THE INS AND OUTS OF I/O

Paul Harris talks us through the different types of I/O offerings that are available today, to highlight the importance of making the right choice for an application.

Process and factory automation controllers connect to a wide variety of sensors, instruments, valves and other equipment through input/output (I/O) cards or racks that are either co-located within the same cabinet (Local) as the Controller/CPU or installed further away (Remote).

Defining the difference between Local and Remote I/O is quite straightforward, but the defining differences between Remote I/O and Distributed I/O can be more nuanced and can be further confounded by vendors' definitions or marketing collateral, just as many automation vendors prefer to use a name such as Process Automation Controller (PAC) over Programmable Logic Controller (PLC).

The most used I/O type is Local I/O. It will most often come from the same vendor as the Controller/CPU since it is ordinarily directly connected to the Controller/CPU by integrated racks or cages that hold four, eight, 16 or 32 point I/O cards. Some Local I/O expansion racks or bricks – as they are often referred to – can be separate from the main CPU and connected over a digital bus or highway via twisted pair wires or Ethernet cables, albeit installed within the same physical cabinet.

Since Local I/O is typically intended to be installed within the same enclosure as the Controller/CPU, environmental operational characteristics and hazardous area approvals tend not to be as robust as for remotely installed I/O.

Next comes the challenge of outlining the differing characteristics between Remote I/O and Distributed I/O, especially since many vendors refer to them interchangeably. If we use history and release to market timelines as a basis, Remote I/O came first and thus tends to be less flexible, capable and smart when compared to later released Distributed I/O.

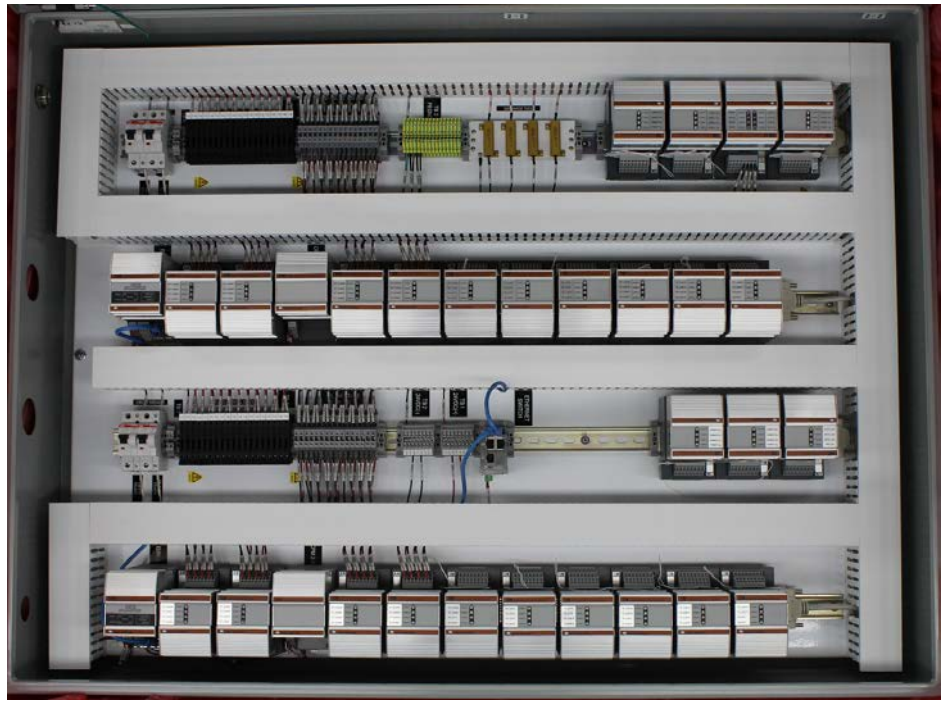
Initially Remote I/O was nothing more than Local I/O reconfigured and housed to be remotely installed from its corresponding Controller/CPU. Communication was no longer along a backplane but now designed to convert its connected analogue I/O signals to a digital format that was transmitted back to the host controller over proprietary buses or highways. Remote I/O is limited in scope and does not contain complex or advanced CPUs or processors to handle math, complex control, peer-to-peer communication with other Remote I/O modules nor does it allow the connection of additional I/O modules. And, while operational characteristics and hazardous approvals exceed that of most Local I/O products, it is still somewhat more limited than Distributed I/O.

More complex

Distributed I/O harnesses all the capabilities of Remote I/O and more. As the name suggests, Distributed I/O is a more complex piece of equipment that can be distributed throughout a process plant or automation facility without the concern of continuous communication with its host Controller/CPU. This is because most Distributed I/O products contain an advanced CPU and often real time operation system that allows localised control and monitoring, along with several other capabilities.

Because Distributed I/O is designed to exist on its own, it can be a preferred choice of remote I/O due to its ability to be redundant or fault tolerant should it lose communication with a primary Controller/CPU. In addition, Distributed I/O can share signals between other peer Distributed I/O systems from the same vendor or alternative vendors utilising industry open or standardised protocols such as MODBUS RTU.

Designed with the intent of being used for remote installations, Distributed I/O typically allows for installation in more harsh operating environments and often have a minimum of Class I, Div 2/Zone 2 approvals and sometimes carry Zone 0/1 approvals.



Distributed IO.

With its diverse capabilities Distributed I/O can be well suited to not only be a local controller and I/O device but may have additional built-in capabilities to support peer-to-peer communications, gateway functions – such as HART to MODBUS RTU or MODBUS/TCP conversion, contain embedded webservers for ease of viewing real time process data with an off the shelf web browser, data logging and even IIoT or Industry 4.0 capabilities employing MQTT (Message Queuing Telemetry Transport) protocol for seamless connections to cloud services like AWS (Amazon Web Services) or Microsoft Azure.

Lastly, recent advances in secure spread spectrum, long range and mesh wireless telemetry have further enabled I/O products to provide solutions once thought impossible. WirelessHART, ISA 100 and many proprietary short- and long-range unlicensed solutions are now optionally embedded directly within the I/O product itself spawning an entirely new category of remote or distributed types of I/O solutions.

Remote IO.

I/O products, regardless of type, have advanced incredibly fast during the last decade. So much so that several of the above-mentioned differentiators have blurred the once defined lines that separated them. For the user, it is imperative that each vendor's solution and technology offering be thoroughly examined to ensure functional, operational and design compliance.

Paul Harris is general manager at Moore Industries-Europe.