EOS Software Systems

for

Satellite Laser Ranging and General Astronomical Observatory Applications

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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
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
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
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
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