- First one is Transmission Time (tx) and second is propogation time (tp).

Now question, yeh transmission Time (tx) Kya hota hai aur yeh propogation time (tp) Kya hota hai ??

- Joh sabse pahala hum dekte hai yeh transmi-ssion time kya hota hai ??

Transmission Time :→

Is transmission time ko usually tx se represent karte hai.

- Joh transmission Time kya hota hai ??

Ans- Transmission time is a time required to put the data over the media (channel).

- Data ko media par rakne ka joh time lag raha hai woh transmission time kahlata hai.

- Matlab kya, jaise physical layer K pass data available hai, physical layer bits ko voltage level par convert karte hai. Joh saari bits ek saath voltage level mein toh convert nahi hogi.

* Pahale pahali bit hui phir dusri hui phir thisri hui -- so on.

- Joh pahali bit jaise hi cable par aayi, uske baad data ki last bit ko cable par aane mein

Kitana time lag raha hai, yeh pura time kya kahalega aapka transmission time.

* Data ko cable par rakne mein time kyo lag raha hai because bits ko hum voltage level mein convert karrahai hai. Us conversion mein hamko time lag raha hai,

- Aur wahi time hamara kya time kahalayega transmission time.

- Dusra parameter hai propogation delay :→

PROPOGATION DELAY :→

Ques :→ Now yeh propogation delay kya hota hai ??

Ans → Propogation delay is the time taken by single bit to cover the distance between sender and receiver.

- Single bit ko sender se receiver tak jane mein jitana time lag raha hai woh kya kahalata hai hamara propogation delay.

- Note that single bit hai pura data ko transmit karne ka ~~time~~ ki baat nahi horahi hai.

- Toh aab frame ko sender se receiver tak jane mein kitana time lagega ??

Ans :→ Agar hum last bit k liye time compute kar le, ki last bit sender se receiver tak kab pahuchegi, agar last bit pahuch gai pura data already pahuch hi jayega.

- Agar apka transmission time t_x hai toh t_x time mein kya hoga, aapki last bit kaha pe aa jayegi cable par.

- Last bit ko cable par aane mein kitana time laga t_x.

- Utane time k baad woh aage baregi, usko distance cover karna mein kitana time lagega, propogation time lagega i.e t_p time lagega.

- Toh last bit channel par kab aayi t_x time par, aur t_p time mein receiver k pass pachu gayi.

- Toh last bit ko ~~receiver~~ se ~~sender~~ ~~tx~~ sender se receiver tak pachuchane mein kitana time laga $t_x + t_p$.

- Itane time mein last bit pachu gayi matlab pacha hi data pachu gaya.

- Hum kya kar rahai RTT compute kar rahai hain RTT mein sabse zyadi chij kya aayi the ki hamko frame ko kaha send karna hai sender se receiver tak send karna hai.

  t_x time mein frame ki last bit channel par aayi + t_p time woh kya hogi, traverse hoke receiver k pass pachu gayi.

- Toh $t_x + t_p$ time mein frame sender se receiver

K pass pachu gayi.

- Aab receiver us frame ko process karega, process karega matlab, immediately acknowledgement send karega toh nahi, woh sabse pahale frame ko process karega, check for error, agar frame mein koi error aayi hai toh woh negative acknowledgement send karega.

- Aur agar koi error nahi aayi toh positive acknowledgement send karega sender ko.

- Aur frame ko process karne wale time ko hum kya kahate hai frame processing Time.

- Suppose afki frame mein error nahi aayi, toh aab receiver kya karega acknowledgement ko generate karega.

- Now yeh acknowledgement bhi kya hai data hi hai isko wire par rakega.

- Now question yeh hai frame ko media par rakne ka time aur acknowledgement ko media par rakne ka time same hoga ki different hoga??

Ans:→ Different hoga, kyo different hoga?? data/frame ki size jada hogi usko rakne mein jada time lagega aur acknowledgement ki size choti hogi toh usko rakhane mein kaam time lagega. Isliye dono ka transmission time different hoga.

- Joh acknowledgement K transmission time ko hum t_{xA} kaha dete hai.
- Joh t_{xA} time mein hamara acknowledgement kaha aagaya cable par aagaya.
- t_{xA} time mein acknowledgement ki last bit kaha aagayi cable par aagayi.
- Plus usko aab jana hai toh jane mein kitana time lagega t_p lagega.
- Joh $t_{xA} + t_p$ time mein kya hoga, acknowledgement kaha se kaha tak pachu jayega from receiver to sender.
- Now yeh sab mila K hamara kya banta hai round - trip - time.

$$RTT = \cancel{t_x + t_p} + \cancel{t_{xA} + t_p}$$

$$RTT = (t_x + t_p) + \text{Frame Processing Time} + (t_{xA} + t_p)$$

$(t_x + t_p)$ — for frame

$(t_{xA} + t_p)$ — for acknowledgement

- yaha overlapping mein kaam horaha hai.
- But usually, ek toh frame processing time nahi given hota hai, i.e negligible hota hai, toh agar frame-processing time given nahi hai toh usko consider nahi karna hai.

- Aur acknowledgement bhi bohut chota hota hai, toh uske transmission time ko generally consider nahi kiya jata hai.

- Agar given hai toh aapko add karna hai, agar nahi given hai toh unko consider nahi karna hai.

- Now aab RTT ka formula kya ban gaya

$$RTT = t_x + 2t_p$$

- Now aab hum dekte hai how to compute transmission time, t_x kaise nikalna hai.

$$t_x = \frac{\text{Length of data}}{\text{Data transfer rate}} = \frac{L}{R}$$

$$t_x = \frac{L}{R}$$

Data transfer rate kaise given rahati hai, - jaise →

100 Mbps = 100 Megabits per second

- Network mein bytes nahi chalta hai bits hi chalta hai.

- Agar Mbps ka agar 'b' small mein hai toh difinitly it is Megabits. Aur Agar ye 'B' capital mein hai (MBps) toh it will be

Data - 2ki power mein lagey 1Kb $\Rightarrow 2^{10}$ bits

1Kbps $\approx 10^3$ bits/sec

Mega bytes. yeh conversions hai.

Mb → Mega bits
MB → Mega Bytes.

1 Mbps = 10^6 bits per second
1 Gbps = 10^9 bps
1 Kbps = 10^3 bps

Ques:→ Find the transmission Time for 1000 byte frame over 100 Mbps Channel ??

Ans→

$$t_x = \frac{L}{R} =$$

Here $L = 1000$ bytes $= (1000 * 8)$ bits

$L = 8 * 10^3$ bits

$R = 100 * 10^6$ bits per second

$$t_x = \frac{L}{R} = \frac{8 * 10^3}{100 * 10^6} = 8 * 10^{-5} = 80\,\mu s$$

- Now aab hum dekte hai how to compute propogation delay, t_p kaise nikalna hai.

$$t_p = \frac{\text{Distance between two stations}}{\text{Signal propogation speed.}}$$

$$t_p = \frac{D}{S}$$

- Signal ~~progarf~~
- Signal propogation Speed matlab apki jo waveform banrahai hai, woh wave form aagey kis speed se propogate horaha hai.

Ques:- The distance between two station is 1000 km and signal traverse at the speed 2/3 of the speed of light. Find propogation delay (t_p)?

Solution:

$$t_p = \frac{\text{Distance}}{\text{Signal}} = \frac{(1000 * 1000)\ m}{\frac{2}{3} * 3 * 10^8} = \frac{1}{200} = 0.5\ sec$$

Ans →

$$t_p = \frac{1}{200} \times 10^5 = 5\ ms = 5 * 10^{-3}\ sec = 5\ ms$$

$$100$$

$$\boxed{t_p = 5\ ms}$$

$(1\ km = 1000\ m)$

Speed of light = $3 * 10^8$ m/s.

- Now Stop and wait protocol dear hai kya kahata hai, woh yeh kahata hai ki sender should wait for the time slightly greater than RTT, agar utani der mein acknowledgement nahi aaya, toh sender should retransmit the frame.
- Now is protocol mein problem kya hai, pahali problem kya aayi the ki sender kitani der wait kare,
- Joh us problem ka solution hamne kya nikala ki RTT time tak lag-bag wait kare.
- Now dusri problem kya aati hai stop and wait mein aur hum uska kya solution nikal te hai.
- Sender ne pahali frame send ki, now receiver

ne us frame ko accept karliya aur uska acknowledgement send kiya, lekin woh acknowledgement network mein lost hogaya.

- Lost hogaya toh sender us frame ko retransmit karega, now sender ne phir se us frame ko send kar diya.

- Toh kya receiver ko ~~pehla~~ frame ko accept karna chahiye tha, toh nahi kyo?? Because it is duplicate frame.

- Par receiver toh yahi samje ga ki koi nayi frame sender ne send ki hai.

* Toh stop and wait mein problem kya hai, ki there is no way to differentiate between new frame and duplicate frame.

- Nayi frame aarahai hai ki duplicate frame aa rahai hai, is k liye koi ~~differentiate~~ ~~hi~~ nahi ~~kar~~ sakta: isko receiver differentiate nahi karsakta.

- Toh aab kya kare,?? to aab kya kare iske liye hamne kya scheme introduced ki, ki assign a number to each frame.

- Toh numbering kaise kare aaise kare kya 1,2,3,4.5 aaise numbering kare kya, yeh number kaha store hogy obviously frame k header mein save hoga.

- Agar koi bhi information agar protocol add

Karta hai toh kaha karta hai uski header mein

- Toh yeh number kaha add hongey frame k header mein.

- Agar header mein kohi bhi chij add karna hai, toh us chij ki length toh fix karni hi pargi.

- 7 tak k number 3 bits mein Representent hojayegey, 32 tak k number 5 bit mein Repusent hojayegey.

- Aaise kaha matlab har frame ko alag number d fessible nahi hai.

- Suppose numbering 3 bit ki kar d toh pehle frame ko kya number assign k 0, dusri frame ko 1 --- so on uske, Now seven k baad wapas numbering kaha se start hogi 0 se.

- Ultimately Networking mein hamara aim kya hota hai, ki jitana kam hamara header ho, utna better hai.

- Agar hum agar 1 bit ka frame number rakhe toh bhi chalega. Jaise pahala frame ka 0 dusri ka one --- like this.

- Agar aaisa bhi kiya toh kohi problem nahi aayegi.