

# **Computer Networks**

**Lecture on**

**Other Transport Protocols**

## Plan of This Lecture

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- User Datagram Protocol (UDP)
- Other datagram protocols
- Other stream protocols
- Wireless & mobile transmission control protocols

# User Datagram Protocol

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## Main UDP features

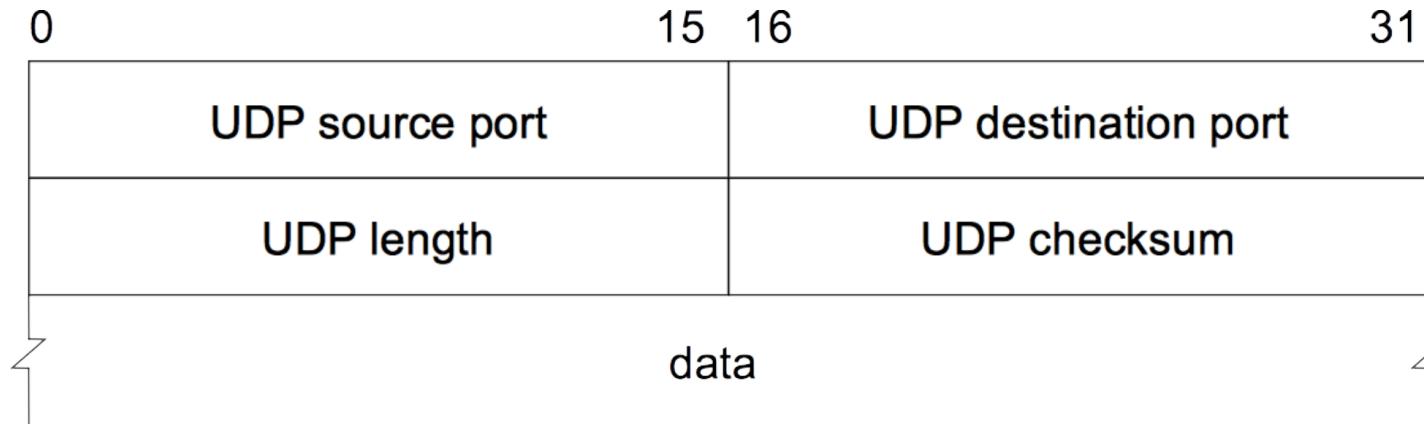
- unreliable
- connectionless
  - one process can serve many others in a time
- datagram flow
  - no need for data structure synchronisation
- no congestion control !!!
- simple

## Applications

- real-time      where delay & jitter must be minimized, e.g. multimedia
- energy constrain devices
- short request & short answer
- Remote Procedure Calls over LANs

## UDP header:

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source port is not obligatory

checksum is not obligatory,

- of all bytes of the UDP datagram and IP meta-header (IP addresses)
- calculated in ones' complement numeric representation

(value 0 has two representations: all 1s and all 0s)

- if == 0 then ignored
- covers all UDP bytes and IP addresses from IP header as well as TCP checksum
  - If NAT changes IP addresses, then IP & UDP/TCP checksums must be recalculated

# Other Datagram Protocols

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## **UDP-Lite**      Lightweight User Datagram Protocol

- Partial checksums that only covers part of a datagram
  - The length field points the last checked byte
  - The non checked bytes can be corrupted
- 2<sup>nd</sup> layer protocol should accept a frame with CRC error
- Applications              over radio links
  - VoIP              some codecs can deal with errors
  - Data streams with forward error correction

## **Reliable User Datagram Protocol**

- Acknowledgment of received packets
- Windowing and congestion control
- Retransmission of lost packets
- Over buffering (faster than real-time streaming)
- Lower overhead than TCP

## **Datagram Congestion Control Protocol**

- UDP with congestion control
- Reliable connection setup, teardown and feature negotiation
- Unreliable data
- Numbered packets
- Applications – with timing constraints on the delivery of data
  - streaming media
  - multiplayer online games

# Other Stream Protocols

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## Stream Control Transmission Protocol

- Works over IP
- Reliable in-sequence transport
- Messages streams – not byte streams as TCP
  - number of streams is negotiated at start-up
- Four-way handshake – protection against SYN-attack
- Congestion control
- Applications
  - Telecommunications signalling
  - Limited usage – lack of NAT support & some middleboxes

## **Real-Time Transport Protocol**

- Works over
  - UDP – data transport                      **RTP**
  - TCP – control transport                    **CRTP**
- For delivering audio and video (e.g. VoIP)
- Payload type identification
- Sequence numbering
- Timestamping

## **QUIC                      – Quick UDP Internet Connections**

- Works over UDP
- Tailored to HTTPS: HTTP plus TLS encryption
- Supports multiplexed streams in a single connection
- Reliable transfer of numbered packets
- Provides advanced congestion control



## **MTCP                    – Multipath TCP**

- Multiple network interfaces on a host
- Multiple standard-TCP subflows, e.g.
  - via Wi-Fi
  - via a mobile network
- Parallel or backup configuration
- Considered applications
  - Offload mobile networks

# Wireless Transmission Control Protocol

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WTCP is a proxy-based modification of TCP

- Proxy is on the edge of a wireless cloud
  - the end hosts are unaware of the proxy
- Improves effectiveness in wireless networks
- Differentiates between reasons of packet loss:
  - damage in radio media
  - queues overflow
- Adapts to varying delays:
  - selective acknowledgements with probing

# Mobile Transmission Control Protocol

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There have been many research articles

## **TCP over Second (2.5G) and Third (3G) Generation Wireless Networks**

RFC 3481 - Best Current Practice 2003

## **MTCP for Mobility Management over IP networks**

draft-kuangyj-mobile-tcp-00.txt 2004

- TCP tuning
- Improves effectiveness in wireless networks
- TCP options selection
- Modification of parameters for:
  - retransmissions
  - flow-control
  - congestion avoidance

# Summary

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- User Datagram Protocol (UDP)
- Other datagram protocols
  - UDP-Lite
  - Reliable User Datagram Protocol
  - Datagram Congestion Control Protocol
- Other stream protocols
  - Stream Control Transmission Protocol (SCP)
  - Real-Time Transport Protocol (RTP)
  - Quick UDP Internet Connections (QUIC)
  - Multipath TCP (MTCP)
- Wireless Transmission Control Protocol
- Mobile Transmission Control Protocol

# Questions

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1. What are main features of UDP protocol?
2. Which kind of applications uses UDP transport?
3. UDP is a connectionless unreliable protocol like IP. Why do applications use UDP and not directly IP?
4. What are obligatory fields in a UDP PDU?
5. Compare UDP with TCP regarding: connectivity, reliability, speed and data synchronization.
6. Mention at least 3 other (than UDP and TCP) transport layer protocols. What for do we use them?
7. What are the main futures of Real-time Transport Protocol?
8. Why does the standard TCP configuration work inefficiently over radio links?
9. Which TCP options can be used for better communication over radio links?
10. How does Wireless Transmission Control Protocol work?