TCP-IP Simulcast network

Advanced base stations for the new generation of professional mobile radio

DMR

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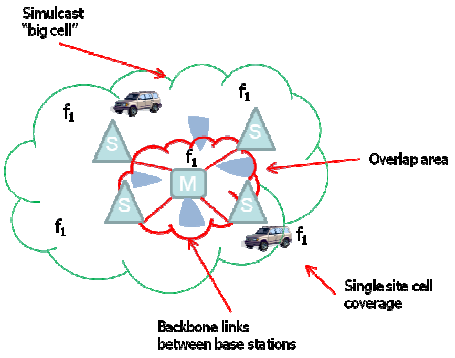
Radio Activity Solutions

Via Ponte Nuovo, 8 - 20128 Milano — Italy
Tel. +39.02.36514205 - FAX/Voicebox +39.1782242408
radio.activity@fastwebnet.it - www.radioactivity-tlc.com

About SIMULCAST

A simulcast network is a very powerful and professional solution for radio systems. In simulcast network all the repeaters are active on the same frequency and at the same time. Main advantages:

- *Automatic and continuous roaming and hand-over => Easy to use, fast setup call*
- *Functioning like single "big repeater" => automatic and simple conference call operation*
- *All stations directly connected to the network => Integrated communication sys*
- *The same RF channel over all Network => no change of channel in the coverage area, frequency saving*



The simulcast solution is the best in case of emergency due to easy and fast "open channel" mode of operation:

- *all people involved in emergency can listen all communications so they are continuously informed about the critical situations*
- *the regulation of network access is made by user, absolutely more intelligent and efficient than a trunking SW logic*

No scanning required.

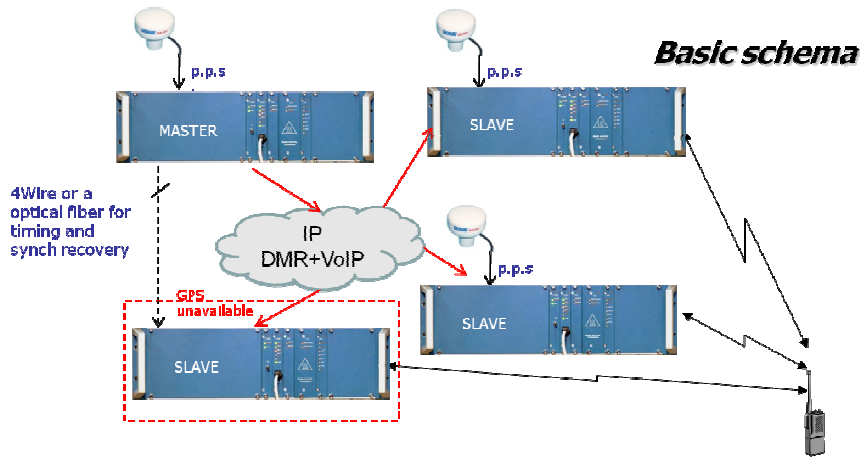
Forget your previous trouble experience on simulcast networks.

The simulcast network based on a TCP-IP backbone

This is the most common application of the Radio Activity base stations. Every base station has got an Ethernet port to connect to a LAN backbone network.

An important distinction between an over-IP system and a conventional (switch-based) one is that with a IP system there is no central switch, thus eliminating a critical point of potential failure. Instead, full signaling is made by IP (Internet Protocol) network technology to provide reliable data routing between network components. This combination of IP technology and the advanced DMR communication standard produces a feature-rich solution with a surprising degree of flexibility and resilience.

One base station of the radio network works as "Master" station. It require a fixed IP address. The other base stations are configured as "Slave" stations with an IP static or not.



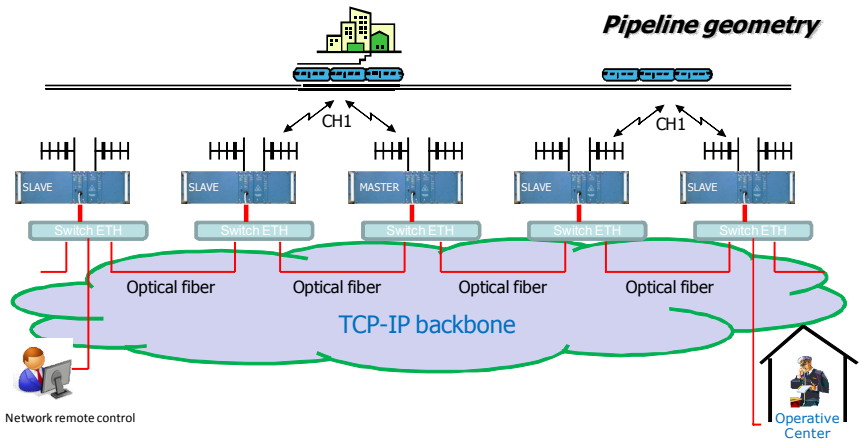
Through the LAN, the Slave base stations search the Master one and then they log themselves to it. The master governs the radio network sending timing and related information to the slaves.

The incoming signal from a terminal equipment is received from one or more base stations. All base stations receiving a valid signal send it to the master station via the Ethernet interface through the LAN backbone. The master station waits the arrival of all signals and then performs the selection of the best signal. The master selects the incoming signals continuously on the basis of signal/noise (analog) or maximum likelihood (digital DMR).

The master station sends back the best signal to all the slaves via the Ethernet interface through the LAN backbone utilizing a multicast IP protocol.

All the slaves synchronize the signals received from master on the local GPS signaling base. All the base stations synchronize also their timing, protocol history and carrier frequency to the GPS. The synchronization procedure requires less than 1-2 minutes to reach the requested precision after a "cold start up". Thanks to the very high stability of internal clock sources in conjunction with sophisticated network algorithms, the synchronism remains good enough up to 8 hours after GPS missing.

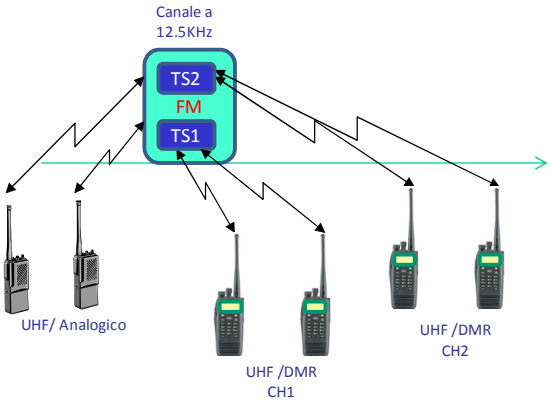
Where the GSP signal is not available or it is "too evanescent", it



is possible to recover all precise synchronisms via a twisted pair of copper or a 4Wire interface (e.g. from a fiber optics MUX). Radio Activity develops other methods for synchronism recovery, contact Factory for details.

In the event of a radio site becoming isolated from the network it can continue to operate in standalone mode until such time as normal network communications are restored. Any sites still able to communicate with each other can also continue to work together whilst temporarily isolated from the main part of the network.

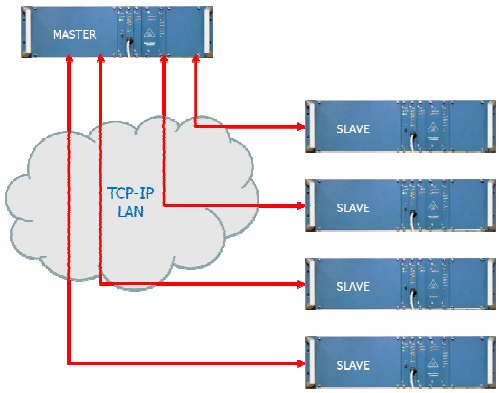
The simulcast or multicast network can work in dual mode, that is, it can recognize if the incoming signal from a terminal equipment is analog or digital and configure itself as analog or DMR simulcast network. In the first case the voice will fill the entire channel (no other contemporary communication is allowed) and it will be compressed in quasi-



Advantages of TCP-IP

A TCP-IP backbone connectivity is very attractive to build professional radio networks. Since today it was very hard to implement a simulcast network over IP due to the instability of delay and time inaccuracy. Now Radio Activity has open the way to do it with many advantages:

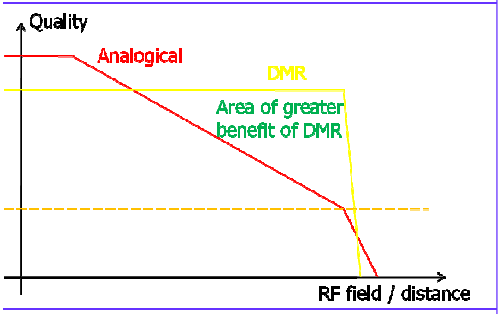
- *UDP/TCP-IP is the most common protocol in the world: standardization reduces dramatically the costs*
- *the IP world is well known and a lot of technicians are able to operate efficiently on it*
- *the communication redundancy is intrinsically assured by the protocol*
- *every base station is identified by an address (IP) instead then a (fixed) connection: it is easy to expand a network adding new base stations!*
- *all communications are carried out in the same digital format (the analog one also) without any noisy conversion and avoid periodic tediously audio level adjustments*
- *a unique ETH port connects several base stations: this cuts the cabling costs and reduces the probability of failure*
- *a lot of customers has got a proprietary TCP-IP infrastructure for video-surveillance, remote controls, and other services: using the same infrastructure reduces the maintenance costs*



Advantages of DMR

Over conventional systems

- *Two contemporary communications over 12.5KHz bandwidth*
- *European open standard*
- *Lower minister frequency license costs per channel*
- *Increase spectral efficiency*
- *Fast and reliable data communications*
- *Smooth migration from analog systems*
- *Communication security with various level of encryptions*
- *Powerful features (ID on PTT, emergency call, text messages, ..)*
- *Built-in applications (positioning over voice, telemetry, …)*
- *Easy upgradability from single repeater to network*



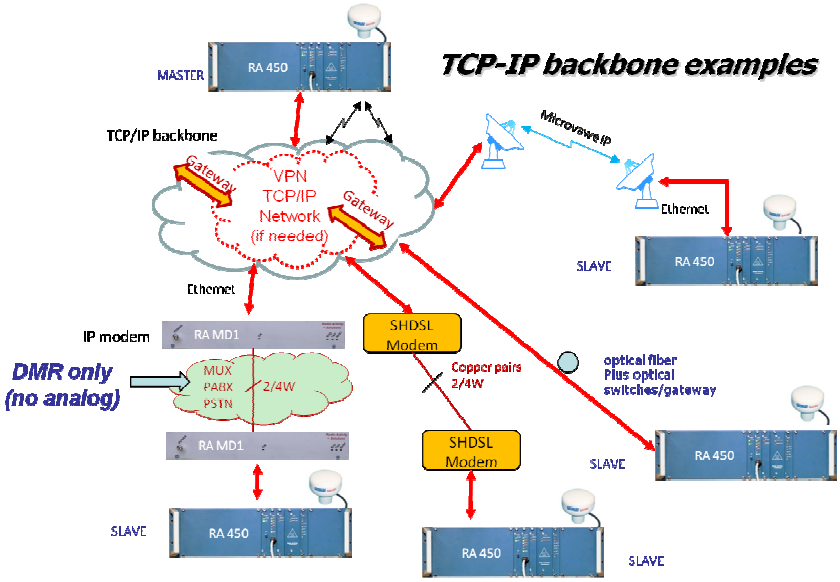
Over TETRA systems

- *Very low infrastructure costs*
- *More coverage area*
- *Total reuse of existing conventional infrastructure (sites, power supply, ant…)*
- *Easy to manage and maintain*
- *Very low power consumption (solar panel compatible)*
- *Low cost TCP/IP or UHF links between the base stations*
- *Better spectral efficiency and same main features*
- *Available in all PMR bands (70 MHz, 160 MHz, 450 MHz)*
- *Availability of simulcast solutions for low traffic and wide area coverage systems*

linear format to be exchanged between stations through Ethernet connection. In the latter case the network will support two contemporary DMR communications (both data and voice) over the two timeslots. Full DMR features are supported.

If DMR terminals are programmed in scan mode, they can perform communication both with analog terminals in analog mode and with DMR terminals in digital mode.

A special case should be describe when some link between the slaves is not available (it is difficult to have a LAN connection). A Radio Activity IP modem model RA-MD-1 may be used to perform a LAN connection over a twisted pair of wires or a 4Wire interface (e.g. from a fiber optics MUX). The resulting LAN may have a reduced bandwidth (e.g. 33.6Kb/s or less) and introduces a significant delay (about 50-60 ms). Thanks to the low bandwidth requirements of the DMR Radio Activity base stations, it is possible to use this solution but in digital mode only.



TCP-IP back-bone technical requirements

Protocols:	UDP-IP and TCP-IP (ipv4) unicast, multicast and broadcast
Maximum delay:	Round trip less then 900ms
Minimum bandwidth:	SLAVE: 70Kb/s in analog up/down 24Kb/s in DMR up/down
	MASTER to serve N SLAVE: 70Kb/s in analog down, 70KxN up 24Kb/s in DMR up/down, 24KxN up