

Monitoring CIS Airports

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Amderma Airport
© Petr Gorbunov



- **Examples (incl. MP3s of 50+ airports)**
- **Propagation**
- **Fingerprinting**
- **Strategies and Net Structures**
- **40+ Screenshots**

Amderma <-> Sy[kty]vkar, 5.596 kHz



Welcome to the World of CIS Airports on HF!

Obviously, there exist more than 200 airports in Russia and CIS, Commonwealth of Independent States, comprising Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan and Uzbekistan; see *here*.

Many of them are small, and many of them seem to be equipped with an equipment providing voice communications on shortwave.

Networks

There are two type of channels: point-to-point between airports and using mostly code names, and air-to-ground/ground-to-air, using clear names. These often just short communications can be heard also by DXers. They often hear both stations, but sometimes only the one calling or the one responding. *This list in Russian* may also help.

Names, Pronunciation

Names of airports are often given as they show up on a map (e.g. „Turkmenbashi“ is called „Turkmenbashi“), but there are several nets using code name (e.g. „Shtat“ for „Sochi Adler“). Sometimes the same station shows up in different nets under its code name and its real name (e.g. Rostov-na-Donu Airport as „Rostov“ in the clear or „Shpora“ behind the veil).

Language used is nearly always Russian, i.e. „Aqtöbe“ (Kazakh) is presented as „Aktyubinsk“, and „Toshkent“ (Uzbek) as „Tashkent“.

Without speaking Russian, it can be somewhat difficult to identify even stations like „Perm“ or „Ufa“. The audio clips should help - also to get the majority of all stations, from which than 50+ are presented here. It's just a start, but, believe me, it had been a not so easy one - although it always had been pure fun. There are several websites to assist you in pronunciation of Russian cities, for a start click *here*.

I never tried to get any QSLs which maybe another effort, others tried and had some luck.

This paper has been written as an encouragement to discover more networks and more stations of these nets.

Use Google or Bing Maps!

Googling each airport, will get you a satellite view of it, a description, and often some instructive photos. One of the most impressive for me has been that of *Amderma Airport* showing a typical regional, small airport and some wire antennas (cage/folded dipoles); not too high, for communications of more some 100s than a few 1000s kilometers. I strongly recommend to back the voices by these photos to enhance the impression from what places your hear these transmissions.

There is also an up-to-date list of CIS airports, *here*. And look *here* for 4.000+ airports worldwide.

Some Audio Clips, a lot of Help

Mostly in late autumn 2014, I collected some audio clips on some networks. **They only work with the most recent version of Acrobat Reader!**

Reception quality differs even more than the ever changing transmission quality. I used *TitanSDR* and *SDR-IP* as receivers and an *active quadloop* of 20 m circumference. Please use headphones for listening to the audio clips, some of them are real DX!

A friendly UDXF member whose Russian is better than mine had been of invaluable help in identifying some CIS civilian airport stations; still each mistake is just made by yours truly.

Some Techniques of Monitoring

As by-catch, I developed some notes on techniques to monitor SSB nets (e.g. recording many channels in parallel and analyzing them by a sonagram), some ideas on fingerprinting their transients at key-on/key-off plus noting their offset from their designated channel and a simple way to document the structure of a net. All these techniques can of course be used also for similar applications – may this be broadcast, amateur radio and data communications.

All in all, I really had fun to write down the results of some week's monitoring sessions. Personally, I had visited only the airports of Tashkent, Bukhara, Samarkand and Urgench (plus Moscow) of the region covered. There's a lot to do in the future, in real life as on short wave ...

73 Nils Schiffhauer, DK8OK, January 2015

Cover: Amderma Airport, Russia, north of Polar Circle, October 2014.
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CIS Aero Nets

By accident, I once bumped into a Russian female voice on 5.568 kHz. This net of South Russia caused my initial interest in this topic. I monitored and analyzed it. The Southern Net on 5.568 kHz (see *Figure 1*) provides an easy start with strong signals and good activity. Monitoring of this net had been done in November, and December, 2014.

Sunrise in this region at mid-November is around 04:00 UTC this part of the year, sunset at around 13:30 UTC. Sunrise at my location is at 06:40 UTC, sunset around 15:30 UTC. The distances between this region and me are a bit below 3.000 km. This should qualify for one-hop propagation at the very best.

Communications usually started with day shift at around 03:30/04:30 UTC. Usually net control Rostov-na-Donu (SHPORA) starts calling for radio check. After that, other stations of the net follow to make radio check with SHPO-RA plus among themselves. Communications is usually restricted to very short radio checks, using their nickname or code name instead of the real name of the city or the airport – see map.

If I've got this net rather complete, I would be happy. Other nets (from page 26) are by far not that complete. Hopefully, they may be filled up in the future.

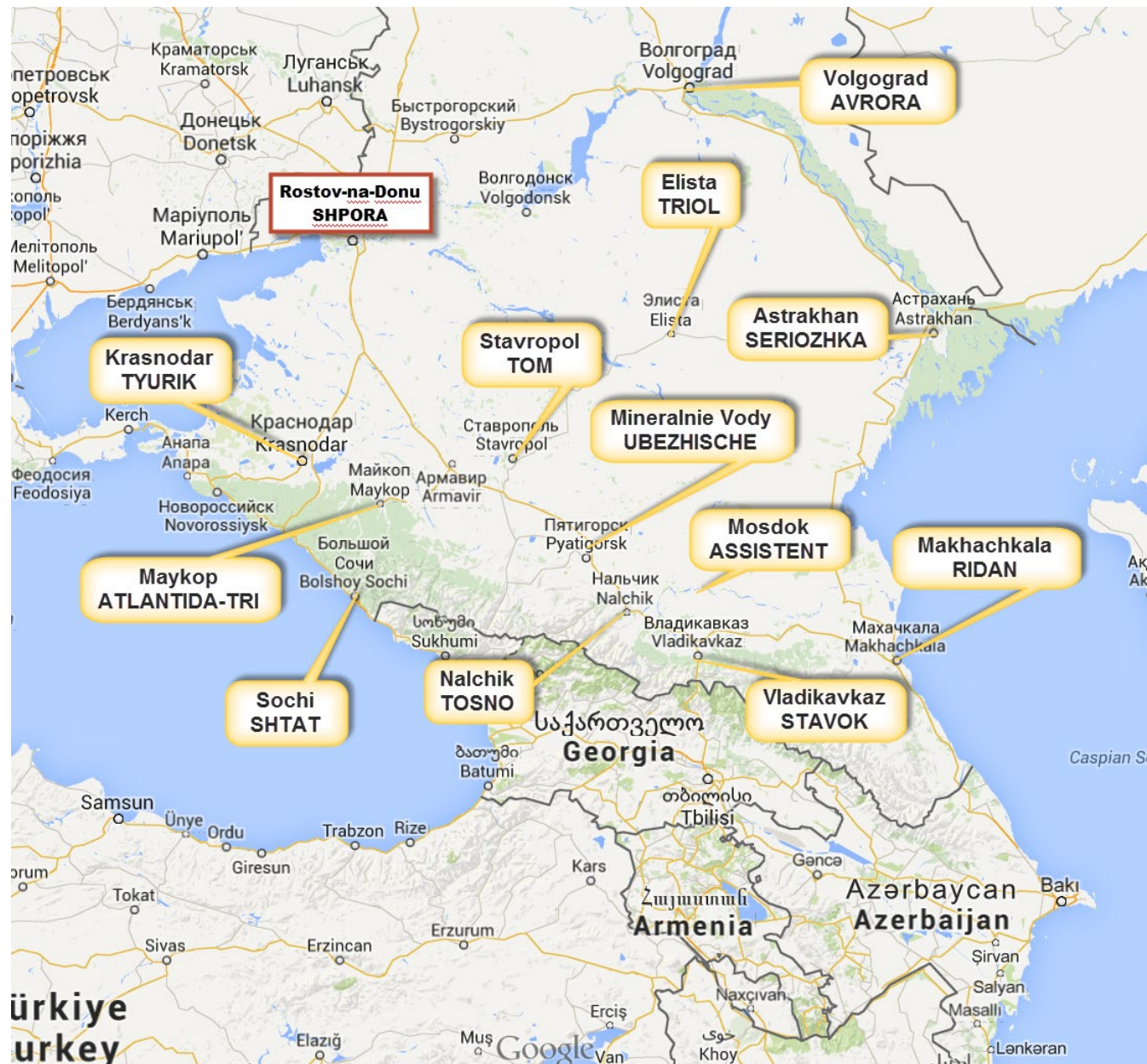


Figure 1: The ground stations of the Russian aero net on 5.568 kHz are located in southern Russia between the Black Sea and the Caspian Sea. This region consists of two Federal Districts, namely South Federal District in the north and North Caucasian Federal District. The latter one consists of six Cis-Caucasian Republics. In this Google Map, I marked the airports I heard in Germany with first their official name, second their code or nickname in CAPS. Net control seems to be Rostov-na-Donu.

Propagation: Does it work at all?

First a look onto the basics of this net: How is the propagation? In the first step, I was interested in the propagation within the net itself. Online tool *LAMP* of Australian's IPS did this job – see *Figures 2* and *3*.

The result: it works just fine in mid-November. The next step is to calculate when there is some propagation between transmitter and me as a receiver. I used *ACE-HF PRO* for this purpose – see *Figure 4*. Modeled was the path from Armavir to my location with 1 kW SSB (the power used at a cage dipole or „dipole nadenenko“ (диполь Надененко) at these stations, as some QSLs of Maarten van Delft do show/tks Max!) and 50% reliability, frequency 5.568 kHz („Channel 03“). Most interesting now is the time, where this net really uses its daytime frequency.

You should do this propagation check also with others nets.

Next step is to program the receiver to record 5.568 kHz from 02:00 UTC to 08:00 UTC, for it's good to have a 60 minutes margin. This recording can be done via audio with any receiver (even: analogue ones) or via a HF recording from a software-defined radio. Start recording at xx:00 (e.g.: 02:00 UTC), because then the re-calculation of the original time from the elapsed time of the audio recording is most easy.

See the following pages for the results, first with *audio recording* from TitanSDR, followed by *HF recording* from SDR-IP.

Figure 4: Propagation on 5.568 kHz between Armavir an Hanover over 24 hours for an SSB transmitter of 1 kW.

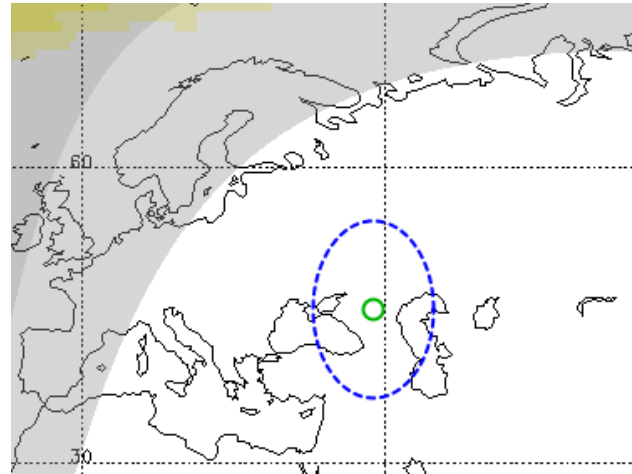


Figure 2: As seen from the net, the ellipse on this map covers the service region. It's in fact a circle of 1.000 km in diameter which had been distorted to an ellipse thanks to the projection of the map.

This „Local Area Mobile Prediction Mode LAMP“ of Australian's IPS will do a propagation prediction within the dashed ellipse for a given set of frequencies over time and distance for a specific date – see figure on the right.

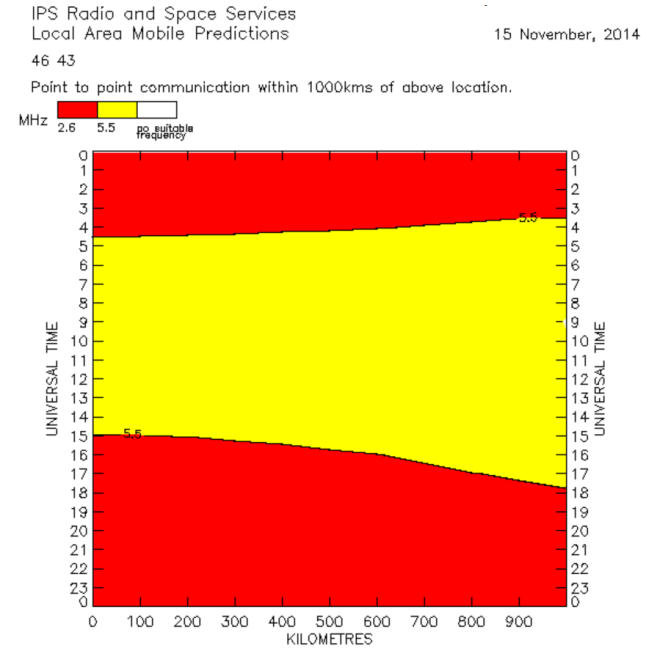
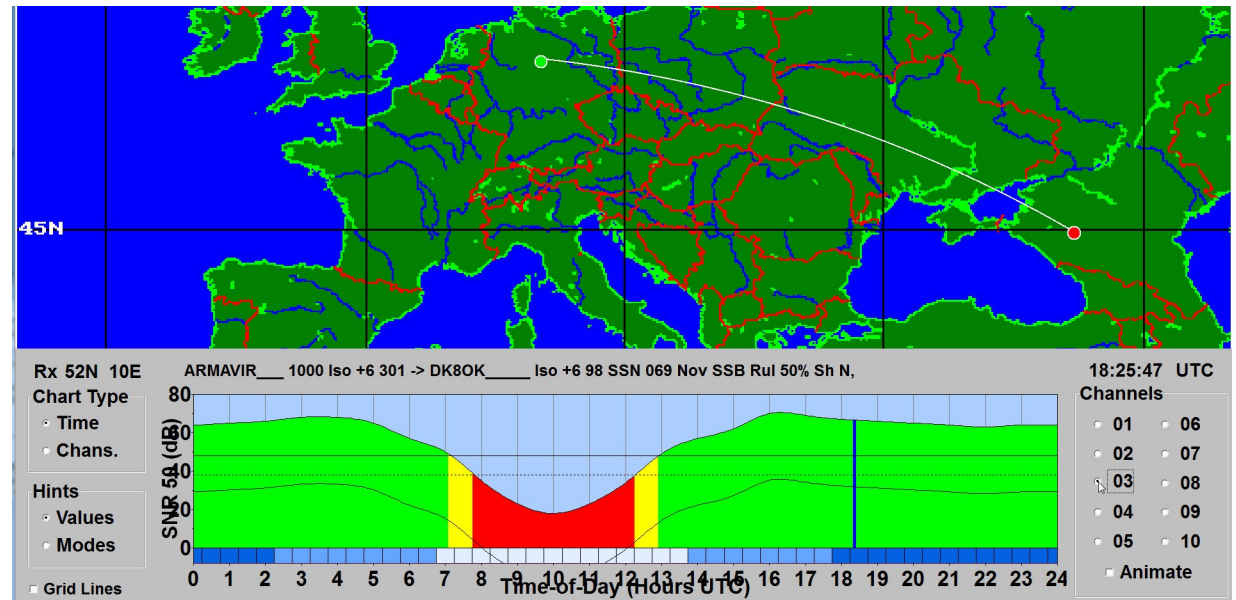


Figure 3: According to HF prediction of IPS, the given nighttime/daytime frequencies of this net (2.655 kHz/never heard/ and 5.568 kHz works just fine in mid-November.



Audio Recording: Play and Annotate

After recording, you have an *audio* file (WAV) of several hours, where you can make out very few activities in vast deserts of noise (*Figure 5*). I used *Adobe's Audition CS6* for the next steps, but you may use any other capable audio software, e.g. *Audacity* (free).

The next steps are to zoom into the parts of activity, to identify the stations and to annotate these clips. These steps are shown in *Figures 6* to *7* (this one: overleaf).

The radio checks are very short. One station (e.g. SHPORA) is calling another (e.g. RIDAN): „RIDAN, SHPORA“. The called station is answering (or not), and saying not much more than „SHPORA, RIDAN“.

Convention has it that the station being called is named first and the station calling at last. This convention is followed in more than 80% of the cases, but not in each one.

With TitanSDR, you may record up to 40 audio channels, also from different HF ranges. This technique has successfully been used to record many CIS-Aero-nets on different channels in parallel and play them one after the other – see page 21.

Audio recording has many advantages over HF recording, but also HF recording has some advantages over audio recording, e.g. manipulating AGC, bandwidth and fine-tuning of the frequency. See from page 18, to have a look onto HF recording and playing.

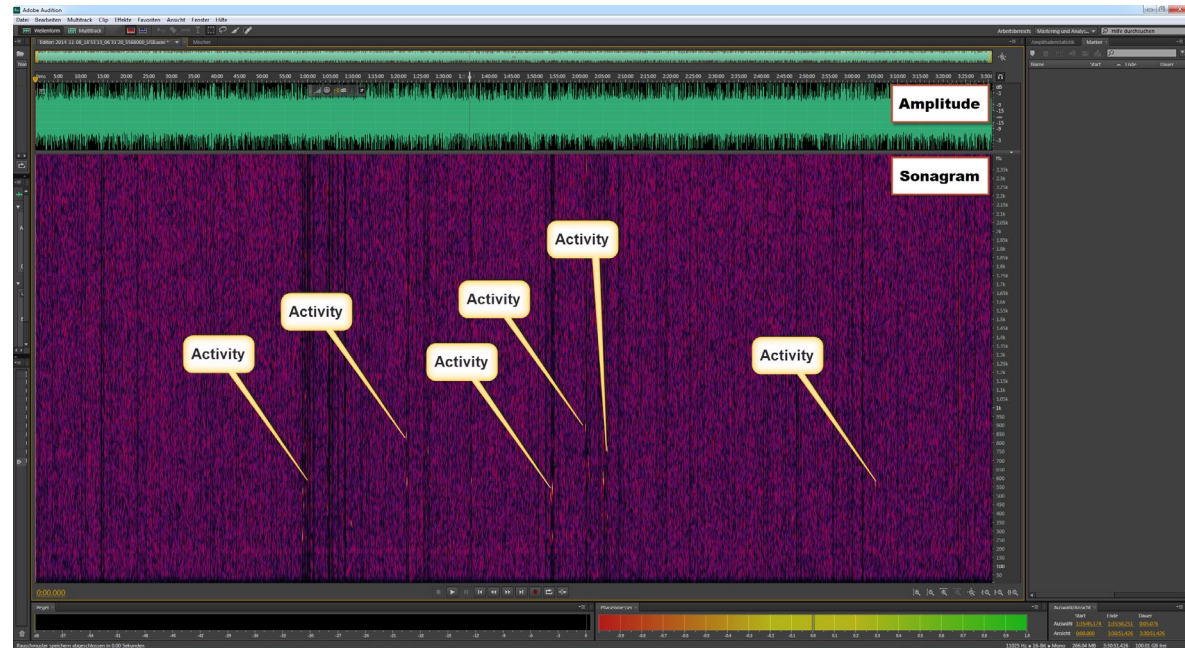


Figure 5: Thanks to the just short activities, you sometimes have to look twice inside an audio file covering many hours.

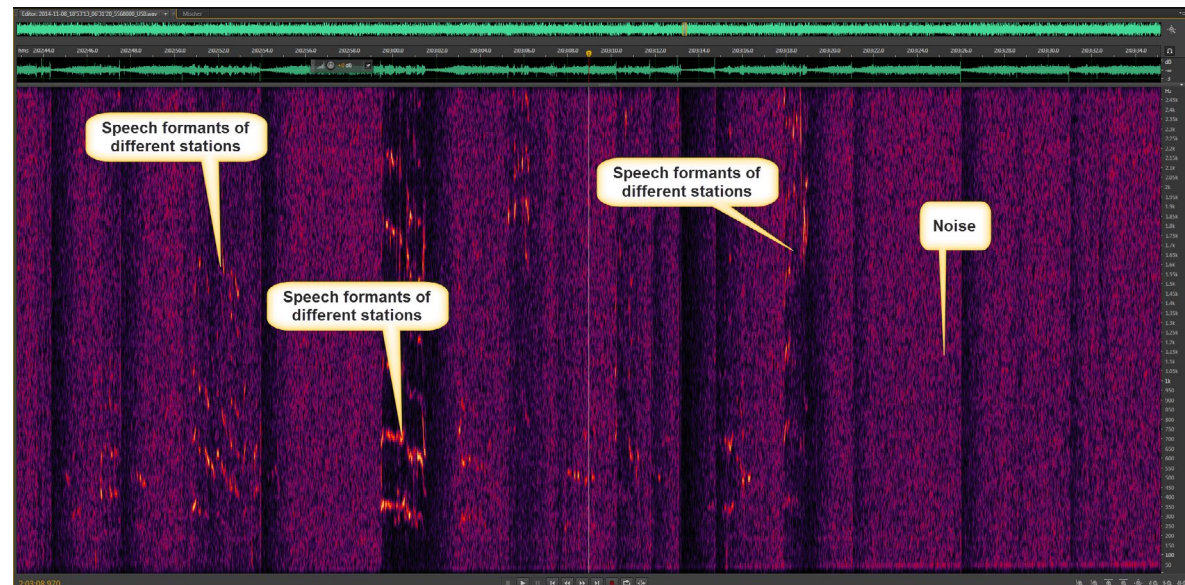


Figure 6: If you zoom into some activity, you clearly see the speech formants as well different signal strength and transmitter's audio bandwidths.



Caveat: All audio clips in this paper only work with the most recent version of Acrobat Reader! Headphones recommended – it's DX!

Figure 7: TRIOL calling SHPORA and two complete radio checks had been annotated above. Click the loudspeaker icon to listen to that part of the clip. Please observe: „TRIOL-->SHPORA“, e.g., means the direction of communications: TRIOL calling SHPORA. Thus, you actually hear TRIOL saying: „SHPORA [called by] TRIOL“.

Log and Annotate

The next step is to „log“ each interesting signal, set a clip marker on its start and end, and to annotate it. This has been done above, see Figure 7.

Audition frames the signal by dashed cursors and let it annotate in the room above. The software also automatically makes up a list (on the right). By just a click, you come back to exactly this part of the clip. You can automatically repeat and even slow down (with pitch retaining) just this part which is very helpful in getting a clue of what was said. Last, but not least, you may save just this part of the clip – as WAV or in a compressed format like MP3.

Interjection:

What Airports doe we can await?

This paper may became part of a future bigger one, dealing with many other aspects of monitoring the airbands. In „the internet“, you'll find a lot of information about this topic – up-to-date and correct to outdated and misleading. A mostly reliable source it *Flightradar24* with updated air traffic. See Figure 8 on the right for an impression.

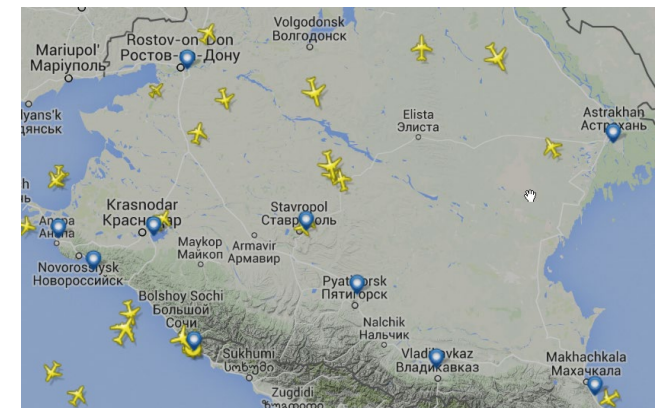


Figure 8: Flightradar24 lists most of the airports in each region with their actual airtraffic. However, not each and every smaller airports and military air base is listed.

What you hear

Mainly you will hear calls for a radio check in a couple of patterns, usually:

- Mostly one station is calling another, this answers giving a report, the initially calling station is closing this communications – or not (Figure 9).
- Sometimes a station is calling in vain (Figure 10).
- Sometimes a station is calling a specific station, but another one answers (Figure 11).
- Sometimes a station is calling a specific station which answers. After exchanging reports, another station jumps in, asking for a report (Figure 12, overleaf).
- Sometimes a station (mostly SHPORA) is asking several stations in a row to answer (Figure 13, overleaf).

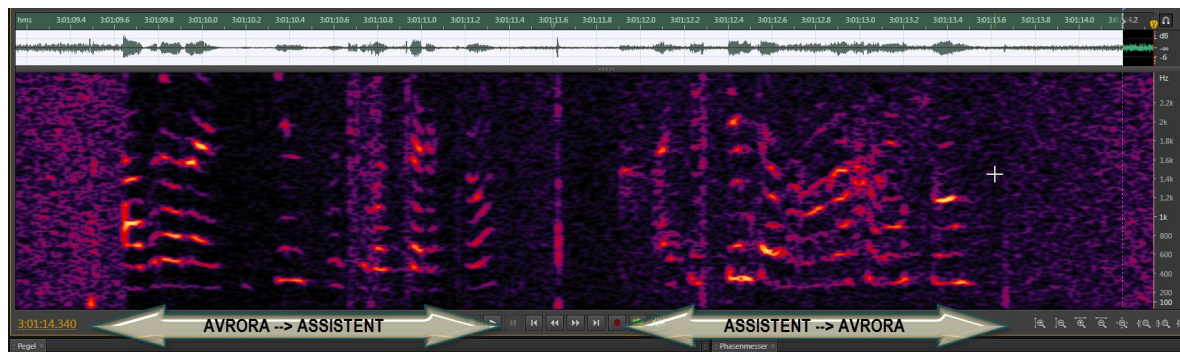


Figure 9: Radio check: ASSISTENT (Mosdok) asking AVRORA (Volgograd) „Do you hear me good?“ AVRORA answering „Good.“

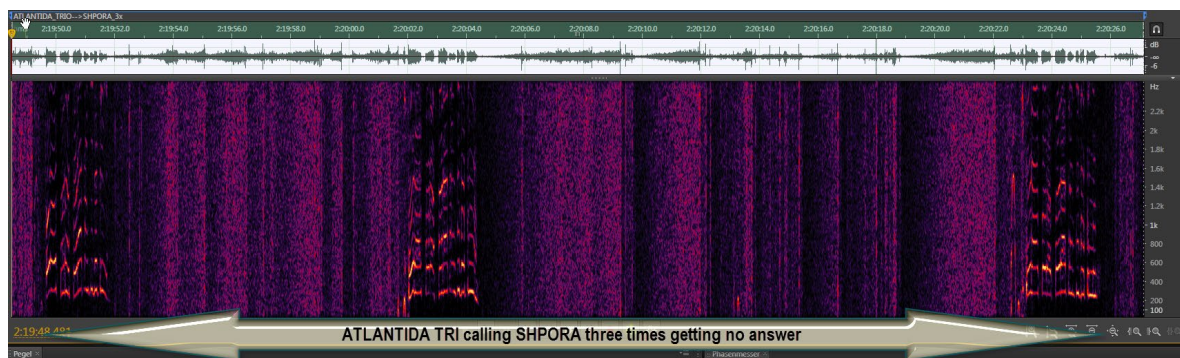


Figure 10: Calling in vain: ATLANTIDA TRI (Maykop) calling SHPORA (Rostov-na-Donu) three times, but getting no answer.

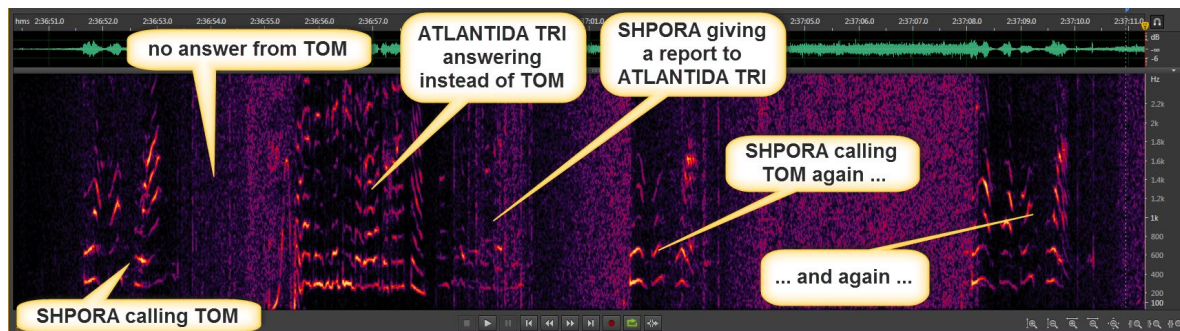


Figure 11: SHPORA calling TOM (Stavropol) for radio check, but getting no answer. ATLANTIDA TRI jumps in, exchanging report with SHPORA. After that, SHPORA again calls TOM – but no luck.

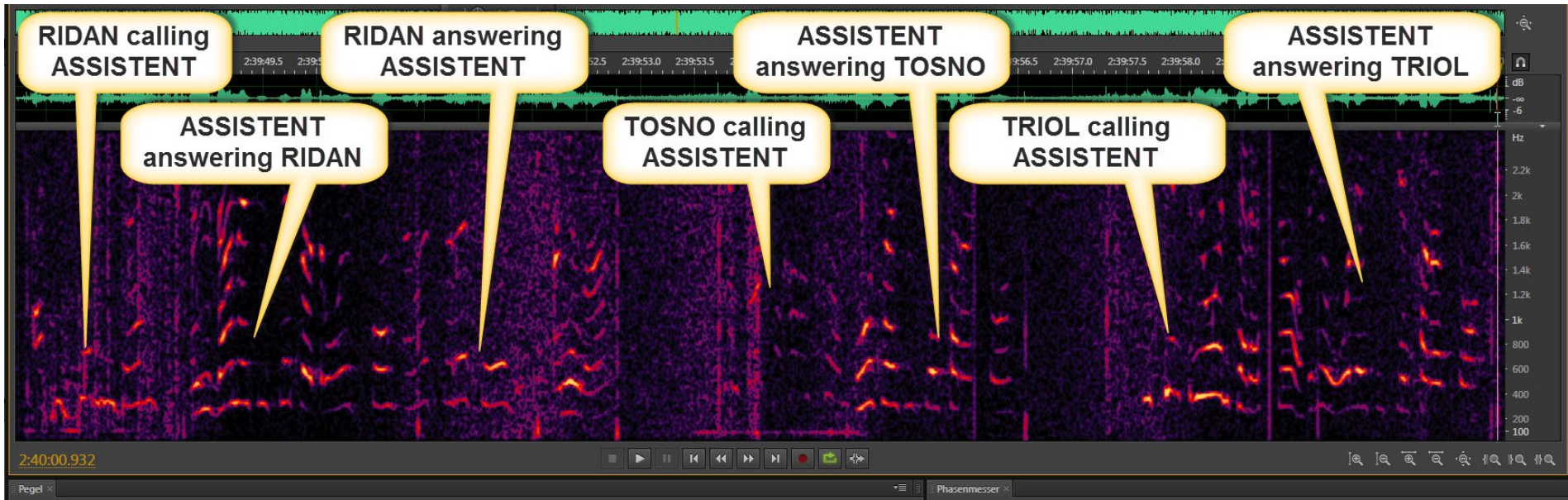


Figure 12: RIDAN (Makchachkala) calling ASSISTENT (Mosdok), they are exchanging radio check. After that TOSNO (Nal'chik) is asking ASSISTENT for a radio check – they exchange it. Eventually TRIOL (Elista) asks ASSISTENT for a radio check – they also exchange reports.

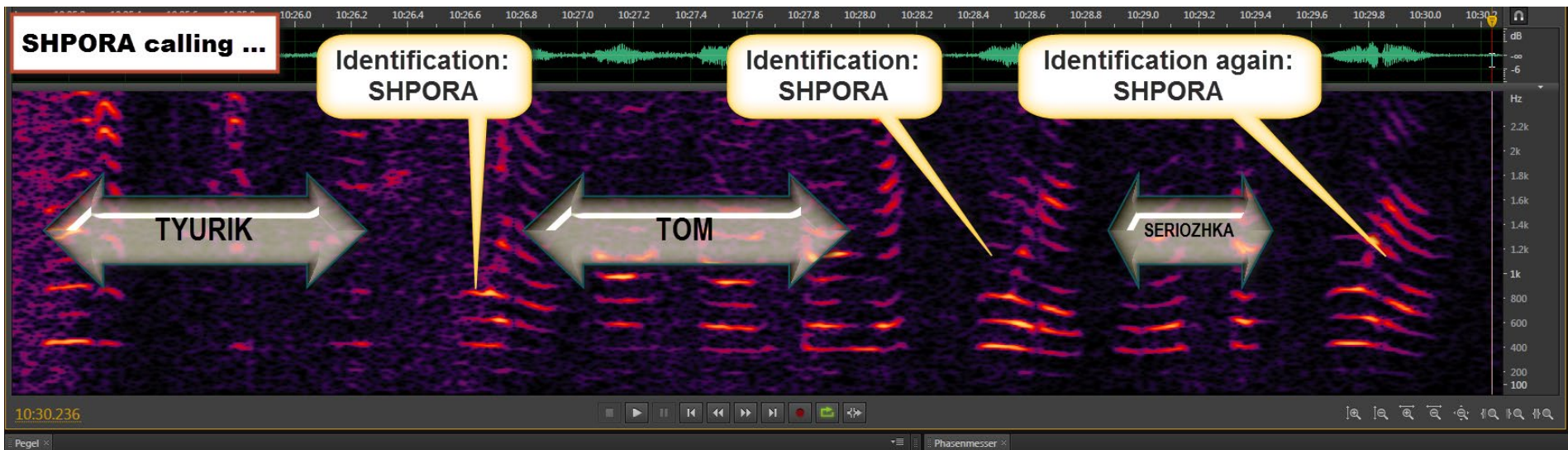


Figure 13: SHPORA (Rostov-na-Donu) calling 3 x TYURIK (Krasnodar), 3 x TOM (Stavropol) and 1 x SERIOZHKA (Astrakhan) for reports.

On 5.568 kHz, I have heard altogether 13 stations. On the previous pages, you will have found eight of them. I do present the five left on this page. These examples should assist you in identifying these voices. They are printed in **bold**.

Just a few words ...

... on the radio checks (r/c) or „proverka svyazi“ (проверка связи) in Russian.

Basic r/c – Airport A calling Airport B:

- „Airport B, Airport A“

Airport B answers:

- „Airport A, Airport B, *khorosho*.“

Airport A finishes the radio check:

- „Airport B, Airport A, *khorosho*.“

Khorosho (хорошо) means „good“ [quality].

A medium signal strength (S3) is reported by:

- *na tri [balla]* (на три [бала]) or
- *[na] troitschko*

And an even lower signal strength (S2) by:

- *dva* (два)

They are no babblers, but sometimes a „good [morning]“ is added:

- *dobroe [utro], khorosho*
(доброе [утро], хорошо)

Or even an „until next time“:

- *do svidanja* (до свидания)

Da (да) = „yes“,

ya (я) = „I, self“ in the sense of „this/here is“,

Prijom = „over“.

Rostov-na-Donu (SHPORA) calling
Astrakhan (SERIOZHKA)
exchanging reports



Rostov-na-Donu (SHPORA) calling
Krasnodar (TYURIK)
exchanging reports



Rostov-na-Donu (SHPORA) calling
Mineralny Vody (UBEZHISCHE)
exchanging reports



Sochi (SHTAT) calling
Rostov-na-Donu (SHPORA)
exchanging reports & et control SHPORA complains that nobody replies to its calls; SHTAT answering that SHPORA's signal is very, very poor – but both are booming into Germany!



Rostov-na-Donu (SHPORA) calling
ATLANTIDA TRI and
Vladikavkaz (STAVOK)
exchanging reports with STAVOK, weak signal



Fingerprinting

Fingerprinting is a technique to identify each individual transmitter by its specific technical features. Another dimension for “fingerprinting” is to recognize even each speaker.

As you see from *Figure 14*, each of the three transmitters shown represents a specific pattern. ATLANTIDA TRI e.g. shows a strong carrier, starting with a unique transient. SHPORA's carrier is much weaker compared to the modulation, etc. Comparing both ATLANTIDA TRI transmissions, you see that the basic transmitter patterns like relationship of carrier to modulation or transient at keying on are the same.

Many of these features can be measured even by amateur means, using a very stable receiver of known absolute frequency accuracy and some software. I am using SDR-IP with a GPS-controlled oscillator as receiver and software like *Audacity* (free), *Adobe's Audition CS6* (350 US-\$, but powerful), *Sigview* (139 US-\$) and *SignalsAnalyzer* for measuring. These should be made with AGC off, especially for the transients.

Measurements can be done on audio level as well as on HF level. To analyze the (suppressed) carrier, you have to de-tune the receiver. If the nominal channel is 5.568 kHz, I recommend a VFO frequency of 5.566 kHz. This transposes all audio frequencies by +2.000 Hz (USB). Hence, you get even severe off-tuning and the carrier which otherwise maybe attenuated by the filters of the receiver – see *Figure 15*. For wider transients, however, a 10 kHz wide window and a transposing of +5.000 Hz should be preferred.

Figure 14: Three different stations on HF level. They show also different features regarding e.g. carrier suppression (right).

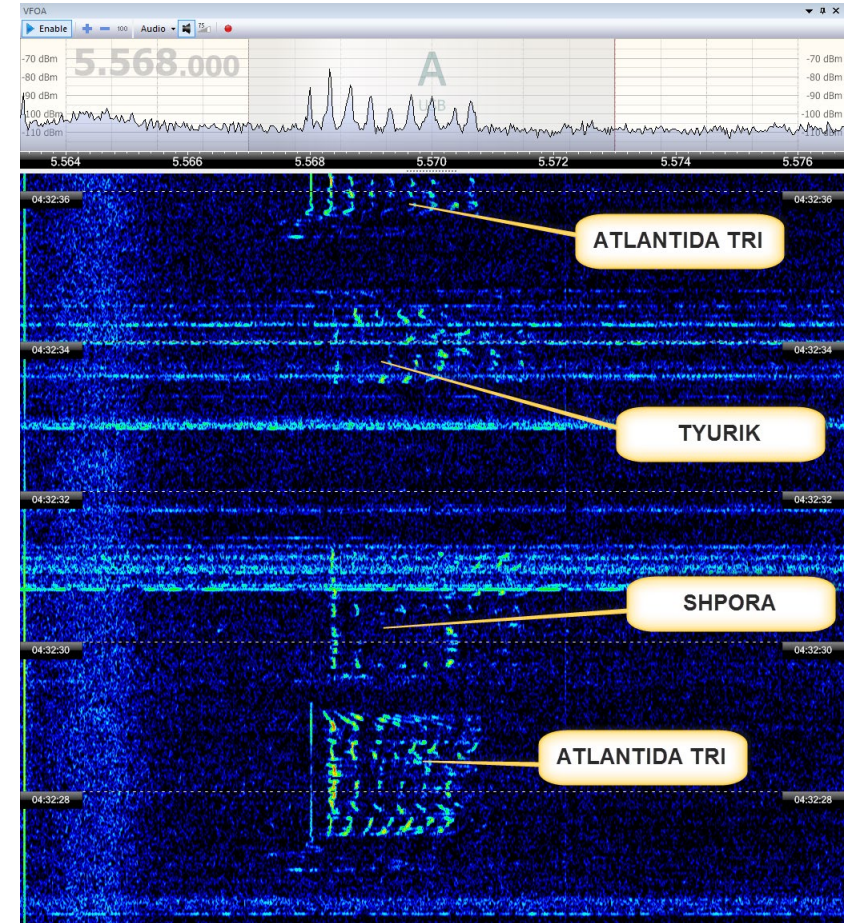
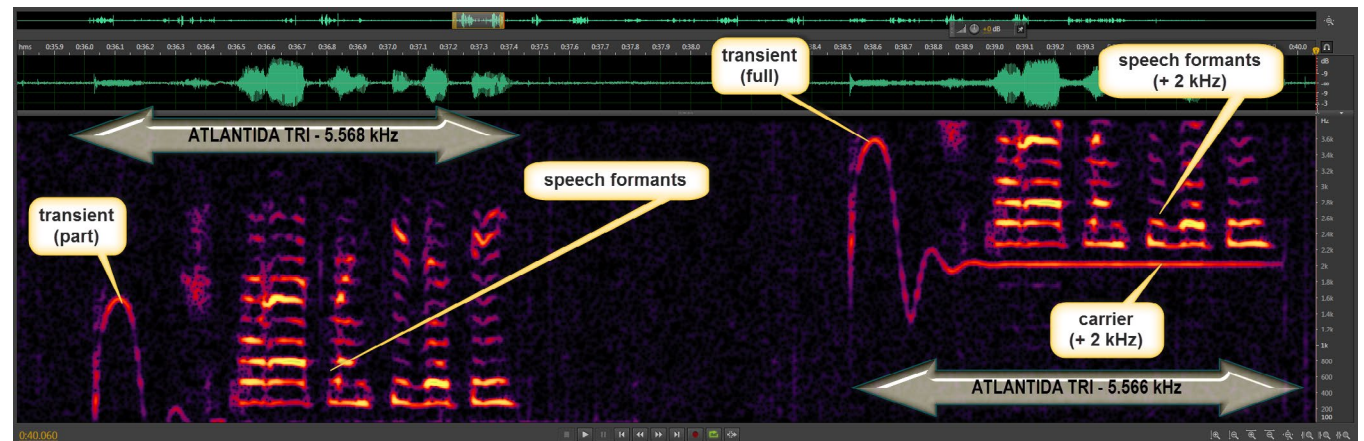


Figure 15: Below, the same transmission of ATLANTIDA TRI, demodulated: first with the VFO tuned to exactly the nominal HF frequency of 5.568 kHz. Then the same transmission, but tuned to 5.566 kHz. In USB, this transposes all frequencies by +2.000 Hz. Please observe that in both transmission, the audio bandwidth of the SDR software has been 0 to 4.000 Hz. Usually, the passband only covers 200 to 2.700 kHz or the like. After transposing by +2.000 Hz as on the right part of this figure, you clearly see the suppressed carrier and its odd behavior at the start of the transmission as a whole.



As it's not the scope of this paper to cover „fingerprinting“ in each detail (stand by for what maybe another paper), I will give here only a few examples on how to measure:

- transients at keying on and off
- attenuation of carrier
- deviation from nominal channel
- passband characteristics of modulation

Transients

If a transmitter is keyed, i.e. switched on or off, it often exhibits short non-stationary signals, or transients. The reason for that is a combination of several effects mostly inside the transmitter, e.g. PLL-locking. Transients are specific to certain types of transmitter's concepts and manufacturers. As many factors do add to an individual transient, they almost certainly differ from each transmitter, even if they are from the same concept, type and production lot. Their visible pattern may also vary by some other circumstances, like time of keying, antenna and propagation.

Transients are measured most easily at signals with a carrier – see *Figure 16* for a first impression of the key-on and key-off transients of Rostov-na-Donu's Volmet broadcast on 6.617 kHz (SignalsAnalyzer), transposed at + 5 kHz.

Key-on transients are often more prominent in time and frequency than key-off transients. Key-off transients maybe that short that they fall under the limit of what a human ear will recognize (<20 ms, or so).

In this paper, transients are measured in frequency (sonagram) and time (oscilloscope).

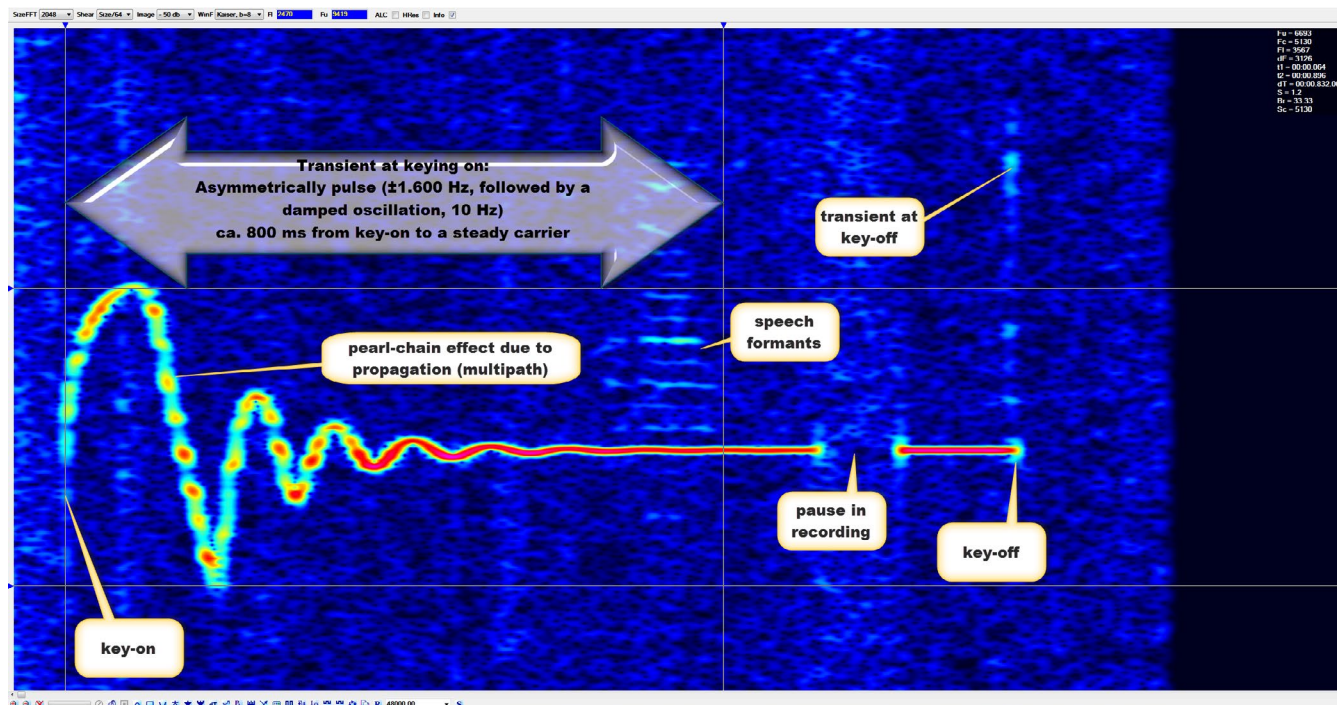


Figure 16: Sonagram of start and end of Rostov-na-Donu Volmet on 6.617 kHz, showing transients at key-on and key-off.

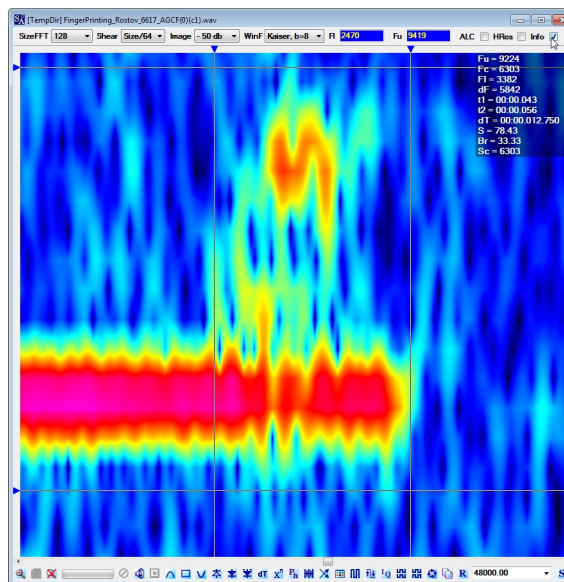


Figure 17: Sonagram of transient at key-off, zoomed.

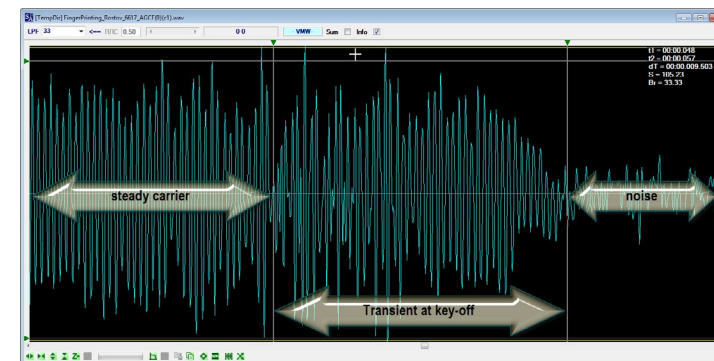


Figure 18: Oscilloscope at key-off. First you see the steady carrier. Due to multipath propagation with its mixed ways, it's not a pure tone. Then key-off starts with a transient and a slightly falling frequency, followed by noise after the transmitter eventually had been switched off. Time measurements of these pulses are difficult due to their short time of mostly under 10 ms and thanks to multipath effects which are lengthening a pulse, and „modulating“ it.

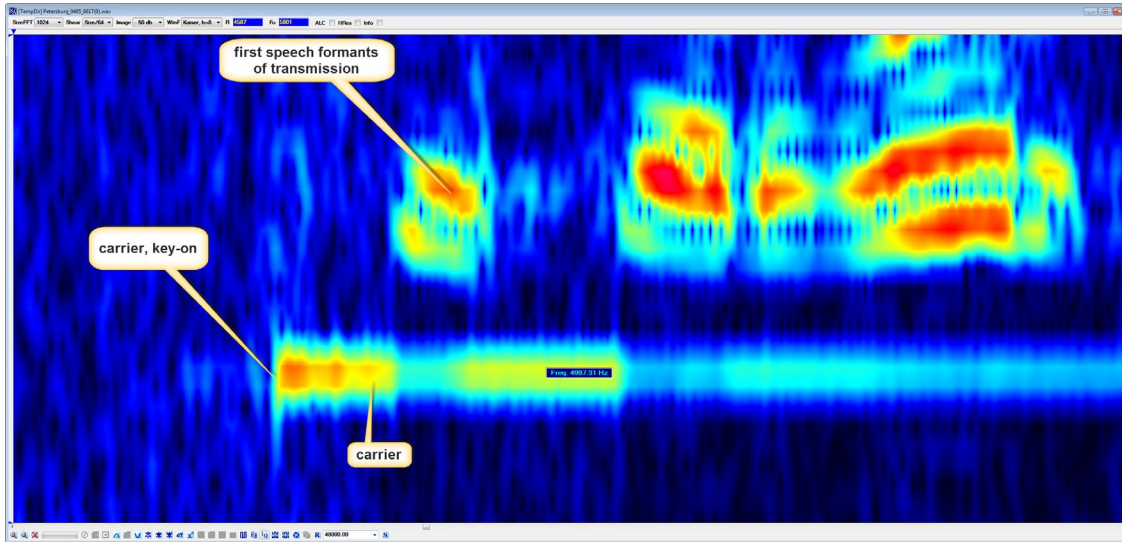


Figure 19: Obviously no detectable transient at keying-off Petersburg Volmet on 6.617 kHz.

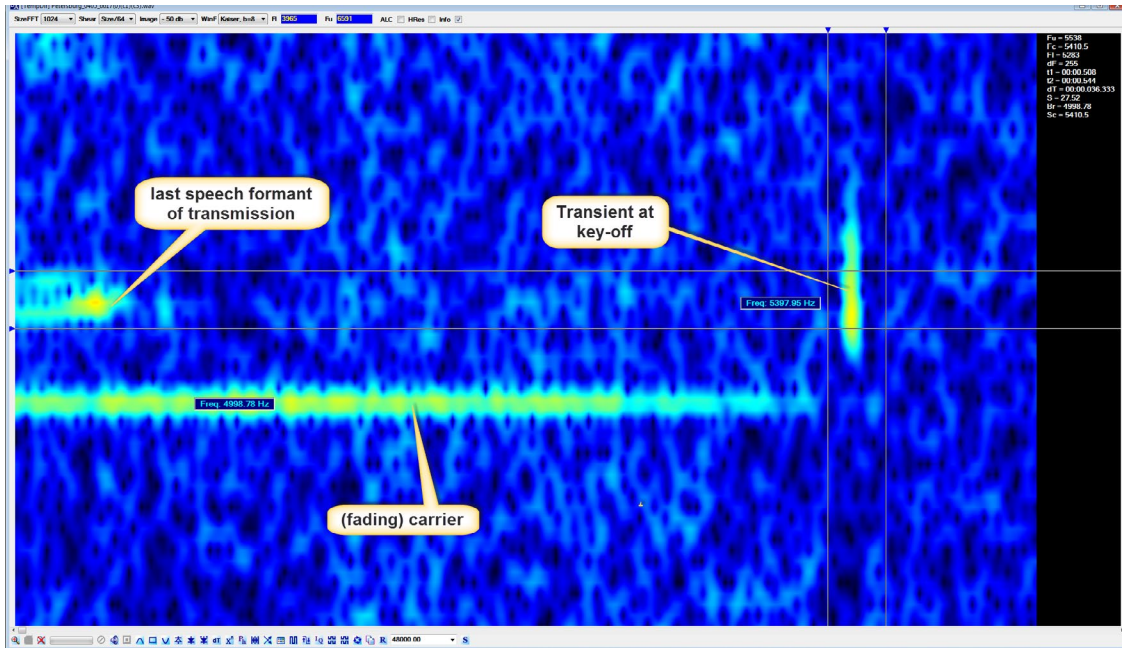


Figure 20: At keying-off, this sonagram shows a distinctive transient.

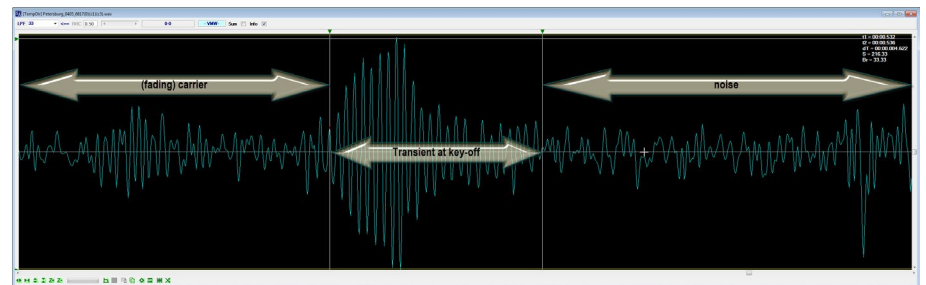


Figure 21: In the oscillogram, the length of this transient (plus possible multipath) can be analyzed.

Another example: Petersburg Meteo, 6.617 kHz. Here the key-on seems perfect, whereas keying-off shows a transient of up to 4,6 ms length. Why: *up to*? The transient seems to be *shorter*, but multipath propagation may have prolonged the pulse.

You may use the sonagrams and oscillograms of different transmitters to build up a library. There you can look up a relationship of transmitters just thanks to their same or similar pattern.

On HF with its multipath propagation, this method is not as precise as fingerprinting of humans. There simply are too many changing influences which may modify the pattern a bit. On the other hand, transients will give at least a strong clue.

Attenuation of Carrier

Professional speech communications on short-wave mostly uses upper sideband, suppressed carrier (USB). Due to technical reasons, this carrier is suppressed by 30 to 60 dB, referenced to the peak envelope power (PEP) of the signal.

Such a signal needs about 10 dB signal-to-noise ratio to get intelligible – or 44,8 dB/Hz in a bandwidth of 3.000 Hz. Fast Fourier Transformation FFT, used to build up spectra and sonagrams, works with much smaller filters („resolution“). If you take a resolution of 3 Hz instead of 3.000 Hz, you get a „gain“ of about 30 dB. This gain makes it possible so see and measure even the suppressed carrier of an USB signal.

Two other flavors of USB are: USB with full carrier and USB with reduced carrier (by about 10 dB). This kind of modulation is popular with older transmitters/receivers, and we find it also with the CIS nets.

It's difficult to exactly measure the degree of carrier attenuation from just one transmission, because most communications is very short so that selective fading, cutting small trenches of 30 dB and more through the passband, is limiting such a task.

See next page(s) for carrier deviation from nominal channel. There you will also see how to make a rough estimation of the degree of carrier attenuation.

Figure 24: USB and suppressed carrier which nearly is too faint to be seen (SHPORA-Rostov-na-Donu, 5.568 kHz)

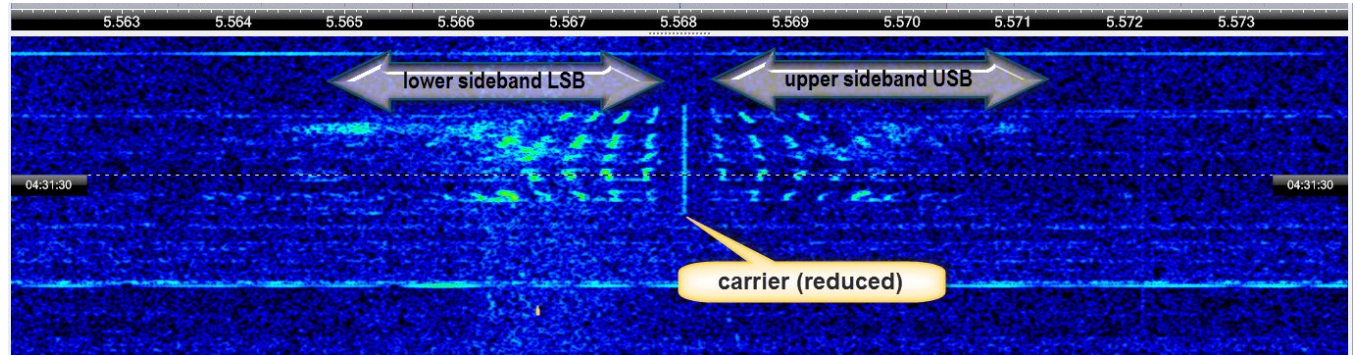


Figure 22: AM with both sidebands and reduced carrier (TOSNO-Nalchik, 5.568 kHz). Also e.g. Samara uses this mode.

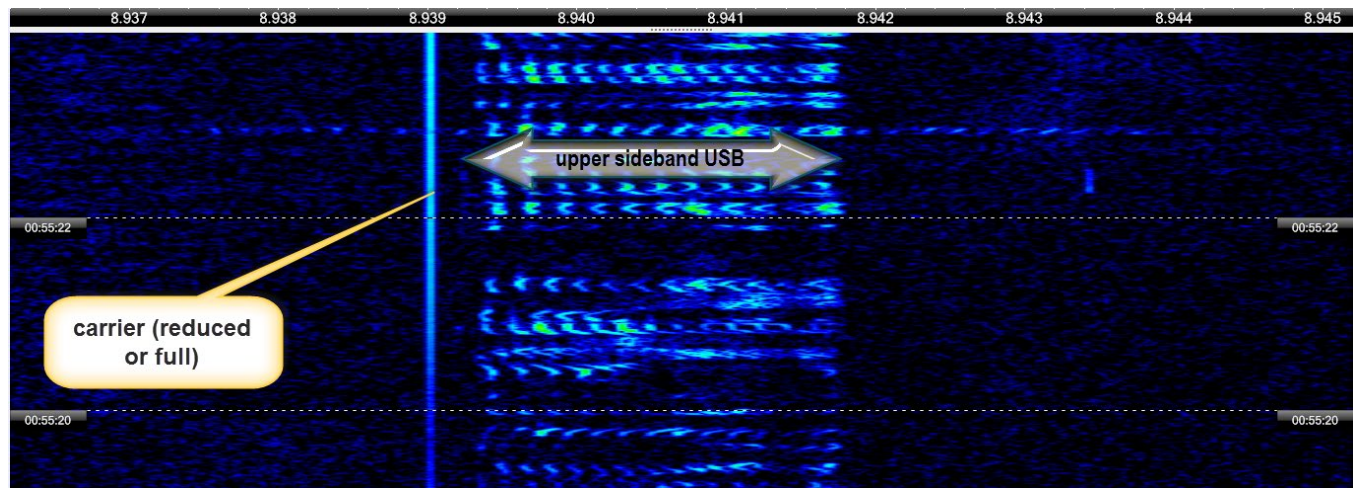
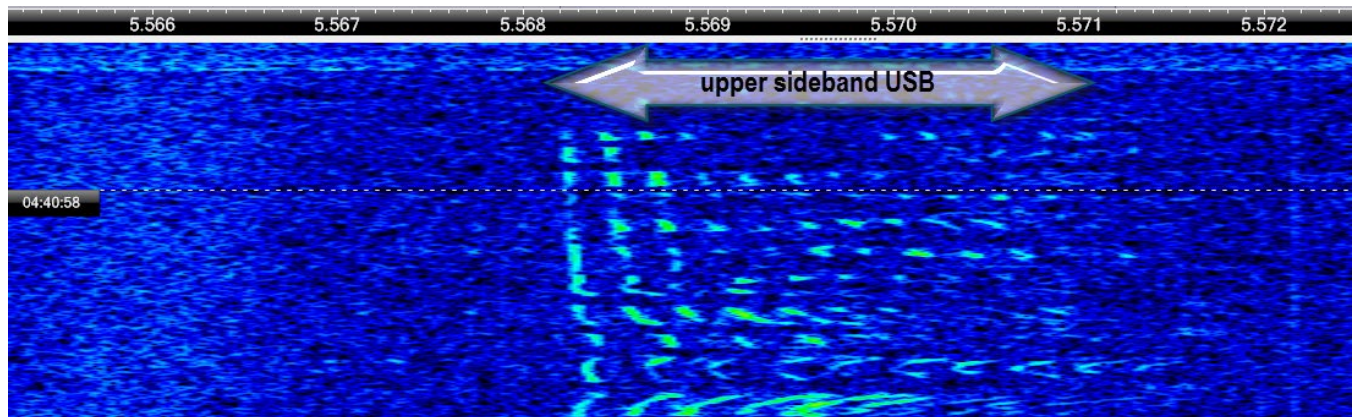


Figure 23: USB and reduced or full carrier (Rostov-na-Donu VOLMET, 6.617 kHz)



Carrier deviation from nominal channel

The *nominal channel* is the listed frequency, e.g. 5.568,000 kHz. The majority of HF transmitters do show slight differences (deviation) from this channel. This can be also used for „fingerprinting“.

The following examples do measure the deviation on the audio level. You have therefore to transpose the recording by e.g. +2.000 Hz.

With voice communications, the carrier presents the *most narrow peak*. Sometimes it may be broadened due to effect within the transmitter (e.g. phase noise) or the communications channel (e.g. doppler spread). Even if software resolution is down to .1 Hz or more, the property of HF channels reduces the repeatability down to 1 Hz or the like.

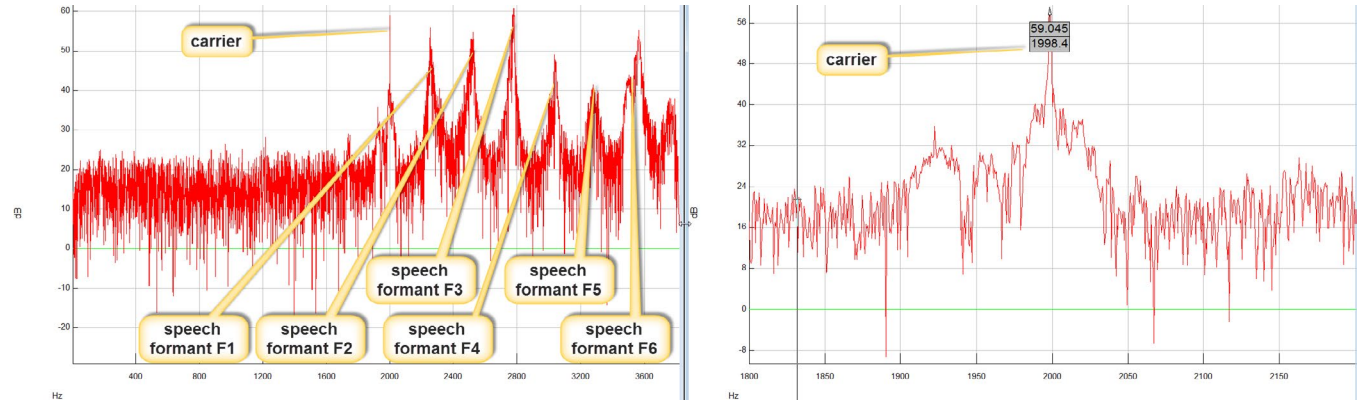


Figure 25: This shows a part from the signal of Figure 15, where we have a steady carrier. An FFT with Sigview reveals some distinct peaks – that of the formants and a sharp peak around 2.000 Hz (left). 400 Hz around 2.000 Hz were zoomed, and „Automatic Peak Detection“ returned a carrier frequency of 1.998,4 Hz. This means 5.567,9984 kHz or a deviation of -1,6 Hz from the channel of 5.568 kHz for ATLANTIDA TRI at that time.

Measuring carrier's attenuation ...

...is more than difficult because you nearly never will have on pure tone being transmitted in the passband as it is measured in dB compared to peak power of such modulation. As we measure only relative differences of levels, we simply neglect noise. With speech, there is a work-around to get at least the dimension of attenuation:

- If you see the left part of Figure 25, you see some broader peaks (speech formants 1 to 5). You may add their power (≈ 67 dBm, *see here* for how to do that) and get an attenuation of the carrier of ≈ 8 dB.

For measuring the carrier's frequency, you must use a strong and stable part of the transmission.

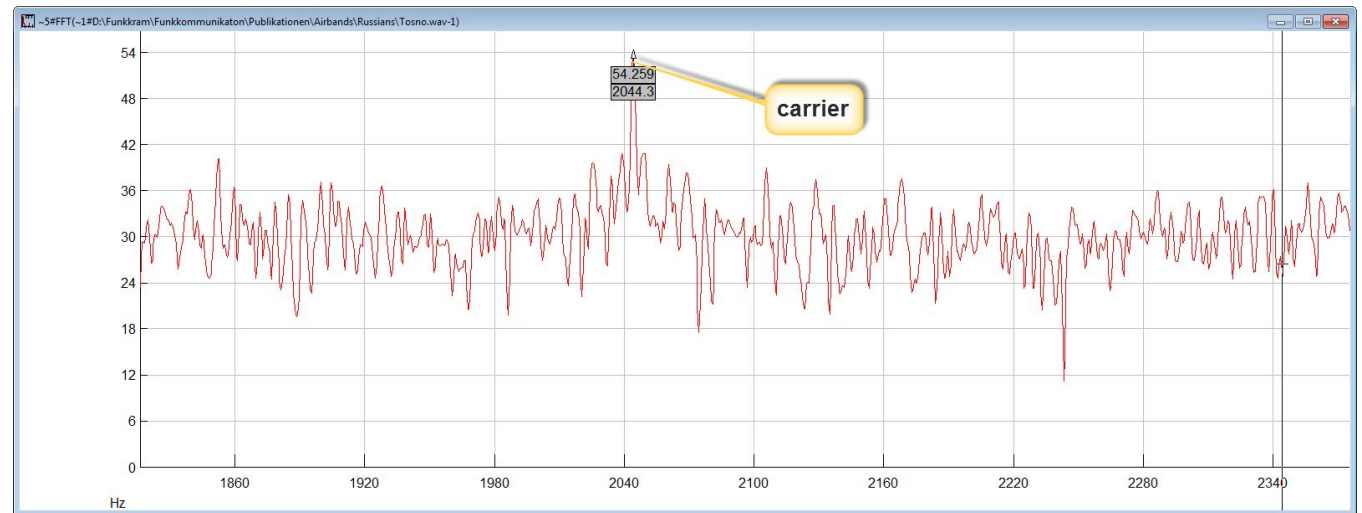


Figure 26: TOSNO on 5.568 kHz shows a frequency of 2.044,3 Hz after transposing +2.000 Hz. Hence, it's original transmit frequency is 5.568,0443 Hz. If you compare the vicinity of this TOSNO-carrier (with two distinctive and parallel peaks) with the broad noise of the above carrier from ATLANTIDA TRI, you may bet that TOSNO is working with a quartz oscillator for each channel and ATLANTIDA TRI using a PLL circuit exhibiting some phase noise.

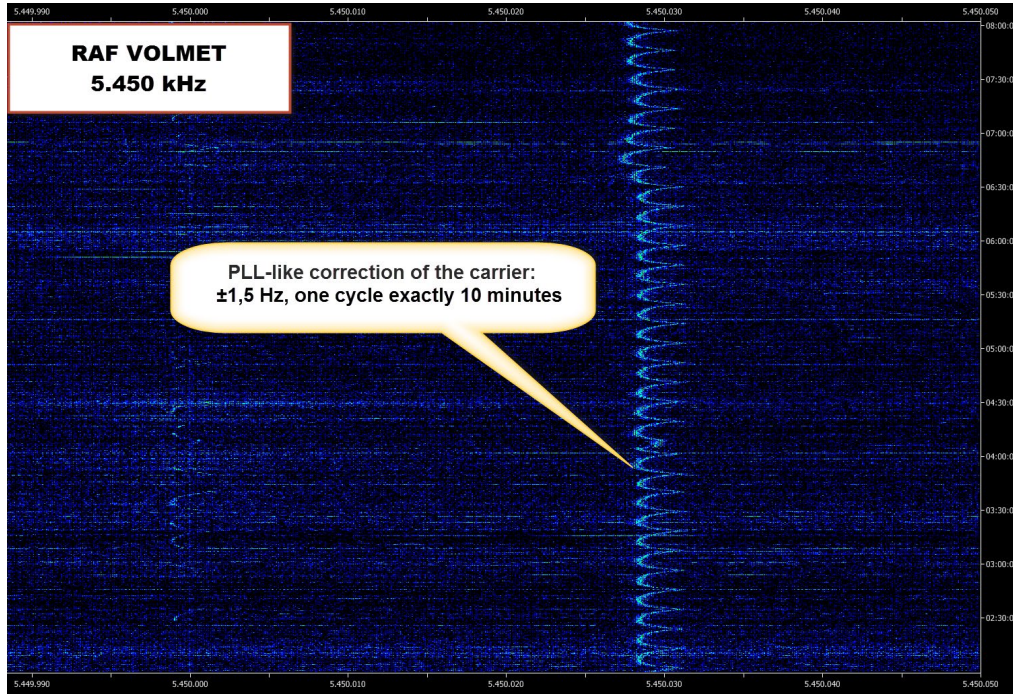


Figure 27: (left) The continuous VOLMET transmission of RAF on 5.450 kHz exhibits a sinus-like structure. This faint signal of the suppressed SSB carrier is only revealed at a resolution of 0.012 Hz. This is an „amplification“ of 54 dB over a 3 kHz bandwidth. Duration: six hours.

High-resolution Frequency Measurements

Short SSB transmissions with a good suppression of their carrier make it difficult to exactly measure their frequency: You simply will not get the small bandwidths (<1Hz) to achieve necessary sensitivity and averaging needed for this purpose.

Longer or even continuous SSB transmission are another story, see Figure 27 for a continuous broadcast over hours, revealing a PLL-like correction of its frequency, or Figure 28 with an intermittent VOLMET broadcast, showing some temperature drift of the transmitter.

Such measurements can only be accomplished with a receiver which uses a GPS standard. Otherwise you don't know, what exactly you are measuring – receiver or transmitter or both.

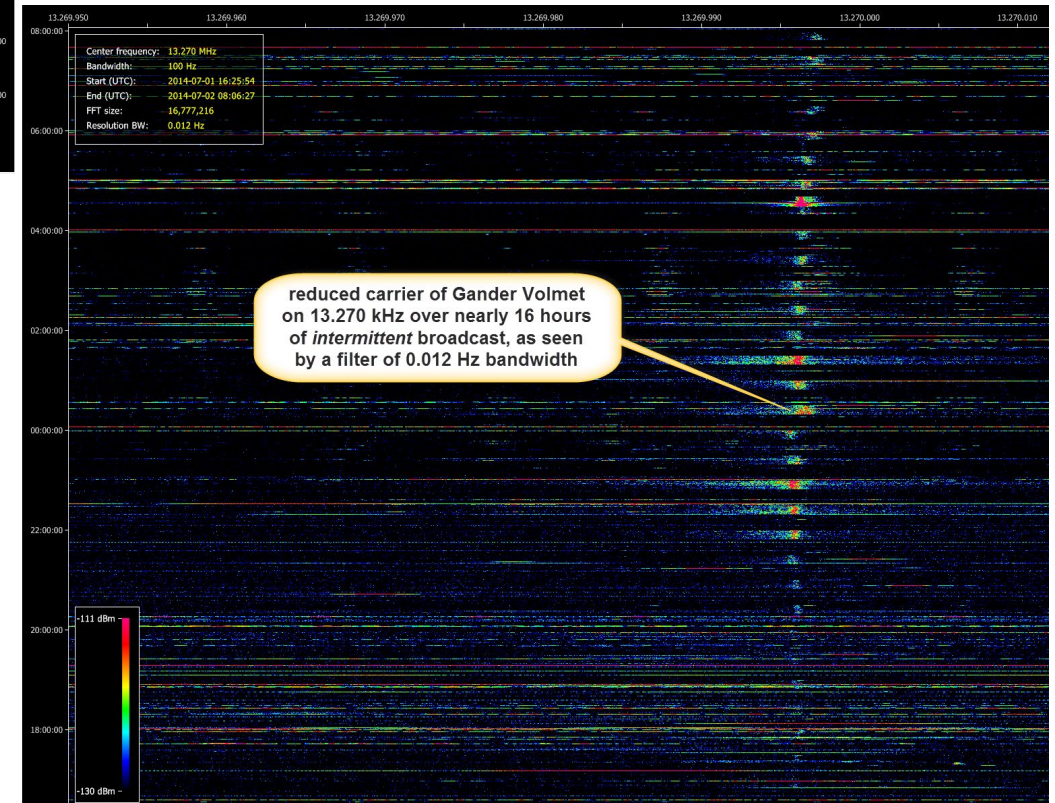


Figure 28: Also a longer transmission, but intermittent show some drift – here Gander VOLMET over nearly 16 hours.

Passband of a transmission

The passband of a transmission plus some factors like dynamic compression will also contribute to „fingerprinting“.

„Passband“ is the speech bandwidth of a transmission. Usually it starts from 100 Hz to avoid transmission of AC hum (50/60 Hz) from the power supply. It often stops around 2.700 Hz. Here, of course, you can see only that part of the passband which is filled by the speaker and the passband of her/his microphone.

I think it obvious on how to measure the bandwidth of the signal, e.g. the highpass frequency (from nominal carrier frequency to first speech formant), the bandwidth and maybe others features like harmonics above 2,7 kHz or so.

Speech compression cares for more „punch“ of the signal and leads to a „brick-like“ sonagram.

See an example of a rather punchy signal on the right.

Also here, for fingerprinting a library of screenshots will help. You quickly will get a collection of different passbands and modulations depths.

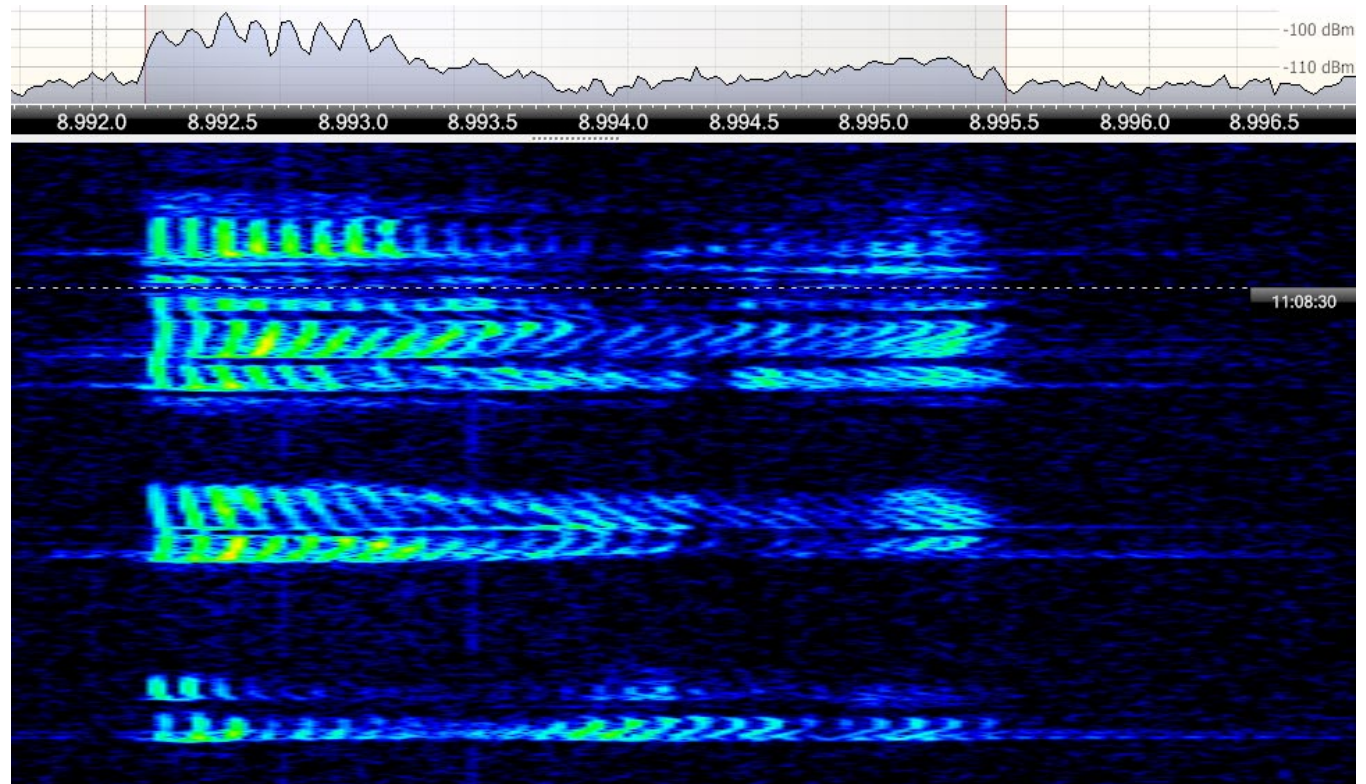


Figure 29: Collective callsign „Mainsail“ on 8.992 kHz transmits here with a strong dynamic compression.

Fingerprinting: Miscellanea

There are many more additional factors which can make a combination of transmitter, speaker, microphone and environment rather unique. See the figures on the right for two examples.

A new idea is to use some software which allows for *speaker's recognition*. *PRAAT* (free) offers some feature for e.g. analyze WAV files, compare and correlation – see next page.

They should show some further suggestions to improve „fingerprinting“.

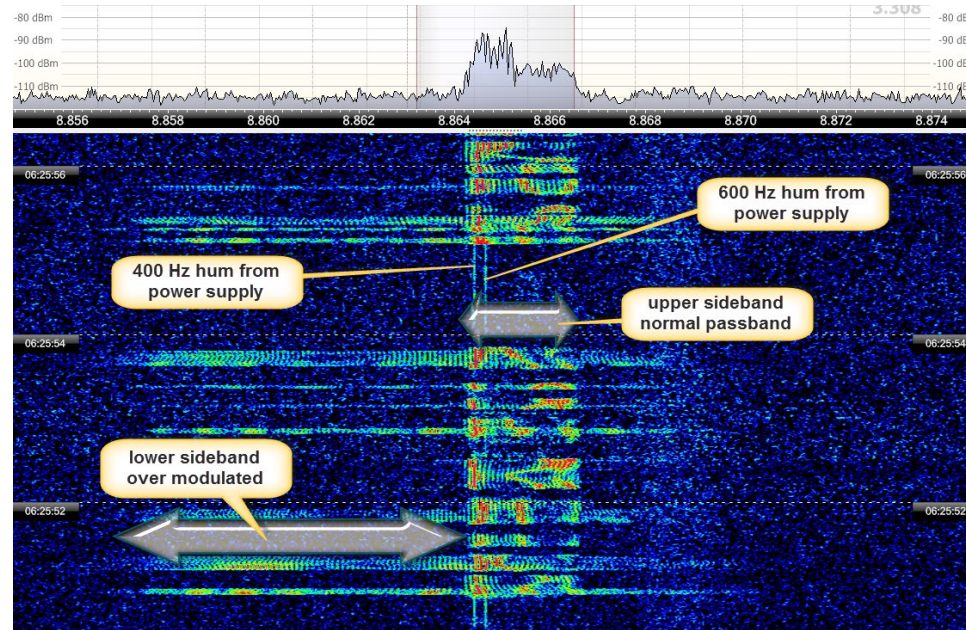


Figure 30: Here we see a badly aligned transmitter. It transmits well into the suppressed lower sideband, showing 14 kHz width there. In the pauses you also clearly see two carriers at 400 Hz and 600 Hz, originating from the airplane's power supply.

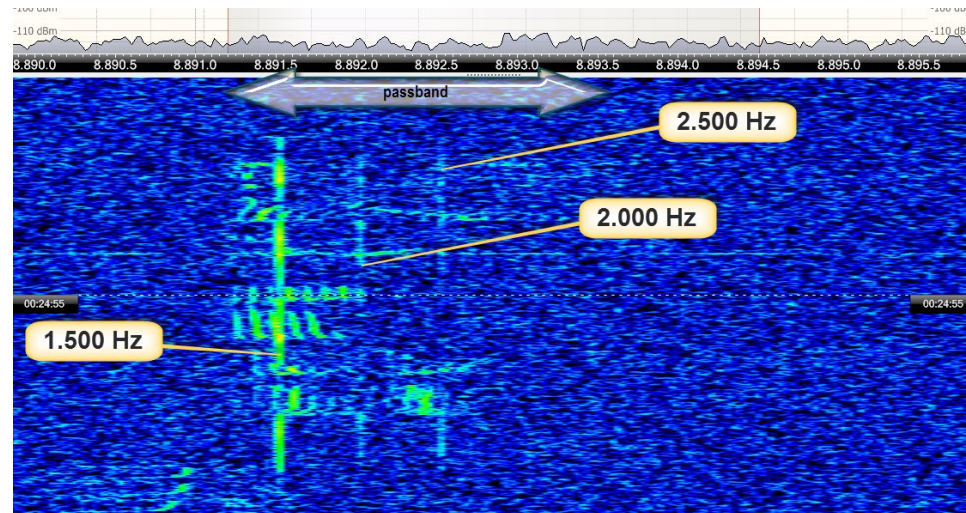
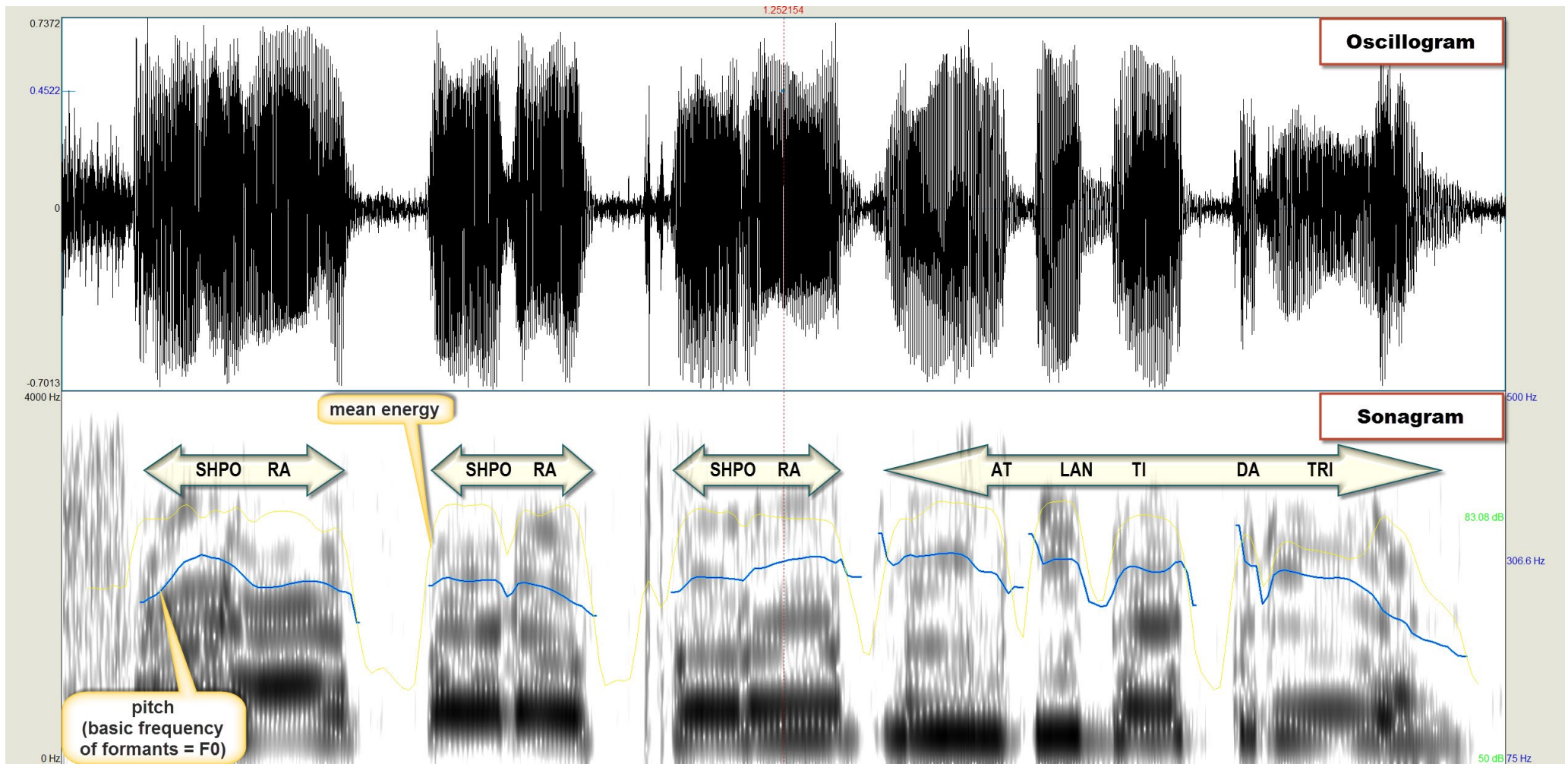


Figure 31: Here the even three carriers seem to originate from acoustic noise of inside the airplane – one fundamental at 1.500 Hz and some other at 2.000 Hz and at 2.500 Hz.



The figure above shows just a basic function of SPRAAT software. By comparing the formants of e.g. the same vowels of different transmission, you may add to „fingerprinting“ even a bit of „speaker’s recognition“.

Figure 32: „SHPORA SHPORA SHPORA, ATLANTIDA TRI – as software Praat sees this transmission. In the upper window you see the oscillogram, in the bottom window the annotated sonagram with the speech formants. Praat does also calculate e.g. F0, the basic frequency of the formants, and the mean power in dB, plus providing many more features and functions.

Strategies: HF or AF?

There are several strategies to do efficient monitoring. On the previous pages, I worked mostly with AF or audio files and recording of specific demodulated channels. This can be done if all stations don't deviate too much from their nominal channel, and if you are interested mostly in the content of a transmission. Many other applications call for HF recordings of the whole band, e.g. 4 to 6 MHz being most interesting for the CIS net. For me, this is the method of choice. To give an example of this workflow:

- Record the range of 4 to 6 MHz for 24 hours. With hardware SDR-IP (16 bit ADC) and free software *SDR-Radio PRO*, this will result in a couple of files comprising around 650 GB.
- Do a complete sonagram of this range with SDR-Radio PRO's Data File Analyser – see on the right.
- For better handling, this should be zoomed, i.e. split up in different files. I use files of one megahertz and six hours each, and a sonagram of 10.000 width (frequency) x 10.000 pixel length (time) – you can scroll the sonagram.
- Point with your mouse to any signal at any time on the sonagram and: play. You can record the audio, do „transposing“, inspect the pattern of the signal etc.
- See the following figures on how to proceed.

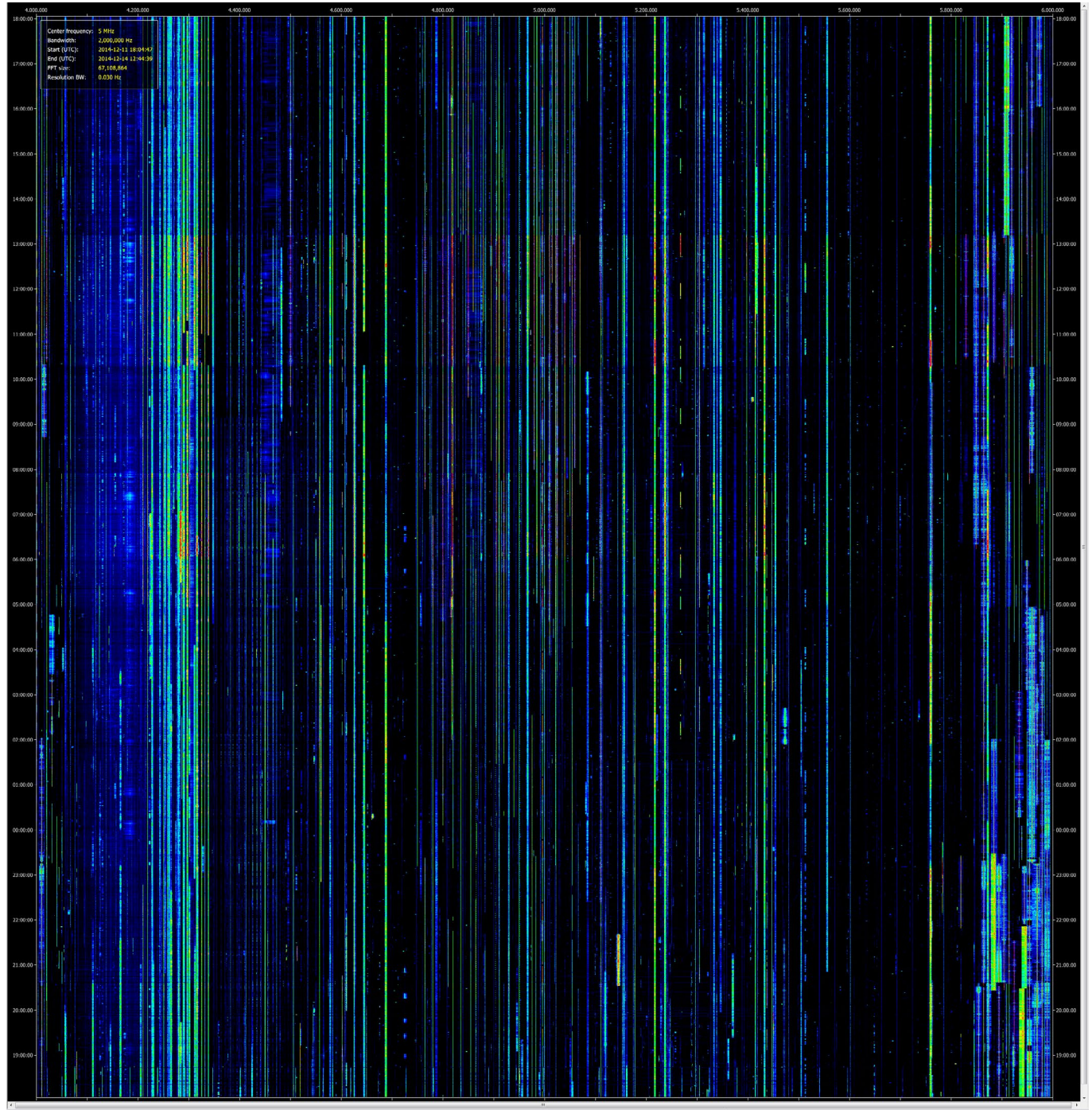


Figure 33: 24 hours from 4 MHz to 6 MHz – „living“ sonagram made with SDR-Radio PRO software, weighing 650 GB.

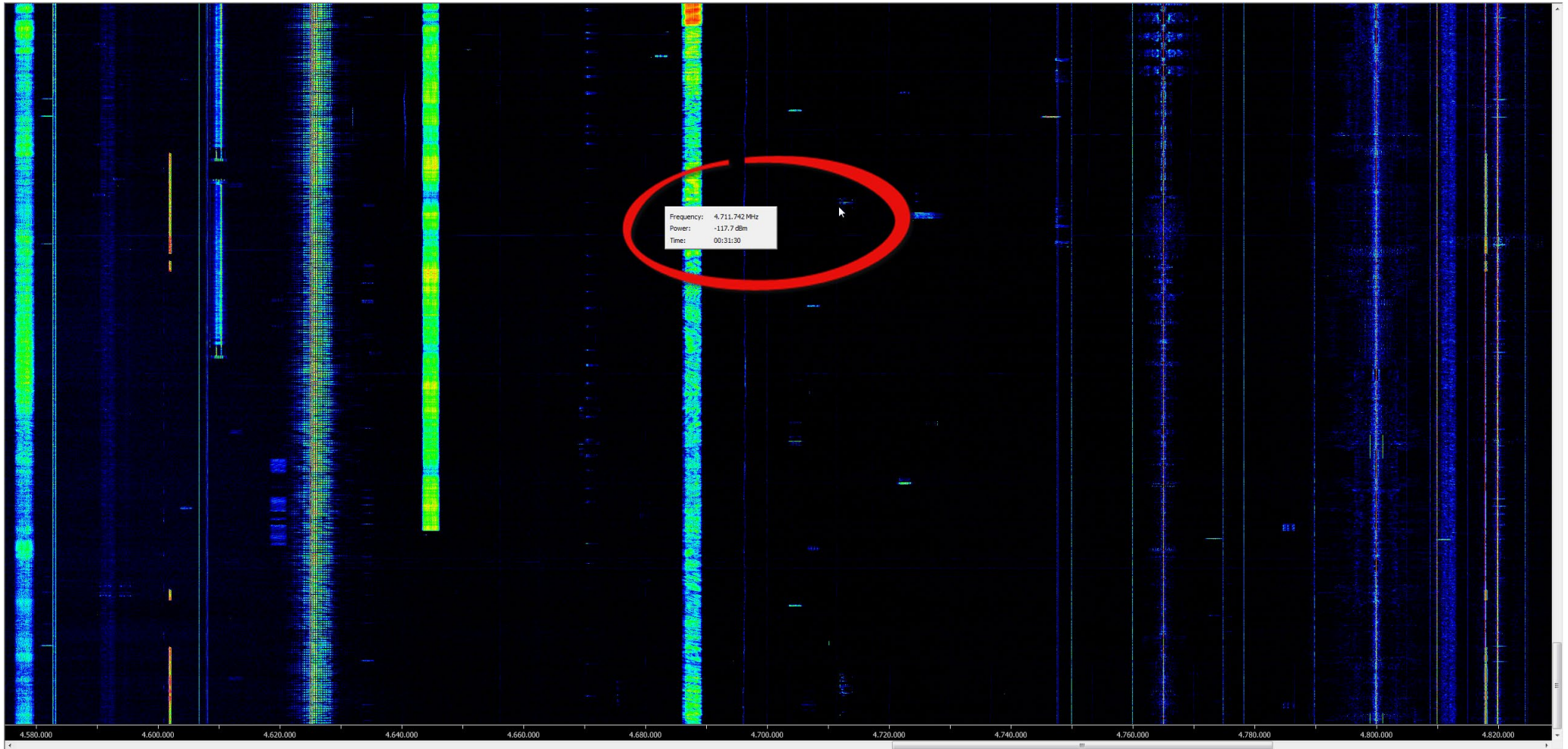


Figure 34: Here, the 24 hours x 2 MHz-sonagram from the previous page has been split into eight pieces of 6 hours x 1 MHz each. This screenshot shows a 1:1 part of it, featuring a signal on CIS-Net 4.712 kHz. In „Player“ mode, you can simply point and click onto a signal and listen to it – see next page.

Stop press: As Simon told me, a significant improvement of this software is underway. It will e.g. synchronize the sonagram of „SDR Data File Analyser“ with SDR-COM software. Stay tuned!

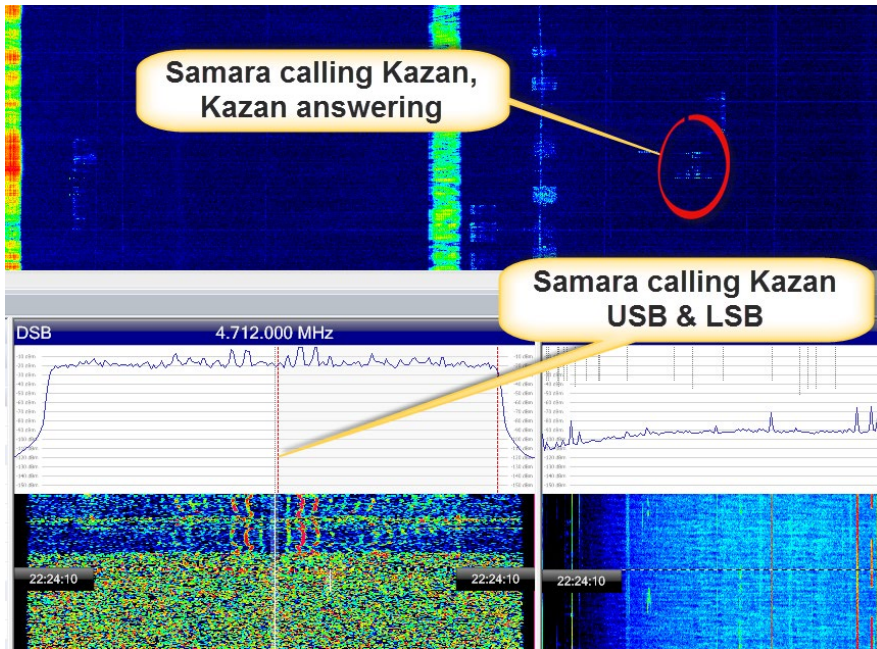


Figure 35: Here I pointed and clicked to a signal onto the sonagram, „Player“ mode activated. What you see in the left window is a 1:1 representation of a 10.000 x 10.000 pixel sonagram. In my eyes, each activity is clearly visible, and mostly I can recognize from the pattern in the songram the type of modulation. In this case, it turned out to be a double-sideband transmission from Samara (DSB), answered by Kazan (USB). You cannot only listen to this signal, but also record it. As some demodulation features of this „sonagram mode“ are rather restricted (e.g. missing AGC-Off or wide bandwidths for the transposing techniques), it can be used to digging out these activities and play the recording at this time and frequency in another module of this software, see below.

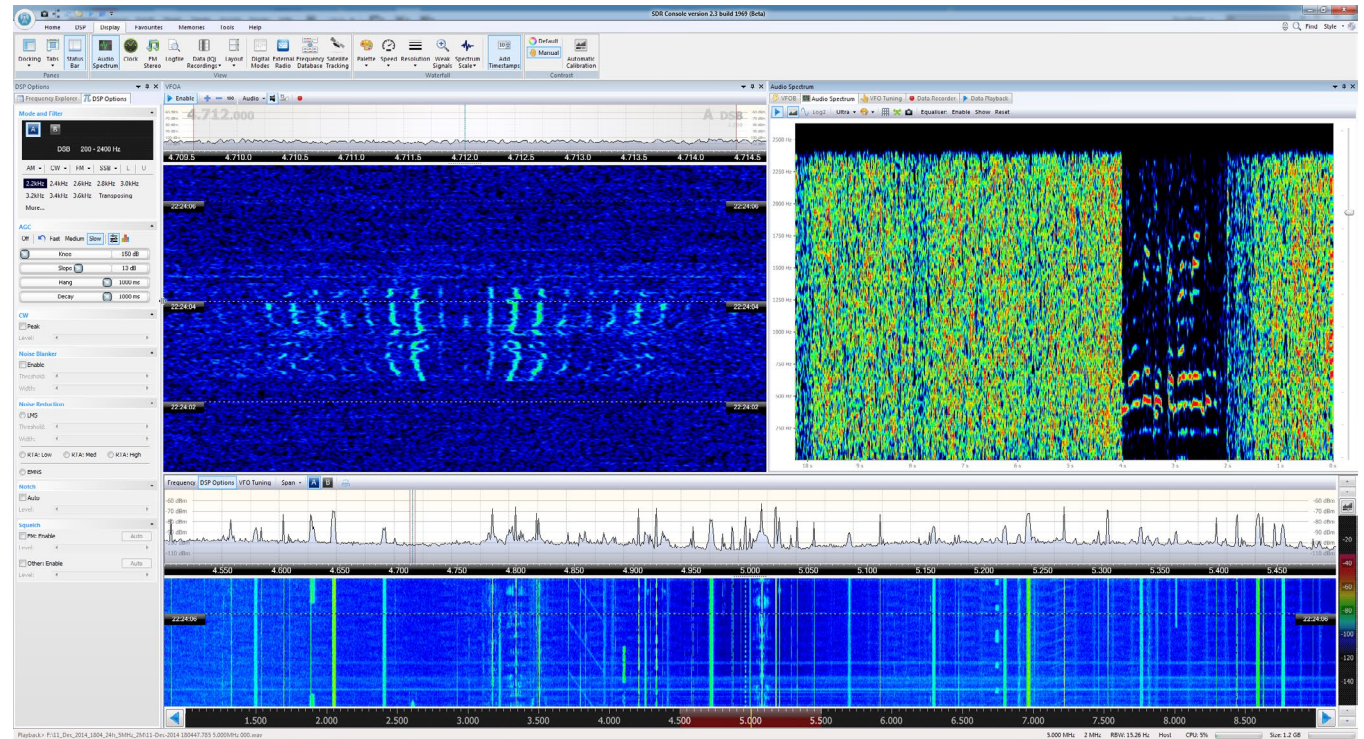


Figure 36: Once you have found a signal in the sonagram, you can also play it in the „Playback“ module of SDR-RadioPRO where you simply call up the 24h/2MHz-recording, choose frequency and time and let it go. Here you have all features like bandwidth up to 24 kHz for transposing or AGC Off to record transients.

On the upper left window of the screenshot you see the DSB signal of Samara, covered by a DSB filter. In the upper right window you see an audio sonagram of this demodulated signal. In the bottom follows the spectrum and eventually the sonagram of this 1-MHz-range.

On the left, you can change mode, bandwidth, AGC etc.

Audio Recording – Stat-of-the-Art

A few SDRs do offer the feature of recording not only one but many audio channels. TitanSDR excels in this respect with recording up to 40 audio channels in parallel (below). Each can be scheduled regarding start and off.

With this receiver, you may also program four completely different HF ranges and place up to 40 narrowband channel in these ranges (right).

Figure 37: With TitanSDR, you may place up to four different HF ranges of 312 kHz width each, e.g. the aero bands around 5,5 MHz, 6,6 MHz, 11,3 MHz and 13,3 MHz as in the Figure on the right. Within these four wideband HF ranges you may place up to 40 different narrowband ranges (demodulators) for recording.

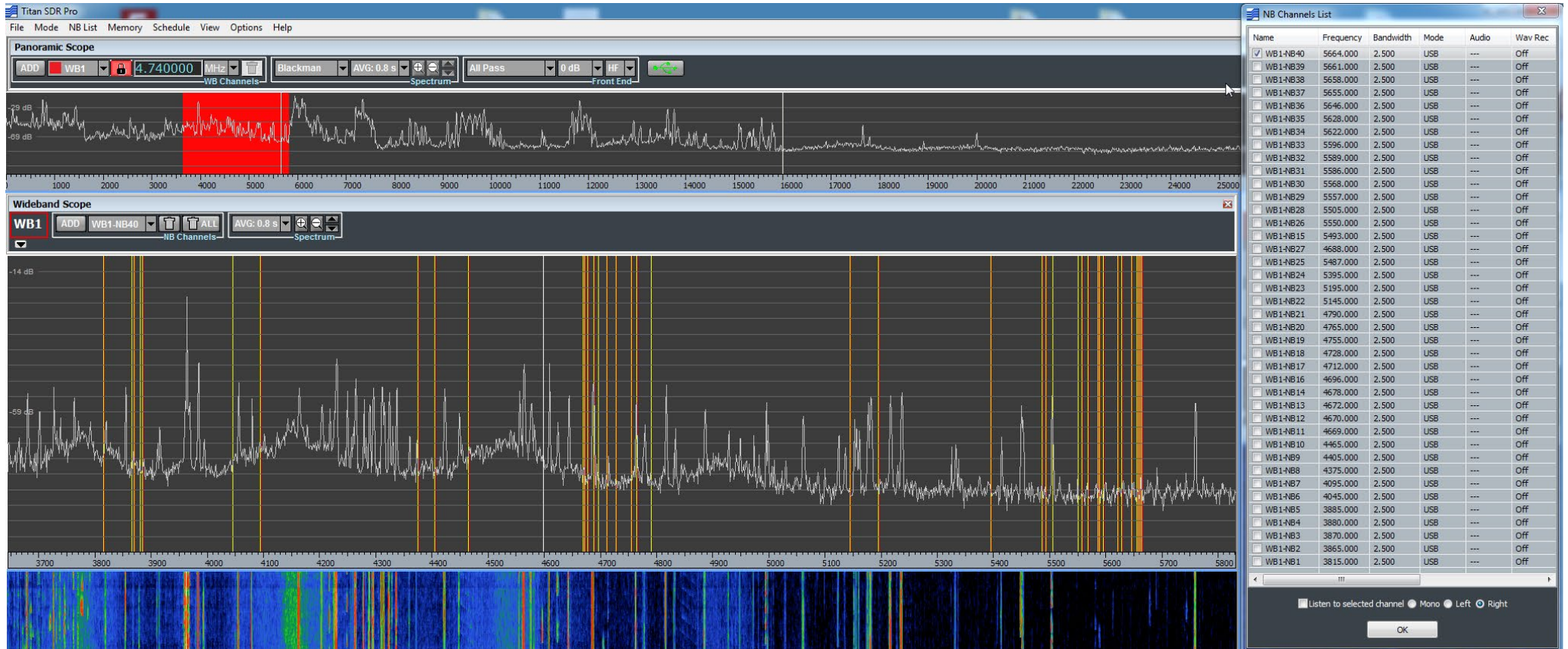
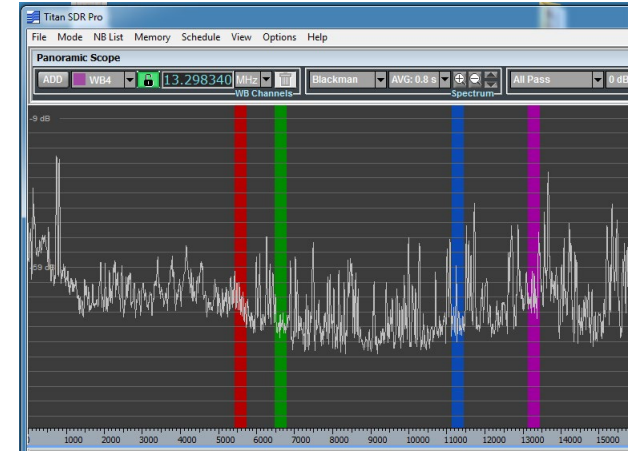


Figure 38: Here a maximum of 40 scheduled narrowband channels had been programmed in the 5 MHz range to cover 40 listed CIS aero channels in a row over 24 hours. Each of the 40 demodulated and saved WAV files then weighs around 1,7 GB.

Local or Remote?

All recordings in this paper have been made „on own soil“ in Northern Germany. However, this page is an exemption as it uses recordings from a remote SDR.

There are many reasons to use one of the remote stations available in the internet, being *WebSDR.ORG* one of the most popular site and the *TwenteSDR* the most popular SDR, or to use a private station, remotely controlled – *look here for an outstanding example*. Propagation as well local noise or/and antenna restriction are among the main reasons to change from a receiving post in house and garden.

For some hard-core DXers, remote DXing is like shooting animals in the zoo. If there is a „code of ethics“, remote DXing should be noted together with the log if the remote location is at a greater distance than just to avoid local noise and/or antenna restrictions.

My very personal view of this topic is to use remote SDRs just to check if a station is active at all and to get it „in the clear“ for pronunciation etc. You may have another view.

To give an example of how useful remotely controlled SDRs are, I choose the website hosted by *Moe Wheatly & RFSpace* and mostly powered by SDRs of *RFSpace*. You'll get an easy access to this network by downloading free software *SDRanywhere*. Have a look into *this short video* to see how smoothly and easy this works.

Of this net, I find the „Karelia“ SDR especially useful. It's near the Russian border in Finland, and it provides outstanding low noise plus good signals – see the Figure and the audio clip, right.

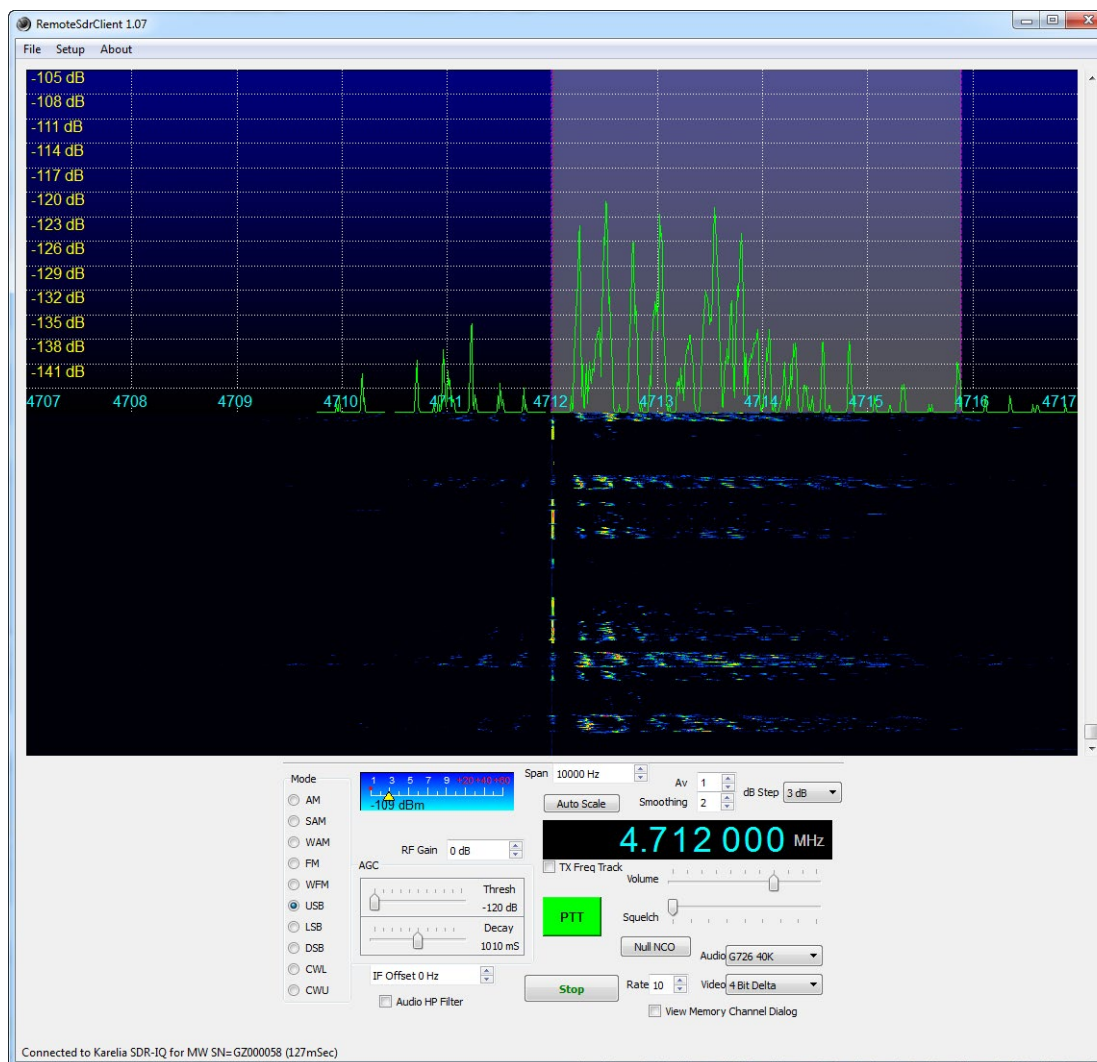


Figure 39: This is an example of the remote SDR there in Karelia, early January 2015, 13:30 UTC. It's accessed with *SDRanywhere* software. Please see the adorable low noise level, providing clear signals.



The audio clip shows the excellent quality of the Karelian SDR plus that of the software. Reception was in January, at around 13:30 UTC and provides crystal-clear signals from e.g. Saratov, Novosibirsk and Chelyabinsk. Virtually nothing was heard in parallel at DK8OK's site. The new *CloudSDR of RFSpace* will popularize remote DXing even more.

Relationship of Net Stations

The more traffic, the more difficult it is to analyze the relationship of it. Of most importance is the question after the NCS, or net control station.

A diagram-drawing software like *Graph Editor yEd* (free) is doing this job quasi-automatically. You just have to put in which station is calling whom, and who is responding. The directions of calls/responding is marked by arrows in either direction.

This has been with a calling session of Samara Radio on 4.712 kHz, starting at 18:17 UTC and lasting not longer than nearly three minutes.

Just assign a box per station, connect those stations calling and being called, and let the software clean up the picture by a proper layout – „radial“ on the figure on the right.

This clear star structure of the net is an easy case. Let's go for something different on the next two pages, where we combine to techniques – namely annotated markers and these visualizing of the relationship of the stations.

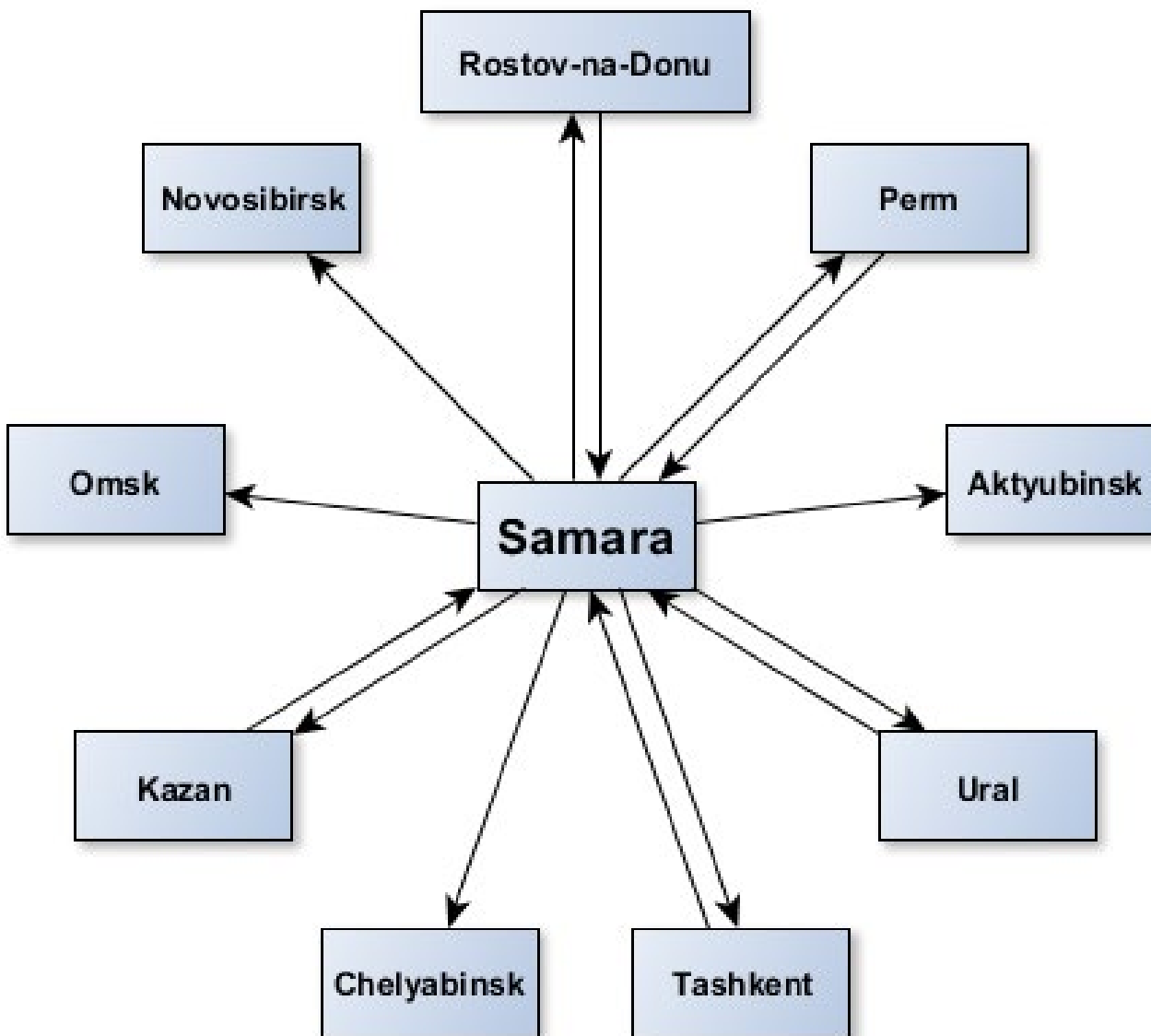


Figure 40: Samara is calling nine stations from 18:17 UTC, five of them do answer. With a software like yEd Graph Editor, you automatically get a clear picture of this communications. The stations are not organized according to their geographical positions – which would be another task.

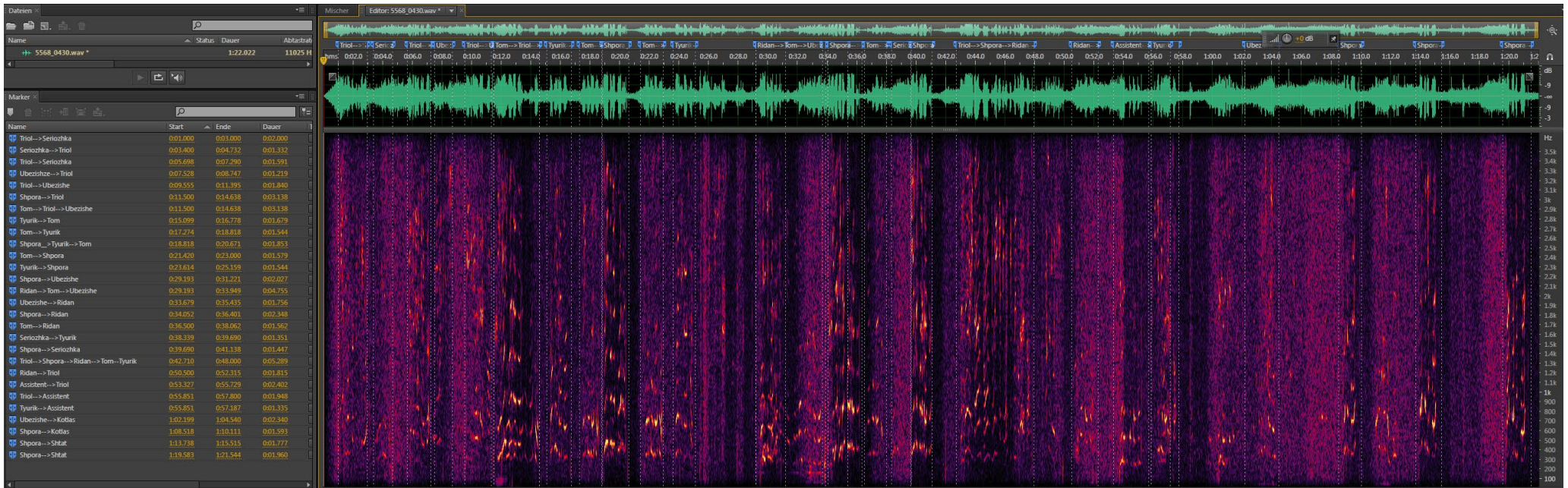


Figure 41: (above) This is an audio clip of 1:22 or 82 seconds length, containing at least 28 different callings of different stations; a few even remained unidentified. It was the start of the Southern Net on 5.568 kHz at 04:30 UTC on December 13th, 2014. You can listen to the whole clip with a click on the loudspeaker icon. All identified calls had been marked (left), and put into yEd to get a clue on the structure of communications in this network, see next page.

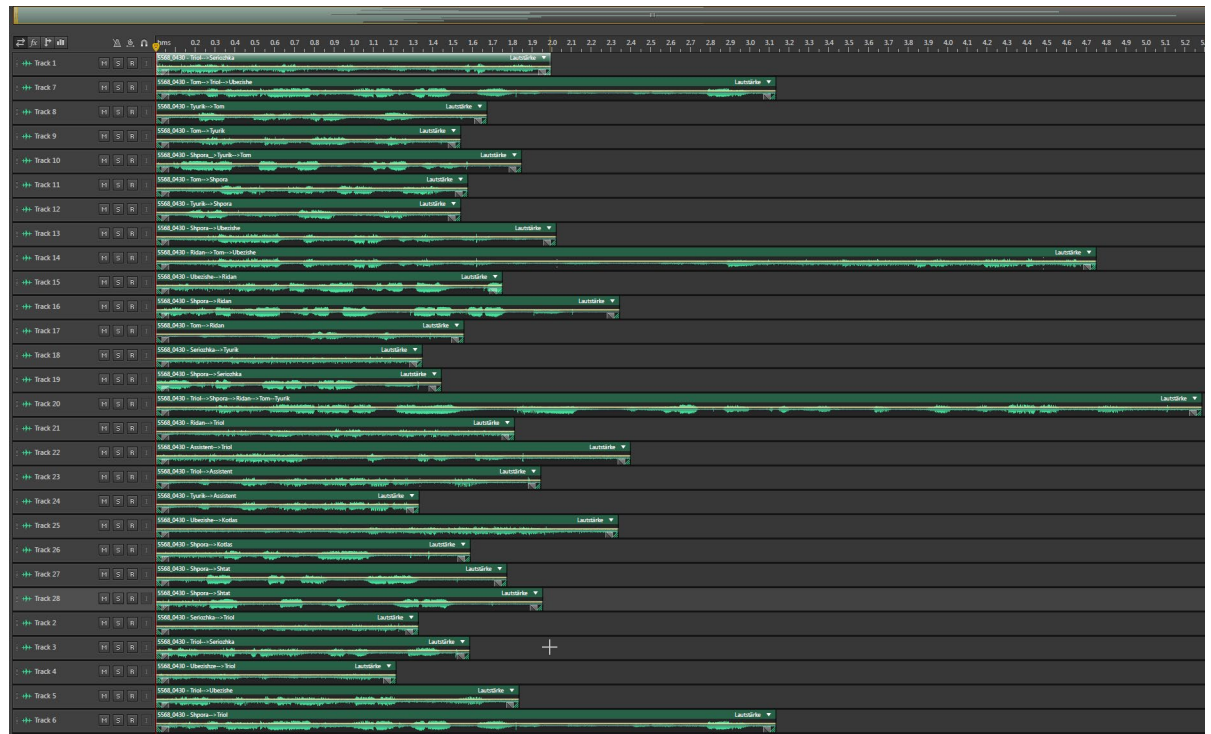


Figure 42: Here you see each clip separated in a Multisession of Audition.

Software yEd is a perfect tool to automatically visualize the previous 28 callings within no more than 82 seconds to a net structure. This can be done in many different ways, depending on the task. Please find two different representations of the same data on this page.

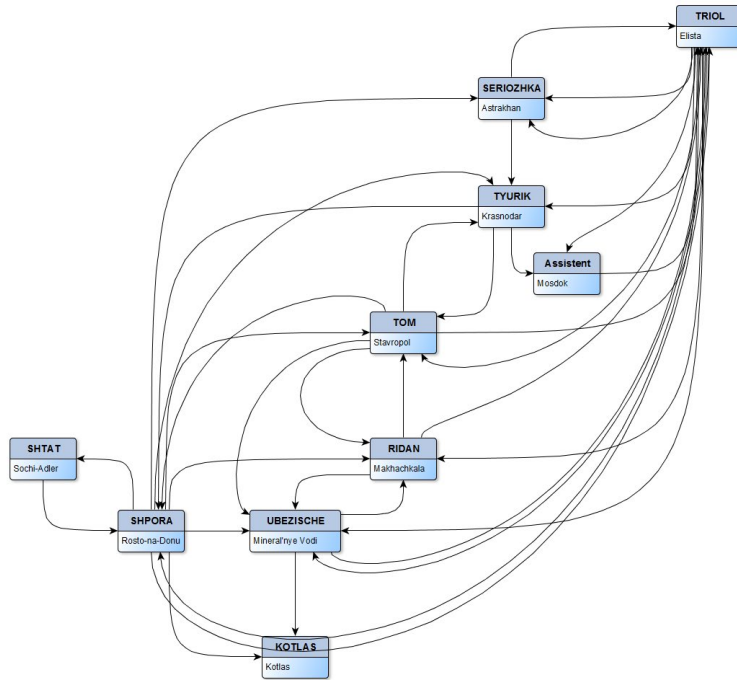


Figure 43: Here yEd arranges the data in an „orthogonal UML“ structure ...

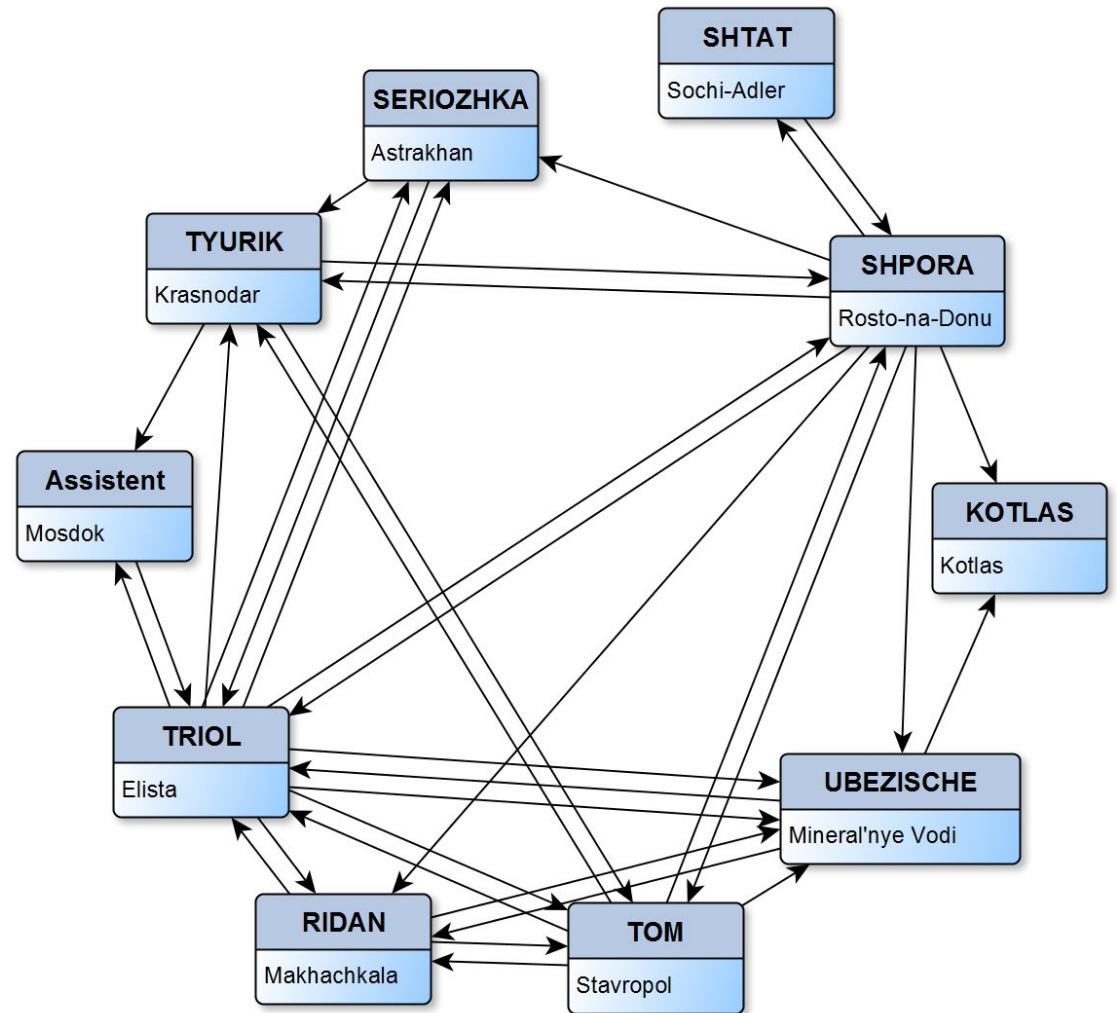


Figure 44: ... whereas here they are arranged in circle manner. The software provides many more patterns, just choose what fits your data and task best.

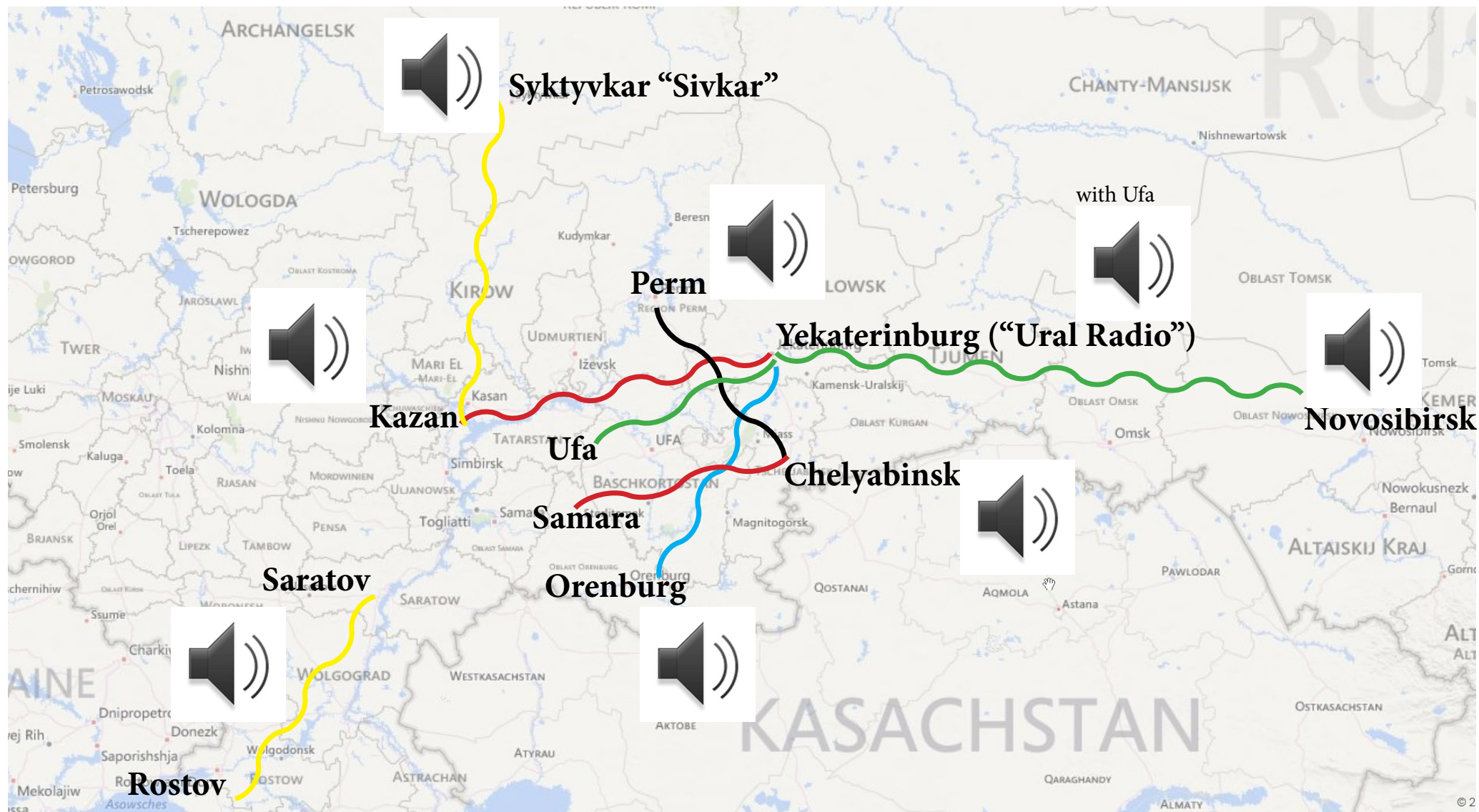
Please find some more MP3s of other nets and airports on the next pages.

CIS-wide Net – 4.712 kHz

On the previous pages, we featured the Southern (cis-caucasian) net on 5.568 kHz to introduce into some techniques. For european listeners,

this is the best starting point. From this page, we introduce some other nets. We start with this CIS-wide net on 4.712 kHz. The stations tend to

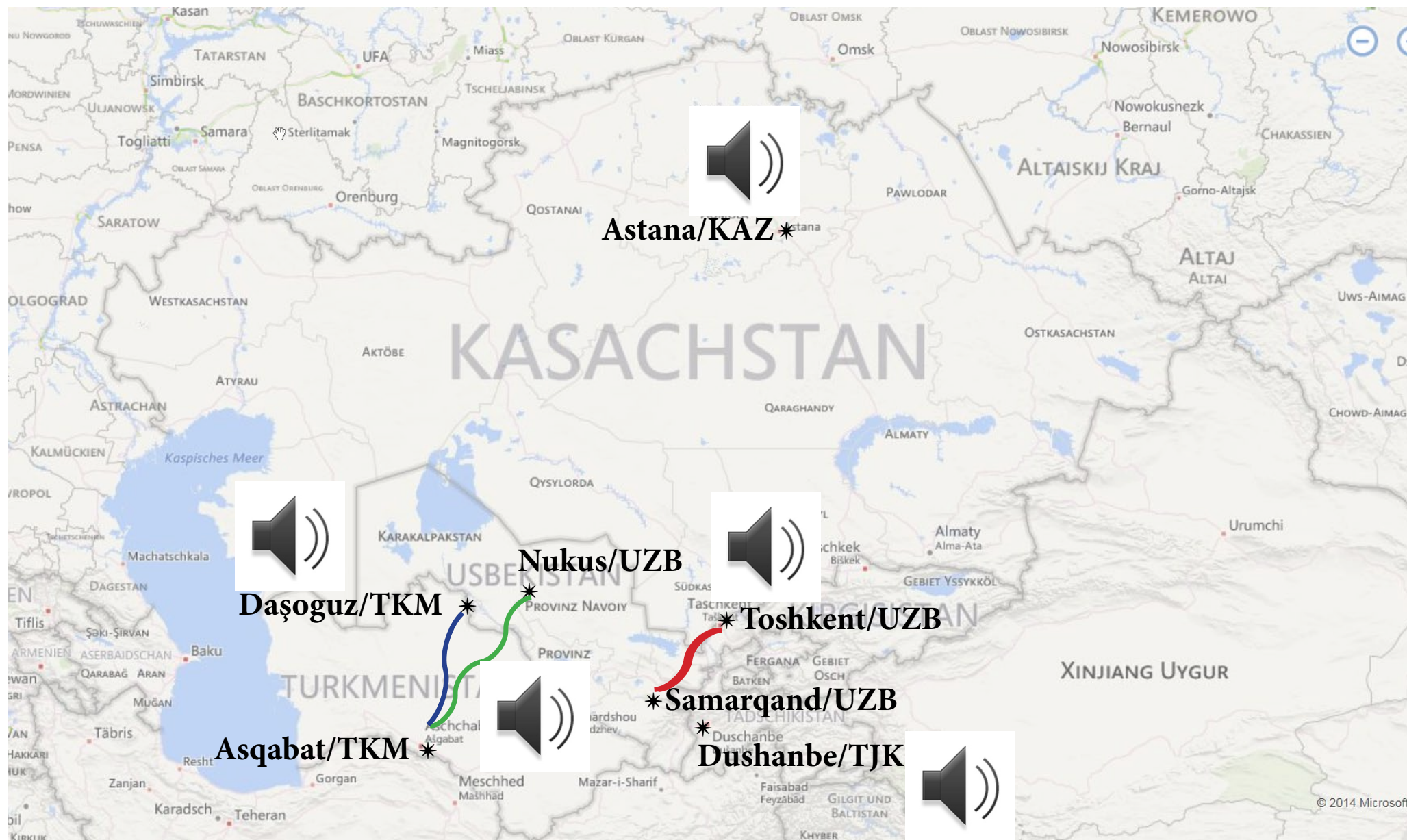
do radio checks around xx:00 and xx:30, plus or minus some minutes. Also this net seems to have been covered largely complete.



CIS Net – 4.728 kHz

On this frequency, we find some stations of the southern CIS – a selection of some exotic desti-

nations like Samarqand. The map comes from Bing/Microsoft.

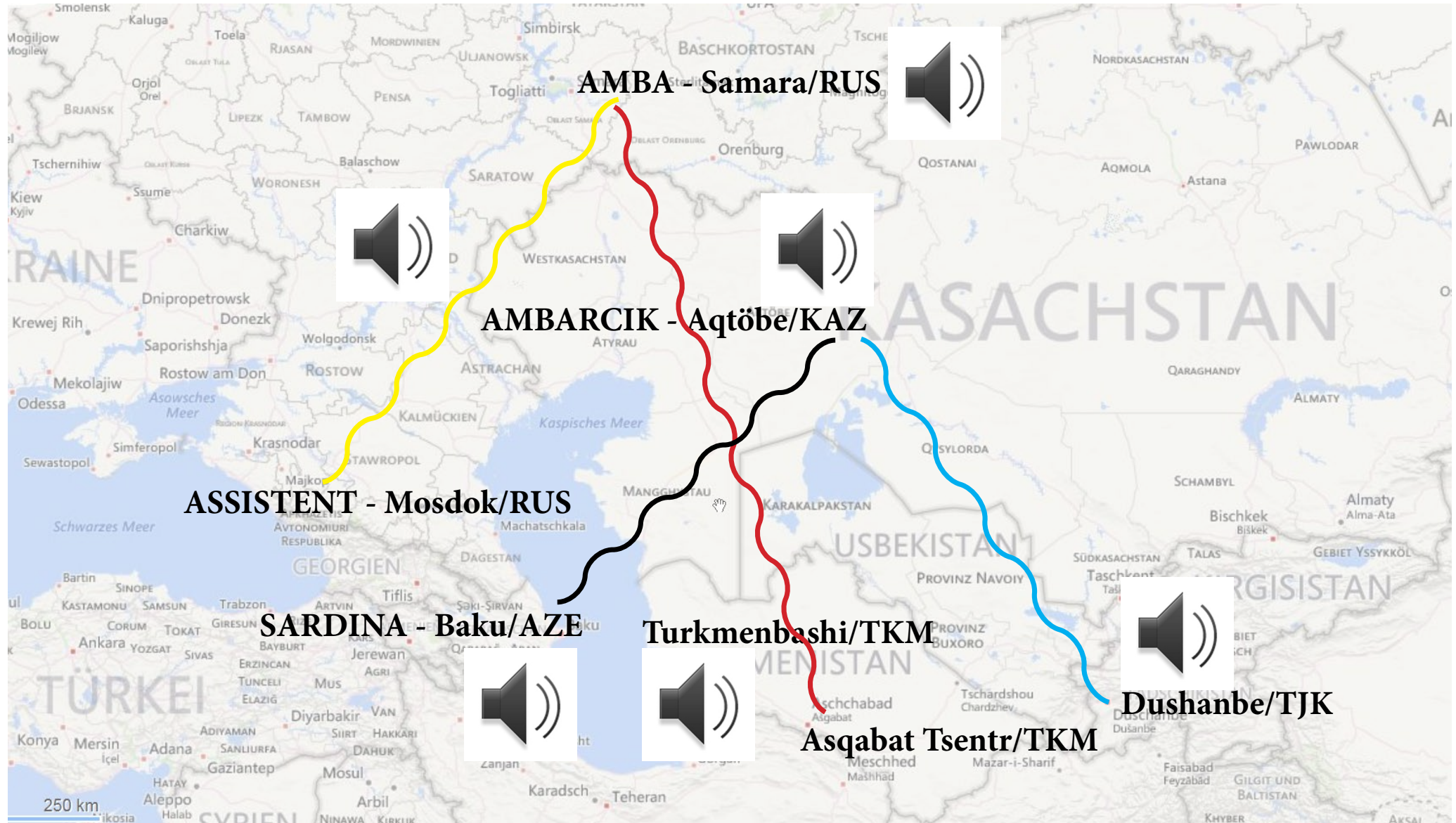


CIS Net – 5.145 kHz

On this frequency, we find some stations of the southern CIS – a selection of some exotic desti-

nations like Turkmenbashi and Baku. They are mixed code names (CAPS) and clear names, both

are given on the map. The map comes from Bing/Microsoft.



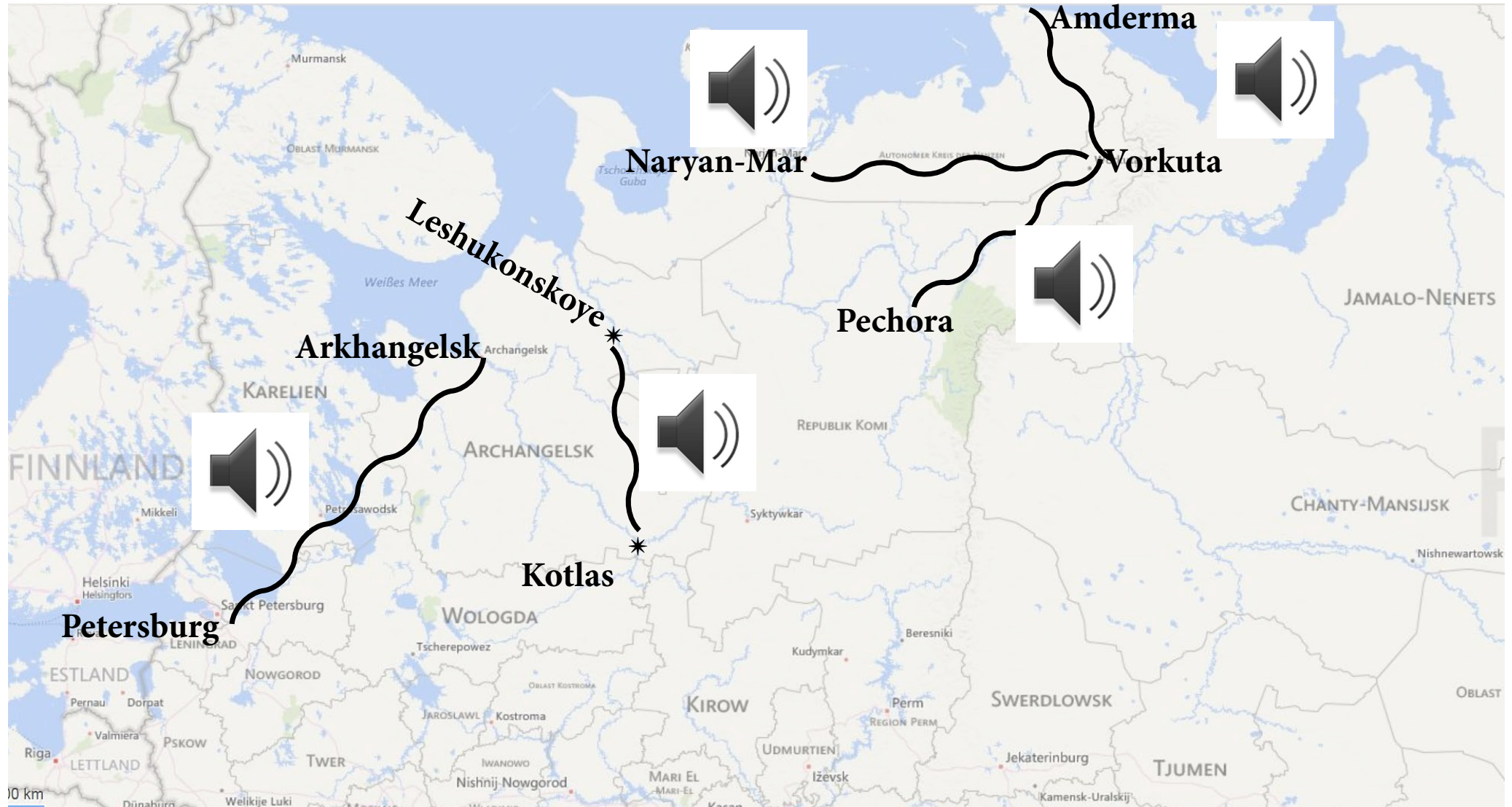
Northwestern Net – 5.596 kHz

On the previous pages, we feature the Southern (cis-caucasian) net on 5.568 kHz to introduce into some techniques. For european listeners, this is the best starting point.

From this page, we introduce some other nets. Their audio clips are far from being as complete as those from the Southern net. Nevertheless, they should give a small insight into a lively scene. We start with the Northwestern Net on 5.596 kHz which their net control stations Kotlas

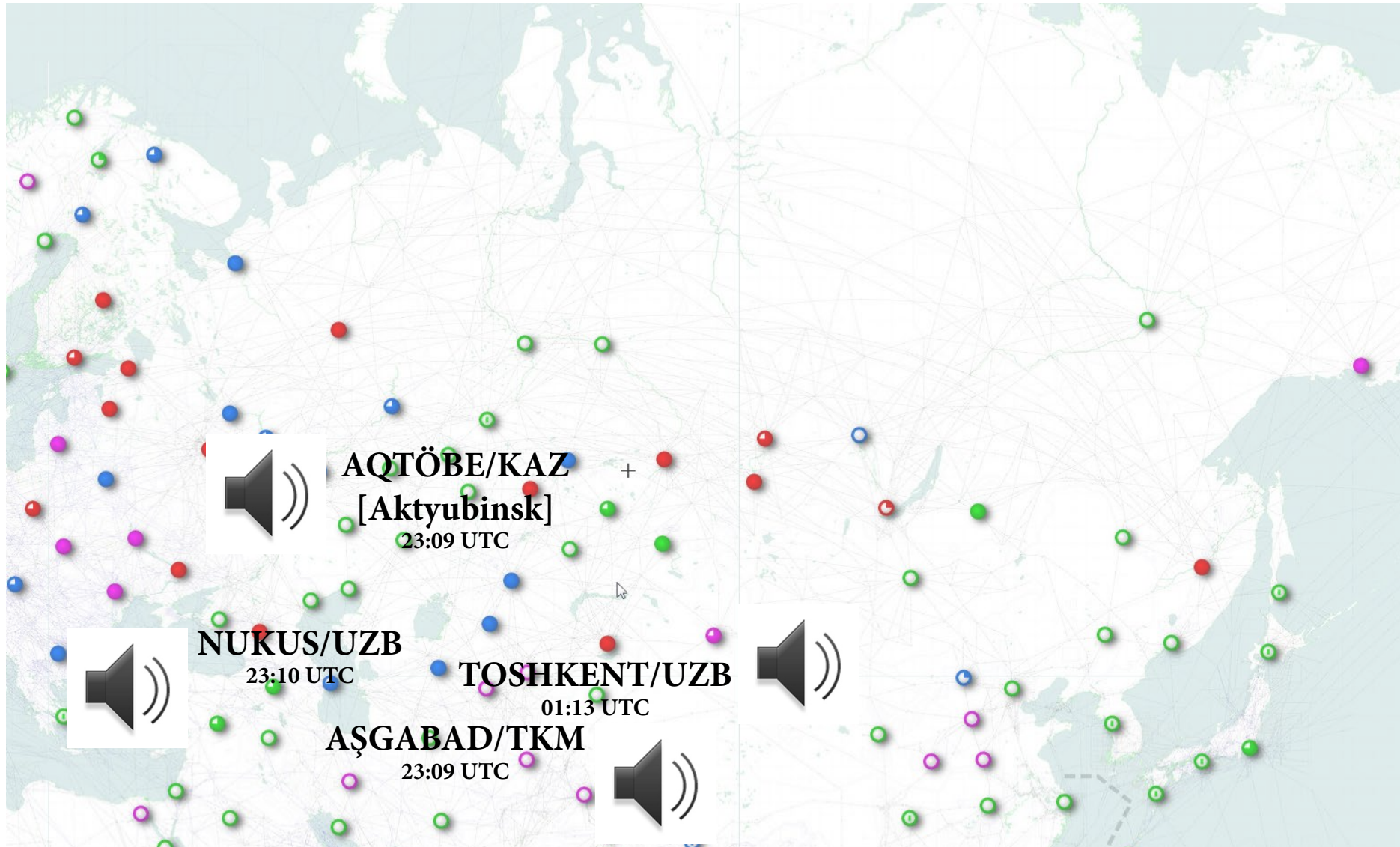
or Archangelsk starting at around 04:30 UTC during my monitoring time in early December 2014.

The map used here is from *Bing/Microsoft*.



Central Asia – 8.951kHz

In this net, mostly clear names of the airports are used. It covers airports from Russia (RUS), Uzbekistan (UZB), Azerbeidshan (AZE) and Turkmenistan (TUR). Map: *SkyVector*.



A mixed Collection

On this and the next page you find a mixed collection of some audio clips of *frequencies* (plus a few *stations*) which hadn't been covered above. See this map (Google Maps) for a more general orientation of their location. On the following page you will find the MP3s.



Air Force /Naval Aviation stations are colored.

For more information see *here*.

4.672 kHz

VOLOGDA with PETERSBURG



6.685 kHz

POLIS (Orenburg) with
KORSAR (Pskov)



4.712 kHz

ROSTOV-NA-DONU with
MIN[ERALNYE-]VODY



6.685 kHz Russian Air Force

KORSAR (Pskov) with
DAVLENIE (Taganrog)



5.632kHz

[Mys] KAMENNNYY with
PETERSBURG



8.950 kHz

MURMANSK CONTROL calling
UNITED 895



6.270 kHz Russian Air Force

KAPEL (Omsk) with
KATYUSHA (Novosibirsk)



8.950 kHz Russian Air Force

PROSELOK (Bryansk)



6.405 kHz

ZOOTEKHNİK (Tyumen) with
CADIK-DWA (Surgut)



11.193 kHz

MOSCOW



6.405 kHz

BRAZHKA (Chelyabinsk) with
UNID



11.354 kHz Russian Naval Aviation

KROKET (Kaliningrad) with
PRIBOJ (Moscow)



6.405 kHz

MELODYA-DWA (Kazan) with
ZOOTEKHNİK (Tyumen)



11.360 kHz Russian Air Force

KLARNETIST (Tver) with
DAVLENIE (Taganrog)



6.405 kHz

ALENKI (EKATERINBURG)
calling several stations, no joy



Below please find some unidentified stations or tentative IDs (Almaty - were they calling or being called?).

There are many other frequencies where you can find these and other stations.

Now it's your turn!

5.827 kHz Russian Air Force

KATOLIK (unidentified location)



6.270 kHz Russian Air Force

ALMATY?



6.270 kHz Russian Air Force

BADIK-DWA (Vorotyn/Gomel?)



6.270 kHz Russian Air Force

KAPEL (Omsk) with
KRATER (unidentified location)



Appendix: CIS VOLMET

Nowadays, only a small number of weather broadcasts from CIS airports transmits on short-wave. The map (made from *SkyVector*) on the right shows these locations, I have heard in recent months, plus a short audio clip.

