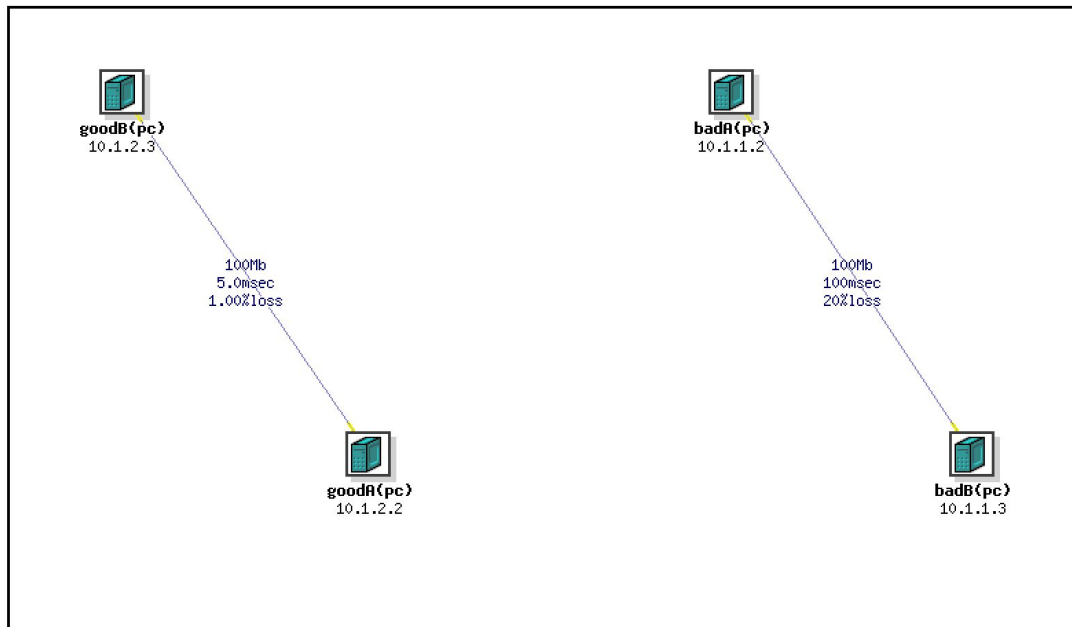


# Fast, Reliable File Transfer

EE 542: Cloud Computing  
Professor Cho  
Lab Assignment 5

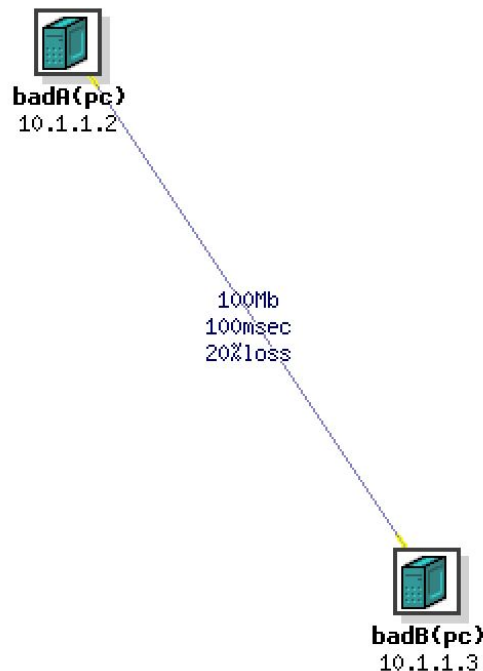
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# Introduction

File transfer protocols which primarily use TCP as their transport protocol are extremely unreliable over lossy links.

For example, on our emulated link (with 200 ms RTT and 20% loss) scp was not able to transfer files around one gigabytes

[illegible]

# File Transfer Utility

TCP file transfers are inherently encumbered on lossy links (because of TCP's over emphasis on the reliability of transferring each packet and the exponential window back-off in event of packet loss which has a 1-in-5 probability in our link). Therefore, we chose to only rely on UDP for our protocol.

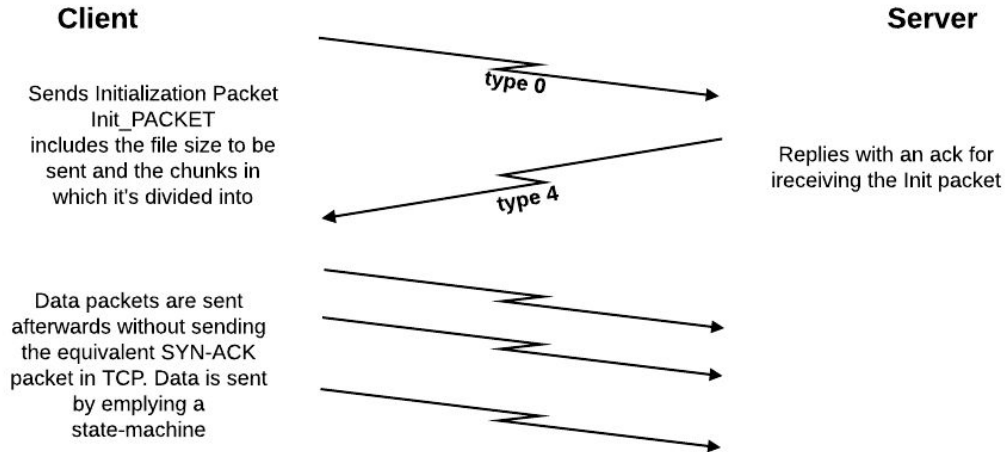
UDP in itself also cannot transfer files in a reliable fashion. We experienced irretrievable packet losses without building in our own lightweight reliability mechanism. For the socket code, we incorporated the UDP packet code from Lab 2 exercises. To ensure connection and delivery, we defined different structures and built-in checks, expanded on in the next slide.

data\_size specifies the size of each chunk (the file is broken into chunks to be sent more efficiently, more on this later). Since Ethernet breaks down each packet into 1500-byte datagrams, we chose to make the process more efficient by preemptively dividing the file ourselves.

- The last data packet is normally smaller, so a different size is allocated

Init packet is used to perform a simple handshake to acknowledge the existence of the receiver.

ack\_packet is an int-array which acts as an accumulated ack packet for ensuring reliable delivery of all packets.



```
#define data_size 1400
```

```
struct packet{
    uint8_t type;
    int sequence_number;
    char data[data_size];
};
```

```
struct Init_PACKET{
    uint8_t type;
    uint file_size;
    uint chunk_size;
};
```

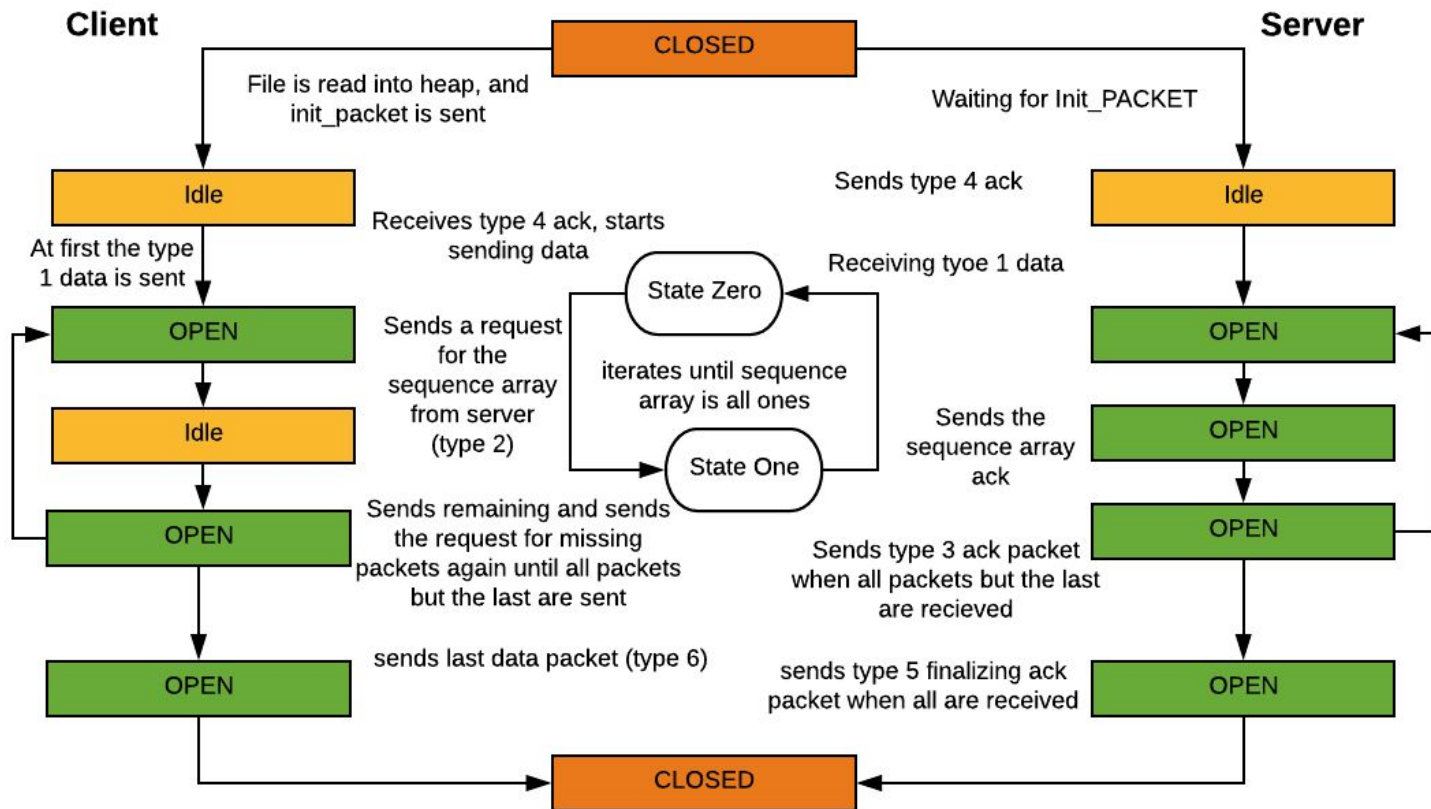
```
struct ack_packet{
    uint8_t type;
    uint8_t packet_tracker[20000];
};
```

# Packet Types

To make distinctions between packets easier, we specified each packet structure with a type, which is enumerated below

```
type 0: client --> server: init_packet
type 1: client --> server: normal-sized data packets
type 2: client --> server: client request server's missing packet (ack) sequence
type 2: server --> client: server sends updated missing packet (ack) sequence
type 3: server --> client: receiver ACKs everything except last packet
type 4: server --> client: ACK - init_packet receipt
type 5: server --> client: entire transaction done
type 6: client --> server: final data packet
```

# Reliable UDP File Transfer State



# Results - 65MB Good Link

Client.c output:

65MB over 1% loss link

Delay = 0.118s

→ Throughput =  $65 / 0.118\text{s} = 550\text{MBps}$

```
usc542ee@goodb:/tmp$ ls -la
total 206156
drwxrwxrwt 7 root root 4096 Sep 13 23:30 .
drwxr-xr-x 27 root root 4096 Jul 20 2017 ..
-rwxr-xr-x 1 usc542ee EE542 18304 Sep 13 23:30 client
-rw-r--r-- 1 usc542ee EE542 12016 Sep 13 23:30 client.c
-rw-r--r-- 1 usc542ee EE542 9668 Sep 13 13:46 client_udp.c
-rw-r--r-- 1 usc542ee EE542 20480 Sep 13 13:54 .client_udp.c.swn
-rw-r--r-- 1 usc542ee EE542 20480 Sep 13 13:52 .client_udp.c.swo
-rw-r--r-- 1 usc542ee EE542 4096 Sep 13 13:50 .client_udp.c.swp
-rw-r--r-- 1 usc542ee EE542 104857600 Sep 13 23:29 data100M.bin
-rw-r--r-- 1 usc542ee EE542 1048576 Sep 13 14:11 data65.bin
-rw-r--r-- 1 usc542ee EE542 104857600 Sep 13 13:49 data.bin
drwxrwxrwt 2 root root 4096 Sep 13 13:36 .font-unix
drwxrwxrwt 2 root root 4096 Sep 13 13:36 .ICE-unix
-rw-r--r-- 1 usc542ee EE542 3806 Sep 13 23:31 log_client.txt
drwxrwxrwt 2 root root 4096 Sep 13 13:36 .Test-unix
drwxrwxrwt 2 root root 4096 Sep 13 13:36 .X11-unix
drwxrwxrwt 2 root root 4096 Sep 13 13:36 .XIM-unix

usc542ee@goodb:/tmp$ ./client
Usage: no filename provided
usc542ee@goodb:/tmp$ ./client data65.bin
File Size: 1048576
No of shunks : 749
Max file size : 1048576
Memory read : 1047200
Memory left to read : 1376
count value : 748
File Size read: 1376, count : 748
Init packet sent
Init packet no : 0

Ack of init received
Started timer!
type 4
type 4
type 2
type 2
type 2
type 3
all packets received except last
Packet Type 5 (cumulative ack) received :
type last 3
all packets sent
Total Transfer Time: 0.117655 seconds
usc542ee@goodb:/tmp$
```

# Results - 1GB Good Link

Client.c output:  
1000MB over 1% loss link  
Protocol failure - Segmentation fault

```
usc542ee@godb:/tmp$ ls -la
total 1231224
drwxrwxrwt 7 root root 4096 Sep 13 23:43 .
drwxr-xr-x 27 root root 4096 Jul 20 2017 ..
-rwxr-xr-x 1 usc542ee EE542 18304 Sep 13 23:43 client
-rw-r--r-- 1 usc542ee EE542 12018 Sep 13 23:43 client.c
-rw-r--r-- 1 usc542ee EE542 9668 Sep 13 13:46 client_udp.c
-rw-r--r-- 1 usc542ee EE542 20480 Sep 13 13:54 .client_udp.c.swn
-rw-r--r-- 1 usc542ee EE542 20480 Sep 13 13:52 .client_udp.c.swo
-rw-r--r-- 1 usc542ee EE542 4096 Sep 13 13:50 .client_udp.c.swp
-rw-r--r-- 1 usc542ee EE542 104857600 Sep 13 23:29 data100M.bin
-rw-r--r-- 1 usc542ee EE542 1048576000 Sep 13 23:35 data1G.bin
-rw-r--r-- 1 usc542ee EE542 1048576 Sep 13 14:11 data65.bin
-rw-r--r-- 1 usc542ee EE542 104857600 Sep 13 13:49 data.bin
drwxrwxrwt 2 root root 4096 Sep 13 13:36 .font-unix
drwxrwxrwt 2 root root 4096 Sep 13 13:36 .ICE-unix
-rw-r--r-- 1 usc542ee EE542 65536 Sep 13 23:40 log_client.txt
drwxrwxrwt 2 root root 4096 Sep 13 13:36 .Test-unix
drwxrwxrwt 2 root root 4096 Sep 13 13:36 .X11-unix
drwxrwxrwt 2 root root 4096 Sep 13 13:36 .XIM-unix
usc542ee@godb:/tmp$ ./client data1G.bin
File Size: 1048576000
No of shunks : 748983
Max file size : 1048576000
Memory read : 1048574800
Memory left to read : 1200
count value : 748982
File Size read: 1200, count : 748982
Init packet sent

Ack of init received
Started timer!
Segmentation fault (core dumped)
usc542ee@godb:/tmp$
```



# Results - 65MB Bad Link

Client.c output:

65MB over 20% loss link

Delay = 0.2.564s

→ Throughput =  $65/2.564s = 25.35$  MBps

```
usc542ee@badb:/tmp$ gcc client.c -lm -o client
usc542ee@badb:/tmp$ ./client data65.bin
File Size: 1048576
No of shunks : 749
Max file size : 1048576
Memory read : 1047200
Memory left to read : 1376
count value : 748
File Size read: 1376, count : 748
Init packet sent

Ack of init received
Started timer!
all packets received except last
Packet Type 5 (cummulative ack) received :
type last 5
all packets sent
Total Transfer Time: 2.563930 seconds
usc542ee@badb:/tmp$
```

# Results - 1G Bad Link

Client.c output:

1000MB over 10% loss link

Protocol failure - Segmentation fault

```
usc542ee@badb:/tmp$ gcc client.c -lm -o client
usc542ee@badb:/tmp$ ./client data65.bin
File Size: 1048576
No of shunks : 749
Max file size : 1048576
Memory read : 1047200
Memory left to read : 1376
count value : 748
File Size read: 1376, count : 748
Init packet sent

Ack of init received
Started timer!
all packets received except last
Packet Type 5 (cummulative ack) received :
type last 5
all packets sent
Total Transfer Time: 2.563930 seconds
usc542ee@badb:/tmp$
```