Designing for distraction-less state changes

A design proposal for a network state aware car integrated Spotify application.

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Abstract

Listening to music while driving is very common, and lately music streaming services such as Spotify has moved into the infotainment system in the car as an application made for interaction while driving.

In order to stream music through the Spotify smartphone application an Internet connection is needed. However, this connection might be unreliable or unavailable during driving, making only downloaded playlists that are stored locally on the smartphone available for listening. However, the application’s support for the driver when going offline has been limited, making it dangerous and problematic to navigate the application in order to find a new playlist that is downloaded, all while driving.

This thesis has focused on designing a good user experience for the Spotify application in the car when it goes offline, determining how it could support the driver and minimize dangerous and unnecessary interaction.

Based on literature studies, a quantitative user survey, user testing and a brainstorming workshop a design proposal has been produced as a result of this thesis. The proposal recommends that if downloaded content is available, display it to the driver as soon as the streamed song has finished playing. If no content is available, the application should lock out the driver from interaction. When going back online, it should ask if the driver wants to stay with the currently playing content or switch back to what was streamed before. The menu will not give access to parts that cannot be used when offline, and the library will only display content that is available offline.

By applying these guidelines the driver will get a good understanding of the network state change, a one-click experience to play downloaded content, and an application that clearly communicates possible actions during changes in the network state.
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1 Introduction

Music is an artform that has been a part of human culture for thousands of years and is deeply connected to our emotions [1]. It can give us feelings of pleasure and emotional arousal [1], help with mood enhancement, cope with problems and define personal identity [2]. Music is a basis in our social lives, and has throughout history been shared and enjoyed in social contexts [3].

Through the possibilities of streaming, music can be legally accessed and shared digitally through various sources available on the Internet. Music streaming is a growing market, and revenue is mainly made through advertisement or paid subscriptions. Subscriptions increased with 39% in 2014, resulting in 41 million paying subscribers around the world [4], and continued to grow in 2015, resulting in 67.5 million paying subscriber at the end of the year [5].

Music streaming opens up for new possibilities, solutions and variety within music listening, where on is in-car implementations. This is important since a majority of drivers listens to music while driving [6], which is a situation where mobile applications are complex and dangerous to use.

1.1 Spotify

Spotify is a Swedish company founded in 2006 by Daniel Ek and Martin Lorentzon. Its main business is music streaming, but has in the last years broadened to streaming podcasts and video as well. The company has over 75 million active users, whereof 30 million are paying for the service, meaning Spotify has almost 45% of all paying subscribers for music streaming services in the world [5]. The service is available in 59 markets all over the world, and on a multitude of platforms. Apart from being available on Mac and Windows,iPhone and Android smartphones, Spotify is available on smartwatches and Playstation, in cars and in the browser to mention some alternative platforms. This thesis was written in collaboration with a team within Spotify named DeLorean, which main focus is to enable the Spotify experience in cars.

The Spotify application on iOS and Android smartphones can be connected to the car stereo to play music to stream music, but also to download music making it available for when there is no internet connection. The service can also be used directly on some cars head units, either through an implementation in the car or by connecting a smartphone with the application installed to the car.
1.2 Music in the Car

Music in the car has been around since the first introduction of in-car radio in 1922 [7], and is an option that grew in popularity with the car itself, making radios and stereos something found in almost every car today.

People listen to music while driving due to the enclosed environment which opens up for freedom of choice, making it possible to fully enjoy the music without having to negotiate or be judged for your choice of music. Since travelling by car allows for time to think, music can help with feelings that might arise, such as stress and sadness, but also to avoid drowsiness during long trips and act as company. [8, 2]

In order to stream music through Spotify an internet connection is needed. In many populated areas this is not an issue, but for some the cellular connection can be unreliable, resulting in loss of data, or in worst case, no ability to stream music at all. To solve this, Spotify allows premium users to download music and other content before going offline, making it available all the time, although this is often limited to available storage space on the driver’s phone.

1.3 Downloaded Content

Having a Spotify premium account makes it possible to download playlists and other content to making it available an internet connection is not available. This can be suitable when commuting by train or subway, travelling by plane or boat, or driving your car deep into the forest or countryside. Downloading content can be done over Wi-Fi or cellular network if it is allowed by the user, and can vary in quality depending on personal preferences and amount of storage on the user’s smartphone. The Spotify smartphone application allows the user to download podcasts and music, but not videos. To access downloaded content the user can use Search to search for songs, albums and artists, or go to Your Library where all of the user’s content is displayed, even the content that is not available offline. The user cannot use Home, Browse or Radio to display or play downloaded content, since these views are dependent on an internet connection.

1.4 In-car Distractions

While driving, things like conversations, phone calls and background noises can be distracting for the driver. If the car is equipped with an in-vehicle information system (IVIS), it can help the driver by displaying information about the route, music playing, phone notifications and more. Interactions with this system has been shown to be the most demanding for the driver [9], and are performed approximately eight times per hour of driving [8]. Since every interaction is considered a distraction, all interactions to change or affect the music playing can be seen as dangerous.
1.5 Existing In-car Implementations and Interfaces

Many drivers bring their phone with them in the car to interact with various applications, where the most popular ones to use are social media and music services [10].

To use Spotify in the car it needs to be connected to the car, which can be done via an auxiliary (AUX) cord, USB or Bluetooth. This enables playing Spotify through the stereo, and interaction through the sound system controls is often limited to the actions previous and next song, play and pause. As interaction is dangerous [8] and demanding [9], some cars have supported an application graphical user interface (GUI) on the car’s IVIS to assist driver interaction, which has been embraced by Spotify.

Spotify already exists on the third party IVIS solutions Apple CarPlay\(^1\) and Android Auto\(^2\), and is also directly integrated into cars from BMW and Mini Cooper\(^3\), Tesla\(^4\), Ford\(^5\) and Volvo\(^6\).

1.6 Goal of the Thesis Study

A new GUI for Spotify in the car’s IVIS is being under development, and works by running all the logic on the phone, and through the connection to the car render an interactive application on the IVIS screen. The IVIS application can through protocols display information such as playlists and recommendations, support actions as add to library, save song locally, add to a playlist and more. This thesis has been based on this new in-car Spotify application and GUI, where the goal of this thesis study has been to create an interaction design for the Spotify application interface when it goes from online to offline, and vice versa. The desired result has been a behavior that is as non-distracting and helpful as possible, making the driver interact as little as possible with the IVIS.

The following is the research question of this thesis:

How can the Spotify user interface on the car’s IVIS act and communicate necessary information in a safe way to the driver when going from offline to online and vice versa?

To answer the research question it was split up into three smaller questions.

- How does a user, e.g the driver, wish to interact with their downloaded content?
- How can the system inform the user of available content while not interrupting

\(^1\)http://www.apple.com/ios/carplay/
\(^2\)https://www.android.com/auto/
\(^5\)http://www.gottabemobile.com/2013/02/25/spotify-joins-ford-sync-applink-lineup/, accessed 2016-02-10
their preliminary focus on driving?

- How will the system assist the driver when going from online to offline and vice versa in a safe way?
2 Designing for Cars

As more technology finds its ways into cars, more functions and features appear as well, which creates new requirements for the interaction design of the car’s IVIS. Some major differences between designing for smartphone and IVIS applications are that the latter cannot force attention from the driver, interactions cannot be time consuming nor can the application set the pace of the interactions [11, 12]. When designing for in-car usage of applications it should always be remembered that the driver is performing two simultaneous actions, where driving is the one in priority. The driver is to be considered a novice of both the application and the IVIS, and that no training has been completed before usage starts [13]. This means no interactions should ever require the driver to need more than one hand to perform it [11].

2.1 Driver Distraction and the Effects of Interaction while Driving

Since driving the vehicle is the main task, being interrupted both disturbing and annoying [14]. Distraction is not safe, independent of age and environment [9], which for vehicle spans a wide range [13].

Studies have shown that the higher the cognitive load a driver has, the more narrow will their focus be, resulting in less viewing in mirrors and on instruments making the vehicle control suffer [15].

Of all distractions interactions with the IVIS is considered one of the worst [9]. A driver interacts with the IVIS approximately eight times per hour of driving [6], which is one of the most visually demanding things a driver can do [9, 8]. Glances should be kept to 1 second, maximum 1,5 second to be in an acceptable time span [12]. Glances longer than two seconds increase the risk of crashing with a factor two or more [16], making visual-manual tasks having the highest crash risk ratios [17].

2.2 Design Development Criteria

To design for IVIS interactions, a few specific requirements are recommended to be met. The following summarizes the topics of these requirements:

- Create a in-depth understanding of the task, the user and the system.
- Define usability criteria for the specific application, with context of use as a key aspect
- Ensure that the needs of the user do not conflict with the criteria.
• Balance functionality with usability of in-vehicle technologies when creating design recommendations.

[18].

2.3 Guidelines for IVIS Design

A few general rules has been gathered from different scientific articles, and are presented below.

Consistency  Consistency is important for creating a good user experience by easing the creation of a mental model of the system and development of a feeling of familiarity [12]. When being consistent, the driver can use their mental model even when exploring new parts of the application, making understanding easier and keeping interaction time down, but also lower the cognitive workload. This is extra important due to studies showing that practice does not lower the cognitive workload on easy or difficult tasks. Keeping symbols and graphical features consistent through the application creates both consistency and familiarity for the driver. [19]

Information  When receiving information, it should be written in plain language and be precise, and not contain more than four units of information. The information should indicate the precise problem, or if there is no problem, be presented in an informative style. [12] Recommendations are that the given information should be assimilated with a few glances [11], that the information should be presented for a sufficient time, being enough for the driver to interpret it in their own pace, until the information is dismissed or it becomes outdated [12].

Focus and interaction time  Making interactions or information to detailed or complex increases focus time, which should be avoided Keeping focus time low, enables glances to be short (around a second), and few in amount. This also has an affect on the cognitive load of the driver. The system should always let the driver control the pace of interaction to not force their attention away from safely driving the vehicle. [12, 11] If possible, the application can prioritize frequently used features to make access to them faster [13].

Interaction  Swiping gestures are preferred due to being perceived as more straightforward and intuitive [10], but do also require less precision together with having less severe distraction effects [20]. However, gestures combined with navigating in lists has no correlation to screen orientation, but are perceived as useful when the amount of items from the list are no more than five at the same time [20]. The pace of the interaction should always be set by the driver, and a interaction sequence should always be able to be resumed after an interruption [12, 11]. This relates to that no time critical responses should be presented to the user, due to creating distraction and stress [11].
3 Method

This chapter describes the methodology of this thesis study. The parts of this method are not entirely connected to each other, but the result of each step has affected the next one. Each part contains a detailed description explaining how and why it was conducted.

3.1 Literature Study

To gain fundamental knowledge of designing for cars, driver distraction and the driver’s environment, a literature study was performed. The literature consisted of scientific articles on these topics, and were all found on Google Scholar\(^1\) and on the webpage of Umeå University Library\(^2\). The articles could be categorized as follows:

- Music (habits and effects of listening)
- Interaction (Interaction design for IVIS, effects of interaction, use cases, mobile usage in the car)
- Psychology (Driver distraction, effects of high cognitive workload, music listening while driving, drowsiness, inattentional deafness)
- Technology (car and smartphone communication,
- Research methods within human-computer interaction

3.2 User Attitude Research

To be able to understand the user, a survey was conducted in order to get quantitative data from a variety of topics. The survey gathered general information about the respondents’ usage of a music streaming service, listening habits and if and how they listen to music while driving. The survey also covered habits for downloading playlists, experience with bad coverage and what the user would like an application to do when entering offline mode.

The topics in the survey were the following:

- Amount of downloaded playlists per user.

\(^1\)https://scholar.google.se/
\(^2\)http://www.ub.umu.se/
• Reasons for downloading playlists.
• Whether they use a streaming service while driving.
• Whether they download a playlist before going on a long drive.
• Whether they have experienced bad cellphone coverage when driving, and how it affected their music streaming.
• What they would do if their phone goes offline and the music stops.
• What they wish the application would do for them.

The answers often consisted of a pre-defined set of answers, but were often completed with an optional free text input. Some questions were open and designed to trigger the respondents imagination, coming up with a creative and personal answer. The survey was open for 9 days, and can be seen in appendix A.

3.2.1 Webpages for Survey Publication

The following list contains the webpages where the survey published.

**Reddit**  /r/WeAreTheMusicMakers³, a forum for music makers, /r/Music⁴, a forum for music interested people, /r/SampleSize⁵, a forum only for spreading surveys.

**Facebook**  D.A.D - Development of Automotive Design⁶, for people interested and active within automotive design. Meeting Point of Car Lovers⁷, a general discussion group for car interested people, Car Audio Enthusiasts: World Wide⁸, a group for in-car audio builds enthusiasts. Car Chicks Society⁹, a group for car loving girls worldwide. Due to gender restrictions, the survey was shared to this group through a female colleague.

**Forums**  Garaget.org¹⁰, a Swedish internet forum for enthusiasts and lovers of the car world, sharing their cars and knowledge with each other. Volkswagen Owners Club¹¹, an internet forum for Volkswagen owners and enthusiasts living in Great Britain.

³https://www.reddit.com/r/WeAreTheMusicMakers
⁴https://www.reddit.com/r/music
⁵https://www.reddit.com/r/SampleSize/
⁶https://www.facebook.com/groups/1429486647363489/
⁷https://www.facebook.com/groups/730161113669406/
⁸No longer existing group on Facebook, accessed in March when publishing the survey
⁹https://www.facebook.com/groups/586751578102898/
¹⁰http://www.garaget.org/
¹¹http://volkswagenownersclub.com/vw/
3.3 Attending Live User Tests

The design of the full application was developed in parallel to this thesis work, and was going through user testing, which opened up for collaboration. After the initial interview and user test there were some minutes left, where questions could be asked to the test participant about usage of downloaded playlist and opinions around being offline. The first interview about offline was conducted by the author of this thesis, and the two other by his colleague Olga Hörding\textsuperscript{12}. The purpose was to get an understanding of the drivers views and thoughts of offline mode, which could differ from the answers in the survey due to the respondent now being in a car and aware of what the application could look like.

The following questions were asked to all three participants.

- What would you do when going offline?
- How would you wish the application to act when going offline?
- What do you wish would happen to the music you’re playing when you go offline?
- You are in the Now Playing view and the music ends because you’re offline. What do you wish the application to do from here?
- What do you expect to see in the Home view?
- Where do you expect you can navigate in the app when you’re offline?

After the tests the notes were gathered for evaluation, and the result summarized in a document for further use, both in design and as reference material.

3.4 Brainstorming Workshop

Since the three views Now Playing, Home and Your Library has different possibilities when being offline, help was needed to generate ideas for what to do with them, to get usage examples and information about what not to do. To get a lot of information and ideas a brainstorming workshop was chosen as an effective method, due to taking a limited time to execute and at the same time getting ideas in high quantity and quality. Three tasks were made, one for each view. All were made to be as open as possible while still keeping the participants on track, to minimize loss of ideas while maintaining productivity. Each task was set to require three people in order to optimize discussions but not leave someone out of the conversation. All tasks can be seen in Appendix B.

Nine participants were gathered for the workshop, making it three participants per task. These participants had different professions, including developers, designers, managers and thesis students, and were limited to Spotify employees only due to

\textsuperscript{12}Test leader for the automotive design testing
disclosure around the project. The different professions were chosen so the workshop involved people with different mindsets, backgrounds and driving environment thinking to give the ideas being created a variety.

To get the most out of the workshop, an interview was held with Rob Nero\textsuperscript{13}, a designer with prior experience in leading this kind of workshop. Based on his recommendations, the following schedule was set for the workshop.

15 min Short introduction of the thesis scope, warm-up to spark creativity and start communication, introduction of groups and tasks.

10*3 min Each group worked on each task.

5 min Introduction of voting system, where every person can with a pen put three dots on any ideas they like. Every person got three new dots per task for voting, making it a total of nine dots per person over all.

15 min Short and effect walk-through of ideas, each presented by respective group. Voting on each task.

30 min Documentation of result.

The presentations of the ideas were recorded in order to prevent loss of explanation after the workshop ended. After the workshop all ideas were sortied and reviewed.

3.5 Prototype Development

To visually evaluate the ideas, prototypes were made. Firstly they were made as hand-drawn sketches on paper, making it possible to quickly evaluate a quantity of ideas. The ideas were evaluated based on feedback collected in the user attitude survey and live user test interviews together with applicability based on knowledge from the literature study. When the amount had been limited, lo-fi sketches were made in the application Sketch \textsuperscript{14}. The digital sketches were made to fit the final product in size and design language\textsuperscript{15} to maintain familiarity and to ease future work.

3.6 Prototype Testing and Evaluation

The prototypes needed in-depth evaluation, resulting in a user test of these. All prototypes tested can be seen in Appendix D.

\textsuperscript{13}Interview held 15th of March 2016 at the Spotify HQ

\textsuperscript{14}http://www.sketchapp.com/

\textsuperscript{15}Following the design language of the prototype this work was based on.
3.6.1 Think Out Loud Test

The test type was chosen to be *think out loud* due to focusing on impressions and understanding of the prototypes, and because no prototypes were made to be interactive. This type of test only requires simple views to be tested and a test subject. The test subjects’ task is to look at the view presented, and speak out about all thoughts about the view he or she has. A think out loud test enables understanding for the user’s mindset and thinking, it is cheap to perform due to not being dependent on lots of equipment, it is robust, convincing, easy to learn, it can be performed at any stage of the development cycle and is very convincing [21]. What can come out of a test of this type is convincing feedback, usable quotes for articles and a good understanding of the users mindset [22].

To get the test subjects to properly understand the concept of a *think out loud* test, a demo was performed by the author [22].

3.6.2 Test Equipment

One goal of the test session was to maintain a realistic feeling, so a driving simulator was used by the test subjects. This was to simulate the feeling of driving a car, resulting in the test subjects only having the time of a short glance to determine what they saw on the screen. From this the test subjects could describe how much they saw, what they thought and what possible actions were available in the views, while driving a car. The simulator equipment consisted of Lane-Change-Test simulator [23], a gaming kit steering wheel and pedals connected with USB to the computer, a PC running Windows 10 to run the simulator on and a TV screen as display. An iPad Mini\(^{16}\) was set up to act as IVIS screen, and would be the unit displaying the prototypes being tested. The tester took notes digitally and recorded the whole testing session to save comments for later evaluation. Figure 1 is from a user test session and visualises the user testing environment.

Figure 1: User testing setup and equipment. Driving simulator is shown on the screen, a test subject is sitting behind the wheel with gas and brake pedals on the floor. An iPad Mini was put on a stand to simulate the IVIS screen, and showed the prototypes being tested. The computer was used by the tester to take notes.

3.6.3 Test Participants

Since around five people are perceived as enough for a user test [24], four people were gathered for this test, all being employees at Spotify. To get an unbiased mindset no test subjects worked with developing automotive applications, with the application being tested and who had not been part of the brainstorming workshop described earlier in section 3.4.

3.6.4 Test Execution

The test followed a fixed scheme that was identical for each test subject, and was calculated to take no more than 30 minutes. Each test subjects were given identical instructions, to maintain a stability level of the test. The test was performed in a small meeting room, and all tests were done directly after each other.

3.6.5 The Views

The views, e.g. the screens of the designs made, were grouped under the categories Now Playing, Recommended to Play, Back Online, No Content Available, Your Library and Browse. The screens were switched in the order explained in the test schedule (see Appendix C). The following paragraphs explains what was being
tested and why for each category.

**Now Playing** The *Now Playing* view consisted of two versions, where one displayed a *No Internet Connection* text message at the bottom. The purpose was to see if the test subjects noticed the text bar at the bottom or not. The views tested can be seen in Appendix D, images 27 and 28.

**Recommended To Play** This test consisted of two views, both displaying available and downloaded content, where the difference were that one view had a shortcut to Your Library. The purpose was to see if the test participants understood why the views were displayed, why there was a difference between the two otherwise similar views, and if they understood what interactions were possible. Both views tested can be seen in Appendix D, images 29 and 30.

**Back Online** The *Back Online* view displayed the current playlist or album being played, with the text *Keep on playing* above it, and another option displaying the previously streamed album or playlist with the text *Go back to* above it. The purpose of the view was to quickly enable the user to change back to what was streaming before going offline if they wanted to, which was tested beside basic understanding of why the view was shown. The view can be seen in Appendix D, image 31.

**No Content Available** This test consisted of three different views, all displaying the exact same message. Difference was that the way they displayed it, and how it limited the interactivity of the application. The message shown was *You are Offline - No content available*. Whether or not the application behind was interactive was to be decided by the test subjects. All these views are available in Appendix D.

**Your Library** This test focused on discussion and opinions, hence the test participants did not driving during it. The purpose was to get opinions from the test subjects about how they would like their *Your Library* view to look for easiest interaction while driving. The views can be seen in Appendix D, views 35, 36 and 37.

**Browse** *Browse* was the last view to be tested. The *Browse* view consisted of a simple message, *You are Offline - Browse is not available*, and will be displayed if the person navigates to *Browse* via the menu. The purpose was to test the comprehensibility of the message. The view can be seen in Appendix D, view 38.

### 3.7 Design Proposal

A design proposal was made, with the purpose of creating a more finalized version of the designs, that follows the feedback from the survey, live user tests and prototype user testing, and making a proposal for what the driver needs when using the Spotify
application when going offline. The same approach and tools were used as for the prototype development (see 3.5), in order to be efficient.

3.8 Implementation

To be able to test what could be implemented, two technical prototypes were developed. These prototypes were based and built upon what was implemented at the time being.

3.8.1 Technologies Used

The application is built as a web based GUI, with the Javascript library ReactJS\textsuperscript{17} to modularize each component, and Javascript library Redux\textsuperscript{18} to manage states across the application.

To be able to communicate with the Spotify application, a local build of the iOS\textsuperscript{19} application was built using Xcode\textsuperscript{20}, which communicated through a temporary local server.

3.8.2 First Implementation

The first application was built only using ReactJS, and no Redux. This prototype focused on building a flexible Your Library view, that will respond to a network change. Only focus was to test the limitations of the GUI and its responsiveness.

3.8.3 Second Implementation

The second implementation focused on showing proposals for what to play based on what is available on the smartphone. This view comes in two version, one where only three playlists are downloaded and they are the only ones being showed, and one where more than three playlists are downloaded and three of them will be displayed, together with a Go to Your Library button. Images 29 and 30 from Appendix D illustrate the views that were implemented. These views were made with ReactJS and Redux, where the Redux global state handler eased communicating that the application was offline.

\textsuperscript{17}A frontend library developed by Facebook to modularize web components and increase rendering performance using a virtual DOM. \url{https://facebook.github.io/react/}.

\textsuperscript{18}A global state managing library that also enables logging, time travel etc. \url{https://github.com/reactjs/redux}.

\textsuperscript{19}Apple's operating system for mobile devices, \url{http://www.apple.com/ios/what-is/}, accessed 2016-05-10

\textsuperscript{20}Integrated Development Environment for building iOS and OSX applications, \url{https://developer.apple.com/xcode/}, accessed 2016-05-10
4 Results

This chapter presents the results from the survey, user test interview, brainstorming workshop and implementation prototypes. The results were used as a base for the Design Proposal, explained in the next chapter.

4.1 User Attitude Research

A total of 119 people responded to the survey, being between 20 years (or younger) to 40 years old, 78.2% were men and 19.3% women, and where 72.3% uses a music streaming service of some kind. The music listening habits per day varied, but a majority listened between 1-2 hours per day. The full result of hours per day of music listening can be seen in Figure 2

Approximately how many hours per day do you spend listening to music?

34.8% had zero playlists downloaded, and for the respondents that had downloaded content a majority of 34.8% had between 1-3 downloaded playlists. Only 21.7% had 4 or more downloaded playlists available at the same time.

The main reason for downloading a playlist was to save cellular data, followed by bad coverage and for in-flight access. The full result can be seen in Figure 3. The possible answers in Figure 3 are:

- Bad Coverage
- Saving my cellular data
- For flying or other travels where there’s no internet connection
- I don’t know
• I don’t offline playlists
• Other

**If you offline playlists, for what reason do you do it?**

[Bar chart showing reasons for downloading playlists]

72.2% of the respondents drove everyday, whereas 29.6% of all respondents listened to streamed music every time. When they were asked about their music preparations for longer drives (more than one hour), 37.7% of the respondents said they downloaded one or more playlists to bring on the trip.

**Do you occasionally play music from a music streaming service when driving?**

[Pie chart showing how often respondents played music]

**Figure 3:** Reasons for downloading playlists. 106 responses.

**Figure 4:** How often the respondents used to play music from a music streaming service while driving. 115 responses.
Do you download playlists on your music streaming application before going on a long drive?

![Figure 5: How the respondents solved music when driving for longer than 1 hour. 114 responses.](image)

A majority of the respondents used downloaded playlists as an alternative music source when losing connection to the cellular network, or switched to Radio, as seen in Figure 6. This can be related to 67.3% of the respondents had sometime experienced bad reception affecting their music streaming, where 33 people explained that the music had stopped before or after finishing the current song playing, 4 people said it started lagging or skipping and 2 reported that music lagged and/or stopped. The result for experience with bad cellphone coverage can be seen in Figure 7.

Let’s say you are streaming music while driving, but suddenly your phone loses internet connection and can’t stream anymore. What do you do?

![Figure 6: Actions taken by users when they lose connection to the cellular network. 112 responses.](image)
Have you ever experienced bad cellphone coverage that affected your music streaming?

![Pie chart showing 67.3% Yes, 23% No, and smaller percentages for I don't know and Other.]

Figure 7: However the respondents have experienced that bad cellphone coverage had affected their music streaming. 113 responses.

To get ideas of how a smart application can help, the respondents were asked what they wanted the application to automatically do when losing its reception. The following list is a summarize of the free text answers. The first item in the list contains subgroups due to not being able to separate them into own groups, neither put them under one common topic.

- Play a downloaded playlist/switch to offline/play local music/allow me to play downloaded music/switch to most recently played playlist (35)
- Pause the music (3)
- Alert me (2)
- Switch to Radio (1)
- Nothing (8)
- Other (21)

4.2 Live User Test Attendance

The following are the results from the user tests.

- Downloaded content should be presented automatically
- Music should stop when going offline and music cannot continue playing
- The driver should be able to navigate everywhere
- Everything should be accessible
- Everything should be visible
- Options should be given on what to play next
- Now Playing view should give quick access to downloaded content
4.3 Workshop Results

The following are the questions or challenges that were chosen to focus on from the workshop, together with their results.

**Discard Home or Your Library.** To remove one of them when going offline since having both were by the workshop participants perceived as redundant.

**Order of downloaded content.** When going offline, the downloaded content that is available in *Your Library* should be displayed above the content that is not available, if displayed at all.

**Graphical offline indicator.** Display to the driver that they are offline in a similar way that it is done on the smartphone applications.

**Change labels to indicate offline.** Make labels throughout the application or where necessary display that the content beneath them are available when being offline.

**Play an audio message telling the driver that the application is offline.** To play an audio message, either a sound or a voice message, telling the driver that the application is offline.

**Auto-play a similar song from downloaded content.** When going offline, the application should automatically find similar songs to what was being streamed among the downloaded content, and play that.

**Show alternatives for what to play, Either With/without auto-play, or if user clicks next/previous button.** Display suggestions of playlists or albums that are downloaded to the driver when the current stream has stopped. A drawing displaying this idea can be seen in Figure 8.
Figure 8: Post-it from the workshop displaying how a recommended to play view could like.

**Give options of what to play when going back online.** This idea was by the test participants related to the idea described above, but should display options of what to do when coming back online. The test participants example were to ask the driver if they wanted to keep on playing music from the downloaded playlist or album, or go back to what was being streamed before, assuming they were streaming before going offline.

**Few and large objects.** In general, few and large objects should be displayed to aid the driver and create secure interactions.

### 4.4 Prototype Development

This section presents the prototypes that were made based on the result from the workshop.

**Offline indicator** The offline indicator was set at the bottom due to the menu being up top, and made to be similar to the one in the smartphone applications.

![Offline Indicator](image)

**Figure 9:** An offline message shown at the bottom of the application

**Recommended to play** The following images show a view containing three playlists or albums that is suggested by the Spotify application. The view representing the case where no more than three playlists are downloaded and available offline can be seen in Figure 10.
Figure 10: Recommendations for what to play, when the driver has no more than three downloaded playlists on their smartphone.

If the driver has more than three downloaded playlists or albums, the playlists or albums will be compressed and an option to view Your Library will be shown on the right hand side. This view can be seen in Figure 11.

Figure 11: Recommendations for what to play together with a shortcut to Your Library, since the driver has more than three downloaded playlists on their smartphone.

Two more editions of the Recommended Downloaded Content window was made to experiment with the layout of the window. The first one, illustrated in Figure 12, displays the downloaded recommendations in a modal overlay. Benefits with displaying it this way is that it can overlay any view that is active at the specific moment, instead of temporarily replacing or taking over the Now Playing view.
Figure 12: Modal overlay view for music recommendations when going offline.

The second version was made fill out the whole screen, hiding the menu and everything behind it. Advantages is a flexible design and more space, making it possible to optimize the view for cars, and is illustrated in Figure 13.

Figure 13: Fullscreen view for music recommendations when going offline.
Figure 14: Options for possible actions when reception is back and streaming is possible again.

4.5 Prototype Testing and Evaluation

The result from the user testing are grouped in the same way as in 3.6, and will tell what the users said during the test.

**Now Playing** In this test, two people quickly noticed the message at the bottom quickly, one after a short time, and one did not notice it at all. One commented that it should be more clear.

**Recommended To Play** For both views tested, three out of four test participants commented that they were offline, what was displayed were their downloaded playlists and that they from that view could directly start playing music by clicking one of the content options. Two persons told that they could close the window if they wanted. For the view displaying three playlists or albums only, one test participant expressed uncertainty of the content order. One test participants thought it was tough to read the text *Recommended downloaded content* while driving, and another expressed general thoughts over reading complications. Two participants said they would use the *Your Library* shortcut to look for content, and one expressed confusion over why the *Your Library* button was present at all.

**Back Online** The participants saw what was playing at the moment, they understood that they could go back to what had been playing earlier, that they could close the window and they understood that they were playing a downloaded playlist. One test participant expressed confusion over when the recently played content was actually played, and one wanted a button that takes you to the ”main view”. Two participants expressed gratitude that it was clear what was playing right now.
No Content Available  For all three views tested in this group, every test participant understood that they were offline and that no content could be played. For the first view, every participants expressed that they could not do anything and one expressed he/she could use the menu. In the second view every participant said they could not click anywhere, one expressed gratitude over being able to see through the message where they were before the application went offline and one thought the view was very clear. One participant thought that the cross in the upper right corner, intended to belong to the Now Playing view, belonged to the modular overlay and could therefore dismiss the view. The third view got negative feedback in form of being not as aesthetical, looking like an error message and consisting of less detail than the two other views. Three participants recognized that the window could be closed, and one expressed that the application behind is still accessible and could be navigated. One said also that there is no idea to have this view, since there is no content to go back to when dismissing the window. In summary, two people preferred the first view, and two preferred the second view.

Your Library  Here two views were tested, one where unavailable items are grayed out but visible, and one where only downloaded items are visible. For the first view, all participants said that grayed out playlists were not available, three said that downloaded playlists are clearly available, and one expressed that it would be good if all downloaded playlists could gather in the top of the list instead of being spread out. For the second view where no unavailable playlists were shown, two said that this view was more clear and easier to search in and two said that everything is grouped. Two test participants preferred the second view, whereas two did not give a direct answer to which one they preferred.

Browse  For the Browse view, all participants said that it was not available, three participants said content was still available, and two based that assumption on the fact that it looked like the Now Playing view was still active and playing something. Two participants said that they could not browse for new playlists, but they can go to Your Library to find playable music.

4.6 Implementation

Two prototypes were made, each exploring different parts of the offline integrations. They are separately described below.

4.6.1 First Prototype

The content in Your Library changed from displaying all content to only what was available offline. This was made in an early stage of development of the final prototype, meaning no access to actual playlists or albums were available. Due to this, the information had to be faked, with custom flags set to the playlists that were supposed act as downloaded. Due to the structure of ReactJS, the offline state had to be sent in complex ways through different components.
4.6.2 Second Prototype

This prototype created two views, one where up to three playlists or albums were available to play when going offline, and one where a Go to Your Library was added if there were more than three playlists or albums were available offline. These views depended on a state that listened to the application’s and the smartphone’s network connection, and triggered the views to be displayed when it changed from online to offline. No playlists indicated whether or not they were downloaded, which was an issue dependent on the current iOS implementation and the API connected to the web-based view. The workaround for this was to use playlists from Recently Played, to be able to create a more functional design.
5 Design Proposal

This chapter will summarize what came out of the results, e.g. what came out of implementation, user testing and the workshop. It contains a design proposal around how and what to do when the application goes offline, with variations and recommendations to be applied to different designs.

5.1 Behavior

The following is a short summary of the behavior of the application when it goes offline, where all parts will be separately explained in detail later in this chapter. This behavior is based on results from the survey, user participant interviews, the workshop and user testing, together with the IVIS design guidelines explained in chapter 2. The following is the behavior when the application goes offline and the driver has content that is available offline:

- A bar will be displayed at the bottom of the application with the text No internet connection available. This bar will remain for as long as the application is offline, and be visible wherever the driver may navigate in it.

- A modal window will be displayed suggesting playable content for the driver, which could be started with one click.

- Your Library will display only what is downloaded, and will not give access to the submenu-choices Radio and Shows.

- The menu choices Home and Browse will not be clickable due to being dependent on an internet connection.

When going back online, a modal window similar to the one shown when going offline will be shown, but display options to stay with currently playing downloaded content or go back to what was being streamed before. This assumes that the driver switched from streaming to playing downloaded content when going offline. If the driver did play downloaded content when going offline, only the bar at the bottom of the screen will be shown and no modal window will be displayed. If the user does not have any downloaded content on their unit, the application will become non-interactive until an internet connection is established again.
5.2 Navigation

The navigation is not only limited to the menu and where to navigate, but also recommends what happens in some views if its content is not available. This section will go through how the driver is informed that a view is not accessible, and how the menu will act when going offline.

The navigation consists of access to five different views, namely *Search, Home, Browse, Your Library* and *Now Playing*. Before going offline, the menu looks as shown in Figure 15.

![Figure 15: The menu when being online. From left to right, the menu options are: Search, Home, Browse, Your Library, Now Playing, with the last one being the one active at the moment.](image)

When going offline, the views *Home* and *Browse* will become unavailable, due to them being dependent on an internet connection. Due to this, these menu options will become grayed out and unclickable, as seen in Figure 16. This is to reduce interactions by reducing menu options, and to inform the driver of what is available. This should be similar to the behavior in the smartphone application, resulting in both familiarity and consistency with it [19]. Here it assumed that the driver has some downloaded content available on their smartphone application.

![Figure 16: The menu when being offline but while available content.](image)

When offline, *Your Library* is the only menu option that consists of submenu choices that are visible. The submenu options are *Playlists, Songs, Albums, Artists, Radio* and *Shows*, where the last two will not be available at all, independent of downloaded content on the smartphone. This is due to one being Radio, which needs an internet connection, and the other one being Shows, which should not be displayed while driving due to distractions\(^1\). Figure 17 visualises the submenu choices of *Your Library*.

![Figure 17: The submenu choices for Your Library when being offline.](image)

\(^1\)Decided by Spotify
If no content is available at all, e.g. the driver has no downloaded playlists or albums on their smartphone, the driver will be informed about this and the application will be non-interactive (see 5.5 for more information). This means the menu will be inaccessible, as seen in Figure 18.

![Figure 18](image)

**Figure 18**: The menu is inaccessible if the driver has no downloaded content on their phone.

The behavior of the navigation is created to effectively inform the driver what is available and interactive, making glance time short [11].

### 5.3 No Internet Connection Message

This is a message that will be constant, not dismissible and will be shown at the bottom of the application. Its purpose is to inform and remind the user that the application has no connection to the internet. The proposal for the *No Internet Connection* bar can be seen in Figure 19. It is made to be similar to the one used in the smartphone applications, with reasons of being familiar for the user, but also containing enough text to be precise and easy to read [11, 12]. How it looks on Android can be seen in Figure 20.

![Figure 19](image)

**Figure 19**: The *No Internet Connection* message at the bottom of the application.
User testing revealed that the bar is hard to notice, but no changes has been made to make it more prominent, due to different scenarios and other elements being displayed at the same time that completes this message. To make this clear, here are the following use cases.

- If the user has no downloaded content at all, the bar will be accomplished with a big central message displaying that information.
- If the user has downloaded content, a modal overlay window will display the available content together with a header informing about its offline state.

These two completions are being further explained in the sections below. In summary, to colorize or in other ways making the message bar more prominent might be redundant, and is therefore not recommended for this application.

### 5.4 Offline With Downloaded Content

If the application is going offline, contains downloaded content and if the driver is at the moment streaming music, a modal overlay view will be displayed containing proposals of what to play based on what is available locally. The view is made in two versions, one displaying three albums or playlists, and one where a direct navigation button to *Your Library* is present. These views will only show up if the driver is
listening to streamed music, when the units buffer is empty, e.g. the buffered song has finished playing, and the application is still offline when the song has ended.

The views can be seen in Figure 21 and 22.

**Figure 21:** Playlists or albums displayed for quick access. Will be displayed without direct navigation button to *Your Library* since it is here assumed that no more than three albums or playlists are downloaded.

**Figure 22:** Playlists or albums displayed for quick access, with direct navigation button to *Your Library* to be able to browse for more downloaded content.

The differences from what was user tested (see section 3.6 and 4.5) is the shorter text that is now saying *Play this:* only. This due to feedback saying it was hard to read the former longer text. Both views displays three albums or playlists to quickly play, but to show the *Go to Your Library* button more than three playlists or albums needs to be downloaded on the smartphone. To play what is displayed, a simple tap on the selected content is enough, which is a clear interaction according
to the user tests. After pressing the selected content it will start to play, and the driver will be taken back to where they were before the view showed up. Feedback that the selected content is playing is through sound and what is displayed in the Now Playing view or tab. These modal windows will only disappear if the driver plays something from what it recommends, or if the window is dismissed. It will not dismiss itself unless an internet connection is established, in order to make the pace of the interaction be controlled by the driver [12].

5.5 Offline Without Downloaded Content

If no content is available the driver will be informed of this. The view shown in Figure 23 displays what will be shown in this scenario.

![Figure 23: Message telling the driver that no content is available, that also locks out the driver from interacting with the application.](image)

This view locks the application, making it inaccessible for use until it is connected to the internet again. If the application should be kept interactive, Your Library needs to show content that is not downloaded since there is otherwise nothing to show at all under any tab in the application, but in this design proposal, that is not the case.

For further thoughts see 6.2.

5.6 Your Library

This view will only display what content is downloaded, and will not be accessible if there is no available content. Here the header Recently Played is replaced with Downloaded Playlists, and beneath only the downloaded content is shown. As seen in Figure 24 both albums and playlists share one space, and where it ends there is a message informing the user that no more content can be found on their unit.
No specific downloaded songs are shown, but they are available under their menu option. To decide a specific order for the content more research around usage is needed.

![Image of downloaded content view](image)

**Figure 24:** The *Your Library* view when going offline. This view shows all the downloaded content under one header, with an ending message saying that no more content than this is available. To notice is that this is a full view, meaning that all this content will not be shown at the same time due to screen size restrictions.

### 5.7 Going Back Online

Another use scenario is when the driver has gone from online to offline, switched to a downloaded playlist and then came back online. Since the downloaded content can be seen as a temporary choice of music, the view seen in Figure 25 shows a modal window asking if the driver wants to go back to what was streaming before, assuming they were streaming and changed to downloaded content when they went
offline. This view shows what is playing at the moment, giving the driver feedback that they don’t have to do anything if they want to continue playing. It will only be dismissed automatically if the application goes back to an offline state, since the view is then classified as outdated. This was perceived as useful according to the user tests.

![Image: You are back online!]

**Figure 25:** This view gives the driver an option to go back to what was streaming before they went offline and the driver changed to downloaded content.
6 Discussion

This section will discuss the outcomes of the design proposal and how its connected to the research and studies done in this thesis. It will then continue with aspects of locking out the driver from interaction or not when going offline without content, since there is a possible downside to it, and finish by discussing applicable areas of the design proposal in general, without focusing on Spotify or other music applications.

6.1 The Design Proposal

As shown in 4.1 the majority of users has around 1-3 downloaded playlists on their smartphones, if any. This has been a limitation when looking at possible features in the application, where one idea has been to use the Home view to create recommendations for the driver of what to play when going offline, based on the downloaded playlists and albums available. However, this was not made a reality in a concept stage due to a limit of available content. To be noticed is that no data has been collected about the size of the downloaded playlists or albums, making this still a possibility for future implementations or similar if the amount of content is enough regardless of amount of playlists or albums.

Different versions of the view that recommends what to play when going offline were proposed (see 4.4), but needs to be fully evaluated. The design of these versions depends mostly on the final design of the whole interface, to match its intended user experience and design patterns. The same goes for the You are back online-view (see 5.7), since it is supposed to look the same, but have a different purpose.

Another evaluation is to see if and in that case how disturbing the modal views are. This is important since a driver should not be disturbed [14], which might affect the driver’s perceived workload [9]. This is easier to test in a real-life situation, even though user tests were done with a driving simulator, due to the driver might then lack knowledge about the circumstances of this modal window. However, all interactive views has been made with size and amount in mind to ease interactivity [20], minimize interaction time by enable one-click interactions or reducing possible options when going offline to support the driver and keep focus and interaction time to a minimum [12, 11]. No modal windows will disappear after a fixed time to keep the driver in control of the pace of interaction [12, 11], even though that could also reduce interaction time. If a timer was set on the modal windows they would disappear after a certain time if the driver did not perform any interactions. This is useful when the result of no interaction is desired by the driver, which will result in an unnecessary interaction to dismiss a view that does not help the driver. An example is if the application regains internet connection and a the application asks if the driver would like to keep playing from the downloaded playlist or go back
to what was being streamed before internet connection was lost. If we assume the driver wants to keep playing from the downloaded playlist but after a while needs to change song, the driver needs to dismiss the modal window first in order to get access *Now Playing*. If the modal window would be automatically dismissed after a while, this extra interaction would not be needed. However, this strides against the recommendations of in-car interactions, meaning extra work is needed to validate if an automatic action actually assists the driver.

### 6.2 Lock Out the Driver

As seen in the design proposal (section 5.5) it was chosen to lock down the application from interaction if it was offline and no content being available. This was mostly due to the design of *Your Library*, which is the only view displaying downloaded content and would have been the only view usable if the application stayed interactive, together with *Search*. A possible scenario that contradicts this decision is if the application is locked down from usage, the driver might pick up their phone in order to browse their content there, which is dangerous and not made for usage when driving [8, 9]. That makes up the biggest argument for keeping the application interactive, which also follows the results from the user participant interviews, even though it speaks against parts of the prototype test results. If the driver is able to still interact with the application, a message can be brought up when entering a view that is not usable when offline. An example of this message can be seen in Figure 26.

![Figure 26: The message shown to the driver when navigating to a view which content is unavailable when offline.](image)

### 6.3 Applicability

The design proposed in this thesis paper can theoretically, and maybe partially, applied to more applications that are developed for interaction through the car’s IVIS, and that handles streaming and downloaded content, or in some way needs an offline-specific design that should assist the driver. A more general design proposal is the behavior of the navigation, which can be applied to a majority of applications. The most applicable part of this is the lockout of the driver when no content is available at all, which can, if proven to be a successful design decision, be applied
to almost all internet connection demanding IVIS applications that are based on a touchscreen.
7 Limitations

The following part explains limitations set during the work, that has limited the outcome of the results or the design proposal, or parts that has not been explored during the work of this thesis.

7.1 Parallel Product Development

In the beginning of this thesis work the design of the main application was in an early stage. No decisions had been made regarding structure, user flow, menu and navigation structure, making the initial work focused on availability, user attitude and possibilities, and based on the behavior of the smartphone application. Throughout the process, the whole application design came together, and at one point a decision was made to base the prototypes used in this thesis on the prototypes of the main application that were actual at that time. The product continued its development, making parts of the design proposal a proposal of behavior rather than an actual design. Since the application continued its development in parallel, no focus was put on graphical design details, animations, colors and sizes, since that kind of design needs to match the overall design of the application, which was not finished.

The technical development, the coding of the actual application, started about halfway through the thesis, making the time scheduled for creating a prototype of the offline mode delayed. It was also discovered during the development of the second offline prototype that there was no way to detect if a playlist was downloaded or not, making parts of the prototype based on recently played playlists rather than downloaded ones.

7.2 Aspects of User Experience

This thesis has focused on what the driver needs for support when going offline, e.g. which views and interactions are needed to play downloaded music or similar. It has therefore not focused on how these views are presented regarding to animations, durations, timing, color and contrasts in the views, which are aspects within user experience that affects the driver as well. This has been due to both time reasons and that no guidelines for these kind of designs have not been set by the application’s designer, and neither has it been part of the main focus of the thesis.
8 Future Work

This section enhances future steps for the application that will complete the application interface, and create a better user experience.

8.1 The Very Next Steps

Investigate on how animations and transitions can be implemented in order to make the modal views and other informative views to be displayed without disturbing the driver but still being there and informing about the application’s current state.

The texts in the modal windows has not been thoroughly investigated and evaluated, making room for improvement. Here there is hope that the views themselves together with the music stopping will be enough to make the driver understand that they are offline and why the application GUI changed, but this assumption can not be applied to all drivers. Related is the text in the views which needs to be properly developed to follow IVIS design guidelines from the car and IVIS manufacturer, as well as get a personality that represents Spotify.

The animations, transitions and graphical design should also follow the over all design guidelines for the application, together with the rules set by the car and IVIS manufacturer’s interaction restrictions for third party applications.

8.2 Future Features

If the Spotify application could pre-buffer more songs than possible today, a driver could go through a long tunnel or an area with bad reception without noticing that the application is offline, since enough songs are automatically available locally on their smartphone. This could create a seamless experience independent of smartphone reception for a longer duration, even though still limited. This pre-buffer could store songs based on the current artist or genre to give two examples, and working in a similar way as Radio to determine what to store locally.

Another future implementation is to handle an offline mode with a possible voice implementation. A question around how the GUI would change if there was a voice implementation in Spotify arises, and could make big parts of this design proposal questionable or in need of a re-design. Voice implementations could help the driver by letting them control the application without removing their hands from the steering wheel, and reduce the need of get feedback visually. This can be completed with a voice feedback feature, telling the driver the state of the application, possible actions and feedback from voice commands from the driver.
8.3 Car Manufacturers

Since the application runs on the phone but uses the in-car screen as a second screen, this application can be made to fit a variety of cars. A future development would be a more responsive design made to fit a variety of cars. The differences between cars are often screen sizes, input tools (e.g. buttons, knobs, touch screens), and placement of the screen, which needs to take into consideration when creating a more responsive application.
References


Appendices
A Survey

The survey that was sent out to users of streaming service and that listens to music while driving. The survey was part of the pre-design work.
In-Car Music Consumption

Hi!
This survey is about music and in-car listening. The information gathered is completely anonymous and will only be as a base for my master thesis work.

It is split up in 4 steps:
1. About you (shortly)
2. Music listening habits (3 questions)
3. In the car (7 questions)
4. Other input

It takes between 3-5 minutes to finish.

*Required

1. What's your age? *
   Mark only one oval.
   - 20 years old or younger
   - 21-30
   - 31-40
   - 41-50
   - 51-60
   - 61 or older

2. Do you identify yourself as a *
   Mark only one oval.
   - Woman
   - Man
   - Other
   - I prefer not to answer

3. Do you have a driver’s license? *
   Mark only one oval.
   - Yes
   - No After the last question in this section, stop filling in this form.
4. Are you using any music streaming service (such as Spotify, Google Play, Apple Music, Tidal, etc)? *

Music streaming service is an application on your smartphone. Locally stored and privately owned files are stored on your smartphone. If you do not own a smartphone, choose the last answer.
Mark only one oval.

☐ Yes - I use a music streaming service
☐ No - I play locally stored and privately owned files
☐ No - I use other sources (radio, CD, etc)

Music Listening Habits
Here follows some short questions about your music listening habits. Please observe that music streaming application means the application on your smartphone (Spotify, Tidal, Apple Music, Google Play etc)

5. Approximately how many hours per day do you spend listening to music? *

Mark only one oval.

☐ Less than 0,5 hours
☐ 0,5 - 1 hour
☐ 1 - 2 hours
☐ 2 - 3 hours
☐ 3 - 4 hours
☐ 4 hours or more

6. Approximately how many playlists do you usually have offline at the same time in your music streaming application? *

Mark only one oval.

☐ I don’t know
☐ None
☐ 1-3
☐ 4-6
☐ 6 or more

7. If you offline playlists, for what reason do you do it?
Tick all that apply.

☐ Bad coverage
☐ Saving my cellular data
☐ For flying or other travels where there's no internet connection
☐ I don’t know
☐ I don’t offline playlists
☐ Other: ......................................................................................

Driving The Car
PLEASE OBSERVE that these question adress you as a driver, and NOT as a passenger.
8. How often do you drive? *
   *Mark only one oval.*

   - Daily
   - Weekly
   - Monthly
   - A few times a year

9. Do you occasionally play music from a music streaming service when driving? *
   *Music streaming service such as Spotify, Google Play, Apple Music, Tidal, etc
   *Mark only one oval.*

   - Yes - Always
   - Yes - Very often
   - Yes - But not that often
   - No - Never

10. Do you offline playlists on your music streaming application before going on a long drive?
    *A long drive is more than 1 hour.*
    *Mark only one oval.*

    - Yes - I offline one or more playlists on my music streaming application
    - Yes - I bring CD's or store files locally on my phone (not offline on a music streaming application)
    - No - I don't prepare anything
    - Other: .................................................................

11. Have you ever experienced bad cellphone coverage that affected your music streaming?
    *Mark only one oval.*

    - Yes
    - No
    - I don't know
    - Other: ......................................................................

12. What happened when your phone lost/had bad cellphone coverage?
    *Affects can be things like music stops playing because it can't buffer enough, it tries to play the song but only plays half of it because it can't stream all of it, it shows an error messages, etc.*

    ........................................................................
    ........................................................................
    ........................................................................
    ........................................................................
    ........................................................................
Let's say you are streaming music while driving, but suddenly your phone loses internet connection and can't stream anymore.

The 2 questions below are related to this description.

13. **What do you do?**
   *Mark only one oval.*
   - [ ] Switch to Radio
   - [ ] Switch to CD's
   - [ ] Switch to offlined content
   - [ ] Silence - I choose not to listen to anything
   - Other: .........................................................................................

14. **Let's say your music streaming application automatically detects that you have no internet connection - what do you want the application to do then?**
   Use your imagination!
   ........................................................................................................
   ........................................................................................................
   ........................................................................................................
   ........................................................................................................
   ........................................................................................................
   ........................................................................................................

**Other**

15. **So, last thing. If you have any additional information you'd like to add regarding in-car music listening, offline music, bad cellphone coverage or something you might think relatable, please tell me here.**
   ........................................................................................................
   ........................................................................................................
   ........................................................................................................
   ........................................................................................................
   ........................................................................................................
   ........................................................................................................
B  Workshop Instructions

The following are the questions given to the participants of the brainstorming workshop.

Now Playing  You are viewing Now Playing. How should this view act when going from online to offline? Offline to online?

Home  Home is an experimental page. How can the Home assist the driver? What is shown here? Why, and what order does it have?

Your Library  When you go offline, what happens in Your Library? How is downloaded content displayed to the driver?

Each task came with the following supporting questions.

Now Playing

- Display that a change of content is happening (if it happens automatically)? How should the next song be chosen? Similar to the one playing? From most played playlist? “Pick one randomly”?
- Should Now Playing become hidden and let the user pick content themselves? Hide to help display content or hint that the user should perform an action?
- Inform that you are back online?
- What music should play? Go back to streamed music, if that was what was played before going offline? Stay on the playlist/album playing now?

Home

- Keep original Home content? To lower potential confusion? Or not to, to focus on downloaded content?
- How to display downloaded content? Should or should not. In what order? Should Home-view give recommendations based on downloaded content?
- Display content in what order? Mixed? Based on how much it’s been listened to? Decided and non-changable order, or flexible?
Your Library

- Should non-downloaded content be displayed? Where? How? Why?

- What’s the order of the downloaded content? Most recently played? Most played? Alphabetical?

- How should it be displayed? Mix Albums, Songs, Artists, Playlists? Or sort them separately?

- What counts as downloaded? Is there any idea to show a playlist / album if it only contains one song that’s available offline? How should partially downloaded playlists be handled? (Partially is either a playlist that hasn’t finished its download process, or one that contains songs that are downloaded in other playlists.)
C  User Testing Directives

The following are the instructions given to each test subject during user testing of prototypes.  Welcome test subject to the test. Before we start I’ll let you test the Spotify in the car application, and the driving simulator. Let’s start with the application. This is what is seen on the car’s screen, and is about the size shown on the iPad.

* Application testing, approx 1-2 minutes *

You will now have a minute to test drive the simulator to get a feeling for it.

* Test drive *

Question to test subject: Ask for OK to record session.

Focus today is Spotify in the car. The test is of the type think out loud, where you’ll see some different views and you’ll tell what you think about what you see. Today we are testing some design propositions related to when you are offline. During the test you will drive this car simulator, and on this [iPad] screen a view will be shown. I will change this view, and when you feel for it you will look at the screen. Remember that driving the car is your first priority. The views are wireframes, so they are rough digital sketches. Nothing is clickable, so your task is only to look at the views, and tell what you see, what you think you can do, and what you would do when you see this view. It is okay to point and simulate a click if you feel like it.

* Demo a think out loud test. *

We will now start the test. Show the test subjects the following views

- Show “No internet connection” bottom bar.
- Show NP without bar, switch on bar when person is driving, ask for changes made.
- Take note of time it takes for them to see the bar.
- “Recommended to play offline”—window
- Show NP with bar. Apply Recommended-view. Ask to describe what they’re seeing.
- “You are back online, what do you want to do”—window-thing
- Show NP with bar. Show Back Online-view. Ask to describe what they’re seeing.
- You have no content. Which view do you prefer? Switch between views after the person has finished describing it.
* Stop the driving * We will now test some views while not driving. * Show Your Library layout in following order *

- Your Library when online.
- Your Library when offline with grayed out playlists that are unavailable.
- Your Library when offline where unavailable playlists are hidden, and downloaded playlists are collected under a "Downloaded Playlists" header.

* Ask to describe which one they prefer, or discuss their preferences Last view, this will be shown 'as is'. * Show Browse in offline mode *.

* Thank the test subject for their participation.*
D Views Used in User Testing

These are the views that were used in the user testing, described in 3.6 and 4.5.

Figure 27: View 1: Now Playing in its online state.

Figure 28: View 2: Now Playing in its offline state.
Figure 29: View 3: Recommended to play if no more than three albums or playlists are available.

Figure 30: View 4: Recommended to play if more than three albums or playlists are available, which then displays the Go to Your Library-button.
Figure 31: View 5: Options of actions when going from offline to online, which is only shown if something not downloaded was playing when entering offline mode, and a change was made to play downloaded content.

Figure 32: View 6: The first out of three views displaying the information that no downloaded content is available. In this the driver can navigate through the whole application.
Figure 33: View 7: The second out of three views displaying the information that no downloaded content is available. Here, the driver cannot access anything, and the application is locked from usage since nothing can be played.

Figure 34: View 8: The third out of three views displaying the information that no downloaded content is available. This viewed used the same modular container as the Recommended to play views, and can be dismissed.
Figure 35: View 9: Your Library when being online. Used as a starting point for the user test.
Figure 36: View 10: Your Library when going offline, and the unavailable content is grayed out.
**Figure 37:** View 11: Your Library when offline, but where all unavailable content is hidden.

**Figure 38:** View 12: The Browse view when offline.