Impact on Timing receivers from live GNSS interference

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GNSS (timing) receivers are vital components in many types of critical infrastructure, such as cellular communication or energy distribution. Due to their often-known fixed location and the low signal strength of the GNSS signals, such installations are easy targets for intentional interference. It is thus important to understand of typical equipment's behavior when under the influence of jamming and spoofing.

Due to proliferation of GNSS to many areas of applications, it is virtually impossible to obtain permission to conduct open-air jamming experiments, therefore most characterization of the interference behavior is done in EMC chambers or using direct connection with cables and GNSS simulators.

Few test locations, often restricted in a military environment, exist that allow developers and users to test GNSS equipment under realistic conditions.

Jammertest is an annual Norwegian initiative where participants can expose various types of GNSS systems to open-air GNSS jamming, spoofing and meaconing at a site in northern Norway. It can be used to test PNT solutions in their intended environment, such as road automotive, maritime or airborne. The organizers also provide traceable reference time at the test-site which allows to assess the performance of GNSS based time and frequency system under interference.

During Jammertest 2023, the organizers generated over 100 different scenarios, ranging from low power/low-cost jammers to advanced scenarios with 10+W transmit power, as well as advanced time/location spoofing and meaconing scenarios.

This paper presents an analysis of the behavior of a timing receiver during a subsection of scenarios recorded during the Jammertest week in September 2023. The results are compared to, and further investigated by cable-based measurements performed in the lab.

It will also present how different types of interference impacts the various variables inside the receiver, as well as the difference in interference power required to change on the various receiver variables and a degradation of the timing accuracy provided by the receiver.

The paper shows our analysis of the differences found between the open-air and cable-based interference measurements. It also presents how different variables in a modern COTS receiver can be used for detection of open-air interference as well as the difference in interference signal power required for detection versus a significant output degradation.