

GM HMI User Experience Guidelines for Downloadable Applications

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1. ABOUT THIS DOCUMENT

This document is intended as a guide for developers who are creating downloadable applications for GM infotainment systems utilizing the internet application framework. In addition to minimum size and safety requirements that need to be met, the system hardware and environment is described.

To aid developers further, examples of GM widgets and implementations are provided, although at this point they are guidelines, not requirements.

This should be treated as a living document that is subject to change based on learnings from implementation of downloadable applications and changes to driver distraction and workload assessment criteria.

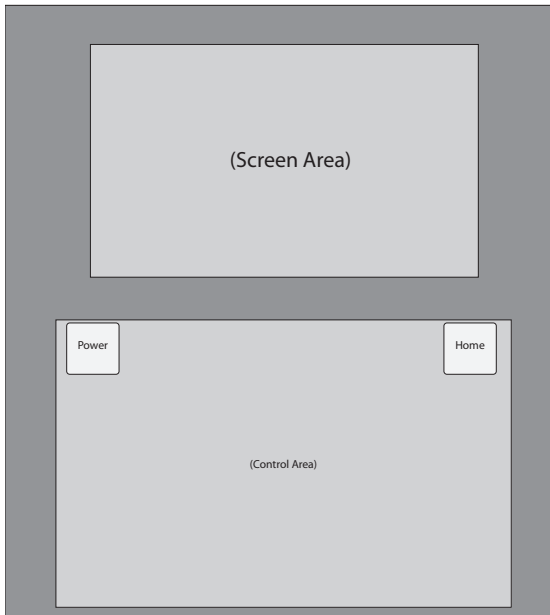
1.1 DOCUMENT CONVENTIONS

Text in red is used to indicate information not yet available or TBD.

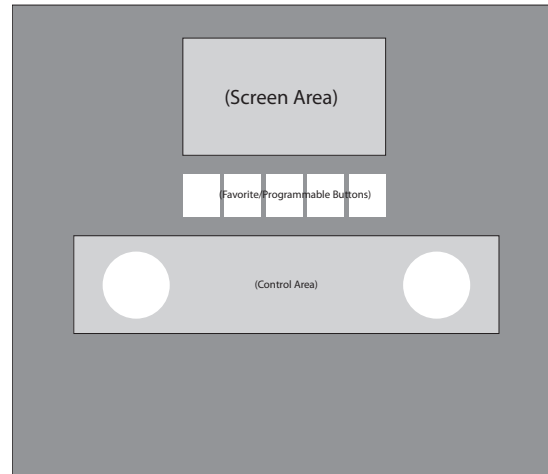
2. HARDWARE & SYSTEM ELEMENTS

2.1 INTERNET APPLICATIONS FRAMEWORK

The internet applications framework, and therefore internet/downloadable apps, are being implemented on several different vehicle platforms. As such, there will be varying capabilities / requirements for each system. This document will attempt to provide the necessary information for developers looking to create applications for all/any of the available systems.



**Figure 2.2.1.1 Next Gen 8”
Example Layout**



**Figure 2.2.1.2 Next Gen 4.2”
Example Layout**

2.2 DISPLAYS

2.2.1 NEXT GEN INFOTAINMENT

2.2.1.1 8-INCH DISPLAY

An 8” color touch-screen with an 800x480 pixel resolution. The screen measures 174.0 mm x 104.4 mm with a dot pitch of 0.2175 mm.

2.2.1.2 4.2 INCH DISPLAY

The 4.2” base radio has a 480X272 resolution. The screen is non-touch and measures 92.88 mm x 52.632 mm with a dot pitch of 0.1935 mm.

2.2.2 CCR / CNR

2.2.2.1 7-INCH DISPLAY

A 7" inch screen in both touch and non-touch implementations with an 800x480 pixel resolution. The screen measures 152.4 mm x 91.4 mm with a dot pitch of 0.1905 mm.

This display comes in a variety of packages, so a representative image isn't necessarily applicable.

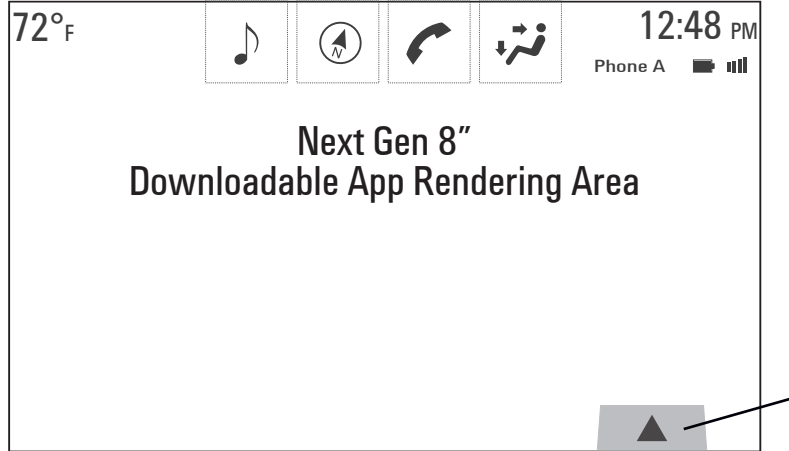


Figure 2.3.1.1

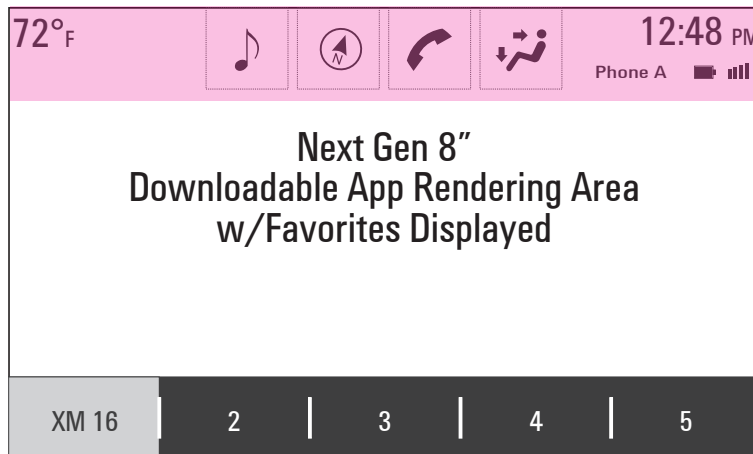


Figure 2.3.1.2

2.3 SYSTEM ELEMENTS

2.3.1 DISPLAY AREA

Internet applications are displayed at the full resolution of the system screen, but there are several elements that are overlaid on top of the application rendering area. Developers should be aware of these areas and take them into consideration. Depending on the system, content placed in this area may be visible at times, but will most likely not be available for interaction on screen (touch).

2.3.1.1 NEXT GEN 8"

APPLICATION TRAY & SYSTEM STATUS

The Applications Tray contains three to five applications and provides the main method for switching between those applications. Additionally, the current temperature, time, connected device status, etc. is displayed.

On the 8" next gen display, the app tray & system status are displayed along the top of the screen, requiring approximately 90 pixels from the top edge.

While content from the internet/downloadable application is displayed underneath the system elements, this area should not be used for any controls/buttons. For now, a solid color (black) fill in this area is suggested.

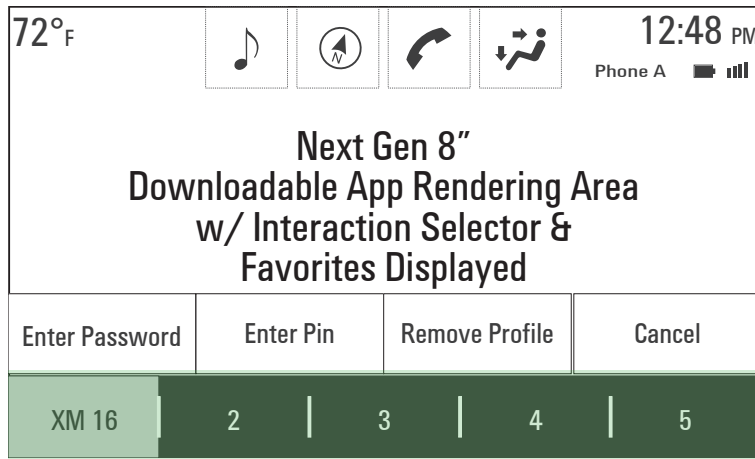


Figure 2.3.1.3

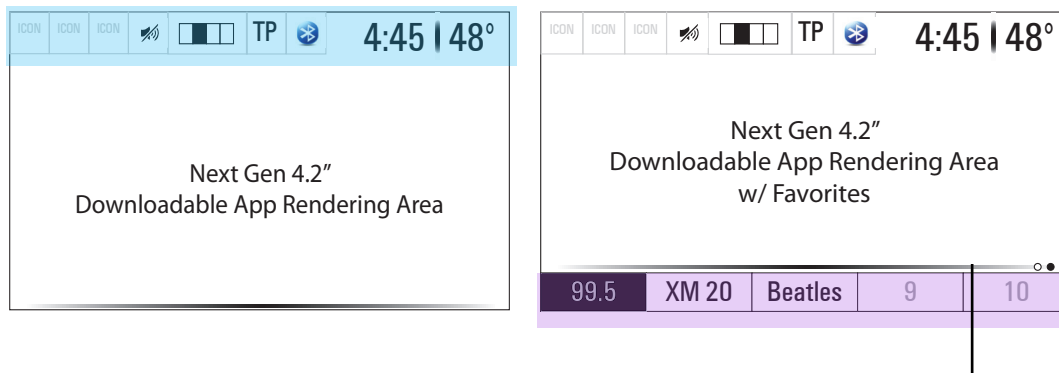


Figure 2.3.1.4

FAVORITES

While utilizing downloadable apps, users will be able to access, edit, and update their system-wide favorites (presets). The favorites display area may be minimized, in which case the favorites selector tab is shown (see Figure 2.3.1.1 on previous page).

On the 8" next gen display the height of the tab is 51 px, 117 px wide, and the center is 116 px in from the right edge. **Note:** for this button the touch area is much larger than the graphic; it is approximately 80 px tall from the bottom edge by approximately 117 px wide.

This tab is visible when an interaction selector or favorites are not displayed.

2.3.1.2 NEXT GEN 4.2"

SYSTEM TRAY

The system tray displays vehicle information to the user, and requires 40px of display space from the top edge of the screen.

FAVORITES

While utilizing downloadable apps, users will be able to access, edit, and update their system-wide favorites(presets). Favorites are accessed via soft keys on the center stack controls.

The favorites bar separates the favorites from the rest of the content, and is approximately 5 pixels tall. It is displayed whether or not the favorites are minimized.

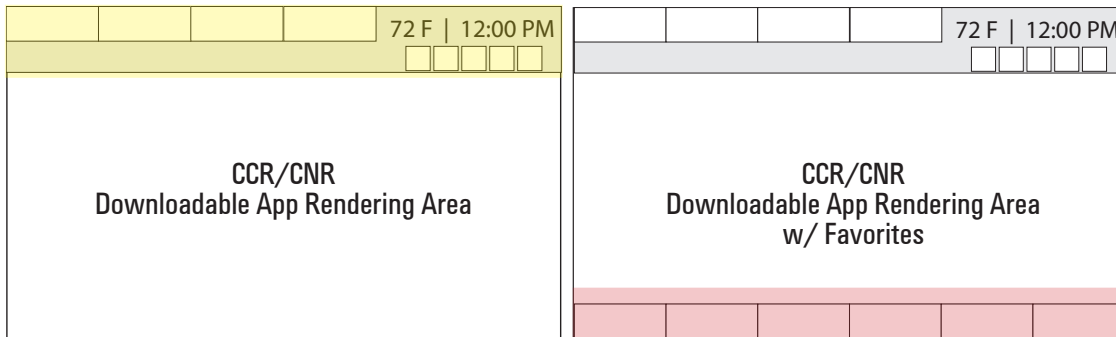


Figure 2.3.1.5

When displayed, the favorites (combined with the favorites bar) require 40 pixels from the bottom of the screen.

2.3.1.3 CCR/CNR 7"

SYSTEM TRAY

The system tray displays vehicle information to the user, and requires 75 pixels of display space from the top edge of the screen depending on the section of screen (the row of icons below the temp/time).

FAVORITES

While utilizing downloadable apps, users will be able to access, edit, and update their system-wide favorites(presets). Favorites are accessed via the touch screen or soft keys on the center stack controls depending on the touch or non touch implementation

When displayed, the favorites require 55 pixels from the bottom of the screen.

3. INTERACTIONS

3.1 SYSTEM DEPENDENT CONTROLS

The different platforms and/or systems implementing the internet applications framework have variations in which interaction methods are available to the user. To design for the widest possible audience, developers will need to take this into consideration.

This section of the document will describe available interaction methods and which systems they will be available on.

3.2 PROXIMITY SENSING

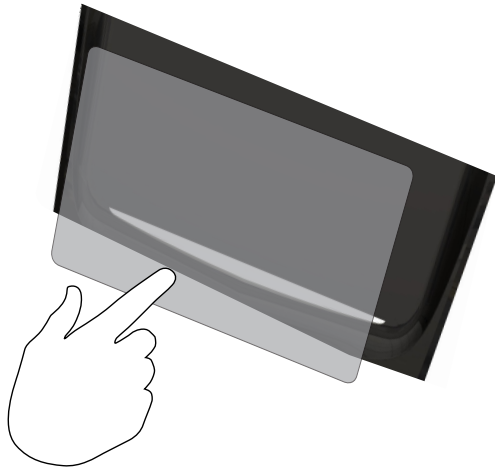


Figure 3.2.1.1
Proximity Sensing

For Cadillac vehicles only, proximity sensing in the center stack enables specific interaction capabilities with the system. Proximity sensing in the center stack is used to display additional information and controls that are normally not displayed when no one is interacting with the touch screen. The primary use of proximity sensing is to keep the screen cleaner and clutter-free when it is not being used.

One example of use is to only display playback controls when proximity is detected.

3.3 ROTARY KNOB

A standard, rotating knob is used for multiple purposes throughout the system. See the framework documentation for further details on how these actions are translated to an app.

When available, the rotary knob should be enabled for use with activities which the user has a reasonable expectation of knob functionality (e.g. scrolling a list).

To enable an app to be deployed to the largest number of vehicles, rotary controls should be accounted for, as not all vehicles will be touch capable. All vehicles except Cadillacs with the up-level 8" Next Gen system will have a rotary knob that can be used as an input method to control an app.

3.3.1 ROTATE

Users can rotate the Tune / Menu rotary-push knob or the Volume knob on the faceplate.

3.3.2 PRESS

Users can press on the center of the Tune / Menu rotary-push knob to select a highlighted option or perform a function defined by the app.

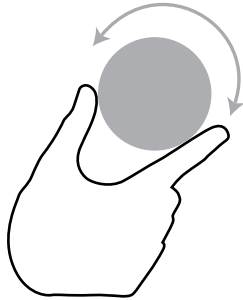


Figure 3.3.2.2
Rotate

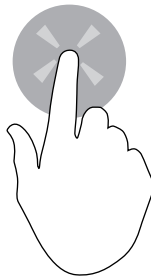


Figure 3.3.2.1
Push



Figure 3.4.2.1
Tap



Figure 3.4.2.2
Press & Hold

3.4 BASIC TOUCH GESTURES

The browser is designed to handle multiple types of touch gestures, making them available as mouse events.

Some systems may use resistive touch screens instead of capacitive touch screens, resulting in a potential loss of sensitivity and multi-touch gestures.

3.4.1 TAP

Mouse Event: Left mouse button click.

Users tap an element on the display to perform a function.

3.4.2 PRESS & HOLD

Mouse Event: Right mouse button click.

Users press and hold an element on the display to perform a function.



Figure 3.5.4.2
Nudge

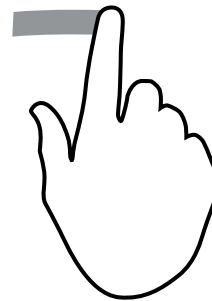
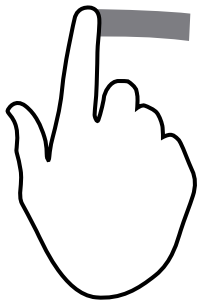


Figure 3.5.4.1
Fling / Swipe

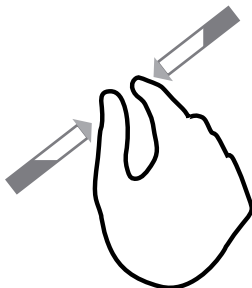


Figure 3.5.4.3
Pinch

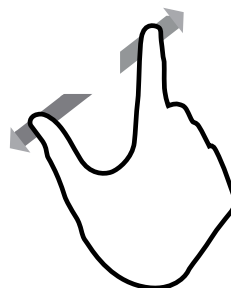


Figure 3.5.4.4
Spread

3.5 ADVANCED TOUCH GESTURES

These gestures may have limited success on resistive screens.

3.5.1 NUDGE

Mouse Event: Single scroll wheel movement, either up or down.

Users drag their finger on the display to perform a function.

3.5.2 FLING/SWIPE

Mouse Event: Multiple scroll wheel movements, commensurate with the fling or swipe movement.

Users flick their finger on the display to perform a function.

3.5.3 PINCH

Mouse Event: Press center mouse button, then move scroll wheel down once, then release center mouse button.

Users put two fingers on the display and bring them together in a pinching motion to perform a function.

3.5.4 SPREAD

Mouse Event: Press center mouse button, then move scroll wheel up once, then release center mouse button.

Users put two fingers on the display and spread them apart from each other to perform a function.

3.6 BACK & PROGRAMMABLE BUTTONS

Some systems have a dedicated back button that apps have access to. See the framework documentation for details.

Similarly, certain systems have a set of programmable buttons along the bottom/side of the screen which apps also have access to. See the framework documentation for details.

3.7 SPEECH

3.7.1 SPEECH RECORDING

Apps may utilize the vehicle systems to record user speech for application use (e.g., offboard speech recognition). In the future, apps may have access to the onboard speech recognition system.

3.7.2 TEXT TO SPEECH

Apps can utilize the text-to-speech engine as necessary to provide information to the users in those systems so equipped. This could be particularly useful in situations where driver distraction prohibits users from reading large amounts of displayed text.

3.8 CONTROL AVAILABILITY

	Next Gen 8"	Next Gen 4.2"	CCR/CNR 7"	
Proximity Sensing	Cadillac Only	Not Available	Not Available	
Rotary Knob	All Models but Cadillac	All Models	All Models	
Basic Touch Gestures	All Models	Not Available	Available on Touch Screen Equipped Models Only	
Advanced Touch Gestures	All Models (Note: unknown performance on resistive displays)	Not Available	Available on Touch Screen Equipped Models Only (Note: unknown performance on resistive displays)	
Physical Back Button	All Models but Cadillac	All models	Varies depeding on System Execution	
Programmable Buttons	Not Available	All Models	Varies Depeding on System Execution	
Speech Recording/Recognition	All Models	All Models	All Models	
Text-to-Speech Engine	All Models	All Models	Varies Depending on System Execution	

4. SYSTEM REQUIREMENTS

In addition to the actual content of the application (html, css, javascript, etc.), the following components are required for an application.

4.1 ICONS

Each application will need to provide an icon for display on the vehicle home screen. These are used by the user to actually launch the application. Developers need only supply the largest icon size, which will be scaled down as necessary.

The sizes are as follows:

NEXT GEN 8"

146 x 146 pixels on the home screen

89 x 70 pixels in the app tray (70 x 70 effective)

NEXT GEN 4.2"

102 x 102 pixels

CCR/CNR

118 x 95 pixels (95 x 95 effective)

4.1.1 CHANGING ICONS

Note: This feature is not available until the model year 14 API is released.

Apps will be able to change their icon to indicate the current state (not running, running, running in background, etc.). When it becomes available, this document will include examples of GM icon treatment if developers choose to utilize this feature and wish to employ a similar style.

4.2 APP VERSION INFO

Applications should provide info to the user about which version of the application is currently on the vehicle. This can be handled in the application as the developer sees fit.

5. APPLICATION DESIGN REQUIREMENTS

5.1 FONTS

5.1.1 FONT SIZE

The following table describes the recommended minimum sizes for text used within the GM HMI. These sizes are based on data from the Federal Highway Administration¹. To account for varying viewing distances, the sizes are calculated using the viewing distance found in GM Vehicles using the Next Gen HMI. As viewing distances become available for other systems, additional information may be added to the table.

Minimum Font Sizes (pixels tall for a capital letter; e.g., “E”)			
	Next Gen 8”	Next Gen 4.2”	CCR/CNR 7”
Titles and Key Elements (status info; list title headers; alert identifier; etc.)	29 pixels	33 pixels	33 pixels
Dynamic / Critical Elements (e.g., list elements; button labels; metadata; etc.)	20 pixels	22 pixels	22 pixels
Static / Non-Critical Elements (e.g., icon labels; 2nd line of Favorites; “Now Playing” text; etc.)	16 pixels	18 pixels	18 pixels

1 <http://www.fhwa.dot.gov/publications/research/safety/98057/ch03.cfm>

5.1.2 FONT SELECTION & LAYOUT

By default, apps will use the system font. Whether or not developers decide to utilize this or import their own, fonts within the app should follow the following rules.

- Body text fonts should be without serifs and italics.
- Stroke width should not be greater than $\frac{1}{3}$ the total character width. The preferred stroke width is $\frac{1}{4}$ the total character width. For text labels with multiple letters, the determination of stroke width should be based on letters such as H, N, or R.
- Space between characters should be at least one stroke width and should be the same throughout the label.
- Space between words should be at least one character width and should be the same throughout the label.
- Font colors should have sufficient contrast with the background color. Keep in mind the display may at times be in direct sunlight.

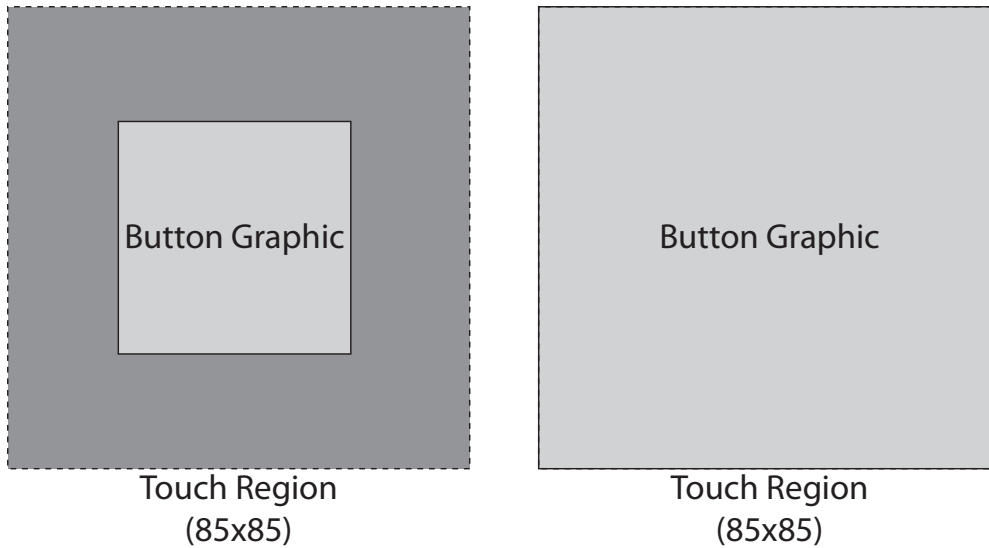


Figure 5.2.4.1

5.2 BUTTONS & NAVIGATION

5.2.1 MINIMUM BUTTON SIZE

When displayed on a touch screen, the touch target regions for buttons and navigation elements should be a minimum of 18 mm square (i.e., 85 pixels tall/wide for Next Gen 8" or 95 pixels tall/wide for CCR/CNR 7").

The graphical element does not need to take up the entire space, but interacting within this area (the touch region) will activate/select the element. Both examples in figure 5.2.1.1 are acceptable.

Note: due to parallax issues in some systems, it is better to place the button graphic "high" in the touch area (if smaller than the minimum touch area boundary) or to extend the touch area below the button graphic boundary by approximately 10-20% to account for the actual touch point being registered below where the user believes he/she to be touching on the screen.

5.2.2 INTERACTION SELECTOR BUTTONS/ICONS

Apps choosing to utilize an interaction selector (only available on Next Gen 8") will need to create the appropriate button images / icons for the system to display. The touch region for an individual interaction selector item is 85x100 pixels, minimum (it could be wider if there are fewer interaction selector buttons). The graphics/label do not need to utilize this entire space.

5.2.3 LIST ITEMS

At this time, list items should use the same sizes as defined for all other buttons. In the future, smaller sizes may be allowed, depending on research data currently being analyzed.

5.2.4 BUTTON SPACING

When possible, buttons should be given adequate spacing to minimize unintended activation due to nearby controls. A 10% margin minimum (approximately 10px on the next gen 8") is a suitable default. See "Note:" in Section 5.2.1 regarding parallax as well when consider spacing of vertically stacked buttons.

5.3 SYSTEM GRAPHICS

5.3.1 THEME INFORMATION

GM vehicles utilize distinct visual styles to create an overall experience to the user. Each GM brand may have multiple themes available to the user. To provide a more consistent experience to users, app developers may want to tailor their visual styles to match these themes. This is not required, but information is provided to assist developers if they choose to do so.

In the future, developers may be able to detect which theme is currently being displayed to further customize their app's look & feel.

Theme information will be provided as it becomes available.

6. INTERACTION REQUIREMENTS

6.1 APP / SYSTEM INTERACTION

6.1.1 BACK

Developers should include “back” functionality in their application through the faceplate button, if available, or an in-app button.

Pressing back should take the user to the previous screen or sub-screen as considered appropriate to the user. If the user is at top level of the app, pressing back should call the “release focus” function to return the user to their previous screen in the system (e.g., Home screen).

6.1.2 ACTIVITY INDICATOR

When the app is performing an action, a visual indicator should be used to inform the user of ongoing activity if the action is taking more than 1 second to complete/update the display.

6.1.3 CONTEXT UPDATING

Apps which update based on context (GPS, Map, POI, Currently Playing) should update automatically or with a single button press.

6.1.4 ERROR CORRECTION

Application allowing text entry should allow for error correction.

6.1.5 ROTARY CONTROLS

Systems which have a rotary control available should take action when the user interacts with that rotary control, even if they are in a touch enabled system.

7. SAFETY & VALIDATION

7.1 WORKLOAD & DRIVER DISTRACTION

Maintaining a safe driving environment is of paramount concern when dealing with in-vehicle applications. GM follows the standards set by the Alliance of Automotive Manufacturer's documentation (<http://www.autoalliance.org/files/DriverFocus.pdf>). Additionally, The National Highway Traffic and Safety Administration has recently released a set of guidelines regarding driver distraction. They are available online at the NHTSA website (at the time of writing, http://www.nhtsa.gov/staticfiles/rulemaking/pdf/Distractio_n_NPFG-02162012.pdf).

Driver Workload is an aspect of system/feature task interaction. The primary concern is that a driver engaged in a given interaction would be capable of operating the vehicle and reasonably capable of responding to the environment.

Driver Distraction represents the condition where the driver capability to observe/respond may be impacted.

7.1.1 NHTSA GUIDELINES

At this time, the NHTSA guidelines are still in draft form, but developers should be aware of the types of restrictions that may soon be enforced.

7.1.2 LOCKOUTS

In general, when the vehicle is in motion, actions available to the user should be limited.

7.1.2.1 LOCKOUT BEHAVIORS

Buttons or controls that operate locked out features should be differentiated visibly from other controls (e.g., grayed out, colored differently, etc.). When users attempt to operate a locked-out control, they should be informed that the control is unavailable while the vehicle is in motion and directed to use any alternate controls (if available).

7.1.2.2 LOCKOUT ITEMS

Applications need to make specific manual controls, both touch screen and faceplate, inoperable within the user interface (e.g., "gray out", ignore faceplate input, etc.) based on vehicle speed, transmission status, or park brake status. Apps can use the "get speed" function to determine if the vehicle is parked, moving at low speed, or moving at high speed.

The following list describes functionality which GM locks out when the vehicle is in motion.

ALPHA-NUMERIC INPUT

- Any manual interaction method for alphanumeric data entry such as address entry, phone number entry, etc.
- Any manual interaction method that directly lead to a screen where alphanumeric data entry is required (buttons/links that lead to such a screen).

HMI Action: Touchscreen buttons “grayed out”; faceplate control inputs ignored.

LISTS

- Any manual interaction method that allows scrolling of long lists, specifically lists that are not sorted alphabetically, numerically, or in some other logical sorting order.

HMI Action: Touchscreen buttons “grayed out”; faceplate control inputs ignored.

7.1.2.3 VIDEO DISPLAY

- Any video playback while not in park / parking brake engaged.

HMI Action: Video disabled / Video playback “blacked out” on screen. Audio playback only from video is available.

7.1.3 MOVING SCREEN ELEMENTS (E.G. ANIMATIONS & TRANSITIONS)

Due to concerns over driver distraction, moving elements on screen should be kept to a minimum. Moving transitions between screens should be short. The transitional elements used by GM tend to measure below 500ms.

7.1.4 IN APP ADVERTISEMENTS

Advertisements, if utilized, should follow the same guidelines as the rest of the app. These include font sizes, limits on distracting elements, etc.

To re-iterate, ads should not include:

- video/moving images (unless the vehicle is in park)
- scrolling text
- large blocks of text

Additionally, objectionable content and/or content meant to mislead the user (i.e. “your vehicle needs service, click here”) is not allowed.

7.1.5 EXTERNAL LINKS

Apps should take care to remove and/or block links to outside resources (e.g. links to an article, an advertiser’s website, etc.).



Figure 7.1.5.1
Group Filters

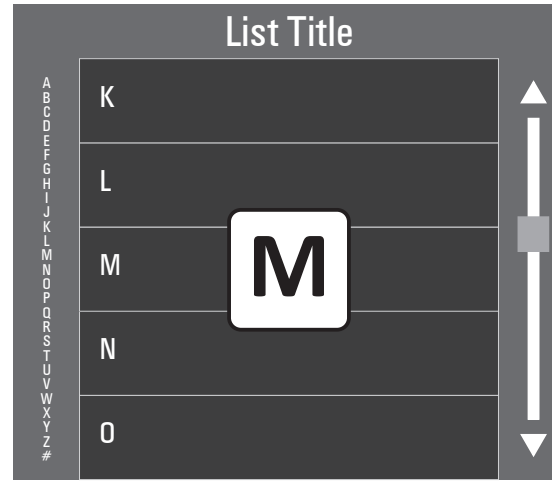


Figure 7.1.5.2
Vertical Keyboard

7.1.6 LIST ORGANIZATION

To optimize searching through a list, developers will need to employ smart search techniques. The following list provides several suggestions, but developers may find alternative methods that are equally effective.

7.1.6.1 GROUP FILTERS

Lists organized first by groups (e.g. “ABC”, “DEF”...) which lead to sub-lists.

7.1.6.2 VERTICAL KEYBOARD

A vertical alphabetically sorted keyboard placed next to the primary list allowing

7.1.6.3 TEXT ENTRY FILTER

Based on user input (such as a T9 or other grouping system), the list is filtered to only display matching items.

7.1.6.4 RECENTLY ENTERED / AUTO-COMPLETE

As a user begins entering data, the system predicts the likely entry, either based on recent input or other algorithms.



Figure 7.1.5.3
Recently Entered / Auto-Complete

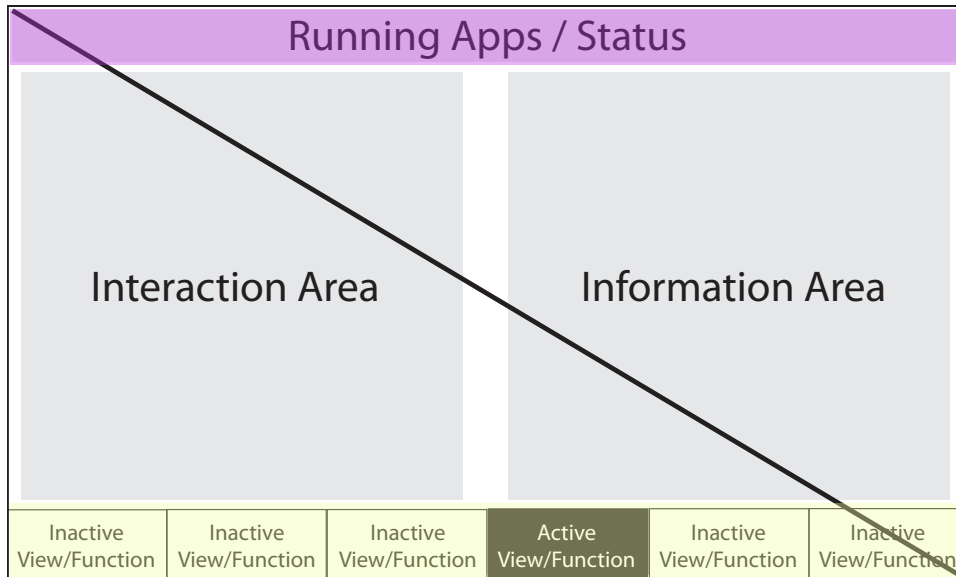
7.2 VALIDATION PROCESS

As information on the submission & validation process becomes available, this document will be updated.

8. CUSTOMER PRIVACY

As information regarding the protection of customer privacy and data becomes available, this document will be updated.

9. GM DESIGN



9.1 NEXT GEN 8"

The following sections detail several elements used within GM's Next Gen 8" HMI, followed by descriptions of how GM has chosen to organize certain types of information on the screen. We have found these to be effective methods in-vehicle, and would suggest developers follow a similar pattern.

Note that the information provided here applies to the HMI designed for the Next Gen 8" screen with a touch screen. Not all of the features/designs may be applicable to the other systems. This document may be updated to include information regarding designs on the other systems.

9.1.1 GENERAL SCREEN LAYOUT

To keep applications familiar to the user when going from one to the next, certain design guidelines were created to keep the interaction similar between applications.

9.1.1.1 APPLICATION TRAY / STATUS AREA

This area is used by the system to display status information and shortcuts to applications of the user's choice.

9.1.1.2 INTERACTION AREA

The Interaction Area is where the primary actions for the user are located. This can include lists, buttons, or any other type of input the user is to perform.

To keep the interactions close to the driver, the interaction area was positioned on the left side of the display. This reduces the amount of reach the driver needs to perform to interact with the display.

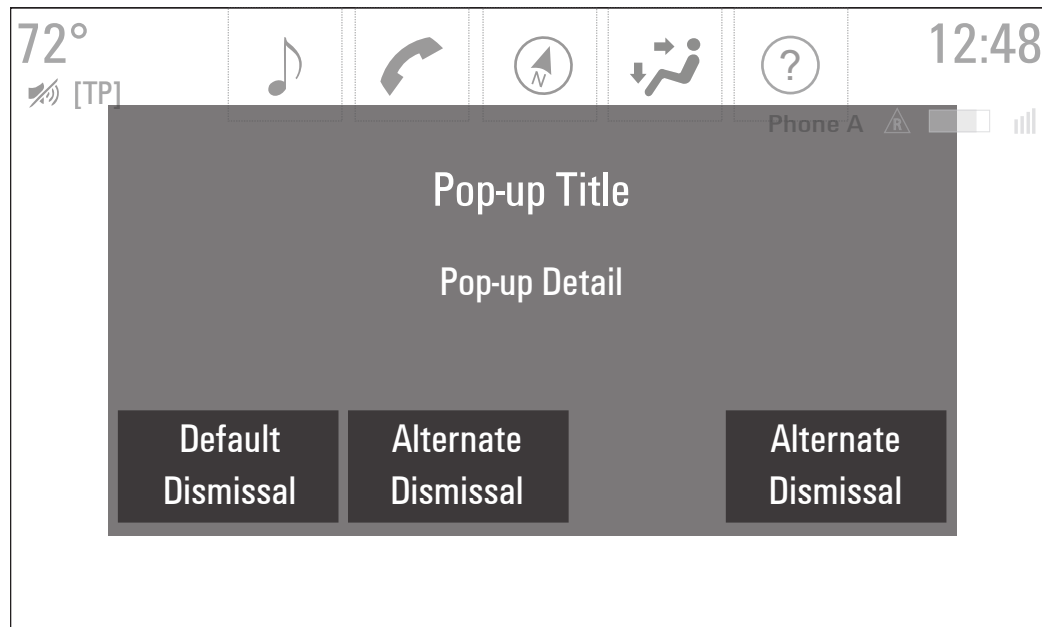
9.1.1.3 INFORMATION AREA

The Information Area is where any status information about the current application is located. This can include icons, pictures, text, or any other information that is not necessarily interactive.

Because the Information Area is not as high priority as the Interaction Area, it is located on the right side of the display.

9.1.1.4 INTERACTION SELECTOR

This element is described in detail later in this document. The Interaction selector is located in the same location in all applications, but the number of buttons and their function is controllable by each application.



9.1.2 POP-UPS & ALERTS

GM uses two distinct styles of notifications to inform users about information or events. Applications only have access to the system alert manager, but developers could choose to mimic the pop-up style if they so choose.

9.1.2.1 POP-UPS

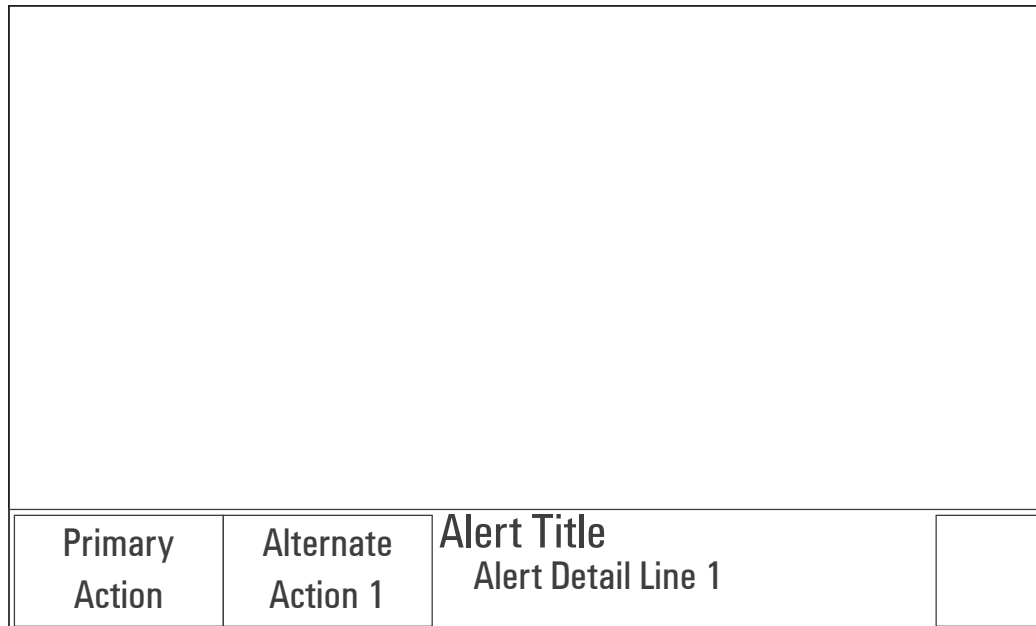
Pop-ups are used to present important information to the user in response to some interaction that the user has just performed. This information could be an error, or confirmation related.

Pop-ups are defined by the following characteristics:

1. Pop-ups are triggered from user interaction with the HMI (e.g. Selecting an Unavailable Favorite, Tips Information Presentation, etc.)
2. Pop-ups may contain multiple dismissal actions the user must choose between to dismiss the pop-up (e.g. Confirm Deletion of Contacts, etc.).
3. Pop-ups will auto-dismiss if not explicitly dismissed by the user.

Pop-ups are presented to the user as a full screen information window. The Pop-up may have some level of transparency, so that underlying information may be slightly visible. The Pop-up window cannot be moved or resized.

Pop-ups are triggered to auto-dismiss after 20 seconds. To offer the user more time to make a final dismissal selection before the pop-up is unavailable, the pop-up will fade into the background over a 3 second period. If the



user touches the pop-up area during the auto-dismiss fade, the pop-up will return to full opacity and the auto-dismiss trigger timer is restarted, ultimately resulting in a subsequent auto-dismiss of the pop-up again.

When a pop-up is triggered and displayed, an associated pop-up audio prompt may be played to notify the user of an active pop-up.

9.1.2.2 ALERTS

Alerts are used to present time critical, asynchronous information to the user that requires attention or input from the user.

1. Alerts are triggered from a system event or outside stimulus (e.g. Incoming Phone Call, Appointment Reminder, etc.).
2. Alerts contain up to three actions the user must choose between to dismiss the alert while present (e.g. Dismiss an Appointment or Snooze, etc.).
3. Alerts will always auto-dismiss, except an Incoming Phone Call, RDS Traffic Announcement (Europe only), or PTY31 Alert (Europe only)
4. Alerts may also immediately be removed if the alert stimulus no longer exists (e.g. Incoming Call rolls into voicemail, RDS Traffic Announcement completes, PTY31 Alert completes)

Alerts are presented to the user in the lower screen area. This area is 94 pixels high (on the 8" screen) in full lower part of the display and full-screen in the Next Gen

4.2" systems.

The Alert has no transparency, so will fully cover anything in the lower screen area when present. The Alert window cannot be moved or resized and can only be removed by selecting an action, auto-dismissing, or removing alert stimulus.

9.1.3 INTERACTION SELECTOR

Users interact with Interaction Selectors in almost every application run by the system. An Interaction Selector allows users the ability to change pages/views within a given application or performs application specific functions when the corresponding Interaction Selector button is tapped.

Interaction Selectors are shown only when there is more than one page/view or function that can be performed in a given application or screen. When shown, an Interaction Selector may be visible at all times or it may only be shown when proximity is sensed or it may be suppressed when interacting with another part of the screen.

The Interaction Selector allows users to perform an action associated with a given application (e.g., Seek UP/DOWN, activate a speech recognition session; cancel an action; etc.). Users tap the desired Interaction Selector "action" button and the corresponding action is performed. The button is temporarily highlighted to show that it was indeed activated. In some instances, the "action" button may remain highlighted while the action

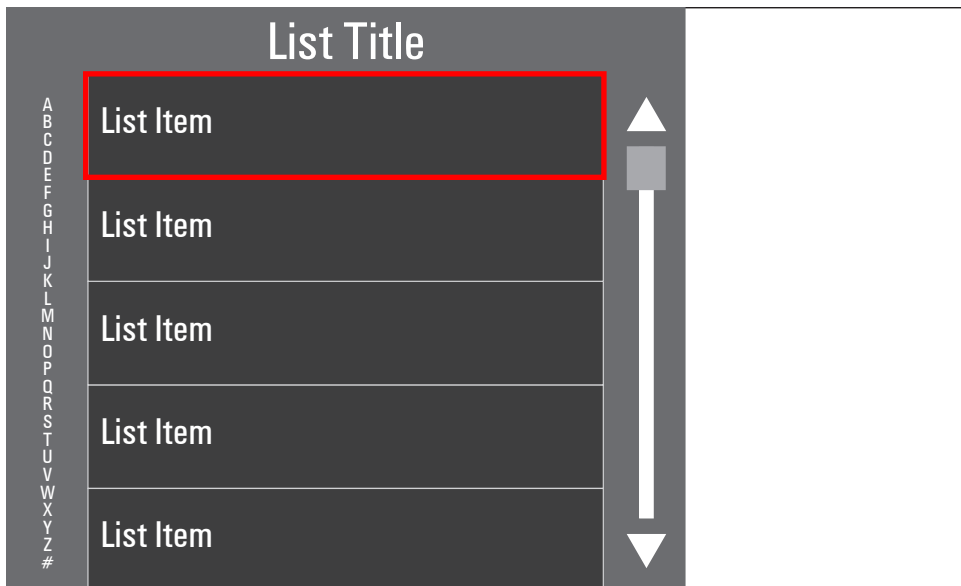
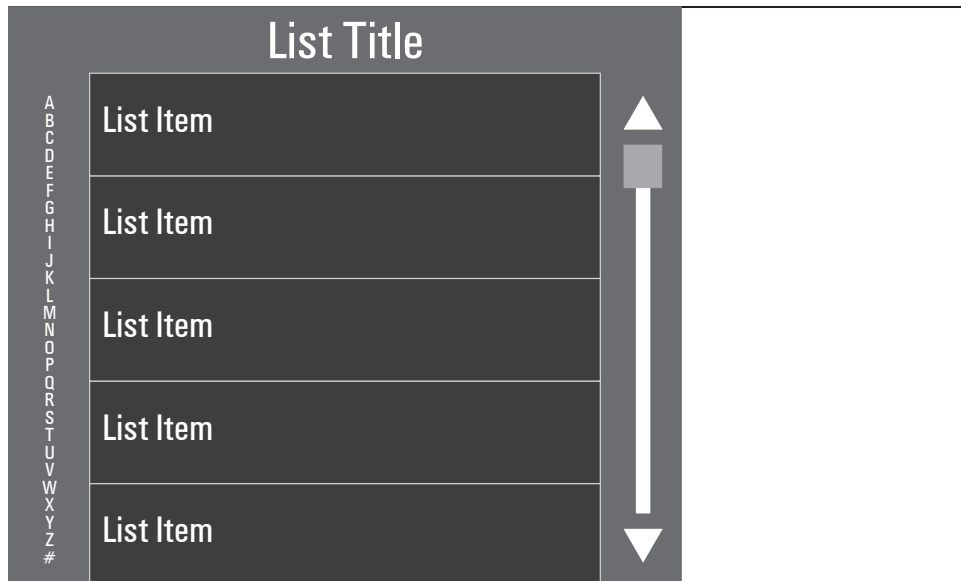
is in process; for example, an active speech recognition session (see specific application sections for details). All Interaction Selector “actions” are performed “on release” when tapping the button.

If a list is already being displayed, tapping the Interaction Selector button associated with displaying that list resets the displayed List to the top/start (e.g., returning to the start alphabetically of the Artist filter list or the most recent date for SMS messages).

In a number of screens, the Interaction Selector is visible and then is automatically minimized when a user begins interacting with the main part of the screen (e.g., a displayed list or keyboard). When this happens, the Interaction Selector remains minimized until the user leaves the screen and returns anew (e.g. goes back to a “Now Playing” screen in audio and then begins to browses stations/media again) or causes the Interaction Selector to be displayed again by tapping or dragging on the “reveal” button (see Figure 2.3.1.1).

Interaction Selector buttons are grayed-out when the function associated with that button is not available. For example, if the map is zoomed in to the smallest scale level, the “zoom in” button on the interaction selector is grayed out.

If the user taps a grayed out interaction selector button, the system displays a pop-up with the corresponding text that the function is not available. Details of such pop-up text are covered below and in the specific application sections.



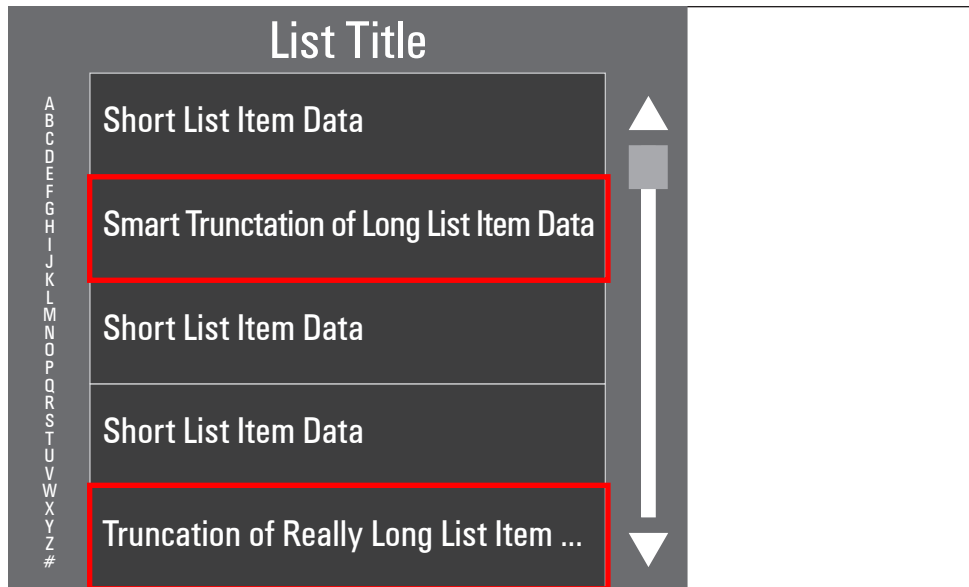
9.1.4 DESIGN SUGGESTION - LISTS

9.1.4.1 LIST ITEMS

Each row in a list contains the List Item (e.g., contact name; song title; message header; etc.). A List Item can be a single line of text, it may be multiple lines tall, and/or contain small or large graphical elements. Therefore, List Item height is dependent on the context of the List Item contents displayed. Both List Item height and width are fixed for a given list displayed.

The number of List Items displays is dependent on the content of the list/sub-list. For example, a single List Item may be displayed when there is only a single Album or Song associated with the higher-level List Item selected. Hundreds or even thousands of List Items may be displayed when there is such content for a given list such as All Songs in "My Media" or a Contact List from a connected device.

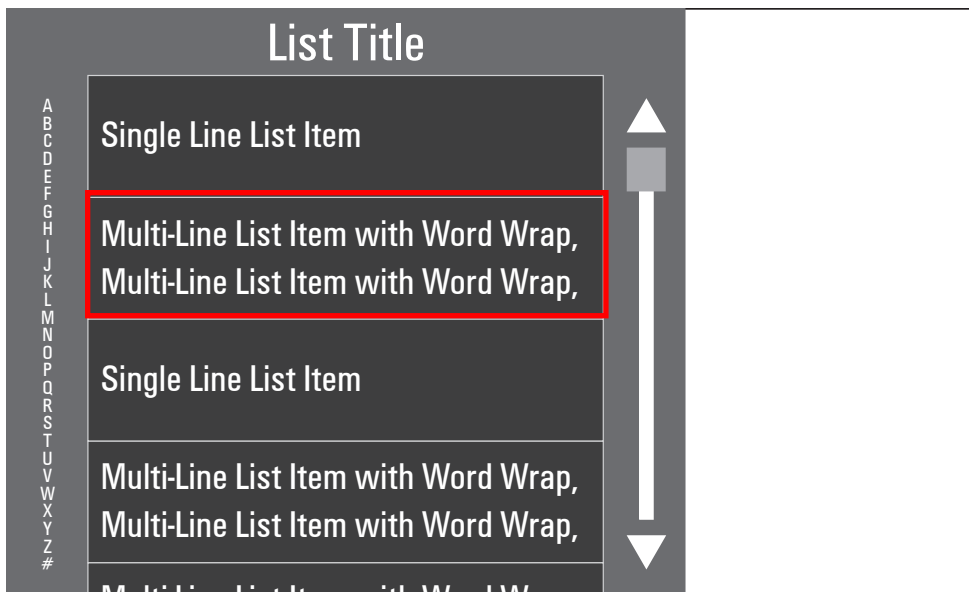
List Items are selectable. Tapping a List Item displays an associated sub-list (e.g., list of songs associated with the album name tapped) or performs an action associated with the List Item selected (e.g., start playback of a song; display an edit screen for the List Item; etc.). The action is performed "on release" when tapping a List Item.

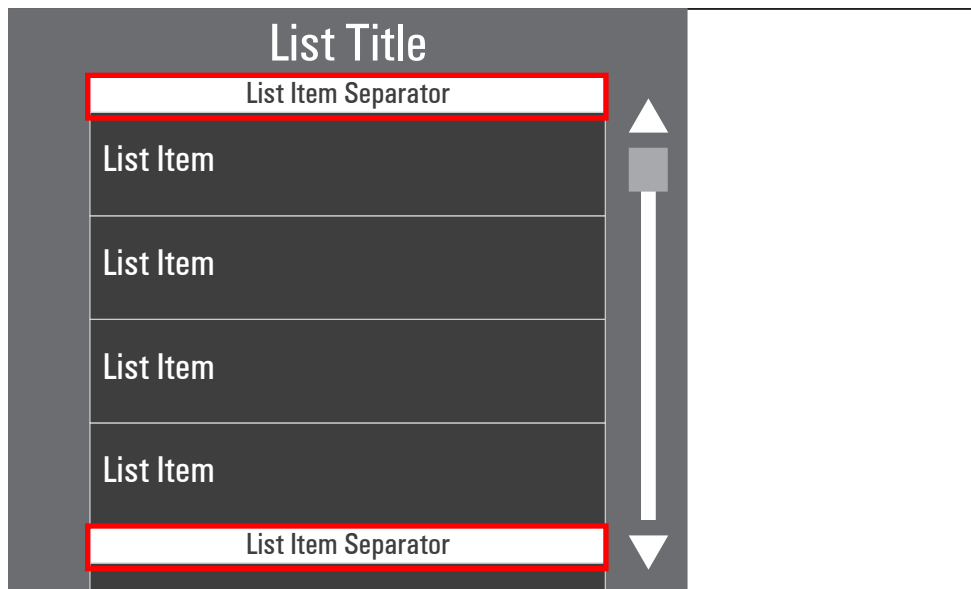


9.1.4.2 DISPLAY OF LONG TEXT INFORMATION IN LIST ITEMS

When a List Item contains variable text that may be longer than the available viewing area in a List Item, it may do one of the following:

- Smart Truncation - if the text string is long by only a few characters (e.g., 3), the font character spacing is compressed to fit all characters in the viewable area.
- Truncation - if the text string is too long to fit with Smart Truncation in the viewable area, the text string is truncated and ellipses (...) are added at the point where the text string was cut off.
- Word Wrap - if the text string is too long to fit on a single line in the viewable area, the text may wrap within the List Item area.





9.1.4.3 LIST ITEM SEPARATORS

List Item Separators may be used to provide context to List Items displayed below a separator. They may contain text or a graphical element and are graphically distinguished from a List Item. A List Item Separator is not selectable.

The height of List Item Separators, in general, are less than the height of a row containing a List Item. However, they may be taller to accommodate multiple lines of text and/or larger graphical elements.

List Item Separators move along with the List Items whenever a list is scrolled. However, there is always one List Item Separator “locked” at the top of a list when they are displayed. List Items scroll behind that “locked” separator until it is replaced by a new List Item Separator associated with the corresponding List Items displayed directly below it. A single List Item Separator may serve as the “title” for the list being shown.

When List Items are arranged in chronological order (e.g., in box for e-mail, recent calls, etc.), Date Separators are used. Typically, the order is reverse chronological such that items at the top of the list are closer to current time and those further down the list are farther back in time. When Date Separators are used, they use the following labeling convention: Today, Yesterday/Tomorrow, and for all other days the actual Date following the date format defined by the Language (or Region)



Figure 9.1.4.1

9.1.4.4 LIST FUNCTION BUTTONS

Function Buttons may be displayed on List Items and/or Lists, and when tapped perform their intended function. For example, a Play button may be placed on a List Item and when tapped begin playing music by the artist name shown in the List Item, or a Back button may be placed on a List and when tapped displays the previous list in the list hierarchy being navigated. The action associated with the Function Button is performed “on release” when tapping a Function Button.

Function Buttons displayed on List Items move with their corresponding List Item when a list is scrolled.

Function Buttons are visible at all times when the list is displayed.

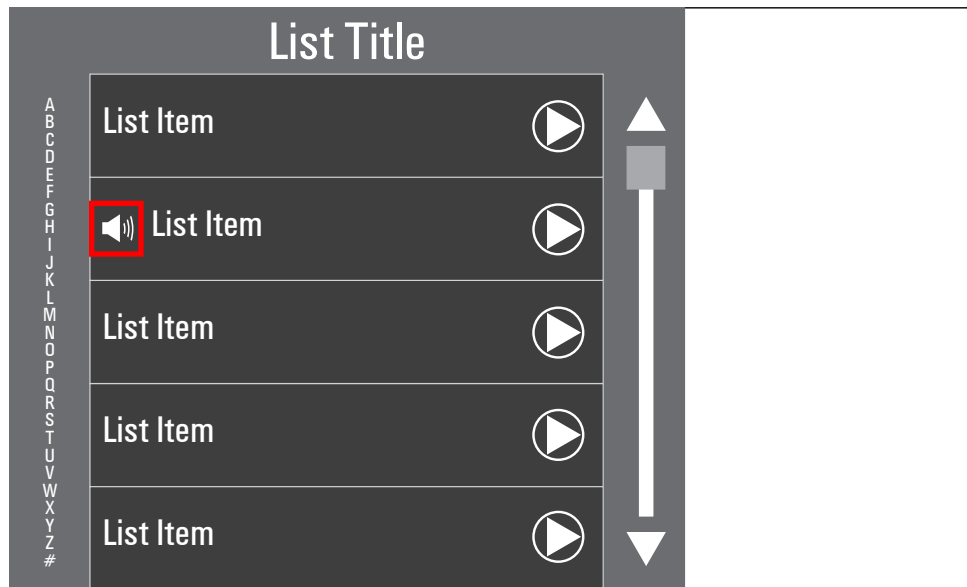


Figure 9.1.4.2

9.1.4.5 LIST INDICATOR ICONS

Indicator Icons may be displayed on List Items; for example, a “Now Playing” icon showing that an Artist Name in a List Item is currently being played.

Indicator Icons displayed on List Items move with their corresponding List Item when a list is scrolled.

Indicator Icons are visible at all times when the list is displayed.

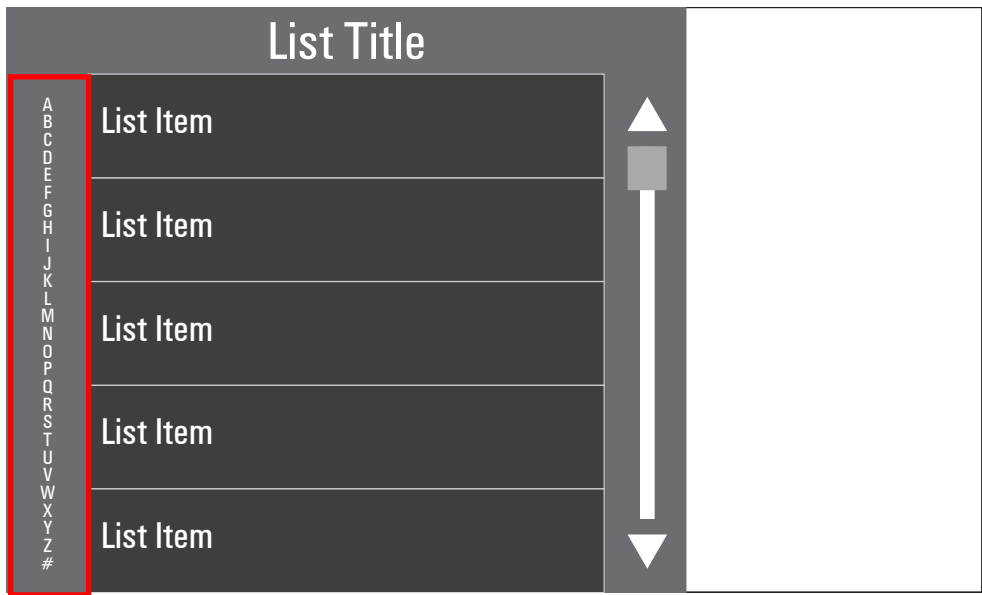


Figure 9.1.4.3

9.1.4.6 VERTICAL KEYBOARD

If the List Items are displayed in alphabetical order or some other order (e.g., numeric), a Vertical Keyboard is displayed adjacent to the list. However, if the number of List Items is short (i.e., the entire list can be shown in the visible area), a Vertical Keyboard is not displayed.

Tapping a letter (or number) on the Vertical Keyboard jumps the list to display the first List Item starting with the letter (or number) selected at the top of the list. The action associated with the Vertical Keyboard is performed “on touch” when tapping a letter. If the user touches a letter that does not have a corresponding List Item in the list displayed, the list jumps to the end of the List Items for the previous closest letter alphabetically, or number, to help show users there are no List Items associated with the letter selected. If the user selects the letter A and there is no corresponding list content starting with the letter A or the letter B, list items starting with the letter C or the next letter in alphabetical order containing list content are to be displayed as the “top” of the list.

For lists containing mixed character content, those items that do not correspond to the characters displayed in the vertical keyboard are displayed under the “symbol” key (i.e., for Latin vertical keyboard) and are ordered according to their unicode value in ascending value order. Section 11 covers other regions and languages’ vertical keyboards.

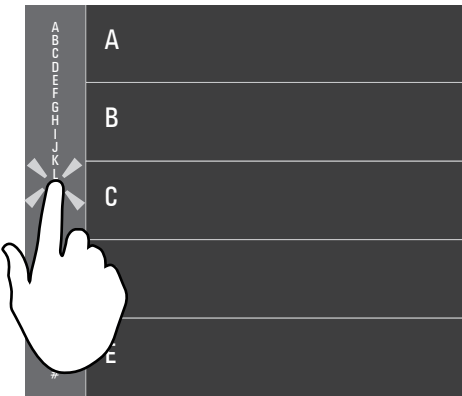


Figure 9.1.4.4

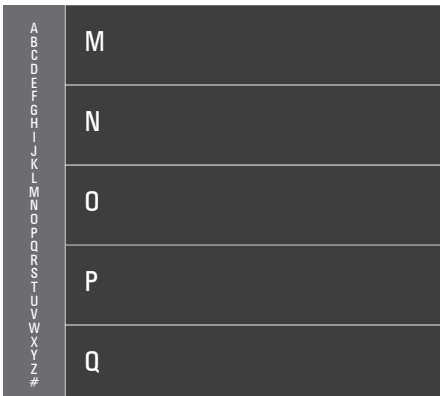
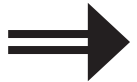


Figure 9.1.4.5

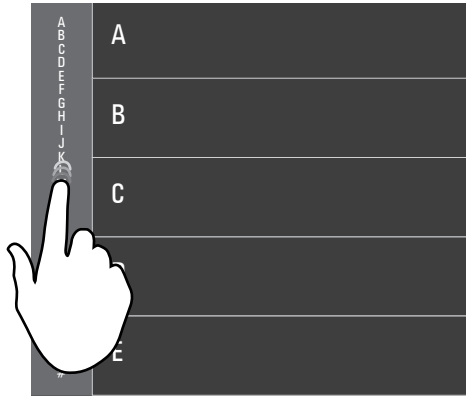


Figure 9.1.4.6

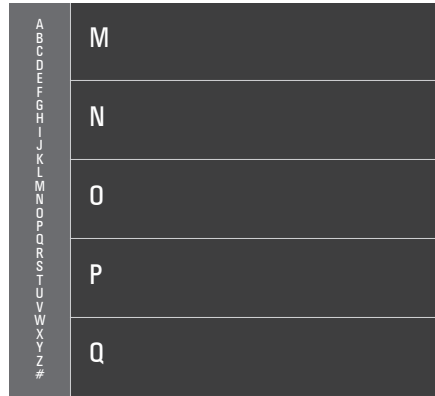


Figure 9.1.4.7

If users keep their finger on the Vertical Keyboard and drag it up/down, the list jumps to display the first List Item starting with the new letter/number that is under the finger pad (i.e., detected touch area) at the top of the list or jumps to the end of the list for the previous closest letter alphabetically (or number) containing List Item contents to show users that there are no List Items associated with the letter/number currently under the finger pad.

The maximum number of characters displayed vertically in the keyboard is 30 and the maximum number of items/characters displayed per line is 4 numbers (e.g., 1020) or 4 characters (e.g., wxyz).

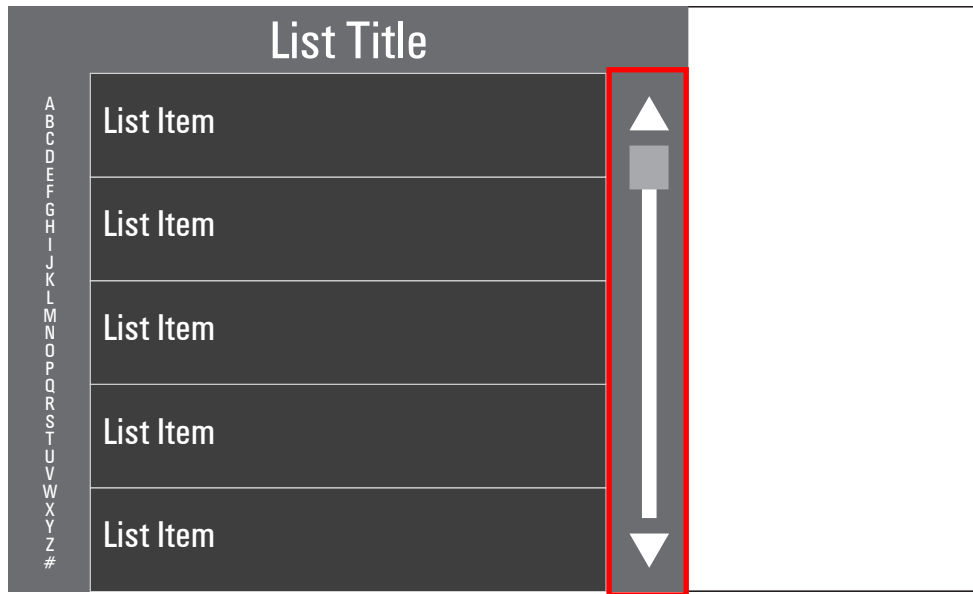


Figure 9.1.4.8

9.1.4.7 SCROLL BAR

If the number of List Items is more than what can be shown in the visible area, a Scroll Bar is displayed adjacent to the list. A Vertical Keyboard may be shown along with a Scroll Bar, if the List Items displayed are ordered alphabetically or numerically.

The Scroll Bar is used to scroll lists in several ways. First, users can drag the Scroll Bar “position indicator / elevator” (i.e., a graphical indication of where the user is in a list) and the list scrolls according to the amount the indicator moved relative to the overall length of the list. When dragging, the list items are “soft scrolled” (vs. jumping from one list item position to the next).

Second, users can tap either above or below the “position indicator / elevator” or on the end-points (e.g., arrow indicators at the end of the Scroll Bar) of the Scroll Bar causing the list to scroll up/down one page of List Items for each tap. The corresponding action is performed “on touch”.

Finally, users can press and hold on the end-points of the Scroll Bar causing the list to page up/down at a rate of 4 Hz (i.e., 4 pages per second).

The Scroll Bar “elevator” is dynamically re-sized to represent the percentage of the list that is currently visible. The “elevator” has a minimum size height (e.g., 20 pixels) for instances where the lists are long and the percentage of the list displayed in the viewable area

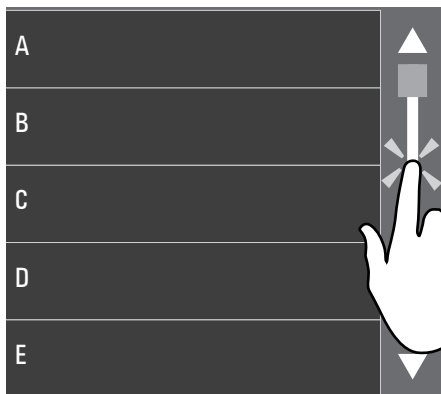


Figure 9.1.4.9



Figure 9.1.4.10

would result in displaying an “elevator” that is only a few pixels tall.

The Scroll Bar behavior is very similar to that used in Windows on a PC.

9.1.4.8 ZOOM BUBBLE

The Zoom Bubble displays a magnified view of the List Items while a list is being scrolled (e.g., the first letter or corresponding frequency/channel value). It is displayed when users hold their finger down on the Scroll Bar and begin dragging the “position indicator / elevator” or when users are ‘fast paging’ by pressing and holding the end points of the scroll bar. The Zoom Bubble disappears when the user stops dragging their finger along the Scroll Bar or removes their finger from the screen after a press and hold gesture.

The item shown in the Zoom Bubble always corresponds to the middle List Item displayed and updates along with the list as it is scrolled. If the list displays an odd number of list items, the “middle” list item is calculated as $((\# \text{ of list items displayed} - 1) / 2) + 1$ where that list item is what gets displayed in the zoom bubble when shown. If the list displays an even number of list items, the “middle” list item is calculated as $(\# \text{ of list items displayed}) / 2$ where that list item is what gets displayed in the zoom bubble when shown. The zoom bubble location does NOT need to change location depending on the type of list displayed (e.g., media list vs. phone list).

Figure 9.1.4.11

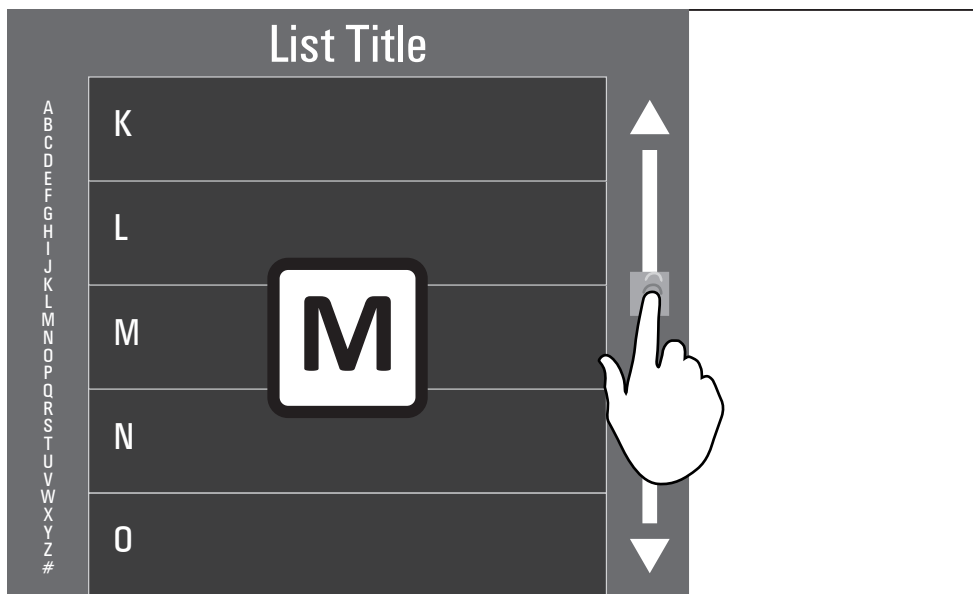


Figure 9.1.4.12

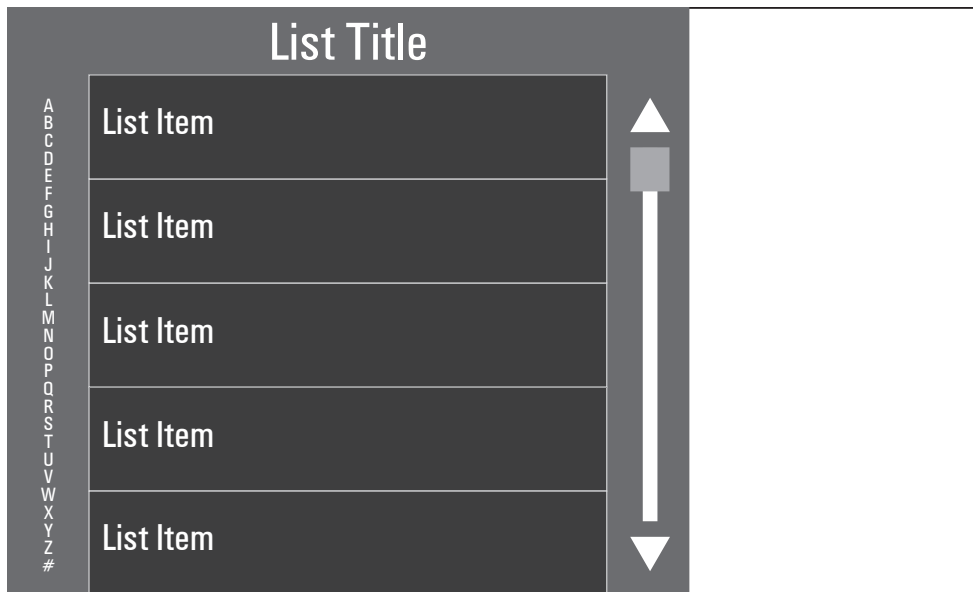


Figure 9.1.4.13

Contents of the Zoom Bubble change depending on what is displayed in the List Items. Only 1 line of text is displayed in the zoom bubble. For example, radio frequencies are displayed in the Zoom Bubble when scrolling the strong station list. In alphabetic lists, the first letter or couple letters of the part of the list being scrolled is displayed in the Zoom Bubble.

9.1.4.9 LIST GESTURES

The following describes the gestures that may or may not be used as part of a list, depending on the specific application's use of lists.

List Gestures include:

- Tap
- List Drag
- Fling
- Drag
- Press and Hold

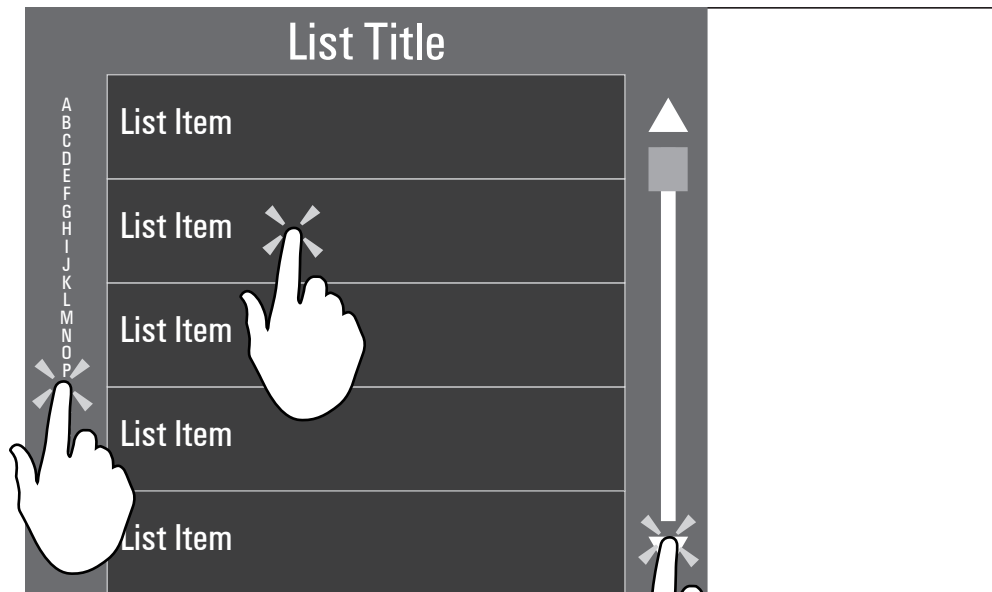


Figure 9.1.4.14

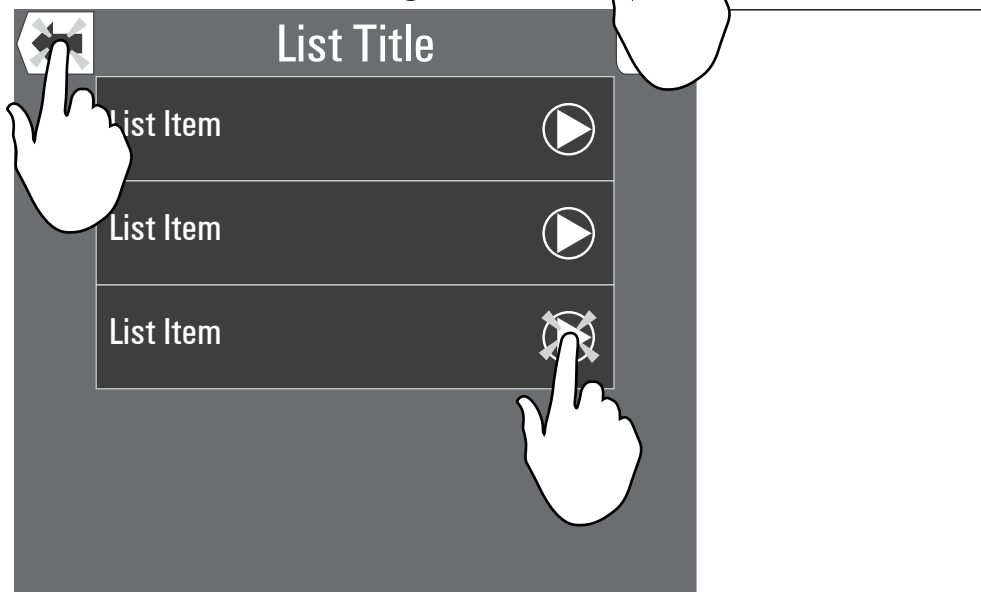


Figure 9.1.4.15

9.1.4.10 TAP

Users tap various List Elements to perform desired functions. Some of these functions are executed “on touch” while most are executed “on release” when tapping the display. See the prior List Element descriptions for instances where Tap is used.

In instances where a Tap gesture is executed “on release” (e.g., to account for other gestures such as Fling or Drag that start when a user touches the display and then moves their finger), once users start to move their finger a few millimeters in a direction while still touching the display, the Tap gesture (selection) is canceled and the other gesture being performed is executed.

If a List Item is only partially displayed in the visible area and the user taps within the partially displayed List Item region, the List Item shows as being selected and the new list is displayed or action performed.

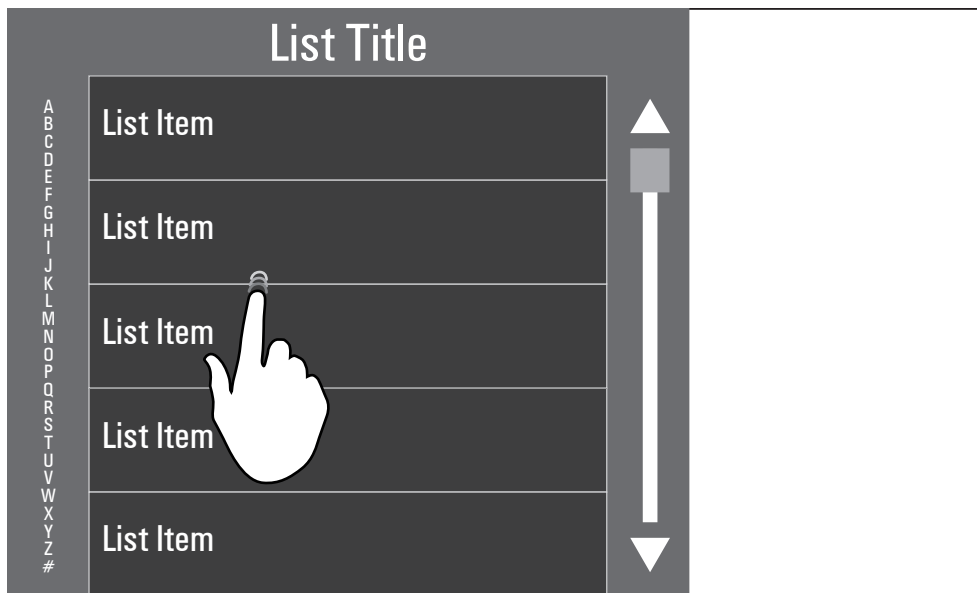


Figure 9.1.4.16

9.1.4.11 LIST DRAG

Lists longer than what can be displayed within the visible area of the screen can be scrolled short distances using a List Drag gesture. Users press anywhere within the List Items or List Item Separators displayed and move their finger in an up or down motion without releasing their finger. The List Items and List Item Separators scroll up or down following the finger's movement in a one-to-one relationship (i.e., gain).

When users remove their finger from the List Item or List Item Separator after starting a List Drag, the List Items and Separators stop moving. A Tap gesture "on release" is not executed when removing the finger after the start of a List Drag gesture.

When dragging, the list items are "soft scrolled" (vs. jumping from one list item position to the next).

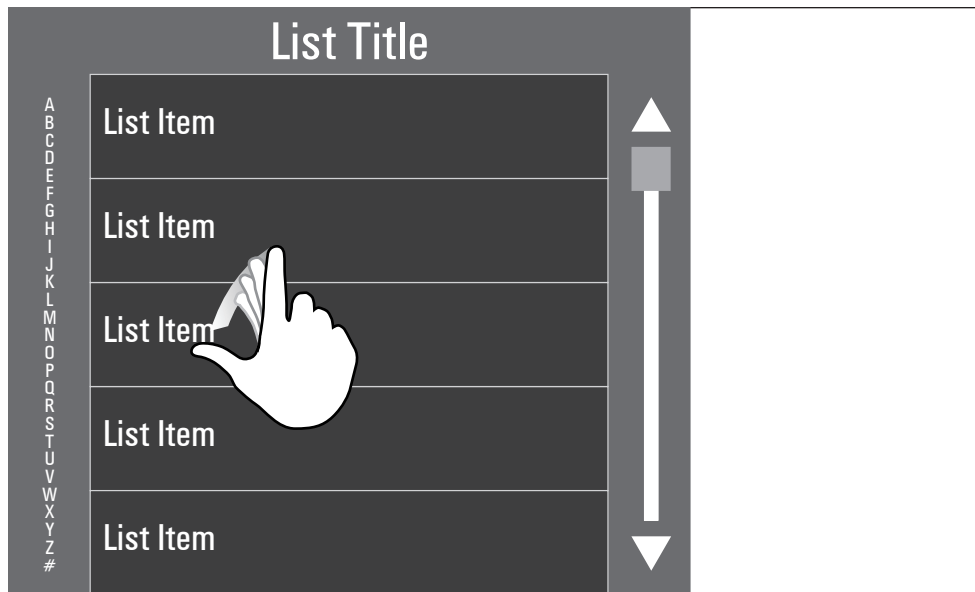


Figure 9.1.4.17

9.1.4.12 FLING

Lists longer than what can be displayed within the visible area of the screen can also be scrolled using a Fling gesture. To “fling” a list, users press anywhere within the List Items or List Item Separators displayed, move their finger rapidly in an up or down motion, and release the list while their finger is still moving. The list continues to scroll as if it had inertia and slows down as if friction were acting upon the list. The speed with which the list scrolls is dependent upon the speed which the finger was traveling when the list was “released” combined with the physics to be defined for the list scrolling behavior (e.g., mass, friction, etc.).

When flinging, the list items are “soft scrolled” (vs. jumping from one list item position to the next).

List scrolling from a Fling gesture is stopped when the end of a list is reached or when the user Taps the list while it is moving.

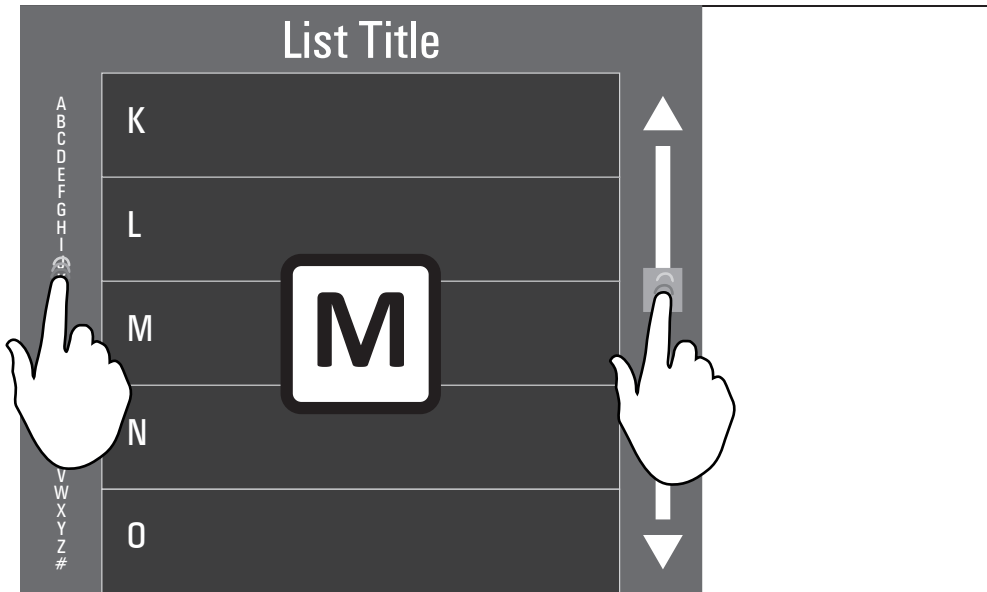


Figure 9.1.4.18

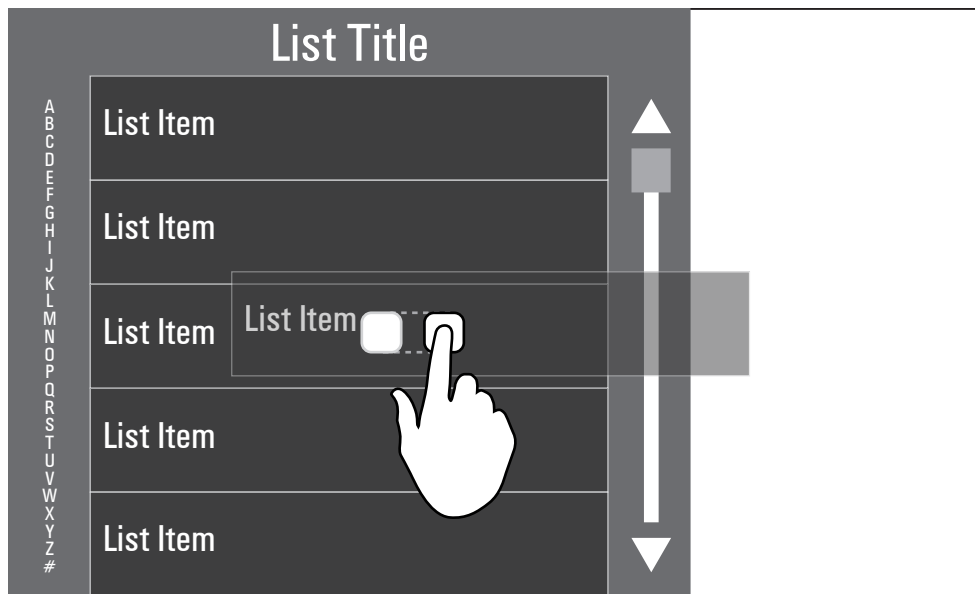


Figure 9.1.4.19

9.1.4.13 DRAG

Users can Drag certain List Elements to perform functions such as scrolling a list, storing a List Item as a favorite, or removing a List Item from the list.

Drag gestures used to scroll lists are described in the Vertical Keyboard and Scroll Bar List Elements sections and the List Drag section.

Users may also be able to drag List Items to store them as Favorites, to remove them from lists and/or to rearrange the order of List Items in a list.

Drags are performed by touching an element on the screen and dragging that finger along the screen while holding on to the element. Removing the finger from the screen releases the item being dragged. The item, when released, is either placed in the new location where it was left/released or is returned to its previous location because certain criteria regarding the drag gesture were not met (e.g., the List Item wasn't dragged and released over the Favorites page; the List Item wasn't dragged far enough away from the list to be removed; etc.).

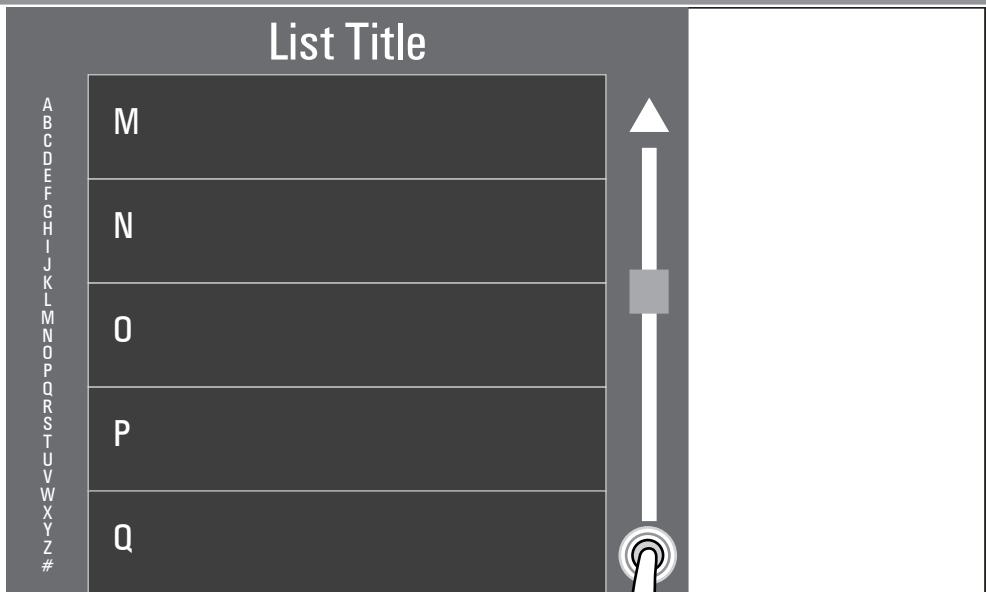


Figure 9.1.4.20

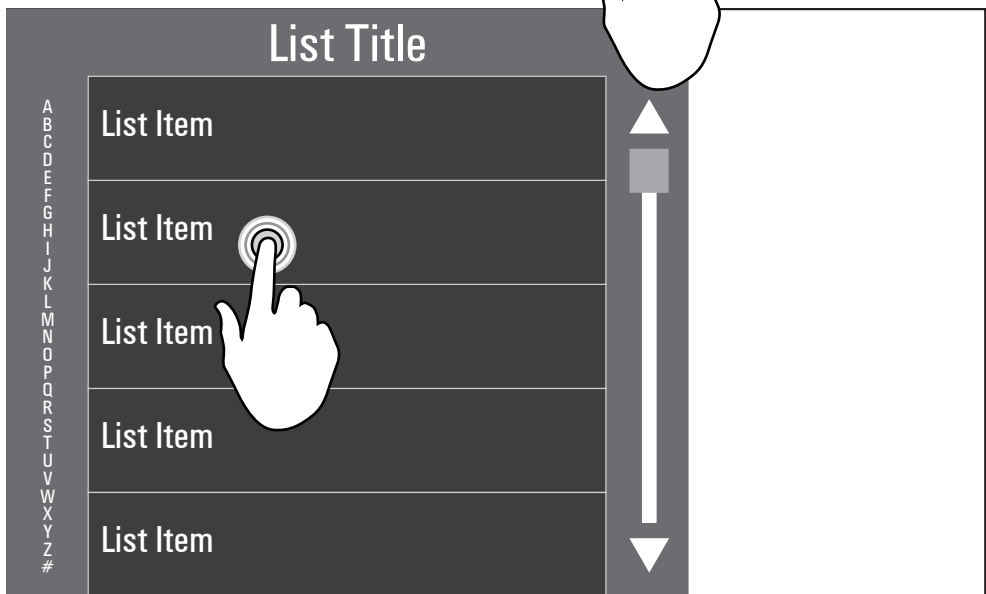


Figure 9.1.4.21

9.1.4.14 PRESS AND HOLD

Users can Press and Hold List Elements to perform desired functions such as scrolling a list which is described in detail in the “Scroll Bar” List Elements section.

In addition, users can Press and Hold List Items to edit them, store them, and/or remove them from lists. Details of Press and Hold gestures such as these are described in the appropriate application sections where they are used.

A Press and Hold is performed by touching the screen with a finger and holding that touch location for longer than 1000-1500 ms.

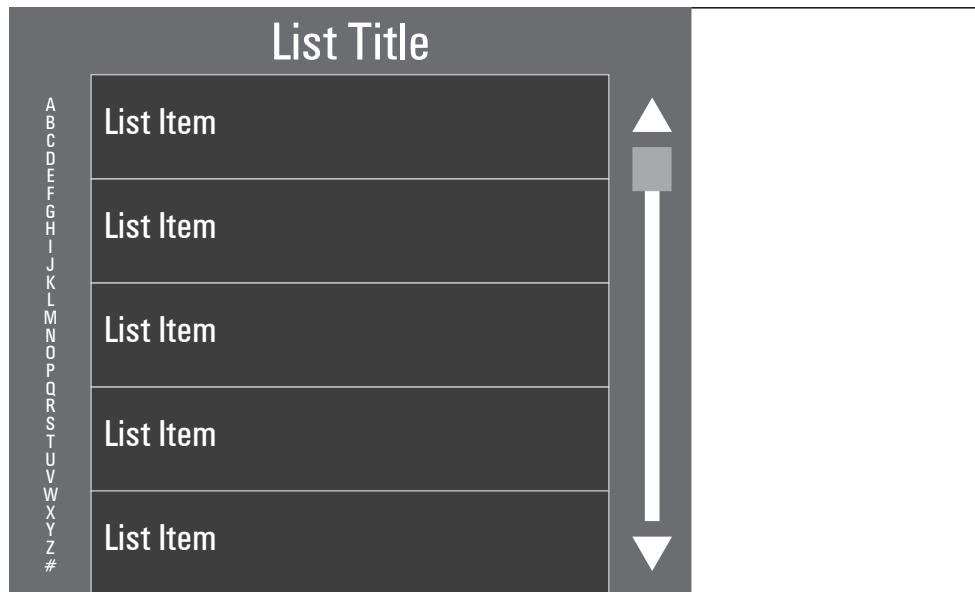


Figure 9.1.4.22

9.1.4.15 LIST INTERACTION BEHAVIORS

The following describes the interaction behaviors that may or may not be operationalized as part of a given list, depending on the specific application's use of lists. As a reference design, look at portable electronic devices with touchscreens that display lists to see how lists behave and are displayed (e.g., splitting List Items at top or bottom of visible area when list is scrolled)

List Interaction Behaviors include:

- Wrapping
- List History
- List Views
- Reset To Top

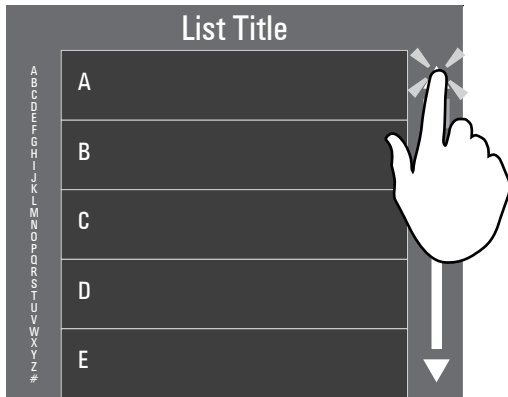


Figure 9.1.4.23



Figure 9.1.4.25

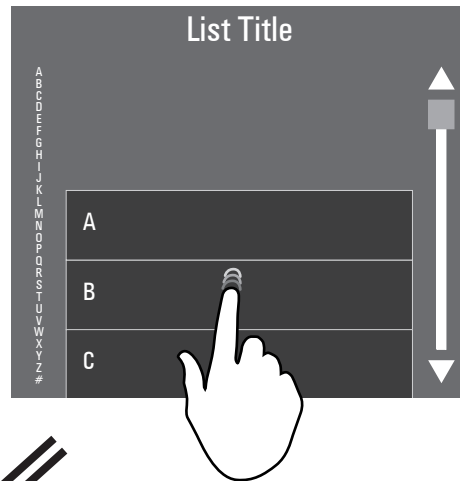


Figure 9.1.4.24

9.1.4.16 WRAPPING

Lists can wrap from start to finish or vice versa. One method to wrap a list is to drag the list when at the top or bottom past it's midpoint at which time it wraps to the bottom or top of the list respectively. Figures 9.1.4.24 and 9.1.4.25 illustrate dragging at the top of the list and having the list wrap to the bottom.

Another method for wrapping a list is to press the Scroll Bar end-points when the list is at its beginning or end. For example, pressing the "up arrow" on the Scroll Bar when at the beginning of a list will cause the list to wrap and display the end of the list.

Lists wrap only when the list is longer than what can be displayed on the single screen (e.g., more than 5 List Items).

For a reference design, look at portable electronic devices with touchscreens that display lists to see how lists wrap.



Figure 9.1.4.26

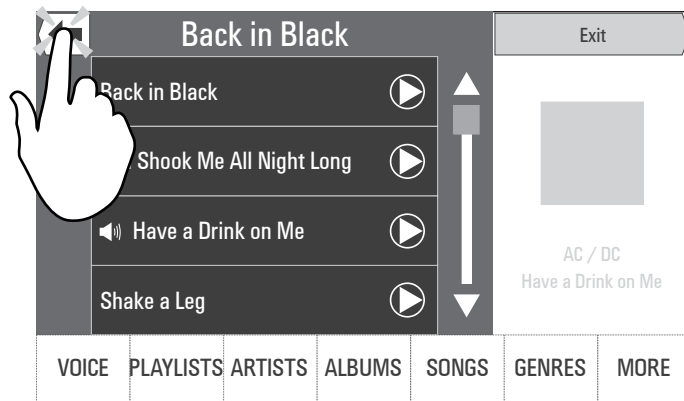


Figure 9.1.4.27

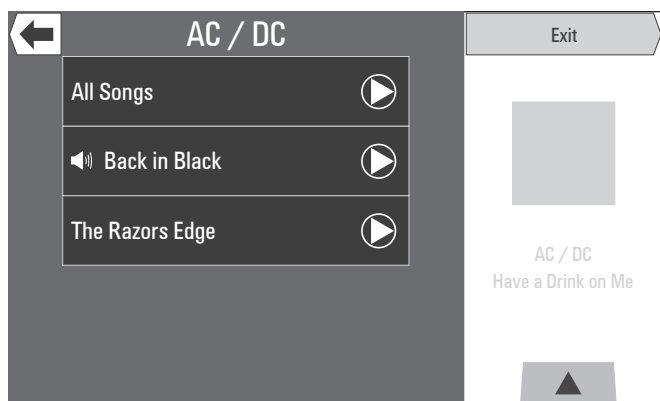


Figure 9.1.4.28

9.1.4.17 LIST HISTORY

When navigating list hierarchies or navigating between screens and lists, the system maintains a “history” of the list position that was last displayed when the given list was last viewed/displayed. The “List History” aids the user in situations such as when backtracking up a station or media search hierarchy; when returning to a station/media list from a now playing screen; or when returning to a Contacts List in the phone application from another screen.

List History is reset on power cycle, except in instances where defined otherwise.

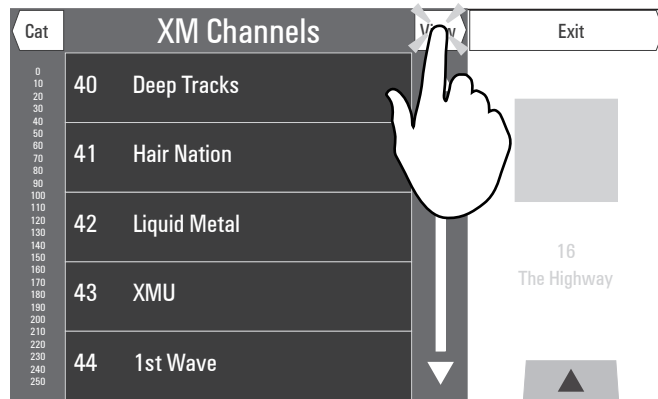


Figure 9.1.4.29

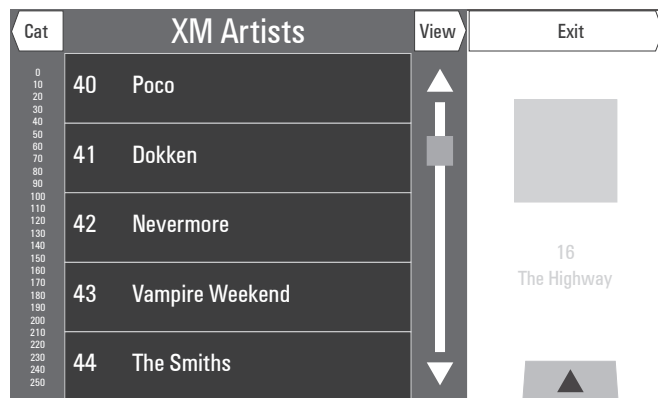


Figure 9.1.4.30

9.1.4.18 LIST VIEWS

List Items can be changed and/or sorted in different ways by pressing the “View” or “Sort” button in the upper right corner of a list. Depending on the List Items displayed by the application, each press of the button sorts the list according to the method defined by the application or changes the List Items displayed. For example, a Places of Interest list may be sorted by distance from current location or alphabetically; while an XM station list may show the channel name or artist name or song name playing on a given channel. A Recent Calls list may show the following: all calls, incoming, outgoing, and missed.

When the user changes the contents of the list with the View button, the title of the list might temporarily show the sorting or view method as specifically defined by the application where this button is used. For example, when a navigation search results list is displayed, pressing the “VIEW” button toggles between the list being sorted by distance, alphabetically, by price, etc. A temporary “sort title” would get displayed to indicate the current list view and that title would timeout after 3 seconds to display the content normally defined to be displayed in the list title region (e.g., POI Name/Category corresponding to the items listed below).

9.1.4.19 RESET TO TOP

If the user has scrolled down the list, they can quickly reset to the top of the list by tapping on the list title.

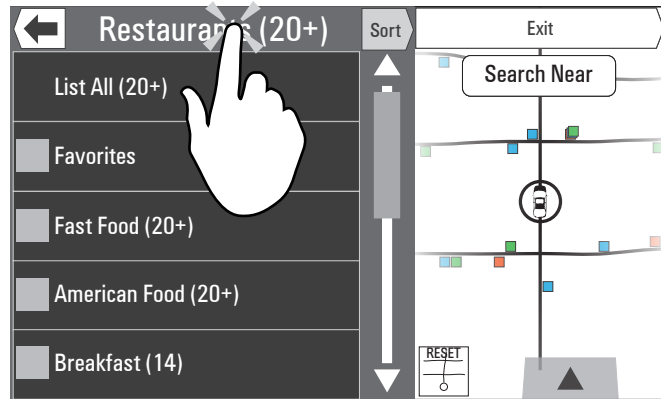


Figure 9.1.4.31

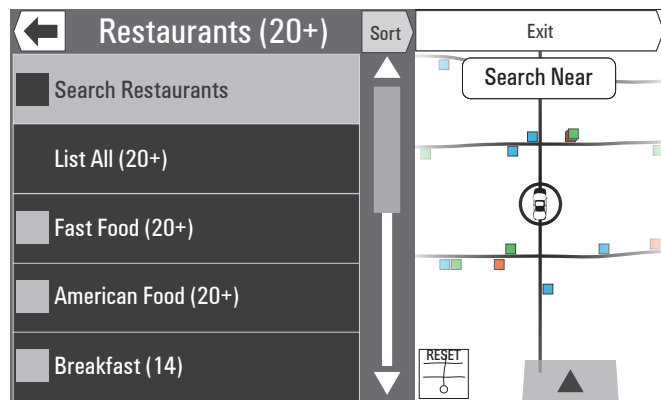


Figure 9.1.4.32

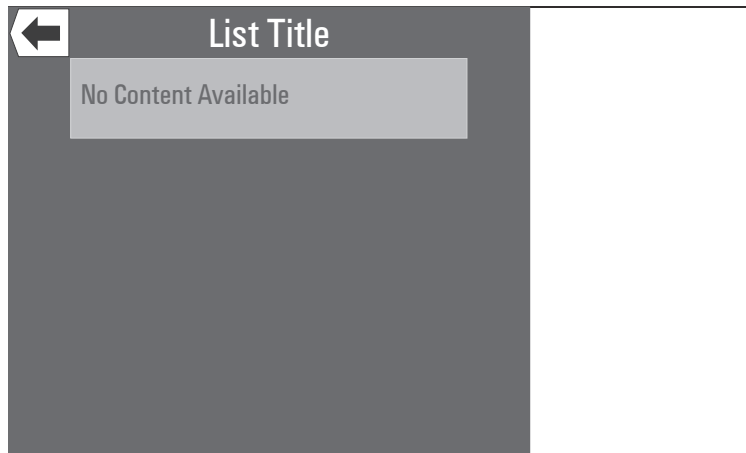


Figure 9.1.4.33

9.1.4.20 EMPTY LIST

If the user has selected a list that happens to be empty, such as a podcast, contact, or recent destination list that has no content, the list is shown empty with a single list item that is grayed out and says No Content Available. This list item cannot be highlighted or selected.

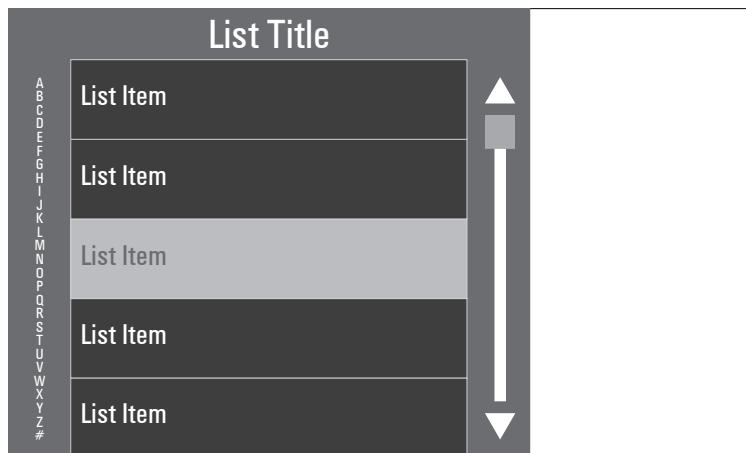
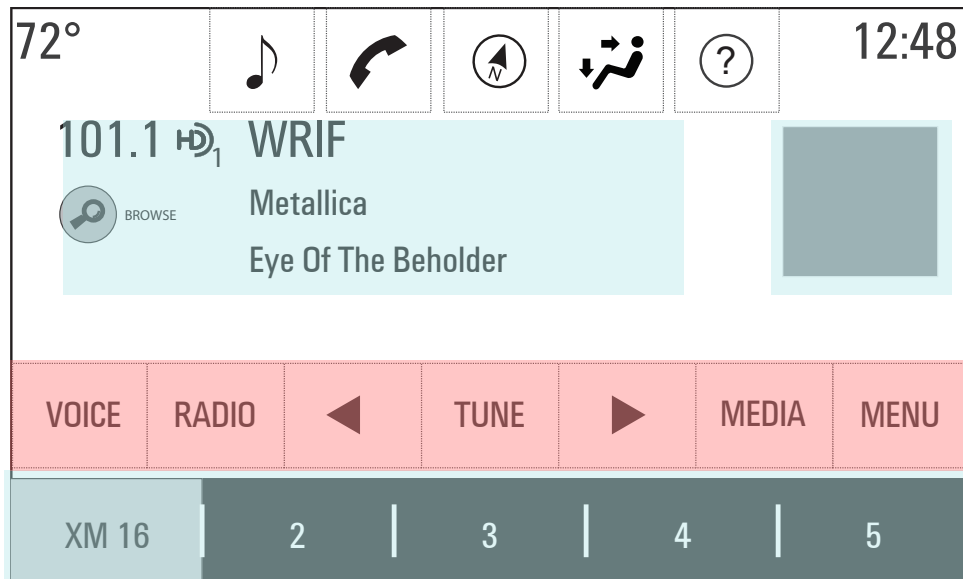


Figure 9.1.4.34

9.1.4.21 UNAVAILABLE LIST ITEM

If a particular list item is either disabled because a function is not available, or the list is empty, it may be shown grayed out. If this list item is selected, a popup is shown to the user to indicate that it is unavailable.



9.1.5 DESIGN SUGGESTION - AUDIO NOW PLAYING

All Next Gen HMI GM full audio screens use a similar format and layout. This screen is often referred to as the “Now Playing” screen.

9.1.5.1 ALWAYS VISIBLE ELEMENTS

The “Now Playing” screen contains the following always visible elements, which are shown in blue:

- Metadata Information
- Graphics
- Favorites
- Time Bar (media playback)

9.1.5.2 REVEAL ON APPROACH ELEMENTS

The “Now Playing” screen with a hand in proximity (only available on Cadillac) adds the following elements, which are shown in red:

- Interaction Selector
- Broadcast Timeshift Controls

9.2 NEXT GEN 8" WITH ROTARY KNOB

Info to be added as available.

9.3 NEXT GEN 4.2”

Info to be added as available

9.4 CCR/CNR

Info to be added as available.

10. REVISIONS

Pages with revisions from version

0.2.2 March 13, 2012 to

0.2.3 June 14, 2012

1	Change: Clarified that this is a living document subject to change based on lessons learned from deployment of downloadable applications and changes in driver distraction and workload assessment criteria.	5
2.2.2.1	Change: Updated display specifications for 7" CCR/CNR (i.e., display area and dot pitch size)	8
2.3	Change: Added Call-Outs and Color Coding to figures and corresponding text to make clear what parts of the screen are being referenced.	9-11
3.2	Change: Clarified that proximity sensing is only on Cadillac vehicles and the primary urpose behind offering proximity sensing.	13
3.3	Change: Clarified Rotary Knob behaviors	14
3.4	Change: Clarified Basic Touch Gesture behaviors	15
3.5	Change: Clarified Advanced Touch Gesture behaviors	16-17
3.7.2	Change: Clarified Text to Speech availability and example use case when developers might want to take advantage of such technology when available.	19
3.8	Change: Updated the control availability table.	20
5.1.1	Change: Updated CCR/CNR 7" minimum font height in pixels requirements based on dot pitch size for those displays and viewing distances	23
5.2.1	Change: Updated requirements for minimum touch area sizes for apps touch elements; also included reference to parallax issues and how to design touch areas and button graphics to accomodate this	25
5.2.4	Change: Updated requirements for button spacing, referencing parallax issues cited in 5.2.1 for consideration when spacing vertically stacked buttons.	26
6.1.5	Change: Softened requirement to a should instead of must for apps to account for operation when using the rotary-push knob.	28
7.1.2.3	Change: Clarified that audio playback only from a video playback is allowed while vehicle is moving, just the video portion must be "blacked out"	30
7.1.x	Change: Deleted duplicate requirements (e.g., 7.1.6 duplicate with 7.1.3)	31