Dual-Android™ on Nexus 10

Samsung Research UK
Presentation

for

Xen Developer Summit

24-25 Oct 2013

Edinburgh, UK

Introduction

- Feasibility: 2 copies of Android on Xen on ARM?
  - Xen on mobile performance?
  - Virtualized GPU required

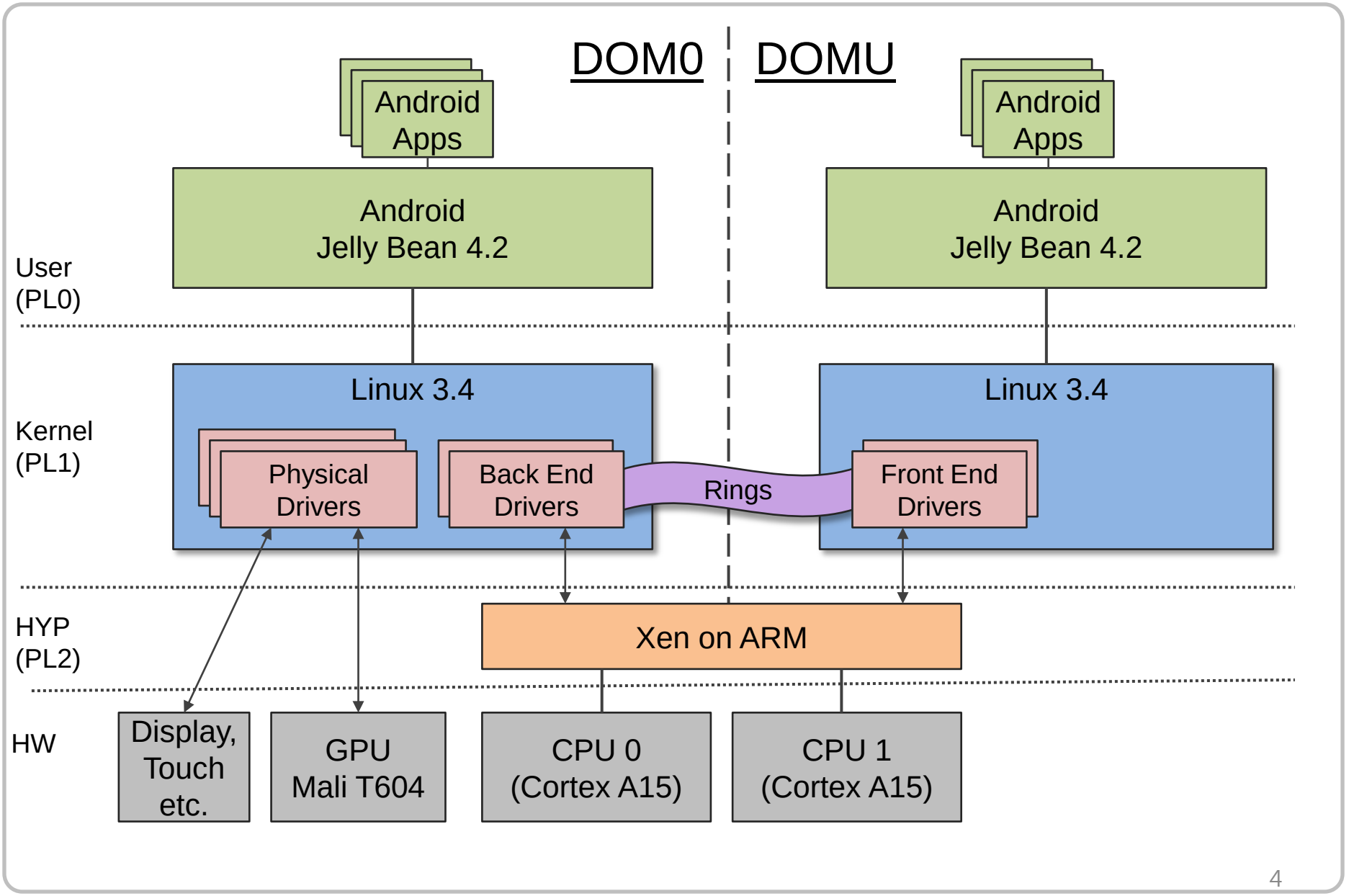
- Nexus 10 device used
  - CPU: ARM Cortex A15 (x2)
  - GPU: ARM Mali T604
  - Memory available: 2GB RAM, plenty of Flash
  - Screen resolution: 2560x1504

Configuration

- Software configuration – 2 VMs only
  - DOM0 = 1st Android
  - DOMU = 2nd Android
  - Linux 3.4
  - Android Jelly Bean 4.2
- Xen 4.2 for ARM
  - Builds on Xen on ARM for Cortex A9 work in Samsung
  - Parallel development in Samsung HQ to community

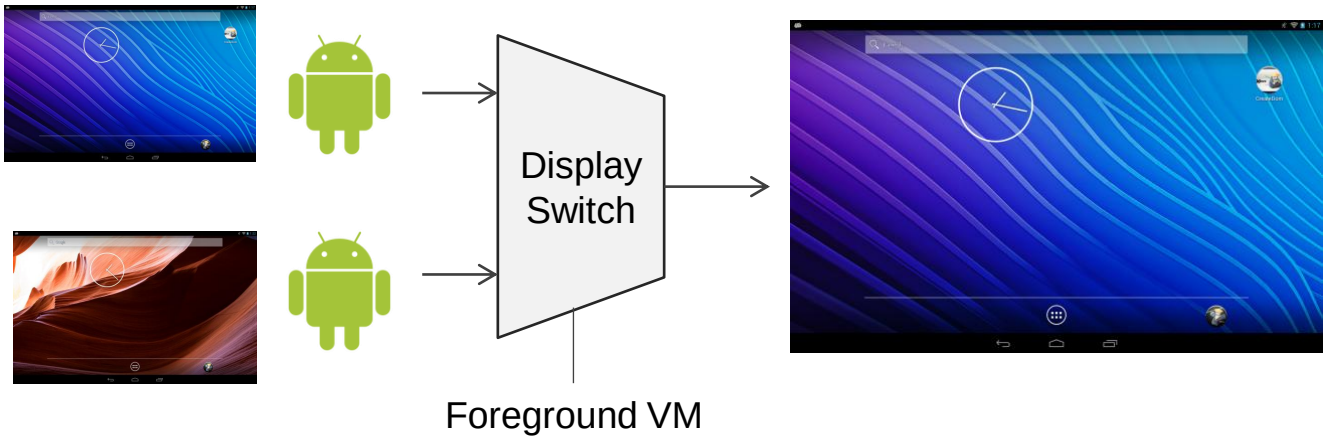
	Xen	DOM0 kernel	DOMU kernel
Memory		1GB RAM	1GB RAM
SMP	Dual-core	Dual-core	Single-core
I/O		Pass through	PV Drivers

Xen PVH Architecture



Mobile Virtualization

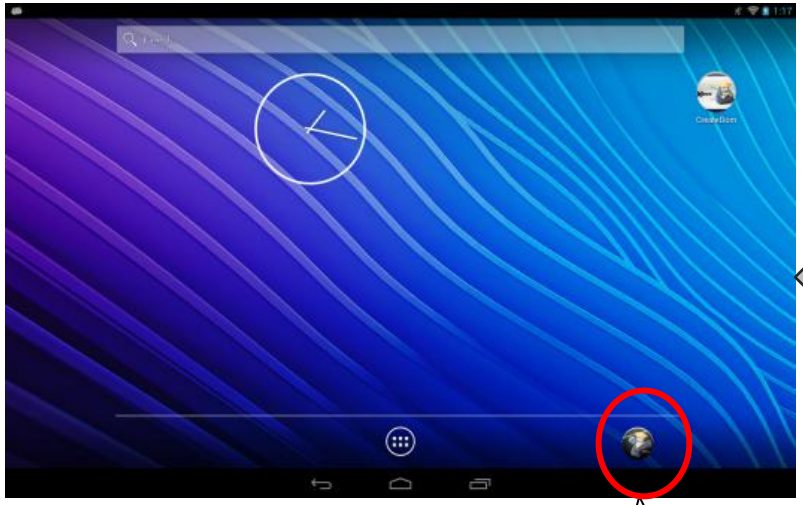
- I/O Challenges – Mobiles have ~50 device drivers
  - Sensors: Touch, gyro, proximity, ambient light
  - Media: Display, GPU, Camera, Audio, Video
  - Connectivity: Charger, USB, WiFi, Bluetooth
- User Switching
  - Xen scheduler runs as normal.
  - “Foreground” VM – user devices require arbitration driver in DOM0
    - Display
    - Touch



Video

- Demo video
  - Switching between Android → Icon or Volume key
  - Angry Birds in DOMU → Near-native performance of PV drivers
  - Angry Birds in DOM0 and DOMU concurrently → Two independent Android
  - 3D Benchmark clip

DOM0 – Blue Wallpaper



Passthrough drivers

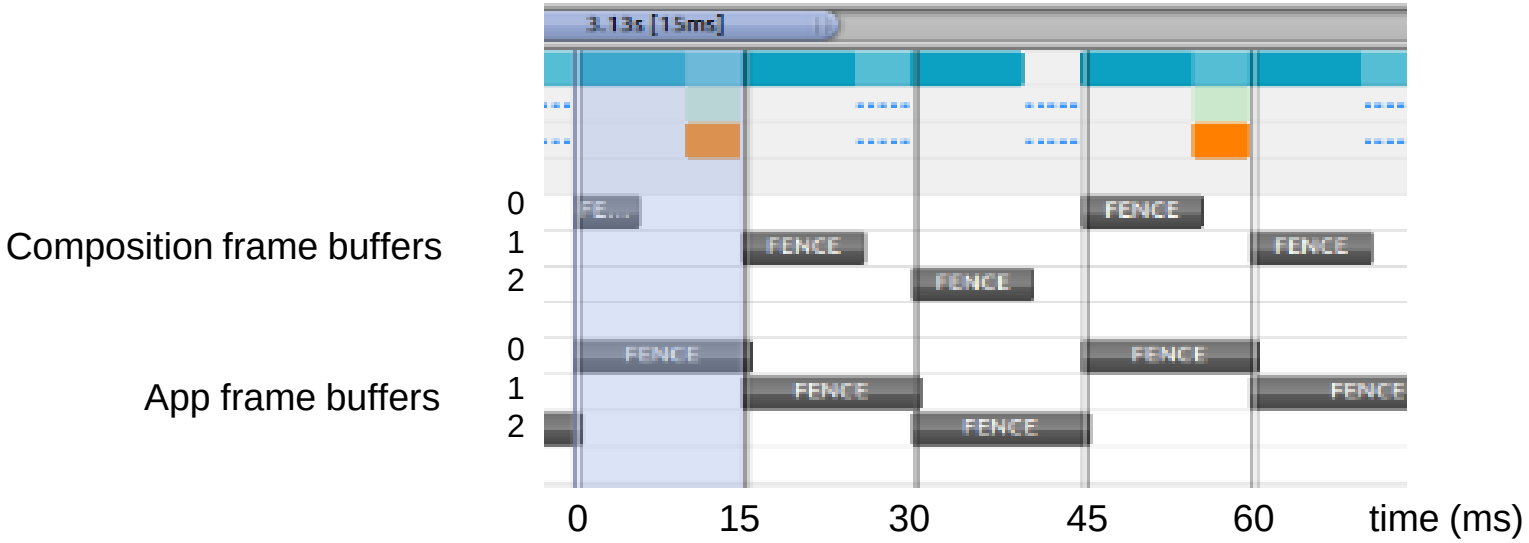
Switching icon

DOMU – Orange Wallpaper

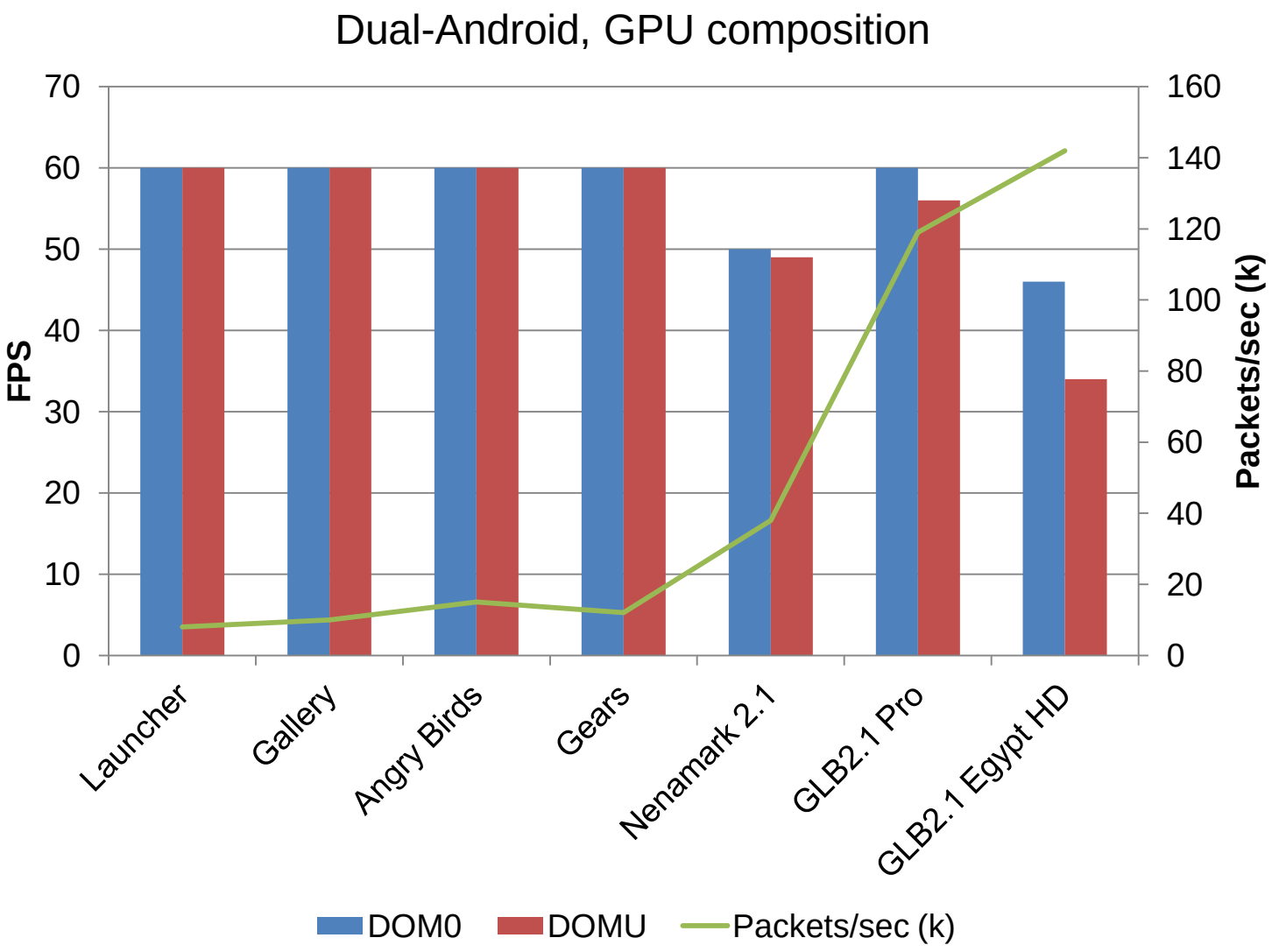
PV Drivers

Near-Native Performance Challenges

- 60 frames per second = 16.6ms per frame
  - GPU renders each surface → GPU composes the surfaces → frame
- Virtualized graphics options
  - API Remoting done above GPU driver for *chipset portability*
- Android JB has “butter smooth” technology
  - Triple buffering
  - Needs reliable Vsync interrupt → Xen event channel stressed
  - Deferred waiting using sync points & fences

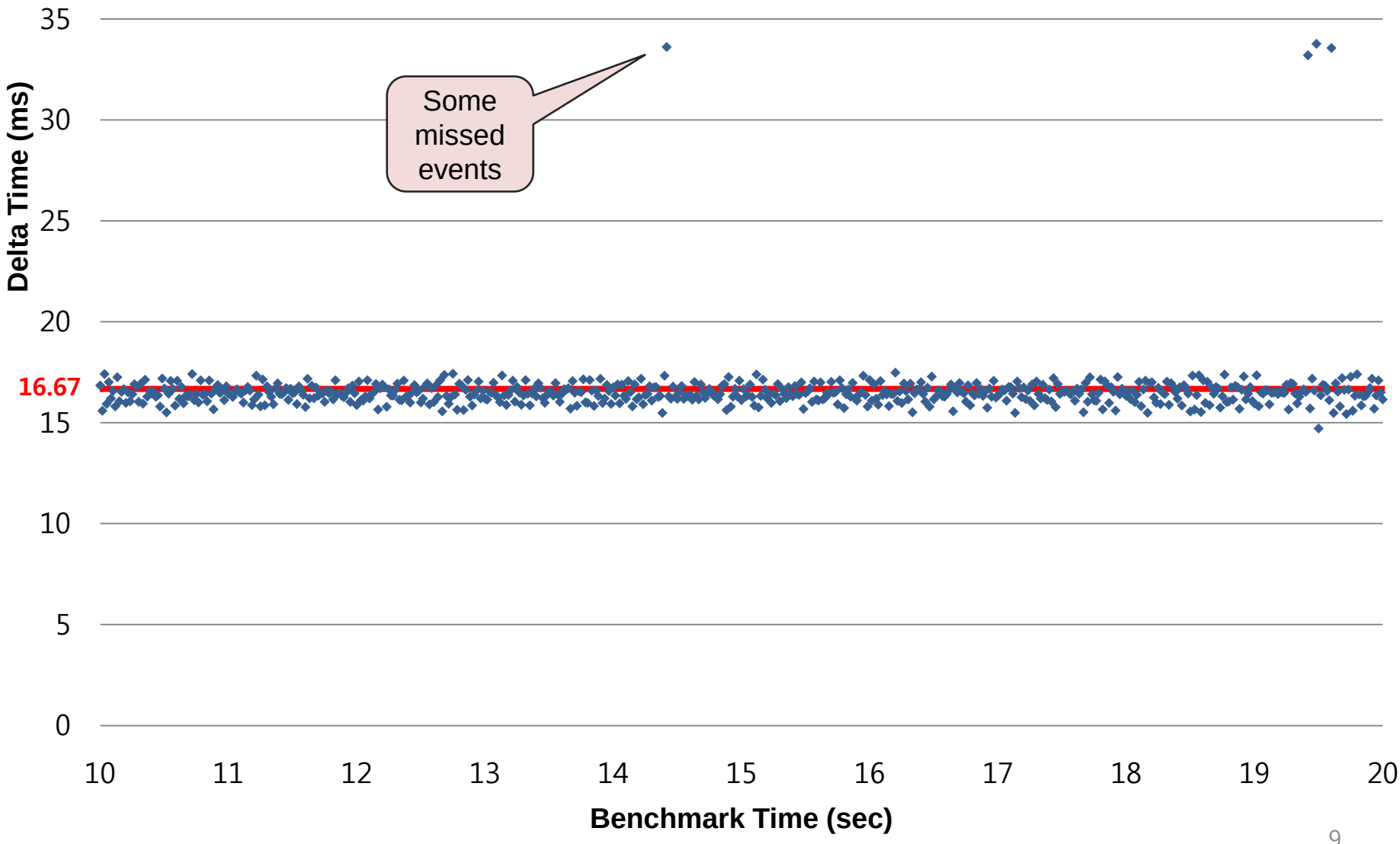


Results



Event Channel Under Stress

❖ DOMU Vsync arrival time delta



Xen For Mobile

- Multi-page ring
  - Needed for throughput performance running benchmarks
  - Ensure low-latency
- Non-linear grant references
  - Old grants are re-used. PV drivers assume linearity
- RAM Allocation limit 512MB
  - Buddy allocator is unable to allocate contiguous chunk of memory from the Domheap memory
- Per-VM interrupts unreliable when stressed
  - Must ensure Vsync is received in DOMU with minimal latency
- Contribution to community
  - Samsung will work to share Xen changes with community
  - Some code is proprietary

Conclusion

- Two Android can run with near-native graphics performance
- Xen runs well on mobile devices
- Using PV drivers, no major changes to Xen architecture required