P15. $t = \frac{1500 \times 8 \text{ bit/pkt}}{10^9 \text{ bit/s}} = 12 \text{ ms}$

设窗口长度为 x. 单向传播时延 10 ms.

$$\frac{12x}{12x+10+10} \geq 98\%. \qquad 0.24x \geq 19.6$$

$$\therefore \quad x \geq 81.67. \qquad \therefore \quad x = 82.$$

R30. P31

$$E_1 = (1-\alpha) \cdot E_0 + \alpha \cdot S_1 = 0.875 \cdot 100 \text{ ms} + 0.125 \times 106 \text{ ms}$$

$$= 100.75 \text{ ms}$$

$$E_2 = 0.875 \times 100.75 + 0.125 \cdot 120 \text{ ms} = 103.15625. = 103.16.$$

$$E_3 = 0.875 \times 103.15625 + 0.125 \times 140 = 107.76$$

$E_4 = 0.875 \times 107.76 + 0.125 \times 90\,ms = 105.54$

$E_5 = 0.875 \times 105.54 + 0.125 \times 115 = 106.7225.$

$D_1 = (1-\beta) \times D_0 + \beta \times |S_1 - E_1| = 0.75 \times 5\,ms + 0.25 \times |106 - 100.75|$

$= 5.0625. = 5.06$

$D_2 = 0.75 \times 5.0625 + 0.25 \times |120 - 105.16| = 8.006875. = 8.01$

$D_3 = 0.75 \times 8.01 + 0.25 \times |140 - 107.76| = 14.0675.$

$D_4 = 0.75 \times 14.0675 + 0.25 \times |105.54 - 90| = 14.435625 = 14.44.$

$D_5 = 0.75 \times 14.44 + 0.25 \times |115 - 106.7225| = 12.9.$

$\therefore$ $TimeoutInterval_1 = E_1 + 4D_1 = 120.99$

$$T_2 = E_2 + 4D_2 = 103.16 + 4 \times 8.01 = 135.2$$

$$T_3 = 107.76 + 4 \times 14.0675 = 164.03.$$

$$T_4 = 105.54 + 4 \times 14.44 = 163.3$$

$$T_5 = 106.72 + 4 \times 12.9 = 158.32.$$

P40. (a). 慢启动在 2-6 轮回. 14-26 轮回.

$$T = 5 + 3 = 8T.$$

(b) 拥塞避免 在 7-16. 18-22 轮回.

$$T = 10 + 5 = 15T$$

(c) 3个冗余ACK. cwnd 减半.

(d) 超时. cwnd = 1 MSS.

P44. (a) 往返时间 RTT.

1 TRTT. cwnd 增加 1 MSS.

$\therefore$ $t = 6$ RTT.

(b) 平均吞吐量 $= \frac{0.75 \times W}{RTT} = \frac{0.75 \times 12\,MSS}{6} = 1.5$.