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### **1. Error detection using CRC checker**

**Filename: CRC.cpp**

**Compile: g++ CRC.cpp -o CRC**

**Run: ./CRC**

```
(base) ammaar@ammaar-Aspire-A715-75G:~/Desktop/CS359 LAB/1801CS08_Assignment7$ g++ CRC.cpp
(base) ammaar@ammaar-Aspire-A715-75G:~/Desktop/CS359 LAB/1801CS08_Assignment7$ ./a.out
Enter the binary CRC checker
10001
Enter the binary string
1010001
Encoded string: 10100010100
Enter the bits to be flipped
15
No error: Remainder = 0000
(base) ammaar@ammaar-Aspire-A715-75G:~/Desktop/CS359 LAB/1801CS08_Assignment7$
```

### **2. Client and Server sending and receiving message encoded by CRC.**

**Server Program (This should be run first)**

**Filename: server.cpp**

**Compile: g++ server.cpp -o server**

**Run: ./server**

**Client Program(In another terminal)**

**Filename: client.cpp**

**Compile: g++ client.cpp -o client**

**Run: ./client**

[illegible][illegible]

**Assumption: Client send the CRC checker first followed by Initial message**  
**This is one - one conversation**

### 3. Wireshark Capture of packets transfer.

Condition: Keep Wifi or any internet connection off

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

No.	Time	Source	Destination	Protocol	Length	Info
12	60.2445257933	127.0.0.1	127.0.0.1	TCP	1090	8880 → 54402 [PSH, ACK] Seq=1025 Ack=3073 Win=65536 Len=1024 TSval=30680890424 TSrc=30680661122 [TCP segment of a reassembled PDU]
13	60.2445030924	127.0.0.1	127.0.0.1	ACK	56	54402 → 8880 [ACK] Seq=3073 Ack=1025 Win=0 Len=0 TSval=30680890424 TSrc=30680890424
14	69.432410885	127.0.0.1	127.0.0.1	TCP	1990	54402 → 8880 [PSH, ACK] Seq=3073 Ack=2049 Win=65536 Len=1024 TSval=30680899612 TSrc=30680900424 [TCP segment of a reassembled PDU]
15	69.43242285	127.0.0.1	127.0.0.1	ACK	68	8880 → 54402 [ACK] Seq=2049 Ack=4897 Win=65536 Len=0 TSval=30680899612 TSrc=30680899612
16	85.931112689	127.0.0.1	127.0.0.1	TCP	1990	8880 → 54402 [PSH, ACK] Seq=3073 Ack=2049 Win=65536 Len=1024 TSval=3068116111 TSrc=30680990424 [TCP segment of a reassembled PDU]
17	85.931118952	127.0.0.1	127.0.0.1	ACK	65	54402 → 8880 [ACK] Seq=4097 Ack=3073 Win=64512 Len=0 TSval=3068116111 TSrc=3068116111
18	85.930942861	127.0.0.1	127.0.0.1	ACK	1090	54402 → 8880 [ACK] Seq=4097 Ack=3073 Win=65536 Len=1024 TSval=3068121569 TSrc=3068116111 [TCP segment of a reassembled PDU]
19	81.389888448	127.0.0.1	127.0.0.1	TCP	68	8880 → 54402 [ACK] Seq=3073 Ack=5121 Win=64512 Len=0 TSval=3068121569 TSrc=3068121569
20	80.978804755	127.0.0.1	127.0.0.1	ACK	1090	54402 → 8880 [ACK] Seq=3073 Ack=5121 Win=65536 Len=1024 TSval=3068131158 TSrc=3068121569 [TCP segment of a reassembled PDU]
21	80.978803856	127.0.0.1	127.0.0.1	ACK	65	54402 → 8880 [ACK] Seq=5121 Ack=4897 Win=64512 Len=0 TSval=3068131158 TSrc=3068131158
22	106.68817371	127.0.0.1	127.0.0.1	TCP	1990	54402 → 8880 [PSH, ACK] Seq=5121 Ack=4897 Win=65536 Len=1024 TSval=3068136869 TSrc=3068131158 [TCP segment of a reassembled PDU]
23	106.68869674	127.0.0.1	127.0.0.1	ACK	68	8880 → 54402 [ACK] Seq=4097 Ack=6145 Win=64512 Len=0 TSval=3068136869 TSrc=3068136869
24	109.683275957	127.0.0.1	127.0.0.1	ACK	1090	54402 → 8880 [ACK] Seq=4097 Ack=6145 Win=65536 Len=1024 TSval=3068140243 TSrc=3068136869 [TCP segment of a reassembled PDU]
25	118.963089426	127.0.0.1	127.0.0.1	TCP	65	54402 → 8880 [ACK] Seq=6145 Ack=5121 Win=64512 Len=0 TSval=3068140243 TSrc=3068140243
26	118.963086565	127.0.0.1	127.0.0.1	TCP	1990	54402 → 8880 [PSH, ACK] Seq=5145 Ack=5121 Win=65536 Len=1024 TSval=3068164378 TSrc=3068140243 [TCP segment of a reassembled PDU]
27	134.185952864	127.0.0.1	127.0.0.1	TCP	68	8880 → 54402 [ACK] Seq=5121 Ack=7169 Win=64512 Len=0 TSval=3068164378 TSrc=3068164378
28	134.186267679	127.0.0.1	127.0.0.1	TCP	65	54402 → 8880 [FIN, ACK] Seq=7169 Ack=5121 Win=65536 Len=0 TSval=3068164378 TSrc=3068164378
29	134.199276354	127.0.0.1	127.0.0.1	ACK	68	8880 → 54402 [ACK] Seq=5121 Ack=7216 Win=65536 Len=0 TSval=3068164378 TSrc=3068164378
30	134.199145773	127.0.0.1	127.0.0.1	ACK	67	54402 → 8880 [ACK] Seq=7170 Ack=5122 Win=65536 Len=0 TSval=3068164379 TSrc=3068164379

▶ Frame 1: 1995 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface lo, id 0

▶ Ethernet II, Src: 00:00:00:00:00:00, Dst: 00:00:00:00:00:00, Seq: 00:00:00:00:00 (00:00:00:00:00:00)

▶ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1

▶ Transmission Control Protocol, Src Port: 54402, Dst Port: 8880, Seq: 0, Len: 0

```
0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 45 00  ....
0010 00 3c a0 f3 40 00 00 00 00 00 00 00 01 7f 00  --<- 0 0
0020 00 01 d4 82 1f 90 da 59 c2 8d 00 00 00 00 a0 02  ....Y
0030 ff d7 7e 38 00 00 02 04 ff d7 02 02 08 0a b6 de  --0-----
0040 6c e4 00 00 00 00 01 03 03 07 02 08 0a b6 de  1-----
```

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	127.0.0.1	127.0.0.1	TCP	1099	8080 → 54426 [PSH, ACK] Seq=1 Ack=1 Wins=1 Len=0 Tsval=3070297238 Tsecr=3070247879 [TCP segment of a reassembled PDU]
2	0.000026283	127.0.0.1	127.0.0.1	TCP	65	54426 → 8080 [ACK] Seq=1 Ack=1025 Win=504 Len=0 Tsval=3070297238 Tsecr=3070297238
3	0.000247936	127.0.0.1	127.0.0.1	TCP	1099	54426 → 8080 [ACK] Seq=1 Ack=1025 Win=504 Len=0 Tsval=3070305680 Tsecr=3070297238 [TCP segment of a reassembled PDU]
4	0.082279153	127.0.0.1	127.0.0.1	TCP	65	8080 → 54426 [ACK] Seq=1025 Ack=1025 Win=504 Len=0 Tsval=3070305680 Tsecr=3070305680
5	0.166371974	127.0.0.1	127.0.0.1	TCP	1099	8080 → 54426 [PSH, ACK] Seq=1025 Ack=1025 Win=512 Len=0 Tsval=3070317604 Tsecr=3070305680 [TCP segment of a reassembled PDU]
6	0.166354573	127.0.0.1	127.0.0.1	TCP	65	54426 → 8080 [ACK] Seq=1025 Ack=2049 Win=504 Len=0 Tsval=3070317604 Tsecr=3070317604
7	0.736257629	127.0.0.1	127.0.0.1	TCP	1099	54426 → 8080 [ACK] Seq=1025 Ack=2049 Win=512 Len=0 Tsval=3070328270 Tsecr=3070317604 [TCP segment of a reassembled PDU]
8	0.736314214	127.0.0.1	127.0.0.1	TCP	65	8080 → 54426 [ACK] Seq=2049 Ack=2049 Win=504 Len=0 Tsval=3070328271 Tsecr=3070328270
9	0.153961426	127.0.0.1	127.0.0.1	TCP	1099	8080 → 54426 [ACK] Seq=2049 Ack=2049 Win=512 Len=0 Tsval=3070328270 Tsecr=3070328270 [TCP segment of a reassembled PDU]
10	0.153974869	127.0.0.1	127.0.0.1	TCP	65	54426 → 8080 [ACK] Seq=2049 Ack=3073 Win=504 Len=0 Tsval=3070328270 Tsecr=3070328270
11	0.5218125368	127.0.0.1	127.0.0.1	TCP	1099	54426 → 8080 [ACK] Seq=2049 Ack=3073 Win=512 Len=0 Tsval=3070350649 Tsecr=3070328270 [TCP segment of a reassembled PDU]
12	0.5218289433	127.0.0.1	127.0.0.1	TCP	65	8080 → 54426 [ACK] Seq=3073 Ack=3073 Win=504 Len=0 Tsval=3070350649 Tsecr=3070350649
13	0.5218708098	127.0.0.1	127.0.0.1	TCP	1099	8080 → 54426 [ACK] Seq=3073 Ack=3073 Win=512 Len=0 Tsval=3070350649 Tsecr=3070350649 [TCP segment of a reassembled PDU]
14	0.6258676116	127.0.0.1	127.0.0.1	TCP	65	54426 → 8080 [ACK] Seq=3073 Ack=4097 Win=504 Len=0 Tsval=3070359825 Tsecr=3070359825
15	0.6815319363	127.0.0.1	127.0.0.1	TCP	1099	54426 → 8080 [PSH, ACK] Seq=3073 Ack=4097 Win=512 Len=0 Tsval=3070365373 Tsecr=3070359825 [TCP segment of a reassembled PDU]
16	0.6815425443	127.0.0.1	127.0.0.1	TCP	65	8080 → 54426 [ACK] Seq=4097 Ack=4097 Win=504 Len=0 Tsval=3070365373 Tsecr=3070365373
17	0.8453453816	127.0.0.1	127.0.0.1	TCP	1099	8080 → 54426 [PSH, ACK] Seq=4097 Ack=4097 Win=512 Len=0 Tsval=3070381772 Tsecr=3070365373 [TCP segment of a reassembled PDU]
18	0.8453457406	127.0.0.1	127.0.0.1	TCP	65	54426 → 8080 [ACK] Seq=4097 Ack=5121 Win=504 Len=0 Tsval=3070381772 Tsecr=3070381772
19	0.8453783552	127.0.0.1	127.0.0.1	TCP	1099	54426 → 8080 [ACK] Seq=5121 Ack=5121 Win=504 Len=0 Tsval=3070391946 Tsecr=3070381772 [TCP segment of a reassembled PDU]
20	0.9470850744	127.0.0.1	127.0.0.1	TCP	65	8080 → 54426 [ACK] Seq=5121 Ack=5121 Win=504 Len=0 Tsval=3070391946 Tsecr=3070391946

# Frame 1: 1990 bytes on wire (8728 bits), 1990 bytes captured (8728 bits) on interface lo, id 0  
 # Ethernet II, Src: 00:00:00:00:00:00 (00:00:00:00:00:00), Dest: 00:00:00:00:00:00 (00:00:00:00:00:00)  
 # Internet Protocol Version 4, Src: 127.0.0.1, Dest: 127.0.0.1  
 # Transmission Control Protocol, Src Port: 8080, Dest Port: 54426, Seq: 1, Ack: 1, Len: 1024

0090	00	00	00	00	00	00	00	80	80	00	00	00	00	00	00
0091	04	34	ab	bc	40	00	00	80	05	77	00	00	01	77	00
0092	00	11	f0	90	64	92	14	c8	f4	10	05	4c	c8	80	18
0093	02	00	02	29	00	00	01	01	04	b7	61	06	b7	00	00
0094	00	47	30	11	30	31	31	30	31	30	31	31	30	30	31
0095	30	30	30	31	31	31	30	30	31	31	30	31	30	30	30
0096	30	30	30	31	31	31	30	31	30	30	31	31	30	31	30
0097	30	30	30	31	31	30	30	31	31	30	31	31	30	30	00011001
0098	31	30	30	31	31	30	30	31	30	31	30	30	30	30	10011001
0099	30	30	30	31	31	30	30	30	31	30	31	31	31	30	00011000
00a0	31	30	30	31	31	30	30	31	31	30	30	31	30	30	10011001
00a1	30	30	31	31	30	31	31	30	31	30	31	31	30	31	00011011
00a2	30	31	30	31	31	30	31	31	30	30	31	31	31	30	01011011
00a3	30	30	30	31	31	30	31	30	31	30	31	31	31	30	00011010
00a4	30	30	30	31	31	30	31	31	30	30	31	31	30	31	00011011
00f0	30	31	30	30	31	31	30	30	30	30	31	31	31	30	01001000
0100	30	30	30	31	31	30	31	31	31	30	31	31	31	30	00011011
0110	31	30	30	31	31	31	30	31	30	30	31	30	30	30	10011101
0120	30	30	30	31	31	30	31	31	31	30	30	31	31	30	00011011
0130	31	31	30	30	31	31	30	30	30	30	31	31	30	30	11001000
0140	31	30	30	31	31	30	30	31	31	31	30	31	31	30	00011011