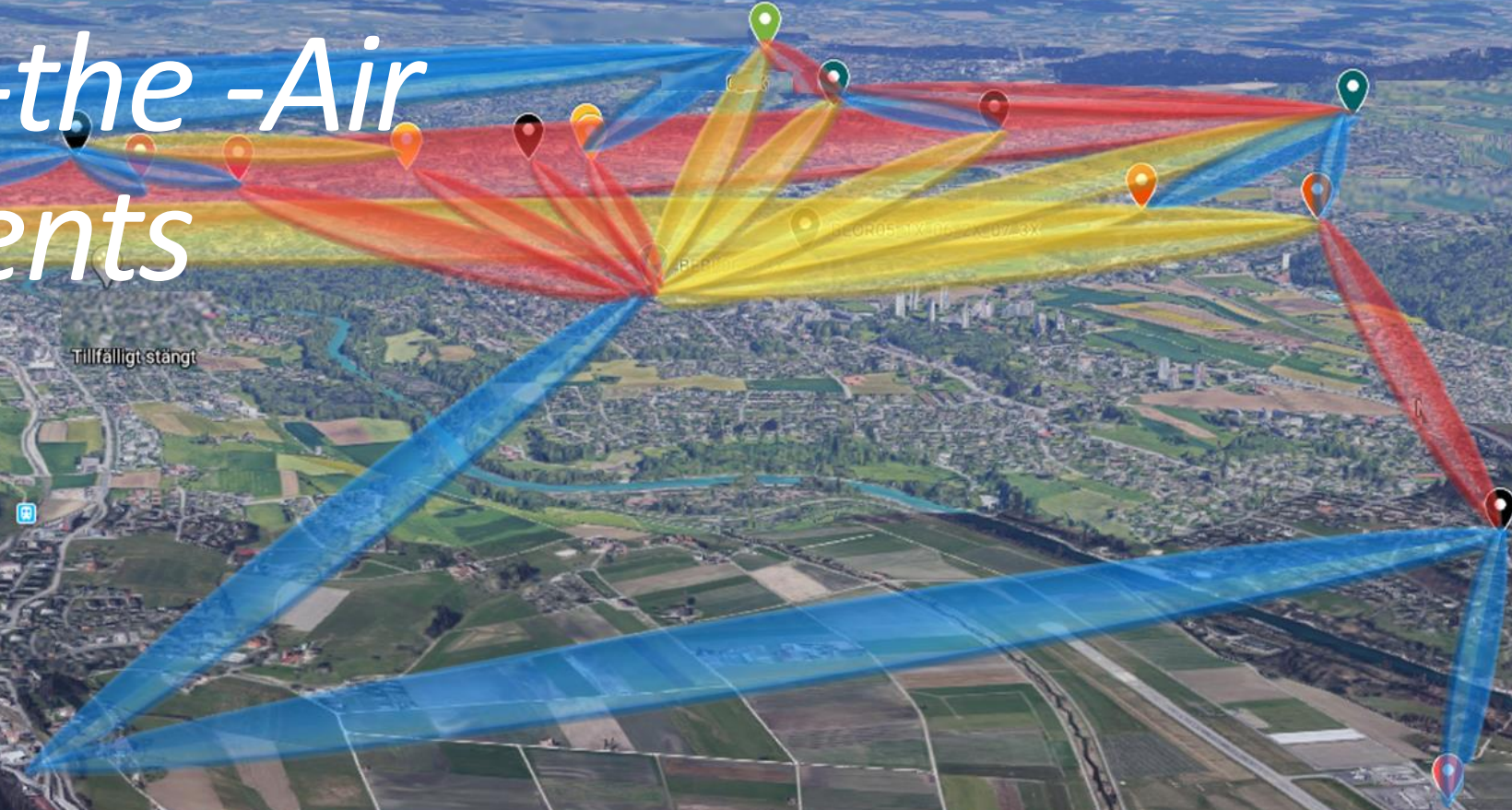


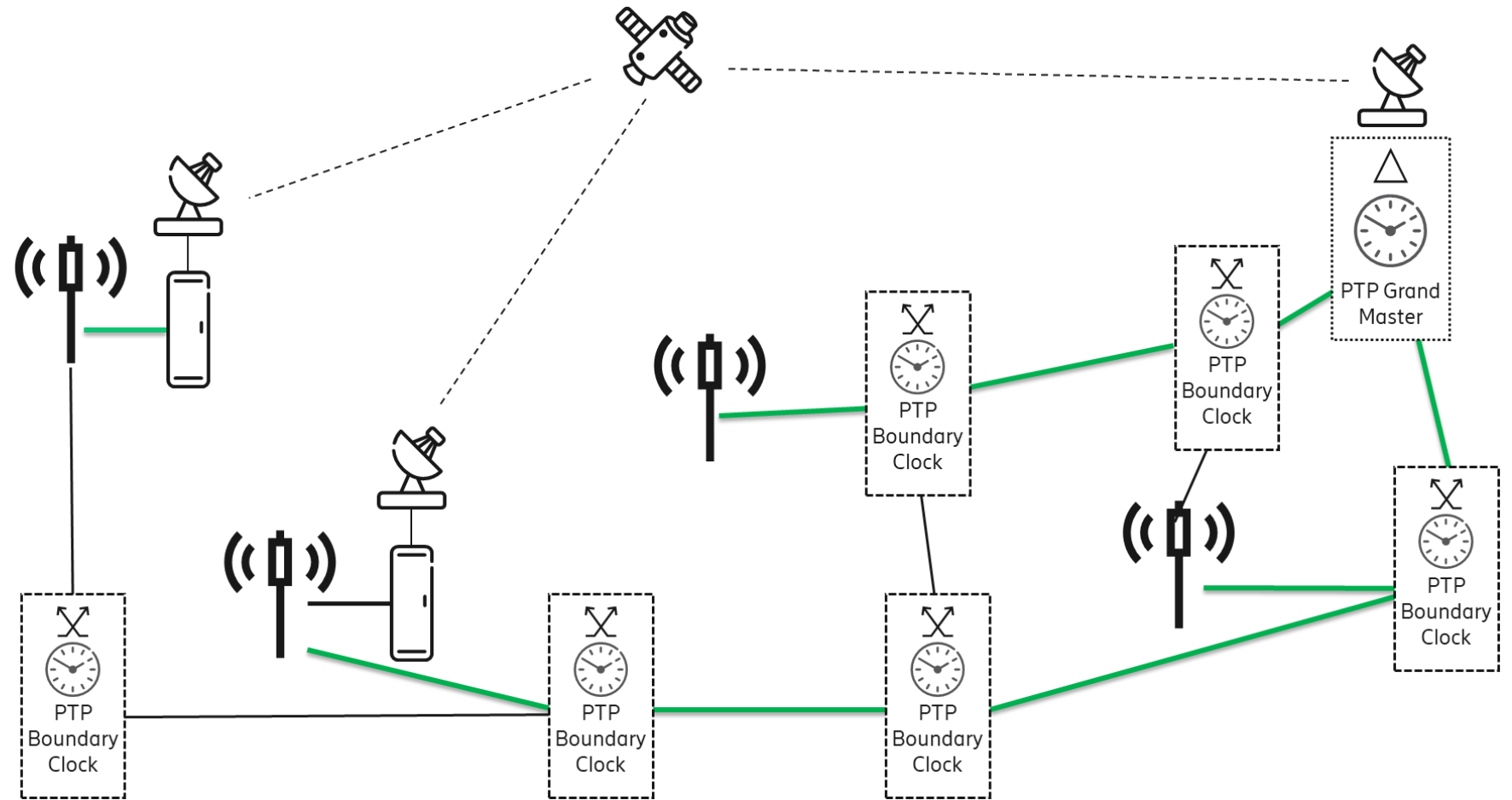
# *Assisted Time Holdover using Over-the-Air Measurements*



*Presenter:  
Alexandra Mikaelsson – Senior Specialist Sync Solution, Ericsson RBS Development*

# Tasks of Network synchronization

- ✓ Distribute
- ✓ Verify
- ✓ Maintain



# Agenda

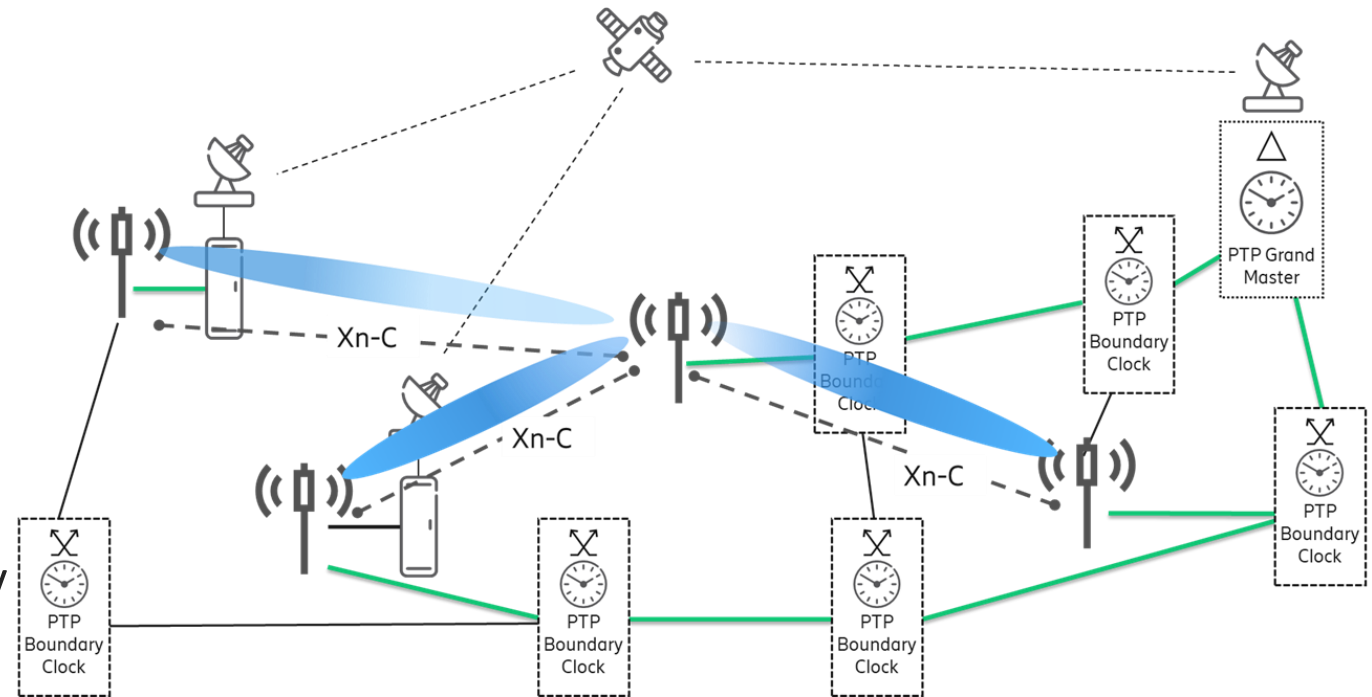
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- Sync accuracy verification with Over-the-Air measurements
- Holdover with Over-the-Air measurements
- Field results: accuracy in holdover



# Method to measure time alignment at the antennas

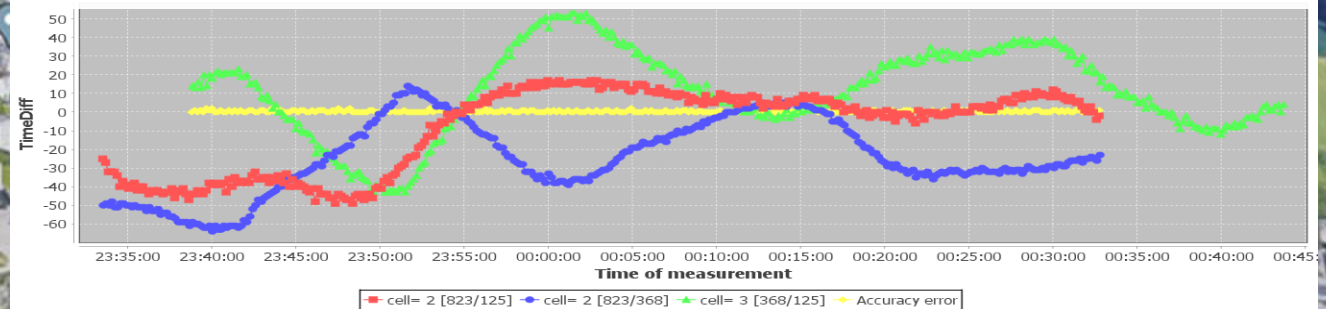
- Two-way measurement
  - Cells transmit and receive radio reference signal over the air and measure its time of arrival.
  - Cells exchange measurement results over backhaul connection.
- Tx/Rx on the same frequency
  - Reciprocal channel, hence, asymmetry is avoided



# Accuracy of over-the-air measurements



$$TAE3 = (TAE1 - TAE2) + \text{measurement\_error}$$



Field result: Measurement accuracy at each moment in time is better than 3 ns (yellow line in the diagram)

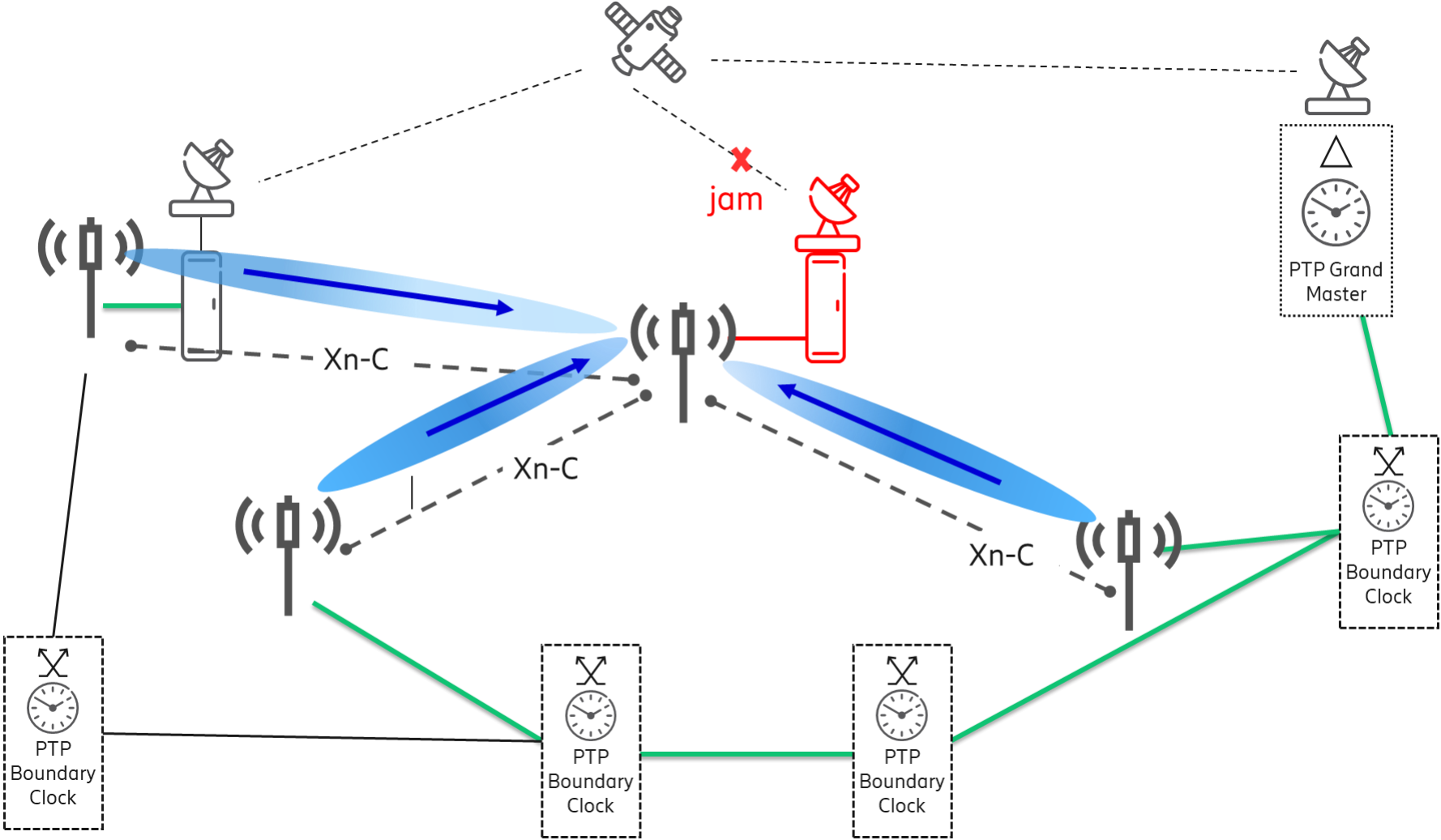
$$(TAE3 - (TAE1 - TAE2)) / 3 < 3 \text{ ns}$$

# Field results: Reachability of over-the-air measurements



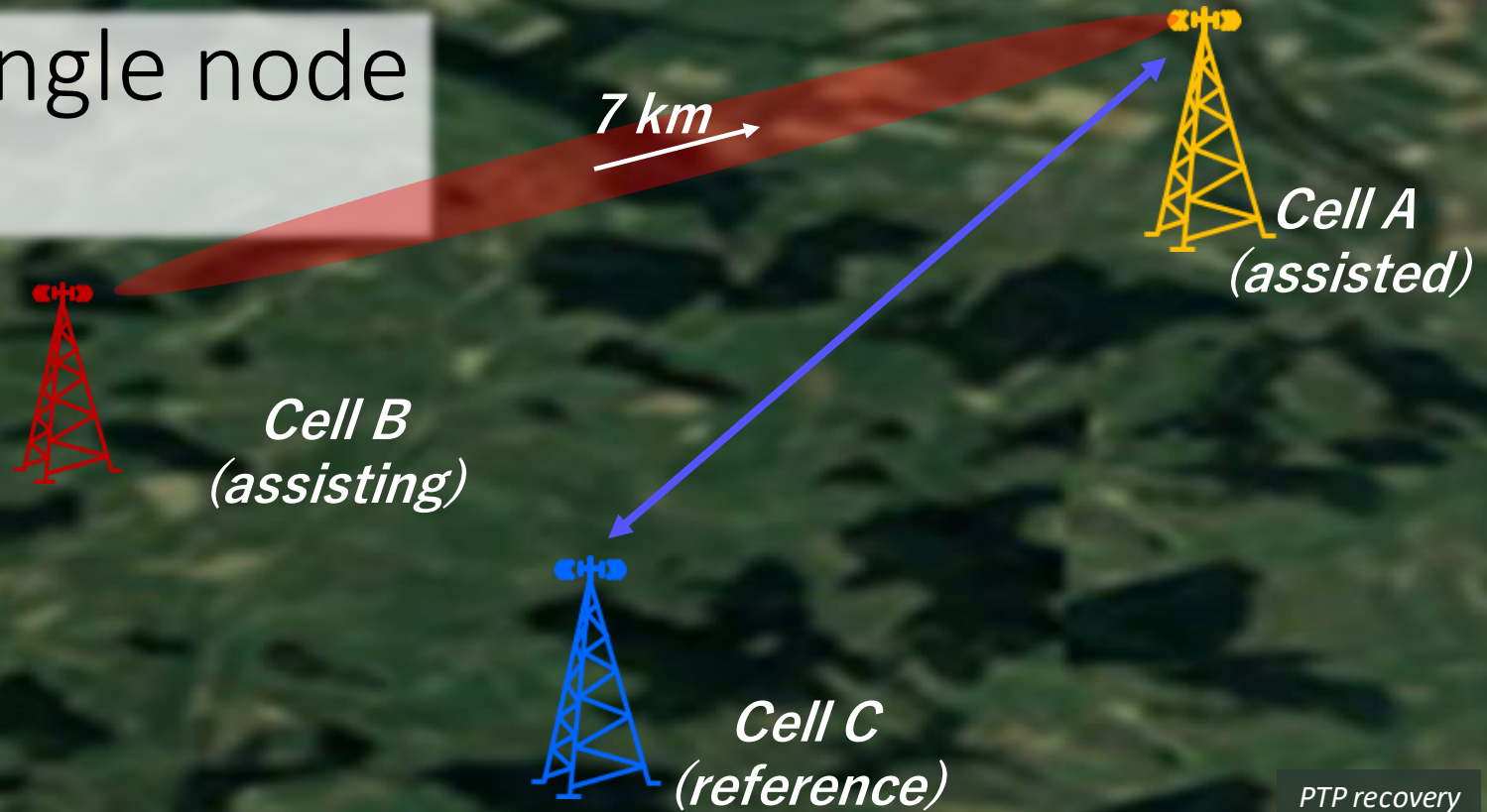
<b><i>Transmission power</i></b>	<b><i>large distance (&lt;19km)</i></b>	<b><i>short distance (&lt;5km)</i></b>
0,32 – 6,46 W	69% (310/446)	83% (246/298)
60 – 100 W	87% (590/672)	92% (364/394)

# Maintaining synchronization with over-the-air measurements



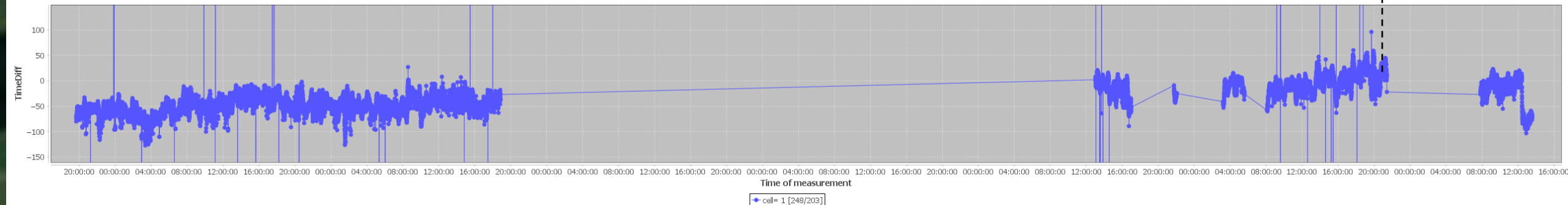
# Field results: Single node performance

- ✓ Experiment duration: 7 days
- ✓ Time Error A-C has increased ~50 ns



Ribs Data analyzer

PTP recovery



7 days



# Reference switch in cluster step 1

Block PTP input to the cluster:  
✓ Cell M selected Cell Y  
✓ Cell N selected Cell X



# Reference switch in cluster, step 2

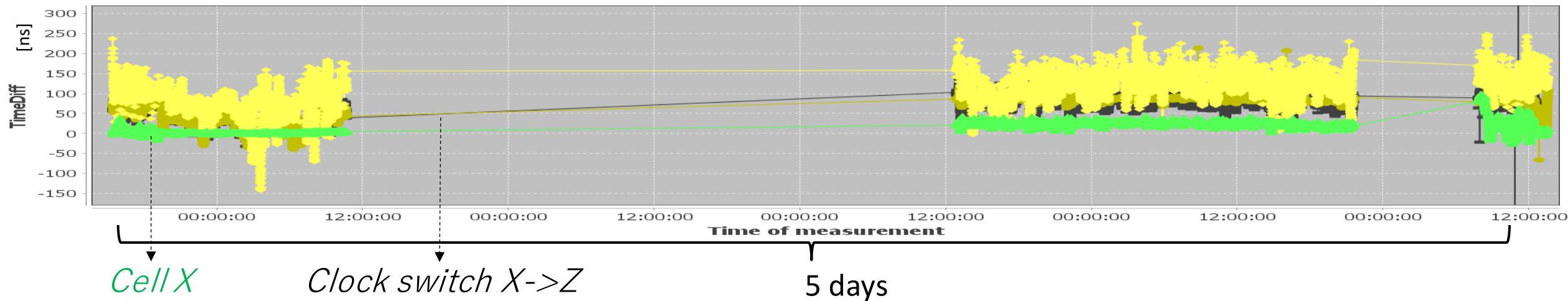
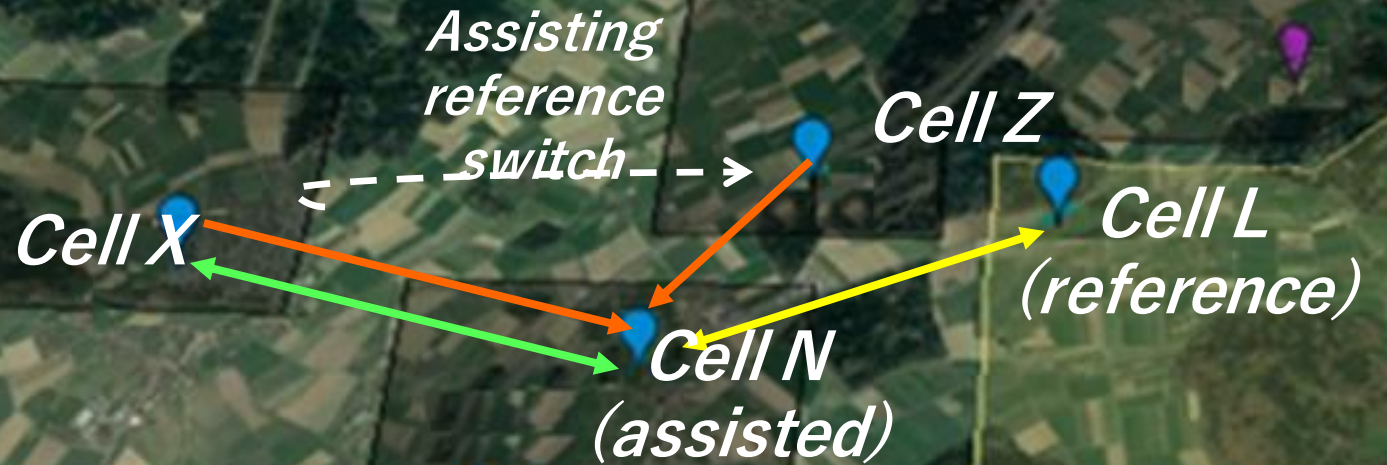
Block PTP to Cell X

- ✓ Cell X selected Cell Y
- ✓ Cell N selected Cell Z

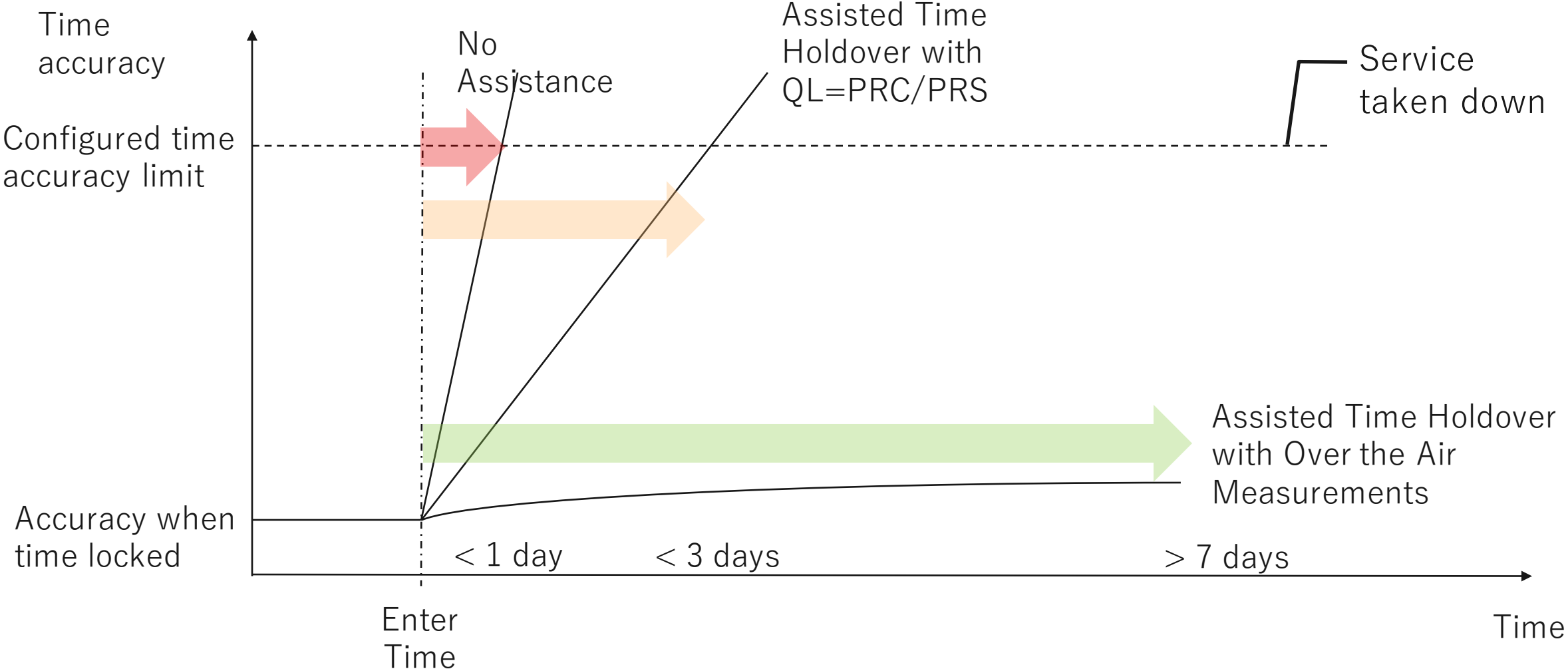


# Field results: performance with reference switch

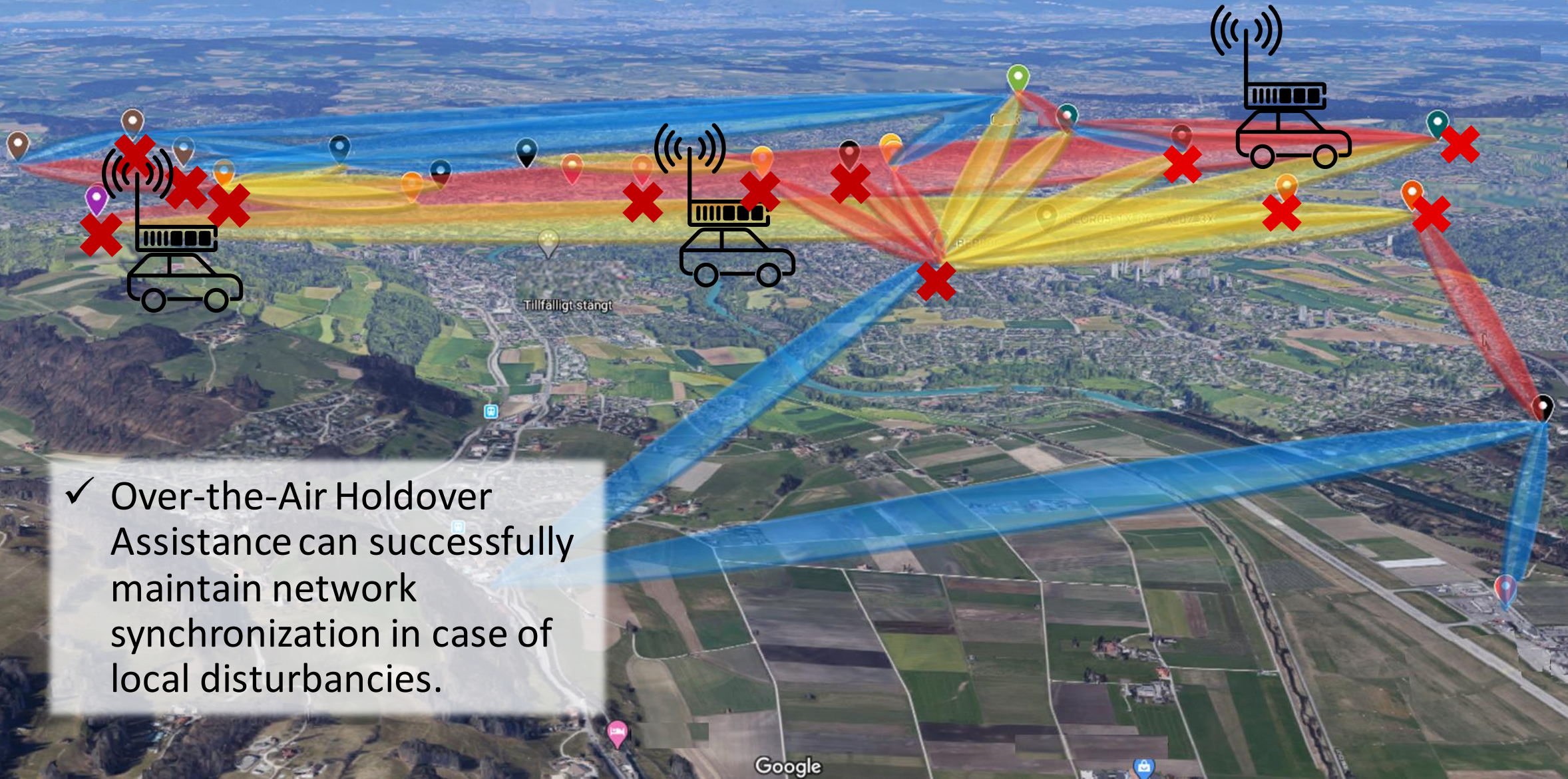
- ✓ Experiment duration: 5 days
- ✓ Time Error N-X and N-L increased < 30 ns



# Time Holdover performance comparison



# Conclusion



- ✓ Over-the-Air Holdover Assistance can successfully maintain network synchronization in case of local disturbances.



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