The Geostationary Lightning Mapper (GLM) on the GOES-R Series

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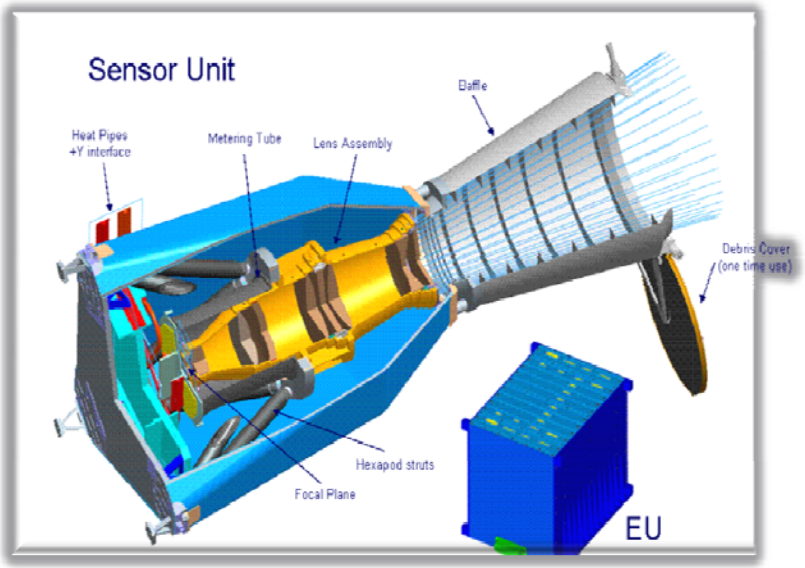
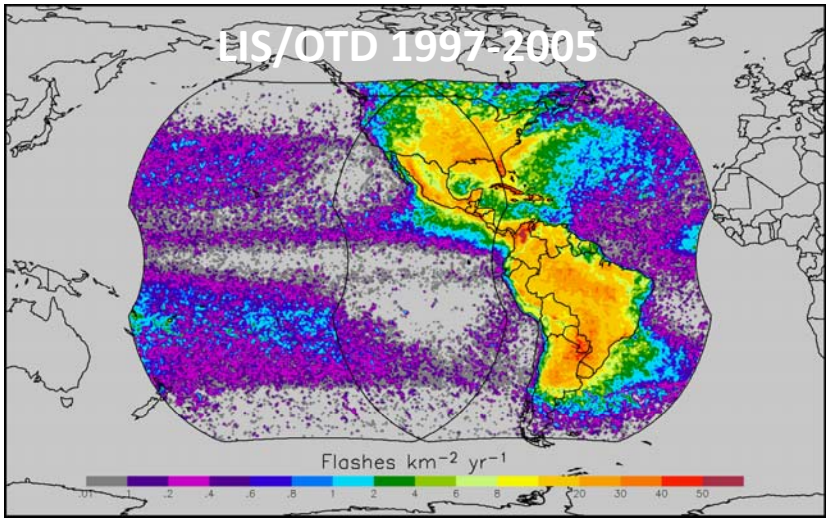
GOES-R Geostationary Lightning Mapper (GLM)



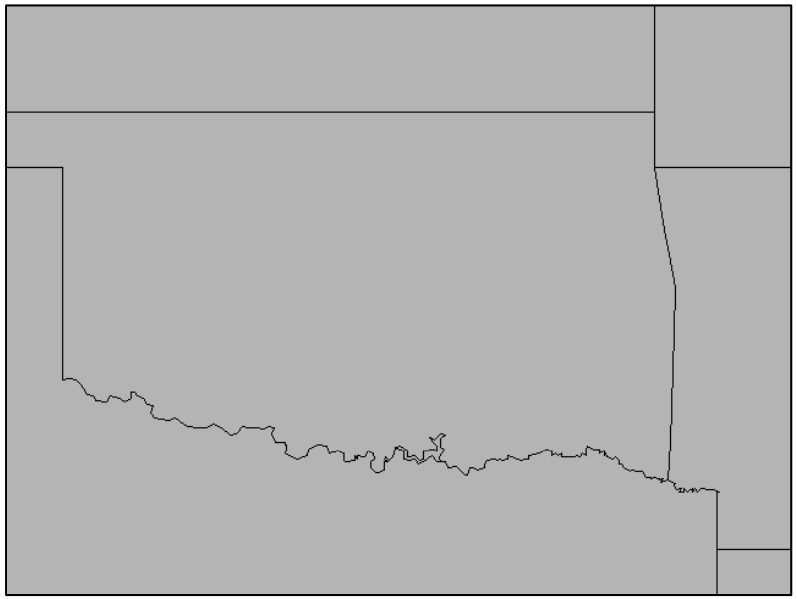
GLM Characteristics

- Staring CCD imager (1372x1300 pixels)
  - Single band 777.4 nm
  - 2 ms frame rate
  - 7.7 Mbps downlink data rate
- Near uniform spatial resolution/ coverage up to 52 deg lat
  - 8 km nadir to 14 km at edge
  - 70-90% flash detection
- < 20 sec product total latency

GLM Combined R/S Coverage



May 3 1999 Oklahoma Tornado Outbreak



1-minute of observations from TRMM/LIS

Natural Hazards and Lightning

- Tornadoes
- Hailstorms
- Wind
- Thunderstorms
- Floods
- Hurricanes
- Volcanoes
- Forest Fires
- Air Quality/NOx

FPA (CCD)

- The FPA must have 1372 x 1300 pixels (1,783,600 pixels), in order to have 1 pixel per average storm cell size
- In order to readout all of those pixels in less than 2 ms, the CCD has 56 outputs
  - Limited to 20 MHz readout rate per output due to availability of high-speed, space qualified,14 bit, ADCS
- Quantum Efficiency (QE) - >90
  - Needed to detect >70% of all lightning
  - Minimum lightning signal of 4.7 µJ
- Well depth / charge capacity (1.92 Me-)
  - Background from sunlit clouds generates ~800 Ke- photoelectrons per pixel in the CCD
- Pixel size 30 µm x 30 µm
  - Needed to achieve the required well depth

Event Processing

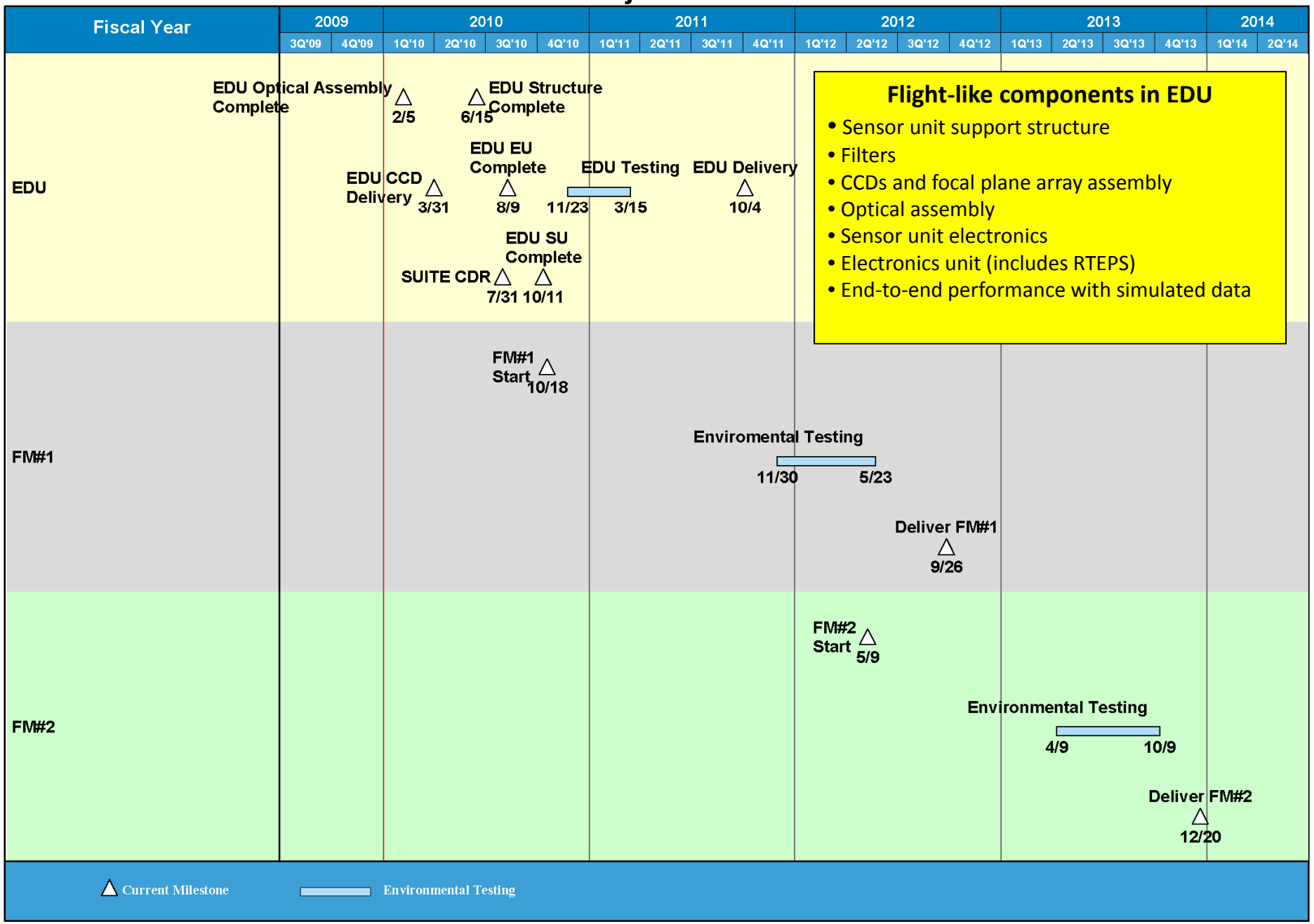
- An event is anything that exceeds the threshold
  - Noise, Proton hit, or lightning pulse
  - All events are transmitted to the ground along with housekeeping and subsampling of the background levels
  - Ground processing determines which events are lightning pulses by looking for strings of pulses, both spatially and temporally (coherency)
  - End-product is time-tagged, geolocated, measured, lightning (PORD Requirement)

Pixel Processing

- GLM @ 500 frames/second produces (1,783,600 x 500), which is 0.8918 Giga pixels/second
- GLM must process every pixel in every frame of data
  - Unlike a star tracker, which after it initially acquires the star field, knows where the stars will be in the next frame
  - GLM has no advanced knowledge of where lightning might occur
    - See video in next slide
  - The background for GLM is variable, both temporally and spatially, across the field-of-view
    - Background from sunlit clouds - ~700 Ke- to ~800 Ke-
    - Sunlit Earth -~150 Ke-
    - Dark Earth – Near zero
      - Star tracker only see black space unless the fov is approaching the Moon or Sun
  - GLM must process all 0.9 Giga-pixels, real-time
    - GLM keeps a running background, on a pixel-by-pixel basis
    - Events/pulses are detected by thresholding above the background levels
    - The thresholds are variable

Nadir View of Actual Lightning Flash Rate from STS52

GLM Project Schedule



Risk Reduction

ETU = Engineering Test Unit

These are being fabricated so they can be tested to make sure we are doing the right thing in the design. They may also be damaged in test. There may be several ETUs in some cases. ETUs are NOT contract deliverables.

ETUs come before EDUs. ETUs are produced as part of LMs strategy for producing a working design by providing 'fabrication practice' and also test articles.

EDU = Engineering Demonstration Unit

- GLM bench unit for performance and limited environmental testing

Instrument Status Summary

Design is progressing toward an early summer 2010 Critical Design Review

- Successfully completed a number of subsystem CDRs. Structures, CCD, Filters.
- Subsystem CDRs will continue through April 2010.

ETU Focal Plane arrays delivered and under test

- Successful testing will result in beginning of Flight CCD fab

ETU Filters delivered and tested

- Filter mounting fixtures being tested with ETU filters
- Ready to begin fab of flight filters

ETU mechanical structure fabricated

- Mechanical testing scheduled for late January

Optical Assembly (telescope) being assembled and readied for performance and environmental tests

ETU electronics boards have begun fabrication (10 types of boards total)

INR models being developed

- Preliminary models tested using simulated data files

Interface meeting have begun between GLM and the spacecraft supplier