SHARKFEST '12

Wireshark Developer and User Conference

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The story…

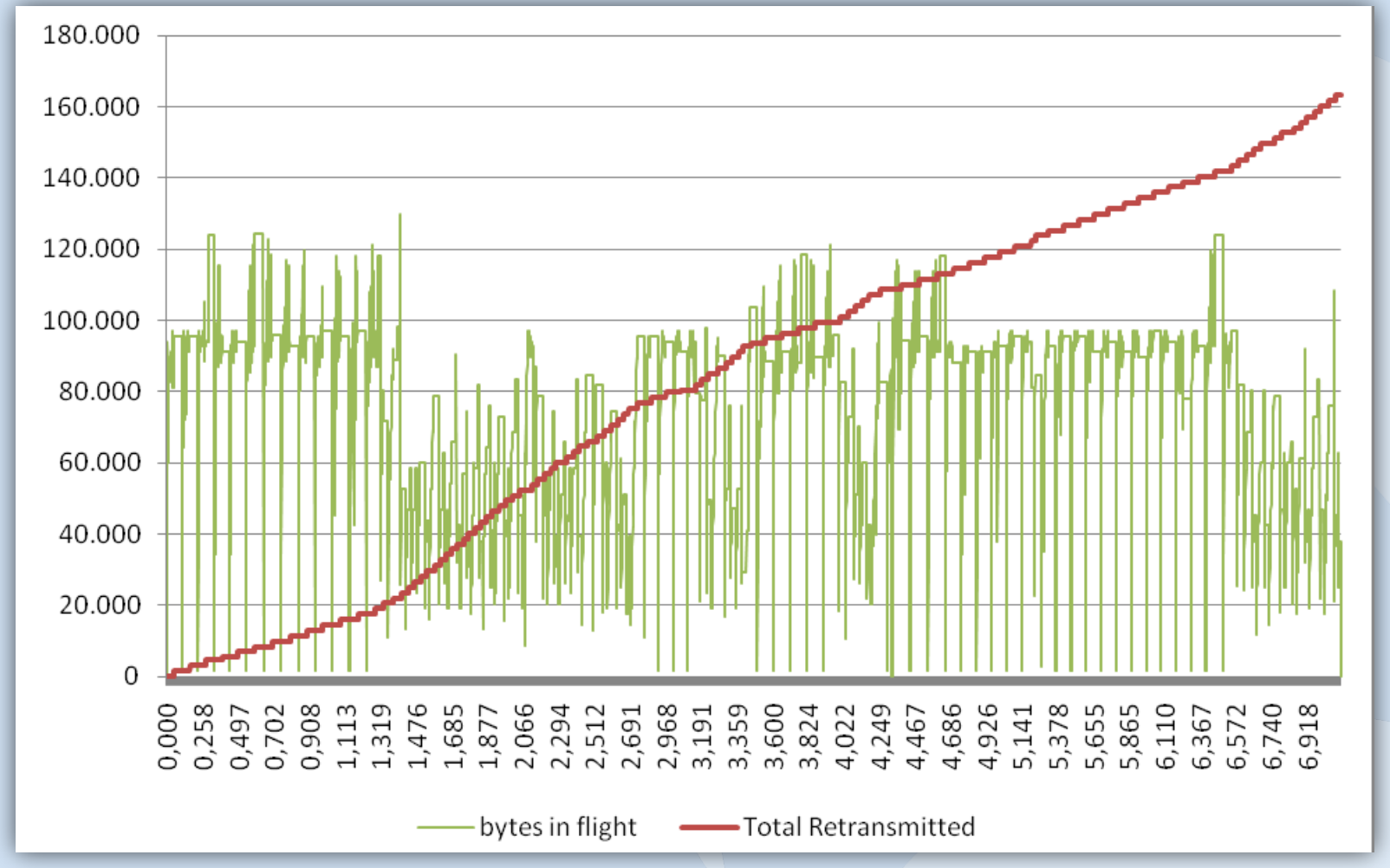
- Customer just went through migration from WindowsXP to Vista plus implemented VoIP
- Afterwards experiencing heavy packet loss on infrastructure switches
- Users complaining that „everything is slow“

Verifying that there is a problem

- Test plan with certain standard tasks
  - Uploads
  - Downloads
  - Mail attachments
  - …
- Sniffing traffic at three points
  - Core
  - Distribution to Access
  - Client

Performance Problem ?

Constant packet loss



Reaction to packet loss

Sending side

- Retransmit
  - When?
  - What?
  - How fast?
- Continue sending
  - When?
- Ignore the fact a packet got lost?

Recieving side

- Request more data?
- Request less data?

→ Adjust recieve window?

TCP Receive Window

- 16 bit Value in the TCP Header
- Ranges from 0 to 65535
- Works as a receive buffer for incoming TCP payload bytes
- Adjusts the data transmission rate of the sender
  - specifies the maximum of bytes in travel
- Wireshark monitors rwnd (e.g. „TCP Window Full“)

TCP „Send Window“

- Does it exist at all?
- If it does, since when?
- What is it good for anyway?
- Where could you observe the Send Window size in Wireshark?

- More details to come…

Other TCP „windows“ ?

- Receiver Window (rwnd)
  - The most recently advertised receiver window
- Congestion Window (cwnd)
  - A TCP state variable that limits the amount of data a TCP can send. At any given time, a TCP MUST NOT send data with a sequence number higher than the sum of the highest acknowledged sequence number and the minimum of cwnd and rwnd
- Initial Window (IW)
  - The initial window is the size of the sender's congestion window after the three-way handshake is completed

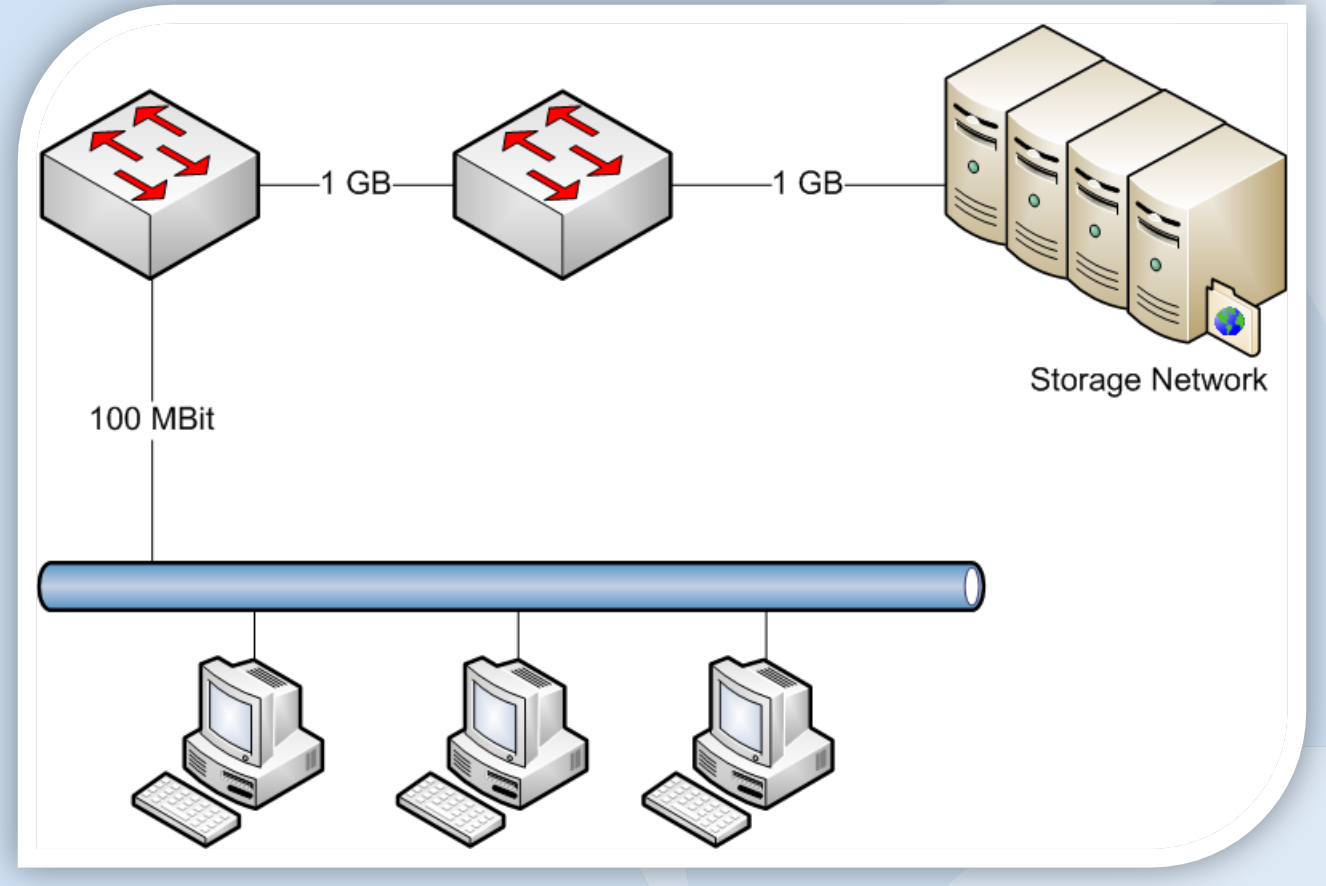
More other „windows“…

- Loss Window (LW)
  - The loss window is the size of the congestion window after a TCP sender detects loss using its retransmission timer
- Restart Window (RW)
  - The restart window is the size of the congestion window after a TCP restarts transmission after an idle period (if the slow start algorithm is used)
- Flight Size
  - The amount of data that has been sent but not yet acknowledged aka “bytes in flight”

How to react to packet loss?

- Mostly depends on the stack in use
- All stacks should reduce send rate on short notice
- Large receive buffers result in optimized retransmission of packets
- Fast Retransmission and SACK are standard nowadays → „true“ RTO triggers are rare

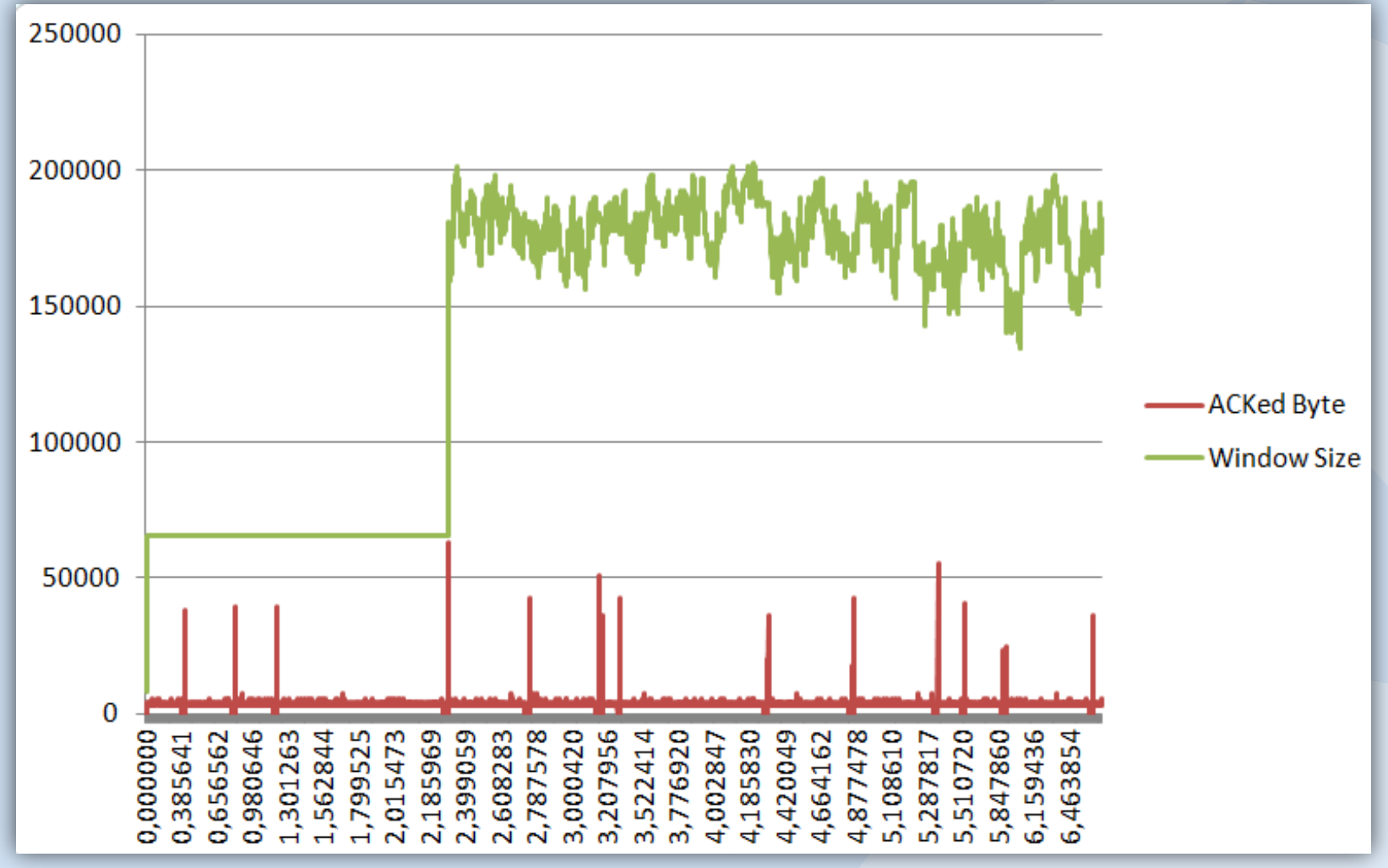
The Lab setup…



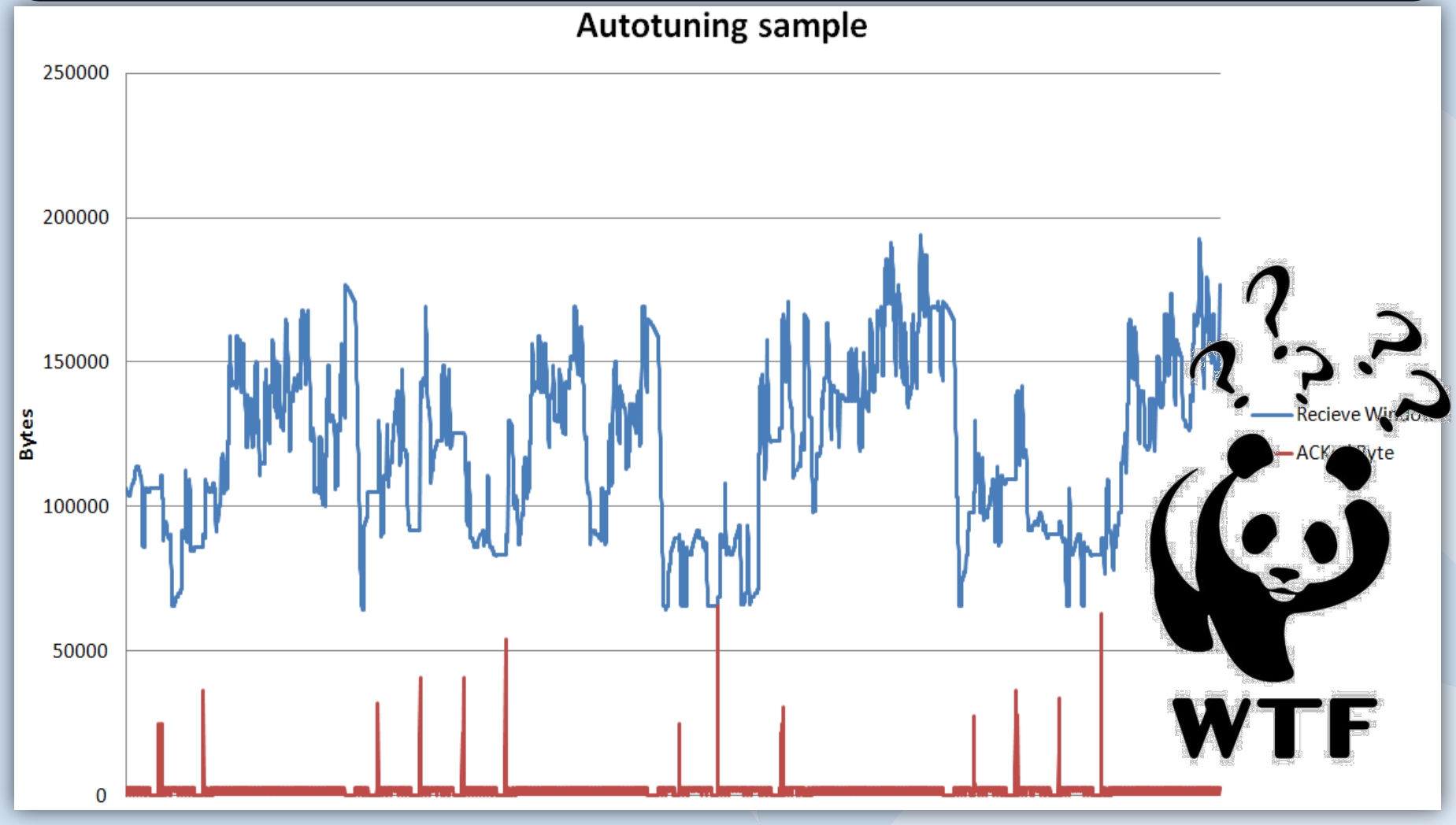
TCP Receive Window Autotuning

- In use since implementing the NG-Stack of Microsoft Vista
- Stack and/or application can tune the TCP receive window for the duration of the tcp connection
- Was created for adjustments of rwnd on LFPs

How does Autotuning behave?



How does Autotuning behave?



Autotuning Level

- Can be configured using the `netsh command`
- Available settings:
  - Disabled
  - Highlyrestricted
  - Restricted
  - Normal
  - Experimental

Adjusting rwnd

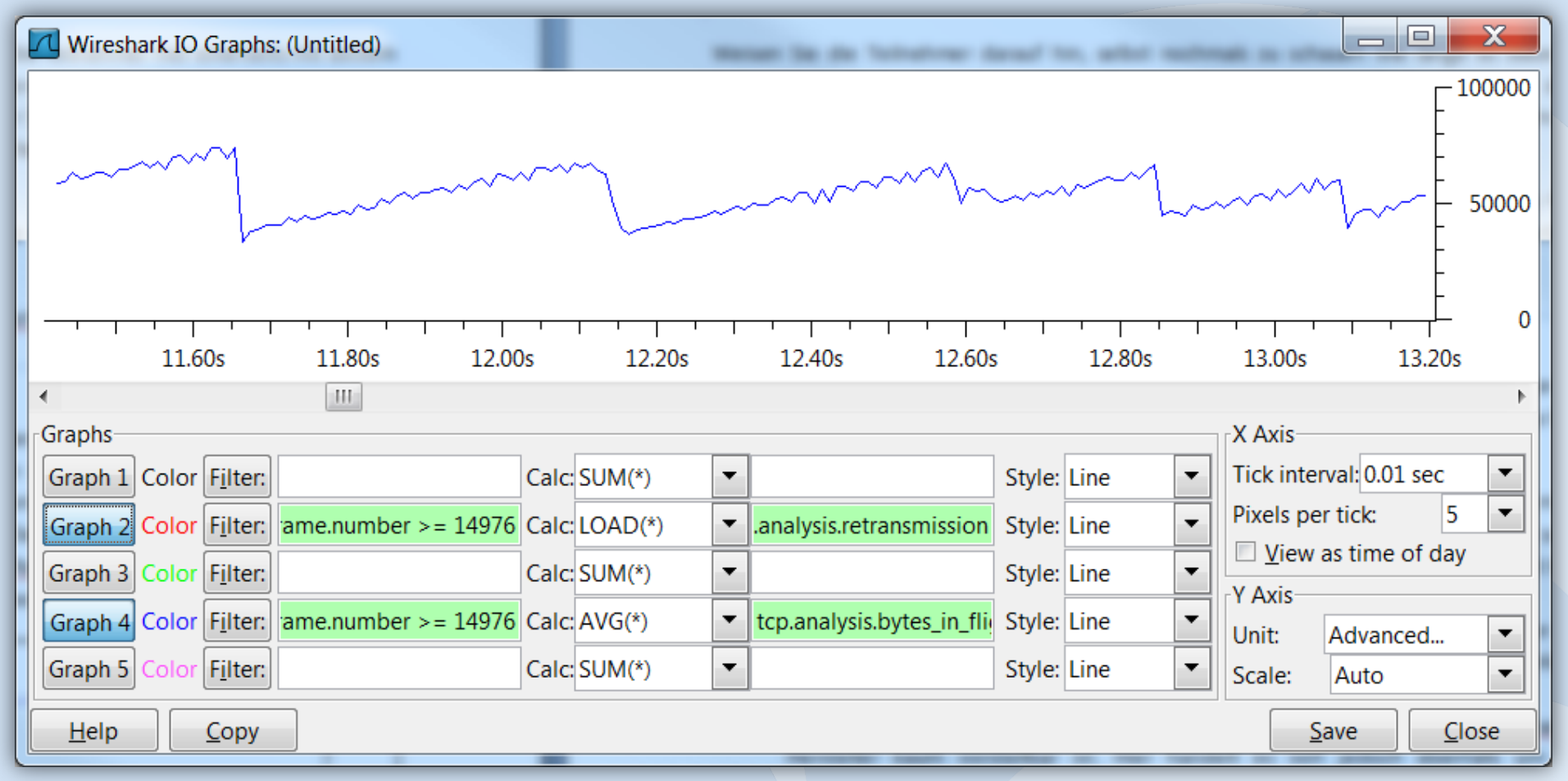
- Not available anymore: static configuration via Windows Registry settings
- Adjusting of the AutoTuning Level is possible:

Disabled	65.536 bytes
(Highly) Restricted	max. 262.144 bytes
Normal	max. 16.777.216 bytes (!)
Experimental	max. 1.073.741.824 bytes

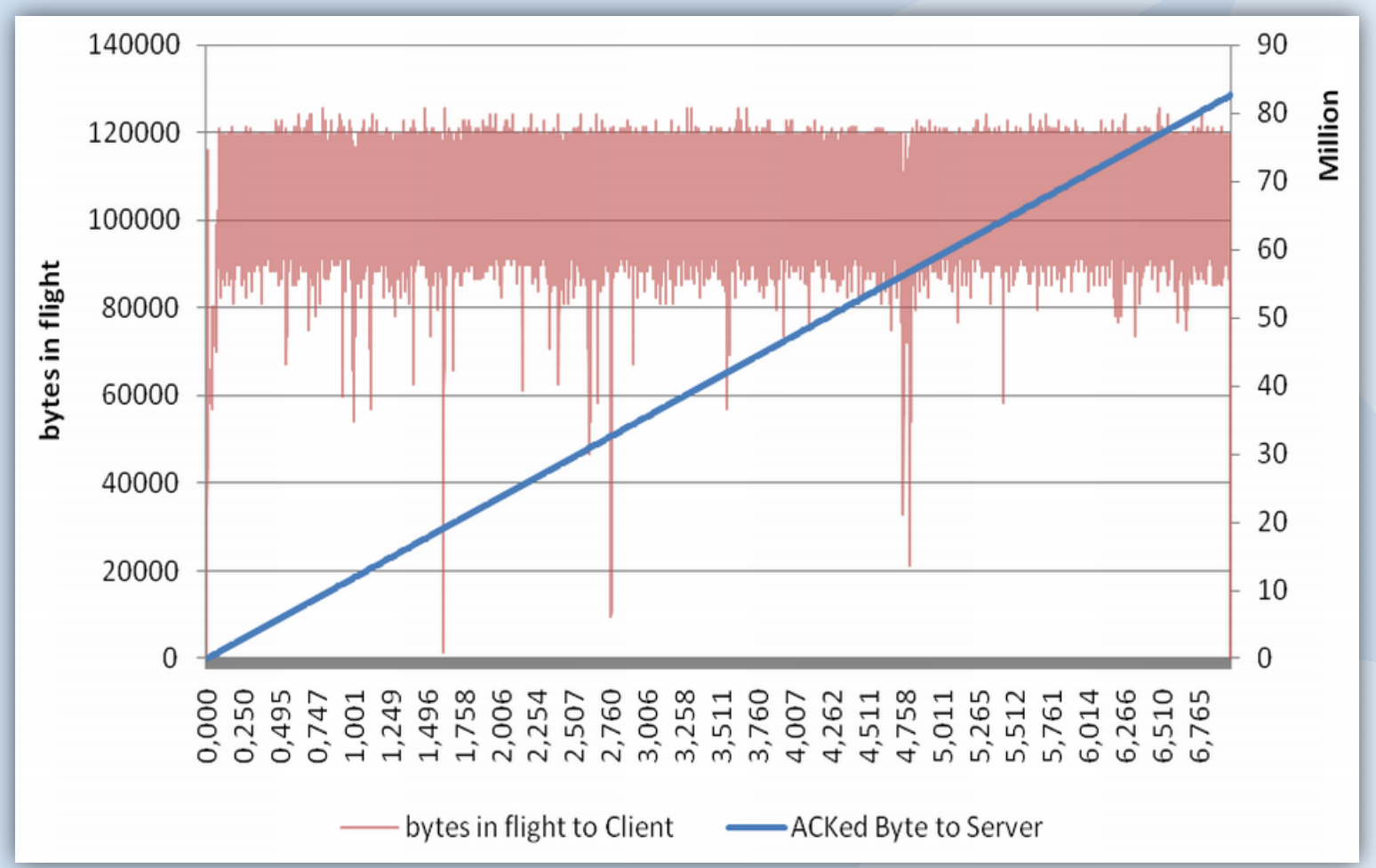
Window Scaling Heuristics

- Settings of the TCP stack that calculates the Autotuning Level for different network profiles
- If the scaling heuristics are in use, the Autotuning Level provides a base for calculating the Receive Window and the scale factor
- Application can use this mechanism to take control of TCP stack behavior
- The use of Scaling Heuristics blocks deactivation of Receive Window AutoTuning!

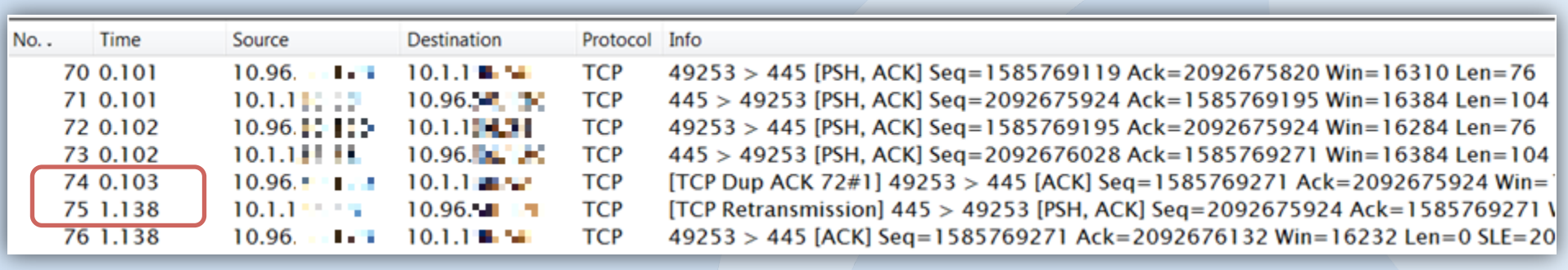
So whats happening ?



Problem#1 - Constantly full buffers



Problem#2 RTO



No. .	Time	Source	Destination	Protocol	Info
70	0.101	10.96.	10.1.1	TCP	49253 > 445 [PSH, ACK] Seq=1585769119 Ack=2092675820 Win=16310 Len=76
71	0.101	10.1.1	10.96.	TCP	445 > 49253 [PSH, ACK] Seq=2092675924 Ack=1585769195 Win=16384 Len=104
72	0.102	10.96.	10.1.1	TCP	49253 > 445 [PSH, ACK] Seq=1585769195 Ack=2092675924 Win=16284 Len=76
73	0.102	10.1.1	10.96.	TCP	445 > 49253 [PSH, ACK] Seq=2092676028 Ack=1585769271 Win=16384 Len=104
74	0.103	10.96.	10.1.1	TCP	[TCP Dup ACK 72#1] 49253 > 445 [ACK] Seq=1585769271 Ack=2092675924 Win=
75	1.138	10.1.1	10.96.	TCP	[TCP Retransmission] 445 > 49253 [PSH, ACK] Seq=2092675924 Ack=1585769271 \
76	1.138	10.96.	10.1.1	TCP	49253 > 445 [ACK] Seq=1585769271 Ack=2092676132 Win=16232 Len=0 SLE=20

Problem#3 Delayed ACK

Source	Destination	Size	Info	delta dis
10.17.1.;	10.1.vi.'i	86	[TCP Dup ACK 6#5] 60421 > 445 [ACK] Seq=1461501365 Ack=4066767320 Win=16605 Le	0.000
10.1.vi.'i	10.17.1.;	1518	[TCP Fast Retransmission] NBSS Continuation Message	0.000
10.1.vi.'i	10.17.1.;	1518	[TCP Out-Of-Order] NBSS Continuation Message	0.000
10.1.vi.'i	10.17.1.;	1518	[TCP Out-Of-Order] NBSS Continuation Message	0.000
10.17.1.;	10.1.vi.'i	86	60421 > 445 [ACK] Seq=1461501365 Ack=4066770240 Win=16425 Len=0 SLE=4066808912	0.000
10.1.vi.'i	10.17.1.;	1518	[TCP Out-Of-Order] NBSS Continuation Message	0.000
10.17.1.;	10.1.vi.'i	86	60421 > 445 [ACK] Seq=1461501365 Ack=4066773160 Win=16425 Len=0 SLE=4066808912	0.000
10.1.vi.'i	10.17.1.;	1518	[TCP Retransmission] NBSS Continuation Message	0.000
10.17.1.;	10.1.vi.'i	86	60421 > 445 [ACK] Seq=1461501365 Ack=4066774620 Win=16425 Len=0 SLE=4066808912	0.196
10.1.vi.'i	10.17.1.;	1518	[TCP Retransmission] NBSS Continuation Message	0.000
10.17.1.;	10.1.vi.'i	86	60421 > 445 [ACK] Seq=1461501365 Ack=4066776080 Win=16425 Len=0 SLE=4066808912	0.202
10.1.vi.'i	10.17.1.;	1518	[TCP Retransmission] NBSS Continuation Message	0.000
10.17.1.;	10.1.vi.'i	86	60421 > 445 [ACK] Seq=1461501365 Ack=4066777540 Win=16425 Len=0 SLE=4066808912	0.202
10.1.vi.'i	10.17.1.;	1518	[TCP Retransmission] NBSS Continuation Message	0.000
10.17.1.;	10.1.vi.'i	86	60421 > 445 [ACK] Seq=1461501365 Ack=4066779000 Win=16425 Len=0 SLE=4066808912	0.202

What I learned from TCP RFCs

- TCP stacks **are** different
- There MAY be issues where:
  - RECOMMENDED reading is REQUIRED
  - you MUST read some RFCs and
  - SHALL NOT give up too early ☺

Thank you !