Control Systems in ESO's Telescopes and Instruments

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Content

- Introduction

- The ELT
  - Control System

- The VLT
  - Maintenance
  - Obsolescence
  - VLT/ELT Interoperability

- Instrument Strategy

Introduction

- ■ Presentation gives some examples of Control Systems in ESO's telescopes & instruments

- ■ Control systems often built in house supported by dedicated industry contracts for components
  (example: ELT M1 LCS)

- ■ In other cases, control systems are part of larger contracts for subsystems
  (example: ELT M2/M3/M4/M5)

Introduction

- ■ ESO's industry contracts very different in volume:
  - ➢ From few kEuro to several 100MEuro

- ■ Chances for small companies as well as major global players

- ■ Different kind of contracts:
  - ➢ Complete (sub-)systems
  - ➢ Components
  - ➢ Manpower
  - ➢ Know how/consulting

The Extremely Large Telescope (ELT)

■ Largest optical/infrared telescope in the world
  ➢ 39m segmented primary mirror
  ➢ Science: exo-earths, deep universe, resolved populations
  ➢ Construction ongoing

■ Project
  ➢ Construction 2014-2027, on Cerro Armazones
  ➢ ESO cost: ~1300 MEUR incl. instruments and contingency

See:
https://elt.eso.org/about/webcams/
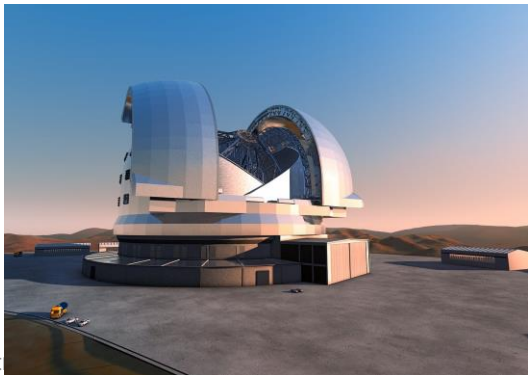
ELT Control System

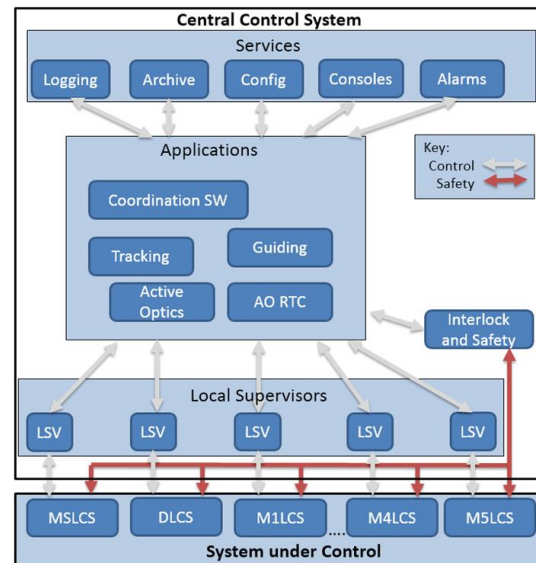■ ELT Control System implementation is distributed
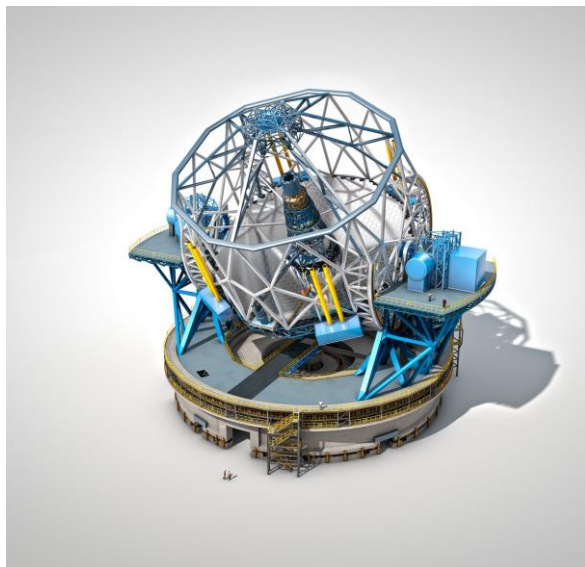
Contracts:

- Subsystems with their Local Control System (LCS)

- Dedicated SW contracts

ESO:

- Central Control System

- Local Supervisors

- M1LCS

ELT Control System Status

■ Subsystem LCS's in development by suppliers

■ M1LCS: first version available and under test

■ Central Control System and Local Supervisors in development at ESO

■ Support for ESO internal development by outsourcing contract
  ➤ Call for tender planned for Q4/2022
  ➤ Up to 4 FTE/year for up to 5 years
  ➤ Contribution to CCS, LSVs and related activities

The Very Large Telescope (VLT)

■ In operation since >20 years

■ 4 unit telescopes (UTs) with 8.2m primary mirror

■ 3 instruments per UT

■ 4 additional auxiliary telescopes (ATs) with 1.8m

■ Interferometer (VLTI) with additional instruments

Maintenance
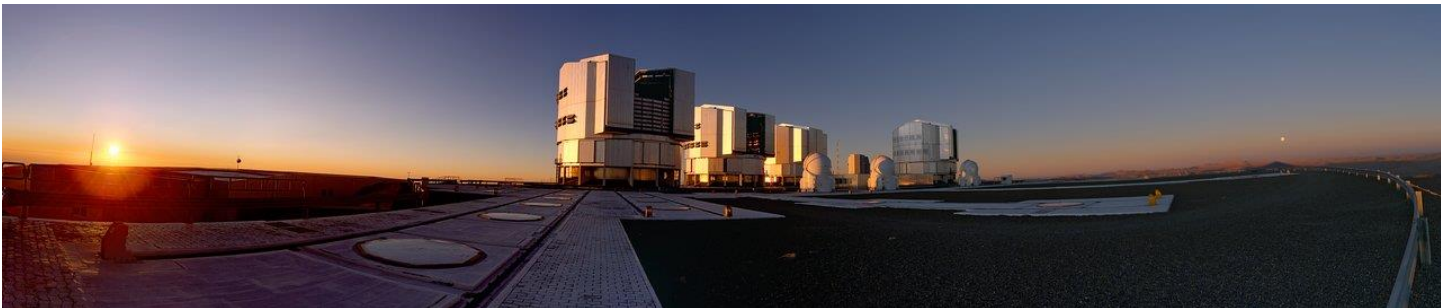
- The control SW for VLT/VLTI consists of >2 million NLOC

- New release every year
  - ~200 bug fixes
  - ~50-100 changes due to new features and improvements

- New features mainly from requirements of new instruments and infrastructure

- Supported by outsourcing contract
  (4 FTE per year over 2+1+1+1 years)

Obsolescence

- Years of operation bring obsolescence problems

- Projects to upgrade/refurbish usually done in house

- Examples:
  - ➢ Replacement of electronic components
  - ➢ Introduction of new standards (e.g. VME -> PLC)
  - ➢ SW changes often a consequence (drivers, OS version)

- Some parts of the work contracted; HW to be purchased

- The total budget over next 5 years for upgrades is ~1.5 MEUR (not limited to control systems)

Interoperability Programme

■ ELT and VLT Operations to be done by one common team

■ Some upgrade of VLT components to ELT technology under obsolescence projects

■ Activities for integrated operations being discussed/planned right now

■ Examples:
  ➢ Common SW environment (repository, build structure, …)
  ➢ Common alarm system
  ➢ Common data flow tooling

Instrument Strategy

- Instruments for VLT and ELT are mainly built by consortia (institutes and universities)

- Typical development time: ~5 years

- Lifetime of instruments 10 – 15 years

- Consortia follow ESO's technical standards (Electronics, cryo, …)

- Instrument SW built on base of ESO's Instrumentation Framework

- New frameworks for ELT instruments:
  - ELT IFW (Instrument FrameWork)
  - RTC Tk (Real Time Computer Toolkit)
- New VLT instruments also based on IFW and RTC Tk
- Several releases of IFW and RTC Tk to consortia made already; development of additional functionality continues
- Possibly some contribution by outsourcing contract (see ELT)

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