

ICD for NAOMI to OCS

1. Summary

This is a preliminary ICD for the software interface between NAOMI and the WHT Observatory Control System (OCS). This interface is not yet properly defined, therefore this ICD summarises the NAOMI requirements in this area as well as stating what is currently known about the interface to the OCS.

2. WHT OCS

This document does not assume the "WHT OCS" to be anything very sophisticated. It simply reflects the idea that for efficient, reliable observing, there must be some software which has the responsibility for coordinating cooperation between the Science Instrument software, the Telescope Control software, the Data Acquisition system and NAOMI. It is assumed that the OCS does this by sending fairly high-level commands to these separate subsystems in the correct order and accepting acknowledgements from them. It is assumed that these commands and acknowledgements are implemented using DRAMA.

A simple example of the operation of the OCS is:

- ❖ Tell the TCS to slew to an (RA,Dec).
- ❖ Tell NAOMI to position its pick-off, given the demand TCS (RA,Dec) and the guide star (RA,Dec).
- ❖ Tell the Science Instrument to move its mechanisms (eg filter wheel) to the required position.
- ❖ Wait until the TCS and NAOMI report they are ready.
- ❖ Tell the TCS to expect autoguiding.
- ❖ Tell NAOMI to lock onto the guide star and start acting as an autoguider.
- ❖ Wait until NAOMI and the Science Instrument report they are ready.
- ❖ Tell the Data Acquisition system to start the exposure.
- ❖ Wait until the exposure is complete.
- ❖ Tell NAOMI to unlock from the guide star.
- ❖ Tell the TCS to ignore autoguiding.
- ❖ Wait until NAOMI and the TCS have returned to their inactive state.

It is assumed that actual sequences such as the above will have to be programmed by ING staff.

The purpose of this document is to ensure that NAOMI provides the commands necessary to allow the OCS to carry out its function, and to ensure that constraints set by NAOMI on the usage of those commands are well understood.

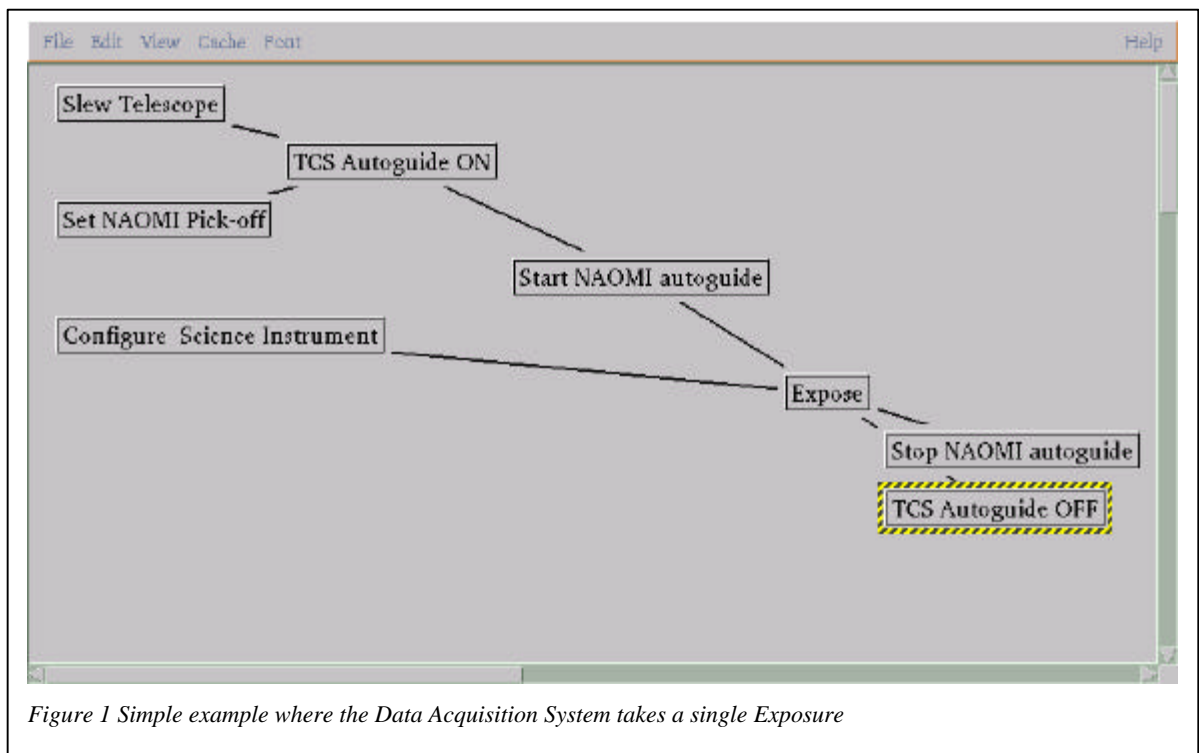
3. Assumptions About NAOMI Operation

For the purposes of this document, NAOMI has to be seen as a system which acts in response to a small number of high-level commands. What is involved in NAOMI actually carrying out these commands can be ignored. For example, NAOMI locking onto the guide star and acting as an autoguider may require an operator interacting with one of the GUIs attached directly to the AO system. This interaction may become unnecessary in due course as the operation of closing the AO loops is made more automatic. This interface should be as independent as possible of such upgrades to the operation of the AO system.

4. Observing Scenarios

4.1. A Simple Example

This is a diagrammatic summary of the above simple example sequence.



4.2. A Dithered Observation

A dithered observation involves performing a set of exposures while looping through a sequence of (RA,Dec) offsets.

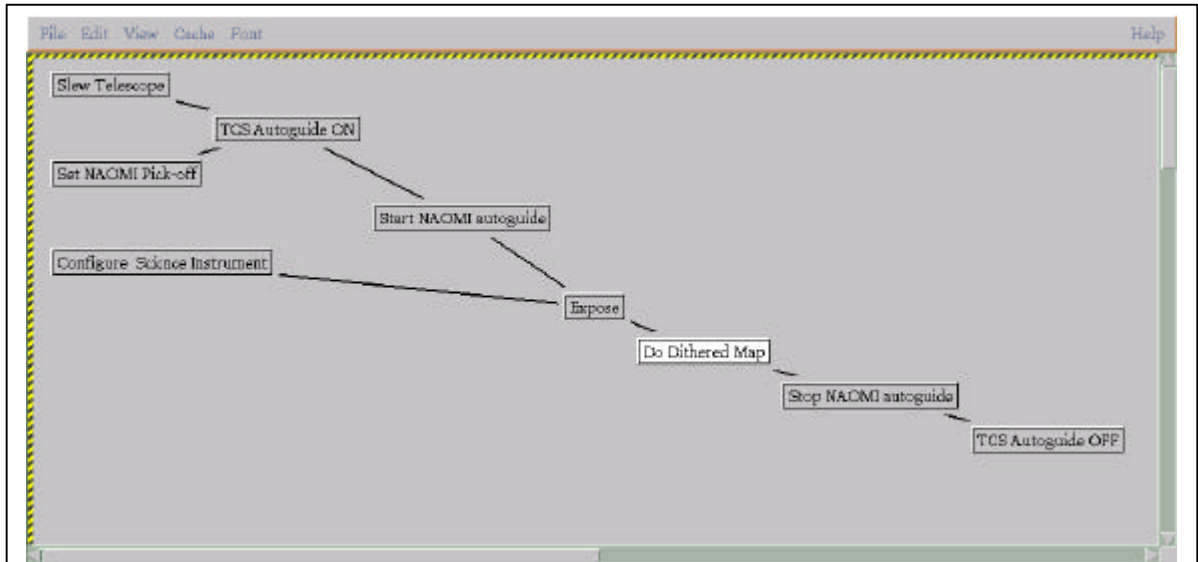


Figure 2 A set of Exposures in a Dithered Map

The Do Dithered Map item is repeated for the number of dithered moves. It is assumed the system is given a table of the required offsets making up the dithered pattern. The detail of DO Dithered Map is:

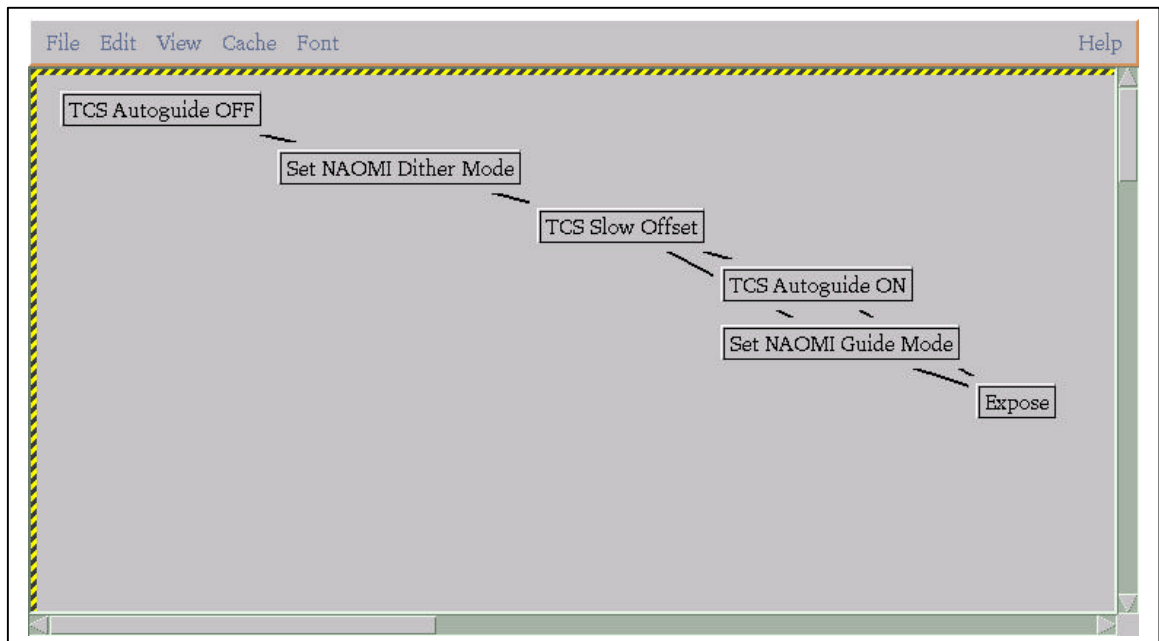


Figure 3 Dithered move and Exposure

5. Required NAOMI Commands

The following commands have to be provided by NAOMI to allow the observing scenarios to be implemented.

5.1. Set NAOMI Pick-off

This command has as parameters:

- The demand (RA,Dec) of the telescope pointing centre.
- The demand (RA,Dec) of the guide star.
- The NAOMI (X,Y) of the telescope pointing centre.
- The direction of North in the image plane.
- The scale of the image plane.

The action of the command is to calculate the required position of the pick-off in NAOMI XY coordinates and move it there. The command completes when the pick-off is at the demanded position.

5.2. Start NAOMI autoguide

This command has as parameters

- An estimate of the guide star magnitude, or a "don't care" value.
- An acceptable error for the guide star magnitude.
- An indicator of acceptable image quality for the guide star.
- A flag for immediate telescope autoguide OR preliminary pick-off adjustment.

The action of the command is to close the AO loops and to start offloading excessive excursions in guiding and focus to the TCS.

The action of closing the loops is complex and may involve operator interaction through the real-time AO user interfaces. The AO system may be capable of estimating the magnitude of the guide star, and may also be able to estimate the quality of the guide star image. In this case, the parameters make it possible to request the system to fail to obtain lock if the characteristics of the guide star are suspicious (eg. it is the wrong magnitude, or has an image like a double star or extended object).

In general the guide star image will not appear perfectly centred in the pick-off. Typically, this will be due to an error in the catalogue position of the guide star due to proper motion, and so the correct behaviour of the system is to move the pick-off to centre the guide star before starting to act as a telescope autoguider. This leaves the telescope correctly centred at the demand (RA,Dec).

In some instances the coordinates of the science object may be uncertain, but its offset relative to the guide star may be known. In this case, the pick-off should be left alone and the system should switch straight into autoguiding mode. This will cause the actual pointing centre of the telescope to shift.

Once the system has completed its attempt to get into autoguiding mode, the command completes and returns a success/failure status and an estimate of the guide star magnitude.

5.3. Stop NAOMI autoguide

This opens the AO loops and stops offloading the guide and focus data to the TCS.

5.4. Set NAOMI Dither Mode

This command is only valid when NAOMI is already autoguiding. Its effect is to maintain lock on the guide star, but guiding errors are switched from being fed to the TCS to being fed to the NAOMI pick-off. This means that a controlled shift of the telescope will cause the pick-off to track the moving image of the guide star.

5.5. Set NAOMI Guide Mode

This command is only valid when NAOMI is in Dither Mode. It stops feeding guiding errors to the NAOMI pick-off and starts feeding them to the TCS instead.

6. Parameters to be Made Available by NAOMI to the OCS

The expectation is that the OCS will write these to the FITS header of the science image.

- Actual pick-off (X,Y) coordinates.
- Image quality estimates.

7. Issues to be Resolved

Obviously outstanding questions include:

- What is the mechanism for deciding which lenslets should be used and should choice of lenslets be under the control of the OCS.
- When will the NAOMI 5arcsec field be used and should the OCS have access to a command to cause NAOMI to do guide star acquisition using the 5arcsec lens.
- How is the information for setting the NAOMI AtmDC provided.
- How is the time-dependent offset between NAOMI coordinates and the Science Instrument due to atmospheric dispersion to be handled.
- The focus of the WFS has to be set, and may be dependent upon the filter used in the Science Instrument.
- When is the WFS filter wheel set.
- Is pupil rotation caused by the field rotator to be handled.
- Is modal/zonal control to be set on demand from OCS, or should NAOMI decide on the basis of guide star magnitude.
- Is non-sidereal tracking to be supported. If so, in what form (eg tracking on non-sidereal science object; using non-sidereal guide "star" for sidereal science object).
- Is an observing mode for making an image mosaic to be supported.
- Is the pre-correction camera (PEC) to be used for image acquisition, or can this role be left to the science instrument.