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Gemini Controls Group Interface Control Document

ICD 8 — Non-Conforming ICS Interfaces

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This document defines the interfaces available for attaching non-conforming instruments to the Gemini 8m Telescopes.

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 8 — Non-Conforming ICS Interfaces) identifies those interfaces in the Gemini system that are available for attaching non-conforming instruments to the Gemini 8m Telescopes. All of these interfaces are described in other ICDs. These interfaces are:

1.1.1 Required interfaces

These interfaces are required of all instruments that are to be connected to the Gemini 8-m Telescopes. They are:

- system control commands and responses from the OCS to the ICS (ICD 1 — The System Command Interface)
- status information from the ICS to the OCS (ICD 2 — System Status and Alarm Interfaces)
- alarms from the ICS to the OCS (ICD 2 — System Status and Alarm Interfaces)
- raw science data from the ICS to the DHS (ICD 3 — Bulk Data Transfer)
- header information from the ICS to the DHS (ICD 3 — Bulk Data Transfer)

1.1.2 Recommended interfaces

These interfaces, while not required, provide additional functionality and are recommended for all instruments.

- Quick-Look data from ICS to DHS (ICD 3 — Bulk Data Transfer)
- Logging information from ICS to DHS (ICD 4 — Logging Information)
- WFS information from ICS to TCS (ICD 5 — Wavefront Sensing Information Interface)
- WFS information from TCS to ICS (ICD 5 — Wavefront Sensing Information Interface)

1.1.3 Optional interfaces

These interfaces are only needed to support advanced control operations not needed by typical 'non-conforming' instrumentation.

- System Commands from the ICS to the TCS (ICD 6 — ICS/TCS Direct Control Interface)
- Events from the ICS to the TCS (ICD 11 — Event Bus)
- Events from the TCS to the ICS (ICD 11 — Event Bus)

How each of these interfaces is implemented depends upon the hardware and software available with each particular non-conforming instrument. The restrictions imposed by various hardware/software configurations is discussed below.

1.2 Scope

This document covers only the issues involved with attaching non-conforming instruments to the Gemini 8m Telescopes. See the other interface control documentation for details not discussed 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] GSCG.grp.013, *ICD-1: The System Command Interface,* Gemini 8m Telescopes Project.

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

[6] GSCG.grp.007, *ICD-3: Bulk Data Transfer,* Gemini 8m Telescopes Project.

[7] GSCG.grp.008. *ICD-4: Logging Information,* Gemini 8m Telescopes Project.

[8] GSCG.grp.010, *ICD-5: Wavefront Sensing Information Interface*, Gemini 8m Telescopes Project.

[9] GSCG.grp.011, *ICD-6: ICS/TCS Direct Control Interface,* Gemini 8m Telescopes Project.

[10] GSCG.grp.015, *ICD-7a: ICS Subsystem Interfaces,* Gemini 8m Telescopes Project.

[11] GSCG.grp.021, *ICD-11: Event Bus,* Gemini 8m Telescopes Project.

[12] GSCG.grp.016, *Glossary for the Gemini Software,* Gemini 8m Telescopes Project.

[13] *WHT ADAM/EPICS INTERFACE*, Version 0.2, Paul Martin, Chris Mayer, Phillip Taylor, 27 July, 1994. Available from the authors.

[14] EPICS *Alarm Handler User's Guide*, Martin Kraimer, Ben-Chin K. Cha, Mark Anderson, Janet Anderson, September, 19, 1991, Los Alamos National Laboratory.

[15] EPICS *Alarm Configuration Tool and Alarm Handler User Interface System Requirements Definition (DRAFT)*, Janet Anderson, Ben Chin-Cha, August 30, 1993. Los Alamos National Laboratory.

[16] EPICS *Archiving Reference Manual* (DRAFT), Roger Cole, Los Alamos National Laboratory. [N.B. This document is in preparation. The Gemini project has a draft copy. Contact the author for up to date information].

[17] EPICS *Channel Access Reference Manual*, Jeffrey O. Hill, EPICS Group, Los Alamos National Laboratory.

[18] EPICS *Input/Output Controller Record Reference Manual*, J.B. Anderson, M.R. Kraimer, October, 1992.

[19] *EPICS: IOC Application Developers Guide,* Los Alamos National Laboratory.

[20] EPICS *State Notation Language and Run-time Sequencer Users Guide,* Andy Kozubal, Los Alamos National Laboratory

[21] CAPFAST *Electronic Circuit Design CAE User's Manual,* Phase Three Logic inc., Beaverton, Oregon.

[22] AAO/DRAMA_GUIDE_3, *Guide to Writing DRAMA Tasks,* Tony Farrell, Anglo-Australian Observatory.

[23] AAO/DITS_SPEC_5, *Distributed Instrumentation Tasking System*, Tony Farrell, Anglo-Australian Observatory.

[24] AAO/SDS_07, *Self-defining Data System (SDS)*, Jeremy Bailey, Anglo-Australian Observatory.

[25] AAO/IMP_MANUAL_8, *Interprocess Message Passing (IMP) System*, Keith Shortridge, Anglo-Australian Observatory.

1.4 Abbreviations and Acronyms

See *Glossary for the Gemini Software,* [12].

1.5 Glossary

See *"Glossary for the Gemini Software"* [12].

2.0 Overview

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

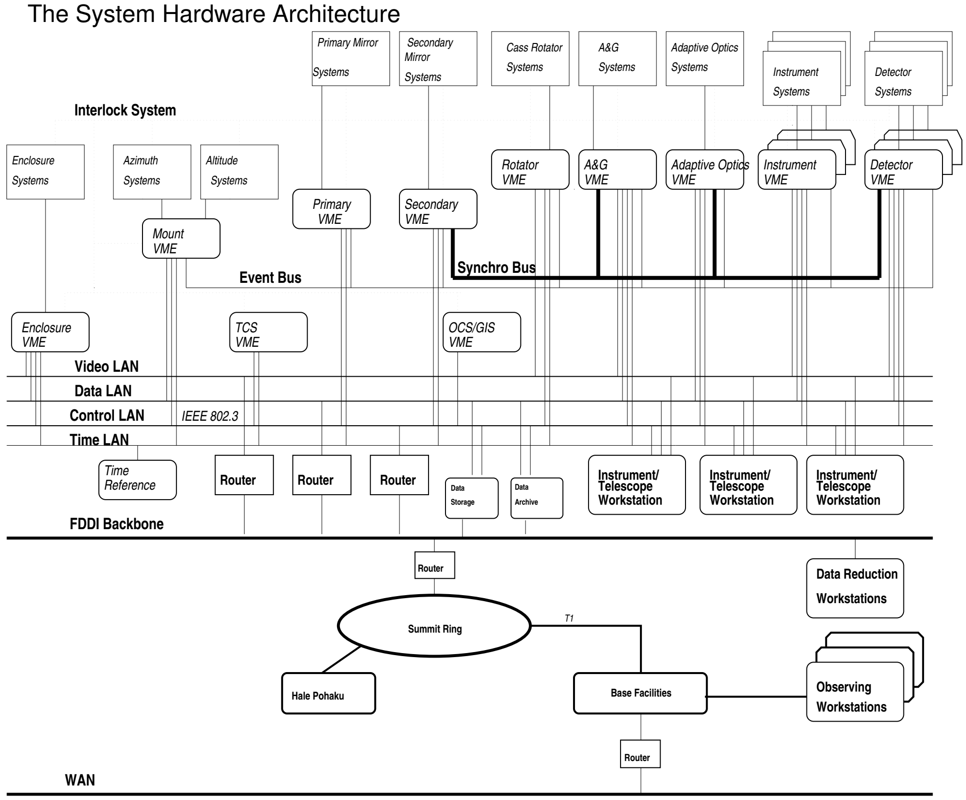
2.1 System Hardware Architecture

Instruments that, for one reason or another, do not meet the Gemini interface control standards for conforming instrumentation are termed *non-conforming* instruments. Examples of non-conforming instruments are:

- An instrument with a Unix-based software control system.
- A transputer-based instrument lacking EPICS capabilities

The degree to which non-conforming instruments can be integrated into the Gemini Control System depends heavily upon the differences between that instrument and conforming instrumentation. Some non-conforming instruments may be nearly fully integrable, while others may operate at reduced functionality.

FIGURE 1. The System Hardware Architecture



2.1.1 The Instrument Control Systems (ICS)

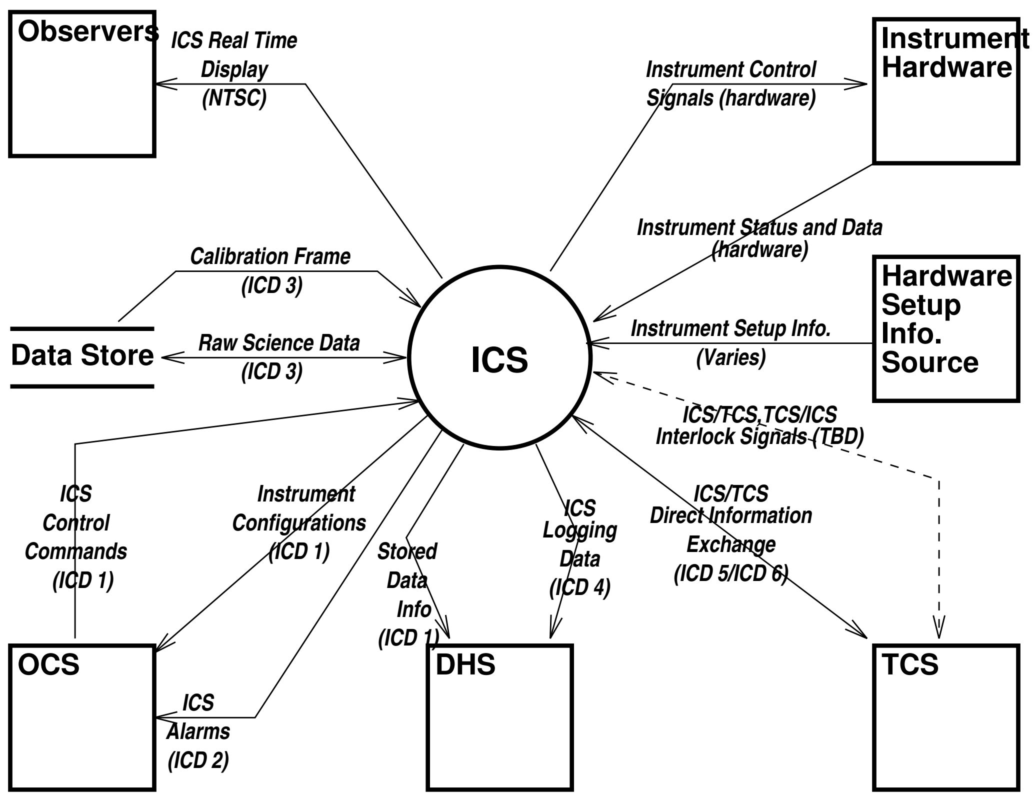
A "conforming" ICS is VME-based running VxWorks and EPICS and meeting the requirements for the appropriate interface control documents. Non-conforming instruments lack one or more of the above components.

2.2 Communication Architecture

2.2.1 Context Diagrams

The following context diagram shows the system interfaces to a typical instrument.

FIGURE 2. Context Diagram for a typical ICS Command/Status/Alarm interface



2.2.2 Events and Responses

The events that may on the ICS interface and the responses to those events, and shown in the following table. Refer to Section 3.0, “Behavior,” on page 6 for information on

Event	Response
GetVersion sent to ICS	ICS replies with its version identification string
GetStatus sent to ICS	ICS replies with its current status
GetID sent to ICS	ICS replies with its unique identification string
SetStatus set to ICS	ICS enters indicated operational level (simulation, standby, etc.)
RunTest	ICS performs self-test and reports results

what causes these events. Note that the client initiates all the events except for alarms.

2.3 The Services Component of the Interface

2.3.1 Communication Services and Protocols

At a minimum, any non-conforming instrument to be connected to the Gemini Control System must communicate through TCP/IP using the EPICS Channel Access message passing system and must provide the functionality described in ICDs 1-3 ([4], [5], [6]).

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 Control of ICS subsystems

The Gemini Control System views any instrument as an integrated unit containing both a detector array controller and an optical component controller. All instruments attached to the GCS must support this model and respond to commands as described in ICD 1 [4], provide status and alarm information as described in ICD 2, and use the bulk data transfer method described in ICD 3 [6]. While the use of EPICS may not be feasible with a particular non-conforming instrument, the behavior of the instrument, *as seen by other components of the GCS*, must match that of an EPICS-based instrument.

3.2 Collection of Status information

See ICD 2 [5] for a description of the required behavior.

3.3 Alarm processing

See ICD 2 [5] for a description of the required behavior.

4.0 Implementation

EPICS provides a portable Channel Access server that non-VME based instruments may use to implement the functionality required for support of ICD 1. Client programs that communicate using Channel Access to the Status and Alarm database are required to implement the functionality described in ICD 2 and ICD 4.

ICD 3 requires the use of the Bulk Data Transport mechanism as provided by the Data Handling System.

ICD 5 (WFS information) is only available if an interface is provided to the Gemini Synchro bus. This hardware interface is complicated, if not impossible, for non-VME based VxWorks systems.

Support for ICD 6 requires the same infrastructure as required for ICD 2,.

Implementation of ICD 11 and ICD 12 is TBD.

5.0 An example -GECKO

As an extreme example of a non-conforming instrument, this section examines how GECKO, CFHT's fiber fed spectrographic instrument, might interact with Gemini on Mauna Kea.

5.1 Assumptions

First, GECKO is not to be moved from the CFHT enclosure.

The data obtained by GECKO is assumed to be processed by data processing facilities of CFHT and not by the Gemini DHS. In addition, no status or alarm information is expected back from GECKO by the Gemini control system. Finally, it is assumed that GECKO will not respond to OCS sequencer commands.

From Gemini's side, it is assumed that this use of GECKO is experimental and thus that no OCS Observing Tool support is provided - the telescope and instrument will be controlled only in a 'classical' interactive observing mode.

Thus GECKO is an *extremely* non-conforming instrument, with adherence to none of the Gemini interface protocols. This is insufficient to use GECKO, so some modification to GECKO is required.

5.2 Modifications to GECKO

Since GECKO is an existing instrument in use at CFHT, it is assumed that adaptations to conform to Gemini requirements would be minimal. In particular, the only changes to GECKO would be software changes to support the acquisition of header information from Gemini's Status and Alarm database. Thus GECKO would function as a client of the SAD database, making EPICS Channel Access calls to obtain header information. No other changes to GECKO are required.

5.3 Physical connections

In the case of GECKO, the science data would be fed to GECKO through a optical fiber from the Gemini enclosure to the CFHT enclosure. Control communications would flow through the summit communications ring. There would be voice communications between the on-site staff at both telescopes.

5.4 Behavior

Here, the Gemini operations staff would point the telescope at the appropriate target and begin tracking. Once the telescope is tracking to specifications, the Gemini operations staff informs the CFHT staff of this condition, at which point GECKO begins an exposure.

Once the exposure completes, the CFHT staff inform the Gemini staff, at which point a new target position may be obtained.

At the appropriate moments in GECKO's operation, the GECKO software samples the Gemini Status and Alarm database to obtain any necessary header information to accompany the science data.

The data produced by GECKO could be entered into Gemini archives interactively after processing by CFHT.

5.5 Improving the 'conformity' of GECKO

From this primitive model, it is possible to improve the compliance of GECKO to Gemini standards by providing the interface specified by ICD 1:

- Adding a portable Channel Access server would enable GECKO to receive and respond to Gemini OCS sequencer commands, allowing an OCS recipe to automatically direct GECKO.
- GECKO would need to supply CAR (command action response) records for inclusion into Gemini's Action Response database, to signal action completions from GECKO to the Gemini Observatory Control System.

This would require coding effort to implement the server and to provide the functionality to process OCS directives, as well as the development of an OCS recipe to handle the sequencing between the telescope and GECKO.

Although possible, it is probably not desirable to increase the conformity of GECKO beyond this level.

6.0 The Programmatic Interface

6.1 General Structure

All non-conforming instruments must respond to OCS commands as described in ICD 1 [4].

6.2 Major System Commands

The major system commands should follow the conventions defined in [2] and are to be defined by the ICS and TCS Work Package groups as part of their respective designs.

7.0 Debugging

7.1 Compiling Programs for Debugging

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

7.2 Debugging Modes

7.3 The Debug Mode

7.4 Booting and Starting

Once power is supplied to the instrument, all other operations must be available through software control, including boot and restart processing.

8.0 Error, Alarm and Logging System

If a non-conforming instrument is to be fully integrated into the GCS, it must support the following operations using the methods described in the appropriate ICDs. Operation is possible without these interfaces, but restricts the ability of the system to track and report instrument performance.

8.1 Error System

See ICD 2 [5] and ICD 4 [7].

8.2 Alarm System

See ICD 2 [5].

8.3 Logging System

See ICD 4 [7].

9.0 System Attributes

9.1 Maintainability

9.1.1 Adaptability and Enhancement Potential