City lights

Built to offer efficient voice and data communications for electricity supply workers, a TETRA network serving the Johannesburg area is set to develop into something significantly larger as other user groups share its potential. **Richard Lambley** reports

Radio antenna at Crown Gardens, a TETRA site which forms part of the Johannesburg City Power network (photo: Global Communications, Pretoria)

One of South Africa's most successful TETRA networks is a mission-critical regional system operated by City Power, the electricity distribution utility serving the Johannesburg area – a service of the city's local authority.

"We went live April 2010", says Thabo Litsili, who manages the telecoms department, at the company's modern headquarters in Johannesburg. "We've got 11 base station sites which cover the City Power Johannesburg region. The system is mainly used by the electricians for communication. We also use it for data to connect our Scada systems here."

The Scada system (Supervisory Control And Data Acquisition) is a type of industrial control network. Connected mainly through private fibre cables running alongside the power distribution lines, this equipment is used extensively by City Power's engineers for the monitoring and control of electrical plant and other equipment at outlying substations. "We can remotely switch on and off, do operations remotely", explains Mr Litsili. "We don't have to be at the substations. And also we monitor the substations to check the power consumption, load levels and so on. That we can do remotely from here, which is the central control centre."

With the introduction of the TETRA radio system, some critical gaps in the Scada network have at last been bridged. "Most of the communication is done over fibre optic cables and we're using TETRA only at remote stations where we don't have any connectivity at all", Mr Litsili continues.

"The reason why we went this way is because we were using an old analogue system before, which had limitations. We then said, let's go with TETRA, because with digital we can do voice as well as data. We couldn't do data on the old analogue system."

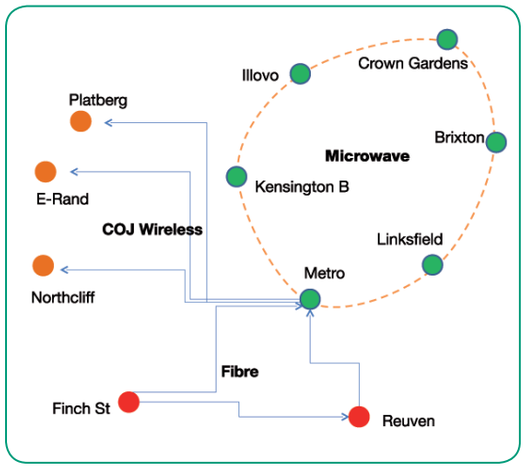
At City Power's headquarters in Johannesburg are Nkanyiso Msomi (left) and Thabo Litsili of the engineering services department. "If you look at the nature of our business, it's all communication", Mr Msomi says

Saving time

With their extensive remote management system, City Power's engineers can respond rapidly to changing demands on the electricity network and deal with emergencies as they arise. The area is prone to powerful electric storms and lightning strikes – and if a neighbourhood suddenly loses power, they can often restore it without having to send a technician out to investigate. And because of the area's notoriously heavy peak-time road traffic, the savings in down-time can often be enormous.

Here the inherent security of TETRA transmission, whether voice or data, is key benefit. "Especially in terms of, say, Scada, it's very important information for us, so we don't want any interruption or anybody listening in on it", Mr Litsili says. "For instance, if there are guys looking at a substation on a particular line, you have to switch it off, and you don't want that to be interrupted. There are lives!!"

Another important function of the Scada system is access control at the remote sites, and protecting plant. Theft of electricity through unauthorized connections is plainly a troublesome problem: a poster campaign across the city appeals for information about miscreants. Furthermore, as in many countries, soaring metal prices are driving thefts of copper cable. Before the TETRA network was installed, City Power depended for its data needs on GPRS – but this offered no guarantee of reliable communication and it also proved quite costly. "It's not a *huge* amount of data", Mr Litsili concedes. "But at least with the TETRA system we've got ownership of the system – so if anything goes wrong, we are in control. With GPRS, we relied on third-party operators."



City Power's TETRA system currently has 11 radio sites. Six are linked by microwave, three with fibre and four by a high-speed Alvarion wireless network in the City of Johannesburg (CoJ). A further seven TETRA sites are to be added to complete the system

Southern Africa: taking a different approach

In Africa, TETRA is ready to flourish – but it needs an approach which differs from the European one. So believes Roelf Kloppers, vice-chairman of the Southern African TETRA Association and an independent consultant steeped in decades of experience across the mobile radio business.

"Traditionally we are, on average, about eight years behind a new technology once it starts being implemented in places like Europe", he says. "The reason is that our regulatory environment has to get sharpened up for that, and frequency spectrum has to be cleared. That's a whole process to go through. Standards have to be decided on – and although we are in [ITU] Region 1, our regulator follows a policy of not being obliged to follow Region 1 all the time. So they sometimes will allow, for certain applications, Region 2 or other technologies, and in different frequency bands – which leads to a stretched-out period of introduction.

"Then, distribution in Southern Africa of TETRA is much different to what we see with conventional mobile radio. And a lot of people didn't catch on to that early. Because they were a distributor for one of the big internationals in South Africa for mobile radio, automatically they considered themselves to be experts wanting to do the TETRA distribution and not understanding the technology. At the beginning it was a big problem. It's a big technological and commercial leap.

"And then because of the costs, we find that, to implement it on a national basis, our needs differ vastly from that in Europe in that we have huge geographical areas with low volumes [of radio traffic]. Again, our total systems approach is different to that of Europe, where you have a lot of low base station sites with high volumes of users. We have high sites – very high sites – with low volumes of users. And that is a costly way, then, to provide infrastructure."

This, Roelf Kloppers explains, is why the City of Cape Town and the populous Gauteng Province, which includes Johannesburg and Pretoria, were the first to have TETRA networks – systems for public safety and security services. Next came the Eastern Cape Province with the major centres of Port Elizabeth and East London. Perhaps next in line will be KwaZulu-Natal, with Durban and Pietermaritzburg.

Roelf Kloppers, vice-chairman of the Southern African TETRA Association: "Our needs differ vastly from that in Europe", he says

"But it still doesn't take away the problem of the remote areas", Mr Kloppers continues. "They still are on the conventional analogue spectrum that has to be cleared up again for other technologies in 400 MHz. They are going to have hybrid systems for a long time. And you will find that there have got to be gateways in existence for a long time."

Some provinces, he believes, may never see TETRA at all – for example, the remote Northern Cape. "I don't think they will even think of introducing a public safety and security system there in the next 10–15 years, because the population is too low. A base station site sitting on a high mountain covering five or ten mobiles and five or ten handhelds doesn't justify the cost. And they are pretty well covered by existing analogue systems and even with upgraded analogue. I shouldn't say this in the TETRA environment, but I can see that DMR is possibly going to have an effect in there."

■ *The Southern African TETRA Association: www.sata.org.za*

Not just a walkie-talkie, not just a cloud – a radio solution

Though the original motive power for TETRA came from the needs of public safety bodies, Roelf Kloppers finds that innovation in data communications, including telemetry and Scada systems, has transformed TETRA over the past two or three years into an attractive choice for many smaller systems.

"I think is that is where the main growth is going to be from Southern Africa", he says. "The big companies, like the traditional Motorolas, Cassidians and that, will remain the leading companies, in my view, on the larger systems. But in the other areas, the likes of Rohill, Hytera (I don't know about the others, but those are the two that are well represented in South Africa and have proven track records here) have shown that they are willing to make sure that the systems that are implemented *work*.

Roelf Kloppers, of the Southern African TETRA Association: suppliers must be willing to hold the hand and make sure that systems work, he says

"This is something that international suppliers or manufacturers and system houses should take good cognizance of: that they are going to see smaller systems out of Africa – infrastructure-wise, cloud-wise – but they *have* to be willing to hold the hand and make sure that the systems work. It's not where you can jump on an aircraft and within half an hour you are at the switching centre of the network."

Affordable TETRA

Beyond public safety, Mr Kloppers can point to successful TETRA applications in South Africa's mines, in heavy industry (TETRA systems at two large petrochemical plants will be featured in the next issue of this magazine), and in several municipalities where they provide support for local public services.

But for public service bodies in particular, a TETRA installation may represent a heavy financial investment. How do they justify such expenditure?

"TETRA is affordable if they can get to the point where they understand that TETRA is a cloud", Mr Kloppers emphasizes. "TETRA is not another walkie-talkie system. The typical mobile radio salesman that started off selling TETRA was selling a replacement for analogue, and that's *not* what you should sell. You should sell a solution for the total municipal and other user requirement."

Often in these cases, the perceived alternative to a TETRA network is a push-to-talk (PTT) system based upon low-cost mobile phones. "Somewhere along the line, somebody has to make a big thing about this", comments Roelf Kloppers, philosophically. "GSM-PTT was locally trialled in an emergency service and it was proved that it is never going to work. It's an ill-informed lobbyist thing: somebody has an interest in a business that has a GSM connection and now they are pushing to put in a GSM solution. Well, they can quickly sell phones and in many cases the user likes it because they have cheap cellphones then – *company* cellphones that they can use for illicit purposes."

But then, he warns, the airtime bills will start to come in – and the GSM system may no longer seem quite such a good deal.

New applications

Radio coverage of the TETRA network is still incomplete, though the department has very recently been given the go-ahead to install the remaining seven planned radio sites. But already it is saving money, even on ordinary voice calls by staff. "The guys were using cellphones, so we've seen some reduction in GSM costs", Mr Litsili says. "Instead of phoning with a cellphone to the control centre, they are now using TETRA, which is free.

"At the moment it's just voice and data. But we are looking in the future to integrate it with our dispatching system – the MDT [mobile data terminal], which is automatic dispatching of electricians. It's on a separate system now, but in future we're looking at integrating it into TETRA."

Plans are also going ahead to manage the city's street lighting system over TETRA, he continues. "What the system does is it monitors the street lights and with the system you are able to switch on and off. You can also check the status of the lights and it also tells you if, in a run, there are lights which are out or that are not working. You can see that on the system. It's quite a nice system."

Replacing the traditional day/night switches, the system will prevent lamps from remaining lit wastefully during the daytime. So far the system has been implemented only along major roads and highways, but next it will be extended to all parts of the city via TETRA. And there are plans to bring in other city agencies and functions – for example, the traffic lights (known in South Africa as robots) at main road junctions. GSM modems have been used to control and synchronize these, but theft of the SIM cards has left many of them operating out of phase or not functioning at all, contributing further to Johannesburg's traffic jams.

City Power's network is working successfully and delivering the communications benefits seen by other TETRA users around the world. Based on infrastructure from Rohill, the system is being implemented and maintained under a service level agreement by Ikwezi Maintenance & Communications. Ikwezi has also been asked to complete the original network deployment plan by installing the remaining base stations. The company is an offshoot of Global Communications,

Radio site at Brixton, in Johannesburg's western suburbs

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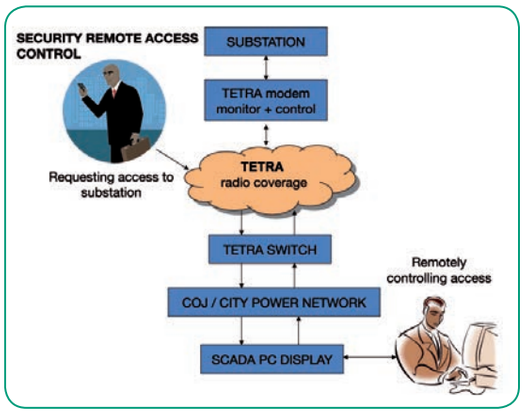


For City Power, Ikwezi Communication & Maintenance has implemented a variety of data applications over the TETRA network – including power system protection, ripple control, automatic meter reading and (seen here) access control at remote sites

a radio supplier and system integrator established in the Johannesburg-Pretoria area for some 35 years.

But for other TETRA networks in Southern Africa, the journey has been more difficult. An example is a system for the municipality of Tshwane (Pretoria). Initially the contract went to an office automation company which seems to have lacked the radio knowhow and TETRA experience to implement the technology successfully. Installation errors and an incorrect choice of antennas at the base station sites led to disappointing radio coverage. But after many difficulties and delays, the project was eventually placed in Ikwezi's hands, and today the system is working well and achieving its original goals.

"It *was* a disaster", declares Errol Baker, of Global Communications, candidly. "But we've been given this opportunity to recover and try to get TETRA back and give it a good name – and that's what we're doing at the moment. So far it is working like a dream. We've really got it up and running properly."

Elsewhere, Ikwezi's drive to restore the reputation of TETRA in Africa has concentrated on an expanding municipal network in Mbombela (formerly Nelspruit), and a system serving a key centre of South Africa's mining industry, at the Rustenburg mines of Anglo American Platinum.

Remote control

"We have remote access into all our networks, which gives us the capability to interrogate the system and pick up a fault before it becomes a serious issue", says engineer Jon-Pierre Booysen, at a screen display on his PC terminal in Global Communications' headquarters. "We do this via our own VPN access, though some clients prefer using their own VPN access. In this instance we're looking at the Mbombela system, which is close to the Mozambique border."

Clicking his mouse, he continues: "Over here we have different sites, with the Civic Centre being our main site that does all the switching. So we go to Civic – and then you have subdivisions for microwave going in and out, ethernet switches, and then all the TETRA devices. With TETRA devices we can have a look at the amount of subscribers currently on the network.

"Every five minutes we take a grab of the system to see the amount of active calls. You can clearly see that round about two o'clock in the afternoon, when they do a shift change, there's a peak, and from midnight to about 5 a.m. it's the lowest. We can gather historic data from this."

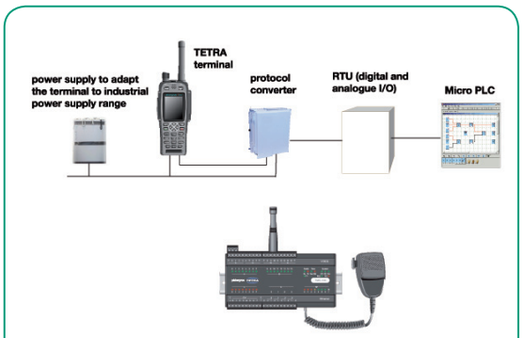
The remote access system can also be used to upload software upgrades and updates. But besides reporting the overall health of the radio equipment, it monitors details such as the temperature in the radio cabinets and the state of the incoming electricity supply. In case of a failure at a site, there is a battery back-up supply which will last for up to two days.

But the monitoring system does not rely only on human vigilance. "Should a breaker fail at a site, the intelligent system that we have will indicate a fault and raise an alarm in the system", Mr Booysen explains. "We have some reporting rules, and it will send it out by e-mail or SMS, and we can have distribution lists on that.

"This system has eight sites, one carrier each, so it's quite a small system. We are planning an upgrade now and the order for that is imminent. We would add another five sites and upgrade all sites to two-carrier."

Supporting around 280 users at any one time, all equipped with Sepura terminals, the Mbombela network is used by the emergency services and public utilities, roads and transport, bus services, and staff at the town's large football stadium.

"During the 2010 World Cup, we ran call detail recording and with 600 Sepura terminals they performed a little bit over 25 000 calls within one month", Mr Booysen remembers. "The call setup time was just over 100 milliseconds. We were using quite a fast microwave backbone."



Scada: an all-in-one system for data acquisition with remote visual and audible alerting. City Power uses TETRA-based industrial radio modems from Piciorgros

City Power's Scada technicians play a key role in maintaining the supply for the area's electricity consumers

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TETRA modems

Though these other TETRA systems are used mainly for voice communication, City Power is expanding its pioneering use of data, with support from Ikwezi's engineering team. Ikwezi is supplying TETRA radio modems from Funk-Electronic Piciorgros in Germany, and initially it has taken delivery of more than 1000.

"The request is there from City Power to monitor things like substations and street lighting", says Errol Howard, head of digital at Ikwezi. "So far we are running on three projects at the moment, one being the mini-substations in the outlying areas. Nobody knows if they're up and running or down, so we are able now to use these modems to trigger through to the control room and notify what the error is. So we can monitor right through from A to Z."

"The street lighting was an interesting project", Errol Baker adds. "They had done it via GSM, and I think they had been broken into three times and all the SIM cards had been stolen. And then obviously the bills that would be generated were really out of control! That is a major problem."

Another current project is to monitor prepaid metering, to guard against fraud. "We've got quite a variety that we are able to do just to get the ball rolling", comments Mr Howard.

Errol Baker (left) at Errol Howard, at Global Communications's Pretoria base

"Those are the value-adds that we've added to the networks", Errol Baker sums up. "Now it's taken off in City Power, it's starting at Tshwane, we are ready for Mbombela as well. The scope of TETRA for us... we are only in its infancy, we really believe. There are new projects that we are busy with – but TETRA projects don't happen overnight, so it takes a few years before that happens."

City Power hopes to bring other public-service user groups on to its network in due course, to share communications costs, cut mobile phone bills and improve efficiency. However, Errol Baker believes that the sharing could go further and wider in the future, using inter-system interfaces to combine neighbouring authorities into a larger network. TETRA's ability to support large numbers of user-groups independently would enable their communications to remain separate.

"In the East Rand, now called Ekurhuleni, they would like something similar", says Errol Howard. "But instead of putting up their own network they could just tap into City Power. They could operate as a totally separate user group, but in times of need they could interlink. They're quite keen to go that route, but then they would need their own node in existence. All they'd do is put up their base stations and hop on board.

"And we're doing the same in the West – it used to be called the West Rand, now called Mogale. Exactly the same scenario. There's more than enough capacity in the network; it's just the coverage, which we'll assist because they can contribute to more base stations, more high sites, and everybody benefits at the end of the day.

"Fortunately, they are all municipalities we're dealing with. Within the municipalities, all using the same Rohill infrastructure, it's quite easy for us to do. It's excellent equipment, Rohill. I *love* Rohill!"

World Cup wins

City Power gained early experience of network-sharing during the 2010 World Cup football tournament in South Africa, when the fire and ambulance service and other city

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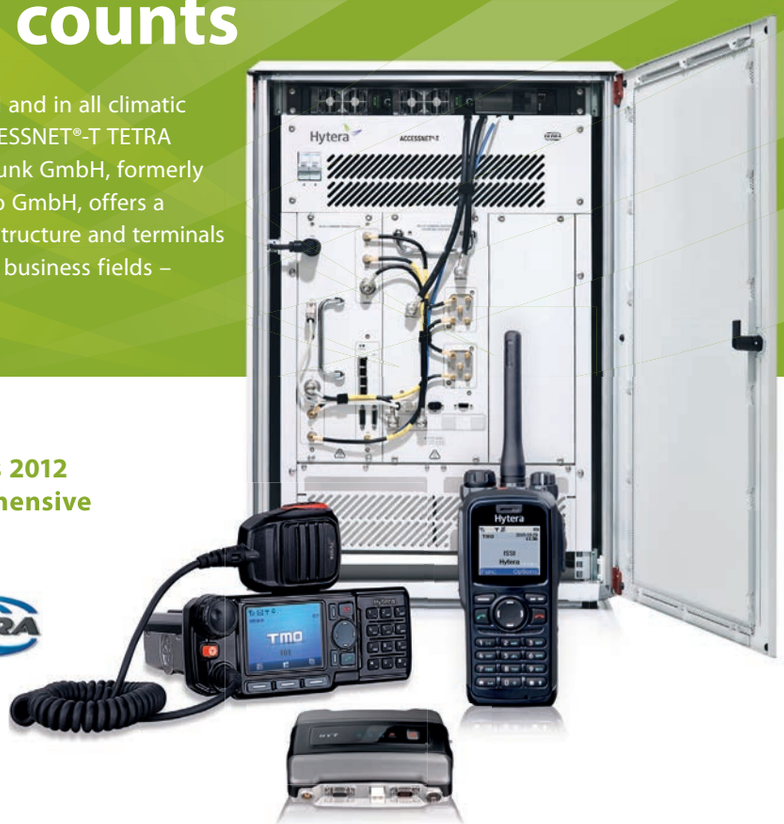

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departments joined the new system. Immediately it offered a big improvement in flexibility over City Power's old analogue radio equipment, which consisted of simple VHF repeaters. "We only had five channels, which was the problem", recalls Thabo Litsili. "But now with TETRA we can create as many groups as we like."

Training City Power's staff to use the new radios was straightforward, he says. "It was not a problem, because it was basically the same as the cellphones which they already used. We did the whole change management thing here with training, awareness campaigns and all that before we implemented the system."

But he adds: "There was big resistance in the beginning because the guys had to give up their cellphones where they could make private calls. So it was quite a challenge to get them to use the system!"

Another challenge was to persuade staff to accept the GPS location feature of the new TETRA radios, which enables managers to see exactly where they are. City Power chose to emphasize the beneficial aspects of this. "We didn't put it like they would be tracked", explains Mr Litsili. "The way we put it was that in case of emergency we would be able to locate them if there was a problem. That's how we put it across."

'It was definitely a good decision'

As the network grows with the additional radio sites now to be completed, TETRA training will soon be needed for the remaining electricians who work in districts which are not yet served. "Once we've expanded the system we should be able to cover those areas, and all people can come on to the system", Mr Litsili adds.

Equally enthusiastic about the TETRA system is Nkanyiso Msomi, acting director of engineering services at City Power. "Oh, it *works*!", he exclaims, genially. "It definitely does work, and it has saved us a lot of time from the communication point of view. If you look at the nature of our business, it's all communication. During the day, after hours – throughout, it's all about communication. It's all voice and data."

Mr Msomi is also enthusiastic about proposals to bring other groups and other utilities on to the system. "We have been in discussion with them and they would be willing definitely to join us and come and utilize it", he says. "If you look at what we did during the World Cup, we were running on TETRA and we got savings from the operational cost point of view in terms of what we *would* have spent, and what we spent using TETRA. During the World Cup it literally paid for itself.

"It was definitely a good decision. We have presented it now to the AMEU [South Africa's Association of Municipal Electricity Undertakings] so that other municipalities as well can come and join.

"We started with 11 sites, we're putting in an extra seven sites, and that shows that it has got a huge thumbs-up from everybody."

Shortening the equipment repair cycle

Supporting the growing TETRA community in South Africa is its own TETRA Academy, a training centre Is hosted in Port Elizabeth by the Faculty of Engineering of Nelson Mandela Metropolitan University. Set up during and in support of South Africa's preparations for hosting the 2010 World Football Cup tournament. This Academy is helping to overcome skill shortages by turning out well-qualified TETRA engineers and technicians, as well as offering opportunities for telecommunications research up to doctoral level.

Alongside this activity, a locally-based TETRA industry is beginning to emerge in South Africa, creating applications and system add-ons with local needs and circumstances in mind.

But how can the TETRA industry in general contribute to the growth of TETRA in Africa? Somewhere near the top of any South African user's list would be a commitment by manufacturers to support local repair and maintenance of their products. This is because it can be discouragingly expensive and time-consuming to obtain support from overseas.

For users who depend on technical back-up from abroad, a simple repair to a radio unit, or even just buying a new knob, may take months, while generating a mass of paperwork and handling fees.

To return a radio to the manufacturer, a user organization in South Africa must find the original customs documents relating to its importation. Then it must wait weeks for the shipment to be cleared through customs on its way out and, after the repair has been completed, again on the way back. And if the faulty unit happens to be a part of the network infrastructure, one or more radio cells of the TETRA network may be out of service during all this time.

Another way manufacturers could help, suggests Roelf Kloppers, of the Southern African TETRA Association, would be by offering locally-available standby equipment. "There are methods that we have used before with analogue, where, if for instance you buy 10 handheld radios, there's one "spare" radio in the cupboard but you are not allowed to use it for normal purposes", he says.

"On the infrastructure side, I think it's very important to look at redundancy – and not redundancy in the same cabinet, but redundancy as a separate thing. Or separate normally functional equipment that can be slotted into the same frame. But redundant equipment on a turnaround basis in a cost-effective way – because it's not cost-effective to have spare base stations sitting in your store."

Necktie of the Southern African TETRA Association, worn with pride by vice-chairman Roelf Kloppers. With a grin, he explains that tetra can also mean a variety of tropical fish