TCPW BR: A Wireless Congestion Control Scheme Base on RTT

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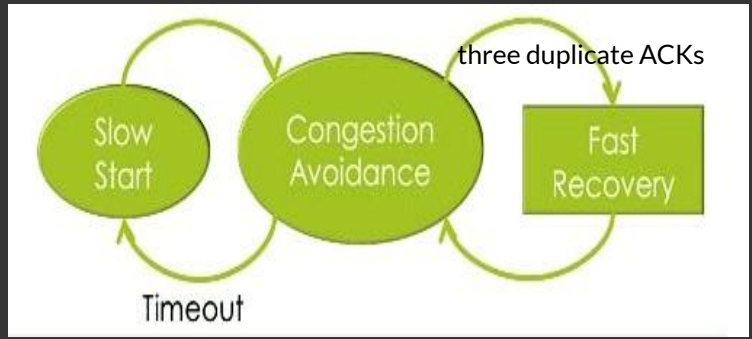
TCP Westwood scheme

TCPW adopts the idea of bandwidth estimation.

- After three duplicate ACKs ⇒
  - Ssthresh=(BWE*RTT min)/seg_size
  - if Cwnd>Ssthresh then Cwnd=Ssthresh
- After RTO times out ⇒
  - Ssthresh=(BWE*RTT min)/seg_size
  - Cwnd = 1



Problem With TCPW

- TCP Westwood cannot distinguish between congestion and wireless packet loss

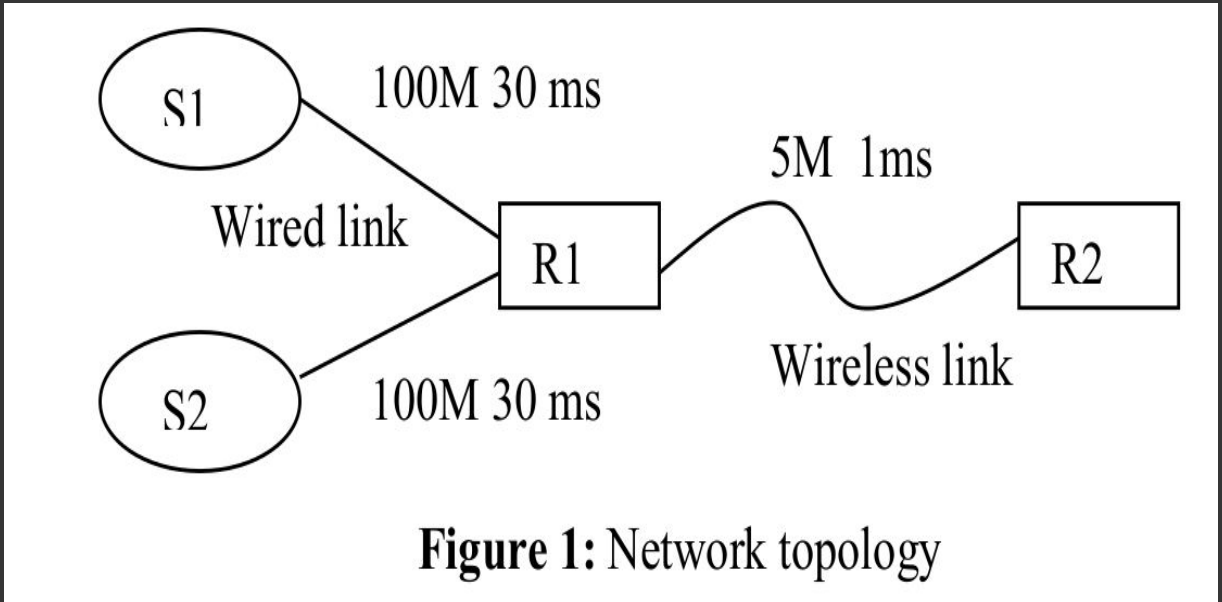


Figure 1: Network topology

Problem With TCPW

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Table 1: Bandwidth utilization at different bit error rates

Bit error rate	Queue algorithm			
	Drop-Tail	RED	REM	PI
0%	95.22%	90.94%	94.44%	95.32%
1%	70.44%	70.42%	72.72%	67.90%
2%	47.16%	44.10%	43.20%	42.04%
3%	34.24%	35.23%	32.08%	32.06%

TCPW- BR scheme

1. Congestion level division

⇒The first step is to determine an accurate RTT estimation scheme.
⇒This paper uses the method of timeout retransmission timer to predict the RTT.

$$F = RTT_{max} - RTT_{min}$$

$$R = (RTT - RTT_{min})/F$$

*$R \in [0,1]$ indicates the extent to which the currently confirmed data segment is used in the network transmission process

Table 2: Congestion level classification

R	[0,0.25]	(0.25,0.5]	(0.5,0.75]	(0.75,1]
L	1	2	3	4

2. TCPW BR algorithm

i. Congestion level = 1 ⇒ congestion probability is small

ii. Congestion level =2 ⇒ there is slight congestion ⇒ reduce the value of the growth factor P

iii. Congestion level >=3 ⇒ congestion is proved to be serious.

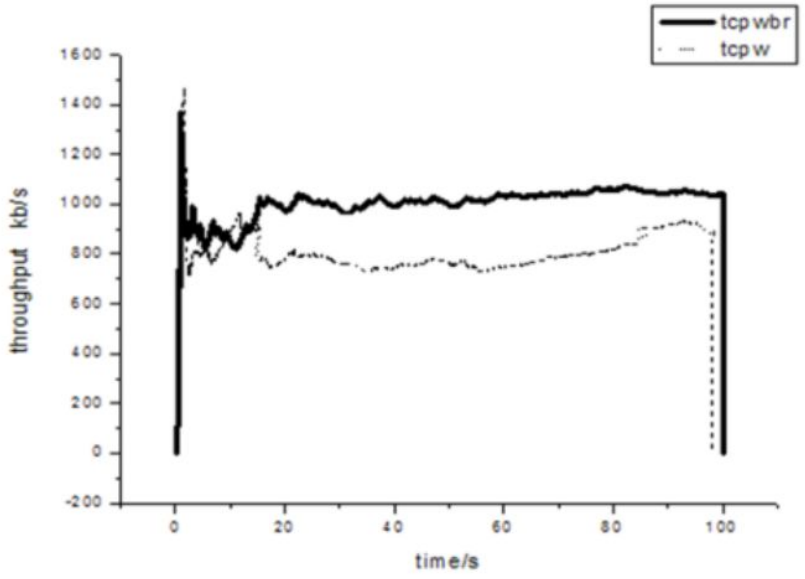
Table 3: Growth factors corresponding to congestion levels

L	1	2	3	4
P	maintain	0.867	0.5	0.4

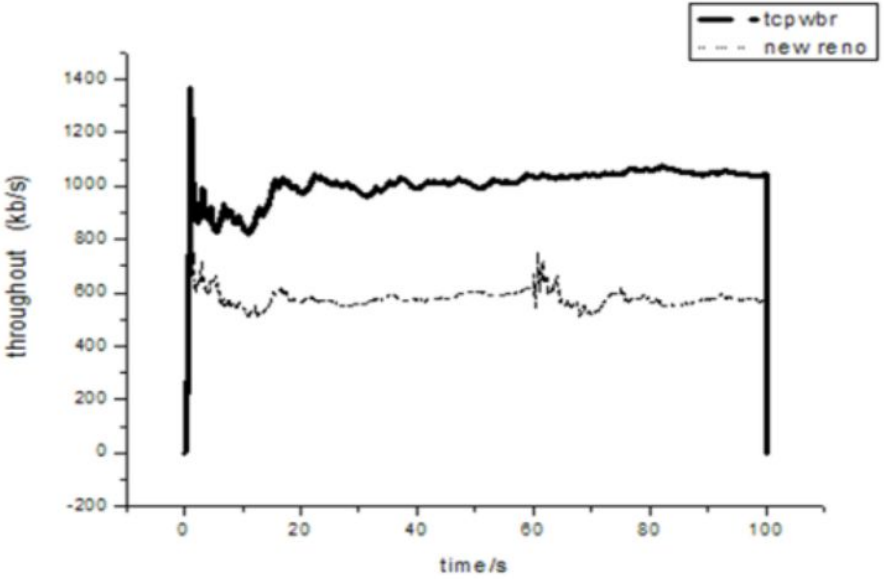
2. TCPW BR algorithm

```
(1) Each time an ACK of a new data segment is received,
    If (congestion level=1||congestion level=2)//Think it is wireless packet loss, mild congestion
        Cwnd=Cwnd+1;
    If (Cwnd>Ssthresh)
        Cwnd=Cwnd+(1/Cwnd)*p;
(2) After receiving a duplicate ACK before timing out
    If (duplicate ACK=3&& congestion level=1)
        Fast retransmission;
        Quick recovery
    If (duplicate ACK=2&& (congestion level=3||congestion level=4))//Think it is a congestion packet
    Slow start or congestion avoidance;
      Cwnd=Cwnd*p;
      Ssthresh =(BWE*RTTmin)/seg_size;
    If (Cwnd>Ssthresh) then Cwnd=Ssthresh;
    If (duplicate ACK=3&& congestion level>2)
    Slow start or congestion avoidance;
      Cwnd=Cwnd*p;
      Ssthresh=(BWE*RTTmin)/seg_size;
    If (Cwnd>Ssthresh) then Cwnd=Ssthresh;
```

Benefits of TCPW - BR



(a) tcpw compared to tcpw br



(b) tcpw br compared to newreno

Figure 3: Comparison average throughput when the link error rate is 3%

Benefits of TCPW - BR

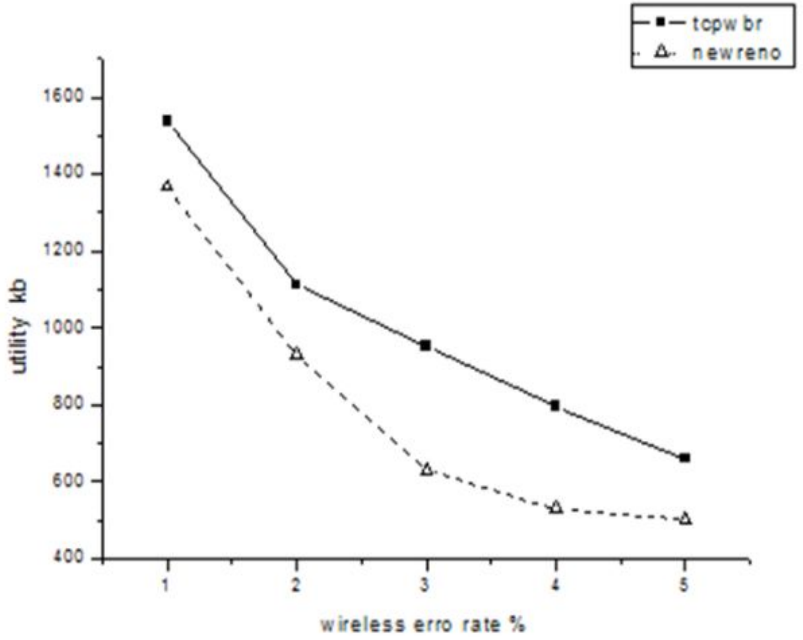


Figure 5: Bandwidth utilization of TCPW BR and Newreno at different bit error rates

Reference

TCPW BR: A Wireless Congestion Control Scheme Base on RTT.

Tian, Liwei & Li, Jinfeng & Zhang, Longqing & Sun, Yu & Yang, Lei. (2019). Computers, Materials & Continua. 61. 233-244. 10.32604/cmc.2020.06135.

https://www.researchgate.net/publication/338163187_TCPW_BR_A_Wireless_Congestion_Control_Scheme_Base_on_RTT