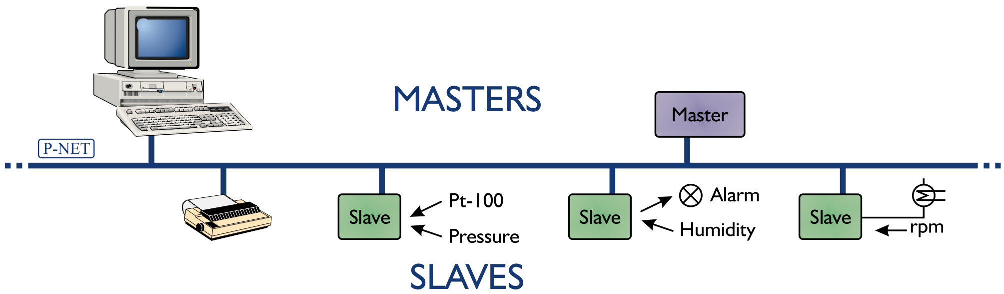
Universal Process Interface for the P-NET Fieldbus

Apart from perhaps the intelligent P-NET magnetic flow transmitter, probably the most widely utilised P-NET module, included in many of the thousands of operational projects worldwide, is the Universal Process Interface (UPI). Why should this be so, and what is its attraction? Well, in order to explain the versatility of this second generation device, a brief explanation of fieldbuses in general, and P-NET in particular, needs to be given.

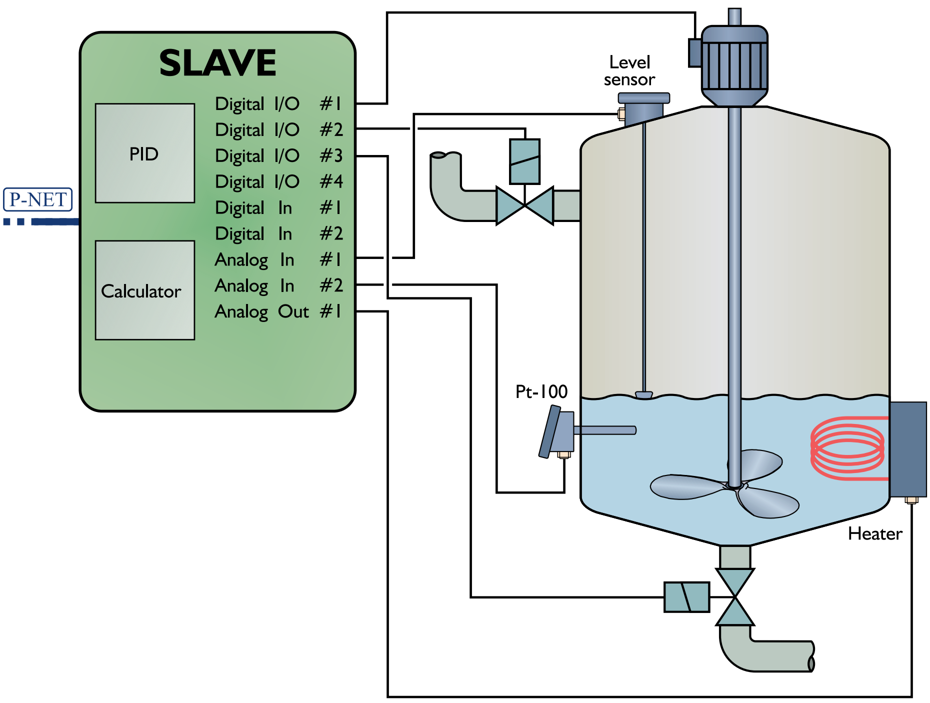
Fieldbuses allow information, in the form of measurement data, control and set point parameters and configuration records, to be transmitted from one device to another, via a single cable. Further, a number of devices can be connected to this one cable, in a chain or ring. Devices which can demand information to be extracted from or to be sent to other devices are called *masters*, and those which can only respond to requests are called *slaves*. Some fieldbus types only allow one master to be present on the bus (single master fieldbus), while others, like P-NET allow many masters to be connected (multi-master fieldbus),(fig 1). With this in mind, it is not difficult to deduce that processing power (intelligence) can be distributed throughout a system, rather than relying on a single central controller. That is not to say that a slave can't possess processing power, merely that it can't instigate a transmission.



Figur 1 - Master/Slave Structure of P-NET

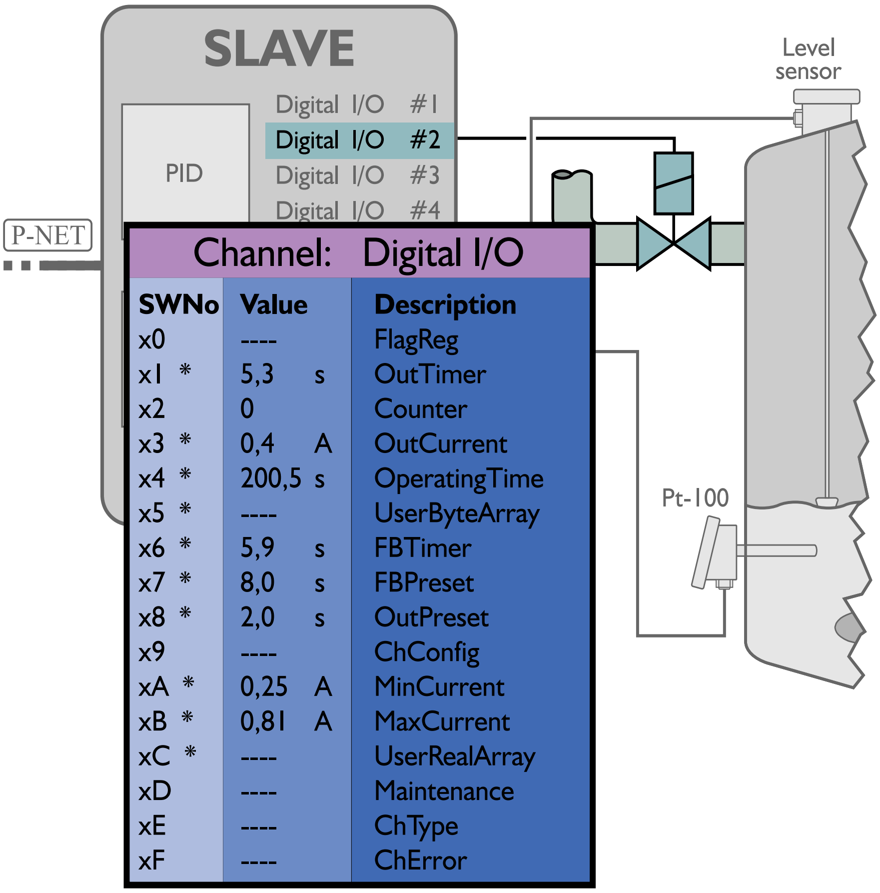
Now, the Universal Process Interface is a slave device or *node*, and offers the ability to be just configured for basic input/output, or for more elaborate uses, programmed to perform a particular autonomous process, not unlike a PLC. The compact DIN rail mounted module, from outward appearance, consists of 4 digital I/O's and 2 additional digital inputs, 2 analog inputs and an analogue output (fig 2). However, the hidden power inside includes a number of facilities, which allow the UPI to be turned into elegant intelligent transmitters. The first feature is the *calculator channel*, which allows programmable logical functions to relate any of the local inputs and outputs (analogue as well as digital), or global variables received from the rest of the system. The second feature is the *PID regulator channel*. As one might expect, this function block can be configured to reference measurements and set points and produce either an analogue or digital result. The third powerful internal feature, which warrants an additional built in microprocessor, is the *pulse processor channel*. This channel is also programmable in relation to the digital inputs and outputs, to produce high speed counting, timing and comparison functions up to 100 KHZ.

Before proceeding further, an explanation of a P-NET channel ought to be given,



Figur 2 - UPI Functionality

because it is a very important P-NET philosophy, especially in the light of ever increasing interest of *object orientated programming* and *function blocks.* A P-NET channel can either be thought of as structured collection of addressable registers which apply to a single input or output, or as an *object* incorporating the *properties* of a particular I/O or function (eg PID). Using the register concept, any P-NET channel consists of 16 registers with addresses x0 to xF, (fig 3). Each channel also has an address, so if digital output 2 of the UPI was identified as channel 2, and one wanted to see the number of times this output had changed (counter), either internally or externally, one would request this data from address 22. Each P-NET module connected also has a *node address* , so if for example, this UPI had been configured with node address 35, any master within this fieldbus would use the address structure 35 22, to obtain the data. So, a UPI consists of a number of standardised channel types, which from a master's point of view for a given type, all have the same structure. Thus, a UPI consists of 6 digital channels, 2 analogue input channels, an analogue output channel, a PID channel, a calculator channel and a pulse processor channel. Also included in this, and every other P-NET module, is the *service channel,* which consists of registers appertaining to the overall node, such as node address, watchdog timer, serial No. Manufacture etc (ever heard of plug and play?). The important fact to remember is that all validated P-NET modules, sensors, transmitters. Controllers etc., are all structured this way. Therefore for a module which has

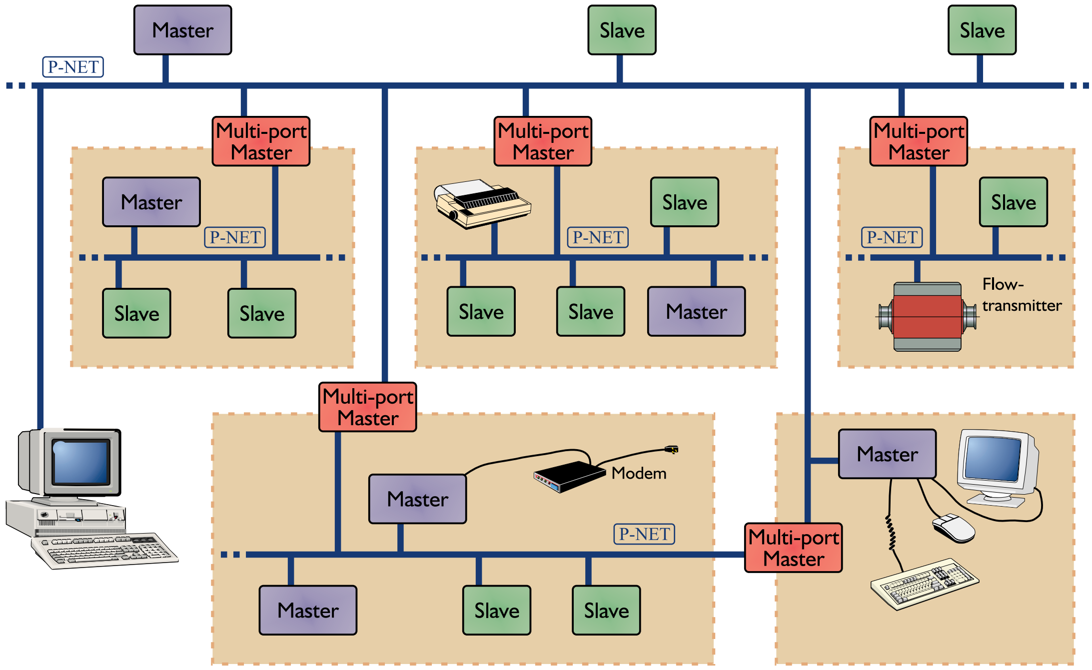


Figur 3 - Single Channel Structure

been specifically designed for pure digital I/O consists of a number of standard digital channels (eg 32), and nothing else. Alternatively, a more specialist module may consist of a standardised weight channel plus a standardised calculator channel, and a PID channel and a couple of digital channels for good measure. What this means is that general purpose or specialised modules from a number of different manufactures can (and do) all work together.

What can, and has been done, with the UPI to make it such a popular device? Well to begin with, it has previously been mentioned that the use of the calculator channel enables such a module to be used like a PLC. However, rather then programming a central PLC to perform a number of functions, with the disadvantage of then having to distribute wiring to a number of sensors and actuators, why not distribute the logic to the locality of each individual process, preserving one of the great advantages of fieldbuses? Since the calculator channel can operate on real (floating point), integer and boolean variables, be referenced to the PID channel, the pulse processor channel, and the digital and analogue I/O, the mind boggles as to the possible functionality. The author has personal experience of the design of two particular P-NET transmitters. The first was an alternative to the popular P-NET magnetic flow transmitter, which is not suitable for non conductive fluids. It was necessary to integrate both turbine and positive displacement flowmeters into a number of fuel management systems for British Rail. A UPI was used to count and measure the frequency of pulses from turbine pick-up coils and PD meter sensors. This was done using the pulse processor and a couple of digital inputs.

Next, the calculator was used to compute flow rate, compensated using temperature from a PT100 connected to an analogue input, and record this together with a batch volume and accumulative volume, in 3 addressable registers. The PID channel was used to control flowrate through a rate valve by use of the analogue output. Finally, another digital output was used to control a solenoid valve to control the batch. Each flowmeter in the system had a single UPI mounted on or near the flow transducer. In one system, there were some 25 flowmeters of various sizes and types. A number of masters scattered throughout the system (including PC's), needed the results of these processes, but using the attributes of P-NET, some 300 fully processed



variables were able to be requested and confirmed per second. Incidently, these particular systems were divided into sectors, but since P-NET is unique in being a multi-net protocol, masters from one P-NET *cell*, were able to transparently request data from another cell. (Fig 4).

A similar philosophy was used to produce a contents gauge for a sealed and pressurised sampler receiver for use in North Sea oil rigs. Here changes in pressure and temperature needed to be measured (2 analogue inputs) and a calculation (Boyle's Law) needed to be made of the actual and percentage fill of the sealed container. When full, the receiver had to be changed and taken back to the mainland by helicopter for analysis. The dynamic results were displayed on two loop powered digital displays, derived from the analogue output. The spare digital I/O's were used to change the display (actual volume or %), and to control an alarm signal.

It is known that many other examples exist in a wide selection of projects. How about a 4 phase stepper motor position controller, or a dissolved oxygen transmitter? With fieldbus enabling technology now available, is the PLC as we know it, now under threat? Well that's another story!

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