15-441 Project 1 Overview

9/1/04

Your Assignment Is …

To implement a TFTP server.

Detailed handout on course website.

What exactly does this involve ?

What is TFTP ?

- The Trivial File Transfer Protocol
  - Basic file transfer protocol
  - Supports only Get & Put operations
- Major uses :
  - Netbooting workstations
  - Example of a simple but useful protocol
- Defined by a standards body document
  - RFC 1350   (1992)
  - RFC 783   (1981) (obsolete)

The Standard

- ## RFC 1350
  - Internet Engineering Task Force (IETF)
  - Request For Comment (RFC)
  - Number 1350

- ## Defines
  - Message types & formats
  - Sequence of messages

- ## Written in very rigid style
  - Not necessarily easy to understand

Packets

- Sent over User Datagram Protocol (UDP)
  - Single message (datagram)
  - See chapter 5.1 for details

2. Only 5 types :
  - RRQ (filename, mode)
  - WRQ (filename, mode)
  - DATA (block number, data bytes)
  - ACK (block number)
  - ERROR (error code, error message)

- Largest packet is limited to 516 bytes

Protocol

- Stop and wait protocol - send a message, wait for reply

- Send DATA(1,…) in response to RRQ

- Send ACK(n) in response to DATA(n)

- Send DATA(n+1,...) in response to ACK(n)

- What happens when a message is lost?

  - Sender retransmits DATA or RRQ
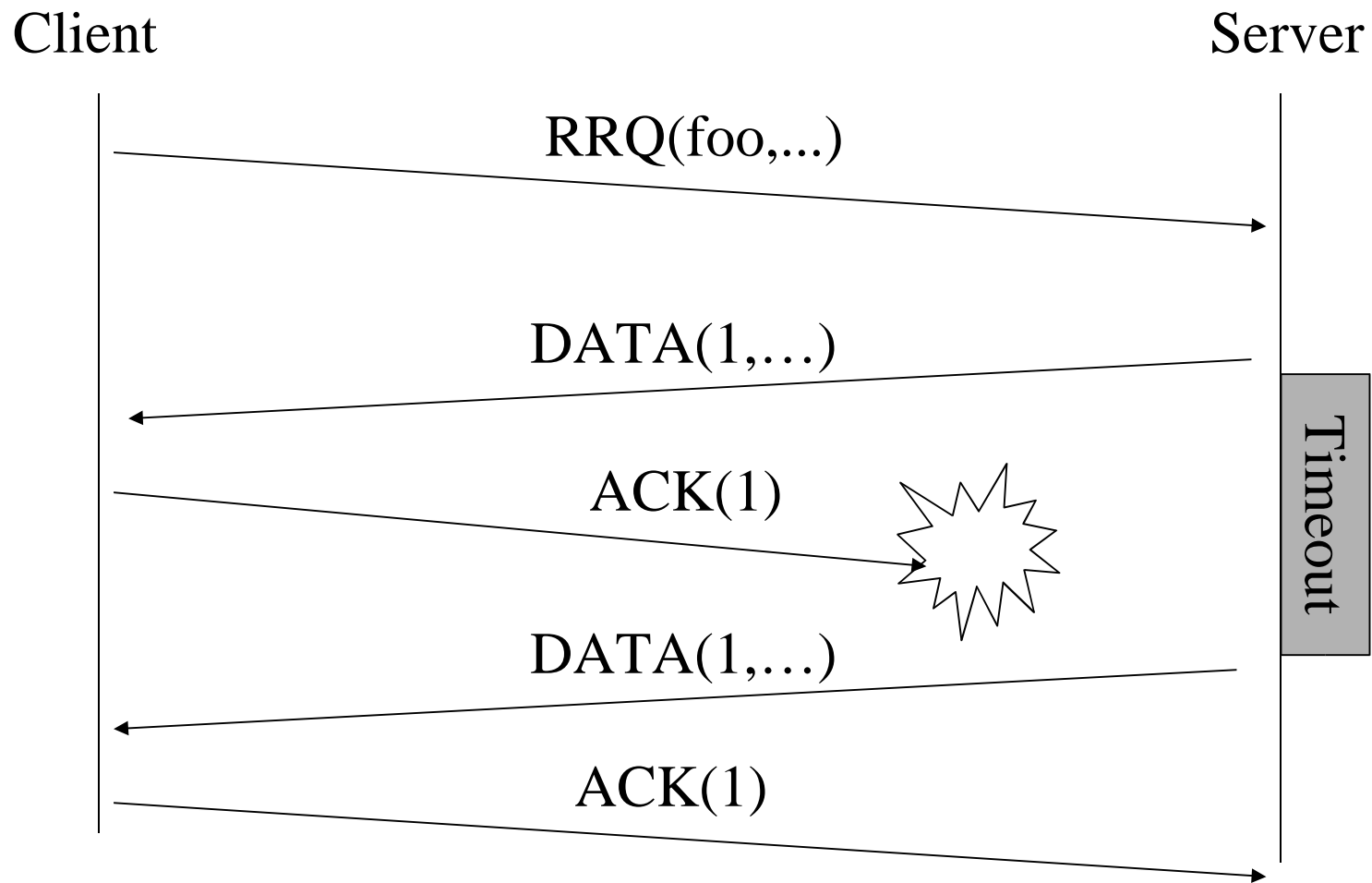
  - How do you know when to stop?

Get Example

Client   Server

RRQ(foo,...)

DATA(1,…)

ACK(1)

DATA(2,…)

ACK(2)

Get Example (lost packet)

Client

Server

RRQ(foo,...)

DATA(1,…)

ACK(1)

Timeout

DATA(1,…)

ACK(1)

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Hints

- Protocol Issues

- Network Byte Order

- Debugging tools

- Project Planning

General Protocol Issues

- TFTP uses the well known port 69 UDP
  - Usually only superuser can bind to ports < 1024
  - Use a different port instead
- Responses to RRQ/WRQ are sent out on a different port than 69.
  - Have to create another socket
  - `bind` with the right option will pick any free port
- Each side can consider the connection terminated when it sends an ERROR packet
  - What if the ERROR packet is lost ?

Network Byte Order

- Network functions deal in bytes
  - `recv` will return the buffer `send` sent
- Multi-byte structures in a message are more complicated (eg: integers)
  - One host could be big-endian, the other little-endian
  - Choose one byte order for messages on the wire (pages 536-538)
- Provide conversion functions for common types
  - `Long  : htonl, ntohl`
  - `Short : htons, ntohs`

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Debugging Tools

- ## TFTP clients
  - `tftp` installed on Andrew Linux & Solaris
  - `get` & `put` do the obvious things
  - `trace` prints the packets sent & received

- ## `tcpdump`
  - View all traffic
  - May require superuser privileges

- ## `netstat`
  - List open sockets

Project Planning

- ## Start early !

- ## Read the assignment & RFC soon

- ## This project may be larger than your previous ones.

  - ### Expect about 750-1000 lines of C-code

  - ### Most of the complexity will be in exceptional handling.

- ## Think about the corner cases early

Questions ?