CGSIC Timing Subcommittee Report

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(presented by Dr Jerzy Nawrocki)

AREAS BEING SERVED

- Coordinated Universal Time (UTC)
- International Timing Centers
- Global Navigation Satellite Systems
- Telecommunications Industries
- Two-Way Satellite Time Transfer (TWSTFT)
- Two-Way Optical Fiber Time Transfer (TWOTFT)
- Power Grids and other Industries
- As Research and Comparison Tool
- Other

CGSIC Timing Subcommittee
on 25 September 2017
Chair: Dr. Włodzimierz Lewandowski, Polish Central Office of Measures
Co-Chair: Mr. Michael Lombardi, National Institute of Standards and Technology

9:00 Introduction – Dr. Włodzimierz Lewandowski, GUM
9:10 Report from the National Institute of Standards and Technology (NIST) - Dr. Stefania Romisch, NIST
9:35 Report from the United States Naval Observatory (USNO) – Mr. Stephen Mitchell, USNO
10:00 Report from the Naval Research Laboratory (NRL) - Ms. Francine Vannicola, NRL
10:20 Break
10:40 Report from the John Hopkins Applied Physics Laboratory (APL) – Ms. Erika Sanchez, APL
11:00 State of the Art GPS Timing Applications – Mr. Said Jackson, Jackson Labs Technologies, Inc.
11:20 Robust GNSS Receivers for Ultra-Precise Time Frequency Transfer – Mr. Mo Kapila, Septentrio, Inc.
11:40 Traceability and GPS Timing Signals – Dr. Demetrios Matsakis, USNO
12:00 Group Discussion
12:30 Session End

Some topics

- BIPM Rapid Service UTCr
- Fiber optic time transfer
- Optical atomic clocks
- 2017 CCTF Meeting

BIPM Rapid Sevice UTCr

- **Based on daily data reported (daily) by contributing laboratories**
- **Weekly access to daily values of [*UTCr-UTC*(*k*)]**
- **Automatically generated weekly solution over four weeks of data (sliding solution)**

Oncoming Optical Fibre - TWOTFT

- Long-term goal: Compare the optical clocks ~10^{-18}@day
- More than 14 UTC laboratories actively involved
- Already operational UTC(AOS)-UTC(PL) by AGH
- Immediate Applications in UTC:
  - Validate the BIPM GNSS calibrator with u_B ~ 200 ps
  - Validate the new GNSS and TW**S**TFT techniques
- **New challenges**
  - the theoretical issues
  - the practical issues: data processing, format, programs …

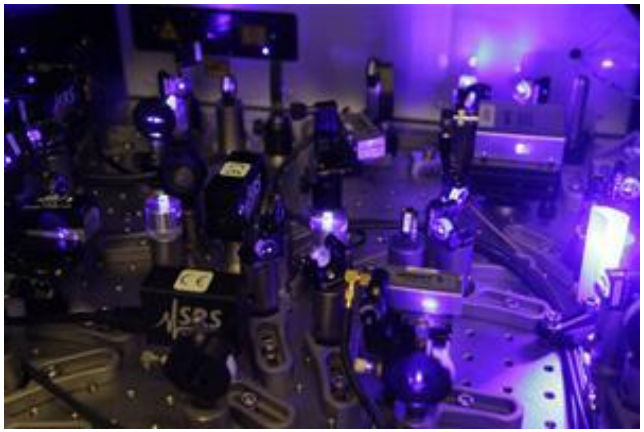
Optical Fiber Links: realized long hauls

Location	Length	Performance (*)
Check Rep/Austria	550 km	TT, evaluating accuracy 30 ps/20s
China	50 km	FT $20\times10^{-15}/\tau$
Finland	900 km	TT 1 ns
France-Germany	1400 km	FT $1\times10^{-16}/\tau$
France-UK	800 km	FT $\times10^{-15}/\tau$
Italy	1284 km	FT $0.2\times10^{-15}/\tau$
Japan	120 km	FT $0.8\times10^{-15}/\tau$
Poland	800 km	TT 70 ps - FT $35\times10^{-15}/\tau$

(*) accuracy for Time Transfer (TT)
Allan deviation for frequency Transfer (FT), extrapolated to 100 km (scaling law L3/2).
[*adapted from D. Calonico et al., European Phys Lett, 110 40001 (2015)*]

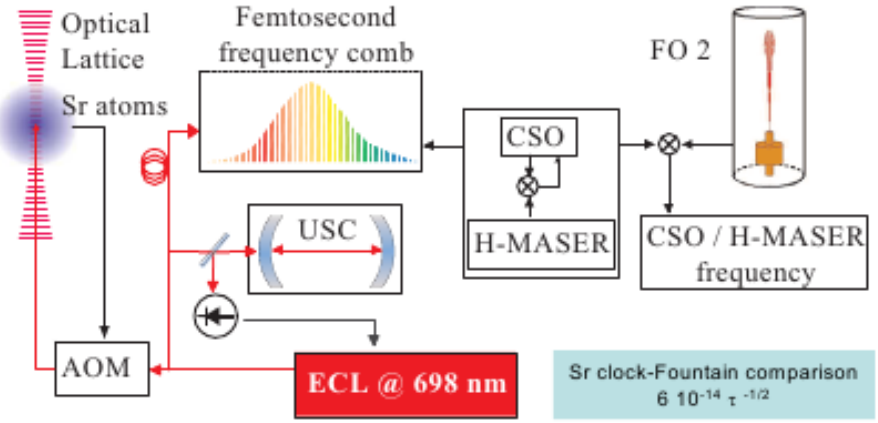
Polish Optical Clock - FAMO

National Laboratory of Atomic, Molecular and Optical Physics



A system of two independent strontium optical lattice clocks.
The system consists of two atomic standards interrogated by a shared ultra-narrow laser, pre-stabilised to a high-Q optical cavity and an optical frequency comb

Expected future stability
~10^{-18}



21st Meeting of the
Consultative Committee for Time and Frequency
BIPM, 8-9 June 2017

Recommendations

Four CCTF 2017 RECOMMENDATIONS

- on recommended frequency standard values for applications including the practical realisation of the metre and secondary representations of the second

- on improving Two-Way Satellite Time and Frequency Transfer (TWSTFT) for UTC Generation

- on the utilization and monitoring of redundant time transfer equipment in the timing laboratories contributing to UTC

- on the definition of time-scales TAI and UTC

Thank you !