#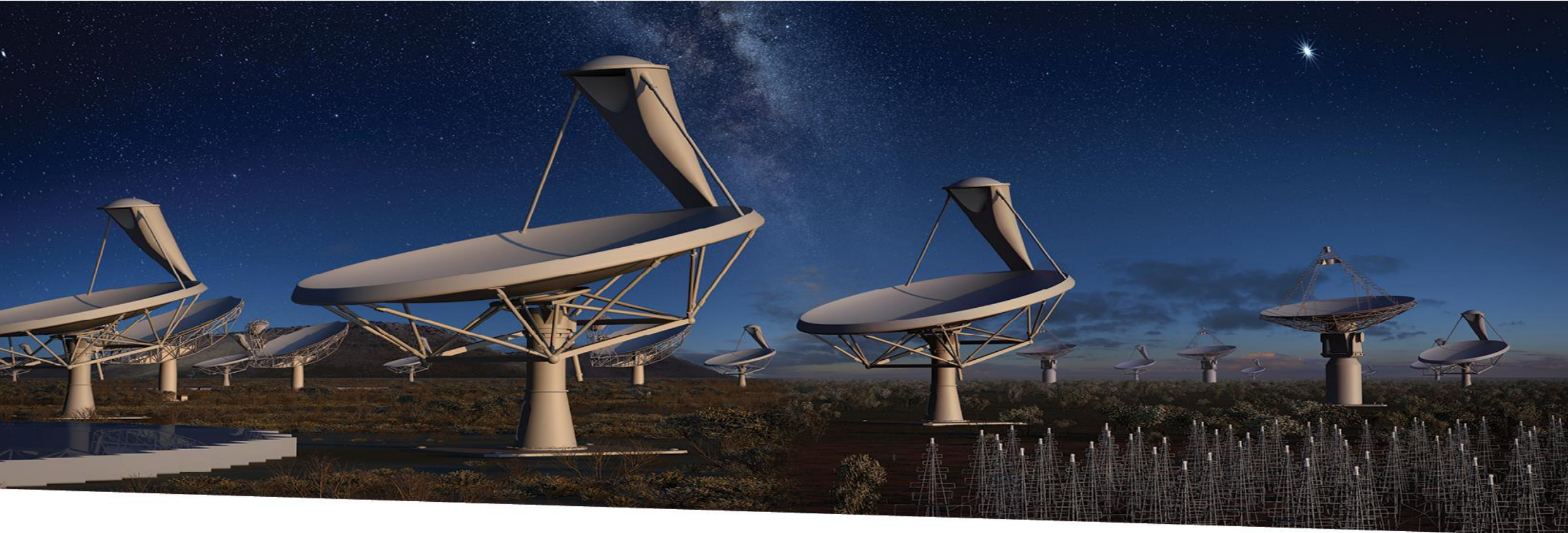 TANGO-Grafana: an online diagnostic tool to assist in the analysis of interconnected problems difficult to debug in the context of the Square Kilometre Array (SKA) telescope project

SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope

Matteo Di Carlo (INAF-OAAB)

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SKAMPI

- The 🌍 SKA MVP Prototype Integration (SKAMPI): set of software artefacts, the corresponding repository and continuous integration facilities for the development, testing, and integration of the SKA prototype software systems
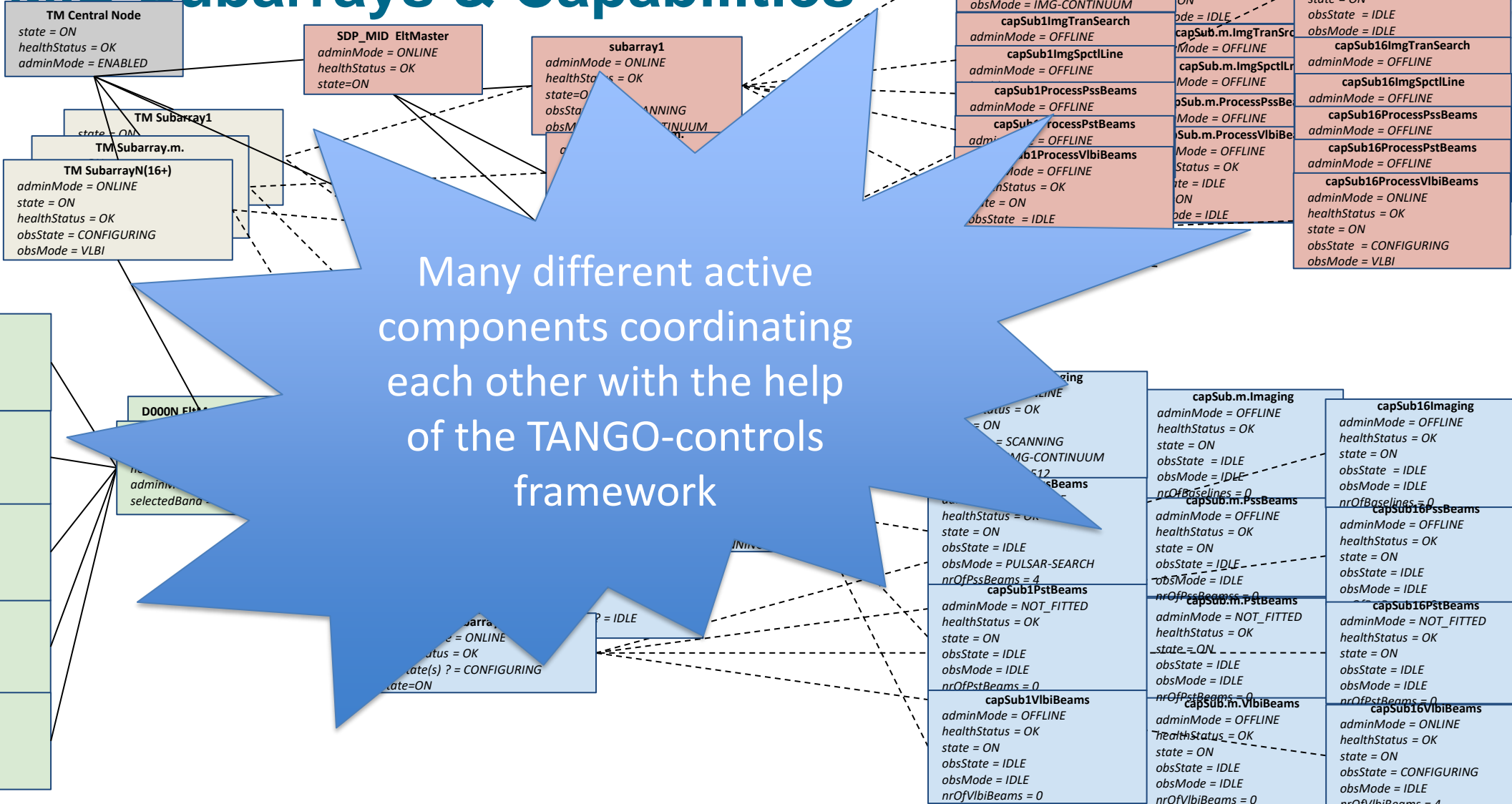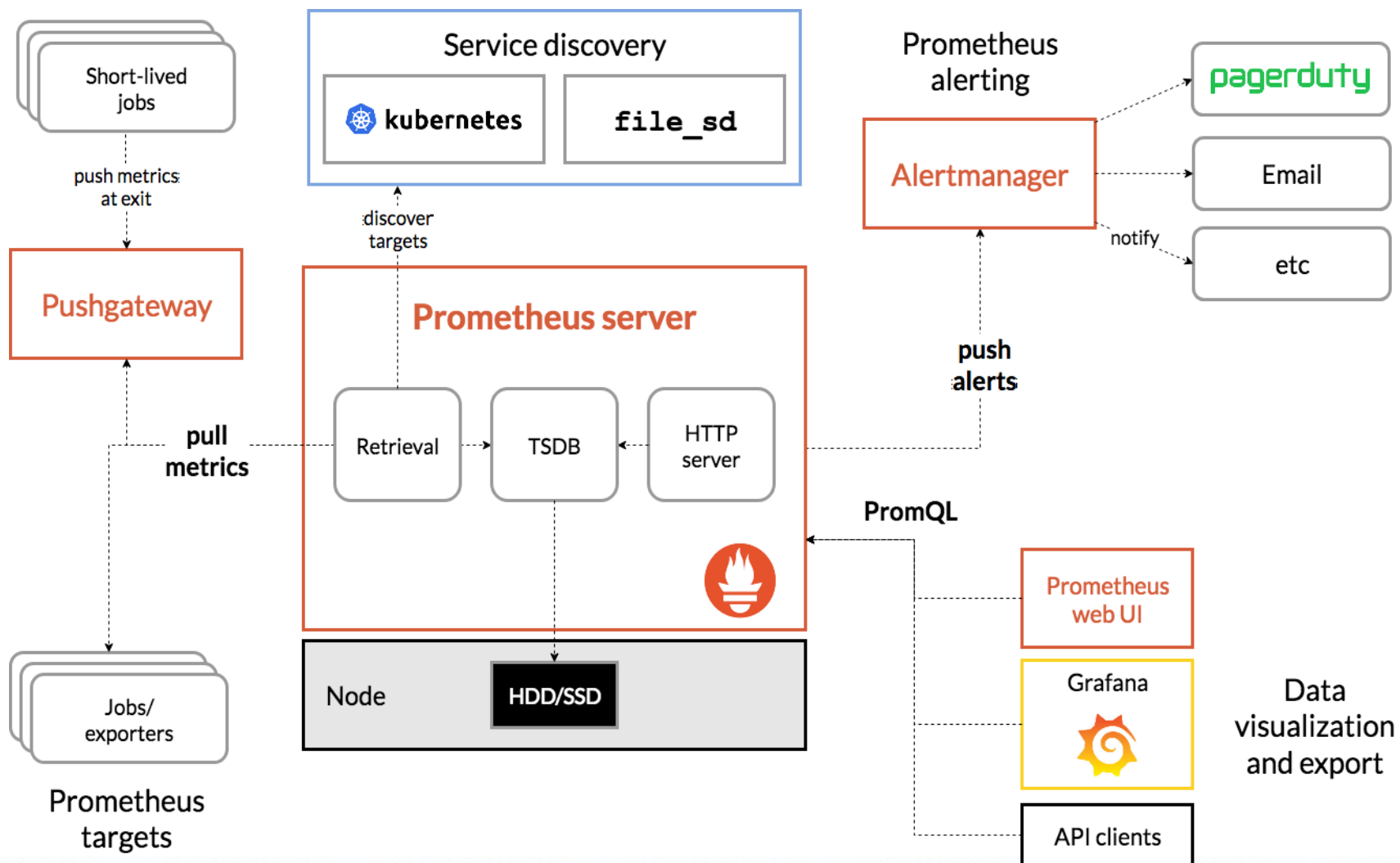
SKA-MID Subarrays & Capabilities

TM Central Node
state = ON
healthStatus = OK
adminMode = ENABLED

SDP_MID EltMaster
adminMode = ONLINE
healthStatus = OK
state=ON

subarray1
adminMode = ONLINE
healthStatus = OK
state=ON
obsState = SCANNING
obsMode = CONTINUUM

TM Subarray1
state = ON

TM Subarray.m.

TM SubarrayN(16+)
adminMode = ONLINE
state = ON
healthStatus = OK
obsState = CONFIGURING
obsMode = VLBI

capSub1ImgCont
adminMode = ONLINE
healthStatus = OK
state = ON
obsState = SCANNING
obsMode = IMG-CONTINUUM

capSub.m.ImgCont
Mode = OFFLINE
Status = OK
te = IDLE
ON
de = IDLE

capSub16ImgCont
adminMode = OFFLINE
healthStatus = OK
state = ON
obsState = IDLE
obsMode = IDLE

capSub1ImgTranSearch
adminMode = OFFLINE

capSub.m.ImgTranSrc
Mode = OFFLINE

capSub16ImgTranSearch
adminMode = OFFLINE

capSub1ImgSpctlLine
adminMode = OFFLINE

capSub.m.ImgSpctlLr
Mode = OFFLINE

capSub16ImgSpctlLine
adminMode = OFFLINE

capSub1ProcessPssBeams
adminMode = OFFLINE

Sub.m.ProcessPssBe
Mode = OFFLINE

capSub16ProcessPssBeams
adminMode = OFFLINE

capSub1ProcessPstBeams
admin = OFFLINE

Sub.m.ProcessVlbiBe
Mode = OFFLINE

capSub16ProcessPstBeams
adminMode = OFFLINE

Sub1ProcessVlbiBeams
Mode = OFFLINE
Status = OK
e = ON
de = IDLE

capSub16ProcessVlbiBeams
adminMode = ONLINE
healthStatus = OK
state = ON
obsState = CONFIGURING
obsMode = VLBI

capBand1
adminMode = OFFLINE
healthStatus = OK
obsState = IDLE
state=ON

capBand2
adminMode = ONLINE
healthStatus = OK
obsState = SCANNING
state=ON

capBand3
adminMode = OFFLINE
healthStatus = OK
obsState = IDLE
state=ON

capBand4
adminMode = OFFLINE
healthStatus = FAIL
obsState = IDLE
state=ON

capBand5
adminMode = OFFLINE
healthStatus = OK
obsState = IDLE
state=ON

D000N EltM
adminM
selectedBand

Many different active components coordinating each other with the help of the TANGO-controls framework

...ging
tatus = ONLINE
...us = OK
= ON
= SCANNING
= IMG-CONTINUUM
512

capSub.m.Imaging
adminMode = OFFLINE
healthStatus = OK
state = ON
obsState = IDLE
obsMode = IDLE
nrOfBaselines = 0

capSub16Imaging
adminMode = OFFLINE
healthStatus = OK
state = ON
obsState = IDLE
obsMode = IDLE
nrOfBaselines = 0

...sBeams
admin...
healthStatus = OK
state = ON
obsState = IDLE
obsMode = PULSAR-SEARCH
nrOfPssBeams = 4

capSub.m.PssBeams
adminMode = OFFLINE
healthStatus = OK
state = ON
obsState = IDLE
obsMode = IDLE
nrOfPssBeams = 0

capSub16PssBeams
adminMode = OFFLINE
healthStatus = OK
state = ON
obsState = IDLE
obsMode = IDLE

capSub1PstBeams
adminMode = NOT_FITTED
healthStatus = OK
state = ON
obsState = IDLE
obsMode = IDLE
nrOfPstBeams = 0

capSub.m.PstBeams
adminMode = NOT_FITTED
healthStatus = OK
state = ON
obsState = IDLE
obsMode = IDLE
nrOfPstBeams = 0

capSub16PstBeams
adminMode = NOT_FITTED
healthStatus = OK
state = ON
obsState = IDLE
obsMode = IDLE
nrOfPstBeams = 0

capSub1VlbiBeams
adminMode = OFFLINE
healthStatus = OK
state = ON
obsState = IDLE
obsMode = IDLE
nrOfVlbiBeams = 0

capSub.m.VlbiBeams
adminMode = OFFLINE
healthStatus = OK
state = ON
obsState = IDLE
obsMode = IDLE
nrOfVlbiBeams = 0

capSub16VlbiBeams
adminMode = ONLINE
healthStatus = OK
state = ON
obsState = CONFIGURING
obsMode = IDLE
nrOfVlbiBeams = 4

...barray...
...e = ONLINE
...tus = OK
...te(s) ? = CONFIGURING
state=ON

? = IDLE

Prometheus as monitoring solution

Prometheus exporter

- It is an http server which answer to requests with time series text/information
- Every time series is uniquely identified by:
  - its metric name and
  - optional key-value pairs called label

```
<metric name>{<label name>=<label value>, ...}
```

- It must have all the information related
- Development information:
  - https://prometheus.io/docs/practic
  - Python client library for developmer
    - https://github.com/prometheus/client

4 types of metrics:
- Counter: cumulative metric
- Gauge: single numerical value that can arbitrarily go up and down
- Histogram: samples observations (usually things like request durations or response sizes) and counts them in configurable buckets
- Summary: samples observations (similar to a *histogram*)

Grafana

- Engine for displaying data on web coming from many data sources
  - Working with grafana means to create dashboards which allows to understand something
- Plugin architecture where a plugin can be:
  - A panel
  - A data source
  - An app (combination of data source and panels for a specific purpose)

TANGO-Grafana: PROMETHEUS + GRAFANA + TANGO-controls
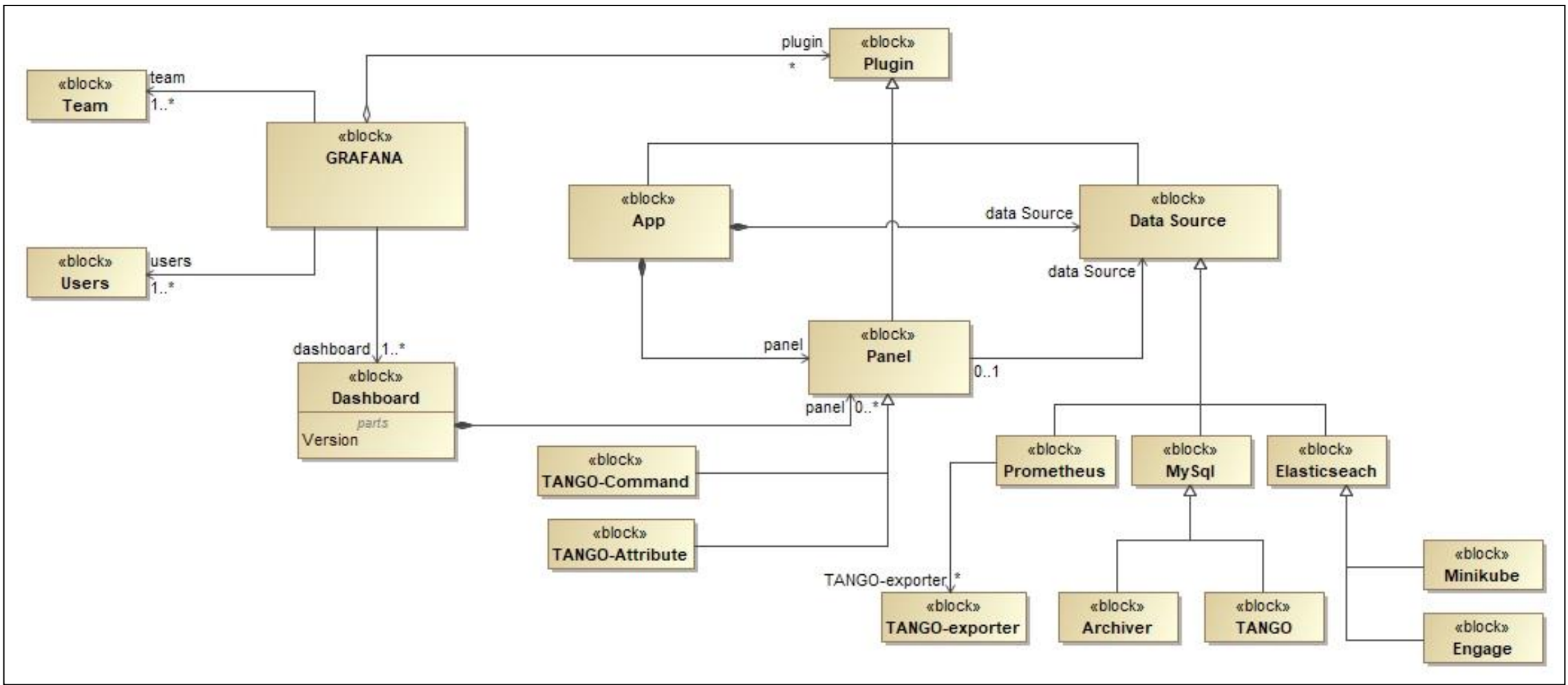
TANGO-Exporter

- Read all the attribute of a
- Timeout set

```
device_attribute{
    device="mid_
    dim_x="1",di
    label="obsSt
    name="obsSta
    str_value="I
    type="enum",
    x="0",y="0"
} 0.0
```

Prometheus graph engine

Grafana grap...

device_attribute{device="sys/tg_test/1",dim_x="1",dim_y="0",type="float"}
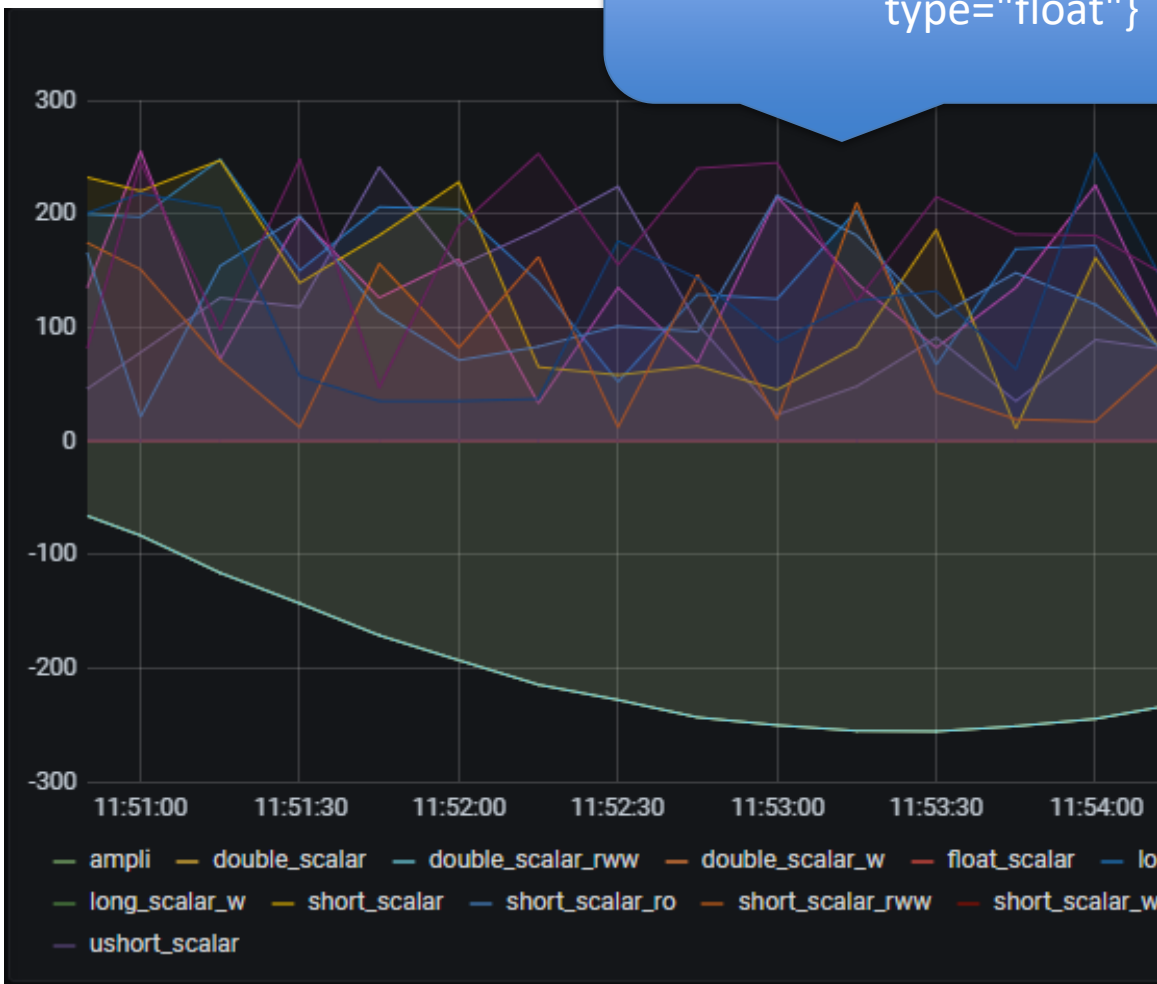
device_attribute{device="sys/database/2",name="Timing_average"}

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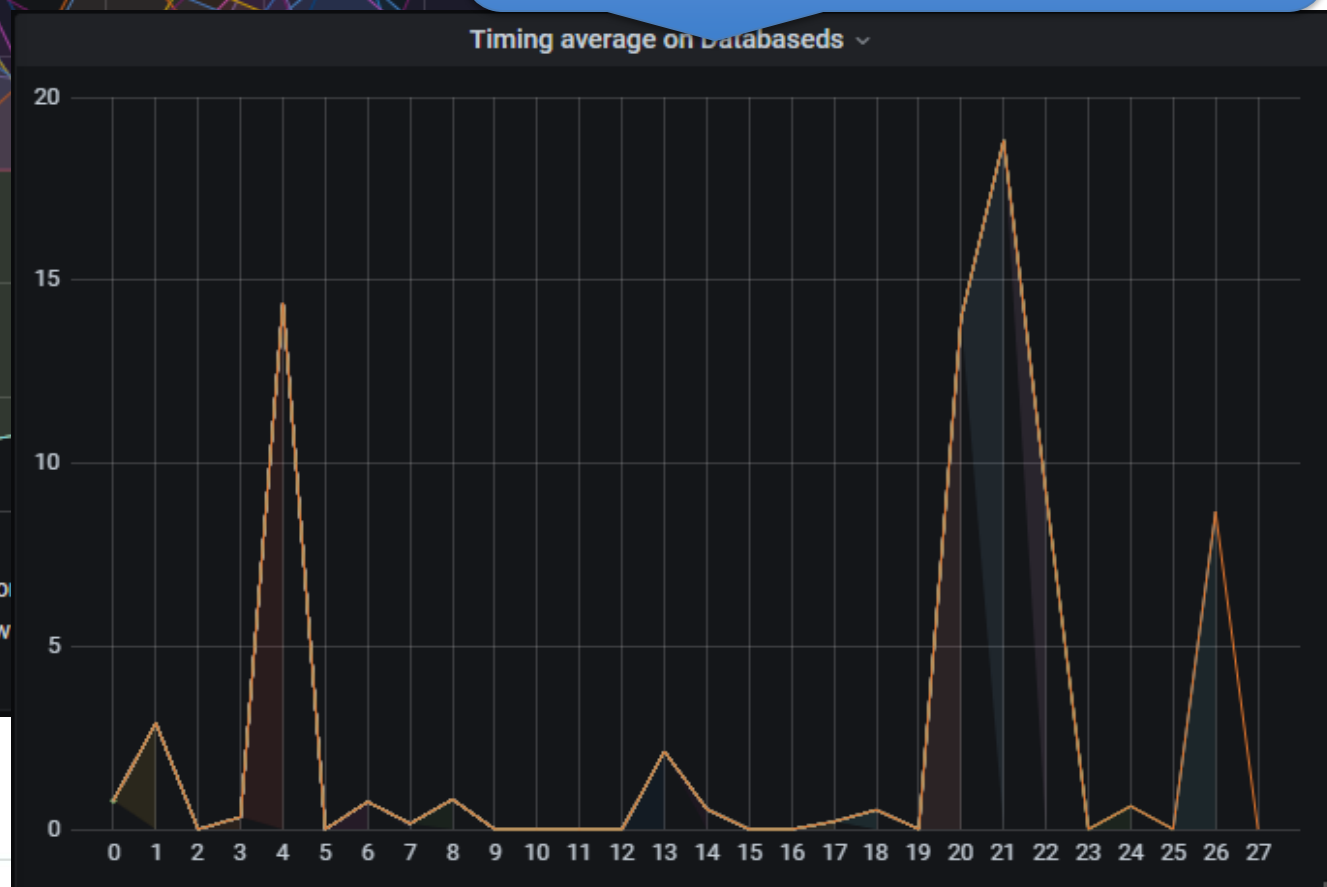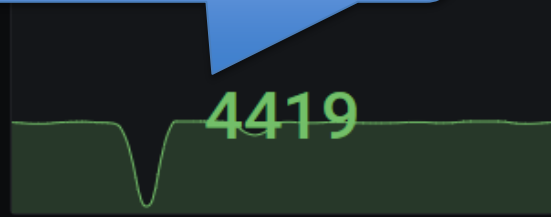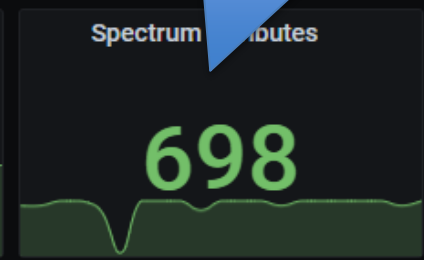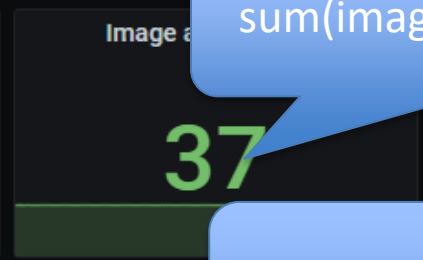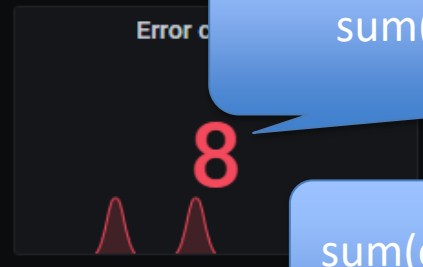
TA...

sum(attribute_count)
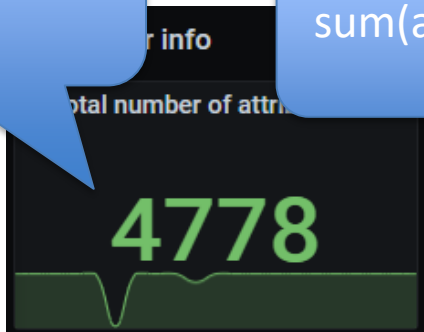
sum(attribute_read_count)

sum(spectrum_attribute_count)

sum(image_attribute_count)

sum(error_count)

sum(error_attr_count)
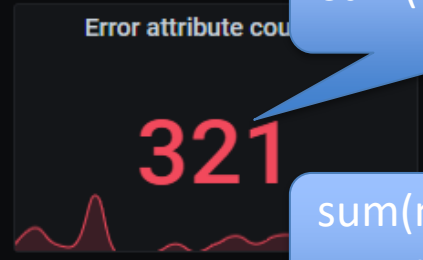
sum(not_managed_attribute_count)

...r info

...tal number of attri...

4778

4419

Spectrum ...ibutes

698

Image a...

37

Error c...

8

Error attribute cou...

321

Not managed attribu...

38
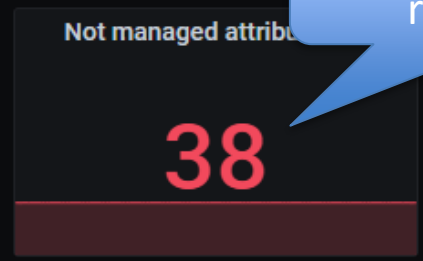
TANGO Database information

```
{
  "name": "sys/database/2",
  "host": "databaseds-tango-base-test",
  "port": "10000",
  "info": [
    "TANGO Database sys/database/2",
    " ",
    "Running since 2020-05-22 13:56:03",
    " ",
    "Devices defined  = 246",
    "Devices exported  = 234",
    "Device servers defined  = 83",
    "Device servers exported  = 77",
    " ",
    "Device properties defined  = 6603 [Hi...lgth = 19562]",
    "Class properties defined  = 99 [Hist...
    "Device attribute properties defined
```

...0//devices"

http get http://tango.rest.mid.integration.engageska-portugal.pt/tango/rest/rc4/hosts/databaseds-tango-base-test/10000/

TANGO-Attribute: displaying strings

In prometheus and gr[a...]

In order to display stri[...]

- Show attributes in a[...] state/string/enum)[...]

Attribute list for devices

Device	Attribute	Value
sys/database/2	State	ON
sys/database/2	Status	Device is OK
sys/database/2	StoredProcedureRelease	release 1.13
sys/tg_test/1	State	RUNNING
sys/tg_test/1	Status	The device is in RUNNING state.
sys/tg_test/1	ampli	20
sys/tg_test/1	boolean_scalar	1
sys/tg_test/1	double_scalar	-131.84906460303185
sys/tg_[...]	double_scalar_rww	-131.84906460303185
[...]est/1	double_scalar_w	0

Rows per page: 10   1-10 of 47

device_attribute{device=~"$devices"}

TANGO-Archiver data source
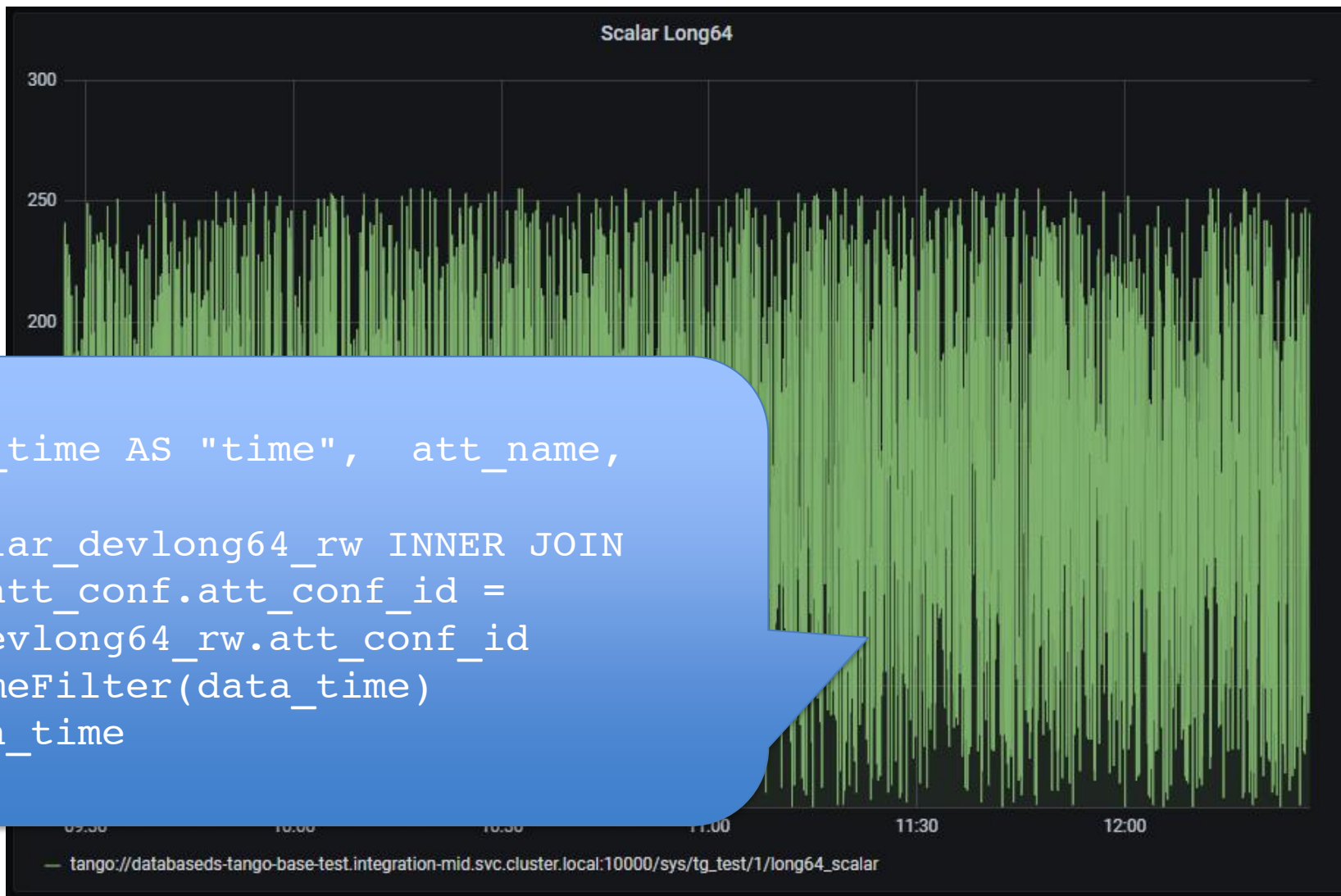

```sql
SELECT  data_time AS "time",  att_name,
value_r
FROM att_scalar_devlong64_rw INNER JOIN
att_conf ON att_conf.att_conf_id =
att_scalar_devlong64_rw.att_conf_id
WHERE  $__timeFilter(data_time)
ORDER BY data_time
```

TANGO-Archiver data source and Plotly

Desired Pointing (time interval)

```
SELECT
    data_time as time_sec,
    att_conf.name,
    idx,
    value_r as value
FROM att_array_devdouble_rw INNER JOIN att_conf ON
att_conf.att_conf_id =
att_array_devdouble_rw.att_conf_id
WHERE att_conf.att_name = 'tango://databaseds-tango-
base-test.integration-
mid.svc.cluster.local:10000/mid_d0001/elt/master/desire
dpointing'
AND $__timeFilter(data_time)
ORDER BY data_time desc
```
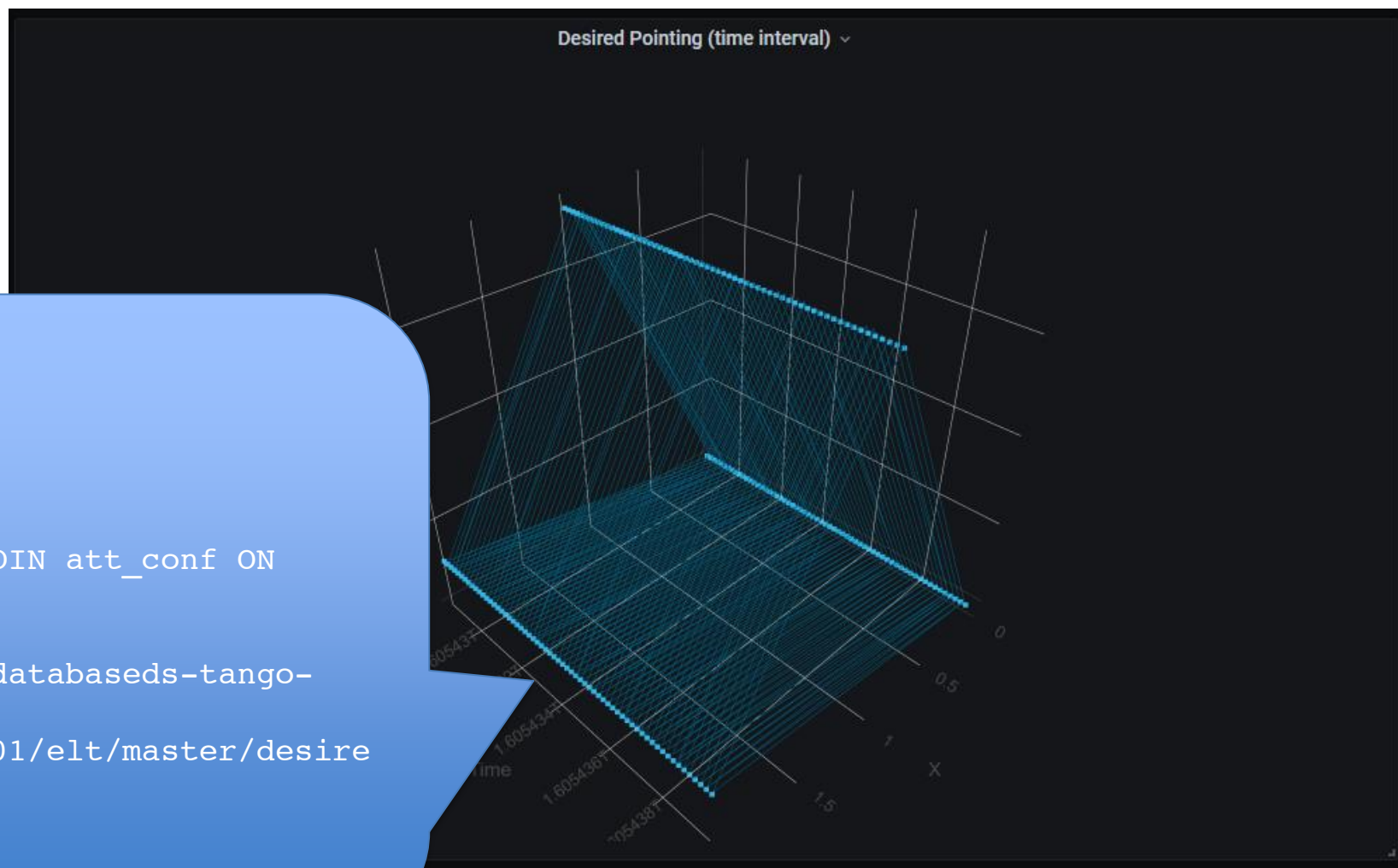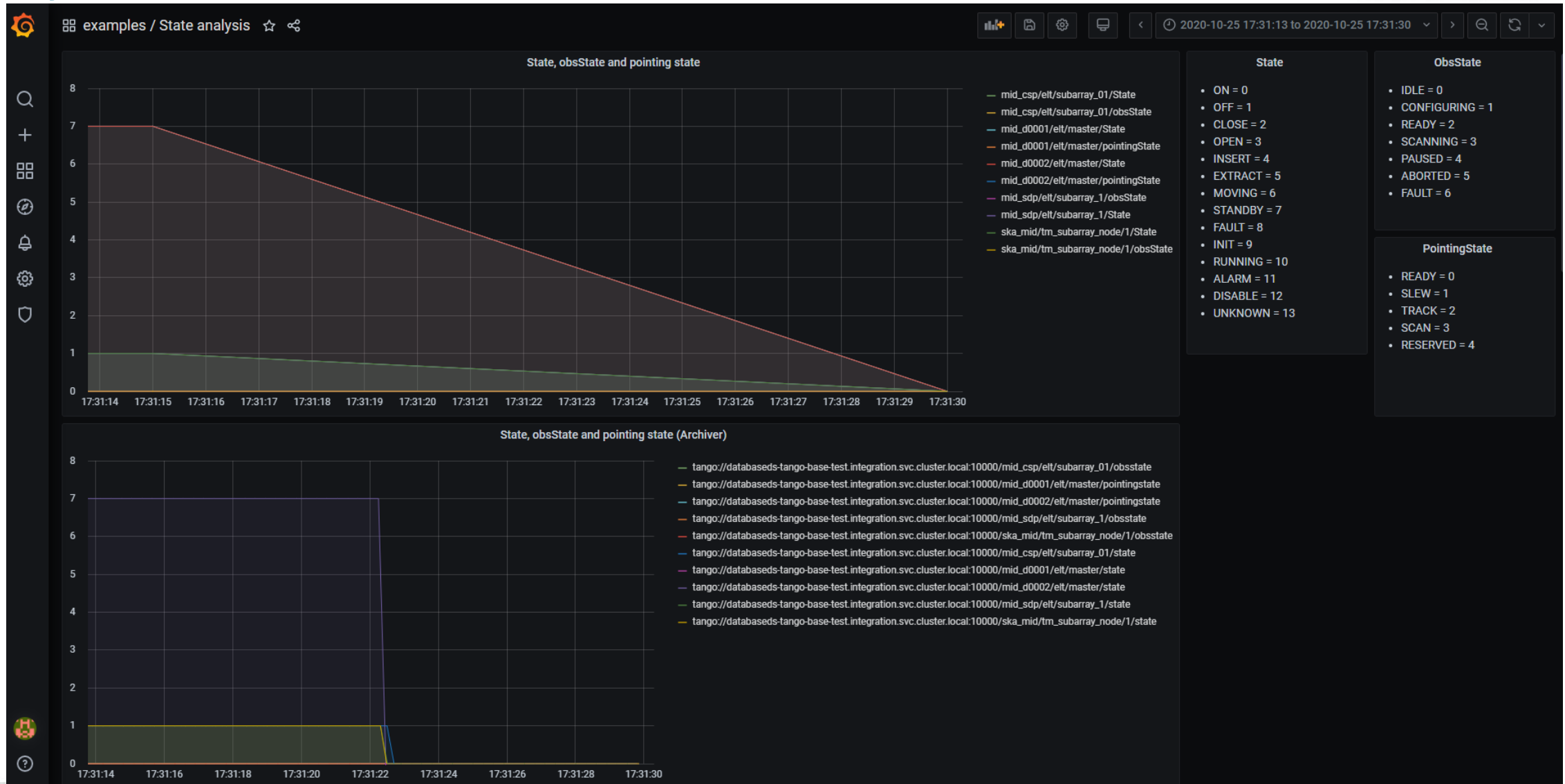
Elasticsearch data source

ska_severity: ERROR

Logs

Error logs

Time	ska_tags	Message	ska_line_loc	_id
2020-11-15T11:32:12.396Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	Oauty3UBdjH/
2020-11-15T11:32:07.433Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	sq6ty3UBLCq
2020-11-15T11:32:02.397Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	g6uty3UBdjH/
2020-11-15T11:31:57.381Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	nq6ty3UBLCq
2020-11-15T11:31:52.530Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	rauty3UBdjHA
2020-11-15T11:31:52.201Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	qquty3UBdjH/
2020-11-15T11:31:47.353Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	CKusy3UBdjH
2020-11-15T11:31:42.417Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	3Hasy3UB9E\
2020-11-15T11:31:37.385Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	1a6sy3UBLCq
2020-11-15T11:31:32.363Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	DKusy3UBdjH
2020-11-15T11:31:27.512Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	d6usy3UBdjH
2020-11-15T11:31:22.482Z	tango-device:mid_csp/elt/master	Can't retrieve proxy for device 'mid_csp/capability_monitor/fsp'	CspMaster.py#404	F3asy3UB9E\

ska_tags, Message, ska_line_loc, _id, _index, _source, _type, agent.ephemeral_id, agent.hostname, agent.id, agent.type, agent.version, ecs.version, host.name, input.type, kubernetes.container.image, kubernetes.cor
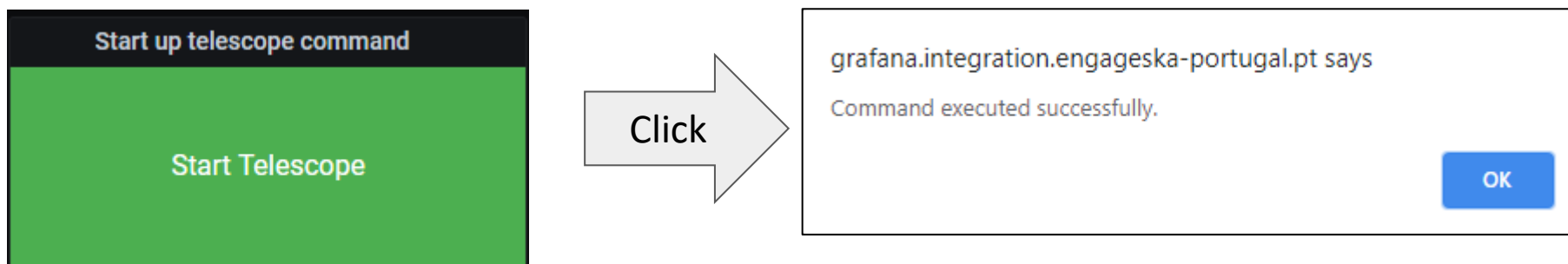
Exploring the Universe with the world's largest radio telescope

Many datasources one dashboard

Exploring the Universe with the world's largest radio telescope

TANGO-Command

- CORS problems
  - Proxy server to authentication and call to the TangoGQL backend
  - Getting the parameter for the call is tricky

Webjive integration

- Inclu...
  - Ifra...
- Prob...
  - Au...
  - To...

Thanks

More information at: gitlab.com/ska-telescope/TANGO-grafana