NIGHTLY DATA STORAGE REQUIREMENTS FOR GEMINI INSTRUMENTS

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1.0 Introduction

All of the instruments and facilities in the baseline complement are sufficiently defined in terms of array size and basic functionality that it is possible to estimate nightly data quantities for all of the detectors arrays mounted at Gemini's Cass focus (instruments and wavefront sensors). Understanding typical nightly data rates has obvious implications for a number of Gemini subsystems, including the DHS, long term data store (archive), data distribution system (e.g. the medium used to send astronomers their data), and observatory-base facility communications. This short technical note lists estimates of nightly data quantities (in Gbits) for the Gemini telescopes and instruments, assuming the Phase I baseline instruments are in place at each site.

2.0 Nightly Data Quantity Estimates

Table 1 summarizes data quantity estimates. Note that these estimates could certainly be in error by a factor of 2, but it is doubtful they are as much as 10x in error. Furthermore, some experiments will naturally generate much greater data quantities than "typical". These rare situations should be considered but should not drive requirements, e.g., if a few hours instead of a few minutes are required to transmit data from Mauna Kea to Hilo on rare occasions (say a few times a year), this is not a major operational perturbation. Also note that these tabulated values do not include processed frames, which might add as much as ~50% to the "typical Gbits nightly archived" column when averaged across all of the detectors.

Referring to Table 1, nightly data quantities are driven by array sizes more than any other factor, like read rates, varying operational modes, etc. For example, though the PWFS's will be read out essentially continuously at high frame rates, the very small array size (80x80 pixels) merged with foreseen needs to store raw WFS data leads to small quantities compared to instruments. NIRI, with typical dither applications and relatively short integration periods, will probably produce more frames per night than GNIRS, as the latter will often use longer integrations due to lower flux levels associated with spectroscopy. Similarly, MIRI will often operate at very high frame rates (few hundred frames per second) but operationally these frames will be coadded in the controller and, at most, ~1 frame per nod cycle (so 1 per ~10 seconds) will be sent to the DHS for storage.

The high frame rate for NIRI deserves explanation. The ~5000 frames produced is much higher compared to "nightly typical" because this assumes 4 occultations are

Instrument	Frame Size	Bits/Frame	Max. Nightly Frames	Typical Nightly Frames	Typical Gbits Nightly Archived
NIRI	1024x1024	32	5,000	500	20
GNIRS	1024x1024	32	500	200	6
MIRI	~256x256	32	3,000	500	1
GMOS	4096x6144	16	200	100	40
HROS	4096x4096	16	300	100	26
PWFS	80x80	16	100,000	10,000	1
OIWFS	~5x10	16	100,000	10,000	<<0.1
AOWFS	12x12x4	16	100,000	10,000	0.1

Table 1 - Estimated data quantities generated by the Phase I instruments and facilities are listed.

recorded in a night (test or calibrations on stars plus science targets) with NIRI running in movie mode, which can send 512^2 frames to the controller memory at 20 fps for ~60 seconds. Despite the much higher frames rates, the reduced effective array size leads to only a factor of ~2 increase in nightly data quantity compared to typical amounts.

For the optical instruments GMOS and HROS, fewer bits per pixel and lower frames rates are more than offset by the relatively large mosaic arrays used in setting typical data quantities. Both spectrometers will acquire comparable nightly numbers of frames, with HROS probably having a greater maximum as it is more likely to be used on bright star high resolution applications and/or applications requiring many calibration frames over the course of a night. In any event, GMOS sets the peak nightly rate among the entire instrument complement with ~40 Gbits produced on a typical night. Note that blending GMOS with another instrument in the queue during a night will not produce higher quantities since only one instrument will be typically run at a time (ignoring parallel calibration or engineering tests).

Finally, as mentioned before, though the wavefront sensors will be running nearly constantly all night, and it may be operationally advantageous to record some fraction of the raw frames (this will likely be useful during commissioning), even a PWFS running full-out at 200 fps for a minute will still only generate ~1 Gbits of raw data and repeating this experiment another ~40 times in a night will only generate as much data as GMOS on a typical night. The quantities implied for the OIWFS and AOWFS running in this mode are at least a factor of 10 smaller than the PWFS, hence the wavefront sensors in general should not drive requirements.

Ostensibly these nightly quantities should not pose major technical challenges for Gemini. A single Exabyte tape or DVD can be used to send astronomers GMOS data from a typical night and it should take ~30 minutes to transmit a night of GMOS data from the summit to Hilo over a DS3 link, assuming ~50% efficiency.