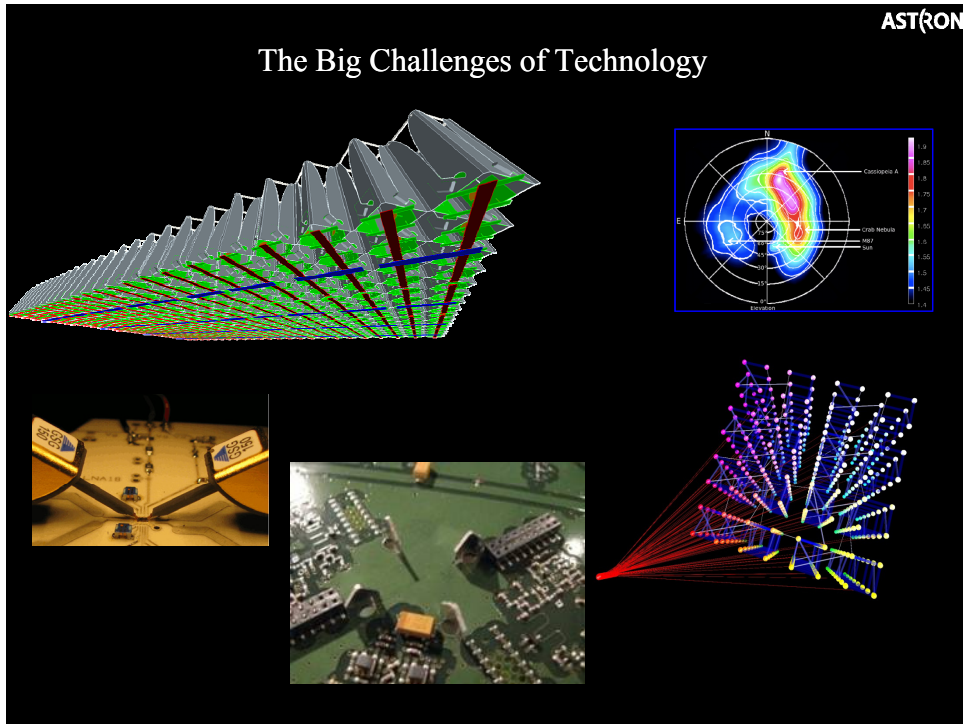




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The Big Challenges of Technology



ASTRON Netherlands Institute for Radio Astronomy

Westerbork Synthesis Radio Telescope (WSRT) - Low Noise Amplifiers



Balanced 4.5-9 GHz Cryogenic LNA

Balanced L-band Cryogenic LNA

Single-ended Cryogenic C-band LNA

$$S = \frac{A_{eff}}{T_{sys}} \sqrt{B \cdot T}$$

MPFE

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Principle of operation next generation Radio-telescopes

Phased Arrays for SKA Telescopes

LOFAR (dipole-antennas)

Innovation for Science and Innovative Business

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LOFAR
Low Frequency Array
Worlds largest radio telescope !

LOFAR - WAN characteristics

- Unidirectional data transport
- No data routing
- 216 Gbps to Groningen (6 DVDs/s)

LOFAR Correlator/Supercomputer and storage:

- Uses 1 (14 TFlops) of 3 racks
- Total capacity: 20 TFlop en 2 PByte

LOFAR - arms

- 16 stations
- 3 Gbps per station
- Distance to LOFAR core < 120 km

LOFAR - Core

- 24 stations
- 3 - 6 Gbps per station
- Intra core distance < 5 km

LOFAR - international

- 8 stations
- 3 Gbps per station
- Distance to LOFAR core ~ 1000 km

> 81.000 dipole antennas
in phased array configuration

DIT IS INDUSTRIËLE PRODUCTIE!

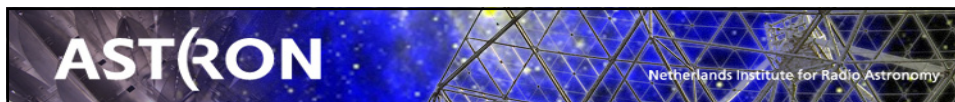


LOFAR = economische activiteit

- Directe TO bij N-NL bedrijven: 12 M€
- Competitie !! (Eu)

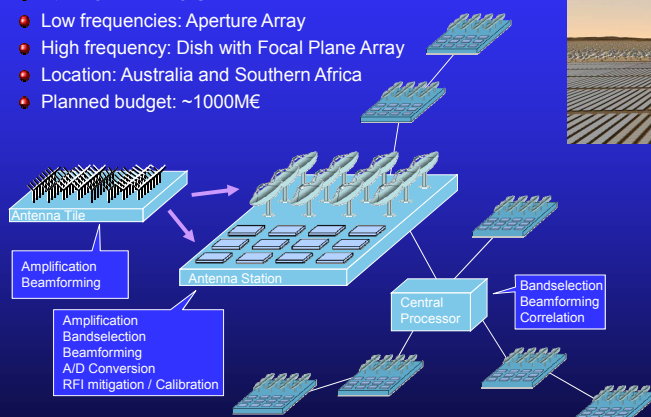
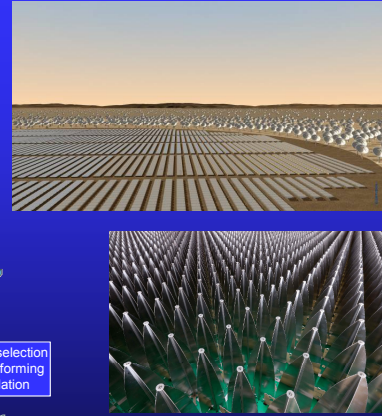
LOFAR = Low Frequency Array
 Geopend in 2010
 -70.000 sensoren High Band
 -30.000 sensoren Low Band
 -Industrie betrokken vanaf prototype bouw.
 -Europese aanbesteding
 -Veel NN industrie betrokken bij de bouw
 -Projectomvang ongeveer 70-100 miljoen
 -Europese telescoop, export

*Ervaring leert:
 vroegtijdige betrokkenheid van MKB geeft grotere
 kans op winnen productietenders*


Square Kilometer Array (SKA) : the 21st Century Radio Telescope

- $\Delta\nu = 70 \text{ MHz} - 20 \text{ GHz}$
- Low frequencies: Aperture Array
- High frequency: Dish with Focal Plane Array
- Location: Australia and Southern Africa
- Planned budget: ~1000M€

- European FP6 program: SKA Design Study (SKADS)
- EMBRACE demonstrator is part of the SKADS programme (DS5)

Innovation for Science and Innovative Business





De weg naar de Square Kilometer Array

"Internationaal scoren met een nationale piek"

SKA = Square Kilometer Array

- 3000 schotel antennes van 15 m dia
- 400 stations van 56 m dia,
 - ± 100 miljoen sensors
 - ± 5 miljoen electronic units
- >1 miljard all in cost (4% NL? >40 M€)
- 100 keer gevoeliger dan huidige radio telescopen
- Europe, Australia, South Africa, a.o.
- Locatie: South Africa en Australia
- Roll out start 2015
- Klaar >2020

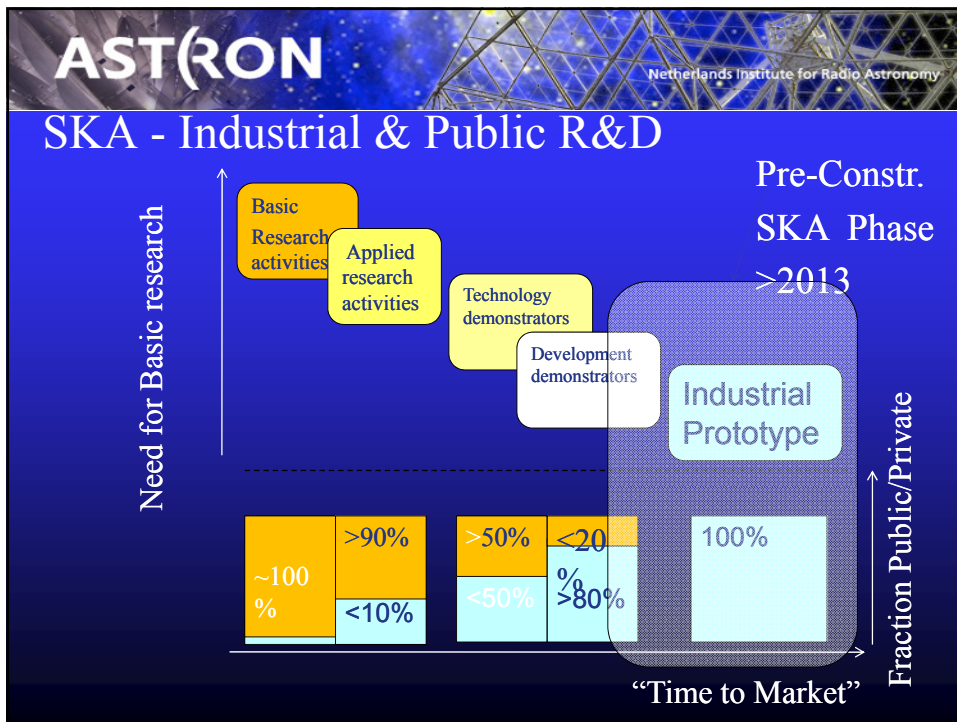
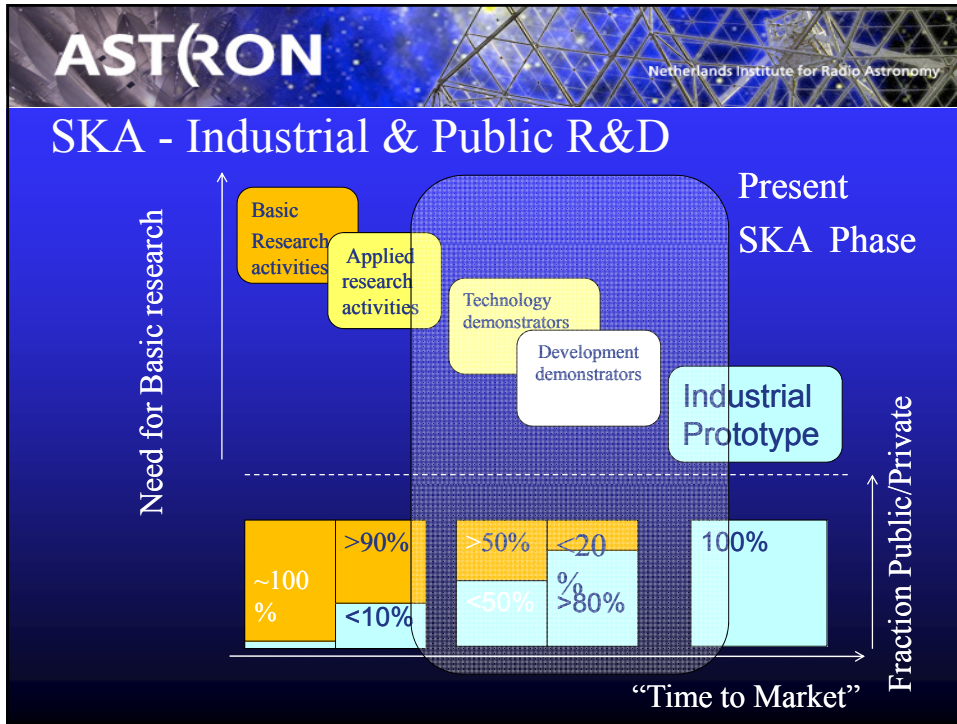




SKA, AAVP and Sustainable Society

- Position SKA as First Green Mega-science Project
 - ◆ Society wants it (!,?)
 - ◆ Example: Zero Carbon Australia Stationary Energy Plan (100% carbon capture)
 - ◆ European Platform of Universities in Energy Research (EPUE)
- AAVP Activities also focus on
 - ◆ Sustainable Energies
 - ◆ Power use e.g. Self-sustainable AAVP receptors/tiles, low-power processing; green high performance computing
 - ◆ Materials e.g. environmentally friendly
- Sustainable energies involvement in Europe:
 - ◆ Mediterranean Europe in particular Spain, Portugal
 - ◆ Research supported by EC/ part of ESFRI roadmap (6 projects)
 - ◆ Other countries e.g. Germany, Siting Countries?, other...
- Human Capital , ICT infrastructure, etc. (recent "COST" workshop)





Another view on the SKA:

A scientific infrastructure of “Smart Antennas”, intelligent, autonomous sensor system, part of a wide area network

Themes (from a wider perspective):

- ICT and high-performance computing
- Radio-technology and Embedded systems
- Wide area Sensor network
- Microsystem-technologies (e.g.MMIC)
- Supervisory- and System health monitoring systems
- Sustainable energy generation and distribution
- Green Design & Smart manufacturing en -services.

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EARLY ENGAGEMENT WITH INDUSTRIES (Example)

Design for manufacturability (DFM)

UNIBOARD

- A multi-purpose, scalable, high-performance computing platform for radio-astronomical applications
- Highest performance currently available for radio astronomy




Credits: Paul Boven (fotos)

- > 8x Altera Stratix IV 40 nm FPGA (1288 multipliers, 1517 pins)
- > 8x 2 DDR3 modules
- > 4x4 10 GbE links (input)
- > 4x4 8 bit LVDS (output)



This film was taken at the premises of Neways Leeuwarden BV



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Valorisatie van Technologie

(Matrix SKA-componenten v.s. Speerpunten HTSM en FP7/8/HORIZON 2020)

Thema	Low-power Telecoms (Beyond CMOS), Future Networks	Smart Energy Networks (FP7)	Factors of the future	Smart energy grids en/of Advanced Software Engineering
SKA component				
Low-power LNA, BFC	NXP			
Correlators (HPC), energie-zuinig		IBM		
Optical interconnects (long range High speed datatransfer)			TE	
Station Sub-systems: Lean manufacturing & integration				IsiTerra Neways Major Electronics
System health management systems, Callibratie en validatie				S&T

3e Commercial Application domains

Nog beter: 3D matrix

Open for new contributors!!

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Collaboration:

- R&D collaboration
 - ◆ Stimulating innovation, support of own strategy
 - ◆ Building clusters
 - ◆ Contracts
 - ◆ All forms (*remark: EC rules for procurement*)
- Strategic Engagements
 - ◆ Larger context
 - ◆ Business and politics
 - ◆ Larger parties involved
- Industrial Consortia; (see Dutch Position Paper IBM/Siemens/NXP)

AvA26012011 Dwingeloo IID_2



CONCLUSIONS

- NL SKA Roadmap:
 - ◆ Scientific role (PI of key science case)
 - ◆ Industrial participation in R&D en roll-out
 - ◆ European Centre for Radio Astronomy (@ ASTRON)
- SKA Beyond Science
 - ◆ Industrialisation and economical impact
 - ◆ Education and Outreach (Lissaboa agenda)
 - ◆ Sustainability (green computing, low power electronics)
- An excellent chance for Dutch / European community: science, technology and business
 - ◆ International “window” for “getting in lane” ~1 jr.

The slide features a dark blue background with a glowing blue arc at the top, resembling a celestial body or a data stream. The ASTRON logo is prominently displayed in white at the top right. Below it, the text 'Creating Synergy!' is written in yellow. A central diagram shows a dashed yellow triangle with a solid yellow vertical line and two white arrows pointing from the top vertex to the bottom vertices, which are labeled 'Science' and 'SME'. The bottom of the slide shows a globe with a line graph and several coins, symbolizing the transition from science to the market. The tagline 'From the edge of the universe to the market place' is written in cyan at the bottom. Contact information for the Technology Transfer Office is listed on the left side.

ASTRON
Netherlands Institute for Radio Astronomy

Creating Synergy!

Contact:
ASTRON Technology Transfer Office
Ronald Halfwerk
Tel +31 521 595 286
+31 6 2909 1760 (cell phone)
Fax +31 521 595 101
halfwerk@astron.nl
www.astron.nl

Science **SME**

From the edge of the universe to the market place

Credits.(parts of this presentation): Koos Kegel, Arnold van Ardenne, Marco de Vos