EDOS: 20 Years of Level 0 Processing for Terra

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- EDOS Overview
- EDOS Support for Terra
- EDOS High Rate White Sands Architecture
- Terra LANCE Support
- Some 20 Year EDOS Statistics
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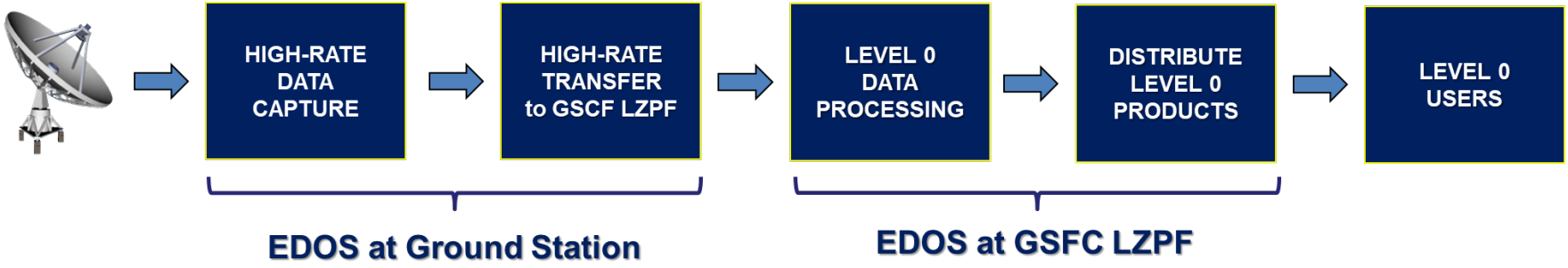
Background

- The EOS Data and Operations System (EDOS) began level 0 processing of Terra science data in 1999, after more than 5 years of design and development.
- EDOS has performed high-rate data capture, level 0 processing, and level 0 product distribution for **ALL Terra science data for the past 20 years**.
- The initial EDOS system design was multi-mission in scope to include Aqua (2002) and Aura (2004) following closely behind Terra.
- This multi-mission approach was leveraged through today, providing a stable infrastructure and flexible framework to add new missions to EDOS, currently supporting 5 additional missions on top of Terra, Aqua, and Aura.
- Current NASA missions supported include Terra, Aqua, Aura, ICESat-2, SMAP, and OCO-2; current NOAA missions supported include SNPP and NOAA-20.
- During the 20 years of Terra support, EDOS also supported ICESat, ALOS, OCO, and EO-1 before these missions terminated.

EDOS Overview

- EDOS is a distributed system with both ground station components and a centralized level 0 processing facility (LZPF) at GSFC.
- EDOS high rate data capture components at the ground stations capture the high-rate science downlinks and perform front-end processing (frame synching, decoding, and de-randomization).
- Data is transferred to the LZPF at the Goddard Space Flight Facility over high rate WAN networks, using both open and closed network resources.
- At the LZPF, EDOS generates, archives and distributes level zero products to next-level science users around the world.



EDOS Overview
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- LZPF processing includes separation of data based on instrument and application, time-ordering and gap-filling packets to produce the most complete products possible.
- EDOS products include both near real-time (NRT) low-latency products and time-based products from multiple ground station contacts.
- A full backup LZPF system is also maintained at GSFC to support EDOS contingency operations.
- EDOS also maintains a data archive facility at White Sands that contains life of mission product archives for selected EOS missions, including Terra.
- In 2006, EDOS was refined with a unique multi-mission design called “data-driven” which automatically recognizes a supported CCSDS mission based on spacecraft ID.
- EDOS autonomously captures science data at 7 remote ground stations and automatically initiates transfer of science data to GSFC over open or closed or WANs.
- EDOS delivers roughly 1 Terabyte of level zero products daily worldwide in a variety of formats and protocols.
- EDOS nominally runs end-to-end with no operator intervention required, but operations personnel monitor the system 24x7 to respond to any anomalies that may occur.

EDOS Overview
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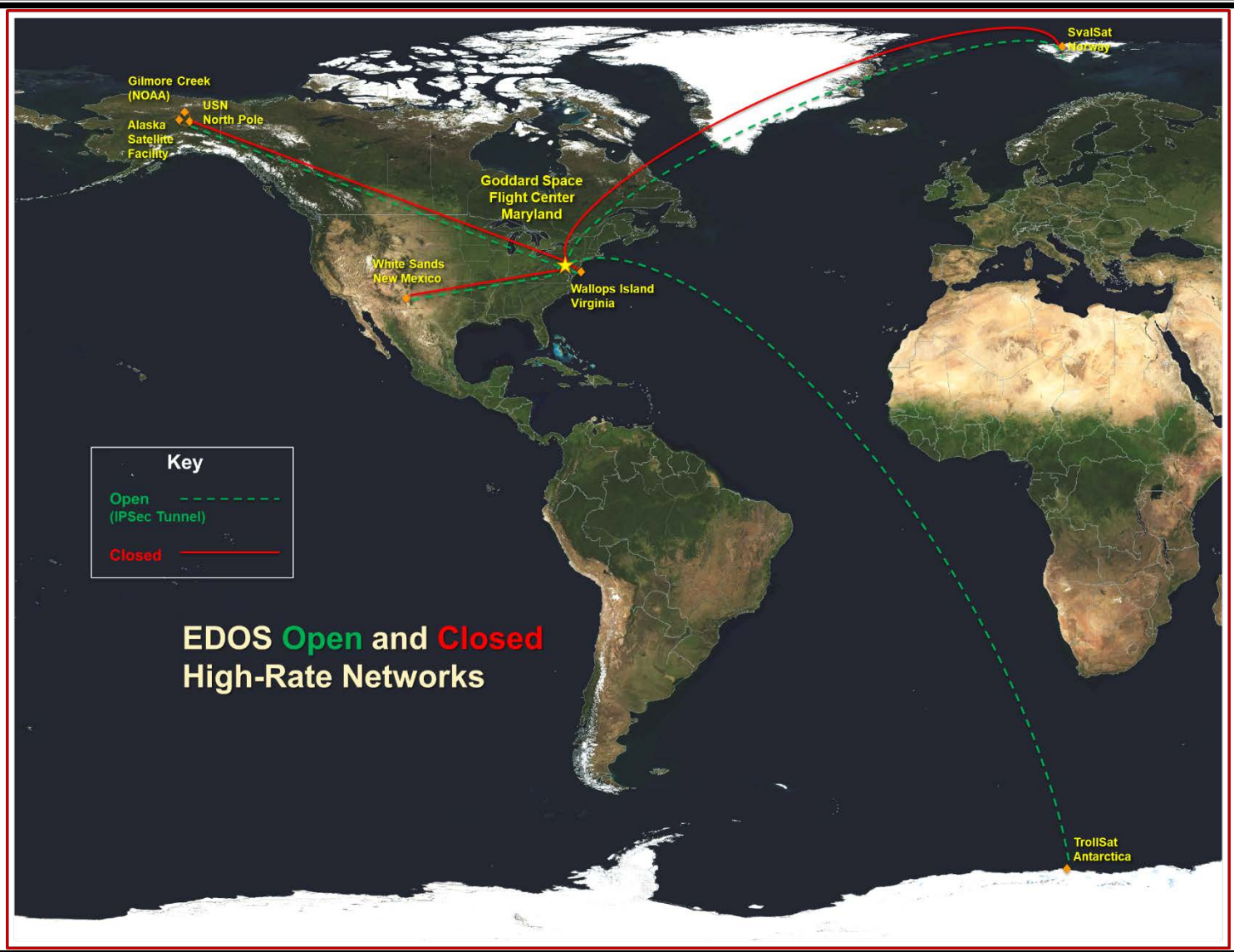


EDOS Support for Terra

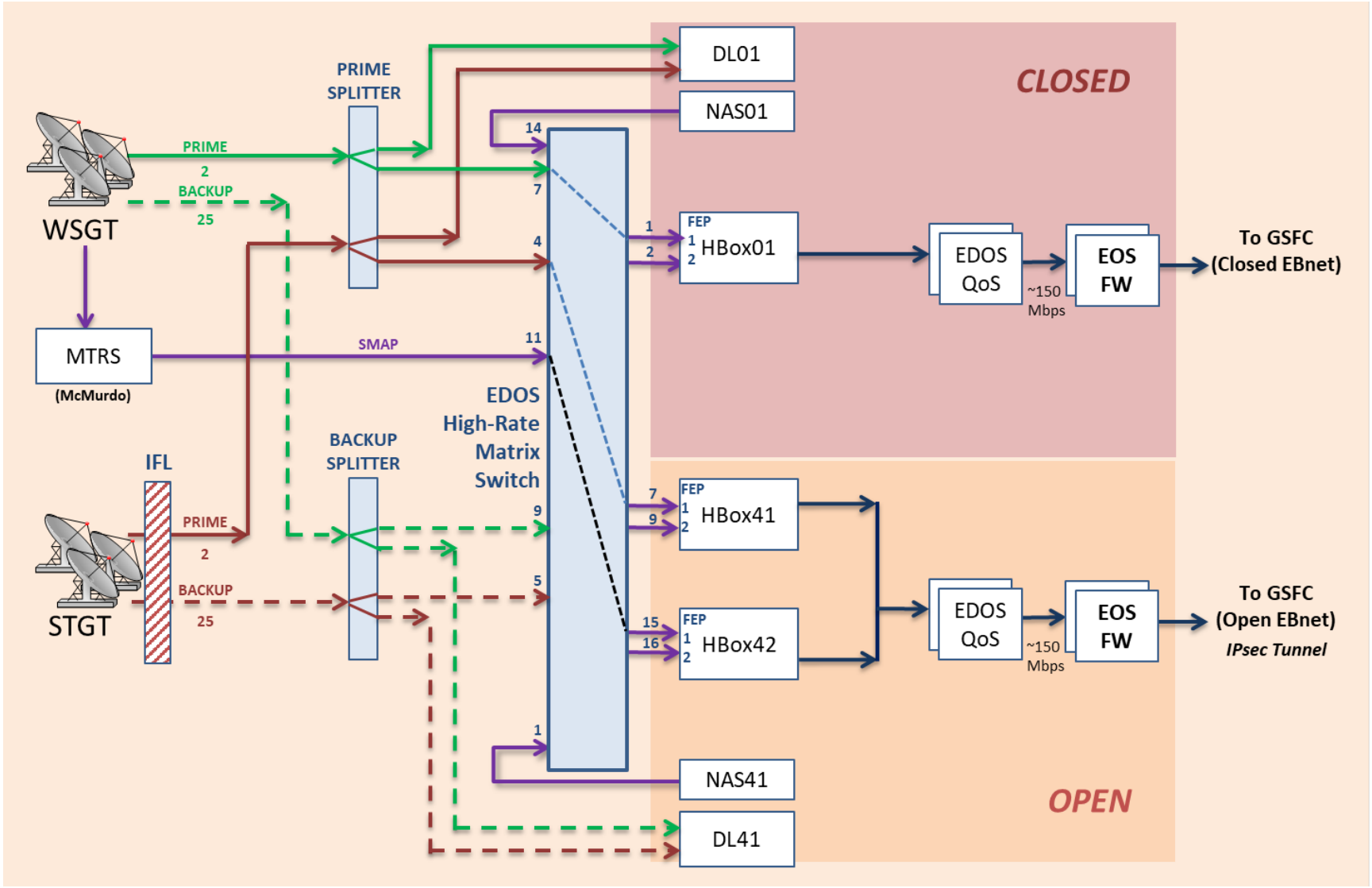
- Terra data is normally down-linked via TDRSS at NASA's White Sands Complex twice per orbit (at 150 Mbps), but X-band proficiency passes at other ground stations are also performed on a regular basis for contingency operations.

- EDOS processes Terra data for both session-based (single contact) near real-time (NRT) users as well as time-based users.

- EDOS produces session-based NRT Level 0 products for 4 Terra instruments:
  - MODIS NRT data to NOAA and MODAPS (dual stream)
  - MOPITT NRT data to LaRC DAAC (dual stream)
  - MISR NRT data to LaRC DAAC (dual stream)
  - ASTER NRT data to LPDAAC
  - Terra Housekeeping data to GSFC EOC and BEOC

- EDOS produces time-based Level 0 products for all 5 Terra instruments:
  - MODIS 2 hour PDS to MODAPS
  - MOPITT 2 hour PDS to LaRC DAAC
  - MISR 2 hour PDS to LaRC DAAC
  - CERES 6 hour PDS to LaRC DAAC (dual stream)
  - ASTER 2 hour PDS to ASTER SPDS, Japan
  - Terra Housekeeping 2 hour PDS to GSFC EOC/BEOC and GSFC DAAC

EDOS High Rate White Sands Architecture for Terra



Terra LANCE Support

- NASA's Land Atmosphere Near real-time Capability for EOS (Earth Observing System) (LANCE) provides global data and imagery from selected EOS satellites, including Terra, in less than 3 hours from satellite observation to meet the needs of the near real-time (NRT) users.
- LANCE defines latency as the time from satellite observation to product delivery. EDOS produces session-based data sets especially for LANCE NRT use and delivers the Level 0 products in an expedited manner to designated LANCE elements.
- For Terra, EDOS processes NRT data on a dual stream basis for MOPITT, MISR, and MODIS LANCE elements.
- EDOS performs the Level 0 processing for all of the LANCE NRT data except for GCOM-W1 (AMSR-2) and ISS (LIS).
- The primary contributor to latency of Level 0 data is the transfer of the data across the high-rate WAN. EDOS has implemented numerous latency enhancements to decrease WAN transfer time in support of LANCE.
- EDOS nominally delivers Terra NRT data to MOPITT, MISR, and MODIS LANCE elements with an average latency less than 1 hour of instrument observation time.

Some 20 Year EDOS Statistics

- In the last 20 years of EDOS support of Terra, EDOS has captured Terra data at White Sands for approximately 7,305 days.
- The average number of Terra contacts per day at White Sands is 30 contacts per day (twice per orbit).
- As a result, EDOS has captured more than 219,150 ground station contacts of Terra data in the last 20 years.
- The average volume of data downlinked per contact is approximately 9.3 GB
- At the average Terra downlink of 280 GB per day, this equates to EDOS processing of more than 2,045 TB of raw Terra science data in 20 years!

Summary

- The EOS Data and Operations System (EDOS) began level 0 processing of Terra science data in 1999, after more than 5 years of design and development.
- EDOS has performed high-rate data capture, level 0 processing, and level 0 product distribution for ALL Terra science data for the past 20 years.
- EDOS products include both near real-time (NRT) low-latency products and time-based products from multiple ground station contacts.
- EDOS produces session-based NRT Level 0 products for 4 Terra instruments, and produces time-based Level 0 products for all 5 Terra instruments.
- For Terra, EDOS processes NRT data on a dual steam basis for MOPITT, MISR, and MODIS LANCE elements, and nominally delivers the NRT data to LANCE elements with an average latency less than1 hour of instrument observation time.
- EDOS continues to reduce latency for Terra LANCE elements with the goal of transferring the data from the ground station to LZPF across the WAN in near real-time.