

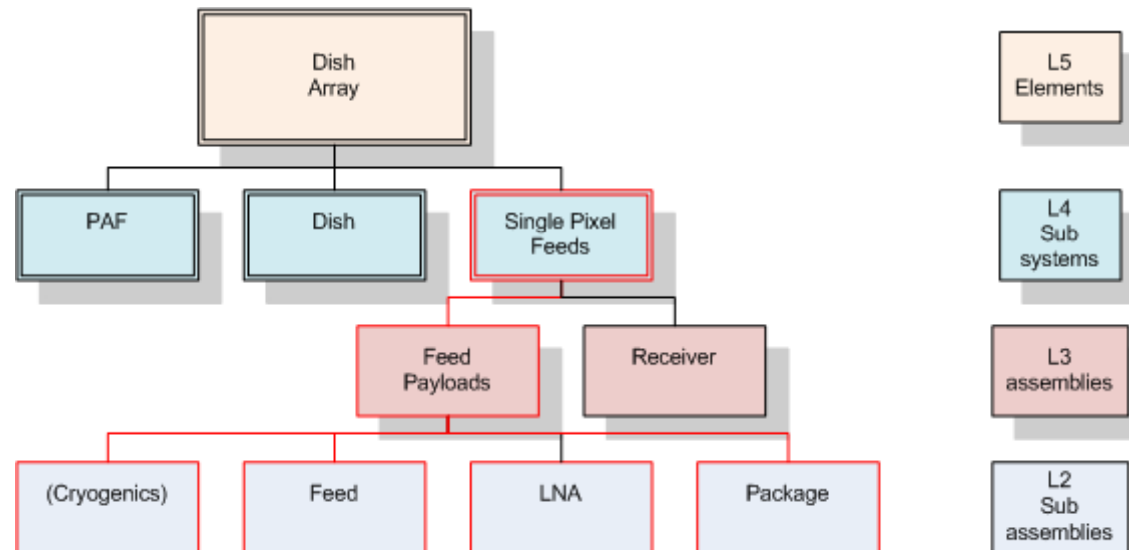


Introduction to single pixel feed payloads

Dish Array hierarchy



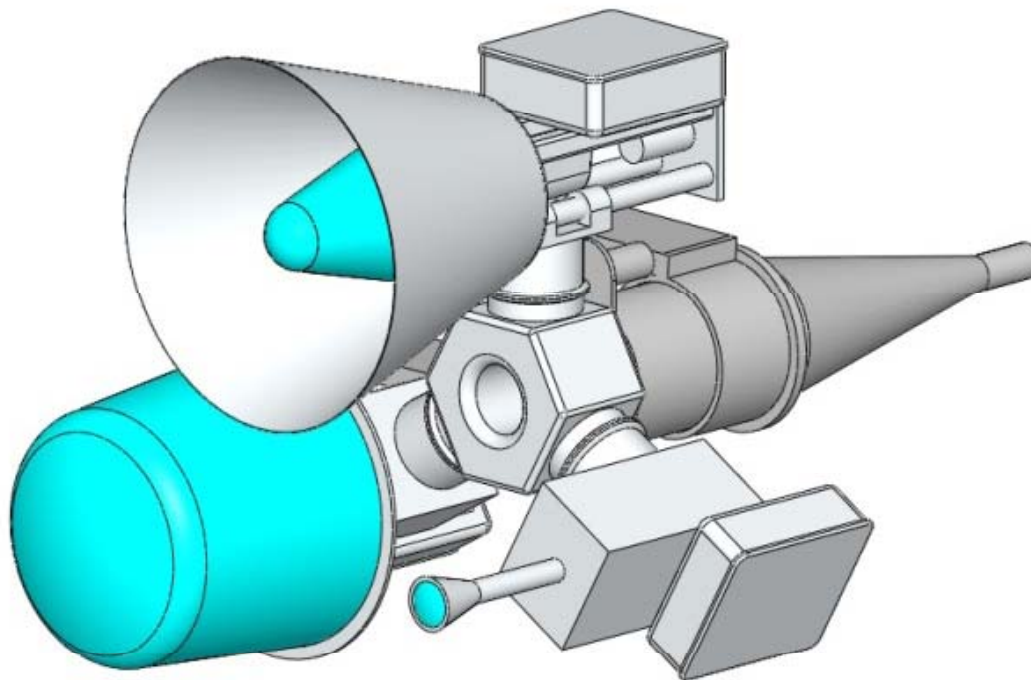
- SPF payloads comprise feed (including OMT if needed), LNAs, cryogenics (if needed) and packaging (dewar or other housing)



SPF feed payloads



- This shows one concept to accommodate multiple feed payloads on a 'feed indexer'



Matt Fleming

Dish Array: key functional requirements (1)



- The SKA1 sensitivity requirement is $1000 \text{ m}^2\text{K}^{-1}$ in the range 0.45 to 3 GHz.
- The SSEC baseline for SKA1 calls for 250 dishes equipped with octave band feeds to meet this requirement. 3 feed payloads per dish will be needed.
- This is based on an assumed T_{sys} of 30 K and aperture efficiency of 70 %.
- SKA2 is expected to require $10,000 \text{ m}^2\text{K}^{-1}$

Dish Array: key functional requirements (2)



- Excellent beam and sidelobe stability, and excellent phase and amplitude stability will be necessary to meet dynamic range requirements. Also stable and repeatable polarization.
- SPF feed payload performance will substantially influence the Dish Array performance.

Dish Array: key non-functional requirements (1)



- ‘The Phase 1 Dish Array shall be designed for a continuous operational period of at least 12 months, without the need for planned maintenance.’
- Feed payloads will need to be extremely reliable, and designed for minimal maintenance: preferably no routine maintenance. This is a challenge for the cryogenics.
- Failure to produce sufficiently reliable low-maintenance cryogenics will result in enormous operating costs and loss of science output.

Dish Array: key non-functional requirements (2)



- ‘The Phase 1 Dish Array shall be upgradable.’
- SPF payloads will be modular sub systems with well-defined interfaces.
- Rapid upgrades will be possible by addition or replacement of SPF payloads.
- This will aid the transition from SKA1 to SKA2.

System costs



- Capital cost of SPF payloads will be low compared to dish cost.
- Operating costs will be substantial:
 - Power consumption (especially cryogenics)
 - Maintenance (especially cryogenics)
- Low sensitivity = higher system cost
 - If effective area is low and/or system noise temperature is high then more dishes will be needed to meet system sensitivity requirements: this also means more signal transport, more signal processing, more computing, more power.
- SPF payload design is critical to SKA system cost