RIA-AstroMadrid **1.**
Instrument control system and scheduler

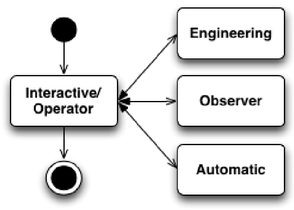
J. Guàrdia[4], J. Colomé[4], I. Ribas[4],
and the CARMENES Consortium[1,2,3,4,5,6,7,8,9,10,11]

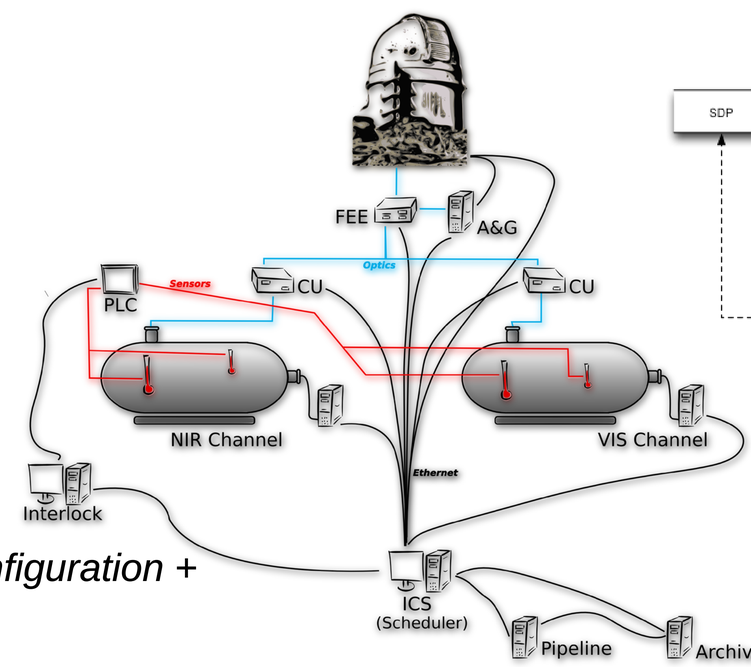
[1]Max-Planck-Institut für Astronomie ☐[2]Instituto de Astrofísica de Andalucía ☐[3]Landessternwarte Königstuhl ☐[4]**Institut de Ciències de l'Espai** ☐[5]Institut für Astrophysik Göttingen ☐[6]Instituto de Astrofísica de Canarias ☐[7]Thüringer Landessternwarte Tautenburg ☐[8]Universidad Complutense de Madrid ☐[9]Hamburger Sternwarte ☐[10]Centro de Astrobiología ☐[11]Centro Astronómico Hispano-Alemán – Calar Alto Observatory

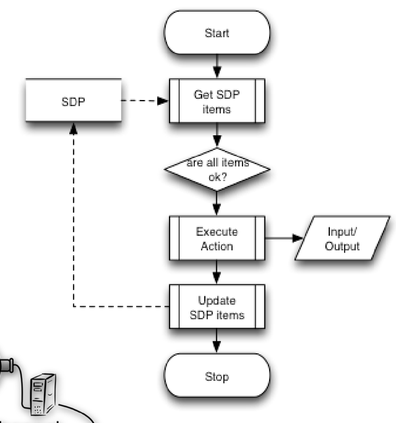
The overall purpose of the CARMENES instrument is to perform high-precision measurements of radial velocities of late-type stars with long-term stability. CARMENES will be installed in 2015 at the 3.5 m telescope in the CAHA observatory (Spain) and will be equipped with two spectrographs in the near-infrared and visible windows. The technology involved in such instrument represents a challenge at all levels. The instrument coordination and management is handled by the Instrument Control System (ICS), which is responsible of carrying out the operations of the different subsystems and providing a tool to operate the instrument from low to high user interaction level. The main goal of the ICS is to maximize the instrument efficiency by operating it in an integrated and reliable manner. The CARMENES scheduler is another key element in the control layer. It is responsible for the observatory time optimization and, thus, it plays a critical role in achieving an efficient operation. Its main purpose is the allocation of tasks, while maximizing the scientific return of the facility and minimizing the operational costs. The scheduler is based on Artificial Intelligence techniques and considers long- and short-term varying conditions for the prioritization of tasks. The ICS and the scheduler application are described.

Operational Design

- ❑ **Control Modes**
  - ➔ Interactive/Operator
  - ➔ Observer
  - ➔ Engineering
  - ➔ Automatic
- ❑ **Operation Modes**
  - ➔ Single/Multiple channel
  - ➔ **CARMENES MODE** *MASTER channel is NIR*
- ❑ **Scheduler for task prioritization**
- ❑ **Nominal Workflow** ➔ *Task selection + Change configuration + Acquisition of NIR & VIS spectra + Data processing*



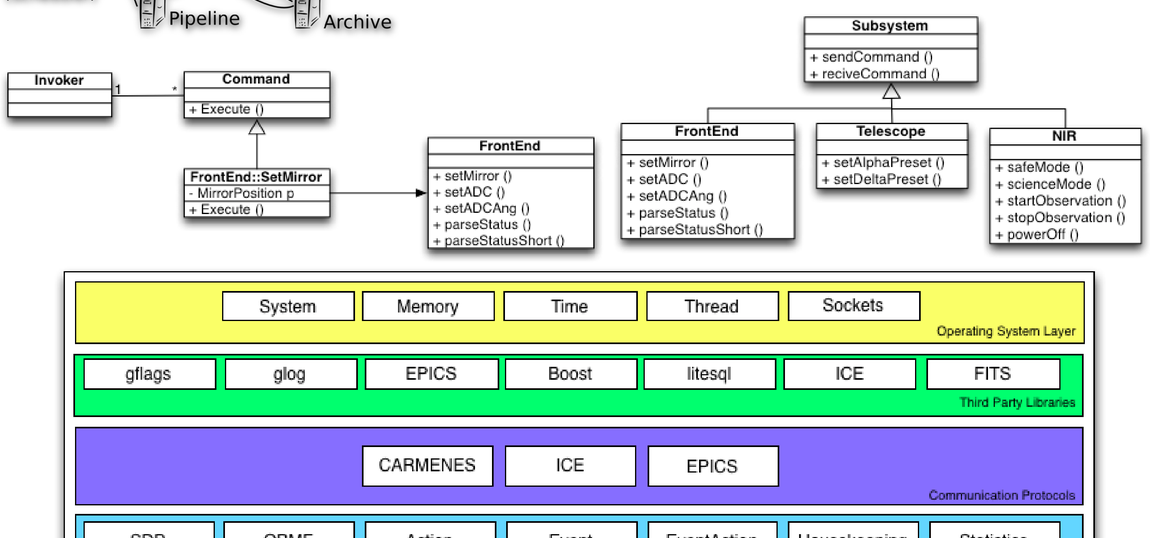




Action flux diagram

Instrument Control System

- ❑ **Central application in the instrument control layer**
  - ➔ Modular architecture
  - ➔ High level of abstraction design motivated by the heterogeneity of the different subsystems
  - ➔ *Master/slave model architecture* **ICS is the main MASTER**
- ❑ **Operation handled with actions triggered by events**



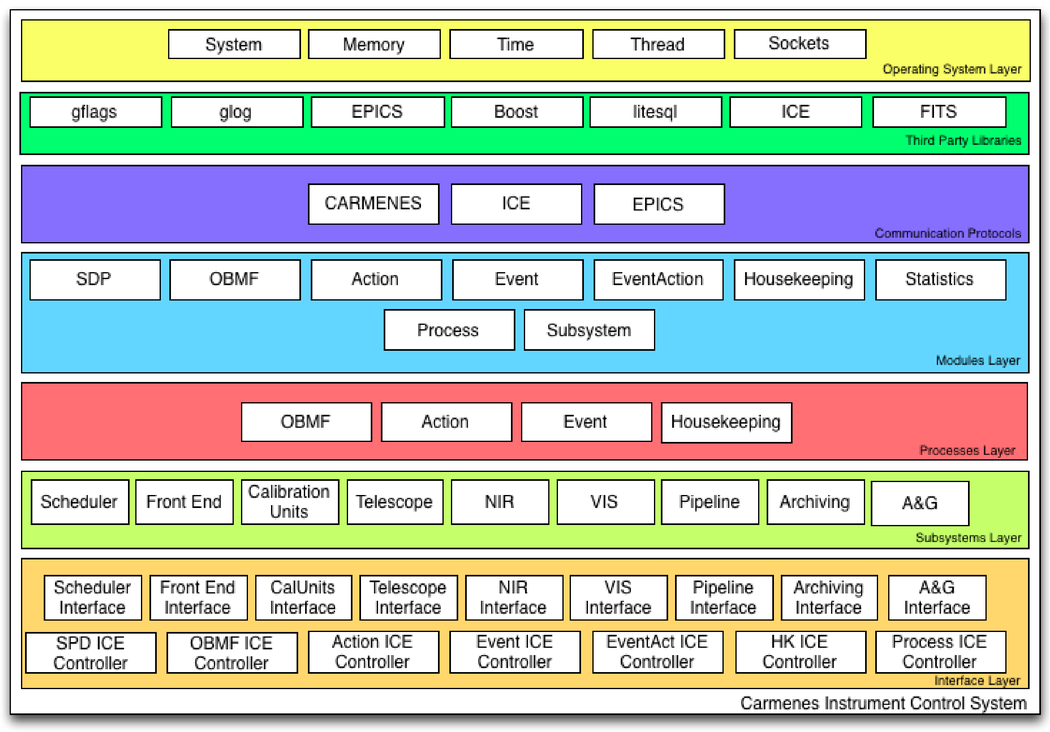
Subsystems layer contain a class for each subsystems
Each subsystem inherits from the subsystem abstract class defined in the modules layer and implements the Façade design pattern. This pattern hides the details of each subsystem action and the subsystem communication protocol.

Customize procedures
ICS is highly customizable: each command can be executed in an analogous manner for all the subsystems

Protocols
Internet Communications Engine (ICE), EPICS & CARMENES TCP/IP protocol

Modular Design

- ❑ **Operating System Layer:** Interaction with the operating system. Provides functionalities to manage threads, semaphores, file systems, etc.
- ❑ **Third-Party Libraries Layer:** Libraries used from third party developers.
- ❑ **Modules Layer:** Information management, encapsulated in data structures, grouped into modules.
- ❑ **Procedures Layer:** Defines processes to manage data and actions.
- ❑ **Subsystems Layer:** Contains subsystems abstraction.
- ❑ **Communication Layer:** Contains protocols to communicate with subsystems.
- ❑ **Interface Layer:** Defines all communication APIs to interact with the subsystems, modules and procedures.



Layers and main modules of the CARMENES ICS

http://carmenes.caha.es/