Version

Nicolas A. Barriga, Carlos Quiroz, Arturo Núñez

27052011/01

Created: May 27, 2011

Modified: May 27, 2011



**Change Record**

|  |  |  |  |
| --- | --- | --- | --- |
| **Version** | **Date** | **Author** | **Notes** |
| 1 | May 27, 2011 | Nicolas A. Barriga | * First Version |

Table of Contents

1 Introduction 1

1.1 Document Purpose 1

1.2 Intended Readership 1

1.3 Conventions 1

1.4 Acronyms 1

1.5 Reference Materials 1

2 Overview of the Gemini Data Service 2

2.1 Data Values Composition 2

2.2 Data Label Generation 2

2.3 Sending FITS Headers from Seqexec to GDS 3

3 GUI 5

4 Implementation Details 9

4.1 Protocols 9

4.2 Scala 10

# Introduction

This document provides a description of the Gemini Data Service (GDS) Design.

## Document Purpose

The purpose of this document is to present the GDS design for review by interested parties.

This document does not rehash the critical information in references and . It is assumed that the reader has read these other documents and understands their content.

## Intended Readership

The intended audience for this document is *groups who are writing software, design review documents or providing operational support* *for Aspen instruments*.

## Conventions

The GDS is still under active development and things that are expected to undergo some changes are marked like this paragraph with a yellow exclamation point. There are not many of these situations in this document.

Code examples and individual methods are written in a fixed-width font like this: unsubscribeToStatus.

## Acronyms

ACM Action Command Model

CMS C++ Messaging Service

DHS Data Handling System

GIAPI Gemini Instrument Application Programmer Interface

GMP Gemini Master Process

GSDN Gemini Data Storage Network

ICD Interface Control Document

JMS Java Message Service

PCS Primary Control System

TCS Telescope Control System

TLC Top Level Computer

WCS World Coordinate System

GDS Gemini Data Service

ODB Observing DataBase

XMLRPC eXtensible Markup Language Remote Procedure Call

RMI Remote Method Invocation

EPICS Experimental Physics and Industrial Control System

FITS Flexible Image Transport System

## Reference Materials

x

|  |  |
| --- | --- |
| [1] | Kim Gillies and Arturo Nunez, "Aspen GIAPI Design and Use," 2006. |
| [2] | Kim Gillies, "Guidelines for Designing Gemini Aspen Instrument Software," 2004. |
| [3] | Norman Hill, Dayle Kotturi, Severin Gaudet, Steve Cockayne, and Jennifer Dunn, "ICD 3.2 -- The DHS Interface," Gemini Observatory, 1998. |
| [4] | Norman Hill and Severin Gaudet, "ICD 3 -- Bulk Data Transfer," Gemini Observatory, 1996. |
| [5] | Steven Beard, "ICD 1.9/3.2 Science Instrument to Data Handling System," 1997. |
| [6] | FITS Standard Specification. [Online]. http://archive stsci.edu/fits/fits\_standard/fits\_standard.html |
| [7] | XML-RPC Home Page. [Online]. <http://www.xmlrpc.com> |
| [8] | Experimental Physics and Industrial Control System. [Online]. <http://www.aps.anl.gov/epics/> |
| [9] | Java Message Service. [Online]. <http://en.wikipedia.org/wiki/Java_Message_Service> |
| [10] | OSGi Alliance. [Online]. <http://www.osgi.org> |
| [11] | Jini.org. [Online]. <http://www.jini.org> |
| [12] | The Scala Programming Language. [Online]. <http://www.scala-lang.org/> |

x

# Overview of the Gemini Data Service

The Gemini Data Service is the system that will (partially) replace the Gemini Data Handling System (DHS) for GIAPI based instruments, such as GPI.

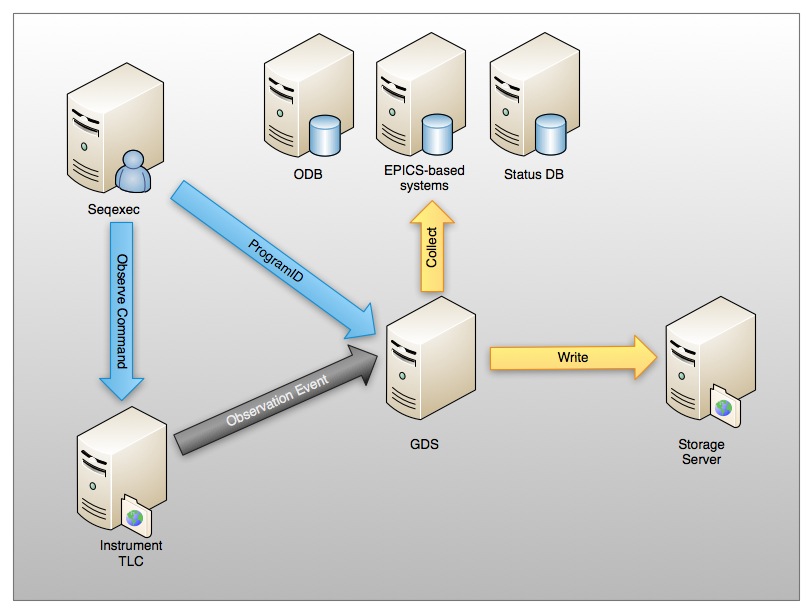


Figure : GDS System Diagram

## Data Values Composition

The GDS is a component that listen for Observation Events sent from an instrument and that reacts to them by sampling the state of the Observatory, observation database, instrument, etc. The sampled information is then added to the data files produced by the instrument. This process is called value composition, where all sampled values upon observation events are composed into the data file.

The design uses the concept of actors or agents that are independent objects that can sample the information. This design makes it simple to keep track of the progress and make each of these actors, a single purpose, very simple to implement component.

It also makes it easy to extend the composition as the core components can discover new modules in charge of gathering these values

## Data Label Generation

Currently, the dataset names (or datalabels) generation is performed via a control command by the DHS, at the request of the seqexec. The seqexec later specifies who will contribute data to this dataset, at which point itself and the contributors can start sending data. A first study of the following documents and code was done:

* ICD 3: Bulk Data Transfer
* ICD 1.9/3.2: Science Instrument to Data Handling System
* dhs/dhs/dhsData/list.C
* dhs/dhs/dhsData/ctl.C

This investigation shows that the datalabel generation functionality is fairly independent from the data storing functionality, in a way that no files are created, and no internal state changes (except for a list of the last labels generated), when labels are generated. Furthermore, data can be sent with arbitrary datalabels not generated by the DHS.

So, there are three main alternatives for instruments using the GDS:

1. Continue with the seqexec requesting datalabels to the DHS, and then not sending any data to the DHS, but instead sending it to the GDS. The major disadvantage is a dependence on the DHS for GIAPI based instruments.
2. Extract the datalabel generation from the DHS to an external service that the DHS can query for most instruments, and the seqexec can query for GIAPI based instruments. The major disadvantage is the risk of modifying a complex piece of software like the DHS. For consistency and simplicity, if this option is taken, the communication with the new external service should use the same protocol as the one used in Sending FITS Headers from Seqexec to GDS.
3. Generate datalabels independently in GDS and DHS, and ensure no collisions will happen by changing the naming convention.

## Sending FITS Headers from Seqexec to GDS

The FITS headers that the seqexec provides, must be passed to the GDS. There aren't many suitable remote communication alternatives supported both by tcl and java/scala. The most suitable seems to be XMLRPC, which has implementations in both languages, and is relatively simple, but much higher level than using plain http or tcp.

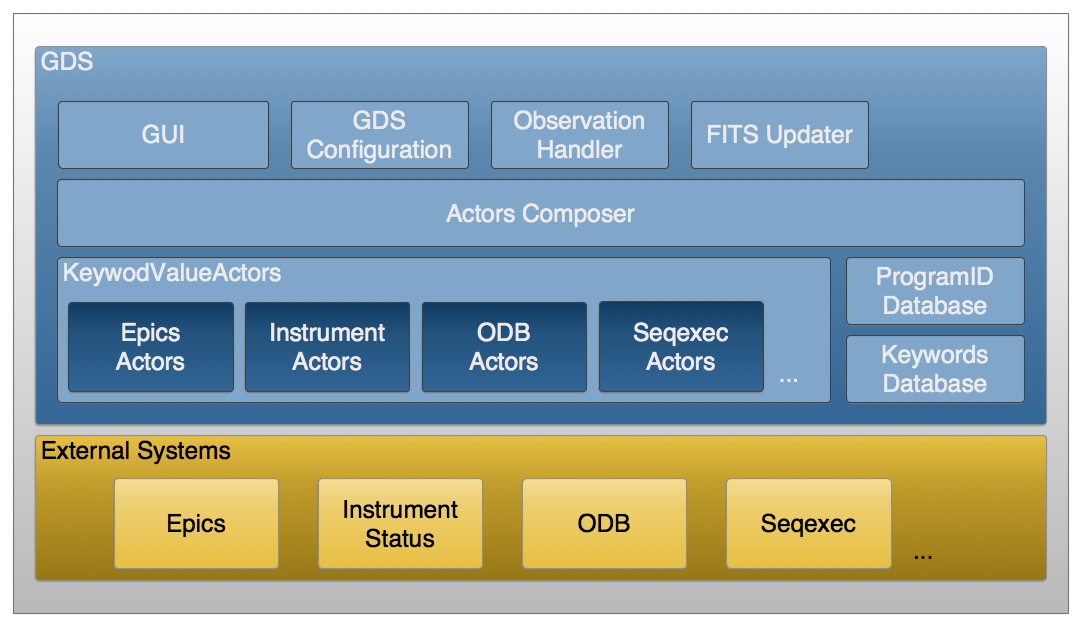
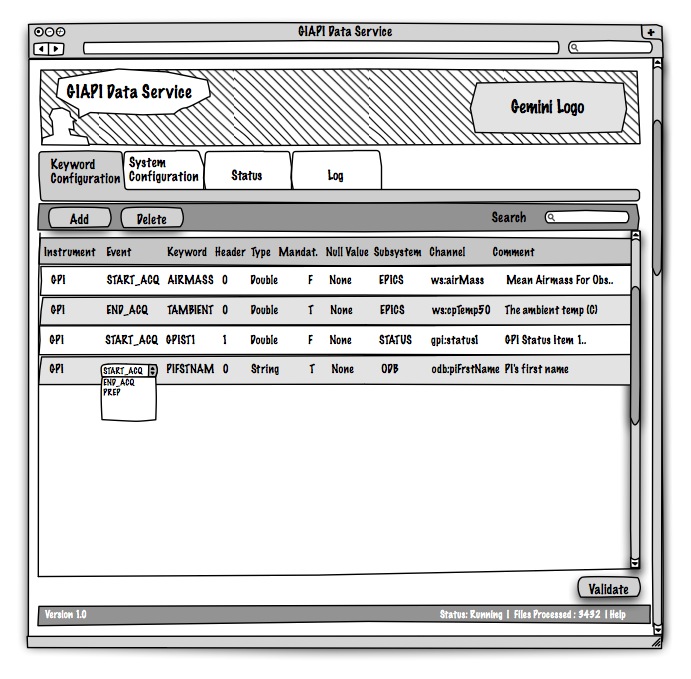
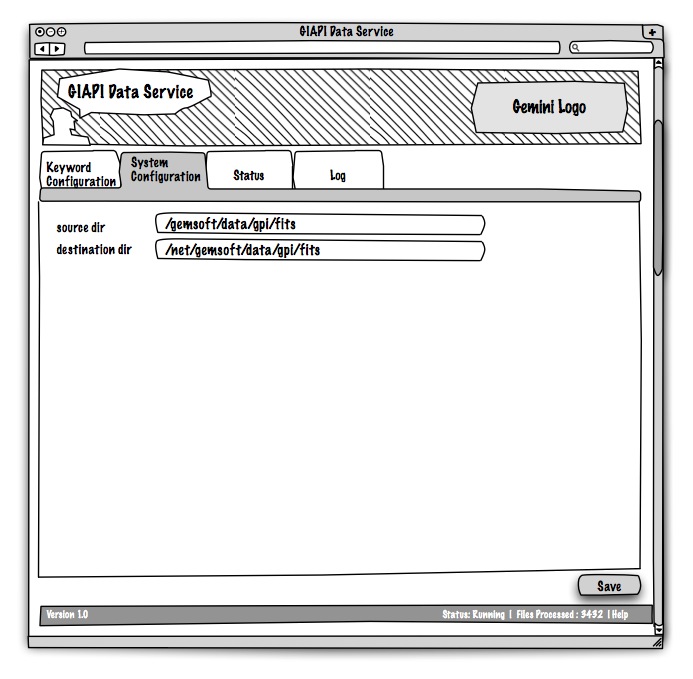


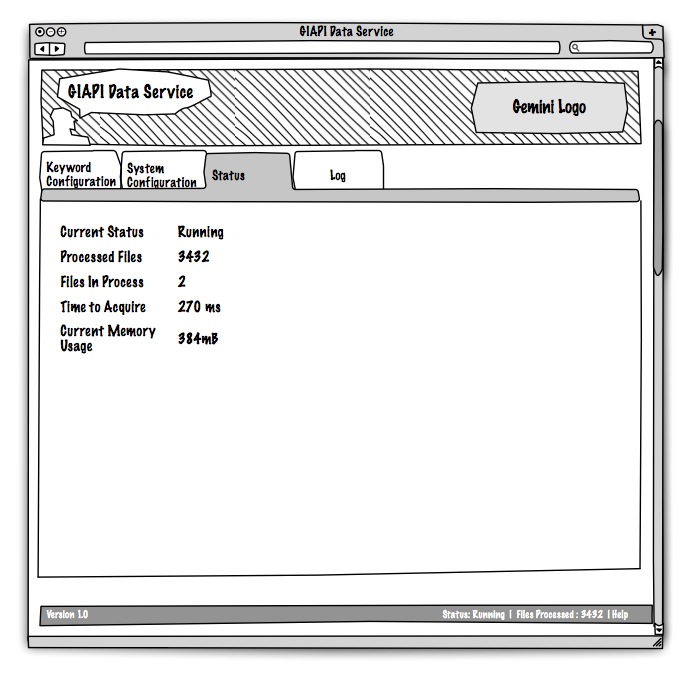
Figure : GDS Module Diagram

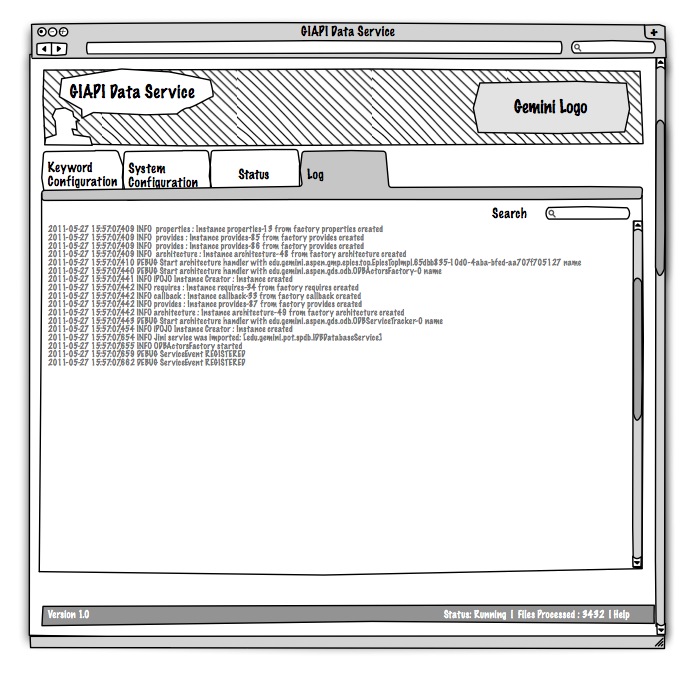
# GUI

These are mockups of the proposed GDS user interface.



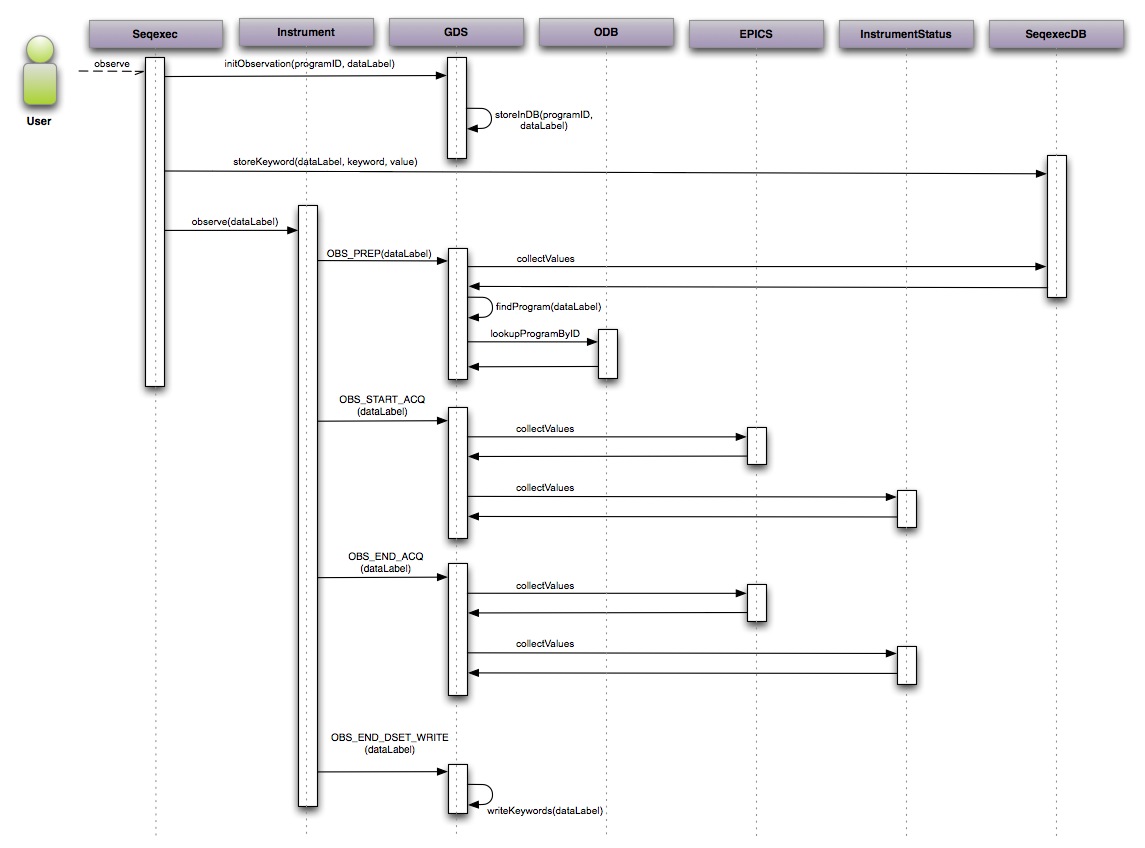






# Implementation Details

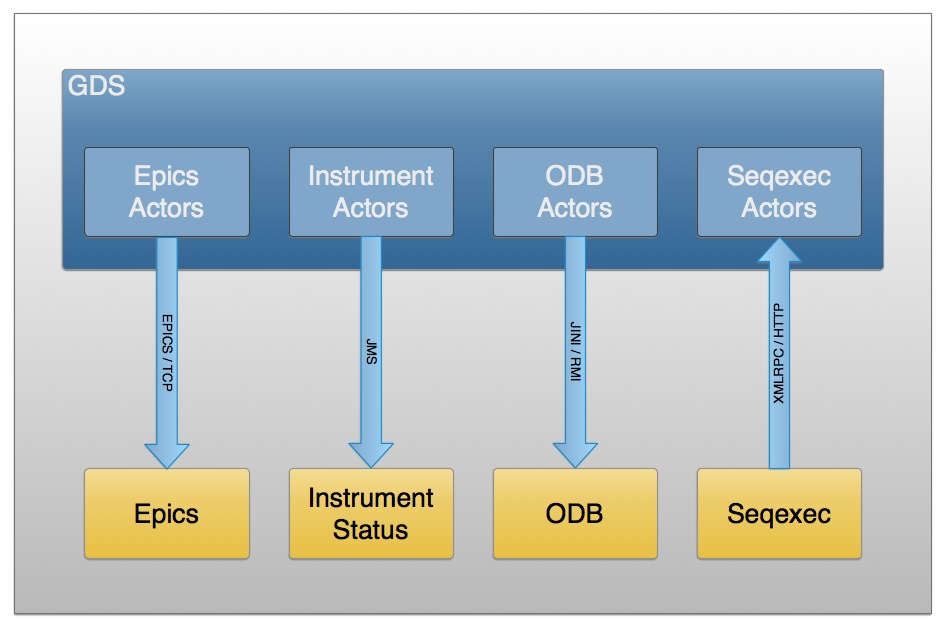
The following sections are of interest only to software engineers who need to maintain the GDS code base.



## Protocols

The GDS uses several protocols to communicate to different external systems. Most of these were chosen because current or legacy applications use them.

* EPICS: Currently used by most instruments and the OCS. The GDS needs to collect information such as weather data, which is accessible via EPICS.
* JMS: GIAPI based instruments publish status information via JMS. This information is received by the Gemini Master Process (GMP), and is accessible by the GDS via OSGi.
* Jini/RMI: Used by GDS to query the ODB for static information of programs, such as principal investigator’s names.
* XMLRPC: Used by the seqexec to communicate keywords to the GDS.



## Scala

The GDS is mostly written in Scala. Scala was chosen because of several reasons:

* Compiles to bytecode, runs on a standard JVM and transparently interoperates with Java.
* Statically typed combined with a type inference mechanism.
* Combination of functional and object-oriented paradigms.
* The actor concurrency model provides a safe way to build concurrent applications that scale easily.