# Software Directions in Gemini Instruments

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### Contents

- State of current instruments and software.
- Key concepts in Gemini instrument software.
- Plans and changes for Aspen instruments.



#### Gemini Software Status

- 2 telescopes in operations in two hemispheres. Goal of 90%+ science time.
- Sophisticated telescopes: > 20 concurrently running computers/site during night-time operations.
- 12 facility + visitor instruments delivered at sites.
- 4 instruments waiting in house or under construction.
- 12 staff at 2 sites + ~ 3 contractors.



### Gemini Software Systems



### Software Forces and Motivators

- Gemini hardware and software choices were made in ~1995.
- ICDs were written in roughly the same time with the Gemini hardware and software choices in mind.
- Many software packages have been delivered and are working successfully every night.
- Astronomers have come up with some new ways of observing.
- A lot has changed since then in the world of software and hardware.



# A Conforming Gemini Instrument (the ICDs)

- The OCS through the OT and seqexec controls the instrument and other systems such that ICDs are in tact.
- Instruments must respond properly to the ICD sequence commands (apply, datum, etc. ICD 1x).
- Status information must leave the instrument to be accessible to Gemini systems (ICD 2).
- Gemini provides services (WCS info, chopping, OIWFS) documented in other ICDs.
- Data is delivered to the DHS (ICD 3).



# Anatomy of a Gemini Instrument



Communicates with Gemini

Instruments

**GMOS N/S** 

NIRI

# ALTAIR Close-Up



### Thin-Client Architectur



# Gemini Points on Current Instrument Situation

- Gemini is satisfied with the way the Gemini software system is designed.
- EPICS-based instruments have been solid and reliable.
- Problems with delivered instruments have not generally been software-related although integration is often difficult and costly.
- Our experience with delivered instruments allows us to see how changes can be made to improve things.



# Plans and Changes for Aspen Instruments

- Hardware/OS Choices
- Simplifying For Everyone
- Software Changes
- Support Issues



# Lessons Learned from Current Instruments and Builders

- Simplify the Gemini environment as much as possible.
- Allow builders more freedom in their software system.
- Simplify the integration effort for Gemini and builders.
- Clarify software responsibilities for Gemini and builder.
- Reduce software costs in effort and equipment.
- Reduce reliance on VxWorks, PPC and VME.
- Provide timely and appropriate levels of support.





#### nstrument Software

- Promote and support more hardware choices.
- Promote and support more than one OS choice.
- Provide deeper support for interfacing to Gemini services.
- Reduce builder need for extensive Gemini software knowledge.
- Minimize extra computers (i.e. the thin-client).
- Reward those who use supported choices.





#### nstrument Hardware

- Support and promote x86 hardware as the primary choice for instrument top-level.
  - Gemini provides a recommended configuration.
  - Or criteria for desired x86 choices.
- Continue to support VME/PPC-based solutions for those applications that require it.
- Devalue other choices unless technically necessary.





### en OS Choices



- Promote Linux as the primary supported OS choice for instrument top-level.
  - Recommend and support a specific Linux/RT Linux choice.
- Continue to support VxWorks as an RT choice for those groups that wish it and systems that require it.
- Reward the use of supported OS choices.



#### Platform Summary



EPICS Linux/x86 Other Linux/x86





- Preferred architecture for instruments specifies a toplevel, Linux-based x86/PCI system.
- Top-level provides the platform for integration with Gemini and sequencing of instrument.
- Instrument builder software uses Gemini API to interface to Gemini and integrate with builder-specific code.
- All code, other than Gemini API components, on toplevel and is responsibility of builder.
- Devalue solutions that do not maximize use of top-level.



# nd/Control API

- Gemini provides a thin, library/API that is used on the top-level to integrate with OCS.
- API provides support for accepting status subscriptions and updating status.
- API provides support for listening for commands and providing completion information.
- API provides access to telescope WCS service.
- API provides any necessary OIWFS services.



### **EPICS** Use

- EPICS will continue to be a supported as a Gemini instrument option.
- EPICS is reasonable for builders who have gained the experience.
- Platform of choice for EPICS is Linux/PCI/x86 using EPICS version 3.14.x.
- Plan is to make EPICS as simple to use as possible by providing a more complete system.
- The same API will be provided for the EPICS environment.





# Advantages

- Architecture is similar to plug-in approach wanted by builders.
- Primary hardware/OS is freely available and hardware is cheap and popular.
- Details of ICD compliance are handled by Gemini.
- Allows greater reuse of builder software investment when practical for both parties.
- Provides a clear separation of software responsibilities between Gemini and builder.



# Advantages

- Specific hardware/OS choice reduces costs and simplifies long-term support.
- Clear separation of responsibilities allows Gemini to focus on ICD compliance, maintenance of API, instrument testing, and observatory operations.
- Generate a new, simpler ICD/document for builders that reduces need to publish and explain current ICDs.
- A high value is placed on integrated instrument functions. Thin-clients no longer necessary



#### Gemini Points

- Increased software design freedom for builders means an increased support load for Gemini.
- Fewer opportunities for code reuse and growing staff expertise.
- We still must be able to disallow instrument software designs that are not viable or risky.
- Consideration will be given to who well proposed instrument software can be supported.



### Instrument Development GUI

— T-ReCS Java Engineering Interface (ver 2003/10/23)						
File Help Look&	Feel					
Master Detector	Bias PreAmp	Temperatur	e Motor High-Level Motor Low-Level Motor Parameters	Scripts EPIC	S Recs System	
Instrument Setup	rePUT>Epi	Current 1	niri.dl	🔲 g Set		
Camera mode	-	r imaging	NTRT	ed Cfg	INIT	DATUM
Imaging Mode	-	r field		Edits		
Filter (ov=T)	-	• Qs-18.3เ	Top level control	inputs	CLEAR	PARK
Slit Width	-	Open	Simulation Mode: NONE	Up		
Grating	-	Mirror	GOOD	own	TEST	ABORT
Central Wavelen	8.6	8.6	Instrument Sequencer IDLE	Cfg		
Overrides	rePUT>Epi	Current	Components Controller	9.504	OBSERVE	STOP
Sector		Open	IDP5	-		
Aperture		Matched	CC Shared (WFS) Comp.		Show Opt	ical Path
_ Pupil		Open-1			•	
_ Lyot Stop			Detector Controller	Arc	hive File on Host =	trecskepler-
		KDIO	IDLE IDLE	E /dat	ta/trecs/2004-031.1/	S001.fits
Observation Set	rePUT>Epi	Current	GOOD	DHS	S Label: \$2004020	1S0128
Observing mode		chop-no	Wavefront Sensor CC IDLE		r Noto:	
Data mode		save			a note:	
Sky Noise		20	Engineering		-	-
any backyround Air Maee		1.5	Adjusted Time= 0.72306 Tatal= 0.43	p.Control	APPLY	CAD: 132
mii Mass		1.0	Aujusteu Time- 0.72590 Total- 0.15	is Disabled		CAR: IDLE
Additional Observation Parameters Chop Throw (arcsec) 15.0 CAR-Msg:						
et.Control State: WARN: Detector is NOT powered on trecs:hearthea						Danel L



# GUI Strategy

- Instrument builders deliver an "acceptance test and engineering" control screen with their instrument.
  - GUI is used by builder during instrument construction.
  - GUI demonstrates control of all mechanisms, presents all status items, and controls data acquisition in all observing modes.
  - Builder uses whatever toolkit they wish and connect to instrument as they wish independent of Gemini interface.
  - Gemini does not use this GUI at the sites during normal operations.





# Support Provides

- Gemini support works with builder to provide a suite of tests to use with the instrument through the Gemini instrument interface during instrument development and acceptance.
- Gemini provides a Gemini-centric operations/engineering control and monitoring screen using the Gemini instrument interface.
- Gemini provides the OCS/Observing Tool/seqexec integration as we currently do.



#### Instrument Data

- Currently data and some header info is prepared and sent via ICD3 to the DHS (Data Handling System).
- ICD3 use causes testing difficulties for builders.
- Gemini must usually deliver a configured DHS to builders.
  - Costly in equipment and manpower for Gemini.
- We have some concerns regarding scalability of DHS with regard to data demands of future instruments.





### Data Strategy

- Gemini has near-term plans for installing highperformance network area storage or storage area network (NAS or SAN).
- NAS/SAN will provide backbone for "New DHS"
- Gemini provides simplified data API.
  - Instruments write dataset files directly to NAS. Data in FITS format, but not FITS files.
  - Header info from normal status update events.
  - Instrument writes FITS files to local storage during testing.



# Simplified DHS API

- Instrument provides data acquisition events for DHS.
- Gemini provides simplified data API.
  - Instruments write dataset files directly to NAS. Data in FITS format, but not FITS files.
  - Header info from normal status update events.
  - Instrument writes FITS files to local storage during testing.
- Details are still being developed.





- Data processing procedures for current Gemini instruments are developed by Gemini staff.
- Gemini Online Data Processing (OLDP) is undergoing commissioning now.
- For Aspen, builders create data processing routines that can be integrated with Gemini OLDP.
  - IRAF routines are a possibility as are other packages.
- Requirements for OLDP integration will be released.



# Support for Instruments

- Support from Gemini has been spotty for instrument builders.
- For Aspen, Gemini provides more support possibilities:
  - Gemini provides OCS-side test code.
  - Gemini provides programmer who travels often to the site to work with builder programmers.
  - Gemini provides on-site programmer for the duration of the project. Gemini programmer is responsible for instrument software.





### Final Points

- These changes have been under consideration for some time.
- Based upon successes and failures of current instruments.
- More detailed information will be made available with next package.
- It is still possible to provide comments and advice that can result in changes.
- Questions/Comments?

