CMB-S4

DAQ -SAT Interface Control Document

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Document release signatures

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REVISION HISTORY

Version Letter	Revision Date	Author: Notes
v1	6/26/20	Initial Draft
v2	11/5/21	Add some details

REFERENCED & APPLICABLE DOCUMENTS

The requirements in the following documents apply, but this document supersedes if there is a conflict.

RReference used within this doc	VVersion	Title & Description, including Document number if applicable	Notes, relevant part of document

TABLE OF CONTENTS

1. Purpose and Scope

This document defines and describes the interfaces between the DAQ and the SAT.

2. Abbreviations and Definitions

2.1 Abbreviations

DAQ	Data Acquisition and Control
SAT	Small Aperture Telescope
TCS	Telescope Control System
OCS	Observation Control System

2.2 Definitions

3. Mechanical/Structural Interfaces

3.1 DAQ computer

There is a computer which functions as both data acquisition and control, located in a centralized facility. We should budget for one rack-mounted DAQ computer per telescope, although it is likely we will consolidate. Physical, thermal, power and data interfaces are specified in DAQ-sites ICDs

DAQ-SAT-0010 DAQ Cable layout on the SAT

We should not need a separate computer for readout control, although that may be dependent on readout choice.

DAQ-SAT-0020 Cable layout to TCS

Cable path through SAT and supporting structure, i.e. cable trays

3.2 Telescope Control system Interfaces

3.2.1 Description

Telescope control system to be provided as a turnkey system from telescope vendor. Interface is IP based interface: control words to move telescope to position and readout data. Interface needs to be defined, but we anticipate the primary mechanical interface will be a cable from the TCS to a PTP-capable switch, although is vendor-dependent. Because timing is also being supplied on the network, this will also provide absolute PTP timing to the TCS. If they require a different absolute timing (eg, IRIG), we can supply a boundary clock which takes PTP timing and can produce analog or other clock signals.
(we still need to develop some type of specification although this may belongs in requirements)

As a turn-key system, we should not need to specify their cable arrangement to the sensors. Cables (ethernet, one cable, or more with IRIG) will need to be routed from TCS to the nearest DAQ ethernet switch in the SAT (location TBD).

Question: is this because the same vendor that makes the TCS makes the telescope components where their sensors and actuators go such that it is their own internal interface? Yes, that is the assumption, which is reasonable at this point in telescope design.

4. SIGNAL INTERFACES

4.1 BOLOMETER CONTROL/READOUT

Covered in readout-DAQ ICD

4.2 TCS

Assuming the telescope vendor is doing something sensible, their IP interface will provide both the control interface and the data interface.

In SO, we have 200Hz data from the az/el/boresight, and slow data (~1Hz) on other fields (motor currents, status, temperatures, etc).

4.3 CRYOGENICS AND CRYOSTAT HOUSEKEEPING SIGNALS

4.3.1 PLC OCS Interface

[consider breaking this up into pulse tube, DR, vacuum]

Cryogenics is responsible for providing an OCS agent for high level control of the DR, pulse tubes, and vacuum equipment (high level = turn on/off). Access to these control commands will be managed by the OCS system such that there will be fine-grained control over which users can access OCS cryogenic commanding.

An example of one way this is accomplished is that a PLC from the cryogenics group performs low level control of cryogenics and vacuum systems for the cryostat. OCS provides high level supervisory control (user interface). PLC writes interfaces with OCS through an OPC server. OCS writes historical values to the DB.

Two way communication is required between OCS and cryogenics (OPC?). Monitoring information travels from PLC to OCS, control information travels from OCS to PLC.

4.3.2 Cryostat/Cryogenic monitoring

Monitor signals include, but are not limited to: cold thermometry, status and state variables for DR valves and other components, pressures, helium mixture flow, compressor cooling water temperatures, heater power, AC resistance bridge settings. It is generally assumed this readout is measured at ~1-5x per minute, with the possible exception of a few faster-cadence thermometry signals (which would be measured at a few Hz).

(Add list of monitor signals coming from PLC to OCS)

ALSO we need the following table filled out.

(Format: Instrument / Location / Sample rate)
(Example:
100mK Temperature sensor located on focal plane # samples per second)

4.3.3 Cryostat/Cryogenic Control

(Add list of control signals from OCS to PLC)

Control signals

4.3.4 Timing Signals

What signals (time-of-day and frequency reference) does the cryogenics system need, in what format, and delivered to where? In particular, need to think about phase-locking cryogenics readout involving AC-biased thermometers to detector readout.

Currently intended to get timing from readout. This would only be needed as a fallback/alternative. Plan is to provide a 1PPS signal at the cryo readout (same box also can make 10 MHz, other frequencies).

4.4 Grounding

4.5 Inventory of SAT Housekeeping

- PDU (ibootbar) -- does this support SNMP? SO's does.
- UPS -- can we use NUT? Currently baselining SNMP for SO to help write a general interface
- cooling water flow
- cooling water temperature

- cooling water pressure
- compressed air pressure
- vacuum pressure
- heater power/power supply
- switch: data flow -- NW thinks this is internal to DAQ; DAQ had planned to provide all networking equipment
- Calibration, eg: (what of these need to be controlled, and how?)
  - FTS (may require control)
  - chopper (may require control)
  - wire grid (may require control)
- Observatory wide (eg):
  - weather monitor (temperature, wind speed, baro pressure)
  - timing (synchronized, GPS lock, etc)
  - water vapor radiometer

- Covered elsewhere:
  - Bolo readout
  - thermometry
  - telescope platform
  - cryogenic control, including pumps, DR, pulse tube compressors

4.6 Sensors in the SAT Mount

includes atmospheric sensors