

# Software-defined radios: New Horizons for DXing

By DSWCI 817 Nils Schiffhauer

**Software-defined radios (SDRs) are strongly fading in. They will provide nothing less than a revolution in DXing. Nils Schiffhauer<sup>1</sup>, DK8OK, is observing the receiver scene for almost 40 years. Share his enthusiasm, read his story.**

Semi-professional receivers more hesitantly adopted digital signal processing, DSP. However, nowadays some of them have stepped forward from former digitizing the audio, then low intermediate frequencies to now straight to the antenna. Most striking examples of them not only do convert the whole range of at least 10 kHz to 30 MHz directly from analogue to digital,<sup>2</sup> but they provide a panoramic outlook to a range of up to 400 kHz.<sup>3</sup>

This will result in a revolution of DXing. It will tear the blinkers down, which had stuck us to one and only frequency at any given time. The new generation of broadband SDRs also provide clever recording tools. With e.g. "Perseus" of Nico Palermo, IV3NWV, recording of 400 kHz bandwidth is possible. Ten minutes call for roughly 1,8 gigabyte, scratching with less than 0,4 percent at the capacity of those ever growing internal as external hard disks.



*Good things come in small packages: Perseus even works with this lightweight Samsung Q30*

## Timeless AIR Leh

Where is the beef? Take AIR Leh, 4.760 kHz. Covered by AIR Pt. Blair in the afternoon, this elusive Himalayan maybe caught at s/on on around 02:12 UTC when the easterly Andaman's lying long since in sunshine, and thus have faded out. To catch Leh at this (for European DXers) untimely hour, you recently had to programme receiver and recorder. When replaying, you surely noted to have opted for the wrong sideband. Next night, next try. And so on, station for station.

When DXing the new way, you just record the whole night from e.g. 4.700 kHz to 5.100 kHz. At replaying, you have all the bells and whistles at hand like "DXing live" (save for rotating/switching the antenna ...). You can freely tune within the 400 kHz range, you can change demodulation from AM to synchronous AM to SSB, changing AGC hanging time, switching the noise blanker on or off, plus tailoring brick-wall filters of more than 100 dB stop-band attenuation – sidebands independently – to get the most out of the precious signal. This leads to an unprecedented intelligibility.

So just click in the waterfall spectrum (more on that below) at this rising carrier on 4.760 kHz, optimize filters etc., lean back (in this case with headphones, I have to admit), and just listen. Interference moves? Just move your filter appropriately. After having filed your reception report with the advertisements starting around 02:28 UTC, change to other frequencies. Peru,

Colombia, Cuba – it is just up to you. In addition, you are not clued to your shack. Why don't we do it on the road, as the Beatles suggested 1969? Collecting all details to file a reception report to ELWA, can be done in midsummer's full midday sunshine, even rushing under the Channel from London to Paris.

There – and not only there – you can also loop through those important  $\pm 60$  seconds around the full or half hour. With some luck, you harvest ten definite station identifications from ten different stations on different frequencies at the same time in no more than 20 minutes. Something interesting among? Just rewind, tune into this one, and listen until f/out or s/off. Something overheard because of sub-optimal tuning? Just repeat as often as you want. Record the optimum audio, convert it into an MP3 file, and e-mail it to the station's technical director.

## Waterfall up

What had been a dial, or a digital readout, now is a spectrum or waterfall display. The spectrum marks each station with a little "hill", showing its position in the range, and its level. The waterfall draws lines of carriers and shows the modulation pattern. Broadcasting stations look like those Rorschach tests, whereas digitized speech or multitone transmitter like Piccolo or Coquelet reminded me on punched paper tape, feeding the teletype machine in the 1970s.

From both representations, you can conclude to the modulation, its extent, and its depth. It is very interesting to compare e.g. NBC Kaduna's 1-kHz-tone at s/on with the same of RTV Djibouti at s/on. It tells you a lot on the care; transmitters are serviced and handled with. It also explains why this strong signal delivers a low and muffled audio, and that not too bumping one results in a crisp sound. In addition, it provides an optical assistance in tailoring the filter – regarding upper limit, lower limit and bandwidth.

A waterfall display might be new to you. Soon you will not miss it as a valuable tool showing the characteristics of transmitters, instantaneously informing on an s/off of an interfering station, and so on. I especially treasure its capacity of collecting time. It leads to deep insights if you scrutinize e.g. an afternoon from 3,5 to 7,5 MHz (e.g. with the SDR-14). At a glance, you easily see s/on, s/off, f/in, and f/out. You also can reliably estimate the time of the strongest propagation plus the less interference. Thus, waterfall plus recording of a wide band surely will revolutionize also your DXing.

## 2.500-folded power

There is also another advantage passing by with the waterfall, namely its resolution. It depends on several factors, for there is a trade-off between resolution of time, and resolution of frequency. But normally resolutions in the range of a couple of hertz are easily available, and resolutions in the milli-hertz range do provide propagation studies including Doppler effects, resulting in small frequency changes due to motion on the ionosphere.

For "resolution" can simply be translated as "filter", it has a dramatic effect unearthing stations like ZLXA 3.935 kHz or "The Cross", 4.755 kHz. Long before you can hear any audio, the waterfall display easily depicts their trace. If you are do listen at a 2,5 kHz bandwidth, a resolution of 1 Hz does yield an advantage of factor 2.500 or 34 dB. It is the same effect, as ZLXA transmitting with 2,5 megawatt of power instead of their decent 1 kW. Thus, even with a small active aerial, you can at least see weak stations, even "identifying" them, as long as they do have a specific deviation from the assigned frequency (as with those mentioned examples).

Today's SDRs by far outclass black box radios like e.g. Icom's IC-R1500. Dynamic-wise, they are at least on par with conventional middleclass-receivers. Is this true for e.g. the SDR-14, a recent test of "Perseus" against such celebrities like Telefunken's E1500, Hagenuk's RX1001 and AR-7030 at a 42 m long Windom surprisingly revealed: Perseus is at least on

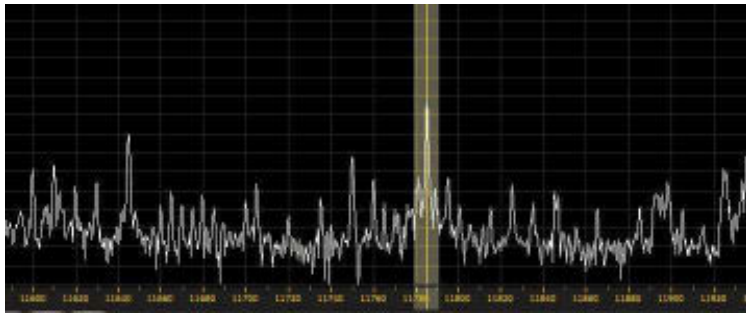
par with the AOR, the now former "Gold Standard" of DXing under around 5.000 Euros.

To prove some aspects of this assertion, I have provided some 50 audioclips, representing almost all vicissitudes of DXing, on a website.<sup>4</sup> They are short MP3 files, giving a real "radio feature" about HF quality and intelligibility of this newest SDR. Pictures say more than words. Therefore, the commented screenshots should stress this text and show, how much fun a SDR can be.

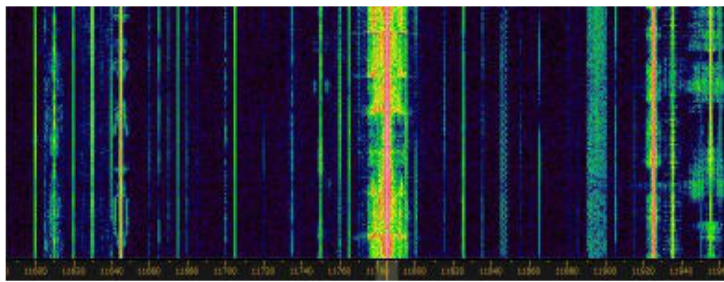
For me, those broadband SDRs are a fascinating tool. Even used like a conventional radio, they deliver a superb reception quality at a comparatively low price. However, you should dive deeper. Because if you fill this technology with your ideas, it will reveal truly new horizons of our hobby.

*Text, pictures, and translation from German:*

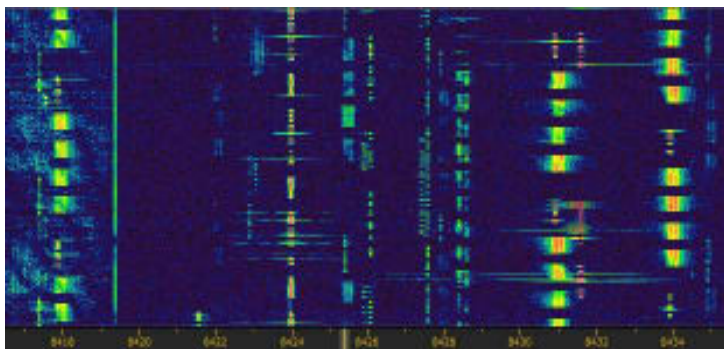
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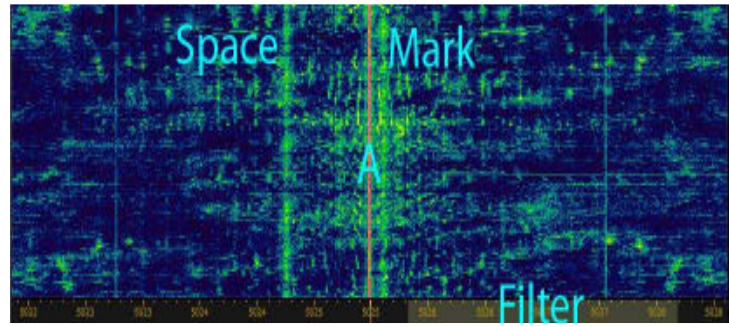
*You are in midst the 25-meter band (Perseus your host), showed here as spectrum ...*



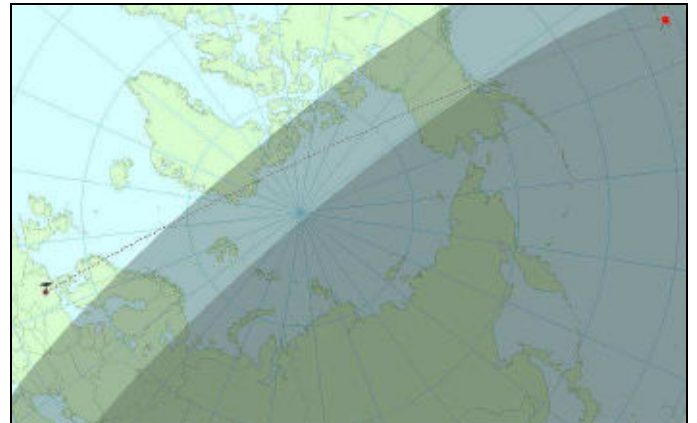
*... and here as waterfall display, each picturing different characteristics.*



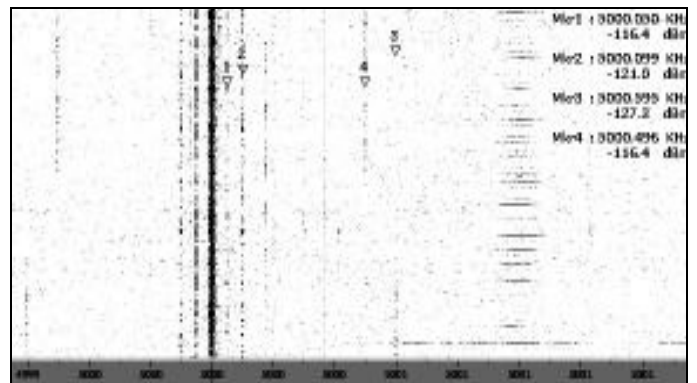
*A waterfall-look into the maritime band at 8 MHz reveals many stations. Just place the mouse, and click. They will be heard and/or decoded by your software like SkySweeper<sup>5</sup> or the like.*



*A waterfall display plus Perseus' flexible filters let you optimize reception very quickly and easily. Here Radio Rebelde on 5.025 kHz (A) is disturbed by an RTTY signal. The filter has been tailored to avoid interference, and getting most from the Salsas.*



*Here the inherent sensitivity of a waterfall display shows WWVH/Kauai during grey line reception at one late-October afternoon. The markers show 50 Hz sub-carrier (1) of BPM Lintong, 100 Hz sub-carrier (WWVH), and the distinctively switched 500 Hz and 600 Hz audio tones of WWVH (3, 4). The vertical position of the markers depicts the level of the associated signals. They are shown above right in numbers – frequencies and levels in dBm, as well.*



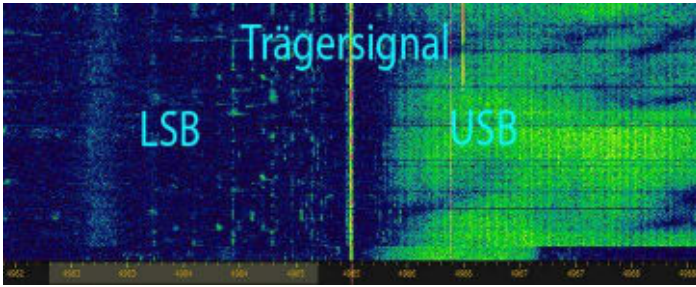
*VE3NEA's DX-Atlas<sup>6</sup> clearly visualizes the grey line propagation between author's QTH in Germany and Hawaii at 15:30 UTC on 22 October.*



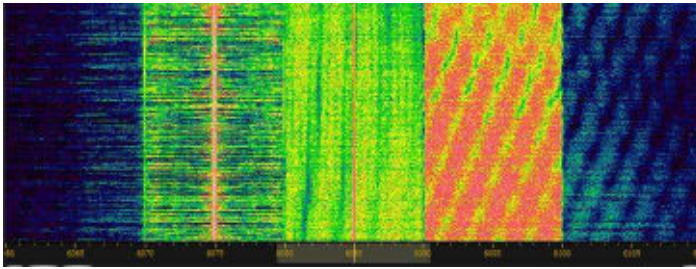
**Our 50<sup>th</sup> Anniversary Badge.**

If you have it, it can be yours by sending 1 IRC or one EURO to the editor-in-chief, Kaj Bredahl Jorgensen

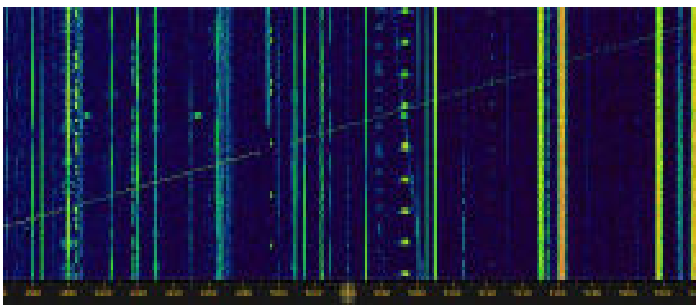




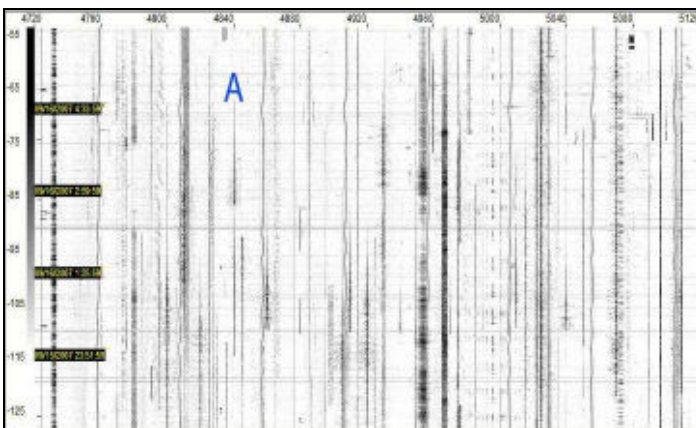
Lusaka 4.965 kHz is a clear case for synchronous AM detection: its upper sideband nearly completely masked by an interfering station, it quickly locks onto the carrier ("Trägersignal", in German). Thus, its lower sideband can be received nearly without interference.



The waterfall display reveals the ever frequency-selective structure of fading, as this snapshot from on AM and two DRM stations in the 49-meter band shows.



Ever asked what this short pitching tone maybe? Most surely it is an ionosonde, a continuously tuned transmitter (speed: often 100 kHz/s) to detect the reflection capability of ionospheric layers. This one omitted the range around 5.000 kHz – as it should, not to disturb time signal stations.



Started around 21:00 UTC (bottom), this waterfall display shows the range from 4.720 kHz to 5.120 kHz until about 07:00 UTC (SDR-14). From carefully evaluation of this picture you can pinpoint s/on, s/of, f/in and f/out for all stations (and: interferers!) in this range – thus deriving the best time of listening.

<sup>1</sup> \*1955, member of DSWCI first time in the mid-1970s (re-entered 2007), DL-0817. SWL and amateur radio operator (DXCC Honor Roll). Receivers: SDR-14, Perseus, IC-R8500 plus Hagenuk RX-1001, Telefunken E-1500 and AR-7030 (on loan for testing purposes)

<sup>2</sup> Among them: CIAO Radio  
[\[http://www.comsistel.com/CiaoRadio/CIAOradio.htm\]](http://www.comsistel.com/CiaoRadio/CIAOradio.htm) FDM77  
[\[http://www.eladit.net/FDM77page.asp\]](http://www.eladit.net/FDM77page.asp)

<sup>3</sup> SDR-14 / SDR-IQ provide 190 kHz [<http://www.rfspace.com/>], Perseus providing with beta software 400 kHz [<http://www.microtelecom.it/perseus/index.htm>]

<sup>4</sup> [http://www.ssb.de/amateur/englisch/perseus/perseus\\_e.shtml](http://www.ssb.de/amateur/englisch/perseus/perseus_e.shtml)

<sup>5</sup> <http://www.skysweep.com/>

<sup>6</sup> <http://www.dxatlas.com/>

### One day on 60 m

Software-defined radios provide recording of a wide frequency range, i.e. 400 kHz with the "Perseus" receiver. Nils Schiffhauer, DK8OK, took a recording of the 60-meter band for 24 hours from November 21 to November 22. It then took several hours to scrutinize this recording, and derive the list with all relevant times (s/on, s/off, f/in, f/out). With Perseus, you can tune within the recording like "live". That is: to tune frequency, change mode and AGC, and play it repeatedly to get some difficult to catch IDs.

Tuning within the recordings is also time consuming. However, it is pure fun to loop through all AIR stations during their nightly s/on "Vande Mataram", followed by their – mostly – clear local ID. Stress had been laid onto Asia and Africa. Thus, some LA station surely has been missed, and still buried in the recording.

Please look at the next page.

### Good news for Tropical Bands DX-ers

The World Radiocommunications Conference 2007 (WRC-07) concluded its work on Nov 16. Held in Geneva, and attended by some 2600 delegates from communications' administrations worldwide, WRC-07 rejected proposals for additional spectrum allocation for the SW broadcasting service in the 4-10 MHz bands.

The need for additional spectrum was intended to support HF broadcasting in North America. This is in stark contrast to the continuing decline in HF services from other regions - during 2007, several international broadcasters closed down or seriously reduced their services, recognizing that SW broadcasting is becoming a redundant obsolescent platform for delivering entertainment, information, culture or news. Many international broadcasters have moved into internet and satellite delivery modes, a trend which will intensify in 2008.

Domestic HF broadcasting is also experiencing a continuing decline, with widespread introduction of VHF-FM now seen as a cost-effective, efficient, and quality medium.... (Padula, Nov 16).

Even though the number of tropical bands stations is declining, this WRC-07 decision means that these popular DX-bands will not be crowded by international broadcasters. (Anker Petersen)

**60 meter band survey by Nils Schiffhauer, Germany  
by help of SDR Radio**

FRQ	STATION	s/on	f/in	s/off	f/out	REMARKS
4725	UNID					IS 19:00, female
4735	UNID			16:00		14:55 mx
4750	Qinghai PBS	22:00		16:00/02:00		at s/on TS, ID in C & E; s/off 02:00 after TS
4750	Bangla Desh Betar			16:00		ID 15:59 "Bangladesh Betar", mostly Qinghai dominating
4760	AIR Pt. Blair	23:52			01:30	s/on with 1-kHz-tone, ID AREPS: f/out 00:30
4760	AIR Leh	02:12			03:15	English news 02:45
4770	NBC Kaduna	04:30				
4780	RTV Djibouti		14:45			19:00 ID (Somali?)
4790	R. Visión				08:30	06:53 ID "Radio Visión" & "La Voz de la Salvacion" (O=3-4)
4800	Voice of China	19:59	12:15	17:31	02:45	s/on with anthem and TS, s/off with anthem
4800	AIR Hyderabad	00:10		17:40/02:15		s/on with 1-kHz-tone, under China; s/off 02:15: local ID in E
4810	Armenian Public Radio					19:00: musical box IS, anthem, ID in Armenian at 19:01:30
4820	Xizang PBS	20:00	12:30		02:30	s/on with TS and ID
4820	La Voz Evangelicá?					SIO 142 in Spanish, after f/out Xizang PBS at 02:35
4835	AIR Gangtok?					
4860	AIR Delhi				03:10	TS, 17:30 news in E (who behind?)
4874,55	RRI Sorong					22:00 "Song of the Coconut Islands", low mod
4880	AIR Lucknow?	00:10				15:00: "Yeh Akashvani ?? he"
4885	Radio Clube do Para				08:10	06:57 ID
4905	Xizang PBS	21:00	12:20			s/on also in E, male and female: "China Tibet People's Broadcast Company"
4910	AIR Jaipur	00:20		17:41	03:15	s/on with 1-kHz-tone, 17:30 local ID, nx in E (also 02:45)
4915	Radio Difusora Macapá				08:30	ID 08:01
4920	AIR Chennai				02:45	s/off with ID, 17:30 nx in E under Xizang PBS
4920	Xizang PBS	21:00	12:20			s/on also in E, male and female: "China Tibet People's Broadcast Company"
4930	VoA Botswana		15:55			19:00 VoA-ID & News, QRM Türkmen Radio (but only in LSB!)
4940	VoA Sao Tome					19:00 VoA-ID & News
4950	AIR Kashmir			02:14		15:00 ID in Hindi?, switched to nx in E
4975	Voice of Russia, Yangiyul					19:00 World Service ID, Chimes
4976	Radio Uganda	01:57			04:30	s/on with S6, but low audio, 04:00 nx in E
4980	Xinjiang PBS	23:30	12:45	03:00		s/on "East is read", ID, s/off 03:00 just before f/out
5010	AIR Thiruvananthapuram	00:20	13:30	17:41		s/on with 1-kHz-tone, ID, 17:30 nx in E, s/off suddenly
5010	Radio Nasionaly Malagasy			19:00	03:40	s/on before 02:20, beating with AIR until s/off or f/out around 02:40
5015	AIR Delhi		12:40	18:31		18:30 ID, nx in E, sudden s/off, Türkmen Radio behind
5020	<del>SIBS</del>					SIBS tried during grey line 07:30 and 19:00, not a trace
5025	ORTB Parakou	16:26				sudden s/on into running px, 19:00 ID in F, E in background (VL8K that day?)
5025	Türkmen Radio					22:00 ID in Türkmen
5025	Radio Rebelde		21:30		10:15	f/in under ORTB
5030	Radiodiff. du Burkina	05:20/17:01		00:00	07:15	s/on 05:20 1-kHz-tone, covering CTR, 05:27 anthem; s/on 17:01 abruptly with mx, covering CHN
5030	Voice of China					16:00 ID (Beijing), TS, in C
5030	University Network,				07:20	English
5035	R. Aparecida				07:10	Portuguese., but no ID hrd
5040	UNID					19:00 weak spurious, Hrvatski Radio?
5040	AIR Jeypore	00:23		17:40		s/on with 1 -kHz-tone, ID, 17:30 nx in E
5050	WWRB	00:00				s/on weak with E ID under Chinese, but getting better soon/vy weak at 04:50, lost or s/off seconds later
5055	NOTHING					no s/on 00:45 Pakistan, nothing LA
5060	Xinjiang PBS	23:30	12:40	18:00/03:00		s/on: TS, "East is Red", local ID in C und E ("China Xinjiang People's Radio Station"), s/off: TS, ID in C, s/off 03:00 just before f/out
5066,33	R. Candip	04:00				S6, well modulated
5070	WWCR	22:59			10:20	listed s/on NOV-MAR: 22:00, ID
5075	Voice of Pujiang?					weak, 16:00 typical TS of Chinese stations, C
5080	<del>Pakistan</del>					listed s/on 02:00: but nothing heard
5100	R. Bana Asmara	03:55				IDs, low modulation