

Survey
on information for people with reduced mobility
in the field of public transport
- Final Report -

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1 Needs and requirements of people with different mobility impairments regarding vehicles, stops, operating schedules and services in public transport

1.1 Disability/Mobility impairment:

Inability to walk

People who are unable to walk are normally wheelchair users. The variety of possible medical causes and individual living situations that make the use of a wheelchair necessary corresponds with the multitude of motorized and non-motorized wheelchair models in use.

But they have a lot in common. As for example, wheelchair users are not able to negotiate steps, kerbs or stairs. Low thresholds are normally negotiable, but lead to personal uncertainty and sometimes also to uncertainty about the stability, the manoeuvrability etc. of the wheelchair. Steep ramps and long road gradients can only be negotiated with assistance.

That assistance should be avoided in order to make a self-determined life possible. Moreover, the people assisting are often unskilled, assistance is not possible or not wanted and could have incalculable consequences for the wheelchair user's and naturally also for the helping person's life and limb, especially regarding the negotiation of obstacles of all kind.

Against this background, vehicles, stops and stations, the operating schedule and general service in public transport should comply with the following requirements to meet the needs of passengers who are unable to walk:

Vehicle

- Step-free entrance and exit with almost no gap and only a minimal drop in level
- Step-free corridors and manoeuvring space without thresholds and without a drop in level
- Corridors, storage places, seats, toilets and service areas are required to have sufficient manoeuvring and clear space
- All operating controls and communication systems should be within reach of sitting persons
- All doors and corridors should be of sufficient width
- Doors should be operated fully automatically

Stop/station

- Step-free accessibility with almost no thresholds and only a minimal drop in level
- Step-free manoeuvring space without thresholds and without a drop in level
- Footways, storage places, toilets and service areas are required to have sufficient manoeuvring and clear space
- All operating controls and communication systems should be within reach of sitting persons

- Step-free accessibility of the shelter without thresholds and a minimal drop in level
- All doors and corridors should be of sufficient width
- Doors should be operated fully automatically
- Sufficient parking space

Operating schedule

- Reliable intervals between the vehicles that comply with the criteria mentioned above
- Prompt provision of compensation possibilities in case of failure of the vehicles that comply with the criteria mentioned above

Service

- Step-free accessibility of machines and counters with almost no thresholds and only a minimal drop in level
- Step-free manoeuvring space in front of machines and counters without thresholds and without a drop in level
- Sufficient manoeuvring and clear space in front of machines and counters
- All operating controls and communication systems should be within reach of sitting persons
- Counters of all kind should be designed at a height that is suitable for wheelchair users
- All doors and floors should be of sufficient width
- Doors should be operated fully automatically

1.2 Disability/Mobility impairment:

Walking impairment

The group of walking impaired people is very heterogeneous. But these people have many things in common: They don't need a wheelchair, except for extreme situations, but do often need a walking aid as for example crutches, a rollator or an artificial leg. It is always difficult for walking impaired people to cross roads with high traffic volume and overcrowded footways or places. Kerbs, stairs and steep ramps are also difficult to negotiate. If there are no handrails or other gripping aids or supports provided, some may even be unable to negotiate these obstacles. Normally, thresholds can be managed easily, but they can also present a tripping hazard. Because walking requires a physical effort for walking impaired people, we have to assume that they get tired faster than other people, what has an effect on the maximum walking distance, maximum walking time, maximum standing time, maximum standing capacity and maximum speed of movement possible. Due to their quick exhaustion, long detours and waiting periods are especially arduous.

Against this background, vehicles, stops and stations, the operating schedule and general service in public transport should comply with the following requirements to meet the needs of passengers with walking and standing impairments:

Vehicle

- Almost step-free entrance and exit with almost no gap and only a minimal drop in level
- Step-free corridors and moving space without thresholds and without a drop in level
- Doors should be operated fully automatically
- The whole vehicle should be equipped with handholds and other gripping aids
- Seating next to the doors

Stop/station

- Almost step-free accessibility with almost no gap and only a minimal drop in level
- Step-free moving space without thresholds and without a drop in level
- Seating next to the entrance and exit doors and in close proximity to the stopping place of the vehicle
- Almost step-free accessibility of toilets and service areas with almost no thresholds and only a minimal drop in level
- Avoidance of long distances to make normal journeys possible

Operating schedule

- Reliable intervals between the vehicles that comply with the criteria mentioned above
- Prompt provision of compensation possibilities in case of failure of the vehicles that comply with the criteria mentioned above

Service

- Almost step-free accessibility of machines and counters with almost no thresholds and with only a minimal drop in level
- Doors should be operated fully automatically
- Seatings at all counters that are staffed with personnel
- Avoidance of long distances between machines and/or counters that provide different services

1.3 Disability/Mobility impairment:

Impairment of the trunk and/or the upper extremities

This group of mobility impaired people is also very heterogenous. The impairment of the trunk and/or the upper extremities may for example be the result of a lack of physical strength, a limited movement capability, uncontrollable and involuntary coordination and movement disorders or physical deformations. Therefore, these people have problems to operate controls and communication systems of all kind, because they find it difficult or they are unable to grip, push etc. In many cases, but not inevitably, people suffering from the disorders mentioned above are also fully or partly walking impaired. In such a case, the requirements mentioned below should be viewed together with the requirements of wheelchair users or of people with walking impairments.

Vehicle

- All operating controls and communication systems should be placed at the level of the trunk and in close proximity to the trunk, they should be easy to operate without much physical effort and gripping ability or – as far as technically possible – full compensation by audible in- and output without control buttons
- Doors should be operated automatically

Stop/station

- All operating controls and communication systems should be placed at the level of the trunk and in close proximity to the trunk, they should be easy to operate without much physical effort and gripping ability or – as far as technically possible – full compensation by audible in- and output without control buttons
- Doors should be operated fully automatically
- Sufficient parking space and stopping areas, also for the larger cars of disabled transporting services and taxis for people not driving themselves

Operation schedule

- Reliable intervals between the vehicles that comply with the criteria mentioned above
- Prompt provision of compensation possibilities in case of failure of the vehicles that comply with the criteria mentioned above

Service

- All operating controls, communication systems and counters should be placed at the level of the trunk and in close proximity to the trunk, they should be easy to operate without

much physical effort and gripping ability or – as far as technically possible – full compensation by audible in- and output without control buttons

- Doors should be operated fully automatically

1.4 Disability/Mobility impairment:

Restricted growth

For people of restricted growth, problems do arise, whenever operating elements of all kind, counters, tables and similar things are fixed too high. Consequently, they cannot, only partially or only under degrading conditions and with degrading aids use their functions. Because of their low body height, their angle of vision is comparable to the angle of vision of children or sitting people.

In general, it is to assume that people of restricted growth and wheelchair users have many things in common regarding their needs in public transport. Moreover, they have some things in common with walking impaired people. This is especially the case in view of the distances that they are able to walk, their speed of movement and also their ability to negotiate steps and gaps.

Therefore, vehicles, stops and stations, the time schedule and service should comply with the following requirements:

Vehicle

- Low step height and small gap width at the entrance of the vehicle
- Low step height inside the vehicle
- All operating controls and communication systems should be fixed at approx. the same height as for wheelchair users with impairment of the trunk and/or the upper extremities
- Doors should be operated fully automatically

Stop/station

- Stairs should have a low step height to guarantee accessibility
- To make the access of toilettes and service areas by stairs possible, a low step height is necessary
- All operating controls and communication systems should be fixed at approx. the same height as for wheelchair users with impairment of the trunk and/or the upper extremities
- Doors should be operated fully automatically
- Avoidance of long distances to make normal journeys possible

Operation schedule

- Reliable intervals between the vehicles that comply with the criteria mentioned above

- Prompt provision of compensation in case of failure of the vehicles that comply with the criteria mentioned above

Service

- All operating controls and communication systems should be fixed at approx. the same height as for wheelchair users with impairment of the trunk and/or the upper extremities
- Counters and tables of all kind should be fixed at approx. the same height as for wheelchair users with impairment of the trunk and/or the upper extremities
- Doors should be operated fully automatically

1.5 Disability/Mobility impairment:

Blindness and visual impairment

Despite of the use of viewing aids (glasses, contact lenses), the visual function of visual impaired people is not normal. Their visual acuity in long or short range is reduced to 1/3 – 1/50 of the normal values and is mostly accompanied by a limitation of the field of vision and a high glare sensitivity. That results in orientation difficulties, e. g. concerning the detection of low obstacles in areas with poor contrast and the perception of objects at decentralized areas.

Especially elderly people suffer from visual impairments and their number is increasing steadily as reflected in the changing age pyramid.

In addition to the described group of people with vision impairments, there is a relatively large group of people whose vision is impaired by colour weakness or colour blindness. These people are unable to distinguish certain colours or any colours at all. The most frequent cases of colour weakness and blindness are related to the colours green and red.

Blind people have either no visual or a very low visual capability, what does not mean a better orientation in traffic. They orientate themselves by audible and tactile signals and use a long cane or a guide dog as mobility aid.

The general requirements on the design of vehicles, stops and stations as well as the operating schedule and service that will enable visual impaired and blind people to orientate themselves are:

Vehicle

- For the entrance and the exit (doors, handholds, stairs, bottom of the vehicle), colour contrasts and differences in brightness should be used to create orientation aids
- Easy preception, detection and distinction of all equipment elements (corridors, landings, seats, standing places) by a clearly colour contrasted design and avoidance of dazzle produced by light sources

- Perception of visual information from short distances with a good level of contrast, dazzle-free and with a sufficient letter height as well as easily understandable audible announcements
- Marking of all operating controls and communication systems by clear colour contrast and differences in brightness as well as raised, tactile, illuminated elements at a central place
- Standardized designs for an easy recognition

Stop/station

- Clearly contrasted and tactile way guidance system to the stopping place
- Pedestrian crossings with audible or tactile signals
- Clearly contrasted and tactile way guidance system at the stopping place to bus, tram and train platforms and elevators
- Marking of the operating controls of elevators by colour contrasting and differences in brightness as well as raised and tactile control buttons
- Marking of fittings
- Avoidance of obstacles as well as clearly contrasted and tactile warning surfaces at dangerous spots
- Glass screen partitions and doors should be colour contrasted, the glass used must be unbreakable glass
- Visual information should be recognizable from a short range and should contrast with the surrounding area, easily understandable audible announcements
- Standardized designs for an easy recognition

Operating schedule

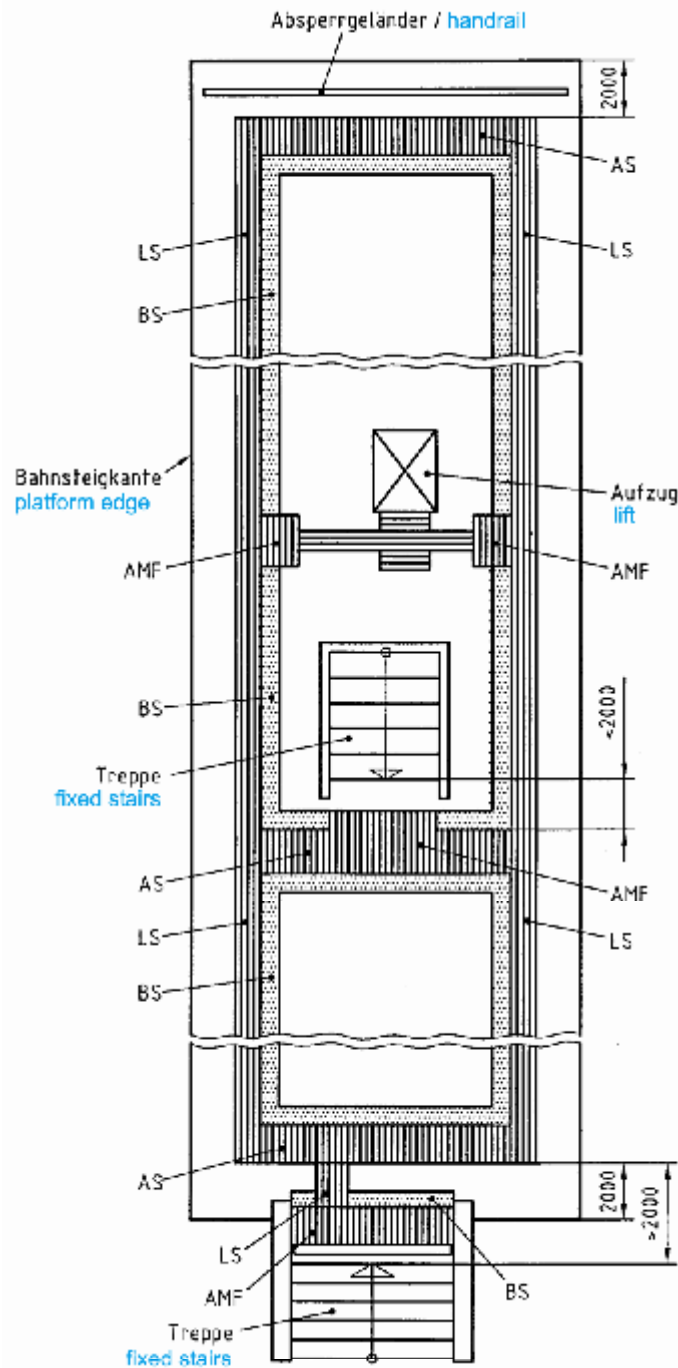
- Reliable intervals between vehicles that comply with the criteria mentioned above
- Easily understandable announcements and additional and special orientation aids in case of breakdowns

Service

- Contrasting and tactile way guidance system to toilets, counters and service facilities
- Marking of the operating controls of machines and (emergency) telephones by colour contrasted design and raised, tactile, illuminated elements
- Standardized designs for an easy recognition

Figure 1:

Example of the layout and labelling of tactile floor elements inside a rapid transit stop
 (from DIN 32 984) – Source: Verband Deutscher Verkehrsunternehmen, Barrierefreier ÖPNV
 in Deutschland, Barrier-free public transport in Germany, Düsseldorf 2003



- AS = Auffangstreifen / "reception" strips
- AMF = Aufmerksamkeitsfeld / attention field
- LS = Leitstreifen / guide strips
- BS = Begleitstreifen / "escort" strips

Maße in Millimeter / measures in millimeters

1.6 Disability/Mobility impairment:

Deafness and hearing impairment

This group includes people with mild and moderate hearing loss, hard of hearing, late-deafened (hearing-loss after language acquisition) and deaf people who are deaf from birth or lost their hearing before language acquisition. The number of elderly people in our society is increasing steadily, what means also an increase of the total number of deaf or hearing impaired people: At the moment, there are approx. 70 million in Europe. They estimate that there will be about 80 million people suffering from that illness in 2005.

Hearing impairment is above all a communicative disability that partly affects speaking ability (see speech impairment, chapter 1.6) and always hearing ability. Hard of hearing people do often not only hear sounds very quiet but also distorted; they have a reduced hearing range, e.g. they are unable to hear shouts from far away. Late-deafened and deaf people have to rely on visual information. In principle, markings and information should also be provided visually for that group of people and additional aids should also be available to guarantee orientation and security. Therefore, vehicles, stops and stations, the time schedule and service should comply with the following requirements:

Vehicles

- Exterior visual systems on the front of the vehicle, on the side of the entrance and on the rear displaying the number of the route, the final destination and, if necessary, the next stop
- Internal audible and visual displays for the simultaneous and equivalent pre-announcement of the destination of the vehicle, the route, the next stop and possible connections at that stop
- Compliance to special design specifications for an optimal audible and visual provision of regular and special information
- Clearly visible route diagrams with information about the point of departure and the final destination as well as all stops
- Easy operation of communication systems with a visual echo

Stop/station

- Simultaneous and equivalent audible and visual displays with pre-announcements
- Compliance to special design specification for a visual (information boards, timetables, displays) and audible provision of regular and special information
- Way guidance to the toilet by use of visual signage
- Easy operation of communication systems (information and emergency telephones) with visual echo

Operating schedule

- Reliable intervals between vehicles that comply with the criteria mentioned above
- Special orientation aids in case of breakdowns
- Prompt provision of compensation possibilities in case of failure of the vehicles that comply with the criteria mentioned above

Service

- Way guidance to counters and other service facilities by use of visual signage
- Mobility centrals and comparable facilities should be equipped with a textphone

1.7 Disability/Mobility impairment:

Speech impairment / reduced ability to speak

There are many causes for a speech impairment. In our society, people with such a disability are often excluded from an important part of the existing communication structures. In most cases, speech impairment does not mean the inability to speak, but the disability of other people to adapt themselves to the speech problem. Apart from the professional use of sign language, in most cases only the family of a speech impaired person is for example able to communicate in sign language. We would be able to understand speech impaired people, if we would take the time for communication or train a little bit.

Realistically seen, that will not happen in public transport in the near future and outsiders will not learn the sign language. This regrettable fact has the consequence that also the following requirements of passengers with a speech impairment are mainly intended to avoid the necessity of verbal information and communication.

Vehicle

- The use of a vehicle should be possible without verbal communication.

Stop/station

- Orientation should be possible without verbal communication

Operating schedule

- Stopping requests should be possible without verbal communication

Service

- The use of machines should be possible without verbal input

1.8 Disability/Mobility impairment:

Cognitive and mental impairment

People with a cognitive impairment learn and develop themselves under extremely difficult circumstances and are permanently confronted with serious difficulties and problems, especially in a strange environment. They often do adapt slower to new situations and they have longer reaction times than other people. For an appropriated behaviour that is indispensable in public transport, it is very important for them to have their own security and to know their way around. They are faced with new situations again and again, what makes them feel overtaxed, because they have not learned to cope with new situations.

Mentally impaired people suffer from relationship, experience, recognition, orientation, concentration, attention and memory disorders. They often have anxiety and panic attacks, what may result in loss of control and avoidance behaviour as for example heart racing, perspiration, dizziness and over-breathing.

Vehicles, stops and stations as well as the operating schedule and service should comply with the following requirements to meet the needs of the group of people mentioned above:

Vehicle

- Exterior, easily understandable displays showing the route number, final station and, if necessary, intermediate stops
- Marking of all operating controls with clear and easily memorable pictograms
- Internal, easily understandable displays and announcements informing about the final station, the route, the next stop and possible connections at that stop
- Easily understandable route diagrams with pictures and information about the point of departure, the final destination as well as all stops
- Equipment that helps to reduce anxiety and gives a feeling of security

Stop/station

- Way guidance with easily comprehensible information in writing and with pictures in short distances
- Appropriate way guidance to the toilet and resting places
- Easily understandable announcements
- Marking of all operating controls with clear and easily memorable pictograms
- Appropriately equipped communication systems like information and emergency telephones

Operating schedule

- Reliable intervals between the vehicles that comply with the criteria mentioned above

- Special orientation aids in case of breakdowns
- Prompt provision of compensation possibilities in case of failure of the vehicles that comply with the criteria mentioned above

Service

- Way guidance to the counters and other service facilities that comply with the criteria mentioned above

1.9 Disability/Mobility impairment:

Organic malfunctions

Malfunctions of the inner organs may possibly be a side effect of a disability, a consequence of the natural ageing process etc. People of any age may be affected, but we have to assume that in most of the cases elderly passengers are definitely and potentially affected. Because you can't see by looking at someone, if he/she suffers from malfunctions or not, all passengers should generally be seen as potential members of that group.

Below, the requirements that may result from the malfunction of inner organs are divided into two categories: the hygienical and the medical, tendentially life-threatening needs.

It is true that the hygienical needs may „only“ have unpleasant but not life-threatening consequences, but in the personal experience of those passengers, it will have the same consequence, if public transport operators do not take the hygienical and medical needs into account: they will not use public transport.

Therefore, people with organic malfunctions have the following requirements:

Vehicle

- Vehicles should provide toilets, also on short routes
- Emergency system that does not only guarantee security but also an immediate medical aid for passengers

Stop/station

- Also smaller stops should provide toilets
- Clear marking of toilets at large stations
- Emergency call system that not only guarantees security, but also special and immediate medical aid for passengers

Operating schedule

- The driving staff should be able to give information about the toilets at the different stops of a route

- The driving staff should be able to independently call for medical aid without a delay

Service

- All service areas should provide a toilet
- All service areas should be able to immediately call for medical aid

1.10 Disability/Mobility impairment:

Suffering from allergies

People suffering from allergies are normally not mobility impaired. Only the combination of allergic reactions to certain substances and the existence of such substances in public transport vehicles or on the way to these vehicles, causes an impairment of mobility. Not only the range of substances that can cause an allergic reaction is very broad, but also individual persons (e.g. passengers) as well as institutions (e.g. bus operators) can additionally be responsible for their existence at public areas. Here, it is necessary to differentiate and consider measures, which are suitable to avoid, not completely, but as far as possible, substances that cause allergic reactions.

Therefore, people suffering from allergies have the following requirements:

Vehicle

- Creation of an index by the transport operators, which includes the substances that cause the most allergic reactions
- Gradual replacement of the seat covers, floor coverings etc. used in vehicles and use of materials that help to reduce the number of allergic reactions

Stop/station

- Creation of an index by the station operators, which includes the substances that cause the most allergic reactions
- Gradual replacement of the seat covers, floor coverings etc. used in stations and closed stops and use of materials that help to reduce the number of allergic reactions

Operating schedule

- Prohibition of the transport of animals with the exception of guide dogs for blind and other people in public transport vehicles
- If employees with customer contact are dressed alike: use of materials that help to reduce the number of allergic reactions

Service

- Creation of an index by the operators of information centres with customer contact and which are open to public that includes the substances that cause the most allergic reactions
- Gradual replacement of the seat covers, floor coverings etc. used in customer centres that are open to public and use of materials that help to reduce the number of allergic reactions
- If employees with customer contact are dressed alike: use of materials that help to reduce the number of allergic reactions
- Prohibition of animals with the exception of guide dogs for blind and other people in customer centres that are open to public

Table 1:

Percentage of people with different disabilities / mobility impairments within the population of Germany (at a rough guess by German organizations of disabled people¹)

Disability / Mobility impairment	Percentage (approx.)
Inability to walk	0.43 %
Walking impairment	10 %
Impairment of the trunk and/or the upper extremities	0.72 %
Restricted growth	0.12 %
Blindness and visual impairment	5.05 % ²
Deafness and hearing impairment	17.1 %
Speech impairment / reduced ability to speak	1.46 %
Cognitive and psychical impairment	10.4 %
Organic malfunctions	16 %
Suffering from allergies	30 %

¹ It can be assumed that the following figures originating from estimates and surveys of the relevant disabled associations in Germany are representative for the populations of Western and Northern European countries.

² Of which colour weakness or colour blindness: 4.25 %

2 Needs and requirements of persons with different mobility impairments on the provision of information in public transport

2.1 Disability/Mobility impairment:

Inability to walk

The already mentioned requirements and needs of people who are unable to walk and therefore have to use wheelchairs have serious consequences for the use of public transport by that group of people. In most cases, wheelchair users are not able to use a whole transport chain independently, i.e. to be mobile in a wide sense, if not all, or at least, most of the requirements mentioned are taken into account. That also results in high requirements on the reliability of information and the reliability regarding real time.

In comparison, the accessibility of information does only present a relatively small problem for wheelchair users and is basically deducible from the requirements on the design of stops/stations and services mentioned above, what means that written information provided for example at stops and stations (e.g. timetables, order of coaches) has to take into account the sitting position of the wheelchair user and the therewith connected angle of vision, the necessary manoeuvring and clear space and the obstacle-free accessibility of the information.

There are two possible methods to guarantee reliability that are applied in practice.

The first method consists of the assignment of symbols to vehicles and stops, time schedules and services that comply with all needs and requirements. The application of this method would presumably result in a significant reduction of the routes and transport chains that can be independently and fully used by wheelchair users. Depending on the degree of the extension of a vehicle fleet and infrastructure, these symbols may be suitable to compress information for mobility impaired passengers and integrate it in the general information system. But when using this method, there still remains the problem of the differences between the countries and cities of Europe regarding the already existing standards and the standards in planning. If a stranger does not have sufficient knowledge of the symbols and standards used in a country or city, he still runs a serious risk when using public transport.

The other method consists of a differentiated and therefore tendentially more reliable, but also much more data-intensive way of taking into account the needs of wheelchair users. Depending on the degree of differentiation, the question arises, if more information does not lead to confusion and dislike against public transport. Moreover, too differentiated passenger information presents the danger that, despite of many individual information sources, the really important information or the method of its marking may be inadequate.

Real time information does provide – if we assume that there already exists a functioning, barrier-free transport system – a high degree of comfort for wheelchair users and other passengers. In this context, the question of reliability also arises. If real time information is

only seen in connection with the location of a vehicle and the calculation of the distance still to be covered as well as the driving time, it does not provide the reliability of information that is necessary for e.g. wheelchair users, because real time information does not provide information about the general accessibility and usability of a vehicle for that group of people and does not provide information about breakdowns that may limit the access, use etc. The question of the degree of generalization and differentiation of information already mentioned above does also apply for real time information.

2.2 Disability/Mobility impairment:

Walking impairment

For walking impaired people, the accessibility of passenger information does only require the consideration of some general principles regarding the provision of information. They do result from the circumstance that walking impaired people, as already mentioned, are not able to walk long distances and walk very slowly. Therefore, information sources should be provided at a central place or, at least, in a visible distance from each other. If walking impaired passengers have not only to cope with changing the vehicle and stop, but also with additional unnecessary detours in order to obtain information, they see themselves confronted with bigger difficulties. Moreover, in view to the accessibility of information for that group of people, the different aspects of design regarding barrier-free accessibility have to be taken into account that do for example also apply for requirements on the design of vehicles and stops.

The reliability of passenger information does mainly include two dimensions.

On one side, there is the reliability of information about the design of vehicles and stops that has to be available for walking impaired travellers. The methods possible are nearly the same as for wheelchair users. It is basically possible to use symbols to mark a specific standard of accessibility and usability as well as provide concentrated or subtly differentiated information about barrier-free designed areas and services. Although the requirements on the design of vehicles and stops resulting from a walking impairment are similar to the requirements of wheelchair users, the question of the use of symbols is decisively different. Wherever low floor vehicles are used, a significant obstacle for walking impaired people is removed without the necessity of additional requirements on stops and vehicles. The criteria low floor vehicle is therefore, concerning walking impaired people, the essential one regarding the reliability of information. That a symbol is better suitable to signalize the existence of a low floor vehicle than written information or similar methods is obvious. The problem, how information should be prepared in addition to the quality characteristic „low floor“ remains unsolved. The already in connection with the wheelchair users outlined considerations do also apply for walking and standing impaired people.

The second significant dimension of reliability refers to the information about operating schedules and is strongly connected with real time, because walking impaired people have, besides the already described needs on static passenger information, very specific needs regarding dynamic information. Regarding dynamic passenger information, it is assumed that the passengers are also able to quicker compensate the information due to its quick availability, especially information about short-term operational changes as for example an unplanned platform change. But for walking impaired people, this is normally impossible or only very rarely possible. Therefore, the reliability of information about the point of departure and final destination of a vehicle is absolutely necessary.

Apart from this, real time information could also be helpful for walking impaired people, if it provides information about changes in the operating schedule sooner than normal, so that these people also have the time to react for example on traffic pattern changes. Generally, this development should not have the consequence that one assumes, the provision of information based on real time will automatically mean quicker reaction of all travellers. For walking impaired people, short-term changes in the operating schedule still remain a problem, even if they are informed in time.

2.3 Disability/Mobility impairment:

Impairment of the trunk and/or the upper extremities

The accessibility to passenger information for people with impairment of the trunk and/or the upper extremities becomes a problem, if, as normally usual, the „50 percentile man“, i.e. the standard human, serves as basis for the design of the environment, vehicles and the services provided, because then, a certain body height as well as radius of movement of the arms and hands is determined. Consistently, most of the operating controls and communication systems are placed in a way that they are practically not usable for these people.

They are excluded from information, when it isn't provided audibly or, for sitting persons, easily visible or when it is necessary to operate too little, too hard elements or when these devices are too far away. To turn the argument on its head, this means that it should be possible to obtain information and communicate either without pressing a request button or by using a control mounted at a lower level than normal. Besides from concrete solutions to that problem there is a general necessity to use easy to operate and large operating controls to avoid the exclusion from information and communication.

The requirements on the reliability of information and real time information are the same for people with impairment of the trunk, the arms, the hands or the fingers as for people who are not mobility impaired. As long as the accessibility to information and communication before and during the trip is secured, no other requirements are necessary. If the accessibility and usability are not permanently guaranteed, the question of reliability gets a new dimension.

Then, there is no closed travel chain provided, because of the punctual exclusion from information and communication.

2.4 Disability/Mobility impairment:

Restricted growth

As well as for people with impairment of the trunk and the upper extremities, the access to passenger information for persons with restricted growth becomes a problem, whenever the „standard human“ serves as basis for the design of vehicles, stops, information sources, machines etc. As a consequence, operating controls of all kind and also most of the communication systems are not or only partially usable or visible.

Passenger information for persons with restricted growth should therefore comply with the following requirement: operating elements should be fixed at a height that is suitable for the group of people mentioned. Normally, this is the case, when the appropriate media can also be operated by wheelchair users, who additionally suffer from impairment of the trunk and the upper extremities. Information sources should also be fully visible to people with a low body height. This is normally the case, when also the needs of children regarding the height and angle of vision are taken into account. If passenger information is provided within the framework of personal contact, i.e. at counters or tables, these counters and tables have to be of a height suitable for those people. This is normally the case, when also the needs of wheelchair users are taken into consideration.

The requirements of persons with restricted growth regarding the reliability of information and real time information are in general not very different from those of other groups of people. As long as the accessibility to information and communication before and during the trip is secured, no other requirements are necessary.

But additionally, persons with restricted growth often have a specific form of walking impairment, because of their low body height, so that in such cases, the above mentioned requirements of walking impaired people should, in principle, also be considered.

2.5 Disability/Mobility impairment:

Blindness and visual impairment

For blind and visual impaired people using public transport, orientation is of great importance. Only by precise orientation they are for example able to avoid dangers that may be life-threatening or to reach their destination. Therefore, there are high requirements on the accessibility and reliability of information in general and real time information.

Already the information that serves for the marking of for example entrance and exit doors of vehicles, ways and in the station of traffic light sequences has to be accessible for this group

of people, e. g. it has to be rich in contrast and has to provide a tactile and partly audible design. Besides the necessity of a high level in contrast, all other information has to be realizable as equal and simultaneously audible announcements or retrievable speech outputs. An only tactile understanding (e. g. of timetables) cannot be an alternative, but a useful, additional orientation aid for those who are trained in the reading of braille (point writing).

A reliability of the above mentioned marking could be reached by a standardized design that guarantees an easy recognition: The same colour contrasts for the same equipment elements, operating controls always at the same places and the same signal tones for the same situations. In general, all real time information is audibly and repeatedly announced or could be activated from an audible information system by blind or highly visual impaired people. For that group of people, it would be very helpful to obtain, apart from the information about the route number, final destination and exact time of arrival, additional information as for example about breakdowns (failure of audible announcements in the vehicle).

Using colour as the only design element is unsuitable in particular for people suffering from colour weakness or colour blindness. However, consistent use of the contrasts and colour combinations that are also advantageous for all other people with vision impairments will also minimise the obstacles for this group of people.

Regardless of all specific passenger information needs of blind people and people with vision impairments, it is recommendable to produce this kind of information on the basis of the two-channel principle (synonymous with two-sense principle). All information is conveyed so that it addresses at least two of the human senses, **sight**, **hearing** and **touch**. In this way – regardless of any further requirements of specific user groups – around 90 percent of the population are provided with adequate information.

2.6 Disability/Mobility impairment:

Deafness and hearing impairment

In general, all audible information including alarm and signal tones for these people, should be provided as simultaneously and equally optical information, what is the elementary requirement for an accessibility of information for deaf and hearing impaired people. The high importance of the provision of visually understandable information on and in the vehicle, at the stops and in the station results in high requirements on the density of their provision, their recognizability and legibility, also under bad conditions as dirtiness, dazing, sunlight and darkness.

In alarm situations, warning signals should be clearly visual as optical signals (flash lights). Additionally, optical displays should give information about the different kinds of dangers and the danger area. Escape routes should be designed as way guidance systems and equipped with light diodes.

An essential characteristic of reliability of information for this group of people is the option of a communication on request and the option to report a case of emergency. To make that possible, two-way intercoms in elevators and (emergency) telephones should also provide visual options. A video-phone would be optimal, but necessary is at least an optically recognizable confirmation that the message has been received and understood.

The access to a public fax machine or textphone, at least in stations, would also be a useful aid for an external communication and also to get in contact with a (possibly existing) call centre that verbally informs the addressee intended.

For a better orientation and possibly also to avoid dangers (by information about emergency situations), optically well recognizable real time information means an important increase of quality. It should in any case be provided timely to offer passengers the possibility to e. g. prepare themselves to get on and off or to change the vehicle as well as to go to another platform etc.

Besides the already mentioned requirements on optical information, all audible information has to provide a high standard of quality to guarantee that it is audible for hearing impaired passengers. It must be ensured that audible information is heard also over background noises. The announcements should be accent-free as well as clearly formulated and articulated.

Furthermore it is also very useful for hard of hearing and deaf people that information is principally supplied by using the two-channel principle (see chapter 2.5). This ensures that this group of people is not excluded in any way because – regardless of further requirements – another sense is addressed in addition to hearing.

2.7 Disability/Mobility impairment:

Speech impairment / reduced ability to speak

For speech impaired people, there must be another possibility of communication provided for all situations where normally speech is required, e.g. asking of questions, reporting of emergency cases or making a speech input.

Two-way intercoms in elevators and (emergency) telephones as well as machines should be equipped with manually operational option buttons.

Moreover, a public fax machine or textphone should be provided in order to offer speech impaired people the possibility to get, right around the clock, in contact with an emergency service (e.g. the police) for emergency cases or with any ordinary call-centre.

The service staff in vehicles and stations should be prepared to react on the receipt of written messages.

Regarding persons with a slight speech impairment, e.g. people who stutter, it is important to listen attentively and patiently and to answer normally.

2.8 Disability/Mobility impairment:

Cognitive and psychical impairment

The accessibility of information for cognitive impaired people is mainly realized by an as simple, easy understandable and easy memorable provision of information as possible. Moreover, a clear presentation with the help of pictures is recommended.

The accessibility of information for psychically impaired people is mainly realized by guaranteeing that they are able to keep self-control or to rapidly regain it. By appropriate information, they should be for example able to quickly go to resting places, where they experience a feeling of well-being and where they are able to relax.

For both groups of people mentioned above, it is very important to be surrounded by familiar things to feel secure. If this is impossible due to a modification in operating schedule, an especially passenger-friendly and understanding person should be easy to find that is able to help them to increase their feeling of security.

Regarding the effects of real time information that informs about short-term changes, e.g. platform changes in only a few minutes, arises the question, if this may not result in confusion instead of a better orientation for cognitive impaired people.

2.9 Disability/Mobility impairment:

Organic malfunctions

The accessibility of passenger information for people with organic malfunctions is no independent problem as long as the malfunction does not result in disability or mobility impairments.

Reliability is, regarding the requirements mentioned above, of great importance. A passenger that feels unsecure, because he doesn't know if the next vehicle or the next stop provides a toilet or an adequate emergency telephone, may avoid public transport and the transport operator may, in long or short term, lose a customer.

Real time information is mainly important and useful, when a high degree of reliability, regarding the requirements already mentioned, can be reached. If real time information is not able to comply with this requirements, it results for example in the situation that passengers are informed about the failure of a toilet at short notice, what means that this information is, apart from a general increase in comfort, worthless for the people with the impairments mentioned above.

2.10 Disability/Mobility impairment:

Suffering from allergies

Passengers suffering from serious allergic reactions to certain substances should generally avoid to get in contact with such substances. Naturally, the same applies for public areas. It is true that operators of vehicles, stations and customer centres cannot completely prevent allergic reactions, but they have the possibility to completely or partly banish the most aggressive substances and such substances, which are very often responsible for allergic reactions, from their area of responsibility. This is the main requirement that has to be fulfilled in order to make passenger information for people suffering from allergies useful. Because after all, they do, in other respect, neither suffer from mobility impairment in general sense, nor by a restricted access to passenger information.

For that reason, it is relatively easy to work out the requirements of customers suffering from allergies when it comes to the preparation of information. As many passenger information as possible should include references to the existence of an index including substances causing most of the allergic reactions, the materials that are proscribed in that index and the existence of a marking of those transport vehicles and places that are free from the substances mentioned in the index.

Table 2:
Needs and requirements of persons with different mobility impairments on the provision of information in public transport

Disability / Mobility impairment	Needs and requirements on the provision of passenger information regarding ACCESSIBILITY	Needs and requirements on the provision of passenger information regarding RELIABILITY	Needs and requirements on the provision of passenger information regarding REAL TIME
Inability to walk	<ul style="list-style-type: none"> – sitting position – angle of vision must be taken into account – manoeuvring and clear space in front of all media – obstacle-free accessibility to all media 	<ul style="list-style-type: none"> – symbols for certain accessibility standards <p>or</p> <ul style="list-style-type: none"> – differentiated information on accessibility 	<ul style="list-style-type: none"> – symbols for certain accessibility standards <p>or</p> <ul style="list-style-type: none"> – differentiated information on accessibility – sooner information about short-term changes in the operating schedule – information about the breakdown of lifts at stops and stations
Walking impairment	<ul style="list-style-type: none"> – information sources should be provided at a central place or in a visible distance from each other – obstacle-free accessibility to all media 	<ul style="list-style-type: none"> – symbols for certain accessibility standards <p>or</p> <ul style="list-style-type: none"> – differentiated information on accessibility 	<ul style="list-style-type: none"> – symbols for certain accessibility standards <p>or</p> <ul style="list-style-type: none"> – differentiated information on accessibility – sooner information about short-term changes in the operating schedule

			<ul style="list-style-type: none"> – information about the breakdown of lifts at stops and stations
Impairment of the trunk and/or the upper extremities	<ul style="list-style-type: none"> – obtain information and communicate without pressing a request button <p>or</p> <ul style="list-style-type: none"> – controls mounted at a lower level – controls easy to operate – large operating controls 	none	none
Restricted growth	<ul style="list-style-type: none"> – angle of vision must be taken into account – operating controls and service counters fixed at a reduced height – information sources should be provided at a central place or in a visible distance from each other 	none	<ul style="list-style-type: none"> – sooner information about short-term changes in the operating schedule
Blindness and visual impairment	<p>information has to be:</p> <ul style="list-style-type: none"> – rich in contrast – of a tactile or audible design 	<p>reliability increases with standardized design:</p> <ul style="list-style-type: none"> – same colour contrasts for the same equipment elements – operating controls always at the same places – same signal tones for the same 	<p>information must be:</p> <ul style="list-style-type: none"> – audibly and repeatedly announced <p>or</p> <ul style="list-style-type: none"> – activated from an audible information system

		situations	– information about breakdowns of audible announcements (e. g. in vehicles or at stations)
Deafness and hearing impairment	<ul style="list-style-type: none"> – audible information must be provided as simultaneously and equally optical information – audible information must provide a high standard of quality to guarantee that it is heard by hearing impaired persons also over background noises – optical information must be legible also under bad conditions as dirtiness, dazing, sunlight and darkness – communication must be possible by video-phone, public fax machine or textphone 	<p>relevant especially to report a case of emergency:</p> <ul style="list-style-type: none"> – two-way intercoms in elevators and emergency telephones should provide visual options – optically recognizable confirmation that a message has been received and understood 	<ul style="list-style-type: none"> – information must be optically provided – information about breakdowns of optical announcements (e. g. in vehicles or at stations)
Speech impairment / reduced ability to speak	<ul style="list-style-type: none"> – an alternative possibility of communication must be provided for all situations where normally speech is required – staff must be prepared to react on the receipt of written messages – staff must be prepared to react on persons who stutter by listening attentively and 	<p>relevant especially to report a case of emergency:</p> <ul style="list-style-type: none"> – two-way intercoms in elevators and emergency telephones should be equipped with manually operational option buttons 	<ul style="list-style-type: none"> – public fax machine or textphone in order to get in contact with a call-centre providing real time information

	<p>patiently and answering normally</p> <ul style="list-style-type: none"> – communication must be possible by public fax machine or textphone 		
Cognitive and psychological impairment	<ul style="list-style-type: none"> – simple, easy understandable and easy memorable provision of information – clear presentation with the help of pictures – make sure that persons with psychically are able to keep self-control or regain it rapidly – resting places – be surrounded by familiar things 	<ul style="list-style-type: none"> – short-term information may result in confusion instead of a better orientation – in case of a modification in operating schedule, an especially passenger-friendly and understanding person should be easy to find that is able to help to increase a feeling of security 	<ul style="list-style-type: none"> – short-term information may result in confusion instead of a better orientation
Organic malfunctions	none	<p>information about:</p> <ul style="list-style-type: none"> – a toilet provided within the next vehicle – a toilet provided at the next stop – an emergency telephone provided within the next vehicle – an emergency telephone provided at the next stop 	<ul style="list-style-type: none"> – useful if the reliability of relevant information increases
Suffering from allergies	<ul style="list-style-type: none"> – relevant only if personal contact (e.g. at a customer center) is needed 	<p>information about:</p> <ul style="list-style-type: none"> – existence of an index including substances causing allergic 	<ul style="list-style-type: none"> – marking of vehicles and places that are free from the proscribed substances causing

		<p>reactions</p> <ul style="list-style-type: none">– proscribed materials– existence of a marking of vehicles and places that are free from the proscribed substances	<p>allergic reactions</p>
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3 Static and dynamic passenger information in consideration of the needs of mobility impaired passengers

3.1 Essential parameters of passenger information

Today, it is generally assumed that the customers' acceptance of the local public passenger transport depends, apart from customer-friendly facilities and vehicles, essentially upon qualified and up-to-date passenger information. The latest developments to improve passenger information increasingly fulfill the information needs of the users of local public passenger transport. In addition to conventional static information as for example signs with target timetables, real time dynamic information that is rapidly updated and suited to the current traffic situation, is becoming more and more available. It is the aim, to make passenger information available through use of dynamic media, wherever a passenger has to make a decision for his trip or journey. The combination of static and dynamic passenger information guarantees, so to speak, a closed media chain that offers orientation and security. The whole passenger information system should comply with the highest possible information requirements of customers who do not know their way around and the information requirements of new customers who are not familiar with public transport in order to guarantee that all users, including potential customers, are provided with information.

There is static information available for all journey stages, from planning to realization, and for some years, especially due to the introduction of telematics systems, there has also been an increase in the provision of dynamic real time information. Below, you find a description of the essential characteristics of the provision of information in public transport. Both, already existing information sources as well as sources that are still being tested or introduced, are described. In order to do this, it seems to be helpful to separate the whole journey into eight stages: planning of the journey, start of the journey, before the start of the ride, start of the ride, during the ride, changing of the vehicle, leaving the vehicle, the journey itself.

To plan the journey, i.e. before the start of the journey, a static media as for example a railway guide, a net arrangement drawing, a timetable on CD ROM, disk or in internet are consulted. Moreover, there is also dynamic information media provided such as information services of the public transport operators that are supported by electronic information systems. Passenger information is for example available, sometimes in different languages, by e.g. BTX, telephone, mail, personally in customer centres, mobile phone, WAP mobile phone or internet. Additionally, there are electronic, interactive information systems with data fed online by a central passenger information computer.

For the start of the journey, i.e. the way to the transport vehicle, e.g. static information as signs and columns to the stop or station that are visible from far away as well as maps of the environment with information about the connections of the local public passenger transport are provided. Dynamic information is provided on flexible, electronically controllable displays, showing for example information on updated departure times. Further orientation aids are available by mobile phone from information services or systems.

Directly before the start of the ride, stations and stops provide static information as columns or masts with the final destination, the route number as well as stop arrangement drawings, timetables with target departure times, maps of the environment, information on service facilities, travel possibilities for special user groups, breakdowns etc. Dynamic information is provided by electronically controllable displays and automatic announcements and informs about e.g. departure times, breakdowns and changing possibilities in real time. Additionally, electronic, interactive information systems are also available.

At the beginning of the ride, static information on the outside of the vehicles informs about e.g. entrances, special equipment, door operation and ticket selling in the vehicle. This information is completed by dynamic, electronically controllable displays showing the route number, final destination and intermediate stops.

Static information in vehicles includes e.g. general arrangement drawings, route maps with connection possibilities and network maps. There is also static information about ticket selling, ticket devaluation, seats reserved for certain groups of people, wheelchair spaces, door operation and emergency procedures. Flexible, electronically controllable display and announcement systems for location and special information for example about the name of the next station, the route with connection possibilities, if necessary, the exit side, breakdowns etc. serve as dynamic media. More detailed passenger information and information on events as well as reports, news and advertising can be provided on multimedia displays.

When changing the vehicle, signs with the name of the stop or station, information on exits, elevators, toilets, service facilities etc. and a way guidance system to the points of departure as well as with information on connections, their route numbers and destinations serve as static information.

Dynamic information, sometimes provided in different languages, is provided on electronically controllable displays and by automatic announcements about connection possibilities, connection times and special information. In special cases, the operator's staff

makes additional announcements. Moreover, certain stops and stations offer the use of electronic, interactive information systems.

When leaving the vehicle, static signs provide information about the name of the stop or the station, exits, elevators, toilets, service facilities etc. Further information is provided on stop environment maps and station arrangement drawings.

By dynamic information, especially by announcements that are sometimes also provided in different languages, the passenger is informed about stop and station names, services and breakdowns e.g. faulty escalators and elevators. During the whole journey, there is static information available like printouts from an information system, a personal timetable with route recommendations, a pocket timetable or general arrangement drawings in a handy format.

A dynamic, individual and updated timetable and route information is retrievable at different, portable communication devices.

3.2 Potentials and borders of static and dynamic passenger information for mobility impaired people

On condition that a higher acceptance of public transport by real and potential customers essentially depends on the quality of the passenger information provided, in the fields of vehicle comfort, design of stops and stations, accessibility and service, i.e. in the fields that are, apart from the information already provided, essential for public transport, numerous improvements were made in the last years and centuries that on the whole led to a higher customer satisfaction. Only where certain standards are met, we can speak of a modern transport company that also, to make its service more attractive, optimizes the passenger information, i.e. intends to design it more customer-friendly.

When you look closely on the requirements of mobility impaired people, you can already detect a discrepancy between disabled and non-disabled passengers. Despite of all efforts taken in the last years, public transport is not fully prepared to fulfill the needs of the different groups of people with mobility impairment. Often, there are interrupted mobility chains, so that concerning to these customers, we have to speak of an incomplete mobility system.

That has essential consequences for the passenger information that is provided today and will be provided in the near future. Because they will be still a long time confronted with the task

to provide and process information about existing as well as not existing mobility possibilities for the group of people mentioned above.

But concerning mobility impaired people, it is naturally also true that the satisfaction with the transport services and the actual as well as potential use of this service will increase, if passenger information will be reliable and up-to-date and if it will be rapidly and easily available. Below, it is outlined, what static and dynamic passenger information can in principal do for mobility impaired people, what it actually does and where are its weaknesses. The fact that attractive information services must naturally comply with the requirements of the customers already provides the first weakness: Transport companies do not seem to have secure nor detailed knowledge about the actual requirements of the different groups of passengers with mobility impairment. The same seems to apply for the field of research and development of future-oriented models for passenger information. They have all in common that the requirements, deducible from the single stages of a mobility chain, are more or less, but in general not completely known or taken into account.

The deficits mentioned do not need to exist, because the biggest part of the medical knowledge about specific forms of impairment and the therewith connected disabilities, the requirements on a barrier-free environment and the knowledge about the general, not disability-specific needs and requirements of passengers are principally known and available to all. This makes for example the main aim of dynamic information systems, namely the improvement of passenger information in all stages of a transport chain, very difficult.

Notwithstanding, static as well as dynamic information systems provide, also apart from the mentioned difficulties, potentials for the satisfaction of the specific information needs of disabled people in the single stages of a mobility chain. The static information media consulted for the planning of the journey already mentioned in the previous section, generally offers possibilities to take the specific needs of passengers with mobility impairment into account. Merely, here arises the question of the manageability of some mediums and the amount of data processed by them. But this question was already discussed with regard to traditional media. An extract from a timetable was always handier than for example the railway guide, but its information content is far more limited.

In practice, the reports on the consideration of the requirements of mobility impaired passengers are normally reduced on rudimentary but also useful information about the full or limited accessibility of vehicles for wheelchair users. As already mentioned, in most of the cases, a method is used to mark a vehicle in a general way as independently accessible for a wheelchair user or only accessible with assistance. Further information, especially for people

with other mobility impairments, are mostly not provided. On the other hand, these markings for wheelchair users can also be of great assistance for walking impaired passengers, because there needs regarding accessibility are generally also taken into account.

Apart from detailed information about the design of a vehicle, also information about other fields as for example the design of the stops of a route or the services provided for (mobility impaired) passenger are only rarely provided. It is all the more regrettable in view of the fact that the media consulted to prepare the journey as e.g. the CD ROM or the internet in principle offer enough capacity and user interfaces to process and provide the appropriate data.

Especially under the point of view that the previously mentioned information sources could be designed accessible for all user groups, because of their basic structure or by an appropriate adaption, it is incomprehensible that they include only a small amount of data for mobility impaired travellers. Thus, already the first step of a journey – the planning of the journey before the start of the journey – is unnecessarily aggravated. In most of the cases, the general possibilities to make appropriate static media accessible and usable for all are not considered for reasons of disknowledge, carelessness or to save money.

The discrepancy between the used and not used opportunities of media to provide information for mobility impaired passengers, is in the case of dynamic information media much bigger than in case of static information. Notwithstanding, the necessity to equip electronic information services and information services staffed with personnel with information that makes passenger information, including the appropriate information for mobility impaired people, at least available to a part of the group of people with mobility impairments, is seen by more and more transport companies and information providers. But also here, a method for the processing of the data that goes beyond the consideration of the accessibility of vehicles for wheelchair users and walking impaired people is the exception.

The accessibility of such information systems for all user groups could – comparable with the static media – basically more easily realized before the start of the journey. But in view of the variety of possible means of communication on the field of the dynamic information provision, it arises the question, which final devices including user interfaces will be most suitable for the majority of mobility impaired users and if there are devices that will exclude single user groups. Moreover, it has to be taken into consideration, if the information technological standard as well as the content of the information could be processed and used equally by all user groups.

For the way to the transport vehicle and the way back from the transport vehicle as well as for the journey itself, for static media applies the same as for the planning of the journey. The processing of data for mobility impaired people is basically possible and the method of provision as well as the density of provision varies in the range mentioned above.

But in public ways and at stops or stations, the possibility to communicate the necessary detail information as a whole to the end-user as well as to guarantee accessibility for all is limited, because signs, network and environment maps etc. provide optical limits for some or all user groups because of their size and attachment possibilities. The same applies for audible provision of information. High quality standards are easier to realize within closed rooms than at public places.

Also in case of tactile information, the information content cannot be extended endlessly. With increasing complexity of the environment as well as complex public places and bad conditions to move, it is much more difficult to inform users with the help of a tactile system. Also the provision of dynamic information at public places has its limits, if merely devices and displays with similar limitations as those of the signs in roads are used. In general, media that on one hand provides large or numerous, optionally usable interfaces is most suitable to display large amounts of data that is differentiated in content and also visibly differentiated. Tests with large screens at stops have resulted in high acceptance and demand, especially from non-disabled persons.

The information provision by mobile phone is naturally also a possibility of dynamic passenger information that is also able to adequately take into account the requirements of mobility impaired people. If it makes sense to use such terminals depends upon the question if it could be barrier-free designed, if necessary by adoption, for all users or not.

In summary, two things should be emphasized:

- 1) Nearly all known static and dynamic passenger information systems provide potentials, thus they are suitable to provide information that complies with the needs of mobility impaired people. Information is provided in different degrees of quality and must not be alike for all passengers and travel stages, but is also conceivable as a combination, what was already translated into action.
- 2) The quality and reliability of the information depends essentially on how far the public transport operators and information providers know, which requirements the different groups of mobility impaired passengers in general have on public transport and in special on a closed mobility chain.

4 Good Practice

Research was carried out to assess the resources provided for people with disabilities and mobility impairments on the Internet pages of EMTA members and information providers in other large European cities and in selected Canadian and US cities.³ The information available in English and in German was evaluated.

Unfortunately little information was provided in multiple languages meaning passengers or potential passengers dependent on particularly reliable information are immediately put at a disadvantage. This includes people with reduced mobility who want to travel around their destination using public transport after arrival by air or rail, for example, as tourists or business travellers.

The Internet sites for the following cities provide references to information in English or German about special facilities for passengers with reduced mobility and thus seemed to set an example for other cities: Berlin, Birmingham, Boston, Chicago, Frankfurt, Glasgow, Hamburg, Hanover, London, Los Angeles, Manchester, Montreal, Munich, New York, San Francisco, Toronto, Washington and Zurich.

The following cities provided information about special facilities for passengers with reduced mobility on the Internet in English or German and thus set an example for other cities: Berlin, Birmingham, Boston, Chicago, Frankfurt, Glasgow, Hamburg, Hanover, London, Los Angeles, Manchester, Montreal, Munich, New York, San Francisco, Toronto, Washington, Zurich.

The services provided by the respective passenger information centres in these cities for people with disabilities and mobility impairments were assessed above all on the basis of their **accessibility**, their **availability** and their **content**. Furthermore those responsible for the services were interviewed using the questionnaire enclosed.

This study does not aim to produce a league table. Therefore the focus is on aspects adjudged to be significant examples of improvements to the mobility of disabled people. These aspects were found during the extensive analysis of the information available to customers with reduced mobility, i.e. the research carried out on the Internet, the study of various printed

³ The homepages of information centres in the following cities and regions were covered: Amsterdam, Athens, Barcelona, Berlin, Bilbao, Birmingham, Boston, Brussels, Chicago, Dresden, Dublin, Frankfurt, Geneva, Glasgow, Graz, Hamburg, Hanover, Helsinki, Leipzig, Lisbon, Liverpool, London, Los Angeles, Madrid, Manchester, Marseilles, Miami, Milan, Montreal, Munich, New York, Oslo, Paris, Prague, Quebec, Rome, San Francisco, Seville, Stockholm, Toronto, Valencia, Vienna, Vilnius, Warsaw, Washington, Zurich.

material and the evaluation of the questionnaire. This does not mean, however, that criticisms have not been made where necessary.

New York

On the *Metropolitan Transportation Authority* homepage (www.mta.nyc.ny.us), there is a clearly visible link to information for people with disabilities. From there, visitors to the website are guided through all aspects of barrier-free mobility in New York in a unerring and well-structured manner.

The main target groups (wheelchair users, people with walking difficulties, vision or hearing impairments and blind people), the categories of accessibility and usability (wheelchair accessible, fully accessible) on the public transport system, the basic standards that apply and all other information (for example, additional information possibilities, help provided, reduced fares etc.) are well organised. The information is provided in different media (including large print versions, Braille brochures and audio tapes) for disabled and non-disabled people alike and can be obtained at all times online, by post, telephone and textphone.

All in all, this is a very good example of passenger information for people with reduced mobility because of its good structure.

San Francisco

Passenger information for the San Francisco Bay Area can be accessed via the *Metropolitan Transportation Commission* site (www.mtc.ca.gov). The link to details for travellers with special needs is sadly last but one in a total of 25 sections. The 25th section provides details on the special brochure formats available. The link to access information for the website is, however, right at the top of the page, i.e. right at the other end.

From the 24th section you can reach an overview of the different documents on the subject of mobility for people with disabilities. Some are available in electronic versions. They include an overview of 12 transport companies and their websites providing information for passengers with reduced mobility.

All further information for passengers with reduced mobility is provided by the respective public transport operators. The structure and form of this information as well as the respective details vary greatly.

The two main companies operating the railways (BART) and the buses (MUNI) shall be used as examples to give an impression of the good practice followed by the transport services. Both provide extensive information for people with reduced mobility, see www.bart.gov/guide/disabledAccess/overview.asp and www.sfmuni.com/rider/access.htm. This information is also available in different formats. Furthermore website accessibility has been provided for blind people and those with vision impairments. However, you need to

click links like “About This Site” or “Website Info”, which are not immediately to hand, to access these features.

A “Trip Planner” can be reached in 2 steps via the MTC homepage and is also accessible for blind users and users with vision impairments. The options available when you enter your starting point and destination include “Senior” and “Disabled”.

These categories are only related to the fare calculation, however.

The MUNI bus company points out a new technological feature. Some bus and metro stops are equipped with “Talking Signs” for blind and low-vision passengers that playback information, for example, on the destination reached, exits and entrances, service desks and connected lines, using an infrared receiver. This orientation aid will become more widespread in public transport and also other parts of the city in future.

Boston

Passenger information for the Massachusetts Bay Transportation Authority (MBTA) is available on the homepage (www.mbta.com) in the section “Travelling on the T”. It provides direct access to information for users with reduced mobility in the menu under the title “Disability/Senior Services”.

The MBTA’s “Office for Transportation Access” and its services including the Paratransit and Call-a-Lift Bus programmes, reduced fare rates for the elderly and disabled passengers and a training programme for the use of public transport are described. The office also provides information and advice services via telephone and textphone for all reduced mobility-related needs.

From the same page, you can reach clear maps of the subway and district train lines. The stops fulfilling the wheelchair access criterion are indicated with a wheelchair pictogram. The parking facilities and stations are labelled separately. There is no further definition of this criterion. The details on the stations also include a description of their location and a small map of the area. The stations with public textphones are listed in a separate section.

Further information on lines and the vehicles used for commuter train lines, subways, urban railway lines, buses, ships and ferries as well as current information on the status of lifts at stations can be obtained by telephone.

You cannot call up information on the different vehicles. One exception is a number of bus operators who state their vehicles have wheelchair access, but do not provide any further details.

The real-time information system is helpful. It provides information on faulty lifts at stations.

Los Angeles

On the *Los Angeles County Metropolitan Transportation Authority* website (www.mta.net), you can call up the “Service for the Disabled” page via the “A user’s guide to the Metro Bus

& Metro Rail system” menu. From there, you can reach information on reduced fares for disabled users, the Paratransit service, brochures in Braille for blind users and 19 frequently asked questions. They mainly deal with the needs of wheelchair users, but also provide information for other groups of passengers with reduced mobility. For example, users of respirators and oxygen equipment and passengers with crutches are dealt with.

The large amount of detailed information, including data on the size and load capacity of lifts indicates that the vehicles and stops are barrier-free. The method of providing information with answers to FAQs tends to restrict the Internet users as they cannot find and call up the exact information they require.

This also applies for the particularly detailed information provided a few steps away from the homepage via the “MTA Accessibility Page” for blind and vision impaired people in the form of an audio cassette and also in text form for people hard of hearing.

Washington

Passenger information can be accessed on the Washington Metropolitan Area Transit Authority website (www.wmata.com). The “Seniors/Disabled” section can be found in the top menu bar. The first lines of this page, “Metro is user-friendly for senior citizens and persons with disabilities”, are followed by links to sections on reduced fares and the Paratransit service.

Next comes general information (for example, about trained staff in vehicles and at stops) and details of lifts at stops. There is a direct link to a map that is also available in a text version and has links to the individual stops with sections on the current status of all lifts. In addition to indicating lifts that are out of service, the date on which they should be back in use is also given. The failure of lifts is shown for all stations.

Details for different groups of people with reduced mobility (blind or low-vision person, mobility-impaired person, deaf or hearing-impaired person) follows the general information. Nevertheless the information is only general, for example, the section about lift-equipped and kneeling buses that make up 70% of the fleet. In this context, an additional service is mentioned. If a bus with a lift does not run on a specific route, you can order a special vehicle by telephone up to 3pm on the day prior to the journey.

Chicago

Passenger information for the Chicago Transit Authority (CTA) is available at www.transitchicago.com. Under the “Travel Information” section, the “Accessible Services” link leads straight to detailed information for passengers with reduced mobility. From a total of 140 bus lines, 123 are described as “fully accessible” and equipped with lifts and ramps. In addition, all accessible railway stations are listed, but without defining this criterion. Telephone and textphone numbers are provided for you to inquire about the status of the lifts

at stations. There is a link to the working hours of the customer assistants at all railway stations. The accessible stations are also indicated in this list. Another link, “Visitor Information”, takes you to the various service operators. PACE (buses) and METRA (trains), for example, give detailed information for passengers with reduced mobility. Unlike the other operators, METRA distinguishes the criterion of accessibility for hard of hearing and vision impaired as well as for people with reduced mobility and also offers a film.

One special feature is the Trip Planner, which can be accessed via the CTA homepage. The options available in this feature include, “Do you require a lift, a ramp, elevator or accessible station?”

CTA has recently set up a “Taxi Access Program” that allows people with reduced mobility to use services run by 18 companies at reduced rates 24 hrs a day. In Chicago, this is only available to registered customers of the Paratransit service, however.

Toronto

On the Toronto Transit Commission (TTC) website (www.city.toronto.on.ca/ttc), the “Accessible Service” link is the second item in the TTC Service drop-down menu. Accessible bus lines and subway stations are clearly listed and indicated with the international wheelchair symbol. A short explanation informs you that accessible bus stops are indicated with this pictogram and that not all stops on accessible routes are accessible. The subway stations with accessible lifts are also indicated with this pictogram. Two further links take you to the maps of the bus lines and subway stations as well as their routes. Furthermore a telephone number is given for 24-hour information on out-of-service lifts.

An updated brochure “Easier Access Information”, which can be downloaded in pdf format, contains detailed information on accessible buses with lifts or ramps, the facilities at subway stations and access to subway trains, for example. The text is informative and illustrated with diagrams and pictures. It looks at the needs of wheelchair users in detail and also blind passengers to some extent, but does not provide information for persons hard of hearing.

We recommend also checking the individual transport companies that can be reached via the TTC website under the “TTC Information” section in the menu for “About the TTC”. For example, the company Go Transit provides detailed information about access to buses and trains, the space provided in the vehicles and the facilities at stations.

Furthermore other sections provide general information, for example, about Sheppard Subway, with details on accessibility. Again this is almost only for wheelchair users.

Montreal

Passenger information is available on the *Société de Transport de Montréal* website (www.stcum.qc.ca). There is a direct link to a detailed description of the Paratransit service. Timetables can be viewed in several steps via the “Bus: Maps and Schedules” link. The

connections that are suitable for wheelchair users are indicated. There is no further explanation of this criterion. Further information, for example, about the metro and the commuter trains, is only available in French and will therefore not be looked at in this study.

London

The Transport for London (TfL) website is at www.londontransport.co.uk/tfl. “Access & Mobility” is a link to possible information for customers with reduced mobility. Then the further route to the different information, the formats in which they are provided and where and how they can be used is clear. The same applies for the specific information on accessibility and usability of the different means of transport.

The information on low-floor buses with “kneeling” suspension is confusing. This type of bus is normally described as accessible for wheelchair users leading you to believe that London has a very dense network of completely barrier-free bus lines. At the same time, it is also stated that more and more low-floor buses are equipped with a ramp. It is ignored that these are obviously two very different accessibility standards for wheelchair users that should be clearly distinguished.

The differentiation in the “Journey Planner” is more defined and thus more advantageous for customers with reduced mobility. You find this section on the TfL homepage without knowing beforehand, however, that it has information for passengers with reduced mobility. There is also no indication of this on the next level either. Different categories with which people with disabilities can plan a journey using public transport only appear under “More Options”. The following four categories are available:

- Cannot use stairs
- Cannot use escalators
- Cannot use lifts
- Need wheelchair accessible vehicles

Furthermore people with walking difficulties can enter their approximate speed and the maximum walking time.

One point for criticism remains despite all of the advantages offered by the Journey Planner particularly for customers with reduced mobility: Wheelchair users cannot tell whether the “need wheelchair accessible vehicles” category includes all low-floor buses with kneeling suspension or just low-floor buses with a ramp. The system used to prepare information and assess accessibility therefore needs revision.

Otherwise TfL’s Journey Planner is an excellent example of passenger information for people with reduced mobility.

In the form described, a text-only version of the Journey Planner could be called up for people with low vision and blind people by the link “Visually Impaired”.

Birmingham

The passenger information provided on behalf of the West Midlands Passenger Authority is on the website of the CENTRO operator (www.centro.org.uk) and is only available as a “text only version”. From the homepage you can reach all information for customers with reduced mobility via the “Mobility” link. Divided into the sections “Buses and coaches”, “Trains”, “Metro”, “Taxis and private hires”, information is provided on the different means of transport and their operators. Furthermore there is a page with general information for passengers with reduced mobility (for example useful addresses, telephone numbers etc.) and a page on fares for this group of customers.

The pages for the various means of transport do not contain any details on the accessibility standards and other barrier-free features on the different types of vehicle. The exact locations and times these vehicles are used as well as further information required for self-determined travel are not available with one exception. Only the telephone numbers for the service and information centres of individual operators are given for customers with reduced mobility to contact.

It was not possible to find out whether the new Journey Planner, provided by CENTRO on its website, provides details for passengers with reduced mobility because of technical problems at CENTRO.

Manchester

Passenger information for the Greater Manchester Passenger Transport Executive (GMPTE) is available at www.gmpte.gov.uk. The “Accessible Transport” link leads to information for customers with reduced mobility.

You are firstly told about the existence and address of the GMPTE Access Unit and then given three possibilities to find out more – about reduced fares for the disabled, the “GMPTE Access and Disability Panel” and other “Useful Information”.

“Useful Information” provides the actual detailed information for customers with reduced mobility. These are subdivided into a total of 21 sections informing you about matters of varying importance. However, none of the information provided includes details on the accessibility and usability of a particular public transport line, a specific bus stop or a particular means of transport, for example. There is only general information stating that successive improvements have been made in all areas of public transport.

These enhancements have been very extensive so far. It is therefore pointed out that more and more bus stations are barrier-free. The following features are indicated, for example, dropped kerbs at crossings to make it easier for wheelchair users to get around, tactile paving, talking signs, visibility strips and improved lighting. However, there is no indication of where these improvements have been made. The same applies to most of the other 21 sections. A

telephone number is at least indicated for information on wheelchair accessible low-floor buses in the corresponding section.

The “GMPTE Access and Disability Panel” is interesting. This is obviously an advice forum open to everyone. You can register yourself by entering your personal details and answering a few questions, for example, on the type of disability, the means of transport you usually use etc.

Glasgow

The Strathclyde Passenger Transport website (www.spt.co.uk) only provides information on free bus travel for elderly and disabled people when it comes to customers with reduced mobility. If you click this link, you will find explanations on this topic.

If you take the other routes from the homepage, which are not indicated as being relevant for people with reduced mobility, you will find dispersed information, for example, about 34 wheelchair accessible buses run by SPT to pick up disabled and elderly people from home, about newly set up mobility centres equipped with induction loops and low-level counters and about new commuter trains that also have facilities for people with disabilities. There are no further details about the accessibility of buses, bus stops etc.

It is only on the ScotRail website that you can reach via various SPT links where you will find further information on barrier-free travel, for all of Scotland, however.

One thing that should be pointed out here in particular is the alphabetical list of all stations in Scotland and the information provided on the conditions there for customers with reduced mobility (www.scotrail.co.uk/resources.htm). This is done using a total of 13 station features.

Berlin

The homepage of the *Berliner Verkehrsbetriebe* (BVG) (www.bvg.de) has a “Mobilität” (Mobility) link in the “News & Info” menu under which you can call up exact information for passengers with reduced mobility in 15 sections. This includes information on orientation aids for blind people, lifts and ramps in underground and suburban railway stations as well as the number to call for information on out-of-service lifts at underground stations. In addition, there is a network map listing the stations with lift or ramp access. You are informed that mobile ramps are available to get on and off underground trains that are fitted to the vehicle by the driver.

The next link takes you to information on CCTV-monitored emergency and information columns whose design is described in detail. They are suitable for wheelchair users and also for deaf people. Deaf persons are told to indicate their hearing difficulty with a corresponding hand gesture and wait until a member of staff comes with a pen and paper to help communication.

Furthermore bus and tram lines as well as their timetables are described as being “accessible” (equipped with a lift or ramp) or “disabled-friendly” (accessible with assistance).

One special feature is the FunMobil, a chartered tour bus with a lift and space for up to 8 wheelchair users and a disabled toilet meeting modern ICE train standards.

On the page „Informationen für mobilitätsbehinderte Mitbürgerinnen und Mitbürger“ (Information for disabled citizens), the “Mobilitätsinformationen der S-Bahn Berlin“ (Information on mobility assistance at the Berlin suburban rail) link takes you to details on all suburban railway stations with information on the existence of orientation aids for blind people and accessibility using lifts and ramps. There is no indication, however, of how wheelchair users and other passengers with walking difficulties can get into S-Bahn trains.

Frankfurt

The website of the *Rhein-Main-Verkehrsverbund* (RMV) (www.rmv.de) provides information on stations, fares, vehicle equipment as well as useful links for customers with reduced mobility via the “RMV-Angebot” (RMV Services) and “Barrierefreies Reisen” (Barrier-free Travel) menu items. These pages also contain details on a service hotline and the free brochure “Mobilität für alle” (Mobility for all) with all relevant information for people with reduced mobility.

The information provided on stations consists of maps of the various railway stations that have facilities for people with reduced mobility in some way or the other. The station maps are sorted in alphabetical order and are all available in pdf format. At the same time, it is stated that users can decide for themselves whether a station is accessible and usable for them or not from the map details. A network map in which the corresponding stations and lines are marked is also available in pdf format and helps orientation.

The information on vehicle equipment concerns all regional rail vehicles. The different types of vehicles and their facilities are listed with regard to accessibility and usability for passengers with reduced mobility. The vehicles that do not have a lift or ramp are named and you are told to refer to the station maps for information on height differences and gaps between vehicles and platforms that may also allow access without aids. Furthermore all lines on which the described vehicles run are listed.

Further links to local (the city of Frankfurt) and national (German Railway – Deutsche Bahn) transport systems and their information media completes the information for customers with reduced mobility. These sites do not necessarily feature the same information and transport infrastructure standards as above, however.

A text-only version of the normal timetable information in German can also be called up directly from the first page of the RMV website for people with low-vision and blind people.

Hamburg

On the *Hamburger Verkehrsverbund* (HVV) website (www.hvv.de), the “HVV-Spezial” menu contains the “Mobilitätsbehinderte” (Mobility Impaired) link leading to essential information for this group of customers.

You are told that the bus lines marked with the wheelchair symbol in the maps exclusively use low-floor buses with kneeling suspension and ramps. If not all of the buses on a line have this kind of access, the suitable ones are indicated separately. Minibuses that are not accessible are sometimes used in the evening. A telephone number is provided for information about the operation of low-floor buses on night bus lines.

The S-Bahn suburban trains are accessible by means of a ramp fitted by the driver. When accessing underground trains, height differences of 5 – 18 cm have to be tackled. It is even 27 cm at 2 stations. The varying height differences at the stations can be checked on a map as well as the lift and ramp facilities.

The harbour ferries are a special feature. Some are accessible via ramps and 3 ships have a toilet suitable for wheelchair users. A telephone number is provided should you require further information.

There is also information for different user groups, for example, orientation aids for blind passengers at some stops and information on the “Trainscreen” in underground trains that can also be used by persons hard of hearing.

Furthermore you can take advantage of the “Geofox” electronic information system. Systems similar to “Geofox” are used in numerous other cities. “Geofox” does have a “disabled-friendly” option, however it is not explained. The standards of accessibility and usability met by the routes described as “disabled-friendly” are therefore not clear.

Hanover

The *üstra Hannoversche Verkehrsbetriebe* website (www.uestra.de) has a “Service” link in the “Kunden” (Customers) section. This link takes you to passenger information for people with reduced mobility entitled “Mobilität für alle” (Mobility for all).

Firstly, you are informed about the üstra brochure for customers with reduced mobility, “Für alle mehr Mobilität” (More mobility for all), which is issued each time the timetable is changed. The brochure is available from the Customer Centre and all public offices or can be ordered free of charge from üstra by telephone. You can also read it online and download it in pdf format. The information is also available in Braille.

Furthermore advice and information is provided at the Customer Centre where a barrier-free area has been set up specially for passengers with reduced mobility. A Braille printer is available, to print personal timetable information, as well as an equipment for hard of hearing customers.

The bus lines on which low-floor buses with automatic ramps run all day or most of the day are listed on the Internet and in the brochure. The departure times are also given in the brochure. The timetable boards and the timetable information indicate suitable buses. The location of equipment such as ramps, request buttons, wheelchair spaces and so-called disabled seats can be checked on a diagram of the vehicle.

Tramlines indicated as suitable for wheelchair users are listed in the brochure together with departure times for lines on which almost only suitable vehicles operate. Suitable vehicles are also indicated in the timetable boards and the timetable information.

Another link on the “Mobilität für alle” page takes you to a section on the tram network where you can see the stations accessible without steps. This overview is also included in the brochure.

Finally, there is a mention of vehicle access courses offered by üstra for wheelchair users on a regular basis at a tram terminus.

The brochure also lists the stations on the rail network with orientation strips and tactile paving for blind passengers and describes emergency and information columns with an additional button that can be reached from a wheelchair.

Munich

The *Münchner Verkehrs- und Tarifverbund* (MVV) website (www.mvv-muenchen.de) only has a “Mobilitätsbehindert” (Mobility Impaired) link in the “Tickets & Preise” (Tickets & Prices) section. First of all you are informed about reduced fares for severely disabled people. There are only further links to maps of the barrier-free suburban rail, underground and tram network at the end of this page.

Information on lift, ramps and disabled toilets is given for suburban railway and underground stations. The various differences in height between the platform and vehicle floor (2-7 cm, 8-13 cm and 24-30 cm) are also listed.

The overview also specifies bus lines dividing them into 2 categories: Lines on which mainly low-floor buses with access aids run and lines on which mainly low-floor buses without access aids run. This distinction is not made on the maps available on the Internet. Both categories are indicated with the wheelchair symbol.

The map of the tram network specifies for each individual line whether all vehicles are accessible or whether they normally alternate every 20 minutes. Again this distinction is not made on the maps provided on the Internet: All lines named are simply labelled with the wheelchair symbol. You need to call a telephone number to find out if the trams on these lines are equipped with lifts or ramps. This information is not available on the website.

One special feature is the new electronic schedule available since October 2002. In addition to the “Slow Walking” option, you can select “Cannot use fixed stairs”, “Cannot use escalators”,

“Cannot use lifts”, “Require low-floor vehicle”, “Require vehicle with lift or same-level access”.

After entering these options, a questionnaire for people with reduced mobility appears to assess the customer service. It can be presumed that the new timetable information combined with this efficiency analysis will contribute to a real improvement in the information for customers with reduced mobility.

Zurich

The *Züricher Verkehrsverbund* (ZVV) website (www.zvv.ch) immediately draws your attention to “MobilPlus”, the ZVV concept for people with disabilities. This concept is available as a text-only version as well as a pdf file or a brochure (sent by post).

In terms of current operation, there is only information for wheelchair users. This is very disappointing because the ZVV states that many vehicles are not yet accessible and, when they are, the routes and times of operation can only be checked by telephone on the day of travel.

As the ZVV has opened its “MobilPlus” concept to discussion by means of various media, it can be expected that lasting changes will be made to improve the accessibility and usability of public transport and thus also the passenger information provided in the Zurich region. Attention is drawn to future developments across Switzerland via a link to the Federal Office of Transport website.

4.1 Key aspects of the good practice found out

The basic requirement for easy and quick use of the information for passengers with reduced mobility is central indication. On the Internet, this is the case with the first page normally opened by passengers (see: figure 2). In brochures containing general information for all users of public transport, the table of contents would be the obvious place. The respective details need to be located centrally (see: figure 3) whenever information is provided within the public transport system. It should be noted that the initial reference does not necessarily have to address each group of people with a disability – a standard symbol like that for wheelchair users (see: figure 4) would therefore be sufficient – but it still should not only be perceptible to passengers with (full) vision.

A clear structure and consistency is decisive in the quality of passenger information for disabled people and people with reduced mobility. What information is provided? Which passenger group does it concern? What is the system behind the information? These are the decisive questions that need to be answered when the users start their research (see: figure 5).

A further essential element in good passenger information for people with reduced mobility is the depiction of the different information sources available. This can, for example, be a brochure that is also available as a pdf file on the Internet as an additional service (see: figure 6). There can also be alternative formats like audio tapes and text-only versions at the Internet that are often the only way people with vision impairments can access relevant information (see: figure 7 and figure 8). In this context, it is also important that passengers using one of the aforementioned information sources are told before setting out which media they can access during the journey (see: figure 9) and what communication and information possibilities are available (see: figure 10). For passengers with hearing difficulties and speech impediments for example, the textphone is a very decisive element (see: figure 11).

Two methods have emerged in practice to indicate the available transport and transfer possibilities that passengers with reduced mobility can use within a network or with an individual operator. One method uses standardisation of accessible and usable (alternatively: inaccessible and non-usable) vehicles and stops with standard terms or pictograms (see: figure 12). The other uses the most detailed possible listing of single or also complex information on the design of vehicles, stops etc. and which group of people can use them and how (see: figure 13 and figure 14). Good examples of the second method are, for example, plans of vehicles (see: figure 15 and figure 16) or stops (see: figure 17) and also pictures of important accessibility and usability features (see: figure 18 and figure 19). Also the network maps (see: figure 20) and timetables (see: figure 21) for single lines indicating travel possibilities for disabled people should be mentioned at this point. The method used to convey the corresponding information mostly depends on the availability of accessible and usable vehicles as well as the development of the infrastructure. Both methods – standardisation and detailed information – can be combined, however, and are also used parallel to each other in practice.

The integration of existing data on the accessibility of vehicles and stops in a journey planner (see: figure 22 to figure 24) is particularly worth mentioning. Although one or two passenger information providers offer a journey planner on their homepage, integration of the needs of disabled people in this kind of system is rare at present. But people with reduced mobility in particular benefit from being able to plan their journey exactly for their own needs beforehand and thus arrive safely. The advantages for this group of people are therefore obvious as long as the data on the accessibility and usability of a transport system is reliable and will be maintained in the future.

5 Recommendations and Conclusion

The basis for an optimal passenger information for mobility impaired people would undoubtedly be to take account of all vehicle, stop, time schedule and service design requirements of the different groups of disabled people, which are mentioned in chapter 1. Nonetheless, it will probably still take many years until the operators of public transport vehicles and infrastructures will be able to sufficiently take into account all requirements. Behind this background, the question inevitably arises, which requirements should be taken into consideration first and which one's last. But it is not incumbent on the present survey to answer that question.

But regarding the preparation and provision of information, it is obvious that it is an advantage to systematically and precisely optimize the situation of the particular user groups in public transport. The more the situation of a user group develops in the direction of a closed and barrier-free transport chain – also if that is only the case for one route, one part of town or one region – the easier is in principle the preparation of appropriate passenger information for that group.

This is no plea to take into account the needs of one group of disabled people after another. Naturally, measures to improve the situation have to be taken simultaneously. But behind the background of the later preparation of appropriate information about the progress in the design of a barrier-free environment, it would be ineffective, to take account of the requirements of mobility impaired users according to the “watering can” principle, a principle of indiscriminate all-round distribution, i.e. to take unsystematic and uncoordinated measures. Because a result of this would be that the data input and maintenance would either be very labour-intensive and costly or the information for disabled customers would be relatively unsatisfying. There are still many examples for this in most of the big cities of Europe that can be explained by history, behind the background that people are only becoming slowly aware that disabled people want to live self-determined, but that shouldn't be relevant for the future development.

The method that is necessary to improve the vehicle fleet, the infrastructure, the time schedule and service, is naturally also necessary for the elaboration of passenger information for the target groups already mentioned. In the following, such a method is presented. It describes the fundamental general requirements on passenger information for mobility impaired customers and includes structure elements that should be taken into account in the planning and later provision of appropriate information in the many different kinds of media.

Table 3:

General requirements on passenger information for mobility impaired customers and structure elements of appropriate information

<u>Requirement</u>	<u>Structure</u>
A reference to the existence of special information for disabled and mobility impaired customers should be easy to find	The first reference to existing information for disabled and mobility impaired people should be easy to find e.g. on the first regular page of the passenger information for all customers on the internet. The reference to the “text only version” should also be placed here, as far as the normal version includes graphical information. Printed media, audio cassettes etc. should for example be orderable by customers through a well-known information hotline.
Reference to the different groups of people for which the special information is provided	It should be quickly visible, for which group of customers the particular information is intended – e.g. wheelchair users, blind, visual impaired, deaf, hearing impaired passengers etc. In internet, this can be done by pictograms or text. At telephone hotlines, this information can either be announced (electronic speech output) or communicated (call centre staff).
Reference to the different media by which the information is provided	Internet: If possible, the introduction should already include a reference to existing brochures, its audio, braille or large print versions, downloadable pdf files etc. Printed media: reference to other formats (e.g. braille, large print) and other media (e.g. audio cassettes, internet) Information hotline or help hotline: reference to the telephone, textphone or fax number of the hotline and essential additional information (e.g. their business hours, if only information or also help is provided etc.) in all other media at a central place; the hotline itself should in turn give information about other media and formats as well as their sources of supply.
Different categories of accessibility and usability	A useful categorization and eventually also graduation is necessary that makes clear, for which group of people and, if necessary, with which restrictions vehicles, stops etc. are accessible and usable – e.g. „only for wheelchair users“, „only for blind passengers“, „only for walking impaired persons“, “restricted access for wheelchair users”. A classification of

	some categories is recommended if the information is intended for relatively many user groups – see for example New York: „wheelchair accessible“ and „fully accessible“.
Presentation of the different categories of accessibility and usability	For mobility impaired users, the different categories of accessibility/usability regarding the provision of information in every media that takes into account the needs of mobility impaired people, should be easy to find and clearly understandable.
Use of symbols	The use of symbols to present a certain category is recommended, if these symbols are clear and do always have the same content. Moreover, a symbol should always have the same design and colour (as for example as pictogram in vehicles and on timetables, as sign at stops etc.).
The same standards for every category of accessibility and usability	Every category of accessibility and usability that is put up and used by a transport operator or information provider should base on the same design and technical standards, so that these categories are absolutely reliable for mobility impaired customers!
Presentation and explanation of standards	The presentation and explanation of technical and design standards that form the basis of the categorization of accessibility and usability, should be placed at central place in all media provided for mobility impaired passengers. If it should in some cases not be possible to prevent deviations from a standard, this should already be indicated at the presentation and explanation of the standards or the therewith connected categories of accessibility and usability.
Differentiated presentation of the whole transport provided and the therewith connected infrastructure	To give the users a better overview, a classification of information for mobility impaired people into means of transport, their stops, eventually existing operation specifics etc. is recommended. If an information provider unifies with his service the information of different transport operators and/or suburbs, cities and regions, a presentation basing thereon is also possible: that means, at first information about the operator or the local authority district and then information about the transport vehicles, stops, etc. that the operator has at his disposal or that are used in the local authority district.
Marking of all wholly or	Every timetable or timetable abstract – available in printing, on-

partly accessible and usable vehicles	line, in speech or another form – should include references that show, which vehicle corresponds to which category of accessibility and usability. If whole routes or networks are barrier-free, it is sufficient to include an appropriate reference in every timetable or timetable abstract. While this is common practice for static information, comparable real-time information is not known up to now.
Marking of all wholly or partly accessible and usable stops/stations	For mobility impaired passengers, every stop/station should be marked with regard to accessibility and usability in the different media. If the stops of a whole route or a whole network are barrier-free, it is sufficient to include an appropriate reference in the corresponding information source.

The above mentioned requirements and the steps of their realization refer to the provision of information in common media and well-known barrier-free formats. The investigations about good practice showed that, apart from this, some transport operators or information providers provide additional, specific information that is either intended only for mobility impaired people or for all customers, what includes the consideration of persons with special needs in public transport. That information consists for example in

- ground plans of vehicles
- plans of stations and stops
- information on out-of-service lifts at stations (partly in real-time)
- electronic journey planners
- textphones
- presentations of typical situations in real transport flow with the help of media
- „Talking Signs“.

All this media can be very useful for mobility impaired people or parts of them. But in general, transport operators or information providers have to

- examine the use of one or another medium with their own method for the creation of a barrier-free environment
- take into account the national and international guidelines for barrier-free construction and design
- take into consideration the above mentioned passenger information requirements
- follow the established design guidelines for formats that are intended for the use of particular groups of disabled people.

Apart from all recommendations given so far that are influenced by taking into account the needs of all mobility impaired people, it is recommendable for the provision of information of all kind to use the so named „two-channel principle“ (synonymous with two-sense principle) resulting from the idea of „Design for all“. According to that principle, all information at all places, e. g. in vehicles, at stops and stations, in customer centres, internet, at service hotlines etc. have to appeal to at least two of the three human senses **sight**, **hearing** and **touch**. With the consequent application of such a strategy in view of the provision of information, about 90 per cent of all customers in public transport would be provided with information. On the way to an accessibility of passenger information for all mobility impaired user groups, this would be a consequent strategy that would, at the same time, be open to the consideration of additional special needs regarding the provision of information.

The quality of passenger information in public transport stands and falls with the satisfaction of the customers. That's the reason why in many places customer surveys are regularly carried out. This is done, because it is to assume that the discussion with representatives of passenger organizations or committees alone is not enough to be able to record and take into account the needs of customers. There is nothing similar in view of mobility impaired customers. It's true that disability experts and their organization are often consulted about improvements, but a systematic interviewing of mobility impaired people, who use public transport and such people, who do not use it, is not known. From our point of view, such a survey would be an essential element of the necessary evaluation of the own efforts for an improvement of the situation of mobility impaired people in public transport.

This naturally includes a customer survey regarding the accessibility, reliability and general quality of passenger information provided for mobility impaired people. Some providers already have concepts for this service and are evaluating the information provided for people with reduced mobility by means of a customer survey on the Internet. Expert consultation would definitely be useful in this area to point out any weaknesses in the information provided and in the survey and to correct them where possible in advance.

Finally a further point on real-time information and the technological developments associated with it, such as telematics. Both fields offer numerous possibilities for the provision of information for people with reduced mobility. But despite all of the existing potential, the decisive factor is the methods used to acquire information for this group and the systems used to supply it to customers. The question is therefore not whether real-time information is advantageous for passengers with reduced mobility, but what content should be provided in which situations and in what way.

Table 4:
Main aspects for the provision of high quality and accessible passenger information

Contents	differentiated and detailed information about the available media that provide information for disabled and mobility impaired persons
	information about the existing accessibility and usability scheme
	differentiated and detailed information about the accessibility and usability of vehicles
	differentiated and detailed information about the accessibility and usability of stops and stations
	information about the kind of media by which passengers will be informed in the case of an unforeseen incident
	information about breakdowns of accessible vehicles
	information about breakdowns of lifts at stops and stations
	information about breakdowns of audible announcements (e. g. in vehicles or at stations)
	information about breakdowns of optical announcements (e. g. in vehicles or at stations)
	information about short-term changes in the operating schedule
Form	guarantee of a complete chain of information
	obstacle-free access to all media
	information sources should be provided at central places and easy to find
	symbols, easy to understand, for certain accessibility and usability standards
	controls mounted at a lower level
	controls easy to operate
	consistent adherence to the two-channel principle for provision of all kind of passenger information
	information must be audibly and repeatedly announced or activated from an audible information system
	public fax machine or textphone in order to get in contact with a call-centre providing information
	same colour contrasts for the same equipment elements
	same signal tones for the same situations
	two-way intercoms in elevators and emergency telephones should provide visual options
	optically recognizable confirmation that a message has been received and understood
	two-way intercoms in elevators and emergency telephones should be equipped with manually operational option buttons
information has to be rich in contrast and of a tactile or audible design	

	audible information must be provided as simultaneously and equally optical information
	audible information must provide a high standard of quality to guarantee that it is heard by hearing impaired persons also over background noises
	optical information must be legible also under bad conditions as dirtiness, dazing, sunlight and darkness
	communication must be possible by video-phone, public fax machine or textphone
	simple, easy understandable and easy memorable provision of information
	clear presentation with the help of pictures

6 Summary

When we talk about people with disabilities and with reduced mobility, it is extremely important that they are not treated as a homogenous group. The common characteristic of “reduced mobility” simply indicates that this group of people cannot use public transport at all or can only use it to a limited extent. The requirements of these people for barrier-free use of public transport are diverse, however. The basic condition for high-quality passenger information for people with disabilities and with reduced mobility is thus awareness of the special needs of these passengers. The requirements related to vehicle materials, the infrastructure, operation and service in public transport and the requirements regarding the provision and accuracy of the respective information need to be distinguished here.

Without a doubt, it is advantageous for data preparation and also for the provision of information if especially the vehicle construction and the infrastructure within a transport system already meet the requirements of passengers with reduced mobility. The less this is the case, the greater the demands placed on the content and the reliability of passenger information. On the other hand, a public transport system that is completely free of barriers would, in the ideal case, only have the duty to inform people about the failure of individual system components in good time.

In any case, the provision of passenger information is an independent field for the group of people mentioned in which the aim is to combine the required content with the appropriate compilation of information.

The information content provided should basically relate to the accessibility and usability of vehicles, stations and service facilities. The different limitations of people with mobility impairments should be taken as a basis. Accessibility and usability therefore have a different meaning as for example for wheelchair users and passengers with walking difficulties than for people with vision or hearing impairments. Of course, the reliability of the information provided should also be ensured.

Information on accessibility and usability should not just refer to normal operation. Moreover, people with reduced mobility, in particular, need to be informed about failures in good time, for example, about lifts at stations, lifts or ramps on vehicles and about optical or acoustic information systems in vehicles, at stations or in service facilities which are out of order. Against this background in particular, real-time information – if there is the corresponding data basis – represents a particularly reliable aid for people with mobility impairments.

An important condition for passengers with reduced mobility to call up the information available is the information being easy to find and the media carrying it being easy to use. Adequate preparation can take the form of special information – for example, brochures, online information or information by telephone or fax – or be part of the normal passenger information system. The decisive factor is that the available media can be easily found at any time.

The design of passenger information for people with reduced mobility should be seen from two points of view:

- Design in the sense of easiest use, i.e. the essential content can be acquired correctly and quickly
- Design in the form of alternative formats to conventional ones.

Design in the first sense demands above all use of a consistent system of terms (for example, wheelchair accessible or fully accessible) and symbols (for example, wheelchair user pictogram). Design in the second sense refers to guaranteeing accessibility of all relevant information by all user groups – i.e. also all passengers with a wide range of disabilities – in the form of a complete chain of information.

The aspect last mentioned sets high requirements for the provision of information. Starting with the different requirements of passengers with reduced mobility, information needs to be both accessible and available in every single situation – this concerns in particular wheelchair users, people with walking difficulties and other passengers with physical limitations – and also be adequately discernible for people with sensory impairments. While a wide range of experiences have been made for wheelchair users and people with comparable impairments with regard to the design of barrier-free homes and buildings that in principle only have to be transferred to the area of public transport, a great deal of ground needs to be made up for people with sensory impairments. The maxim for designing all kinds of information media should be consistent adherence to the two-channel principle (synonym: two-sense principle). Regardless of further special requirements of individual groups, this allows around 90 percent of the population to use all passenger information provided on all sections of a journey.

Finally, the authors of this study would like to point out that they are aware that the development of barrier-free passenger information varies greatly in the different countries and towns. Nevertheless one thing should always be taken into consideration from whatever development stage you look at this subject: Incorporating people with reduced mobility and their organisations in the planning, decision-making and realisation structures on all levels is absolutely essential for actually achieving mobility for all!

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