Robustness Upgrading of GNSS DO

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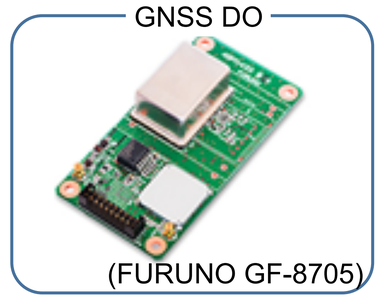
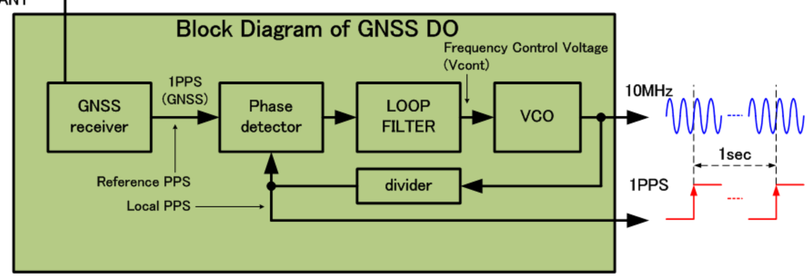
Introduction

GNSS DO (GNSS Disciplined Oscillators) are composed of a GNSS receiver and an OCXO or Rb oscillator whose timing output signals are controlled to agree with the signals broadcast by GNSS satellites.
Highly accurate timing and frequency can be provided for the synchronization of systems such as broadcast equipment and mobile base stations.





However, the robustness of DO has room for improvement against GNSS threats.

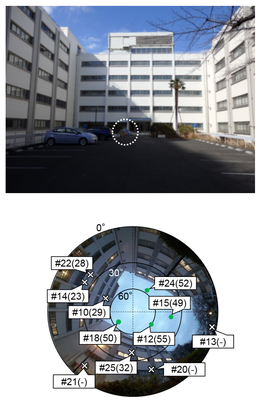
1) One of the GNSS systems may experience some reception issues.
   → We suggest how to use **Multi GNSS**
2) Multipath of GNSS signals may degrade the timing accuracy.
   → We studied the influences of **Multipath** and how to mitigate them.
3) It is necessary to prepare for the possibility of totally losing GNSS signals.
   → Switch from GNSS to internal free-running oscillators – so-called **Holdover**
   Especially, the ability to maintain 1.5μsec holdover timing accuracy is important.

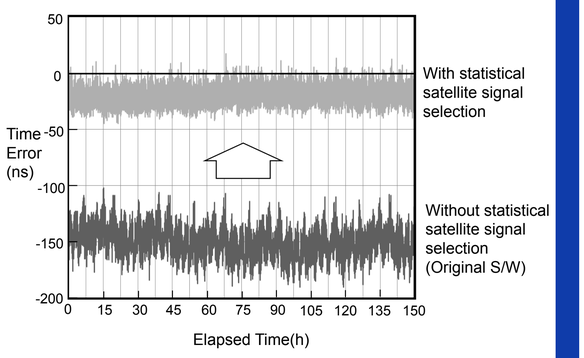
Multi GNSS

Nowadays, there are increasing numbers of GNSS that are available to utilize; GPS, GLONASS, QZSS, Galileo and BeiDou.

However, these systems may experience trouble. For example, some satellites of GPS sent out 13.7μsec faulty UTC correction parameters on January 26, 2016.

Using Multi GNSS, we can determine whether a GNSS is in trouble or not.
(This works as a kind of RAIM)



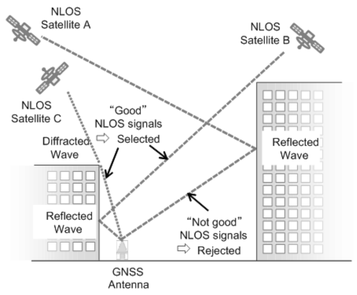


Cited from NTT R&D's presentation in IEICE Technical Report CS2016-77(Feb 2017)

Multipath

When using GNSS DO in urban areas, the influence of multipath can not be ignored.
In case of using NLOS satellites, with the multipath, the timing error (TE) may reach several hundreds of nano seconds.

We experimentally showed that TE can be effectively improved by eliminating multipath satellites.



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Holdover

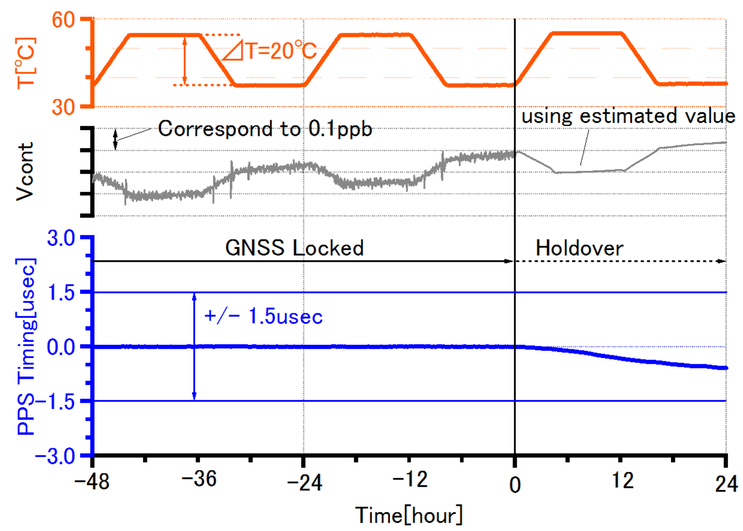
In recent years, Holdover timing accuracy of 1.5μsec has been drawing attention as TD-LTE becomes widely used.

We achieved 1.5μsec / 24hours holdover under ⊿T=20℃ environmental temperature condition changes by using OCXOs.
This means that the frequency deviation is less than 2E-11 during this period.

Method

As is well known, the frequency of OCXO changes with Aging and Temperature.

Our algorithm can estimate both the Aging and Temperature coefficients of the OCXO during GNSS Locked condition.



Experimental result of N=10