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Gemini Controls Group Interface Control Document

ICD 5 - Wavefront Sensing Information Interface

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GSCG.grp.010-ICD05_wfs/01

This document defines the EPICS-based interfaces within the ICS and TCS that transport wavefront sensor information.

1.0 Introduction

1.1 Purpose

An overview describing all the interfaces in the Gemini system is given in document "GSCG.grp.005, Gemini System Interfaces, Gemini 8m Telescopes Project." (which is reference [3] as listed on page 2).

This document (ICD 5 - Wavefront Sensing Information Interface) specifies those interfaces in the Gemini system that transfer wavefront sensor information. The interfaces involved are

- The transfer of wavefront sensor information from Telescope Control System (TCS) subsystems to Instrument Control System (ICS) subsystems.
- The transfer of wavefront sensor information from Instrument Control System (ICS) subsystems to the Telescope Control System (TCS) subsystems.
- The transfer of wavefront sensor information from a Telescope Control System (TCS) subsystems to another TCS subsystem.

Of particular interest is the transfer of Wavefront Sensing Information from the A&G and AO systems to the M2 Control system.

1.2 Scope

This document covers only the wavefront sensor data movement between and within the TCS and ICS systems. The movement of these entities from the TCS and ICS systems to other major systems is covered by the *Gemini Software Design Description* and *ICD - The System Command Interface.*

Only conforming instruments are considered here.

1.3 Applicable Documents

The following documents should also be consulted:

[1] SPE-C-G0037, *Software Design Description*, Gemini 8m Telescopes Project.

[2] SPE-I-G0009, *Software Programming Standards,* Gemini 8m Telescopes Project.

[3] GSCG.grp.005, *Gemini System Interfaces*, Gemini 8m Telescopes Project.

[4] The EPICS documentation, most notably the *EPICS:IOC Application Developers Guide*

[5] GSCG.grp.013, *ICD 1 - The System Command Interface*, Gemini 8m Telescopes Project.

[6] GSCG.grp.014, *ICD 2 - Systems Status and Alarm Interfaces*, Gemini 8m Telescopes Project.

[7] GSCG.grp.017, *Glossary,* Gemini 8m Telescopes Project

1.4 Abbreviations and Acronyms

See document [7] *Glossary* for a complete list of acronyms used in the Gemini ICDs.

1.5 Glossary

See document [7] *Glossary* for a complete list of terms used in the Gemini ICDs.

2.0 Overview

The Software Design Description, [1], describes the Gemini Control System.

2.1 System Hardware Architecture

The systems that must conform to this ICD are VxWorks-based systems using EPICS for internal communications and control that also use the WFS Data Link for transmitting and receiving wavefront sensor data. These systems are part of the ICS and the TCS.

2.1.1 The Instrument Control Systems (ICS)

A “conforming” ICS is VME-based running VxWorks and EPICS.

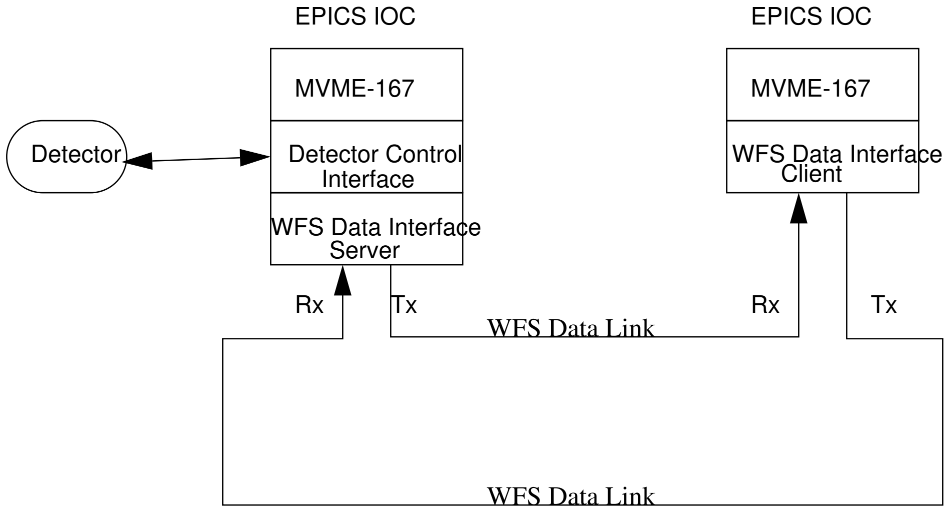
A “non-conforming” ICS is assumed to be Unix-based without access to EPICS or VxWorks.

No other ICS architectures are supported.

2.1.2 The Telescope Control System (TCS)

The TCS is distributed across multiple VME-based VxWorks and EPICS systems, one for the TCS proper and one for each TCS subsystem.

FIGURE 1. Hardware Architecture



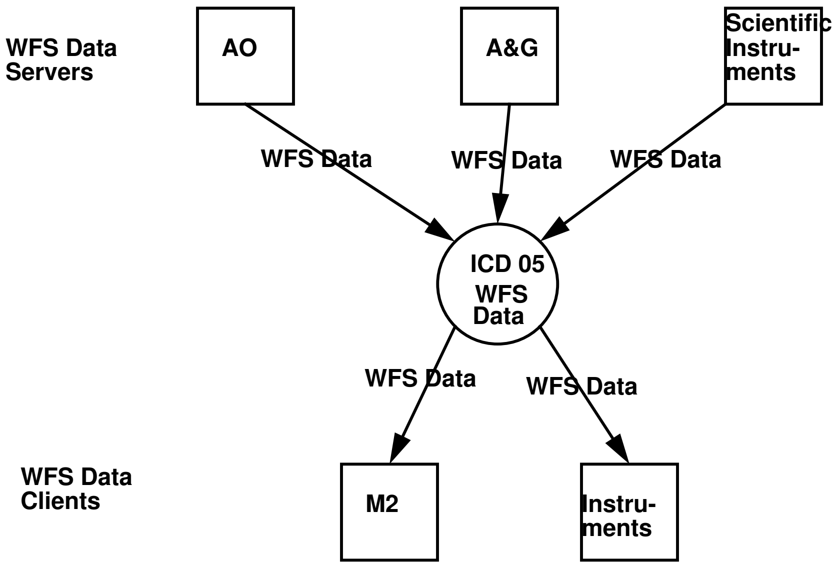
2.2 Communication Architecture

The WFS Data client and server IOCs communicate using EPICS database records which interface

2.2.1 Context Diagram

The following context diagram shows the system interfaces between the WFS client and server IOCS.

FIGURE 2. Context Diagram



2.2.2 Events and Responses

The events which may happen on the wavefront information interface, and the responses to those events, are shown in the following table. Refer to “Behavior” in section 3.0 below for information on what causes these events.

Event	Response
A WFS Data client registers an interest in a specific source of wavefront sensor data.	The WFS Data client receives updates on that WFS data server’s wavefront sensors data.
A WFS Data server updates its wavefront data.	Any WFS Data clients that have registered an interest in that server’s data are notified.
Wavefront information interface connection is lost.	The client and server receive notification of the disconnection.

2.3 The Services Component of the Interface

2.3.1 Communication Services and Protocols

Communication takes place by means of the writing and reading of values into EPICS database records associated with the WFS Data Link hardware.

2.3.2 Host Support Services

N/A. In this case there is no host or target.

2.3.3 Target Support Services

N/A. In this case there is no host or target.

3.0 Behavior

3.1 Select WFS Data Server <server>

Client systems may register interest in wavefront sensor information by selecting one specific server for WFS Data.

3.2 Update WFS Data

Server systems may update wavefront sensor information by writing arrays of Zernike (or equivalent) polynomial coefficients into their private output channel on the WFS Data Link. Any client who have registered interest in that channel will be notified.

3.3 Disconnections

WFS Data Link disconnections are monitored by the error system (see section 7.1 below). Both the wavefront sensor server and client systems must be capable of generating alarms that can be processed by the OCS.

4.0 Implementation

Transmission of Zernike (or equivalent) polynomial coefficients can be achieved by either accessing EPICS database records that are tied to the wavefront sensor information or alternatively by using a C subroutine interface.

4.1 Introduction

Wavefront sensor data will be transmitted in the form of the coefficients of the first N Zernike polynomials. The Array Analog In (AAI) and Array Analog Out (AAO) records will be used since they provides a means of transferring several values across the WFS Data Link in a synchronous fashion without any danger of these values losing consistency. The number of coefficients in the array can vary from 1 up to that defined by the record's NELM (N elements) field. The actual number of coefficients being transmitted will be the first element in the array record.

The remainder of this section will follow the format used in the EPICS IOC Record Reference Manual. In particular, in tables where the fields of a record are defined, the following terms will be used (quoting from the manual):

Field. The field name.

Type. The database field type.

DCT. Is the field definable via a database configuration tool.

Interest. Interest level for the output of the database test routines:

0: Application developer: Field may change during processing.

1: Application developer: Not change during processing.

2: System developer: Major interest.

3: System developer: Minor interest.

4: No interest: pad field.

Initial. Initial value when record is created.

Access. Is this field accessible via database access?

Modify. Can this field be modified via database access?

Monitor. Does the record processing routine trigger monitors by a call to db_post_event when this field changes value?

PP. Process Passive? Will dbPutField call dbProcessPassive when this field is processed?

4.2 Array Analog In/Out (AAI/AAO) Records

4.2.1 Field Summary

The following figure shows the AAI/O record in its intended use as the focus of command arguments and control at the top-level of an EPICS system. A standard EPICS Field Summary is presented in Table 1.

Besides including the required set of fields, these records also support the standard simulation mode fields SIMM, SIML, SVAL, SIOL, and SIMS.

TABLE 1. Array Record Field Summary

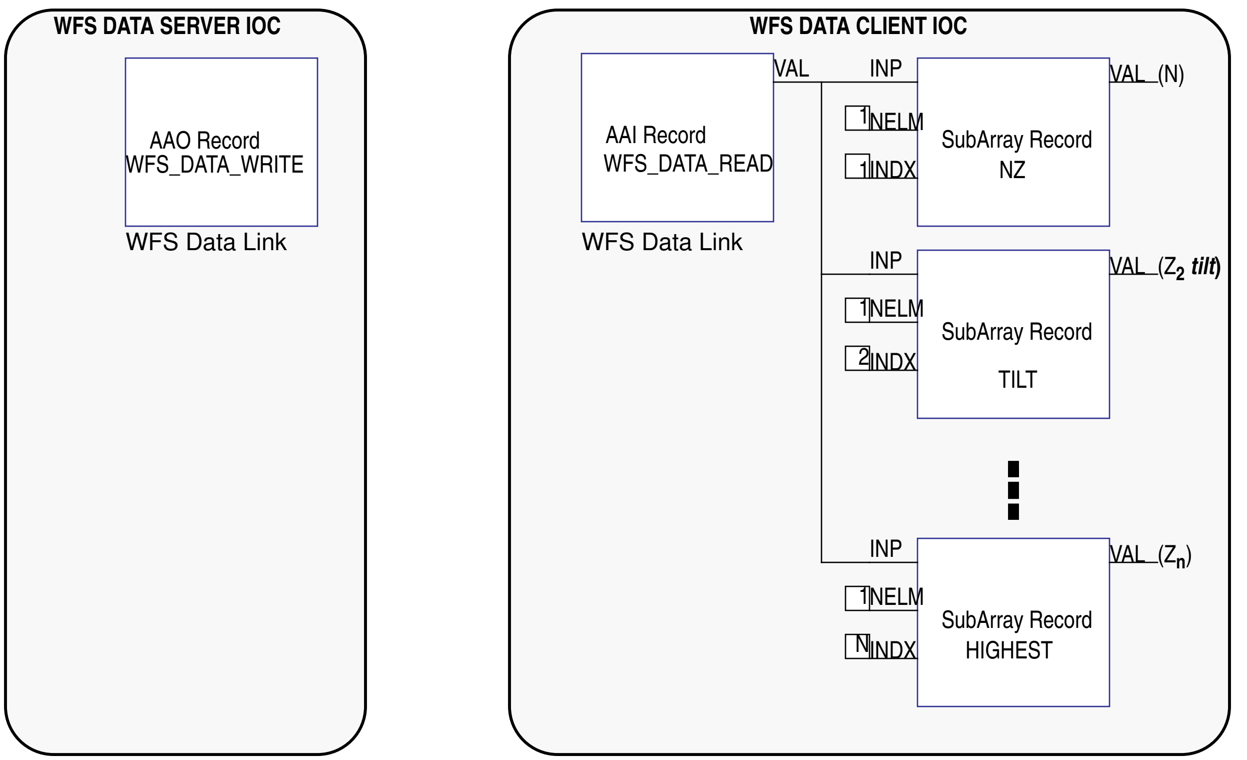
Field	Type	DCT	Interest	Initial	Access	Modify	Monitor	PP
VAL	NOACCESS	No	0	void *val	No	No	No	Yes
PREC	SHORT	Yes	1	0	Yes	Yes	No	No
OUT | INP	OUTLINK | INLINK	Yes	1	0	No	No	No	No
EGU	STRING	Yes	1	null	Yes	Yes	No	No
HOPR	FLOAT	Yes	1	0	Yes	Yes	No	No
LOPR	FLOAT	Yes	1	0	Yes	Yes	No	No
NELM	ULONG	Yes	1	1	Yes	No	No	No
FTVL	GBLCHOICE	Yes	1	FTYPE	Yes	No	No	No
NORD	ULONG	No	0	0	Yes	No	No	No
BPTR	NOACCESS	No	4	void *bptr	No	No	No	No

4.2.2 Field Descriptions

The new fields of the AAI and AAO records have the following descriptions.

VAL	Value Field. This is used to reference the array.
PREC	Display Precision. Precision with which to display VAL. This field is not used by record support except to supply a value when get_precision is called.
OUT | INP	Output or Input Link. This field is used by the device support routines to decide where to send output or to obtain input.
EGU	Engineering Units. ASCII string describing Engineering Units. This field is not used by record support except to supply a units description string when get_units is called.
HOPR	High Operating Range
LOPR	Low Operating Range
	These fields determine the upper and lower display limits for graphics displays and for upper and lower control limits for control displays. The fields are not used by record support routines themselves other than to honor calls to get_graphic_double or get_control_double.
NELM	Number of Elements in Array.
FTVL	Field Type of Value. This is DBF_STRING...DBF_ENUM.
NORD	Number of Elements Read.
BPTR	Buffer Pointer. Holds address of array.

FIGURE 3. Transmission of Wavefront Sensor Information via Array Records



5.0 The Programmatic Interface

5.1 General Structure

The programmatic interface will exist that is capable of use by local VxWorks tasks that may wish to read or write wavefront sensor data while remaining below the level of EPICS database and record processing.

Each WFS Data server will have a globally-known channel for which it has exclusive write access.

5.2 C Subroutine Interface

A subroutine interface will be provided which can be used simultaneously with the EPICS records. The proposed subroutine calls are:

/* Read an array of Zernike coefficients from a specific WFS data channel */

STATUS wfsReadZernikes(int channel, int nZernikes, double *array);

/* Write an array of Zernike coefficients into a specific WFS data channel */

STATUS wfsWriteZernikes(int channel, int nZernikes, double *array);

5.3 Major System Commands

The major system commands should follow the conventions defined in [2].

5.4 Attributes

6.0 Debugging

6.1 Compiling Programs for Debugging

See [4] for information on compiling and linking programs which use EPICS.

See [2] for information on how to compile and link Gemini software for debugging.

6.2 Debugging Modes

6.3 The Debug Mode

6.4 Booting and Starting

7.0 Error, Alarm and Logging System

7.1 Error System

The WFS data system will use the error handling capabilities supplied by the underlying WFS Data Link hardware system.

The device driver will perform periodic test of the data link state, and report this and other error conditions to the higher level EPICS software using the standard EPICS Alarm State/Severity mechanism.

7.2 Alarm System

See the above section, 7.1.

7.3 Logging System

The interface should have the capability of logging the messages sent. Each logging message should be logged with a time stamp and a title. This is provided via the EPICS archiver facility (AR).

8.0 System Attributes

8.1 Maintainability

8.1.1 Interface Design Recommendations

8.1.2 Adaptability and Enhancement Potential

It should be easy to add new data structures as needed, with the consent of the Gemini project office.

9.0 Development and Test Factors

9.1 Project Control

The project has control over the standard set of commands and parameters used for this interface. New commands and data structures should only be added after consultation with the project.

Any new commands or parameters should be added to this document after a change control process which involves a period of time for general comment.

9.2 Deliverables

The interfaces described in this report are all directly implemented using EPICS. Consequently, applications of this interface should provide the appropriate EPICS database, a full description of the functionality accessible through the interface, and any support routines that are required.

9.3 Acceptance Testing

Gemini systems must be able to run in a mode which allows their communication with other Gemini systems to be tested. The simulator should mimic the behavior of this interface.