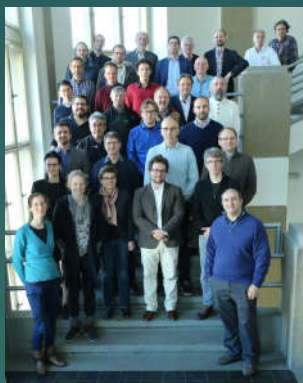


The H2020 European Project CLONETS: clock services over optical-fibre networks in Europe



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WP1: Definition of key technologies from RESEARCH INFRASTRUCTURES, NRENs and the TF community as input for the formulation of roadmaps.

WP3: Identification of additional applications and MARKETS utilizing TF transmissions over fibre.

INPUTS from Research oriented T/F users

INPUTS from Market oriented T/F users

WP2: Definition of technology development roadmaps and strategic agenda, developing of a global vision for TF services over fibre in Europe leading to necessary pan-European roadmaps and deployment strategies.

WP4: Impact, training and dissemination.

Coordinator
<http://www.clonets.eu>

Participants

- Observatoire de SYRTE
- INRIM
- PTB
- NPL
- RENATER
- CESNET
- PSNC
- LPL
- MenloSystems
- PIK TIME SYSTEMS
- ISI CAS
- SEVEN Solutions
- OPTOKON
- AGH
- UCL
- Third Parties
- CIRFS
- top
- GARR

D1.1: High precision T/F needs of research infrastructures

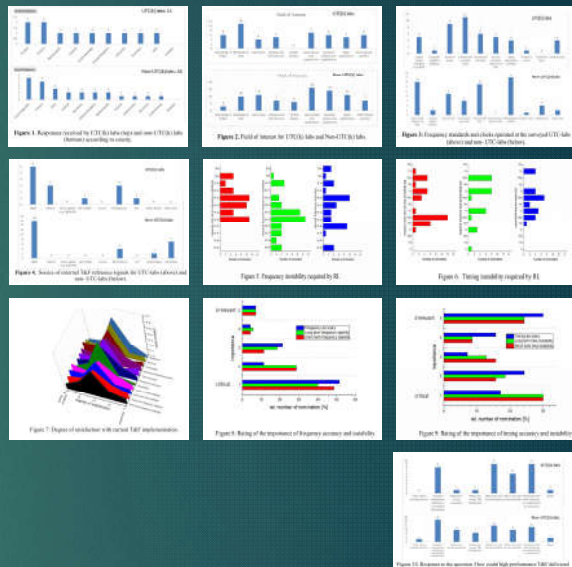


The survey has revealed that

- Applications requiring highest-performance **frequency accuracy and instability** prevail upon those requiring **precise timing**.
- Receiving time is still based on satellite techniques. However, the most demanding timing applications already require an instability only met by dissemination through optical fibres.
- A clear view and ranking of the importance of traceability to the SI, the availability of T&F signals at a remote location, the resilience of such signals and issues related to security.
- The availability of a fibre based T&F service is of highest importance for UTC labs as well as for non-UTC labs.
- Traceability is considered important, but not regarded as problematic by non-UTC labs.
- Resilience attracted significantly more consideration than security.

Overall, the results of the survey support the CLONETS consortium's current understanding of the relevance of high precision T/F reference signals for RIs.

The communities that believe to benefit most from a fibre based T&F service: radio-astronomy, geodesy, accelerator- and spectroscopy- laboratories, calibration laboratories and potentially space agencies.



D1.5 Fiber T/F Techniques Survey



fiber noise suppression scheme	communication link type	distance	performance (approx.) (ADEV, TDEV, uncertainty)	TRE
CW OPTICAL CARRIER	active cancellation	> 1000 km	10 ⁻¹⁸ @1s; 10 ⁻¹⁶ @1d	6-7
	two-way comparison	50...100 km	10 ⁻¹⁷ @1s; 10 ⁻¹⁷ @1d	5-6
OPTICAL FREQUENCY COMB	active cancellation	50...150 km	TDEV 500 fs@1s	4-5
	RF CARRIER			
active cancellation with optical delays	bi-directional dark fiber	< 100 km	10 ⁻¹⁸ @1s; 10 ⁻¹⁷ @1d	5-6
active cancellation with electronic delays (ELSIAB)	bi-directional dark fiber	> 600 km	10 ⁻¹⁸ @1s; 10 ⁻¹⁷ @1d	7-8
TIME	phase conjugation	100...150 km	10 ⁻¹⁸ @1 day for old DWDM	7-8
	two-way comparison		10 ⁻¹⁸ @1 day for coherent DWDM	5-6
optical frequency comb	bi-directional dark fiber or channel	~600 km	TDEV ~2 ps	6-7
	uni-directional DWDM channel	~500 km	TDEV ~30 ps	6-7
active cancellation with electronic delays (ELSIAB)	bi-directional dark fiber	> 100 km	calibration uncertainty < 40 ps	4-5
	bi-directional dark fiber	> 600 km	TDEV < 1 ps	7-8
protocol-based (White Rabbit PTP)	uni-directional DWDM channel	> 1000 km	5x10 ⁻¹⁸ @1s Accuracy < 40 ps	7-8
	bi-directional dark fiber	40...80 km	calibration uncertainty < 10 ns	7-8

D4.2 Training Blueprint



Training blueprint

- Organised by technical level (Entry - Advanced).
- Target audience as follows:

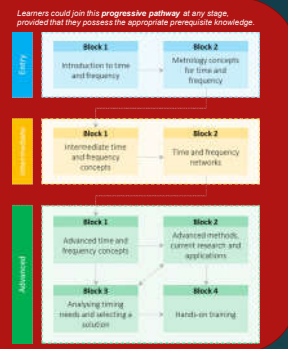
Entry - General audience, policy makers, those who need a foundational knowledge of time, frequency and dissemination practices.

Intermediate - Industry professionals/end users/researchers moving into time and frequency; Industry/academic non-specialists new to time and frequency.

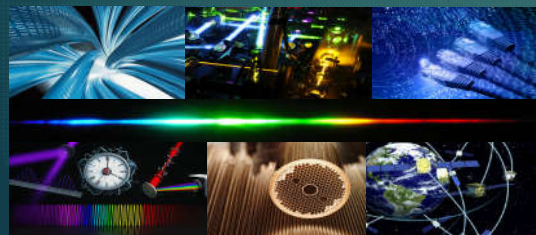
Advanced - Industry professionals/researchers working in the time and frequency domain seeking to gain specific advanced-level knowledge or practical know-how.

Content within each technical level

- Organised into blocks.
- Blocks group related concepts.
- Subsequent block building on previous blocks.
- Progressive learning pathway.



D4.5 2nd level Specializing Master's Programme in PHOTONICS FOR DATA NETWORKS AND METROLOGY



Data traffic will experience a dramatic growth over the next years driven by 5G access, high-definition video, virtual and augmented-reality contents, and the considerable growth in cloud services due to Big Data Exchange. Photonic data networks will be required to be more and more pervasive and elastic, to supporting the paradigm of Internet of Things and to enabling Industry 4.0. Besides data transport, photonic networks will also distribute time and frequency (T/F) standards for research and industry, enabling orders of magnitude performance improvements with respect to satellite systems, over continental geographical areas. The list of institutions supporting the initiative testifies the need for a vertical multidisciplinary knowledge, from the transmission layer up to the IP layer, and training such new professional figures is indeed the mission of the 2nd level Specializing Master's Programme. The Programme is supported by the EU through the project H2020-INERAINNOV-CLONETS, and will offer theoretical and practical lecturing, hand-on experiences and a final internship in European industrial and/or research environments.

Deadline: May 7th 2018 (11:59 a.m.)
 Participation fee: € 4,000
 Campus: Politecnico - Lingotto, Turin
 Format: full time
 Language: English
 ECTS: 60

Internship: at companies and/or research institutes in the photonic technologies field
 Number of participants: min 10 – max 25

<https://didattica.polito.it/master/photronics/2019/apply>



- COURSES**
- Digital Communication
 - Optical Transmission
 - Photonic Devices
 - Time and frequency metrology
 - Ultra broadband access network
 - Long-haul optical transport
 - Photonic Networks
 - Quantum Communications
 - Photonics applications in metrology
 - Time and frequency laboratory
 - Security for ICT
 - Communications laboratory
 - INTERNSHIP



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