

Single- or multiple-antenna Array Stations?

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Summary

Two Array Station designs are compared:

- 1) A single large concentrator
- 2) A tied, thinned, group of smaller concentrators.

The single concentrator design results in a better dynamic range in SKA images

Definitions

A **concentrator** is an antenna with a single feed point, e.g.:

- A reflector
- A Luneburg lens
- A log-periodic antenna

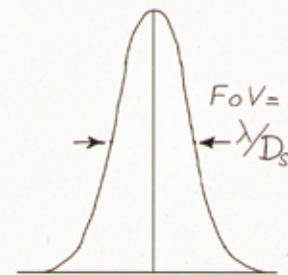
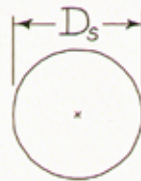
An **Array Station** is:

- a single concentrator.
- a group of antennas combined phase-coherently (tied) to form one beam (or more).

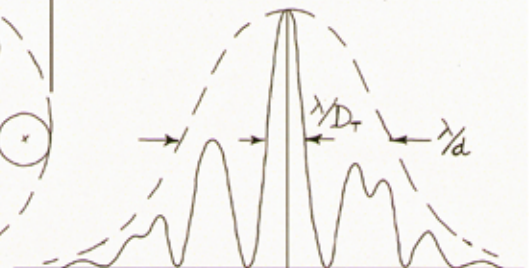
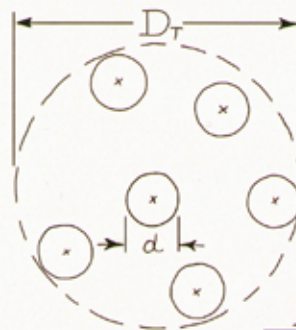
The **Thinning Factor** is:

$$t = \frac{\text{Array Station geom. area}}{\text{total collecting area}}$$

Single Concentrator Array Station



Randomly Thinned Array Station



Advantages of a single large concentrator

Compared with a thinned group of concentrators:

- The field of view (FoV) is greater.
- There is much less energy in near sidelobes.
- Fewer receivers and phase stable links are required.
- No phasing and beam forming networks are required within Array Stations.

Example

	Single concentrator	Thinned array (t=5)
Diameter	72 m	160 m
FoV (1.4 GHz)	0.20°	0.09°
Relative energy in FoV	100%	20%

SKA: dynamic range considerations

- Radio sources lying in the Array Station sidelobes generate artefacts in the synthesized image.
- The magnitude and distribution of this sidelobe confusion depends on the Array Station configuration, and is less harmful for a single concentrator than for a thinned group.
- Mitigation by CLEANing depends on accurate knowledge of the sidelobe structure of every Array Station and hence is much more practicable for single concentrator Array Stations.

Conclusions

- For high dynamic range wide-field imaging, each Array Station of the SKA is preferably a continuous (ie not a thinned) collecting area.
- The sidelobe confusion of any SKA design should be investigated by detailed simulation.