Assignment 1

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Q1: ping another computer
A1:

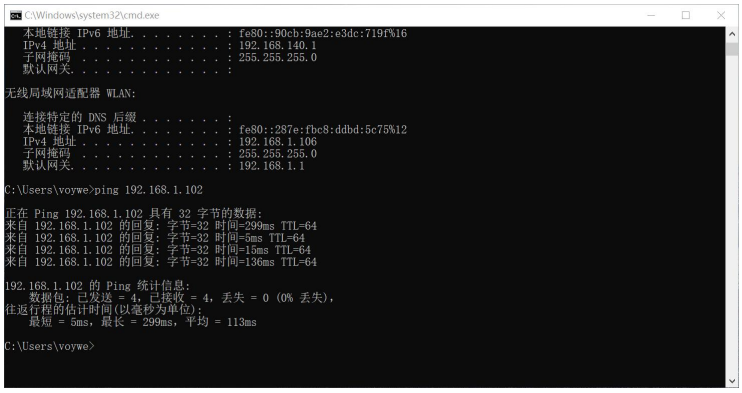

Figure 1: default

Q2: traceroute a server
A2:

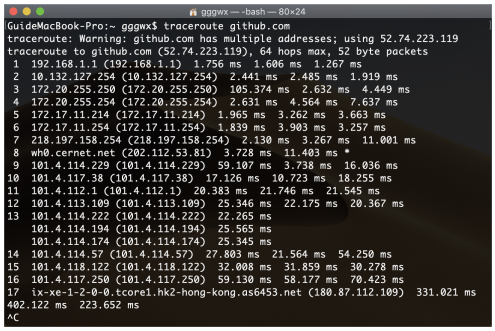

Figure 2: default

1 Problem7

In this problem, we consider sending real-time voice from Host A to Host B over a packet-switched network (VoIP). Host A converts analog voice to a digital 64kbps bit stream on the fly. Host A then groups the bits into 56-byte packets. There is one link between Hosts A and B; its transmission rate is 2Mbps and its propagation delay is 10ms. As soon as Host A gathers a packet, it sends it to Host B. As soon as Host B receives an entire packet, it converts the packet's bits to an analog signal. How much time elapses from the time a bit is created (from the original analog signal at Host A) until the bit is decoded (as part of the analog signal at Host B)?

Solution: time elapses $= 56 * 8bits/64 * 10^3 + 56 * 8/2 * 10^3 + 10 = 17.224$ ms

2 Problem8

Suppose users share a 3 Mbps link. Also suppose each user requires 150 kbps when transmitting, but each user transmits only 10 percent of the time.

1. When circuit switching is used, how many users can be supported?
2. For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting.
3. suppose there are 120 users. Find the probability that at any given time, exactly n users are transmitting simultaneously.
4. Find the probability that there are 21 or more users transmitting simultaneously.

Solution:

1. 3 Mbps / 150 kbps = 20 users can be supported.
2. $p = 0.1$
3. $p = \binom{120}{n}\ p^n(1-p)^{120-n}$
4. $p = 1 - \sum_{n=0}^{20} \binom{120}{n}\ p^n(1-p)^{120-n}$

3 Problem9

Consider the discussion in Section 1.3 of packet switching versus circuit switching in which an example is provided with a 1 Mbps link. Users are generating data at a rate of 100 kbps when busy, but are busy generating data only with probability p = 0.1. Suppose that the 1 Mbps link is replaced by a 1 Gbps link.

1. What is N, the maximum number of users that can be supported simultaneously under circuit switching?
2. Now consider packet switching and a user population of M users. Give a formula (in terms of p, M, N) for the probability that more than N users are sending data.

Solution:

1. $N = 1Gbps/100kbps = 10000$
2. $p = \sum_{n=N+1}^{M} \binom{M}{n} \; p^n(1-p)^{M-n}$