Türk Telekom

ITSF2026

2 - 5 November | Geneva

Calnex

Synchronization Under GNSS Jamming & Spoofing

OTA Validation and Inter-Operator Cross-Link Interference Analysis



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Türk Telekom
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KEEPING NETWORKS ACCURATE

GNSS interference is no longer a resilience scenario. It is something mobile operators are experiencing in live networks.

Türkiye had already been exposed to significant GNSS jamming and spoofing activity.

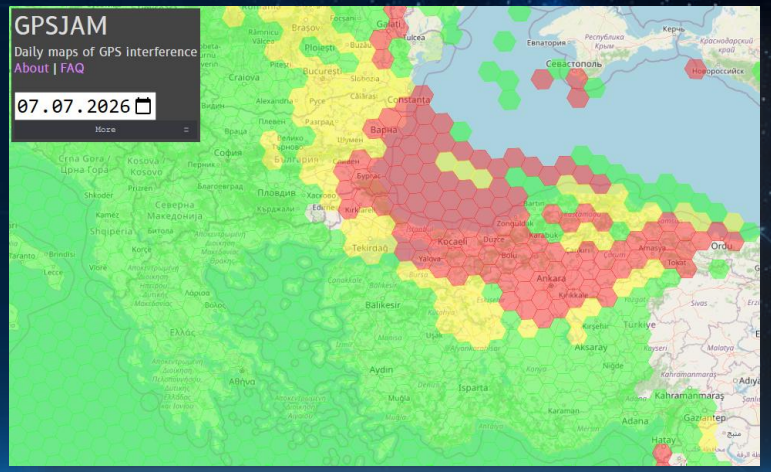
During the NATO Summit on 7–8 July, the level of disruption reached an exceptional peak.

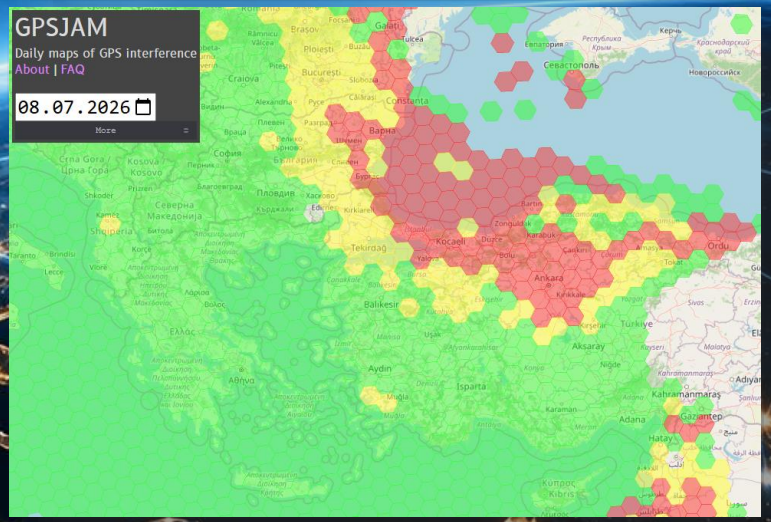
This created a unique opportunity to go into the field and measure what was actually happening and the impact.

We measured synchronization across multiple operators and correlated the observed behaviour with reatime network KPI’s.

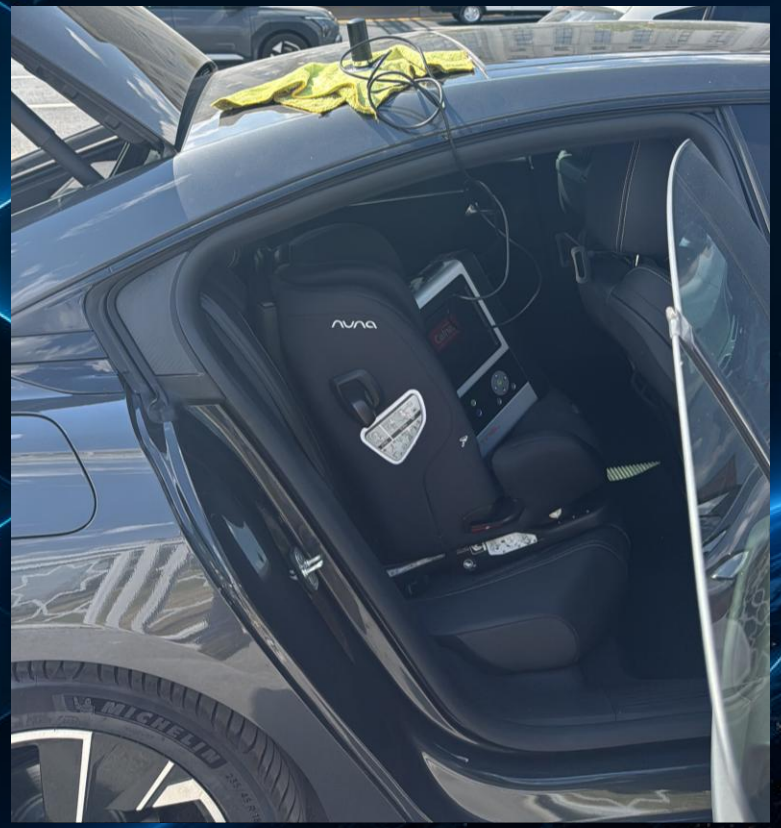
What we found is particularly important: a synchronization problem does not remain within the network where it originates.

Today, we will share those real-world measurements, the impact we observed on 5G performance.





During the summit there was a curfew. Special permissions where needed, however the device used for measurement and it's carrying bag looked like it could be mistaken for a Bomb. Hence a police escortguard was assigned.







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Operator	Frequency	Bandwith	GSCN
X	650976	100	8030
X	644640	40	7964
Y	632640	100	7839
Y	631296	20	7825
Z	641280	80	7929



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Operator X



-567 ns

Operator Y



490 ns

Operator Z



6250 us

PUSCH = Physical Uplink Shared Channel

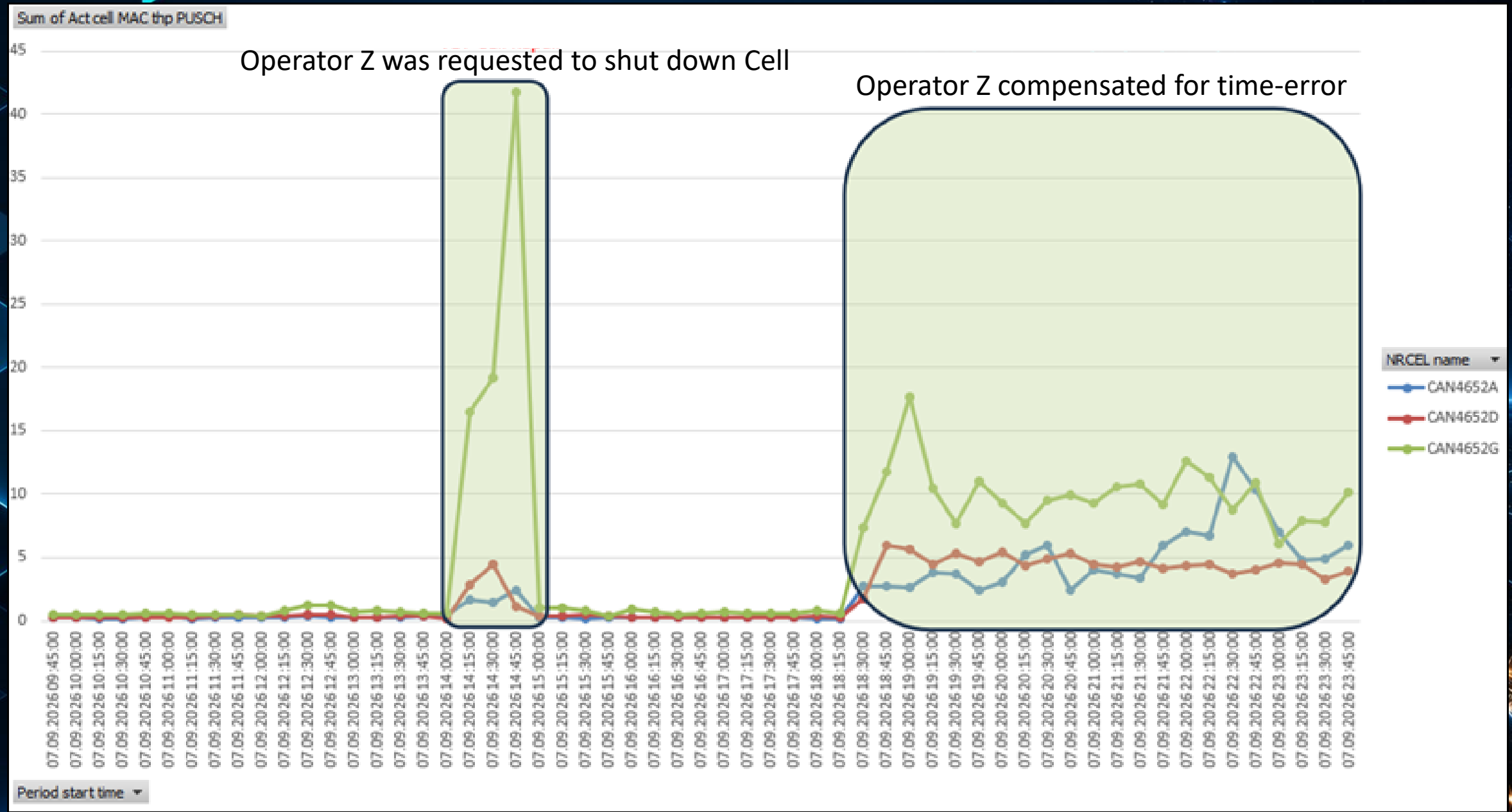
This is the primary physical data channel in wireless cellular networks (like LTE and 5G NR) used to send user data and control information from a mobile device to a base station.

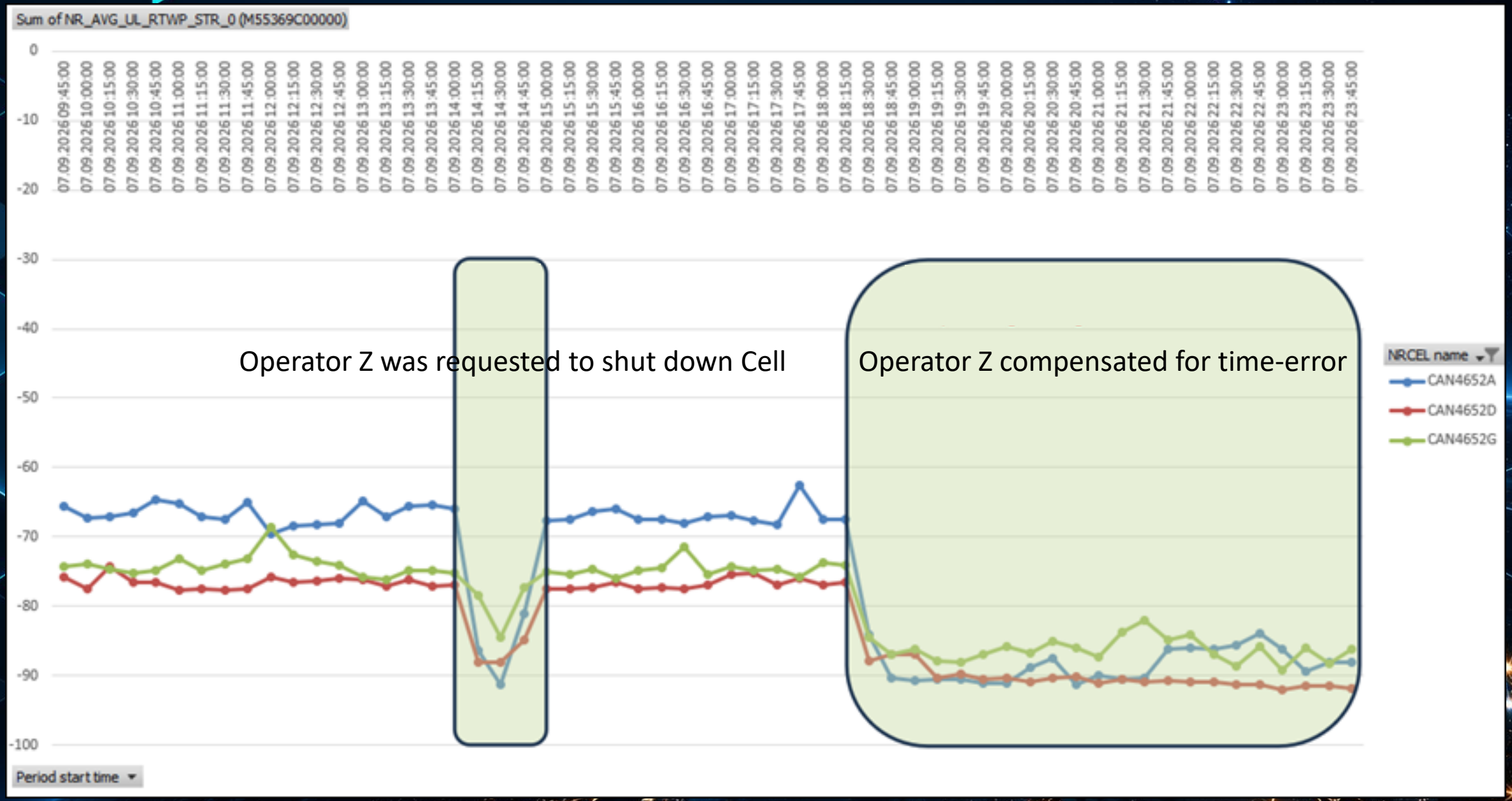
RTWP = Received Total Wideband Power

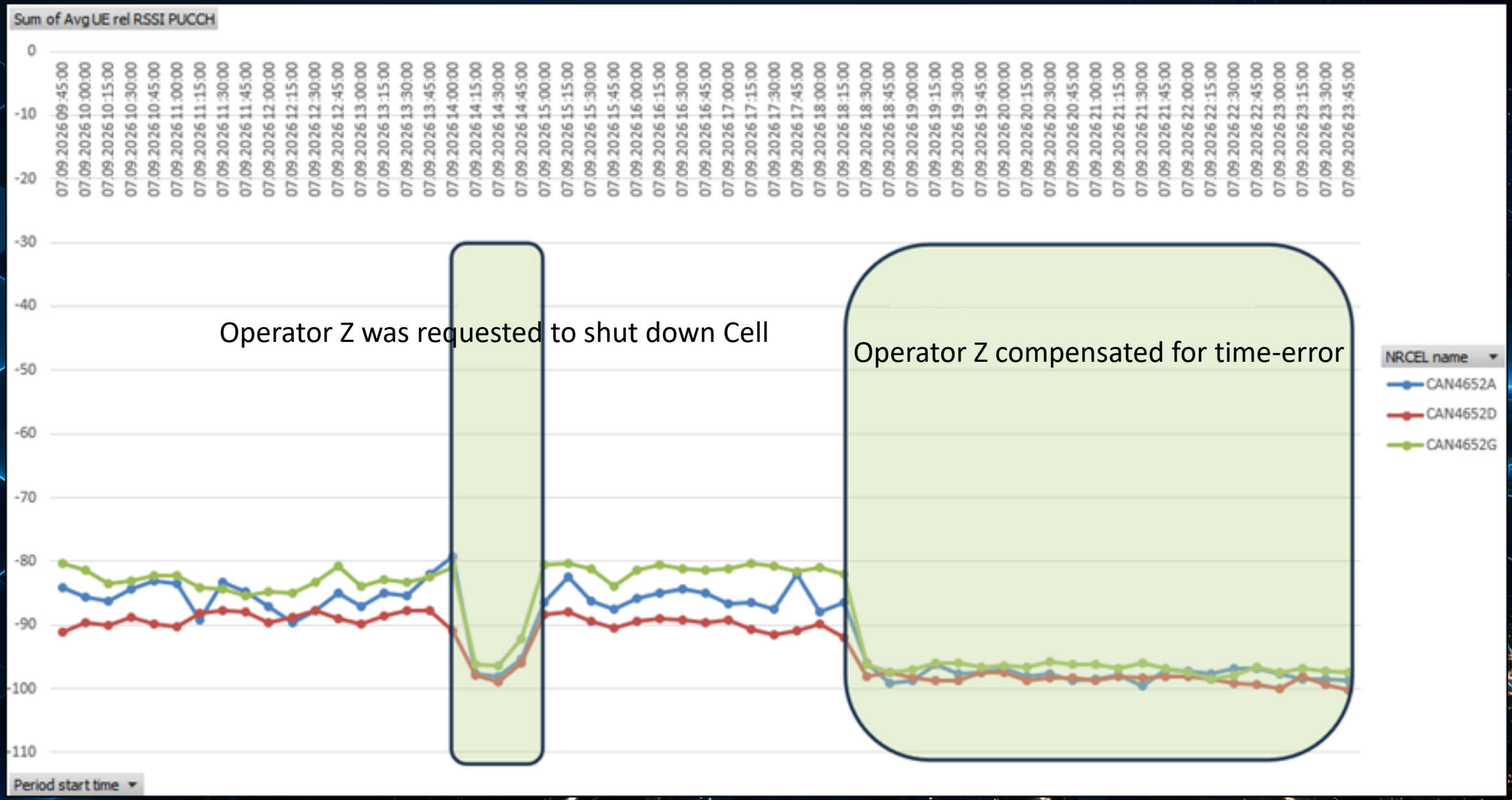
Is a key measurement parameter in cellular networks that calculates the total power received by a base station (NodeB) across its entire operating frequency band.

RSSI = Received Signal Strength Indicator

This is a measurement of the power level present in a received radio frequency signal.


Sum of Act cell MAC thp PUSCH
Operator Z was requested to shut down Cell
Operator Z compensated for time-error
45
40
35
30
25
20
15
10
5
0
07.09.2026 09:45:00
07.09.2026 10:00:00
07.09.2026 10:15:00
07.09.2026 10:30:00
07.09.2026 10:45:00
07.09.2026 11:00:00
07.09.2026 11:15:00
07.09.2026 11:30:00
07.09.2026 11:45:00
07.09.2026 12:00:00
07.09.2026 12:15:00
07.09.2026 12:30:00
07.09.2026 12:45:00
07.09.2026 13:00:00
07.09.2026 13:15:00
07.09.2026 13:30:00
07.09.2026 13:45:00
07.09.2026 14:00:00
07.09.2026 14:15:00
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07.09.2026 14:45:00
07.09.2026 15:00:00
07.09.2026 15:15:00
07.09.2026 15:30:00
07.09.2026 15:45:00
07.09.2026 16:00:00
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07.09.2026 22:45:00
07.09.2026 23:00:00
07.09.2026 23:15:00
07.09.2026 23:30:00
07.09.2026 23:45:00
Period start time
NRCEL name
CAN4652A
CAN4652D
CAN4652G


Sum of NR_AVG_UL_RTWP_STR_0 (M55369C00000)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
07.09.2026 09:45:00
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07.09.2026 23:15:00
07.09.2026 23:30:00
07.09.2026 23:45:00
Operator Z was requested to shut down Cell
Operator Z compensated for time-error
NRCEL name
CAN4652A
CAN4652D
CAN4652G
Period start time


Sum of Avg UE rel RSSI PUCCH
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
07.09.2026 09:45:00
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07.09.2026 10:30:00
07.09.2026 10:45:00
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07.09.2026 20:45:00
07.09.2026 21:00:00
07.09.2026 21:15:00
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07.09.2026 23:00:00
07.09.2026 23:15:00
07.09.2026 23:30:00
07.09.2026 23:45:00
Operator Z was requested to shut down Cell
Operator Z compensated for time-error
NRCEL name
CAN4652A
CAN4652D
CAN4652G
Period start time

During the NATO summit we visited various sites and took measurements of locations that where known to us to have bad KPI.
They all had similar problems, a basestation (each time a different operator X, Y or Z) had bad synchronisation and was causing interference. This in turn was showing similar RSSI KPI's.







CONCLUSION

When GNSS becomes unavailable for whatever reason at the base station, there will be no reference to validate the timing received from the network.
A base station will be unaware that its timing is wrong.

The base station will remain operational and continue transmitting despite a significant phase error.
The impact will cross operator boundaries causing bad or no service.

You cannot manage what you cannot measure.
Good synchronization is a must.
Good measurement is the key

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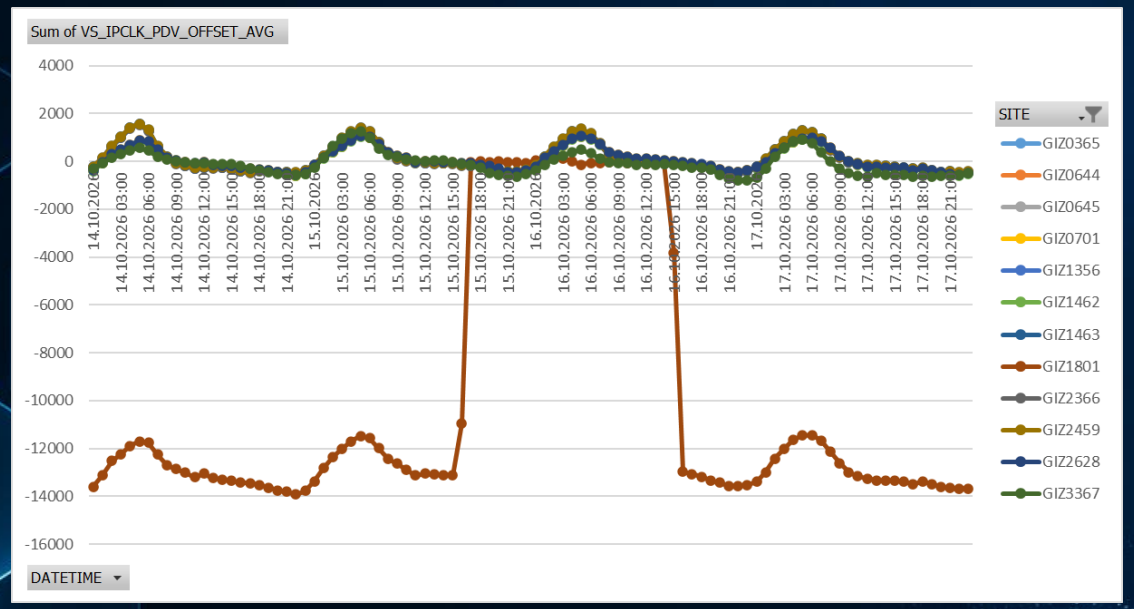
Thank You

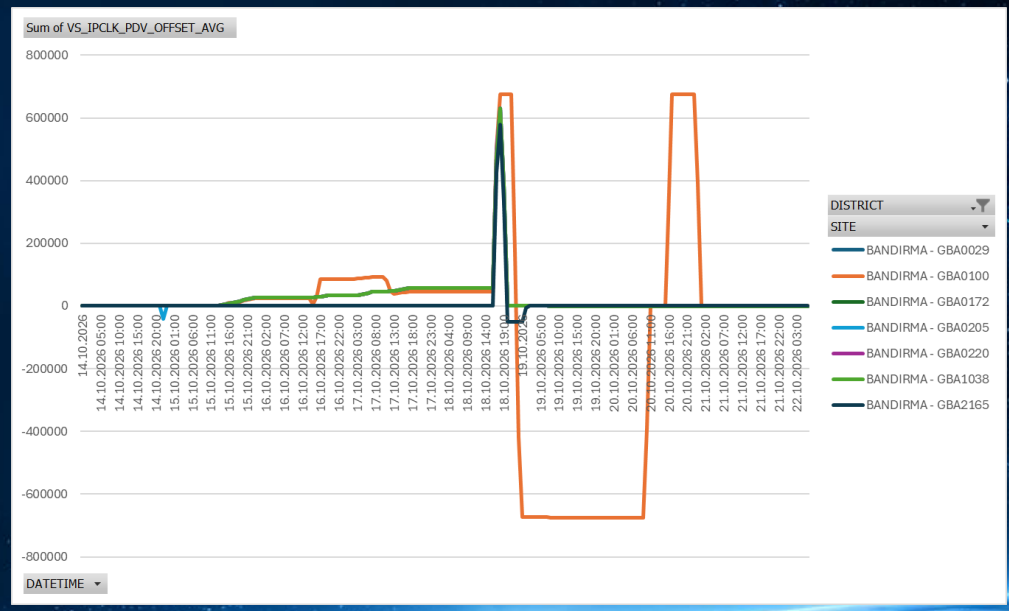


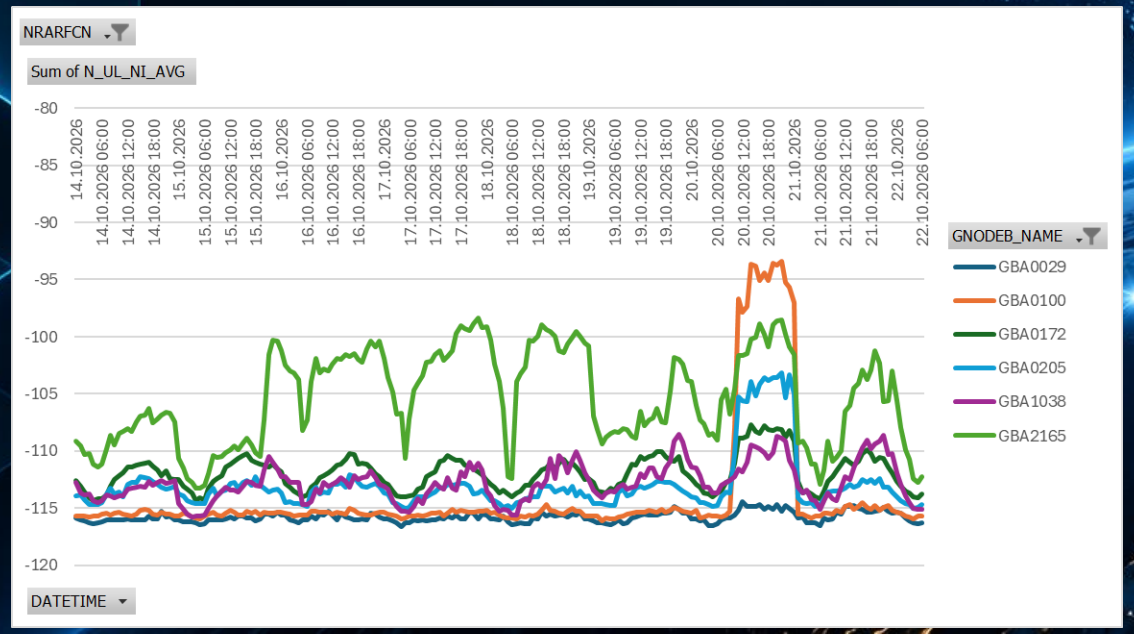
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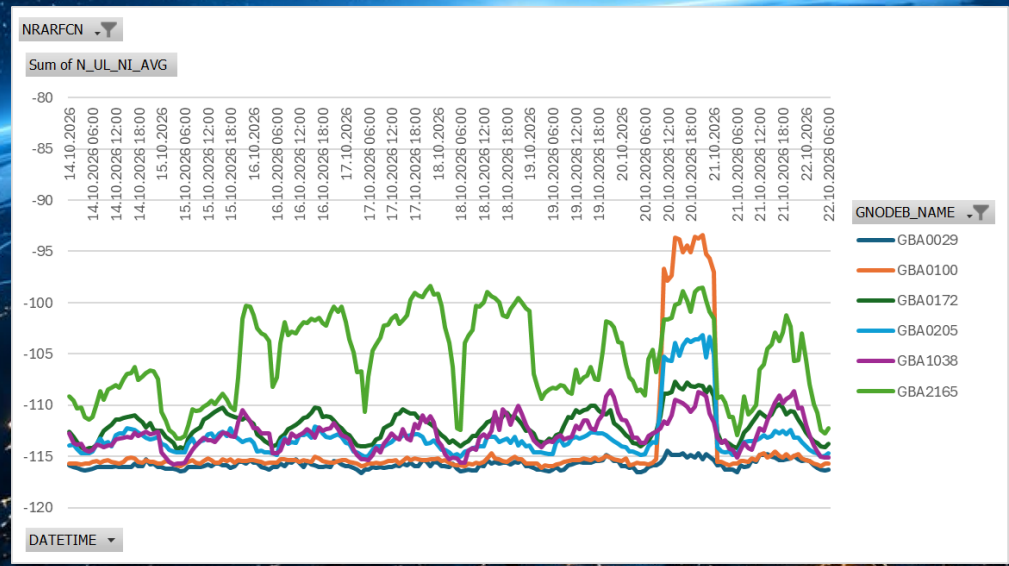
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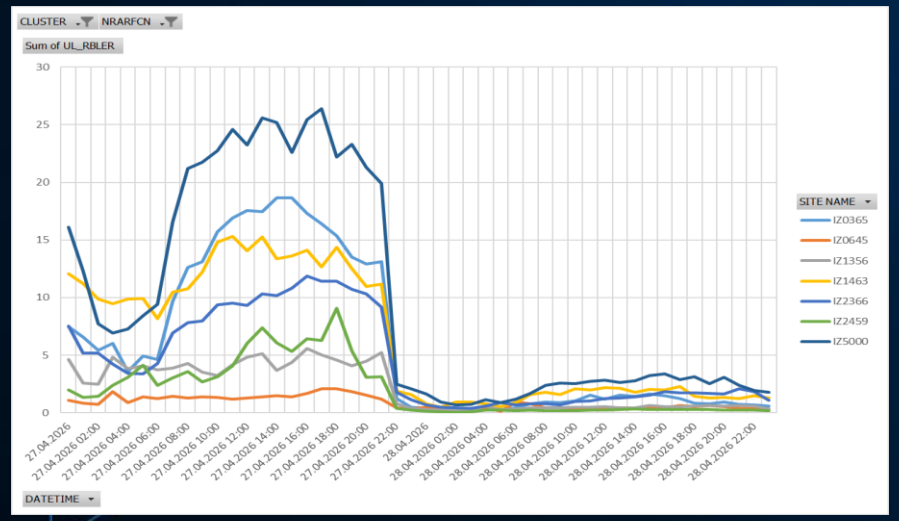
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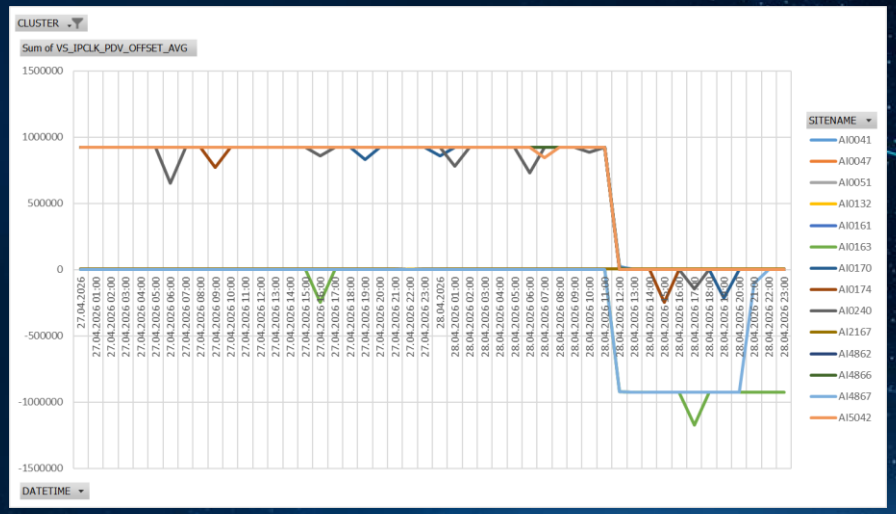


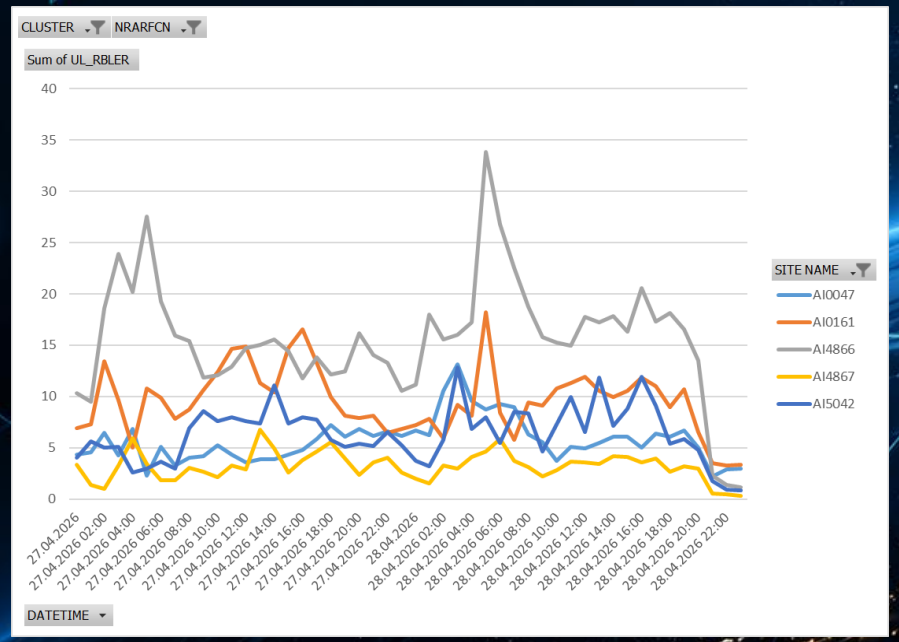


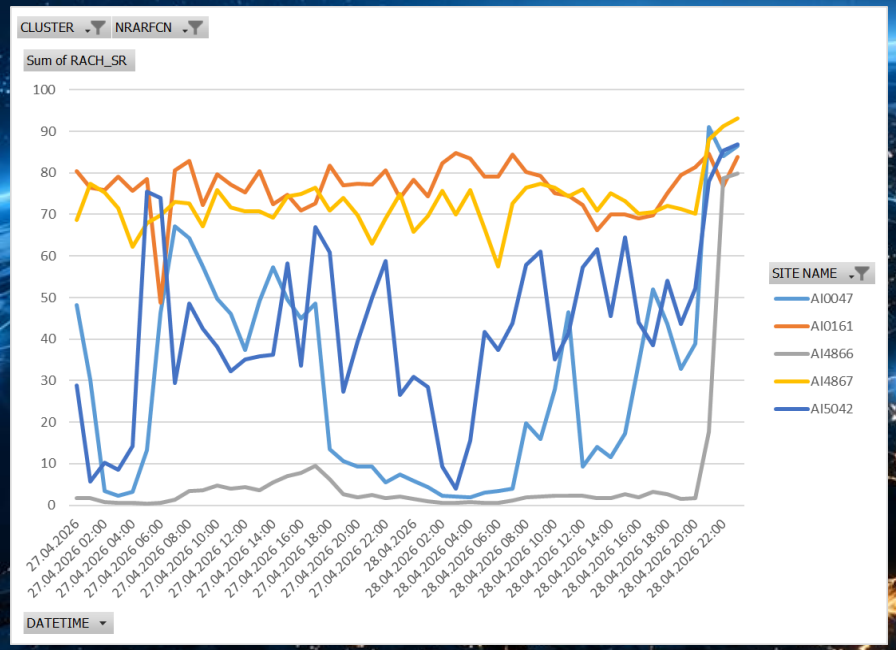





CLUSTER
NRARFCN
Sum of UL_RBLER
SITE NAME
IZ0365
IZ0645
IZ1356
IZ1463
IZ2366
IZ2459
IZ5000
DATETIME


CLUSTER
Sum of VS_IPCLK_PDV_OFFSET_AVG
SITENAME
AI0041
AI0047
AI0051
AI0132
AI0161
AI0163
AI0170
AI0174
AI0240
AI2167
AI4862
AI4866
AI4867
AI5042
DATETIME


CLUSTER
NRARFCN
Sum of UL_RBLER
SITE NAME
AI0047
AI0161
AI4866
AI4867
AI5042
DATETIME


CLUSTER
NRARFCN
Sum of RACH_SR
SITE NAME
AI0047
AI0161
AI4866
AI4867
AI5042
DATETIME