Recent achievements at Metsähovi Radio Observatory

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Jouko Ritakari[1], Jan Wagner[1], Guifré Molera[1]

[1] ***TKK, Metsähovi Radio Observatory***
Metsähovintie 114, 02540 Kylmälä, Finland
Email: Jouko.Ritakari@tkk.fi

INTRODUCTION

To get good results in radio astronomy we very often have to develop our own equipment. This is a description of such a process and the serendipitous discoveries we made on the way.

HIGH-SPEED DATA ACQUISITION

To get a better signal-to-noise ratio in radio astronomy and especially in very long baseline interferometry the easiest way is to increase bandwidth and data rate. We had already designed our own 512 Mbps recorder six years ago using a normal Linux computer.

This time our design goal was to reach four or even eight Gbps. For feasibility we decided use standard 10-Gbps Ethernet links. Sampled RF data is sent to 10GbE with boards developed by the SETI@home group in UC Berkeley. Together with the UC Berkeley team and Jodrell Bank Observatory in United Kingdom we developed a suitable data acquisition and UDP/IP streaming firmware [1].

After several months of disk recorder testing we have managed to get the recording to work at 4-5 Gbps speeds. These results are documented in a separate paper [2].

HIGH-SPEED DATA TRANSFER

The normal TCP/IP protocol is woefully inadequate for our needs. As a starting point for a much faster protocol we adopted Tsunami UDP developed in the Indiana University, USA. Four years ago we could demonstrate 512 Mbps rates over the plain old Internet.

With our new hardware-based UDP/IP packetizer much higher speeds had become feasible. During a workshop in Shanghai we decided to perform an ad-hoc ultra-fast streaming demo from Metsähovi to Onsala, Sweden. We got permission from the Funet, Sunet and Nordunet networks to fill their 10 Gbps trunk lines with up to 8 Gbps of our data. The same lines were simultaneously handling all the academic traffic between the Nordic countries.

The demonstration was a spectacular success, see Fig. 1.

SCIENTIFIC RESULTS

The new equipment found immediate use in the search for the Kronian water and ESA Venus Express satellite tracking experiments, both by Sergei Pogrebenko et al, Jive, Netherlands. Metsähovi participated in the measurements and in the development of algorithms. A graph of the results is in Fig. 2, they show that it is possible to track a satellite to 100 earth-sun distances even with a small telescope like Metsähovi [3].

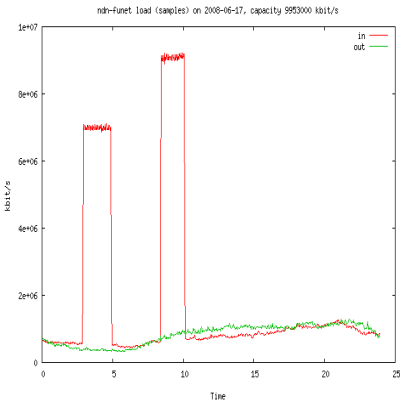

Figure 1: Real-time Internet data streaming at 6 and 8 Gbps using the Metsähovi system. Plots © Nordunet.

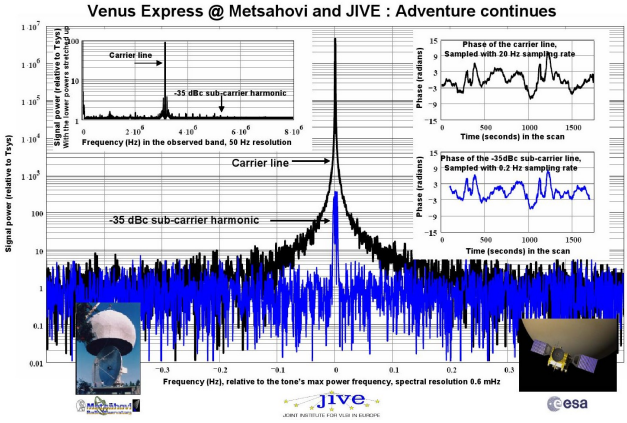

Figure 2: Results of the Metsähovi, JIVE phase-referenced satellite tracking demo allow GPS-like tracking beyond 100 earth-sun distances.

REFERENCES

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