



XPT Digital Trunking System Technology White Paper

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1. Preface

DMR (Digital Mobile Radio) is becoming more abundant in the professional two-way radio industry due to the technology's clearer voice, better privacy, longer battery life, superior data features and ability to double the channel efficiency. In order to further enhance their customers' digital migration, Hytera announced Pseudo Trunk technology to share 2 time slots of TDMA in automatically. With this technology, Hytera DMR users could use a 2 channel digital trunking system with one frequency and the cost of a conventional system.

As more customers migrate from analog to digital technology, the industry is developing rapidly and producing faster and smarter equipment with broader bandwidth as well as more sophistication. Businesses that are growing and have a large number of team members may find that current conventional systems can no longer satisfy their communication requirements. Many large enterprises desire for a two-way radio solution with a higher capacity for both voice and data using the system's channels as a shared resource in order to save on infrastructure and licensing costs.

2. XPT System Overview

XPT (Extended Pseudo Trunk) is a new distributed trunking system solution developed by Hytera. This digital solution is developed on the basis of Hytera's Pseudo Trunk technology and further expanded with the advantages of digital trunking system. The XPT system has three main advantages: A dedicated control channel is not required, large capacity and easy migration of infrastructure.

Today's digital conventional radio systems combine the advantages of two-way radio communication, digital technology, as well as many of the strengths and functions of analog systems. A recurring issue with many conventional communication systems is that each channel resource is restricted since each channel supports one call at a time. Digital trunking systems have a larger coverage area, stronger noise-cancelling capabilities and channel resources that can be allocated automatically. The platform construction of a trunking system, however, is complex and it is inconvenient to upgrade a conventional system to trunking system. Moreover, the trunking system will usually require a large amount of equipment and cost to support.



Figure 1: XPT digital trunking system

XPT system is an economical and practical digital upgrading solution for those looking to migrate to a digital trunking technology. This solution allows them to build an extended pseudo trunking system using multiple RD982S repeaters. The system has the scale and efficiency of trunking technology, clearer digital voice quality, and extended communication capacity realized by the channel-sharing logic of XPT technology. It can support high density voice and data communications for thousands of people using only a single base station.

The differences between XPT system and conventional system or trunking system are listed below.

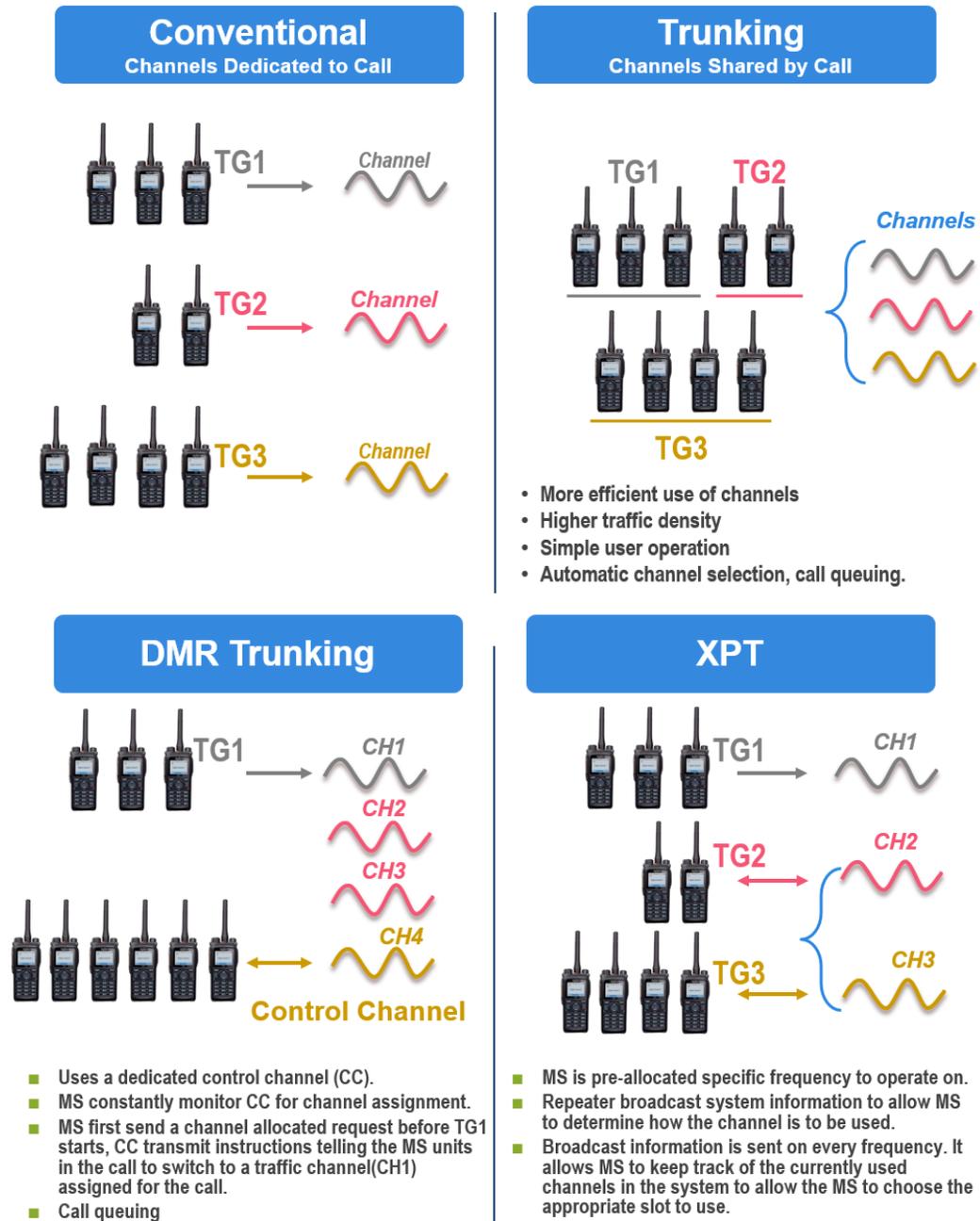


Figure 2: Differences between conventional and trunking system

XPT system is a digital trunking system which consists of a master repeater and multiple slave repeaters. When configuring an XPT system, the radios will be allocated with a specific frequency and slot in advance. An idle radio always monitors its idle home repeater. The home repeater will broadcast the XPT system's status information in each frequency via a beacon signal. This informs the radio of available channel resources. In the case of a busy channel, the radio can switch to an available channel and slot to communicate.

An XPT system can be enabled only by upgrading the firmware version of radios and repeaters to V7.0 or higher. A license is also necessary for each RD982S on the system. Enterprises currently using RD982S repeaters, can extend the communication capacity of their existing system without purchasing additional equipment aside from a layer-2 switch and Ethernet cables to connect the system. Hytera's XPT system supports digital functions of a conventional system as well as providing high capacity, a large coverage area, and a cost-efficient digital trunking solution.

3. XPT System Hardware

3.1 XPT Base Station

The main components of an XPT system include repeaters (RD982S), combiner, divider, duplexer and IP switch. All the repeaters on a site are connected to the IP LAN network. One of them will work as master repeater and all the rest repeaters will work as slave repeaters.

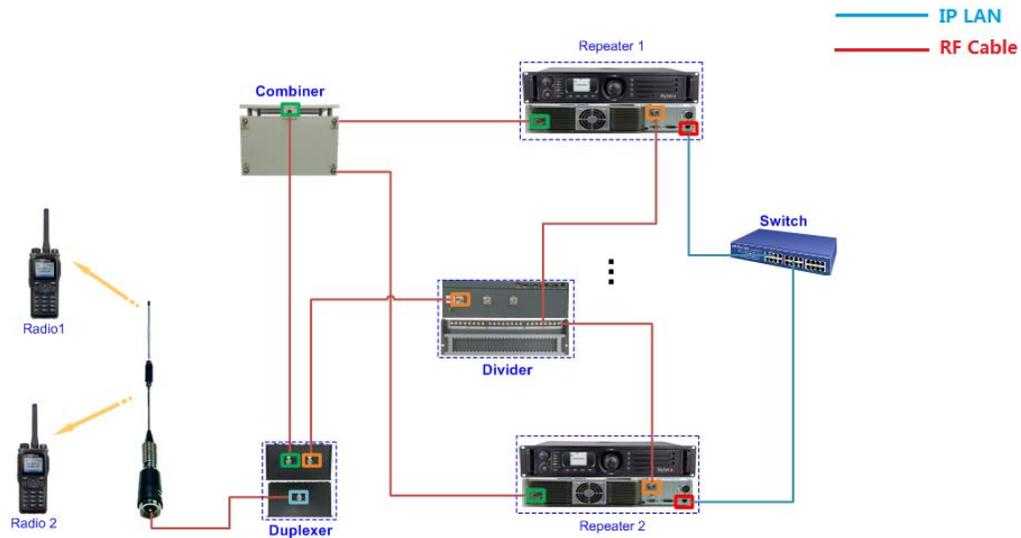


Figure 4: Infrastructure of XPT system

3.2 XPT Subscribers

Hytera DMR subscribers can be upgraded to XPT mode without any additional license. The firmware of subscribers must be R7.0 or higher version. Supported subscriber models and frequencies are listed below:

Terminal Model	Frequency Range
PD602 (G)	VHF(136-174MHz), UHF(400-527MHz)
PD662 (G)	VHF(136-174MHz), UHF(400-527MHz)
PD682 (G)	VHF(136-174MHz), UHF(400-527MHz)

Terminal Model	Frequency Range
PD702 (G)	VHF(136-174MHz), UHF(400-470MHz, 450-520MHz)
PD752 (G)	VHF(136-174MHz), UHF(400-470MHz, 450-520MHz)
PD782 (G)	VHF(136-174MHz), UHF(400-470MHz, 450-520MHz)
X1e	VHF(136-174MHz), UHF(400-470MHz, 450-520MHz)
X1p	VHF(136-174MHz), UHF(400-470MHz, 450-520MHz)
PD792Ex IIC	VHF(136-174MHz), UHF(400-470MHz, 450-520MHz)
PX702 UL913	VHF(136-174MHz), UHF(400-470MHz, 450-520MHz)
PD782 UL913	VHF(136-174MHz), UHF(400-470MHz, 450-520MHz)
X1p UL913	VHF(136-174MHz), UHF(400-470MHz, 450-520MHz)
MD652 (G)	VHF(136-174MHz), UHF(400-470MHz, 450-527MHz)
MD782 (G)	VHF(136-174MHz), UHF(400-470MHz, 450-520MHz)

4. XPT Features

- Voice call
 - Private call
 - Group call
 - All call
 - Emergency call
 - Polite access
 - Telephone call *

- Supplementary call
 - Alert call
 - Remote monitor
 - Radio enable/disable
 - Radio check
 - Emergency alarm

- General features
 - Scan
 - Access limitation
 - Interference detection *
 - Fault tolerance
 - RDAC
 - Encryption*
 - Roaming*

- Data operation
 - Text Message Service (TMS)
 - RRS/GPS*
 - Quick GPS *
 - Dedicated data revert *

- Dispatcher features
 - RRS/GPS*
 - OTAP *
 - PSTN/PABX *
 - Voice recording *



Note: *Items with * will be available in a future version of XPT.*

5. XPT Technology Performance

The main technology specifications of XPT system are listed below:

- The channel capacity of XPT system is 8 times as large as a Hytera digital conventional communication system.
- The number of traffic channel can be extended to 16 (8 x 2 Time Slots).
- Support up to 16 dedicated data revert channels when GPS is released.*
- Theoretically can support up to 65,535 radios, but practical application (Erlang C) would be 1,200 radios.
- Radio ID range from 1 to 65535, group ID from 1 to 249, emergency group ID from 250-254, and all call ID is 255.
- A radio can only make a group call which is pre-defined in the master repeater.
- Support polite access
- Priority for emergency call and all call.
- The system integrates audio and data application, such as GPS, text message, telemetry.*
- Support Hytera remote diagnostic and control (RDAC) program to ensure the performance of system.
- An existing Hytera digital conventional system using RD982S repeaters can be migrated to XPT system smoothly with the purchase of an upgrade license.



Note: *Items with * will be available in a future version of XPT.*

6. XPT Applications

6.1 XPT System with Hytera RDAC

Hytera RDAC (Repeater Diagnostics and Control) is a PC-based application designed for monitoring and controlling all repeaters registered in the XPT system.

XPT repeaters are connected to each other via one switch, and then connected to local RDAC client (PC installed with RDAC software) via switch or connected to remote RDAC client through WAN via router, so as to make sure that the users can diagnose and control each repeater via RDAC at any time in any place.

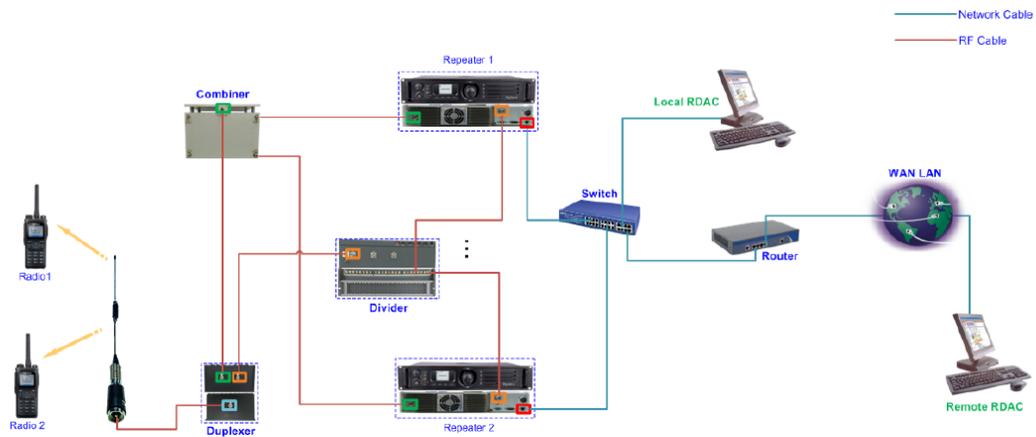


Figure 5: XPT system with Hytera RDAC

7. Advantages of XPT System

Hytera's XPT system is a specialized low-cost digital trunking solution, which can help large enterprises to communicate swiftly and efficiently. It also provides reliable digital technology and possess the advantages of traditional trunking system.

7.1 Maximizing Capacity

The biggest constraint for large organization using a conventional system is that a talk group can only use one channel of the repeater at any time. Hytera's XPT system has solved this problem. Enhanced by the channel-sharing logic of XPT technology, this system allows a radio to communicate in all repeaters on the site. There is no need for specific control channels, thus the channel utilization and capacity is increased.

By integrating the channels of multiple repeaters operating under digital repeating mode within the same zone without dedicated control channels, an XPT system can meet FCC FB8 frequency allocation rules and share its frequency allocation with other systems. One XPT single-site system can support up to eight repeaters. Each repeater can be used as voice sharing channel or dedicated data channel, with a total number of 16 virtual channels. Theoretically, an XPT system can support up to 16 voice channels or data channels simultaneously. It is eight times of the capacity of Hytera digital conventional system. Each XPT system can support digital communication of up to 1200 users with a general traffic mode.

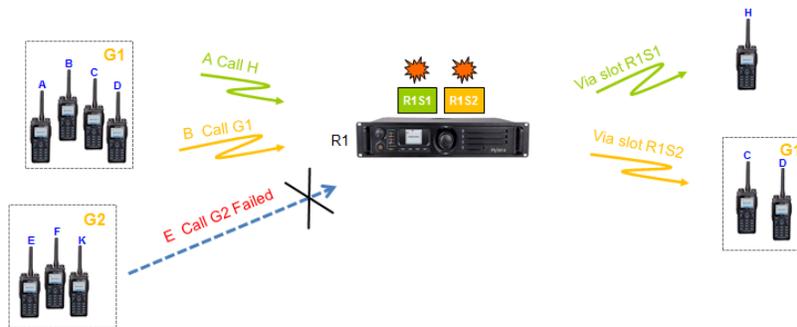


Figure 7: Traditional Repeater Communication

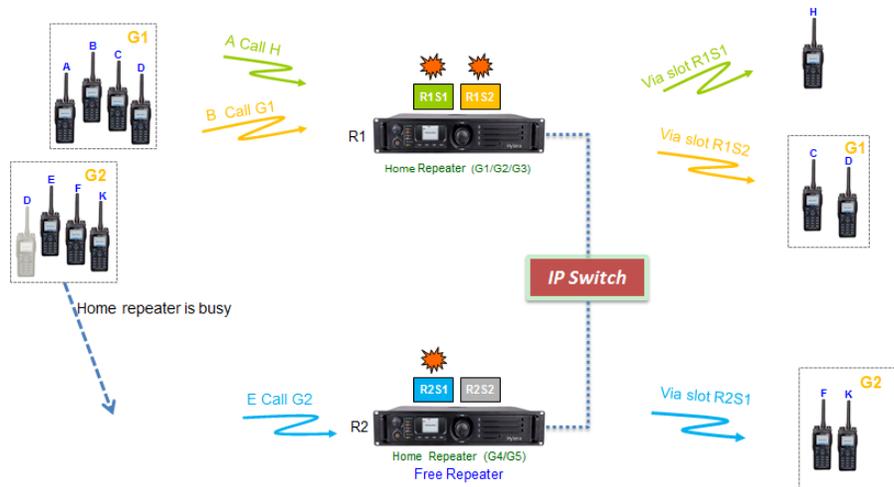


Figure 8: XPT Single-site System Communication

7.2 Expanding a System Cost-Efficiently

An XPT system is based on a Hytera digital conventional system. By using the Hytera RD982S repeaters, the original system can be upgraded by software and firmware. There is no need for new controllers and the existing duplexers can be used. The cost of upgrading to an XPT system is relatively low. The existing Hytera conventional system can be migrated smoothly into an XPT system by obtaining an upgrade license per repeater and upgrading the firmware of both repeaters and subscribers on the system. Hytera's XPT system supports Hytera radios PD6, MD6, PD7, MD7 and X1 series radios.

7.3 Providing Outstanding Functions and Flexibility

An XPT system can meet a large organizations communication needs by integrating and utilizing the system's channels. Also, it possesses the advantages and functions of conventional system, providing higher capacity and frequency efficiency, integrated data communication and enhanced voice communication, such as voice (private call, group call, all call and emergency call), data (text message, work order* and GPS*) and advanced functions (scan, fault tolerance, system authentication, alert call and remote monitoring). An XPT system can also be compatible with phone system*, dispatching system* and RDAC software of repeater for enhanced flexibility.

 **Note:** Items marked with an asterisk will be available in a future release of XPT.

7.4 Improving Fault-tolerance Performance

An XPT system can avoid interference caused by irregular situations using fail soft mode and interference detection. With these two functions, interference can be reduced and XPT system can keep operating.

Fail Soft Mode: Since an XPT system is a distributed trunking system, it has no control center. An XPT system can automatically detect most of the failure, such as abnormality auto detection, physical connection break-up, network card looseness, network off-line, exchange abnormality or router abnormality. The system will deal with different failures according to the actual situation to lessen the impact to the system and ensure that the repeater can still work when it is in fail soft mode. When the problem is solved, the repeater will exit fail soft mode and support XPT services again.

Interference detection: The up-link signals of a repeater may be interfered by other signals. For example, when the up-link signal of common-frequency is interfered, the radio under this repeater may not be able to use the communication channel. The free repeater in an XPT system can detect the up-link signals via corresponding mechanisms. When up-link signal interference is detected, XPT system will assign other repeater as the new free repeater and inform the radios in the system to switch to the new repeater for monitoring. Thus, the transmitting and receiving of radio services will not be affected.



Note: *XPT Interference detection will be available in later version*

7.5 Balancing System Communication Load

Load balancing technology is included in the XPT system. This can balance the activity of groups to different home repeaters, so as to reduce the call conflict rate at a particular repeater and to increase the successful rate of call set-up. This feature becomes more useful the more repeaters there are on a particular system. With this technology, XPT system can support more calls at one time and drastically limit busy channel rates.

7.6 Reducing Conflicts via Handshaking Mechanism

An XPT system uses the mechanism "Request and Permit" to allocate channels. Before initiating a call, the radio will perform data handshake with the repeater, so as to ensure that the call can access a valid channel. When the data handshake between the radio and the master repeater fails, the radio will request to perform data handshake with a free repeater. Only after the handshake is successful, the radio can transmit voice services and data services on this free repeater. The advantage of data handshake is that it will not cause the radio to stay on a wrong channel due to call conflict. Also, it can prevent interference from a radio with a strong signal to another radio using the same channel.

8. Summary

Hytera's XPT digital trunking system is developed by Hytera, providing a practical, cost-efficient and smart channel-sharing digital solution. It can help large enterprises communicate swiftly and efficiently with a low cost, load balancing technology and without the need for control channel licensing. XPT is suitable for industries and departments such as public security (police department, firefighting, etc.), manufacturing, utilities, hotels, airports, piers, and oil / gas productions; also, it is suitable for dispatching communication in emergency situations such as rescue and relief work. An XPT system is a key communication system for large organizations with high capacity requirements looking for a cost-efficient way to migrate to a digital radio system using all the system's channels as a shared resource.

Hytera, a leading designer and manufacturer of professional mobile radio communications equipment, is dedicated to bringing the most valuable and customized solutions to clients across the world.

We offer complete and customized communication solutions to government, public security, utility, transportation, enterprise & business for higher organizational efficiency.

Founded in 1993 in Shenzhen, China, Hytera has grown to be a key player in PMR (Professional Mobile Radio) communication industry with a large customer base in more than 80 countries and regions across the world. In China, Hytera's market share ranks the 2nd, the 1st among Chinese manufacturers; globally Hytera has reached the 2nd in Overall Terminal category 2.