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Space Geodesy Satellite Laser Ranging Computer Design

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ABSTRACT

The new Space Geodesy Satellite Ranging (SGSLR) computer architecture and software will allow full automation to be realized after the lessons learned during development of the NGSLR prototype. A more streamlined approach will be shown using industry standard I/O devices, more powerful off the shelf computers and an open source operating system with a real-time application interface. SGSLR will utilize most of the NGSLR software. This new approach will consolidate systems, provide a broader expanse of hardware solutions and reduce computer related costs and maintenance.

Introduction

- The SGSLR computer design derives from the knowledge gained from the Next Generation Satellite Laser Ranging (NGSLR) system and other legacy systems
- Much of the NGSLR functionality will remain the same but the redesigned computer system will take advantage of the latest computer advances and standard interfaces
- The new design uses Linux as the base operating system with the Real-Time Application Interface (RTAI) applied for the hard real-time functions

Operating Systems

The operating systems that will be utilized are Linux and Microsoft Windows™

- The Linux operating system will be installed with the Real-Time Application Interface (RTAI) on the computers requiring hard real-time constraints
- Computers not requiring hard real-time will simply use the Linux operating system
- Use of Microsoft Windows™ operating system will enable the ability to use packages not supported under Linux

Upgrade Computer Hardware

- Utilizes the latest multi-core CPU's on a standard PCI/PCIe bus in a rack mount, desktop or laptop systems

- Some computers will be consolidated from the NGSLR design to the SGSLR maintaining the same functionality, others may be consolidated in the future

- Allows for reduced cost and expands options for future upgrades to SGSLR

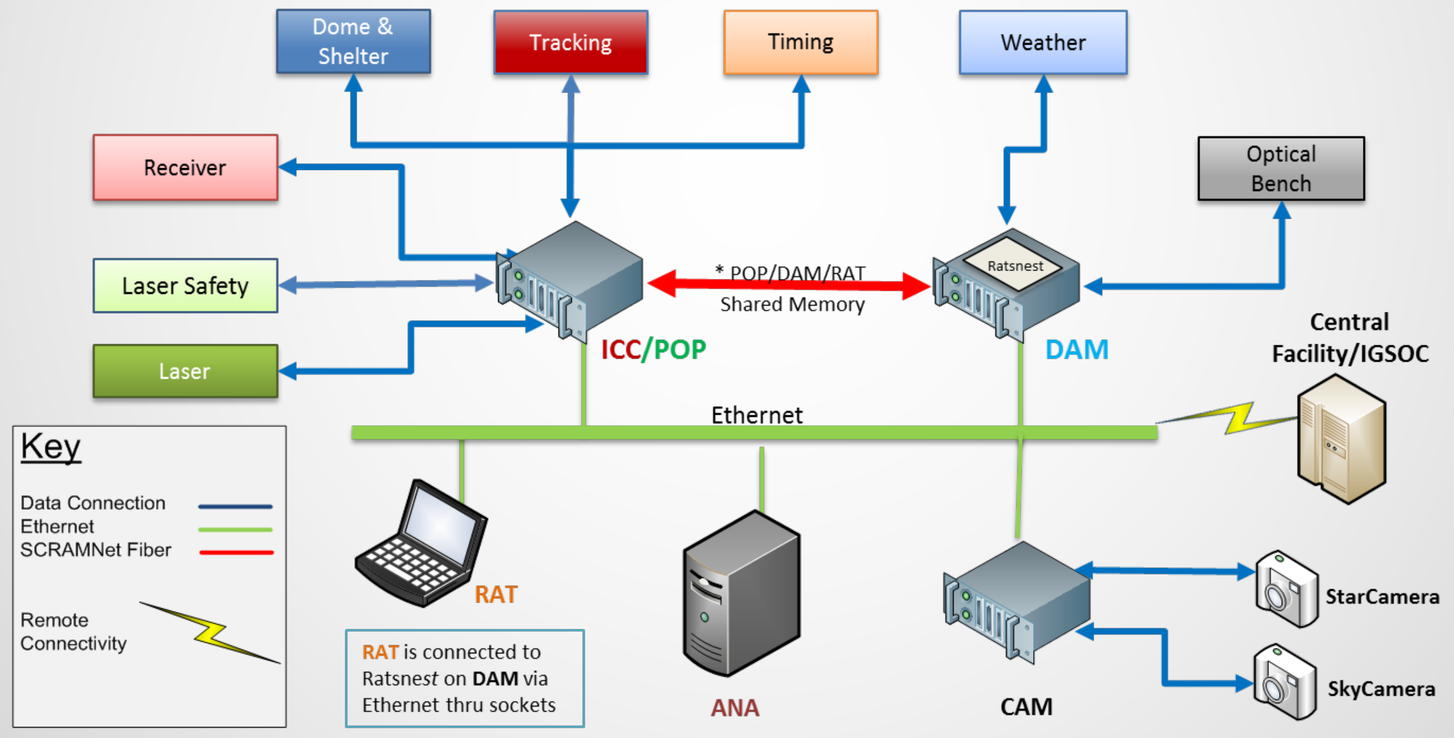
Computer Interfaces

Communication interfaces will be industry standard

- Curtiss-Wright ScramNet™ fiber optic token ring network for a new shared memory implementation
- BC635 interface to GPS
- Digital I/O
- RS232/RS485
- TCP/IP – sockets
- USB

SGSLR Subsystem and Computer Connectivity

The **Interface Control Computer/Pseudo-Operator (ICC)/(POP)** makes many of the operational decisions based on the weather, priority tracking schedule and system readiness. It also controls the following subsystems: Tracking (telescope/mount), Laser, Receiver, Laser Safety and Ranging Control Electronics.



Device Access Manager (DAM) controls many components on the Optical Bench, hosts the Ratsnest interface to RAT, interfaces to the meteorological instruments and monitors health & safety to establish system readiness

The **Remote Access Terminal (RAT)** allows operator interaction with the system

The **ANAlysis (ANA)** computer performs post processing analysis and transfers data to central facility

The **CAMera (CAM)** computer hosts both the sky and star cameras, and is also used to configure the laser

Automation Demonstrated by NGSLR Prototype

- System automatically downloads and follows predictions and schedule
- System configuration changes between satellite tracking, ground calibration, and star calibration are done automatically by the software based on the target
- Ground calibration data collection is completely automated, including setting ND filters to obtain correct return rate from the ground target, and calculating the system delay
- Risley prisms are controlled by software to point the transmit ahead of receive
- Pulse repetition frequency (PRF) is changed by software to prevent collisions between outgoing and incoming pulses
- Laser safety including aircraft detection
- Real-time signal processing (LEO to GNSS)
- System automatically generates normal points and transfers to the central facility hourly

Automation to be Completed with SGSLR

- Automated satellite search and acquisition
- Automated dome shutter control
- Beam divergence control (based upon satellite orbit)
- Cloud coverage automated decision process (change targets)
- Closed loop tracking
- Automated Laser setup and monitoring

NGSLR/SGSLR Software Architecture

Green boxes indicate major NGSLR to SGSLR changes:
(1) Complete automated satellite search and acquisition, beam divergence control, cloud coverage decisions and closed loop tracking
(2) Updated messaging system
(3) Integrate new shared memory , add automated dome shutter control, interface to hardware sensors and UPS's

Pink boxes indicate software changes from external developers that require changes to existing software:
(a) Standard interfaces eliminated the need for custom drivers
(b) Real-time Linux is POSIX compliant

Blue boxes will have no or few changes

Remote Control Interface			
Prediction Calculations	Target selection	① Decision Making	Post Processing & Normal Point Generation
Target Tracking	Data Collection	② Safety & Health	Data Transfer
③ Hardware Monitoring & Control			
ⓐ Drivers			
ⓑ Operating System			