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## ON THE COVER



The DAMM BS422 multi-tech platform is built for the future of critical communications. An outdoor base station featuring four technologies in one box, it covers operators' needs today and tomorrow with a technology-independent solution featuring multi-technology, multi-frequency, multi-carrier and simulcast in the one unit.

Multi-technology — the BS422 features four technologies in one box: TETRA, DMR Tier III, TEDS and analog.

Multi-frequency — extended coverage is achieved by supporting VHF and UHF mode in all technologies.

Multi-carrier — provides a flexible, cost-efficient solution by enabling up to four carriers in one box, and even combining multiple technologies in one box.

Simulcast — available for DMR and analog, and now also offering repeater functionality for TETRA and TEDS.

The BS422 can be used outdoors in hybrid mode, enabling operators to run, for example, one carrier in TETRA, the second in DMR and the third in TEDS, thereby enabling cross-technology communication.

Or, all four technologies can be activated on the one carrier using the multi-carrier feature. It's also possible to use different technologies at different sites and combine them into one network with a single, central subscriber register.

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I'm writing this the day after Comms Connect Sydney wrapped up for another year. And what a great event it was. It was good to meet with so many representatives from industry, government, emergency services and so on. (If I didn't get to say hello this time, I'll catch you in Melbourne in November.) The expo had a great buzz about it, and the speaker sessions were fascinating and informative, as always.

A big thanks and congratulations to the WF Media events team for hosting another successful conference.

In this issue we look at some of the most challenging radio comms applications of the near future. Such as MIMO and 5G. MIMO (multiple-input, multiple-output) technology promises to substantially change the mobile broadband dynamic, by providing a huge increase in bandwidth that can deliver vast amounts of data. The associated 5G networks will "undoubtedly evolve our wireless networks to heights never before imagined" writes National Instruments' Matej Kranjc in this issue. (It might also result in more and more people walking along, heads down, staring into their smartphone screens, about to step off the kerb into traffic — necessitating the introduction of traffic lights built into footpaths. Don't laugh, it's already happening.)

And what about the long-promised future world of self-driving cars? It won't be long before they're here, and they're going to need reliable comms to swap speed, distance and safety data amongst themselves and automatic oversight systems. And that means rigorous testing. The article from Rohde & Schwarz in this issue shows how it might be done.

Jonathan Nally, Editor  
cc@wfmedia.com.au

## August 2016

APCO 2016  
13–16 August  
Orlando, Florida  
apco2016.org

AFAC 2016  
30 August–2 September  
Brisbane Convention & Exhibition Centre  
afacconference.com.au

Communic Indonesia 2016  
31 August–3 September  
Jakarta International Expo, Kemayoran  
communicindonesia.com

## September 2016

Comms Connect Adelaide 2016  
23 September  
National Wine Centre, Adelaide  
adelaide.comms-connect.com.au

## November 2016

Critical Communications Middle East 2016  
7–9 November  
Jumeirah Beach Hotel, Dubai  
criticalcommunications-me.com

MILCIS 2016  
8–10 November  
National Convention Centre, Canberra  
milcis.com.au

Comms Connect Melbourne  
22–24 November  
Melbourne Convention & Exhibition Centre  
melbourne.comms-connect.com.au

*For a full list of dozens of industry events, see  
[criticalcomms.com.au/events](http://criticalcomms.com.au/events).*



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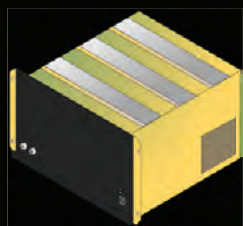
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# RACE CONTROL

## COMMS FOR MOTORSPORT'S BIGGEST CONTEST





More than 500 MOTOTRBO radios were used during the 2016 Formula 1 Rolex Australian Grand Prix.

**T**his year the Formula 1 Rolex Australian Grand Prix marked its 20th anniversary, with the race (held in March) being the opening contest in the FIA Formula One World Championship season.

The 5.3-kilometre-long Albert Park Grand Prix Circuit is built from scratch every year, partially utilising public road sections around Albert Park Lake, south of Melbourne's CBD. In preparation for the event, work starts two months prior to the race — erecting trackside fencing, pedestrian overpasses, grandstands and other infrastructure.

The race wouldn't be possible without partnerships with companies that specialise in various solutions. One such company is The P.A. People. Based in Sydney, The P.A. People is among a select group of major event communications specialists worldwide, with experience extending to activities such as the summer and winter Olympic Games, the Commonwealth Games, the Asian Games in Doha Qatar (2006), the Inaugural European Games in Baku (2015) and the New Year's Eve celebrations on Sydney Harbour.

While The P.A. People has provided the audio system for the Australian Grand Prix for six years, this year was the first time it had been awarded the contract for the radio network. This contract involved the provision of two Motorola Solutions MOTOTRBO IP Site Connect sites and more than 500 Motorola two-way radios with 12 channels.

Two-way radios provide critical communications for the event, such as for the medical teams who provide immediate medical support on the track. Radios are also issued to security staff, engineers, firefighters, race control and cleaning staff, as well as the recover and rescue crew members, who are on hand to remove damaged cars or debris from the track.

During set-up prior to the race, the two-way radios operate on Motorola Solutions'

IP Site Connect coverage. During race week they cut over to Motorola Solutions' radio system (the 'event radio system'). The changeover to the event radio system institutes a tactical network, as it becomes dedicated to event users. As a result the network is more responsive and all the radios can key up very quickly — critical for such a big event.

MOTOTRBO was selected for the Australian Grand Prix for a number of reasons:

- Call clarity and radio quality: One Senior Marshall, Arthur Cooksley, is stationed directly underneath an audio speaker, yet reported that the "clarity was good and I can hear over all the noise".
- Battery life: A trunked radio system places greater demands on battery life, yet long days on-site mean that the radios must operate for long shifts without recharging. Cooksley commented that "the battery life is great: I never have to charge it through a day's shift".
- Dedicated channels: The system was set up without time sharing, so that each team using the radios has exclusive use of their channel. Moreover, the medical team's channel is locked down so they cannot accidentally change channel.
- Security: As part of the security measures for such an important event, MOTOTRBO's restricted access to system (RAS) key prevents the radio files from being copied and prohibits access to the network.
- Rugged design: The 2016 Formula 1 Rolex Australian Grand Prix weekend experienced the best that Melbourne's weather had to offer: extreme heat followed by cold, stormy days. Scott Davidson, senior systems engineer for The P.A. People, described it as "first dusty, then wet, then muddy, but the radios stood up to it all".
- Transmit interrupt functionality: All MOTOTRBO two-way radios were programmed with transmit interrupt





RADIOS ARE ISSUED TO MEDICAL TEAMS, SECURITY STAFF, ENGINEERS, FIREFIGHTERS, RACE CONTROL AND CLEANING STAFF, AS WELL AS THE RECOVER AND RESCUE CREW MEMBERS.

functionality. If a radio user accidentally keys up — for example, the radio push-to-talk is accidentally pressing against something and the user does not notice — race control can take back control of the talk group to free the channel and allow others to use it. This is an important feature when there are emergencies so that if the channel is being used, someone can interrupt the call to ensure their urgent information gets through quickly and they do not need to wait for the channel to become available.

- **Software Radio Management:** When setting up and integrating all the radios in the fleet, The P.A. People were able

to use Motorola Solutions' Software Radio Management application to bring all radios online on the network quickly and easily. The application can program up to 16 radios at one time and track which radios have been successfully programmed, providing a clear view of the entire fleet and a code plug history for each radio.

- **Flexible solutions:** The role of the medical crew is to attend any accidents on the track and provide first aid to the drivers, so a rapid response with continual access to communication is vital. Their activities must not be encumbered by the equipment they use. The medical crew initially requested mobile radios

for each car; however, The P.A. People suggested portable radios, held in place by a chest harness that can be worn under a seatbelt. A headset could then be attached in a way that ensured it did not become an obstacle if a medical officer got out of their car, thereby ensuring continuous radio contact with the Race Control Room.

"The MOTOTRBO radios are rugged and reliable," said track manager Campbell Waller. "We've been using these radios all around the world. We first purchased a lot of these radios in 2006, and they are still going today, which is a testament to their quality."

Motorola Solutions' equipment also impressed Craig Moca, manager, engineering, at Australian Grand Prix Corporation, particularly the battery life of the MOTOTRBO radios. "The big issue in digital radio before was battery life, but these batteries have been lasting a day and a half, which is fantastic, as is the ease of using the handsets," added Moca.

The P.A. People intends to expand on the functionality of the two-way radios at future Grands Prix. Proposed initiatives include merging the list of staff names with radio programming for improved asset management, a radio shack for troubleshooting and a dedicated channel for The P.A. People on the same two-way radios instead of using a separate radio system.

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# Industry Talking

ARCIA held its annual Sydney event at the Novotel in Homebush on the 15th of June. As is now becoming somewhat of a tradition, this was the same night as the NSW versus Queensland State of Origin rugby league match. The healthy rivalry between the teams was matched at the dinner table, with our Queensland guests leaving no-one in doubt about who they supported. A victory dance was performed as the Queenslanders took over the stage with their maroon scarfs proudly displayed as the NSW Blues succumbed.

The event was a sellout with 200 guests enjoying a presentation by our international guest speaker, Lance Valcour. The presentation — on how people involved with public safety communications need to collaborate — was very topical, and it was interesting to see the number of similarities that Canada has with Australia in terms of size, people and government structures.

The NSW ARCIA committee was also very pleased to award Mark Crosland from RFI the annual state award for services to the industry. Mark has been involved in the industry for more than 25 years and is most widely known for his efforts in organising the RFI Spurious Challenge. His knowledge and customer service have earned him the respect of the NSW Industry.

Members attending Comms Connect and the ARCIA events will have seen the new way we are presenting the organisation, with graphics and icons that we feel paint a terrific picture of our industry. Our theme of 'No plane takes off, no ship sets sail and no train leaves the station' is helping people realise just how important and necessary our industry really is. We encourage members to use this new material in their own businesses to keep our message out there. There is also a lot of work going on in the background to improve the website and provide more useful content for the benefit of members.

ARCIA is working with the ACMA on a set of guidelines for aviation-to-LMR interconnection systems. The draft version has been completed and ARCIA is grateful for the help of both the ACMA and Airservices Australia in developing these guiding principles. Interference protection of critical air band frequencies is essential; however, there are tremendous benefits to the aviation industry when properly engineered LMR systems are able to be used in conjunction with air band services. ARCIA expects that the guidelines will provide clarity for all parties involved in this important industry sector, as well as satisfying regulatory requirements.

The next event will be ARCIA Brisbane and Comms Connect on 27 July. Bookings are open, so please book your tickets now for both Comms Connect Brisbane and the ARCIA dinner. The following day ARCIA will have the annual AGM in Brisbane, where it will be time to nominate committee members for the coming year. The AGM will

feature reports from all of our subcommittees and executive, so please come along and show your support.



Hamish Duff, President  
Australian Radio Communications  
Industry Association



## Tetrapol desktop adapter

The Airbus Defence and Space TPH900 Tetrapol desktop adapter enables emergency services operators to communicate flexibly. By combining secure mobile communication with administrative functions, the adapter incorporates voice recording, a PTT button and a USB port to connect a computer. In addition, an external antenna can be attached, giving users better transmission in an office situation.

Whether users work in a broadcast vehicle during a football match or in the branch office of a small town, they can easily switch from secure communication in the field to the office. The product also offers the mapping app OM100, making it easy for firefighters, police commanders and rescue workers to link existing information with geolocalisation data.

**Airbus Defence and Space Oy**

[www.airbusdefenceandspace.com](http://www.airbusdefenceandspace.com)

## TETRA radio

The Motorola Solutions ST7000 small TETRA radio introduces a new form factor that combines an intuitive and discreet design with a traditional radio's audio quality and dependability. Its semi-integrated antenna helps it fits easily in a pocket, while touch-sensitive buttons and integrated Bluetooth 4.0 wireless technology give it operational flexibility.

Features include: a reversible USB C connector for flexible charging and programming; 3.5 mm audio connector for accessory compatibility; vibration alerts and haptic feedback for discreet use; white OLED screen with a touch user interface for easy navigation; tactile keys that provide simple push-to-talk, volume, talkgroup and power control with an intuitive, touch-screen user interface that controls other radio functions; and an open speaker port and automatic gain control for clear audio against the loudest background noise.

Other features include: a weatherproof design with IP54 rating; certified to withstand shock and drops with a MIL-STD 810 F/G rating; extended battery life of up to 19 h; low distortion, loud audio; and 1.8 W transmission power.

The ST7000 will be available globally at the end of 2016.

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# PUBLIC SAFETY UPGRADES

*Jonathan Nally*

Tasmania's emergency services interoperability gateway will soon be boosted with a new common dispatch system.

Tasmania's remote population centres and sometimes rugged terrain can present significant challenges to first responders when disaster strikes — and less-than-ideal comms can often make the situation worse.

One outcome of the inquiry held in the aftermath of the state's devastating 2013 bushfires was recognition of the need to improve interoperability of communications between emergency services agencies and other organisations. The solution chosen was an 'interoperability gateway' that would act as a bridge between disparate communications systems.

Tasmania Police and the other emergency services operate on different networks. The police and, to a much smaller extent, the SES, operate on the government's Trunk Mobile Radio Network (TMRN), which is a digital-capable network. It's also used by the Tasmanian electricity supply industry (TESI), which comprises Hydro Tasmania (the power generator) and TasNetworks (the grid operator).

The TMRN is based on Harris Corporation EDACS 800 MHz proprietary technology, which enables analog and digital communications using the same infrastructure. The TMRN was constructed and commissioned by Ericsson in the mid-1990s.

The Tasmania Fire Service and Ambulance Tasmania, meanwhile, use a series of 70 MHz analog networks.

The Tasmanian Department for Police and Emergency Management (DPEM) issued a tender in early 2015 for ongoing operation and maintenance of the TMRN, with the aim of letting a contract for services for a period of three years with the option of two, 1-year options. DPEM required that services were to be delivered using the existing network equipment, infrastructure and reporting systems as far as is practicable.

Ericsson was the successful tenderer, given a four-year contract to provide for the ongoing operation, monitoring, maintenance and security of the network.





The TMRN will continue to operate until a new whole-of-government radio network solution has been implemented, which will be procured via a separate tender process.

The interoperability gateway, which was commissioned in February 2015, has been implemented by putting patches into place in the different services' communication centres. It provides flexibility. So, for instance, if there were two separate incidents, one in Hobart and one in Launceston, the gateway could patch both incidents together or two separate patches could be put in place for the respective entities. The patches can remain active on a long-term basis or they can be removed and reinitiated for a specific activity as required.

The gateway uses standard off-the-shelf technology from the Harris range of EDACS equipment and has been installed as part of the TMRN and connected to the fire and ambulance services using microwave links.

From the EDACS IP network at police headquarters, there's a microwave link to the Tasmania Fire Service headquarters building. At the end of that microwave link there's a Harris NetworkFirst device, which is the interoperability gateway. This converts the IP stream from the trunk network to 4-wire E&M interfaces, which are then connected into the Acom dispatch system consoles. The same system is used to connect with Ambulance Tasmania.

The microwave services are configured as 1+1 to give high redundancy. Plus, between Fire and Ambulance there is a fibre-optic ring connecting the two switches, providing an alternate route for the signals.

As an interim measure, some other steps were taken. For example, Tasmania Police purchased a number of VHF radios that were directly compatible with the Fire and Ambulance service networks. Just under \$250,000 was allocated to purchase 30 Tasmania Fire Service radios for Tasmania Police and 50 Tasmania Police radios for the State Emergency Service. This capability was in place for the 2013-14 bushfire season.

The Tasmanian government is moving towards establishing a new, whole-of-government radio system by 2020, which will put all of the users onto one network. It has a project running on this, to determine the business needs of the users. Once that is completed, it will look at what the issues and solutions are for a whole-of-government network, such as spectrum.

Initially the whole-of-government network will focus on the core government radio users, such as police and emergency services and the Tasmanian electricity supply industry (TESI), but the intention is that the network will have the ability to bring other government radio users onto it as it is in place.

### Putting it into practice

*Critical Comms* spoke with the Deputy Commissioner of Tasmania Police, Scott Tilyard, to find out how the interoperability gateway has been faring.

"Because of the way we work, not just here in Tasmania, but certainly right around Australia and in many other places in the world now, [we need] a multiagency response to large-scale incidents and events in particular," said Tilyard. "So there is a need for our frontline responders in particular to be able to communicate with each other if necessary."

"Over the years we've learned, through many experiences, the benefits of agencies working more collaboratively, and training together as well," said Tilyard. "So it isn't just the actual response and recovery, it's also the preparedness type of work. These days we certainly do operate in that way, more so than we have done in the past."

"Certainly training and working together it does give you a much better appreciation for some of the issues that the other services providers face," he added. "And being better informed means you're making better decisions yourself as well."

The system has been running for just over a year, and according to Tilyard it has been meeting expectations.



“

OVER THE YEARS WE'VE LEARNED, THROUGH MANY EXPERIENCES, THE BENEFITS OF AGENCIES WORKING MORE COLLABORATIVELY, AND TRAINING TOGETHER AS WELL.

“We don't have it activated all of the time — we activate it as required,” he said. “It was certainly designed in particular for those large-scale type of events, such as major bushfires and flooding and those sorts of things.

“But it can used on a day-to-day basis for any incident really where there's a benefit in our frontline people communicating directly with each other, as opposed to having to go through our respective radio control centres,” he added.

Tilyard said he knows from personal experience that having interoperable comms can be a significant benefit on the ground. “If emergency services are operating in close proximity to each other, to be able to talk to the fire truck down the street certainly helps,” he said. “On a day-to-day basis we'll attend to things like motor vehicle crashes, and you'll have fire and ambulance and police there, and sometimes SES, and they won't necessarily need to be talking on the radio at the scene... but there'll be other incidents where there might be a benefit.”



*Tasmania Commissioner of Police, Darren Hine (right) and an officer discuss the use of mobile tablet devices (on stand, in foreground).*

In terms of interoperability, Australia is fortunate in having relatively few emergency services organisations... unlike, say the US, where there are tens of thousands of police, fire, ambulance and other emergency services agencies and jurisdictions. For instance, in the US, from a policing perspective, there could be state police, municipal police and university police responding to the same incident.

“I know they can often confront significant jurisdictional issues,” said Tilyard. “Something will happen in a particular location and there won't necessarily be unanimous agreement as to who's in charge.

“We are fortunate here in Australia that we have much fewer jurisdictions, so we don't have to confront a lot of those issues.”

We also asked the Deputy Commissioner about reports that surfaced in the mainstream media earlier this year, of criminals eavesdropping on police communications using scanners.

“Obviously with the advances in technology, scanning digital transmissions is possible, it can be done,” he said. “We're yet to validate the information that was received that some criminals are scanning some of our transmissions on the digital network. But as a precautionary measure we've actually encrypted [the radios used by] some of our more specialist units, so that sort of scanning is not possible.

“In terms of the whole-of-government radio network that we're moving towards, we obviously intend that digital encryption will be part of the functionality of that network,” he added.

## Common dispatch system

In addition to the upgrades, current and planned, for the radio systems, Tasmanian emergency services agencies will soon have the benefit of brand new emergency services computer-aided dispatch (ESCAD) systems as well.

At present, police, fire and ambulance use separate CAD systems that are not integrated in any way, while SES doesn't have one.

A few months ago, the Tasmanian Premier, Will Hodgman, announced that Fujitsu Australia had been awarded a \$6.5 million contract for the initial acquisition and implementation of the ESCAD system. The contract will also provide support and maintenance





for five years following implementation of the system, bringing the total cost to \$15.3 million.

Local Tasmanian company Synateq has been engaged by Fujitsu to assist in the implementation of the project and for ongoing support.

The ESCAD system will manage medical, police, fire and emergency incidents from the initial notification of an incident until its conclusion, and will have the ability to track the status and location of resources and analyse responses post-incident.

The system presently used by Tasmania Police was built in-house nearly 30 years ago. According to Deputy Commissioner Tilyard, it's done an "exceptionally good job" and is still meeting the force's business needs today. "But it's at end of life, so that was really a catalyst for us to look at a replacement system," he said.

"And, of course, these days the question needs to be asked, what is the whole-of-government benefit we can get from this?" he added. "Rather than just replacing a system for police, we needed to look more broadly to a common system for emergency services and police.

"And certainly in some other places in the country that has already been done," he said. "So it was agreed that we would move to a common system and it would be used by all of the services and, for the first time, give SES a dedicated CAD capability as well."

It's not intended that the different services will integrate their radio rooms, but they will all use the common ESCAD system, with some tailoring of screens in terms of the information that's presented. They'll be able to share information and data through the system, which at present can be done only via telephone or email.

"For example, if there's a fire at a location and police units are dispatched, the operators will know that the fire service has already dispatched a fire unit and approximately what the ETA will be," said Tilyard. "That sort of information isn't available now unless somebody makes a phone call, basically.

"From our perspective, it's all about delivering a better level of service to the community, but making our frontline responders safer as well."

All of the services will be operational with the new ESCAD system in October of 2017.



### Cable and antenna tester

The Anritsu S331E Site Master Cable & Antenna Tester, available to rent from TechRentals, is suitable for installation and maintenance use by wireless service providers, contractors, military, aerospace and defence, and public safety.

Rugged and portable, it can be used for maintaining legacy networks in addition to 3G and 4G networks and servicing base stations. The device also allows technicians to complete sweeps quickly and implement fast trace naming while in the field.

Features include: return loss, VSWR, cable loss and distance-to-fault; insertion loss; antenna tuning; 4 h battery life; daylight viewable display and built-in touch screen keyboard; and USB connectivity.

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## PTT multimedia app

Airbus Defence and Space has introduced Tactilon Agnet, a group communication application for voice, data and video over LTE, offering more possibilities than the classical PTT functions for voice calls. Previously, users with smartphones could initiate a group call. With Tactilon Agnet, a group member can also immediately and securely send photos and videos at the push of a button. As a result, emergency personnel can work more quickly and successfully to locate and rescue people.

Tactilon Agnet also has LTE quality of service (QoS) and multimedia capabilities, such as photos and videos. It is fully aligned with the standard Release 13 for Mission Critical Push to Talk (MCPTT) of the 3GPP, a global organisation that sets international telecommunications standards. The multimedia functions of Tactilon Agnet are based already on the principles of future Release 14, focusing on mission-critical enhancements such as mission-critical data and Video over LTE.

**Airbus Defence and Space Oy**

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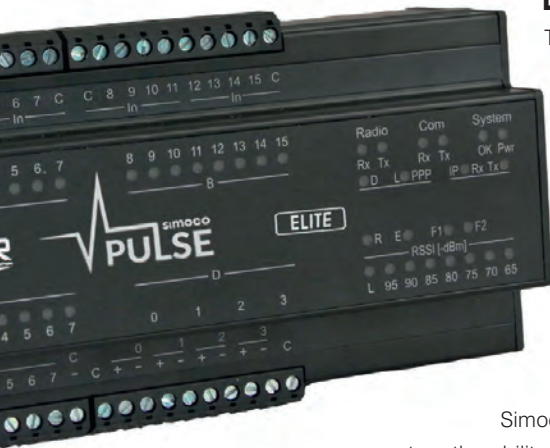
Intercoms



Many more







## DMR RTU

The Simoco Pulse ELITE is a fully integrated RTU with digital and analog inputs for the collection of data and status information from a variety of equipment in the utilities sector such as pumps, meters, switchgear and PLCs (programmable logic controllers). The ELITE is available in a number of configurations depending on organisational requirements.

The overall Simoco Pulse solution enables organisations to manage and control networks across vast operational areas by ensuring the reliable communication of low-band data. Data gathered can be used to indicate network performance and outages and operate assets remotely, giving greater insight and control to companies such as utilities providers, as well as those controlling systems in the oil and gas sectors and the transport industry.

Simoco Pulse can connect tens of thousands of sites and devices, providing operators the ability to constantly monitor and control networks and assets.

**Simoco Australasia Pty Ltd**

[www.simocogroup.com](http://www.simocogroup.com)

## Outdoor Wi-Fi access point

Cambium Networks has released the cnPilot E500, a high-capacity, controller-managed outdoor Wi-Fi access point (AP) that provides connectivity under demanding conditions. The 802.11ac dual-band AP supports 16 SSIDs and up to 256 active users and is suitable for enterprises and service providers looking for a high-performance WLAN solution.

The device features a high transmit power of 29 dBm, the ability to daisy-chain power via a PoE out port to power a security camera or a wireless backhaul link node and an LTE co-existence filter to filter out nearby small-cell LTE interference. This means it can support a large number of users in difficult outdoor conditions.

Managed through cnMaestro, the Cambium Networks cloud-based or on-premises-based Wi-Fi controller, the product also includes a mesh backhauling capability for outdoor deployments. It comes with an IP67 rating for wind, sand and rain resistance. The device is now available through the company's distributor networks.

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# SCADA SECURITY CHALLENGES FOR OPERATORS OF INDUSTRIAL NETWORKS

Jonathan Nally

Network operators need to keep on top of evolving security issues in SCADA systems.

**A**t the recent Comms Connect conferences in Wellington and Sydney, 4RF's CTO, John Yaldwyn, shared his insights into how to keep SCADA networks safe and secure.

4RF was founded in 1998, with a focus on supplying point-to-point and point-to-multipoint radio systems for critical infrastructure and public safety. Based in New Zealand, the company has subsidiaries in Europe, the USA and Australia, with manufacturing occurring in Australia, New Zealand and the USA. It exports to more than 140 countries.

*Critical Comms* spoke with Yaldwyn to get a summary of his thoughts.

**Critical Comms:** At Comms Connect, you showed the audience how to get the most out of limited bandwidth for SCADA. How is that done?

**John Yaldwyn:** The digital transformation of legacy SCADA UHF radio to fat narrowband is changing critical infrastructure field area network perspectives. To deliver useful capacity, a practical approach to IP optimisation is necessary. Start with a good network design, use features such as IP header and payload compression, and combine QoS with micro firewall filtering to ensure that only the necessary traffic is permitted over the radio network.

**CC:** SCADA would seem to be a mature technology, so why is security still an issue?

**JY:** Most mature SCADA systems are based on legacy serial connections and proprietary protocols. This obscurity combined with the non-routable nature of serial connections has limited vulnerability. Legacy serial systems are actually easily exploited in certain types of attack without additional safeguards. Where serial operation must

still be maintained, best practice requires wrapping serial traffic in a protective layer of encryption and authentication.

**CC:** What sort of new security challenges are operators of SCADA systems experiencing?

**JY:** The two key concerns are the threat environment and the move to IP. Modern SCADA systems are based on routable IP protocols and so the potential for compromise is much higher. The complexity of SCADA systems and the demands for industrial control systems to integrate with business applications such as billing systems can lead to a dangerous lack of isolation. With IP-based equipment and web-based tools, issues of authentication of system users and maintainers must also be considered.

**CC:** How would you rate network operators in terms of their awareness of the issues? Are some sectors better than others?

**JY:** I think that critical infrastructure operators are becoming aware of security issues, particularly in the electricity space. In the USA, bulk electricity suppliers have mandatory security requirements to meet and those 'best practice' recommendations are also being adopted by the distribution network operators. These requirements from North American Electric Reliability Corporation (a not-for-profit regulatory authority) are set out in their series of CIP (critical infrastructure protection) plans.

We're seeing similar trends worldwide but with varying degrees of priority. Some excellent work available to utilities and industry partners has been developed by the Centre for the Protection of National Infrastructure in the UK and similar government entities, such as New Zealand's National Cyber Security Centre (formerly the Centre for Critical Infrastructure Protection) and the Australian Cyber Security Centre.





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Pic credit: Idaho National Laboratory

# FINDING MIMO

## GETTING 5G RIGHT FROM THE START

*Matej Kranjc, Managing Director, ASEAN, ANZ, National Instruments*

To unlock 5G's enhanced connectivity and economic value, researchers need a faster pathway to prototype.



Pic credit: Ervins Strauhmanis

Industry analysts predict 50 billion devices will be connected to mobile networks worldwide by 2020. Australia's biggest telecommunications carrier, Telstra, is looking into building early prototypes to deliver faster mobile network and aims to offer its 5G network by 2020. And the 2018 Commonwealth Games on the Gold Coast is set to be the testing ground for a next-generation 5G network.

5G will undoubtedly evolve our wireless networks to heights never before imagined, but along with these advancements it brings a set of challenges. Researchers must address the requirements of unprecedented wireless data rates, find solutions for network latency and responsiveness while accommodating a one-thousand-fold increase in capacity.

And if all that isn't enough, service operators are demanding that these advances consume less energy than existing infrastructure.

The solution to these challenges lies in prototypes and, more specifically, the kind of 5G prototypes that enable wireless researchers to test experimental ideas using real systems in real-world scenarios.

National Instrument's (NI) integrated hardware and software baseband platforms are presently being used in several research and prototyping efforts. These include a partnership with Nokia Networks to demonstrate 5G millimeter wave (mmWave) technology, and with Samsung in building a prototype 5G FD-MIMO base station designed to serve multiple users with high data rate.

When done right, 5G prototypes can lay the foundation for rapidly increasing an organisation's time-to-market schedule.

### Setting a new standard

Recognising the large amount of speculation regarding 5G networks, the world's standardisation bodies, including the 3rd Generation Partnership Project (3GPP), have recently begun to transition concepts into reality.

Not surprisingly, the vision painted by Mobile Telecommunication (IMT)-2020, the Next Generation Mobile Networks (NGMN) and the 3GPP is expansive. 5G researchers now must build the framework that will redefine our current way of life.





Pic credit: Timothy Allen

From automobiles and transportation systems to manufacturing, energy, healthcare monitoring and more, life is becoming switched on.

To achieve this, researchers are adopting new design approaches to help with the challenging task of defining, developing and deploying 5G technologies within a random access network.

Most participants acknowledge that conventional approaches to vetting 5G technologies take too long and incur significant costs. Therefore, building a prototype and a proof of concept earlier in the process enables faster commercialisation.

### Blazing a new path

To expedite the time it takes to produce a working prototype, many researchers have adopted a platform-based design approach that embraces a unified design flow. It starts with maths and simulation and then maps the algorithm in a system and working hardware.

Consider Samsung, which has built one of the world's first demonstrators of multiantenna technology with a base station (BTS) that includes 32 antenna elements, called Full-Dimension

MIMO or FD-MIMO. FD-MIMO uses a 2D grid of antennas to create a 3D channel space.

With FD-MIMO, service operators can place antenna grids at elevated positions, such as on buildings or poles, and aim the antenna beams at users on the ground or in adjacent buildings to consistently deliver enhanced data rates.

Researchers at Lund University in Sweden have taken this multiantenna concept to the next level with their Massive MIMO prototype. Massive MIMO increases the number of antennas in a cellular BTS to hundreds.

Composed of low-cost technology, the grid of antenna elements focuses the energy directly at the user while enabling the hundreds of antennas to more easily detect weak signals from mobile devices. Additionally, Massive MIMO uses linear coding techniques to simplify the processing at the BTS.

As more BTS antennas enhance the mobile user data experience, we can see how theory confirms that Massive MIMO may also dramatically reduce the power consumed by both the BTS and mobile devices.

Because multiple low-cost BTS antennas transmit lower aggregate power than a monolithic approach, the power consumed by the BTS may be reduced by a factor of 10 or more.

Fundamentally, enhanced data rates and increased capacity are constrained by spectrum according to Shannon's theory on channel capacity. More spectrum yields higher data rates, which help service operators accommodate more users.

As such, service operators around the world have paid billions of dollars for spectrum to service their customers, yet the currently available spectrum below 6 GHz is almost tapped out. Researchers are now investigating the possibility of deploying cellular networks above 6 GHz, specifically in the mmWave bands.

Worth noting is that the mmWave spectrum is plentiful and lightly licensed, meaning it is accessible to service operators around the world. Furthermore, researchers at Nokia Networks are also investigating mmWave technologies, and the preliminary results are encouraging.

This year, Nokia Networks demonstrated a fully working mm-Wave prototype that delivers the fastest rates ever recorded for mobile access. The Nokia Networks prototype, composed of a BTS and user equipment (UE), consistently streamed data at a rate of over 10 Gbps at 73.5 GHz. Nokia Networks' achievement paints a promising future for mmWave and 5G.

5G promises many exciting new developments to ultimately improve our lives through enhanced connectivity and unlock tremendous economic value. But for us to reap these benefits, researchers need a faster path to prototype. A platform-based design approach promises the possibility to deliver these new developments faster.

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# WIRELESS WORLD RECORD TEAM ACHIEVES SPECTRUM EFFICIENCY MILESTONE

*Paul Harris, University of Bristol and Steffen Malkowsky, Lund University*

A research team has set a world record for 5G wireless spectrum efficiency using a laboratory massive MIMO testbed.

**M**assive multiple-input, multiple-output (MIMO) technology promises to provide huge capacity and energy efficiency gains for future 5G networks, which will have to accommodate increased data rates and the rapid proliferation of smart connected devices without consuming any more of the radio spectrum.

Using National Instruments (NI) platforms to develop a 128-antenna, real-time massive MIMO testbed, we were able to use just 20 MHz of spectrum (within the 3.5 GHz band) to simultaneously serve 12 client devices over-the-air, with an aggregate data rate of 1.59 GBps, and set a new world record for 5G wireless spectrum efficiency.

The Communication Systems & Networks (CSN) Group at the University of Bristol formed in 1985 to address the research demands of the fixed and wireless communications sectors. It combines fundamental academic research with a strong level of industrial application. The group has well-equipped laboratories

with state-of-the-art test and measurement equipment and first-class computational facilities.

'Bristol Is Open' (BIO) is a joint venture between the University of Bristol and Bristol City Council, which supports initiatives that contribute to the development of a smart city and the IoT.

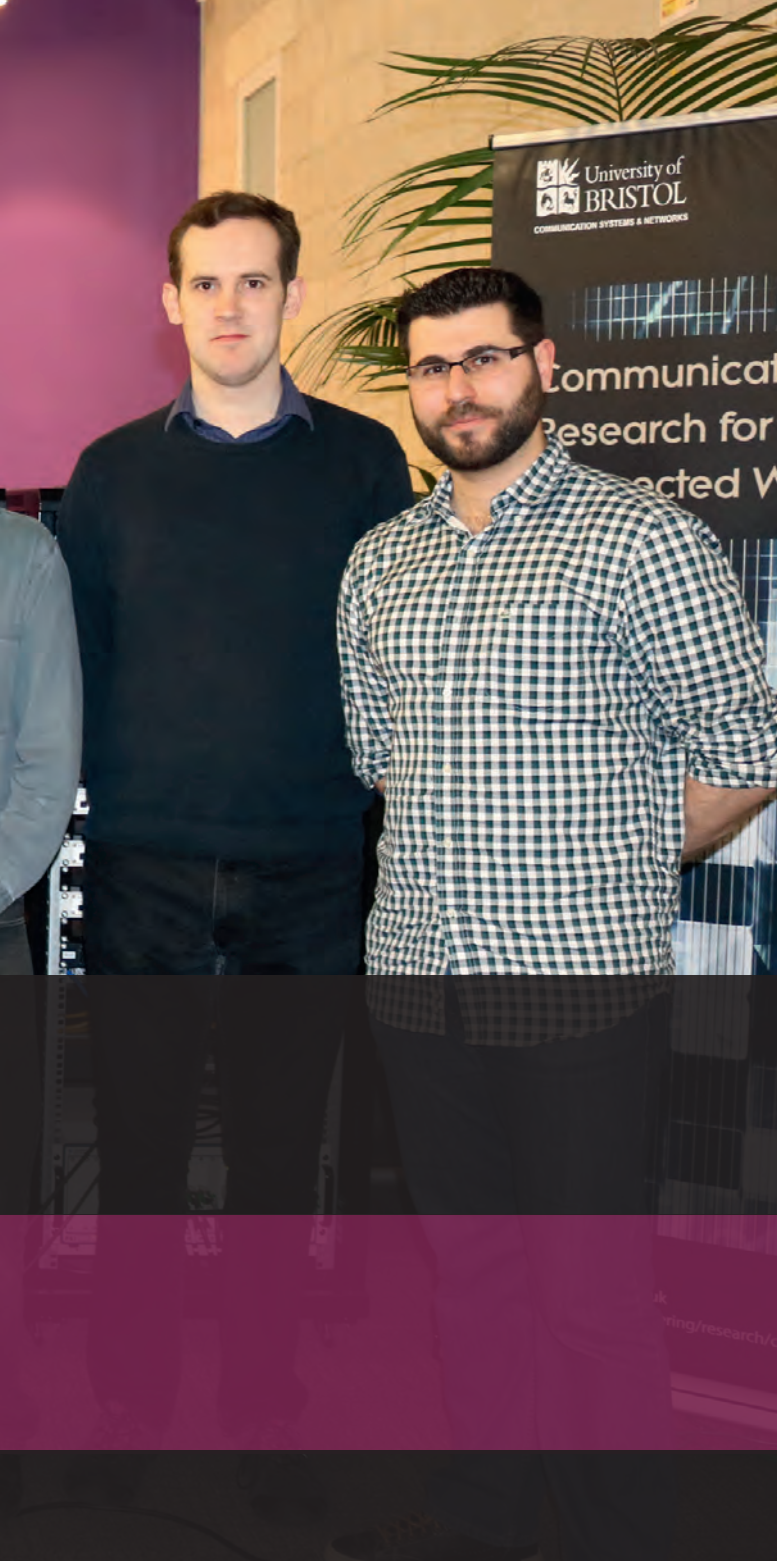
Lund University seeks to be a world-class university that works to understand, explain and improve our world and the human condition. The Electrical Engineering and Information Technology Department (EIT) covers a wide range of research areas in the fields of analog and digital, as well as communications system design.

It has been at the forefront of massive MIMO research including massive MIMO theory, channel measurements and accelerator design.

## The journey to 5G

In addition to mobile phone subscribers, who are predicted to each consume 20 GB per month in North America by 2020, networks will also need to provide broadband internet access to rural areas.





*The University of Bristol team in front of the record-breaking massive MIMO testbed.*

Coupled with its ability to average out the effects of fast fading in multipath propagation environments (most urban and industrial settings), it can also fundamentally improve latency at the physical layer by reducing the number of errors caused by sudden drops in signal level.

### Benefits of massive MIMO

In a multi-user MIMO communication system, devices can simultaneously transmit on the same frequency band whilst the base station uses multiple antennas to unravel their respective data streams in the spatial domain.

For downlink transmission, the base station performs the reverse process, transmitting back to all users simultaneously using a technique known as beamforming.

If the spatial signatures of each device are uncorrelated enough, the result is a K-fold increase in system capacity, where K is the number of users present.

For signal processing reasons, the base station requires at least the same number of antennas as users. MIMO is currently found in both Wi-Fi and 4G cellular, operating with up to eight antennas.

### Developing the testbed

Through a collaborative effort with the NI Advanced Wireless Research Group in Austin, Lund University in Sweden and the Bristol City Council, we successfully implemented a 128-antenna massive MIMO system that can serve 12 wireless devices on the same time-frequency resource.

The testbed is designed with the NI massive MIMO reference design, combining five NI PXIe-1085 chassis. The master chassis contains an NI PXIe-1085 controller, an NI PXIe-6674T timing module and four NI PXIe-7976R FlexRIO FPGA modules. Four slave chassis are linked via x8 MXI.

We connected 16 USRP-2943R software-defined radios (SDRs) via x4 MXI links to each slave chassis, collectively providing a total of 128 RF chains. The accurate 10 MHz OXCO reference from the NI PXIe-6674T along with a digital trigger was distributed to all USRP SDRs through eight OctoClock clock distribution modules, ensuring tight hardware synchronisation.

Finally, we used an additional six USRP-2953R SDRs with x1 MXI links to laptops that mimic user clients. We used LabVIEW software, the LabVIEW FPGA Module and NI-Sync to develop the massive MIMO reference design that powers the system.

In a large and complicated system such as this, there are many things that can go wrong. However, NI provided an unrivalled, ubiquitous level of integration between its software development tools and commercial hardware products, which helped us easily modularise this complex system. We wanted a flexible, powerful solution built on a single, well-supported platform.

The PXI Express platform is a solid foundation for any high-throughput, low-latency system, and it is well supported by many years of experience from NI. We were able to build upon this

Most prominently, future networks must also accommodate the Internet of Things (IoT) and the proliferation of smart telemetry devices.

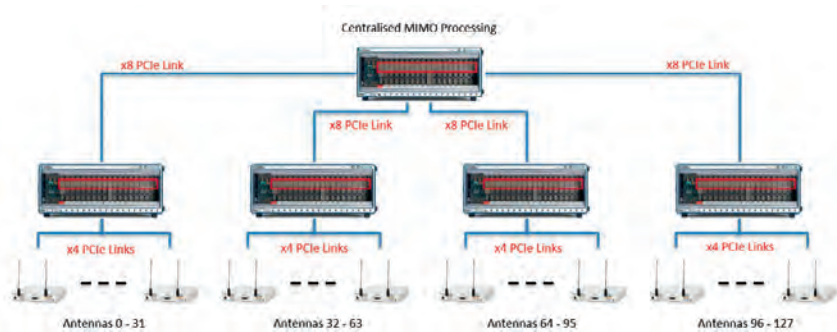
Analysts predict that, by 2020, each person in the United Kingdom will own and use 27 internet-connected devices. This will contribute to the expected 50 billion connected devices worldwide.

Aside from connectivity, new industrial applications (smart factories and machine-to-machine communications) and consumer applications (4K video streaming and driverless vehicles) require high data rates, lower latencies and improved reliability.

This is challenging telecommunications engineers to innovate rapidly to ensure that the fifth generation of cellular networks (5G) can cope with these unprecedented demands.

A massive MIMO system can spatially multiplex more devices without consuming any more radio spectrum, which is an extremely valuable and scarce resource.





A highly scalable massive MIMO system, combining PXI and USRP RIO.



Uplink throughput in real time at the base station.  
Left: Individual stream rates for each user.  
Right: System sum rate.

well-established standard and integrate nearly 100 different pieces of hardware, yet seamlessly develop our entire application within a single software framework.

This highly modular approach and tight software and hardware integration not only gives us the solution we need right now, but ensures that future changes to the hardware configuration are cost- and time-effective.

To spatially separate and distinguish the signals from all 12 wireless devices whilst meeting real-time constraints, we implemented parallel MIMO processing across the integrated FPGAs within the four FlexRIO modules. Each needed to perform 24 million  $12 \times 128 \times 128$  matrix multiplies per second for signal detection alone.

This leads to another major benefit of PXI Express — peer-to-peer (P2P) streaming — which enables the deterministic transfer of data between cards within the PXI Express chassis.

P2P was pivotal to the success of our application, enabling direct point-to-point transfer between our 68 FPGAs without having to send any of the data through the host processor or memory. This empowered us to achieve the optimal throughput and latency performance required for real-time operation.

The P2P functions in LabVIEW simplified the implementation of each stream so we could easily map source, destination and data type.

## Record-breaking results

This was the world's first real-time demonstration of a 128-antenna massive MIMO system simultaneously serving 12 devices over-the-air in the same frequency band.

With a sum rate of 1.59 GBps in only 20 MHz of bandwidth, we achieved 79.4 b/s/Hz — the highest recorded spectral efficiency in the world to date.

This technology can enable a 12-fold increase in spectrum efficiency compared with current LTE (4G) networks, whilst offering the connection reliability and decreased latency required for Industrial IoT and real-time control applications.

As the BIO testbed has proven, massive MIMO can deliver a strengthened network capacity that will help network operators to reliably host an ever increasing number of wireless devices.

Furthermore, with a 100x increase in radiated energy efficiency, we can greatly reduce the power consumption and operating cost of a wireless network.

From a consumer perspective, wireless devices and mobile handsets will also experience improved battery life.

## Next steps

The NI PXI Express platform provided a solid framework to build our system on, which is rugged, easily reconfigured and capable of meeting the demanding throughput requirements for 128-antenna MIMO operation.

We will soon deploy the massive MIMO testbed on a rooftop site within the city of Bristol and connect it to the BIO fibre-optic network to conduct further research in real-world deployment scenarios.

Eventually, we will split the system into four 32-antenna subsystems and use the fibre network to implement a distributed massive MIMO configuration.

All of this work ultimately pushes forward the validation of this promising technology, allowing network operators to consider practical deployments for real networks.

## Acknowledgements

We would like to thank the collaborating professors and PhD students in Bristol — Mark Beach, Andrew Nix, Paul Harris, Siming Zhang, Henry Brice, Wael Boukley Hasan and Benny Chitambira — and at Lund — Fredrik Tufvesson, Ove Edfors, Liang Liu, Steffen Malkowsky, Joao Vieira, Zachary Miers, Hemanth Prabhu, Erik Bengtsson, Xiang Gao and Dimitrios Viastaras — for contributing to the success of this project.

We would also like to thank the members of the NI Advanced Wireless Research Group for their extensive work in developing the FPGA architecture for the massive MIMO reference design and for continuing to work closely with us to bring the system online. We genuinely could not have achieved this fantastic result without them.



Researchers Paul Harris and Siming Zhang with the BIO 128-antenna massive MIMO system.



## Broadband PTT platform

Motorola Solutions' WAVE 7000 provides a high-performance PTT platform that can be linked to private or public LTE and LMR networks so that users can communicate across any network on any device.

Whether on a consumer smartphone, a ruggedised handheld or a two-way radio, WAVE 7000 offers a secure, optimised PTT experience. It is designed with a roadmap to meet 3GPP Release 13 'Mission Critical PTT' standards for high-availability PTT over LTE. Because WAVE 7000 can be integrated at the network level, it provides reliability, subsecond call performance and crisp voice quality.

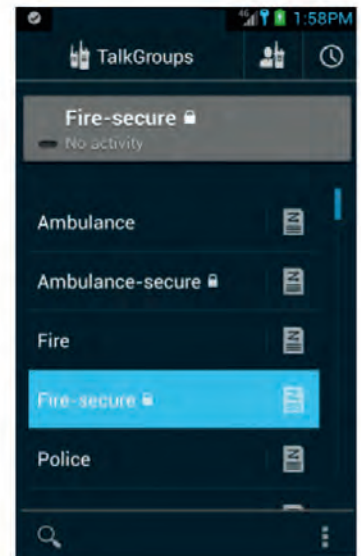
WAVE 7000 offers a high-capacity PTT solution that supports hundreds of thousands of users on a single server instance. With server clustering, operators can easily add millions of PTT users, supporting even the largest of deployments. It is built on a fully redundant, high-availability architecture. Local redundancy provides an additional server within the same location as the primary server, ensuring that even if hardware fails, WAVE does not. Georedundancy provides additional servers in separate geographic regions, protecting users' networks against catastrophic events.

Flexible call types include: group, personal group, ad hoc group, private, 'polite' private and broadcast. Mapping with real-time awareness means operators can: know the location of team members, no matter what device they use; select layers of data to see different work teams or resources; message, PTT or call individuals or groups based on their location; instantly create geofenced groups for PTT and messaging; and personalise maps with specific data.

Operators can also share images, video and audio clips for increased awareness and create incident groups for quick content sharing.

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## Stand-alone TETRA network

The Airbus Defence and Space Claricor Cell is a compact, standalone communications network based on TETRA technology. The system can be quickly set up for vehicle convoys and firefighting or rescue operations in remote regions.

The fully equipped system works as a standalone solution, or users can easily integrate it into existing national or smaller TETRA networks. It is transportable in ruggedised boxes, works in rolling vehicles and offers a wide range of technical features. Its tap-proof TETRA system is preconfigured and has a plug-and-play function. The design enables the end user to set up the whole system within 10 min.

With rain protection as well as diverse power supply systems — current and battery — Claricor Cell runs independently for hours in remote locations without electricity or other networks. It ensures full voice and data transmission is available, and it is compatible with LTE technology for expansion.

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## HF software-defined radio

Barrett Communications has announced the Barrett 4050 HF SDR, its HF transceiver which includes software-defined radio technology. The product features a 24-bit colour touch-screen interface and is designed for use by law enforcement and security organisations, as well as NGOs and commercial businesses.

The device's adapter ensures simple integration with existing networks, while for vehicle and remote installations, its wireless access point (built into the control head) allows mobile cellular handsets and tablets to connect directly to the transceiver. Advanced network configurations are supported by the Barrett 4050 Breakout Box (BoB), which also provides Wi-Fi and ethernet connectivity.

The product's Secure Digital Voice option, with variable vocoder rates of 600–2400 bps and DES and AES digital encryption standards up to 256-bit, delivers continual good communication performance and security. The digital signal processor (DSP) provides clear, intelligible voice communications on analog circuits through the digital removal of interference. The standard DSP noise reduction system provides good voice quality by reducing radio-frequency interference and the effects of electrical interference by enhancing audio signals to provide easier listening.

Multiple data waveform options are provided, including MIL-STD-188-110A/B (STANAG 4285, 4415, 4481, 4529, 4539), CLOVER 2500 and the forthcoming CLOVER NG standard. Multiple languages are available, including Arabic, Chinese, English, French, Russian and Spanish, with additional languages being added progressively.

**Barrett Communications Pty Ltd**

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## Hybrid TETRA-LTE solution

Focused on public safety and defence markets, the Sepura hybrid TETRA-LTE solution for tactical operations — based on the company's eNEBULA digital communications network — enables quick and easy deployment of critical communications networks in emergency and special operations situations.

Offering reliable coverage and broadband capacity through professional LTE technology, it enables first responders and armed forces to provide a quick response in emergency situations. Compliant with regulations for military-grade equipment, and built to withstand harsh conditions, the solution enables the sharing of real-time video from urban, mobile and body-worn environments. This can also be combined with TETRA technology in a hybrid deployment, offering a full range of communication solutions, including comprehensive mission-critical voice services.

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## TETRA infrastructure

Sepura NEBULA TETRA infrastructure is 100% EtherNet/IP-based and fully scalable from small to national systems. Its IP architecture enables high levels of redundancy, providing a fault-tolerant network design, with a wide range of base stations (up to 75 W) to deliver optimal coverage.

The product enables single or double links to be established between the site base stations and the system control node based on any type of technology, while gateways provide external connectivity as well as an IP interface access protocol (N2A) for third-party applications. Extended data functionality using multislot packet data, circuit mode data or synchronous data manager (SDM), where the IP-protected algorithm significantly reduces data polling time, delivers an applications-friendly environment within PMR.

The eNEBULA variant supports both TETRA and LTE radio access in the same system, while the user-friendly network management system provides an integrated experience for network administrators.

The solution is supported by a range of end-to-end services, including radio propagation, site surveys, systems design, project engineering, installation, commissioning and maintenance. Service models can be tailored to meet customer requirements.

**Sepura PLC**

[www.seapura.com](http://www.seapura.com)

## Military VHF radio

Codan Radio Communications has introduced the Sentry-V military VHF radio, which operates across the 30 to 88 MHz frequency band with AES-256 encryption and advanced coding technology for voice clarity.

Sentry-V is based on a software-defined radio platform, with voice and data transmission capability across analog and digital networks supporting all major protocols, including P25, DMR, analog FM and DVOA. It is optimised for rugged environments (built to MIL-STD-810G) and includes capabilities for tactical operations, such as a multilingual interface, onscreen GPS mapping, Bluetooth interoperability, GPS reporting and an in-built radio repeater mode to extend the communications range of a network.

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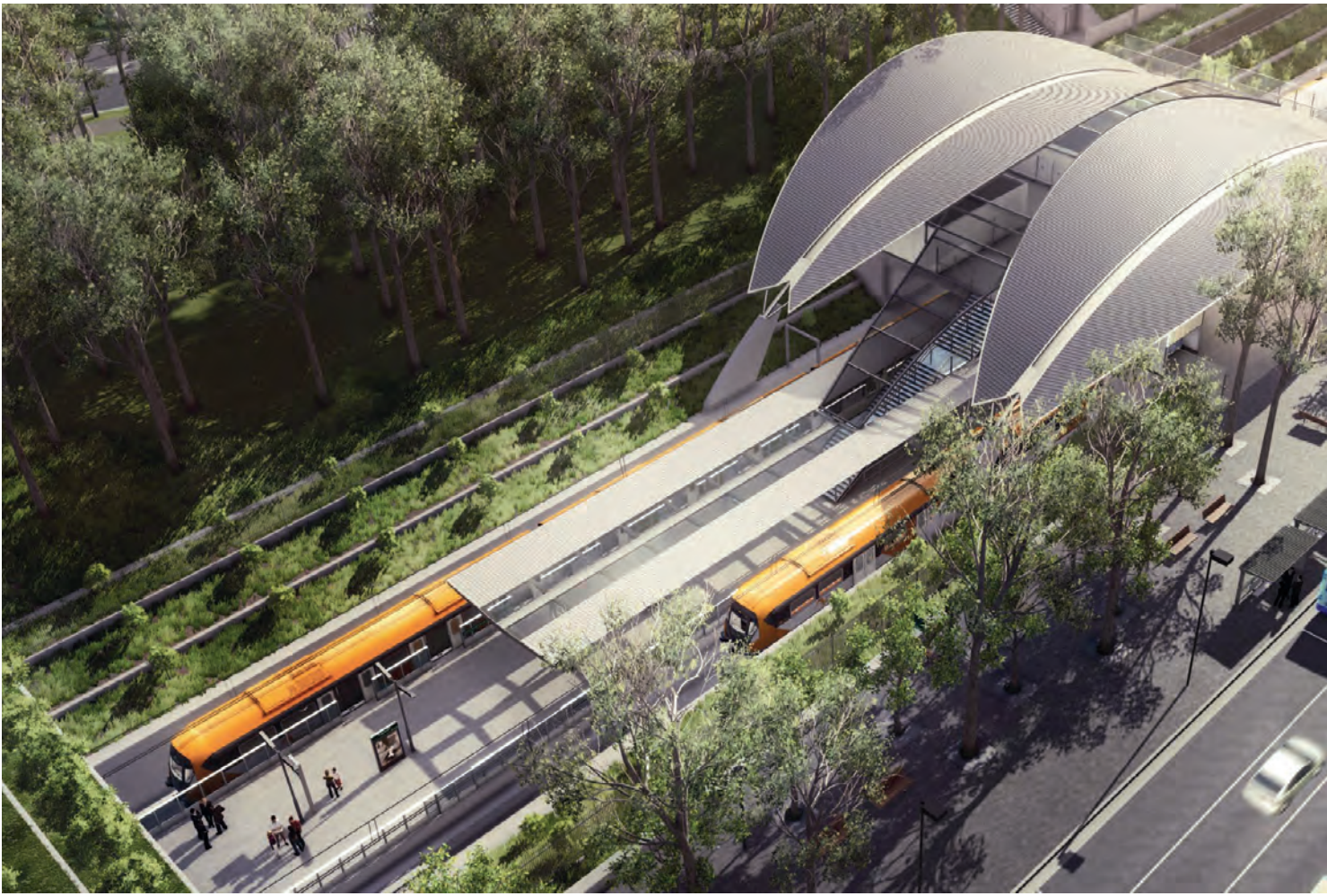
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# RAIL NERVE CENTRE

Sydney Trains' \$276 million Rail Operations Centre will improve communications and coordination across the network.

**W**ork has begun on Sydney Trains' new Rail Operations Centre (ROC) project, a \$276 million whole-of-network venture that will modernise management of operations to support better service delivery for Sydney Trains and its customers, through improved disruption management, communications and coordination across the network.

The transformational project will improve coordination across the new systems, enabling delivery of more accurate and timely information about delays, leading to faster incident resolution and service recovery.

"This new centre will ultimately improve train reliability for customers, and when there are delays, information will be communicated much more quickly," said NSW Minister for Transport and Infrastructure Andrew Constance.

To be built at Green Square, the ROC will ensure all facets of the train network are controlled from a single location, with new technology to manage train movements and customer safety.

According to a government statement, knowledge from across the globe has been sourced, from London, Hong Kong and Tokyo, to ensure the design incorporates the latest technology that will improve train services.

Sydney Trains Chief Executive Howard Collins said the organisation's performance has been held back in recent years by outdated technology and having to respond manually to incidents.



"At the moment we manage the trains and tracks, respond to incidents, communicate with customers and monitor their safety from different locations and in different ways," he said.

"One example is that during an incident, there are multiple phone calls made between the person reporting the incident, the person who controls the trains, another party in charge of fixing the fault and the response team in the field.





"The new centre will mean each of these parties are informed the moment the issue is reported, and because they will all be in the same location, receiving more information, they can ensure the best response to get our customers moving again."

The ROC with its network control centre and support functions will be housed in a new five-level building (plus a plant room), with provision for a co-located fire station in the future. It will be operational 24 hours per day, seven days per week.

System integrator Ajilon commenced work on the project in January 2015, and the project is currently in the design stage. A Review of Environmental Factors (REF) is currently underway, which will be displayed for community comment later this year. The government is consulting with the City of Sydney,


other government departments and key stakeholders as part of the process.

Preliminary building activities are planned to start in mid-2016. The ROC is expected to open in 2018.

"We are looking forward to working with Sydney Trains on this very exciting project," said Ajilon Managing Director Ger Doyle.

"Our key focus at Ajilon is to put the customer at the heart of what we do and we look forward to helping Sydney Trains create a highly coordinated system that is customer-centric at its core."

Ajilon is an Australia-wide company that has over 1100 consultants. The Sydney Trains contract comes after other recent governmental and commercial successes for clients such as NSW Health, Water NSW, Transport NSW, Hutchinson Ports Australia and Telstra.




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### Smart radio

Airbus Defence and Space has launched the Tactilon Dabat smart radio, a fully rugged smartphone and TETRA handheld radio in one device.

Featuring a large 4.7" touch screen, the smart radio is suitable for accessing smart apps, even while wearing gloves, and also offers relevant modules found in other TETRA radios. It is interoperable and can work on any standard TETRA network.

In addition to the push-to-talk button, users benefit from a long-lasting, removable and rechargeable battery ensuring that they stay connected during long incidents. The audio processing is designed for professional operation and enables loud and clear voice communication. Front and back cameras also allow images to be captured, while the device can be worn on the lapel in order to capture videos and send them to a control centre or to colleagues.

The product is rugged and both dustproof and waterproof with Ingress Protection ratings IP65 and IP67. All information within the smart radio is encrypted and protected against threats.

**Airbus Defence and Space Oy**

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# LIFESAVING LOCATION SERVICE

With almost 70% of emergency calls coming from mobiles, location determination is more important than ever.

**C**alls to Triple Zero (000) from mobile phones now contain improved location information, following upgrades to the Triple Zero service.

Of the 8.3 million calls made to Triple Zero in 2014–15, 66.9% — 5.6 million — were from mobile phones.

"Locating callers quickly in an emergency situation is vital, and I congratulate the mobile carriers and emergency services organisations (ESOs) on this tremendous initiative," said acting Australian Communications and Media Authority (ACMA) Chairman Richard Bean.

"Optus, Vodafone, Telstra (in its capacity as mobile carrier, the emergency call provider and initial answering point for Triple Zero 000 calls) and ESOs have been working in partnership to upgrade their relevant systems," he added.

Announced at a meeting of the ACMA's Emergency Call Services Advisory Committee, all ESOs throughout Australia have implemented functionality to automatically receive better information about the location of a mobile caller to Triple Zero.

Unlike fixed landline phones, emergency calls from mobile phones have not previously been able to automatically give emergency services potentially helpful information about the caller's location.

Emergency services can now receive automated location information derived from the mobile networks for most phone calls to Triple Zero. In some circumstances this will be a very helpful supplement to information provided verbally by the caller about their location.

## Getting closer

Caller location can potentially be narrowed down to a radius ranging from 50 metres to 90 kilometres, with the degree of accuracy influenced by the number of base stations within a given handset's vicinity.

Accuracy is greater in built-up and more urban areas where the majority of calls originate and less accurate but still useful where base station deployment is sparse, more likely in rural or remote areas.

The ACMA regulates and monitors the provision of the emergency call service under the Telecommunications (Emergency Call Service) Determination 2009 (the Determination). The Determination imposes obligations on the emergency call service provider, telecommunications carriers and carriage service providers.

The Triple Zero emergency call service uses an operator-assisted telephone service that connects callers to police, fire or ambulance in life-threatening or time-critical situations.

Telstra, as the emergency call service provider for Triple Zero, continues to perform above the regulatory requirement for answering emergency calls. In 2014–15, 98.7% of calls were answered within 10 seconds, against a target of 95%.

Triple Zero is the primary emergency service number in Australia and can be dialled from any fixed or mobile phone and certain VoIP services. The emergency call service is currently a voice call service. Callers are asked for information about the location of the emergency to assist in transferring the call to the appropriate state or territory emergency service organisation coordination centre for it to despatch the police, fire or ambulance closest to the caller in the shortest possible time.

Australia's Triple Zero Awareness Working Group released a mobile smartphone app — Emergency + — in December 2013 for iOS and Android and recent Windows handsets to take advantage of handset GPS capability. The app shows users GPS coordinates that can then be verbally passed on to emergency services.

*Information courtesy the ACMA.*



## Digital multimeter

NI has launched the NI PXIe-4081 7½-digit high-performance digital multimeter (DMM) and 1.8 MSa/s isolated digitiser, offering engineers the flexibility, resolution and isolation needed to tackle challenging applications that require smarter test systems in industries from consumer electronics to aerospace and defence.

The PXI Express DMM features 15 ppm accuracy for DC voltage measurements up to two years after calibration. It is capable of voltage measurements from nanovolts to 1 kV and resistance measurements from micro-ohms to giga-ohms. A solid-state current shunt configuration offers eight DC current ranges from 1 µA to 3 A and six AC rms current ranges from 100 µA to 3 A.

The product occupies a single 3U PXI slot and provides good channel density for high-channel-count systems, delivering 17 DMM channels in a single PXI chassis occupying 4U of rack space. For high-throughput applications, the isolated digitiser mode can acquire DC-coupled waveforms in all voltage and current ranges with a 1.8 MSa/s maximum sample rate. By changing the digitiser sampling rate, engineers can vary the resolution of the digitiser from 10 to 23 bits for speed and accuracy.

**National Instruments Aust Pty Ltd**  
[www.ni.com/oceania](http://www.ni.com/oceania)

## Handheld wireless network tester

NETSCOUT has introduced the AirCheck G2, its second-generation handheld wireless network tester that provides fast and simple isolation, troubleshooting and diagnosis of wireless issues.

The product is designed to enable IT responders to collect important information to resolve a host of Wi-Fi complaints, ranging from network-based problems and configuration issues to environmental or client device misconfigurations. Featuring a one-button AutoTest that provides a pass/fail indication of the wireless environment, the product identifies common problems and also gives an instant view of test results. This includes network availability, connectivity, utilisation, security settings, rogue hunting and interference detection.

The purpose-built tester supports the latest Wi-Fi technologies (802.11a/b/g/n/ac) and arms technicians with easy-to-understand insights into 802.11ac wireless networks that help to reduce escalations. It also connects to a centralised test results management platform, Link-Live, that facilitates greater job visibility, project control and fleet management for larger distributed environments.

Other features include: a 5" touch-screen display; ethernet tests for AP backhaul verification; 802.11ac 3 stream radio; and automatic uploads of basic connectivity tests to the Link-Live cloud service.

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# CAR-TO-CAR COMMS

## ENSURING SAFETY THROUGH RF TESTING

*Dr Thomas Brüggem, Project Manager, RF Test Systems for Intelligent Transport Systems, Rohde & Schwarz*

To ensure safety-related data is received even under poor conditions, radio systems must adhere to minimum standards and be verified using RF tests.

**R**oad safety has improved steadily as a result of many inventions. Mechanical systems such as safety belts and airbags, as well as electronic safety equipment such as ABS and ESP, have decreased the number of accidents and their consequences in the past decades.

In order to further reduce the number of accidents, new technologies are needed. Critical traffic situations can be detected before they occur through the wireless exchange of information between vehicles (V2V communications), as well as with the traffic infrastructure and all traffic participants (V2X communications).

For example, all vehicles that drive through a crossing can exchange information about speed and direction. This makes it possible to detect potential collisions, issue appropriate warnings and autonomously initiate early countermeasures.

However, this scenario can only become reality if there is a reliable wireless exchange of information between the vehicles, even under poor transmit conditions and without line of sight.

If a single piece of information is missed, one or more of the vehicles will gain an inaccurate view of the actual situation, conceivably with deadly consequences.

### Possible interference

Wireless communications systems can be affected by different types of interference. Many of these are known collectively as fading. This includes shadowing and interference caused by physical effects such as scattering, diffraction, refraction and reflection, which cause multipath propagation of the signal (Figure 1).

In other words, multiple versions of the same signal are received at the antenna at different times and with different signal levels and interference. Superpositioning of the individual signals at the receive antenna can distort, attenuate or even cancel out the received signal.

Traffic participants are also continuously moving, which adds a time variant to the fading scenario. All receivers inside vehicles are confronted with continually changing conditions and signal qual-





ity. Safety-critical applications must function reliably under these conditions.

If a receiver cannot handle fading with the time variant, it will not be able to detect and process the received signal at the antenna. Strong coding and specialised protocols cannot compensate for the loss of the receive signal. Safety-relevant information is lost.

This can represent a considerable safety risk, especially when drivers have come to rely on warnings from a V2X system and do not expect it to fail.

### Testing physical transmission

To minimise the safety risk arising from poor transmit conditions, the RF transmitters and receivers found in onboard units (OBU) and roadside units (RSU) of communications systems must exhibit certain characteristics. Developers and users wanting to integrate V2X components into their system can use RF tests to verify these requirements.

The two lowest layers of the OSI model (Figure 2) factor into these tests because they are responsible for the physical transmission of the data message:

- The physical layer is responsible for the physical transport of the data via a transmission medium. In the case of V2X communications, data is wirelessly transmitted via the air interface. This layer uses specific modulation modes, carrier frequencies and bit rates. Often the quality of the channel over which the data is transmitted is also taken into consideration.
- The data link layer is made up of two components: the MAC layer and the LLC layer. The medium access control (MAC) layer regulates access to the transmission medium for multiple subscribers. This is relevant for RF measurements. The logical link control (LLC) layer handles tasks such as error detection and correction at the protocol level.

In contrast, tests at the protocol level, ie, from the LLC layer up to the application layer (Figure 2), are not suitable for verifying RF characteristics. These tests check that the bitstream, which is generated in the LLC layer from the received signal, is processed correctly. The RF signal at the receive antenna is ignored.

As a result, all tests at the protocol level rely on one important prerequisite — that the signal with the message has been received at the vehicle antenna and converted into a bitstream. It is acceptable for the bitstream to contain bit errors, but only as many as can be corrected using channel coding.

For error-free processing of the bitstream, the message must appear in the application layer precisely as it was received at the OBU antenna. This triggers additional actions, such as a warning message on the display or automatic braking.

The RF module (ie, the MAC layer and the physical layer) in the OBU must therefore meet certain minimum requirements, eg, with respect to the power and frequency accuracy and the packet error rate (PER).

In addition, the transmitted signal must not interfere with any of the transmission technologies in the adjacent frequencies. These characteristics can only be verified with RF tests, not protocol tests, because any interference in the transmitted signal is conducted to the receiver via the OBU's RF module.

But how can RF module requirements be tested? And how can it be ensured that a transmitted message is actually received? A look at the mobile communications industry shows that three different types of RF tests are used to validate and certify smartphones:

- Regulatory tests check the interference that the transmit signal causes in other frequencies to ensure that it stays within a specified limit. Typically, regulatory agencies specify these limits and adherence is legally binding. These types of specifications are already available for V2X units.
- Conformity tests ascertain whether a smartphone meets the RF specifications of the technology it uses to transmit. For example, smartphones must not exceed a specified maximum packet error rate or maximum transmit power. A separate test specification often describes how to perform and evaluate these tests.



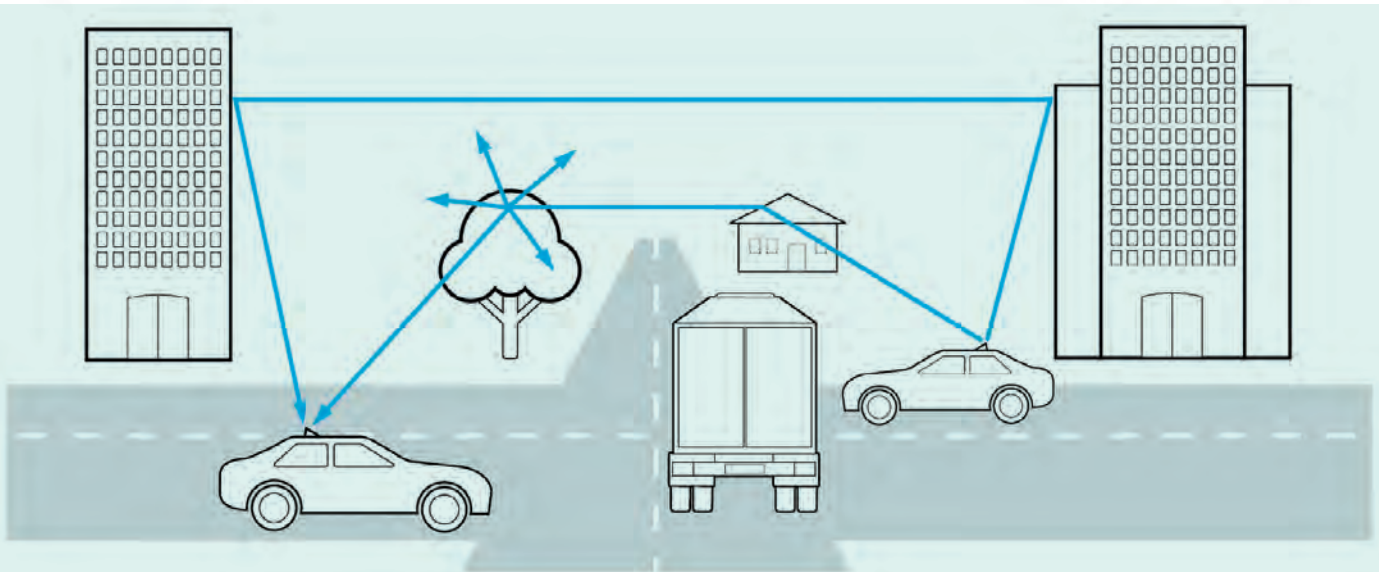


Figure 1: Example of fading due to multipath propagation without a line-of-sight path. Source: Rohde & Schwarz.

- Some mobile communications providers mandate stricter or additional tests beyond those described here to differentiate themselves from the competition by providing better transmission quality and better network reliability. Mobile devices must meet these special requirements in order to be allowed into the network.

### Radio over cable

The automotive industry tests automotive components and electronic control units in the lab, on testing grounds and even on public roads. For wireless communications, this is the equivalent of field tests, offering a realistic environment for RF tests.

However, other influences such as the weather can unpredictably change the RF characteristics of the radio link. The test set-up and test sequence depend on the vehicles involved and the antenna locations, and often they can be changed only with considerable effort.

This is not practicable for testing a new device that is still in the development stage. What is needed instead are alternatives that permit realistic testing in the lab.

In wireless communications, conducted tests represent an alternative to field tests. A test system simulates the transmission channel, while a cable replaces the actual radio link. These types of RF tests can be performed for each prototype and each time the software or hardware is changed.

This approach has many advantages that make development faster and less expensive while reducing errors:

- The tests can be performed at any time and at low cost.
- The test conditions are clearly defined at all times and can be changed at any time irrespective of outside influences.
- Clearly defined test sequences, when performed under the same conditions, lead to comparable results.
- Reproducible and comparable results facilitate debugging.
- Parameters can be easily modified. This is in contrast to the great deal of effort required to modify the fading profile in a field test, for example.
- Multiple tests can be combined into test sequences and then performed automatically. This makes it possible to run long-term tests to study the reliability of a prototype.
- Certain RF tests, such as error vector magnitude (EVM) or RX sensitivity tests, only make sense as conducted tests. In a field

test, uncontrolled noise and interference from external sources falsify the measurement results.

Depending on the selected scenario, channel simulation exactly simulates the physical attributes of the radio link. Today's signal generators can also simulate the special V2X fading profiles in real time.

Field tests still make sense, especially for antenna measurements, eg, for determining antenna characteristics or for beamforming tests. Although conducted tests cannot completely replace field tests, channel simulation can simplify testing, easily and cost-effectively supporting development in the lab.



**RECEIVERS INSIDE VEHICLES ARE CONFRONTED WITH CONTINUALLY CHANGING CONDITIONS AND SIGNAL QUALITY. SAFETY-CRITICAL APPLICATIONS MUST FUNCTION RELIABLY UNDER THESE CONDITIONS.**

### Detecting RF problems

To be able to compare the test results of the various hardware and software versions of a V2X unit, all test procedures must be clearly defined. Some countries have therefore defined test specifications for V2X systems that include test cases in four categories (see Boxes 1 and 2):

- **TX in-band:** The test cases in this group test the transmitter (TX) characteristics, eg, maximum and minimum transmit power, frequency accuracy and modulation accuracy.
- **TX out-of-band:** The unwanted transmit power outside of the allowed frequency band must not disrupt other technologies. TX out-of-band test cases therefore measure this transmit power and compare it against the allowed limit.
- **RX in-band:** This category tests the receiver (RX), eg, by measuring the lowest receive power at which the received signal can still be decoded or by measuring performance with fading. Figure 3 shows a screenshot of an R&S SMW200A vector signal generator with a configured V2X fading profile.
- **RX out-of-band:** Specialised test cases measure whether the OBU or RSU unintentionally emits transmit power in other frequency bands when the transmitter is switched off.



Layer	Name	
7	Application layer	
6	Presentation layer	
5	Session layer	
4	Transport layer	
3	Network layer	
2	Datalink layer	Logical link control (LLC) Medium access control (MAC)
1	Physical layer	

Figure 2: The OSI model. The Open Systems Interconnection (OSI) model was standardised as a reference model in order to permit data message transmission across a wide variety of technical systems. It combines the various tasks and protocols for a network into layers. The two lowest layers are the physical layer for the physical transmission of data messages (eg, via a copper cable, a fibre-optic cable or a radio frequency) and the data link layer, consisting of the medium access control (MAC) layer and the logical link control (LLC) layer.

Frequency accuracy
Modulation accuracy
Out-of-band emissions
Transmission power level
Spectrum emission mask
Spurious emissions

#### Box 1:

Examples of RF tests that verify transmit characteristics of an on-board or road-side unit.

Adjacent channel rejection
Non-adjacent channel rejection
Decentralised congestion control
Out-of-band emissions when transmitter is off
Performance with fading (packet error rate)
Sensitivity

#### Box 2:

Examples of RF tests that verify receive characteristics of an on-board or road-side unit.

Various plug tests for V2X have shown that especially the TX out-of-band and fading tests are problematic for many devices under test (Figure 4). It is possible, however, to detect these RF problems during the development phase by using appropriate test instruments.

The RX tests can be performed with a signal generator that is capable of generating a V2X signal. A signal analyser covers the TX test cases. Depending on the dynamic range of the analyser, a filter for the V2X signal is needed to cover the broad frequency range of the out-of-band measurement.

At present, various wireless technologies are under discussion for implementing the V2X communications, in particular WLAN 802.11p, LTE and 5G, which will be available several years from now.

Regardless of which technology is used, T&M equipment manufacturers such as Rohde & Schwarz already offer the test solutions needed for V2X. For example, solutions based on the

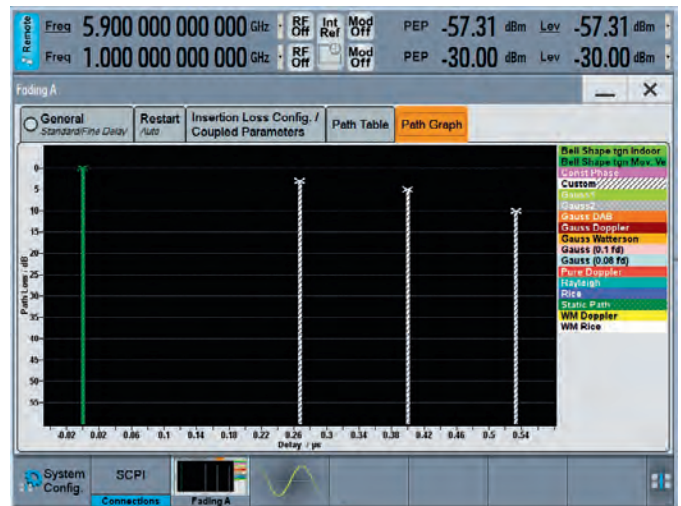


Figure 3: An R&S SMW signal generator showing a fading profile for V2X at 5.9 GHz. Source: Rohde & Schwarz.

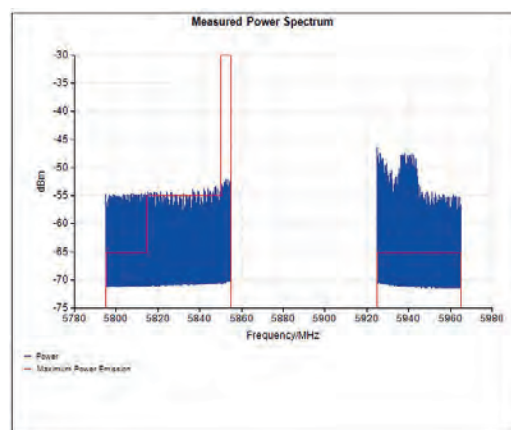


Figure 4: TX out-of-band test. The transmit power (blue line) of an 802.11p unit exceeds the allowable limit (red line) at multiple points. The frequency range between 5855 and 5925 MHz is reserved for V2X in Europe and in the USA. Source: Rohde & Schwarz.

widely distributed LTE technology can be tested using the R&S TS8980 RF test system family. The available tests are continually being updated based on each LTE development, making it also suitable for V2X.

## Summary

Development of wireless, automated communications between traffic participants will continue in order to improve road safety. Safety-critical messages must be transmitted reliably and quickly in every environment and every traffic situation.

Protocol tests alone are not sufficient because they do not test the circumstances under which the transmit signal arrives at the receiver. Only RF tests can ensure that the minimum physical requirements are met by OBUs and RSUs, so that lives can be saved during emergencies.

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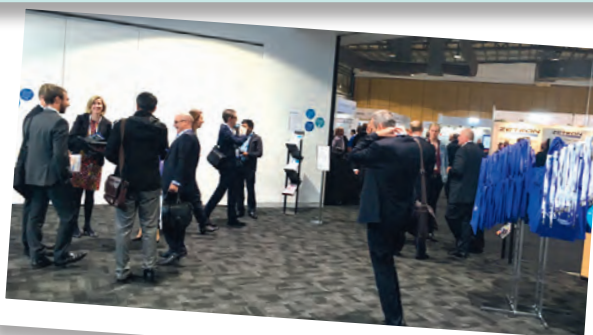




# SYDNEY SUCCESS COMMS CONNECT CONFERENCE AND EXPO

*Jonathan Nally*

Hundreds of industry professionals gathered for two days of top-level presentations and workshops, and to visit the busy expo hall.



The third annual Comms Connect Sydney was held in late June, at Olympic Park in Sydney's west. Attendance was up significantly on last year, the exhibition hall was buzzing and a full program of speakers and workshops kept delegates very busy. From the author's perspective, the event had a very good vibe, with plenty of anecdotal evidence from exhibitors of lots of business done and important connections made. Many attendees commented favourably on the slightly different mix of visitors in Sydney compared to Melbourne, including lots of representatives of the various emergency services organisations.

The opening keynote address was given by Phillip King, Acting Managing Director of the NSW Telco Authority, who gave the audience an update on activities, including developments with the Critical Communications Enhancement Program.

King explained that, in line with the NSW Government Operational Communications Strategy, the Authority is implementing reform in collaboration with public sector agencies and industry partners. He told the audience that, while recognising the continuing importance of radiocommunications and the ongoing program to develop an integrated network for those agencies, the Authority is also working to ensure it will have access to the services it needs into the future. This involves a program of work that includes building a foundation for public safety mobile broadband, developing a shared

platform for mobility as well as considering the needs of front-line staff in regional areas.

King also discussed some of the drivers and challenges for the Authority in balancing service delivery and reform, and the impacts on and opportunities for agencies and industry participation in delivering the outcomes required for the sector.

The second keynote was given by Alexander MacQuarrie (Lecturer, Paramedic Program, School of Biomedical Science, Charles Sturt University) and Ben Hinton (Health and Fitness Officer, NSW Police Force), who spoke about the rise of biometrics in keeping emergency responders safe, and the concomitant need to get that data from point to point.

After that, it was straight into a full program of presentations (two streams) and workshops (three streams) on a wide range of topics: from smart cities and intelligent transport systems; from big data and analytics to disruptive technologies; from LMR to microwave, TETRA to marine, SCADA to IoT; and from public safety to cybersecurity and disaster response.

Lots of big names were in attendance to give presentations or take part in the workshops: Krisztian Som (NEC Australia), Andrew Cribb (Marine Rescue NSW), Martin Chappell (Motorola Solutions), Charles Emer (NSW State Emergency Service), Matthew Smith (NSW Rural Fire Service), Chris Robson (NSW Police), Mark Loney





(ACMA), Gregory Wild (Fire & Rescue NSW), Alex Stefan (Telstra), Bidar Homsey and Jan Thompson (Ericsson), Ross Spearman (Tait Communications), Greg Gale (Microsoft Australia), John Yaldwyn (4RF) and Caroline Milligan (Crest Advisory), to name only about half of them.

The full program is still available on the event website ([sydney.comms-connect.com.au](http://sydney.comms-connect.com.au)), and by the time you receive this copy of the magazine, most of the presentations should be available for download, in case you missed them or want to see them again.

Milligan, for instance — whose first Comms Connect presentation was in Wellington earlier this year — once more held the audience captive with her insights into the use of social media to gather and disseminate information during times of crisis.

Gregory Wild, Alex Stefan and Geoff Spring (Centre for Disaster Management and Public Safety, University of Melbourne) led an interesting discussion on Next Generation Triple Zero, presenting a very positive picture of efforts being undertaken to address the need for enhancements such as better location services for emergency management authorities. (Incidentally, during her presentation, Milligan quoted figures from the US that suggest more than 75% of people expect first responders to arrive within three hours of receiving a call for help via social media channels, even if the relevant emergency services do not accept calls via such channels.)

The exhibition hall was packed with display stands, including many for companies that were represented for the first time at Comms Connect. I tried to speak with as many exhibitors as I could, all of whom told me that they were very happy indeed with the number and calibre of expo visitors. The first day in particular was very busy, but the second day did not disappoint. Numbers were up on last year, demonstrating that the Sydney event just keeps getting better every year.

### Don't miss Melbourne

One-day Comms Connect events will be held in Brisbane in late July, and in Adelaide in September, both of them in conjunction with the annual ARCIA industry days and networking dinners (see [comms-connect.com.au](http://comms-connect.com.au) and [arcia.org.au](http://arcia.org.au) for details).

Then, the major event of the year, Comms Connect Melbourne, will follow in November. To be held in the usual location (the Melbourne Convention and Exhibition Centre) from 22 to 24 November, it promises once again to be the highlight of the industry calendar. As this issue was going to press, the call for papers deadline had just passed, so keep an eye on the event's website ([melbourne.comms-connect.com.au](http://melbourne.comms-connect.com.au)) for the full three-day program, due out in a couple of months. And don't forget to register early to take advantage of the early-bird rates.

### Time warp networking

Thousands of years ago, when your *Critical Comms* editor was young, I was forced to undertake

a week of work experience during high school. Being a technically minded kid in a country town, initially I despaired of finding something that would suit my interests. But through a lucky coincidence, I ended up spending a fabulous week in the workshop of the local Forestry Commission radio techs, Paul Boekenstein and John Batchelor. (The coincidence was that the workshop was located directly across the road from the school.) So enjoyable was the experience that I went back and did it again the following year.

But the coincidences don't stop there. Who should I bump into at Comms Connect Sydney, more than 30 years later, but John Batchelor, who's still going strong in the same role. (Paul has now retired.) Pictured are my good self, flanked by John (on my right) and his colleague, Mark Shenstone.

So there you have it — it always pays to attend Comms Connect, because you never know who you might meet! It also pays to give a work experience kid a go, for you never know where it might take them.



Comms Connect (WFEvents)  
[www.comms-connect.com.au](http://www.comms-connect.com.au)



# BETTER BEEPERS

Belgium's ASTRID emergency services paging system has been updated.

**B**elgium's ASTRID has completed the changeover from its old paging system to a new one. Paging is used by the fire brigades and emergency services to send messages to volunteers, who are equipped with pagers through which they can receive alert notices.

The main users of the system are the (voluntary) fire brigade, the Civil Protection Service, several medical emergency services, doctors, hospitals and the Red Cross. Paging subscriptions are free of charge for emergency zones (fire brigade) and public emergency services.

More than 2.3 million pages pass through the network every year.

The changeover took place on 4 June, following several months of preparation. The technically complex migration was completed in just four hours (between 8 am and noon), during which time the paging service was interrupted.

After the switchover of the 226 antennas in various locations all over the country, the pagers of the volunteer firefighters and emergency responders — as well as the alarm terminals at the fire stations — automatically connected to the new system. The work also included on-site technical maintenance on 30 antennas.

Preparations for renovating the infrastructure and ensuring continuity of the service provision in the future began one year ago. ASTRID worked closely together with the user organisations throughout the entire process.

Radio communications were not interrupted during the switchover operation as it did not involve the ASTRID TETRA network.

## Necessary works

Certain components of the old paging system had become outdated



or had reached end-of-life status, and the supplier was no longer able to offer maintenance or a replacement.

After consultation with the users, it was decided to re-opt for POCSAG, a widely used technology standard that continues to meet the operational needs of the emergency services.

The renewal of the system encompassed the replacement of the network core and its auxiliary system (consolidated in three data centres) and the gradual replacement of the emitters on the antennas.

"This technological upgrade offers a direct operational benefit to the users in the field, ie, the 12,000 volunteer firefighters who are active throughout Belgium," said Christophe Grégoire, chief operations officer at ASTRID. "In addition, it ensures continuity of the paging service for another 15 years."

"I would like to thank all of the users and everyone who has participated in the works for their contribution to this complex migration effort."

Features of the new paging system include:

- messages are transmitted faster as a result of more rapid processing in the centralised system;
- better redundancy — the centralised systems are redundant and continually exchange their data;
- advanced system monitoring from the ASTRID Service Centre;
- no need to replace the 21,000 pagers already in use in the field;
- guaranteed technological support from the supplier of the infrastructure (Thales) for the next 15 years.

New key features in the longer term will include encryption, acknowledgment of receipt and automatic retransmission effort in the case of failed delivery.

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# Backhaul

*Backhaul takes you on a trip down memory lane as we look at what was happening in the comms field of yesteryear.*

**25 YEARS AGO.** The cover of the August/September 1991 issue of *What's New in Radio Communications* featured the Hewlett-Packard HP 8920A RF communications test set, which packed a whopping 22 different instruments



*The HP 8920A test set.*

into the one unit. Elsewhere in the magazine, we reported on Hutchison Telecommunications buying the Motorola Message Express Paging business in Australia; the world's first GSM network tests (in Finland and Sweden); and a doubling of AARNet's satellite internet link (via OTC) bandwidth from 128 to 256 kbps (it had been just 56 kbps the year before). Rockwell Systems Australia had won a \$2 million contract to supply HF radios to the RAAF for its C-130 aircraft, and Queensland's Redland Shire awarded Philips a \$140,000 contract for PRM80-series mobile radios.

**10 YEARS AGO.** The cover of the July/August 2006 issue of *Radio Comms Asia-Pacific* featured a promotional picture from Pacific Wireless Communications,



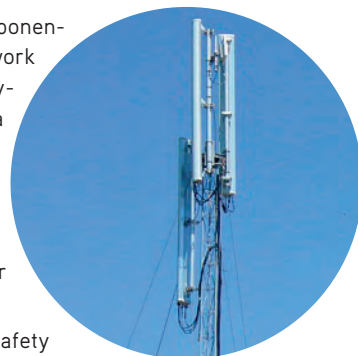
a firm that had been established just three years earlier. PWC was spruiking the RDX 3588 rapid deployment transponder and a range of accessories, such as remote speaker microphones and batteries. We reported

on Daniels Electronics signing an agreement with Motorola to have the former's P25 base stations and repeaters sold throughout Australia and New Zealand. The ACMA and RMIT were offering short courses (aimed at the public, apparently) covering topics such as CDMA, TETRA, Bluetooth, APCO, GPS, 3G and so on. Tait Electronics was reported to have completed an upgrade of the Victorian StateNet Mobile Radio network, under contract to Telstra. And the Zeon trunked, high-speed digital network was due to begin operating in Sydney and Brisbane, having already been switched on in Melbourne.

## Spectrum

### Public safety must embrace connectivity

Digital connectivity for people, places and things is growing exponentially. A key element of this is the National Broadband Network (NBN), which is expanding access to fixed, wireless and Sky-muster satellite services across Australia. In addition, Australia has an exceptionally high penetration of mobile subscriptions, with approximately 21.3 million services. Of these, as many as six million subscribers access the internet through their mobiles. To complement this access, many network operators, infrastructure providers and local governments are planning or have already deployed Wi-Fi services.



Discussion of the future communications needs of public safety agencies must include consideration of how best to leverage the extensive existing fabric of internet connectivity. The public safety and critical communications sector faces significant challenges arising from the proliferation of multiple technical standards, a diverse ecosystem of hardware, software and firmware platforms, and a wide range of operators and stakeholders. This is contrasted by citizens converging — meeting all their communication needs with devices they carry — phones, tablets and computers. Public safety communication needs to embrace a more proactive use of these mediums.

One significant opportunity to tackle the challenges associated with the current mix of complex communications platforms is the transition of most operators and vendors of networks and platforms towards a software-defined networking (SDN) regime. SDN provides a way to decouple network systems into a hardware elements with the networking and interoperability controlled via an operating system, such as on a computer or mobile phone. This enables freedom to architect new ways of using the network through a range of software-defined interfaces (such as an app on a smartphone).



Whether it is a smart TV or smartphone, a public safety communications service could be pushed as a software feature of such platforms. This will potentially allow a faster adoption of public safety interfaces for the current mix of communications platforms and networks. As mobile, fixed and Wi-Fi internet services increasingly provide a means to identify the location of customers within a particular physical location of interest, public safety agencies can tailor their messages via their public safety communication interface to directly target a specified audience in a specified region.

Despite the extent of network connectivity, it is possible that some modes of communication may be compromised in emergency situations — natural disasters, bushfires or floods. Public safety agencies need the capability to rapidly deploy network augmentation infrastructure to remedy missing communications and re-establish limited connectivity to support the public safety and recovery operations. Such an approach is currently challenged by licensing and regulatory arrangements that hinder the capacity of public safety agencies to roll out ad hoc communications networks in times of need.

There are many opportunities for the public safety sector to take advantage of the exponential growth in connectivity. However, to ensure the development of the most appropriate models, there needs to be a proactive and collaborative effort between government, regulators, standards bodies, industry, network operators and public safety agencies to collaborate on fast-tracking the digital transformation.



*Thas A Nirmalathas is Professor of Electrical and Electronic Engineering at the University of Melbourne, Director of the Melbourne Networked Society Institute, Academic Leader for the Melbourne Accelerator Program and Investigator in the Mission Critical Communications Program at the Centre for Disaster Management and Public Safety.*





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