
Digital Laser
Communication System

Laser Communications Group Members

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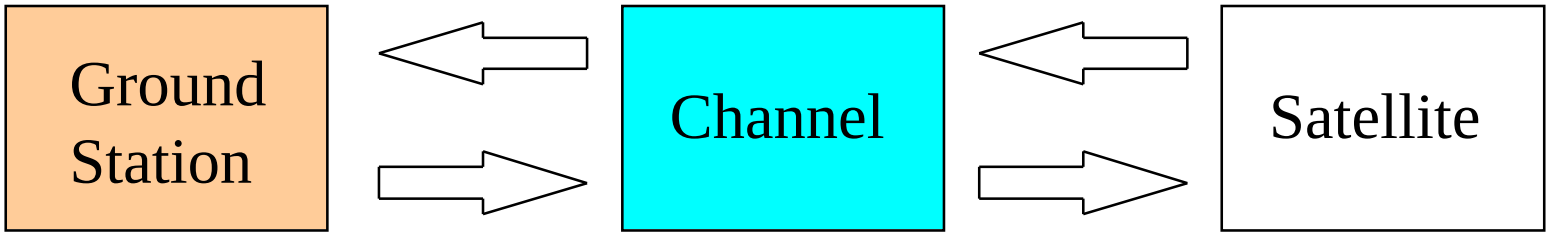
OBJECTIVES

- Design a High Speed, Reliable Alternative Communication System for the University of Arizona's Student Satellite Project
- Demonstrate the feasibility of a two-way LASER communication link between a Small Satellite and a Ground Station
- Build a ground-to-ground communication link as a test bed

Design Goals

- Uplink - send test data to satellite to confirm working link
- Utilize LASER Communication System as alternative channel for TT&C team's standard uplink (actual commands)
- Full two-way LASER communication (uplink commands / downlink data)

System Overview



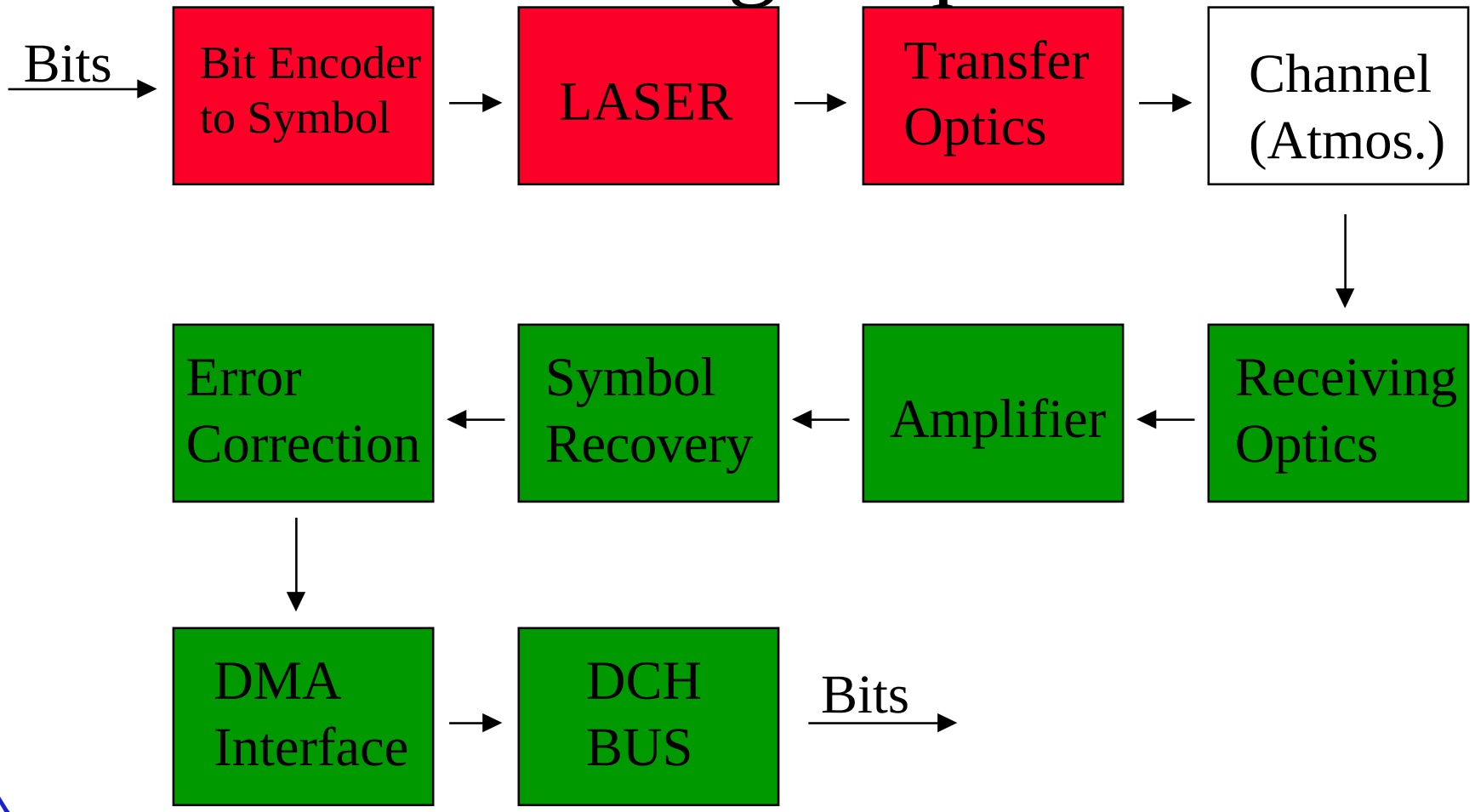
Groundstation Description

- Control System (data and tracking)
- Telescope & LASER Mounts
- LASER & Transmission Optics
- Receiving Package (photodetector)

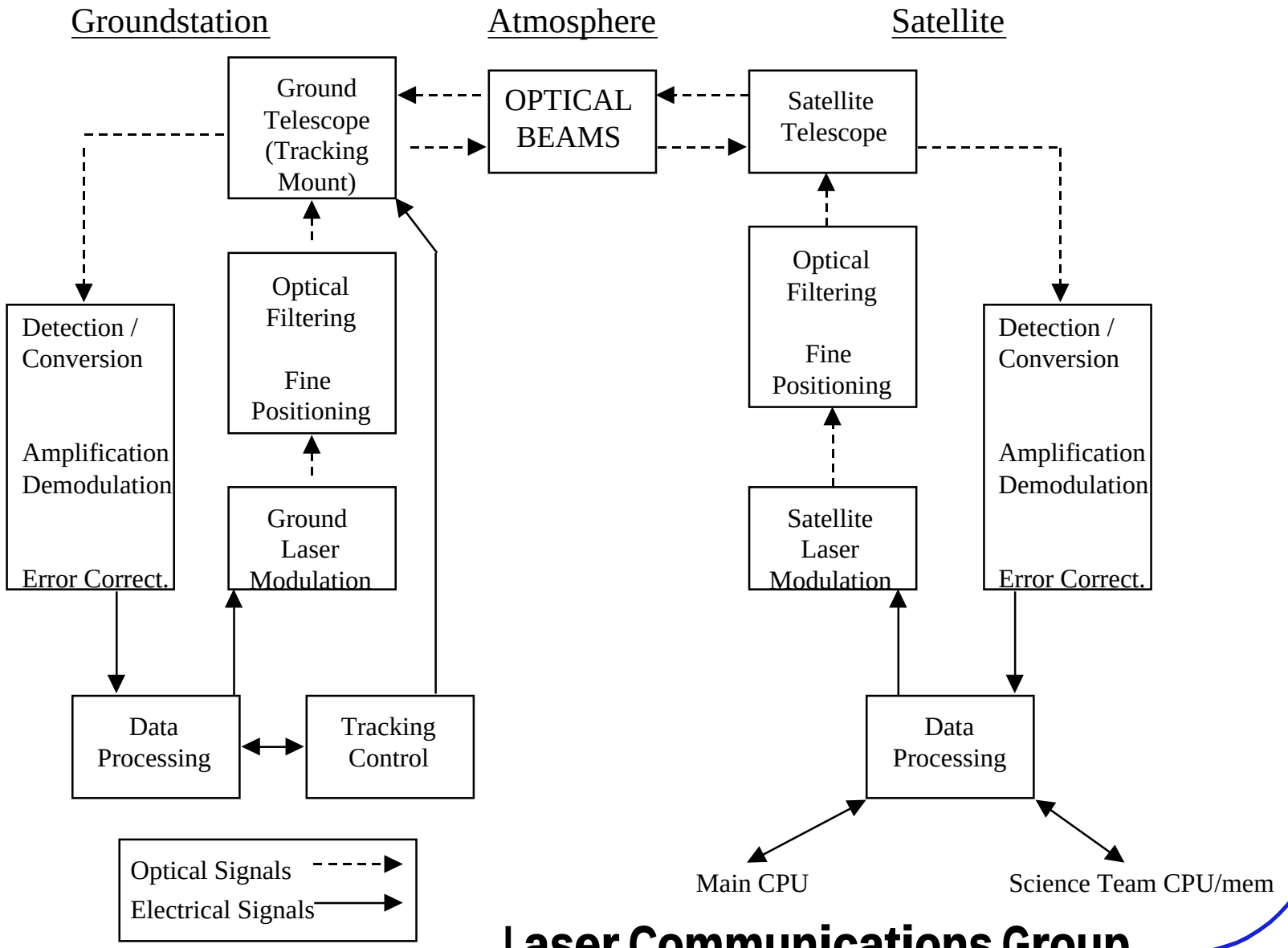
Satellite Description

•Utilize Science Team's Telescope & Processing Capability for LASER Communication
•Transmission & Receiving Package.

Uplink/Downlink Data Processing Sequence



Overall System Block Diagram

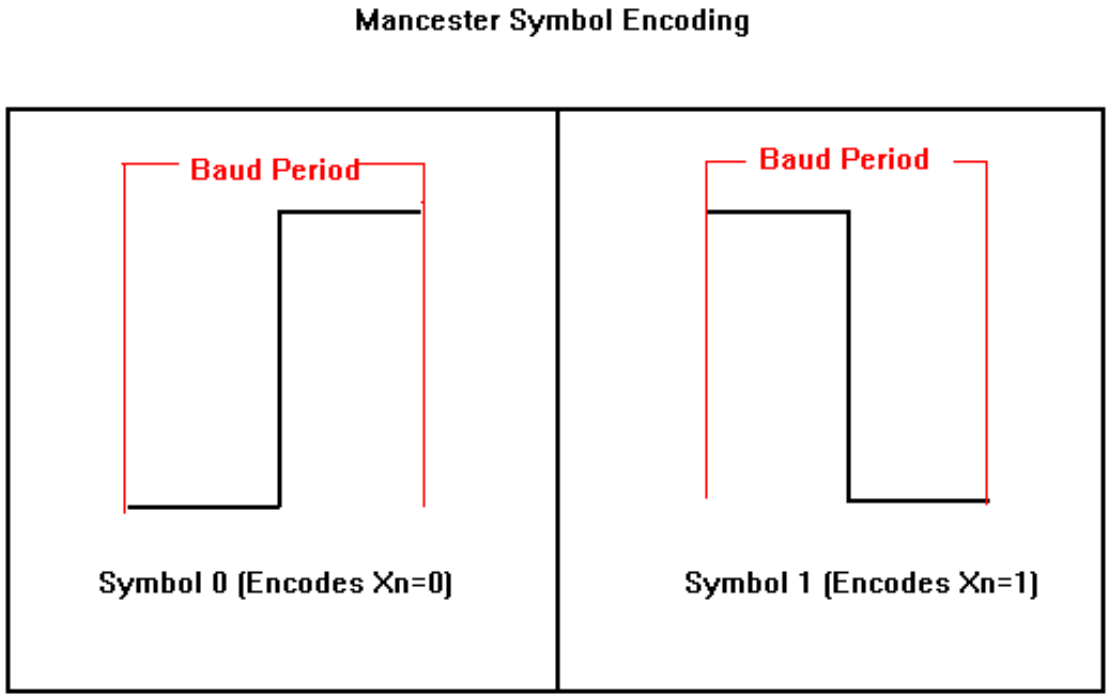


Communications Protocol

- 10Mbit/sec Data Rate
- Manchester Encoded Data
- Error correction
- Packet (Frame) Protocol with Resend

Manchester Encoding (2-PPM)

- Two Position Pulse Modulation
- 1 bit per symbol
- Transmit power data-independent

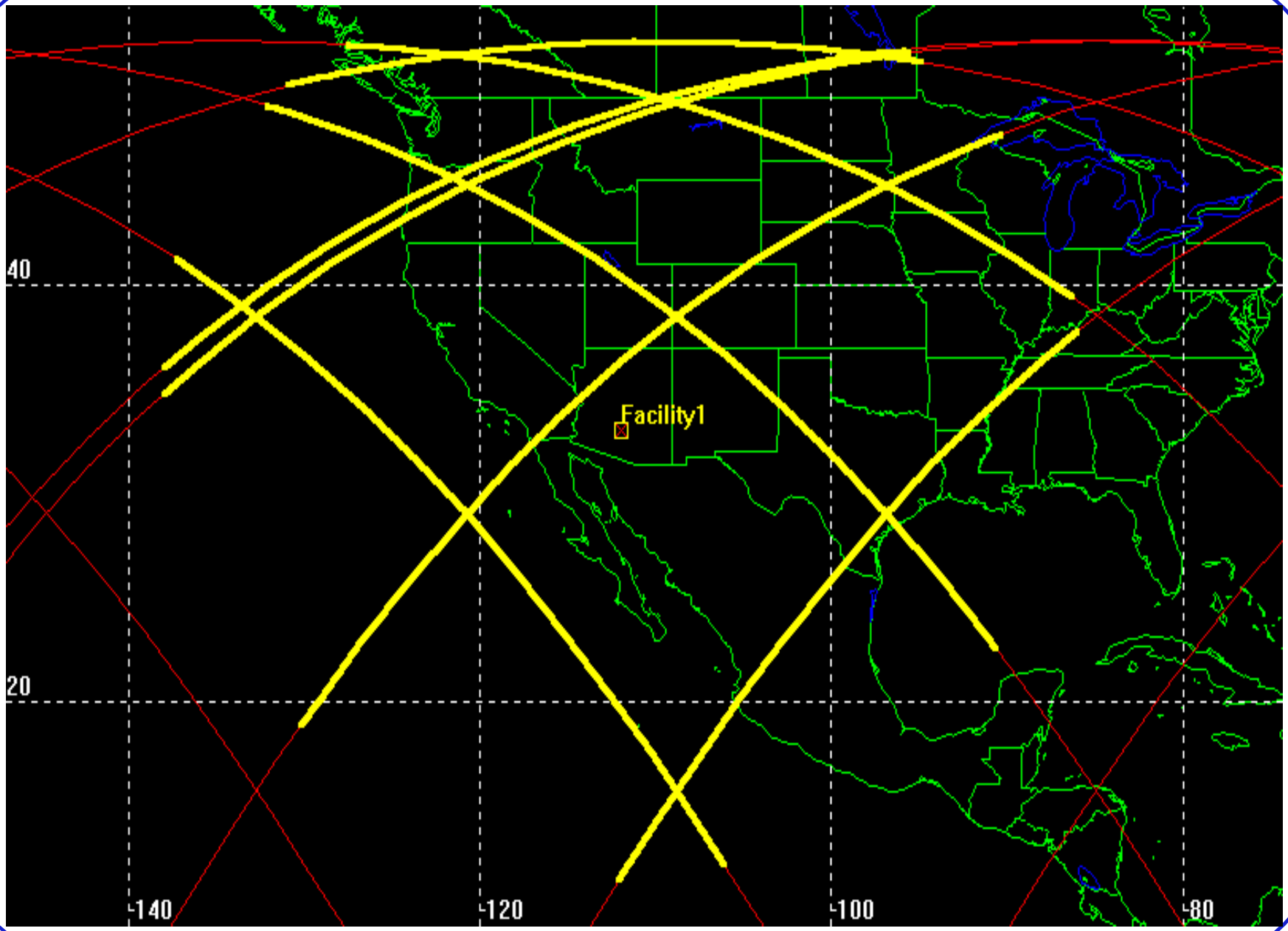


Error Detection / Correction

- Utilize forward error control to handle as many errors as possible
- Retransmission of packet (iff packet is destroyed)

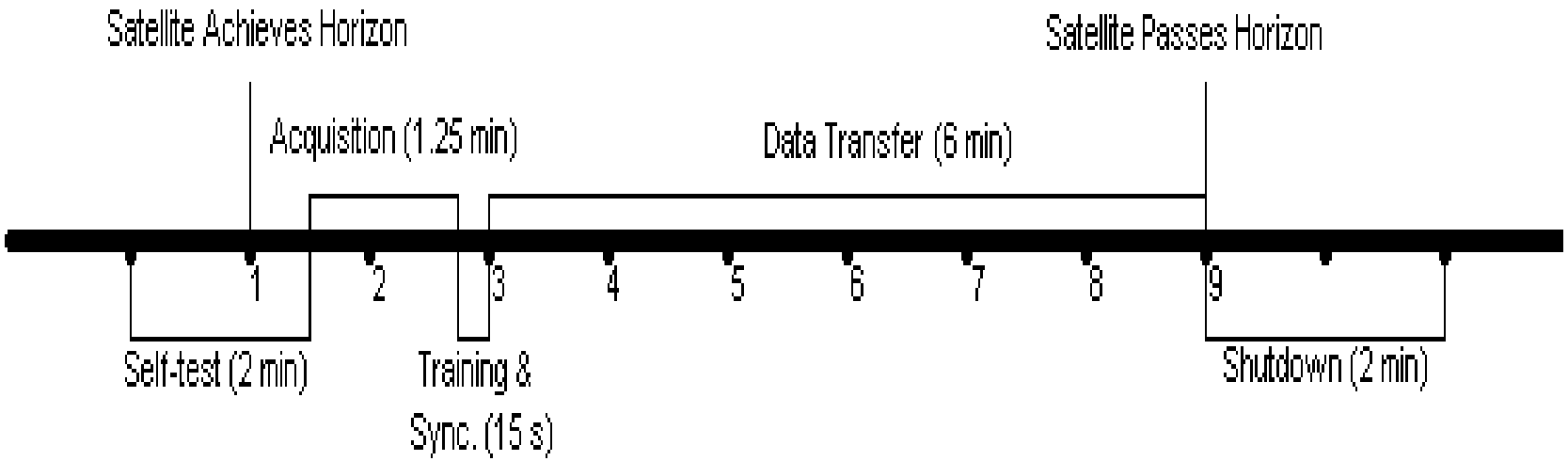
Forward Error Correction (cont.)

- Example of an error correction IC is the National Semiconductor DP8400-2-E^2C^2
- It can correct 2 bit errors in a 16 bit data word + 6 check bits. This chip can also be cascaded to correct up to 3 bits
- Propagation Delay is well within our desired data rate for single bit error correction


40
20
140
120
100
80
Facility1

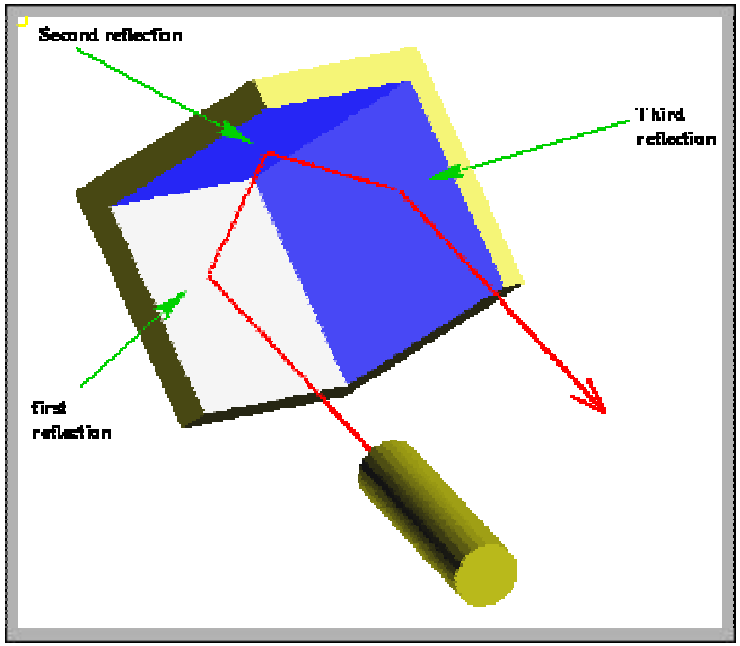
Access Time

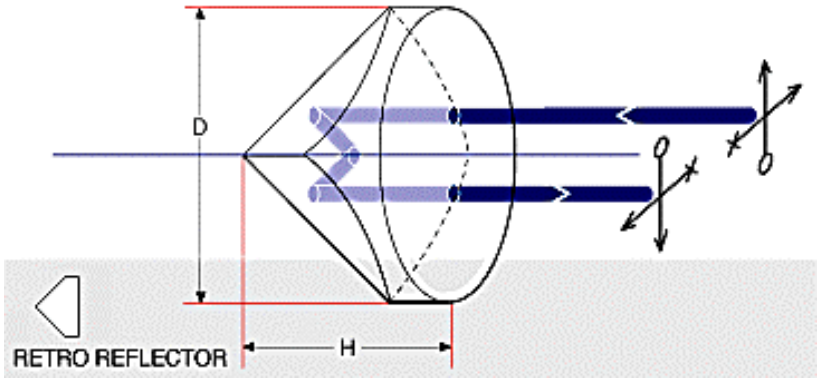
Approximate timeline given a pass by the satellite directly overhead (9 minute access time)



Retroreflectors

Retro-reflectors deviate light by 180 degrees independently of its angle of incidence. This means that any light incident on the surface will be reflected back along the same path that it came from





Interfaces With Other Systems

- Optical dichroic splitters to split light from Science Team's telescope
- Spacecraft CPU: compliance with DCH bus specifications (also utilize a direct memory access scheme to get to data storage)
- Power: compliance with Power team distribution system
- Guidance: Rely on GNC system for coarse orientation

Opportunities For Student Involvement

- LASER Research
- LASER Modulation Circuitry
- Encoding/Decoding Circuitry
- Optic Train (For Ground link And Groundstation/Satellite Systems)
- Interfacing With Other Teams' Systems

Involvement Benefits

- Integration of Senior Project with SSP research
- Leadership opportunities
- Resume′ material
- Possible paid research (pending grant success)

Benefits of LCS Experience

- Chris Gee working on airborne laser at Boeing
- Matt Gilbert worked a Co-op at IBM
- Mitesh Patel worked a Co-op at Raytheon
- Emma Harty hired at Ball Aerospace for the summer
- Emma Harty and Jeff Moore received Honors Research Grants

Contact Information

For more information:

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- Http://www.physics.arizona.edu/ssp/sti

To fill out an online application:

- Http://www.physics.arizona.edu/ssp