Frequent asked questions about DMR systems

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ABOUT DMR SYSTEM

Which are the main differences between a simulcast network and a multi-site multi-frequency one?

1. A simulcast system uses the same frequency over all the coverage area. No scanning or manual changing of channel is required from the user terminals. The entire network operates like a single "big repeater".
2. The multi-frequency network requires a "beacon" signals to be sent every few minutes to permit to the mobile to find the base station. The beacon signals must be long enough to permit the scanning of all the channels in the scan list (about 4-6 sec). In multi-system environment these transmission may disturb adjacent systems. In simulcast no beacon is required, the base stations are in hibernate mode (TX off) when no valid communication are present.
3. The switching time (scan) between a station to another may require one to several minutes. During scan the mobile is not reachable from the Central Office and it misses every audio or digital communications. Simulcast doesn't require any scan, beacon or similar functions: no missed communications moving through the sites.
4. A multi-site multi-frequency network requires a set (3 to 5 typically) of different frequencies to cover a region. It increases the license costs for frequencies allocation. A simulcast one required only 1 channel (2 frequencies) over the total area.
5. In simulcast network hand-over (base station changing) and roaming (research of desired group of users) are fully automatic, fast and without interruptions (click-less). In a multi-site multi-frequency network, hand-over is not allowed (a cell changing produce killing on the incoming call). The roaming features require more time to ensure that the called users have finished the scanning procedure.
6. In a multi-site multi-frequency network, a text messaging to a group of users (not confirmed) may not be received from the users during scanning. The probability of receiving the right message is higher in simulcast network.
7. In a simulcast network all the signals emitted by the base stations must be the same and at the same time: it is not possible to use one timeslot for local (on 1 base station only) communications and the second for all area communication. In a multi-site multi-frequency network it is possible.
8. The simulcast network requires a precise timing recovery, sophisticated algorithms and perfect matching of the base stations to work properly. The cost of simulcast is typically higher than multi-frequency one.

Can I use a VHF/UHF base system with UHF, or VHF link frequencies?

Yes you can. The Radio Activity DMR solution permits to use a standard DMR base station to perform a robust, long distance or non visibility connection between DMR base stations. These links are dual mode (DMR/Analog) also.

In normal simulcast system, can I use an IP backbone instead of UHF?

Yes you can. The IP backbone is the preferred way for connect the Radio Activity base stations. Now a day this solution is not provided by the products of our simulcast competitors.

Do you support IP link in analog simulcast system also?

Yes we do. With the Radio Activity DMR Simulcast Repeaters you can operate in both analog and digital mode through an IP network. We use a proprietary algorithm to realize a VoIP conversion with synchronization and linear coding of the signalling (e.g. 5 tones / FFSK modem).

Can I use in a DMR simulcast network one timeslot for wide area coverage and the second for the local area (e.g.: single repeater)?

No you can't. If you have some not linked stand alone repeaters which are working on the same frequency in DMR mode, the network is critical because each repeater can work with 2 timeslots at the same time and when a communication is ongoing on one timeslot, the repeaters transmits also on the second one an "Idle" timeslot. In this way when you access one repeater on one timeslot, you actually forbid communication on both the timeslots to other near repeaters. If a mobile will access a near repeater, in the overlapping areas you cannot speak.

You can assign different colour codes to different repeaters in order to exactly know which repeater you will enter to, but if they are not linked together you cannot disable transmission of others when a repeater is busy.

I have to change my old conventional radio system in a new digital one. Which are the main differences between DMR and TETRA?

The main differences are:

1. TETRA system has a 3+1 (minimum) channels starting point in 25KHz bandwidth. A lot of users has got a single 12.5KHz channel, operate in open channel and don't need more traffic. With a DMR system, without changing frequency, they could operate as previous with a lot of other "digital" features like GPS positioning, audio encryption, efficient messaging, remote control, ….
2. DMR is more flexible in backbone base station connections. TETRA requires E1/T1 interface with a lot of bandwidth (Mb/s) not easy to manage in severe environments. DMR requires low cost TCP/IP connection with very low bandwidth (<33 kb/s). A Radio Activity DMR base station can be connected with another DMR transceiver to perform a robust, long distance or non visibility connection.
3. DMR doesn't require any expensive dedicated switch node devices to build a network. The simple IP connection between DMR base stations enables to use low cost and general purpose backbone transportation network devices. A TETRA system requires expensive switch node to manage the inter-station connections.
4. DMR allows higher power supply efficiency. Due to the linearization requirement of a TETRA transmitter and the continuous activity of the control channel, a TETRA base station requires 4 to 8 times the power of the DMR one. The power absorption of TETRA base station requires also cooling and conditioning system adding other power consumption. DMR base station is solar panel ready.
5. DMR exists in all conventional mobile radio bands. TETRA exists in 400 MHz band only. To change an existing VHF radio network to TETRA should require new frequencies and many other sites. Every site could have a significant rent cost per year and it requires expensive Mb/s connections. With DMR can be used the existing frequencies and no other sites are required.
6. DMR has a higher efficiency. A TETRA base station offers 4 timeslots in 25 KHz of bandwidth. One timeslot is dedicated to signaling, so the remaining 3 timeslots perform 3 contemporary communication channels. In DMR the 2 timeslot available from a base station require 12.5 KHz bandwidth but no timeslot is required for protocol. DMR spectral efficiency is 4CH/25 KHz, the TETRA one is 3CH/25 KHz.
7. DMR has a lower cost for the licensing of frequencies of the Ministry. Due to the narrower band requirement (1/2 of TETRA) the cost of leased frequency should be less.
8. The implementation of the same coverage radio system with the DMR has a cost per channel, all-inclusive, lower by 3 to 5 times compared to the TETRA one.
9. DMR is a very simple system for maintenance people. It is very similar to the analog one and is easy to understand it. It doesn't require special instrumentation, the analog ones can be used with optimum results. TETRA is a complex system, hard to learn and to maintain, it requires TETRA compliance instrumentation.
10. DMR has the chance to work in simulcast, feature very important in large areas with low radio traffic. TETRA system doesn't perform simulcast operation, it requires different frequencies allocation in the adjacent TETRA cells.
11. DMR permits smooth migration from analog to digital system. The automatic dual mode analog/DMR feature permits the coexistence of mixed terminals over the same radio network. TETRA needs the total changing of the existing analog terminals.
12. DMR has the same user's features of TETRA. Except for full duplex on terminals (this is a future DMR enhancement), the main features of TETRA and DMR are quite the same: digital audio, data messaging, positions reporting, encryptions, group managing, fast set-up call, ….
13. TETRA is a trunking system targeted to point to point communications in multi cell – high traffic environments. Like a telephone network, hundreds of users in a little area require a lot of radio cells to deliver the communications. DMR is a dedicated channel system targeted to point to multipoint communications in wide area. During an emergency situation most of the communications are point to multipoint to ensure proper coordination between all those involved in the crisis scene.

The Motorola's DMR radios have many useful features such as: SMS short data transfer, telemetry, GPS. In case of simulcast is there any problem on transferring such application data over your repeater both in standalone single site and simulcast wide area network?

Are Radio Activity base stations compatible with Motorola MOTOTRBO™ ones?

Digital Mobile Radio (DMR) is an ETSI standard that is the same used by Motorola MOTOTRBO™ TDMA.
Our repeaters and networks are transparent to most Motorola terminals signalling. We have tested (in simulcast also) our base stations with Motorola terminals. We assure full compliance with Motorola SMS, GPS messages, selective call, low level encryption, high level encryption. The encryption pass through our systems independently from the keys used (Motorola repeaters require the same key). The alarm messages sent from the base stations are readable on the Motorola MOTOTRBO™ terminal's display.

How can I manage the migration from analog to DMR during the overlap period?

Our RA DMR allows communication both in analog and in digital on the same channel, instantly switching between them in a real time dual operating mode and using it together with Motorola and others vendors' terminals on the market. The operation of analog and digital portable/mobile radios mixture is as follows:
Set a sub-audio tone squelch in TX and RX on all terminals to avoid the noise into the analog equipment during the DMR communication.
If you have RA DMR cover (by a single repeater or by a network) it is possible to use the portable/mobile analogue radios to communicate with digital portable/mobile radios (DP 3400/3401/3600/3601 and DM 3600/3601/3400/3401) and vice versa but only in analogue mode. As you know the Motorola DP and DM terminals can be programmed both in analogue and in digital automatically by the Scanner Mode function. So if the caller terminal is an analogue one, the digital Motorola terminal, by the scanner function, is able to understand that has to use the analogue channel mode. But if it is a digital terminal that has to call an analogue terminal, the user must to know that he has to dial an analogue terminal and manually to set his terminal to analogue mode.

What do you mean by "pin to pin" analog substitution exactly?
I mean that the DMR solution was designed by ETSI to substitute the existing analog system with the same coverage performance. In this sense, where there is an analog system working at 12.5KHz, the DMR replacement in the same sites should reach the same coverage area of the analog one. The frequency licenses, the power supply, the branching and antenna system and most of the links may be re-used successfully. At the end, the DMR digital evolution of an analog system requests to substitute the transceivers only.

I read that only TETRA offers time division full-duplex terminals. There are no such time division full-duplex DMR terminals. Is this correct? What is the significance of time division full duplex?
The time division full duplex is a full duplex communication obtained without a RF duplexer. The terminal sends own signal in a timeslot and receive the signal from the network in another timeslot. It switch from RX to TX continuously. It is not needed a duplexer so the terminal performs a low cost and a reasonable height. It is the same of a GSM communication. Now a day no manufacturers (that I know) has got a TDM duplex solution for DMR. DMR protocol permits and specifies the full duplex operation. It requires a lot of DSP power and fast PLL settling time. I think that the current HW of the Motorola terminals may support full duplex with a specific SW develop and optimization. Probably we will see it in the next 8-10 months.

What is the C/I figure and how it influence the spectral efficiency?
It is the acronyms of Carrier on Interference ratio. It represents the ability of the receiver to receive correctly a desired signal in the presence of an interference in the same frequency. The interference signal may be generated by another network/terminal working in the same channel. A low C/I ratio permits an easier re-use of a frequency in congested areas. This fact is very important in the estimation of the "over all" spectral efficiency. The C/I of DMR is some dB better than the TETRA one therefore it DMR permits a better re-use of frequency.

You note that it is difficult to use solar cells to power TETRA infrastructure? Why—because of the continuous control channel on air?
Yes it is. TETRA needs a control channel always active. In addition the TETRA infrastructure requires more power because the modulation schema is linear instead of saturated. To give the same RF power, a linear RF power amplifier performs an efficiency of 15-20% respect to the 50-60% of the saturate one.

Radio Activity is a manufacturer of base stations? Do you manufacture DMR equipment?
Radio Activity is an engineering company focalized in radio communications. We had designed and we are producing a family of high performance DMR base stations. Now a day we have not an own DMR terminal.

COMPARISON BETWEEN RADIO ACTIVITY AND MOTOROLA DMR

Which are the main differences between a Radio Activity base station and a Motorola MOTOTRBO™ one?

The following are the unique functions of Radio Activity not performed by MOTOTRBO™ DMR base station:

1. Automatic dual mode DMR/Analog operation. On MOTOTRBO™ repeater it is possible to select DMR **or** Analog mode but it is not allowed the automatic switching between the standards. This is determined at the initial configuration, and is not updated dynamically. Therefore at any given time, it either operates as a digital repeater or as an analog repeater.
2. Soft diversity receiver. This is a very powerful function available as option in Radio Activity base station only. Diversity reception increases considerably the access coverage area (see the relative application note).
3. Simulcast applications. Radioactivity has developed a "built in" complete set of functions dedicated to the simulcast network realizations: a lot of timing/synchronism ways (GPS, Digital, external source, from 2Wires interface, etc.), digital and analog "click-less" voting systems, distance delay compensation, automatic modulation index control, etc... It is very hard to synchronize the Motorola DMR base stations due to the external inaccessibility of the fine timing reference.
4. Telephone Interface. Radio Activity base stations can be connected to an optional IP telephone line interface. This interface should be put everywhere on the same IP sub-net of the network master station (or a single repeater). With standard DMR messaging function, it is possible from a terminal to call a PSTN user. The interface can support up to 2 contemporary telephone connections (one per each timeslot). Motorola MOTOTRBO™ hasn't an automatic telephone interface. The Radio Activity telephone interface will be available on April 2010.
5. 70MHz and 900MHz band. Radio Activity base stations can operate in these radio bands. A customer that needs a new infrastructure in these bands can do that installing base stations operating in analog but being able to support future 80/900 MHz DMR terminals. Now a day, there aren't MOTOTRBO™ equipments operating in these radio bands.
6. Software remote upgradability. All software and firmware are up-gradable from remote center (via IP/GSM/GPRS/RS232) without service interruption (few seconds for the final reboot only).
7. LINUX inside. The powerful of a full LINUX operative system inside the transceiver permits to develop a number of applications with low effort and with a high level of SW stability.
8. Powerful GSM/GPRS/TCP-IP/DMR based remote control. All internal parameters (frequency, delay, synchronism, color code, sub-audio, etc.) can be remotely controlled and modified. A complete set of measurements about mobile terminal access (frequency offset, modulation index, sub-audio deviation, SINAD, timing, etc.) is remotely available for maintenance and monitoring purposes.
9. Alarm messages to the terminals directly. Every base station sends to the selected "maintenance group" of terminals a short message to inform in real time the user about the major failure happened (power supply low, IP connection fail, synchronism fail, etc.).
10. Modular design. The base stations are composed by few units, easily changeable from frontal view. The modules are the same for all products so this reduces spare parts and maintenance costs. All modules are designed for maximum performances to work as rugged 100% duty base station. Motorola base station is based on two vehicular radios joined in a 19" chassis.
11. Customization. Radio Activity is a flexible engineering company specialized in RF and wireless systems. Our "soft radio" approach permits to easily customize performances, protocols and more. We believe that for Motorola the products customization is harder.
12. Real open standard. The Radio Activity DMR solution can perform all the protocol used by the terminals. Now a day Motorola only has got terminals with some proprietary protocols. HYT is arriving with (probably) some difference in protocol. The same may occur when Tait and other DMR players will be ready to sell terminals. Radio Activity is able to perform a real multi-standard DMR vendors independent transportation layer.
13. Services Ports. The RA-XXX base stations implement some IP ports target to Operative Center applications. Through these ports it is possible to monitor and send selective call, text messages, GPS positions, telemetry messages, digital audio (both analog or DMR). These services are available for all traffic in the network, **for private communications also**.
14. Extra low ETH bandwidth (about 64kb/s for analog, 33.6kb/s for DMR only) is required to connect Radio Activity base stations. Instead, the customized algorithms and IP protocol developed by Radio Activity reduces dramatically the bandwidth required. It is possible to use an IP modem (e.g.: RA-MD1) to connect two DMR base stations via a copper pair (also from PSTN).

15. ETH bandwidth repeater number independent. In Motorola multi site repeater the traffic from one repeater is sent to every repeater; therefore the required bandwidth of the ISP link at one site is a function of the amount of other sites in the system. Adding a repeater at one site increases the required bandwidth at all sites. Note that for most Internet Service Providers, the uplink bandwidth is the limiting factor and the downlink bandwidth is usually multiple factors above the uplink bandwidth. In Radio Activity system the Master station sends the best signals in multicast mode. Say N as number of repeaters (slave), on Master station the bandwidth required is Nx33.6Kb/s, while the slave repeaters require 33.6 kb/s only.
16. Delay tolerance in IP-multisite. The Motorola multi site repeater requires a back-end network having total delay of no more than 90ms. Radio Activity base stations tolerate backbone TCP/IP delays up to 960ms. It permits very flexible connections in simulcast applications also.
17. Backbone connections between base stations via UHF links. The Radio Activity DMR solution permits to use a standard DMR base station to perform a robust, long distance or non visibility connection between DMR base stations. These links are dual mode (DMR/Analog) also. Motorola Base station allows TCP/IP broad band connections only.
18. Easy upgradability from single repeater to simulcast network. The soft design permits an easy and at low cost growing of the system. Save customer investments starting with a repeater and moving to a network to increase coverage area.
19. Cross coding ZVEI/CCIR to DMR signaling to cross-connect conventional (old) equipments to the new one (DMR). MOTOTRBO™ terminals perform conventional 5 tone signaling only with an internal optional module designed by third party.
20. Very low power consumption (typ. 8 W @RX). Motorola requires more power for cooling system (fun) and to supply the two vehicular radios.
21. Flexible power supply. The RA-XXX accepts power supply source from 12/24/48 Vcc with or without negative ground to facilitate the insertion in the standard telecom environments.
22. Compact size (1/2 rack 19" 3UT) and weight (6Kg). Motorola size is 1 rack 19" with a weight about 14 Kg.

ABOUT RA-XXX BASE STATIONS

I know Motorola products, what about Radio Activity transceivers?

Radio Activity designs, manufactures, and markets radio communications equipments in VHF and UHF bands, both analog and digital ones: Radio Repeaters, Modems, Digital Audio Matrix and Network management systems. We are especially skilled in the Analog and ETSI DMR simulcast solution.
The Radio Activity base stations are extremely robust and widely used: more than 1300 base stations of the same "SW defined" radio station family, installed in the past 3 years (the most in h24 continuous transmission) report less than 1% of failure only.

Does Radio Activity base stations support digital coded squelch called DCSS?

Yes it does. The repeater regenerates the CTCSS/DCS tone. It is possible to set different tones/codes for RX and TX and also different DMR color code.

Is it possible to use Enhanced Privacy with the repeater?

Yes it is possible but the functioning is not very stable because the algorithm used on the terminals sends some privacy information on the initial blocks. If the end user misses these blocks, the terminal requests a lot of time to synchronize the algorithm and it miss the communication.

Is it possible to use Enhanced Privacy with your telephone interface?

The enhanced privacy is not available on our telephone interface yet.

Is the receiver a true rake receiver, or are you just summing the inputs from the receivers?

Yes it is. The receivers are coherently summed with a maximum likelihood algorithm and after that the modem performs the bit extraction.

Is it possible to program the repeater and update the firmware via LAN, with the programming software?

Yes it is possible.

Is firmware and software upgrades in the future free?

Yes they will be free of charge. Only special functions like simulcast key will be send on payments basis.

How is the IP on the repeater set the first time?

The standard IP is 192.168.1.120 port 4000, but we can set it as you want before the expedition.

Regarding the 220 volt power supply, does it mount inside the cabinet? does it charge backup batteries?

Normally our base stations are mounted inside a Telecom infrastructure with secondary power supply coming from batteries (12/24/48Vcc). We haven't a AC/DC converter specifically developed for our transceiver. We suggest to buy locally a general purpose power supplier (a low cost AC/DC with >75W 13-14V for laptop may be good for your application) that matches your needs.

Will it send an sms alarm if there is a power loss, and when the power is back?

Yes it sends. Connecting a power supply loss contact to the alarm input of the base station produce the sending of a DMR messages to a predefined group of terminal (see the example in the related document).

Will it send sms when the batteries is low on power?

Yes it sends. The base station sends the alarm message when the input voltage goes down 11Vdc.

Can I use a different duplexer instead than the Radio Activity suggested one?

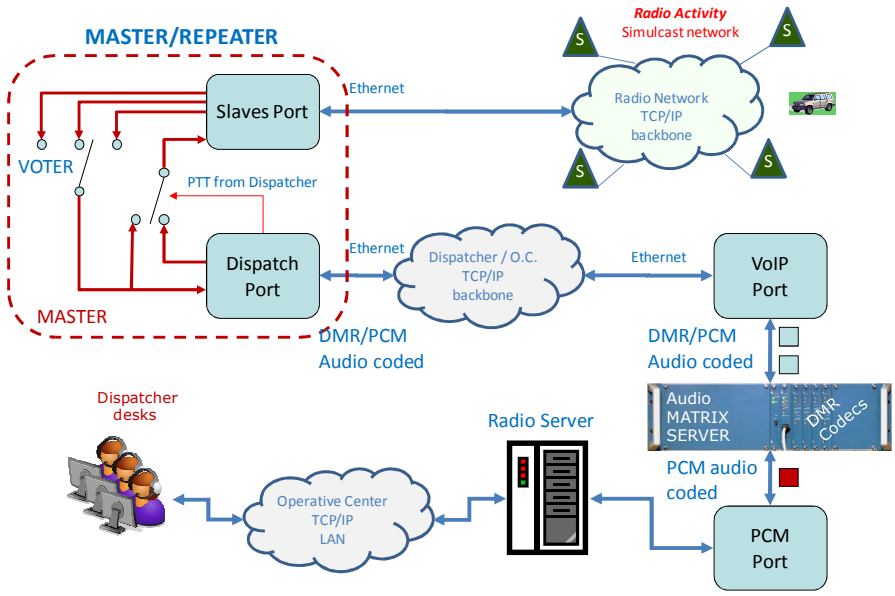
Yes you can. A general purpose 6 cells notch duplexer may be enough (min isolation TX/RX = 75 dB).

Is it possible on your repeater to send and receive audio and selective call directly from a desk audio console?

No it is not possible. RA-XXX base station can be equipped with a 2/4 wires balanced audio port. This port works in analog only. In addition there aren't consoles on the market that permit to encode-decode the DMR selective call.

We suggest to use a **PC based dispatcher solution**. We suggest to use a **PC based dispatcher** solution.

The purpose of the **Dispatch Port** on the RA-XXX base station is to give the right instrument for the develop of a full PC based Operative Center giving a multitude of features with own customisation. The Dispatch port of the RA-XXX base station can be used directly or through a trans-coder device named "RA-TI-XX". The digital audio coming from DMR terminal is coded with the AMBE II+TM (Advanced Multi Band Excitation) developed by Digital Voice Systems. The audio received on the master station of the network, through the IP backbone network, may be analog or digital (DMR).



An application may connect itself directly to the "Dispatch Port" of a base station/Master. In this case the audio packets will be

PCM if sourced from analog terminals or services like modems or DMR coded if sourced from DMR terminals/devices. To decode the DMR audio streaming it is necessary to implement a trans-codec engine into the audio server/PC base dispatcher. This SW is not furnished by Radio Activity.
Where the DMR audio format is not useful as is it, it is possible to use the RA-TI-XX module to perform the correct translation of the format. It connects its "VoIP Port" to the "Dispatch Port" of the Master, it translates the audio format PCM/DMR and offer the analog audio on the "PCM Port". The RA TI XX device use the PCM format (8bit@8KHz A low) for the audio applications on the radio server or on the PC of the operator desk. This PCM stream is available from the port "PCM Port" of the RA TI XX device through the LAN network.

COMPARISON BETWEEN CONVENTIONAL ANALOG AND DMR

How can I work with (existing) analog and DMR mobile?

When an analog terminal accesses to the network, the other analog terminals listen him (obvious) and also the DRM terminals can listen the communication in the analog mode channel. For inter-operability Analog/DMR, it is necessary to set a sub-audio tones squelch on the receiver of the terminals (it stops the noise in case of DMR signalling into the analog receivers).
When a DMR terminal accesses the network using the Slot 1 or 2, the other DMR terminals can hear him and the analog terminals don't listen noise. Our network/repeater switches automatically DMR/Analog mode according to the terminal access mode.
We suggest to set-up the DMR terminals with scanning functions on two channels with the same frequency but one as analog and the other as DMR. In this case both analog and DMR incoming communications are listened.

Is it possible to make auto patching between (existing) analog users to DMR?

No, it isn't. The analog radios use all the channel bandwidth (both timeslots). No Slots are available for other DMR users.

I have an analog 12,5KHz conventional radio system, what about coverage changing it in DMR standard?

The coverage area in DMR should be near the same as existing analog one. This sentence is true for professional quality communications (we suggest diversity facility on the base stations).
The terminals haven't diversity but this fact is not important due to the lower interference. When the RF field goes down to about 14-12dB SINAD in analog, the DMR terminals switch off the communication. At the end, you should have full quality DMR communications in the existing area in which the analog quality is >20dB SINAD. Outside the communications switch off rapidly.