

EBU **TECHNICAL**



Open Software Defined Radio for Radio Broadcasting

EBU Webinar
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Mathias Coinchon

EBU TECHNICAL
European Broadcasting Union





Digital radio,
far too complex/costly
for small radios
or experimenters ?



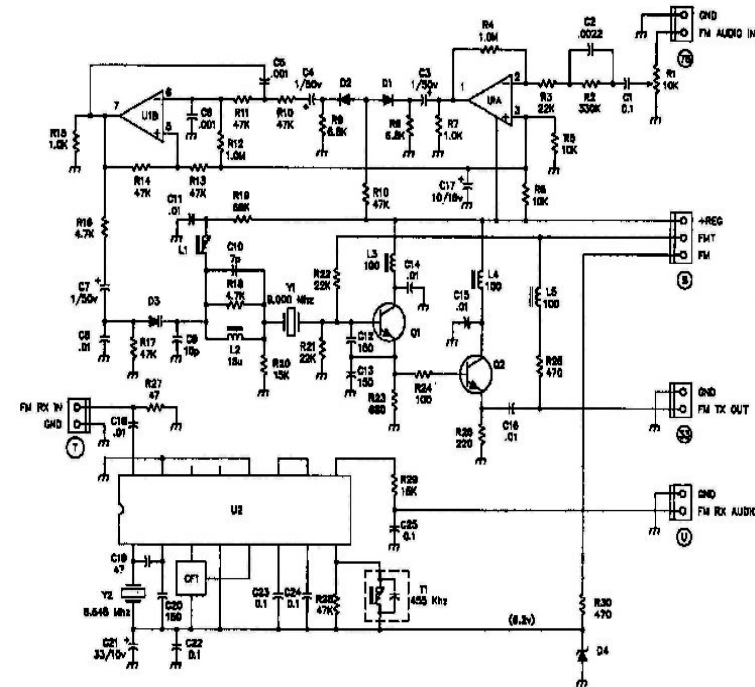
It may not be the case
anymore...
(since the democratisation of
software defined radio)

Software defined radio



Traditional approach of radio transmission/reception

- Specific dedicated hardware
- Low volumes, high prices
- Limited flexibility
- Few possibilities of evolution



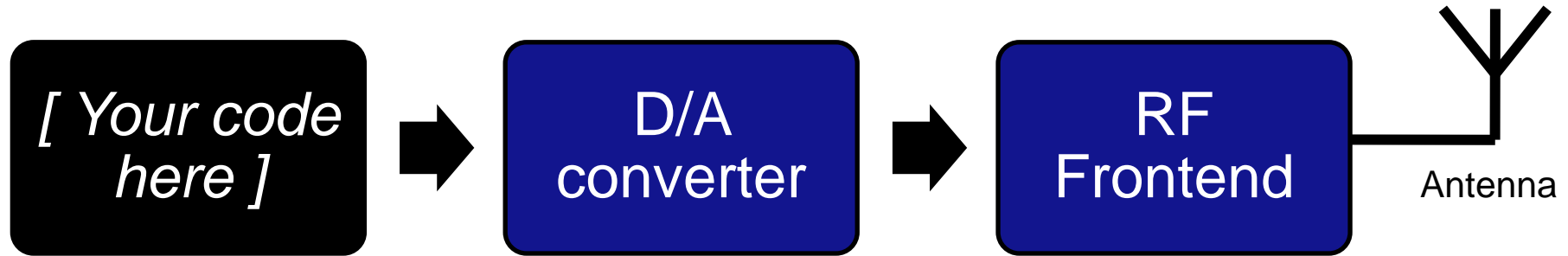
U1: LM308H
U2: LM339H
U3: MP3-3003
D1-D2: 1N4148
D3: 1N5008
D4: 1N700A
Y1: 8.000 MHz
Y2: 8.545 MHz
OP1: CPU4882

REFERENCE DIMENSIONS LAST USER
C25, R30, L4, D3, R2, U2

NOTE: UNLESS OTHERWISE SPECIFIED
1) CAPACITORS IN PICOFARADS (PF)
2) INDUCTORS IN MICROHOURS (uH)
3) RESISTORS IN OHMS AND 1/4W

Output: 400 mV P/P - 13 Ohm load, 9.2 V P/P - Open
with 10 VDC on REG and FMT

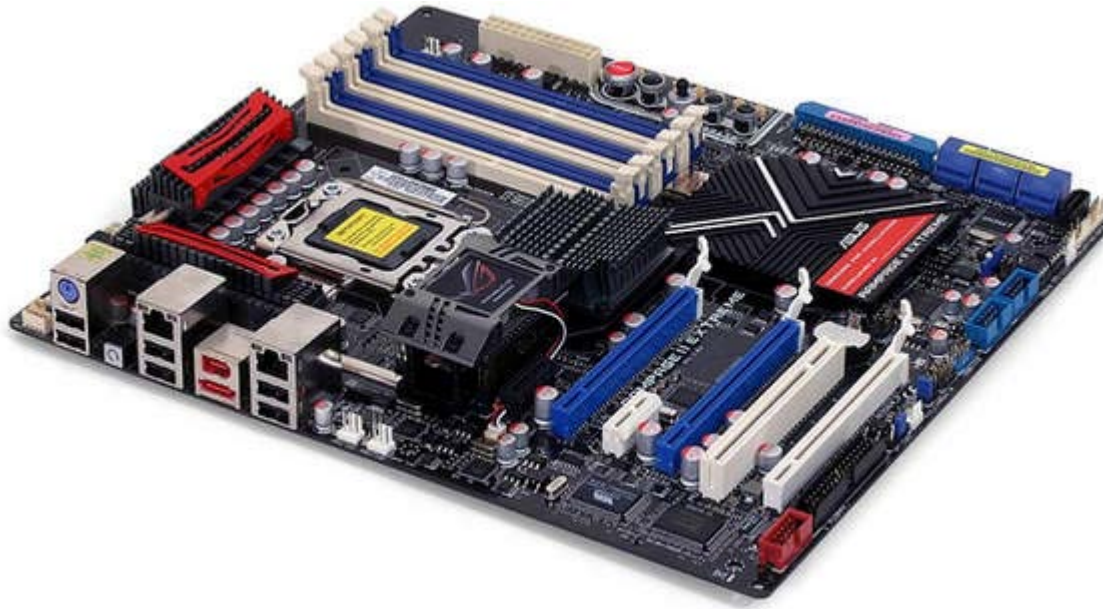
Software Defined Radio (SDR) Principle



- Software (de-)modulation
 - Can run on a standard PC platform
- Generic hardware
 - « Like a soundcard » but for radio waves

=> High flexibility, limited by CPU/Interface

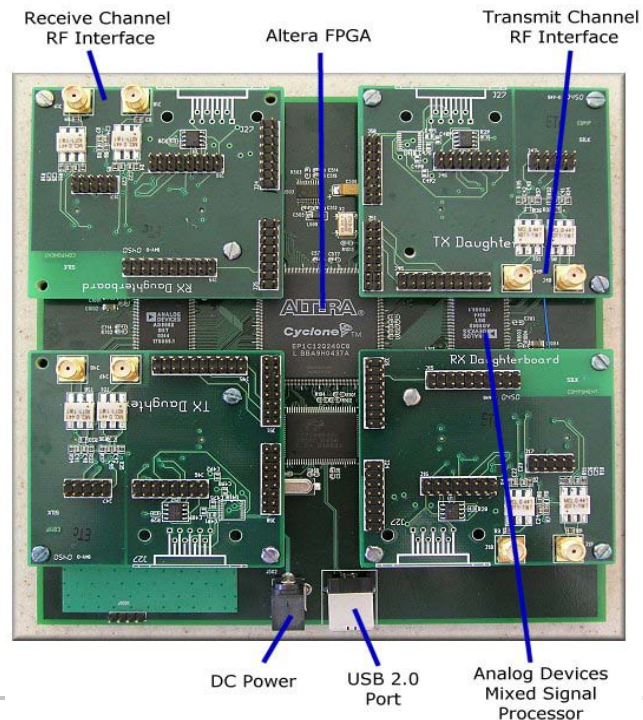
PC platform nowadays



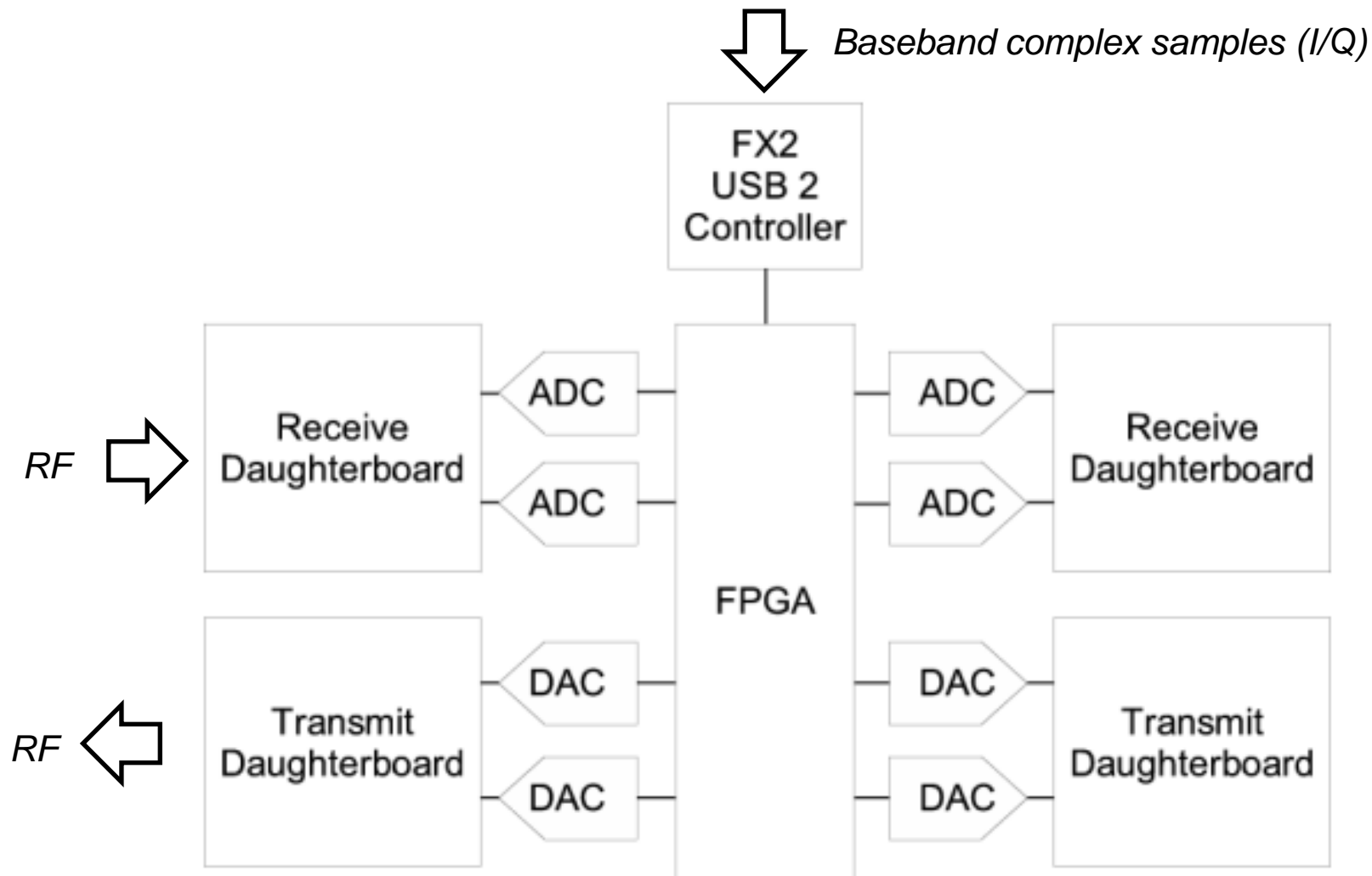
- Powerful enough to perform live encoding, multiplexing and complex modulation (COFDM) on a single PC
- High speed interfaces
- Incredibly low price considering the complexity and processing power

Democratisation of Software Defined Radio

- USRP: Universal Software Radio Peripheral
 - Open hardware solution sold by Ettus for 700\$
 - Schematics, FPGA code available to the public
 - Can transmit or receive signals up to 15MHz BW



USRP: Universal Software Radio Peripheral



What you can do with the USRP and a PC

- FM RDS transmission and reception
- DAB/DAB+ transmission (CRC-mmbTools)
- DRM/DRM+ transmission/reception (Spark, Dream)
- DVB standards, possible but no open projects yet
- Local GSM Network (OpenBTS project)
- GPS receiver
- Aircraft beacon receiver
- Passive Radar
- DECT, RFID, Wifi, etc

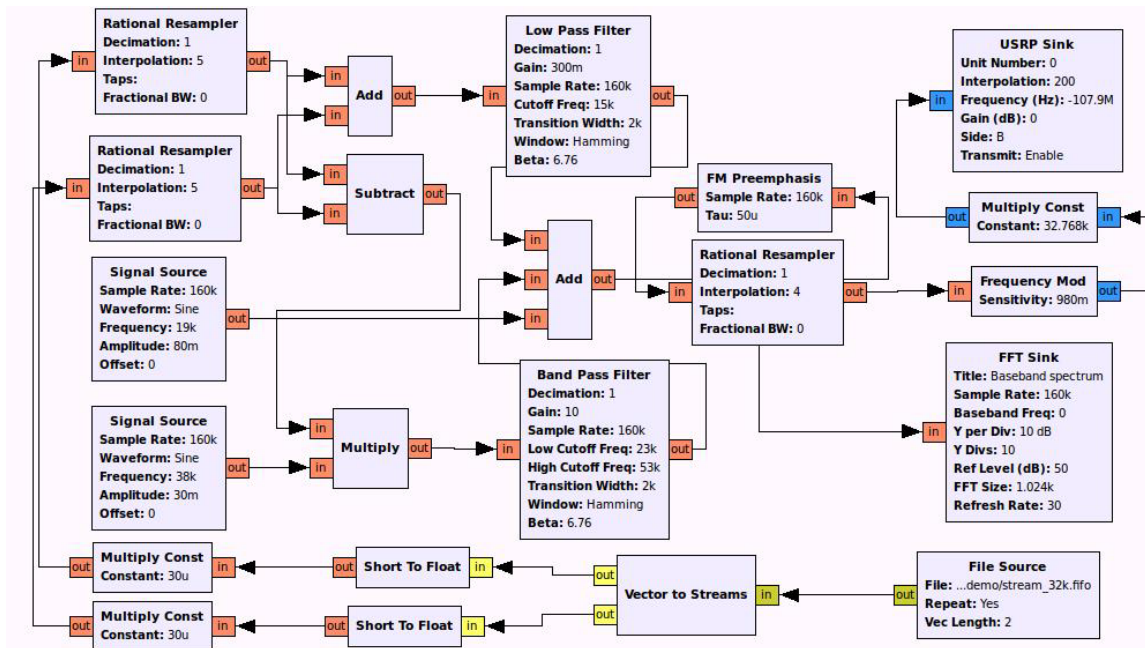


SDR projects for broadcasting



Gnuradio, “The Radio Legos”

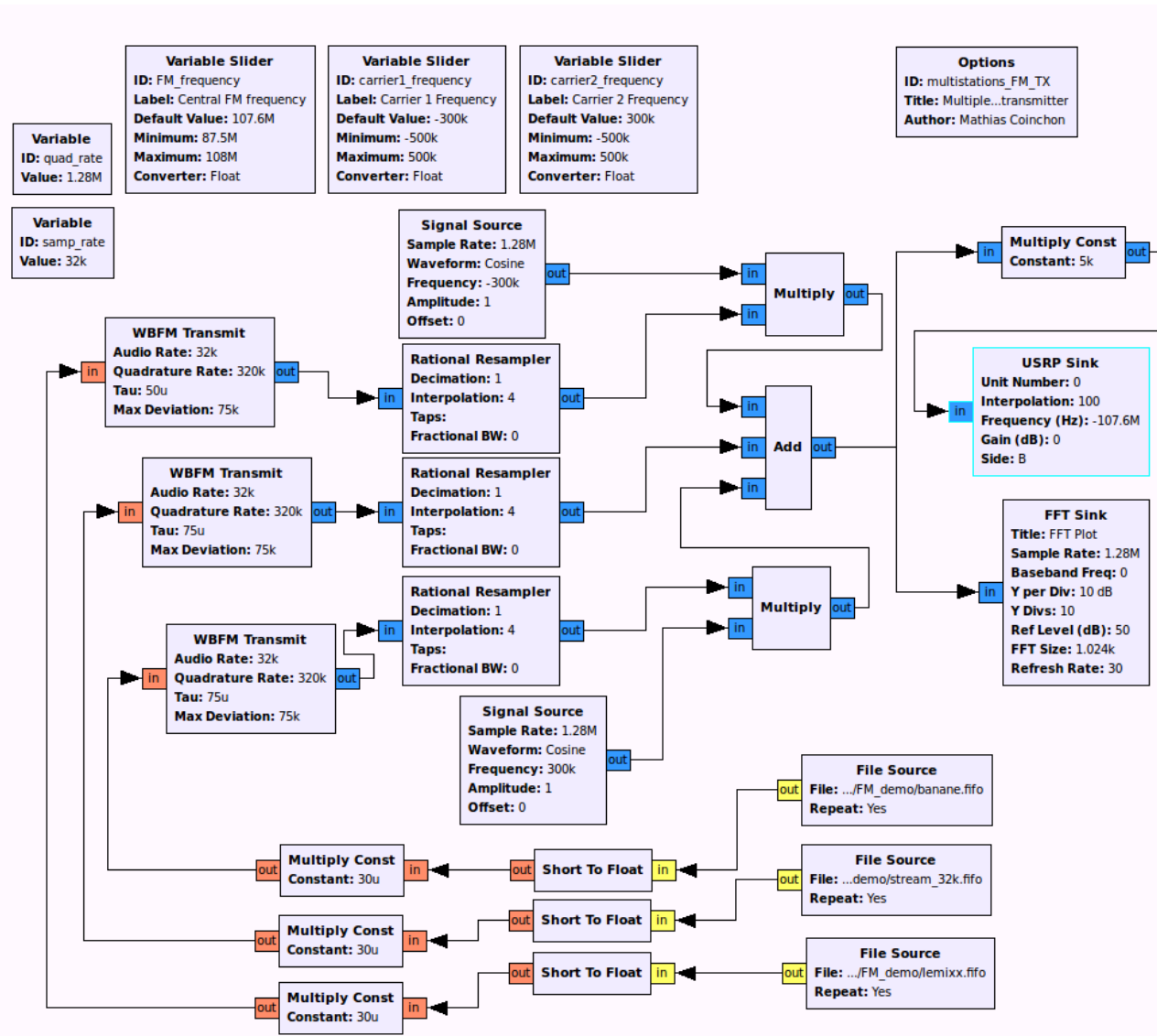
- Gnuradio: open software radio blocks
 - DSP blocks written in C++
 - Interfacing using Python or graphical tool (GRC)
 - Runs on Linux (MacOS and Windows with limitations)



FM Stereo Transmitter



Multiple channels FM transmitter



DAB Software Radio



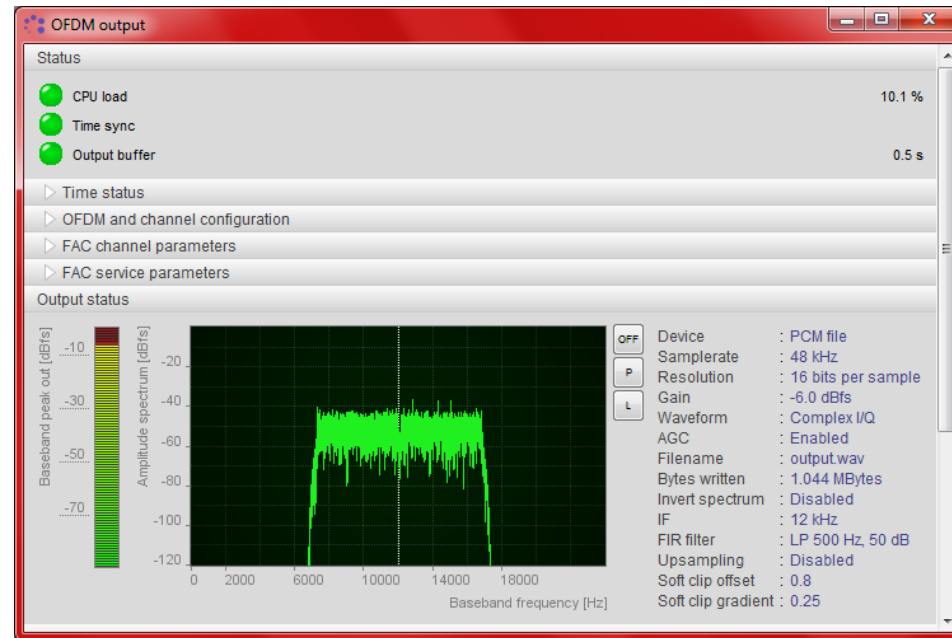
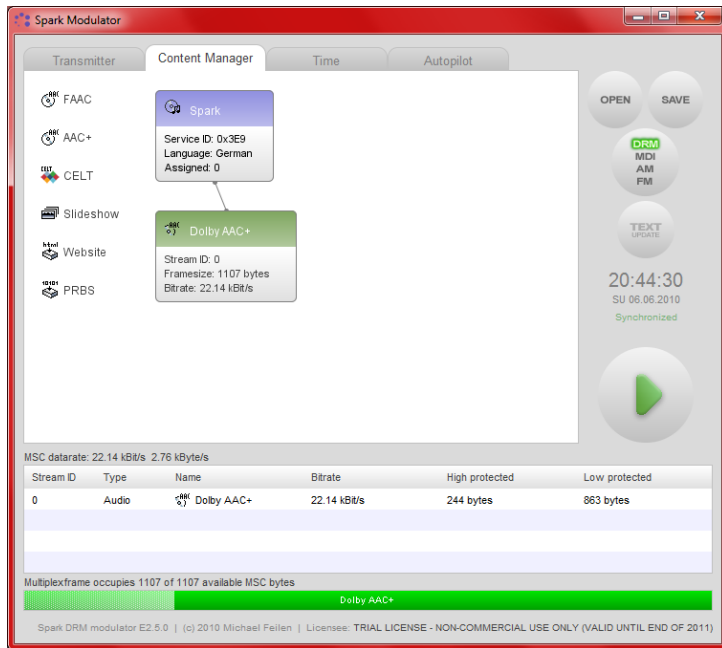
<http://mmbtools.crc.ca>



- Developed by Communication Research Center (CRC), Canada
 - Francois Lefebvre, Pascal Charest
 - First public demo at IBC2006
 - Presented to WorldDMB TC, Eindhoven 09/2006
- CRC-DABMUX: DAB/DAB+/DMB Multiplexer
- CRC-DABMOD: DAB Mode II OFDM modulator (no SFN)
- Other tools for slideshow, CELT, DAB+, etc
- Open sourced in 2009-2010 (GPL license)



Spark



- DRM/DRM+ encoder/multiplexer/modulator
- Not Free/Open but trial and licensed versions (windows)
- <http://www.drm-sender.de>

Practical cases with DAB and CRC mmbttools



Application: Performance at Label Suisse festival

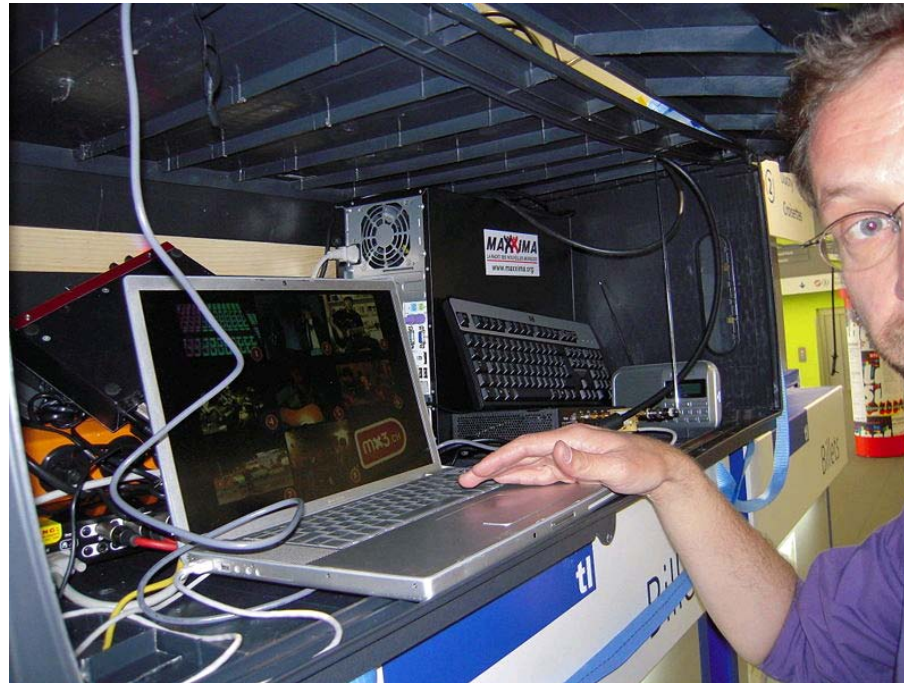


- Live local broadcasting of 8 DAB channels
- Audio from a video projection of 8 music bands playing
- First licensed DAB transmission fully open source



***Warning:
This is not
an EBU
project***

Application: Performance at Label Suisse festival



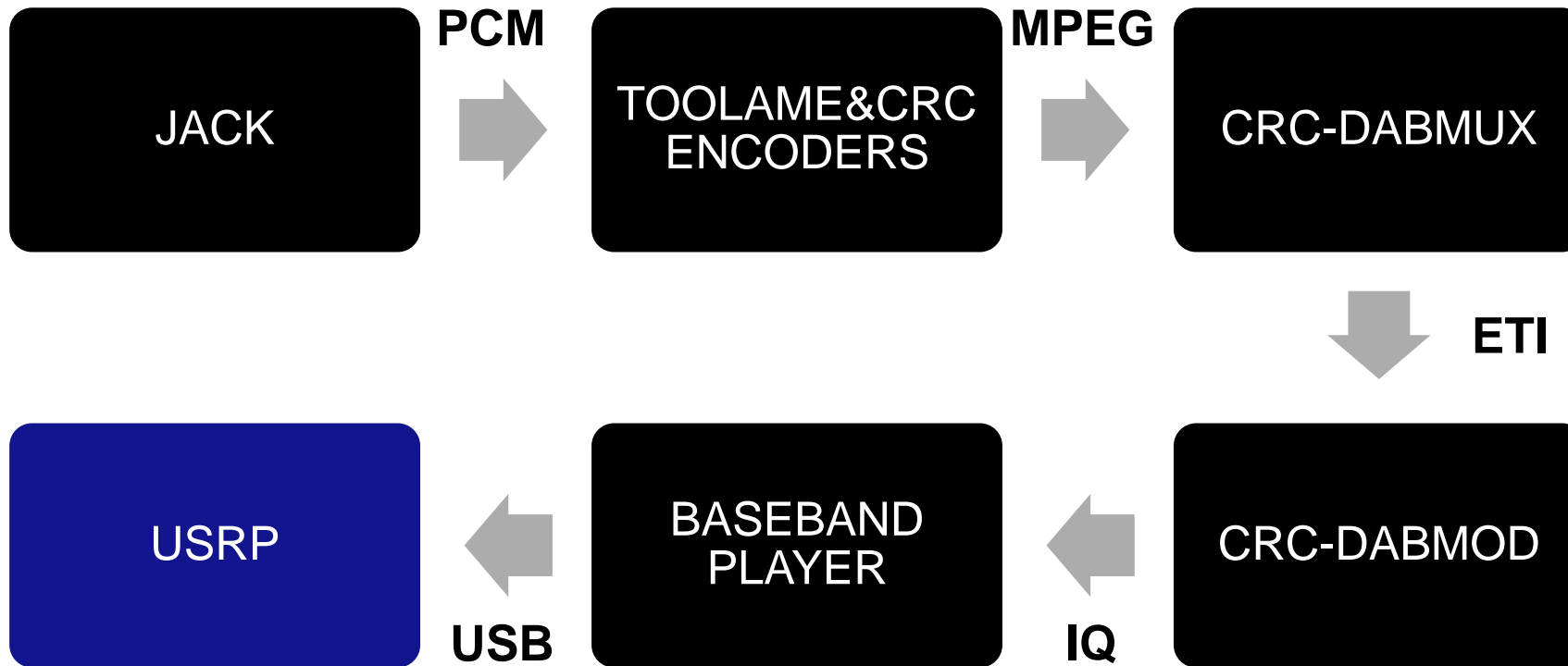
- DAB transmission by Maxxima
- Video projection by MXLab



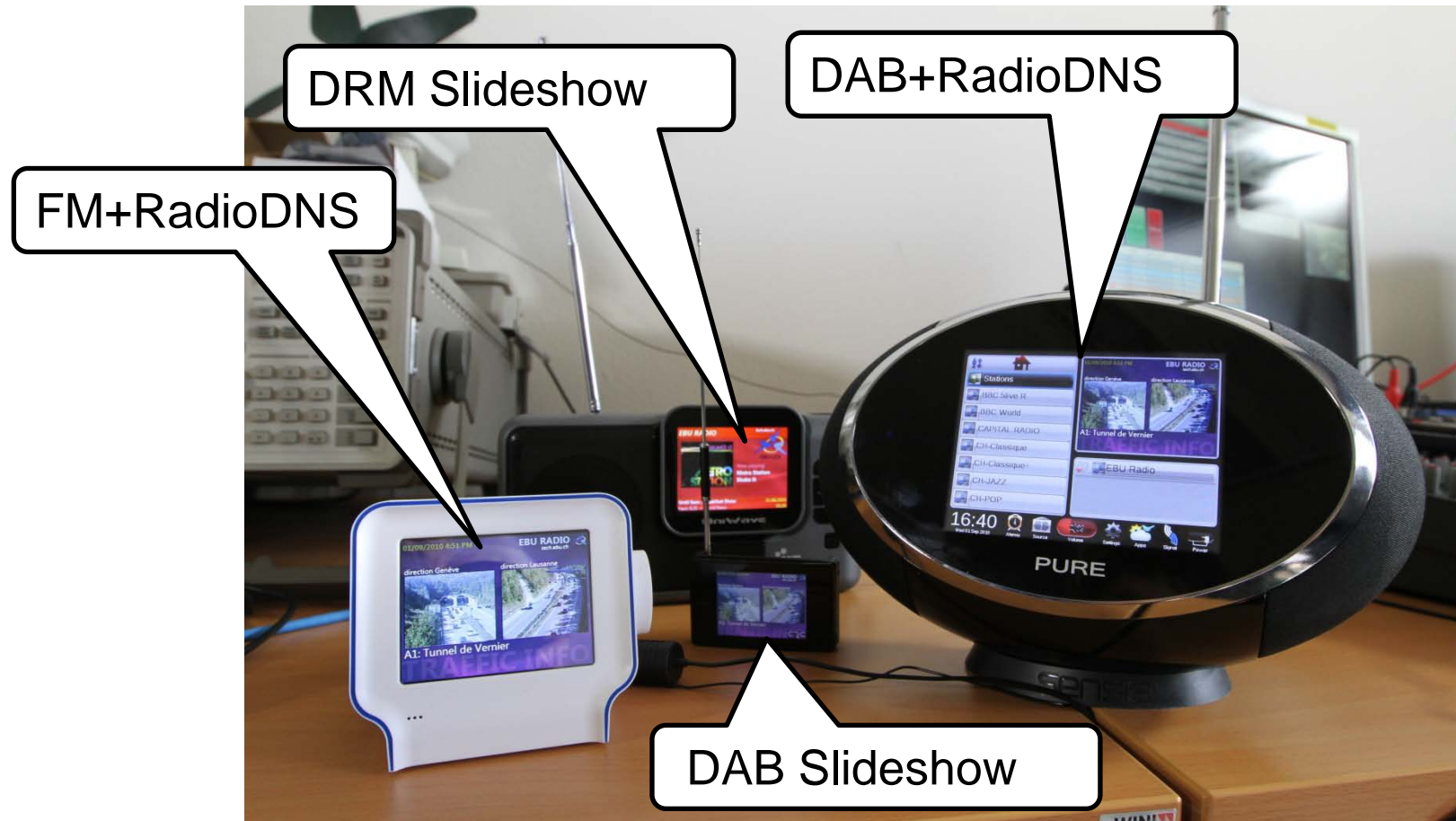
More information on <http://www.opendigitalradio.org>



Integrating open source blocks on Linux



Application: Multiplatform & Hybrid Radio demo



- Generation of DAB (+Slideshow), FM RDS, DRM broadcast signals

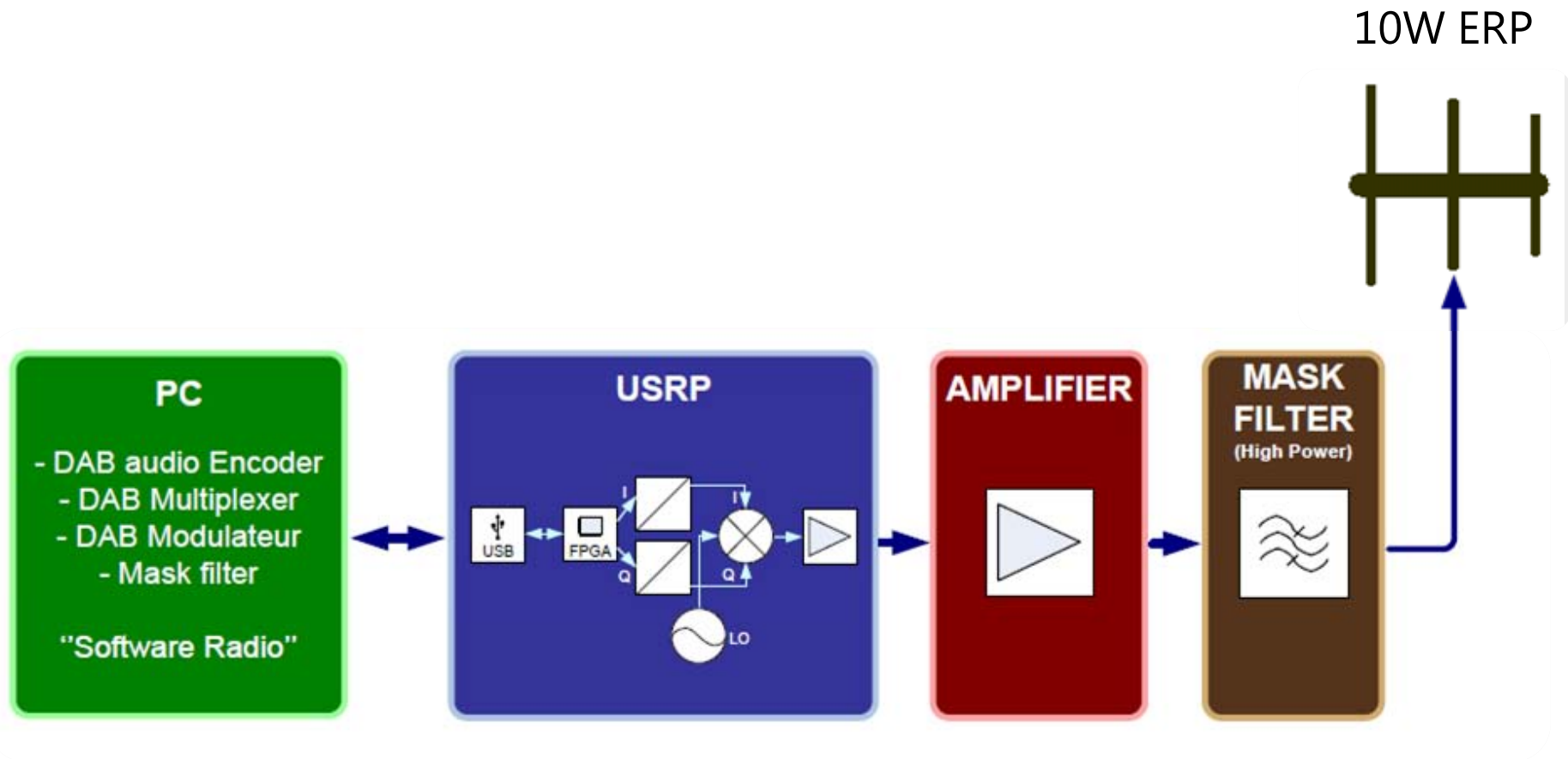
Application: EBU Multiplatform Hybrid demo at IBC



DAB/DAB+ (and FM, DRM, streaming) in a box



Hardware for local DAB/DAB+ transmission



Application: The EBU demo at IBC 2010

- Local DAB coverage at IBC
- DAB/DAB+ live and DMB pre-recorded
- Equipment for DAB transmission:
 - PC: ~800€
 - Linux, gnuradio, CRC-mmbTools: 0€
 - USRP + RF frontend: 1150\$ (~820€)
 - Amplifier 35 Watts CW, 6W OFDM: ~ 150€
 - VHF Mask Filter, 6 cavities: 1300 €
 - VHF 5dB 3 elements Antenna: 300€
 - Small equipment: 100€
 - **TOTAL: ~ 3500 €**



Under development (Warning: not an EBU project)

- Higher power transmission for coverage of a city
- Temporary digital licence (Maxxima radio project)



600W (CW) class AB
amplifier
development
(by Stan Roehrich
Maxxima.org)

MAXXIMA
LA RADIO DES NOUVELLES MUSIQUES

Demo



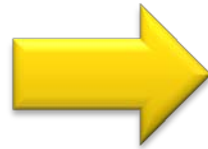
Analysis



Software Defined Radio benefits



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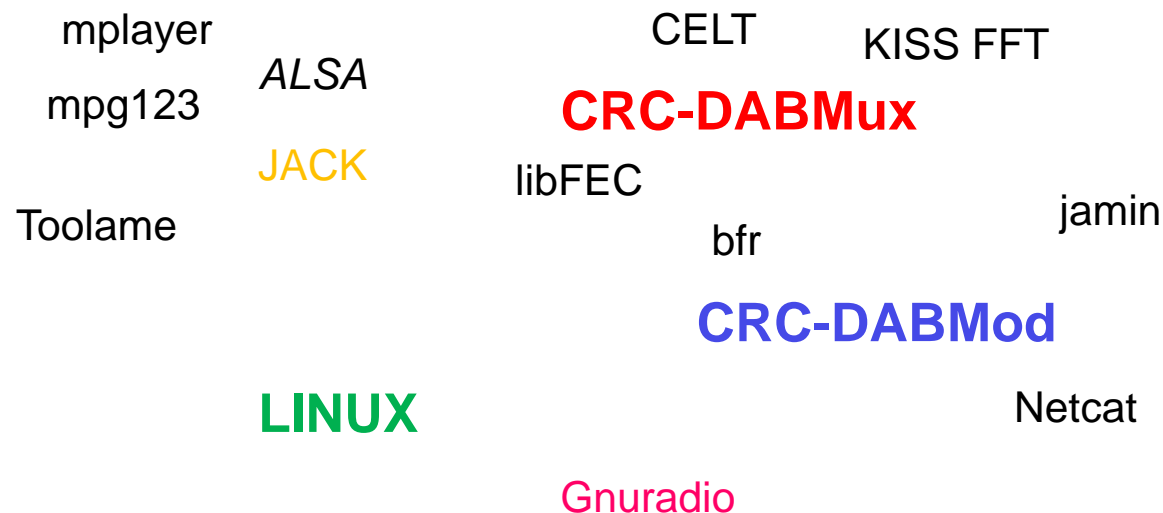


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- SDR lower the costs by shifting to generic hardware
- Enable flexible multiplatform transmission (and reception)
- Still experimental but this could change rapidly...

Open source benefits

- Quick integration by re-using existing blocks
 - Demonstrators, experimentation, developments, etc
- Code can be reused for commercial applications also (as long as it respects the licence)
- Can help to boost adoption of a standard



Implications in the longer term

- Digital Broadcasting transmission gets democratized
- Enabling innovation, local broadcasting, etc
- Lowering costs

Where's the business value in this context ?

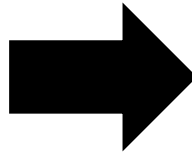
- Turnkey solutions
- Quality hardware for RF transmission (amplification, etc)
- Service and support
- Sophistication (user interface, special features)
- Transmission sites

What about spectrum management ?



Some examples from the past

- FM
 - Used for broadcasting since 1955
 - Democratisation in the eighties => community radio explosion (many of them became today's big private radio groups)
- Audio
 - From separate instruments/effects to software plugins



Conclusion

- Digital radio transmission gets democratised
- This solution is EXPERIMENTAL
 - And we are not selling a solution nor providing any service
- Good for experimentation, local broadcasting, etc
- Not a threat for DAB industry but an opportunity
 - Open/democratised tools enable innovation (Internet example)
- All this is possible thanks to major CRC investment in DAB software now offered as free open source project
- Will you participate to the future enhancements ?



EBU TECHNICAL



Mathias Coinchon
coinchon@ebu.ch

+41 22 717 27 16

