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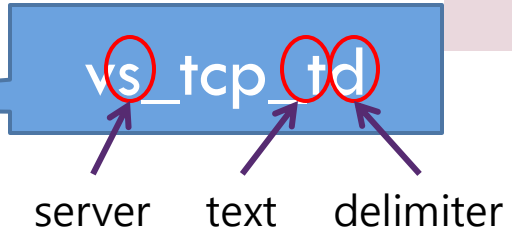
5장. 프로그램 수정

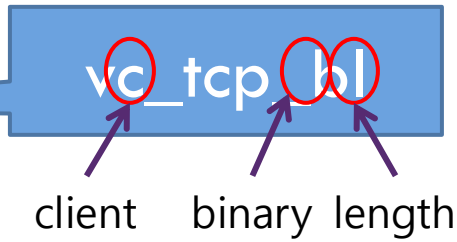
오류 상황 및 해결 방안

- VoteClientTCP.c에서 수신된 응답에 먼저 송신한 요청 메시지가 남아있어 득표수 확인이 안되는 이상 현상 발생
  - 방법 1
    - GetNextMsg()를 한번 더 호출하여 남아있는 메시지를 제거한 후 응답 확인 가능
    - 근본적인 해결책이 될 수 없음
  - Stream I/O로 Wrap 하는 과정에서 시스템의 오동작이 발생하는 것으로 추정됨
  - 방법 2
    - VoteClientTCP.c와 VoteServerTCP.c에서 Stream I/O로 Wrap 하는 과정을 제거하고, DelimFramer.c와 LengthFramer.c에서 파일이 아닌 소켓에 바로 읽고 쓰는 방식으로 수정
- Makefile을 이용하여 개발을 용이하게 할 필요가 있음

Makefile

```
Common_files = addressUtility.o dieWithMessage.o
LIBS = -lsocket -lnsl
CFLAGS = -xc99

vs_tcp_td : vsTcp.o tcpServerUtility.o voteEncodingText.o delimeterFramer.o  $(Common_files)
	cc -o vs_tcp_td $(CFLAGS) $(LIBS) vsTcp.o tcpServerUtility.o voteEncodingText.o delimeterFramer.o  $(Common_files)

vc_tcp_td : vcTcp.o tcpClientUtility.o voteEncodingText.o delimeterFramer.o  $(Common_files)
	cc -o vc_tcp_td $(CFLAGS) $(LIBS) vcTcp.o tcpClientUtility.o voteEncodingText.o delimeterFramer.o  $(Common_files)

vs_tcp_tl : vsTcp.o tcpServerUtility.o voteEncodingText.o lengthFramer.o  $(Common_files)
	cc -o vs_tcp_tl $(CFLAGS) $(LIBS) vsTcp.o tcpServerUtility.o voteEncodingText.o lengthFramer.o  $(Common_files)

vc_tcp_tl : vcTcp.o tcpClientUtility.o voteEncodingText.o lengthFramer.o  $(Common_files)
	cc -o vc_tcp_tl $(CFLAGS) $(LIBS) vcTcp.o tcpClientUtility.o voteEncodingText.o lengthFramer.o  $(Common_files)

vs_tcp_bd : vsTcp.o tcpServerUtility.o voteEncodingBin.o delimeterFramer.o  $(Common_files)
	cc -o vs_tcp_bd $(CFLAGS) $(LIBS) vsTcp.o tcpServerUtility.o voteEncodingBin.o delimeterFramer.o  $(Common_files)

vc_tcp_bd : vcTcp.o tcpClientUtility.o voteEncodingBin.o delimeterFramer.o  $(Common_files)
	cc -o vc_tcp_bd $(CFLAGS) $(LIBS) vcTcp.o tcpClientUtility.o voteEncodingBin.o delimeterFramer.o  $(Common_files)

vs_tcp_bl : vsTcp.o tcpServerUtility.o voteEncodingBin.o lengthFramer.o  $(Common_files)
	cc -o vs_tcp_bl $(CFLAGS) $(LIBS) vsTcp.o tcpServerUtility.o voteEncodingBin.o lengthFramer.o  $(Common_files)

vc_tcp_bl : vcTcp.o tcpClientUtility.o voteEncodingBin.o lengthFramer.o  $(Common_files)
	cc -o vc_tcp_bl $(CFLAGS) $(LIBS) vcTcp.o tcpClientUtility.o voteEncodingBin.o lengthFramer.o  $(Common_files)

clean :
	rm *.o
	rm vs_tcp_* vc_tcp_*

all : vs_tcp_td vc_tcp_td vs_tcp_tl vc_tcp_tl vs_tcp_bd vc_tcp_bd vs_tcp_bl vc_tcp_bl
```





방법 1(임시방안) vcTcp.c (1)

```
1  #include <stdio.h>
2  #include <string.h>
3  #include <stdlib.h>
4  #include <stdint.h>
5  #include <unistd.h>
6  #include <errno.h>
7  #include <sys/socket.h>
8  #include <netinet/in.h>
9  #include <arpa/inet.h>
10  #include <netdb.h>
11  #include "Practical.h"
12  #include "VoteProtocol.h"
13  #include "Framer.h"
14  #include "VoteEncoding.h"
15
16  int main(int argc, char *argv[])
17  {
18        if (argc < 4 || argc > 5)  // Test for correct # of args
19              DieWithUserMessage("Parameter(s)", "<Server Address/Name> <Server Port/Service> <Candidate> [I]");
20
21        char *server = argv[1];    // First arg: server address/name
22        char *service = argv[2];   // Second arg: server port/service
23
24        int candi = atoi(argv[3]);
25        if (candi < 0 || candi > MAX_CANDIDATE)
26              DieWithUserMessage("Candidate # not valid", argv[3]);
27
28        bool inq = (argc > 4) && (strcmp(argv[4], "I") == 0);
29
```

방법 1(임시방안) vcTcp.c (2)

```
30      // Create a connected TCP socket
31      int sock = SetupTCPClientSocket(server, service);
32      if (sock < 0)
33              DieWithUserMessage("SetupTCPClientSocket() failed", "unable to connect");
34
35      FILE *str = fdopen(sock, “r+"); // Wrap for stream I/O
36      if (str == NULL)
37              DieWithSystemMessage("fdopen() failed");
38
39      // Set up info for a request
40      VoteInfo vi;
41      memset(&vi, 0, sizeof(vi));
42
43      vi.isInquiry = inq;
44      vi.candidate = candi;
45
46      // Encode for transmission
47      uint8_t outbuf[MAX_WIRE_SIZE];
48      size_t reqSize = Encode(&vi, outbuf, MAX_WIRE_SIZE);
49
50      // Print info
51      printf("Sending %d-byte %s for candidate %d...\n", reqSize,
52                      (inq ? "inquiry" : "vote"), candi);
53
54      // Frame and send
55      if (PutMsg(outbuf, reqSize, str) < 0)
56              DieWithSystemMessage("PutMsg() failed");
57
```

파일 스트림으로
Wrap 하는 과정

방법 1(임시방안) vcTcp.c (3)

```
58      // Receive and print response
59      uint8_t inbuf[MAX_WIRE_SIZE];
60      memset(&vi, 0, sizeof(vi));
61      size_t respSize = GetNextMsg(str, inbuf, MAX_WIRE_SIZE); // Get the message
62      respSize = GetNextMsg(str, inbuf, MAX_WIRE_SIZE);       // by kgu
63
64      if (Decode(inbuf, respSize, &vi)) { // Parse it
65              printf("Received: %d\n", respSize);
66              if (vi.isResponse)
67                      printf("  Response to ");
68              if (vi.islnquiry)
69                      printf("inquiry ");
70              else
71                      printf("vote ");
72
73              printf("for candidate %d\n", vi.candidate);
74              if (vi.isResponse)
75                      printf("  count = %llu\n", vi.count);
76
77      }
78
79      // Close up
80      fclose(str);
81
82      exit(0);
83  }
```

GetNextMsg를 한번 더
호출하여 이상 메시지 제거

방법 2 - 수정된 vcTcp.c (1)

```
1  #include <stdio.h>
2  #include <string.h>
3  #include <stdlib.h>
4  #include <stdint.h>
5  #include <unistd.h>
6  #include <errno.h>
7  #include <sys/socket.h>
8  #include <netinet/in.h>
9  #include <arpa/inet.h>
10  #include <netdb.h>
11  #include "Practical.h"
12  #include "VoteProtocol.h"
13  #include "Framer.h"
14  #include "VoteEncoding.h"
15
16  int main(int argc, char *argv[])
17  {
18        if (argc < 4 || argc > 5)  // Test for correct # of args
19              DieWithUserMessage("Parameter(s)", "<Server Address/Name> <Server Port/Service> <Candidate> [I]");
20
21        char *server = argv[1];    // First arg: server address/name
22        char *service = argv[2];   // Second arg: server port/service
23
24        int candi = atoi(argv[3]);
25        if (candi < 0 || candi > MAX_CANDIDATE)
26              DieWithUserMessage("Candidate # not valid", argv[3]);
27
28        bool inq = (argc > 4) && (strcmp(argv[4], "I") == 0);
29
```

방법 2 - 수정된 vcTcp.c (2)

```
30      // Create a connected TCP socket
31      int sock = SetupTCPClientSocket(server, service);
32      if (sock < 0)
33              DieWithUserMessage("SetupTCPClientSocket() failed", "unable to connect");
34
35      // Set up info for a request
36      VoteInfo vi;
37      memset(&vi, 0, sizeof(vi));
38
39      vi.islnquiry = inq;
40      vi.candidate = candi;
41
42      // Encode for transmission
43      uint8_t outbuf[MAX_WIRE_SIZE] = {0};    // by kgu
44      size_t reqSize = Encode(&vi, outbuf, MAX_WIRE_SIZE);
45
46      // Print info
47      printf("Sending %d-byte %s for candidate %d...\n", reqSize,
48              (inq ? "inquiry" : "vote"), candi);
49
50      // Frame and send
51      if (PutMsg(outbuf, reqSize, sock) < 0)
52              DieWithSystemMessage("PutMsg() failed");
53
54      // Receive and print response
55      uint8_t inbuf[MAX_WIRE_SIZE] = {0};     // by kgu
56      memset(&vi, 0, sizeof(vi));
57      size_t respSize = GetNextMsg(sock, inbuf, MAX_WIRE_SIZE); // Get the message
58
```

소켓 스트림화 과정 삭제

버퍼 초기화

PutMsg( ) 함수 세번째 인자가 socket_fd로 수정됨

버퍼 초기화

GetNextMsg( ) 함수 첫 번째 인자가 socket_fd로 수정됨

방법 2 - 수정된 vcTcp.c (3)

```
59        if (Decode(inbuf, respSize, &vi)) { // Parse it
60                printf("Received: %d\n", respSize);
61                if (vi.isResponse)
62                        printf("  Response to ");
63                if (vi.islnquiry)
64                        printf("inquiry ");
65                else
66                        printf("vote ");
67
68                printf("for candidate %d\n", vi.candidate);
69                if (vi.isResponse)
70                        printf("  count = %llu\n", vi.count);
71
72        }
73
74        // Close up
75        close(sock);
76        exit(0);
77  }
```

방법 2 - 수정된 vsTcp.c (1)

```
1  #include <stdio.h>
2  #include <string.h>
3  #include <stdbool.h>
4  #include <stdint.h>
5  #include <unistd.h>
6  #include <fcntl.h>
7  #include <errno.h>
8  #include <sys/socket.h>
9  #include <arpa/inet.h>
10  #include "Practical.h"
11  #include "VoteProtocol.h"
12  #include "VoteEncoding.h"
13  #include "Framer.h"
14
15  static uint64_t counts[MAX_CANDIDATE + 1];
16
17  int main(int argc, char *argv[])
18  {
19
20          if (argc != 2) // Test for correct number of arguments
21                  DieWithUserMessage("Parameter(s)", "<Server Port/Service>");
22
23          int servSock = SetupTCPServerSocket(argv[1]);
24                  // servSock is now ready to use to accept connections
25
26          for (;;) { // Run forever
27
28                  // Wait for a client to connect
29                  int clntSock = AcceptTCPConnection(servSock);
```

방법 2 - 수정된 vsTcp.c (2)

```
30
31          // Receive messages until connection closes
32          int mSize;
33          uint8_t inBuf[MAX_WIRE_SIZE] = {0};     // by kgu
34          VoteInfo v;
35          while ((mSize = GetNextMsg(clntSock, inBuf, MAX_WIRE_SIZE)) > 0) {
36                  memset(&v, 0, sizeof(v)); // Clear vote information
37                  printf("Received message (%d bytes)\n", mSize);
38
39                  if (Decode(inBuf, mSize, &v)) { // Parse to get VoteInfo
40                          if (!v.isResponse) { // Ignore non-requests
41                                  v.isResponse = true;
42                                  if (v.candidate >= 0 && v.candidate <= MAX_CANDIDATE) {
43                                          if (!v.isInquiry)
44                                                  counts[v.candidate] += 1;
45                                          v.count = counts[v.candidate];
46                                  } // Ignore invalid candidates
47                          }
48                          uint8_t outBuf[MAX_WIRE_SIZE] = {0};    // by kgu
49                          mSize = Encode(&v, outBuf, MAX_WIRE_SIZE);
50                          if (PutMsg(outBuf, mSize, clntSock) < 0) {
51                                  fputs("Error framing/outputting message\n", stderr);
52                                  break;
53                          } else {
54                                  printf("Processed %s for candidate %d; current count is %llu.;\n",
55                                          (v.isInquiry ? "inquiry" : "vote"), v.candidate, v.count);
56                          }
57                  }
```

버퍼 초기화

GetNextMsg( ) 함수 첫 번째 인자가 socket_fd로 수정됨

버퍼 초기화

PutMsg( ) 함수 세번째 인자가 socket_fd로 수정됨

방법 2 - 수정된 vsTcp.c (3)

```
58                      else {
59                              fputs("Parse error, closing connection.\n", stderr);
60                              break;
61                      }
62              }
63              puts("Client finished");
64              close(clntSock);
65      } // Each client
66  // NOT REACHED
```

방법 2 – 수정된 delimiterFramer.c (1)

```
1  #include <stdio.h>
2  #include <stdlib.h>
3  #include <stdint.h>
4  #include <unistd.h>
5  #include "Practical.h"
6
7  static const char DELIMITER = '\n';
8
9  /* Read up to bufSize bytes or until delimiter, copying into the given
10  * buffer as we go.
11  * Encountering EOF after some data but before delimiter results in failure.
12  * (That is: EOF is not a valid delimiter.)
13  * Returns the number of bytes placed in buf (delimiter NOT transferred).
14  * If buffer fills without encountering delimiter, negative count is returned.
15  * If stream ends before first byte, -1 is returned.
16  * Precondition: buf has room for at least bufSize bytes.
17  */
18 int GetNextMsg(int sockfd, uint8_t *buf, size_t bufSize)
19 {
20         int count = 0;
21         uint8_t nextChar;
22
23         while (count < bufSize) {
24                 read(sockfd, &nextChar, 1);
25                 if (nextChar == EOF) {
26                         if (count > 0)
27                                 DieWithUserMessage("GetNextMsg()", "Stream ended prematurely");
```

GetNextMsg( ) 함수 첫 번째 인자가 socket_fd로 수정됨

read( ) 함수 이용
첫번째 인자가 sockfd이고,
1바이트씩 읽어들임

방법 2 – 수정된 delimiterFramer.c (2)

```
28                      else
29                              return -1;
30              }
31              if (nextChar == DELIMITER)
32                      break;
33              buf[count++] = nextChar;
34      }
35
36      if (nextChar != DELIMITER) { // Out of space: count==bufSize
37              return -count;
38      } else  { // Found delimiter
39              fprintf(stderr, "GetNextMsg: %d bytes : %s\n", count, buf);
40              return count;
41      }
42 }
43
```

방법 2 – 수정된 delimiterFramer.c (3)

```
44  /* Write the given message to the output stream, followed by
45   * the delimiter.  Return number of bytes written, or -1 on failure.
46   */
47
48  int PutMsg(uint8_t buf[], size_t msgSize, int sockfd)
49  {
50
51          // Check for delimiter in message
52          int i;
53          for (i = 0; i < msgSize; i++)
54                  if (buf[i] == DELIMITER)
55                          return -1;
56          if (write(sockfd, buf, msgSize) != msgSize)
57                  return -1;
58
59          uint8_t last_ch = (uint8_t) DELIMITER;
60          write(sockfd, &last_ch, 1);
61
62          return msgSize;
63  }
```

PutMsg( ) 함수 세번째 인자가 socket_fd로 수정됨

write( ) 함수 이용
첫번째 인자가 sockfd이고,
주소와 크기만 전달됨

write( ) 함수 이용
소켓에 DELIMITER 삽입

방법 2 – 수정된 lengthFramer.c (1)

```
1  #include <stdio.h>
2  #include <stdlib.h>
3  #include <stdint.h>
4  #include <unistd.h>
5  #include <netinet/in.h>
6  #include "Practical.h"
7
8  /* Read 2-byte length and place in big-endian order.
9   * Then read the indicated number of bytes.
10  * If the input buffer is too small for the data, truncate to fit and
11  * return the negation of the *indicated* length.  Thus a negative return
12  * other than -1 indicates that the message was truncated.
13  * (Ambiguity is possible only if the caller passes an empty buffer.)
14  * Input stream is always left empty.
15  */
16 int GetNextMsg(int sockfd, uint8_t *buf, size_t bufSize)
17 {
18
19        uint16_t mSize = 0;
20        uint16_t extra = 0;
21
22        if (read(sockfd, &mSize, sizeof(uint16_t)) != sizeof(uint16_t))
23              return -1;
```

GetNextMsg( ) 함수 첫 번째 인자가 socket_fd로 수정됨

read( ) 함수 이용
첫번째 인자가 sockfd이고,
길이를 읽어 들임

방법 2 – 수정된 lengthFramer.c (2)

```
24
25          mSize = ntohs(mSize);
26
27          if (mSize > bufSize) {
28                  extra = mSize - bufSize;
29                  mSize = bufSize; // Truncate
30          }
31          if (read(sockfd, buf, sizeof(uint8_t)* mSize) != mSize) {
32                  fprintf(stderr, "Framing error: expected %d, read less\n", mSize);
33                  return -1;
34          }
35
36          if (extra > 0) { // Message was truncated
37                  uint8_t waste[BUFSIZE];
38                  read(sockfd, waste, sizeof(uint8_t) * extra); // Try to flush the channel
39                  return -(mSize + extra); // Negation of indicated size
40          } else
41                  return mSize;
42  }
```

read( ) 함수 이용
첫번째 인자가 sockfd이고,
먼저 읽은 길이만큼 를 읽어 들임

방법 2 – 수정된 lengthFramer.c (3)

```
43
44  /* Write the given message to the output stream, followed by
45   * the delimiter.  Precondition: buf[] is at least msgSize.
46   * Returns -1 on any error.
47   */
48  int PutMsg(uint8_t buf[], size_t msgSize, int sockfd)
49  {
50          if (msgSize > UINT16_MAX)
51                  return -1;
52
53          uint16_t payloadSize = htons(msgSize);
54          if ((write(sockfd, &payloadSize, sizeof(uint16_t)) != sizeof(uint16_t)) ||
55                          (write(sockfd, buf, sizeof(uint8_t)* msgSize) != sizeof(uint8_t) * msgSize))
56                  return -1;
57          return msgSize;
58  }
```

PutMsg( ) 함수 세번째 인자가 socket_fd로 수정됨

write( ) 함수 이용
첫번째 인자가 sockfd이고,
주소와 크기만 전달됨