

## IV. Instrument Control Software



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Our URL: <http://carmenes.caha.es/>

**Abstract.** 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 2014 at the 3.5 m telescope in the German-Spanish Astronomical Center at Calar Alto observatory (CAHA, 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 and the CARMENES control layer architecture is to maximize the instrument efficiency by reducing time overheads and by operating it in an integrated manner. The ICS implements the CARMENES operational design. A description of the ICS architecture and the application programming interfaces for low- and high-level communication is given. Internet Communications Engine is the technology selected to implement most of the interface protocols.

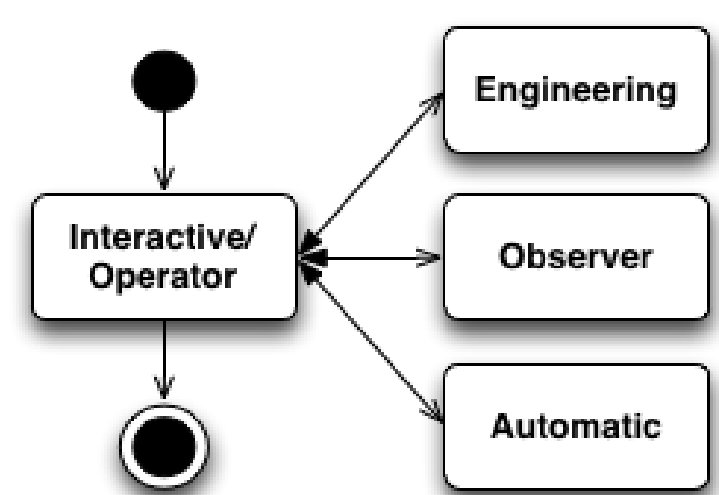
\* Poster 8446-25 → Quirrenbach, et al., "CARMENES. I: instrument and survey overview", SPIE 8446 (2012)



### Operational Design

#### Control Modes

- Interactive/Operator
- Observer
- Engineering
- Automatic



#### Operation Modes

- Single/Multiple channel
- **CARMENES MODE** MASTER channel is NIR

#### Scheduler for task prioritization

- Poster : 8848-59 Session 8



#### Nominal Workflow → Task selection + Change configuration + Acquisition of NIR & VIS spectra + Data processing

### Instrument Control System

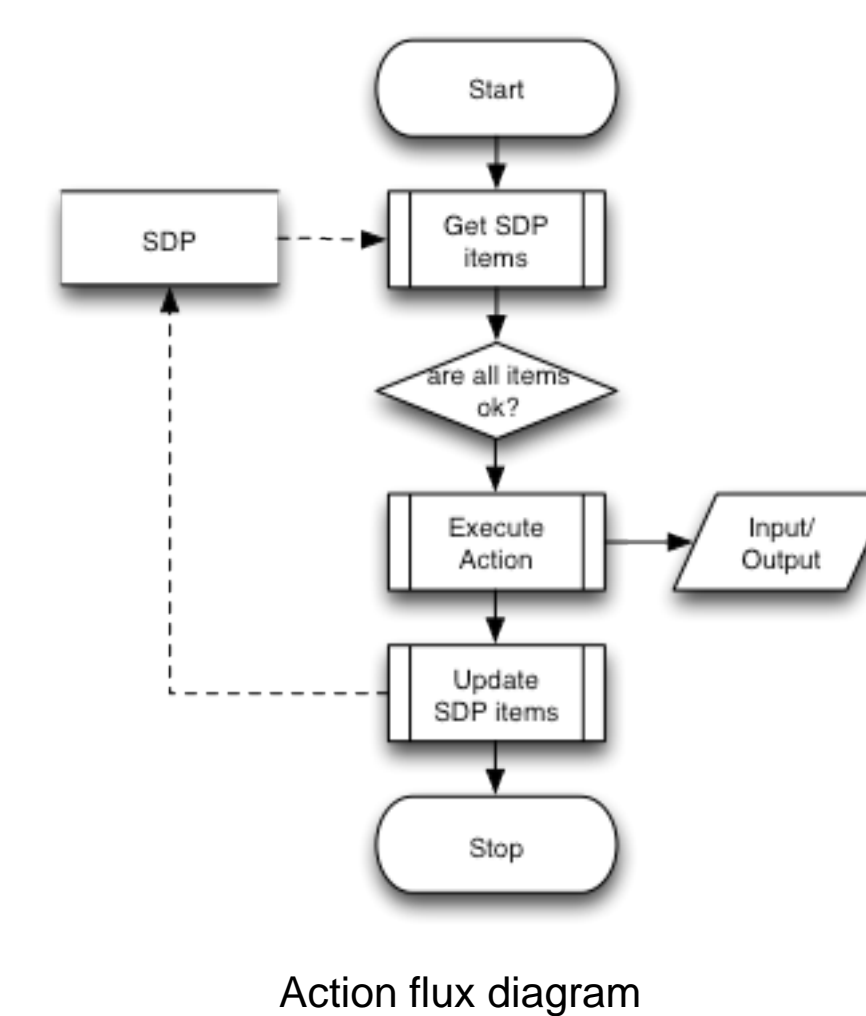
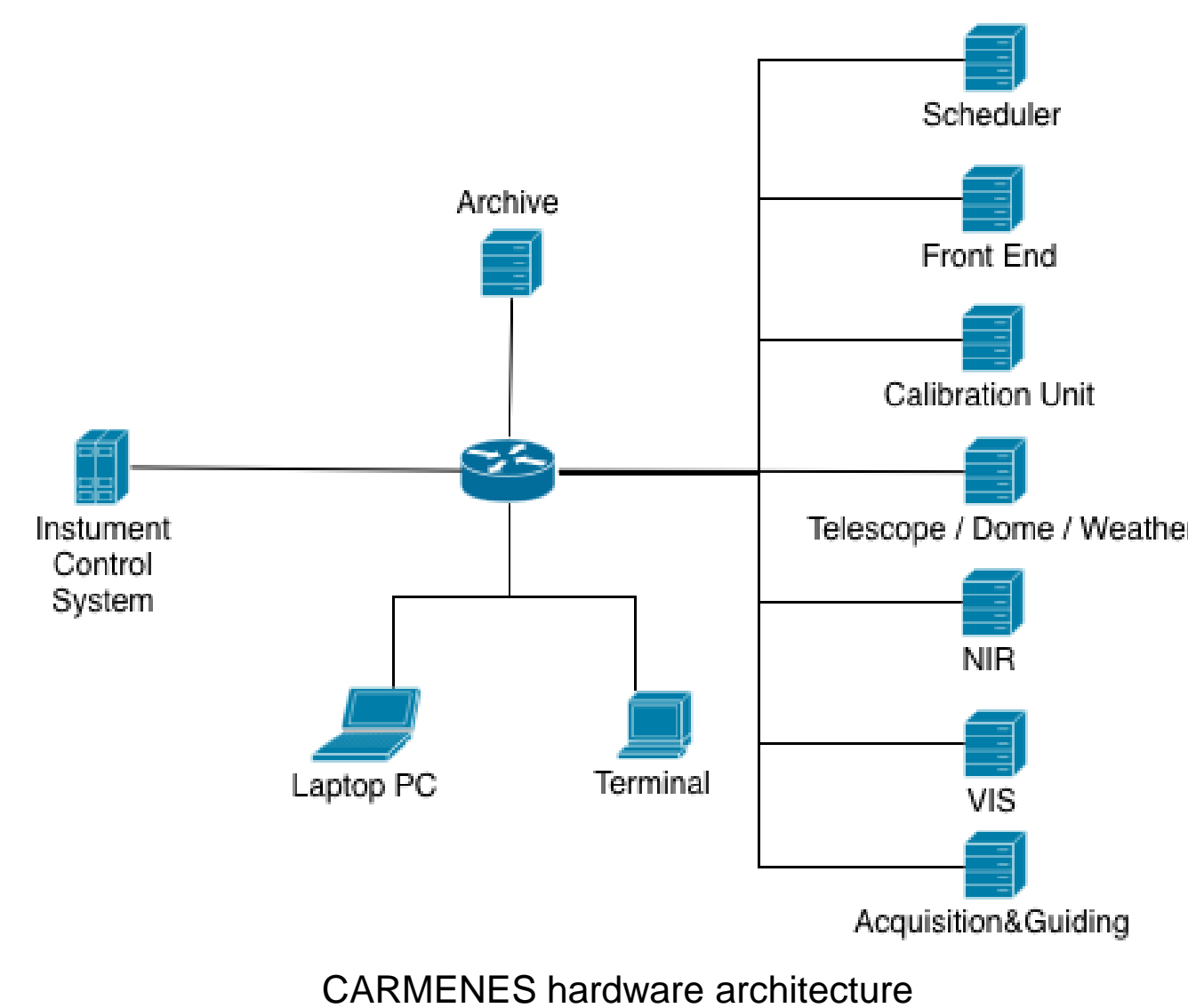
#### Central application in the instrument control layer

- 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

### 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.



#### Subsystems layer contain a class for each subsystems

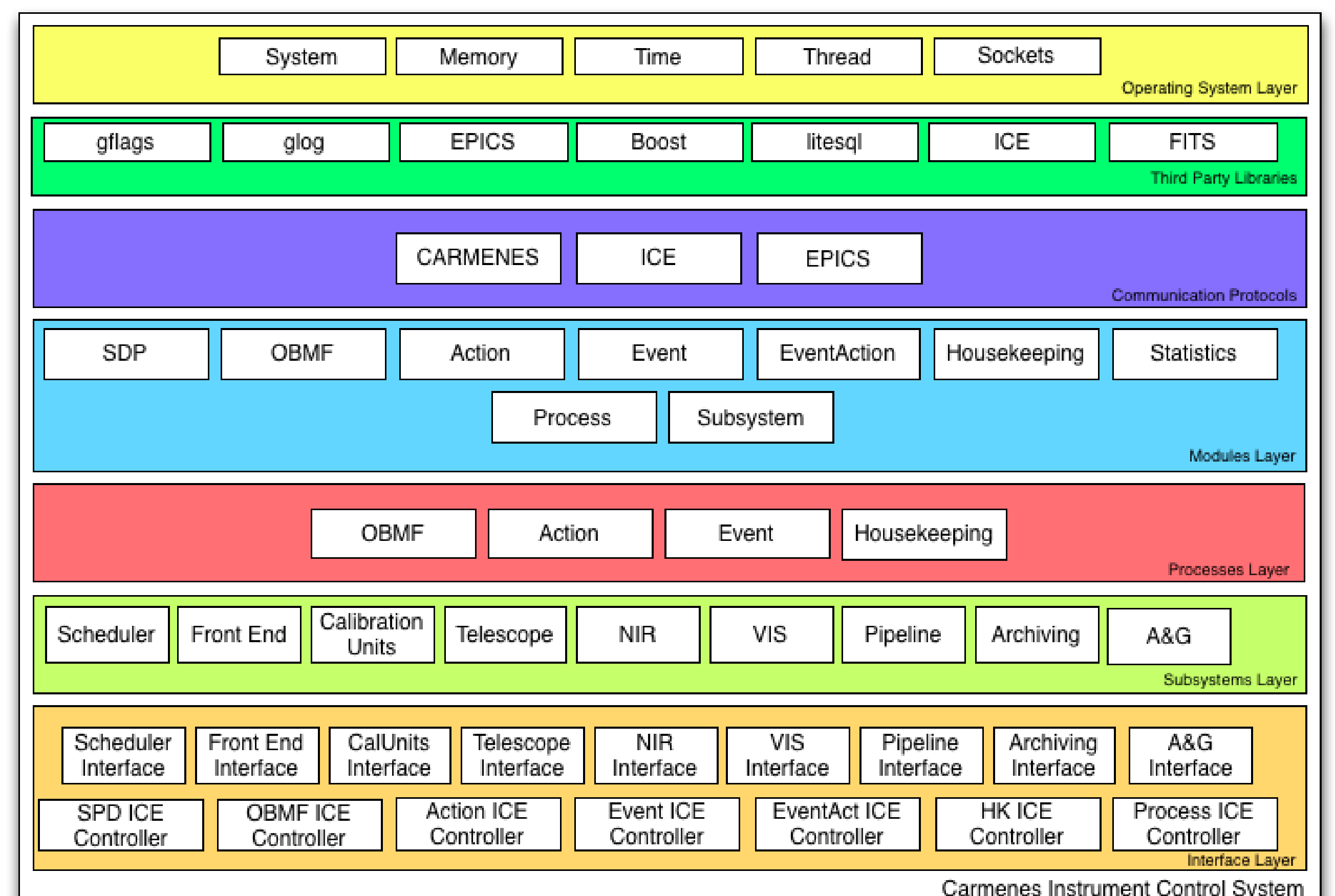
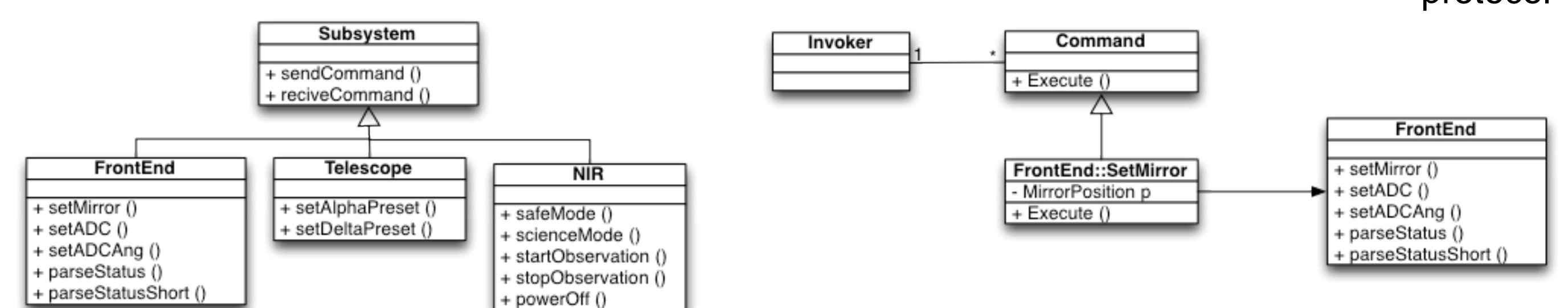
Each subsystem inherits from the subsystem abstract class defined in the modules layer and implements the Façade design pattern. This pattern hides the details of each subsystem action and the subsystem communication protocol.

#### 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



Layers and main modules of the CARMENES ICS