

# SKA Networks

**SA3CC Meeting**  
**7 May 2025**

Richard Hughes-Jones,  
H&R Consultants

In Collaboration with The University of Manchester

# SKA Phase 1 Two Telescopes – One Observatory



**SKA1\_Low 50 – 350 MHz**  
**131,000 dipoles 512 stations of 256 antennas**  
**65 km baselines at Murchison**



**SKA1\_Mid 350 MHz – 14 GHz**  
**64 MeerKAT dishes & 133 SKA1 dishes**  
**120 km baselines at Karoo**

## Each SKA Telescope has Three Networks

### Data Network

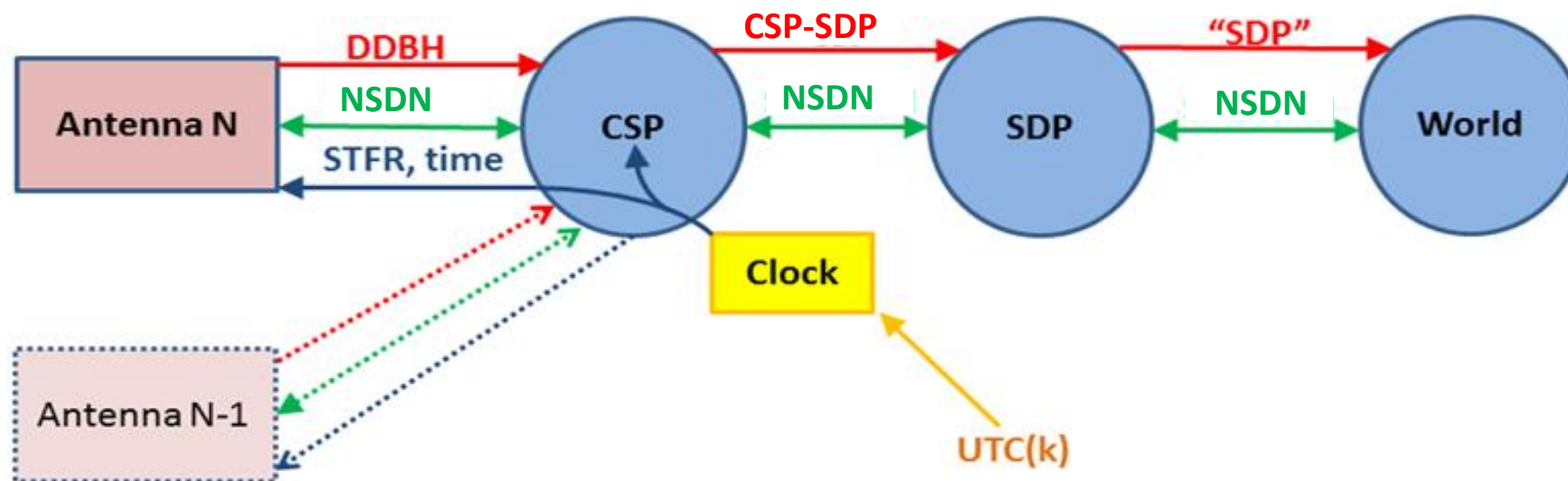
- DDBH
- CSP-SDP
- SDP to Regional Centres

### Sync & Timing

- Clock ensemble
- Freq. & Phase very nice photonics
- **1 ps accuracy, 10ns over 10 years**
- UTC time: White Rabbit

### Non-Science Data

- Control & Monitor
- Alarms
- Internet, VoIP

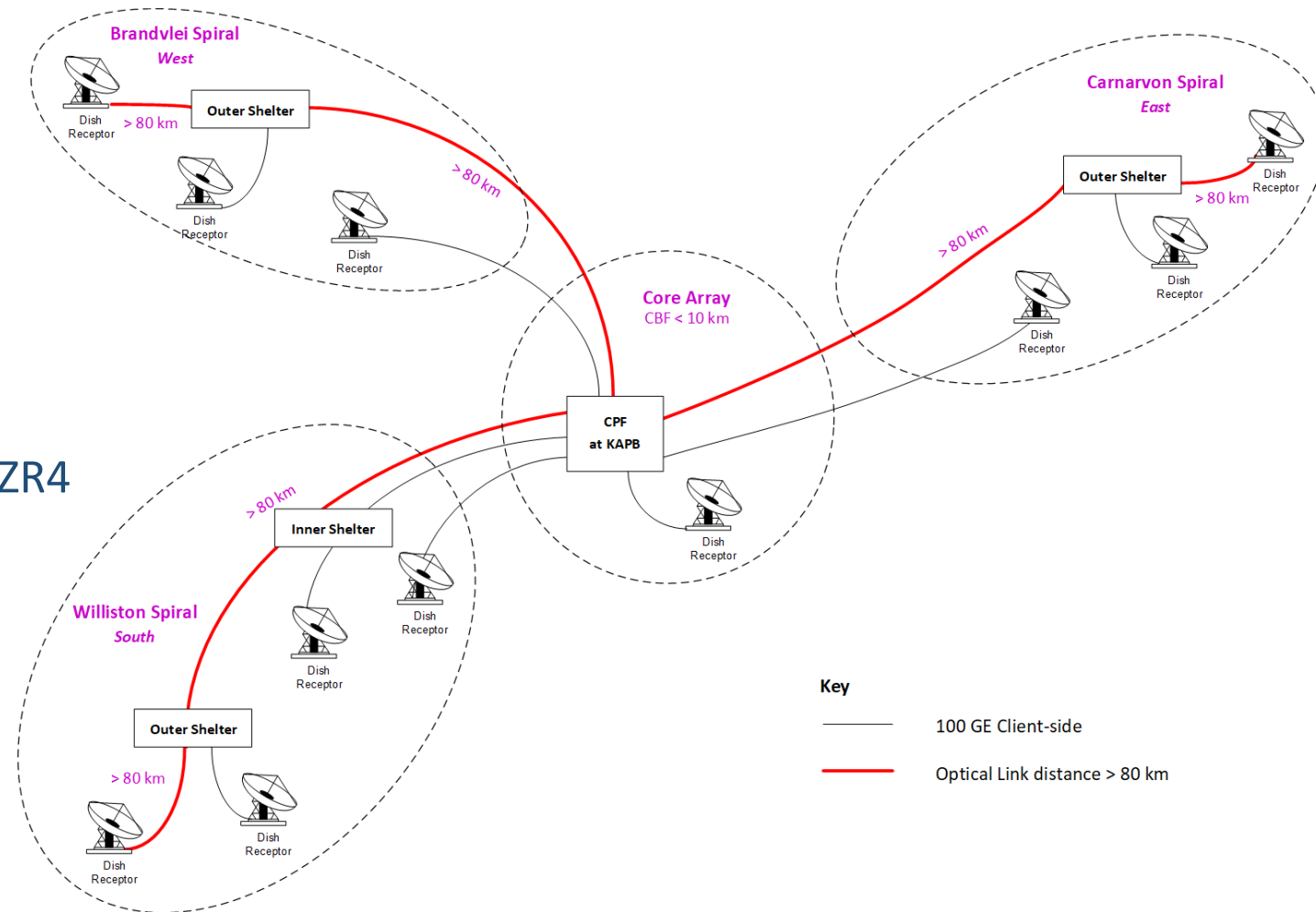


# Connecting the Dishes for Long-Haul Transport

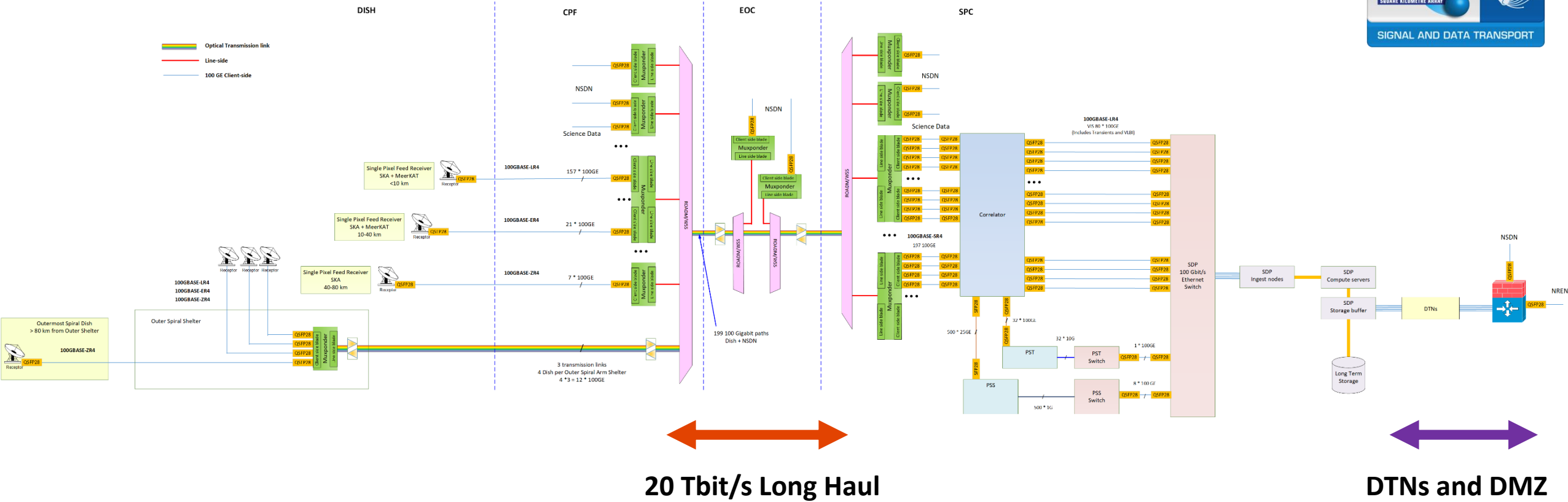
- Both telescopes are made up of a core region and 3 spiral arms
- Core region has the Central Processing Facility, CPF

- For SKA Mid AA4
- 160 Dishes < 10km 100GBASE-LR4
- 23 Dishes 10-40 km 100GBASE-ER4
- 11 Dishes 40-80 km 100GBASE-ZR4
- 3 Outer Spiral Dishes 80-90 km 100GBASE-ZR4

**But the correlators were moved to  
Cape Town for SKA Low  
Perth for SKA Mid**



# The Science Network in the SKA1-Mid Telescope

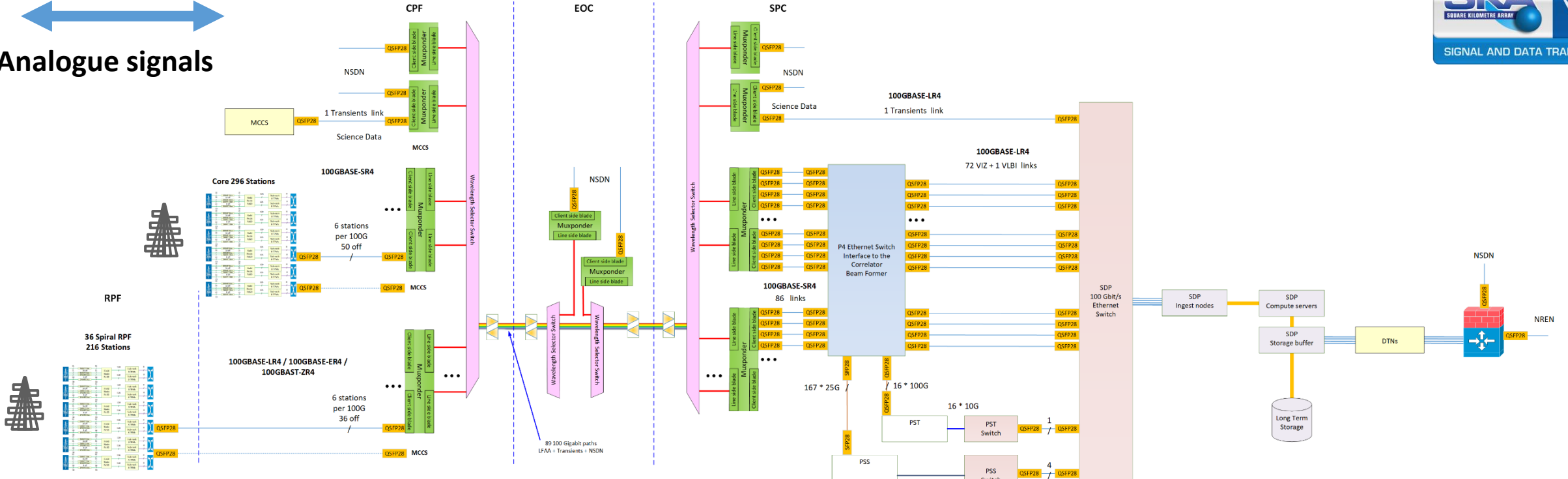


- Each dish has a 100 Gigabit link to the Correlator
- Optical transport on single fibre pair from the Karoo to Cape Town 737 km

# The Science Network in the SKA1-Low Telescope



Analogue signals



Legend for data rates and connections:

- 100 Gbit/s Data (Blue line)
- 100 Gbit/s MCCS (Dotted blue line)
- Line Side 150, 200, 400 Gbit/s (Red line)
- 40 Gbit/s (Purple line)
- 10 Gbit/s NSDN (Green line)
- RfF (Green line)

9 Tbit/s Long Haul



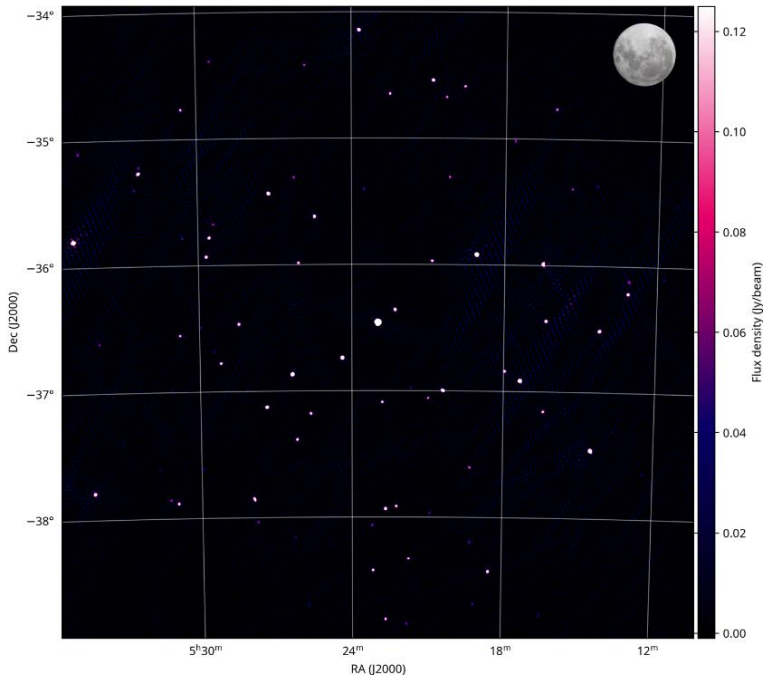
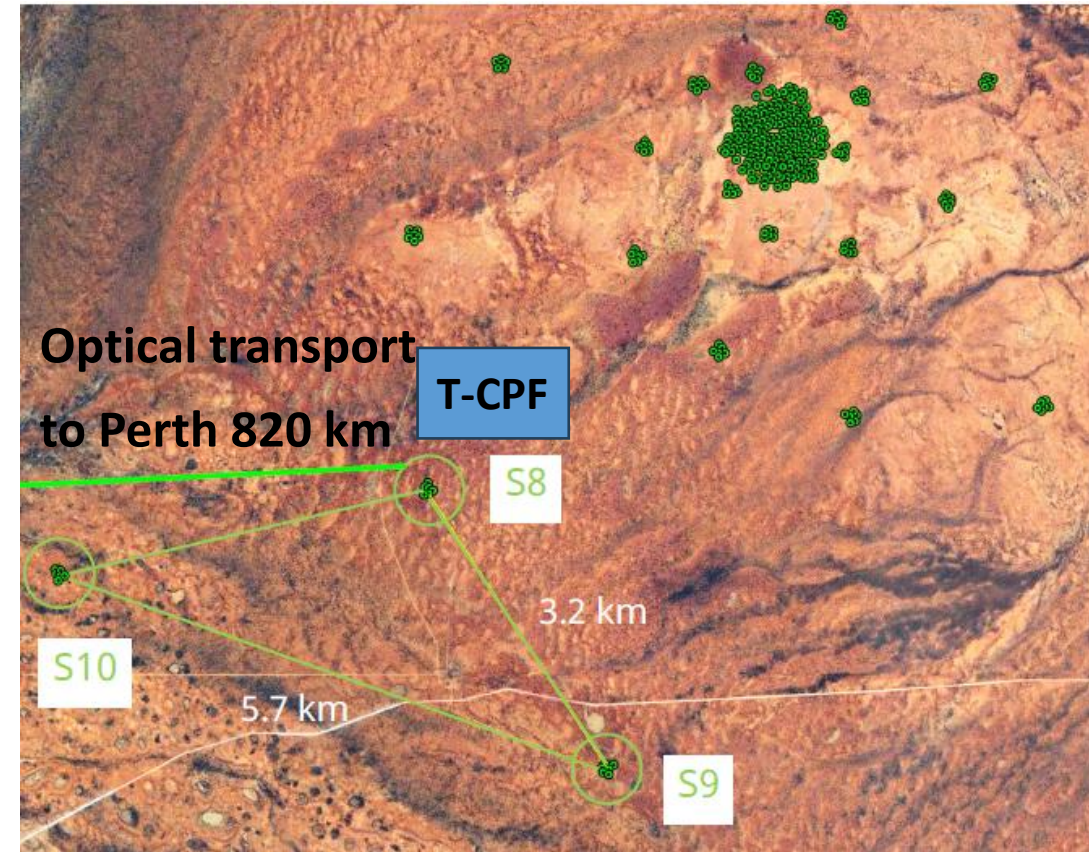
DTNs and DMZ



- Optical transport from the MRO to Perth 820 km
- 6 Stations per 100 Gigabit link

# SKA1-Low AA0.5 Construction Update

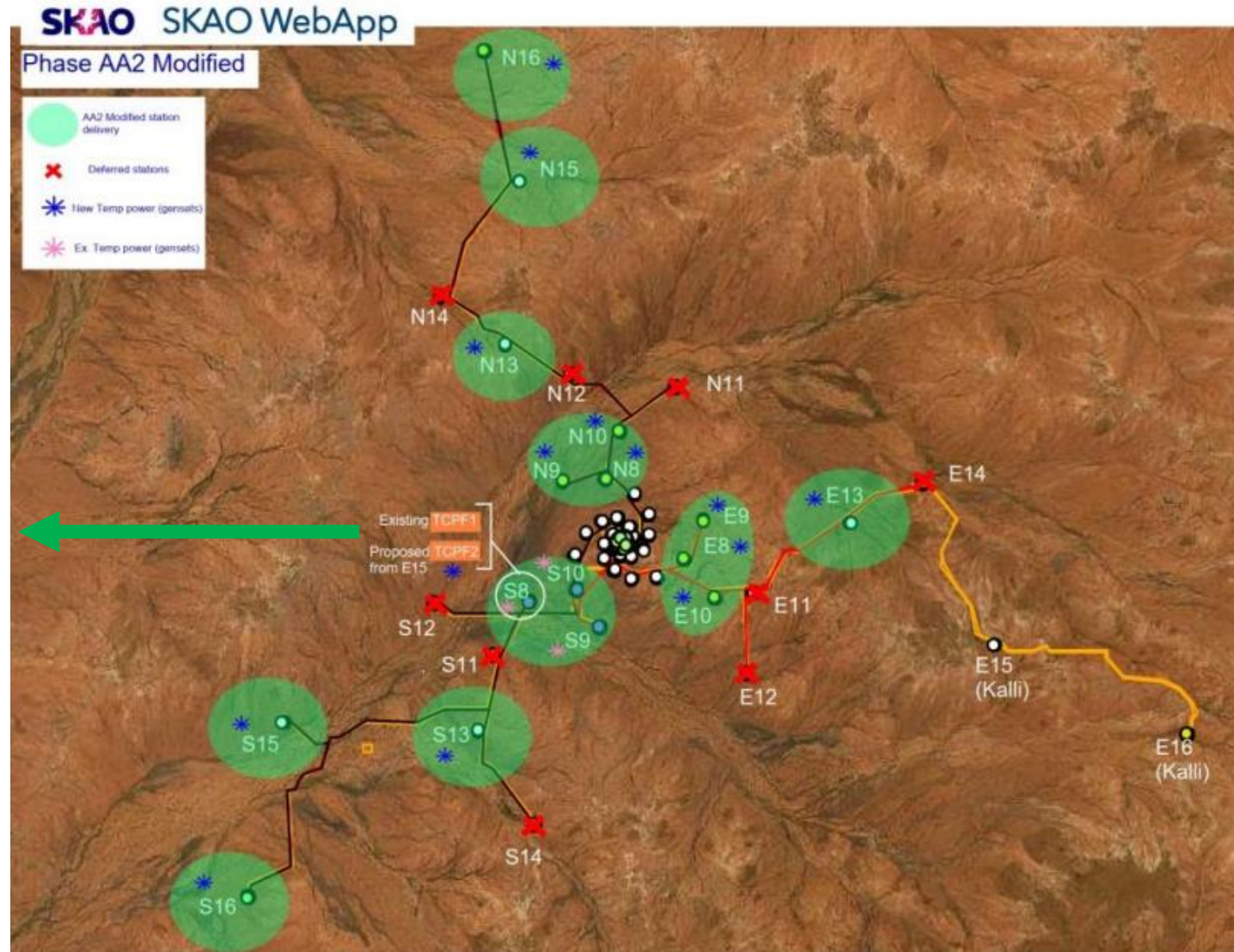
- Long Haul network:
- 3 \* 100 GE QSFP28-100G-LR4 client optics to the Temporary CPF for Stations at locations S8, S9 and S10
- Transported to Perth via 200G wavelengths running 16 QAM @ ~ 34 Gbaud.
- 10 GE for NSDN



- First image of the brightest galaxies in the Universe.
- From 4 stations: 2 at S8, 1 at S9, and 1 at S10
- 1,024 of SKA-Low's two-metre-tall metal antennas

# SKA1-Low Towards AA2

- Temporary CPF at S8:
- 68 Stations on the spiral arms
- No stations in the core
  
- Long Haul Network:
  - 16 \* 100G clients with QSFP28-100G-LR1 or QSFP28-100G-ER1 optics.
  - Will use 800G wavelengths at ~ 140 GBaud with ~16 QAM
  - Present as 2 \* QSFP-DD clients with 4 x 100G-LR1 break-outs.
  - For spans > LR1/ ER1 reach, the 100G clients regenerated as 100G-ZR4

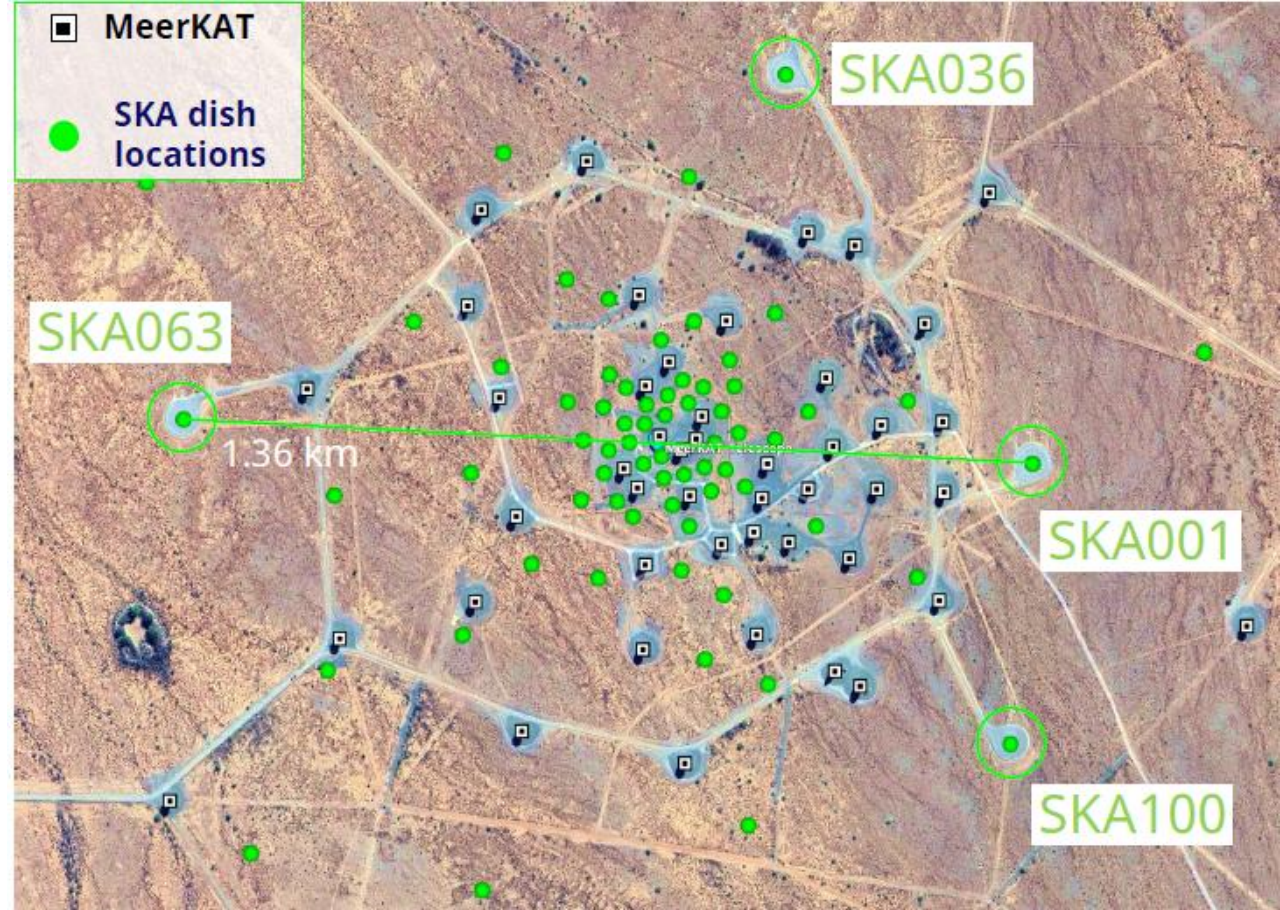
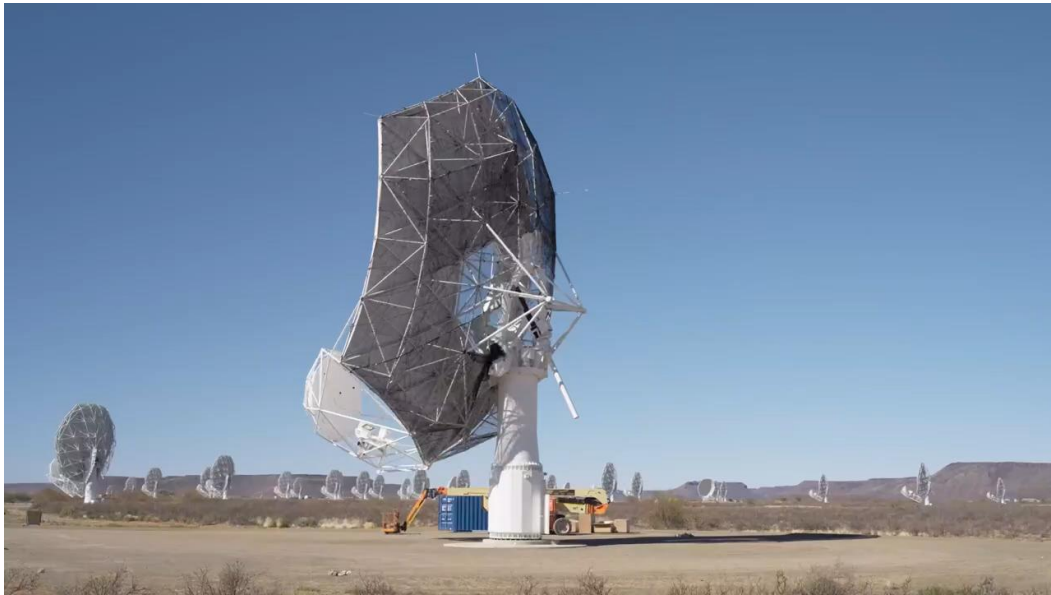


With thanks to  
Tim Rayner  
AARNet



# SKA1-Mid AA0.5 Construction Update

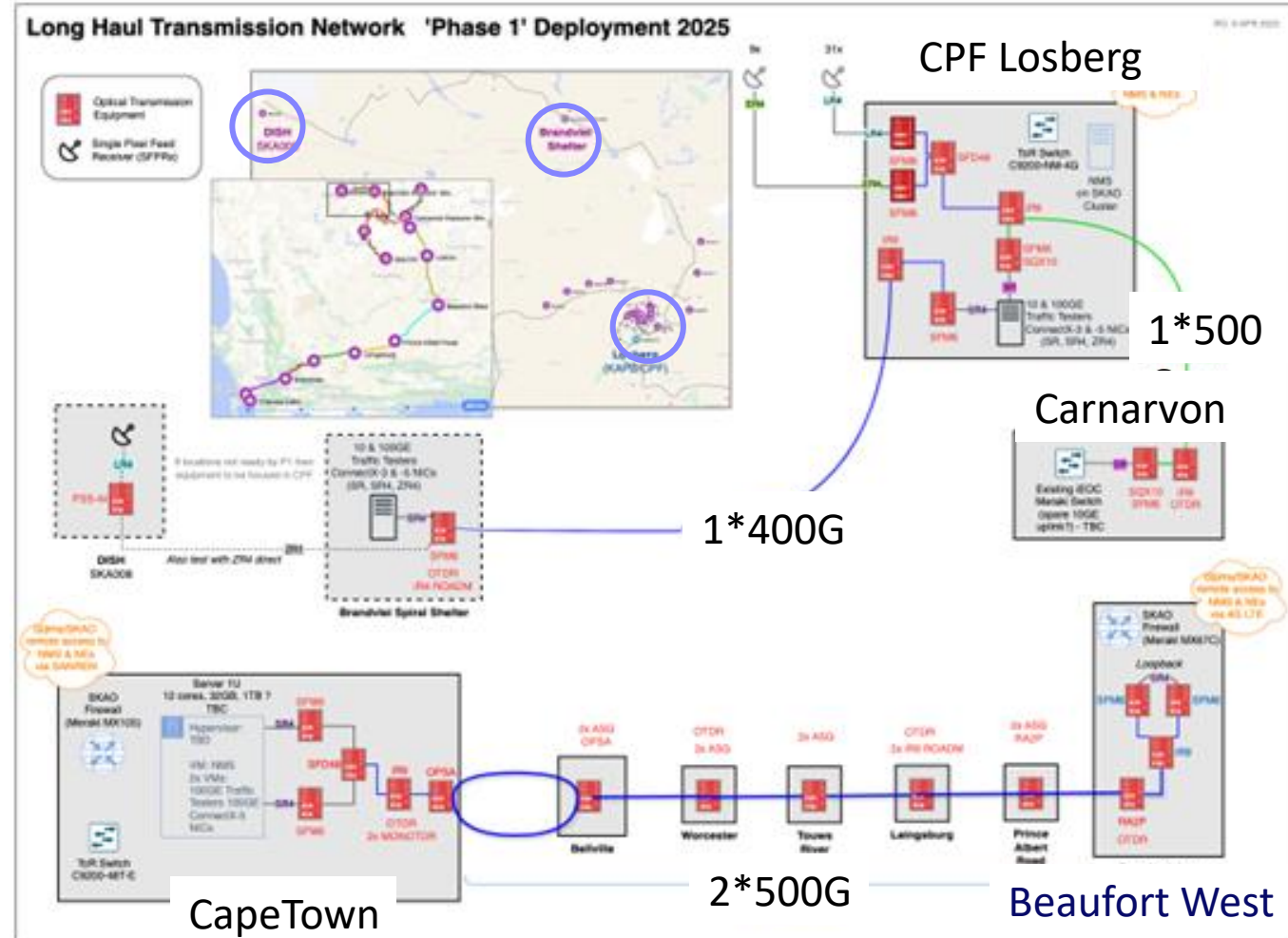
- **SKA063** – erected and can move with MeerKAT dishes. photogrammetry underway
- **SKA001 & SKA100** – dish surfaces lifted
- 4 more dishes on site, more on the way
  
- **Goals for 2025**
  - Signal chain tests with 1<sup>st</sup> Dish
  - Fringes with AA0.5



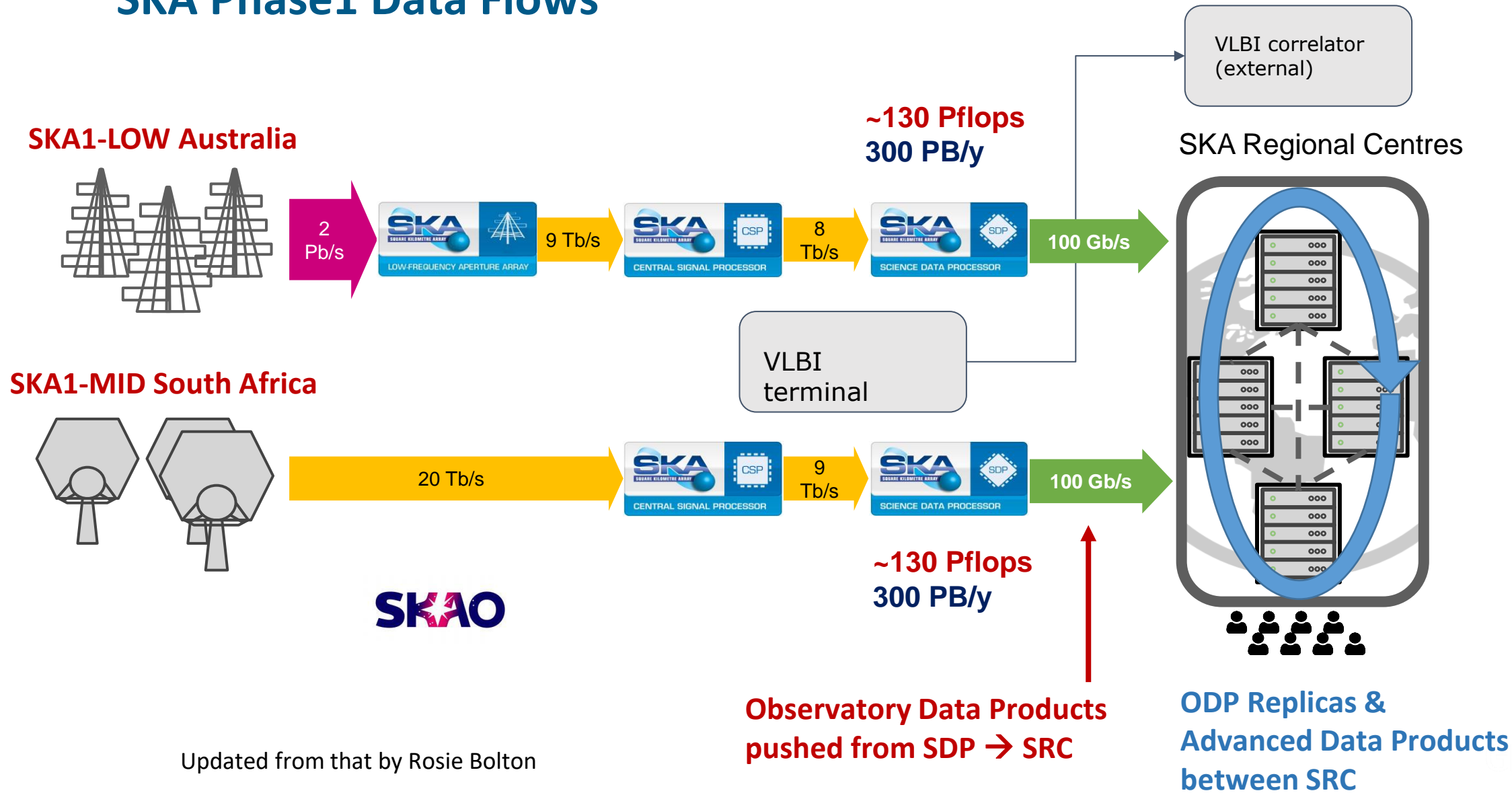
# SKA1-Mid AA0.5 /AA1 /AA2 Networking

- Long Haul Transmission Network:
- Awarded to South African partner Gijima and Nokia
- The Liquid Telecom dark fibre route between Beaufort West and Cape Town is now operational.
- Beaufort West to Carnarvon fibre link
  - Tender review 9 May 2025
  - Contract start Jul 2025
  - 22 km Overhead 78km underground
- Phase 1 deployment planned for this summer.
- Transmission equipment along the Brandvlei spiral arm outermost dish to the outer shelter and on to the CPF at Losberg.
- Use <sup>10</sup> \* 400G wavelength

With thanks to  
Richard Oberland



# SKA Phase1 Data Flows



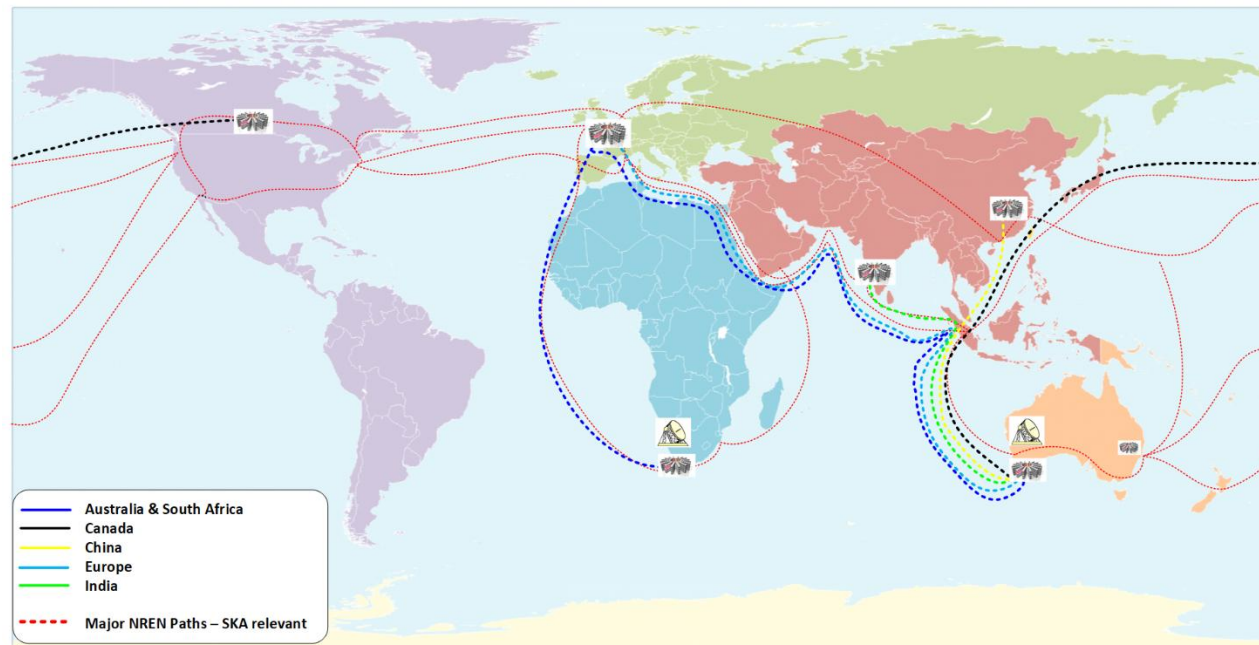
Updated from that by Rosie Bolton

# Global Paths of the Data Flows over the Academic Networks

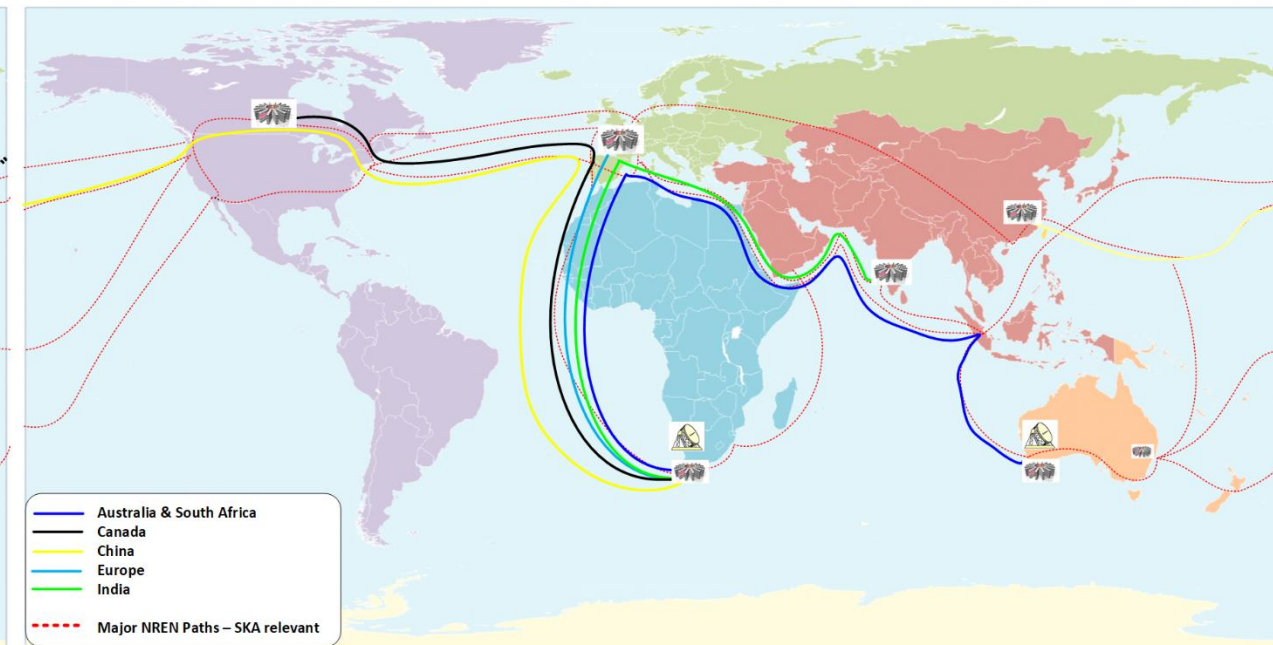
- Five flows on the submarine cable from Perth to Singapore .
- Then join the general purpose routed IP academic network.
- Single flows on the routes to Canada, China and India, Australia is local, and two 20 Gbit/s flows would be carried to London to reach SRCs in Europe and South Africa.

- Five flows on the submarine cable from Cape Town to London.
- Then join the general purpose routed IP academic network.
- Different submarine cables used to reach India and Australia, Europe is local, and two 20 Gbit/s flows cross the Atlantic to SRC in Canada and China.

## SKA1-LOW Australia

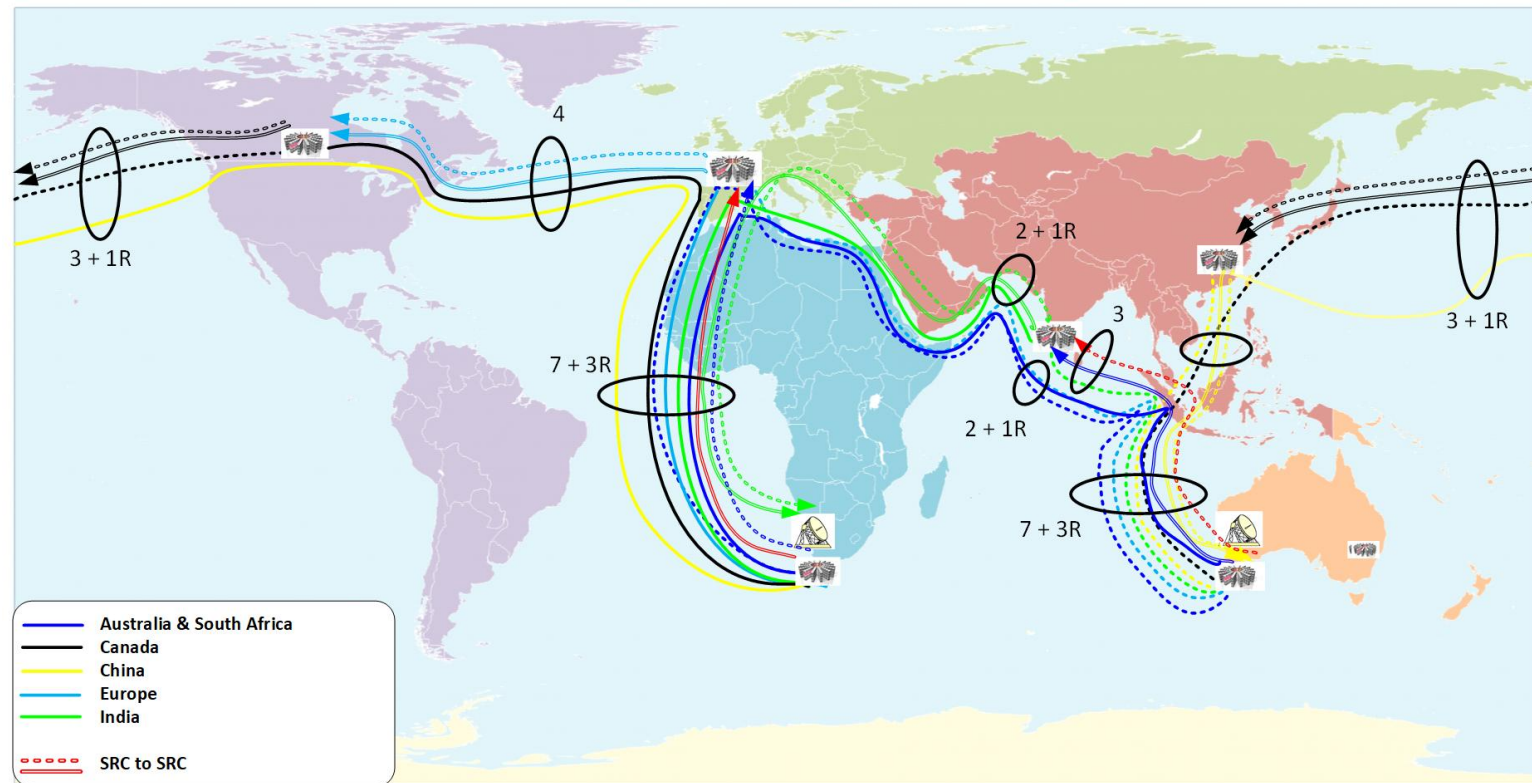
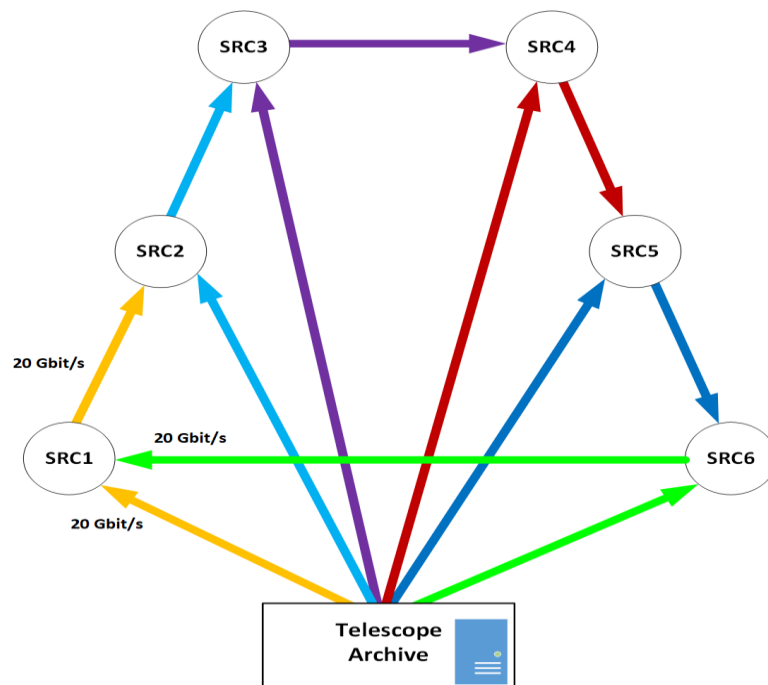


## SKA1-MID South Africa

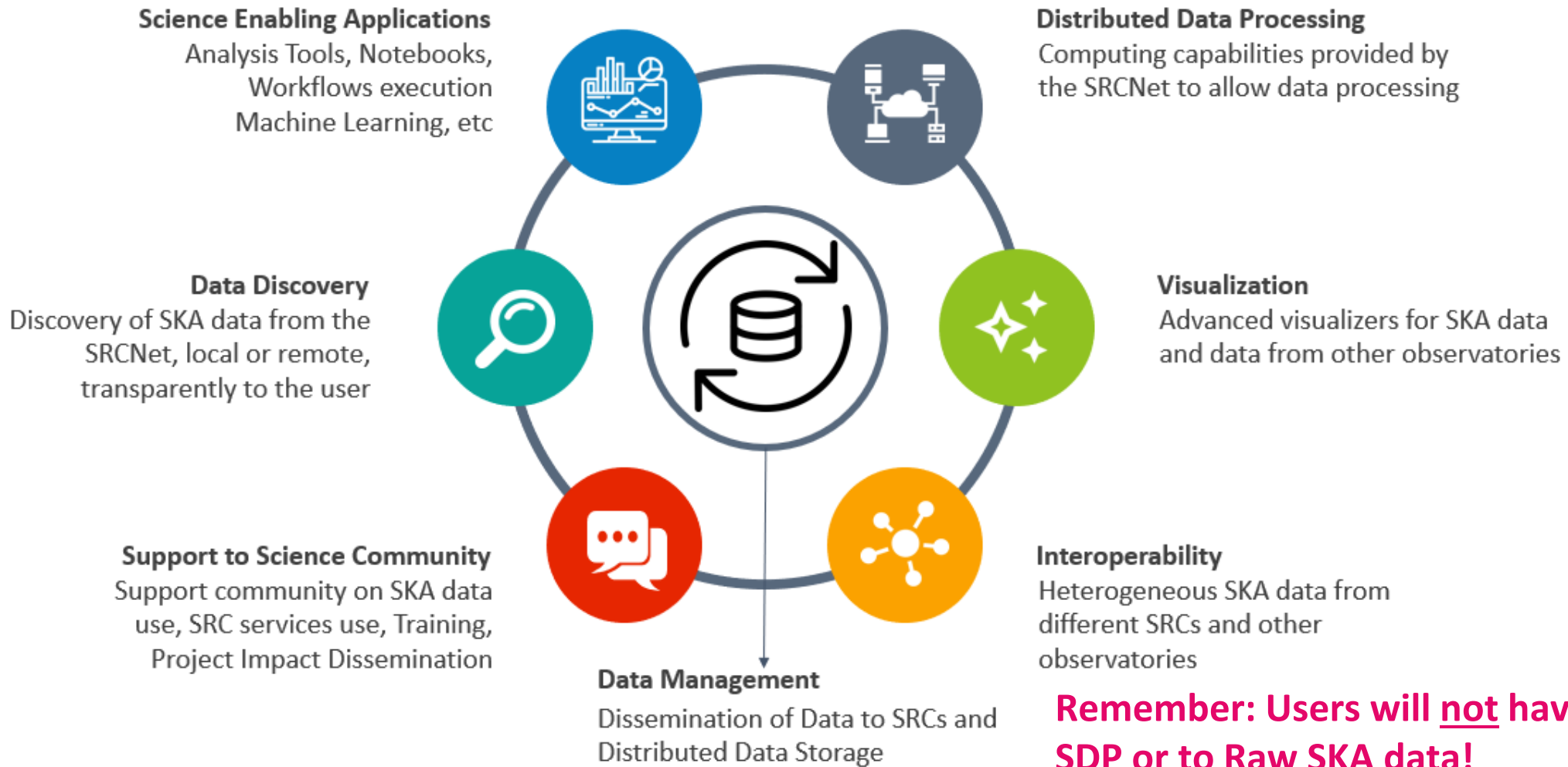


# Global Data Flows for the SRC Re-distribute a 2nd Replica

- Each SRC accepts its fraction of the Observatory Data Products and re-distributes to another SRC.
- SRC has 20 Gbit/s flow from the telescope & a second continuous 20 Gbit/s flow from another SRC.
- Each SRC sends out a 20 Gbit/s flow.
- Makes substantial use of the shared academic network.



# SKA Regional Centre Capabilities

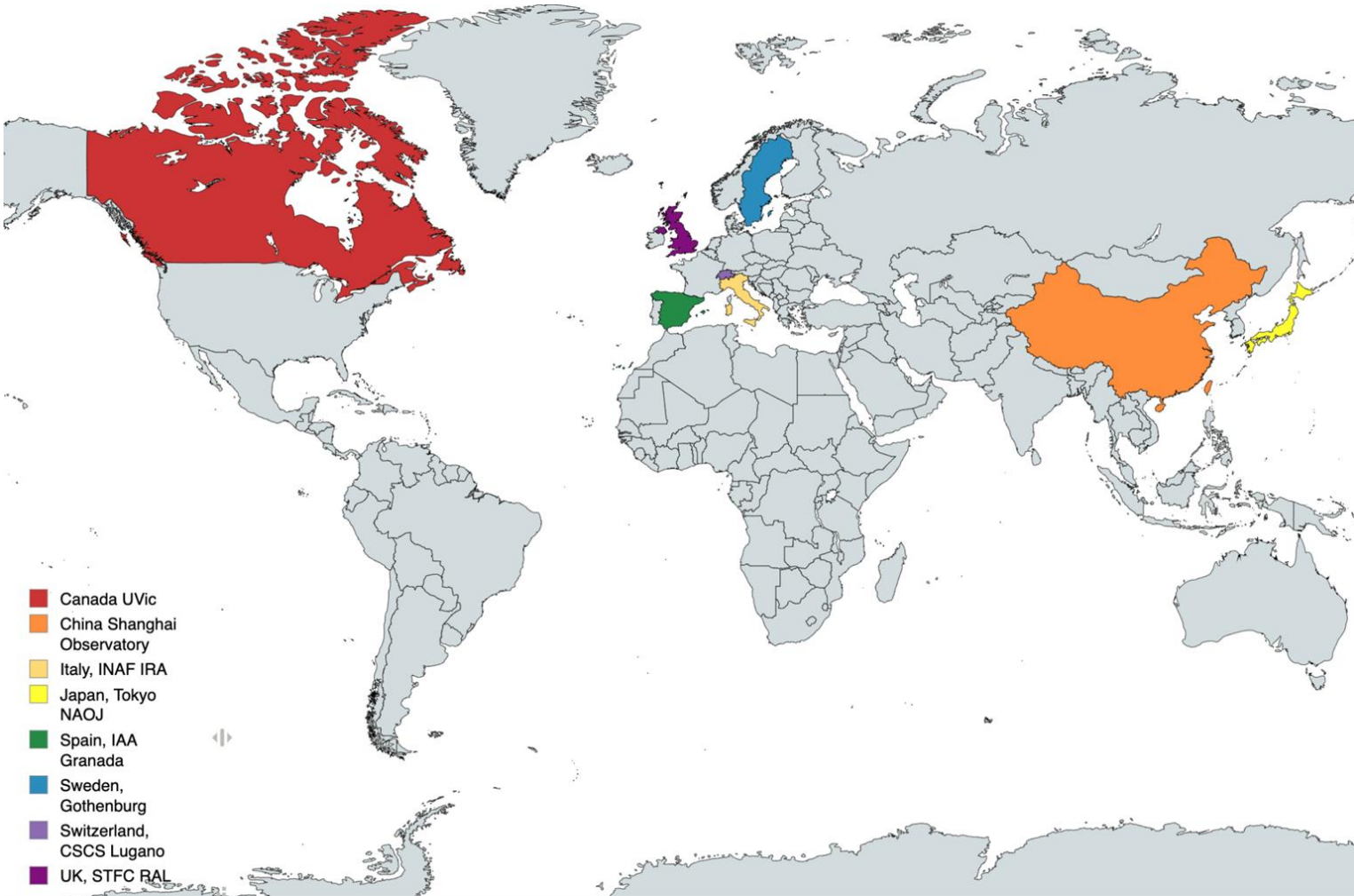


Delivering SKA data products to scientists, storing SKA data for future use, computer facilities to undertake scientific analysis and local user support all fall outside of the construction budget

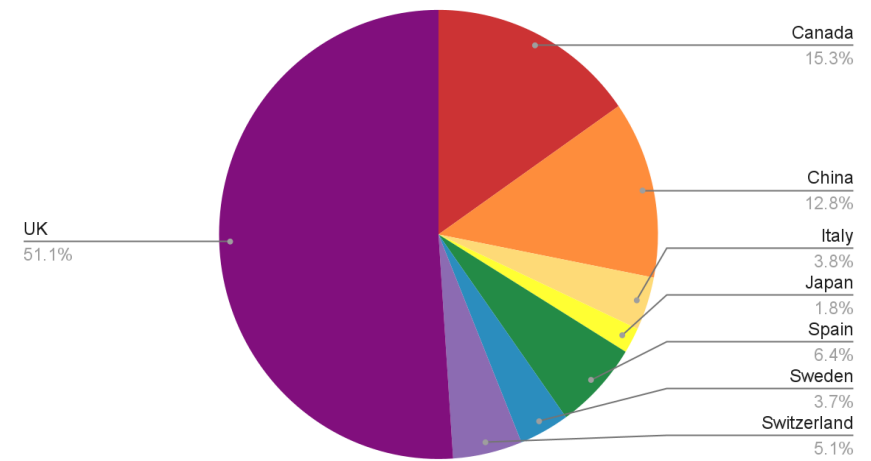
With thanks to  
Rosie Bolton &  
Shari Breen

# SRCNet 0.1 planned sites

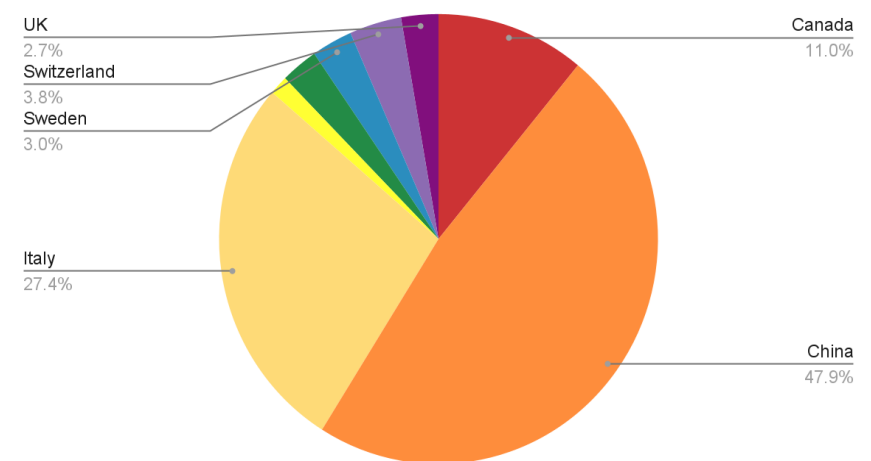
- 8 sites + SKAO will contribute compute and storage resources to SRCNet0.1, for 2025 testing period



Storage fraction for SRCNet0.1



Compute fraction for SRCNet0.1

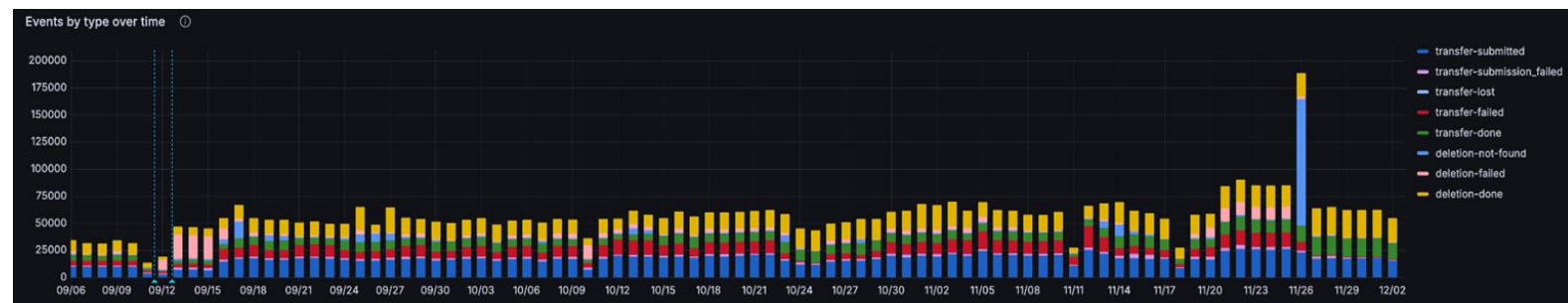


## SRCNet 0.1 Node Status

- The global services are running / resilient
  - Rucio,
  - FTS,
  - IAM,
  - Science Gateway,
  - APIs

NLSRC_PROD_DC	NLSRC_DCACHE	JPSRC_STORM_P	JPSRC_STORM	ITSR
0%	0%	0%	0%	
0%	0%	0%	0%	
0%	0%	0%	1%	
0%	0%	0%	0%	
-	0%	0%	0%	
0%	-	0%	0%	
0%	0%	-	1%	
0%	0%	1%	-	
0%	0%	0%	0%	
0%	0%	2%	1%	
0%	0%	0%	1%	
0%	0%	0%	0%	
0%	0%	0%	0%	

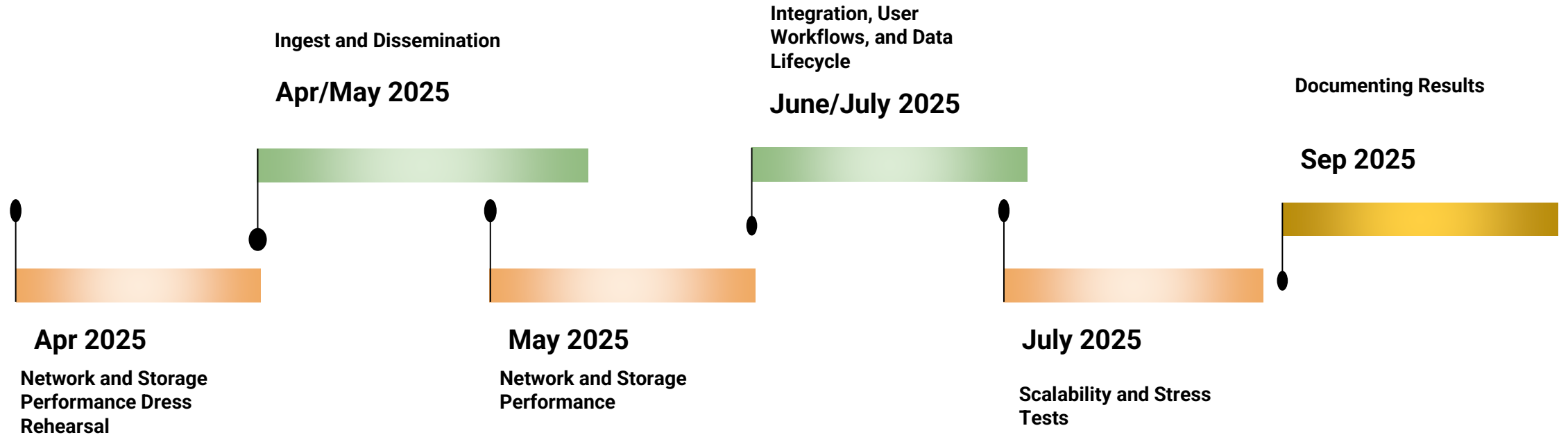
- Switched to the SKA FTS and IAM system with Rucio!  
750k successful transfers since then!





# Test Campaigns in Progress

## Data Lifecycle including User Experience



## Engineering Tests

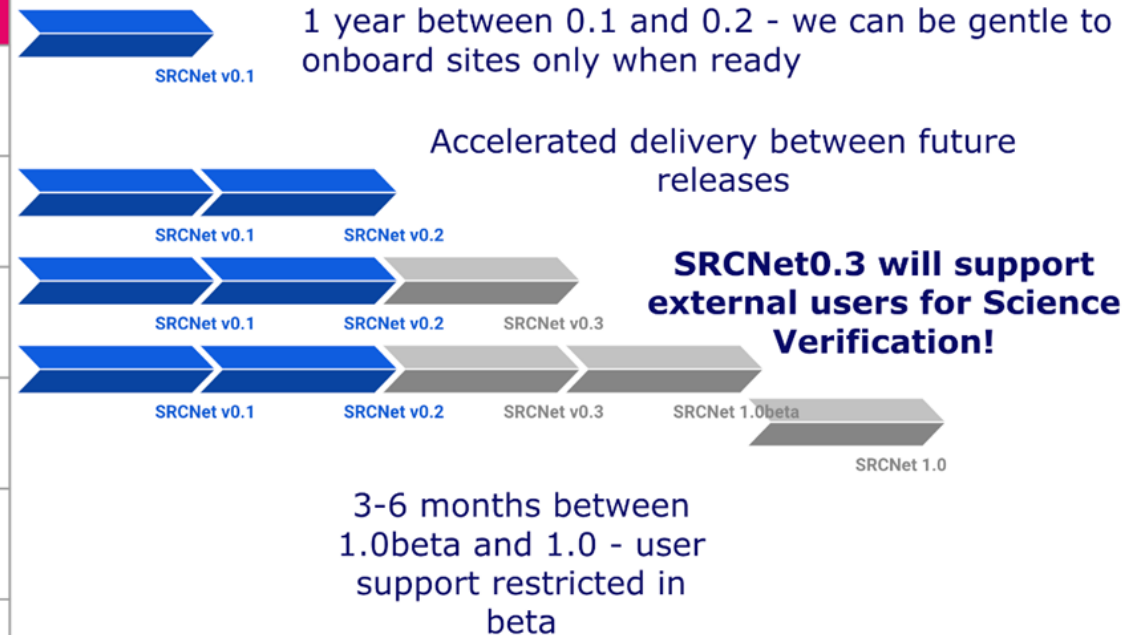
- Explore inter-node connectivity (Data Movement)
- Exercise our SRCNet v0.1 service/system limits
  - Includes the federation approach
- Check our end-to-end workflow



# MPS in the overall timeline context

## Staged Delivery and SRCNet releases side by side

Milestone event (earliest)		SKA-Mid (end date)	SKA-Low (end date)
AA0.5	4 dishes 6 stations	2025 May	2024 Nov
AA1	8 dishes 18 stations	2026 May	2025 Nov
<b>AA2</b>	<b>64 dishes 64 stations</b>	<b>2027 Apr</b>	<b>2026 Dec</b>
AA*	144 dishes 307 stations	2028 Jan	2028 Mar
Operations Readiness Review		2028 Apr	2028 Aug
AA4	197 dishes 512 stations	TBD	TBD



*Pre-SV testing on 0.2 release. Test scaling at some sites. Prove use cases are supported.*

*SKAO timeline may change. Our official project end date is still end June 2028*

To support science verification work in AA2 (Q4 2026) means completing deployment of a stable, tested version of SRCNet software on sites with appropriate scale by end of PI31. Really want almost all functionality 6 months before (Q1 2026 = SRCNet0.2)



# Any Questions ?

