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UX EVALUATION

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#635

# In-Car HMI UX Evaluation & Benchmarking

## Rivian R1T

In this edition, the UX team is testing the Rivian R1T. Its system offers an HMI experience that manages to be both familiar and unique in fairly equal parts. The in-vehicle experience bears no small resemblance to that of a modern Tesla.

Overall, the vehicle provides a commendable HMI experience from a newcomer manufacturer, which is certainly comparable to offerings from other more established OEMs and, with improvements, has the potential to be a leader among peers.

| COVERAGE | FREQUENCY | PUBLICATION FORMAT | PAGES |
|---|---|---|---|
| GLOBAL, NA, CHINA, EUROPE | ANNUALLY, QUARTERLY, 6 CARS PER YEAR | PDF, POWERPOINT, EXCEL, ONLINE | 150+ |

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# Scoring

- **Features and functionality:** evaluating whether the solutions provide features that customers expect, need and solve problems (or provide a wow factor).
- **Usability:** evaluating whether the features available are easy to learn and use. This considers areas such as ergonomics, legibility, usability characteristics and how the system implements the various features.
- **Reliability/stability:** evaluating the repeated usability and whether the users can have a similar (positive) experience each time.
- **Perceived quality:** evaluating the potential perception in quality of the HMI components and how this contributes to the overall customer experience.

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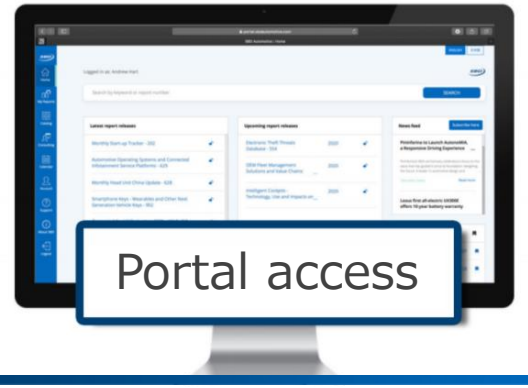



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In-Car HMI UX Evaluation & Benchmarking Series
Rivian R1T

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June 2022

# In-Car HMI UX Evaluation & Benchmarking Rivian R1T

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# Introduction

# Aim of this report

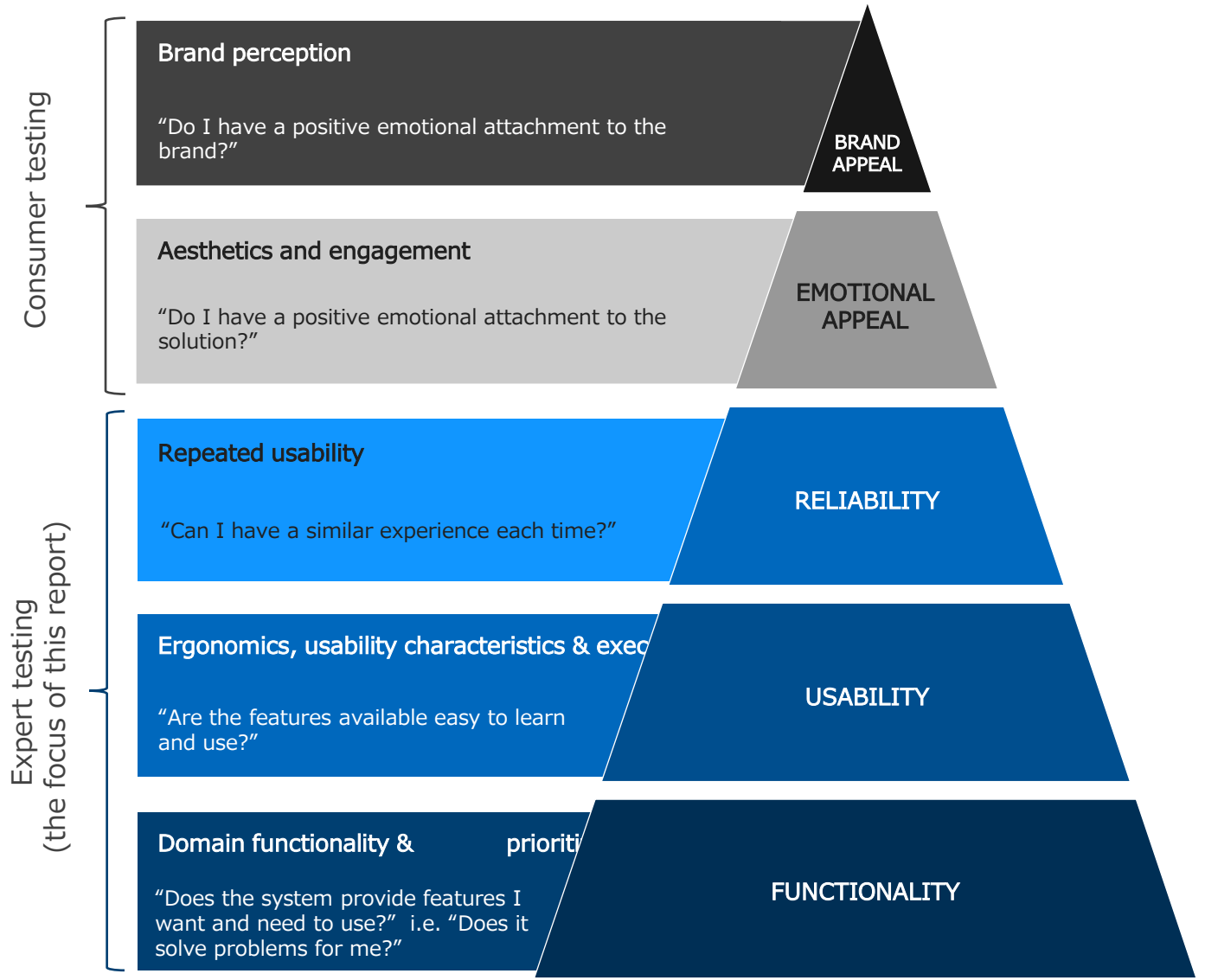
Welcome to the 2021 HMI benchmarking report series. This report has been created to provide a fair, unbiased and objective view of the latest in-vehicle HMI solutions in the European, US and Japanese markets. Evaluations are carried out by SBD usability experts with a deep understanding of CASE domains such as the Connected Car and ADAS & autonomy domains.

One of the core goals of these studies is to provide a true indication of what the final customer experience of each solution could be. To do this evaluations are focused on providing scoring and analysis in the following areas:

- **Features and functionality:** evaluating whether the solutions provide features that customers expect & need, and solve problems (or provide a wow factor)
- **Usability:** evaluating whether the features available are easy to learn and use. This considers areas such as ergonomics, legibility, usability characteristics and how the system implements the various features
- **Reliability/stability:** evaluating the repeated usability and whether the users can have a similar (positive) experience each time
- **Perceived quality:** evaluating the potential perception in quality of the HMI components and how this contributes to the overall customer experience

SBD supports clients throughout the development of new HMI and products from a relatively simple companion app to a more complex multi-domain infotainment solution. The methodologies used in these reports take into account many years of experience with consumer testing and custom client projects to provide a fair and, as much as possible, objective methodology.

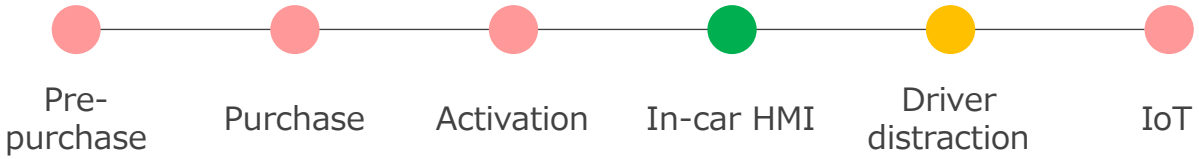
All viewpoints and analysis within the report are aimed defining areas of concern through a data driven approach. This report aims to benchmark and score solutions whilst also being able to provide actionable recommendations to design and development teams.




SBD's view on the hierarchy of needs for CX benchmarking

# Scope of report: focus on in-car HMI evaluations

The scope of evaluations in this report are constrained to the in-car HMI experience, in both static and dynamic conditions. One notable element is driver distraction which SBD covers at only a high level in this study as carrying out a full driver distraction evaluation requires biometrics test equipment to ensure the collected data is unbiased and objective.




A full evaluation of the end-to-end customer experience is not within scope of this report, but it is something which SBD has may years experience in from both a consumer and expert perspective. Other areas such as the companion app, online portal and in-home smart devices are not in scope as they are defined as “out of car” experiences.

Within the vehicle, any HMI element the user interacts with is evaluated including steering wheel controls, touch screen displays, voice control, HUDs and digital keys. The features and services on offer have been broadly grouped into the following domains (or test areas):

- ADAS domain
- Infotainment domain
- Navigation domain
- Voice recognition domain
- Connected services domain
- Convenience domain

# 2022 vehicle list

SBD has chosen six cars to evaluate in 2022, based on two selection categories. New/interesting UX focuses on systems with to never-seen-before features or functionality, or the implementation of a solution that has previously been a challenge or pain-point for end-users. New mass-market UX includes vehicles in segments that are sold in high numbers and are entering a new generation of UI for that vehicle. While we make best efforts to adhere to the chosen cars and schedule, the last year has seen release dates slipping significantly, so it may be necessary to make substitutions.

## Cars tested

### Lucid Air

- Potential disruptor
- Multiple displays
- US market test

### Rivian R1T

- New disruptor
- Appears to have an innovative approach to HMI
- US market test

## Awaiting test

### Renault Megane E-Tech

- LG's new Android Automotive IVI
- French market test

### Xpeng P5

- High level of ADAS
- Advanced voice recognition
- Configurable avatar
- China market test

### GMC Hummer EV

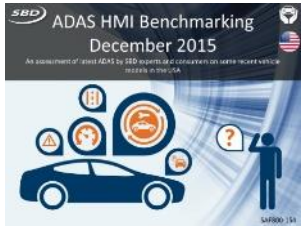
- GM's new Android OS system
- Unreal Engine graphics
- US market test

### Lexus NX

- New Lexus system
- Cloud-based navi
- New voice recognition
- German market car, UK test

# SBD experience through years of testing in-car solutions

Over the last nine years SBD has evaluated 95 solutions from a Connected Car or ADAS perspective for our public report series (many more for private client evaluations). This current report series is an evolution of both test methodologies to provide a holistic view of in-car HMI. Furthermore, custom evaluations methodologies used across the globe for SBD clients have been included where applicable to enhance to overall approach.























# One page methodology overview

One of SBD's core goals of this report is to be as objective, fair and as transparent as possible. To achieve this, various methodologies are used throughout the testing to evaluate different areas of the solution in various conditions.

These methodologies are a mix of different types of tests:

- **Objective tests:** where the value provided is not influenced by a tester's viewpoint e.g. response time
- **Subjective tests:** the test score is based on the expert testers' viewpoints e.g. task ease of use
- **Task-based:** evaluations carried out based on a predefined task list e.g. navigate to a pizza restaurant near location X
- **Freeform:** random free testing by the tester with no clear pre-defined task list. This allows the testers flexibility to dig deeper into various parts of a solution when needed
- **Scoring range:** ranges and definitions of how to score a test element e.g. poor depth and accuracy score = the results provided are not in line with what is reasonably expected by the user
- **Static:** tests are carried out when the vehicle is not moving
- **Dynamic:** tests are carried out when the vehicle is moving in various road conditions and locations e.g. motorways/highways, cities, villages, country roads etc.
- **Misuse/failures:** carried out to evaluate the stability of the solution in unusual conditions e.g. repeatedly pressing the voice command button

This document does not provide a detailed description of the methodology and this page serves to provide an overview of the approach.

For a detailed discussion and presentation of SBD's methodology please contact us.

| Test area | Type of tests | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Objective | Subjective | Task based | Freeform | Scoring range | Static | Dynamic | Misuse/ failures |
| First impressions | | ✓ | | ✓ | | ✓ | ✓ | |
| Static tasks | ✓ | ✓ | ✓ | | ✓ | ✓ | | |
| Dynamic tasks | ✓ | ✓ | ✓ | | ✓ | | ✓ | |
| Random free | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| Navigation specific tests | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ |
| Voice recognition | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Performance & response | ✓ | | ✓ | | | ✓ | ✓ | ✓ |
| System Usability Scale (SUS) | | ✓ | | | ✓ | | | |
| Final SBD UX score | ✓ | ✓ | | | ✓ | | | |
| ADAS | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| UX heuristics | ✓ | | ✓ | | | ✓ | ✓ | |
| Execution | | ✓ | | | ✓ | | | |
| Ergonomics | ✓ | ✓ | ✓ | | | ✓ | ✓ | |
| Legibility & readability | ✓ | | ✓ | | | ✓ | ✓ | |
| Perceived Quality (PQ) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |

# Example slides from the full 150+ page report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# Stand-out delight features, performance features likely to please

Delight feature considerations:

- Of the R1T's delight features, all are good implementations of varying success and are expected to be noticed by users as a point of satisfaction in the overall user experience.
- The integrated Rivian Camp Speaker was found to be one of the most satisfying of the delight features. With a strong design, exceptional integration and satisfying sound quality, the Camp Speaker is viewed as a 'wow' feature.
- The Alexa smart integration is another delight feature that is likely to provide user satisfaction due to its versatility.

Camp Speaker is a 'wow' feature

The Camp Speaker is an example of a well-implemented design idea that provides a level of 'wow.' The simplicity of its integration into the center console is a strong point: a simple stow-away method for storage and charging. The Camp Speaker connects easily to mobile smartphones via a Bluetooth connection, and was noted as having a high quality sound output. Overall this is an exceptional feature that is very likely to appeal to the majority of the customer base.

Performance feature considerations:

- Performance features are mostly well implemented and expected to please users.
- Rivian's OTA update process was intuitive and provided an improved ownership experience.
- Hardware was found to be fast and responsive which is likely to promote user satisfaction and engagement.
- Automatic charging stop calculations offer optimized charging to give the most range in the least time on extended trips.
- A well-integrated owner's manual offering multiple ways to search provides added benefits, helping to ensure the user has the best chance of finding the information they require.


ADAS graphical interface is impressive

The instrument cluster has a stand-out graphical interface that is expected to provide a pleasing experience to users. Relatively few other automakers provide this level of information (Tesla being one) and the fact this is provided by a startup is to be commended. Although the system is not perfect (for example pedestrians on bicycles were often mistaken for motorcycle riders), the implementation is expected to be considered an impressive feature by users.

# Lane departure warning exhibited unexpected behaviour

2. ADAS

When crossing a lane line, the lane departure warning displayed. The driver carried on crossing the line and the system then started tracking the next lane line over.

The highlighted lane moved from the current vehicle's lane to the next one, keeping the yellow warning color even though that lane required no warning. The system updated, clearing the warning indicator within one second.

| Frequency | Low | Medium | High |
|---|---|---|---|
| Severity | Minor | Major | Critical |

# Key lowlights

Driver has to sit forward to reach the far side of the display

## Reach: Right-side of central display

**Use of the media tab in particular reveals reach issue**

Due to the size (15.6-inches) and landscape configuration of the central display, touchscreen interactions cause the driver to lean forward and extend their reach to access any content on the furthest side.

One example of such content is the media tab that slides out from the right side of the display, allowing control of phone and media when in other areas of the system. Although controls are duplicated on the steering wheel, many drivers may prefer to use this tab instead due to its visual nature.

A further example is settings (e.g. for ADAS) which have switches on the very right side of the screen.

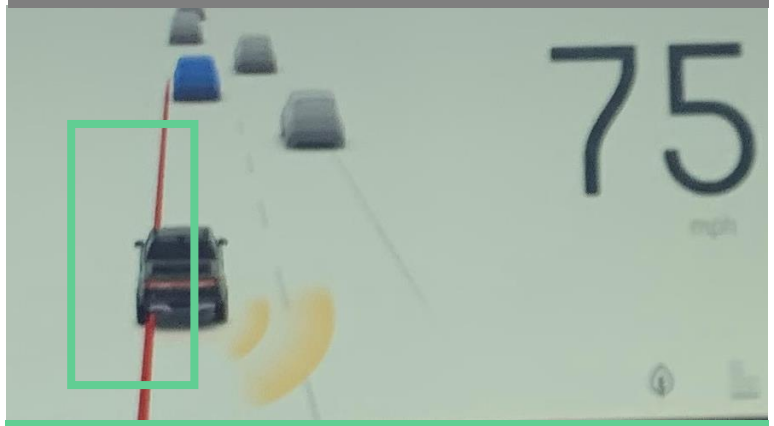
# Perceived Quality: Tactile

| Level 1 | Tactile |
|---|---|
| SBD viewpoint | **Stiffness & looseness:** No wobble experienced during testing, everything feels secure and high quality. Also hard buttons and stalks gave a rugged feel, which contributes to the overall robust impression of the vehicle.<br>**Force feedback:** No haptic feedback for the display. Feedback from steering wheel buttons and stalks and any other buttons performed as expected.<br>**Material quality:** The feel of all buttons/stalks/displays provided an impression of good quality and matched the brand identity of the truck.<br>**Material harmony:** Tactile quality is consistent throughout the vehicle. The rear control panel could have a slightly higher sensation of quality.<br>**Geometric & Positioning:** The overall shape of the hard buttons and shifters conveys good quality and fits the brand identity. |

| Level 2 scoring | | | | |
|---|---|---|---|---|
| Stiffness & looseness | Force feedback | Material quality | Material harmony | Geometric & positioning |
| Excellent | Good | Good | Good | Good |

# SAE Level 0 ADAS: System usage

System usage: LKA/LDW

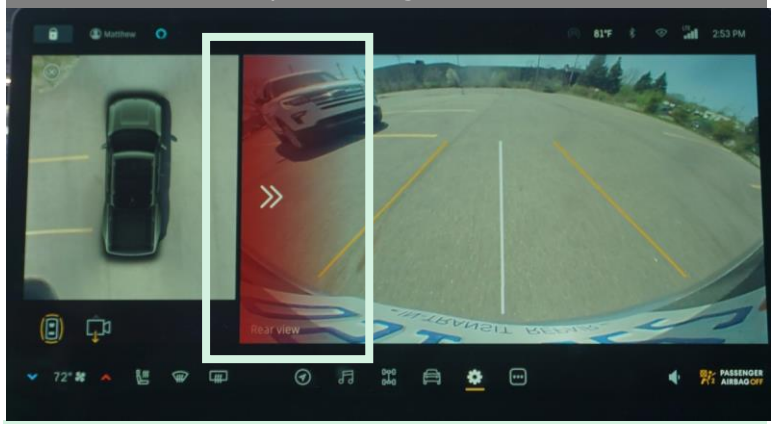



Visual graphic for LKA

System usage: BSM

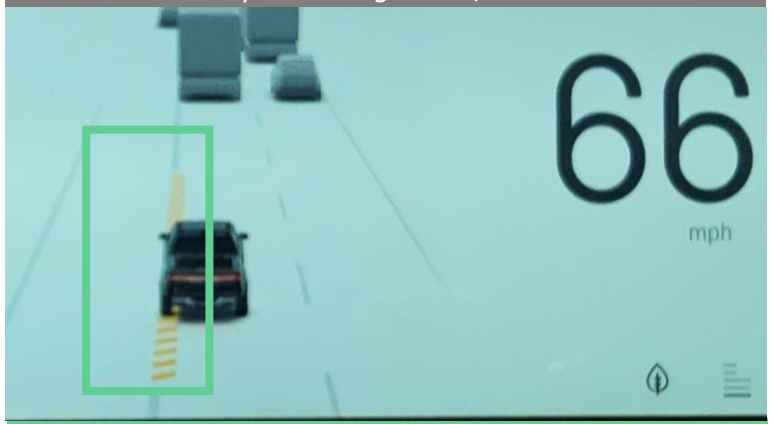

BSM graphic when vehicle is detected in blind spot

System usage: RCTA



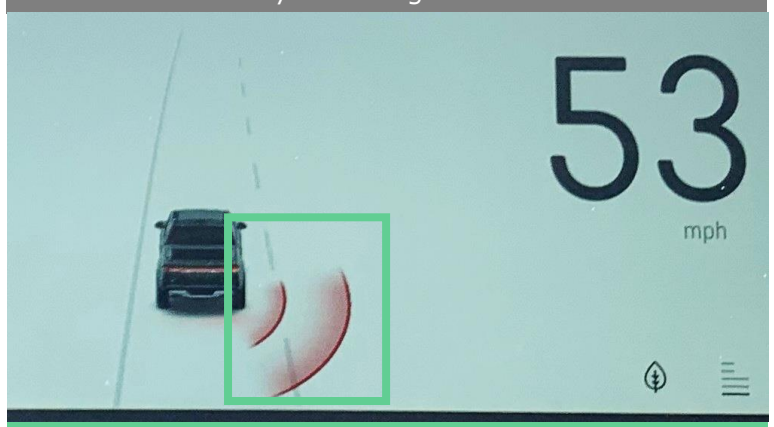

Directional warning in central display in red

System usage: LKA/LDW




Visual graphic for LDW

System usage: BSM

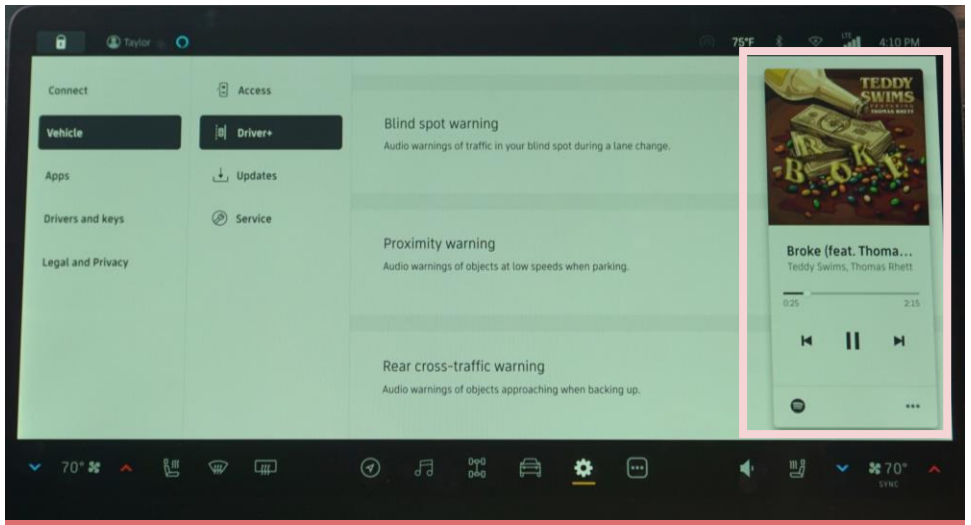



BSM graphic turns to red when turn indicator is active and a vehicle is within the blind spot

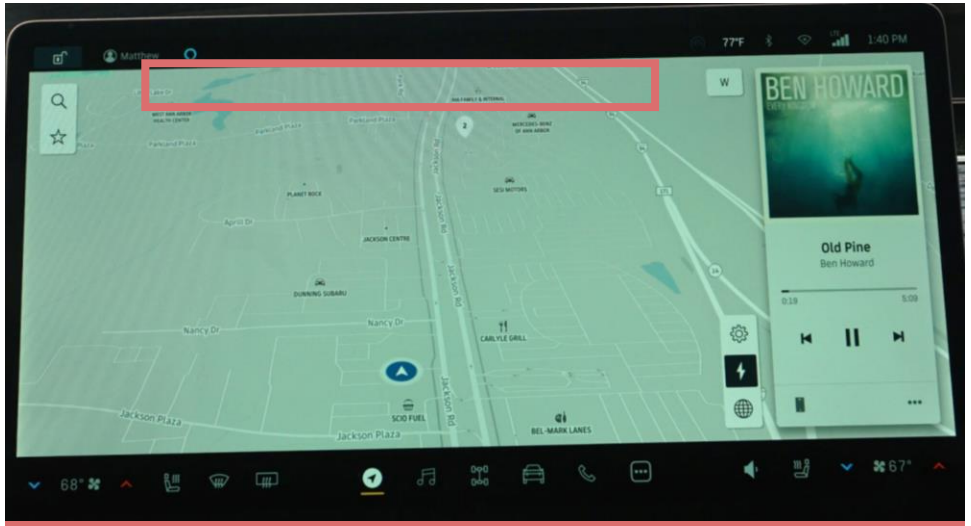
# Media/Phone tab hinders use of some features

| | |
|---|---|
| Category | Infotainment |
| Description | Media/Phone tab on right side of screen hinders use of features throughout the system |
| SBD viewpoint | A tab slides in from the right side of the screen to enable media and phone control throughout the system. It has three states: fully open, collapsed, but showing that it's available, or when cleared by the user by swiping right, fully invisible. The tab can provide tangible benefits but due to issues with implementation, it hinders usage of some other features.<br>• When the tab is open within the Settings menu, it can obscure important on/off switches for settings such as the Driver+ ADAS features.<br>• When the tab is open in the navigation menu and the user has selected the charging icon, the options to filter the charging POIs on the map will not appear at the top of the screen (see example on this slide).<br>• When the tab is collapsed on the right, it has the appearance of a scroll bar, which can lead to confusion as it gives the impression that the current screen is scrollable.<br>• Also when collapsed on the right, it prevents use of some controls.<br>The tab provides definite benefits, particularly for passenger interaction, but requires some improvements to its integration in order to overcome the highlighted issues. |

| UX impact | Major negative | Minor negative | No impact | Minor positive | Major positive |
|---|---|---|---|---|---|




Media tab blocks on/off switches for ADAS controls

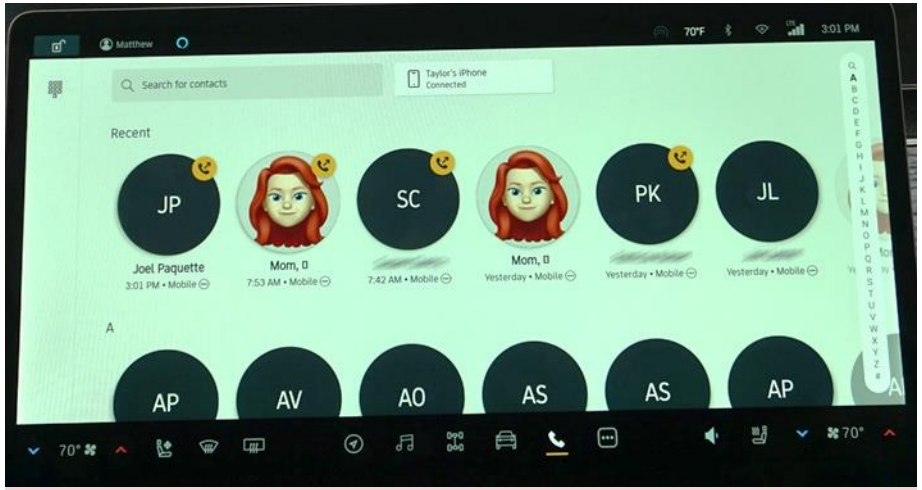



Open media tab disables filter options for charging POIs on the map

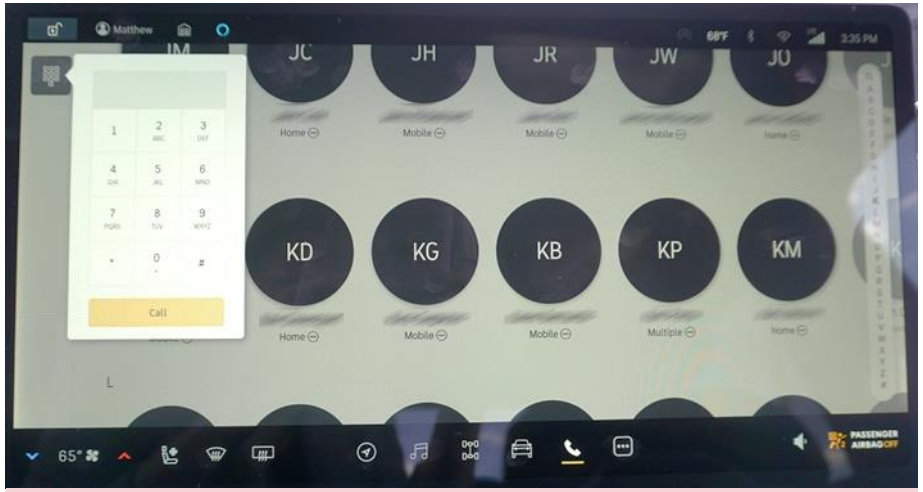
# Phone menu lacks some features

| | |
|---|---|
| Category | Infotainment |
| Description | Some phone features lacking – no favorites or messaging offered |
| SBD viewpoint | The infotainment system lacks some expected features for Bluetooth paired phones.<br>• Once a phone has been paired to the system and contacts are enabled to be downloaded, the options offered in the phone menu are fewer than expected.<br>  ▪ Recent – recent calls are shown at the top of the contacts page and do not have their own page as is the general convention.<br>  ▪ Contacts – contacts can be searched or scrolled through.<br>  ▪ Number pad – shown as a popup rather than a separate page, not considered an issue.<br>• Some features that are missing from this phone menu are<br>  ▪ Favorites – the user's favorite contacts.<br>  ▪ Messaging – the ability to receive and send text messages (recommend voice/typed/predefined entry when stationary, voice/predefined only when driving).<br>Due to the premium nature of the vehicle and high price point, consumers are likely to expect these options to be offered in the phone menu. The lack of smartphone mirroring further restricts messaging ability. |

| UX impact | Major negative | Minor negative | No impact | Minor positive | Major positive |
|---|---|---|---|---|---|




Recents are shown at the top of the page above all contacts.

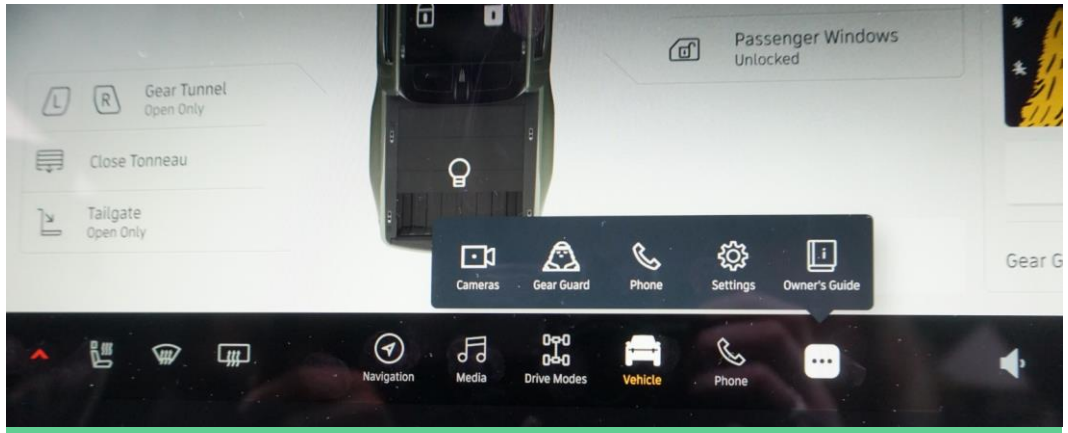



Number pad offered in phone menu

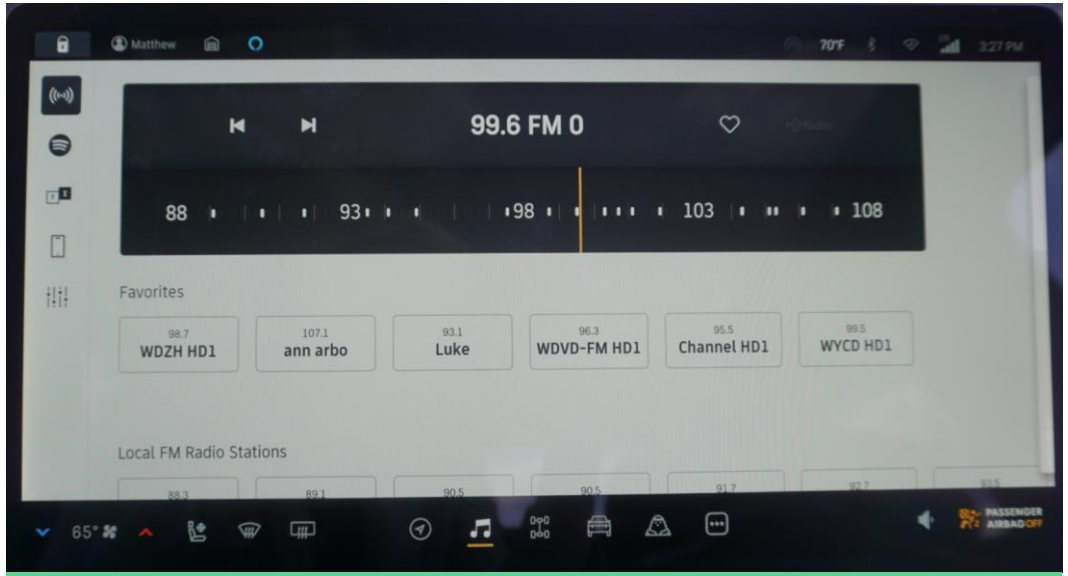
# Shallow menu structure overall

| | |
|---|---|
| Category | Infotainment |
| Description | System layout makes for a shallow menu structure throughout the system |
| SBD viewpoint | The combination of the large central display and effective information architecture allow for a shallow menu structure throughout the system.<br>• The 16-inch display allows for most relevant buttons to be readily accessible from their main menu, so the user doesn't have to dig for what they're looking for.<br>• The system doesn't have a 'Home' menu, instead it has a permanently displayed navigation bar at the bottom of the screen, allowing quick access to all core areas. Five shortcut icons are shown (in addition to the '⋯' shortcut) with the first four static and the last one reflecting the last additional section used.<br>A shallow menu structure can lower distraction while driving and improve learnability and intuitiveness. This was found to be the case in the R1T, and leads to an overall positive user experience. |

| UX impact | Major negative | Minor negative | No impact | Minor positive | Major positive |
|---|---|---|---|---|---|




Permanently accessible navigation bar at bottom of infotainment system




One-touch access to all core features in each main menu

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