Pactor Series Overview

Pactor is a radio transmission mode used by amateur radio operators, marine radio stations and radio stations in isolated areas (e.g., high seas and expedition routes) to send and receive digital information via radio. A robust network of Pactor stations has been established to relay data between radio stations and the internet, extending internet access for users. Pactor utilizes a combination of simple FSK modulation and the ARQ protocol for robust error detection and data throughput.
Generational improvements to Pactor include Pactor-II, Pactor-III and Pactor-4 which are capable of higher speed transmission.

Description of Pactor Modes

Pactor-I

Pactor-I was developed in the 80s by the German radio amateurs Hans-Peter Helfert and Ulrich Strate. It was derived from AMTOR.
Pactor-I uses AFSK (Audio Frequency Shift Keying) modulation with a tone spacing of 200 Hz and the data rates of 100 and 200 baud. It uses an ARQ protocol, which means the data is sent in packets and has to be acknowledged by the receiving station. The receiving station can request a retransmission of a packet when it is not received properly. The ARQ cycle time in Pactor-I is always 1.25 seconds. To verify the data integrity, all data packets carry a 16-bit CRC checksum.
In order to increase the data throughput, Pactor supports a built-in Huffman compression, which is able to compress the text. If there are a lot of repeating sequences in the data, an additional compression scheme — the run-length encoding — is applied to increase the throughput further.

Baudrate	Data bytes / packet
100	8
200	20

Table 1 Pactor-I transmission rate.

Pactor-II

After the success of Pactor-I, the SCS company was founded in 1992 and the proprietary Pactor-II modes was developed.
This mode uses 2 PSK (Phase Shift Keying)-modulated carriers with a carrier spacing of 200 Hz and a symbol rate of 100 baud.
Other than its predecessor, Pactor-II applies a forward error correction (FEC). The maximum throughput is 700 bps (bits per second). As Pactor-I, the whole signal fits into a 500 Hz wide channel. The transmission rates are adjusted based on the channel quality.

Modulation	Code rate	Byte/packet (1.25s cycle)	Byte/packet (3.75s cycle)	Net rate	User rate
DBPSK	1/2	5	36	200	100
DQPSK	1/2	14	76	400	200
8-DPSK	2/3	32	156	600	400
16-DPSK	7/8	59	276	800	700

Table 2 Pactor-II transmission rate.

Pactor-III

The development of Pactor-III was a huge leap forward. It achieved a user data rates up to 3200 bits per second.
Pactor-III uses multi-channel PSK and pulsed-shaped OFDM for transmission. Up to 18 channels can be used. The symbol rate is still 100 baud. However, the bandwidth is increased to 2.4 kHz, which corresponds to the width of an HF voice channel.
There are 6 speed levels and two packet cycle lengths. The number of carriers used and the transmission rate depend on the speed level, which is again adaptive according to the channel quality.

Pactor-III

Speed level	Carrier number																	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1						X							X					
2				X		X		X			X		X		X			
3			X	X	X	X	X	X	X	X	X	X	X	X	X	X		
4			X	X	X	X	X	X	X	X	X	X	X	X	X	X		
5		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

*Table 3 Pactor-III multi-channel scheme. "X" means the carrier is used in this speed level. The carrier frequency is 480 + 120 * (carrier number) Hz.*

Level	Mod	Carriers	Code length	Code rate	Data rate (bps)	User rate (bps)	Bytes/packet Short	Bytes/packet Long
1	DBPSK	2	9	1/2	200	100	5	36
2	DBPSK	6	7	1/2	600	300	23	116
3	DBPSK	14	7	1/2	1400	700	59	276
4	DQPSK	14	7	1/2	2800	1400	122	556
5	DQPSK	16	7	3/4	3200	2400	212	956
6	DQPSK	18	7	8/9	3600	3200	284	1276

Table 4 Pactor-III transmission rate.

Pactor-4

The newest generation Pactor-4 was first introduced in 2011, together with a new modem by the company SCS.
Pactor-4 implements 10 speed levels. Level 1 uses dual-channel chirp DBPSK. The other levels use a single carrier PSK signal at 1500 Hz, modulated at 1800 baud. The single carrier PSK scheme is adopted from the famous MIL and STANAG mode series.

Modulation schemes change depending on the speed level. Robust levels use the spread spectrum modulation, where other normal levels use coherent PSK and QAM modulation schemes. At the receiver side an adaptive equalizer is running to combat various unfavorable channel conditions in the HF transmission.

Level	Cycle	Baud rate	Modulation	Code rate	Data rate (bps)	Net rate (bps)	User data rate (bps)	User bytes / packet
1	Long	66.667	DBPSK	1/2	133.33	66.667	47	22
2	Long	112.5	DQPSK *	1/2	225	112.5	85.3	40
3	Long	112.5	DQPSK *	5/6	225	187.5	147.2	69
4	Long	225	DQPSK *	5/6	450	375	300.8	141
5	Short	1800	BPSK	1/3	1800	600	256	40
7	Short	1800	QPSK	1/3	3600	1200	537.5	84
8	Short	1800	8-PSK	1/3	5400	1800	819	128
9	Short	1800	16-QAM	1/3	7200	2400	1101	172
5	Long	1800	BPSK	1/3	1800	600	433	203
6	Long	1800	BPSK	5/6	1800	1500	1096.5	514
7	Long	1800	QPSK	5/6	3600	3000	2199.5	1031
8	Long	1800	8-PSK	5/6	5400	4500	3304.5	1549
9	Long	1800	16-QAM	5/6	7200	6000	4407.5	2066
10	Long	1800	32-QAM	5/6	9000	7500	5512.5	2584

Table 5 Pactor-4 transmission rate. (spread spectrum modulation).*

Compression

In order to increase the data throughput, Pactor-I employs a packet-wise Huffman compression scheme. It uses a fixed Huffman tree.
In Pactor-II an additional scheme, the Pseudo-Markov Compression (PMC), was introduced. PMC works similar to Huffman compression, but after each character, the Huffman table may be switched. PMC exploits the fact that for different letters, the probabilities for the following letters are different. There are several PMC modes, optimized for German and English texts and for capital and small letters.

Applications

SCS Mail and EasyTransfer

SCS Mail is a software written by the company SCS. It transfers emails via Pactor.
EasyTransfer is a software by SCS as well. It transmits and receives files via HF.

Pactor IP Bridge

Pactor modems also contain a so-called “Pactor IP Bridge” (PIB). This supports TCP/IP connections via HF. A computer connects to the modem via the PPP protocol, and the modem translates PPP packets to a format suitable for the HF transmission. It also applies TCP/IP header compression to reduce the overhead. This functionality can be used to send and receive emails and surf in the internet using any software.

Typically, when using PIB, one side acts as a host or gateway, to which clients can connect. This is called the host mode. There is also a protocol called “Free Signal Protocol” (FSP) that can be used alongside with the host mode. When using FSP, the host regularly transmits its callsign when it is available for connections. Clients can then connect by replying to a free signal packet.

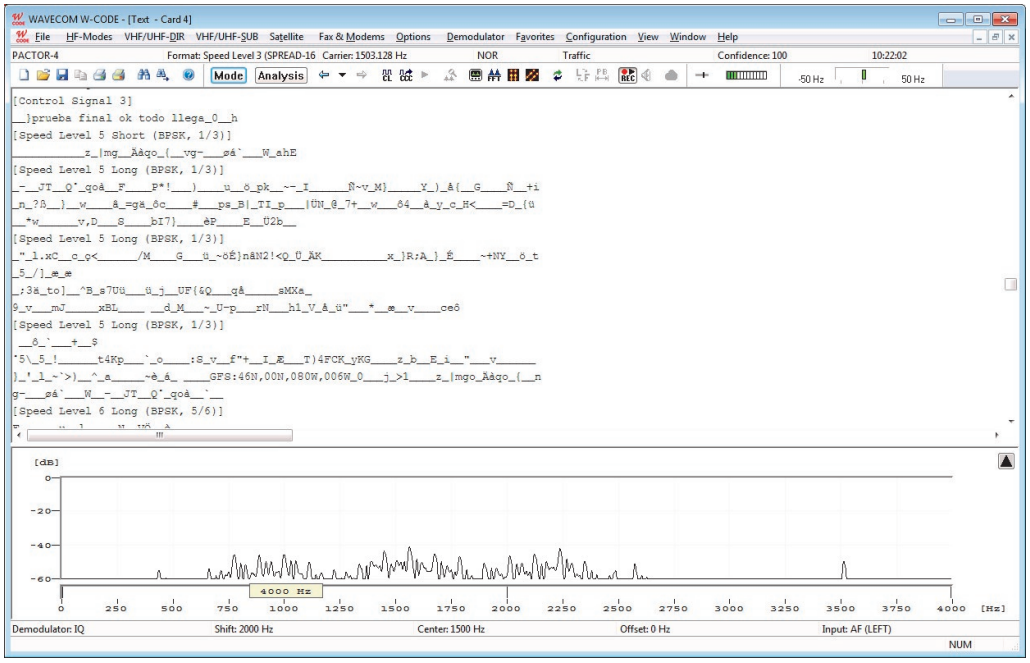
Networks

There are many networks using Pactor series as communication protocol.

- Global Link Network (GLN) is a global HF network. It supports the Pactor IP bridge functionality, and is used mostly by ships. It supports up to Pactor-III and uses the free signal protocol. The connections of GLN are encrypted.
- SailMail is another HF network. It is used to transmit and receive files. PIB is not supported, but Pactor-4 is used by SailMail.
- Amateur Radio: Pactor series are very popular among amateurs all over the world. The amateur communication can often be heard on the corresponding frequencies.

Wavecom Implementation

The whole Pactor series are implemented in the Wavecom decoders (HF-Modes).
All the Pactor decoders demodulate and decode the Pactor signals, make frequency tracking, recognize and verify the CRC checksum and automatically decompress and decode user data to its final protocol layers.



Since more than thirty years Wavecom Elektronik AG has developed, manufactured and distributed high quality devices and software for the decoding and retrieval of information from wireless data communication in all frequency bands. The nature of the data communication may be arbitrary, but commonly contains text, images and voice. The company is internationally established within this industry and maintains a longstanding, world-wide network of distributors and business partners.

Product Information

Products	http://www.wavecom.ch/product-summary.php
Datasheets	http://www.wavecom.ch/brochures.php
Specifications	http://www.wavecom.ch/product-specifications.php
Documentation	http://www.wavecom.ch/manuals.php
Online help	http://www.wavecom.ch/content/ext/DecoderOnlineHelp/default.htm
Software warranty	One year free releases and bug fixes, update by DVD
Hardware warranty	Two years hardware warranty
Prices	http://www.wavecom.ch/contact-us.php

System Requirements

	Minimum	*Recommended*
CPU	P4 Dual-Core 2.4 GHz	Core i5 or Core i7 2.8 GHz
Memory	2 GB RAM	4 - 8 GB RAM
OS	Windows XP	Windows 7 32-bit or Windows 7 64-bit

Distributors and Regional Contacts

You will find a list of distributors and regional contacts at http://www.wavecom.ch/distributors.php

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