Experiences Developing a Wayland-Based Tizen IVI HMI

Ossama Othman
Context

• Provide human-machine interface (HMI) better suited for Tizen IVI
  • Driver safety
  • React to vehicle state

• Options
  • Leverage existing user interfaces: mobile, desktop
  • Develop IVI-specific HMI
Problems

- Mobile and desktop user interfaces
  - Suboptimal screen geometry: resolution, orientation
  - Do not react to vehicle state
  - Not safe for drivers
  - Many features are not useful or suitable for IVI
  - Underlying graphics subsystem may be too large or slow
- Develop IVI-specific HMI
  - May require kernel and graphics hardware expertise
  - May require additional resources for in-house development
  - Cost
Solution

- Develop IVI HMI by leveraging Wayland and HTML5/JS
  - Efficient
  - Lightweight
  - Rapid prototyping
  - Simple architecture
  - Open-source
  - Avoids legacy issues with mobile and desktop
HMI Service

• Provides “home screen”
• Facilitates layout of application graphical surfaces
• Out of scope
  • Application lifecycle, sound and input management
Compositor

- Handles interactions with graphics hardware
- Combines and renders multiple graphical “surfaces” into an image displayed on-screen
- **Wayland**
  - Core compositor protocol used by IVI HMI
  - Additional IVI HMI-specific Wayland-based protocols to be defined
- **Weston**
  - Reference Wayland compositor
  - HMI will leverage extensibility to fill feature gaps
Application Run-time

• Provides reusable set of functionality to applications
• HTML5
  • Webkit
  • Web API implementations
  • Toolkits
• Native
  • C library
  • Middleware
  • Toolkits
Client Application

- Draws surfaces in a buffer
  - Cairo
  - OpenGL
  - etc
- Shares buffer with compositor through Wayland
- Examples
  - Media player
  - Browser
Component Interaction
Server Side Architectures

- **HMI Service**
  - Stand-alone
  - Integrated
- **Server side architecture remains transparent to the client**
  - Just an implementation detail from the client point of view
  - Client does not determine where surfaces are placed
Stand-alone HMI Service

- HMI service is another Wayland based client
- Separate process from compositor
- Communicates with compositor just as client application would
- Example: GENIVI style layer management
Integrated HMI Service

- HMI Service integrated with compositor
  - Embedded directly in compositor plugin
  - Performs same functions as standalone service
## HMI Server Side Architecture Comparison

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stand-alone</strong></td>
<td><strong>Integrated</strong></td>
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<tr>
<td>Reusable / Flexible</td>
<td>Simpler architecture</td>
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<tr>
<td></td>
<td>Flexibility may not be needed</td>
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<tr>
<td>Better fatal error recovery</td>
<td>More efficient: less IPC</td>
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<tr>
<td></td>
<td>Less efficient: more IPC</td>
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<tr>
<td></td>
<td>Rapid prototyping</td>
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<td>Fatal error recovery may be more difficult</td>
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<td>Potentially easier to compromise compositor state</td>
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HMI Server
Side Problems
Problem: Layout of Both Web and Native Applications

- HTML5 based HMI cannot readily place surfaces created by native application
- HMI is generally layer based
  - Layer is a collection of surfaces
  - Sample layers: home screen decorations, input layer, split “screens”
- No concept of layers in HTML5
  - May be emulated using multiple HTML5 Canvases
- Canvas based approach not always suitable
  - Not all Web applications use Canvases
  - Cannot be used for native applications
Solution

• Compositor
  • Plugin exposes layer functionality required by HMI

• Web run-time
  • Plugin provides JavaScript API that allows interaction with the compositor

• HMI alternatives
  • Use WebSockets to communicate between compositor plugin and HTML5 based HMI
  • IVI-specific Node.js extensions
Other Problems

- **Direct use of `wl_shell` in application or toolkit**
  - Specific to desktop shell model / use case
  - Not entirely applicable to IVI
  - Compositor `wl_shell` implementation may not be available
  - Proposal for better handling of different Wayland shell types currently under review upstream
References

• **Tizen IVI Images**
  • Daily: [http://download.tizen.org/releases/daily/2.0alpha/ivi-wayland/](http://download.tizen.org/releases/daily/2.0alpha/ivi-wayland/)
  • Snapshots: [http://download.tizen.org/snapshots/2.0alpha/ivi-wayland/](http://download.tizen.org/snapshots/2.0alpha/ivi-wayland/)
  • Tizen 3.0 based IVI images are a work in progress

• **Wayland and Weston**
  • [http://wayland.freedesktop.org/](http://wayland.freedesktop.org/)
  • [http://cgit.freedesktop.org/wayland](http://cgit.freedesktop.org/wayland)

• **GENIVI®**
  • [http://www.genivi.org/](http://www.genivi.org/)
  • [http://projects.genivi.org/ivi-layer-management/](http://projects.genivi.org/ivi-layer-management/)
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