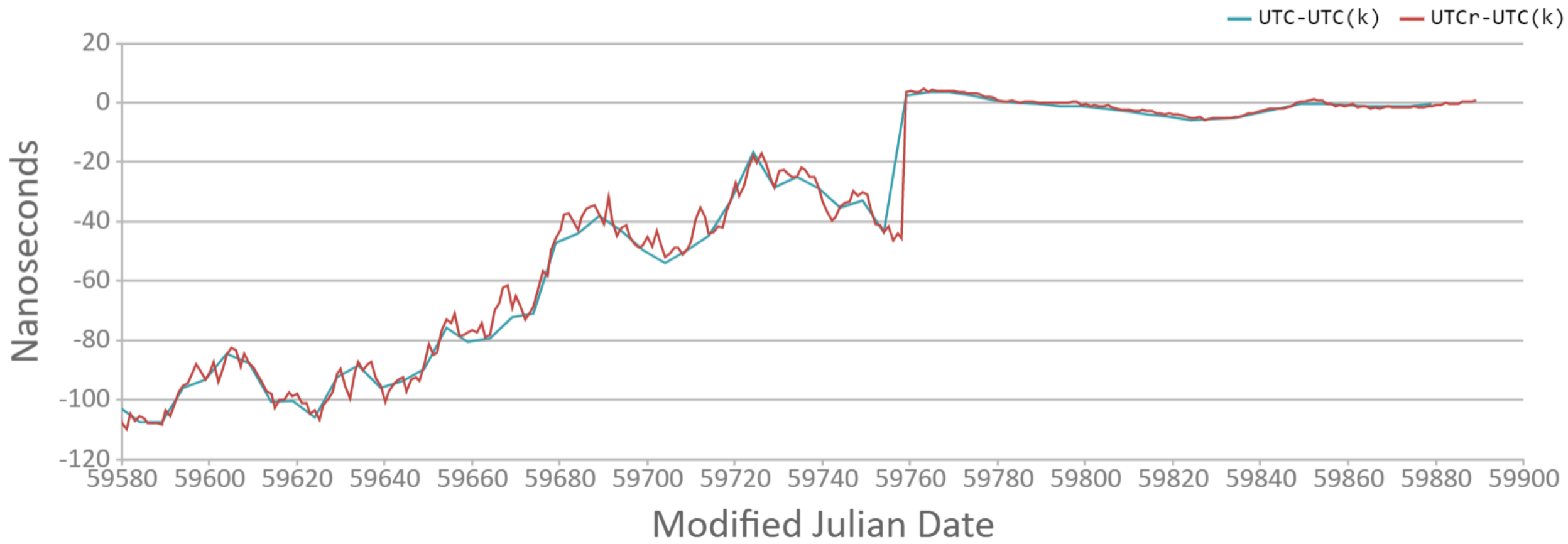# Topics for master degree projects at Justervesenet's timing lab

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Justervesenet

National timing lab

- Contributes clocks to UTC

- Generates UTC(JV)
  < 10 ns offset from UTC

- RnD: Secure network timing
  - NTP
  - PTP/PTP White Rabbit
  - Digital Substation
  (Statnett)

- RnD: GNSS-interference
  detection and resilience
  against jamming and
  spoofing.
  (Norsk romsenter, FFI)

- RnD: High accuracy GNSS
  timing services (Fugro)

https://www.linkedin.com/posts/harald-hauglin-3140a610_clocks-contributing-to-taiutc-during-2020-activity-6776892563841404928-mqrY/
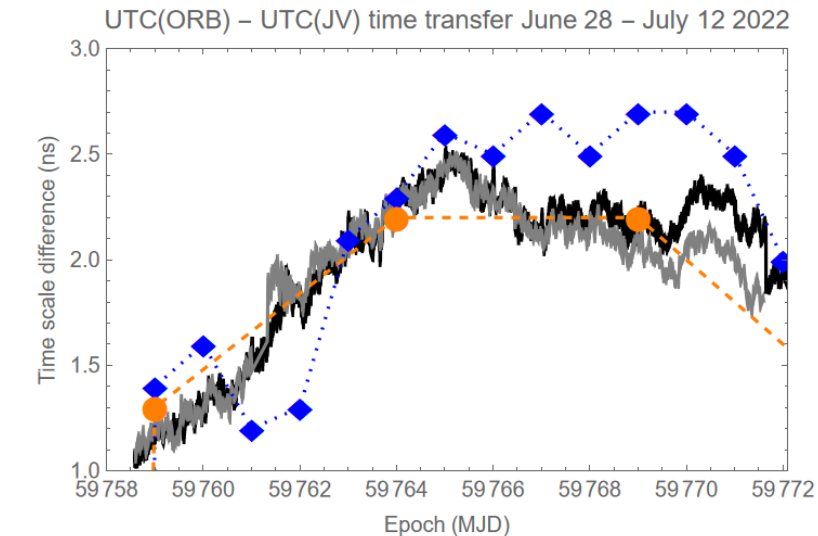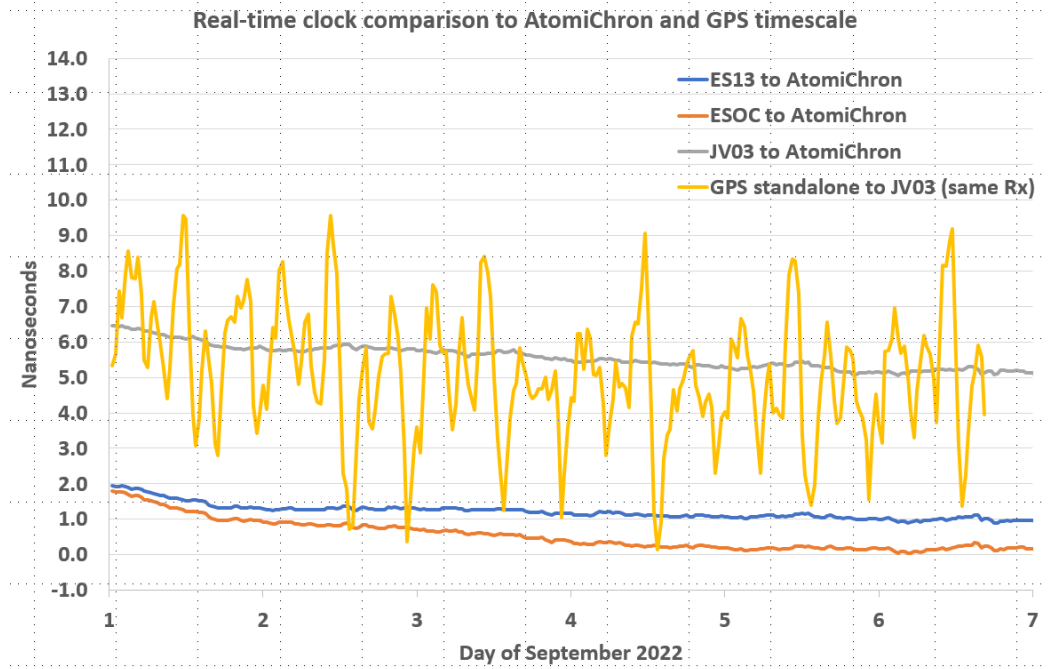
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Improvements in UTC(JV) during 2022 – long term goal << 10 ns offset

UTC-UTC(JV)

https://webtai.bipm.org/database/canvas.html?lab=JV&utclab=ok&utcrlab=ok&mjd1=59580&mjd2=59900

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Potential topics in high accuracy GNSS timing – in collaboration with Fugro

Real-time clock comparison to AtomiChron and GPS timescale

- ES13 to AtomiChron
- ESOC to AtomiChron
- JV03 to AtomiChron
- GPS standalone to JV03 (same Rx)

UTC(ORB) – UTC(JV) time transfer June 28 – July 12 2022

- BIPM post processed PPP orb – jv02 (latency > 10 d)
- Fugro real time PPP brux – jv03 (latency < 1 s) 11.0 ns fixed offset added
- UTC(ORB) – UTC(JV) via UTCr (latency > 3 d)
- UTC(ORB) – UTC(JV) via Circular T (latency > 10 d)

- Fugro realtime PPP timing service AtomiChron launched november 2022

- Orders of magnitude improved stability/precision over stand-alone state-of-the art GNSS timing

- Calibration of delays and exploration of systematics is a challenge to exploit full sub-ns potential of real time PPP

- Unexplored potential for use cases of distributed sub-ns timing:
  - Sensor systems
  - Radar
  - ….

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Potential topics in high accuracy GNSS timing – in collaboration with Fugro

- Use of AtomiChron for real time steering of clocks and monitoring of long term accuracy against UTC
  - Steering of local clock (OCXO x-tal oscillator and/or passive H-maser) using data from Atomichron
  - Measurements of stability and accuracy relative to UTC(JV)/UTC

- Use of GNSS simulator to calibrate GNSS timing reception chains (antenna, cabel, GNSS receiver)
  - Anechoic chamber
  - Orolia Skydel simulator (https://orolia.com/manuals/skydel/index.html)
  - Characterization of systematic changes in delays due to temperature/humidity etc

- Open to other suggestions for application of sub-ns timing

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Potential topics in GNSS interference – jamming and spoofing

- Generation of simulated spoofing and jamming scenarios
    - Orolia Skydel using advanced jamming/spoofing (https://orolia.com/manuals/skydel/index.html)
    - Tests of different kinds of GNSS devices (stationary timing, mobile navigation, …)
    - Tests and comparisons of different interference detection and authentication mechanisms:
        - Galileo OSNMA
        - Fugro AtomiChron nav data autenthication
        - Other analysis of GNSS observation data
        - ....
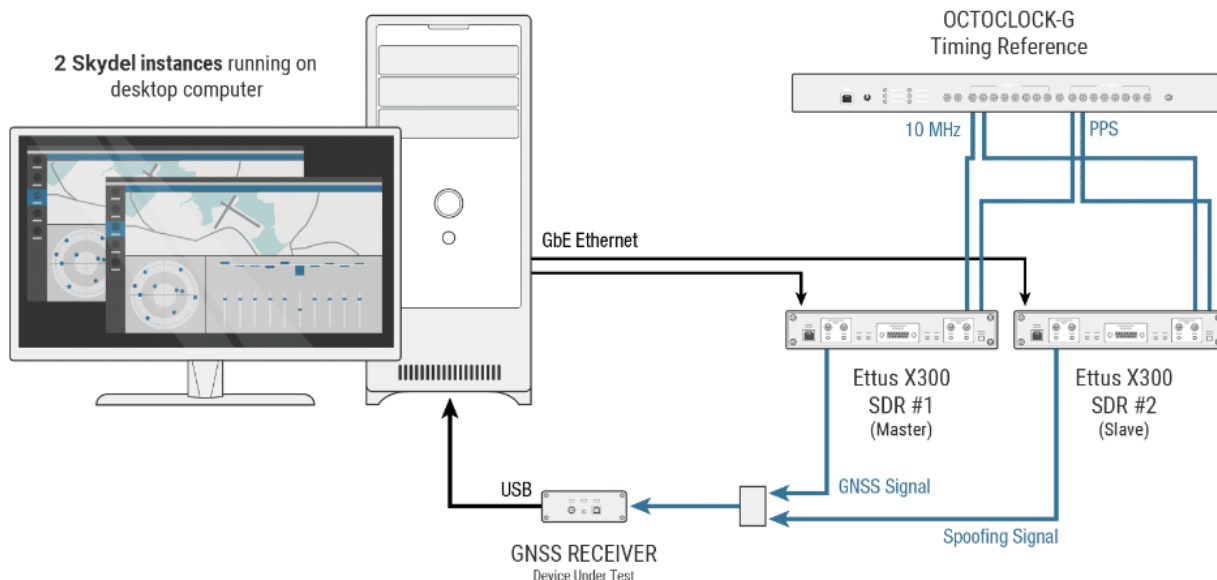
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More information, other suggestions, lab tour?

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