

# Software Defined Radio

## \$15 SDR Receiver



## Kako dela?

- ❖ Vhod iz antene je filtriran in podan na ADC konverter (RTL2832U). Izhod je poslan na USB računalnika.
- ❖ Filtriranje, demodulacijo in procesiranje opravimo na računalniku.

# Kaj potrebujemo?

- ❖ računalnik z 1.0 GHz+ CPU
- ❖ DVB-T tuner, ki vsebuje RTL2832U čip
- ❖ anteno
- ❖ posebne gonilnike
- ❖ Software
  - SDRSharp

# Primer nekaj kompatibilnih DVB-T tunerjev

VID	PID	tuner	device name
0x0bda	0x2832	all of them	Generic RTL2832U (e.g. hama nano)
0x0bda	0x2838	E4000	ezcap USB 2.0 DVB-T/DAB/FM dongle
0x0ccd	0x00a9	FC0012	Terratec Cinergy T Stick Black (rev 1)
0x0ccd	0x00b3	FC0013	Terratec NOXON DAB/DAB+ USB dongle (rev 1)
0x0ccd	0x00d3	E4000	Terratec Cinergy T Stick RC (Rev.3)
0x0ccd	0x00e0	E4000	Terratec NOXON DAB/DAB+ USB dongle (rev 2)
0x185b	0x0620	E4000	Compro Videomate U620F
0x185b	0x0650	E4000	Compro Videomate U650F
0x1f4d	0xb803	FC0012	GTek T803
0x1f4d	0xc803	FC0012	Lifeview LV5TDeluxe
0x1b80	0xd3a4	FC0013	Twintech UT-40
0x1d19	0x1101	FC2580	Dexatek DK DVB-T Dongle (Logilink VG0002A)
0x1d19	0x1102	?	Dexatek DK DVB-T Dongle (MSI DigiVox? mini II V3.0)
0x1d19	0x1103	FC2580	Dexatek Technology Ltd. DK 5217 DVB-T Dongle
0x0458	0x707f	?	Genius TVGo DVB-T03 USB dongle (Ver. B)
0xd393	FC0012	GIGABYTE	GT-U7300
0x1b80	0xd394	?	DIKOM USB-DVBT HD
0x1b80	0xd395	FC0012	Peak 102569AGPK
0x1b80	0xd39d	FC0012	SVEON STV20 DVB-T USB & FM

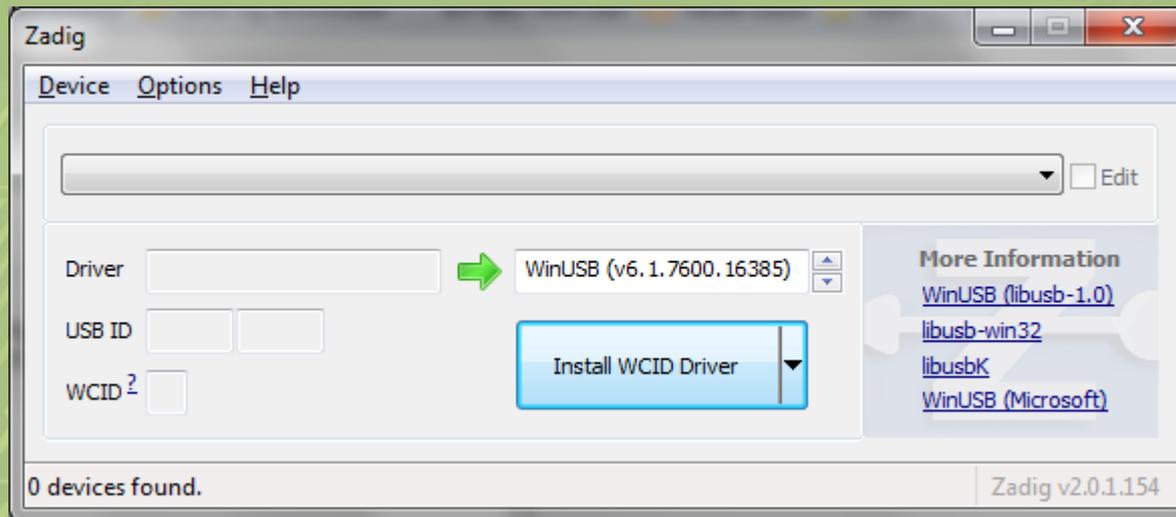


# Software - Drivers

Installation:

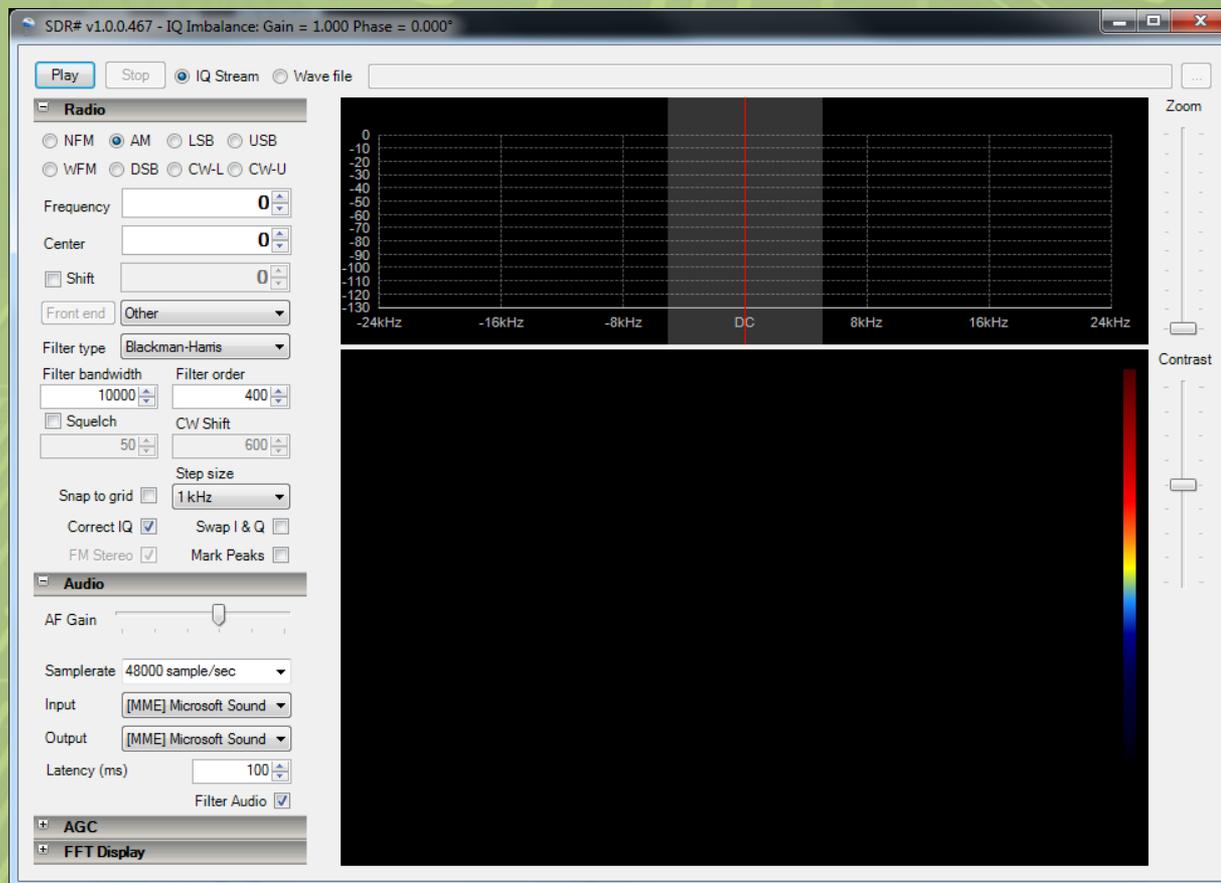
<http://rtlsdr.org/softwarewindows>

Na voljo tudi skripta ki namesti driverje.



# Software - SDRSharp

- SDR# iz <http://sdrsharp.com>
- Paket ki ga prenesemo, je potrebno razpakirati
- Poženemo SDRSharp.exe



# Sledenje letal

## AIR TRAFFIC CONTROL



What my friends think I do



What my mom thinks I do



What society thinks I do



What pilots think I do

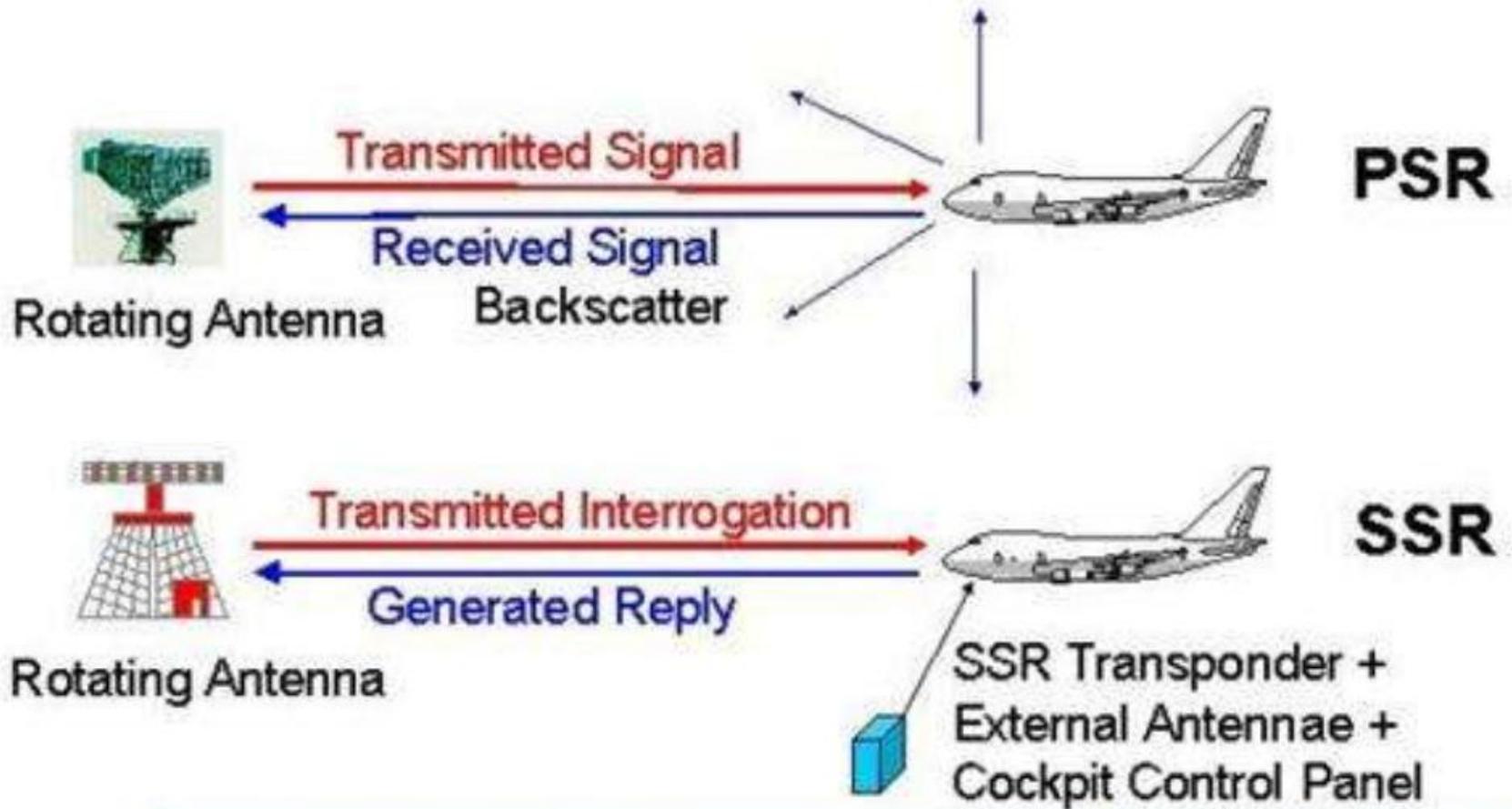


What I think I do



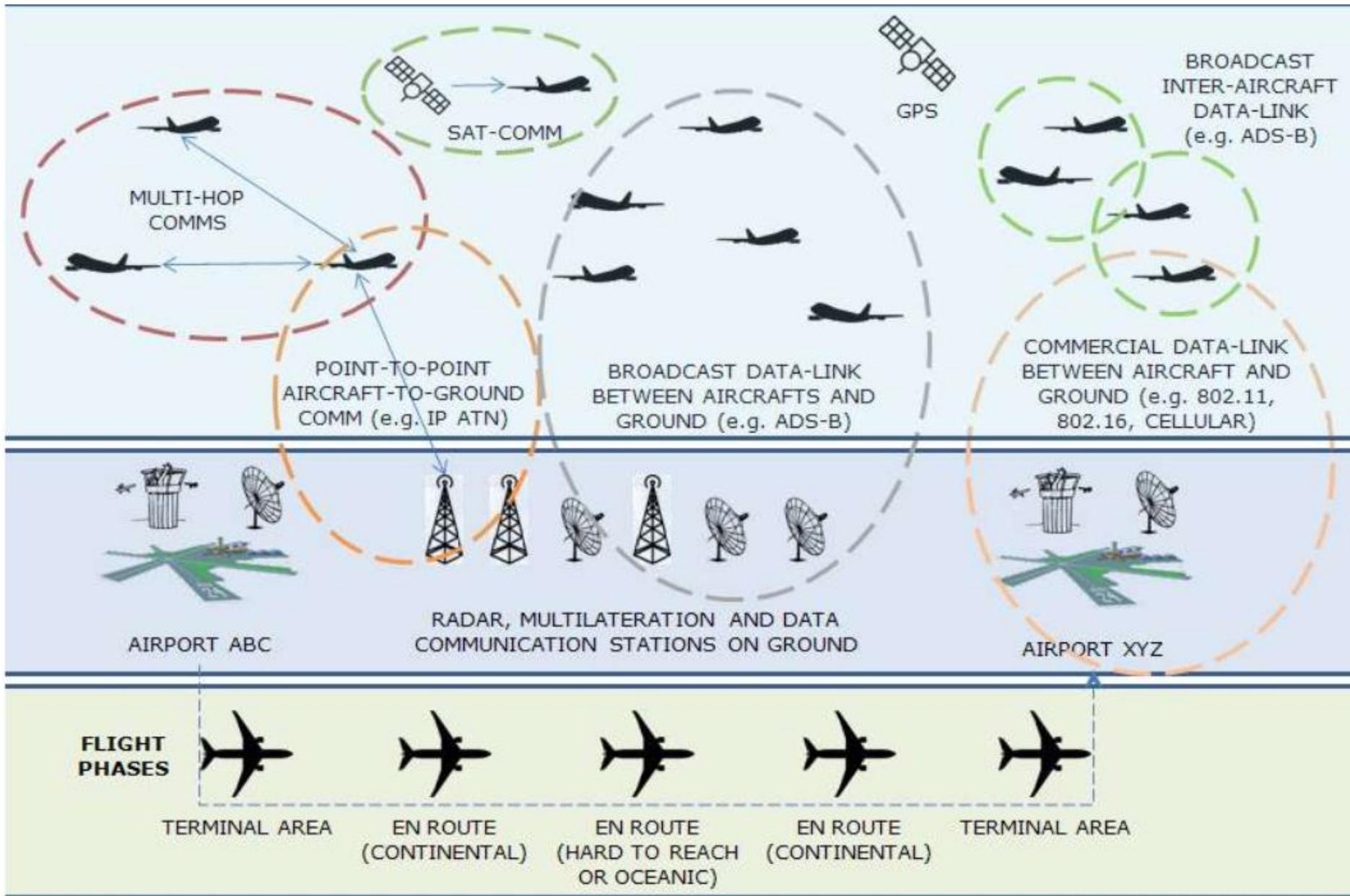
What I actually do

# Letalski radarji

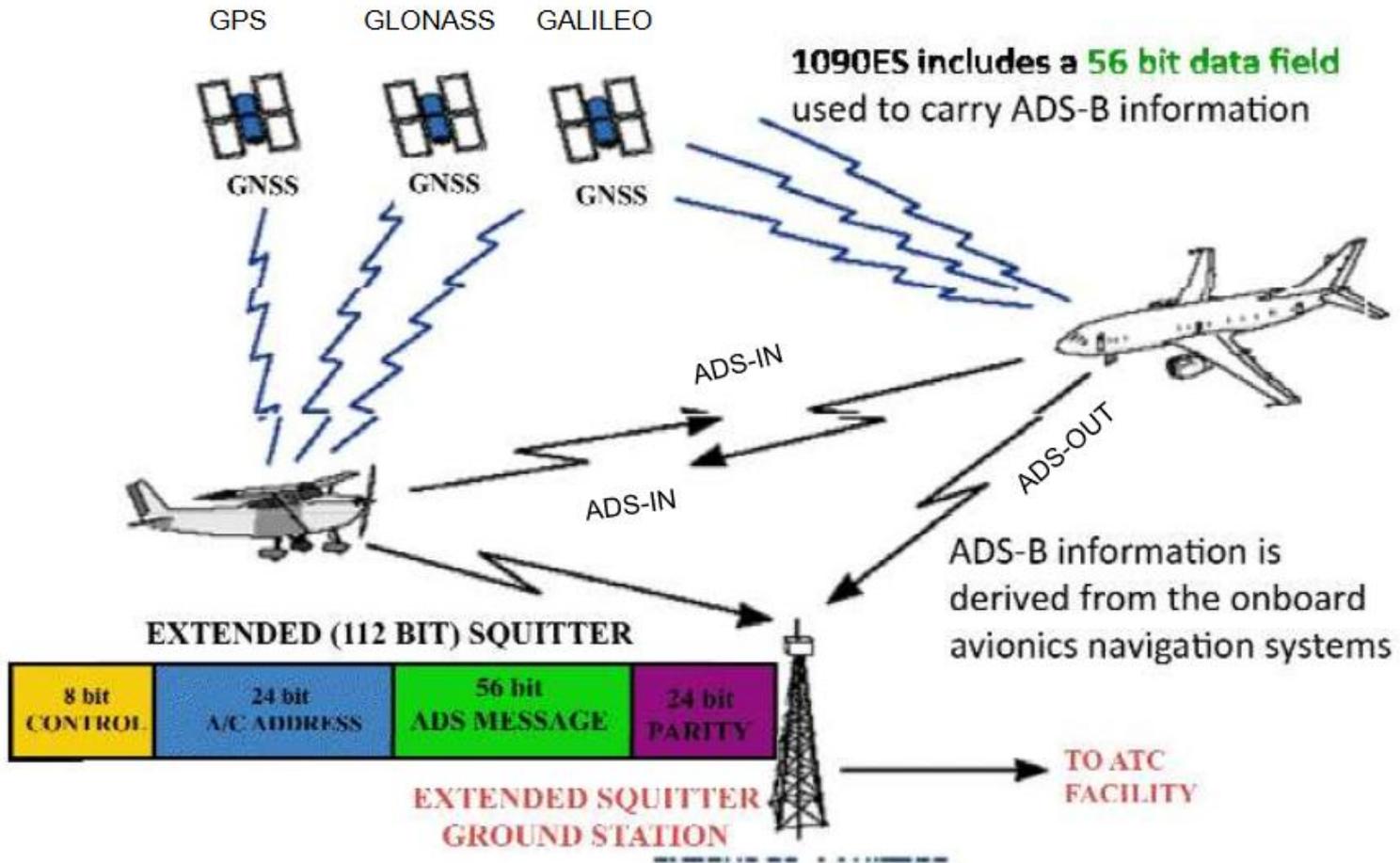


# Monopulse secondary surveillance radar (MSSR)

- Mode S
- TCAS  
(Traffic Collision Avoidance System)
- ADS-B  
(Automatic dependent surveillance –  
broadcast)



# Kaj je ADS-B?



## Mode S

Interrogated data

Mode A/C  
Mode S



Elementary and  
Enhanced Mode S

Altitude  
Code  
Aircraft  
Address

Flight ID  
Selected Alt  
Mach Number  
Magnetic Heading  
Roll Angle  
Track Angle  
Track Angle Rate

TAS  
IAS  
GS  
VS

## ADS-B-Out

Broadcast Data

DO-260-like  
Extended  
Squitter

Position  
Velocity  
Flight ID

## ADS-B-Out

Broadcast Data

DO-260B

- Position
- Velocity
- Flight ID
- SIL/SDA
- Length/Width
- Mode A code
- Emerg Code
- NIC
- NACp/NACv
- Geo Altitude
- TCAS data
- GPS Ant Offset
- + more....

## ADS-B-In

Received Data

ADS-B/CDTI  
Applications

Near Term

- AIRB
- EVApp
- ITP
- SURF

Future

- IM
- SURF-IA

ADS-B:

- Mode-S; 1090Mhz (replies + broadcast) in 1030 Mhz (interrogation)

# Sporočilo dolgo 112 bitov

BIN format: 10001101010010000100000011010110001000000010110011000011 01110001110000110010110011100000010101110110000010011000

HEX format: 8D4840D6202CC371C32CE0576098

Bit from	Bit to	Abbr.	Name
1	5	DF	Downlink Format
6	8	CA	Message Subtype
9	32	ICAO24	ICAO aircraft address
33	88	DATA	Data frame
89	112	PC	Parity check

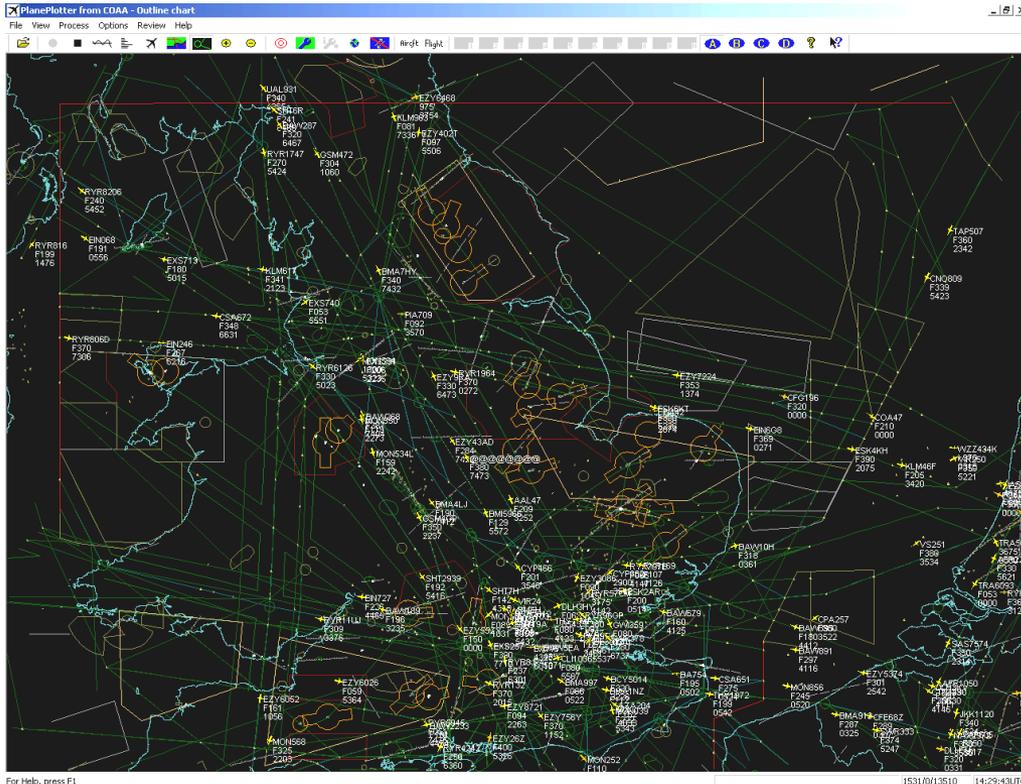
# ADS-B Data

DF	TC	Content
17	1 to 4	Aircraft identification
17	5 to 8	Surface position
17	9 to 18	Airborne position (Baro Alt)
17	19	Airborne velocities
17	20 to 22	Airborne position (GNSS Height)
17	23	Test message
17	24	Surface system status
17	25 to 27	Reserved
17	28	Extended squitter AC status
17	29	Target state and status (V.2)
17	30	Reserved
17	31	Aircraft Operation status

DF = Downlink Format. Za ADS-B sporočilo mora biti vrednost dec. = 17  
TC = Type Code (znotraj enega podatkovnega okvirja) in nam pove kje se nahajajo določene informacije.

# Sprejemanje v praksi

- RTL 1090
- Plane Plotter



CLSE RTL1090 - (c) jetvision.de - B:101 **BETA** X

**1090.000 MHz** STOP

Tuner AGC  OFF  22.9 dB ? Test

RTL AGC  OFF

Mode S  Mode AC Send UDP  OFF SISEX  OFF

List  Flight table Config  OFF

ICAO	C/S	ALT..MCP	V/S	GS	TT	SSR	C*456^	SC	MSGS
45ACC1	SAS627	F308>300				4771	...	5	372
440681	BER391E	F390=		452	040	7352	e...	5	601
484F06		F031>030	+ 4	215	209		...	6	21
44CE70	BEL5MA	F018>040	- 9	178	230	7134	...	5	63
4492B4	BEL54P	F280>310	+ 4	421	220	4746	o...	9	209

<10 <20 <40 <80 <120 120+

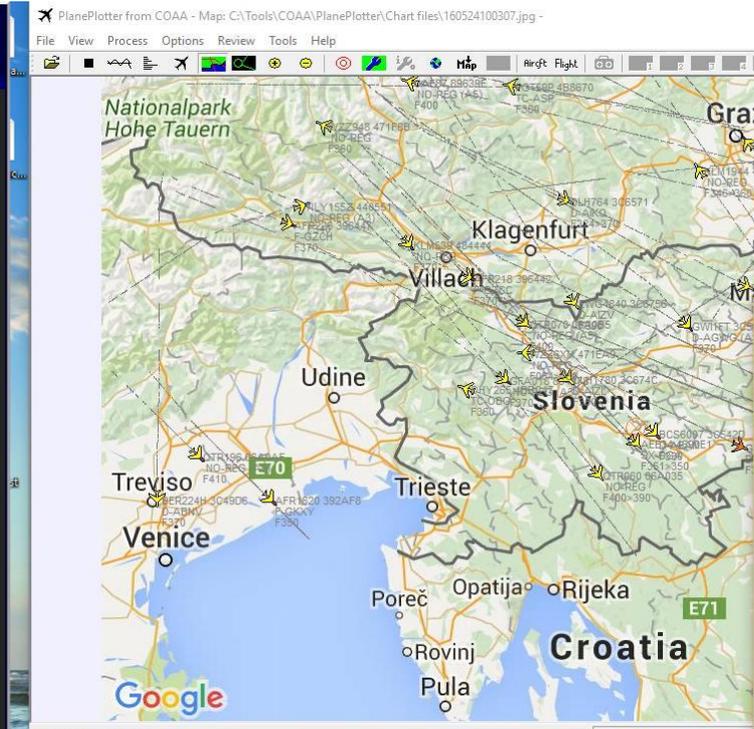
UDP BS HTTP

31 ms 27/sec THR: -80db [7] Port:31001 A/C: 5 R820T-00000014

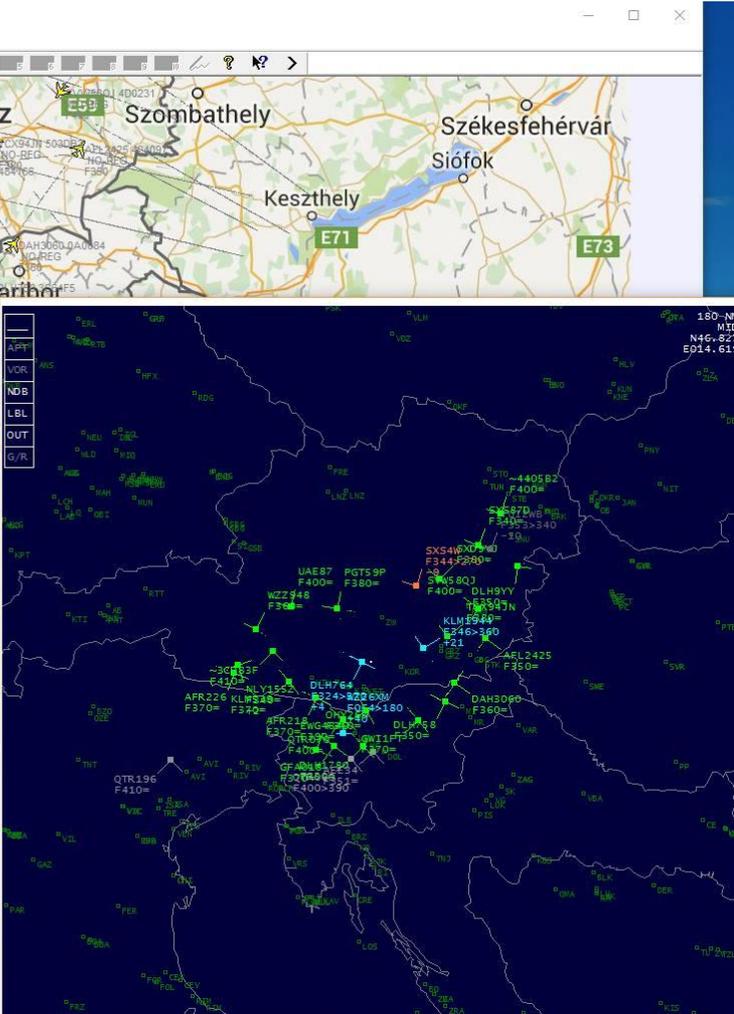
OPEN RTL1090 - (c) jetvision.de - B:161

# 1090.000 MHz STOP

ICAO	C/S	ALT..MCP	V/S	GS	TT	SSR	G*456A	SK	MSGs		
440451		F340						10	2		
3D07CD	DEBEZ	F080			6501			19	6		
0663E1		F350						35	2		
89639F	UAE87	F400	477	283	3271	*	..5	13	5078		
EC4183		F400			7604			34	6		
06A035	QTR060	F400>390	485	141	7112	*	..	22	4233		
48C0CF	SXS87D	F340	478	292	3207	*	..	9	325		
3C6756	EWG4840	F390	462	149	6435	*	..	39	3998		
488670	PGT59P	F380	465	281	5363	*	..	9	4745		
484444	KLM539	F370	477	143	3171	*	..	32	652		
396447	AFR226	F370	467	111	0672	*	..	13	487		
3C64F5	DLH758	F350	468	117	7653	*	..	14	5148		
473188	WZZ948	F360	450	298	1000	*	..	10	5918		
3C5EE7	QWL1FT	F370	473	139	7661	*	..4	22	5732		
506F84		F037			7777			8	56		
488C47	OHY265	F360	445	290	3250	*	..	24	774		
440582		F400	462	288	4536	*	..	11	54		
424097	AFL2425	F350	437	036	0232	*	..	15	6058		
3C0C3F	TUI2WB	F353>340	-	9	478	291	4610	..	10	488	
406016								6	3		
0A0084	DAH3060	F360	475	035	0240	*	..	24	872		
8961E6		F390	474	127	0106	*	..	12	98		
06A0AF	QTR196	F410	511	135	0111	*	..5	7	1242		
3CD83F		F410	421	136	7654	*	..	9	136		
894078	GFA018	F370	469	128	0664	*	..4	39	3227		
4690E1	AEE34	F351	471	138	7630	*	..	17	3859		
48CC85	SXS4W	F344>270	-	8	458	288	3227	..	5	2936	
3C5C4C								6	2		
4D0231	SVN580Q	F400	498	217	6551	*	..4	12	622		
440551	NLY155Z	F340	+	2	432	072	1000	6..	4	8	1375
06A085	QTR070	F400	505	132	7604	*	..5	46	3090		
3C6571	DLH764	F324>370	+	4	437	117	7130	*	..	22	1935
3C0A43	SXD9YJ	F380	458	314	7375	*	..	15	2013		
440C9C	AUA1521	F301>350	+25					6506		19	5438
501D00	CTN4434	F250			6040			..	58	777	
471E49	WZZ60M	F064>180	+40	242	272	6503		..	28	220	
3C6495	DLH9Y	F350	423	100	1000	*	..	10	399		
484166	KLM1944	F346>360	+21	457	326	4607	*	..	20	914	
3C674C	DLH1780	F350	476	136	7116	*	..	50	2941		
48AA74		F370	440	097	7123	*	..	7	42		
5030B3	TCX943N	F380	443	321	3443	*	..	9	847		
484F2E		F380						5	2		
396442	AFR218	F370	479	114	0671	*	..	27	2513		



SPI AUA1521\_NO-REG



List Table Stats WSI Scope Plug-ins RTL1090 homepage

93 ms 871/sec THR:76db [11] Port:31001 A/C:60 R820T-00000001

# Smeti v zraku

L9-66

506F62

Slovenian Territorial Defence Force

Slovenia

Military

Pilatus PC-9 M

PC9

Altitude:  
3955 m

Vertical Speed:

Speed:

Heading:

Distance:

Squawk:  
2402

Engines:  
Single turbo

Species:

Wake Turbulence:

Landplane

Light

Route:

Aircraft is not transmitting its callsign



# Poslušanje ATC

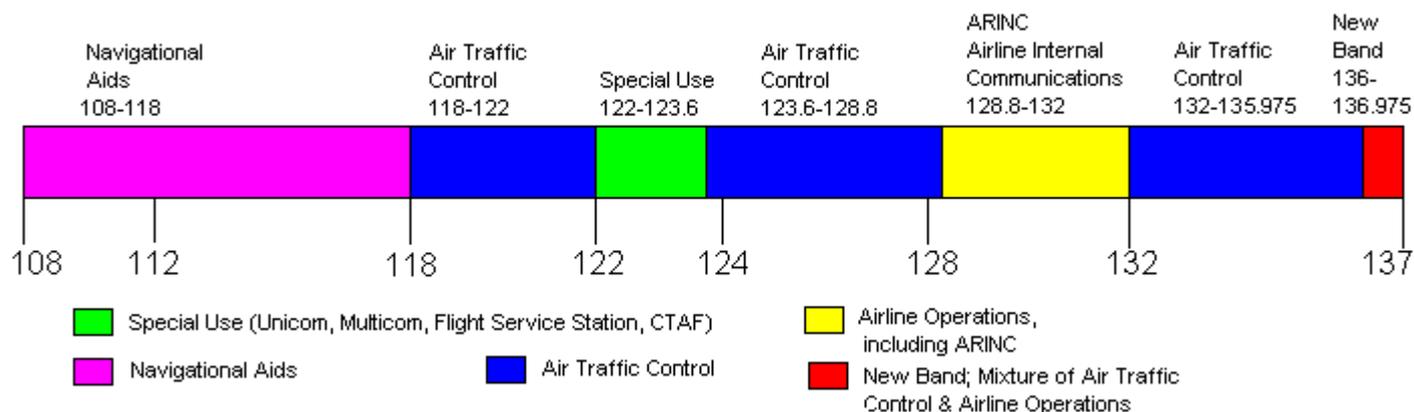
Amplitudna modulacija

Brez enkripcije

VHF 108-137 MHz



## Civilian Aircraft Radio Band



## Approved ATC frequencies for: vACC Slovenia

Callsign	Position Name	Frequency
LJLA_CTR	Ljubljana Center (main frequency)	131.27
LJLA_I_CTR	Ljubljana Information	118.47
LJLA_U_CTR	Ljubljana Center (upper airspace)	128.87
LJLJ_APP	Ljubljana Approach	135.27
LJLJ_ATIS	Ljubljana ATIS	128.17
LJLJ_GND	Ljubljana Ground	121.62
LJLJ_TWR	Ljubljana Tower	118.00
LJMB_APP	Maribor Approach	119.20
LJMB_TWR	Maribor Tower	134.30
LJPZ_APP	Portoroz Approach	124.87
LJPZ_TWR	Portoroz Tower	128.80