



REGIONAL
CENTRE
NETWORK

SKA Regional Centre Global and Local Network Provisioning

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SRCNet Global and Local Network Provisioning

- **Background**
- SRC Distribution & GREN
- Estimating data volumes and bandwidths
- Strategic Coordination
- Summary

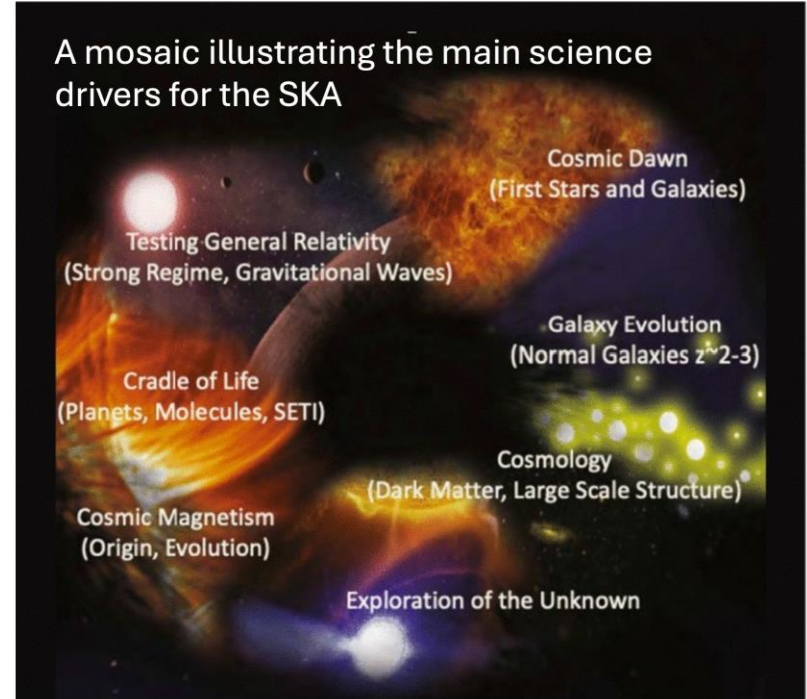


Square Kilometer Array: Transforming radio astronomy

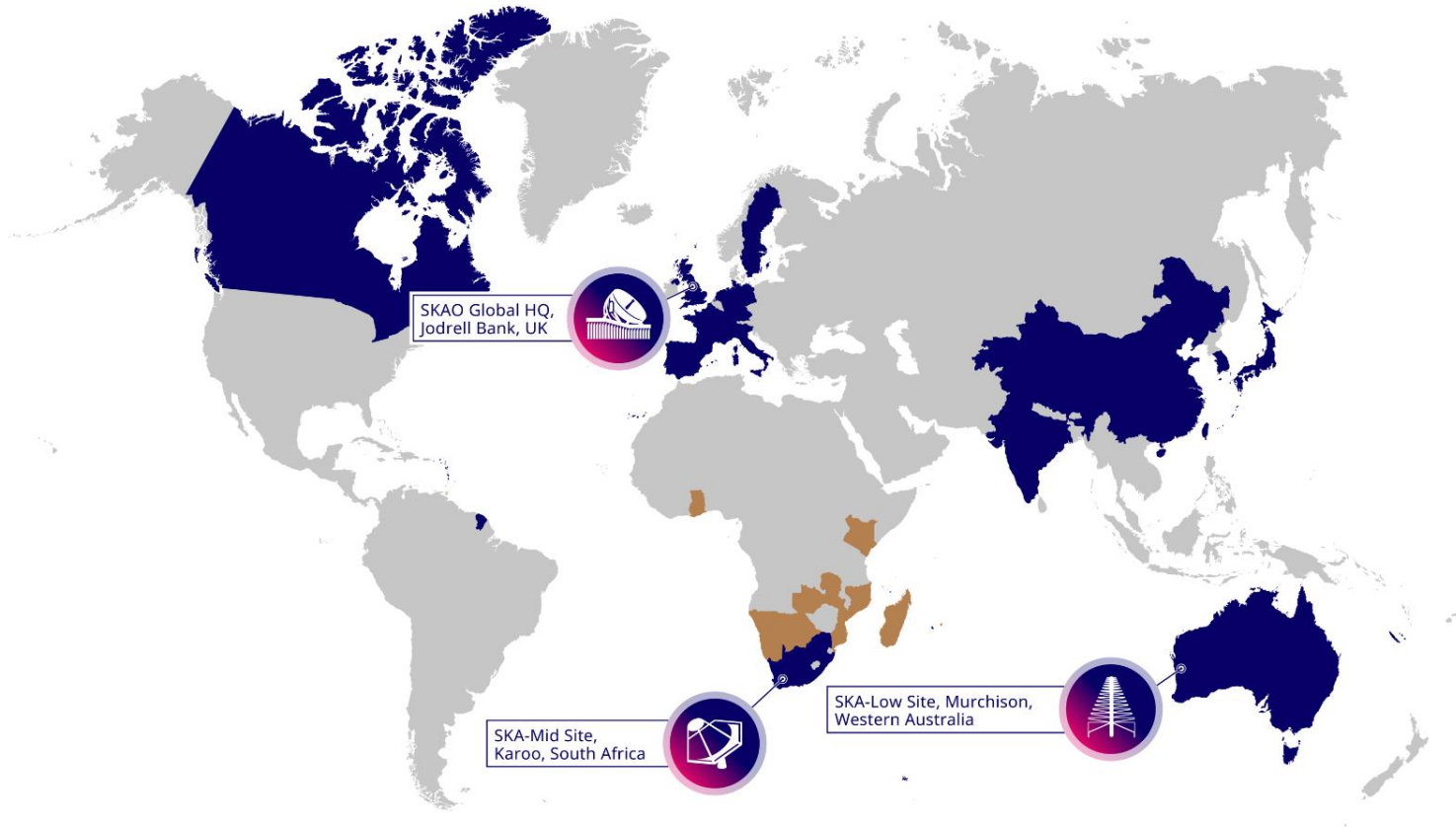
The Square Kilometer Array (SKA) Observatory (SKAO) is a next-generation radio astronomy facility which will cover the frequency range from 50 MHz to 15 GHz.



Composite image of the SKA telescopes, blending real hardware already on site with artist's impressions. credit: SKA Observatory



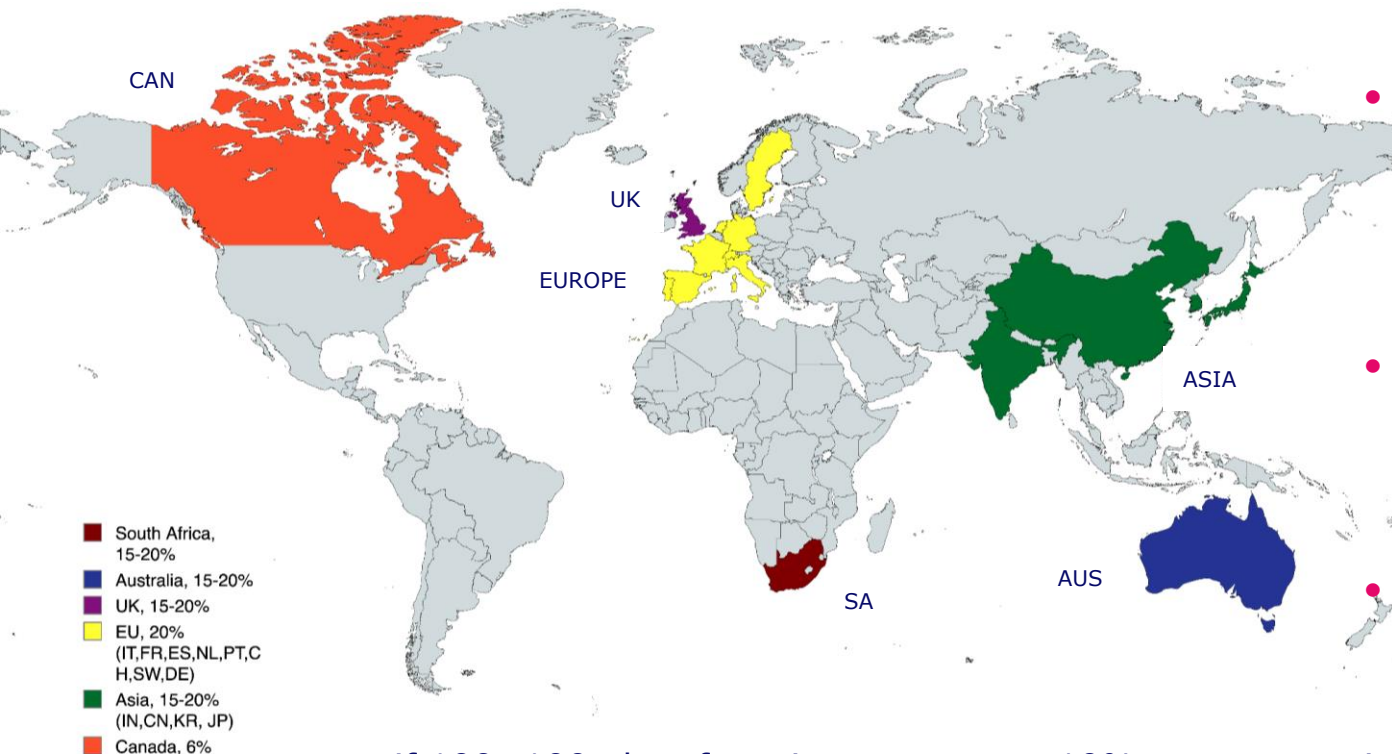
Credit: SKA Observatory



- SKAO Partnership - includes SKAO Member States* and SKAO Observers (as of April 2023)
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- African Partner Countries
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SKA Regional Centre Broad Distribution

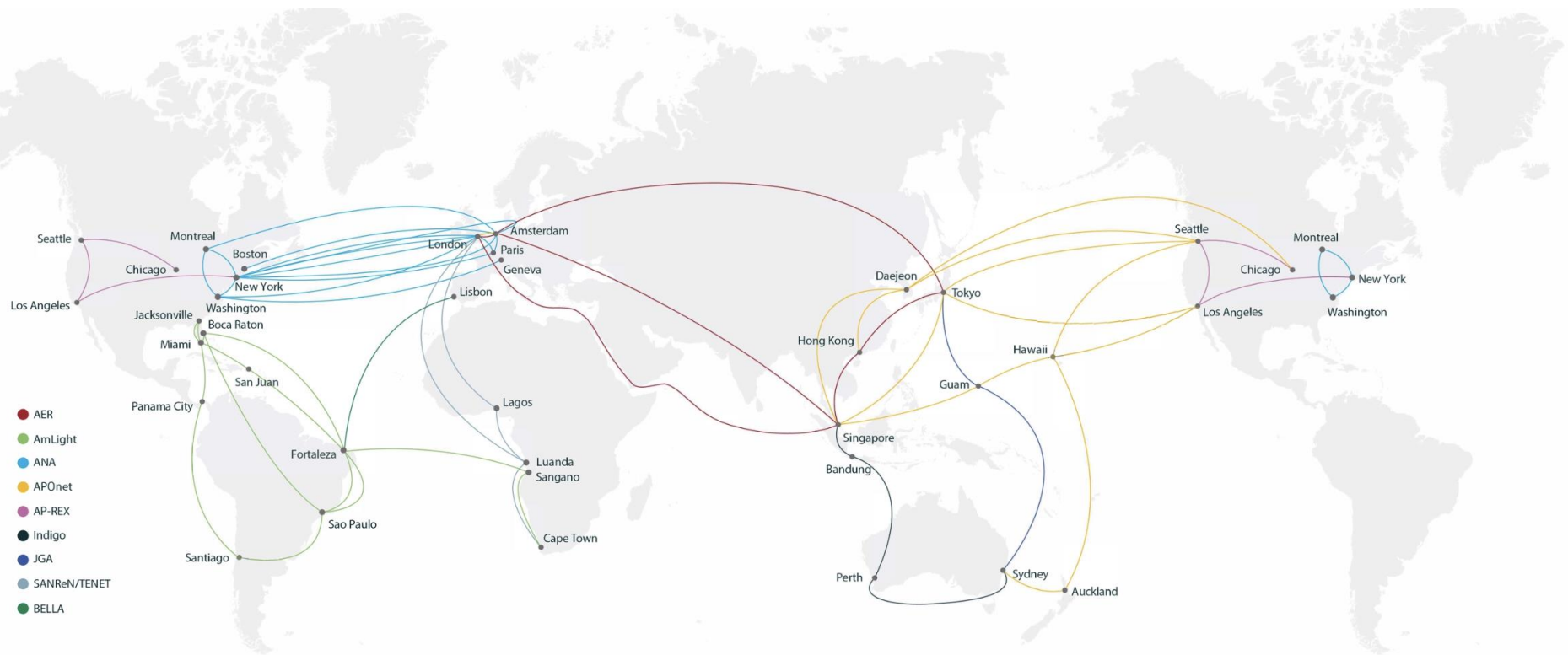


- Roughly, 6 global zones of equivalent size (Canada smaller)
- **Distribute two base copies** of each data product to different countries, and perhaps insist to different regions
- Average incoming rate per (20%) region not more than 2x40 Gbit/s = 80Gbit/s (~2x12 Gbit/s for Canada)
- **Modelling assumes average 100 Gbit/s out of SA and AUS**

e.g. if 100+100 gbps from instruments, a 10% partner receives 40gbps data (400 TBytes per day, 140 PBytes per year)



The Global Research & Education Network



From Shari's talk we're heading towards ~150PB/year from each of WA & SA to Singapore and London respectively. Average of ~50Gbit/s.



Estimating SRC data volumes and bandwidths

The combined expected volume of data output from both telescope sites over one year.

This is assumed over one year of continuous average output.

Annual data [PB] 500

Increase of data (fraction) per year (compounded).

This assumes the total data on disk is increasing slowly over time.

Annual increase in volume fact... 0.00

Number of years from the start.

This allows for extrapolation into future years from a given starting point.

Year increment 0

The average fraction of ADP compared to telescope input.

Assumed average ADP size relative to total telescope data.

ADP size factor 0.30

The number of replicas that SRCNet should hold on disk.

(Note this includes the primary copy and additional copies of data.)

Replicas (Disk) 2

Annual expected data on disk.

Annual Archive Growth [PB]

The percentage of data a given SRC should receive.

• This is representative of the contribution of the given SRC.

Percent SRC [%] 10.00

Expected volume of data retransmission due to failures and data consolidation activities.

Fraction of re-tries 1.50

Additional overhead of network operations (e.g. packet headers).

Network overhead (8:10 enco... 1.25

Required SRC Node data disk capacity.

SRC Disk [PB]

Developing a modeling tool that takes

- Total data volume being sent to the SRC network
- Assumptions about retries, ratio of analysis products to data from instruments, etc

For a given percentage size SRC gives

- Total disk storage
- Tape growth per year
- Ingress and egress average bandwidths
- Ingress and egress peak bandwidths

This is enough for SRCs to know where they should be aiming in discussions with their NRENs

Estimating SRC data volumes and bandwidths

The combined expected volume of data output from both telescope sites over one year.

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Tool that takes

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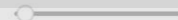
Annual data [PB]



500

Assumed average ADP size relative to total telescope data.

ADP size factor



0.30

For a given percentage size SRC gives

The number of replicas that SRCNet should hold on disk.

(Note this includes the primary copy and additional copies of data.)

Replicas (Disk)



2

- Total disk storage
- Tape growth per year
- Ingress and egress average bandwidths
- Ingress and egress peak bandwidths

Annual expected data on disk.

Annual Archive Growth [PB]

1300

The percentage of data a given SRC should receive.

• This is representative of the contribution of the given SRC.

Percent SRC [%]



10.00

Expected volume of data retransmission due to failures and data consolidation activities.

Fraction of re-tries



1.50

Additional overhead of network operations (e.g. packet headers).

Network overhead (8:10 enco...



1.25

Required SRC Node data disk capacity.

SRC Disk [PB]

130

This is enough for SRCs to know where they should be aiming in discussions with their NRENs

Estimating SRC data volumes and bandwidths

The combined expected volume of data output from both telescope sites over one year.

This is assumed over one year of continuous average output.

Annual data [PB] 500

Increase of data (fraction) per year (compounded).

This assumes the total data on disk is increasing slowly over time.

Annual increase in volume fact... 0.00

Number of years from the start.

This allows for extrapolation into future years from a given starting point.

Tool that takes

- Total data volume being sent to the SRC network
- Assumptions about retries, ratio of analysis products to data from

Expected volume of data retransmission due to failures and data consolidation activities.

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SRC Disk [PB]

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SRC Disk [PB]

Estimating SRC data volumes and bandwidths

Peak capacity factor

- This factor accounts for short-term surges in data rates above the long-term average. Even if the average transfer rate can be met most of the time, real-world traffic often "bursts" at higher rates over short intervals.
- By applying a burst capacity factor, we ensure the network is provisioned so that these spikes do not saturate the link.

Peak capacity factor 2.00

Network bandwidth utilisation factor

This adds further headroom to avoid saturation, especially on shared links or when other overheads and competing traffic are present.

Network utilisation factor 2.00

SRC Node Ingress rate, volume, and peak rate.

Ingress [PB]

Ingress [Gb/s]

Ingress Peak [Gb/s]

SRC Node Egress rate, volume, and peak rate.

Egress [PB]

Egress [Gb/s]

Egress Peak [Gb/s]

Network Peak Bandwidth Estimated Requirement

Ingress Peak Network Bandwidth Egress Peak Network Bandwidth

Estimating SRC data volumes and bandwidths

SRC Input volume vs Share size

Volume [PB] /Share [15%]	5	10	15
100	13	26	39
250	32.5	65	97.5
500	65	130	195

	Input
Annual Disk Volume [PB]	780.00
ADP size fraction	0.30
Annual increase fraction	0.00
Year count	0.00
Number of Replicas	2.00
Data Consolidation / retry factor	1.50
Network overheads factor	1.25
Peak capacity factor	2.00
Network Bandwidth factor	2.00

100

Share [%]	1	2	5	10	15	20
Disk [PB]	3	5	13	26	39	52
Ingress Data [PB]	3	5	13	26	39	52
Egress Data [PB]	1	3	6.5	13	20	26
Ingress Rate [Gb/s]	1	3	6.2	12	19	25
Ingress Peak Rate [Gb/s]	3	5	12	25	37	50
Ingress Peak Bandwidth [Gb/s]	5	10	25	50	74	99
Egress Rate [Gb/s]	1	1	3.1	6.2	9.3	12
Egress Peak Rate [Gb/s]	1	3	6.2	12	19	25
Egress Peak Bandwidth [Gb/s]	3	5	12	25	37	50

250

Share [%]	1	2	5	10	15	20
Disk [PB]	6.5	13	33	65	97.5	130
Ingress Data [PB]	6.5	13	33	65	97.5	130
Egress Data [PB]	3.2	6.5	16	32.5	48.8	65
Ingress Rate [Gb/s]	3.1	6.2	16	30.9	46.4	61.8
Ingress Peak Rate [Gb/s]	6.2	12	31	61.8	92.8	124
Ingress Peak Bandwidth [Gb/s]	12	25	62	124	186	247
Egress Rate [Gb/s]	1.5	3.1	7.7	15.5	23.2	30.9
Egress Peak Rate [Gb/s]	3.1	6.2	16	30.9	46.4	61.8
Egress Peak Bandwidth [Gb/s]	6.2	12	31	61.8	92.8	124



Estimating SRC data volumes and bandwidths

- For one of the (ultimately) largest SRCs such as the UK these bandwidths could already be accommodated by the existing links provided by JISC both to the labs involved and to GÉANT.
- By 2029 those campus connections and the connections to GÉANT should accommodate the requirement comfortably.

Volume [PB] [15%]	5	10	15
	100	26	39
	250	32.5	65
			97.5

	Input
Volume [PB]	XYZ
ADP size fraction	0.3
ADP fraction	0
Year count	0
Number of Replicas	2
Data Consolidation / retry factor	1.5
Network overheads factor	1.25
Peak capacity factor	2
Network Bandwidth factor	2

	100	150	200	250	300	350
Disk [PB]	3	5	13	26	39	52
Ingress Data [PB]	1	3	6.5	13	20	26
Egress Data [PB]	1	3	6.5	13	20	26
Ingress Rate [Gb/s]	3.2	12	19	25		
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Whose responsibility?

Analogy with WLCG holds.

- The T1s are responsible for assuring agreed bandwidth to CERN – which they do by procuring OPN links
- CERN in turn has to provide its own endpoints
- This is all done by negotiation with (and payments to) network providers

In SRCNet (and the SKAO SDPs)

- The sites are responsible for negotiating sufficient bandwidth – effectively connecting them to one part or another of the GREN
- In almost all cases – both in terms of countries and specific campuses the bandwidth itself is there
 - Mostly, comfortably more than necessary
- The only question is agreeing with the NREN in question about paying for utilization

There are some ongoing discussions WRT to

- China (100GB may not be enough for both WLCG & SRCNet)
- India
- Some specific sites



New SRCNET Network Strategy group

Convening SRCNET Network Strategy Group

- Rosie's request last year
- Aim
 - Provide assurance that global network provision is in place
 - Provide forum to coordinate any action required
 - Provide forum for more strategic technical discussions
 - Eg use of VRFs
- Email list set up (took longer than you'd think)
- There is still the more technically oriented NREN forum

Scheduling meetings

- Looking for F2F meetings with critical mass of members present
 - TNC?
 - TechEx?
 - APAN?
 - We're unlikely to find one that everyone attends
- But also important to strengthen the technical collaboration we see at meetings like this.
- We can expect the data movement model to "loosen"
 - Network likely to be less of a limitation than storage availability – as has happened in WLCG



Summary

Data Volumes and Bandwidth estimation

- SKAO is refining its roadmap for how much data will be produced and when
- In SRCNet we can translate that to local bandwidth requirements at SRCNet sites
 - Can map that to the developing requirement
- It is the responsibility of sites to ensure they have the network provision required locally
- NRENs and SRCNet sites can negotiate if investment/development is required

SRCNet Networking coordination

- SRCNet Network Strategy Group
 - Able to confirm global requirements fit in existing or planned capacity
 - Able to ensure any global or local issues are addressed
 - Meeting at existing international forum around the world
- NREN Forum
 - Continue to work on more technical coordination – eg monitoring
- These sessions in the LHCOPN-LHCONE context are invaluable
 - It is vital that we are able to collaborate



Questions / discussion

