Naming	Mali-T720	Mali-T760	Mali-T820	Mali-T830	Mali-T860	Mali-T880	Mali-G71	Mali-G72	Mali-G31	Mali-G51	Mali-G52	Mali-G76	Mali-G57	Mali-G77	Mali-G68	Mali-G78
Architecture	Midgard						Bifrost						Valhall			

API Suppport	Mali-T720	Mali-T760	Mali-T820	Mali-T830	Mali-T860	Mali-T880	Mali-G71	Mali-G72	Mali-G31	Mali-G51	Mali-G52	Mali-G76	Mali-G57	Mali-G77	Mali-G68	Mali-G78
OpenGL ES 1.1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OpenGL ES 2.0	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OpenGL ES 3.0	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OpenGL ES 3.1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OpenGL ES 3.2		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vulkan 1.0		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vulkan 1.1							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vulkan 1.2							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OpenCL 1.0	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OpenCL 1.1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OpenCL 1.2		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OpenCL 2.0							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OpenCL 2.1											✓	✓	✓	✓	✓	✓

Core Features	Mali-T720	Mali-T760	Mali-T820	Mali-T830	Mali-T860	Mali-T880	Mali-G71	Mali-G72	Mali-G31	Mali-G51	Mali-G52	Mali-G76	Mali-G57	Mali-G77	Mali-G68	Mali-G78
ASTC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AFBC		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Shader framebuffer access	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Multiple Render Target[1]		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4xMSAA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8xMSAA		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16xMSA		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8-bit integer dot product							✓				✓	✓	✓	✓	✓	✓
FP16 / R11G11B10 accelerated blending[5]													✓	✓	✓	✓

Microarchitecture Features	Mali-T720	Mali-T760	Mali-T820	Mali-T830	Mali-T860	Mali-T880	Mali-G71	Mali-G72	Mali-G31	Mali-G51	Mali-G52	Mali-G76	Mali-G57	Mali-G77	Mali-G68	Mali-G78
Transaction elimination	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hidden surface removal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IDVS geometry pipeline							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Core Config	Mali-T720	Mali-T760	Mali-T820	Mali-T830	Mali-T860	Mali-T880	Mali-G71	Mali-G72	Mali-G31	Mali-G51	Mali-G52	Mali-G76	Mali-G57	Mali-G77	Mali-G68	Mali-G78
Warp width	N/A	N/A	N/A	N/A	N/A	N/A	4	4	4	4	8	8	16	16	16	16
Thread count (max)	256	256	256	256	256	256	384	384	512	768	512/768	768	1024	1024	1024	1024
FP16 operations/clock	32	52	28	56	52	78	48	48	32	48	64/96	96	128	128	128	128
FP32 operations/clock	20	28	16	32	28	42	24	24	16	24	32/48	48	64	64	64	64
Fragments/clock	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Pixels/clock	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Texels/clock	1	1	1	1	1	1	1	1	2	2	2	2	4	4	4	4
Load/store cache size (bytes)	16K	16K	16K	16K	16K	16K	16K	16K	4K	16K	16K	16K	16K	16K	16K	16K
Texture cache size (bytes)	2K	8K	2K	4K	8K	8K	8K	8K	16K	16K	16K	32K	32K	32K	32K	32K
Tile bits/pixel[2]	128	128	128	128	128	128	128	256	256	256	256	256	256	256	256	256

Texturing	Mali-T720	Mali-T760	Mali-T820	Mali-T830	Mali-T860	Mali-T880	Mali-G71	Mali-G72	Mali-G31	Mali-G51	Mali-G52	Mali-G76	Mali-G57	Mali-G77	Mali-G68	Mali-G78
Bilinear cycles/sample	1	1	1	1	1	1	1	1	2	2	2	2	4	4	4	4
Trilinear filtering	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2
Nx anisotropic filtering[3]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	xN[4]	xN	xN[4]	xN	xN	xN	xN	xN	xN
Depth format w/out reference	x2	x2	x2	x2	x2	x2	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1
Depth format with reference	x2	x2	x2	x2	x2	x2	x1	x1	x1	x1	x1	x1	x1	x2	x2	x2
Data size over 32 bits/texel	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x2	x2	x2
ASTC w/out EXT_decode_mode	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x2	x2	x2
3D format with linear filtering	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2	x2
N channel 32bit/channel format with linear filtering	x4N	x4N	x4N	x4N	x4N	x4N	x4N	x4N	x4N	x4N	x4N	x4N	x4N	xN	xN	xN
N plane YUV format	xN	xN	xN	xN	xN	xN	xN	xN	x1	x1	x1	x1	x1	x1	x1	x1

Midgard ISA Config	Mali-T720	Mali-T760	Mali-T820	Mali-T830	Mali-T860	Mali-T880
Thread count (max)	256	256	256	256	256	256
Max work registers (128b)	16	16	16	16	16	16
Thread count with 0-4 work registers	256	256	256	256	256	256
Thread count with 5-8 work registers	128	128	128	128	128	192
Thread count with 9-16 work registers	64	64	64	64	64	96

Bifrost ISA Config	Mali-G71	Mali-G72	Mali-G31	Mali-G51	Mali-G52	Mali-G76
Thread count (max)	384	384	512	768	768	768
Max work registers (32b)	64	64	64	64	64	64
Thread count with 0-32 work registers	384	384	512	768	768	768
Thread count with 33-64 work registers	384	384	256	384	384	384

Valhall ISA Config	Mali-G57	Mali-G77	Mali-G68	Mali-G78
Thread count (max)	1024	1024	1024	1024
Max work registers (32b)	64	64	64	64
Thread count with 0-32 work registers	1024	1024	1024	1024
Thread count with 33-64 work registers	512	512	512	512

1: OpenGL ES has 4 render targets and Vulkan 8
2: Tile storage per pixel may be able to exceed this, but with reduced tile size
3: Worst-case anisotropic filtering performance with a MAX_ANISOTROPY = N
4: Mali-G72 r0p3 / Mali-G51 r1p1 or higher required
5: Bifrost onwards has float blending. Valhall adds hardware acceleration for standard blend operations

arm MALI

This reference sheet covers from the Midgard Mali-T720, to Valhall GPUs, up to Mali-G78.

The API Support, Core Features and Microarchitecture Features tables cover which GPUs support which technologies. For more on given technologies see links below.

The Core Config table details the specs of the chips, rather than just whether features are available. As such for each GPU it has threads in a warp, total threads, and operations/texels etc per clock cycle, as well as cache sizes. Note that for tile write rate on Arm chips this is both fragments written into the tile and the pixels written back out of the tile. Thread count is the total shader core hardware capacity; note that for OpenGL ES only 128 threads are exposed.

For Texturing, to work out cycles/sample for more complicated filters than bilinear, apply the multiplications in the tables on top of the bilinear performance to combine to the required filter. Remember to invert the bilinear samples/cycle to get cycles/sample. For example, a simple trilinear will be 2 x 1 cycles/sample on a Mali-G72, and 2 x 0.25 cycles/sample on a Mali-G77. To add in 4x anisotropic filtering, multiply by a further 4x. Note that anisotropic filter scaling is the worst-case number caused by the maximum number of sample taps, it will usually be less than this. Texture performance will differ from Image performance. Depth performance with/without reference refers to e.g., a shadow sampler with reference comparison returning a weighted bool vs a normal sample returning the actual depth value.

Finally, the architecture-specific tables give thread counts and registers for the chips. For more on the generations of Arm architectures see links below.

For a general picture of Arm architectures see:

- Developer.arm.com

Specific architecture pages:

- Midgard (Mali-T600 – Mali-T880)
- Bifrost (Mali-G71 – Mali-G76)
- Valhall (Mali-G57 - Mali-G78)
- Performance Counters for Mali GPUs

For further reference on the technologies mentioned in the sheet, please refer to these webpages:

- ASTC (Adaptive Scalable Texture Compression)
- AFBC (Arm FrameBuffer Compression)
- MSAA (Multi-Sample Anti-Aliasing)
- Transaction Elimination
- Hidden surface removal
- IDVS (Index-Driven Vertex Shading)
- Shader framebuffer access – (GLES)
- Shader framebuffer access – (Vulkan)

NOTE: Mali-G78AE has the same base configurations and support as Mali-G78 but includes extra safety features.