

20/2/24

Internet - heterogeneous devices.

CSP - cloud service providers

DHCP - dynamic host configuration protocol → is a server.

↳ works on the process DORA - discover, offer, request, acknowledge.
by broadcast (10.0.0.1 - 255.0.0.255) lease (1hr / 1 day etc).

ip config / release

ip config / renew

ping - packet internet groper

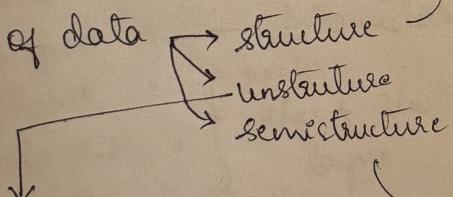
Data - is a raw fact (volume)



info - which has meaning

↳ knowledge → wisdom.

3 types of data



→ stored in a desired format.

- RDBMS (SQL)
- similar to email
- CRUD - create
read
update
delete

- 20% of data is structured.

→ mixture of both.
Eg - HTML

is in form of object.

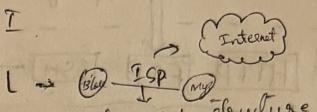
(NOSQL)

↳ generally 80% data is unstr.

Ex: Images, Videos, audios etc.

- Data life cycle - depends on its value.

1/3/24 Types of network

- covers limited geographical area. → same building.
- 1) Local area n/w (LAN) - ethernet, wifi, FDDI
- 2) Wide " " (WAN) - T₁ lines, leased line, DSL → 
- 3) campus " " (CAN) → diff buildings. ← n/w b/w - same bus infrastructure.
- 4) Metropolitan " " (MAN) - diff locations
- 5) Personal " " (PAN) - bluetooth, NFC, ethernet.
near field comm.

- n/w is determined by its size, location, ownership.

Network Model (Layered task)

OSI model - open system interconnect
↳ reference model.

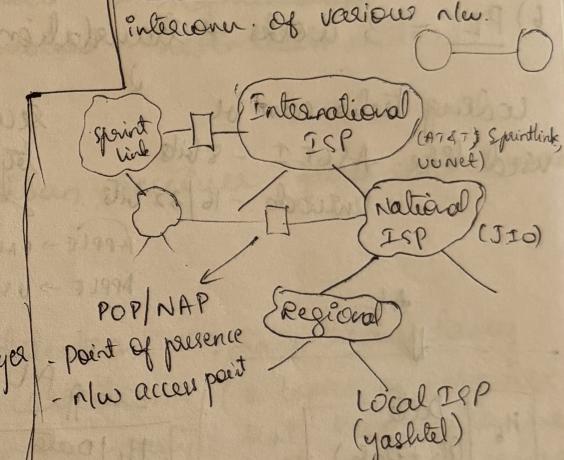
Practically implemented n/w → TCP/IP.

- ↳ 7. Application layer }
 - 6. Presentation "
 - 5. Session "
 - 4. Transport "
 - 3. Network " ↓ router
 - 2. Data link " ↓ cables
 - 1. Physical " ↓ cables
- ↓ 8 layers
- ↳ intermediate layer
- H/w & S/w

7) AL → provides user interface. → management, network, mail, security, remote access, http, ftp, telnet, ssh, dns, dhcp, snmp, smtp
All these are protocols - consists of set of rules!

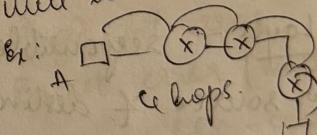
Data frame gets added with additional info - encapsulation.
↓
decapsulated at receive side.
→ so that receiver can understand what client is asking.

Internet - n/w of n/w,
interconn. of various n/w.

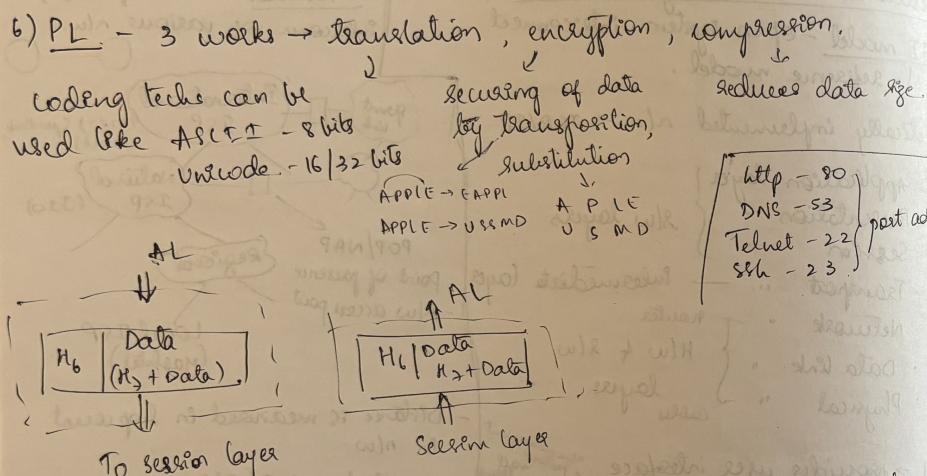
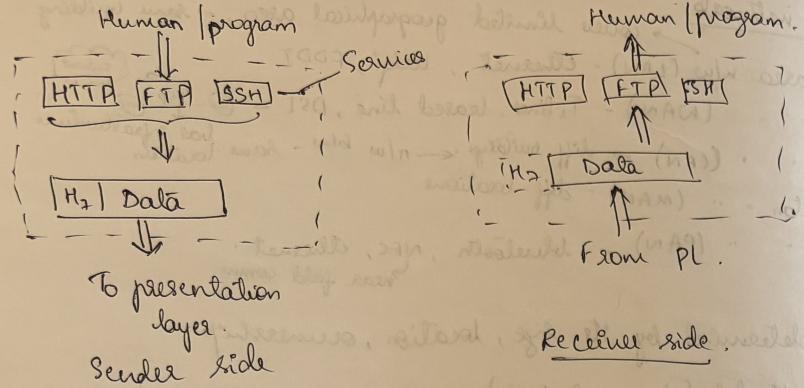


- Distance is measured in hop count
in n/w.

- will be < 8 hops.

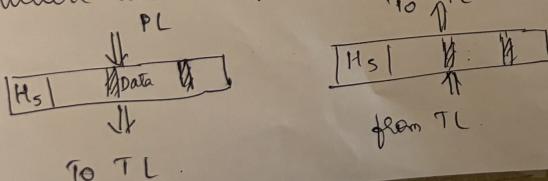


- Discovered by Aspa in 1960's.



5) Session Layer - responsible to create, maintain, terminate the session b/w source & destination.

- a) Dialog control
b) Add checkpoint - if connection gets disconnected while file transferring then once the file is reestablished, it'll start from where the checkpoint is assigned. (coorder - 100 CP, 550 starts from 500.)



4) TL - It is responsible to deliver every segment from sender process to receiver process (or) end-to-end delivery.

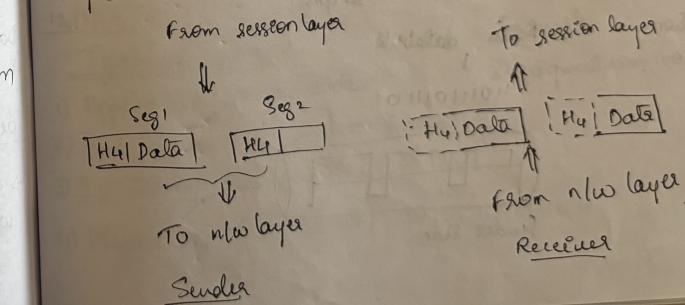
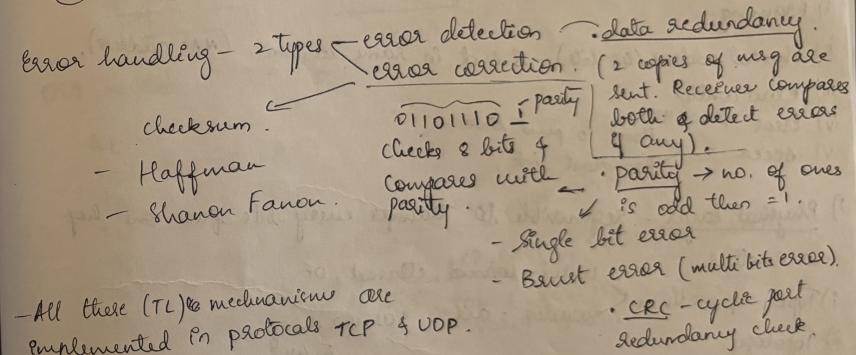
- a. Port address (or) Service address
- b. Segmentation & reassembly.
- c. Flow control.
- d. Error " well known unknown is given sequence no. (-1023 - 1023 may few use it.)
- e. Connection " connection oriented.

3 types of port address → i) well known → 0 - 1023 (16 bits)
ii) Registered → 1024 - 49153
iii) Unregistered → 49154 - 65535.

Msgs → into small management parts - segmentation.
At receiver side, these parts are combined - reassembly.
Sequence no. should be given.

- When the sender rate is higher than receiver - flow control work

S → R

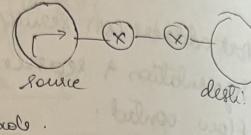


3) Network layer - responsible to send a packet from source to destination.

i) Logical addresses / IP address (32 bits)

has 2 info
host nw info

ii) Routing



RIP
EIGRP
BGP
OSPF
Protocols

32 bits → grouped in octet → called dotted decimal.

Ex: $10.24.1.1 \rightarrow 10.24.1.1$ (nw info) → 10.24.1.1 (same address)
 $10.24.1.2 \rightarrow 10.24.1.2$

Subnet: 255.255.255.0
mask
→ host part changes
used to diff. the host & netw.
changes

2) Data link layer - responsible to transfer frames from one hop to another

i) Framing

ii) Physical address (48 bits) - 8 4 d in same location. (MAC address).

iii) Flow control

iv) Error " Point to point link 10110 (fixed)"

v) Access " Broadcast link. suffit"

vi) Physical layer - responsible to transfer every bits from one hop

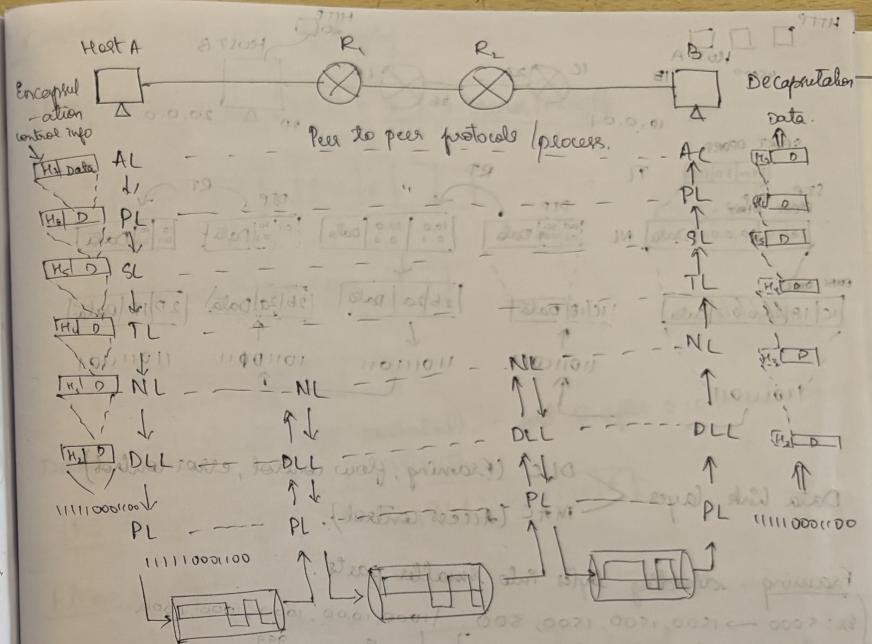
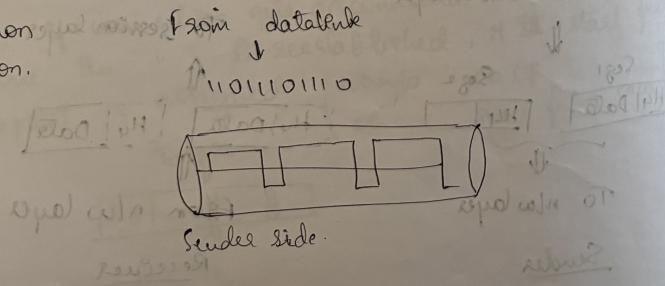
to another. Rj45 wired - coaxial, ethernet, OF

vii) Type of medium wireless - air 802.11 2.4GHz 5.8GHz between 5.6KHz

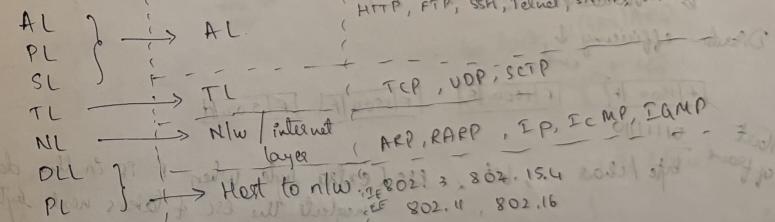
viii) Topology

ix) Data representation from datalink

x) Line configuration.



OSI model | TCP/IP



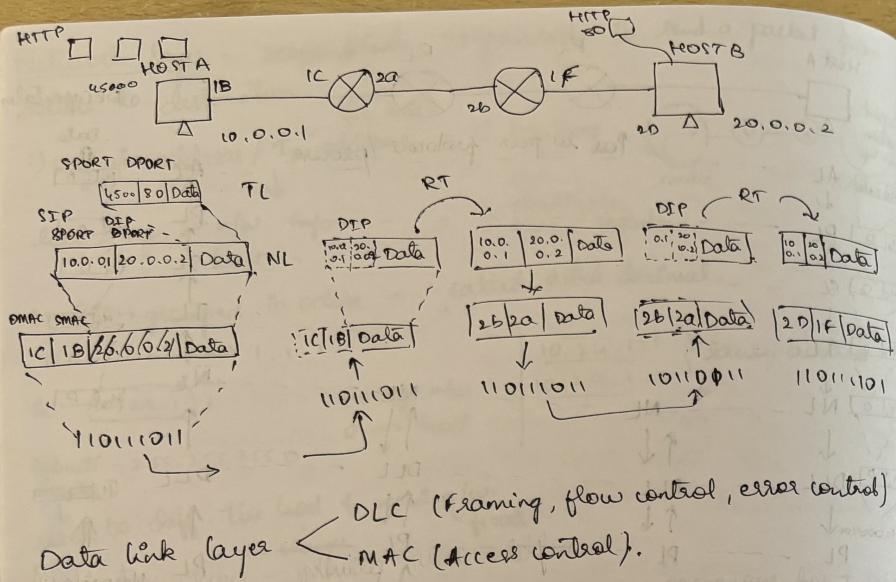
13/3/24.

Types of address

- 1) Application specific address
- 2) Port address (16 bits) 0-65535
- 3) IP address (32/128 bits) - 10.1.1.1
- 4) Physical address (48 bits) - 1a:1b:1c:1d:1e:1f (mac)

Example

x48@gmail.com



Framing - dividing bytes into smaller parts.

Ex: 5000 → 1500, 1500, 1500, 500. | 1000, 1000, 1000, 1000, 1000.
 Ethernet → (MTU = 1500)
 max

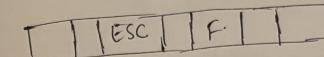
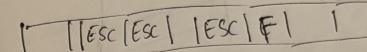
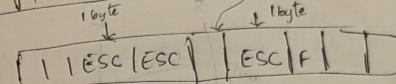
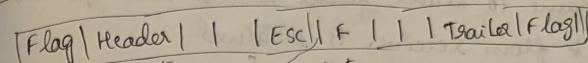
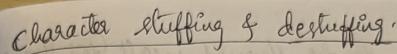
→ 2 types of size framing

Disadv- efficiency ↓
 end

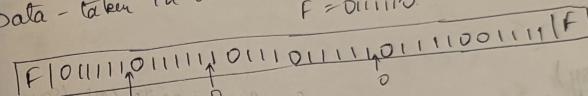
$F 1500 F$	$F 1500 F$	$F 1500 F$	$F 1500 F$
----------------	----------------	----------------	----------------

Start of frame 0111110
 byte / char , bit , esc (extra byte when F is in the data),
 - neglects the esc & takes next byte.

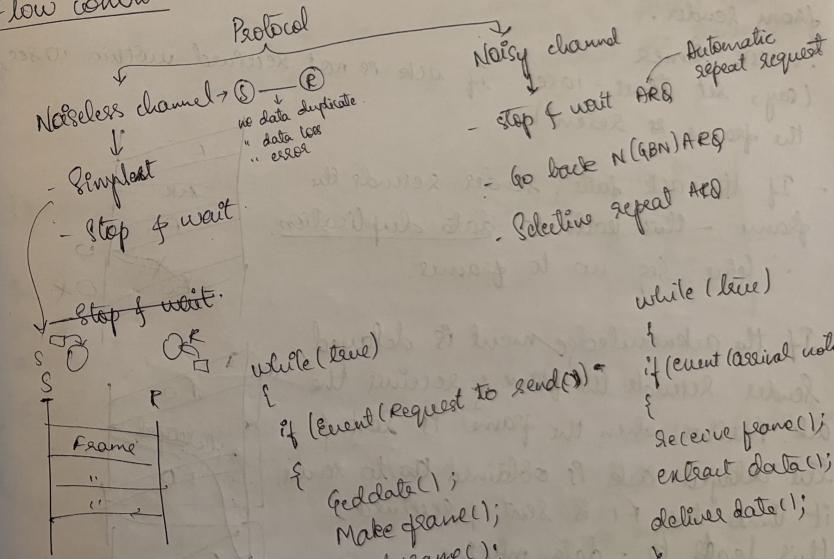
$F ex F F $



ESC F Data - taken in bits. (bit oriented). - add 0 after 5 consecutive ones
 $F = 011110$



flow control



```

    white (tree)
    {
        if (event (Request to send()))
        {
            if (current (arrival condition))
            {
                receive frame();
                extract data();
                deliver data();
            }
        }
    }
}

```

Stop & wait

After sending a frame to receiver, sender should wait for some time till the ack from receiver is obtained.

while (true)
canSend = true;

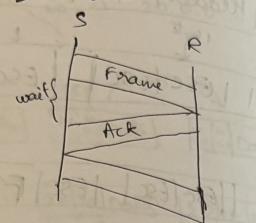
{
if (event (request to send) & ! canSend)

{
getData();

makeFrame();

sendFrame();
canSend = false;

}

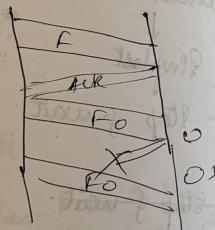


Stop & wait (noisy)

Sender waits for ack from receiver & receiver waits for frame from sender.

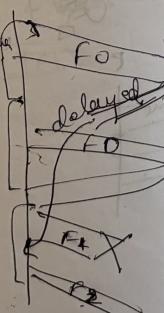
∴ use timer (say, set time = 10 sec). If ack is not received within 10 sec, the frame is resent.

- If the ack fails, sender resends the frame → this leads to data duplication.
- ∴ Give seq. no to frames.



If the acknowledgement is delayed, sender resends the frame & receives the ack. Further, when the frame is lost & ack is obtained back to sender, the delayed ack is obtained back to sender → it thinks the F1 is sent & received → this leads to data missing.

∴ give labels to acks.
ARQ - automatically requests for f & ack.



Delays

$$T_t = \frac{L}{B} - \text{no. of bits}$$

bandwidth

bit: 1000 bits

$$1000 \times 8 = 10240$$

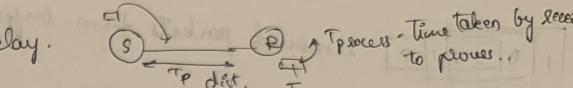
$$10240 \times 10^{-9} = 10.24 \mu\text{s}$$

$$T_t = \frac{1000}{1000} \mu\text{s}$$

bit

T_p - propagation delay.

$$T_p = \frac{d}{v}$$

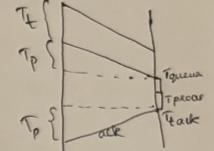


$$\eta = \frac{\text{usefull time}}{\text{total time}} \rightarrow T_{data} + T_{idle} + T_p + T_{process} + T_{ack} + T_{idle}$$

$$\text{for LAN} \leftarrow \frac{T_t}{T_t + 2T_p} = \frac{1}{1 + 2(\frac{T_p}{T_t})}$$

$$\left[T_t = 1 \text{ msec } T_p = 1.5 \text{ msec} \right] \quad \eta = \frac{1}{1 + 2(\frac{1.5}{1})} = \frac{1}{4} = 25\%$$

depends on config.
will be 100%
bit: doesn't take much time
so



$$\frac{T_t}{T_t + 2T_p} \geq \frac{1}{2}$$

$$2T_p \geq T_t + 2T_p$$

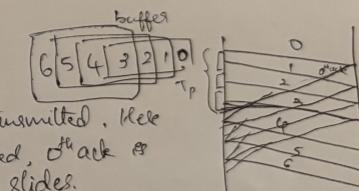
$$T_p \geq 2T_p$$

e.g. 10 packets needs to be transmitted. Every 4th packet gets lost.

1 2 3 4 5 6 7 8 9 10

↑ 4 ↑ 7 ↑ 10

Pipelining - for efficiency
↓ sliding window mech.



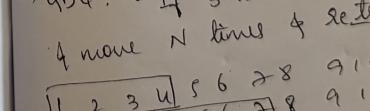
In T_p, other packets are transmitted. Here by the time 4th packet is lost, 4th ack is obtained, the window is slides.

GBN → 1. Sender buffer size → N > 1 $\eta = \frac{N \times T_t}{T_t + 2T_p}$

- SR. 2. Receiver " 3. Cumulative AR.

→ GBN. - If 3 is lost then go back to last packet than sender tried & more N times & retransmit all 4. 6 5 4 3 2 1 0 = 18.

Every 4th bit is lost.

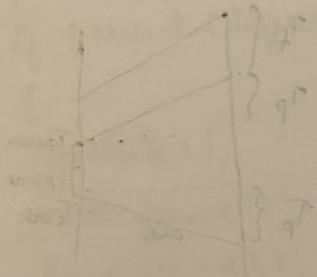


$T_f = 1 \text{ msec}$ $T_p = 49.5 \text{ msec}$ GB10 $\eta = ?$

$$\eta = \frac{N}{1+2a} = \frac{10}{1+2.49.5} = \frac{10}{1+99} = \frac{10}{100} = 10\%$$

removed packets from buffer can be reused

1	0	3	2	1	0
---	---	---	---	---	---



$$100T + 20T + 100T + q^2T + 100T + 100T = \dots$$

$$100T + 20T + 100T + q^2T + 100T + 100T = \dots$$

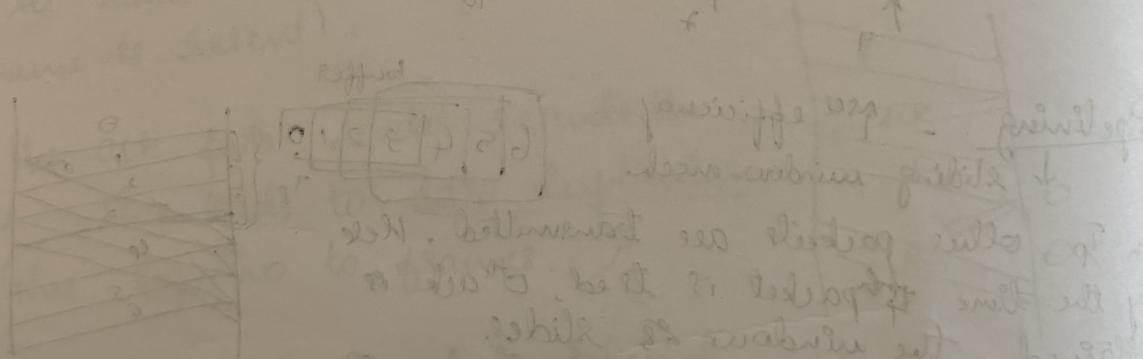
$$q^2 \times c + T = q^2 T + q^2 T + T$$

$$\frac{1}{(q^2)c+1} = \frac{T}{q^2c+T}$$

$$\frac{1}{c} \leq \frac{T}{q^2c+T} \quad \left[\frac{1}{q^2c+1} = \frac{1}{c} \right]$$

$$q^2c+T \leq q^2c$$

not drop frame $q^2c \leq T$
between cells c \rightarrow $c = \frac{1}{q^2}$



If the acknowledgement is received before the next cell is transmitted, the link is idle. If the acknowledgement is received after the next cell is transmitted, the link is busy.

The link is idle if the acknowledgement is received before the next cell is transmitted, and it is busy if the acknowledgement is received after the next cell is transmitted.

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