The Array Control and Data Acquisition System of the Cherenkov Telescope Array

cherenkov telescope array

I. Oya[1], E. Antolini[1], L. Baroncelli[2] , J. Borkowski[3], A. Bulgarelli[2], A. Carosi[4], J. Colomé[5], V. Conforti[2], M. Fuessling[1], J.A. Hinton[1], C. Hoischen[6], J. Jacquemier[4], D. Lebout[7], E. Lyard[8], G. Maurin[4], D. Melkumyan[9], A, Mitchell[1], K. Mosshammer[9], N. Parmiggiani[2], I. Sadeh[9], S. Schlenstedt[1], T. Schmidt[9], U. Schwanke[10], J. Schwarz[11], G. Tosti[12], R. Walter[8], P. Wegner[9], for the CTA Observatory[13].

[1]CTAO gGmbH, Germany. [2]INAF - O.A.S. Bologna, Italy, [3]CAMK, Poland, [4]LAPP, France[5], IEEC-CSIC, Spain, [6]Universität Potsdam, Germany, [7]INRIA, France, [8]University of Geneva, Switzerland, [9]DESY, Germany, [10]Humboldt-Universitaet zu Berlin, Germany, [11]INAF - Osservatorio Astronomico di Brera, Italy, [12]University of Perugia, Italy
[13]See www.cta-observatory.org

ABSTRACT

The Cherenkov Telescope Array (CTA) will consist of more than 100 telescopes deployed in two sites. The Array Control and Data Acquisition (ACADA) system will be the central element of on-site CTA operations. The mission of ACADA is to manage and optimize the telescope array operations at each of the CTA sites. To that end, ACADA will provide all necessary means for the efficient execution of observations, and for the handling of the several Gb/s of data generated by each individual CTA telescope. This contribution describes the challenges, architecture, design principles, and development status of ACADA.

Supported by:

ACADA Requirements

- **Science Operations and Technical Operations modes**
- **Operation of at least 8 independently operable telescope sub-arrays**
- **Managed by an operator and a support astronomer**
- **Collect data from all telescope cameras:**
  - **24 Gb/s per Large-Sized Telescope (up to 4/site)**
  - **12 Gb/s per Medium-Sized Telescope (up to 25 in CTA-S and 19 in CTA-N)**
  - **2 Gb/s per Small-Sized Telescope (up to 70 in CTA-S)**
- **Reduce data so the rate sent offsite to less than 5 Gb/s**
- **Conduct field-of-view search for transient and/or time-variable phenomena**
- **Issue science alerts to the external world within 10 s of detection**
- **Interface to networks for astrophysical transients and react within 5 s**
- **Up to 200,000 monitoring data points in each installation**
- **Full restart within 2 minutes**
- **Core functionality must be available during 99% of the time in which observations are possible**

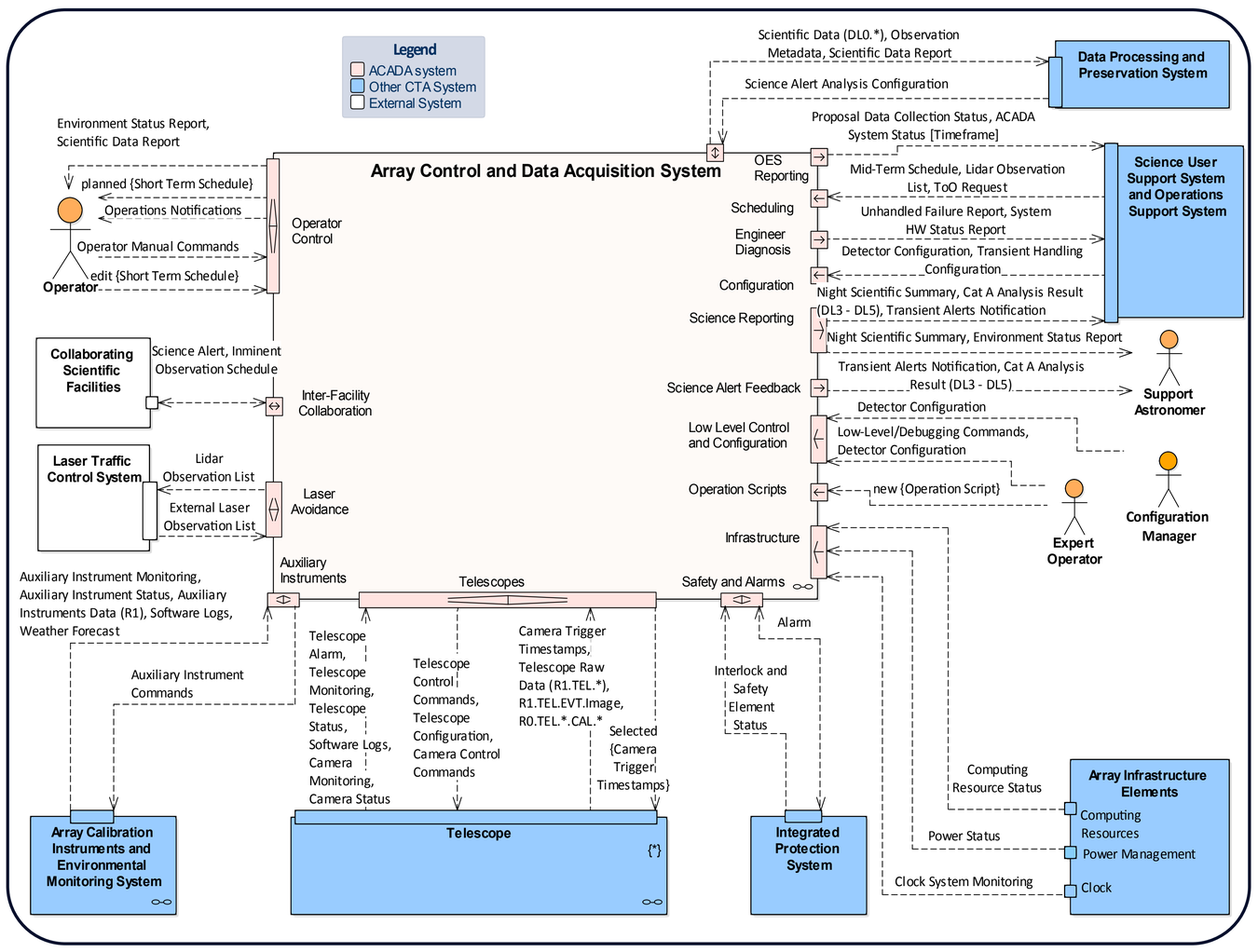

Fig. 1: Context of ACADA

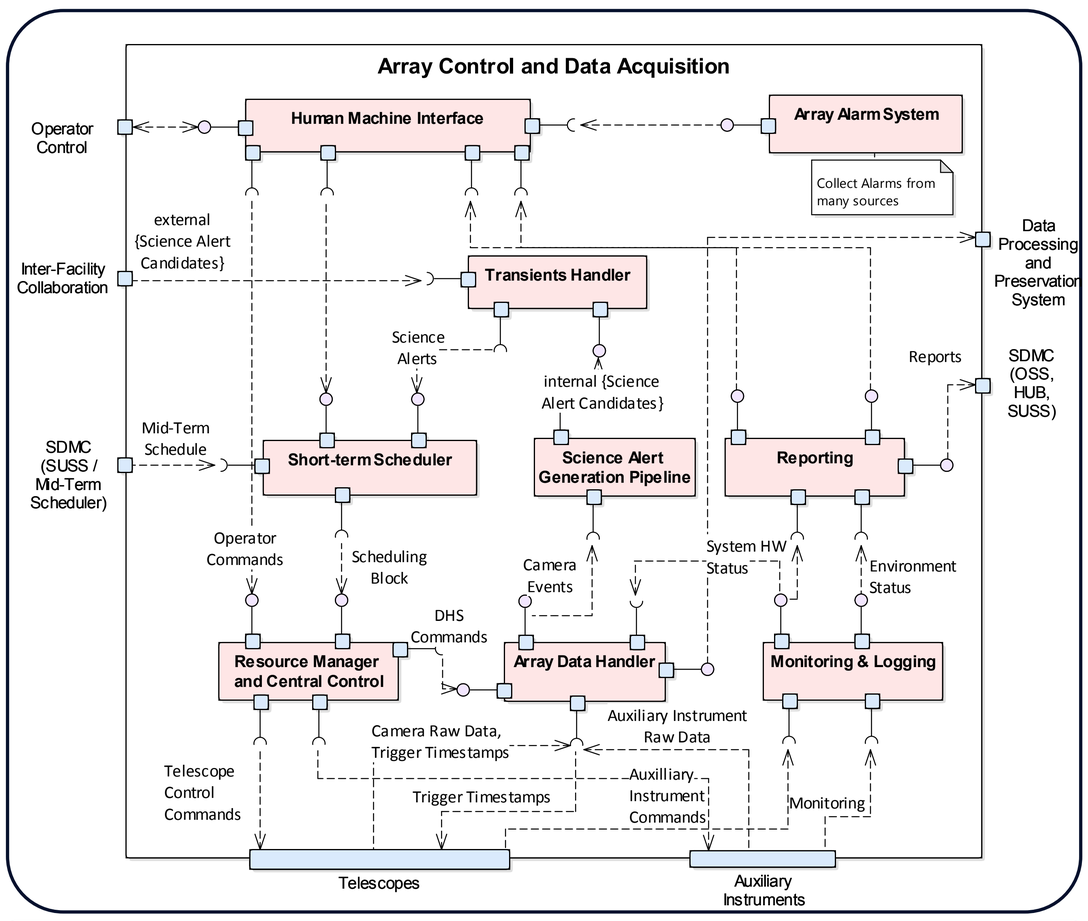

Fig. 2: Main components of the ACADA system

Architectural Considerations

- **Supervision tree to replace failing components**
- **Avoid "dusty dark corners"**
- **Automatic shutdown of unreachable parts**
- **Control tickets to solve conflicting orders**
- **Prefer idempotent operations**
- **Fail fast with timeouts**
- **Organize components layering to avoid impact of failures**

Status

- **System requirements specified**
- **Model-based system architecture in place [1]**
- **System context (Fig. 1) and internal decomposition (Fig. 2)**
- **Advanced prototypes exist for main subsystems (e.g. [2]).**
- **Assembly, Integration, and Verification (AIV) procedures and environment [3]**
- **Software being tested in first CTA telescope on-site**

References

[1] I. Oya, et al, Proc. ACAT'17, Seattle, USA, Contribution 42, 2017
[2] See poster MOPHA092
[3] See poster MOPHA007

ACKNOWLEDGEMENTS

We gratefully acknowledge financial support from the agencies and organizations listed here: www.cta-observatory.org/consortium_acknowledgments