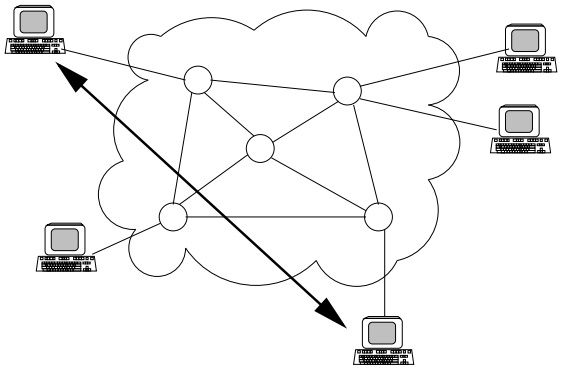
Review: ARQ Protocols

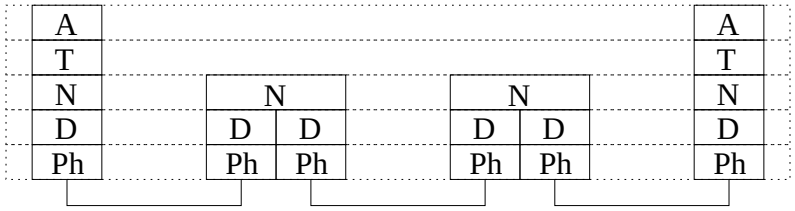


Reliable Data Transfer?

Review: ARQ Protocols

- Can we apply ARQ Protocols to Human Interaction (Communication)?
  - Stop-and-Wait
  - Go-Back n
  - Selective Repeat
- Can Apply ARQ in every layer
- Go-Back n ARQ can be used for:
  - Congestion Control
  - Flow Control
- One has to be careful when designing a ARQ protocol!

Review: ARQ Protocols



Does it make sense to implement ARQ in more than one layer?

Where are we in the Course?

Basics:

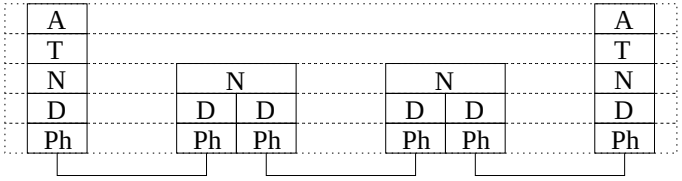
- Network Types (“Hardware”)
- Layered Network Architecture (“Software”)
- Reliable Data Transfer
- Tools for Performance Analysis

Implementation:

- Design of Protocols
- Analysis of the Service provided by Protocols

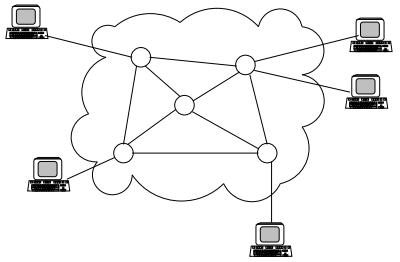
Quality of Service

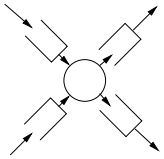
- Delay



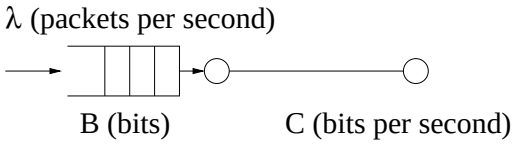
  - Processing Delay
  - Queueing Delay
  - Transmission Delay
  - Propagation Delay

Queueing Delay





Queueing Delay



Delay depends on B, C, and λ
Maximal delay is equal to
Loss depends on B, C, and λ

Design Objectives

- Given network resources and a Quality of Service (QoS) requirement, what is the maximal traffic load that we can support?
- Given network resources and a traffic load, what QoS do we obtain?
- Given a QoS requirement and a traffic load, what are the network resources that we need?

These questions are difficult to answer!

Approach

- Simple Models
- More Qualitative than Quantitative Analysis (Insight !)
- However, sometimes these models work quite well !

Relation between Traffic Load and Delay

Simple Model

Other Questions

- Average Delay?
- Expected Number of Packets in the Buffer?
- Probability that a Packet is lost?

We need a Probabilistic Model

Outline

Models

- Packet Arrivals: Poisson Process
- Packet Length: Exponential Distribution
- System: Queueing Theory