SOFTENG 364: Assignment #1

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Exercise 1

I. File transfer using TCP

Run TCPserver_Exercise1.py, then run TCPclient_Exercise1.py

The received file is named received.wav

The original and received .wav file are the same. This is shown by the same size of the file, and by observation of the sounds the wav files produce.

II. Timing of the file transfer

```
D:\Courses\SOFTENG_364_Networks\Assignments\1>python TCPclient_Exercise1.py
Connection established to server localhost: 12000
File transfer complete - file name: audio.wav, saved as received.wav
start: 1588322934.6124752 end: 1588322934.615439 difference: 0.0029637813568115234
```

The start of the timing is measured just after the code to write a new file is executed.

The timer was put here because after this the data starts to be read.

The end of the timing is measured after the client has been sent no more data.

There is some inaccuracy as it takes time to execute the timing commands.

The time taken for the transfer is 2.96ms.

III. Wireshark analysis of file transfer

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Packets #1, #2, and #3 are are the TCP 3-way handshake. This is shown by the SYN flag, then the SYNACK, then the ACK flag.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	127.0.0.1	127.0.0.1	TCP	108	62774 → 12000 [SYN] Seq=0 Win=65535 Len=0 MSS=65495 WS=256 SA…
2	0.000038	127.0.0.1	127.0.0.1	TCP	108	12000 → 62774 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=6549…
3	0.000057	127.0.0.1	127.0.0.1	TCP	84	62774 → 12000 [ACK] Seq=1 Ack=1 Win=2619648 Len=0

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The shutdown packets are #276-279. These are recognised by the FINACK flags being set, and the acknowledgment packets in response to those packets.

276	0.003020	127.0.0.1	127.0.0.1	TCP	84	12000 → 62774 [FIN, ACK] Seq=139245 Ack=1 Win=2619648 Len=0
277	0.003031	127.0.0.1	127.0.0.1	TCP	84	62774 → 12000 [ACK] Seq=1 Ack=139246 Win=2611456 Len=0
278	0.003511	127.0.0.1	127.0.0.1	TCP	84	62774 → 12000 [FIN, ACK] Seq=1 Ack=139246 Win=2611456 Len=0
279	0.003525	127.0.0.1	127.0.0.1	TCP	84	12000 → 62774 [ACK] Seq=139246 Ack=2 Win=2619648 Len=0

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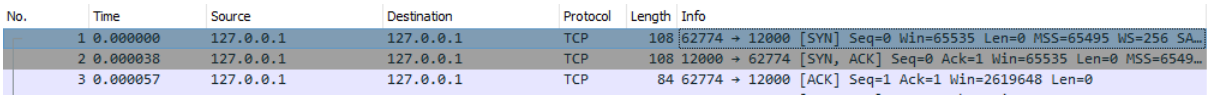
The source and destination IP addresses are both 127.0.0.1, as we are sending and receiving on localhost.



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	127.0.0.1	127.0.0.1	TCP	108	62774 → 12000 [SYN] Seq=0 Win=65535 Len=0 MSS=65495 WS=256 SA…
2	0.000038	127.0.0.1	127.0.0.1	TCP	108	12000 → 62774 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=6549…
3	0.000057	127.0.0.1	127.0.0.1	TCP	84	62774 → 12000 [ACK] Seq=1 Ack=1 Win=2619648 Len=0

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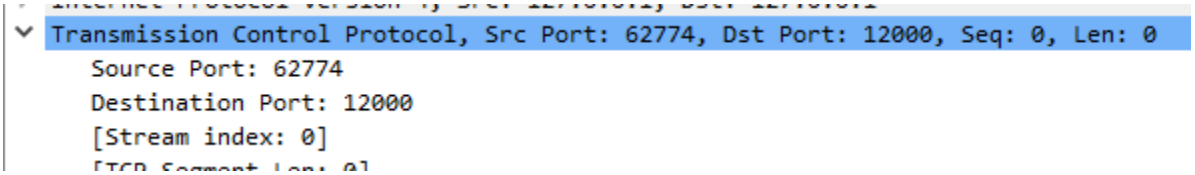
The source port is 62774 and the destination port is 12000 (as specified in the python file).



```
Transmission Control Protocol, Src Port: 62774, Dst Port: 12000, Seq: 0, Len: 0
    Source Port: 62774
    Destination Port: 12000
    [Stream index: 0]
```

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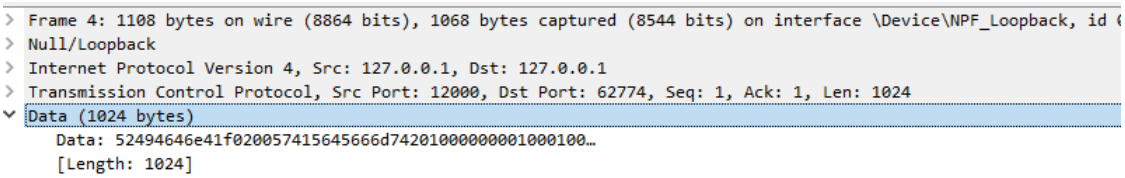
The file transfer started with packet #4, the first to contain data.



```
Frame 4: 1108 bytes on wire (8864 bits), 1068 bytes captured (8544 bits) on interface \Device\NPF_Loopback, id
Null/Loopback
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
Transmission Control Protocol, Src Port: 12000, Dst Port: 62774, Seq: 1, Ack: 1, Len: 1024
Data (1024 bytes)
    Data: 52494646e41f020057415645666d74201000000001000100…
    [Length: 1024]
```

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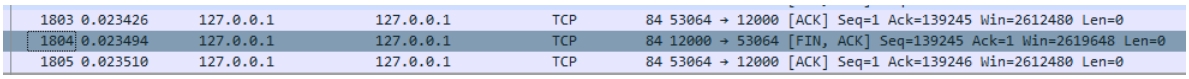
The file transfer ended on packet #1804, with a the FIN and ACK flags set.



1803	0.023426	127.0.0.1	127.0.0.1	TCP	84	53064 → 12000 [ACK] Seq=1 Ack=139245 Win=2612480 Len=0
1804	0.023494	127.0.0.1	127.0.0.1	TCP	84	12000 → 53064 [FIN, ACK] Seq=139245 Ack=1 Win=2619648 Len=0
1805	0.023510	127.0.0.1	127.0.0.1	TCP	84	53064 → 12000 [ACK] Seq=1 Ack=139246 Win=2612480 Len=0

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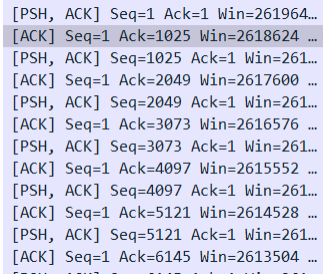
Discuss the file transfer process

First, the connection was set up using a TCP 3-way handshake. Then, as per the configuration, chunks of 1024 bytes were sent by the server to the client.

The first sequence number with data was 1. The client acknowledges this data by sending and ACK packet with ACK number of 1025, which is the sum of the sequence number and the size of the data. This process

continues, with the relative sequence number staying at 1, and the acknowledgement number increasing by 1024 each time a packet is received.



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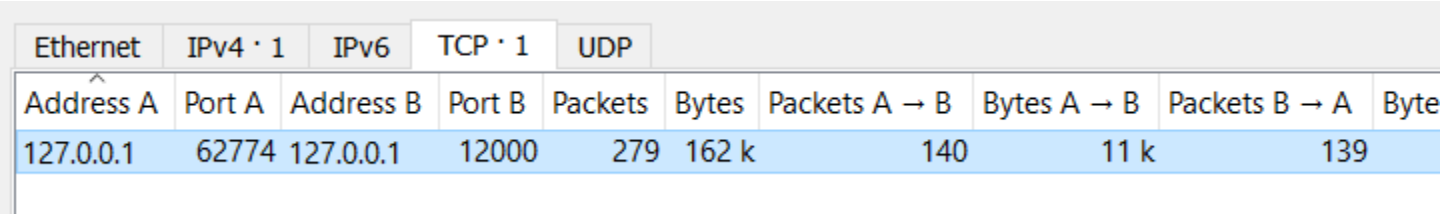
According to WireShark, the amount of time the file transfer took was 3.5ms. This is larger than the calculated time in part 2, as it did not include the setup and tear down time. From this we can deduce setup and tear down took approximately 0.5ms.



Exercise 2

1. Analysis of Interaction with the MaryTTS server in Auckland.

The last packet is assumed to be the HTTP OK response. If this is not present, then the last TCP packet where the packets are reassembled is assumed to be the last packet#

2. Analysis of the MaryTTS server based in Germany

3. Comparison of the two MaryTTS systems from a networks perspective

The first eight packets are the same, which facilitate the set up of the website. The first HTTP GET request retrieves the HTML file for the web page. After retrieving this information, both websites retrieve files referenced in the web page, which are: mary.js, an icon for the tab, voice list, input and output options, audio output file-types, audio effects and their default values, and the logo icon displayed on the web page.

The port numbers that MARYNZ utilizes are: 58626, 58627, 58628, 58630, 58631, 58632, 58633, and 58634.

The port numbers that MARYDE utilizes are: 56529, 56530, 56531, 56532, 56827, 56829, 56830, and 56830.

Table 1: HTTP GET requests to UoA MaryTTS Server

Starting time	GET Packet#	Ending time	Last Packet#	Source port#	Dest port#	Description
9.020712	73	9.026077	75	58626	59125	Retrieve HTML file for web page
9.056283	88	9.060862	93	58627	59125	Retrieve mary.js file needed for web page
9.064732	108	9.069526	122	58628	59125	Retrieve icon for tab title
9.153521	147	9.159704	160	58630	59125	Retrieve voices list
9.155872	154	9.161205	165	58631	59125	Retrieve input/output options
9.155895	155	9.161624	170	58632	59125	Retrieve audio output file-types
9.156218	156	9.163576	173	58633	59125	Retrieve audio effects and their default values
9.160807	163	9.166295	177	58634	59125	Retrieve icon for logo
9.170574	187	9.191741	191	58631	59125	Change voice to sh_neu-hsmm
9.171599	190	9.191840	193	58633	59125	Get default input text for NZ English
16.498194	237	16.524372	240	58633	59125	Get default input text for US English
16.499392	238	16.524310	239	58631	59125	Change voice to cmu-slt-hsmm
18.961087	255	19.626276	606	58633	59125	Passing arguments to website to generate audio file
27.033301	653	27.100822	659	58633	59125	Change voice to sh_neu-hsmm
27.033314	654	27.100695	656	58631	59125	Get default input text for NZ English
28.878285	667	29.417301	859	58631	59125	Passing arguments to website to generate audio file
36.386060	900	36.393621	904	58631	59125	Get default input text for Maori
36.386308	901	36.393561	903	58633	59125	Change voice to akl_mi_pk_voice1-hsmm
40.185856	950	40.321462	1023	58631	59125	Passing arguments to website to generate audio file

Table 2: HTTP GET requests to MaryTTS Server

Starting time	GET Packet#	Ending time	Last Packet#	Source port#	Dest port#	Description
0.602807	3	0.879162	16	56530	59125	Retrieve HTML file for web page
0.914332	19	1.464286	55	56532	59125	Retrieve mary.js file needed for web page
0.914730	20	1.190484	41	56529	59125	Retrieve icon for tab
1.509861	61	1.784339	74	56531	59125	Retrieve voices list
1.782997	69	2.057822	86	56827	59125	Retrieve input/output options
1.783909	73	2.059000	89	56830	59125	Retrieve audio output file-types
1.785124	78	2.060645	102	56829	59125	Retrieve audio effects and their default values
1.785212	79	2.059691	98	56531	59125	Retrieve icon for logo
2.066442	105	2.341127	112	56829	59125	Get default input text for French
2.067146	106	2.339862	110	56830	59125	Change voice to upmc-pierre-hsmm
18.839862	233	19.115119	245	56829	59125	Get default input text for British English
18.840093	234	19.113948	243	56830	59125	Change voice to dfki-spike-hsmm
35.612788	403	36.623951	487	56829	59125	Passing arguments to website to generate audio file
51.590572	564	51.865692	570	56829	59125	Get default input text for US English
51.590995	565	51.864715	568	56830	59125	Change voice to cmu-slt-hsmm
62.117288	695	63.939109	960	56829	59125	Passing arguments to website to generate audio file
73.296216	1038	73.571083	1042	56829	59125	Get default input text for German
73.296669	1039	73.570419	1040	56830	59125	Change voice to bits4
83.536958	1102	84.470687	1176	56829	59125	Passing arguments to website to generate audio file

As each unique port number used corresponds to a process, the number of processes for both MARYNZ and MARYDE are eight.

Another similarity between MARYNZ and MARYDE are the number of "GETs", which are both nineteen.

A major difference between these two systems are the download times for the "cmu-slt-hsmm en_US fem" text. MARYNZ took 0.665189 seconds, while MARYDE 1.821821 seconds. As the MARYNZ server is located in New Zealand, which is closer to the host than the MARYDE server, the propogation time for messages is lower.

The number of packets in the "GET" statements that precedes the streaming of the audio files is consistent for all audio files, at two packets.

However, the number of packets in the streamed audio files does differ between the two systems. MARYNZ has an average of 92 packets (from 175, 74, 28) and MARYDE has an average of 97 packets (62, 171, 60). This difference may be due to differences in the amount of text needed to be synthesized, as the voices and input text are not always the same.

The time to download text spoken by "sh_eu-hsmm en_NZ male Hmm" was 0.539016 seconds compared to 0.135606 seconds for the "akl_mi_pk_voice1-hsmm mi male hmm" and 0.665189 seconds for "cmu-slt-hsmm en_US fem". The reason why akl_mi_pk has a low time is probably due to the input text being quite short "Haere Mai" versus "Welcome to the world of speech synthesis" for the other two voices. The difference in timing between "sh_eu-hsmm" and "cmu-slt-hsmm" may be due to queuing, or processing time for these different voices.

4. Traceroute to MaryNZ and MaryDE

```
C:\WINDOWS\System32>tracert 130.216.236.122

Tracing route to engresdev09.its.auckland.ac.nz [130.216.236.122]
over a maximum of 30 hops:

  1     1 ms     1 ms     1 ms  NF18ACV.Home [192.168.1.1]
  2     4 ms     3 ms     3 ms  default-rdns.vocus.co.nz [60.234.8.50]
  3     4 ms     4 ms     4 ms  default-rdns.vocus.co.nz [101.98.5.32]
  4     3 ms     4 ms     3 ms  default-rdns.vocus.co.nz [101.98.5.33]
  5     5 ms     4 ms     4 ms  210.7.39.177
  6     5 ms     4 ms     4 ms  210.7.39.178
  7     *        *        *     Request timed out.
  8     *        *        *     Request timed out.
  9     *        *        *     Request timed out.
 10     *        *        *     Request timed out.
 11     *        *        *     Request timed out.
 12     *        *        *     Request timed out.
 13     *        *        *     Request timed out.
 14     *        *        *     Request timed out.
 15     *        *        *     Request timed out.
 16     *        *        *     Request timed out.
 17     *        *        *     Request timed out.
 18     *        *        *     Request timed out.
 19     *        *        *     Request timed out.
 20     *        *        *     Request timed out.
 21     *        *        *     Request timed out.
 22     *        *        *     Request timed out.
 23     *        *        *     Request timed out.
 24     *        *        *     Request timed out.
 25     *        *        *     Request timed out.
 26     *        *        *     Request timed out.
 27     *        *        *     Request timed out.
 28     *        *        *     Request timed out.
 29     *        *        *     Request timed out.
 30     *        *        *     Request timed out.
```

Figure 1: Traceroute to MaryNZ, 130.216.236.122

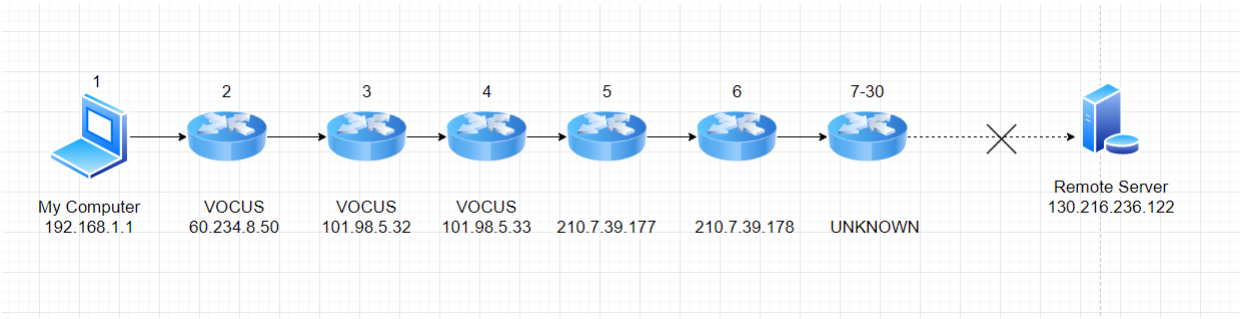


Figure 2: Route diagram for MaryNZ

```
C:\WINDOWS\System32>tracert 134.96.190.208

Tracing route to lnv-90208.sb.dfki.de [134.96.190.208]
over a maximum of 30 hops:

  1     1 ms     1 ms     1 ms  NF18ACV.Home [192.168.1.1]
  2     4 ms     3 ms     4 ms  default-rdns.vocus.co.nz [60.234.8.50]
  3     4 ms     4 ms     4 ms  ae8-20.cpcak-mdr-r1.vocus.co.nz [101.98.5.23]
  4     4 ms     3 ms     3 ms  ae9-20.cpcak-mdr-r1.vocus.co.nz [101.98.5.22]
  5     6 ms     4 ms     4 ms  BE-101.bdr02.akl05.akl.VOCUS.net.nz [175.45.102.233]
  6   129 ms   129 ms   129 ms  be10.cor01.akl05.akl.nz.vocus.network [114.31.202.100]
  7   128 ms   128 ms   128 ms  be200.cor02.lax01.ca.us.vocus.network [114.31.202.47]
  8   128 ms   133 ms   128 ms  bundle-102.bdr02.lax01.ca.vocus.net [49.255.255.15]
  9   129 ms   148 ms   128 ms  v123.core1.lax2.he.net [64.62.151.125]
 10   128 ms   129 ms   128 ms  100ge2-2.core1.lax1.he.net [72.52.92.121]
 11   182 ms   183 ms   183 ms  100ge12-1.core1.ash1.he.net [184.105.80.201]
 12   188 ms   188 ms   187 ms  100ge1-1.core1.nyc4.he.net [184.105.223.166]
 13   254 ms   254 ms   254 ms  100ge16-2.core1.lon2.he.net [72.52.92.165]
 14   261 ms   260 ms   261 ms  100ge6-2.core1.ams1.he.net [72.52.92.214]
 15   263 ms   264 ms   263 ms  10ge8-1.core1.dus1.he.net [184.105.80.126]
 16     *        *        *     Request timed out.
 17   273 ms   283 ms   273 ms  kr-saa12-0.x-win.dfn.de [188.1.241.186]
 18     *        *        *     Request timed out.
 19     *        *        *     Request timed out.
 20     *        *        *     Request timed out.
 21     *        *        *     Request timed out.
 22     *        *        *     Request timed out.
 23     *        *        *     Request timed out.
 24     *        *        *     Request timed out.
 25     *        *        *     Request timed out.
 26     *        *        *     Request timed out.
 27     *        *        *     Request timed out.
 28     *        *        *     Request timed out.
 29     *        *        *     Request timed out.
 30     *        *        *     Request timed out.

Trace complete.
```

Figure 3: Traceroute to MaryDE, 134.96.190.208

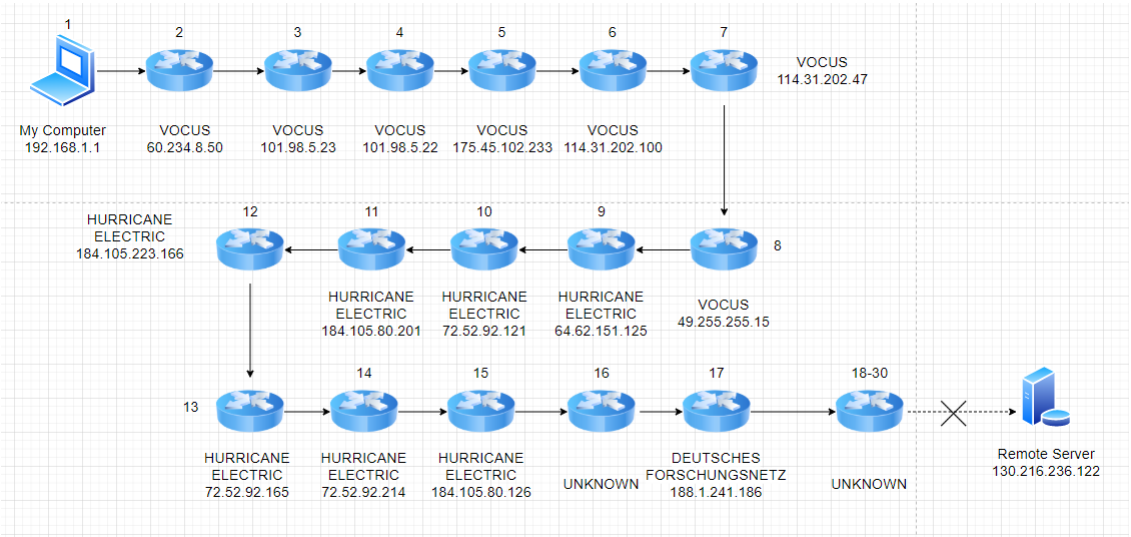


Figure 4: Route Diagram to MaryDE