Signals Analyzer – some Examples, Step-by-Step [to be continued]

1. \rightarrow Open the WAV file with SA (File > Open file...)



2. \rightarrow With the left mouse button pressed, "frame" a part of the signal.



3. → Trim the signal with "Size FFT", "Shear" "Image", "ALC", "HRes" in the upper part of the window and "+" and "-" on the lower left.

 \rightarrow Place the rulers to measure the bandwidth of the signal and the time of one element.

 \rightarrow Click "Info", and those information will appear in the upper right: e.g. 247 Hz width, one element measured with 139,319 milliseconds.

 \rightarrow Click right mouse button, and then in the menue "Auto define parameters". This will calculate the bitrate ("Brate", here 16,49 Hz).

With "MFSK", also the space between the tones (in Hz) is automatically calculated and shown ("S = 7.18")



4. \rightarrow Click the icon "Phase detector" in the bottom and ...



5. → ... click right mouse button to open a menu.
 → Click "Wave Form module" in this menu.
 This will show precisely each tone ...



6. ... which can be better seen, when magnified vertically and horizontally, etc.



7. \rightarrow Change back from zoom to previous scale.

 \rightarrow Click "Sum". This will add a vertical diagram, showing each tone, and it's number of occurrences by the length.



8. This magnification will show the principle.



9. → Place one frequency ruler on the highest peak, and the other on the lowest peak.
→ Open menu with right mouse click, and click "Count freqs". This will show the "grid" number (i.e. the number of tones, being "32"), plus the difference between each tone in Hz (7.81 Hz).

During these measurements, the Hz/pix value should be around 0.5 to 0.3 (here: 0,295).



Analyzing an (Q)PSK-Signal

1. \rightarrow Open the WAV file with SA (File > Open file...)



2. \rightarrow With the left mouse button pressed, "frame" a part of the signal.

TempDir] QPSK_BPSK(0).wav		
SizeFFT 1024 • Shear Size • Image - 50 db • WinF Kaiser, b=8 • F 0	Fu 4000	ALC HRes Info
		÷
		March 100 March 100
		P P 2000 00

3. → Trim the signal with "Size FFT", "Shear" "Image", "ALC", "HRes" in the upper part of the window and "+" and "-" on the lower left.

 \rightarrow Place the rulers to measure the bandwidth of the signal and the time of one element.

 \rightarrow Click "Info", and those information will appear in the upper right: e.g. 53 Hz width, one transmission measured with 40,384 seconds.

 \rightarrow Click right mouse button, and then in the menue "Auto define parameters". This will calculate the bitrate ("Brate", here 31,25 Hz).



→ Click the icon "Phase plane" in the bottom. This will call the first window, where carrier frequency (1019 Carrier) and bit rate (31,25 BR) are automatically set. Click "LoadFile", and select that file you want ...



5. \rightarrow ... click "LoadFile".

 \rightarrow Choose from menue "n-Ary" the most probable number of phase (change them, if you don't get a clear picture).

The phase plane can be seen in the wind at the bottom left, here QPSK with four phases (4-PSK), and "transitions" between phases clicked.

TempDir] QPSK_BPSK(0).wav	
	$ \begin{array}{c cccc} & Mode & Blocks \\ & AM & 0 & 10 \\ & & X^{N} & 20 \\ & & & 30 \\ \hline & & & 40 \\ \hline & & & 50 \\ \end{array} $
	Image: Weight of the section of th
Image: Constraint of the sector of the se	302,68 Offset mode detected Angles Vectors of dem Output Dem as 2 < > > Delay 0,000 Clear > Points 2000 > Contrast 15

6. With a broad signal, you also start with "framing" and measuring of bit rate (2400,02 Hz).



7. \rightarrow Click "Phase plane" in the bottom.

-										
Fmin	0	Fmax	4000	Scale 1	▼ FFT:	Size 1024 • Lo	wLevel (1	Stretch 🔽	
						i na tao 🚹 📖 Shini ta				
		144	ALALA	A 11 1. 1 M	ALL MAN	NUM ALAM	And A shirts	A ship a la fa fa		
		1000	Attes					п. с. н.		
	1.	4							174 g	
	- 7									
the second se										
	10-1 10-1					DI I	0 Offs	at mode detected		
		ototo		1819,5	Carrier	PLL Slow	0 Offse	et mode detected		
C	Current	state		1819,5	Carrier	PLL Slow Medium	0 Offse	et mode detected Vectors of dem		
C	Current onl	state y	Î.	1819,5 2400,02	Carrier BR	PLL Slow Medium Quick	0 Offse	et mode detected Vectors of dem as 2 +		
(gra	Current only phical s	state y pectri	um!	1819,5 2400,02 2	Carrier BR • n-Ary	PLL Slow Medium Quick Hard	0 Offse Angles	et mode detected Vectors of dem as 2 •	Trimming 0	Start
(gra	Current only phical s	state y pectri	um!	1819,5 2400,02 2 V Synch BF	Carrier BR In-Any	PLL Slow Medium Quick Hard	0 Offse Angles Output Dem	et mode detected Vectors of dem as 2 ~	Trimming 0 Delay 0.000	Start
(gra Fo	Current only phical s	state y pectru	um!	1819,5 2400,02 2 ☑ Synch BF ☑ NonStop	Carrier BR • n-Any R	PLL Slow Medium Quick Hard AutoReset	0 Offse Angles	et mode detected Vectors of dem as 2 •	Trimming 0 Delay 0.000 Pointe 2000	Start Clear
(gra Fo	Current only phical s	state y pectro e Plar	um! ne,	1819.5 2400.02 2 ✓ Synch BF ✓ NonStop	Carrier BR In-Any R	PLL Slow Medium Quick Hard AutoReset Transitions	0 Offse Angles Output Dem	t mode detected Vectors of dem as 2 •	Trimming 0 Delay 0.000 Points 2000	Start
(gra Fo pl	Current only phical s or Phase lease lo	state y pectru e Plar ad fil	um! ne, e!	1819,5 2400,02 2 V Synch BF V NonStop	Carrier BR n-Ary R	PLL Slow Medium Quick Hard AutoReset Transitions Ulfe	0 Offse Angles Output Dem 4 4 4	et mode detected Vectors of dem as 2 •	Trimming 0 Delay 0.000 Points 2000 Contrast 15	Start

8. → Click "LoadFile". You won't see one clear peak of the carrier with its sidebands in the window.

TempDir] RFSM8000_Connect_VR6TC(0).wav			
	ли	▲ Mode Blocks ○ AM ○ 10 ○ X^N ○ 20 ○ 30 40 1 ▼ 50	
	M h	Image: Corr-OFF Break Image: SaveAs Reset	
1819,5 C 2400,02 Bi 2 n ✓ Synch BR NonStop ■ RRC filter	arrier PLL Slow ® Medium Quick Ary AutoReset Transitions V Life > 0,5 0 V Diff	10,73 Offset mode detected Angles Vectors of dem Output Dem as 2 Trimming 0 Delay 0.000 Output Dem as 2 Contrast 80	Start Clear LoadFile

9. → Change "N" (above right) from 1 to a number, which presents you with a clear peak and its sidebands. Here you eventually end after "1" and "4" at "8". Thus, this is an 8PSK signal.





10. → Click "Start", and the phase plane show eight phase states – here without "Transitions" being clicked.

TempDir] RFSM8000_Connect_VR6TC(0).wav		
p. M.	▲ Mode Blocks ▲ ▲ 10 ● X^N 20 ● X^N 20 N ● 30 N ● 40 8 ● 50	
 1800 Carrier 2400,01 BR 8 ▼ n-Ary ∑ Synch BR ∑ NonStop RRC filter ✓ → 0,5 	PLL SaveAs Reset Slow I1.52 Offset mode detected Medium Output Dem as 2 Quick Output Dem as 2 Hard > AutoReset > Transitions > Uife > >	Trimming 0 Break Delay 0,000 Clear Points 2000 Contrast 80 LoadFile

Analyzing an OFDM-Signal [WinDRM, 64PSK]

1. \rightarrow Open the WAV file with SA (File > Open file...)



2. → With the left mouse button pressed, "frame" a part of the signal – not too tight with the frequency rulers, as then one later gets a wrong bit rate!
 → Click right mouse button, and then in the menue "Auto define parameters". This will

calculate the bitrate ("Brate", here 37,48 Hz). Click also "Info".

eFFT 1024	 Shear 	Size	- Im.	age - 50	db 🔻	WinF K	aiser b=8	• B	0	Fu 40	00 AI	C HRes I Info	
	Jonodi	0.20		ago ou		(ji			-				-
		, i										Fu = 2955	
												Fc = 1567.5	
								Br	ate: 37.48	3 Hz		FI = 180	
												— dF = 2775 —	
												t1 = 00:22.527	
												t2 = 01:48.415	
												dT = 01:25.888	-00
												S = 0.01	
												Br = 37,48	
		- Jacob										SC = 1567,5	
		2000											
						C doubles							
1													

- 3. \rightarrow Click "OFDM"-module.
 - \rightarrow Click "Find CT".
 - \rightarrow Click "ADP" to find exact baud rate (here: 37,559 Bd, shift 46,784 Hz).

 \rightarrow With the sliders, trim both the left windows so as in the picture below. Use also slider "Scale FFT" to fully see all channels.



4. \rightarrow Click with the left mouse button into the first channel, which will be prolonged in green.



5. \rightarrow Double-click the last entry in the upper right window (here: "LS=213; LG=42 ...), and the phase plane will appear.

SA SA-OFDM - • × Min Br-LS 36 8 222 Max Br-LS 400 8 20 Total LS 3093 Current LS 1380 Survey List of K = 37,559 Br = 46,784 Sh Magic K = 14/570,24561404 * LG(CP) = 42171 T.U $CH_Up = 8$, Freq = 374/269 $CH_Down = 0$, Freq = 0dFreqs = 374,2699, GH Col Mode A - 0 ÷ Each 1 ÷ Start+ 0 ÷ . 30 Symbols . Scale FFT + 7 * * -25,0867 Shift Frequency ADP 37,499911 Break Find CT [TempDir] WinDRMBS6425(0).wav

 \rightarrow Click "Show", and the phases will build up.

6. As the "Shift Frequency" (here: -25.0867 Hz) is just calculated by the software, it has to be *corrected manually and very carefully* in almost each case to get a stable phase plane. This can be a bit tricky. But this picture tells that you are approaching the correct value ...



7. ... further and further ...



8. ... until reaching a steady phase plane like this.

It shows a star-like center (main data) plus five outer phases for synchro etc.



9. → Change "Each" and "Start+", until you get a steady phase plane as shown below. Thus, this is a 64-PSK signal.





16-PSK (WinDRM)

© 2012: Nils Schiffhauer, DK8OK