

RADIO ALTIMETER INTERFERENCE IN APPROACH

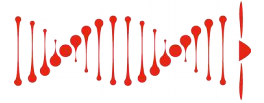
ICAO Frequency Spectrum Management Panel (FSMP)
Eleventh Working Group meeting (WG11)
Web meeting: 1 – 12 March 2021

Agenda item 3: RadAlt and WAIC issues
Information Paper 06 (IP06)

Josep Giné – ATR / Radio $f(x)$

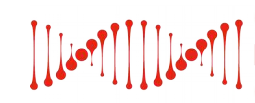
Ref EYA 3177/20 – v 0.15





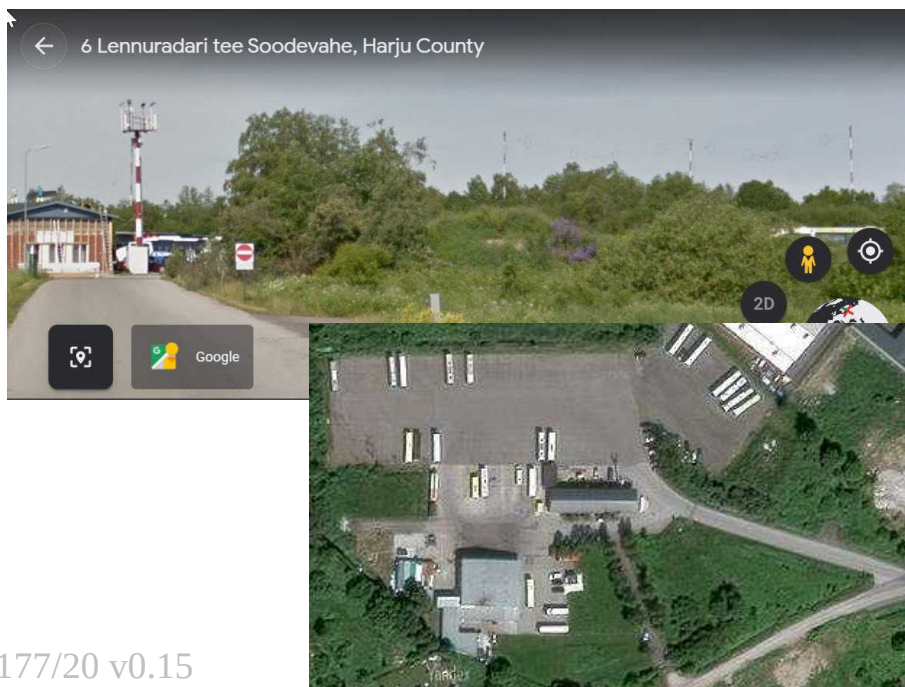
- **Context**
 - Erroneous Radio Altimeter indication when in approach on a regional aircraft fleet
 - Airworthiness certified Radio Altimeter
 - Finland (Helsinki), Estonia (Tallinn), Sweden (Visby)
- **Initial investigation**
 - **Radio Altimeter**
 - Checked equipment operational reliability with Radio Altimeter supplier
 - Stable removal rate on worldwide fleet along the last 5 years
 - No deviations to certified design found on repairs leading to an erroneous indication condition
 - **Factual analysis on 20 flight recorded occurrences**
 - Indication > true radioaltitude (positive bias)
 - Disturbance ^ shaped lasting ~ 4..6 s (typical at usual final approach speed)
 - Final approach (typically h < 1000 ft Above Ground Level (AGL))
 - Concentrated at very specific locations along the approach (deterministic pattern)
- **How are these disturbed radioaltimeter locations related to licenced radio sources ?**

Identified radio sources along EETN 26 approach



Location # 1 - P1

- Operator : Elisa
 - Bus parking (6, Lennuradari tee)
 - (59.413°N, 24.897°E)
- Mobile technology : 3G & 4G
- Bands : (800, 900, 2100) MHz



Location # 2 - P2

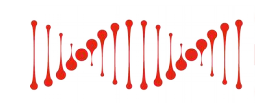
- Operators : Telia & Tele2
 - Coop Logistikakeskus building
 - (59.416°N, 24.886°E)
- Mobile technology : 3G & 4G
- Bands : (800, 900, 1800, 2100) MHz



Mobile station & aeronautical radio sources : see details on Annex#2

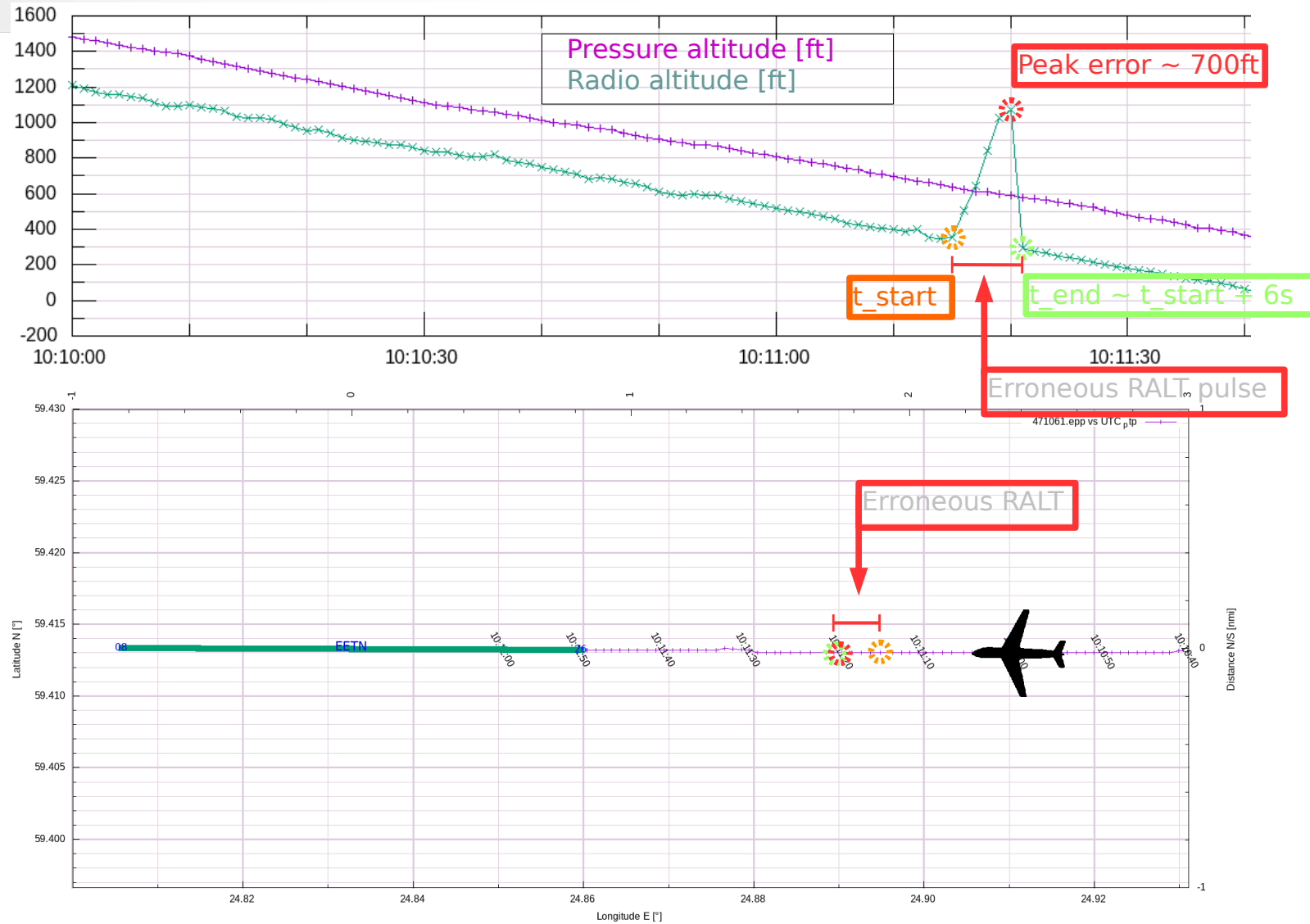
Image credits: Location#1 : Google, Yandex
Location#2 : Coop Logistikakeskus, Tasstuvenergia

Location of radio sources along EETN 26 approach



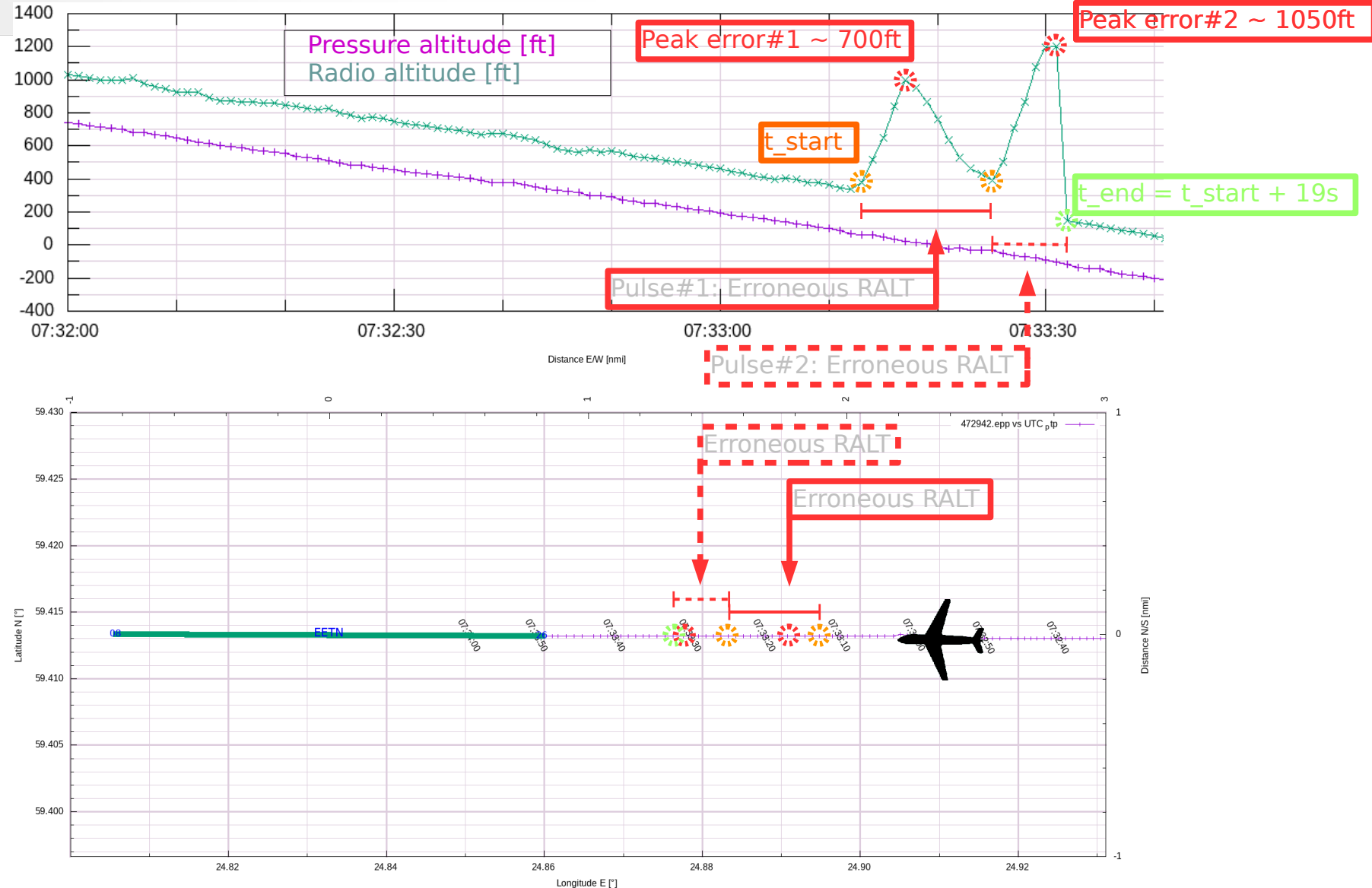
Typical occurrence @ EETN 26

median values (n=10 occurrences) → See full dataset on Annex#1

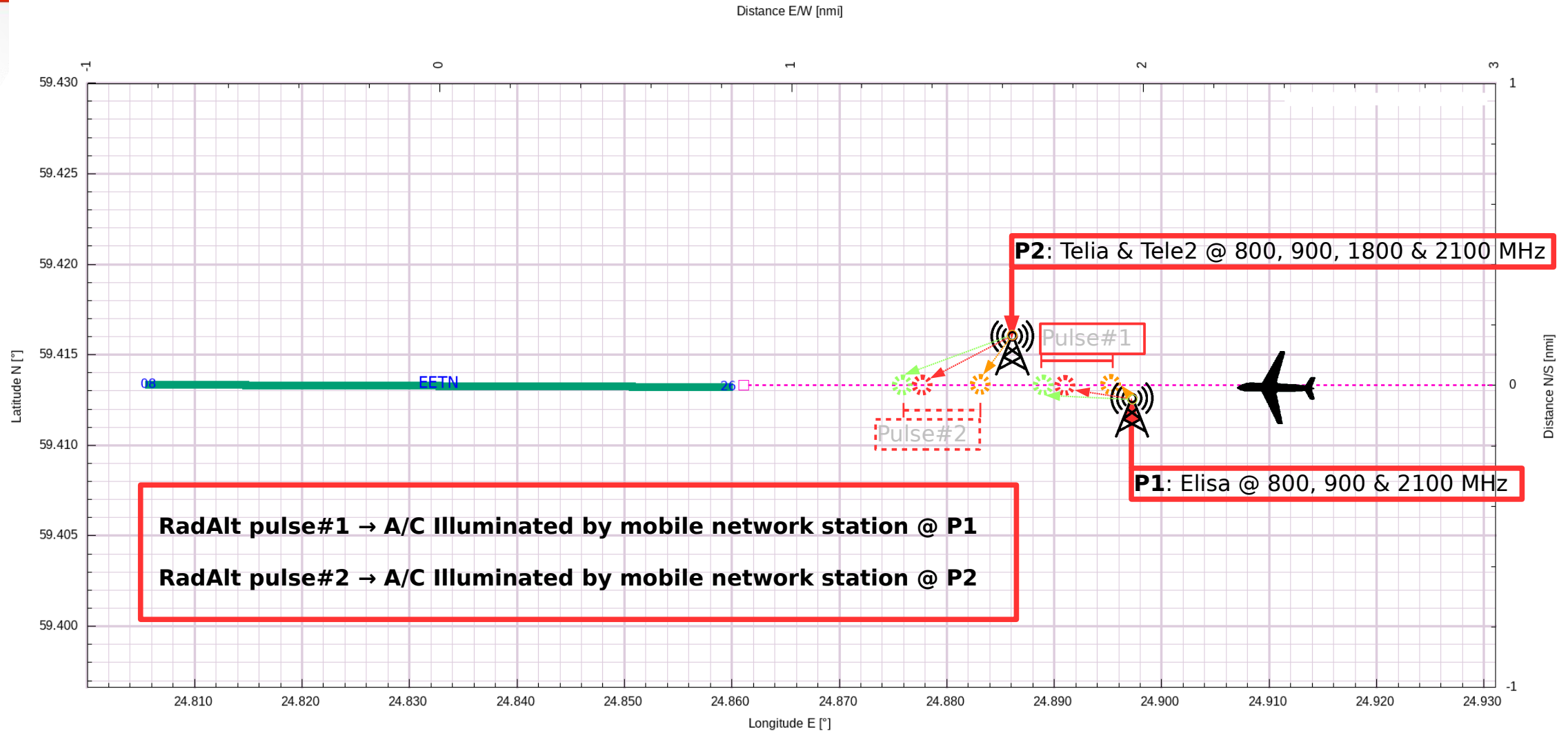
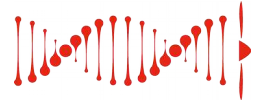


Worst occurrence : dual pulse @ EETN 26

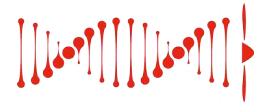
max values (n=10 occurrences) → See full dataset on Annex#1



Systematic correlation occurrences ↔ mobile networks



Concluding remarks



- **Facts**

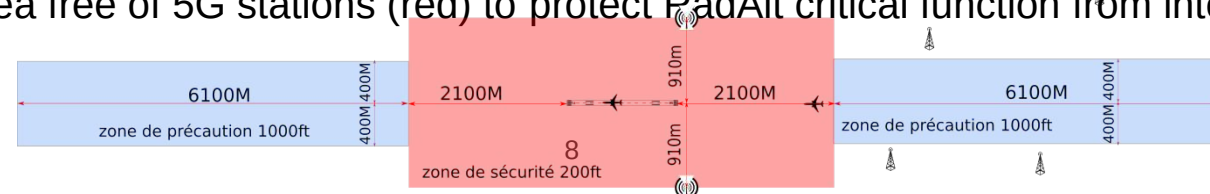
- All these occurrences are linked to licenced 3G/4G mobile networks stations close to final approach area

- **Causes**

- Drastical spectrum usage changes since first airworthy radio altimeter specification (FAA TSO C87 dated 1966)
- RF susceptibility when RadAlt is exposed to a crowded spectrum environment (> 2300 cases since 2017)
- No interference mitigation strategies implemented around aerodromes (e.g. Δ distance \rightarrow interference isolation)

- **Mobile networks/5G/RadAlt coexistence considerations**

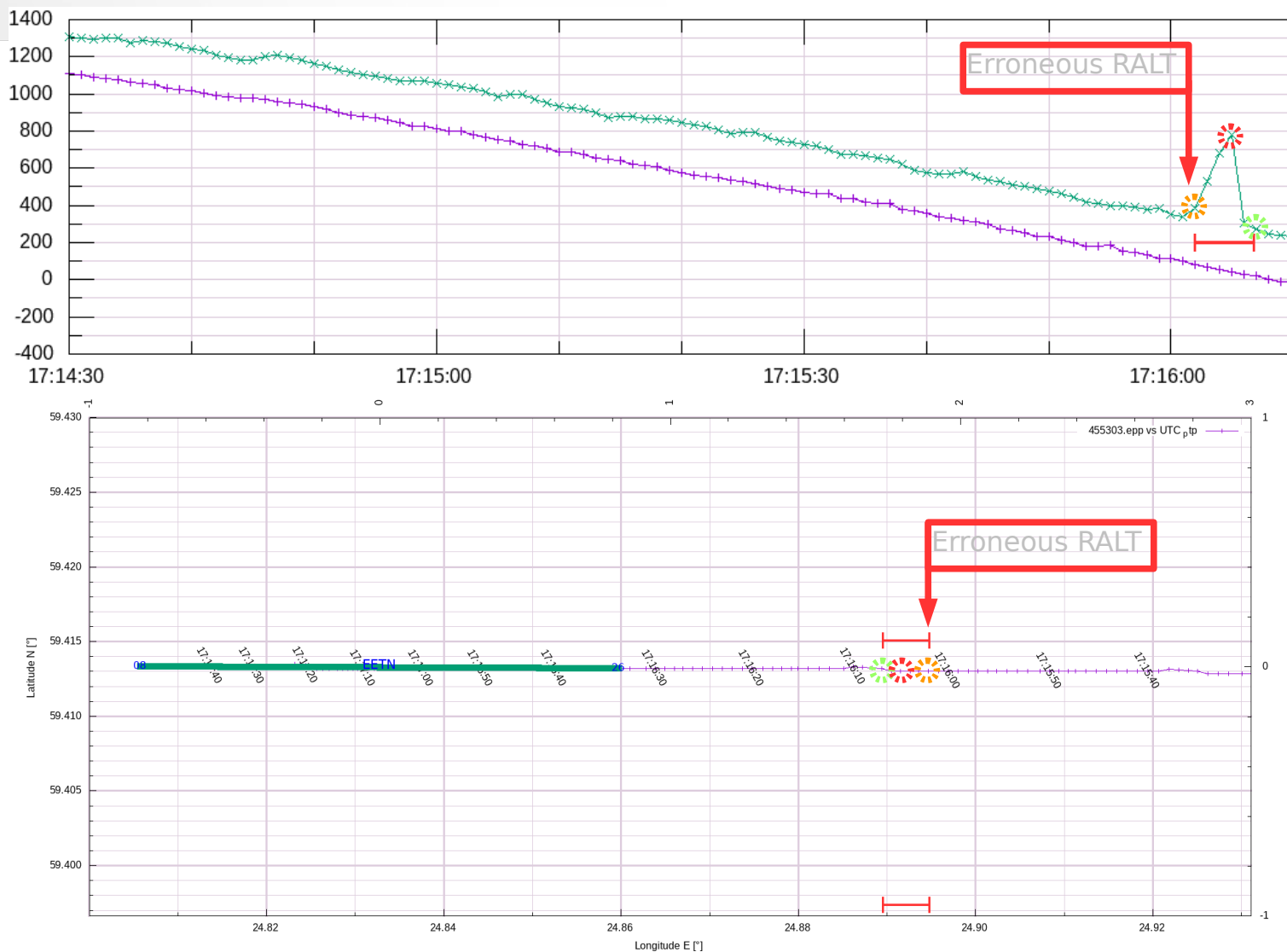
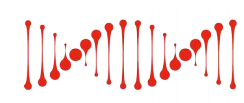
- Need to improve awareness of these issues by Spectrum Management / National Aviation Authorities (NAAs)
 - 3G/4G/(5G) mobile network stations proliferation around aerodromes
 - Airworthiness certification of new RadAlt robust to 3G/4G/5G is long and costly (> 3 years dev + > 5 retrofit)
 - Approximately 1200 units of this same radio altimeter type are estimated in operation today
- What could we done in the short & mid term horizon (next 2-3 years) for a better coexistence?
 - Aerodrome mitigation actions are necessary to protect RadAlt safety of life function
 - Interim France 5G policy implemented by DGAC FR & Spectrum Management (ANFR) authorities:
 - Safe area free of 5G stations (red) to protect RadAlt critical function from interference

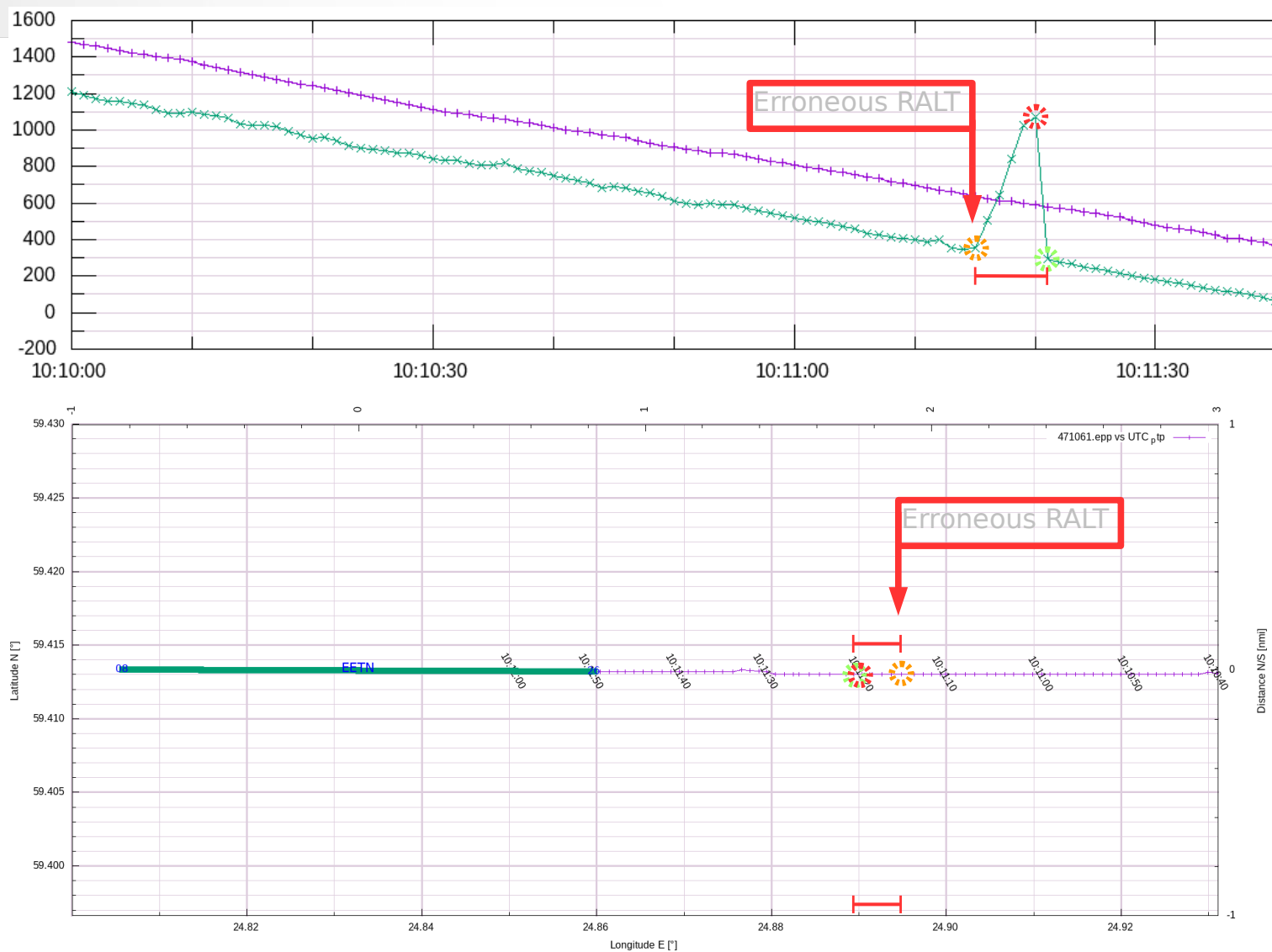
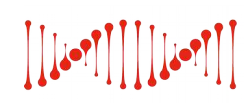


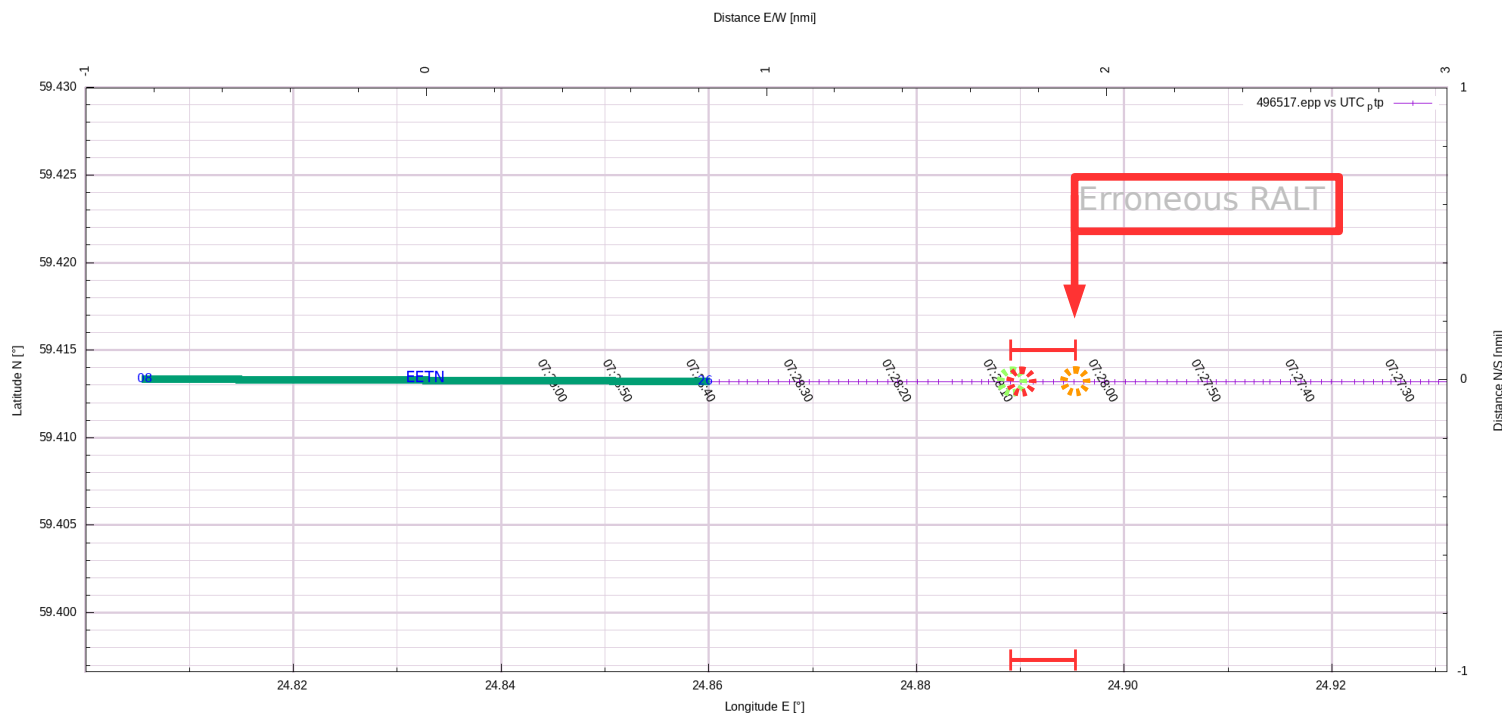
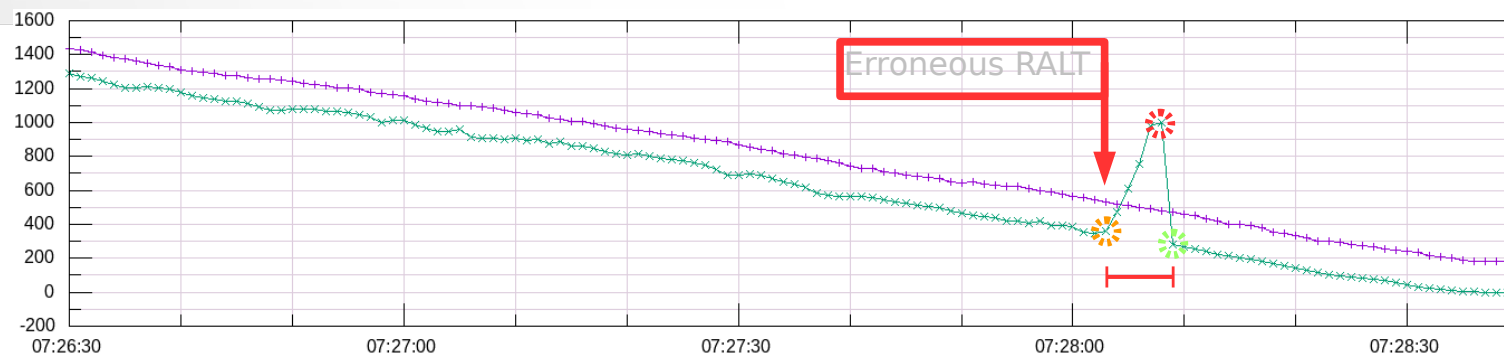
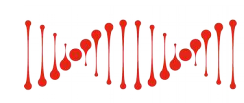


Annex#1

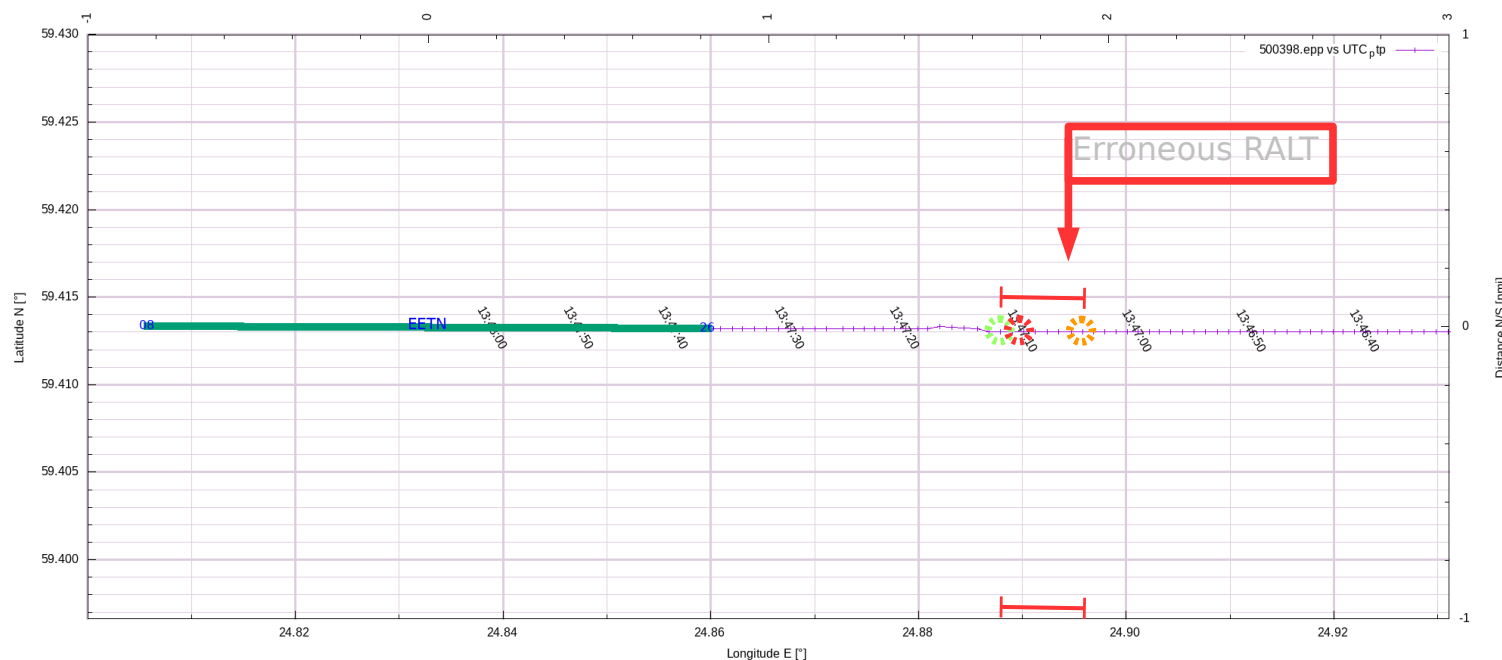
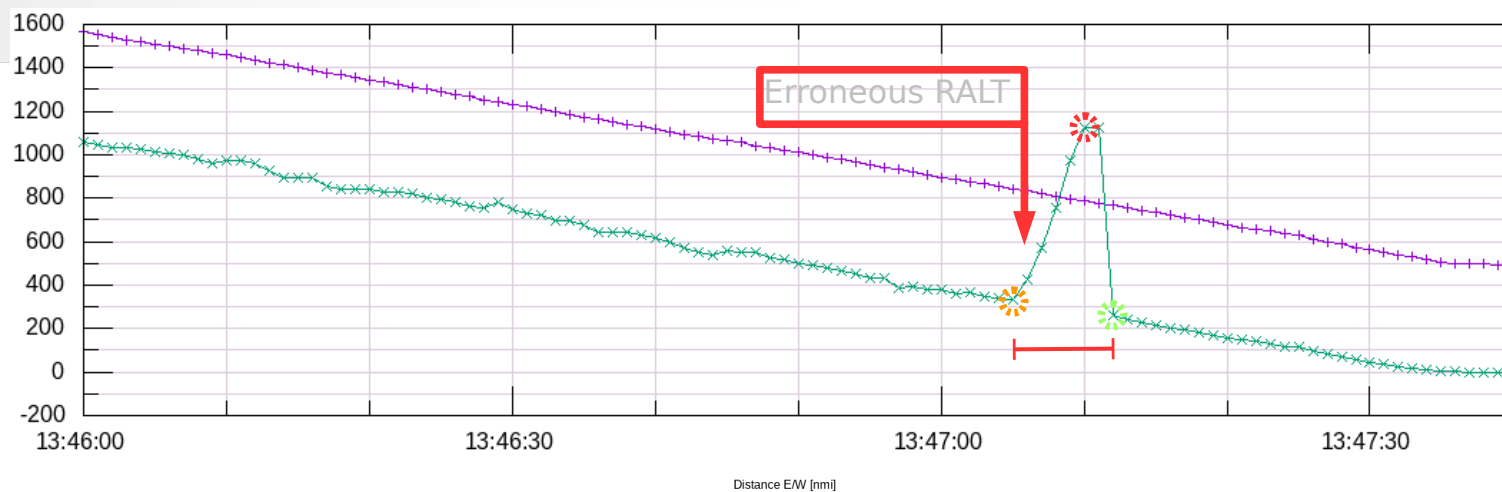
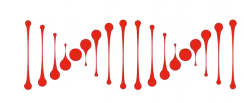
Detailed recorded data on
Tallinn (EETN 26) occurrences

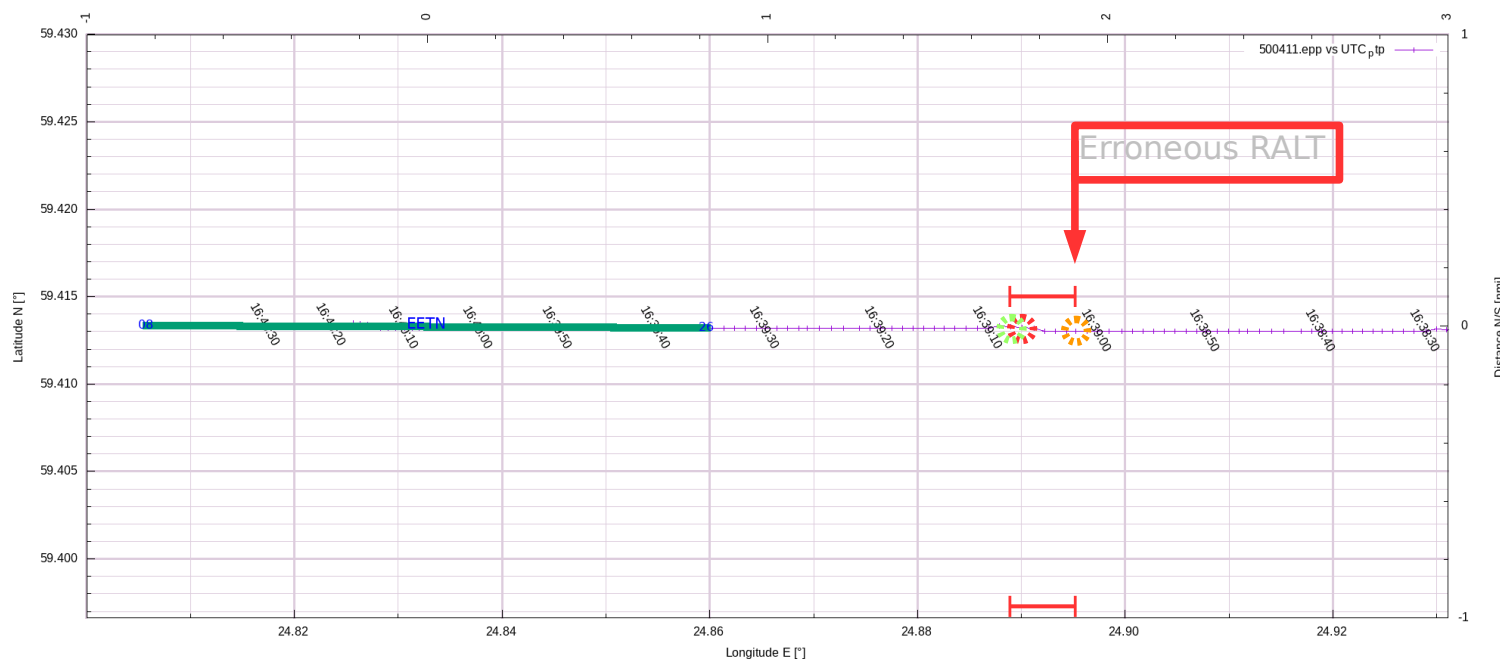
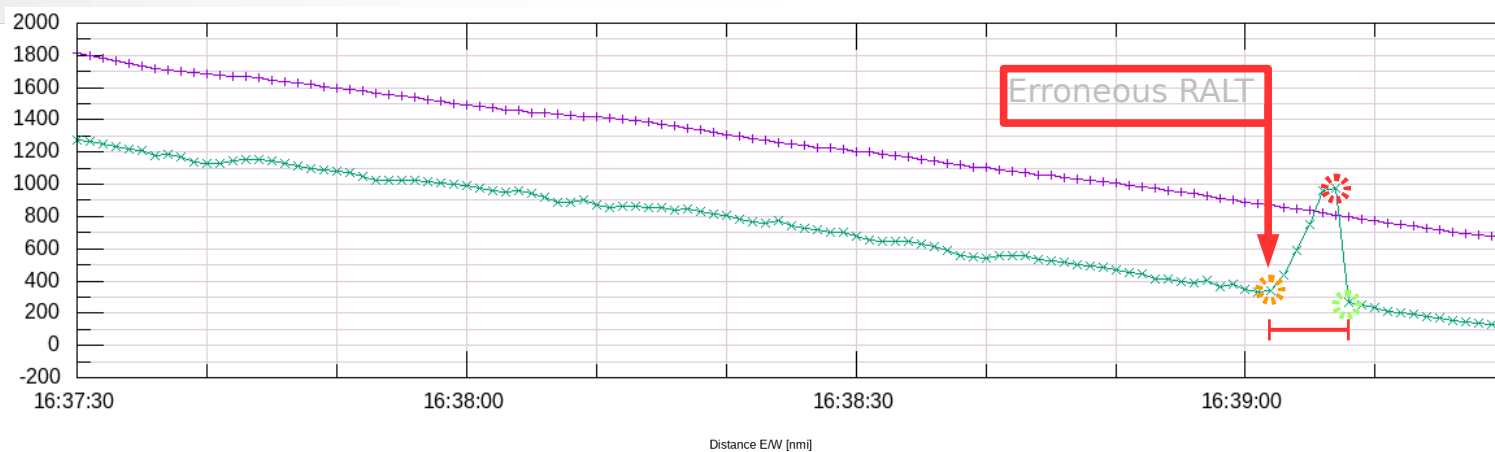
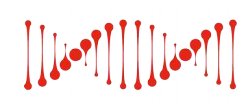


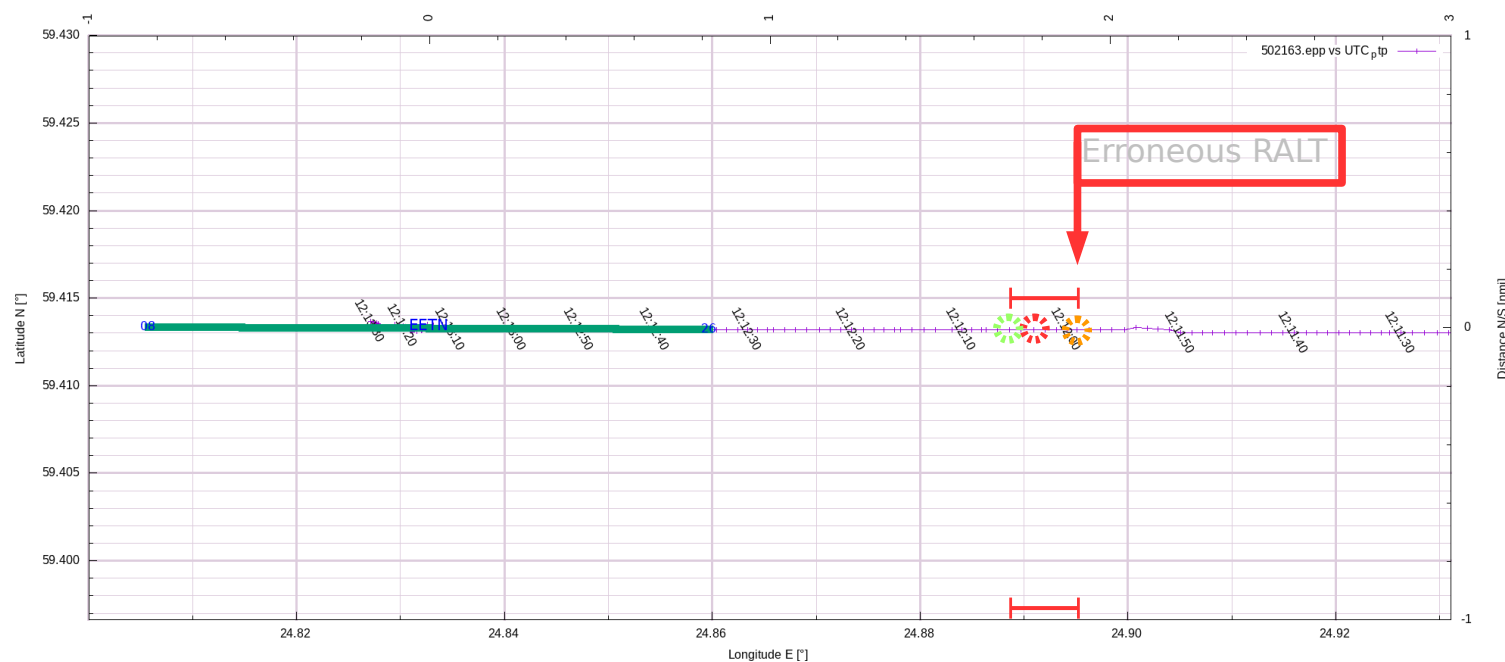
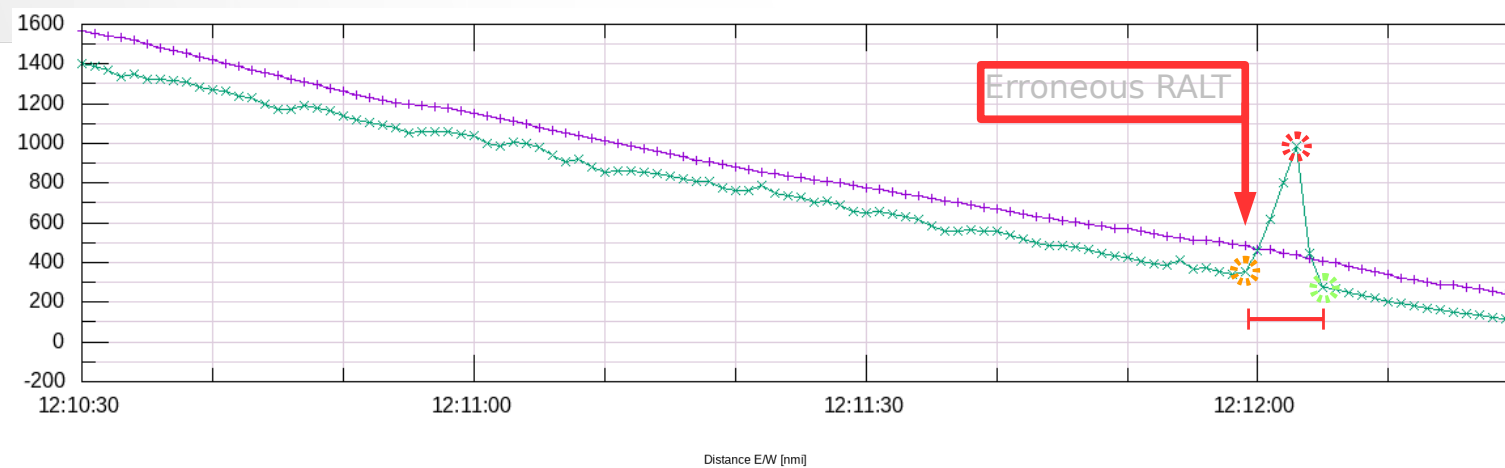
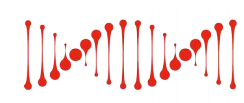


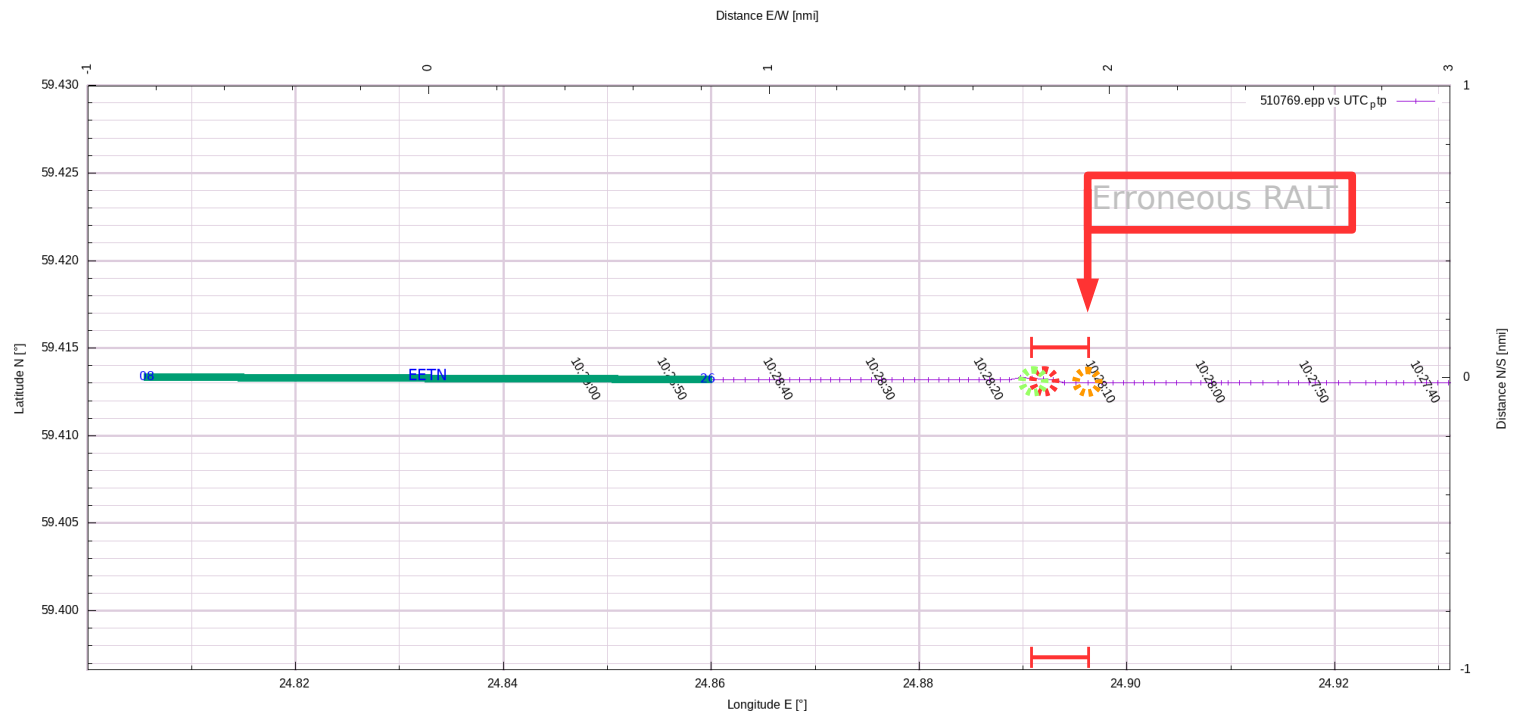
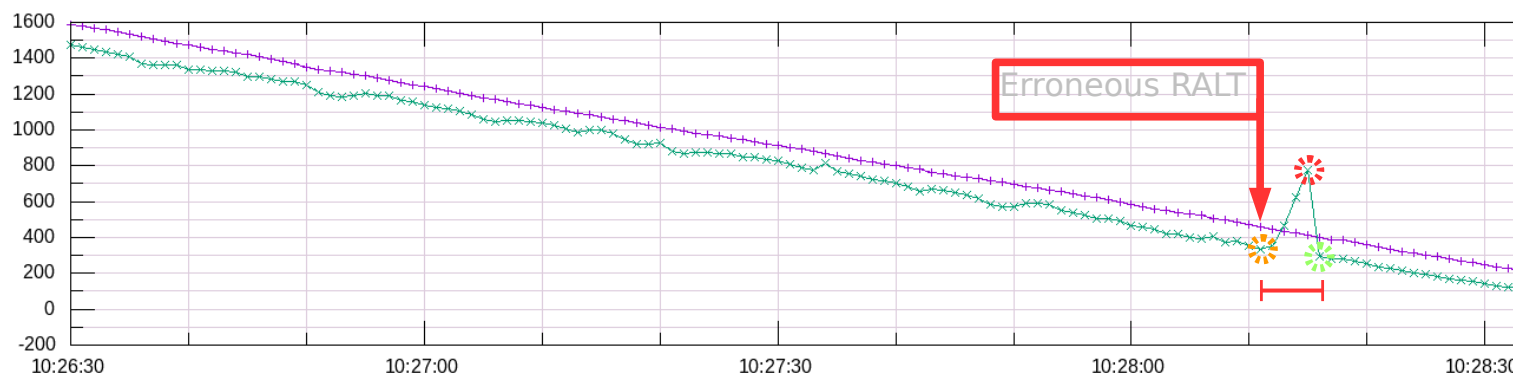
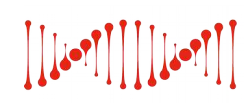


Occurrence 20191010_0757 (REC=500398.dat, A/C Registered XXXTG)

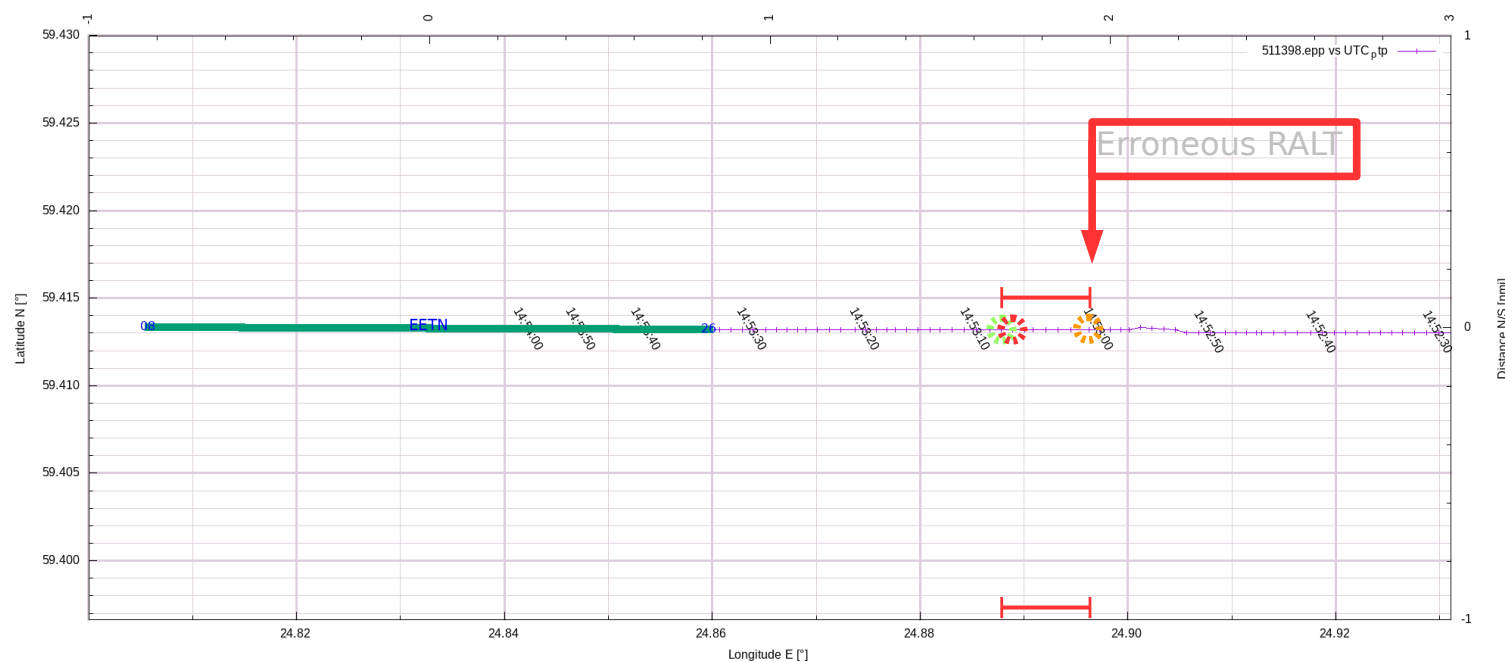
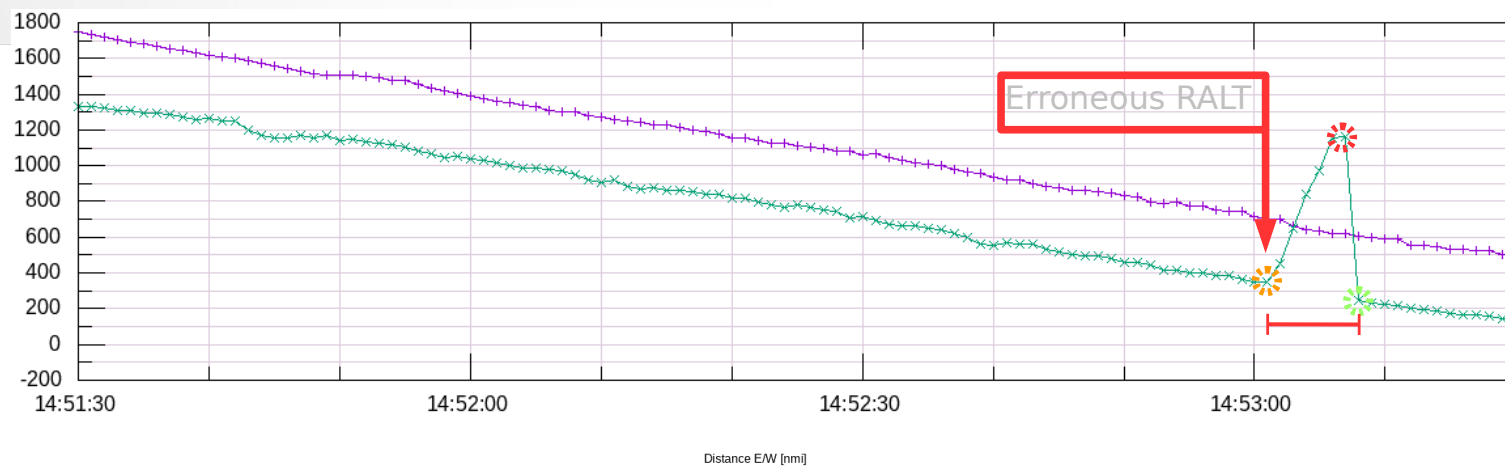
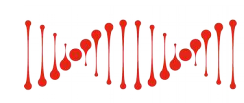


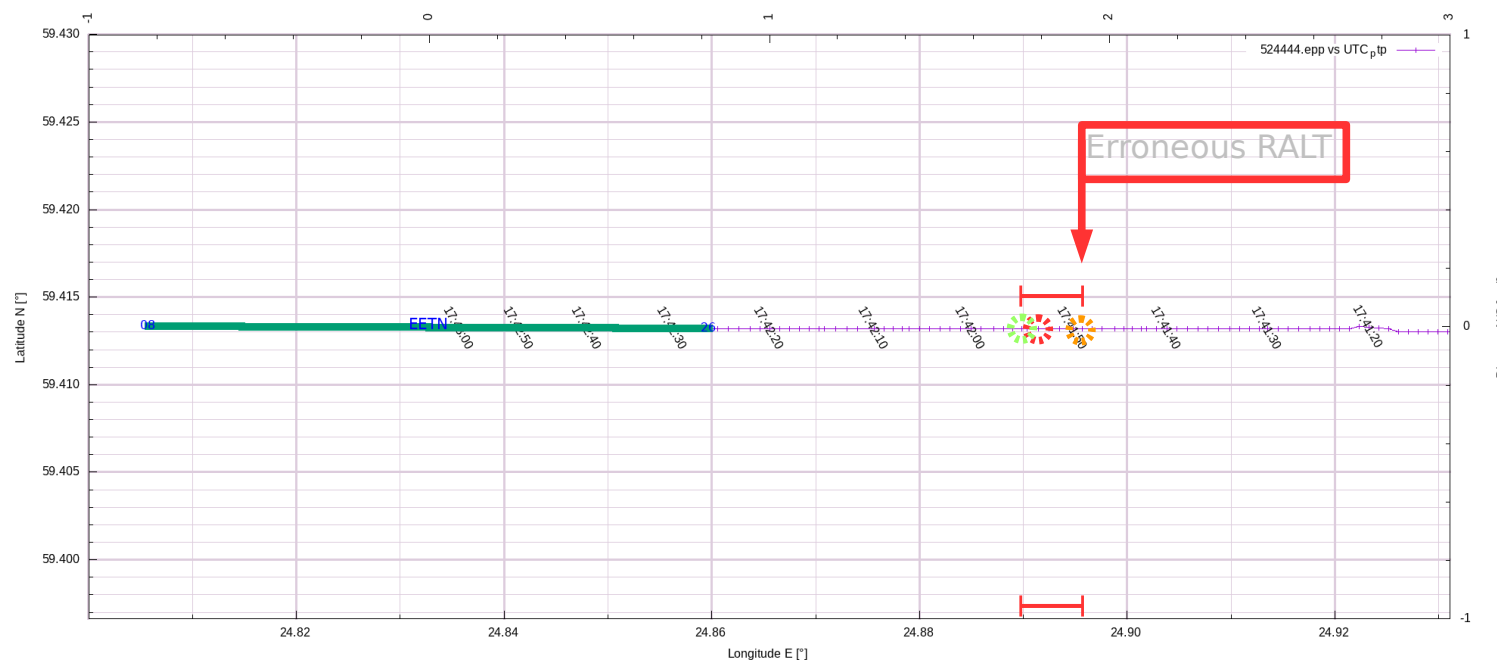
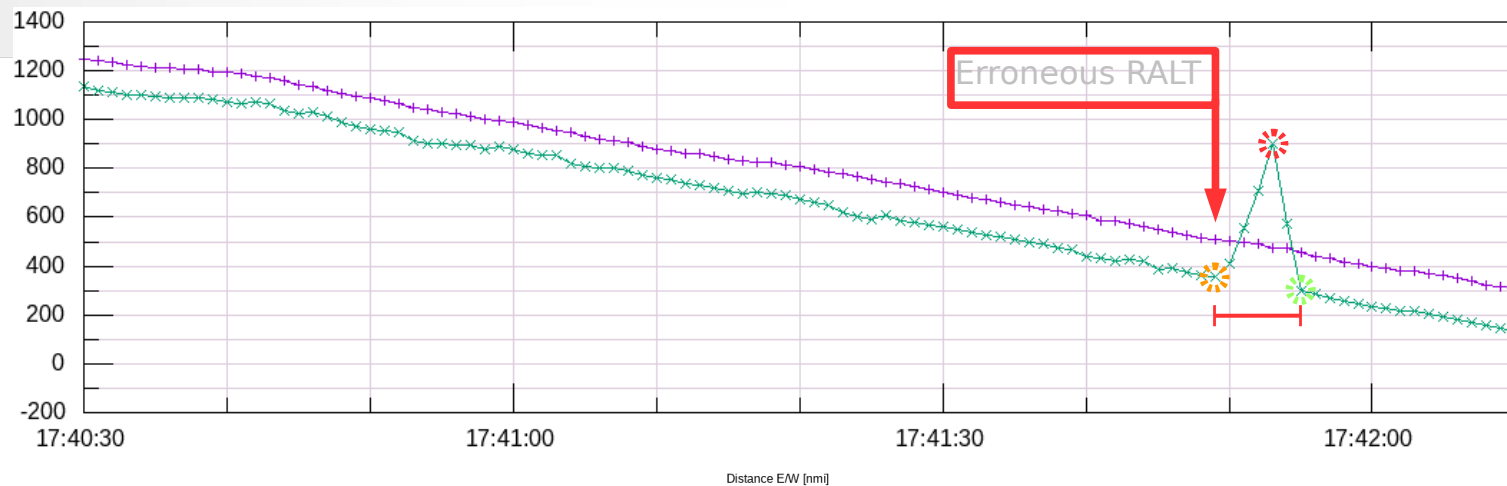
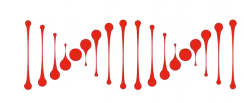




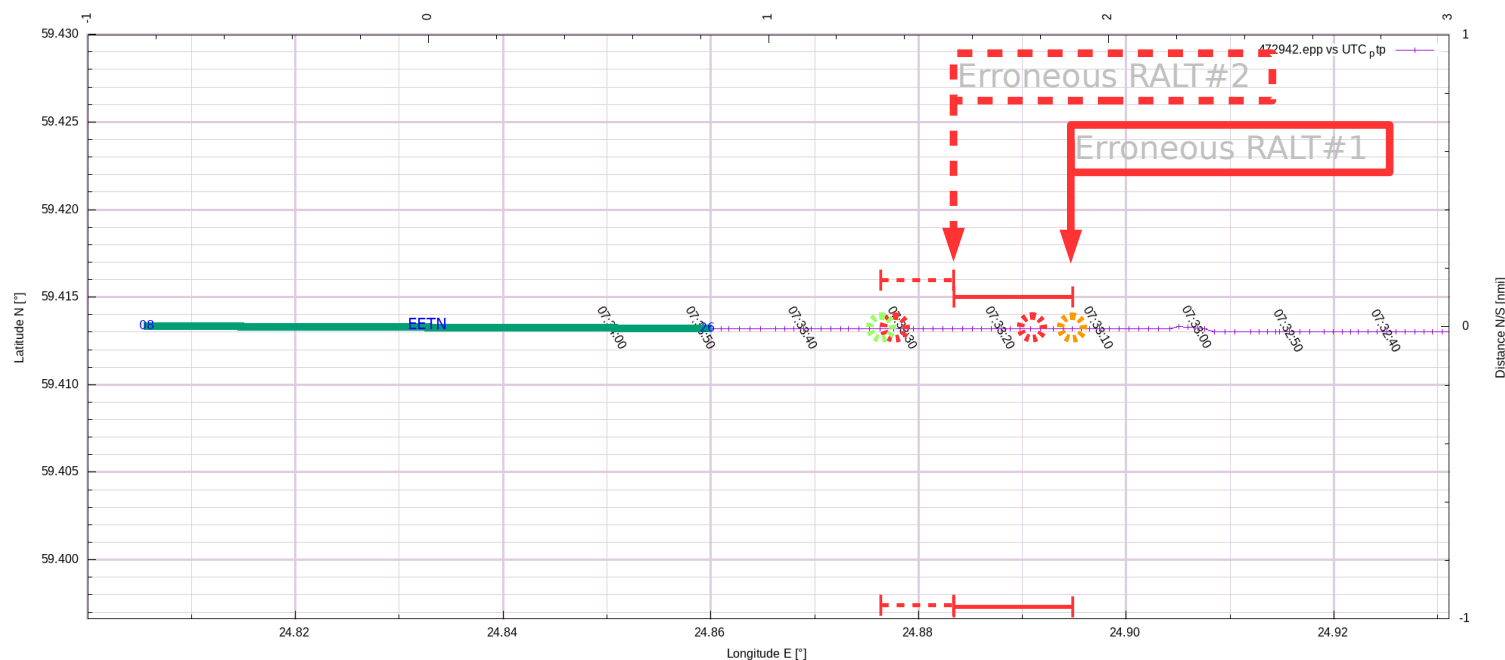
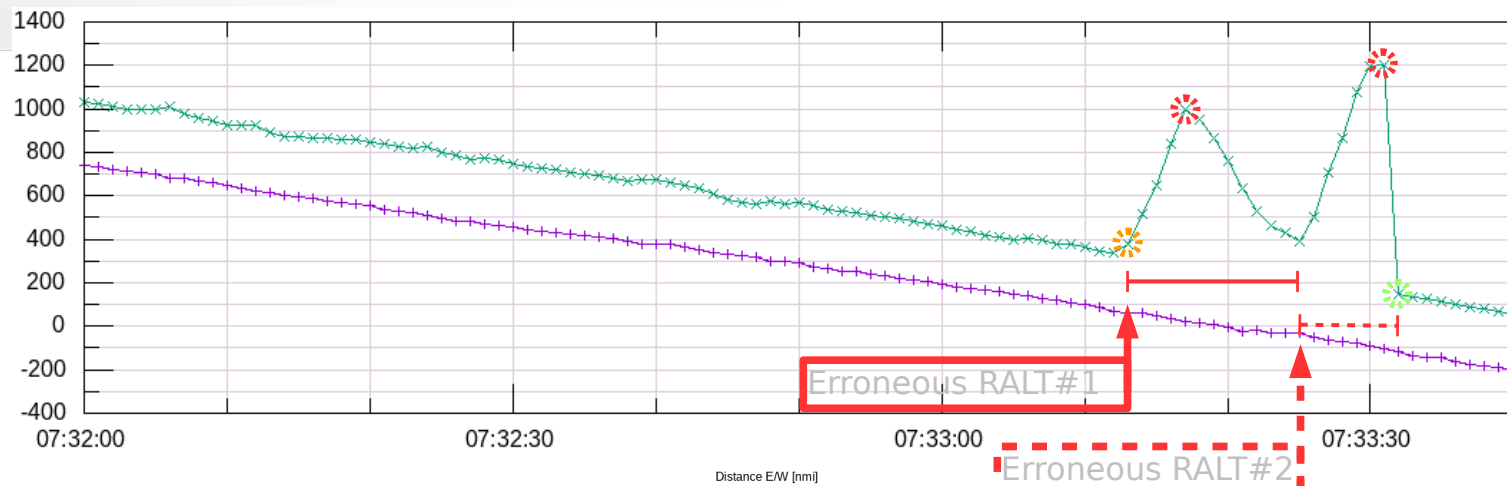
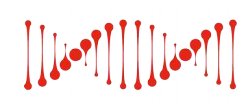


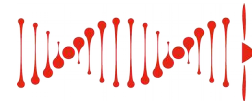
Occurrence 20191231_0744 (REC=511398.dat, A/C Registered XXXTF)





Occurrence 20190402_0741 (REC=472942.dat, A/C Registered XXXTE)

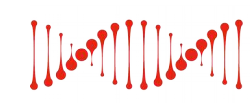




Annex#2

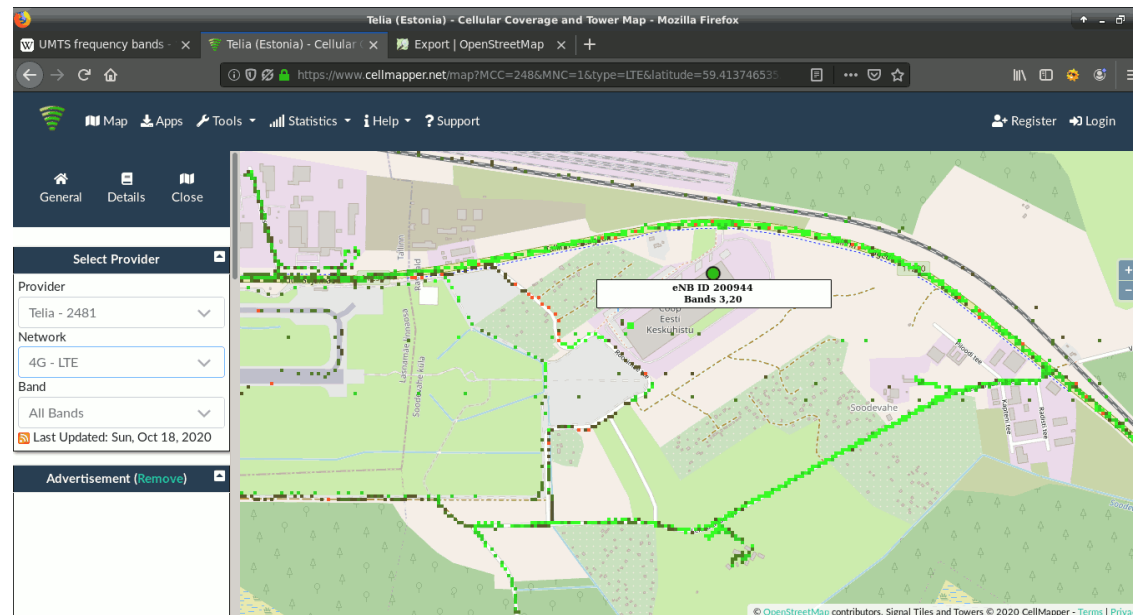
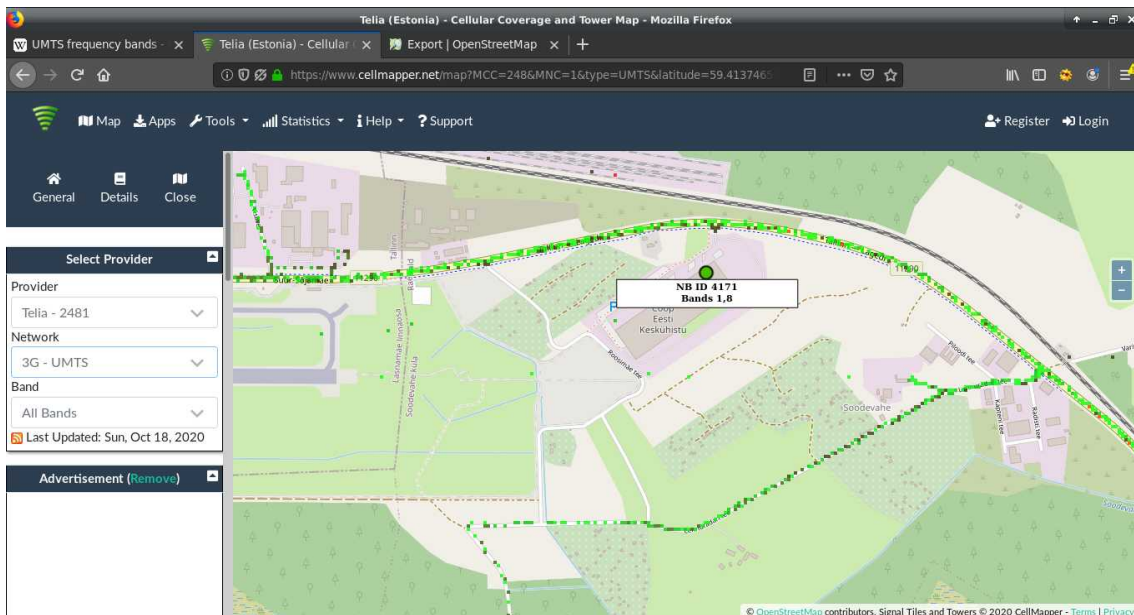
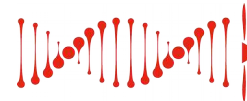
Location of radio sources
close to Tallinn (EETN 26) approach

Tallinn aerodrome radio environment above 1GHz



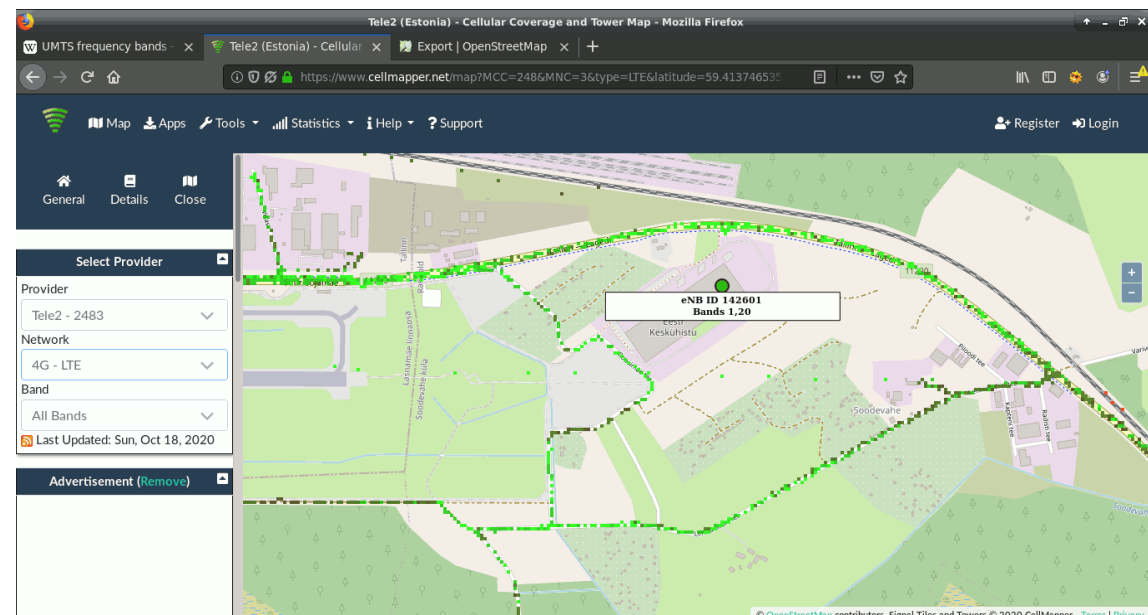
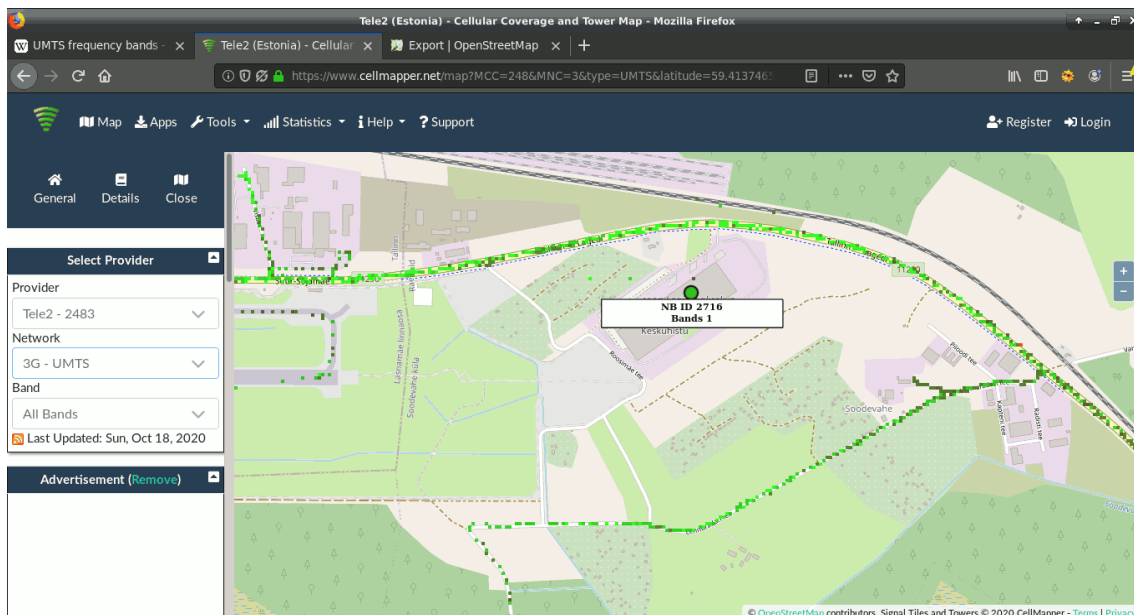
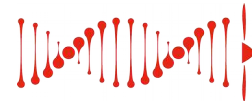
- Exhaustive list (supported by the courtesy of Estonia Spectrum Management Authority <https://www.ttja.ee/>)
 - Surface Movement Radar @ 9 GHz
 - C band VSAT 4 km apart from aerodrome (uplink ~ 6 GHz, downlink ~ 4 GHz)
 - Enroute DME 59X (80 NM range @ FL500)
 - Approach DME CH20X or CH30X (25 NM range)
- High isolation to these sources (frequency & distance to occurrences) allows to discard them as the likely cause

Telia mobile network



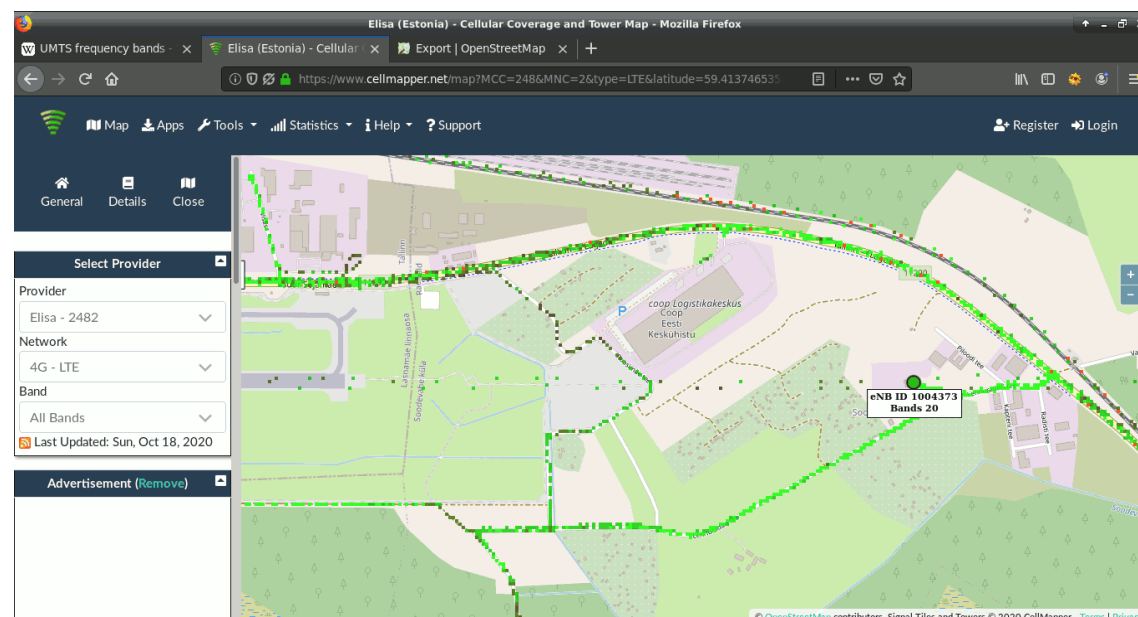
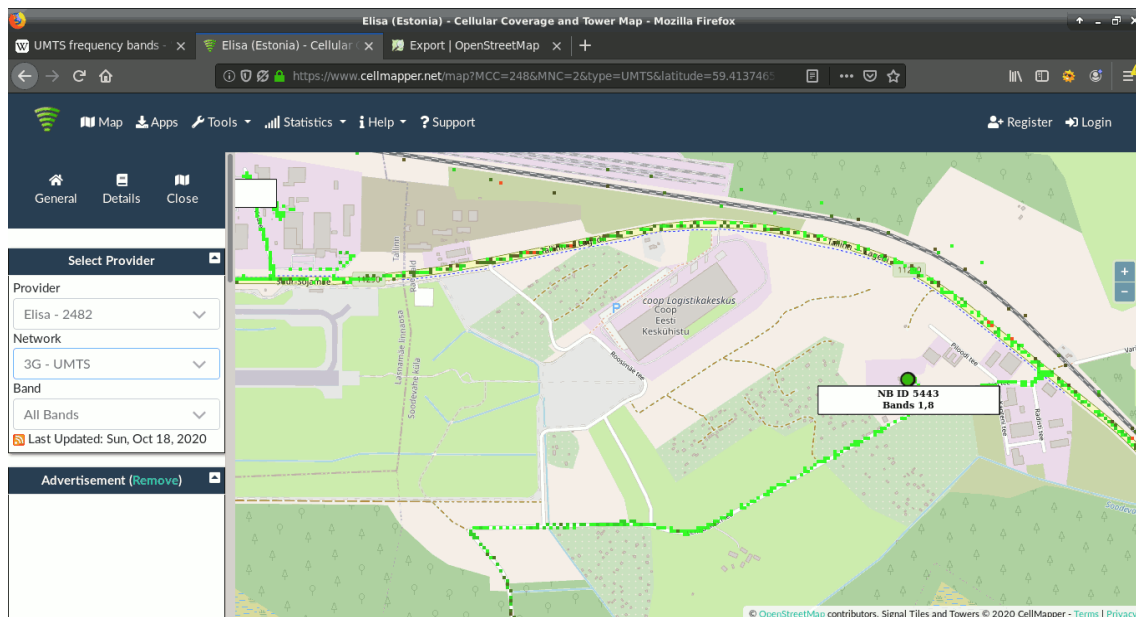
- Location : Coop Logistikakeskus building
- Frequency bands : 800 MHz (#20), 900 MHz (#8), 1800 MHz (#3), 2100 MHz (#1)

Tele2 mobile network



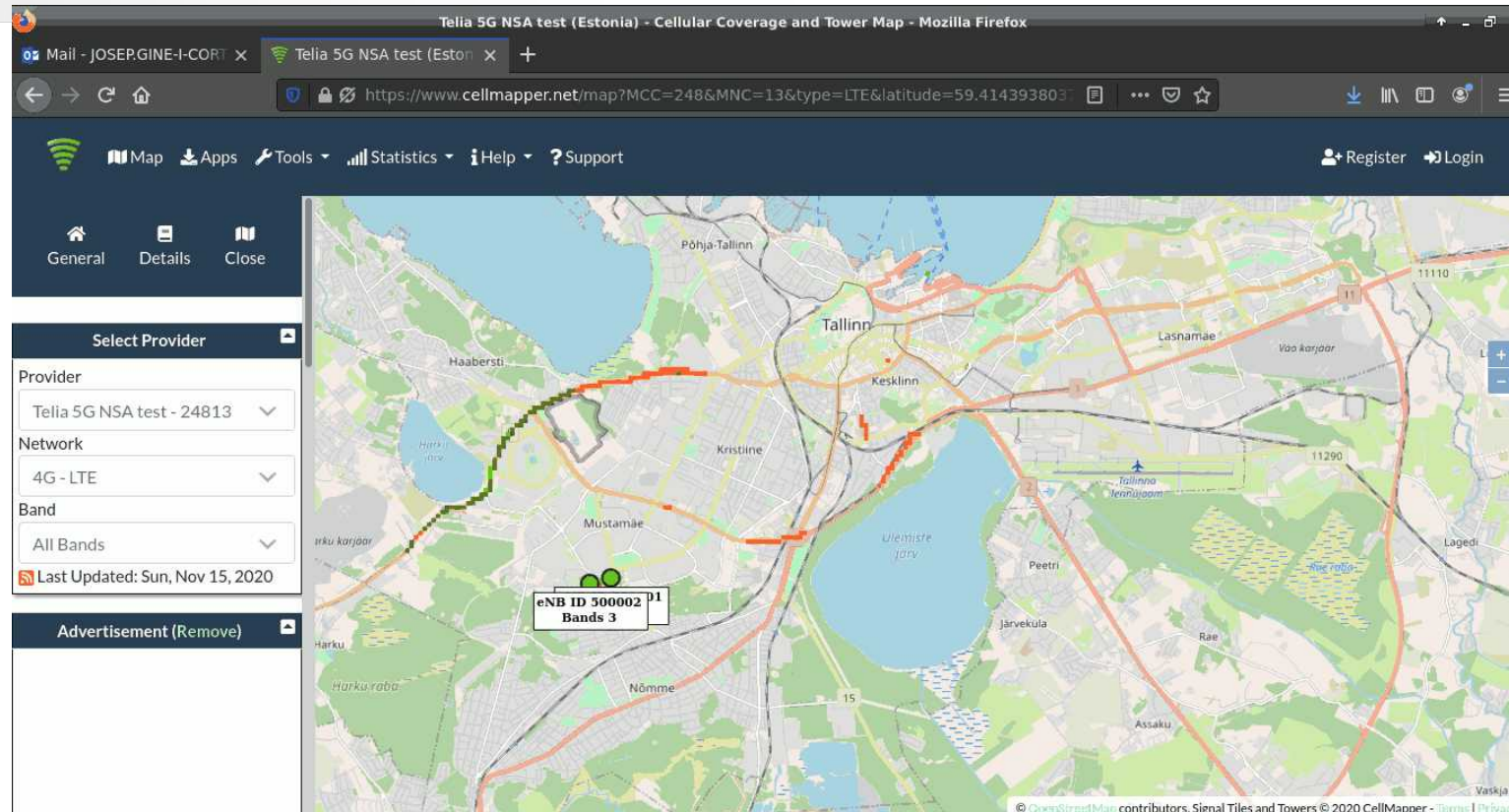
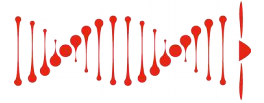
- Location : Coop Logistikakeskus building
- Frequency bands : 800 MHz (#20), 2100 MHz (#1)

Elisa mobile network



- Location : Bus parking
- Frequency bands : 800 MHz (#20), 900 MHz (#8), 2100 MHz (#1)

Telia 5G mobile network (trial)



- Location : Tallinna Tehnikaulikool → ~ 10 km from Tallinn Airport → no impact on A/C
- Frequency bands : 1800 MHz (#3)



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