Chapter V
Wireless TCP

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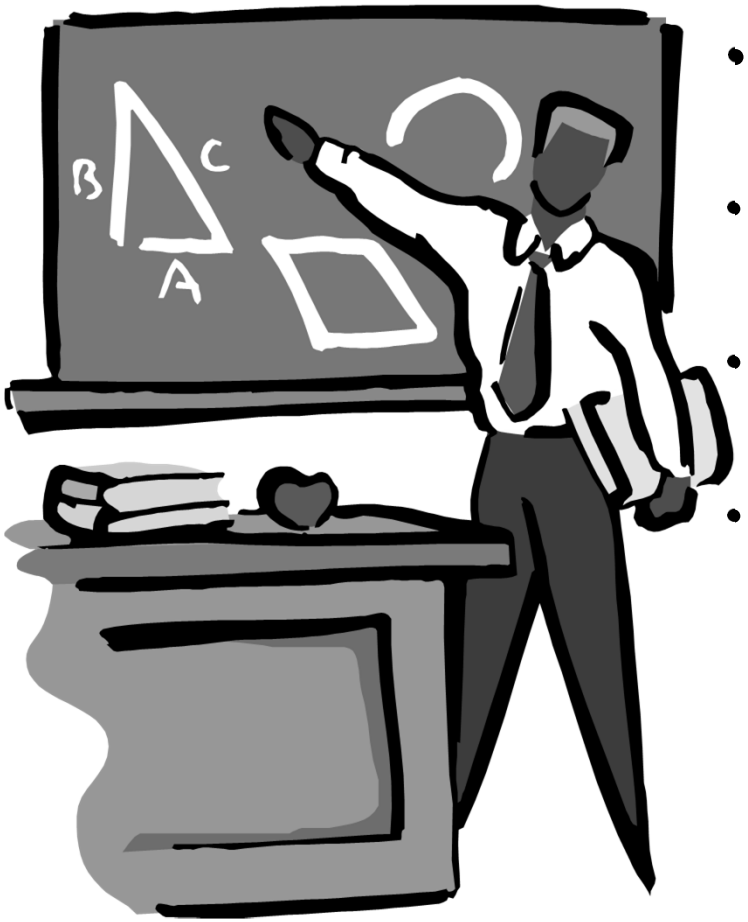
Wireless TCP



- 1 - Wireless Networks
- 2 - Problems for TCP and taxonomy
- 3. Pro-active approaches
- 4 . Re-active approaches

Wireless networks

- Infrastructure – based wireless networks
  - Rely on pre-installed infrastructure (e.g. base stations / access points)
  - Examples:
    - classical (unihop) cellular networks,
    - Wireless Local Area Networks (WLANs) configured in infrastructure mode

Wireless networks

- Infrastructure-less wireless networks
  - Deployed on the fly (no base stations / access points)
  - Examples:
    - Mobile ad hoc networks (MANETs)
      - Could be built using WLANs configured in infrastructure-less mode

Wireless networks

- Hybrid wireless networks
  - Made up of:
    - Infrastructure based portion
    - Infrastructure-less portion
  -

Wireless networks

- Hybrid wireless networks
  - Classical example:
    - Multi-hop cellular network
      - Classical unihop cellular network (eg. GSM, 3G) portion
      - Mobile ad hoc network (MANET) portion to connect cellular phones that are outside base station coverage
      - Key benefits:
        - » Increased coverage
        - » Improved performance

Wireless networks

- Key characteristics
  - Signal fading
    - Dispersion, reflection and diffraction due to obstacles
  - Mobility
    - Terminal mobility (i.e. keep on-going sessions alive while roaming)
      - Handoff / Handover in infrastructure based – networks
  - Limited power and energy

Problems for TCP and taxonomy of solutions

Problems for TCP

- Random loss of segments mistaken as indication of congestion
  - May be caused by fading
    - Triggering of wrong decisions in TCP state machine
      - » Unnecessary slow start

Problems for TCP and taxonomy of solutions

Problems for TCP

- Burst loss of segments mistaken as indication of congestion
  - May be caused by mobility (i.e. handoff/handover)
    - Triggering of wrong decision in TCP state machine
      - » Unnecessary slow start

Problems for TCP and taxonomy of solutions

Problems for TCP

- Packet re-ordering
  - May be caused by mobility (i.e. handoff / handover)
    - Triggering of wrong decisions in TCP state machine
      - » Unnecessary fast re-transmit and fast-recovery

Problems for TCP and Taxonomy of solutions

Several taxonomies exist

Taxonomy used in this course

– Pro-active

- Avoid the problem (i.e. TCP segment loss without knowing the exact cause: congestion or random / burst error)

Problems for TCP and Taxonomy of solutions

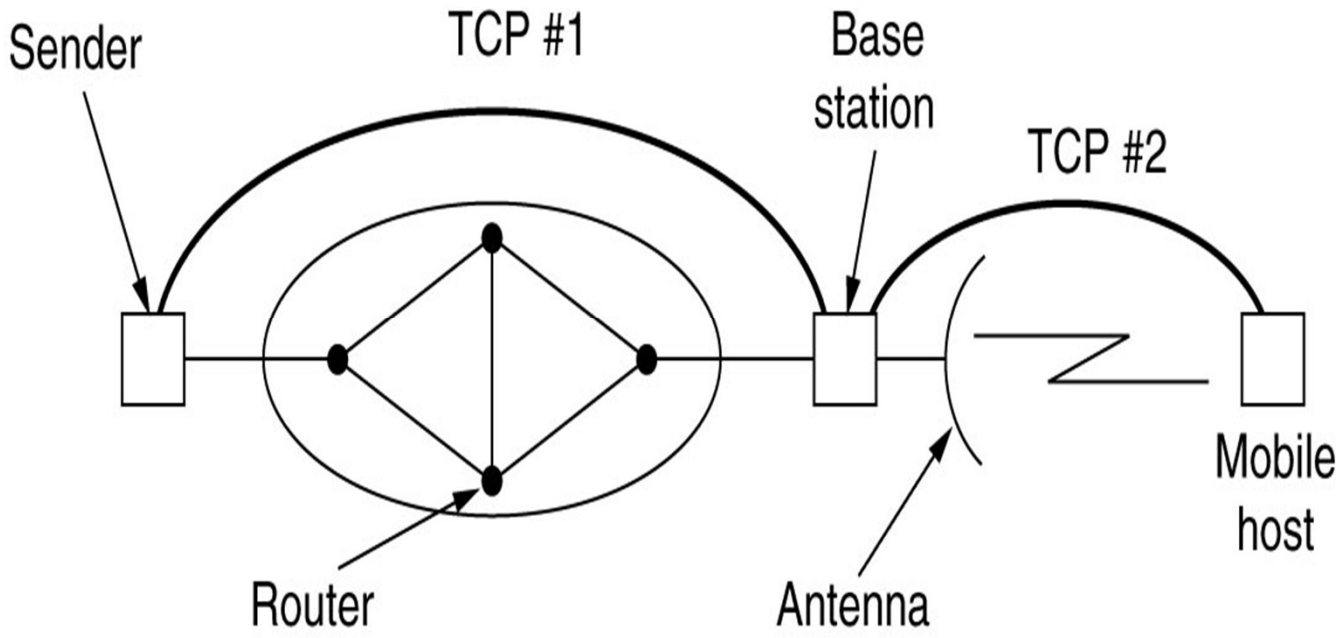
Several taxonomies exist

Taxonomy used in this course

– Re-active
  - Let the problem happens (i.e. TCP segment loss without knowing the exact cause)
  - Figure the exact cause and take appropriate actions

Pro-active approaches

Split TCP (basic form)



Pro-active approaches

Split TCP (Basic form)

- Applicable to networks with a fixed portion and an infrastructure based – wireless portion
  - Split the connection in two (fixed part and wireless part)
  - Cause of segment loss determined by where the loss happens and relevant decisions are taken

Pro-active approaches

Split TCP

- Sample of disadvantages
  - Violation of TCP semantics
    - ACK may arrive before segment reaches receiver because sent by base station
  - Lack of general applicability
    - Link base station – mobile may not be the last mile (e.g. multi hop cellular networks)
  - Inefficient handling of handoff / handovers
    - Need to transfer connection state from old base station to new base station

Re-active approaches

Cross layer approaches

- Let the problem happens (i.e. segment loss without knowing the cause)
- Use information from other layers including non adjacent layers to determine the cause

Re-active approaches

Cross layer approaches

- Example: ILC - TCP
  - Sender side solution
  - Relies on a state manager that collects relevant information from all layers including
    - Link state (bad or good)
      - » Bad link indicates imminent handoff and good link indicates completion of handoff

Re-active approaches

Cross layer approaches

- Example: ILC - TCP
  - Upon timeout
    - Check link state
      - » Good implies congestion
      - » Bad implies imminence of handoff
        - » Suspend TCP state

References

- K. Pentikousis, TCP in Wired-Cum-Wireless Environments, IEEE Communications Surveys and tutorials, fourth quarter 2000
- K-C Leung and V. O.K. Li, Transmission Control Protocol (TCP) in Wireless Networks: Issues, Approaches and Challenges, IEEE Communications Surveys and Tutorials, Fourth Quarter 2006