

3GPP TSG-RAN WG3 #86
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San Francisco, USA

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Agenda Item: 20.1.5
Source: Fujitsu
Title: Basic Information on Flow Control
Document for: Info

Why Flow Controls?

- October 1986 Internet had its first congestion collapse
- Link LBL to UC Berkeley
 - 400 yards, 3 hops, 32 Kbps
 - throughput dropped to 40 bps
 - factor of ~1000 drop!
- 1988, Van Jacobson proposed TCP flow control

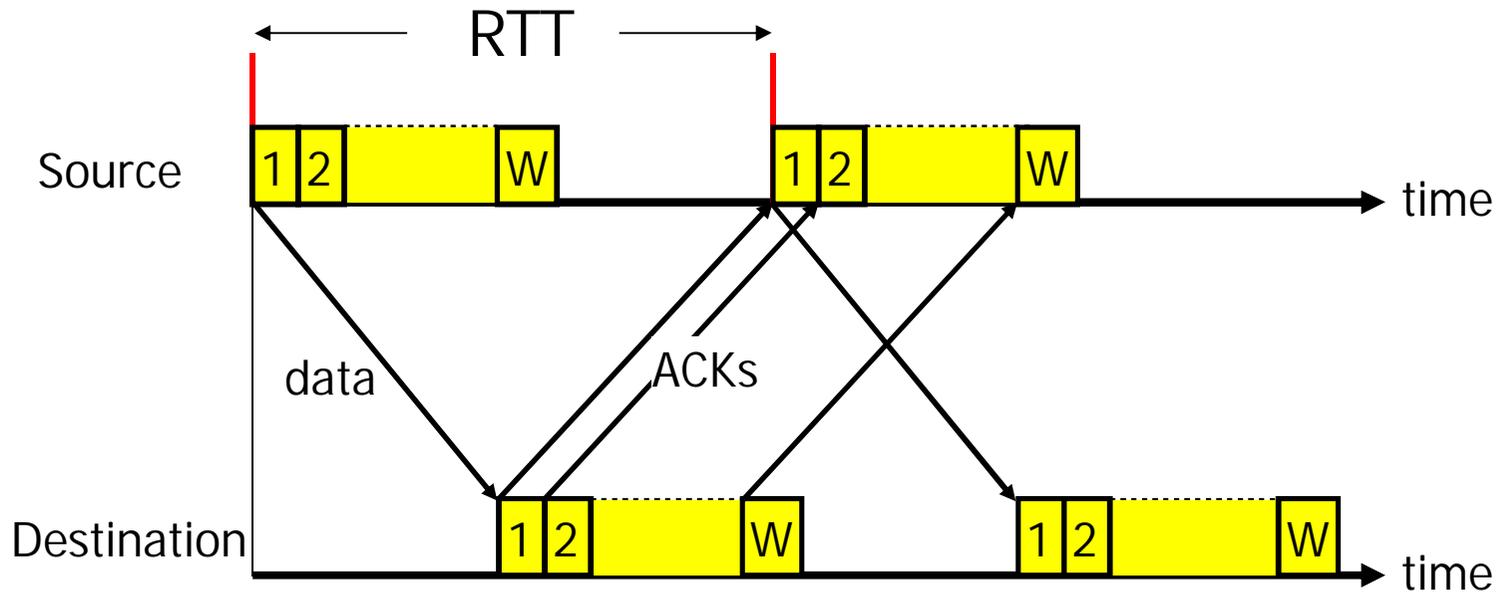
Flow Control has been existing for over two decades.

Aims of TCP

- TCP seeks to deliver a byte stream
 - from end-to-end, in order, reliably
 - allowing multiplexing
 - use bandwidth efficiently
- TCP achieves reliability using ACKs
- **Robustness Principle**
 - *be conservative in what you do,*
 - *be liberal in what you accept from others*

To a certain extent, X2UP is similar to TCP.

Basic in Window Flow Control



- offered load = $\frac{W \times \text{MSS}}{\text{RTT}}$

(*MSS: Maximum Segment Size; RTT: Round Trip Time*)

- If W is too small then throughput \ll bandwidth
- If W is too big then load $>$ bandwidth
→ congestion occurs

TCP Window Flow Controls

- Receiver flow control
 - Avoid overloading receiver
 - Set by receiver
 - **awnd**: receiver (advertised) window
- Network flow control
 - Avoid overloading network
 - Set by sender
 - Infer available network capacity
 - **cwnd**: congestion window
- Set $W = \min(\mathbf{cwnd}, \mathbf{awnd})$

Basic in Receiver Flow Control

- Receiver flow control
 - Avoid overloading receiver
 - Set by receiver: receiver (advertised) window W
- Receiver advertises **awnd** with each ACK
- Size of **awnd** can be *the* performance limit

Flow Control in X2UP is a typical receiver flow control mechanism:

- **awnd: the available buffer size indicated by SeNB**

Basic in Network Flow Control

- Source calculates **cwnd** from indication of network congestion
- Congestion indications
 - **Losses**
 - Delay
 - Marks
- Algorithms to calculate **cwnd**
 - Tahoe, Reno, Vegas, RED, REM

Congestion Indications defined in X2UP :

- **the number of lost X2-U PDUs reported by SeNB**

Assuming the bottleneck is Uu interface:

- **The status of PDCP PDU delivery in sequence to the UE**

Conclusion

- Flow Control has been existing for over two decades, including Receiver flow control and network flow control.
- To a certain extent, X2UP is similar to TCP.
- Flow Control in X2UP is a typical receiver flow control mechanism:
 - Window Size: the available buffer size indicated by SeNB
- For network flow control, assuming the bottleneck is Uu interface, only Congestion Indications (reported by SeNB) defined in X2UP:
 - The status of PDCP PDU delivery in sequence to the UE
 - The status of X2-U PDUs delivery
- The flow control algorithms are left to implementation for both MeNB and SeNB.