Ultra-Low Power - Mobile and IoT Graphics Solutions

Think Silicon S.A. was founded in 2007, has locations in Patras, Greece (DC + HQ), Toronto, Canada (HQ North America) and San Jose, CA, USA (Sales office). Only six (6) companies in the world have the knowledge to develop graphics IP technology. Think Silicon is one of them!

***Performance per mm^2 per Watt per Dollar … the benchmark our customers focused on*!**

Think Silicon develops Graphics Processors (GPUs) and Display Processors/Controllers for the IoT, Wearable and broader display devices markets, and its growing demand for ultra-low power, area and memory constrained SoCs. A cost efficient but still vibrant 3D/2D graphics experience is a key element to succeed but without sacrificing visual performance and dispense the ability of ultra-low power consumption.

Think Silicon's configurable GPUs have a wide range of operation areas and applications such as fitness, lifestyle, healthcare, infotainment, automotive, security etc. and can drive displays from 1.32" up to 6.0" and resolutions from 320x320 up to full HD. The Display Controller IP is a powerful "Swiss Army Knife" which contains multiple smart tools and functionalities to compose graphics and process video signals up to 8K resolutions on multiple layers.

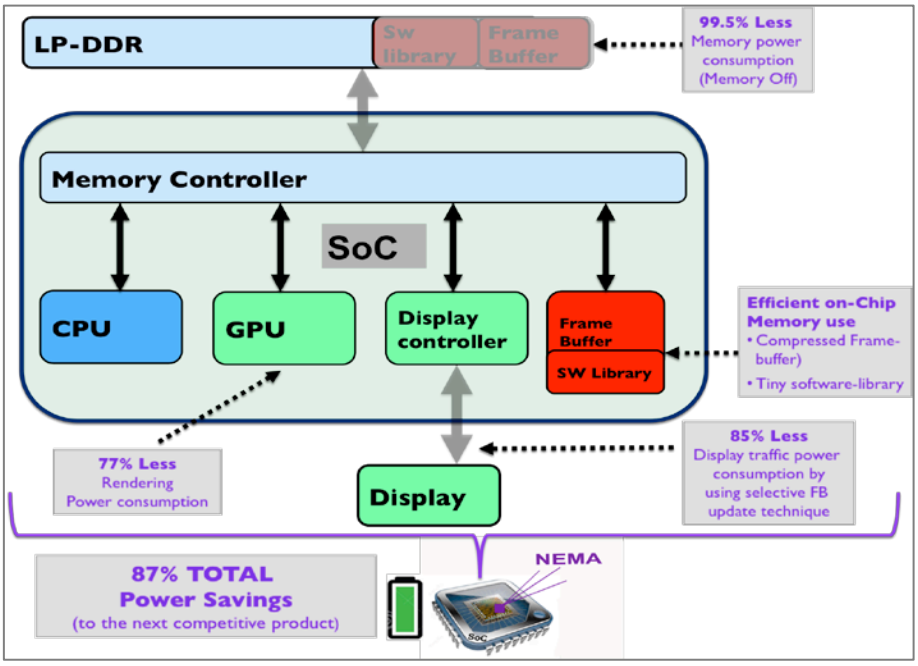
Think Silicon's IP has been licensed to leading semiconductor companies for display, multimedia, VoiP, Wearables applications and microcontroller and IoT platforms.

The Battery Dilemma!

Over sixty four 64% (and growing) of todays' mobile-users are not satisfied with their battery life! Thirty 30% of the first generation smartwatch buyers returned their watches because the battery last less than 1 day of regular usage. The majority of todays' available devices and their embedded SoCs are not power optimized to meet todays and future user expectations. The Internet of Things (IoT) paradigm has put extended battery life at the top of the requirements list for new products.

NEMA – GPU SERIES – Unique Architecture Advantages Powered by a New Rendering Technology

NEMA is the first GPU architecture specifically designed for the ultra low power demands of the broader IoT and Wearable market. Unlike the competition, which just downscaled legacy Mobile-GPU architecture and turned them into 'new' IoT GPUs. Think Silicon was going the opposite way. In close collaboration with our customers and OEMs, we analyzed the next generation devices and software applications and developed from scratch a radical new architecture, the NEMA-GPU-Series.



A smartwatch or a home automation device has a much smaller display than a smartphone or a tablet. Those devices display the human machine interfaces (or Graphical User Interface), for the majority of the usage time, and don't need to execute 3D (gaming) applications. Legacy GPU's without optimized architecture and graphics APIs do not offer a rigorous methodology to distinguish different display resolutions (e.g., 1920x1080 with 400x400) or color depths (e.g., 32-bit with 6-bit). They are optimized for vibrant mobile 3D-game apps but NOT for 3D GUI's and its standard email/web browsers/social media applications.

NEMA incorporates a power-efficient **Display and content-aware** rendering technology and **several** proprietary **compression** techniques. NEMA-GPUs are dynamically controlling the precision of the arithmetic and memory operations **adapting to any display resolution** or even **type** (e.g. round, curved, or flexible) and are vertically designed for the efficient execution of the graphics workload required by **vivid 3D GUIs**.
Innovative methods to reduce GPU-to-Display traffic, combined with the proprietary compression techniques shrink the required graphics memory. The compressed: frame-buffer, images and software libraries, are so small in size **(typical 360kByte)** that they fit into the internal SoC memory. Expensive off-chip DDR memory can be minimized or entirely eliminated.

NEMA **Content and Display aware** GPUs consume **four** (**4) times less power** than any competitive IP in the market. Proprietary compression techniques **reduce** the **memory footprint** by **six (6) times** thus **eliminating** the need for **external DDR memory**. The result is a **reduction** of **power consumption** by **73%** when the system is **active** and by **58%** when the system is **idle** (see table1)**.**

SoC + Memory Power savings Using nema in next gen SoC compared to current SoC (includes CPU, GPU, Peripherals, BlueTooth LE , onchip SRAM, External LPDDR)	
Next gen SoC using nema vs current SoC	**SoC state**
58% less power	Idle
73% less power	active (simple + complex tasks)

Table 1

NEMA - Power Leadership on Product Level

Extensive evaluations with our Tier-1 customers proved that these power savings on system level (SoC, Memory) can be extrapolated to the product level (e.g., smartwatch). Depending on the display technology (e.g., OLED, color e-paper) and the method to activate it (e.g., manual, motion, position, gesture), the battery life in a smartwatch (or any other battery-limited device) can be extended from **2.4 days to 4.8 days** (see table 2).

Device Battery Life improvement (includes SoC + Memory + color e-paper Display)			
	Active(hours)	Idle (days)	Average(days)
Gen2 Smartwatch	2.5	5.2	2.4
Next gen Smartwatch using nema	10.8	11	4.8

Table2

NEMA - Cost Leadership on Chip Level

The ultra-low gate count of **NEMA** reduces the total silicon footprint and provides savings between **$0.03 till $0.10 per chip** to the next comparable product from the competition (see table).

Integration

Think Silicon's IP is flexible and configurable and we work together with the customer to contrive the right set up to meet their design requirements. Automated design methods are used to minimize the time-to-market span. Once our customers have completed the first integration with our IP, follow up projects can be leveraged in a fraction of time due to our unique system modularity. Customers such as **Microchip, Faraday, Dialog, Redpine Signals, Tier1 fabless semiconductor company** have proved the reliability and quality of our designs.

Think Silicon offers a wide range of Graphics and Display Processor - IPs with different power-performance tradeoffs.

Graphics Processors				
Product Name	**Nema|p**	**Nema|t^{100}**	**Nema|t^{200}**	**Nema|t^{400}**
Characteristic	**2D GPU**	**tiny 3D GPU**		
GPU core	1	1	2	4
Silicon area 28nm / mm^2	0,07	0,1	0,15	0,25
Core clock MHz @28nm	150	400	400	400
Shader GOPS (half/full)	1,8	4,8	9,6	19,2
Pixel Rate (Mpixel/sec.)	150	400	800	1600
Triangle rate (M tri/sec)	-	31	62	123
Vertex rate (M vtx/sec)	-	92	369	1477
2D Rendering	✔	✔		
Smart Composition	✔	✔		
3D Rendering	✘	✔		
Leakage (mW)	0,049	0,07	0,105	0,175
MMU	✔	✔		
Compression				
TSFBc	✔	✔		
TSTXc	✘	✔		
TSZBc	✘	✔		
Operating System Support				
RTOS	✔	✘		
Linux	✔	✔		
Android	✘	✔		
Graphics API Support				
bare-metal library	✔	✘		
ugfx	✔	✘		
DirectFB	✔	✔		
OpenGL|ES1.1/2.0	✘	✔		

Display Processors			
Product Name	**Nema|dc^{100}**	**Nema|dc^{400}**	**Nema|dc^{700}**
Characteristic	Display Controller	Multilayer Display Controller	Multilayer Display Controller
Processor core	1	1	1
Silicon area ST FDSOI@28nm / mm^2	0,02	0.02-0.1	0.1-0.5
Resolution	xGA (1024x768)	full HD (1920x1080)	8k (7680x4320)
Composition	1 layer	4 layer	7 layer
MMU	✘	✔	✔
TSFBc Compression	✔	✔	✔
Rotation 90/180/270	✘	✘	✘
Scaling: up/down/Horiz./Vert.	✘	✔	✔
Display Interfaces	MIPI DPI-2/DBI-2,LVDS,BT.656,Serial: RGB/RGBX, Parallel:RGB/YUV		
Software System Support	bare-metal library, RTOS/Linux/Android		