

# Phase 1 System Requirements Specification (SyRS)

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- The SKA requirements landscape
- Requirements since CoDR
- The relationship between the HLD and the SyRS
- Current requirements emphasis – the DRM
  - 1.3 vs 1.4
- Other source documents
- Roadmap to the System Requirements Review
- Role of Standards

- Information leading to formal Requirements are obtained from:
  - Needs of ‘Technology Agnostic’ Astronomers
    - DRM
  - Needs of ‘Technology Conscious’ Astronomers
    - DRM, Strategies & Philosophies
  - Inputs of Experienced Observational Astronomers
    - Operations Plan, Strategies & Philosophies
  - Inputs from SKA related pioneering projects
    - Strategies & Philosophies
  - The Statutory/Regulatory environment
    - Strategies & Philosophies
  - The physical environment
    - Environmental Specification
  - Standards
  - Inputs of Experienced System, Integration, Infrastructure, Verification, Management, Quality, Reliability .... Engineers
    - ‘Plans’
  - Inputs of Technology Evangelists
  - Inputs of Consulting Technologists
- Some of these latter stakeholders can also supply solutions!

- The nature of the community means that requirements engineering is particularly difficult in the early phases
  - The preponderance of ‘soft’ requirements
  - The widespread belief that Requirements Engineering is inflexible
  - The magnitude of the work to achieve consensus
- The first expression of most requirements (the ‘proto requirement’) usually needs clarification and refinement
- Proto requirements sometimes give rise to conflicts
- Even complete, correctly expressed, non conflicting proto requirements need scrutiny regarding necessity, heritage, credibility, implicit pessimism/optimism, abstruseness, ...

- Descoped Science Requirements
  - Reduce the number of science DRM components
  - Negotiate the performance and functionality required for those DRM components
    - Ongoing
- Extensibility to Phase 2
  - Some such requirements have been identified
    - *Dish figure and feed accommodation*
    - Ongoing
  - Extensibility requirements are likely to be on the critical path

- The High Level Description is a comprehensive discussion of the principal technologies and technical schemes within an exemplary framework
- The HLD is not a design, which would be inappropriate before the requirements capture and architectural tradeoff phases are complete
  - It is a “look-ahead” and helps to concentrate the mind on getting Requirements right
  - It is not strictly traceable from the SyRS
- The System Requirements Specification is the nexus for all incoming high level requirements and the root of all System Engineering activity
- The SyRS is in an early stage of development and contains:
  - Considerable white space in the non-science requirements sections
  - Some unstable science requirements
  - Limited traceability and verification
- The SyRS development is a major and continuous task
  - It is necessary to carry it out formally and correctly, as it becomes the source work for many trade studies, scoping exercises, budgetary measures, etc
  - Change Control is now mandatory, although Baselineing does not take place until just before SRR

- Principal Science Requirements Document for SKA<sub>1</sub>
  - Somewhat modelled on NASA requirements process (hence ‘Mission’)
  - Describes ‘DRM components’ derived from Science Case Key Science Projects
- Version 1.4 contains 49 formal requirements based on 5 DRM components plus extensibility considerations
- This Review is based on Version 1.3
  - Not fully reflected in Phase 1 descriptions
    - *50 MHz vs 70 MHz lower frequency reach*
  - 1.4 exists
- 1.4 has significant changes
  - Emphasises the need for configuration control
- Comments to SyRS (and by implication DRM) show that considerable clarification is required
  - Tolerances, trade spaces, scalars that are actually vectors/functions, etc
- The status is to be expected at this stage, but there is much work to be done

# DRM 1.4 changes

- A requirement for  $A_{\text{eff}}/T_{\text{sys}}$  of 2000 (1000) over 50-240 MHz for the Aperture Arrays (from Memo 125)
  - Change from 70 to 50 MHz acknowledged and subject to analysis (see TN)
- Maximum baseline of 50 km (200) for AAs (although 200 remains justified for other reasons?)
- AA station diameter of 35m (30m) and a total number of >140 (>160)
- Dish polarisation purity of 40dB now applies over the accessible sky (rather than just zenith)
- Cadence of pulsar timing observations is now specified

- Design Reference Mission v1.3
- SKA Science Working Group, “The Square Kilometre Array Design Reference Mission: SKA-mid and SKA-lo”, report, v.1.0
  - For extensibility considerations
- SKA Strategies and Philosophies WP2-005.010.030-TR-001
  - Principles
  - Priorities
- SKA Site Climate Data
  - Not a requirements source, but will be used to create top level physical environmental requirements
- ‘The Radio Frequency Interference Environment At Candidate SKA Sites’ WP3-010.020.000-R-002
  - Not a requirements source, but will be used to create top level RFI environment requirements
- Site Selection Criteria
  - Considered complied with, and retired, upon Site Selection
- Operations
  - ConOps
  - Use cases
  - Availability expectations
- Applicable national statutory instruments
  - Health & Safety legislation
    - Construction, operation, decommissioning
  - Utility regulations
    - Power, water, PSTN, data carriage
  - Environmental legislation
    - Construction, operation, decommissioning
  - Socio-political legislation
    - Rural development policy
  - Culture & Heritage legislation
    - Conservation, access rights
  - Energy policy
    - Carbon emissions
  - Security policy
    - Criminal, political
  - International trade policies

- Detailed review, refinement and negotiation of the SKA<sub>1</sub> DRM
- Develop Use Cases for each of the chapters of the SKA<sub>1</sub> DRM to understand and extract the technical requirements
- Gather, refine and analyse the system requirements
- Development and refinement of the science and support Operations concepts
- Derive environmental and regulatory requirements and constraints
- Continue to document the requirements and constraints in the SKA<sub>1</sub> System Requirement Specification under Change Control
  - Making them available to Domains on a planned basis
- Establish a lower level Document Tree
- Establish a preliminary Verification Plan
  - This includes introducing special budgetary control requirements
- Conduct Domain Concept Design Reviews
- Consider the outputs of the Domain CoDRs at the Observatory level.
  - This will include models of aspects such as cost, performance, power, reliability etc.
- Establish further Observatory level cost models to assist convergence on an outline full lifecycle cost
- Develop the SKA<sub>1</sub> architectural design document



# Questions

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- A very large number of Standards can apply to SKA activities, from development to decommissioning
- Standards will be implicit in statutory obligations
  - Perhaps including unfamiliar (non-ISO) ones
- Standards help us in the Verification task
- The intelligent use of Standards helps control costs
- It is common in large science projects to reference, or make applicable, Standards when there is little or no cognizance
- Elective whole cloth adoption of Standards must be done with some care and with appropriate investment of resources