Mobile Transport Protocol

Unit - II

TCP in Mobile Networks

- Since scenarios for losses in wireless are different from wireless (mostly due to congestion, rarely bit error), TCP designed for wired cant be used
- Wireless Networks differs from wired such as:
- Lower bandwidth
- Bandwidth fluctuations with time
- Mobility
- Higher delay
- Intermittent disconnections
- High bit error
- Poor link reliability

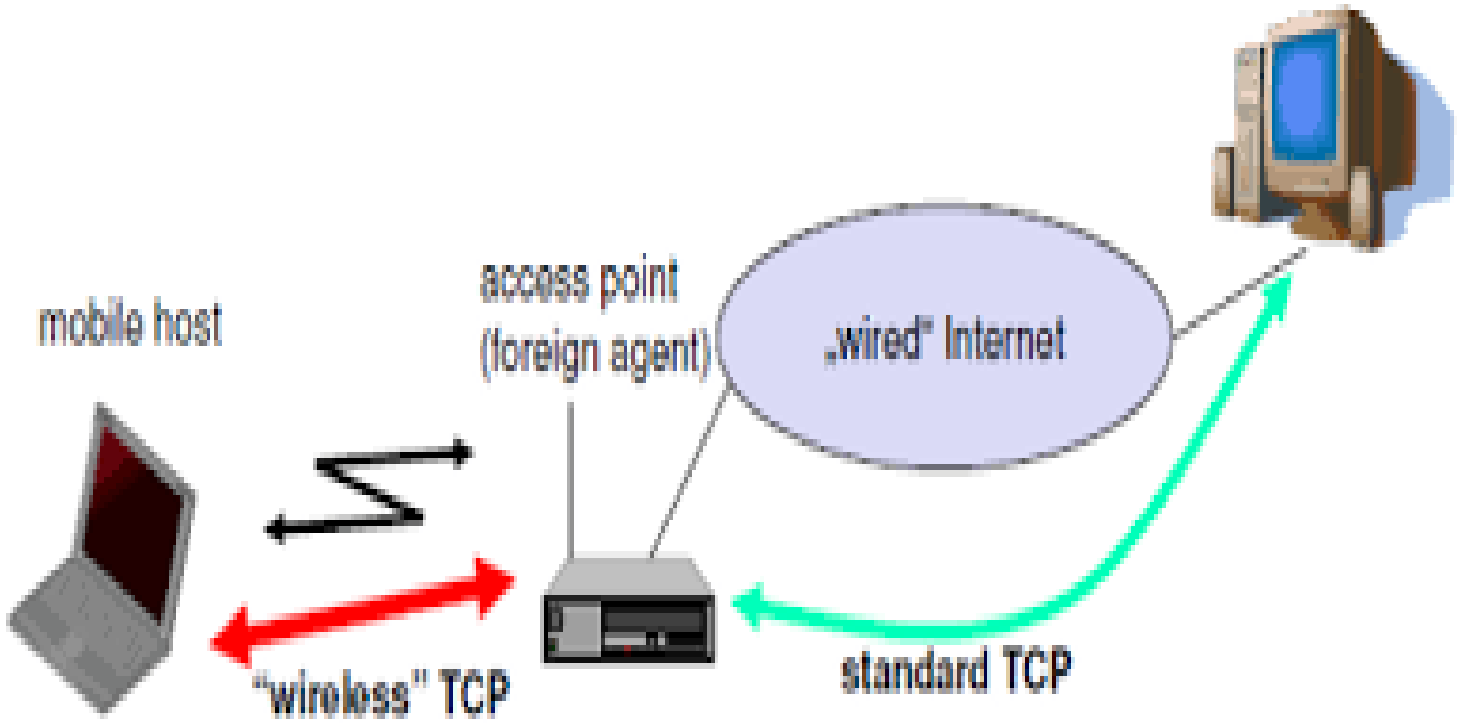
Contd…

- To deal with the scenarios of wireless, many modifications to transport protocol has been developed
- These modifications are different for single and multi-hop wireless networks

- TCP for Single hop wireless networks:

  - I – TCP (Indirect TCP)
  - Fast Retransmission
  - Snooping TCP (S-TCP)
  - Mobile TCP (M-TCP)
  - Freeze TCP

Indirect TCP (I-TCP)



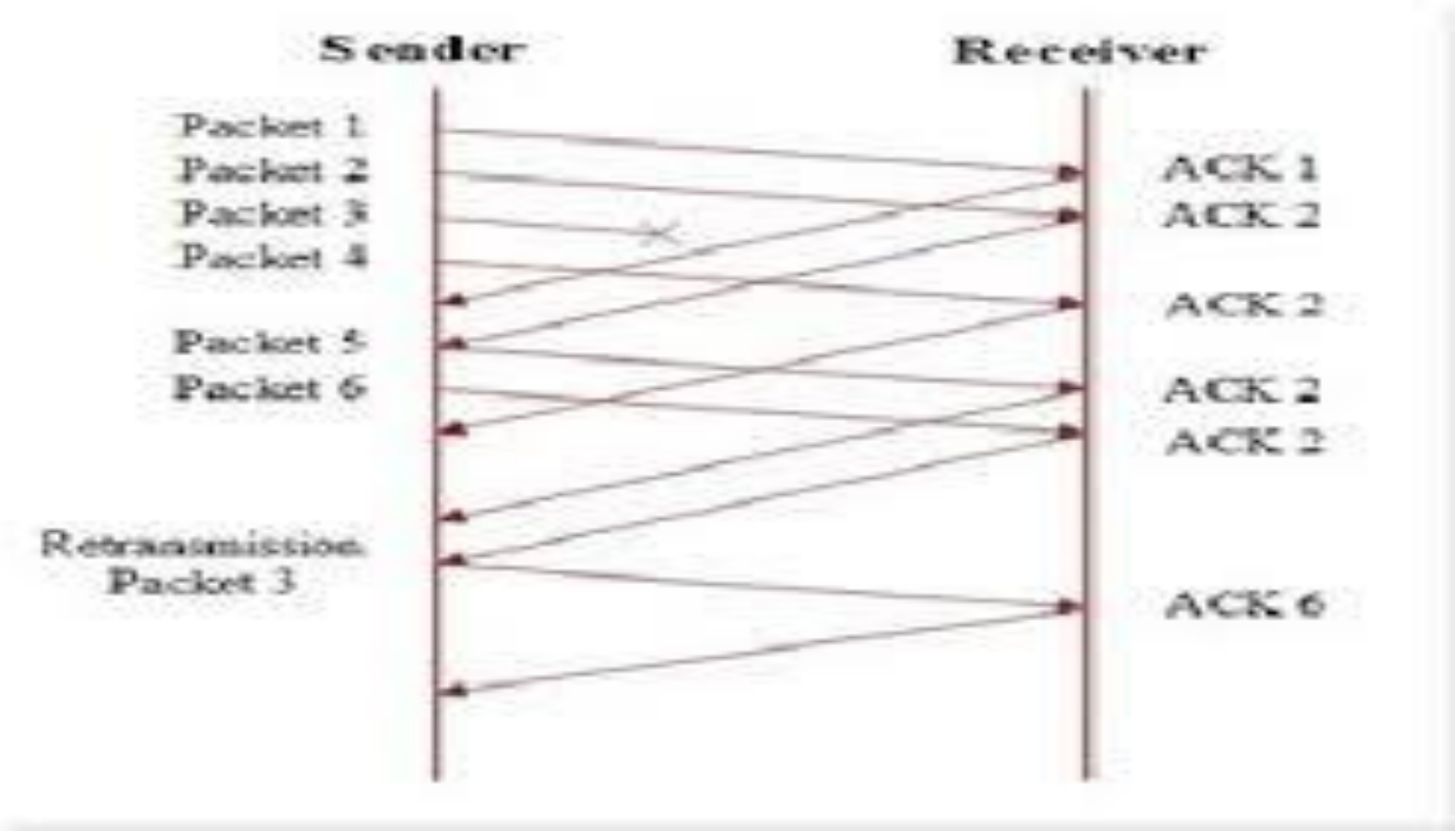
Indirect TCP (I-TCP)

- The connection between Fixed Host (FH) and Mobile Host (MH) is divided into 2 connections –
- FH and Base Station (BS) - wired part, BS to MH - wireless part
- BS (usually FA) maintains 2 separate connections
- FH sends packet to BS, BS send ACK to FH
- BS forward the packet to MH, if packet lost it retransmits (known from missing ACK or 3 dup ACKs)
- If MH moves out of range, BS has to transfer state of MH to new BS

I - TCP

- Advantage:
- No modification to TCP required at FH or MH
- Wireless loss not propagated to wired part
- Latency less due to local retransmission in wireless part
- Disadvantage:
- TCP End to End Semantics is lost (as BS send ACK not the MH to FH)
- BS or FA must be a trusted entity

Fast Retransmission



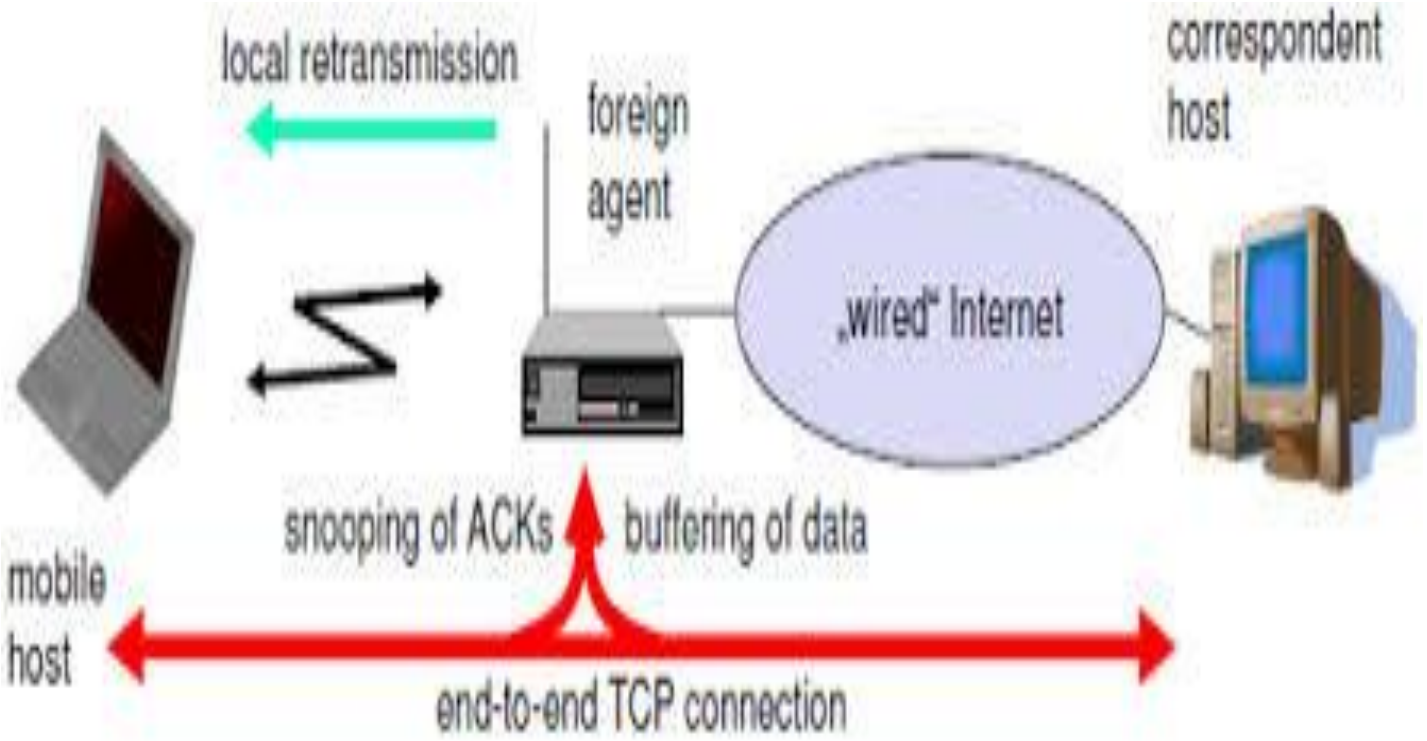
Fast Retransmission

- To overcome delay in transmissions due to intermittent disconnection when MH moves to another FA
- Extremely short disruptions before Timer expires TCP does not invoke Slow Start
- But for long disruptions like handover, invokes Slow Start results in inefficiency
- To avoid this, when MH registers to new BS, it sends 3 dup ACKs to FH via BS
- So FH retransmit immediately before timer expires and does not invoke Slow Start

Contd...

- Advantage:
- Reduces time to get re-connected to new FA without wait for RTO expires
- Disadvantage:
- Only applicable for packet loss due to handover, other wireless errors not addressed

Snooping TCP



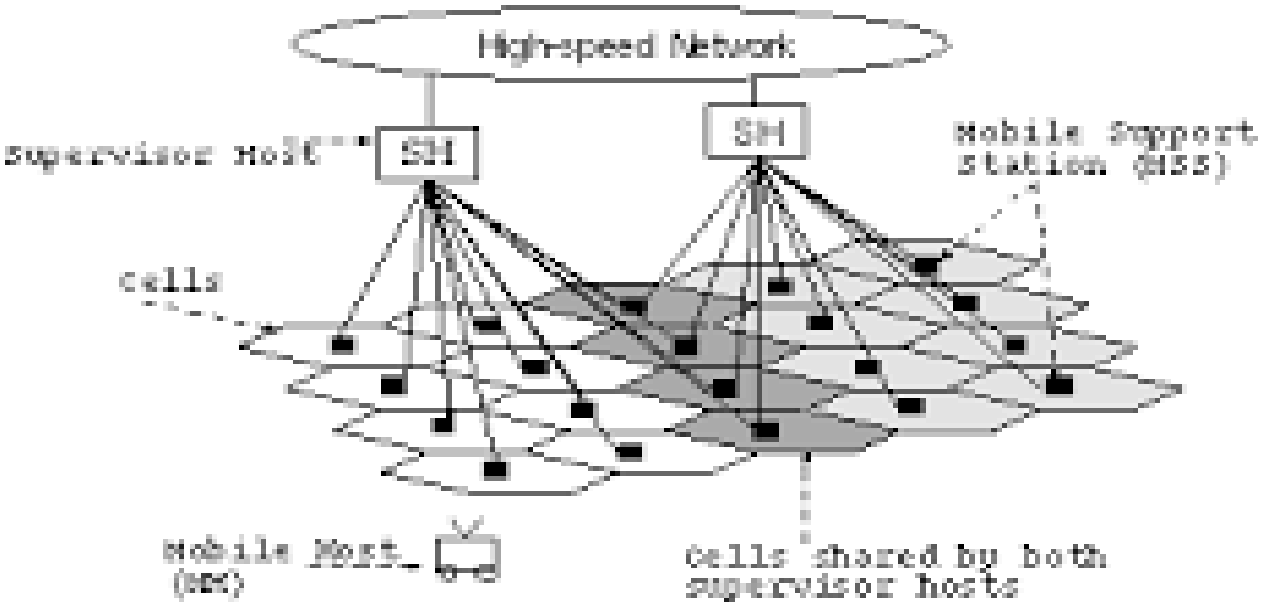
Snooping TCP

- Improves performance of TCP maintaining end to end semantics
- Modified software at BS called **Snoop**
- Snoops packet flow in both directions (FH to BS and BS to MH)
- Buffers all Segments close to MH, till successfully transmitted
- When packet lost at MH, notified to BS via 3 dup ACKs, it retransmit locally to MH
- To maintain end to end semantics, does not send ACK to FH
- So after timeout FH retransmit and BS filter duplicate packet from reaching MH

Contd…

- For segments destined to FH, if FA detects holes in sequence no. , notify via NACK to MH and fill it locally
- FA forward it to FH, reordering is done at FH
- Advantage:
- TCP end to end semantics is maintained
- In case FA crashes, FH can retransmit
- Local retransmission at wireless part, so less latency
- Disadvantage:
- Wireless errors propagated to wired part
- NACK additional mechanism between FA and MH
- If encryption scheme used at Transport layer (SSL, TLS) applied end to end, snooping and buffering useless

Mobile TCP (M-TCP)



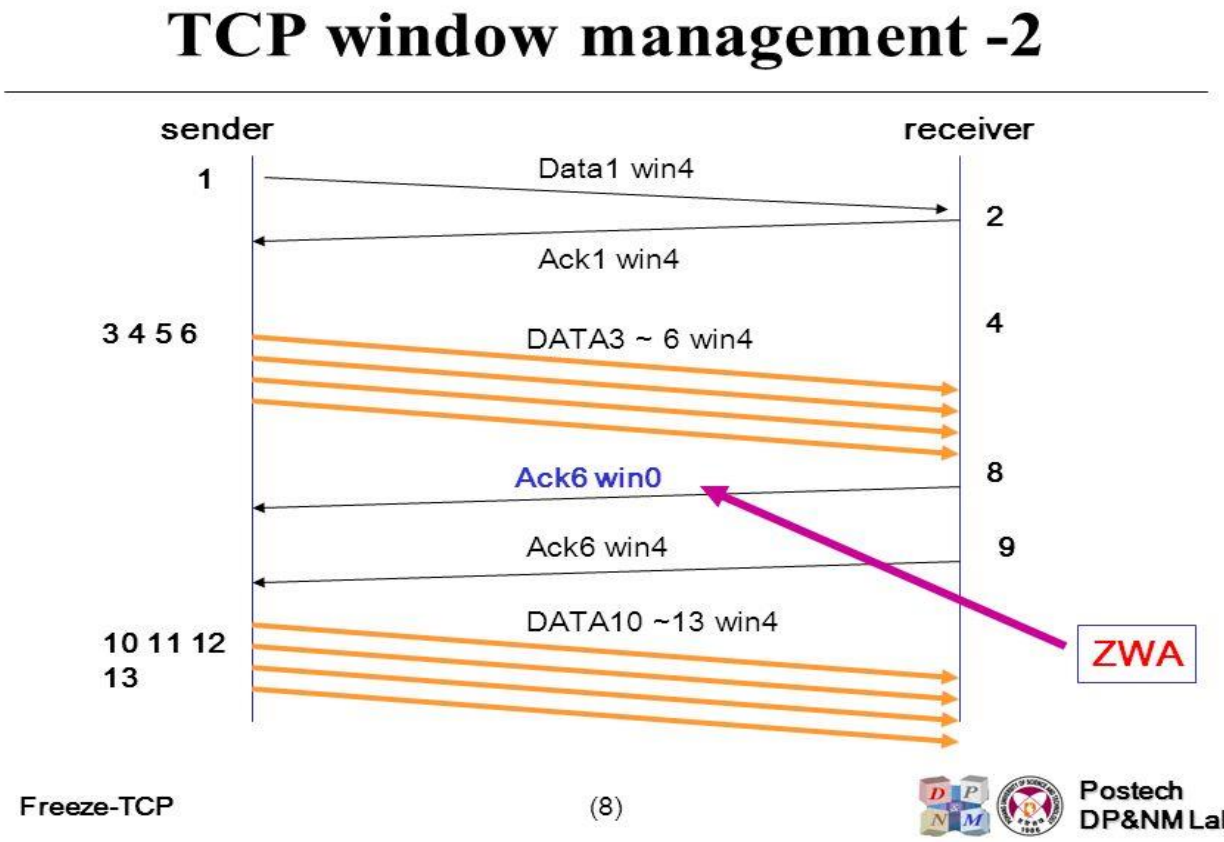
Mobile TCP (M-TCP)

- Frequent disconnection in Wireless due to fading, handover, lack of bandwidth causes delay is unacceptable to user
- M-TCP avoid this rather shrinking the window or invoking Slow Start
- TCP connection is segmented into wired and wireless part
- FH and Supervisory Host (SH) – wired part
- SH to MH – wireless part
- SH controls many BS
- Wired part uses **unmodified TCP** and wireless part **modified TCP** w.r.t. wireless

Contd…

- Packet acknowledged to FH only if MH receives, so end to end semantics preserved
- If SH finds FH not received ACK, it decides MH is disconnected and sets FH window to **zero**
- This prevent re-transmission, when SH notices MH connected, sets window of FH to full size
- When MH moves from current SH to new SH, it transfers the state of MH to new SH
- M-TCP requires bandwidth manager at wireless part for fair sharing as it uses modified TCP

Freeze TCP


TCP window management -2
sender
receiver
1
Data1 win4
2
Ack1 win4
3 4 5 6
DATA3 ~ 6 win4
4
Ack6 win0
8
Ack6 win4
9
DATA10 ~13 win4
10 11 12
13
ZWA
Freeze-TCP
(8)
Postech
DP&NM Lab

Freeze TCP

- Freezes TCP Sender before disconnection occurs
- MAC layer informs Transport layer before connection is actually interrupted and receiver sends **zero advertisement Window** to sender
- When re-connected, receiver notify sender to un-freeze window
- To avoid Slow Start during disconnection at sender, freezing info should send quickly
- Does not need intermediate node, so can be used even if payload is encrypted
- Used in Virtual Private Network (VPN)
- Lots of changes should be made in software at CH, MH, FA

TCP in Multi-hop Wireless Networks

- In Mobile Adhoc Network (MANET) all nodes are Mobile Host (MH)
- No intermediatery to supervise communication
- Packets are transmitted in multi-hop fashion
- Nodes move freely and network topology changes unpredictably
- Original TCP cannot be used to differentiate between packet loss due to link failure and congestion
- Hence TCP extended for MANETs called **TCP Feedback** is proposed

TCP – F (TCP – Feedback)

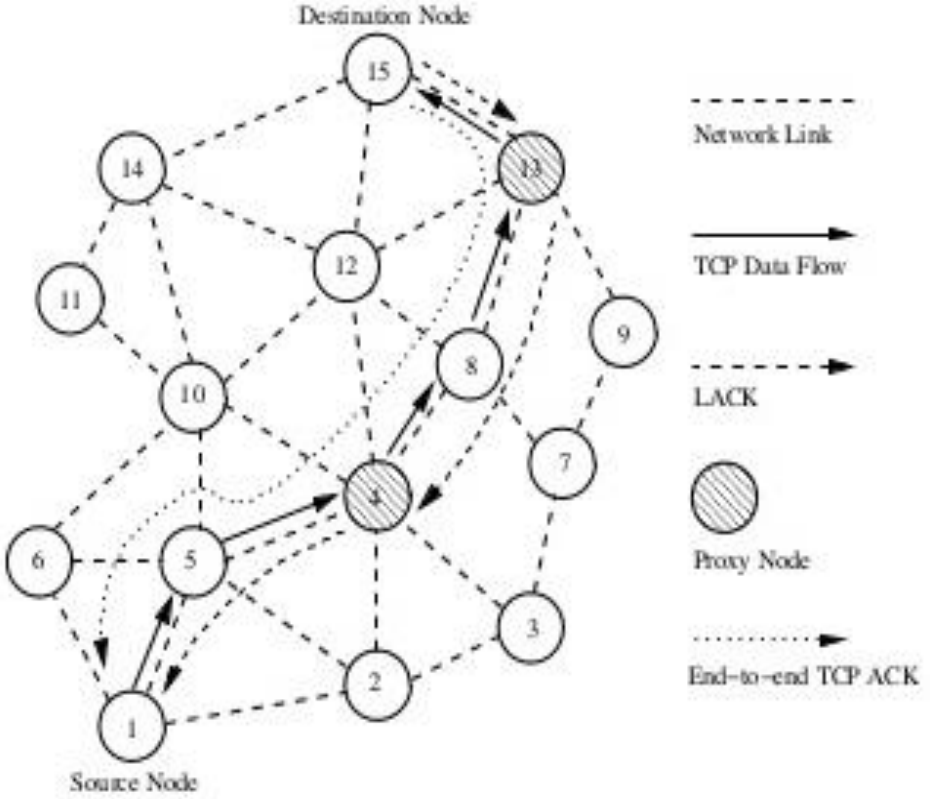


Figure 9.9. An illustration of Split-TCP.

TCP – F (TCP Feedback)

- Source MH sending packet to destination MH, if intermediate MH detects route failure due to mobility:
- It sends the Route Failure Notification (RFN) to source
- Invalidates the route to prevent further packet transfer to Source MH via that route
- If intermediate MH, knows alternate path it uses that path and discards RFN
- Receiving RFN, Source MH, stop sending packets, invalidates timer and freeze send window
- Source MH remains in that state till it receives Route Re-establishment Notification (RRN)