

Weak signals, Far Horizons

Arnold van Ardenne

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Astro far and weak

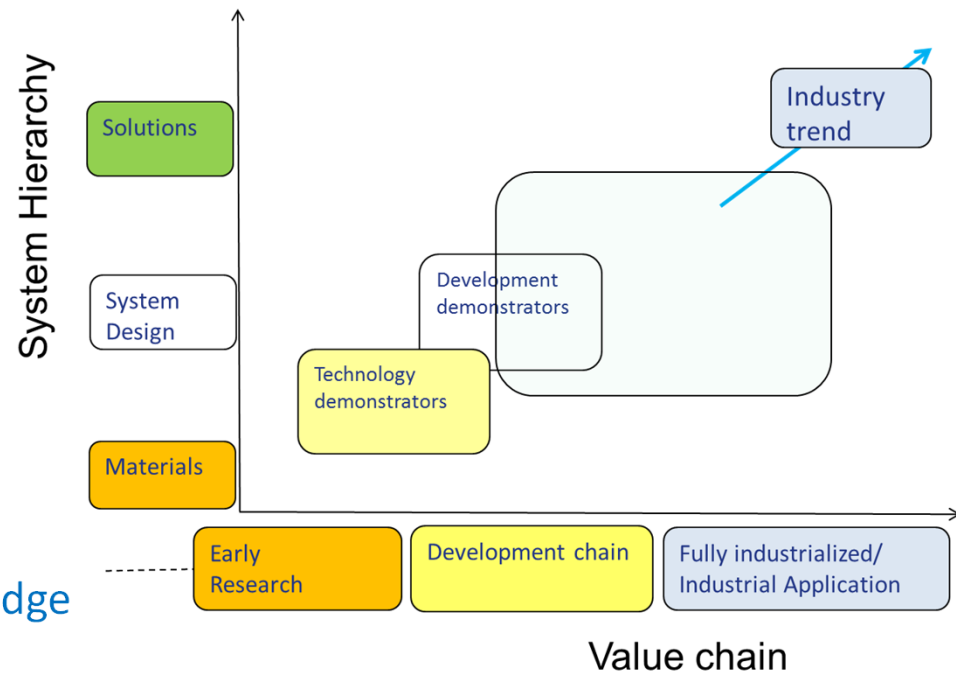
- We no can map (Planck) the CMB after 380.000yrs after the Big Bang , 13.8 Byrs ago
- We can see the mobile phone on the moon and identify it with the strongest radio source on the sky (provided it is transmitting)
- We soon can do much more given all new planned observing platforms but..... society is changing

Not about Astronomy only predictions 2001

1. *E - business becomes M – business* OK
2. *Mobile business now only in start-up phase* OK
3. *No business through internet is misjudgement* OK
4. *Content becomes most important in virtual world* OK
5. *Energy saving technologies have a great future* OK
6. *Wireless telematics = future* OK
7. *Electronic fraude rapidly increasing; future for encryption and identification* OK
8. *In 2005 : 1 Billion wireless internet users* OK
9. *“Being wireless” becomes lifestyle* OK
10. *Advanced track and trace applications* OK?
11. *Our second nature: real time palm video in full colour* OK?
12. *Ergonomics: simplicity, ease of use, design, fun, accessibility* OK
13. *Mobile phone becomes also Cashphone* about OK

Note: No facebook, twitter, Android as enabling platform etc. ; Seredipities shape the world

Trend to “farm out” Industrial R&D (i.e. risk dumping to Universities)
 require more public funds to (applied) science as a consequence, not less



- More balance between core/base knowledge and societal benefits (applied)
- Essential for Unknown-unknowns (leading to seredipities) and known-unknowns
- Endless examples of hugely important seredipities (penecilline, magnetron, dynamite , velcron, 3M, X-rays for diagnostics, Poly-ethylene etc., etc.), **same in astronomy!**
- Innovation is a confrontation with ideas to the market; not a design (although lead-up time could be long though, ask John O’Sullivan, 20yrs?)

Emphasize and Educate: Some Contributions of RADIO ASTRONOMY (TECHNOLOGIES) TO OTHER FIELDS

Radio Astronomy	Technological Spinoff	Application
Radio Interferometry	Wireless LAN technology Location of wireless sensor nodes	WiFi Internet networking e.g. Location of mobile emergency calls
Very Long Baseline Interferometry Precision astrometry	Most accurate (hydrogen maser) clocks International celestial reference frame. GPS reference frames Precision State Vector/position	Space communication, satellite navigation Earth orientation parameters, geodesy, time keeping Interplanetary spacecraft navigation, Planetary science
Aperture synthesis and image reconstruction	(Fourier) imaging techniques Massive Data, Algorithms & Database Thinned aperture imaging radiometry	Medical imaging tomography Image de-blurring (Green) Computing Earth sciences
(Homologous) antenna design	Precision antennas Widefield Antenas	Communications and radar GMES, GNSS S&R
Low Noise Amplifiers	Highly sensitive commercial cryogenically cooled receiving systems	Telecommunications
Endeavour	Societal, Public	Education , Inspiration UNAWE, Astrotechnology?



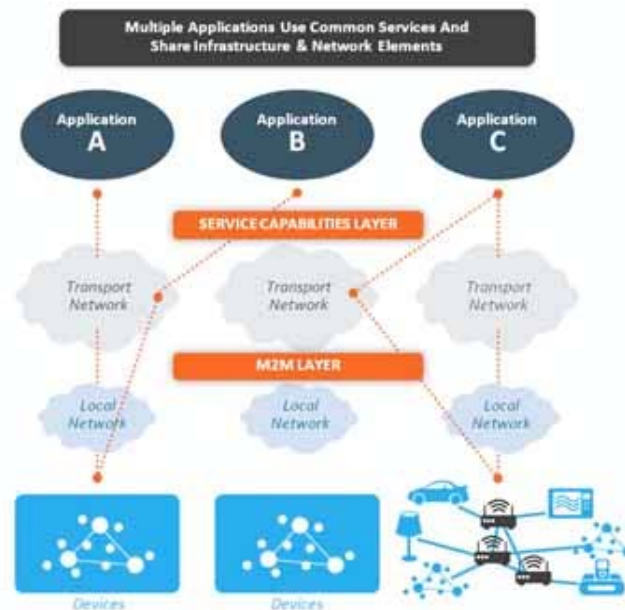
ASTRO R&D: Remain on the ball; Other developments over last ten+ years (besides f-book, twitter etc.)

- From fixed channel to CDMA; Qualcomm now 115B\$ company
- SAMSUNG is introducing a 5G network
- D-Wave launches 521 QUBIT computer
- From Mobile-to-Mobile to Internet of Things (M2M to IOT):

Irwin Jacobs (founder)
described as:
Made Q. successful by
Passion and Persistence

Where the Industry Needs to Be: Breaking Through The Silos, Enabling Interoperability & Scale

- **Standardized** Service Platform leveraged by multiple applications
- Leverages capabilities of underlying transport networks
- Offers **core capabilities** required by many different applications
- M2M Gateway enables diverse access network technologies and device types to interconnect



Interoperability between Diverse Applications, Networks and Devices

...and then Leadership; passion and persistence



“General Tendencies do not alone decide; great personalities are always necessary to make them effective”

Leopold von Ranke (Historical writer 1795-1886)

Therefore: It is about Astronomy⁺.

Some predictions for 2023

- Realization of ambitions for RadioAstronomy depend on how well societal benefits have been made clear
- SKA2 to be finished before 2025
- Rethink High Frequency SKA as global project: Is same as ALMA-low (15-150GHz); to be build in South America for 2025-2035 period
- U-LOFAR on the backside of the moon serious project
- ASTRO technology education track in Dutch (technical)universities
- Strengthen the connection between “Space” and “Earth” Sciences as collaborative aim
- But then, who can really predict the (near) future.....

In Concluding

Impressive and Incredible progress made in available instruments for ASTRONomy with more to come and proud and pleasure to have been some part of it all

Challenges are great at all levels “as usual” when “dipping” into unknown territories structurally, financially and otherwise but confident that all the great works and ideas will work out!

Thanks a lot to all the speakers of today, the SOC, the LOC and in short all who made this event so memorable

Thanks a lot to the many good and great colleagues and people I was happy to have met over the last decades at ASTRON and elsewhere!!

*Thanks also my “enablers”; my wife
Els, children Boudewijn, Nora en Eva
and their partners Dominique and
Timo, for their patience and endurance*

