The P-NET Fieldbus within the European Standard

It is less than 12 months since the standards authorities of all European Union and EFTA countries, had the opportunity to vote on the CENELEC proposals for a composite European Fieldbus standard EN 50170, which includes P-NET as Vol. 1. The result was overwhelmingly positive, and all member states now have to take steps to rescind any current national standard and adopt the newly ratified standard.

Why was it necessary to go through this proceedure, and what advantages will this yield for European manufacturers and users? The aspect of standardisation has taken place for the following reasons:

1. To highlight the availability of fieldbus types which are open and royalty free, fully specified and documented, have already achieved national standard status, can be shown to have been in widespread active use, and have user group support and conformance facilities.

2. To provide a standard to process and manufacturing industries, on the basis that no single world standard exists.

3. To ensure that the development of equipment and systems using fieldbus technology is no longer stifled due to the previous lack of any international standard.

Well firstly, what is a fieldbus? Fieldbus is a generic term for a serial data comunications medium, which is designed to connect together all kinds of sensors, actuators, transducers, programmable controllers and data processing equipment, within a coherent system. The "field" part of the name implies that the object of this technology is that the included apparatus is installed throughout the area of some operational process. This is opposed to being a bus within a single cabinet, or one intended to interconnect commercial data processing equipment (eg. Ethernet).

There are some available bus types which meet the criteria of connecting sensors and actuators together, but which tend to be bit based and designed to operate within a small area. Such busses tend to be used for high speed bit transfer within the confines of a single machine. The name Sensor-bus has evolved to describe such media.

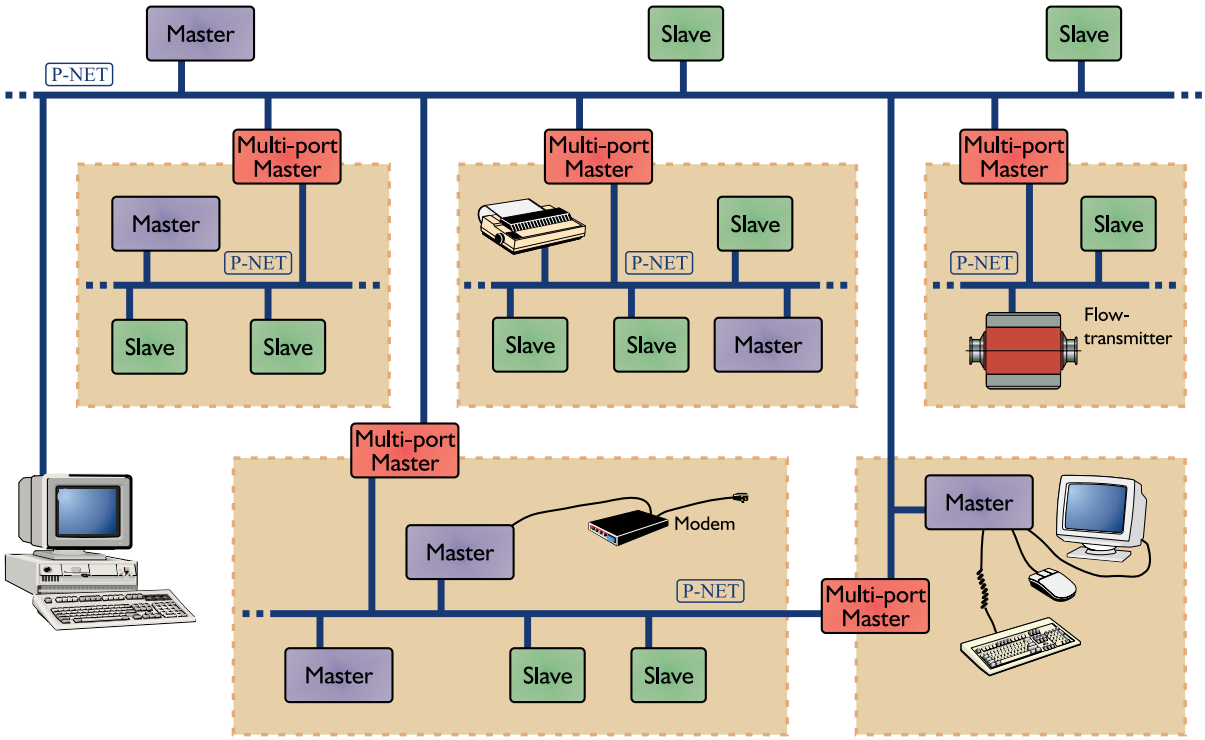
P-NET, which is a derivation of "Process" and "Local Area Network", has been utilised over the past decade to such an extent, that numerous projects based solely on this technology, have already been installed world wide.

P-NET is a Master/Slave protocol, which means that certain nodes on the network act as requesters for data (masters), and other nodes act as responders (slaves). In keeping with more advanced fieldbus technology, P-NET is also a Multi-master protocol. This means that many requesters can reside on the same bus or network. This is very important, since one of the main advantages of a fieldbus is that it promotes distributed processing, and doesn't rely on a single central processor. One aspect of P-NET's Multi-master operation is that if a master requests data from a slave (or another master), the addressed node must respond within a specified time frame, and before another master is allowed to use the bus. This makes P-NET particularly deterministic. A master has the right to use the bus when it holds a *token*, but due to an ingenious method of *virtual token passing*, means that no additional data needs to be

transmitted. These aspects of immediate response and token passing makes P-NET highly efficient in terms of data transfer rates.

A factor which is regarded as a unique feature of P-NET, is that it is also a Multi-Net protocol. The advantageous implications of this attribute, are that a plant or system can be easily divided up into autonomous cells. Each cell or net is able to inter-communicate through a dual (or n) port master, without any additional software overhead. This feature also provides natural redundancy facilities, which have, for example, been found to be an absolute necessity in control systems installed on ships requiring Llyods approval. The end result of such a distributed multi-master, multi-net fieldbus, is that a plant or control system becomes a cellularised but also a monolithic parallel processor.

The Multi-Net Structure of the P-NET Fieldbus



P-NET is probably the only fieldbus to be specified for layers 1,2,3,4 & 7 of the OSI model. Layer 1, being the physical layer, specifies a single speed of 76.8Kps. This has been chosen as the optimum speed to ensure that standard off the shelf micro-controllers with built in UARTS, can be utilised within master or slave nodes, without the need for special chips, but also allows up to 300 floating point fully confirmed measurements to be transferred per second, on a single bus. The system throughput increases to even higher rates, depending on the number of multi-nets involved. The most popular transmission medium used is RS485, again using standard components, although I.R., fibre optics and an intrinsically safe medium IS16 have also been specified. Up to 32 masters within 127 nodes, can be connected to a single bus. Normally connected as a ring without terminators, P-NET can be laid as a terminated line, up to 1.2 Km in length. A standard repeater will double this, but using fibre optics will extend a line by 3.1Km.

Moving to the upper layers, the P-NET specification describes “Channels”, which provide a standardised way of dealing with process variables as objects. A Channel offers an easy way to access a variable, together with all its associated data. A Channel consists of up to 16 addressable registers, containing various data structures, each accessed with a symbolic address called a softwire No. . For example, within a standard Analogue Channel, SwNo 0 would contain the result of a measurement which has already processed into engineering units. Two other SwNos. would be used to set the zero point and span, another for configuring the channel, such as for defining whether a current or voltage is being measured. Other SWNos. might deal with setting alarms limits or indicating errors. What this defined structure provides is a standard way of accessing, or setting values, from anywhere on P-NET. A new manufacturer would either use one of the numerous standard Channels already specified, or define and register a new one.

The object orientated nature of P-NET provides a natural association with the world of the PC. A PC, fitted with a P-NET interface card, becomes a master on the fieldbus. The application of VIGO, a fieldbus management system, running under Windows ‘95, provides the ability to include all P-NET variables within standard applications such as Excel and Access, together with providing a fieldbus link to purpose built applications written in object orientated languages, such as Visual Basic, Visual C++, or Delphi. Since VIGO is OLE compliant, means that SCADA applications supporting OLE can also use P-NET variables. VIGO also allows the transfer of fieldbus data between networked PC’s eg Novell.

VIGO is also structured for use with other fieldbus types, and an additional advantage of the emergent European Fieldbus standard, has been to encourage dialog between the organisations involved in the different technologies. This has culminated in the formation of a European project called RACKS, whose aim is to enable inter-communication between the different fieldbus types.

The future of fieldbus communication is bright. A firm foundation has now been provided, to enable manufacturers to update or design new sensors, instrumentation and controllers, to take advantage of this open and standardised technology, and for systems integrators and end users to begin to reap the rewards.

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