

Software-Defined Demodulation of DAB/DRM+/FM on Low-Cost Mobile Devices



Live DAB/DRM+/FM Reception on Asus Nexus 7 Tablet

Source: <http://www.youtube.com/watch?v=T1EDuezrYVY>

More than ten years ago, Software-Defined Radios (SDRs) like the Dream receiver or the FhG software radio have proven that software-based demodulation of digital radio signals on state-of-the-art hardware is possible¹. Recent laboratory experiments, conducted at the University in Kaiserslautern in Germany, have revealed that the demodulation of DRM+ signals can be achieved in real-time using medium-range multi-core ARM embedded CPUs².

We have taken this approach one step further, by showing a multi-standard SDR receiver for DAB, DRM+ and FM running in real-time on a low-cost single-core ARM embedded platform for 25 USD, known as Raspberry-PI. This demo was presented at the Radio Hack event in February, 2013 in Geneva³ and the audience showed great interest in experimenting with such a platform. However, as the computing performance of the Raspberry-PI is limited, the maximum achievable bit-rate is 64 kBit/s, which might be not satisfactory for MPEG2 audio streams.

In order to show the full capabilities of our work, we've ported our multi-standard receiver to an Asus/Google Nexus 7 tablet and recorded a live-demo of our solution. The Nexus 7 tablet ships with the latest Android release, which does not have support for some of the interface libraries required by our receiver. Therefore, we have replaced Android OS by Ubuntu 12.04⁴, where we have interfaced the RTL-SDR⁵ USB stick, which forwards the RF signal to our baseband decoder stack via TCP. In the video, the EZCAP RTL stick is used in USB host mode for reception, which requires a separate USB OTG adapter. Both, the adapter and the USB stick can be bought together

1 <http://drm.sourceforge.net>

2 <http://www.uni-kl.de/aktuelles/news/article/tu-fertigt-im-auftra/>

3 <http://tech.ebu.ch/events/drs2013/radiohack2013>

4 <http://www.modaco.com/topic/358822-youtube-how-to-install-ubuntu-1204-on-your-nexus-7/>

5 <http://sdr.osmocom.org/trac/wiki/rtl-sdr>

for 20 USD. For mobile operation it is beneficial that the RTL stick can operate fully host-powered and does not require a separate power supply, provided that the tablet or mobile phone provides USB host mode. The sample rates used by the stick are 2.048 MHz for DAB and 1.024 MHz for DRM+ and FM. We would like to remark that the adjacent channel rejection of the RTL stick for DRM+ signals can be poor. In how far this limits the reception performance in the field is subject of further investigation. Since there are no regular DRM+ broadcasts on air, the Spark⁶ DRM transmitter together with the USRP+WBX⁷ signal generator have been used to generate the DRM+ signal, which is received live by the USB RF dongle. In the demo video, DAB and FM signals are received live from Olympiapark in Munich at 222.064 MHz (DAB - Bayern Ensemble) and 94.5 MHz (FM – M45.5).

The key motivation for developing this demo was to determine in how far SDR-based decoding of multi-standard digital radio is feasible on low-cost mobile phones and tablet hardware. As such, the minimum requirements for the receiver to be real-time capable is a 600 MHz ARM Cortex™ CPU with NEON instructions or a 600 MHz Intel CPU with SSE instructions. The baseband decoder is written in highly-portable fixed-point code and BER performance simulations have shown that the DRM+ and DAB receivers can cope even with critical channel scenarios. Hence, we've come to the conclusion that nowadays the question of “which digital radio receiver is the best to buy?” might transform to “which SDR APP is best to download?”.

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www.drm-sender.de

6 <http://www.drm-sender.de>

7 <http://www.ettus.com>