



## The Current Status of the GOES LRIT

NOAA-WP-21 provides the status of the Low Rate Information Transmission (LRIT) on the GOES I-M spacecraft. As of October 03, 2005, LRIT broadcast is operational on both GOES-east and GOES-west spacecrafts. NOAA continues to work with users and vendors to resolve anomalies in the LRIT broadcast and assess the quality and reliability of the service. Our current planning will focus on improving data dissemination in the future and providing low cost systems to acquire the NOAA broadcasts. Improvements in the service include additional in-situ observations and more hydro-meteorological information.

Now that NOAA's LRIT is operational on both the GOES-east and GOES-west spacecrafts, our immediate plans include continuing the transition from the 128 kbps to 256 kbps during the GOES-N era.

Other items being considered for future implementation include expanding the product suite, adding higher resolution imagery (e.g. 1km), adding other compression algorithms (e.g. JPEG2000, zip), improving navigation information, and adding a web server for LRIT files. Though these are some of the ideas for future enhancements, by no means is LRIT restricted in this scope. As the LRIT matures and becomes more utilized by the user community, so shall the capabilities offered.



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### 1. Introduction

The United States has completed the transition from the WEFAX system to the LRIT system, on GOES I-M spacecraft. The transition to full time LRIT on GOES-East and GOES -West was respectfully implemented March 1, 2005, and October 3, 2005. This activity completes the NOAA transition plan from WEFAX to LRIT, ending the successful mission of the WEFAX system and beginning the new mission of LRIT.

### 2. System Transition

The processing of data and the subsequent transmission of the LRIT products was designed to be more robust and flexible than the previous WEFAX service. This flexibility extends to the data ingestors, the product processors, and the transmission and reception portions of the system.

The LRIT system ingestors in Suitland, Maryland are capable of processing the GOES GVAR data stream. This equipment is configurable; they provide 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.

The CGMS LRIT Global Specification defines a reference model with multiple layers. The model is generally consistent with both the Consultative Committee for Space Data System (CCSDS) and the International Standards Organization's (ISO) Open Systems Interconnect (OSI) reference model. The LRIT system is essentially a unidirectional flow of data from a transmission side (uplink) to a reception side (downlink). The model used for the NOAA LRIT implementation includes seven layers consisting of:

- Application Layer
- Presentation Layer
- Session Layer
- Transport Layer
- Network Layer
- Data Link Layer
- Physical Layer

On the transmission side, data is processed into LRIT files in the Application and Presentation Layers, which correspond to the LRIT Product Processor. Performed in layers 3 through 7, LRIT Communications Processing is concerned with sending LRIT files from the transmission side to the reception side.



The LRIT Product Processor (LPP) system adds flexibility and robustness to the LRIT system. A configurable system, the LPP's primary purpose is to create LRIT product files from various input sources, such as the GOES data from the data ingestors. It is in the LPP that product priority is determined and assigned. Not only is the LRIT data assigned a transmission priority, it is also given a processing priority. The distinction between the two relates to where the priorities are implemented. The processing priority's significance is in the LPP; whereas the transmission priority is significant in the communications processing. Processing priority represents the amount of CPU a given process receives relative to the other processes concurrently being performed. Transmission priority represents the priority an LRIT product file receives in the communications processing system. This priority allows for higher priority data to supersede lower priority data currently being transmitted. Such priority processing permits data that is deemed more urgent the opportunity to be transmitted quickly, thus reducing the latency for higher priority data.

### **3. Past Performance**

The recently completed plans for LRIT implementation and transition were as follows:

Initial ground testing of simultaneous LRIT and existing EMWIN transmissions were positive (i.e., acceptable performance) at the 128 kbps data rate.

Testing continues whenever a non-operational GOES spacecraft is brought out of storage of health and safety validation.

Timesharing on GOES-East began October 2003.

Timesharing on GOES-West began October 2004.

Full LRIT on GOES-East began March 01, 2005.

### **4. Current LRIT Capabilities**

This LRIT broadcast is a consolidated mode of data dissemination that includes the combination of Weather Facsimile (WEFAX) products, a portion of the US National Weather Service's Emergency Manager's Weather Information Network (EMWIN), and information from the GOES Data Collection System (DCS). The NOAA LRIT development focused on five major objectives:

LRIT formatting of the current WEFAX service, additional products and services with improvements on latency and product flexibility, the inclusion of additional National Weather Service (NWS) products and information, the Emergency Management Weather Information Network (EMWIN) data, and the inclusion of GOES Data Collection System (DCS) information that is currently broadcast by commercial satellite to the continental U.S.

The first area has highest priority whereas support for the other improvements depends on available data transport capacities after the highest priority LRIT needs are addressed. The product suite of the WEFAX service transmitted through the LRIT system is the baseline of the LRIT data content. The baseline products include the following:

GOES Infrared full disk

GOES Water vapor full disk



GOES Visible full disk  
GOES Infrared northern hemisphere  
GOES Water vapor northern hemisphere  
GOES Visible northern hemisphere  
GOES Infrared continental U. S.  
GOES Water vapor continental U. S.  
GOES Visible continental U. S.  
GOES Infrared southern hemisphere  
GOES Water vapor southern hemisphere  
GOES Visible southern hemisphere  
GOES Rapid Scan  
GOES-9 Infrared full disk (GMS replacement)  
GOES-9 Visible full disk (GMS replacement)  
Various National Weather Service charts  
Various administrative ASCII messages

The EMWIN (Emergency Managers Weather Information) data is now included in the LRIT data stream. 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.

The EMWIN data, in its current implementation, is a 9600 baud, serial, RS-232 data stream. 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.

NOAA has recently completed a project that will integrate the GOES Data Collection System (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 completed stream is then re-transmitted to the WCDA station where it is up-linked to the GOES spacecraft. When it reaches the spacecraft it is transmitted to the entire hemisphere through a transponder. This service allows any DCS customer who can transmit to the spacecraft – to receive from the spacecraft.

The WCDA facility has the capability to receive the LRIT data. Here a comparison is made with the data that was originally transmitted. This is where the naming convention becomes a real use in the quality monitoring of the GOES DCS data in the LI broadcast. If a file is transmitted and not received, then an automatic retransmission is generated.

In addition, the WCDA has commissioned software that is open-source and Government-owned that will select the GOES DCS data from the total LRIT stream to allow users to display the DCS data in its original format. This software is available to all manufacturers that would like to use it. To obtain a copy of this software, please visit our website at [www.noaasis.gov/LRIT/](http://www.noaasis.gov/LRIT/).

### 5. Transition

The LRIT/WEFAX timeshare was active on GOES-west from 0000Z on 9 October 2004, until 03 October 2005. The transition phase lasted approximately 12 months, at which point WEFAX was eliminated from the GOES-west and LRIT began to operate continuously. Figure 1 below represents the timeline for transition.

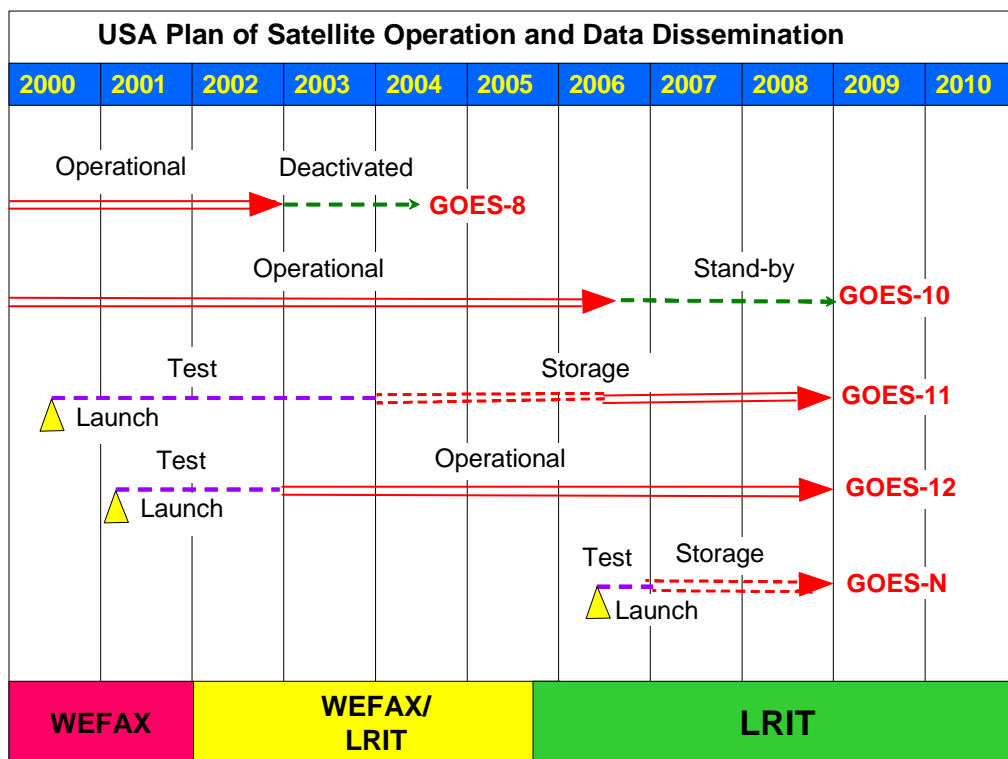


Figure 1: LRIT Transition



The transition on the GOES-West satellite commenced October 03, 2005. Full LRIT service is operational on both GOES-East and GOES-West spacecrafts. NOAA will no longer support WEFAX operations through its environmental satellites. Our current planning will focus on improving data dissemination in the future and providing a low cost system to acquire the NOAA broadcasts.

## **6. Summary**

Now that NOAA's LRIT is operational on both the GOES-East and GOES-West spacecrafts, our immediate plans include continuing the transition from the 128 kbps to 256 kbps during the GOES-N era.

Other items being considered for future implementation include expanding the product suite, adding higher resolution imagery (e.g. 1km), adding other compression algorithms (e.g. JPEG2000, zip), improving navigation information, and adding a web server for LRIT files. Though these are some of the ideas for future enhancements, by no means is LRIT limited to just these. As LRIT becomes utilized by the user community and matures, so shall the capabilities.