

Advancing Control System Technology for Your Power Plant

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ABSTRACT

With over twenty years deploying advancing technologies, microprocessor based Distributed Control Systems (DCS) are now powerful assets for new and modernized power plants. Historically, Power Generators depend on the control system to provide the most reliable means for control, operational efficiency and advanced process optimization. The latest DCS designs are now available to support plant owners with new business goals to improve overall effectiveness in operations as well as optimizing maintenance routines at the plant level and even across an entire corporate fleet.

Recalling only a short time ago, mid 1990's, the primary industry push was for open systems. Now, not only has the open system goal been met but it has been greatly surpassed to a point that the control system now provides a security conscious 'open system' that is 'tightly integrated' and at every level from field I/O to corporate networks. This technical paper provides an overview of control systems and how they have evolved to provide the most current technologies available now. The paper reflects upon system requirements being driven by plant developers, industry standard groups and owners, and also explains how to tightly couple the control system with smart and predictive maintenance applications. The 'secure open system' is important for Power Generators who are most interested in improving O&M for their plants while maximizing return on investment for their control system. Finally, based on emerging technology, a look at possible future evolutions in control systems is discussed.

KEYWORDS

DCS – Distributed Control System
I/O – DCS inputs and outputs either hardwired or through soft interface
PC – Personal Computer
HMI – Human Machine Interface
PID – Proportional Integral Derivative Control Algorithm
Data Link – DCS Soft interface

API – Application Programming Interface
OPC – Ole for Process Control standard for soft interface over Ethernet
VMS – operating system used for operator workstations
@aGlance – Process data interface available over Ethernet
Inferential Smith Control – Advanced model based DCS function code
OEE – Overall Equipment Effectiveness
O&M – Operations and Maintenance
I&C – Instrumentation and Control
P&ID's – Piping and Instrumentation Drawings
AO – Asset Optimization
CMMS – Computerized Maintenance Management System
OPC DA – Data Access
OPC AE – Alarm and Event
OPC HDA – Historical Data Access
Green Field
Brown Field
EPC – Engineer Procure and Construct plant design firms
FF – Foundation Fieldbus
HSE – High Speed Ethernet
SOE – Sequence of Events
CIP – Critical Infrastructure Protection

INTRODUCTION

This technical paper reflects upon the ~~technology of distributed~~ control systems as applied to electrical generating power plants. With over twenty years of ongoing development, the industry has witnessed three major generations of DCS system evolution. While specific system release dates vary between vendors, generally the first generation DCS evolved over the 1980's, second generation during the mid 1990's and third generation in the mid 2000's. With each major system release many new DCS system capabilities and features have been added, effectively providing new benefits to plant designers and plant owners. While the subject material can be extensive, the context of this document is to provide an overview of the key elements which have shaped the way DCS systems are applied in a functional power plant application.

This document provides separate sections for each of the three major generations of DCS system evolution. Beginning with the 'Early DCS' of the 1980's, to the 'Open System' of the 1990's and into the latest technology available today with the 'Third Generation' DCS, this document discusses plant owner and designer requirements as well as how the technology at the time provides benefit. Also a fourth section is provided that discusses possible future evolution with DCS development.

EARLY DCS - MICROPROCESSOR BASED CONTROL

While the official introduction of the microprocessor based distributed control system occurred prior to 1980, systems of this vintage were typically limited to simple loop controllers with minimal data acquisition capabilities. The most significant feature for the early DCS, was the ability to geographically distribute control system processor and I/O components, thus benefiting plant design by greatly reducing the amount of field wiring needed between control equipment and field instruments. As the First Generation DCS system evolved through the 1980's, advances in microprocessor and PC technology enabled many new features and enhancements such as processor redundancy, soft CRT HMI and PC based engineering tools.

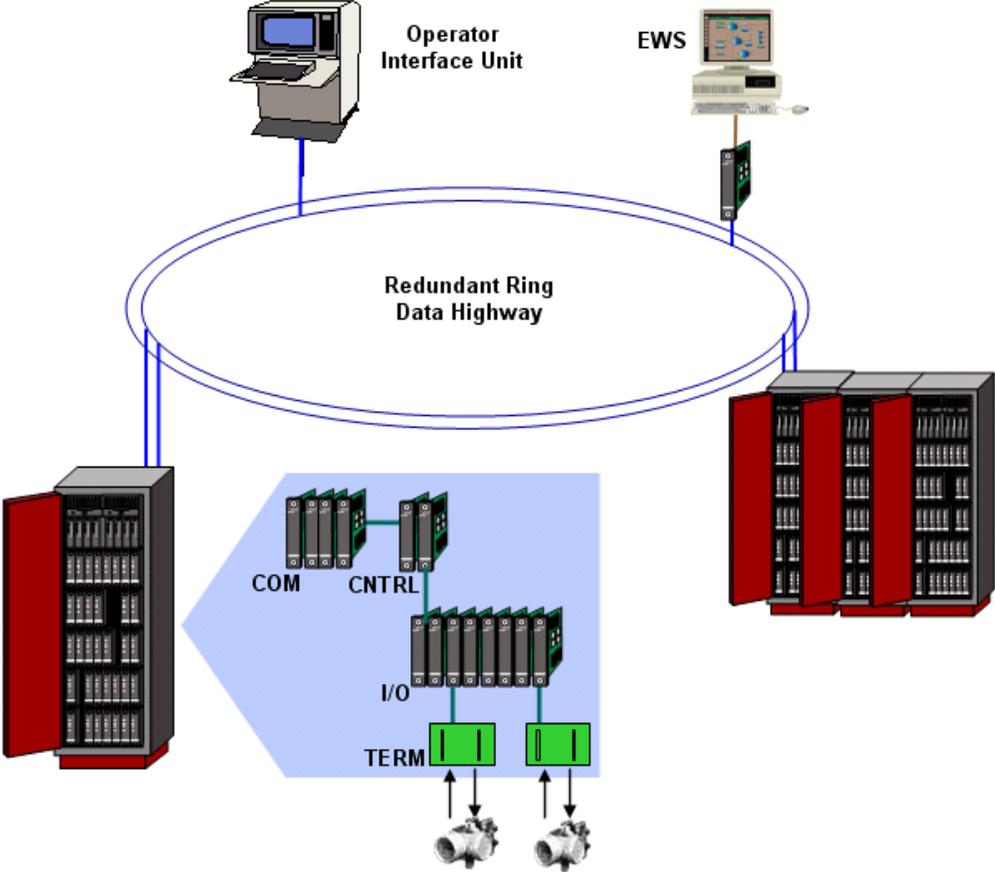
First generation systems were promptly welcomed by utility and process industry segments as the DCS offered, at the time, something completely new—the ability to execute complex control strategies within a reliable and redundant microprocessor based digital controller. Control systems of this period evolved to include PC based engineering and system verification tools that employed a new approach for designing process control logic called either 'function code' or 'function block' programming. In relatively short time, function codes became both popular and powerful with DCS systems affording many new variations of block types from simple Boolean functions through advanced algorithms for analog PID control. Function codes, which are controller library elements, simplify both the visual representation and logical implementation of large and complex control strategies. Function codes still remain accepted within the utility and process industries and are widely used when programming control systems of today.

First generation DCS innovations also included, modular packaged hardware for powering and processing all the necessary I/O types, integrated versions of rugged and modular I/O terminations, integrated hand stations and also an integrated operator interface station with ability to display control faceplates, process control graphics, trends, alarms, logs, reports, control system health and other data for operations. While control system hardware afforded a clean modularized approach that could be packaged and sized for small to large process control applications, the integrated system utility software allowed all the DCS components (controller, I/O, operator station and engineering tools) to work together and be closely coupled for speedy performance and integrated system diagnostics.

Reviewing the early DCS system designs, the primary focus was to deliver redundant, reliable, rugged and predictable control system hardware and software. The DCS modular package proved advantageous when used with either Utility green field or control system retrofit applications. The DCS also delivered the ability to provide flexible application software. With technology advancements in controller memory and speed, the control system engineer quickly realized that control logic strategies would truly only be limited by the engineers' imagination. Collectively when compared to the predating technologies of plant computers and electrical analog control systems, the 'early DCS' really stands out as a tremendous leap in technology for the time period. First Generation systems were built using proprietary technologies. Thus third party connects were considerably

limited to custom developed interfaces. Realizing this limitation is one factor that led to the next generation 'Open System' DCS.

Figure 1: Example First Generation DCS



THE 'OPEN SYSTEM' DCS

Around the early 1990's, DCS systems began to be recognized as an optimum strategy for gathering and integrating data from the various automation systems within a plant. Perhaps the strongest driver for 'open' technology, users desired a 'single window' concept where the plant DCS served as the single point of integration for other sub system controls. Whether building a new green field site or adding a new plant process to an existing power plant, quite often, PLC controls were delivered as a packaged component along with the plant subsystem mechanical equipments. As a result, several DCS

interfaces were developed to effectively merge data from subsystem automation systems along with the data from the plant DCS. Also, a key driver for 'open' technology, power generators began to specify that control system data be made available to corporate networks. The concept of the fleet management center would be afforded through DCS 'open interface' to plant LAN and corporate WAN. The advantage for plant owners was the ability to view, monitor and analyze all plant process data remotely with a team of experts in one common location for many plants. This afforded the opportunity to assist plant operations by providing unit efficiency analysis and supporting additional coordination between units.

The concept of the 'Open System' DCS was to provide new interface connections that would allow the control system to openly communicate with third party applications. However, accomplishing this required a major control system R&D effort. New hardware and software were needed to support interfaces at multiple layers within the DCS (impacting controller, communication network and HMI). Including both forward and backward compatibility between the earlier generation DCS and the new open system technology was also a common design goal. With open interfaces available at multiple layers within the DCS system and the system evolution capabilities fully developed, the open control system was released in 1992. This effectively was the Second Generation DCS.

For connections made to the DCS controller, the 'open system' provided both standard and custom serial drivers that were capable of communicating to a wide range of plant devices such as PLC systems, vibration monitors, relay protection, process data recorders and many others. These interfaces evolved to support data link redundancy, control variable inter-locking, supervisory control and applications for data acquisition. The most common 'standard' protocols afforded included serial Modbus as well as other vendor specific open PLC protocols.

For connections directly at the control network, a PC based 'Open API' was developed to serve as a high performance data pump when Ethernet connectivity was required. Ethernet interfaces, when used for control integration, were developed to support integrated time-stamp applications. With this option, a master clock is used to synchronize time for multiple systems. The Ethernet interfaces evolved to support link redundancy, alarm transparency between systems (i.e. alarm and event), and integrated sequence of events recording. These capabilities soon became foundational requirements for Ethernet used with process control which later evolved into standard OPC.

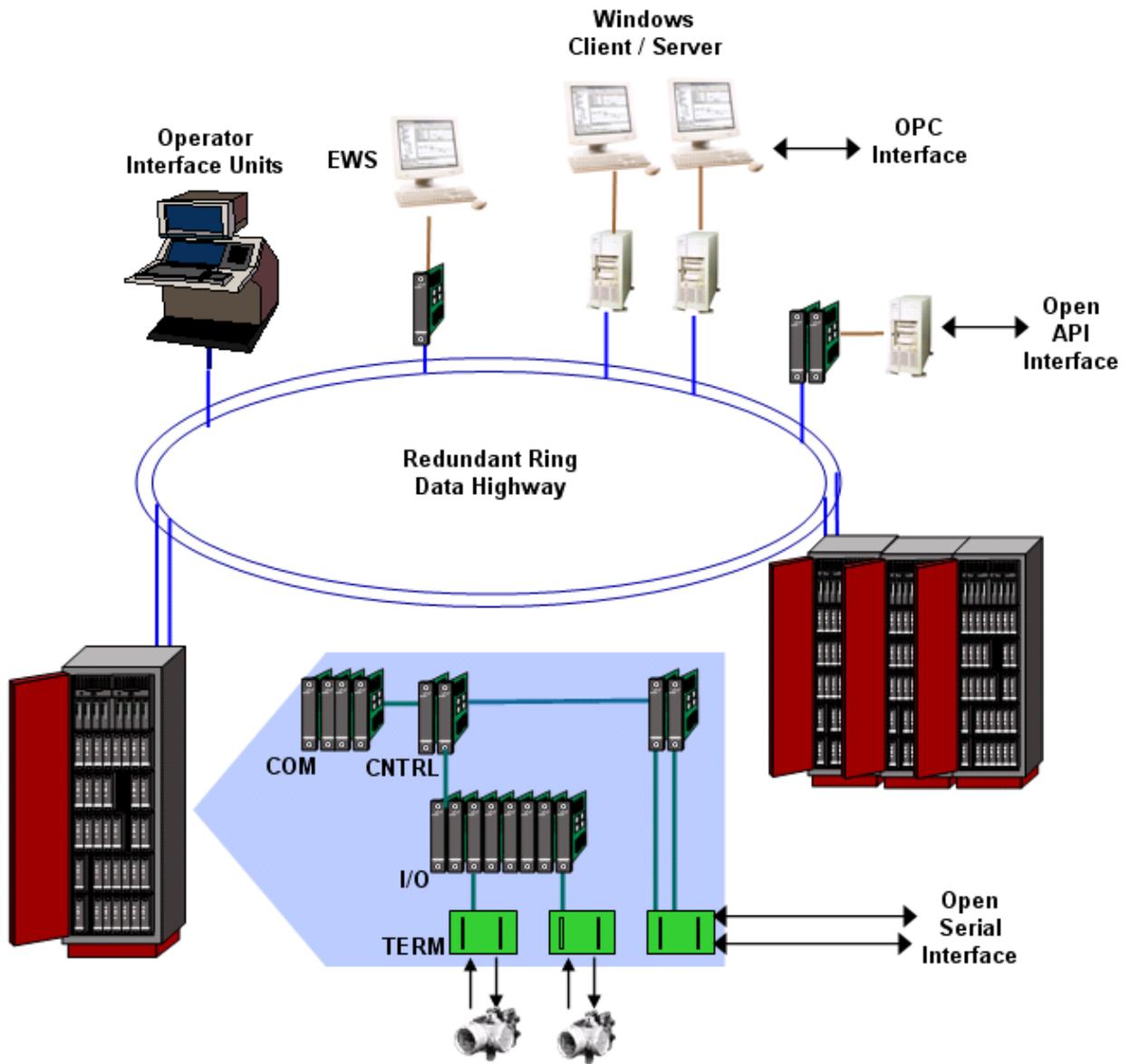
At the operational network level, Microsoft Windows technology emerged to play a significant role within the 'open control' system. For the HMI, Windows NT operating system clients would replace older technology VMS and UNIX clients. Additionally, completely new Windows based client/server systems were developed for the HMI and also for the engineering work station. The industry demand for the standard Windows technology was very strong. Using the PC technology and applying standard Ethernet permitted the use of commercial off-the-shelf hardware for PC's, network switches, routers, media converters and cabling. This was recognized as a new benefit as DCS vendor proprietary equipment would not be necessary for the DCS operational network components (HMI and

associated equipment). It was recognized as well that the HMI platform could also be used to drive open interfaces and initially middleware software such as @aGlance server was included with systems. This was then followed by OPC which further supported the ability to provide yet another approach for open connectivity.

Second Generation DCS provided several other innovations. These included, but were not limited to, integrated distributed sequence of events recording, fiber optic operator and control network communications, integrated combustion and steam turbine controls, advanced process modeling function codes (i.e. inferential Smith controller), OPC client and server, advanced combustion optimization, single pushbutton plant startup and shutdown, web server for HMI process displays, scripted logical code for graphic elements, 3D graphic elements, high-fidelity simulated simulators, and several others.

Summarizing 'Open System' technology, DCS vendors did hold true to their commitment to deliver open systems. While some of the early technology API's provided vendor specific protocols which were often cumbersome to use, these were then superseded by consistent industry standard Ethernet interface protocols. The connection products provided plant owners with new opportunities to improve plant and fleet operations and efficiency. Integrated PLC and other plant device data within the DCS, provided 'single window' operational views for plant process data. This allowed for consistent plant process information to be delivered to the plant operator (common DCS presentation for reporting, alarming, trending and graphical display). DCS bulk data integration with plant historians provided the ability to easily communicate large data sets over corporate networks to fleet management centers for real-time process data analysis. Some plant owners implemented enterprise solutions which use DCS process data as well as engineering tools to effectively trouble-shoot systems and processes remotely over the corporate network. The shift to Windows technology was established and delivered in full strength for the operator HMI and EWS. While the advantages of using commercial off the shelf equipment were realized, also it became necessary for DCS system users to become more proficient with the computer IT related network set-ups and trouble shooting techniques. In general, this meant new challenges for the control system engineer and maintainer. Ethernet, Windows OS client/server, TCP/IP, DCOM and other technologies forced new training for control system engineers and plant I&C staff. Additionally, some plant owners elected to have involvement by the corporate IT personnel whenever DCS connections were made to corporate networks. Security, in the sense of system integrity, began being addressed. System login, anti virus, secure modem access, tools for PC maintenance were regular project considerations. As time progressed through the 'open system' time period, security was a growing initiative. However, over the follow-on years, the issue of DCS system security has grown to a major consideration.

Figure 2: Example Second Generation DCS



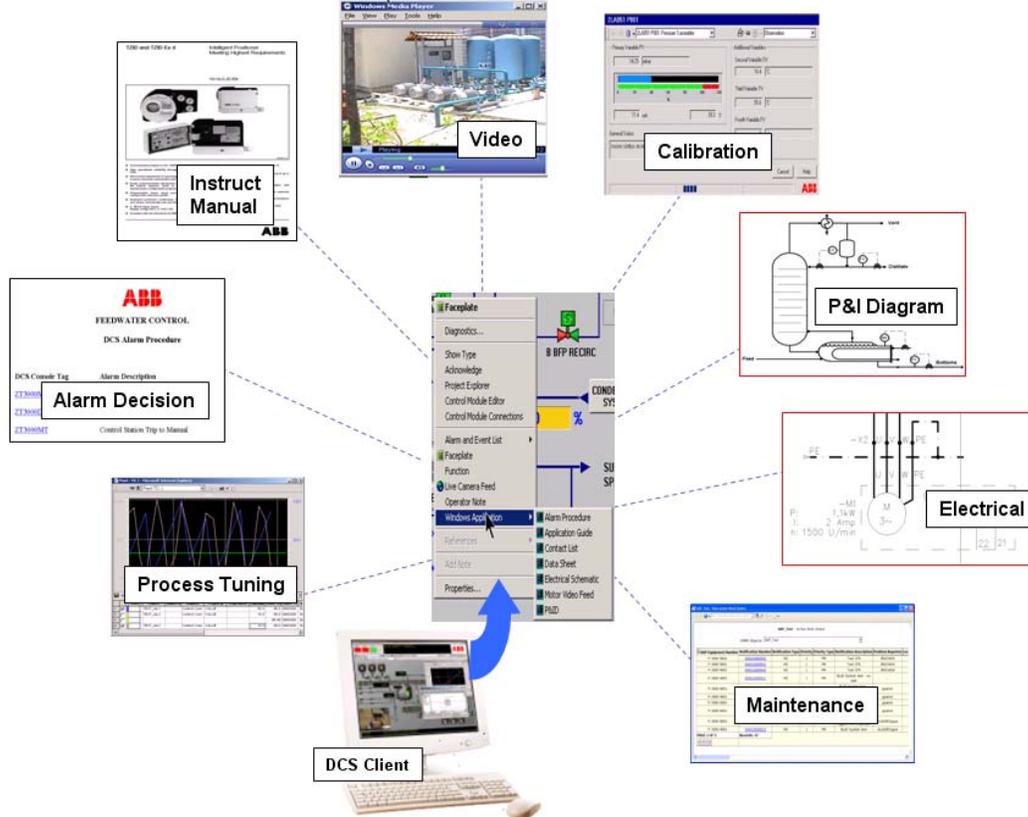
'THIRD GENERATION' DCS

Similar to many industries of today, power generators are faced with intense pressure to improve bottom line profitability. This is influencing new business goals directed at power plants to focus on increasing operational efficiency and overall equipment effectiveness (OEE). OEE, a tool used to identify production loss and asset availability, is applied to improvement programs driven to increase plant availability and maximize plant performance. Supporting plant owners with the business goals, 'to improve plant operations and OEE', the 'Third Generation' DCS, provides a system that can deliver the right information to the right person at the right time for informed decision making. Extending from the previous 'open system' technology, where process data interfaced with the DCS was simply 'made available' for integration, the 'Third Generation' DCS now uses powerful object oriented design technology to tightly integrate process data with asset optimization and maintenance management systems as well as provide simple access to any O&M information that is available for the plant or fleet. The ABB DCS system for deploying these strategies is Industrial IT System 800xA, an example of 'Third Generation DCS'.

ASPECT SYSTEM TECHNOLOGY

Enabling tightly integrated information throughout the DCS system required a major development effort. The DCS system was re-designed to use a new object oriented technology called 'aspect system' that is embedded within the platform core. Aspect system technology provides an enterprise-wide data management and decision making tool in addition to an operator's console. The technology allows any O&M information to be linked to DCS graphical objects, thus affording all users from plant operators to executive managers with individual views into their plant processes. Providing the right information to the right person at the right time for informed decision making is the premise and an effective time saver that increases operational efficiency. Examples of graphical object 'aspect links' applicable to plant operators include, alarm decision procedures, standard operations manuals, live video feeds and many others. Similarly, links for I&C personnel include trouble-shooting information such as plant P&ID's, owner's manuals, equipment specifications and application guides. Links used by maintenance include work orders, fault reports, spare parts. Permissions can be set to manage individual user views as they relate to each of the aspect links, this insures that only operators can operate, I&C can maintain equipment, engineers can tune and etc. As links may be used for application launches as well as all the typical document formats, the possibilities for operational efficiency improvements are unlimited.

Figure 3: Example Aspect Links



ASSET OPTIMIZATION TECHNOLOGY

Supporting plant owner goals to increase OEE through increased plant availability, asset optimization tools are now available within the DCS. Asset optimization, which is used for predictive maintenance, increases plant availability by extending the life of plant assets and by avoiding unplanned shut downs. For each plant asset, a logical analysis is provided called the 'asset monitor' which provides 24/7 supervision of the plant device or process. Asset monitor options can be scaled to include any quantity of assets from plant to fleet. Example asset monitors include DCS control components, PC and network equipment, smart instruments (HART, Foundation Fieldbus & Profibus), control loops, plant equipment pumps and drives, and power plant processes such as feed water heaters, water quality, exchangers and many others. Providing 'Unified Information', the asset optimization is directly integrated with the computerized maintenance management system (i.e. SAP, Maximo). From DCS graphical displays, plant I&C staff can access work orders, spare parts and any maintenance activity as well as rely upon the DCS to identify asset problems and automatically generate the fault reports that are downloaded into the CMMS system.

EXPANDED CONNECTIVITY FOR PROCESS CONTROL

Third Generation DCS control processors have been expanded to support many new options for connecting plant process control equipment. HART, OPC, Modbus TCP, Modbus RTU, Profibus, Foundation Fieldbus and Device Net are supported for redundant controller applications. This provides plant designers with a high degree of flexibility for control system layout as well as final control element device selection. Additionally, specific to power plant applications, controller extensions are included to integrate DCS specialty hardware for turbine control (over speed, auto synch, valve position), vibration monitoring and flame scanner applications.

Controller and I/O modules have been re-designed to occupy a much smaller foot print than previous generation DCS systems. The components are DIN rail mountable and operate using 24VDC supply voltage. This affords a more scalable solution for DCS system layout as it is much easier and economical to physically distribute remote I/O clusters throughout the plant. The advantage now is that DCS I/O can be distributed to support all sub system controls, thus affording a common platform and control strategy for the total plant.

Integrated field bus is a significant DCS enhancement. Supporting intentions to save wiring and installation cost, plant designers (EPC's) are now specifying field bus applications for new 'green field' and 'brown field' plant sites. The field bus strategies applied most recently within U.S. power plants includes Foundation Fieldbus, Profibus and DeviceNet, and it is common to use a mix of these protocols to achieve an overall plant design. Each protocol offers situational advantages that relate to differences in control communication speed, requirements for bus and instrument power, redundancy, and the availability of certain protocols with certain devices. The latest DCS offerings provide a highly flexible approach for integrating field bus protocols (FF, Profibus and DeviceNet). Multiple field bus networks, of varying types, can connect to a common and redundant DCS control processor set. Additionally, redundant communication is provided for extending high speed field bus layers (FF HSE and Profibus DP) into field locations. All of this allows for an efficient and effective DCS architecture layout with centrally located control processors communicating with various remotely distributed field bus trunk and segment layers.

Field bus integration can be applied to smart process instruments as well as with plant electrical gear (MCC's and Switchgear). For many years, switch gear protective relay interfaces have been limited to transferring data acquisition type signals into the DCS. However, the digital field bus options now enable an effective means to provide DCS initiated control actions as well as the data acquisition for plant electrical equipment. As electrical gear is generally dense with DCS I/O, there poses a strong opportunity for significant wiring and installation cost savings. Therefore, plant designers are now specifying the digital bus options for controlling these electrical equipments. Electrical equipment manufactures are providing connection options for Profibus, Device Net and IEC61850. DCS connectivity is compatible for Profibus and Device Net while new development is underway for IEC61850 integration.

Perhaps a word of caution related to field bus, considerable engineering attention is required when designing field bus applications. Complexities such as instrument partitioning, segment limitations, power conditioning, instrument power, instrument firmware and many other variables need to be taken into account. DCS vendors are now providing valuable consultation, early in the plant design stage, to assist plant designers (EPC's) and owners and insure best practice field bus designs are followed.

ENGINEERING TOOL ENHANCEMENTS

The DCS engineering tool has been enhanced to enable user definable objects as 'library function blocks'. This approach allows complete control strategies (i.e. Motor Operated Valve Control) to be designed into a single function block that is available as an element within the project configuration library. As the function block is used with many devices throughout the project, it maintains its reference to the original library element ('inheritance'). This allows for consistent design approach for all similar plant devices and also simplifies control configuration maintenance when code modifications are required.

Function block programming still remains widely used for power plant control applications. The engineering tool supports many new libraries for function blocks and also carries forward a function code library consistent with previous first and second generation DCS systems. In addition to function blocks, the engineering tool supports programming for ladder logic, instruction list, structured text and sequential flow charts. Supporting IEC 61131 in addition to libraries from the previous first and second generation DCS provides considerable flexibility for the logic designer programming controller configuration.

Configuration tools provide an integrated engineering environment. 'Unified Information' is afforded through integrated field bus management tools that allow plant I&C staff to access bus builder and calibration tools for HART, FF and Profibus directly from the graphic or engineering design objects. The user can monitor control configuration and also tune from the engineering tool CAD logic and take advantage of aspect linking technology and embed useful documents and charts, such as Pump Curves, Motor Curves, Steam Temperature Tables and other engineering data.

DCS SECURITY AND THE 'OPEN SYSTEM'

Third Generation DCS is built upon open standard technologies and makes extensive use of Windows OS, Ethernet and OPC. Windows client/server is used for the HMI applications and can be expanded to support remote terminal server, remote operator workplaces, thin client and remote access for history and asset management. The systems also offer extensive connectivity options which have grown to include OPC DA, AE and HDA along with full client and server redundancy and on-line brokering of interfaced data. Moving toward open system technology does in effect 'open the door' for increased control system security risk. As Windows and Ethernet technology are widely used within practically all industries known to man, so then, there are more people who become

knowledgeable of not only the benefits of the open technology but also the potential vulnerabilities. New Critical Infrastructure Protection (CIP) regulations recently adopted by NERC and FERC, have spawned many DCS and SCADA security related organizations, committees and discussion groups. Effectively, the subject of DCS security poses new challenges for plant owners as well as DCS vendors.

From the plant owner perspective, security procedures must be documented and adopted by system users, operations and maintenance. The procedures need to be maintained and updated whenever changes are required. Internally, procedures should be enforced to insure appropriate operational behavior and compliance. Plant owners will tailor security procedures as necessary to support plant specific and fleet-wide goals. Ultimately, the procedures are owned by the power generating company and these will need to be defended whenever regulating bodies perform DCS system security audits.

From the DCS vendor perspective, secure solutions will continue to be made available. Industry requirements and trends need to be tracked and accounted for within the overall DCS design. Consultation to end users will be provided to understand any unique security requirements then to work with the users to deploy a specific security strategy. This requires personnel that have a strong background with Windows networking applications as well as an idea of what is accepted practice for secure process control, control system change management and the inherent security tools within the individual OEM control system. Configuring the Windows applications, security is used to manage user login, PC node access and etc. At the control system, typically user access rights are set to define 'who can control plant devices', 'who can make system changes', 'who can tune control loops' and etc. Example strategies that are currently used to support control system security include domain group policies and group user accounts, anti-virus, certified security appliance devices, routers and firewalls, intrusion detection systems, audit trail systems, procedures for physical security, options for disaster recovery and others.

We can expect that DCS security will receive considerable attention well into the future. With many federal and private agencies involved, definition of industry regulations and control system guidelines will be ongoing for many years. Solutions provided by DCS vendors will adapt to the latest industry requirements. The vendors will also support users with any specific requirements. With planning, secure solutions can be designed into every control system project that is delivered. Early consideration of plant security requirements is recommended during the beginning of a new control system project. Project meetings should be coordinated to discuss the plant policies such as operational requirements for login, system access, configuration rights, system administrator role, potential involvement of corporate IT personnel and others.

POWER PLANT SIMULATORS

Simulator systems have been available for many years and one of the common goals of a plant simulator is to help plant operations become more proficient with running the power plant. Keeping

the plant on-line and available to produce power is due to experienced operations and the ability to react quickly to 'save the unit' during process excursions. Simulator systems also provide excellent testing grounds for DCS system logic configuration changes as well as a good training tool for DCS maintenance. In earlier versions, power plant simulator systems were offered as controller hardware based 'stimulated' or a PC based 'emulated' simulators. New developed DCS OEM simulator technology provides a 'virtual' training simulator. Virtual simulators are PC based environments for running the DCS controller configuration. They use only a small foot print, can run an excess of 20 controllers on a single PC node, and are much easier to maintain when compared to the hardware based stimulated simulators. Differing from emulated simulators which previously provided an estimate of the running controller code, the virtual approach uses the OEM control processor algorithms to provide the exact match for execution of the controller application code. The virtual approach allows for standard DCS HMI and engineering tools to be used with the simulator system and without the need to translate controller configuration from the actual running plant controls to the simulator. Simulation runtime features are included to afford simulation run, freeze, speed up, slow down as well as other features.

FUTURE DEVELOPMENTS

One future expectation is that field bus trunk layer communication will evolve to Ethernet. This will allow for a common Industrial Ethernet Field Network to be designed that will eliminate the current need to run multiple physical media types for trunk layers when multiple field bus protocols are used. Plant designs will be able to distribute a redundant fiber optic common network trunk to all areas of the plant which are utilizing field bus instrumentation. This will promote a consistent design approach for the field bus network equipment as well as consistent tools used to design and maintain the trunk layer. Also, with less 'protocol specific' cabling, a more cost effective plant cabling design can be installed. Other potential benefits include synchronized event logging and a consistent security model. Expectations are that the Industrial Ethernet trunk will support various field bus instrument protocols which can be mixed onto the common network. Segment drops off the main trunk will be used to connect clusters of instrumentation equipment. Perhaps these drops may consist of Profibus DP, Profibus PA, FF H1, Profinet, HART, DeviceNet and others.

DCS controller connectivity is currently under development for integrated Profinet. Profinet uses standard Ethernet as backbone communication and is expected to be compatible with the Industrial Ethernet Field Network approach mentioned above. Profinet will be compatible with Profibus and is expected to provide field bus communication for process instruments as well as for low voltage plant electrical components such as switchgear, MCC's and drives. DCS integration for Profinet will include control, signal monitoring, asset optimization and device management tools.

DCS controller connectivity is currently under development for integrated IEC-61850. IEC-61850 uses Ethernet as backbone communication and will enable DCS controller integration for medium and

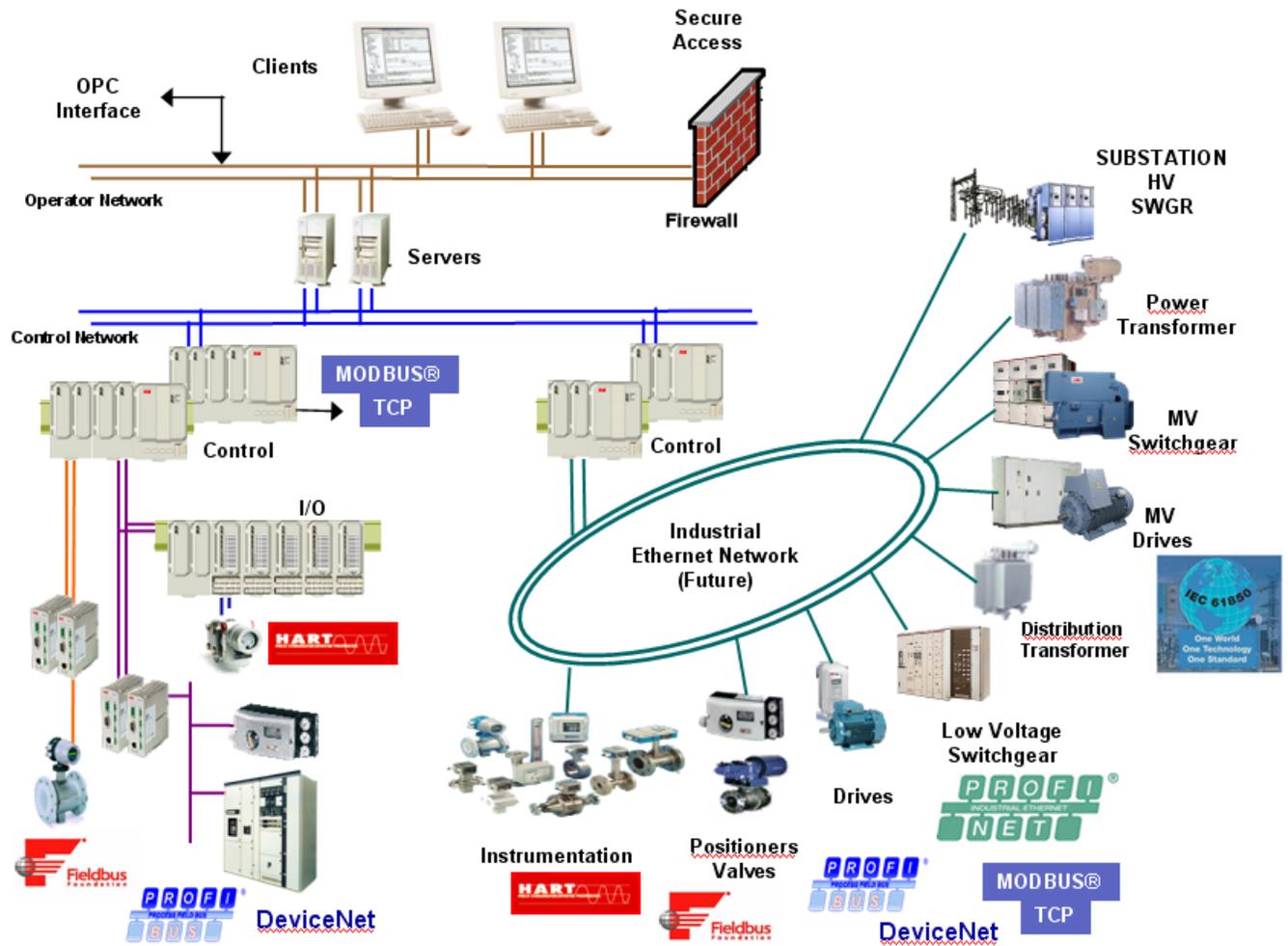
high voltage electrical equipment. Used with electrical power distribution and substation equipment, IEC-61850 is being deployed within medium and high voltage drives, switchgear, motor starters, relay protection, generator and transformer protection, excitation and synchronization. DCS integration with IEC-61850 will include control, monitoring, asset monitoring, time stamp and integrated configuration tools to program the Intelligent Electrical Devices. With Profinet and IEC-61850 and an industrial Ethernet, it is expected that the DCS will be able to tightly integrate electrical system packages along with instrumentation for process control into a common system.

Outside of additional protocols, field bus deployment may be influenced by underlying configuration and maintenance utilities such as EDDL, FDT/DTM and potential merger of these into a common Future Device Integration.

Anticipate power plant applications will make more use of wireless. In cases where laying out field cabling is difficult, wireless offers a key advantage to make installation simple. Potential applications include roaming HMI's using wi-fi, alarm management and maintenance alerts using SMS messaging and many new options for wireless instrumentation and machinery condition assessment.

Attention to DCS system security will continue to grow. Expect industry regulations to be refined. Control system security audits will be conducted by regulating agencies and these will reveal new potential weaknesses that will need to be addressed. In all, DCS vendors will work closely with end users for project planning, implementation and commissioning of secure DCS secure strategies. May also see biosensor based verification systems to help manage secure login for operations.

Figure 4: Example Third Generation DCS



SUMMARY

For over twenty years, distributed control systems have played an integral part of modern power plant design. Invariably, with DCS systems of past and present, the plant control system remains as the critical component that power generators rely upon to insure safe, continuous and reliable process operations at all times. While control system integrity and safety remain as cornerstone requirements, many new features have been added over the years offering remarkable benefits to owner operators as well as plant designers.

Many First Generation systems are still in operation today and performing as designed controlling power plants. However, First Gen systems were built using proprietary technologies and interface capabilities were very limited. While Second Generation systems emerged with 'Open Technology', these effectively provide 'open interface' solutions. The latest DCS offerings 'Third Generation' systems are built upon an object oriented design technology offering tighter integration of data and other plant O&M information to afford new operational and maintenance benefits....

- Aspect system technology enables plant process and maintenance information to be integrated within the DCS and organized so that it is readily available to the right person at the right time for informed decision making. Asset optimization, also with integrated maintenance management, provides real time diagnostics related to the health of equipment and processes. These are examples of how the latest DCS technology can support a power plant owner interested in increasing operational efficiency as well as improving overall equipment effectiveness.
 - The incorporation of object oriented design technology simplifies control system navigation. This can be applied to improve operational response times during process upsets as well as making more efficient control system maintenance and trouble-shooting.
 - The ability to inherit library attributes within control application software simplifies configuration maintenance when control system changes are needed.
 - Available today, there are many options for integrated field bus support also with integrated device management tools and integrated asset monitors.
 - Modular DIN rail design for controllers and I/O makes it easy to distribute controllers and I/O through out the plant or use the centralized controller concept with remote I/O drops for fieldbus as well as hardwired.
 - Virtual simulator systems offer small footprint, are easy to maintain and provide control loop execution that is 'true' to the actual plant controls. The most realistic operator training can be provided when integrating the actual HMI and engineering tool platform along with a virtual simulator.
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- Extensive use of Windows, Ethernet and OPC enables many options for openly integrating a multitude of applications while using commercial off-the-shelf technology.

While there are many advantages to applying the open technologies (Windows, Ethernet and OPC), it is important to recognize the potential security risks when using them. With upfront project planning and having the right people involved, secure and regulator compliant DCS solutions can be delivered. Additionally, having someone with process control plus some level of IT experience on your team can be very valuable when dealing with the network and security related DCS issues.

Many DCS system changes have occurred within the past 10 years. Expect several enhancements with field bus and common industrial Ethernet as well as strong attention to security and new applications for wireless. Look forward to equally fast-paced changes over the next decade.