1.

a) Yes

b) TCP

c) no

d) no

2.

a)

$b_1 = r_4 t_4$

$b_2 = (1 - 0.1) \times r_4 t_4 + 0.1 \times r_3 t_3$

$b_3 = (1 - 0.1) \times [0.9 \times r_4 t_4 + 0.1 \times r_3 t_3] + 0.1 \times r_2 t_2$

$= 0.9^2 \times r_4 t_4 + 0.9 \times 0.1 \times r_3 t_3 + 0.1 \times r_2 t_2$

$b_4 = 0.9 \times [0.9^2 \times r_4 t_4 + 0.9 \times 0.1 \times r_3 t_3 + 0.1 \times r_2 t_2] + 0.1 \times r_1 t_1$

$= 0.9^3 \times r_4 t_4 + 0.9^2 \times 0.1 \times r_3 t_3 + 0.9 \times 0.1 \times r_2 t_2$

$+ 0.1 \times r_1 t_1$

b) $d_n = (1 - \mathrm{u})^{(n-1)} \times r_n t_n + \mathrm{u} \times \sum_{k=1}^{n-1} [(1 - \mathrm{u})^{k-1} \times r_k t_k]$

c) $d_\infty = \frac{u}{1-u} \sum_{k=1}^{\infty} [(1 - \mathrm{u})^k \times r_k t_k] = \frac{1}{9} \sum_{k=1}^{\infty} [(0.9)^k \times r_k t_k]$

3.

a) 7, 9, 8, 7, 9, 8, 8

b) Packet 3, 4, 6, 7, 8

c) Packet 3, 6

d) 2 time units delay (audio playout begins at t = 10)

4.

a)

Delay sequence: 7, 7, 9, 8, 7, 9, 8, 8

$d_2 = 0.9 \times 7 + 0.1 \times 7 = 7$

$d_3 = 0.9 \times 7 + 0.1 \times 9 = 7.2$

$d_4 = 0.9 \times 7.2 + 0.1 \times 8 = 7.28$

$d_5 = 0.9 \times 7.28 + 0.1 \times 7 = 7.252$

$d_6 = 0.9 \times 7.252 + 0.1 \times 9 = 7.4268$

$d_7 = 0.9 \times 7.4268 + 0.1 \times 8 = 7.48412$

$d_8 = 0.9 \times 7.48412 + 0.1 \times 8 = 7.535708$

b)

Deviation sequence: 0, 0, 1.8, 0.72, 0.252, 1.5732, 0.51588, 0.464292

$v_2 = 0.9 \times 0 + 0.1 \times 0 = 0$

$v_3 = 0.9 \times 0 + 0.1 \times 1.8 = 0.18$

$v_4 = 0.9 \times 0.18 + 0.1 \times 0.72 = 0.234$

$v_5 = 0.9 \times 0.234 + 0.1 \times 0.252 = 0.2358$

$v_6 = 0.9 \times 0.2358 + 0.1 \times 1.5732 = 0.36954$

$v_7 = 0.9 \times 0.36954 + 0.1 \times 0.51588 = 0.384174$

$v_8 = 0.9 \times 0.384174 + 0.1 \times 0.464292 = 0.3921858$

5.

a) **1123**1123**1123**… or **1213**1213**1213**…

b) **112**112**112**112…