



NAVAL
POSTGRADUATE
SCHOOL

Live RF to DIS7

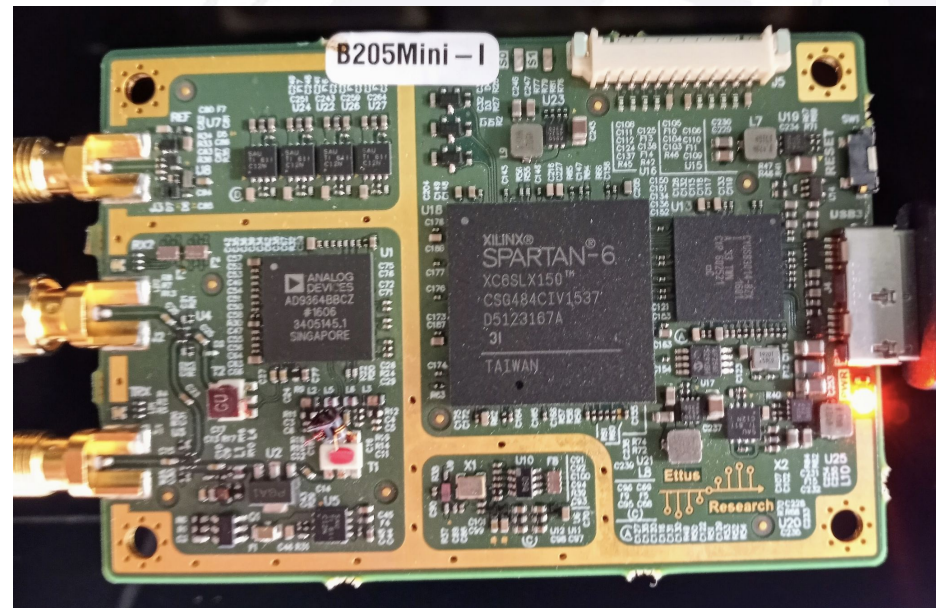
ADSB Entity State PDU
MV3500 | Q3 | Lentz

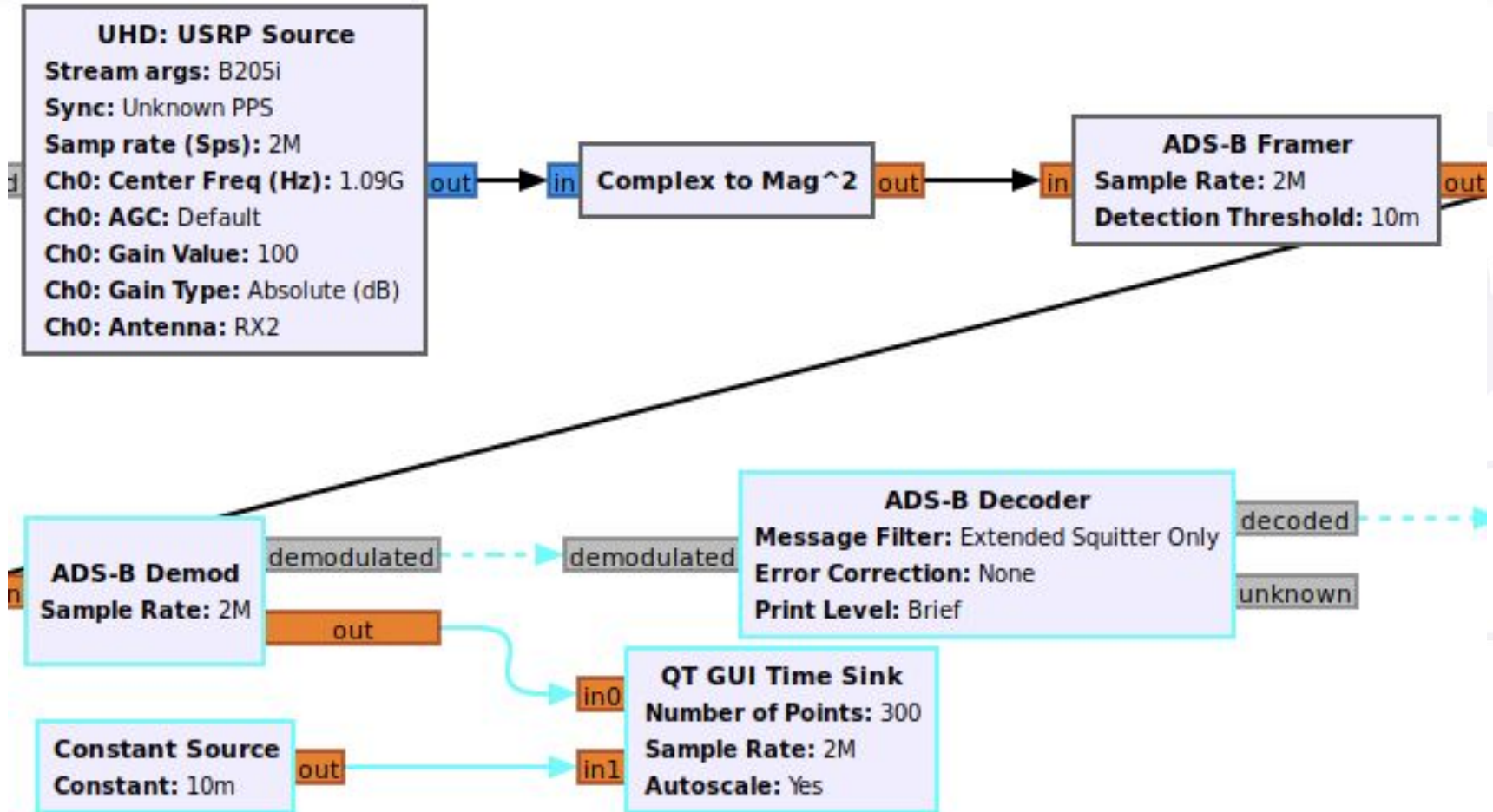
Excellence Through Knowledge



This project demonstrates the simulation of software-defined transmitter/receiver systems through an aviation RF receiver use case. Effective as a 'home aviation spotter' awareness system, the concepts implemented demonstrate scalability as a node within a distributed networked simulation of global RF emitters.

- **Software defined transceiver** - takes image for FPGA implementing RF to networked Entity State PDU
- a software-defined radio setup with a compiled FPGA image to receive ADS-B data
- a conversion model for transforming message traffic to the Entity State DIS format
- a watch system to visualize DIS broadcasts and alerts when variables are within tolerance for conditions of interest.







Aircraft Data via ADSB

Time	ICAO	Callsign	Alt ft	Climb ft/m	Speed kt	Hdng deg	Latitude deg	Longitude deg	Msgs
20:30:10	ac08fa	SKW5025	11150	-1280	398	-74	42.8322950	-89.2147391	65
20:30:10	a3e936	N351HC	-1	128	164	-25	43.0989990	-89.3877038	26
20:30:10	a3a0cc		24100	-960	441	-26	42.5952976	-89.9870336	8
20:30:10	aa8b74			128	413	-169			2
20:30:10	a43b04	N3718T	8050	192	135	-154	43.1376801	-89.5318674	134
20:30:10	a2d8db	N2828B	40225	-3392	580	-30	42.9291237	-89.0175738	142
20:30:10	a05225	N12JD	21000	64	285	-2	42.9336090	-89.5163461	170
20:30:10	a16862	N190CE	2200	-192	135	-159	43.1164856	-89.4494061	116
20:30:10	a35e3c	N316MP	3225	-448	99	169	43.0941514	-89.3744332	123
20:30:10	a54501		3125	128	122	-68	43.1247253	-89.6146482	7
20:30:10	a36e61	ASA1014et24025o		0	443	-26			7
20:30:10	a5ff57	N486ER	-1	1024	95	15	43.1620245	-89.3147932	78



```
def print_planes(self):
    index = 0
    for icao in self.plane_dict:
        last_seen = datetime.datetime.utcnow().strftime("%H:%M:%S")

        if self.plane_dict[icao]["callsign"] is not None:
            callsign = "{:8s}".format(self.plane_dict[icao]["callsign"])
        else:
            callsign = " "*8

        if np.isnan(self.plane_dict[icao]["altitude"]) == False:
            altitude = "{:5.0f}".format(self.plane_dict[icao]["altitude"])
        else:
            altitude = " "*5

        if np.isnan(self.plane_dict[icao]["vertical_rate"]) == False:
            vertical_rate = "{:5.0f}".format(self.plane_dict[icao]["vertical_rate"])
        else:
            vertical_rate = " "*5

        if np.isnan(self.plane_dict[icao]["speed"]) == False:
            speed = "{:5.0f}".format(self.plane_dict[icao]["speed"])
        else:
            speed = " "*5

        if np.isnan(self.plane_dict[icao]["heading"]) == False:
            heading = "{:5.0f}".format(self.plane_dict[icao]["heading"])
        else:
            heading = " "*5

        if np.isnan(self.plane_dict[icao]["latitude"]) == False:
            latitude = "{:11.7f}".format(self.plane_dict[icao]["latitude"])
        else:
            latitude = " "*11

        if np.isnan(self.plane_dict[icao]["longitude"]) == False:
            longitude = "{:11.7f}".format(self.plane_dict[icao]["longitude"])
        else:
            longitude = " "*11

        num_msgs = "{:4d}".format(self.plane_dict[icao]["num_msgs"])
        age = "{:3.0f}".format(int(time.time()) - self.plane_dict[icao]["last_seen"])

        send_dis7_entity_state_pdu(latitude.strip(), longitude.strip(), altitude.strip(), speed.strip(),
```



PDU Capture via Wireshark

No.	Time	Source	Destination	Protocol	Length	Info
26971	1196.4973536...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26972	1196.4978965...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26973	1196.4980517...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26974	1196.4982870...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26975	1196.4987409...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26976	1196.4988770...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26977	1196.4990076...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26978	1196.4995425...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26979	1196.4997723...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26980	1196.4999055...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26981	1196.5000341...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26982	1196.5003034...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26983	1196.5004986...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26984	1196.5006301...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26985	1196.5007579...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26986	1196.5008794...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26987	1196.5010054...	127.0.0.1	127.0.0.1	DIS	186	PDUType:
26988	1196.5011609...	127.0.0.1	127.0.0.1	DIS	186	PDUType:

Extra: 0

▼ Entity Linear Velocity

X: 543

Y: 0

Z: 0

▼ Entity Location

X: 42.9538429

Y: -90.6040519

Z: 29000

▼ Entity Orientation



NAVAL
POSTGRADUATE
SCHOOL

Want to replicate?

Video walkthrough:

<https://www.youtube.com/watch?v=e7BWm0TBmFk&t=4s>

Adapted Source Code:

<https://github.com/ricklantz/gr-adsb>

Excellence Through Knowledge