EOS Software Systems

EOS

for

Satellite Laser Ranging and General Astronomical Observatory Applications

ILRS Conference, Canberra 2006

Observatory Control System

- Control telescopes, enclosures, lasers and many other devices
- Provide an ‘Observatory’ abstraction
- Automate observatory operations

The Software Challenge

- Previous Observatory Control Systems were not scalable:
  - × Monolithic
  - × Highly-Coupled
  - × Inflexible
  - × Domain and Problem-Specific
  - × Hard to Maintain

The Software Solution

- These pressures inspired a modern ‘Observatory Control System’:

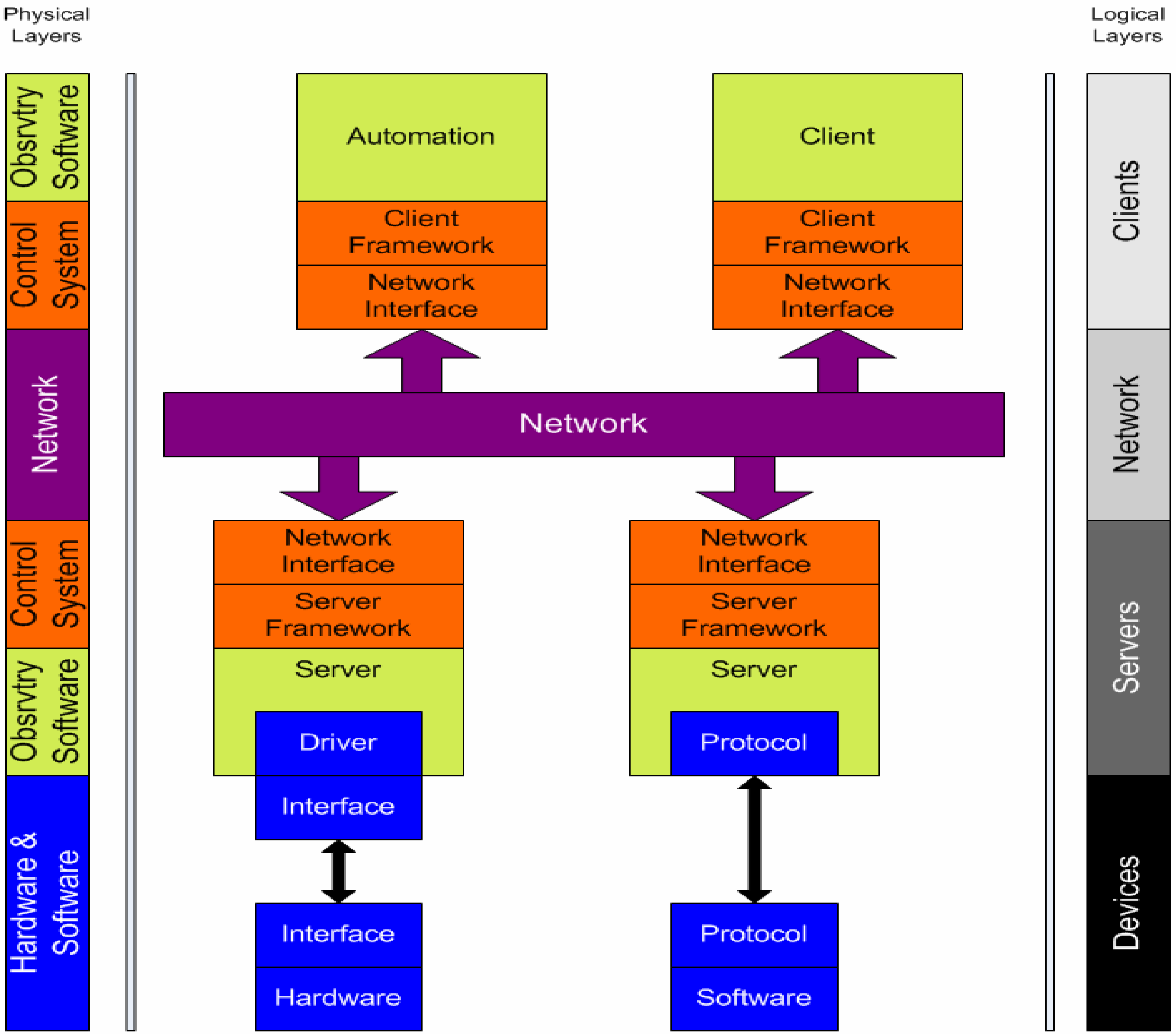
  - ✓ Modular
  - ✓ Loosely-Coupled
  - ✓ Flexible
  - ✓ Maintainable
  - ✓ Domain and Problem-Independent

Basic Architecture

- Observatory = Hardware & Software +
  Network +
  Control System Software +
  Observatory Software

- Control System Software =
  Servers +
  Clients +
  Interfaces & Frameworks

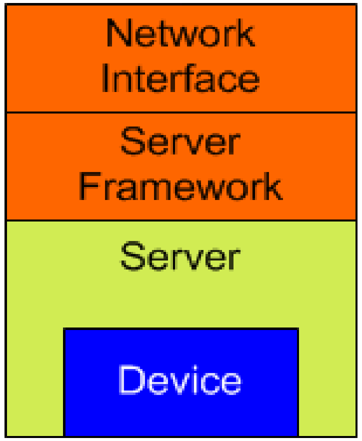
Basic Architecture



EOS Proprietary

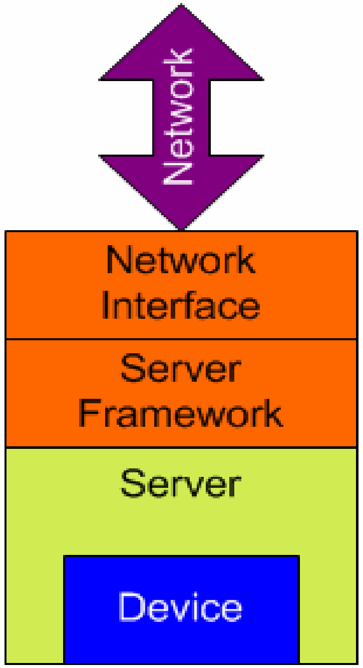
Hardware & Software

- Hardware and Software are fundamental building blocks
- Problem – often heterogeneous
  - platforms, e.g. PC, Mac
  - operating systems. e.g. Windows NT, XP, Linux
  - interfaces, e.g. serial, CANopen, USB, Bluetooth
  - protocols, e.g. sockets, CORBA, COM
- Hardware and Software ‘Devices’
  - Devices abstract specifics
  - all Devices have the same ‘look’, ‘feel’, behaviour



Network

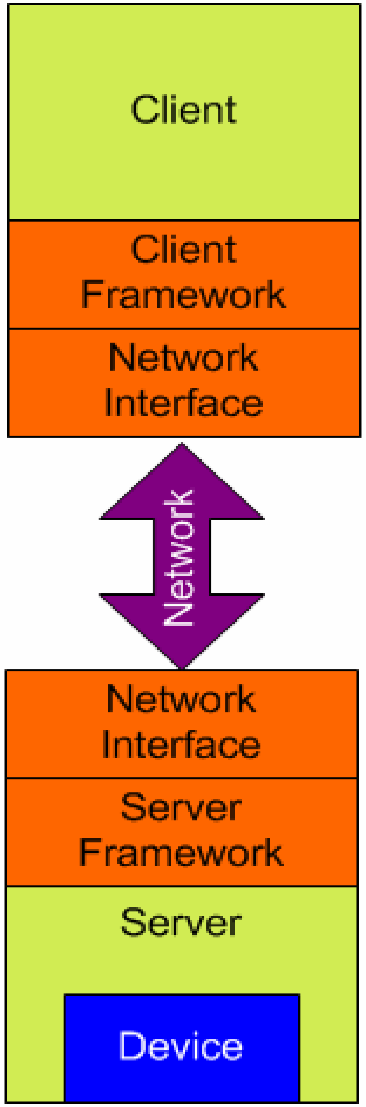
- Usually can't run an Observatory on one computer
  - limited capacity, eg. CPU, memory, expansion slots
- Multiple computers -> Network -> Network-enabled Observatory Control System
- Devices communicate over Network using common, abstract Network Interface
  - provide universal communications abstraction



Control System Software
- Client / Server

- Client applications
  - connect to Servers over Network / Internet
  - use Devices via Server applications
  - common Network Interface

- Server applications
  - abstraction of Devices
  - provide services to Client applications
  - common Network Interface



EOS Proprietary

Observatory Software

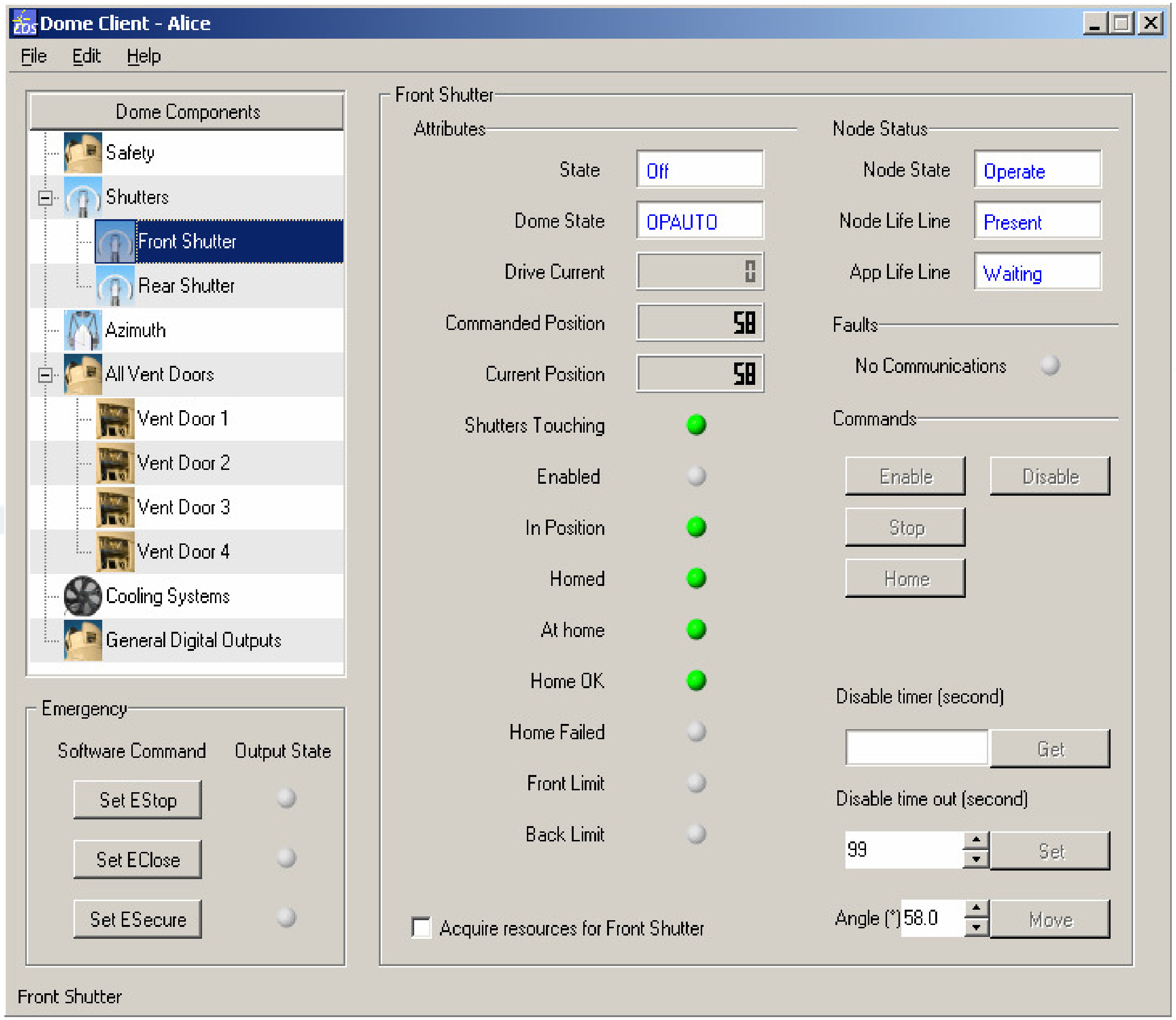
- Software to meet general observatory requirements
- Software to meet specific customer requirements
- Built using Observatory Control System Frameworks

Servers

- Manage hardware and software Devices
- Cooperate to perform observatory tasks
- Building Blocks
  - hierarchical
  - separation of concerns
  - complex systems, simple components

Clients

- Connect to Servers anywhere on Network
- Send commands, receive replies
- Subscribe / Publish
- Asynchronous
  - ✓ no polling
  - ✓ more-efficient
  - ✓ less code



Emergency

Software Command	Output State
Set EStop	○
Set EClose	○
Set ESecure	○

Front Shutter

Attributes

State	Off
Dome State	OPAUTO
Drive Current	0
Commanded Position	58
Current Position	58
Shutters Touching	●
Enabled	○
In Position	●
Homed	●
At home	●
Home OK	●
Home Failed	○
Front Limit	○
Back Limit	○

☐ Acquire resources for Front Shutter

Node Status

Node State	Operate
Node Life Line	Present
App Life Line	Waiting

Faults

No Communications ○

Commands

Disable timer (second)

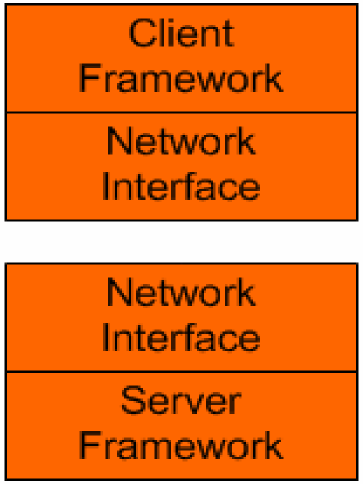
Disable time out (second) 99

Angle (°) 58.0

Front Shutter

Interfaces & Frameworks

- All software supports common Network Interface and built using common Frameworks
  - Client framework
  - Server framework
- Advantages:
  - ✓ hide complexity
  - ✓ facilitate re-use
  - ✓ extend systems
- Available to customers to extend their systems independent of EOS



Client Framework

Network Interface

Network Interface

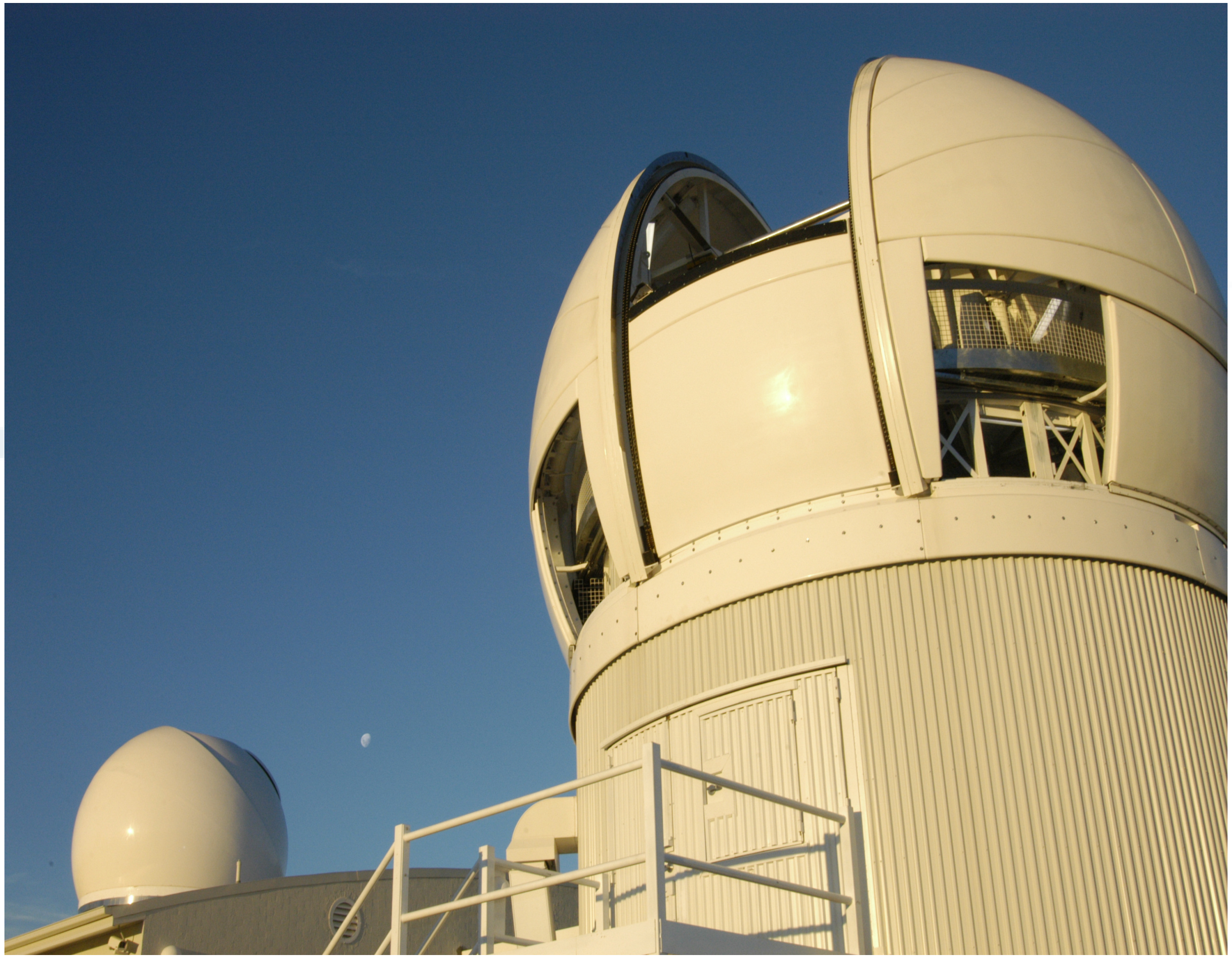
Server Framework

Automation

- Control System Automation
  - System Management
  - Device Management
  - Resource Management
- Observatory Automation
  - Task Scripting
  - Task Scheduling
  - Open Loop Control
  - Closed Loop Control

Case Study – Mt. Stromlo

- Mt. Stromlo facility built using Observatory Control System



- Station supports two ranging systems:
  - SLR
  - Debris
- Two Systems:
  - different requirements
  - some shared components
  - same Observatory Control System
  - no problems

Conclusion / Plans for the Future

- Network of Stations
  - a Station is a Network of Devices; next a Network of Stations
  - enable cooperative, over-the-horizon and global observing and ranging programmes
- Observatory Control System without EOS telescopes and enclosures
- Non-observatory control systems