



HYTERA WHITE PAPER

# DMR Migration

## What You Need To Do



## Executive summary

Since two-way radio was introduced back in the 1930s, it has been mostly an analogue history. Indeed, the vast majority of two-way radio systems in operation today are still analogue.

For many, that's fine. Enthusiasts and shop workers probably don't need much more than analogue systems to cover short distances within the same building. However, add in complications and you see the limitations of analogue. Concrete walls in stadia, for instance, can block transmission, while the noise from the crowd can reduce call quality.

Add in multiple users, and you have the risk that critical messages don't get through because the line is already being used. In some areas of the world, frequency spectrum for using 2-way radios is limited or not available.

On top of this, in a world where communication devices offer a wide range of features in a user-friendly format, analogue radio is generally best for simple half-duplex speech communication only.

But that's changing. Digital Mobile Radio (DMR) is transforming the way businesses communicate, and meeting many of the frustrations organisations find with analogue systems.

### DMR offers:



Greater call capacity



More reliability



Security features



Greater functionality



Better call quality



Privacy features



Longer battery life



Increased spectrum efficiency

The most noticeable feature of DMR is the increased call capacity, with the ability to split an existing channel into two meaning you increase your capacity instantly. Add in better call quality and enhanced security features such as lone worker or man down, and you make a compelling case for migration.

Upgrading from analogue to Digital Mobile Radio (DMR) is not something you do lightly. There will be challenges, and you will require the help of a specialist to ensure that the upgrade goes smoothly – but there are significant benefits to making the move.

This White Paper outlines the reasons for migrating to DMR, the benefits of making the switch, and the steps you need to take. We will look at the following points:

- Why businesses are moving from analogue to digital
- The questions you need to ask
- Migration options that are available to you
- A step-by-step guide to migration

## What is DMR?

DMR stands for Digital Mobile Radio. It is an open digital mobile radio standard as defined by ETSI (European Telecommunications Standards Institute), and was created so that radio communications buyers were not 'locked in' to any particular supplier or solution.

There are three tiers: Tiers I and II were created in 2005 while Tier III was established in 2011. Tier I is for licence-free use while Tier II is for conventional radio systems, mobiles and hand portables within the bands 66-960 MHz. Tier III is for trunking operations across the same bands, and supports voice and messaging functionality.

## Why businesses are moving from analogue to digital

### Capacity

One of the main reasons businesses are switching to DMR is capacity. DMR allows you to at least double your capacity. DMR effectively splits out a single 12.5kHz channel into two – supporting two calls at the same time, independently.

This is called Time Division Multiple Access, where the communication paths are active for half the time, but at intervals so small that the difference is inaudible to users.

As the airwaves become more crowded, the old system which was built to handle just a few broadcasters, has started to 'creak at the seams'. The ability, therefore, to split the spectrum, means that more people can communicate across a company's licenced channel, without having to worry about interference.

Those channels work independently, so with two slots, you can carry two separate or private conversations, or you can use one slot for data or priority signalling, with the other reserved for conversation.

With DMR Tier III, capacity is further expanded with the ability for users to access different channels if others are occupied. User groups share a pool of channels, and any radio user can access any channel. The system's control centre automatically allocates a channel from the pool, and if all channels are in use, call priority levels are taken into account. If a call is a higher priority than the other calls on the system, a lower priority call will be 'kicked off' to make room. If the call is the same or lower level priority as those taking place on the system, it will be placed in a queue to access the resource.

## **Infrastructure**

Unlike TETRA, where transition would be a wholesale change in infrastructure, DMR allows you to take advantage of existing analogue infrastructure.

By infrastructure we are not referring to the radio equipment itself, but the supporting elements of the system – things like the antennas, antenna cabling, and combining equipment. Of course all of these command a significant amount of cost, so the ability to be able to re-use these is a significant advantage and an attractive proposition.

In the case of migration you are typically going to re-use the same frequencies. Tetra tends to be limited to only certain parts of a band depending on the country, and this is always UHF in Europe. A migration from analogue could be at VHF or UHF. Because the same frequencies that were used for analogue will be reused, then the same infrastructure like cabling, antennas and combining equipment can stay in place on a site.

## **Features**

In addition to the two slot TDMA in Tier II, there are a number of extra features that are not present in analogue. For instance, DMR radios are significantly more energy efficient with approximately 40% longer battery life when compared with analogue. This is because, unlike analogue, the 2 slot TDMA DMR radio is only actually transmitting half the time (using 1 or 2 alternating slots). DMR radios can also have new voice and data services depending on the radio model chosen.

There is the potential for user-friendly private (one-to-one) calls. It is often far easier to use data applications such as GPS (for tracking) and telemetry (for handling alarms via your radios). DMR standards support the transmission of IP data over the air which makes standard applications easy to develop. And with location services, this makes DMR the logical choice for critical service industries.

Some features of digital are simply more user-friendly. For instance, with analogue it was possible to make individual and sub-group calls on certain legacy analogue systems but these often required the user to remember to press a series of buttons on their radio rather than work via a familiar mobile phone-like contact list (as in DMR).

Encryption is something that is far easier to adopt in a digital domain (after all we are already dealing with information that is a stream of 1s and 0s). It's a matter of applying an encryption algorithm to this bit stream. With analogue there was significant processing required to achieve encryption. The resultant effect to radio users is the difference in coverage area. Analogue systems deploying encryption offer significantly reduced coverage range than an unencrypted one. Digital systems supporting encryption have minimal reduction in coverage over an unencrypted one, often no difference at all.

## Quality

The greater your security requirement, the more important it is that your calls are clear and unbroken. The slightest chance of a misunderstanding can put lives at risk.

Analogue radio can suffer from certain limitations, which affect the quality of the transmission. The environment itself can act as a limiter on sound quality, so any obstructions, while distance from the transmitter significantly decreases quality.

The difference with digital is that error correction is built in, ensuring the voice is clear throughout the coverage area, cancelling out static that is common in analogue, and many digital systems cancel out noise completely through the transmitter.

## Efficiencies & improvements

When you decide to upgrade your network you most certainly do not want to simply replace it with what you already have.

Yes digital gives you advantages described above, but also digital makes it easier to integrate more features and functionality. Examples might be the addition of indoor location, asset tracking, work orders, and other applications that benefit your industry or business. A standardised development API can allow for the integration of other applications. The AIS is a DMR standardised protocol offered by Hytera to allow for integration to both our Tier 2 and Tier 3 offerings.

Additionally there are application developer's kits for some of the Hytera Tier 2 and Tier 3 terminals that allow for integration to these.

## Questions that have to be asked

- What tier does your business require? Tier III (Trunked) allows for multiple channels that are doubled in capacity over analogue trunked systems while Tier II allows existing conventional analogue channels to be split in two.
- Do you need analogue fall-back?
- Is there any proprietary functionality in place?
- How will you minimise operational disruption during the migration?

## The benefits – by industry

### Hospitality

In the hospitality industry, style and substance are both paramount. Yes, it's important that radios work well and provide full coverage but discretion is also key. The smaller, lighter form factor of many modern DMR radios make them the obvious choice for those in hotels, restaurants and spas.

Communication with staff that don't use radios is also important. Therefore the ability to integrate DMR radios easily into a phone system is perfect, allowing for cross-platform communication. In other words, staff that are constantly on the move can now speak to reception and desk-based staff at the press of a button.

Guest satisfaction is imperative. Integration of DMR radios into other systems such as call bells, fire alarms and building management systems ensure any request or alarm is dealt with quickly and efficiently.

Security of guests is paramount in whatever part of the hospitality industry you work in. Hytera radios are extremely popular in stadium management thanks to the multi-channel functionality which helps multiple departments communicate at all times, and the excellent noise cancellation levels.

DMR is part of the hospitality industry's responsibility to protect its guest and its staff at all times.

### Oil & gas

Radios from Hytera, such as the PD7 series, offer a variety of passive emergency features. As well as Man-Down and Lone-Worker, they offer a dedicated emergency button and the ability to be GPS tracked. This ensures colleagues and managers are instantly aware of an emergency and its location so they can take the appropriate action.

There is also typically a requirement for intrinsic safety. Portable radios that support IECEx (Supporting the standards of ATEX and FM) are frequently deployed. The Hytera PD715Ex and PD795Ex portables support this standard.



*Hytera's PD715Ex and PD795Ex ATEX portables*

## Manufacturing

Working in a warehouse or factory can be dangerous, which is why having a rugged radio with man-down capabilities is essential. You are able to keep track of all your workers. The man-down feature will activate when the radio becomes horizontal and if the worker doesn't acknowledge it, a signal will be sent to the supervisor.

Having a powerful battery that will last the entire day is another key feature you will need when working in manufacturing. Being out on the floor all day, you won't get the opportunity to charge your radio battery or get a new radio.

## Utility sector

Safety is the most important aspect to think about in the utility sector. You need a radio that is both waterproof and rugged, so if you drop it there will be no risk of you electrocuting yourself or breaking the radio and being without for the remainder of the day.

Additionally – a lot of utilities companies use radio networks because they operate in areas where there is no mobile coverage, terrain is challenging and weather can be inhospitable. These days, there is sometimes a requirement for workers to operate alone in these places – so emergency features like Lone Worker and Man Down can be important.

In some utilities environments (e.g. Nuclear power plants) intrinsic safety can be a requirement. Portable radios that support IECEx (Supporting the standards of ATEX and FM) are frequently deployed. The Hytera PD715Ex and PD795Ex portables support this standard.

Utilities companies very often don't migrate solely on voice. In the case of electrical utilities, buyers want to implement the ability to use the network to convey substation data. Water utilities will also want their SCADA and telemetry systems integrated.

In both of these cases there are typically RTUs on site. Connection to these with a radio type device (typically a radio modem that supports standards like DNP3, MODBUS and IEC 101 and 104) that can sit on the network is typically a requirement.



*Hytera's PD79xEx range*

## Retail

Retail outlets can be loud environments with constant background noise making it difficult to hear what is being said over a communication device. Whilst earpieces can be used so that the listener can hear clearly, the transmission quality from those speaking can be drowned out in the crowd. This is where DMR's noise-cancelling functionality truly shines.

Often, staff in retail will work longer shifts. With the increased battery life DMR offers, users know they can rely on their radio to last as long as they can.

## Emergency response

The UK emergency services mostly use the dedicated TETRA network, although some fire brigades have looked to DMR, as for a start they tend to use VHF which is not offered in TETRA. In this area Hytera have a good product offering, with again terminals that offer a migration pathway (In this case the technology was analogue conventional so the migration would be to Tier 2 DMR).

ATEX Intrinsic safety is often a requirement for some of the situations that fire crews have to attend, as are specific accessories to be worn when the person is wearing gloves, helmets, breathing apparatus and heavy duty clothing.

Therefore, products like the PD6 series and PD7 that are rugged and waterproof, support analogue conventional and DMR, have an ATEX variant and can use the specialised accessories required (bone conduction and throat microphones, large PTT controller buttons).



*Hytera's PD6 range*

# Migrating to DMR – a step-by-step guide



## Assess

If you have an existing communications system in place, you need to assess exactly what you've got now. This includes everything from the hardware, software, applications and other products. Many systems that are being migrated tend to have evolved over time, and will typically consist of a core network with additional 'Add-ons' that have appeared as features developed and more complex requirements surfaced. Examples might be that the radio system ended up supporting a Scada system that was supplied by another manufacturer.



## Requirements capture

Understand what features are being used across your network, and what gaps you have in terms of usage. Understand what data is being used across the network – to what level, and where. You may have geographical issues, places where calls are being made frequently or infrequently, and you may have performance issues across your network.

The requirements capture phase is all about a deep understanding of your current system, and what you expect out of a replacement, which helps you define your future requirements.

Migrating from analogue to DMR does allow you to take advantage of your existing infrastructure – but you need to define what it is that's lacking and what you need beyond what you've got.

What added capacity do you need? What added capacity do you plan to need over the next five years? Are there any DMR features that could benefit your organisation, for instance GPS, encryption and text messaging?

Think additionally about whether you will need specific safety features, and map out the communications workflow across your organisation. Who communicates with who? Who monitors who?



## Plan and propose

This stage is all about scoping how you're going to bring in your new communications system. Some businesses tend to phase different features in, while others go for a simple 'switch off / switch on' which has its risks, but at least allows for a swift transition.

This really depends on the business and how it operates. Some may not be able to adopt a 'switch off / switch on' approach because they are too large, or their communications are mission critical.

Consider how that migration is going to happen – is it going to be an overnight migration or are you going to have the two systems running in parallel?

Consider equally which equipment you can re-use, and which you no longer need. You may be running an analogue system but you might already have DMR-ready dispatchers. This equipment may or may not be part of your long-term plan.

What additional equipment might need to be supported and integrated on the network, or alternatively what replacement solutions could be offered instead?



## Design

*Once you have a plan for migration, a detailed design is required to define how to implement the proposal. No stone should be left unturned and all risks should be considered and eliminated.*

You need to find a way to support your ongoing operations during the transition. A plan needs to be implemented to support that change – both during and after the migration.

Disruption, however, needs to be minimised at all costs. Indeed, many organisations cite disruptions as one of the key factors for not going ahead with Digital Migration, but there are migration paths that can reduce disruption and phase the value in over time.

One possible option is to deploy digital alongside analogue, for instance using analogue for voice with digital for data. Therefore, you only phase in the data communications in the first instance.

A further option is to run digital and analogue side-by-side, with the aim of phasing out the analogue services over a set period. This would require specific devices that can carry both digital and analogue communications. This would help if you are seeking to get the best out of your current infrastructure and soften the IT cost.



### **Final acceptance**

At this point you should get final acceptance of your design proposal, although sometimes the test phase might be required here, whereby you require some kind of proof of concept of the design.



### **Test of concept**

This may be carried out prior to deployment or prior to acceptance in order to support the design concepts. It would typically be on a small scale and would test out the concepts proposed at the design phase.



### **Deploy**

At this stage the design/equipment and rollout has been planned and accepted and the actual deployment would commence. Typically this would be a staged migration that would involve actual installation/implementation and training of all those using or supporting the network or solution.



### **Equipment**

A key consideration is your equipment – if switching with a parallel network then dual-mode terminals will be required. They require less training and are easier to use, and can operate on the legacy network.

Terminals will operate as DMR where it is available, analogue if not.

## About Hytera Digital Migration Radios

Hytera radios can be part of your transition. With the PD505, for instance, you can transition from analogue to digital while keeping analogue in the background. This dual mode gives you smooth transition, but equally gives you the main digital features such as one-touch call, text messaging and the two-slot communication, opening up an extra slot.

All our Tier 2 terminals can support dual mode, in that they have analogue conventional and Tier 2 conventional. You can program channels of identical frequency to support the two modes independently or create a scan group containing the analogue and digital channels so that the radio can lock on and receive the transmission in the right mode.

Additionally our PD4 series has a feature called **'Mixed Mode'** which is typically only available in the repeaters. With mixed mode the radio on a particular channel assesses whether the incoming transmission is analogue or digital and it then transmits back in the right mode.

Our Tier 2 repeaters can all operate in Mixed Mode. This means that the repeater can be deployed and support a fleet of radios where some are analogue and some are digital, allowing for a gradual migration of terminals.

For Tier 3 migration, the PD7, MD7 and X1 series are all able to support analogue MPT and Digital Tier 3 to assist with a migration process. There is an 'auto-switch' feature in the radios that should assist with radios choosing the appropriate network depending on which is available.

The RD985s repeater can be deployed in MPT1327 or DMR Tier 3 mode.



*Hytera's X1 range*