1. We combine six 200-kbps sources into three 400-kbps. Now we have seven 400-kbps channel.

a. Each output frame carries 1 bit from each of the seven 400-kbps line. Frame

size = 7 × 1 = **7 bits.**

b. Each frame carries 1 bit from each 400-kbps source. Frame rate = **400,000**

**frames/s.**

c. Frame duration = 1 /(frame rate) = 1 /400,000 = **2.5** μ**s**.

d. Output data rate = (400,000 frames/s) × (7 bits/frame) = **2.8 Mbps.** We can also

calculate the output data rate as the sum of input data rate because there is no synchronizing bits. Output data rate = 6 × 200 + 4 × 400 = **2.8 Mbps**.

1. We assume that the transmission time is negligible in this case. This means that we suppose all datagrams start at time 0. The arrival timed are calculated as:

**First:** (3200 Km) / (2 × 108 m/s) + (3 + 20 + 20) = **59.0 ms**

**Second:** (11700 Km) / (2 × 108 m/s) + (3 + 10 + 20) = **91.5 ms**

**Third:** (12200 Km) / (2 × 108 m/s) + (3 + 10+ 20 + 20) = **114.0 ms**

**Fourth:** (10200 Km) / (2 × 108 m/s) + (3 + 7 + 20) = **81.0 ms**

**Fifth:** (10700 Km) / (2 × 108 m/s) + (3 + 7 + 20 + 20) = **103.5 ms**

The order of arrival is: **3** → **5** → **2** → **4** → **1**

1. We use the formula **B = (1 + d)** × **(1/r)** × **N**, but first we need to calculate the value of r for each case.

1 kbps = 1024 bps

6 kbps = 1024\*6 = 6144 bps

1. r = 1 → B= (1 + 1) × (1/1) × (6144 bps) = 12**288 Hz**
2. r = 2 → B = (1 + 1) × (1/2) × (6144 bps) = **3072 Hz**