PROSPECTS OF TRANSFERRIG THE LARGE VOLUMES OF RADIO ASTRONOMY DATA

E.A.Isaev [1,2,3], P.A.Tarasov [4]

[1] Pushchino Radio Astronomy Observatory, Astro Space Center, Russia
[2] National Research University "Higher School of Economics", Russia
[3] Institute of Mathematical Problems of Biology, Russia
[4] OOO «NPK-INFORM»

ABSTRACT. Shows the volume of scientific data generated by the leading radiostronomicheskimi projects. The methods of transmission of large amounts of data in the present time and in the future.

Key words: radioastronomy, data transfer.

Currently there has been a significant increase in the volume of experimental data in astronomy and astrophysics. A single observation that can last from several seconds to several minutes gives from a few megabytes up to several gigabytes of data or even more. There is a need for transfer of this information for filtering, storing and further studies [1].

Let's consider some of the largest astronomical research projects that operate with huge amounts of information.

An array of radio telescopes LOFAR is one of the largest international projects. Regular observations are being conducted from December 2012, but have not yet reached its full capacity [2]. This array of telescopes requires the bandwidth from 2 to 20 Gb/s to operate in the normal mode from the cable system that connects the stations. These stations will unite around 10,000 of radio antennas.

The largest global astronomical project under development is currently The Square Kilometre Array (SKA) [3]. This project is scheduled to reach the full capacity of data collection in 2024. It is expected that the SKA telescope will generate more than 1 exabyt of data per day upon reaching its full capacity, which is comparable to the volume of all Internet traffic existing at the moment.

The only technology that is currently capable of meeting the growing demand for the transfer of scientific data is fiber-optic communications. The fastest fiber optic data transmission was achieved by the Japanese companies Nippon Telegraph and Telephone Corporation (NTT). Their September 2012 experiment showed a record speed of data transfer. During the testing of a new link, the specialists have registered the data transfer speed of 1 petabit per second over fiber optic cable with 12 channels and the lightguide length of 52.4 kilometers [4]. In the summer of 2014 a team of researchers from the Danish Technical University has set a record for the fastest data transfer rates in the world with a single transmitter (43 Tb/s) [5].

The transmission of information using one of the quantum characteristics of photons – their "twist" – the orbital angular momentum of photons with respect to their direction of propagation – is currently being studied very intensively. It is currently prospected that in the near future it will allow a virtually unlimited expansion of data transmission bandwidth. It is this property of photons which allows the transmission of information through qubits in a quantum superposition, so an infinite number of states describing arbitrary points in a multidimensional space can be the units of data transfer. A recent experiment proved the reliability of a method even when information is transmitted through the atmosphere. Transfer rate is 4 pixels per second. Given the purpose of the experiment – to show that at large distances the turbulence of the atmosphere in the process of transfer has no significant impact on the reliability of data transmission – it is possible to draw a conclusion about the prospects of this method for the transmission of large amounts of information [6].

Thus, in order to maintain an efficient transmission, filtering and processing of the data received from the radio astronomy facilities, it is necessary to implement innovative technological solutions to significantly increase the speed of data transmission both through the existing communication networks and through the construction of the new channels of communication that will deal with the transfer of extra-large volumes of data while taking the projected rate of growth into account.

References

1. Isaev E. A., Kornilov V. V., Tarasov P. A., Samodurov V. A., Shatskaya M. V. Transmission, storage and processing of large amounts of astronomical data. Preprints. Physical Institute of the PN Lebedev, Russian Academy of Sciences. Series "Preprint". 2014. № 8.
2. The official site of the project LOFAR. URL: http://www.lofar.org/.
3. The official site of the project SKA. URL: http://www.skatelescope.org/.
4. World Record One Petabit per Second Fiber Transmission over 50-km. Официальный сайт NTT Group company. 2012. URL: http://www.ntt.co.jp/news2012/1209e/120920a.html.
5. The official website of the Danish Technical University. URL: http://www.dtu.dk/Nyheder/2014/07/Verdensrekord-i-dataoverfoersel-paa-danske-haender-igen.
6. e-print «Twisted light communication through turbulent air across Vienna».http://arxiv.org/abs/1402.2602.