Hytera

# WHITE PAPER

## Multi-mode Advanced Radios Underpin The Future of Critical Communications

## *Changes in user demand during the evolution from narrowband to broadband*

The availability of broadband technology from 3G, 4G, 5G and WLAN networks has provided access to a wide range of applications beyond the capacity of traditional voice-dominated two-way radio networks. In particular, broadband technologies support the transmission of large data files, mobile access to online databases, and video applications.

With the exception of nationwide public safety networks, the coverage area of narrowband networks is usually limited by spectrum availability, licensing regimes, cost and environmental factors. Many critical voice communications users want access to guaranteed coverage beyond their narrowband networks and in signal blind spots. They also want to make use of the new applications broadband technology provides.

Command centers can now integrate a wide range of technologies, including land mobile radio (LMR), cellular, Wi-Fi, IoT sensor data, AI applications, CCTV, vehicle and bodyworn video, as well as being able to access large office databases. Public safety and other critical communications users want to access the same applications in the field to enhance situational awareness, improve decision making and boost safety.

However, many organizations do not want to abandon their narrowband networks, partly because they want to realize a return on their original investment and partly because broadband voice services do not yet meet the required mission critical performance criteria.

*This means there will be a period of coexistence between narrowband and broadband networks. A solution is therefore required that allows end-users to benefit from both technologies. The ideal solution is to deploy a radio supporting both technologies, so users get the best of both worlds.*

## Extended voice services

Industry users rely on instant PTT voice services within narrowband coverage areas. However, if they leave the coverage area or are in a coverage blind spot, they can communicate by voice over public broadband networks.

The radio will automatically switch over to the best available network, so users do not have to make the change manually. Instead, they can continue to concentrate on the job in hand without caring about which network they are on. Once they press the PTT button, the user will quickly connect to team members anytime, anywhere.

## Use multimedia services to make decisions

In both day-to-day operations and emergency incidents the situation on the ground changes rapidly. It is hard to accurately and quickly feedback information to the command center and colleagues through voice alone.

While retention of mission critical voice communications remains essential, users also want real-time connections to the command center through pictures, video intercom, or video pulling. This assists the command center to quickly make more accurate decisions and respond to situations in a more informed and timely manner.

## Real-time data upload

Knowing the location of assets in the field is fundamental to decision making in public safety service scenarios, as it enables more efficient voice and visualized dispatching. Real-time positioning enables the command center to make better-informed decisions about when and where to best deploy particular assets.

When there is a high volume of voice traffic, voice services usually preempt the channel resources reserved for sending positioning data due to the limited capacity of narrowband systems. As a result, radios cannot upload positioning data to the command center in these busy scenarios.

To enable visualized dispatching, users need the positioning information and dynamic group number assignment to be transmitted over both narrowband and broadband networks. That way users can reserve the narrowband network to ensure critical voice communications get through, and use the broadband network to enable the real-time transition of critical data information.

## Free users' hands and focus on the task at hand

End-users, such as police officers, need to focus on the task at hand, so they want communications equipment they can use instinctively, enabling them to keep their eyes up and their hands free. The end-users are then able to focus on the immediate task as they do not have to operate the radio or smartphone manually, while still ensuring they can communicate with other team members.

## Work more efficiently and in standardized ways

End-users want a radio that is not only a communication device but one that can support the mobile office and access big data applications in the field as well. The radio should, therefore, be able to support different industry applications, including standardized digital workflow applications and digital forms that can be filled in and transmitted from the field, rather than having to return to the office to fill out paper forms and reports or input information into desk computers.

For example, in the past, traffic police had to communicate with the dispatch center via voice to look up vehicle information. The search process takes two people 55 seconds each. Whereas, if police officers can use the radio with integrated police apps to query databases and search for vehicle information, it only takes one person 11 seconds. Fewer personnel are involved and it takes less time to complete the query, making the whole process up to 10 times more efficient.

## *Smart devices in the critical communications industry*

The world is now moving into an era of intelligent connectivity where Smart Home and Smart Building systems, Internet of Things, VR, AR and Artificial Intelligence (AI) are emerging. As the demand for the mobile office and high-quality broadband data services grows stronger among critical communications users, it is clear that traditional narrowband PMR radios are no longer able to meet all their needs.

End-users need a smart radio able to adapt to increasingly complex work scenarios and which helps them focus on the task at hand. The two smart devices now available for critical communications users that meet these needs are rugged smart radios and rugged smartphones.

### Rugged smart radios

Hytera offers the following rugged smart radios: the PDC760, PTC760, and PTC680 multi-mode advanced radios; and the PDC550 Push-to-Talk over Cellular (PoC) radio. These radios natively integrate multiple communication modes, including broadband and narrowband networks, as well as public and private networks, in various scenarios to enable collaboration among users with different types of devices.

*Rugged smart radios deliver traditional mission critical voice services, but at the same time they also meet end-users' needs for real-time video surveillance, image recognition, command and dispatch, fast response, data access, and efficient mobile office solutions. These rugged smart radios can assist users in executing multiple tasks simultaneously to improve their efficiency and performance.*

The key advantages of rugged smart radio are: compatibility with narrowband communication systems, which protects the user's original investment; PTT keys, knobs, emergency alarm keys and programmable keys, in line with the usage habits of PMR users; professional audio chips, low power consumption and high volume, which ensures clear audio in any environment; and they are also waterproof, dustproof, highly durable and reliable.

Rugged smart radios can also be divided into the following two categories to meet PMR users' different needs.

The first type is the smart radio supporting full PMR trunking services, such as the Hytera PDC760, PTC760 and PTC680 multi-mode advanced radios. These radios embed a narrowband platform and a broadband Android platform. As a result, they can simultaneously work as an Android smartphone and a PMR two-way radio. These radios not only provide reliable mission-critical voice services, but also deliver rich multimedia services such as video calling and video uploading in real-time.


***PTC680 multi-mode advanced radios***

The radios support a deep convergence of broadband and narrowband networks. They automatically connect to the narrowband trunking system over the broadband network to implement communication with a narrowband radio using PMR trunking technology to ensure reliable communications at all times. They also feature a unified interactive interface and multiple-mode access with the same ID number on both types of network to provide users with a non-differentiated user experience.

The second type of smart radio, like the PDC550 PoC radio, supports PMR conventional services. These radios are based on the Android platform to provide broadband trunking voice services and compatibility with rich data applications to offer a modern work platform for critical communications users.

At the same time, they support PMR conventional services and enable fast and timely communication in emergencies. These radios have low management and maintenance costs, but do not support PMR trunking services. Another advantage is that the cost of customizing narrowband radio features is high, but Android apps are cheaper to develop.

## Rugged smartphones

Rugged smartphones are designed to meet the broadband trunking voice requirements of PMR users. At the same time, they provide pictures, videos, and other multimedia data and real-time video services to meet PMR users' diversified needs beyond voice calls.

The advantages of a rugged smartphone include: high version system platform, easy hardware/operating system upgrades, strong compatibility, small terminal size, easy portability and cost-effectiveness.

*However, this kind of rugged smartphone does not support PMR direct mode operations. If the public mobile phone network is not available in an emergency scenario, these rugged smartphones cannot ensure fast and timely communication. Finally, the rugged smartphone does not allow PMR users to operate the device using just one hand via the channel or volume knob, smart key or PTT button in emergencies.*

## *Why multi-mode advanced radios are suitable for industry users*

Critical communications users such as first responders, utility, and airport staff, are looking to take advantage of the latest developments in both information and communications technology to improve the quality and efficiency of their day-to-day operations and response to incidents. By harnessing voice, video, data and multimedia services, a wider range of intelligence can be gathered in real-time to enable more informed and smarter decision making.


The multi-mode advanced radios can be easily integrated with larger intelligent platforms and control room dispatching solutions to support 'smart scenarios' for emergency services. For example, police officers, firefighters and paramedics can stream video from their radio or body worn video device back to the command center to give supervisors a better idea of what is happening at the scene of the incident, enabling them to make faster and better-informed decisions.

Conversely, the control room can send relevant images and video clips out to first responders in the field to improve their situational awareness, enabling them to make a better, more informed response and helping to improve their safety through enhanced intelligence.

Police officers can receive photos of suspects or missing persons sent from the command center to their multi-mode advanced radio. This makes it much easier to spot a suspect, as officers no longer have to rely on a purely verbal description. They can then confirm the identity of the suspect or missing person on the spot by using the facial recognition function on the radio.

Electronic forms can be filled in digitally and uploaded immediately to the correct police database using the radio's broadband technology. With the addition of a portable Bluetooth printer, things like stop and search forms or traffic tickets can be printed and issued on the spot out in the field.

Similarly, interviews with suspects and witnesses can be digitally recorded using video or audio in the street or home and uploaded to the correct digital incident case file either from the field or later at the station. This makes the police officer's life easier and the collection and processing of evidence faster, more accurate and with a clear audit trail.

This improves efficiency as police officers no longer have to take the suspect, victim or witness back to the office for processing. They can therefore stay longer on the street where they are most needed.

Commanders need to know the exact location of police officers, firemen and ambulance crews in real time to be able to respond effectively to an incident. Traditional narrowband radios generally adopt GPS for positioning. However, once the users go indoors or enter a basement, no GPS signal is available and the positioning function of narrowband radios fails.

Multi-mode advanced radios overcome this limitation as they use GNSS to make quick and accurate positioning in open outdoor areas, while location-based service (LBS) or WLAN is used for positioning when the radio user moves indoors or to an area not covered by GNSS.

The multi-mode advanced radio can therefore be tracked no matter where the user goes, as it supports both indoor and outdoor location-tracking capabilities. Being armed with precise location data on where human assets are positioned enables the command center to make smarter decisions in emergencies.


Airports must have reliable and secure communications to enable them to function efficiently. For this reason most airports will have an existing PMR network. However, the airport may need to expand capacity, boost indoor coverage or communicate with organisations and groups of users who do not have access to the narrowband LMR network.

Multi-mode advanced radios can be used to extend the network beyond the range of the LMR system by using broadband networks to infill blind spots or to provide coverage inside buildings and to enable users who do not have a two-way radio to communicate with LMR users.

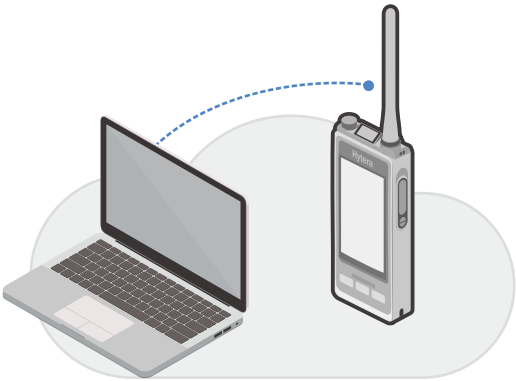
Adding more PMR infrastructure is not a particularly cheap option, but nor is installing 4G small cells to distribute the signal inside airport buildings and underground areas if modern building materials are blocking the cellular signal from outside. However, most airport buildings already have Wi-Fi everywhere, which provides a flexible broadband alternative.

When a user enters an airport building the multi-mode radio simply roams automatically onto the Wi-Fi network and users can communicate with colleagues by pressing the PTT button as usual and without having to worry about manually switching the radio over to the other technology.

Hytera multi-mode advanced radios make it much easier to manage, reconfigure and upgrade radios. In the past, it could take 1080 minutes to program 1000 radios via a programming cable - a task that requires manual monitoring.

However, smart mobile device management (MDM) technology means the multi-mode advanced radio can be wirelessly upgraded using over-the-air programming (OTAP) via 3G, 4G or WLAN.

Radios can therefore be configured and software and firmware upgrades installed without the need to return all the radios to a central location for manual reprogramming. It takes just 23 minutes to wirelessly program 1000 multi-mode advanced radios over the air - a huge 97% saving in time compared with wired programming.



1000 Multi-mode Advanced Radios

Smart MDM programming 23 minutes

Traditional cable programming 1080 minutes

※ Testing conducted by Hytera. Data depends on server performance, network bandwidth, and many other factors.


The oil and gas industry relies heavily on critical voice communications, but it also uses a lot of near- and real-time data. For example, companies often want to implement better mobile workflow management applications across all their production facilities and deploy a solution for remote asset monitoring and control automation of equipment.

Workers at isolated facilities or oil pipelines crossing remote areas usually rely on private TETRA two-way radio networks, as there is no other option available other than expensive satellite terminals. But other personnel working at major refineries and offices often favor using broadband communication devices. It can, therefore, be a problem to find a solution that keeps both sets of personnel happy.

Hytera multi-mode advanced radio terminals solve the problem, as the radios support PMR, LTE, Wi-Fi and Bluetooth. This enables both parties to use the radio standard best suited to their job role and geographic location, while also allowing them to communicate with each other.

As well as providing multi-mode voice communications, the device supports oil and gas workflow management applications. The application normally exchanges data with the control center via LTE and Wi-Fi as the primary networks. But if these are not available the data can still be transmitted via the IP-based TETRA network backbone.


Multi-mode advanced radio can also support different municipal services applications, including standardised digital workflow applications and digital forms. One example is 'smart' garbage collection. Many modern cities have installed IoT sensors in public garbage bins, which automatically report the volume of rubbish in each bin to the city management platform.

When the garbage bins are full, the management platform will send out a work order to the garbage collection team's multi-mode advanced radios specifying the location of the bins that need emptying. The chosen garbage collection team acknowledges the order to the central management platform and heads out to empty the bins. Once out in the streets, the team can also check the status of other nearby garbage bins. If they are nearly full they can empty those bins as well on the same run.

Another example is when traffic police or traffic wardens find a fallen tree blocking a road. The officer can take photos and send them, along with location information, via the multi-mode advanced radio to the management platform. Once again, the management platform will issue a work order to the relevant departments. If fire department assistance is needed, the traffic officer can call the fire department using the LMR voice service of the multi-mode advanced radio.

## *Future prospects*

The continuous development of 3GPP open standards provides a clear evolutionary migration path from 4G LTE to 5G and beyond. Mission and business critical communications users can take advantage of the much larger, multi-vendor 3GPP cellular ecosystem and the economies of scale, competition and lower costs that this provides compared with the much smaller narrowband technology ecosystem.

3GPP has already introduced many mission critical functionalities that were once unique to narrowband two-way radio systems into the broadband 4G LTE standard and now 5G standard.

> *In Hytera's view, the higher added-value services and ability to continuously upgrade functionality using open standards means multi-mode advanced radios will eventually replace traditional narrowband two-way radios to become the mainstream device of choice for mission and business critical users.*

This will not happen overnight, however. Hytera has pioneered the multi-mode advanced 'smart' device, which means end users can get the best of two complementary worlds - narrowband and broadband on a single device. This provides them with more choice and access to many more services and enables a smooth migration path from narrowband to broadband solutions. In the future, Hytera will launch new multi-mode advanced radios with 3GPP Mission Critical Services (MCS) broadband trunking services and LMR direct mode.

The adoption of multi-mode advanced radios allows end-users to retain their mission or business critical narrowband networks for as long as they want so that they can realize a full return on their LMR investment. Once mission critical broadband networks are fully mature and meet the demanding requirements of mission critical communications users, they can then transition over to broadband at a time of their choosing.

As more vendors enter the mission critical broadband ecosystem, prices will drop and users will enjoy more and higher value services at a lower cost. The era of the multi-mode advanced intelligent radio has arrived.

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