Timing is everything

Choosing the right components, such as the clocking solution, can be as important as processor selection. By **Ron Wade.**

Market research compiled by IDC and cited by Intel estimates that, by 2015, there will be 15billion internet connected devices in use. Most of those devices will not be recognisable as pcs, but Intel hopes that its chips will be inside many of them.

The infrastructure surrounding the pc format is so well established – providing an easy platform for both hardware and software development –that it is, perhaps, the only architecture that could actually meet the market expectations in the given timeframe.

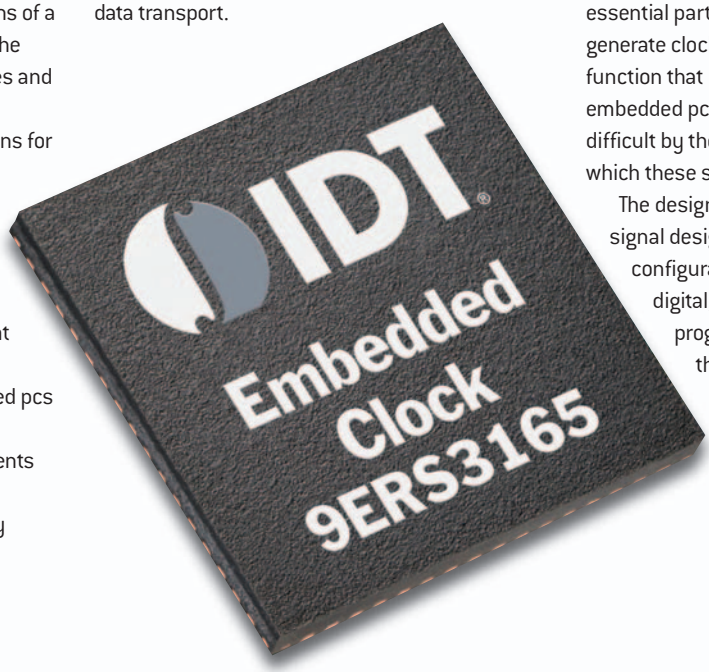
Many of these new Internet enabled devices will be based on an embedded pc format, taking many forms and with different requirements than conventional pc systems.

Of course, the embedded pc isn't a new concept. There are many suppliers of single board computers that can be considered embedded pcs, whilst many OEMs develop their own embedded pc hardware to meet the specific needs of their end product. In essence, there is a lot more freedom for manufacturers of embedded pcs in terms of choosing the size, shape and operating system. But, at a component level, they must, naturally, comply with the expectations of a product branded as a pc if they are to reap the benefit of readily available peripheral devices and ease of development.

An embedded pc needs to make provisions for a multitude of interfaces, expansion and connectivity options, such as PCI Express, USB and Serial ATA. This myriad of standards requires a complex, but well defined, clocking architecture. In order to meet the high expectations for reliability that are typically associated with embedded applications, the manufacturers of embedded pcs must select components that have been developed in accordance with the requirements of the environment from suppliers who understand those requirements. If the many different subsystems are to work together, a key component of any embedded computer is the system clock. Fortunately, there are suppliers that offer clocking solutions for the pc architecture that are specifically designed to meet the requirements of embedded applications, including IDT. In fact, IDT still supplies a clock chip family (9248AG-92LF) that was designed for the Intel 440BX and 440MX chipsets, and first introduced in 1998. A 10 year product lifespan would be unthinkable in the desktop pc world, where systems often have a life of less than 10 months.

What makes a good clock?

The standards based pc architecture means the requirements for the system clock synthesiser are clearly defined. Although it may be theoretically possible to use generic clock devices to create the clock tree, this would be a complex and inefficient solution. For instance, the system clock within a pc provides much more than a clock for the cpu; today, a pc must support numerous high speed serial interfaces that may also have clock signals embedded within their data transport.



Fortunately, suppliers offer a range of devices that integrate several phase locked loops (PLLs) to generate the reference clocks that are an essential part of the functionality. These devices generate clocks within strict tolerances, a function that is even more challenging in an embedded pc as the task is made all the more difficult by the extreme operating conditions in which these systems may find themselves.

The design of a clock generator is a true mixed signal design challenge. Whilst the configuration and control of the device is digital, with many devices offering serial programmability of output frequencies, the quality of the output clock is highly dependent upon the design of the oscillators and PLLs, as well as the device's immunity to noise.

A prime requirement of a clock synthesiser targeting an

embedded pc is long term stability. Without stability, the entire system may become compromised and one of the main causes of clock instability is power supply noise. In a consumer application, electrical noise is always present. But, in industrial applications, the severity of that noise is typically increased. Overcoming this hazard requires careful design considerations that aren't necessarily present in components targeting the consumer pc.

Embedded devices must meet strict emc criteria that require emitted interference to be minimised. One way to reduce the rfi generated is to reduce the slew rate of the output signals and many clock vendors provide a programmable slew rate to allow designers to optimise the system. Another approach to reduce the electrical noise produced by a clock synthesiser is a spread spectrum phase locked loop (PLL) as shown in Figure 1. EMC laboratories measure generated interference in frequency bands. By modulating the main clock signals, the interference is not concentrated at one frequency, but rather spread over several bands, thereby reducing the likelihood of the system exceeding the limits in on particular band. In an embedded pc, the clock would typically be modulated with a 0.5% down spread. However, while this helps minimise emi within the system, it imposes other design constraints in an embedded pc applications.

Typically, any pc must now include a PCI Express Gen2 interface, which may operate from either a synchronous or an asynchronous clock. But, when spread spectrum PLLs are used, the PCI Express specification prohibits asynchronous clocks, which imposes even more stringent requirements in terms of clock skew and drift. Complying with these requirements demands a clock synthesiser that has been developed specifically to meet these challenges. To reduce susceptibility to electrical noise, which is a main contributor to instability in a clock synthesiser, manufacturers integrate a voltage regulator within the clock synthesiser. This performance enhancing innovation is a further example of how the heartbeat of a digital system – the clock synthesiser – is very much a mixed signal device.

IDT has recently introduced a family of devices specifically targeting embedded pcs. As well as being specified to the industrial temperature range, they feature a fully integrated voltage reference to reduce the effects of power supply noise and are fully compliant with Intel's CK505 specification. Furthermore, because they target the industrial market, where product lifecycles are typically much longer than commercial pc lifecycles, each part in the family is guaranteed to be supplied and supported for at least seven years.

With the high degree of standardisation, choosing a clock synthesiser for an embedded pc application is straightforward. Clocking solutions are matched to specific chipsets, with Intel even defining clock synthesiser specifications. Manufacturers will typically offer a choice of devices for each chipset, allowing engineers to trade off features, such as output configuration and package, to select the best device for their application's requirements.

With an increasing number of industrial pc form factors now available, their use in a growing market segment, with its own unique requirements, presents an opportunity and a challenge. For many companies, the challenge can be managed by choosing suppliers who understand those unique requirements and offer the right products to address them.

Author profile:
Ron Wade is technical marketing manager with IDT's computing and multimedia division.

Fig 1: Block diagram of the 9E4104 embedded clock