



GREENWAVES TECHNOLOGIES Announces Next Generation GAP9 Hearables Platform Using GLOBALFOUNDRIES 22FDX Solution

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GreenWaves' GAP9 hearables platform enables state-of-the-art features such as scene-aware active noise cancellation and neural network-based noise reduction with no compromise in area, cost or energy

Grenoble, France, and Dresden, Germany, October 15, 2020– GreenWaves Technologies today announced a next-generation hearables platform based on its GAP9 IoT application processor using GLOBALFOUNDRIES® (GF®) 22FDX® solution. The announcement was made at GF's annual Global Technology Conference (GTC).

Targeting the fast-growing hearables market, which is forecasted to be over one billion units in 20241, GAP9's unified and easy-to-program architecture enables state-of-the-art sound quality and user experience. It does this by significantly reducing the energy required for normal activities such as music playback, active noise cancellation and voice commands, and freeing up power to improve audio quality through neural network-based features including deep noise reduction and acoustic scene detection. It does this with no compromises in area, cost or energy versus competitor solutions.

GAP9 uses two innovative features of GF's 22FDX solution – adaptive body bias (ABB) and eMRAM. GAP9 uses ABB to narrow the sign-off window, which contributes significantly to its ultra-low power consumption. GAP9 processes neural networks with a power efficiency of 330µW/GOP, at the same time providing market-leading energy performance for low-power, low-latency digital signal processing (DSP) operations such as audio filtering.

"What is really exciting our GAP9 partners is the unprecedented room for innovation that we are offering them," said Loic Lietar, CEO of GreenWaves. "Processing a music stream with active noise cancellation consumes less than 10 percent of GAP9 resources, leaving plenty of headroom for dramatically improving the audio comfort or other new cutting-edge features, at the same time simplifying their development. GF's 22FDX platform, with its incredible performance, ultra-low power capability, low-leakage, and flexibility, was instrumental for enabling us to hit our performance targets."

In addition to ABB, GAP9 also takes advantage of 2MB of GF's advanced embedded non-volatile memory (eMRAM) feature of its 22FDX solution, which has allowed GreenWaves to reduce by 3.5 times the energy used for transfers of neural network parameters.

"What GreenWaves has accomplished with its new hearables platform based on the GAP9 application processor, by realizing significant efficiency gains and redirecting that windfall of power to support the architecture's innovative features that provide great sound for users, is incredible," said Mike Hogan, senior vice president and general manager of Automotive, Industrial and Multi-market at GF. "GreenWaves' achievement showcases, loud and clear, why GF's feature-rich 22FDX platform has become the solution of choice for innovative companies working at the forefront of IoT, hearables, wearables, and edge AI."

With its high performance, ultra-low power requirements, and broad integration capabilities, GF's industry-leading 22FDX platform has realized \$4.5 billion in design wins, with more than 350 million chips shipped to customers around the world. 22FDX solutions deliver the industry's lowest operating voltage, with the ability to operate at 0.4 volt ultralow power and at 1 pico amp per micron for ultralow standby leakage. 22FDX solutions are manufactured on GF's state-of-the-art 300mm production line at Fab 1 in Dresden, Germany.

GAP9's architecture combines an autonomous, intelligent peripheral controller and streamer capable of processing data on the fly, with a trans-precision compute cluster capable of energy scaled performance from a few MOPs up to 150 GOPs. The level of performance provided enables real-time, ultra-low power processing of state of the art recurrent and convolutional neural networks (NN). With GAP9, hearable and wearable products can now provide voice pickup features that were up to now only feasible in cloud-assisted applications.

The intelligent peripheral controller in GAP9 includes a revolutionary new building block for digital filtering: the smart filter unit (SFU). The SFU is an application specific stream processor designed to perfectly blend ultra-low latency, ultra-low power filtering with the flexibility of traditional cores. The SFU's data is streams, its instructions are filters and its program is a graph of filters. The SFU revolutionizes Audio Filter development for Active Noise Cancellation, Spatial Sound and other general music and voice stream filtering, blending microsecond latency with AI based filter adaptation at market leading energy levels.

The combination of the intelligent peripheral controller and streamer and the cluster delivers a single, unified architecture for control application, NN, DSP and filtering.

GAP9 simplifies hearables development through a homogeneous design, which provides DSP, Neural Network acceleration and ultra-low latency audio streams processing with a RISC-V based core architecture combined with a complete development flow for integrated neural network and audio filter design.

GreenWaves is partnering with leaders in the audio algorithmic and tools industry to offer our customers the state of the art in sound quality and user experience.

GAP9 is already enjoying strong customer traction and will be in volume production in Summer 2021.

¹ Strategy Analytics, MOBILE ACCESSORIES: Global Bluetooth Headset Sales Forecast to 2025, July 2020

About GreenWaves Technologies

GreenWaves Technologies, a fabless semiconductor company, designs disruptive ultra-low power embedded solutions for interpreting and transforming rich data sources such as images, sounds, radar signatures and vibrations using AI and signal processing in highly power-constrained devices such as hearables, wearables and IoT sensors. Founded in 2014, GreenWaves' mission is to revolutionize the market for next generation hearable devices and intelligent sensors. The company is headquartered in Grenoble, France. For more information, visit www.greenwaves-technologies.com.

About GF

GLOBALFOUNDRIES (GF) is the world's leading specialty foundry. GF delivers differentiated feature-rich solutions that enable its customers to develop innovative products for high-growth market segments. GF provides a broad range of platforms and features with a unique mix of design, development and fabrication services. With an at-scale manufacturing footprint spanning the U.S., Europe and Asia, GF has the flexibility and agility to meet the dynamic needs of customers across the globe. GF is owned by Mubadala Investment Company. For more information, visit www.globalfoundries.com.

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