MOVING MOBILE GRAPHICS

Sam Martin, Arm

SIGGRAPH requested we state whether you can go wild with your cameras or not.
We'll this is a course about mobiles. So sure, go wild with them.
Slides will also be online though!

MOVING MOBILE GRAPHICS

Sam Martin

Hi!

I love SIGGRAPH + captivated by all things mobile -> led me to my current job.

Course aims

- Spotlight to recent advances in mobile graphics.
- Hopefully raise awareness of mobile amongst the siggraph community
- Aim to inspire as well as inform

Taken separately, "mobile" and "graphics" are mature things.

In combination - new challenges / opportunity to impact people's lives

As a research topic perhaps still needs a bit of TLC. Hopefully this course will help a bit.

"The smartphone is the defining technology of the age"

The Economist

March 2015

Mobile's importance is such that the Economist chose to call the smartphone "the defining technology of the age".

I'd argue it's not really a technology. Yes, it has keystone technologies that enable it but…

It's the product of years of effort in a huge industry, including logistics, new types of stores, new business models.

A raft of industries now sit on top. I think it's a good reminder that when we say "technology" we sometimes mean technology and business shifting together.
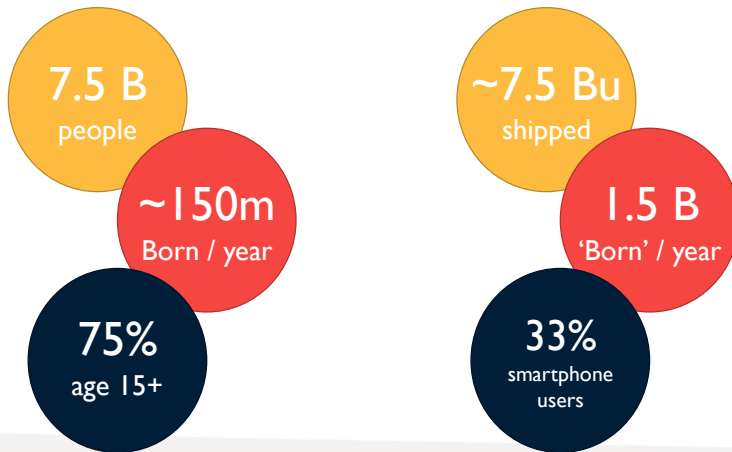
To get a sense of scale, I think it's interested to compare phones to humans.

Last year, shipped 1.5bu. 1/3rd of population owning one. This year may see 1.8-1.9b shipping this year. Expected to saturate around 2b/year or so.
Compare this to humans: In 2017, world bank est 7.53bp, of which 5.575bp 15+ or over.

>Birth rate was nearly 1.9% last year, or around 150m. So we make about 10x the number of phones than we do people.

This is a market limited only by world population and distribution of wealth.

>Successful advances in graphics technologies that are applicable to mobile will be felt by hundreds of millions of people.
>Successful advances that are cost-effective will be felt across the globe.
>"only" a 1/3rd of the pop owns a phone. Whereas 3/4 of the world could own one.

Some comments on the data here:
I took population figures from the World Bank.

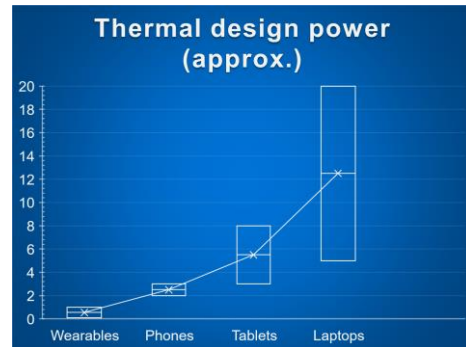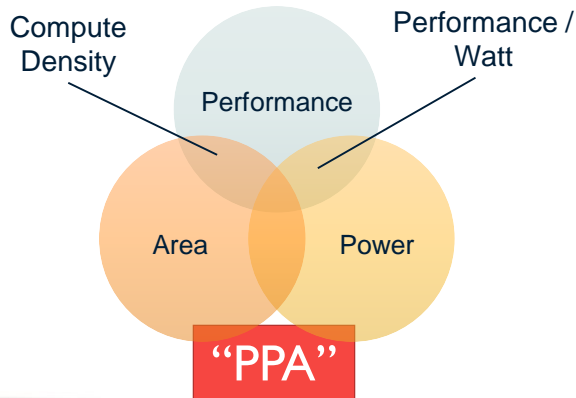Phone figures vary a bit, depending on what you are counting.
I took smartphone shipments per year and integrated over 10 years to get total shipments. This has a big error margin but is certainly on the order of humans.
GSMA count all connected devices, and give a higher figure of 8.7Bu total, 5B unique subscribers. (https://www.gsmaintelligence.com/)
That suggests that while only a 1/3rd own a smartphone, the 89%-ish of everyone 15+ owns a phone-like thing. This is probably an overestimate as it assumes unique connections is 1:1 with humans.

To properly measuring success in mobile it is insufficient to just measure performance.
This is true of non-mobile, but we are particularly sensitive to scale.

Perf/watt – easy to boost power and get more perf – also known as cheating ☺ For power constrained applications, like VR, reducing power will actually make things go faster.
Adding area – similar to adding cost. Remember size of market is limited by distribution of wealth. Now this is something that only hardware designers and silicon providers have any control over, and in practice increasing area also tends to increase power, but perhaps a useful way of thinking about this is as cost. Die area costs money. If you really want an idea to be applicable to large number of people you need to get this down – recall that wealth distribution is a limiting factor. Sometimes reducing area is a hardware designer managing to make things smaller, but sometimes it's intentionally doing more in software, or reusing other existing hardware blocks, in order trade some power for cost.

These 3 are common and important enough you may hear them abbreviated as PPA.

Further measures are bandwidth and latency. Bandwidth costs a lot of power, and often impacts directly on the thermal headroom of the SoC, so it is something you can't afford to be wasteful with.

Also note the very uneven distribution of power across devices. Area follows a similar curve. It's a curve that rises very steeply as you increase the TDP.

MODERN PREMIUM SOC

CPU	• Typically 4-8 cores, range of sizes
Gfx	• 1440p+ • Premium 400+ Gflops, (mid-range 100 Gflops)
Accel.	• Video, Display, Image/Signal processing, … • *Coming soon*: **ML accelerators**
Bandwidth	• Up to 29.8 GB/s peak. • **But**: Limited to <1/2 by power in practice

* exceptions apply!

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Here are some high levels figures for a 'typical' premium SoC.
Please take these figures as very hand-wavey guidance. The industry has a lot of variety in it so it's hard to categorise what a smartphone is, particularly in terms of performance figures.

To illustrate, GPU gflops vary enormously from 10s glops and could potentially push up to 1Tflop. So giving a ballpark figure for this is hard.
It's certainly worth assuming that not all GPUs have significantly more capacity than the CPUs. Smaller SoCs tend to shrink the GPU before the CPU.

Compared to desktop devices, this is roughly a 10th of a reasonably priced new desktop device, where you can expect 192GB/sec, 4000 gflops, etc.
Power (battery and thermals) are shared in mobile.
Power can limit things sooner than you may expect, notably bandwidth.

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DIGITAL SWISS ARMY KNIFE

Sensors	• Motion, temperature, proximity, GPS, …
Cameras	• High quality back facing (dual camera) • Smart front facing
Radios	• Wifi, 3G/4G/xG modem • Short range: NFC, Bluetooth, …

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A smart phone is more than just a unified SoC. It's a swiss army knife of sensors, cameras and connectivity options.

This is having a huge impact on what graphics means on mobile.
- Computational photography (Pixel 2 portrait mode, dual camera reconstruction)
- Augmented photos/video – stickers, filters animated heads, etc
- AR – see Victor's later talk on dense slam

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VR/AR are naturally mobile

New form factors, wearables, AIO, multiple devices

Today we see games, but there is also promise in other areas

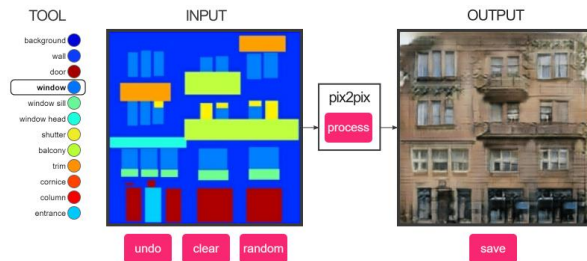   Training, education, museums

      Healthcare

      Enterprise

      Related industries: smart home, consumer robotics

Today, focus on XR and rendering.

Want to comment briefly on what's next.
ML stands to be a very significant tech.
Can assume accelerators are coming (some are already here). 2020 onwards will have a significant ML accelerator.

What does this mean for graphics and computations photography?
For example, when is it worth simulating and when is it worth hallucinating?

Andrew – intro to graphics on mobile: architectural differences and api details
Rob – changes being made to accelerate XR
Hans-Kristian – benchmark of modern rendering and post-AA techniques

MOVING MOBILE GRAPHICS PT.2

https://community.arm.com/graphics/b/blog/posts/moving-mobile-graphics

Dense Vision on Personal Devices
- Victor Prisacariu, 6D.ai, Oxford Vision Lab

Maximising Rendering Efficiency
- Felipe Lira, Unity

Preparing Android for XR
- Jiwen Cai, Google Daydream

Victor – talking and demoing dense SLAM on mobile
Felipe – recent changes in Unity (SRL) for mobile
Jiwen – how android has been adapted for XR

Q&A at the end of each half.

THANK YOU! QUESTIONS?

Many thanks to all our speakers

Special thanks to:

- Manish Sirdeshmukh
- Rahul Prasad
- Micah Knapp
- Salman Saeed

We'd love to know how we did. Let us know via the SIGGRAPH app survey.

Any other feedback, thoughts, ideas:
- sam.martin@arm.com
- @palgorithm

Course notes will be available online shortly:

https://community.arm.com/graphics/b/blog/posts/moving-mobile-graphics