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BROADBAND

SAIEE THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | **AUGUST 2016**

IGNORANCE CAN BE COSTLY

A SAFEhouse Guide to the Regulation of Electrical Products

SAFE™ HOUSE

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There is a good deal of confusion and misunderstanding about:

- Which regulations are applicable to which electrical products and services
- The roles of authorities such as the National Regulator for Compulsory Specifications (NRCS), the SABS and the Department of Labour.

The SAFEhouse Association has produced a guide to help specifiers, suppliers and users determine the standards and regulatory requirements applicable to electrical products and services covered by legislation.

Download a free copy of the SAFEhouse Guide to the Regulation of Electrical Products from **www.safehousesa.co.za**

Download free copies of SAFEhouse guides from

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Guides contain helpful information on:

- Regulatory references & requirements
- Technology
- Indications of risk in using substandard products and services

To find out what you can do to avoid or reduce the risks that result from using sub-standard, dangerous electrical products, consult SAFEhouse guides or visit www.safehousesa.co.za for some recommendations.

The SAFEhouse Association is a non-profit, industry organisation committed to the fight against sub-standard, unsafe electrical products.

For more information contact:
Pierre Nothard: 011 396 8140
Email: pierren@safehousesa.co.za

www.safehousesa.co.za

SAFE™ HOUSE
Suppliers you can trust

SAFEhouse members have signed a code of conduct: Your assurance of commitment to offer only safe electrical products.

As at 14/07/2016

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REGULARS

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Another August is upon us and there are so many things to be grateful for. Not only do we celebrate women's month (pg 16), but I also celebrate 5 years working for the SAIEE, bringing you this publication, the 53rd issue under my wing.

It has been inspiring (for me), and I trust that you, the reader, have enjoyed the **watt**now journey so far.

This issue focuses on Broadband, which can be a headache to anyone, or be a total win for some. We start off the feature with an article explaining everything you should know about Broadband; read it on page 22.

We take a look at the 'inside' of Broadband, by dissecting it and having a look at how intelligent the software has to be. Find this on page 36.

Pieter Grootes recently hosted a Broadband Breakfast at SAIEE Head Office and he kindly wrote an article on his presentation. Find it on page 42.

Page 46 showcases one of the winners of the 2016 IEC Young Professional's Competition, Nevin George's essay on "The influence of IEC on Transnet".

My old stalwart, Dudley Basson wrote another masterpiece aptly named SmartGrid Scheduling Dynamics, which forms an inevitable part of the new digital revolution. Read more on page 50.

André Hoffmann wrote our opinion piece (pg 58) this month, discussing "Threats to broadband in South Africa".

To all the women in our engineering industries, thank you for your endless task of oiling the wheels. I salute you.

Herewith the August issue, enjoy the read.

Minx

Earn CPD Credits *Visit www.saiee.org.za to answer the questions related to these articles to earn your CPD points.*

THE ULTIMATE HAND-HELD POWER QUALITY ANALYZER

Introducing the Pure BlackBox

The Pure BlackBox is an advanced ClassA power quality analyzer embedded with *Elspec's innovative PQZIP technology.*

It is an easy to use plug and play device that continuously records all power quality parameters with no threshold and recording configuration needed. The device is available in two versions: Single Phase and 3-Phase.

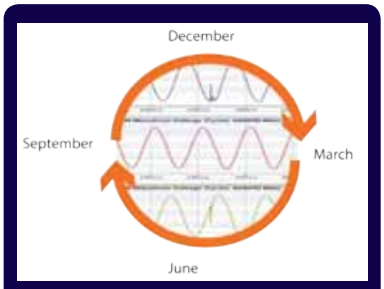
The BlackBox

The PQZIP continuous recording enables it to easily predict, prevent and troubleshoot issues without the need to set up triggers or thresholds in order to capture a specific event. With PQZIP the installation is straight forward!

Outstanding Features:

Extended Harmonic Recording

The Pure BlackBox records and stores 128 harmonic components at 50Hz resolution and 512 inter-harmonic components at 5Hz resolution for both voltage and current.

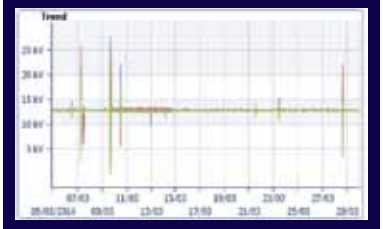


Continuous Waveform Recordings

The Pure BlackBox is the only hand held analyzer able to record and store all electrical parameters, at any given time for more than a year with no gaps in the data. It provides a clear and comprehensive view of network conditions at all times, offering the most advanced power quality analysis capabilities.

Get the most accurate information

The Pure BlackBox records voltage and current waveform sampled at a rate of 256 Sample/Cycle at 50/60Hz, which provides information at a very high resolution, enabling it to detect and analyze the slightest change.



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TC MADIKANE
2016 SAIEE PRESIDENT

It was a pleasure to interact with Centre chairperson in SAIEE House, Johannesburg on the 30th of June 2016. We had a workshop with EXCO, Centre Chairperson and staff to discuss the business of SAIEE and to align and streamline our services to members.

The attendees were reminded that functions such as membership, bursaries, Continual Professional Development (CPD) administration, investments and Corporate Partners are all centralised. In other words those functions are handled by head office to ensure that consistent information is provided to all our members. The Centre Chairpersons presented their plans for 2016, which entailed outreached programmes, technical tours, and CPD courses. It was encouraging to note the energy that they have to ensure that members benefit from SAIEE activities. Council took a resolution to revive the interest group in East London. Rob Ferrier, from Buffalo City Municipality, represented the East London interest group at the workshop. We plan to be visiting East London in August 2016, to encourage potential members to join SAIEE, and also to ensure that the existing SAIEE members benefit from SAIEE activities. I encourage our members in ALL Centres to support the Centre Chairs, and to play an active role in the Centre events.

In line with our vision to represent the entire spread of Electrical Engineering Practitioners, the theme for August is broadband. Thank you to Pieter Grootes (former General Manager of Markets and Competition at the Independent Communications Authority of South Africa, who was our guest for the broadband breakfast event that took place on 6 July 2016). His presentation covered what has been achieved in South Africa, what is still to be achieved, and what changes to expect in the next five years. The SAIEE relationship with IEEE goes from strength to strength, and in July we were fortunate to have presentations at the University of Cape Town and University of Johannesburg by the IEEE President and CEO, Prof Barry L Shoop. His presentations covered disruptive innovations as a vehicle to develop critical thinking, creativity and innovation skills. The events were well attended.

The Engineering Council of South Africa (ECSA) issued an invitation to all registered individuals, and recognised volunteer associations for public consultation roadshows. ECSA intends to review three documents namely; Voluntary Association (VA) recognition framework, Continuing Professional Development (CPD) policy and Commitment & Undertaking (C&U) guidelines in addition to the establishment of the accord with employer bodies. Nine public consultations took place in July nationwide. In August three further roadshows will take place in Durban, Richard Bay and in Johannesburg. For more details visit the ECSA website. I encourage our members to download these documents, read them and submit their comments to ECSA. SAIEE has formed a task team that will participate on the Roadshows, and submit SAIEE's comments accordingly.

Together with local Leadership, we visited some of the Institutes of Higher Learning, to encourage them to be part of the big family in the electrical engineering space, SAIEE. We also inspired them to take their studies seriously, so that one day they can be Electrical Practitioners. SAIEE continues to support the student chapters with industry tours, mentorship and to assist with job placement for in service training.

I would like to thank ALL our members who spend 67 minutes to contribute to their communities in whatever form during 'Mandela Month'. Your collective effort will go a long way to ensure that South Africa is better a country to live in….

TC Madikane
Pr. Eng | FSAIEE | FSAAE

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#ThingsThatReallyMatter

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Small Business Software Attracts The Big Guns

Clive Butkow | Chief Executive Officer Grotech

Since entering the market SMEasy - the award-winning, easy-to-use business management and accounting software specifically designed for entrepreneurs with little accounting know-how - has attracted both national and international attention, securing endorsements and funding from several established and prestigious backers.

The most recent support for SMEasy comes from Grotech, a section 12 J Venture Capital Company with a wealth of business experience and substantial networks. Grotech is the disruptive technology fund of choice and aims to *"invest minority stakes in established high-growth technology-driven startups"* says Clive Butkow, Chief Executive Officer of Grotech. *"Grovest's investment in SMEasy in 2015 proved to be an ideal fit and delivered impressive results"* continues Butkow. *"With the addition of Grotech's investment we expect to see great things from this highly scalable software - ideally suited to the SME market."*

This investment comes shortly after SMEasy signed a strategic partnership with Africa's leading telecomms giant MTN Business who recently launched SMEasy in Kenya branded as MTN EasyAccouting. The innovative cloud-based product boasts vital small business management features including contacts management, quoting, invoicing, payroll, money management and reporting. It is easy-to use, requires no accounting know-how and is very affordable, ideally suited to start-ups and small businesses across Africa.

Productivity and Profits 'in the pipeline'

First Cut, distributors of cutting consumables and capital equipment to the South African market, is very focused this year on introducing the benefits of innovative fibre laser technology and 3D laser cutting machines to the local tube industry.

The BLM Group, an Italy-based leader in tube cutting and bending technologies, has for decades focused on optimising the tube fabrication process, and the company's LT8.10 'laser tube' machine brings versatility of metal cutting to a new level. This is according to Andrew Poole, Managing Director at First Cut.

"As one of our key international principals, we are excited to have already introduced the wide-ranging advantages of BLM's fibre laser cutting machines to a number of our customers in the steel industry. The machines provide a highly versatile cutting solution that is also significantly faster, cheaper to run and more accurate than conventional processing," says Poole.

The fibre laser source in the BLM machines enables the user to cut tubes of any material type (including copper, brass, aluminium, stainless steel, zinc-coated steel, mild steel) from 12mm to 240mm in diameter. It also processes any conceivable shape of tube, as well as open profiles, with ease.

"BLM fibre laser machines can cut to length, drill any size hole or cut any shape geometry - all in a single machine," says Neil Labuschagne, Technical Sales - Tube Division at First Cut. *"Essentially they perform the same function as traditional tube processors, minus all the cumbersome steps, material handling between operations and additional labour.*

Pinnacle to distribute the world's first true Android PC

Pinnacle, one of Southern Africa's largest ICT distributors, is pleased to announce that the company has signed a distribution agreement with Jide Technology and will be distributing the Remix Mini, the world's first true Android PC.

The Remix Mini is powered by Remix OS, a custom engineered version of Android Lollipop developed by Jide Technology. Remix Mini allows end users to work and play with the entire Android app ecosystem while taking full advantage of intuitive PC features such as a taskbar, multiple window multi-tasking, and full mouse and keyboard support.

With a focus on emerging markets and affordability, Remix Mini will launch in South Africa at a price point approximately half the cost of a traditional entry-level PC. The first Remix Mini stock lands during July and will be available through Pinnacle's reseller channels and at all Makro stores in South Africa.

"We are particularly excited about launching the Remix Mini in South Africa," said Max Stone, Brand Director at Pinnacle. *"The Remix Mini merges PC productivity with Android mobility, eliminating the barriers between document creation and mobile consumption. Remix Mini makes modern computing technology affordable and accessible to schools, parents and entrepreneurs and will transform how people access and work with information."*

"We appreciate that Pinnacle shares our vision of pioneering productivity on Android and making computing accessible and affordable to people throughout South Africa," said David Ko, Vice President of Sales and Marketing at Jide Technology. *"We look forward to the next few years as we deepen our partnership and shape the future of Android PCs for hundreds of thousands of families, students and businesses throughout Southern Africa."*

For more information, contact 011 265 3100.

Understand the Brexit Impact on IT

The U.K.'s referendum vote to leave the European Union (EU) caught many within and outside the U.K. off guard. CIOs and IT leaders, in particular, may wonder how the pending changes in the financial and political landscapes will impact their organizations, vendors, and technology purchases over the coming months.

John-David Lovelock, research vice president at Gartner, noted that business discretionary IT investments, which struggled during the run up to the vote, will suffer in the short term and the effects will spread further than Western Europe.

"In the wake of the U.K.'s exit from the EU, some new larger, long-term strategic projects will now be put on pause and likely not restarted until 2017 when the outlook with the U.K. outside the EU becomes clearer," he said.

"The fibre laser tube cutter's ability to cut a wide variety of material types and thicknesses makes it a universal tool. Hard tooling is eliminated and replaced by a flexible beam. The end result is maximised production time with minimum waste."

The 3D cutting functionality of the BLM LT range of fibre laser machines adds to the flexibility of the system, facilitating the easy tilt cutting of thick-walled steel for chamfers and weld preparations and for producing interlocking joints on tubes and beams on steel structures.

The 'laser tube' family of machines from BLM are all fully CNC-operated and automated for multiple functions; while also enabling the quick change-over between various functions and materials.

Furthermore, importing of CAD drawings via BLM's own software programme enables highly accurate and reliable production lines, with the added advantage of minimising waste.

With tubes an integral part of so many industries and structures, fibre laser cutting machines have wide applicability, notes Labuschagne.

"Tubes have particular relevance in the automotive components industry, but also in aeronautical, furniture, structural engineering and transport sectors – the options are endless.

With a company like BLM, which is intensely focused on ongoing research and development (R&D) of fibre laser tube cutting, new technological parameters and design possibilities are being explored and developed all the time."

"We have established an excellent relationship with BLM in order to provide our customers with the highest levels of service and support. Our own team of qualified technicians travel to Italy regularly for technology updates and training," notes Labuschagne.

For Poole, the multiple advantages of fibre laser cutting equipment in the tube industry bring excellent long-term return on investment (ROI) to First Cut's customers.

"In this challenging and capricious economic climate, customers are all seeking to reduce production time and costs. BLM's fibre laser technology is more cost-effective to operate, reduces energy consumption and is substantially faster than conventional cutting methodologies – up to 40-50% faster. This makes it a compelling option for tube fabricators in South Africa," he concludes.

WATTSUP

Smart And Safe Mining Machines

Legislation mandating the use of Pedestrian Detection Systems (PDS) came into being in South Africa in 2015, driving the deployment of Booyco Electronics' locally manufactured systems on local mines.

Booyco Electronics' fully integrated PDS represents the latest generation of this technology and offers a supply of information, which allows the safety intervention capability coupled with a data hub that enables integration with Trackless Mobile Machinery (TMM) and other OEM underground vehicles and equipment. Each PDS is deployed based on application specific risk assessments ensuring that it is fit-for-purpose.

Anton Lourens, Managing Director of Booyco Electronics, says the company's PDS incorporates very low frequency technology for pedestrian detection either on surface or underground together with GPS technology for vehicle detection on surface. It delivers specific warning, controlled slow-down and stopping zone alerts around a vehicle when detecting pedestrians or other vehicles.

This is unique in that it is able to achieve zone shaping and create narrow band zones in close proximity on the side of vehicles.

It features full self-diagnostics, and has visual and voice display activated in the case of a PDS warning or a system failure. The technology incorporates various downloading options for recorded data including wireless when at an access point. It is supplied complete with testing equipment for both the surface and underground areas to ensure maximum functionality.

Lourens says the company has also developed a high processing power controller. It acts as a processing gateway and all sensing technologies and informational data is channelled through this. *"This enables the user to create the requisite artificial intelligence which is fed to the control systems of the trackless mobile machinery on a site."*

Research and development in the field of PDS will continue unabated, considering Booyco Electronics' ongoing interaction with mines and its participation in initiatives, such as The Earth Moving Equipment Safety Round Table (EMESRT) forum.

Participation at EMESRT, for example, has also allowed the company to gain insight into the global requirements for PDS equipment and share its own extensive experience gained over more than ten years in this sector with leading international mining houses.

"It is satisfying to be able to collaborate with these organisations in terms of the strides Booyco Electronics has made with its technology," Lourens concludes.

The role of cyber security in the manufacturing industry

Cyber security has become an integral component of any organisational strategy. With intellectual property becoming even more essential in a highly competitive world, no company can afford not to ensure that this critical asset is protected. For manufacturers, with complex supply chains, the need to prioritise security is even more important, says Tiaan van Schalkwyk at Deloitte South Africa.

"The world is becoming increasingly connected. As new mobile devices are released and more bandwidth becomes available, employees are more reliant than ever on accessing sensitive corporate data irrespective of their physical location. Business is well and truly real-time but what impact does this have on security, especially in such a dynamic environment as manufacturing?"

One of the biggest challenges is to ensure that security of information technologies is included in all operations. The complexity of this cannot be underestimated. Systems and networks used in manufacturing environments have significantly more stringent requirements than those used in a general office.

"Manufacturers need to have the peace of mind that the safety, availability, and reliability of all aspects of their systems are nigh on guaranteed."

Helping your city save money and bringing the consumer choice

In December 2015 LinkAfrica received the Frost & Sullivan Best Practices Award for fibre innovation. In presenting this award, Frost and Sullivan recognised Link Africa's patented methods of least disruption for fibre optical network deployment. This method includes FOCUS™, Atlantis Hydrotec and small format horizontal drill rigs.

Improvements in the South African fibre market, particularly in terms of the quality and reach of the infrastructure, has not yet translated into affordable access to the full range of communication services to all. As a result, broadband penetration in South Africa remains relatively low compared to other lower-middle-income countries. According to Statistics South Africa, 10% of South African households had access to the Internet at home in 2014. Approximately 34% of South Africans have access to the Internet and of these, 88% are accessing the Internet via a mobile phone. There is therefore still a need for fast, reliable and sustainable connectivity.

Three of the key challenges inhibiting growth in the fibre market in South Africa are the lack of competition, the high cost of deployment and regulatory constraints.

LinkAfrica recognises these challenges and has developed its unique FOCUS™ method to meet South Africa's growing need for fast, reliable and sustainable connectivity.

Link Africa builds-, owns- and operates-fibre optic networks in South Africa's major cities. It has the capacity to build over 3,500km of fibre backbone in South Africa's key metropolitan areas. Link Africa's proprietary suite of innovative fibre deployment methodologies and technologies has distinct advantages compared to its competitors. The fibre optic cables are deployed in existing municipal service networks. As up to 80% of the cost of a fibre optic network lies in the provision of the trenches and ducts FOCUS™ reduces the deployment cost significantly. Furthermore, the technology reduces civil disruption, ensures route independence, and it is also four times faster to deploy. This is particularly beneficial in the Fibre to the Home (FTTH) market, as it minimises the need for excavating streets and pavements.

From components to solutions: The data centre evolution

The convergence of IT and energy is opening up a wealth of new opportunities. This is according to Maria de Lurdes Carvalho, vice-president for Data Centre Solutions, EMEA region, Schneider Electric – a specialist in energy management and automation. De Lurdes recently presented at the IDC CIO Summit in Mozambique, where she in particular spoke about the role that a data centre's physical infrastructure plays in the heart if IT transformation.

"Today, we are living in a smart world. Everything's becoming more intelligent; the information and telecommunications technology, the electric grid, and also our homes and cities. These trends are driving massive growth of digital traffic while data generation is accelerating through the network, that is, the Internet of Things (IoT). IoT is bringing challenges in data centre security, capacity, and analytics that will require the industry to restructure how it stores and processes data to effectively handle all that IT load," she continued.

It is however not through efficient components that you will have an efficient data centre, you need to have them work efficiently together. Prefabricated and standardised subsystems are the way to go to ease.

During her presentation, De Lurdes expanded on this topic and said that customers are currently looking for a data centre solution that is more efficient, reliable, predictable, costs effective and understandable, and offers both higher density and a simpler experience.

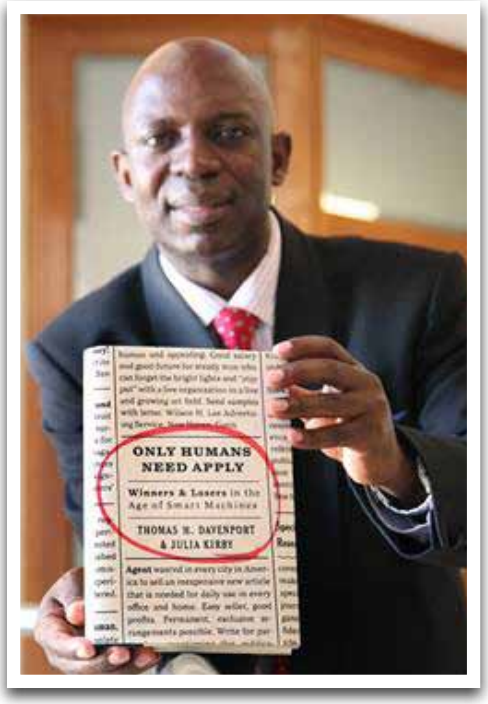
"What we have learnt is that the before-mentioned wish list cannot simply be achieved by making better components, such as UPSs, switchgears, controls, air conditioners and power distribution," she added.

"What we do know is that a customer's supply needs to evolve from components to subsystems – including the IT room, facility power and cooling, security and DCIM – to solutions that offer an innovative combination of technology, products and services, as well as provide an integrated response."

Facilitating the convergence between facilities and IT transformation has become essential, highlighted De Lurdes. *"At Schneider Electric, we believe in a new efficiency paradigm to drive long-term sustainability."*

WATTSUP

AI: the end of some jobs, but the dawn of new ones



Daudi Ngona
International Corporate Account Manager, Digital Skills Academy

In an Artificial Intelligence future, those with high end computing skills will not only survive, but thrive, says Digital Skills Academy.

"No industry – from farming to fintech – is immune to the changes being wrought by the new digital economy," says Paul Dunne, CEO and Founder of Digital Skills Academy. "*Artificial Intelligence (AI), once the stuff of sci-fi, is already making an impact in the digital world*," he notes.

Gartner predicts that by 2018, 20 percent of business content will be authored by machines, more than 3 million workers globally will be supervised by a 'robo-boss' and 45 percent of the fastest-growing companies will have fewer employees than instances of smart machines.

By 2020, autonomous software agents outside of human control will participate in five percent of all economic transactions and smart agents will facilitate 40 percent of mobile interactions.

In this algorithmic and smart machine-driven world, people and machines must define harmonious relationships, says Gartner.

Echoing this view, Professor Thomas Hayes Davenport from the MIT Centre for Digital Business and author of *'Only Humans Need Apply: Winners and Losers in the Age of Smart Machines'*, says: *"Anyone who is prepared to consider technology more as a colleague than a competitor, has a far greater chance of survival in the digital age."*

While AI presents opportunities for business, it also brings with it a very real threat to traditional jobs.

Prominent thinkers, including Bill Gates and Stephen Hawking, have highlighted concerns over the wisdom of placing too much emphasis on AI-based cognitive technologies, in particular the threat they pose to long-term job security.

"It is likely we will see some job losses in the future: perhaps up to 10 percent of those working in areas that can be highly automated will lose out to machine learning," Davenport says.

However, Davenport believes the trend towards automation will happen quite slowly and so any job losses caused by the current wave of technological advancement will happen over the next decade or so. *"The kinds of cognitive technologies currently in existence can only replace tasks, not entire jobs,"* he stresses.

Anyone with an appetite for learning should not fear the ramifications of life in the digital age, he says. Those willing to embrace technology through further education will thrive in the age of AI robotics.

Digital Skills Academy, an innovative leaders in current digital technology education, believes individuals should be honing their IT skills to take advantage of the opportunities set to open up in an AI era.

"By adding new digital skills to existing staff in their business, organisations will not only be prepared for the increased levels of machine automation in the workplace but will have a workforce equipped to work alongside machines, helping to drive business growth and achieve significant competitive advantage," says Dunne.

Digital Skills Academy programmes develop talent with skills that are cutting-edge in the marketplace today. The one-year, online and part-time International BSc Degree programmes blend the most in-demand and current coding languages, the creativity of digital design and the innovation and entrepreneurial thinking of digital business.

Accredited by Dublin Institute of Technology (DIT), the programmes are designed to rapidly enhance participants' career prospects through a combination of online learning and real-world experience working in international cross-functional teams on live industry-assigned projects.

Intensified Heat-transfer Invention by Unisa

Hot on the heels of their earlier successes in Australia, China and the United States, chemical engineers at Unisa are patenting an invention that could spark a revolution in the synthetic fuel industry, especially in Waste to Energy technology.

While the world's fuel supply is still dominated by crude oil, synthetic fuel production is gaining ground. Some plants, such as those in Qatar, are generating as many as 140 000 barrels of synthetic fuel a day, says Dr Xiaojun Lu, Senior Researcher in Fischer-Tropsch Synthesis at the Materials and Process Synthesis (MaPS) unit on Unisa's Science Campus.

At present, synthetic fuel can be more costly to produce than oil-based fuel, largely because of the lengthy process involved. This has meant that less research, development and investment has been devoted to streamlining synfuel processes than on conventional fuels.

"So the Unisa invention – an intensified heat-transfer method for fixed-bed reactors that is used in synthetic fuel production – has great potential to improve process performance and reduce costs," says Lu.

A major cost factor in synthetic fuel production is the catalysts used inside the reactors to convert synthetic gas (a mixture of hydrogen and carbon monoxide) to synthetic fuels. The syngas can be made from biomass, carbon-containing waste, coal or natural gas.

Catalysts are components vital to converting feedstock to fuel, and the longer they last and the more efficiently they work, the smoother and less expensive production is likely to be. One of the most common ways in which catalysts are damaged or destroyed is when there is overheating inside the reactor during the conversion process.

"When the chemical reaction is highly exothermic and a lot of heat is released, that heat needs to be removed very effectively," says Lu. Excessive heat can damage the catalyst, forcing the plant engineer to shut down the reactor to replace the catalyst. This suspension in operation also escalates equipment and operating costs.

Enter the Unisa invention – being patented as *"Tubular fixed bed reactor with heat pipe for internal heat removal for Fischer-Tropsch synthesis"*.

"The invention tries to eliminate hotspots in the reactor, reducing the catalyst cost and increasing the overall production rate. If this type of invention could be implemented in a big project, it could save the manufacturer between 20% and 30% of the reactor and catalyst cost respectively, while retaining the same production capacity," Lu says. *"The life of the catalyst could be extended and the overall plant would have a longer time online."*

Briefly, here is how the invention works inside a traditional fixed-bed reactor:

- The reactor is a cylinder containing tubes, into which the catalyst is loaded. The tubes are packed in a way that leaves gaps, creating "empty volume" that is normally used for a cooling medium. However, the conventional cooling method is insufficient for the Fischer-Tropsch reaction, and therefore requires an additional heat-transfer path to remove excess heat.

- A heat pipe designed by the Unisa team is inserted into the catalyst bed to provide an additional heat-transfer path. It is essentially a piece of sealed tubing containing liquid. When heated, the liquid turns into gas, which absorbs and removes the heat from the catalyst bed through evaporation.

- The gas is then turned back into liquid at the top section of the heat pipe, where it heats up the reactants to the reaction temperature. The condensed liquid flows back to the section where the catalyst is to absorb heat again.

The invention is being patented both in South Africa and internationally. A Patent Cooperation Treaty application was filed in 2015 and the process is due to enter the national phase in May 2017.

The Unisa team of inventors, comprising Lu, Prof Diane Hildebrandt and Prof David Glasser, has previously worked on international energy projects, which have given the team a sound insight into current trends in alternative fuel production.

In 2004, they worked on a coal gasification and synthetic fuel project in Australia, and from 2005 to 2009 they designed and commissioned a coal-to-liquid fuel plant in China. Most recently, the team has been working on a gas-to-liquid fuel project in Houston, Texas. The invention is part of the Waste to Energy technology developed by the MaPS group at Unisa, which is centred on using renewable energy to provide clean fuel from carbon-containing waste, such as biomass, agricultural and forestry waste, and solid municipal waste.

However, the application of this invention is not limited to the Waste to Energy field. It could attract strong international interest from producers in countries such as the United States and Eastern Europe, where the use of fixed-bed reactors is widespread.

All are seeking ways to drive down costs and push up efficiency. *"Our research teams are on the lookout for better solutions,"* says Lu. *"This invention is trying to push reactor design to the next level. You could say it is the next step in reactor design."*

Your FTTH initiative

A QUESTION OF ACCOUNTABILITY

Fibre is big, and getting bigger. Fibre offers faster, richer broadband experience compared to other broadband technologies and provides fast reliable access to people who need to stay connected - be it for work, play or studying. High-speed data connections are very desirable, and communities with fibre installed are seeing increases in property prices and overall saleability as a result.

As operators roll out fibre optic cables across the country, many developers are getting into the game early and rolling out fibre during the construction phase in order to increase the saleability of their properties. Likewise, many existing developments are getting fibre to improve the overall attractiveness of these estates.

As in any burgeoning market it comes with certain challenges. The Fibre to the Home (FTTH) Council Africa was formed in 2010 in recognition of the fact that, given the rapid growth expected in the industry, some sort of co-ordination was required to ensure the industry could thrive and deliver the best possible quality service to South African consumers.

The FTTH Council Africa is an independent, not for profit organisation and is an active member of the Fibre Council Global Alliance (FCGA) alongside the FTTH Council Europe, Asia Pacific, North America, Middle East and North Africa. Its activities are funded through member contributions.

The Council's charter is to educate Africa governments, policy makers and political leaders on why and how high-speed fibre connectivity can be delivered to citizens in the coming years.

Through consultation with all major stakeholders and understanding their strategies and concerns, the Council endeavours to be the voice of the industry and to help create a better future for all involved. In turn the Council supports government with issues such as policy and regulation, best practice and minimum standards through an independent voice.

Member engagement is encouraged on all levels and participants are kept informed on industry trends and success stories. FTTH Council Africa offers members an opportunity to network and collaborate and discuss best practice frameworks that are in the best interests of all.

In addition, FTTH Council Africa members have signed a code of conduct and have pledged that they will pay respect to the quality of their services, products and operations with a reputation for honesty, fairness, respect, responsibility, integrity, trust and sound business judgment.

Members agree, specifically, to co-operate for the benefit of all, particularly when engaging with other ENCS license holders (the telecommunications providers) and with the local, provincial and national authorities.

Technical excellence and quality assurance are particularly emphasised by the Code, which holds that members should foster both, and ensure that work is carried out professionally and competently.

The Code of Conduct further requires members to respect others' property and assets when carrying out roadworks and to abide by best practise safety standards and health and safety practices.

The FTTH Council may discipline or terminate membership of members

in violation of its Code. Likewise, it investigates complaints against its members and acts accordingly at the end of its investigation process.

For developers and consumers, this means that companies which are members of the Council have committed to delivering work of a high standard.

The deployment of fibre optic cable is not a trivial task, and the provision of services over a fibre network likewise, requires technical skill and expertise to be done correctly. Fibre is an asset to a development that will deliver returns and improve the quality of life for all who live there. A poorly deployed or badly provided service, on the other hand, can rapidly turn into a white elephant.

Developers and estates should ask two things when choosing a fibre service provider, in addition to reviewing costs and service requirements:

- Membership - Is the provider a member of the FTTH Council Africa? Members are issued with a membership certificate which they should be able to produce on request.
- References - a reputable provider will have no problem with providing contactable references for previous work done.

FTTH Council Africa maintains a list of current members on its website. It also supports communities looking to invest in fibre in a number of ways. Communities can register on the site, which enables providers to see where there is high demand and plan their activities accordingly. It also gives communities access to workshops where they can engage other communities looking to rollout fibre - organised and held by FTTH Council Africa for free.

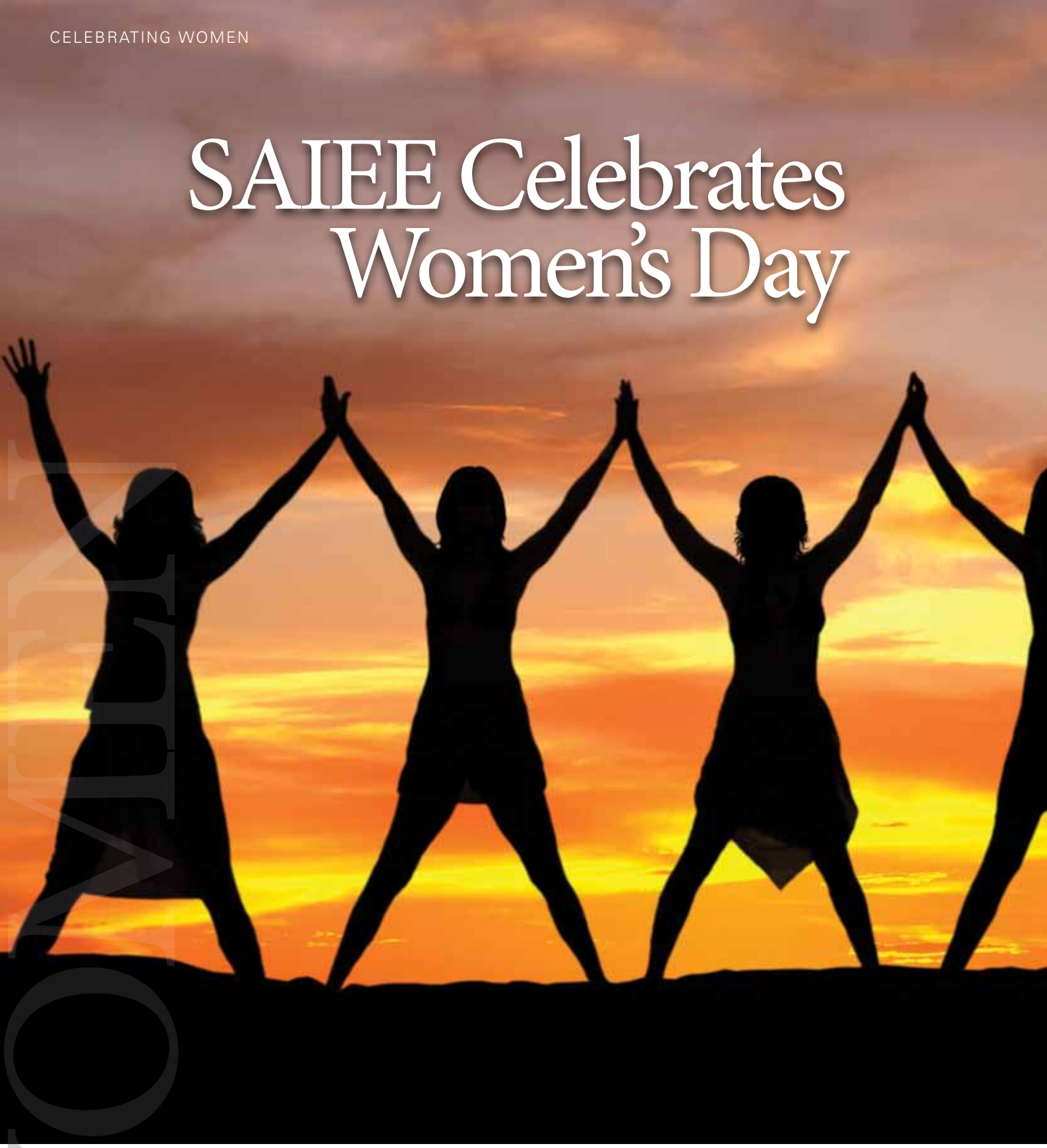
FTTH Council Africa has also developed collateral that explain FTTH in simple terms and make it easy for everyone to understand what it is all about.

The site is also home to a community toolkit which guides communities looking to start the fibre rollout, including information on the value fibre brings, how to organise within your community to drive the project, how to create a business case and how to go about finding a provider to deploy in your neighbourhood.

FTTH Council Africa believes that the development and deployment of fibre based broadband access networks will enhance the quality of life for South African citizens and Africa as a whole, and provide African countries with an infrastructure for the future. Its mission is to see the adoption of fibre deployments by all broadband stakeholders, thereby enhancing the lives of all people living on the African continent.

For more information contact: Juanita Clark, 082 418 1441 or email Juanita@ftthcouncilafrica.com wn

SAIEE Celebrates Women's Day



In the spirit of celebrating National Women's Day on the 9th of August, I decided to shine the spotlight on the women, who are amongst 50 engineers serving on the South African Institute of Electrical Engineers (SAIEE) Council. These women not only juggle careers, they are wives and mothers and still find the time to volunteer and contribute to our institute. I posed a few questions to get to know them better...

BY | MINX AVRABOS

If you want something said, ask a man; if you want something done, ask a woman.

- Margaret Thatcher

Council Women

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JANE BUISSON STREET FSAIEE

How long have you been a member of the SAIEE? I became a member ± 9 years ago. I'm a Fellow.

Where did you study? NHD Elec Eng (H/C) at UJ, BSc (Stats & Comp Sc) at UNISA and MEng (Information Engineering) at Wits.

What is your favourite meal? Mussels

What do you do to relax? I'm a psychotically addictive reader, and for fun I love walking in the cold.

Are you in a relationship? Do you have children? Yes, I've been married 25 years and have two children, both in their early twenties.

What advise do you have for young aspiring engineers? The same as I would any young person, make sure you enjoy what you do; it's not worth dragging yourself through the next 40 years!

REFILWE BUTHELEZI MSAIEE

How long have you been a member of the SAIEE? Approximately 5 years

In a 100 words, please describe a typical day in your life (as if a woman has such a thing). I have recently moved to a new role at Rand Water, which is extremely exciting and challenging. Because I have moved from the power to water industry, I have had a steep learning curve, therefore my days have been packed with key stakeholder meetings related to projects, management of all automation, control and instrumentation assets, and IT/OT integration related matters. I am slowly getting back to a more measured pace.

Where did you study? University of Johannesburg.

2016 SAIEE President TC Madikane's theme is two-fold - #makeithappen and #ploughback – How have you embraced his theme? As an engineer I struggled to understand how the engineering industry would continue to grow and flourish when the matric results are constantly a matter of concern. I therefore had to find a way to contribute towards expanding the reach of science, mathematics and English education to disadvantaged schools. My involvement at the Pfuxani STEM (Science, Technology, Engineering and Mathematics) foundation, awarded me the opportunities to make that happen.

What do you do to relax?
I love the outdoors, so I enjoy picnics now and then. At home, I love cooking, reading and watching TV with the family. I need to learn how to bake now.

If you could invent anything, what would it be? I would invent an ironing robot for working moms.

SY GOURRAH FSAIEE

How long have you been a member of the SAIEE? I have been a member of the SAIEE since 2003 and a Fellow since 2012.

Please describe a typical day in your life.

As a woman, balancing work, family commitments and household requirements is often the largest challenge for me. A typical day in my life would be as follows: Firstly, I spend quite time, then check the latest on news24 and Facebook!!! Making the lunches and checking the kids' schedules with last minute instructions of what must go into their bags!! Check that the transport for extra mural activities is on track and head for the road. A day at the office often starts at 6:30am when I check emails and then I feel like my office converts to a train station. Project updates, financial updates, tenders, meetings and numerous problems on sites that have to be co-ordinated and managed.

Finally, when I head home I have to mentally prepare my shopping list, and decide what's for dinner. As soon as I get home, the cooking starts, get the kids to shower, pack their bags, start with homework and supervise the studying for tests. We eventually have supper and fall into bed exhausted. And then I wonder where I fit in exercise - lol???

Where did you study? Graduated from Mangalore University in India as a Bachelor of Engineering: Electrical & Electronics

What is your favourite meal? Of course hot curry – lol!

What do you do to relax? I love to travel, see new places, experience different cultures, experiment with a variety of culinary tastes, watch movies and read quite a lot.

Are you in a relationship? Do you have children? Yes - married to Dawie with two kids – Kayleigh & Keegan

PRUDENCE MADIBA SMSAIEE

How long have you been a member of the SAIEE? I became a member 14 years ago.

In a 100 words, please describe a typical day in your life. No matter how busy life gets, I always make the time to take my kids to school in the morning. Then I'm off to work, and managing the extra mural activities for the kids. I usually get back home around 7 pm, just in time to set the dinner table, check homework and bath the kids. Then I usually review ECSA reports, follow up on actions from committees, and then check any urgent emails before going to bed. My day is gone.

What is your current position in your company? I work for Eskom as a Senior Manager for Electrical and Control & Instrumentation Engineering.

What is your favourite meal? An African meal, samp and beans with beef stew.

Are you in a relationship? Do you have children? I am a wife and a mother of two. Ditheto is 11 years old and Mhlonipheki is 3 years. I have a young family that also requires my attention and availability to participate in the family/school activities.

What advise do you have for young aspiring engineers? Africa is a beautiful continent, full of opportunities and only through creating a society that is technically skilled to take advantage of these opportunities, can Africa be set free to grow to its full potential. The power lies within us. We can make a difference. It is not upon someone else, we all have the ability to contribute - what better way than applying it to the engineering field.

LEBO MAPHUMULO MSAIEE

How long have you been a member of the SAIEE? Since 2005

Where did you study? Universiti Technologi Petronas in Malaysia.

2016 SAIEE President TC Madikane's theme is two-fold - #makeithappen and

Council Women

continues from page 19

#ploughback – How have you embraced his theme? I do a lot of work for ECSA. I started in 2008 and am still going strong. This is my way of giving back to the profession and the country.

What is your favourite meal? Samp and mogodu (tripe) and sashimi .

What do you do to relax? I enjoy going to the movies with my babies.

Are you in a relationship? Yes I'm married and have 3 children.

If you could invent anything, what would it be? A system that would afford everyone equal education and health care. Private school and hospital fees are so expensive, even a typical middle class worker can't afford it.

What advise do you have for young aspiring engineers? Let your work speak for you!

AMELIA MTSALI
SMSAIEE

How long have you been a member of the SAIEE? 12 years

Where did you study? I studied electrical engineering (National Diploma and B-Tech at Technikon Northern Gauteng-Soshanguve Campus (now called Tshwane University of Technology). I also enrolled for Masters in Project Leadership and Management at UKZN.

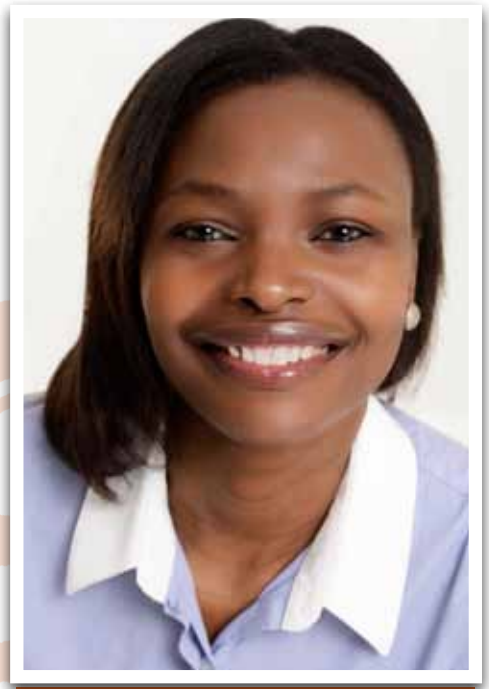
What is your current position in your company? I am a Middle Manager in Eskom, Power Delivery Division, and PTM&C Department where I am responsible for Metering, Measurements, DC & Auxiliary Supply systems and also Security Systems.

What do you do to relax? Is there anything called relaxing? I make some time to either go out for dinner/movie with my husband, or take the kids on an outing. If I were at home, I would take a long bath with a good book to read.

If you could invent anything, what would it be? An automated timer, which monitors people's daily activities and activate it when a person has reached a "saturation point", switches off to force them to take a break and unwind before the body physically gives up. We often push ourselves so hard that we don't even notice when our bodies signal deadly condition until it is too late.

What advise do you have for young aspiring engineers? I would give them this quote by Abdul Kalam "If you FAIL, never give up because F.A.I.L means "First Attempt in Learning". E.N.D is not the end; in fact E.N.D means "Effort Never Dies". If you get NO as an answer, remember N.O means "Next Opportunity".

Young engineers should not be afraid to ask if they require assistance. They should set some goals, believe in themselves, give 100% attitude, always strive to be the best, and enjoy what they do.



ELEKHANYANI NDLOVU
MSAIEE

How long have you been a member of the SAIEE? I have been a member since 2007.

In a 100 words, please describe a typical day in your life: A typical day in my life is a highly organised one. I have accepted that, in order for me to do all the things that count in my life, I have to plan, prepare and be disciplined in the execution on my day, and do what needs to be done, when it should be done. I wake up very early in the morning, and I spend an hour of quiet time in prayer, which is followed by 15 minutes of exercise, 1 hour 40 minutes each morning for each of my commitments (SABS Board Work, SAIEE and ECSA

Work, Phato Investment Cooperative, UJ activities and Household Admin). I make sure that daily I eat breakfast, drink 2 litres of water, I read, I listen to good music, I call or whatsapp a loved one, I have 30 minutes uninterrupted play time with the kids, I read a bed-time story for the kids, and say a prayer, I prepare for the following day (lunch, outfit, to-do list), and prioritise my work to-do list for the following day. I also try cook good healthy food most days of the week. I try and sit with the family for dinner at least 3 times a week. Most days I get it right and I am effective.

Where did you study? I studied BSc (Electrical Engineering) at the University of Cape Town.

What is your current position in your company? I am Head of Engineering at Pele Energy Group, which is Black Owned South African IPP (Independent Power Producer)

2016 SAIEE President TC Madikane's theme is two-fold - #makeithappen and #ploughback – How have you embraced his theme? The theme is quite an inspirational. The theme is not only applicable to my work as council member, so I embraced it by letting that be my focus for the year.

What is your favourite meal? That's difficult to say because eating is one my favourite things to do, so I eat out a lot and I have a lot of favourites, it depends on how I feel.

Are you in a relationship? Do you have children? I have been married for 7 years now to Siyabonga Ndlovu, and I have two children: a boy (Mondli), who turns 6 in September, and a girl (Owethu) who turned 2 in April.

What do you do to relax? To relax I read a good book and listen to good music.

If you could invent anything, what would it be? Time expansion machine…

What advise do you have for young aspiring engineers? Engineers create value and solve problems, and to do that you need skill, focus and a determination to do what needs to be done, no matter how difficult. So don't give up just because it's difficult, it gets better with time and experience, and in the end it's worth the effort of developing and harnessing the skill.

THANDIWE NKAMBULE
SMSAIEE

How long have you been a member of the SAIEE? I have been a member of SAIEE since 2003.

Where did you study? I studied BScEng(Electrical) and MEng(Electrical) at Wits University, and MBA at the UCT GSB.

What is your current position in your company? I am the Network Engineering and Design Manager at Eskom Distribution Kwa-Zulu Natal Operating Unit.

2016 SAIEE President TC Madikane's theme is two-fold - #makeithappen and #ploughback – How have you embraced his theme? I would not be where I am today if others had not ploughed back both their time and money in the profession. I am very passionate about this, as I know the impact it can have on the development and growth of our country, and in reducing inequality.

What is your favourite meal? This is a very difficult question for me to answer as I really love food and I am a very adventurous as well. My favourite meal changes every day, I just love well-prepared food.

Are you in a relationship? Do you have children? I am in a relationship with Siyabonga Khumalo, we are not married and I do not have children of my own but he has three adorable children.

What do you do to relax? I read, or go for long walks, or watch TV, or go out with family and friends, or go to the spa, etc.

If you could invent anything, what would it be? I would invent a better transport system for South Africa, I think a lot of our people's productive time is lost sitting in traffic, and commuting between places.

I would also do away with winter, and have the sun set after 8pm daily.

What advise do you have for young aspiring engineers? Live like today is your last day but plan like you are going to live forever. wn

Earn CPD Credits

This article is dedicated as a coaching guide to provide Internet users with information on the fast Internet broadband access available today and the different types of broadband service you can select.

BY | ENRIQUE DE ARGAEZ

BROADBAND is the common term for a very fast connection to the Internet. It allows users to download online entertainment such as video clips and music, listen to digital radio, send e-mail faster and speeds up everything they do online.

A broadband service can transmit information at up to 40 times the speed of a dial-up modem connection. As the connection is always on, like water or electricity, users don't need to dial up every time they want to log on.

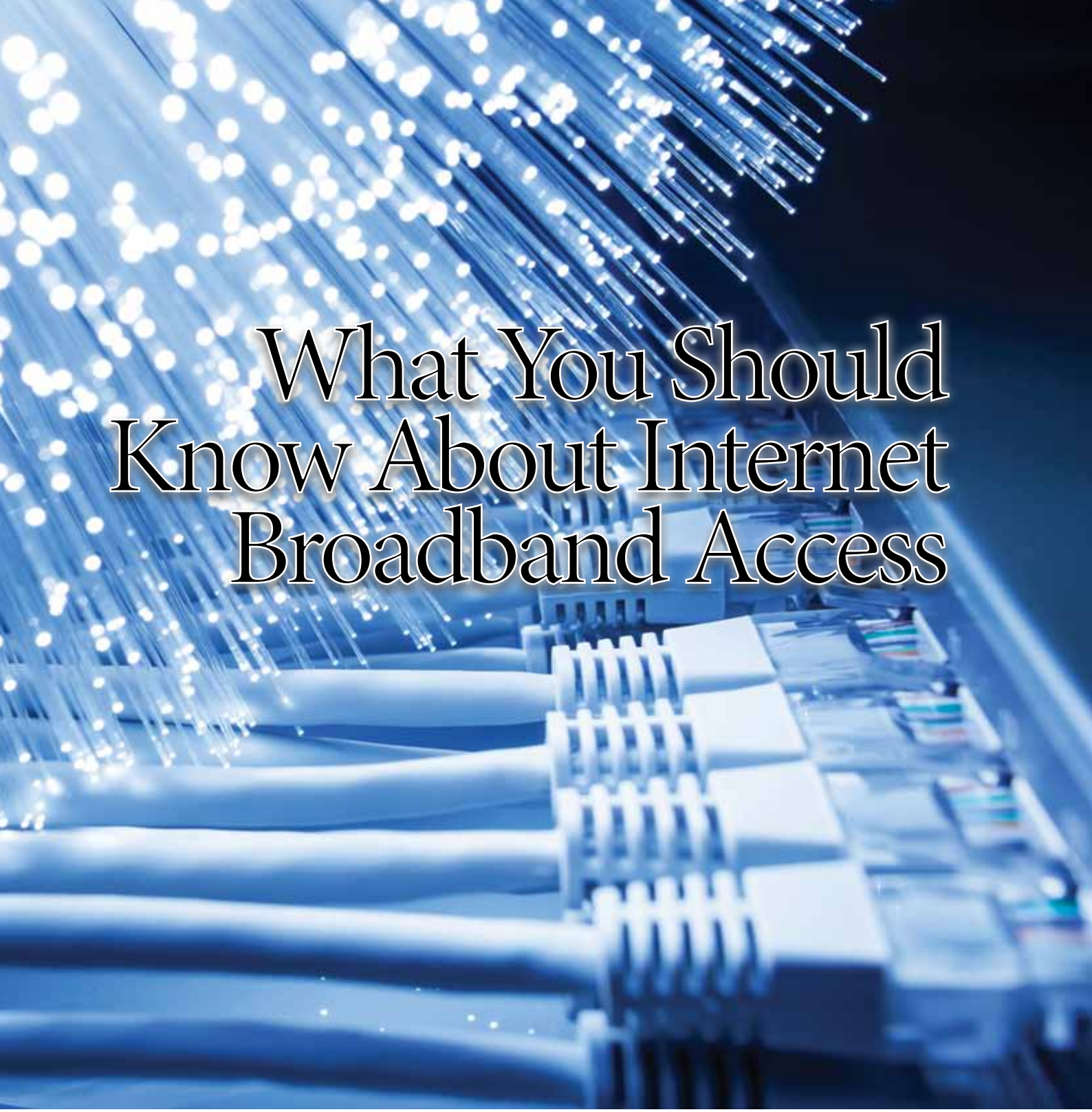
Broadband ADSL also lets people surf the internet and use the telephone at the same time.

Broadband is revolutionising online activities everywhere for businesses, entertainment and public services. Faster speeds of up to 160 times a dial-up connection will bring about new services, including internet-TV and video on demand, across home, business and public life.

FAST INTERNET

For the majority of those looking to upgrade to broadband Internet for the business or home, it's all about the extra speed.

Generally, the term broadband refers to a high-speed Internet transmission (usually 256Kbps and above) featuring a permanent connection. Now coming in a range of high-speed connection plans across a variety of access services, broadband promises



What You Should Know About Internet Broadband Access

to knock the socks off its analog dial-up predecessor for downloading multimedia content images and graphics, videos, networking games, and music streaming.

There are three ways of getting online with broadband - via your TV cable box, your satellite or via your phone line. If you've got cable TV, this is an easy option, but the most common type of broadband access is an upgraded home telephone line called ADSL (Asymmetrical Digital Subscriber Line). ADSL is always connected so needn't be dialled up each time, and you can make phone calls on the same line while it's being used. This entails two costs - a special broadband modem, and an upgrade for your phone line. It's easy to avoid paying for these, however - broadband telephone companies are desperate to sign up customers, so all-inclusive bundles where the start-up costs are paid are common.

ALWAYS ON CONNECTION

More than just the practical benefits of a faster connection, broadband can also change the way you approach using the Internet. With a dial-up connection you may consider it a nuisance to log on frequently to look up small items online

Broadband Access

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— for example, using the Yellow Pages to find a phone number. If, instead, you have an always-on, fast connection, these tasks can be completed quickly, with little fuss. This may seem a trivial example, but it demonstrates a change to a more casual approach to Internet usage.

PRICE FACTOR

Given that broadband services are often touted as being more expensive — there's also the issue of price. In short, broadband is more costly than dial-up.

However, with so many packages out there today many broadband packages are quite comparable to dial-up services. If you are a frequent dial-up user, this equates to many phone calls during a month. Once you factor in the cost of local calls every time you dial-up, plus the cost of your monthly plan, your 56Kbps account may not seem that cheap after all. If you've opted for a dedicated second phone line, you will also be paying additional line rental fees. Compare this to the ADSL plans now available and you can start to see the economic potential of broadband services to their dial-up counterparts.

With an ADSL or cable modem connection, for example, you can surf the Web without tying up your phone line — plus, the connection can potentially be shared amongst other PCs in your home. ADSL, cable modem, satellite and wireless services do generally cost more to set up, but as you will see from this buying guide, there are a variety of ways to reduce the costs of installing the service as well.

TYPES OF BROADBAND

One of the first decisions to be made is what kind of connection you want. There are several options for setting up high-speed services, which all come under the broadband umbrella. However, the type of broadband service you need and have access to will be determined by your speed requirements, budget, and the location (city or regional) of your home or office.

ISDN

Prior to the advent of DSL there were not many high-speed solutions for the home or office. One such is ISDN (Integrated services digital network) which is a dial-up symmetrical service which allows speeds from 64Kbps to 128Kbps. Dedicated ISDN lines can reach up to 256Kbps. The problem with ISDN is that it is incredibly expensive, especially in light of current broadband pricing available today. Nor is it as quick as cable or DSL.

DSL

Telephone networks were never intended to carry data at high speeds; they were initially built to carry an analog voice by converting your voice into an electrical signal. A modem converts digital signals into an analog audio signal that can easily be carried over a phone line. The technical limitations of phone lines mean that the fastest they can carry a signal is around 56Kbps.

DSL (digital subscriber line) technology gets around this problem by using the phone line to carry digital signals directly, without converting them to an analog signal first. This has three advantages: it allows much higher data rates than a regular modem; the connection is always on, which means that you don't need to dial-up each time you want to use the Internet (and incur another cost); and, because the copper wire is split at the exchange, you can use your home phone while on the Internet. ADSL leaves the frequency spectrum between 0kHz and 4kHz free for your telephone service and uses 20kHz to 2.2MHz for data transfer over the copper line. In other words, one phone line will suffice.

There are many different types of DSL, but the one most readily available to consumers and small businesses is Asymmetric Digital Subscriber Line, or ADSL. The asymmetric term means that the service has a much higher downstream bandwidth speed than upstream bandwidth (downstream refers to a transmission from the network to the user, and "upstream" is in the other direction).

ADSL MODEM

ADSL is added to an existing analog phone line in the same way services such as call waiting are added to existing phone services, in conjunction with a special modem. The modem plugs into your computer through either the Ethernet or USB connection (depending on the type of modem), and in the case of connecting through the Ethernet, a network card will be required.

For an ADSL connection to work, your phone needs to be connected directly to the phone exchange by a copper wire connection, and you need to live within a

5km radius to the exchange. The distance isn't a problem for most city residents, but is a great deal more of a problem for rural residents. Plus, if any part of the connection is digital, for example through a switchboard, ADSL won't work. For people in businesses with PABXes, remember that most fax lines are not connected through the switch, and may not be suitable for ADSL.

Telephone companies need to install special equipment at the telephone exchange to handle ADSL connections. You don't need to know much about these things except they have weird names like BRAS or DSLAM (DSL access multiplexor) which essentially convert the copper signal to the main ATM telecoms fibre backbone.

The best way to find out if you're eligible for ADSL is to check with the service provider. Several ISPs now offer services on their Web sites which can tell you if the copper wires around your area are suitable for DSL services. According to surveys, around 70% of copper wires throughout the world are DSL capable.

ADSL is usually available to consumers in the following range of speeds:

- 256Kbps downstream/64Kbps upstream
- 512 Kbps downstream/128Kbps upstream
- 1500Kbps downstream/256Kbps upstream

While ADSL can reach speeds of up to eight to 10Mbps over short copper lengths, it is almost never run at this speed. Most carriers cap the service at a rate of 1.5Mbps. This is because only a few customers in a close proximity to the exchange will be able to get these higher data rates. So, to avoid favouring users who are geographically close to the exchange, carriers elect to offer the same speed to all users.

Other DSL services available which are targeted at the SME and larger business market include SDSL (symmetrical DSL, which basically provides users with equal upstream and downstream speeds of up to 2.3Mbps), and HDSL or High bit-rate DSL. HDSL, one of the earliest forms of broadband, is predominantly a business grade service used for wideband digital transmission within a corporate site and between the telephone company and a customer.

Like SDSL, HDSL is a symmetrical service and offers speeds of up to 1.5Mbps. Both symmetrical services are targeted at businesses that require a higher level of upstream speed, to perform applications such as Web hosting and teleconferencing (more on these later).

Another developing broadband technology is Very High data rate DSL, or VDSL. VDSL promises to offer speeds of up to 50Mbps for lines up to 300 metres in length and runs on existing single copper pairs. There are two competing standards of VDSL: one which uses the same technology as ADSL and essentially adds extra frequencies to the standard ADSL frequencies; and a second which employs a completely different coding scheme.

Unfortunately, VDSL is a very expensive technology to deliver and is unlikely to be deployed on a wide scale because most customers won't be close enough to the exchange.

While VDSL has a much higher possible throughput than ADSL, it doesn't really help in extending reach over ADSL. Where it is likely to be used is in an environment where customers are close to the termination point and a service such as video requiring more than 7Mpbs is being delivered.

CABLE

The fibre networks that bring you cable TV at home can be more than an addition to your viewing options — it can also be your means to fast Internet access.

HFC (Hybrid Fibre-Coaxial) networks that are used to carry cable TV pictures are also capable of carrying data at very high rates. The current cable TV signal doesn't take up all of the available bandwidth, because these cable networks were designed to carry a digital TV signal, rather than the current analog signal — and this spare bandwidth can also be used to carry Internet data.

However, people who live in blocks of flats or apartments may face additional difficulties. If cable isn't already installed in your building, getting it installed requires the cooperation of the body corporate or building manager.

Even in buildings where cable is already installed, depending on the type of equipment in place in your building, you may not be able to use cable as an Internet connection.

Broadband Access

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Unlike DSL a cable service is "shared". This means all subscribers on a given neighbourhood or node [a connection point] share a fixed amount of bandwidth. In theory the more people connected to a node, the slower it takes to download information off the Internet. In other words, a node accessed by only 250 people will generally provide a faster service than a node with 2,000 users.

Cable companies have tricks to get around this. One of the cable operators tricks is to scale its network (where more connection points are added) to suit the number of customers in a particular area of the network. Adding more connection points means they are able to rebalance the network so that customers in all areas of the network are receiving equal performance levels. Scaling the network is also known as "Node Grooming" and the cable companies say they carry out node grooms regularly.

Once the cable is installed, you'll need a cable modem to get connected. This connects at one end to the cable, and at the other end to your PC, either through an Ethernet or a USB connection. Cable modems can transfer data at theoretical speeds of up to 3Mbps. However, because cable is a shared medium with many other users on the same line, performance varies with the amount of subscribers using that particular stretch of bandwidth, as well as the usage patterns.

Most cable modems use Ethernet connections, and the cable company will be happy to sell you a network card as part of the installation if you don't already have one. (In fact, they prefer you to use the card they sell you, because they know it works well with the modem, even though — in theory — the modem should work with any card.) When the cable connection is installed, the technician will also load the required software on your PC. Software is available for all versions of Windows and for Mac OS, but not all providers have Mac software, so it's worth checking before you order. While there is no official support, it is theoretically possible to connect under Linux.

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Many operators use a cable modem that is compliant with the DOCSIS (Data Over Cable Service Interface Specification) standard, which is the most common standard used worldwide. DOCSIS is an open standard, and any manufacturer can make modems that support it.

Cable download speeds are very fast, but, as usual, this can depend a great deal on the source from which the files are being downloaded. Ping times are also very fast, which is a boon for online games. However, as with the rest of the Internet, performance varies depending on the time of day and several other factors, such as the number of subscribers on the specific bandwidth strand.

SATELLITE

Satellite is often touted as an alternative to fixed-line access such as cable or ADSL, but it does have limitations and is yet to offer the same sort of data speeds. Despite that, satellite has succeeded in providing much faster and often more reliable Internet service, particularly in rural and regional areas, than the standard public system telephone network.

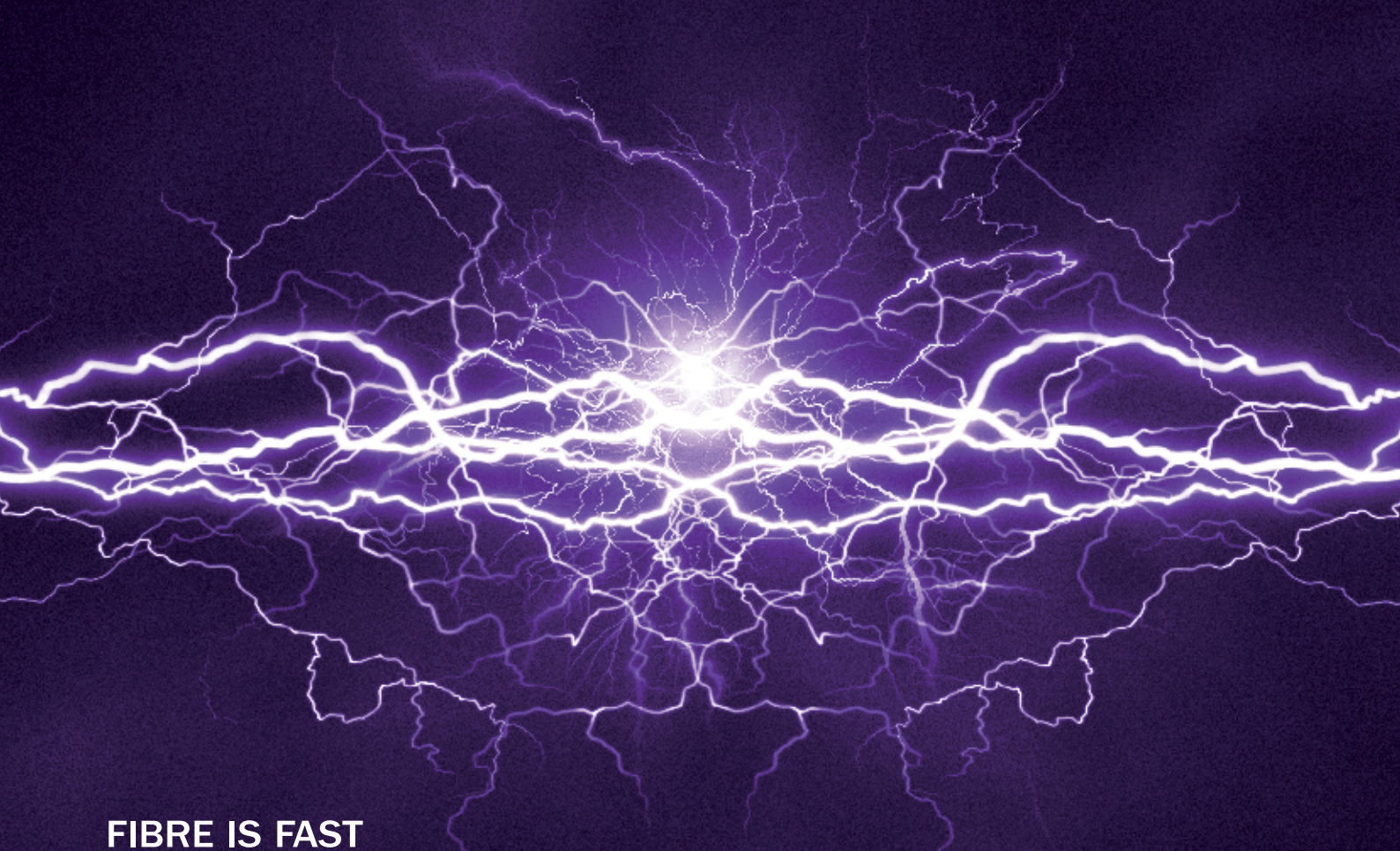
There are two types of satellite services you can use: asynchronous and synchronous. Similar to the asymmetrical DSL service, asynchronous means that there are different speeds for upstream and downstream traffic (again, downstream is faster than upstream).

Synchronous satellite services on the other hand, have the same speed for upstream as for downstream, which makes it more suitable to services that are heavily impacted by delays, like video and audio streaming.

Generally these satellite technologies work on one of two principles:

- Data is downloaded from the satellite to a terrestrial base station and from the base

Lightning Speed?
Try Fibre Speed.



FIBRE IS FAST

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station to the consumer by microwave link. The consumer requires a receiving dish or antenna and a standard phone modem for uploading data to the base station and from there to the satellite.

- Data is downloaded directly to the consumer's satellite dish but a phone modem is still required to upload data to a terrestrial base station and to the satellite.

Data download speeds for consumer systems usually range from 64Kbps to 400Kbps, with upload transfer rates restricted to the 33Kbps maximum of any 33Kbps or 56Kbps modem. More expensive corporate systems can go as high at 2Mbps. Speeds can be affected by traffic volume and even bad weather, and costs vary considerably depending on the carrier.

2-WAY SERVICES

However, recent satellite technology developments have paved the way for the launch of broadband satellite service. This service connects the user to the Internet via a 2-way satellite connection.

The 2-way service promises users download speeds of up to 512Kbps, and upload speeds of 64Kbps or 128Kbps. Unlike the 1-way satellite services mentioned above, the 2-way service also provides users with an "always on" connection to the Internet because it no longer requires a dial-up modem connected to a phone line to upload data. Instead, the information that is exchanged between the satellite, your dish and satellite equipment is securely encoded and decoded by a special satellite modem attached to your PC.

Because 2-way uses a different satellite to transmit Internet services and requires different hardware to operate, users with existing 1-way equipment will not be able to upgrade to the new 2-way product.

Again, like ADSL or cable, the satellite 2-way service has been designed to only support a single computer connection.

WIRELESS

Wireless broadband services are centred around the IEEE 802.11 standard.

Lucent Technologies, Nortel Networks and Symbol Technologies worked with the Institute of Electrical and Electronics Engineers (IEEE; www.iee.org) to create the IEEE 802.11 specification for use with wireless area networks. There are currently four specifications in the family: 802.11, 802.11a, 802.11b, and 802.11g.

The most widely deployed of these today is 802.11b (often called Wi-Fi), which runs on the public 2.4GHz spectrum and is capable of data speeds of up to 11Mbps over a range of up to 150m.

This data-only system utilises a small base station connected to a wired network or to the Internet and transmits data wirelessly to multiple workstations, which can be desktops, laptops or even handheld PCs. Each base station can service several users equipped with wireless receiver cards in their computer, and base stations can be overlapped to allow several hundred users to access the network or Internet.

But while 802.11b has gained the most popularity of the wireless services, the first Wi-Fi5 or 802.11a certifications for wireless LAN access points and cards were out in October 2002. 802.11a uses the 5GHz waveband and promises speeds of up to 54Mbps, but is not interoperable with 802.11b.

BUSINESS AND HOME BROADBAND ACCESS

The primary differences between residential and SME/SOHO broadband customers is the criteria they use to select their service. For SME/SOHO users, performance and price will be key ingredients in selecting a broadband service, as well as support for value-added services such as VPNs. Fixed price packages versus fixed volume also play a role for large or small businesses. For consumers, it's all about price and value.

For those who are planning to use broadband services in a business environment, there are several differentiators to look out for, particularly in the DSL space. Business DSL services for example, can include support for multiple users and tailored network configurations, additional technical support and a higher level of guaranteed network performance.

STATIC AND DYNAMIC IP ADDRESSES

A key factor for business users to consider is the static IP address options. To understand why there are two different ways of assigning IP addresses, it is important to know what an IP address is used for.

An IP address is the defining tag which identifies the host computer on the Internet. This includes identifying the network being used to access the Internet, as well as the host computer accessing the data across that network. A good way to understand the difference between a static and dynamic IP address is to compare a public telephone (dynamic IP) to your home phone (static IP).

The dynamic IP address is like a public telephone, as it provides you with a temporary connection to the Internet for you to download information from. Once you log off the internet (hang up the phone), you will lose that particular IP address (phone number) and the IP address will be thrown back into the network and re-allocated to another user. The next time you log on to the internet, your ISP will allocate you a number from its available pool of numbers.

In comparison, a static IP address is fixed to either or both the sender or receiver of data across the Internet (much like your permanent home phone number is allocated to you). With dynamic IP, Web servers will only be able to locate you through that IP address for that partcular Internet session.

So, if you want to upload information (eg. give Web servers your IP address so they can contact you, such as with e-mail or hosting your own Web site), you will need to ensure whatever service you sign up for provides you with a static IP address.

However, having a permanent connection (by giving other Web servers the ability to locate you) will pose a greater security risk, so you will need to put security measures in place, such as firewalls.

Around half of ISPs currently providing ADSL residential services offer static IP addresses with some of their plans, but often the monthly rates will be higher than those offering dynamic IP addresses.

Cable providers in the residential market offer dynamic IP addresses only.

SHARING BROADBAND ACROSS MULTIPLE PCS

There are a number of ways to share your broadband with multiple computers. These fall into two categories. The first is a line sharing option provided by the ISP. This requires additional outlets to be installed in your home or office for each PC. It is a simple solution that requires no additional configuration, but is currently only available with certain cable companies.

The second involves running a Local Area Network (LAN) in your home or office. It is important to note that while most ISPs will allow you to run a LAN from a single connection point on ADSL or cable services, they will not provide any support for the LAN, and recommend you consult a communications specialist to set it up for you. In some instances the ISP may be able to refer you to an appropriate consultant, but this will depend on the ISP. Some ISP will refer its ADSL customers wanting to establish a LAN to a professional third-party consultant, but others do not deal with LAN services at all.

The other issue with setting up your own LAN is providing each user with their own e-mail account. If you want to have multiple user accounts included in your broadband service but have only signed up as an individual user with your ISP, you may incur a fee for each additional user you introduce. For instance, customers who have signed up to the service as a single user initially, will have to pay extra setup and ongoing monthly fees for each user account they want to add on to their service. This means that if you want to have seven people hooked up on your LAN with different e-mail addresses, you will need to pay an additional fee per month on top of your monthly service charges to have the additional user accounts connected. However, other ISPs do not have this restriction on multiple user accounts. Most will provide residential subscribers with as many as five e-mail accounts on its cable service free of charge.

If you are going to set up a LAN on your broadband service, be it cable or ADSL, there are three main ways of sharing the connection between multiple PCs.

Firstly, you can use a hardware router, which is arguably the best solution, although it is also the most expensive one. Router prices start at a couple of hundred dollars, and allow you to simply plug your modem into one side and your PCs into the other and you're away. They handle the logging-in, line sharing and security without the issues that plague most of the alternatives, which involve specific hardware and software configuration, as well as a dependency upon a single server PC.

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DSL router Option two is to use a proxy server, which is a piece of software that runs on the PC that is connected to the modem. In addition to proxy software, you will need a network card and cable for each computer as well as a network hub.

For cable, this requires that the server PC has two network cards - one for the modem and one for the LAN. ADSL users have the additional option of plugging the modem directly into the uplink port on the hub (using a special crossover cable).

Once you have your hardware sorted, there are plenty of proxy server software packages available. Many of these are freeware (such

as AnalogX at www.analogx.com), but most are inadequate if you want to do more than just surf the Web and read e-mail.

Those that are suitable for using with other applications such as IRC, gaming, instant messaging, FTP and peer to peer networking will usually involve a fair amount of configuration and trial and error to get working properly. If you have an old, unused PC, it might be worth considering using it as a dedicated proxy server.

Using software such as Smoothwall (www.smoothwall.org), you can quickly and easily configure it to run as a standalone proxy server without the need for a Windows licence (as it is Linux based) or any other cost, aside from a network card.

The benefit of using a proxy server is primarily the level of control you have over how PCs on your LAN connect to the Internet. The downside is that each Internet application on each client PC must be configured to use the proxy. If you are running Windows 95 or you want to keep your LAN secure and undetectable, then a proxy is probably the best way to share your connection. If you are running a later version of Windows, or Linux, or your PCs are going to be using Internet applications such as instant messaging and multiplayer games, then using Network Address Translation may be a better option for you.

Option three is to use Network Address Translation (NAT). This is commonly done using Internet Connection Sharing (ICS) built into Windows 98, ME, 2000 and XP. Linux users will need to configure ipchains or install something like freesco (www.freesco.org) to utilise connection sharing via NAT.

This option is transparent to users on your network as it involves each computer being assigned an IP address by the ISP. So if your ISP doesn't allow you to use LANs, then this is not really an option. The benefit of NAT is that it requires almost no configuration at all and allows you to use all your PCs as if they were directly connected to the modem. As per the proxy server option, you will need a network card and cable for each computer as well as a network hub. You will also need an additional network card for the server PC unless you are using ADSL and choose to connect the modem to the hub with a crossover cable.

It is worth bearing in mind that of all the options available, the last two are limited by the fact that if the computer connected to the modem crashes or is shut down, the Internet connection will be unavailable. If you use a router or have multiple outlets installed, then all your PCs are online all the time, and none are dependent on the others working correctly.

RUNNING A SERVER ON YOUR COMPUTER

Most broadband packages do not allow you to run server software from any computer connected to your modem, be they Web, FTP, e-mail or other type of server. Those that do usually involve your server being assigned a static IP address. Essentially, this means that your computer's online location will be predetermined. Therefore, a static IP address is useful because it allows it to be mapped to a domain name in the DNS. For example, if you want to run a Web server for www.yourname.co.za from your home or office, you need to have a static IP that can be mapped to that domain name, in order to make it visible on the Internet. If you haven't specifically requested an IP address from your ISP, then you will almost certainly be on a plan that dynamically assigns you an IP each time you log on with your modem.

It is possible, though, to have a domain name mapped to your computer even if you are assigned an IP address dynamically. The general name given to this technique is Dynamic DNS, or DDNS. To use DDNS, you need to use a service provider which requires you to install client software on your PC. The function of this software is

to broadcast your PC's IP address to the DDNS server, allowing your IP address to change without your domain name seemingly disappearing from the Net.

If you run remote access software such as pcAnywhere or VNC, then a dynamic DNS service such as those mentioned may be quite useful if you want to access your desktop from the Internet.

A BACK-UP PLAN

Although broadband operators have a scheme to refund their Internet clients for network outages, this doesn't solve the problem of what to do when your broadband connection goes down. So if you're moving from a regular dialup modem, our advice is not to uninstall it.

Chances are it will come in handy when you need to send an e-mail or use the Web but you can't connect because the ADSL network is down. Remember, DSL is still a newly installed technology so some operators may have a few hitches during their initial roll-out phase.

If you use your modem to send and receive faxes, then bear in mind that broadband won't replace this particular function at all. If you have a second phone line that was dedicated to the modem, then you can probably justify ditching it and sharing the one line for the phone and modem.

A good backup plan for times when your broadband service goes down may be to find an ISP that offers a prepaid dialup account. This way you're not locked into a monthly fee for a service you rarely need, but when you do, you only pay for what you use.

SECURITY

Whenever you are accessing the Internet you are exposing your computer to potential risk. Because people don't tend to stay too long on a PC when they have dial-up connections, most don't pay that much attention to the threat. Many users are savvy when it comes to security, installing not only antivirus software but firewalls as well. Zone Alarm is the clear favourite if HelpScreen is a judge – largely because it is free (there is a Pro version which has more features, but this incurs a cost) and very effective.

The importance of a firewall when you are connected to a broadband service cannot be stressed enough. Unlike dial-up, where a user can disconnect their Internet connection and then in an inadvertent way also secure their PC because they are offline, broadband users don't have that luxury. They are exposed to the Net's nasties continuously So when you are not monitoring your computer, why not get software to do it for you. It is up to you whether you want to use a free Firewall or pay for one – most of the antivirus vendors offer some sort of firewall. But whatever the case, install it. Having a broadband connection without a Firewall is an invite to security incursions.

OTHER QUESTIONS TO ASK:-

Is this service available in my area?

The best way to check whether a broadband service is available in your area is via an ISP's Web site. One way to do this, for example, is to enter your phone number or postcode in the ISP facilities on their Web sites which will allow you to see whether you can receive their chosen services.

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How much does it cost to install?

Installation prices will depend on a range of conditions, including whether you install the service yourself or opt for a technician; how long you sign up to the plan; what modem you choose (for example, if you select a 1 or 4 port ADSL modem, or if you buy a modem independently of the ISP) and any additional equipment you need (such as a Ethernet card, additional phone line filters or splitter).

SELF-INSTALLATION PACKAGES

Several broadband ISPs have also been actively promoting self-installation ADSL packages, which not only save subscribers from the hassle of waiting for a professional technician to come out to their home, but also reduce the cost of installing ADSL services.

To give an example, a new range of self-installation packages for 1 and 4 port ADSL services are available, which take money off the price of having the service installed by a professional.

These savings are based on subscribers installing the modem and service themselves. Users will be charged an additional fee to have the service installed by a technician. Prices are again on an ISP-by-ISP basis, so check out some of their Web sites for more details on professional versus self-install charges.

ADSL BROADBAND IN A BOX ADSL ROUTER

A range of ADSL services have now been introduced as bundled broadband packages available from retailers shelves. Much like purchasing a pre-paid mobile phone, these broadband in a box bundles provide subscribers with an approved selection of modems, service plan, and one fixed IP address and are targeted at home and SME users. If you're confident you can install the service yourself, or you need the static IP address, this option may be a good one for you.

WHAT ARE THE DOWNLOAD LIMITS PER MONTH?

Most broadband services are now capped at a certain amount of download capacity per month, which means you will be charged an additional amount for any excess downloads. Some service providers, however, offer uncapped plans which do not charge for additional usage, but instead reduce in speed as users exceed their monthly limit. This is worth looking into if you think you are likely to go over your specified download limit.

The download limit is determined by the plan you sign up for. Plans for both ADSL services and cable in the residential space range from 300MB download limits per month, to up to 10GB (and of course, the more download bandwidth you require, the higher the monthly usage charge). Make sure you check these limits thoroughly before subscribing to a service.

Note: Some ISPs will also charge for upstream traffic. If you are planning to upload a lot of data onto the Internet (running a Web site for example), you're best to check out what the ISP's policy is regarding uploading information before you sign on the dotted line.

WHY ARE DOWNLOAD LIMITS SO HIGH?

You will find that when you exceed a download limit, and then start paying by the megabyte, the normal fee varies with some operators charging slightly more. The main reason for this is because the most Internet traffic in the world is directed at US sites. The problem with this is that the cost of sending information undersea is expensive. So these high tariffs imposed by the undersea cable operators are then passed onto to the broadband service provider who then passes these on to users.

WHAT IS THE ACCEPTABLE USE POLICY?

With most Internet services, subscribers are expected to sign a contract to cover the usage of these services. When signing up to a broadband service, this is known as an acceptable use policy. In other words it is a code of conduct.

Some of the conditions subscribers must adhere to when signing such a policy is not to knowingly transmit a computer virus or disrupt the network, illegal acts such as accessing another person's computer system or sending bulk unsolicited e-mail. A copy of the ISP's acceptable use policy should be available on their Web site.

WHAT SERVICE LEVEL GUARANTEES (IF ANY) DO YOU SUPPLY WITH THIS SERVICE?

In the residential broadband space, very few ISPs provide service level guarantees for their ADSL broadband service. Business plans will tend to offer a more reliable service, and guarantee a certain

level of performance from the network. This guarantee will be up to the ISP. Most of the equipment provided by the ISP will be covered by a warranty (the length of which will depend on the contract you have signed up for).

WHAT LEVEL OF CUSTOMER SUPPORT DO I RECEIVE?

Again, this will depend on the individual ISP, as well as the plan you select. Business customers can expect a higher level of support than residential users, but they will pay more for the privilege.

HOW LONG DOES IT TAKE TO INSTALL?

For DSL services, ISPs suggest it will take around 15 working days to have the entire installation process completed (this can however, stretch out to four weeks depending on the availability of the required modem, or the number of subscribers in the queue to be connected). Note: broadband in a box customers are also subject to these waiting times. Cable customers on the other hand are able to hop onto the service immediately after it has been installed.

DO I GET A DISCOUNT IF I ALREADY HAVE AN EXISTING PHONE ACCOUNT?

ISPs that offer other services such as Internet or telephony often have special deals in place for existing customers who want to sign up to broadband, so it's worth checking these out to see what kind of deal you are entitled to. For example, customers can receive discounts on the monthly costs for broadband services if they have existing telephony accounts or cable TV. Other ISPs may waive the costs of installing the service if you are already a dial-up customer.

HOW LONG IS THE SERVICE PLAN?

The length of the service plan you select can also have a bearing on the amount you pay for the installation of the service. Generally, the longer the contract, the cheaper the cost of installation will be.

Bear in mind, if you wish to cancel the service, ISPs will charge a cancellation fee (this is usually worked out on the proportion of months you had remaining on the contract – much like a mobile phone bill).

WHAT SYSTEM REQUIREMENTS DO I NEED?

- ADSL system requirements
  For a PC connection, you will need a 200MHz or higher Pentium processor, with a Windows operating system (with the exception of a very few who can support Windows 95, you will need Windows 98 S.E. or up). The amount of RAM you require to run the service will depend on the operating system you use: for example, users with Windows 98 will need 16MB – 64MB of RAM, while Windows 2000 and ME users will need 64MB RAM. All users will also need between 20MB - 150MB of free hard disk space, as well as either a USB or Ethernet port (depending on the modem).

  Mac users are recommended to have a Power PC or iMac, and require 20MB free hard disk space as well as an Ethernet connection. Mac OS users will need 12MB RAM, while Mac OSX users will require 128MB RAM in order to access an ADSL service.

  Both Mac and PC users need to have a CDROM drive for the installation software.

- Cable system requirements
  System requirements for cable services are similar, and Windows users will need a system with similar RAM specifications as those mentioned above. Cable services will require 125MB – 150MB of free hard disk space (although some Windows XP users with cable plan will need 500MB of free hard disk space). All cable modems for Windows connect through to your PC via either a PCI slot or USB port, so users will also need to have a spare USB port, while Macintosh users will need to have an Ethernet connection.

- Can I use Linux?
  Cable and ADSL providers do not officially support Linux, but that doesn't mean you can't use the service with this operating system.

Some cable services use DHCP to allocate IP addresses to users. DHCP is a standard protocol for allocating IP addresses on Ethernet networks, and has been used in small and large office networks for years. All you need to do to switch your broadband service to your Linux computer is configure a UNIX DHCP client with the correct DHCP id.

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You also need to ensure your network card is set up correctly for Linux.

Some cable users will need to configure their Linux machines for unique home-grown protocols. These programs provide user/password login control, as well as regular network checks, but was designed for the officially supported platforms only – not Linux.

While Linux is not officially supported by ISPs offering ADSL services, the PPPoE protocol (more on this below) used in ADSL technology to connect users to the service is well supported by Linux. Again, it's just a matter of configuring the PPPoE client to suit your Linux set up.

WHAT MODEM SHOULD I USE?

External ADSL modems are available with two network interfaces: USB or Ethernet. USB compliant modems allow users to connect the modem to their PC via a USB port, while Ethernet-based modems connect up via the PC's Ethernet port. (Note: users will also need a network card to support an Ethernet modem).

While your choice of modem will effect the cost of your ADSL installation, modems can also play a surprisingly influential role in the security of your high-speed connection. Some ADSL modems for example, offer additional features, such as built-in firewalls or PPPoE clients.

If you are going to bring your own modem, be wary that ISPs will not let you use any old modem; you will need to buy a product approved by the ISP. This will also mean that your modem will not be covered by any warranty from the ISP. In addition, some ISPs will not allow you to bring along your own modem – you will only be able to get the modem available at the time of installation.

Another thing consumers should be aware of is that not all ISPs offer modems with their services – and in some cases, the use of the modem is on a rental basis. This means that if you want to cease services with one ISP and join another before your contract is up, you will be expected to return the modem to your original ISP. Make sure you check the conditions of modem use before signing up to any plans.

Before we leave this point, it is important to stress the importance of the modem as a security measure. If possible, do not skimp on the modem. Security is a big issue with broadband (see Security) and if you install a modem with a in-built Firewall – and there are many available today, you are cutting down the risk to your information from the outside world considerably.

Once the modem is connected and you have confirmation from your ISP that the service has been connected at their end, install the software, enter your username and password through the PPPoE client (see glossary for more details) and you're online.

PPPOE CLIENT

PPPoE (Point-to-Point Protocol over Ethernet) is a specification for connecting multiple computer users on an Ethernet local area network to a remote site through a modem or similar device. This client is used by ADSL service providers to authenticate their customers on the network.

During an initial exchange between the PC and the remote site (or ISP), the PPPoE client learns the network address and allocates the dynamic or random IP addresses assigned to a user each time they authenticate to a broadband service.

When an Internet session ends, that IP address goes back into the pool and gets allocated to someone else.

As the PPPoE client is a generic program, users do not have to stick with the client packaged alongside their broadband service. A list of PPPoE clients can be obtained by doing a Google search.

Unlike dial-up connections, DSL and cable modem connections are "always on". Since a number of different users are sharing the same physical connection to the remote service provider, a method is needed to keep track of user traffic, including which user should be billed.

Once a session is established between an individual user and the ISP, the session can be monitored for billing purposes. Because it is similar to the client used for dial-up, PPPoE clients are exposed to the same amount of vulnerability to attack. wn

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Change is coming to Communications Service Provider (CSP) networks, because it has to: a more flexible, intelligent network is fast becoming a strategic imperative for leading CSPs.

BY | JAMES BRIDGES

The Role of Software Intelligence in Network Transformation

Until recently, network flexibility was largely limited to automating specific tasks in a network, and the automation of these tasks was not tightly coupled with overall business processes. With the advent of software-centric networking models, CSPs will be able to offer services that are differentiated by the architecture and flexibility of the network, and fully integrated with OSS (Operational Support Systems)/ BSS (Broadband Switching System) systems, rather than simply providing connectivity services.

While Software-Defined Networking (SDN) and Network Functions Virtualisation (NFV) technologies are at the core of this change in network architecture, it's how software intelligence is integrated with these technologies that will be key to the value delivered by this network transformation.

The demand for network capacity seems insatiable. AT&T recently stated that data traffic on its mobile network grew a thousand-fold from 2007–14, while revenues from its wireless operations were up only 60%.

With 5G mobile networks appearing at the end of the decade, and promising a 100x increase in wireless broadband speeds, it's clear that CSPs are facing a critical business challenge: how to accommodate network traffic demand that is growing far faster than revenues.

The answer, of course, is migration to a virtualised infrastructure with SDN/NFV technology. This migration to software-centric networks is happening on a global basis. That's largely because CSPs around the world see the benefits that will accrue from adoption of this technology, and are taking an active role in driving this change.

While cost savings are certainly a component of value in the migration to SDN/NFV, there is growing recognition that service agility, and the opportunity to develop a business model based on delivering innovative services are the real benefits that will accrue to CSPs.

New business models based on service agility and service innovation will drive value from the CSPs' network infrastructure and are the real driving force behind a stepped-up pace in evaluation and deployment of SDN/NFV.

Now, how do you deliver these business benefits of SDN/NFV? By implementing functions such as deep packet inspection, policy control and enforcement, and analytic, software-based network intelligence can, in near-real time, change the path of network traffic, apply Virtualised Network Functions (VNFs) in a defined sequence to individual traffic flows, and optimise network performance for particular subscribers, a group of subscribers, or a particular network service such as video streaming.

Effective application of network intelligence in a virtualised infrastructure will enable what CSPs want: service agility and service innovation.

Software Intelligence

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KEY MESSAGES

- Moving to software-centric networks promises faster service velocity with a network infrastructure that can rapidly respond to customer needs with more innovative services.
- With SDN and NFV, CSPs are putting more control in their customers' hands. In trials and early deployments of NFV, CSPs are giving their customers a self-service portal for direct control of the telecom company's (telco's) network functions. With this capability, innovation will be in the hands of the telco's customers.
- There is growing recognition that service agility, and the opportunity to develop a business model based on delivering innovative services, are the real benefits that will accrue to CSPs.
- Intelligent networks are fast becoming a strategic imperative. At the heart of this network transformation are NFV and SDN technologies, which will enable flexibility, scalability, automation, and on-demand service, but the real goal for CSPs is much broader than simply the deployment of a new technology.

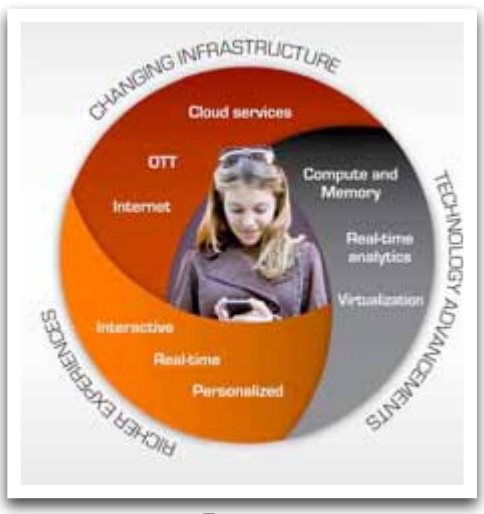

Figure 1:
Current Market and Customer Landscape

CHANGE IN CUSTOMER EXPECTATIONS

Traditionally, control of the network has been in the service providers' hands, and customers have been restricted to the limited set of service options offered by their local network provider. Telcos don't have a reputation as innovators, and customers have had to settle for the slow, measured pace of service enhancements, and the glacial pace with which their providers introduced new services. However, the Internet, Over-The-Top (OTT), and cloud services have helped to change customer expectations for communication services. Residential and mobile customers have become used to the rapid pace of innovation and speed of delivery of web-based services. Where telco providers may take three months or more to enhance a service offering, many OTT service providers make changes to their product offerings with software releases that are rolled out several times a day. Their experience with virtualisation and cloud-based services has led enterprise and individual subscribers to expect a minimal time to turn a service up (or down), to pay for their services based on actual usage, and access to online libraries of network capabilities and services. In addition, customers want ready access to all the bandwidth they need.

TECHNOLOGY DISRUPTIONS ARE SETTING NEW BENCHMARKS FOR CUSTOMER EXPECTATIONS

A number of advances in technology are raising the bar for customer expectations from their network services. Faster Central Processing Unit (CPU) clock speeds, faster memory access, higher I/O bandwidth between CPU sockets, and larger cache memory have significantly improved processor performance. In 2004, Intel moved towards an architecture with multiple processor (cores) on the same CPU chip and today CPUs with up to 16 cores are available. The DDR4 memory standard, introduced in 2014, supports up to 512GB per Dual In-line Memory Module (DIMM), allowing high-density memory configurations for high-performance computing. These shifts in hardware design have led to more powerful servers and have had a profound impact on the ability of software to handle tasks in near-real time.

With increased processing power, real-time data analytic software can allow network operators to translate an awareness of subscriber, network, device, location, application, time, and usage patterns to improve network performance, and dynamically optimise the use of network resources. In the IT space, compute virtualisation has drastically changed expectations of the time and cost to introduce new applications and services. Network operators are looking to take advantage of the flexibility presented by advancements in virtualisation in re-architecting their networks. With a virtualised architecture operators can achieve operational savings through automation, and capital savings through the consolidation and standardization of hardware elements.

THE PROBLEM WITH TRADITIONAL TELCO NETWORKS: LACK OF FLEXIBILITY RESTRICTS SERVICE INNOVATION

Over the last few decades, telcos have invested trillions of cash to boost the capacity of their networks, attract new customers, and grow revenues. However, delivering bigger pipes is no longer a path

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Software Intelligence

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to satisfying customers and commercial success. Network operators are constrained by the relative inflexibility of their existing network infrastructure. Depending on the physical platform, enhancing or changing the services offered can mean the deployment of new equipment throughout a service area, and provisioning individual devices is time consuming and expensive. These legacy networks and their relatively static configuration lead to a slow pace of innovation.

As networks grow they become more complex, and the manual methods typically used for managing networks lead to static configurations that are unwieldy and expensive to change. To grow, CSPs need to tackle this complexity head-on, and improve the utilization of network resources and their operational efficiency. Solving this issue requires more intelligent, software-controlled networks, capable of more efficient operation with new capabilities for automation, flexibility, and scalability.

CHANGE IN CSP BUSINESS MODELS

Moving to software-centric networks promises faster service velocity with a network infrastructure that can rapidly respond to customer needs. The migration to Commercial Off-The-Shelf (COTS) hardware and virtualisation lowers the barriers to entry for vendors, generating a new competitive supplier environment and enabling rapid innovation. However, as network operators evaluate new software-centric approaches to networking they find they are weighed down by an installed base that is difficult to modify or upgrade. The challenge for network operators is how to best build out their infrastructure to address new customer expectations and traffic growth in a capex-constrained environment.

Figure 1 shows a historic and forecast data for SP revenues and capital intensity from 2000–19.

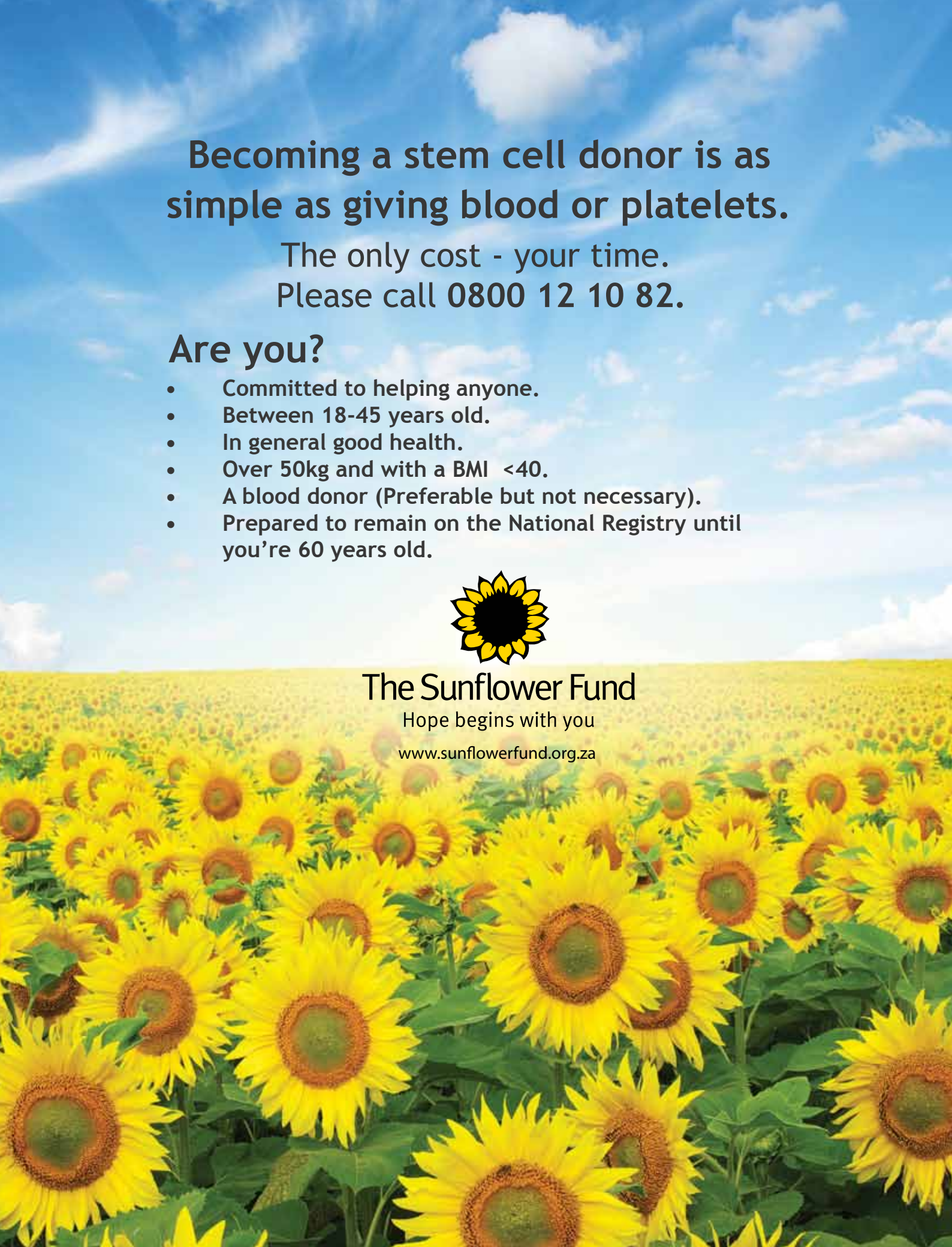
OSS/BSS systems have grown rigid and unwieldy and will need to adapt to this new, more flexible approach to networking by becoming a focal point for innovation. New approaches to OSS/BSS functions will react to the network state and performance Key Performance Indicators (KPIs) to control customers' Service Level Agreements (SLAs) and Quality of Experience (QoE), rather than simply acting as a tool for back-office operations. A virtualised network, fully integrated with intelligent OSS/BSS capabilities, will be the foundation for future telco business models based on agile automatic configuration of virtualised network functions, and will lead to a role for CSPs as integrated communications providers rather than operating as dumb pipe providers.

CHANGE IN A CAPEX-CONSTRAINED ENVIRONMENT

When SDN and NFV were first introduced, capex and opex savings were thought to be the driving force behind adoption of these technologies, and cost savings continue to be important. However, as the technologies have developed, and the industry has moved closer to deployment, there is growing recognition that service agility, and the opportunity to develop a business model based on delivering innovative services, are the real benefits that will accrue to CSPs.

Business models based on service agility and innovation are what will drive value from the CSPs' network infrastructure and are the driving force behind a stepped-up pace in evaluation and deployment of SDN/NFV. However, the deployment of a virtualised infrastructure at scale will require capex investments, and CSPs are facing a capex-constrained environment.

The large CSPs have all guided expectations for future capex spending down. AT&T, (US telecoms company), one of the leading proponents of a virtualised infrastructure, has gone as far as to announce its plan to spend just $18bn in capex in 2015, down $3bn from last year. So, the challenge for CSPs worldwide is how to affect change within capex constraints. wn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BROADBAND IN SOUTH AFRICA

what we have achieved and what the future holds

Access to affordable broadband services has been a goal of the South African government since 2010. Things have changed dramatically, with internet penetration greater than 50% in 2015 compared to less than 10 per cent ten years earlier.

Disappointingly this has nothing to do with fixed broadband connections and all to do with 3G mobile coverage reaching close to 95 percent of the population by 2015.

BY | PIETER GROOTES

South Africa's broadband policy, SA Connect, sets ambitious targets, with 80% of citizens having access to the internet at download speeds of 100 Mbps by 2030.

Current mobile technologies cannot achieve this without huge increases in both available spectrum and the densification of their radio frequency networks. While access to the internet through mobile phones has served South Africa well, the target has changed: we now need connections at high speed and quality, where buffering becomes a thing of the past.

Mobile and fixed wireless solutions will always be in the mix but South Africa needs fibre to the home to achieve the SA Connect targets – at affordable prices.

WHAT DO WE CURRENTLY PAY FOR INTERNET ACCESS?

We currently pay about R0.05 per megabyte on a mobile network in South Africa for ten gigabytes (Gigs) of data. This is similar to the rest of the world. We also pay a similar fee for ten Gig ADSL line. The value of a fixed line is for consuming high volumes of data and a better quality of service than a mobile device. The general Telkom ADSL connection cannot offer this. South Africans are therefore not used to connecting to the internet via a fixed line.

THE CURRENT ENVIRONMENT

The big operators consistently report year on year growth in data demand of over 30%. The mobile guys want to maintain this growth but are constrained by the lack of radio frequency and the consequent need to densify their radio networks. This limits their ability to offer higher quality of service and increases operational and capital expenditure costs. In other words mobile retail prices may not reduce any time soon.

However, the administrative delay in the release of spectrum creates an opportunity for fixed line broadband networks to catch up. Fibre offers the very characteristics that ADSL does not: high speeds at a consistent high quality with large volumes of data.

Telkom's fibre price per megabyte for its smallest package (10 Mbps, 50 Gig cap) offers a price per meg of under R0.014. This is significantly lower than the prices available on mobile networks. So why is this happening?

Broadband in South Africa

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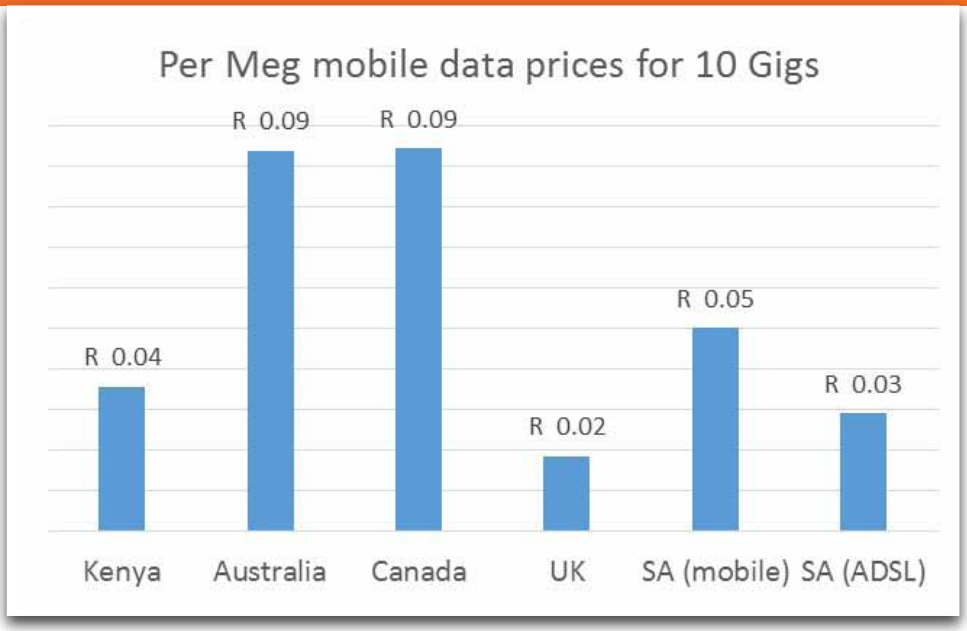


There are over four hundred licensees who can build fixed line services courtesy of the Electronic Communications Act and subsequent licensing process in 2008. These legal changes made it conceptually possible to compete against any other operator without using Telkom's infrastructure to connect to the rest of the world. It took time for this to develop.

The first move was in the construction of alternative networks between Cape Town, Johannesburg and Durban from 2007 onwards. Companies like Dark Fibre Africa, Fibreco and to a lesser extent Liquid Telecom pushed prices down by up to 80%. Alternative international gateways outside of Telkom's control via SEACOM and EASSy made it even easier to compete. The next target was the metro rings. By 2012 it was possible to build a network to the home and not have to use any of Telkom's services. Two challenges remained: what retail price and how quickly can networks be deployed.

Challenger networks do not have the cost base of Telkom nor do they have the same goals and ambitions of massive networks. The challengers typically cherry-pick areas to construct networks based on agreement with a suburban community representative forum. The cost per connected home (excluding the CPE) for this business model is approximately R14,000. Telkom is obliged to follow a different approach based on its existing network infrastructure and its efforts to remain competitive. The long-term future of Telkom is dependent on the number of houses and businesses it connects.

Without the household connections Telkom will lose significant revenues from long distance and international traffic services. Telkom is forced to follow a "build it and they will come" approach which raises the cost per connected home to around R31,000 . This will reduce as take up of Telkom services increases. The retail prices available today already reveal that prices per megabyte are close to R0.015 for a 40 Gig cap or around R700 a month. As household data consumption grows (and it will with Wi-Fi calling etc), the cost of data to the household will reduce dramatically. On certain packages the price for a megabyte is already less than one cent.

WHAT THE FUTURE HOLDS

SA Connect has set the target that 80% South African's have access to the internet at 100 megabits per second (Mbps). Current mobile technologies can theoretically offer these speeds, but not when the mobile tower is shared between a number of users, i.e. the service is contended or shared.

Fixed wireless can certainly provide these speeds. However, it is not technically possible, nor aesthetically pleasing, to have multiple antennae and receiver transponders on every rooftop. The only viable long-term solution is fibre to the home.

To give you an idea of the scale of things: there are over twenty million fixed broadband subscribers in the UK. There are fewer than 1.2 million ADSL lines in operation, with active fibre connections estimated to be around the 50,000 mark. None of the current ADSL lines can currently deliver the SA Connect target for 2030. This means that the entire fixed line access network (the part of the network that connects your home to the internet) need to be replaced.

However, this is costly. Connecting one more customer to a mobile network costs next to nothing compared to connecting one more household even if the household should consume much larger volumes of data. The high cost means that fibre roll-out will take time, even with Telkom's installed base of fibre to the curb. A conservative guess of the total size of the market for fibre is that it is the same as the installed and active fixed line voice subscriber base of today, approximately four million connections. The longer it takes to deploy fibre the greater the problem will become as urbanisation increases.

Telkom has set its goal at connecting one million homes to fibre by March 2018. Other players have targets of between 100,000 and 300,000 over the next few years. If this is achieved, fewer than ten per cent of households in 2018 will have access to high speed broadband. Given reported take-up rates of between 30%-40%, licensees will have to construct more than four million connections to match the same number of existing active broadband subscriber numbers of ADSL, and fibre consumers combined. As take-up rates increase, so the cost of connecting homes will decrease. As long as the built environment supports the deployment of fibre (densification of suburbs and properly designed multi-tenant buildings) the incentive to deploy fibre networks will increase and the cost will reduce. So what sort of household penetration can we expect to see?

The conservative estimate of market size is equivalent to the number of functional telephone lines today – or roughly four million homes. This represents 25% of urban homes in 2030. The high stakes forecasts are where fibre reaches close to 40% of urban homes by 2030 or close to 6.5 million homes connected with fibre. This is six times the number of active ADSL subscribers today.

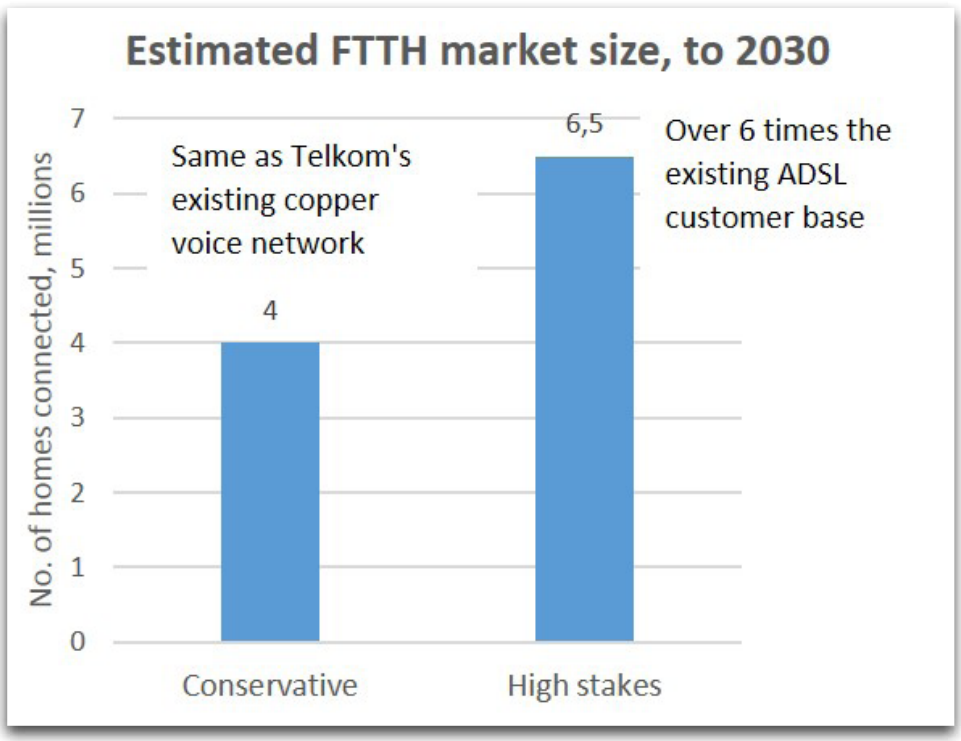
The market is there as shown by the number of licensees deploying infrastructure today. The financial returns are there (for now) for two reasons: the network that provides that last mile connection has a saleable asset that other networks would be willing to buy in the future and the current retail pricing does not suffer from legacy policy distortions – the connection to your house today is priced more like a mobile contract: you pay for your usage as well as the handset or device that comes with it. This will stimulate increased deployment of fibre connections to lower return geographic areas as networks hunt for the next connection. The new fibre networks are therefore financially sustainable in the long run, absent any policy or anti-competitive distortions.

WHAT WILL HAPPEN?

Fixed and mobile services face administrative challenges. The mobile operators desperately want access to more spectrum to deploy both 4G and in future 5G services. The delays in the digital switch-over looks like the mobiles will only get access to sub one gigahertz spectrum after 2018. Fibre deployments are dependent on approvals from municipalities. The collective challenge is government's lack of clarity regarding SA Connect, Telkom as the lead agency for broadband and the proposed wholesale wireless access network.

In my view, government's budget for huge projects is constrained by the challenges of SAA, SAPO and Eskom. Just like the mobile operators were asked to bring telecommunications to all South African's back in 1996, again the private sector will be asked to provide high speed broadband. The situation is vastly different however: there are many more players who are willing and able to deploy fibre and other fixed wireless solutions.

The dominance and reliance on Telkom has been forever broken, you and I just don't feel it yet. The dominance and reliance on the mobile operators by many will remain as long as there are barriers to new network deployment and spectrum licensing. However, South Africa is not being ripped off when buying the large mobile data packages. The new Telkom packages announced on the 21st of June offer mobile connectivity at close to fibre prices. Things are changing quickly – watch this space. wn



Nevin George
Winner
2016 IEC YP Essay Competition

Transporting raw materials such as coal, iron ore and others is crucial for the South African economy. Transnet has an integrated model whereby it manages ports, pipelines and rail network to fulfill this mandate. By adopting the International Electro-Technical Commission (IEC) and SABS standards has allowed Transnet to be competent to deliver integrated, safe and efficient services. The company aspires to be customer focused by executing its Market Demand Strategy (MDS). Greater efficiency can be attained through ensuring that new and old locomotive fleets are maintained according to international standards set by the IEC. It is encouraging to note that a variety of IEC standards used at Transnet are also enforced in many other countries globally. The IEC cooperates closely with the International Organization for Standardisation (ISO) and the International Telecommunication Union (ITU), which together provide the framework for standardisation of most of Transnet's operations. The IEC is made up of members, called national committees that are drawn from all continents. South Africa is one of the few IEC members from the African continent and so Transnet can access, maintain and contribute to setting standards globally.

This report will analyse the possible development areas for the IEC within Transnet, discuss the relevant background and answer the questions associated with the future of the SABS (South African Bureau of Standards) which produces

The influence the IEC has on Transnet

BY | NEVIN GEORGE | WINNER 2016 IEC YP ESSAY COMPETITION

South African National Standards (SANS) used currently. Some of the questions that this report will aim to answer include:

1. What is the background of the IEC and how do the standards set by the IEC fit into a Transnet wide structure?
2. Are we applying detailed standards set by the IEC such as SANS 3000, SANS 10405 and IEC 61508 in our public transport system, and not only in Transnet's core operation which is mass cargo transport?
3. Does Transnet comply with the European and American standards used for their railway mass cargo transport system?
4. The current standards used cover the Reliability, Availability, Maintainability, Operability and Safety (RAMMOS) of our current projects, operations and future plans at Transnet. Would it be possible as an IEC member country for South Africa to introduce, implement and use new IEC standards that would be adopted internationally?

IEC standards are a key element in ensuring the security and integrity of a complex inter-connected system such as the South African railways. The IEC is a non-profit,

IEC influence on Transnet

continues from page 47

non-governmental standards organization that prepares and recommends standards on the use of all electrical, electronics and associated technologies. IEC standards cover a wide spectrum of specialty areas such as power generation, distribution and transmission to the conformity of basic electronic items such as batteries, engines, solar technology, modern warfare equipment, measuring instruments, artificial intelligence and many others to ensure conformance to the good standards and practices. The IEC was the result of discussions between the British and American Institutes of Engineers in 1906. The IEC is instrumental in developing standards for units of measurement such as the International System of Units (SI - Système Internationale) that is in use today.

The IEC is currently the world's leading organization in its sector for publishing standards relating to electrical, electronic and related technologies and has been a key factor in assisting the development of SABS standards locally.

Standards such as SANS 3000, SANS 10405 and IEC 61508 deal with areas under which Transnet operation falls. It includes technical specifications for engineering and operational standards, transportation of goods by rail and road and the reliability, availability, maintainability and safety of the fleet, freight, pipelines and ports divisions that make up Transnet. SANS 10405:2009 takes care of the transport of dangerous goods by rail in terms of the operational, design requirements and emergency preparedness.

This SANS standard also covers SANS 3000 (Railway Safety Management), SANS 10228 (Identification and classification of dangerous goods for transport), SANS 10229, SANS 10231 and SANS 10232 (Transport of dangerous goods). The consignor, train operator and consignee involved with the transport of goods by rail should follow the safety measures implemented by the IEC.

It is clear that Transnet fleet operators are taking responsibility for their actions as the financial results for 2016 showed that targets have been achieved with 100% efficiency for injuries on site, locomotive reliability and volumes lost. This means that there have been minimal deaths on site while goods are being transported and the volume of cargo lost is kept to its limits. Transnet standards are kept high because the depots where the cargo is transported through such as Richards Bay, Ermelo, Cape Town (Bellville), Pyramid South, Sentra-Rand and others conform to IEC standards. SANS 10405:2009 notes that the train operator should ensure that the containers or rolling stock are suitable for loading and are in a good condition.

Shunting operation is undertaken with consideration that wagons and coaches could contain dangerous or fragile goods. The SANS standards are not only applied to the railway transport system, but also considers the design, construction, testing and maintenance of road vehicles as well as the transport of dangerous goods by road as detailed by SANS 1518 (2011). It includes IEC 60079 which oversees the protection of equipment in explosive atmospheres.

SANS 10228 (2010) deals with the identification and classification of dangerous goods for transport. It covers SANS 1518 which is the design, construction and testing of road vehicles and portable tanks. It considers the hazardous environment in terms of the substances released and typical pollutants such as Lead, Nitrogen Dioxide, Sulphur Dioxide and Ground-Level Ozone.

IEC 61508 deals with the functional safety of electrical/electronic/programmable electronic safety related systems. This international standard sets out a generic approach for all the safety life cycle activities for the systems used and adopts a risk based approach by determining the safety and integrity requirements. Transnet has utilized this standard due to the legal requirements: it specifies what should be included in company policy, guideline adoption from safety authorities, industry standards and guidelines as well as the impact of operational standards associated with fleet operations.

This standard is actually a robust mechanism for the ports, pipelines, freight and rail divisions of Transnet. It determines the mean failure rate of operations and then determines the mitigation strategies to deal with the failures by using risk methods. IEC 61133:2006 is another important standard for Transnet in terms of railway vehicles. It specifies that newly designed and constructed railway vehicles (rolling stock) should be thoroughly tested for compliance with standards before entry into service.

The IEC standards identify the biggest impact areas within the company and ensure the highest standards of quality and delivery. The 1064 project at Transnet includes OEM's (Original Equipment Manufacturers) such as CNR (China North Rail), CSR (China South Rail), GE (General Electric) and BT (Bombardier Transportation), and their operations.

It requires the cooperation of multiple stakeholders, working with precision, and is labour intensive. These factors combined with deadlines, and pressure from senior management, could lead to safety standards being compromised. The SANS and SABS standards provide a framework and description of standards, the use of which can smooth such processes and prevent safety compromises.

The train operators within the business also need to ensure that the wagons used comply with the design requirements, as set out by standards SANS 3000-1, SANS 3000-2-1 and SANS 3000-2-3. These standards specify the legislation concerning the security risks of the rolling stock so there are no delays on the test routes when cargo is transported on the GFB (General Freight Business) and Coal lines. It also details the procedures for the evaluation and testing of security plans, communication plans and procedures to identify losses and theft.

IEC/TC9 relations outlines the electrical equipment and the systems required for the railways and are used extensively for the standardization of Transnet protocols. This includes the rolling stock, steady installations, management systems for railway operations and their responsible interfaces with the environment. In South Africa as well as the rest of the world, IEC/TC9 relations cover not only railway networks, but also metropolitan transport networks, tramways, trolley busses and fully automated transport systems. The standards used relate to systems, software and components that deal with the electrical, electronic and mechanical aspects which rely on electrical quality factors. The IEC standards also deal with the electronic and electromechanical aspects of power components that are commonly used on Transnet locomotives.

A major characteristic of the international railway network is its specificity, and critical consideration of detail, in terms of the standards practiced, which leads to high efficiencies and improved customer satisfaction. This is one particular area where proper planning of the project has to be undertaken to increase efficiency, e.g. when operating the Gautrain. ISO/TC269 is one of the newer developed standards created for product development within the rail industry for outcomes such as construction, operations, parts and equipment maintenance, rail and vehicle infrastructure, but it excludes electrical and electro-technical products and services covered by IEC/TC9.

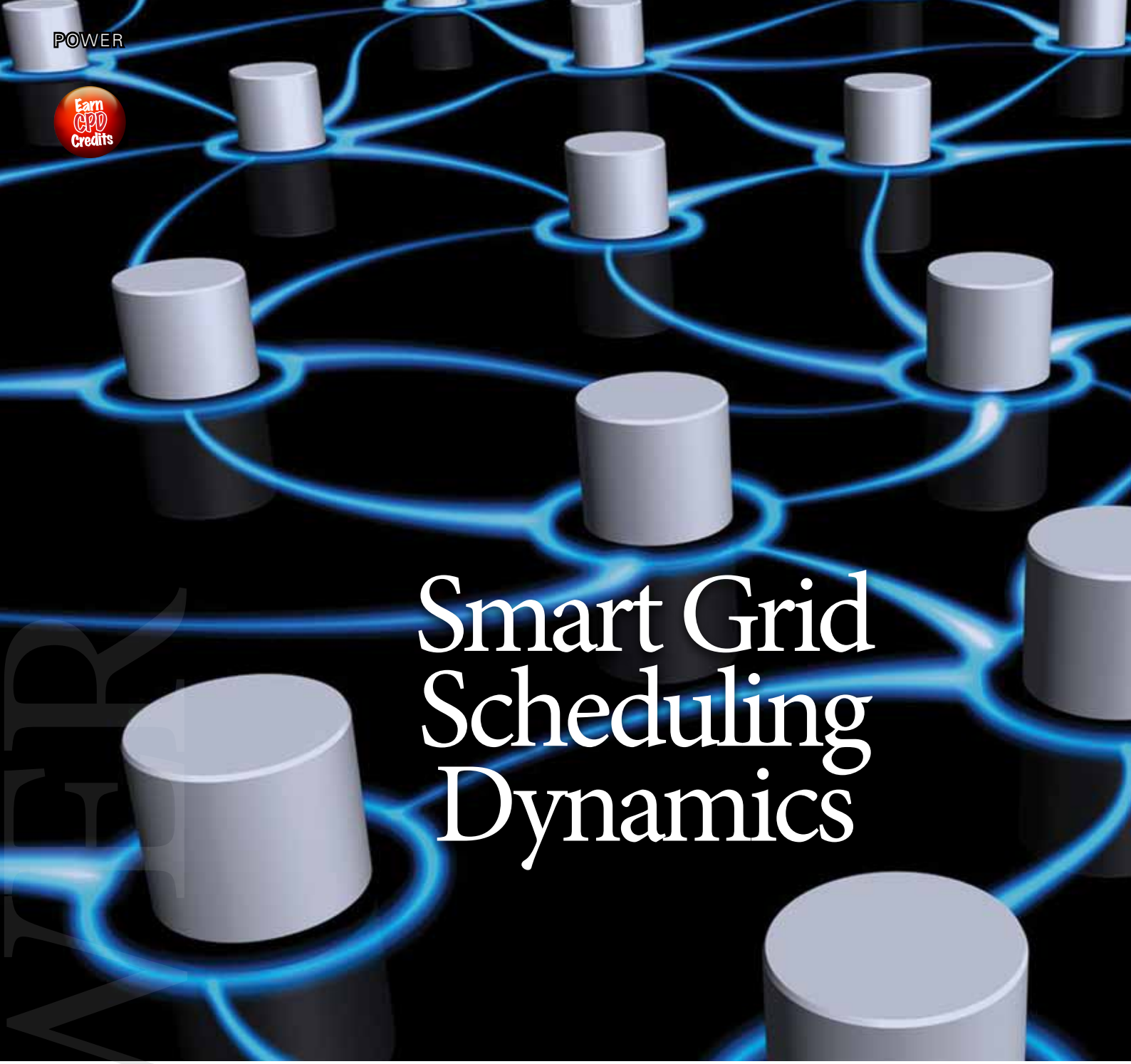
It is also crucial to ensure the safety of passengers using the public transport system in South Africa by maintaining and following the standards set by the IEC. A close relationship needs to be maintained with the International Union of Railways (UIC) and the International Association of Public Transport (UITP). This co-operation will ensure the use of world-wide solutions to satisfy design needs and regulatory requirements. Common examples include control command systems, protective provisions for traction circuits, electromagnetic compatibility, design of automatic guided transportation systems and the comprehensive theories ensuring urban system safety.

These developments of IEC/TC9 and ISO/TC269 standards are actively followed by industry in more developed countries. Specifications and standards need to be identified world-wide to enable technical co-operation, inter-operability and railway system coherence. The future of IEC/TC9 is of particular importance to Transnet in its growing spectrum of urban transport.

In conclusion, it can be summarized that the IEC has a major role to play in Transnet in terms of its future operations and the Market Demand Strategy. The SANS and IEC standards covered in this report take into consideration the transport of dangerous goods by road or rail, efficiency of new locomotive fleets before entry into service and provides a generic risk-based approach for all safety related activities that fall under Transnet operations. The freight, pipelines and rail divisions of Transnet have maintained high standards of quality and delivery.

Transnet therefore can compete with the standards set by Europe and America if the IEC/TC9 relations are implemented. This will take care of the rolling stock, steady equipment installations, management systems for railway operations and their interface with the environment. Co-operation with global organisations will help Transnet to use world-wide solutions to satisfy design needs and regulatory requirements.

I therefore think that Transnet has the potential to design new standards provided that we work closely with the IEC and modernise our current railway system infrastructure. Although America and Europe are further ahead in terms of their public transport system, rail infrastructure network and standards development, it is possible for Transnet and South Africa to contribute to the creation of practical and applicable international standards in the railway sector. wn



Smart Grid Scheduling Dynamics

Smart Power Grids form a logical and inevitable part of the new Digital Industrial Revolution. We take a practical, and down to earth look at this highly complex, and dynamic branch of engineering.

BY | DUDLEY BASSON

A Smart Grid will consist of two closely linked networks: the power distribution network and the communication and control network. These will hardly be static, and will have to rapidly adapt to changing topology of power supply and usage. An additional, and essential part of the communication will be the network of Phasor Monitoring Units (PMU), which will monitor phase angle shifts in voltage and current, at widely separated parts of the power grid.

At present there is no single standard definition of what constitutes a smart grid. In practice the grid will be defined by the physical supply, usage and control of electric power, and will be in a continuous state of change and growth. The Wikipedia definition is given as: *A smart grid is an electrical grid, which includes a variety of operational, and energy measures including smart meters, smart appliances, renewable energy resources, and energy efficiency resources. Electronic power conditioning and control of the production and distribution of electricity are important aspects of the smart grid.*

The power network will largely consist of existing infrastructure: A small number of large power stations, a number of grid connected renewable power sources, pumped storage schemes, all the transmission lines, a large number of substations, and a huge number of end users, who will both consume and supply electrical power.

Smart Grid Dynamics

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It may also be necessary to install high capacity flow batteries to buffer supply and demand. The vanadium redox flow battery (VFB) holds much promise in this regard. GE started production of high performance 10 MW 60 MWh batteries in 2014, and 1 GW 6 GWh batteries are now in development. This is energy storage on a scale comparable to that of a pumped storage scheme, such as South Africa's Ingula. Much R&D work is currently being done on flow battery electrolytes, in particular at Denmark's Aarhus University. The communication network will require installation of smart meters at end users, as well as substations and other strategic points. The smart meters will supply a wealth of information, such as real time power usage, power supplied back to the grid, power factor reduction due to inductive loads, capacity for shedding of non-vital loads etc. Communication must be two-way, giving end users status information, as well as providing remote switching control. People who feel that the detailed metering may constitute an infringement of privacy have expressed concern. This could well be a problem for users engaging in industrial activities in residential areas. The communication network will make extensive use of M2M (machine to machine) communications. This is also referred to as Machine Type Communications (MTC).

The technical committee of the European Telecommunications Standards Institute (ETSI) is developing standards for M2M communications. The M2M abbreviation is unfortunately overworked, also having other meanings not related to engineering. The smart grid will need to deploy large-scale wireless sensor and actuator networks (WSAN), which will support the M2M communications. The cellular networks may also feature large in the smart grid.
Several thousands of smart meters have been installed in South Africa, which are used for remote on-line billing purposes. These allow end users to view their energy consumption by website, which shows consumption graphically in half-hour sampling, as well as pre-paid credit status, and other information.

Fully-fledged smart grid operation will, however require two way M2M communication. Smart grid meters will be a far cry from the antiquated spinning disc, and confusing multi dial readout. In addition to a screen display, with a wealth of information on energy consumption and sale, they will also offer Bluetooth and Wi-Fi communication, giving the users access and control by cell phone or computer. Bluetooth and Wi-Fi both utilise the 12 cm microwave band. When smart grids are fully implemented, it will be possible for domestic users to use a cell phone to switch on the washing machine, or receive a text message from the stove, saying that the oven roast is ready. More importantly, it will be possible to select the times when the house and electric car batteries can be used for energy sale to the grid, or for recharging. Similarly, the PV solar panels will also be programmable. If differing tariffs are introduced for time of day usage, users will be able to take advantage of lower tariffs for non-urgent power consumption, such as water heating and battery charging, and supply power at peak usage times. Users introducing harmonic content to the grid will require active filtering.

It remains, of course, important to avoid wastage of electrical energy. In sunny climates, using solar water heating and sunlight, instead of tumble driers, can save much energy.

Users in remote areas, who are not connected to any grid, can also make a significant contribution to the environment by utilising renewable energy sources. Small-scale remote users (30 kW), can profitably use self-contained Concentrated Solar Dish Power units, which have built-in heat storage, to give several hours of after-dark power.

The communication and control network will usually comprise a combination of telecommunication methods, depending on local conditions:

- Short-range wireless technology (SRWT)
- Mobile networks using SIM cards.
- Local telephone lines.
- Fibre optic cable.
- Power line communications (PLC).
- Bluetooth and Wi-Fi.

Power-line Communication (PLC - This abbreviation is best avoided as it has dozens of other meanings). Narrow band power-line communications have been in use since as early as 1922. The first carrier frequency systems began to operate over high-tension lines, with frequencies of 15 kHz to 500 kHz, for telemetry purposes. In the 1930s, ripple carrier signalling was introduced for use on the medium and low voltage distribution systems. The data signal must be at least 3 kHz above mains frequency to avoid interference from the mains. The mains wiring is not twisted or shielded and can therefore act as an antenna, transmitting and receiving signals, which can be problematic. The power may need to be filtered to protect sensitive equipment. Transformers can

block the higher frequency signals. In some jurisdictions power line communications are prohibited. PLC offers a convenient vehicle for M2M in buildings, or groups of buildings, as all the wiring is in place, but must be used with circumspection.

The quantity of information required by the central scheduling facility will be huge. Table 1 is a suggestion of parameters that might be handled by the smart grid management system and does not represent any particular installed system.

In addition to the network hardware, phasor measurement units (PMU) will need to be installed at various parts of the network, presumably at the substations. Measuring voltage and current phase angle deviations at remote parts of a network with microsecond accuracy would be unthinkable without timing signals from GPS satellites. For GPS usage at least three satellite timing signals are required but for phasor timing a single satellite signal will suffice. The time stamped information (synchrophasors) will be processed by the central facility in real time. There is an in depth treatment of phasor measurement in the June 2014 issue of **watt**now.

Monitoring both voltage and current phasor shifts will permit power factor measurements at various points facilitating the implementing of dynamic power factor correction. Correcting adverse power factor is important as this can reduce wasteful conductor heat losses in the lines and permit fuller usage of line capacity. In Europe, dynamic power factor correction is required to be incorporated in end user equipment. Capacitor banks can also be provided in switchyards for wide area correction. Major power users may also

TYPE OF RESOURCE	ONLINE INFORMATION	STATUS INFORMATION
Power generation facility	Real time output Spare output	Change in capacity due to planned or possible unplanned maintenance. Expected fuel availability.
Solar voltaic farms	Real time output Spare output	Sun availability Local weather predictions
Concentrated solar farms	Real time electrical output Heat storage output Heat storage spare capacity	Sun availability Local weather predictions
Pumped hydroelectric storage scheme	Output to grid Output to storage Spare storage capacity	Maximum storage capacity Planned delivery/storage cycle Planned or possible unplanned maintenance.
Flow battery storage	Input/output power Available capacity	Storage capacity
Wind farm	Real time output Potential output	Local weather predictions Expected change in wind flow
Biomass or biogas	Current output Spare output	Change in capacity due to planned or possible unplanned maintenance. Expected fuel availability.
Substations and Switch-yards	Transformer loading Present switching configuration Voltage and current transformer readings Phasor measurements	Capacity and switching configuration Switching possibilities Available capacitor banks
End users	Real time power usage Energy supply to grid per billing period Energy consumption per billing period Power factor Harmonic content to grid Energy storage capacity	Non essential power for load shedding House and electric car battery capacity Oversupply capacity Photovoltaic capacity
Islanding zone	Real time power usage Storage of all offline user information	Maximum time of islanding operation
Oversupply users	Power requirement	Time duration of continuous power required

Table 1

Smart Grid Dynamics

continues from page 53

use large synchronous capacitor machines for power factor correction. These have the advantage of being continuously adjustable to absorb or produce reactive power and can also stabilise erratic loads. Synchronous capacitor machines are basically synchronous motors running without any attached load. Voltage phase angle shifts will give an indication of parts of the grid under stress and at risk of losing synchronisation, resulting in blackout, or worse still, rolling blackouts.

An important feature of a smart grid will be the ability of 'self healing'. When the failure of an important network link is detected, the smart grid should be able to isolate the fault and reduce end user inconvenience as much as possible. A SCADA (Supervisory Control and Data Acquisition) system will assume over-all control of the smart grid. Implementing smart grid technology on existing grid infrastructure will normally be done incrementally over a period of several years. This will be a time when much ageing equipment will be replaced. Vast numbers of meters will have to be replaced and new billing systems compatible with the smart grid implemented. A useful approach is to use a part of the existing grid as a small smart grid, which can later become an islanding zone in the large grid, which has sufficient resources to function for several hours detached from the large grid.

This will also provide useful experience in smart grid management and after full implementation will provide a convenient load, which can be shed at times of peak power demand.

Several systems for smart grid management are available and much further development of these can be expected.

Denmark's 'State of Green' program has implemented a smart grid on the Island Bornholm which will later become an 'islanding zone' of the eventual countrywide smart grid.

The Technical University of Denmark in Lyngby launched the EcoGrid 2.0 Smart Energy Project on 11 April 2016 using Siemens technology.

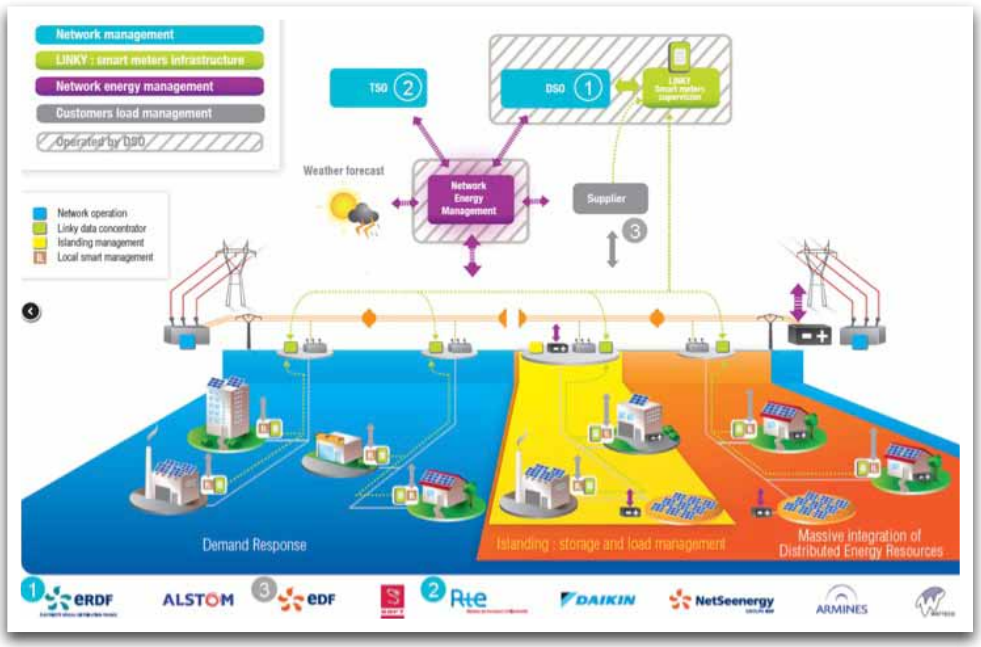
France launched their pilot Nice Grid in the medieval town Carros near Nice on the French Riviera. The pilot will test programs of dynamic load management to:

- Enhance the integration of solar power generation into the existing distribution grid
- Ensure the security of energy supply at local level
- Reduce consumption levels during peak demands
- Study the islanding of a neighbourhood based on solar generation and electrical storage

The pilot grid comprises some 1500 users including a business park which forms an islanding zone which can be detached from the grid at times of peak power demand, especially during the high tourist season.

The GE Distributed Energy Resource Management System utilises consumption information from smart meters with load forecasts, status updates from the grid and weather reports. The grid utilises Saft Lithium-ion batteries with a total capacity of 1,5 MWh.

This smart grid demonstration project is led by ERDF (Electricité Réseau Distribution France), which manages the national low- and medium-voltage electricity distribution network. Some 2500 ERDF Linky smart meters are planned. The other partners are electricity generation company Alstom, electric utility EDF (Électricité de France), battery manufacturer Saft, and other industrial partners and innovative SMEs such as wireless sensor company Watteco and the EDF subsidiary NetSeenergy, a specialist in energy management for buildings.



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Smart Grid Dynamics

continues from page 54

In 2010 the Australian Government launched their 'Smart Grid, Smart City' Program committing approximately $100 million in funding to the Ausgrid consortium which included: Ausgrid (one of the three New South Wales electricity distribution entities); IBM Australia; GE Energy Australia; Grid Net; CSIRO; TransGrid; EnergyAustralia; Landis+Gyr; Sydney Water; Hunter Water; the University of Newcastle; the University of Sydney; Lake Macquarie City Council and the City of Newcastle. Several major electrical user areas have been designated for the 'Smart Grid, Smart City' trials.

China is currently the world's largest user of electrical energy. A five year plan was announced to invest $250 billion in electrical power infrastructure of which $45 billion was earmarked for smart grid technologies by 2010 and a further $240 billion by 2020 to complete the smart grid. By this time, Ultra High Voltage (UHV) and other intra-regional transmission capacity will reach 400 GW, enough to connect all planned coal, hydro, nuclear and wind power to areas with high demand. The total smart meter market is estimated at 330 million units.

In Zhangbei, Hebei Province, Lithium Iron-Phosphate (LiFePO4) batteries were installed capable of storing 36 MWh of energy in conjunction with solar and wind projects. The scheduling of a vast number of dynamic resources is well established in computer science. An interesting example is IBM's system VM/370 introduced in 1972.

This Virtual Machine consisted of two parts: the Control Program (CP) booted in the bare hardware and the multiple virtual machines running under it – usually Conversational Monitor System (CMS). The CP could also host other virtual machines – even other mainframe operating systems such as MVS/370 and DOS/VSE. CP had built in safeguards to prevent the use of privileged instructions by guest systems from bringing everything crashing down.

CP could host hundreds or even more than a thousand CMS users giving each the impression that they had exclusive access to the mainframe. Each user had a directory profile defining disk requirements and various options as well as virtual memory size which could be even larger than that of the mainframe hardware. The CMS users each had a visualisation of hardware which was different to the actual hardware available.

The user terminals at that time (pre PC era) were screen monitors and keyboard with no user programmable functionality. CMS gave the users the functionality to develop and run their own application programs with full access to the mainframe software and access to peripheral devices such as printers, plotters, tape drives, private disks etc. which could be attached by the operator.

Using CMS under VM gave the terminal user the feeling of a personal computer. The job control language REXX used with CMS was a pleasure to use and was fully programmable. The text editor was highly sophisticated and also programmable.

The ability of VM to host other operating systems was especially useful for developing and testing new operating systems without requiring the dedicated use of a mainframe computer for lengthy periods. This was also very useful for end users migrating from one mainframe operating system to another. The most excruciatingly detailed coding of the mainframe was the microcode. The computer basic instruction set comprised a large number of machine instructions which were used as mnemonics in assembler language programming, but not all of these were hardwired into the CPU. Many of these were programmed into the microcode giving more flexibility in the design of the hardware. Microcode meant programming right down to the bare metal.

In the 1980s I would task newly arrived systems programmers with their "baptism of fire". This was to install a new update of VM running as a guest application under VM/370. Working at this level of complexity required a clear head and cool nerves. When the log-in logo of the new CMS running under the guest VM appeared on the screen, this was the signal for much relief and celebration. In order to easily recognise which CMS was on the screen, the log-in logo of the piggy-back CMS was modified to show a well gruntled pig. After testing, the new VM could be implemented without any downtime inconvenience to the users.

Running further guest systems under the guest system was also possible but served no purpose other than macho bravado. The IBM mascot of VM/370 was a teddy bear. In those days computer software was supplied with source code, which was very useful for customising the systems.

Many public domain enhancements were available, especially from the University of Waterloo, which included a high performance VM Scheduler, a super optimising FORTRAN compiler, and a phenomenal text editor.

The heartthrob of VM was a highly complex piece of software known as the 'Scheduler'. This would allocate time slices to the hundreds of users taking into account their requirements of CPU computations, access to disks and databases and slow peripheral devices. The scheduler was able to keep accurate account of every user's usage of computer time. Users of business and accounting applications made heavy use of database access, some made use of tape drives and the engineers made heavy use of CPU for FORTRAN programs.

Manufacturing system users would make extensive use of the huge product family tree databases and also had a direct line to the stores picking machines. The picking machines were connected together by a current loop and linked to the mainframe by means of a start-stop line. The picking machines did not have their own software driver, so a plotter driver was modified and pressed into service.

The users who could not be scheduled were the design engineers running mathematical model simulation programs. These would cause the computer to sit down, chin on hand, like Rodin's statue 'The Thinker', sometimes for hours on end. The only way to schedule these users was to persuade them to run their simulations after everyone else had gone home.

Dynamically scheduling a huge smart grid network, of widely differing sources and sinks, with differing characteristics, bears some resemblance to scheduling a network of computer users. Future development of smart grids may eventually embrace international linkages, making intelligent power distribution as pervasive as the Internet. wn

ABBREVIATIONS AND ACRONYMS RELATING TO SMART GRIDS:	
AMI	Advanced metering infrastructure
CENELEC	European Committee for Electrotechnical Standardisation
CEN	European Committee for Standardisation
DLMS	Device Language Message Specification
ETSI	European Telecommunications Standards Institute
3GPP	3rd Generation Partnership Project
GPS	Global Positioning System
HAN	Home area network
HVAC	Heating, ventilating, and air conditioning
ICT	Information and communication technology
LLN	Low-power and lossy networks
M2M	Machine-to-machine communications
MTC	Machine Type Communications
PLC	Power-line communication
PLC	Programmable logic controller
PMU	Phasor monitoring unit
RPL	Routing protocol for Low-power and lossy networks
RTU	Remote terminal unit
SCADA	Supervisory control and data acquisition
SIM	Subscriber identification module
SG	Smart grid
SM	Smart meter
SRWT	Short-range wireless technology
VFB	Vanadium redox flow battery
VQM	Voltage quality management
WAMR	Wireless automatic meter reading
WAN	Wide Area Network
WSAN	Wireless sensor and actuator networks

IN MY OPINION : ANDRÉ HOFFMANN

Threats to broadband in South Africa

The telecoms market has been under a process of managed liberalisation since 1996, with a key milestone being reached, with the enactment of the new Electronic Communications Act in 2005.

BY | ANDRÉ HOFFMANN | FSAIEE

Another key milestone was reached in 2008 when Altech's successful legal bid to challenge adjudication of new individual Electronic Communications Network licences (i-ECNS) provided many in the South African telecoms industry with the hope of true liberalisation in the market.

While this has been beneficial in introducing competitive services and pricing to the retail telecoms market, it has however, had the unintended consequence of emboldening landlords and property developers, practically the larger ones, to see the now fragmented telecoms industry as an additional revenue opportunity, instead of an enabler of 21st Century economy for their tenants.

In flagrant disregard of section 22 of the Act , some property developers are making access to their facilities conditional on onerous and one-sided legal contacts, that not only limit tenants' choice of Service Provider, but in some cases even prevent access to bonafide licenced Service Providers, based on convoluted 'exclusivity' agreements, that are downright anti-competitive. Furthermore, some property developers now not only expect revenues from equipment room, or mast / antenna space rental to licenced Service Providers, but are pushing for wholesale and retail revenue share of all ICT connections and services terminated in their buildings, or on their properties. This has ramifications for carrier interoperability, quality of service, licencing obligations and the key tenets of Open Access, as well as potentially adding unnecessary layers of cost to communications service delivery in South Africa.

Property developers have no rights to behave in a predatory way towards the telecoms industry, and try to position themselves between Service Provider and the end-user. The Telecoms and Service Provider Industry ('the Industry') has had to fight local government to get reasonable access to public spaces (Refer Annexure A: The Constitutional Court in the matter of Tshwane City v Link Africa and Others 2015 (6) SA 440). The telecoms industry is more than willing to exercise its rights to do the same in the private space.

The Industry reserves its right to access any land or property, public or private, for the purposes of providing the services it is licenced to provide,

in accordance with prevailing legislation, and in consultation with the relevant stakeholders.

The Industry is committed to conducting itself in a reasonable, ethical and responsible manner, to ensure that all end-users can get full, and unrestricted access, to the services offered by any licenced Service Provider, and on the same terms and conditions, irrespective of physical location.

Furthermore, to work collaboratively with any licenced Service Provider, to ensure effective and well manged access to developed precincts, pavements, servitudes and buildings, is done with the least amount of disruption or inconvenience to all stakeholders while ensuring delivery and operational network imperatives are maintained.

The Industry understands that landlords have a reasonable expectation of getting a return on their investment in properties and facilities. However, this return should be garnered from the tenants in the leasing value proposition, inclusive of all features and services available in the facility being leased, and not by positioning revenue leakage in the service delivery chain of the Telecommunications and Service Provider Industry.

The Industry remains committed to assist landlords and property developers to position themselves for meeting the 21st Century networks expectations, within their buildings catering for things such as:

- Rooftop base station / antenna space and power requirements.
- In building riser capacity, design specification and cable management.
- Building cable access and redundancy.
- Equipment rooms specifications and accessibility.
- Electromagnetic or radio frequency interference.
- Tenants with special telecommunications needs. (i.e. high levels of service availability).
- Access, safety and security considerations.

The Industry is quite willing to pay a reasonable set-up and monthly fee to the respective landlord or Property Company for any equipment space, power and facilities services rendered to the Service Provider at market related rates.

Landlords and Property Companies should acknowledge that, having strong connectivity to the high-speed fibre based communications networks will significantly advantage them against those that are not 'on-net'.

Unless the telecoms industry can stand together, and speak with one voice, they will be exposed, either individually or collectively, to revenue piracy and

Threats to broadband in South Africa

continues from page 59

extortionary tactics by bullying developers and property portfolio managers, who see their domains as accessible only on terms dictated by themselves, in flagrant disregard for the statutes of the Act. and this This is not in the best interest of the consumer, or managing the costs of broadband in the medium to long term.

These are some of the identified risks:

a) Certain precincts or buildings may be commercially 'locked-out' as options for some Service Providers. Tenants with a global or national footprint of offices will be compromised, if their approved Service Provider is 'locked-out' of a particular building.
b) Market viability of the Service Providers may be under threat, if margin squeeze is forced on the service delivery chain, as a result of meddling by landlords.
c) End users will be at risk of lower quality services, and at potential higher costs, with operational control of critical path network infrastructure being under split responsibilities.
d) End-to-end network services level agreements will be complicated.
e) Landlords and property managing agents may be exposed to network and regulatory compliance imperatives.
f) Landlords and property managing agents may be exposed to anti-competitive sanction if they insist on limiting Service Provider access.

A dangerous precedent may have already been set by some small or medium licenced operators, who capitulate to the bullying tactics of the property moguls running some prestige commercial properties. This means that getting access to tenant offices in the precinct can only be facilitated by the acceptance of compromising, and one-sided terms and conditions imposed by the facility owners or their agents.

Tenants and normal commercial consumers, taking up retail or office rental services in such facilities, are often blissfully unaware of the connectivity choice limitations, and additional cost factors, they may be getting themselves into.

This idea, of garnering additional revenue from services delivered to and from properties, is fraught with business and regulatory complexity for the property developer, and the industry at large. Something they have clearly not thought through properly.

- Are all service providers treated the same way?
- What about other utility services such as potable water, electricity and waste water services – do these price regulated services get levied a premium by the facility management before being delivered to the tenants?
- If a parcel delivery service such as DHL comes to the building reception and needs to get a signature from a tenant on the 10th floor of some controlled building – does the landlord insist on a stairs and lift usage levy from the agent?

This is not tenable for basic services such as water and electricity, and is not tenable for telecoms services either. Furthermore, this arrangement is fraught with potential extortion and other financial risks, where property developer relationships and positioning creates turbulence in the telecoms market.

Landlords and Property Developers should stick to their knitting, and rather seek to enable their facilities in the most cost effective way, so that they not only attract good quality tenants, but that they keep them satisfied over their term of their tenancy. wn

calendar

AUGUST | SEPTEMBER | OCTOBER

AUGUST 2016

4	Charles Landy Memorial Lecture	Johannesburg	www.saiee.org.za
12	Sunflower Fund Women's Day Breakfast	Johannesburg	www.sunflowerfund.org.za
11-12	Cloud Computing Fundamentals	Johannesburg	roberto@saiee.org.za
11-12	Design of Economical Earthing Systems	Cape Town	roberto@saiee.org.za
16-19	Managing Projects Effectively	Johannesburg	roberto@saiee.org.za
17-18	2016 Information Security for South Africa (ISSA)	Johannesburg	www.ieee.org.za
17-18	Fundamentals of Long Term Evolution Mobile Communications	Johannesburg	roberto@saiee.org.za
18-19	Power Utilities Theft Conference	Johannesburg	www.amabhubezi.co.za
23	Medium Voltage Electric Cable Jointing & Terminating	Durban	roberto@saiee.org.za

SEPTEMBER 2016

7-8	Fundamentals of Power Distribution	Johannesburg	roberto@saiee.org.za
14-15	Photovoltaic Solar Systems	Johannesburg	roberto@saiee.org.za
20	Bernard Price Memorial Lecture	Wits/Johannesburg	geyerg@saiee.org.za
21	Power Transformer Unit Protection & Testing	Johannesburg	roberto@saiee.org.za
21	Bernard Price Memorial Lecture	Cape Town	geyerg@saiee.org.za
22	Power Transformer Operating & Maintenance	Johannesburg	roberto@saiee.org.za
22	Bernard Price Memorial Lecture	KwaZulu Natal	geyerg@saiee.org.za

OCTOBER 2016

11-12	Fixed Broadband Access Technologies	Johannesburg	roberto@saiee.org.za
12-13	Fundamentals of Practical Lighting Design	Johannesburg	roberto@saiee.org.za
17-18	MS Project Professionals	Johannesburg	roberto@saiee.org.za
19-20	Core Financial Management for Engineers	Johannesburg	roberto@saiee.org.za
21	SAIEE Banquet	Johannesburg	geyerg@saiee.org.za
25	MV Electrical Cables Jointing & Terminating	Johannesburg	roberto@saiee.org.za
26-27	HV Circuit Breakers; Operating & Maintenance	Western Cape	roberto@saiee.org.za
26-27	Optical Fibres, Cables & Systems Fundamentals	Johannesburg	roberto@saiee.org.za
26-28	Sub Sharan African Power Summit	Cape Town	www.ssapower.com

= CPD Courses

WATT? is a forum related specifically to the industrial and commercial electrical sector.

Do you have any burning questions, topical issues or points of interest about the electrical industry, from the perspective of a contractor, supplier or professional service provider? Submit your comments, thoughts, ideas, suggestions or questions for the attention of our industry experts, and these will be addressed in a future issue of the magazine. This is your forum, and we would like to hear from you!

WATT? is an opportunity for people on the ground to engage with each other and related professionals in an informative and friendly manner. This is a platform for you to discuss anything related to your particular sector, to highlight anything new, or to ask a specific question related to a technical topic or to engage in general industry issues. . Please note that we will not be considering anything related to the domestic sector, such as residential wiring.

We hope that this section of the magazine not only becomes a regular feature, but that it is widely read and distributed among your peers. Remember, it can only become a success with the full participation of our readers! Send your burning questions to minx@saiee.org.za - subject 'WATT?'.

We look forward to hearing from you.
- Ed

The rapid pace of technological change and product development is a global trend that affects entire economies. We may have access to more information than ever before, but is this information readily understandable? Does it give us insight into the fundamental issues? Is it precise and based on technical clarity?

QUESTION ONE

Why is testing for Polychlorinated Biphenyl (PCB) in transformers so important?

ANSWER ONE

Polychlorinated Biphenyl (PCB) is synthetic oil-like chemical that is considered extremely toxic, and was banned in the early 1980s.

Testing for PCB is essential to ensure your own safety, the safety of personnel, and that of the environment. If high PCB levels are present in a transformer, this can pose a health threat when maintenance needs to be carried out. Exposure to excessively high levels could cause a number of reactions from skin rashes, to eye irritations, to irritation of the respiratory tract and headaches, to name just a few.

If PCB contaminated transformer oil spills onto the ground around the transformer, it will impact on the environment, as it will concentrate in the fatty parts of micro-organisms. A chain reaction occurs whereby it is absorbed into the water, plant life and potentially into our future food supply.

Significantly, PCB has a very slow degradation process, which makes amplification within organisms greater. It has also been shown to cause damage to the reproductive and immune systems of wildlife and humans.

The recommended PCB levels in a transformer should be below 50 parts per million. When testing is done, anything higher means that either the transformer oil must be changed, or the transformer oil must be regenerated. *See table 1.*

QUESTION TWO

Why is Karl Fischer analysis needed in a transformer?

ANSWER TWO

The main function of transformer oil is to provide electrical insulation. Moisture can initiate from two sources; the atmosphere, if you have a free breathing transformer with leaking, or poorly functioning breathers, or from internal sources due to degradation of cellulose, and any by-products caused by heated insulating oil. This is the most common source of contamination within a transformer. An increase in moisture content within the transformer can lead to a decline of the insulating properties of the oil, which may result in dielectric breakdown. Oil and water are not mutually soluble due to the difference in chemical properties, which means they do not blend.

When temperatures fluctuate within a transformer, a small amount of water will dissolve in the oil, and as the transformer cools down, any dissolved water will become free again, resulting in poor insulation and oil degradation.

WATT?

Excessive moisture content within the oil can also lead to the breakdown of insulation paper in the windings.

A coulometric Karl Fischer instrument is used to detect the water levels within the oil. The unit is very sensitive and can detect levels to a few parts per million.

QUESTION THREE

What affects the dielectric strength reading of a transformer?

ANSWER THREE

Testing the dielectric strength of transformer oil is done to determine the oil's ability to withstand electrical stress without any failure.

Particles in the oil have a significant effect on the insulating oil, as it decreases the dielectric strength of the oil. The size of particles found in the transformer oil will determine the degree by which the dielectric strength in the oil has been degraded.

The most common particles found in transformer oil are carbon from the tap changer, paper, and dust.

Regeneration of the transformer oil, filtration of the current oil, or replacement with new oil needs to be done to remove any unwanted particles, thereby recovering the dielectric strength of the oil.

The insulating oil tends to be more stressed than the paper, as the dielectric constant of oil is less than that of paper.

As a result of this, the insulating oil is considered to be the weak link in the transformer, and the condition of the oil needs to be maintained in order to sustain its dielectric strength properties.

This test goes hand-in-hand with the Karl Fischer test. If the moisture content is high, the dielectric reading will be low, and vice versa.

In circumstances where both tests indicates a low reading, the maintenance team needs to be informed, since oil contaminants could be coming from other sources within the transformer tank.

QUESTION FOUR

What is the acceptable acid level in a transformer?

ANSWER FOUR

An acid test, otherwise known as the TAN test, is normally used as a measure to determine when transformer oil should be replaced or reclaimed.

The unacceptable neutralization value of the oil is anything above 0.200mg KOH/g. When these levels are reached action needs to be taken to ensure full transformer functionality.

Regeneration is the most common process used to remove acid from transformer oil. In severe cases, it is recommended that the oil be regenerated or replaced with new oil. Should these actions not be taken, the oil will become corrosive and produce dissolved sludge and eventually sludge deposits. These deposits can result in overheating of the transformer and also have the ability to weaken the insulation material, which will result in failure of the transformer. wn

TABLE 1 - THE ACCEPTABLE PCB LEVELS ARE AS FOLLOWS:

1	2	3
PCB CONTENT LEVELS	**PCB LEVELS**	**PCB LEVELS, COMMON NAMES**
<1	0	PCB free materials
1-10	1	Non PCB materials
11-20	2	
21-50	3	
51-500	4	PCB contaminated materials
>500	5	PCB materials

August

Movers, shakers and history-makers

COMPILED BY | JANE BUISSON-STREET
FSAIEE | PMIITPSA | FMIITSPA

1 AUGUST

1981 MTV launched on cable TV. The first video played was "Video Killed the Radio Star" by The Buggles.

2 AUGUST

1873 The Clay Street Railroad began operation, and was the first cable car in San Francisco's now famous cable car system.

3 AUGUST

1977 Radio Shack introduced their first computer, the TRS-80. This relatively low cost computer helped drive the acceptance of the personal computer in the home.

4 AUGUST

2007 NASA launched the Mars Phoenix lander. Phoenix was the first spacecraft to land on the Martian arctic surface. Its mission was to dig for ice and assess if the Martian arctic ever had conditions that could have supported life.

5 AUGUST

1928 Trademark serial number 71270581 for Ford was filed.

6 AUGUST

1916 Watermelons were banned by the 'military brass' in El Passo. Evidently, the offending melons' rinds could not be burned or properly disposed of and so caused a plague of flies in the camp.

7 AUGUST

1906 The Flexible Flyer's trademark was registered. A flexible flyer is a steerable wooden sled with thin metal runners.

8 AUGUST

1963 This is the date of "The Great Train Robbery" in United Kingdom when thieves held up a train carrying the Royal Mail and stole 120 mail sacks. The mail sacks contained cash and gems valued in excess of £7 Million.

9 AUGUST

1898 Rudolf Christian Karl Diesel was granted a patent for his "internal combustion engine", the Diesel engine. Diesel was a German inventor and mechanical engineer, who was also famous for his mysterious death.

10 AUGUST

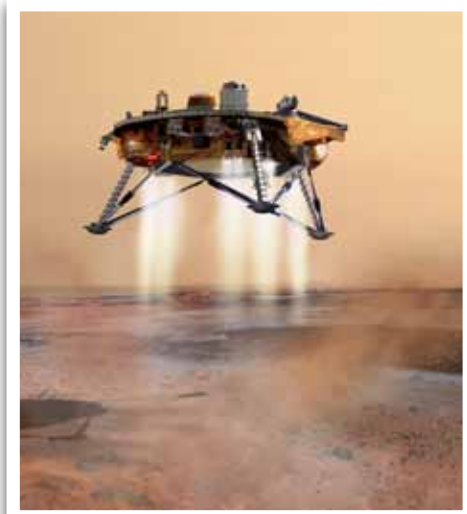
2004 The iTunes Music Store became the first store to have a catalogue of more than one million songs.

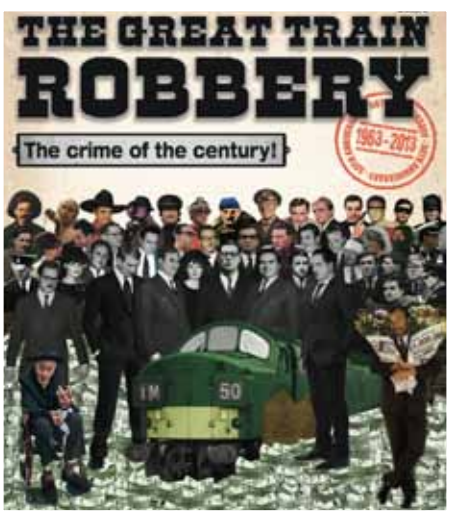
11 AUGUST

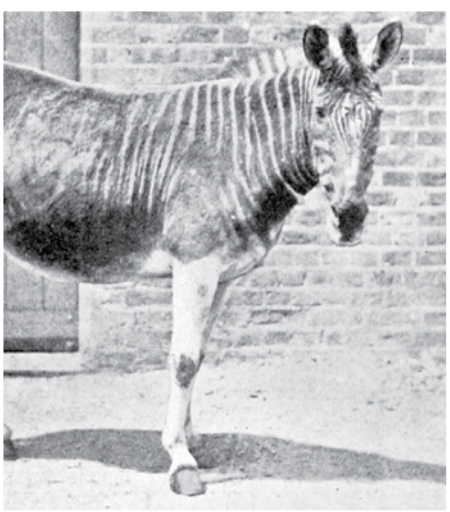
1999 There was a total eclipse of the sun seen starting in the Atlantic, a few hundred miles east of Boston (USA), and seen throughout Europe, Asia, The Middle East.

12 AUGUST

1883 The last quagga died at the Artis Magistra Zoo in Amsterdam, Netherlands.







13 AUGUST

1960 The Central African Republic declared independence from France.

14 AUGUST

2006 Dell recalled 4.1 million laptop batteries, manufactured by Sony, which had flaws that could result in the batteries overheating, catching fire or exploding.

15 AUGUST

1914 he Panama Canal, connecting the Atlantic and Pacific oceans, was officially opened.

16 AUGUST

1995 Microsoft introduced Internet Explorer.

17 AUGUST

1982 "The Visitors" by ABBA became the world's first commercial music compact disc (CD).

18 AUGUST

1937 Kiichiro Toyoda founded the Toyota Motor Company in Japan

19 AUGUST

1996 South African major political parties began their submission to the Truth and Reconciliation Commission (TRC).

20 AUGUST

1882 Tchaikovsky's "1812 Overture" debuted in Moscow.

21 AUGUST

1911 The Mona Lisa was stolen by a Louvre employee.

22 AUGUST

2006 The country of Liberia produced two sets of new stamps from their post office, the first to be made since the start of the civil war in 1989.

23 AUGUST

2012 News was dominated with the story of Cecilia Gimenez (80), who took it upon herself to restore a fresco of Jesus, which was painted by Elias Garcia Martinez at the Sanctuary of Mercy Church near Zaragoza. Unfortunately, her amateur restoration did not turn out the way she hoped.

24 AUGUST

1847 Charlotte Bronte finished the manuscript of 'Jane Eyre'.

25 AUGUST

1972 Computerized axial tomography (CAT scan) was introduced in Great Britain.

26 AUGUST

2002 Earth Summit 2002 began in Johannesburg, South Africa.

27 AUGUST

2003 The city of Fairbanks, Alaska connected to what was at the time the world's largest battery backup.

28 AUGUST

1845 The first issue of Scientific American magazine was published.

29 AUGUST

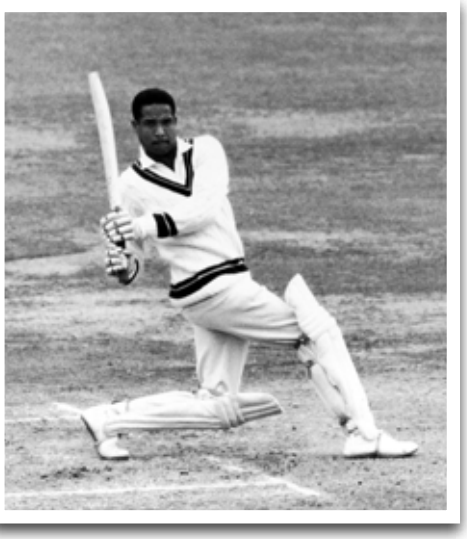
1831 English scientist Michael Faraday discovered electromagnetic induction.

30 AUGUST

1969 The first Interface Message Processor (IMP) was delivered to Leonard Kleinrock's research group at UCLA. The IMP was the device that would interconnect networks between research facilities on the developing ARPANET, the precursor to the Internet.

31 AUGUST

1968 Garfield Sobers became the first batsman ever to hit six sixes in a single over of six consecutive balls in first-class cricket. wn



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Eastern Cape Centre

Chairman | Carl Hempel

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Southern Cape Centre

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Vaal Centre

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Western Cape Centre

Chairman | Bruce Thomas

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