Medical Alarms on the NBN

&

Next Generation Networks

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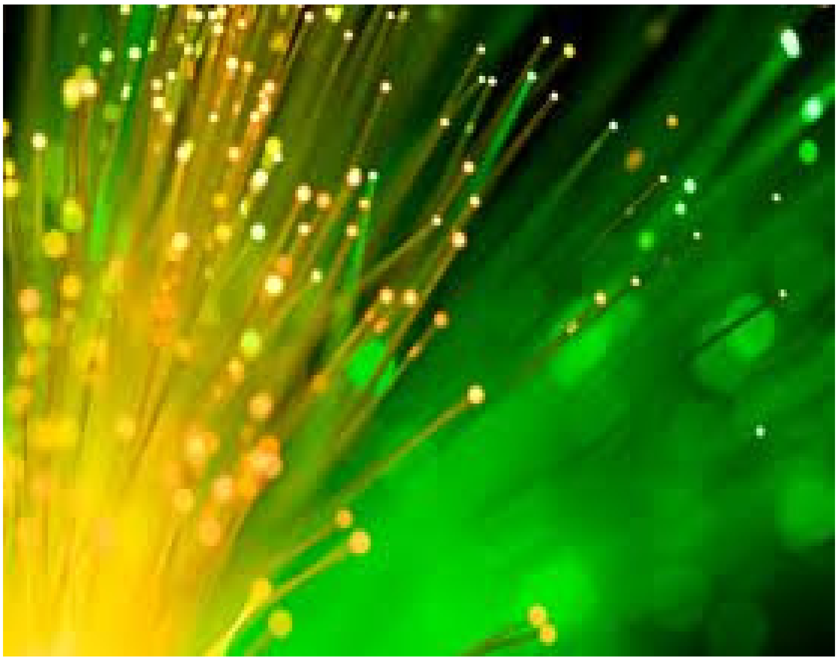

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1. Summary

Please see the disclaimer at the end of this document

The NBN is a high quality network which, depending on the type of service provided and the capabilities of the customer's chosen Retail Service Provider (RSP), is suitable for the connection of conventional PSTN medical alarms. However, significant issues remain concerning the provision of battery back-up and the battery run-time during a mains power failure, battery condition monitoring and battery replacement, the type of voice service provided by the customers RSP, and the migration of a customer's in-premises telephone wiring to the new voice service.

It is essential that medical and security alarm customers contact their alarm service provider as soon as possible after being advised of service migration to the NBN in their area, and definitely prior to entering into any telecommunications service agreement.

Medical alarm customers should tell anyone who contacts them from NBN Co. or an RSP that they have a medical or security alarm connected to their telephone service.

People with medical alarms should also register their medical alarm service on the Medical Alarm Register at www.nbnco.com.au/campaigns/medical-alarm-register.html

The NBN Fibre-to-the-Home (FttH) network is suitable for connecting all medical alarms through the Universal Voice UNI-V connection. The RSP will need to provide the correct voice service over the UNI-V port.

The technology and capabilities of the new NBN Fibre-to-the-Node (FttN), also called the Multi-Technology-Mix (MTM) network are not fully clear at this time, however the MTM system is **unlikely to support centrally monitored medical alarms.** Monitored alarm customers may need to change to a 3G wireless alarm when their telephone service is migrated to the NBN MTM network. In most cases the cost of the equipment upgrade, and the associated 3G wireless service charges, will be bundled into higher alarm service fees, (see 3G section below).

Non-monitored medical alarms, which call responders rather than a 24/7 monitoring centre, are expected to work when connected to the NBN MTM network, but the RSP will need to provide an analogue voice service through a connection on their gateway equipment.

Alarm users changing to the MTM network should select an RSP that can provide an analogue connection on their gateway, which also allows for the connection of standard telephones and medical alarms.

At this time it is expected that the MTM network will have some battery back-up capacity, but its provision may not be universal and the battery run-time will vary depending on network loading and other factors. Medical alarm customers should ask their RSP about providing battery back-up on the MTM service. A battery back-up power supply will also need to be provided to power the RSP supplied gateway equipment during a power failure.

3G Wireless Alternatives

Issues with the NBN can be avoided by using a 3G wireless medical alarm. There are two basic solutions:

1. **Use a 3G medical alarm**
   Medical alarm monitoring services can provide a 3G medical alarm where the client lives in an area with reliable 3G wireless coverage. In most cases the cost of the equipment upgrade, and the associated 3G wireless service charges, will be bundled into higher alarm service fees.

2. **Use a 3G Gateway/Fixed Wireless Terminal**
   Non-monitored medical alarm systems (family and friends alarms) may be connected to a 3G gateway with battery back-up (also called a 3G fixed wireless terminal with battery back-up). This device replaces the NBN completely by connecting to the 3G mobile wireless service. It provides an analogue connection for standard telephones and conventional medical alarms, and also provides an Ethernet connection for connecting a computer and the Internet. Some 3G gateways also provide in-home Wi-Fi.

   The customer will also need to purchase a 3G voice and data SIM from their preferred wireless service provider.

   A 3G fixed wireless terminal can provide a very cost effective alternative to the NBN for all a clients telecommunications needs and the connection of non-monitored medical alarms, so long as the data download requirements are not very high, (i.e. normal internet usage, but not downloading large video files etc.)

Other Services (Naked DSL Ect)

VCi does not recommend connecting centrally monitored medical alarms VoIP or Naked-DSL services unless the quality and transmission characteristics of the network, end-to-end, can be assured, and then only if the network and all customer equipment is battery backed-up.

Medical and security alarms can be connected to the Optus HFC network. However, the Optus HFC network is to be incorporated into the NBN MTM network, and may no longer be suitable.

Centrally monitored alarms are likely to stop working without warning if a customer's PSTN telecommunications service is converted over to a Fixed Wireless Terminal. In many cases the customer, or the alarm service provider, may not be aware of the service change.

2 Background

Around the world, telecommunications networks are changing, from 'plain old telephone service' (POTS) networks that carry data as a secondary usage, to Internet Protocol (IP) data networks that carry voice as a secondary usage. Analogue Public Switched Telephone Networks (the PSTN) are being phased out as telecommunications networks are modernised.

Next Generation Networks, maintain only a single network for voice, data and video, enabling carriers and service providers to reduce costs and increase their revenue by maximizing service offerings. In Australia, migration to all-IP networks has been underway for some time, with trunk, (inter-exchange), corporate and government, and public telecommunications networks adopting IP technology, and the National Broadband Network (NBN) is being rolled out to customers across the country in order to provide fast modern infrastructure for new and yet to be developed on-line applications.

The transition from the PSTN to an IP-only network will take many years to complete and will affect all telecommunications users, including medical and security alarms. During the transition period a variety of alarm connectivity technologies will be required to address the various customer connectivity scenarios including: Fibre to the Home (FttH), Fibre to the Node (FttN)/Multi-Technology Mix (MTM), satellite and fixed wireless technologies.

Through its representative body "PERSA", and in close co-operation with NBN Co various Australian government agencies and the telecommunications industry representative the "Communications Alliance", the Australian medical alarm industry is working to achieve, as much as possible, a seamless transition for medical alarm users.

This paper discusses the various customer access technologies, some of the key technical requirements for connection of existing medical alarms to the new network, and the changes and difficulties occurring with the introduction of the NBN.

3 The Universal Service Obligation (USO)

Australia is a large and sparsely populated country. According to the OECD, for every square kilometre of land mass there are, on average, around three Australians, (OECD 2009), with about 64% living in capital cities, (ABS 2008a). The Universal Service Obligation (USO) is a government policy to ensure all Australians, no matter where they live or conduct business, have reasonable access, on an equitable basis, to standard telephone services and payphones.
Australia's dominant telecommunications company is Telstra and, as the primary universal service provider, Telstra is responsible for fulfilling the USO throughout Australia.

Naturally, providing a universal telecommunications service in sparsely populated areas is very expensive and uneconomic, and must be subsidised. The USO is administered by the Telecommunications Universal Service Management Agency (TUSMA) and funded by a levy per customer from all telecommunications carriers.

At this time the USO only applies to voice-only services. A customer with (or connecting) an internet or data service is not classed as a voice-only customer and their service will not fall within the USO provisions.

The Telecommunications Universal Service Management Agency was abolished on 1 July 2015 with its functions transferred to the Department of Communications.

4 Accessing the Customer

An 'access technology' is simply a method of connecting a customer to a telecommunications network. Also called the 'last mile' connection, simply because it spans the distance from the telephone exchange (or some other point of network interconnect such as a 'Node') to the customer's premises, it is typically the most difficult and expensive part of any fixed-line network to install. Whoever owns the 'last mile' connection has a significant advantage in the marketplace, as other service providers need to buy wholesale customer access from them.

In Australia, the dominant customer access technology is still the Telstra owned copper PSTN exchange line, which connects customers to the (also Telstra owned) local telephone exchange.

Local Loop Unbundling

For over one hundred years there was only one public telecommunications network in Australia - the PSTN - owned by the Post Master Generals Department (the PMG) which later became Telecom Australia, and only one customer access technology - the copper cable or 'twisted pair'.

The 1982 Davidson Enquiry recommended ending Telecom Australia's monopoly and by late 1999 Telstra was formed and fully privatised, with the Australian Government retaining a major shareholding.

Although the Australian telecommunications market became open to competition, and many carriers and service providers competed vigorously for business, Telstra retained ownership of critical network assets, including the 'last mile' customer access network.
To pave the way for new competition in the telecommunications market, the ACMA introduced a regulatory process called Local loop unbundling (LLU or LLUB).
LLU allowed multiple carriers to access a customers' exchange line, for a 'reasonable' wholesale access fee paid to the owner of the line, i.e. Telstra.

The Australian Competition and Consumer Commission (the ACCC) forced Telstra to accept LLU and also attempted to regulate the price Telstra charged its competitors for wholesale access to its network. Naturally Telstra was not too happy about providing its assets to a competitor who intended to take its customers, sometimes it is said at less than commercial rates.

In such an environment, it's not surprising that Telstra's competitors turned to other options to connect to the customer, and free themselves as much as possible from having to rely on Telstra. As a result, the Australian telecommunications landscape now contains a multitude of service providers, some with their own networks and some buying wholesale access from network owners, and a variety of customer access technologies.

The Public Switched Telephone Network - PSTN

The Telstra owned PSTN has been in operation for over one hundred years, and provides a very reliable voice-band (300 Hz – 3 kHz) telephone service, which is also capable of carrying low-speed (56 kBit/s) modem data.

The PSTN uses a variety of technologies. Inter-exchange parts of the network are fully digital, but the 'last-mile' connection from the local telephone exchange to the customer is a voice-band analogue service, overlaid on a 50 Volt DC voltage feed from the exchange, delivered over copper wires – much as it has been for over 100 years.

Asymmetric Digital Subscriber Line (ADSL)

ADSL is a high speed data service which is overlaid on the copper PSTN service. This is possible because human voice uses low frequencies, (300 Hz to 3 kHz), and ADSL uses higher frequencies, (25 kHz to several MHz). The ADSL signal is injected onto the customer line at the local telephone exchange using equipment called a DSLAM, and the voice and data signals are separated at the customer end using a low frequency/high frequency splitter circuit, called an ADSL filter. An ADSL gateway/modem is required at the customer premises.

ADSL download speeds are greater than the upload speeds, hence the term 'asymmetric'. ADSL2+ is capable of up to 24 Mbit/s download speeds, but only up to about 1.5 km from the DSLAM at the exchange, after which the maximum speed falls off quickly. Generally, the longer the copper cable connecting the customer to the DSLAM, the slower the maximum obtainable data speed.

Naked Digital Subscriber Line (DSL)

A Naked-DSL service is a digital-only service, with no connection to the PSTN trunk network at the local exchange. The customer copper line has no dial-tone, and no voltage feed, and will not support conventional telephone equipment. A DSL gateway/modem device is required at the customer premises.

If a voice telephone service is required, either a Voice-over-IP (VoIP) telephone or a computer running an IP telephony application can be connected to the customers gateway/modem. An Analogue Telephone Adaptor (ATA) can be used to connect a conventional analogue telephone to the DSL service.

Customers typically use this type of service to obtain lower call costs but, in the past, Naked-DSL services have sometimes been inferior.

If an analogue medical or security alarm system is connected to a DSL service through an ATA, the ATA and the entire end-to-end network must be correctly configured. Additionally, because there is no voltage feed from the telephone exchange to power the customer equipment, all customer equipment must be battery backed-up to protect against a mains power failure.

As the Quality of Service cannot be guaranteed, and there is no battery backup, a Naked-DSL service is not recommended for the connection of centrally monitored medical alarms. As the rollout of the NBN continues, Naked-DSL services are being migrated to the NBN.

Hybrid Fibre Cable (HFC)

HFC networks consist of a fibre backbone distribution network with coaxial cable local distribution to customer's premises. A system of amplifiers and splitters reticulate the signal around a local area in a tree and branch type structure.
The combination of fibre and a coaxial cable provides sufficient bandwidth for multi-channel pay-television distribution and very high speed data services, (at least up to 100 Mbit/s).

The Optus HFC network also provides a high quality telephone service. The customer's in-home telephone wiring is disconnected from the incoming PSTN exchange line and is then connected to an analogue telephone adaptor (ATA) port on the cable modem.

At this time the Optus HFC cable network is suitable for the connection of centrally monitored medical alarms, so long as battery back-up unit is provided for the modem/gateway equipment at the customers premises.

The Optus HFC network is expected to be incorporated into the NBN MTM network. Its future suitability for centrally monitored medical alarms is unknown.

Fibre to the Home/Fibre to the Premises (FttN/FTTP)

Fibre-to-the-Home (FttH), (also called Fibre-to-the-Premises -FttP), takes the super high speed optic-fibre cable to an optical modem/gateway device located at the customer's premises.

FttH has the highest speed potential of all networks, up to 1 GBit/s or more and in the NBN configuration can provide the highest grade voice service.

The NBN is initially expected to use FttH in green-field sites (new construction), where the cost of running fibre into the premises is low, and use the FttN/MTM solution in built environments.

Fibre to the Node (FttN), Hybrid Fibre Twisted Pair (HFTP), or Multi-Technology-Mix (MTM).

In order to speed the roll-out of the NBN, and also to reduce cost, (though that is now questionable), Fibre to the Node (FttN), is expected to become the dominant customer access technology, at least in the medium term.

An FttN network terminates the optic-fibre cable at some convenient point in the neighborhood, called a 'Node', probably a cabinet in the street or a box in the basement of an apartment block, and some other access technology is used to span the short distance from the node to the customer.

The term Multi-Technology Mix (MTM) is a general term to describe a network which relies on a mix of all available customer access technologies.

Because FttN/MTM can use the existing copper or coax cable to span the distance from the Node into each customer's premises, FttN/MTM was expected to be much less expensive to roll-out than FttH in brown-field (built-up) areas. Very high data speeds, (up to 100 MBit/s), are still possible if the customer is close to the node, however for most customers the speed is expected to be slower than FttH but faster than ADSL2+.

The Australian government has recently stated that FttN/MTM will be the dominant network architecture (60%) in the NBN, and trials have recently concluded using a technology called VDSL with vectoring (very fast DSL using a system of dynamic interference reduction) between the Node and the customer's premises.

At this time the FttN/MTM service not expected to be suitable for the connection of centrally monitored medical alarms, due to its latency and transmission characteristics. It is expected to be suitable for non-monitored medical alarms if the RSP provides an analogue voice service.

It is now expected that the MTM network will have a degree of battery back-up, but it may not be universal and the run-time will vary depending on the number of customers on any node, and the traffic levels. A separate battery back-up power supply will always be needed to power the RSP supplied gateway equipment at the customer's premises.

Customer Equipment

All telecommunications networks require some sort of equipment located in the customer's premises. In the case of a telephone service over the PSTN the customer equipment is simply the standard telephone.

Fibre, DSL, ADSL, VDSL and HFC customer equipment consists of a routing gateway/modem, usually with a number of Ethernet ports for connection to computers, entertainment systems and VoIP phones etc. The gateway may also contain an ATA with one or two 'simulated PSTN' connections, for connection of analogue telephone equipment.

In the NBN FttH system the customer equipment consists of a Network Termination Device (NTD), also called an Optical Network Termination unit (ONT), but basically an optical modem, a Routing Gateway (RG) and an ATA. A battery back-up power supply may also be provided.

Each NTD provides two analogue UNI-V ports and five digital UNI-D ports. To encourage competition and allow unbundling of services, in the spirit of the earlier LLU process, each port on the NTD can be assigned to a different Retail Service Provider (RSP), so a customer's entertainment can come from say Foxtel, internet from Optus, and telephone from say Telstra. Analogue devices such as conventional telephones, FAX machines and medical and security alarms can be connected to the UNI-V voice ports, and digital devices such as computers and entertainment systems connect to the UNI-D data ports. NBN Co. provides an optional battery back-up unit to FttH customers by "customer informed consent".

In the NBN FttN/MTM system, the customer equipment will comprise a VDSL modem/gateway device. A VoIP or Wi-Fi telephone may be supplied by the Retail Service Provider (RSP). An analogue Telephone Adaptor (ATA) may also be provided in the gateway device.

The FttN/MTM system is expected to be an interim stage in network modernization, with the ultimate goal being a full fibre network.

5 Technical requirements of PSTN Medical Alarms

Battery Back-up

Australian Standard AS4607 requires centrally monitored medical alarms to have at least 36 hours battery back-up, in case of a mains power failure. Only the PSTN, or a stand-alone 3G wireless solution with low call activity, can support that requirement.

There is no Australian Standard for non-monitored medical alarms.

Mode-3 Wiring

Medical and security alarms use a special telephone wiring configuration that allows the alarm to take control of the customer’s phone line, so an alarm call can still be made if other telephone devices are off-hook or in use. In Australia, this wiring configuration is called Mode-3.

When a customer with a medical or security alarm is to be migrated onto an NBN voice service the Mode-3 wiring configuration must be preserved. The easiest way is for the installer to identify the incoming exchange line, cut it off from the exchange, and reconnect it to the UNI-V port on the NTU. The customer’s telephone line will then be disconnected from the PSTN, and reconnected to the NBN service, without any interference to the customer’s wiring or the Mode-3 configuration.

All telecommunications and data cabling, other than pre-made cable assemblies, must be installed by a suitably qualified person.

Service Configuration

Each type of network modem/gateway device contains a configuration file which sets the correct operating parameters for the services provided, and for network compatibility. For conventional centrally monitored medical and security alarm systems to work correctly, the configuration must be set to enable the highest packet priority (lowest delay), the ITU-G.711 codec standard (best audio quality) throughout the network, and in-band DTMF (DTMF transmission as digitised audio) throughout the network.

The correct service level for centrally monitored medical and security alarms is Traffic Class-1 (TC-1). This may not be the default configuration setting, and not all service providers may support a TC-1 service. The choice of service providers, and the set-up or changeover to the NBN requires careful co-ordination between the customer, the RSP, and the alarm service provider.

Non-monitored medical alarms, which do not use high-speed DTMF for communicating with a central monitoring service, may operate correctly over a lower service level. At this time it is believed services provided over the MTM network are likely to be Traffic Class 2 (TC2).

Choice of Codec

To enable audio (voice, or analogue tones such as FSK modem tones, DTMF tones, or FAX) to be carried over a data network, the audio must be converted to digital signals at the sending end, and then converted back to analogue voice-band audio at the receiving end.

This conversion process is done by a device called a codec (**code**r-**dec**oder) conforming to one of several International Telecommunication Union (ITU) standards. The coder takes 'samples' of the audio waveform at a high sampling rate and converts these to a digital data stream for sending. Digital data streams received by the decoder are reassembled in order, and then reconstructed into the original audio waveform.

Modern codec's are increasingly implemented as software applications running on specialised microcomputers called digital signal processors (DSP's).

The quality of the received audio depends on the speed at which the codec's at each end digitise and reconstruct the original analogue audio. Higher sampling speeds provide higher quality transmission, but generate the highest amount of data and require the greatest bandwidth and network resources, (and, naturally, also the greatest network cost).

High quality telecommunications networks use ITU-G.711 codec's that digitise the audio into a 64 kBit/s data channel. This provides good phone quality audio and can also reproduce complex sounds, analogue modem tones, and FAX and DTMF tones.

In an attempt to save bandwidth, and therefore cost, highly voice-optimised codec standards were developed – such as ITU-G.723, ITU-G.729 and others. These codec's reduce the amount of bandwidth required by compressing (reducing sound level range) of the audio and by other techniques which highly optimise the coding-decoding process for voice. Very highly voice-optimised codec's are known as 'vocoders'.

The amount of bandwidth available in the network, and the customer access technology affects the choice of codec, the digitisation characteristics, and the degree of voice compression used. Multi-standard codec's have been developed that can be reconfigured on-the-run by sending control commands to the network. These codec's can be switched to G.711 mode when a high quality codec is required for transmitting high quality speech, DTMF or data, and switched back to a voice-optimised mode for speech. Sometimes a first attempt is made using G.711 and if the network is busy, (congested), a second attempt may be made using another lower data rate, higher compression codec standard.

The choice of codec standard is critical as it determines what, if anything other than voice, can be sent over a network. To make matters even more complex, when calls are routed between different types of networks, or between networks owned by different providers, often a conversion process sometimes occurs, (trans-coding), which bridges between different codec standards. It is therefore difficult to know the exact transmission characteristics of a particular end-to-end telecommunications link.

Wireless networks always use codec's with high levels of voice compression in order to make the most effective use of the limited radio frequency spectrum. Wireless networks may switch Codec standards dynamically in response to traffic levels and the need to conserve radio spectrum.

As the NBN FttH system has plenty of available bandwidth the G.711 Codec standard is the standard configuration over the UNI-V voice service, but, for centrally-monitored medical alarms, it will be important to ensure that all carriers involved in an alarm call, end-to-end, use the G.711 standard without trans-coding.

No details are currently available on the type of Codec used in the NBN FttN/MTM network. At this time it is believed services provided over the MTM network are likely to be Traffic Class 2 (TC2).

Voice Performance over IP

Medical alarms typically use very sensitive microphones to extend the voice range from a person needing assistance to the microphone in the alarm base unit. High background noise levels are common and often compete with the person's voice.

In an IP system, usually data is only sent when the codec detects that a person is actually talking, and accurate detection may be very difficult in an environment with high background noise levels. Errors and switching delays in the codec's voice activity detector may cut-off leading voice syllables, or fail to detect voice at all, adversely affecting intelligibility.

These shortcomings become very noticeable when the person's voice level is around the threshold of the codec's voice activity detector, or near the level of the background noise. If possible, voice activity detection in the modem/gateway should be switched off.

Transmission of DTMF Tones

Monitored medical and security alarms communicate with central-office alarm monitoring receivers using a DTMF data standard developed many years ago. DTMF is an analogue signal containing a mix of two non-harmonically related high and low frequency audio tones. The use of two simultaneous audio tones allows DTMF receivers to distinguish between a DTMF tone and voice, avoiding false activations on voice, or 'voice hits'.

All the previous factors affecting Voice performance also affect the carriage of DTMF tones. Unfortunately, DTMF receivers are quite susceptible to distortion, background noise, and amplitude variation between the high and low frequency tones, and IP networks often have difficulty accurately transmitting a DTMF tone.

In addition to issues associated with the choice of codec, an IP network sends information in packets containing a few tens of bytes of data. The data packets propagate through the IP network from one end to the other in a random manner (one packet could go via Sydney and the next via Darwin) and, due to network delays (latency), are not necessarily received in the order they are sent. Depending on the path they take through the network, transmission delay may vary between about 60 and 300 miliseconds, or more for a satellite circuit. The packets are reassembled at the receiving end in a device called a 'jitter filter', and output as much as possible in the order they are sent. Some packets may be received too late to be reassembled in correct order, and some may be lost altogether.

Although short delays and drop-outs are not too noticeable in human conversation, these issues become very important when transmitting time-critical data. To overcome these types of problems, DTMF tones are sometimes sent across an IP network as network commands that start and stop the play-out of regenerated DTMF in the gateway/modem at the receiving end.

The latency (delay) in an IP network can vary significantly, and will delay the initiation of the start and stop commands at the receiving end. The effect of this is to significantly and randomly change the timing of the DTMF tones at the receiver. This is not an issue for applications like phone-banking, where everything happens at finger-poking speed, but it is a severe problem for an alarm system where the alarm data is sent to the central-office receiver as a string of short, typically 60ms long and 60ms spaced, time critical DTMF tone pulses. DTMF tones sent as 'out-of-band' network commands can be very significantly delayed and stretched to the point where all alarm data is corrupted.

Because DTMF is so entrenched in modern telecommunications systems, Next Generation Networks need to handle DTMF with acceptable audio distortion and transmission delays. The FttH UNI-V system seems to be able to carry DTMF transmission equally as well as the PSTN.

Single Frequency Tones and FSK over IP

Monitored medical and security alarms use single-frequency 'request-to-send' and 'acknowledgement' tones to initiate and acknowledge DTMF alarm data transmission, and some alarms may also use FSK modem tones for alarm data and/or remote reprogramming.

Continuous single-frequency tones, including frequency or phase shift keyed (FSK/QPSK) modem data and FAX tones, require an ITU-G.711 codec standard. Voice-optimised codec's do not transmit single tones well, causing severe level and phase distortion on the received audio. The FttH UNI-V system seems to be able to carry single frequency tones equally as well as the PSTN.

6 IP/VoIP Alarms

IP/VoIP alarms are starting to appear on the Australian market but, due to the complexity of the technology involved, they are currently significantly more expensive than conventional analogue PSTN alarms. Data speed or capacity is, for the most part, not important for medical alarms as only a few bytes of data need to be transferred during each alarm call, and call incidence (repetition) is very low.

IP capability is really only an advantage if large amounts of data need to be transmitted, (such as video or bio-medical data), or if equipment needs to be tested almost continuously, or if call-cost is a critical factor.

7 The National Broadband Network

In 2008 Telstra announced its intention to build a wholesale-only FttN network, using VDSL over its existing copper lines into customers' premises.

However, in April 2009 the Federal government announced plans to build the NBN within 8 years, (earlier in Tasmania), delivering very high speed access to 98% of the population, over an FttH network in high density areas and by wireless and satellite in rural areas. Telstra submitted a non-complying tender proposing only an 80-90% penetration network, and was subsequently removed from the Tender process. In response, Telstra announced its intention to raise speeds on its existing wireless and HFC networks to comparable speeds to the proposed NBN.

Then, in 2011, Telstra signed an agreement with NBN Co., estimated to be worth A$9 Billion after-tax, to transfer its internet customers in fibre service areas to the NBN and agreed to lease dark-fibre, spare exchange space and cable ducts, to NBN Co. Telstra remains a network owner but, for a number of years, is prevented from marketing their 4G mobile network as an NBN alternative.

In the NBN model, NBN Co. owns the customer access network and allows equal access to multiple RSPs. One hundred and twenty service boundary points, (points of interconnect – POI's), are planned throughout the network, for RSP's to connect into the NBN. In this way, the NBN model encourages competition and allows customers to buy different services from different RSP's, who all purchase wholesale bandwidth from NBN Co.

The PSTN is to be decommissioned in each fibre service area 18 months after fibre roll-out is completed. Fibre roll-out completion is determined by the number of premises passed, so copper disconnection in an area is not dependent on the number of actual customers migrated to the NBN, but rather on the availability of the NBN.

The NBN roll-out has been slower and more expensive than anticipated, and service uptake lower than expected. In order to reduce costs and speed delivery the Australian government has announced that FttN/MTM will play a major role, especially in brown-field areas, (built up areas), and multi-unit dwellings, (apartment blocks, etc), at least in the medium-term. FttH is expected to remain dominant in Greenfield sites, (new construction areas), and is seen as the long-term end-goal technology for all fixed-line connections.

Connecting Medical Alarms to the NBN

If a voice service is provided through the NBN Fibre to the Home UNI-V voice port, the transmission characteristics will be at least equal to the PSTN and will be suitable for connection of all medical alarms.

Medical alarms may also be connected to the UNI-D data port through an analogue telephone adaptor (ATA), so long as the service provided is a TC1 service.

However, the run-time of the NBN's optional battery back-up power supply is only 5-8 hours and does not match the Australian Standard AS4607 requirement for 36 hours. Issues remain about the monitoring of the battery condition and the proposed DIY replacement of batteries.

The new NBN Fibre-to-the-Node (FttN), also called the Multi-Technology-Mix (MTM) network **does not** support PSTN medical or security alarms that communicate with a Central Monitoring Service. Monitored alarm customers will need to have their alarm equipment changed to a 3G wireless alarm when their telephone service is migrated to the MTM network.

Non-monitored medical alarm which call responders rather than a 24/7 monitoring centre are expected to work when connected to the MTM network, but the RSP will need to provide an analogue voice service through an analogue telephone adaptor (ATA) as part of their gateway equipment. A battery back-up power supply will also need to be provided to power the RSP supplied gateway equipment during a power failure.

At this time it is expected that the MTM network will have some battery back-up capacity, but its provision may not be universal and the battery run-time will vary depending on network loading and other factors. Medical alarm customers should confirm the degree of battery backup provided on their MTM service.

The NBN and the Universal Service Obligation

There are cabling expenses associated with connecting a customer's home telephone wiring, and their medical alarm, to an NBN voice service. Many older Australians using medical alarms have a voice-only service and, at this time, it is expected that the costs associated with converting their existing in-premises telephone wiring to connect to the NBN will fall under the USO provisions. However, the USO does not extend to customers who also have a data connection – simply because they are, then, not a "voice-only" service.

8 Wireless Services

Due to the difficulties associated with connecting centrally monitored medical alarms to the NBN, especially the proposed FttN/MTM system, medical alarms in Australia are migrating to 3G wireless.

Wireless provides mobility, and is a viable alternative to a fixed-line service in many situations. However, wireless network access fees can be a significant factor in the overall cost of an alarm system, especially as medical alarms also require a voice service for the operator or responder to hold a conversation with the user.

3G Wireless Alternatives

Issues with the NBN can be avoided by using a 3G wireless medical alarm. There are two basic solutions.

1. **Use a 3G medical alarm**
   Medical alarm monitoring services can provide a 3G medical alarm where the client lives in an area with reliable 3G wireless coverage. In most cases the cost of the equipment upgrade, and the associated 3G wireless service charges, will be bundled into higher alarm service fees.

2. **Use a 3G Gateway/Fixed Wireless Terminal**
   Non-monitored medical alarm systems (family and friends alarms) may be connected to a 3G gateway with battery back-up (also called a 3G fixed wireless terminal with battery back-up). This device replaces the NBN completely by connecting to the 3G mobile wireless service. It provides an analogue connection for standard telephones and conventional medical alarms, and also provides an Ethernet connection for connecting a computer and the Internet. Some 3G gateways also provide in-home Wi-Fi.

   The customer will also need to purchase a 3G voice and data SIM from their preferred wireless service provider.

   A 3G fixed wireless terminal can provide a very cost effective alternative to the NBN for all a clients telecommunications needs and the connection of non-monitored medical alarms, so long as the data download requirements are not very high, (i.e. normal internet usage, but not downloading large video files etc.)

When the provision or the repair of a copper PSTN service is not economical field technicians may install a 3G Gateway/Fixed Wireless Terminal (FWT), often mounted on the outside wall of a premise.

The FWT connects to the customer's incoming telephone line in place of the PSTN exchange line, and standard fixed-line call rates are charged. As nothing appears to have changed, the customer may not be aware their service has been swapped-over from a fixed-line to a wireless service.

A Note on Wireless Services:

Due to latency, (time delays), and the way DTMF signals are carried over 3G wireless networks, most FWT's are not compatible with centrally monitored medical or security alarms, and they may stop working without warning.

Wireless can be highly reliable in areas with consistently strong received signal strength, multiple cell coverage, and when the equipment is not moved. However, in general, wireless services do not have reliability equal to the PSTN.

A wireless alarm installation must include a careful evaluation of signal strength and the equipment, especially the antenna, must not be moved from one location to another, even over very short distances, without signal strength evaluation.

(At 850MHz, a frequency band used by mobile phones, a full wavelength is about 35 cm and a half wavelength about 17.5cm. Addition and cancellation caused by reflections in the signal path can cause deep nulls and high peaks in received and transmitted signal strength over each half wavelength of distance. In practice the situation is far more complex as multiple reflections commonly found in buildings tend to 'fill-in' the reflected peaks and nulls to some extent.

Diversity reception, where two antennas or receivers are placed a small distance apart, is effective at overcoming the signal strength nulls caused by signal reflections. Other diversity techniques include 'polarization diversity' where one antenna is orientated vertically and the other horizontally, and frequency diversity where a radio signal may be repeated on two frequencies which have a significant difference in wavelength so signal nulls do not occur in the same position. Diversity in the cell-phone network is achieved to some extent by relying on multiple cell coverage, and a hand-over from one cell to another when necessary. Reliability can also be improved by using dual-networks.

External antennas can be mounted outside a building to increase received signal strength, but care must be taken to ensure the coax cable losses are not excessive. Cellular repeaters can also be used to fill-in poor signal areas. (Radio signal path-loss increases with frequency, and increases dramatically through buildings. The well known inverse-square-law for free-space electromagnetic attenuation becomes a much higher attenuation characteristic through buildings, depending on construction to the 3rd, 5th or even higher power, so a radio signal often falls of much faster through buildings than expected).

More Information

The Communications Alliance has released a Guidance Note: *Migration of Back-to-Base Medical and Security Alarms to Fibre To The Premises (FTTP) Open Access Networks - Considerations Industry Guidance Note IGN 004, at:* *http://www.commsalliance.com.au/__data/assets/pdf_file/0019/42094/Migration-of-Back-to-Base-Medical-and-Security-alarms-IGN-004-Final-V3.pdf*

Update: This guidance note is under review to take into account the MTM network.

NBN Co have produced an information paper, *Security and Medical Alarms on the NBN* at: http://www.nbnco.com.au/content/dam/nbnco/documents/security-and-medical-alarms-on-the-nbn.pdf

Disclaimer

VC International Pty Ltd (VCi) has used its best efforts to prepare this document from information available at the time, (January 2016). As this is a very rapidly changing area of technology we highly recommend you seek the latest advice from your Retail Service provider and medical alarm supplier.

VCi does not warrant this information to be free of errors and omissions.

Abbreviations

4G	Forth Generation Cellular Wireless Network
ACCC	Australian Competition and Consumer Commission
ADSL	Asymmetric Digital Subscriber Line
ASIAL	Australian Security Industry Association
ATA	Analogue Telephone Adaptor
CODEC	Coder-decoder used to convert between analogue and digital signals
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
DTMF	Dual Tone Multi Frequency
FSK	Frequency Shift Keyed (a low-speed modem protocol)
FttH	Fibre to the Home
FttN	Fibre to the Node
FttP	Fibre to the Premises (same as FttH)
FWT	Fixed Wireless Terminal
G.711/G.723/G.729	Common codec standards (there are many others)
GBit/s	one thousand million bits per second (data speed)
HFC	Hybrid Fibre Cable
HFTP	Hybrid Fibre Twisted Pair (same as FttN)
IP	Internet Protocol
ITU	International Telecommunications Union
kHz	kilohertz (a frequency of one thousand cycles per second)
LLU or LLUB	Local loop unbundling
LTE	Long Term Evolution Cellular Wireless Network
MBit/s	one million bits per second (data speed)
MHz	Megahertz (a frequency of one million cycles per second)
MTM	Multi-Technology-Mix used on the NBN, also see FttN
Mode-3	A special wiring configuration for medical and security alarms
ms	millisecond (one thousandth of a second)
Naked-DSL	An IP only DSL service without a PSTN service
NBN	National Broadband Network
NBN Co.	Company building and owning the NBN
NGN	Next Generation Network
NTD	Network Termination Device (also called an ONT)
ONT	Optical Network Termination (also called an NTD)
PERSA	Personal Emergency Response Services Association
POI	Point of Interconnect (for RSP's to connect to the NBN)
POTS	Plain Old Telephone Service
PSTN	Public Switched Telephone Network
QoS	Quality of Service

QPSK	Quadrature Phase Shift Keying (a high-speed modem protocol)
RG	Routing Gateway
RSP	Retail Service Provider
TC-1	Traffic Class One (a standard for network carriage quality)
TUSMA	Telecommunications Universal Service Management Agency
UNI-D Port	The digital connections on the NBN NTD
UNI-V Port	the analogue connections on the NBN NTD
USO	Universal Service Obligation
VCi	VC International Pty Ltd
VDSL	Very High Speed Digital Subscriber Line
VoIP	Voice over Internet Protocol