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mbs ÆSyBus Concept

Introduction

Ethernet and Internet Protocol (IP) have emerged in recent years as the undisputed leaders in communication. More than 90% of all communication hardware is Ethernet based and the success of the World Wide Web has made Internet Protocol, and the associated Transport Control Protocol (TCP), the most successful and available protocol in existence. Consequently, previously unimaginable resources have been directed to the development and success of this communication duo and as a result, they have enjoyed ever increasing performance, combined with prestigious support, availability and low costs.

It is only natural that industry should look upon this phenomena and ask, how it too can benefit from this amazing resource of low cost, high performance, readily available communication hardware and software components and infrastructure. Consequently, we are seeing the emergence of many Industrial Ethernet concepts such as EtherCAT, ProfiNET, LXI, etc.. Even AFDX is an example of Industrial Ethernet, and these technologies are bringing new and exciting opportunities and capabilities to the engineers involved in industrial control, test and development.

mbs is also aware of these developments, but, with its ÆSyBus products, it has chosen not to develop new protocols and infrastructure, but to exploit recent advances by using what there is. In this way, the user of **mbs**' ÆSyBus products can take advantage of the amazing arsenal of hardware and software support for Ethernet and TCP/IP protocol.

The ÆSyBus Concept

The ÆSyBus concept provides an escape from the straight jacket environment of card-caged systems, which are often squashed together with the products under test to minimise cable lengths and other problems. With the ÆSyBus family, the equipment under test connects via ÆSyBus Interface Modules to a low cost, high speed network of distributed processing and interface centres, using Gigabit Ethernet and Internet Protocol.

Multiple applications on single or multiple Host Computers can log-on to unique user ports and simultaneously monitor and control the many facilities provided by the ÆSyBus Modules. Scheduling facilities are provided, not only to control the transmission of periodic data, but also for transferring blocks of receive data directly to the host applications that need them, and then, only when necessary.

And, how about multiple ÆSyBus Modules working together on the same network? Don't they get out of sync?

Not at all. The ÆSyBus Modules have onboard timers, which can be synchronised among themselves and external timers and have dedicated hardware to prevent clock drift. These same clocks are used for time stamping events and all scheduling activities. To make this possible with sub-microsecond synchronisation, Ethernet messages, sent and received by the modules, are time stamped as the first octet is transmitted or received, as per the IEEE-1588 Precision Time Protocol (PTP) specification.

And, how is all this made possible?

For time critical tasks, the ÆSyBus modules have avoided the use of embedded processors, which process data serially. Instead, the ÆSyBus modules use FPGAs to realise many tasks in parallel. In fact, even the processing UDP/IP protocol stack is performed in hardware, and at line speed when operating at a Gigabit data rate. ÆSyBus modules can take all the bus traffic that can be thrown at them without falling over. But they are not aggressive to other systems on the network. They respond to Ethernet Flow control messages and in addition implement configurable internal flow control logic.

Yes, this all sounds great, but I've heard that Ethernet and connectionless UDP protocol are unreliable?

Yes, that is true for networks which use hubs, that allow message collisions to occur. But the ÆSyBus modules are designed to be used in a Full Duplex mode, with Ethernet Switches, in the same way as AFDX is used on aircraft. As for UDP protocol, it is true that messages can be lost if they are allowed to pass over routers into the uncontrolled world of an overloaded Internet, but here again, the Ethernet Switches and flow control save the day. The Ethernet switches are intelligent devices, which store incoming messages before marshalling them onto the output ports to where they are needed. These storage buffers are typically very large and can store many messages per output port. In addition to this, they incorporate flow control mechanisms which moderate the message flow out of the switch and warn hosts when input buffers are becoming full. And to cap it all, the Gigabit Ethernet Interface transfers the data many thousand times faster than most of the interface data buses it serves. For example, it is 10,000 times faster than ARINC-429 and a 1,000 times faster than Mil-Std-1553. The total bandwidth of the network is hardly used!

Finally, the user has the option to power the ÆSyBus modules via the Ethernet Cables. Versions are available with Power over (Gigabit) Ethernet (PoE), where a special PoE Switch or PoE Midspan places 48V power on the Gigabit Ethernet signal lines. **mbs** produces PoE switches, which operate at a Gigabit and use all 8 lines of the CAT5 cable to transfer the power.

Software

The choice of Ethernet data bus with UDP/IP protocol provides the user with a freedom unimaginable in the past. No longer is it necessary for a single program to control all of the communication with the interface card. With the ÆSyBus concept, the user can divide the system into logical parts and implement them in separate applications, on the same computer or on separate computers attached to the network, and these connections can be broken and reconnected while the system is working. No need to switch the system down when connecting a new host to the network.

And how about software drivers for my exotic operating system?

This should not be a problem. Almost all serious operating systems and software development environments provide support for the TCP/IP protocol stack, to which UDP belongs. You can take advantage of all the special tools and classes provided by these systems to easily connect to the UDP user ports on the card, or sending and receiving messages etc..

In addition to the support of readily available software development tools, the ÆSyBus interfaces come with example software and support classes written in Visual C# and provided with source code. You don't have to waste time struggling with an unfamiliar programming language and environment. You just continue with your favourite tools, they are almost certain to provide the support you need to access the Ethernet/IP and consequently the ÆSyBus devices. In addition, the ÆSyBus Interfaces are provided with full documentation and various Windows based utility programs to help you configure IP addresses and check out your network connection.

The ÆSyBus Family

The ÆSyBus family of products is only just beginning. To start the family, **mbs** has launched interface cards and standalone modules for three types of data buses, namely, ARINC-429, Mil-Std-1553 and RS485. To support the standalone modules, **mbs** has also developed an Eight Port Gigabit Ethernet Switch with integrated Power over Ethernet, so that ÆSyBus Modules can be remotely powered via the same CAT5 Ethernet cables which carry the Gigabit Ethernet data.

More products are being developed, not only to widen the range of interface products, but also to improve the infrastructure and so provide new solutions, opportunities and capabilities for exploitation by expedient engineers.

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