

# Dokumentácia k prvému zadaniu MTAA

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## Implementácia a knižnice:

Pri riešení bol použitý programovací jazyk Python 2.

Celý kód telefónnej ústredne bol stiahnutý z [GitHub - tirfil/PySipFullProxy: Basic Sip Proxy written in Python \(All requests and responses go through proxy\)](#) konkrétne súbor “sipfullproxy.py”.

Knižnice som použil tie ktoré boli v “sipfullproxy.py” teda SocketServer, re, string, socket, sys, time, logging a datetime.

## Funkcionality a ich implementácia:

Základné a niektoré iné funkcionality (registrácia, prijatie, hlasový hovor, skončenie hovoru a skončenie nezačatého hovoru, konferencia, presmerovanie a videohovor) boli implementované v “sipfullproxy.py”, ktoré som len zabalil do vlastnej funkcie main.py na obrázku:

```
vals = input("Chces nastaviť custom hodnoty pre port a ip host? Ak ano stlač 1 inak 2")
start_call = False
#sipfullproxy.start_call = False

if vals == 1:
    PORT = input("Zadaj port")
    HOST = raw_input("Zadaj ip adresu proxy")
else:
    HOST, PORT = '10.10.57.87', 5060

hostname = socket.gethostname()
logging.info(hostname)
ipaddress = socket.gethostbyname(hostname)
if ipaddress == "127.0.0.1":
    ipaddress = sys.argv[1]
sipfullproxy.recordroute = "Record-Route: <sip:%s:%d;lr>" % (ipaddress, PORT)
sipfullproxy.topvia = "Via: SIP/2.0/UDP %s:%d" % (ipaddress, PORT)
server = SocketServer.UDPServer((HOST, PORT), sipfullproxy.UDPHandler)
server.serve_forever()
```

Ďalej som pridal súbory glob\_vars.py, kde sa nachádzajú globálne premenné a call\_log.txt, kde sú výpisy z volaní.

Kvôli zostávajúcim funkcionalitám som upravoval prevzatý “sipfullproxy.py”. Najprv som si vo funkcii processCode upravil SIP stavový kód “180 Ringing” na “180 Zvoní”:

```

def processCode(self):
    origin = self.getOrigin()
    if len(origin) > 0:
        logging.debug("origin %s" % origin)
        if registrar.has_key(origin):
            socket, claddr = self.getSocketInfo(origin)
            self.data = self.removeRouteHeader()
            data = self.removeTopVia()

            if data[0] == "SIP/2.0 180 Ringing":
                data[0] = "SIP/2.0 180 Zvoní"

```

Potom som ešte robil logovanie denníka hovorov. Vo funkcii call\_log sa robilo zapisovanie do súboru. Vo funkcii processRequest sa pri prijatí invitu zaznamenajú mená volajúceho a volaného a k tomu čas kedy invite prišiel:

```

try:
    call_log("caller: " + self.data[11].split(":")[2].split("@")[0])
    call_log("called: " + self.data[0].split(":")[1].split("@")[0])
    call_log("at time: " + str(datetime.datetime.now()))
except:
    call_log("video started at: " + str(datetime.datetime.now()))

```

Potom sa v tej istej funkcii tiež kontroluje, či prišiel decline alebo začal hovor:

```

self.sendResponse("200 OK")
elif rx_code.search(request_uri):
    if glob_vars.start_call == True and self.data[0] == 'SIP/2.0 200 OK':
        call_log("call started at: " + str(datetime.datetime.now()))
        glob_vars.start_call = False
    if self.data[0] == 'SIP/2.0 603 Decline':
        call_log("call declined at: " + str(datetime.datetime.now()))
        glob_vars.start_call = False

self.processCode()

```

Všetky tieto informácie sa zapisujú do call\_log.txt. Pre všetky záznamy komunikácie v pcap formáte je na github aj záznam z call\_log.txt v txt formáte. Call log informácie som však nevytváral pre všetky pcap súbory.

## User guide:

Spúšťa sa main.py. Po spustení sa objaví prompt na zadanie čísla "1" alebo "2". Po zadaní "1" je možné zadať port na ktorom proxy server počúva a ip adresu na ktorej sa nachádza. "2" slúži na preskočenie tejto časti, vtedy sa použijú defaultne hard code hodnoty pre port a ip servera, sú nastavené na moje hodnoty. Potom treba vypnúť firewall na zariadení na ktorom beží proxy a následne sa môže volať. Používal som linphone aby fungoval aj videohovor.

## Záznamy pcap s opisom:

No.	Time	Source	Destination	Protocol	Length	Info
2694	268.352874	10.10.61.68	10.10.59.133	SIP	714	Request: REGISTER sip:10.10.59.133:5060 (1 binding)
2695	268.354145	10.10.59.133	10.10.61.68	SIP	728	Status: 200 OK (1 binding)
4138	372.881732	10.10.63.119	10.10.59.133	SIP	642	Request: REGISTER sip:10.10.59.133:5060 (1 binding)
4139	372.883958	10.10.59.133	10.10.63.119	SIP	657	Status: 200 OK (1 binding)
4140	372.986827	10.10.63.119	10.10.59.133	SIP/XML	1017	Request: PUBLISH sip:world2@10.10.59.133:5060
4141	372.987688	10.10.59.133	10.10.63.119	SIP	517	Status: 200 OK
4716	389.060171	10.10.63.119	10.10.59.133	SIP/SDP	1184	Request: INVITE sip:jakub2@10.10.59.133:5060
4717	389.071811	10.10.59.133	10.10.61.68	SIP/SDP	1316	Request: INVITE sip:jakub2@10.10.59.133:5060
4719	389.128075	10.10.61.68	10.10.59.133	SIP	336	Status: 100 Trying
4720	389.131359	10.10.59.133	10.10.63.119	SIP	274	Status: 100 Trying
4725	390.049160	10.10.61.68	10.10.59.133	SIP	523	Status: 180 Ringing
4726	390.049577	10.10.59.133	10.10.63.119	SIP	459	Status: 180 Zvoni
4816	400.733707	10.10.61.68	10.10.59.133	SIP/SDP	1354	Status: 200 Ok
4817	400.735521	10.10.59.133	10.10.63.119	SIP/SDP	1292	Status: 200 Ok
4822	401.234894	10.10.61.68	10.10.59.133	SIP/SDP	1354	Status: 200 Ok
4823	401.235326	10.10.59.133	10.10.63.119	SIP/SDP	1292	Status: 200 Ok
4824	401.326521	10.10.63.119	10.10.59.133	SIP	439	Request: ACK sip:jakub2@10.10.61.68:53284;transport=udp
4825	401.327251	10.10.59.133	10.10.61.68	SIP	536	Request: ACK sip:jakub2@10.10.61.68:53284;transport=udp
4826	401.409391	10.10.63.119	10.10.59.133	SIP	439	Request: ACK sip:jakub2@10.10.61.68:53284;transport=udp
4827	401.410068	10.10.59.133	10.10.61.68	SIP	536	Request: ACK sip:jakub2@10.10.61.68:53284;transport=udp
4910	412.696046	10.10.61.68	10.10.59.133	SIP	440	Request: BYE sip:world2@10.10.63.119:49754;transport=udp
4911	412.698457	10.10.59.133	10.10.63.119	SIP	536	Request: BYE sip:world2@10.10.63.119:49754;transport=udp
4912	412.748979	10.10.63.119	10.10.59.133	SIP	514	Status: 200 Ok

SIP komunikácia medzi volajúcim 10.10.63.119 a prijímačom 10.10.61.68 cez proxy 10.10.59.133. Aj s registráciou obidvoch účastníkov hovoru, upravenou SIP správou pre "Ringing" kde je práve vidieť ako ide neupravená správa do zariadenia s proxy a von vychádza už ako "Zvoni". Vždy pri registrácii ide správa zariadenie->proxy a potom proxy-> zariadenie. Pri Trying a pokuse o hovor ide zase volaný->proxy->volajúci, podobne je to aj napríklad pri BYE, ale výmenu BYE správ začína zariadenie, ktoré hovor ukončuje.

## SIP komunikácia s DECLINE:

272	26.794644	10.10.63.119	10.10.59.133	SIP/SDP	1183	Request: INVITE sip:jakub2@10.10.59.133:5060
273	26.800191	10.10.59.133	10.10.61.68	SIP/SDP	1315	Request: INVITE sip:jakub2@10.10.59.133:5060
274	26.836145	10.10.61.68	10.10.59.133	SIP	336	Status: 100 Trying
275	26.836541	10.10.59.133	10.10.63.119	SIP	274	Status: 100 Trying
277	27.001953	10.10.61.68	10.10.59.133	SIP	523	Status: 180 Ringing
278	27.002616	10.10.59.133	10.10.63.119	SIP	459	Status: 180 Zvoni
357	37.237153	10.10.61.68	10.10.59.133	SIP	481	Status: 603 Decline
358	37.238958	10.10.59.133	10.10.63.119	SIP	419	Status: 603 Decline
360	37.274125	10.10.63.119	10.10.59.133	SIP	417	Request: ACK sip:jakub2@10.10.59.133:5060
361	37.275100	10.10.59.133	10.10.61.68	SIP	549	Request: ACK sip:jakub2@10.10.59.133:5060

Decline funguje podobne ako BYE.

SIP konferencia:

31	23.254279	192.168.1.11	192.168.1.10	SIP/SDP	1187 Request: INVITE sip:boo@192.168.1.10:5060
32	23.264949	192.168.1.10	192.168.1.11	SIP	268 Status: 100 Trying
33	23.418992	192.168.1.10	192.168.1.11	SIP	453 Status: 180 Zvoni
34	23.469960	192.168.1.11	192.168.1.10	SIP/SDP	1191 Request: INVITE sip:foo@192.168.1.10:5060
35	23.473656	192.168.1.10	192.168.1.12	SIP/SDP	1323 Request: INVITE sip:foo@192.168.1.10:5060
36	23.663069	192.168.1.12	192.168.1.10	SIP	330 Status: 100 Trying
37	23.663469	192.168.1.10	192.168.1.11	SIP	268 Status: 100 Trying
42	24.201604	192.168.1.12	192.168.1.10	SIP	520 Status: 180 Ringing
43	24.202133	192.168.1.10	192.168.1.11	SIP	456 Status: 180 Zvoni
44	24.554484	192.168.1.11	192.168.1.10	SIP/SDP	1191 Request: INVITE sip:foo@192.168.1.10:5060
45	24.558077	192.168.1.10	192.168.1.12	SIP/SDP	1323 Request: INVITE sip:foo@192.168.1.10:5060
46	24.625769	192.168.1.12	192.168.1.10	SIP	520 Status: 180 Ringing
47	24.626285	192.168.1.10	192.168.1.11	SIP	456 Status: 180 Zvoni
49	26.707215	192.168.1.10	192.168.1.11	SIP/SDP	1259 Status: 200 Ok
54	26.902283	192.168.1.10	192.168.1.11	SIP	679 Request: SUBSCRIBE sip:moo@192.168.1.11;conf-id=ai0h9;transport=udp
87	27.230502	192.168.1.10	192.168.1.11	SIP/SDP	1259 Status: 200 Ok
107	27.417486	192.168.1.10	192.168.1.11	SIP	679 Request: SUBSCRIBE sip:moo@192.168.1.11;conf-id=ai0h9;transport=udp
145	27.784320	192.168.1.11	192.168.1.10	SIP	431 Request: ACK sip:boo@192.168.1.10:62764;transport=udp
158	27.885304	192.168.1.12	192.168.1.10	SIP/SDP	1320 Status: 200 Ok
159	27.885304	192.168.1.11	192.168.1.10	SIP	431 Request: ACK sip:boo@192.168.1.10:62764;transport=udp
161	27.885985	192.168.1.10	192.168.1.11	SIP/SDP	1258 Status: 200 Ok
221	28.397726	192.168.1.12	192.168.1.10	SIP/SDP	1320 Status: 200 Ok
223	28.398345	192.168.1.10	192.168.1.11	SIP/SDP	1258 Status: 200 Ok
224	28.407270	192.168.1.10	192.168.1.11	SIP	679 Request: SUBSCRIBE sip:moo@192.168.1.11;conf-id=ai0h9;transport=udp
239	28.523497	192.168.1.11	192.168.1.10	SIP	431 Request: ACK sip:foo@192.168.1.12:47474;transport=udp
240	28.523926	192.168.1.10	192.168.1.12	SIP	528 Request: ACK sip:foo@192.168.1.12:47474;transport=udp
251	28.628319	192.168.1.11	192.168.1.10	SIP	431 Request: ACK sip:foo@192.168.1.12:47474;transport=udp
252	28.628690	192.168.1.10	192.168.1.12	SIP	528 Request: ACK sip:foo@192.168.1.12:47474;transport=udp
442	30.409493	192.168.1.10	192.168.1.11	SIP	679 Request: SUBSCRIBE sip:moo@192.168.1.11;conf-id=ai0h9;transport=udp
845	34.406022	192.168.1.10	192.168.1.11	SIP	679 Request: SUBSCRIBE sip:moo@192.168.1.11;conf-id=ai0h9;transport=udp
1260	38.292007	192.168.1.10	192.168.1.11	SIP	679 Request: SUBSCRIBE sip:moo@192.168.1.11;conf-id=ai0h9;transport=udp
1674	42.415135	192.168.1.10	192.168.1.11	SIP	679 Request: SUBSCRIBE sip:moo@192.168.1.11;conf-id=ai0h9;transport=udp
2081	46.392995	192.168.1.10	192.168.1.11	SIP	679 Request: SUBSCRIBE sip:moo@192.168.1.11;conf-id=ai0h9;transport=udp
2489	50.410978	192.168.1.10	192.168.1.11	SIP	679 Request: SUBSCRIBE sip:moo@192.168.1.11;conf-id=ai0h9;transport=udp
2894	54.391714	192.168.1.10	192.168.1.11	SIP	679 Request: SUBSCRIBE sip:moo@192.168.1.11;conf-id=ai0h9;transport=udp
3313	58.410859	192.168.1.10	192.168.1.11	SIP	679 Request: SUBSCRIBE sip:moo@192.168.1.11;conf-id=ai0h9;transport=udp
3687	61.479611	192.168.1.10	192.168.1.11	SIP	543 Request: BYE sip:moo@192.168.1.11:58627;conf-id=ai0h9;transport=udp
3692	61.564042	192.168.1.11	192.168.1.10	SIP	510 Status: 200 Ok
3696	64.868380	192.168.1.12	192.168.1.10	SIP	449 Request: BYE sip:moo@192.168.1.11:58627;conf-id=ai0h9;transport=udp
3697	64.869499	192.168.1.10	192.168.1.11	SIP	546 Request: BYE sip:moo@192.168.1.11:58627;conf-id=ai0h9;transport=udp
3698	64.914904	192.168.1.11	192.168.1.10	SIP	510 Status: 200 Ok
3699	64.915672	192.168.1.10	192.168.1.12	SIP	448 Status: 200 Ok

192.168.1.11 “moo” začína konferenciu a proxy beží na zariadení 192.168.1.10. Prvé bolo pozvané a zdvihlo zariadenie 1.10 “boo” a druhé 1.12 “foo”. Prvé sa odpojilo 1.10, druhé 1.12.

234	93.474177	192.168.1.12	192.168.1.10	SIP/SDP	1222 Request: INVITE sip:moo@192.168.1.10:5060
235	93.477633	192.168.1.10	192.168.1.11	SIP/SDP	1354 Request: INVITE sip:moo@192.168.1.10:5060
236	93.554234	192.168.1.11	192.168.1.10	SIP	330 Status: 100 Trying
237	93.554617	192.168.1.10	192.168.1.12	SIP	268 Status: 100 Trying
238	94.836333	192.168.1.11	192.168.1.10	SIP	517 Status: 180 Ringing
239	94.840094	192.168.1.10	192.168.1.12	SIP	453 Status: 180 Zvoni
253	100.618967	192.168.1.11	192.168.1.10	SIP/SDP	1271 Status: 200 Ok
254	100.620904	192.168.1.10	192.168.1.12	SIP/SDP	1209 Status: 200 Ok
255	101.014144	192.168.1.12	192.168.1.10	SIP	434 Request: ACK sip:moo@192.168.1.11:58627;transport=udp
256	101.014750	192.168.1.10	192.168.1.11	SIP	531 Request: ACK sip:moo@192.168.1.11:58627;transport=udp
336	138.076738	192.168.1.12	192.168.1.10	SIP	670 Request: REFER sip:moo@192.168.1.11:58627;transport=udp, in-dialog
337	138.077379	192.168.1.10	192.168.1.11	SIP	767 Request: REFER sip:moo@192.168.1.11:58627;transport=udp, in-dialog
338	138.132012	192.168.1.11	192.168.1.10	SIP	517 Status: 202 Accepted
339	138.133147	192.168.1.10	192.168.1.12	SIP	455 Status: 202 Accepted
340	138.224812	192.168.1.11	192.168.1.10	SIP/SDP	1232 Request: INVITE sip:foo@192.168.1.12:47474;transport=udp, in-dialog
341	138.226837	192.168.1.10	192.168.1.12	SIP/SDP	1329 Request: INVITE sip:foo@192.168.1.12:47474;transport=udp, in-dialog
342	138.261271	192.168.1.12	192.168.1.10	SIP	345 Status: 100 Trying
343	138.261652	192.168.1.10	192.168.1.11	SIP	283 Status: 100 Trying
344	138.276354	192.168.1.12	192.168.1.10	SIP/SDP	1312 Status: 200 Ok
345	138.277475	192.168.1.10	192.168.1.11	SIP/SDP	1250 Status: 200 Ok
346	138.796768	192.168.1.12	192.168.1.10	SIP/SDP	1312 Status: 200 Ok
347	138.797547	192.168.1.10	192.168.1.11	SIP/SDP	1250 Status: 200 Ok
348	138.874129	192.168.1.11	192.168.1.10	SIP/SDP	1218 Request: INVITE sip:boo@192.168.1.10:5060
349	138.920323	192.168.1.10	192.168.1.11	SIP	268 Status: 100 Trying
350	139.121928	192.168.1.11	192.168.1.10	SIP	432 Request: ACK sip:foo@192.168.1.12:47474;transport=udp
351	139.121928	192.168.1.11	192.168.1.10	SIP/sip_	551 Request: NOTIFY sip:foo@192.168.1.12:47474;transport=udp   , with Sipfrag(SIP/2.0 100 Trying)
352	139.126859	192.168.1.10	192.168.1.12	SIP	529 Request: ACK sip:foo@192.168.1.12:47474;transport=udp
353	139.127264	192.168.1.10	192.168.1.11	SIP	517 Status: 200 OK
354	139.146702	192.168.1.11	192.168.1.10	SIP	432 Request: ACK sip:foo@192.168.1.12:47474;transport=udp
355	139.147151	192.168.1.10	192.168.1.12	SIP	529 Request: ACK sip:foo@192.168.1.12:47474;transport=udp
356	139.430801	192.168.1.10	192.168.1.11	SIP	453 Status: 180 Zvoni
364	143.617271	192.168.1.10	192.168.1.11	SIP/SDP	1258 Status: 200 Ok
374	143.937034	192.168.1.11	192.168.1.10	SIP/sip_	576 Request: NOTIFY sip:foo@192.168.1.12:47474;transport=udp   , with Sipfrag(SIP/2.0 200 OK)
375	143.937572	192.168.1.10	192.168.1.11	SIP	546 Status: 200 OK
398	144.162083	192.168.1.10	192.168.1.11	SIP/SDP	1258 Status: 200 Ok
508	145.162768	192.168.1.10	192.168.1.11	SIP/SDP	1258 Status: 200 Ok
526	145.334619	192.168.1.11	192.168.1.10	SIP	431 Request: ACK sip:boo@192.168.1.10:62764;transport=udp
547	145.523911	192.168.1.11	192.168.1.10	SIP	431 Request: ACK sip:boo@192.168.1.10:62764;transport=udp
579	145.809422	192.168.1.11	192.168.1.10	SIP	431 Request: ACK sip:boo@192.168.1.10:62764;transport=udp
2187	161.060461	192.168.1.10	192.168.1.11	SIP	529 Request: BYE sip:moo@192.168.1.11:58627;transport=udp
2189	161.097338	192.168.1.11	192.168.1.10	SIP	510 Status: 200 Ok
2227	170.168490	192.168.1.11	192.168.1.10	SIP	432 Request: BYE sip:foo@192.168.1.12:47474;transport=udp
2228	170.169936	192.168.1.10	192.168.1.12	SIP	529 Request: BYE sip:foo@192.168.1.12:47474;transport=udp
2229	170.218530	192.168.1.12	192.168.1.10	SIP	513 Status: 200 Ok
2230	170.224438	192.168.1.10	192.168.1.11	SIP	451 Status: 200 Ok

192.168.1.12 “foo” začína hovor a volá 192.168.1.11 “moo” potom hovor presmeruje na 1.10 “boo” – proxy. Hovor najprv skončí 1.10 potom 1.11

Pri videu je to podobné ako pri normálnom hovore, len sa posielala ešte jeden invite pri zapínaní kamery.

71	10.340918	192.168.1.11	192.168.1.10	SIP/SDP	1355 Request: INVITE sip:foo@192.168.1.10:5060
72	10.343847	192.168.1.10	192.168.1.12	SIP/SDP	1487 Request: INVITE sip:foo@192.168.1.10:5060
73	10.504837	192.168.1.12	192.168.1.10	SIP	330 Status: 100 Trying
74	10.505224	192.168.1.10	192.168.1.11	SIP	268 Status: 100 Trying
75	10.692464	192.168.1.12	192.168.1.10	SIP	520 Status: 180 Ringing
76	10.692892	192.168.1.10	192.168.1.11	SIP	456 Status: 180 Zvoni
77	12.534019	192.168.1.12	192.168.1.10	SIP/SDP	1334 Status: 200 Ok
78	12.535883	192.168.1.10	192.168.1.11	SIP/SDP	1272 Status: 200 Ok
79	13.281025	192.168.1.12	192.168.1.10	SIP/SDP	1334 Status: 200 Ok
80	13.281475	192.168.1.10	192.168.1.11	SIP/SDP	1272 Status: 200 Ok
81	14.021156	192.168.1.12	192.168.1.10	SIP/SDP	1334 Status: 200 Ok
82	14.022067	192.168.1.10	192.168.1.11	SIP/SDP	1272 Status: 200 Ok
83	14.424319	192.168.1.11	192.168.1.10	SIP	431 Request: ACK sip:foo@192.168.1.12:45103;transport=udp
84	14.425015	192.168.1.10	192.168.1.12	SIP	528 Request: ACK sip:foo@192.168.1.12:45103;transport=udp
85	14.573743	192.168.1.11	192.168.1.10	SIP	431 Request: ACK sip:foo@192.168.1.12:45103;transport=udp
86	14.574298	192.168.1.10	192.168.1.12	SIP	528 Request: ACK sip:foo@192.168.1.12:45103;transport=udp
87	14.638548	192.168.1.11	192.168.1.10	SIP	431 Request: ACK sip:foo@192.168.1.12:45103;transport=udp
88	14.638969	192.168.1.10	192.168.1.12	SIP	528 Request: ACK sip:foo@192.168.1.12:45103;transport=udp
122	18.128267	192.168.1.12	192.168.1.10	SIP/SDP	199 Request: INVITE sip:moo@192.168.1.11:63958;transport=udp, in-dialog
124	18.130204	192.168.1.10	192.168.1.11	SIP/SDP	296 Request: INVITE sip:moo@192.168.1.11:63958;transport=udp, in-dialog
125	18.174468	192.168.1.11	192.168.1.10	SIP	345 Status: 100 Trying
126	18.174928	192.168.1.10	192.168.1.12	SIP	283 Status: 100 Trying
173	22.253585	192.168.1.11	192.168.1.10	SIP/SDP	1458 Status: 200 Ok
174	22.255977	192.168.1.10	192.168.1.12	SIP/SDP	1396 Status: 200 Ok
175	22.506509	192.168.1.12	192.168.1.10	SIP	435 Request: ACK sip:moo@192.168.1.11:63958;transport=udp
176	22.506887	192.168.1.10	192.168.1.11	SIP	532 Request: ACK sip:moo@192.168.1.11:63958;transport=udp
199	36.945586	192.168.1.12	192.168.1.10	SIP	435 Request: BYE sip:moo@192.168.1.11:63958;transport=udp
200	36.947299	192.168.1.10	192.168.1.11	SIP	532 Request: BYE sip:moo@192.168.1.11:63958;transport=udp
201	37.007714	192.168.1.11	192.168.1.10	SIP	510 Status: 200 Ok
202	37.008112	192.168.1.10	192.168.1.12	SIP	448 Status: 200 Ok

Záver a môj github:

Všetky pcap súbory, kód a log súbory sú na:

[https://github.com/jakubganadik/mtaa\\_1\\_ganadik](https://github.com/jakubganadik/mtaa_1_ganadik)