MicroTCA.4 for the ESO Astronomical Detector Controller (9th MTCAWS)

Public

Abstract

The Extremely Large Telescope (ELT) is under construction on Cerro Armazones in Chile. MicroTCA.4 will be used as a basis for the new modular ESO detector controller for all future visible and IR scientific detectors. The presentation gives an overview over current MTCA.4 related developments at ESO and how the new controller can continue the legacy of the previous ESO detector controller, NGC, that has enabled groundbreaking astronomical discoveries on the Very Large Telescope (VLT) over many years of operation.
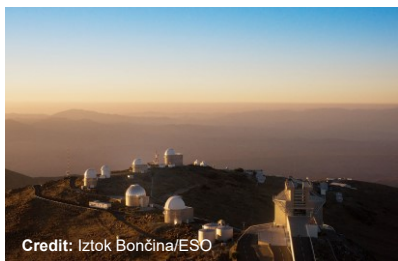
European Southern Observatory

Credit: ESO

- ■ European Organization for Astronomical Research in the Southern Hemisphere

- ■ Intergovernmental Organization

- ■ Founded: 1962

- ■ 16 Member States
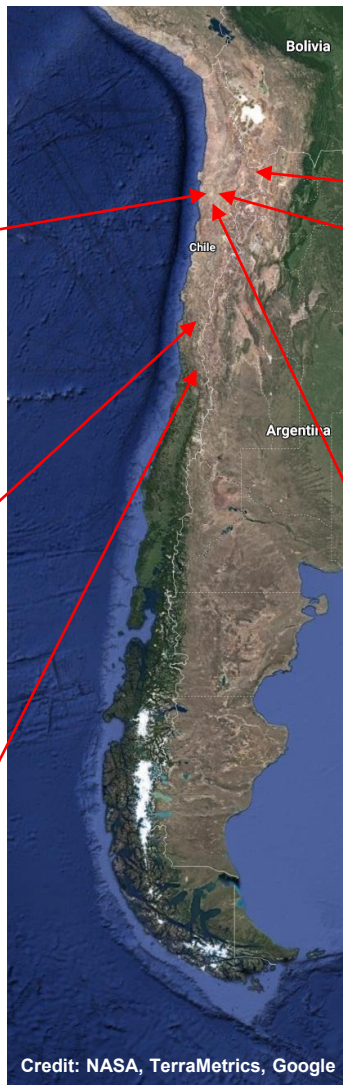 - + Chile (Host Country)
  - + Australia

ESO Telescope Sites

Paranal Residencia

Credit: John Colosimo / ESO

La Silla Observatory

Credit: Iztok Bončina/ESO

Santiago de Chile

Credit: ESO & ALMA (ESO/NAOJ/NRAO)

Bolivia

Chile

Argentina

Credit: NASA, TerraMetrics, Google

Paranal Observatory

Credit: G.Hüdepohl/ESO

ALMA/APEX Observatory

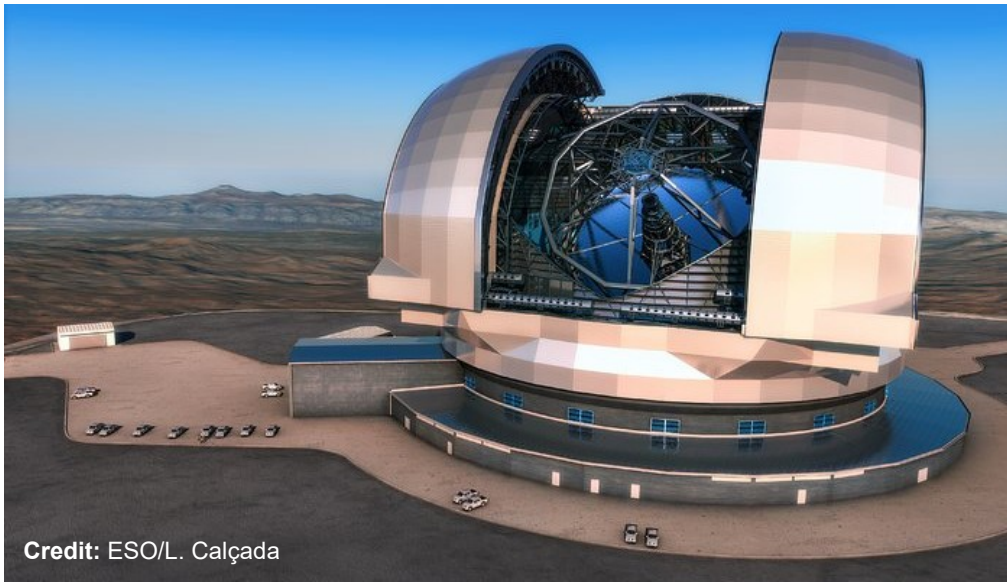Credit: ALMA (ESO/NAOJ/NRAO), A. Marinkovic/X-Cam

ELT Building Site

Credit: ESO

Extremely Large Telescope

- First Light: 2025 (planned)
- Primary Mirror: 39.3m
- Primary Mirror Area: 978m²

Credit: ESO/L. Calçada

Credit: ESO/Sergio Dalle Ave & Roberto Ragazzoni (INAF-OAPD)

Instruments and Detectors

Extremely Large Telescope

Credit: ESO/L. Calçada

4x Very Large Telescope

Credit: J.L. Dauvergne & G. Hüdepohl

HARMONI

Credit: ESO/L. Calçada & Olga Cucciati et al.

(e.g. High Red-Shift Galaxies)

METIS

Credit: ESO/L. Calçada

(e.g. Protoplanetary Disk)

MICADO

Credit: ESO/L. Calçada

(e.g. Black Holes)

~12x Detector

~7x Detector

~9x Detector

https://www.eso.org/public/teles-instr/elt/instruments/
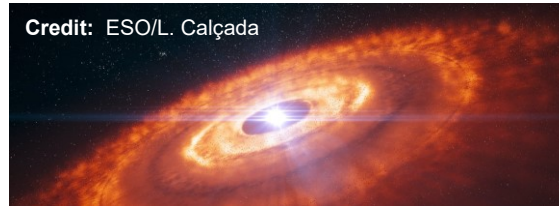
Detector Interfacing
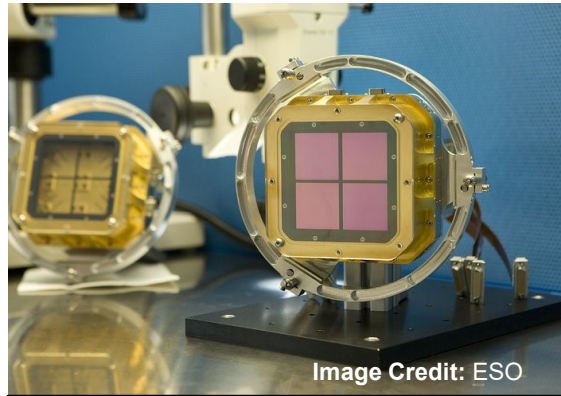
Image Credit: ESO / HARMONI

Image Credit: ESO

Cryogenic Preamp

Data Storage

Control Systems
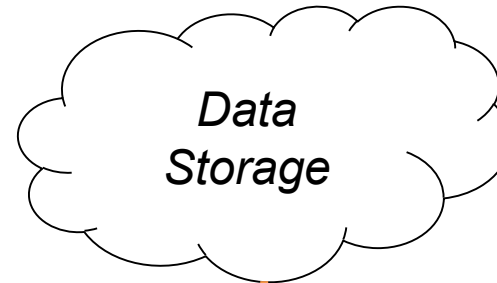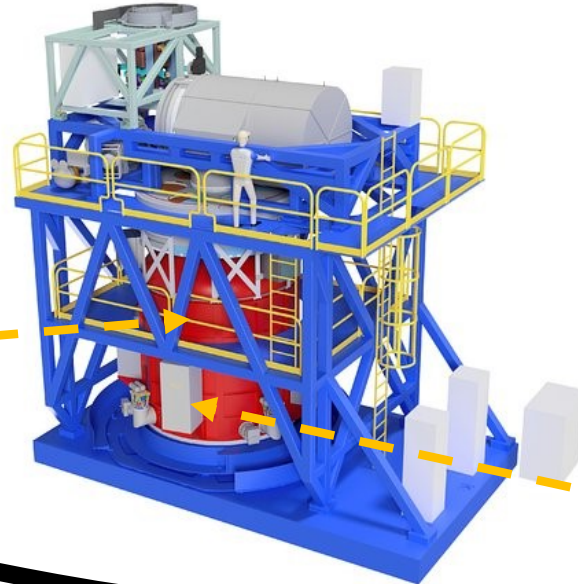
10GbE

NGCII
MTCA.4 based Detector Controller

~20 DC Biases
- 2.0V to 45V
- 2μV/K stable
- Very low noise

~20 Clocks
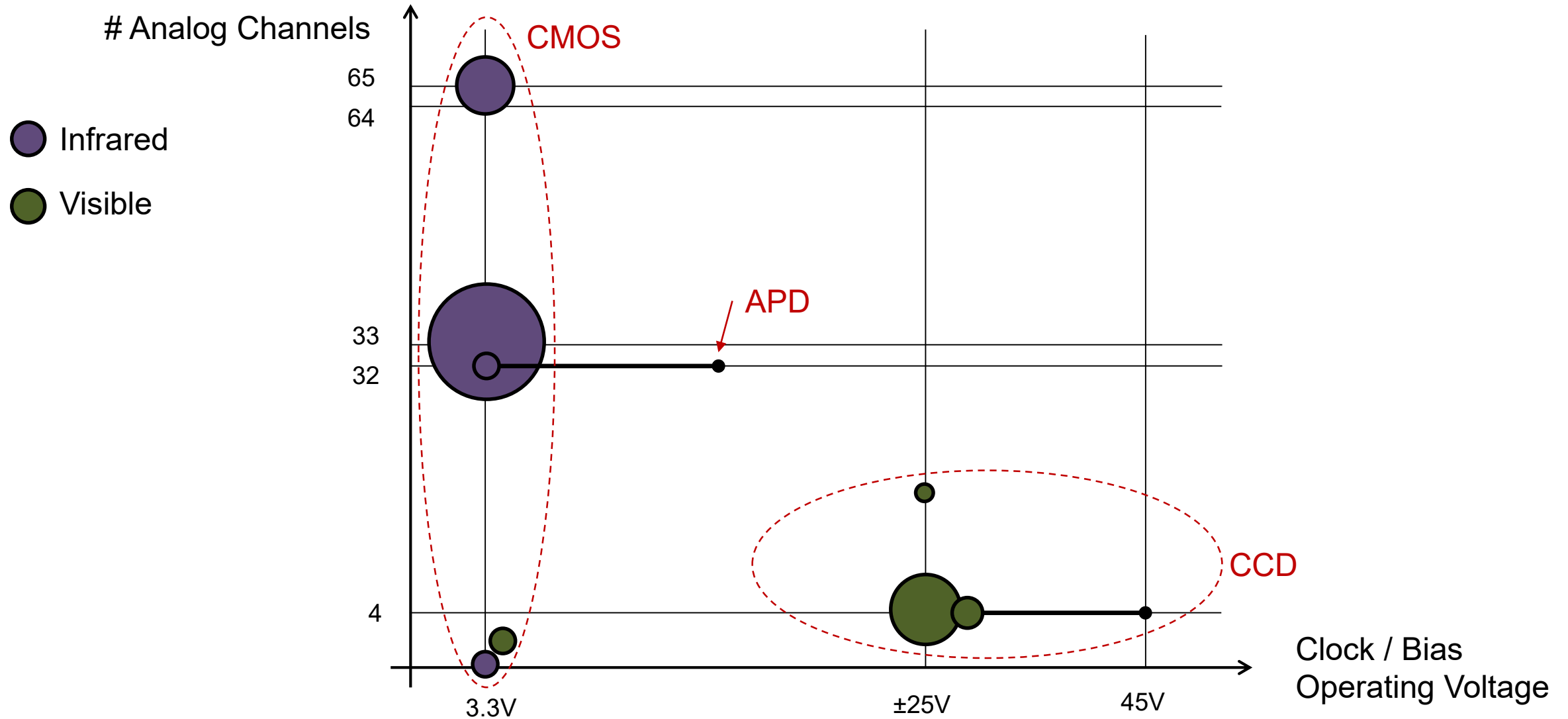- <10MHz
- Adjustable Levels
- Slope Control

~4-65 Analog CH.
- >= 10 MSps
- Differential
- Precise Triggering

Detector Technology

MTCA Adoption

- **Fully Adopt MTCA.4**
  - No plans to implement MTCA.4.1

- **Shelf:**
  - Chosen not to go for standard 12 Slot (low module density)
  - Baseline will be 6 slots in 2U for highest RTM/HU density.

- **MCH:**
  - Standard MCH using PCIe
  - Support for x8 PCIe on some slots appreciated
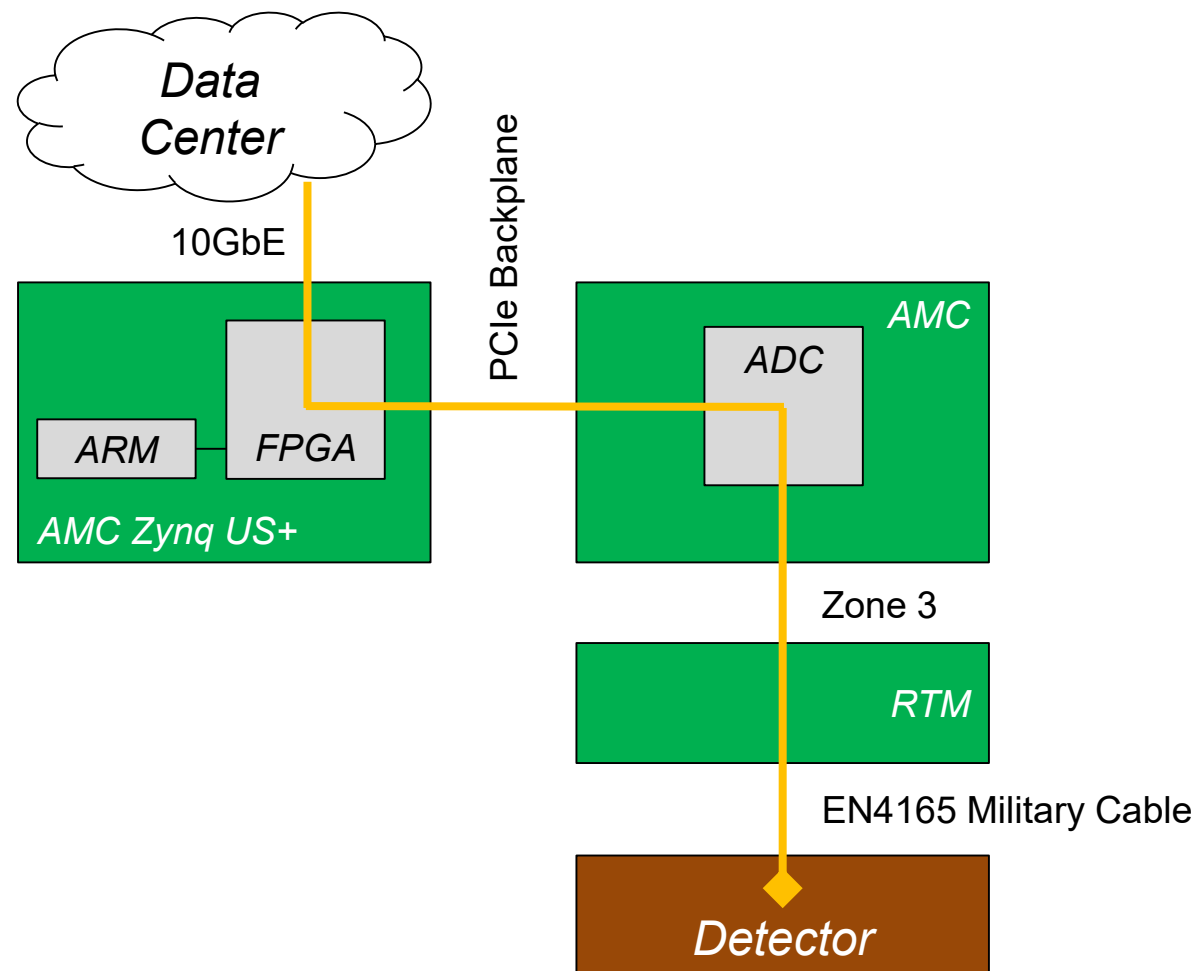
- **PSU:**
  - Standard 600W AC PSU

MTCA.4 Modules (Commercial)

- **Zynq US+ AMC**
  - FMC Carrier (10GbE)
  - White Rabbit Support
  - D1.x Profile Zone 3

- **Artix 7 AMC**
  - FMC Carrier
  - D1.X Profile Zone 3

- **No CPU**

Data Center

10GbE

PCIe Backplane

AMC Zynq US+

ARM — FPGA

AMC

ADC

Zone 3

RTM

EN4165 Military Cable

Detector

MTCA.4 Modules (In House)
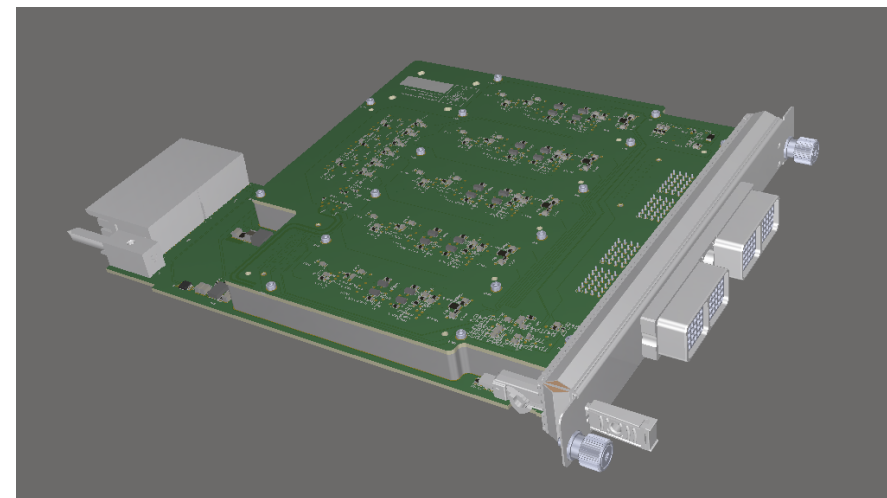
- ■ **CMOS Clock/Bias RTM**
  - ➤ 20 CMOS Bias Channels
    - • <2µV/K Drift
    - • 0..5V
  - ➤ 20 CMOS Clock Channels
    - • 2.0V to 5V CMOS Clock into 5m cable
- ■ **CCD Clock RTM**
  - ➤ 24 CCD Clock Channels
    - • Tri-Level ±15V
    - • Optional Slope Control
- ■ **CCD Bias RTM**
  - ➤ 24 CCD Bias Channels
    - • ±25V, low drift

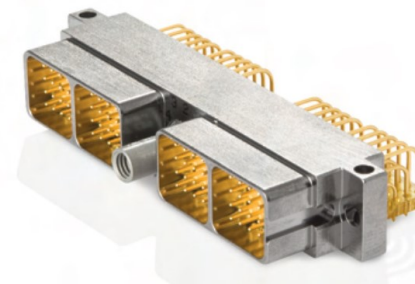*All RTMs: EN4165 Rugged Connectors*

Image: TE Connectivity

MTCA.4 Modules (In House)

- **22 Channel ADC AMC**
  - 22 ADC Channels
  - SAR ADCs
  - 10Msps
  - 16 bit / 18 bit
  - Custom Sequencing and Triggering

- **22 Channel Analog RTM**
  - Companion to AMC
  - 22 Analog Frontend Channels

Conduction Cooling

- Some systems cannot use air cooling

- Water assisted conduction cooling required.

- Approach
  - Make hybrid MTCA.4 and MTCA.3 rack
  - Copy electrical topology from existing 5/6 slot rack.

- Challenges:
  - Clamshell for Double-Mid-Size RTMs/AMCs
  - MTCA.3 PCIe MCH supporting MTCA.4 Clocks

- Setting up cooperation with Australian National University