General Status of LOFAR and E-LOFAR

Role of ASTRON Radio Observatory in

Operations, Interaction with Science Projects, and International Parties

ASTRON

NWO
Netherlands Organisation for Scientific Research

LOFAR

LOFAR Status

- Ongoing development
  - Technical project manager *André Gunst*
  - Correlator/processor, observing modes, monitor/control software, etc.
  - Calibration (BBS, MeqTrees) algorithms, software and commissioning (Project scientist *Ger de Bruyn*)
  - User Software (Coordinator *Michael Wise*; contributions from various User groups, International contributions welcome !)

- Test/commissioning observations with CS1 proceeding
  - Operated by the Radio Observatory
  - Weekly CS1 meetings (webcast, contact: *Corina Vogt*)
  - HBA characterisation
  - Debugging/commissioning
  - Support of calibration and user software development

LOFAR Status

- Procurement process in full swing
  - Led by Project Directorate (*Michiel van Haarlem*, *Jan Reitsma*); rollout manager *Mark Bentum*
  - Tender calls placed (many packages follow European rules)
  - Bids coming in / expected shortly
  - Negotiations, contracts in next couple of months
  - Initial batch in 2008: 20 NL stations + handful of international stations
  - Detailed roll-out plans being set up right now (complex logistics, including bird breeding season in the LOFAR core)

- E-LOFAR: Several stations sold, many more expressions of interest, discussions on operational phase starting.
  - Questions ? Don't know who to contact ? *Corina Vogt* can refer you !

E-LOFAR Participants

- GLOW:
  - Effelsberg station delivered
  - Garching, Potsdam, Tautenburg stations ordered
  - Jülich station federal funding proposal submitted
  - Postdocs / software developers to be hired
- LOFAR-UK:
  - Chilbolton, Cambridge, Jodrell, Edinburgh
  - 1 station funded, site to be chosen
  - STFC funding proposal:
    - 3 more stations
    - postdocs, software developers
    - local operations support
- Sweden:
  - Onsala station funded

E-LOFAR Participants

- Poland:
  - Funding proposal submitted for 3 stations
- Austria/Ukraine:
  - Expressions of interest, funding promising
- Italy:
  - Expressions of interest, funding being sought

- Expressions of interest from multiple parties including
  - Bulgaria
  - Ireland
  - Malta
  - Mauritius

- FRANCE, WHICH IS WHY WE ARE HERE !

Descope

- April - September 2007: Extensive Reviews of the project
  - Critical Design Review, BSIK funding mid-term review
  - Main conclusions:
    - R&D developments in good shape (CS1 results)
    - Development costs in line with original estimates
    - Shortfall in co-financing
      - Break-up of original international consortium
      - Unsuccessful additional funding requests in 2005/6
    - Hence building original LOFAR77 unrealistic in short-term.
- Descope process conducted August - November 2007
    - Information and involvement of scientific community
    - Several iterations, including an open workshop (17 September 2007)
    - Recommendations coordinated by Prof. Ralph Wijers (chairman ARC), support by LOFAR project directorate
- Phase-1 will not allow all LOFAR77 science to be done, but excellent first steps with *groundbreaking capabilities*

Descope: constraints

1. Money: 25 M€ phase 1
2. Rollout Schedule: finish before end 2009
3. Software = capabilities
4. Calibrate-ability
5. Expandability: (?)0-8 M € phase 2, ...
6. E-LOFAR
7. Operations: cost control
8. Other sciences (geo/agro/meteo/....)

Descope: conclusions

- Reduce Individual Station size/content to build more stations:
  - 48 Receivers (RCUs)
  - 2x48 Low-band Antennas (LBA)
  - 48 High-band antenna (HBA) tiles (in core 2x24)
- 50% of NL Stations in core - 50% remote
  - minimum 18 core + 18 remote stations
  - more stations if funding developments are positive (max: 25+25)
  - skew configuration towards German stations
  - Retain 100 km NL baselines if possible
- 20 NL stations to be built in 2008
  - 16 core, 6 remote, 1 distant
- Remaining NL stations in 2009
- Integrated Hardware + Software Roll-Out plan

LOFAR-phase1 rationale - I

50%-50% core/outer stations,
aim 25+25 stations

- uv-coverage has priority over raw collecting area, both core (EoR, Radio Sky Monitor) and outer (Surveys) need to be good ⇒ more smaller stations
- Below 25+25, good uv-coverage quickly gets harder

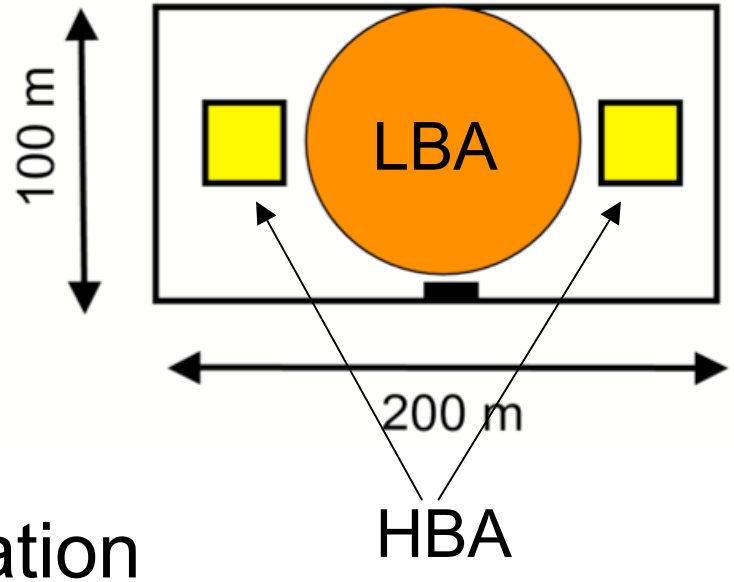
LOFAR-ph1 rationale - II

NL outer station: 96(48) LBA, 48 HBA, 48 RCU

- HBA and RCUs are expensive, so reduction most helps getting more stations
- LBA are cheap, hard to add, so install all 96 and use LBL/LBH to connect all, but only 48 can be used.
  - Select inner/outer 48
  - Select ‘minitile sum’ of 2 for better sensitivity
- NOTE: 48 has larger FOV!

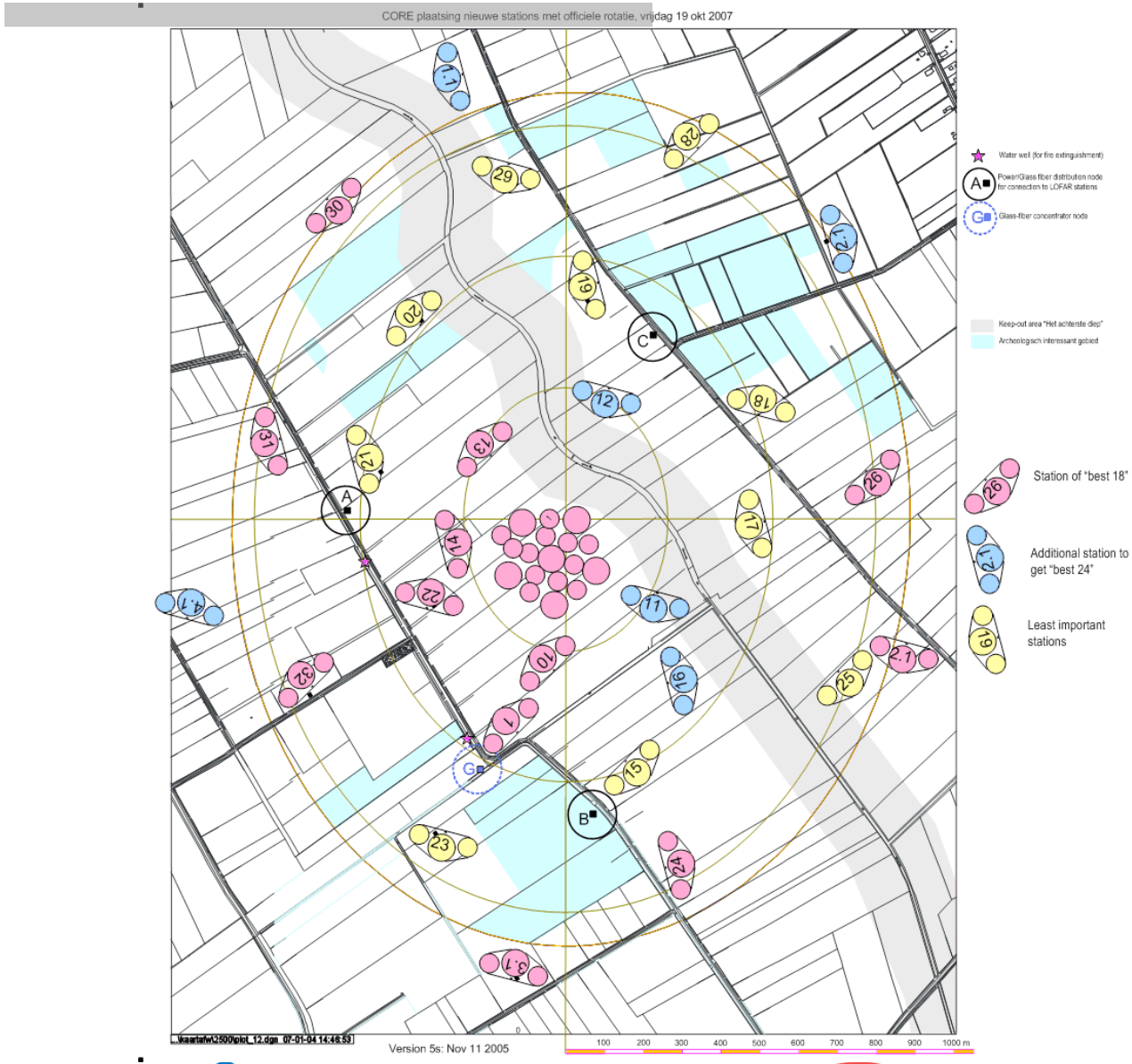
LOFAR-ph1 rationale - III

NL core station: 96(48) LBA, 2x24 HBA, 48 RCU



- LBA same as remote station
- HBA split in two fields at ends of 100m x 200m field
  - Better uv-coverage in core
  - 24-HBA substation has even larger FOV
  - Price to pay: 2x data rate (2 substation signals out)

Core Configuration



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LOFAR-ph1 rationale - IV

Maintain long baselines and build lopsided towards Germany

- Important for resolution and depth (confusion limit) and connection to E-LOFAR
- Lopsided to East gives more weight to long baselines than symmetric distribution around core
  - Price to pay: more observing time to fill uv-plane

LOFAR-ph1 rationale - V

E-LOFAR stations 96 LBA, 96 HBA, 96 RCU

- Fewer outer baselines: sensitivity very important for calibration
- Split-station would require needs higher data rate; use of larger FOV initially doubtful

LOFAR organisation

- Within the NL LOFAR Consortium/Foundation ASTRON is the largest partner, assumes the vast majority of the risk, provides the expertise and man-power for the development, roll-out and commissioning of LOFAR.
- LOFAR Managing Director reports on a daily basis to ASTRON General Director.
- Radio Observatory ASTRON will be responsible for LOFAR astronomical operations.
- Radio Observatory ASTRON will be the international communities contact point for E-LOFAR.

LOFAR Astronomical Exploitation

- ASTRON / Radio Observatory responsible for long-term coordination of LOFAR astronomical exploitation
- Run as a broad common-user observatory
  - Making the transition now from “project” to “observatory”
- LOFAR internationalisation fully taken on board, integrated operations model
  - There will also be some stand-alone usage of foreign stations

LOFAR Astronomical Exploitation

- Astronomical user groups must be empowered to focus on their particular science projects
  - Freedom to choose optimal way to conduct research
  - Incentives to collaborate, contribute to collective facilities
  - Connection to Radio Observatory via Users and Developers Committees, which will meet regularly

- 3-tier allocation scheme to do justice to all interests
  - Long-standing LOFAR KSPs given proper recognition:
    - Highly valuable contributions, major undertakings
  - New parties welcomed and encouraged, especially if:
    - Contributing to development of (extended) LOFAR infrastructure
    - Contributing to sustained LOFAR astronomical operations
  - Substantial fraction open to worldwide community. This is vital:
    - To foster the user community
    - For the overall and long-term scientific success

Evolving Observatory Structure

- Integrated operations of LOFAR and WSRT for maximal efficiency

- All personnel gradually moving to Dwingeloo
  - LOFAR and WSRT sites visited for maintenance as needed
  - Extension of Dwingeloo building being planned
  - Room for initial operations in Dwingeloo now in use

- New structure for the Observatory
  - Science Support Group (vital link to astronomers)
  - Technical Operations (integrated processes)
  - Systems Engineers (anchor expertise, enhancements)

Internationalisation

- Operational model with multiple partners has resemblances to both EVN and JIVE
  - Dispersed station exploitation/ownership
  - Integrated scheduling/operation/processing

- Relationships with partners are likely to be diverse:
  - Different goals (Scientific, Technical, and Political)
  - Different means to contribute (stations or other hardware, software, processing/storage, brainpower, cash)
  - Different modes of interaction
  - Different level/value of contributions
  - Different timescales

Internationalisation

- Vital ASTRON Radio Observatory interest to ensure properly integrated E-LOFAR exploitation
- ASTRON is likely to remain the dominant partner based on total investment and level of direct operational control
- Diversity best accommodated through tailored bilateral agreements with ASTRON on specific collaboration in development and exploitation of LOFAR
  - Requires that regular joint meetings of all partners on operational and science policy issues be held at Board level
  - RadioNet-FP7 Network Activity !
- All bilateral agreements based on uniform, well-defined principles and guidelines, set out in these meetings, including
  - Standards / levels for station operation / maintenance
  - Parameters of 3-tier resource allocation scheme

Internationalisation

- Consortium Agreements are about institute and observatory business, and do not govern specific science projects or collaborations
- Scientists and groups must conduct their own business to optimise their individual science projects
- All individual observing projects must be carefully tailored
  - need to compete for limited resources
  - reviewed by independent, international APC:
    - Science, analysis strategy & resources, team & collaboration, progress
- Long-standing KSP scientists get recognition for their initial contribution via reserved access
- Other (international) scientists can be attractive collaborators to existing projects:
  - Strengthening of scientific team; complementary observing access
  - Enlarged/reserved access to observing resources