

A person wearing a VR headset and reaching out to a glowing digital particle in a futuristic space. The background is a dark, blue-toned environment with floating particles and light flares, suggesting a virtual or augmented reality setting. The person is sitting on the floor, looking up at the glowing particle.

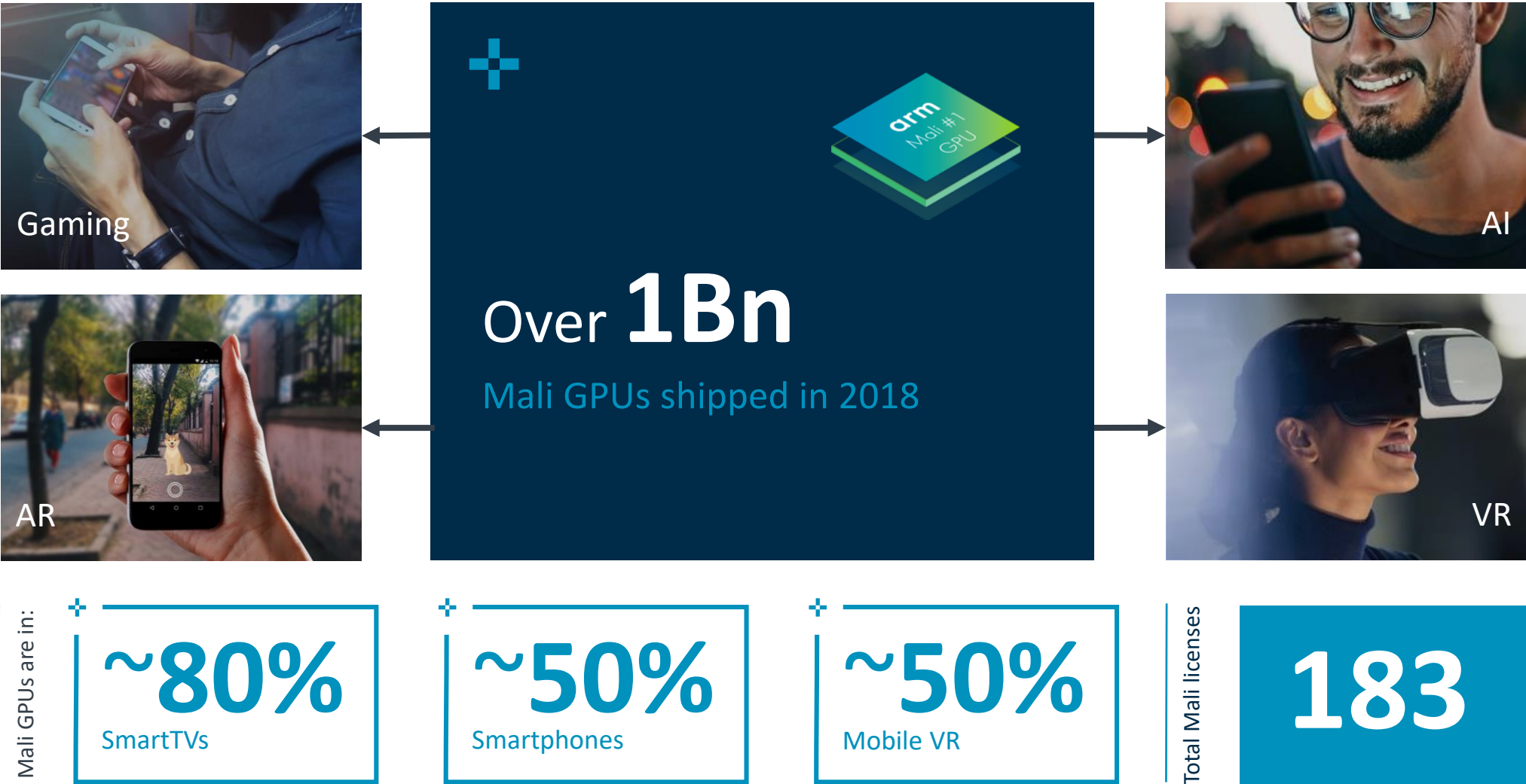
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Mali-G57: Premium GPU Performance for Mainstream Devices

Tech Symposia 2019

Daniele Di Donato, Product Manager
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Arm Mali GPUs: The World's #1 Shipping Graphics Processor



Arm Mali Graphics Processor Roadmap

High Performance

Mali-G71

Mali-G72

Mali-G76

Mali-G77

Mainstream

Mali-T830

Mali-G51

Mali-G52

Mali-G57

Ultra-Efficient

Mali-450

Mali-470

Mali-G31



Complex and Challenging GPU Powered Use Cases

High-fidelity mobile gaming



Augmented reality and virtual reality



On-device machine learning



Arm Mali Graphics Processor Generations

VALHALL

Mali-G77

Mali-G57

Superscalar engine, simplified scalar ISA, dynamic instruction scheduling

BIFROST

Mali-G71

Mali-G51

Mali-G72

Mali-G52

Mali-G31

Mali-G76

Unified shader cores, scalar ISA, clause execution, full coherency, Vulkan, OpenCL

MIDGARD

Mali-T600 GPU series

Mali-T700 GPU series

Mali-T800 GPU series

Unified shader cores, SIMD ISA, OpenGL ES 3.x, OpenCL, Vulkan

First Valhall GPU for Mainstream Market Delivers Outstanding Device Performance



1.3x

better
performance

Compared with Mali-G52 3EE running complex content with same process node under similar conditions

Leap in Gaming Performance and Efficiency

Efficiently supporting growing graphics and ML complexity

30%

better energy
efficiency

30%

more
performance density

60%

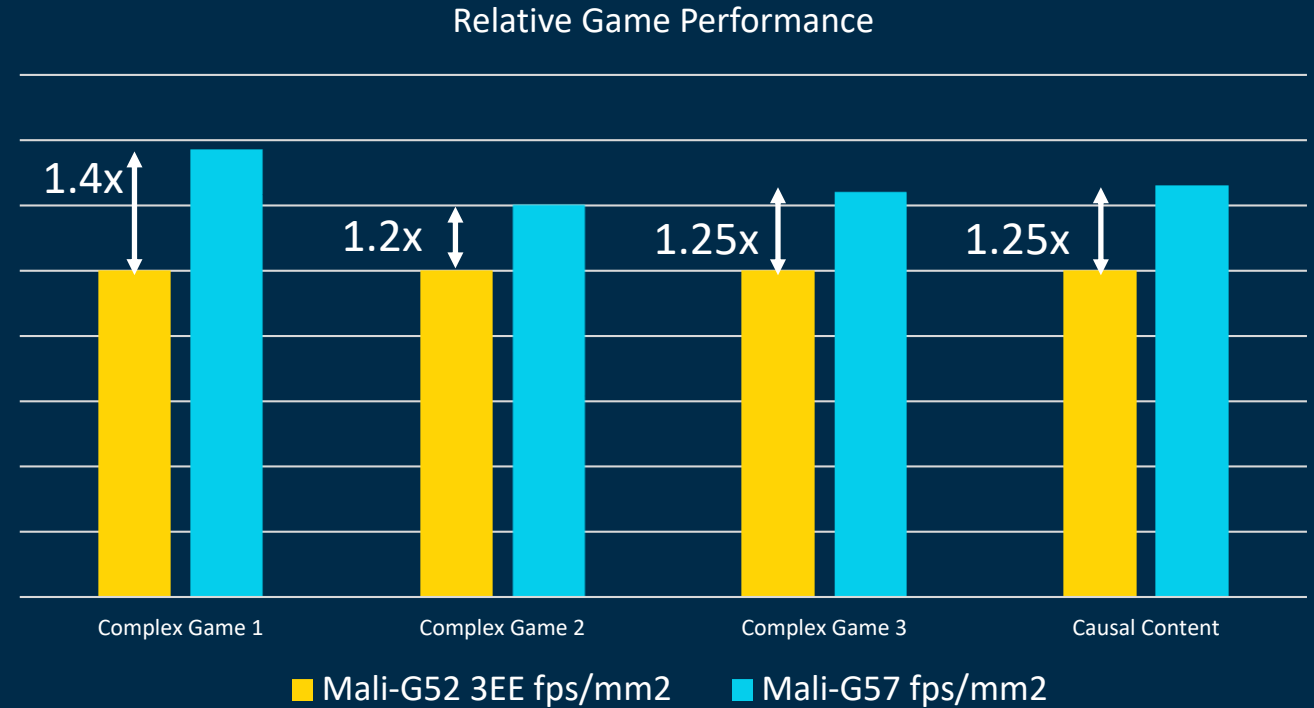
improvement for
machine learning



Compared to Mali-G52 3EE on same process node under similar conditions

Improved High-Fidelity and Casual Gaming Performance

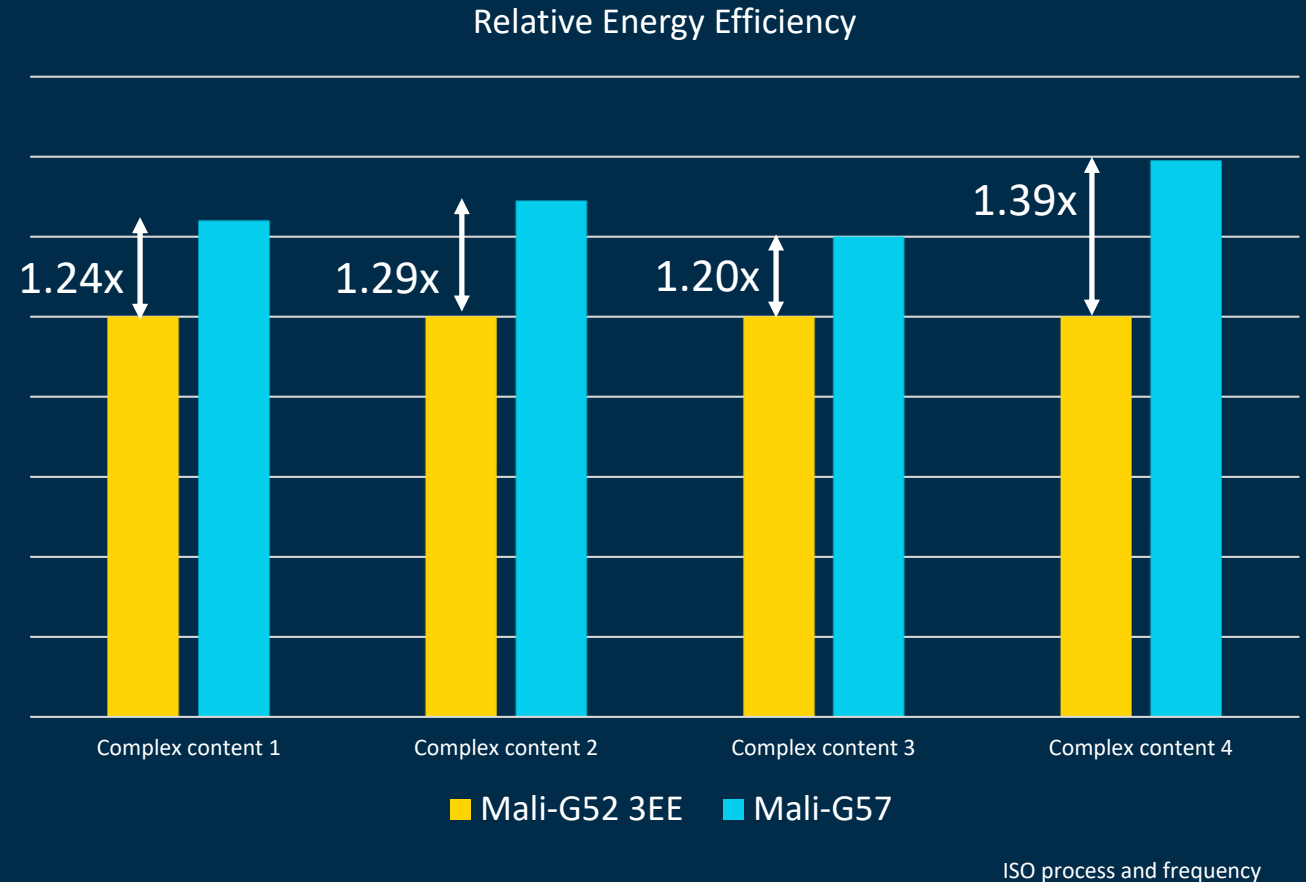
- Mali-G57 delivers more performance-per-square millimetre
- Up to 2x more compute capabilities when compared with G52 2EE
- Quad texture mapper has large impact on some texture heavy games



ISO process and frequency

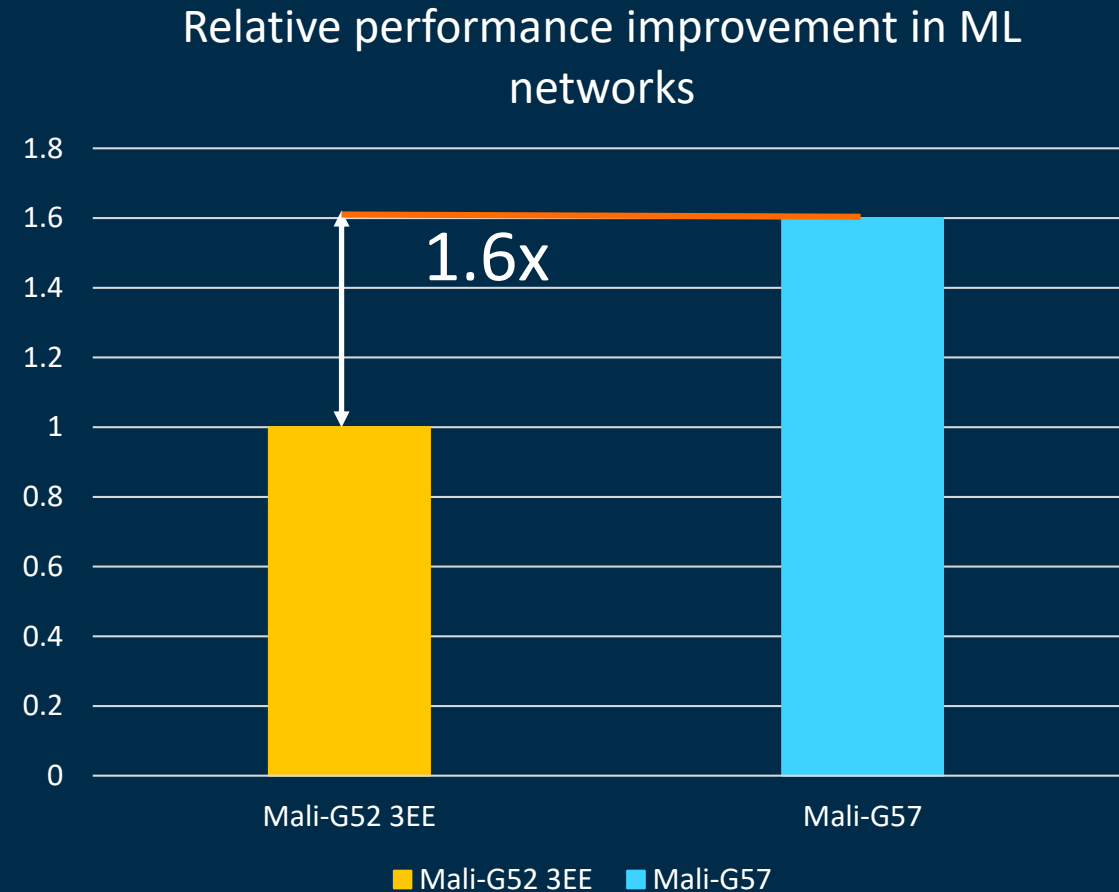
Delivers Even Longer Game Play

- Mali-G57 boosts energy efficiency across all workloads
- Delivers longer battery life for mainstream products
- Average 1.3x improvement in energy efficiency across wide range of content



Enhanced On-Device Intelligence

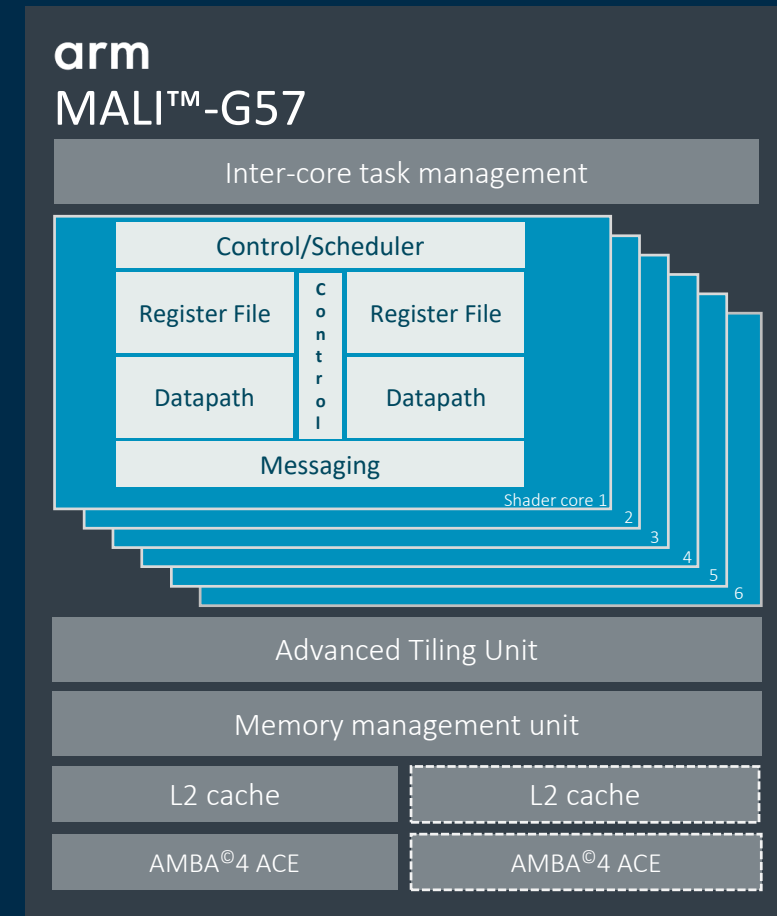
- Mali-G57 significantly improves Machine Learning inference performance
- Average improvement for multiple NN networks



ISO process and frequency

Excellent improvements, configurability and flexibility

- Introduction of Vahall architecture for Mainstream markets
- Single execution engine per shader core with increased FMAs
- Quad texture mapper
- Optimized Load and Store cache for ML networks
- Configurable 1 to 6 shader cores

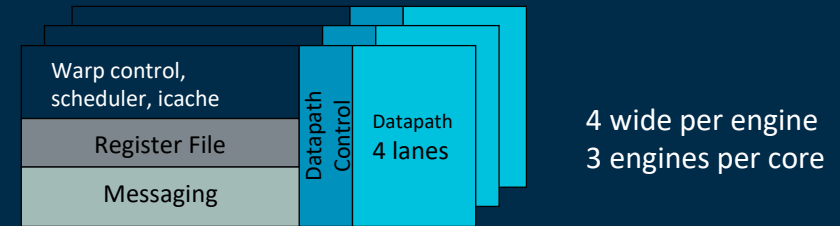


Valhall Architecture Goals

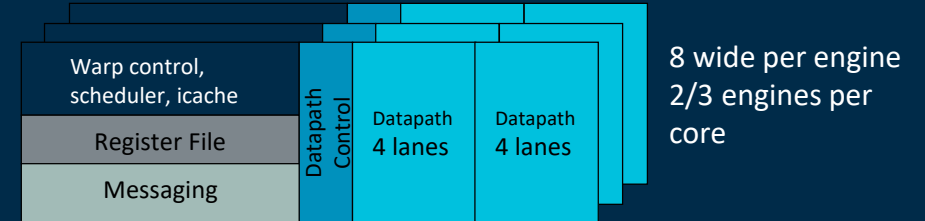
- The new Mali architecture following Bifrost
- 2nd generation of Arm GPU scalar architecture for high-performance, high-efficient GPUs
- 16-wide warp-based execution model
- New simplified and compiler-friendly instruction set
- Aligned to new APIs



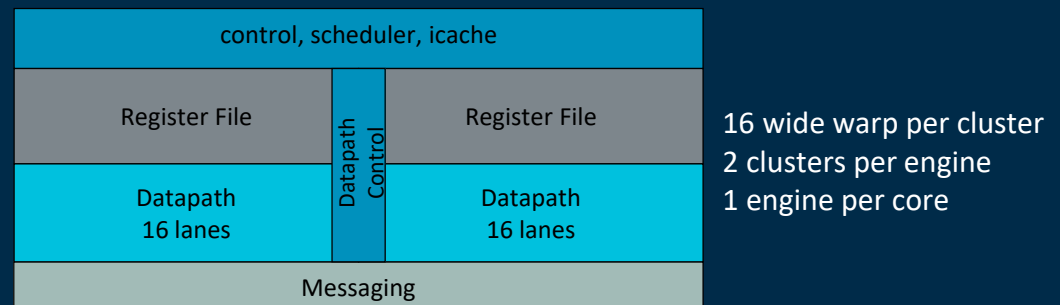
Mali-G51 Execution Engine



Mali-G52 Execution Engine

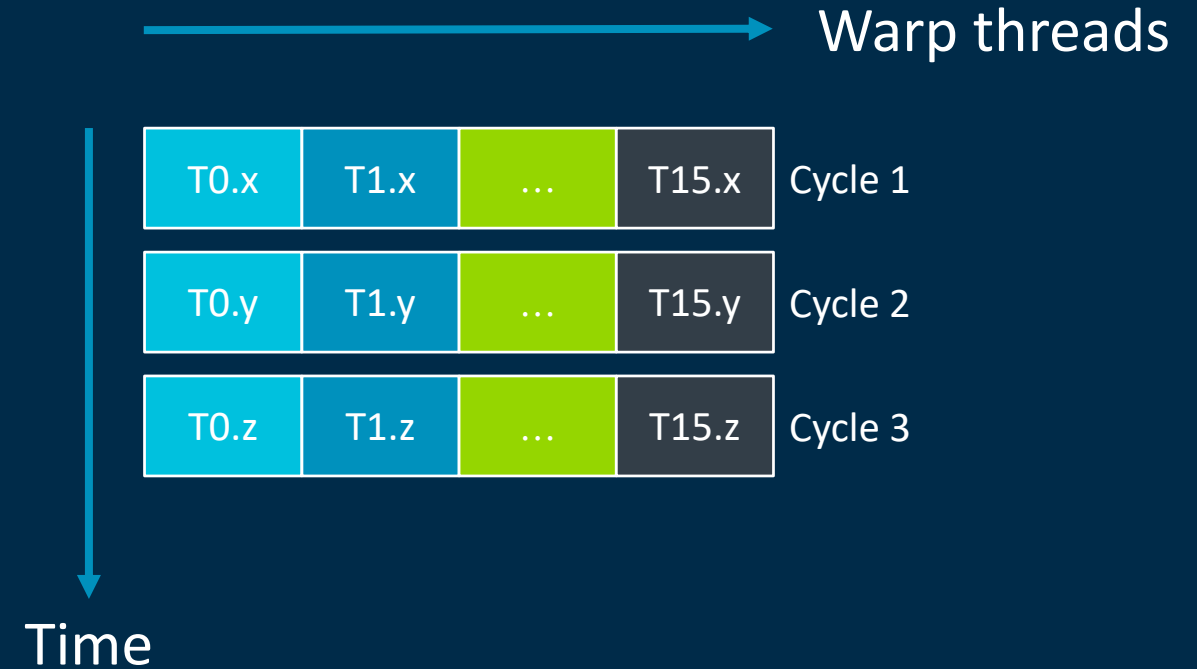


Mali-G57 Execution Engine



Valhall Fundamentals

- Warp-based execution model
 - 16 threads executed in lockstep in a *warp*
- New instruction set
 - Operational equivalence to Bifrost
 - Regular, unconstrained instruction encoding
- Dynamic scheduling of instructions
 - Done by HW
 - No more clauses, tuples and fixed issuing
- Dependency system
- New features
 - AFBC1.3
 - Support for FP16 render targets
 - HW allocated vertex shader outputs



Efficient Shader Core with increased compute capabilities

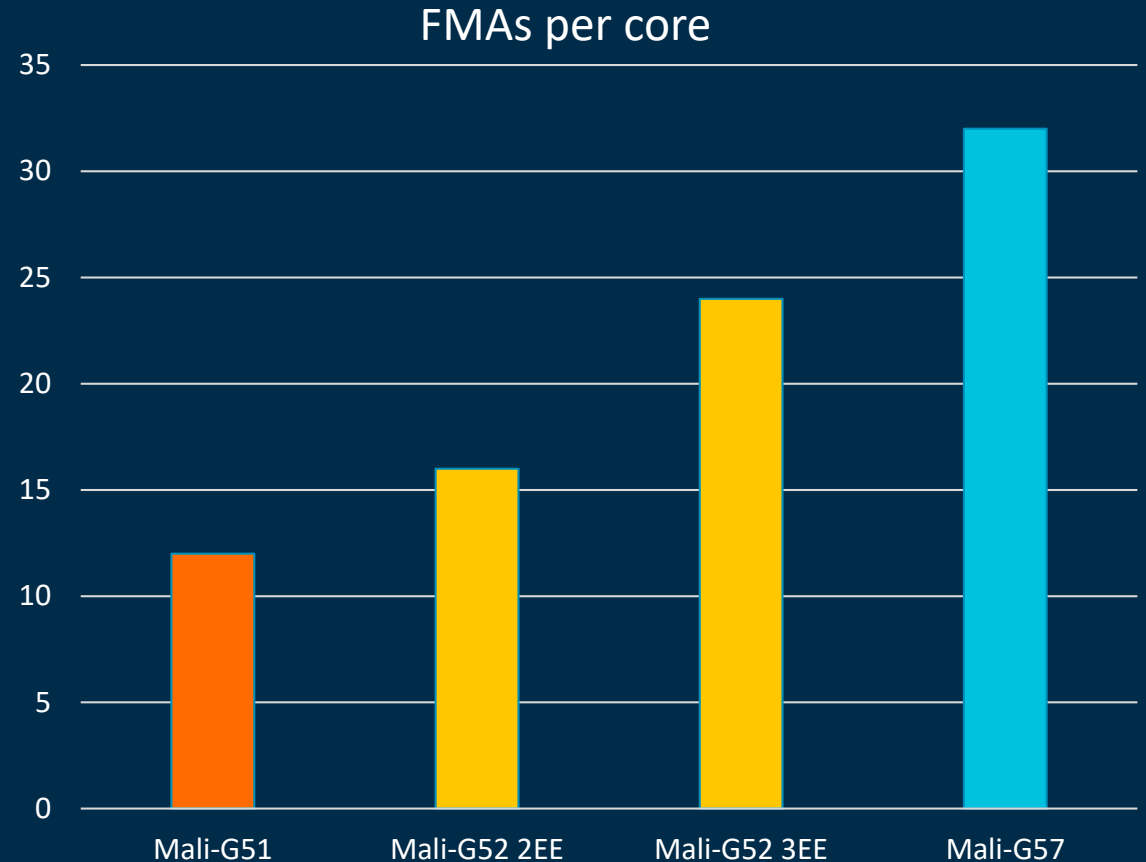
New gaming content becoming more complex

32 FMAs per-core

2.6x FMA compared to G51

2 FMA compared to G52 2EE

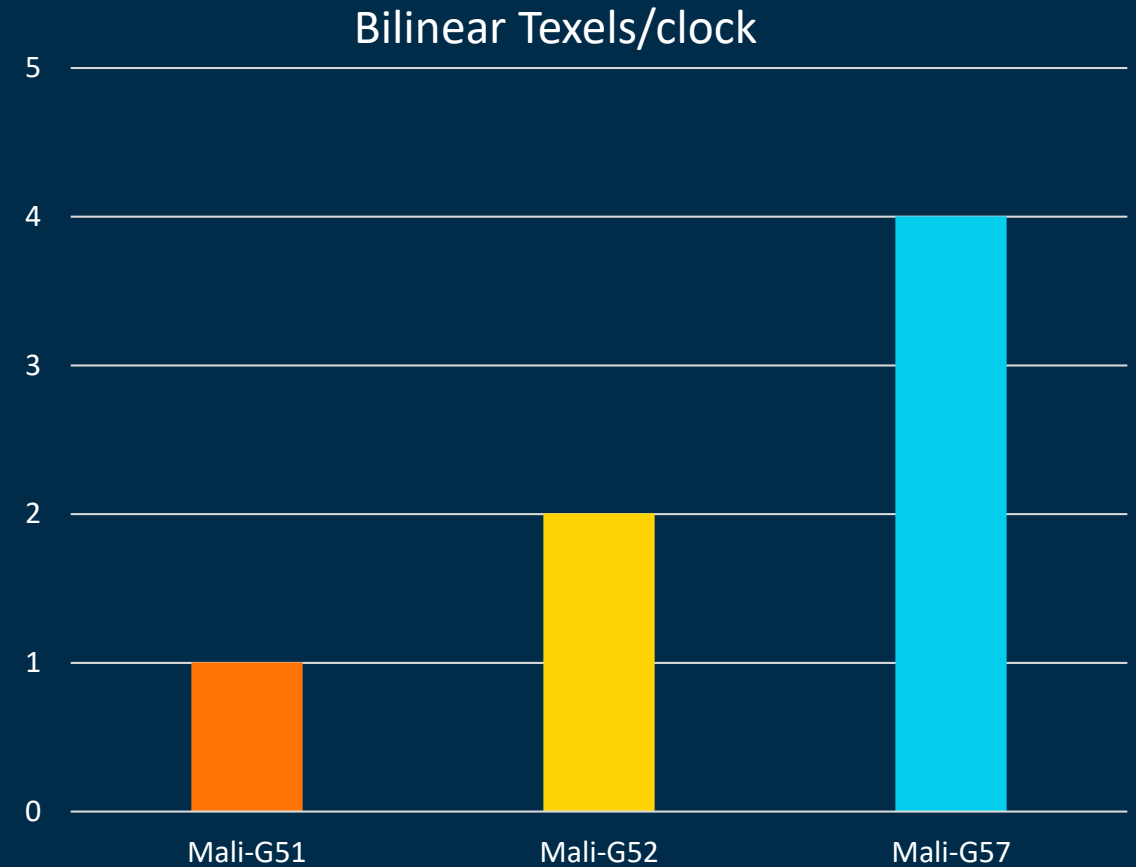
1.3x FMA compared to G52 3EE



Quad Texture Mapper Doubles Throughput

New gaming content becoming more complex

+ **4 texels/cycle**
2x Mali-G52
throughput



Improved Load and Store cache



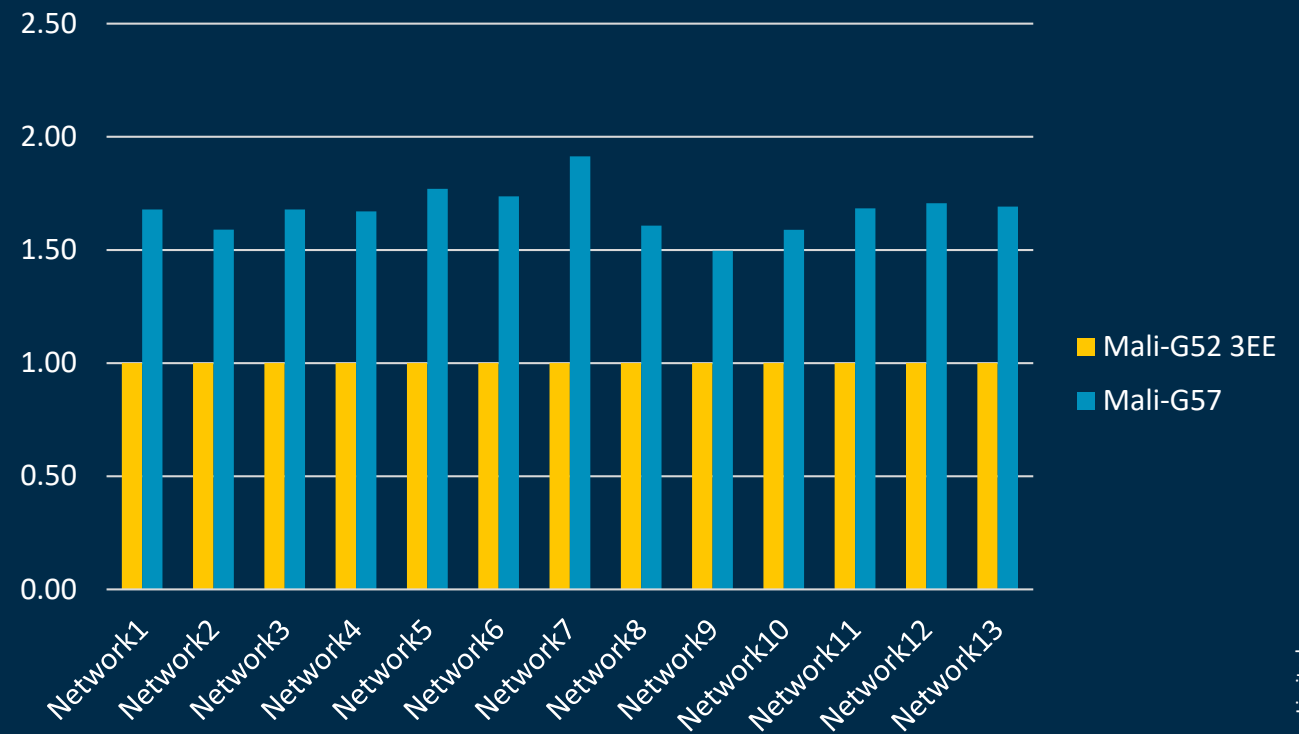
Throughput improvements

Internal datapath is cacheline wide

Latency improvements

Number of pipeline stages reduced by half

Relative NN performance



Bringing Premium Device Experiences Mainstream

- High-end graphics performance at increased efficiency
- First mainstream GPU with new Valhall architecture
- Outstanding Mali GPU performance improvement to enable premium use cases on mainstream devices



30%

more energy
efficient*

30%

more performance
density*

60%

machine learning
improvement*

*Compared to Mali-G52 3EE on same process node under similar conditions

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Thank You

Danke

Merci

谢谢

ありがとう

Gracias

Kiitos

감사합니다

धन्यवाद

شكراً

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The ARM logo is displayed in a white, lowercase, sans-serif font. The letters are bold and modern, with the 'a' and 'm' having a slightly rounded, friendly appearance. The logo is centered horizontally on the left side of the slide.

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