

Detailed Summary of the Report

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(i) Study Approach and Literature Review

This study was conducted over a short timeframe (approximately four weeks) during May and June 2003. Network Strategies conducted a review of existing literature that attempted to scope the TTY market within Australia, in addition to making direct contact with a number of stakeholders and interest groups, comprising a combination of face-to-face meetings, telephone conversations and email correspondence.

Source of publications included:

- Discussion papers and research from community groups, such as the Australian Association of the Deaf (AAD), Communication Aid User Society (CAUS), the Deaf Society of NSW and Telecommunications and Disability Consumer Representation (TEDICORE).
- Publications from government organisations such as the Australian Communications Authority (ACA), Department of Communications, Information Technology and the Arts (DCITA), Department of Family and Community Services (FACS) and the Human Rights and Equal Opportunity Commission (HREOC).
- Papers from industry stakeholders, including Australian Communication Exchange (ACE), Pacific Access (now Sensis) and Telstra; and technical papers from the Australian Communications Industry Forum (ACIF), manufacturers and standards bodies.

The review of this literature found few instances of reliable data relating to the size of the market and TTY usage. Many papers relating to TTY policy and strategy within Australia did not contain any estimates of the market, or even references to estimates from other sources. This appears to be due to the lack of access to reliable data relating to the total market for TTYs and the difficulties in obtaining data on TTY usage. Any data on the number of TTYs found in the literature has been estimated, and at varying degrees of reliability.

(ii) The Potential Market for TTYs

The most recent information on the incidence of hearing loss within the Australian population comes from a disability survey conducted by the Australian Bureau of Statistics (ABS, 1998, catalogue no 4433.0). This survey found that 6.4% of the population had a hearing impairment, however the proportion increases with age (Exhibit 1).

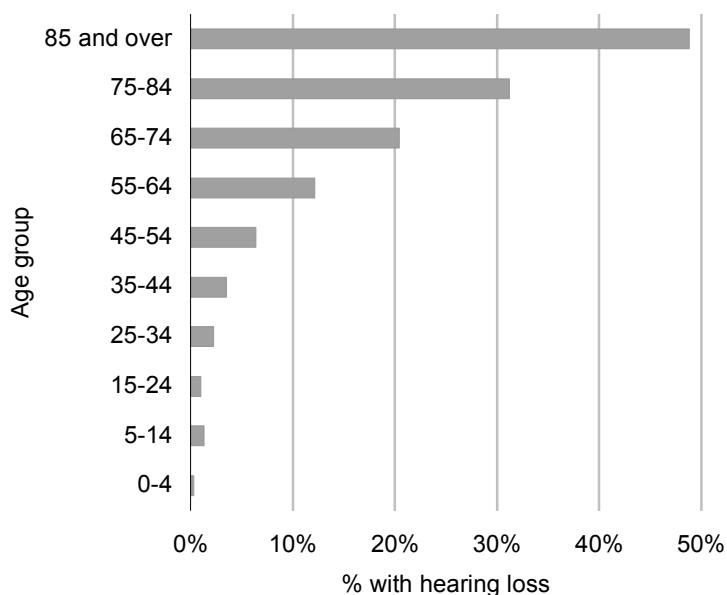


Exhibit 1:
Proportion of the population with hearing loss, by age group (1998)
 [Source: Australian Bureau of Statistics]

The low fertility rate and increasing life expectancy mean that Australia's population will continue to age, and thus the number of people with age-related hearing loss is likely to continue to increase. This will result in an increase in the proportion of the population with hearing loss.

The Communication Aid User Society (CAUS) suggested that between one person in 500 and one person in 300 may have a speech impairment.

CAUS and Printacall described the TTY market for people with speech impairments as significantly under-developed. There appears to be a perception that the TTY is an aid for the deaf and hearing impaired only, and there is little knowledge about TTYs or the NRS amongst advisers and carers of people with speech impairments.

It should be noted that the potential market for TTYs is not a single homogenous entity. While there are certainly some commonalities, the characteristics and needs of the deaf, hearing and/or speech impaired are different. Even within these groupings, individuals may have very different requirements and capabilities.

Besides the TTY there are alternative telecommunications equipment options available for people who are hearing and/or speech impaired, including volume

control telephones and modems (for use with a personal computer). The appropriate solution for any user will depend upon that user's own preferences and capabilities.

Demand drivers

A number of factors were identified as influencing the take-up and usage of TTYs. These included:

- affordability;
- ease of use;
- effective distribution of information on TTY services to the community;
- TTY access to business, government and community services; and
- the ability to communicate between various devices.

(iii) Options for Obtaining TTYs

Users currently have two options for obtaining TTYs:

- renting a TTY, at the same price as a standard telephone handset if the user has a disability, via the Disability Equipment Program (DEP) of one of the carriers; or
- direct purchase of TTYs from a supplier or retailer.

Prior to 1995, the only option available to potential users was to purchase a TTY. Due to the high cost of equipment, some TTYs were donated to users by community service organisations.

From June 1995, TTYs were supplied through the National Relay Service (NRS) under a Commonwealth-funded voucher scheme, the National Relay Service Telecommunications Equipment Access (NRS-TEA) programme. The voucher scheme also permitted the customer to obtain a more expensive TTY than the maximum value of the voucher if the customer contributed the difference in the cost. If the cost of the TTY was less than the voucher amount, the customer could use the remainder to pay for a maintenance programme.

In 1997, following the *Scott v Telstra Corporation Limited* case, which clarified Telstra's legal responsibility for provision of equipment to provide access to the standard telephone service, Telstra assumed responsibility for disability equipment. The NRS administered Telstra's program until the commencement of Telstra's DEP in 1998. The supplier of TTYs within Australia, Printacall Communications Technology, is currently contracted to provide DEP TTYs through Telstra (both Retail and Wholesale) and Optus.

Telstra Disability Equipment Program

To be eligible for a TTY through Telstra's DEP, the customer must:

- have a disability and be unable to use the standard telephone handset;
- be a Telstra customer for basic line rental, or be associated with a Telstra customer (eg. be a member of the same household of a Telstra customer or an employee of a Telstra customer); and
- complete an application form that is signed by an appropriate medical practitioner.

While some businesses are eligible for TTYs through the DEP, this is generally only small businesses or home offices. Business customers with PABXs, Commander systems or other switchboard systems are not eligible for products through Telstra's DEP.

Telstra Wholesale recently launched a wholesale DEP, so that Telstra resellers and service providers can offer disability equipment to their own customers.

Optus Disability Equipment Program

Optus commenced offering TTYs to customers in 2000-01. Optus' DEP is available to its residential direct connect customers in Sydney, Melbourne and Brisbane (that is, the Optus cable area). Application for a TTY through the Optus DEP does not require a form to be signed by a medical practitioner.

(iv) Scoping the Current Market Size

No firm data is available on the size of the TTY market. The best information is Printacall's estimate of 13 000–15 000 TTYs within Australia. Around 3 000 Telstra DEP TTYs are currently rented, and Optus has 218 DEP TTY customers.

Various other sources estimate that there are between 10 000 to 17 000 TTYs within Australia.

No organisation contacted was able to provide more detailed statistics within the timeframe of the project. Most organisations indicated that considerable effort would be required to provide more comprehensive information, and that this would require a period of at least four to six weeks.

Estimate of the total market

Printacall estimates that as of the end of 2002 there were 13 000–15 000 TTYs that had been sold within Australia.

The Printacall estimates are based upon:

- Printacall sales;
- carrier DEP customers; and

- an estimate of opposition sales prior to 1995 when the second supplier of TTYs in Australia, Hardie Communications, ceased operations.

There is some uncertainty over the estimate for the written-off component. Anecdotal evidence suggests that customers upgrading TTYs often donate their old machines to families, friends or charities.

Recently, ACE estimated that there are 15 000 TTYs in Australia. This figure was based on the following assumptions:

- 5 000 TTYs supplied by ACE under the voucher scheme during 1995–98;
- an estimated 5 000 TTYs provided through DEPs and TTY sales since 1998; and
- an estimated 5 000 TTYs provided prior to 1995 that are still in operation.

A lower estimate of the numbers of TTYs (10 000) was given in a paper presented at the February 2003 Australian Communications Industry Forum (ACIF) seminar on Any-to-Any Text Connectivity. The author of this paper stated that this estimate represented a figure often quoted by other key stakeholders.

Reliable and up-to-date data on purchased TTYs is difficult to obtain. If a TTY was purchased through a retailer, then the supplier obtains customer information only if the customer returns a warranty card or contacts the supplier for maintenance. Due to privacy restrictions, retailers cannot provide the supplier with customer information.

During the period 1995 to 1998, the NRS supplied 5 000 TTYs under the voucher scheme and prior to the introduction of Telstra's DEP. Further breakdown of this figure would require additional resources to analyse archived information and it is uncertain as to how many of these TTYs are still actively being used, nor if the information would still be current.

People who are deafblind can also access the fixed telephone network through the use of a Braille TTY. The Braille TTY has a dual keyboard and allows conversations to be output both in Braille and on the TTY fluorescent display.

There are very few Braille TTYs installed. Telstra estimates that there are now around 20 Braille TTYs nationally, of which five were supplied under its DEP.

TTY payphones

At the time of the consultancy, there were 165 Telstra TTY payphones. Details of the location of TTY payphones can be found on Telstra's website <http://www.telstra.com.au/disability/typayphones/index.htm>.

For each metropolitan and regional area the locations are listed by suburb/town, building name, location within the building and the street address. Exhibit 2 below summarises this information.

<i>Region</i>	<i>Number of TTY payphones</i>
New South Wales – Sydney	24
New South Wales – Regional	5
<i>Total New South Wales</i>	<i>29</i>
Victoria – Melbourne	17
Victoria – Regional	7
<i>Total Victoria</i>	<i>24</i>
Queensland - Brisbane	22
Queensland - Regional	24
<i>Total Queensland</i>	<i>46</i>
South Australia – Adelaide	10
South Australia – Regional	6
<i>Total South Australia</i>	<i>16</i>
Western Australia – Perth	25
Western Australia – Regional	10
<i>Total Western Australia</i>	<i>35</i>
Tasmania	9
Northern Territory	2
Australian Capital Territory	4
<i>Total Australia</i>	<i>165</i>

Exhibit 2:
Number of TTY payphones by region, May 2003 [Source: Telstra]

Telstra publishes its criteria for the provision of TTY payphones in its *Standard Marketing Plan*:

Telstra will continue to work with organisations representing deaf, hearing and/or speech impaired people to identify appropriate new locations for TTY payphones, and review existing locations to ensure that the placement of these payphones meet the requirements of the local community. The guidelines applying to the siting of TTY payphones can be raised by disability consumer groups, representing the interests of people with a disability, at Telstra's Consumer Consultative Council, which meets three times per year, or as part of Telstra's Disability Forum held twice each year.

Priority is given to the provision of these facilities at high usage sites such as major shopping centres, airports and major railway stations where 24-hour access is generally available. However, in consultation with consumer groups, it has been recognised that TTY payphones need to be installed in supervised locations for safety reasons and to prevent vandalism, with a priority being given to suitable locations that provide 24-hour access.

Further information on Telstra's Marketing Plan can be found on its website at <http://www.telstra.com.au/universalservice/standard.htm>.

Data issues

There are two separate components of the TTY market:

- DEP customers; and
- customers with their own TTYs (purchased, obtained via the voucher system or other means).

The carriers are the prime source of information relating to TTYs supplied via the DEPs, although Printacall, as the supply contractor to the carriers, also has relevant data. With regard to non-DEP TTYs, Printacall is the most complete source of data on this component of the market.

DEP customers

Since 1998/99, the ACA has reported in its annual *Telecommunications Performance Report* the number of TTYs supplied by Telstra (and Optus from 2001/02) via their DEPs during the financial year. The reports can be accessed by visiting the ACA website at http://www.aca.gov.au/aca_home/publications/reports/reports/performance/index.htm.

The level of detail in the reports has varied from year to year. This data includes new equipment as well as replaced and upgraded equipment, so it is not possible to determine the total number of DEP customers from the information provided to the ACA. The ACA does not hold any additional data other than what has been provided within its annual Performance Report.

Telstra stated that it currently has around 3 000 TTYs supplied to customers through its DEP. The overwhelming majority of these are residential customers. Optus reported that as at June 2003, there were 218 TTYs supplied through its DEP to residential direct connect customers. Of these TTYs, there were 55 Superprint 4425 and 163 Uniphone 1150. The ACA *Telecommunications Performance Report* states that Optus supplied 36 DEP TTYs during 2001/02.

Individual carriers should be able to provide information on the number of DEP TTYs, subject to privacy considerations. Discussions with the carriers indicate that geographically-based data or other demographic information may also be available, but this may require some time and resources to extract, depending upon the detail required.

Collection of statistics on DEP TTYs would need to ensure that all carriers and service providers offering DEPs are included and that no double counting of

wholesale customers occurs. Note that detailed customer data will be held by the service provider, not the wholesaler.

Owned TTYs

It would be extremely difficult to obtain reliable demographic and geographic information on customers who do not rent a TTY through a DEP.

The reliability of TTYs means that many machines supplied prior to the introduction of the DEPs remain active. Printacall is aware of TTYs from the mid-1980s that are still in operation, and has occasionally seen machines from the early 1980s. While Printacall has sales statistics back to 1982, these records may not reflect the current location or details of the person now using each TTY. Customers may move, or donate old TTYs to others.

TTY Directory

The TTY Directory has been published annually by Sensis since 1995. The print run is 8 000 copies, of which 7 000 are distributed by post. Anyone can request a copy of the TTY Directory, and it is provided free-of-charge.

Listings are also free-of-charge. To request an entry, a customer must complete a listing request form. Listings remain in the directory unless an amendment or deletion is specifically requested: the source database for the TTY Directory is quite separate to that for the White Pages directory or any other carrier information, so cancellation of the line will not affect the TTY Directory listing. Consequently, a number of the entries are out-of-date. Both the ACA and the Australian Association of the Deaf (AAD) have conducted informal tests in which a random sample of business numbers in the TTY Directory were phoned: in both instances it was found that a significant proportion (approximately one third) of these calls were either unanswered or the TTY service was no longer connected.

Sensis has indicated to Network Strategies a strong interest in determining the size of the TTY market, as it is examining (unspecified) issues relating to the TTY Directory. Sensis was unable to comment within the timeframe of this project on whether any action is being undertaken to address the accuracy of the TTY Directory.

It should also be noted that some residential customers do not wish to be included in the TTY Directory due to privacy or security concerns. Sensis has no information on the level of under-representation within the TTY Directory, as it has no knowledge of any TTYs for which the customer did not provide a completed listing request form. Carriers do not supply Sensis with information on DEP TTYs.

National Relay Service (NRS)

The NRS holds information only on those customers with an account or who have registered for a customer profile (this records the type of service used by the customer when contacting the NRS, thus streamlining the call process). Users making only local and STD calls do not require an account and thus customers in the NRS database could not be considered representative of all TTY users.

Customer account records within the NRS database would therefore only include:

- customers with a registered profile;
- customers with an NRS account prior to the commencement of the new billing arrangements introduced in 2002 and whose details are still current; and
- new customers since June 2002 who make international and premium calls.

(v) TTY Models

The TTY models provided through Telstra's DEP include:

- Uniphone 1150;
- Superprint 4425; and
- Miniprint 425.

Telstra recently announced the addition of two new TTYs to the DEP: a Braille TTY and a Large Visual Display (LVD) TTY. The Superprint 4425 is the most popular model in Telstra's DEP - Telstra did not specify a date for this data, so it is assumed that this refers to current DEP customers.

Retail prices of the various TTY models are shown in Exhibit 3. A retail price for the Braille TTY was not provided.

<i>TTY model</i>	<i>Price (including GST)</i>
Uniphone 1150	\$760
Miniprint 425	\$880
Superprint 4425	\$1090
Superprint 4425L (used with Large Visual Display)	\$1390
Large Visual Display (used with Superprint 4425L)	\$745
Compact	\$695

Exhibit 3:
*Retail prices of
TTY models
June 2003
[Source:
Printcall]*

While all the above models (except the Compact) can connect directly to the normal (analogue) telephone line, the Superprint 4425 and the Miniprint 425 also have acoustic couplers, so they can be used with digital switchboards.

Optus currently offers two models under its DEP: the Superprint 4425 and the Uniphone 1150. Its most popular model is the Uniphone 1150, comprising more than three times the number of Superprint 4425.

Printacall also offers a portable TTY model called the Compact. It is designed to be easily transportable, and it operates only via an acoustic coupler rather than a directly connected telephone line (thus may also be used over a digital line). The Compact utilises identical technology to that of the other TTYs, so the same technology issues apply to this model. This model is available only for purchase – it is not included within any carrier's DEP. Printacall stated that the Compact is being phased out as mobile phones (and SMS) are proving more popular.

Maintenance issues

The fault rate of TTYs is very low. Printacall states that since the 1995 *Scott v Telstra* case, the reliability of TTYs has improved further, due to:

- improvement in design of newer models, as the manufacturer has addressed faults of earlier models; and
- testing of all TTY units by the supplier before distributing to customers.

In cases where faults are reported on TTYs supplied under the DEP, Printacall couriers a replacement TTY to the customer. Included is a courier bag for the return of the original TTY. The customer keeps the replacement TTY and the TTY reported as faulty is repaired and refurbished (if possible) by Printacall. Printacall did not divulge the number or proportion of TTYs that are refurbished. Printacall also provides a repair service for private, corporate and government owned TTYs.

The main problems appear to be damage caused by lightning strikes and replacement of the rechargeable batteries (these degrade with age, although the unit can still operate from mains power).

(vi) TTY Usage

It was not possible to source comprehensive data on TTY usage during this review. The carriers stated that they did not collect any information on TTY usage, and other organisations contacted were unaware of any studies on usage – primarily due to the inability of these other organisations to access call data.

Some limited information is available from various research studies. However, relevant data did not appear to be collected using rigorous statistical methods. ACE also provided us with daily statistics on the number outbound calls from the NRS.

Existing data on TTY usage

Telstra had no data on TTY usage, but it noted the common understanding that TTY conversations are longer than voice conversations. Around 6% of the calls to Telstra’s Disability Enquiry Hotline are TTY calls.

A study by Deakin University found that there was very low usage of TTYs among a sample of people with speech impairments (Exhibit 5). While the sample was very small (64 people), the results suggest that there may be some potential for additional take-up of TTYs in this sector. The accuracy of the data would be limited by the small sample size.

	<i>Use daily</i>	<i>Use several times a week</i>	<i>Rarely use</i>	<i>Never use</i>
Touchphone	21%	19%	23%	38%
Handsfree telephone	12%	19%	18%	51%
TTY	5%	2%	–	93%
Fax	4%	13%	5%	77%
Email	12%	18%	9%	61%
Internet chat	4%	–	11%	85%

Exhibit 4: Usage of telecommunications equipment among a sample of people with speech impairments. Source: Owens, J. (2002), *Accessible information for people with speech & communications impairment*, Deakin University and Communication Aid User Society.

The AAD in their report *Telecommunications service access issues for Deaf people*, <http://www.aad.org.au/download/ServiceAccessIndustry.pdf>, found that deaf people preferred direct contact with an organisation rather than going through the NRS, the main reasons given being ownership of the conversation, speed, and accuracy of the information received. This information was described as being collected through a consultation process, so may not be representative. A large portion of the information collected through the AAD’s Deaf Telecommunications Access and Networking (DTAN) project appears to be in response to questions raised within the project’s discussion papers. These were disseminated through the AAD’s website only, and are unlikely to be representative of the total deaf market.

Several participants in ACE’s Video Relay Interpreting (VRI) trials indicated the potential frustrations of TTY and NRS calls, but this data is only anecdotal.

Comments made by some VRI participants regarding TTY and NRS calls included:

- using TTYs is very slow;

- some users have difficulties in communicating due to limited English literacy skills; and
- it is difficult to convey emotions over TTYs.

Data issues

In order to perform a detailed traffic analysis, the following steps are usually required for the data collection task:

- identify a sample of lines that are used with TTYs; and
- gather a sample of call records for those lines.

There is no straightforward method of determining whether a telephone line is connected to a TTY. While the carriers will have accurate records of their DEP customers, the sample should also include non-DEP customers. Clearly, it would be more difficult to target non-DEP customers.

Call records are usually extracted from either the carrier's billing system or the telephone exchange records. However, it is impossible to determine whether any individual call was a TTY call, a voice call, a dial-up Internet call or a fax call. As many telephone lines may be used for multiple purposes, this means that the individual call records will not provide sufficient information for analysing TTY usage.

(vi) Substitution of Alternative Services

Advances in technology have provided a number of different communications options suitable for the deaf and persons with hearing or speech impairments. Those currently available to users within Australia include:

- TTYs;
- fax;
- using modems in conjunction with personal computers;
- email;
- SMS via mobile telephony services; and
- instant messenger and chat applications via the public Internet or private intranets, such as MSN Messenger.

ACE's view is that while a variety of options were being used extensively, this tended to be at the 'upper end' of the community, that is, those who are highly educated and relatively affluent. The potential user seen as 'average' exhibited more reluctance to adopt new technologies.

The Deaf Australia Online II project collected some limited information on the types of communication methods used by its participants, but the samples were extremely small and could not be considered representative. More information about this project can be found at <http://www.circuit.rmit.edu.au/projects/dao2/>.

Printacall described the demand for modems through a DEP to be very low, primarily because modems are now commonly bundled with PCs.

It was not possible to obtain any current estimates of the number of deaf, hearing and/or speech impaired users of mobile services. The ACA, in a submission to the HREOC Inquiry into the *Disability Discrimination Act 1992: mobile phones and people with hearing impairment*, October 1999, noted that in a sample of 300 users of the Advanced Mobile Phone Service (AMPS) conducted in June 1999 by Sweeney & Associates, 3% of respondents stated that they used a hearing aid. At this time, six months before the closure of the AMPS network, the number of active AMPS users was declining rapidly; and given that TTYs were unable to be used on the alternative Global System for Mobile (GSM) communications and Code Division Multiple Access (CDMA) networks, there may have been a over-representation of hearing impaired users who were continuing to use the older technology. In addition, with the introduction of inter-carrier SMS in late 2000, there was an increase in the attractiveness of mobile technology to the deaf and hearing impaired, so the nature of the current mobiles market is very different to that of 1999.

The Australian Association of the Deaf (AAD) conducted an ‘anecdotal survey’ on SMS usage in November 2001 and found that the deaf mobile phone users in the survey were making ten times the number of SMS calls than the average user, although it was also noted that there was a wide variation in the level of usage, with some users making over 300 SMS calls per month while others made around 15–25 SMS calls per month. It should be noted that it is unclear whether this survey was based on data from a representative sample of sufficient size to make valid estimates. Other anecdotal evidence suggests that SMS appeals more to the younger age groups.

Printacall stated that Internet and modem-based communications were suited more to a business environment, where PCs were operational throughout the business day and ‘always on’ Internet connections were more common. In the home, a PC would not generally be running all day, may take a couple of minutes to boot up when it is switched on, and indeed may be shared amongst several household members. This renders it less convenient for communications purposes than a TTY.

Another popular substitute service for TTYs was stated to be fax, however no data on the level of usage was able to be sourced. The AAD states that ‘many people have personal fax machines at home to communicate with generic businesses and family members who live outside local call area codes’ however no data is provided to support this statement.

(vii) New Technology and TTYs

TTYs were designed to work with the low speed analogue fixed line voice networks of the 1960s. Significant efforts are required in Australia around the issue of their incompatibility with modern digital wireless and IP-based fixed data networks.

TTYs are incompatible with the CDMA wireless local loop (WLL) system that Telstra is rolling out in some rural and remote areas. Telstra as the Universal Service Provider has implemented processes that will provide an alternative technology for any customers wishing to use a TTY in CDMA WLL affected areas.

In addition to the CDMA WLL system, TTYs cannot be used with the mobile networks (CDMA and GSM) operational within Australia nor Voice over IP (VoIP) systems. These are all technologies that use various types of voice compression (which enable more effective use of telecommunications network capacity) that distort the Baudot signals used by TTYs in Australia for transmitting text conversations. A number of organisations, such as the ACA, ACIF and Telstra, are currently undertaking research into the use of TTYs with various telecommunications technologies.

Only TTYs fitted with acoustic couplers can operate over a digital line, such as those used by digital switchboards. One of the most popular models of TTYs, the Uniphone 1150, does not have an acoustic coupler. This model is currently offered via both Telstra's and Optus' DEP, but alternative models with acoustic couplers are available from both carriers.

If a user wishes to make a direct international call to another TTY user, the call will only be successful if the two TTYs can communicate. This requires the two TTYs to use matching protocols, thus an Australian TTY user can directly call only other countries that use TTYs with Baudot 50 (such as in Ireland, South Africa and New Zealand). Some models of TTY in Australia can switch between Baudot 50 and Baudot 45.45 (as used in the United States and Canada), so it will be possible to call TTY users in that country if the local TTY is manually switched to Baudot 45.45 prior to the call. Australian TTY users are unable to make a direct call to TTY users in other European countries as they use different protocols. Furthermore, overseas callers are unable to make a direct call to Australian TTY users unless their TTY can switch to a mutually compatible protocol. Calls to and from overseas TTYs can, however, be made via the NRS.

A solution for interoperability of digital GSM mobiles with TTYs has been developed in the UK. The solution involves transmitting over a 300bit/s data channel instead of a voice channel. In the United States CDMA and GSM mobile network operators have worked with the TTY Forum and standards organisations to deploy TTY services over their networks and to ensure interoperability.

Exhibit A.1 illustrates how the current boundaries of TTY communications may be expanded with the implementation of an interoperability solution.

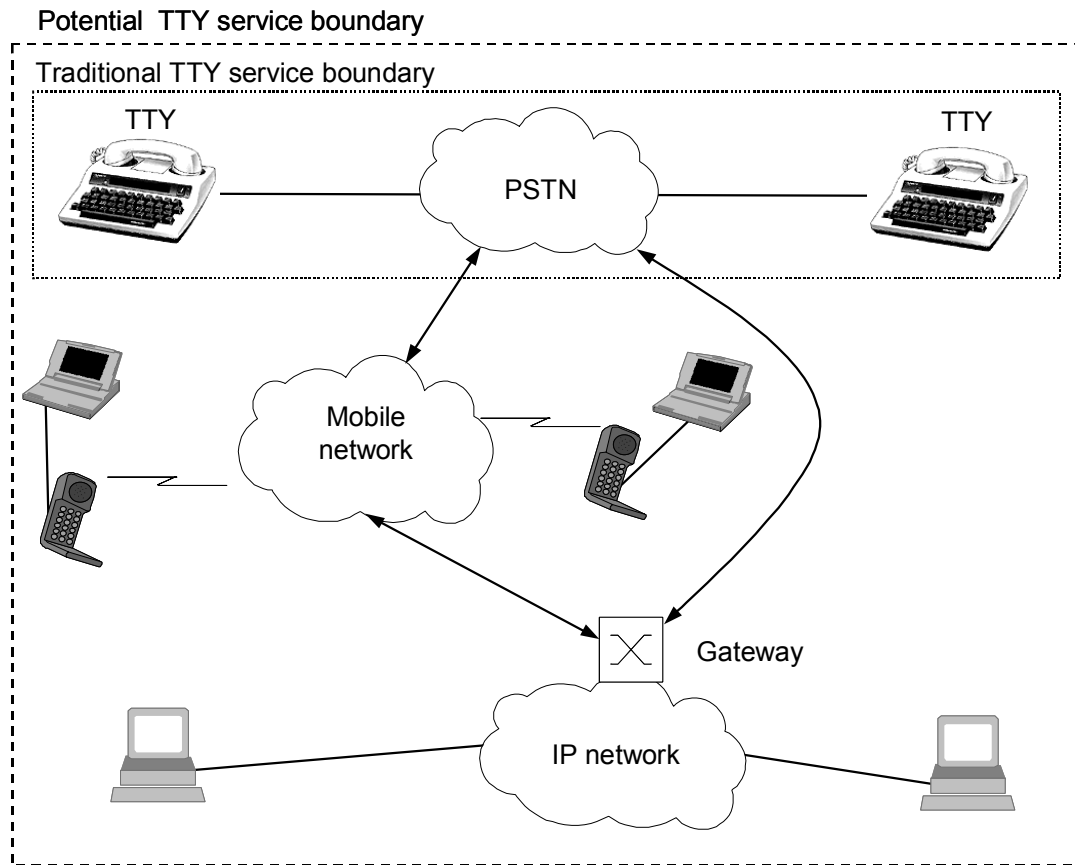


Exhibit A.1: Any-to-any TTY text communications in PSTN, mobile and IP networks [Source: Network Strategies]

Baudot code to packetised data conversion

There are many codecs which have been designed for voice to data conversion. However, not all of these can accurately convert Baudot tones. Some (such as the G.711 protocol) are able to convert the Baudot tones into data packets and reconstruct them without error. Others (such as the mobile GSM standard) do not fare so well. Each codec has its own bandwidth requirement which affects the cost of VoIP service.

VoIP protocols

H.323 and SIP are the VoIP protocols which support a range of voice codecs which can (to varying degrees) handle Baudot tones.

Most VoIP gateways currently use H.323. This is an ITU-T standard for transmitting over IP-based non-guaranteed bandwidth local area networks. Transmission of packets and delivery is based on best effort with no quality of service (QoS). This protocol supports a range of voice codecs, including G.711 mentioned above. It has

been found to be inadequate for implementing VoIP in public telecoms networks, and additional signalling protocols have been developed to provide that scalability.

More recently, Session Initiation Protocol (SIP) has come to prominence. It is a major improvement over H.323 as far as the quality of service is concerned. SIP is very closely related to Internet protocols such as HTTP. SIP has some key advantages over other protocols, the most notable of which is that the protocol suite includes support for presence notification and management, which can be used for instant messaging and for providing additional conferencing features. The popularity of SMS and instant messaging provides ample evidence that users are keen on such instant-response text services.

For text conversation using Baudot tones there is the potential for poor quality service if the conversation is handed off to a VoIP system. VoIP systems exploit the protocols of IP networks to transport voice traffic at a fraction of the cost of transporting voice traffic over traditional switched voice networks. Problems with using VoIP systems to carry TTY traffic include:

- the ability of different coder/decoder protocols (codecs) to compress and reconstruct the Baudot signal into its original form;
- the choice of VoIP protocol; and
- quality of service (QoS) concerns regarding packet loss and jitter (the variance in delay).

Providing quality of service

Much criticism has been made of the voice quality achieved by VoIP services which use the Internet. These very low cost services typically have very low or nonexistent levels of QoS control and are not indicative of the increasingly high QoS levels which can be achieved using operators' high capacity managed IP networks.

TTY communication over IP networks is particularly affected by the level of QoS. Because of the nature of Baudot code some packets are more important than others, and thus packet loss or delay may result in garbled messages. The human ear is more tolerant to packet losses than a TTY.

Managed IP networks greatly reduce delays and packet losses and enable more reliable and accurate communication.

V.18

V.18 is a protocol which allows interworking between TTYs with the following interface types in the Public Switched Telephone Network (PSTN)/Integrated Services Digital Network (ISDN) environment:

- Baudot 45.45 baud (US TTYs);
- Baudot 50 baud (used in England, Australia, and some other countries - also known as 'international' Baudot);
- V.21/text telephone version (used in Sweden, Norway, and Finland);

- DTMF (used in Denmark, Holland, and some other countries); and
- EDT ('European Deaf Telephone', used in Germany, Austria, Switzerland, and several other countries).

V.18 is an interface which allows enabled devices (such as the Nokia 9000 mobile telephone) to communicate with TTYs which use the interface types stated above. For communication with TTYs using different interfaces V.18 may be implemented on the device, on the TTY or in the network. It is understood that there are few V.18-equipped TTYs in domestic use. Until they become more common it is probably more cost effective to implement any-to-any connectivity by putting V.18 gateways in the network (as BT have done in the UK).

The Australian Communications Industry Forum's (ACIF) Disability Advisory Body is currently examining the ways of allowing interworking between different interface types and is showing a keen interest in V.18.