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Institute of Computer Science
Chair of Communication Networks
Prof. Dr. Tobias Hoßfeld

Towards Understanding the Global IPX Network from an MVNO Perspective

Viktoria Vomhoff, Stefan Geißler, Tobias Hoßfeld

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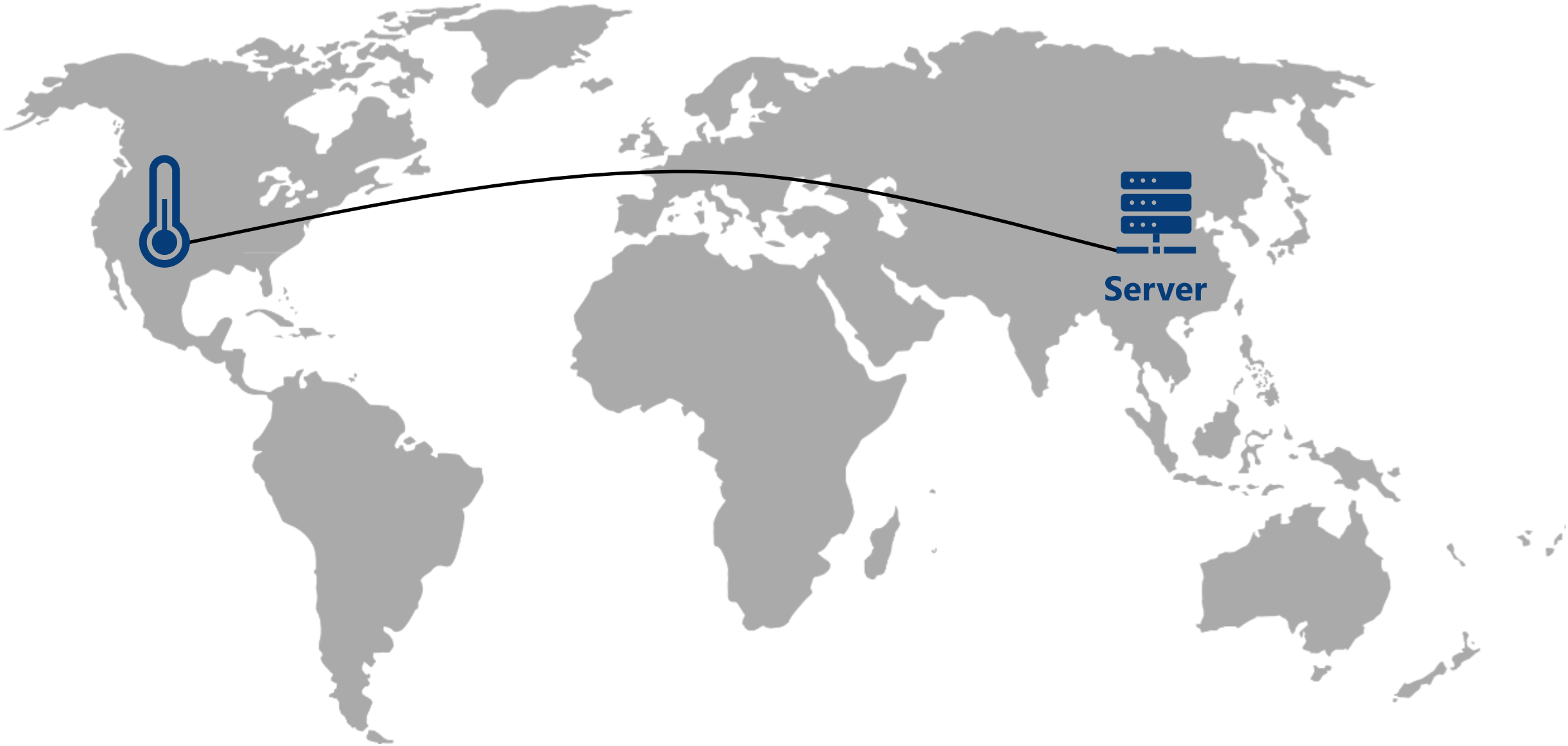
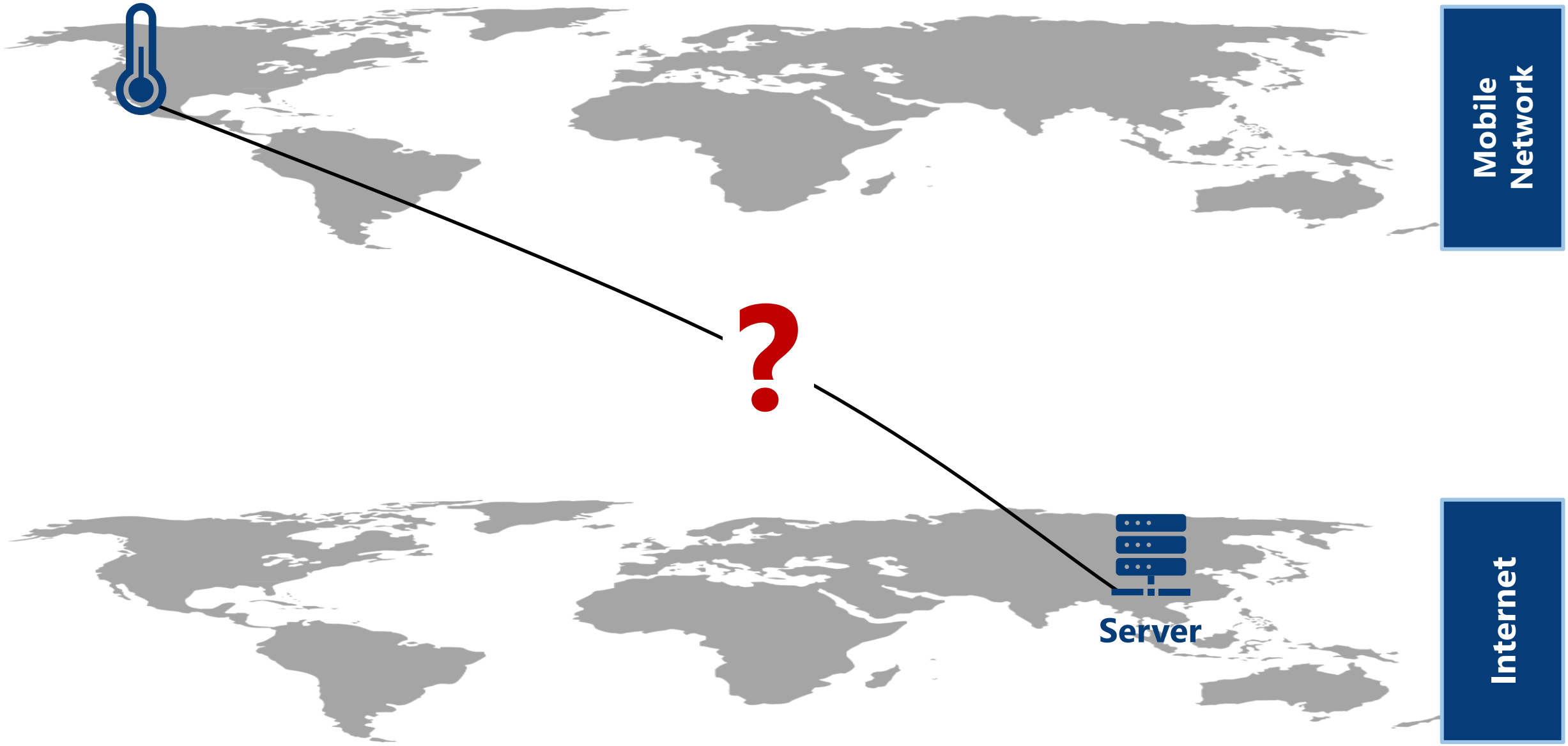
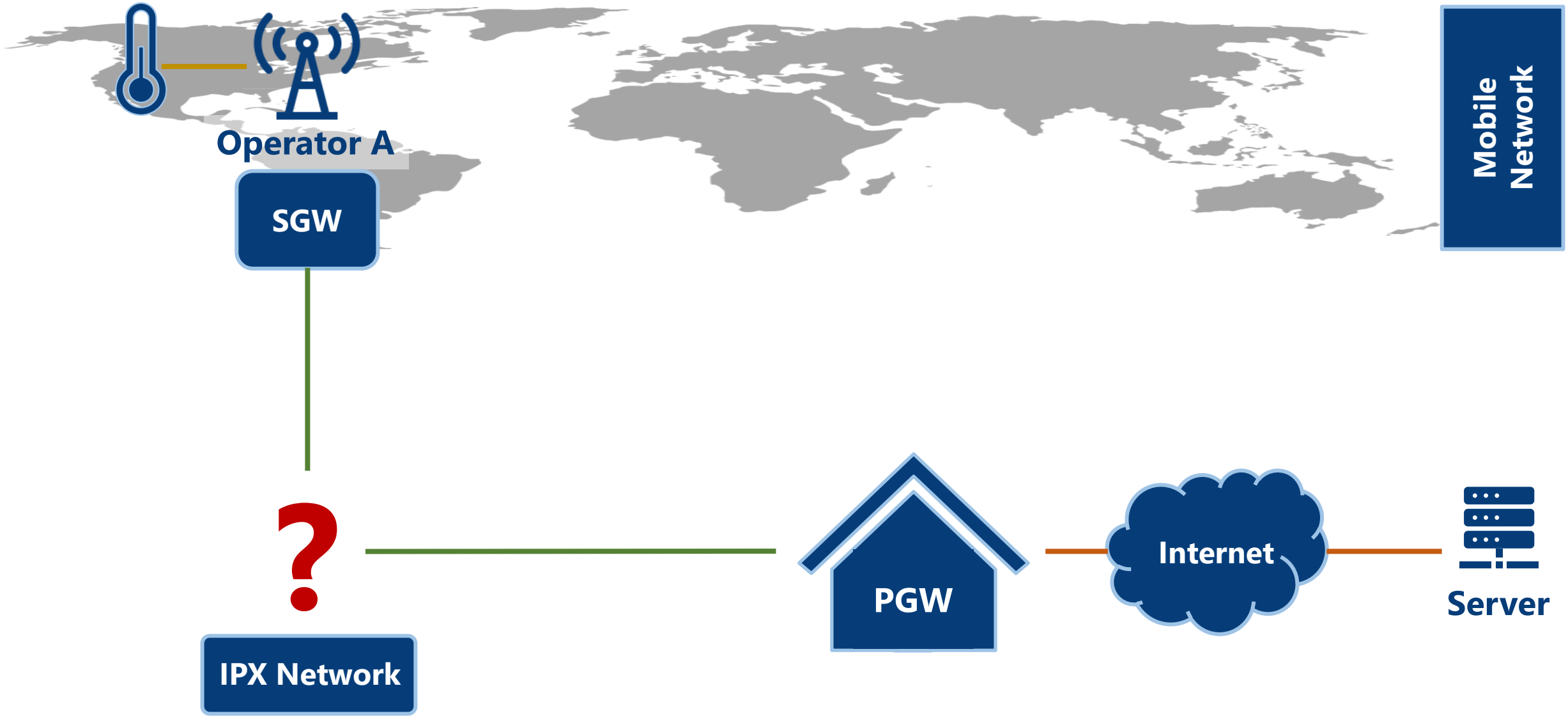
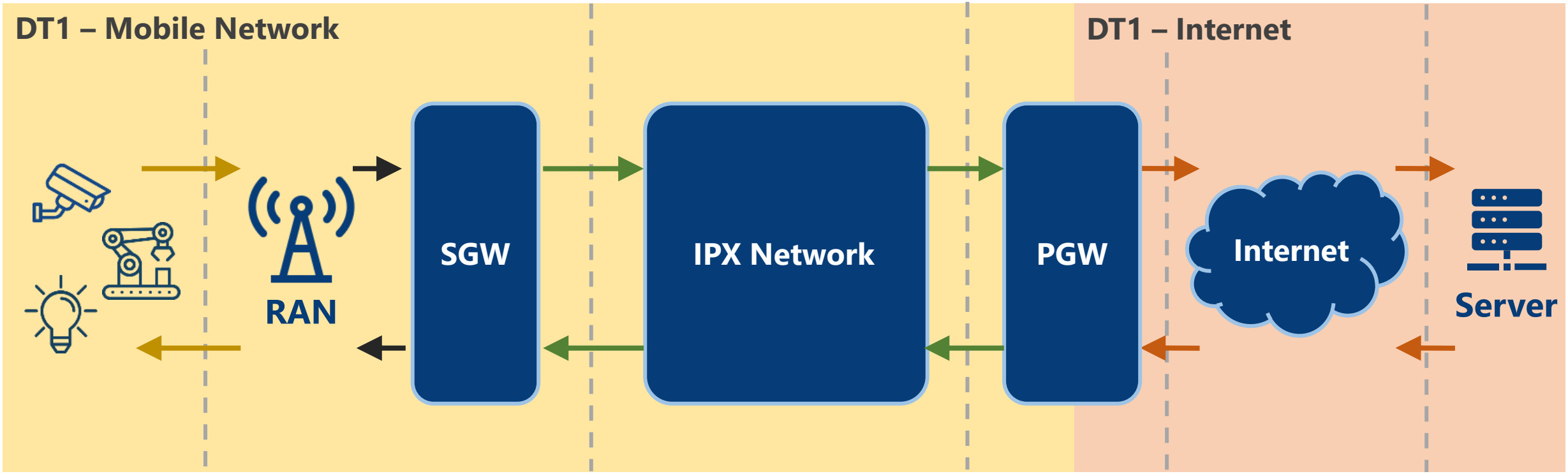

Server


Mobile Network
?
Server
Internet

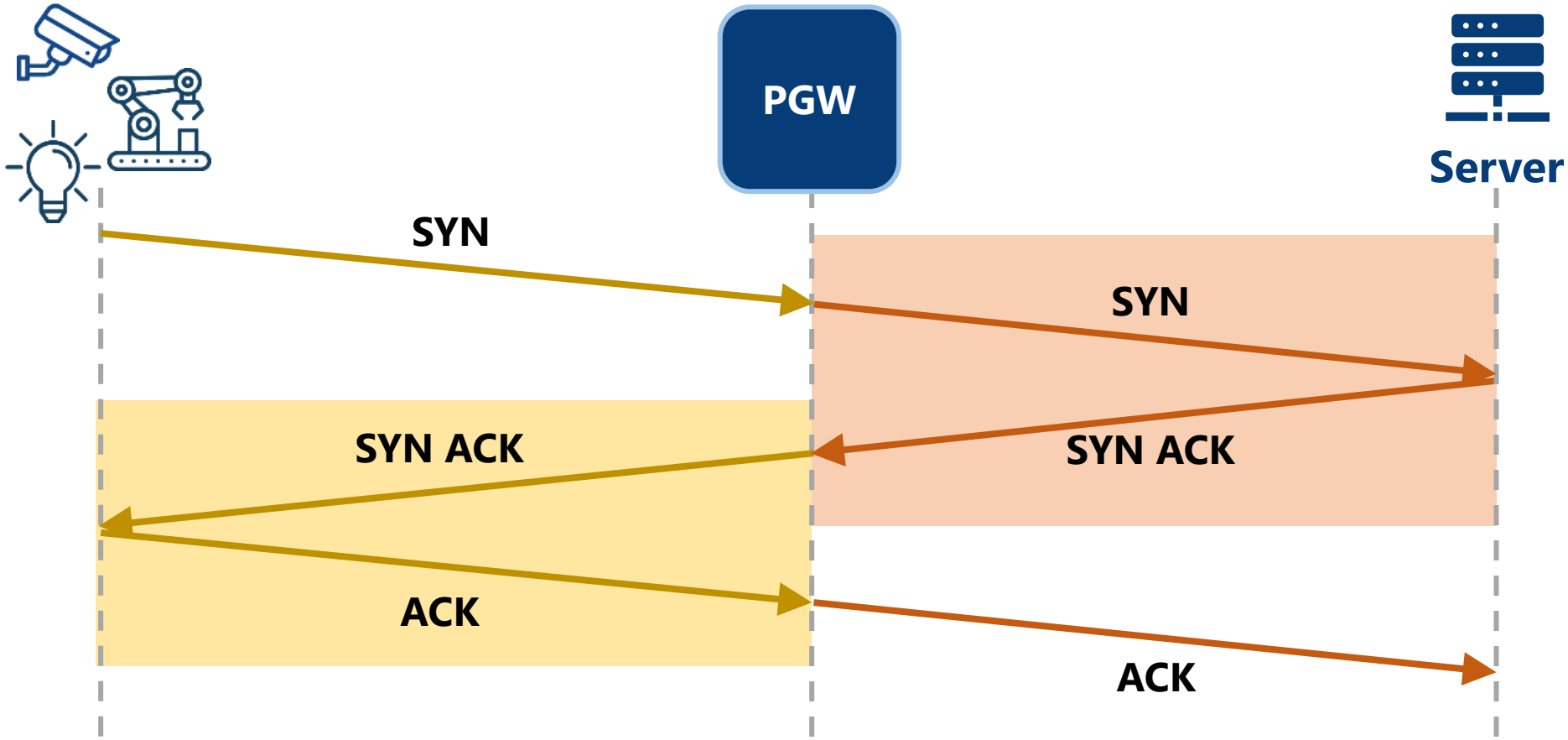

Operator A
SGW
Mobile Network
?
IPX Network
PGW
Internet
Server

Dataset Overview

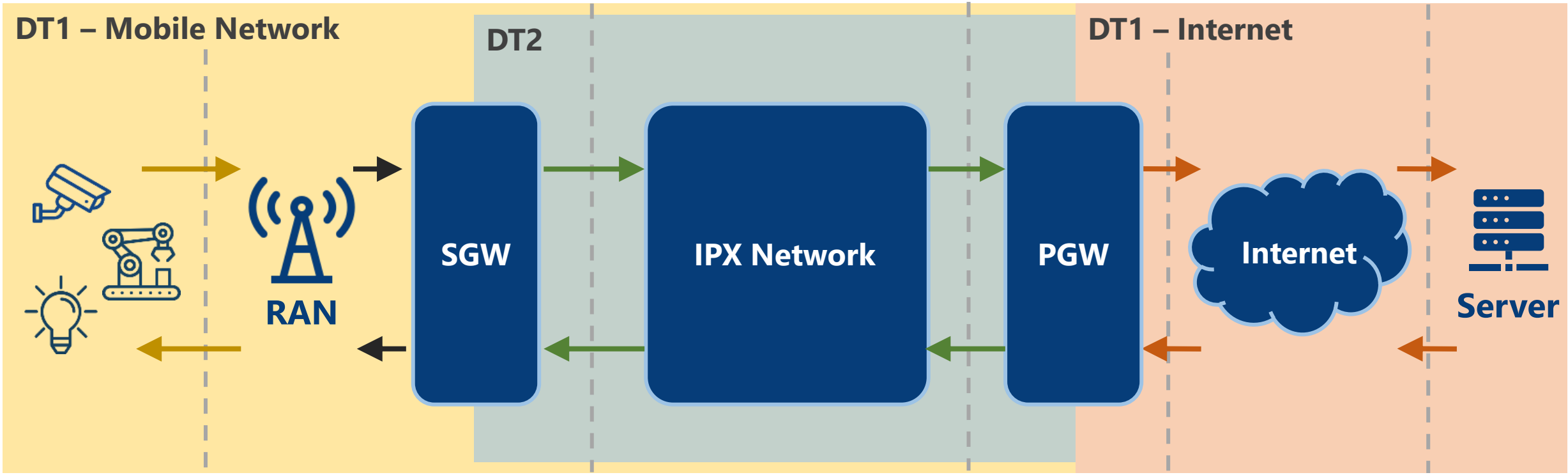


No.	Data	Type	Location
DT1	User Plane Traces	L2-4, MCC/MNC	Device – PGW – Server

DT1 – Delay Measurements

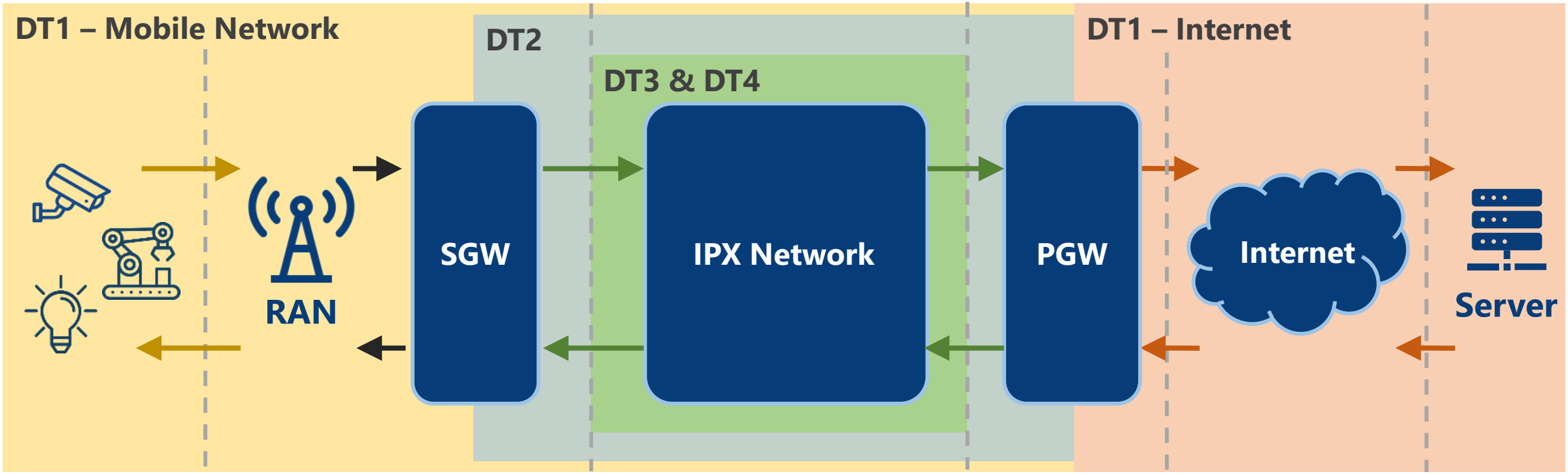


Dataset Overview

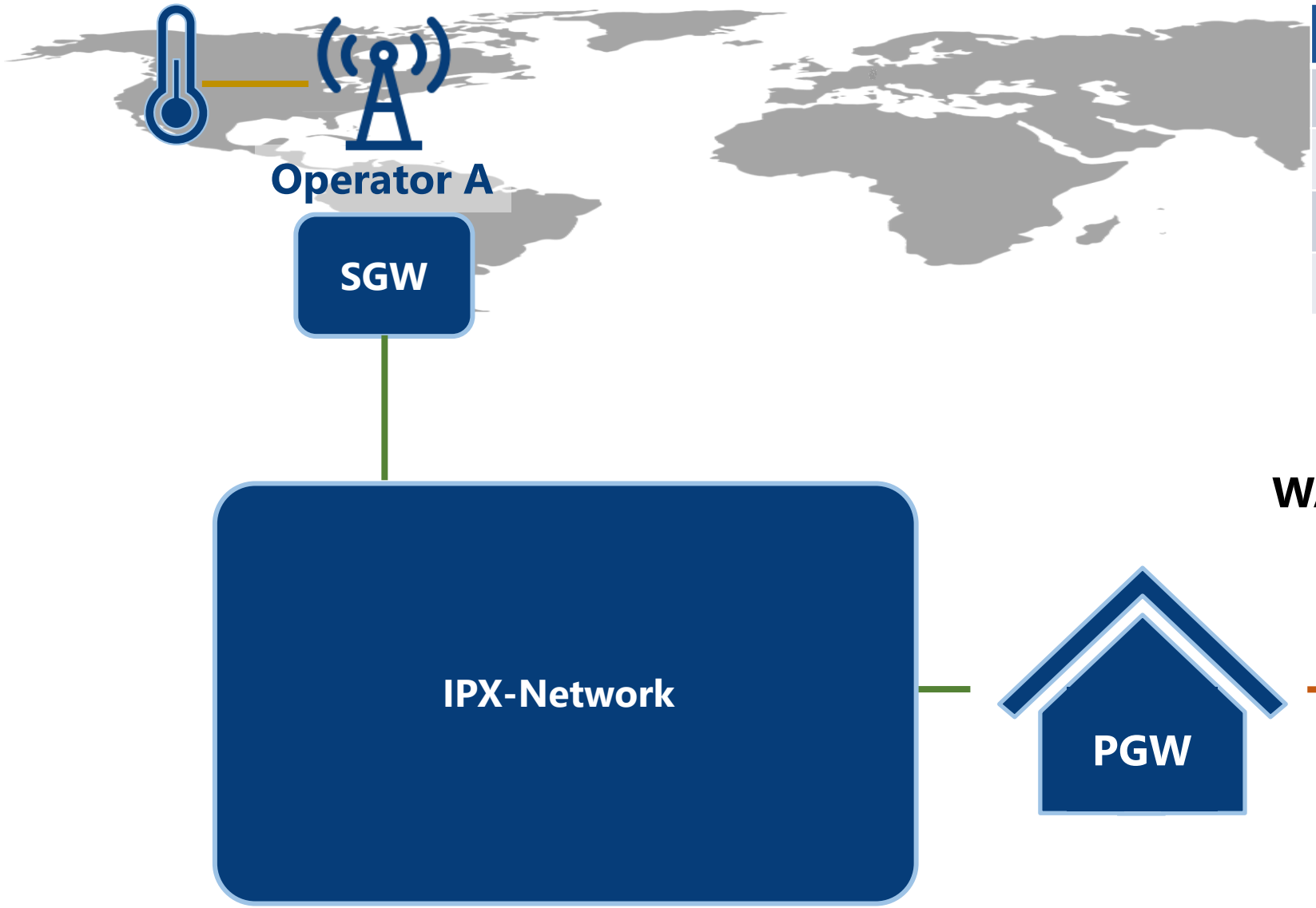


No.	Data	Type	Location
DT1	User Plane Traces	L2-4, MCC/MNC	Device – PGW – Server
DT2	IPX Delay Measurements	Response Times	SGW – PGW

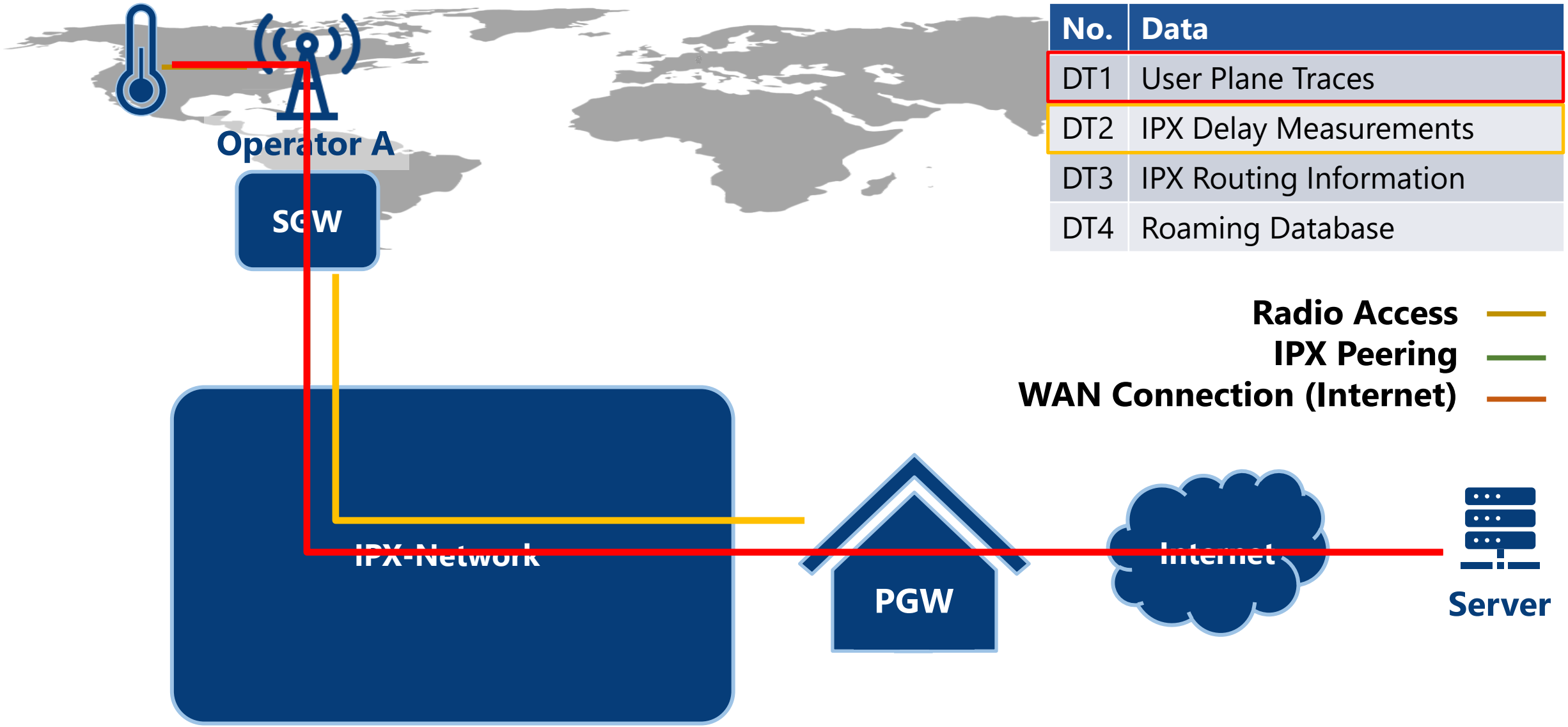
Dataset Overview



No.	Data	Type	Location
DT1	User Plane Traces	L2-4, MCC/MNC	Device – PGW – Server
DT2	IPX Delay Measurements	Response Times	SGW – PGW
DT3	IPX Routing Information	AS Paths	IPX Network
DT4	Roaming Database	IR.21	IPX Network



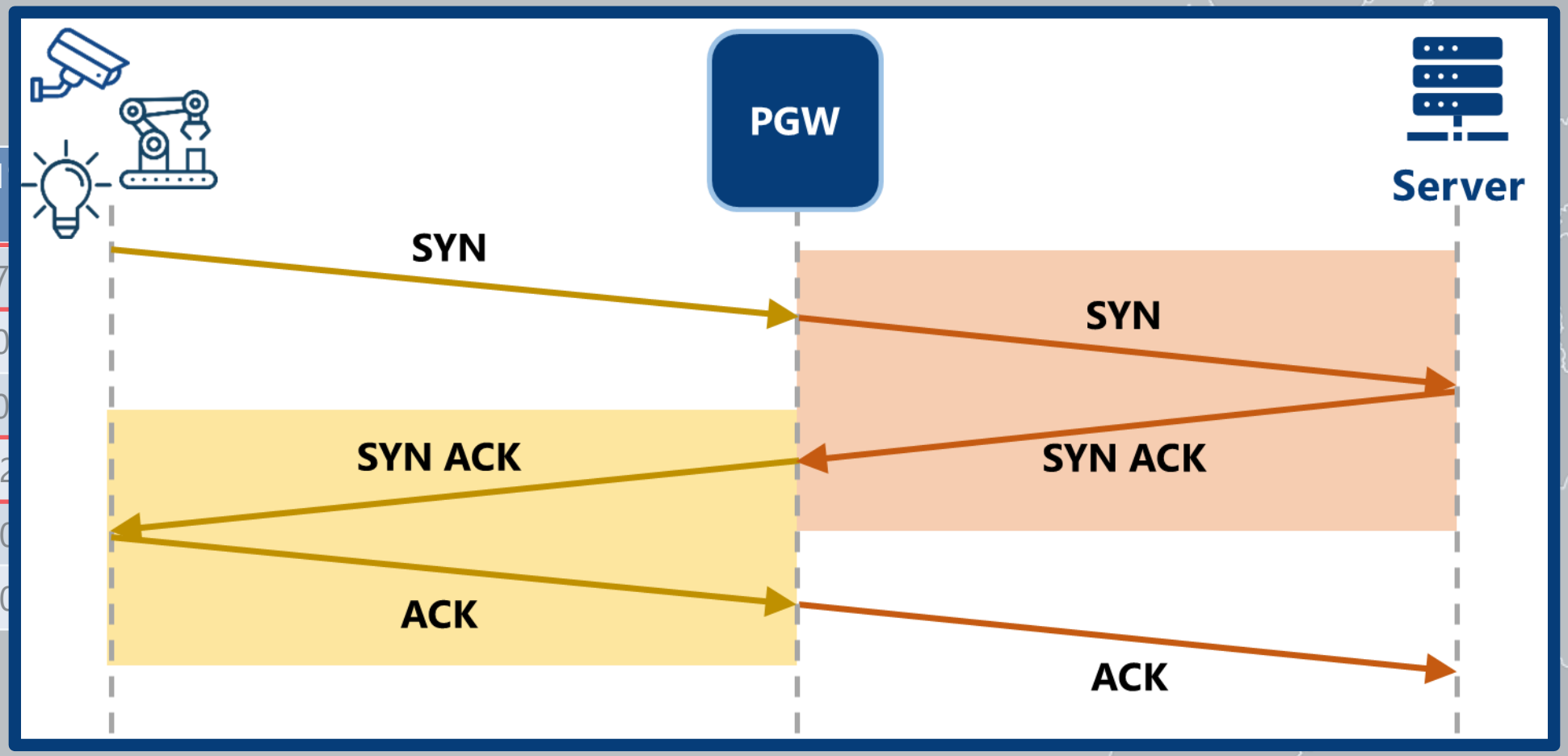
No.	Data
DT1	User Plane Traces
DT2	IPX Delay Measurements
DT3	IPX Routing Information
DT4	Roaming Database



No.	Data
DT1	User Plane Traces
DT2	IPX Delay Measurements
DT3	IPX Routing Information
DT4	Roaming Database

DT1: Germany

		1
Mobile Network	C	47
	D	40
	E	60
Internet	C	0.2
	D	0.0
	E	0.0



DT1: Germany

		1% Quantile (ms)	99% Quantile (ms)	Mean (ms)	Median (ms)
Mobile Network	C	47.41	378.37	83.96	71.41
	D	40.30	732.91	108.37	60.28
	E	60.15	868.33	147.26	98.47
Internet	C	0.24	118.61	20.57	0.82
	D	0.013	176.17	22.83	10.91
	E	0.087	186.57	27.35	19.48

DT1: Germany

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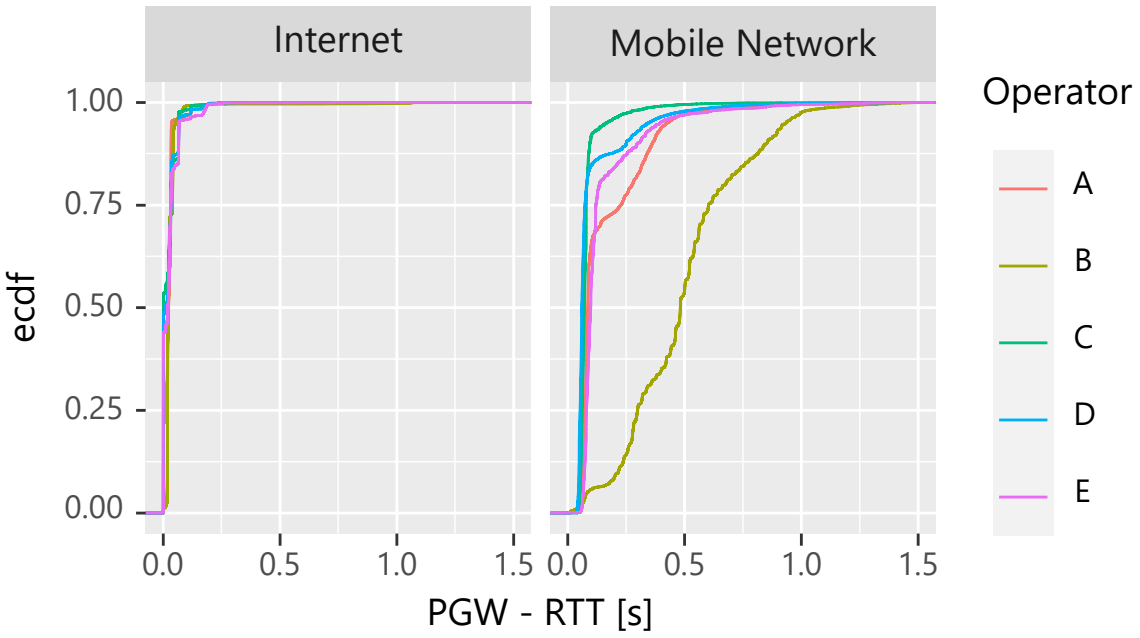
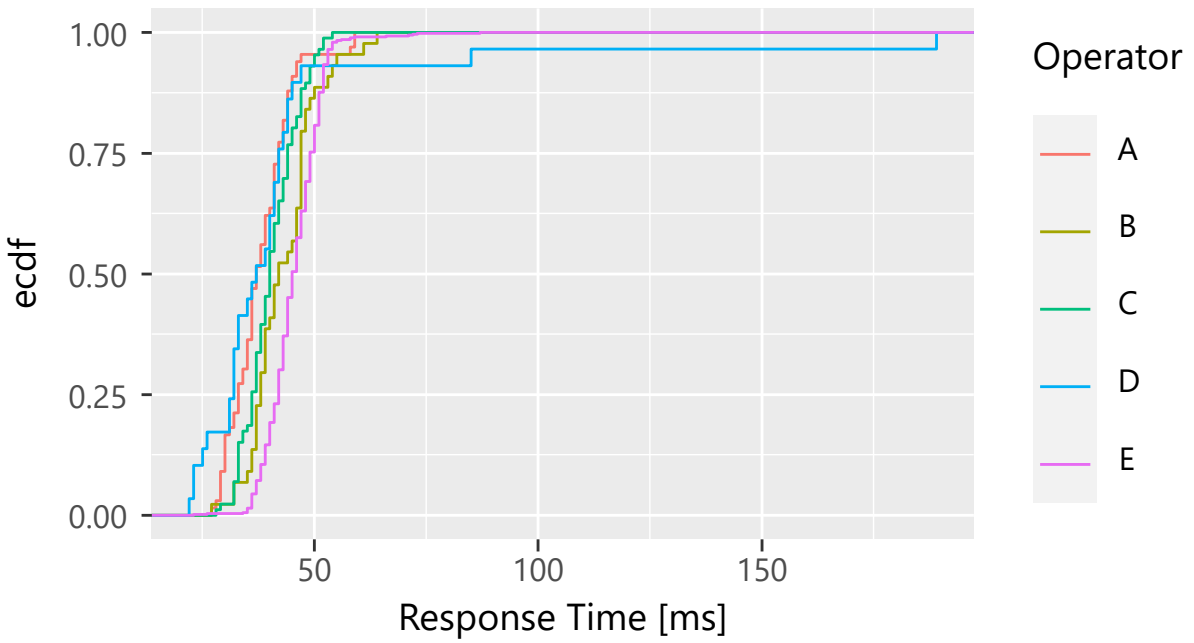
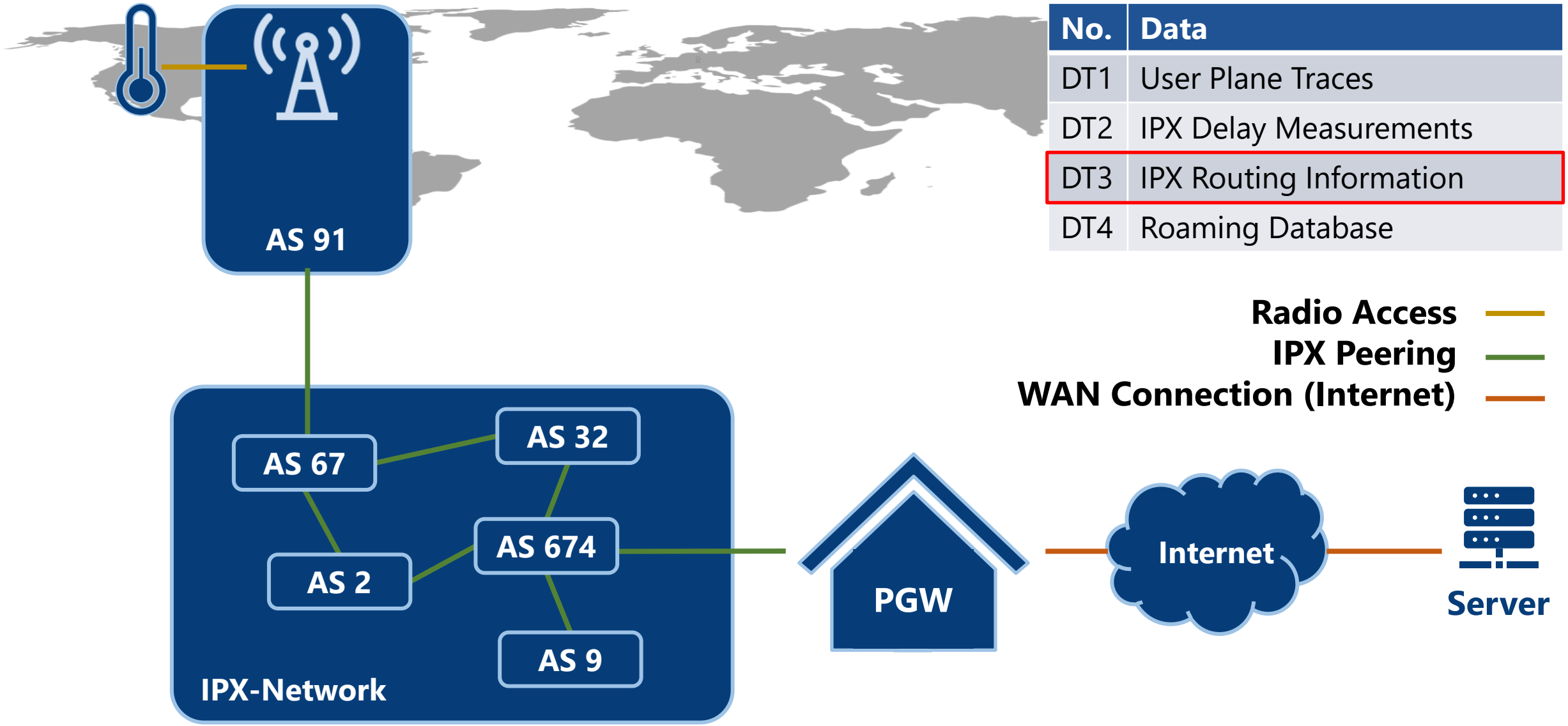
DT1 & DT2





- TCP Handshake
- Split in *Internet* und *Mobile Network* part
- No significant differences in Internet part

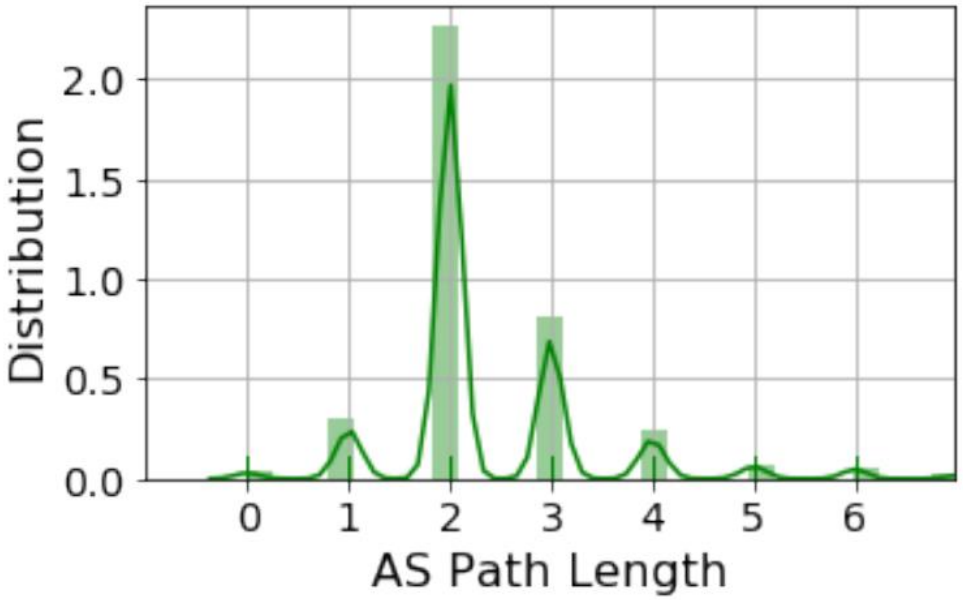
- Active measurements
- GTP Echo Requests
- Response time dependent of AS Path



No.	Data
DT1	User Plane Traces
DT2	IPX Delay Measurements
DT3	IPX Routing Information
DT4	Roaming Database

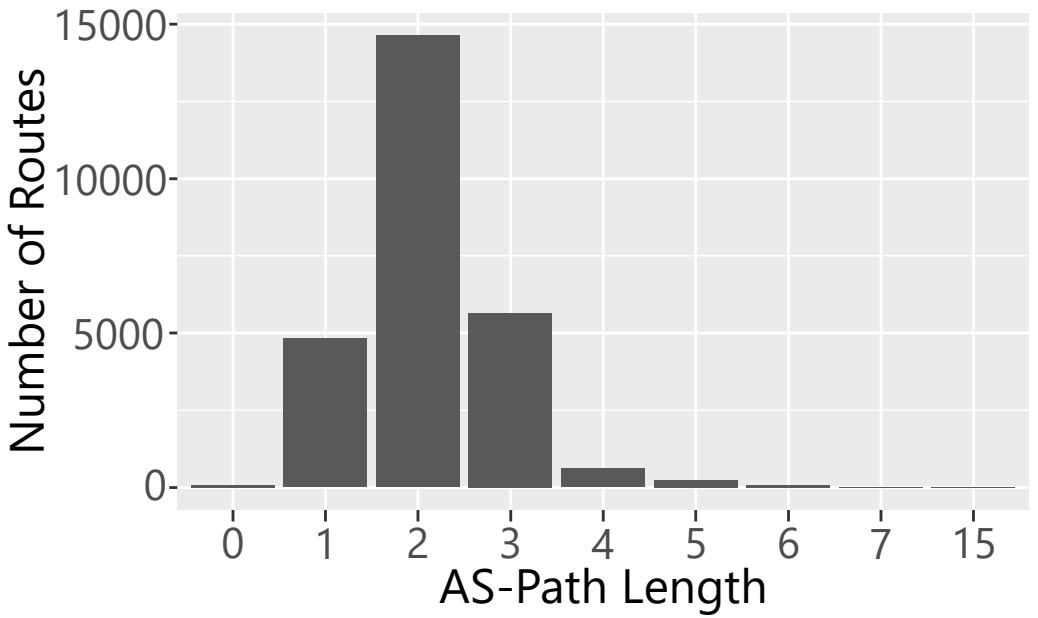
DT3

- MNO

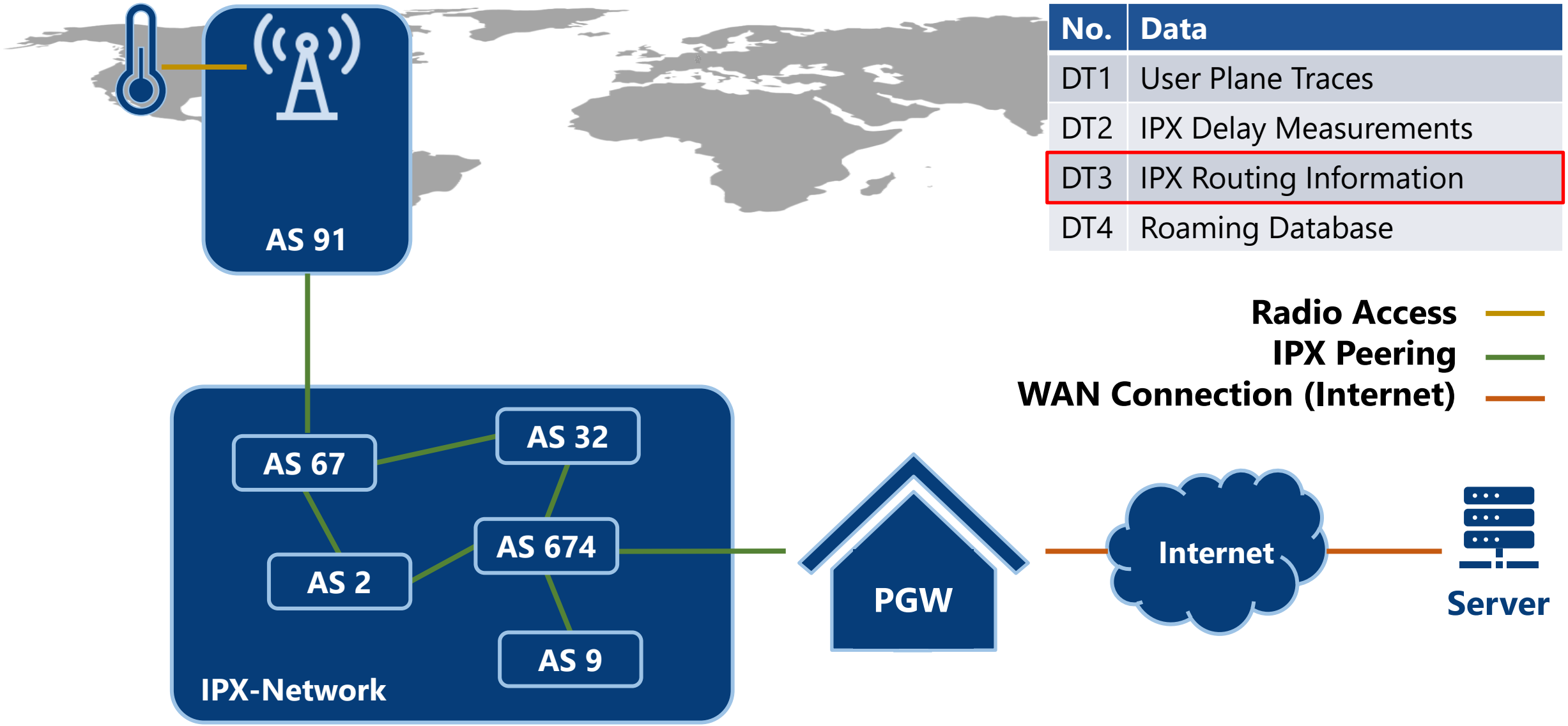


Lutu, Andra, et al. "A first look at the ip exchange ecosystem." *ACM SIGCOMM Computer Communication Review* 50.4 (2020): 25-34.

- MVNO



- BGP routing information
- Number of traversed Autonomous Systems (AS)



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DT2	IPX Delay Measurements
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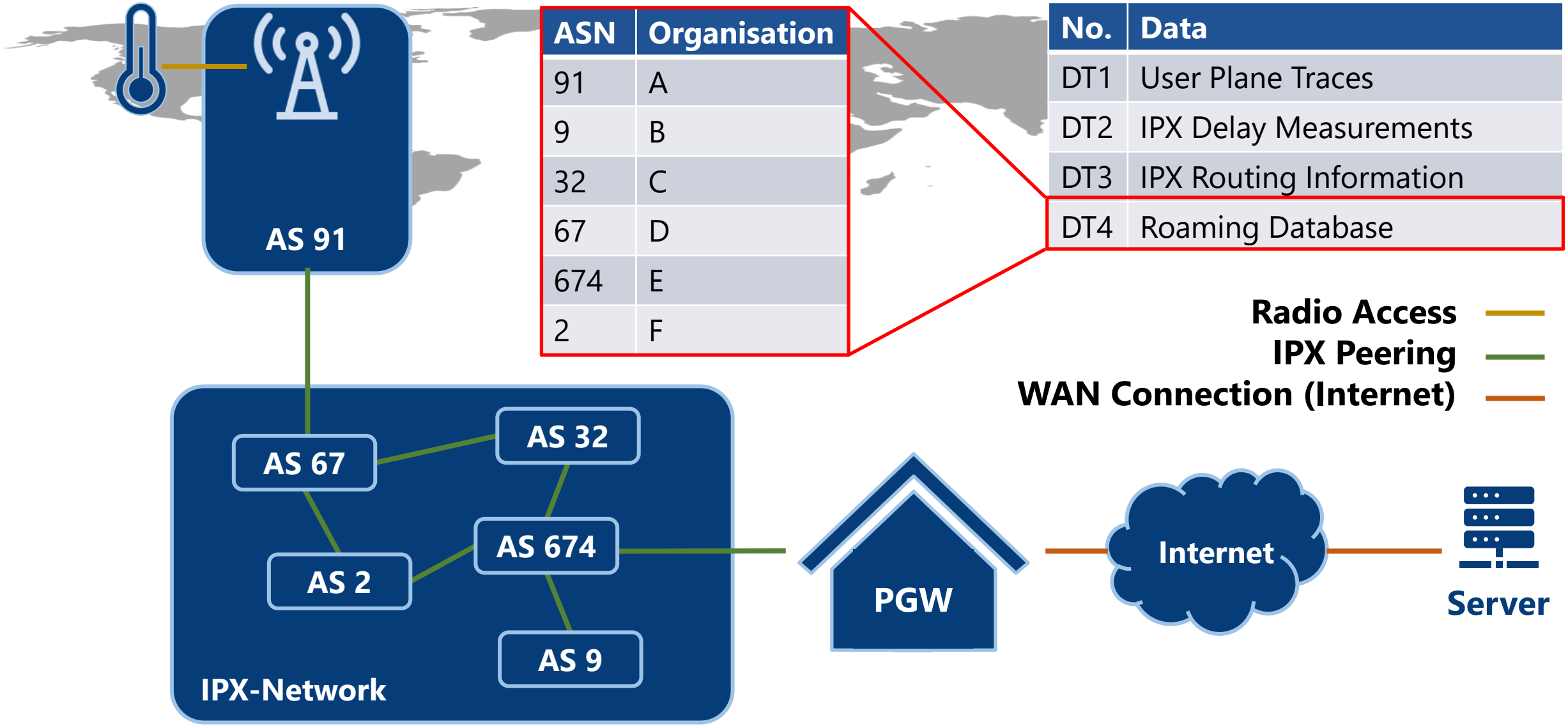
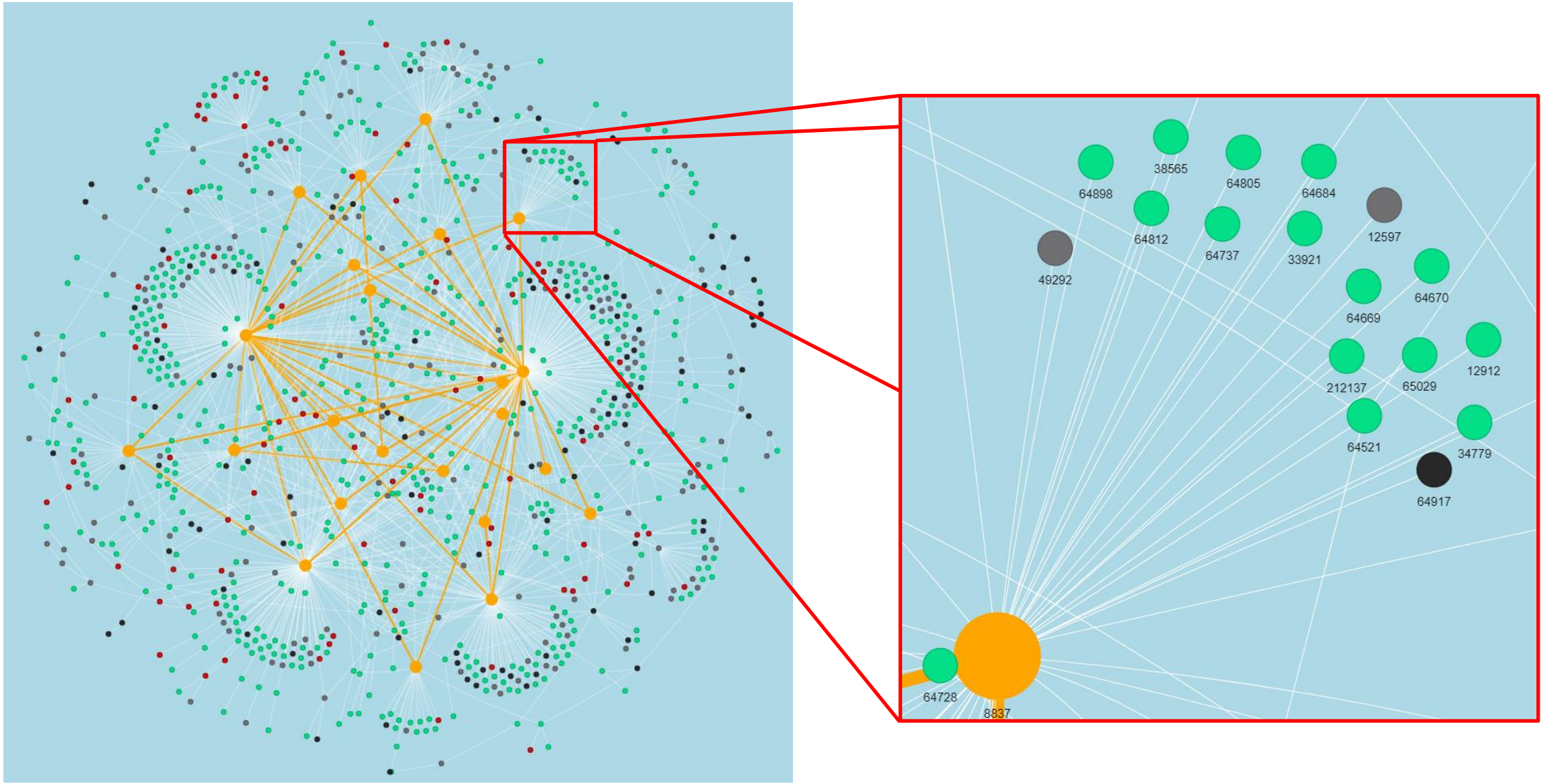
DT4	Roaming Database



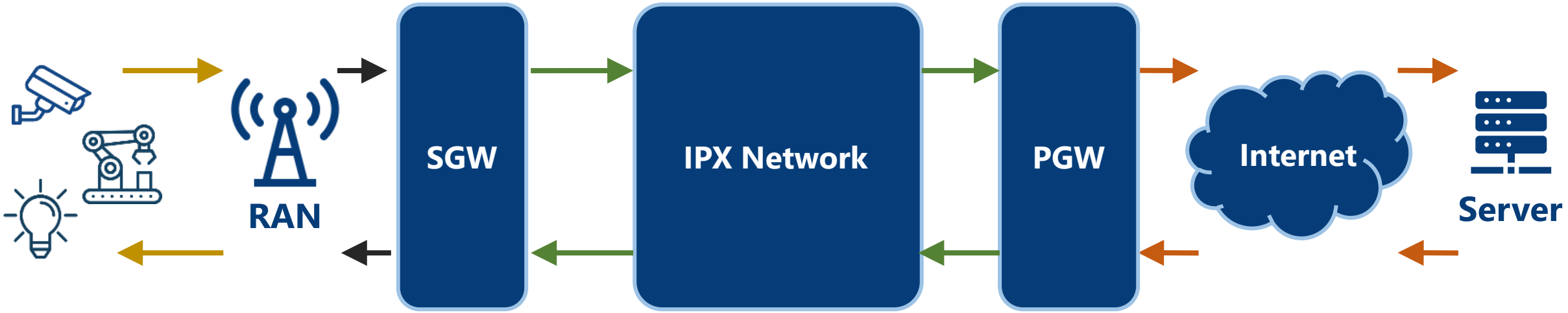
ASN	Organisation
91	A
9	B
32	C
67	D
674	E
2	F

No.	Data
DT1	User Plane Traces
DT2	IPX Delay Measurements
DT3	IPX Routing Information
DT4	Roaming Database

DT3 & DT4


64898
38565
64805
64684
64812
64737
33921
12597
49292
64670
64669
12912
212137
65029
64521
34779
64917
64728
8837

Combining Datasets



- DT1: Device → PGW RTT
- DT2: SGW → PGW RTT

} Device → SGSN

- DT2: SGW → PGW RTT
- DT3: AS Path

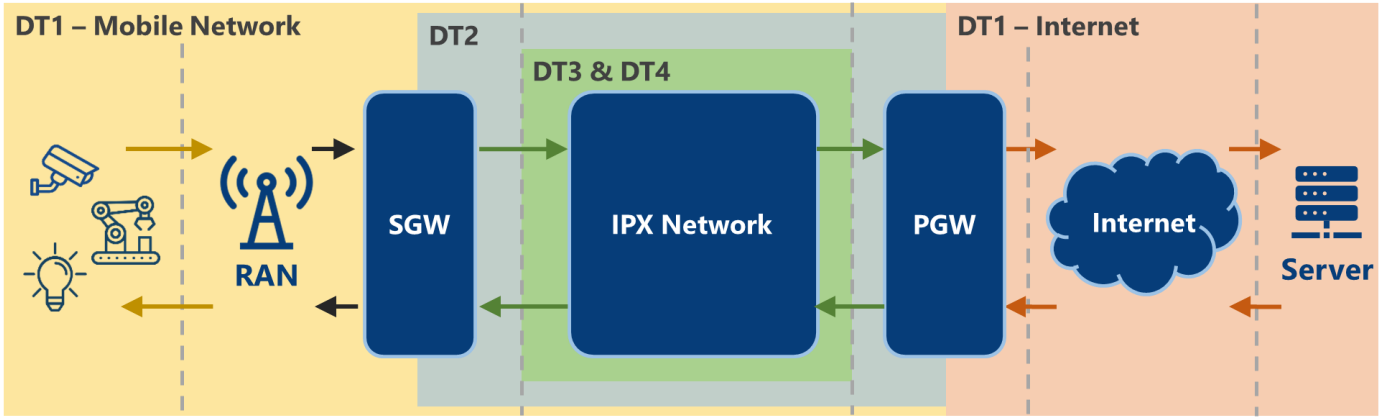
} Delay of AS Path

Is it possible to identify QoS metrics for specific AS?

Conclusion

Goal: **Understand source of QoS impairments in mobile roaming**

No.	Data	Type
DT1	User Plane Traces	L2-4, MCC/MNC
DT2	IPX Delay Measurements	Response Times
DT3	IPX Routing Information	AS Paths
DT4	Roaming Database	IR.21



- Future Work
  - Combine Datasets
  - Analysis of further user plane & IPX delay measurements
  - Model to optimize quality
  - Mechanism to predict optimal route based on application server location
  - Analyze applications (VoD, web conferencing)