TIZEN™ DEVELOPER CONFERENCE
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Design and Implementation of Tizen Emulator

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- Tizen Virtual Board
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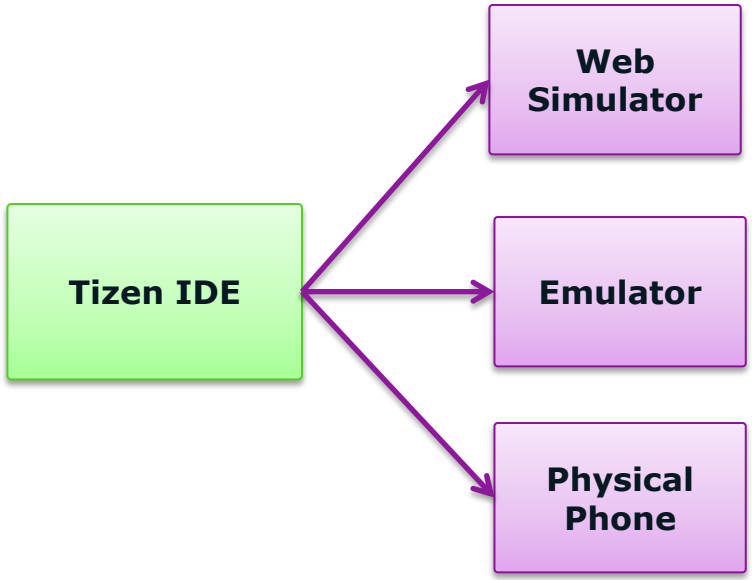
Introduction

Tizen Development Runtime

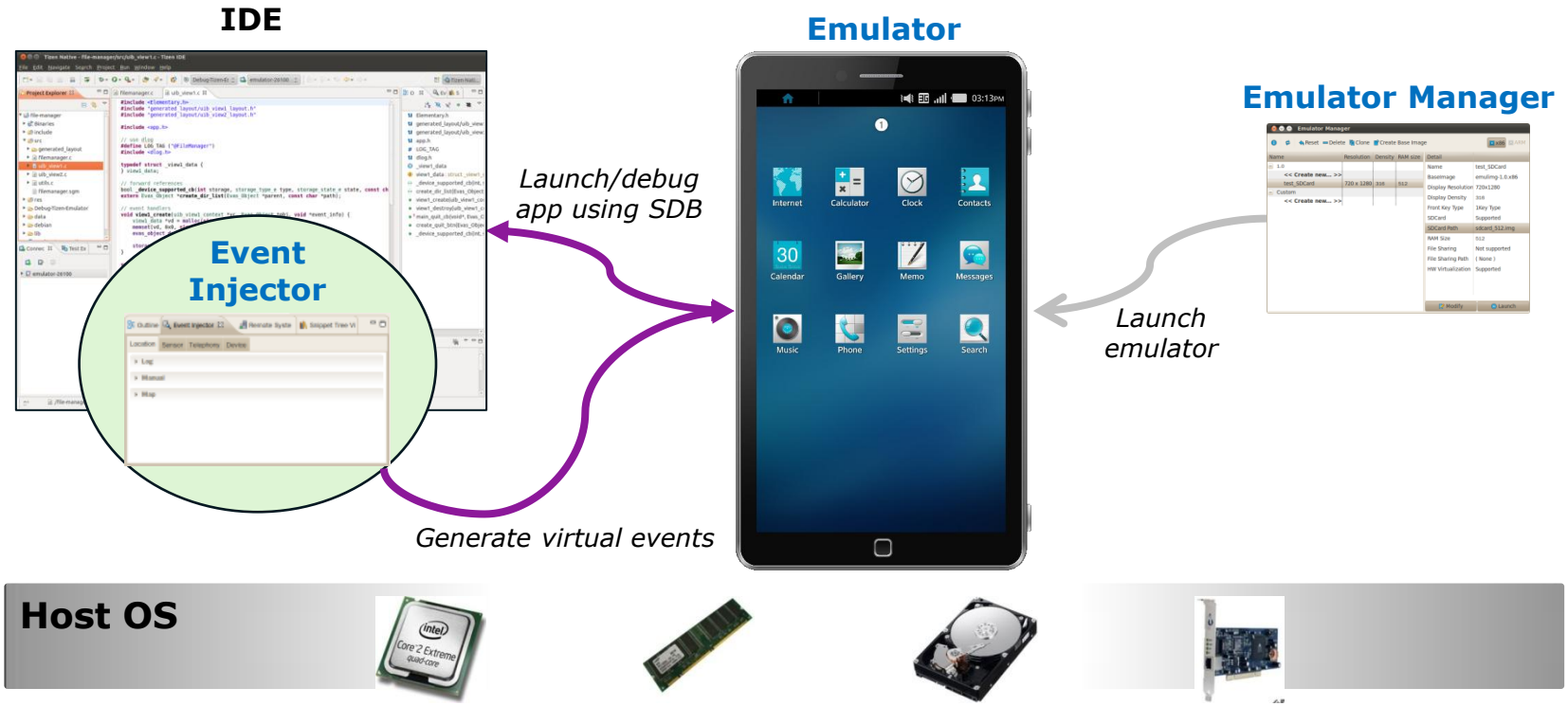
- Web simulator
  - For web applications
  - Support oneshot web runtime
- Emulator
  - For web/native applications and platforms
  - Support full system runtime
- Physical phone
  - For web/native applications and platforms including BSP (Board Support Package)
  - Support full system runtime



Tizen Emulator Tools (1/2)

- Tizen emulator tools
  - Provide development environment for Tizen platform/app w/o real physical devices
  - Consist of QEMU based **Emulator**, **Emulator manager** and **Event injector**
  - Provide interoperation with **Tizen IDE** using **SDB** (Smart Development Bridge)
  - Currently, support x86 guest arch only

Tizen Emulator Tools (2/2)



Features Summary

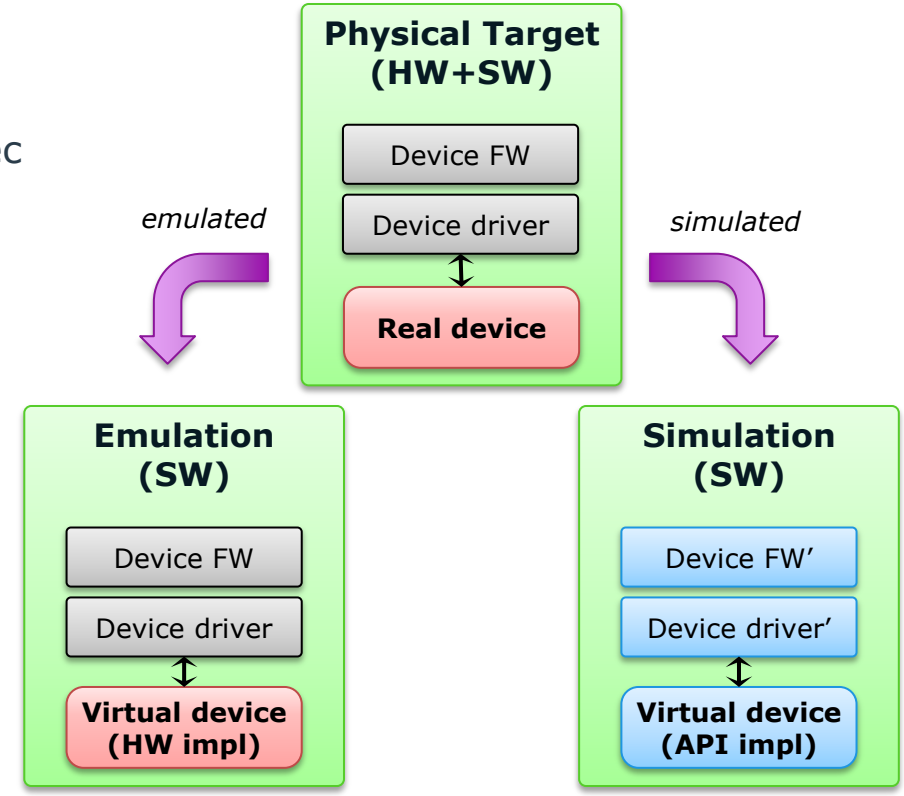
- Tizen emulator features compared to physical targets or other emulators

Category	Pros	Cons
Usability	▪ Easy to get (just download SDK) ▪ Configurable devices and skin ▪ Various virtual device input support ▪ Multi-instance support for emulator ▪ Host directory sharing	
Performance	▪ Capability of HW VT acceleration ▪ Codec and GLES acceleration ▪ virtio	
Compatibility		▪ Not all devices are fully supported • e.g. WiFi, BT, radio, etc.

Key Design Concepts

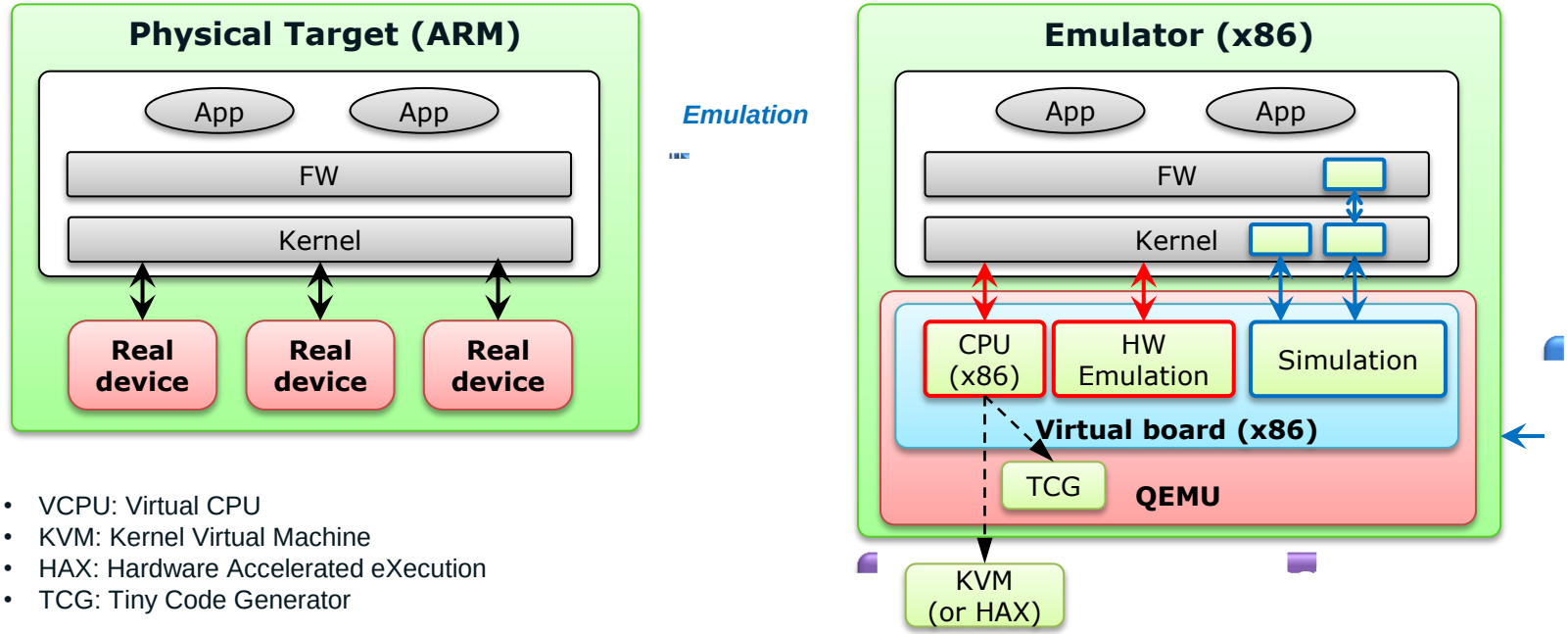
Emulation vs. Simulation

- Emulation
  - Strict implementation of device spec
  - No guest modification
  - Conventional approach of QEMU
  - Poor performance and flexibility
- Simulation
  - API-centric implementation
  - Guest modification needed
  - e.g. virtio



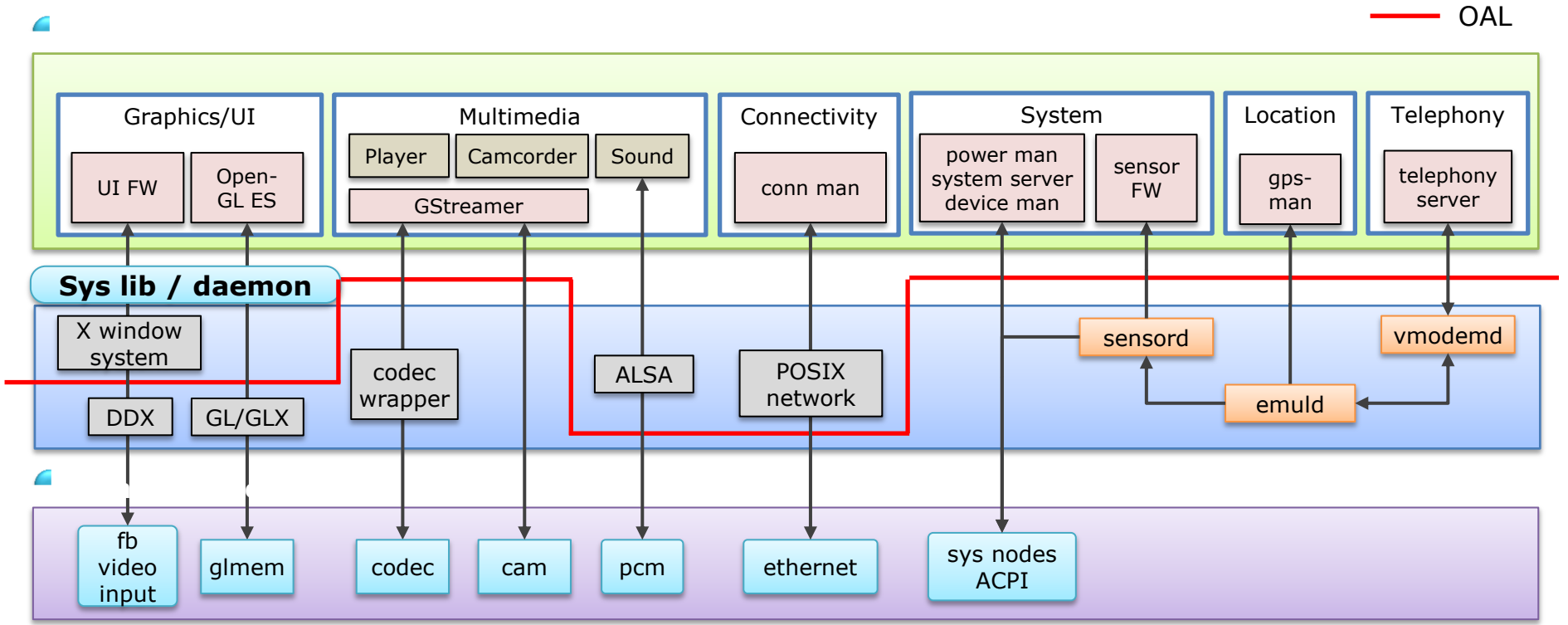
Hybrid Emulation

- "HW emulation + simulation" for better performance and flexibility



- VCPU: Virtual CPU
- KVM: Kernel Virtual Machine
- HAX: Hardware Accelerated eXecution
- TCG: Tiny Code Generator

OEM Abstraction Layer



Tizen Virtual Board

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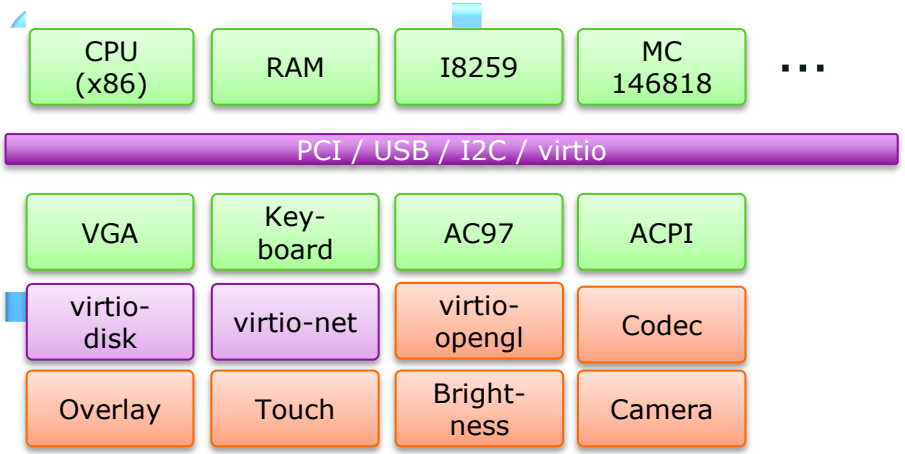
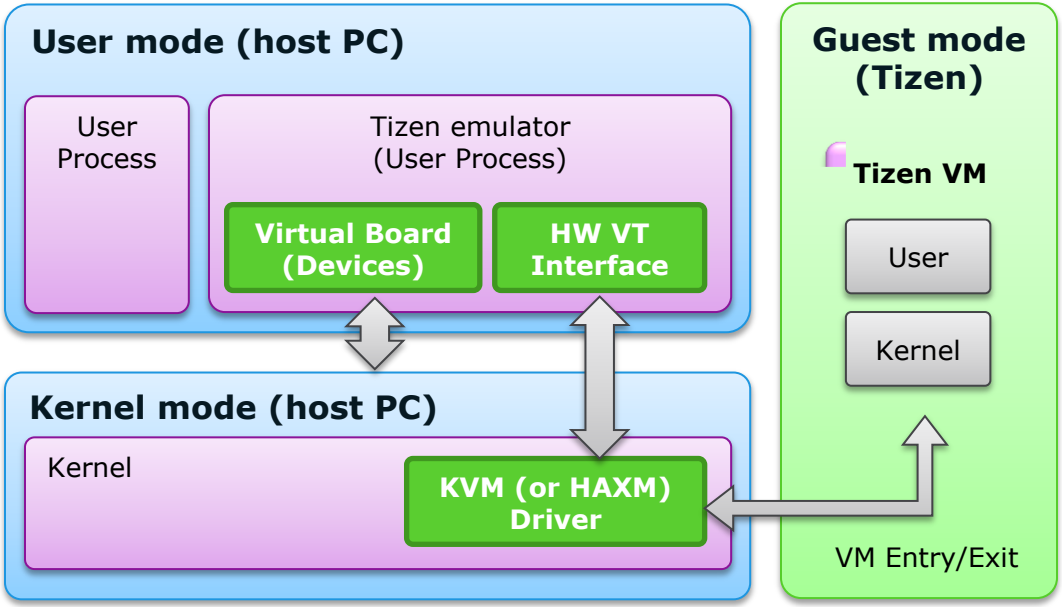
Virtual Board Overview

- Tizen virtual board provides virtual HW devices
- Board constructions
  - QEMU PC board
    - Intel Pentium II chipset + devices
  - virtio devices from QEMU
    - virtio-disk, virtio-net and virtio-9p
  - New devices from Tizen
    - virtio-opengl
    - Overlay, codec, camera, multi-touch, etc.



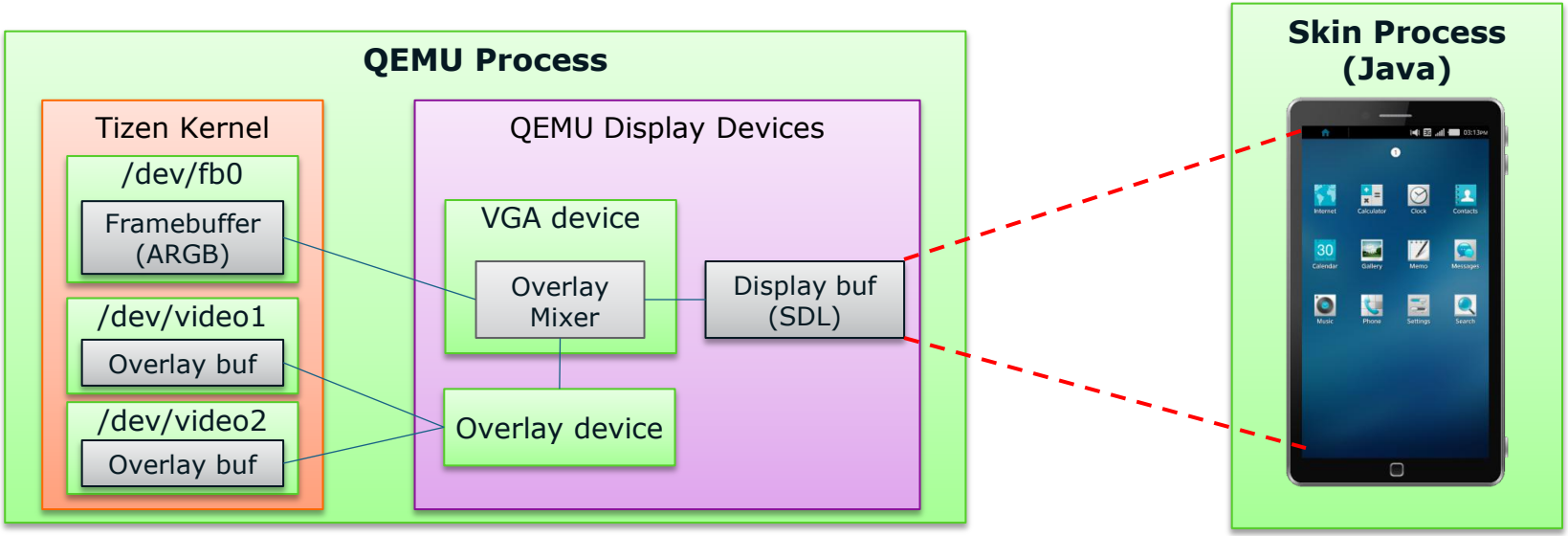
Execution with HW VT Acceleration

- High performance w/ HW VT support
  - Intel VT-x or AMD-V
  - Special kernel driver needed: KVM in Linux and HAXM in Windows
- Additional performance considerations
  - Removing core affinity from Windows
  - Optimization for guest memory access
  - Separate display thread



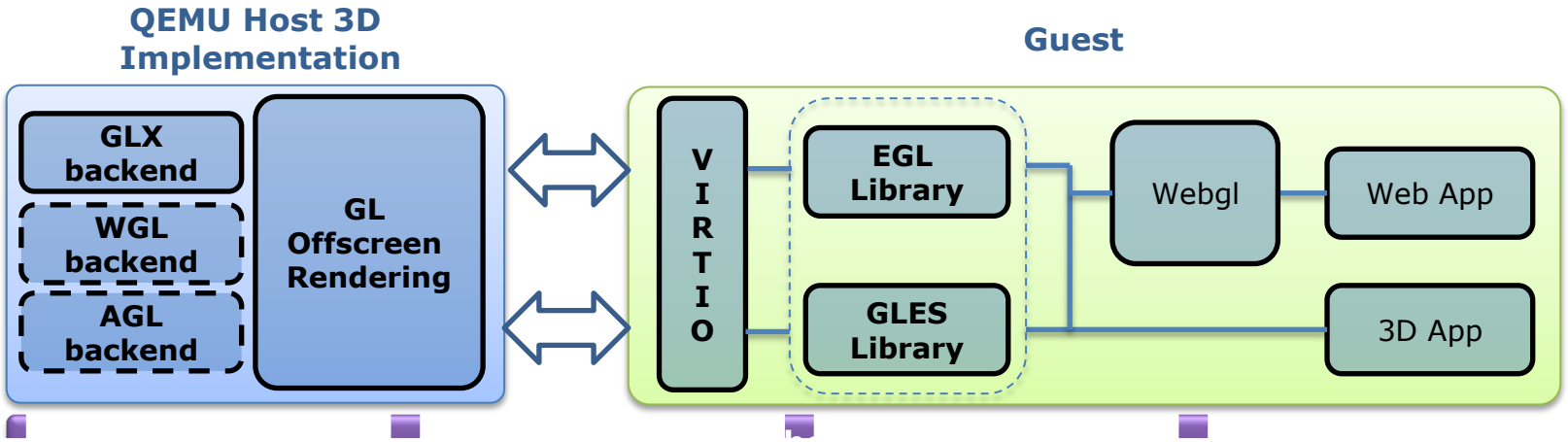
Skin/Display

- Emulator skin with high portability/usability written in Java
- Display devices based VGA
  - VGA device (1 framebuffer) + Overlay device (2 overlay buffers)
  - Sharing SDL display buffer between QEMU and skin processes



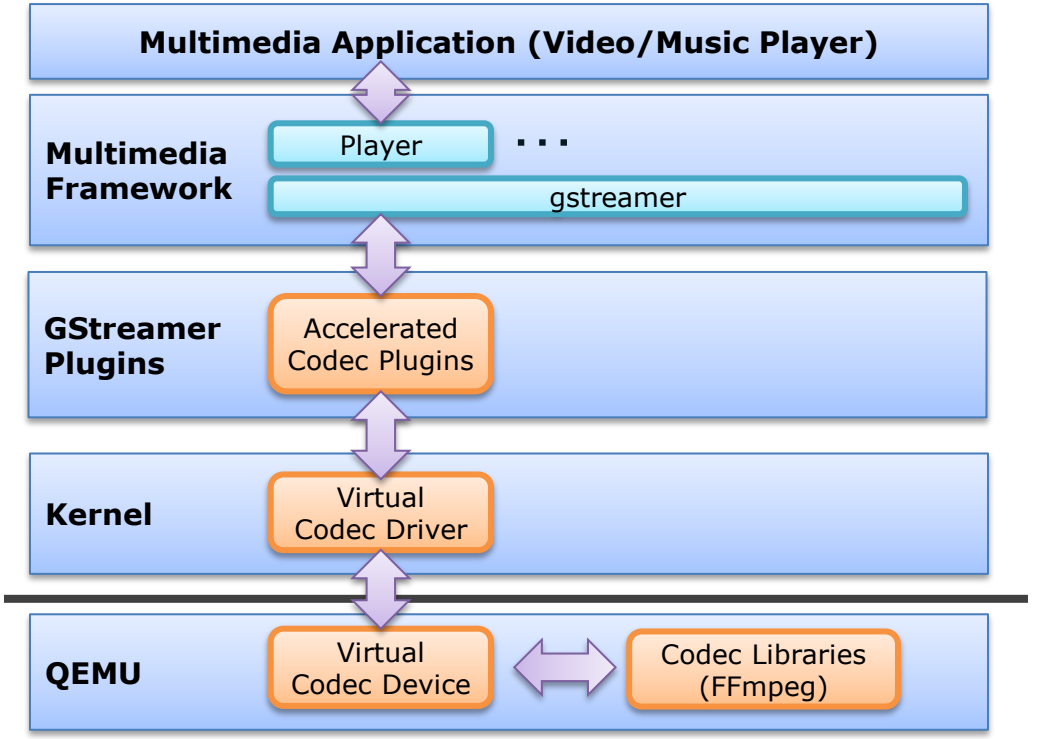
GLES Acceleration

- Support OpenGLES/EGL APIs with high performance
- GLES/EGL calls are performed in offscreen rendering by host GPU if it exists
  - gl command passing to QEMU via virtio
  - gl command buffering to avoid copy-back overhead



Codec Acceleration

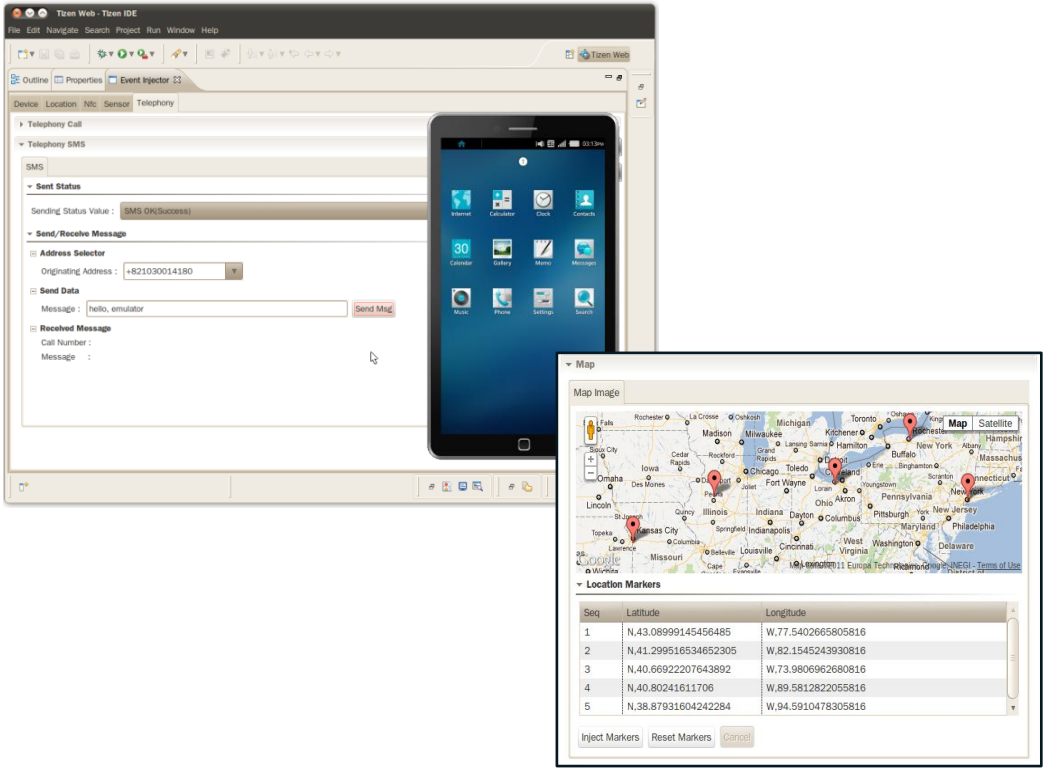
- Support video playing even w/o HW VT support
  - Typically, QEMU TCG is not fast enough to run guest video codec
- AV Codec API delegation to host



Advanced Functionalities

Event Injector

- Rich event injection for ease of test
  - Sensors
    - Accelerometer
    - Gyroscope
    - Geomagnetic
    - Proximity
    - Light
    - Motion
  - Location
    - Manual/Map/Log file
  - Telephony
    - Call/SMS (from/to event injector)
  - NFC
    - NDEF message
    - NFC Tag
    - P2P
  - Device
    - Battery level
    - Earjack
    - USB
    - RSSI



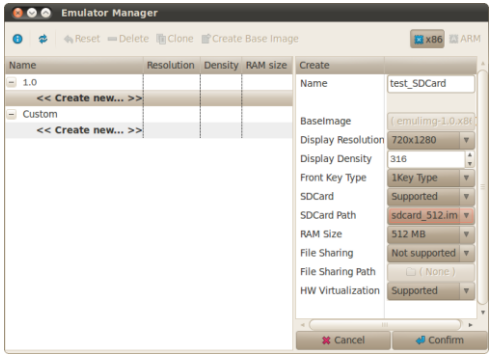
Host Directory Sharing

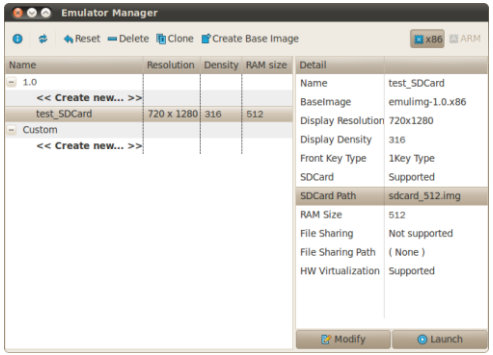
- Directory sharing between host PC and Tizen guest
  - Useful for large size of resource files (e.g. multimedia files)
  - No need to upload files to guest via ssh
  - No worries about guest disk size

- Implementation via network file sharing
  - For Linux host
    - virtio 9p protocol
  - For Windows host
    - Samba protocol (Windows7 needs ID/PW according to security policy)

Emulator Manager

- Provides interfaces to experience various emulator targets and to test portability
  - VM management including file system images and HW configurations
  - VM (Virtual Machine): a set of configuration for Tizen guest
- Supports configurable virtual HWs
  - Display resolution: HVGA / WVGA / WSVGA / HD
  - Display density (DPI)
  - RAM size
  - Front key type
- Saves disk spaces for Tizen guests using QCOW2
  - QCOW2 (QEMU Copy-On-Write 2) image format
    - "Read-only base image" / "Read-writable image" pair
  - Multiple images can share a same base image





Conclusion

- Hybrid emulation is effective for mobile emulator
  - Flexible to support various mobile devices with high performance
  - OpenGL / Codec performance (Ubuntu 11.04, Intel i7 3.4GHz, 4GB RAM)
    - Webgl fpstest (fps): **0 (guest mesa w/o VT) → 6 (w/o VT), 20 (w/ VT)**
    - H.264 decoder (fps): **0 (guest codec w/o VT) → 3.7 (w/o VT), 22.4 (w/ VT)**
- x86 guest boosts up emulator performance with HW VT support
  - Execution performance (Windows7, Intel i7 2.93GHz, 4GB RAM)
    - Booting time (sec): **57 (w/o VT) → 17 (w/ VT)**
    - CoreMark (iteration/sec): **910 (w/o VT) → 8450 (w/ VT)**
    - SunSpider (msec): **6540.5 (w/o VT) → 575.2 (w/ VT)**
- Event injector is user-friendly enough to test various virtual events
- Emulator manager provides interfaces to experience various emulator targets and to test portability

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