Modernization of the Laser Ranging Observatory at Haleakala, Maui

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Abstract:

The Satellite Laser Ranging Observatory at Haleakala, Maui (HOLLAS) had been operating on borrowed time the last few years. The aging Digital Equipment Corp (DEC) PDP-11 computer hardware and the RSX-11 OS had not been supported by DEC for years.DEC ceased to exist as a company in the mid 1990 's, and spare parts for the computer system were becoming increasingly difficult to procure. In addition, the 28 year old telescope control system was failing. A task to modernize the system was undertaken during the last two years. In order to reduce both short term and long term costs, the HOLLAS system upgrade was based as much as possible on the NASA TLRS system hardware and software upgrades installed by Honeywell-TSI over the last few years. This paper will identify and discuss the changes to the Haleakala system, any problems incurred during the process, and still in-progress additions to the system.

Project Goals

- **Modernization and Standardization of the Computer Hardware and Software.**
- **Replacement of the Telescope Control System Electronics.**
- **One Observer Operations.**

Modernization and Standardization of the Computer Hardware and Software.

- Migrate From DEC, RSX, Qbus, HP Environment to the Pentium, LynxOS, X-Windows, CAMAC and Linux Environment in use at all other NASA SLR Sites. (See Figure 0)
- Modify Software and Hardware that has already been Developed for TLRS System for use by HOLLAS System.

One Observer Operations

- Control System moved from old LUNAR/SATELLITE Control Room to the Laser Room.
  - Operator now has easier access to both the computer control and to the laser.
  - Signal cables have been shortened considerably.

One Observer Operations (cont)

- **Installation of an Aircraft Detection Radar System.**
  - **HOLLAS will connect to a Real-Time Radar feed from the FAA Honolulu Center for Radar Approach.**
  - **System has been developed for the Air Force Maui Space Surveillance Site (MSSC) by Boeing, Inc. (See figure 1)**
  - **System is not yet Fully Operational.**

Replacement of the Telescope Control System Electronics.

- **Outside Vendor Contracted to Replace Telescope Control System.**
  - **Installation was 6 months behind schedule.**
  - **Installed System is Not Currently Operating To Specifications.**
    - **Data Rate is ~70% of Historical Rates Obtained at HOLLAS.**
    - **Additional Engineering by Vendor is Necessary.**

Conclusions

- **HOLLAS was not producing data from October 1, 1999 through August 13, 2000 while these modifications were being installed.**
- **HOLLAS is currently operating with a single 2 person observation shift .**
- **24/7 Ranging Operations can commence with the completion of the Aircraft Detection Radar System installation and the addition of another staff member.**

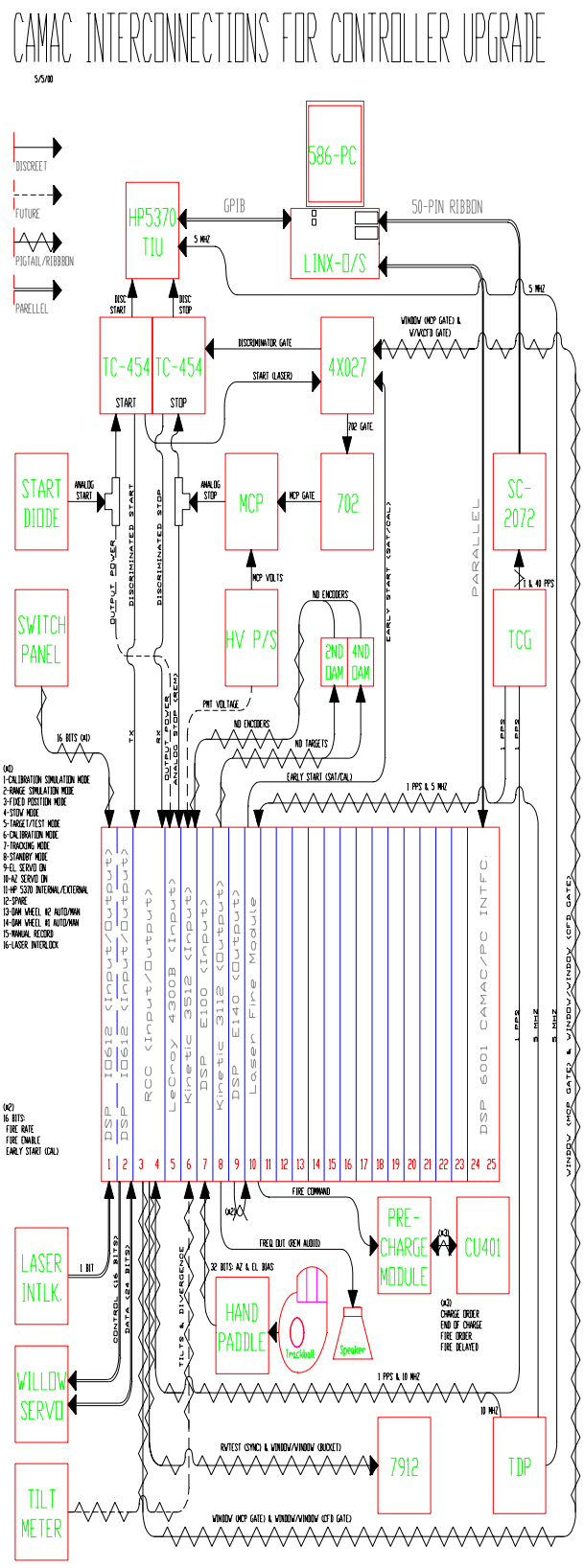

Figure 0 – Controller Interface

All the functions that were performed via the DEC Q-BUS interface were moved to CAMAC. Off-The-Shelf components were used wherever possible.

Two custom interfaces were designed by Honeywell-TSI and one by the University of Hawaii.

- The Range Control Card (RCC) provides gating information to the Tennelec 454 Start and Stop Discriminators. It also calculates the time between request for fire and actual laser fire (XDELAY).

- The Laser Fire Module (LFM) produces the 1,2,4,5 and 10 Hertz fire signals for the laser.

- The 4X027 Gating Module provides a gate to the Stop Discriminator during “Early Start”. This module provides correct gating when ranging to the Calibration Cube which is only 39 meters distant.

CAMAC Interconnections for Controller Upgrade

Acronyms and Descriptions.

- **2/4ND OAM - Optical Attenuation Mechanism Control**
- **4X027 - "Short Target" Gating Module. In a Passive Mode during Satellite Ranging**
- **586-PC - USLogic 166MHz Pentium based Personal Computer**
- **702 - High Voltage MCP Gate Control**
- **7912 - HP7912 Digitizing Display Unit**
- **CU401 - ND:YAG Laser Fire Control Unit**
- **DSP E100 - 24 Bit Input Register. Hand Paddle Control.**
- **DSP E140 - 24 Bit Output Register. LFM Control.**
- **DSP IO612 - 24 Bit Input/Output Registers**
- **HP5370 TIU - HP5370B Time Interval Counter**
- **HV P/S - High Voltage Power Supply for the MCP**
- **Kenetic - Analog/Digital and Digital/Analog Modules. OAM and HV Control.**
- **Laser Intlk - Laser Interlock Control**
- **LeCroy4300 - Analog to Digital Converter. Receive Energy Measurement.**
- **LFM - Laser Fire Module. Early Start Control.**
- **LINX-O/S - LynxOS Real Time Unix**
- **MCP - ITT MultiChannelPlate Photo Multiplier Tube**
- **RCC - Range Control Card. Gate Control and XDELAY Measurement.**
- **SC-2072 - Timing Signals Terminal Block**
- **TC-454 - Tennelec 454 Discriminator**
- **TCG - Time Code Generator**
- **TDP - Rubidium Frequency Standard**
- **Willow Serv - Telescope Control Electronics**

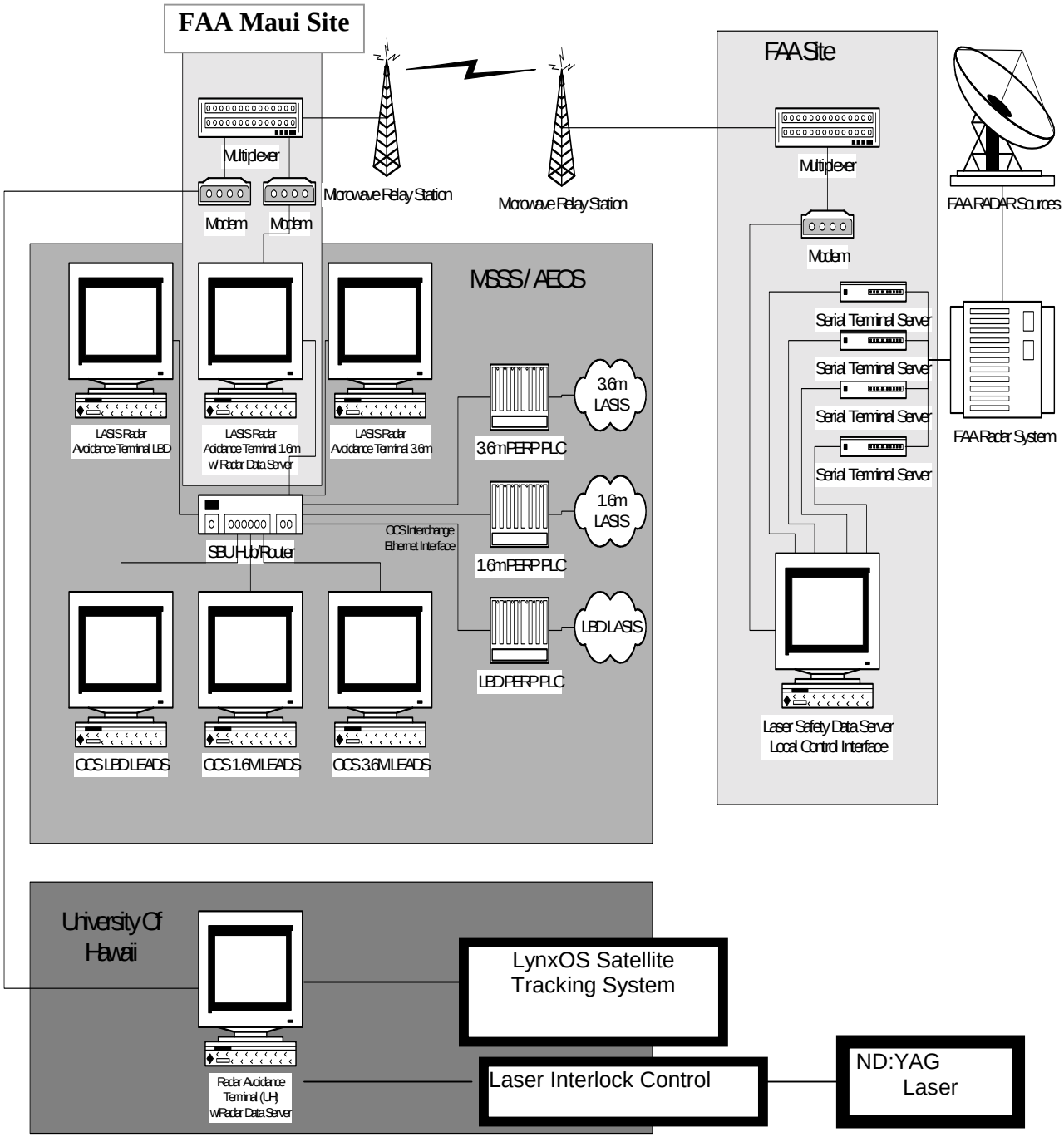

Figure 1 - Network Interface Diagram

The network interface diagram above shows the communications layout and the physical data flow paths. The key software components in the system are the FAA Data Server which executes at the FAA Site, the MSSC Data Server which executes at the MSSC, and the display application at MSSC and University of Hawaii LURE Observatory which displays the data to the operator. Data Server interaction with the Satellite Tracking System and the Laser Interlock will control laser fire Enable/Disable.