

I n t e r n a t i o n a l T e l e c o m m u n i c a t i o n U n i o n

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

F.921

(03/2017)

SERIES F: NON-TELEPHONE TELECOMMUNICATION
SERVICES

Accessibility and human factors

Audio-based network navigation system for persons with vision impairment

Recommendation ITU-T F.921

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 multideestination 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.921

Audio-based network navigation system for persons with vision impairment

Summary

Recommendation ITU-T F.921 explains how audio-based network navigation systems can be designed to ensure that they are inclusive and meet the needs of persons with visual impairments. Recommendation ITU-T F.921 adopts a technology neutral approach by defining and explaining the functional characteristics of the system. The aim is to give designers of audio-based network navigation systems the information that they need at the initial stages of development to anticipate and overcome any restrictions and barriers that prevent users with visual impairments from making full and independent use of the built environment. Recommendation ITU-T F.921 explains how to accommodate users' experience of audio-based network navigation systems and ensure the interoperability of those systems. This Recommendation recognizes that by meeting the user needs of persons with visual impairments, audio-based network navigation systems may also benefit persons with other disabilities, age-related conditions and specific needs, as well as the general public.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T F.921	2017-03-01	16	11.1002/1000/13185

Keywords

Accessibility, audio-based, network navigation system, persons with disabilities.

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

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/>.

© ITU 2017

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

Table of Contents

	Page
1 Scope.....	1
2 References.....	1
3 Definitions	1
3.1 Terms defined elsewhere:.....	1
3.2 Terms defined in this Recommendation.....	2
4 Abbreviations and acronyms	3
5 Conventions	3
6 Design principles	3
7 Validation principles.....	3
8 Directions.....	3
9 Audio instructions.....	3
9.1 Components of an audio instruction.....	3
9.2 Audio instructions – Classification	4
10 Specific features, landmarks and objects.....	5
10.1 Entrances and exits	5
10.2 Pathways.....	5
10.3 Decision points	5
10.4 Tactile walking surface indicators	5
10.5 Escalators.....	6
10.6 Stairs	6
10.7 Lifts.....	6
10.8 Ticket control gates and barriers	7
10.9 Platforms.....	7
11 Railway stations.....	7
12 Mobile app features	8
Appendix I – Examples of an audio instruction.....	9
Bibliography.....	10

Introduction

This Recommendation explains how audio-based network navigation systems can be designed to ensure they are inclusive and meet the needs of persons with visual impairments. This Recommendation adopts a technology neutral approach by defining and explaining the functional characteristics of the system.

The aim is to give designers of audio-based navigation system the information that they need at the initial conception stage to anticipate and overcome any restrictions and barriers that prevent users from making full and independent use of the built environment. Whilst existing audio-based network navigation systems have utilized mobile technologies to provide users with efficient, effective and satisfying wayfinding and the standards for the hardware, compatibility and interoperability for mobile technologies may provide a useful basis for promoting audio-based navigation, this Recommendation explains how to accommodate the users' experience of inclusive audio-based network navigation systems (IABNNSs) and ensure the interoperability of those systems. This Recommendation recognizes that, by meeting the user needs of persons with visual impairments, IABNNSs can also benefit persons with other disabilities, age-related conditions and specific needs, as well as the general public. This Recommendation can be applied to IABNNSs in a variety of built environments, including those in urban or rural settings.

NOTE – This Recommendation on audio-based network navigation systems does not consider the specialized requirements of people who are deaf or hard of hearing.

Recommendation ITU-T F.921

Audio-based network navigation system for persons with vision impairment

1 Scope

This Recommendation specifies requirements for the design of inclusive audio-based network navigation systems (IABNNSs) to accommodate users with vision impairment as well as users with a wide range of characteristics and capabilities. This Recommendation aims to help design professionals to achieve an inclusive environment through IABNNSs that augment the physical environment by the provision of aural information about environments for users. This Recommendation does not consider the specialized requirements of people who are deaf or hard of hearing.

In addition, while this Recommendation recognizes the necessity of providing audio-based network navigation outputs in languages determined by the user, it is beyond scope of this Recommendation to provide a specific solution. However, implementers should not implement an audio-based network navigation solution that only uses the English language. Future work aims, among other things, to address this issue, and will explore the use of meta-coding for providing a flexible user-centric translation system.

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.

[ISO 23599:2012] ISO 23599:2012, *Assistive products for blind and vision-impaired persons – Tactile walking surface indicators*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 accessibility [b-ITU-T F.791]: The degree to which a product, device, service, or environment (virtual or real) is available to as many people as possible.

3.1.2 disability [b-ITU-T F.791]: Any restriction or inability to perform a function or activity in the manner or the range considered average or accepted functionality, resulting from an impairment or reduction of ability, than can be either permanent or temporary.

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

3.1.4 persons with age related disabilities [b-ITU-T F.791]: Persons when they age, often develop cognitive and physical disabilities that are caused by the aging process itself. Examples are diminished eyesight, deafness in varying degrees, reduced mobility, or cognitive abilities.

3.1.5 persons with specific needs [b-ITU-T F.791]: Includes persons with disabilities (PWD), persons who are not literate, those with learning disabilities, children, indigenous people, older persons with age related disabilities, and anyone who has a temporary disability.

3.1.6 platform accessibility features [b-ITU-T F.791]: Accessibility functionality provided as standard on a particular hardware/software platform.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 audio alert: Aural signal designed to precede audio instructions.

3.2.2 audio instruction: Aural message to provide wayfinding instructions and directions for users of audio-based network navigation systems (IABNNSs).

3.2.3 cardinal coordinates: Means of communicating general directions to a user based on points of a compass where 'North' is straight ahead.

3.2.4 clock face directions: Means of communicating general directions to a user by reference to the positions of the hours on an analogue clock with 12 o'clock being straight ahead.

3.2.5 countable delimiter: Word or phrase that uses numbers to communicate directions, e.g., the first (corridor).

3.2.6 decision point: Crossing or intersection of a pathway, e.g., a route to a railway station ticket gate for departing passengers and the gate for arriving passengers.

3.2.7 degree directions: Means of communicating general directions to a user by reference to the degrees of a circle, with 0° being straight ahead.

3.2.8 descriptive delimiter: Word or phrase that describes an object or an environmental feature to communicate directions, e.g., the lower (concourse).

3.2.9 directional delimiter: Word and phrase that usually follows a verb and communicates direction, e.g., left.

3.2.10 egocentric frame of reference: Reference frame in which the spatial layout and orientation are communicated based on the individual's current location and viewpoint.

3.2.11 inclusive audio-based network navigation system (IABNNS): Technologies used to augment the physical environment by the provision of an audio version of that environment for users.

3.2.12 journey completed notification alert: A sequence of short three-note rising pitch sounds of equal duration provided when the scheduled journey is complete. They are different to mobile device operating system alerts.

3.2.13 landmark: Feature in the physical environment, e.g., an isolated column.

3.2.14 notification alert: A sequence of short two-note sounds of equal duration provided just before audio alerts and audio instructions to notify the user of an impending audio alert or audio instruction. This is different to a mobile device operating system alert.

3.2.15 object: Small feature in the physical environment, e.g., a lift control button.

3.2.16 orthogonal: Means of communicating general directions to a user that is different to the 'degree' approach and uses directions based on 90° angles from a direction straight ahead.

3.2.17 pathways: corridors, ramps, tunnels, subways, escalators, stairs or lifts (elevators), footways and road crossings.

3.2.18 person with a disability: person who has a physical or mental impairment that has a substantial and long-term adverse effect on her or his ability to carry out normal day-to-day activities.

NOTE – [b-UNCRPD] covers the rights of people with disabilities.

3.2.19 platform: A boarding facility to provide access to rail-mounted vehicles.

3.2.20 proportional directions: Means of communicating general directions to a user that is different to the 'clock face' or 'degree' approach and uses terms like 'straight', 'ahead', 'left' and 'right'.

3.2.21 segment: Distinctive area in an environment, e.g., a railway station forecourt.

3.2.22 sequential delimiter: Word or phrase that limits the relationship of one object to communicate directions, e.g., after (the gates).

3.2.23 vision impairment: A vision loss that cannot be corrected by the use of glasses, refractive correction, medication, or surgery. The vision loss may affect visual acuity, central or peripheral visual field defects, or reduced contrast sensitivity.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

IABNNS Inclusive Audio-Based Network Navigation System

5 Conventions

The following conventions are used in this Recommendation. The word 'should' indicates an essential requirement in order to conform to this Recommendation. The word 'may' indicates a recommendation with which it is not essential to comply in order to conform to this Recommendation.

6 Design principles

The principles for the design and interoperability of an IABNNS should involve users in the design, development and validation process, in a real environment. Users should help to identify the location of the main points of interest, key features and routes that are safe and convenient. The route should have defined segments and landmarks and be the most accessible. The content, terminology and classification used in the audio instructions is shown in clause 8.

7 Validation principles

The principles for the validation and interoperability of an IABNNS should include the testing of the installation, configuration, usability and accessibility.

8 Directions

Directions should be provided through the use of an egocentric frame of reference that communicates general directions and alerts based on a clock face, degree, proportional or orthogonal approach, as defined in clause 3.2. The most accessible route should be used.

NOTE – An allocentric frame of reference, which communicates general directions and alerts based on cardinal co-ordinates ([b-Chen, 2015]; [b-Kalia, 2010]) (as defined in clause 3.2), may be used.

9 Audio instructions

Audio instructions and audio alerts should be clear, unambiguous, effective and safe ([b-Allen, 2000]; [b-Kulyukin, 2008]). The piloting or chaining of routes should allow instructions to be related to particular segments of the route. The most accessible route should be used.

9.1 Components of an audio instruction

An audio instruction should contain the elements specified in 9.1.1 to 9.1.3.

NOTE – Two examples of an audio instruction using the elements included in this clause are shown in Appendix I.

9.1.1 Verbs

Verbs are used to communicate the action required, e.g., 'walk'.

9.1.2 Orientation information

Orientation information is used to communicate users' current location in relationship to their surroundings, e.g., 'you are approaching'. Orientation information should make reference to features of the physical environment and the route. These include segments (3.2.20), pathways (3.2.17), decision points (3.2.6), landmark (3.2.13) and objects (3.2.15).

9.1.3 Direction information

Direction information is used to communicate directions to the user. Direction information should use directional delimiters (3.2.9), countable delimiters (3.2.5), sequential delimiters (3.2.21) and descriptive delimiters (3.2.8).

9.2 Audio instructions – Classification

Audio instructions are classified [b-Gaunet, 2005] as in 9.2.1 to 9.2.8.

9.2.1 Route starting instructions

Define the starting point of the route, the type of environment and identify the orientation of the user, e.g., "Welcome to Central Station. You are now on the main concourse. For your train, walk forward to the ticket barriers".

9.2.2 Route ending instructions

Define the ending point of the route, inform users they have reached their destination and that audio instructions are ending, e.g., "You have exited Central station. You are now on the east side of Alpha High Street facing the Town Hall".

9.2.3 Progression direction instructions

Define the direction to the next segment, pathway, decision point, landmark or object e.g., "At the bottom of the stairs, turn left and walk forward to the ticket gates".

9.2.4 Reassurance progression direction instructions

Reassure users that they are following a route that is communicated by audio instructions, e.g., "Keep walking forward" and should be provided every 25 m on routes where there are no changes of direction or decision points.

9.2.5 Orientation progression direction instructions

Communicate a change in direction prior to reaching an environmental feature, e.g., "At the next tactile paving intersection, follow the tactile paving route to the left".

9.2.6 Alerts of the location of the next environmental feature

Communicate information about the location of the next environmental feature, e.g., "The down escalator is the one on the left."

9.2.7 Alert to an environmental feature

Communicate information about an environmental feature that is close to the user, e.g., "You are approaching the escalators."; "You are approaching the stairs".

9.2.8 Alert to current location

Communicate information about the spatial layout of a location and the position of the user.

10 Specific features, landmarks and objects

This clause includes a range of decision points, landmarks and objects where particular instructions and alerts should be provided. Audio instruction directions should utilize the most accessible routes.

10.1 Entrances and exits

The audio instruction communications from an IABNNS should:

- utilize the most accessible entrance and exit;
- allow users to choose their entrance and exit;
- provide information about the type, size and opening configuration of doors;
- provide information about the position and type of door opening furniture and operating controls.

10.2 Pathways

The audio instruction communications from an IABNNS should:

- utilize the most accessible pathway;
- allow users to choose their pathway;
- provide information about the type and size of the pathway;
- inform users of any curve in the pathway.

10.3 Decision points

The audio instruction communications from the IABNNS should:

- be provided at all decision points;
- utilize the most accessible decision points;
- allow users to choose their decision points;
- provide information about the type, size and configuration of decision points.

10.4 Tactile walking surface indicators

There are two different types of tactile walking surface indicators [ISO 23599:2012], namely warning and directional indicators.

10.4.1 Warning walking surface indicators

These indicators are used to warn of pedestrian hazards.

10.4.2 Directional walking surface indicators

These indicators are used to provide direction information.

The audio instruction communications from an IABNNS should:

- be provided for all walking surface indicators;
- utilize the most accessible route of walking surface indicators;
- provide information about the type, size and configuration of the walking surface indicators.

NOTE – Some tactile walking surface indicators indicate the proximity of platforms.

10.5 Escalators

The audio instruction communications from an IABNNS should:

- enable the user to locate the escalator;
- describe the proximity of the escalator;
- describe the moving direction of the escalator;
- describe the numbers of escalators in any group;
- describe the moving direction of each escalator in a group;
- describe the location of the handrail;
- where appropriate, state the side of the escalator where travellers stand;
- describe the relative width/length of the escalator;
- describe the next direction of the route when leaving the escalator.

The proximity of an escalator should be given in an audio instruction 8 ± 1 m from the escalator.

10.6 Stairs

The audio instruction communications from an IABNNS should:

- enable the user to locate the stairs;
- describe the proximity of the stairs;
- describe the direction of the stairs;
- describe the numbers of steps;
- describe the location of a landing within a flight of stairs;
- describe the location of handrails;
- where appropriate, state the side of the stairs travellers use to move up and down;
- describe the relative width/length of the stairs;
- describe the next direction of the route when leaving the stairs.

NOTE – Only describe the number of steps when less than 12.

The proximity of a staircase should be given in an audio instruction 8 ± 1 m from the first step.

10.7 Lifts

The audio instruction communications from an IABNNS should:

- enable the user to locate the lift;
- describe the proximity of the lift;
- describe the numbers of lifts;
- describe the location of call buttons outside the lift;
- describe the size of the lift;
- describe the location of call buttons inside the lift;
- indicate which button to operate to get to different levels;
- describe the next direction of the route when leaving the lift.

The proximity of a lift should be given in an audio instruction 8 ± 1 m from the lift

The audible announcements generated by lifts e.g., the next lift to arrive, the travel direction of the lift, the entry and exit floor, and the position of the opening doors should supplement the audio instruction communications from the IABNNS.

10.8 Ticket control gates and barriers

The audio instruction communications from an IABNNS should:

- enable the user to locate the gates and barriers appropriate to the direction of travel;
- describe the proximity of the gates and barriers;
- describe the numbers of gates and barriers;
- describe the size of the gates and barriers;
- describe the next direction of the route when leaving the gates and barriers.

The proximity of gates and barriers should be given in an audio instruction 8 ± 1 m from the gate or barrier.

All users, including those with guide dogs, should be directed to the widest accessible gate.

The use of gates and barriers for arriving or departing travellers should be clearly described.

NOTE – The terminology around ticket control gates and barriers can vary between countries. In this Recommendation, the term 'gate' refers to wide, accessible gates and the term 'barrier' refers to an accessible route that is controlled to permit ingress and egress.

10.9 Platforms

The audio instruction communications from an IABNNS should:

- enable the user to locate the platform appropriate to the direction of travel;
- describe the proximity of the platform;
- describe the type of platform;
- describe the numbers of platforms;
- describe the size of the platform;
- describe the size of the gap between the platform edge and the rail-mounted vehicle;
- describe any difference between the length of the rail-mounted vehicle and the platform;
- describe the next direction of the route when leaving the platform.

The proximity of a platform should be given in an audio instruction 8 ± 1 m from the platform.

NOTE – Platforms are a hazard because of the risk of falls.

11 Railway stations

This specific type of built environment includes a range of segments, decision points, landmarks and objects where particular instructions and alerts should be provided, see clause 9.2. Audio instruction directions should utilize the most accessible routes. The segments described in this clause are the forecourt, interchange to other forms of transport, concourse, retail areas and platforms.

The audio instruction communications from an IABNNS that relates to segments should:

- describe the start of a segment;
- enable the location of the segments;
- describe the location of the segments;
- describe the proximity of adjoining segments;
- describe the type of segment;
- describe the size of the segment;
- describe the next direction of the route when leaving the segment.

12 Mobile app features

The mobile app features specific to the IABNNS for the built environment should provide instructions and alerts that are accessible, simple, clear, concise, consistent, understandable and safe.

The audio instruction communications from an IABNNS that are delivered through a mobile app should:

- use a notification alert before an alert or instruction;
- provide user preview;
- enable user replay;
- enable user search by dictation;
- use a journey completed notification alert.

NOTE 1 – A single action button should be utilized for user replay.

NOTE 2 – User replay can mask current instructions.

Appendix I

Examples of an audio instruction

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

This appendix gives two examples of an audio instruction using the elements included in clause 9.

Audio instruction

Example 1

"Turn left and take the escalator down to the platforms.

The down escalator is the one on the left."

The instruction comprises the following elements:

Verb (i.e., "turn"), directional delimiter (i.e., "left"), verb (i.e., "take"), environmental feature is the pathway (i.e., "the escalator"), directional delimiter (i.e., "down"), directional delimiter (i.e., "to"), environmental feature is the area/segment (i.e., "the platforms"), directional delimiter (i.e., "the down"), environmental feature is the pathway (i.e., "escalator"), state-of-being verb (i.e., "is"), directional delimiter (i.e., "the one on the left").

Example 2

"At the bottom of the stairs, turn right and walk forward to the platform."

The instruction comprises the following elements:

Sequential delimiter (i.e., "at the bottom"), environmental feature is the pathway (i.e., "the stairs"), verb (i.e., "turn"), directional delimiter (i.e., "right"), verb (i.e., "walk"), directional delimiter (i.e., "forward"), directional delimiter (i.e., "to"), environmental feature is the segment (i.e., "the platform").

Bibliography

- [b-ITU-T F.791] Recommendation ITU-T F.791 (2015), *Accessibility terms and definitions*.
- [b-Allen, 2000] Allen, G.L. (2000). [Principles and practices for communicating route knowledge](#). *Applied Cognitive Psychology*, **14**, 333–359. Available (viewed 2017-03-22) at: www.paulmckevitt.com/cre333/papers/allen.pdf.
- [b-Chen, 2015] Chen, H.E., Lin, Y.Y., Chen, C.H., Wang, I.F. (2015). BlindNavi: a navigation app for the visually impaired smartphone user. In: *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems*, pp. 19–24). New York, NY: ACM.
- [b-Gaunet, 2005] Gaunet, F., Briffault, X. (2005). Exploring the functional specifications of a localized wayfinding verbal aid for blind pedestrians: Simple and structured urban areas. *Human–Computer Interaction*, **20**(3), 267–314. Available (viewed 2017-03-22) at: http://lpc.univ-amu.fr/dir_provence/dir_gaunet/articles/Exploring%20the%20functional%20specifications%20of%20a%20localized%20wayfinding%20verbal%20aid.pdf.
- [b-Kalia, 2010] Kalia, A.A., Legge, G.E., Roy, R., Ogale, A. (2010). [Assessment of indoor route-finding technology for people with visual impairment](#). *Journal of Visual Impairment and Blindness*, **104**(3), 135–147. Available (viewed 2017-03-22) at: www.ncbi.nlm.nih.gov/pmc/articles/PMC3160142.
- [b-Kulyukin, 2008] Kulyukin, V., Nicholson, J., Ross, D., Marston, J., Gaunet, F. (2008). [The blind leading the blind: Toward collaborative online route information management by individuals with visual impairments](#). In: *AAAI Spring Symposium: Social Information Processing*, pp. 54–59. Available (viewed 2017-03-22) at: <http://lpc.univ-amu.fr/IMG/UserFiles/Images/The%20Blind%20Leading%20the%20Blind.pdf>.
- [b-UNCRPD] United Nations (2007), *Convention on the rights of persons with disabilities*.

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	Tariff and accounting principles and international telecommunication/ICT economic and policy issues
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling, and associated measurements and tests
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities
Series Z	Languages and general software aspects for telecommunication systems