the lowest risk approach, while maintaining the NOAA low cost goal. A typical user station consists of four main components as illustrated in Figure 2 below. The 1.8-meter antenna is a parabolic dish antenna with no auto tracking. The downlink signal is received at 1691 Megahertz (MHz) with a data rate of 128 kilobits per second. The signal may be filtered to reduce adjacent channel interference and/or amplified by a low-noise amplifier. Then, it is down-converted to the Radio receiver IF frequency. The IF amplifiers have an IF bandwidth capable of receiving a 293 kbps symbol stream. The IF signal is then demodulated in the receiving processor demodulator and the base band output to the receiving processor is a serial bit stream. Domain 6 Work stations receive this data stream, groups file segments, extracts and concatenates them and finally displays or stores the outputs.

NOAA has two LRIT user stations at the NOAA Satellite Operations Facility (NSOF), Suitland, Maryland and another set at the Wallops Virginia CDA. These receive stations serve as monitoring and quality control tools for the NOAA LRIT system. Two small antennas (1.6 m) for reception of GOES-East and GOES-West LRIT broadcasts are installed on the NSOF building with a redundant antenna for each broadcast. The NSOF LRIT user stations are equipped with standard software for LRIT data stream processing along with custom applications for monitoring LRIT transmission availability. The Help Desk Operators monitor the LRIT system availability on a 24/7 basis.



**Figure 2 LRIT User Station**

### 3. Current System Content

The LRIT broadcast product offering includes a combination of: 1) GOES imagery data, 2) the US National Weather Service’s Emergency Manager’s Weather Information Network (EMWIN), 3) a copy of the observations from the GOES Data Collection System (DCS), 4) National Weather Service Environmental products including tropical weather forecast text and graphic products and 5) graphical image products from MTSAT and Meteosat imagery.

#### 3a. GOES Imagery Products

Although the NOAA LRIT system consists of several categories of products, the primary product is the reduced (4 km) resolution GOES imagery. The GOES Advanced Front End Processor ingestor systems continually process a GOES GVAR data stream making LRIT files of the visible, infrared and water vapour channels of all GVAR scenes received from the GOES satellites at the NOAA Satellite Operations Facility in Suitland, Maryland. As this equipment is configurable; it provides the operator the ability to specify the segmentation level of each product for processing and transmission. The ingestors also permit the configuration of parameters i.e., the

region of coverage, the data resolution, and the channel(s), to be processed. Additionally, Rapid Scan Operations (RSO) data are ingested and can be made available to the LRIT Product Processor (LPP) system. The flexibility of the data ingestors enhances the overall robustness of the LRIT system.

A LRIT format visible, infrared and water vapour image for each GVAR scene received at the NSOF is sent through the appropriate satellite broadcast. Thus, GOES-East imagery is sent through the LRIT-East broadcast and GOES-West imagery is sent through the LRIT-West broadcast. The infrared imagery from the East broadcast is sent through the West broadcast and the opposite is true for the West infrared imagery being copied onto the East broadcast. This provides a limited redundancy or overlap of the imagery from the opposite footprint.

### **3b. Emergency Managers Weather Information Network (EMWIN) Content**

A copy of the EMWIN data stream is now included in the LRIT broadcast. The basic, or native, data formats of the LRIT system and the EMWIN system are not immediately compatible. The former is a file based system and the latter is serial data. To include the EMWIN data in the LRIT data stream, one-second chunks of the serial EMWIN data are converted to small files. The EMWIN serial data contains start and stop bits which are necessary for the serial protocol but are simply added overhead for the LRIT file. These are removed leaving only the 8 bit ASCII characters to be transmitted in the EMWIN file within LRIT. These files are identified uniquely within the LRIT data stream as are all other files in LRIT. At the LRIT receiver end, these files are received and stored as are all LRIT files. Software within the receiver reads the ASCII character data from the EMWIN files, adds the start and stop bits back in and makes the newly serialized data available to any of the EMWIN data display programs or to an outgoing serial port on the receiver.

### **3c. GOES Data Collection System (DCS) Content**

NOAA has also integrated a copy of the GOES DCS data into the LRIT broadcast. The GOES DCS data has been enhanced so that all of the data files being transmitted to the SES Americom spacecraft (i.e., the US domestic satellite service, DOMSAT) is ported to a computer at the Wallops Command and Data Acquisition (WCDA) Facility. Software has been designed to build a file of the GOES DCS data based on three criteria. First, there can be a parameter based on time; second, their size of the file can be based on the number of messages; third, the number of bytes can be the determining factor. The criteria are selectable.

When the file is built at the WCDA, it is tagged with a "date/time group" name. This is useful in determining the confirmation of the file transfer. The DCS files are transmitted to the Environmental Satellite Processing Center (ESPC) facilities in Suitland, Md. At this point the files are incorporated in the Low Resolution Information Transfer (LRIT) data stream. This service allows any DCS customer who can transmit to the spacecraft – to receive their data back from the same GOES spacecraft.

### **3d. Graphic format files of Japanese Meteorological Agency Multi-functional Transport Satellite (MTSAT) and European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) Meteosat Geostationary Imagery Content**



Graphic JPEG format files of three hour, full disk MTSAT and MSG imagery are retrieved and disseminated every hour over both the LRIT East and West broadcasts. These files extend the range East and West of the GOES footprint to a limited extent. A project is currently underway that will retrieve MTSAT LRIT imagery files, process them into LRIT files and disseminate them over the LRIT West broadcast.

**3e. NOAA National Weather Service Tropical Storm and other Warnings and Critical Weather Informaton.**

The latest tropical weather bulletins and warnings are retrieved from the NOAA National Hurricane Center in Miami, Florida and are broadcast every hour over the LRIT East and West broadcasts until an updated file is present on the target site. This method assures that the last available file is always being provided.

**3f. Schedule**

The LRIT broadcasts are not schedule dependent. Depending on priorities that are set, the products go out as they are received or acquired. The GOES imagery files follow the GOES Schedules and Scan Sectors that can be found at: <http://www.oso.noaa.gov/goes/schd-sector/index.htm>.

The basic LRIT product table can be found below in Tables 1 and 2.

Product Name	Format	Source	Schedule	Reference
GOES East	Imagery: 1. Visible 2. Infrared. 3. Water Vapor.	LRIT System	GOES Schedule	<a href="http://www.oso.noaa.gov/goes/schd-sector/index.htm">http://www.oso.noaa.gov/goes/schd-sector/index.htm</a>
GOES West	Imagery: 1. Visible 2. Infrared. 3. Water Vapor.	LRIT System	GOES Schedule	<a href="http://www.oso.noaa.gov/goes/schd-sector/index.htm">http://www.oso.noaa.gov/goes/schd-sector/index.htm</a>
Tropical Storm Products	Graphic	NOAA/NWS Hurricane Center	Hourly	<a href="http://www.nhc.noaa.gov/tafb_latest/">http://www.nhc.noaa.gov/tafb_latest/</a>
EMWIN	Text	National Weather Service	As Received	<a href="http://www.weather.gov/emwin/index.htm">http://www.weather.gov/emwin/index.htm</a>
DCS	Text	NOAA/NESDI S/OSO	As Received	<a href="http://www.noaasis.noaa.gov/DCS/">http://www.noaasis.noaa.gov/DCS/</a>
Meteosat	Graphic	NOAA/NESDI	Hourly	<a href="http://www.osdpd.noaa.gov/ml/info/i">http://www.osdpd.noaa.gov/ml/info/i</a>



(MSG)		S/OSDPD		ndex.html
MTSAT	Graphic	NOAA/NESDI S/OSDPD	Hourly	<a href="http://www.osdpd.noaa.gov/ml/info/index.html">http://www.osdpd.noaa.gov/ml/info/index.html</a>
Administrative Text Message	Text	LRIT System Administrators	Hourly or As Needed	N/A

Table 1: NOAA GOES East LRIT Content Table

Product Name	Format	Source	Schedule	Reference
GOES West	Imagery: 1. Visible 2. Infrared. 3. Water Vapor.	LRIT System	GOES Schedule	<a href="http://www.oso.noaa.gov/goes/schd-sector/index.htm">http://www.oso.noaa.gov/goes/schd-sector/index.htm</a>
GOES East	Imagery: Infrared	LRIT System	GOES Schedule	<a href="http://www.oso.noaa.gov/goes/schd-sector/index.htm">http://www.oso.noaa.gov/goes/schd-sector/index.htm</a>
Tropical Storm Products	Graphic	NOAA/NWS Hurricane Center	Hourly	<a href="http://www.nhc.noaa.gov/tafb_latest/">http://www.nhc.noaa.gov/tafb_latest/</a>
EMWIN	Text	National Weather Service	As Received	<a href="http://www.weather.gov/emwin/index.htm">http://www.weather.gov/emwin/index.htm</a>
DCS	Text	NOAA/NESDI S/OSO	As Received	<a href="http://www.noaasis.noaa.gov/DCS/">http://www.noaasis.noaa.gov/DCS/</a>
Meteosat (MSG)	Graphic	NOAA/NESDI S/OSDPD	Hourly	<a href="http://www.osdpd.noaa.gov/ml/info/index.html">http://www.osdpd.noaa.gov/ml/info/index.html</a>
MTSAT	Graphic	NOAA/NESDI S/OSDPD	Hourly	<a href="http://www.osdpd.noaa.gov/ml/info/index.html">http://www.osdpd.noaa.gov/ml/info/index.html</a>
Administrative Text Message	Text	LRIT System Administrators	Hourly or As Needed	N/A

Table 2: NOAA GOES West LRIT Content Table

#### 4. Short Term Plans (2011-2015) for the GOES LRIT Service

##### 4a. Product Suite



We will continue to work on a project to secure JMA MTSAT LRIT imagery to add to the NOAA GOES LRIT West broadcast to help serve the Pacific Region. This project is being worked in cooperation with the National Weather Service Pacific Region and the WMO Region V.

The LRIT program will investigate the feasibility of using LRIT and the follow on HRIT/EMWIN broadcast as an official re-broadcast of DCS observations within the Americas and the GOES footprints thus expanding the geographical area within which GOES DCS is rebroadcast to users now receiving the re-broadcast over the DOMSAT re-broadcast. Current plans assume that we will carry a copy of the DCS data in any case.

We will continue to work with the user community particularly the Pacific Region to expand the product suite offered by the LRIT broadcasts.

#### **4b. System Hardware and Software Upgrades:**

We will continue the project to complete and then test the EMWIN connection from the Wallops CDA facility into the adjacent LRIT system at the Critical Infrastructure Protection (CIP) facility at Wallops, Virginia. This is the final step in the installation of a complete back-up LRIT system within the Continuity Of Operations Plan.

The LRIT Program will continue to work closely with the GOES-R and EMWIN Programs on the design of the ground system and product suite for the planned HRIT/EMWIN service planned for the GOES-R Series of satellites.

We are in the process of installing upgraded LRIT Domain 6 receiver monitoring stations at the NOAA Satellite Operations Facility and to integrate new capabilities for visualizing NWS EMWIN products and GOES DCS observations that are being provided by commercial vendors and are available for purchase by LRIT users.

#### **4c. Outreach and Capacity Building**

The LRIT program continues to perform outreach briefings at the NOAA Direct Readout Conferences and GOES User Conferences.

We have also installed a live demonstration of the LRIT, EMWIN and EMWIN-on-LRIT broadcast stream along with simulated data resembling the planned HRIT/EMWIN broadcast at the previous two Direct Readout Conferences (Miami 2008 and 2011 and at the previous GOES User Conference (Madison, Wisconsin 2009). Part of the live presentation, we have demonstrated the feasibility of receiving EMWIN, LRIT and HRIT/EMWIN using a proof-of-concept prototype receiver funded by the GOES-R Program and developed by Aerospace. More technical information, source code and diagrams on the Software Defined Radio Prototype Receiver can be found at <http://www.goes-r.gov/users/hrit.html> and then <http://www.goes-r.gov/users/hrit-links.html>.

### **5. Summary**



NOAA's LRIT service is operational on both the GOES-East and GOES-West spacecrafts. It will be available on the GOES 14-15 satellites when they are brought into service. On the future GOES-R series of satellites, LRIT will transition to a combined HRIT/EMWIN Service. Our short range plans include the expansion of the product suite and completion of the LRIT system at the COOP site. NOAA will also continue its outreach efforts with an increased focus on the upcoming HRIT/EMWIN system for GOES-R series of satellites.