

P_{15}

$$t_1 = \frac{1500 \cdot 8}{10^9} = 0.012 \text{ ms}$$

由题

$$0.98 = \frac{0.012n}{30 + 0.012} \quad \text{得 } n = 2451$$

P_{31}

$$\text{由题 } 0.98 = \frac{0.012n}{30+0.012n} \quad \text{得 } n = 2451$$

P₃₁

$$\text{DevRTT} = (1-\beta) \cdot \text{DevRTT} + \beta \cdot |\text{Sample} - \bar{\text{Est}}|$$

$$\bar{\text{EstRTT}} = (1-\alpha) \cdot \bar{\text{EstRTT}} + \alpha \cdot \text{Sample}$$

$$\therefore \textcircled{1} 106\text{ms}: \text{Dev} = 0.75 \times 5 + 0.25 \times 6 = 5.25\text{ms}$$

$$\bar{\text{Est}} = 0.875 \times 100 + 0.125 \times 106 = 100.75\text{ms}$$

$$\text{TI} = 100.75 + 4 \times 5.25 = 121.75\text{ms}$$

$$\textcircled{2} 120\text{ms}: \text{Dev} = 0.75 \times 5.25 + 0.25 \times (120 - 100.75) = 8.75\text{ms}$$

$$\bar{\text{Est}} = 0.875 \times 100.75 + 0.125 \times 120 = 103.16\text{ms}$$

$$\text{TI} = 103.16 + 4 \times 8.75 = 138.16\text{ms}$$

$$\text{同理得 } \textcircled{3} 140\text{ms} \begin{cases} \text{Dev}: 15.77\text{ms} \\ \bar{\text{Est}}: 107.76\text{ms} \\ \text{TI}: 170.84\text{ms} \end{cases}$$

$$\textcircled{4} 90\text{ms} \begin{cases} \text{Dev}: 16.27\text{ms} \\ \bar{\text{Est}}: 105.54\text{ms} \\ \text{TI}: 170.62\text{ms} \end{cases}$$

$$\textcircled{5} 115\text{ms} \begin{cases} \text{Dev}: 14.57\text{ms} \\ \bar{\text{Est}}: 106.72\text{ms} \\ \text{TI}: 165\text{ms} \end{cases}$$

P₄₀. 传输轮回

- (a) TCP在区间 $[1, 6] \cup [23, 26]$ 慢启动
- (b) 在 $[6, 16] \cup [17, 22]$ 拥塞避免运行
- (c) 冗余ACK (因为没降到1)
- (d) 超时 (因为窗口长度回到1)

P₄₄ (a) 往返时间恒定

$$\therefore \text{Ans} = 12 - 6 = 6 \text{ RTTs}$$

(b) 到 $T = 6 \text{ RTT}$, $\text{cwnd} = 11 \text{ MSS}$

$$\begin{aligned} \therefore \text{avg} &= \frac{1}{6} (6 + 7 + 8 + 9 + 10 + 11) \\ &= 8.5 \text{ MSS/RTT} \end{aligned}$$