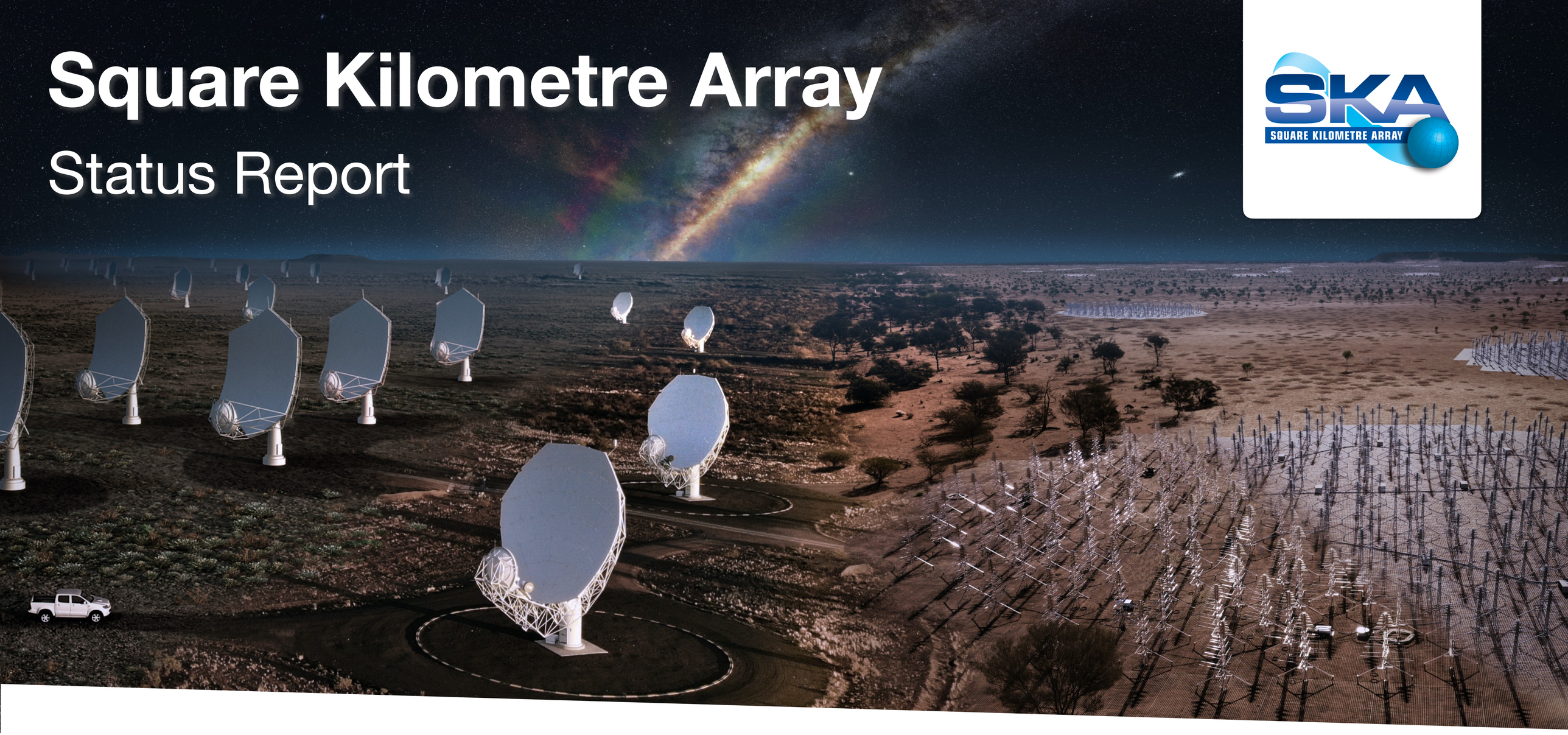
Square Kilometre Array

Status Report



SQUARE KILOMETRE ARRAY

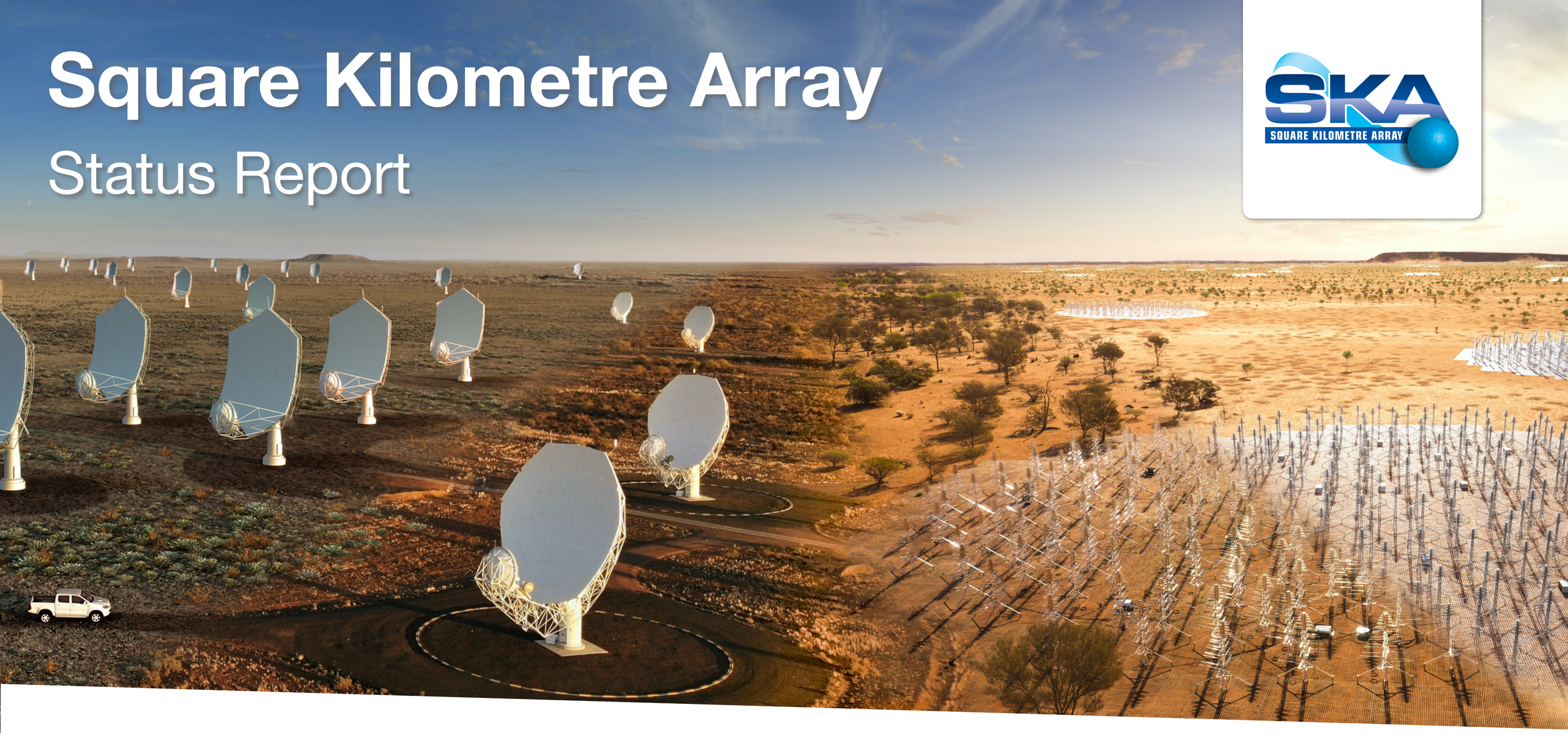
Exploring the Universe with the world's largest radio telescope

Juande Santander-Vela

TANGO Status Meeting, 2020-11-17

Square Kilometre Array

Status Report



SQUARE KILOMETRE ARRAY

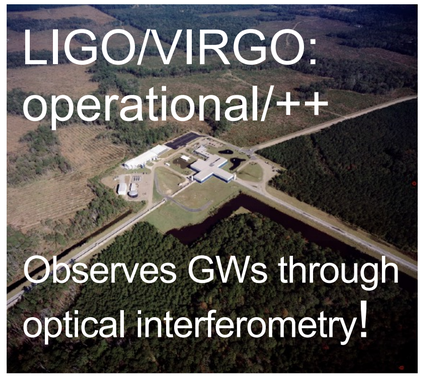
Exploring the Universe with the world's largest radio telescope

Juande Santander-Vela

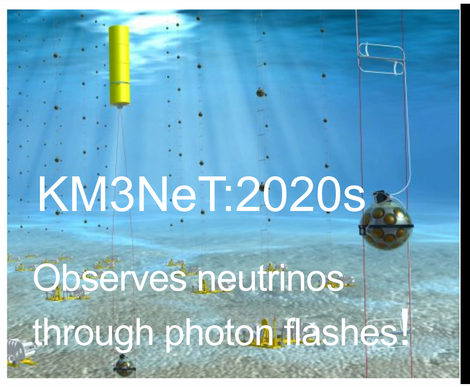
TANGO Status Meeting, 2020-11-17

21st Century Observatories

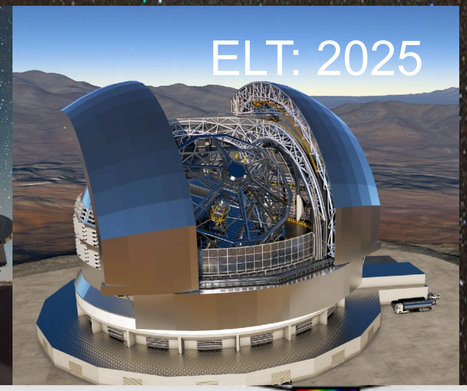
LIGO/VIRGO: operational/++

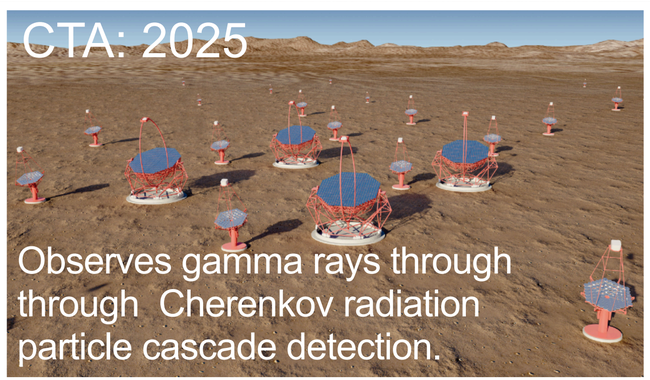


Observes GWs through optical interferometry!

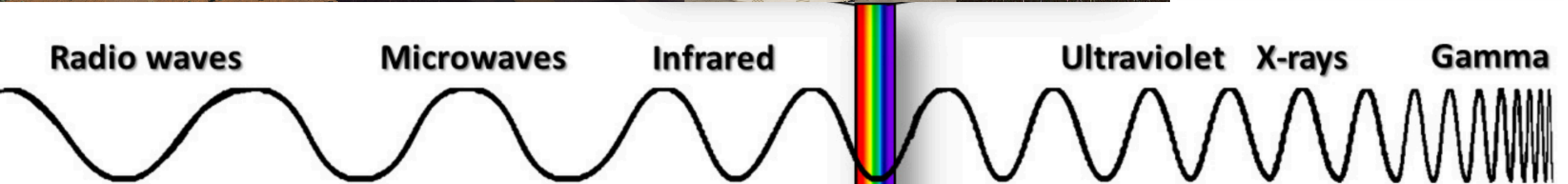


Observes neutrinos through photon flashes!





Observes gamma rays through through Cherenkov radiation particle cascade detection.




SKA
SQUARE KILOMETRE ARRAY

SKA Key Science Drivers: The history of the Universe

SKA Key Science Drivers: The history of the Universe

Testing General Relativity
(Strong Regime, Gravitational Waves)

Cosmic Dawn
(First Stars and Galaxies)

Galaxy Evolution
(Normal Galaxies z~2-3)

Cradle of Life
(Planets, Molecules, SETI)

Broadest range of science of any facility, worldwide

Cosmic Magnetism
(Origin, Evolution)

Cosmology
(Dark Energy, Large Scale Structure)

Exploration of the Unknown

SKA1 Telescopes

SKA1 Telescopes

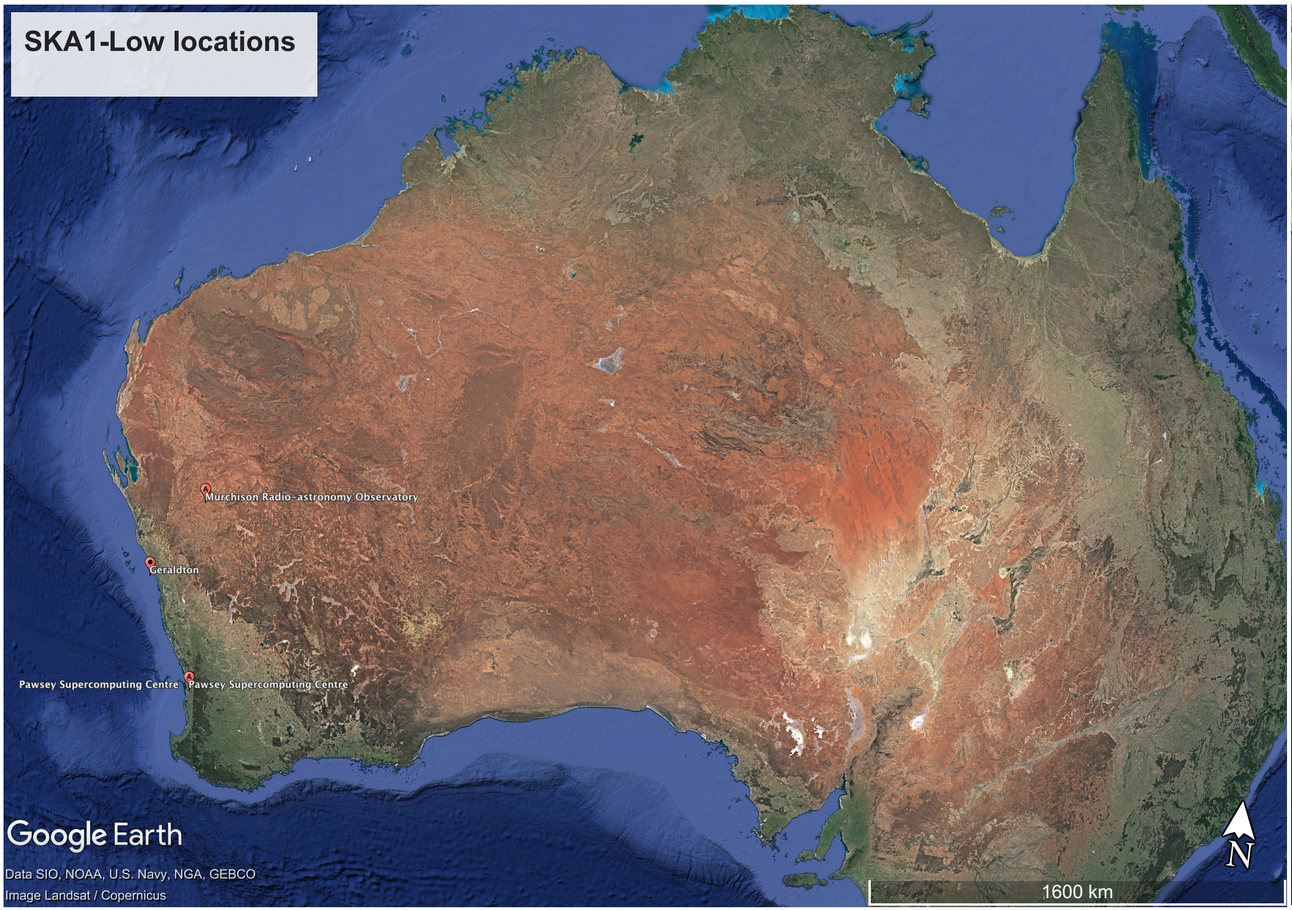
SKA1 Telescopes

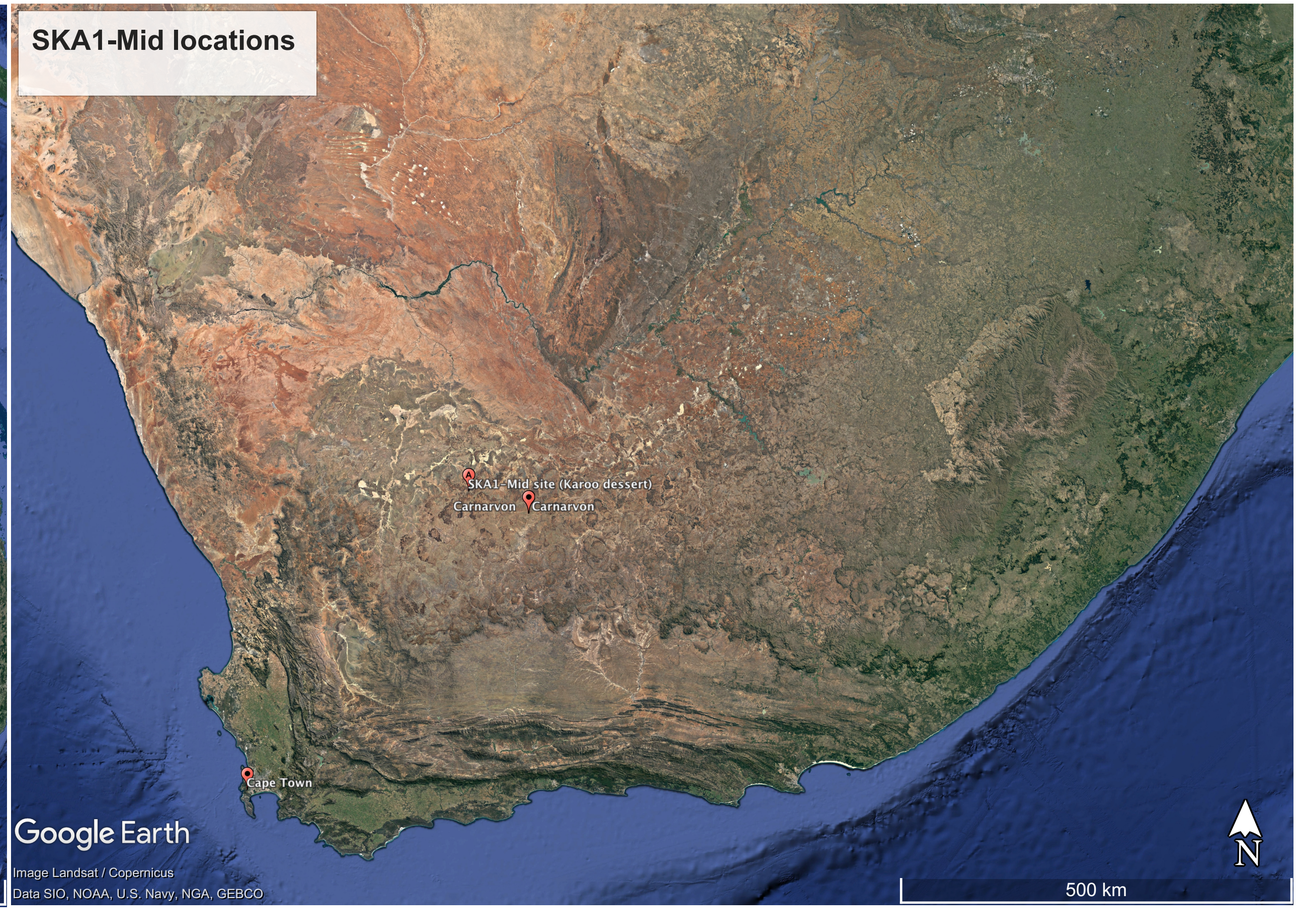
SKA1 Telescopes

Two world-leading telescopes

Acting as world-leading observatory

SKA1 Sites





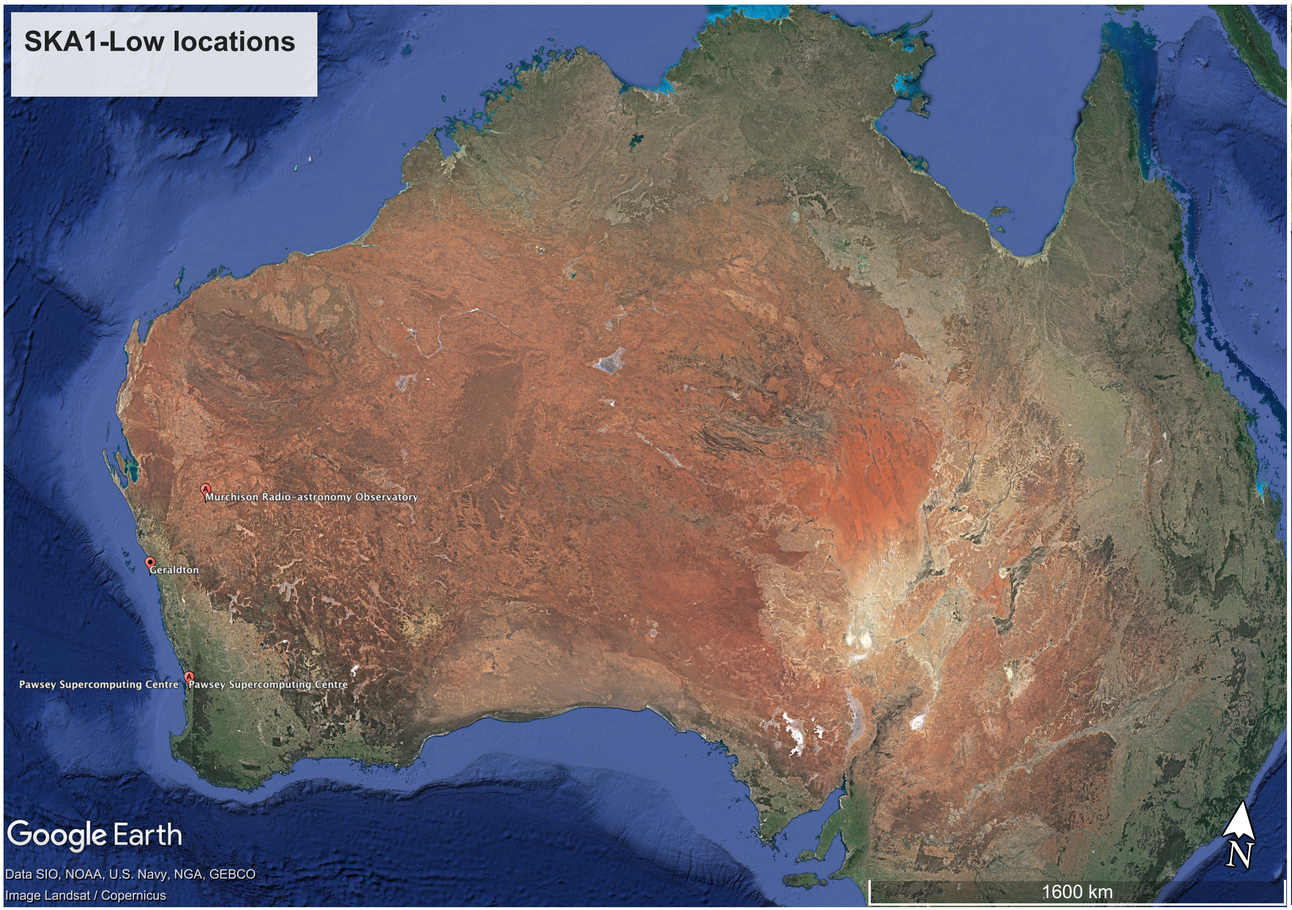
Exploring the Universe with the world's largest radio telescope

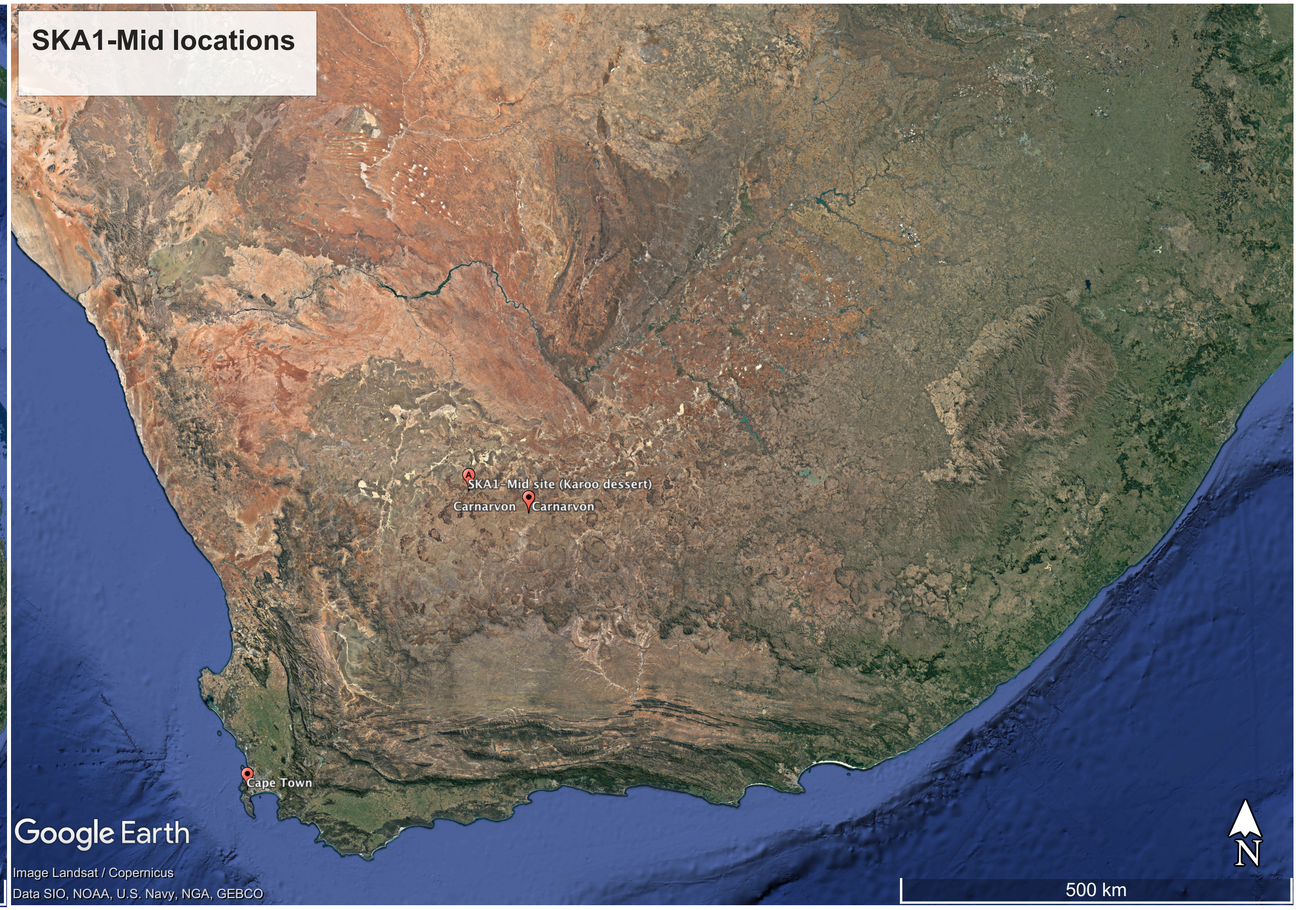
SKA1-Low


Murchison Radio-astronomy Observatory
Geraldton
Pawsey Supercomputing Centre
Pawsey Supercomputing Centre


SKA1-Low
300 km
Murchison Radio Astronomy Observatory
Murchison Radio-astronomy Observatory
Geraldton
Geraldton
Perth
Pawsey Supercomputing Centre
Pawsey Supercomputing Centre
SKA
SQUARE KILOMETRE ARRAY

SKA1 Sites





Exploring the Universe with the world's largest radio telescope


SKA1-Mid
SKA
SQUARE KILOMETRE ARRAY
SKA1-Mid site (Karoo dessert)
Carnarvon
Carnarvon
Cape Town
Google Earth
Image Landsat / Copernicus
N


SKA1-Mid
SKA1-Mid site (Karoo dessert)
SKA1-Mid site (Karoo dessert)
Carnarvon
Carnarvon
Canarvon
500 km
Cape Town
Cape Town
Google Earth
Image Landsat / Copernicus
N

SKA HQ: Jodrell Bank, UK

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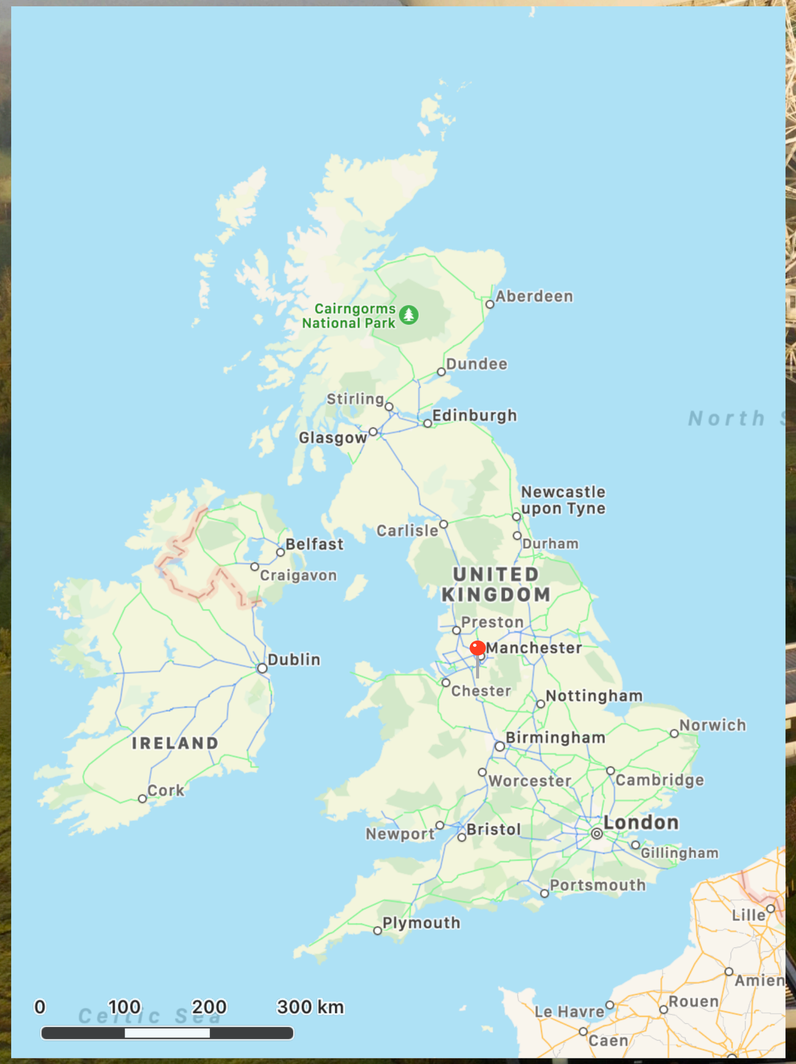
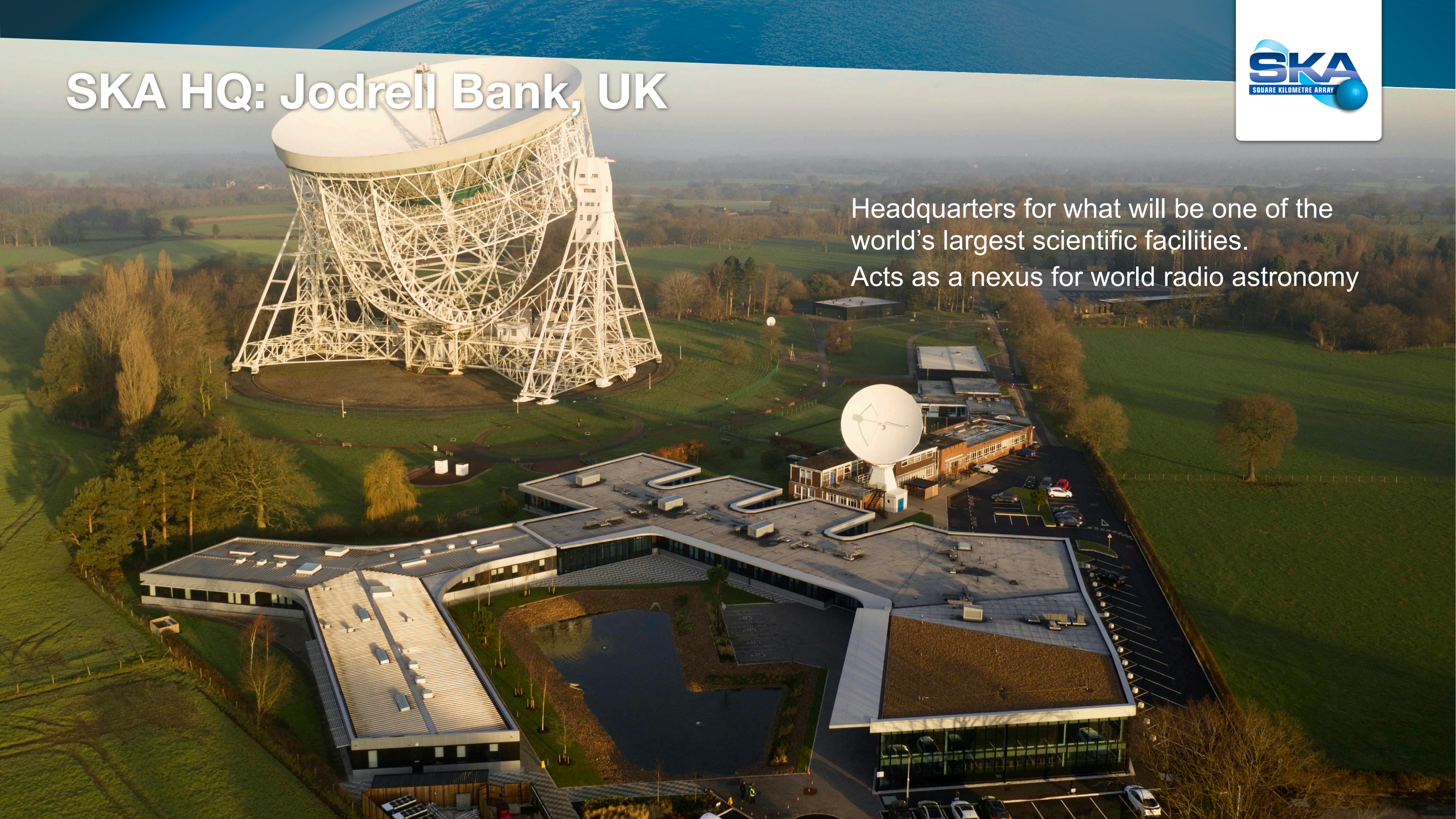


SKA HQ: Jodrell Bank, UK



Headquarters for what will be one of the world's largest scientific facilities.

Acts as a nexus for world radio astronomy

SKA HQ: Council Chamber

SKA Organisation

Exploring the Universe with the world's largest radio telescope

SKA Organisation

- Australia (DoI&S)
- Canada (NRC-HIA)
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SKA Members
*SKA Observatory founding members

African Partner Countries

Exploring the Universe with the world's largest radio telescope

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- Japan
- South Korea
- … More!

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In the process of becoming an Inter-Governmental Organisation

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Exploring the Universe with the world's largest radio telescope

Treaty signed: Rome, 12 March 2019

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✅ ✅ ✅ ✅ ✅

(Almost there!)

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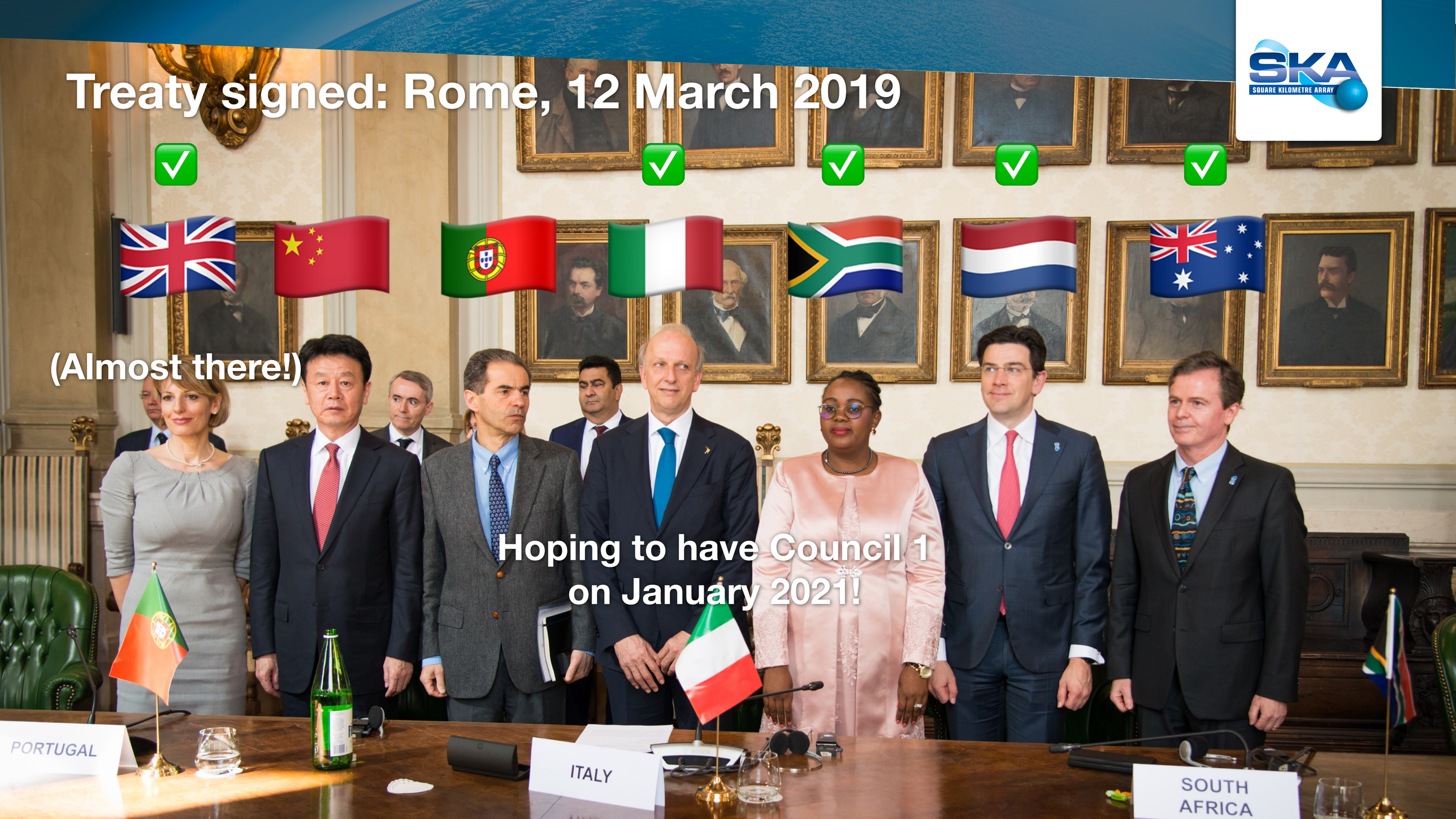

Hoping to have Council 1 on January 2021!

Recent Progress

- All major reviews completed:
  - Jan-Mar 2020: Critical Design Review
  - Mar 2020: Operations Review
  - Apr 2020: Cost Review
  - July 2020: Business-enabling Review

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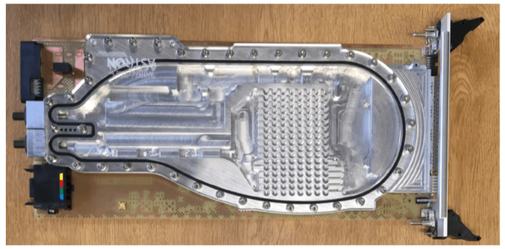
- Major Milestone:
  - Construction Proposal & Observatory Establishment and Delivery Plan endorsed by the SKA Board.

SKA Data Flow Challenge

Few km

~7 Tb/s

Low Central Signal Processor



800 km

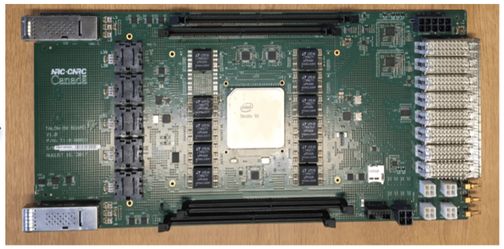
~5 Tb/s

Perth Supercomputer

130 Pflops

700 PB/yr

~8 Tb/s



Mid Central Signal Processor

Few km

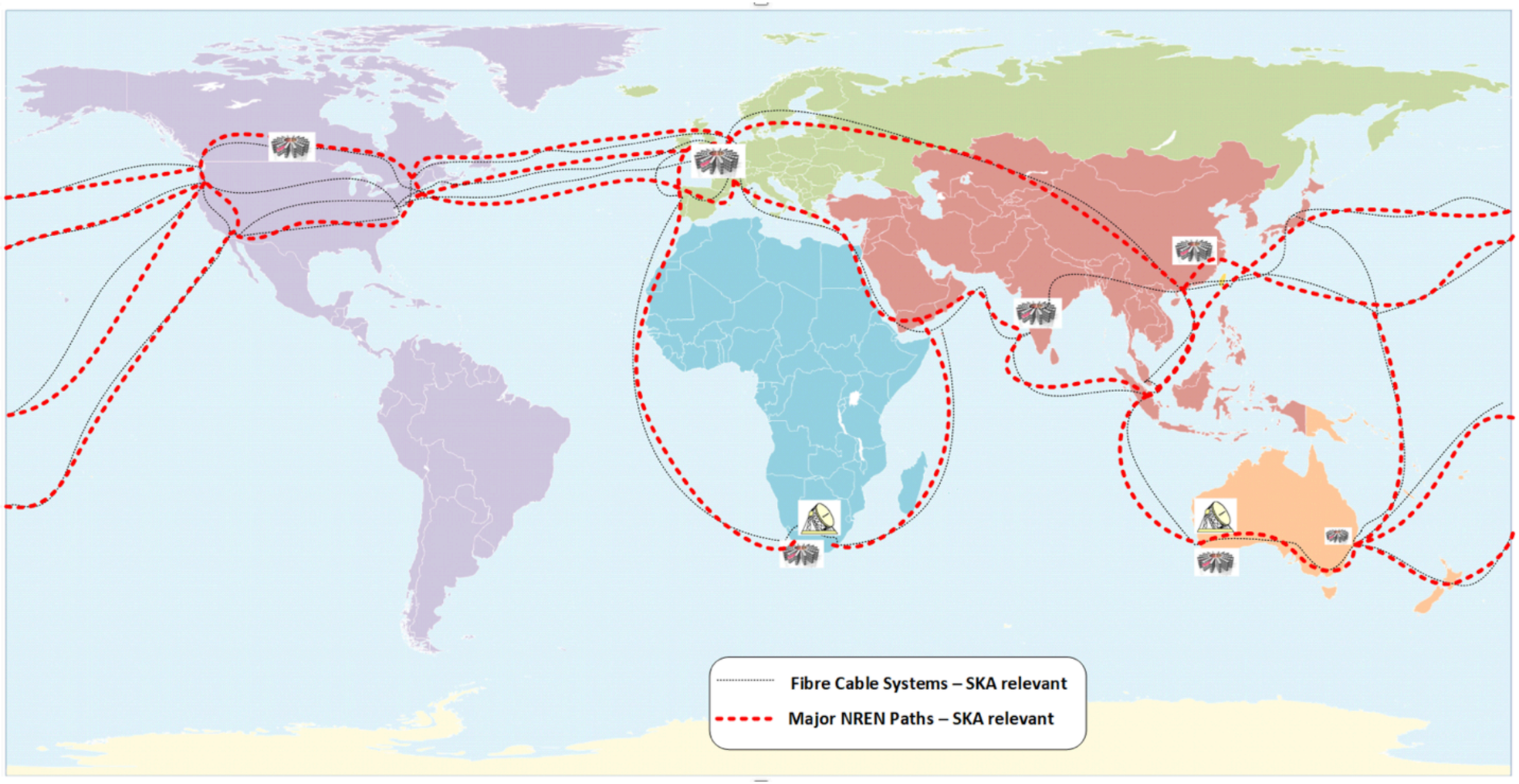
130 Pflops

~5 Tb/s

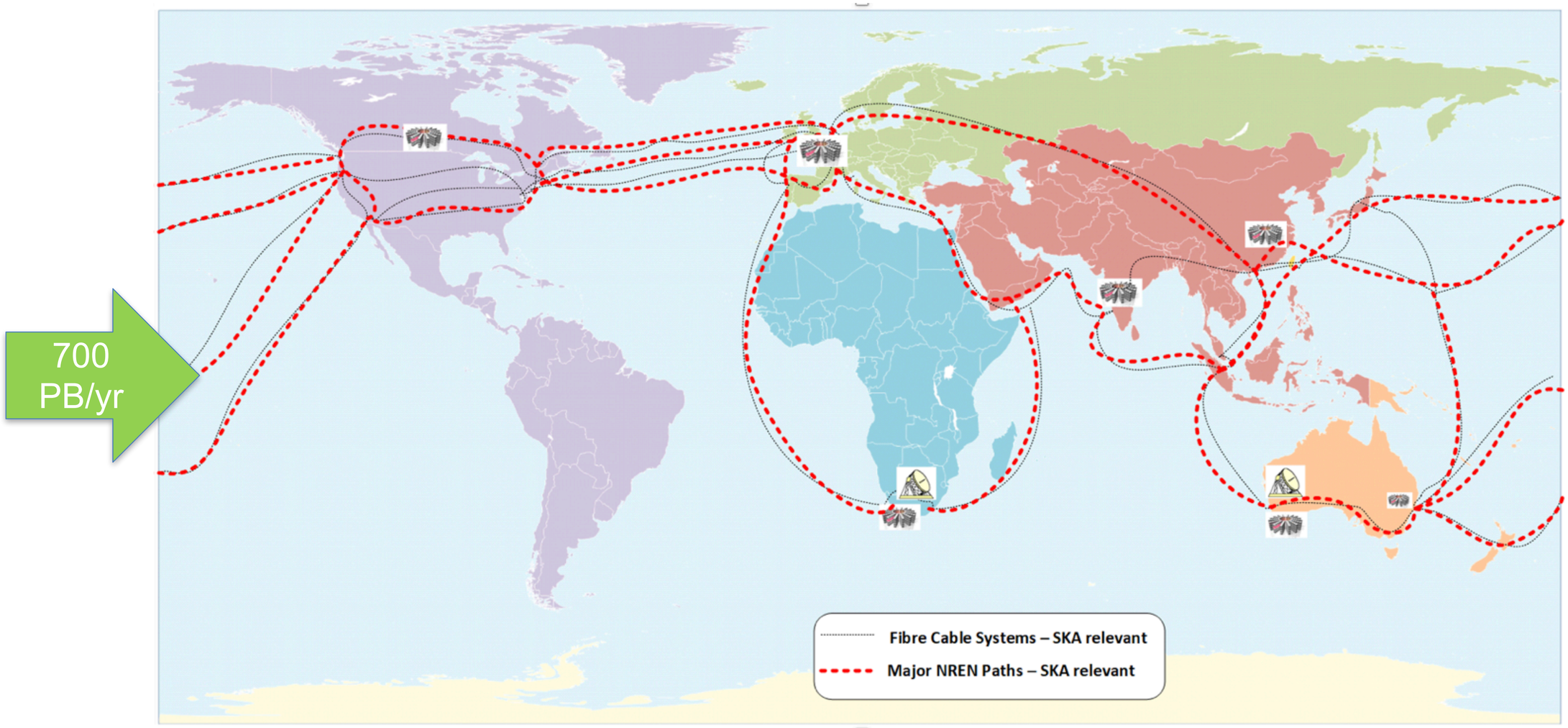
Cape Town Supercomputer

600 km

SKA Data Flow Challenge: SKA Regional Centres



SKA Data Flow Challenge: SKA Regional Centres



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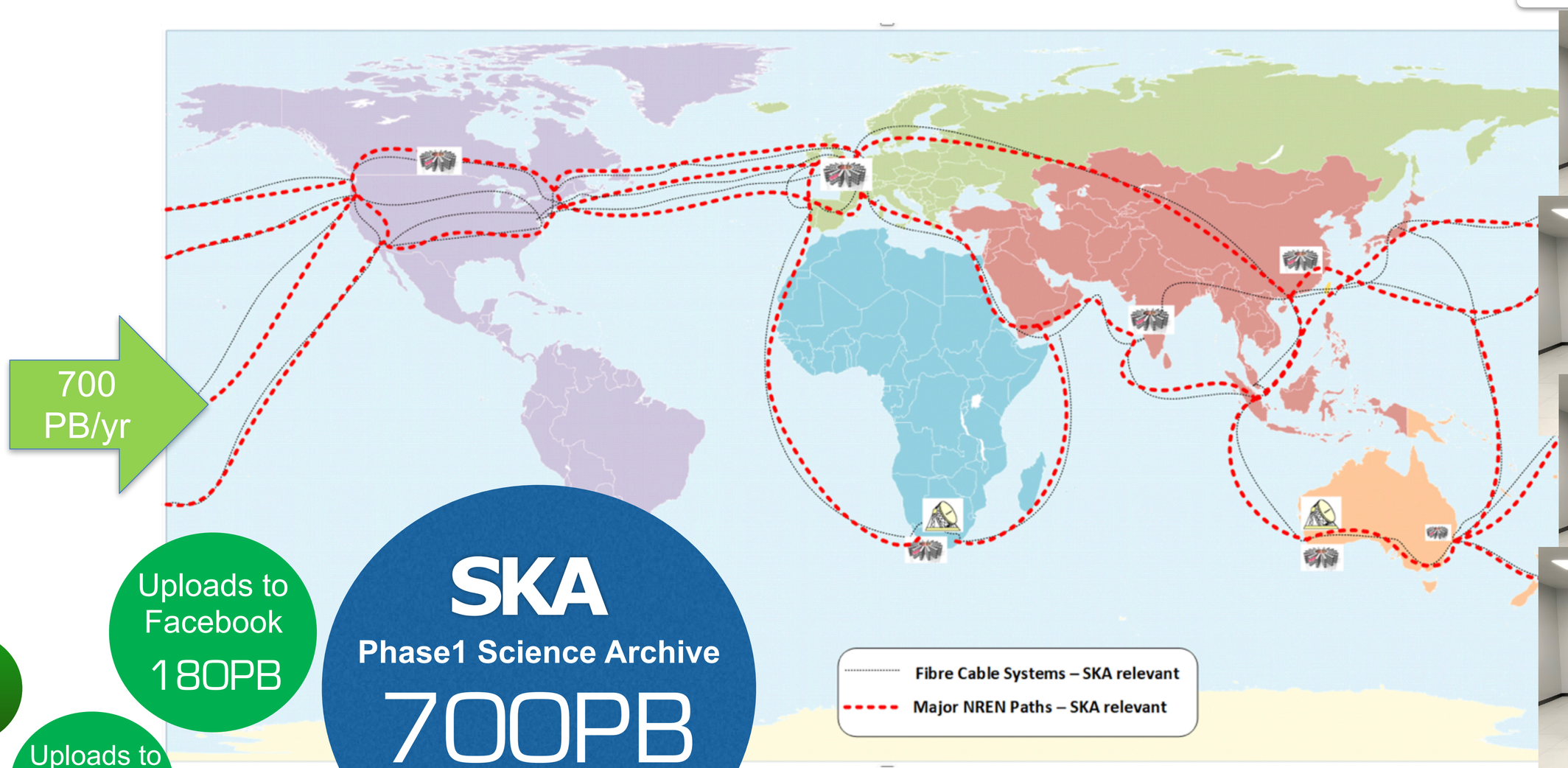

Difficulties in coordinating software development

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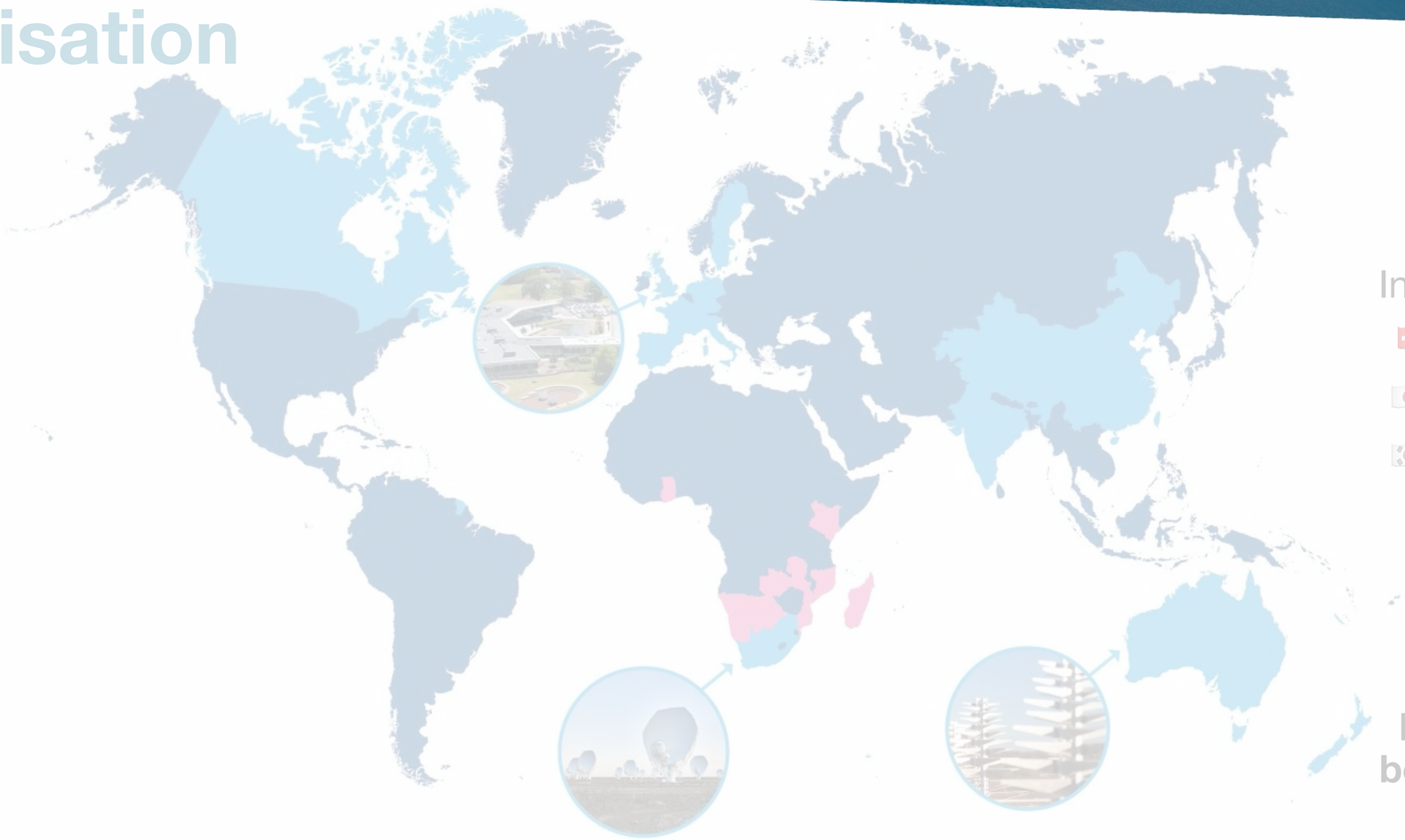

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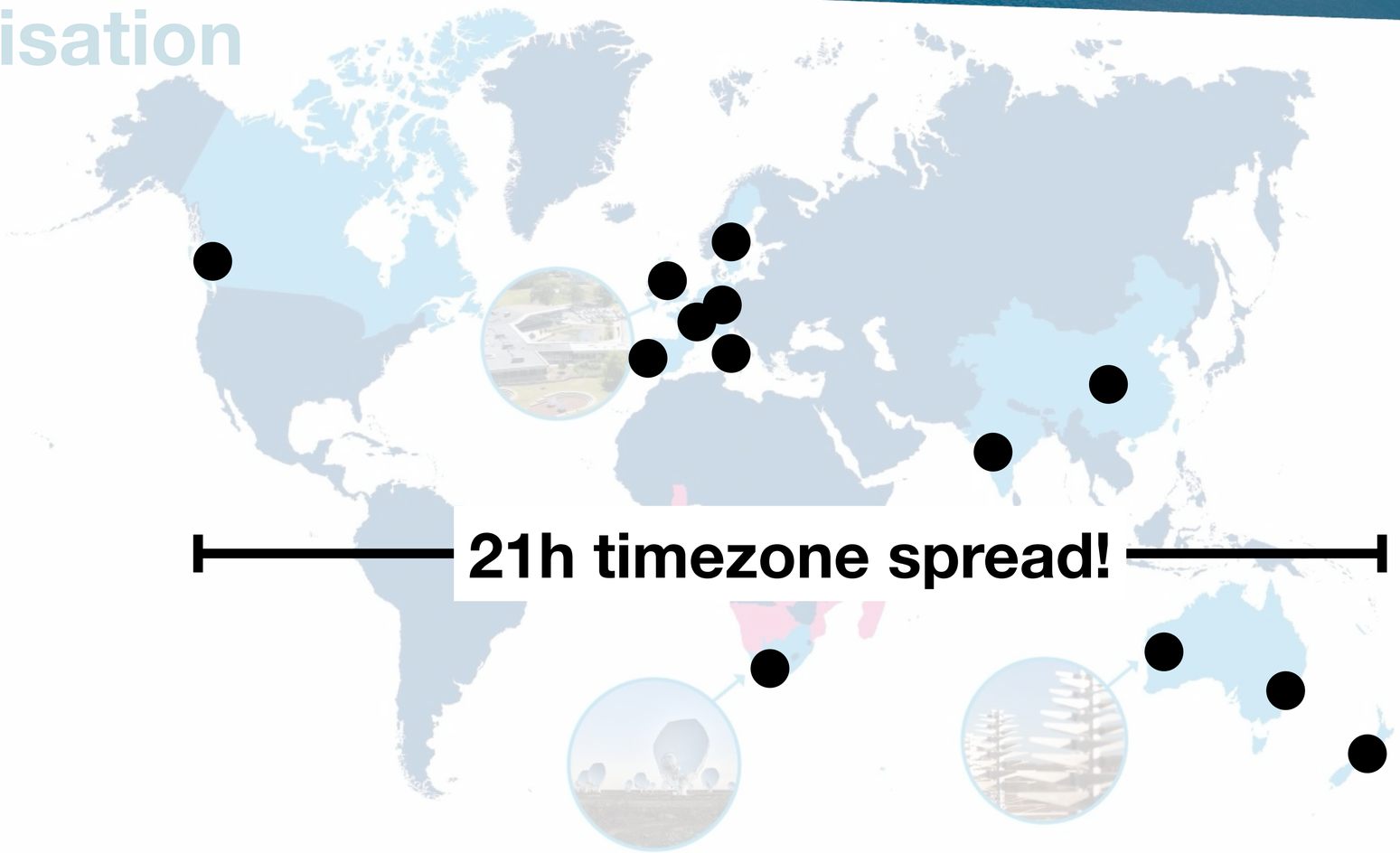

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Already 17 teams from 20 institutions!

		HQ	IT-Aveiro	INAF	NCRA	Raman In	NZA	Swinburn	CSIRO	ICRAR/UV	NRC	UMAN	Oxford	RAL	UK ATC	SARAO	Cambridg
	Total Effort	*19*	*3.45*	*3.6*	*12.3*	*1*	*1.6*	*0.85*	*7.3*	*3.05*	*8.95*	*7.1*	*3.5*	*3.7*	*4.1*	*14.5*	*5.2*
CIPA	8.95										8.95						
NCRA	7.9				7.9												
Buttons	6.1				1									1	4.1		
Cream	4.6		0.8	2.8	1												
KAROO	5.5															5.5	
Perentie	5.75							0.85	3.25								
MCCS	6.15	2.5			0.5				1.05			2.1					
OMC Product Team	4.1	1.8			1.4											0.9	
ESCAPEES	4.2	4.2															
NZAPP	1.6						1.6										
PSS	6.9			0.2		1						3.2	2.5				
SCHAAP	5.9																
SIM	7												1	2.7			2.9
SPAZA	5															5	
Yanda	5.05								2	3.05							
DP Product Team	6.4	2.6														2.3	1.5
System	6.35	1.8	2.65	0.6	0.5											0.8	
PLANET	5.4	1.7										1.8					0.8
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- ~5 FTE Average team size from 16 Consultants + SKAO
- ~160 people involved - ~60% average time commitment

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And this is ~50% of the effort that we will have to lead… just on software!

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- ~5 FTE Average team size from 16 Consultants + SKAO
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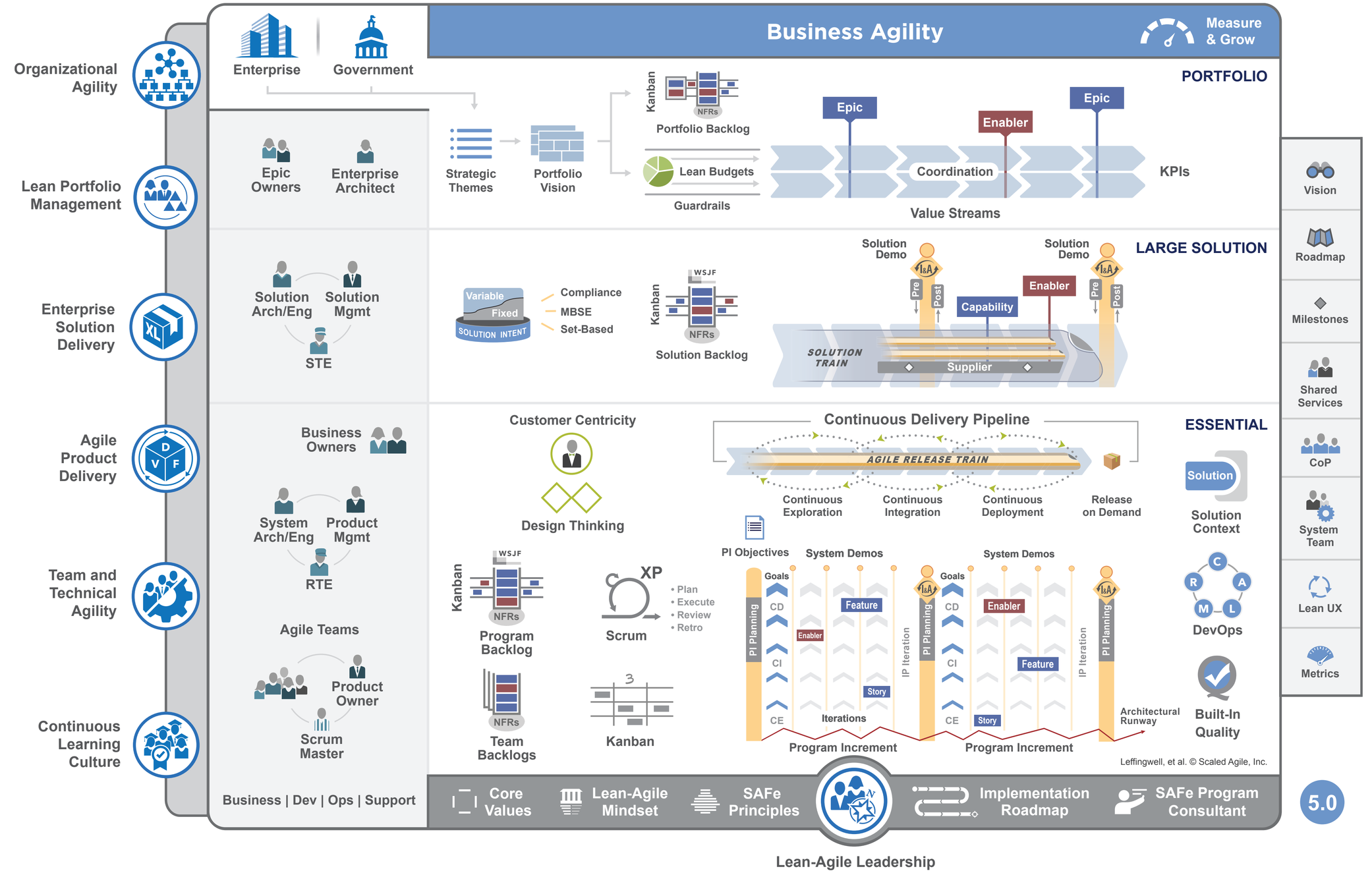
How to solve that issue?

How to solve that issue?

Or how to provide the right level of information and decision making delegation?

Test Driving SAFe®

SAFe® for Lean Enterprises



er Centricity

n Thinking

XP

- Plan
- Execute
- Review
- Retro

Scrum

3

Kanban

Continuous Delivery Pipeline

AGILE RELEASE TRAIN

Continuous Exploration

Continuous Integration

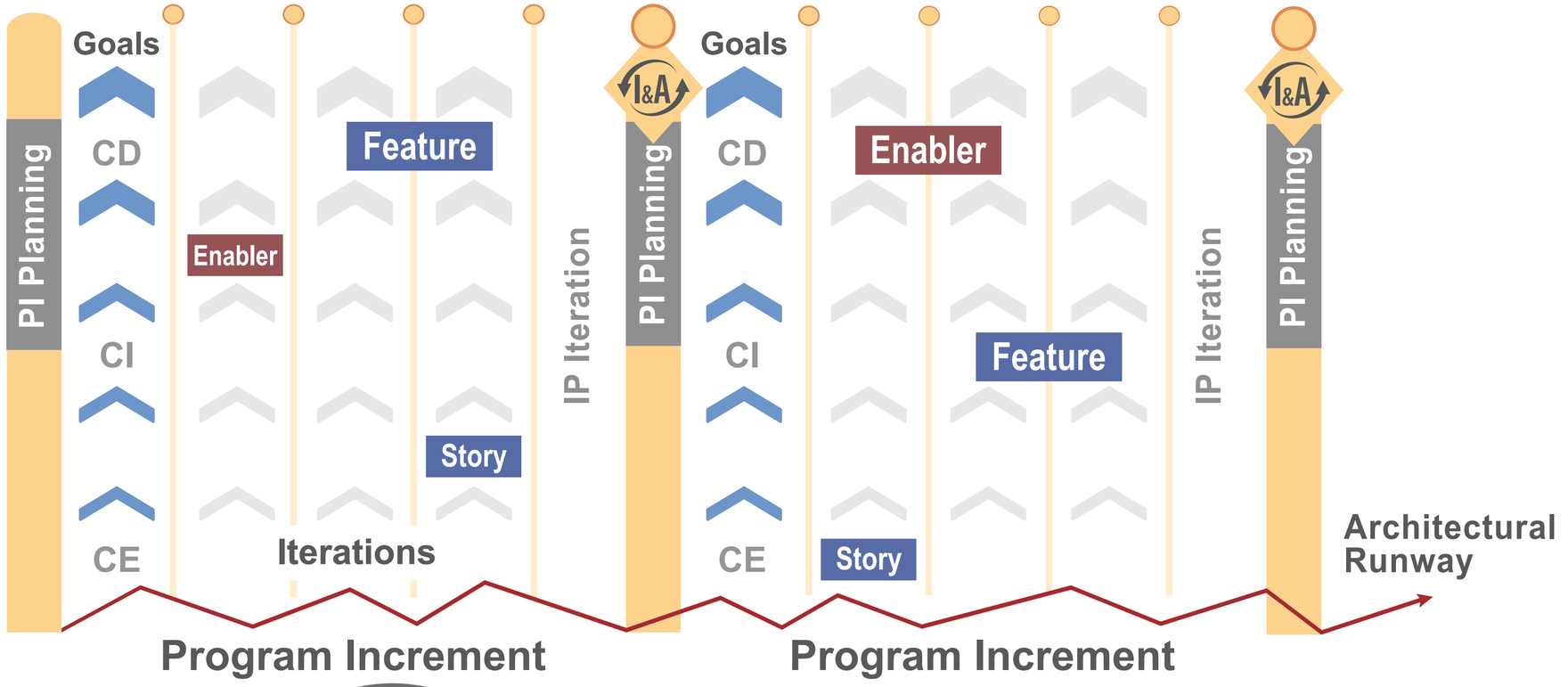
Continuous Deployment

Release on Demand

PI Objectives

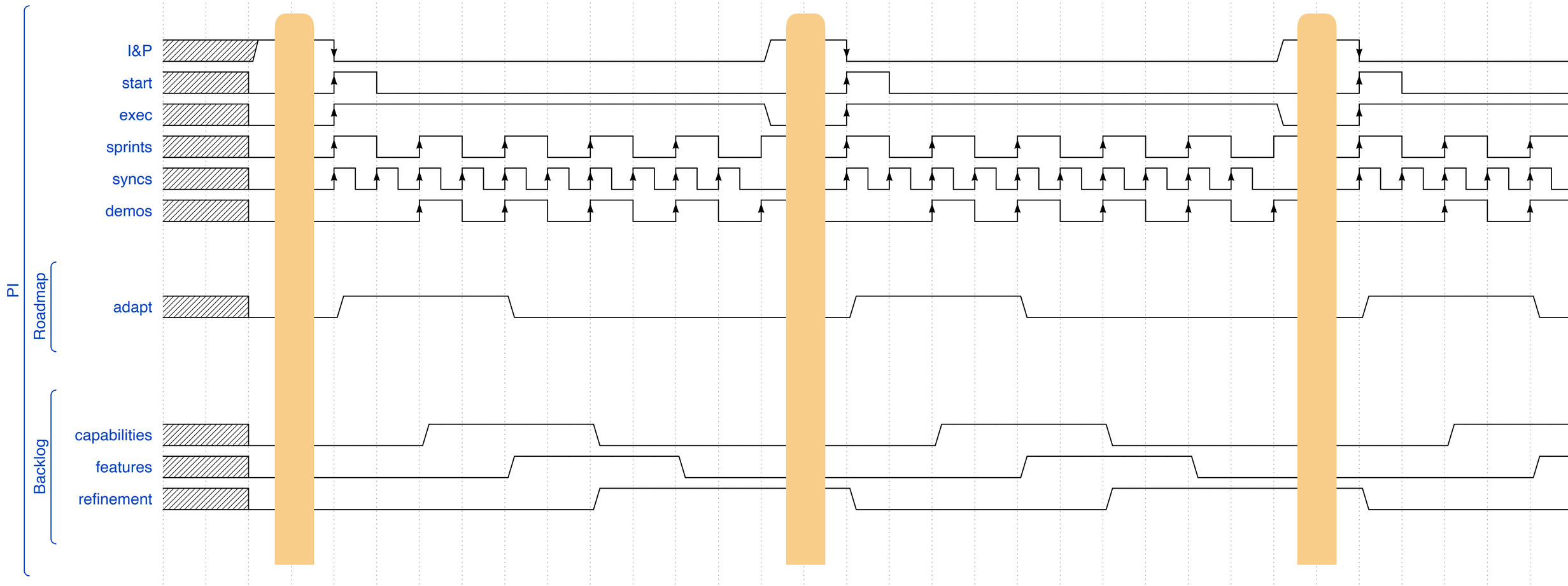
System Demos

System Demos

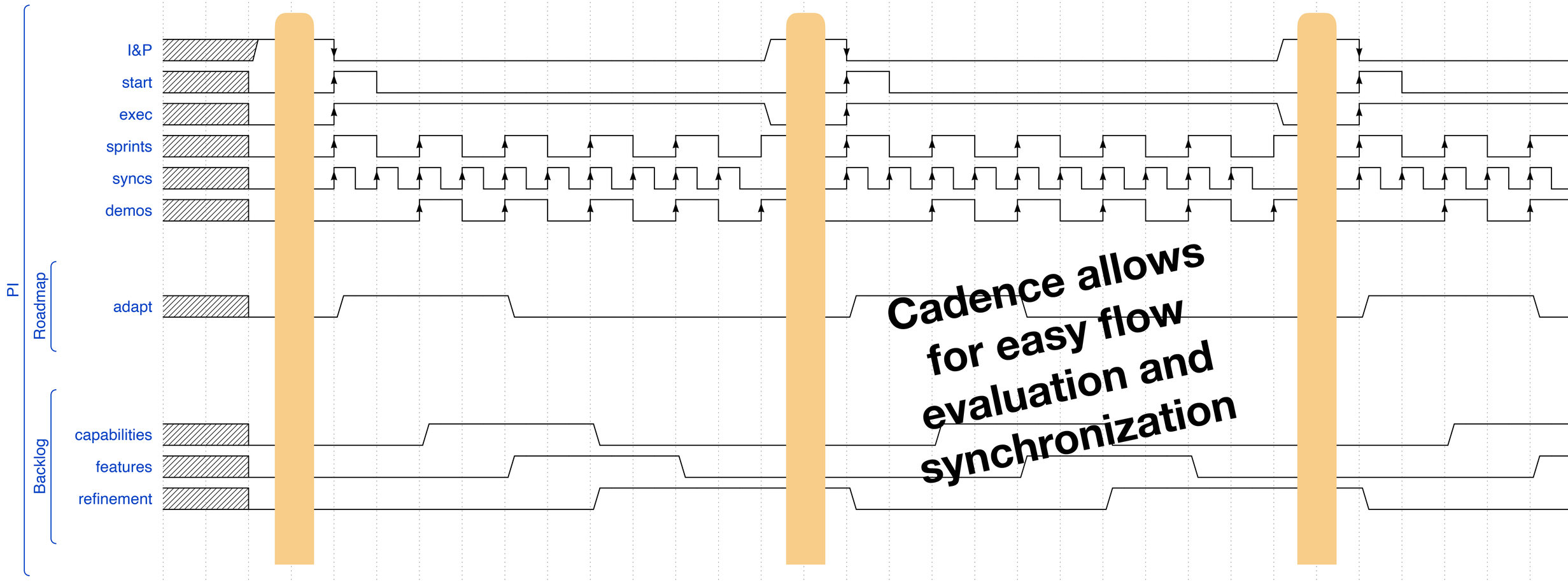


Leffingwell, et al. © S

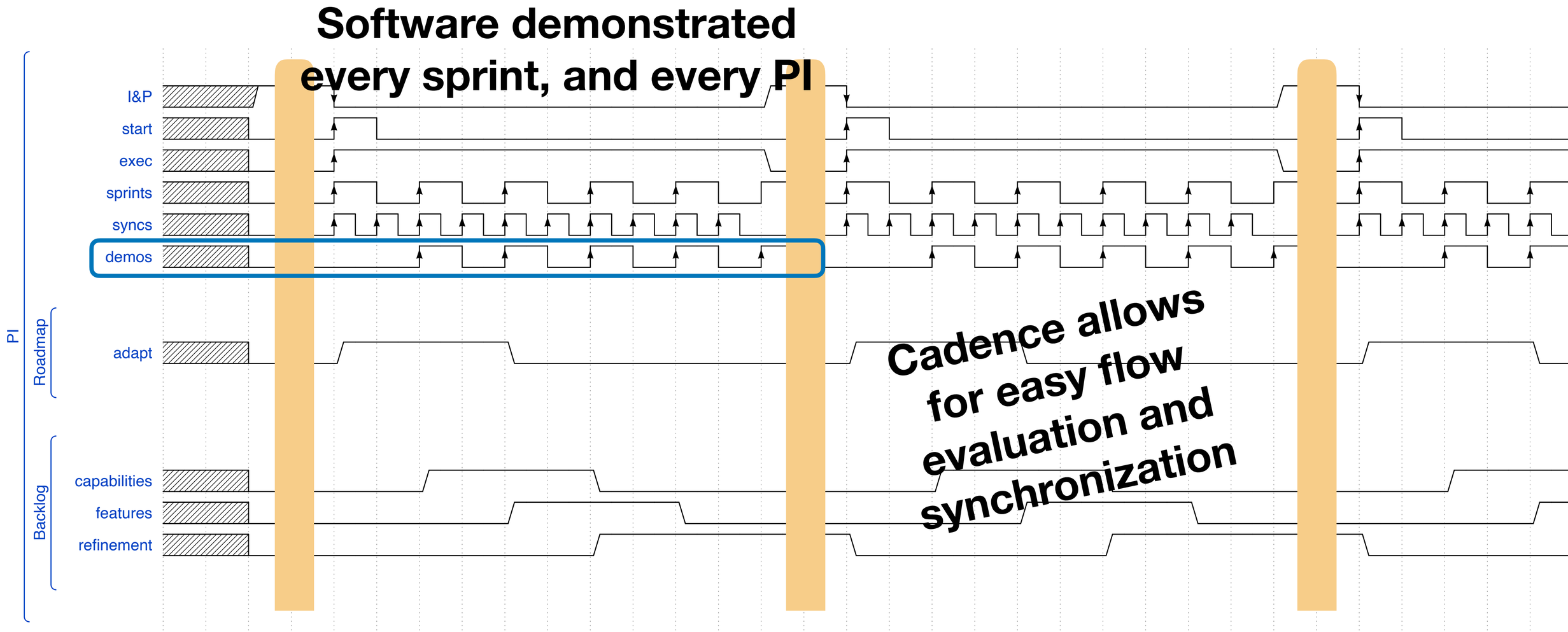
The PI, Sprint, and Sync Cadence



The PI, Sprint, and Sync Cadence

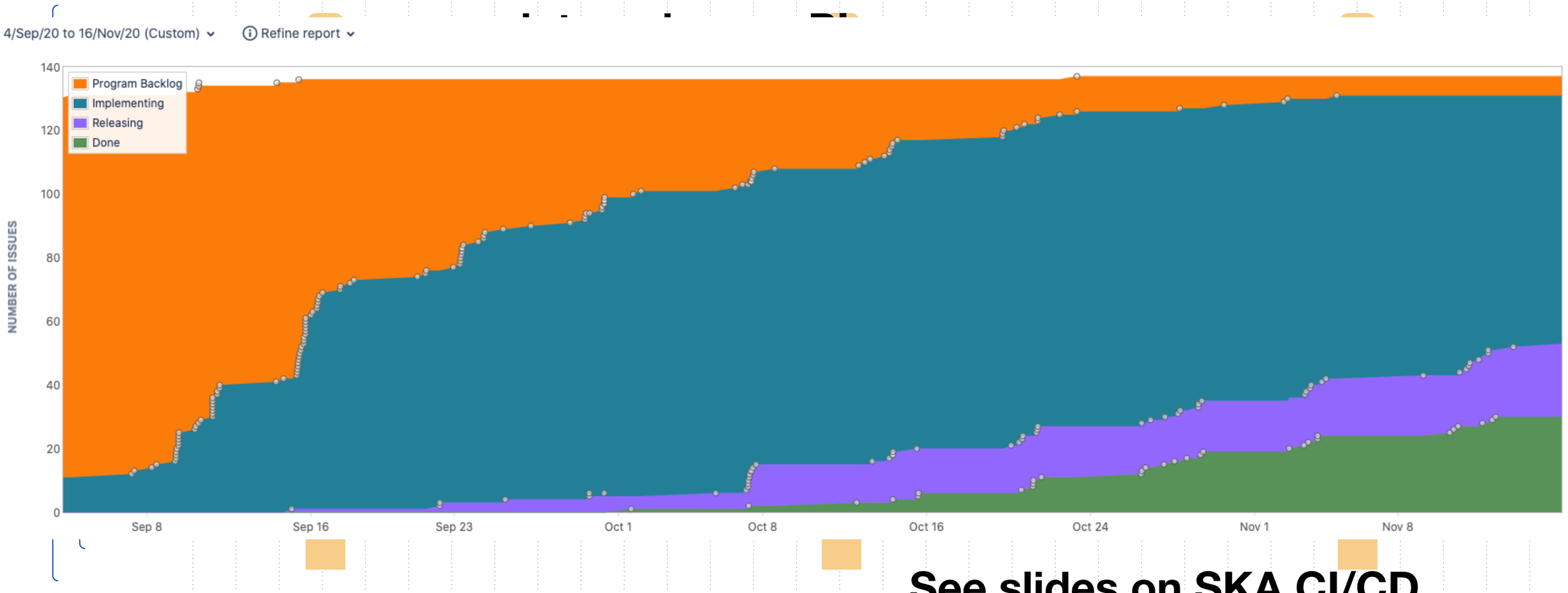


The PI, Sprint, and Sync Cadence



The PI, Sprint, and Sync Cadence

Software demonstrated



See slides on SKA CI/CD on Wed 18, 9:20 GMT+1

What about COVID-19?

We did not miss a beat!

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Thanks to the distributed infrastructure, wonderful people, and the effort to make even more things possible in a remote way…

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Including PI Planning!

Thank you everyone!

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Thanks to the distributed infrastructure, wonderful people, and the effort to make even more things possible in a remote way…

Including PI Planning!

TANGO-related updates

TANGO-related updates

Or the part that you probably care more about 😉

SKA Control: TANGO

- Decided in March 2015
- Control Harmonisation Project started March 2016 → **CS_Guidelines**
- Good uptake from the community
- INAF, SKA SA, and SKAO are now members of the TANGO Controls Organisation

STEERING COMMITTEE

The Tango Controls executive body is the Steering Committee. It makes strategic decisions about core developments in the Tango collaboration. There is one representative from each institute who has signed the Tango Controls Collaboration Contract. The representative is the person who is highest in each institutes's hierarchy and has sufficient technical knowledge about Tango. This representative should have enough power to decide on allocating resources to developing software for Tango. To ensure that the right decisions are made and match those of the user community, advice must be sought by the committee from their respective users and developers on a regular basis.

There are 2 types of members of the Tango Controls Steering Committee Members:

1. *Core members* - contribute financially to the maintenance of Tango and commit at least 6 months of an engineer annually to develop and commit source to the Tango Controls core projects
2. *Contributing members* - contribute to the financing of the maintenance of Tango.

Both members normally use Tango and write and share Tango device classes with the community.

The current Tango Controls Steering Committee member representatives are:

Chairman:	**Andy Götz (ESRF)**
Coordinator:	**Jean-Michel Chaize (ESRF)**
ALBA (core)	**Guifre Cuni**
ELETTRA (core)	**Lorenzo Pivetta** (deputy Claudio Scafuri)
ESRF (core)	**Andy Götz,** (deputy Jean-Michel Chaize)
SOLEIL (core)	**Gwenaëlle Abeille**, (deputy Sandra Pierre-Joseph)
DESY (contributing)	**Thorsten Kracht,** (deputy Teresa Nunez)
INAF (contributing)	**Matteo Canzari**
MAX-IV (contributing)	**Vincent Hardion**
SKAO (contributing)	**Nick Rees**
SKA-ZA (contributing)	**Anton Joubert**
SOLARIS (contributing)	**Michał Ostoja-Gajewski,** (deputy Grzegorz Kowalski)
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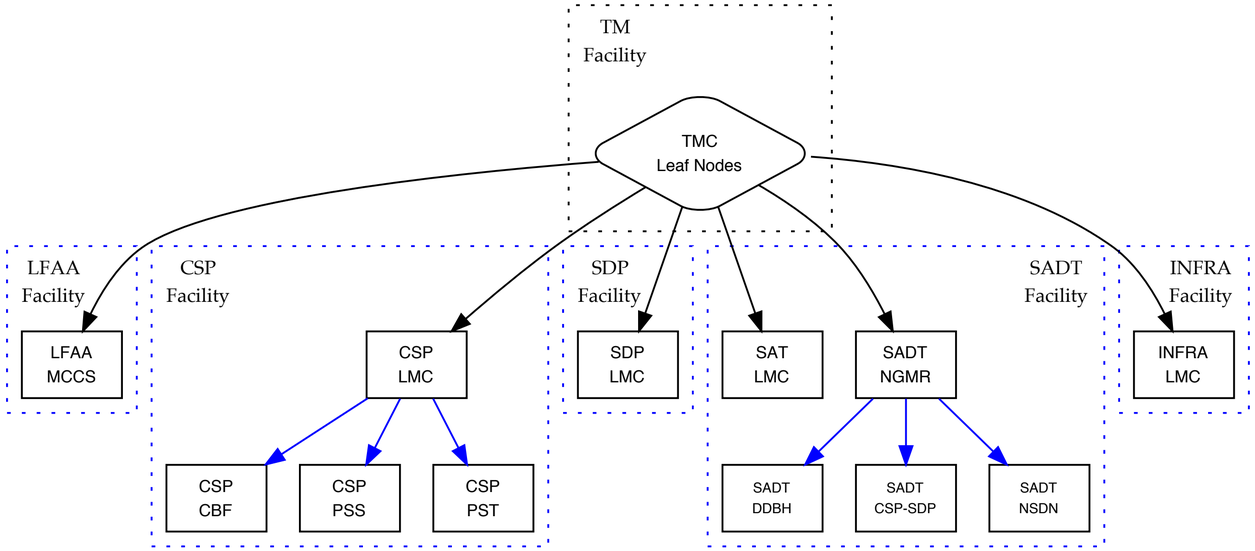
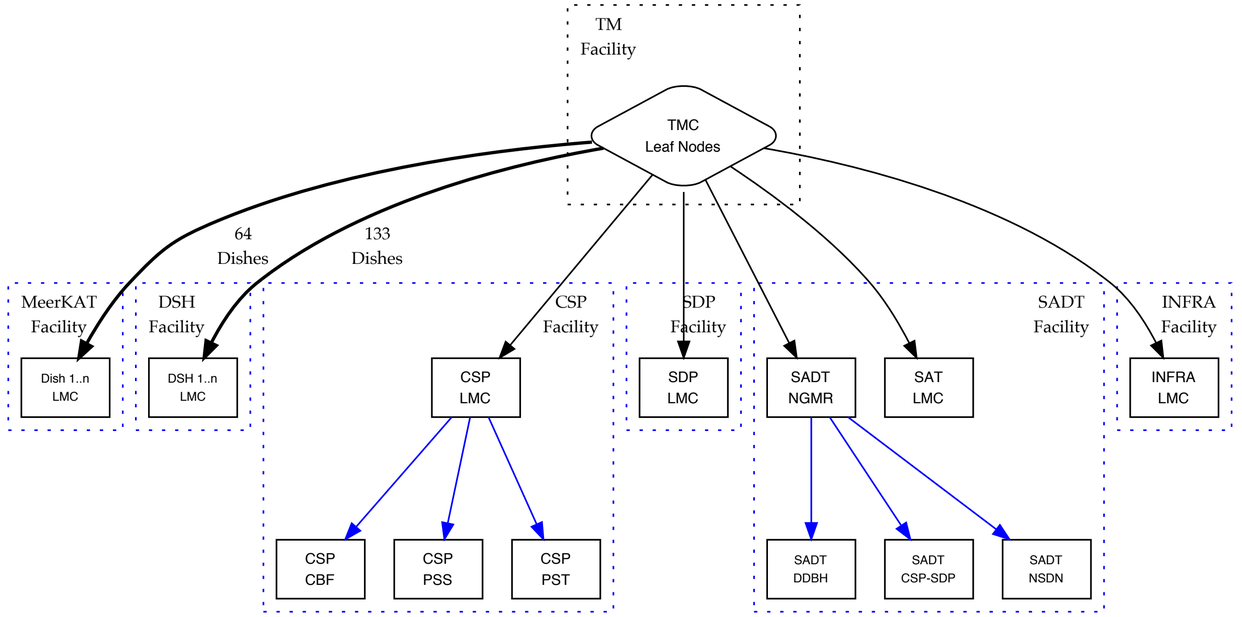
SKA Control Hierarchies

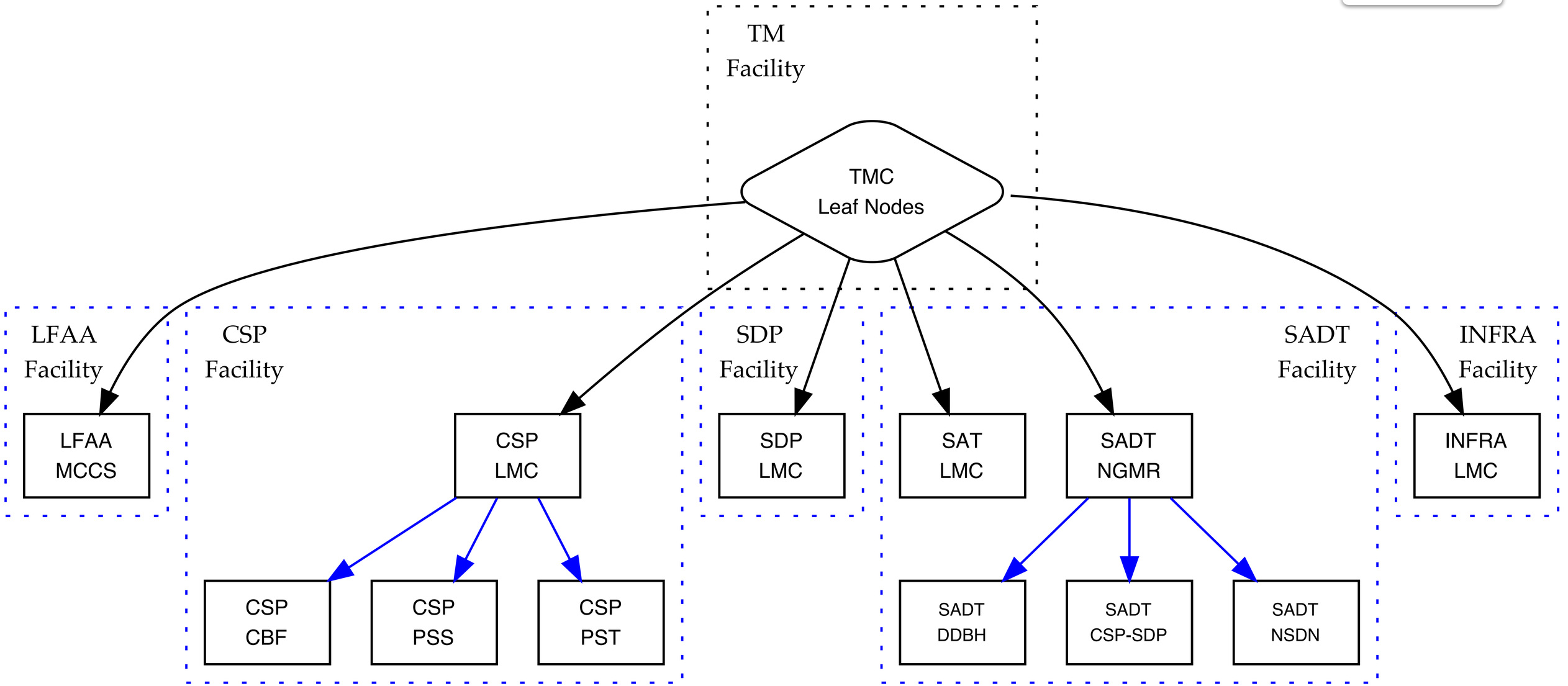
SKA1-Low



SKA1-Mid



SKA1-Low Control Hierarchy



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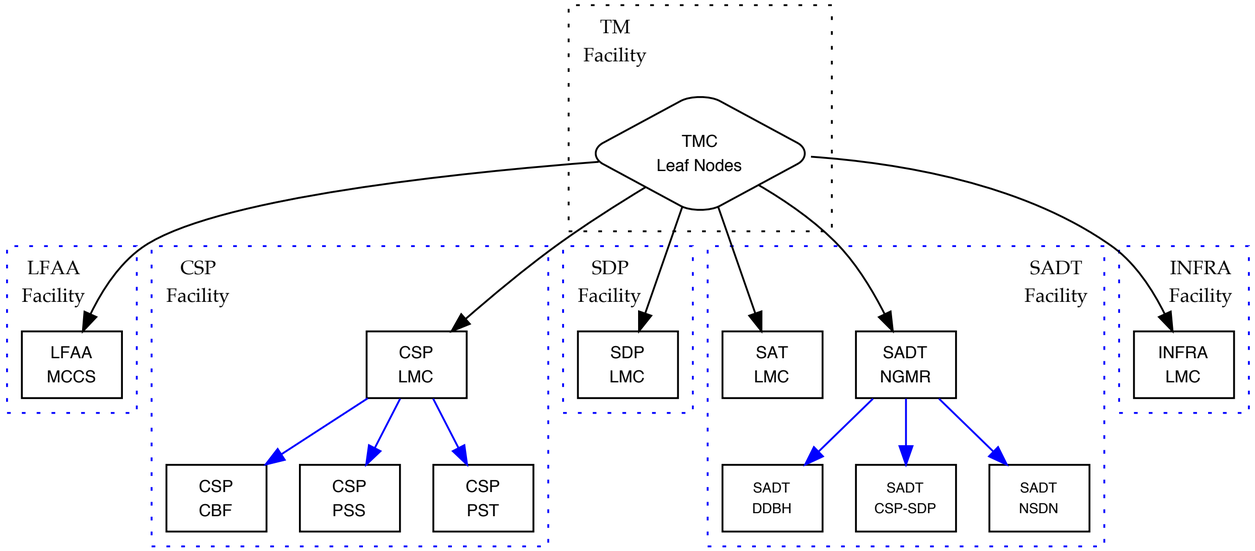

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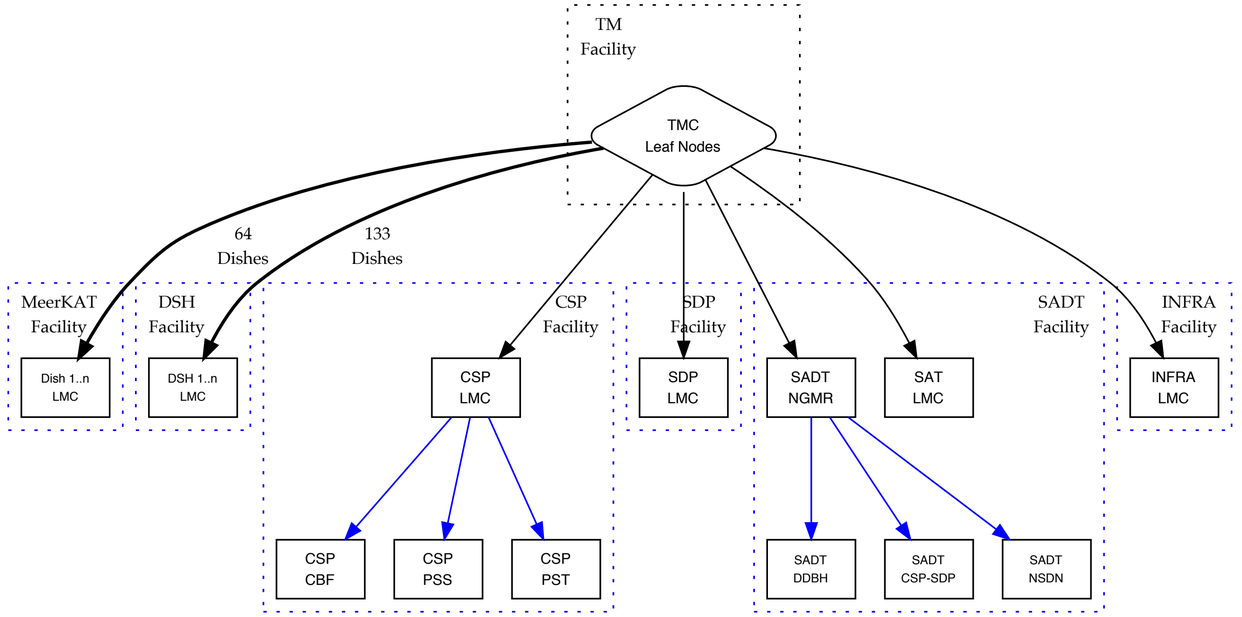

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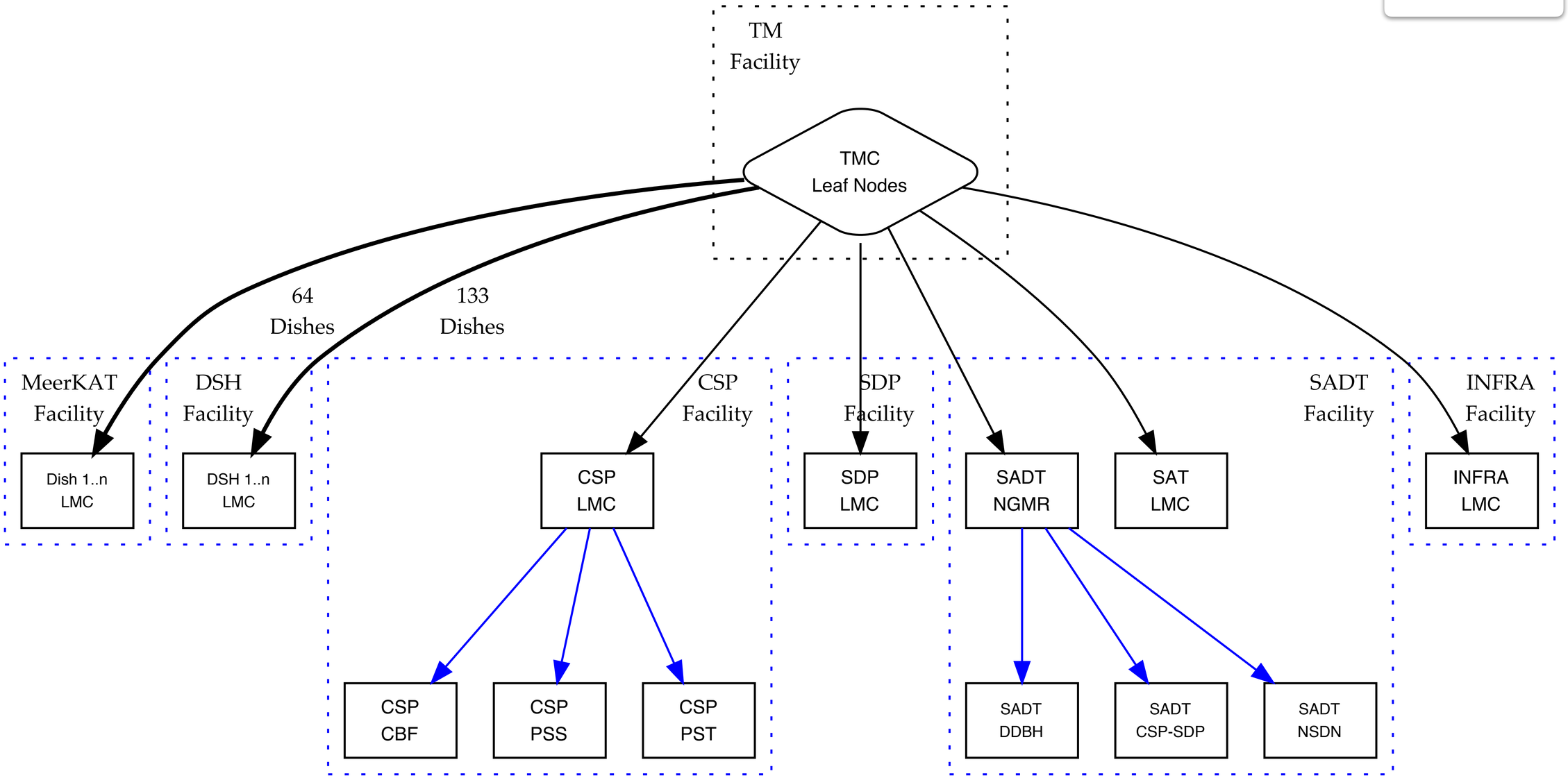

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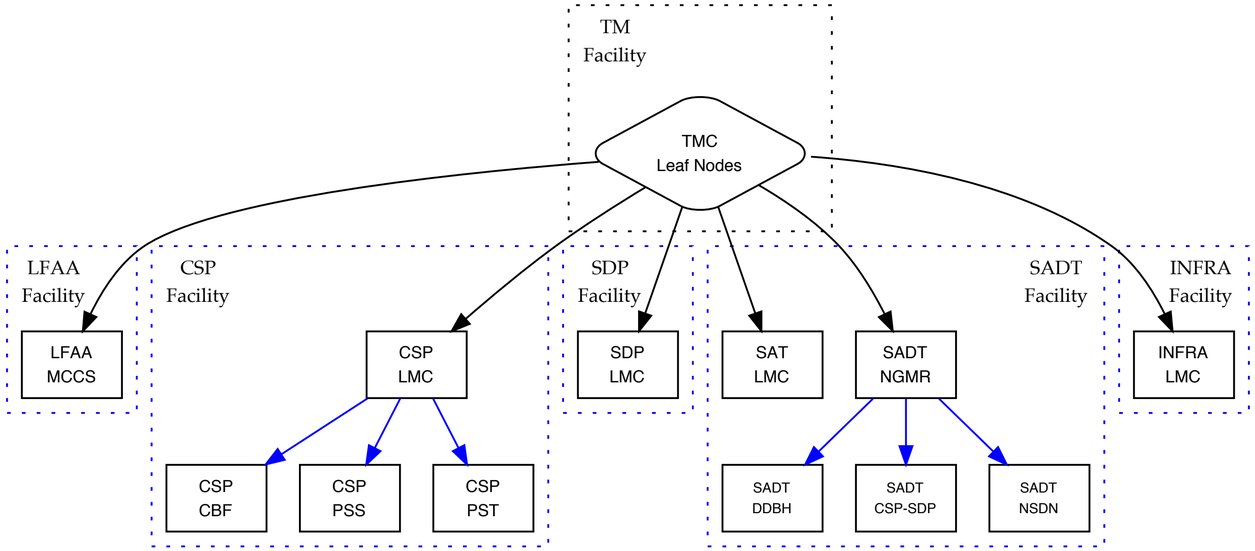

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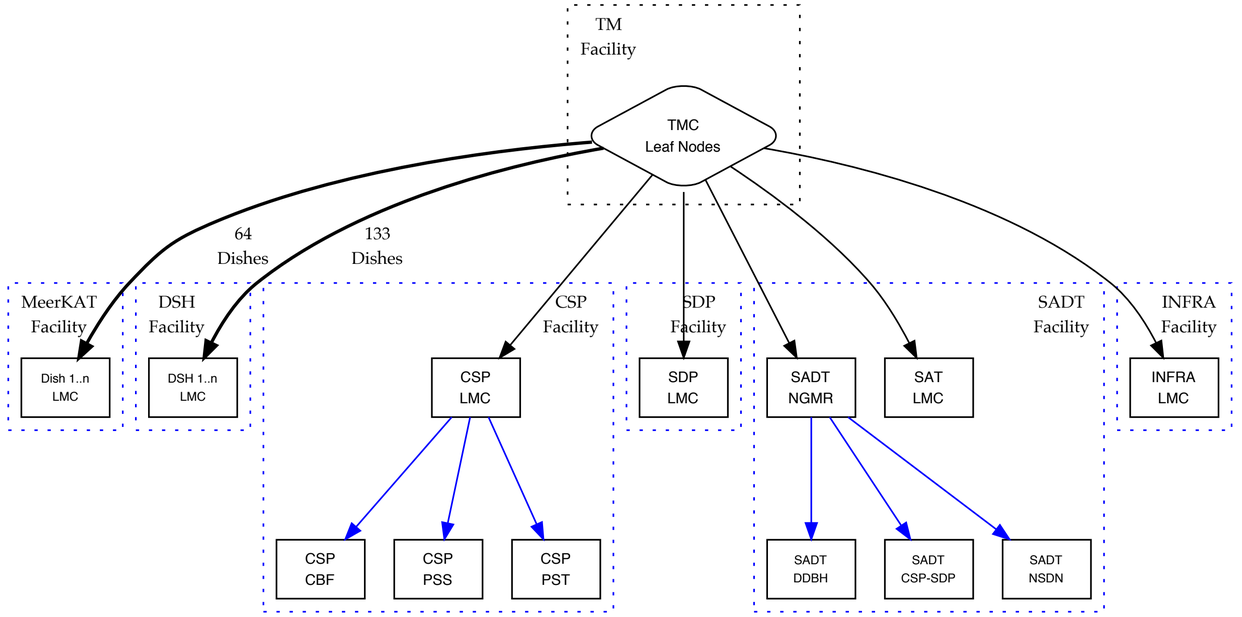

SKA Control Hierarchies

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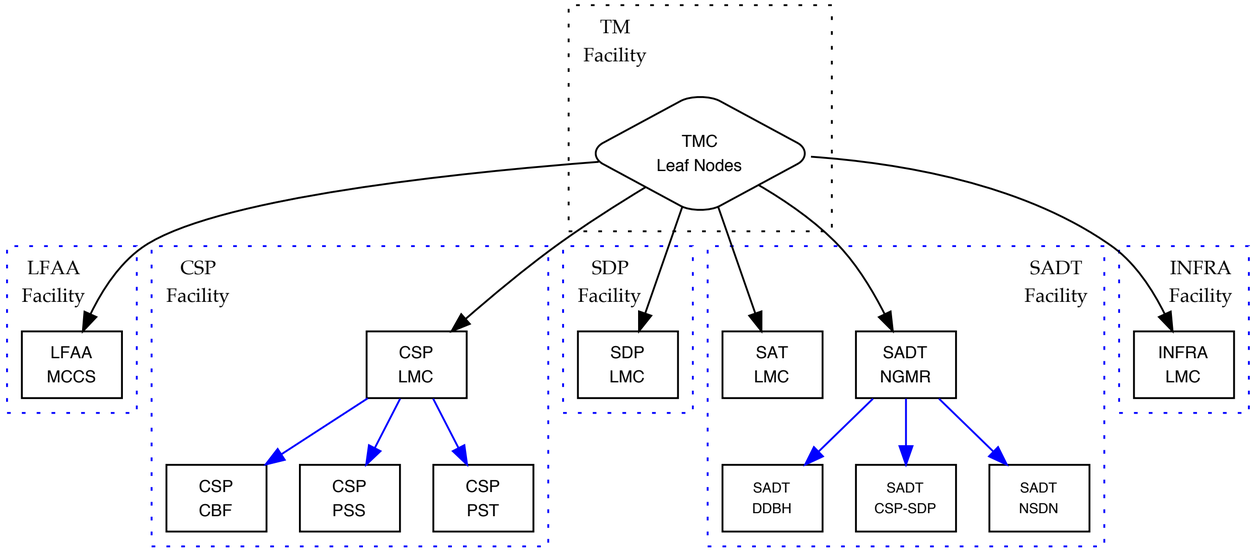
It does not look very complex…



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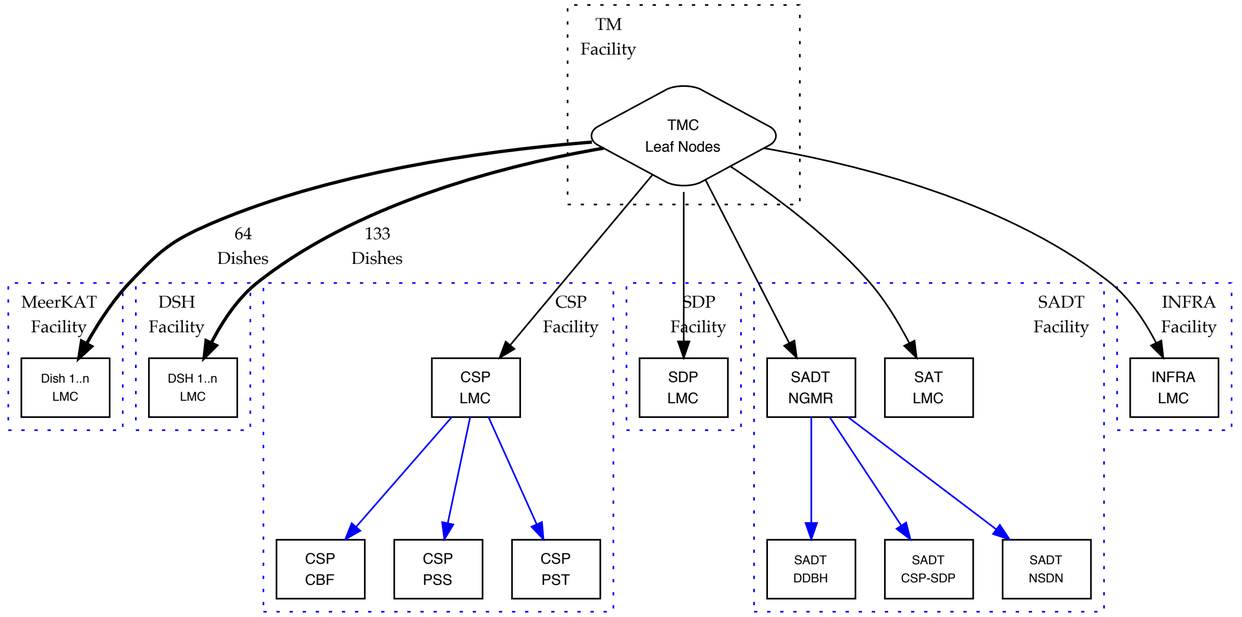

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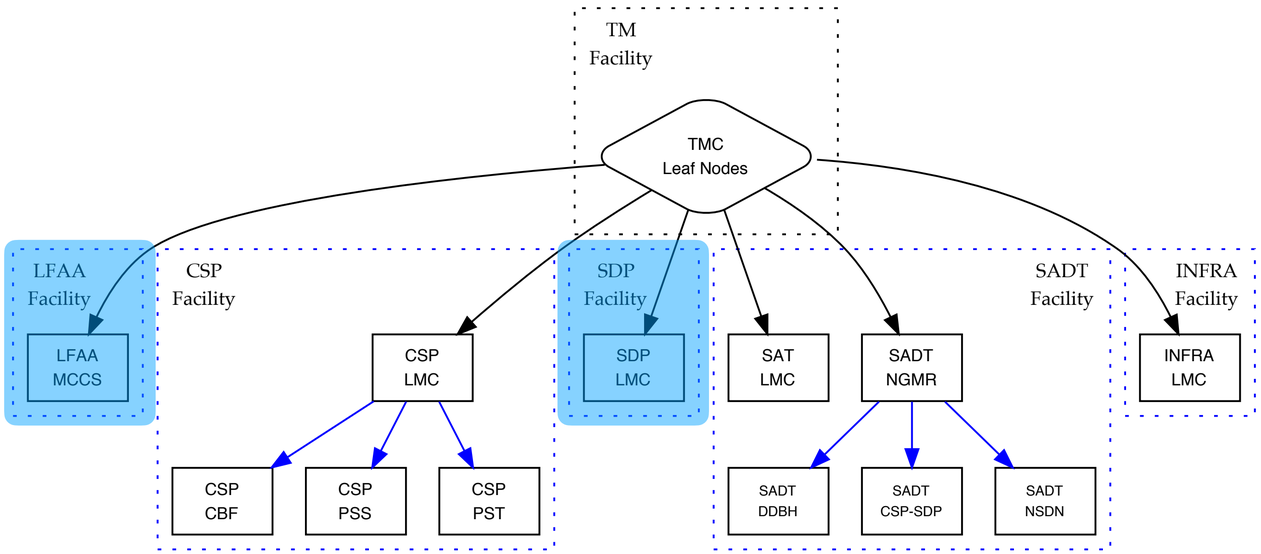

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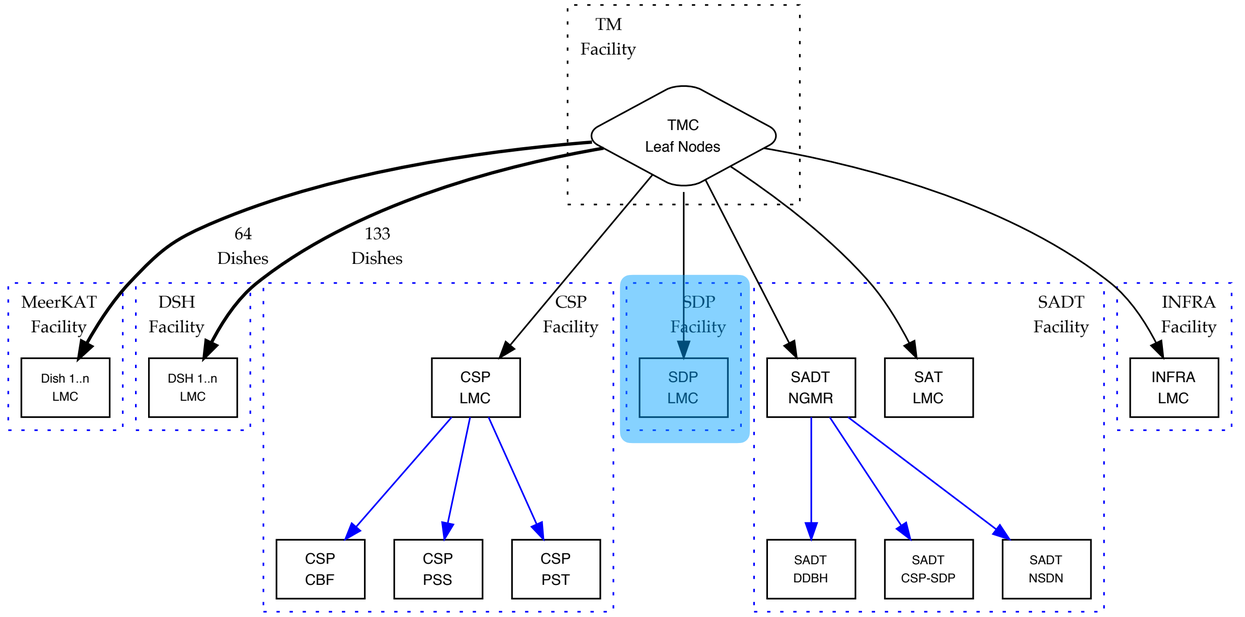

But tens of thousands of devices will live under these hierarchies!

SKAMPI: The SKA MVP Product Integration

- Based on Kubernetes
  - Each pod is a TANGO Device Server is a TANGO Device
    - Each facility's TANGO DB is a pod
    - We are examining the shortcomings of this granularity, and trying to look at potential solutions
  - Helm charts allow for customized deployment of sets of functionality
- Uses HDB++ currently as the archiver
  - Need to update to the latest library of HDB++
  - Looking at an ElasticSearch-based solution is in our roadmap
- Testing and Staging environments
- Continuous Integration & Continuous Delivery with automated Merge Request testing

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Still ironing some issues, but working well!

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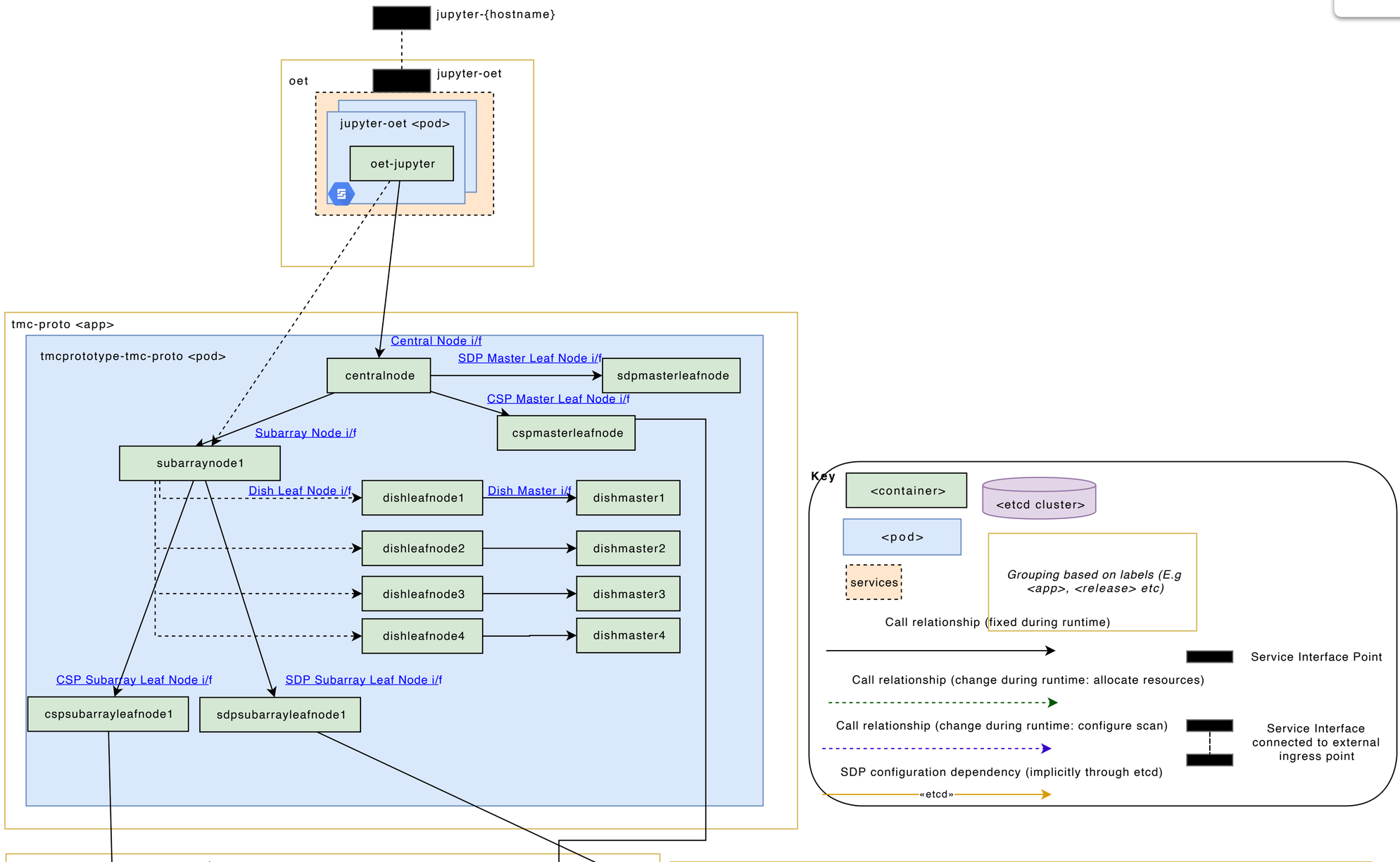

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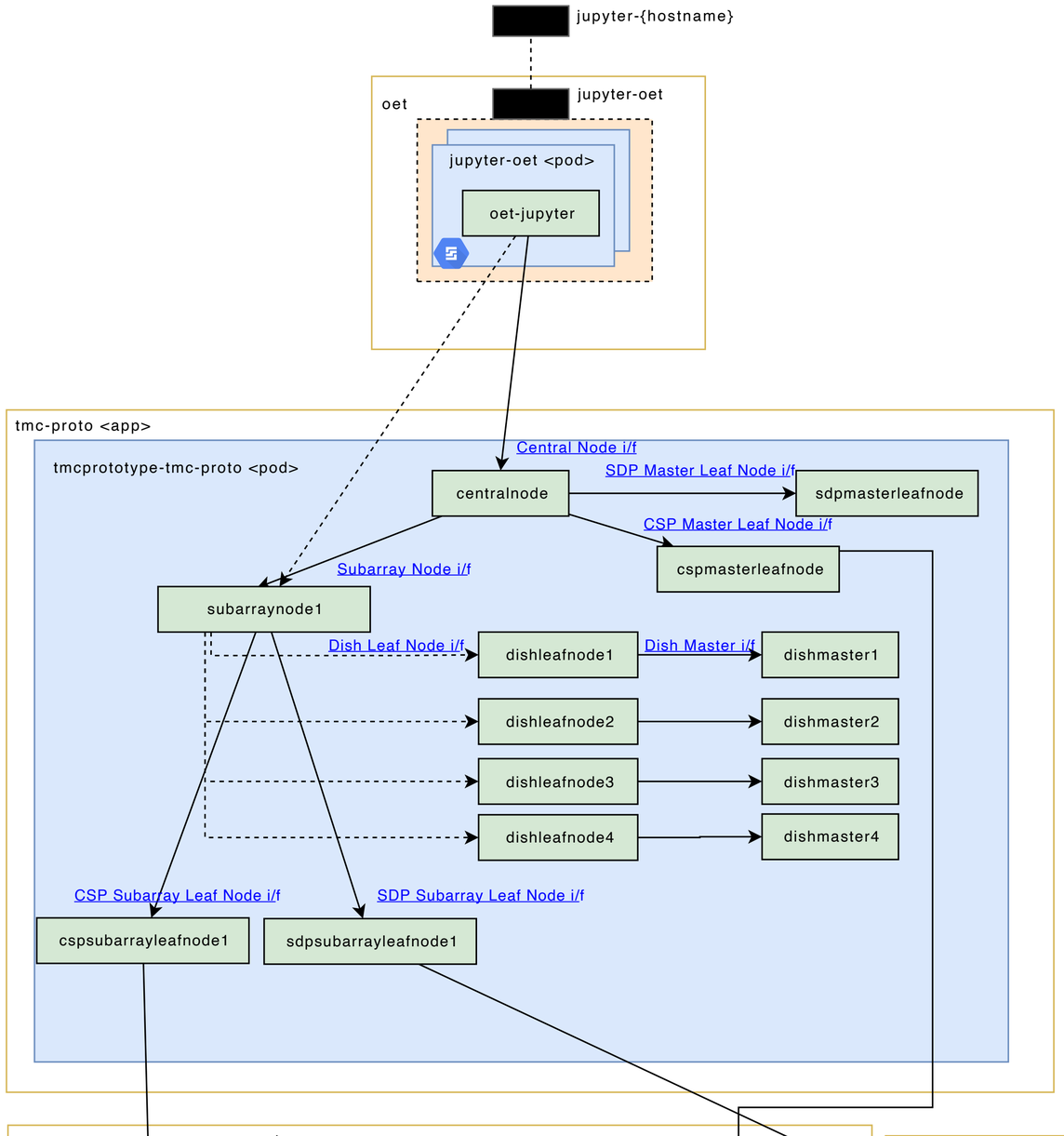
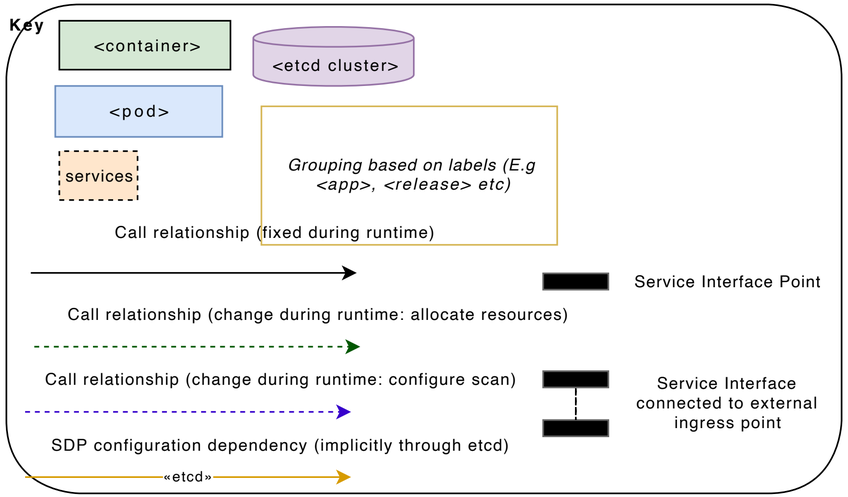
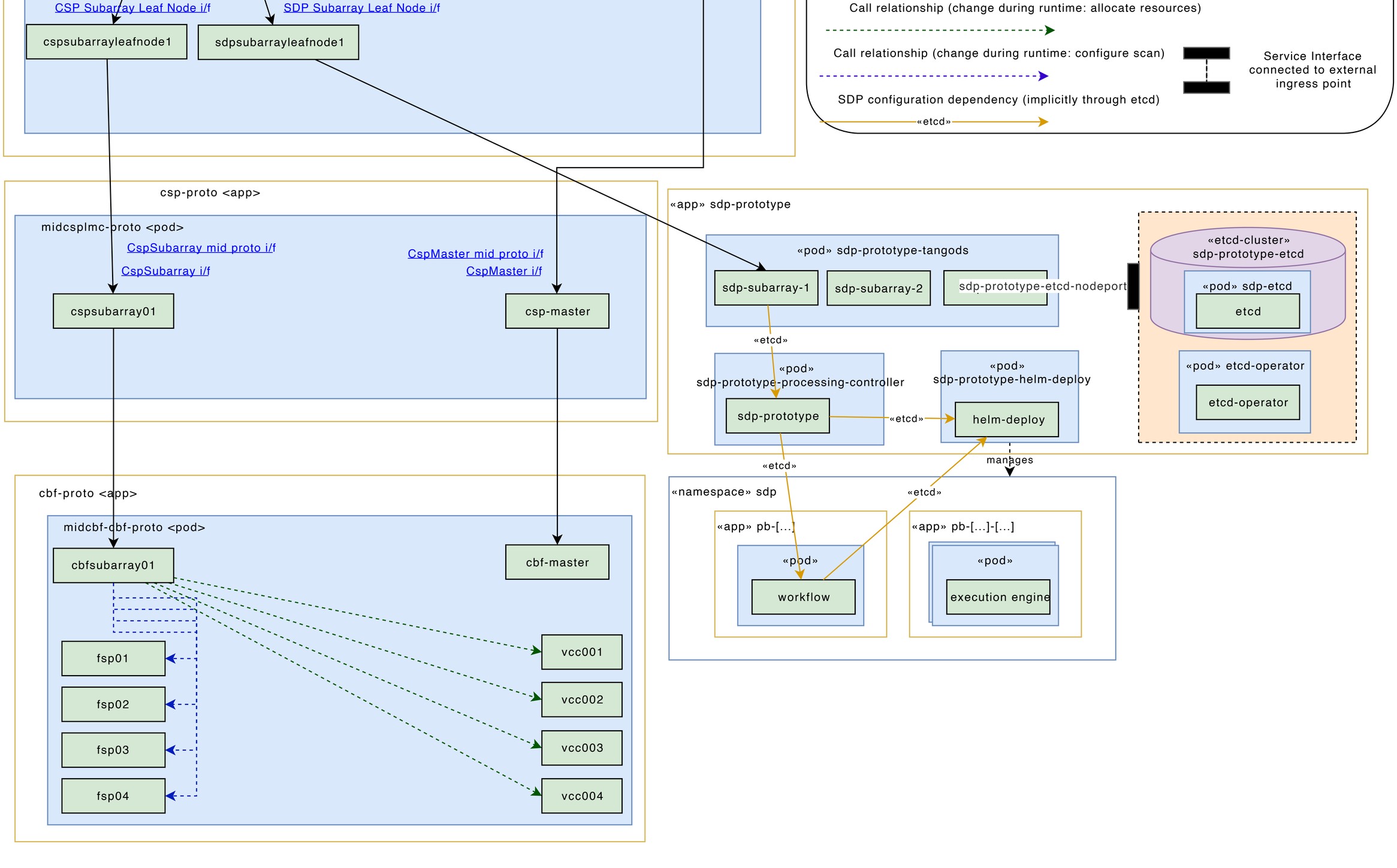


Deployment view of SKAMPI



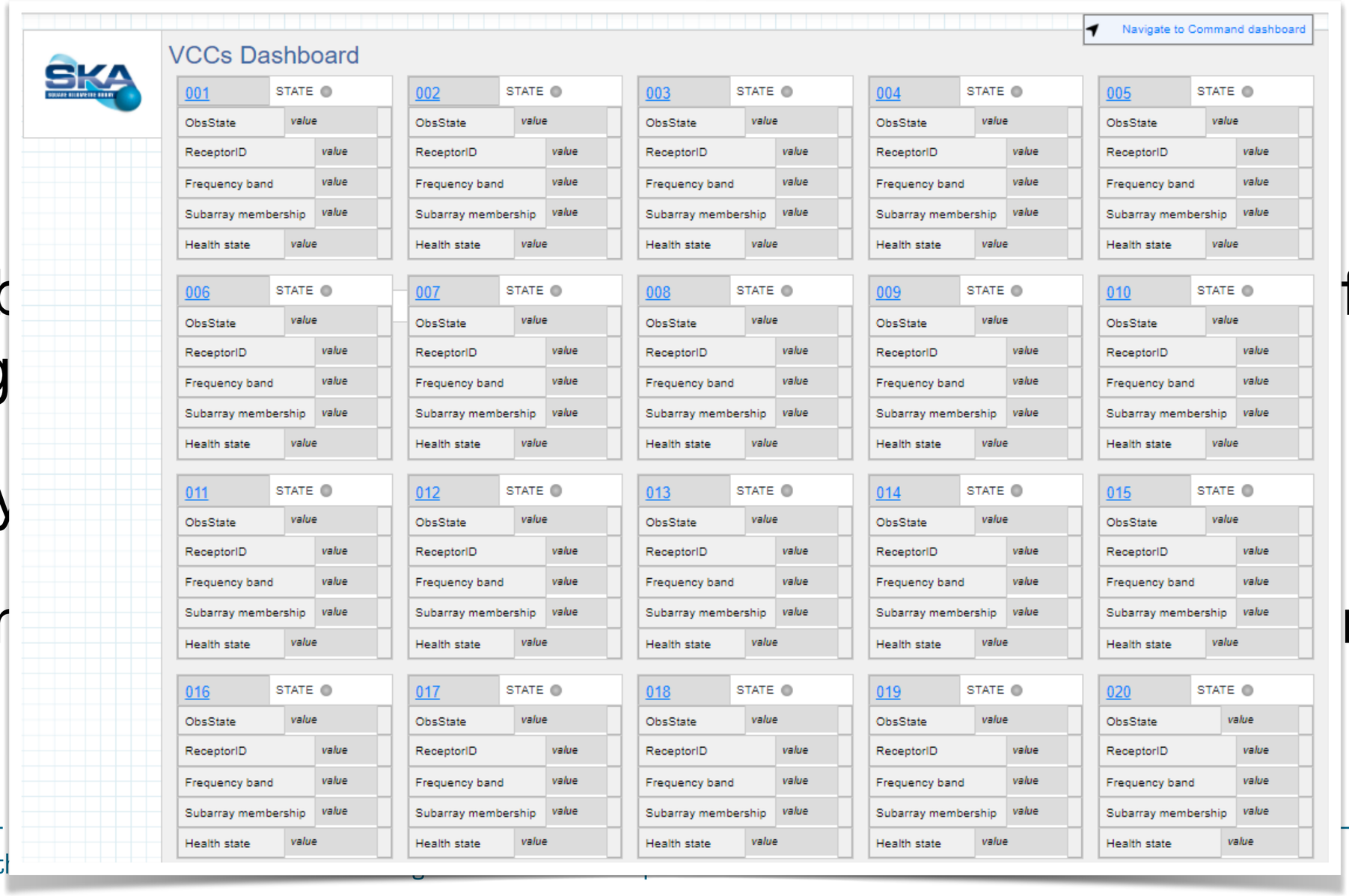

CSP Subarray Leaf Node i/f
SDP Subarray Leaf Node i/f
cspsubarrayleafnode1
sdpsubarrayleafnode1
Call relationship (change during runtime: allocate resources)
Call relationship (change during runtime: configure scan)
Service Interface connected to external ingress point
SDP configuration dependency (implicitly through etcd)
«etcd»
csp-proto <app>
midcsplmc-proto <pod>
CspSubarray mid proto i/f
CspSubarray i/f
CspMaster mid proto i/f
CspMaster i/f
cspsubarray01
csp-master
«app» sdp-prototype
«pod» sdp-prototype-tangods
sdp-subarray-1
sdp-subarray-2
sdp-prototype-etcd-nodeport
«etcd-cluster» sdp-prototype-etcd
«pod» sdp-etcd
etcd
«pod» etcd-operator
etcd-operator
«pod» sdp-prototype-processing-controller
sdp-prototype
«pod» sdp-prototype-helm-deploy
helm-deploy
manages
cbf-proto <app>
midcbf-cbf-proto <pod>
cbfsubarray01
cbf-master
fsp01
fsp02
fsp03
fsp04
vcc001
vcc002
vcc003
vcc004
«namespace» sdp
«app» pb-[…]
«app» pb-[…]-[…]
«pod»
workflow
execution engine

WebJive

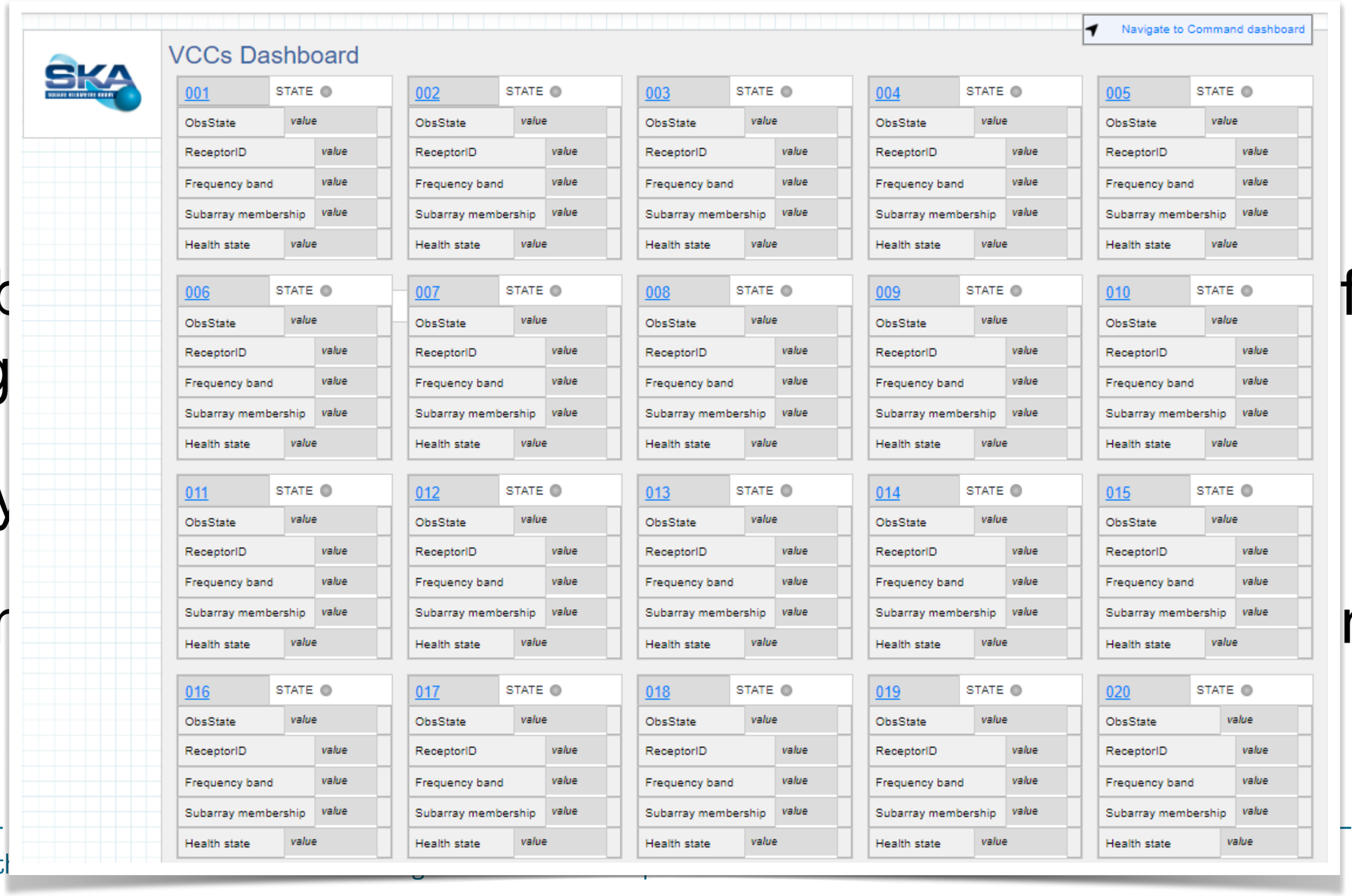
- WebJive downselected for the HTML5-based interface for Engineering dashboards
- Very fruitful collaboration with MAX IV
- Many performance, UI/UX, and testing improvements

WebJive

- Web face for Eng
- Very
- Mar nts



WebJive



- Web face for Eng
- Very
- Mar nts

See Webjive talk 17:10 GMT+1 today!

TANGO issues for SKA

- The SKA will have tens of thousands, and potentially hundreds of thousands of TANGO Device Servers.
- We are betting on an event-driven architecture →
  - Finding the edge cases of Event subscription and Event-forwarding
  - Looking into **kernel training** to raise local capabilities → brings more TANGO experts in the fold
- Building up on testing, tracing, etc.

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First training session started!

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Testing and TANGO CoPs

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Using what TANGO provides:
`DeviceProxy`, `DeviceTestContext`, `MultiDeviceTestContext`

Conclusions

Conclusions

Or this talk is almost over 😉

Conclusions

- We’re almost ready to start constructing the SKA!
  - Just waiting for the green light → Council 2?
- The Control Systems are a **very significant** part of the work we need to do in **software**.
- All software will be planned, developed, delivered, and evaluated within an Agile framework → SAFe
- We are invested in TANGO for the really long term!

SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope

www.skatelescope.org

SQUARE KILOMETRE ARRAY

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Thank you!

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Questions?

SKA-related talks in this meeting

- Juande Santander-Vela: *SKA Status Update* (this talk)
- Giorgio Brajnik: *WebJive progress report and the WebJive team(s)* (today, 17:10)
- Matteo Di Carlo: *CI-CD practices at SKA* (tomorrow, 9:20)
- Anton Joubert: *Unit testing Tango devices in Python* (tomorrow, 10:00)
- Matteo Di Carlo: *TANGO Grafana [and SKA]* (tomorrow, 11:00)
- Giorgio Brajnik: *WebJive demo and architecture* (tomorrow, 11:30)
- Giorgio Brajnik: *WebJive tutorial* (tomorrow, 14:00)
- Also somewhat related:
  - Jan David Mol: *LOFAR is ready to Tango* (today, 11:00; LOFAR is an SKA pathfinder)
  - Matteo Canzari: *TANGO training video series* (tomorrow, 15:25; Matteo works within SAFe team Cream)