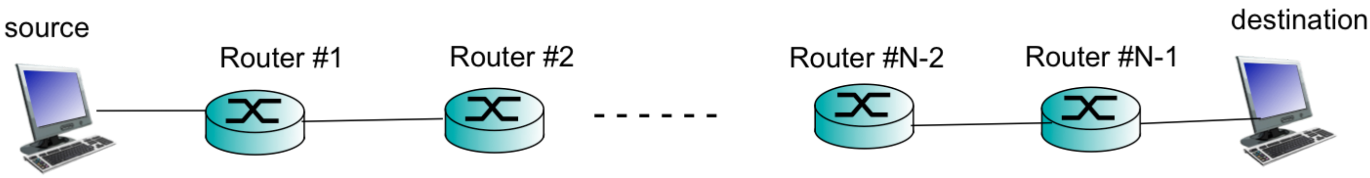
Sample Question: Message Switching vs Packet Switching (Please discuss)

This was a past exam question. Students are strongly encouraged to discuss the solution in the comments below. It may help to visualise the delays using the timing diagrams used in the lectures.

Consider an *N* -hop path (i.e. *N-1* intermediate routers) between a source and destination as depicted in the figure below. The source wants to transmit a file of size *kP* bits to the destination. There are two options: (i) Transmit the entire file as one large chunk (i.e. packet) of data. This is what we refer to as *message switching* or (ii) Break up the file into *k* packets, each of size *P* bits and transmit these packets back-to-back. As you may recall, this is *packet switching* .



All links (i.e. hops) have the same transmission delay and propagation delay. Assume that the propagation delay of a link is *d* sec. Assume that the transmission delay for transmitting P bits on a link is *T* sec. Thus, transmitting the entire file (as is the case in message switching) on a link takes *kT* sec.

Assume that there is no other traffic on the network. Ignore the time taken by each router to process each packet (or message). Assume that packet headers are negligible.

Compare the end-to-end delay incurred in transmitting the file for the two options outlined above, i.e. message switching vs packet switching. Which incurs lower delay and under what conditions?

Resource created about a month ago (Monday 16 July 2018, 02:50:37 PM), last modified 30 days ago (Monday 23 July 2018, 08:19:36 PM).

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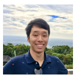

Michael Yoo (/users/z5165635) 20 days ago (Thu Aug 02 2018 16:12:27 GMT+1000 (Australian Eastern Standard Time))

Assume that most routers use store-and-forward switching.

If we are transferring a large file (i.e. several hours to transfer) under message switching, each router will have to receive the entire message to start forwarding. This implies an idle cost of T multiplied by the number of routers, which may take several days.

If we transfer the same file under packet switching, each router is only idle to receive the first packet, after which it starts forwarding at line rate. This implies a much less idle time on each router therefore less delay.

Reply

Zhuang Li (/users/z5188950) 25 days ago (Sat Jul 28 2018 15:14:36 GMT+1000 (Australian Eastern Standard Time))

According to the description, there are

k packets (P bits each)

N links (d sec)

N-1 routers(T sec for every P bits)

Total delay includes processing delay,transmitting delay,queuing delay and propagation delay.While in this question, the 1st and 3rd could be regarded as 0,which means total delay consists of transmitting delay and propagation delay.

For message switching,there are 1 source and (N-1) routers and N links, so the total delay is equal to NkT+Nd

For packet switching,the total delay is the period from the time first packets leave the source to the time last packet arrives at the destination.We could divide the total delay into two period, the first period named delay1 is from the beginning to the time that last packet finishes its first transmitting at first router.The other period named delay2 represents the rest journey to the destination. In delay1 it passes 1 links and 2 router so delay1 one is equal to d+2KT.Then ,the last packet moved from the router 1 to destination through N-2 routers and N-1 links which consumes (N-2)T+(N-1)d sec.So total delay is (N-2+2k)T+Nd sec.

According to the two results, we could find the message switching delay grows faster when we increase only 1 of these variables(k,N,d,T) .If (N-2)(k-1)>0, which is equal to N>2 and k>1,message switching has higher delay. Given that k and N is always higher than 0,so in most cases(if N>2), packet switching delay is lower.

Reply

Yipu Ding (/users/z5180553) 26 days ago (Fri Jul 27 2018 12:39:31 GMT+1000 (Australian Eastern Standard Time))

N(kT+d) for message switching.

for packet switch, since we send packets back-to-back, the time the last packet reach the first router is kT+d , then the last packet has to go through another N-1 hops to get to the destination--which takes (N-1)(T+d), so the total time is

(kT+d)+(N-1)(T+d)

the time for message switching equals to (N-1)(kT+d)+(kT+d), compared to packet switching, message switching will always be slower based on the assumptions given.

Reply

Boyuan Ding (/users/z5092145) 27 days ago (Thu Jul 26 2018 20:24:46 GMT+1000 (Australian Eastern Standard Time))

N(kT + d) for message switching as others said

for packet switching:

I personally think it would be the time period between the first packet sent and the last one received, hence

(T1 time it takes to send the last packet ->transmission delay for the whole packet? -> kT) plus

(T2 time it takes for the last packet to get to the destination) which can differ:

if if d < T, which is the case that packet arrives before some of its bytes are still being transmitted so it has to wait:

N*T

d > T, it doesn't need to wait hence N*d

Reply

Daniel Hocking (/users/z5184128) 28 days ago (Wed Jul 25 2018 17:13:22 GMT+1000 (Australian Eastern Standard Time)), last modified 28 days ago (Wed Jul 25 2018 17:46:04 GMT+1000 (Australian Eastern Standard Time))

There are already some pretty good answers so I will try not to repeat too much.

Firstly there are a few (fairly unrealistic) assumptions that change the answer from a real world situation:

- All links have the same transmission and propagation delay
- No other traffic on the network (so no queuing delay)
- No processing delay
- Packet headers are negligible (so no real overhead from small packet size)

And the following definitions:

- N: number of hops
- k: number of packets
- T: transmission delay / packet sized chunk of data
- d: propagation delay

Now using message switching the total time would be: N(kT + d)

EDITED: I'm leaving the old answer in even though its wrong, or at least the reasoning is. Essentially you don't need multiple unique routes to get the advantages of packet switching, as was stated in other answers just having multiple hops will give you the benefit.

So packet switching should still be at least equally good even in the worst case where there is a single hop (given the above assumptions), but if there are multiple hops then packet switching will be faster as it can send the early packets with much less delay then when it has to wait for the whole message to arrive.

Old answer below ====================================

The time taken for packet switching would be more variable as it would depend on how many different routes there are between the source and destination. I think in the best case we could assume that there are k possible routes between the source and destination, with only one link on the first and last hop, this would give an overall time of: (kT + d) + (N - 1)(T + d)

The above formula is saying the best case time would be the time taken to send each packet serially on the first hop, and then after that each packet takes its own route so how long would it take for that last packet to get to the destination after all packets have been initially sent.

This assumes there are enough equally good routes that each packet can take its own route, but even in the worst case where there is only one route, it appears that the end-to-end delay shouldn't be any worse than message switching, given the above assumptions.

In a real world situation where factors like the overhead of the header matters, there are situations where message switching could have a lower delay, and it would be more reliable, but in general packet switching is better and that is why it used in most situations.

Reply

Michael Tran (/users/z3461919) 28 days ago (Wed Jul 25 2018 10:29:52 GMT+1000 (Australian Eastern Standard Time))

Message switching would be good if the message is relatively small, as well as having a small number of routers.

Packet switching would be good if the message can be broken down into a lot of packets. This is because as you send the packets, you can continue to do work on the other routers, so work is done concurrently.

The time for message switching will be N(d + kT), while the time for packet switching N(d + t) + kd. We can see that it is advantagenous to have packet switching with N is large.

Reply

Semisi Taufa (/users/z5192989) 29 days ago (Tue Jul 24 2018 22:13:23 GMT+1000 (Australian Eastern Standard Time)), last modified 29 days ago (Tue Jul 24 2018 22:22:38 GMT+1000 (Australian Eastern Standard Time))

For a large N, message switching will take more time as the entire message will be stored at each of the hop points till it is completely received. However, packet switching can increase d because packets may take different links (longer distance) to the destination.

Reply

Abanob Tawfik (/users/z5075490) 29 days ago (Tue Jul 24 2018 17:57:04 GMT+1000 (Australian Eastern Standard Time))

would message switching cause a delay of N(d + kt) seconds as each router must wait for the signal to be received before transmitting it to the next "hop", whereas there is continous transmission with packet switching as the message is broken up into chunks and sent out. please correct me if i'm wrong but would packet switching cause a delay of N(d+t) + (k)*d (constant data transmission kd) seconds? this would mean in most cases where n is very large, packet switching will incur a lower delay, as it is continously transmitting data, whereas in cases where N is smaller or in the case n = 2, message switching be better? not certain if my answer is accurate.

Reply

Nadeem Ahmed (/users/z1058484) 29 days ago (Tue Jul 24 2018 19:23:45 GMT+1000 (Australian Eastern Standard Time))

The question assumes that for both message switching and packet switching each router employ "store and forward" (we will study this in the next lecture). What this essentially means that the router will wait for arrival of complete (message or packet as the case may be) before forwarding it to the next hop. Lets see what other students come up with.

Reply

Wenxin Wang (/users/z3454684) 29 days ago (Tue Jul 24 2018 13:47:12 GMT+1000 (Australian Eastern Standard Time))

packet switching is better solution.

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