

Università degli Studi di Padova -Dipartimento di Ingegneria Informatica

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Si modifichi il programma tcp.c in modo che sia in grado di visualizzare su schermo, per ogni pacchetto TCP acquisito, la dimensione della finestra del controllo di flusso del TCP, tenendo conto della *option* del TCP "window scale” indicata nel capitolo 2 della RFC 7323, riportato nel seguito, che permette di superare il limite dei 16 bit del campo Window del segmento tcp (chiamato SEG.WND).

Si scarichi anche la RFC793. <https://tools.ietf.org/html/rfc793>

Si entri nel server cloud con il comando ssh *nome\_utente*@88.80.187.84

**CONSEGNA 17.10**

TCP Window Scale Option  
  
2.1. Introduction  
  
 The window scale extension expands the definition of the TCP window  
 to 30 bits and then uses an implicit scale factor to carry this  
 30-bit value in the 16-bit window field of the TCP header (SEG.WND in  
 [RFC0793]). The exponent of the scale factor is carried in a TCP  
 option, Window Scale. This option is sent only in a <SYN> segment (a  
 segment with the SYN bit on), hence the window scale is fixed in each  
 direction when a connection is opened.  
  
 The maximum receive window, and therefore the scale factor, is  
 determined by the maximum receive buffer space. In a typical modern  
 implementation, this maximum buffer space is set by default but can  
 be overridden by a user program before a TCP connection is opened.  
 This determines the scale factor, and therefore no new user interface  
 is needed for window scaling.  
  
2.2. Window Scale Option  
  
 The three-byte Window Scale option MAY be sent in a <SYN> segment by  
 a TCP. It has two purposes: (1) indicate that the TCP is prepared to  
 both send and receive window scaling, and (2) communicate the  
 exponent of a scale factor to be applied to its receive window.  
 Thus, a TCP that is prepared to scale windows SHOULD send the option,  
 even if its own scale factor is 1 and the exponent 0. The scale  
 factor is limited to a power of two and encoded logarithmically, so  
 it may be implemented by binary shift operations. The maximum scale  
 exponent is limited to 14 for a maximum permissible receive window  
 size of 1 GiB (2^(14+16)).  
  
 TCP Window Scale option (WSopt):  
  
 Kind: 3  
  
 Length: 3 bytes  
  
 +---------+---------+---------+  
 | Kind=3 |Length=3 |shift.cnt|  
 +---------+---------+---------+  
 1 1 1  
  
 This option is an offer, not a promise; both sides MUST send Window  
 Scale options in their <SYN> segments to enable window scaling in  
 either direction. If window scaling is enabled, then the TCP that  
 sent this option will right-shift its true receive-window values by  
 'shift.cnt' bits for transmission in SEG.WND. The value 'shift.cnt'  
  
  
  
Borman, et al. Standards Track [Page 8]  
   
RFC 7323 TCP Extensions for High Performance September 2014  
  
  
 MAY be zero (offering to scale, while applying a scale factor of 1 to  
 the receive window).  
  
 This option MAY be sent in an initial <SYN> segment (i.e., a segment  
 with the SYN bit on and the ACK bit off). If a Window Scale option  
 was received in the initial <SYN> segment, then this option MAY be  
 sent in the <SYN,ACK> segment. A Window Scale option in a segment  
 without a SYN bit MUST be ignored.  
  
 The window field in a segment where the SYN bit is set (i.e., a <SYN>  
 or <SYN,ACK>) MUST NOT be scaled.  
  
2.3. Using the Window Scale Option  
  
 A model implementation of window scaling is as follows, using the  
 notation of [RFC0793]:  
  
 o The connection state is augmented by two window shift counters,  
 Snd.Wind.Shift and Rcv.Wind.Shift, to be applied to the incoming  
 and outgoing window fields, respectively.  
  
 o If a TCP receives a <SYN> segment containing a Window Scale  
 option, it SHOULD send its own Window Scale option in the  
 <SYN,ACK> segment.  
  
 o The Window Scale option MUST be sent with shift.cnt = R, where R  
 is the value that the TCP would like to use for its receive  
 window.  
  
 o Upon receiving a <SYN> segment with a Window Scale option  
 containing shift.cnt = S, a TCP MUST set Snd.Wind.Shift to S and  
 MUST set Rcv.Wind.Shift to R; otherwise, it MUST set both  
 Snd.Wind.Shift and Rcv.Wind.Shift to zero.  
  
 o The window field (SEG.WND) in the header of every incoming  
 segment, with the exception of <SYN> segments, MUST be left-  
 shifted by Snd.Wind.Shift bits before updating SND.WND:  
  
 SND.WND = SEG.WND << Snd.Wind.Shift  
  
 (assuming the other conditions of [RFC0793] are met, and using the  
 "C" notation "<<" for left-shift).  
  
 o The window field (SEG.WND) of every outgoing segment, with the  
 exception of <SYN> segments, MUST be right-shifted by  
 Rcv.Wind.Shift bits:  
  
 SEG.WND = RCV.WND >> Rcv.Wind.Shift  
  
  
  
Borman, et al. Standards Track [Page 9]  
   
RFC 7323 TCP Extensions for High Performance September 2014  
  
  
 TCP determines if a data segment is "old" or "new" by testing whether  
 its sequence number is within 2^31 bytes of the left edge of the  
 window, and if it is not, discarding the data as "old". To insure  
 that new data is never mistakenly considered old and vice versa, the  
 left edge of the sender's window has to be at most 2^31 away from the  
 right edge of the receiver's window. The same is true of the  
 sender's right edge and receiver's left edge. Since the right and  
 left edges of either the sender's or receiver's window differ by the  
 window size, and since the sender and receiver windows can be out of  
 phase by at most the window size, the above constraints imply that  
 two times the maximum window size must be less than 2^31, or  
  
 max window < 2^30  
  
 Since the max window is 2^S (where S is the scaling shift count)  
 times at most 2^16 - 1 (the maximum unscaled window), the maximum  
 window is guaranteed to be < 2^30 if S <= 14. Thus, the shift count  
 MUST be limited to 14 (which allows windows of 2^30 = 1 GiB). If a  
 Window Scale option is received with a shift.cnt value larger than  
 14, the TCP SHOULD log the error but MUST use 14 instead of the  
 specified value. This is safe as a sender can always choose to only  
 partially use any signaled receive window. If the receiver is  
 scaling by a factor larger than 14 and the sender is only scaling by  
 14, then the receive window used by the sender will appear smaller  
 than it is in reality.  
  
 The scale factor applies only to the window field as transmitted in  
 the TCP header; each TCP using extended windows will maintain the  
 window values locally as 32-bit numbers. For example, the  
 "congestion window" computed by slow start and congestion avoidance  
 (see [RFC5681]) is not affected by the scale factor, so window  
 scaling will not introduce quantization into the congestion window.