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Case Study

Metro in Oporto

A Trunked Radio project

"This solution provides a private operational radio system which can be used for emergency communications or by the drivers of the vehicles, and even by users of portable handheld devices."

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"... A reliable communications system capable of being used by operators, drivers of the vehicles (which use voice radios in the metro) and staff, who uses portable handheld devices."

Metro in Oporto

In 2006, Wavecom was contacted by Bombardier Transportation for consultancy regarding the Metro communications network in Oporto, becoming, in 2007, responsible for the management of the related coverage and infrastructure issues.

In 2009, it was awarded the planning and implementation of the voice radio network of the Gondomar line. A year later, Wavecom was responsible for the coverage of the new station at Sto. Ovídeo(Gaia).

The trunked radio solution implemented on the Metro in Oporto is based on the MPT 1327 protocol. This solution provides a private operational radio system, which can be used for emergency communications or by drivers of the vehicles, and even by users of portable handheld devices.

Thus, it is necessary that the voice radio solution enables a reliable communications system, able to be used by operators, drivers of vehicles (which use the voice radio available in the Metro) and staff, who uses portable handheld devices.

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The project in numbers

- 10 base stations;
- More than 90 portable handheld devices;
- More than 100 vehicles in use;
- 3 repeaters;
- 64 Km of solution coverage (7 Km of tunnels);
- 70 stations (14 of them underground).

MPT1327 | Main features

MPT1327 is a signalling standard for PLMR (Private Land Mobile Radio) trunked systems. It is published by the Department of Trade and Industry (DTI) in the UK and sets out the rules of protocol for communication between the trunking system controller (TSC) and the users of the radio units, operating mainly in Sub-band 1 and 2, VHF band III from the United Kingdom. This protocol has become the standard for analog trunking systems worldwide. It can be used to implement a wide variety of systems, from small systems with only a few radio channels to large networks formed by interconnection of TSCs.

The protocol offers a wide range of features and options for the system. However, it is not mandatory to implement all the features available and we can only implement a subset of the protocol, according to the users' needs. The standard defines only the air signalling and imposes a minimum number of conditions for the design of the system.

Additional specifications will be required for specific implementations, such as:

- Features to be implemented;
- The parameter values;
- Channel plan;
- Criteria for the registration of radio units, in terms of network;

Protocol properties

The protocol can allocate:

- 1.036.800 addresses for each system;
- 1.024 channels;
- 32.768 ID codes.

The protocol sends a 1200 bit/s signal with the subcarrier modulated in Fast Frequency Shift Keying (FFSK). It is designed to be used by units with two radio frequencies half-duplex and duplex TSCs.

In order to complete the setup of calls, the signal is transmitted to the control channel. The TSC can operate using one of two strategies for the control channel, a dedicated or a shared one.

A dedicated system has a permanently available control channel for signalling, while in a shared system the control channel may be assigned to traffic (voice

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or data) if all other channels are being used. The use of a dedicated control channel is suitable for TSCs with any channels, while, on the contrary, the use of dedicated channels is not suitable for TSCs with fewer channels.

Available features for the user

Type of Call

Voice Calls - Voice calls can be made with different priority levels. For conference calls the "conversation" mode can be chosen, in which everyone is allowed to speak, or the "mute" mode in which only the caller speaks.

Data Calls - For transmission of unrequired signals.

Parameters are available to specify the type of priority (normal or high) and, for conference calls, if members of the called group may or may not answer.

Emergency Calls - An emergency call takes precedence over other types of calls, which may end prematurely so that a channel is released, allowing an emergency call to be made.

Include Call - During a call, a unit may apply for another user to join the same call. This feature can be used to implement a conference call or a call transfer.

Status Messages - 32 status messages can be exchanged between the units. The meaning of these two messages is identified as a "call-me-back request" and "cancel previous call-me-back request". The remaining thirty messages may be set by the user.

Short Data Message - Messages up to 184 bits can be exchanged between units or between units and the TSC.

Standard Data Call - A standard data channel can contain up to 1023 links, though not all need to be active simultaneously. Data can be transferred between radio units or between radio units and other data services connected to the base station or other networks. The errors in the data channel are corrected by a repeat request (ARQ) before data is transmitted to another link or device.

Making Calls

The radio unit can make a call to the following destinations (except for status messages that cannot be made to the PBX, PSTN or to groups):

- Individual radio unit;
- Group or all units in the system;
- PBX number, up to 9 digits;
- PSTN number, up to 31 digits.

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Receiving Calls

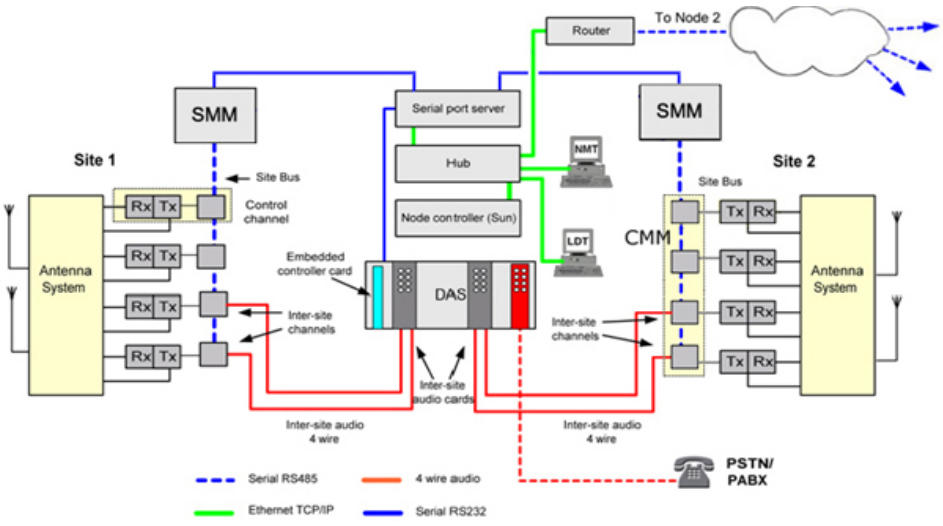
The radio unit can receive calls from another radio unit, a line unit or (except for status messages) from a PBX or PSTN extension. The status messages or short data messages can be received through the TSC.

For a call from a radio unit, a line unit or a TSC, the address of the calling unit can be provided to the called unit. If a call is made by a PBX or a PSTN extension, the gateway of the caller is given as the origin of the call. A unit may refuse to receive any calls, sending a "busy" or "out-of-vehicle" command or even selecting the received calls, being able to reject them according to their precedence. There is also the possibility, in the event of not being able to answer quickly, of sending the status message "Will call back", informing the incoming call that we will contact as soon as possible.

Call Forwarding

If a radio unit does not wish to receive calls, you can route future calls to another address. The radio unit calling is informed of the alternate destination and performs automatically a new call. The user can also decide whether to make the call or not, to the new destination.

Example of trunked radio solution architecture:



(Taken from "T1541 System Operation Simulation" from Tait)

Associated services

- Trunked radio consultancy;
- Trunking networks design;
- MPT 1327 protocol experts;
- Maintenance and implementation of trunked radio systems.

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About Wavecom:

Wavecom was established in 2000 and has three core fields of activity: Wireless Networks and Networking, Unified Communications and R&D.
Our core business consists of the development and integration of telecommunications solutions, specialized in Radio and Unified Communications technologies. The company started its activity as a telecommunications integrator specialized in Wireless, expanding then its activity to the Unified Communications field.
In Portugal, the company has 29 employees. It is also present in Cape Verde and Brazil.
Wavecom is the market leader for wireless connections in unlicensed band and has developed the major VoIP project (Open Source) in Europe.

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