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SvxLink-UDP

svxlink erlaubt die Anbindung von Audio (sowohl als "Mic", wie als "Lautsprecher") über UDP.

Dazu ist etwa folgender Abschnitt in der Konfiguration von svxlink notwendig:

```
[TxUDP]
TYPE=Local
AUDIO_DEV=udp:44.143.100.200:4300
AUDIO_CHANNEL=0
PTT_TYPE=NONE
CARDS_CHANNELS =1

[RxUDP]
TYPE=Local
AUDIO_DEV=udp:0.0.0.0:4301
AUDIO_CHANNEL=0
SQL_DET=VOX
VOX_FILTER_DEPTH=100
VOX_THRESH=10
```

44.143.100.200 ist die fiktive Adresse des Ziels der UDP-Daten auf Port 4300. Daten für Rx werden am Rechner (Adresse 0.0.0.0) am Port 4301 entgegengenommen. Nachdem es bereits RX und TX gibt ist es nun notwendig die neuen Quellen und Senken zu integrieren. Für "RX" wird ein Voter verwendet, für "TX" ein Multiplexer:

```
[MultiTX]
TYPE=Multi
TRANSMITTERS=Tx1,TxUDP

[Voter]
TYPE=Voter
RECEIVERS=Rx1,Rx1,RxUDP
VOTING_DELAY=200
BUFFER_LENGTH=0
```

An anderer Stelle - etwa in der RepeaterLogic - ist nun die neue Definition statt "Rx1" bzw "Tx1" einzufügen:

```
[RepeaterLogic]
TYPE=Repeater
RX=Voter
TX=MultiTX
```

Die Daten werden mit zwei Kanälen mit jeweils 16 Bits kodiert. Pro Sekunde werden 48 UDP-Pakete mit einer Länge von 4032 Bytes übermittelt, dh. je Paket 1008 Samples mit einer Sample-Rate von 48.000 Samples/s, der wohl internen Sample-Rate von svxlink.

```
[2025-03-10 21:12:45.603] Received 4032 bytes from ('127.0.0.1', 53786):
8eff00006eff000037ff0000fafa0000befe000099fe000094fe0000a7fe0000cefe0000fbfe00
001eff000034ff00003cff00003dff000044ff00005bff000086ff0000c2ff00000000000003500
000051000000480000001f000000deff000094ff00005aff00003fff00004cff000089ff0000e9
ff00005b000000d900000004e010000af010000f801000026020000390200003702000022020000
```

ff010000d5010000a9010000810100006301000050010000490100004801000048010000410100
003101000015010000f1000000ce000000b3000000a6000000a4000000ab000000b4000000a800
00008400000046000000e6ff000077ff00000cfff0000b0fe000079fe000072fe000095fe0000dc
fe00003dfff0000a0fff0000fafff000043000000730000008c000000970000009200000086000000
730000005400000028000000efff0000a4fff00004fff0000f9fe0000acfe000075fe00005bfe00
0067fe000095fe0000d8fe00002dfff000080fff0000c2ff0000eeff000000000000f9fff0000e2ff
0000c5fff0000abff000096fff00008aff000085fff00007fff000076fff00006cfff000065fff00006b
fff000086fff0000c4fff00001e000000900000000f01000083010000d6010000fe010000f1010000
b60100005a010000ef000000870000002f000000ebff0000b5fff000084fff000050fff000010fff00
00c9fe000084fe00004afe00002efe000034fe00005afe000097fe0000d8fe00000bfff00001cfff
000007fff0000d2fe00007ffe000028fe0000e1fd0000b1fd0000a3fd0000b7fd0000e3fd000020
fe000065fe0000affe0000fffe000053fff0000b6fff00002200000092000000050100006b010000
b7010000ec01000002020000fe010000ee010000d9010000c6010000c0010000c4010000c90100
00d7010000e1010000e2010000e7010000ec010000f50100000b0200002c020000520200007a02
000099020000ab020000a702000091020000710200004302000017020000f3010000ce010000ac
010000890100005801000018010000ce0000007600000020000000dbff0000a6fff00008bfff0000
8bfff000094fff00009fff0000a2fff000087fff000054fff000011fff0000befe00006ffe000037fe00
000efe0000fbfd0000f8fd0000eeffd0000d7fd0000abfd000064fd000010fd0000bfc00007dfc
00005afe00005bfc00007afc00000abfc0000dcfc00000dfc000000efd000000efd00000f4fc0000e6
fc0000e9fc00000cfd00004dfd0000a0fd000004fe000064fe0000b3fe0000f8fe000032fff0000
66fff0000aef00000800000072000000f70000007c010000ef0100005402000097020000b50200
00c5020000c5020000bd020000c2020000cc020000d3020000e2020000e6020000da020000c802
0000aa020000840200005d0200003402000007020000d8010000a30100006c01000030010000f8
000000ca000000a00000007f000000670000004200000014000000dcfff00008cfff000036fff0000
e8fe00009ffe000072fe00006afe000076fe00009bfe0000d1fe000001fff00002cfff000050fff00
0066fff00007bfff000097fff0000b9fff0000e9fff000023000000600000009a000000cb000000eb00
0000fd00000002010000020100000201000005010000160100002f0100004c0100007101000091
010000a6010000b3010000b0010000a00100008701000067010000440100002301000005010000
ea000000cf000000b10000009100000068000000390000000a000000d9fff0000adfff00008aff00
006dff000058fff000048fff000035fff000020fff0000bfff0000effe0000d5fe0000c1fe0000acfe
00009afe000087fe00006afe000040fe00000bfe0000cbfd00008bfd000057fd000039fd00003b
fd000060fd0000a3fd0000f8fd000051fe0000a0fe0000d6fe0000edfe0000e6fe0000c4fe0000
8ffe000056fe00001efe0000eeffd0000cefd0000bffd0000bcfd0000cefd0000edfd000014fe00
0048fe00007efe0000acfe0000dcfe000002fff00001bfff000036fff000050fff00006aff00008eff
0000b6fff0000ddfff0000020000001e000000290000002b000000250000001a0000001e00000033
000000590000009b000000ee00000047010000a7010000010200004c0200008a020000b6020000
cc020000d1020000c6020000aa020000850200005d0200003b02000026020000260200003d0200
006b020000a7020000ea020000280300005803000077030000810300007d030000720300006103
0000530300004d0300004103000033030000260300007030000de020000b3020000790200003d
02000006020000ca01000093010000660100003901000012010000f9000000dc000000c2000000
ac000000810000004900000006000000a8fff00003cfff0000d0fe000059fe0000eafd00008afd00
0029fd0000cfff00007dfc000024fc0000cefb000084fb000043fb00001afb000010fb00001efb
000044fb000078fb0000a8fb0000cefb0000e3fb0000e4fb00000dafb00000cefb0000cafb0000d5
fb0000f0fb00001ff000056fc000089fc0000c0fc0000f1fc000017fd00004dfd00008dfd0000
d6fd000041fe0000bcfe000038fff0000c5fff000046000000ad0000000a0100004a010000690100
007d0100007d0100006801000059010000460100002e010000290100002a0100002e0100004601
00006601000087010000b8010000ee0100002502000065020000a5020000de0200000c03000024
03000020030000f7020000ad0200004a020000d30100005c010000f7000000aa00000082000000
7f00000097000000c2000000f800000029010000550100007f010000a3010000cc010000000200
0032020000630200008d020000910200007002000027020000a90100000a01000062000000bfff
00003dfff0000f2fe0000e6fe00001cfff00008bfff00001d000000c100000060010000e301000041
0200007702000080020000640200002f020000da01000071010000fa0000006b000000d2fff0000
3cfff0000aef000003dfe0000fbfd0000f0fd00001cfe000076fe0000eeffe000067fff0000c8fff00
00fefff00000000000d1fff000077fff000008fff00009bfe000030fe0000d3fd000082fd000029fd
0000c5fc0000051fc0000cdfb000049fb0000d7fa000093fa000008afa0000c0fa00003dfb0000ea
fb0000adfc000071fd00001cfe00009afe0000e4fe00000afe0000e2fe0000a7fe000056fe0000
f7fd0000a1fd00005cfd000031fd00003dfd000082fd000000fe0000cafe0000c8fff0000dc0000
000b0200002403000009040000c30400003b050000720500008305000074050000510500002d05
000006050000db040000b10400007e0400004404000012040000e8030000ce030000d9030000fe
030000360400007c040000b5040000d4040000bf04000073040000f70300003a0300005a020000
6d0100006500000063fff000073fe000083fd0000a7fc0000eeffb000047fb0000cafa000084fa00
0064fa000076fa0000b4fa0000fafa000042fb00007efb00008bfb000076fb00004afb0000fdfa
0000b7fa00008cfa000078fa00008efa0000c8fa000019fb000078fb0000d8fb000040fc0000af
fc000024fd0000c2fd000081fe000056fff00005400000059010000440200001d030000c4030000
2c040000710400009204000096040000a7040000be040000d70400000c050000420500006d0500
009e050000c1050000d1050000e4050000ea050000e3050000d7050000b9050000840500003805

```

0000d30400005d040000d10300003e030000b30200001f020000920100001301000088000000ff
ff00007cfff0000e7fe000053fe0000cdfd00003efd0000bcfc000053fc0000e9fb000091fb0000
53fb00000fffb0000d5fa0000abfa000072fa00003ffa000017fa0000ebf90000cef90000c9f900
00d3f90000f5f900002bfa000069fa0000aafa0000e2fa000010fb000033fb00004afb00006fffb
0000a5fb0000f2fb00006efc00000cfd0000bcfd000088fe000051ff000000000000a60000002e
0100008d010000e70100002d020000580200008a020000af020000bd020000d2020000dd020000
da020000e9020000ff0200001a030000540300009c030000e90300004a040000a9040000fc0400
0047050000790500008e0500007c05000042050000e504000060040000c6030000290300008e02
00000b020000ae0100006c0100004d01000049010000480100004b0100004f0100004301000034
0100002a01000014010000ff0000000ed000000bd00000007d00000034000000cbff000060ff0000
0aff0000c2fe0000a6fe0000befe0000f7fe000052ff0000bfff0000250000007f000000c70000
00f7000000160100002f0100003f0100004c010000560100004d0100002e010000f40000009800
00001f00000094ff000001ff000075fe0000fcfd0000a4fd00006bffd00004ffd00004afd00004b
fd000045fd00002bfd0000f5fc0000a2fc000034fc0000bafb000046fb0000defa000092fa0000
67fa000052fa00004cfa000049fa00003cfa000021fa0000fcf90000dbf90000cdf90000dbf900
001afa000082fa000003fb000009afb00002bfc0000a0fc000003fd00004efd000087fd0000d3fd
000034fe0000a9fe00004bfff0000fdff0000a500000051010000e401000050020000bb0200001b
03000074030000ea03000067040000dc04000058050000b9050000f30500001b0600002c060000
2d0600003f06000005f0600008c060000c9060000000700001f0700001c070000ec060000930600
001706000089050000ff0400007904000008040000b30300006403000022030000ee020000a902
00006202000020020000c6010000660100000b010000950000001a000000a9ff000022ff0000a6
fe000044fe0000defd00008efd00005dfd000025fd0000fafc0000defc0000b9fc00009dfc0000
94fc000093fc0000a9fc0000dafc000015fd00005cfd0000a7fd0000e3fd000011fe000030fe00
0041fe00004dfe00005dfe00007dfe0000affe0000effe000042ff000098ff0000e3ff00002700
00005600000006c0000007c000000800000007a0000007d0000007f1000000630000003f
000000010000000b6fff00005aff0000f7fe0000a3fe00005ffe00002ffe00001afe000014fe0000
10fe00000bfe0000f8fd0000d8fd0000adfd00007efd000052fd00002afd000000afd0000ebfc00
00c7fc00009afc000066fc000030fc000007fc0000f9fb000016fc000062fc0000d6fc00006bfd
000007fe00008ffe0000fe000045ff000066ff000079ff00008bff0000aaff0000ebff000048
000000b40000002d0100009a010000ed01000033020000670200008f020000cb02000016030000
6b030000d80300004304000009c040000e70400001605000028050000280500001a050000ff0400
00db040000a60400005c040000fa0300007f030000f602000067020000e40100007f0100003401
00000c0100000301000000010000fc0000000f3000000cc000000940000005600000001000000af
ff00006bfff00001ffff0000e0fe0000

```

Der digitale Kanal kann auch parallel zu einem bestehenden Kanal erstellt werden, etwa durch eine Multi-TRX-Konfiguration:

```

[MultiTX]
TYPE=Multi
TRANSMITTERS=Tx1,TxUDP

```

Einfacher Python-Code zur Ausgabe der UDP-Daten:

```

import socket
from datetime import datetime

def start_udp_server(host='0.0.0.0', port=4300):
    # Create a UDP socket
    sock = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)

    # Bind the socket to the address and port
    server_address = (host, port)
    sock.bind(server_address)

    print(f"Starting UDP server on {host}:{port}. Waiting for data...")

    try:
        while True:
            # Receive data from the client
            data, address = sock.recvfrom(65535)

```

```

        # Get the current timestamp with milliseconds
        timestamp = datetime.now().strftime('%Y-%m-%d %H:%M:%S.%f')[:-3]

        # Convert the data to hexadecimal format
        hex_data = data.hex()

        # Print the timestamp and the received hex data
        print(f"[{timestamp}] Received {len(data)} bytes from {address}: {hex_data}")

    except KeyboardInterrupt:
        print("\nServer is shutting down.")
    finally:
        sock.close()

if __name__ == '__main__':
    start_udp_server()

```

Einfacher Python-Code um die Daten auf 8000 Samples/s zu konvertieren:

```

import socket
import numpy as np
from scipy import signal
import wave

def low_pass_filter(data, cutoff, fs, order=5):
    nyquist = 0.5 * fs
    normal_cutoff = cutoff / nyquist
    b, a = signal.butter(order, normal_cutoff, btype='low', analog=False)
    return signal.lfilter(b, a, data)

def start_udp_server_with_processing(host='0.0.0.0', port=4300, output_file='output.wav'):
    sock = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
    sock.bind((host, port))

    print(f"Listening on {host}:{port}")

    out_wave = wave.open(output_file, 'wb')
    out_wave.setnchannels(1)
    out_wave.setsampwidth(2)
    out_wave.setframerate(8000)

    try:
        while True:
            data, _ = sock.recvfrom(4096)
            samples = np.frombuffer(data, dtype=np.int16)[::2]

            filtered_samples = low_pass_filter(samples, cutoff=3400, fs=48000)

            downsampled_samples = signal.resample_poly(filtered_samples, up=1,
down=6)

            out_wave.writeframes(downsampled_samples.astype(np.int16).tobytes())

    except KeyboardInterrupt:
        print("\nServer shutting down.")
    finally:

```

```
sock.close()
out_wave.close()

if __name__ == '__main__':
    start_udp_server_with_processing()
```

Das Downsampling und die Ratenadaption basiert auf Samples von lediglich 20ms, damit kommt es zu Artefakten.