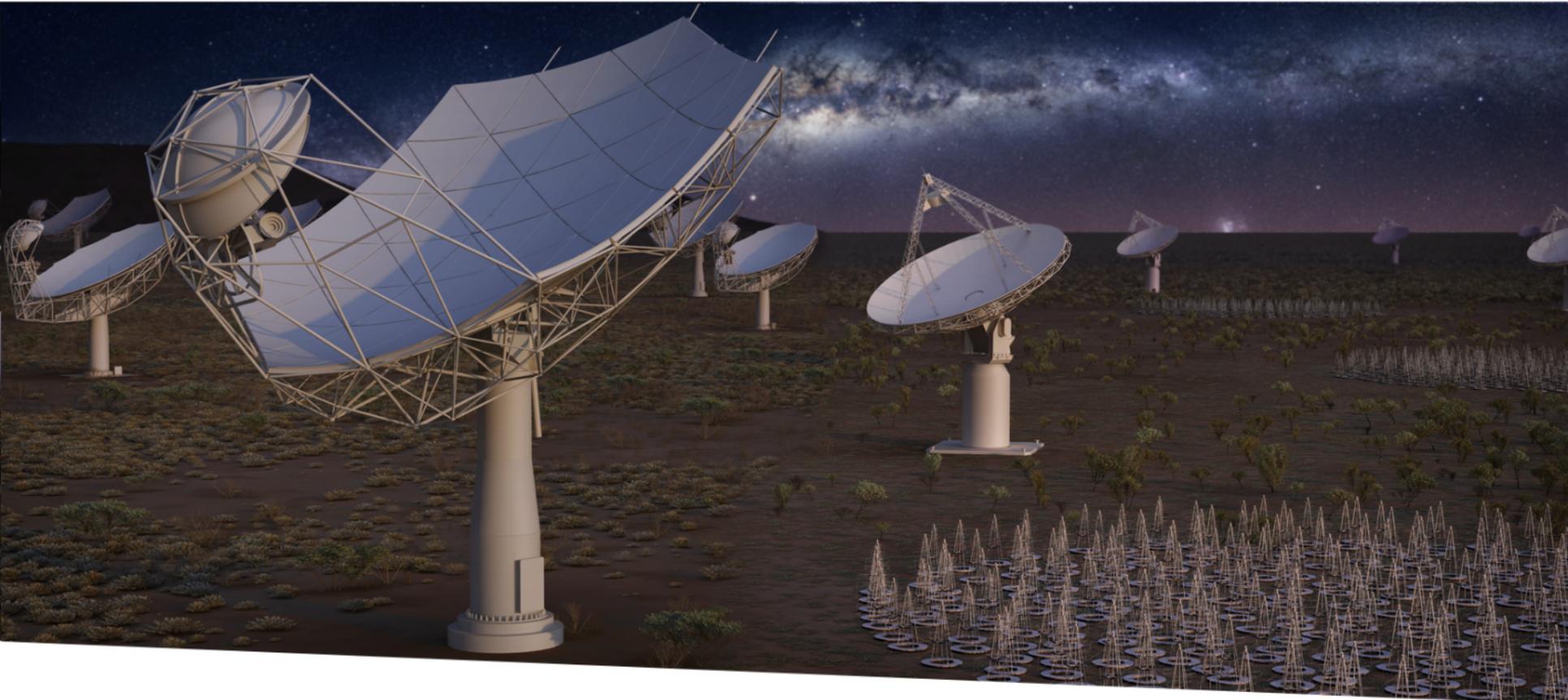


SKA Control System Guidelines

And Architecture



SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope

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Why



Member countries



Partner countries (hosting)

- International project, 10 member countries (Australia, Canada, China, India, Italy, New Zealand, South Africa, Sweden, the Netherlands, United Kingdom)
- In fact, around 100 organizations across about 20 countries participating in the preliminary design and development of the SKA and now engaged in the critical design of the telescope
- Large worldwide community with different backgrounds
- Local Monitoring and Control (LMC) standardization + harmonization effort in place since 2015

What

A set of three main documents:

- SKA1 Control System Guidelines – Main volume
- SKA1 TANGO Developers Guidelines
- SKA1 TANGO Naming Convention

plus six additional technical notes, at various levels of completion:

- SKA Control Model
- SKA Logging
- SKA Configuration and Control
- Integrating Distributed TANGO Facilities
- Element Archiving and Central Archiving
- Element and Central Alarms Handling

making a total of some 330 pages (well... that's not so bad... and you can start with just 120)

SKA Control System Guidelines made possible by the contribution of a group of people.

Intended to be working documents -> evolve with the project.

Purpose

Control System harmonization across SKA

- Identify common approaches for Monitoring and Control
- Identify and summarize generic design patterns
- Identify proper TANGO design patterns
- Avoid TANGO anti-patterns
- Maximize the benefits of the TANGO framework
- Identify and draft preferred SKA Control System general architecture (with TANGO)
- Setup templates for Interface Control Documents
- Define guidelines for SKA TANGO developers

SKA TANGO facilities

- SKA telescope in fact made by two telescopes: MID and LOW
- Each telescope made by a number of different “Elements”: DISH, CSP, SDP, INFRA, LFAA, SAT, TM... some belong to MID, some to LOW
- Each Element will be responsible of one or more TANGO facilities

Facility	Description	Facility	Description
SKA-MID	Central Telescope Manager for MID	SKA-LOW	Central Telescope Manager for LOW
MID-CSP	Central Signal Processing for MID	LOW-CSP	Central Signal Processing for LOW
MID-SDP	Science Data Processor for MID	LOW-SDP	Science Data Processor for LOW
MID-Dnnnn	One for each dish, 170 SKA1, ~2500 SKA2	LOW-LFAA	Low Frequency Aperture array
MID-SAT	Synchronization And Timing for MID	LOW-SAT	Synchronization And Timing for LOW
MID-SADT	Signal and Data Transport for MID	LOW-SADT	Signal and Data Transport for LOW
MID-INFRA-SA	Infrastructure SA	LOW-INFRA-AU	Infrastructure AU
MID-Mnn	MeerKAT precursor receptors (64)	LOW-ASKAP-WSS	ASKAP precursor ancillary
MID-MKAT-ANC	MeerKAT ancillary		

Element M&C

Element Monitoring and Control scope and responsibilities have been defined with respect to Central Telescope Manager:

- Standalone Element TANGO facility **top level hierarchy** for TANGO devices
 - Control System pattern for operational control in normal use
 - Control System pattern for rolled-up monitoring and reporting
 - Archiving patterns
 - Logging patterns
 - Rolled-up SKA alarms reporting
 - Drill-down diagnostics and monitoring
-
- Template for TANGO based TM-<Element> Interface Control Document (ICD)
Capture logical Element to TM interface for operational control and rolled-up monitoring

Terminology

- **Monitoring** – subscribing to attribute events to evaluate its value/quality factor
- **Archiving** – gathering attribute values from a device to save it to an engineering archive
- **Logging** – additional information emitted by components for fault finding or forensics. Can be stored as well (log storage)
- **Failure** – inability to perform the required function to the specification
- **Fault** – the condition which causes software to fail to perform its required function
- **Error** – difference between actual output and expected output
- **Alarms – SKA adopts the IEC 62682 standard → Clarifications**
 - TANGO Attribute alarms: TANGO core well known mechanism, not IEC 62682 compliant
 - Element/Telescope Alerts: any complex, rule-based, aggregated asynchronous notification
 - SKA/Telescope Alarms: IEC 62682 compliant alarms (i.e. requiring a timely response by the operator)

SCM state(s) and mode(s)

SKA Control Model (SCM) state/mode Attributes and TANGO State

- Design pattern to define a set of “standard” common states and modes: **SCM Attributes**
- Mandatory SCM interactions specified as well

Name	R/W	Mem	Opt	Values
TANGO State	n	n	n	UNKNOWN, OFF, INIT, DISABLE, STANDBY, ON, ALARM, FAULT
obsState	n	n	y	IDLE, CONFIGURING, READY, SCANNING, PAUSED, ABORTED, FAULT
adminMode	y	y	n	ONLINE, OFFLINE, MAINTENANCE, NOT_FITTED, RESERVED
healthState	n	n	y	OK, DEGRADED, FAILED, UNKNOWN (mandatory for some devices)
obsMode	n	n	n	IDLE, IMG_CONTINUUM, IMG_SPECTRAL_LINE,...
controlMode	y	y	n	REMOTE, LOCAL
simulationMode	y	y	n	TRUE, FALSE
testMode	y	y	n	NONE, custom values
configProgress/ delayExpected	n	n	y	Percentage progress/ Time for CONFIGURING → READY transition

SCM interactions



- **healthState**

- Interpreted based on children and own device State, adminMode, healthState
- ...

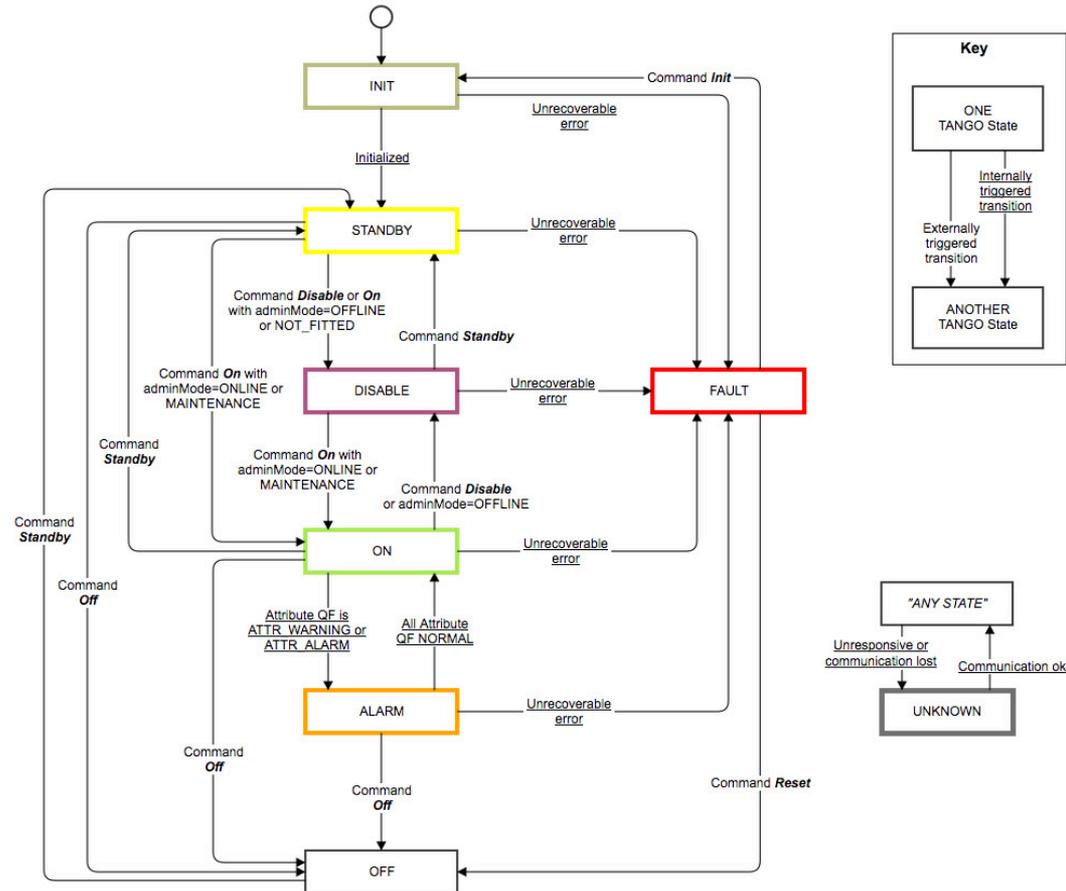
- **adminMode**

- When adminMode is NOT_FITTED, TANGO State shall be DISABLE
- When adminMode is RESERVE, TANGO State shall be DISABLE

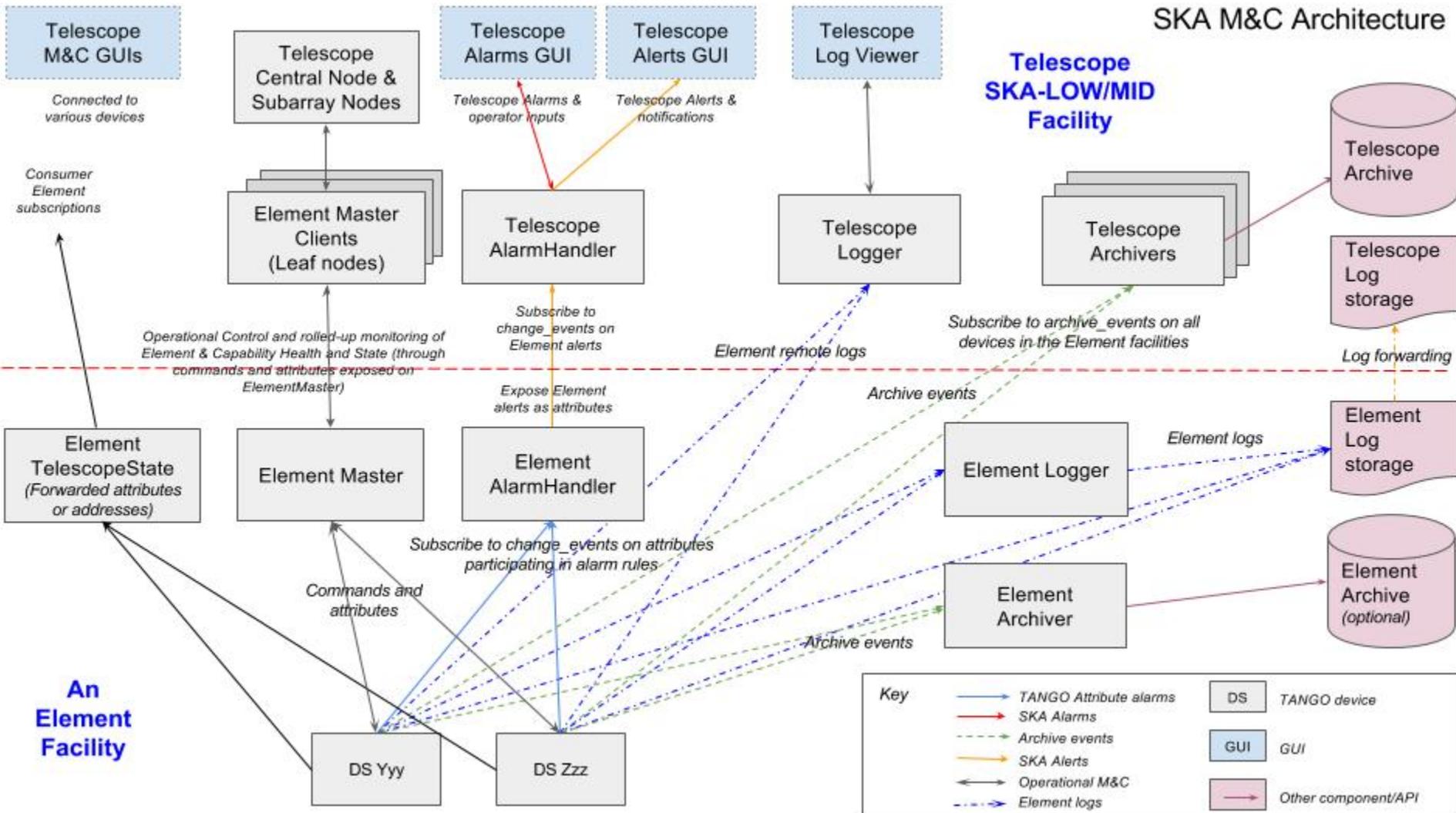
Rationale: prevent TANGO devices from raising Attribute alarms when devices off-duty

- **State (TANGO State)**

- Equipment, i.e. devices shall power-up in STANBY State
- TANGO State may be DISABLE for other reasons than those related to adminMode



Integrating TANGO facilities



Integrating TANGO facilities

Patterns and policies defined for:

- ElementMaster TANGO device
 - Element entry point for operational monitoring and control
 - Provide “Element level” FQDNs
- Logging services
 - TANGO Logging Service: in-time monitoring of log messages
 - ElementLogger/TelescopeLogger TANGO devices
 - ElementLogger: LogConsumer interface for Element-wide logs
 - TelescopeLogger: LogConsumer interface for Telescope-wide logs
 - Rsyslog + Elastic Search stack: log storage for fault finding and forensics
 - TANGO rsyslog device (Log4Cxx, Boost.log)
- Element AlarmHandler/Telescope AlarmHandler TANGO devices
 - Element level aggregation via formulas → provide just relevant alarms
- Element Archiver/Telescope Archiver TANGO devices
 - Element archiving → HDB++ featuring MariaDB backend (optional)
 - Telescope archiving → HDB++ featuring Cassandra backend

SKA TANGO developers guideline

Design Guidelines for the TANGO developers cover various aspects, including:

- Element and Device modeling
- Device Class documentation
- TANGO configuration database
- Device implementation aspects, including:
 - Device states and modes Polling and events Attributes
 - Attribute alarms
 - Quality factor
 - Attribute archiving
 - Unsolicited information / command progress
 - Configuration
 - Device locking
 - Commands provided by TANGO
- Naming conventions for commands, attributes, properties
- Standard commands foreseen for “Element Level” devices

SKA device naming convention

- Device names globally unique within the observatory
- Centralized management of SKA device names
- Naming for SKA TANGO facilities defined
- Naming for SKA TANGO devices defined
 - Avoid “.” (dot) and “-” (dash) in device name
- Controlled number of SKA TANGO device domains (as in <domain>/<family>/<member>)

Where to?

...get the SKA Control System Guidelines?

- Documents unrestricted
- Main document revision 2 to be released
- The additional technical notes are at various levels of completion, require revision

Thanks



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