Deployment of the First-Ever Operational Network of Commercially-Provided GOES-16 Direct-Receive Ground Stations in Central and South America

Richard Stedronsky*, Eric Baptiste and Dr. Hae-Yong Shin

Enterprise Electronics Corporation (EEC), Enterprise, AL, USA

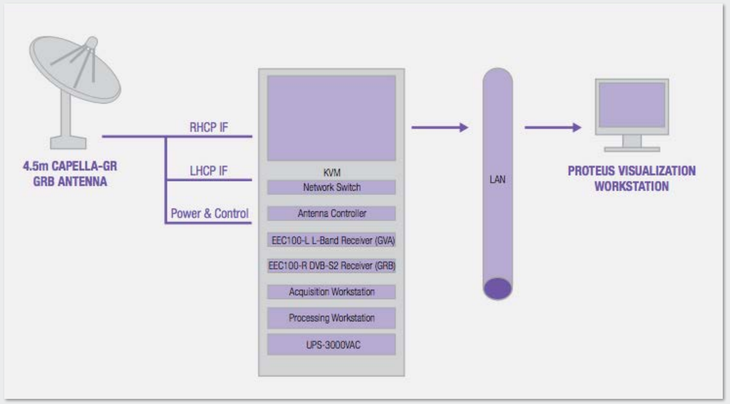
**Corresponding author R. Stedronsky (sted@eecweathertech.com)*

Introduction

Following the recent launch of the GOES-R (GOES-16) geostationary satellite system, many government entities across the Americas began seeking new, GOES-16-compliant direct receive ground stations. Such ground stations permit users to receive, process, visualize and distribute data streaming directly from the GOES-16 satellite. Enterprise Electronics Corporation (EEC) began work on a new, GOES-16-compliant direct receive ground station back in 2013. Dubbed Capella-GR, EEC has since delivered over 15 such systems to customers spanning the western hemisphere. GOES-16 became fully operational as GOES-East on 18 December 2017. Capella-GR users are now receiving the higher resolution (both spatially and temporally) data, as well as a wide array of new products and imagery. Deployment of these Capella-GR system prior to GOES-16 becoming operational was key in ensuring numerous organizations experienced a seamless transition, with no loss of data or risk to people or property.

Systems Overview – Capella-GR

EEC offers Capella-GR systems with 3.7m, 4.5m, and 6.5m antenna configurations, depending on customer location. The typical system consists of an antenna + feed horn assembly, short server rack with ingest & processing computers, and an end user visualization workstation running EEC's Proteus software.



Typical Capella-GR Configuration Schematic

Typical Capella-GR Antenna (Left) and Computing Rack (Right)

Capella-GR Advanced Baseline Imager (ABI) Products

Using the Capella-GR system, users are able to process all 34 of the Advanced Baseline Imager (ABI) products currently available. In the future, an additional set of 31 products will become available, and these will also be processed by the Capella-GR system.

ABI - BASELINE PRODUCTS	ABI - FUTURE PRODUCTS	
Cloud & Moisture Imagery (KPP)	Aerosol Particle Size	Sea And Lake Ice: Age
Radiances*	Aircraft Icing Threat	Sea And Lake Ice: Concentration
Aerosol Detection (Including Smoke & Dust)	Cloud Type	Sea And Lake Ice: Motion
Aerosol Optical Depth	Ozone Total	Probability Of Rainfall
Volcanic Ash: Detection & Height	Visibility	Rainfall Potential
Cloud Optical Depth	Cloud Ice Water Path	
Cloud Particle Size Distribution	Cloud Layers / Heights	SEISS
Cloud Top Phase	Cloud Liquid Water	Energetic Heavy Ions*
Cloud Top Height	SO_2 Detection	Magnetosphere Electrons And Protons: Low Energy*
Cloud Top Pressure	Low Cloud And Fog	Magnetosphere Electrons And Protons: Medium & High Energy*
Cloud Top Temperature	Upward Longwave Radiation: Surface	Solar & Galactic Protons
Hurricane Intensity	Convective Initiation	
Rainfall Rate / QPE	Enhanced "V" / Overshooting Top Detection	GLM
Legacy Vertical Moisture Profile	Tropopause Folding Turbulence Prediction	Lightning Detection: Events, Flashes & Groups*
Legacy Vertical Temperature Profile	Upward Longwave Radiation : TOA	
Derived Stability Indices	Absorbed Shortwave Radiation: Surface	EXIS
Total Precipitable Water	Downward Longwave Radiation: Surface	Solar Flux: EUV*
Clear Sky Masks	Flood / Standing Water	Solar Flux: X-Ray*
Downward Shortwave Radiation : Surface	Ice Cover	
Fire / Hot Spot Characterization	Snow Depth (Over Plains)	SUVI
Land Surface (Skin) Temperature	Surface Albedo	Solar Imagery: UV*
Sea Surface Temperature	Surface Emissivity	
Reflected Shortwave Radiation: TOA	Vegetation Fractions: Green	MAGNETOMETER
Snow Cover	Vegetation Index	Geomagnetic Field*
Derived Motion Winds	Currents	
	Currents: Offshore	** Included In GRB*

Current and Future ABI Products Available to Capella-GR Users

Proteus – Greater Accuracy in Forecasting

One of the core components to the Capella-GR system is the Proteus software suite. Proteus is a multi-platform forecasting application, designed for detailed integration and analysis of meteorological satellite imagery and data. The Proteus image-processing suite offers meteorologists, oceanographers, environmental agencies, and other research organizations the ability to perform detailed analysis of imagery and data from weather satellite systems.

FUNCTION	NOTES
Cursor Display	Pixel value, physical value (temp or albedo) and lat/lon of the cursor position are displayed.
Configuration Selection	Setup files determine parameters of automatic image generation.
Simultaneous Window Displays	User can select up to four image simultaneously opened display windows.
Generation of MPEG2 or AVI	Animation loops can be saved as MPEG2 or AVI files, with user specified speed and image quality. These files can be used to output directly to PAL/NTSC format (for display on a monitor) if video output card is available
Color LUTs	Selection of 10 pre-defined lookup tables for met applications. Up to 50 user defined tables.
Overlays	Inbuilt Overlays: Gridlines Political boundaries and coastlines Latitude Longitude labels User can define Overlays Forecast MODEL GRIB and Topographic Overlays
Annotation	Automatic annotation of satellite name, data and time to images and animations.
Movie Loop Display	Up to 48 image animation loops can be generated from: a) time span b) last picture and total number c) mouse highlighting from selection Animation loop can be automatically updated with the latest satellite image. Full control of the animation loop: (start/stop, dwell, speed, direction, end delay)*
Image Combination	Arithmetic combination of images can be used to generate new images. Operations can be on pixel or physical values
Generation Of Standard Image Formats	Images can be saved as PNG, BMP, TIFF, PS, JPEG, GEOTIFF
Scatter Plot	
Skew-T	Tephigrams from NOAA & METOP Sounders
AODT	Automated Dvorak Technique capability
Histogram	2D & 3D Histograms
3D Clouds	3D rendering of clouds from Geostationary satellites

Proteus Performance Specifications

Central and South America Installations

Over the past two years, EEC has delivered numerous Capella-GR systems into Central and South America. The end users vary, including national meteorological agencies, military entities, universities and disaster management organizations. The graphics and details below outline a number of these clients, who helped create the first network of of commercially-provided GOES-16 direct-receive ground stations spanning Central and South America.

Dirección Meteorológica de Chile (DMC) Capella-GR Installations in Santiago (Left), Puerto Montt (Center) and Easter Island (Right x2)

Instituto Meteorológico Nacional (IMN) Capella-GR in San José, Costa Rica

Sistema de Alerta Temprana (SIATA) Capella-GR Installation in Medellín, Colombia

In addition to the numerous systems delivered into Central and South America, EEC also supplied Capella-GR systems to US-based organizations. These include both the the US Naval Research Laboratory (NRL) in Monterey, CA, and NASA's Marshall Space Flight Center in Huntsville, AL.

Multiple Capella-GR Systems at the NRL in Monterey, CA

Capella-GR Installation at NASA-Huntsville

Conclusions and Acknowledgment

With GOES-16 now fully operational as GOES-East, Capella-GR users are able to take advantage of the full suite of ABI products. Additionally, the rapid updates provided by GOES-16 allow clients to gather more data faster in order to support more accurate, timely and precision severe weather decisions based on satellite imagery. Capella-GR customers are also able to use the new ABI data to advance Numerical Weather Prediction initialization and estimated rainfall products, helping support improved forecasts to protect people and assets. EEC is also working with existing Capella-GR users to prepare for the near-term launch of GOES-S, currently scheduled for March 2018.

EEC would like to acknowledge the DMC, IMN, SIATA, NASA-Huntsville, and NRL for all of their cooperation in fielding these advanced systems. Additionally, EEC would like to thank all of its international partners, who helped educate various organizations on the impact of GOES-16 and the need for new systems to process the data.