Mobile Transport Layer

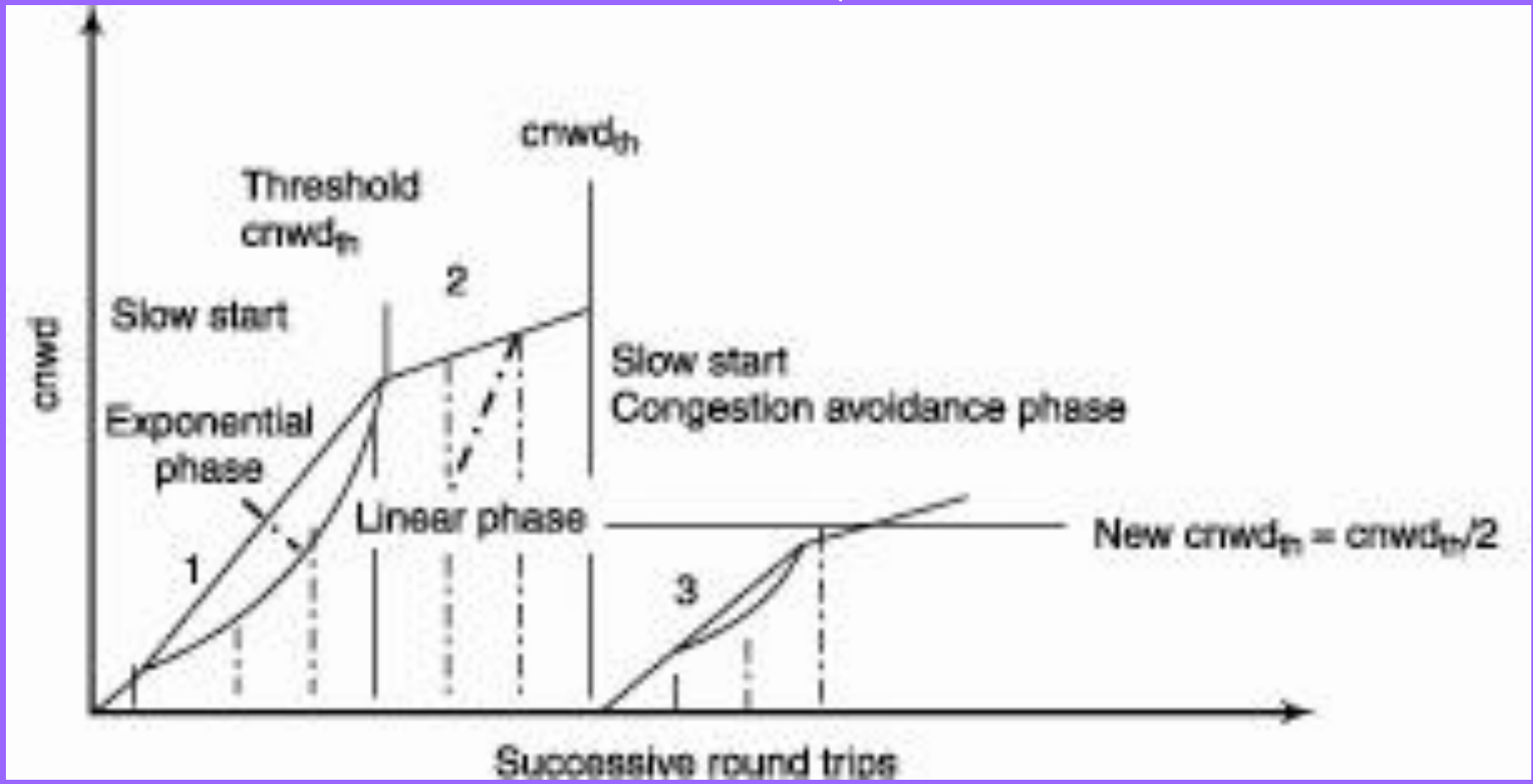
Lesson 04

Slow start and Fast Recovery Methods for congestion control in conventional networks

Slow start method for conventional networks

- The entails starting from a very small window
- Increasing the window size exponentially up to a threshold value
- Then linearly till congestion sets in
- Once congestion sets in, the window slow starts again with the new threshold value set to one half of the window size at congestion

Window sizes on successive round trips in four phases of the slow start method



First exponential growth phase—slow start phase

- Congestion network window size (cnwd) is equal to 1 at the start of a new data stream
- After each RTT (after which the acknowledgement field is used to send the next data stream), for each subsequent stream, the window is doubled till a window threshold is reached
- Now, cnwd = cnwd $\times$ 2 when 1 $\times$ cnwd $\leq$ $cnwd_{th}$, where $cnwd_{th}$ is threshold window

Second linear growth phase—congestion avoidance phase

- After cnwd = $cnwd_{th}$ the linear growth starts
- Control further exponential growth in order to avoid congestion

Example

- Assume RTT_0 (RTT when cndw =1)
- Assume the exponential phase consists of up to the 10th round trip
- So $cnwd_{th} = 2^9$
- The number of segments transmitted 1 + 2 + 4 +… + 256 + 512 = 1023
- At 11^{th} RTT cndw = 513
- At 12^{th} RTT cndw = 514
- Timeout for 12^{th} RTT = $518 \times RTT_0$

Third phase– Congestion avoidance phase

- Starts after linear growth causes congestion and cndw = $cnwd_{cntrl}$, and this congestion needs to be controlled by two actions

(i) resetting cnwd to cnwd ÷ cnwd = 1

(ii) Reducing $cndw_{th}$ = $cnwd_{cntrl}$ ÷ 2 or 2 (which ever is more) after the timeout period of the last trip indicating congestion

Third phase– Congestion avoidance phase

- In the congestion avoidance phase, the exponential phase (slow start phase) step starts again

Fourth linear phase– after new threshold

- After cndw reaches the new cndwth, the linear phase starts

Fifth phase

- Actions similar to one at third phase recurs at fifth phase (cndw = 1 and new $cndw_{th}$ = new $cndw_{cntrl} \div 2$

Example

- Assume that cnwd at the start of congestion phase in the 17th RTT
- $cndw_{cntrl}$ sets $cnwd_{th}$ to 518/2
- New $cnwd_{th}$ = 259
- 18th RTT, cnwd = 1
- 19th, cnwd = 2, and so on till cnwd becomes 256 in 26th RTT since $cnwd_{th}$ = 259

Example

- 27th RTT, cndw = cnwdth = 259
- During the slow start phase, 1 ≥ cnwd ≥ new $cnwd_{th}$
- During the linear phase cnwd will be incremented by 1 after each RTT, starting from the 28th RTT

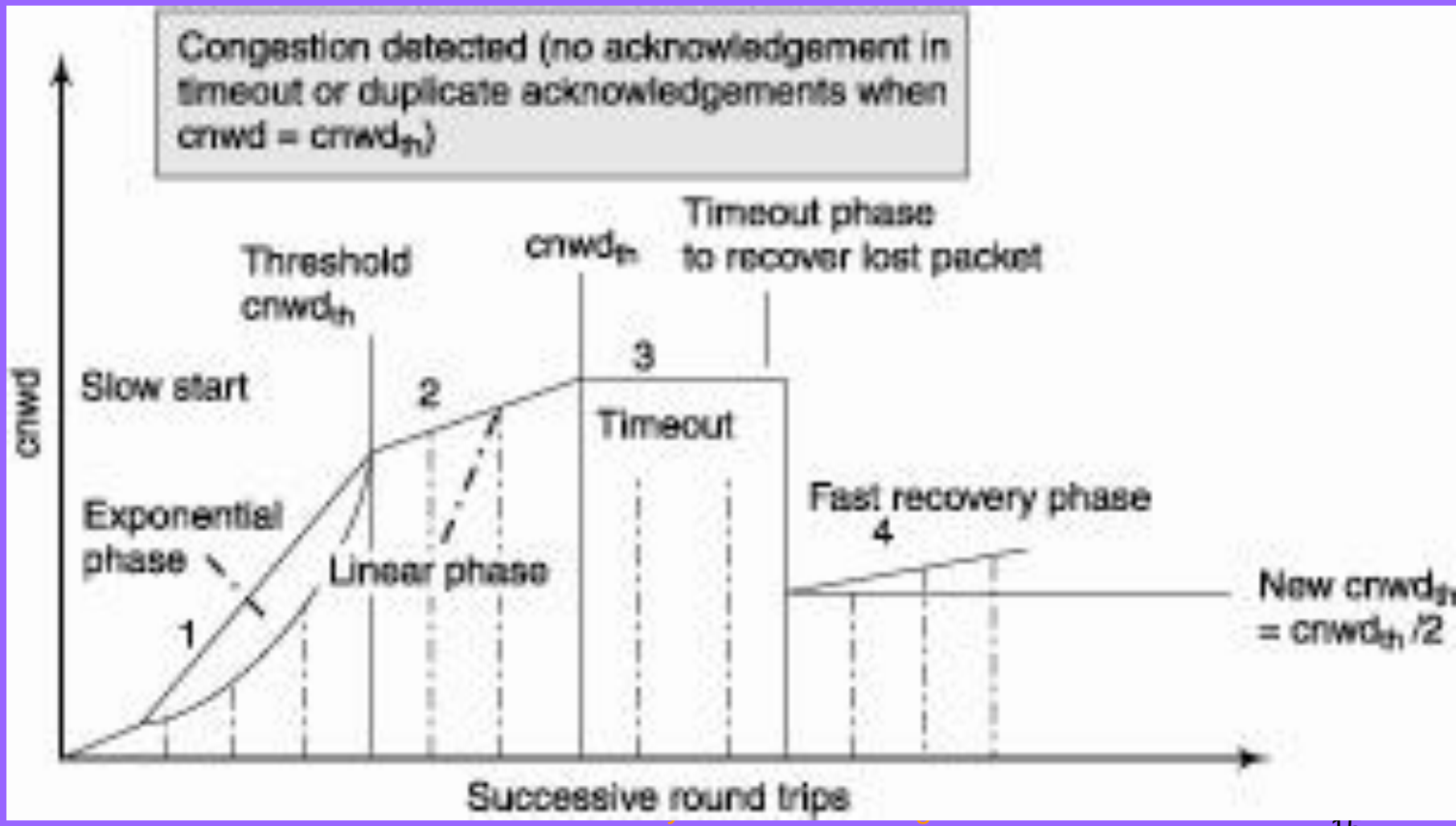
Fast Recovery

- First phase: Slow start exponential from cnwd = 1and cndw = cndw $\times$ 2 after each RTT
- Second phase: Slow start linear after cndw = $cndw_{th}$ and cndw = cndw +1 till = $cndw_{ca}$
- Third phase: Timeout

Fast Recovery Phase– Modification of slow start third phase

- Third phase and fourth now differ
- Between third congestion avoidance phase earlier and linear second phase, in place of exponential phase, a timeout region added with constant and = $cndw_{ca}$
- Lost packet retrieves during timeout
- Further cndw does not restart from 1 as earlier but from $cndw_{th} \div 2$

Modification of slow start by fast recovery congestion avoidance phase after a timeout



Example

- Assume that cnwd at the start of congestion avoidance phase in the 17th RTT
- $cndw_{ca}$ sets $cnwd_{th}$ to 518/2
- New $cnwd_{th}$ = 259
- 18th RTT, cnwd = $cndw_{ca}$ till a timeout period
- After timeout in 26th RTT since $cnwd_{th}$ = 259; new cndw = 259

Example

- 27th RTT, cndw = cnwdth = 259
- During the linear phase cnwd will be incremented by 1 after each RTT, starting from the 28th RTT till cndw = $cndw_{ca}$ = 518 or till congestion starts

Summary

- Slow-start and Slow-start fast-recovery methods
- First phase and third phase in Slow-start method cndw start from 1, doubles in each RTT till threshold
- Third phase in slow-start fast-recovery method differ cndw is constant for a timeout period and = $cndw_{ca}$

...

...Summary

- Fourth phase in slow-start fast-recovery method same as fourth phase in slow start, cndw starts from new threshold $cndw_{ca} \div 2$ and after each RTT change linearly till $cndw_{ca}$

End of Lesson 04

Slow start and Fast Recovery Methods for congestion control in conventional networks