ASCENDER TECHNOLOGIES LTD.

Android in the Cloud Technology

Puts ARM Servers in the Cloud

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Ascender's technology, created specifically for ARM processors, offers services that Intel servers cannot provide. This enabling technology runs standard Android apps in the Cloud with the ability to view these apps on a wide variety of remote clients, and supports a broad range of use cases.

Features of *Android in the Cloud* technology

- Enables cost and computer resource efficient remote execution of unmodified Android apps on multiple platforms.
- Enables viewing on the remote client without performance compromise.
- Enables remote access to a large number of +1,000,000 available Android apps.
- Provides a high graphical frame rate using low network bandwidth.
- Solves the BYOD problem of managing multiple systems and platforms.
- Typically uses less than 40 KBytes/sec of network bandwidth, while providing:
  - full resolution
  - low latency

  - lossless compression
  - 60 frames per second graphic stream.
- Reduces cost of cloud hosting:
  - OS containerization rather than machine virtualization.
  - rendering is done on the client side
  - No GPU's on the remote host.

Proofs of Concept: Nine ARM Servers Tested

We tested nine ARM platforms as Remote Android hosts (Table 1). Each platform runs standard Linux distributions with modified Linux kernels which simultaneously support both standard Linux and multiple Android image functionality. The Android image runs in a Linux container using LXC. The Raspberry PI2 was tested running one Android image. Both the Odroid XU4 and the Scaleway C1 were run with four simultaneous Android containers. The HP Moonshot M400 was tested running 20 Android containers. The HP Moonshot, Huawei and Cavium platforms would probably host more Android images, than listed in Table 1, but more images could not be tested practically.

***Android in the Cloud* on AWS: Containers with Virtualization**

Android in the Cloud uses Linux container technology for Android image isolation. We ported *Android in the Cloud* to Amazon's ARM a1 cloud offering. *Android in the Cloud* on AWS cloud offers additional image isolation due to the underlying machine virtualization. Benefits include:

- Better image isolation and security,
- Flexible virtual machine (KVM) sizing and resource allocation,
- AWS global infrastructure,
- AWS ease of use,
- Flexible capacity limits.

Results

Users could not differentiate between the performance of the local servers (RPI2, Odroid C2 and Xu4) and the wide area (international) servers (Scaleway, Moonshot, Cavium, Packet and AWS). The local client was in Israel. The distance to the remote servers for both Paris and Amsterdam is 3,300 km. The distance to NYC is 9,000 km. The distance to Houston is 11,000 km.

Conclusion

With *Android in the Cloud* technology, all the server platforms that we tested:

- stream graphics at 60 fps with minimal resources,
- use low network bandwidth, and
- are insensitive to network latency.

End-User Case Examples for *Android in the Cloud*

Ascender's technology enables a new ARM ecosystem (Fig 1) supported by Cloud ARM servers.

Wearable Devices	IoT Devices
Mobile Enterprise Devices (BYOD)	Inexpensive Mobile Devices
Desktop Clients	Cloud Gaming
App Library / Subscription Model	Set-Top Boxes
WebGL Browser Based Implementations	Automated Testing

Platform	Processor	Cores/Threads	Bits	Memory	Location	Images Supported
Raspberry PI2	BCM2836	4	32	1 GB	Israel	1
Odroid XU4	Exynos5422	8	32	2 GB	Israel	4
Odroid C2	Amlogic A53	4	64/32	2 GB	Israel	1
Scaleway C1	Armada 370/XP	4	32	2 GB	Paris, France	4
HP Moonshot M400	AppliedMicro	8	64/32	64 GB	Houston, TX	20
Packet Type 2A	Dual Cavium TX	96	64	128 GB	Amsterdam	~100
Packet Type 2A2	Huawei HiSilicon	64	64/32	128 GB	Amsterdam	~100
Cavium	Thunder/X2	56/224	64	256 GB	NYC	>100
AWS	Graviton/a1	1-16	64/32	2-32GB	Ohio/Ireland	1-16

Table 1: Android in the Cloud Implementations

Ascender's
Android in the Cloud

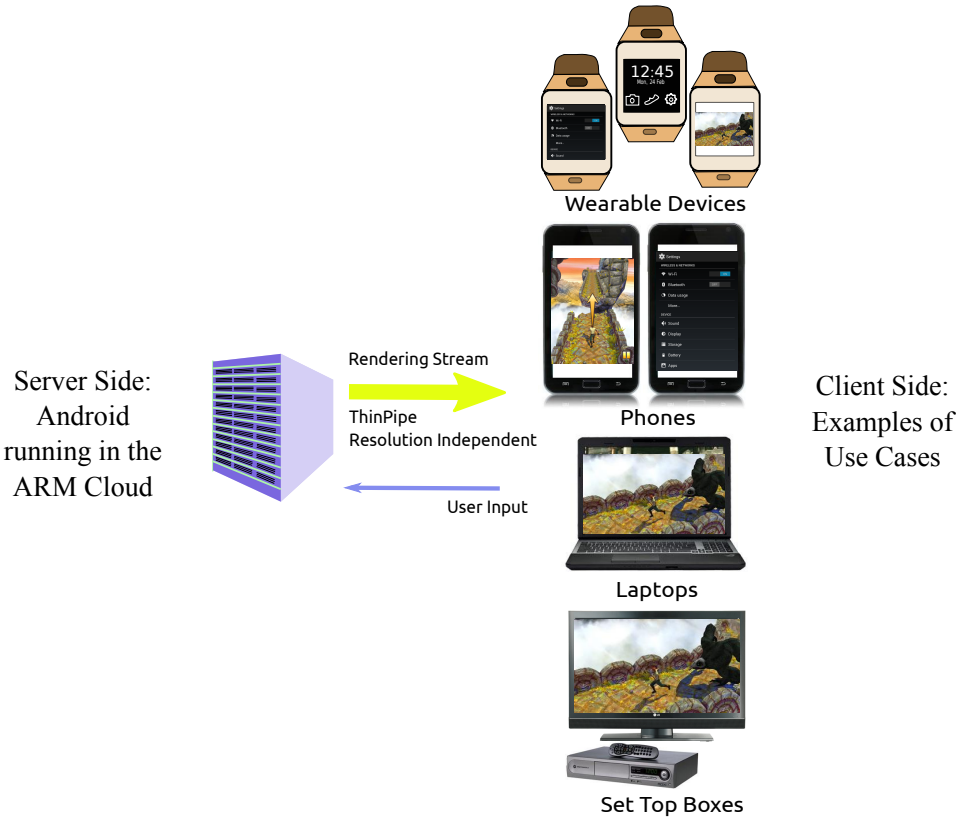

Figure 1: System Diagram