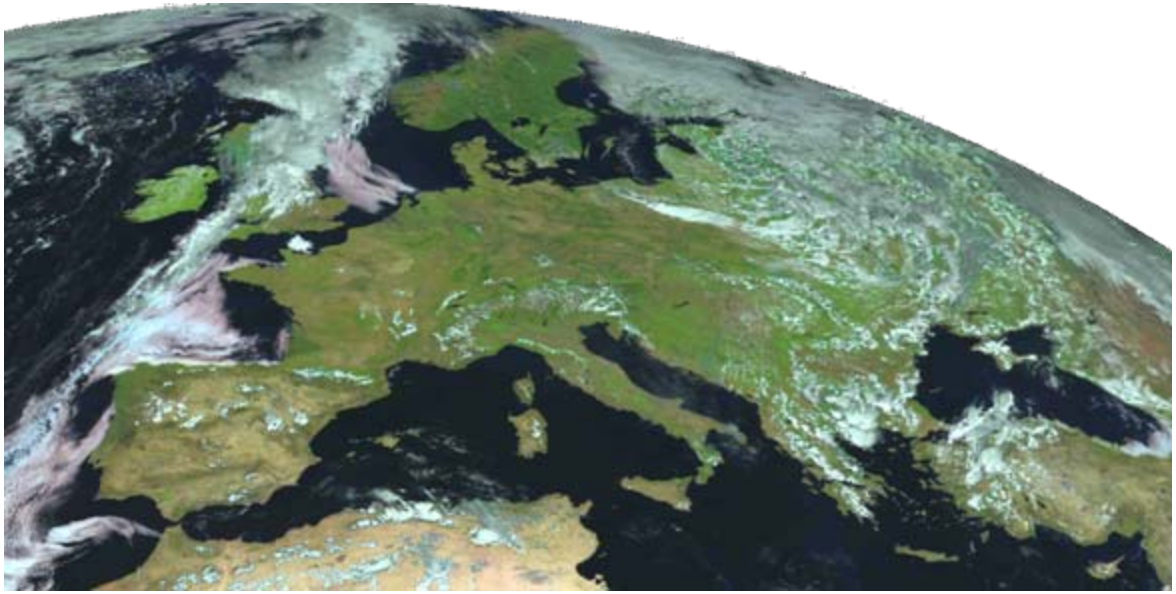
SKADS

The European plans toward the SKA



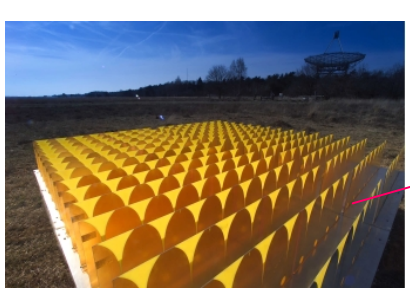
Michael Kramer
Jodrell Bank Observatory
The University of Manchester

Introduction

The SKA Design Reference Concept:

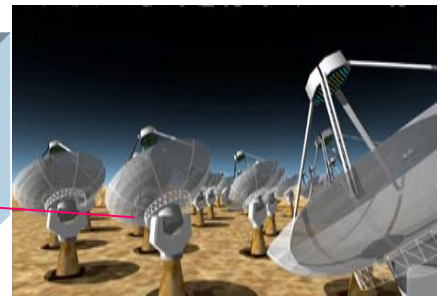
- Aperture phased arrays
- Small diameter dishes

Small D(iameter) large N(umber of Stations) approach



Aperture array tiles

Small dishes with smart feeds in focus



0.1 GHz ~1 GHz 25 GHz

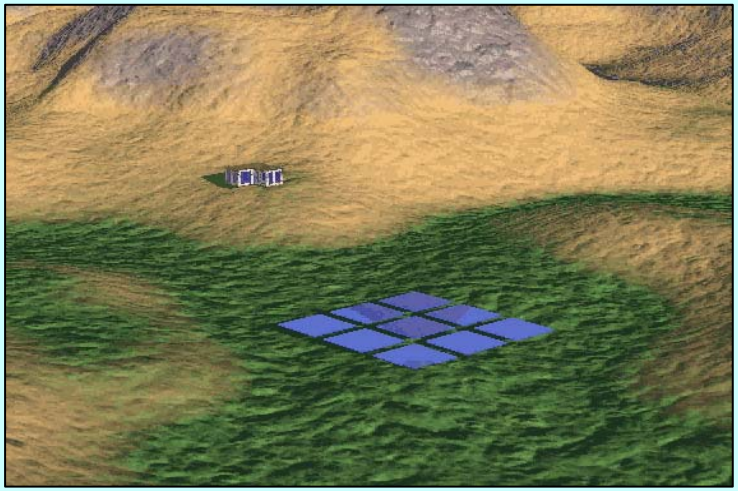
SKA LowBand

SKA High Band

SKA Frequency Range

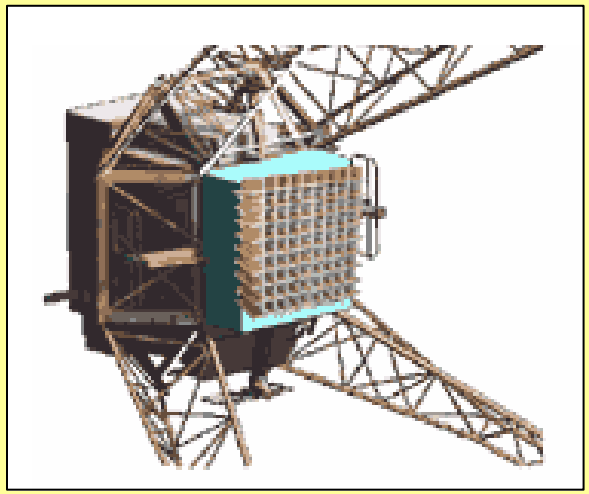
Phased Arrays of receivers

SKADS



Aperture Arrays

"solid state fish-eye lens"

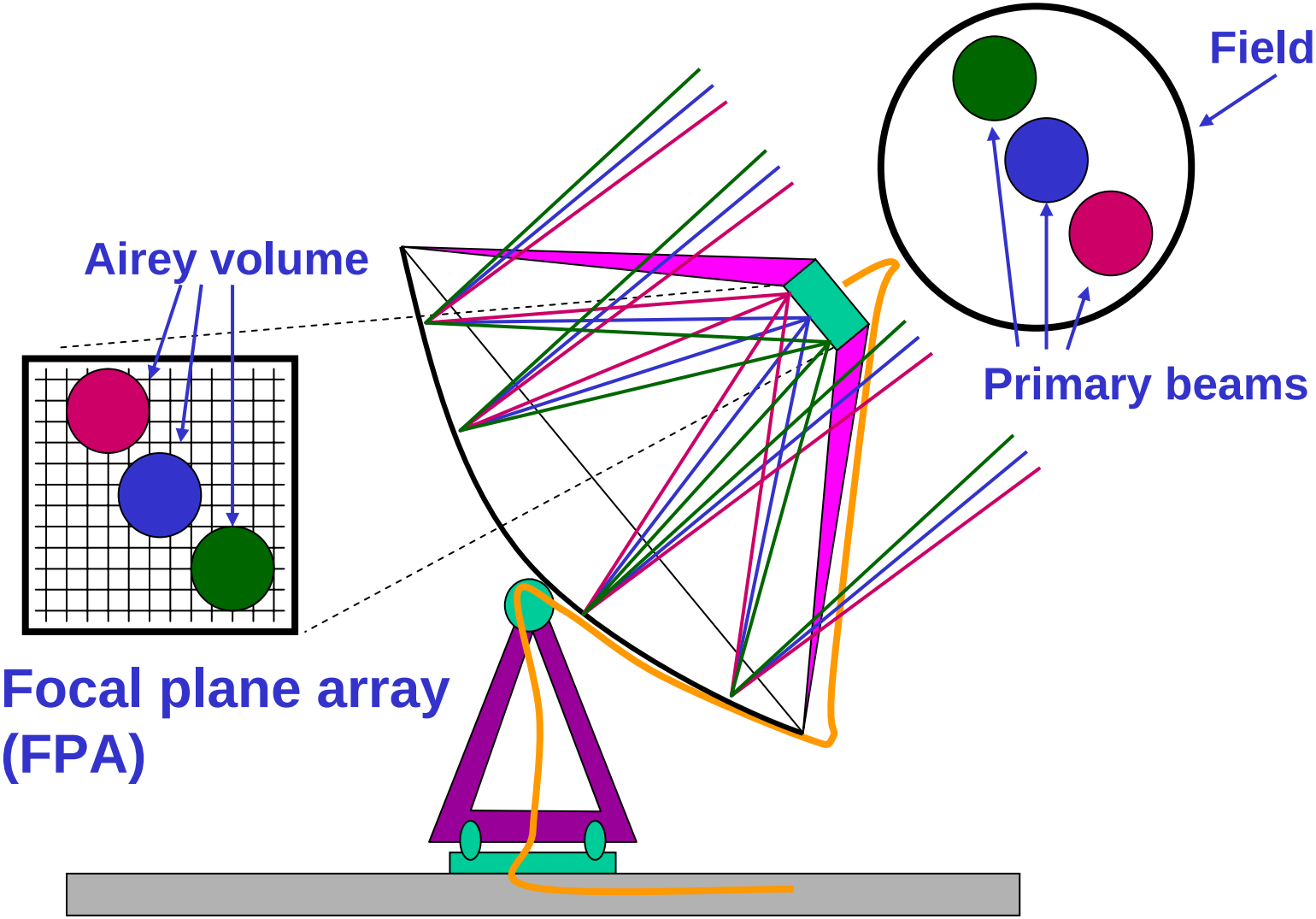


Focal Plane Arrays

"radio cameras"

The revolution in radio telescopes

Multi-beaming with FPAs



SKADS Objective

"…is to establish cost-effective technology and solutions … and for the first time (ever) to prove the viability of phased arrays as an end-to-end system concept for future radio astronomy."

(FP6 proposal)

SKADS

- A 38M€ FP6 program (incl. 10.44M€ EC) to
  - Demonstrate Technological Readiness
  - Demonstrate Scientific Readiness
  - Target costing issues
- A European project involving 29 partners, i.e.
- Radio astronomy institutes, universities and industry
- 8 EU countries
- plus Russia, South Africa, Australia & Canada

UK Partners:

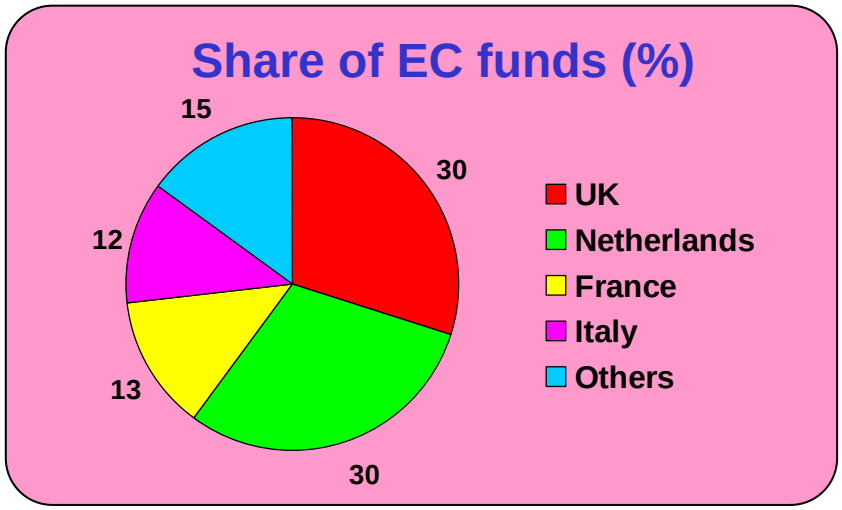
EU & UK contributions

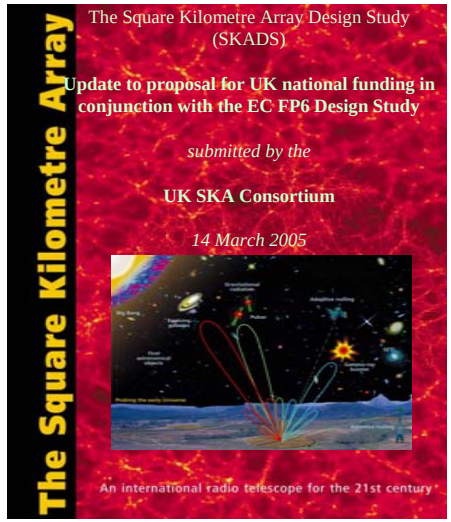
EU SKADS

- FP6 initiative
- Consortium of 29 institutions
- Total funding is €38m
- EC funding of €10.44m
- Commence October 2005

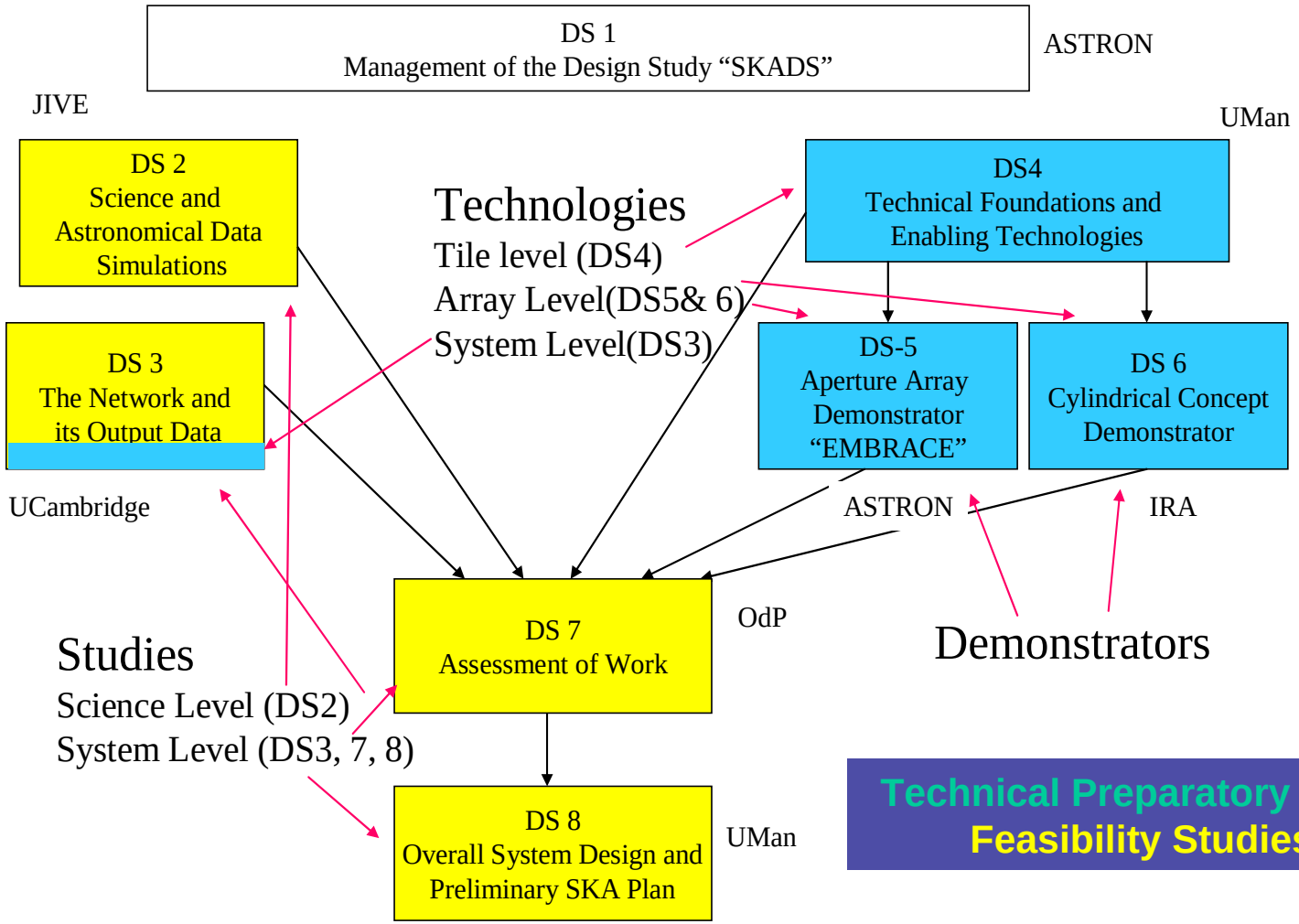
UK SKADS

- 6 institutions
- Total project £7.6m
- EC contribution £2m (€3m)
- Key science and tech. projects
- Strong ‘technical triangle’





The SKADS structure



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Design Studies (DS) & Titles Leading partners	DS Tasks	Partners	DS Task - Titles
DS1 - Coordination and Management	Coordinator	ASTRON	SKADS Coordination and Management
ASTRON			Manchester based Project Engineer
DS2 - Science & Technical Specification	DS2 - T1	Oxford	Science Simulations
JIVE	DS2 -T2	JIVE	Astronomical Data Simulations
DS3 - The Network & its Output Data	DS3 - T1	U Man	Network Infrastructure & Data Transmission
Cambridge	DS3 - T2	ASTRON	Data Handling, Control and Distributed computing
	DS3 - T3	Cambridge	Architecture and the Network Simulator
	DS3 - T4	ASTRON	A Study of Siting & Related Issues
	DS3 - T5	Cambridge	SKA for the User
	DS3 - T6	ASTRON	Scaleable Design and Implementation
DS4 - Technical Foundations & Enabling Technologies	DS4 - T1	U Man	Front End-Technologies
	DS4 - T2	INAF-IRA	Signal Control & digitisation
U Man	DS4 - T3	OPAR	RFI Mitigation Strategies
	DS4 - T4	ASTRON	Wideband Integrated Antennas
	DS4 - T5	Oxford	Beam-forming at patch level
	DS4 - T6	U Man	The 2-PAD Demonstrator
DS5 - The EMBRACE Demonstrator	DS5 - T1	ASTRON	Design of EMBRACE
ASTRON	DS5 - T2	ASTRON	Development of EMBRACE as a System
	DS5 - T3	OPAR	EMBRACE Assessment of Performance
DS6 - The Cylinder Demonstrator	DS6 -T1	INAF-IRA	Design of Sub-Systems
INAF-IRA	DS6 -T2	INAF-IRA	Development and Demonstration
	DS6 -T3	INAF-IRA	Assessment of Performance
	DS6 -T4	ASTRON	Phased Arrays on Concentrators
DS7 - Assessment and Critical Reviews	DS7 - T1	OPAR	Continous Assessment and Critical Reviews
OPAR			
DS8 Overall Systems Design and Preliminary SKA Plan	DS8 - T1	U Man	Overall System Design and Preliminary SKA Plan
U Man			

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DS3 - The Network & its Output Data Cambridge	DS3 - T1 DS3 - T2 DS3 - T3 DS3 - T4 DS3 - T5 DS3 - T6	 Cambridge ASTRON	 SKA for the User Scaleable Design and Implementation
DS4 - Technical Foundations & Enabling Technologies U Man	DS4 - T1 DS4 - T2 DS4 - T3 DS4 - T4 DS4 - T5 DS4 - T6	U Man INAF-IRA OPAR ASTRON Oxford U Man	Front End-Technologies Signal Control & digitisation RFI Mitigation Strategies Wideband Integrated Antennas Beam-forming at patch level The 2-PAD Demonstrator
DS5 - The EMBRACE Demonstrator ASTRON	DS5 - T1 DS5 - T2 DS5 - T3	ASTRON ASTRON OPAR	Design of EMBRACE Development of EMBRACE as a System EMBRACE Assessment of Performance
DS6 - The Cylinder Demonstrator INAF-IRA	DS6 -T1 DS6 -T2 DS6 -T3 DS6 -T4	INAF-IRA INAF-IRA INAF-IRA ASTRON	Design of Sub-Systems Development and Demonstration Assessment of Performance Phased Arrays on Concentrators
DS7 - Assessment and Critical Reviews OPAR	DS7 - T1	OPAR	Continous Assessment and Critical Reviews
DS8 Overall Systems Design and Preliminary SKA Plan U Man	DS8 - T1	U Man	Overall System Design and Preliminary SKA Plan

- Establishes the bedrock for the SKA chosen design

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- Exploring the optimum communication topology
- Developing techniques for the transfer of precise (ps) clock signals

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DS7 - Assessment and Critical Reviews OPAR	DS7 - T1	OPAR	Continous Assessment and Critical Reviews
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- Research in & development of key front-end technologies
- The advanced ***2-PAD*** all digital tile is built and demonstrated.

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- Construction of EMBRACE demonstrator

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- System tests using large collecting area of “Northern Cross” in early project stages e.g. wide-angle multi-beam digital beam forming

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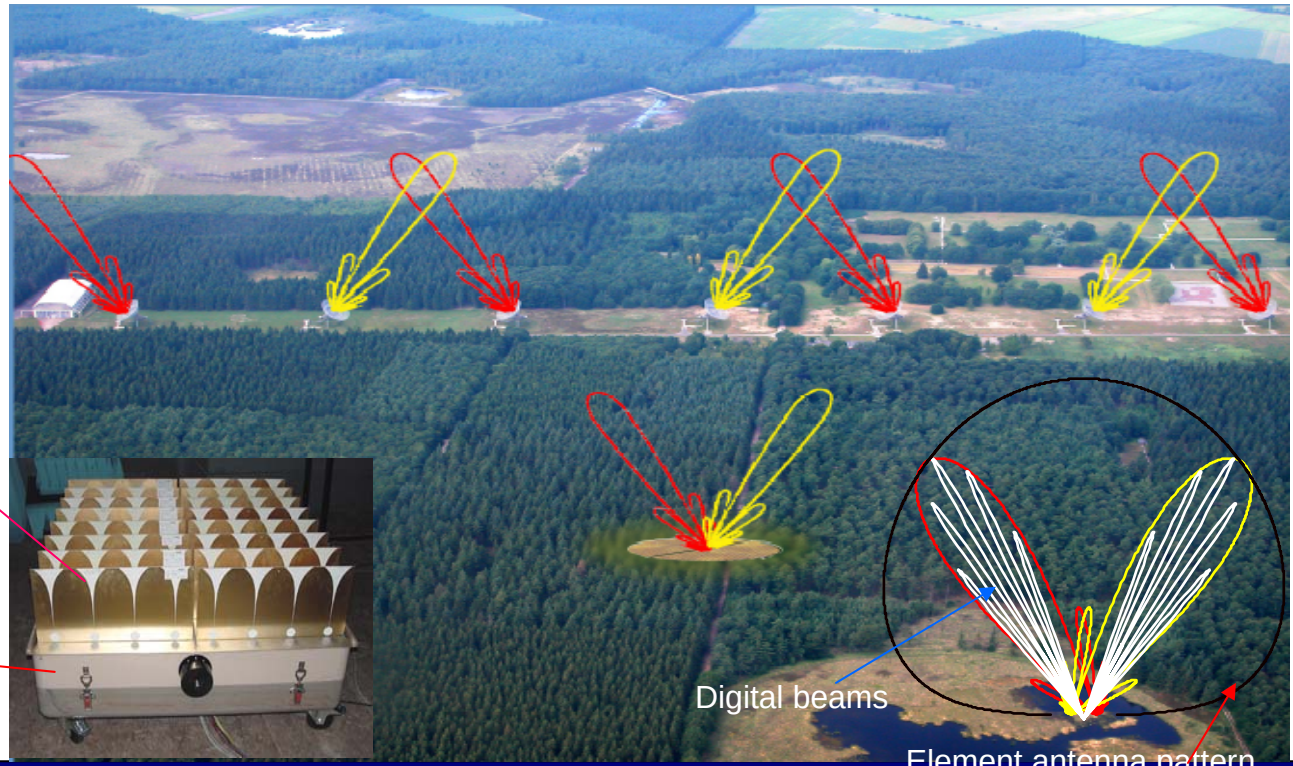
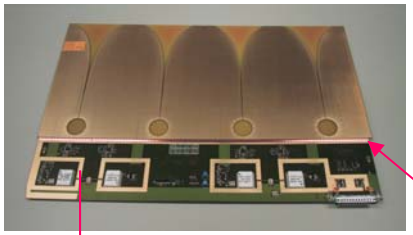
- The prime SKADS deliverable: a complete SKA design

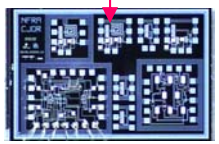
EMBRACE

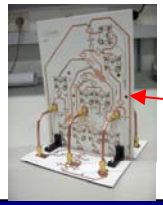
Electronic Multi-Beam Radio Astronomy ConcEpt

- Logical step to assess the scalability of aperture array concept (technology & costs) and to understand how to calibrate such a system to the required accuracies
- 400m^2 tiles distributed over two locations Westerbork (300m^2) and Nancay (100m^2)
- Frequency range: 450- 1600 MHz
- min. 2 independent FOV´s beams, 4 digital beams/FOV
- Station Processing ~5-10 Tops/sec
- Adaptive beamforming (deterministic & adaptive)



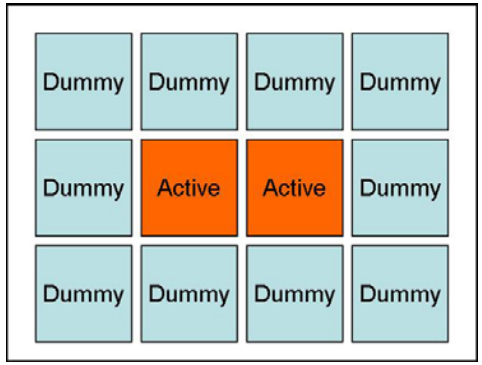


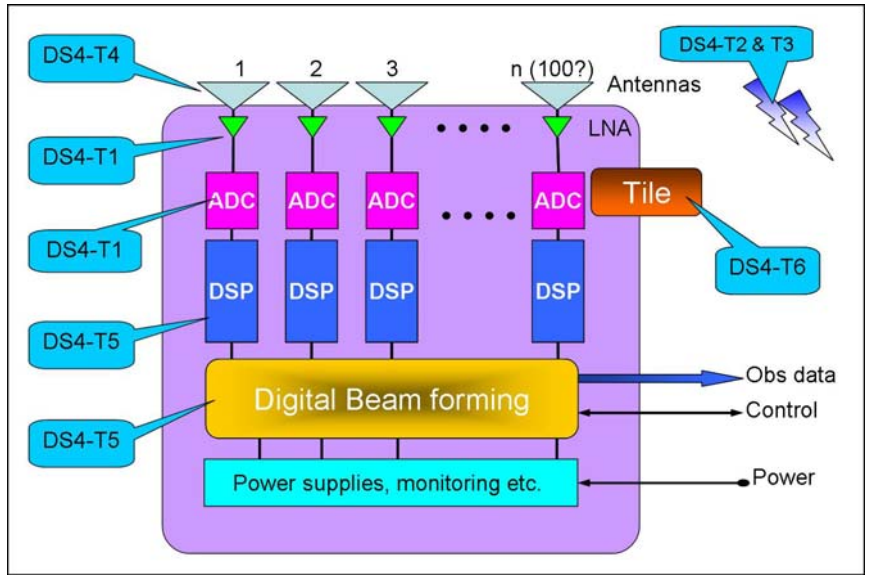




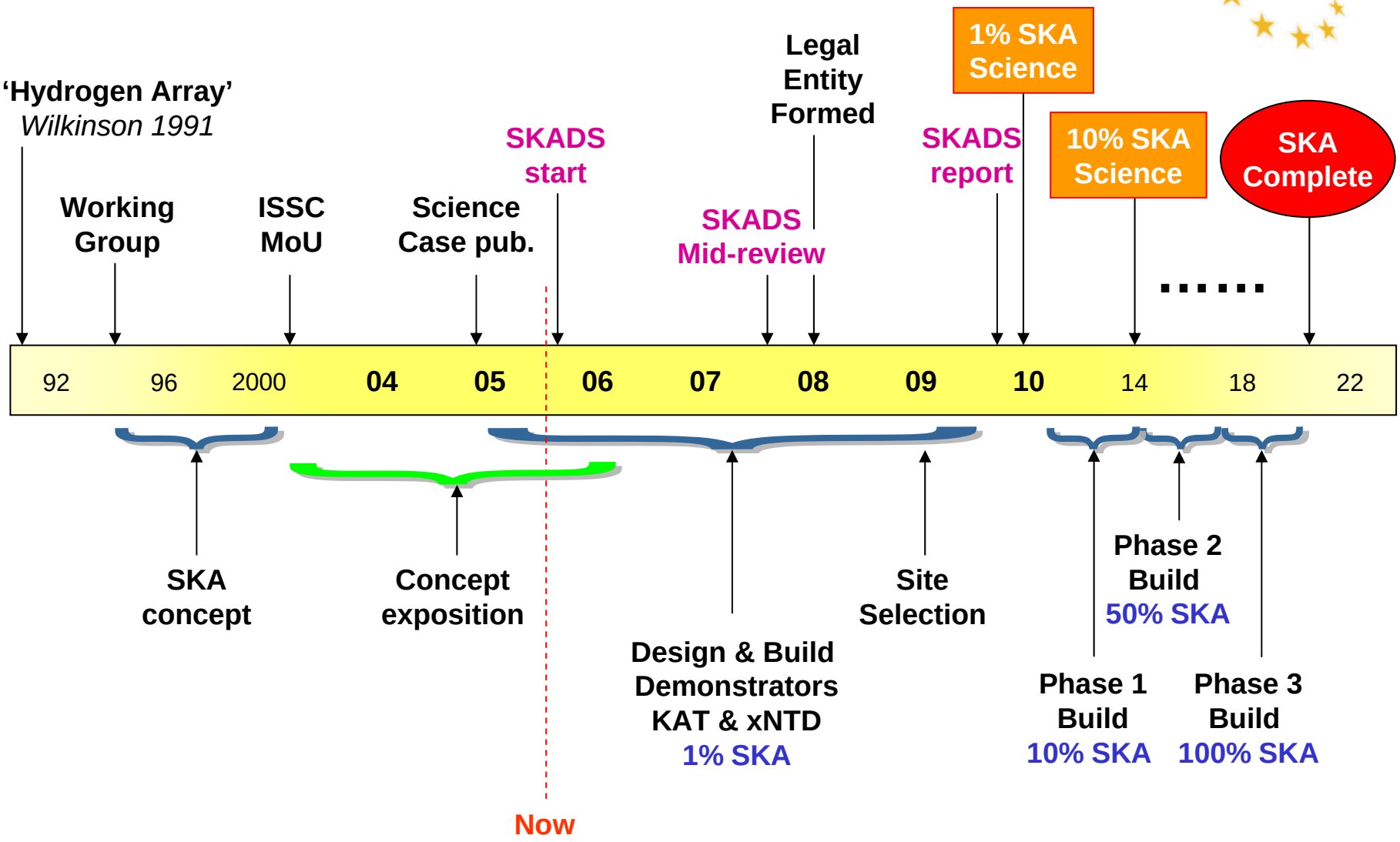
2-PAD

- Dual polarisation all-digital phased-array tile
- Two fully operational tiles plus ten dummy tiles for effective system tests
- Realisation of design and development work carried out in other work packages
- System compatible with EMBRACE
- Demonstration of effective RFI mitigation on an all-digital tile





SKA Timeline



Summary

- SKADS is a ~40M€ project
- EU contributes 10.44M€
- Last week:

  PPARC recommendation to provide £5.6M!!
- EMBRACE and 2-PAD will be built!
- Strong-links to KAT and xNTD (=1% SKA)
- SKA Phase 1 (10%SKA) possible even without US funding
- EU institutes will not only be at centre of SKA science (note that 3 out of 5 KSPs have European lead!) but also at SKA technology!