Apollo Lake processors will be the heart of future embedded computers

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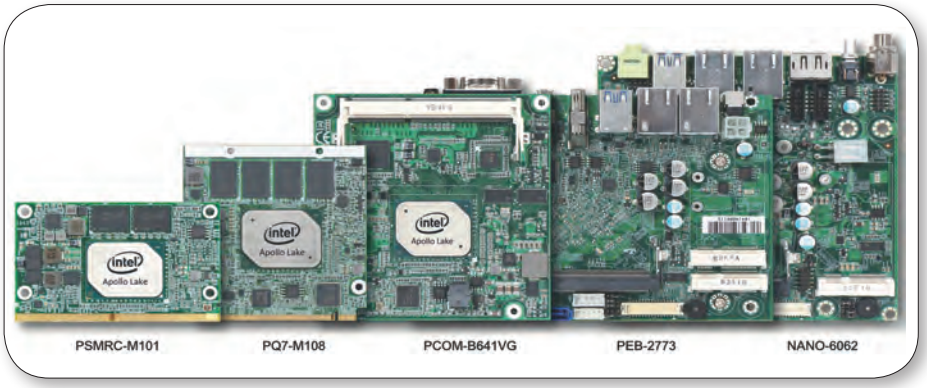
The embedded industry must wait for the latest Intel process generation - code name Apollo Lake – but has developed numerous boards and modules based on this CPU series. Examples of different standards and form factors from COM express to 3.5 inch document the versatility of the building block and the high interest of the market.



Based on the five Apollo Lake processors on the embedded roadmap, Portwell has already launched computer-on-modules and boards with these processors.

■ Almost 13 years ago Intel launched the Pentium M, and made the transition from the pure hunt for more performance by constantly raising the clock frequency, as in the days of the Pentium x processors, to the age of less power consumption. In 2006 the Tick-Tock model was announced, with its continuous improvement of production technology with a reduced nm process – Tick and Tock standing for new micro architecture. At that time some may have asked themselves, when will Intel hit the physical limits? The answer is in ten years. With the fourth generation of the Core i processors it has happened, and instead of a Tick, a so-called refresh is established. Refresh stands for everything (production technology and micro architecture) staying the same, but the processor getting improved internally, making performance increase possible. Intel's new development process is called PAO: Process – Architecture – Optimization.

■ For the Atom processor series, the old Tick–Tock model is still in place. The last step, a Tock-generated Apollo Lake, is the latest in the successful Atom story. Time will show when the PAO development model will reach Atom processors as well. But for the moment, the market is watching what boards and modules based on Apollo Lake processors will come. The tapered edges of the metal cap and the metal cap itself are a hallmark for the Intel Apollo Lake processor – but in everyday life it will disappear under the heat sink. Offering a broader contact space for cooling solutions is one feature that will help embedded vendors to design more compact systems with even more processing power. This is the superficial improvement, but what improvements have been made inside the processor? The newcomers are manufactured in 14nm technology and provide approximately 30 percent better computing and 45 percent more graphics/video performance than their predecessors. The power consumption remains relatively low at 6 to 12W TDP and stays at the level of the former generation.

The new silicon features Intel Gen 9 graphics, which in the past was reserved for the sixth-generation Core processors only. This gives the new CPU series a significantly improved support for 4k graphics resolution. Up to three independent displays can be operated simultaneously, and DirectX 1.2, OpenCL 2.0 and OpenGL 4.2 are supported. The integrated security engine provides better security while the optional Error Correcting Code (ECC) preserves data integrity. The protection capabilities in the new processors have been built from the ground up to ensure a new level of security. Each time the system starts up secure boot with Intel Platform Trust Technology helps to keep the device safe, blocking dangerous programs, so only trusted software is launched. All this works behind the scenes of the new processor but delivers more power and advanced cooling to applications.

There is just one weakness with the new Apollo Lakes: not all five types on the embedded roadmap are available in quantities right now. The embedded world must still wait for the Atom x5 and Atom x7 versions. For this reason, most versions of the already designed boards and modules are delayed until Intel starts to supply the new Atom version. Based on these five processors on the embedded roadmap, embedded vendors have already launched computer-on-modules and boards based on these processors. As in the past, the Atom processors are mainly designed on small form factors or one with limited power envelope. Two Apollo Lake based modules and two boards will be taken as example to showcase the variety of products the Apollo Lake potentially offers.

The ultra-low-power Intel Atom processor E3900 family as the engine of a COMe basic module allows to make a design that brings COM units with a power consumption under 6W~12W which is a perfect fit for fanless applications. This also allows supporting a wide -40°C to 85°C industrial grade temperature range. On the memory

Product Name	Atom™ x5-E3930	Atom™ x5-E3940	Atom™ x7-E3950	Celeron® N3350	Pentium® N4200
Cores/Threads	2	4	4	2	4
Base/Burst Frequency	1.3/1.8 GHz	1.6/1.8 GHz	1.6/2.0 GHz	1.1/2.4 GHz	1.1/2.5 GHz
TDP	6.5 W	9.5 W	12 W	6 W	6 W
Max Memory	8 GB	8 GB	8 GB	8 GB	8 GB
Memory Types	DDR3L up to 1866 MT/s; LPDD R4 up to 2133 MT/s	DDR3L up to 1866 MT/s; LPD DR4 up to 2133 MT/s	DDR3L up to 1866MT/s; L PDDR4 up to 2400 MT/s	DDR3L/LPDDR3 up to 1866 MT/s; LPDDR4 up to 2400 MT/s	DDR3L/LPDDR3 up to 1866 MT/s; LPDDR4 up to 2400 MT/s
Max Memory Channels	4	4	4	2	2
ECC Supported	Yes	Yes	Yes	No	No
Graphics ‡	Intel® HD Graphics 500	Intel® HD Graphics 500	Intel® HD Graphics 505	Intel® HD Graphics 500	Intel® HD Graphics 505

Apollo Lake processors on the Intel Embedded Roadmap

side 32GB DDR3L 1600/1866 MT/s SDRAM on two 204-pin SODIMM sockets makes it faster than Baytrail or Braswell-based modules. Expansion interfaces support four PCI Express x1 Gen2 (5.0GT/s) (maximum) for enhanced video performance and offer the flexibility to configure to two x2 lanes or one x4 lane. In addition, three high-resolution display interfaces are supported: DP (DisplayPort) or HDMI, VGA and LVDS with double 3D performance compared to the previous generation. The whole package provides a more powerful solution for targeting IoT and Industry 4.0 applications.

Designed according to the latest improved and particularly rich feature set on SGeT SMARC 2.0 specification, SMARC 2.0-based modules are capable of offering protection against unauthorized re-use or re-provisioning of original parts. Modules like this can be equipped with 2x USB 3.0, 6x USB 2.0 (1x OTG), 1x SDIO3.0, 1x SATA 3, and up to 4x PCIe Gen2 lanes. Also onboard are 5x I2C, 2x SPI, 4x UART, 12x GPIO, and HD audio featuring an integrated audio DSP with Intel Smart Sound Technology. The modules can handle industrial -40 to +85°C temperatures.

The NANO-ITX form factor is quite famous in the embedded market because of its great balance of small size and reasonable connectivity set. Equipped with the Apollo Lake such boards are able to operate with a thermal design power (TDP) under 12W for fanless applications and also support a wide industrial temperature range from -40°C to 85°C and a wide voltage range of power input from 12V to 24V for rugged applications. The flat/low-profile design - measuring 16.4mm in height with I/O shield - allows space-saving installation in display and panel PCs, making the realization of digital signage and control solutions for industry and business applications a quick and easy task. In addition, they support up to 4096x2160 pixels with DisplayPort, 1920x1200 pixels with VGA, and dual channel LVDS up to 1920x1200 pixels, and are designed with the flexibility for connecting to three independent display interfaces. Support for four USB 3.0 ports ensures fast data transmission with low-power consumption. One 5 Gb/s PCI Express 2.0 lane can be used as 1x full-size mini-PCIe. Two SATA 3.0 interfaces with up to 6 Gb/s (one of them available as mSATA and the other for SATA) allow quick and flexible system expansions. The Intel I210-IT Gigabit Ethernet controllers provide dual Gigabit Ethernet LAN access via the two RJ45 ports. A significant benefit of using NANO-ITX is that customers can design their own unique systems for medical, networking, Panel PC, kiosk and digital signage applications based on it.

A 3.5' SBC equipped with the Apollo Lake processor really takes advantage from its processor power and feature set. On the graphic side, it supports one dual-channel 24-bit LVDS connection, one DisplayPort (DP) and HDMI on rear I/O with resolution up to 4096x2160. The 204-pin non-ECC SODIMM provides maximum memory, making it capable of supporting up to 8GB of DDR3L. It can support a total of six COM ports, six USB 3.0 ports and dual Gigabit Ethernet. The thermal design power (TDP) under 12W allows fanless

applications. The board also supports a wide industrial temperature range from -40°C to 85°C and a wide voltage range of power inputs from 12V to 24V for rugged applications. Two 5Gbit/s PCI Express 2.0 lanes can be for use as 1x full-size Mini-PCIe (supporting mSATA) and 1x half-size Mini-PCIe socket. It also supports one SATA 3.0 interface with up to 6 Gb/s to allow quick and flexible system expansions. The Intel Ethernet Controller I210-IT provides dual Gigabit Ethernet LAN access via the two RJ45 ports. Such a board fits into a variety of market segments and applications such as retail, networking, Panel PC, industrial automation and digital security surveillance. The embedded community will continue to extend the portfolio on board level form factors equipped with the Apollo Lake processor family. And soon we'll see the first Box PCs and Panel PCs based on Apollo Lake as well. ■