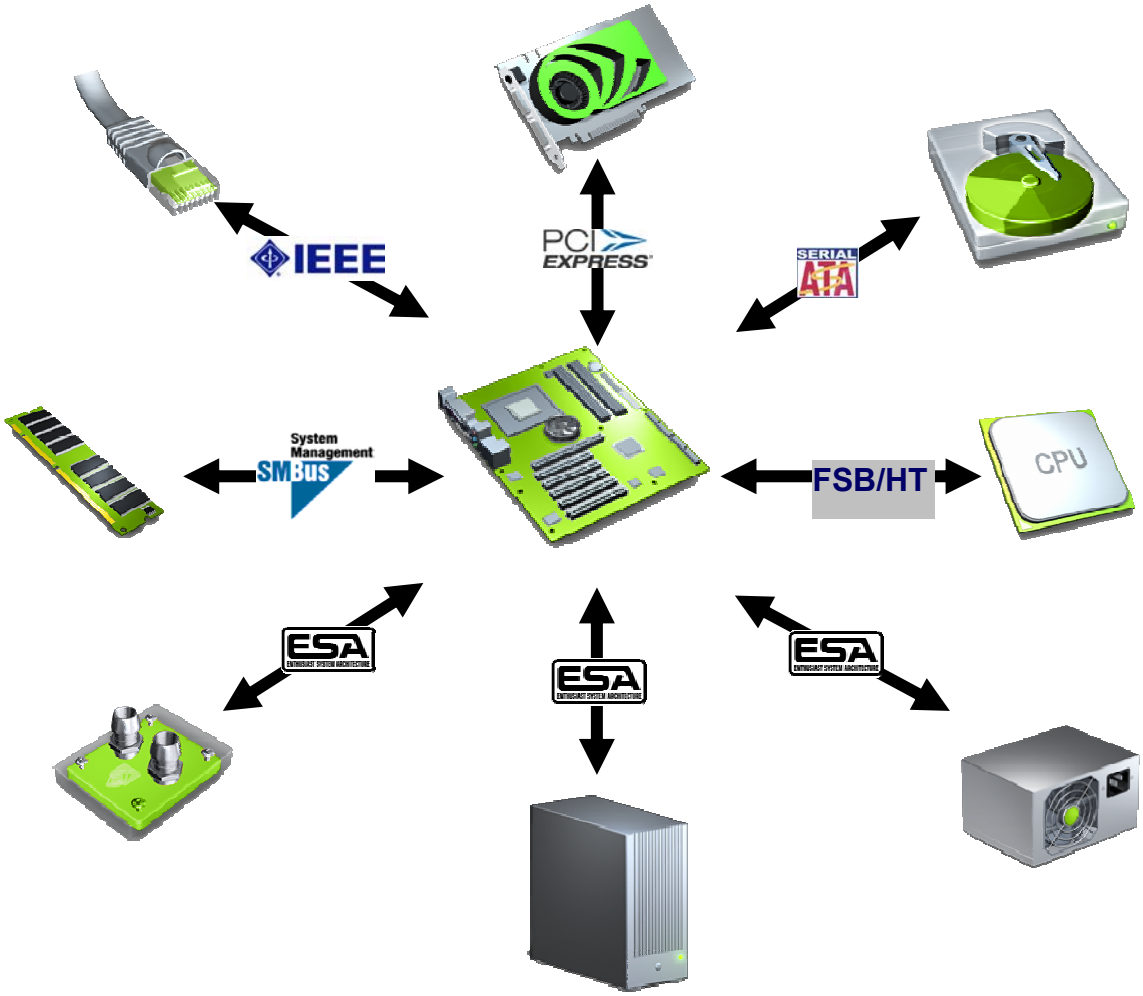
Unrivaled System Communication and Management with ESA Components

PC enthusiasts have traditionally been burdened with the task of achieving the maximum performance and functionality from components while having only a bare minimum amount of information at their fingertips. Specific customizations and optimizations are typically a trial by error process which often requires restarting the system and entering the BIOS after each alteration. This procedure can take a considerable amount of time as the user experiments with which settings work and which settings result in issues with stability and noise. ESA (Enthusiast System Architecture) is a new open industry standard that enables certified PC components (chassis, power supplies, and water cooling systems) to communicate status and control in real-time.

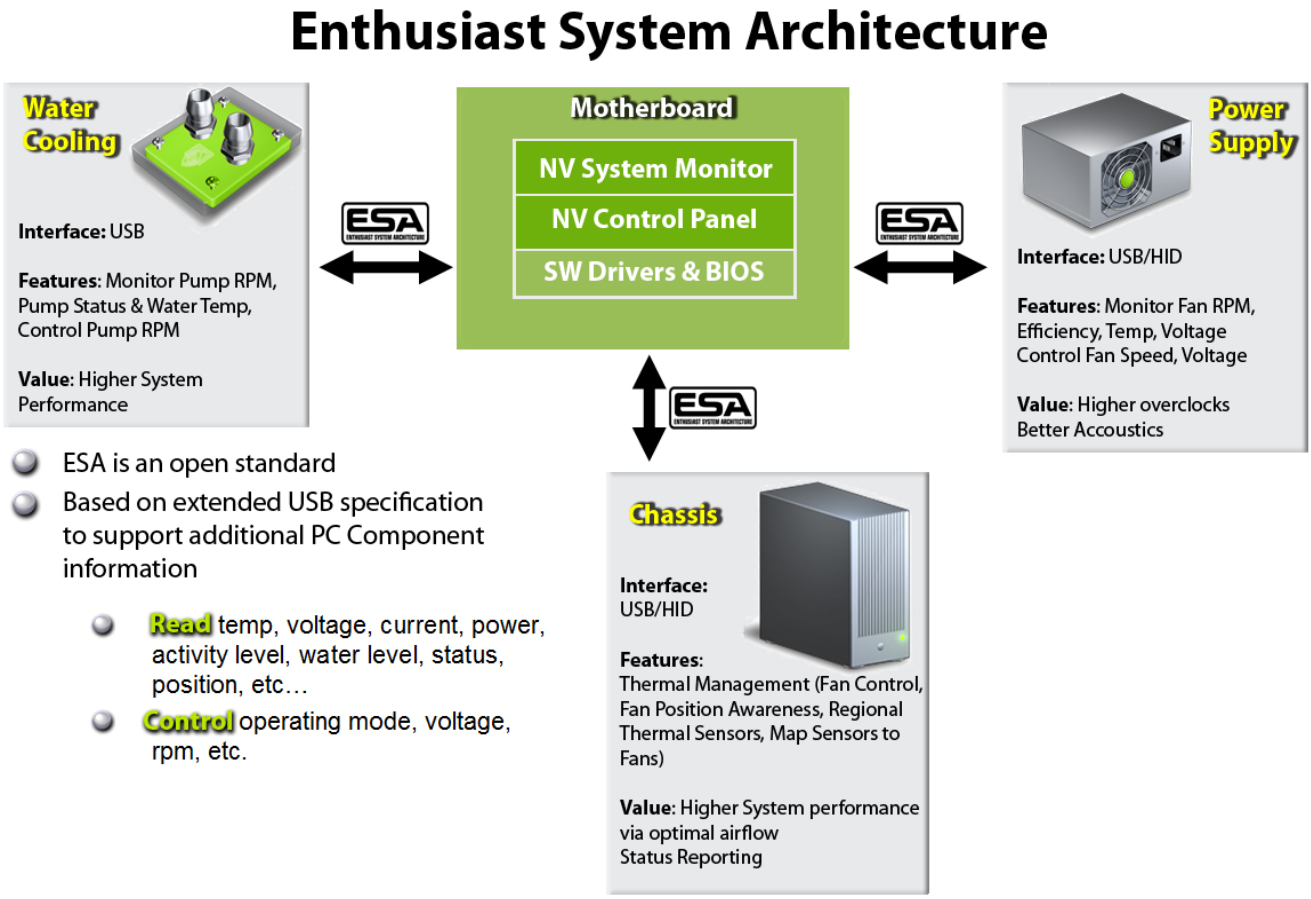
ESA-compliant applications provide enthusiasts with unprecedented software control to achieve better performance and optimal thermal and acoustic operating environments. In addition, ESA incorporates a comprehensive certification and branding program for ensuring the highest levels of component compatibility and strengthen consumer awareness.

The ESA Ecosystem



Unlike the conventional tangled web of proprietary hardware and software which offer dramatically different levels of quality and functionality to the table, ESA consolidates a wealth of information and makes it readily accessible throughout the entire component ecosystem. With a robust collection of real-time data available, on-the-fly adjustment can be made to a wide variety of settings to minimize noise, increase stability, and maximize performance.

ESA is built around the widely adopted USB specification. Here, ESA defines new USB HID usages for monitoring and controlling ESA devices. This communication is enabled by embedding a microcontroller (containing a USB 2.0-compliant full speed device controller) into the ESA enabled component, and then connecting it through a USB cable to the PC Host. This cabling is typically accomplished internal to the PC chassis using a USB header on the motherboard, but an external USB connection is also supported. Once recognized by the host application, the ESA device can be monitored and controlled via the ESA protocol.



Initially ESA components will be comprised of chassis, power supplies, and water cooling components. Thanks to ESA's unique and flexible architecture, these components will be able to provide a wide array of information to the user. Here, data ranging from temperatures, fan speeds, and voltages will be relayed real-time to the user giving them the most current system status possible. Specifically, the reported data points for the appropriate hardware are listed below:

Application Benefits

ESA delivers multiple advantages to enthusiast users based on the specific component enabled. Some examples are detailed below

- **Power supply**

An ESA enabled power supply will take advantage of the new control plane to:

1. Adjust delivered power based on host specified operating point. This will allow for quieter operation when max power output is not demanded
2. Adjust voltage levels of output. Useful to fine tune overclocking boards with limited regulation capabilities

3. Report power supply operating conditions and status. Useful to determine how close to rated maximums the power supply is operating. Also runtime voltage drop can be observed to understand system stability issues.
4. Ability to report internal temperature which is an important factor to power supply stability and performance. This ultimately has an impact on overall system performance and operation.

- **Water Cooling**

An ESA enabled water cooled device will take advantage of the new control plane to:

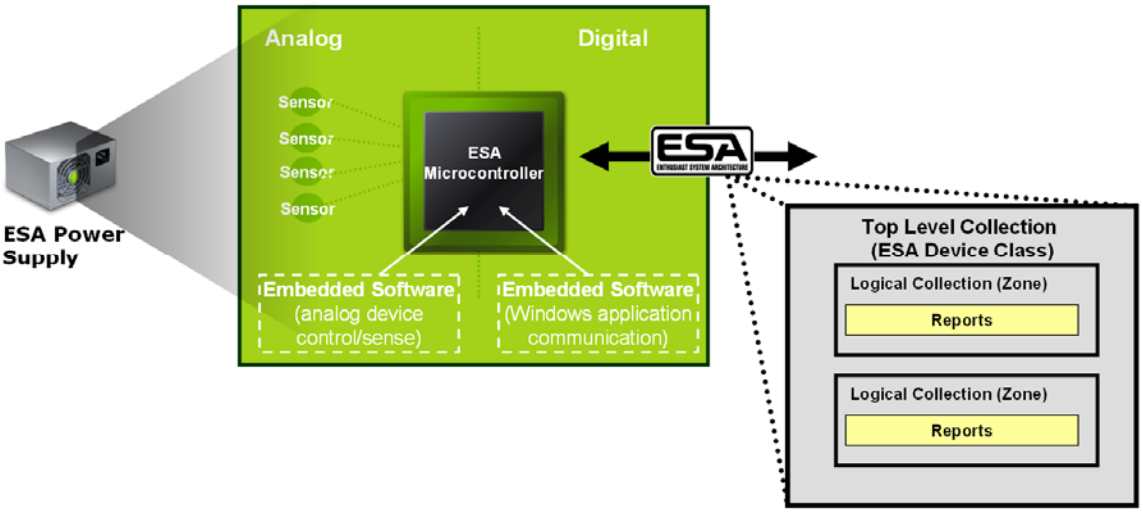
1. Adjust pump speed based on system monitored device temperatures (CPU, GPU, MCP, other)
2. Adjust fan speeds based on monitored device temperatures
3. Report flow rates, water levels and temperatures to give early warnings of leaks or thermal problems.

- **Chassis**

An ESA enabled chassis will take advantage of the new control plane to:

1. Manipulate LEDs and LCDs to reflect system status
2. Communicate fan and thermal sensor status for devices controlled by the chassis. This includes 3D positions of thermal and acoustic zones within the chassis using three dimensions of position data.

ESA Architecture Details

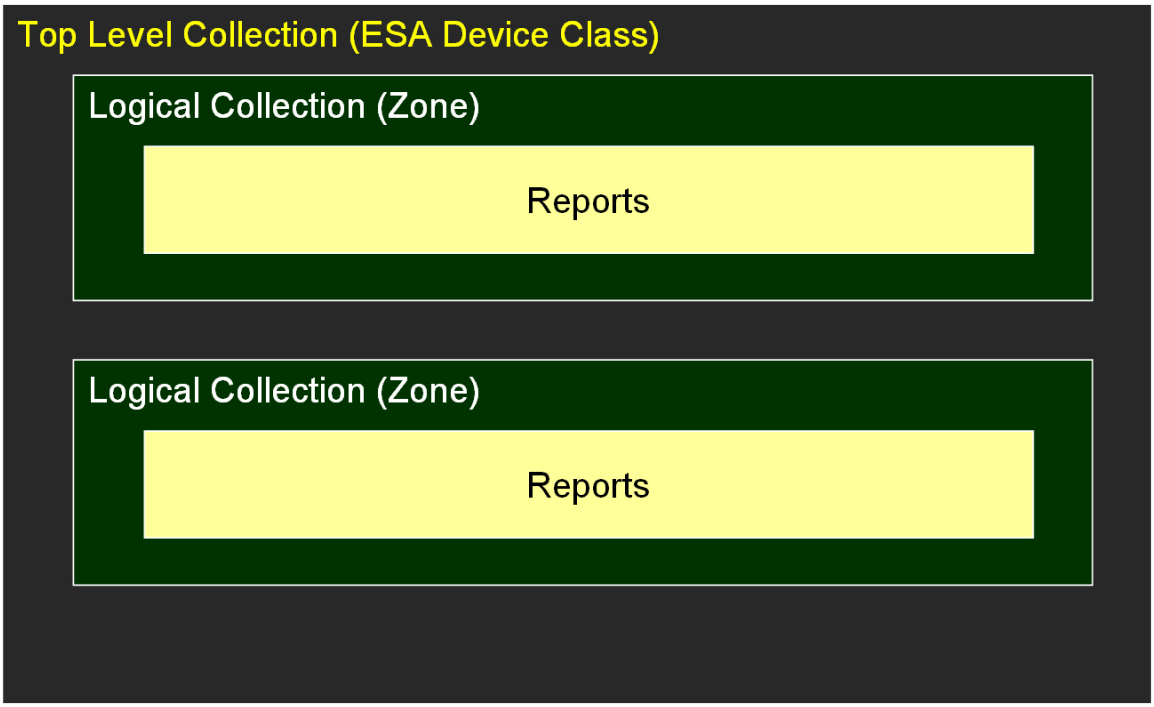


The ESA architecture is designed to facilitate a well-defined protocol for communicating information about sensors and controls within an ESA device. This communication is enabled by embedding a microcontroller into the enabled components. The microcontroller integrates a USB 2.0-compliant full speed device controller which is used as the primary communication channel between the PC

motherboard and the ESA enabled component. The microcontroller is effectively a single chip implementation of the digital control portion of ESA.

Elements act as the building blocks of the ESA architecture. An Element is the USB HID structure that describes control/sense circuits and devices attached to the microcontroller.

- Elements have the following properties:
  - String description
  - Range of operation (maximum, minimum, warning points)
  - XYZ position – most applicable to chassis
  - Spatial zone (describes positional relations with devices within a PC component or within devices of different PC components)
  - Color (Red/Green/Blue) – most applicable to LEDs
  - Status (functional, full/empty, etc)



With regards to ESA, hardware components are seen as unique "Collections". For a given system, there can be multiple collections comprised of various supported hardware.

- Collections have the following properties:
  - Top Level Collections describe the general features of the device (i.e., Water Cooler, Chassis, Power Supply)
  - A physical device can expose more than one top level collection
  - A top level collection has one or more child collections that represent zones of sensors and controls
  - A top level collection can have a string descriptor to provide a plug and play friendly name for the device

Within a collection, there are more granular segments referred to as "zones".

- Zones have the following properties:

- Sensors and controls are organized into zones
- From a HID perspective this is implemented as child collections within a top level collection
- Multiple zones are permitted, but not required
- Multiple zones make sense for chassis to describe various parts of the physical enclosure
    - Front of case
    - HDD Bay
- Report ID's (optional in HID specification) are always used

Comprehensive Industry Support

Thanks to the innovation and control ESA provided to the end-user, NVIDIA has been able to gather comprehensive support for the new standard from the industry's leading enthusiast system and component vendors. Since USB acts as the core interface and is already extremely well supported, designs remain simple and effective. In addition, NVIDIA offers vendors reference firmware to dramatically reduce the development cycle and bring products to market faster than ever before. Since NVIDIA offers this reference firmware free-of-charge, even smaller component vendors can offer ESA-certified components. From its inception, ESA has already been validated with products offered by leading enthusiast hardware vendors and the list of supporting partners continues to grow.