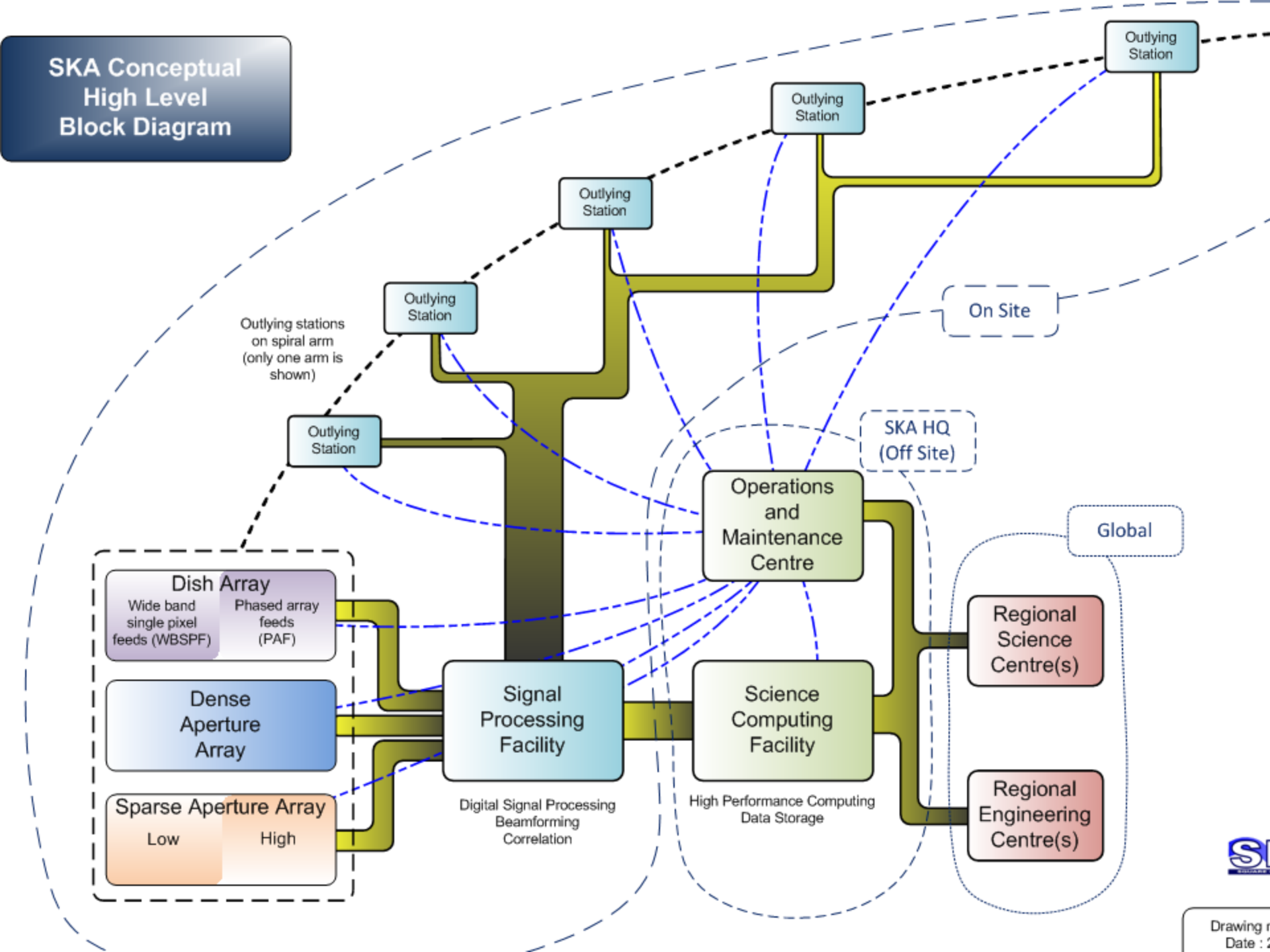
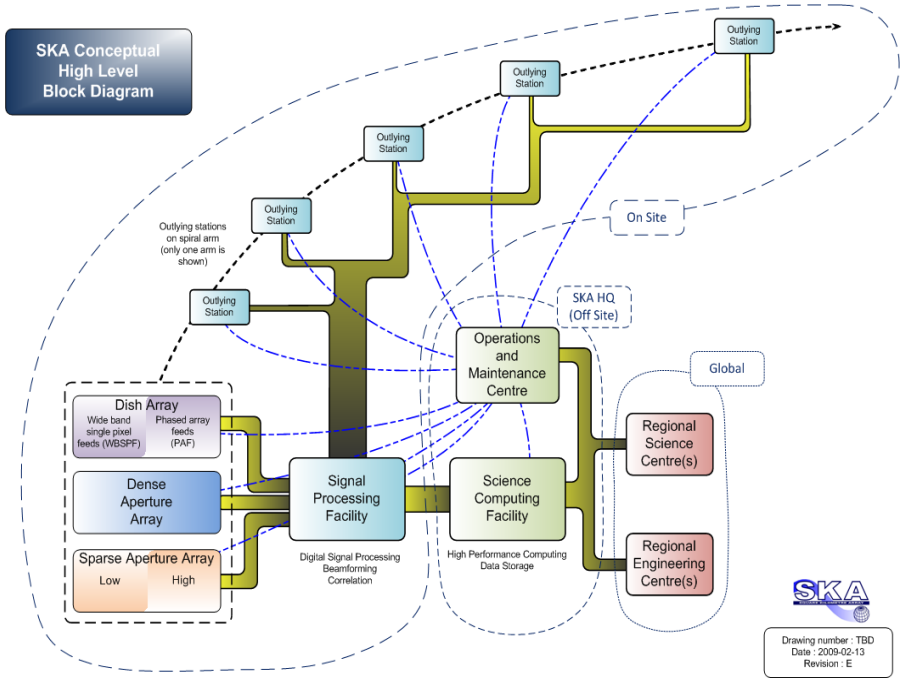
SKA Technology

Neil Roddis
SPDO


SKA Conceptual High Level Block Diagram
Outlying Station
Outlying Station
Outlying Station
Outlying Station
Outlying Station
Outlying stations on spiral arm (only one arm is shown)
On Site
SKA HQ (Off Site)
Global
Operations and Maintenance Centre
Dish Array
Wide band single pixel feeds (WBSPF)
Phased array feeds (PAF)
Dense Aperture Array
Sparse Aperture Array
Low
High
Signal Processing Facility
Digital Signal Processing
Beamforming
Correlation
Science Computing Facility
High Performance Computing
Data Storage
Regional Science Centre(s)
Regional Engineering Centre(s)

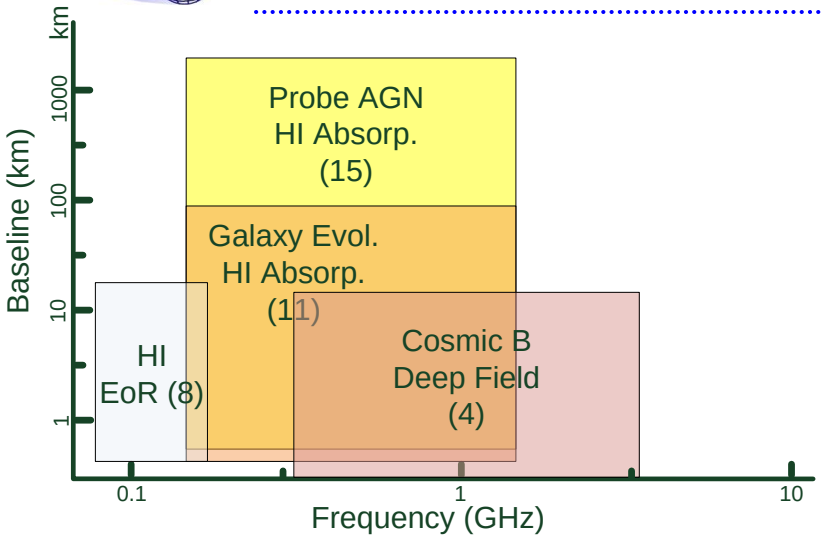
How do we assess technology?

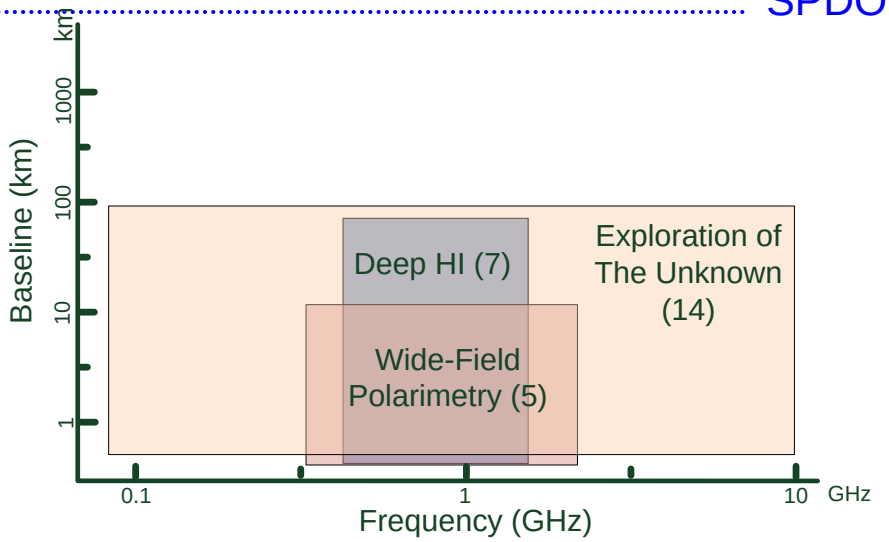
- Science output
- Capital cost
  - Infrastructure
  - Hardware
  - Software
  - Installation and commissioning
- Operating cost
  - Power
  - Maintenance

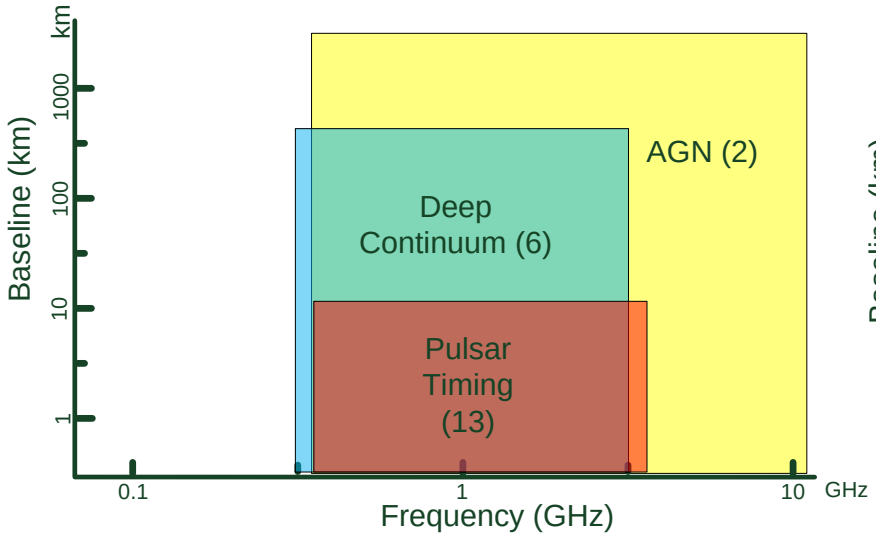


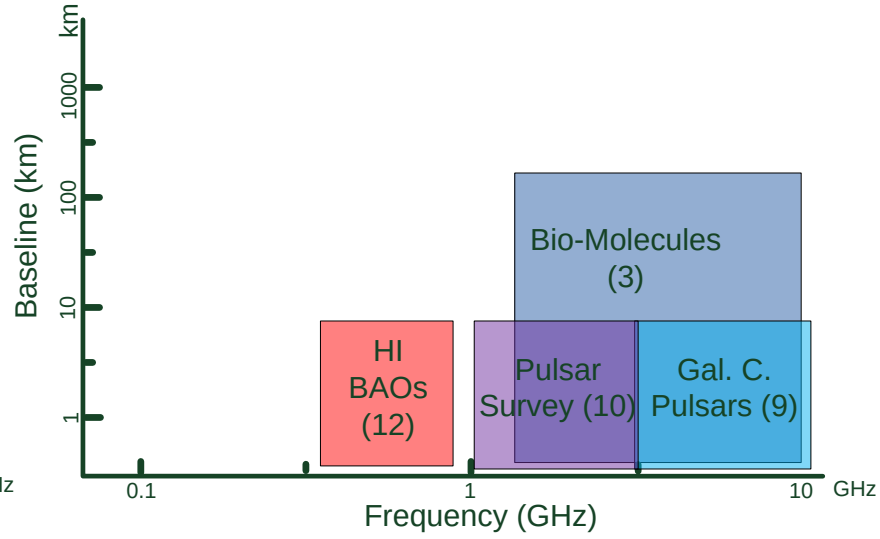
We must assess all aspects of the technology

DRM Components



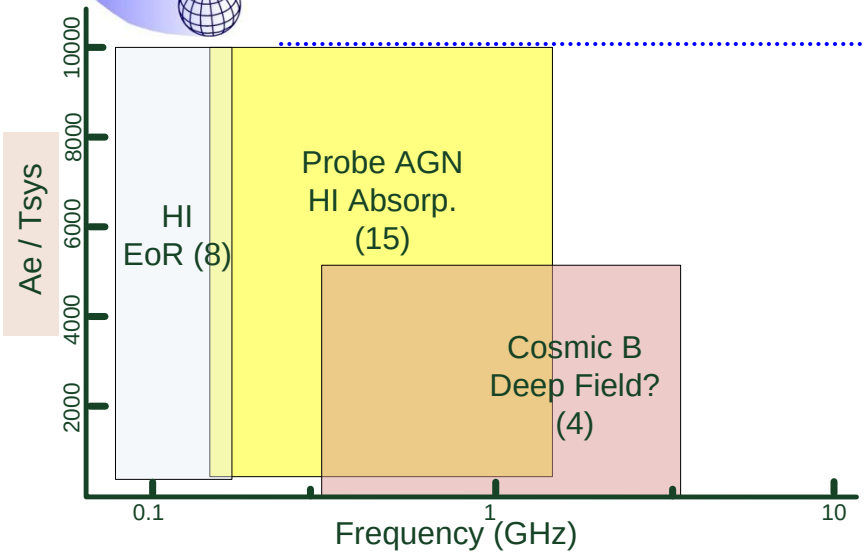


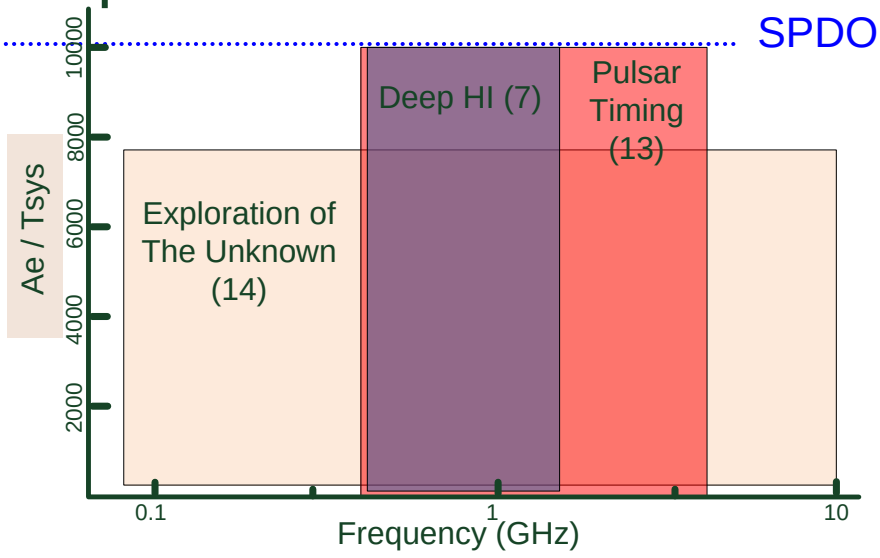


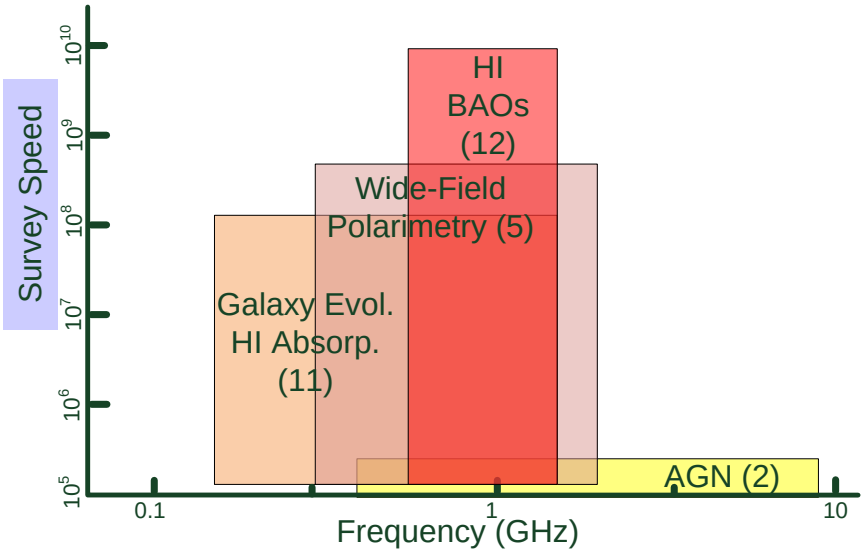


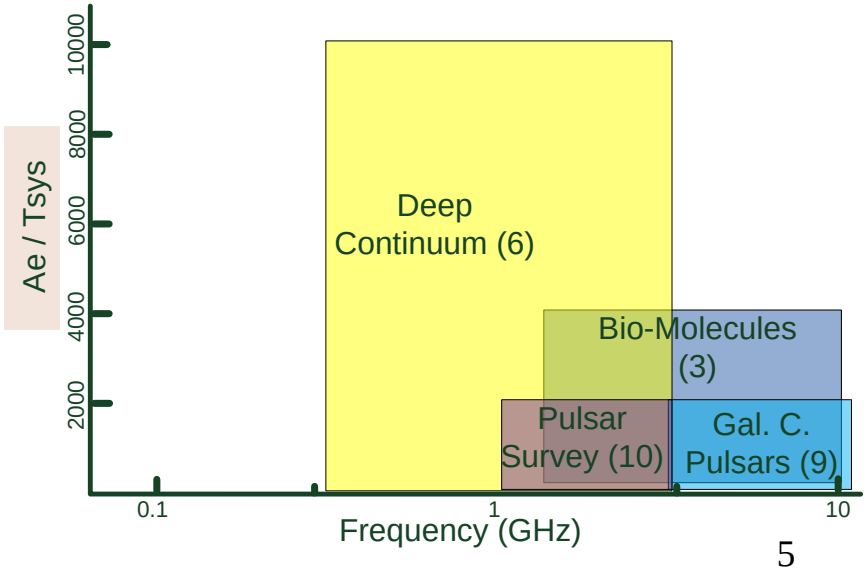
DRM Components

SPDO





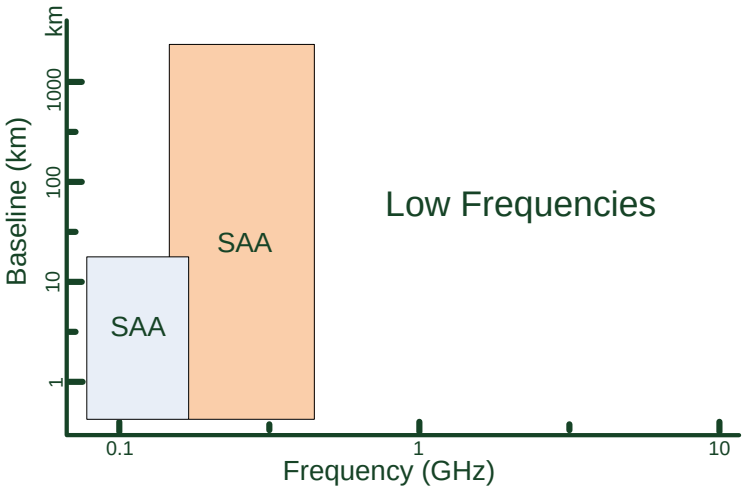


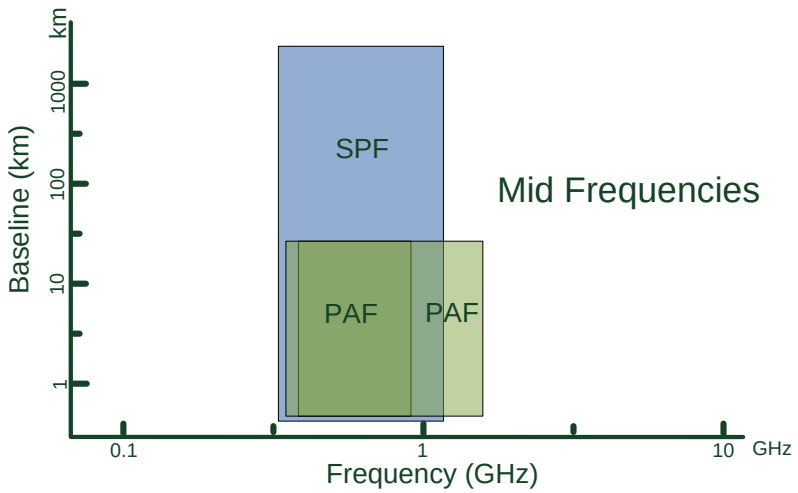


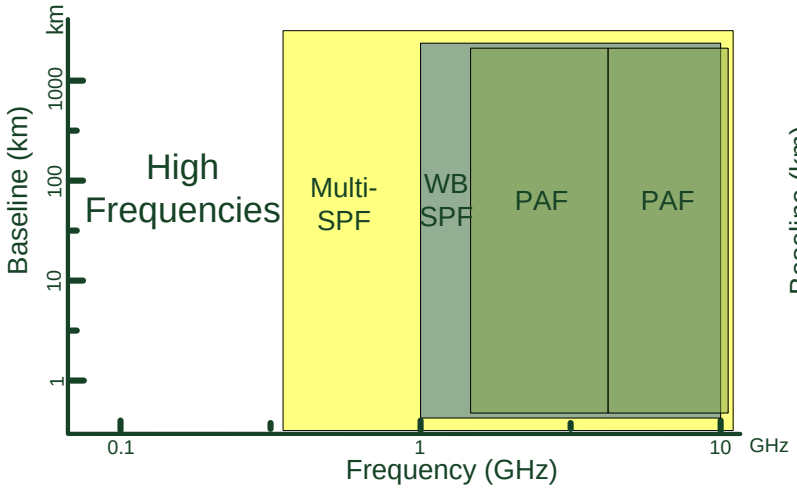
Technologies under discussion

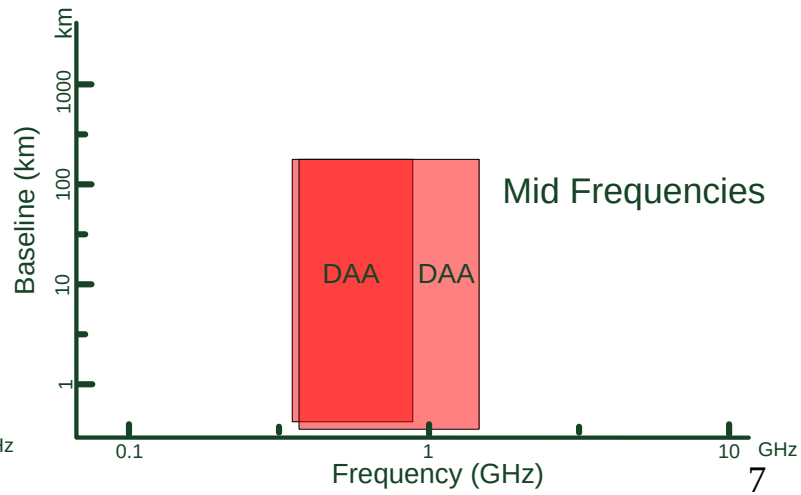
- Dishes and wide band single pixel feeds (WBSPFs)
- Dense Aperture Arrays
- Dishes + Phased Array Feeds (PAFs)
- All need signal transport, signal processing, computing and software.

Receptor Concepts



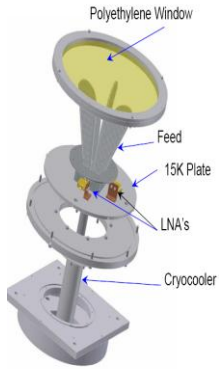


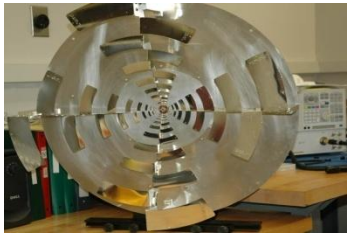


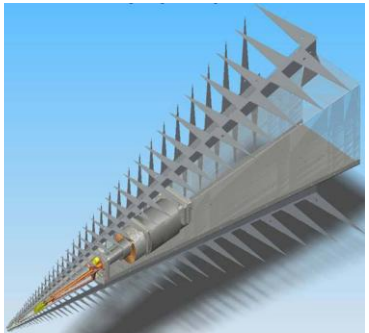


Dishes +WBSPFs

- ~3300 15 metre dishes = 10,000 m^2K^{-1}
- 1 – 10 GHz
- SSFoM ~ 10^8 $m^4K^{-2}deg^2$ @ 1 GHz
- Baselines up to 3000 km
- Cryogenic LNAs

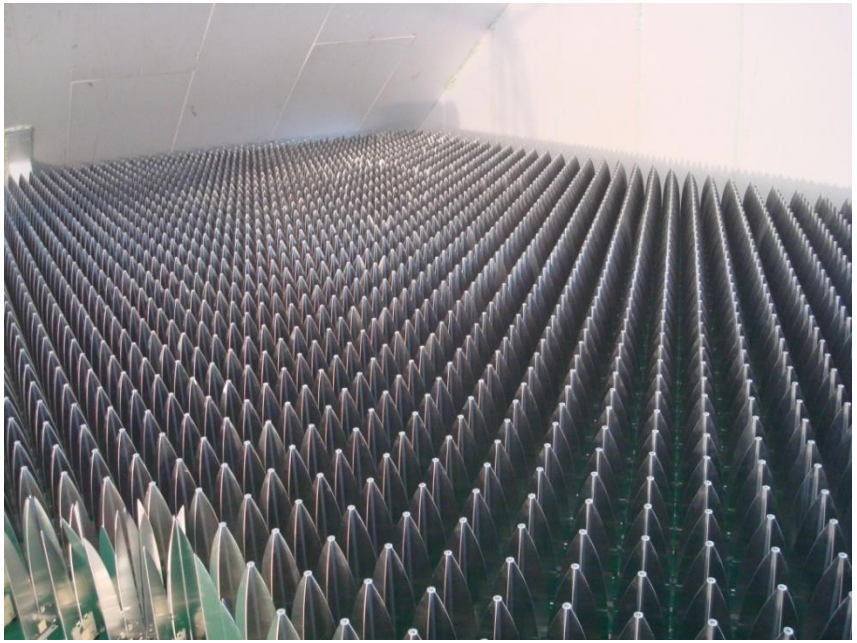


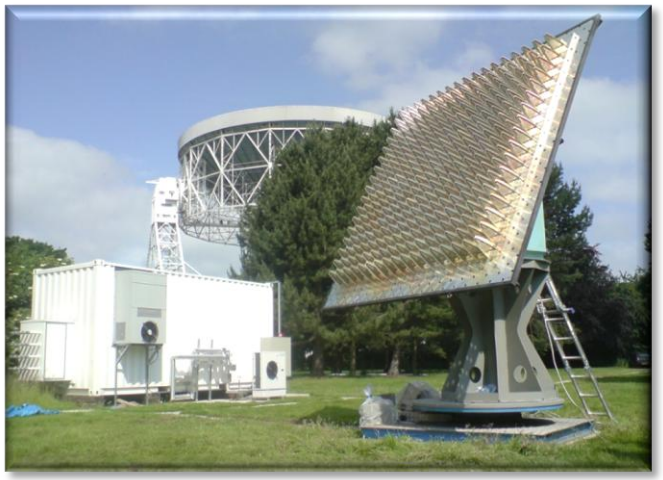




Dense Aperture Arrays

- 250 56 m stations = 10,000 m^2K^{-1}
- 0.4 – 1.4 GHz (?)
- SSFoM ~ 10^{10} $m^4K^{-2}deg^2$ @ 1 GHz
- Baselines up to 200 km
- Ambient temperature LNAs





Dishes +PAFs

- 2000 (?) 15 metre dishes = 4600 m^2K^{-1}
- 0.5 – 3 GHz (?)
- SSFoM ~1.2 x 10^9 $m^4K^{-2}deg^2$ @ 1 GHz
- Baselines up to 200 km
- Ambient temperature LNAs at lower frequencies

Performance examples summary

Technology	Frequency range GHz	Baseline range	Ae/Tsys m^2K^{-1}	SSFoM $m^4K^{-2}deg^2$	Detail
Dish + SPF	1 - 10	Up to 3000 km	10,000	8.6×10^7 @ 1 GHz	3300 15 m dishes η= 60 % Tsys = 35 K
Dense AA	0.4 – 1.4	Up to 200 km	10,000	10^{10} @ 1 GHz	250 56 m stations Tsys = 40 K
Dish + PAF	0.5 - 3	Up to 200 km	4600	1.2×10^9 @ 1 GHz	2000 15 m dishes η= 65 % Tsys = 50 K

Some key questions for each proposed technology

- What will be the quantity and quality of science it will deliver?
- What needs to be done to ensure that the expected performance requirements will be met?
  - frequency range, survey speed, baseline range, sensitivity, processing speed, power consumption etc.
- How do we ensure that we can afford to build it (and write the software)?
- What needs to be done so that we will be able to afford to run the system?
  - power, maintenance
- How will we verify the performance?

Panel members

- Astronomer - provides scientific motivation
- Technology specialist - provides current status and progress
- Independent technology analyst - provides "skeptical review"
- Support systems specialist

Panel topics

- Scientific use of the technology
- Technical readiness
- Technical roadmap with milestones
- Risks and their mitigation

end