### Network\_week4\_lec4-2-20240926

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The other issue is rtp here in the very beginning already, mentioned many times around the trip attack, because all of these two relate the network is into a situation networking, very contested, the running the time out and rtd is supposed also in the change. You should the network is like a loaded. Nobody use just you. So rtd and i'm running out the same thing should be shorter. How do you practice? This works. All right? That means longer than rtd but the rtd variable. In terms of time of the people, you're set too short, premature. We already saw that the acknowledgment still on the way design will reach you in 1/2 way. You say, come out, you send again. So the same or packet you send again, this time.

Actually, receiver already got it. The other one is rtd if you said it too long for you to come out too long, that's a failure. You did response, also you waiting. So the little working resource you didn't for the utilize. In practice, this is a dilemma you want to get shorter. You maybe got some more if you get longer. So how I have a precisely this value that's very challenge. Nobody can guarantee you're saying is absolutely right. But if you're not absolutely right, you make it is the most cases. All right? So too short, premature time up, unless it's only because emission, too long, slow reaction to second in the lost level, resources wasted. Now, the question how we estimate rtt so the one critical situation you can sample, for example, in the internet, if you guys already got to look at one practice, really, you came from the center the key signal to the other server to say how long it takes.

Actually, that's it's a kind of you measure rtt from 1720. And he said, but in this case, we typically ignore retransmission because that's a failure already. This is your. So after that, even this round, you said, come out to to test the rtg next commodities, rtt the time is always a difference. So typical company you will always be using. So every single art is in the management. You you put them all together and divide by number of time, you get the sample rtp then you can estimate you give a lot of time.

This estimate is last time, for example, currently estimate is 5 million seconds. Okay? You one minus alpha. This is next one. This is current number one. Current one, sorry, this is next one challenge. Pick up is the current about those three is found in a second ec plus alpha alpha. And this is sample. Several png several are to be, for example, this is 51. The alpha triple got very small. In this case, it is 126, 0 . 125. For example, if look in the end, you maybe get the six seconds, the new one.

Okay? A in a second means this sample maybe take a lot longer. So this basically is history is right. Previously you hierarchy. It is major dominant. This album is a small one that include a recent, the changes. In this case, if you find out your result in the Current 5 million seconds means the networking now become more congested. Your rtd should be longer if in the end, you calculation point is number 4 . 5 seconds. That means the network in terms of rte now is no longer congested, because several topic is probably you reduce from the following a sentence to 4 . 5 seconds.

This is actually helping you dynamic change that this equation, if you further expand this one minus alpha, I can say one minus alpha. This this is currently one equals one minus alpha. The pre this one is previous one minus alpha, evc double prime, and plus alpha sample. Last time. In the end, you can see this is one minus alpha geometric decrease.

If you already knew that this is a common exponential with the moving area of sometimes called linear auto regression, very basically estimation from the history. And the current one is doing as a basic value. Some of you already know the machine learning. I we're basically formula, right? This is one. Let's look at the diagram here. You can see what's the difference. This is the . the the diamond one is you manual tested is right. So this is the pink square means is you doing every using the formula, you got this one, sometimes this variation is quite a lot, right? Because that means that they won't get traffic is not stable, is what? A wider, one, one power, sometimes very high, sometimes very low. So this is one issue is how often we we're doing this change. This is made by the internet authority. I really don't know, maybe is every 24 hours, maybe the 48 hours. So definitely is not very fast, because otherwise that the the most time to do this kind of the adjustment.

The other issue. So we already talk about estimation is not amazing. Then we have further given the safe safeguard that one, you say, you just give this value after they have a bottle above or below. So you give a system margin, basically saying time up, okay? The city is, you already estimate rtt plus four times deviation rtt this is the trick is over here. This you already use the linear regression calculating that. This one, you have to similarly relation one. You rather in sample one, you minus estimation one and use of solution value, because it may be larger, may be small, may be positive, may be negative, is right.

In this case, you can find this formula one minus beta, the relation. And part of this. This is currently reference ok the beta, you cross 1/4.

So that's why you feel in 4 times that then some students ask me, how do you know the alpha equals 01, 25, beta equals 0, . 25. How do you do that? All the sticking? I don't know either. So most of this is a practice available for people. Design the system in the early days, then the test where are the men this one sense of saying, does it experience? Make it a decision? All? Right. Now we can see in terms of tcp first of all, your data set from application there, your message kick out in the socket in the center, right? So that you create a segment with a sentence number. So the number, this segment, we already see it. You have mss maximum. You have 4,090 65, maximum segment side, ok 40965. For that one. So depends, you may be just 200. You may be 1,000. Different saying that you have different mess. It's about the time is not already running, think of time as the oldest giving you.

You very, first of all, you haven't said that you supposed to have the first package you send after you have a timer, you successful or the the carbon remove the second one and the third one ok so it is you only one at a time, right? Oldest, always done on act the second, expire in the world is coming after. Okay? Once time out, you need to be transmitted the signal, cause the time out, this is not the time out. For acknowledgment, if I received from is aa segment, this we talk about segments are already, i'll get what is known to be act. Starting timer if they are still out at the signals. This is about the acknowledgment in terms of the civil is the rfc 5681. So this some things ii do not talk about here is interested in referred to this rfc go to the number one more share.

Now, we talk about the transmission who the segment of failure is possible, how this procedure, okay? For example, you said that the current discipline is the number of start from 92, this single number of eight and five. So denial is supposed to get a 100 right of knowledge and 100 actually received, but may be lost in the road. So this is reading a wire that if you give the volume so that you will send this carbon signal.

Now again, because this target only one over this one, you can find it later. And 92 + 8 and 100, this is lost of longing and scenario. So this one sentence is already used to talk about. It's right. It's window of a equals two. For example, in this case, this batch of segments. Here are two is right. This segment is eight, and this is 20. So you can know this. The second numbers start from 92 if you successful, because you already do this, each second and less. So you will know the second is started. The number should be 100. The first one, second, almost seven, at the same time, you can power line once you successful is return is 100. This return the 120, but the one issue in the first one, you can say, come out earlier than you receive a technology.

In this case, once it must realize different with that, you can see here, actually, in this side, receiver side of this, as I said, you have a pointer is indicated so far from very beginning to here, how many packets you got it? You here on this, you actually already got 120 right in the several side.

So once you send, again, actually, this already received, but you haven't. Here I send a technology in the 120. This is a little different with original package ok this button. This is all also right in the receiver side will always said so far from very beginning, so far, the successful one. So that means to this part. And actually you already got 120. So that's why you said 120 back. I'm trying to be, this is called different mission and not take it in the car. We somehow call replicate because they are already. You said they, excuse me, this premature on the time out. Then we look at the could you have earlier lost the package? This one 120. So the this is exactly the previous case we got here, because in the end, this is the same one. The center of liberal party is right. But here to this ., the part of the body. So this one, we say that a lot of acuity act always power, early loss. You got it because receiver side determine whether you received or not.

So now we can continue send the next one, but currently 120. This is the second number should be from 120. This man, a segment of 55 and so on. Tcd faster transmit transmission or what happened? Ok this give you guys some sense. Ok suppose you in this badge, 12345, you can transmit five segments in pipelines, right? So you can see the very first one successful, you acknowledge in 100. The second one send way is lost. So despite the third course and the 5th, this is three second success percent. But what knowledge even always 100? Because to here point, do anyone can tell me why is between 100, not something like this, the rest of three, the the second segments next put together? Why point out this maybe is just each of them.

We trade with 100, so that's why government return for 300, 200, 300, 400 instead of is 100. So anyone can explain to me because this, as I mentioned last time, you use who back in style. You are cumulative acknowledgment. That means so far. This is 100. You got it, but here you have a gap is right. This one said always last primitive, successful point is here is 100. So that why for this one, also a committee with the here? So that's why. So all of this use this one, please give us an indicator ok suppose you time up in this point we transmit is right. But before your time out, you already got three identical reply. We call the duplicate things. So this indicate that there will be something wrong, something lost.

So instead, you you took this part, let me transmit. You can transmit over here. But after we send this rate, you can do that. Okay? The service we duplicate x indicates three segments received after a missing, a segment lost the second. So it has to be a problem here. All right. So that means you have to do this is the same again. Okay? This one little give a name. We called ai md addictive increase. Aii think we can increase md multiplexing decreasing. That's later we talk about that. So this is one of the networking situation you need. You just windows. All right? So be careful, receive the saving of the three duplicate. X indicates. Three segments received after a missing segment lost. The segment is not. So you're telling me that you're supposed, i'm out of this point. But if you for this part, you already got three identical, duplicate, then you're not waiting to this .. Rather, you action from here. We can't be the is a segment again.

Then we talk about this one in terms of control. The flow control, you can see here from the center side, this is receiver a stack. The packet probably receive a central side. You going from the physical this link layer. Ip code means network they are equal to times four layer. This means the central part, but here, tcp you each of these segment, I need the internal socket and and go to application process is right to the top.

Here, you supposed to have a certain why we call the flow means your segment by segment seven, bike by bike. And so this is a buffer. In case, if the buffer of all, you can, another process very quickly, so the segment or the data will be lost. Right? One issue. Another one is from here, the 71, another one, you need transporter, you need processing d or relax into the application there. So application, removing data from tcp circuit, this like a hand from transport layer to application layer like this, get away you you pass away if this side speed fast, that is slow or that's the faster this slow, that's okay, everything you can go through that.

But you could the process is known, you delivery too fast, then you got problem is right. So that's what we do. What happens if they're looking. They are from this man who they are underneath of cargo to talk about transform there. Delivery, they are faster than application. They are removed data from such a buffer for what happened.

Basically, you may be use a we call the flu control, receiver control center, ok the source seven. Segments data to the receiver should be acknowledgement is right. The acknowledgement content. Tell the sender you're send too fast, then what do you do? Receiver control sender. So sender would the overflow receive a buffer by transmission too much, too fast?

How do you achieve? That's our law. We see what one is. One, i'm sorry. We look at the flow control in the receiver side is your application process in subjects, right? You're supposed to have a buffer. The buffer are the two parts. This is called rwad what's rr means receiver with wad means the window side, ok entire. You can say rnd this area buffer, some already buffer, means you already received, you are currently processing packet by packet. Take it in the socket is right. So this is a free space. Still able to receive segments from the central side.

The several buffer side, typical, as I mentioned, that means single maximum single segment size, 44 thousand and ninety 65. Many of the system, the american just receive a buffer on this. This is from here to here. The entire side hold total, maximum. I have total. How much is it? This model of the system is by dedicated and adjustable, right? Sender email about, I can implied that means if the r wat is entire bubble, the remaining, you can send free buffer space. So that means you send the speed can not larger. That is then the buffer put the whole that the data will be lost. So guarantee receiver, but not overflow.

All right? The receiver, you can save the control. I receive over a center receiver window. Since now, we will look at how do you manage managing these issues. Before it's changing data, set up receiver, first, you build the process, you need to have a city, right? You in the sale, the central side, you have process and the several side of the process. So agreed to get the connection, agreed to connection parameters. What's the start the second number? Because you get the workforce, the segment you always start from zero is right. But our follow the segment, so maybe you already saw that 92 or 40, you always increase the second number.

In here, you have a host name, and for example, whose name, basically ipii guess. So this government collection, one a way you can go like this with all the two way and a hundred city. Let's say, for example, our human alice and for the alice asked about this talk about say, okay, so you already built collapse and this is two ways.

One ask why to rely. If we use the computer to save our world, this one request, the connection come on. This one said I accepted your collection. This seems it's right, is no problem. But in the practice, whether this sound is, whether or any always work in networking, because you have reply is not reliable. Already says it may be lost in the halfway. So you provide example, you get a collection after a certain point that you didn't have a reply, you need to be transmitted this. You can start again, right? So you couldn't see outside two way, the ideal one, you send a collection request. They are certainly your request. Then next one, you send the data and then unlocked. And I saw this perfectly ideal case. But we already mentioned internet. He is not reliable. In this case, what do you do? For example, to send it here, this is where tv one you send a request at this dinner or safety.

For example, the apply that after this ., apply the disconnected, you run away. Here, maybe you're retesting the why? Because of this delay, you are coming out earlier, you can send to here, right? So that so after you send, they send aa combat. But in this case, you can see here, you premature, you send again, then you engage.

But before you get a second point, you've already gone. So in this case, we call the half way, half open. This side is open for you. The clients are actually, you already terminate, you already run away, you're no longer engaged. This is because both sides cannot see each other, just a similar communication. So this is not acceptable. Two way have a safety in practice anymore. This is, if you example, we sent this tough situation. Why is it like here you are duplicate? These are made. You come out earlier. Then you see, for example, you send, actually, the you apply for the delay. You will be transmitted after a certain part, you already believe. So this always is a hard way to to make it. A problem is for the yeah, so you said for the three way, happy chicken, that's the real tcp above. All right? Firstly, you send a request. The first one is called just a single b not a chemical is the same. It is called simple line 1 bit.

I want to request for connection to here and cover the sections number x this one said in the several side was the second number. Then they said this company seven eights are number 1 + 1, because I send one single page back. After this received you, because of the both side, this is a simple number from here. We will give you. And then this side, the several side argument, it is why here? So this that is an acknowledged. I can here. So in this case, both sides, the sentence number from the line, from the the 00 k so both sides body, this one, you finished the initial one.

So that's why we call the three way. Firstly, you said that you gotta accomplishment and this one they understand again. So that means this one always on. So that's really once in terms of complication denied, you have to finish. That's right. So the server closed currently connection also send a segment. Just a single bit is finished. B is one. So once you received this one, you mean you close the current collection. So just for that one, now we talk about the so called congestion, the control principle. We already mentioned that flow control basically is sender and receiver. The several buffer is limit, and receiver can through acknowledgement control center or center fast or slow, right? Congestion means you are not is by individual rather than collectively ever.

For example, this is an intersection in the highway, the car from a different direction, go through this .. So that means, as I mentioned, like a bridge from the laws and subs. So lots of people want to go some go in the loss. If not too many variables go through this break, you can very easily pass through. If it is too many people like public holidays, congested, you may be more, very slowly and take it half hour in 1 hour out through. So a similar situation like this, that is many pairs. We'll talk about tcp is 1 ~ 1. So from 1,000 to 1 to the destination, so many different sources to different destination, but they share links. Here are the routers. 2 minutes also send too much data too fast within available game hunger.

In the end, you have a long delay because you need a buffer, right? You may be unavoidable capital loss, because the power of size always limited. If many, too fast, you you put the whole processing. So this one has to say that if you're doing research in the future of the in the communication networks, 1/4 effort basically is rolling or kind of resolve the congestion, neither the methods. This is the decision in the top ten problems in terms of research. Now we've got two concepts once the blue control is in 1 pair from south to the conditions, right? That means you carry your center, faster center to or slowly several.

And this, You need a flow control if the center the speaker lower than receiver processes. If that's okay, every second company or you ever easily process without delay, otherwise you must have delayed the buffer. If your buffer for that the in the second loss, as you come from, congestion come from, as we see, a set of center set to a set of destinations, so that you got this, one basic issue is so called fairness. What called the fairness means giving this particular fairness, for example, 100 negative ok so if two people, that means you share each of you and 1/2, that's right. You cannot say you got a nine after ten out of one, out of ten, then that's unfair to me. Right? So how to make it? These things play every participate is fairly treaty fairy, fairly locating resource. That's also issue, in fact, is actually not necessary, absolutely fail because depends on your payment.

For example, your high priority, you may be paid more, so you get a larger share. If you do not care, you may be able to do less share. This is in the commercial europe, the random things that is also certainly you have another one different concept, so called full congestion control.

But now we've got the so called tct window, ok again, ttct is full control. You receive our window is determined. A center of power flow, congestion window, this window, actually, you have to estimate, as I said, because in this case, you may be changed some routers of the each rotor can come packet.

And how do we pack it? The rotor maybe have some indicator for congestion issue so that this is the window, entire particle.

You suppose these two windows minimum. So this is easy understand.

Now we look at how to measure congestion control. As I said, internet is is to give a system or decentralized system. No one dominated or centralized, I can take care because everybody is peer to peer position. How in this is circumstance? I do not have global knowledge. How do I know the level ok is congested or is okay? Now we look at the basic mechanism behind, okay? As we mentioned, that there are no explicit feedback from network and congestion. Basically, you sharing means you can derive from your observation, from the observed loss delay. For example, this is a typical case. This is two bodies, right? 1 to 1. So your things through a particular role. But in terms of the source and investigation, you don't know which rotor you go through, as I mentioned. It's right in the middle. And they are actually this road is giving is by the in the article calculate this role you should go through.

But no matter what you go through, in the end, you will, in the package, the header part of indicator, how do you do that? Or when you take it by gcp right? So why is it so called available as a system? The content of control rotor? A while director feedback to send out the same or most of this flow as a contented, wrote many indicator contacts they were on lately said, sending me, okay?

For example, this one you need every data you send it to here or a quality back in the quality and the signal. Format. As we already said, there have 1 bit indicator. C means congestion. If one is congested in the 7 + 1, the tcp eee can that's or particular field as an idea you look at the previous section about that. This is some other one.

Now we talk about the so called aimd is, I will give you what exactly means aimd above. This one, so far, the center can increase 7 second rate, and the patent loss occurs that decreases separate on loss, given what is exactly means.

In terms of startup, you send things can start with this slow speed. So if you send aaa second, after you get acknowledgment correctly, then you double your speed that is correctly. You double. Until some degree, you've got a loss, then you reduce use your speed commenting on it, ok then this kind of you already did it.

Repeated ok so we talk about this, give you so called, say, so salty chip, okay? So called soft safety is the one you can say this is called a A 50 increase. This in terms of segment, initially you want, for example, so after here you got a loss. You original, for example, of this supposedly is rain. If you lost it here, you just this is the one you decrease the half rate to. Here is right. If no loss, you increase in this linear increase. So that means addictive increase. After this part, you've got a loss. The current is here. You gotta. Here halfway. In the end, you got a sort is one. Why is the so called? If you have that one increase the second? By one, this is not falling at the itr the most dependent, multi, passive, decreased carter century in half at each loss events.

That's the so called aimd of the about salty behavior, probably a company in the bandwidth, the occupation stuff. This one is the order of that. There are two different ways, not just become the half way coming in half or loss detected by triple duplicate suk this typical we call the randall. You already saw that previously we talk about particular segment, the loss, then the the other segment that you have timer, the timer of the part one, then before the timer, after you have three, duplicate one, that's exactly missing.

One is we call the tcp random, triple duplicate x in this case, you need to cut the rate previous one, cover the one, become 1/2. If cut to one, is the maximum signals, are we lost detected by time out? If this is time out the loss, you come out, you need retransmit. We need to become one. That is one single, basically, part of the whole. Oktcd have 2 kind of a situation, rather. How old? So this issue is very important. All right? Why ai you already mentioned that. So now we look at the congestion control. All right? This is the typical example. You can see the left outside all the package already, a second already sent. So the yellow part is not from here, is window side. Is we call the cwe congestion window side. The yellow one you set up, you have a lot of this one is so called the blue one. You can continue with that.

Okay? Then you can see the center limit is the last 5 % were here. This is last by the act, okay? This means this area. So this area, you spend more than cwnd is congestion window. That's clear for you. You might say that you can send a yellow cover to this area. All right? This congestion window is dynamically adjusted, as I mentioned, because it depends. The tcp window is a minimum congestion window, and blue window is right. So this is on this one, how I calculate tcp red. So this congestion window divided by rtd is that means every second, how many parts you can send?

All right?

Now we talked about ai and d is right. So what was if you got time up, you please send the signal.

What's the process? Initially, you just send a single a segment, is the rate is one, okay? If you successful body, this time you double ok that means next round is the first round. Double means two, actually, 2012. One is 222 is 4 is financial groups. There is two ok this is successfully, then you 44 and 80 k each time. We are forced to single segment. After each of the successor, rtt you just double ok this is congestion did not arrive. Initial reader is slow, but the ramp up very quickly. It's right. So this is kind of ctv up. The very first rtt initially, only one is right.

So next rtv if you successfully come to, the third, you are tt you got the and correctly is four.

So there you got a the code is an exponential groups. Ok now, we already talk about loss, indicate if time are ok this is one. What this means, if you have, for example, you usually have one. Right?

Now you have two, then you have a four, okay? But after here, maybe, for example, this particular one time out, this third one time out, the rate is 124, four. After this, if failure, the rate decrease to one. Okay? That's what the name I got is. That's give a signal. So we say that we have two part. One is re know. One is a whole, is right. So it's kind of one is a whole. All right? If you got a three replicate for this one, you be careful. Okay? The cwd the computer window cut in half a window that grow beyond. That means duplicate cable with some is cut in half, then through linear.

That means original window size is here. If you is the whole, you just cut to half, then increase linear. This one is not correct, I think it, because of the topic from the original one will be careful on this one. Rather on the couple.

Now please have a look. We start from zero from one increase. Here, sh shift. This is a it means already now in the previous one, why you got the one of you. Come up, you brought here. The previous cwad was the side supposed to be. And can you tell me what's in now is one of the previous the cwd side? You drop to one, you put the windows are the decrease to half. So eight, that means original one is 16, right? Because 16, you have time out, you reduce the size. In the windows up into half, you got a once you hear from you exponential growth groups to here half, after this, you only linear groups each time increase by one.

Okay? After here, 12, 12, you have time out, this time out, you decrease to one, right? So then you can get this one. But the time it off, the next the groups, the explosion growth is to one or half is six to here. Then you need a groups for the random means. You are three. We can, for example, if you in this point, you are not dropped to here to half, 12, to half. It means here you have all time, after not yet, here you already received three replica, then you become the window reduced to six, then you linear groups. It is clear for everyone. So this is very important. What's the ssg just heard about? What's congestion window? How to calculate how to derive? Okay? This one. So probably one, maybe you have already, maybe that's argue, list of internet ok so today one major is include the last one. Go back again selectively as we are in terms how to send me the voting that is congestion through common congestion.

And That flow congestion, I have never worked inside the congestion control to control on this concept. I I think we should stop over here. You take 10 minutes against the one about the sessions. You could be made your students have a problem in terms of in the and.