Dish Array requirements

First draft requirements specification

- A first draft Dish Array requirements document has been produced:
  - WP2-020.030.020-RS-001 Rev B
- This is based on the current version of the SKA System requirements, which is aimed at SKA1:
  - WP2-005.030.000-SRS-002 Rev B
- Substantial further revision of both documents will be necessary. Dish Array requirements need to address SKA2 as well as SKA1.
- The System Requirements Review is scheduled for March 2012. The Dish Array Requirements Review will follow.

Requirements development

- Dish Array requirements will be further refined by the SPDO/SPO in consultation with contributing institutions.
- The Dish Array Requirements Review will define a baseline set of requirements.
- Subsequent modifications to Dish Array requirements will be subject to formal change control.

Ordering of requirements

- Currently the Dish Array requirements documents follows the same ordering of requirements as the System Requirements Specification.
- This will be changed such that high priority Dish Array requirements are given greater emphasis.

Some key requirements for the SKA Dish Arrays

- The following slides summarise some key requirements.

Frequency range
DA_REQ_0010

- SKA1 requires 0.45 to 3 GHz
- SKA2 extends this to 10 GHz: this has implications for the dish design
  - Dish performance must meet specifications up to 10 GHz (SKA1 dishes will not be replaced in SKA2).
  - Dishes must be capable of accommodating feed payloads to cover 0.45 (possibly ~300 MHz) to 10 GHz.

Sensitivity (Aeff/Tsys)
DA_REQ_0090

- The Phase 1 Dish Array shall have a sensitivity of 10^3 m^2 K^{-1} in the frequency range 450 MHz - 3 GHz.
- SKA2 requirement is 10^4 m^2 K^{-1} up to 10 GHz:
  - The aim will be to maximize sensitivity per €/$ *total system cost of ownership* whilst meeting other requirements.

Imaging dynamic range
DA_REQ_0200

- The SKA2 system requirement is for an imaging dynamic range for continuum of at least 74 dB at 1.4 GHz.
  - This requires the dish to have extremely stable, predictable beam shape and pointing in typical environmental conditions.
  - Stability and calibratability of the complete signal chain are also vital.
  - *This is a whole system requirement, but the dish array performance must not be limiting.*

Dish Array operating cost

- There is no one specific requirement, but there are multiple contributors:
  - DA_REQ_1020 (power consumption), DA_REQ_0670 (repair period), DA_REQ_0610 (continuous operation period)
  - Thousands of dish systems will be very expensive to operate unless they are designed for high reliability with minimum maintenance. The maintenance regimes at existing radio astronomy observatories will not be affordable on this scale.
  - Routine maintenance intervals of at least one year are required, including dish mechanics and cryogenics.
  - Power consumption is a huge challenge for the SKA and the Dish Array is potentially a big contributor.

Upgradeability and feed flexibility DA_REQ_0640

- The Phase 1 Dish Array shall be upgradable.
  - Upgrades may include addition and replacement of single pixel payloads and receivers as well as the addition of phased array feeds.
- Multiple single pixel feeds and a phased array feed are to be accommodated.
  - A significant means of improving overall SKA system performance will be obtained through enhancement of feeds and receivers, especially in the transition of SKA1 to SKA2.

Minimum life time
DA_REQ_0620

- The Phase 1 Dish Array shall be designed for a minimum life time of 30 years, including initial installation, testing and commissioning period.
- DA_REQ_0650: Life-time extension
  - Large scale maintenance and/or an upgrade shall give the possibility to reach a life time of 50 years (TBC).

Some other important aspects of the Dish Arrays

- Some other aspects not yet explicitly covered in the requirements documents are as follows:
  - Mass manufacture:
    - Innovative manufacturing techniques will be needed to allow cost effective production of 15 m dishes in quantities of thousands.
  - Rapid installation:
    - Dish systems will need to be installed rapidly using minimal on-site manpower and equipment.
    - This is to minimize the impact on observations, as well as keep down the manpower cost.

Summary

- A first draft requirements document has been produced.
- This will be refined over the next 9 – 12 months.
- Dish designs must address SKA2 requirements as well as SKA1.

End