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SERIES F: NON-TELEPHONE TELECOMMUNICATION SERVICES

Accessibility and human factors

Multimedia telecommunication relay services

Recommendation ITU-T F.930

International Telecommunication Union

ITU-T F-SERIES RECOMMENDATIONS

NON-TELEPHONE TELECOMMUNICATION SERVICES

TELEGRAPH SERVICE	
Operating methods for the international public telegram service	F.1–F.19
The gentex network	F.20–F.29
Message switching	F.30–F.39
The international telemessage service	F.40–F.58
The international telex service	F.59–F.89
Statistics and publications on international telegraph services	F.90–F.99
Scheduled and leased communication services	F.100–F.104
Phototelegraph service	F.105–F.109
MOBILE SERVICE	
Mobile services and multidestination satellite services	F.110–F.159
TELEMATIC SERVICES	
Public facsimile service	F.160–F.199
Teletex service	F.200–F.299
Videotex service	F.300–F.349
General provisions for telematic services	F.350–F.399
MESSAGE HANDLING SERVICES	F.400–F.499
DIRECTORY SERVICES	F.500–F.549
DOCUMENT COMMUNICATION	
Document communication	F.550–F.579
Programming communication interfaces	F.580–F.599
DATA TRANSMISSION SERVICES	F.600–F.699
MULTIMEDIA SERVICES	F.700–F.799
ISDN SERVICES	F.800–F.849
UNIVERSAL PERSONAL TELECOMMUNICATION	F.850–F.899
ACCESSIBILITY AND HUMAN FACTORS	**F.900–F.999**

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T F.930

Multimedia telecommunication relay services

Summary

Recommendation ITU-T F.930 provides a functional description of four common types of relay services in use today: text relay, video relay, captioned telephone service relay and speech-to-speech relay. Additionally, it lays out specific functional requirements of relay services pertaining to equipment, call set-up, call experience, emergency communications and message retrieval.

Telecommunications relay services enable persons who have hearing or speech disabilities and who otherwise would be unable to engage in voice telecommunications, to make voice telephone calls to other persons. In all forms of relay services, persons with disabilities connect to a communication assistant via a communications medium that is accessible to them. The communication assistant acts as an intermediary in the telephone call and converts between the accessible communication medium and voice, which is relayed from and to the person on the other end of the call.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
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Keywords

Accessibility, captioned telephony relay service, communication assistant, functional equivalency, speech-to-speech relay, telecommunications relay service, text relay, text-to-speech relay, video relay, video-to-speech relay.

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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

Table of Contents

Recommendation ITU-T F.930

Multimedia telecommunication relay services

1 Scope

This Recommendation introduces telecommunications relay services (simply referred to as relay services). It also defines the reference model, requirements and functionality that facilitate, via an assistive intermediary (i.e., communication assistant, sign language interpreter or lipspeaker), communications between persons who have hearing or speech disabilities with hearing/speaking users over the voice telephony service in a functionally equivalent manner. The aim of this Recommendation is to enable multiple providers, even in different countries, to interwork with one another and allow all users to enjoy the same or similar experience.

NOTE – Technical, regulatory and financial aspects vary from country to country. The Recommendation may include the statement such that there is no extra cost for persons both with and without disabilities to ensure functional equivalency. This edition of this Recommendation provides some of these aspects as initial consideration, e.g., framework and functionality that will impact the user experience globally. These aspects including global interoperability will be covered by further editions of this Recommendation.

It is recommended to follow the requirements and mechanisms described in this Recommendation when the relay services are supported.

It is also emphasized that the relay service is not solely about the media conversion but also includes call handling procedures (alerting, three-way call, and communication-assistant-leg release) and other emulation of user experiences in a functionally equivalent manner. Charging, protection against fraud and confidentiality of communication assistant are also relevant.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T F.703] Recommendation ITU-T F.703 (2000), *Multimedia conversational services*.

[ITU-T F.745] Recommendation ITU-T F.745 (2016), *Functional requirements for network-based speech-to-speech translation services*.

[ITU-T H.625] Recommendation ITU-T H.625 (2017), *Architecture for network-based speech-to-speech translation services*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 impairment [b-ITU-T F.791]: Any loss or abnormality of psychological, physiological, or anatomical structure or function.

3.1.2 lip-reading and lip-reading interpretation [b-ITU-T F.791]: A form of communication and interpretation used by persons who are hard of hearing or persons who are deaf who may or may not use sign language.

3.1.3 lip speaking or oral interpreters [b-ITU-T F.791]: The technique of interpretation for persons who are deaf and hard of hearing, where a trained interpreter speaks silently the dialogue in the audio visual content or in any other event in real time, so that the speech is clearly discernible for persons with hearing disabilities who can lip-read the words from the interpreter's mouth without the use of sign language.

3.1.4 persons with disabilities (PWDs) [b-ITU-T F.791]: The correct way to refer to a person with a disability [b-UNCRPD].

3.1.5 profile settings [b-ITU-T F.791]: This is the ability for the users to store and retrieve multiple profiles containing sets of user interface preference settings without having to reset them each time, including accessibility settings.

3.1.6 real time [b-ITU-T F.791]: Data or services (e.g., broadcasting) that are transmitted with virtually no delay.

3.1.7 relay service [b-ITU-T F.791]: Is a telephone service that enables a person who is deaf or hard of hearing or whose speech is not clearly understood, or who prefers to use sign language, to place and receive telephone calls in real time.

3.1.8 specific needs [b-ITU-T F.791]: This replaces the use of the term 'special needs'. This term refers to a wide range of categories including women, children, youth, indigenous people, older persons with age related disabilities, persons with illiteracy, as well as persons with disabilities [b-ITU PP Res.175], [b-WTDC Res.58], [b-WTDC AP]. See also clause 6.39 [of ITU-T F.791].

3.1.9 text telephone: [b-ITU-T V.18]: A device incorporating text telephony functions.

3.1.10 total conversation service [ITU-T F.703]: An audiovisual conversation service providing bidirectional symmetric real-time transfer of motion video, text and voice between users in two or more locations.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 captioned telephony relay service (CTRS): A telecommunications relay service that allows communication by individuals whose voice is understood by the other user but who cannot hear the response accurately or hear at all. In the captioned telephony relay service (CTRS), the communication assistant (CA) transcribes, in real-time, the speech of the other user word for word into text without interpretation so that it can be read on visual or tactile displays.

NOTE – This service can be used by persons who are unable to type or do not have a keyboard on their equipment and the text can be displayed on a device that does not have a keyboard.

3.2.2 communication assistant (CA): A person working in a relay service with media conversation, as a human intermediary, including sign language interpreters for video relay service.

NOTE – In some forms of relay services, the CA does not play the role of an intermediary and is completely transparent to the non-persons with disabilities (PWD). For example, in captioned telephony relay services, the CA only provides the text transcription to the PWD, and the non-PWD is unaware of it.

3.2.3 disability: An evolving concept, which refers to the interaction between persons with impairments and attitudinal and environmental barriers that hinders their full and effective participation in society on an equal basis with others.

3.2.4 functional equivalency: The capability to which persons with different range of abilities (in particular persons with disabilities and persons with specific needs) are able to use a communication service or system with a level of offered functions and convenience-of-use that is similar to those offered to the wider group of users in a population.

NOTE – These include both technical and economic considerations and that no financial discrimination is imposed on relay service users.

3.2.5 hearing carry-over (HCO): A feature offered by relay services, where the audio of the speaking user is directly transmitted to the other user (who can hear either all or part of the spoken speech).

NOTE – In some forms the communication assistant (CA) does not relay the audio into another communication medium, while in others the CA does, and the persons with disabilities (PWD) has the option of switching between listening and using the alternate communication medium.

3.2.6 sign language: A natural language that, instead of relying on acoustically conveyed sound patterns, uses signs made by moving the hands combined with facial expressions and postures of the body to convey meaning It is also called signed language or simply visual signing.

3.2.7 speech-to-speech relay: A telecommunications relay service that allows communication by individuals with speech disabilities with voice telephone users through the use of specially trained communication assistants (CAs) who understand the speech patterns of persons with speech disabilities and can repeat the words spoken by that person.

NOTE – When the person with disability can type, he or she can use text-to-speech relay.

3.2.8 telecommunications relay service: Synonymous with relay service as defined in [b-ITU-T F.791].

3.2.9 text relay (or text-to-speech relay): A telecommunications relay service that allows communication by individuals with speech and hearing disabilities. Text is converted by a Communication Assistant into verbal information over a voice telecommunication service.

3.2.10 video relay (or video-to-speech relay): A telecommunications relay service that allows communication by individuals with speech and hearing disabilities. Visual information is converted by a communication assistant (CA) to verbal information over a voice telecommunication service.

NOTE – Video relay allows persons with hearing or speech disabilities who use sign language to communicate with voice telephone users through video equipment. The video link allows the CA to view and interpret the party's signed conversation (or visual communication) and relay the conversation back and forth with a voice caller.

3.2.11 voice carry-over (VCO): A feature offered by relay services, where the persons with disabilities (PWD) speaks directly to the other end user. The audio of the PWD is directly transmitted to the other end. In some forms of voice carry-over (VCO) the PWD has the option of switching between speaking and having the communication assistant (CA) speak.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CA Communication Assistant

CTRS Captioned Telephony Relay Service

HCO Hearing Carry-Over

HoH Hard of Hearing

HTTP Hypertext Transfer Protocol

IMS IP Multimedia Subsystem

KPI Key Performance Indicator

MoC Mode of Communication

PSTN Public Switched Telephone Network (fixed and mobile)

PWD Persons With Disabilities

RTT Real-Time Text

STS Speech-to-Speech

TRS Telecommunication Relay Service

TTY Text Telephone

VCO Voice Carry-Over

VoIP Voice over IP

VRS Video Relay Service

5 Conventions

None.

6 Introduction to telecommunication relay services

This clause provides a general overview of relay services and introduces key concepts.

6.1 General

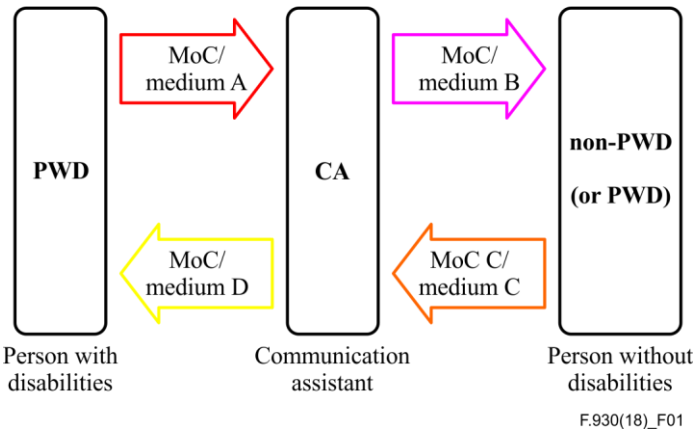
Persons with hearing disabilities (deaf or hard of hearing (HoH)) and/or speech disabilities have difficulties with the use of traditional telephone services, which highly rely on voice.

Relay services are the telecommunication services which allow persons with hearing disabilities (deaf or HoH) and/or speech disabilities to communicate more easily with hearing and speaking users by converting a medium (e.g., voice) to another medium which can appeal to other senses of persons with disabilities.

The user with the disability has a terminal that provides an accessible communications medium, such as video or text. A communications assistant (CA) at the relay centre converts the text or signs, generated by the persons with disabilities, to voice for the hearing person. In the reverse direction, the CA converts the voice, from the speaking person, to the accessible communications medium for the user with a disability (e.g., a person who is deaf, HoH or has a speech disability). This scenario is shown in Figure 1. Users with speaking and/or hearing disabilities are shown as persons with disabilities (PWD) on the left side of this figure. Speaking and hearing users are shown as persons with no-disabilities (non-PWD) on the right side of this figure. Information exchanged is characterized by two levels: mode of communication (MoC) and medium. Mode of communication represents the direct interaction with a person regardless of the existence of networks. Medium is a transmission type supported by networks. Usually, the CA converts or augments the MoC and uses a medium suitable for the converted MoC. Table 1 contains some examples of applicable mediums and modes of communication.

NOTE 1 – Some relay services can be used between PWDs.

NOTE 2 – Multiple CAs are traversed when multiple different conversions are necessary.



Notes to Figure 1:
– MoC: Mode of communication.
– Terminals and network details of relay service are not shown.

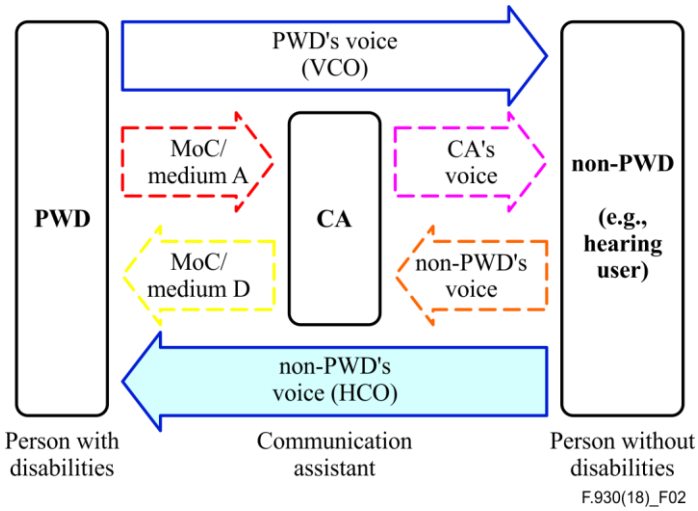
Figure 1 – Relay service communication model

Table 1 – Non-exhaustive examples of relay services

Service	Direction	PWD profile	MoC/ medium	CA handling	MoC/ medium	Non-PWD
Text relay	PWD to non-PWD	Typing capable	Written/ text	Text to speech	Speech/ audio	Listening
	reverse	Text-reading capable	Written/ text	Speech to text	Speech/ audio	Speaking
Video-to-speech relay	PWD to non-PWD	Sign language capable (expression)	Sign language/ video	SL to speech	Speech/ audio	Listening
	reverse	Sign language capable (reading)	Sign language/ video	Speech to SL	Speech/ audio	Speaking
Captioned telephony relay service	PWD to non-PWD	Capable of speech	Speech/ audio	N/A (not applicable)	Speech/ audio	Listening
	reverse	Text-reading capable	Written/ video	Speech to text	Speech/ audio	Speaking
Speech-to-speech relay	PWD to non-PWD	Some speaking difficulties	Speech'/ audio	Speech to speech	Speech/ audio	Listening
	reverse	Capable of listening to speech	Speech/ audio	N/A (not applicable)	Speech/ audio	Speaking
DeafBlind video/text relay	PWD to non-PWD	Sign language capable (expression)	Sign language/ video	SL to speech	Speech/ audio	Listening
	reverse	Text reading capable (Braille/large font)	Written/ text	Speech to text	Speech/ audio	Speaking
DeafBlind video/text to video relay	PWD to PWD	Sign language capable (expression)	Sign language/ video	N/A (not applicable)	Sign language/ video	Sign language (reading)
	reverse	Text reading capable (Braille/large font)	Written/ text	Sign language to text	Sign language/ video	Sign language (expressing)

Persons with speaking and/or hearing disabilities may have other difficulties/disabilities in expressing their thinking (e.g., difficulties with the use of sign language, unfamiliarity with information technology (IT) terminals) and/or observing external information (e.g., blind). Depending on the disabilities and their impact on the communication and its direction, different relay services are more appropriate than others for their situation.

Many relay users are able to either speak for themselves or listen for themselves. In such situations, they might prefer to transmit their voice directly to the remote hearing party or listen directly to the remote hearing party. This system is called voice carry-over (VCO) if users speak for themselves and hearing carry-over (HCO) if users listen for themselves, as shown in Figure 2.



Notes to Figure 2:
– MoC: Mode of communication
– Dashed arrows are optional, depending on choices by the persons with disabilities to use VCO of HCO

Figure 2 – Voice carry-over and hearing carry-over services

Calls using VCO/HCO operate in a similar manner to regular relay calls, except that the user's voice is transmitted to the hearing person directly or via the relay centre, or the hearing person is transmitted to the user directly or via the relay centre.

In the case of VCO (regardless of the use of HCO), the PWD uses their voice in the direction from themselves to the non-PWD. In the case of HCO without VCO, the communication from the PWD to non-PWD in both directions can be beneficial to both users. This condition is indicated in the dotted boxes in Figure 2.

It should be noted that, in HCO, the terminal on the PWD side can either switch between voice and the accessible communications media (such as text or video) or can carry both simultaneously.

It should also be noted that VCO and HCO are not mutually exclusive. For example, a relay user may elect to both speak and listen directly, and use the accessible communications medium passed through a CA as a fall-back in case the relay user experiences a communications breakdown. As a further example, simultaneous VCO and HCO can also be useful in situations where a PWD and their non-PWD children jointly communicate with another non-PWD; in this case the non-PWD can use audio as their favoured communication media while the relay service involvement makes the conversation accessible to the PWD.

Regarding the accessible communications medium, several types of relay services cater to a specific subset of PWDs. These include text relay, video relay, captioned telephony relay services, and speech-to-speech relay and are described in clause 7.

6.2 Functional equivalency

The definition of functional equivalency is provided in clause 3.2.4.

Functional equivalency includes performance and security aspects (e.g., user experience in terms of procedures as well as performance in the pre-and post-call phases, as well as during the actual call).

Functional equivalency includes obligations which service providers should, in a particular jurisdiction, have to meet in order to provide communication services. Functional equivalency implies that the users of relay services would not be at a disadvantage compared to the calling options available to the mainstream (such as through incurring extra costs, being restricted to specific types of equipment, being restricted in types of calls or hours during with relay services operate, or through complicated call set-up methods).

6.3 Components of relay services

Relay services consist of network services (in a narrow sense), terminals and CAs.

The narrow-sense network services carry the various communication media that are used in relay services, and do not change the contents of the information to be carried. Note that a variety of multimedia conversational services applicable to relay services, including total conversation services, are specified in [ITU-T F.703].

Regarding terminals, refer to clause 8.1.

6.4 Consideration on international interworking/interoperability for relay services

Persons without disabilities are able to use global roaming to make voice calls from anywhere to anywhere in the world, even while outside their home country. The principle of functional equivalency suggests that persons with disabilities should have equivalent means to use relay services in a similarly global manner. This topic requires further study on technical, policy, financial, and legal aspects.

7 Four major types of relay services

This clause describes four common, major types of relay services that already have been implemented in multiple countries.

7.1 Text relay (text-to-speech relay)

7.1.1 PSTN-based

The deaf, HoH, or speech-disabled user employs a text telephone connected to the public switched telephone network (PSTN), or a computer that is connected to PSTN via a modem. The CA at the relay service converts the text to voice for the hearing person and converts the voice to text for the deaf person. This scenario is shown in Figure 3.

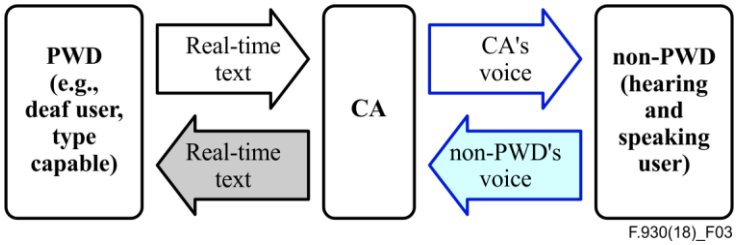


Figure 3 – Text relay service

Typically, either user can set up a call by dialling a prefix followed by the destination number, which routes the call via the relay service. This is one-step dialling. Another way is for either user to call the relay service by dialling a dedicated phone number of the service or the centre, and then providing the remote party's phone number to the CA via text or voice. This is two-step dialling.

In the case of VCO and HCO over PSTN text relays, the user's or hearing party's voice is transmitted over the PSTN line and bridged though the relay service. Text phones on the PSTN typically must switch between voice and text and are not able to carry both simultaneously.

VCO/HCO calls are set up in the same way as regular PSTN text relay calls. In the VCO direction, the deaf user's terminal transmits the voice conversation to the non-PWD without sending real-time text. This voice is also bridged to the CA, whose main role is in the reverse direction to convert the hearing person's voice to text, which is displayed on the deaf person's terminal. A CA listening to VCO direction can smoothly convert speech to text in the reverse direction.

If HCO is used without VCO (complete speech disability), the CA converts text to speech from the PWD to non-PWD.

HCO is used mainly by HoH people who find that the text helps them to understand what is being said, but profoundly deaf users can also benefit as well. HCO is also used by persons who can hear but are unable to speak. In this case, the voice goes from the non-PWD to the PWD and the PWD types their response to the CA who speaks this to the non-PWD.

As PSTN is phased out in favour of IP-based services, PSTN-based text relay services similarly will be supplanted with IP-based relay services.

7.1.2 IP-based

A more recent variation of text-based relay is that the deaf, HoH, or speech-disabled user employs IP-capable hardware or software (such as a computer app, web browser, smartphone, tablet, or a standalone text communication device with display and keyboard) that is connected to the Internet in place of a PSTN connection. The connection between the user and the CA is IP-based, and both text (turn-based or real-time) and voice are transmitted over IP, (e.g., voice over IP (VoIP) services, IP multimedia subsystem (IMS)-based services, or data services). The connection between the CA and the hearing side is typically over PSTN or VoIP bridged with PSTN or IMS. Like PSTN-based relay, IP-based relay offers VCO and HCO. Unlike PSTN, voice can be transmitted simultaneously with text, and text typically can be transmitted and received simultaneously (e.g., as real-time text, see Appendix II).

Call set-up on IP offers more options than call set-up on PSTN. A few variants are outlined below:

User with a disability calls hearing person:

– option 1: the user enters the hearing person's phone number into the terminal and initiates the call. The CA automatically receives the number from the terminal and proceeds to place the call;
– option 2: the user connects to the relay service and types or voices the hearing person's phone number. The CA listens or reads the phone number off the screen and proceeds to place the call.

Hearing person calls person with a disability:

– option 1: the hearing person uses a dial prefix followed by the deaf user's assigned relay service phone number, as in the PSTN case above;
– option 2: the hearing person directly dials the deaf user's assigned phone number, and a relay CA is automatically connected and places the call. This requires that the deaf user's phone number is registered in the ENUM database;

– option 3: the hearing person calls the relay service through its assigned phone number, and verbally gives the CA the deaf user's contact information. The CA places the call accordingly.

7.2 Video relay (video-to-speech relay)

Video relay services (VRS) are primarily targeted at persons who are deaf or HoH and that use sign language, but in principle are not limited to sign language users; lip-reading and other forms of visual communication are also supported. The deaf or HoH user employs video calling or conferencing software, or hardware terminals which connect over IP to a relay centre. The CA at the relay centre interprets from the deaf user's sign language on the video feed to voice for the hearing person and interprets from voice to back sign language for the deaf person. This scenario is shown in Figure 4.

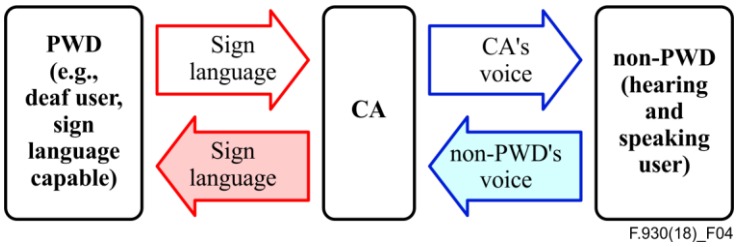


Figure 4 – Video relay service

The options for call set-up are similar to those available to IP-based text relay (described in clause 7.1.2). A common scenario is as follows:

Step 1: A deaf person using a video hardware terminal or software places a call either:

a) directly to a PSTN, VoIP or IMS phone number and the service routes the call to a CA; or

b) to a relay service and is presented with a CA.

Step 2: The CA detects the phone number from the service or using sign language requests the PSTN, VoIP or IMS phone number from the deaf person and the CA then places the call using the provided phone number.

Step 3: The person at the provided phone number communicates with the CA.

Step 4: The CA communicates with the deaf person using sign language (or other forms of visual communication).

Similar to text-based relay services, video relay services support VCO and HCO, which can be supported simultaneously with the video feed. Some video relay services also offer a text-based channel, either via real-time text or turn-based (i.e., total conversation, see [ITU-T F.703]), which is used to transmit supplemental information, especially information that is hard to fingerspell in sign language. The text channel is also used by persons who are deaf and with a visual impairment, but who are unable to follow sign language video but can read text and sign for themselves.

Where sign language is involved, video relay services may entail interpretation between two different languages, i.e., the sign language and the hearing party's spoken language. As with all forms of language interpretation, this means that the CA needs to be a trained professional interpreter who is fluent in both languages, have an understanding of the subject matter that is being discussed during the call, and exhibit awareness of the cultural differences between deaf relay users and the hearing parties. This is in marked contrast to most other forms of relay services where the CA is expected to be transparent between the person with a disability and the hearing party.

NOTE 1 – An interpreter will have a degree of impact on the communication and interpersonal dynamics, due to the nature of their presence in the interpreted event. As such, it is now widely accepted throughout the interpreting profession that interpreters do not function solely as passive conduits relaying messages back and forth between participants. This idea is considered to be dated and current thinking and research illustrates how interpreters play a more active role in any interpreted event ([b-Wadensjö], [b-Llewellyn-Jones], [b-Napier]). Firstly, they are interpreting from one language to another, and secondly, they are facilitating the interaction and the conversational dynamics that arise between two parties. During a video interpreted interaction, the interpreter may use 'linguistic strategies' [b-Roy] throughout the interaction, as necessary, to ensure that the video interpreted exchange runs smoothly and ensure successful communication is achieved.

NOTE 2 – Some of the guidelines on video interpretation in [b-ASLI] can be useful to video interpreters in VRS.

The video connection must be of a sufficient quality to support sign language; some guidance on this is given in [b-ITU-T H.Sup1].

7.3 Captioned telephony relay service

Captioned telephony relay services (CTRS) are targeted at persons who are deaf or hard of hearing and that use their own voice. In this respect, it is similar to text-based relay with VCO and HCO, but unlike text-based relay, CTRS typically does not offer the deaf or hard of hearing user any options for typing text back. CTRS consists of either a special telephone that has a text screen to display captions of what the hearing party is saying, or of software that is installed on a smartphone that displays captions of what the hearing party is saying. Often users of CTRS are older adults who have progressively lost their hearing. They frequently have residual hearing and listen to the hearing party and use the captions as a supplement to augment their understanding of words or phrases that they missed during listening (refer to Figure 5).

Typically, a CA will not be able to transcribe more than one person speaking at the same time. Additionally, the CA may or may not be able to follow a deaf person whose speech is understood by the caller. Therefore, it is necessary for the CA to focus on one voice – that of the non-PWD. This avoids the restriction of people having to take strict turns speaking and allows a more functionally equivalent dynamic telephone conversation with each party being able to interact with the other, and even interrupt each other, as they would in any telephone conversation between non-PWDs.

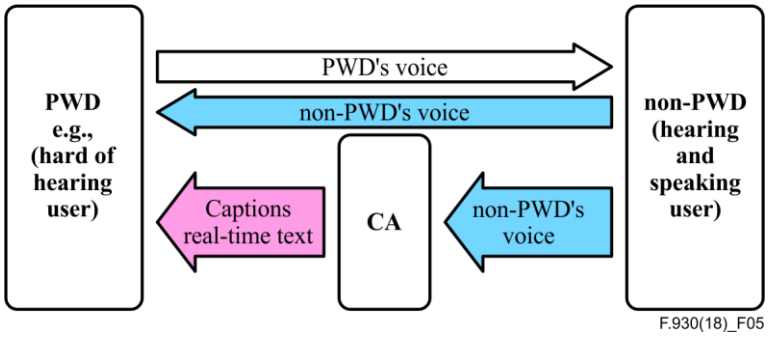


Figure 5 – Captioned telephony relay service

Unlike text-based relays with VCO, emphasis is put on the speed at which the text (i.e., the captions) is generated – captions are expected to follow the conversation in real-time at speeds typical of spoken language. To achieve these speeds, in place of the CA typing, captioned telephony relay services have employed one of three methods:

1) re-speaking: the CA listens to the speech of the hearing party, revoices it, and speech recognition technology automatically transcribes those words from the CA's voice into text, which is then transmitted directly to the CTRS user;

2) computer-assisted stenography: the CA listens to the speech of the hearing party, and employing a special keyboard for faster transcription, types the speech word for word in real time. A computer dictionary translates the input of the keyboard into text, which is then transmitted directly to the CTRS user;

3) automatic speech recognition: It has been anticipated for many years that eventually some portion of captioning might be done automatically without the assistance of a CA using automatic speech recognition (ASR) to provide a text transcription of the voice of the non-PWD. The speech of the hearing party is automatically converted to text through a speech recognition engine, a program developed for the same language, and the text is then transmitted directly to the device of the CTRS user. For an official definition of ASR in ITU-T, see [ITU-T F.745] and [ITU-T H.625].

NOTE – In contrast to the other methods, either no CA is involved, or a CA may be involved in a limited role, such as for the purposes of quality assurance or as a backup if the automated speech recognition fails.

Captioned telephony relay services can be provided over both PSTN and the Internet. In the case of PSTN, voice is transmitted over one phone line, while the captions are transmitted over a second phone line in a typical scenario. In some implementations, a single phone line can support both voice and captions. In the case of Internet-based CTRS, voice is typically transmitted over PSTN or VoIP, while captions are transmitted over an Internet connection. On mobile devices, most existing CTRS services require the user to have both a voice and data plan, and that voice and data can be used simultaneously.

In addition to the call set-up options outlined for relay services in the previous clauses, CTRS services also offer the option of placing a direct voice call to the hearing party first and connecting the relay CA into the call at a later time, for example, at the press of a button. In such set-ups, the CA receives the hearing party's voice from the CTRS user's phone over the second phone line, or over the Internet, rather than interposing itself between the user and the hearing party as in other relay calls. Typically, in such implementations, the CA also receives only the hearing party's voice, and has no access to the PWD's voice.

7.4 Speech-to-speech relay

Speech-to-speech (STS) relay service targets persons with speech disabilities. STS relay enables a person with a speech disability (and unable to type, not allowing for text-relay) to make telephone calls using their own voice (or an assistive voice device). Like all forms of telecommunication relay service (TRS), STS uses specially trained CAs to relay the conversation back and forth between the person with the speech disability and the other party to the call. STS relay CAs are specially trained in understanding a variety of speech disorders, which enables them to repeat what the person with the speech disability says in a manner that makes that individual's words clear and understandable to the other party (refer to Figure 6).

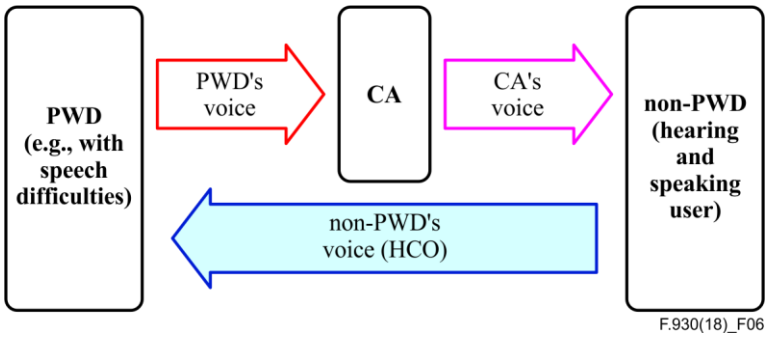


Figure 6 – Speech-to-speech relay service

A dedicated phone is not needed for STS relay. An individual uses a regular voice, VoIP or IMS phone and calls the relay centre through one of the methods outlined in the clause on PSTN text relay. The person is then connected to an STS relay assistant who will repeat the spoken words, making the spoken words clear to the other party. Persons with speech disabilities may also receive STS calls, through the same methods that are used for contacting PSTN text relay users.

8 Service requirements

The following clauses describe recommended functional requirements of relay services.

8.1 End user equipment

A variety of terminal types have been used for relay services, or are newly emerging.

– **relay-service-specific terminals**: text telephone with keyboard and display for text relay service, dedicated videophones for video relay services, and special telephones with a text display for captioned telephone relays;

– **combination of terminals**: the relay-specific terminals above combined with an ordinary telephone for text relay service with VCO/HCO;

– **smartphones, tablets and PCs with applications**: vender-specific, as well as publicly-available applications are available. This type of terminal and application can easily support combinations of media, including new media.

Some legacy PSTN terminals are still in use today and may need further maintenance, even as telecommunications transition to IP-based services.

It is expected that relay services support multiple terminal types with a small variety of communication and media protocols, and/or standardized communication and media protocols.

Detailed terminal requirements need further study.

8.2 Call set-up, modification and tear down procedures

The ultimate aim of all relay service systems is that the call set-up should be no more complicated than that experienced by a pair of non-PWD users calling each other. The relay users should be able to use normal addresses (e.g., phone numbers) without prefixes. The terminals and network should make this possible. The CA should be able to be added to the call as necessary. Other methods of setting up calls may be possible, for example, as described in clause 7.1 for text-based relays; for example, the call set-up and tear-down could be handled by the relay centre.

If a call is made via a relay centre, care should be taken to ensure that information delivered to the destination about the source of the call (e.g., line identification, location information) relates to the caller and not to the relay service. This is especially important in the case of calls made to emergency services where automatic provision of location information and a phone number for call-backs are critical.

The PWD may be issued with a real PSTN, IMS or VoIP phone number, which a non-PWD may call and get routed automatically via a relay service to reach the PWD.

The phone number (and the profile) of the PWD is recommended to be registered such that any calls to the phone number should be automatically routed to the appropriate CA, which follows the pre-registered information (as the profile). The detailed mechanisms, relevant data format, and potential privacy issues need further study.

8.3 Communication assistant

Communication assistants are key to relay service provisioning. Requirements can be classified into two groups:

1) those to be met for the benefit of relay service users (e.g., confidentiality of the communication between PWDs and non-PWDs); and

2) those for the benefit of CAs (e.g., confidentiality of the CAs).

8.3.1 Communication assistant training

A well-trained CA will have the skills and tools to provide the best customer experience. The education and continued development of all CAs is an investment. The reputation as a TRS provider within the deaf, HoH, deafblind, speech disabled communities, and the general public comes from CAs' commitment to providing quality service. This can be done through both quality assurance teams and region-specific training to CAs on region-specific information including the names of local organizations, cities, and other common terms specific to that region.

Relay calls for a wide variety of customers can be challenging and CA training can tackle the challenge using an initial comprehensive training program, including classroom-based, computer-based, discovery-based, and experiential learning methods. CAs learn about relay users' cultures, the evolution of relay products, regulations, policies, procedures and – most importantly - customer conversation and satisfaction skills. This training can be developed in coordination and cooperation with the relay user communities. CA trainees complete a series of scenario-based assessments, culminating in an on-the-job final assessment before graduating from initial training and handling relay calls.

Training should not stop after CAs have started processing calls. CAs should continue to receive regular ongoing training to improve their skills and knowledge. Ongoing training and quality assurance programs are used as incentives to encourage competition between CAs and call centres and encourage continued industry-leading quality.

See Appendix III for examples of specific procedures that have been developed for CA training in the United States.

8.4 Point-to-point calling

End user equipment for making relay calls, as described in clause 8.1, frequently also provides a good communication option for direct point-to-point calls between two PWDs who want to use their preferred communication media. For instance, videophones designed for video relay services also may be the most convenient option with the best video quality for two sign language users to have a direct conversation over video. To cover this use case, both terminals and relay service provider networks should be designed to support point-to-point calls.

8.5 Speed of answer

Key performance indicators for speed of answer require further study.

8.6 Emergency call handling

During emergency calls, time is of the essence, as is the need for accurate and clear communication. Any failure to connect to emergency centres in a timely manner, get accurate information to emergency call centres, or any miscommunications could carry a high price in the form of loss of serious harm or even death of the PWD placing the call. The key functional requirements for placing emergency calls are:

1) accurate and fast routing of the relay to the appropriate emergency call centre: the call centre that the relay service connects to must be the call centre that would have been reached if a non-PWD had made the emergency call in a similar situation. Furthermore, the emergency call centre must receive the call through their normal incoming emergency call phone lines, the same way that a voice emergency call is received from a non-PWD. If CA

availability is limited, emergency calls should be prioritized (i.e., emergency callers can jump the queue of calls waiting for the next available CA to take a call);

2) accurate conveyance of all supporting information: as mentioned in clause 8.3, information on the phone line and the location as it pertains to the PWD, not to the relay centre must be delivered. To the extent that an emergency call centre has access to such information from a non-PWD caller, the same information must be conveyed about a PWD who connects to the emergency services through a relay service;

3) accurate communication: emergency calls place unusual stress on CAs, especially CAs working with video who may be exposed to graphic images. CAs who handle emergency calls must be trained for these situations and equipped with resources to handle the stress. Additionally, if an emergency call centre is able to accept the preferred medium and MoC of a PWD directly without relay centre involvement, PWD callers should be given the ability to connect directly to the emergency call centre and conversing with emergency call takers directly.

To the extent that next-generation emergency calling is being deployed, terminals as described in clause 8.1 and relay call set-up procedures described in clause 8.2, should interoperate with the technical standards specified by these next-generation emergency services. See [b-NENA] and [b-EENA] for examples.

8.7 Message service, storage, indication and retrieval

See Appendix IV for an example of how procedures for message service, storage, indication and retrieval could be implemented.

8.8 Key performance indicators

To achieve functional equivalency, performance associated with the relay services is one of the critical subjects. Parameters to be measured and their values (e.g., the upper limit, lower limit or the acceptable rage) are quite likely to differ for each of the four major services.

Quality of sign language interpreters is also discussed in terms of key performance indicators (KPIs). KPIs for sign language interpreters are under study and will be specified in a separate Recommendation.

9 Service confidentiality and security

To achieve functional equivalency, confidentiality and security associated with the relay services are one of the critical subjects.

Privacy, confidentiality and security shall be maintained to achieve functional equivalency. Privacy, confidentiality and security considerations extend both to the technologies used by relay services and the human CAs.

Relay services shall be able to provide encrypted calls if the mainstream telephone services of the country in which the relay service is located provides encrypted calls. More generally, requirements for confidentiality and call security should mirror those of the mainstream telecommunications services of the country in question.

The detailed mechanisms for achieving privacy, confidentiality and security require further study.

Appendix I

Use of IPTV for telephone relay service

(This appendix does not form an integral part of this Recommendation.)

It is foreseeable, and desirable in some cases, that IPTV be used for VRS. [b-ITU-T Y.Sup5] already states that video conferencing is a possible IPTV service. The following is quoted from [b-ITU-T Y.Sup5]:

Videoconference

A videoconference service is a service providing bidirectional symmetric real-time transfer of motion video, text and voice between end-users in two or more locations. This real-time text differs from instant messaging systems because it is the bidirectional transmission of one character at a time. This gives the end-user the impression of real-time communications, just like voice or video systems that transport streaming media over IP. The concept is aimed at providing for rich media real-time conversation for all people in various situations. This includes, but is not limited to, people that are disabled in some way, e.g., the deaf or hearing impaired, blind people, etc., but also people who find themselves in a situation where the complementing media video, real-time text and voice together fulfil the conversation needs much better than only voice.

[ITU-T F.703] covers videophones with real-time text. Ideally, all videophones should offer this service, but in many cases only video and audio are provided. [ITU-T F.703] is useful not only for the disabled but for anyone who can benefit from the textual back-up of, for example, technical data, language translations, and verbal or signed conversations. It can be used for people who are not only deaf or disabled but people who cannot communicate in either of the two mediums, or do not have command of the spoken language used. This service is useful for documenting information within videophone calls (e.g., phone numbers and addresses) without needing a pen and paper. An example would be to get a flight booking reference when making a travel arrangement.

It is therefore natural to study a combination of ITU-T F.703 and IPTV standards such as ITU-T H.721, ITU-T H.702 and ITU-T H.760 series to be used for VRS. The details of such a combination should be for further study.

Figure I.1 shows an example of how IPTV can be used for VRS. There are two video channels: one for the direction from the PWD to the operator (*Ch*1), and the other for the other direction, from the operator to the PWD (*Ch*2). *Ch*2 can be similar to an ordinary VOD service on IPTV. *Ch*1 may need some other protocol to allow the PWD to connect to the operator as well as to transmit the video image from the PWD.

The operation of the operator is similar to an ordinary VRS. The protocols for VRS can be used for this purpose.

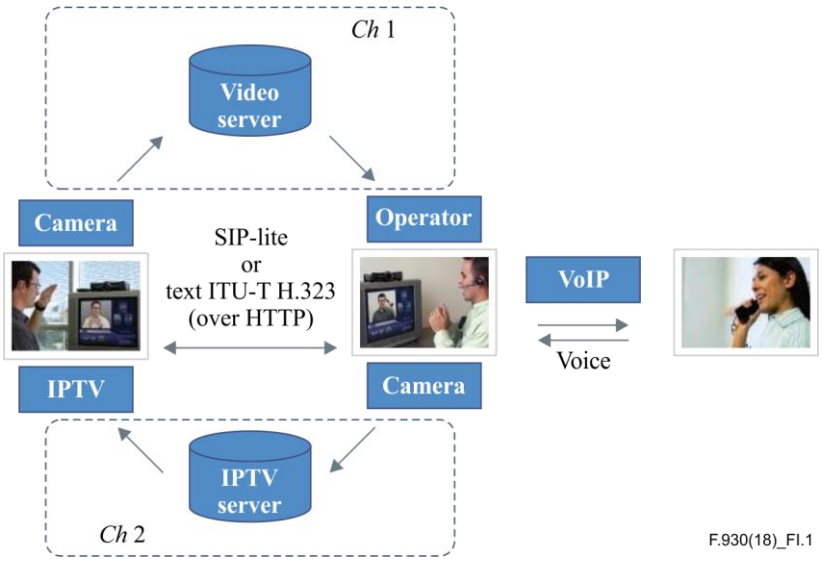


Figure I.1 – An example of VRS using IPTV

Figure I.2 describes an example of a TRS using IPTV that can be used for a HOH person who can use voice to communicate. In this example, a microphone is used to pick up the voice of HoH and the captioned text is sent over IP to be shown overlayed on the screen of the IPTV terminal. The text can be sent using hypertext transfer protocol (HTTP), for example, since this is the common protocol used in IPTV.

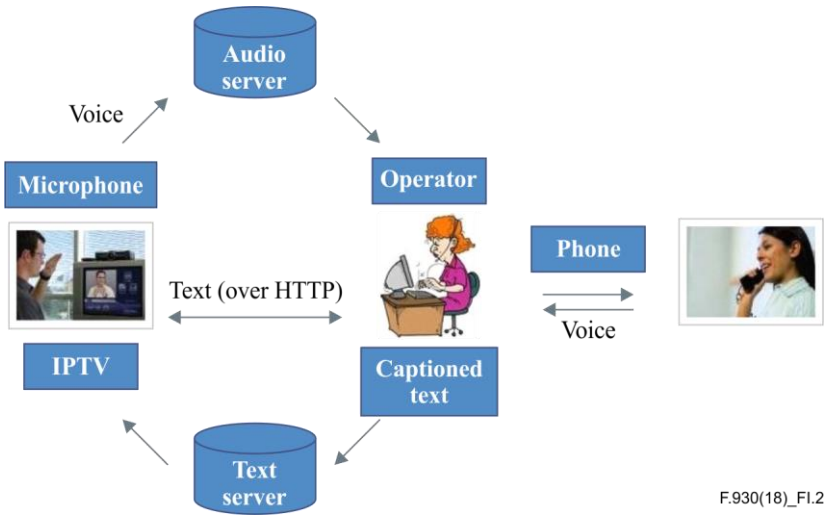


Figure I.2 – TRS using IPTV

Appendix II

Real-time text in the United States

(This appendix does not form an integral part of this Recommendation.)

On 16 December 2016, the United States (US) Federal Communications Commission (FCC) unanimously voted 5-0 to adopt new rules in the matter of the "Transition from TTY to real-time text technology; petition for rulemaking to update the Commission's Rules for access to support the transition from TTY to real-time text technology and petition for waiver of the rules requiring support for TTY technology" ([b-FCC], [b-Gallaudet]).

Background: These rules provide a roadmap for the transition from wireless text telephone (TTY) support to IP-based real-time text communications. To date, wireless carriers have been required under the pre-existing FCC rules to provide support for wireless TTY communications using the Baudot/TIA-825a standard. This support requirement has been shown to be impossible to fulfil on Wi-Fi calling, which recently has been widely deployed in the United States. As a result, in 2015 AT&T simultaneously filed a petition for a waiver from these TTY rules for Wi-Fi calling, and a petition for rulemaking on supplanting the wireless TTY requirements with support for real-time text. Other carriers followed suit after AT&T's filing for a waiver. The FCC granted these waivers in December 2015 for one year and adopted a rulemaking for the transition to real-time text for wireless communications in April 2016.

Scope of the new rules: The rules adopted on 16 December 2016 give wireless carriers the option to either continue support for wireless TTYs or alternatively implement real-time text (RTT) communications. In the event that real-time text is chosen, real-time text implementations must be interoperable across wireless carriers, and also be backward compatible with TTYs [b-TIA-825A], particularly for Public Safety Answering Points for emergency calling, where TTYs currently are deployed under existing law. Real-time text implementations must also support real-time text and voice as part of the same call. To meet interoperability requirements, carriers are permitted to use the IETF RFC 4103 transport protocol in conjunction with ITU-T T.140 as a safe harbour; if they implement this protocol, they are deemed to have met the interoperability requirement irrespective of what peering carriers implement. The final FCC order also provides a list of recommendations for the functional aspects of real-time text implementations (e.g., latency, character error rate, support for call transfers, leaving messages), but do not mandate them.

Wireline communications are currently not in scope of the new rules. Compatibility with the 7-1-1 relay service system is the topic of a Further Notice of Proposed Rulemaking, also adopted on 16 December 2016.

As of February 2018, RTT providers in the United States support text relay calls through a RTT to TTY gateway that is invoked when 7-1-1 is called. Such gateways also are invoked when a RTT user calls a TTY user or vice versa.

Timeline:

- **31 December 2017**: Tier-1 carriers make RTT available in either a downloadable app or in at least one phone;
- **31 December 2018**: Phone manufacturers include RTT functionality in all new phones;
- **31 December 2019**: Tier-1 carriers make RTT available in all new phones;
- **30 June 2020**: Smaller carriers and resellers make RTT available in either downloadable app or in at least one phone;
- **30 June 2021**: Smaller carriers and resellers make RTT available in all new phones.

Appendix III

Procedures for training of communication assistants

(This appendix does not form an integral part of this Recommendation.)

This appendix describes specific methods that a US relay provider has developed for CA training based on its extensive experience in providing relay services.

III.1 Initial training

An initial comprehensive training program of up to 80 hours has been designed to provide CA applicants with the tools and skills necessary to facilitate TRS calls successfully. The CA software application is intuitive and contains on-screen prompts. This means CA trainees need less time to learn to navigate the system and we can spend more time on customer-focused activities such as deaf culture, translating American sign language (ASL) to English, ethics, confidentiality and customer care – as outlined in the clauses below.

III.1.1 Administration and testing (5.5 hours)

From the first day of training, we want all CAs to know what is expected of them including ethics and confidentiality. This time is spent reinforcing all relay call centre policies, as well as ensuring that each CA has mastered all objectives to process calls in accordance with contractual guidelines.

III.1.2 Call processing (30.5 hours)

CAs fully understand the operation of the call-processing terminal. This allows them to meet customer requests quickly and efficiently. Additionally, training focuses on teaching CAs to use correct procedures to process each call-type, billing methods, stress management, and how to handle emergency and hotline procedures.

III.1.3 Role-play and practice (24 hours)

In order to become more proficient in the CA role, we dedicate training time for trainees to receive both simulated and on-line call processing experience.

III.1.4 Diversified culture training (20 hours)

The diversified culture training module represents aims at ensuring that employees develop a sensitivity and understanding to relay customers. The diversified culture training was initially researched and written by a deaf college intern. A number of additional organizations and individual contributors contributed to the ongoing updates. The diversified culture training module includes information about the needs of relay users.

III.2 Instructional methods

We develop all of our training programs using adult learning theories. We incorporate various instructional methods to enhance the CA's ability to learn such as:

– lectures;
– visual graphics;
– flow charts;
– videos;
– role-play scenarios;
– simulated on-line call handling;
– observation of live-call handling.

III.3 Training topics

III.3.1 Initial training schedule

Initial training for TRS CAs consists of up to 80 hours of curriculum, workshops, and exercises to train.

CAs to meet the specialized communications needs of relay users who are deaf, hard of hearing, late deafened, and those who have a speech disability effectively.

III.3.2 Speech-to-speech training

Qualifications

In order to be considered for an STS CA position, CA applicants must successfully achieve the following:

– six months of employment as a CA;
– recommendation and/or approval from supervisor or manager;
– proficiency in all areas of relay call processing including grammar, enunciation and vocabulary;
– hearing acuity test administered by an audiologist using calibrated equipment to perform a speech recognition test and pure tone test.

STS applicants who meet these qualifications receive additional training specifically on STS. Our STS training is delivered by individuals with professional experience related to Speech Disabilities and/or consumer experts and is based on adult learning theories.

III.3.3 STS training overview

STS applicants who meet all qualifications for the STS training program receive eight hours of classroom training specifically on speech-to-speech services. Our STS training program has been developed based on direct experience and consultation with an STS expert obtained during the initial STS trial and conducted along with eight years of experience processing STS calls.

The STS training outline includes specific strategies used to facilitate communication without interfering with the STS user's control over the call including retention of information at the user's request and verification of what is said to verify accuracy.

Tools available to STS CAs and STS CA applicants include:

– audiotapes and videotapes featuring a variety of STS users with speech disabilities (It is important to note that these STS users have voluntarily provided recordings in order to promote the ongoing training of STS CAs and represent a broad range of levels of speech disability and include augmentative devices);
– STS CA training guide, which details the history of STS, the role of the STS CA, comprehension strategies and confidentiality concerns;
– ten hours of additional live observation and mentoring by seasoned, professional STS CAs.

III.3.4 Spanish language CA training program

After completing initial training in English, bilingual CAs receive supplemental, specialized training to process Spanish calls. In order to be considered for an alternate language CA position, applicants must successfully achieve the following:

– recommendation and/or approval from supervisor or manager;
– proficiency in all areas of call processing including grammar, enunciation and vocabulary;
– Berlitz language assessment.

III.4 Alternate language training topics

The following topics are discussed during training:

– additional foreign language training topics;
– appropriate terminology;
– pacing phrases;
– explanation phrases;
– translations conveying the concept rather than word for word;
– macros;
– cultural discussion;
– CTRS training;
– CTRS CA training has been developed by the CTRS technology provider and is consistently delivered in all of our CTRS call centres, including the TRS call centres that process CTRS calls;
– orientation.

Orientation consists of introductions, building tour, required employment paperwork, introduction to call centre policies, confidentiality requirements, and expected standards that must be met to pass training. In addition, in our TRS centres, we have added supplemental diversified culture training specifically targeted towards people who use CTRS including seniors, veterans, and others with a hearing loss.

III.5 Training class

Initial training consists of ten days of classroom and hands-on training. CTRS training is an interactive class combining video and hands on instruction. Each class introduces a skill and allows time to practice the skill. CTRS training uses simulators that allow the CA to listen to pre-recorded scripts and hear the voice of the hearing person in order to practice captioning. During the second week, timing tests are given each day to check CAs' transcription rate and accuracy. Improvement rate is evaluated.

III.6 Training transition and graduation

All CAs that pass two rounds of timing tests consecutively are paired with a mentor for a week. This mentor provides one-on-one coaching for every call. If the CA meets performance expectations on live calls, the trainee graduates and is allowed to process calls independently.

Appendix IV

Procedures for message retrieval

(This appendix does not form an integral part of this Recommendation.)

The following is a brief outline of a US relay provider's standard process used for retrieving voice mails. These standard processes are modified based on individual relay user requests on either a per-call or per-line.

(Customer Profile) basis.

Retrieving Voice Mail Procedures

When a relay user asks to retrieve voicemail, the CA will ask the caller for the appropriate information, if not provided, e.g.,

(MAY I HAVE UR VOICE MAIL NBR AND PASS CODE PLS Q) GA

The CA dials the requested number and reaches an answering machine, keeping the relay user informed of the call progress.

DIALING LOCAL CALL XXX-XXX-XXXX RINGING 1… 2… 3… 4…

Once the voicemail system answers, the CA enters the passcode using a touchtone keypad.

If there are no new messages, the CA will relay this information and wait for additional customers instructions.

(NO NEW MESSAGES) GA

If there are new messages, the CA will retrieve all voicemail messages while keeping the relay user informed and prompting them for actions, as appropriate.

(ONE MOMENT PLS)

(SAVE Q DELETE Q REPLAY Q) GA

(REDIALING TO GET MSGS)

Once all voicemail messages have been successfully retrieved, the CA will inform the relay user and follow the user's instructions.

Bibliography

[b-ITU-T F.791] Recommendation ITU-T F.791 (2015), *Accessibility terms and definitions*.

[b-ITU-T H.Sup1] ITU-T H-Series Supplement 1 (1999), *Application profile – Sign language and lip-reading real-time conversation using low bit rate video communication*.

[b-ITU-T V.18] Recommendation ITU-T V.18 (2000), *Operational and interworking requirements for DCEs operating in the text telephone mode*.

[b-ITU-T Y.Sup5] ITU-T Y-Series Supplement 5 (2008), *ITU-T Y.1900-series – Supplement on IPTV service use cases*.

[b-ITU PP Res.175] ITU Plenipotentiary Conference Resolution 175 (Busan, 2014), *Telecommunication/information and communication technology accessibility for persons with disabilities and persons with specific needs*.

[b-ASLI] Helen Ryan and Robert Skinner. *ASLI Video Interpreting Best Practices.* <https://www.asli.org.uk/app/uploads/2017/05/ASLI_Video_Interpreting_Best_Practice_VIBP-1.pdf>

[b-EENA] European Emergency Number Association, EENA LTD v1.1 (2013), *Next Generation 112 Long Term Definition v1.1*. <www.eena.org/ressource/static/files/2013-03-15-eena_ltd_v1-1_final.pdf>

[b-FCC] United States Federal Communications Commission, *Adoption of real-time text rules, report & order, and further rulemaking*. <https://www.fcc.gov/document/adoption-real-time-text-rtt-rules>

[b-Gallaudet] *Gallaudet University video log in American Sign Language explaining the implications of the new rules:* <https://www.youtube.com/watch?v=tfmAblNvr8E>

[b-Llewellyn-Jones] Llewellyn-Jones, P., & Lee, R. G. (2013). *Getting to the Core of Role: Defining Interpreters' Role Space.* International Journal of Interpreter Education, 5(2), 54-72.

[b-Napier] Roy, C. B., & Napier, J. (Eds.). (2015). *The sign language interpreting studies reader (Vol. 117).* John Benjamin's Publishing Company. Chicago.

[b-NENA] National Emergency Number Association, NENA-STA-010.2-2016, NENA. *Detailed Functional and Interface Standards for the NENA i3 Solution*. <https://www.nena.org/?page=i3_stage3>

[b-Roy] Roy, C. B. (1993), *A sociolinguistic analysis of the interpreter's role in simultaneous talk in interpreted interaction.* Multilingua-Journal of Cross-Cultural and Interlanguage Communication, 12(4), 341-364. Chicago.

[b-TIA-825A] Telecommunications Industry Association (2003), TIA-825 Revision A, *A Frequency Shift Keyed Modem for Use on the Public Switched Telephone Network.*

[b-Wadensjö] Wadensjö, C. (1993), *The double role of a dialogue interpreter*. Perspectives: studies in Translatology, 1(1), 105-121.

[b-WTDC AP] ITU World Telecommunication Development Conference (2014), *Action Plan*.

[b-WTDC Res.58] ITU World Telecommunication Development Conference Resolution 58 (Rev Dubai 2014), *Telecommunication/information and communication technology accessibility for persons with disabilities, including persons with age-related disabilities*.

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