

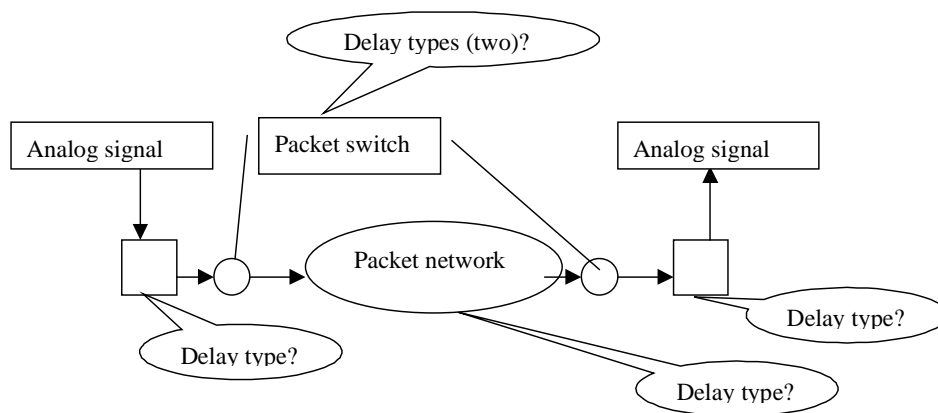


S-38.110 Telecommunication Switching Technology I, Exercise 2
Ilvesmäki, Friday 8.2.2002, 0915am, Lecture Hall S4

The answers are to be returned before the exercise begins (see the above date and time) either to the exercise assistant (in person or via email to lynx@tct.hut.fi) or, preferably, to a box underneath the lab's noticeboard on G-wing 2nd floor. Since we aim to publish the solutions immediately after the exercise, **all late answers will be disregarded**. Please, adhere to the deadline.

Task 1 (Easy)

Name the five different types of delay that data will encounter on its way to the receiver?



Task 2 (Easy)

The velocity of propagation for optical fiber is $2 \cdot 10^8$ m/s. A data source is transmitting at 1Gbit/s. How many bits will there be on a 1000 km of fiber optic cable? (Freeman: 9/29)

Task 3 (Easy - Moderate)

Let us study the echo effect for packetized voice.

A) Suppose that voice is sampled 8000 times/second, and suppose each sample is coded into a 8-bit codeword, byte. Suppose we use, for user data,

- a) 48 byte ATM cells
- b) 1500 byte Ethernet frames

Calculate the time it takes to create one packet in both of the systems.

B) Now suppose we want to call to someone on an analog telephone, assuming digital/analog gateway between the data network and the telephone network. Unfortunately, echoes are generated at the far end (say 6000 km away) of the telephone connection. Calculate the echo delay, assuming that the analog signal travels at the speed of light (300000 km/s).

(Hui: Chapter 2. Exercise 1)

Task 4 (Easy-Moderate)

- A) Assume there is queuing delay within the packet network, which fluctuates randomly between 2 to 20 packet durations for each packet. Compute the bounds for the queuing delay for a transmission speed of 10 Mbit/s and 150 Mbit/s. (Hui: Chapter 2. Exercise 2)
- B) Suppose we use 100 Mbit/s connections with 1500 byte payload. How large a buffer should a switching element have if the maximum delay for one switch is 0,450 ms? How many packets can you fit into the buffer?

