

COMP 5416 Week 7

1. Recall the simple model for HTTP streaming shown as follows. B denotes the size of the client's application buffer, and Q denotes the number of bits that must be buffered before the client application begins playout. Suppose the buffer size is infinite but the server sends bits at variable rate $x(t)$. Specifically, suppose $x(t)$ has the following saw-tooth shape. The rate is initially zero at time $t = 0$ and linearly climbs to H at time $t = T$. It then repeats this pattern again and again, as shown in the figure below.

- (1). What is the server's average send rate?
- (2). Now suppose $Q > 0$. $Q < HT/2$. Determine as a function of Q , H , and T the time at which playback first begins.
- (3). Suppose $H > 2r$ and $Q = HT/2$. Prove there will be no freezing after the initial playout delay.

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2. Consider the figure below. A sender begins sending packetized audio periodically at $t = 1$. The first packet arrives at the receiver at $t = 8$.

- (1). What are the delays (from sender to receiver, ignoring any playout delays) of packets 2 through 8?
- (2). If audio playout begins as soon as the first packet arrives at the receiver at $t = 8$, which of the first eight packets sent will *not* arrive in time for playout?
- (3). If audio playout begins at $t = 9$, which of the first eight packets sent will not arrive in time for playout?
- (4). What is the minimum playout delay at the receiver that results in all of the first eight packets arriving in time for their playout?

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