Early Production Arrays - Mid

- Proposed Scope
- Schedule
- Preliminary Costs
- High level risks

Why Early Production Arrays

The Early Production Array is intended to be a representative end-to-end system based on the SKA reference design, that is the result of system CDR. The EPA will be a prototype integrated system built on a realistic infrastructure and will be used to:

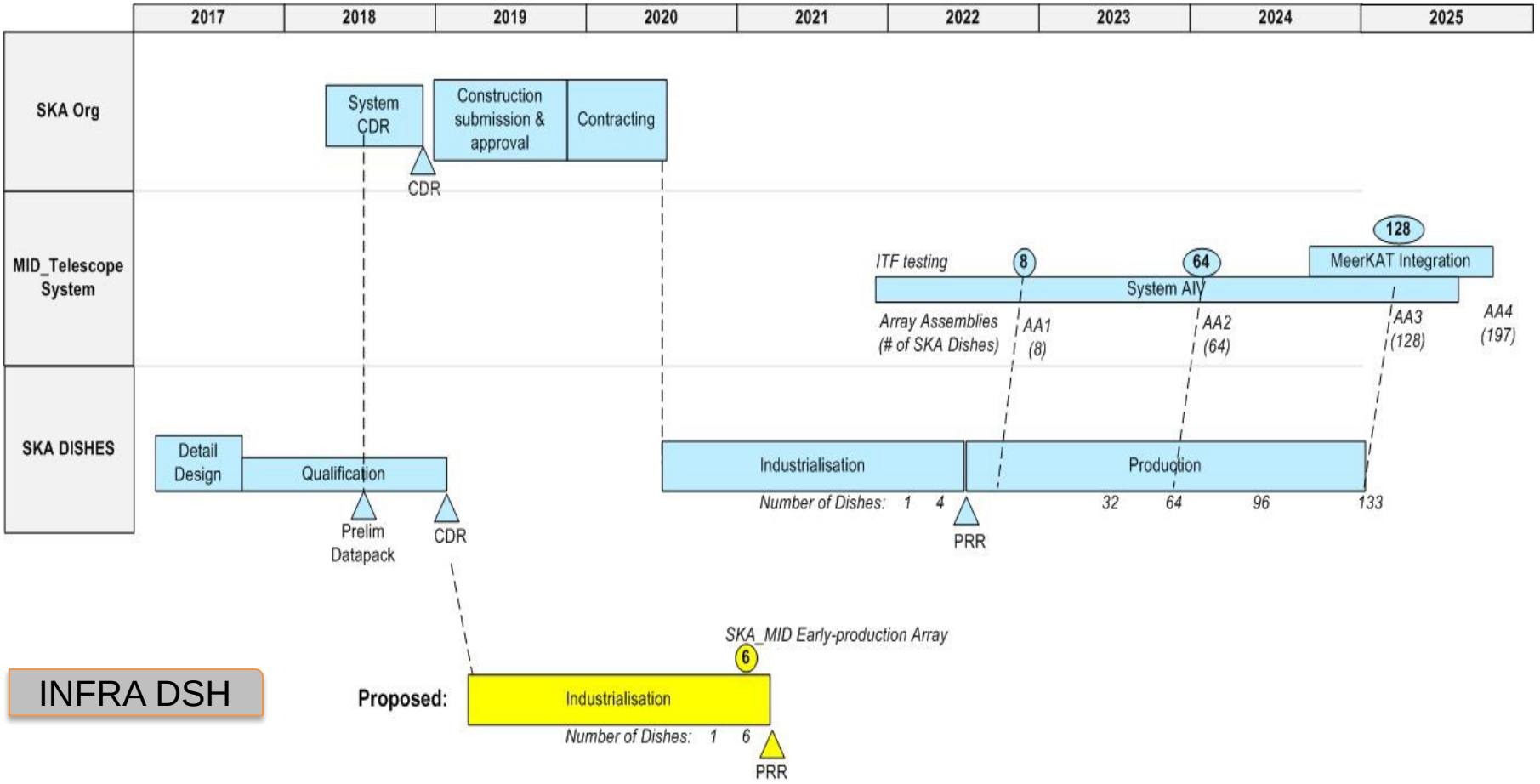
The objective of the EPA is to reduce the risks associated with the roll-out of the telescope in terms of cost, design and performance.

The impact of the EPA will increase when as many sub-systems as possible (hardware and software) are available for integration into the Early Production Array, even if in rudimentary or prototype form.

Stages and objectives

- Stage 1 – 6 Dish Array, Early industrialisation.
- Stage 2 – Signal Chain Qualification
- Stage 3 – Phase closure and early imaging

Roll out Stages



INFRA DSH

SaDT CSP TM

AIV SDP

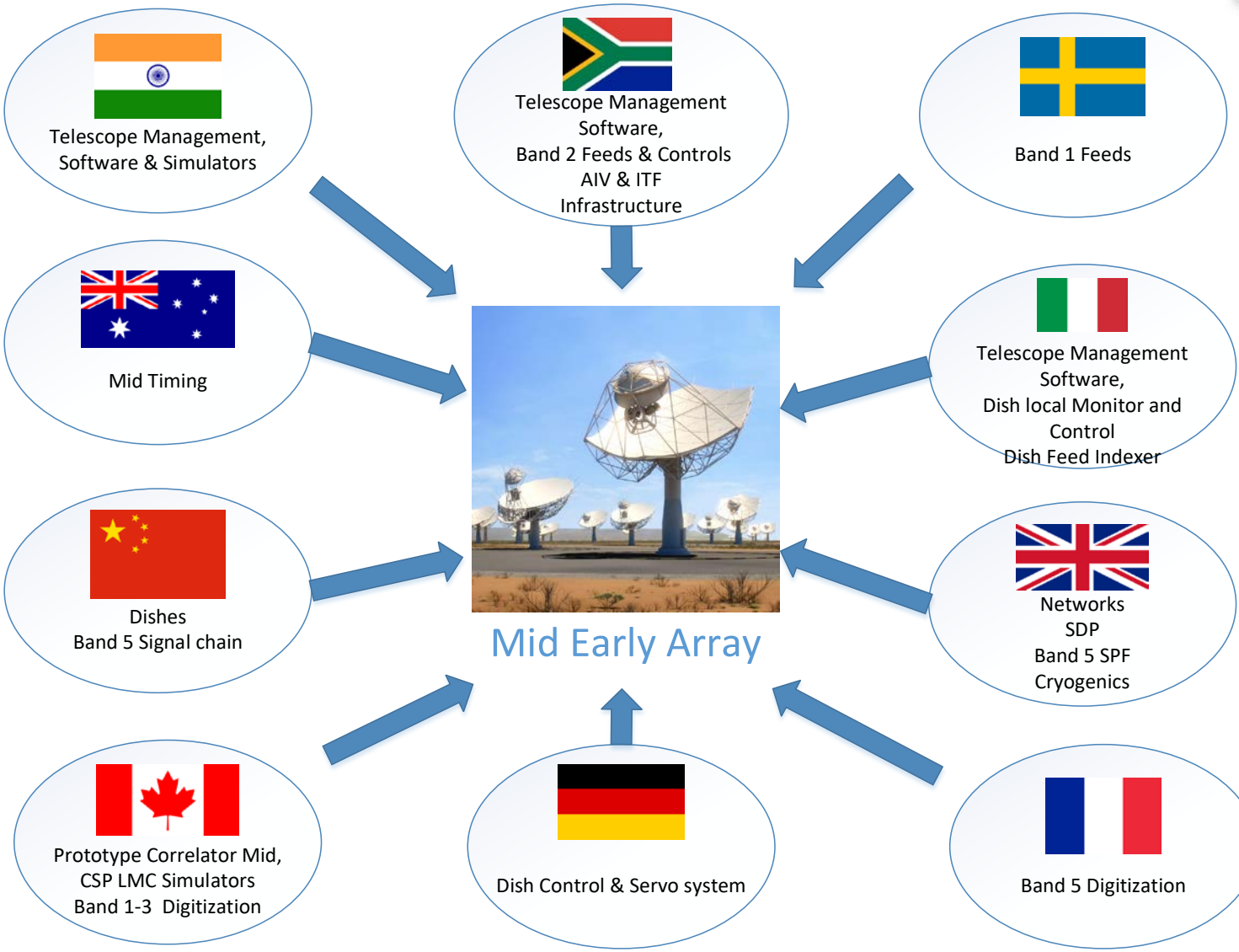
Stage 2

Stage 3

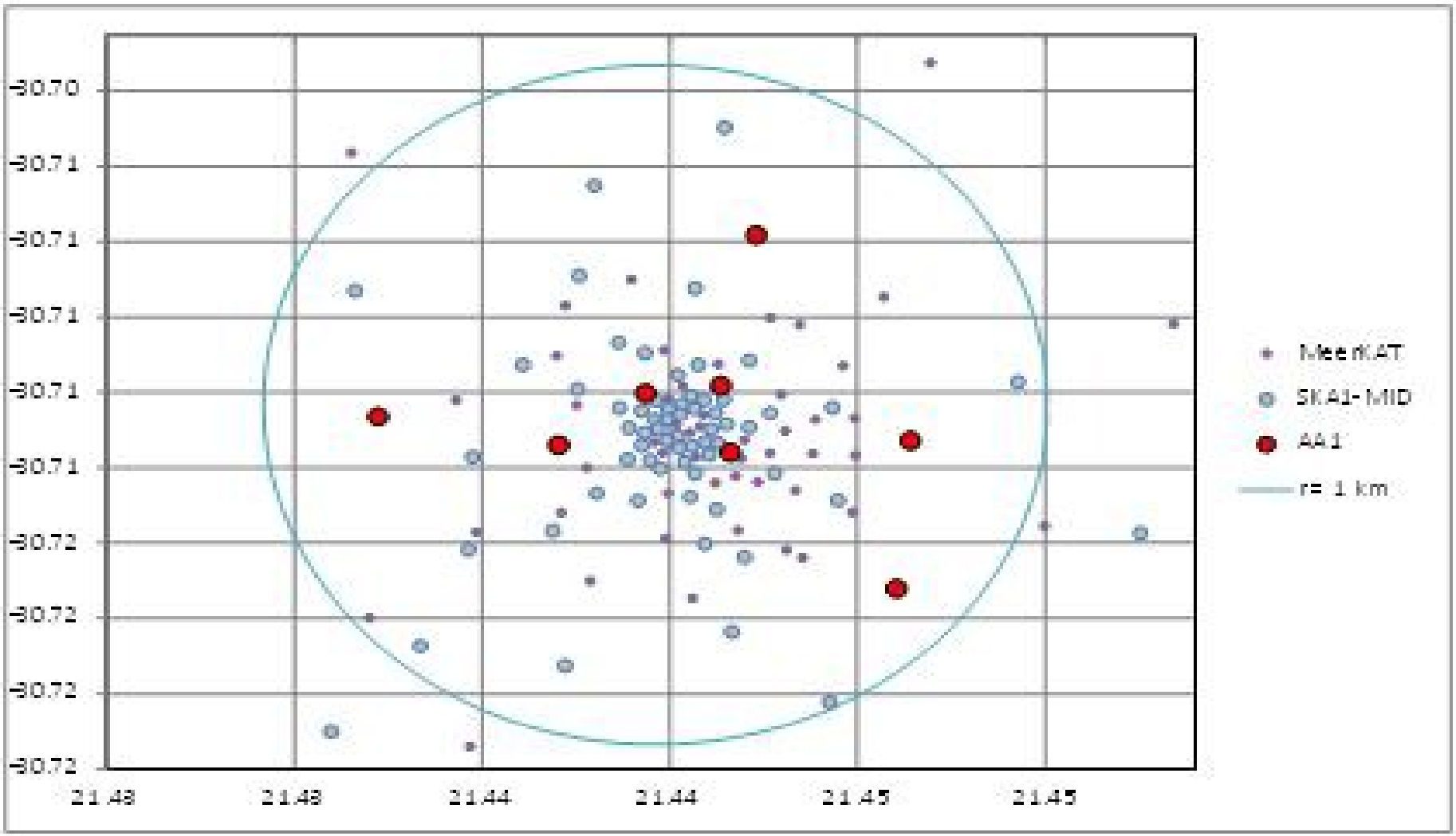
EPA Verification

- Verify hardware and software product interfaces
- Verify basic operator interface to control the system and to monitor system health
- Verify the available functionality provided by SaDT NMGR, NSDN and SAT.LMC
- Verify science data link performance between DSH and CSP over direct connection between DSH and CSP
- Verify non-science data link performance between pedestal-located NSDN and MID-CPF-located NSDN
- Verify non-science data connectivity between NSDN and all NSDN-connected equipment at all locations including pedestal, MID-CPF and the Operations Control Centre
- Verify correlator products
- Obtain and verify the Dish pointing model for each Dish, using interferometry
- Obtain the position for each Dish
- Perform delay calibration
- Perform delay tracking
- Perform baseline delay and phase calibration
- Obtaining fringes, phase closure and amplitude closure
- Verify time and frequency reference accuracy and stability using interim CLOCKS solution
- Verify gain and phase stability
- Verify channelisation performance
- Verify frequency agility
- Perform bandpass calibration
- Verify correlator efficiency
- Start measurements of polarization performance
- Start to verify tied-array beamforming functionality
- Verify overall system sensitivity
- Measure antenna voltage patterns and surface accuracy on the sky
- Measure polarization leakage (at least on-axis)
- Verify calibration
- Verify reference pointing
- Verify EMI requirements

Country contributions

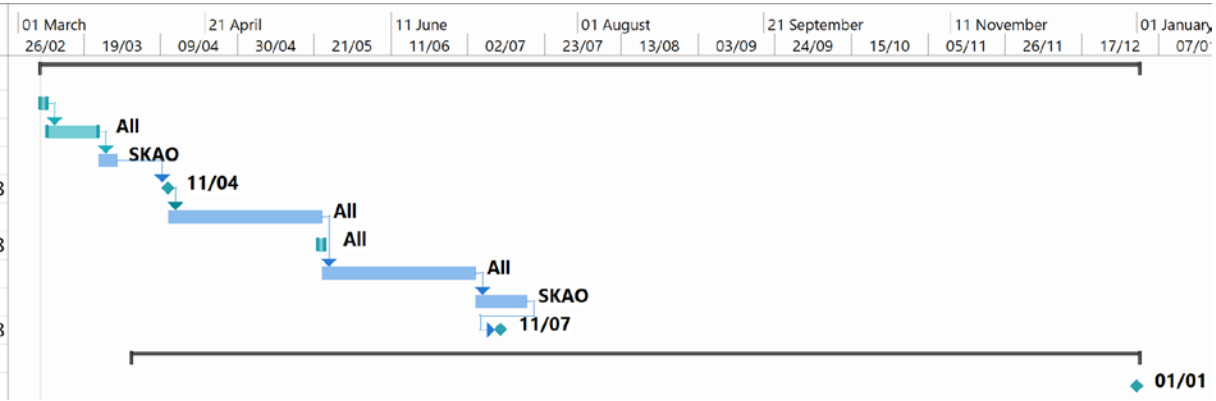


Dish locations



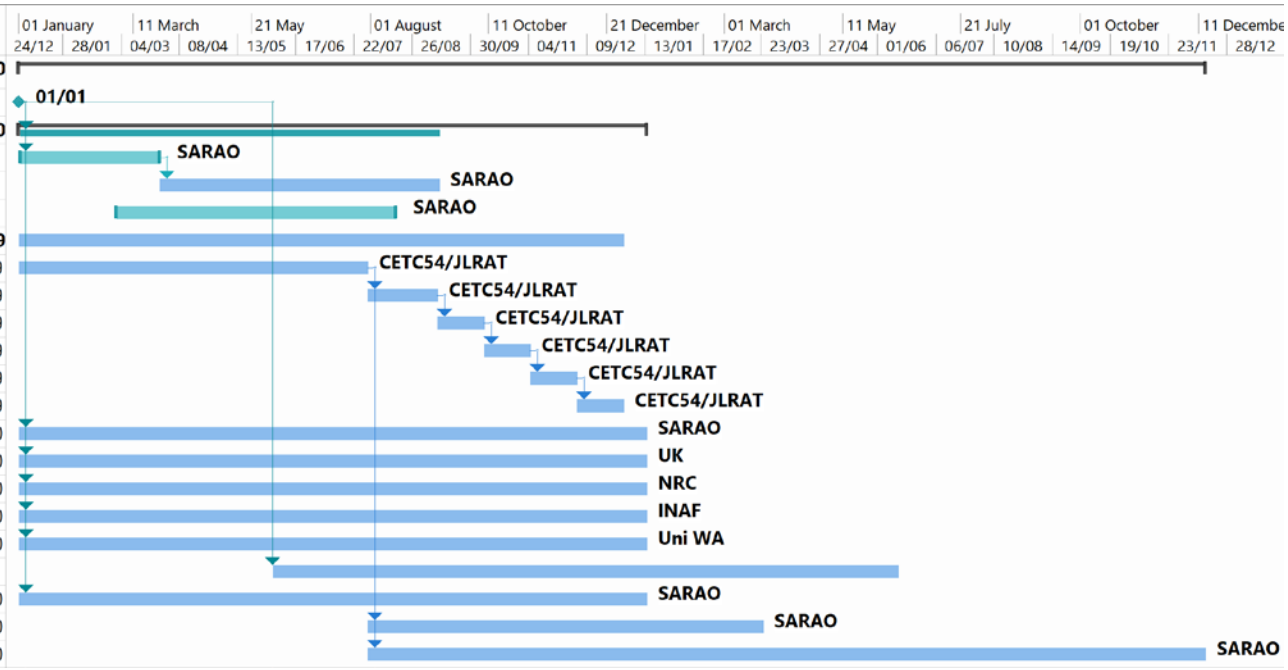
Schedule – Planning

Task Name	Start	Finish
Planning	**Wed 07/03/18**	**Tue 01/01/19**
EPA Workshop	Wed 07/03/18	Thu 08/03/18
Preliminary Plan	Fri 09/03/18	Thu 22/03/18
Preliminary Plan review	Fri 23/03/18	Tue 27/03/18
Board Meeting	Wed 11/04/18	Wed 11/04/18
Detailed Planning	Wed 11/04/18	Tue 22/05/18
EPA Technical workshop	Tue 22/05/18	Wed 23/05/18
EPA Proposal	Wed 23/05/18	Tue 03/07/18
EPA Proposal review	Wed 04/07/18	Tue 17/07/18
EPA Proposal approved	Wed 11/07/18	Wed 11/07/18
Funding Agency Proposals	**Sun 01/04/18**	**Tue 01/01/19**
EPA Kick off	Tue 01/01/19	Tue 01/01/19



Schedule – Stage 1

Task Name	Start	Finish
Stage 1 - Dish Array	**Tue 01/01/19**	**Mon 14/12/20**
Stage 1 Readiness review	Tue 01/01/19	Tue 01/01/19
Infra Structure	**Tue 01/01/19**	**Mon 13/01/20**
Build Permits/ licenses etc.	Wed 02/01/19	Tue 26/03/19
Roads, Trenching, Power	Wed 27/03/19	Tue 10/09/19
Foundations	Fri 01/03/19	Thu 15/08/19
Dish Manufacture	**Tue 01/01/19**	**Mon 30/12/19**
1	Tue 01/01/19	Mon 29/07/19
2	Tue 30/07/19	Mon 09/09/19
3	Tue 10/09/19	Mon 07/10/19
4	Tue 08/10/19	Mon 04/11/19
5	Tue 05/11/19	Mon 02/12/19
6	Tue 03/12/19	Mon 30/12/19
Band 2 SPF Vac & controller	Tue 01/01/19	Mon 13/01/20
Cryogenics	Tue 01/01/19	Mon 13/01/20
Digitizer	Tue 01/01/19	Mon 13/01/20
Dish LMC	Tue 01/01/19	Mon 13/01/20
Dish Fx timing distribution	Tue 01/01/19	Mon 13/01/20
Band 5	Mon 03/06/19	Fri 12/06/20
Dish verification equipment	Tue 01/01/19	Mon 13/01/20
Assembly & Integration	Tue 30/07/19	Mon 23/03/20
Verification	Tue 30/07/19	Mon 14/12/20



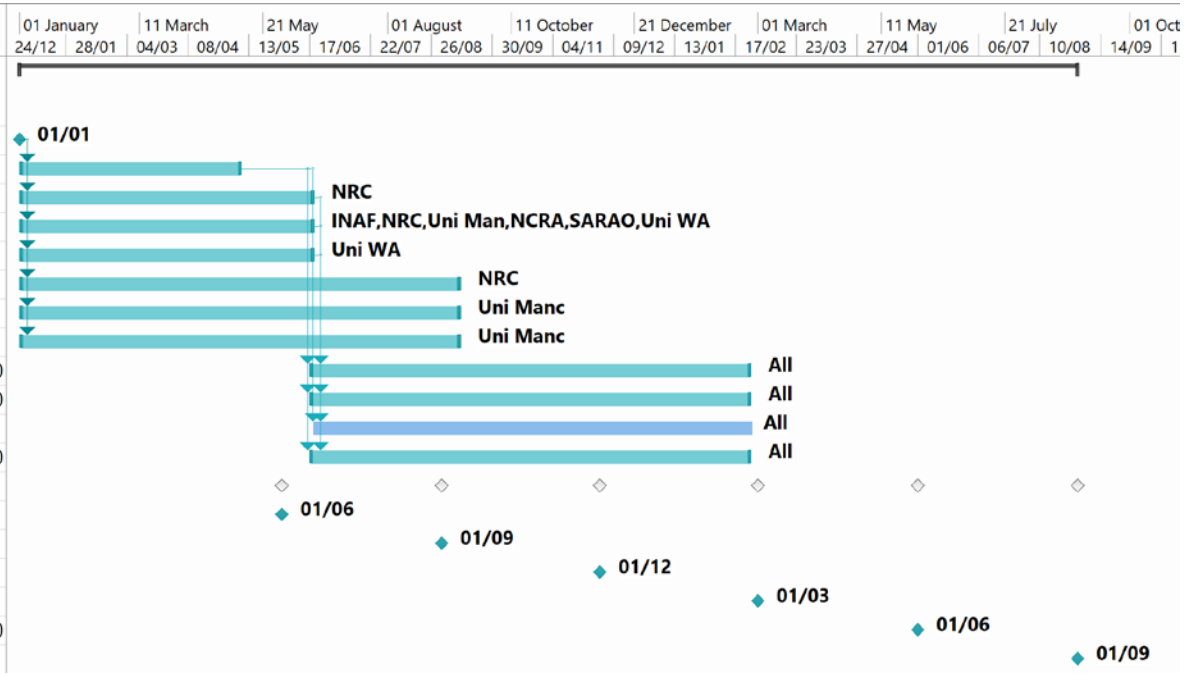
Costs Stage 1

Cost Item		Contributions Cost (€)	by	% of total	Comment	Basis of Estimate
Management		€327,879	SA	3.0%	1 Management FTE over 2 years	Estimated on standardised SA Labour rates
AIV		€327,879	SA	3.0%	1 Senior Eng FTE over 2 years	Estimated on standardised SA Labour rates
Dish	Dish Structure	€5,504,994	China	50.7%	6x Dish Structures + PRR Datapacks	DSH Consortium costing - See Appendix B.3
	SPF Band 2 Feeds	€2,489,512	SA	22.9%	6x B2Feeds, Vac, He, Cntl & PRR Datapacks	DSH Consortium costing - See Appendix B.2
	Dish Fibre Network	€150,000	SA	1.4%	6x Dish Fibre Network	DSH Consortium costing Oct17
Dish Verification System		€648,871	SA	6.0%	As per Dish Consortium Costing	DSH Consortium costing Oct17.
Infrastructure		€1,319,618	SA	12.2%	Roads, trenching, power& array fibre	DSH Consortium costing Oct17
Networks (DDBH & NSDN)		€85,200	SA	0.8%	6x DDBH & NSDN links to Dishes	
Total(€)		€10,853,953				

Ref T Kusel Paper

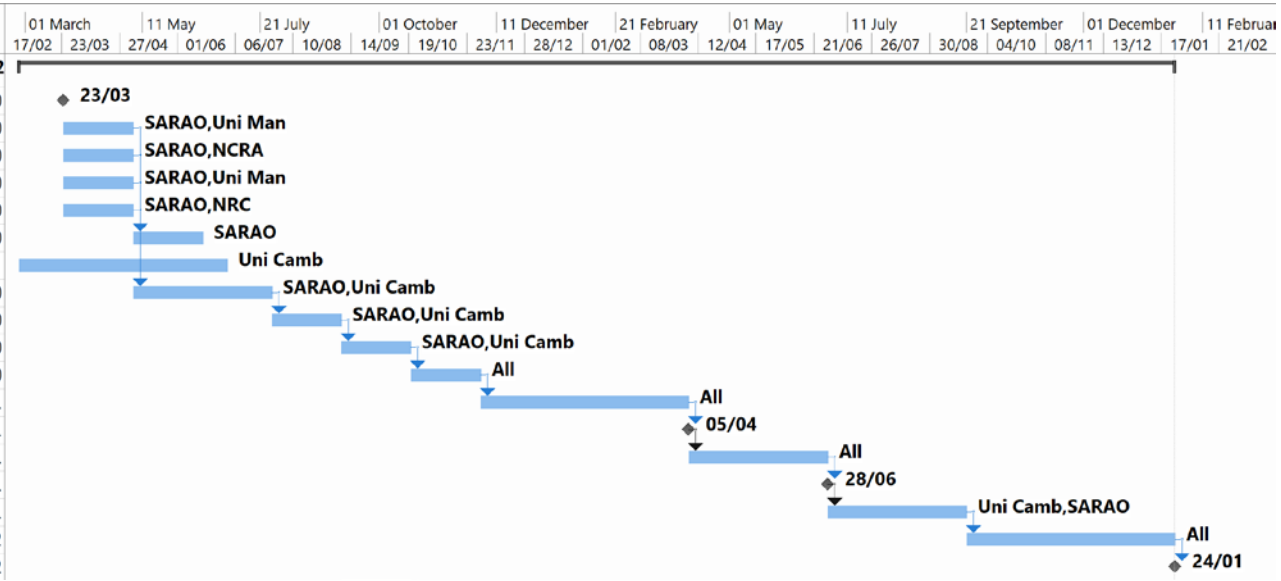
Schedule – Stage 2

Task Name	Start	Finish
Stage 2 - Signal Processing	**Tue 01/01/19**	**Tue 01/09/20**
Stage 2 readiness review	Tue 01/01/19	Tue 01/01/19
ITF development (Distributed)	Wed 02/01/19	Tue 07/05/19
Dish Digitizer x 3 off	Wed 02/01/19	Tue 18/06/19
Hardware Simulators	Wed 02/01/19	Tue 18/06/19
Timing	Wed 02/01/19	Tue 18/06/19
CSP 16K Channels per fx	Wed 02/01/19	Tue 10/09/19
NSDN Network	Wed 02/01/19	Tue 10/09/19
DDBH Simulator	Wed 02/01/19	Tue 10/09/19
Interface verification	Tue 18/06/19	Mon 24/02/20
RFI/ EMI verification	Tue 18/06/19	Mon 24/02/20
Integrated testing	Wed 19/06/19	Tue 25/02/20
Signal chain verification	Tue 18/06/19	Mon 24/02/20
Telescope Model, Phased roll out	**Sat 01/06/19**	**Fri 28/08/20**
TM functional rollout 1	Sat 01/06/19	Sat 01/06/19
TM functional rollout 2	Sun 01/09/19	Sun 01/09/19
TM functional rollout 3	Sun 01/12/19	Sun 01/12/19
TM functional rollout 4	Sun 01/03/20	Sun 01/03/20
TM functional rollout 5	Mon 01/06/20	Mon 01/06/20
TM functional rollout 6	Tue 01/09/20	Tue 01/09/20



Schedule – Stage 3

Task Name	Start	Finish
Stage 3 - Array Early imaging	**Wed 26/02/20**	**Mon 24/01/22**
Stage 3 readiness review	Mon 23/03/20	Mon 23/03/20
Integrate verification Networks to Arr	Tue 24/03/20	Mon 04/05/20
Integrate verificationn TM to Array	Tue 24/03/20	Mon 04/05/20
Integrate verification Timing to Array	Tue 24/03/20	Mon 04/05/20
Integrate verification CSP to Array	Tue 24/03/20	Mon 04/05/20
Signal Chain Verrifcation	Tue 05/05/20	Mon 15/06/20
SDP use of CASA	Wed 26/02/20	Tue 30/06/20
Test of Pipelines	Tue 05/05/20	Mon 27/07/20
Holograpy	Tue 28/07/20	Mon 07/09/20
Dish Pointing	Tue 08/09/20	Mon 19/10/20
Fringes	Tue 20/10/20	Mon 30/11/20
Phase closure	Tue 01/12/20	Mon 05/04/21
3 element array	Mon 05/04/21	Mon 05/04/21
Amplitude closeure	Tue 06/04/21	Mon 28/06/21
4 element array	Mon 28/06/21	Mon 28/06/21
Calibration	Tue 29/06/21	Mon 20/09/21
Detailed pointing	Tue 21/09/21	Mon 24/01/22
6 element array	Mon 24/01/22	Mon 24/01/22



High level Risks

- The scope of the work should be within the planned construction work, but limited additional cost is imposed on the project.
- Costs agreed in the EPA are considered as credits to SKA construction contributions once the IGO is enabled.
- May limit the advantages of open tender for WBS elements.
- Development maybe extended delaying construction.