

# Drive-thru Internet: IEEE 802.11b for Automobile Users

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# Motivations

- Two possible communication types in VANET
  - Vehicle to vehicle (V2V)
  - Vehicle to infrastructure (V2I)
- V2I may be easier to implement first
  - For bulk data transfer (entertainment..)
- One of the first questions coming up...
  - Is 802.11 (WiFi) a feasible solution for V2I purposes?

# Experimental approach

- Reference scenario
  - Fixed and mobile nodes in an Indoor lab
- Highway scenarios
  - Autobahn in Germany
  - Low speeds upto 80km/h
  - High speeds upto 180km/h
- Traffic
  - UDP
  - TCP

# Measurement tools

- UDP: rtpsend, rtpspy
- TCP: tcpx, tcptrace

# Configuration 1

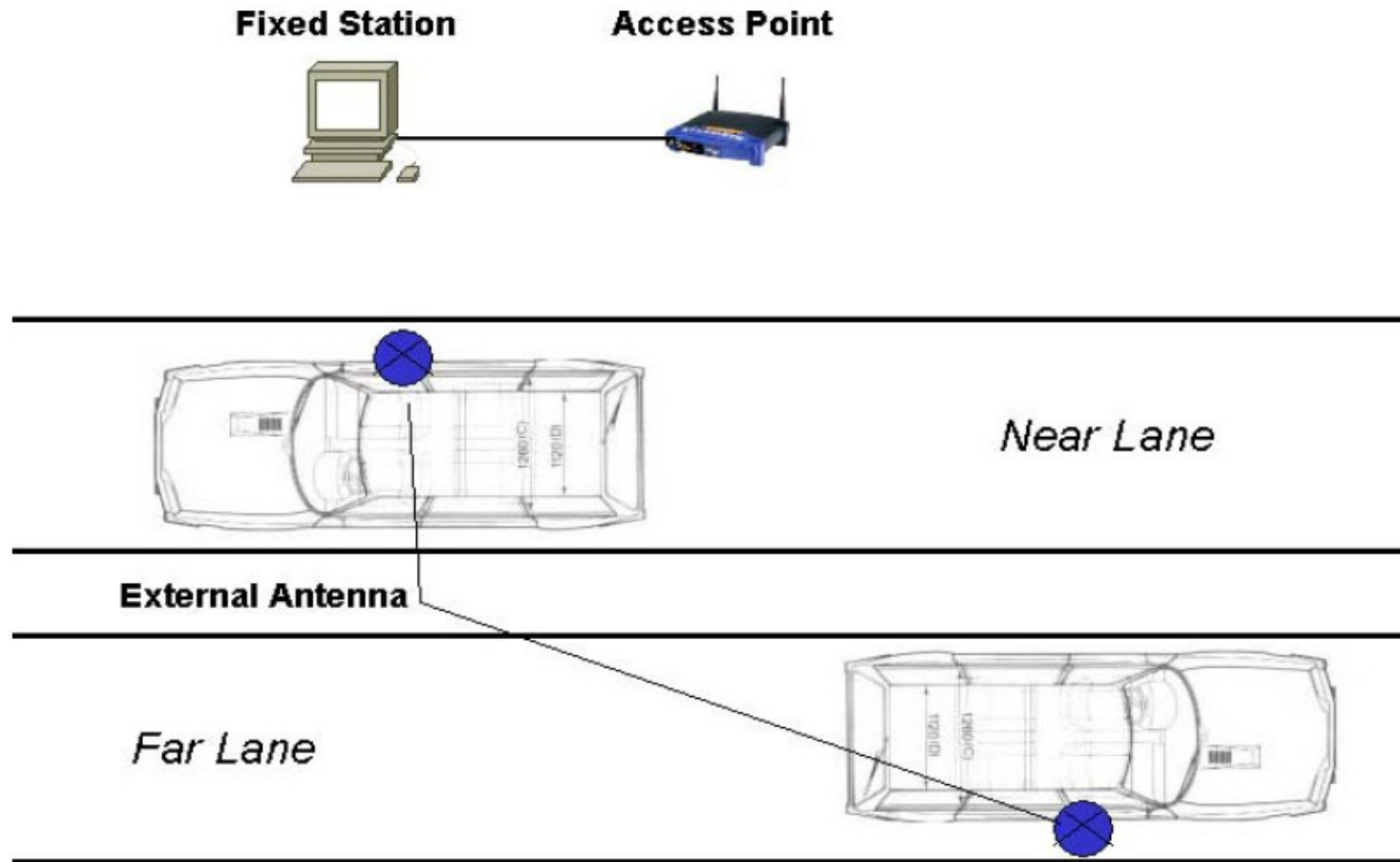
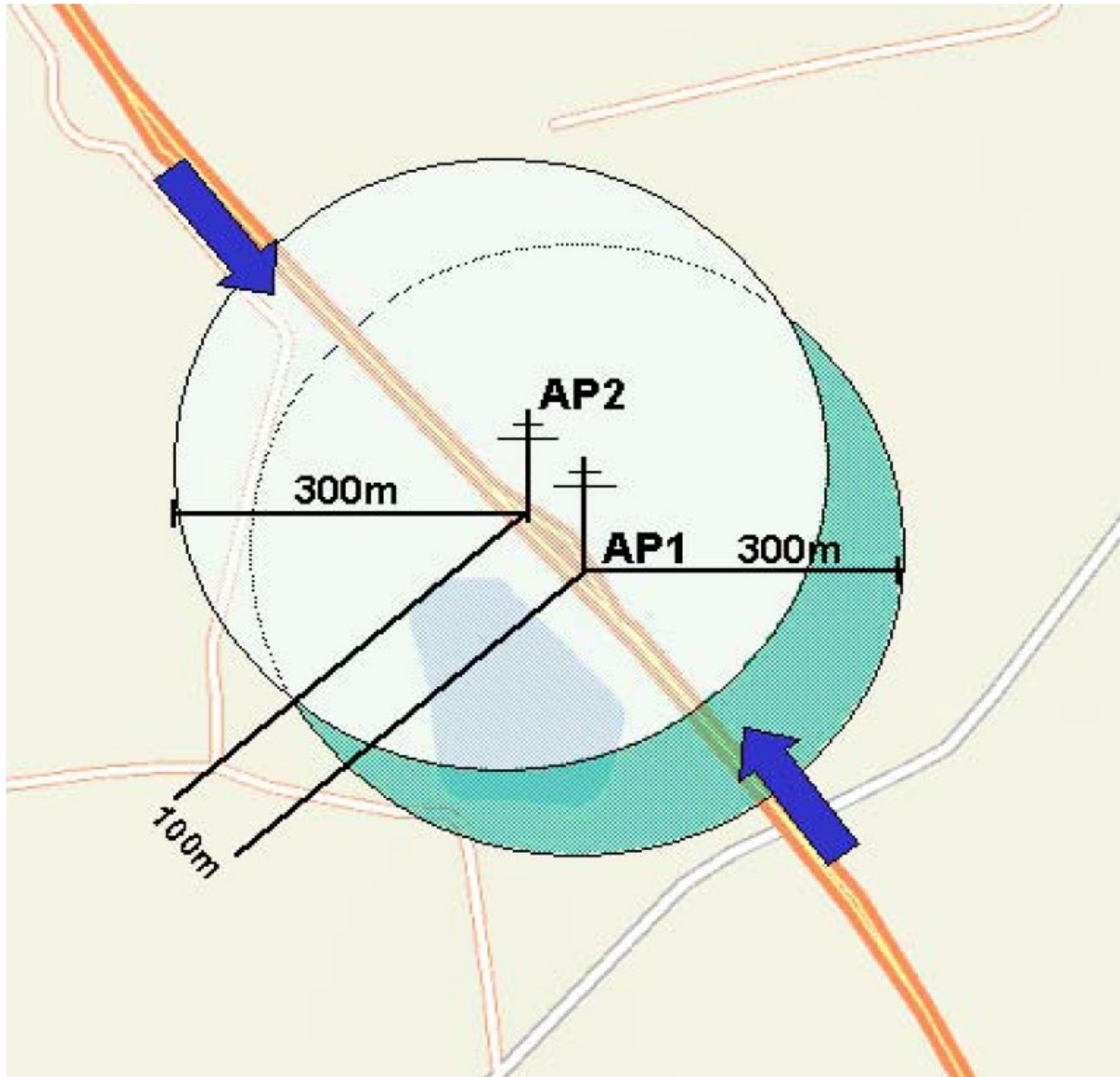
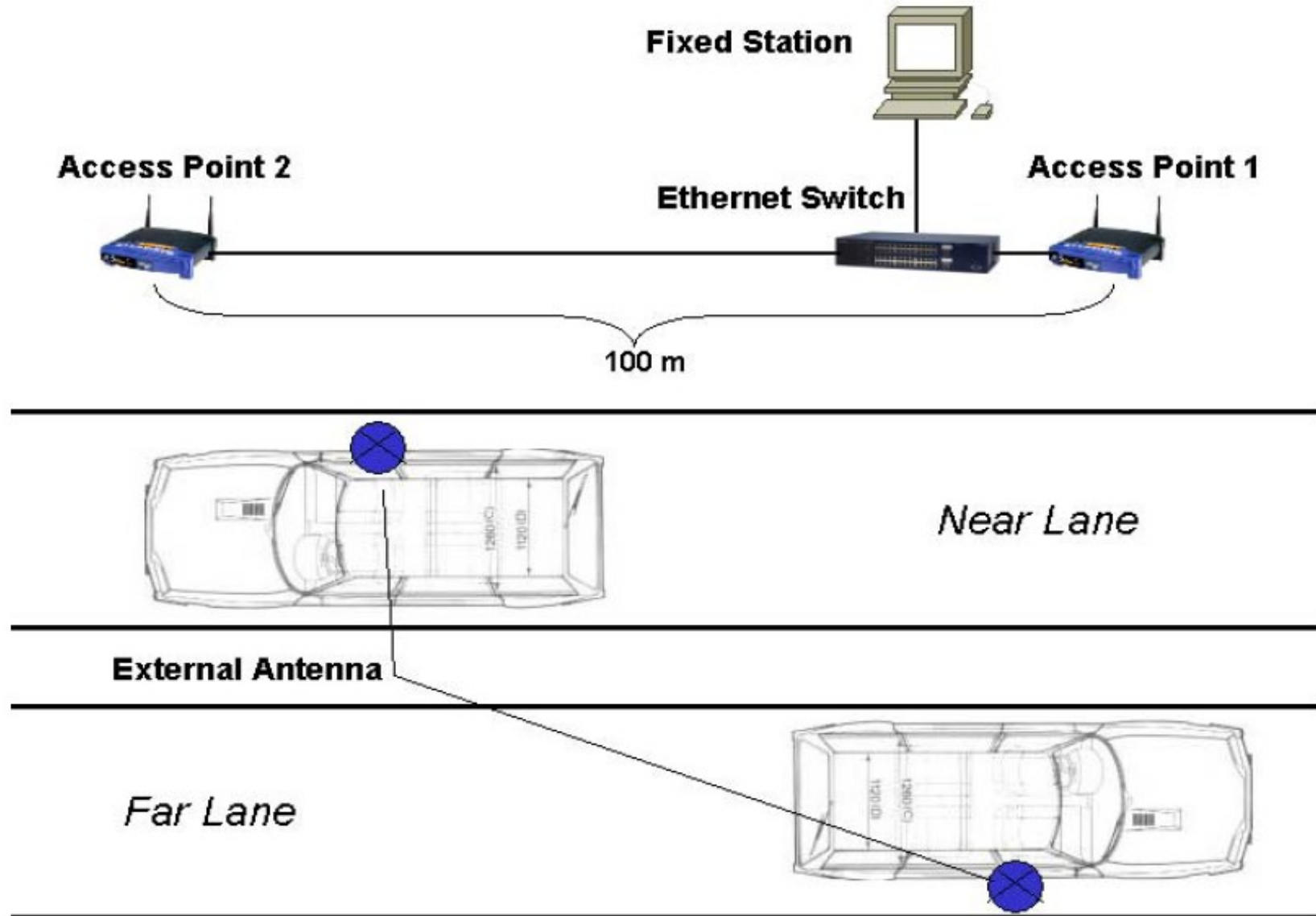


Fig. 1. Highway measurement configuration

# Configuration 2



# Configuration 3



# Reference scenarios, UDP

ID	Sender	Packet size	Interval	Nominal sending rate
1	fixed	1250 bytes	4 ms	2.5 Mbit/s
2	fixed	1250 bytes	2 ms	5 Mbit/s
3	fixed	1250 bytes	1 ms	10 Mbit/s
4	fixed	125 bytes	2 ms	0.5 Mbit/s
5	fixed	125 bytes	1 ms	1 Mbit/s
6	mobile	1250 bytes	2 ms	5 Mbit/s
7	mobile	1250 bytes	1 ms	10 Mbit/s
8	mobile	125 bytes	2 ms	0.5 Mbit/s
9	mobile	125 bytes	1 ms	1 Mbit/s



# Reference measurements, UDP

ID	Nominal sending rate	Effective throughput	Loss rate
1	2.5 Mbit/s	2.38 Mbit/s	4.81%
2	5 Mbit/s	3.38 Mbit/s	31.09%
3	10 Mbit/s	3.79 Mbit/s	62.10%
4	0.5 Mbit/s	0.47 Mbit/s	4.48%
5	1 Mbit/s	0.56 Mbit/s	43.72%
6	5 Mbit/s	4.92 Mbit/s	0.00%
7	10 Mbit/s	5.04 Mbit/s	0.01%
8	0.5 Mbit/s	0.49 Mbit/s	0.00%
9	1 Mbit/s	0.95 Mbit/s	0.01%

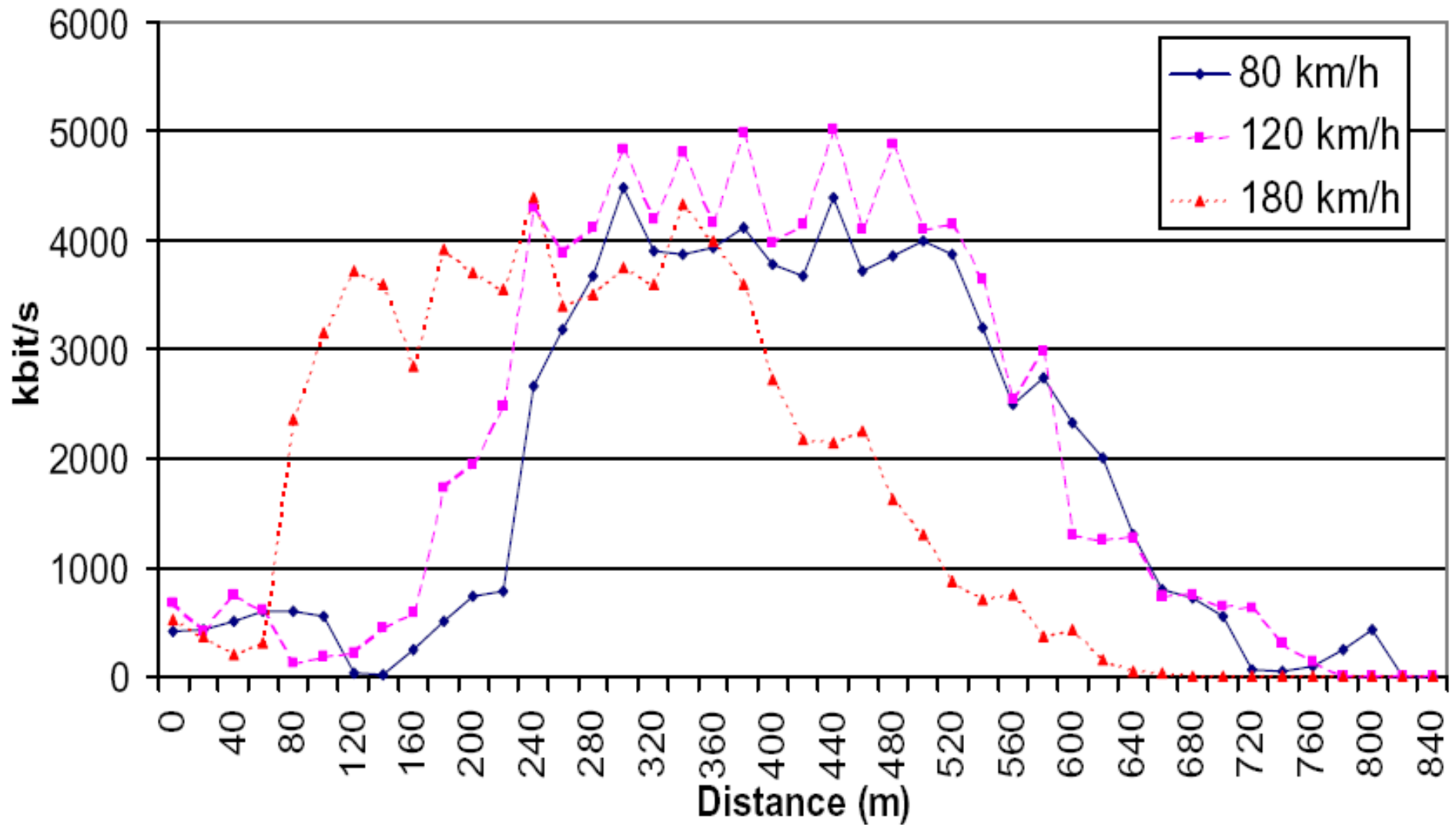
# Autobahn scenarios, UDP

ID	Speed	Sender	Packet size	Interval	Nominal sending rate
1	120	mobile	1250 bytes	2 ms	5 Mbit/s
2	80	fixed	1250 bytes	4 ms	2.5 Mbit/s
3	120	fixed	1250 bytes	4 ms	2.5 Mbit/s
4	180	fixed	1250 bytes	4 ms	2.5 Mbit/s
5	80	mobile	1250 bytes	2 ms	5 Mbit/s
6	180	mobile	1250 bytes	2 ms	5 Mbit/s
7	120	fixed	125 bytes	1 ms	1 Mbit/s

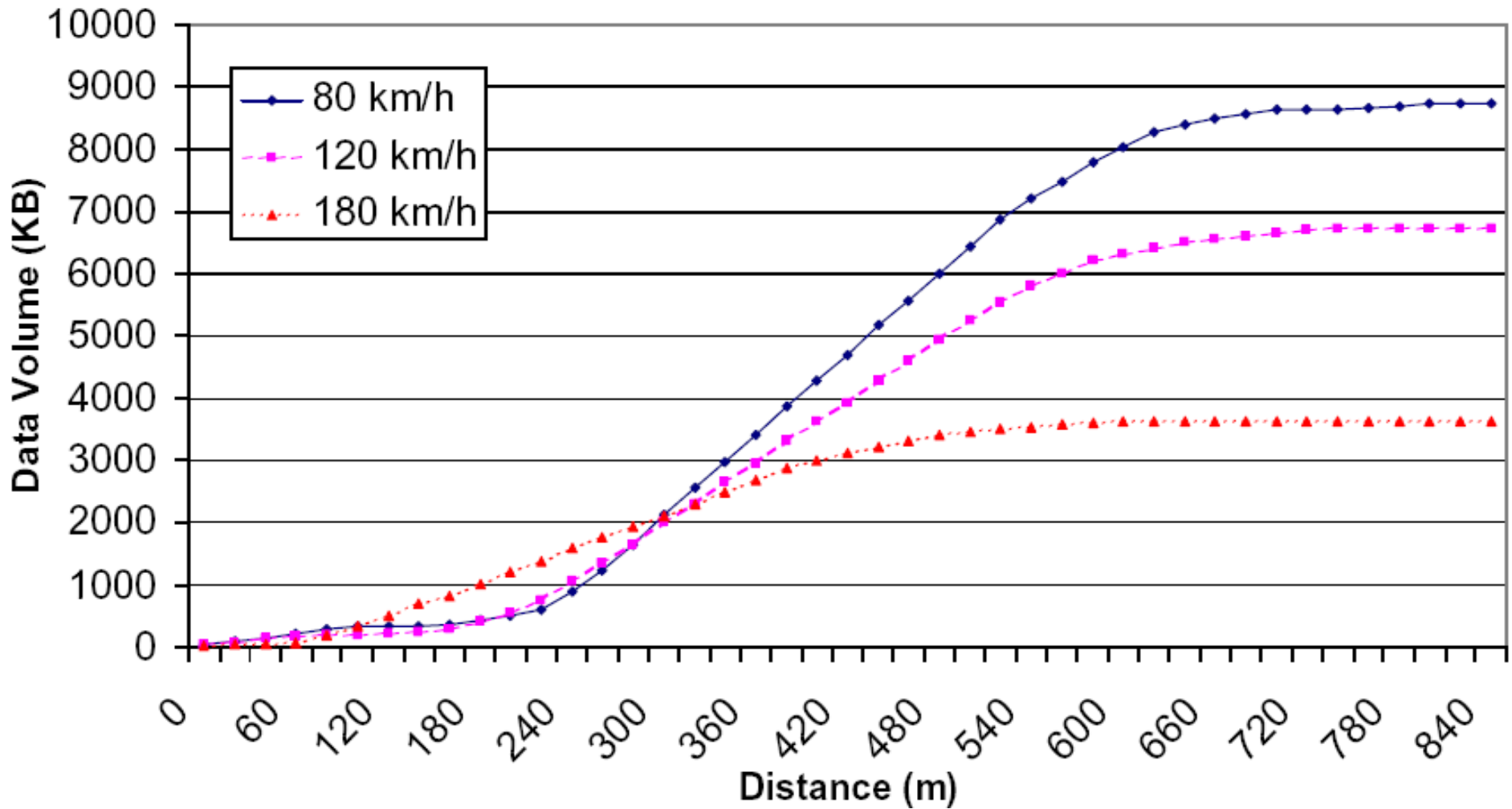
# Autobahn measurements, UDP

ID	Nominal sending rate	Effective throughput	loss rate
1 (near)	5 Mbit/s	0.74 Mbit/s	0.52%
1 (far)	5 Mbit/s	0.88 Mbit/s	0.82%
2 (near)	2.5 Mbit/s	0.75 Mbit/s	57.18%
2 (far)	2.5 Mbit/s	0.76 Mbit/s	43.65%
3 (near)	2.5 Mbit/s	0.42 Mbit/s	63.36%
3 (far)	2.5 Mbit/s	0.62 Mbit/s	52.43%
4 (near)	2.5 Mbit/s	0.43 Mbit/s	62.74%
4 (far)	2.5 Mbit/s	0.17 Mbit/s	57.85%
5 (near)	5 Mbit/s	1.43 Mbit/s	1.02%
5 (far)	5 Mbit/s	1.15 Mbit/s	0.68%
6 (near)	5 Mbit/s	0.82 Mbit/s	0.67%
6 (far)	5 Mbit/s	0.29 Mbit/s	1.43%
7 (near)	1 Mbit/s	0.11 Mbit/s	82.93%
7 (far)	1 Mbit/s	0.05 Mbit/s	84.00%

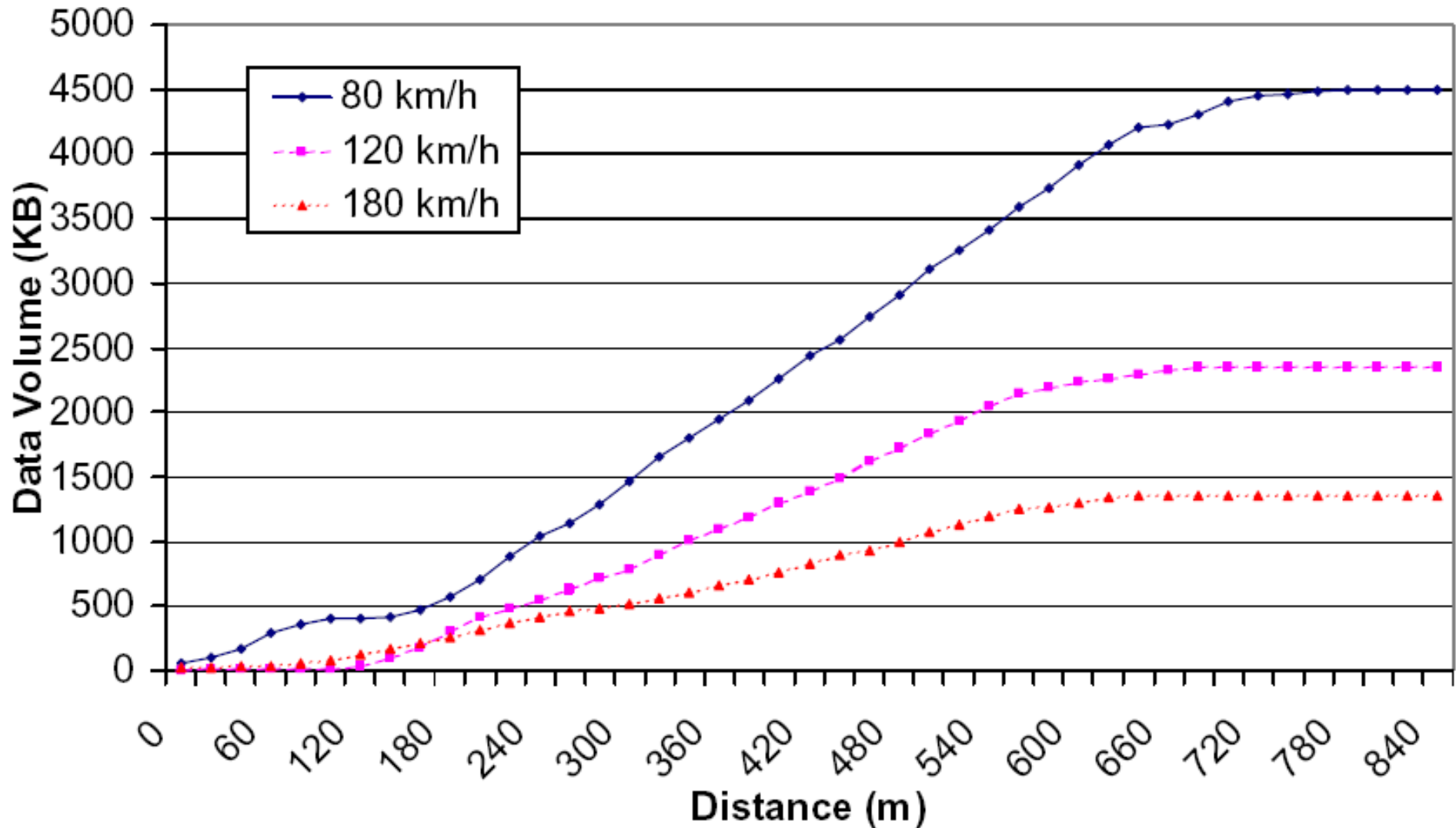
# Throughput, mobile sender, UDP



# Cumulative throughput, mobile sender, UDP

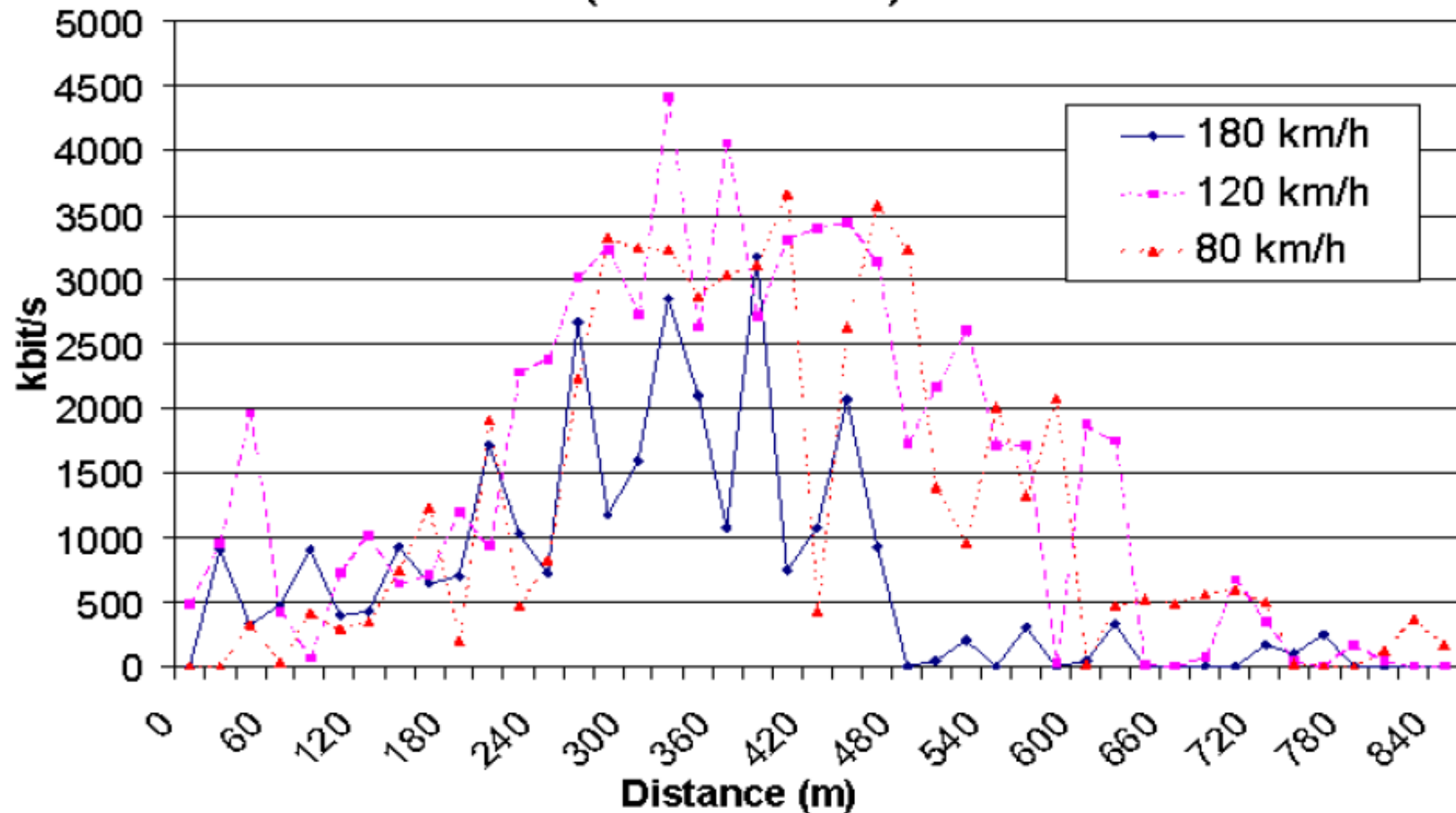


# Cumulative throughput, fixed sender, UDP

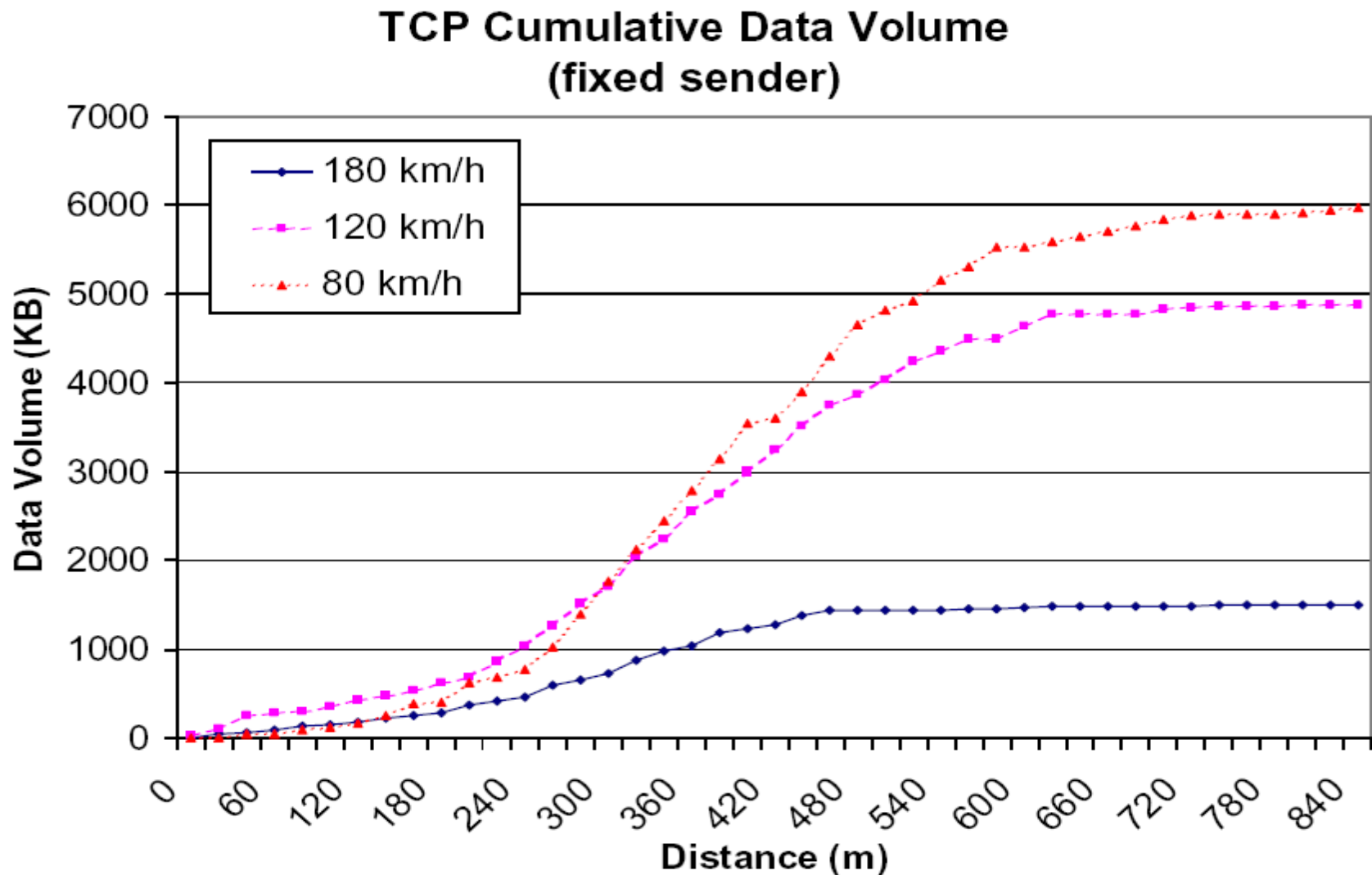


# Autobahn measurements, TCP

TCP Throughput  
(fixed sender)



# Autobahn measurements, TCP





# Autobahn measurements, TCP

