
Publishable JRP Summary Report for JRP SIB 02 (NEAT-FT)

Accurate time/frequency comparison and dissemination through optical telecommunication networks

The aim of the project NEAT-FT is to investigate new techniques for phase-coherent comparison of remotely located optical clocks, separated by distances of up to 1500 km using optical fibre links. Within the scope of the JRP the equipment necessary for reliable operation of fibre links will be developed and all technological steps towards a full optical link infrastructure demonstrated. Beside frequency dissemination, new techniques for time transfer over optical fibre networks will be investigated in order to provide better timing signals than currently available with GPS receivers. For typical spans up to 100 km the JRP aims to improve the accuracy down to about 100 ps. Furthermore, the feasibility of a European fibre network connecting optical clocks in Europe will be studied in close collaborations with potential fibre providers.

NEAT-FT comprises 4 technical workpackages dedicated to frequency (WP 1 & 2) and time transmission (WP 3 & 4) between remote clocks. About 80% of the JRP's total person month and of the total cost are allotted to these 4 workpackages. WP 5 is dedicated to generate impact by establishing close collaboration with the stakeholders. This includes a thorough analysis of the required performance in view of the fibre link capability and possible realisations of such applications with the aim to foster the decision of funding a future European fibre network or of bi-directional connections of selected points of presence.

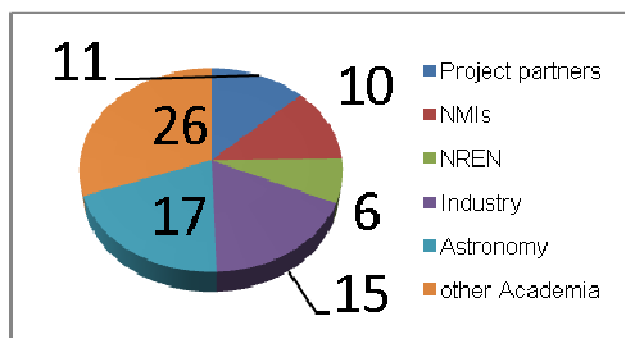
The JRP brings together the long standing expertise of nine leading European National Metrology Institutes (NMI) and one representative (CESNET) from the National Research and Educational Networks (NREN) as unfunded partner to meet the scientific and technical needs for highly stable and accurate reference signals in fundamental physics, GNSS, geodesy, astronomy, and (space-) industry. With the joint activities of the JRP-Partners will provide an alternative to established satellite based T&F methods that allow improvement of clock comparisons at least by one order of magnitude.

Highlights.

- The start date of the JRP was on June 1st 2012.
- Since July 2012 the homepage of NEAT-FT http://www.ptb.de/emrp/neatft_home.html is updated regularly and informs about recent achievements and upcoming events.
- The kick-off meeting was held at PTB/ Berlin on July 18th to 19th 2012. Responsibilities and individual tasks as well as potential candidates for the advisory board and for research excellence grants (REG) have been discussed at the meeting.
- As of November 2012 two organisational REGs have been selected and 42 person months have been allocated to these tasks. With the REG from Akademia Gorniczo-Hutnicza im. Stanislaw Staszica w Krakowie (AGH), Poland, one of the leading institutes in time and frequency in Europe outside the NMI community supports NEAT-FT since November 2012.
- G. Santarelli, former member of LNE-SYRTE, one of Europe's leading scientists on time and frequency transfer over fibres, Prof. Dr. C. Salomon from École Normale Supérieure, Paris, one of the principal investigators of the ACES project, F. L. Hong from the National Metrology Institute of Japan, chairman of the CCTF Working Group on Coordination of the Development of Advanced Time and Frequency Transfer Techniques (WGATFT), and Prof. H. Schuh, a world-wide renowned scientist on Very Long Baseline Interferometry and geodesy have agreed to act as members of the board.
- As part of the workpackage IMPACT (WP5) NEAT-FT has organized a workshop for stakeholders interested in advanced Time & Frequency transfer. This workshop was mainly organized by VSL and

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was held in Hoofddorp, The Netherlands, on November, 20. -21. 2012. The aim of the workshop was to create impact for the European time and frequency metrology, to analyse present needs, to identify potential future applications and to draw up the required performance of remote fibre links. We have invited about 200 individuals from industry, science and network services from all over the world. For the workshop 85 participants signed up. Participants started early on discussing their needs and the



unique possibilities of optical fibre links in two poster sessions, during lunch and dinner time. Thus a direct contact between the JRP-Consortium and the main stakeholders is now established. The distribution of participants is shown in figure 1.

Figure 1: Workshop participants, demonstrating the interest and need for accurate time and frequency distribution.

- As of November 2012 members of the consortium attended several meetings with representatives of National Research and Educational Networks (NREN) and the European fibre network GEANT. Finally, attending the GN3 Project Symposium in Vienna prepared the ground for support of NEAT-FT from GEANT and DANTE representatives. DANTE and NEAT-FT are currently discussing potential fibre routes between major GEANT PoPs. Some of these routes might become available for scientific use within the lifetime of NEAT-FT. In view of an envisaged support from GEANT/DANTE we will discuss the possibility of a direct link between London and Paris within the project life time.
- The Italian project LIFT for establishing an optical network for time and frequency has started in November 2012. LIFT will connect INRIM in Torino with LENS in Firenze via Milano and the Radio-astronomical Center in Bologna (see figure 2) and has as a guaranteed lifetime of 3 years. Including LIFT six fibre links are now available to the consortium.



Figure 2: Topology of LIFT, the Italian fibre link project.

The results of the JRP will enable NMIs to perform better clock comparisons within Europe, and to disseminate highly accurate and stable frequency and timing signals to the user community for groundbreaking science and innovation. Some members of the potential user community are already included in the list of collaborating institutes.

JRP start date and duration:	June 2012, 36 month
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JRP-Partner 4 MIKES, Finland	JRP-Partner 9 VSL, Netherlands
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