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Unified HMI Updates:
Simplified APIs for Dynamic Multi-Display Layout Control

Panasonic Automotive Systems, Co., Ltd.
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Who am I ?

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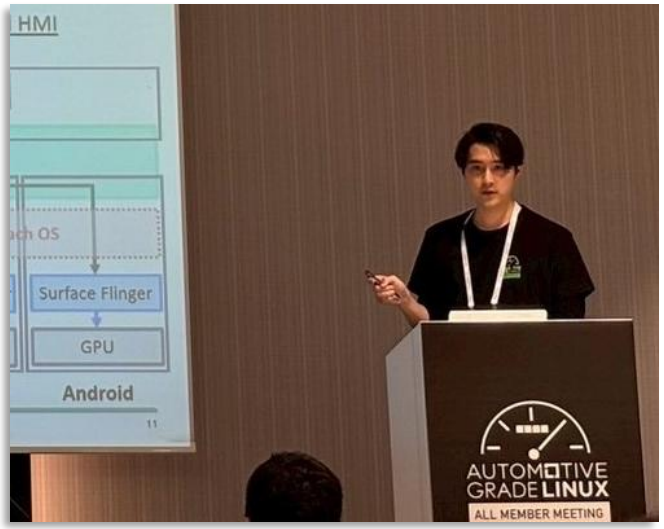
- ✓ Working at Panasonic Automotive Systems Co., Ltd.
- ✓ Focusing on the Unified HMI development.
- ✓ Contributing Unified HMI programs to AGL UCB since Oct. 2024.
- ✓ Hobby: Travel, Ramen, Coffee, Playing with my baby



Agenda

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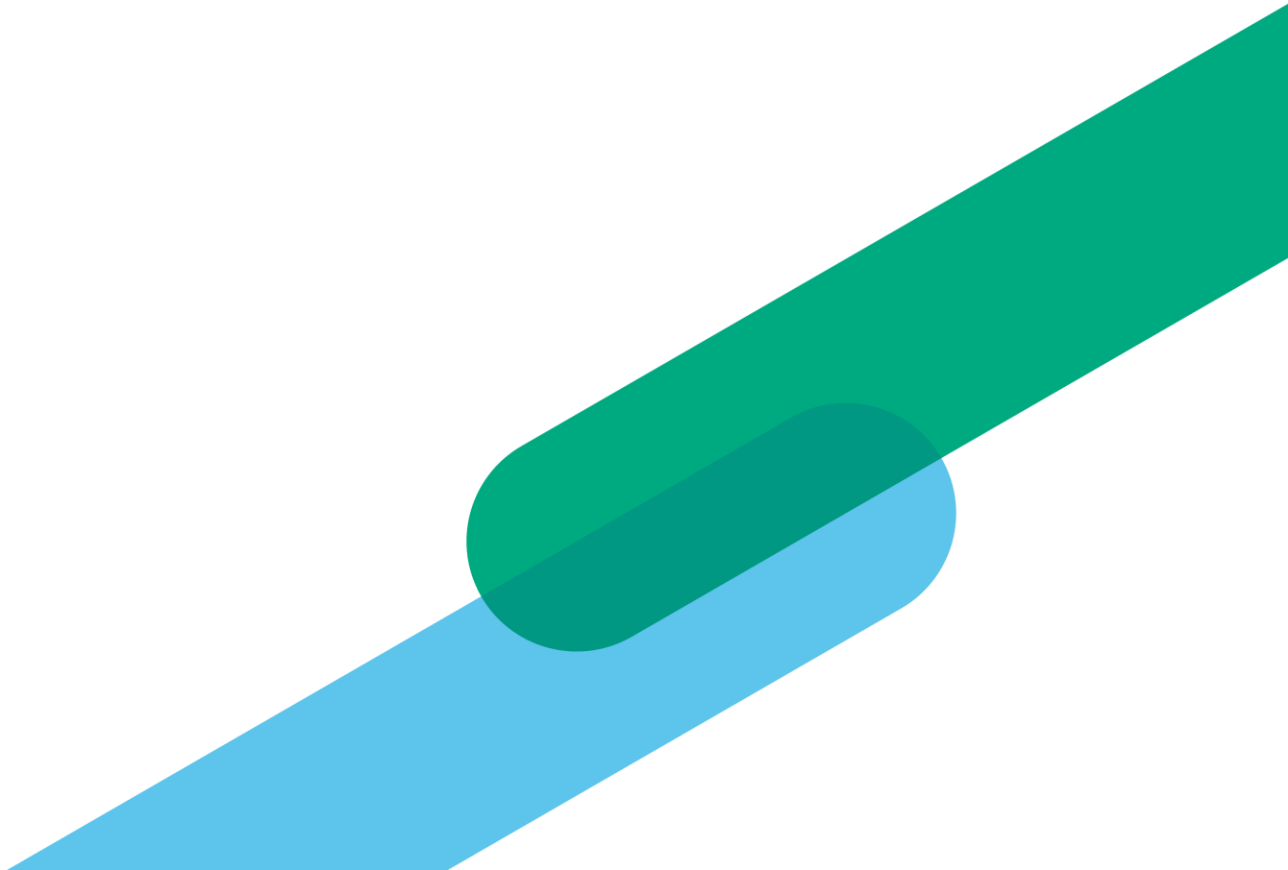
- ✓ What is Unified HMI
- ✓ Unified HMI Architecture
- ✓ Updates for Unified HMI v3.0
  - ✓ UHMI v3.0 architecture
  - ✓ Demo video
  - ✓ UHMI on AGL SoDeV



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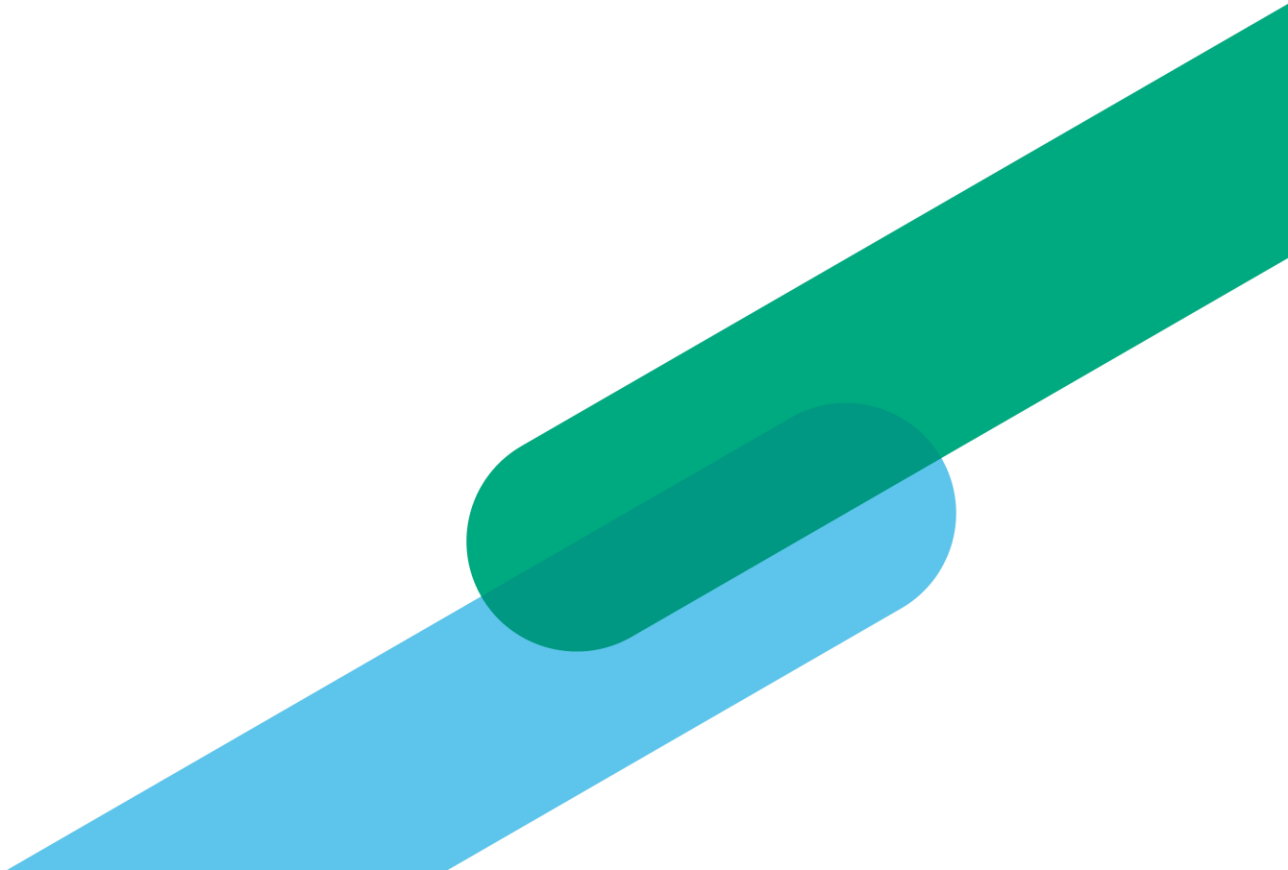

Trends in the Car Cockpit Systems

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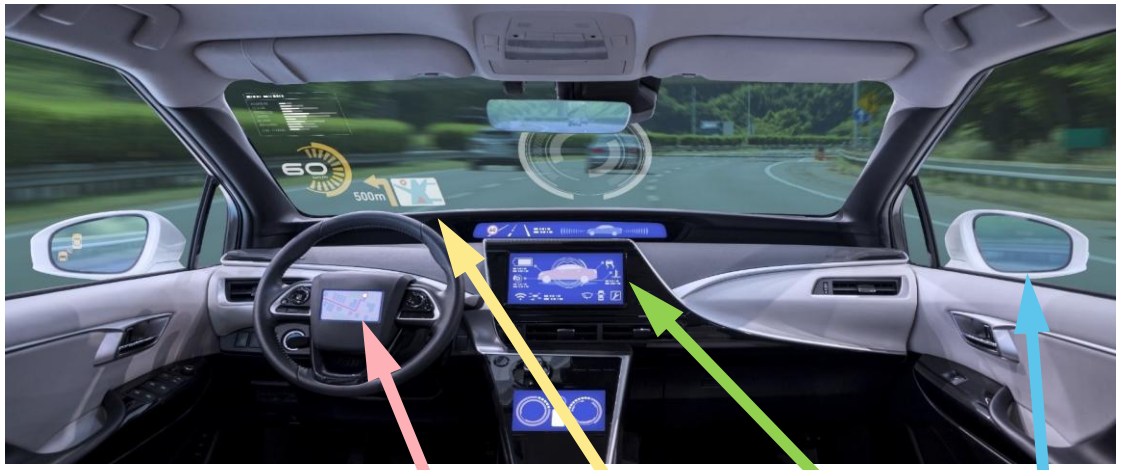
- ✓ The number of in-vehicle displays is increasing because of digitization of many devices.
  => Demands for flexible application display **across multiple displays**
- ✓ However, the development of **ad hoc coordination** for all car grades/models is required.

Future multi-display environment

Develop app layouts by using existing methods



What is Unified HMI

UNIFIED HMI

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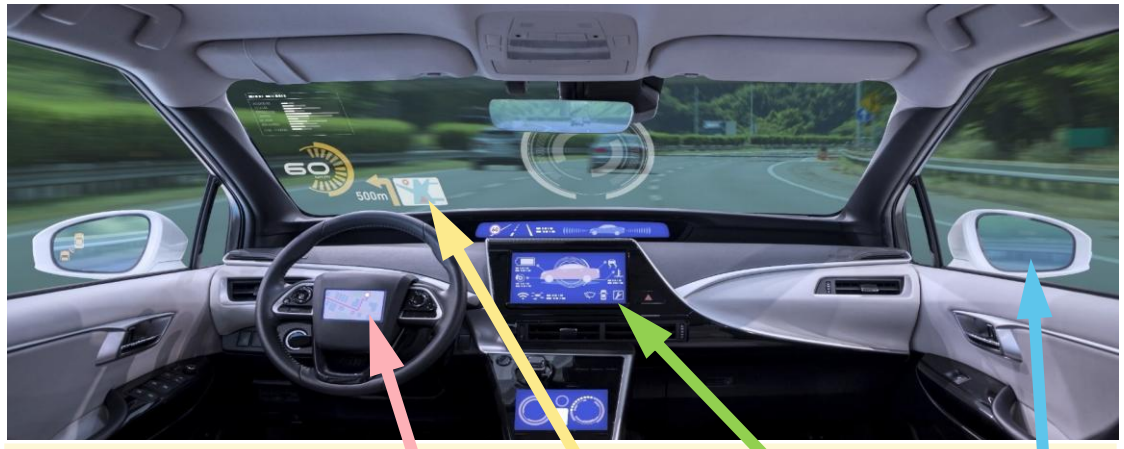
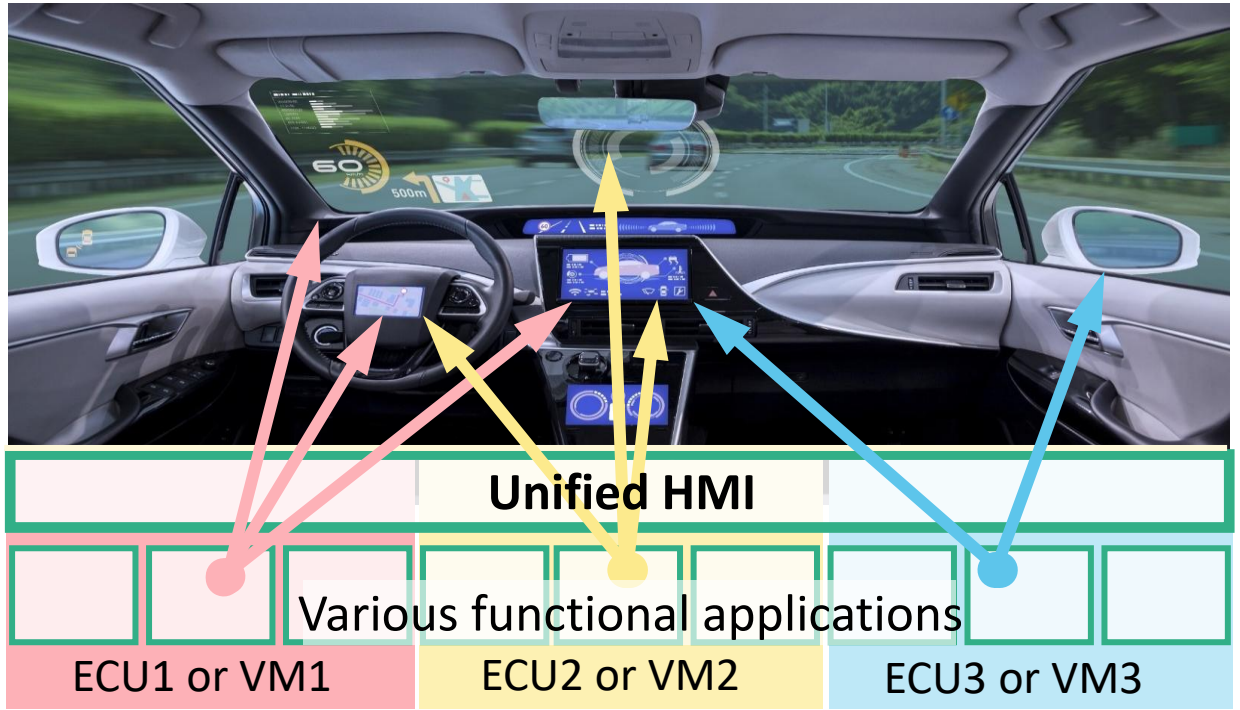
"**Software-Defined**" display virtualization platform based on VirtIO GPU.

- ✓ Flexible app layouts across multiple displays, **independent of hardware and OS configurations.**
- ✓ Specific modifications for each app are not required.

Without Unified HMI



With Unified HMI



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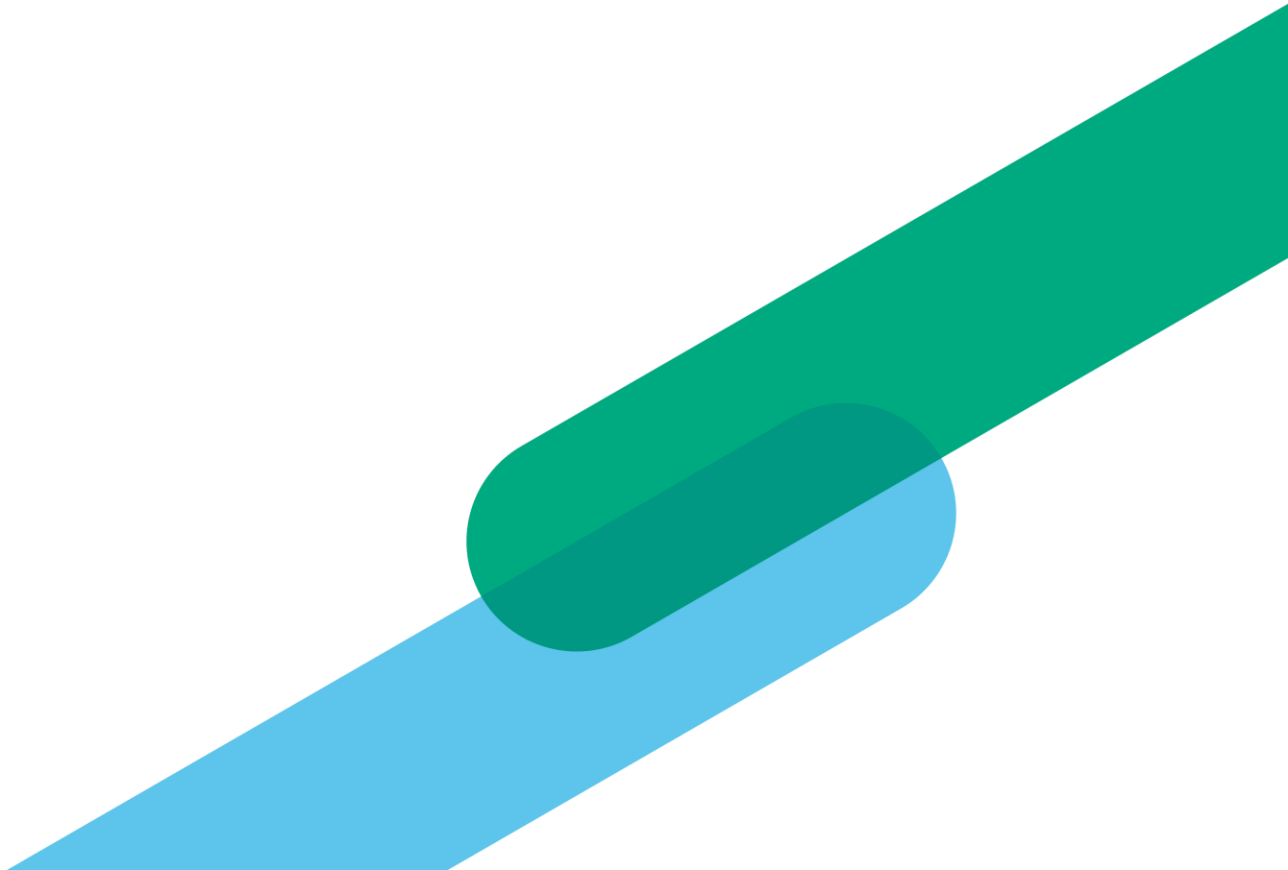

The two main components of Unified HMI

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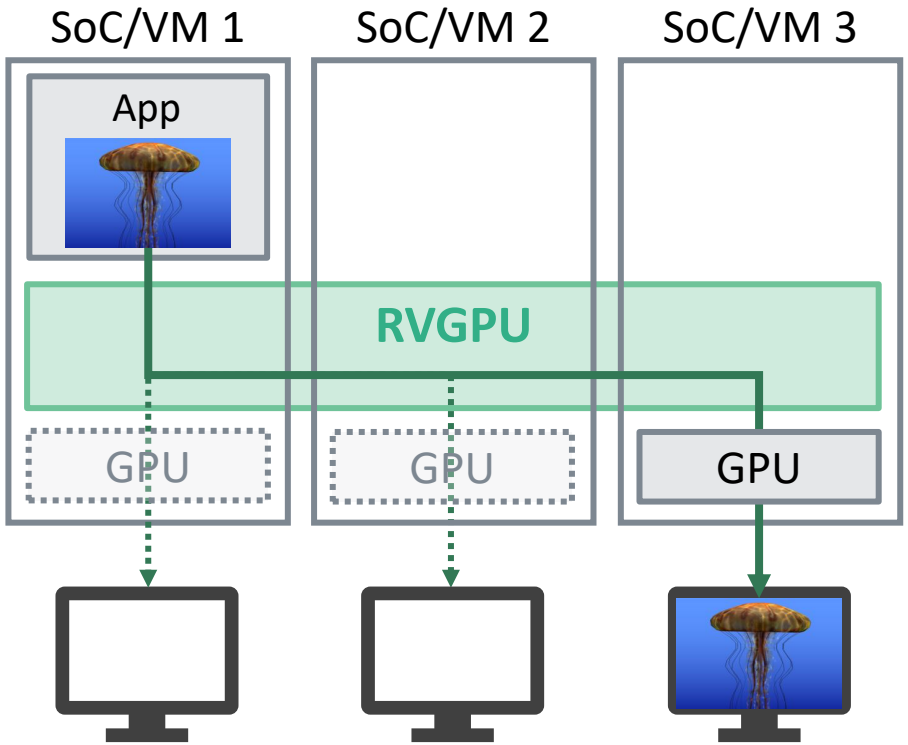
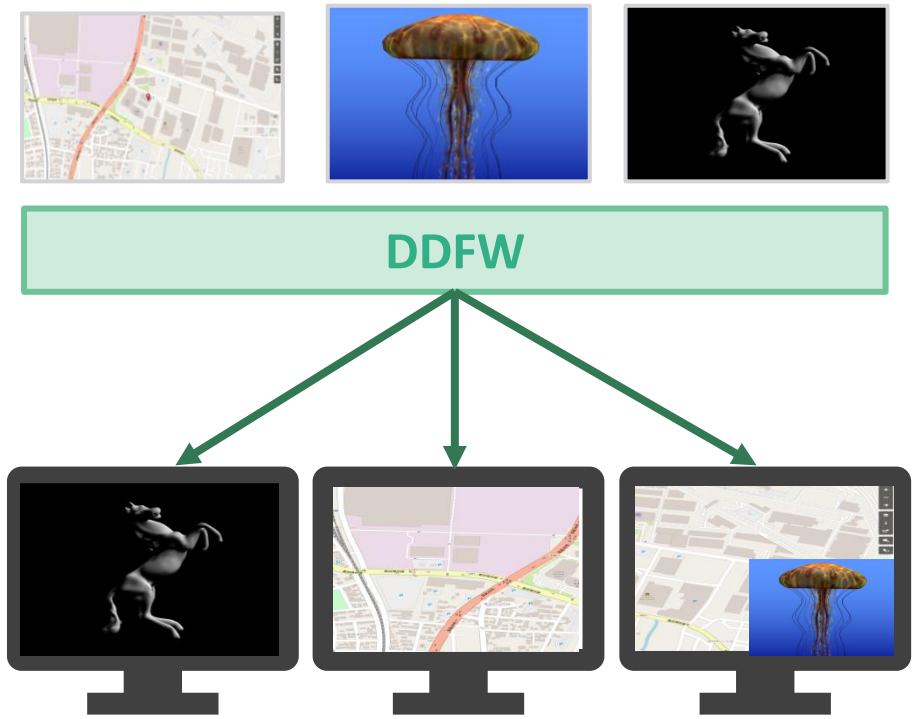
Remote VirtIO GPU Device(RVGPU)

✓ Render apps **remotely in different SoCs/VMs** even when **different OSes** are running.



Distributed Display Framework(DDFW)

✓ **Control layouts** across multiple displays and **manage the lifecycle** of apps.



Map data from OpenStreetMap

Remote VirtIO GPU Device (RVGPU)

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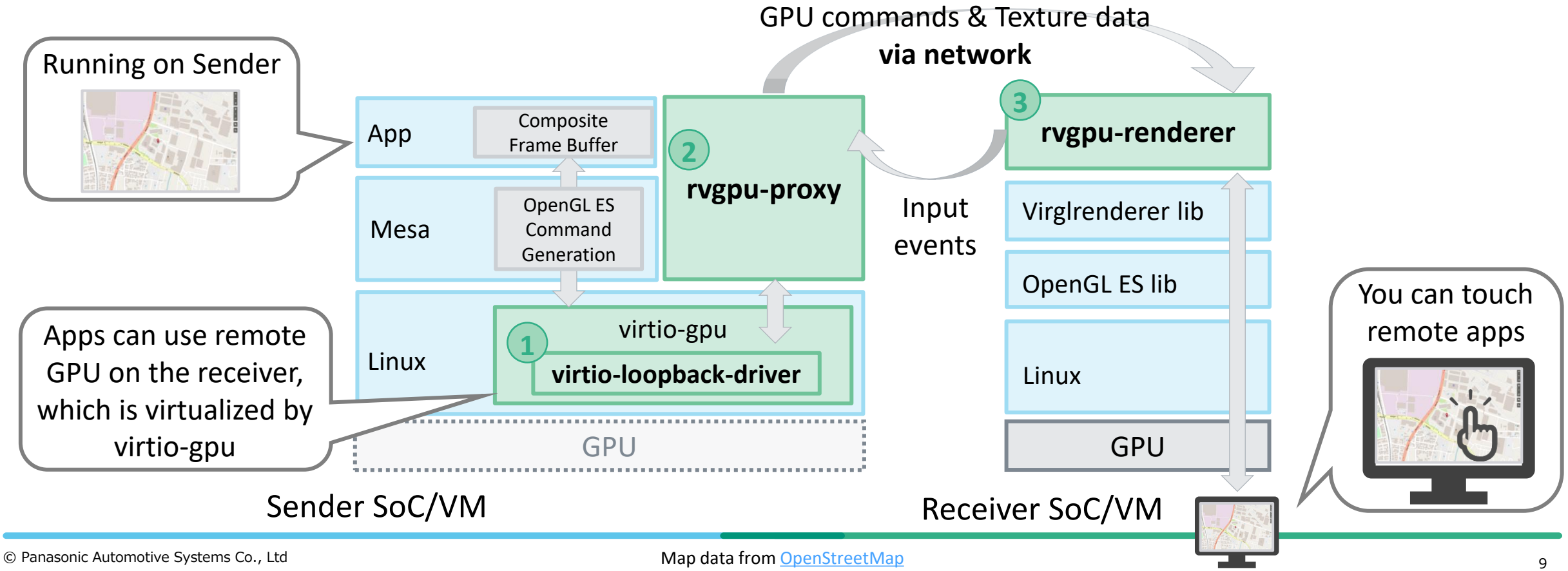
Network extension of **VirtIO GPU** commonly used in GPU virtualization for VM.

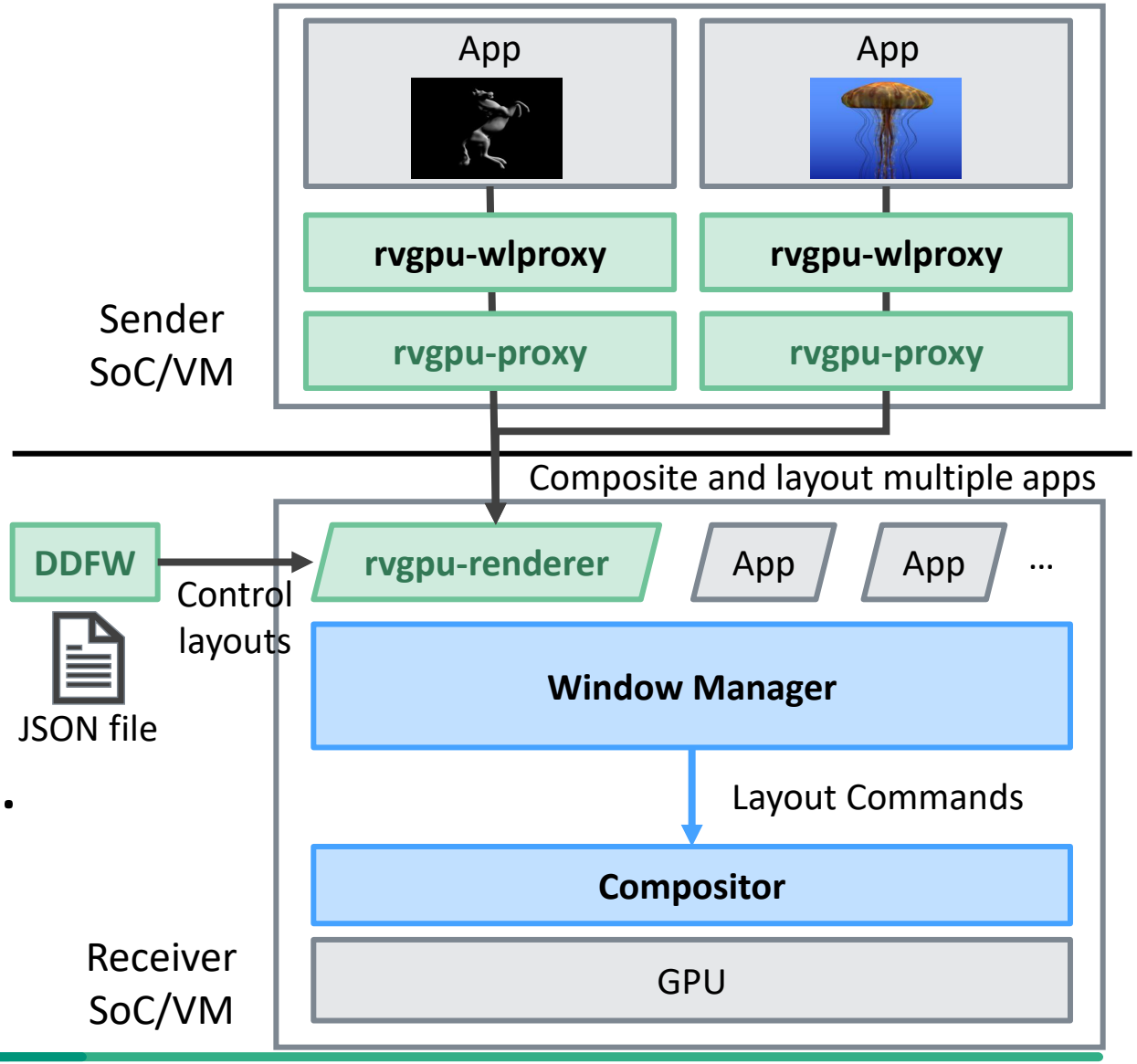
1. virtio-loopback-driver generate virtio-gpu device and receives **GPU commands** through it.
2. rvgpu-proxy sends commands to rvgpu-renderer on the receiver **via network**.
3. rvgpu-renderer render app on the receiver display **as usual data flow**.



Map data from OpenStreetMap

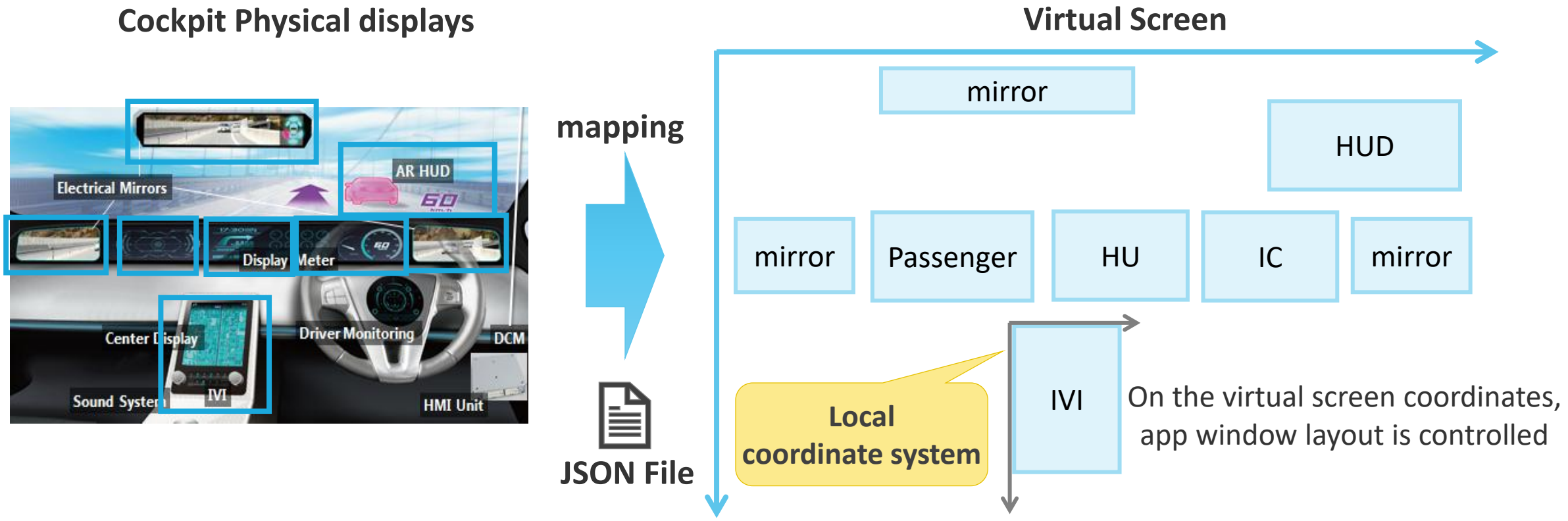
How Unified HMI control layouts

- ✓ rvgpu-renderer **composites** multiple app windows and controls layouts itself.
- ✓ It’s possible to support various OS, such as Linux/AGL/Android **without developing specific plugins for each.**
- ✓ The controlling layout functions can be developed on RVGPU, so it can easily achieve **flexible layouts across different OSes.**



Distributed Display Framework (DDFW)

- ✓ Mapping cockpit physical displays into a **single large virtual screen**.
- ✓ Control app layouts such as location, size, and display order.
- ✓ **Manage the lifecycle** of apps and RVGPU modules.



DDFW architecture

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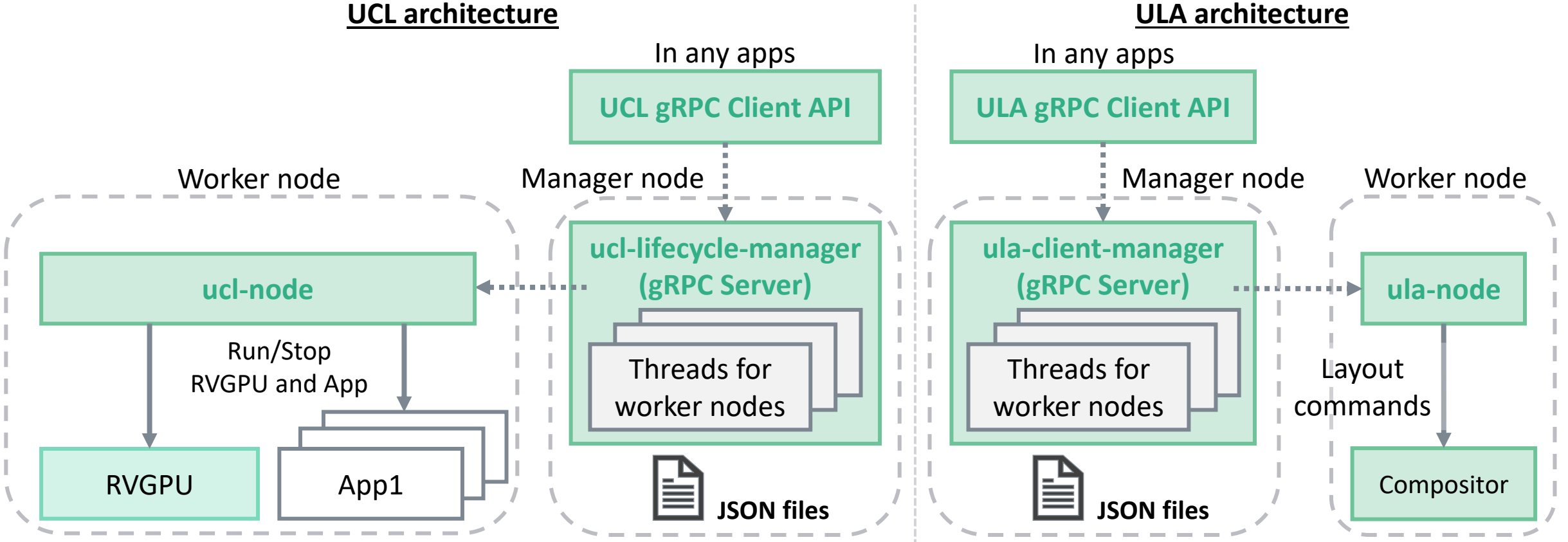
- ✓ Unified Clustering Tools(ucl-tools): Manages **overall lifecycle of apps and RVGPU modules.**
- ✓ Unified Layout Tools(ula-tools): Provides **unified control** of app layouts.
- ✓ UCL/ULA work as defined in **JSON files**.



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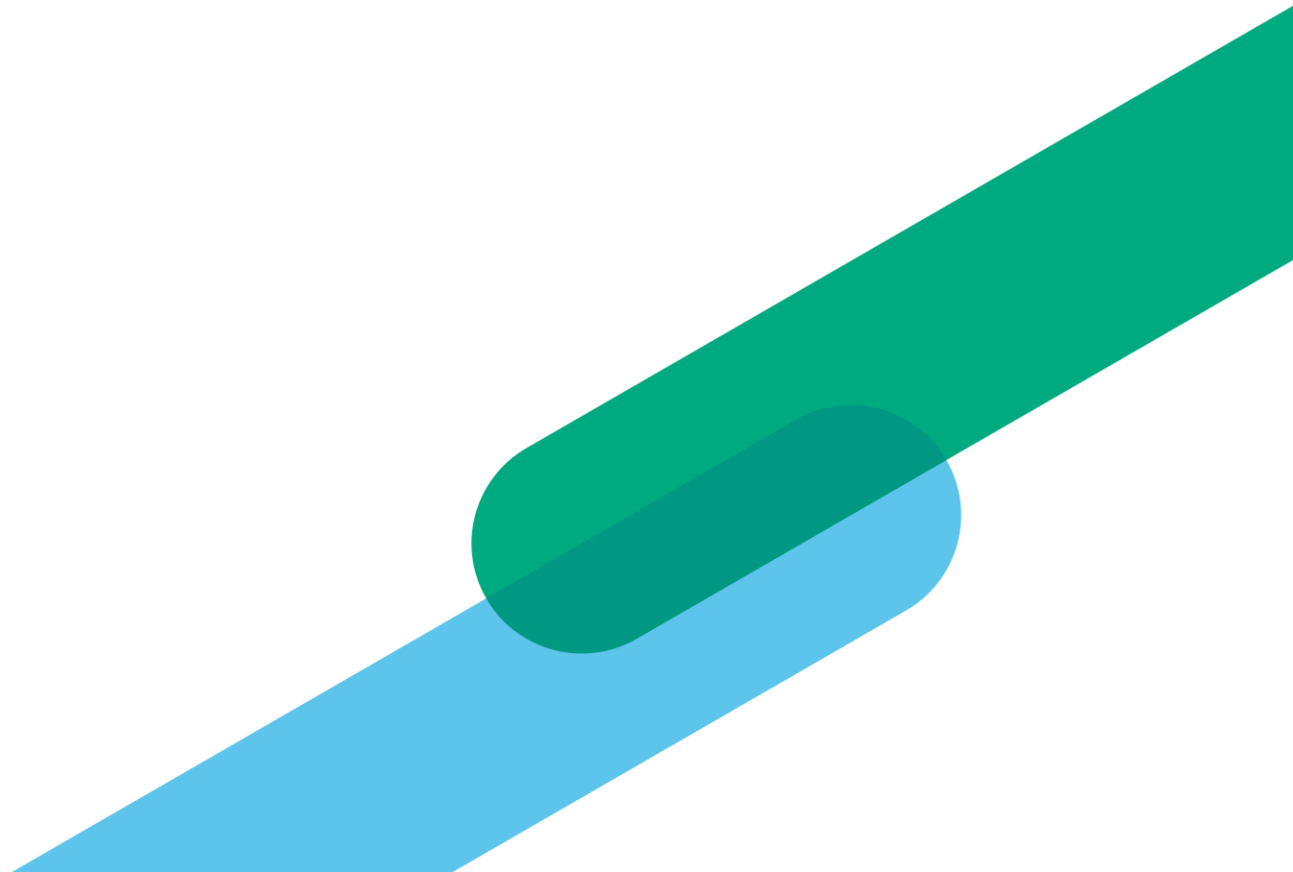
  - ✓ **UHMI v3.0 architecture**
  - ✓ **Demo video**
  - ✓ **UHMI on AGL SoDeV**



Updates for Unified HMI v3.0

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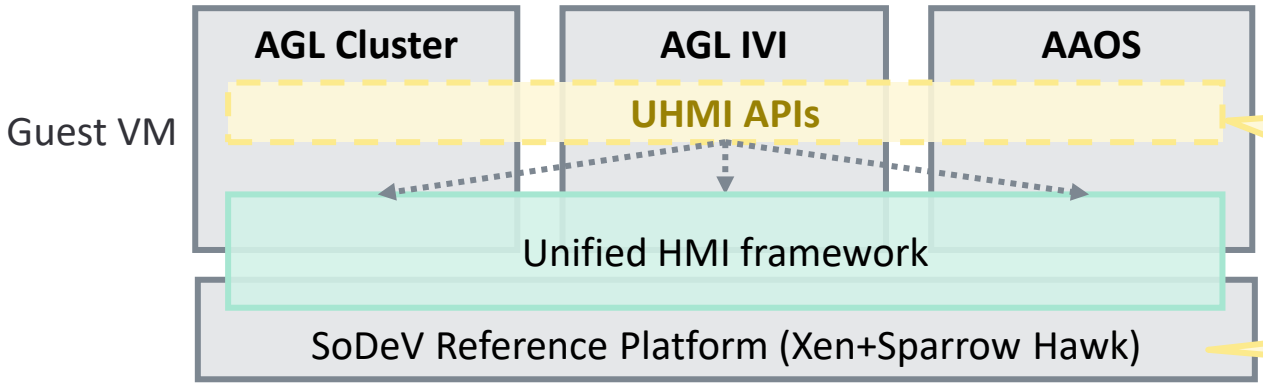
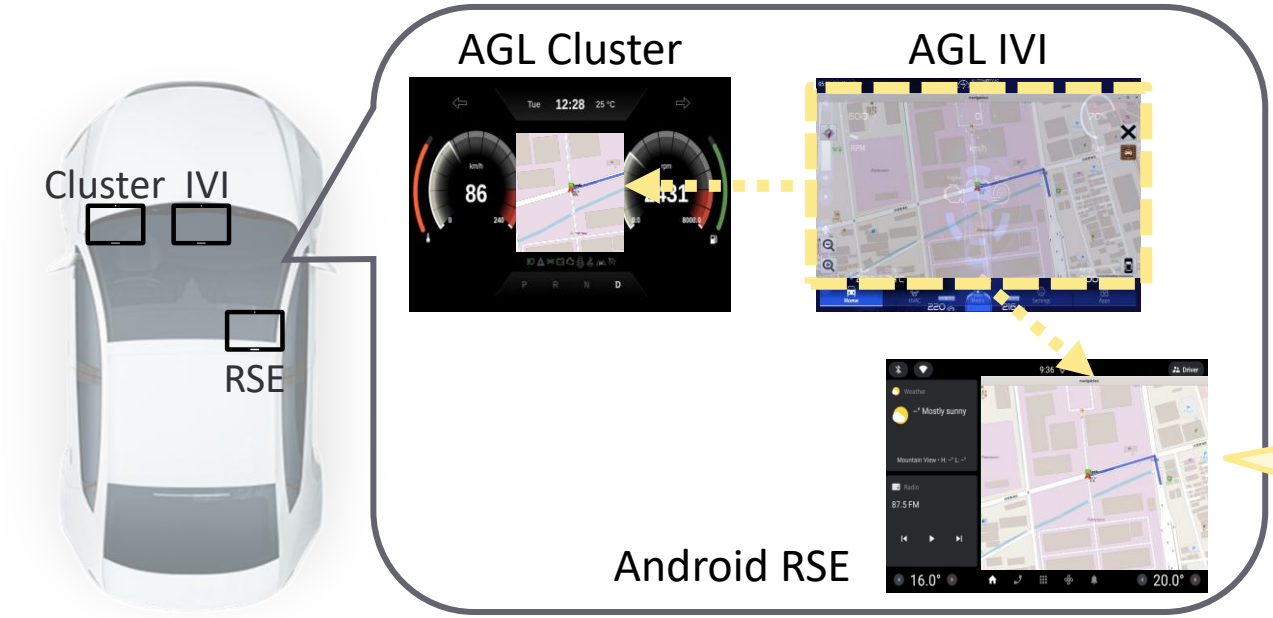
Unified HMI v3.0 focuses on **usability and developer experience**.



1. New simplified APIs to reduce manual steps and JSON handling for developers

2. Add UHMI support on AGL SoDeV

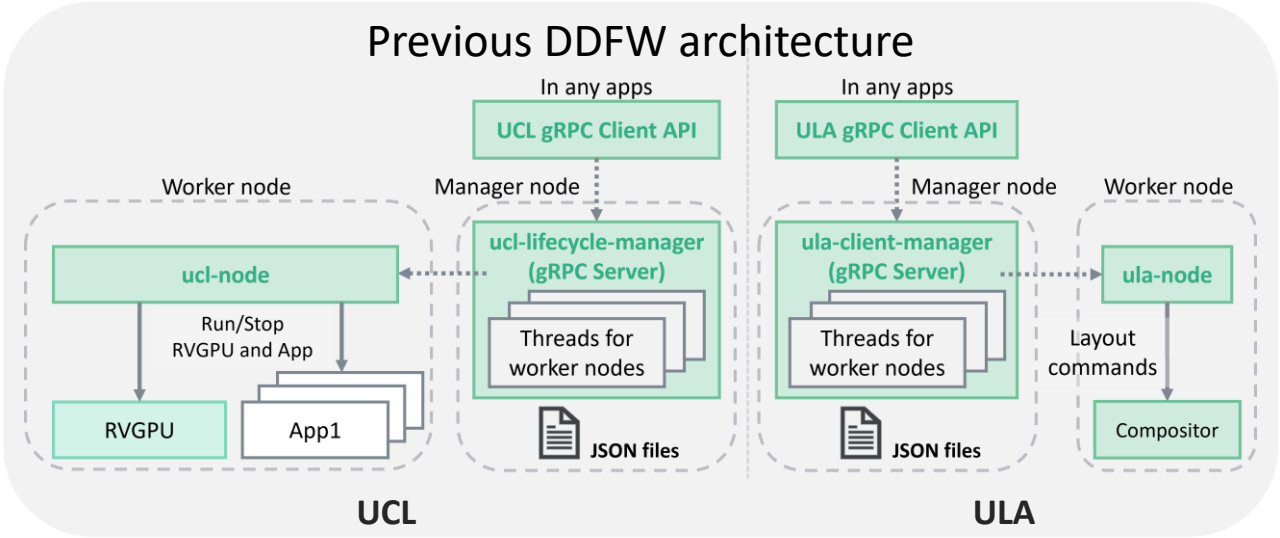


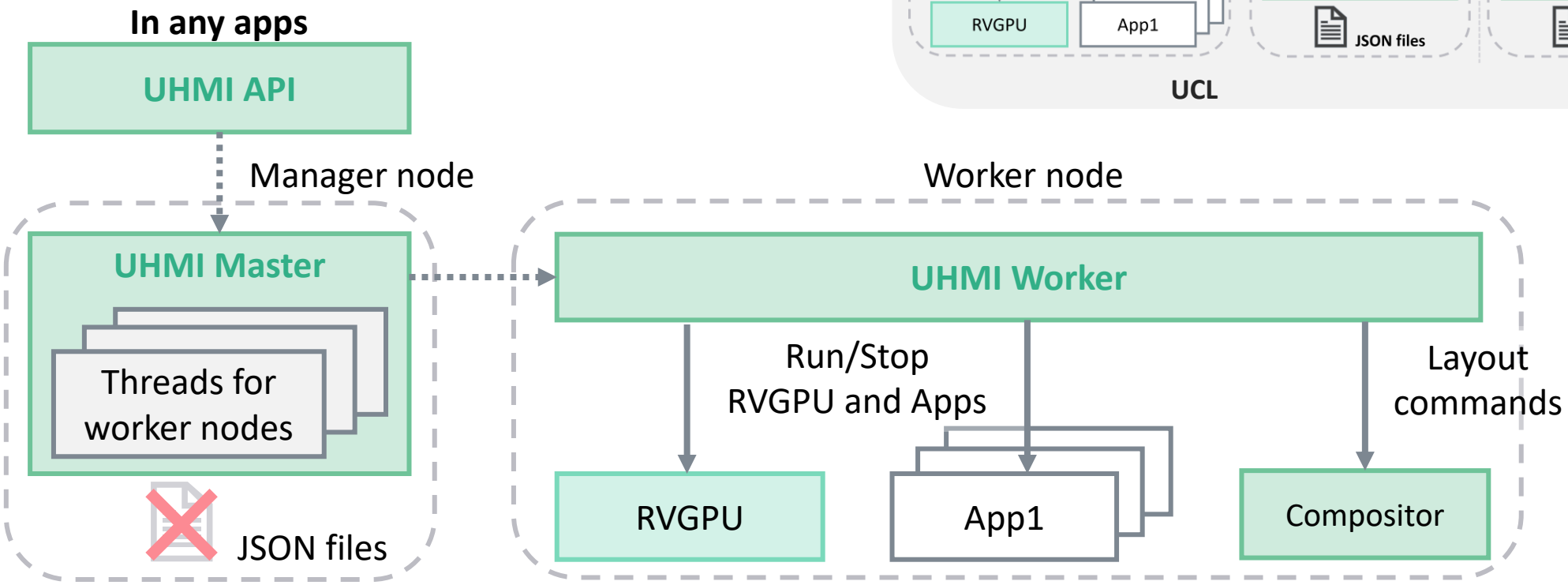
3. New use case: Render AGL apps to AAOS and control layouts to support SoDeV use cases

Map data from OpenStreetMap

Unified HMI v3.0: Simplified architecture

- ✓ Merge UCL/ULA functions
- ✓ **Reduce manual steps**
- ✓ **Dynamic** layout control **without JSON files** (JSON file defines display env is necessary)





Dynamic layout control APIs without JSON

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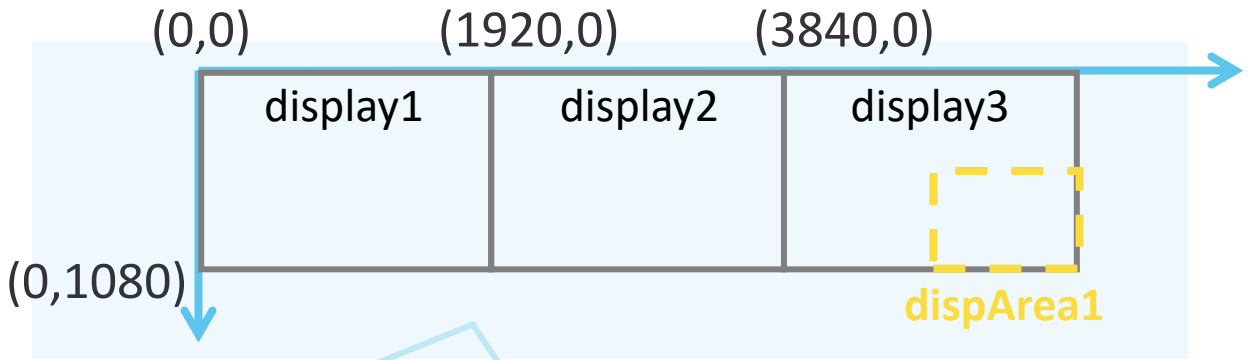
- ✓ Dynamically control layouts while apps are running **with some animation pattern.**
- ✓ **New customized display areas** can be defined in the JSON file.

Virtual screen



JSON file

display1 : x=0, y=0, w=1920, h=1080
display2 : x=1920, y=0, w=1920, h=1080
display3 : x=3840, y=0, w=1920, h=1080
dispArea1: x=4800, y=540, w=960, h=540

Real displays

```
$ moveApp horse display1
$ moveApp jerryfish dispArea1
$ wideApp navi display2 display3
```

Map data from OpenStreetMap

JSON Creation tool

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- ✓ Web application that support creation of Json file **with simple GUI**.
- ✓ Input forms and arrange virtual displays visually using the mouse.

Input Forms

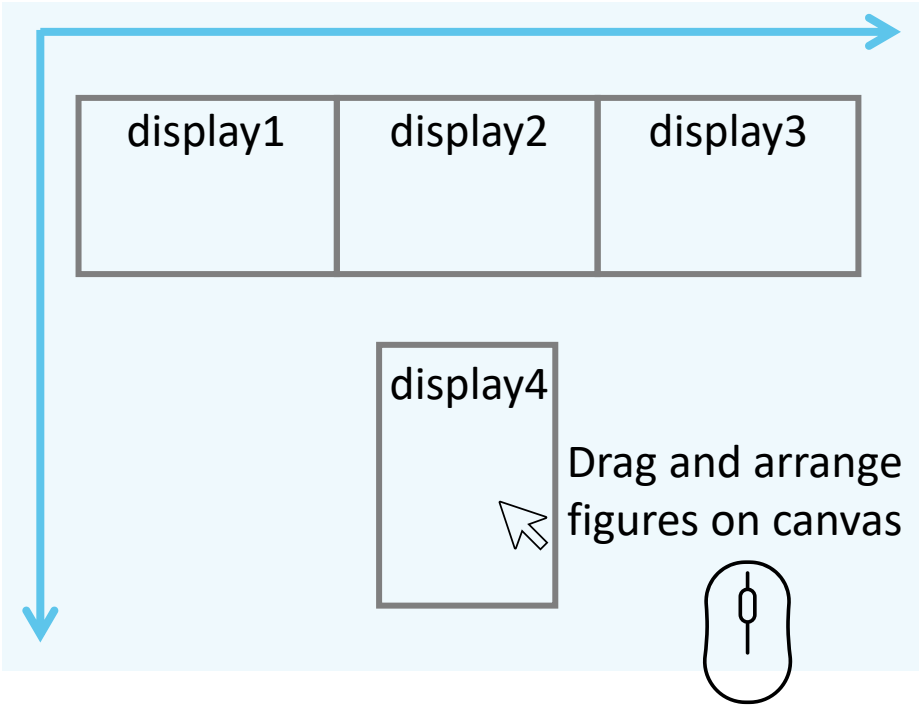
Node

Node Name	IP Address	OS	Environment Variables	Enable/Disable	Delete
Qualcomm SA8255 SoC	192.168.97.0	linux			
Reneses R-Car H3 SoC	192.168.97.0	agl			

Display

Phisical Display Information					Display Arrangement on Virtual Screen				Delete
Screen name	Connected node	Display number	Display resolution		Display Position		Display Size		
			Width	Height	x	y	Width	Height	
IVI display	Qualcomm SAi	0	1920	1080	2340	1080	1080	1920	
Cluster display	Qualcomm SAi	1	1920	1080	0	0	1920	1080	
Center display	Qualcomm SAi	2	1920	1080	1920	0	1920	1080	
Android tablet	Qualcomm SAi	3	1920	1080	3840	0	1920	1080	

Virtual display arrangement



UHMI API examples

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With UHMI v2.0, launch app and control layouts **need three steps and JSON files**:

```
$ ucl-api-comm -c launch_compositor_async                    # launch RVGPU receivers
$ ucl-api-comm -c run_command <path to app.json>             # launch apps via RVGPU
$ ula-grpc-client -c DwmSetLayoutCommand <path to initial-vscreen.json>    # control layouts
```

With UHMI v3.0, it needs **only 1 step without JSON file**:

```
$ uhmi-api –c runApp AppName dispName        # launch apps via RVGPU and layout them
```

Advanced API examples:

```
$ uhmi-api –c
      - moveApp appName dispName          # move app to the indicated display
      - animationApp appName dispName     # move app to the indicated display with animation
      - wideApp appName disp1 disp2       # span app across disp1 and disp2
```

Demo video: How UHMI v3.0 APIs can be used

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Map data from OpenStreetMap

Why is Unified HMI necessary for AGL SoDeV?

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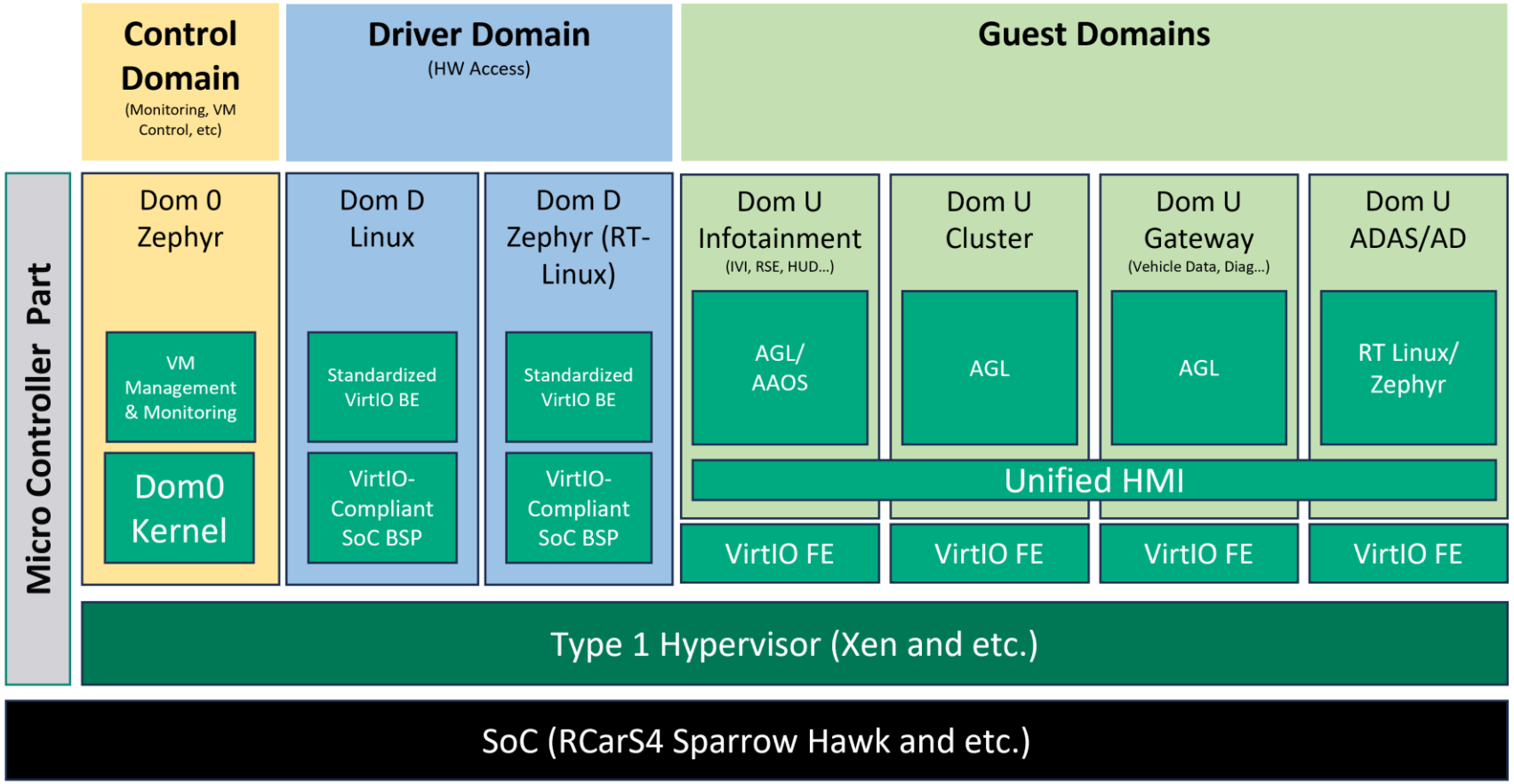
- ✓ Enable **a common and open-source** multi-display virtualization framework.
- ✓ Flexibly developed **with AGL community**



AGL SoDeV BlockDiagram

Unified HMI Reference Architecture on AGL SoDeV

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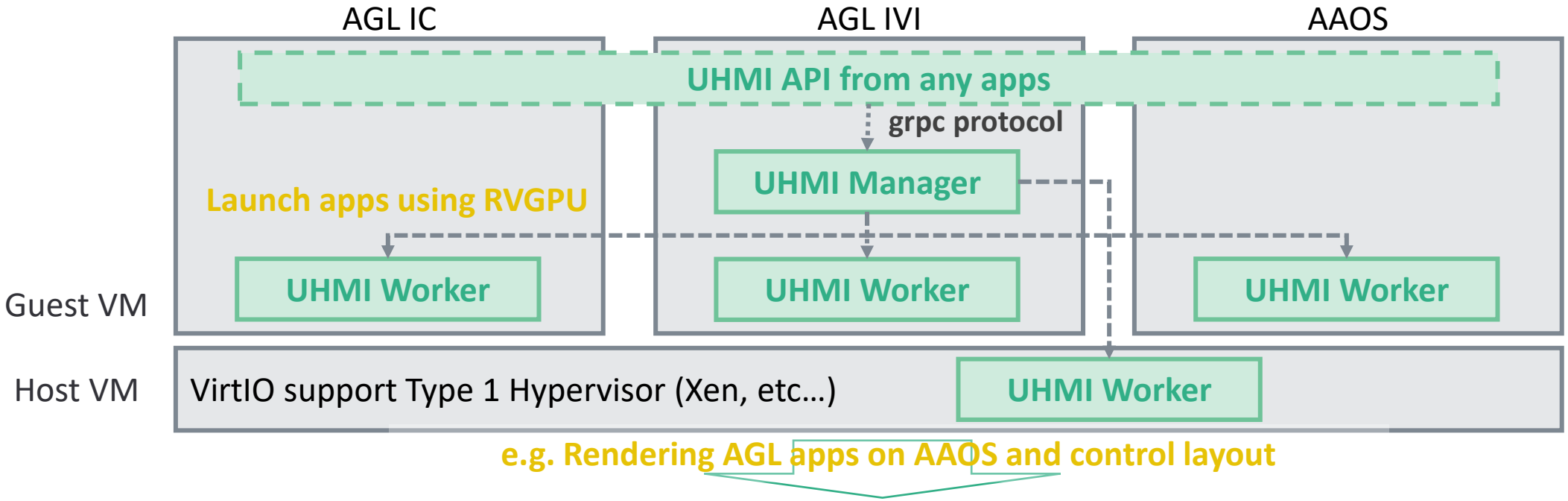
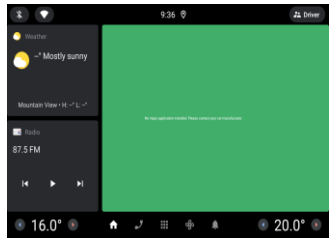
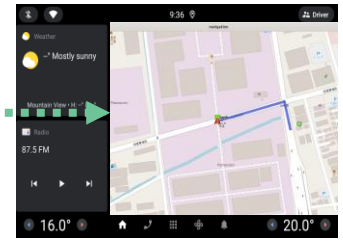


e.g. Rendering AGL apps on AAOS and control layout





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Milestone for 2026

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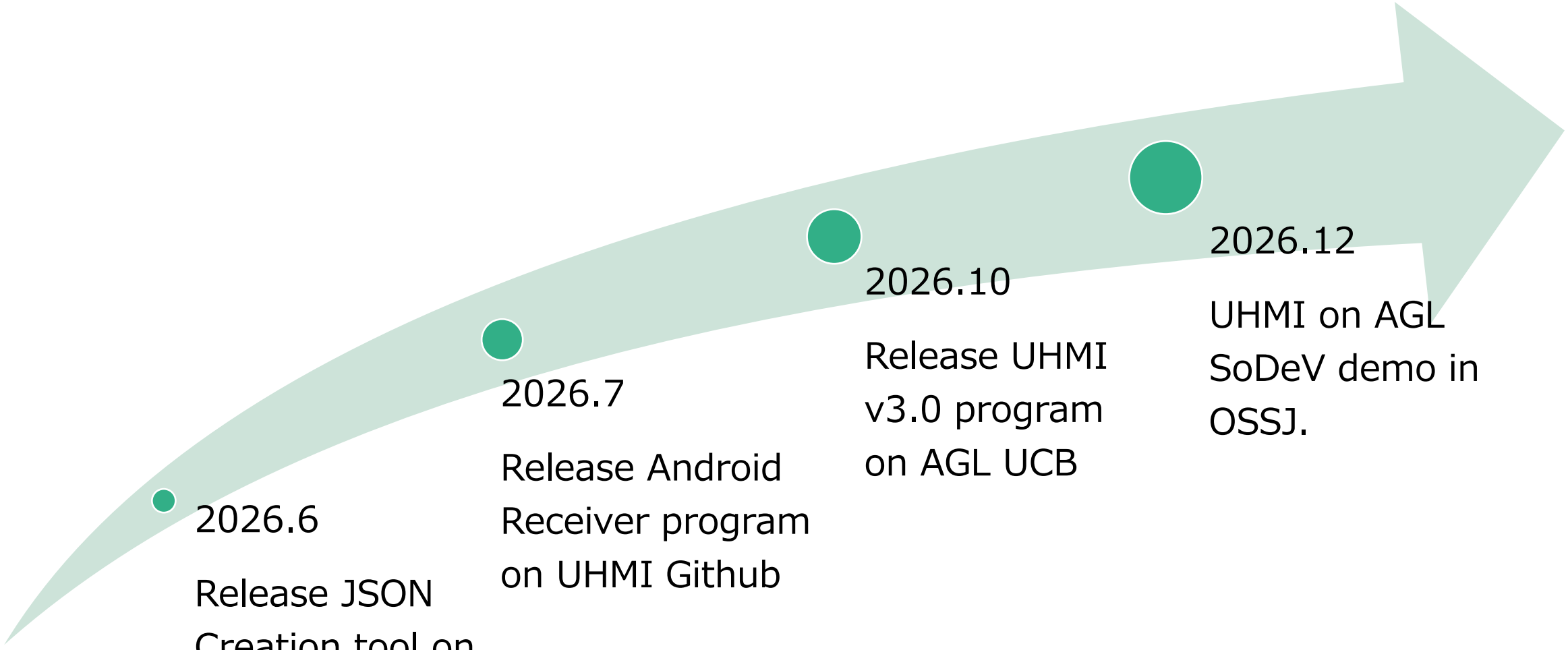

How to access Unified HMI

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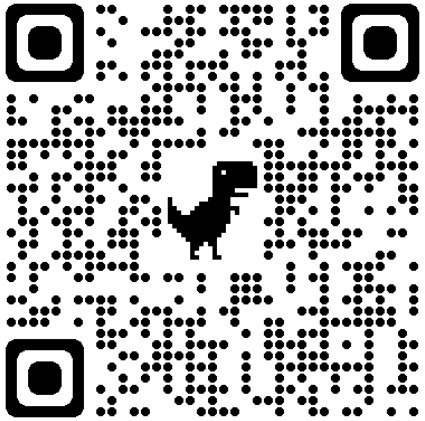
GitHub



- ✓ Access the source code for Unified HMI
- ✓ Compatible with Ubuntu for easy development
- ✓ **Please contribute to the project and report issues!**

AUTOMOTIVE GRADE LINUX

- ✓ Unified HMI is a **standard component of AGL**
- ✓ Includes **meta-uhmi Yocto recipe** for installing Unified HMI
- ✓ Supporting Platforms:
  QEMU, Raspberry Pi 4, and AGL Reference Hardware