

## ***Be it in Sydney, Buenos Aires, Auckland, London, or Wherever, the Radio Coverage Problem is Always There....***

**Article First Published in "CELLULAR & MOBILE International", Overland Park:", Kansas, USA, January, 1998.**

### **Introduction**

Diego Pianciola is the Engineering Manager of "FonoMovil", a major MPT1327 Service provider based in the province of Neuquen in Argentina. John Morehead is the Trunking Manager of "Vertel Communications", a large MPT1327 Service provider based in Sydney, Australia. Gareth S. Watson is a Senior Systems Engineer with "Protocall Ventures" , a major UK based Systems House specialising in the design and supply of MPT1327 Trunked radio systems. And Rob Ottoway is a Senior Engineer working for the Mobile Communications Division of "Telecom New Zealand", based in Auckland, New Zealand.

These guys have probably never heard of each other but yet, they share a very common problem and responsibility: one of their prime jobs is to ensure that their Company Networks provide the best possible radio communications quality. And , as most of us only know too well, that means a constant and ongoing battle with that fundamental limitation of VHF/UHF land mobile systems: whilst VHF/UHF radio waves have many attractive properties, there is a natural limit to the range and coverage that they provide, no matter how much money and effort is invested in the system.

### **MPT1327, a World Wide Radio Trunking Standard**

The MPT1327 Trunked Radio System Standard is a well proven protocol. It has been around now for quite some time, but even so, new MPT1327 systems are still being built all over the world, and the writer of this article for one, believes he is not all that wrong in expecting that the MPT1327 standard, whilst certainly grown out of its infancy, will remain a major force for many years to come yet.

Perhaps one of the most attractive characteristics of the MPT1327 standard is its Wide Area operating principles. Many MPT1327 systems all over the world provide true Wide Area coverage, highly effectively, highly efficiently. Even so, like all other radio systems, even the best designed MPT1327 system will always "fizz out" at the perimeters of its coverage area - the system's range limit. But, the problem does not stop there.

Even locations much closer in are not always covered: underground car parks, tunnels, large concrete structures may not always be blessed with satisfactory coverage, even if they are located relatively close to the system's transmitting sites - the system's coverage limits.

An effective solution to overcome range problems is to add more nodes to the system: new sites can be readily added to any MPT1327 system, as it is designed for Wide Area expansion. A new site however does not come cheap. Apart from the necessary RF elements required for the expansion (base stations, multicouplers, antenna system, power supplies and so on), there is also the need for additional Trunked Site Control equipment, and last but certainly not least, the new site has to be linked to the Main Control Centre, by microwave links or similar means, usually a very expensive affair.

When the expected traffic demand in the newly to be covered area is relatively low, it becomes increasingly hard to justify the cost of a new Trunked site. On the other hand, to simply succumb to the fact that there is no coverage in the "so and so" areas of the system is often impractical also. A large user may just need coverage in that particular area as they have a major depot there. Or Safety or Security considerations may simply leave no choice for the service provider; even if traffic demand in a certain area is practically speaking non-existing, Police or Bush Fire Brigade communications may still have to be provided for.

### **"Cell Extender® ", a Unique Solution....**

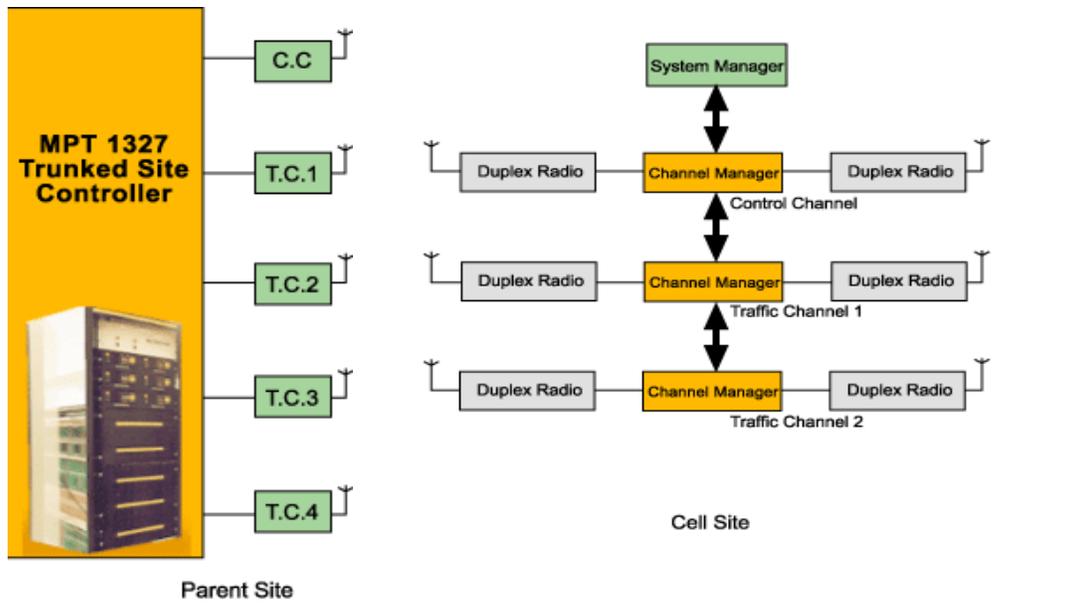
Recognising the problem issues on the perimeter of MPT1327 Wide Area systems, Radio Systems Technologies, a Melbourne, Australia based radio communications solutions Company, have been working for some time now trying to provide answers to these problems.

Their "SmartBridge" range of Interconnect systems provide automatic off-air interconnection between a Trunked and a Conventional system, using cross band repeater principles to connect the two systems. Conventional radios (or Dual Mode radios switched to Conventional operation when leaving the trunked coverage area) use DTMF to signal their call requests to the Interconnect point using a Conventional radio channel. The Interconnect system translates these signals into MPT1327 compatible call requests, and provides a cross band repeating function once the call has been set up. "SmartBridge" systems have been successfully applied on a world wide basis as very effective range extenders. However, they are fundamentally of a single channel nature only and also, they do not provide continuous coverage; trunked operators must manually switch to the local area's Conventional channel when moving out of the trunked system's coverage area.

To provide a more complete answer to continuous coverage requirements, Radio Systems Technologies successfully applied the old, but very effective radio repeater principle to the MPT1327 signalling standard.

This resulted in "Cell Extender® ", a multichannel MPT1327 repeater system, using unique, patents pending technology, which translates signalling data and voice signals received from a "Donor" site onto new frequencies, to re-transmit these signals at full RF power levels.

**Cell Extender® Block Diagram**



*Figure 1. Block Diagram of a Cell Extender® system. Control channel data from a Donor site (a standard MPT1327 site) is received "off air", processed, and retransmitted on a new frequency at full power. The "System Manager" module provides overall System Control. When a call is to be processed, the System Manager will assign the task of actually carrying that call to a vacant "Channel Manager", which will take care of that particular call, providing a full bi-directional duplex cross band repeater link between local mobiles and the Donor site for any Intersite calls. "Local" calls between radios in the Cellsite area are processed on a local TalkThrough basis, not requiring a Traffic channel at the Donor site.*

Using standard radio base stations, Cell Extender® effectively provides a remote "image" of the Donor site, but with fully renewed RF "vigour", as the base stations transmit at full power levels, of up to 50 Watts or higher. Cell Extender® was described in detail in the March 1997 issue of this magazine, so we will not go into its technical details any further in this article. Instead, we will concentrate on some of the applications of the system, in particular the applications implemented by Diego Pianciola of FonoMovil, and John Morehead of Vertel Communications.

## Don't cry for me, Argentina...

FonoMovil is a major Radio Communication Company and Trunked Service provider, located in the province of Neuquen, Argentina. They operate a large MPT1327 system, currently transmitting from a prime site in the City of Neuquen, and a Regional node further out from the city. FonoMovil is a young, but very progressive Company, who started operations in 1994. At present they have a total of approximately 400 users, who are serviced with a total of 5 channels. Users range from transport, electricity and oil companies through to Government and Police fleets. Application features include PSTN interconnection.

As is the case for most Trunking Managers, Pianciola is confronted with the usual range and coverage problems on an almost daily basis. Operating on tight budgets, he had to come up with a practical solution to a serious lack of coverage North of the city, and to a lesser extent, to the East. A "SmartBridge" system installed about 2 years ago has been providing a highly effective and reliable service on a constant 24 hour/seven days a week basis. Originally installed to service only a small number of professionally trained operators covering that area, a rapidly increasing traffic demand had started to outgrow SmartBridge's capacity, increasingly forcing Pianciola into finding a more comprehensive answer to the problem.

Cell Extender® provides a highly cost effective, and readily installed solution, effectively offering all the features and advantages of a new Trunked Site, but at a fraction of the cost. Typical Cell Extender® installations operate with 3 to 4 radio channels, with 1 channel usually dedicated to Control Channel service, and the remaining 2 or 3 channels to Traffic Channel operation. Cell Extender®'s leading edge technology however enables it to operate effectively even with 1 RF channel, using a unique "Self Assign" method to switch from Control Channel to Traffic Channel operation when a user wishes to make a call. So Pianciola decided to start with a single channel system, knowing that he can extend the system's capacity at any time, by simply adding further channels in the future, as and when required.

Figure 2 shows a picture of the installation. The Yagi antenna mounted on the lower section of the mast is used for the path to the Donor site, the omnidirectional antenna provides local coverage. Solar panels are used to provide DC power (Cell Extender®'s very low power consumption provides full compatibility with Solar powered sites). Installed in the Auca Mahuida ranges, 2200meters above sea level, Cell Extender® has given a very impressive boost to the main system's coverage area.

**Single Channel  
(Self Assign) Site**



**Figure 2.**  
**FonoMovil's Cell Extender® system operates at the moment with one single channel only. The site is solar powered and rises approx. 2200 meters above sea level. The Yagi antenna links the system back to the Donor site back in Neuquen. The omnidirectional antenna connects to the Cell site full duplex radio. Strong gale force winds require the mast to be left short, and heavily guyed.**

## Sydney 2000 - We are Getting Ready For It!

John Morehead is Trunking Manager for Vertel Communications, a large Sydney based company, who are Australia's biggest commercial provider of Network Services, operating on more channels than any other Service provider (not including Australia's National Carrier Telstra). Vertel is blessed with some of the most valuable (and quite possibly, the best) Radio

Tower Real Estate in the Sydney area, transmitting from sites like the MLC building (a major Sydney landmark), and Sydney's Centrepoint Tower, a futuristic structure rising some 250 meters over Sydney Harbour. It also operates major transmission facilities in the suburbs, and the Greater Metropolitan Sydney area.

Its overall coverage area stretches from some 175 KM towards the North to about 150 KM down South. Its reach towards the West it at least 100 KM (apart from the odd boat or two there is not much to cover East of Sydney). This area is serviced from over 10 sites, with a total of 48 installed channels. Operating in the VHF 160 MHz Band the system is rapidly expanding. Its users (currently counting close to 2000) range from a variety of smaller companies through to national giants such as Pioneer Concrete (Vertel Communications is part of the Nation Wide "Biscom" MPT1327 Network, covering all Australian capital cities and surrounding areas).

With the Sydney 2000 Olympic Games getting closer every day, the demand for improved communications is growing rapidly, and Vertel Communications is constantly building up their Network to meet that increased demand.

As they know only too well however, the solution is not simply the addition of more and more main sites.

Of course, the system's backbone is its network of Regional Nodes, all linked by microwave bearers back to Sydney. And new Regional Nodes are an indispensable part of future expansion plans. But, even the best Wide Area Network always has those "holes and gaps" where coverage is marginal, or non existing. And the modern Cellular Radio networks have forever changed the public's prevailing perception of the previous few decades that a mobile radio system can not cover all areas all the time.

*Centrepoint Tower, Sydney*



*Figure 3. Sydney, the site of the Year 2000 Olympic Games, is a beautiful city, but hard to cover with radio...*

*Fortunately, it is not so hard if you can transmit from prime sites like Centrepoint Tower (the mast type structure in the centre of the photograph).*

## Mt. View, a Mountain with a Perfect (Radio) View....

About 120 KM towards the North of Sydney, near Cessnock, a medium size country town, the Mt. View mountains rise some 200 meters above sea level. The area is "officially" in the overlap of Vertel Communication's Sugarloaf (further South) and Mt. Arthur (further North) sites, spaced about 90 KM apart. The population density in the area is low, but it carries a lot of business traffic passing through, on the way to or from the far more densely populated Sugarloaf and Mt. Arthur coverage areas. Add a highly undulating and mountainous terrain in between these two sites and you have the classic recipe for a coverage problem - mobiles "don't know whether to lock onto one or the other site", and/or "keep forever change their minds", and/or receive nothing at all.

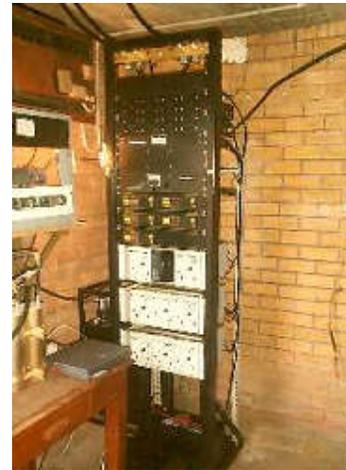
To build a complete new Trunked Site in the area however would not only have been highly uneconomical, it might not even have been the total answer to the problem, seeing that most of the traffic demand is of a transitory nature.

So Vertel decided to install a Cell Extender® system, operating with 1 dedicated Control Channel, and 2 Traffic Channels, linked off the Sugarloaf site further South. To keep the coverage limited to those areas that required it, low cost, low power radio bases (actually full duplex 25 Watt fixed mobiles) were used, and this also helped to keep the total investment low. With the antenna system tailored to further meet these requirements the Mt. View site has become a vital, high performance link in Vertel's radio network, carrying an estimated 100 calls a day on average.

A number of additional Cell Extender® s are planned and/or in the process of being installed closer to the Sydney area. Metropolitan Sydney is a very hard area to cover. The first 90 or so percent is easy (especially if you operate from sites such as Centrepoint and the MLC building). But with Sydney's networks of tunnels, bridges, underpasses, and highly undulating topography, coverage of that remaining 10% is a real problem.

Says Morehead: "Cell Extender® has given us an ideal tool to perfect our overall Network performance, effectively and reliably. It doesn't need microwave links or land lines.

*Mt. View (NSW, Australia)*



*Figure 4. The Mt. View Cell Extender® site is operated by Vertel Communications, a major NSW Area Wide MPT1327 Service provider. A humble installation, but very powerful in its service to the local area....*

The number of installed channels can be readily tailored to meet local area traffic demands. Even coverage into areas like underground car parks, or into large concrete structures, can now be readily provided, by Cell Extender®, using only one single radio channel if necessary, if that's all what the area needs. What's more, a Cell Extender® system is, relatively speaking, quite mobile. It can be easily moved to new locations when the need for local coverage diminishes, or if and when a new Trunked Site has started to cover the area. All it needs is a simple re-programming procedure. Installation is equally simple, there are no complicated or critical adjustments, and it is a true "plug and play" system".

Gareth Watson of Protocall Ventures in the UK can only confirm these experiences. The system that he had installed for one of his clients in W-Europe was prepared and built in the Factory, shipped to site, installed, switched on, and has been providing full interrupted service since that moment. And Rob Ottoway of Telecom New Zealand has exactly that same experience. The only problem that Rob encountered was that. after a successful start, traffic demand in the Cell Extender® area was considerably higher than anticipated. This problem was easily fixed however. An additional channel was ordered from the factory, and readily installed by Rob's staff, as basically all that was needed was updating Cell Extender®'s "System Manager" control module memory with details of the new channel.

### Postscript

Cell Extender® was actually born from a "Please Help" request originated at the time by Vertel Communications, who approached Radio Systems Technologies, a specialist Radio Engineering company located in Melbourne, Australia, for a solution.

It needed some time however to build up the technological confidence that it needs to take on such a critical task. Some of Cell Extender®'s tasks are so time critical that the software has to operate on a what could be loosely called a technologically clairvoyant basis - certain actions and operations are already put in train, even before it is not totally clear yet what the instruction being received from the Donor site is going to require. And...when it then turns out (as it sometimes can!) that that instruction was different after all from what was anticipated originally, Cell Extender®'s software has to carry out some real "fast and fancy" data processing footwork (which is subject to pending patents) to correct the situation, before it becomes a problem.

Cell Extender®'s development was completed around the middle of 1997, and it is now in full production. In addition to the examples mentioned



**Radio Systems Technologies Pty Ltd** ABN 63 127 549 927  
P.O. Box 504, Somerville, 3912, Vic, Australia.  
**Phone:** +613 5978 8011 **Fax:** +613 5978 8022  
**Email:** [admin@rstradio.com](mailto:admin@rstradio.com)  
**Web:** [www.rstradio.com](http://www.rstradio.com)

---

**above, many other Cell Extender® systems have already been successfully put into operation, both in Australia as well as world wide.**