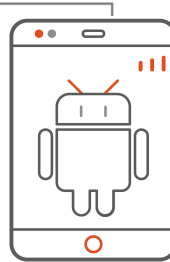
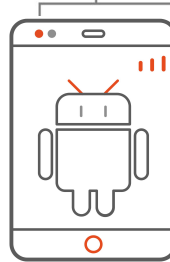
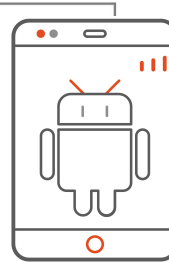
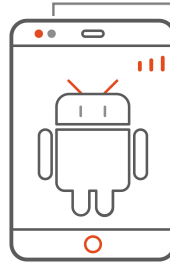
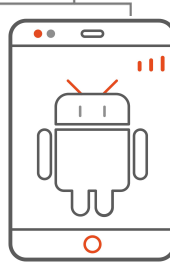
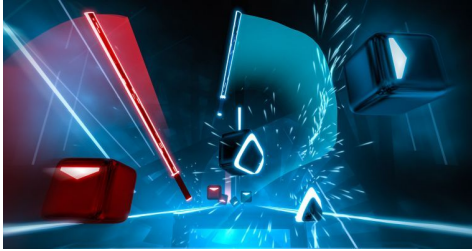


# Anbox Cloud

Scalable Android™ in the cloud

CANONICAL + ubuntu 

# Anbox Cloud



# Anbox Cloud



## Use cases Cloud software for Android Applications

- Mobile game streaming services
- Financial and corporate application streaming
- Application automation
- Android application CI testing

## Built for scale At least 2x scale of VM based systems

- Up to hundred Android instances per server
- Thousands Android instances per rack
- POD scaleout to support near-edge cloud deployments



# Anbox Cloud



## Technology

- Ubuntu kernel with live patch
- LXD for machine containers with clustering support
- MAAS for bare metal provisioning
- Juju for service orchestration and easy deployment

ubuntu<sup>®</sup>



## Features

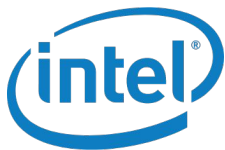
- Runs on x86 and ARM (no binary translation)
- Android 10, 11 and 12 with latest security updates
- Resource management and orchestration of all containers
- Android application lifecycle management
- Secure by design (unprivileged containers, resource restrictions, ...)
- APIs for easy integration



# Global Partnerships

Anbox Cloud runs on any hardware and on any infrastructure platform

x86 servers



Private clouds



GPU



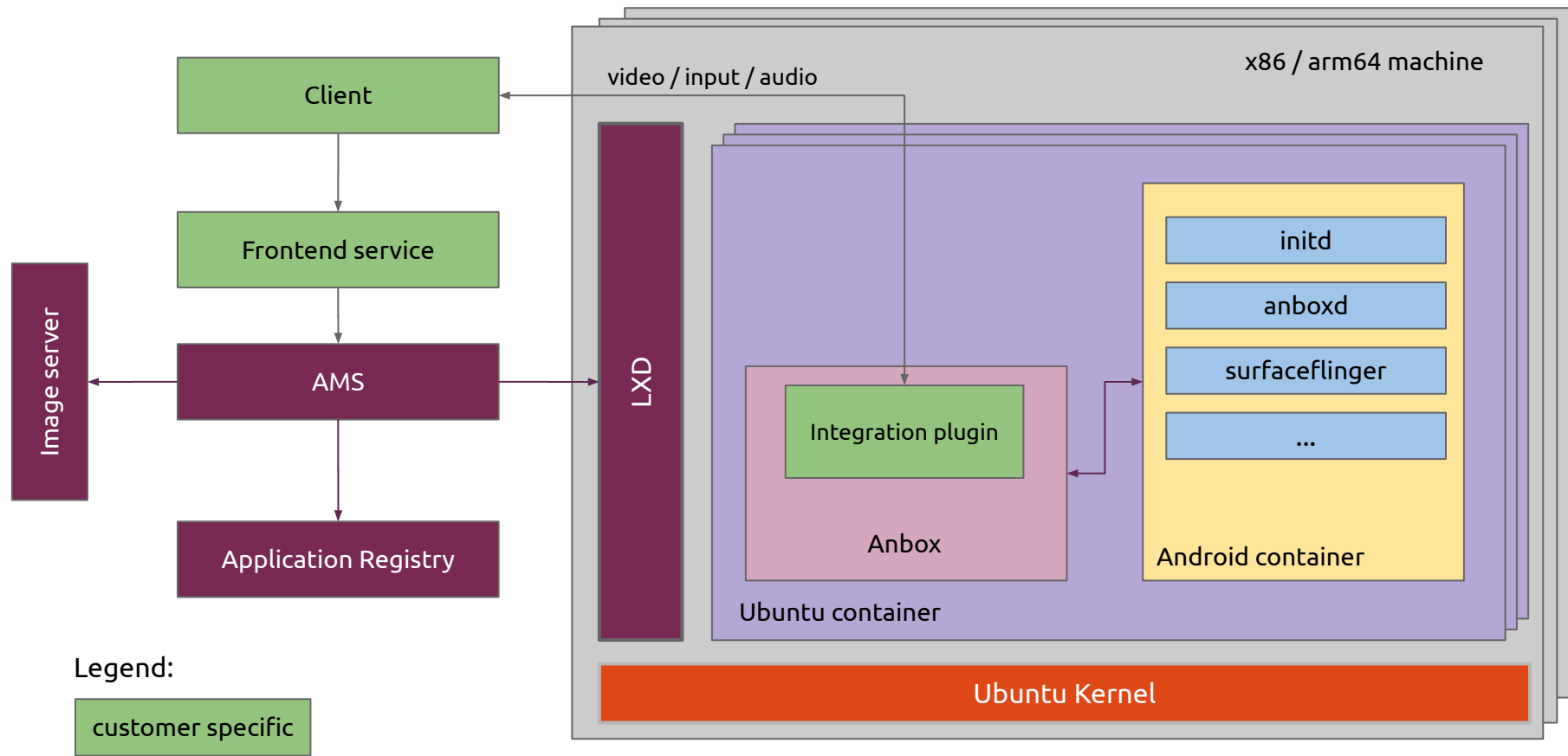
ARM servers



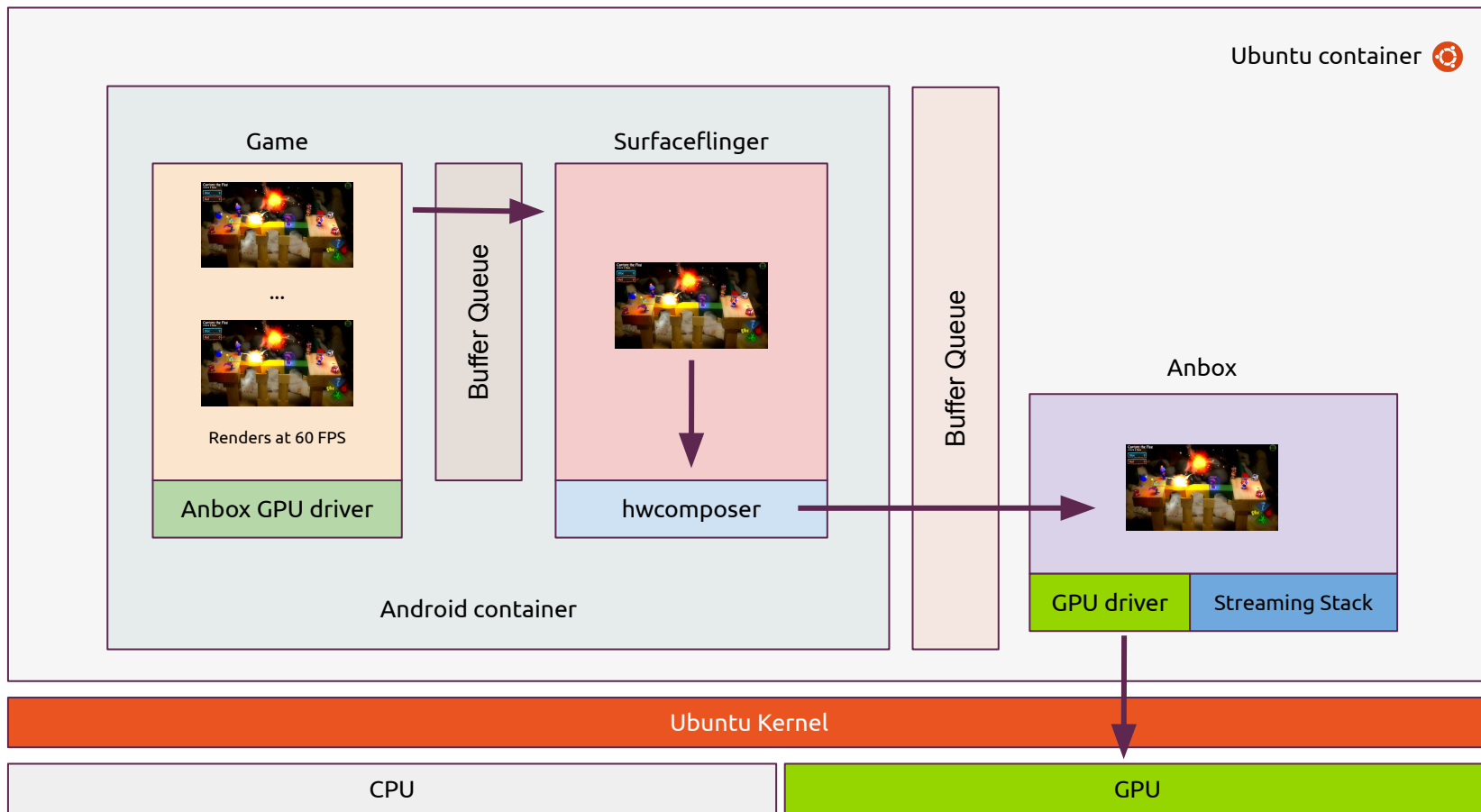
Public clouds



# Machine level architecture



# Rendering pipeline



# Android Hardware support



## Support for various hardware devices

- Location (GPS, ..)
- Sensors (accelerometer, ...)
- WiFi (simulated on top of Ethernet)
- Camera

## Graphics

- EGL 1.5, OpenGL ES 3.1
- Accelerated video decoding (H264, VP8, VP9)
- Vulkan 1.1 support coming soon
- Multiple drivers: null, swrast, GPU
- Supported GPU vendors: Nvidia, AMD



# Container security



## Based on industry standards

- LXD/LXC provides the baseline for all containerization
- Full use of unprivileged user namespaces and AppArmor/Seccomp confinement
- No privileged access for any container to the host
- No direct hardware access (GPU) from Android
- Android is running as nested container for further isolation

## Future

- Full SELinux support once LSM stacking lands in Linux upstream
- vTPM support

# Anbox Cloud Streaming Stack



## Based on WebRTC

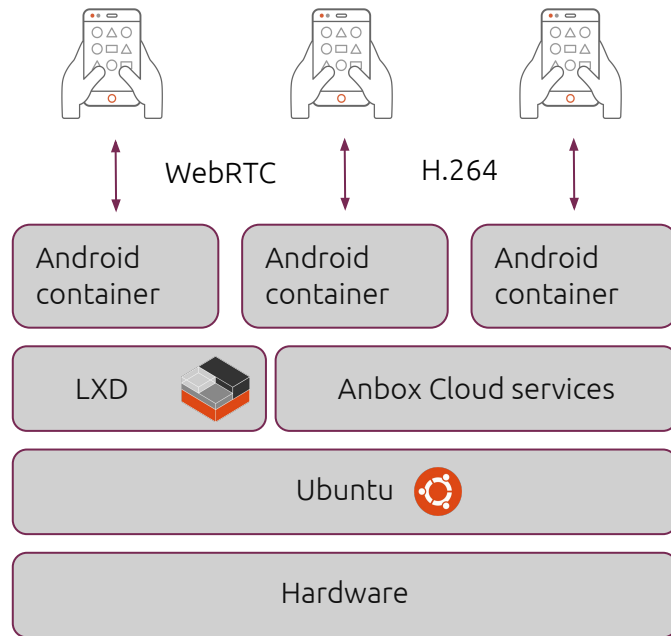
- Support a wide variety of clients (web, native)
- SDK available to allow easy development of clients

## Optimized for high density, low latency and quality

- Supported video codecs
  - H.264 (hardware accelerated)
  - VP8 (software)
- Supports GPUs from Nvidia, AMD

## Ready for scaleout across multiple regions

- Scales with your needs



# Rendering performance

Running bombsquad in an automated stress test mode to simulate actual user driven game play

Running on Ampere Altra - Mt. Snow with 2 Nvidia Tesla T4 GPUs

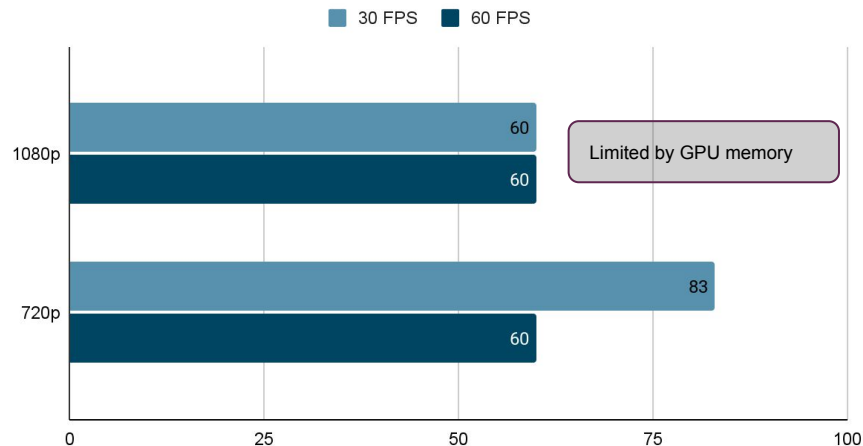
Using Vulkan as interface to the Nvidia GPU for rendering

Remaining GPU rendering can be utilized by software video encoding



<https://www.froemling.net/apps/bombsquad>

Ampere Altra + 2x Nvidia Tesla T4 (rendering only)



# Streaming performance

Running bombsquad in an automated stress test mode to simulate actual user driven game play

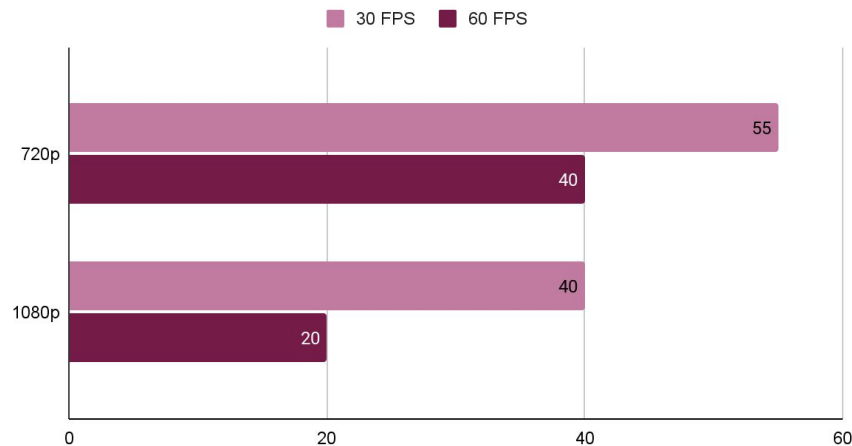
Running on Ampere Altra - Mt. Snow with 2 Nvidia Tesla T4 GPUs

Using Vulkan for rendering and NvEnc (H.264) for video encode with zero-copy render-to-encode



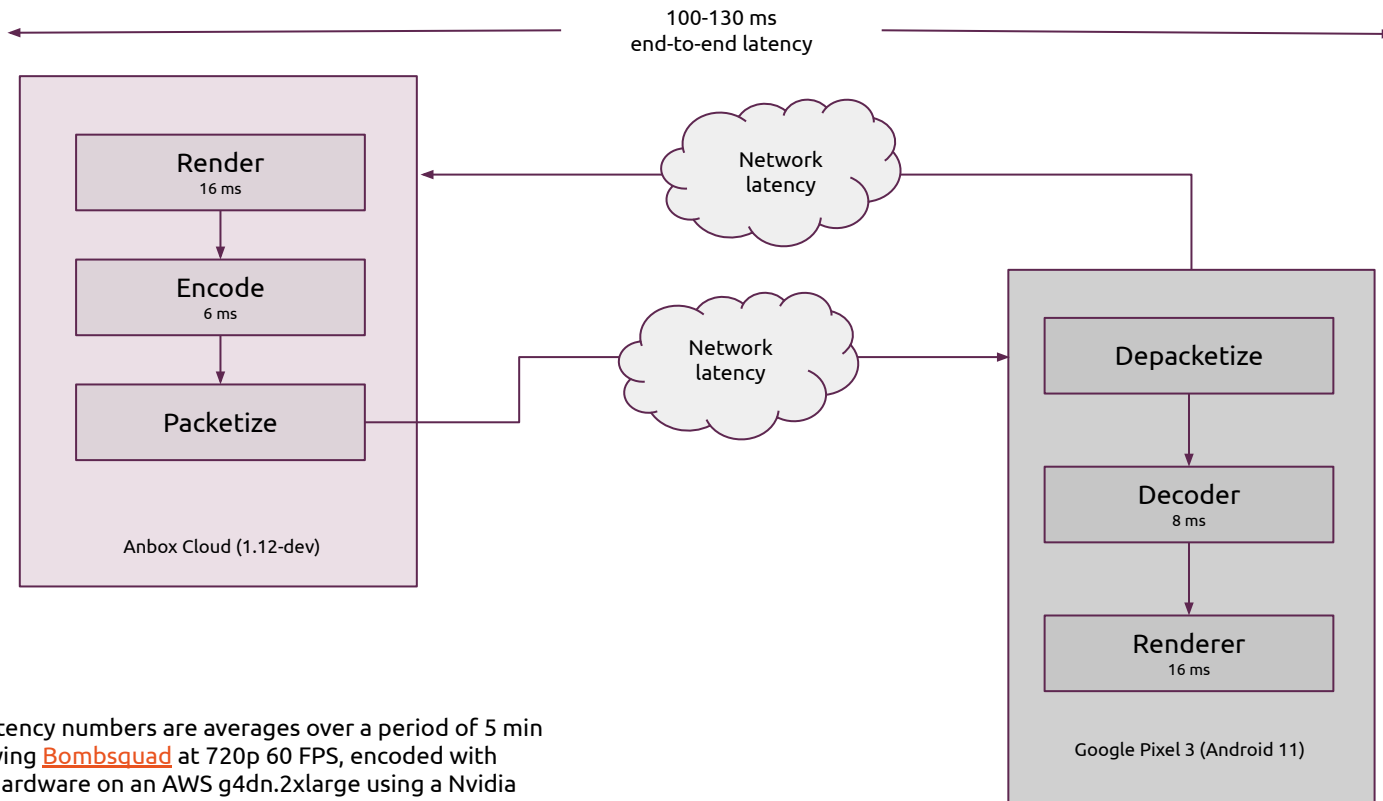
<https://www.froemling.net/apps/bombsquad>

Ampere Altra + 2x Nvidia Tesla T4



Limited by video encoder

# Streaming latency



**NOTE:** Latency numbers are averages over a period of 5 min when playing [Bombsquad](#) at 720p 60 FPS, encoded with H.264 in hardware on an AWS g4dn.2xlarge using a Nvidia Tesla T4 GPU

Thank you. Questions?

