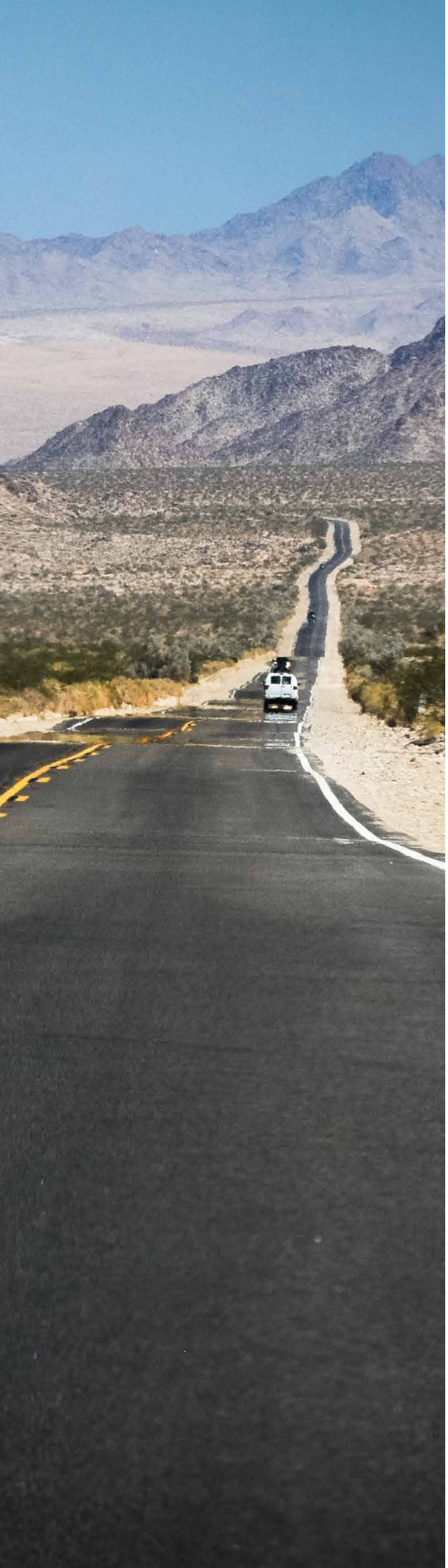
How to power up your Low-Band radio network

TPL Systèmes Whitepaper

TPL
Systèmes de communications



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Introduction

Since the early 50'S, **LMR has been an essential asset for many organizations across the USA.**

Many of them uses **Low-Band in 30-50 MHz** due to its fantastic versatility and long range coverage.

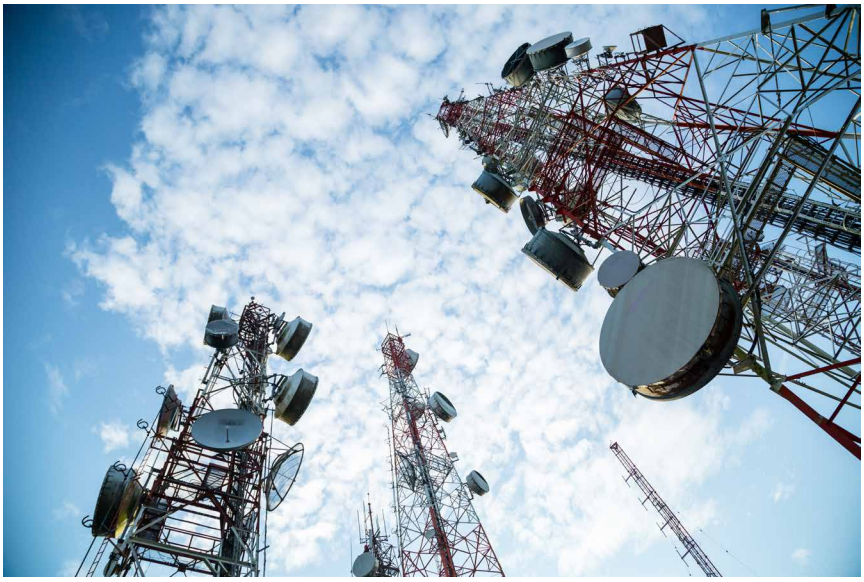
The LMR industry has evolved to using digital technologies with many new protocols and services. For a Low-Band radio system manager, transitioning to digital is tempting but complicated.

Those that have done it have left low-band behind, replacing their entire radio fleet and radio infrastructure with a higher frequency solution. This move has meant adding new infrastructure (base stations, towers, and networks) to fill in the coverage gaps that the use of higher frequencies creates. Such a complicated transition includes high capital costs, and often higher maintenance costs.

Through this white paper, you will discover that **Low-Band** is in a new phase of its evolution now, that **solves these complications**, by advancing Low-Band radio systems themselves into the world of digital technologies.

Chapter 1

Low-Band objectives



For Low-Band radio systems manager, the objectives of an LMR system have always been the same :

- ✓ Use an available frequency band that provides coverage in the most cost-effective way possible, while also supporting repeater and simplex modes of operation. Both modes are widely used and together can offer support for communication methods including dispatching, one-to-many, car-to-car, and tactical team operations.
- ✓ Support resilient and reliable communications. While the radio communication needs of public safety agencies and business organizations may be different, both require a communication system that can perform under the most challenging conditions expected.
- ✓ Provide an operator-friendly and easy to use interface. Whether your organization is a law enforcement agency, fire-rescue team, transportation department, utility company, cargo fleet, or school bus system, they will demand optimal sound quality, comfort and ease-of-use in their radios.
- ✓ Ensure the operations and maintenance of the radio system are low-cost budget items. During the design process the cost of operations and of maintenance should be fully investigated.

Now that Low-Band has evolved to include digital technologies, there are some new objectives to consider. With digital Low-Band there are new digital applications that can be included in the radio system design. These applications and tools can help improve operations and maintenance and also improve the user experience. Since it is still Low-Band there is no need to add new infrastructure sites or replace antenna systems. As a result, transitioning to digital really can be done in a cost-effective way.

Chapter 2

Technology options

Currently Low-Band users can only procure legacy analog products available through radio dealers. Within the market there are no system offerings for both mobile radios and repeaters to construct complete Low-Band networks. There are only a few limited options for mobile radios in the market and almost no repeaters.

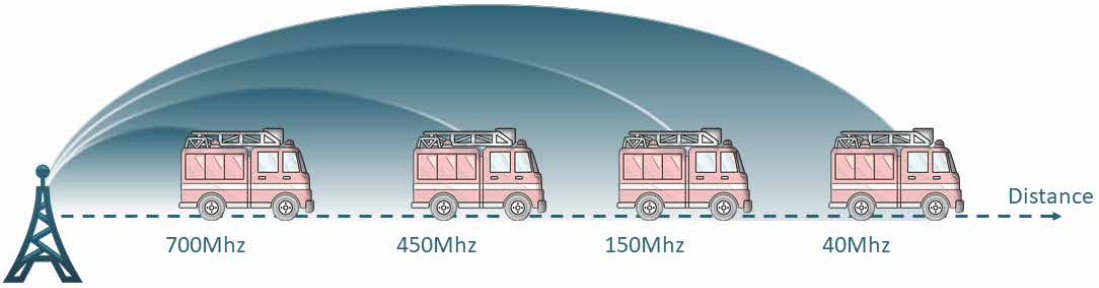
The Low-Band user has only these limited options to operate their network :

- ✓ Maintain the current analog products and use spares which may still be available from vendors. This doesn't offer any path forward for the future.
- ✓ Migrate to another frequency band where analog technology is still available. Much of the radio system will need to be replaced. The migration to another band presents regulatory challenges too. The necessary frequencies may not be available in the desired new frequency band. This may mean a higher frequency band must be used. This increases the cost of the radios and also will increase the number of new radio sites that must be built to match the radio coverage of the original Low-Band system.
- ✓ Migrate to a digital technology such as P25. This also requires a change in frequency band. The migration is a complete upgrade, replacing every aspect of the original Low-Band radio system. The owner will need to acquire new radio sites, buy new infrastructure including repeater radios and antenna systems, and buy new mobile radios.

But now there is another option for the Low-Band user.. With the **new TPL Low-Band digital solution,** no new frequencies are needed, no new sites are needed, and much of the existing infrastructure can still be used.

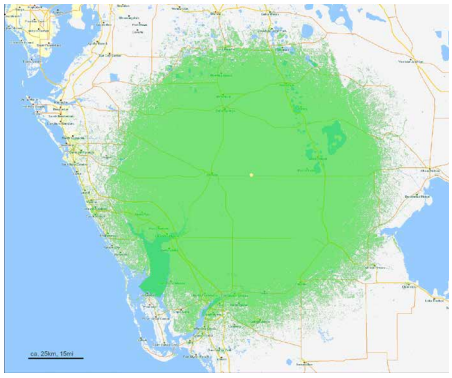
Chapter 3

Coverage comparison

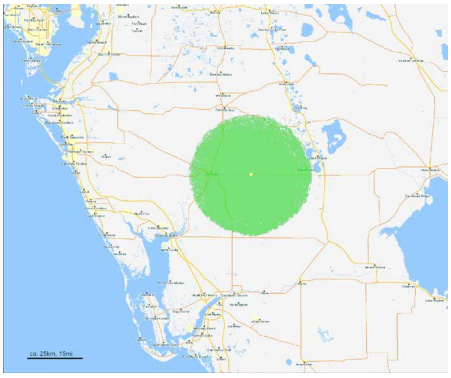


Users of Low-Band need coverage, usually over many square-miles. Their current systems provide this coverage for their operations by combining the radio propagation footprint of multiple radio sites. These sites are usually repeater sites that are interconnected with a back-haul network. The size of the footprint for each repeater site in a radio system is a function of frequency. All things being equal, the lower the frequency, the bigger the footprint. Consider the four major US LMR radio frequency bands and then compare their footprints in the figures below. We will assume all four sites have similar installations (output power, antenna gain, etc.) and similar terrains.

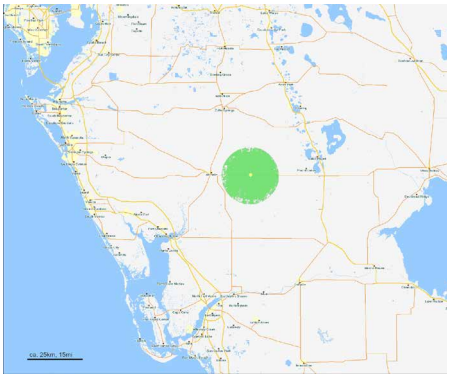
The results of the comparison are very clear. The Low-Band radio system has a distinct advantage in coverage. Each of the other three frequency bands would require more sites be installed to achieve the same coverage as Low-Band. The most dramatic effect is on the 700/800 MHz band. A Low-Band radio system manager who is considering migrating to this band will need many new sites to match the coverage they had. Even a migration to VHF High-band will likely require some new sites that do not exist today.



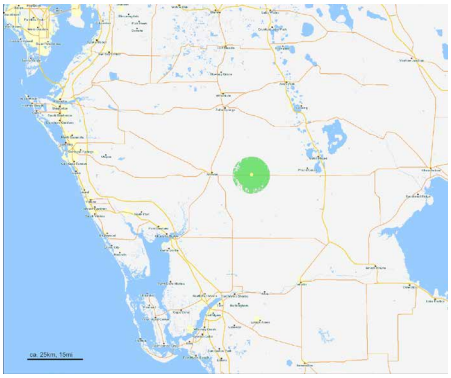
VHF Low-Band



VHF High-Band



UHF



700/800 MHz

Comparing technologies

Comparing technologies and understanding why **eDMR** is the favorite of Low-Band users

Technology	P25 Phase 2	TETRA	dPMR	DMR	eDMR
Low-Band	No	No	No	No	Yes
Frequency Bands available	136-174 400-520 700-800	380-440 810-880	136-174 400-470 450-520 800	136-174 400-520 800-900 810-880	30-50 68-88 146-174
Technology	TDMA	TDMA	FDMA	TDMA	TDMA
Frequency Spacing	12,5 KHz	25 KHz	6,25 KHz	12,5 KHz	12,5 KHz
Slots per native channel	2	4	1	2	3
Easy migration from analog to digital in Low-Band	No	No	No	No	Yes
Cost to access digital from Low-Band	$$$$$	$$$$$	$$$$	$$$	$
Frequency access and licensing costs	Complicated and expensive if available	Complicated and expensive if available	Complicated and expensive if available	Complicated and expensive if available	Not necessary, Current frequencies can be re-used
Network operations	Digital	Digital	Digital and analog capable	Digital and analog capable	Analog & digital with mixed mode possible

Chapter 5

Solution available

Reviewing technology options and comparing the technologies on the last few pages you might get the feeling that Low-Band radio system managers would have a hard time finding a way forward to maintain LMR operations at a reasonable cost.

However, there is a solution available that continues to use Low-Band as a valuable spectrum asset, preserves its superior coverage, and supports legacy operations, all while offering access to new data and digital services.

TPL Systèmes offers real LMR products in Low-band, both in analog as well as digital **eDMR**. Repeaters, mobile radios, and portable radios are available in a portfolio of products delivered to Low-Band customers in Europe, Africa, the Middle East and North America.

- ✓ As a manufacturing leader in VHF radio systems, ***TPL Systèmes*** has developed a Low-Band dedicated product series that offers a migration solution to radio system managers.
- ✓ ***TPL Systèmes*** offers significant experience and strong support for customers worldwide. The **eDMR** technology was created with the goal of ensuring the preservation of the analog legacy of these LMR systems, while increasing spectrum efficiency and offering a wide range of digital features within 30-50MHz.
- ✓ ***TPL Systèmes*** is ready to help you discover this new digital functionality and the new innovative services of **eDMR** Low-Band.

Chapter 5

Solution available

Most Low-Band users want access to digital technology but without the typical system complexities. They want to maintain the ease-of-use they have with analog but enjoy the power of digital technologies. Only ***TPL Systèmes* eDMR** can offer such versatility and comfort in Low-Band. Here is why :

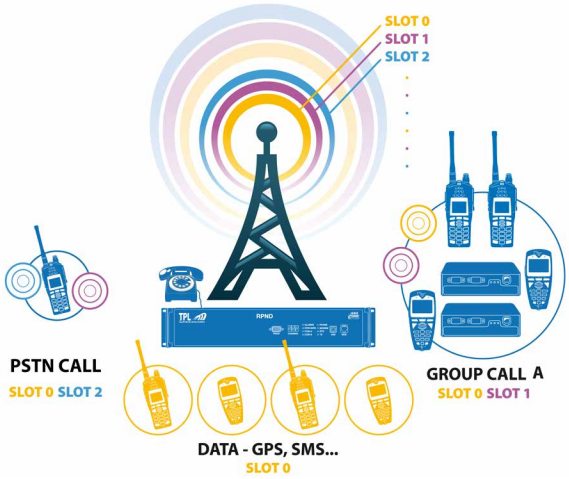
- ✓ **eDMR** offers triple the bandwidth utilization of analog, allowing one data connection and two voice conversations per equivalent analog channel. The **eDMR** protocol was specifically developed to meet the goals and objectives of Low-Band radio system managers who want to transition their operations to digital.
- ✓ **eDMR** has been built to offer high-efficiency services in a conventional system, in effect creating the equivalent of DMR Tier III services within a Tier II architecture.
- ✓ **eDMR** is offered in a full range of products including repeaters, mobile radios, portable radios, network management systems, VoIP dispatch consoles, automatic vehicle tracking, PABX and IPBX gateways, radio modems for utility companies and telemetry applications, gateways for data protocols such as ModBus or IEC101, and gateways to other radio systems such as Tetra , P25, analog, etc.
- ✓ **eDMR** is a proven technology that has gained the confidence of numerous customers around the world including Fire departments, Transportation departments, utilities, and the Red Cross, just to name a few. All of these customers enjoy a close working relationship with ***TPL Systèmes*** who responds quickly to their requests to develop additional features for their **eDMR** radio system.

Chapter 5

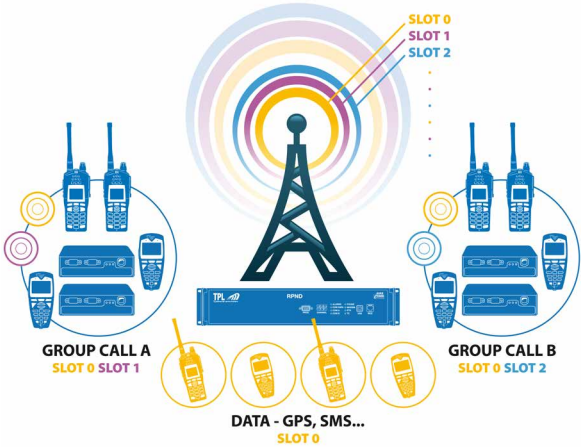
Solution available

eDMR provides three slots within 12,5KHz channel spacing. This ensures the Low-Band user has more than enough communications capacity to cover their needs in terms of voice and digital functionality. With **eDMR**, one slot is dedicated to data communications (signalling, GPS location data, SMS, specific user data for SCADA, radio system management, etc...) and two slots are available at the same time for voice communications or extra data when necessary.
As an example, an AVL management application for a utility may maintain locations of company vehicles on a real-time map, control remote utility devices such as pumps, valves, or circuit breakers, communicate vehicle status data and telemetry and permit SMS messaging between field personnel and management.

Where many other systems are required to use complex trunked radio systems to offer this same level of digital functionality, including multiple radio channels and specialized and inefficient trunked radio system equipment, the **eDMR** solution offers it natively in each 12.5 kHz channel with exceptional spectrum efficiency and ease of use and installation. Since **eDMR** is a newer power efficient digital technology, its repeater equipment is low power by design. This means remote sites can be installed with much smaller power systems than is possible with traditional digital radio systems. By using power efficient **eDMR** equipment, and an efficient microwave backhaul system a truly low power "off-the grid" repeater site is even possible.



Example 1 : Terminal 1 is on a phone call through the PSTN using slot 1; A group call is underway in slot 2; Data is being transferred in slot 0.



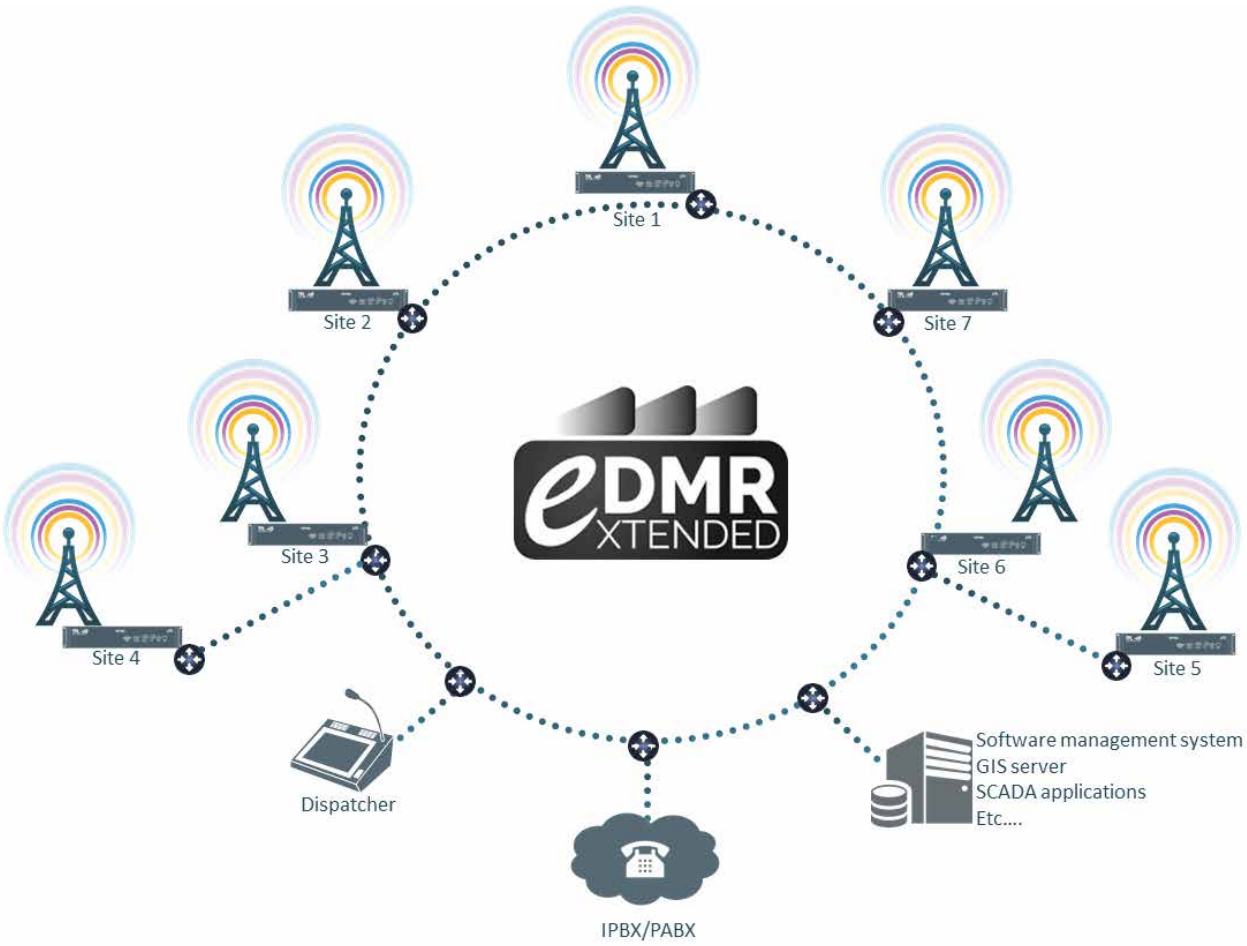
Example 2 : A group call is underway in slot 1; A separate group call has also been initiated in slot 2; Data is being transferred in slot 0.

Solution available

Network management is shared by the repeaters in **eDMR**. This significant advantage means that you don't need to install core network servers to retrieve network status information or to reconfigure how sites or zones communicate with each other. Since analog voter equipment is also unnecessary, network management is completely decentralized, and instead controlled by the **eDMR** repeaters under the supervision of management software.

This concept ensures a high level of reliability and greatly simplifies the design of the network, no matter the number of repeaters in the radio system.

With this powerful advantage, **eDMR** can be deployed in cells or zones, creating communications sectors for one or more sites, zones or the whole network. The design is entirely flexible and reconfigurable by the radio system network manager.



Chapter 5

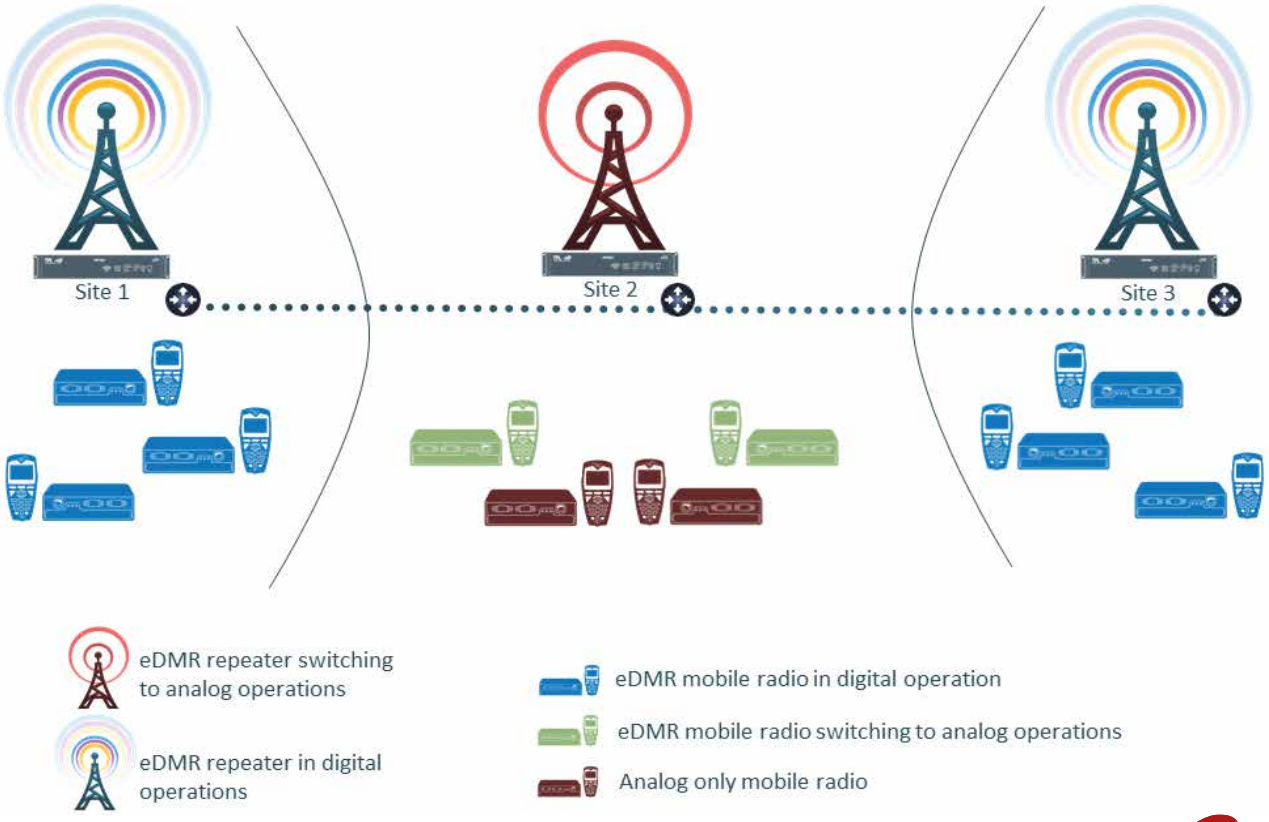
Solution available

Analog / digital switching

During a system migration, one of the most important issues for Low-Band users is ensuring there is zero-impact to current operations while transitioning to digital. If the migration is to a new system on a different frequency band then there is no way to preserve continuity with the current system and the radio system manager is forced to build the new system in parallel with the Low-Band analog system. During the transition two systems must be operated and maintained.

With **eDMR** there's no such requirement. When installing **eDMR** repeaters in Low-Band they can support both analog and digital operation. This means the radio system can be cut-over to digital in sections or at once as the build-out progresses, thus ensuring a zero-impact to operations.

eDMR can actually provide both analog and digital operations within the same network, and within the same repeater. If an existing analog radio system user presses the PTT button on a legacy analog mobile radio the **eDMR** repeater will automatically switch all connected digital mobile and portable radios to analog to ensure interoperability with the legacy analog mobile radio. When the analog call has ended, the repeater and digital mobile radios will go back to their digital operations mode.

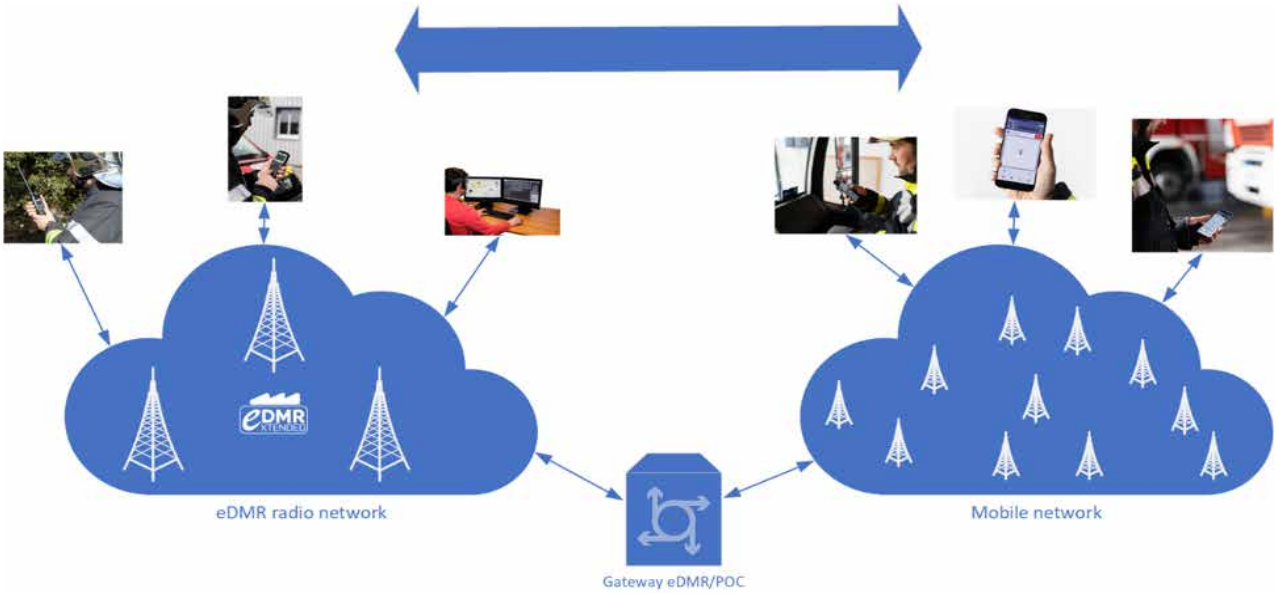


Solution available

Connect your eDMR network to smartphone application

To offer even more versatility to its **eDMR** Low-Band customers, ***TPL Systèmes*** has integrated a new solution using Push-To-Talk Over Cellular, or POC.

eDMR POC lets smartphone users communicate in **eDMR** groups at the touch of one button. It is perfect for connecting people vital to an operation easily and securely, even when they are using different devices and technologies or are out of range of the radio system. This feature allows the team to share information quickly efficiently no matter where they are. It also means managers who may not need to carry a radio every day can also communicate with field personnel in a unique or emergency situation



Chapter 5

Solution available

There are numerous services offered through **eDMR** Low-Band networks and they answer all the needs of any organization operating in Low-Band today.

Services available in Low-Band	eDMR
Digital TDMA with 3 slots	✓
Analog CTCSS/DCS/5 tone/Scanning	✓
Text Messaging & Status	✓
Individual call , Group Call, Zone Call	✓
Emergency Call	✓
Roaming within the network	✓
eDMR Push To Talk Over Cellular (POC) available to connect radio terminal users with a smartphone application through an **eDMR** Low-Band network	✓
Minimum terminal configuration (digital repeaters share network configuration information with mobiles over-the-air)	✓
Classic Talkaround (DMO) & DMO NS Talkaround (direct mode with network survey = GPS tracking)	✓
Full range of equipment : Repeaters, mobile radios, portable radios, and desktop mobile control station radios	✓
Voice Recording , keeps all voice communications recorded	✓
ATTS (Automatic Terminal Tracking System), AVL application to geolocate users for efficient dispatch and safety operations	✓
GIS (Geographical Information System) to display radio positions on a map.	✓
IP Dispatch console (DetraTalk VoIP) allows the dispatcher to call and listen to all groups and zones within the network	✓
Network Management system (DMS) provides history of communications, registering, software versions of terminals, remote configuration and update of repeaters, event push application to send alarms by email or SMS, etc...	✓
PSTN card on repeaters (for sites with land lines)	✓
Gateway PABX and IPBX	✓
Voice Gateway from and to other radio systems (ensures interoperability)	✓

Solution available

Take a look at the whole range of **analog & digital products** dedicated to Low Band in our portfolio.

Mobile radio DM3G :
Compatible with existing analog networks and digital **eDMR** networks.
Provided with a large speaker-microphone, wired or Bluetooth, with GPS, 33-50 MHz, 50W.

Portable radio TDH3G :
Compatible with existing analog networks and digital **eDMR** networks.
Easy-to-use keypad and color screen. GPS and a large range of accessories are available, 33-50 MHz, 5W.

eBase :
Desktop mobile radio compatible with analog and digital **eDMR** radio networks. Integrates mobile radio unit, power supply and loudspeaker. Microphone wired or Bluetooth version.
33-50 MHz, 50W.

Radio Repeater RPND :
Compatible with existing analog networks and digital **eDMR** networks. GPS. 33-50 MHz, 50W.

DetraTalk :
VoIP dispatcher based on a PC platform for **eDMR** network.

Data Gateway :
Gateway for data remote control, IEC101, etc.

PABX or IPBX Gateway :
To ensure phone communications from and to mobile radios through local repeater or **eDMR** core network.

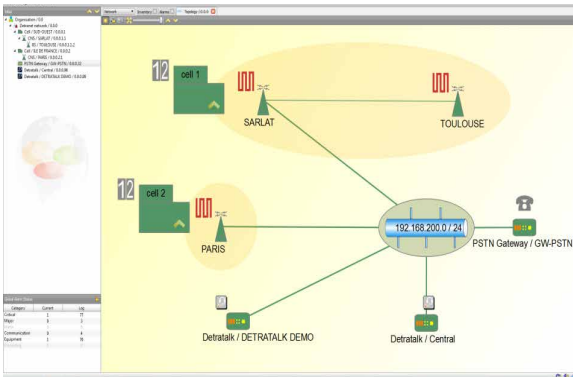
Voice Gateway :
To ensure interoperability from and to other networks and radio protocols.

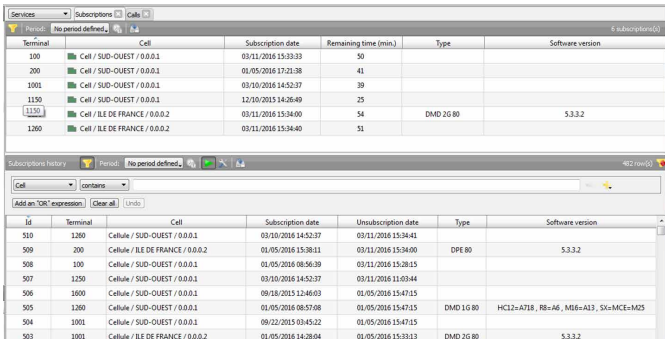
eDMR POC :
Smartphone application to connect to radio terminal users through an **eDMR** Low-Band radio network.

Chapter 5

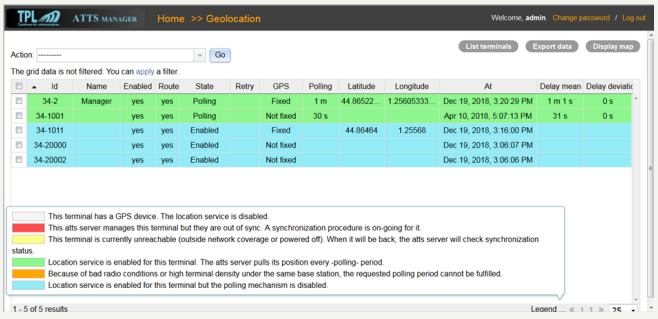
Solution available

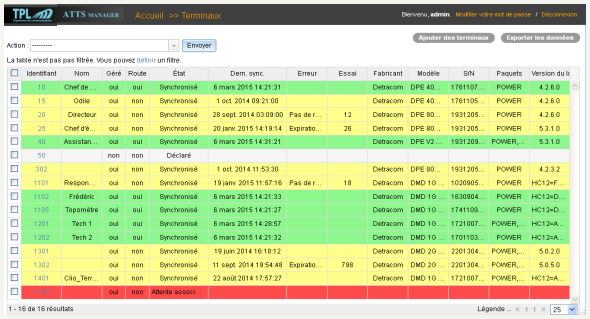
Take a look at the whole range of **tools** dedicated to **eDMR** network management.





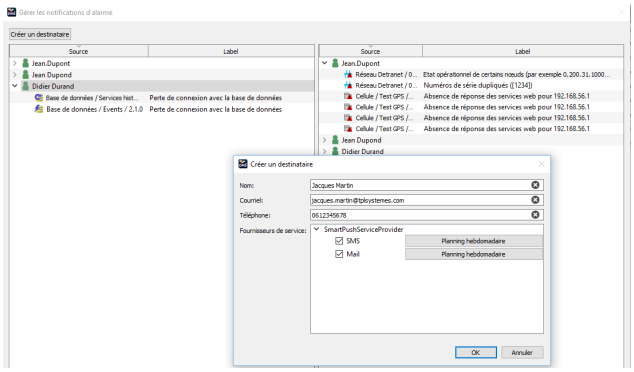
DMS : Control, management and supervision tool for digital **eDMR** networks. Allows network management, data base of features, alarms, history,etc.





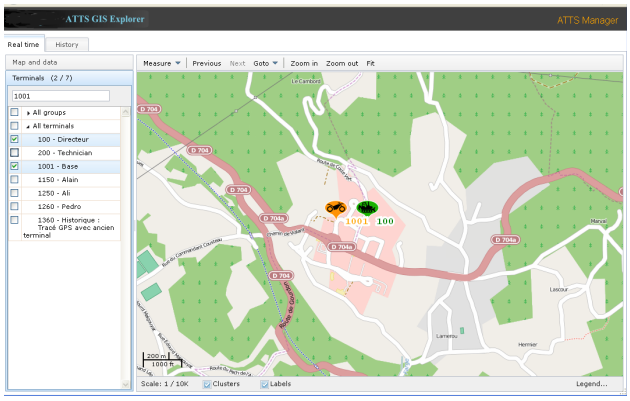
ATTS (automatic terminal tracking system) : An AVL solution for the control, management and supervision of terminals with built-in GPS, within a digital eDMR network. Features include the real-time management of all registered terminals. GPS time synchronization, and terminal parameter retrieval.

Solution available



Event Push : application installed within Network management system to send network alarms by e-mail (SMTP).

Call Recording and Playback : Record, store and retrieve all voice communications that have occurred in the network. Access is through the network management system.



GIS : Geographical information System that allows radio terminal locations to be displayed on maps. Maps can come from Google maps. Open street map, or a specific map of interest.

Chapter 6

Acquisition & migration

eDMR, is by far the right choice for the Low-Band radio manager. It ensures operations are 100% maintained (zero impact) during all steps of the migration process. It offers ease of installation by removing the old analog repeater and replacing it with a new RPND series repeater. With that simply change you are ready to operate in analog and digital, with no gateways to install to ensure communications with legacy devices, no new frequency template to rebuild in your old radios, no licensing of new frequencies. Just operate it and access a full range of digital features while you progressively replace your old radios with new **eDMR** radios.

Do you need a gateway to ensure interoperability with other networks ?

It's not a problem for **eDMR**. Everything can be done easily and more importantly at the pace the Low-Band network manager wants. This minimizes the risk of mistakes, ensures there is no impact and allows time to train users and build their confidence.

So don't wait ! Contact ***TPL Systèmes*** today to ask for your free preliminary design and quote to advance your Low-Band system into the future.

TPL Systèmes has built several distribution channels across the USA. You can ask these local distributors to work with you to find the best way forward to migrate to digital **eDMR** in Low-Band.

About TPL Systèmes

Since its creation in 1989, ***TPL Systèmes***' core activity has been to manufacture, distribute, install and maintain professional radiocommunication equipment for emergency services.

TPL Systèmes is based in France and has a presence in more than 30 countries, including the USA.

Since it began, ***TPL Systèmes*** has become one of the leading companies in the area of radiocommunication equipment and solutions. This leading position is due to three main focus points :

- ✓ **eDMR DIGITAL RADIO TECHNOLOGY AND RADIO TERMINAL PRODUCT RANGE**
- ✓ **CRITICAL MESSAGING SOLUTIONS AND PAGER PRODUCT RANGE**
- ✓ **EMBEDDED EQUIPMENT PRODUCT RANGE**

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