

Understanding Audio Wayfinding and Audio-Based Navigation

A Procurement Guide

Indoor audio-based navigation, also known as audio wayfinding, is a rapidly emerging service that greatly improves the accessibility of the built environment and public spaces for vision impaired people. In simple terms, it works by providing a complementary layer of audio information to a user that helps them to explore and navigate the environment. Audio navigation is usually delivered to end users through a mobile application.

There are various approaches to audio wayfinding, providing different types of information which is then used by vision impaired people in different ways. Some vision impaired people will prefer to use one type of audio wayfinding and many will prefer to use different types depending on what they are trying to do, for example, getting to a specific destination or exploring a new area with no specific goal in mind. The International Telecommunication Union (ITU) has approved a standard for turn by turn audio navigation systems for vision impaired people, ITU-T F.921¹. This standard explains the requirements of such a navigation system for it to be usable by people living with sight loss.

This short document attempts to explain these different approaches, the necessary elements of an indoor navigation system, and some information on different technologies that can support indoor navigation. It is intended to be of use to people who are considering procuring or developing an indoor navigation system that is accessible to people living with sight loss. For an audio navigation solution to be usable for people, it is important to be clear on what type of information it provides and how users are expected to interpret this information to help them travel.

Approaches to providing Audio Wayfinding

To date, commercially available audio indoor navigation systems offer four different types of user support and guidance, sometimes combined:

1. Providing **positioning information** (where am I?)
2. Providing **information on surroundings** (what's around me?)
3. Providing **point of interest information** (details as to what's in front of me such as an exhibit or explanation of a building feature or function)
4. Providing **“point A to point B” turn by turn navigation** directions.

The information provided by these systems can be used by vision impaired people in different ways. Some will use this information to aid them in forming spatial representations of an area, others to obtain a general idea of where their destination is, and others to obtain specific information on the best route to their destination.

¹ <https://www.itu.int/rec/T-REC-F.921-201703-I/en>

There is a distinction between orientation and navigation systems. Orientation systems allow users to understand where they are in a particular environment and use audio information as an allocentric wayfinding aid. Navigation systems take an egocentric approach and do not require the user to form a spatial representation of the area, as it does not require them to understand where objects are in relation to each other.

Elements of an Audio Navigation System

Indoor navigation systems require a highly-accurate map of the environment in which the system is to operate, including information on environmental features such as escalators or lifts, as well as changes in floor surfaces and elevation. Mapping and navigation platforms are available which allow for the map data to be updated, which is important when the layout of a space changes.

Indoor positioning technology is required to locate users within the environment so that the correct guidance can be provided to them. Some more information on Indoor Positioning Technology is provided below.

Indoor navigation is normally provided to end users through a mobile application. Depending on the type of system being provided, this app will require a location and/or routing algorithm to combine the mapping and positioning information to locate and guide users. There are some additional recommendations on mobile app functionality outlined below.

Another option for venue owners is to provide an API for their maps and indoor positioning technology, allowing app developers to use this data to provide audio guidance for end users.

Mobile Application Design and Branding

Venue owners have the option of using a dedicated indoor wayfinding application for their estate, or integrating indoor wayfinding capability in another app with their own branding. While it is possible to take either approach, some users may prefer not to have to download multiple apps for different venues. Equally, if there is already a venue app which provides other functions (e.g. room booking), indoor wayfinding may be a useful additional function to add.

Implementers should also consider providing audio navigation in multiple languages, where users may speak different languages. Audio instructions should be translated with the aid of an accessibility or orientation and mobility specialist to ensure that the information is usable for and interpreted correctly by end users.

Mobile Application Features and Functionality

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

- use a notification alert before an alert or instruction;
- provide user preview, i.e. let a user preview all the audio instructions of a particular route (if providing navigation);

- enable a user to replay an audio message;
- enable user search by dictation;
- use a journey completed notification alert to tell a user that they have reached their destination.

Recommendation ITU-T F.921 also gives guidance on the type of audio instructions to be used in a turn by turn navigation system and the timing and frequency of notifications. This content also provides guidance for the structure and format of audio wayfinding guidance in general.

Mobile apps should also make use of Voice Over/Talkback text-to-speech functionality to ensure that the apps themselves are accessible to vision impaired users.

Indoor Positioning Technology Considerations

A variety of indoor positioning technologies can be used to support an audio navigation system. Indoor positioning technology locates users within a defined space (e.g. a building), allowing an indoor navigation system to provide the right guidance to users at the right time.

Bluetooth Low-Energy (BLE) beacons are possibly the most common indoor positioning technology used today, although more and more providers are making use of Wi-Fi technology, as well as looking at 5G. These technologies allow mobile devices to measure the strength of signals they receive and compare these to expected signals in different parts of a building to judge a user's location. Individual bluetooth beacons can also be used to broadcast information, an approach often used in point of interest systems, where for example, each shop in a retail environment would have its own beacon giving the name of the shop and possibly supplementary information such as opening hours etc.

Indoor positioning systems can also use sensors in mobile devices, such as the accelerometer, the gyrometer, the altimeter and the magnetometer. These sensors can give information on the device's orientation and how the position of the device is changing, but not its precise location.

Most often, in an indoor environment, GPS signals will not be sufficient to locate a user with a sufficient degree of accuracy.

Using location and navigation algorithms, this information can be combined to help guide a user.

Maintaining and Updating an Indoor Navigation System

When installing an indoor navigation system, it is important to consider how the system needs to be maintained and updated. These requirements will vary depending on the indoor positioning system and wayfinding software being used.

The key questions to consider are how to update the audio guidance if the layout of the space changes and what maintenance is required for the indoor positioning system and how often. BLE beacons are often battery powered and hence will need to be replaced at certain

intervals. Some buildings may require more frequent updates to audio guidance if they have multiple or frequently changing layouts.

Questions for Potential Suppliers

Based on the information above, we recommend that procurers ask the following questions to suppliers in their tender documents/RFPs etc.:

- What approach(es) to audio wayfinding does your technology (i.e. your app or SDK) provide?
- What indoor positioning system(s) does your technology use?
- What is your approach to maintaining the indoor positioning system hardware and updating the information delivered to users when needed?
- Does your app provide all the mobile app features as specified by ITU-T F.921?