Longhorn Platform

Why did Ampro create the Longhorn Platform?

The embedded systems market continues its migration toward higher and higher performance single board computers. While the few applications that demand high-end graphics, high-speed I/O, and network bandwidth are leading the charge, many system OEMs and integrators choose these solutions based on the belief that the newest processors will be around the longest. However, the CPUs initially offered for embedded applications are often marginally useful high power dissipation processors that create boards with power demands over 20 Watts. These boards are notoriously difficult to cool.

Ampro has created the Longhorn Platform to offer a low power consumption solution to those application developers and OEMs who need higher CPU and system performance but can't tolerate unreliable cooling fans or require extended operating temperatures.

What are the goals and objectives of the Longhorn Platform?

1. To create a baseline for a family of ultra high performance single board computers offering reliable performance without the burden of a cooling fan and offering the option of extended operating temperature range
2. To carefully select processors with acceptable thermal characteristics for a broad base of embedded applications, and
3. To enable architectural re-use to allow rapid deployment of the platform across the most popular embedded form factors with support for leading operating systems.

What are the key elements of the Longhorn Platform?

The key elements consist of the processor and key support chips. Ampro selected the low voltage and ultra low voltage versions of the Intel® Pentium® M processor family with Intel's 855GME chipset. The chipset features high performance AGP 128-bit 3D integrated video, appropriate for nearly all embedded applications, along with support for DDR memory up to PC2700 (DDR333) speed. Not only is DDR (Double Data Rate) memory less expensive than SDR memory due to the huge volumes created by the desktop and notebook PC markets, but the product longevity is expected to be longer. DDR memory is available with greater capacities (1GB) is readily available in both DIMM and SODIMM formats. PCI bus and ISA bus expansion are part of the architecture enabling the use of hundreds of commercially available PC/104-Plus and PC/104 modules. High-speed USB 2.0 and Gigabit Ethernet round out the Longhorn Platform, while General Software BIOS with Ampro BIOS extensions ensures that Longhorn-based SBCs are of rugged or embedded quality rather than desktop quality.

What criteria does Ampro use to select processors?

Embedded developers need highly-reliable, high-uptime systems. Consequently, Ampro does not select processors that require a fan or heat pipe to operate at the standard operating temperature ranges. It is well known that cooling fans are among the most unreliable parts of an advanced computing system. Cooling fans shorten MTBF of the system and greatly increase the likelihood of a service call on the end equipment during its first few years of operation. In addition, Ampro believes that the cost of designing and deploying heat pipes goes beyond most system companies' expertise and budgets. Hence, Ampro has selected the subset of Intel Embedded Roadmap processors that can be cooled using Ampro's state-of-the-art passive techniques, without active cooling. Intel designates these processors "LV" (Low Voltage) or "ULV" (Ultra Low Voltage).

What processors are included in the Longhorn Platform?

Ampro is using the Intel LV 1.4GHz Pentium M 738 (Dothan core), the 1.0GHz ULV Celeron M 373 (Dothan core) and the 600MHz ULV Celeron M (Banias core) in the Longhorn Platform.

Don't all SBCs offer the option of Low Voltage or Ultra Low Voltage CPUs?

No. Many SBC manufacturers have decided to offer their boards with a Socket 478 CPU socket. While this allows the developer to select from several available Pentium M and Celeron M CPUs, none of the CPUs available in the Socket 478 package are available with Low Voltage or

Processor	CPU Clock	L2 Cache	Vcore	Power Rating	Low Power?
ULV Celeron M 373	1.0 GHz	512 KB	0.940 V	5 W	yes
ULV Celeron M	600 MHz	512 KB	1.004 V	7 W	yes
LV Pentium M 738	1.4 GHz	2 MB	1.110 V	10 W	yes
Celeron M	1.5 GHz	1 MB	1.260 V	21 W	no
Pentium M 745	1.8 GHz	2 MB	1.340 V	21 W	no
Celeron M 320	1.3 GHz	512 KB	1.356 V	24.5 W	no
Pentium M	1.6 GHz	1 MB	1.484 V	24.5 W	no

Source: Intel Corporation

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Ultra Low Voltage technology. The lowest TDP thermal rating of these CPUs is 21 watts, while none of the Low Voltage or Ultra Low Voltage CPUs exceeds a thermal rating of 12 watts.

What form factors does the Longhorn Platform support?

EBX, PC/104, ETX, Mini-ITX and the new EPIC industry standard all support the Longhorn Platform. The corresponding Ampro products are LittleBoard™ 800, CoreModule™ 800, Ampro ETX 800, MightyBoard™ 800, and ReadyBoard™ 800.

Which operating systems are supported?

Windows® XP, Windows XP Embedded, Windows® CE, Linux®, QNX®, and VxWorks® are all supported on the Longhorn Platform. Ampro distinguishes itself from other SBC vendors by developing and supporting board support packages (BSPs) for Windows CE, QNX, and VxWorks. This way, there is only one company to call for questions about how drivers work on the SBC. For Linux, Ampro provides a complete free distribution and SDK. For all of these operating systems except Windows XP, Ampro offers its Custom OS SolutionsSM program to configure the OS to your specifications.

How can I use PC/104 modules, now that new chipsets no longer support the ISA bus?

All Pentium M chipsets use the LPC (Low Pin Count) bus instead of ISA now. LPC was designed to provide key elements of ISA for a desktop or notebook system such as support for the BIOS flash memory device and a super IO chip to add keyboard and mouse support, serial ports and parallel ports. A key architectural element of the Longhorn Platform is the addition of a PCI-to-ISA bridge. This is implemented directly on the LittleBoard 800, and is included in Ampro's optional MiniModule™ ISA PC/104-Plus module for ReadyBoard 800 and CoreModule 800. By making this an optional module, applications that don't require ISA support do not incur the cost or other system overhead. MiniModule ISA is priced under $50 in moderate quantities.

Why not use an LPC-to-ISA bridge instead?

The LPC approach is inferior, imposing restrictions that will prevent many of the hundreds of available PC/104 (ISA) modules from operating. Only 8-bit I/O and memory cycles are supported. Worse yet, the address range available for the ISA bus is quite limited so PC/104 modules that use addresses outside of a fixed range will not work. Ampro's Longhorn Platform not only supports the full 24-bit ISA address range, but also performs 8-bit and 16-bit memory and I/O bus transactions, along with encoding all ISA IRQs and providing seven software-transparent DMA channels. The LPC interface was never intended to support ISA expansion for embedded applications, according to Intel's LPC Specification:

1.1 Goals of the LPC Interface (I/F)

- Enable a system without an ISA or X-bus.
- Intended for use by devices down on a motherboard only (i.e. no connector).
- Support desktop and mobile implementations.

1.2 Assumptions and Functionality Requirements

- Only the following class of devices may be connected to the LPC interface:
  - Super I/O (FDC, SP, PP, IR, KBC) ➔ I/O slave, DMA, Bus Master (for IR, PP)
  - Audio, including AC'97 style design ➔ I/O slave, DMA, Bus Master
  - Generic Application Memory, including BIOS ➔ Memory Slave
  - BIOS Firmware Memory ➔ Firmware Memory Slave
  - Embedded Controller ➔ I/O slave, Bus Master.

Source: Intel LPC Specification, http://www.intel.com/design/chipsets/industry/25128901.pdf

What's PCI-104?

PCI-104 is a new specification released in early 2004 by the PC/104 Consortium. PC/104 bus originally consisted of a single 104-pin connector that implemented all the signals of the ISA bus. In 1997, PC/104-Plus was introduced which added a 120-pin connector that offered the signals of the PCI bus. A PC/104-Plus card provides both connectors, and hence both ISA and PCI bus signals, analogous to many of the PC systems offered through the mid to late 90s. However, the PC/104-Plus specification did not provide for the case where a card might not include ISA support — the case where PCI is the only bus available on the card. This is, in fact, the way most PCs have been built over the past few years. The PCI-104 Specification remedied that oversight by creating a specification for a card with only a single 120-pin connector carrying the PCI bus. While the Little Board 800 provides PC/104-Plus support, offering both the ISA and PCI bus to expansion IO cards, the CoreModule 800 and ReadyBoard 800 provide PCI-104 support and obtain ISA compatibility through the MiniModule ISA card referenced earlier which bridges from PCI-104 to PC/104-Plus.

Which network functions are supported on the Longhorn Platform?

The Longhorn Platform features one 10/100BaseT port and one Gigabit Ethernet port (except ETX module) for high speed networking, and four USB 2.0 interfaces that allows high speed peripheral connections and system extensions. Longhorn products come with Ampro's embedded BIOS which supports LAN Boot function. LAN Boot allows Ampro ETX 800, MightyBoard 800, ReadyBoard 800, LittleBoard 800, and CoreModule 800 to boot an operating system over a network using the leading network protocols such as PXE, RPL, NetWare, DHCP and BOOTP.

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