SLR2000 Data ANalysis Computer (DAN)

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ABSTRACT

The SLR2000 Data Analysis (DAN) computer is responsible for the non real-time data processing, data results archiving, and routine external data communications. Data processing include satellite predictions, station event scheduling, full-rate data processing and normal point generation. The calibration and pass data results will be stored in a database for station self assessment and access via the web. On a daily basis the site will download satellite predictions from an external facility. A daily diary of station activity and problems will be uploaded daily and satellite normal points will be uploaded hourly. Each SLR2000 system will have it's own web site were scientist can retrieve pass statistics, calibration statistics, site weather data, and system performance information. The web site will allow a "SuperTech" to log onto the system to perform routine maintenance such as adding new satellites and retrieving information. The flow and details of the system processing will be presented.

INTRODUCTION

The data analysis computer (DAN) is one of three computers performing the ranging operations for the new NASA SLR-2000 stations. All of the non real-time data operations are performed on it, including the data processing, external communications and station performance assessments. In addition each of the sites will have it's own web page. The computer's functionality is divided into three major sections, 1) the program Overseer, 2) batch procedures, and 3) the Web page. DAN runs on a Pentium VME bus computer with the LYNX operating system the same operating system as that of the Pseudo-Operator (POP).

OVERSEER

The program Overseer provides the main interface to the POP computer. The data exchange between DAN and POP is achieved via two methods shared memory and an NFS mount point. Overseer also provides an interface to the remote access terminal RAT. The program is multi-threaded; these threads are one_second, ten_second, one_minute data_processing and copy_files. The sets up an independent one second timer interrupt that generates a binary semaphore to start one_second thread.

The one_second thread performs most of the checks of the shared memory flags. These flags indicate events such as files have been completed and are ready to be analyzed, informing DAN that POP is still active and the status of the various hardware units. Using this information this thread may set a binary semaphore for another thread

to start. Another major function performed by this thread is the Health and Safety checks. Due to the autonomous nature of the SLR2000 system, a comprehensive monitoring and control system is designed to provide site security, protect the system operation, and respond to system malfunctions.

The health and safety function gathers information regarding health and safety from DAN, POP, and ICC. It reads the sensor for health and safety such as temperature, current and voltage. The software then analyzes the information and compares the present system values against the system norms. If the values exceed the acceptable limits a flag is set in shared memory so that POP can take appropriate action. The flags are combined to form a single system status. There are six status conditions:

White: Not all subsystems have reported on power-up
Green: It is safe to operate
Yellow: Warning
Orange: There is a problem: stop tracking and close the dome
Red: Danger, shutdown for diagnostics and/or turn off power to selected system racks
Black: Shutdown everything and turn off all power

Figure 1 shows a summary of the systems check and how frequently they are checked.

The ten_second thread performs the meteorological functions. These include reading the temperature, pressure and humidity, recording the sky image from the infrared camera and determining the cloud structure, determining the ground visibility and precipitation conditions, and reading the wind direction and speed. These values are then used by the health and safety function to determine if the system can continue to track or if it is safe to track. The cloud determination algorithm uses the sky image to determine sky temperature which indicates were clouds are located. This map or a sub section of it is provided to POP for a realtime determination of sky conditions.

The one_minute thread checks to see if new tracking files are available. If so, it sets the semaphore for the data_processing thread to be run.

The data_processing thread retrieves the tracking data file from POP. Once this function is completed the calibration data is analyzed followed by analysis of each of the satellites. When all of the satellite passes have been completed the normal point analysis processing is performed. File merging and clean up is performed last. The data processing software has been rewritten in support of SLR2000 to allow for a single calibration to be performed each hour allowing for more time to be spent tracking satellites. The software stores each of the calibration results to a database in support of the determination of the satellite system delays. Each satellite pass is summarized and added to a satellite database. Figure 2 describes the new data processing scheme.

The final thread is the copy_file thread. This thread is used to copy files created by POP that need to be archived but not analyzed. These files are moved off of POP's disk and stored onto DAN.

BATCH PROCEDURES

There are four major batch procedures performed by DAN: 1) Acquisition data processing, 2) Event scheduling, 3)Self-assessment and 4) External communications.

Acquisition data processing is performed daily. The central facility performs a daily orbit update that is made available to the SLR network. This data is a set of satellite ephemeredes for the next five days that consist of both vectors once per minute (for realtime tracking) and tuned IRV's for data analysis. The files are zipped into a single file for downloading to the sites. Once this file is downloaded it is unzipped and for each satellite the acceleration is determined and made available to POP.

Once the IRV files are available, a new station schedule is generated. This schedule includes the times and duration for calibrations, satellite tracking, maintenance, and down times (when no events can be scheduled). The last case occurs if the system is located at sites where the SLR 2000 cannot operate during certain periods of time. The schedule provides information on all targets available during all satellite tracking periods; this allows POP to have information about alternate targets in case the priority object cannot be located.

The self-assessment process is used to determine the ranging systems performance for the past 24 hours. The software will determine the calibration stability from the station history, assess the satellite quality, and summarize the daily tracking. The results will be sent back to the central facility and made available on the web page.

The external communication procedures include the retrieval of the daily predictions, and the deposit of the satellite quicklook, normal points, daily assessment, and meteorological information for the past 24 hours. The external facility is also informed when major problems occur. The quicklook and normal points will be deposited on an hourly basis to the external facility, the rest of the events will be on a daily basis.

WEB PAGE

Each site will have its individual web page. The page will provide general information about the site and satellite laser ranging. Scientist will be able to review and gather information about the systems calibrations and satellite data. A SQL based database will be maintained at each site. These databases will contain information about calibrations, satellite passes, meteorological data, system performance, and star calibrations. By providing this information, problems should be resolved more quickly due to the availability of historical information.

The web site will also have a password protected section to allow for certain maintenance functions. These include updating the schedule data file that contains satellite specific information like priorities, adding a new satellite, checking for hardware/software problems, performing minor software updates, performing low level diagnostics and checking site security.

Conclusion

The SLR 2000 project is a very ambitious software task. A lot of new techniques for the processing of data, generation of acquisition data, scheduling and supporting a fully automated field site have been or will be developed in support of this project. The authors would also like to thank Jack Cheek, Tony Mallama and Nick Ton for their contributions in the development of the Data Analysis Computer's design.

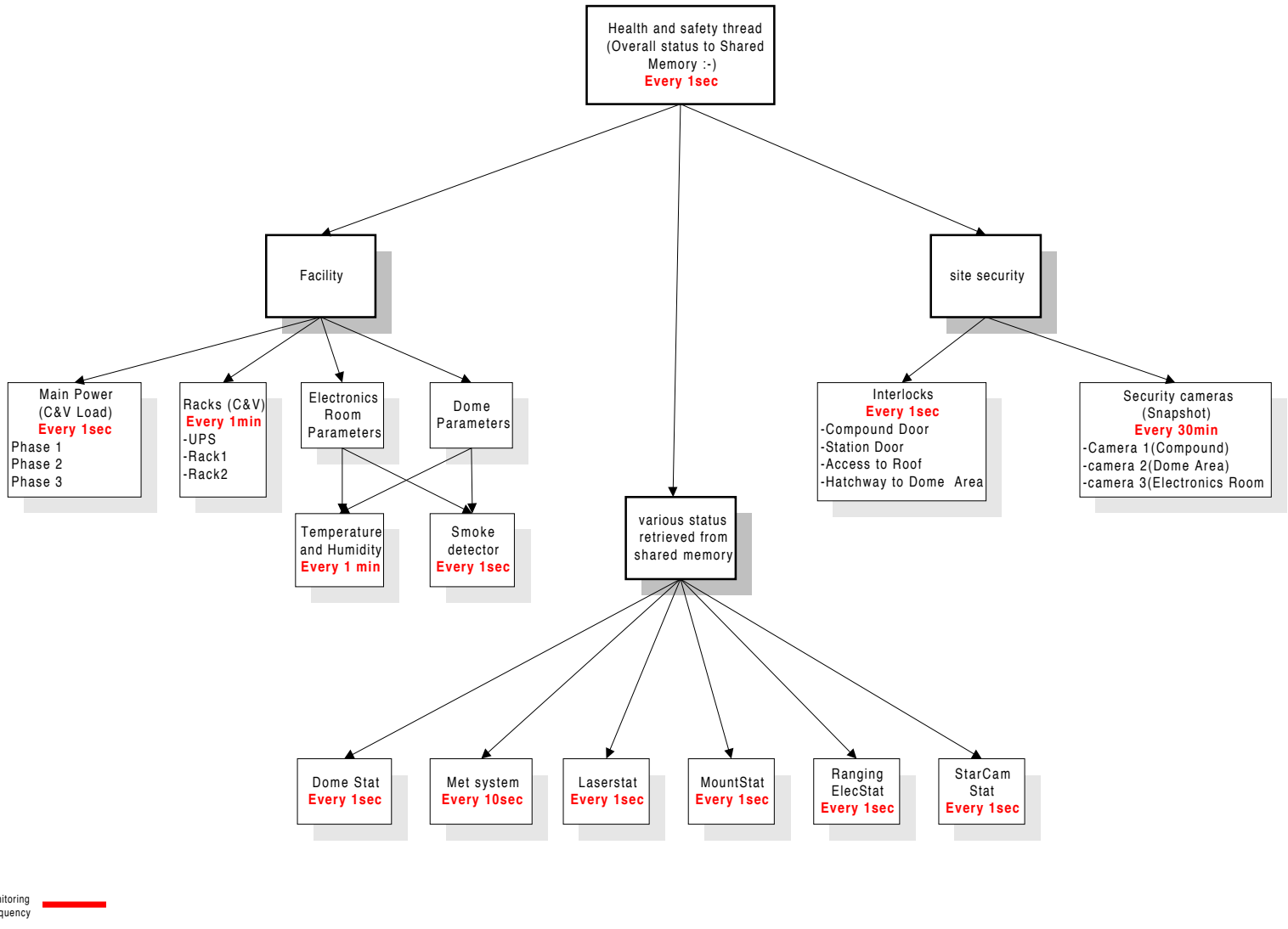

Figure 1. Health & Safety Overview

Figure 2 Data Processing Overview