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MIDDLE EAST TECHNICAL UNIVERSITY
ELECTRICAL ENGINEERING

EE493 ENGINEERING DESIGN 1

VEHICLES CHASING EACH OTHER PROJECT HANDSHAKE PROTOCOL REPORT

1. Introduction

This is a report about the handshake protocol between robots of the vehicles chasing each other project. In this project 2 robots race against each other and after one of them catches the other and is 5 cm away from the other both robots will stop after a handshake protocol.

Standards Committee decided that wifi internet will be used as the communication medium between robots. Moreover ad-hoc (peer-to-peer) network style will be used instead of using a server. This report describes the details of this handshake protocol.

2. TCP/IP Handshake Mechanism

Transmission Control Protocol as known as TCP Three-Way Handshake Protocol is a Transport Layer host-to-host protocol that provides reliable communication over IP networks between two endpoints. TCP provides for the recovery of segments that get lost, are damaged, duplicated or received out of order. Therefore, this protocol is also known as a secure, reliable protocol since it attempts to recover from these errors.

TCP/IP has a built in 3-way handshaking mechanism that ensures that a message is transmitted.

Every segment is labeled with a sequence number. The sequence numbers allow us to detect dropped segments. Also, by using TCP, we can be acknowledged by a message after data is transmitted. On the other hand, if a segment is dropped or damaged, TCP

verifies it via CRC (Cyclic redundancy check) on every segment that is sent or received. If segments do not match, CRC discards them.

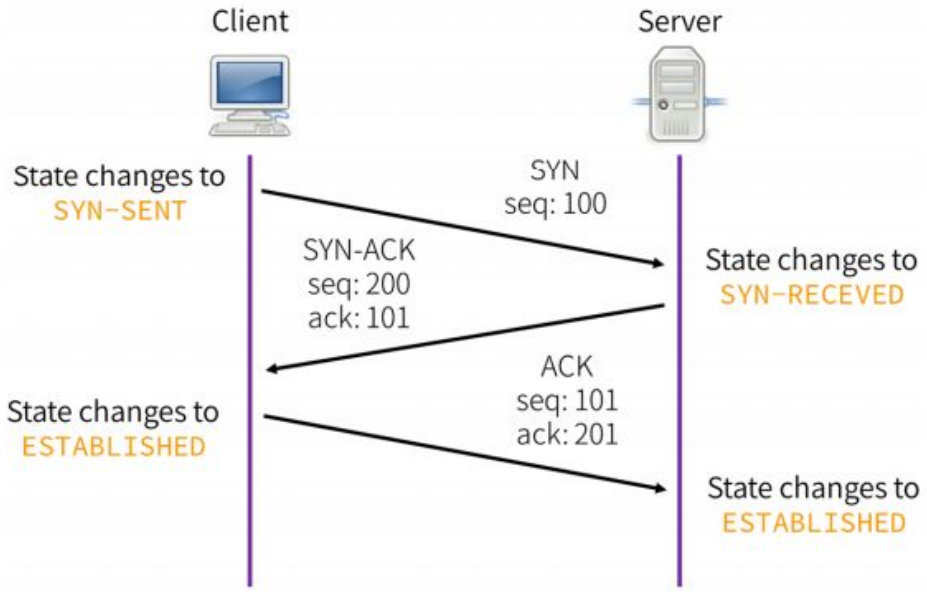

Figure 1 : TCP three-way handshake diagram

As it can be seen from Figure 1, three-way TCP handshake mechanism works like this (Hsu et al.):

1. The client sends a SYN (synchronize) packet to the server, which has a random sequence number.
2. The server sends back a SYN-ACK packet, containing a random sequence number and an ACK number acknowledging the client's sequence number.
3. The client sends an ACK number to the server, acknowledging the server's sequence number.
4. The sequence numbers on both ends are synchronized. Both ends can now send and receive data independently.

Note that the ACK number that one side sends in Figure 1 is simply obtained by adding 1 to the sequence number of the other side.

RST message is used to reset TCP .

Another figure showing steps from initialization to the end of connection is Figure 2 below.

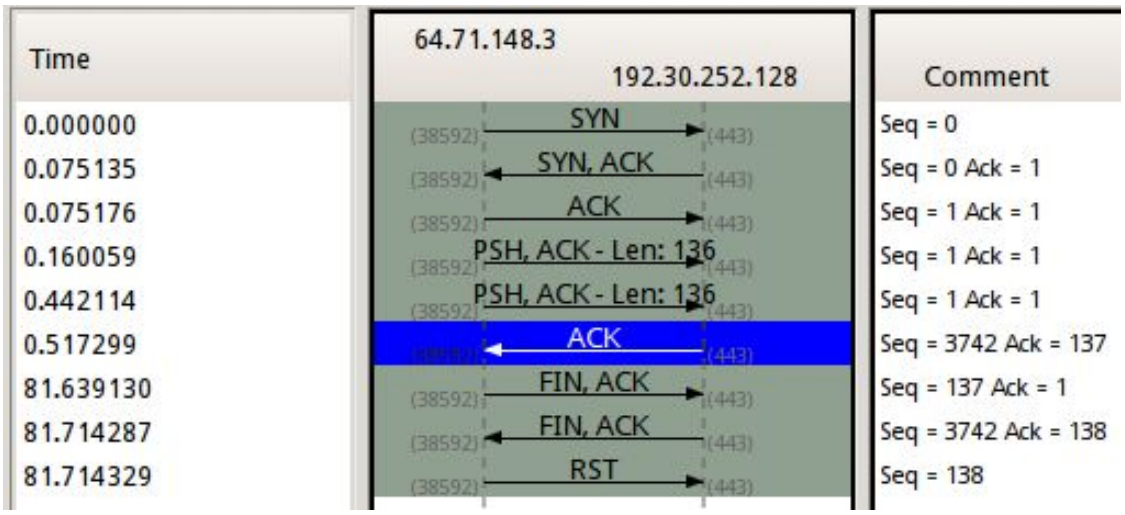

Figure 2: Initialization, data transmission and end of connection steps of TCP/IP handshake mechanism

In this project each robot should have a socket that has a port in number 5000. All data send will be done through this socket, and each robot should listen always the port in the socket.

3. The Information Containing Message

Each group should be assigned a static IP address in order for their robots to communicate with other robots. The IP numbers will be 192.168.1.ID where ‘ID’ is each groups ID number. ID number is given by sorting groups in alphabetical order and adding that order number 1. For example if a group is at 4th place when the groups are ordered alphabetically, their ID is 4+1=5, and their IP address is : 192.168.1.5 . Each of the groups and their respective IP addresses and IDs are shown in Table 1.

Group Name	ID	Static IP Address
ACME Inc.	2	192.168.1.2
Atlanta	3	192.168.1.3
Autonomous Technology	4	192.168.1.4
Blitz	5	192.168.1.5
Doston Bynamics	6	192.168.1.6
Duayenler	7	192.168.1.7
Epiphany	8	192.168.1.8
Esinti	9	192.168.1.9
Jacobian Art Project	10	192.168.1.10
Mind Wizards	11	192.168.1.11
Morpheus	12	192.168.1.12
Orbis Robotics	13	192.168.1.13
Puzzles	14	192.168.1.14
RESTIN	15	192.168.1.15
Robotz with Attitude	16	192.168.1.16
Sesca Dynamics	17	192.168.1.17
SolidVisio Softcorp	18	192.168.1.18
Startech	19	192.168.1.19
Vector Robotics	20	192.168.1.20

Table 1: Group names and their IDs and static IP addresses

It is decided that the robot sending the first message will be the one that catches the other robot. That is, the robot that is 5 cm behind the other robot will send the first message. The message consists of 4 characters, all of which are numbers, first two numbers

determine the ID number of the sender while the last two numbers determine the message of the sender.

When the first robot catches the other firstly it sends the message “ID00”, where ID is the ID number of the group that owns the robot. After receiving this message the robot at the front (who has been caught) acknowledges this by sending the message “ID01”. After receiving this acknowledgement signal the robot at the back sends the message “ID10” , which means “stop”. After sending this message the robot behind immediately stops and the robot at the front immediately stops after it received “ID10” message. If the robot at the front doesn’t acknowledge the fact that the robot behind it catches it, it has to send “ID11”. Summary of the contains of the messages are shown in Table 2.

First two characters	**Last two characters**	**Respective LED light**	**Meaning**
ID of the sender	00	Red	The sender has caught the other robot
ID of the sender	01	Green	The sender acknowledges that it has been caught
ID of the sender	10	Blue	The sender signals to stop
ID of the sender	11	Yellow	The sender does not acknowledge that it has been caught

Table 2: Content of the message and meanings with associated LED lights

4.References

Fu-Hau Hsu, Yan-Ling Hwang, Cheng-Yu Tsai, Wei-Tai Cai, Chia-Hao Lee, KaiWei Chang. (2016). TRAP: A Three-Way Handshake Server for TCP Connection Establishment.*MDPI Applied Sciences Journal*, *6*(358), 3. doi:10.3390/app6110358