

PRODUCT BACKGROUNDERS

EMBEDDED SERVERS

WHEN IS A SERVER NOT A SERVER? A server...is a server...is a server. Or so it might seem to the casual observer. The worldwide market for servers is very large (estimated to be on the order of \$50 billion) and there are scores of manufacturers. Most of the products look pretty similar. They are generally sheet metal boxes designed to mount in a 19 inch rack, between one and four "rack units" (one rack-unit = 1.5 inches) in height and about 26 inches deep. Inside, you will typically find between one and four "x86" processors, up to 6 disk drives and a few slots to install I/O cards. Most of these general purpose or "white box" servers are designed to become part of a "server farm" and collectively, they provide most of the processing power for the world-wide-web and corporate data centers.

Within the broad universe of servers, there are some products that are specialized to meet the needs of specific applications. One example is *embedded servers*. Embedded servers are processing platforms designed to be the 'brains' of a larger integrated system. Examples of systems that incorporate embedded servers include: medical imaging systems, high performance test and measurement instruments, automated industrial equipment, telecommunications "appliances," military imaging and signal processing systems, casino gaming machines and many others.

THE DESIGN CHALLENGES One obvious requirement for embedded servers is that they must fit inside something else. This often results in constraints on space, air-flow and power. If the system is used in close proximity to people, there may also be restrictions on acoustic noise. Systems used in industrial, mobile or military environments often have to withstand temperature, vibration, shock, etc. In extreme applications, embedded servers are completely sealed with no external air flow.

It is obvious that the designers of embedded servers are faced with a number of significant challenges above and beyond what might be expected of a typical server. As a result, embedded servers are typically more compact than standard servers and may have custom form-factors for specific applications. Cooling systems usually require special ducting and fans and may even include liquid and/or conduction cooling for applications where sufficient air flow is not available. Embedded servers typically offer extended operating temperature range and may include special packaging to resist damage from shock and vibration.

HIGH PERFORMERS AND MULTI-TASKERS A second type of requirement for embedded servers is that they often have to perform many tasks in addition to processing and storing data typical of a white-box server. This can include tasks such as motion control for mechanical systems, driving multiple and/or high resolution displays, high-speed signal processing, collecting data from a variety of sensors, performing video compression/decompression and many others. As a result, embedded servers are designed to support multiple add-in boards to provide the necessary I/O (input/output interfaces to external devices), video output, network interface connectivity, etc.

Since embedded servers typically integrate multiple subsystems and function as part of a larger system, product stability is much more critical than for a standard server. Even seemingly minor component changes can result major problems if they result in incompatibilities within or between subsystems. Frequent and/or undocumented component changes, which are typical in white-box servers, can result in production disruptions and/or costly and time consuming re-qualifications for system integrators. As a result, embedded servers are often designed with production life-cycles of 5 years or more, compared to 9-15 months typical of a standard server.

Standard servers are usually installed in a “back room” or data center and are very seldom seen by users. As a result, they typically have a rather plain appearance with the manufacturer’s logo, a few LEDs for diagnostic purposes and little else. Embedded servers are often located in much closer proximity to end users, and for some applications are mounted in plain sight. As a result, customers may require that embedded servers have custom bezels, paint colors and/or boot-up sequences and flash screens to assure that the end system has the appropriate “look and feel” for the application.

LONG-LIFE COMPONENTS ARE A ‘MUST’ While the applications and design challenges for embedded servers often seem to have very few limits, the same can not be said for system manufacturers’ budgets. As a result, embedded servers are typically designed with components derived from the larger volume standard server market. This helps to reduce costs, but also adds some challenges. Component manufacturers often offer a sub-set of their general purpose products as long-life, industrial grade components. Designers of embedded servers must choose components carefully to assure that they will have sufficient lifetime and environmental performance while maintaining costs premiums at no more than about 20% over a standard server.

WHEN IS AN EMBEDDED SERVER THE RIGHT CHOICE? From a customer’s point of view, if the requirement is for a general purpose server that will reside in a data center and is primarily used to run standard application software, a standard server will usually offer the best combination of price and performance. On the other hand, if the application requires integration of multiple subsystems, using a server as part of a larger system, a non-standard operating environment or a stable platform over more than one year, the benefits of choosing an embedded server are clear.

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