VDL-M2 Aeronautical Data Link

Advanced Protocols

WAVECOM
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VDL-M2 Overview

W-CODE software contains a new mode, VDL Mode 2, which is intended to become the replacement for the now ageing, low speed ACARS. For many years, ACARS has been the work horse of air-ground/ground-air VHF data communications. However, global increase in air travel as well as the demand for more bandwidth hogging data applications has also led to an increase in the demand for aeronautical VHF communication channels. In addition ACARS is constrained to 7-bit character oriented data, whereas VDL-M2 natively is bit-oriented. To comply with this demand, aeronautical voice channel band-width has been decreased to 8.33 kHz and new data modes has been considered which will replace some of the voice applications with data applications and thus relieve the congested radio spectrum and improve safety.

One result of these considerations has been the introduction of VHF Data Link Mode 2, VDL Mode 2, which is meant to eventually replace ACARS.

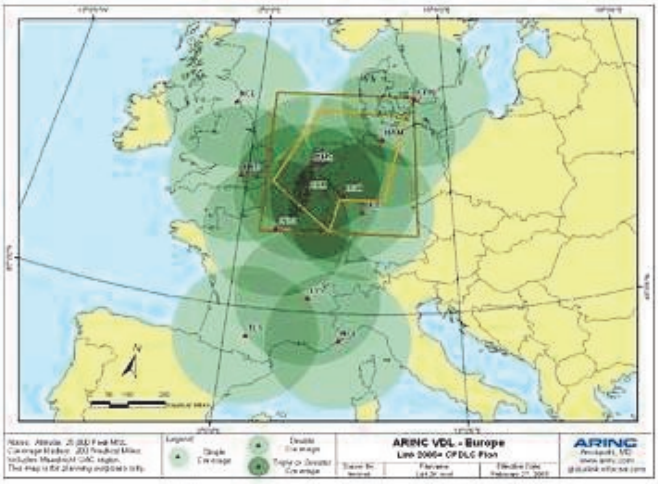

Fig. 1 ARINC European VDL-M2 coverage

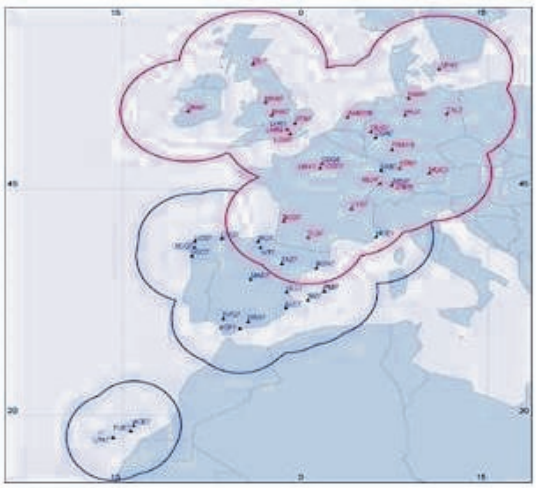

Fig. 2 SITA European VDL-M2 coverage

The overwhelming majority of both ACARS and VDL -M2 networks are operated by two private companies, the US based ARINC (Aeronautical Radio, Inc.) and the Euro-pean-based SITA (Societe Internationale de Telecommunications Aeronautiques), a data communication co-operative owned by the air lines. Both com-panies operate what is probably the largest private network in the world serving all airports and air lines with AOC (Airline Operational…) traffic as well as ATS traffic.

At the time of writing more than 2500 aircraft world-wide have been equipped with VDL-M2 equipment, and the number of VDL-M2 ground stations are increasing on all continents with Western Europe as the most densely covered area.

VDL-M2 Architecture

VDL-M2 supports connectivity to the Aeronautical Telecommunications Network ATN), the Internet of civil aviation authorities. It is also capable of transmitting ACARS messages as ACARS-Over-AVLC (AOA), AVLC (Aviation VHF Link Control) being the Data Link layer of the VDL-M2 protocol stack.
The ATN provides an architecture which basically sees a VDL-M2 station onboard an aircraft as just another node in the ATN, a router in sky so to speak.

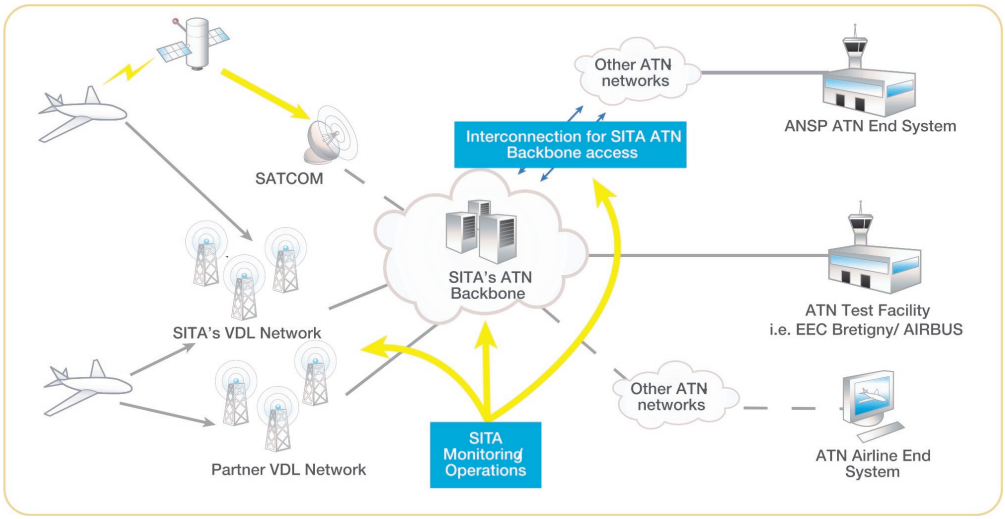

Fig. 3 SITA's ATN/VDL-M2 service by Eurocontrol

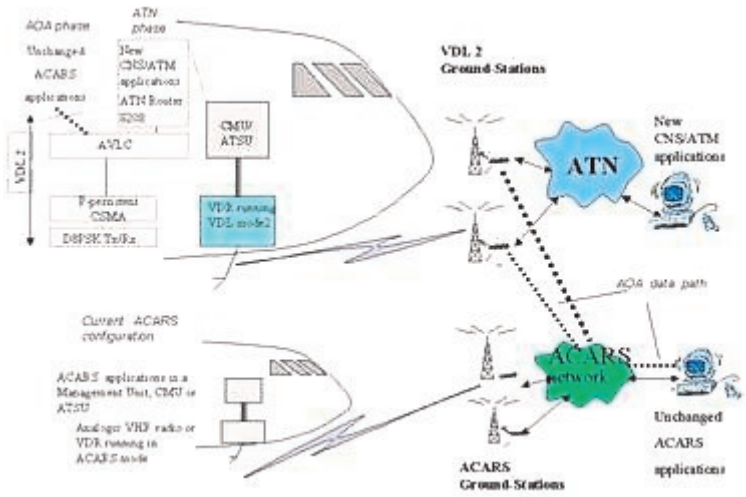

Fig. 4 Basics system architectur

VDL-M2 Protocol stack

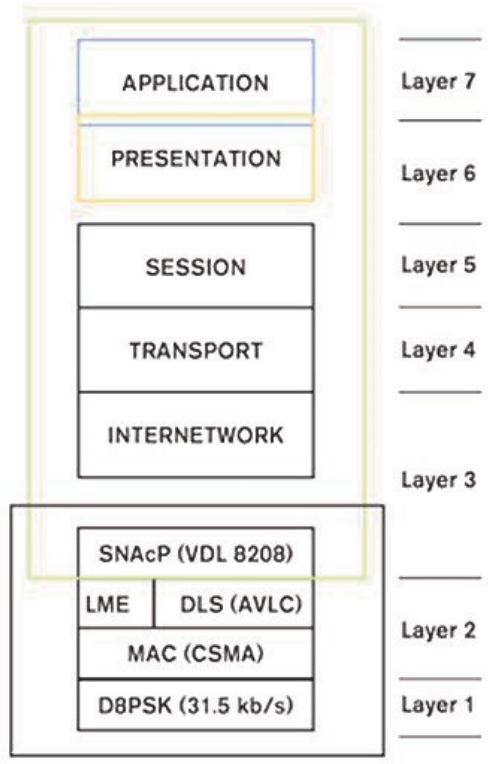

Fig. 5 VDL-M2 Protocol stack

VDL-M2 handles the two lower layers and part of layer three of the OSI seven layer protocol stack.

Layer 1, the physical layer, uses differential 8-phase modulation at a symbol rate of 10.5 ksps or 31.5 kbps (eight phase states yield 3 -bit symbols). In Europe a common signaling frequency has been allocated to VDL-M2, 136.975 MHz on which all stations must transmit their identification messages. This protocol layer is also responsible for bit interleaving and scrambling.

Layer 2, the data link layer, has two sub-layers. One is the MAC (Media Access Control) implements the CSMA (Collision Sense Multiple Access) algorithm – the radio listens to the channel and if it is free it transmits; if not it retries after a random interval. There is no priority mechanism in VDL-M2.

The second Data Link sub-layer called AVLC (Aviation VHF Link Control) uses a HDLC-like protocol. This layer is responsible for error detection, sequencing and addressing.

Layer 3, the network layer, is partly implemented using the ISO 8208 protocol (X.25 Packet Layer Protocol) and acts as adaptive layer which for instance reassembles packets delivered by the data link layer.

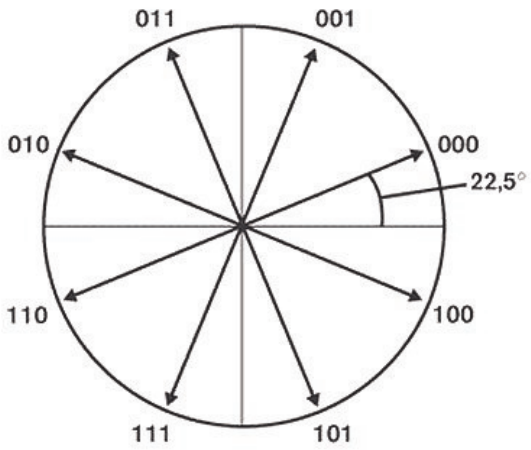

Fig. 6 VDL-M2 D8-PSK modulation

The ICAO VDL Mode 2 standard specifies the use over a VHF link of a Differentially Encoded 8-Phase Shift Keying (D8PSK) modulation scheme providing a data rate of 31.5 kbps, compared with the VHF ACARS rate of 2.4 kbps in the same channel width of 25 kHz.

The VDL Link Layer protocol specifies a Carrier Sense Multiple Access (CSMA) algorithm similar to VHF ACARS. The combination of the VDL D8PSK scheme and its CSMA algorithm provides for a greatly enhanced data load of 31.5 kbps, compared with classic VHF ACARS maximum effective link capacity of just 300 bps.

The radio burst consists of a burst header and a data section. Data is protected by interleaving and a Reed-Solomon Forward Error Correction (FEC) code. A special FEC protects the burst header.

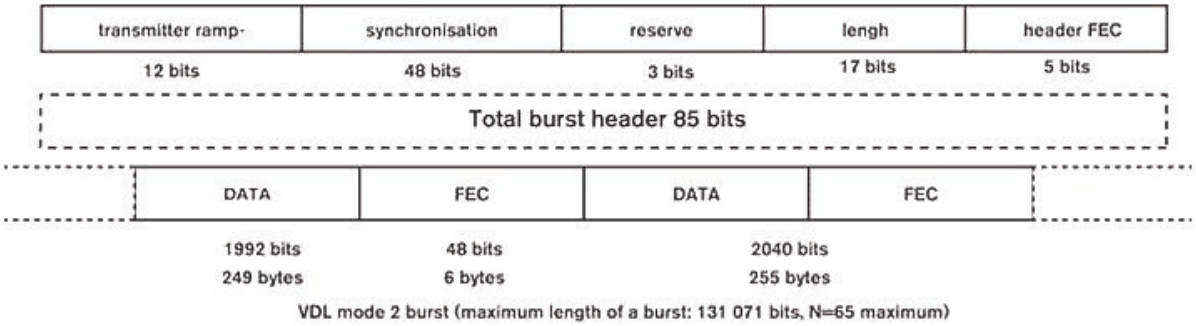

Fig. 7 VDL Mode 2 radio burst

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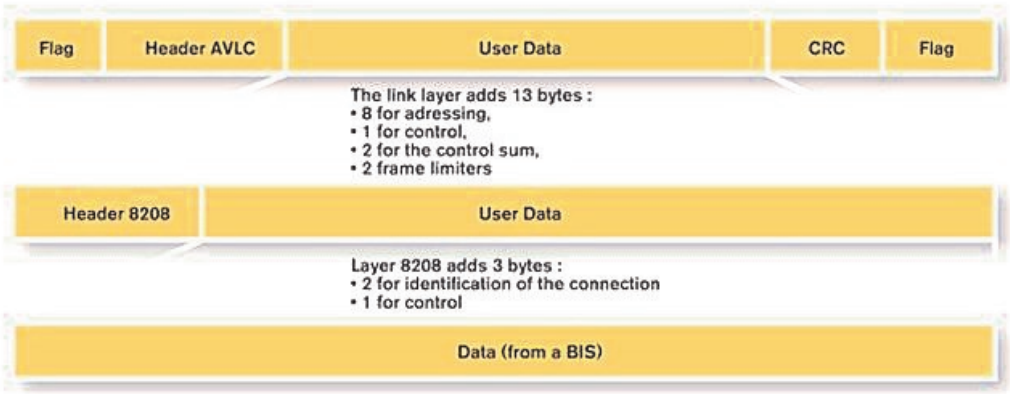

Fig. 8 VDL-M2 user data envelopes

Example of an ACARS message sent via VDL-M2 (AOA) and decoded by W-CODE

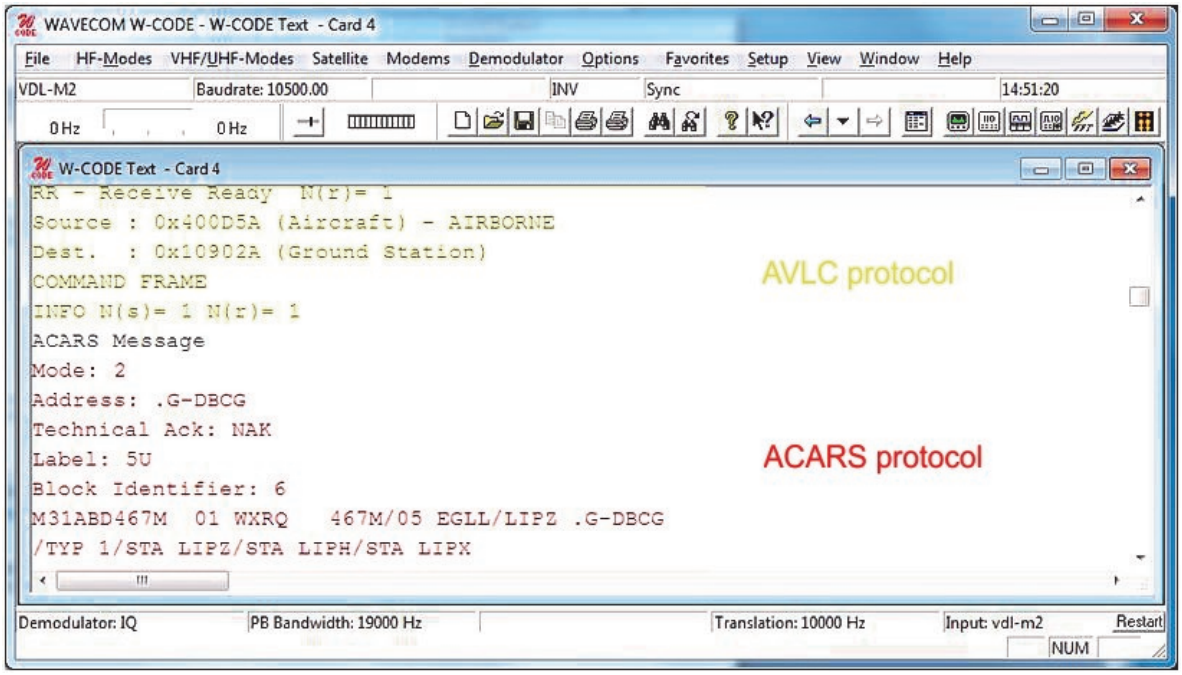

Fig. 9 VDL-M2 Message with AVLC- and ACARS protocol

This example shows a ground station GSIF (General Station Information Frame) frame:

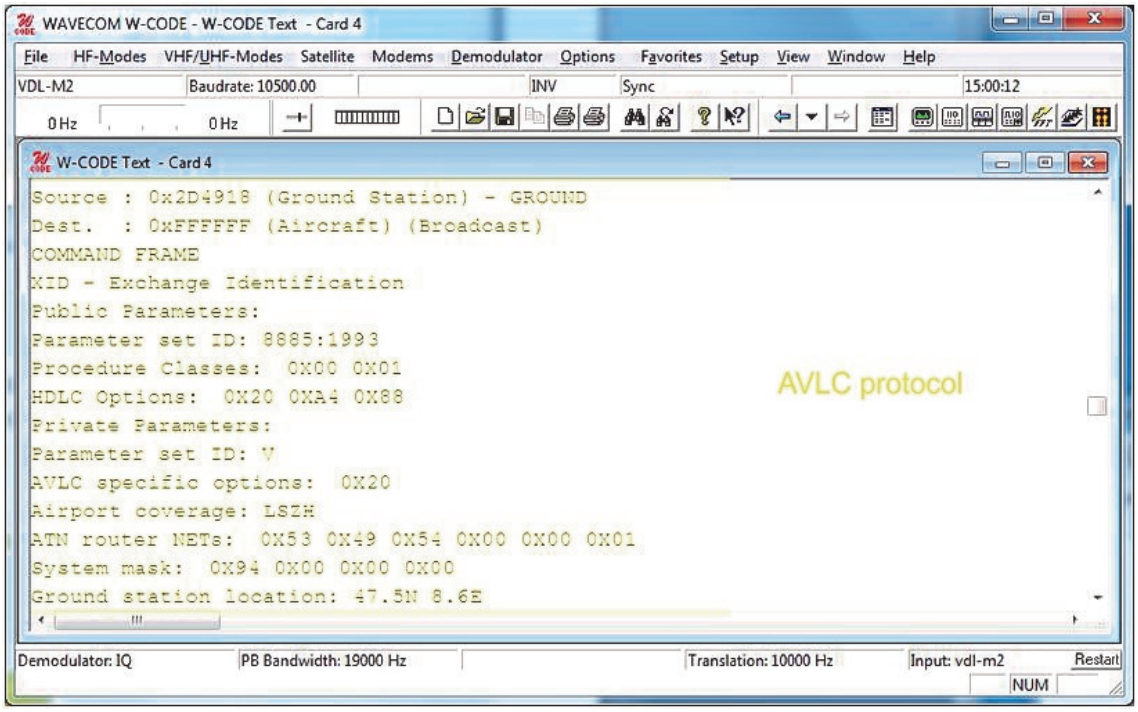

Fig. 10 VDL-M2 Message with AVLC protocol

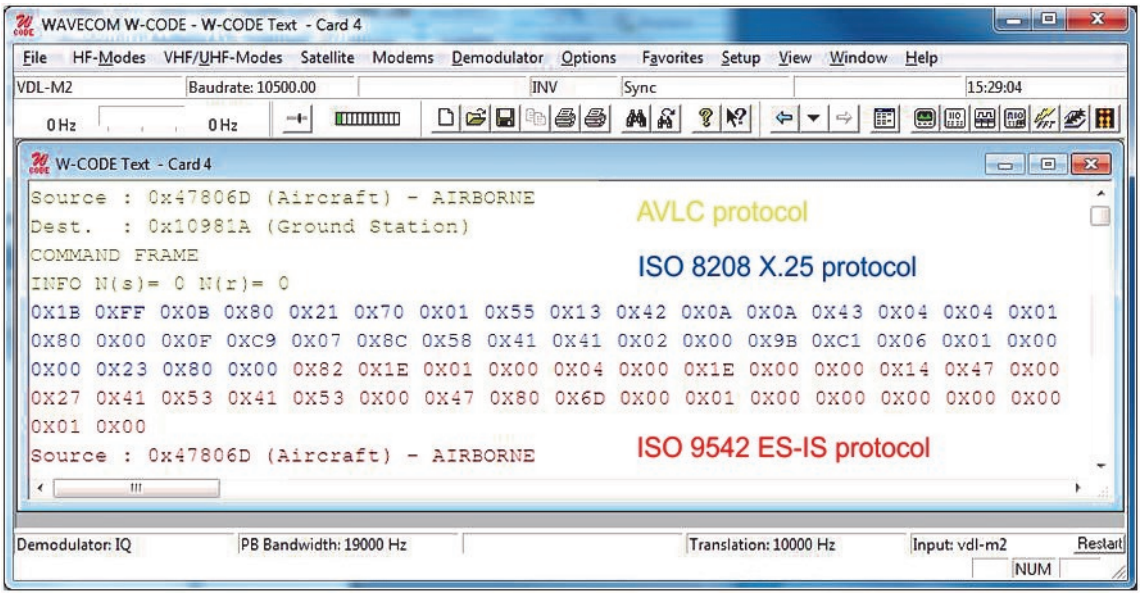

Fig. 11 VDL-M2 ATN ISH packet (Intermediate "Say Hello")

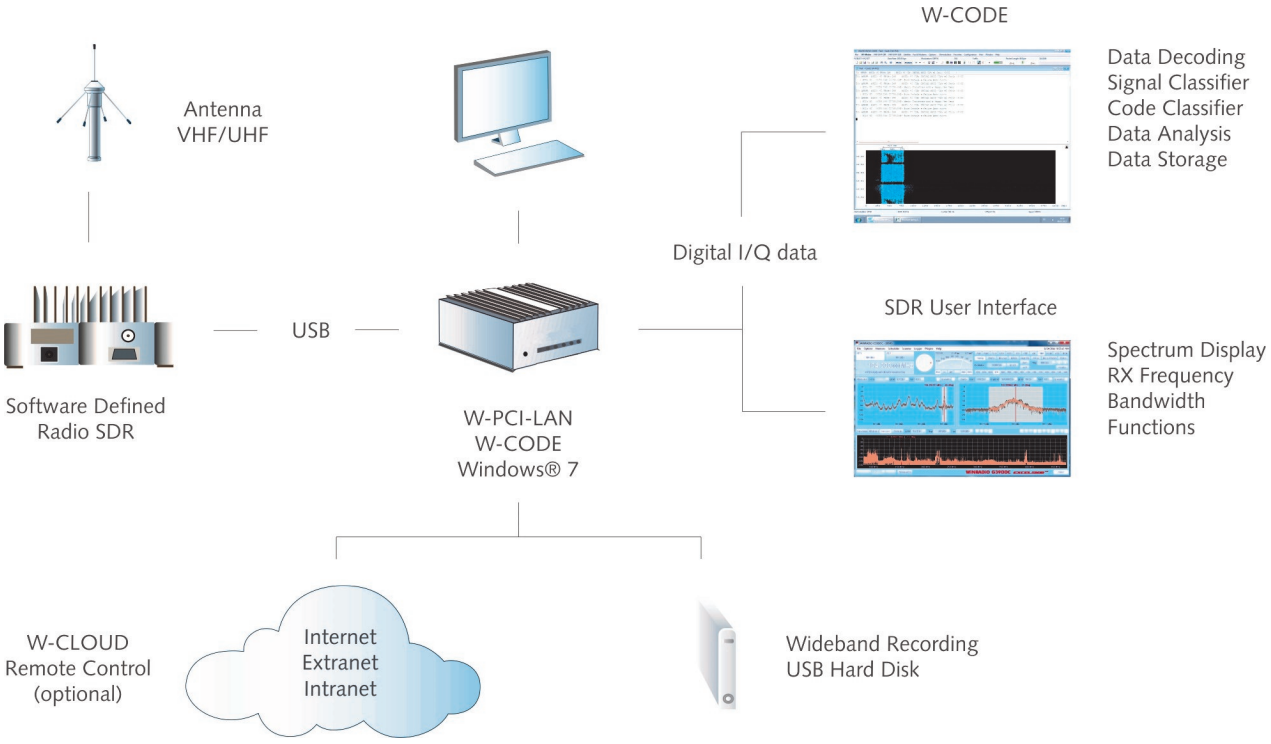

Fig. 12 Configuration for optimal VDL-M2 decoding results

W-CODE accepts input from the host built-in sound card, a number of SDRs, digital audio outputs, WAV files, I/Q data or TCP/IP streams. W-CODE provides all functions required to analyze, decode and process radio data communications throughout the radio spectrum from HF, VHF, UHF to SHF.

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	Core i5 or Core i7 2.8 GHz	Core i7-6700 3.4 GHz
Memory	4 - 8 GB RAM	16 - 32 GB RAM
OS	Windows 7	Windows 10 32-bit or 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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