



VeriSilicon GPU IP - Nano GPU Introduction

DDR-Less, Low Power GPU

VeriSilicon GPU Team

Q2 2025

VeriSilicon Vivante IP Portfolio – Scalable IPs – THE IP PRODUCTS

ISP

NPU

*VPU
Video*

GPGPU

GPU

*DSP
Audio/Voice*

*DPU
Display*

*DSP
Computer Vision*

*Compression/
Encryption*

FLEXA™



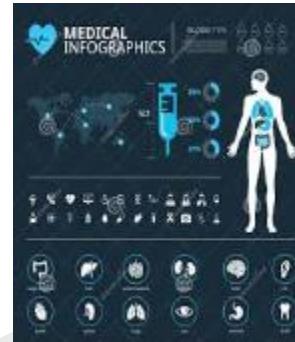
Tablets
Smartphone

AIOT

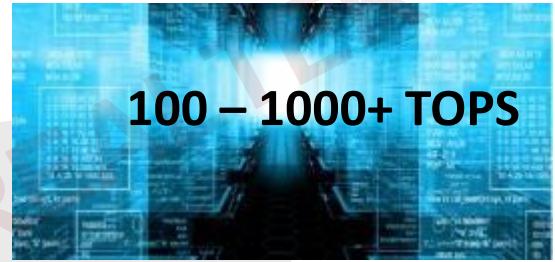
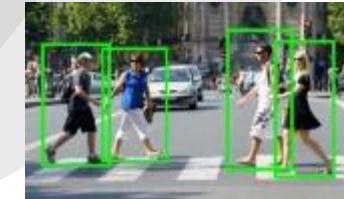


Wearables

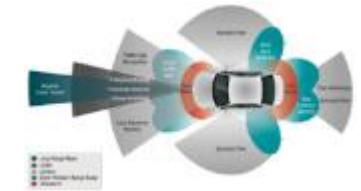
Company Proprietary and Confidential



Automotive



Server Class



VeriSilicon

VeriSilicon Nano GPU Dominates Watch, Wearable and MCU Market



MCU
Wearable

AIoT

Automotive
ADAS

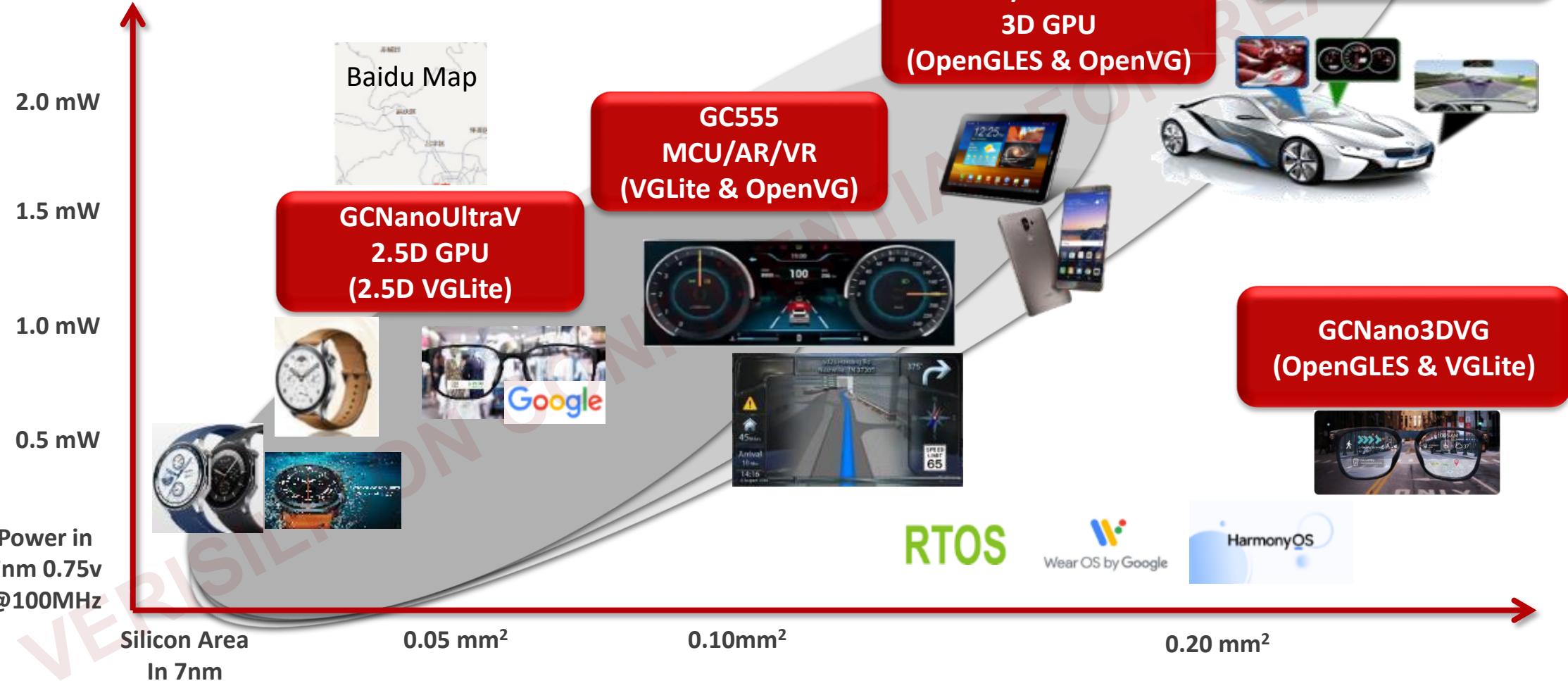


40+ Customers

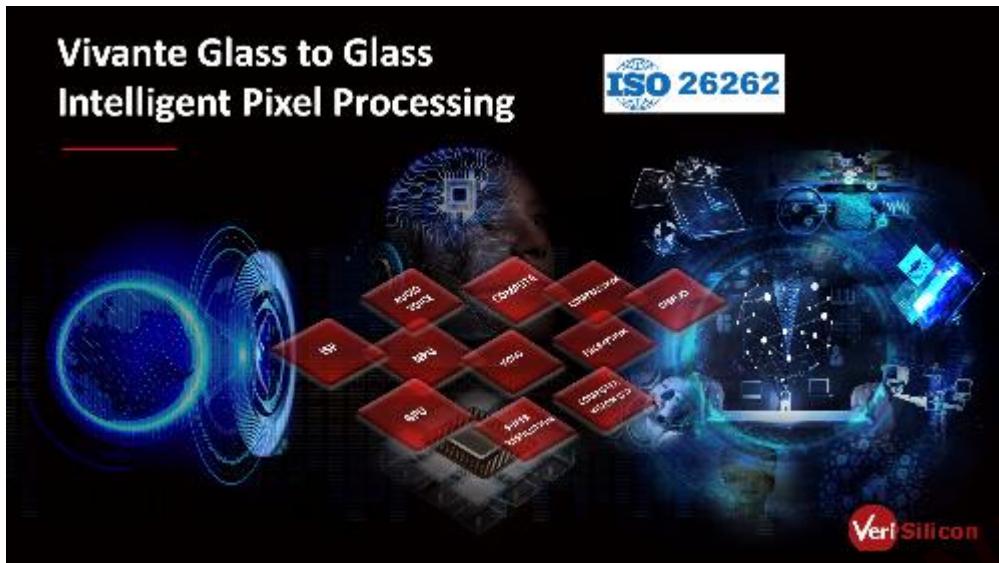
100+ SoCs



VeriSilicon Vivante Wearable GPU (2.5D, 3D)



VeriSilicon Low Power IP Series In Wearables



VeriSilicon Low Power Nano IP Series

FLEXA™

DDR-LESS

Low
Power

Low
Latency

Extremely Low Power, Low Latency, DDR-Less Wearable Solution

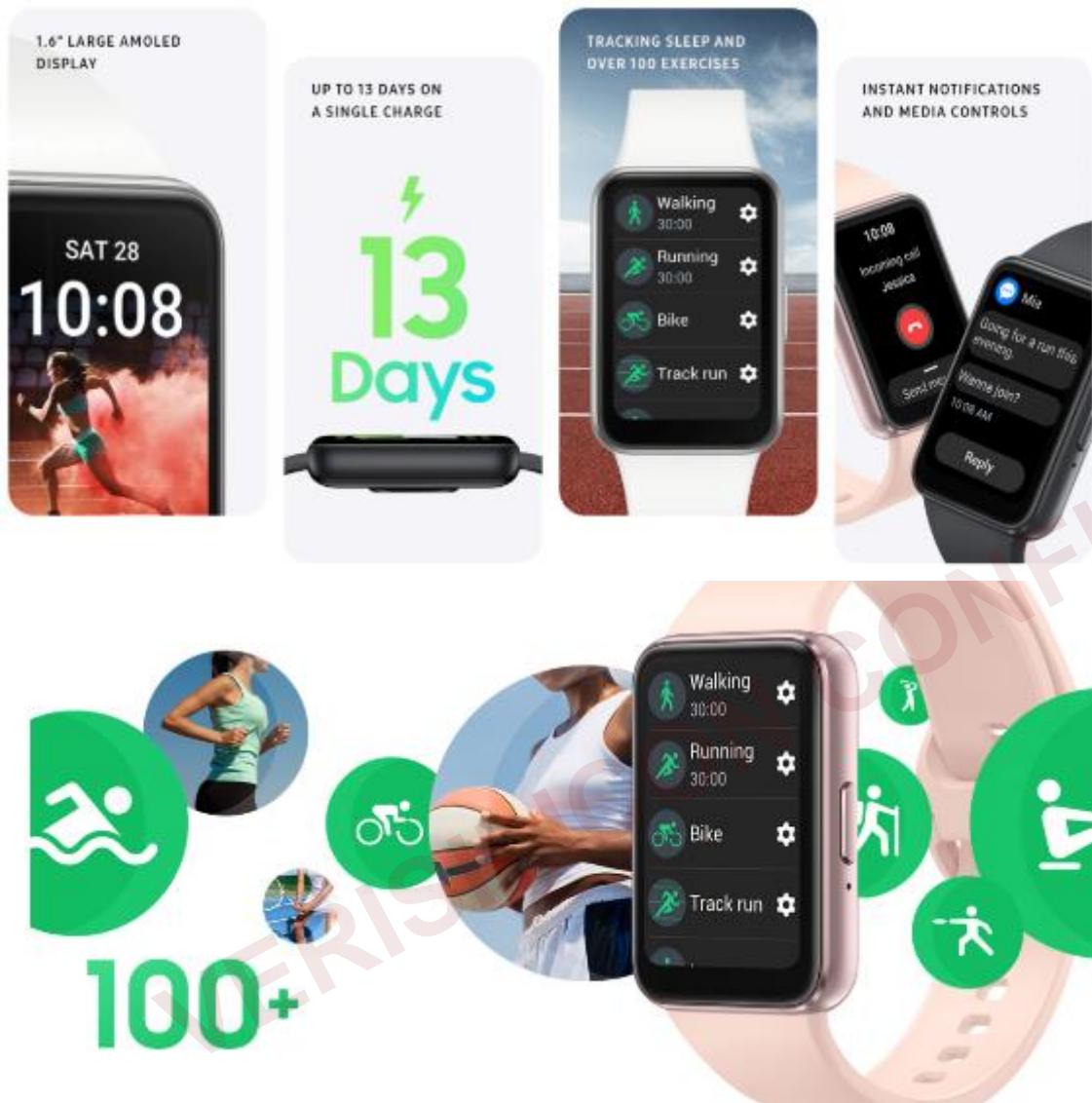
- Over 12 watch SoC customers licensed VeriSilicon's Low Power IPs
- Tie-one World Leading AR/VR Customers Collaborated with VeriSilicon on AR devices.
- Bluetooth Earbuds For Leading Cell Phone



Products with VeriSilicon GPU – Samsung Galaxy Watch 7 (2024)



Products with VeriSilicon GPU – Samsung Galaxy Fit3 (2024)



Galaxy Fit3

VeriSilicon 2nd Generation
2.5D GPU Inside

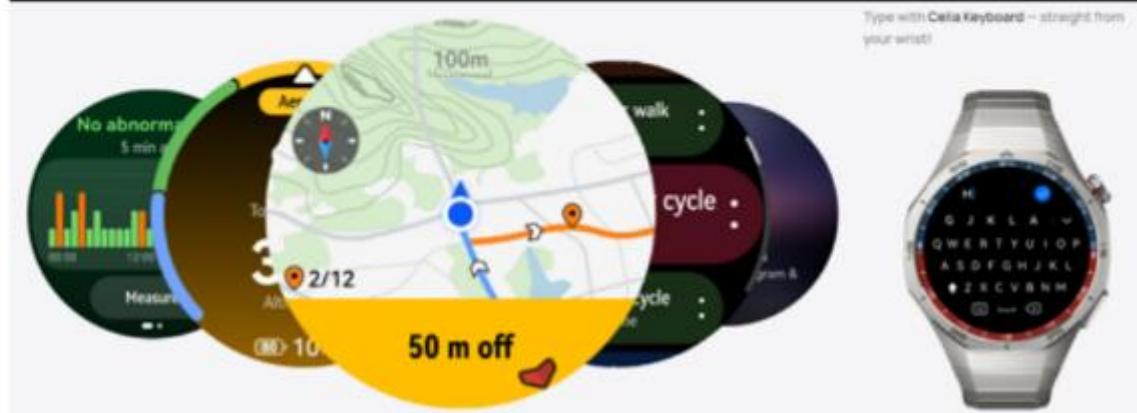
Products with VeriSilicon GPU – Huawei Watch GT5 Pro (2024)

HUAWEI WATCH GT 5 Pro

¥2488 起



VeriSilicon 2nd Generation
2.5D GPU Inside



VeriSilicon

Products with VeriSilicon GPU – Huawei Watch GT5 (2024)



VeriSilicon 2nd Generation
2.5D GPU Inside

HUAWEI WATCH GT 5

玄玑感知系统 | 全新跑骑体验 | 情绪健康助手¹¹ | 强劲续航

- 观看视频

¥1488*起



Products with VeriSilicon GPU Solution

HUAWEI WATCH 4 系列

智慧旗舰 健康领航

一键微体检¹ | 球面蓝宝石玻璃² | eSIM 独立通话³

¥3399⁴



Powered by
HarmonyOS

VeriSilicon 2nd Generation
2.5D GPU Inside

Company Proprietary and Confidential



Products with VeriSilicon GPU – Xiaomi Watch S4 (2024)

xiaomi Watch S4



黑色

黑色不锈钢表圈
黑色氟橡胶表带



银色

银色不锈钢表圈
灰色氟橡胶表带



黑彩虹

黑+彩色不锈钢表圈
黑色氟橡胶+编织表带



eSIM 版

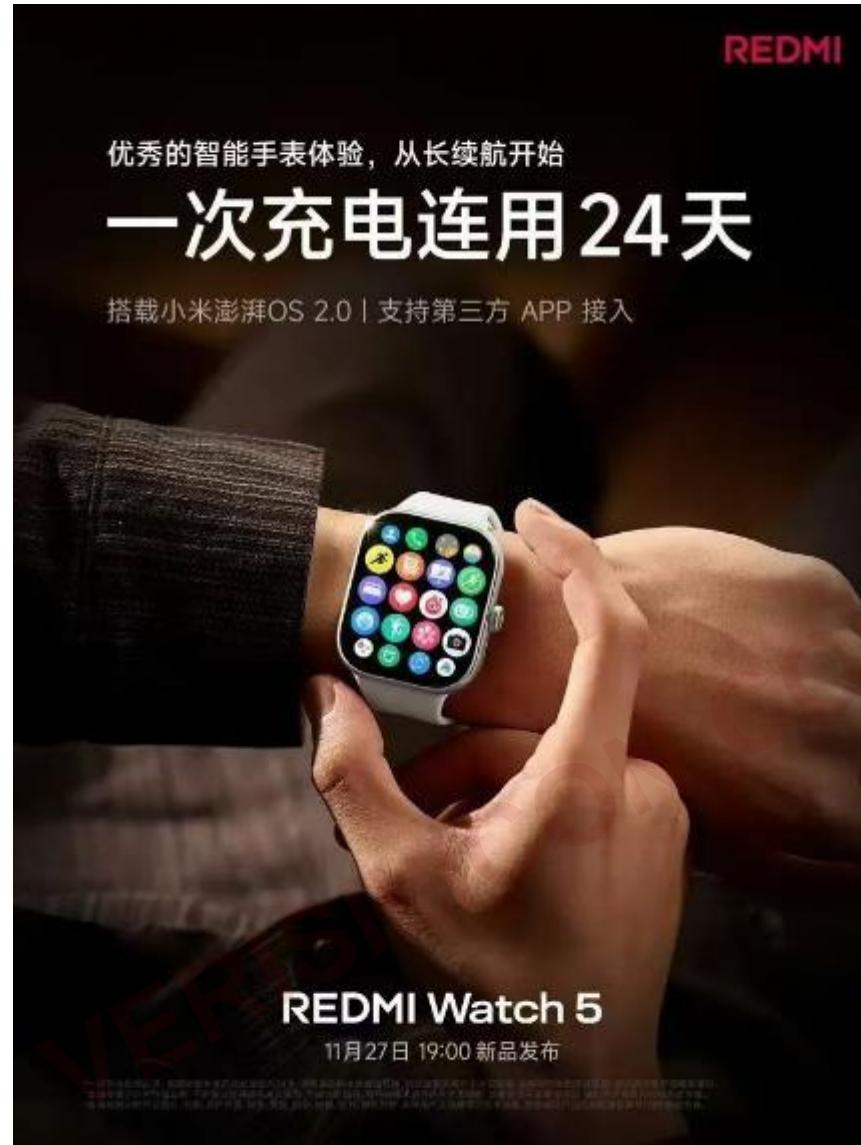
银色不锈钢表圈
灰棕色真皮表带

VeriSilicon 2nd Generation
2.5D GPU Inside

Xiaomi HyperOS 2
控家控车，随手随心



Products with VeriSilicon GPU – REDMI Watch 5 (2024)



REDMI Watch 5^{eSIM}

独立通话 | 12 天 eSIM 典型续航
支持网络蓝牙双模式对讲 | 网络模式无距离限制
蓝牙模式支持最远 200 米 | 支持多人对讲功能

潮流大屏
2.07" AMOLED 高亮高刷屏
1500nits 全局高亮 | 60Hz 流畅高刷
潮流外观
高质感金属表框 | 不锈钢旋转表冠
超大视野
2mm 超窄四等边 | 82% 超高屏占比

超长续航
24 天典型续航
550mAh 大电池 | 12 天 AOD 续航

全面出彩
线性马达
20+独创震动模式
全新 AFE 芯片
97.1% 心率准确度对比金标
支持户外对讲
独立GNSS定位

智能体验
支持更多主流 App
全新融合设备中心

Products with VeriSilicon GPU Solution



VeriSilicon 2nd Generation
2.5D GPU Inside

Products with VeriSilicon GPU – Amazfit T-Rex3 (2024)



超大显示屏

316L 不锈钢表圈
1.5 英寸 AMOLED 显示屏
2,000 尼特 最大亮度

超长续航

27 天 日常使用
42 小时 六星双频 GPS 精准模式
180 小时 超长 GPS 续航模式

内置麦克风

离线语音 快捷操控手表功能
语音备忘录 临时记录重要语音

专为户外探险打造

70°C 耐热性能
-30°C 低温工作模式
10ATM 防水性能

Amazfit T-Rex 3

¥1899 官方售价 ¥1999
首发限时优惠立减100元

9月10日上午10:00
京东 | 天猫 | 微信商城
全渠道现货正式开售
长按识别二维码购买

陨岩红 玄武黑

VeriSilicon 2nd Generation
2.5D GPU Inside

超全户外功能

海拔图、高海拔预警提醒
轨迹导航和转向提醒
丰富的户外类工具

地图图、转向提醒、指南针

ZEPPO 4 400+ 表盘 190+ 小程序

Zepp 读运动数据 170+ 运动
力量训练动作评价

身心准备度 + HRV GPS 语音导航
公交实时提醒

升级潜水模式

支持 45 米自由潜水
EN13319, ISO 5425
GB/T 18828 认证

可拆卸表带

含表带转接头及工具
及轻松更换个性表带

Products with VeriSilicon GPU – OPPO Watch X2 (2025)



2月20日19:00 全球首发



VeriSilicon 2nd Generation
2.5D GPU Inside





Products with VeriSilicon GPU – OPPO Watch X (2024)

OPPO Watch X

智能领跑 健康随行

3月 22 日 正式发布

3月 13 日 0:00
新品预约
3月 22 日 15:00
新品发布会
敬请期待
新品首销



Company Proprietary and Confidential



VeriSilicon 2nd Generation
2.5D GPU Inside



Products with VeriSilicon GPU Solution



vivo WATCH 3 智能表现 健康在线

VERISILICON CONFIDENTIAL

购买 vivo WATCH 3 eSIM 版的 9 大理由

 多场景风格闪变 腕上百变美学，换根表带就是换种风格	 自研蓝河操作系统 从运动到出行，时刻更懂你	 AIGC 表盘* 更智慧的交互体验。畅享无限表盘
 多通道星环健康监测 健康管理更精准、更智能、更安心	 16 天超长续航 ³ 实力大咖，也是续航专家	 微信手表版 ⁷ 随时随地，畅聊微信
 免打扰睡眠监测 ¹⁴ 夜间红外无打扰监测，轻薄贴腮舒适无忧	 应用 ⁵ 支持更多刚需 App，手滑丝滑使用	 专业 AI 跑步教练 定制运动计划，全维数据分析

VeriSilicon 2nd Generation
2.5D GPU Inside

Products with VeriSilicon GPU Solution



VeriSilicon 2nd Generation
2.5D GPU Inside

Company Proprietary and Confidential

VENU 3
系列



Products with VeriSilicon GPU Solution



**VeriSilicon 2nd Generation
2.5D GPU Inside**

Polar Vantage V3

顶级多功能运动型手表

Products with VeriSilicon GPU Solution



VeriSilicon 2nd Generation
2.5D GPU Inside



Products with VeriSilicon GPU Solution

OnePlus Watch 2



OnePlus Watch 2



VeriSilicon 2nd Generation
2.5D GPU Inside

Products with VeriSilicon GPU Solution



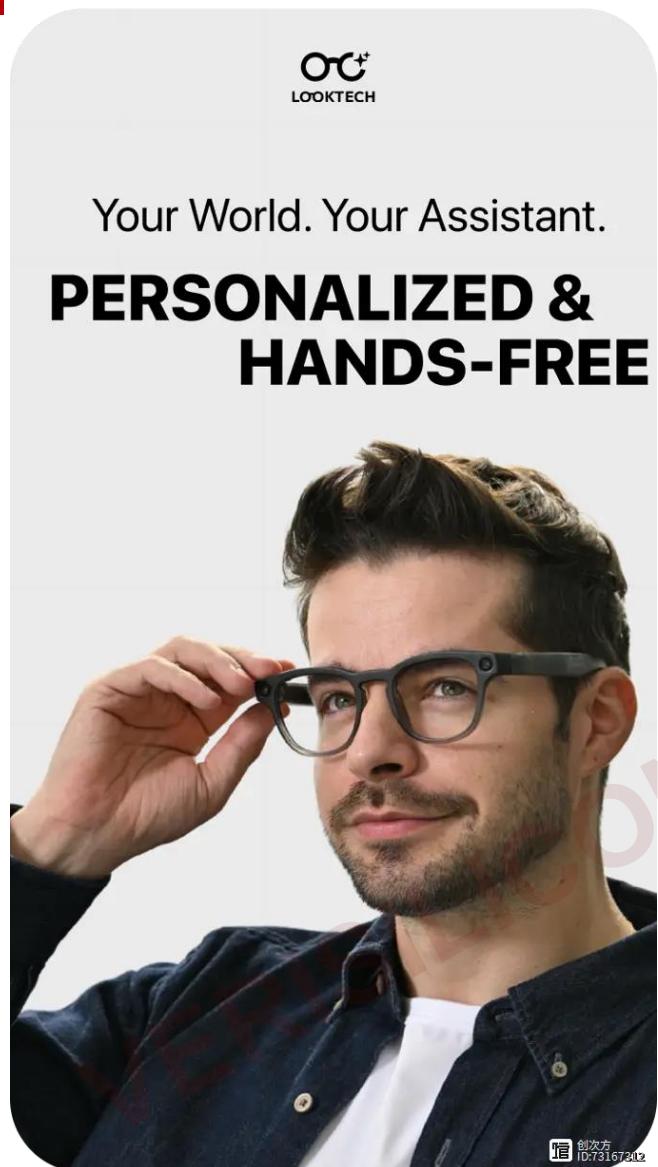
TicWatch GTX10



TicWatch GTX10

VeriSilicon 2nd Generation
2.5D GPU Inside

Products with VeriSilicon GPU Solution

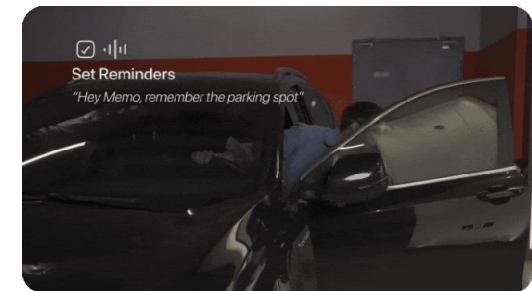
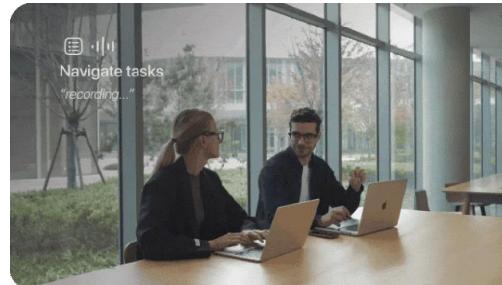
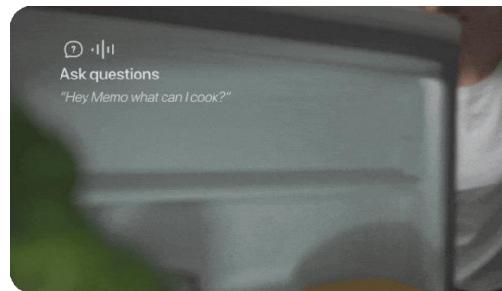
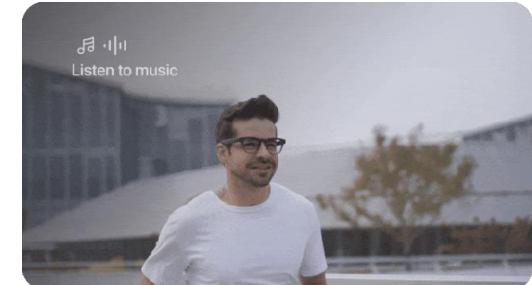
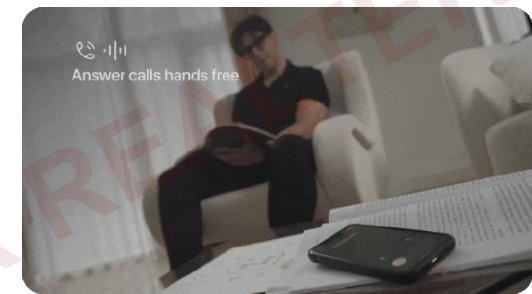


Your World. Your Assistant.

**PERSONALIZED &
HANDS-FREE**



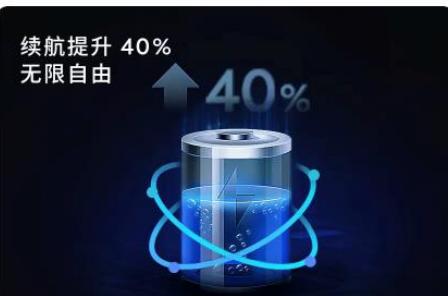
VeriSilicon 2nd
Generation
2.5D GPU Inside



Products with VeriSilicon GPU Solution



VeriSilicon 2nd Generation
2.5D GPU Inside



Products with VeriSilicon GPU Solution

MYVU

全 天 候 时 尚 AR 智 能 眼 镜



VeriSilicon 2nd Generation
2.5D GPU Inside

43g 极轻人因设计



Flyme AR 灵动无界



Flyme AI 大模型



多彩时尚个性化定制



0.3cc Micro LED
纯色光引擎



双目
2000nit
无界信息屏

0.5mm 超线性双扬悦耳



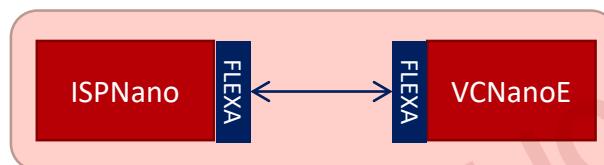
降噪
拾音
私密安全

Wearable Mass Market Opportunities - AR

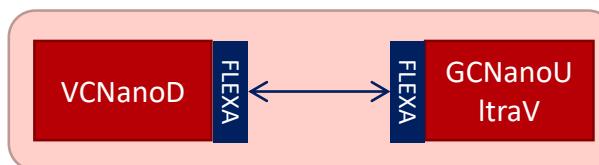


Google

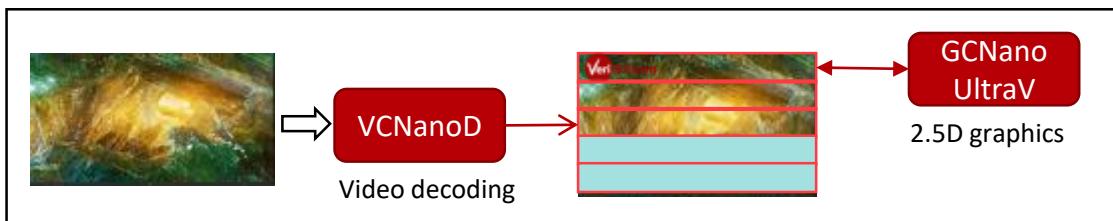
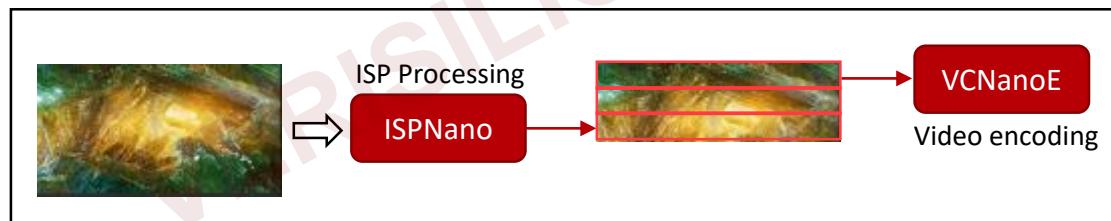
FLEXA™



Ultra low latency encoding
No use of DDR
Ultra low power



Ultra low latency rendering
No use of DDR
Ultra low power



Products with VeriSilicon GPU and Display Solution - Infineon

PSoC™ Edge – The Next Generation of ML Enabled MCUs

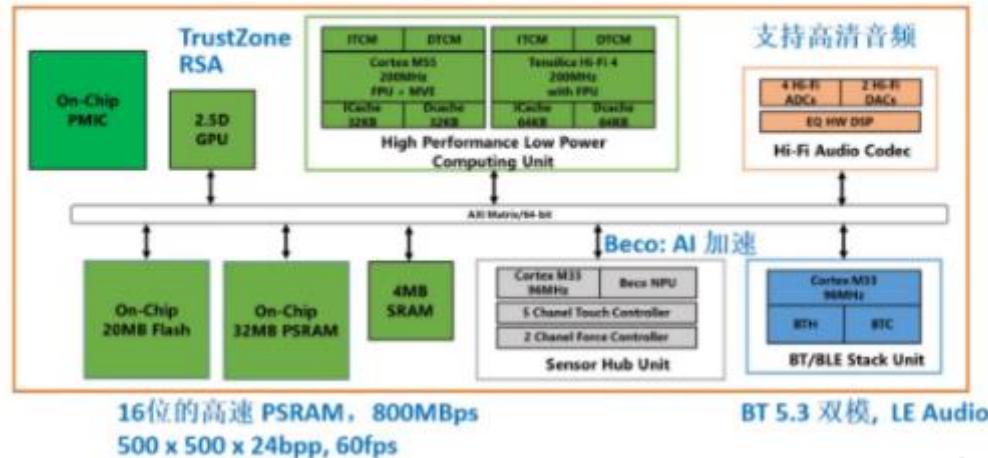
PSoC™ Edge is Infineon's Machine Learning-enhanced sensing, low power, secured, and advanced HMI high-performance microcontroller family and enables designers to deliver unmatched, highly usable end-user experiences for next generation devices.

**VeriSilicon 2nd Generation
2.5D GPU and DPU Inside**

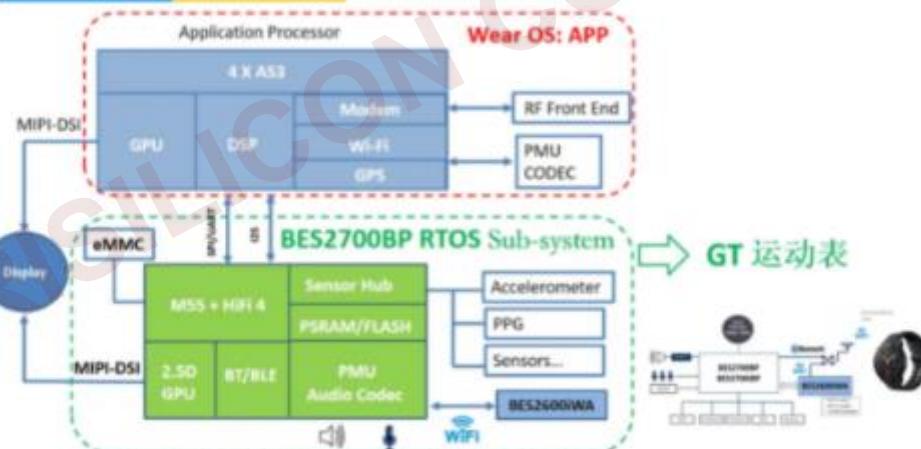


Products with VeriSilicon GPU IP – BES

BES2700BP: 业界第一个12nm运动手表SoC 平台
四核，高算力



智能手表应用: Apps生态 + 长续航



Company Proprietary and Confidential

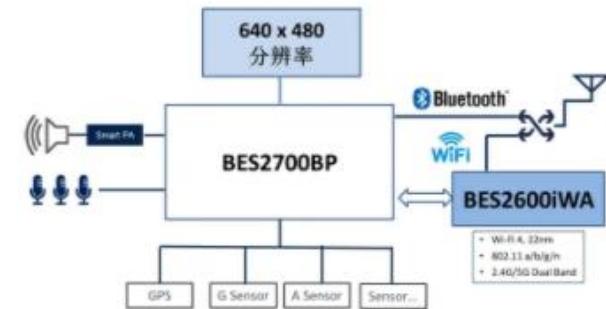
VeriSilicon 2nd Generation
2.5D GPU



轻型智能眼镜应用

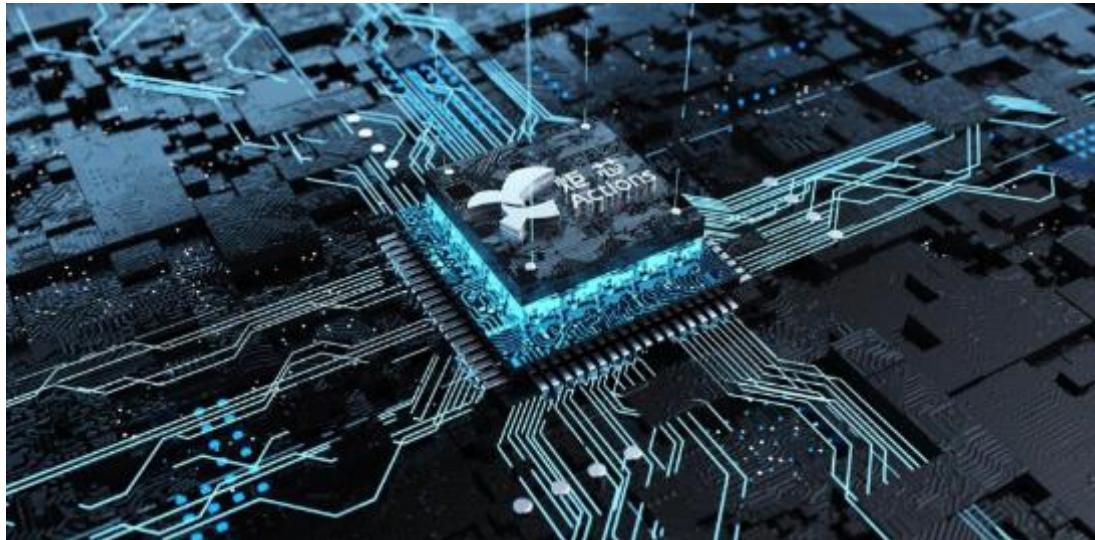
语音通话 语音播报 信息显示 信息提醒

ChatGPT



VeriSilicon

Products with VeriSilicon GPU IP – Actions



智能手表新「芯」
引领腕上新趋势

炬芯科技全新第二代智能手表芯片
正式发布

ATS3085S | ATS3089 | ATS3085E



Company Proprietary and Confidential



Actions Smart Watch Product Comparison

Smart Watch IC

Smart Watch IC	ATS3085L/85C/85	ATS3085E	ATS3085S / ATS3089
MCU	128MHz M4F (16uA/MHZ) +192MHz DSP	192MHz MStar +192MHz DSP	
Internal RAM	481KB SRAM + 4MB/ 8MB/8MB (OSPI DDR PSRAM)	1MB	1.2MB + 4MB/8MB (ATS3085S) / 8MB/16MB/32MB (ATS3089) (16MB/32MB HPI PSRAM)
SPI NOR	2MB (ATS3085 only)	external	0MB/4MB/8MB
SensorHub			✓
Standby Model		Shippingmode: <3uA ; Deepsleep(no Ret): <20uA	
Interface	QSPI/CPU8080/SPI/ Dual SPI Interface/	QSPI(DDR)/CPU8080/SPI/Dual SPI Interface/JDI parallel HSYNC/VSYNC interface	
GPU	2D	2D (JPEG Decoder)	2D + 2.5D (JPEG Decoder)
DSP/EQ Audio Codec		20 Bands PEQ/DRC/AGC	
ENC		AI ENC	
Analog/Digital Mic		2AMIC OR 2DMIC	
BT Version		Bluetooth V5.3	
RX Sensitivity(BLE@1Mbps)	Typ : -98dBm	Typ : -99dBm	
Max TX Power (BDR/BLE)	13dBm	14dBm	

VeriSilicon 2nd Generation
2.5D GPU

Secure Firmware Install (SFI)
Secure Boot 8 Secure Update
PSA-L1



Products with VeriSilicon GPU IP – HPM6800

芯原业界领先的嵌入式GPU IP赋能先楫高性能的
HPM6800系列RISC-V ...

2024-03-04 15:05:15 来源 动态宝 © 北京

VeriSilicon 2nd Generation
2.5D GPU

2024年3月4日，中国上海——芯原股份（芯原，股票代码：688521.SH）今日宣布先楫半导体（简称“先楫”）的HPM6800系列新一代数字仪表显示及人机界面系统应用平台采用了芯原的高性能2.5D图形处理器（GPU）IP。



0

电源	DCDC SOC	DCDC DDR
LDOPMC		LDO2V5
POR/BOR		
时钟	小数分频PLL x5	
OSC 24M	IRC 24M	
OSC 32K	IRC 32K	
系统	DMAx2	WDG x3
MBX信箱		RTC
JTAG调试		
内部存储器	高速RAM 512KB	
外设RAM 32KB	备份RAM 8KB	
ROM 192KB	OTP 4KB	
外部存储器	4b/8b 串行NOR/PSRAM x1	
DDR2/DDR3/DDR3L		
SDIO/eMMC x2		

内核	
RISC-V CPU 0	
32KB L1-I	32KB L1-D
FPU	DSP
PLIC	
256KB ILM	256KB DLM

多媒体	
2.5D OpenVG GPU	
2D图形加速	
JPEG编解码	
LCDC x2	CAM x2
MIPI-DSI/LVDS-Tx x2	
MIPI-CSI/LVDS-Rx x2	
I2S x4	数字音频输出
PDM-Mic	语音唤醒
音量合成器	

协处理器	
FFT/FIR加速	CRC加速
输入输出	

快速GPIO	
GPIO	

通讯接口
UART x9
SPI x4
I2C x4
CAN FD x8
ENET 1000/100/10Mbps x1
USB HS w/ PHY x1

定时器
32位通用定时器x9

模拟
16b SAR ADC 2Msps x1

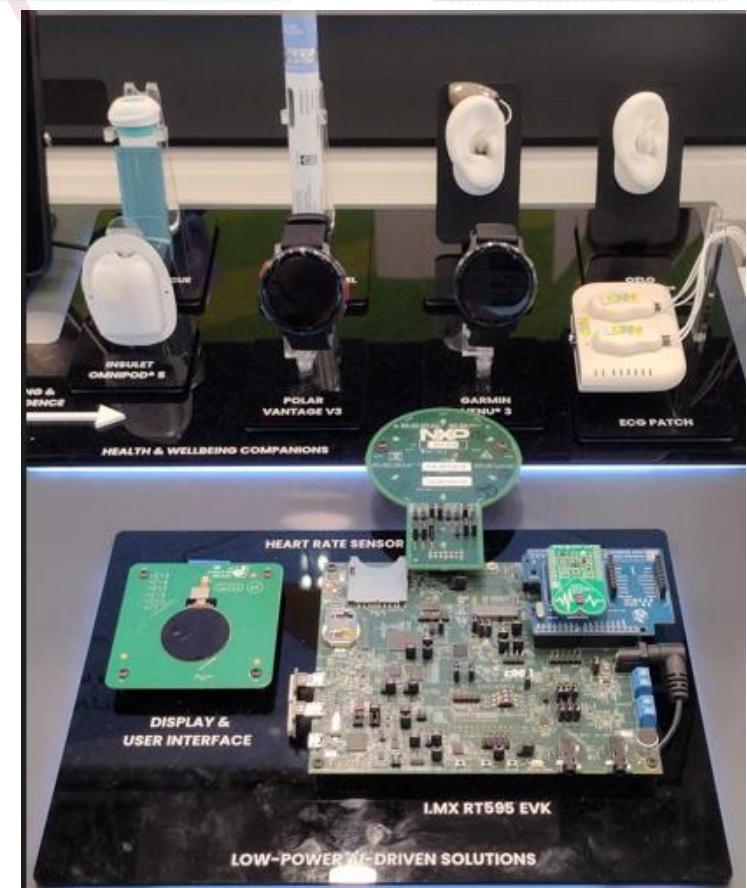
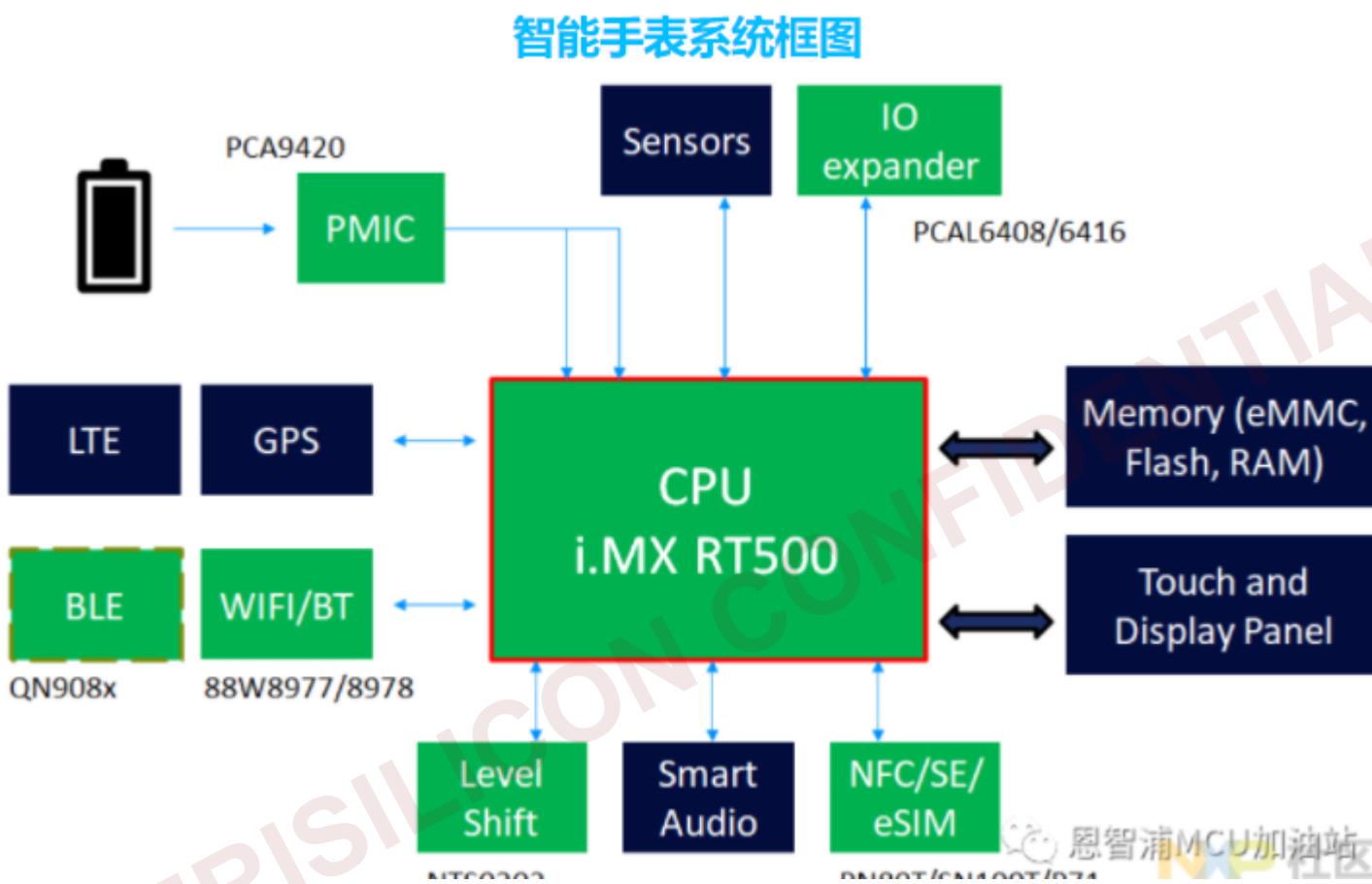
温度传感器

安全
EXIP 在线解密执行
AES/SHA/SM3/SM4
真随机数发生器
安全调试
密钥管理
产品生命周期管理
安全启动 加密/可信任



立功科技基于先楫高性能MCU HPM6800搭载AWTK GUI组件开发的12.3吋汽车仪表方案，实现了传统指针仪表表盘、科技版异形速度条表盘和HACC自动驾驶表盘三个界面。

Products with VeriSilicon GPU IP – NXP RTxxx



Products with VeriSilicon GPU IP – NXP i.MX8M

▲ VeriSilicon GCNanoVulkan GPU

- ▶ Vulkan 1.1/1.0
- ▶ OpenGL ES 3.1/3.0/2.0
- ▶ OpenCL 1.2/1.1

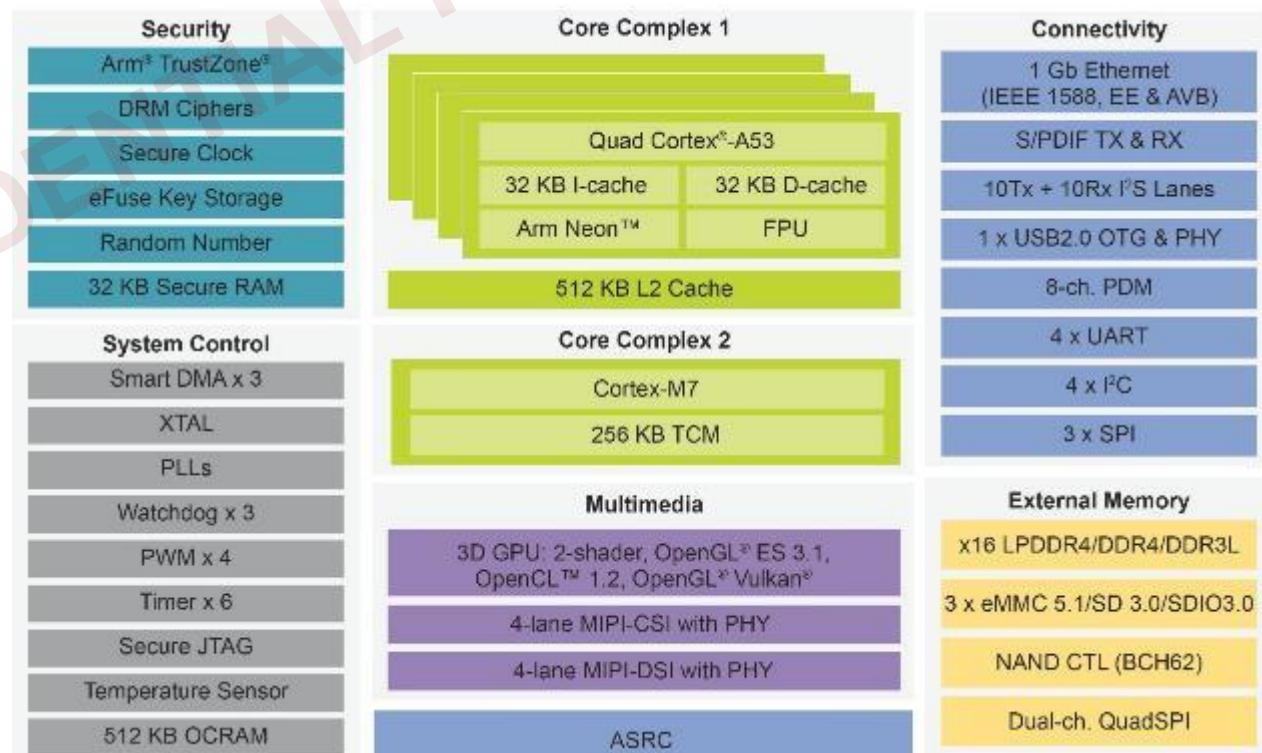
▲ 4x Cortex-A53 core platforms up to 1.5GHz per core

▲ 1x Cortex-M7 core up to 750MHz

▲ System Requirement:

- ▶ 16-bit DRAM interface (LPDDR4-3200, DDR4-2400, DDR3L-1600)

▲ <https://info.cranksoftware.com/platforms/demo-images/nxp/imx-8m>



Products with VeriSilicon GPU IP – NXP i.MX8M-Mini

▲ VeriSilicon GCNano 3D + GC520L 2D

- ▶ OpenGL ES 2.0
- ▶ OpenVG 1.1

▲ VeriSilicon Video Decoder + Encoder

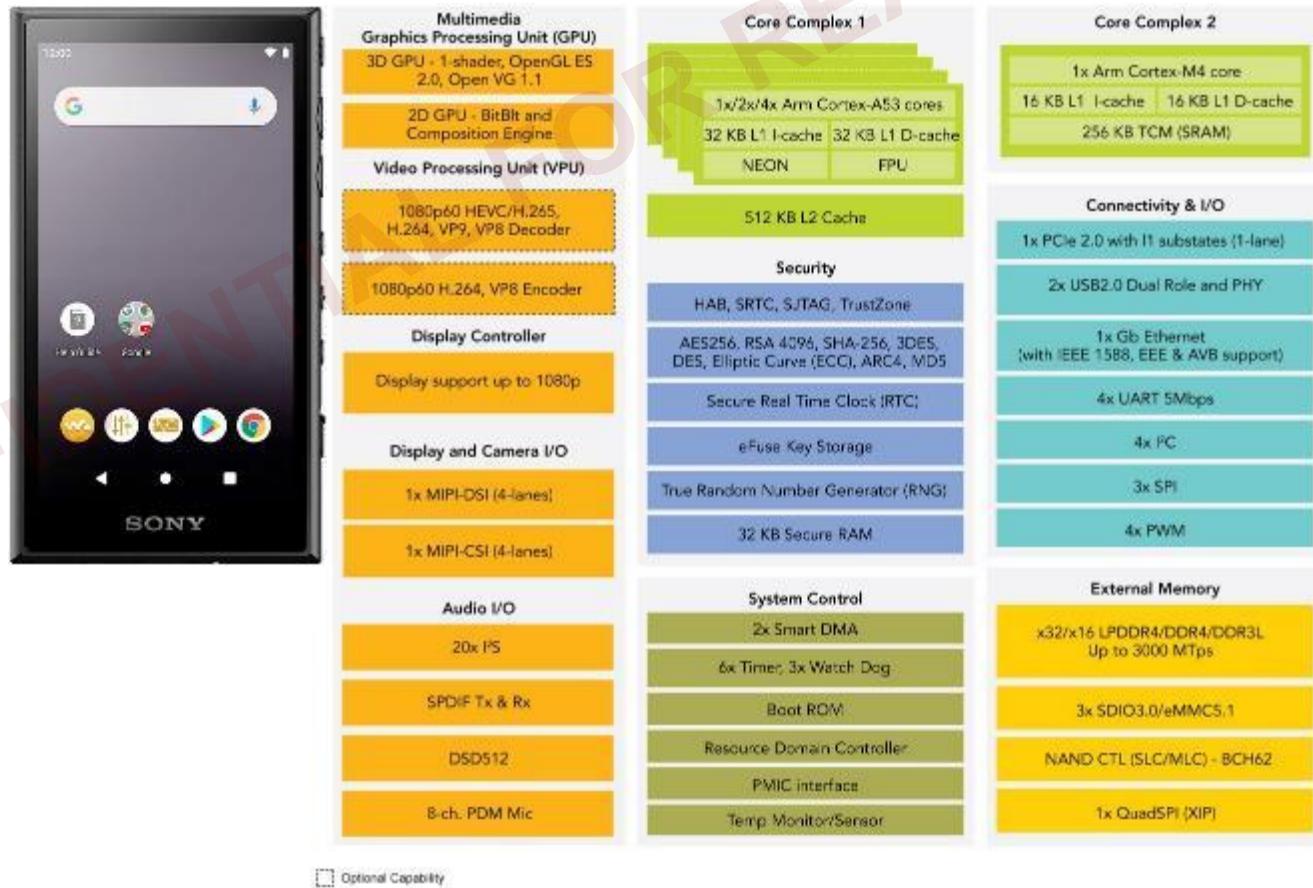
- ▶ 1080p60 VP9 Profile 0, 2 (10-bit) decoder
- ▶ 1080p60 AVC/H.264 encoder, VP8 encoder

▲ 4x Cortex-A53 core platforms up to 1.8GHz per core

▲ Cortex-M4 core up to 400MHz

▲ System Requirement

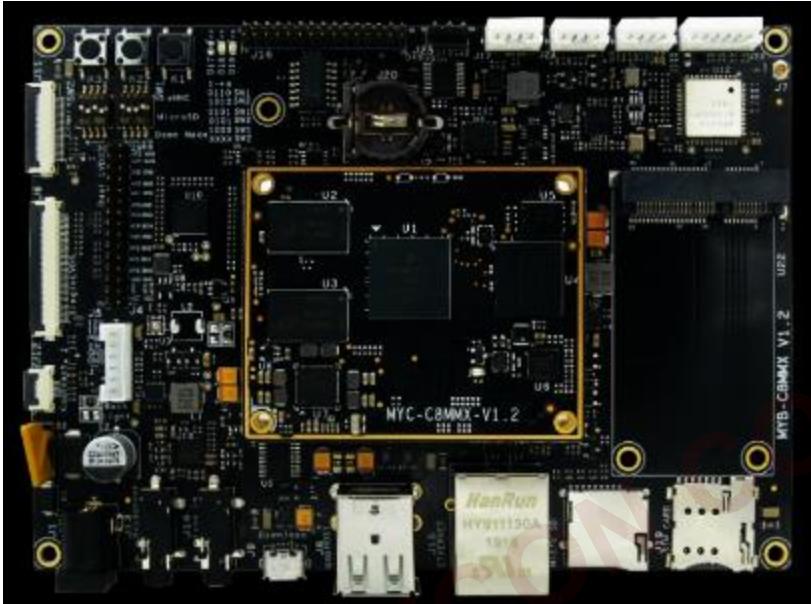
- ▶ 32-bit/16-bit LPDDR4, DDR4, and DDR3L memory.



Optional Capability

Openharmony Gitee: NXP i.MX8M-Mini board

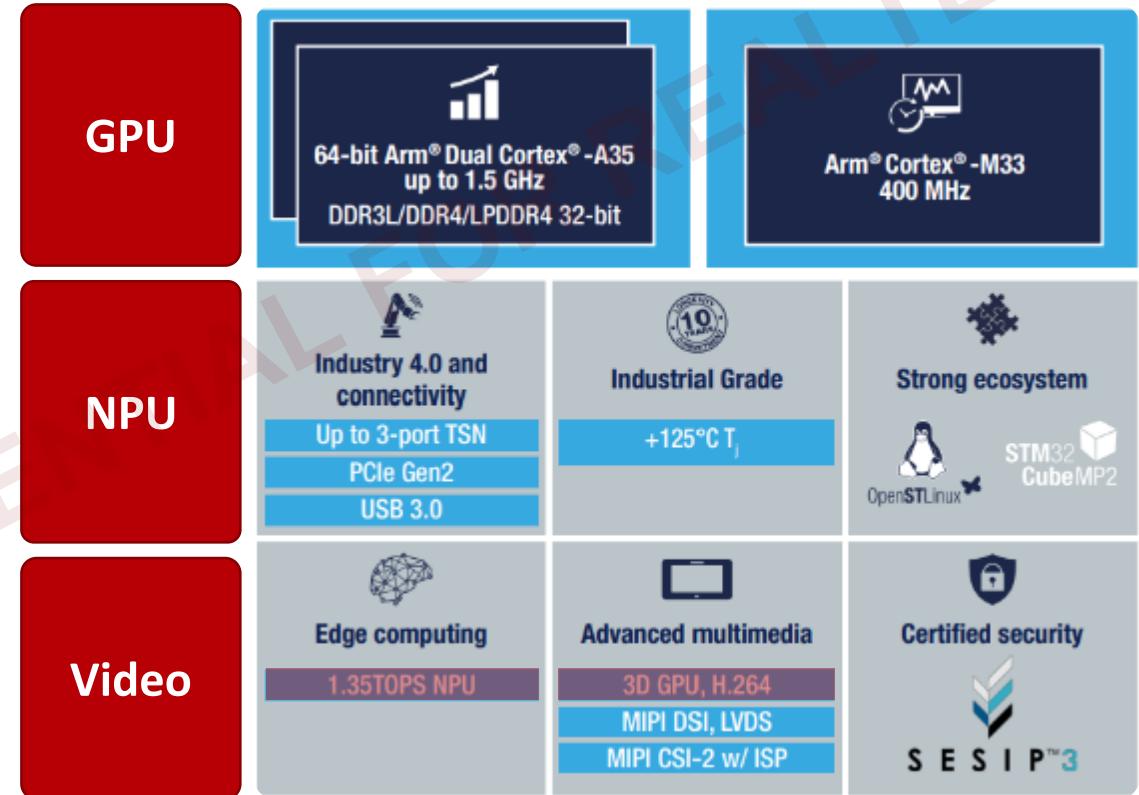
https://gitee.com/openharmony/device_board_osware/blob/master/imx8mm/README_zh.md



VeriSilicon GPU supports OpenHarmony!

Main CPU	1x,2x or 4x Cortex-A53 @ 1.8GHz, 512kB L2
Micro-controller	Cortex-M4 400MHz
DDR	x16/x32 LPDDR4/DDR4/DDR3L
GPU	<u>GC NanoUltra 3D (1 shader) + GC320 2</u> OpenGL ES 2.0
Display Features	LCDIF
Display Interfaces	1x MIPI-DSI
Video Decode	1080p60 HEVC H.265, VP8, H.264, VP9
Video Encode	1080p60 H.264 VP8
Audio Interface	5x SAI (12Tx + 16Rx external I2S lanes) Each lane up to 24.576MHz BCLK (32-bit, 2-ch 384KHz, up to 32-ch TDM); 4Tx + 4Rx support 49.152MHz BCLK for 768KHz
Digital Mic Input	8ch PDM DMIC input
Camera Interface	1x MIPI-CSI (4-lanes each)
USB	2x USB2.0
PCIe	1x PCIe 2.0
Ethernet	1x GbE
SDIO/eMMC	3x SDIO/eMMC
I2C	4
Process	Samsung 14LPC FinFET
Packages	14x14mm, 0.5p
Temperature	-40°C to 105°C (Tj)

ST Micro STM32MP1 & STM32MP2 MPU with VeriSilicon IP



VeriSilicon Vector Graphic 2.5D GPU

Vector Graphics vs. Raster Images

▲ Vector graphics maintain crisp edges and lose no detail when resized, because they are resolution-independent. This resolution-independence makes vector graphics a good choice for visual elements, such as logos, that will be used at various sizes.



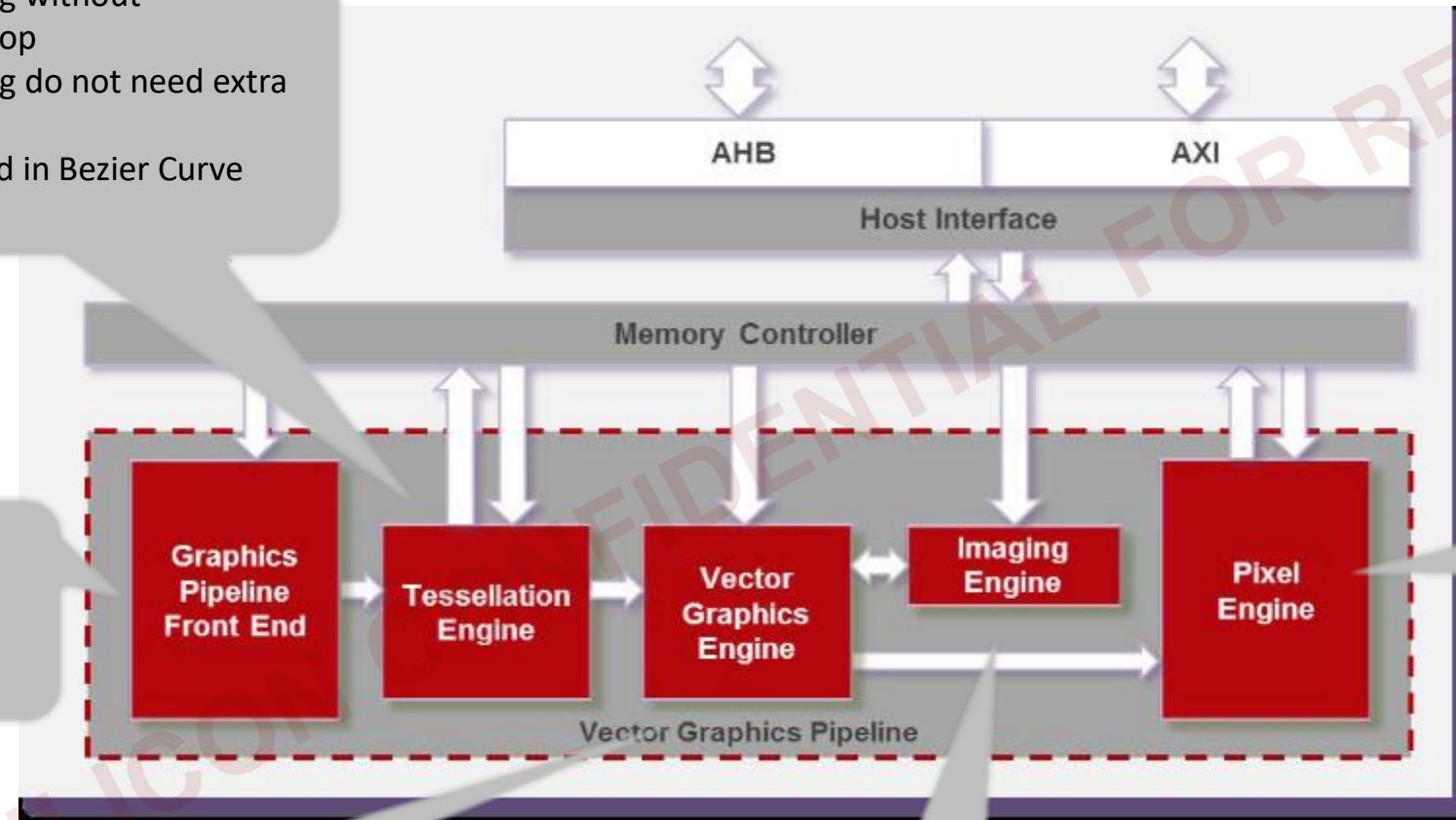
Example of a vector graphic at different levels of magnification



Example of a raster image at different levels of magnification

VeriSilicon Vivante Vector Graphics Core Architecture

- 4x4 Anti-Aliasing without Performance drop
- 4x4 Anti-Aliasing do not need extra SRAM
- No CPU Involved in Bezier Curve generation



Fire and Forget Control mechanism to minimize CPU load

FP24 coordinate precision, no precision difference in any degree rotation

2 Texel/cycle in Bi-linear filter

- Hardware Composition
- Frame buffer Compression

2.5D GPU, Compression and Display Sub-system

▲ Target for watch and wearable device

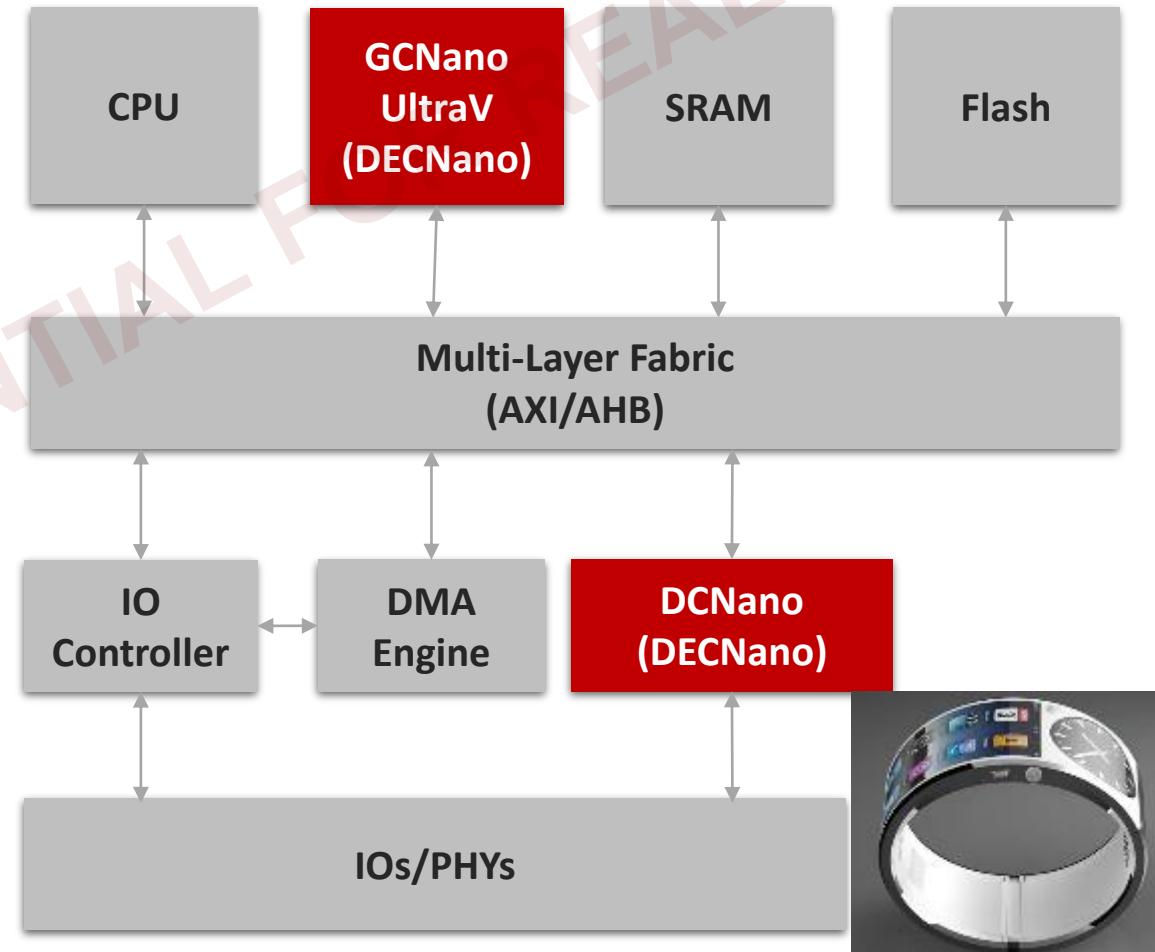
- ▶ GCNanoUltraV(2.5D GPU) + DC9200Nano (Display Controller)
- ▶ DDR-less graphic and display Solution with Frame buffer lossy compression

▲ Smallest Display controller of DCNano series

- ▶ Very small area cost
- ▶ Support up to 1080P resolution
- ▶ Support 2 output panel,
- ▶ One panel for watch face and another one for Virtual Button

▲ Display Interface

- ▶ QSPI interface for sub-display
- ▶ DSI interface for main display



VeriSilicon Vivante Vector Graphics Key Features

▲ Highlights

- ▶ Command list based DMAs, Fire and Forget Control mechanism to minimize CPU overhead
- ▶ Hardware Bézier curve path tessellation and rendering
- ▶ Hardware blending support, Frame buffer compression
- ▶ Hardware clipping, scissoring and masking
- ▶ Hardware transformation and configurable Coordinate Systems
- ▶ Hardware image filters, Point/Linear/Bilinear filtering. Hardware Linear/Radial gradient.
- ▶ 360-degree rotation blit
- ▶ Low CPU overhead

▲ Software and OS Support

- ▶ OS Supported: Linux, FreeRTOS, and other real-time operating systems
- ▶ API Supported: Vivante VGLite API
- ▶ Industry Standards
 - LVGL/ SVG/ OpenStreetMap



VeriSilicon Vivante Vector Graphics Key Features

▲ Drawing Primitives

- ▶ Quadratic/Cubic Bézier curve path
- ▶ Solid/pattern filled close path
- ▶ Stroke path rendering
- ▶ Gradient Filled rectangle
- ▶ Linear/radial gradient paint paths

▲ Text rendering supports

- ▶ Glyph and font rendering

▲ Color formats

- ▶ 32-bit RGBA8888 / BGRA8888 / ABGR8888
- ▶ 24-bit RGBA4444/RGB888
- ▶ 16-bit RGBA5551 / RGB565
- ▶ 8-bit A8 / L8 / RGB332, 4-bit A4 / L4 & 2-bit A2 / L2 & 1-bit A1 / L1
- ▶ 1/2/4/8-bit index format
- ▶ YUV420/YUV422/YUV444

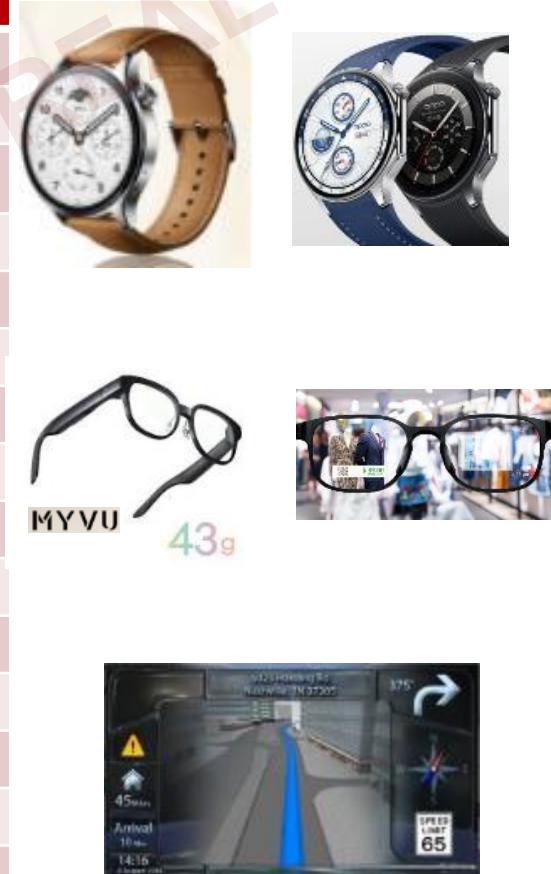
▲ Antialiasing

- ▶ 16x CSAA(4x4), no quality difference between horizontal and vertical direction, 4x4 Anti-Aliasing do not need extra SRAM
- ▶ 8x CSAA(4x2), low cost version, horizontal quality is better than vertical direction



2.5D GPU – GCNanoUltraV/GC555

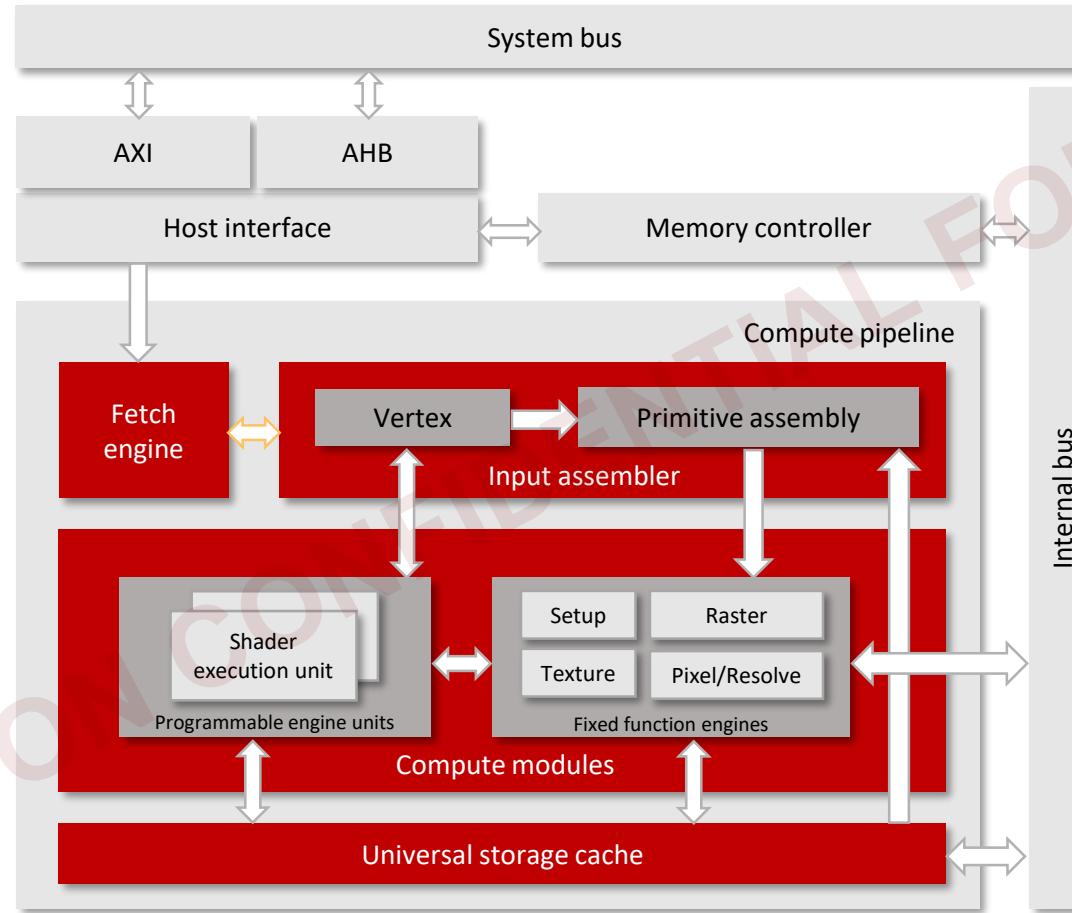
Main Feature/Function	GCNanoUltraV 2.0	GCNanoUltraV 3.0	GC555
Graphic API	VgLite	VgLite	VgLite/OpenVG1.1
Scalable Vector Graphics (SVG)	Support	Support	Support
Light & Versalite Embedded Graphics (LVGL)	Support	Support	Support
Support OS	RTOS/Linux	RTOS/Linux	RTOS/Linux
DDR-less Solution with SRAM	Support	Support	Support
Maximum resolution	4K	4K	4K
Frame Buffer compression	Support	Support	Support
Configuration Bus	AHB	AHB	AHB
Main Data Bus	AXI	AXI	AXI
Bus Latency hide capability (Cycles)	64	512	128
HW Tessellation Units	8	16	16
Pixel Rate (Pixels/Cycle)	1	1	1
Texel Rate (Texels/Cycle)	1	1	1
Achievable Clock Speed (GHz)	1	1	1
Synthesis Logic Gates (MGates) ^①	0.9	1.28	1.2
Memories Bits (KBytes)	3.65	40.93	25.52
Total Synthesis Area (TSMC7 6T ,mm ²)	0.058	0.112	0.097
Projected Silicon Area (TSMC7 6T ,mm ²)	0.09	0.17	0.15



VeriSilicon 3D GPU Solution



Vivante Wearable 3D GPU Block Diagram



VeriSilicon 3D GPU Feature Highlights

▲ Smallest OES2.0 GPU – GCNano/GCNanoUltra

- ▶ Support OpenGL ES2.0 API
- ▶ Support OpenVG 1.1 API
- ▶ **Android OS** support
- ▶ **OpenHarmony OS** support with key customers
- ▶ **DDR-less solution** without SRAM/PSRAM size optimization
- ▶ Support Android 14 wearable OS

▲ Smallest Vulkan GPU – GCNanoVulkan

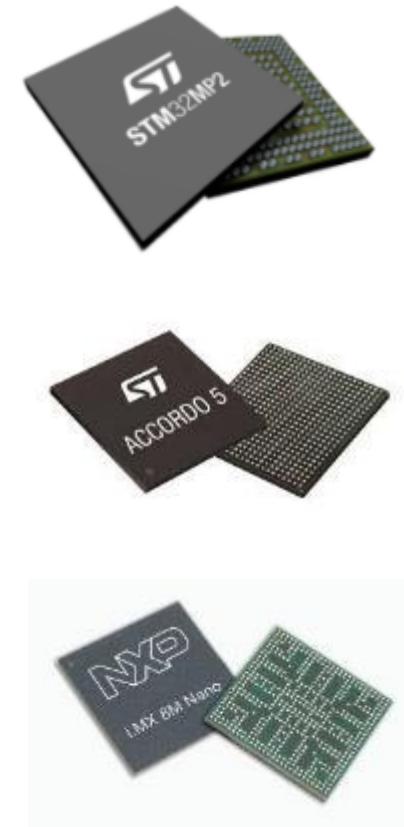
- ▶ Support OpenVG 1.1 API
- ▶ OpenGL ES 3.1/3.0/2.0 API
- ▶ OpenCL 1.2/1.1 API
- ▶ **Android OS** support
- ▶ **OpenHarmony OS** support with key customers
- ▶ MCU/MPU
- ▶ Support Android 14

Although Google wants to raise the minimum GPU API level to ES 3.1 in Android, the market reality is that ES 2.0 devices (MCU, embedded) still take substantial portion of all Android devices. So OpenGL ES 2.0 API is still the minimum GPU requirement for Android 14. <https://source.android.com/docs/compatibility/14/android-14-cdd>

3D GPU – GCNano, GCNanoUltra, GCNanoVulkan

VeriSilicon Vivante GCNano GPU @TSMC7FF,6Track	GCNano	GCNanoUltra	GCNanoVulkan
API Support	OpenGL ES 2.0	OpenGL ES 2.0	Vulkan 1.3 OpenGL ES 3.1 OpenCV 4.6.0 OpenCL3.0
Pixel Rate (Pixels per Cycle)	0.25	0.5	1
Texel Rate (Texels per Cycle)	0.25	0.5	1
FP32 Operations per Cycle	4	8	16
FP16 Operations per Cycle	NA	NA	32
GFLOPS (FP32) @1Ghz	4	8	16
GFLOPS (FP16) @1Ghz	NA	NA	32
Achievable Clock Speed (GHz)	1	1	1
Synthesis Logic Gates (MGates)	1.40	1.56	7.56
Memories Bits (KBytes)	36.5	68.1	129.1
Total Synthesis Area (mm²)	0.12	0.15	0.55
Projected Silicon Area (mm²)	0.18	0.23	0.86
Leakage Power (mW) (TT/0.75V/25°C)	0.23	0.24	1.19
Average Dynamic Power (mW)@100MHz (TT/0.75V/25°C)	5.7	10.1	17.2

Company Proprietary and Confidential



VeriSilicon GCNano3DVG (2.5D GPU + 3D) GPU Solution

▲ A hybrid GPU with 2.5D and 3D Technology, Applicable to both 2.5D and 3D applications

► Hardware composition

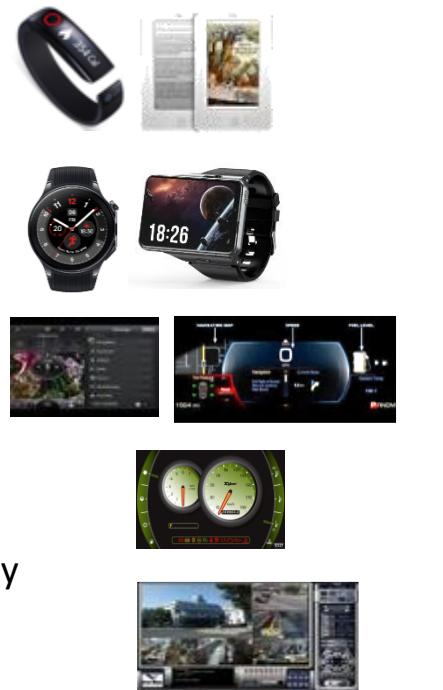
■ Separated 3D graphic and 2.5D graphic render pipelines

- Accelerating the rendering of fancy scenes composed of vector objects and 3D objects
- Fine tuned render pipelines for better PPA

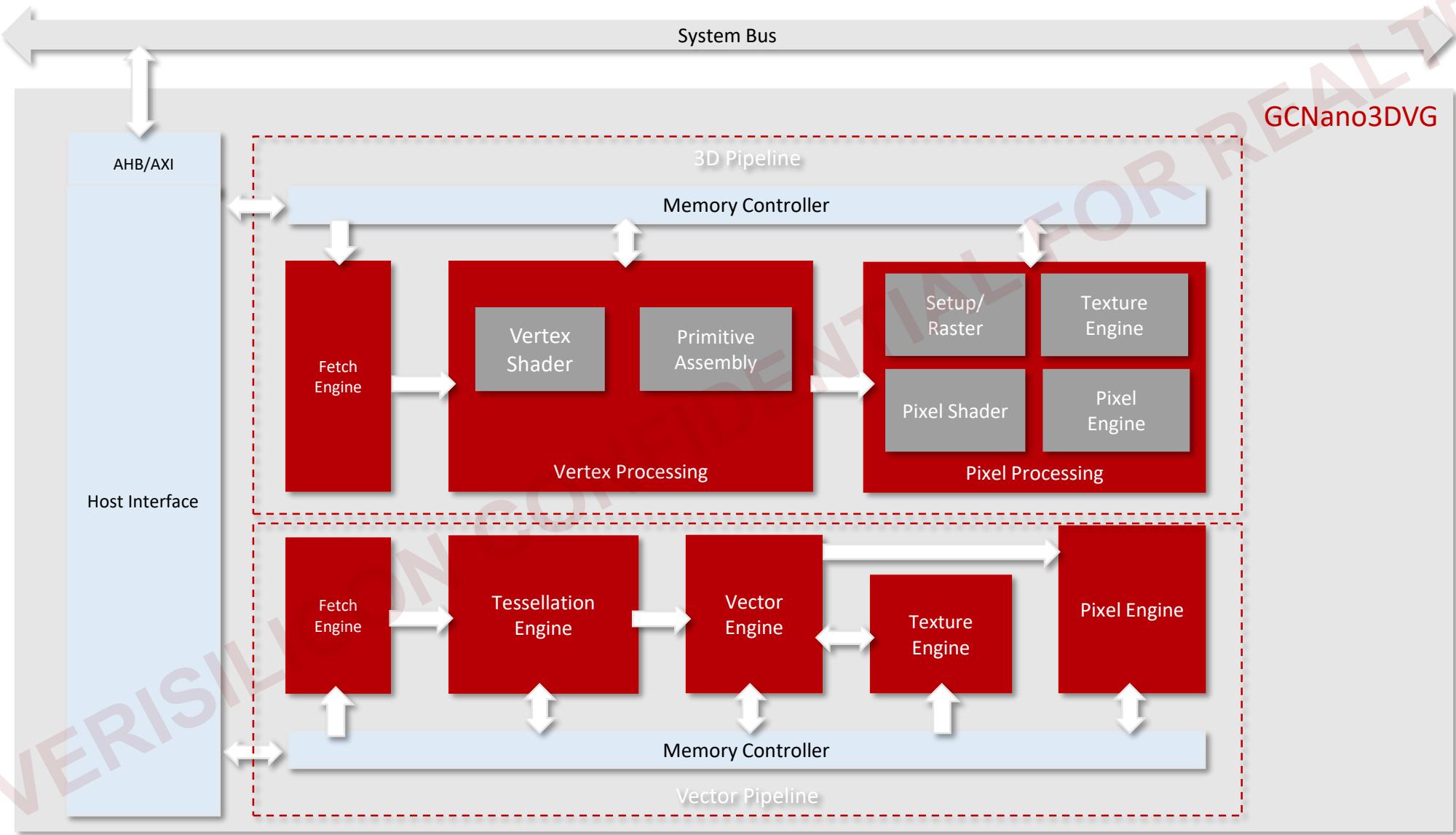
■ Separated Blit Engine, working with graphic render pipelines Independently

■ Unified Command Engine for graphic channels and blit channel

- Ring-buffer based command list for command submission to reduce the synchronization penalty
- Multiple synchronization mechanism between CPU and GPU: interrupt/fence etc.
- HW-handled synchronization among channels for better performance and easier programming
- Minimized CPU load



VeriSilicon GCNano3DVG (2.5D GPU + 3D) GPU Architecture



VeriSilicon GCNano3DVG (2.5D GPU + 3D) GPU PPA

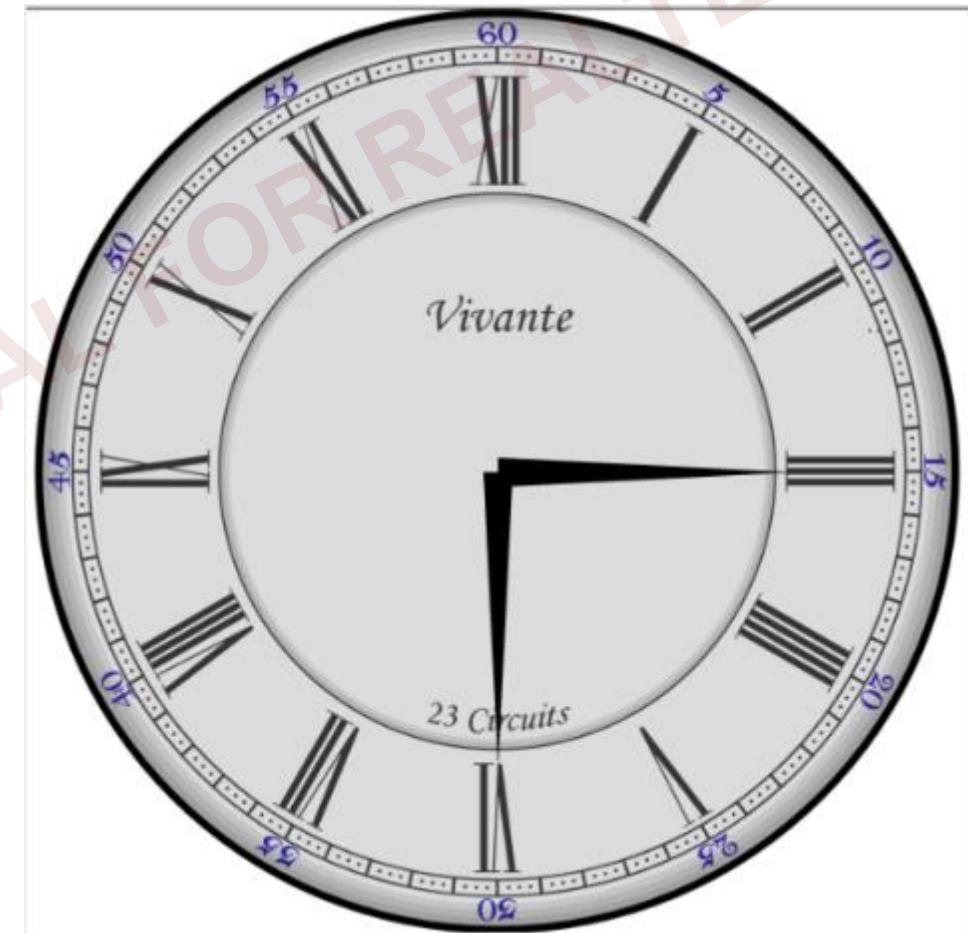
Main Feature/Function	GCNano3DVG
DDR-less Solution with SRAM	Support
Target UI Resolution at 60 FPS	1080P and above
3D Graphics	Pixel Rate (Pixels/Cycle)
	Texel Rate (Texels/Cycle)
	Vec4 Shader Cores
	GFLOPS (32bit)
Vector Graphics	Pixel Rate (Pixels/Cycle)
	Texel Rate (Texels/Cycle)
	Tessellation Units
Bus Latency-hide capability	512
Achievable Clock Speed (Synth, GHz)	1
Synthesis Logic Gates (MGates)	2.84
Memories Bits (KBytes)	109.03
Total Synthesis Area (TSMC7 ,mm ²)	0.262

Nano GPU Application Analysis

Vector GPU DDR Less Solution Usage Scenario (1)

▲ Smart Watch, ALL the UI is done by Vector GPU hardware, no CPU render

- ▶ Resolution: 480x480
- ▶ Performance: 30fps
- ▶ GCNanoUltraV DDR less Solution
 - Frequency requirement: 19 MHz
 - Dynamic Power: 0.52mw (TSMC7nm, 0.75v/25C, @100MHZ)
 - Memory requirement: 1.3MB(Input, output, firmware and internal buffers)
 - CPU load: Less than 3% (1x Cortex-M4 core 150MHz)



Vector GPU DDR Less Solution Usage Scenario (2)

▲ Tiger Benchmark - Fast Vector GPU, Cool Vector

GPU, Small Vector GPU

- ▶ Resolution: 640x480
- ▶ Performance: 30fps
- ▶ GCNanoUltraV DDR less Solution
 - Frequency requirement: 70 MHz
 - Dynamic Power: 1.42mw (TSMC7nm, 0.75v/25C, @100MHZ)
 - Memory needed: 1.6MB(Input, output, firmware and internal buffers)
 - CPU load: Less than 5% (1x Cortex-M4 core 150MHz)



Vector GPU DDR Less Solution Usage Scenario (3)

▲ Font rendering – All the Font is done by Vector GPU hardware by drawing complex path

- ▶ Resolution: 640x480
- ▶ Performance: 30fps
- ▶ GCNanoUltraV DDR less Solution
 - Frequency requirement: 24MHz
 - Dynamic Power: 0.48mw (TSMC7nm, 0.75v/25C, @100MHZ)
 - Memory needed: 1.6MB(Input, output, firmware and internal buffers)
 - CPU load: Less than 3% (1x Cortex-M4 core 150MHz)

There are two potential cases can cause a path restart. 1. The num of intersections of a scan line is over 16/48/48 in NOMSAA/MSAA4X4/MSAA2X2 mode; The GE module has to do one more round of the same path to handle the xNode exceeding. TSClear state is at the beginning of path, 2. The size of tessellation buffer is overflow. GE report tessellation buffer overflow after the end of a path. FE will restart this path again. GE module has to record the GE buffer overflow status. GE module will scissor the path's bounding box into small ones by the vertical direction, the number of small boxes depend on the GE buffer size and the Y-stride of this path (more details see section 3.6.2). GE will process the path with different small bounding boxes by several rounds. Restart a single path strategy.

High quality 16x anti-aliasing – Tiger Case



NO anti-aliasing

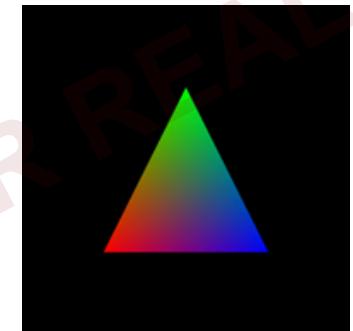


16x(4x4) anti-aliasing

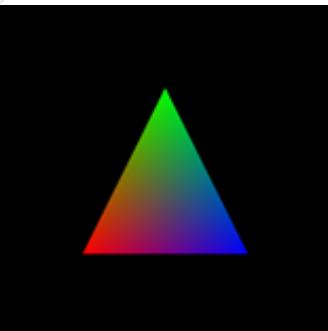
16x(4x4) Anti-aliasing could reach good Render Quality,
NO quality difference in vertical and horizontal direction

3D GPU DDR Less Solution Usage Scenario

	Standard GPU driver memory requirement						Heap memory
	Command Buffer	Window Buffer	Render target	Vertex array Texcoord Indices	texture mipmap	Total	
Tutorial1	128*4 KB	625 KB	784 KB	1 MB	/	2.88MB	9.26MB
Tutorial2	128*4 KB	625 KB	784 KB	1 MB	/	2.88MB	7.93MB
Tutorial3	128*4 KB	290 KB	256 KB	55 KB	2.02 MB	3.09MB	11.79MB
Tutorial4	128*4 KB	625 KB	784 KB	1MB	162.5 KB	3.03MB	8.08MB
Glite Driver Memory Requirement							
Tutorial1	32*2 KB	625 KB	0	128 KB	/	817 KB (2.06MB, 71.6%)	1.54 MB (7.73 MB, 83.5%)
Tutorial2	32*2 KB	625 KB	0	128 KB	/	817 KB (2.06MB, 71.6%)	201 KB (7.73 MB, 97.5%)
Tutorial3	32*2 KB	290 KB	0	55 KB	2.02 MB	2.41 MB (0.68 MB, 22.0%)	4.06 MB (7.73 MB, 65.6%)
Tutorial4	32*2 KB	625 KB	0	128 KB	162.5 KB	980 KB (2.06 MB, 66.7%)	359.14 KB (7.73 MB, 95.7%)



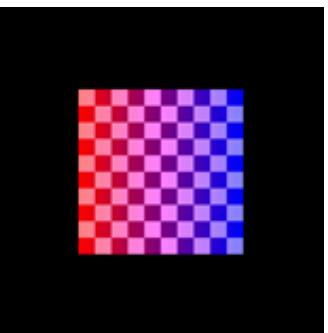
Tutorial1



Tutorial2



Tutorial3



Tutorial4

2.5D GPU Software Stack

VeriSilicon GCNano and GCNanoUltraV Software Overview



GUI Development ECO System

▲ Crank



▲ MicroEJ Studio

► <https://developer.microej.com/supported-hardware/nxp-imx-rt595/>

▲ Monotype

▲ Express Logic GUIX STUDIO

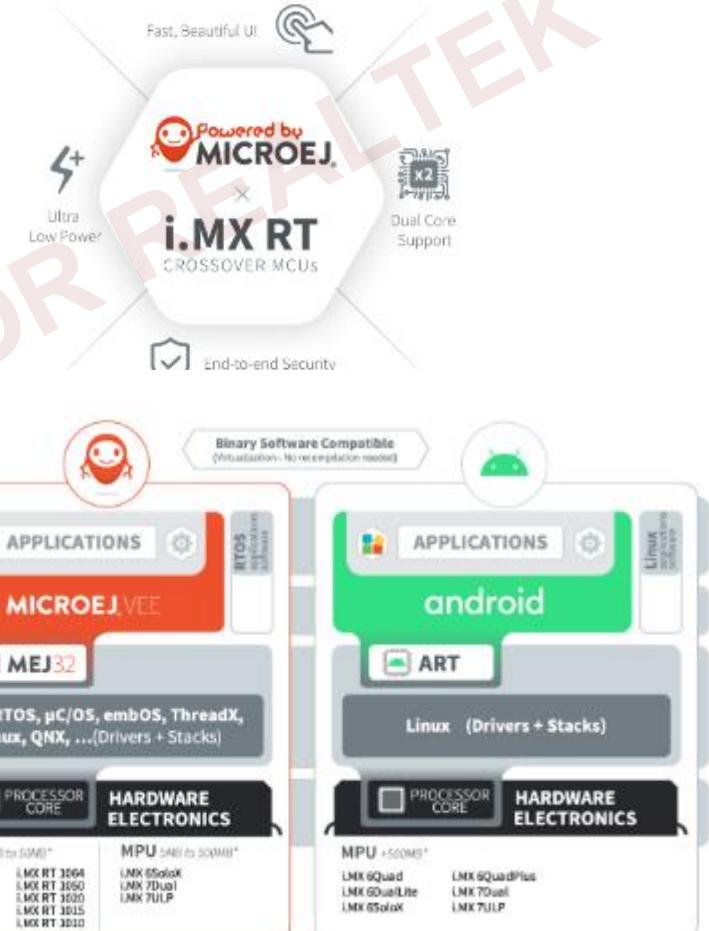
▲ Altia

▲ Korulab

► <https://www.korulab.com/product.html>

▲ Embedded Wizard

► <https://www.tara-systems.de/components/embedded-wizard/>

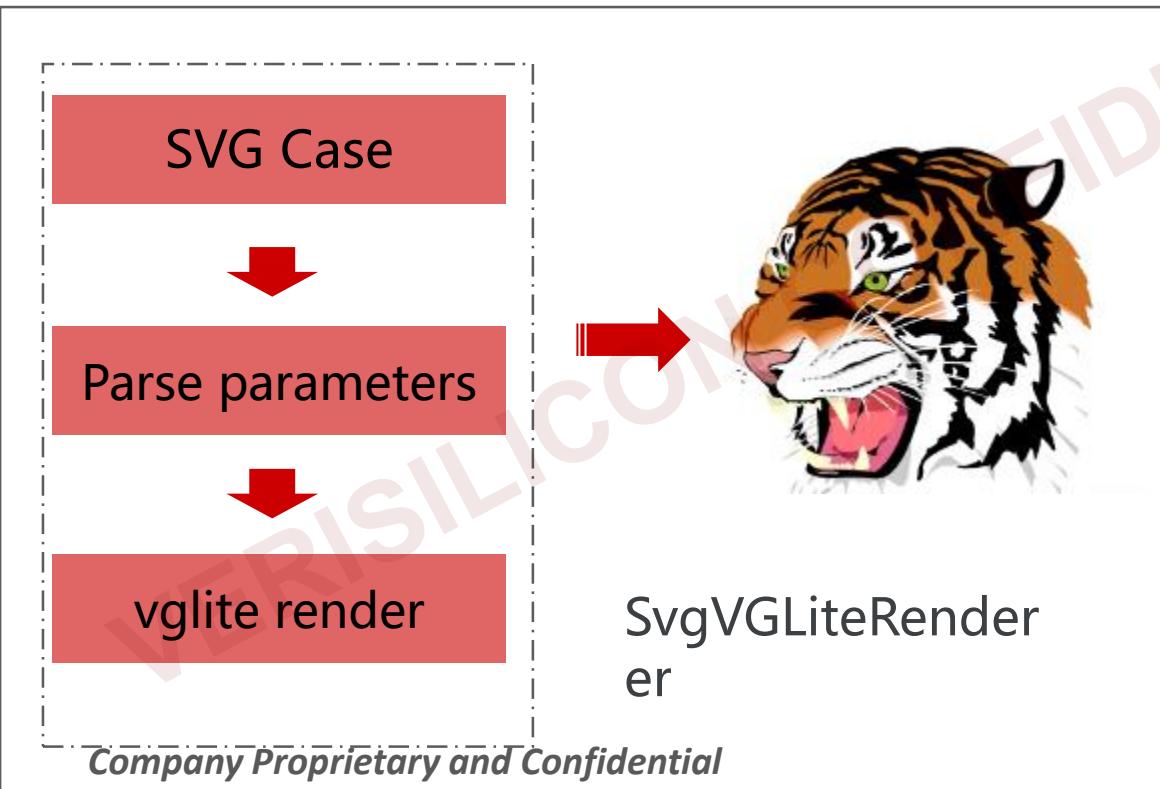


GUI Development ECO System - SVG

The SvgVGLiteRenderer tool can support the parsing of svg files and complete the call to the vglite driver based on the parsing results to achieve rendering acceleration. Use this tool to draw more beautiful pictures, small and efficient.

Industry Standards

Support SVG Tiny 1.2

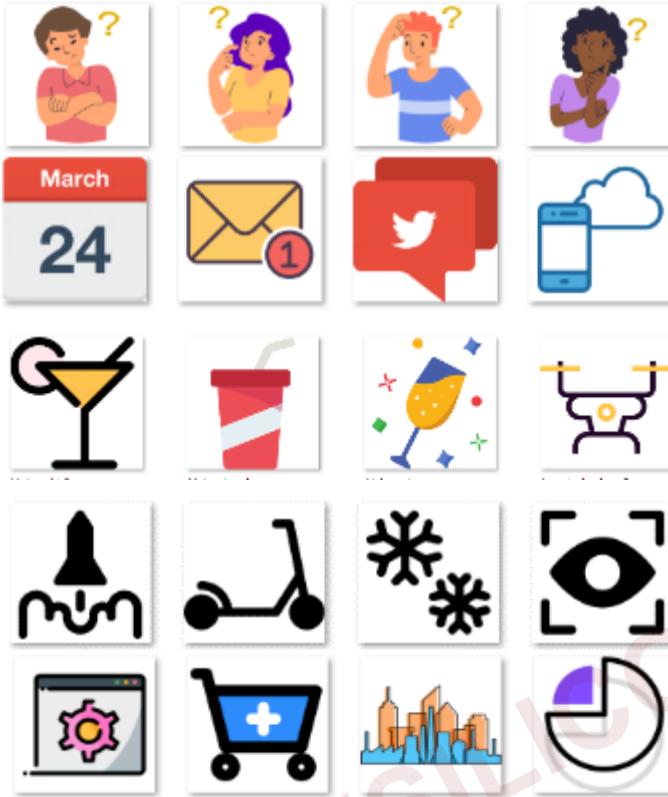


Specific Features

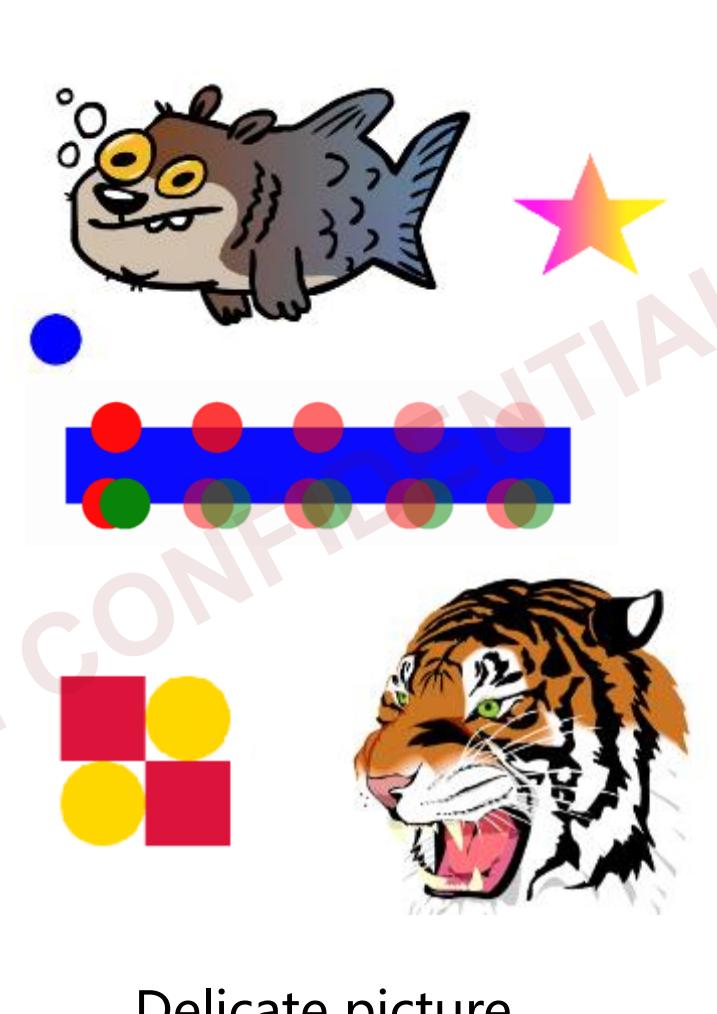
Basic shapes	Paths	Color
rect	moveto	lineargradient
circle	lineto	radialGradient
ellipse	closepath	stop
line	cubic Bézier	stroke/fill
polygon	quadric Bézier	

Document Structure	Others	Font
group	pattern	text
defs	styling	text (move to point)
use	transformation	
image	class	

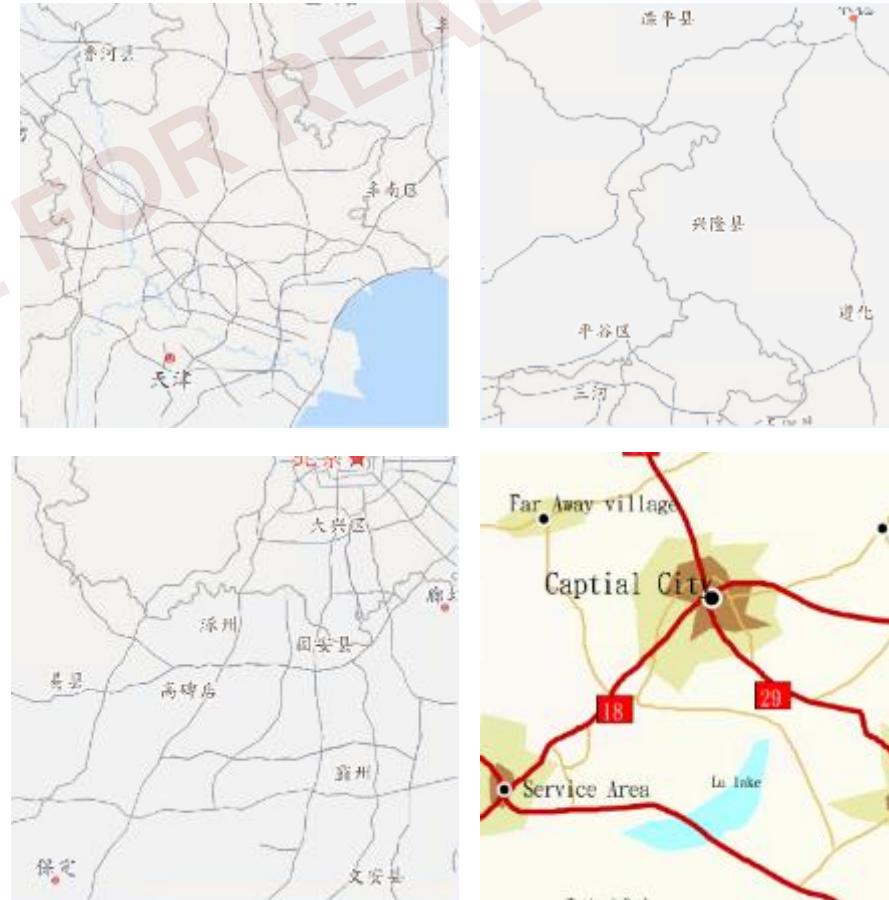
GUI Development ECO System – SVG Case



ICon



Delicate picture



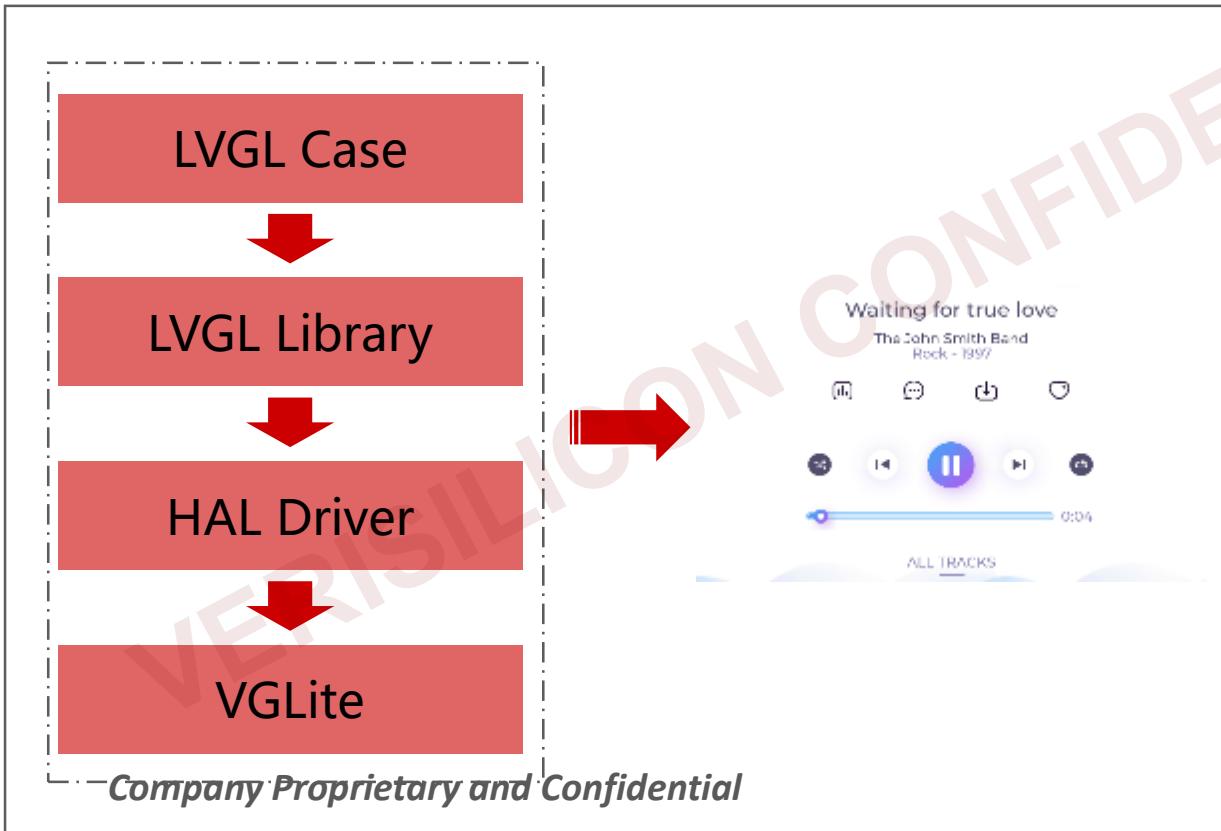
Map

GUI Development ECO System – LVGL

Our vglite currently supports accelerating part of LVGL features based on 8.3 version. After using vglite, rendering can be achieved more quickly. For drawing complex graphics, there is a significant improvement effect.

Industry Standards

Support LVGL 8.3

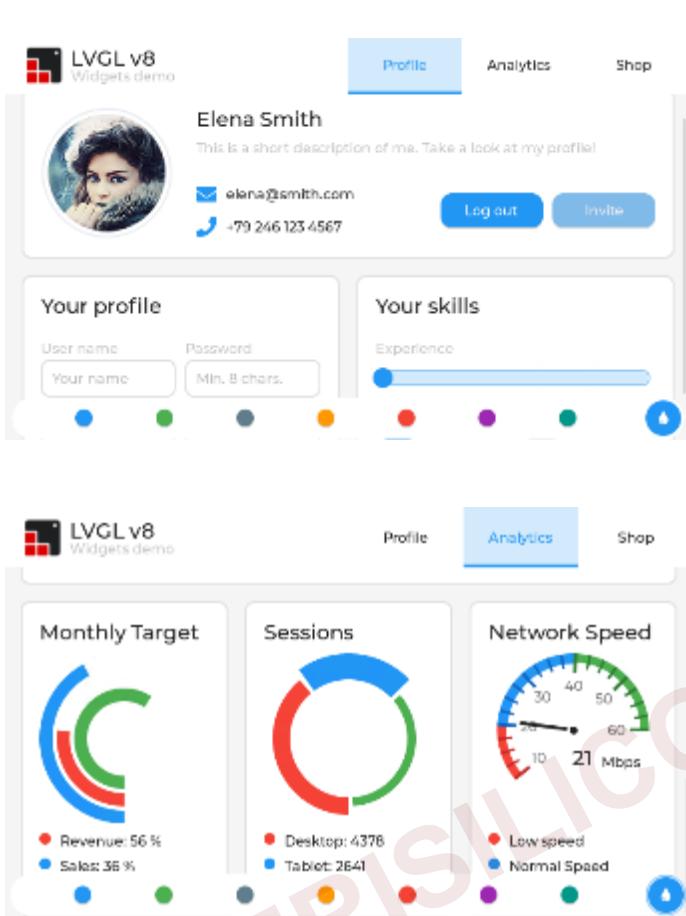


GPU HW Acceleration Features

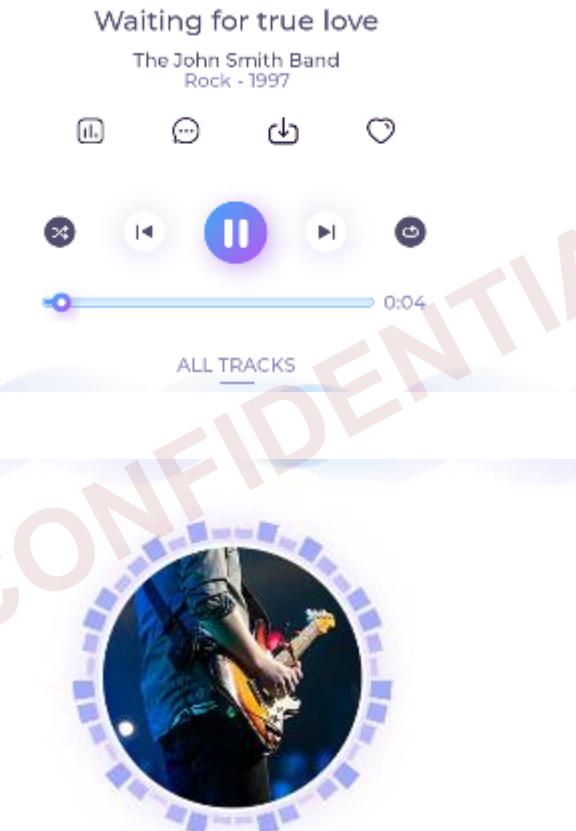
LVGL Features	VGLite Functions
arc	vg_lite_draw
rect	vg_lite_draw
	vg_lite_draw_gradient
decoded image	vg_lite.blit_rect
blend	vg_lite_clear
	vg_lite_draw
	vg_lite.blit_rect



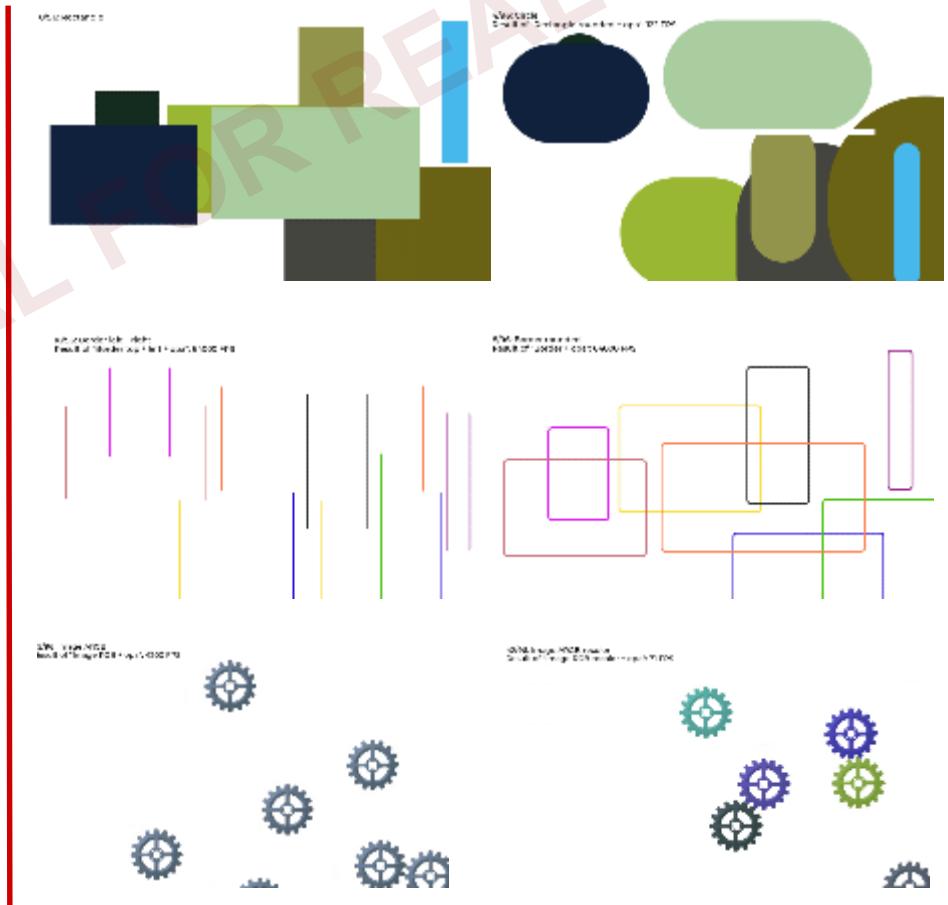
GUI Development ECO System – LVGL Cases



Demo Widgets



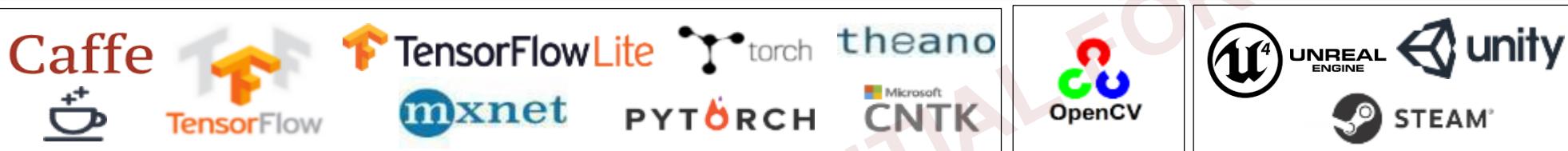
Demo Music



Demo Benchmark

3D GPU Software Stack

GCNanoVulkan Software Stack



Eclipse-Based GPU/VIP Software Development Kit (IDE)



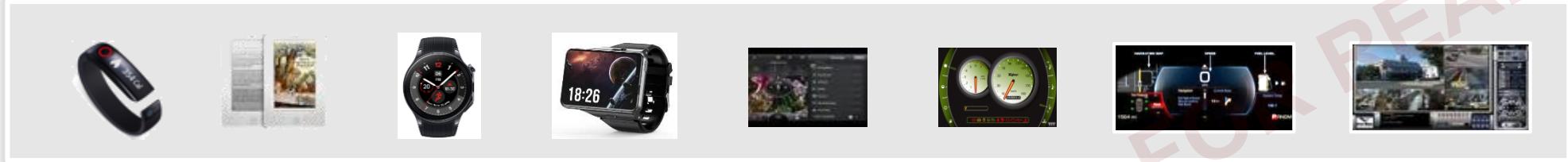
Vivante HAL
(Hardware Access Layer)



Unified Kernel Driver

(Support Android, Linux, Chrome OS, Harmony, etc.)

GCNano/GCNanoUltra Software Stack



EGL 1.4 API Driver 

GLLite OpenGL ES 2.0 API Driver 

(Support tailored ES 2.0 feature set with fixed ES11 gouraud shading ext)

GLSL vCompiler

(Generate VS/PS shader binary offline)

Lite HAL



GLLite Kernel

(Support Android, Linux, Harmony, FreeRTOS, Zephyr, other RTOS)

GCNano/GCNanoUltra GLLite OpenGL ES 2.0 Driver

- ▲ A memory efficient OpenGL ES 2.0 API driver implementation for DDR or DDR-less system.
- ▲ Support Linux, Harmony OS, FreeRTOS, Zephyr, and other RTOS.
- ▲ Support tailored ES 2.0 feature set for specific application to minimize memory consumption.
- ▲ Support three configurations for different systems:
 - 1) Complete OpenGL ES 2.0 API implementation with runtime GLSL compiler.
 - Support runtime GLSL compiler for application's VS/PS shader compilation.
 - Fully pass Khronos ES 2.0 Conformance Test Suite (CTS). Support Android Wear OS.
 - Driver library size: GLLite Driver (~500 KB) + GLSL Compiler (~1400 KB)
 - 2) Tailored OpenGL ES 2.0 API implementation without runtime GLSL compiler.
 - Input pre-compiled GLSL shader binary, which is generated by vCompiler from shader source offline.
 - Compressed texture, framebuffer object, query functions can be selectively disabled.
 - Driver library size: GLLite Driver (~400 KB)
 - 3) Tailored OpenGL ES 2.0 with GL_VIV_ES11_GouraudShading extension.
 - Support OpenGL ES 1.1 fixed gouraud shading mode. No need for GLSL shader binary/source from application.
 - Driver library size: GLLite Driver (~250 KB)



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