

Area: Control Systems
Title: What is an Integrated Control System?
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This paper has been prepared to introduce those unfamiliar with modern control system technology to the current concepts in control system integration. The paper is presented from the view of an oil and gas control system professional.

The acronym ICSS is one which is found with increasing frequency within many areas of industry. It is common practice for modern projects to call for an Integrated Control and Safety System – ICSS, to be provided to ensure that the control, shutdown and safety management of a process plant are performed by a segregated yet interconnected collection of electronic systems. It is a requirement that these systems are capable of seamless communication such that a process operator may quickly determine the state of the plant and provide the necessary manipulations to ensure that optimum operation and maximum safety are achieved.

As process plant complexity increases and workforce availability decreases we find ourselves relying more and more on electronic technology to support and optimise plant operation. The concept of integrated control systems isn't new. Many integration techniques have been tried over the years with varying success. Recent developments in commercial computing technology are now finding their way into the process control arena so allowing seamless integration to become a reality.

Hydrocarbon processing facilities generally rely on a distributed control system to provide all process and equipment control functionality, an independent emergency shutdown system to ensure that the plant can be safely shutdown in the event that normal control is lost or should an unsafe operating condition arise and a Fire and Gas system to continuously monitor the facility for gas releases or fire conditions which could jeopardise the asset.

Distributed Control System (DCS)

The first Distributed Control Systems were introduced to the industry in the mid 1970's. The concept of distributing control functionality to strategic plant locations and interconnecting the controllers such that a single operator can access all plant areas isn't therefore a recent innovation. What has changed over the years is the move away from proprietary networks and hardware to the use of standard information technology hardware and the adoption of the personal computer as the dominant operator interface.

Typically, the operator interface of most if not all modern Distributed Control Systems is based on standard PC hardware, in most cases running a Microsoft operating system. The operator interface interfaces directly with the control system data network to allow the operator to control and monitor the plant and efficiently handle alarms.

The distributed controllers run proprietary control firmware, in many cases this is legacy firmware which has been updated to allow it to interface with modern network technology whilst maintaining backwards compatibility.

The DCS provides all control functionality and allows the operator to manipulate controller setpoints, start and stop devices and execute complex control schemes. Controllers are generally programmed using a combination of the languages defined in IEC61131-3.

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Standard language options are function blocks, structured text, ladder logic or sequential flow charts. These tools allow the engineer to design generic software that can be reused many times to provide a flexible yet well engineered software solution.

Emergency Shutdown System (ESD)

The increasing complexity of modern process plants has led to an increase in complexity of the associated automation software. Society no longer tolerates the risks associated with operating major processing plants and as such every plant now features a dedicated and approved safety system. It is usual for a modern safety system to be approved by a regulatory body such as TUV.

The safety system is responsible for continuously monitoring the status of the process plant and ensuring that it is returned to a safe condition in the event that the control system malfunctions. To ensure that common mode failures are minimised it is common practice for the safety system logic and hardware and field instrumentation and valves to be separate to the control system and its field devices. Safety systems are also provided with a dedicated safety rated network to allow safety actions to be signalled between safety controllers.

It is usual to provide the control room operator with hard wired pushbutton panels such that higher level shutdowns can be quickly initiated regardless of the state of the operator interface. The panels are generally wired directly to safety controllers located close to the control room.

Fire and Gas System (F&G, FGS)

The Fire and Gas System provides an additional layer of asset protection. Unlike the safety system which monitors and reacts to process conditions, the fire and gas system monitors the ambient environment of the process plant. In the event that the system detects a hazardous gas cloud or a fire, action is taken to alert site personnel and to initiate automatic shutdown actions. The Fire and Gas system generally initiates protective actions such as starting fire water pumps and foam pumps, triggering extinguishant release and sealing buildings by stopping building HVAC systems.

It is not uncommon for fire systems to use addressable detection and to interface with the gas system which may well be identical (although separate) hardware to that used to provide the ESD system.

Packaged Equipment

It is not uncommon for complex equipment such as large compressors to be provided by a dedicated equipment supplier. The supplier may insist that they also provide the primary control system as a condition of purchase and to ensure that the machine warranties are preserved. In this case it is usual for the supplier to also make provision for a communication link with the plant DCS. This may be either a slow speed serial data link or a direct, high speed connection to the process control network. The link may provide only basic status information or may provide a full interface between the control systems to allow control of the package from the central control room.

It is clear from the preceding text that some form of interaction between systems is necessary to ensure that all the process control and protective functions operate in an efficient and cohesive way. Not only must the hardware be capable of seamless interconnection but the custom application software must be configured in such a way as to meet the control requirements of the DCS without compromising the safety requirements of the ESD and F&G systems.

Figure 1 provides an indication of how a modern integrated control system may be implemented.

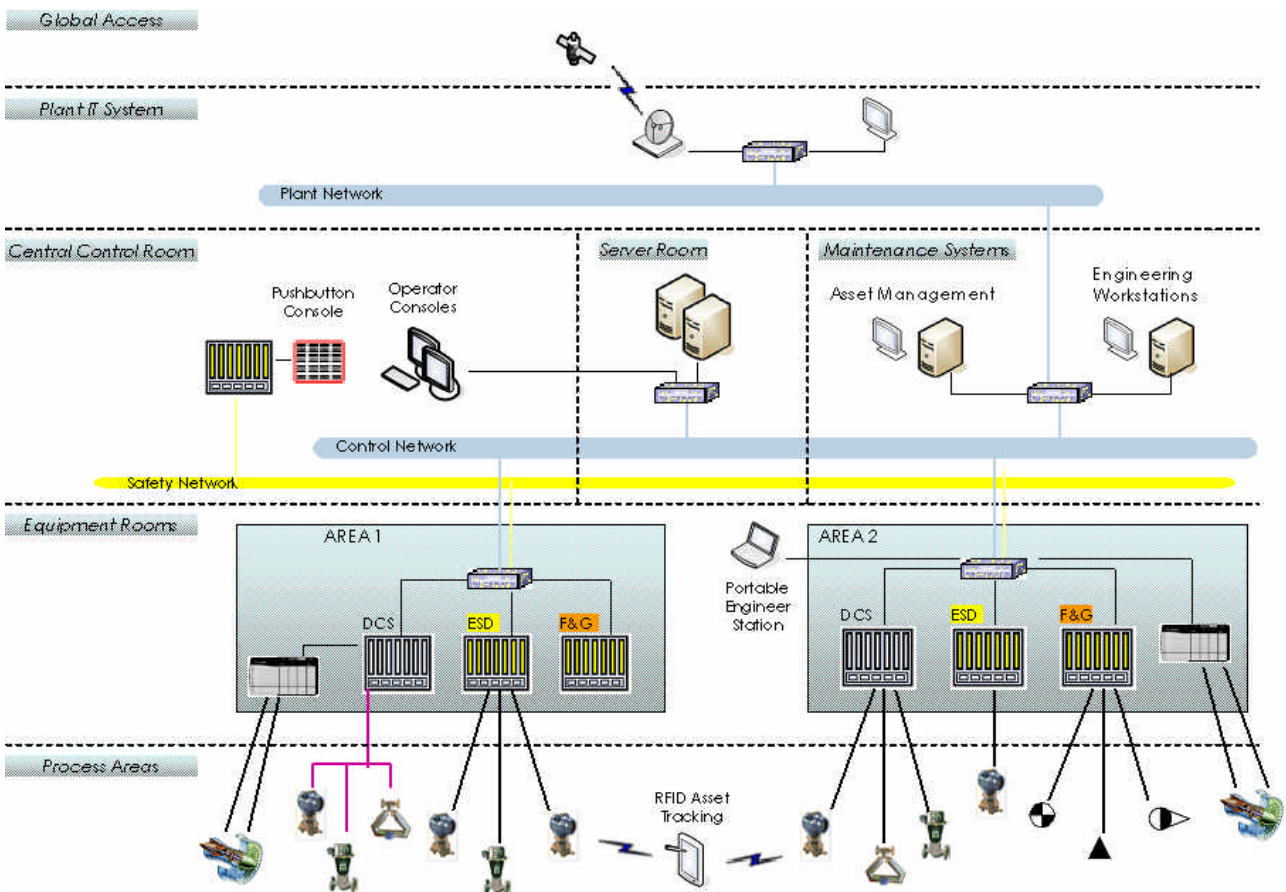


Fig 1 Typical ICSS Architecture

Modern integrated systems are available from a variety of well respected, global system suppliers. The majority of suppliers use Ethernet technology to provide high speed communication between system components. Safety systems are either based on the DCS hardware or, in some cases, are 'bought-in' safety solutions integrated with the DCS to provide ICSS operability. Fibre optic technology is often used to facilitate the process control network as it is impervious to electrical noise and provides long transmission runs without the need for repeaters. Servers and operator interfaces tend to be based on standard and industrialised PC offerings and make use of RAID hard disk arrays and redundancy where necessary.

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The Future

The digital world is shaping the modern world and its influence on the process control industry has had massive effect over the last two decades and it continues to grow. The application of Ethernet technology to deliver process control networks during the 1990's opened the door to development of the ICSS. The introduction of instrument bus technologies such as Profibus and Foundation Fieldbus are now bringing the ability to further distribute the process control algorithms to the field instrumentation. This capability provides truly distributed control and leads to the possibility that the architecture in Fig 1 may soon be transformed. It is conceivable that that the need for the equipment room layer shown in Fig 1 will be dramatically reduced in size or perhaps even removed as the ability to provide high speed communication between field instruments and the capability for these devices to execute complex control algorithms becomes a reality.

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