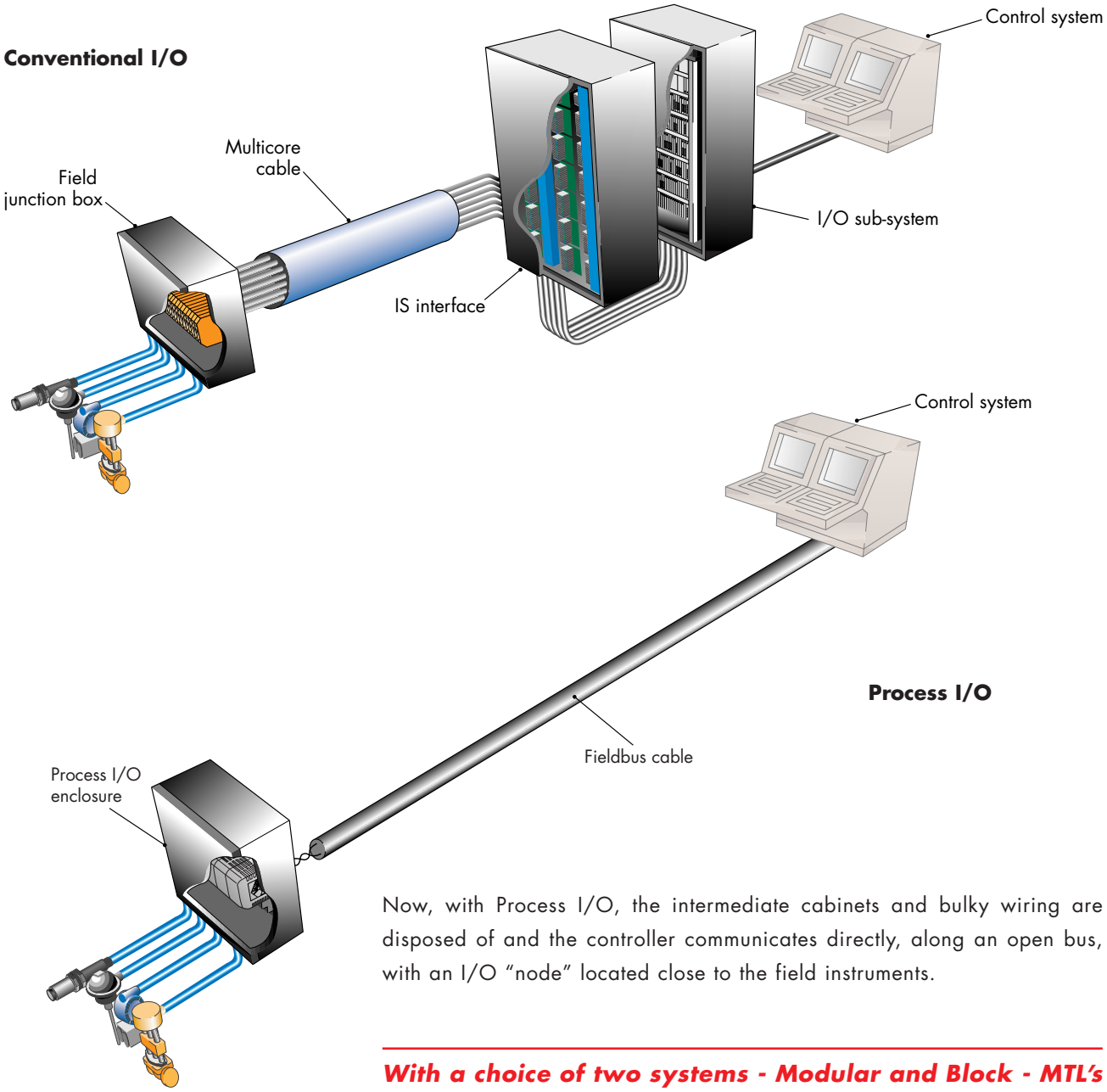
# What is Process I/O™?

PROCESS I/O

## *A radical development in field instrumentation for process industries*

Traditionally, a process control system has consisted of a controller, and its associated I/O subsystem, located in the control room and connected to field instruments via multicore cables and junction boxes.



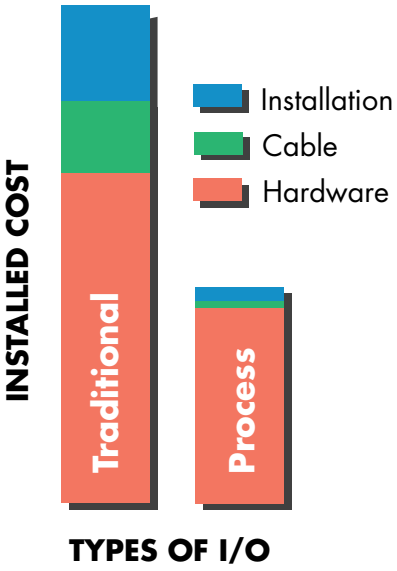

Now, with Process I/O, the intermediate cabinets and bulky wiring are disposed of and the controller communicates directly, along an open bus, with an I/O "node" located close to the field instruments.

***With a choice of two systems - Modular and Block - MTL's Process I/O is both scalable and cost effective for small nodes and large, high density applications***

*Process I/O™ is a trademark of The MTL Instruments Group plc.*

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# Why use Process I/O™?




***Process I/O saves you time and saves you money. It is more than just remote or distributed I/O. It has the accuracy, reliability and ruggedness required for continuous operation in process environments. This allows the benefits of 'open' fieldbuses to be enjoyed with a wide variety of field instruments, including conventional and 'smart' devices and even those located in hazardous areas.***

The most significant benefit of Process I/O comes in the form of cost savings. The savings are achieved by carrying the many I/O signals, from the field to the control room, on a single* communications bus cable instead of the many hundreds of cable-pairs associated with traditional I/O methods. System design, installation and commissioning is accelerated and, by moving the I/O into the field, considerably less space is required in the control room. Further savings are made because low level signal sensors can be terminated at the node, eliminating the need for transmitters for each input. Further indirect savings derive from improved diagnostics, live maintenance and the use of an open bus, allowing package suppliers to provide integrated solutions.

* Note: This could be increased to dual cables for redundant communications.

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# Will Process I/O™ work with my control system?

PROCESS I/O

## *Efficient digital communication between controllers and field instrumentation*

The broader availability of standard fieldbuses and the promotion of open architectures has enabled the development of systems that are capable of fast and reliable communication between proprietary control systems and a variety of field devices, both conventional and 'smart'.

The Process I/O architecture even allows different buses to be connected together, with the node acting as a gateway between device level buses and a fast system bus.

### Host Integration

A Process I/O™ sub-system is designed for easy integration into the host controller, whether it be a DCS, PLC or PC-based Soft-Control or SCADA system. This is assured by the use of a modular bus interface that may be selected according to the type of bus. While the simpler networks - Modbus and Profibus-DP require specific host configuration to interpret data items (assignment of tag descriptors and format/scaling), the more advanced network standards such as Foundation Fieldbus have a complete data model which allows automatic data interpretation. Documented integration solutions are available for many DCS and PLC systems, while OPC (OLE for Process Control) is being increasingly adopted as a standard interface to PC-based systems.

As further bus protocols emerge, the MTL system can adapt easily, bringing the benefits of improved capability and faster loop response times.

### Smart Device integration

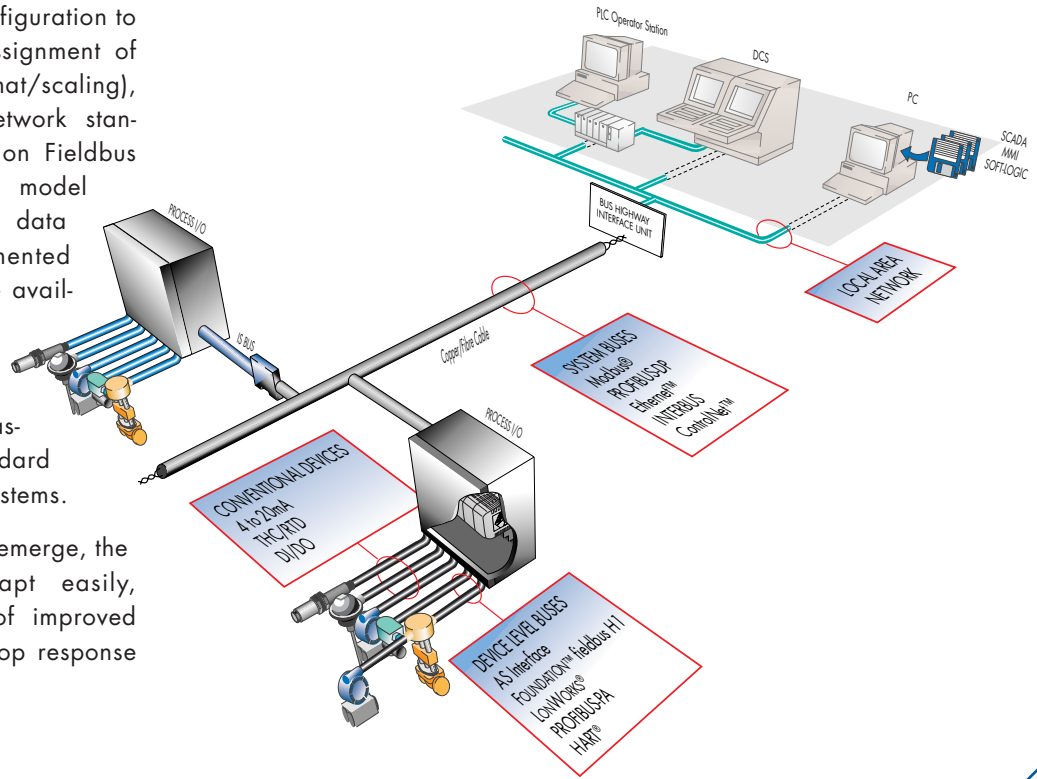
Smart field instruments may support real-time access to multiple variables; for example HART devices allow access to up to 4 variables (via Universal Command 3) in addition to the primary process variable available on the current loop. These variables are polled by the I/O module and are available on the host LAN in the same way as regular I/O values.

### Field device maintenance

Process I/O supports transparent access to intelligent field instruments. This allows read and write of configuration and calibration parameters as well as online monitoring of key variables and status. The generic "pass-through" mechanism is supported by maintenance tools such as AMS and Cornerstone which gain knowledge of device characteristics from the vendor-supplied Device Descriptions (HART and Fieldbus Foundation H1) or Profiles (Profibus PA).

### Configuration

Configuration of Process I/O is carried out using a simple PC-based software tool. Configuration data may be imported or exported as a structured text file allowing integration with the host's system tools. The tools also provide online diagnostic capability.



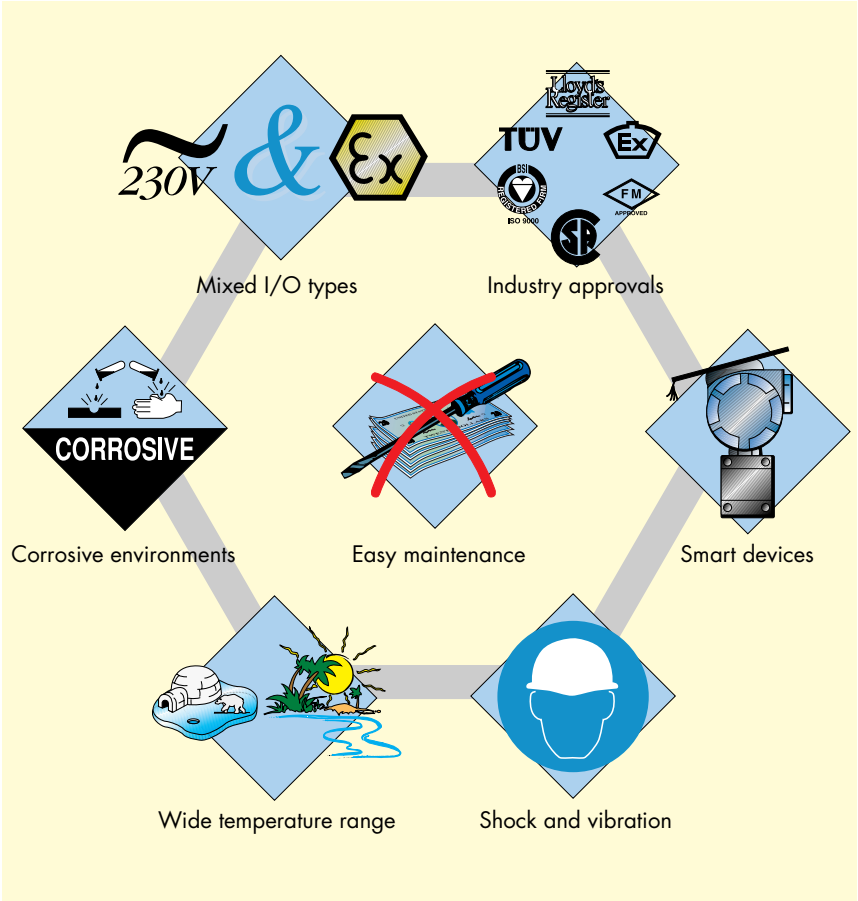

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***The need to locate Process I/O close to the process defines new requirements for environmental ruggedness and maintainability.***

## *Will Process I/O™ survive harsh environments*

Equipment designed for environments like climate controlled switch rooms will not survive in harsh process applications; its service life will be limited, its accuracy impaired and its integrity compromised.

MTL has adopted a new approach. The environmental requirements for field mounting equipment, e.g. sensors and actuators, are well understood and Process I/O has been designed to meet a similar specification in terms of operating temperature range; shock and vibration and corrosion resistance.



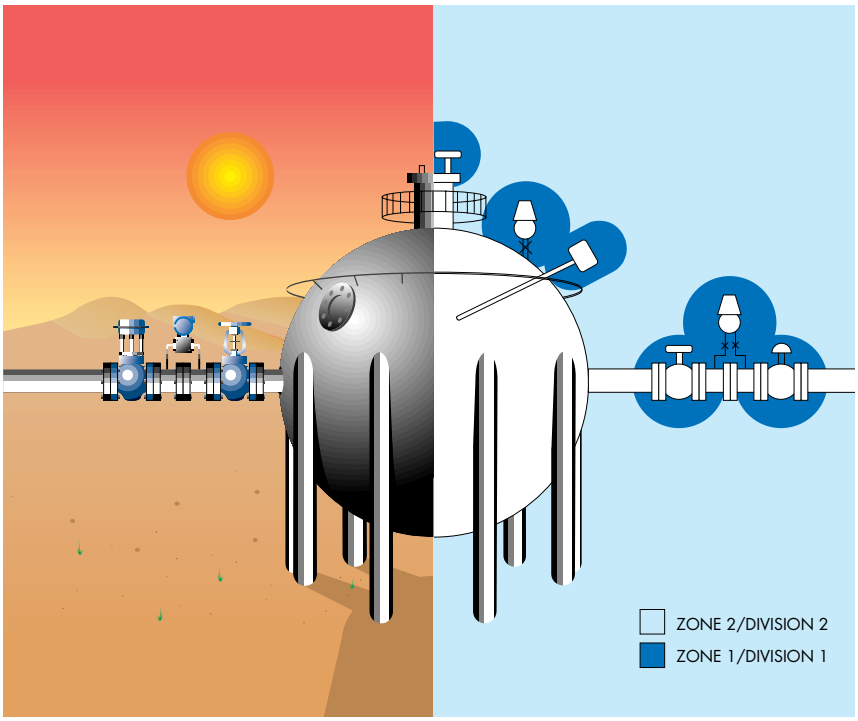

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# Process I/O™ and hazardous areas



***Complete hazardous area capability is essential for any I/O system to satisfy all applications in today's process environments. For field mounted I/O this means the ability to connect to certified field devices and even to locate it in hazardous areas.***

MTL's Process I/O has the lowest installed cost for a system that can meet full statutory requirements, as well as providing the most flexible installation and maintenance procedures that approval standards will allow. For example, it is possible to modify and maintain a remotely-located I/O node without removing power from the installation and without risking the loss of valuable process data or control of the process.




A wealth of industry experience has allowed MTL to define procedures for live maintenance that expand the boundaries of established practice. MTL Process I/O pioneered the ability to 'hot swap' I/O modules in Zone 2 and Division 2 hazardous areas.

**As world leader in the technique of "intrinsic safety" – regarded as the safest and most modern technique for explosion prevention – MTL is perfectly placed to provide innovative and cost effective Process I/O for both hazardous and safe areas.**

In some applications, particularly the siting of I/O in Zone 1/Division 1, only the proven benefits of intrinsic safety used in conjunction with other methods of protection are satisfactory. In fact, applying a combination of techniques also allows both intrinsically safe and 'high power' (such as AC mains operated) devices to be operated from a single Process I/O node.

**MTL Process I/O meets hazardous area needs with safety beyond question**

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# Process I/O™ terminology

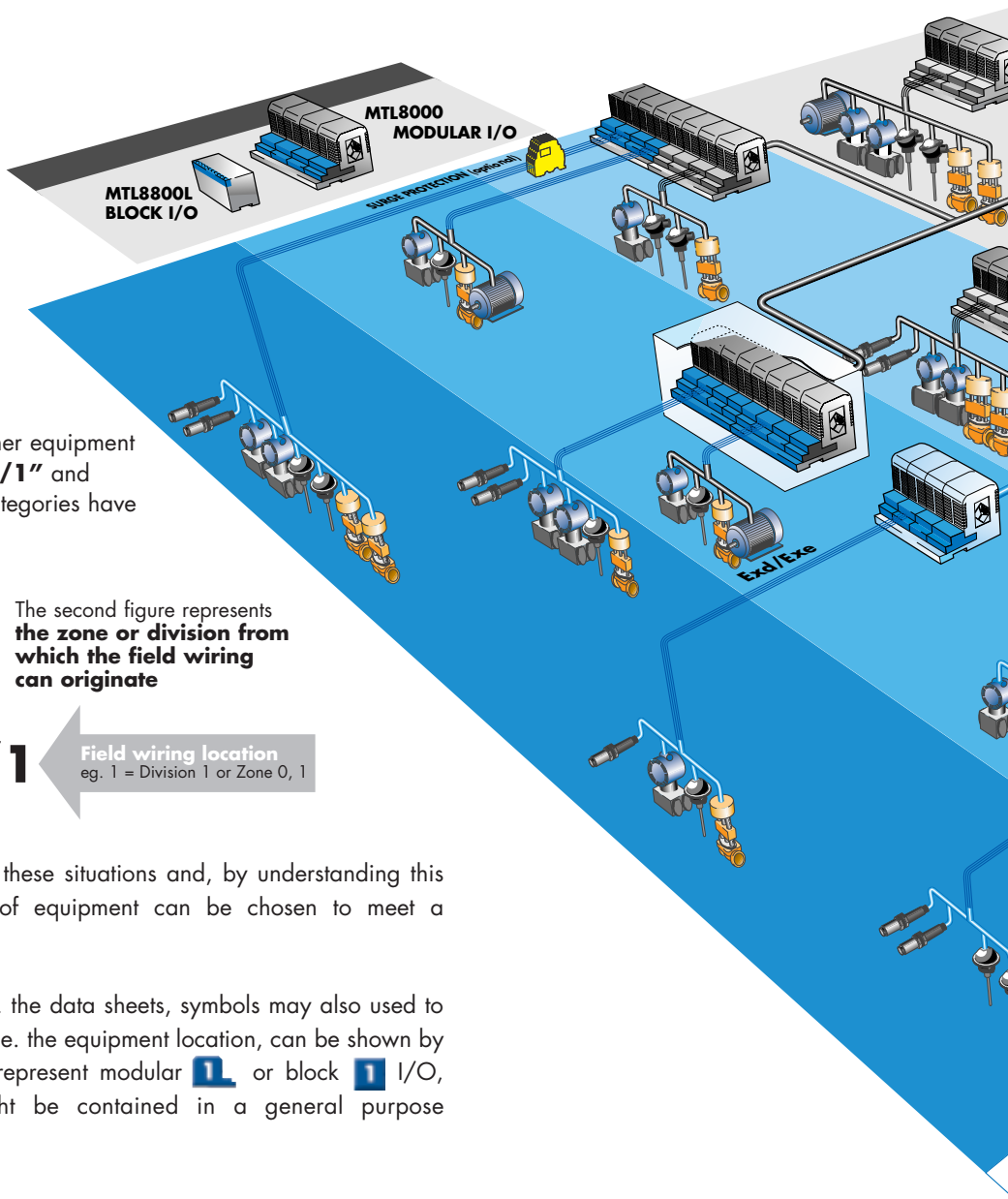
## General purpose applications

Process control has applications in many industries: water treatment, steel making, brewing, power generation, etc., all of which can have harsh plant environments. MTL8000 is specifically designed to withstand such environments and these applications are referred to in this catalogue as general purpose.

## Hazardous area applications

Industries, such as oil exploration, oil refining and chemical and pharmaceutical manufacturing have environments that may contain explosive gases or dust and are referred to as hazardous area applications. MTL is a world leader in technology for preventing explosive hazards and that experience is of major value to users requiring process control equipment for such applications.

MTL has also adopted a terminology, outlined below, that helps users to identify MTL8000 equipment for their specific application.




As well as general purpose, three other equipment categories are defined – **"2/2", "2/1"** and **"1/1"**. The two numbers in these categories have a particular meaning as follows:

The first figure represents **the zone or division hazardous area in which the equipment can be mounted**

The second figure represents **the zone or division from which the field wiring can originate**

**Location of node**
eg. 2 = Division 2 or Zone 2

**2/1**

**Field wiring location**
eg. 1 = Division 1 or Zone 0, 1

The diagram on this page illustrates these situations and, by understanding this terminology, the appropriate type of equipment can be chosen to meet a specific application.

In other parts of this publication, e.g. the data sheets, symbols may also used to illustrate the types. The first number, i.e. the equipment location, can be shown by an equipment symbol which might represent modular 1 or block 1 I/O, similarly the second number might be contained in a general purpose 2 or hazardous area 1 symbol.

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## General purpose and 2/2

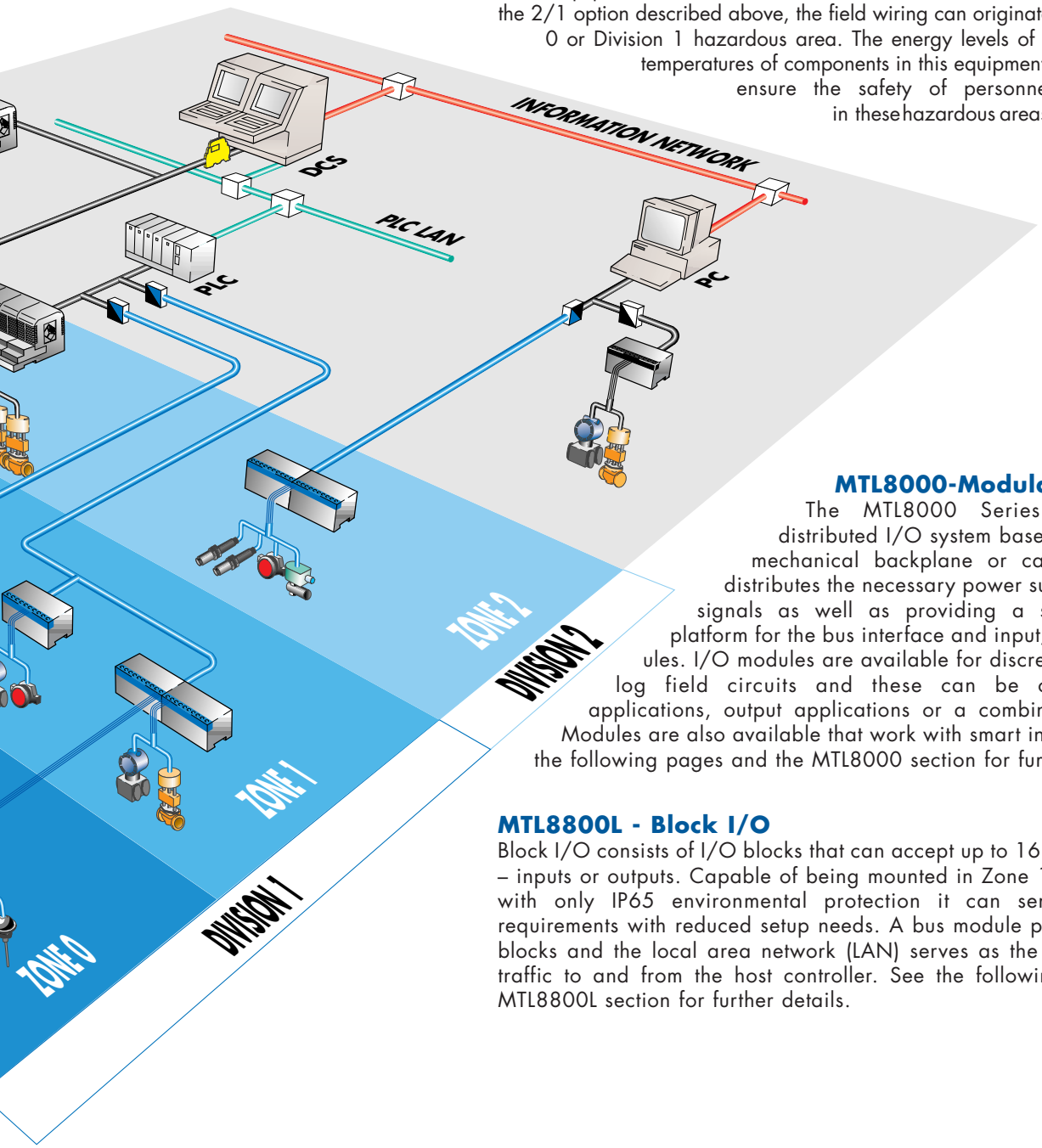
This equipment represents a base level for all applications. It can be used for general purpose work but has been designed also to operate in Division 2 and Zone 2 hazardous areas *without additional safety measures*. The equipment, and its field wiring, can be in a safe area or a Division 2/Zone 2 hazardous area.

## 2/1

While still designed for mounting in Division 2 or Zone 2 hazardous areas, the field wiring is protected by built-in intrinsic safety interfaces. As a result, field wiring that originates in a Division 1, Zone 1 or Zone 0 hazardous areas can be connected to it.

## 1/1

This represents the highest level of protection and versatility, and permits the 8000 series equipment to be mounted in a Zone 1 or Division 1 hazardous area. As in the 2/1 option described above, the field wiring can originate in a Zone 1, Zone 0 or Division 1 hazardous area. The energy levels of signals and surface temperatures of components in this equipment are all designed to ensure the safety of personnel and equipment in these hazardous areas.




## MTL8000-Modular I/O

The MTL8000 Series is a modular distributed I/O system based upon an electro-mechanical backplane or carrier. This carrier distributes the necessary power supplies and control signals as well as providing a stable mechanical platform for the bus interface and input/output (I/O) modules. I/O modules are available for discrete (digital) or analog field circuits and these can be chosen for input applications, output applications or a combination of the two. Modules are also available that work with smart instrumentation. See the following pages and the MTL8000 section for further details.

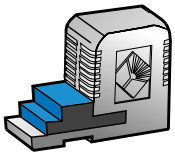
## MTL8800L - Block I/O

Block I/O consists of I/O blocks that can accept up to 16 analog or discrete – inputs or outputs. Capable of being mounted in Zone 1/Division 1 areas with only IP65 environmental protection it can serve smaller scale requirements with reduced setup needs. A bus module placed between the blocks and the local area network (LAN) serves as the interface for data traffic to and from the host controller. See the following pages and the MTL8800L section for further details.

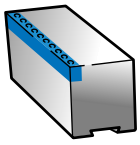
# Process I/O™ – Modular or Block?

***MTL's Process I/O has two, complimentary, product ranges to provide optimum solutions for any application.***

- **MTL8000 Modular I/O** – has I/O modules to meet a wide range of I/O needs. All the I/O modules, together with a host interface and power supplies, mount on a purpose built carrier system. Its key features are 'scalability' and its ability to accommodate different I/O types within a single node.



- **MTL8800L Block I/O** – is easily configurable with minimal training. The I/O block system uses an intrinsically safe control bus providing IS field power to the field sensors/actuators, where required. Its key features are its ability to mount directly within a Zone 1/Div 1 environment and its lower cost for smaller applications.



Both ranges are included in this catalogue, with sections devoted to each. The introductions to these sections contain important information about the products and the user is advised to read them for a broader understanding of the individual products.

## How do I choose between them?

This section looks at some of the key issues and provides two application examples showing how the decision might be made in two different sets of circumstances. The information provides only one perspective on choosing between the ranges but the final choice might need to be based on other factors. You are advised to investigate both the MTL8000 and MTL8800L sections of this catalogue and to review the individual product specifications, both electrical and environmental. **System Specifier's Guides** are also available, for either product range, to help in specifying the components for a particular application.

## Can I mix the two?

Although the information here should help you identify which of the two Process I/O types to use, there will be applications where a mix of the two I/O types is the correct approach. Both product ranges can be mixed on the same local area network (LAN) and appear as individual slaves to the same host controller, each having its own address and individual capabilities.

## What if I can't decide?

If any aspects important to you are not addressed here, contact MTL to discuss your application and obtain further help with your selection. Our Process I/O applications specialists will be pleased to propose a system tailored to your specific requirements. Check the list of representatives and distributors in the **Support** section at the end of this publication for details of your nearest Process I/O specialist or local MTL representative.

## A simple guide

A useful first step for a designer in determining the optimum solution for a particular application is to create a simple plan of the plant including some indication of the distances involved. On this, the major equipment modules, the field sensor and actuator requirements and the I/O types required at each location should be noted. With these key aspects identified, the choice between Block and Modular I/O can begin using the following basic criteria:

| Use Block I/O when: | Use Modular I/O when: |
|---|---|
| ● There are only a **few channels** per location (typically **< 50**) | ● There are **many channels** per location (typically **> 50**) |
| ● There are only a **few I/O** types per location (typically up to 3) | ● There are **many I/O types** per location (typically 3 or more) |
| ● A system that is simple to configure, using DIL switches, is preferred. | ● HART transmitter support; presetable output states on failsafe; and mixed IS and non-IS types are required |

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## Application 1

This example looks at a simple tank farm application. There are 4 rows of 8 tanks, i.e. 32 tanks, each 10m apart. Each tank has 2 valves (=2 DO) each with 2 limit switches (=4 DI) and a 4-20mA level transmitter (=1 AI).

Three I/O configuration options are considered for the concentration of field device wiring, as detailed in the following table.

- Option A - wires all I/O to one central location – average cable field device length is approx. 32m
- Option B - uses 8 (sub)locations each taking the wiring from 4 tanks – average field device cable length is 5m
- Option C - has a node at each tank – average field device cable length is 1m

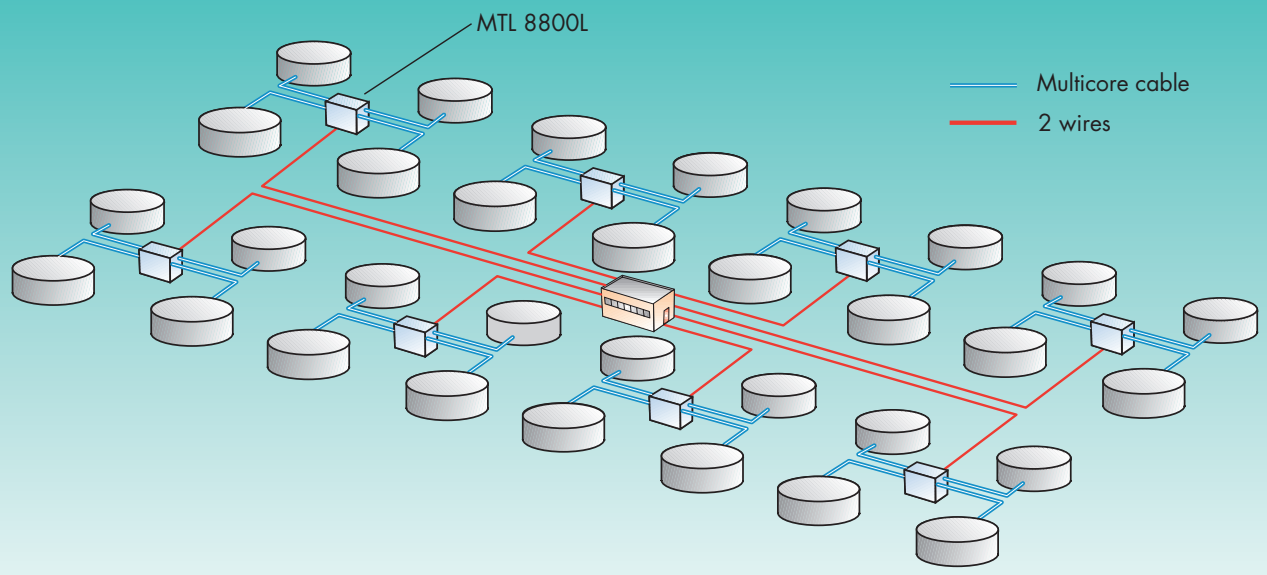
| Option | Number of locations | DI | DO | AI | AO | HI | HO | I/O per location | Total device cable length |
|---|---|---|---|---|---|---|---|---|---|
| **A** | 1 | 128 | 64 | 32 | | | | 224 | 224 x 32m |
| **B** | 8 | 16 | 8 | 4 | | | | 28 | 224 x 5m |
| **C** | 32 | 4 | 2 | 1 | | | | 7 | 224 x 1m |

DI=discrete input, DO=discrete output, AI=analog input, AO=analog output, HI=analogue input + HART, HO=analogue output + HART

At one extreme – Option A – the number of locations is minimised but the field wiring length significantly increases the installed cost. At the other extreme – Option C – the field wiring is very short but the amount of individual I/O equipment required at each location makes it too costly. The optimum – Option B – minimises both the field wiring length and the per-location equipment costs. Consequently, with a total of 28 I/O at each node and three simple I/O types, MTL8800L **Block I/O** would be considered the first choice for this application.

**Note**: By way of comparison, if this instrumentation was implemented using conventional I/O and the control room was located 100 metres away, then Option A would require an additional 22,400 m (approximately) of cable pairs.

**Option B solution**




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## Application 2

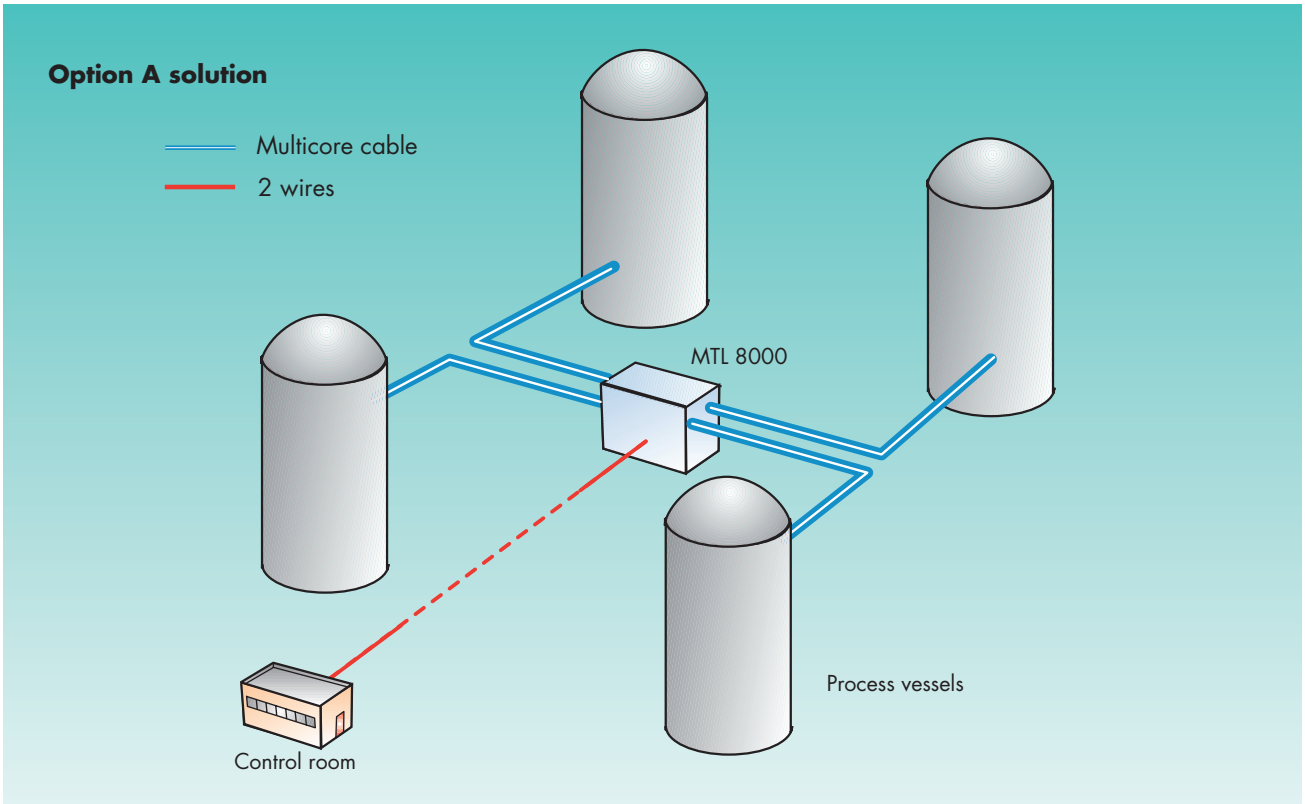
This example considers a simple process plant having 4 process vessels each, approximately, 10m apart. Each vessel has 16 switch inputs (=16 DI); 16 discrete outputs for local indication (=16 DO); 5 analog inputs for level and temperature (= 5 AI); 2 control valves (=2 AO); and 5 HART transmitters for pH, pressure and flow (=5 HI).

Two I/O locations are considered as detailed in the following table

- Option A - places all I/O at one central location – average field device cable length 15m
- Option B - has a location at each vessel – average field device cable length 5m

Although option B represents the shortest device cabling option, the cost overhead of one node per vessel outweighs the cabling advantage. Therefore option A is selected. With a total of 144 I/O points brought to one location, 5 I/O types and, especially, the requirement for HART pass-through to the control system – the MTL8000 Modular I/O would be considered the first choice for this application. Again, conventional I/O would require 144 cable pairs, each going a possible distance of 100 – 200m from the field devices to the control room.

| Option | Number of locations | DI | DO | AI | AO | HI | HO | I/O per location | Total device cable length |
|---|---|---|---|---|---|---|---|---|---|
| **A** | 1 | 64 | 32 | 20 | 8 | 20 | | 144 | 144 x 15m |
| **B** | 4 | 16 | 8 | 5 | 2 | 5 | | 36 | 144 x 5m |




## Additional literature

**AN8000** Application Note, System Specifier's Guide – Modular I/O

**AN8005** Application Note , System Specifier's Guide – Block I/O

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