LOFAR the ultimate test for SURFnet6 Best Practice

The LOFAR sensor network is not just of interest to astronomers. Geophysicists, agricultural scientists and meteorologists also take advantage of it. They have fast access to their research data through lightpaths.

A revolutionary radio telescope consisting of tens of thousands of highly sensitive antennas, a supercomputer and a broadband fibre-optic network. This is the infrastructure that will be delivered by the LOFAR project (LOw Frequency ARray) in 2009. 'Many thousands of antennas, distributed over dozens of stations and spread out over an area of over one hundred kilometres in diameter, will continuously collect signals from space,' says Jan Reitsma, LOFAR Technical Director in Dwingeloo. 'These signals will subsequently be processed and analysed in a supercomputer.'

Changes in the sky

The initiator of LOFAR is ASTRON, the Netherlands Foundation for Research in Astronomy. The ASTRON astronomers will use the virtual low frequency telescope to peer into the universe as far away as thirteen billion light years. This makes it possible to conduct research into the very first objects that came into being after the Big Bang, 14.5 billion years ago. As the antennas collect data continuously, astronomers can also study phenomena that precede small changes in the sky. Jan Reitsma: 'When LOFAR

detects something out of the ordinary, the data of the preceding period can be retrieved. On the basis of these data the onset of these changes can be investigated.'

Explosives

Totally different kinds of phenomena can be monitored when other sensors rather than antennas are connected to the network. 'Instead of looking up we can do research below the earth's surface,' Jan Reitsma explains. The common practice for obtaining information on the geological build-up of the substratum is detonating explosives at the earth's surface. So-called geophones catch the reflection of the vibrations against earth strata. 'But that is always just a record of a single moment in time. Using the natural sounds (background noise) and movements of the substratum, data can be collected continuously. This is done by placing geophones at a depth of 60 to 80 metres. They allow geophysicists to research the substratum up to a depth of thirty kilometres. An additional advantage is that no dangerously large amounts of explosives are needed.' Just like the astronomers, the geophysicists can investigate the onset of changes. The system can also be used to monitor a gas reserve, or the gas quakes related to the mining of gas. The principle has been demonstrated in a test field.

Potato Blight

Precision agriculture is another discipline that can profit from the LOFAR sensor network. Through wireless sensors in a potato field, agricultural scientists can accurately monitor the changes in temperature and relative humidity. In combination with growth models they can predict the probability of, say, an outbreak of potato blight. A farmer will then be able to spray in a very limited area, only where the probability of an outbreak is highest. 'It is a great example of multidisciplinary research,' remarks Jan Reitsma. 'Moreover the information from the weather sensors can in turn be used by other applications. For meteorologists, for example, it is interesting to study the relation between the predictions on a larger scale and the microclimate. The temperature and humidity in the field is also highly relevant for astronomers, as these data can be used to calibrate or correct the signals they receive.'

Dedicated lightpath

The data collected by the sensors are sent over the LOFAR fibre-optic network to the supercomputer in the University of Groningen's computer centre. 'They are processed there and distributed over SURFnet6 to researchers all over the country,' Jan Reitsma says. 'Depending on the amount of data they have their own dedicated lightpath, like the Amsterdam astronomers. For others a lightpath is set up when required.' SURFnet also provides the connection to other countries, where a small part of the telescope antennas is located. Those data are collected in the German Forschungszentrum Jülich and are sent on from there to Groningen.

Strong growth

German academics have become so enthusiastic about LOFAR that they have founded their own version, the GLOW (German LOw Wavelength) consortium. France, England, Sweden, Poland and Italy also wish to construct antenna stations. They will be exchanging information through GÉANT, the European research network with which SURFnet has a connection. The much larger number of antenna stations will allow astronomers to study the universe at even higher resolutions. 'The great thing about SURFnet6 is that we have an excellent high-grade data network at our disposal,' Jan Reitsma concludes. 'Given the strong increase in the amount of data, one may say that LOFAR is the ultimate test for SURFnet6.'

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