SKA Operational Model

Dr Antonio Chrysostomou

Deputy Director of Operations, SKAO

Outline

One Observatory

SKA Operational Model

Observatory Structure

Distributed Operations

Subarrays & Commensality

Data Flow

One Observatory Model

ONE Observatory – **TWO** Telescopes – **THREE** Sites

The SKA Observatory will operate the SKA1-Low and SKA1-Mid telescopes in Australia and South Africa. Its Global Headquarters will be in the UK.

Facilities will be present at each of the host countries to enable the operation of the Observatory's telescopes.

One Observatory Model

ONE Observatory – **TWO** Telescopes – **THREE** Sites

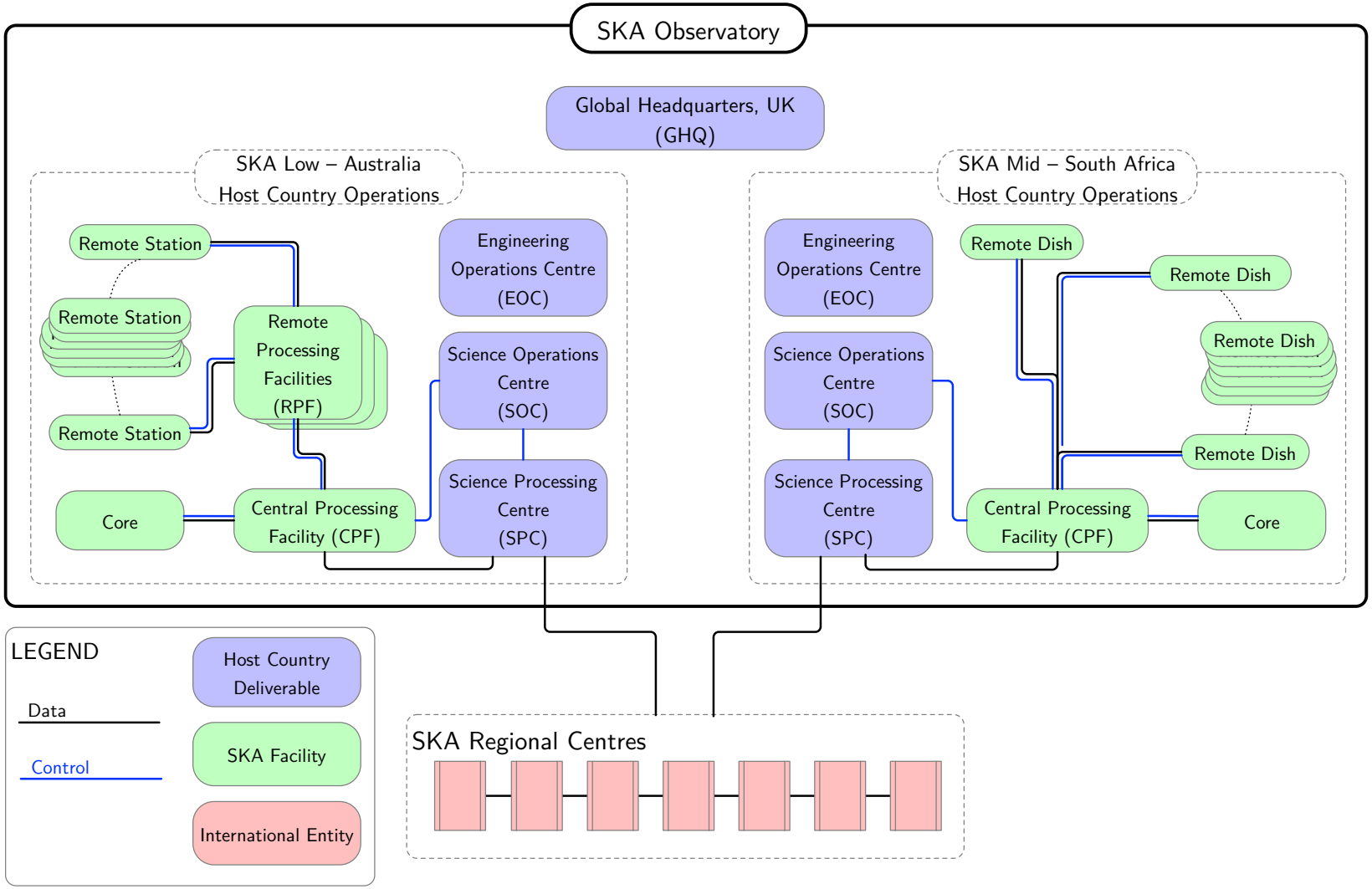
Global Headquarters (GHQ)

Engineering Operations Centres (EOC)

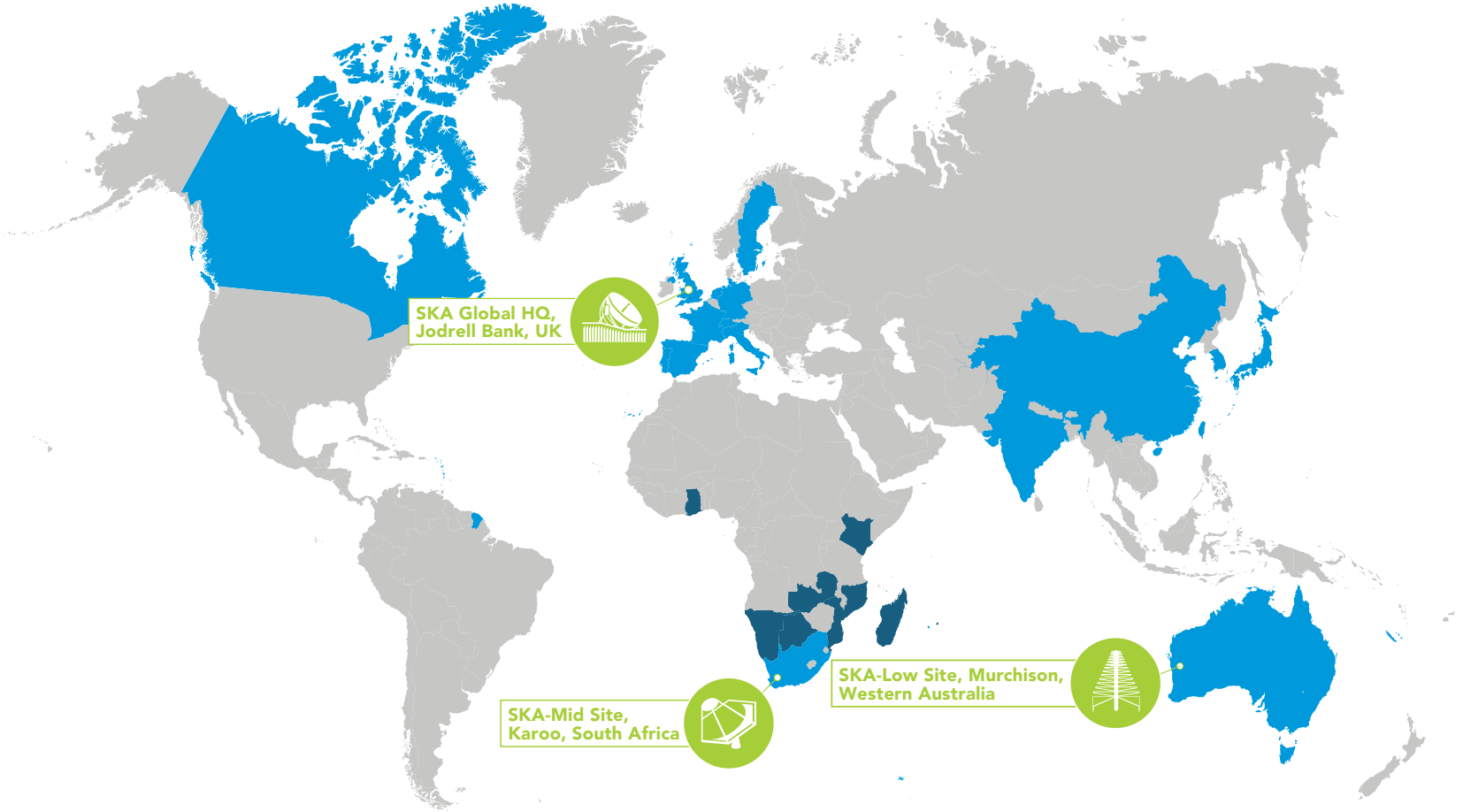
Science Operations Centres (SOC)

Science Processing Centres (SPC)

One Observatory Model



One Observatory Model - Distributed Operations



SKAO Partnership - includes SKAO Member States* and SKAO Observers (as of June 2022)

African Partner Countries

Distributed Operations - SKA in Australia

Design

512 stations × 256 antennas =
131,072 antennas

Densely populated core
(~1km diameter)

Three log-spiral arms
74-km baselines

50 – 350 MHz
instantaneous bandwidth

Distributed Operations - SKA in South Africa

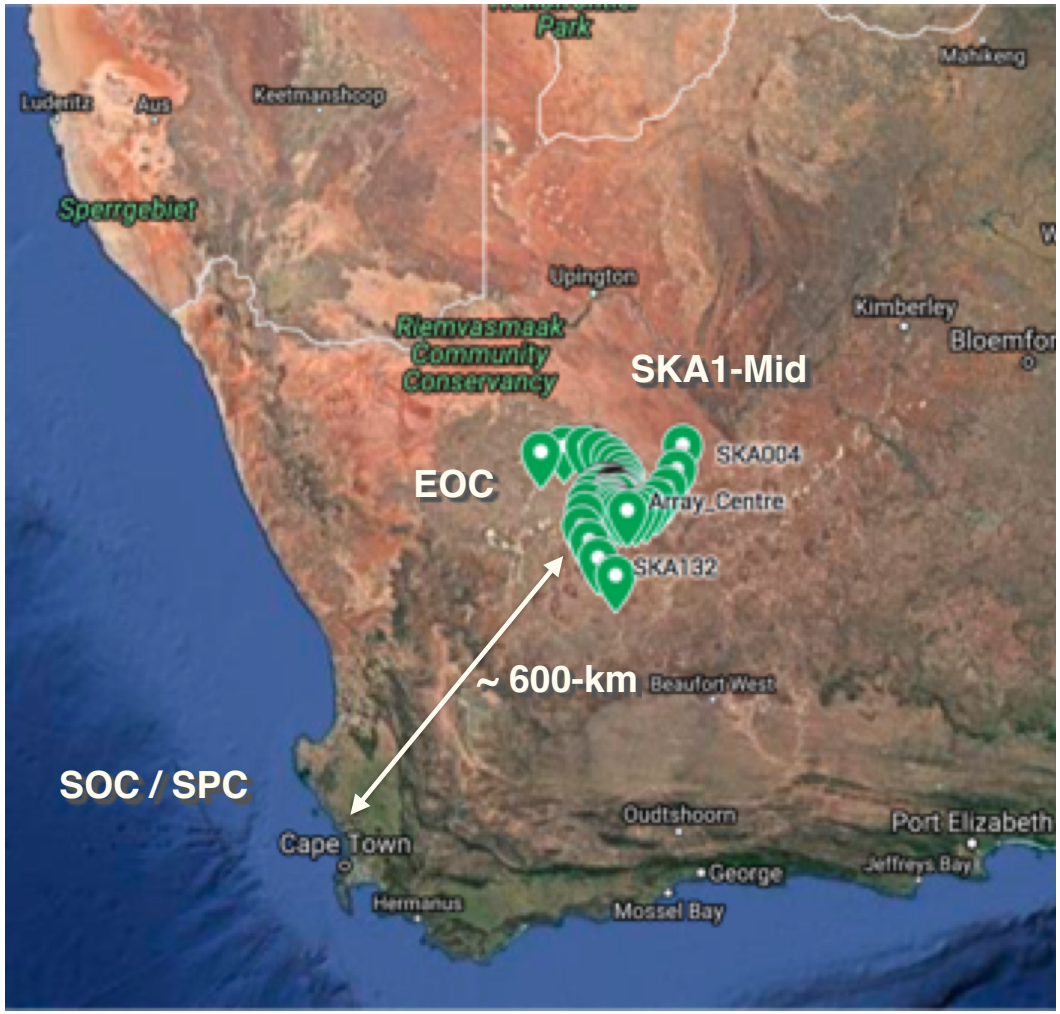
Design

133 SKA1 dishes (15-m)
+
64 MeerKAT dishes (13.5-m)

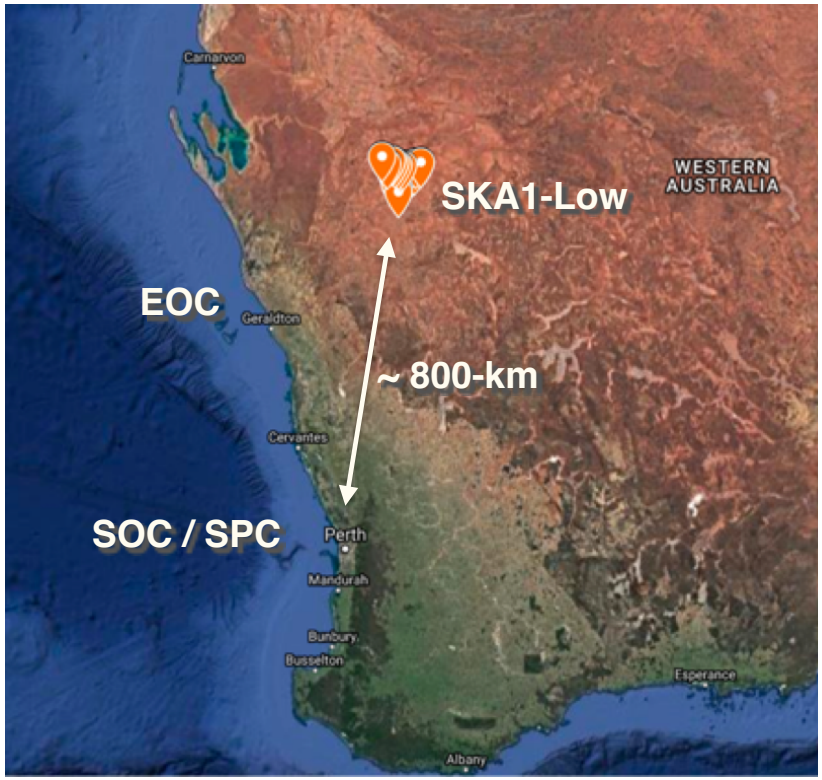
Densely populated core
(~ 2-km diameter)

Three log-spiral arms
150-km baselines

0.35 – 15 GHz
5 receivers



Distributed Operations



Telescope Operations (control and monitoring) will happen at SOCs.
Note the large distances from the SOC/SPC and the telescopes.

SKA Operational Model

Conventional Features

- periodic observing proposals
- service observing (no visiting astronomers)
- flexible/dynamic scheduling
- 24/7 operations

Complex/Challenging Features

- operations from a distance
- high operational availability (~ 90-95%)
- rapid response to transients and ToO
- subarrays and commensality

Observing Modes

See presentation by S. Breen

- imaging (continuum & spectral)
- beam forming for pulsar search & timing, VLBI
- transient search

Proposal Types

See presentation by T. Bourke

- Standard PI proposals
- Key Science Projects
- Long term proposals
- Coordinated proposals
  - between Low and Mid
  - between SKA and other observatories

SKA Operational Model - Subarrays and Commensality

Allows execution of more than one observation/project at the same time

Subarrays will be available to choose from various templates, e.g.

- core subarray
- core + spiral arms
- whole array

SKA Operational Model - Subarrays and Commensality

Three types of commensality:

data = different projects use the same data products for different science goals

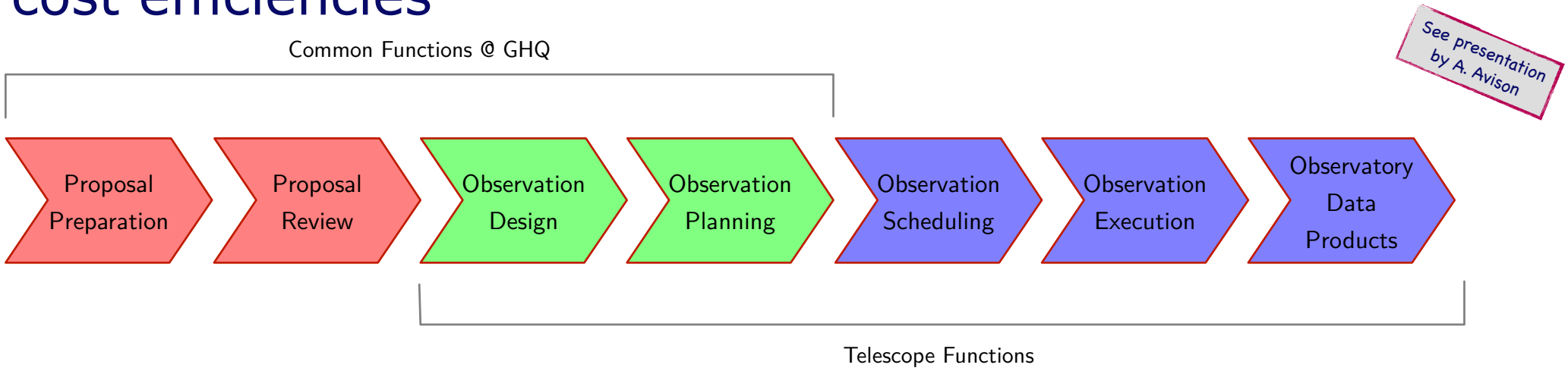
observing = different projects use the same signal/data for different data products (i.e. different SDP workflows)

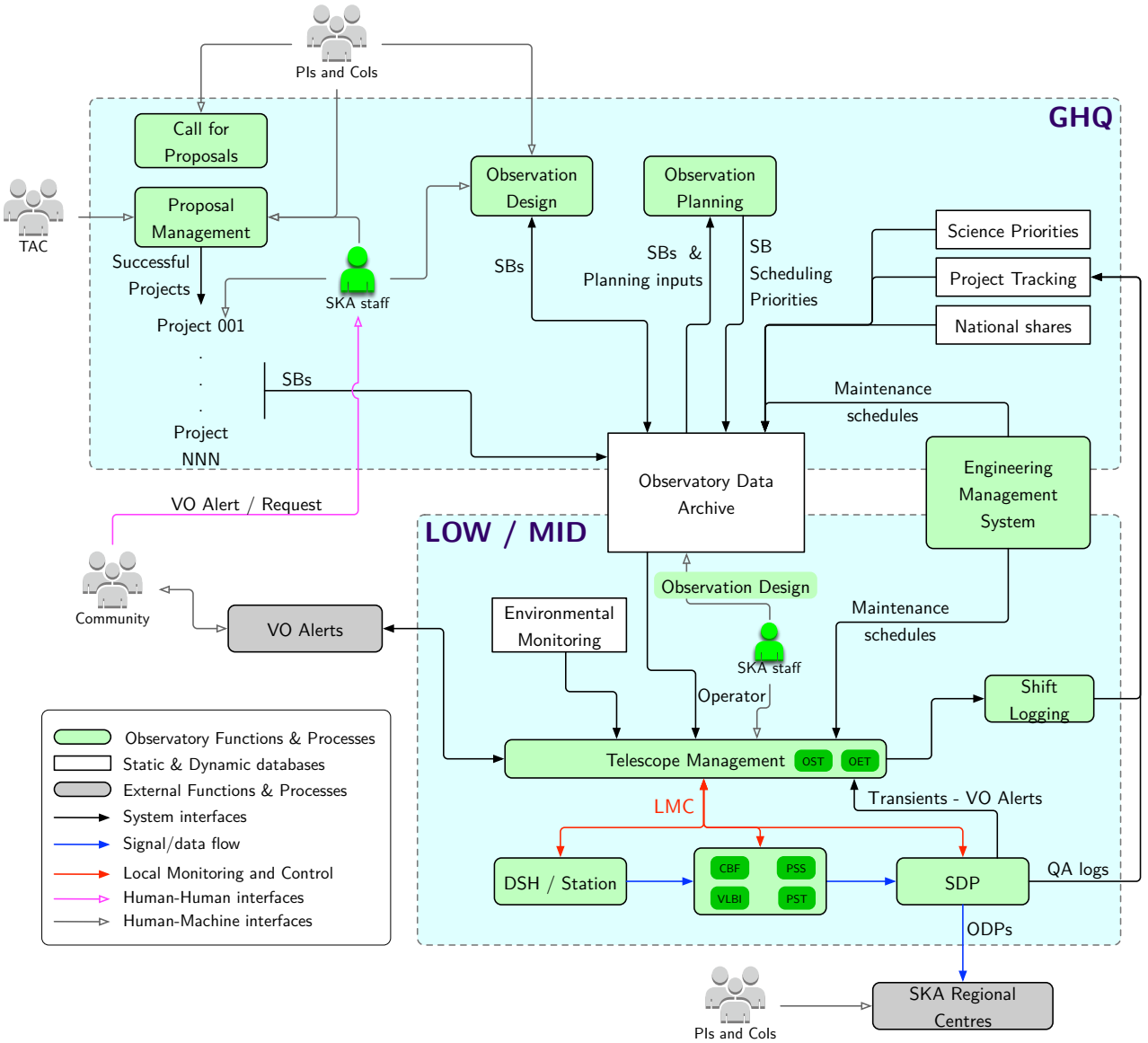
multiplex = configure the telescope into subarrays

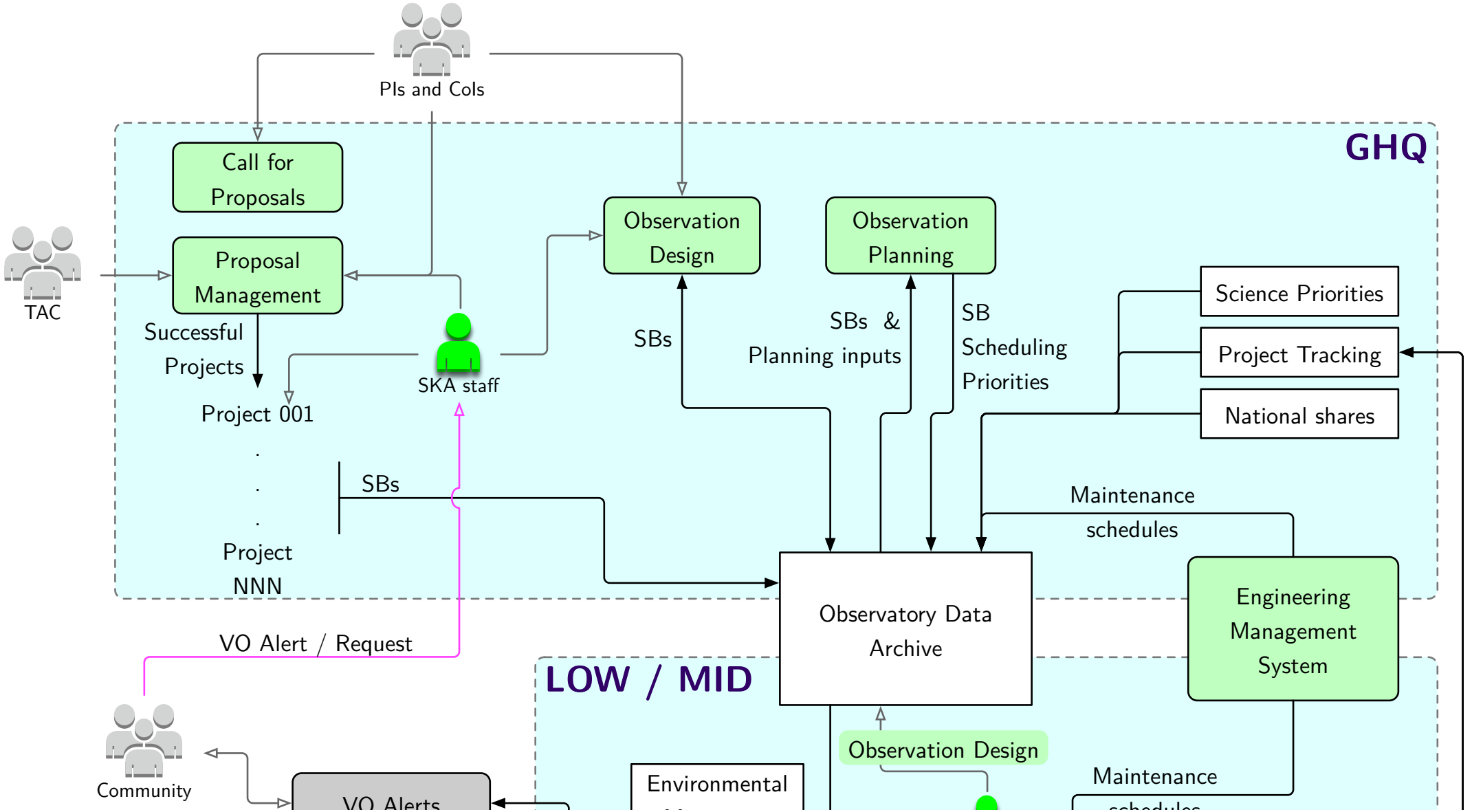
SKA Operational Model

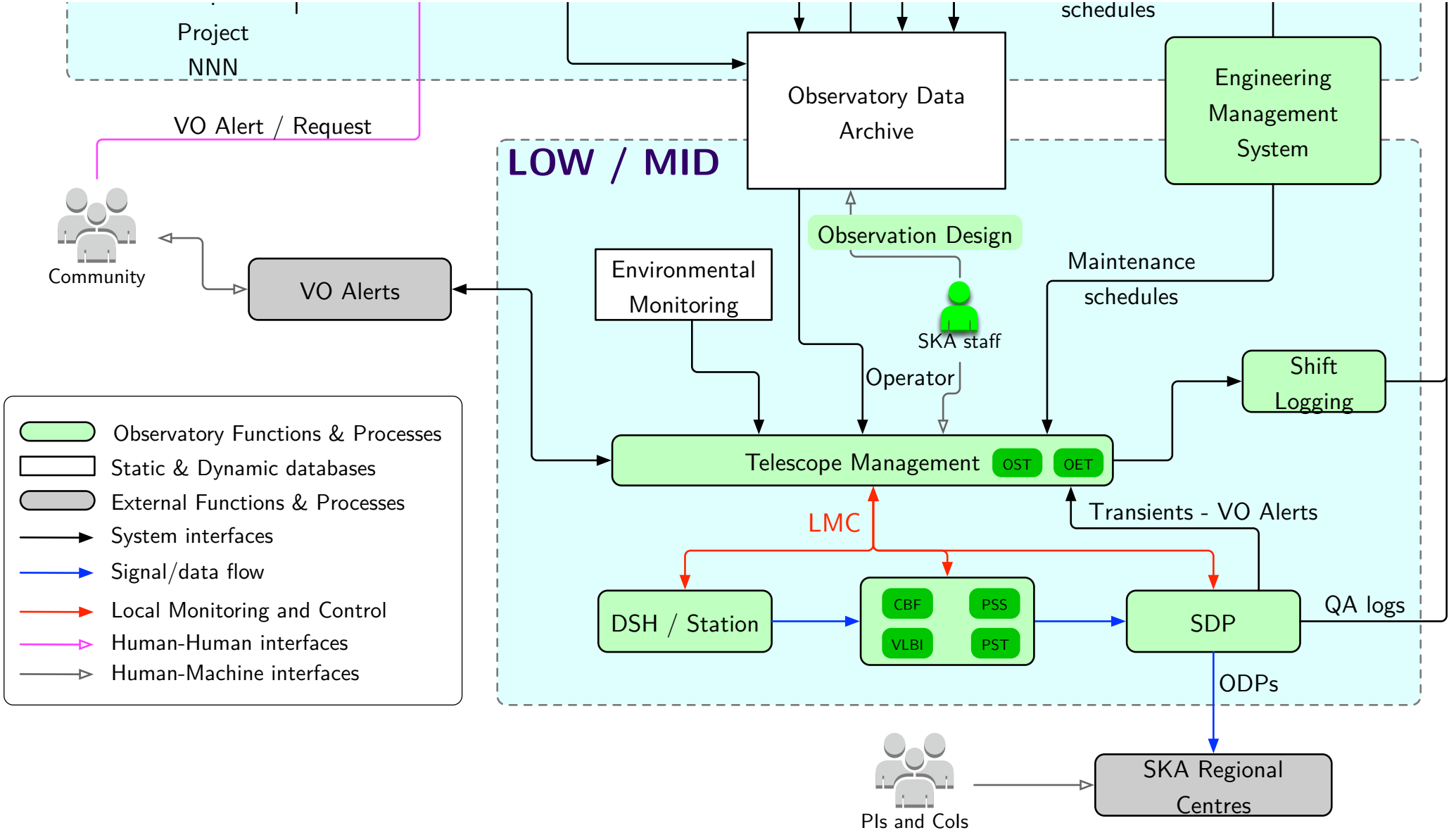
Important to identify commonalities in operation of SKA-Low and SKA-Mid

- avoid proliferation and bifurcation of code bases
- easier support model
- cost efficiencies

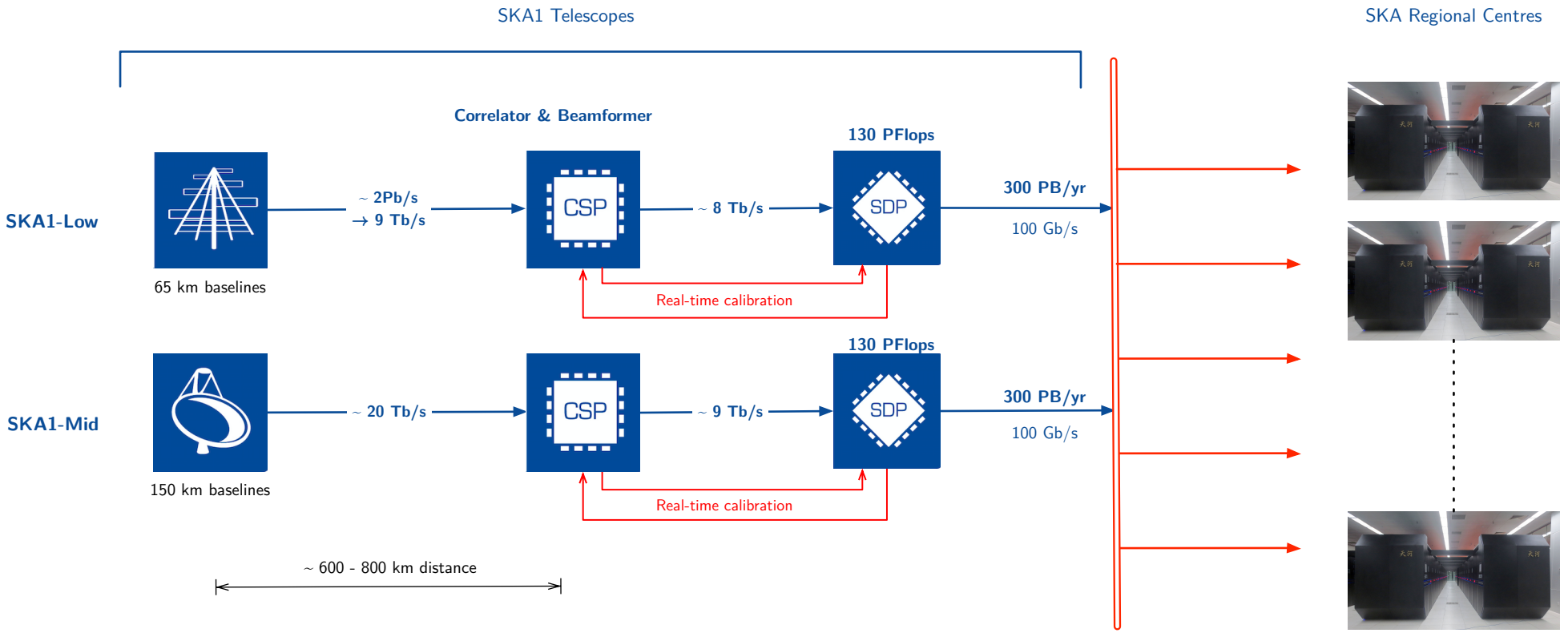



PIs and Cols
GHQ
Call for Proposals
Proposal Management
TAC
Successful Projects
Project 001
Project NNN
SKA staff
Observation Design
Observation Planning
SBs
SBs & Planning inputs
SB Scheduling Priorities
Science Priorities
Project Tracking
National shares
Maintenance schedules
Observatory Data Archive
Engineering Management System
VO Alert / Request
LOW / MID
Community
VO Alerts
Environmental Monitoring
Observation Design
SKA staff
Maintenance schedules
Operator
Shift Logging
Telescope Management
OST
OET
LMC
Transients - VO Alerts
DSH / Station
CBF
PSS
VLBI
PST
SDP
QA logs
ODPs
PIs and Cols
SKA Regional Centres
Observatory Functions & Processes
Static & Dynamic databases
External Functions & Processes
System interfaces
Signal/data flow
Local Monitoring and Control
Human-Human interfaces
Human-Machine interfaces


PIs and CoIs
GHQ
Call for Proposals
Observation Design
Observation Planning
TAC
Proposal Management
Science Priorities
Project Tracking
National shares
Successful Projects
SKA staff
SBs
SBs & Planning inputs
SB Scheduling Priorities
Project 001
SBs
Maintenance schedules
Project NNN
Observatory Data Archive
Engineering Management System
VO Alert / Request
LOW / MID
Observation Design
Community
Environmental
Maintenance


Project
NNN
schedules
Observatory Data
Archive
Engineering
Management
System
VO Alert / Request
LOW / MID
Observation Design
Community
VO Alerts
Environmental
Monitoring
Maintenance
schedules
SKA staff
Operator
Shift
Logging
Telescope Management
OST
OET
LMC
Transients - VO Alerts
DSH / Station
CBF
PSS
VLBI
PST
SDP
QA logs
ODPs
PIs and CoIs
SKA Regional
Centres
Observatory Functions & Processes
Static & Dynamic databases
External Functions & Processes
System interfaces
Signal/data flow
Local Monitoring and Control
Human-Human interfaces
Human-Machine interfaces

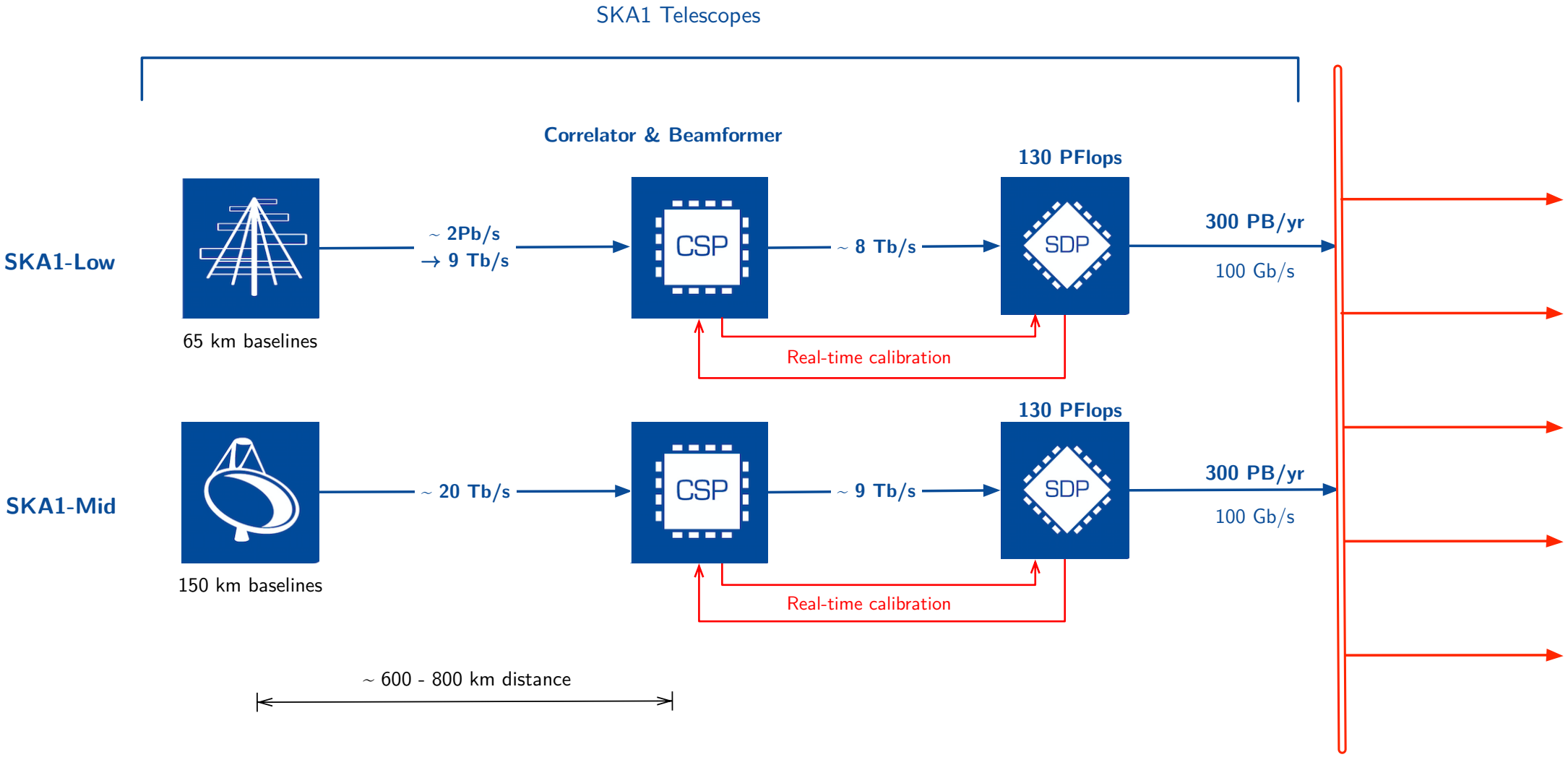
Data Flow through the SKA



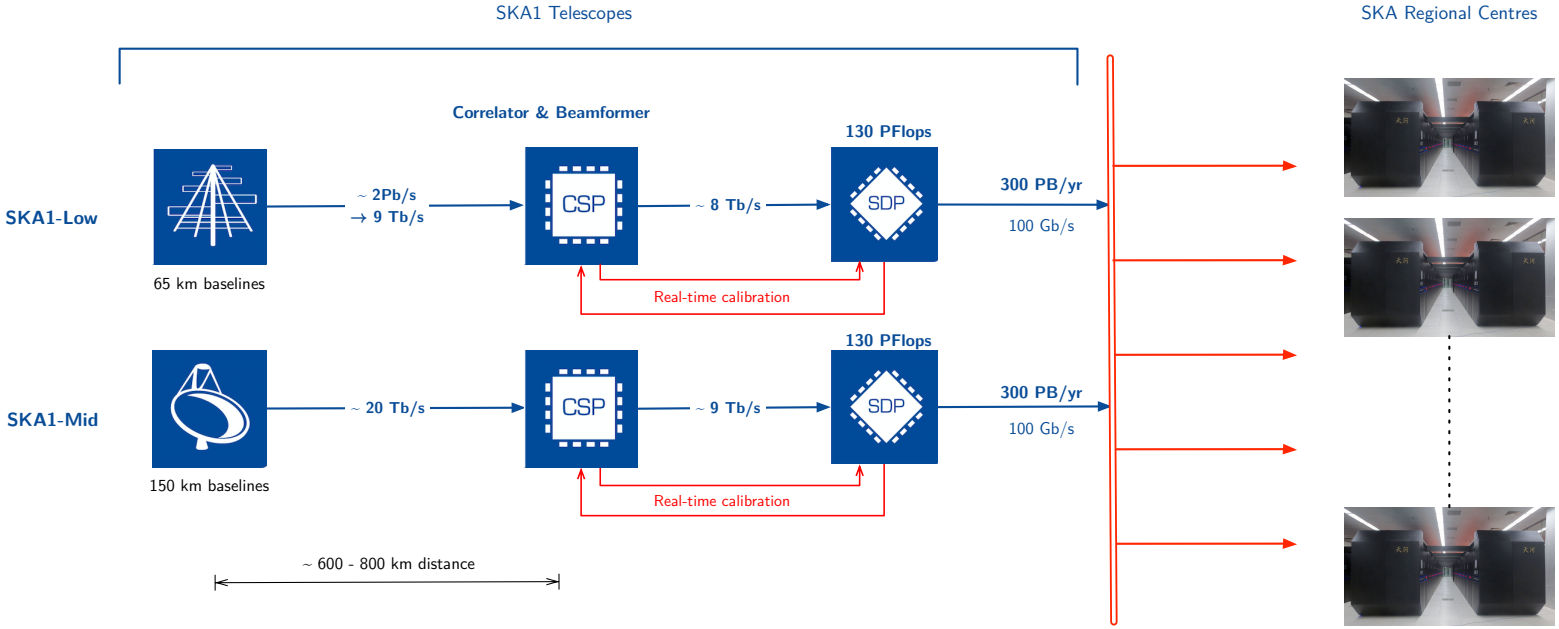
Managing the data flow is one of the greatest challenges for SKA

- scale and versatility ⇒ large data rate requiring robust signal transport and compute power

Data Flow through the SKA



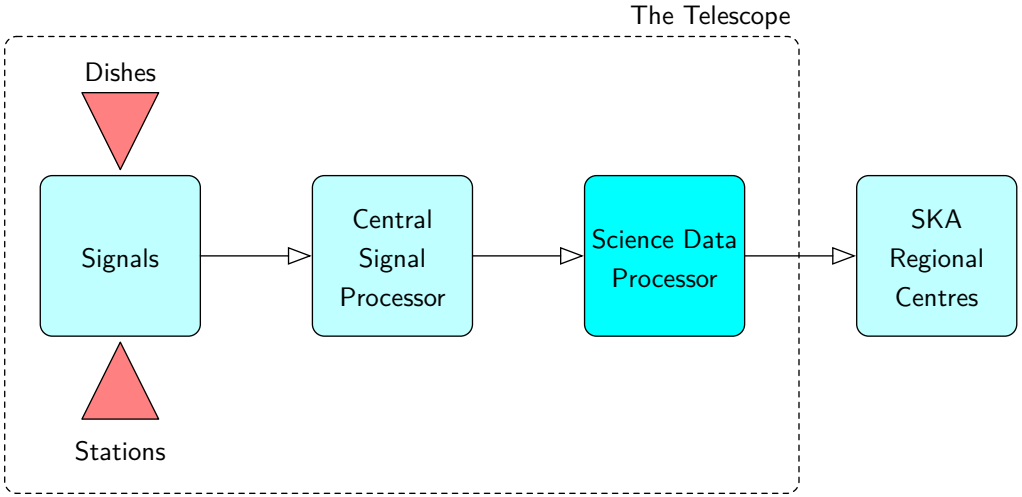
Data Flow through the SKA



Managing the data flow is one of the greatest challenges for SKA

- 0.5-1.0 TB/s from correlator ⇒ 45-85 PB of raw data per day per telescope
- throughput limited by rate at which data can be processed and delivered to SRCs

Data Flow through the SKA



Traditionally, we would not consider SDP an integral part of telescope

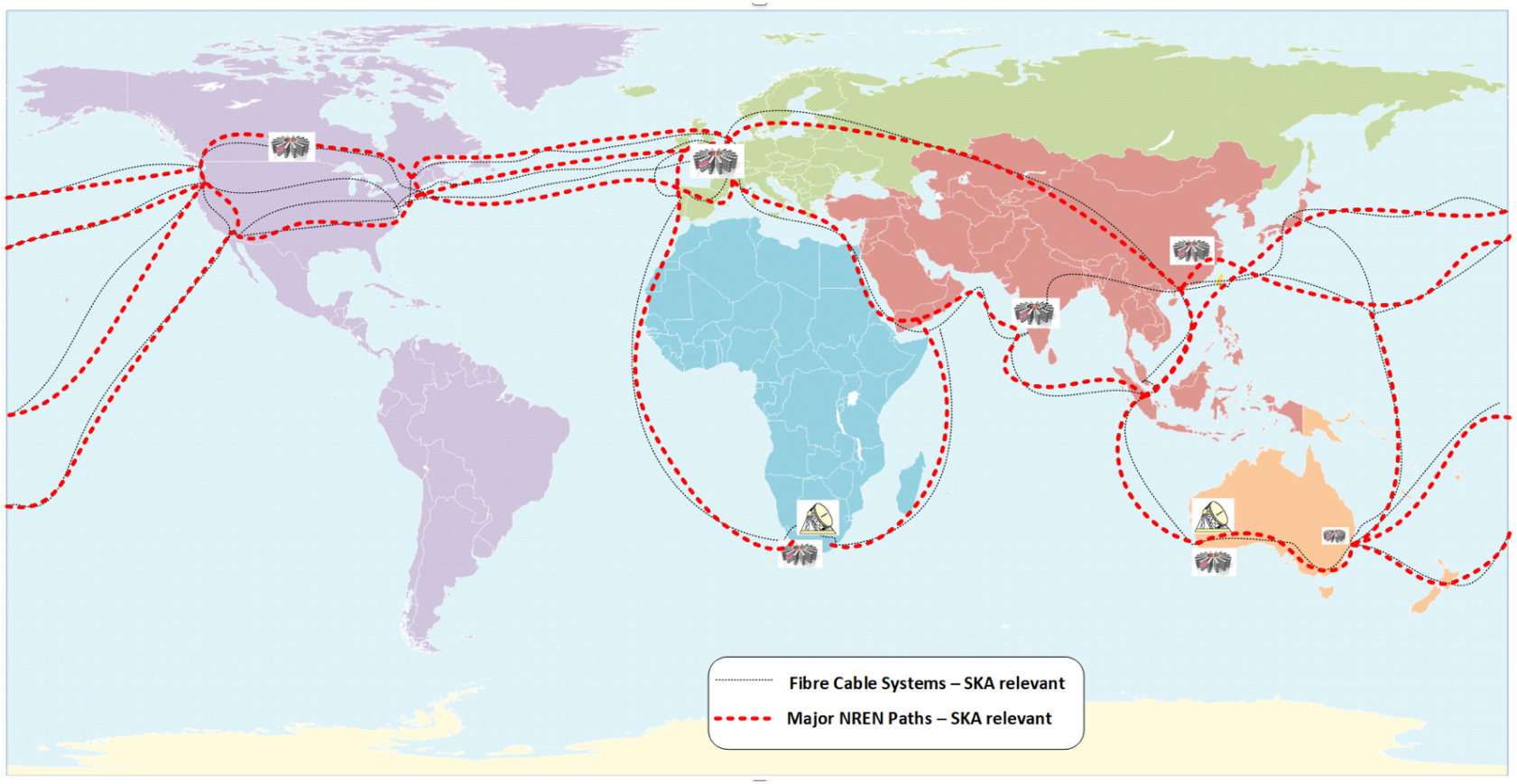
- data reduction should never interrupt or constrain data acquisition

SDP is used for real-time calibration and to generate ODPs

In planning the observing programme, the SDP must become a schedulable resource of the telescopes

Data Flow from the SKA

Observatory Data Products (ODPs) flow from the Science Data Processors in Perth and Cape Town into the SRC Network around the globe



SKA Regional Centres

See presentation by R. Bolton

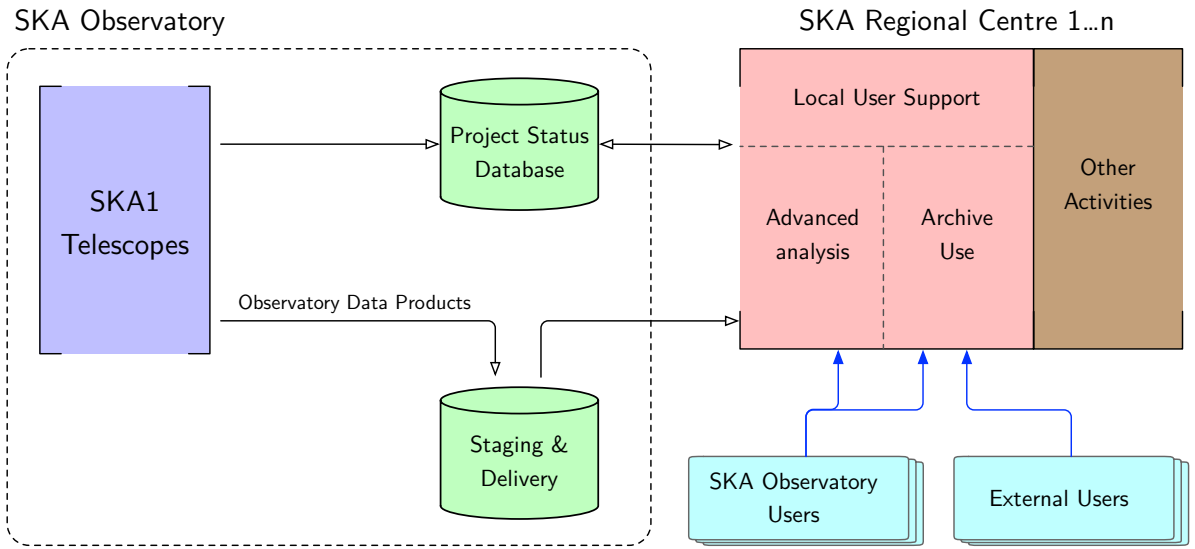
Three main factors that lead to a global collaborative model for SRCs

1. The observatory data products (ODPs) that emerge from SDP will need visualisation, science analysis and modelling
2. The data volumes are so large that direct delivery to end users is unfeasible
3. The community of scientists working on SKA science data will be globally distributed

SKA Regional Centres

The global SRC Network will provide

- platform for collaborative science
- transparent and location agnostic interface for users
- access to project data
- a location for software analysis, modelling, visualisation, algorithm development, etc



SKA Regional Centres

Data Flow	Data Processing	Science Archive	User Support
Maintain the flow of data out of the Observatory and to the SKA community. Allows the science programme to proceed according to schedule	Provide compute resources to allow users to combine and analyse their Observatory & Advanced Data Products	Provide data storage and tools to enable a SKA Science Archive and allow discovery science, perhaps from non-SKA users.	Provide support to users in these SRC activities.

We recognise and acknowledge the Indigenous peoples and cultures that have traditionally lived on the lands on which our facilities are located.

SKAO

www.skao.int