TETRA Overview

TETRA (Terrestrial Trunked Radio) is a digital, trunked mobile radio standard developed by ETSI, the European Telecommunications Standards Institute. TETRA was designed using the experience gained from GSM and from several trunked radio systems. It provides some security measures including authentication mechanisms, air interface encryption and end-to-end encryption. TETRA has found widespread use all over Europe and also outside the EU in public safety, transportation, military and general land mobile applications.

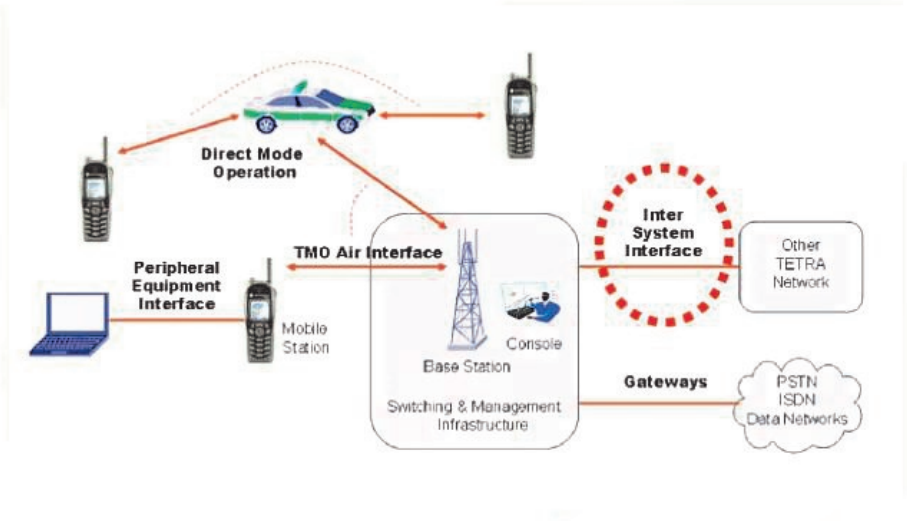


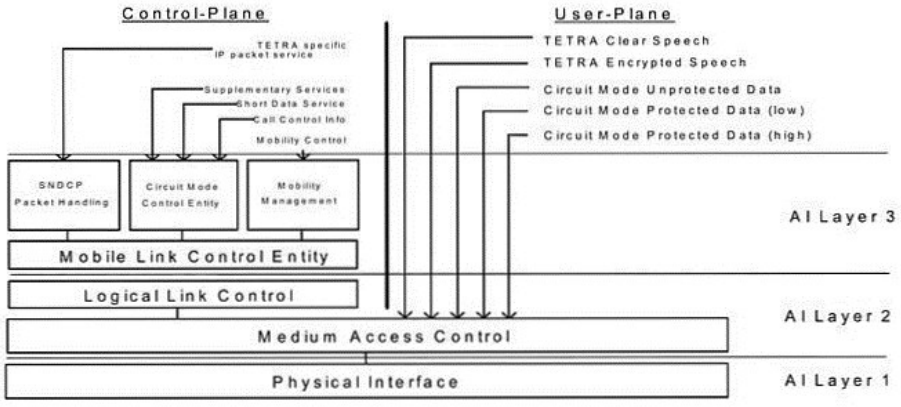
Fig. 1 TETRA network architecture

TETRA Architecture

The common mode of operation is the group calling mode where the user pressing the talk-button is heard by all other users in the same call group. On the other hand private calling enables users to talk in a one-to-one walkie-talkie-like mode. As a more advanced option it is also possible that the devices act as mobile phones where two users can talk in a full-duplex, direct connection like in GSM. Moreover it is possible to transmit Short Data Services (SDS) messages such as SMS, status messages or GPS coordinates and IP data over packet data service.

Mobile stations (MS) can communicate either in Direct Mode (DMO) using a shared frequency or they can communicate using the trunked infrastructure (TMO) after subscribing to a base station. In the Direct Mode, the MSs should be located in the same geographical area. Any MS can access the channel any time if the channel is free and not reserved. DMO allows relay connectivity using a mobile station in a car as a repeater or as a gateway to the TETRA network.

In TMO, the MSs can be located in different geographical areas and the channel access and slot and frequency allocations are handled by the base stations (see fig. 1).



|	Service Access Point (SAP);
AI-1	Air Interface layer 1;
AI-2	Air Interface layer 2;
AI-3	Air Interface layer 3;
C-plane	Control-plane, control information available;
CMCE	Circuit Mode Control Entity;
LLC	Logical Link Control;
MM	Mobility Management;
SNAF	Sub-Network Access Functions;
SNDCP	Sub-Network Dependent Control Protocol;
U-plane	User-plane, control information not available.

Fig. 2 TETRA protocol stack

TETRA Protocol Stack

The complete protocol stack for TETRA is depicted in fig. 2. On the physical layer TETRA uses TDMA with 4 time slots and a π/4-DQPSK, pulse shaping modulation scheme in a 25 kHz wide radio channel and a channel rate of 36 kBit/s. The voice codec used is ACELP. Data is organized into a frame structure shown in fig. 3. The higher level protocol layers are divided into a user plane, which handles user voice and data and a control plane (see fig. 2), which handles signaling and control data. Synchronization and other functions as encryption are based on a frame structure (see in fig. 3).

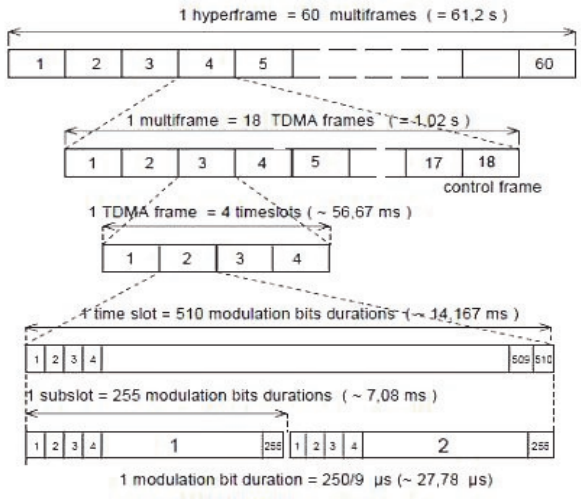


Fig. 3 TETRA frame structure

The data link layer interleaves, scrambles and adds various error-protection functions to the payload data as is evident in the bit processing path of a TETRA terminal illustrated in fig. 4.
As is the case for GSM, TETRA also maintains a complex hierarchy of logical channels mapped to the physical channels, which are the Control Physical channel in time slot 1 and the Traffic Physical channels in slots 2-4. The logical Main Control Channel (MCCH) resides in slot 1. All terminals listen to this channel when in idle state. TETRA supports end-to-end encryption under use control as well as air interface encryption. A great number of security related TETRA networks employ encryption.

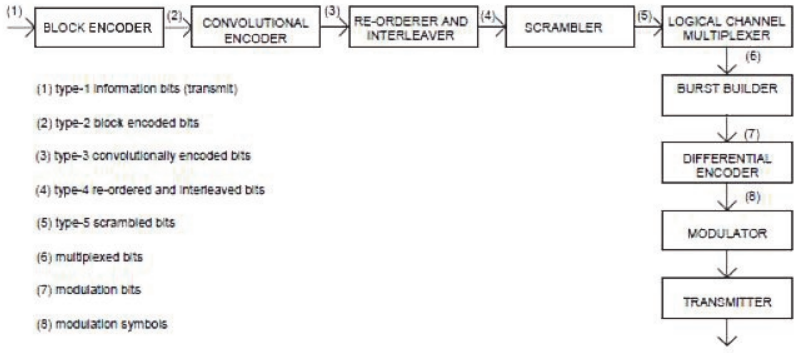


Fig. 4 Bit processing in a TETRA terminal (transmit functions)

TETRA Implementation

WAVECOM's implementation of TETRA is based on TETRA release 1 (TETRA V+D, Voice and Data) and will decode all voice and data traffic albeit with certain constraints. All layer 3 PDUs can be partially decoded (see the TETRA section of the Wavecom Decoder User Manual). TMO and DMO voice calls and SDS messages in all time slots are decoded and can be monitored in real-time as well as being saved to disk for later playback and analysis (see Fig. 5 and Fig. 6).

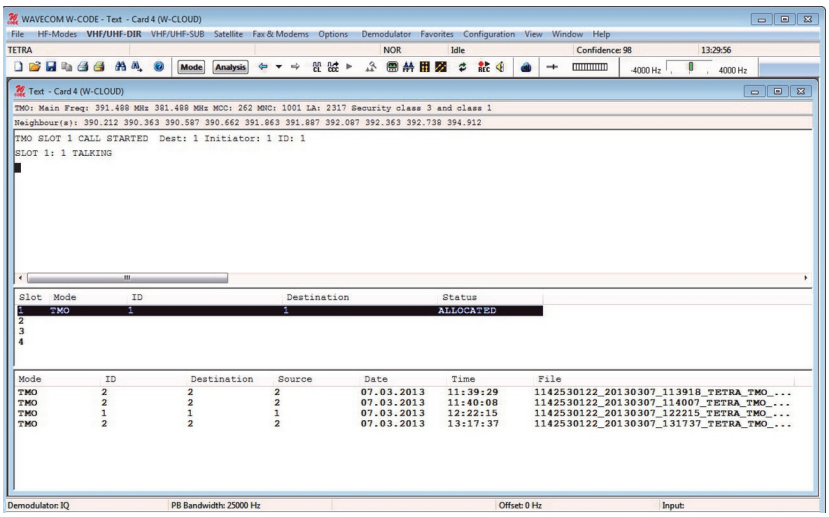


Fig. 5 W-CODE voice call screen

Encrypted data and voice poses specific problems for decoding as decryption of the payload is not attempted. In the current decoder version encrypted traffic similar to other traffic will trigger the indication “TRAFFIC” in the status box, and an option is available for saving traffic to a text file. Saved data and meta-information may be fed to an external decryption process.

A sample of the text file containing encrypted voice and meta-data is shown below:

TMO: Main Freq: 393.912 MHz 383.912 MHz MCC: 123 MNC: 4567 LA: 15972 Security class 3 and class 1
CN: 3756 CC: 2

Encrypted Channel Allocation Dest: 568463 Slot: 1 Frame: 11 Enc. Mode: 2

110111010001010100000000000010110011001110111001000010000011111110111110010110000000001000000100001000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000

2 8 40 5337 (slot – frame – multi-frame – hyper-frame)

100001010111110011001110100001011000111110110100101100000110000111110011000100000000110010100100001101 0
000111001010101011101011011010010101100100001011111010110110000111110011000111011100000001000011101100
011010000111000011111100000000101010000110101010011001010110011010001 11

The Short Data Service (SDS) includes a number of protocols of which the Wavecom decoder fully supports Text Messaging. Other data protocols are displayed as bits due to the lack of detailed protocol descriptions.

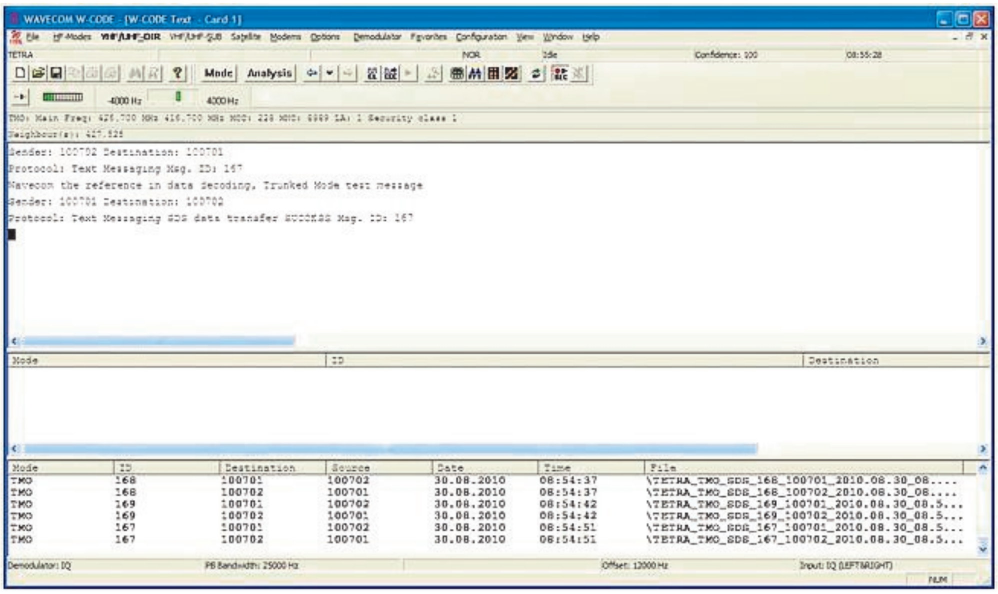


Fig. 6 W-CODE SDS decoding

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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