Subaru Telescope Network 5 or STN5 – The new computer and network system at Subaru Telescope

Junichi Noumaru [1)], Tom Winegar [1)], Eiji Kyono [1)], Hitomi Yamanoi [2)] and Kiaina Schubert [1)]

[1)] Subaru Telescope, National Astronomical Observatory of Japan
650 N.A'ohoku Pl., Hilo, HI 96720, U.S.A.

[2)] Subaru Telescope Mitaka Office, National Astronomical Observatory of Japan
2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan

Introduction

Subaru Telescope replaced its core network and computer system called the fifth generation of Subaru Telescope Network or STN5 and started the operation as of March 2018 with a rental contract. The progress as well as the concept of 'rental contract' was reported by Noumaru (2016).
STN5 is the core network and computer infrastructure that interconnects the telescope control system, the astronomical instrument control system, the observation control system called Gen2, data archive system in Hawaii (STARS), various support servers and user computers and devices. STN5 is connected to the network at the headquarters of National Astronomical Observatory of Japan (NAOJ) in Mitaka, Japan via the dedicated link and via VPN tunnel through the Internet. STN5 is connected to the data archive system in Mitaka (MASTARS), another data archive system for general scientists (SMOKA), Japanese Virtual Observatory (JVO) and data analysis and data archive servers for the instrument Hyper Suprime-Cam or HSC.
We chose to keep the basic concept and hardware configuration of STN4, the predecessor, as those for STN5 because they prospect performance enough to meet the specification and minimum labor for migration. As hardware was updated first time for the last five years, performance was improved accordingly. Performance and software improvement prompted us to deploy virtual machine system so that multiple servers that demand low to medium resource can be consolidated into a single hardware.

Procurement of STN5

Procurement of STN5 was a lengthy process due to the government regulations for the procurement of expensive items. Request for Information (RFI) for STN5 was published on the government paper in August 2016. We drafted the specification of STN5 by using the information we obtained through RFI. In February 2017, availability of the draft specification and request for comment to the draft specification (RFC) were announced through the government paper. Potential vendors and other companies accessed the draft specification. RFC is called to assure the specification to be fair to multiple vendors and to make the specification realistic with the existing technology. Requiring a proprietary product by calling a specific, copyrighted name is prohibited unless this product is definitely required for the procurement. Instead, the specification can define the technical values such as the CPU frequency, the amount of memory, catalog I/O speed, type of protocol, etc. The specification may require the bidders to perform the performance test or the benchmark test and to submit the results. STN5 specification required the registration and search test for MySQL and data I/O test to/from the storage for data archive.
The specification was revised through RFC and made final by June 2017. The bidders picked up the specification and had until July 2017 to submit the proposal and the bid. The technical review was done, and the bid was opened in August 2017. The final score for each bidder was given by the sum of the numbers converted from the performance and from the bidding price. A winner was identified, and the contract was made in September 2017. Then the detailed design started, and the order of hardware/software was done by the vendor. Since the vendor was obligated to start the new system from March 1, 2018, the detailed design, delivery, installation, configuration and verification of the benchmark test must complete in six months. The entire hardware at Hilo base fits in four 17-inch racks and the hardware at the summit fits in two racks.

Summit VM subsystem

Four Host servers, with 6TB local disk space, 2 x 10Gbps NIC, 32 Cores

- Supports five VLAN sub-interfaces for legacy support on older OBCP's migrated to VM
- Eliminates the possible migration of IP addressing with software code
- Host Server 1 serves a Primary Fiber Channel connection to backend storage
- Host Server 2 serves a Secondary Fiber Channel connection to storage
- VM Images are stored on RAID storage, with Host Server 1 acting as NFS server to other servers
  - Any vm can be started on any Host Server
  - If Host Server 1 becomes unavailable, automate script will configure RAID and Host Server 2 to become active, serving NFS of VM images and storage.
  - Minimum restart time will be needed for recovery. Allowing observation to continue.

100 TB Fujitsu Eternus RAID 6 Storage

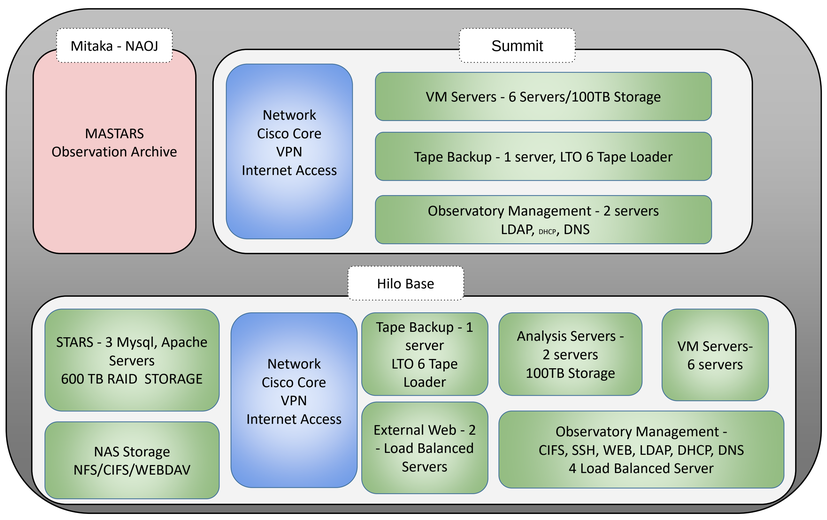
- 30TB DATA area supporting night observation
- 30TB WORK area, observation onsite quick analysis
- 6TB VM Images - Analysis, STS(Subaru Telemetry System), OBCP
- Dual Fiber-Channel Controller,
  - Primary to Host Server 1
  - Secondary to Host Server 2

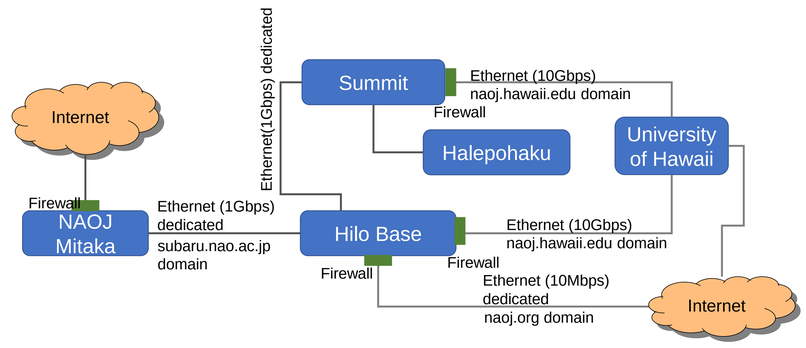
STN5 configuration

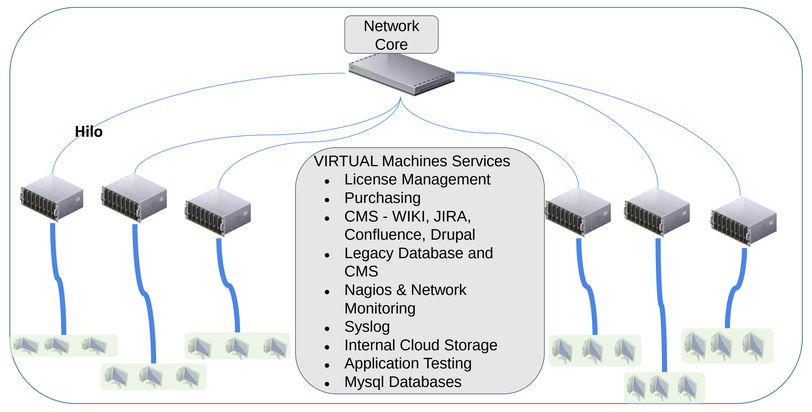
- STN compilation on sub-systems to provide services to majority of essential areas for Subaru Telescope to successfully support daily and nightly work of employees and visiting scientist.
- Hilo Base contains the bulk of the installation
  - 4 Load Balanced server for Internal service, dhcp, dns, ldap, web, ssh access
  - 6 VM Host server
  - 2 Load Balanced DMZ Web servers
  - Storage access via NFS or CIFS(Samba)
  - Analysis systems
  - STARS system, 3 Servers w/ 600TB Archive for all observational data
- Summit System
  - 2 servers for DNS, DHCP, LDAP
  - 4 VM Host servers for Telemetry, Analysis and Legacy OBCP support w/ 100TB usable space
  - Tape Backup
  - Cisco Core switch, with Palo-Alto Firewall, VPN Support for remote collaborators
- Mitaka STARS (MASTARS)
  - 3 Servers, providing access to observation data for retrieval

Network

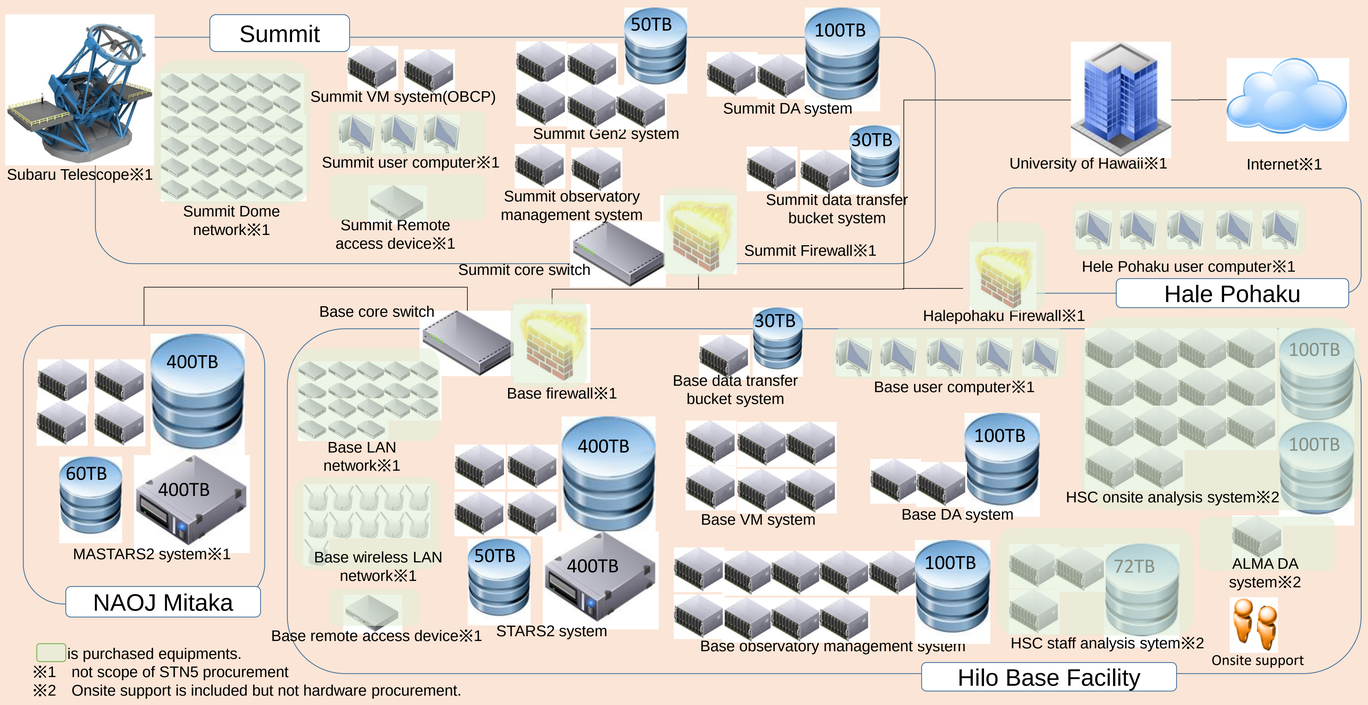
- Subaru Telescope's logical network is complicated due to three domains that it maintains.
- Subaru Telescope's physical network is also complicated due to diversity of facility locations – three in Hawaii and one in Japan and due to having backup routes.
- Currently, performance of firewalls at Hilo base and at the summit facility limits I/O speed to about 2Gbps and 1Gbps respectively from each facility to the Internet via University of Hawaii's network.
- Subaru Telescope and National Astronomical Observatory in Japan provide information through the Internet so that various users can gain access to the services they need. Most services are provided with HTTP/HTTPS. Registered staff and collaborators can access internal resources with SSL VPN.



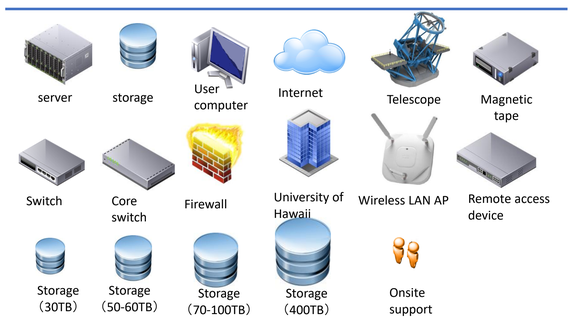




STN5 hardware configurations



Icons



Toward STN6

The contract for STN5 will expire in 2023 and the new system, STN6 will take over. The only drawback of 'rental contract' is relatively high overhead for support personnel from the service vendor since the vendor incurs direct and indirect cost for hiring a service staff, support cost for escalated tickets, cost to mitigate damages that would be brought by unforeseen troubles.
Under the situation that the budget of Subaru Telescope is steadily shrinking, it will be very difficult to maintain our computer and network system with 'rental contract.' Due to limited manpower, we will have to start the study of the design of STN6 as early as from 2019 or 2020. We plan to hire one computer technician who will free up existing system administrators' time so that they can work on design of STN6. To minimize the cost, migrating non-time-critical services to cloud services, eliminating redundant network and storage for data archive will be options.

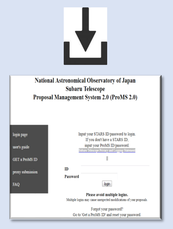
Data archive system (STARS) FITS archive and query

FITS Download during observations

Offsite Observers may download FITS
~30 min after observation for up to ~30 GB/hour

Shared Authentication PROMS & SSPs

Shared LDAP authenticates
Proposal Management (PROMS 2)
& HSC-SSP Reduction users



Services accessible from the Internet

User	Available Services
Observers	Data archive(STARS, MASTARS), Data analysis
Internet public users	Subaru telescope web site, Data archive(SMOKA), JVO
Scientists who proposes the observation	Proms
Visitor to Subaru telescope facility	Visitor form, Subaru telescope web site
Observers who use Mitaka Remote System	Mitaka Remote Visitor From
Subaru staff, collaborators	SSL VPN
HSC-SSP	Data archive and data analysis servers for HSC-SSP

Summary

STN5 is the computer and network infrastructure for Subaru Telescope that resides at Hilo base facility, the Maunakea summit facility and the Subaru Telescope office at Halepohaku mid-level facility. STN5 was procured with 'rental contract' through lengthy 19-month of process and the contract will expire in 2023. Hardware was upgraded and the basic concept and configuration of STN5 were chosen to be quite similar to those for STN4. The capacity of storage was increased to hold large amount of data that HSC will generate. The number of servers is quite similar to those for STN4 but they can run more resource-demanding services. In STN5, we consolidated servers for various services into virtual machines. For system redundancy, RAID 6 storage is connected to two host servers. In case of unavailability of one host server, another host server will be automatically take over NFS server function. The VM system now includes data analysis servers which demand much CPU and I/O.
STN5 will be the last procurement by 'rental contract.' We will start to study for the next computer and network system that will take over STN5 from 2023.

Contact: Junichi Noumaru (noumaru@naoj.org)