

magicGNSS Precise Product Provision for LEO POD Applications September 2020

ION GNSS 2020



Session B4: GNSS Applications in Space

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INTRODUCTION

INTRODUCTION

magicGNSS Product Provision Service has been designed to provide **precise satellites' orbit&clock parameters**, together with Earth Orientation Parameters with a **very low latency**.

For this purpose, files containing the information are typically uploaded to a **SFTP** server.

Currently, this service is supporting, among other:

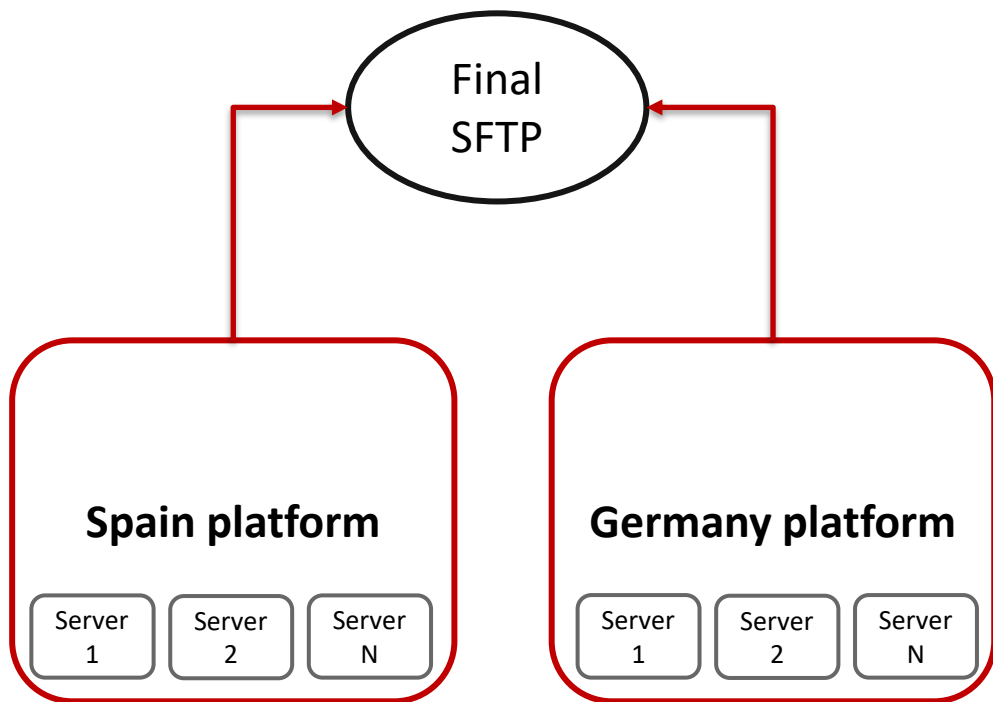
- Various EUMETSAT Radio Occultation missions (<https://www.eumetsat.int/website/home/Satellites/FutureSatellites/EUMETSATPolarSystemSecondGeneration/index.html>)
- Sentinel Mission for ESA (<https://sentinel.esa.int/web/sentinel/about-sentinel-online>)



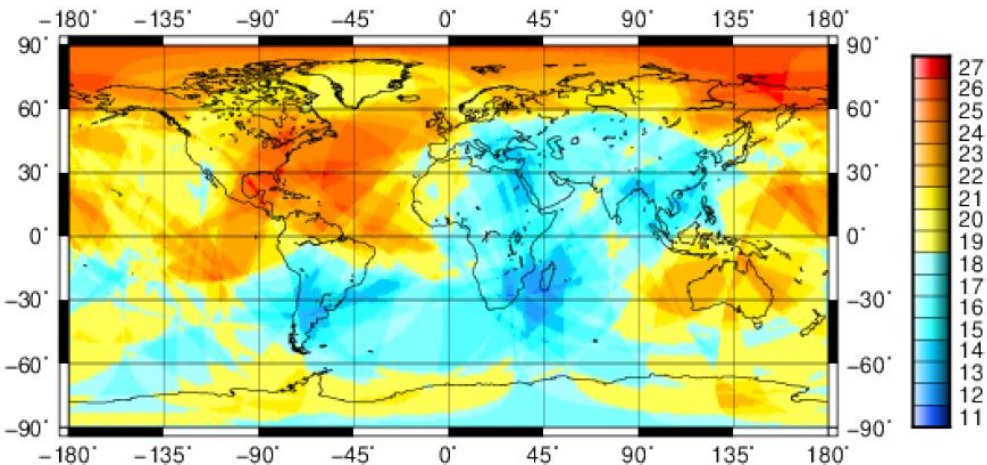
GMV INFRASTRUCTURE

GMV INFRASTRUCTURE

One important point of this service is the **availability and redundancy**, so an infrastructure using different platforms located in two different countries has been designed for this purpose.



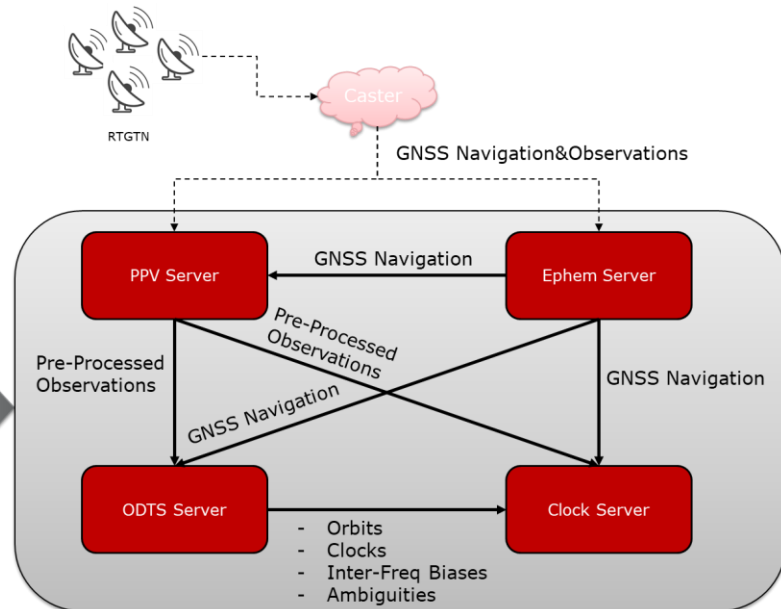
PRODUCT PLATFORMS



magicGNSS is composed by several modules in charge of generating precise products for different constellations.



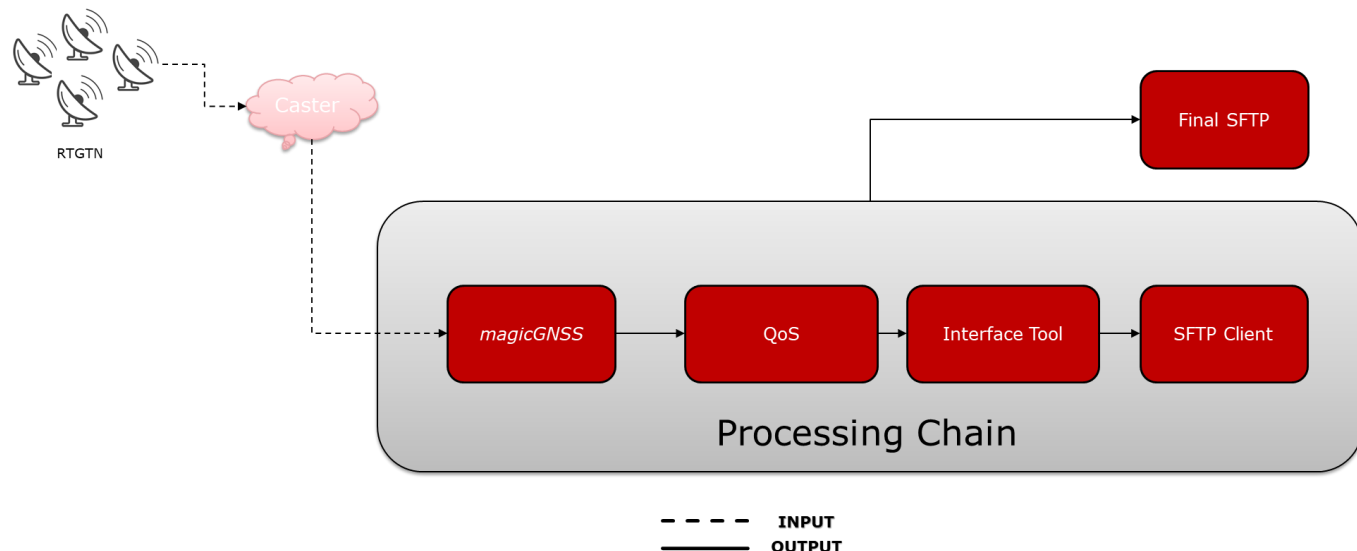
A **stations network** (with SLA) is used to generate the final orbit&clock products, using *magicGNSS* tool suite.



PRODUCT PLATFORMS

Apart from *magicGNSS*, there are other modules in charge of:

- checking the **Quality of Service** with weighting factors between different servers to optimize quality and availability
- generating the **final product** with the desired format using the outputs from *magicgnss* modules
- sending the final product through **SFTP** to the client



SERVICE PROVISIONING SPECIFICATIONS

SERVICE PROVISIONING SPECIFICATIONS

Service is focused on **standard formats to maximize compatibility.**

Detailed **service tailoring has been performed** to cope with each customer's specific needs.

Main file-based products are:

Product	Frequency	Latency	Rate	Estimation Arc Coverage	Prediction Arc Coverage	Format
SP3 orbits and clocks	10/15 minutes	2 min	30 sec	24 hours	24 hours	SP3c/d
RINEX Clock files	10/15 minutes	2 min	10 / 30 sec	24 hours	24 hours	RINEX clk v3.02
EOP	Hourly	2 min	12 hours	4 days	3 days	IERS
Navigation RINEX	Hourly	2 min	Depending on the constellation	24 hours	-	RINEX nav v3.02

SERVICE MONITORING

SERVICE MONITORING

Another important point of a Near Real Time service is the monitoring of the system itself. In order to do that, several technologies are used:

- Nagios and Prometheus for Real-Time alerts.



NAGIOS TC Search ...

Monitoring

Current Network Status
 Last Updated: Fri Sep 11 06:31:50 UTC 2020
 Updated every 60 seconds
 Nagios® Core™ 4.4.3 - www.nagios.org
 Logged in as root

Host Status Totals

Up	Down	Unreachable	Pending
1	0	0	0
All Problems		All Types	
0		1	

Service Status Totals

Ok	Warning	Unknown	Critical	Pending
21	0	0	0	0
All Problems		All Types		
0		21		

Service Status Details For Host 'tc-igs'

Limit Results:

Host	Service	Status	Last Check	Duration	Attempt	Status Information
tc-igs	Active Users	OK	09-11-2020 06:29:09	226d 23h 14m 48s	1/4	USERS OK - 0 users currently logged in
	CPU	OK	09-11-2020 06:26:47	224d 23h 15m 39s	1/4	OK - user: 1.99, nice: 0.50, sys: 0.69, iowait: 0.50, irq: 0.50, softirq: 0.54 idle: 98.76
	Load of Processes	OK	09-11-2020 06:26:55	227d 23h 18m 57s	1/4	OK - load average: 0.68, 1.05, 1.41
	Memory	OK	09-11-2020 06:30:09	2d 14h 54m 46s	1/4	OK - 15.4% (5030744 kB) free
	NTP process	OK	09-11-2020 06:28:22	224d 23h 15m 42s	1/4	PROCS OK: 1 process with args 'ntpd'
	NTP sync	OK	09-11-2020 06:27:28	129d 4h 11m 28s	1/4	NTP OK: Offset: 0.05594956875 secs
	PING	OK	09-11-2020 06:29:49	1d 14h 18m 5s	1/4	PING OK - Packet loss = 0%, RTA = 0.36 ms
	Partition /	OK	09-11-2020 06:27:40	226d 23h 15m 11s	1/4	DISK OK - free space: / 328174 MB (36.92% inode=99%)
	RT Clocks Consistency	OK	09-11-2020 06:24:07	9d 22h 22m 48s	1/4	11/09/2020-05-30 CLOCK Consistency GPS = 0.028383 ns, Galileo = 0.037454 ns (data/output_rtkci/Core/2020/255/rtck_sum20200911_0530.txt
	RT Clocks Phase Residuals	OK	09-11-2020 06:27:04	36d 0h 19m 50s	1/4	11/09/2020-05-30 [0 + Phase RMS = 0.01187 < 0.03] (data/output_rtkci/Core/2020/255/rtck_sum20200911_0530.txt
	RT Clocks Product Gaps	OK	09-11-2020 06:26:49	36d 1h 0m 13s	1/4	OK
	RT Clocks Product Generation	OK	09-10-2020 06:26:37	185d 23h 40m 32s	1/4	[rtkc_sst20200910.cik] and [rtkc_sum20200910.cik] Exist and are not empty in (data/output_rtkci/Core/2020/
	RT Clocks Summary Generation	OK	09-11-2020 06:28:18	36d 0h 23m 34s	1/4	11/09/2020-05-30 [rtkc_sum20200911_0530.txt] Exists and is not empty in (data/output_rtkci/Core/2020/255/
	RT ODTs Consistency	OK	09-11-2020 06:22:30	6d 10h 25m 21s	1/4	11/09/2020-05-30 Orbit GPS = 0.537903 cm, Galileo = 0.781904 cm Clock GPS = 0.018564 ns, Galileo = 0.028532 ns (data/output_odts/Core/2020/255/odts_sum20200911_0530.txt
	RT ODTs Phase Check	OK	09-11-2020 06:25:17	42d 2h 21m 40s	1/4	11/09/2020-05-30 [0 + Phase RMS = 0.00973 < 0.02] (data/output_odts/Core/2020/255/odts_sum20200911_0530.txt
RT ODTs Products Check	OK	09-11-2020 06:27:29	42d 2h 29m 29s	1/4	11/09/2020-05-30 [odts_sum_req.info, sat, tim, gss, est, esp, prd, pcp] Files exist and are not empty in (data/output_odts/Core/2020/255/	
RT ODTs est file Generation	OK	09-11-2020 06:30:24	42d 2h 31m 30s	1/4	11/09/2020-06-00 GPS and GALILEO are used (data/output_odts/Core/2020/255/odts_est20200911_0600.sp3	
RT PPV Station Gaps	OK	09-11-2020 06:29:20	1d 5h 58m 35s	1/4	Less stations than expected have surpassed max gap of 1s [# over 1s: 13] and 5s [# over 5s: 13] in analysed period (10 min) [Total: 46] [# under 1s: 33 - expected # under 1s: 25] [# under 5s: 33 - expected # under 5s: 25]	
RT PPV Station Latency	OK	09-11-2020 06:31:33	2d 13h 0m 20s	1/4	Less stations than expected have surpassed max latency of 10s [# over 10s: 9] and 15s [# over 15s: 9] in analysed period (10 min) [Total: 46] [# under 1s: 37 - expected # under 10s: 25] [# under 15s: 37 - expected # under 15s: 25]	
Reboot Required	OK	09-11-2020 06:30:58	51d 0h 21m 4s	1/4	OK: no reboot required	
Total Processes	OK	09-11-2020 06:29:09	224d 23h 15m 37s	1/4	PROCS OK: 187 processes with STATE = RSZDT	

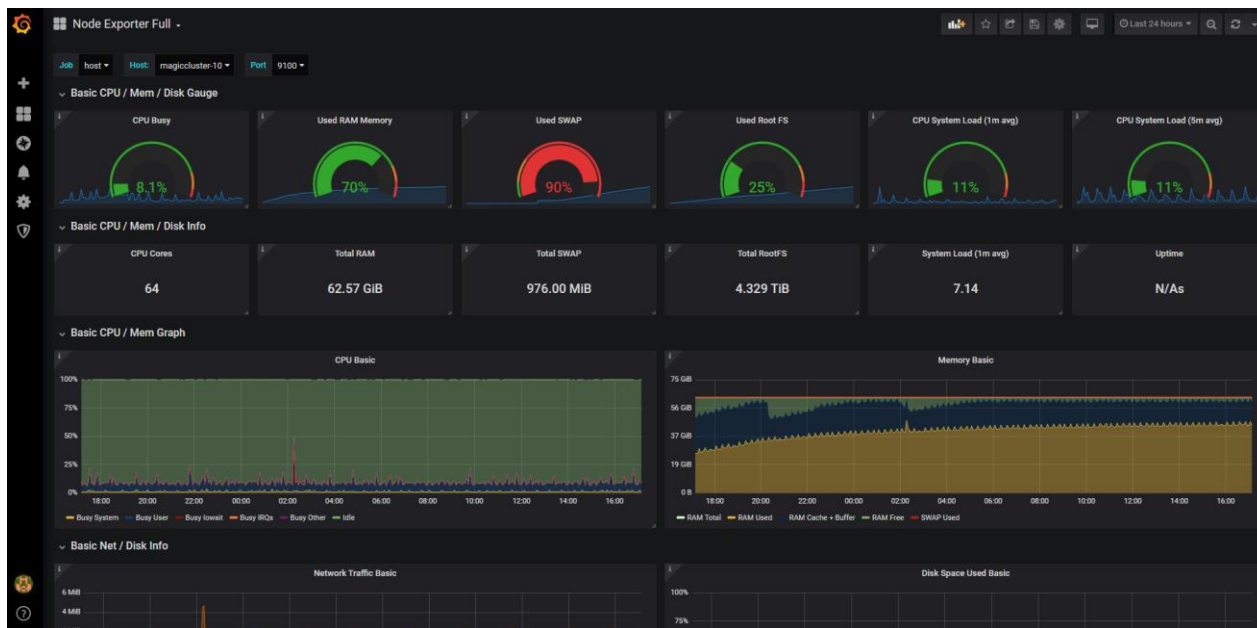
Results 1 - 21 of 21 Matching Services



SERVICE MONITORING

Another important point of a Near Real Time service is the monitoring of the system itself. In order to do that, several technologies are used:

- **Grafana** for HW and system Real-Time monitoring.



SERVICE MONITORING

Another important point of a Near Real Time service is the monitoring of the system itself. In order to do that, several technologies are used:

- **Grafana** for performances analysis.



SERVICE PERFORMANCES

SERVICE PERFORMANCES - SUMMARY

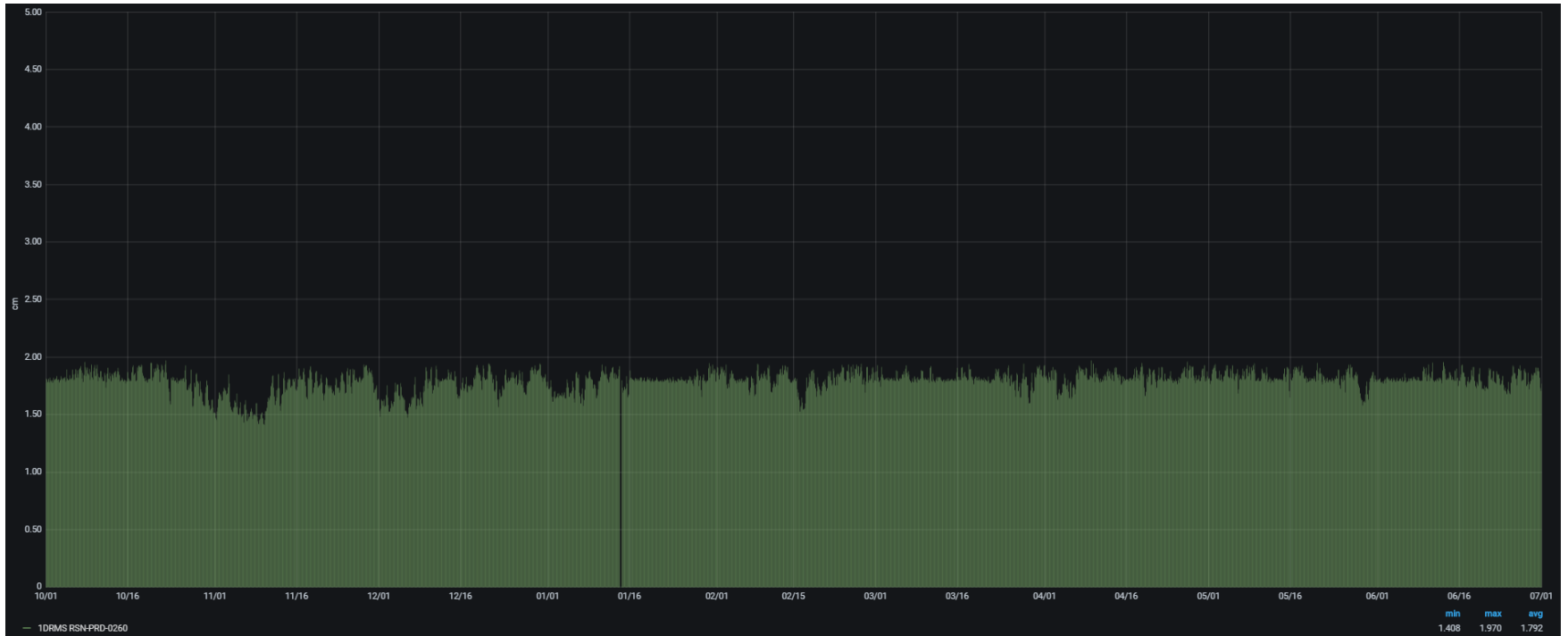
Performaces summary for GPS and Galileo constellation from 1st of October 2019 to 1st of July 2020

Product	Constellation	Min	Max	Mean
Orbits (RMS)	GPS	1.4 cm	1.9 cm	1.7 cm
Clocks (Sig)		0.05 ns	0.07 ns	0.06 ns
Orbits (RMS)	Galileo	2.4 cm	5.6 cm	3.6 cm
Clocks (Sig)		0.03 ns	0.23 ns	0.11 ns

SERVICE PERFORMANCES – ORBITS

Orbit performances from 1st of October 2019 to 1st of July 2020

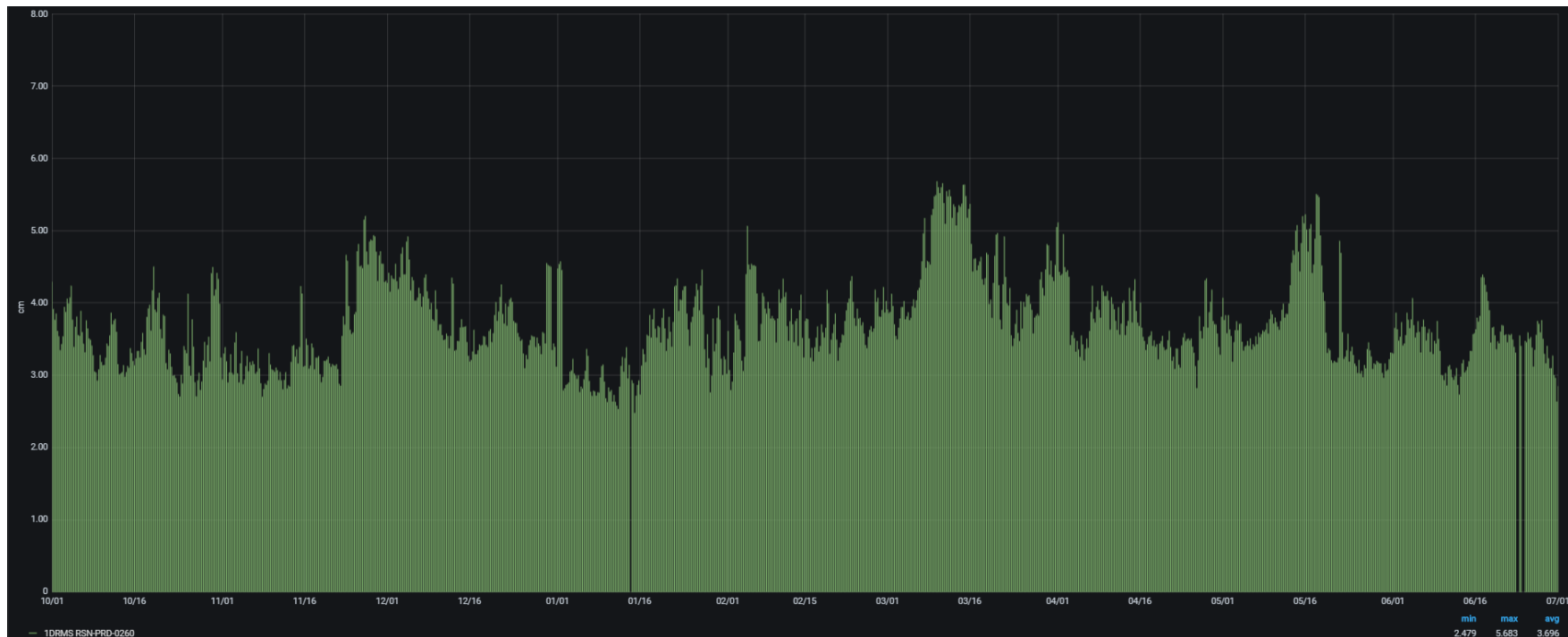
Analyzing the 24 hour of the estimation arc of each product delivered every 10 minutes



SERVICE PERFORMANCES – ORBITS

Orbit performances from 1st of October 2019 to 1st of July 2020

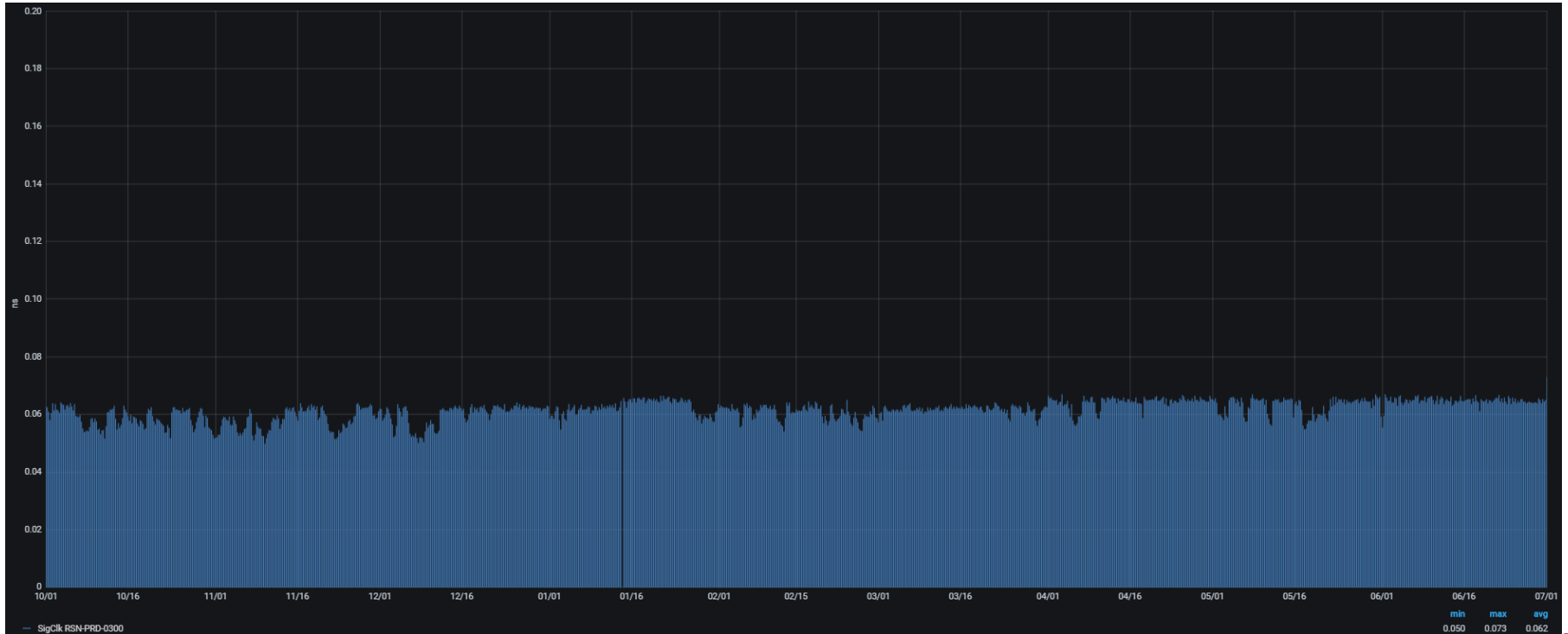
Analyzing the 24 hour of the estimation arc of each product delivered every 10 minutes



SERVICE PERFORMANCES - CLOCKS

Clock performances from 1st of October 2019 to 1st of July 2020

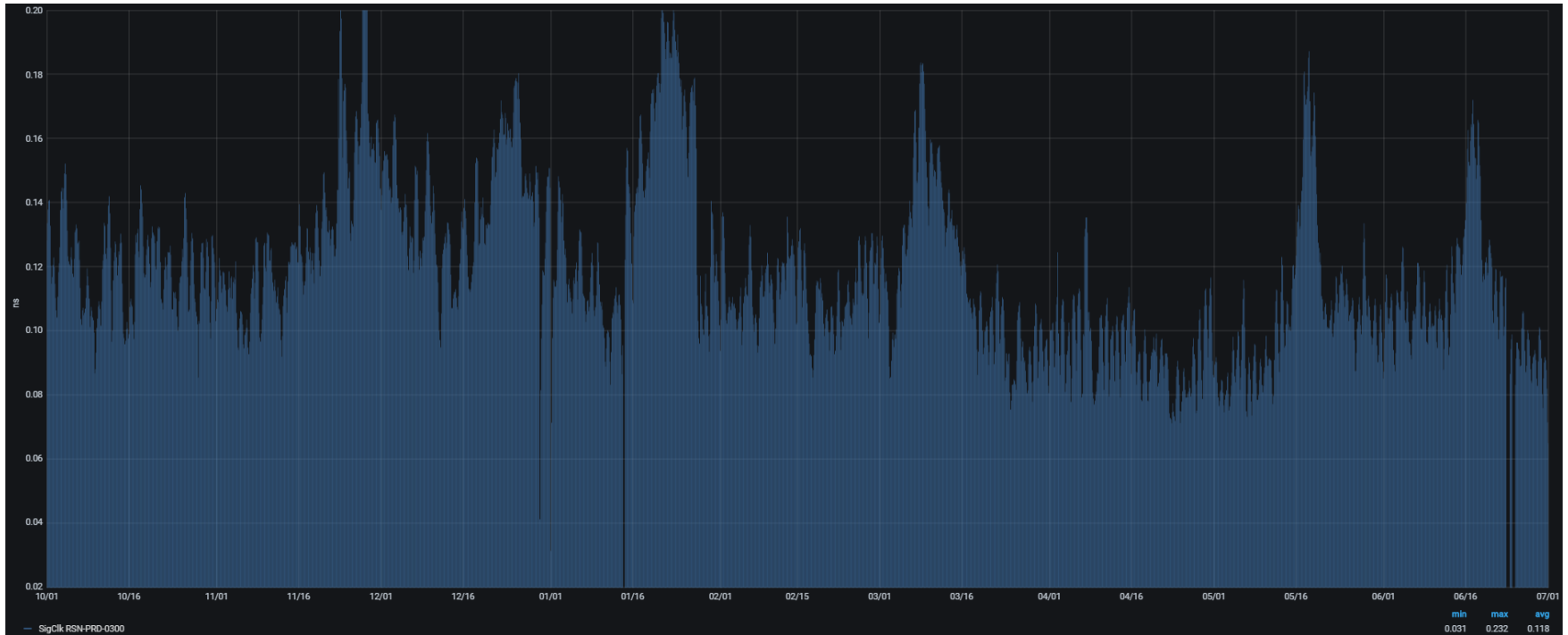
Analyzing the 24 hour of the estimation arc of each product delivered every 10 minutes



SERVICE PERFORMANCES - CLOCKS

Clock performances from 1st of October 2019 to 1st of July 2020

Analyzing the 24 hour of the estimation arc of each product delivered every 10 minutes



CONCLUSIONS

CONCLUSIONS

- **Precise GPS products with reduced latency are becoming more and more demanded** for Atmospheric, Oceanic, Land, Climate Change monitoring Missions.
- Latest missions are equipped with multi-GNSS receivers on-board, being able to provide **accurate products for all GNSS constellations is crucial.**
- Availability and continuity are critical for not impacting the LEO missions.
- GMV has managed undertake these challenges and develop and operate an infrastructure **capable of coping with the aforementioned needs.**

gmv.com

Thank you!!