

CLONETS – Clock Network Services

Strategy and innovation for clock services over optical-fibre networks

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ABSTRACT

Methods for long-distance time and frequency transfer over optical fibres have demonstrated excellent performances and are evolving rapidly. CLONETS is a new European Union-funded coordination and support action intended to accelerate the transfer of these technologies to industry and to strengthen the coordination between research infrastructures and research and education network providers, in order to prepare the deployment of this technology for a sustainable, pan-European fibre network, providing high-performance clock services for European research infrastructures and supporting wider services for industry and society.

Keywords: optical fibre, network, clock, time, dissemination, metrological, service.

1. INTRODUCTION

As is well-known, long-distance time and frequency transfer methods based on optical fibre links have evolved rapidly in recent years, demonstrating excellent performance for frequency transfer and considerable promise for

accurate time transfer. They are attractive both for very high-performance applications such as optical clock comparisons, and for many industrial and societal applications, as an alternative and complement to radio- and satellite-based methods.

Such high-performance links have been developed and are operating in several countries in Europe, including a small number of cross-border connections. These developments have attracted a wide range of financial support, at both national and European Union levels, for example through the European metrology research programmes EMRP and EMPIR. Nevertheless, the high cost of optical fibre rental can be a challenge to the perennality of these links.

CLONETS is a new, European Union-funded project which aims to prepare the transition from the present situation toward a permanent, pan-European, optical fibre-based network providing time and frequency comparisons and distribution at the highest performance levels for research infrastructures, as well as support to a wide range of services for industry and society.

2. CLONETS ACTIVITIES AND OBJECTIVES

CLONETS brings together a diversified group of actors: National Metrology Institutes (NMIs), academic research groups, National Research and Education Network providers (NRENs), an internet exchange and small and medium-sized high-technology companies. Although it does not, for practical reasons, include the totality of the leading European contributors, its participants concentrate a very wide range of expertise and activities in this area.

CLONETS is a coordination and support action, whose function is to identify scenarios and prepare strategies for future optical fibre-based metrological network for precise time and frequency dissemination networks. Its main objectives may be summarized as follows:

- a) collect information on future needs of research infrastructures and on key optical fibre telecommunications and time and frequency transfer technologies expected to have a growing impact;
- b) study industrial and societal applications beyond research infrastructures, identifying stakeholders and their needs and estimating the potential economic and societal impacts of possible developments;
- c) define strategies to support future work, including scenarios for the implementation and management of a core pan-European network and roadmaps for the industrial transfer of the corresponding technology and the development of new commercial products to support the network;
- d) contribute to the training of highly-skilled specialists needed to support these developments and to the policy processes necessary for their realisation;
- e) study the possible contractual and commercial arrangements necessary for the running of such services.

CLONETS will consult widely among research infrastructures including NMIs, and industrial and societal user groups, in order to anticipate the future needs and opportunities for optical fibre-based time and frequency distribution.

CLONETS is an action under the Horizon 2020 European Research Infrastructures work programme. As such it is anticipated that its findings and propositions feed into later stages of this work programme and lead to further EU-supported actions, with the aim of implementing a pan-European optical fibre time and frequency network.

Further below we describe the work plan of CLONETS briefly, in particular the community consultation stage to be carried out during 2017.

CLONETS work plan is composed of 3 groups of Work packages:

WP1-3 deal with reviews of research infrastructure needed for time and frequency (TF) services, and available technologies and NRENs' practises (WP1), the development of a global vision for TF services over fibre in Europe leading to necessary pan-European roadmaps and deployment strategy (WP2) and other applications and markets utilizing TF transmissions over fibre (WP3).

WP4 concerns Impact, training and dissemination.

WP5 concerns Management and reporting.

WP1 (Definition of key technologies and trends) aims at collecting information from research infrastructures, NRENs and the TF community as input for the formulation of roadmaps (WP2), specifically to review current and future needs of research infrastructures including NMIs for precise and accurate TF transfer at the level (preferably better than) that delivered by e.g. GNSS or H masers. It also focuses on reviewing the state-of-the-art and future prospects of fibre-bound TF transfer techniques with regard to service quality and functionality, technical and operational requirements and technology readiness level. There is also being compiled an overview of fibre communication technologies currently deployed or projected by NRENs with sufficient technical and

operational detail to consider their compatibility with TF transfer techniques. Emerging fibre-optic transport technologies are being reviewed regarding their compatibility with TF transfer.

WP1 and WP3 run parallel before WP2 (Definition of technology development roadmaps and strategic agenda) starts to create essential input for it. The WP2 defines the architecture and identify the technology needed to create the TF service delivery system in Europe. It is also produce roadmaps for the industrial development of the technology, which must be deployed to create an operational TF service delivery system

Within WP3 (Identification of additional applications and markets) preliminary list of TF service categories and needs survey questions have been discussed and suggested amongst the project partners, and finalized within Deliverable D3.1. It represents an introduction to next step – the survey of needs of public, research, government and commercial subjects aimed at identification of possible users and stakeholders for TF services. TF optical service categories for users beyond research infrastructure were identified according to several criteria e.g. required accuracy/uncertainty and stability. Such specific service categories are: frequency transfer for distribution/comparison of optical clocks, distribution of TF from NMIs with performance not degrading parameters of Caesium clocks or Hydrogen maser, time transfer between NMIs for comparison of time scales, TF service with performance not worse than GNSS (i.e. GNSS alternative/replacement), TF service in a large optical network (with possible deployment of special network components) and time transfer with uncertainty better than NTP.

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