


1.)



[Local Demos](#) [Documentation](#) [Github Support](#) [Easyrtc.com](#)

## EasyRTC Demo: Instant Messaging

This application demonstrates text messaging using the `easyrtc.sendDataWS` method. It should connect to the server upon start up, and display buttons for the other peers running the same application.

To use it, enter a message into the text box on the left side of the page. Then press one of the buttons for another peer to send the message to that peer. The message should appear on the text box to the right on both this page, and that of the peer.

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### The Demo

I am TkVDsD9TCiRrEDG7

Send to TtIOB2srmoSQMBUx

Received Messages:

**Me:** Ovo saljem s PC-a  
**TtIOB2srmoSQMBUx:** Ovo saljem s mobitela  
**Me:** BOK ja sam PC  
**TtIOB2srmoSQMBUx:** BOK ja sam mobitel

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### The Code

Adapter for loopback traffic capture

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
182	34.784330	:::1	:::1	WebSocket	88	WebSocket Text [FIN]
184	40.259501	:::1	:::1	WebSocket	125	WebSocket Text [FIN] [MASKED]
186	40.261288	:::1	:::1	WebSocket	88	WebSocket Text [FIN]
188	45.982675	:::1	:::1	WebSocket	273	WebSocket Text [FIN]
190	45.984743	:::1	:::1	WebSocket	92	WebSocket Text [FIN] [MASKED]
198	50.228158	:::1	:::1	WebSocket	71	WebSocket Text [FIN] [MASKED]
200	50.228401	:::1	:::1	WebSocket	67	WebSocket Text [FIN]
206	53.140702	:::1	:::1	WebSocket	172	WebSocket Text [FIN] [MASKED]
208	53.144796	:::1	:::1	WebSocket	88	WebSocket Text [FIN]
212	60.271353	:::1	:::1	WebSocket	125	WebSocket Text [FIN] [MASKED]
214	60.272445	:::1	:::1	WebSocket	88	WebSocket Text [FIN]
216	72.732179	:::1	:::1	WebSocket	270	WebSocket Text [FIN]
218	72.732919	:::1	:::1	WebSocket	92	WebSocket Text [FIN] [MASKED]

> Frame 188: 273 bytes on wire (2184 bits), 273 bytes captured (2184 bits) on interface \Device\NPF\_{Loopback, id 0

> Null/Loopback

> Internet Protocol Version 6, Src: :::1, Dst: :::1

> Transmission Control Protocol, Src Port: 8080, Dst Port: 24070, Seq: 960, Ack: 936, Len: 209

> WebSocket

> Line-based text data (1 lines)

423["easyrtcMsg",{"senderEasyrtcId":"TtIOB2srmoSQMBUx","targetEasyrtcId":"TkVDsD9TCiRrEDG7","msgType":"message","msgData":"Ovo saljem s mobitela"]

0000 18 00 00 00 60 0a 0d cf 00 e5 06 80 00 00 00 00

wireshark\_NPF\_Loopback1B31E1.pcapng

Packets: 233 · Displayed: 233 (100.0%) · Dropped: 0 (0.0%) · Profile: Default

No.	Time	Source	Destination	Protocol	Length	Info
2963	16.306587	192.168.88.254	192.168.88.211	TCP	54	8080 → 43984 [FIN, ACK] Seq=35205 Ack=2374 Win=262144 Len=0
2993	17.232748	192.168.88.254	192.168.88.211	TCP	54	8080 → 43992 [FIN, ACK] Seq=73385 Ack=3331 Win=261376 Len=0
2994	17.232898	192.168.88.254	192.168.88.211	TCP	54	8080 → 43990 [FIN, ACK] Seq=93516 Ack=3796 Win=262144 Len=0
4263	31.404800	192.168.88.254	192.168.88.211	Websocket	78	Websocket Text [FIN]
4723	36.324483	192.168.88.254	192.168.88.211	Websocket	57	Websocket Text [FIN]
4777	37.113732	192.168.88.254	192.168.88.211	Websocket	259	Websocket Text [FIN]
4781	37.279480	192.168.88.254	192.168.88.211	TCP	54	8080 → 43998 [ACK] Seq=705 Ack=750 Win=261888 Len=0
5924	48.312560	192.168.88.254	192.168.88.211	Websocket	78	Websocket Text [FIN]
6598	51.405327	192.168.88.254	192.168.88.211	Websocket	78	Websocket Text [FIN]
6777	55.474307	192.168.88.254	192.168.88.211	Websocket	255	Websocket Text [FIN]
6781	55.588953	192.168.88.254	192.168.88.211	TCP	54	8080 → 43998 [ACK] Seq=954 Ack=955 Win=261632 Len=0
7738	61.335344	192.168.88.254	192.168.88.211	Websocket	57	Websocket Text [FIN]
8837	71.405873	192.168.88.254	192.168.88.211	Websocket	78	Websocket Text [FIN]

Frame 4777: 259 bytes on wire (2072 bits), 259 bytes captured (2072 bits) on interface \Device\NPF\_{AF421829-40C2-4298-B901-53E74671E1F2}, id 0  
 Ethernet II, Src: QuantaCo\_f7:d3:d6 (2c:60:0c:f7:d3:d6), Dst: AudioPre\_d9:60:07 (00:12:1a:d9:60:07)  
 Internet Protocol Version 4, Src: 192.168.88.254, Dst: 192.168.88.211  
 Transmission Control Protocol, Src Port: 8080, Dst Port: 43998, Seq: 500, Ack: 722, Len: 205  
 Websocket  
 Line-based text data (1 lines)  
 422[{"easyrtcid":"TkVDsD9TCIRrEDG7","targetEasyrtcid":"Tt1OB2srmoSQMBUx","msgType":"message","msgData":"Ovo saljem s PC-a","easyrtcid":"Tt1OB2srmoSQMBUx","ser

a)

Komunikacija se vrši između mobitela i PC-a, tj. entiteta označenih sa TkVDsD9TCIRrEDG7 i Tt1OB2srmoSQMBUx, ali poruke idu preko (nodejs) servera koji se isto nalazi na PC-u. Zato se TCP veza uspostavlja između mobitela i servera, te između PC-a (tj. browsera) i servera.

PC –  
192.168.88.254

Mobitel –  
192.168.88.211

Server (na PC-u) –  
192.168.88.254

b)

Kao što se vidi u slikama priloženima gore, koristi se protokol Websocket za komunikaciju, kojim se onda šalju poruke (nakon što se inicijalno učitao HTML). Naravno ispod njega se koristi TCP, IPv4, te dalje ovisno o korištenoj tehnologiji Ethernet i WiFi.

c)

Klijenti komuniciraju preko poslužitelja. To se može vidjeti i na gore priloženim slikama, jer svaka npr. odlazna poruka sa mobitela odlazi na IP 192.168.88.254:8080, te se onda sa tog porta poruka dalje pošalje na već neki proizvoljni port koji je otvorio browser. Isto je i obrnuto, browser šalje sa svojeg proizvoljnog porta na loopback IP adresu na port 8080, a onda se sa 192.168.88.254:8080 šalje poruka na mobitel na IP 92.168.88.211.

d)

Slike su priložene gore. U jednom wireshark prozoru možemo vidjeti poruku koju server šalje na browser preko loopback IP adrese, dok na drugom koju server šalje mobitelu.

2.)

a)

WebRTC internals je jedan od predefiniranih stranica (kod mene u chrome-u) gdje su ispisane sve statistike trenutnih pokrenutih WebRTC instanci, tj. sesija.

b)

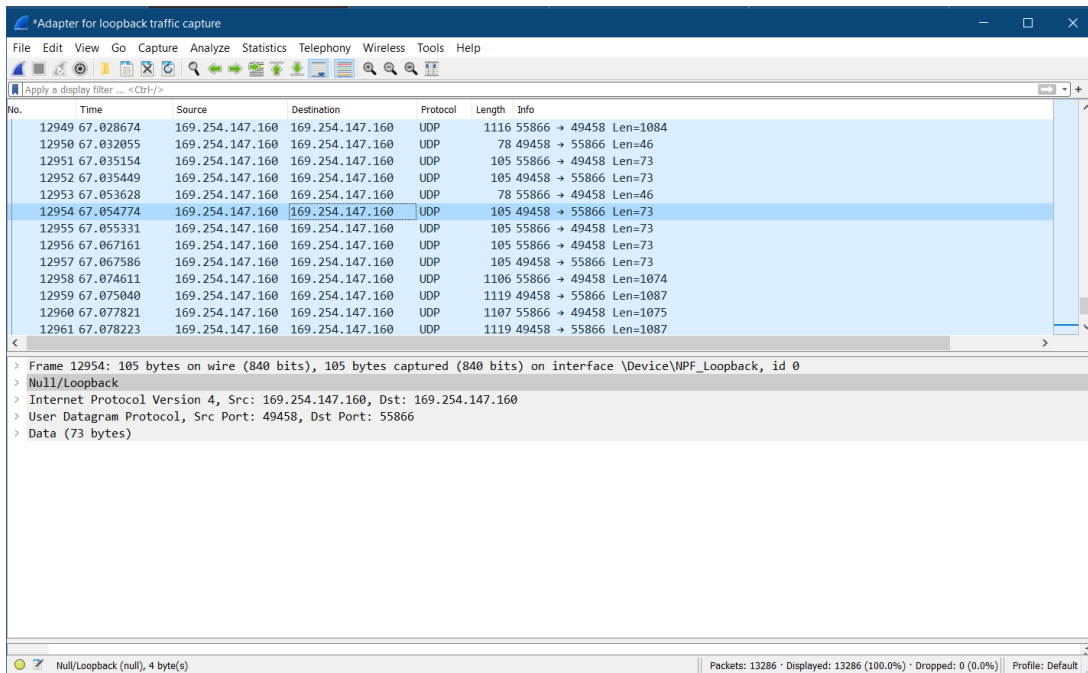
Statistics RTCInboundRTPAudioStream_1413389400	
timestamp	21. 12. 2021. 14:46:29
ssrc	1413389400
kind	audio
trackId	RTCMediaStreamTrack_receiver_1
transportId	RTCTransport_0_1
codecId	RTCCodec_0_Inbound_111
[codec]	opus (111, minptime=10;useinbandfec=1)
mediaType	audio
jitter	0
packetsLost	0
packetsDiscarded	0
packetsReceived	23273
[packetsReceived/s]	50.05005836363684
fecPacketsReceived	0
fecPacketsDiscarded	0
bytesReceived	816807
[bytesReceived_in_bits/s]	14014.016341818315
headerBytesReceived	651644
[headerBytesReceived_in_bits/s]	11211.212072454652

## ▼ RTCInboundRTPVideoStream\_2089870811 (inbound-rtp)

## Statistics RTCInboundRTPVideoStream\_2089870811

timestamp	21. 12. 2021. 14:45:40
ssrc	2089870811
kind	video
trackId	RTCMediaStreamTrack_receiver_2
transportId	RTCTransport_0_1
codecId	RTCCodec_1_Inbound_96
<u>[codec]</u>	<u>VP8 (96)</u>
mediaType	video
jitter	0.018
packetsLost	0
packetsReceived	36535
[packetsReceived/s]	90.361462741345
bytesReceived	37897243
[bytesReceived_in_bits/s]	746329.4573333595
headerBytesReceived	902620
[headerBytesReceived_in_bits/s]	17863.457167711225
lastPacketReceivedTimestamp	1640094340434
[lastPacketReceivedTimestamp]	21. 12. 2021. 14:45:40
jitterBufferDelay	224.371
[jitterBufferDelay/jitterBufferEmittedCount_in_ms]	61.000000000001364
jitterBufferEmittedCount	4175
framesReceived	4176
[framesReceived/s]	10.040162526816111
[framesReceived-framesDecoded]	0
<u>frameWidth</u>	<u>640</u>
<u>frameHeight</u>	<u>480</u>
<u>framesPerSecond</u>	<u>10</u>
framesDecoded	4176
[framesDecoded/s]	10.040162526816111

c)



No.	Time	Source	Destination	Protocol	Length	Info
12949	67.028674	169.254.147.160	169.254.147.160	UDP	1116	55866 → 49458 Len=1084
12950	67.032055	169.254.147.160	169.254.147.160	UDP	78	49458 → 55866 Len=46
12951	67.035154	169.254.147.160	169.254.147.160	UDP	105	55866 → 49458 Len=73
12952	67.035449	169.254.147.160	169.254.147.160	UDP	105	49458 → 55866 Len=73
12953	67.053628	169.254.147.160	169.254.147.160	UDP	78	55866 → 49458 Len=46
12954	67.054774	169.254.147.160	169.254.147.160	UDP	105	49458 → 55866 Len=73
12955	67.055331	169.254.147.160	169.254.147.160	UDP	105	55866 → 49458 Len=73
12956	67.067161	169.254.147.160	169.254.147.160	UDP	105	55866 → 49458 Len=73
12957	67.067586	169.254.147.160	169.254.147.160	UDP	105	49458 → 55866 Len=73
12958	67.074611	169.254.147.160	169.254.147.160	UDP	1106	55866 → 49458 Len=1074
12959	67.075040	169.254.147.160	169.254.147.160	UDP	1119	49458 → 55866 Len=1087
12960	67.077821	169.254.147.160	169.254.147.160	UDP	1107	55866 → 49458 Len=1075
12961	67.078223	169.254.147.160	169.254.147.160	UDP	1119	49458 → 55866 Len=1087

Frame 12954: 105 bytes on wire (840 bits), 105 bytes captured (840 bits) on interface \Device\NPF\_{Loopback, id 0}

Null/Loopback

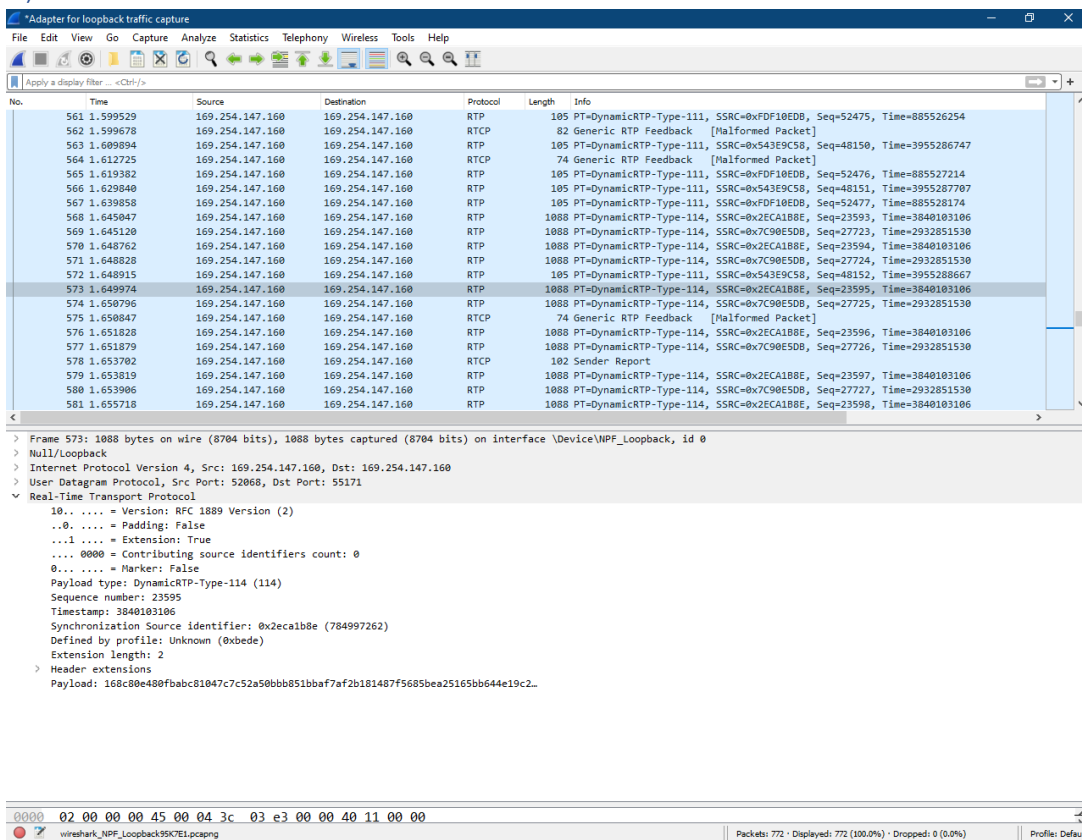
Internet Protocol Version 4, Src: 169.254.147.160, Dst: 169.254.147.160

User Datagram Protocol, Src Port: 49458, Dst Port: 55866

Data (73 bytes)

Kao što se može vidjeti na slici, koristi se UDP transportni protokol za prijenos audio i video struja. No u 'višem' sloju se koriste RTP i RTCP.

d)



No.	Time	Source	Destination	Protocol	Length	Info
561	1.599529	169.254.147.160	169.254.147.160	RTP	105	PT=DynamicRTP-Type-111, SSRC=0x7C90E50B, Seq=52475, Time=885526254
562	1.599678	169.254.147.160	169.254.147.160	RTCP	82	Generic RTP Feedback [Malformed Packet]
563	1.609994	169.254.147.160	169.254.147.160	RTP	105	PT=DynamicRTP-Type-111, SSRC=0x543E9C58, Seq=48150, Time=3955286747
564	1.612725	169.254.147.160	169.254.147.160	RTCP	74	Generic RTP Feedback [Malformed Packet]
565	1.619382	169.254.147.160	169.254.147.160	RTP	105	PT=DynamicRTP-Type-111, SSRC=0x7C90E50B, Seq=52476, Time=885527214
566	1.629040	169.254.147.160	169.254.147.160	RTP	105	PT=DynamicRTP-Type-111, SSRC=0x543E9C58, Seq=48151, Time=3955287707
567	1.639858	169.254.147.160	169.254.147.160	RTP	105	PT=DynamicRTP-Type-111, SSRC=0x7C90E50B, Seq=52477, Time=885528174
568	1.645047	169.254.147.160	169.254.147.160	RTP	1088	PT=DynamicRTP-Type-114, SSRC=0x2ECA1B8E, Seq=23593, Time=3840103106
569	1.645120	169.254.147.160	169.254.147.160	RTP	1088	PT=DynamicRTP-Type-114, SSRC=0x7C90E50B, Seq=27723, Time=2932851530
570	1.648762	169.254.147.160	169.254.147.160	RTP	1088	PT=DynamicRTP-Type-114, SSRC=0x2ECA1B8E, Seq=23594, Time=3840103106
571	1.648828	169.254.147.160	169.254.147.160	RTP	1088	PT=DynamicRTP-Type-114, SSRC=0x7C90E50B, Seq=27724, Time=2932851530
572	1.648915	169.254.147.160	169.254.147.160	RTP	105	PT=DynamicRTP-Type-111, SSRC=0x543E9C58, Seq=48152, Time=3955288667
573	1.649974	169.254.147.160	169.254.147.160	RTP	1088	PT=DynamicRTP-Type-114, SSRC=0x2ECA1B8E, Seq=23595, Time=3840103106
574	1.650796	169.254.147.160	169.254.147.160	RTP	1088	PT=DynamicRTP-Type-114, SSRC=0x7C90E50B, Seq=27725, Time=2932851530
575	1.650847	169.254.147.160	169.254.147.160	RTCP	74	Generic RTP Feedback [Malformed Packet]
576	1.651028	169.254.147.160	169.254.147.160	RTP	1088	PT=DynamicRTP-Type-114, SSRC=0x2ECA1B8E, Seq=23596, Time=3840103106
577	1.651879	169.254.147.160	169.254.147.160	RTP	1088	PT=DynamicRTP-Type-114, SSRC=0x7C90E50B, Seq=27726, Time=2932851530
578	1.653702	169.254.147.160	169.254.147.160	RTCP	102	Sender Report
579	1.653819	169.254.147.160	169.254.147.160	RTP	1088	PT=DynamicRTP-Type-114, SSRC=0x2ECA1B8E, Seq=23597, Time=3840103106
580	1.653906	169.254.147.160	169.254.147.160	RTP	1088	PT=DynamicRTP-Type-114, SSRC=0x7C90E50B, Seq=27727, Time=2932851530
581	1.655718	169.254.147.160	169.254.147.160	RTP	1088	PT=DynamicRTP-Type-114, SSRC=0x2ECA1B8E, Seq=23598, Time=3840103106

Frame 573: 1088 bytes on wire (8704 bits), 1088 bytes captured (8704 bits) on interface \Device\NPF\_{Loopback, id 0}

Null/Loopback

Internet Protocol Version 4, Src: 169.254.147.160, Dst: 169.254.147.160

User Datagram Protocol, Src Port: 52068, Dst Port: 55171

Real-Time Transport Protocol

10... .. = Version: RFC 1889 Version (2)

.. .. = Padding: False

...1 ... = Extension: True

... .. = Contributing source identifiers count: 0

0... .. = Marker: False

Payload type: DynamicRTP-Type-114 (114)

Sequence number: 23595

Timestamp: 3840103106

Synchronization Source identifier: 0x2ecab8e (784997262)

Defined by profile: Unknown (0xbede)

Extension length: 2

Header extensions

Payload: 168c80e480fbabc81047c7c52a58bb851bbaf7a72b181487f5685bea25165bb644e19c2..

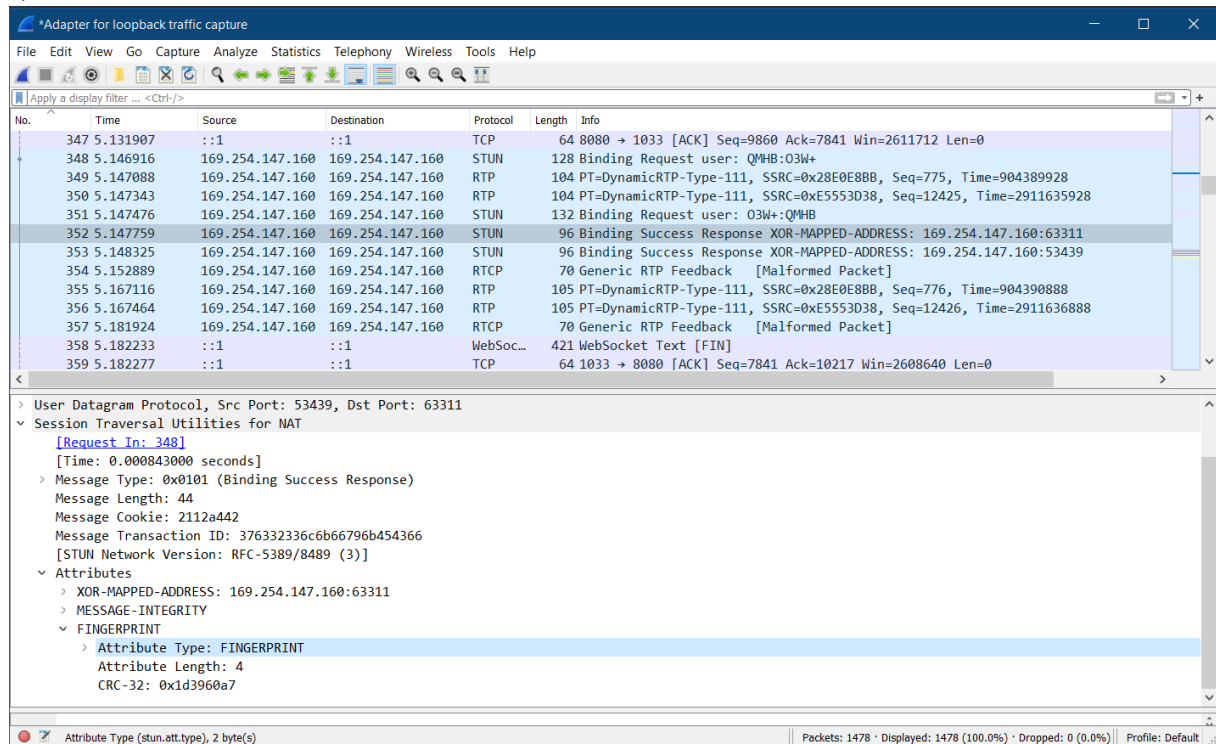
RTP je protokol dizajniran za konzistentni prijenos (najčešće real-time zvukovnih i video) podataka preko IP mreža. RTCP je kontrolni protokol koji koegzistira sa RTP-om te nadzire

kvalitetu usluge i prenosi podatke o sudionicima i raznim parametrima u trenutno pokrenutoj RTP sesiji.

e)

Kao što se može vidjeti iz prethodne slike, ovaj put se podaci ne prenose posredstvom EasyRTC poslužitelja, nego direktno između spojenih entiteta. To se vidi po tome da niti izvorišni niti odredišni port u prijenosu podataka nije 8080 (već su portovi **52068** i **55171**)

f)



Jeidni protokol koji se u ovom slučaju može uočiti (barem koje sam ja uočio) jest STUN. On služi kako bi host (tj. u našem slučaju entitet koji pokreće WebRTC) otkrio nalazi li se iza NAT-a na način da kontaktira nekog predefiniranog poslužitelja koji se nalazi na javnoj IP adresi i pošalje mu upit s koje IP adrese i porta je došao taj upit. Host zna IP adresu koja je dodijeljena njegovom interface-u, te ukoliko se razlikuje od one koje vrati STUN poslužitelj, znači da je host iza NAT-a. Time se ujedno i otkrije javna IP adresa i port. Na slici iznad se može vidjeti slijed razmijenjenih paketa gdje oba browser tab-a pitaju za svoju IP adresu i port, te dobe odgovore.