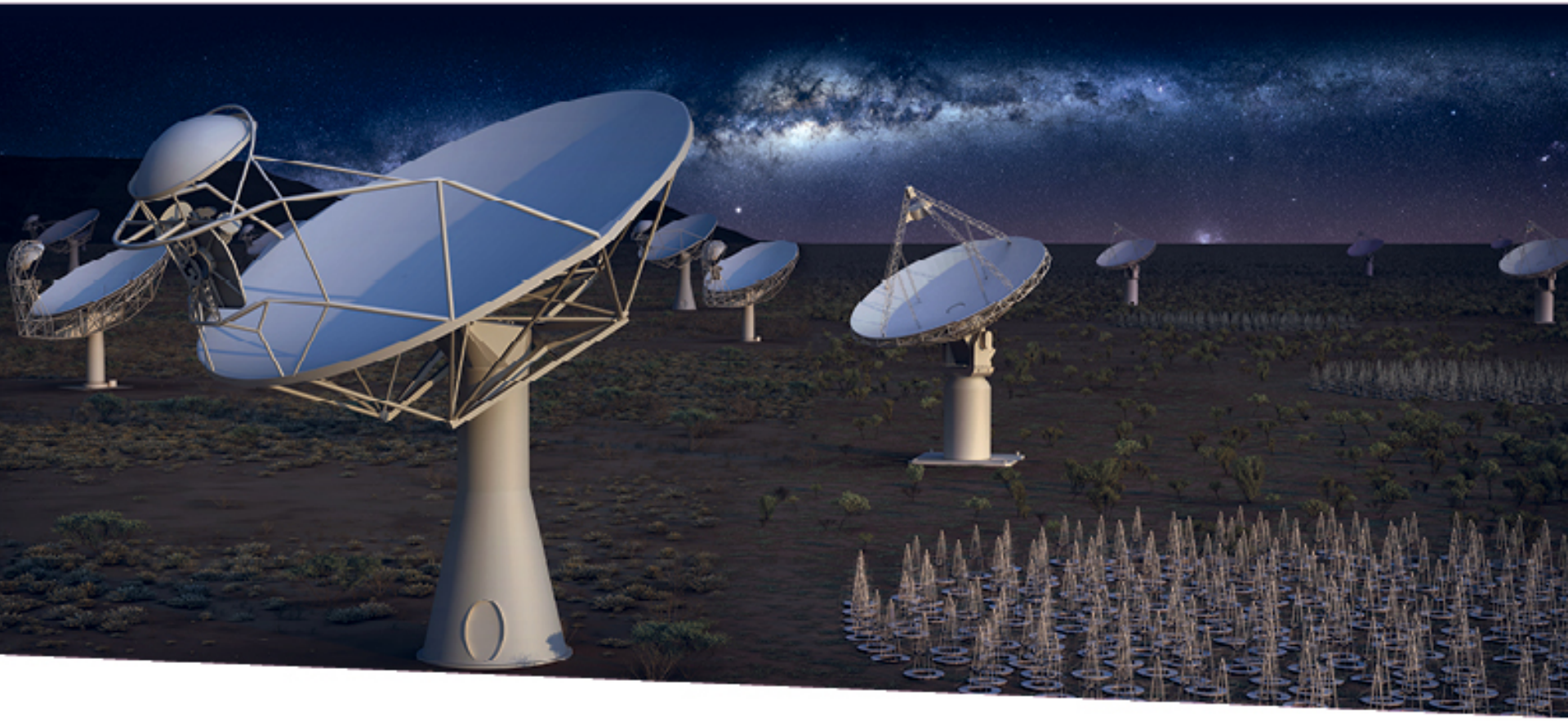
# Assembly, Integration & Verification

## 2017 SKA Engineering Meeting



SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope

**Richard Lord**

13 June 2017

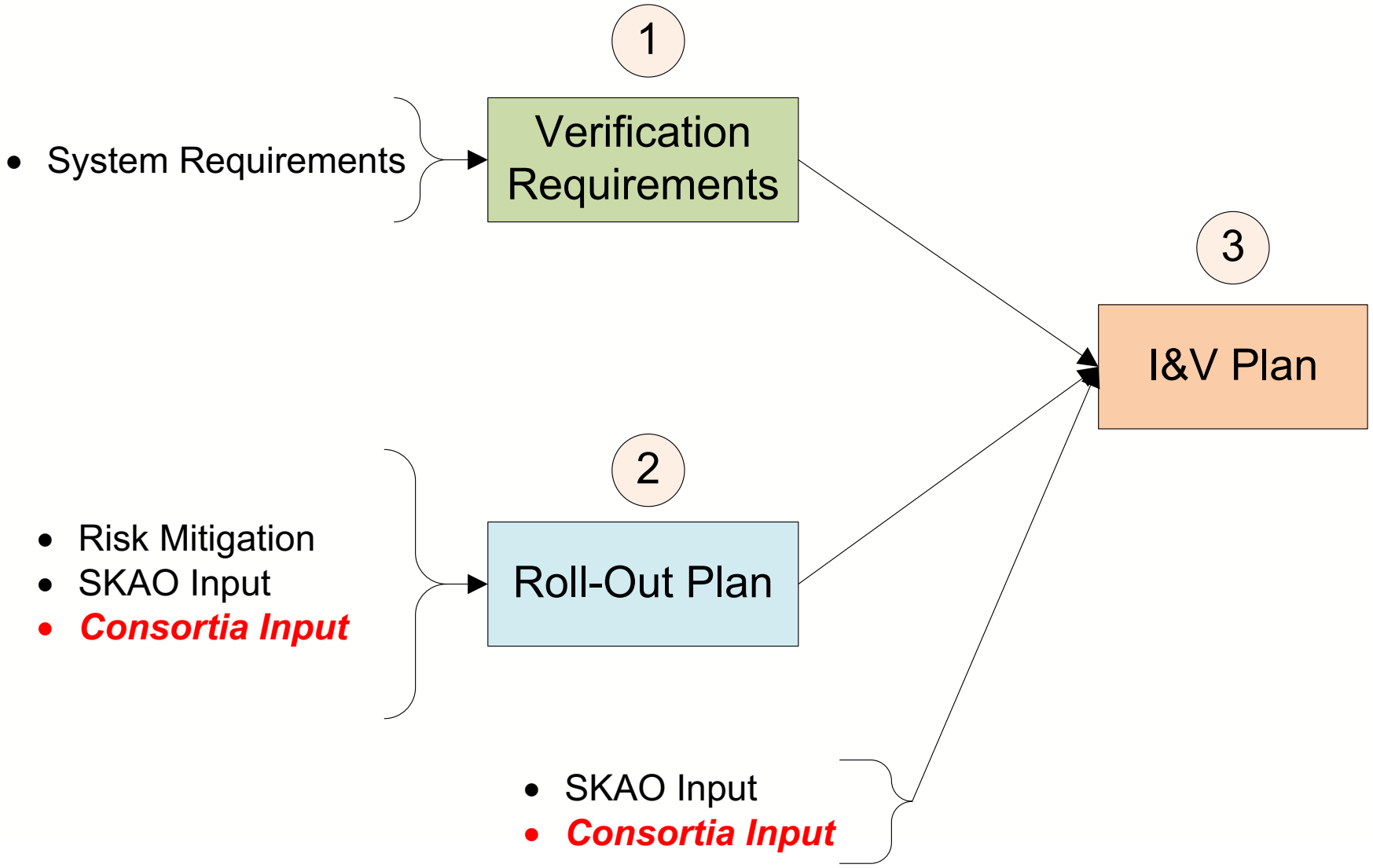
# AIV Consortium Member Organisations



# Overview

- Roll-Out Planning
- Integration & Verification Planning
- MeerKAT Integration Planning

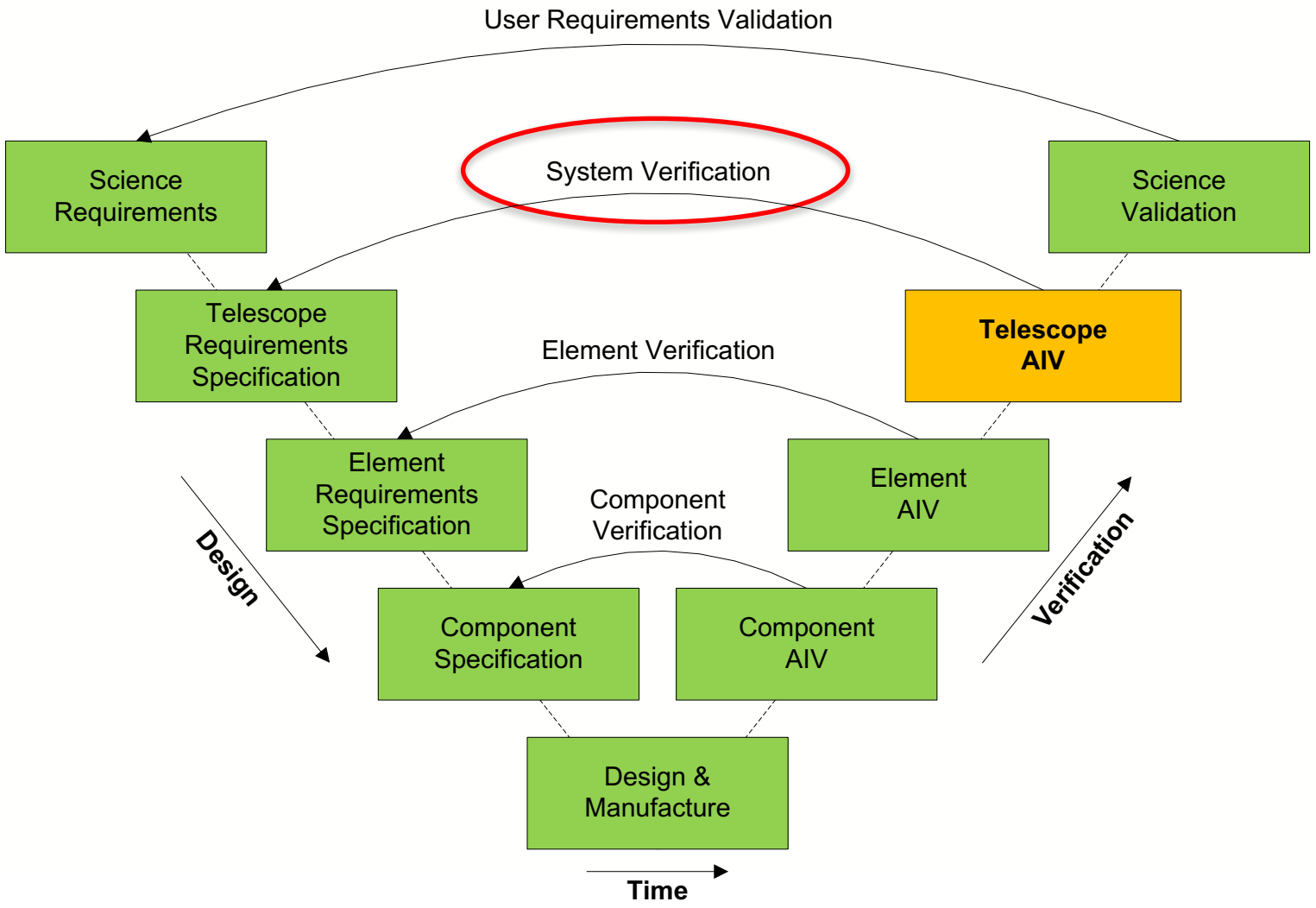
# Overview


1
Verification Requirements
• System Requirements
2
Roll-Out Plan
• Risk Mitigation
• SKAO Input
• Consortia Input
3
I&V Plan
• SKAO Input
• Consortia Input

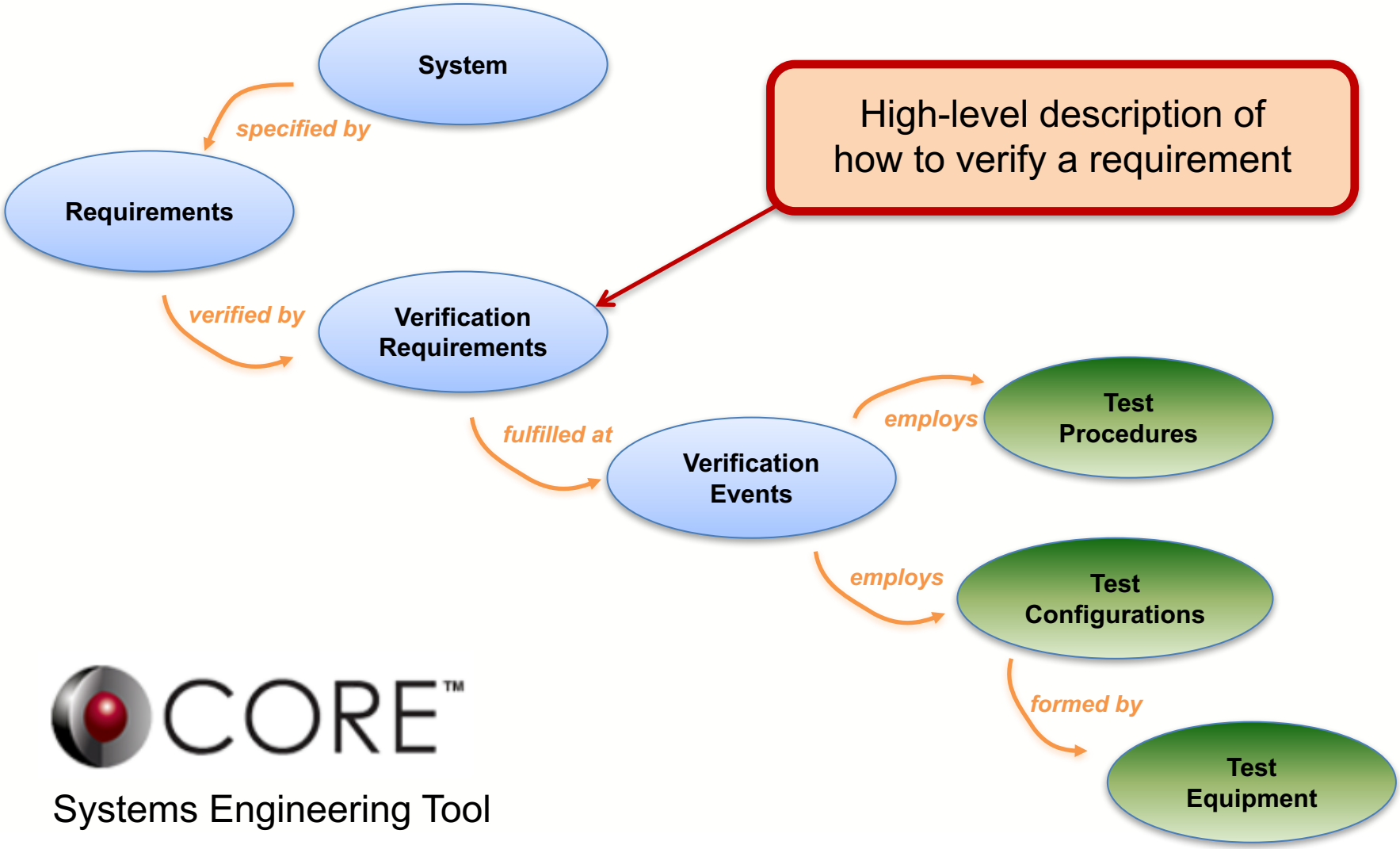
# AIV Stage 2 Milestones

| # | Stage 2: Milestone Description | Due Date |
|---|---|---|
| 1 | Kick-off | Apr 2015 |
| 2 | Telescope Preliminary I&V Plan | Jul 2015 |
| 3 | SEMP and PMP Alignment | Jun 2015 |
| 4 | Product Hand-Over Checklist | Jul 2015 |
| 5 | Updated Cost Model | Aug 2015 |
| 6 | MeerKAT Precursor ICDs | Aug 2015 |
| 7 | Telescope Roll-Out Plan (Next Release) | Sep 2015 |
| 8 | MeerKAT Precursor Integration Plan and ICDs | Oct 2016 |
| 9 | Telescope Verification Requirements (Next Release) | Mar 2017 |
| 10 | Product Hand-Over Checklist | Apr 2017 |
| 11 | Telescope Detailed I&V Plan | May 2017 |
| 12 | Telescope AIV Resource Plan | May 2017 |
| 13 | Telescope Test Procedures (Draft) | Aug 2017 |
| 14 | System Pre-CDR - Document Submission | Aug 2017 |
| 15 | System Pre-CDR – Closure | Oct 2017 |
| 16 | Telescope Test Procedures (Final) | Dec 2017 |
| 17 | System CDR - Document Submission | Mar 2018 |
| 18 | System CDR - Closure | System CDR + 4 weeks |

# V-Diagram


User Requirements Validation
Science Requirements
System Verification
Science Validation
Telescope Requirements Specification
Element Verification
Telescope AIV
Element Requirements Specification
Component Verification
Element AIV
Design
Verification
Component Specification
Component AIV
Design & Manufacture
Time

# Verification Model



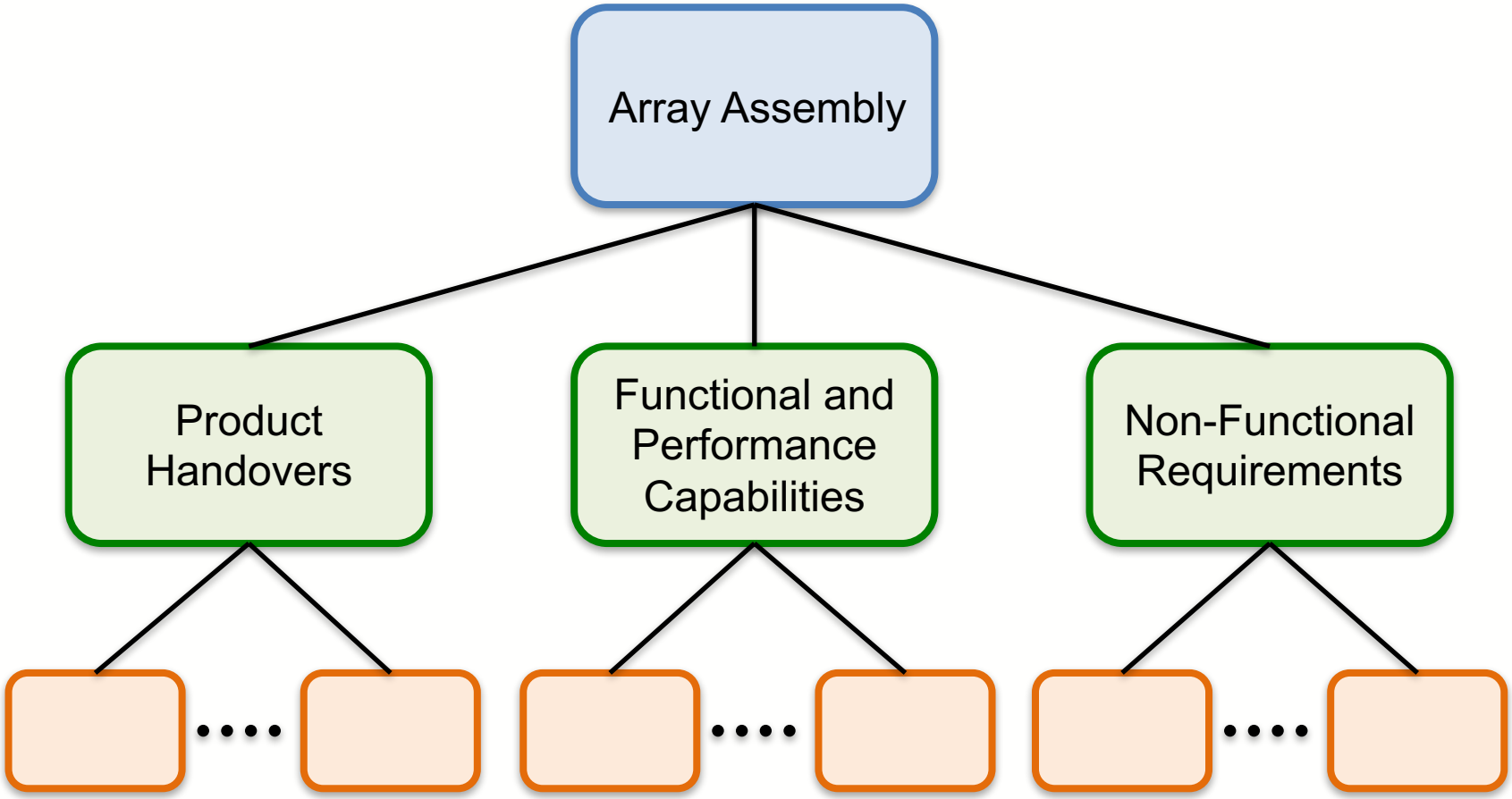

CORE™

Systems Engineering Tool

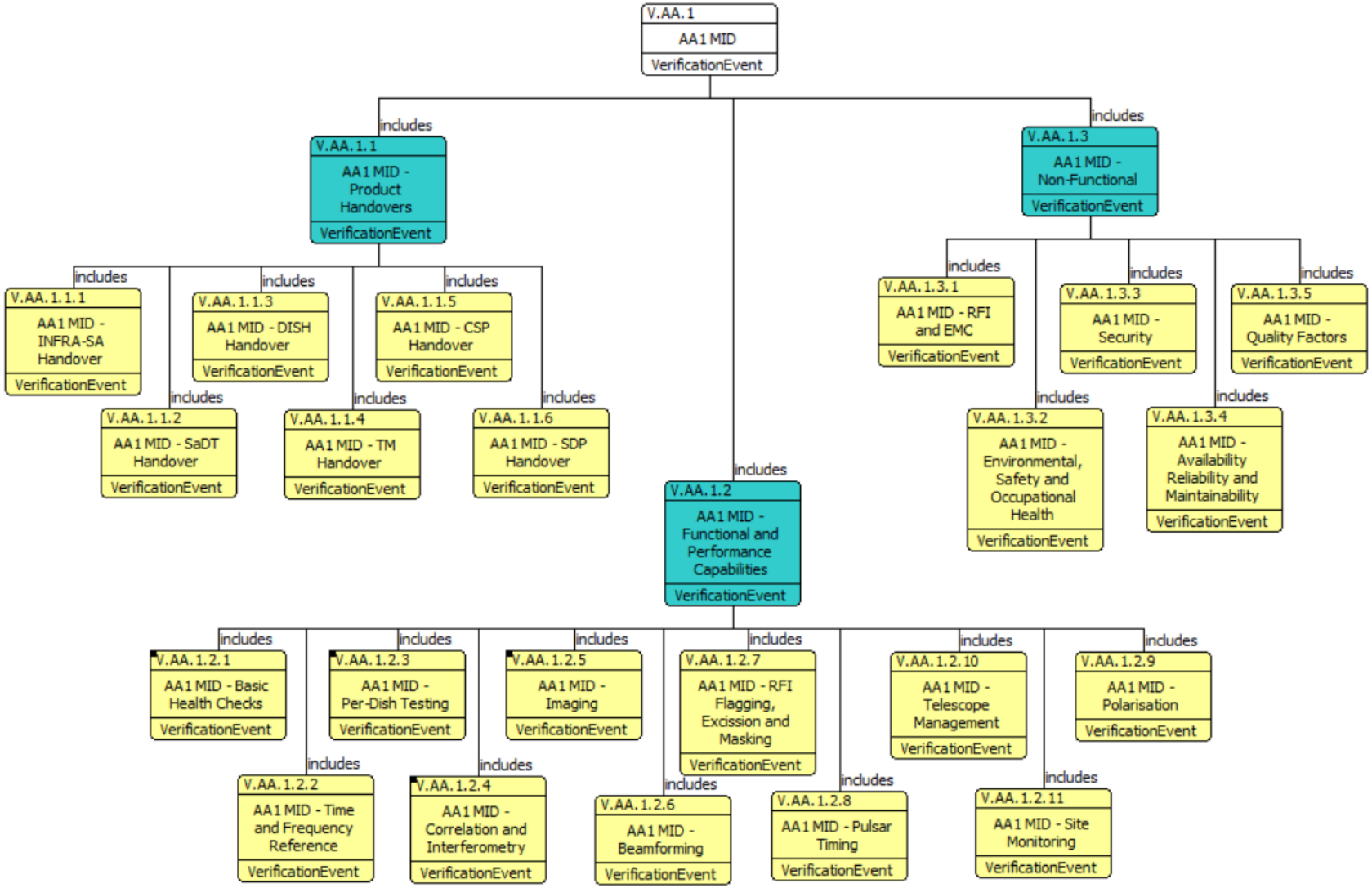
# Verification Requirements

- High-level description of how each requirement will be verified
- At what level of system integration the verification will be performed
  - System ITF, AA1, AA2, AA3, AA4
- Who is responsible for executing the verification
  - I&V Contractor, Science Validation Team

# Verification Events



# Verification Event Tree - Example



# Roll-Out Plan

- Forms the basis for the delivery of products and planning of integration & verification activities
- Considers:
  - Sequencing of implemented functionality
  - Scale: How many Dishes / Stations deployed and when
  - Integration of MeerKAT Precursor into SKA1-MID

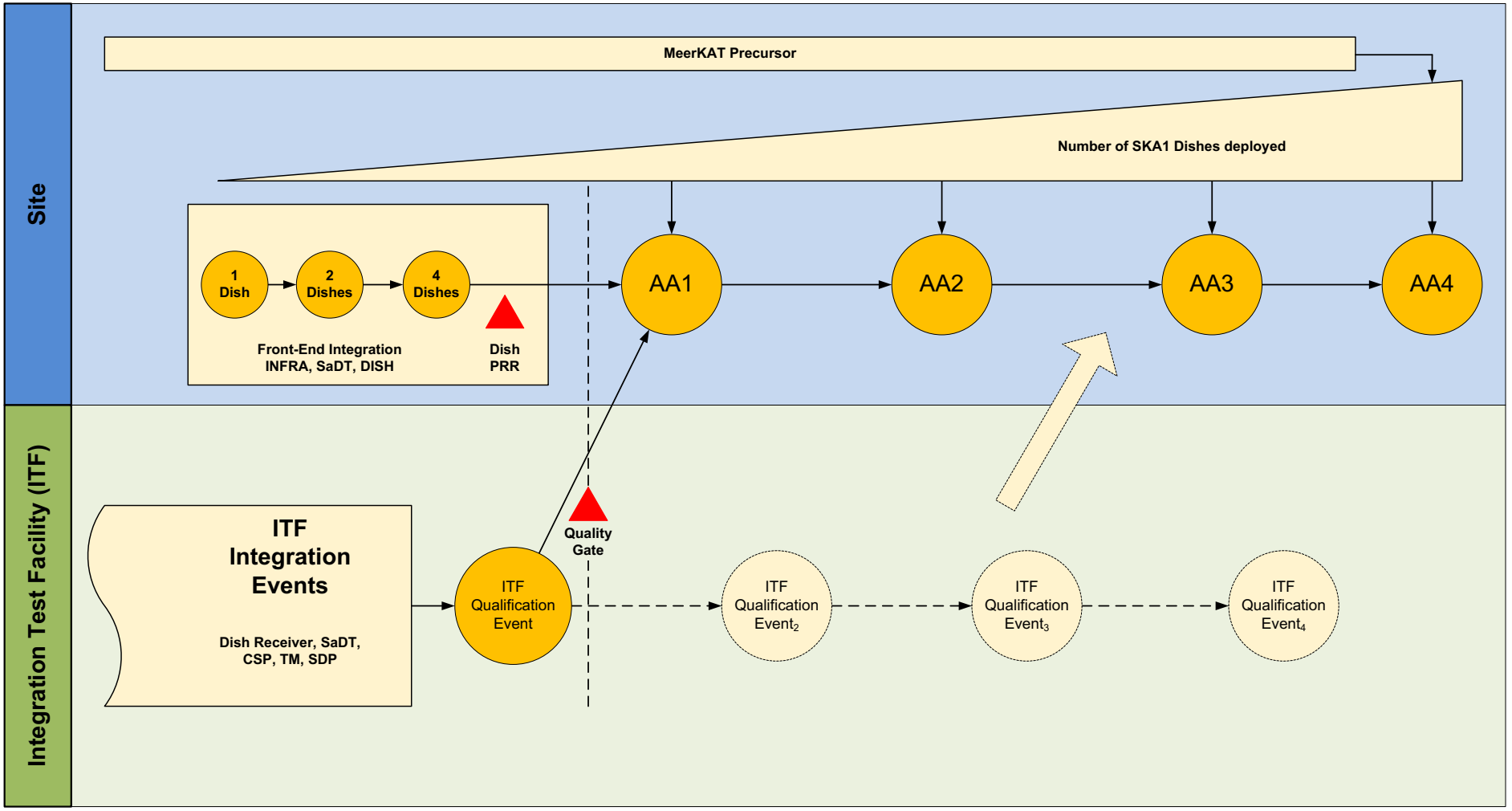
- Sequential process – early retirement of risks
- Achieved by specifying “Array Assemblies”

# Array Assemblies

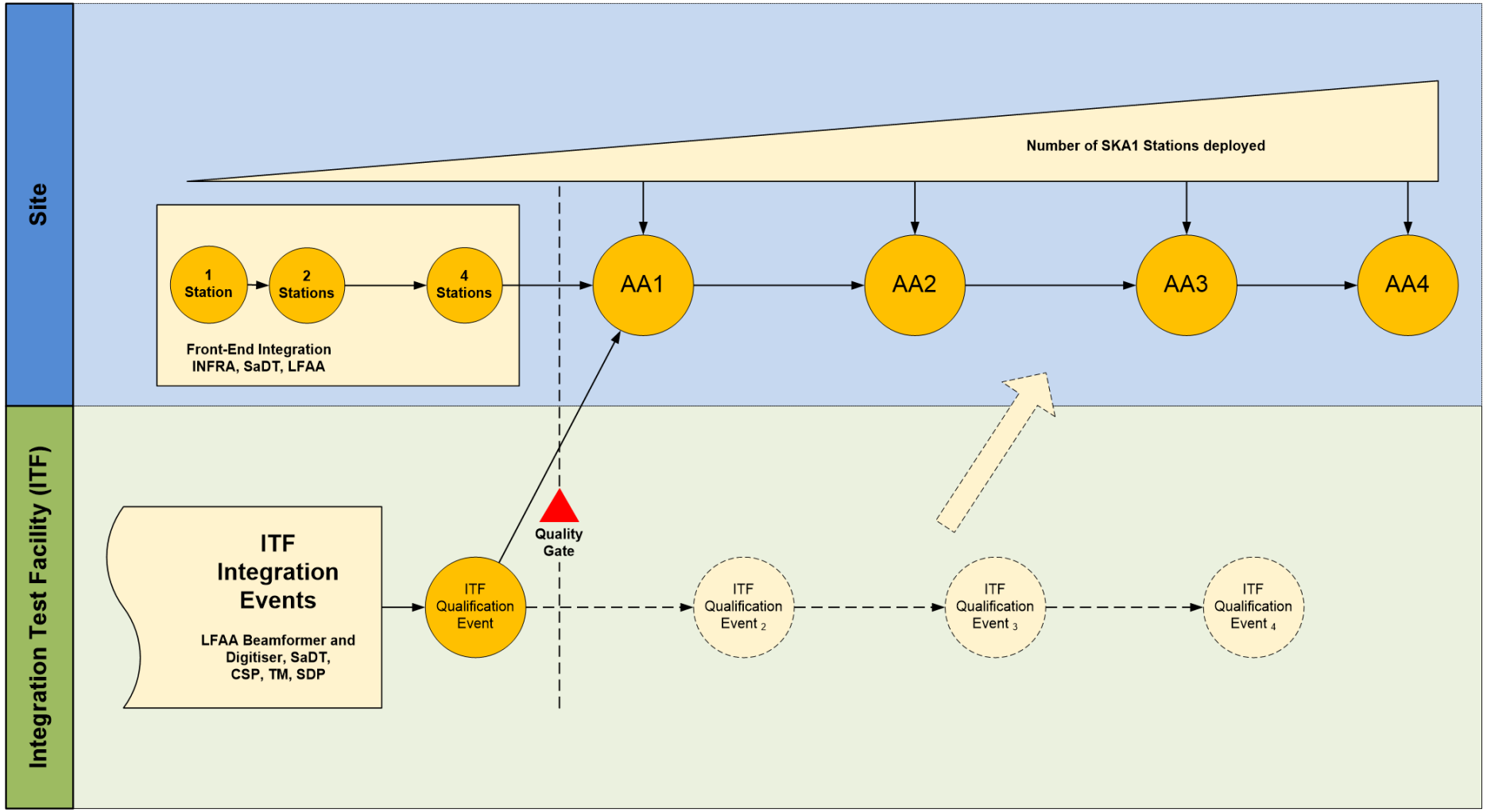
- Described by:
  - Date
    - When all required products have been *installed*, i.e. not necessarily *integrated* into Telescope System
  - Number of Dishes / Stations
  - Array Capability → Determines Element functionality
  - Key Engineering Goals

- Array Assemblies used by I&V Contractor
  - Verification of Level-1 (System Level) Requirements
- Array Releases used by Science Validation Team
  - Validation of Science Requirements

# SKA1-MID Roll-Out Plan



# SKA1-LOW Roll-Out Plan



# Integration & Verification Plan

Provides a structured framework, in which all integration and verification activities will be carried out in a coordinated manner.

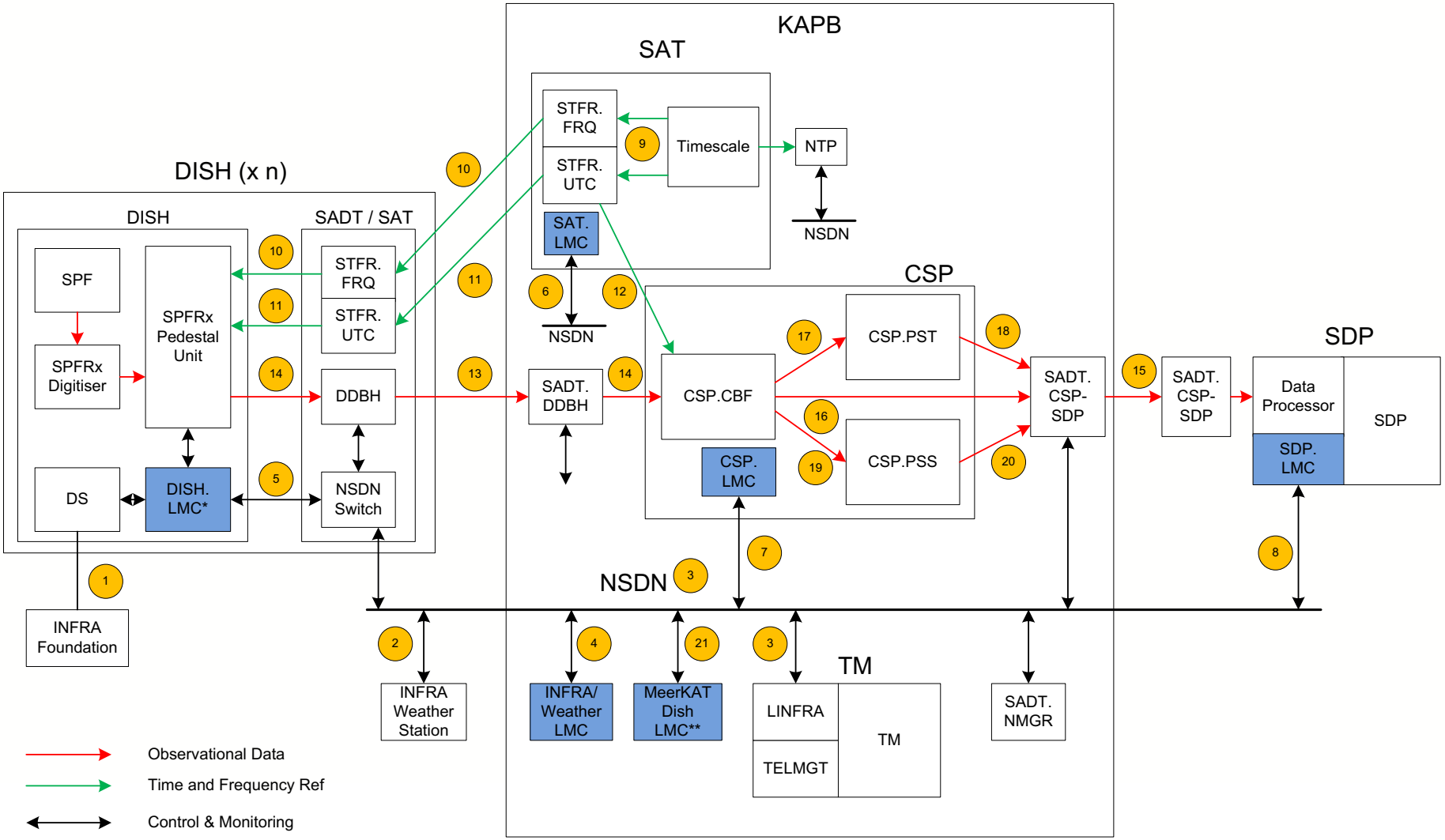
Identifies:

- Integration Events
- Verification Events

Each event has:

- Start date
- Duration
- Resources
- Prerequisites

# Identification of SKA1-MID Integration Events



# Integration Events for MID AA1

| Integration Event | | | | C0+ | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product | Product | FTE Days | # of Personnel | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
| | | | | | | | | | | | | | | | | | | | |
| INFRA.Foundation | DISH.Dish Structure Pedestal | | | x | | | | | | | | | | | | | | | |
| INFRA. | SADT.Trenching & Reticulation | | | x | | | | | | | | | | | | | | | |
| INFRA.Weather Station | SADT.NSDN | | | | x | | | | | | | | | | | | | | |
| SADT.NSDN | TM.LINFRA | | | | x | | | | | | | | | | | | | | |
| | INFRA. Weather Station LMC | | | | x | | | | | | | | | | | | | | |
| | DISH.LMC | | | | | x | | | | | | | | | | | | | |
| | SAT.LMC | | | | | | x | | | | | | | | | | | | |
| | CSP.LMC | | | | | | x | | | | | | | | | | | | |
| | SDP.LMC | | | | | | | x | | | | | | | | | | | |
| TM.TELMGT | INFRA. Weather Station LMC | | | | | x | | | | | | | | | | | | | |
| TM.TELMGT | DISH.LMC | | | | | | x | | | | | | | | | | | | |
| TM.TELMGT | SAT.LMC | | | | | | | x | | | | | | | | | | | |
| TM.TELMGT | CSP.LMC | | | | | | | x | | | | | | | | | | | |
| TM.TELMGT | SDP.LMC | | | | | | | | | x | | | | | | | | | |
| SAT.Timescale | SAT.STFR | | | | | | x | | | | | | | | | | | | |
| DISH.SPFRx Pedestal Unit | SAT.STFR.FRQ | | | | | | | | x | | | | | | | | | | |
| | SAT.STFR.UTC | | | | | | | | x | | | | | | | | | | |
| SAT.STFR.UTC | CSP.CBF | | | | | | | | x | | | | | | | | | | |
| SADT.DDBH | DISH.SPFRx Pedestal Unit | | | | | | | | | x | | | | | | | | | |
| | CSP.CBF | | | | | | | | | x | | | | | | | | | |
| DISH.SPFRx Pedestal Unit | CSP.CBF | | | | | | | | | | x | | | | | | | | |
| SADT.CSP-SDP | CSP.CBF | | | | | | | | | | | x | | | | | | | |
| | SDP.Data Proc | | | | | | | | | | | x | | | | | | | |
| | CSP.PST | | | | | | | | | | | | | | | | x | | |
| CSP.CBF | SDP.Data Proc | | | | | | | | | | | | x | | | | | | |
| CSP.CBF | CSP.PST | | | | | | | | | | | | | | | | | x | |
| CSP.PST | SDP.Data Proc | | | | | | | | | | | | | | | | | | x |
| | | | | | | | | | | | | | | | | | | | |
| NSDN | Operations Centre | | | | | x | | | | | | | | | | | | | |
| TM | Operations Centre | | | | | x | x | | | | | | | | | | | | |

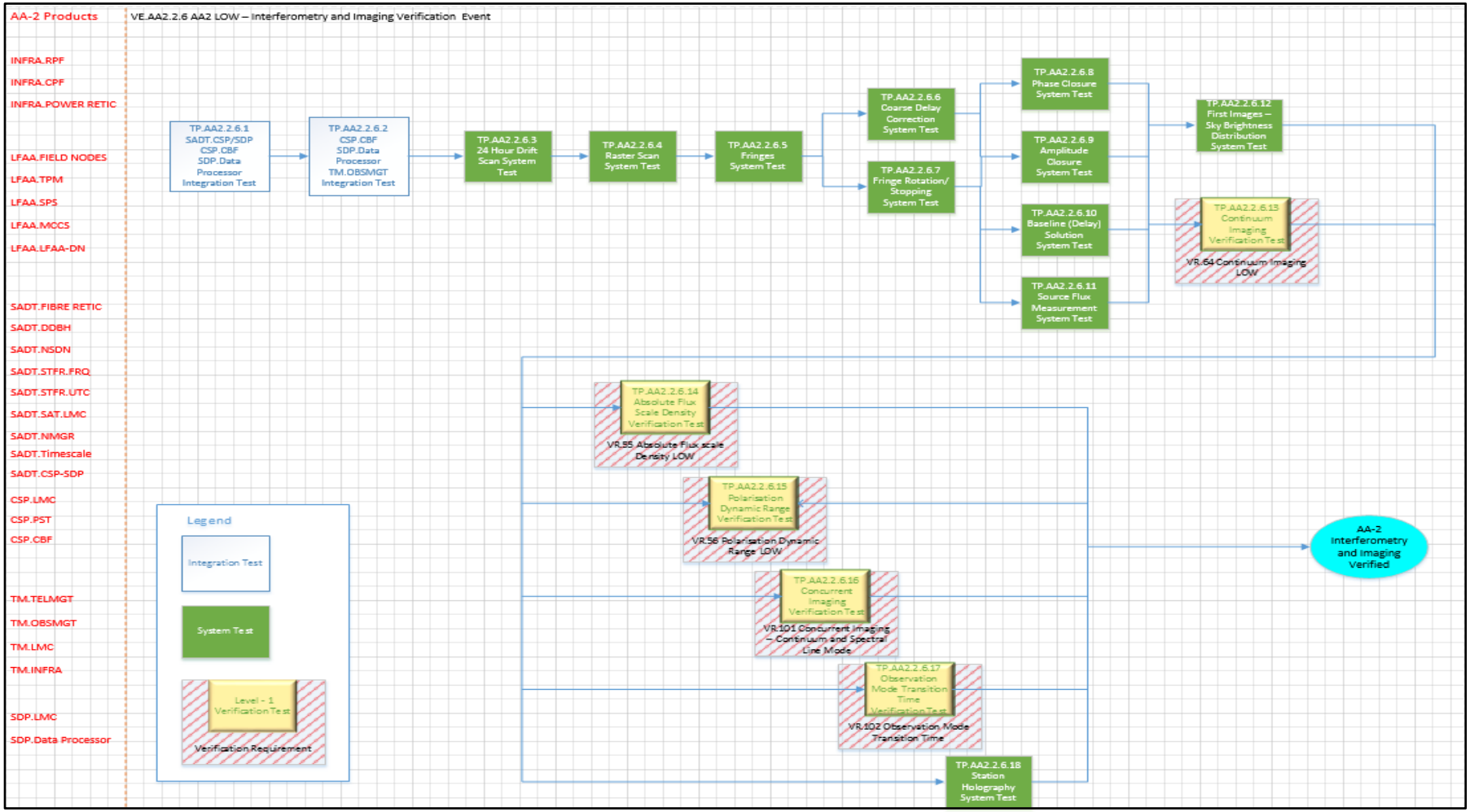
# Verification Events for MID AA1

| Verification Event | | L1 Verification Test | System Test | FTE Days | # of Personnel | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AA1 MID Functional and Performance Capabilities | AA1 MID Basic Health Checks | | Communications with TM | 20 | | | | | | | | x | x | x | x | | | | | |
| | | | System Health Displays | 50 | | | | | | | | | x | x | x | x | x | | | |
| | | Signal Displays | | 30 | | | | | | | | | x | x | | | | | | |
| | | Network Time Protocol | | 5 | | | | | | | | | x | | | | | | | |
| | | Fail Safe during Power or Control Interruption | | 5 | | | | | | | | | | | x | x | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | AA1 MID Time and Frequency Reference | | Non precision Time Stamping Accuracy | 10 | | | | | | | | | | | | x | x | | | |
| | | Time Stamping Accuracy | | 20 | | | | | | | | | | | | | | | | |
| | | Coherence Loss | | 5 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | AA1 MID Per-Dish Testing | | Basic Pointing | 10 | | | | | | | | | | x | x | | | | | |
| | | Blind Pointing | | 20 | | | | | | | | | | | x | x | x | | | |
| | | | Basic Tracking | 10 | | | | | | | | | | | x | | | | | |
| | | Dish Azimuth and Elevation Range | | 5 | | | | | | | | | | | | x | | | | |
| | | Dish Sensitivity | | 20 | | | | | | | | | | | x | x | | | | |
| | | | Beam Pattern | 40 | | | | | | | | | | | | | x | x | x | x |
| | | Solution for Pointing Errors | | 30 | | | | | | | | | | | | | | x | x | x |

# Verification Events for MID AA1

| Verification Event | | Verification Requirements (from L1 requirements) | System Verification Requirements | FTE Days | # Personnel | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AA1 MID - Functional and Performance Capabilities | AA1 MID - Basic Health Checks | | Communications with TM | 20 | | | | | | | | x | x | x | x | | | | | | | | | | |
| | | | System Health Displays | 50 | | | | | | | | | x | x | x | x | x | | | | | | | | |
| | | Signal Displays | | 30 | | | | | | | | | x | x | | | | | | | | | | | |
| | | Network Time Protocol | | 5 | | | | | | | | | x | | | | | | | | | | | | |
| | | Fail Safe during Power or Control Interruption | | 5 | | | | | | | | | | | x | x | | | | | | | | | |
| | | | | 110 | | | | | | | | | | | | | | | | | | | | | |
| | AA1 MID - Time and Frequency Reference | | Non precision Time Stamping Accuracy | 10 | | | | | | | | | | | | x | x | | | | | | | | |
| | | Time Stamping Accuracy | | 20 | | | | | | | | | | | | | | | | | | | | | |
| | | Coherence Loss | | 5 | | | | | | | | | | | | | | | | | | | | | |
| | | | | 35 | | | | | | | | | | | | | | | | | | | | | |
| | AA1 MID - Per-Dish Testing | | Basic Pointing | 10 | | | | | | | | | | x | x | | | | | | | | | | |
| | | Blind Pointing | | 20 | | | | | | | | | | | x | x | x | | | | | | | | |
| | | | Basic Tracking | 10 | | | | | | | | | | | x | | | | | | | | | | |
| | | Dish Azimuth and Elevation Range | | 5 | | | | | | | | | | | | x | | | | | | | | | |
| | | Dish Sensitivity | | 20 | | | | | | | | | | | x | x | | | | | | | | | |
| | | | Beam Pattern | 40 | | | | | | | | | | | | | x | x | x | x | | | | | |
| | | Solution for Pointing Errors | | 30 | | | | | | | | | | | | | | x | x | x | | | | | |
| | | | | 135 | | | | | | | | | | | | | | | | | | | | | |
| | AA1 MID - Correlation and Interferometry | | | | | | | | | | | | | | | | | | | | | | | | |
| | | RF Bandwidth | | 10 | | | | | | | | | | | | x | | | | | | | | | |
| | | | Visibility Data Products | 5 | | | | | | | | | | | | x | | | | | | | | | |
| | | | Phase and Amplitude Closure | 10 | | | | | | | | | | | | | x | x | | | | | | | |
| | | | Demonstrate Fringes | 10 | | | | | | | | | | | | | x | x | | | | | | | |
| | | Basic Correlation Functionality - Integration Time | | 10 | | | | | | | | | | | | | | x | | | | | | | |
| | | Auto-correlation and Cross-correlation Spectra | | 10 | | | | | | | | | | | | | | x | | | | | | | |
| | | Delay Centre Determination | Delay Model Characterisation | 100 | | | | | | | | | | | | | | x | x | x | x | | | | |
| | | | Delay Tracking | 20 | | | | | | | | | | | | | | x | | | | | | | |
| | | | | 20 | | | | | | | | | | | | | | x | | | | | | | |
| | | | RFI Flagging and Excision | 60 | | | | | | | | | | | | | | x | x | x | x | | | | |
| | | | Interferometric Pointing - Pointing model | 50 | | | | | | | | | | | | | | x | x | x | | | | | |
| | | | Short term Gain and Phase Stability | 50 | | | | | | | | | | | | | | x | x | x | | | | | |
| | | Spectral Stability | | 50 | | | | | | | | | | | | | | x | x | | | | | | |
| | | Frequency Band Change Time | | 5 | | | | | | | | | | | | | | | | | | x | | | |
| | | Phase Referencing | | 50 | | | | | | | | | | | | | | | | | | x | x | x | |
| | | | Correlation Polarisation Purity and Leakage | | | | | | | | | | | | | | | | | | x | x | x | x | x |
| | | | | 450 | | | | | | | | | | | | | | | | | | | | | |
| | AA1 MID - Imaging | | Continuum Image Demonstration | 10 | | | | | | | | | | | | | | | | x | | | | | |
| | | | Spectral Line Image Demonstration | 10 | | | | | | | | | | | | | | | | x | | | | | |
| | | | Basic Image Assessment: Position and Flux | 40 | | | | | | | | | | | | | | | | x | x | | | | |
| | | Flux Density Scale | | 40 | | | | | | | | | | | | | | | | | x | x | | | |
| | | | Bandpass Calibration | 60 | | | | | | | | | | | | | | | | x | x | | | | |
| | | | Spectral Sensitivity | 80 | | | | | | | | | | | | | | | | | x | x | x | | |
| | | | Spectral Dynamic Range | 80 | | | | | | | | | | | | | | | | | | x | x | x | |
| | | | Continuum Sensitivity | 80 | | | | | | | | | | | | | | | | | | x | x | x | |
| | | | Continuum Dynamic Range | 80 | | | | | | | | | | | | | | | | | | x | x | x | |
| | | Brightness Dynamic Range | | 80 | | | | | | | | | | | | | | | | | | x | x | x | |
| | | | Mosaicing | 80 | | | | | | | | | | | | | | | | | | | x | x | x |
| | | Imaging Data Products | | 10 | | | | | | | | | | | | | | | | | x | | | | |
| | | Concurrent Imaging Continuum and Spectral Line Mode | | 5 | | | | | | | | | | | | | | | | | | x | | | |
| | | Polarisation Dynamic Range: Imaging | | 90 | | | | | | | | | | | | | | | | | | | | x | x |
| | | Observation Mode Transition Time | | 5 | | | | | | | | | | | | | | | | | | | | | x |
| | | | | 750 | | | | | | | | | | | | | | | | | | | | | |
| | AA1 MID - Beamforming | | Tied Array Data Products | 20 | | | | | | | | | | | | | | | x | x | | | | | |
| | | | Beamformer Phase Up | 10 | | | | | | | | | | | | | | | | x | | | | | |
| | | | Beamformer Performance | 30 | | | | | | | | | | | | | | | | | x | x | | | |
| | | | Beamforming Sensitivity | 50 | | | | | | | | | | | | | | | | | x | x | x | | |
| | | | Beamformer Gain Stability | 50 | | | | | | | | | | | | | | | | | | x | x | x | |
| | | | Beamformer Phase Stability | 60 | | | | | | | | | | | | | | | | | | x | x | x | |
| | | | Drift Scan for TA Beamshape and SEFD Characterisation | 40 | | | | | | | | | | | | | | | | | | | x | x | |
| | | | Beamforming Polarisation Purity and Leakage | 90 | | | | | | | | | | | | | | | | | | | x | x | x |
| | | | | 80 | | | | | | | | | | | | | | | | | | | x | x | x |
| | | Pulsar Timing Number of Beams | | 50 | | | | | | | | | | | | | | | | | | | x | x | x |
| | | TA Beam Coherence | | 40 | | | | | | | | | | | | | | | | | | | x | x | x |
| | | | | 520 | | | | | | | | | | | | | | | | | | | | | |
| | AA1 MID - RFI Flagging, Excission and Masking | RFI Flagging and Masking | | 100 | | | | | | | | | | | | | | | | x | x | x | x | | |
| | AA1 MID - Pulsar Timing | Pulsar Timing Functionality | | | | | | | | | | | | | | | | | | | | x | x | x | x |
| | AA1 MID - Polarisation | | | 120 | | | | | | | | | | | | | | | | | x | x | x | x | |
| | | | Beam Shape and Polarisation Correction | 120 | | | | | | | | | | | | | | | | | x | x | x | x | x |
| | | | Correlation Polarisation Purity and Leakage | 120 | | | | | | | | | | | | | | | | | x | x | x | x | x |
| | | Polarisation Dynamic Range: Imaging | | | | | | | | | | | | | | | | | | | | | x | x | x |
| | | | Beamforming Polarisation Purity and Leakage | | | | | | | | | | | | | | | | | | | | x | x | x |
| | | | | 360 | | | | | | | | | | | | | | | | | | | | | |
| | AA1 MID - Telescope Management | | Communications with TM | 20 | | | | | | | | | x | x | | | | | | | | | | | |
| | | | System Health Displays | 50 | | | | | | | | | | x | x | x | x | | | | | | | | |
| | | Telescope Manager Functionality | | 150 | | | | | | | | | | x | x | x | x | x | x | x | x | x | | | |
| | | Alarm Latency | | 20 | | | | | | | | | | | | | | | | x | x | | | | |
| | | | | 240 | | | | | | | | | | | | | | | | | | | | | |
| | AA1 MID - Site Monitoring | Site Monitoring | | 30 | | | | | | | | | | | x | x | | | | | | | | | |
| AA1 MID - Non-Functional | AA1 MID - RFI and EMC | RFI and EMC Testing | | 300 | | | | | | | | | | | | | | x | x | x | x | x | x | x | x |
| | | Self-induced RFI | | 150 | | | | | | | | | | | | | | | | x | x | x | x | x | x |
| | AA1 MID - Environmental, Safety and Occupational Health | Safety Inspection | | 20 | | | | | | | | | | | x | | | | | | | | | | |
| | | Emergency Stop | | 10 | | | | | | | | | | | | x | | | | | | | | | |
| | | Emergency Communications Demonstration | | 10 | | | | | | | | | | | x | | | | | | | | | | |
| | AA1 MID - Security | | | | | | | | | | | | | | | | | | | | | | | | |
| | AA1 MID - Availability Reliability and Maintainability | Software Updates | | 50 | | | | | | | | | | | | | | | | | | | x | x | |
| | AA1 MID - Quality Factors | Failure detection, isolation and reporting | | 50 | | | | | | | | | | | | | | | | | | | | x | x |
| | | Operational States Logging | | 40 | | | | | | | | | | | | | | | | | | | | x | x |
| | | | | 630 | | | | | | | | | | | | | | | | | | | | | |
| | | | | 3395 | FTE Days | | | | | | | | | | | | | | | | | | | | |
| | | | | 9.30 | FTE years | | | | | | | | | | | | | | | | | | | | |

# I&V Plan for SKA1-LOW Flow Chart (Example)



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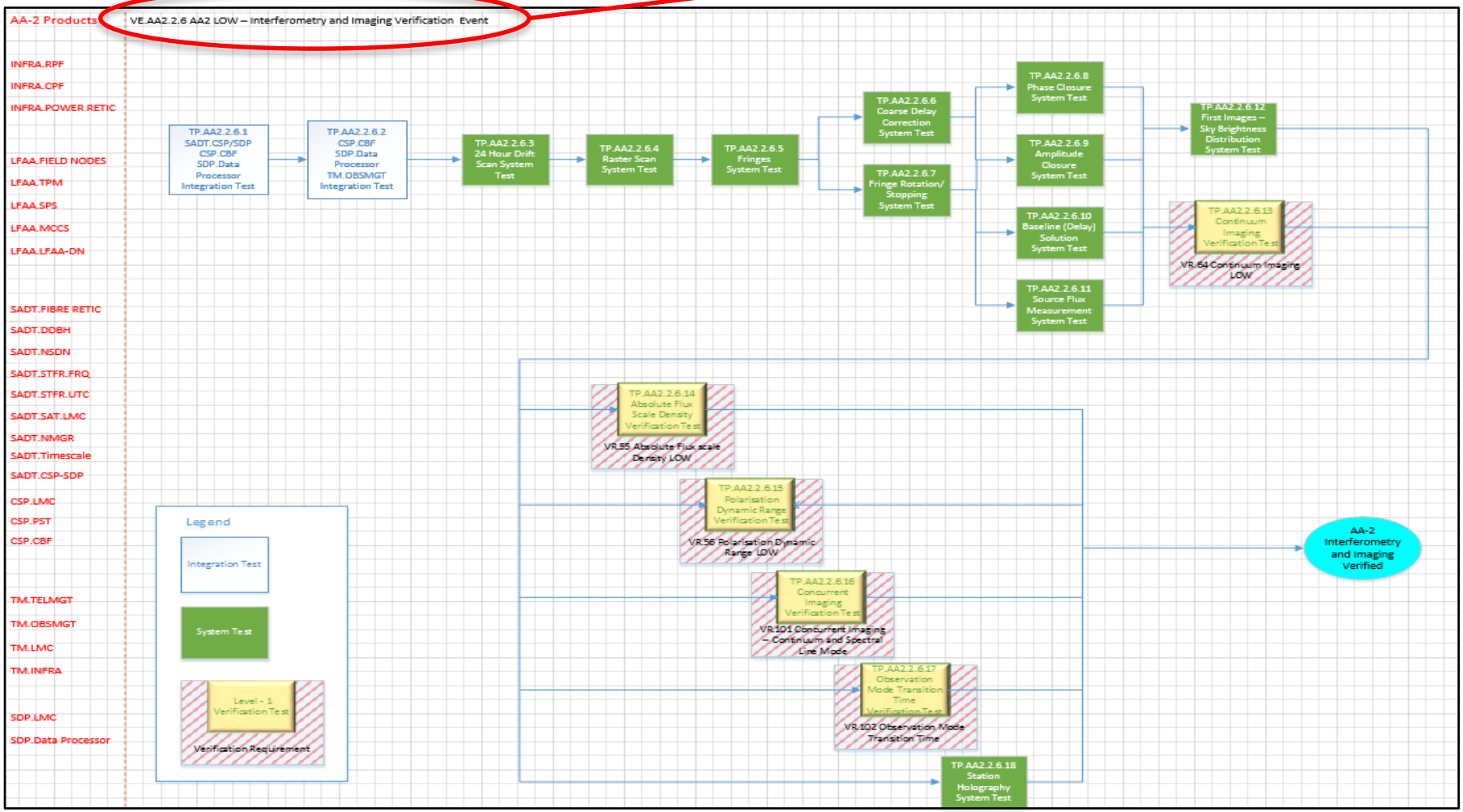

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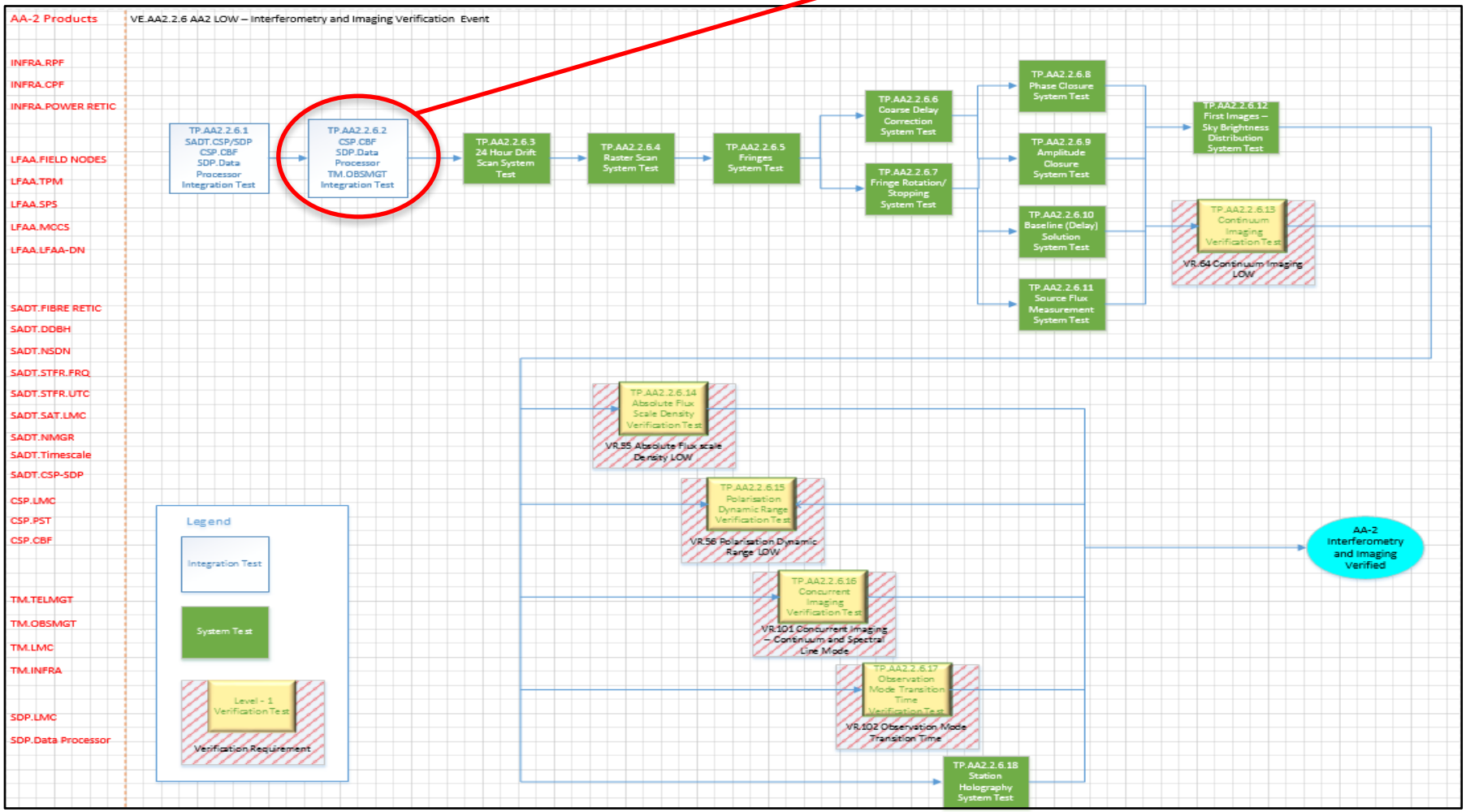

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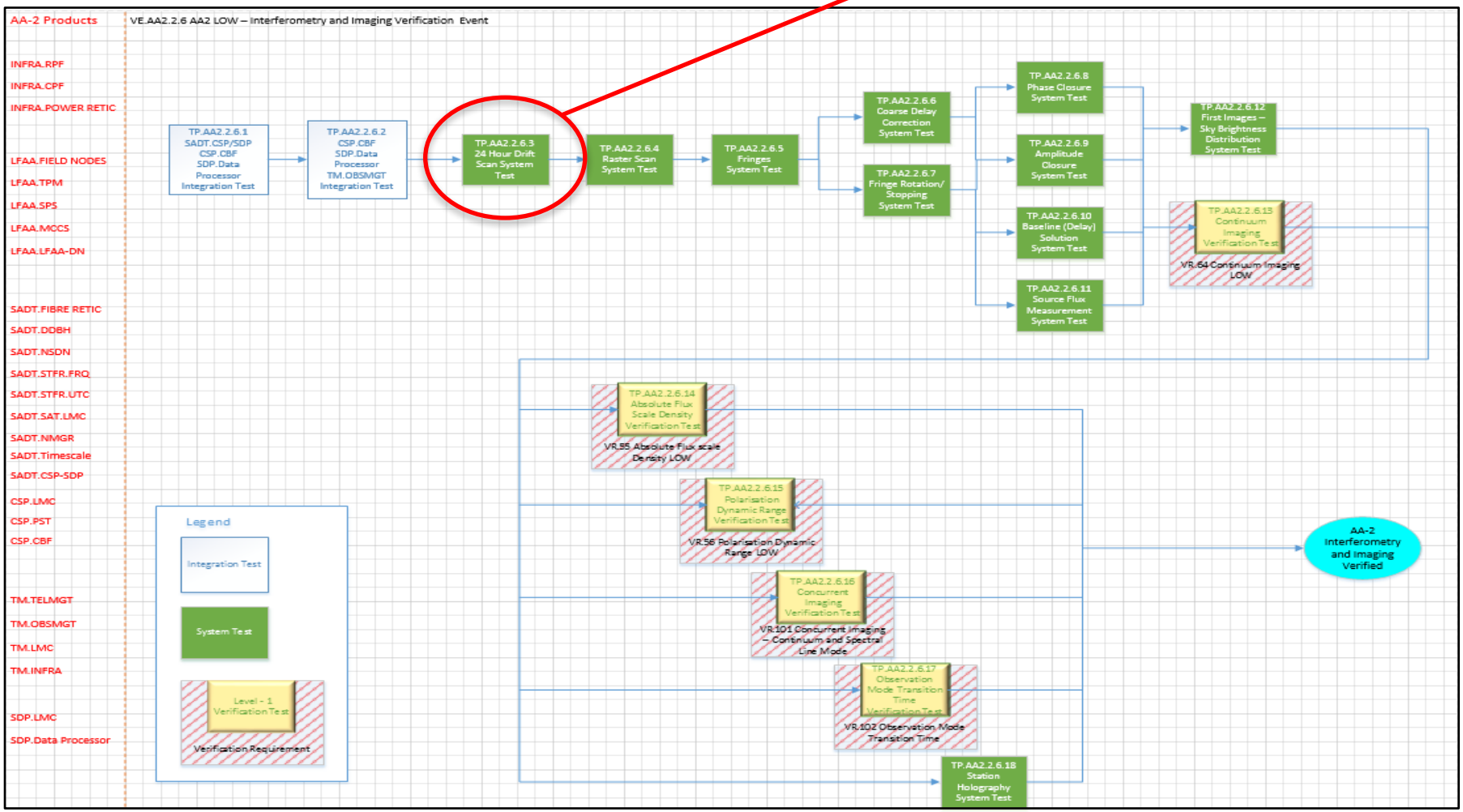
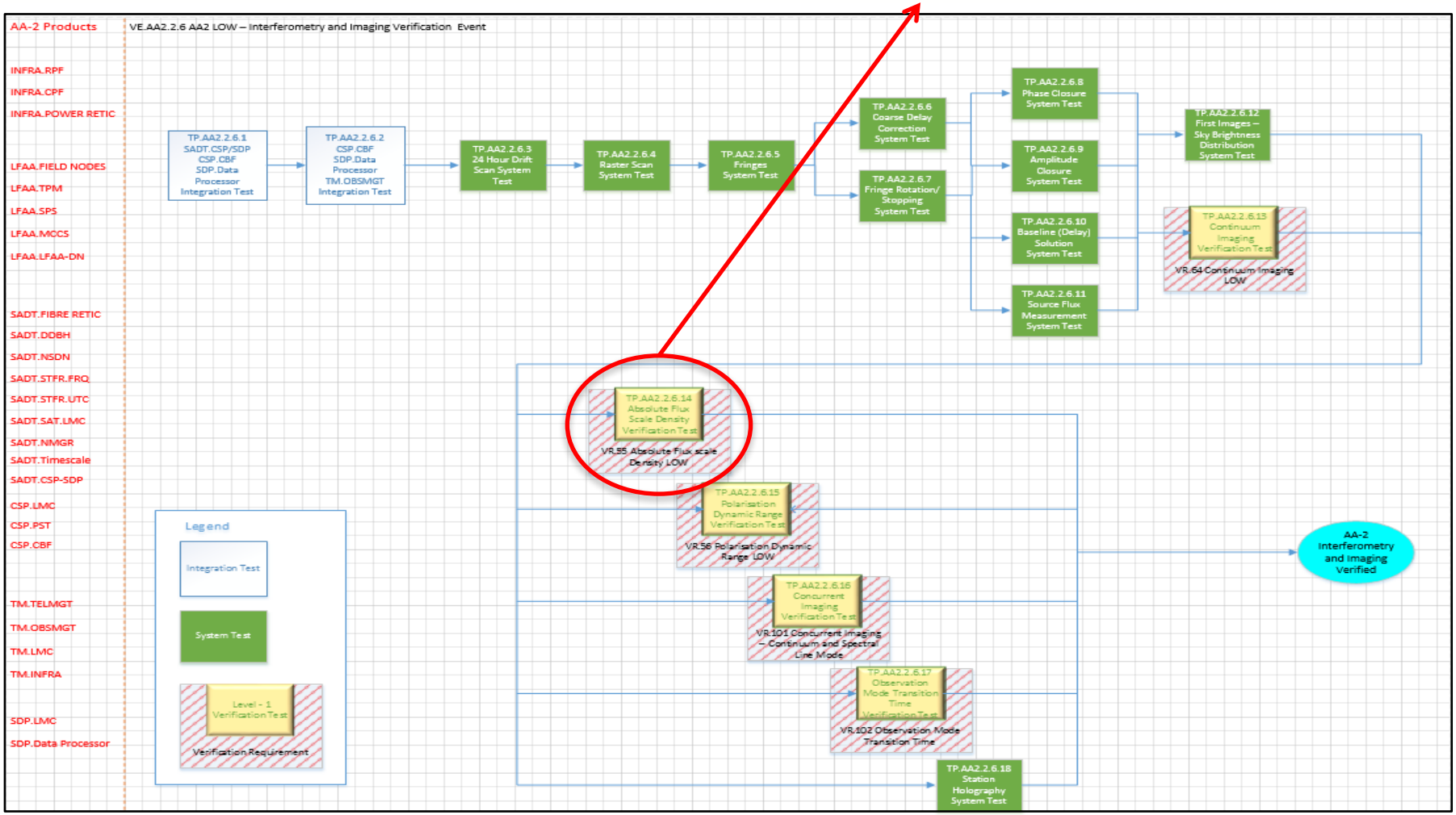
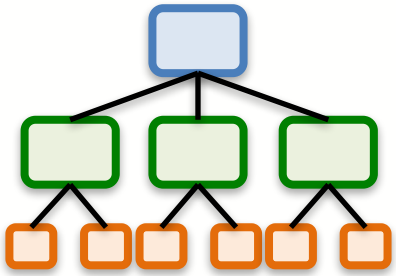


# I&V Plan for SKA1-LOW Flow Chart (Example)



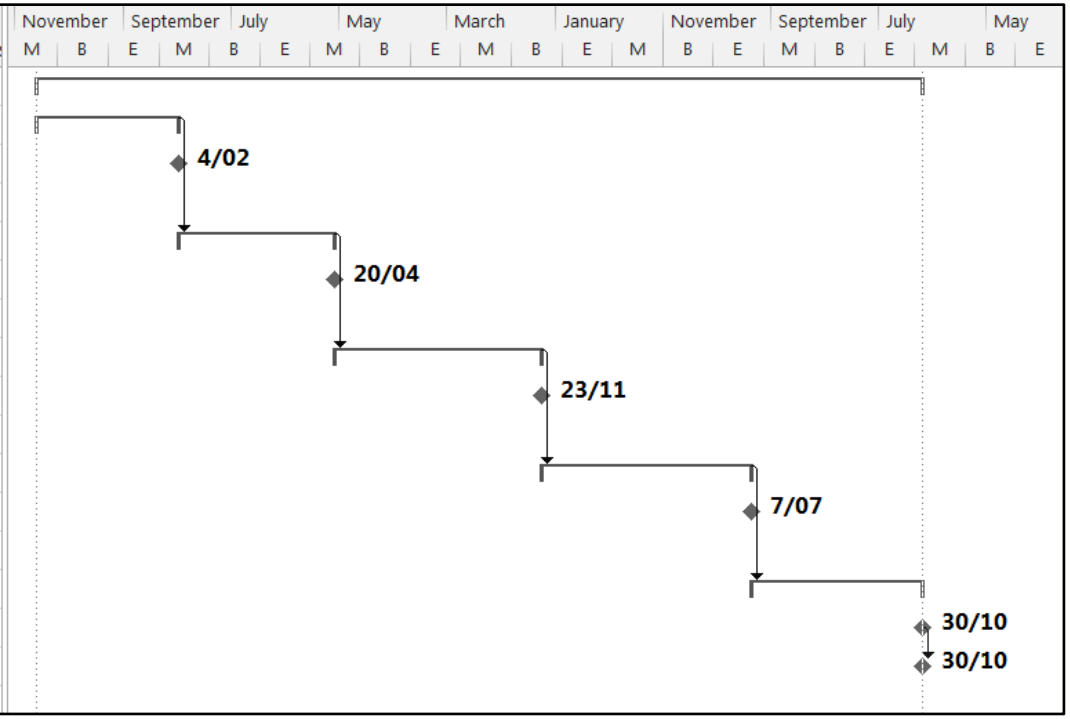
# I&V Plan for SKA1-LOW



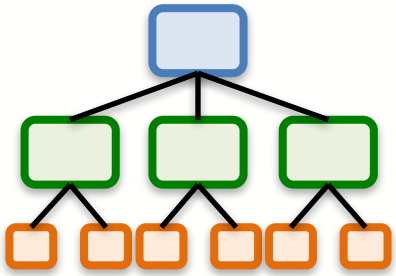
Top Level

- ITF, AA1, AA2, AA3, AA4

| | Task Name | Duration | Predece |
|---|---|---|---|
| 1 | **VE.LOW Verification of SKA1-LOW** | **1783 days** | |
| 2 | **VE.ITF Verification of ITF LOW** | **287 days** | |
| 239 | ITF LOW Integrated and Verified | 0 days | 10 |
| 240 | | | |
| 241 | **VE.AA1 Verification of AA1 LOW** | **314 days** | **2** |
| 578 | AA-1 Integrated and Verified | 0 days | 250 |
| 579 | | | |
| 580 | **VE.AA2 Verification of AA2 LOW** | **416 days** | **241** |
| 1066 | AA-2 Integrated and Verified | 0 days | 589 |
| 1067 | | | |
| 1068 | **VE.AA3 Verification of AA3 LOW** | **422 days** | **580** |
| 1539 | AA-3 Integrated and Verified | 0 days | 1077 |
| 1540 | | | |
| 1541 | **VE.AA4 Verification of AA4 LOW** | **344 days** | **1068** |
| 1918 | AA-4 Integrated and Verified | 0 days | 1542 |
| 1919 | Low Telescope Integrated and Verified | 0 days | 1918 |



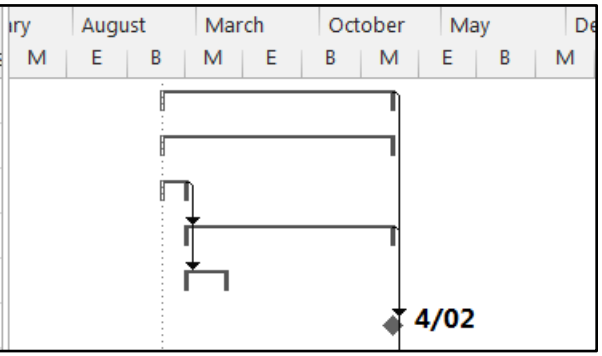
# I&V Plan for SKA1-LOW



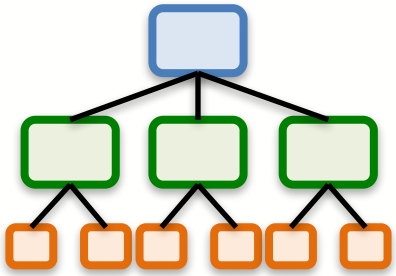
Intermediate Level

- Product Handovers
- Functional and Performance Capabilities
- Non-Functional Requirements

| | Task Name | Duration | Predecessors |
|---|---|---|---|
| 2 | **VE.ITF Verification of ITF LOW** | **287 days** | |
| 3 | **Write Test Scripts for ITF LOW Verification** | **287 days** | |
| 4 | **VE.ITF.1 ITF LOW Product Handovers** | **30 days** | |
| 10 | **VE.ITF.2 ITF LOW Capabilities** | **257 days** | **4** |
| 237 | **VE.ITF.3 ITF LOW Non-Functional** | **50 days** | **4** |
| 239 | ITF LOW Integrated and Verified | 0 days | 10 |

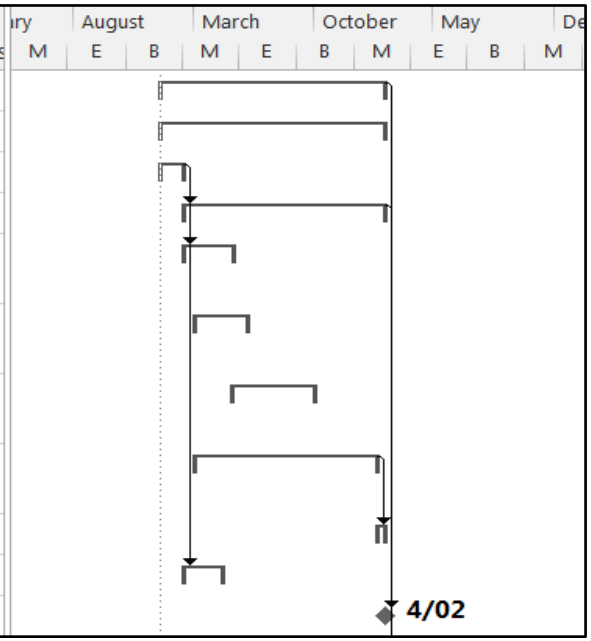


# I&V Plan for SKA1-LOW



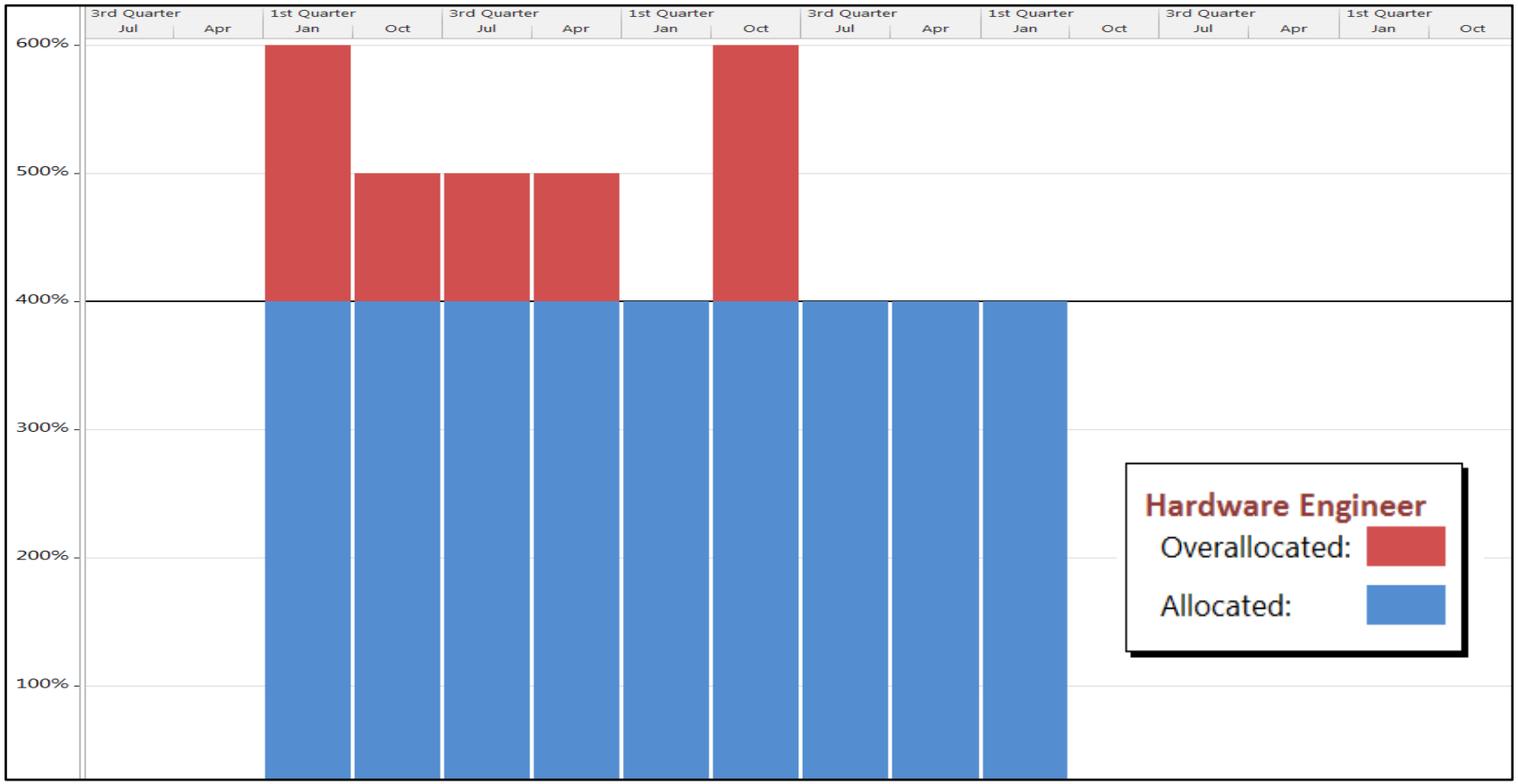
Lower Level

| | Task Name | Duration | Predecessors |
|---|---|---|---|
| 2 | VE.ITF Verification of ITF LOW | 287 days | |
| 3 | Write Test Scripts for ITF LOW Verification | 287 days | |
| 4 | VE.ITF.1 ITF LOW Product Handovers | 30 days | |
| 10 | VE.ITF.2 ITF LOW Capabilities | 257 days | 4 |
| 11 | VE.ITF.2.1 ITF LOW Basic Health Checks and TM Interface Verification Event | 64 days | 4 |
| 101 | VE.ITF.2.2 ITF LOW Time and Frequency Reference Stability Verification Event | 67 days | 40 |
| 135 | VE.ITF.2.3 ITF LOW Autocorrelation and Channelisation Verification Event | 105 days | 122 |
| 193 | VE.ITF.2.4 ITF LOW Basic Interferometry Verification Event | 232 days | 44,48 |
| 227 | VE.ITF.2.5 ITF LOW Clipping Verification Event | 10 days | 193 |
| 237 | VE.ITF.3 ITF LOW Non-Functional | 50 days | 4 |
| 239 | ITF LOW Integrated and Verified | 0 days | 10 |



# I&V Plan for SKA1-LOW

## Resource Planning



# Product Hand-Over Checklist

**Objectives are to ensure that:**

- A well-defined development process was followed for the product
- The product meets its technical specifications, documented by Qualification Test Results (QTRs) and Acceptance Test Results (ATRs)
- The product can be supported and maintained after hand-over
- The product is successfully installed on-site
- The logistic support development for the product is in process

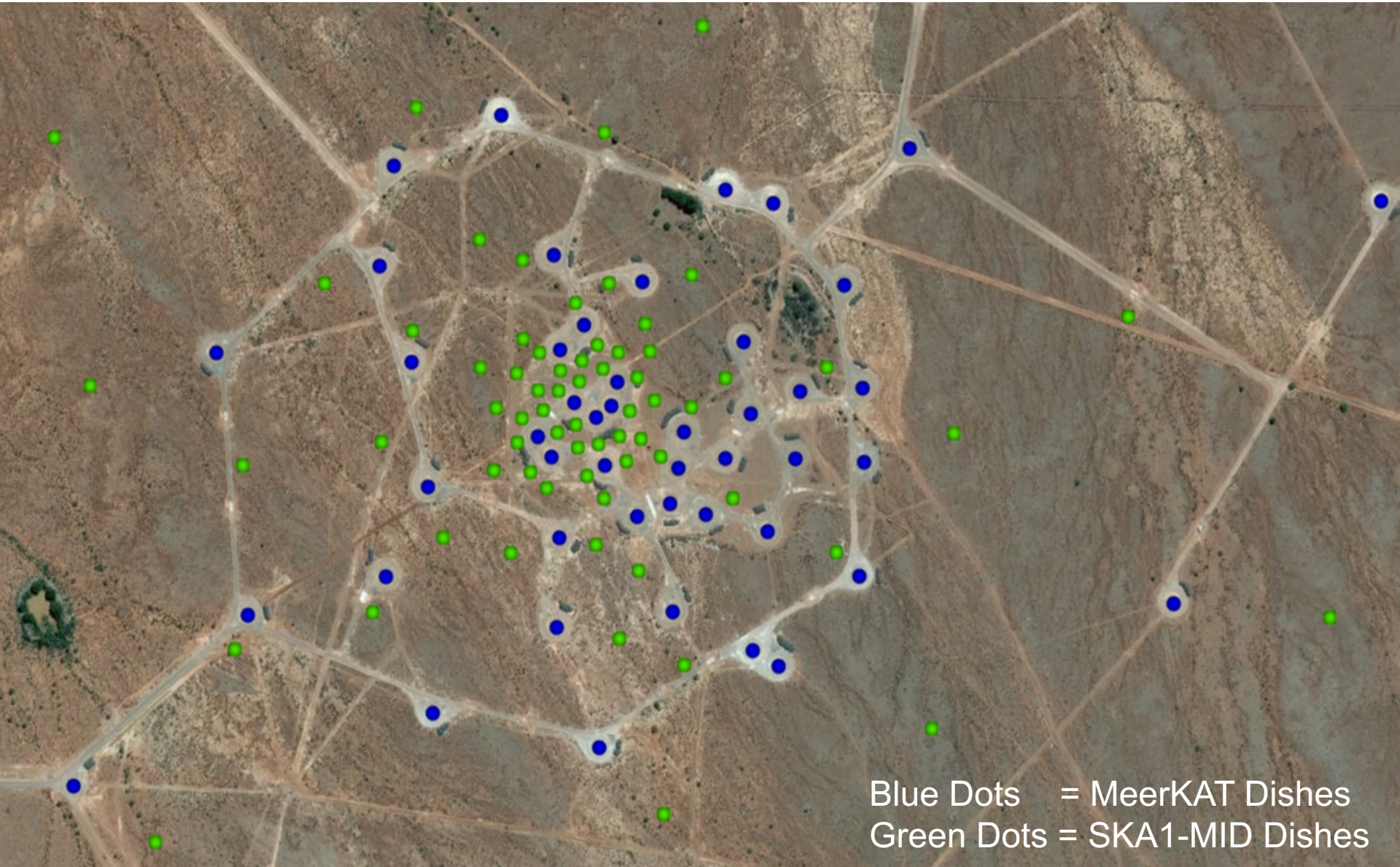
# Integration Test Facility (ITF)

- Multiple ITFs
  - At Element Level or lower
    - All over the world.  Rely heavily on simulators/emulators.  No AIV involvement.
  - At System Level
    - End-to-End line-up of Level-2 products
- System ITF used for:
  - System Level Design Qualification
  - Verification of interfaces between Level-2 products
  - Debugging, troubleshooting, development work, etc
  - Testing of hardware/firmware/software upgrades during Constr. Phase
  - Knowledge transfer (between contractors, engineers, AIV Team, etc)

# MeerKAT Integration Planning

SKA
SQUARE KILOMETRE ARRAY
ASSEMBLY, INTEGRATION & VERIFICATION

# SKA1-MID Core Area



# Relevant Documents

- MeerKAT Precursor Integration Plan (Rev 3)
- Roll-Out Plan for SKA1-MID (Rev 5)
- ICDs
  - MeerKAT to SKA1-MID TM (Rev 2)
  - MeerKAT to SKA1-MID SADT (Rev 2)
  - MeerKAT to SKA1-MID DISH (Rev 1)
  - AIV to INFRA-SA (Rev 1)

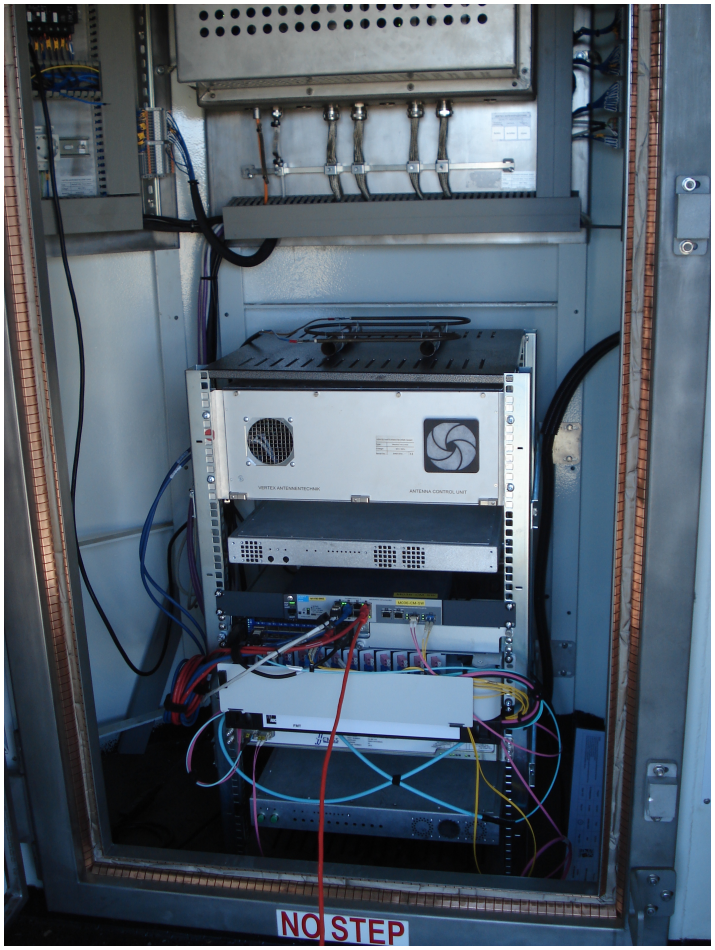
- Currently being updated, following a recent “MeerKAT Integration Review” meeting in South Africa.

# What will be integrated?

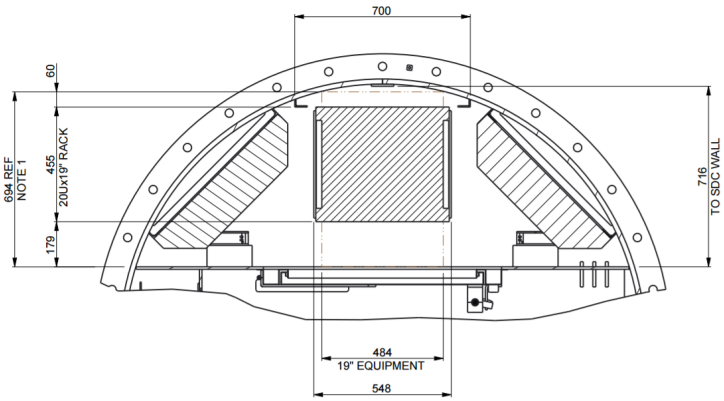
- 64 x MeerKAT Antenna Positioners
- 64 x L-Band Feeds
- 64 x UHF-Band Feeds
- 64 x Receptor Fibre Network (RFN)
- Array Fibre Network (AFN)
- Masers
- Weather Stations and Video Systems
- Portion of MeerKAT LAN

# MeerKAT Integration Issues

Shielded Drive Compartment (SDC)




- Rack Space inside the SDC
- Heat Removal
- EMI shielding requirements
- Re-use of MeerKAT Masers




SECTION Z-Z

NOTES:

1. MAXIMUM EQUIPMENT DEPTH INCLUDING 100 mm RESERVE FOR CONNECTORS.

# Safety during Construction

- Develop a culture of safety awareness
- Verification of Safety Requirements
- Adherence to safety regulations
- Support effective communication

SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope


# Thank You