Think Silicon

Ultra Low Power GPUs for Wearables

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The Company

Who we are?

Think Silicon is a privately held company founded in 2007.

What we do?

Development of **low power GPU** IP semiconductor cores for mobile/embedded devices.

Market

Focus is the broader IoT and specifically the "Wearable" market.

Our Mission

*Support and collaborate with our **customers** to create mutual and enduring values in **each phase** of the project.*

Engineering Team

70 years cumulative industrial experience

20 Chip Designs

Multidisciplinary Team

IP portfolio

Patent Pool

40 Publications

Tier1 OEM
under NDA

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mobile graphics
MARKET
EVOLUTION

Past Decade

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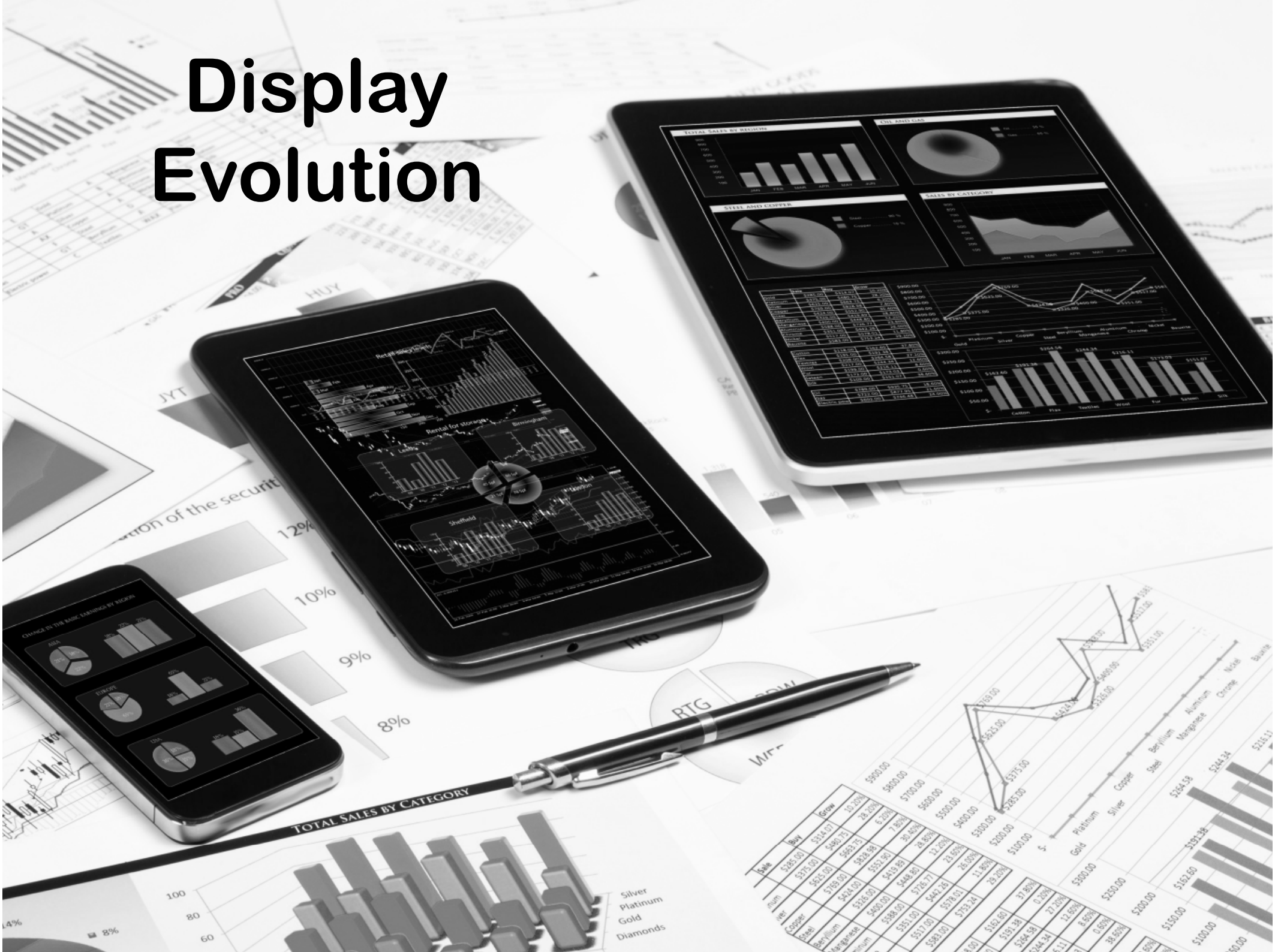
Display Evolution



Future

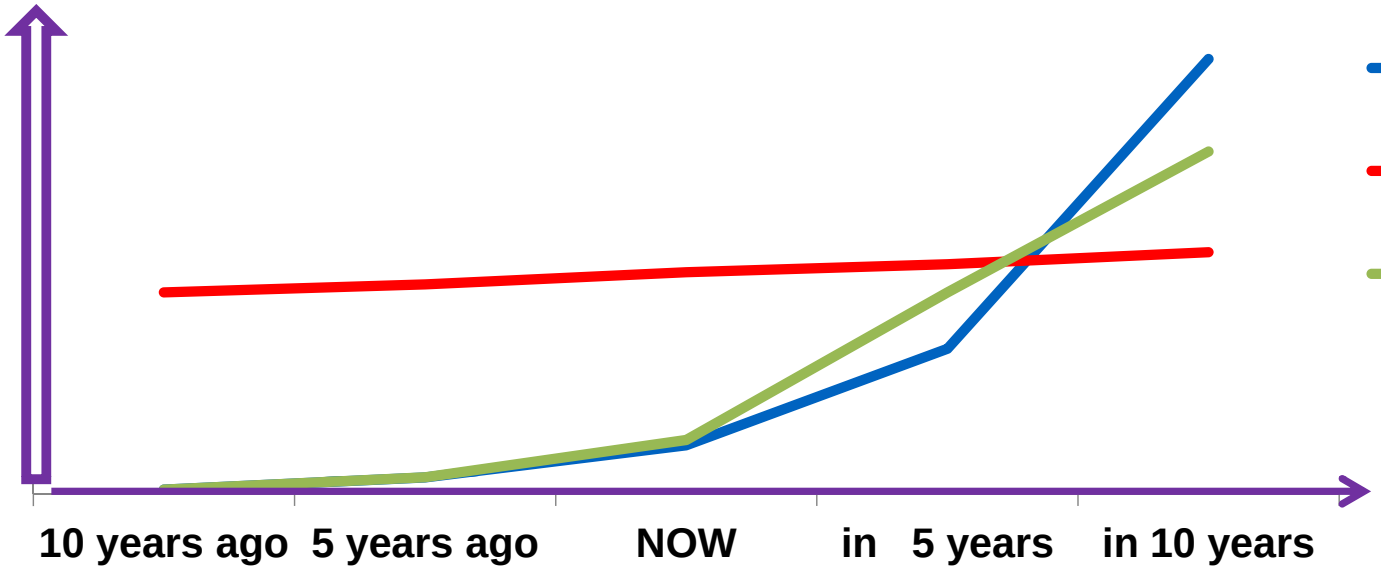
Visualize data from various sources

(Internet of Things paradigm)

Enabling Technology

Graphics Processing Units (GPUs)

Moore's Law in Mobile GPUs



Smartphone GPUs

Applications → in next 5 years will need 4-5x the current GPU perf.

Display resolution→ exponential increase (4K displays are here)

BUT… Power→ roughly under the same power budget (few hundreds milliwatts)

IoT GPUs: few mWatts (< 3 mW) are devoted to graphics

IoT GPUs need multi-level power optimizations

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GPU Challenges

Performance

Time to market

Power consumption

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Coming years: Wearable Market

Think Silicon focuses is on the broader **“Wearable”** market with estimated 700 Million shipped devices in the next five years.

“Worldwide spending on wearable technology will reach $1.4 billion 2014 and **by 2018 is predicted to grow to $19 billion”.**

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GPU Challenges

Power Consumption

Time to market

Performance

GPU Deadlocks

Porting GPUs from the high-end phones to the Wearables failed

it was reported that at least 30% of the Samsung Gear watches sold by the U.S.-based chain Best Buy were being returned by unsatisfied customers

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Application Processor NOW

- Multicore CPU
- Multicore GPU

fully-programmable

- Video Encoder
- Video Decoder
- Image Processors
- Camera Processors
- Vision Processors

ASIC/ASIP
(semi or not)
programmable

Market needs SMARTER mobile GPUs

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Application Processor FUTURE

- Multicore CPU
- Multicore GPU

fully-programmable

- Video Encoder
- Video Decoder
- Image Processors
- Camera Processors
- Vision Processors

Multicore Multipurpose Multidomain GPUs

Mobile GPUs → Media Processors & GPGPUs

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Mobile GPU Challenges

Performance

Power Consumption

Low Die Area

Latency Wall

Memory Wall

Frequency Wall

Adaptability to new Standards

Time to Market

+

Performance per mm^2/Watt/$

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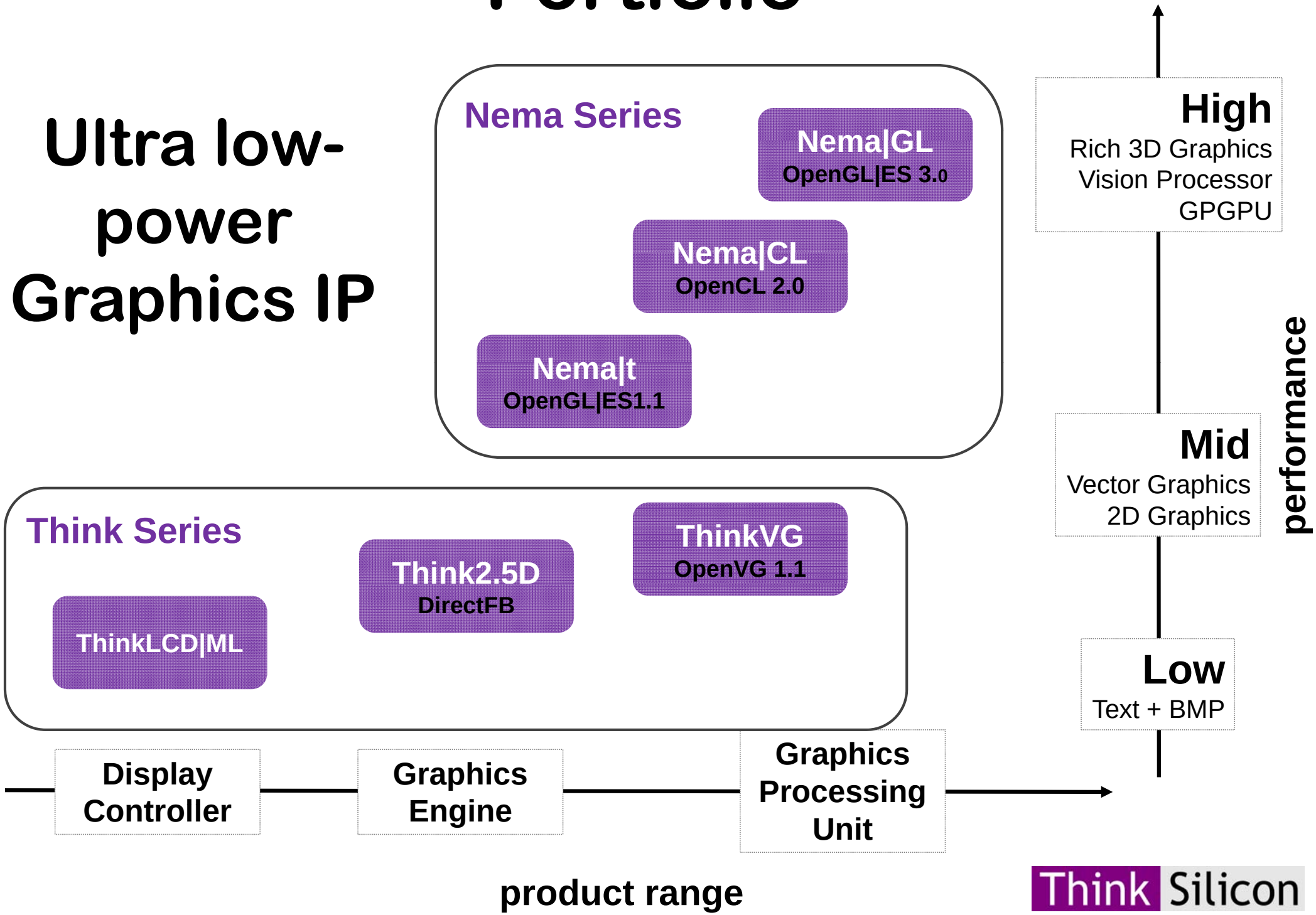
TECHNOLOGY / PROPOSITION

Portfolio

Ultra low-power Graphics IP



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Opportunity

Nema GPU series

Built for the Wearables

- **Power budget** (single-digit milliWatts operations)
- **Small Display Sizes** (e.g., Smartwatches displays)
- **Software** (various "light" OpenGL operations)
- **Available Memory** (libs and images)
- **Memory Bandwidth** (various types of compression)

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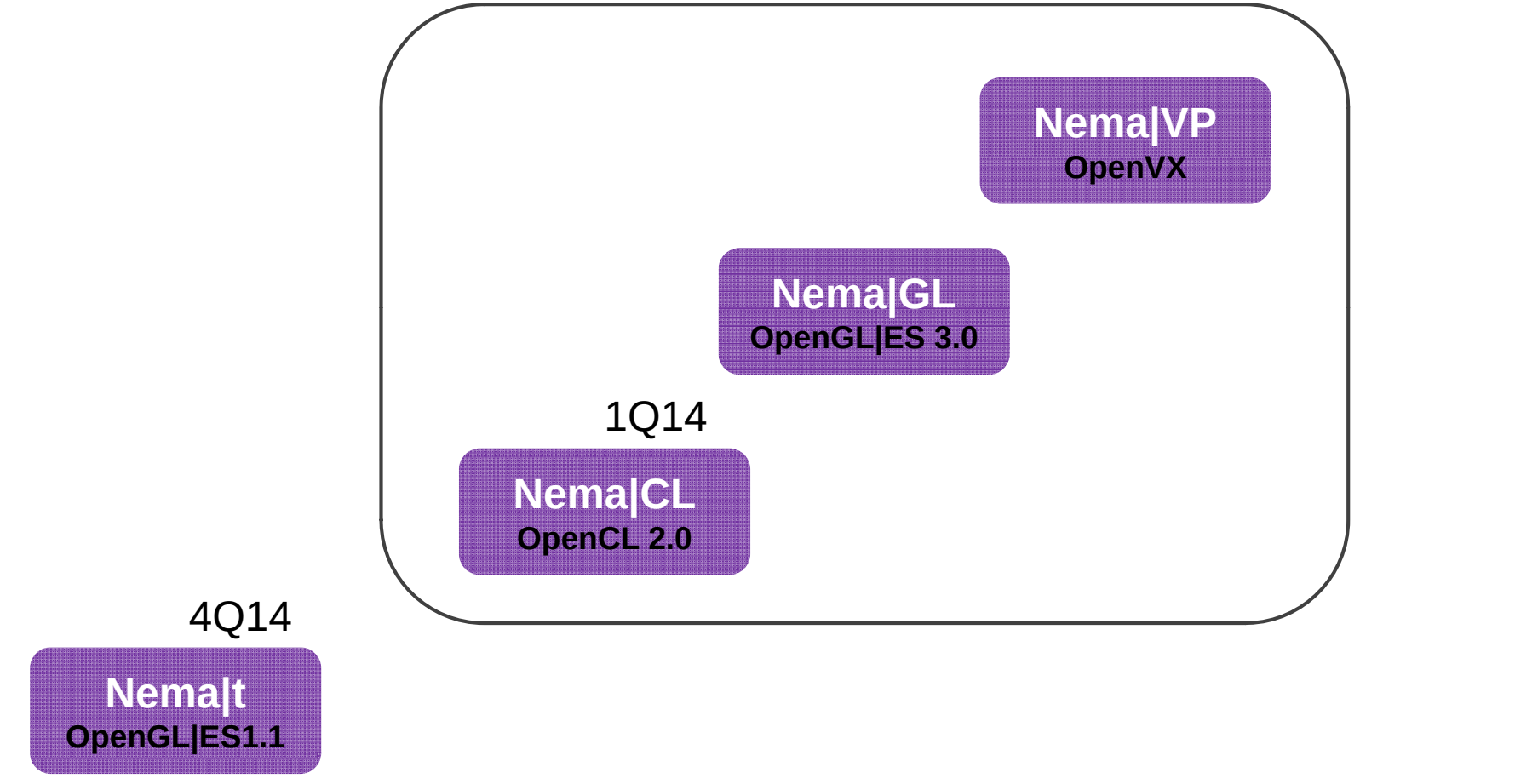
Nema series

NEMA has been specifically developed for the WEARABLE market!



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First Step

Nema|t, a tiny GPU

OS: RTOS, ucLINUX,
API: DirectFB, uGFX, OpenGL|ES1.1
Interface: AMBA AXI/AHB

Multicore Architecture:

- VLIW Core (uNema)
  - Multithread, Proprietary ISA
- Ultra low power Rasterizer
- Texture Unit: Cache with software Prefetching, 4:1 Texture Compression
- Real-time 6:1 FrameBuffer Compression
- 3D support (z-buffer operations) in software

Application area: Wrist devices (Smart-watch, Medical, Fitness, non Wearable/low power etc.)

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First Step

Nema|t – competitive advantage

Extends device (e.g., Smart-watch) battery lifetime up to 5 times!

Compared to the available IoT GPUs Nema|n0

- **Delivers more performance/mWatt**
- Consumes 4x to 10x less power
- Occupies 4x less silicon area
- Saves 3x power consumption from DDR memory accesses
  (US patent pending - Proprietary Frame buffer compression)
- Reduces SoC to Display data traffic (US patent pending)

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Device Power Consumption

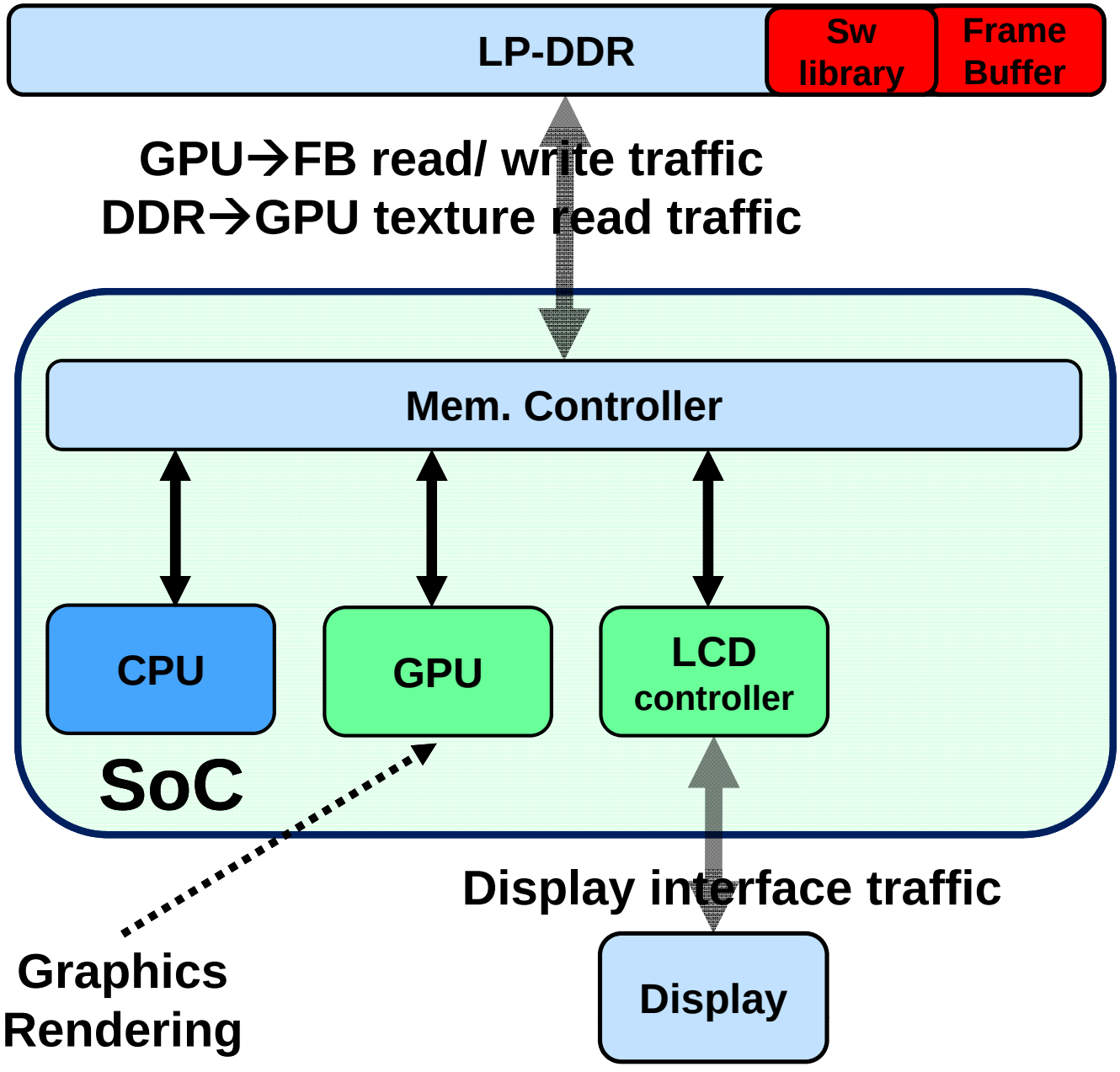
Real life scenario

Smart Watch:
Display 400x400@ 30fps
Processor running @200MHz
DDR Memory 512MB
Battery: 320mA Battery
Typical use case

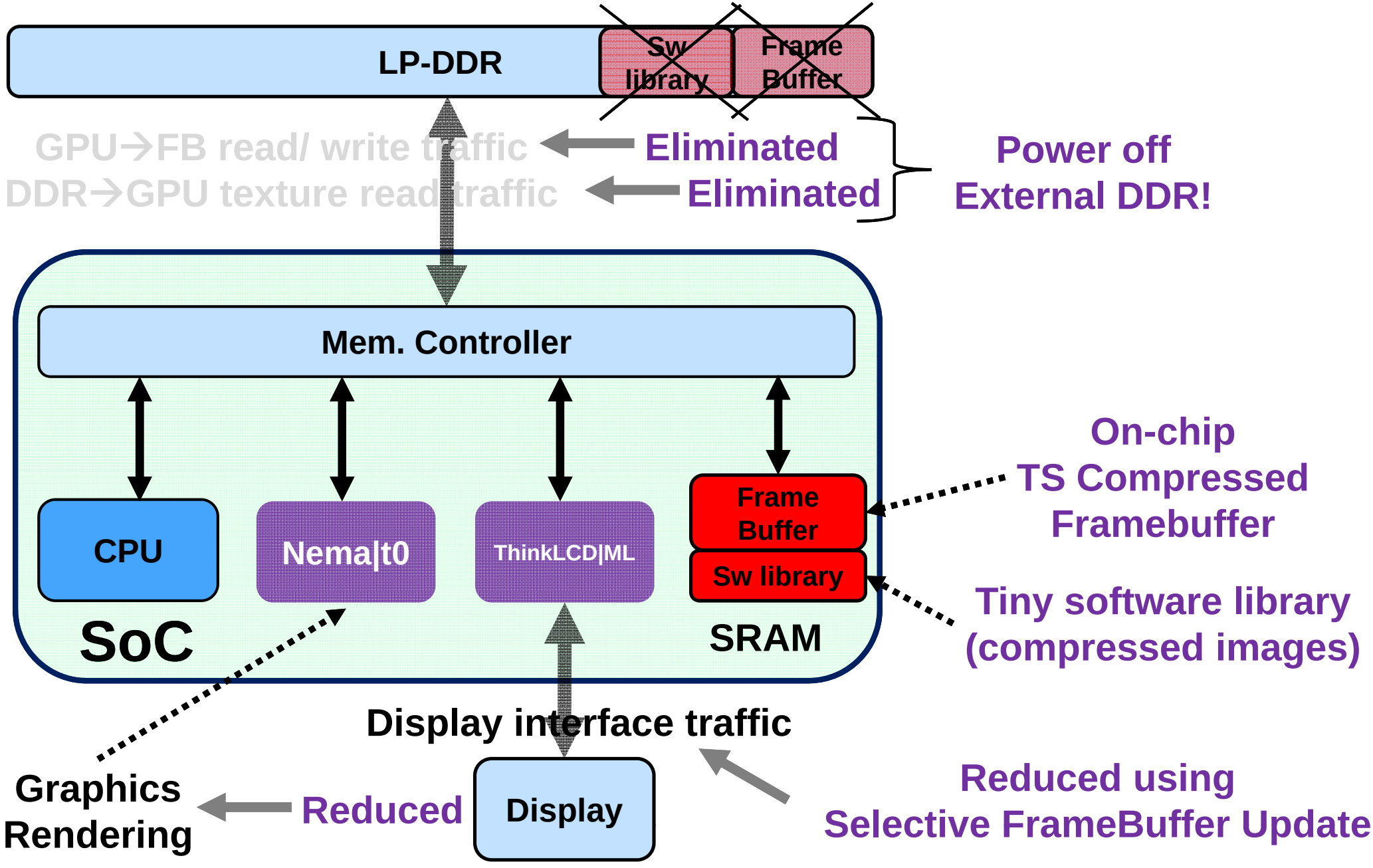
Device power consumption * =
+ SoC power consumption
+ Memory power consumption
+ SoC to Display traffic

*affected from the GPU

System Level Power Consumption



Nema|t power savings



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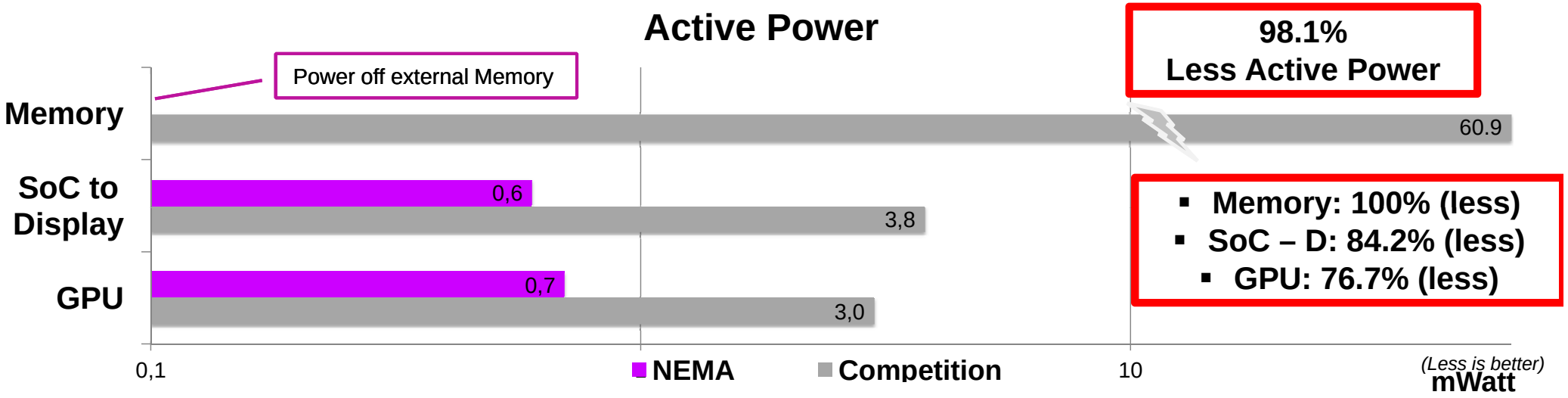
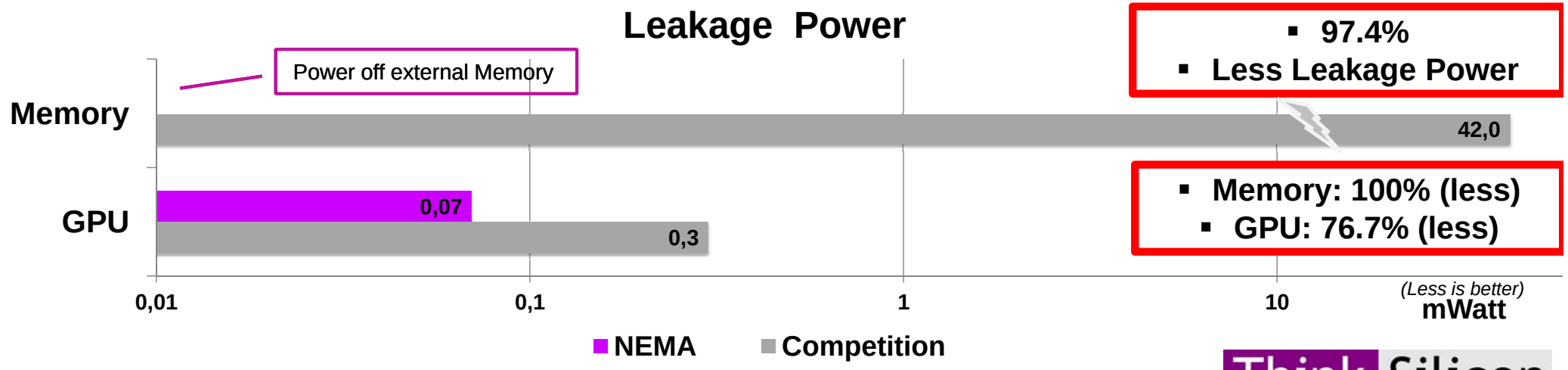
Device Power Consumption Savings: Nema|t

Real life scenario
Smartwatch battery life extension: 5 times!





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Nema|GL

Product Nema|GL

What? **Multi core, ultra threaded GPU**

OS: Linux, Android

API: OpenGL|ES 3.0

Toolchain: CLang, LLVM, GLSL-LLVM IR (in-house)

Why?

Low power consumption
Extremely small silicon footprint
Proprietary Compression

Application area:

Smart Glasses, Head Up Displays, Smart Phones 3rdGen, Tablets 3Gen, Navigation/Tracking-system.

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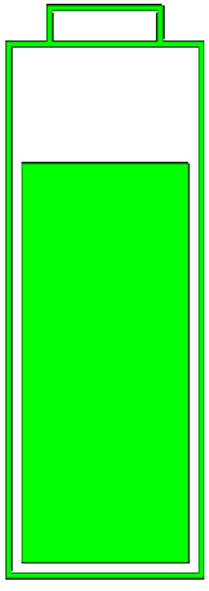
NemaGL – Special Features

Product Nema|GL + Nema|CL



Feature: Compression in

- Framebuffer
- Texture data
- Z-buffer compression

Feature: DVFS in

- Memory-driven core DVFS
- Different number of threads/core

Feature: Faster single thread performance

- No Divergent Thread performance
  (inherit by design- MIMD not SIMD)
  (valuable in GPGPU tasks)
- Compiler driven interlocks
  & prefetching

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