SGSLR

Space Geodesy Satellite Laser Ranging

Plans for a fully automated SGSLR system

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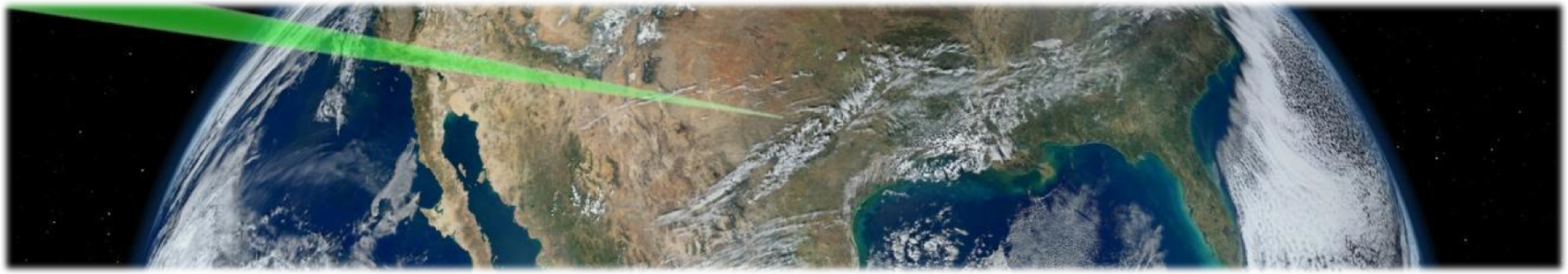
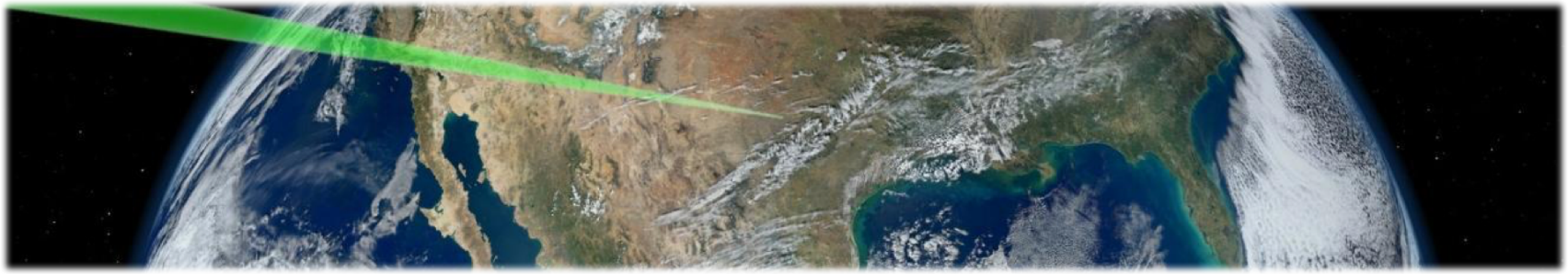
Abstract



The Space Geodesy Satellite Laser Ranging system (SGSLR) is being designed with the goal of full automation. Lessons learned on NGSLR and other systems are being implemented in SGSLR. Automation will be achieved in stages with the first stage being remote operational capability at the McDonald and Ny-Alesund SGSLR systems when many of the operational tasks will already be automated. Ultimately, SGSLR will send science and monitoring data to, and receive commands from, the Space Geodesy Network Operation Center (SGNOC), similar to the way spacecraft now operate. The hardware and software needed to achieve full automation, and the stages of implementation will be discussed.

Part II: Future



Additional Functions for Far Remote

- Need sky camera to view in both day and night and will need to send sky images to remote operator (this function should be operational in 2018)
- Need secure method for operator to send request to hardware to re-enable the laser, or will need for U.S. Federal Aviation Administration to allow software to send request to re-enable the laser
- Primary safety and security responsibility will still lie with operator BUT the hardware/software will now start to perform these functions in parallel

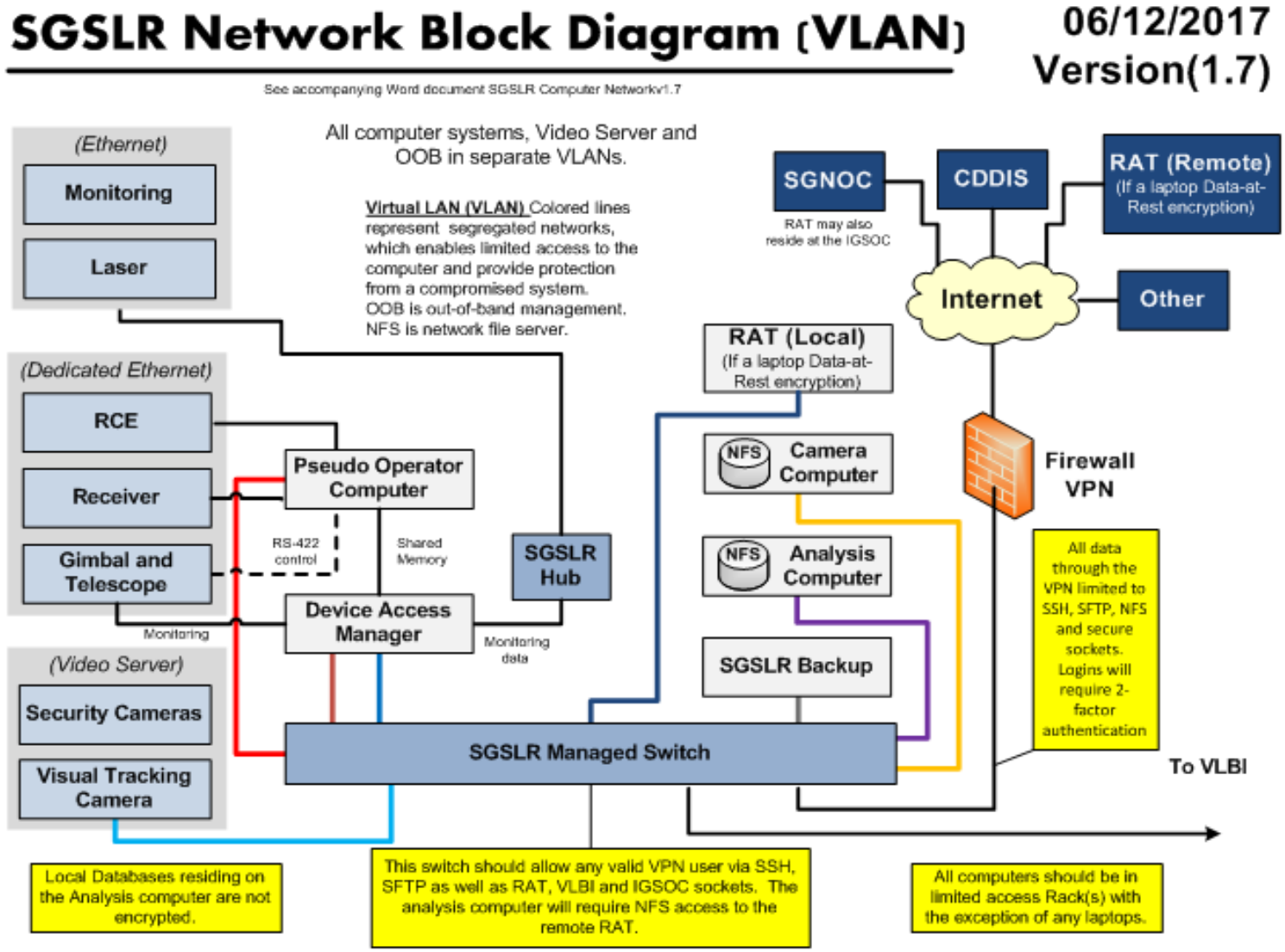
Additional Functions for Full Automation

- Sky camera images must be automatically analyzed to determine where there are clouds and where it is clear enough to range. Software must be able to change target tracked to one in clear area.
- Software must be able to request that the hardware re-enable the laser after blocking it for an aircraft avoidance situation.
- Software IT Security must have been tested and proven.
- SGSLR system hardware/software must be primarily responsible for safety and security.

Tall Poles for Full Automation and how we are working to solve them

- Participating on an FAA Regulation Committee and leading the effort to modify the regulations for outdoor laser use to include automated laser operations. Needed to be able to re-enable the laser without a human.
- Planning and designing the computer systems to ensure they are compliant with increasingly stringent NASA (and Norwegian) IT Security requirements. Automated systems must be extremely secure.
- Working toward automated cloud recognition algorithm and software. We need to automatically determine when to switch tracking to another part of the sky.
- Working our way through the decision paths and what-ifs of an automated system to ensure we have all of safety and all of security planned for and covered, and get the required NASA approvals.

Computer Architecture for IT Security



Path to Full Automation

- Initial operation during installation will be local (operator in the SGSLR shelter operating system through RAT).
- During commissioning the system is expected to be remotely operated from nearby SGP operations building using Remote Access Terminal (RAT). Testing of the automated operations will take place part-time with the operator watching and part-time on its own.
- After commissioning the systems will be operated remotely for multiple daylight shifts per week, while allowing the system to perform automated operations, mostly at night.
- The knowledge gained during these periods will allow optimization of the automated operations resulting in full automation in the future.

In all cases data flows to/from the SGNOC

Full Automation at SGSLR

- There is no human operator for any SGSLR station.
- A human monitors the Space Geodesy Network at the SGNOC or partner NOC: 24 x 7 initially, then perhaps 8 x 5 with the SGNOC performing automated “without any human” operations, monitoring performance and sending out alerts/alarms.
- Engineers at Goddard pick up reports in their emails on what happened at each system and the previous day performance, as well as trends over the last week, month, year.
- Engineers have the capability to remotely stop operations at a station and to run remote diagnostics.
- On-site technicians perform routine maintenance on SGSLR and VGOS. If needed, engineers can talk technicians through more diagnostics and some repairs, watching through streaming video. Most subsystems will be designed to have components replaced with on-site spares or spares shipped from the central facility.