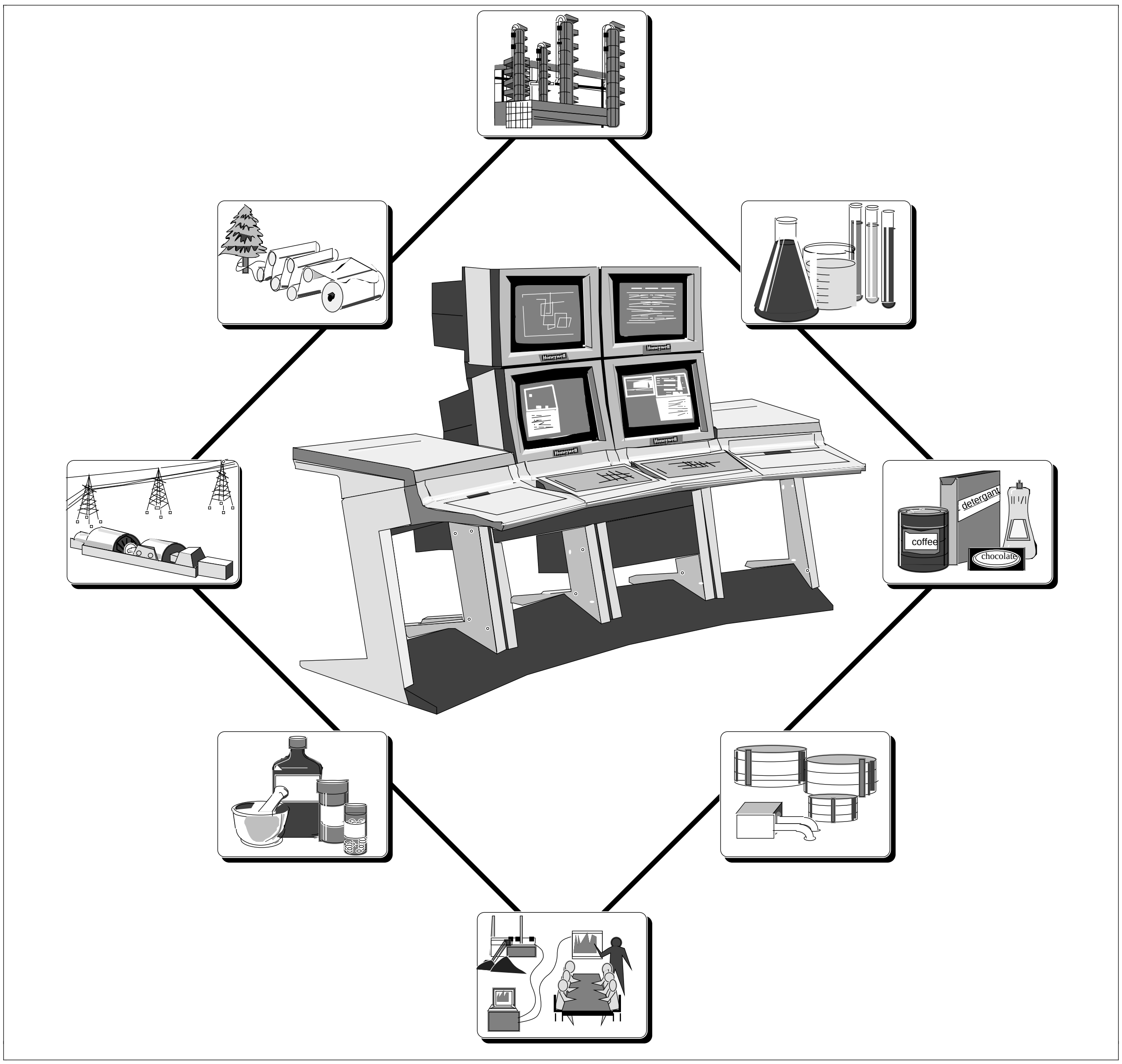
Honeywell

System Technical Data

SW03-500



Honeywell

System Summary

System Technical Data

SW03-500
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About This Publication

This document provides a high level description of the TDC 3000X system. It describes how the TDC 3000X fulfills the information and control requirements of your process. It provides an architectural description of the TDC 3000X system, followed by brief descriptions of the networks and their components that make up the TDC 3000X system.

Various products and components referred to in this document are supported by various software releases, and all described products and components are supported by software release 500. If you would like to know which components of the TDC 3000X system are supported by a given software release, contact your Honeywell representative.

A reference list of product-specific Specification & Technical Data documents is included.

Finally, to help you better understand how the TDC 3000X system can fulfill your specific needs, a section is provided that defines what additional components can satisfy special needs and required enhancements that many of today’s control processes may have, such as advanced control and connections to a Plant Information Network (PIN).

Table of Contents

Figures and Tables

Acronyms

A-MC....Advanced Multifunction Controller
AM....Application Module
APM....Advanced Process Manager
ARM....Archive Replay Module
A^{X}M....Application Module^{X}
BOS....Basic Operator Station
CB....Basic Controller
CG....Computer Gateway
CLM....Communications Link Module
DECnet....Digital Equipment Corporation Network
DHP....Data Hiway Port
EC....Extended Controller
EPLCG....Enhanced Programmable Logic Controller Gateway
HG....Hiway Gateway
HIM....Hiway Interface Module
HM....History Module
LAT....Local Area Transport
LM....Logic Manager
mbps....Million bits per second
MC....Multifunction Controller
NG....Network Gateway
NIM....Network Interface Module
ORU....Optimum Replaceable Unit
P&ID....Piping and Instrument Drawings
PCNM....Personal Computer Network Manager
PID....Proportional Integral Derivative
PIN....Plant Information Network
PIU....Process Interface Unit
PLCG....Programmable Logic Controller Gateway
PLC....Programmable Logic Controller
PLNM....Plant Network Module
PMC....Purchased Material Control (software)
PM....Process Manager
rf....Radio Frequency
QCS....Quality Control System
UAC....Uninterrupted Automatic Control
UCN....Universal Control Network
US....Universal Station
U^{X}S....Universal Station^{X}
VAX....Virtual Address Exchange (DEC computer)

Section 1 – Introduction

1.1 Overview

System Overview

TDC 3000X represents Honeywell's latest advance in sophisticated systems for control of modern industrial processes. TDC 3000X raises the highly successful TDC 3000 to a new level of power and functionality. It provides integrated data acquisition, control, and a powerful operator interface. This is accomplished using a single window to the plant, and can include integrated advanced control. It also now includes the capability of inputting information from external UNIX-based stations directly to the operator's display screen simultaneously with the process display.

Like TDC 3000 in the past, TDC 3000X is the system that will continue to meet the expanding and changing control system requirements of the nineties and beyond. Honeywell continues its commitment to the concept of Consistent Evolution, whereby products, functions, and services are continuously enhanced without making previous investments obsolete.

This commitment began in 1975 when Honeywell introduced the concept of *distributed* architecture to the marketplace. TDC 2000, consisting of its Data Hiway communications network, controllers, operator stations, and other devices, can be made an integral part of today's TDC 3000X. As a result, TDC 2000 users are able to take advantage of the latest functionality at a significantly reduced cost.

What's in this document?

This document contains system-level technical information about TDC 3000X. The first section following the Introduction describes the information and control requirements that TDC 3000X satisfies. The next section describes the "parts" of the system and how they fit together—the system architecture. Next is a discussion of the topics to be considered when selecting a TDC 3000X system. The final section describes the dependability, maintainability, and support features of the system.

Section 2 – Satisfying Information and Control Requirements

2.1 Overview

Introduction

As a result of its distributed nature, TDC 3000X offers incremental functions, incremental capacity, and incremental redundancy. Depending on specific plant needs, customers can, at any time and in almost any quantity, choose from

- **process-connected devices** for data acquisition and basic process control,
- **operator stations** functioning singly or grouped together into one or more operator consoles,
- **engineer/supervisor stations** for placement in office settings,
- discrete **processing modules** for performing specific functions (advanced control, history collection, computing), and
- **gateway and interface modules** that connect process communications networks and computers to the system's principal communications network, and interconnect multiple principal networks.

Using these building blocks, TDC 3000X systems satisfy a wide range of information and control requirements, ranging from the simple to the complex, that include the following:

- a single window to the plant,
- data acquisition,
- incremental levels of distributed digital control,
- history collection,
- reporting,
- communication with non-Honeywell process subsystems,
- computer integration for information management,
- integration of information and control,
- an extension to existing TDC 2000 systems, and
- Open System provisions.

2.2 Single Window to the Plant

Introduction

TDC 3000X has an operator station that is a true "single window" to the plant. The system's single window is the result of a number of features.

Universal Access to Data

Every TDC 3000X operator station has access to extensive data about the TDC 3000X system itself, and access to data that comes from the process-connected systems, optional process subsystems, optional host computers, and optional management networks. When process data is requested for a display, standard application software in the station simply requests the data by tag name, without regard for the data's physical location. Standard network software then locates the data and sends it to the requesting station. For security, individual stations can be configured to have control over only certain information in specified areas of the plant.

Consistent but Flexible Operation

All operator stations are fundamentally the same. Whether the system controls dozens of points or thousands; whether it does simple regulatory control, advanced control, or computer-enhanced control; whether or not a mainframe computer is data-linked for higher-level business information—in short, whether the system is small or large, simple or complex, continuous or batch, or a combination, the operating procedures for the operator station remain the same. The way the operator calls up displays, manipulates variables, acknowledges and handles alarms, starts and stops batches, changes recipes, prints reports—all remain the same, regardless of the size and complexity of the system.

Consistent but Flexible Displays

A variety of informative standard displays are available on every operator station. As a user, you can design and implement an almost unlimited number of custom graphic displays—from the very simple to highly complex—to represent the unique features of your own operations.

Functions for Different Users

The TDC 3000X operator station, known as the *Universal Station*, provides three primary sets of functions:

- for the process operator to monitor and control the process and the TDC 3000X system,
- for the process engineer to implement, modify, and analyze the system database, and
- for the maintenance technician to track system performance and diagnose any problems that the system does not diagnose itself.

Other types of users, ranging from quality-control personnel to laboratory supervisors to upper management, can also make effective use of the Universal Station, as discussed in later sections. Also discussed in later sections are two alternatives to the standard Universal Station—the *"Universal StationX"* and the *"Universal Work Station."*

2.3 Data Acquisition

Introduction

The TDC 3000X system acquires data from all TDC 3000X process-connected devices distributed on one or multiple Universal Control Networks (UCNs), one or multiple Data Hiways, or a combination of UCNs and Data Hiways. Each device scans its associated process instrument(s) at regular intervals, checks the input signals, and converts them to a form suitable for storage in its own process database. In addition, data can be acquired from non-Honeywell equipment as described later. Information acquired by the system is available to all modules, including those residing on different interconnected LCNs.

Data Points

All of the information about the process that the system collects or produces must be structured in some way for easy retrieval. In TDC 3000X, a collection of closely related data values (such as all parameters associated with a control loop) and instructions for their processing is called a *data point*. The data point name (tag name) can be up to 16 characters in length. Each individual value of a data point is identified by a parameter name and is retrieved simply by specifying its name. The system provides a number of different types of data points to cover the entire range of process-management needs.

Data Point Processing

The data values stored in a data point are updated each time the point is processed—in other words, when the instructions in the data point are executed. As part of the "fill-in-the-blank" procedures for establishing data points, the engineer determines how often each data point will be processed. Data points can be assigned to a process-connected device that has a fixed processing frequency, or to a Process Manager, Advanced Process Manager, High Performance Process Manager, Logic Manager, or LCN module with a selection of processing frequencies that can be specified.

At the scheduled time, standard software within each kind of device or module automatically processes the data point—collects process variables, stores them, performs any calculations or other manipulations, and sends outputs to designated locations. In each type of data point, parameters are processed in a unique order; in some types of data points, custom instructions can be inserted.

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Alarms

Alarm states in individual data points are detected by comparing values against limits, ranges, or other conditions specified by the engineer; any changes in alarm states are then reported to the appropriate modules. Alarms can be detected for individual Process Variables (PVs) and for deviations of PVs from setpoints (PV - SP). When a data point is set up, the engineer can also specify alarm trip points in engineering units and associated deadbands as some percentage of the PV range.

Process alarms can be in one of several detection modes. Most alarms are normally enabled, and so occur as configured by the engineer. The system also provides several suppress modes to filter out nuisance alarms of the type that occur during startup and shutdown or as the inevitable result of another alarm.

To accommodate the varying degrees of urgency associated with process alarms, the TDC 3000X system provides five different levels of alarm priority. These range from the no-action level, which totally ignores the occurrence of the alarm, to the emergency level, which immediately and emphatically brings the alarm to the attention of the operator (audible signal, red text on the screen, flashing text, flashing lights, printed messages, etc.).

Alarms are annunciated, displayed, and acknowledged at the operating center. For annunciation, the TDC 3000X system provides (1) multiple contacts of the types needed for both horns and lights, and (2) red and yellow back-lights for keys on the operator's keyboard. Several displays summarize alarms at different levels of detail and by levels of priority, including one type of display that appears and operates much like a conventional annunciator panel. Alarms are acknowledged by pressing a single key.

With the system's history function, process alarms can be automatically recorded in a special journal. Process alarms can be retrieved, reported, enabled, or suppressed by point or by unit.

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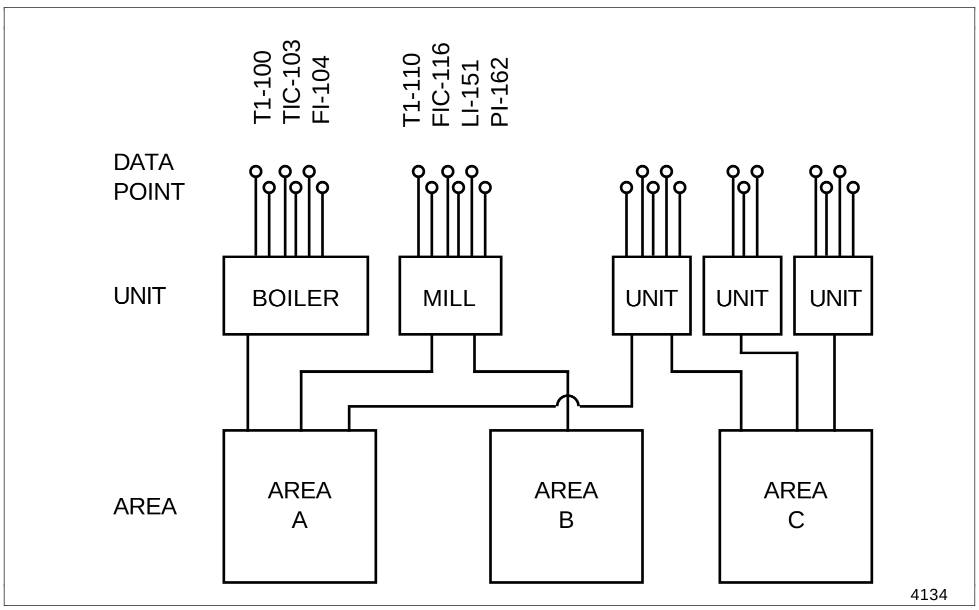
Displays

Information from the accumulated database can also be used in displays at the operating center. Displays are presented on high-resolution, full-color CRT screens in both standard and custom formats. All standard displays in the TDC 3000X system have predefined formats and predefined relationships called hierarchies. Getting from one display to another is easy; the operator touches the appropriate key or keys on the keyboard or selects a target on the Universal Station screen. Custom graphic displays can be created by the user to supplement or even substitute for the standard displays.

The system stores standard formats (the "static" portion of each display), then pulls the current or "dynamic" information from the process database when the display is called up. Once on the screen, most displays are updated every four seconds. Group Displays are updated once every two seconds when the operator-keyboard FAST key is pressed. The FAST key can also be configured to cause certain parameters in custom graphic displays to update at a rate of twice per second.

Operators view and monitor the process through standard operating displays that need to present a wide range of detail. As shown in Figure 2-1, levels of detail range from operating parameters and limits for individual points, to summaries of operating conditions (such as alarms) for individual process units (both continuous and discontinuous) and process areas. Operators in physically separated control rooms can securely share data from other areas of the plant.

Figure 2-1 Relationship Between Point, Unit, and Area

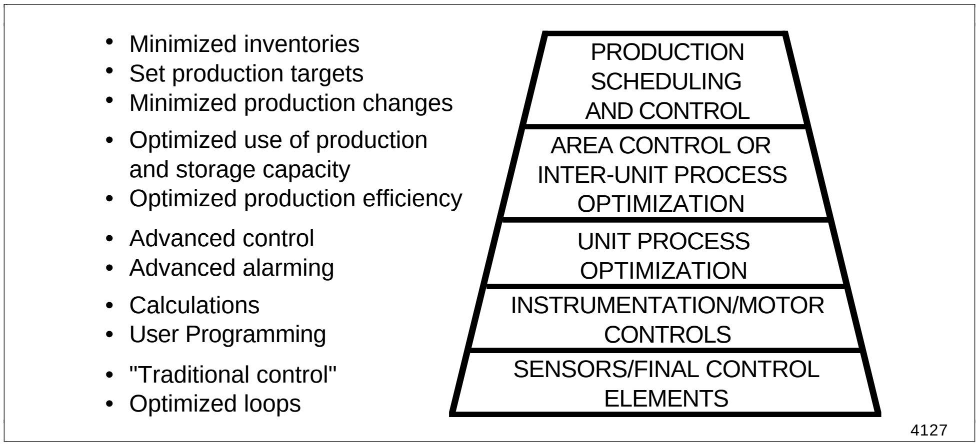


2.4 Levels of Control

TDC 3000X - levels of control

The TDC 3000X system offers the opportunity for different *levels* or *degrees* of distributed control (Figure 2-2). One level might be considered to be control that is based primarily in process-connected devices and acts directly on final control elements. A more advanced level of control might include more complex control calculations and strategies, and can include offering the opportunity for customization. At the highest level of control, TDC 3000X offers the tools for advanced calculation techniques, such as process modeling, apply to sophisticated control schemes, including plant-wide optimization and scheduling.

Figure 2-2 Levels of Control with TDC 3000X



The engineer can take advantage of these control levels to achieve the most economic and efficient control. Control can be configured to fall back to a lower level if a failure occurs at a higher level.

With this kind of incremental-control capability in mind, process engineers can choose those control components of the TDC 3000X system that fit their current needs. As their needs grow or change, additional system components to accommodate growth or to implement higher levels of control can easily be integrated into the existing system.

2.5 Continuous and Discontinuous Control

Overview

At one time, process operations were often categorized as either continuous or discontinuous (or discrete). In reality, most plants have a mixture of the two types of operations. The TDC 3000X system supports both types of processes and makes information from both types available at the same operator station.

Standard Algorithms

TDC 3000X provides a broad range of standard algorithms that perform not only regulatory control functions (through proven PID algorithms, for example), but also other mathematical and logical functions. In addition, the engineer or operator can adjust parameters, such as tuning constants, that affect the characteristics of the algorithm, to achieve optimum control with that data point.

Multiloop Control Strategies

TDC 3000X allows the engineer to easily configure automatic "connections" between data points to implement multiloop control strategies, such as cascades. In a cascade strategy, one data point is the source of the setpoint for a second data point. TDC 3000X offers a number of sources or modes for data points from which the engineer chooses when establishing the database. These modes range from manual to computer and include a temporary override mode that allows the operator to manipulate either the setpoint or the final output of a data point that is normally in one of the automatic modes.

The engineer can also specify whether the operator or the system can change the mode. Whenever a data point's mode is changed, TDC 3000X automatically performs all the functions necessary to prevent "bumps" in the process, including initialization, ramping, and antiwindup.

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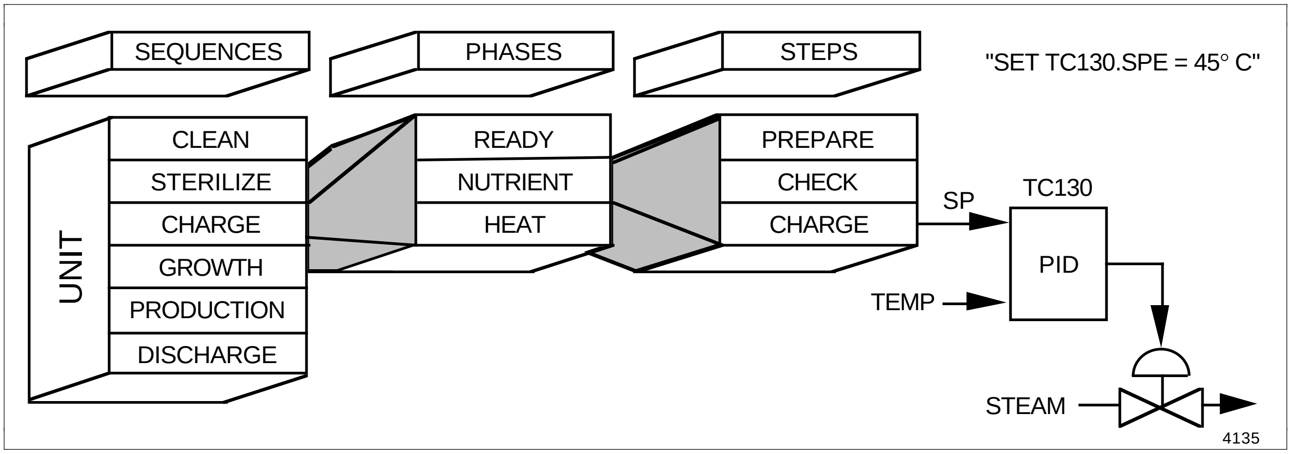
Integration of Continuous, Sequence, and Logic Control

The TDC 3000X Process Manager, Advanced Process Manager, High Performance Process Manager, Multifunction Controller, and Advanced Multifunction Controller integrate continuous control functions with the sequence and logic control necessary for discontinuous operations.

These controllers organize sequence control along the lines of the natural process partitions (Figure 2-3); at the highest level, each functionally independent set of process equipment is defined as a process **unit**. Each unit is partitioned into **sequences**, each sequence is divided into **phases**, and each phase contains several **steps**. Steps are implemented with **statements** that use plain-language commands from the process-oriented Control Language developed by Honeywell.

Figure 2-3 Process Partitioning



As these sequential statements control the sequence of operations being performed, they also initiate any continuous or logic operations required, such as setting setpoints or checking that a valve is closed before admitting fluid into a tank. When these sequence programs are written, the engineer can choose the normal mode of operation for each one; **automatic** mode requires no operator intervention and **semi-automatic** pauses at specified points for the operator to make an entry or an acknowledgment. The system also provides a debugging mode to check out the sequence program before it is put into actual operation.

The operator monitors and manipulates batch operations from displays at the Universal Station. Using these displays, the operator can create a new batch, change recipes, and view batch data while the batch is in progress.

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2.5 Continuous and Discontinuous Control, Continued

Responses to Abnormal Conditions

Sequence programs can be written to provide three levels of response to abnormal conditions: **hold, shutdown**, and **emergency shutdown**. An "abnormal condition handler" is automatically triggered when some process condition or event defined by the engineer occurs. It stops the normal execution order and proceeds with the instructions the engineer gave for handling this particular situation—**hold** all variables at their last good value until otherwise instructed; or execute the given normal **shutdown** procedures, including emptying vessels where possible; or execute the given **emergency** procedures to get the process to the safest possible state in the fastest possible manner.

2.6 History Collection

Description

Almost every organization in a plant can make good use of historical data—if what they want is recorded when they want it, how they want it, and if they can manipulate it in any way they want. The Operations group and the Maintenance group, for example, often are interested in similar process variables: temperatures, pressures, flows, etc. Operations wants this data collected for each process unit, to help them make day-to-day operating decisions, but Maintenance wants such data collected for each piece of equipment, to help them predict trouble and set up preventive maintenance schedules.

The Engineering group, on the other hand, has significantly different needs for historical data. They generally are interested in more variables than other groups, on a smaller piece of the plant, for only a limited time. They want to be able to easily and quickly reconfigure the history format, and they do much more after-the-fact data reduction to find and quantify interactions and relationships.

Other groups have special needs for history, too. Quality Control personnel, for example, often generate laboratory data on samples taken from the process. This data needs to be stored in the database with other data recorded at the time the sample was taken, not at the time the lab data becomes available. Upper-level managers need data to make business decisions, such as average plant-production rates, total monthly production, and total costs, often gathered and presented by cost or profit center.

The flexible, incremental, formatable history function offered by the TDC 3000X system answers all of these needs.

2.7 Reporting

Description

The TDC 3000X system provides a variety of standard formats for reporting current and historical data about the process and the system. At the simplest level, the system can be directed to print each event as it occurs or to print continuous trends covering a specified time span from a particular group display. At a more sophisticated level, data may be grouped into named reports that can be printed (on demand or at specified intervals) or displayed.

Standard **reports** are made up of one or more of the following. A **journal** collects a chronological list of events of a specified class, such as process alarms or operator changes to the process, that occurred within a specific time interval. A **log** collects historical values for a specified set of data-point parameters. A **trend** graphically shows the history of points or parameters over a specified time interval. All reports, journals, logs, and trends for an area are accessible through a menu displayed at the operating center assigned to that area.

The engineer can also create custom logs using the log-building feature provided by the TDC 3000X system.

2.8 Communication With Other Vendors' Subsystems

Description

A plant's equipment is likely to include a wide and complex variety of independent subsystems. These can be dedicated to in-line product analysis, product movement and storage, product dispatching, laboratory analysis, maintenance, inventory, production automation, or information management. Even though they are independent, these subsystems need to work together to accomplish operating objectives.

To meet this requirement for integration of products from other vendors, TDC 3000X provides a number of interfaces, such as the Serial I/O Module in the Advanced Process Manager, the Programmable Logic Controller Gateway (PLCG), the Enhanced Programmable Logic Controller Gateway, the Communications Link Module, and the Data Hiway Port. They provide the data conversion, buffering, and processing necessary for an efficient interchange of information between the system's communication network and these other devices.

To assure smooth startup and compatibility of outside vendor devices, Honeywell for a number of years has sponsored a MultiVendor Interface Program for the Data Hiway Port, PLC Gateway, and more recently the Enhanced PLC Gateway. To date over 60 vendors have qualified their products through this program.

With the interconnection provisions described above, information from these outside-vendor process subsystems and computers can be seen and used from the same operating station that is used for Honeywell equipment.

2.9 Communication with Computer Systems

Description

Extended file handling, data management, and communications capability can be achieved by connecting a computer or network of computers to TDC 3000X.

Much standard software is available and custom software can be written or procured to take advantage of these capabilities, thus integrating the TDC 3000X system with nonprocess areas of the plant—Finance, for example, or Shipping, or Raw Materials Handling, with EDP-type computers responsible for plant management—or with any individual who is responsible for timely decisions that require information generated by the process. This integrated information can be used to develop models that yield capacity-requirements plans, statistical analyses and forecasts, and other management tools—all based on the plant-wide database provided by the TDC 3000X system.

These types of information are also available through the same single window as other types of data from the system.

2.10 Communication with X Window Systems

Description

Third party workstations and other devices that use industry standard network communications and operate under the X Windows software environment can provide input directly to the screen of Honeywell's Universal Station[X]. Accordingly, the operator can display information system data from many such sources simultaneously with TDC 3000[X] process data on the same screen. This can contribute to improved performance based on the timely availability of more complete information.

2.11 Continued Growth: The Special Requirements of TDC 2000 Owners

Description

Owners of existing TDC 2000 systems can easily integrate these systems with the more advanced TDC 3000X products. With the introduction of TDC 3000X, Honeywell honored its commitment to protect its customers' investments—to the philosophy that our systems should be the ones to "start with, live with, grow with."

In keeping with this philosophy, existing TDC 2000 process-connected devices were included as an integral part of the TDC 3000X system. This commitment remains in tact today as we continue to expand TDC 3000X products and capabilities. A new TDC 3000X installation can be configured with only the latest, most technologically advanced, control-room equipment and process-connected devices, or it can be merged with existing Data Hiways and devices—the choice is yours.

TDC 2000 software systems (BASIC, SUPERVISORY, TOTAL, SEER, PMX, AND PMC) can coexist on Hiways in TDC 3000X systems. To facilitate both coexistence of the two systems and migration from TDC 2000 to TDC 3000X, Honeywell offers translation services to convert databases of TDC 2000 systems to the appropriate form for TDC 3000X systems. These services include media conversions, such as from cassettes to cartridge and floppy disks.

Section 3 – System Architecture

3.1 TDC 3000X System Architecture

Overview

In the past, computer systems were centralized with all computer functions performed in a central processing unit. With the advent of low-cost microprocessors, however, it became possible to dedicate computing power to tasks on a much smaller scale. Taking advantage of these developments, TDC 2000 introduced distributed architecture for process control, consisting of microprocessor-based controllers connected through a communications network called the Data Hiway.

TDC 3000X today takes advantage of the even more powerful 16-bit and 32-bit microprocessors developed in the intervening years to distribute the more sophisticated processing tasks that previously required a central computer, such as advanced control and history collection. This distributed processing architecture, which incorporates and expands upon the distributed control architecture of TDC 2000, is vitally important to the flexibility and power of the TDC 3000X system.

System concepts

The following are the most important concepts of the evolving architecture of TDC 3000X:

- A single window to the plant is provided by Universal Stations/Universal StationsX.
- Process Managers/Advanced Process Managers, High Performance Process Managers, Logic Managers, and other process-connected devices provide high performance and security.
- Each device and module in the TDC 3000X system is self-contained, so that functions are distributed.
- All devices in the system communicate over redundant cables that carry all commands and data.
- The earlier distributed-control architecture (Data Hiways with process-connected devices) is merged into the new distributed-processing architecture.
- Interface modules or gateways link the Local Control Network (LCN) to process networks, to process subsystems, to host computers, to plant information networks, and to other LCNs.

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Distributed architecture

The major consequences of the distributed architecture are listed below:

- Data acquisition and control functions can be distributed throughout the plant, using a variety of process-connected devices to meet a plant's needs. A TDC 3000X system can be comprised of multiple Local Control Networks, multiple Universal Control Networks, multiple Data Hiways, and/or multiple Plant Information Networks.
- All functions, from data acquisition and control to integration of lab and other plant data, are distributed, yet all data are accessible through a single universal window, even in a multiple-Hiway and/or multiple Universal Control Network system.
- All TDC 3000X systems can use the same operator station, known as the Universal Station, regardless of size, complexity of control, or relative degree of continuous and discontinuous operations.
- Any module can access parameters in any data point by name, without knowledge of its physical location.
- Very high reliability and security is ensured throughout the system and at all levels of control.
- A TDC 3000X system can use existing Data Hiways and devices, can consist of all new control-room and process-connected equipment, or can consist of both old and new.

TDC 3000X is a family of hardware and software products that can be selectively integrated into a data acquisition and control system to meet the specific requirements of your operation. TDC 3000X offers you a varied and expanding selection of devices from which to choose. To achieve the demonstrated advantages of distributed control, these devices are placed where needed throughout your plant, and then are linked together by highly secure communications networks.

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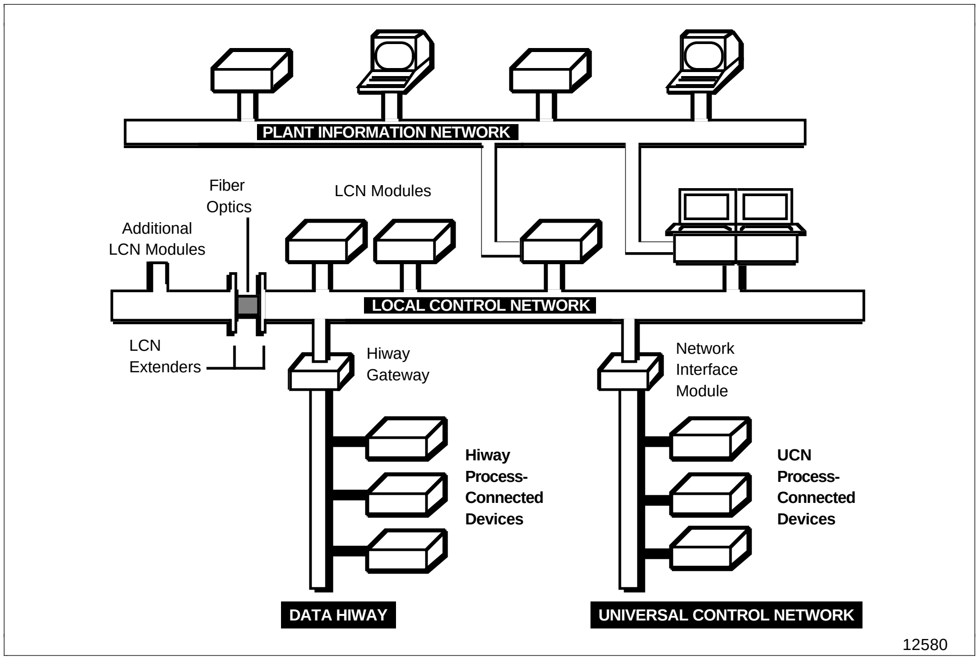
TDC 3000X networks

The four types of networks—the Local Control Network, the Universal Control Network, the Data Hiway, and the Plant Information Network—are illustrated in Figure 3-1 and are described in the sections that follow.

Figure 3-1 TDC 3000X Networks



Section 4 – Local Control Network (LCN)

4.1 Local Control Network

Overview

The Local Control Network is the backbone of most TDC 3000X systems. Its role is to link today's operator stations, processing modules, and gateways/interface modules. The LCN is a local area network that uses high-speed bit-serial communications based on the IEEE 802 standard. It uses a proprietary token-passing protocol that includes many levels of error checking. Operating at 5-million bits per second, the redundant LCN permits a very large database without degradation in system performance.

Either of the two redundant cables can be designated as the active one; the other is then the backup. If the active cable fails or has an excessive error rate, the roles of the cables are automatically switched (the cables can also be manually switched from a Universal Station).

The LCN can be extended to support remotely located operating centers by use of fiber optic cables and LCN Extenders. The LCN Extenders, serving as repeaters, also make it possible to increase the number of modules on the LCN from a maximum of 40 without the extenders up to 64 with the extenders.

4.2 LCN Modules

Overview

In TDC 3000X systems, the information-processing and advanced-control functions that previously were performed by a central process computer have been distributed into discrete modules. These independent modules provide

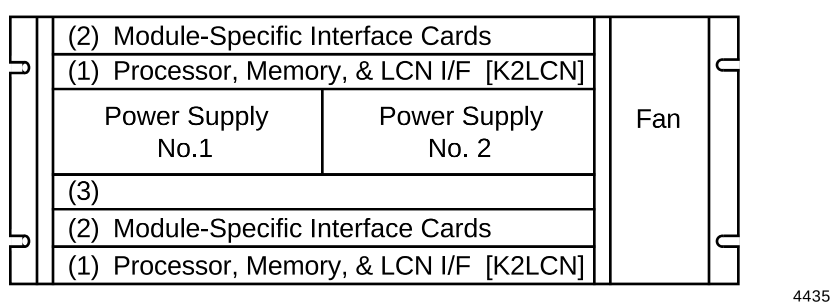
- a single window for access to the system by all types of users,
- the information-processing and storage facilities to support that access, and
- advanced control and information management.

Because both functions and capacity are modular, a TDC 3000X system can be tailored to fit a process plant of almost any size or type. A plant owner selects only those functions needed, in the quantities needed. If requirements later grow or change, additional functions or capacity can easily be added without disturbing the existing system. Modules can be grouped in a single operating center or, by using fiber optic cables, can be distributed over a wider area. In addition, multiple LCNs can be interconnected over long distances through Plant Information Networks and associated Network Gateways.

Other TDC 3000X interface modules and gateways make the TDC 3000X System even more widely applicable, because they allow many types of Honeywell equipment and other equipment manufacturers' products to be connected into the system's communications network. The result is support of a wide range of devices, such as Basic Controllers, PLCs, analyzers, Process Managers/Advanced Process Managers/High Performance Process Managers, Logic Managers, and host computers.

Each LCN module includes printed-circuit boards housed in an electronics chassis. There are two types of chassis available. One, illustrated in Figure 3-2, is a dual-node chassis that has a 3-slot area for one node and a 2-slot area for a second node. Space savings is achieved by using densely packed boards. For example, a single "K2LCN" board holds the microprocessor, the LCN interface, and either 2, 3, 4, 6, or 8 megawords of memory, which are functions required by all module types.

Figure 3-2 Typical Dual-Node Card File Arrangement



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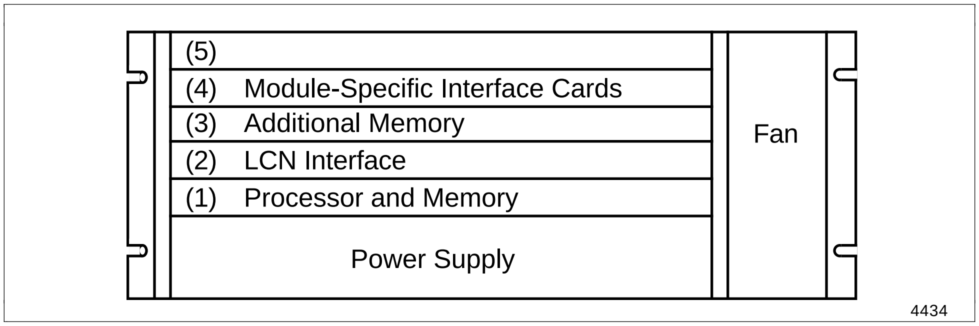
Overview, continued

The other type of chassis, outlined in Figure 3-3, is a single-node, 5-slot chassis that holds up to 5 printed circuit boards.

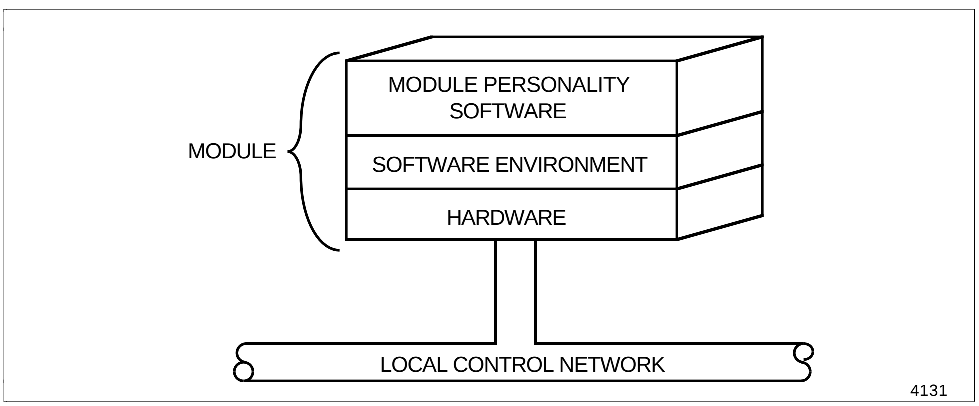
Figure 3-3 Typical Single-Node Card File Arrangement



A fully functional TDC 3000X system requires only standard software. The system is adapted to specific applications not by writing custom software, but by entering the information that the standard software uses. Besides this entry process, known as “system configuration,” users can prepare custom application programs, but these do not alter the standard software in any way.

As illustrated in Figure 3-4, a common set of instructions called the Software Environment is present in every module (some may not need all the functions). The Software Environment manages all of the module's resources. It manages its use of time and memory, makes sure that work gets done on time and according to priorities, handles data transfers and communication with other modules, tests hardware, and diagnoses faults. The Module Personality Software gives each type of module a unique set of capabilities.

Figure 3-4 Software Architecture



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Universal Station (US)

With TDC 3000X, all information supplied from process-connected devices, instrumentation subsystems, and computers through Local Control Networks, Universal Control Networks, and Data Hiways, can be seen and used at a Universal Station. Information is displayed on a high-resolution video monitor, and displays can be called up either by pressing designated keys on a keyboard or by selecting a target area on the screen.

For the process operator, the Universal Station provides a consistent set of operating procedures, regardless of the size of the TDC 3000X system, or the complexity of control implemented in the process, or the mix of continuous and discontinuous operations. Through this universal window, the operator monitors and controls the process, and handles process and system alarms. This is accomplished through the standard displays provided, or through optional custom graphics with smart targets. The operator also uses the Universal Station to display and print process history, trends, and averages; to print reports, logs, and journals; and to monitor and change the status of TDC 3000X equipment.

For the process engineer, the Universal Station provides a means to set up the process database, custom displays, and reports, establish the interface with host computers, and to load system software from floppy and cartridge disks.

For the maintenance technician, the Universal Station provides a means to view system status as well as the detailed diagnostic information that the system creates. Maintenance journals are also available.

Universal Stations are usually grouped in Operator Consoles that can include upper as well as lower tier CRT mounting. Various optional peripheral devices are available, such as printers, trend-pen recorders, floppy disk drives, and cartridge disk drives.

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Universal Station^X (U^{X}S)

Universal Station^X is a Universal Station with an embedded coprocessor. The coprocessor contains industry-standard workstation technology that includes X Window system software. All standard Universal Station displays can be viewed and all standard functions can be performed at a Universal Station^X. In addition, however, the Universal Station^X is capable of showing other informational displays in "windows," at the same time LCN data is being displayed.

These additional windows can originate from external devices that are operating under the X Window environment. Typically these windows would contain data that assist the operator or engineer in making pertinent control decisions. The full-size LCN display can be quickly restored when needed.

Universal Work Station

All information that can be displayed at a Universal Station can also be seen at a Universal Work Station. The Universal Work Station consists of a stand-alone desk-side electronics enclosure, desktop CRT, keyboard, and mouse. Accordingly, it can readily be placed in an office setting, much like a personal computer.

When equipped with an enhanced engineer's keyboard, it becomes a highly convenient tool for the engineer to make changes or additions to the system configuration, or for the maintenance technician to analyze error messages and pinpoint system problems. When equipped with a keyboard nearly identical to an operator's keyboard, it is ideally suited for use by the process supervisor or plant managers to monitor the process and obtain reports and other information of interest.

Continued on next page

History Module (HM)

The History Module (HM) is a smart mass data storage device. It consists of both an electronic chassis and one or more sealed hard disk drives.

The History Module stores system program images, the entire system database as configured by the process engineer, diagnostic information, and historical data as specified. In addition, it can contain custom graphic displays, user programs written in Control Language, and Ladder Logic programs uploaded from a Logic Manager.

The storage capacity of a History Module is allocated by the process engineer, according to the history requirements and the complement of equipment on the LCN, Data Hiway, and UCN. All of the transactions necessary to store specified data in a History Module are controlled by the TDC 3000X system and occur automatically. These operations are invisible to the operator.

The information stored in the History Module is available to any module on the LCN. For example:

- Historical information can be displayed at the Universal Station,
- It can be accessed by the Archive Replay Module and host computers,
- It can be retrieved by user stations on the Plant Information Network, connected through the UXS or AXM, and
- It can be printed as journals, trends, logs, and reports.

Each History Module can be configured to store history for as many as 2400 items. History can be collected, as the engineer directs, for both continuous and discontinuous operations, by time or by event. History of any process variable can be collected as snapshots taken as frequently as every 5 seconds, for example, or as averages calculated at intervals ranging from six minutes to one month.

Events, on the other hand, are time-tagged and chronologically recorded in special event journals; events are occurrences such as process alarms, changes made by an operator to the process or the system, messages sent by the system to the operator, and system errors.

In most cases, defining the history to be collected is a configuration process. Using forms displayed on a US or PC screen, the engineer simply names the parameters to be collected and specifies the type of history to be collected on each one.

Both single- and dual-drive History Modules are available, and additional History Modules can be added to increase storage capacity. Volume redundancy on a second disk is also available.

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Archive Replay Module (ARM)

The Archive Replay Module integrates a personal computer into the LCN for the specific purpose of collecting and analyzing large quantities of historical data. Four types of data can be collected from the LCN:

- Real-time LCN point values,
- HM Continuous History values,
- All real-time Journal entries, and
- HM ASCII files.

Data selected for this purpose is transferred to the PC at the rate of 38.4 Kbaud over an asynchronous data link. After being stored in temporary collection files and moved to hard disk, it is transferred for permanent storage onto an optical disk. Typically this disk has capacity for one to three months of archive data.

Data collected by the ARM can be retrieved at any time and, depending on the type of data, presented as it was stored, displayed as a graphic trend, or formatted for analysis using third party PC software packages. This analysis can be done using the ARM, or by a remotely located IBM-compatible personal computer. The Archive Replay Module thus becomes a powerful tool for use by engineering and maintenance personnel.

Application Module (AM) and Application Module^X (A^XM)

The TDC 3000^X Application Module performs high level calculations and advanced control strategies. It allows control logic to access data from anywhere on the Local Control Network. This means that the Application Module can gain access to a broad scope of process information, from multiple LCNs, UCNs, and Data Hiways.

Control strategies in the Application Module can be implemented with standard algorithms and standard processing of data points, or with custom algorithms and/or custom processing routines. The customizing tool is Control Language/AM, a powerful, easy-to-use, process-oriented language especially designed for process engineers. A number of software packages for use with the AM are available off the shelf to meet specific requirements.

In addition to the features in the Application Module, the Application Module^X (A^XM) has a RISC-based UNIX co-processor that

- provides a communications link to the Plant Information Network
- contains a high capacity hard disk for storage of third-party application software packages, and
- allows you to use a wide range of software applications from a variety of suppliers (only specific software packages that have been tested and validated by Honeywell are supported).

Continued on next page

Interface Modules and Gateways

A primary function of each member of this family of modules is to make the translation between the LCN communication protocol and that used by another network or device. These modules are described in the following paragraphs.

Network Interface Module (NIM)

The Network Interface Module links the Universal Control Network with the LCN. It passes event and alarm information to the LCN modules and responds to requests from the modules for information about the process. It passes configuration data to the Process Managers/Advanced Process Managers and Logic Managers, and transmits database changes from the LCN modules to the PMs/APMs/HPMs and LMs.

The Network Interface Module validates existence of requested points, checks for device status, and checks for device and parameter error conditions.

Hiway Gateway (HG)

The Hiway Gateway links the Data Hiway and the LCN. Process-connected devices present data to the Data Hiway in a variety of forms. The Hiway Gateway accepts this varied data from the Hiway, then converts the data to a consistent form and increases its transmission rate before transferring it to the LCN. Going in the other direction, data from the LCN is converted by the Hiway Gateway to a form and rate appropriate for transmission to the destination device.

The Hiway Gateway detects significant events and alarms in the process-connected devices on the Data Hiway and notifies appropriate modules on the LCN. The Hiway Gateway can also link the LCN to process subsystems, such as tank-gauging systems, lab analyzers, and programmable controllers, through the Data Hiway Port.

Programmable Logic Controller Gateway (PLCG)

The Programmable Logic Controller Gateway provides a direct link between the LCN and non-Honeywell programmable controllers. Using the de facto industry standard protocols of Allen-Bradley and Modbus, the PLCG can also link special-purpose devices such as vibration monitoring subsystems, analyzers, and surge controllers directly to the LCN. The PLC Gateway falls under Honeywell’s Multivendor Interface Program, whereby outside-vendor devices can receive certification as having been jointly tested for operation with the LCN.

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Interface Modules and Gateways, continued

Enhanced Programmable Logic Controller Gateway (EPLCG)

The Enhanced Programmable Logic Controller Gateway performs all functions of the Programmable Logic Controller Gateway, plus some additional capabilities. Included among these enhanced features are redundant network communication paths and faster output rates.

Communications Link Module (CLM)

The Communications Link Module provides the Universal Station operator a window of access to points located on a non-TDC 3000X network. Designed to reduce the number of different windows to the process, the CLM interfaces to remote subsystems in a transparent manner that simulates their direct connection to the Local Control Network. Honeywell offers a wide variety of application solutions. For example:

- Tank Gauging Systems
  - Siemens (formerly Texas Instruments) tank transmitters and PLCs,
  - Other Tank Gauging Solutions (various suppliers),
- Paper Machine Gauging Systems
  - TDC 3000X Lippke QCS,
  - Accuray 1180 Micro System,
  - Measurex Vision 2002 System,
- Remote Telemetry Units
  - Bristol Babcock DPC 3330 and 3335 RTUs, and
- Various other subsystem interfaces based on the Modbus protocol.

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Interface Modules and Gateways, continued

Plant Network Module (PLNM)

The Plant Network Module provides an interface between the LCN and DEC VAX or AlphaAXP computers. A software package called CM50S is available for use with the PLNM. CM50S uses an Ethernet LAT communication channel between a VAX computer or an AlphaAXP computer and up to 4 PLNMs.

Connection of computer systems makes it possible for computer-level functions to be integrated into the TDC 3000X system. This could include, for example, the performance of complex calculations such as used for multivariable process control. The computer programs have access to all LCN data, including history, and therefore can provide the added flexibility of custom reports and other management information. Since the computer is completely integrated into the TDC 3000X system, no data conversion software need be written.

Computer Gateway (CG)

The Computer Gateway provides a standard link between the LCN and host computers that use HDLC, providing the capability for computers from other vendors to perform the same functions as DEC computers.

Personal Computer Network Manager (PCNM)

The Personal Computer Network Manager enables those persons who have the need, to easily obtain current LCN data for real-time decision making. The PCNM consists of hardware and software that serves as a secure interface to multiple personal computers over an Ethernet or Token Ring Local Area Network. Included are a Computer Gateway, a server based on a high performance 80386 personal computer, and special PC display, communications, database, and systems software.

PCNM can serve as a low cost, expandable, “starter” system in a PC LAN information environment. Users can view the TDC 3000X process data in graphic displays, on spreadsheets, or in other third party applications.

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Interface Modules and Gateways, continued

Network Gateway (NG)

The Network Gateway connects the LCN to a Plant Information Network. Two or more LCNs, each with a Network Gateway connected to a PIN, can communicate securely with each other over extended distances. This enables the implementation of the TDC 3000X across multiple control rooms, each with its own LCN, thereby providing coordinated data acquisition over an entire complex.

Up to 64 Network Gateways can be connected to one PIN. The PIN itself can consist of either coaxial or fiber optic cables.

Section 5 – Process Networks and Devices

5.1 Universal Control Network (UCN)

Universal Control Network (UCN)

The Universal Control Network is one of two types of networks whose role is to link process-connected devices with each other and with the LCN. The devices connected to the UCN are the Process Manager, Advanced Process Manager, High Performance Process Manager, and Logic Manager—Honeywell's newest and most powerful data acquisition and control devices. These devices are further described on the pages that follow.

The LCN connection is through the Network Interface Module. Based on communication standards defined by the International Standards Organization, the UCN operates at the same data rate as the LCN—5 megabits per second. Peer-to-peer communications between PMs, APMs, HPMs, and LMs on the same UCN is supported.

The UCN uses redundant coaxial cables. If the controllers are distributed over a wide area, additional security can be achieved by running each UCN cable over a different route. Maximum length is a function of cable type and the number of connected devices.

5.2 Process Manager (PM)

Description

The Process Manager is an exceptionally flexible process-connected device, with a powerful set of data acquisition and control functions. It can be configured with a selectable set of I/O Processors, as well as with control procedures ranging from the simplest standard algorithms to advanced programmable control schemes—for continuous, batch, or hybrid applications. Capabilities include sophisticated regulatory control, fully integrated interlock logic functions, and an advanced Control Language (CL/PM). In addition, the PM supports peer-to-peer communications and compatibility with open system communication architecture.

The Process Manager can be configured with up to 40 single and/or redundant I/O Processors, which perform input and output processing on all field I/O, independent of control processing functions. A wide range of signal types can be handled, including 24 Vdc, 120 Vac, and 240 Vac. The High Level Analog Input, Analog Output, and Smart Transmitter Interface Processors are available as redundant pairs to maximize availability for critical applications. Two options for the remote location of I/O files—at either 1 km or 8 km from the central file—are also available.

Control functions are performed by the Process Manager within the Process Manager Module (PMM). The number of such functions that can be accommodated depends on the type mix and execution rate established during configuration by the process engineer. Data is entered onto convenient screen forms at a Universal Station or Universal Work Station, and then downloaded from the US/UWS through the Universal Control Network to the Process Manager.

Redundant PMM electronics and redundant I/O power can be provided as standard options to increase control-function availability. Battery backup is another PM option.

5.3 Advanced Process Manager (APM)

Description

The Advanced Process Manager (APM), as well as performing all functions of the Process Manager, features additional functions and added capacity. Among these are two special I/O Processors—the Digital Input Sequence of Events IOP (SOE IOP) and the Serial Interface IOP. The SOE IOP provides 1 ms resolution time stamping of digital state changes. The Serial Interface IOP provides an APM interface for a large quantity of Modbus and Allen-Bradley-compatible points.

Table 3-1 lists the available APM processors and the maximum numbers of field connections for each type.

New point types for control have also been added. The Device Control Point provides a single point to control discrete devices such as motors with full view of interlocks, overrides, and values such as motor current. The APM Array Point enables a whole array of values—such as numerics, flags, strings, or times—to be assigned to a single tag name. CL/APM has been enhanced to support strings and times. Added memory in the APM increases the capacity for Control Language sequence statements, and the allowable number of some other kinds of points, such as flags and numerics.

Table 3-1 Advanced Process Manager I/O Processors

Processor Type	Maximum Connections	Redundancy Available
High Level Analog Input	16	√
Low Level Analog Input	8	
Low Level Multiplexor Analog Input	32	
Smart Transmitter Interface	16	√
Serial Interface	2	
Serial Device Interface	2	
Analog Output	8	√
Pulse Input	8	
Digital Input	32	
Digital Input Sequence of Events	32	
Digital Output	16	
Maximum number of I/O Processors (single or redundant) = 40		

5.4 High Performance Process Manager (HPM)

Description

The High-Performance Process Manager (HPM) is Honeywell's leading TDC 3000X control and data acquisition device for industrial process applications. It represents the most powerful, cost-effective controller Honeywell has offered to date.

The High-Performance Process Manager represents an evolution of the highly successful Process Manager (PM) and Advanced Process Manager (APM). Its new dual 68040 processor platform offers a powerful range of capabilities that best meet today's and tomorrow's process requirements.

The HPM offers highly flexible I/O functions for both data monitoring and control. Powerful control functions, including regulatory, logic, and sequencing control, are provided for continuous, batch, sequencing, and hybrid applications.

An optimal toolbox of functions that can be configured and programmed meets the needs of data acquisition and advanced control requirements in a highly secure and performance-intensive manner. HPM capabilities include peer-to-peer communications and compatibility with industry-standard communications protocols.

The High-Performance Process Manager is a fully integrated member of the TDC 3000X family. Accordingly, it is capable of:

- Performing data acquisition and control functions, including regulatory, logic, and sequential control functions, as well as peer-to-peer communications with other Universal Control Network-resident devices.
- Providing bi-directional communications to Modbus™ and Allen-Bradley compatible subsystems through a serial interface.
- Fully communicating with operators and engineers at Universal Stations, UXSs, and Universal Work Stations. Procedures and displays are identical or similar to those used with other TDC 3000X controllers, as well as to APM and PM point displays.
- Supporting higher level control strategies available on the Local Control Network through the Application Module and host computers.
- Using the same I/O and wiring as the PM and APM, thus providing cost-effective upward migration for existing PM and APM users.

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Advanced Features

The HPM provides considerably enhanced functionality over the PM and APM. This includes:

- Improvements in the electronic and software design.
- A new, compact UCN interface.
- A 150% increase in point processing capacity over the PM and APM (2.5 times APM and PM).
- Several new control algorithms.
- Several new CL enhancements.
- Improved I/O link performance through PV scanning.
- More user memory than both PM and APM.
- I/O Simulation capabilities.
- Choice of 7-slot or 15-slot cardfile backplane.
- Flexible point mix change capability.

5.5 Logic Manager (LM)

Description

The Logic Manager is the optimal control device for those applications that require extensive high-speed logic functions, including digital, Boolean, or interlock manipulation. A terminal connected directly to the Logic Manager is used for generating and loading the ladder logic programs. Once entered, multiple programs can be saved under separate file names in the History Module.

Nine data point types can be configured for the Logic Manager. These are:

- digital input,
- digital output,
- analog composite,
- analog input,
- analog output,
- linkage,
- flag,
- numeric, and
- timer.

The linkage point is used for peer-to-peer communication from Logic Manager to Logic Manager, and from Logic Manager to Process Manager, Advanced Process Manager, and High Performance Process Manager. The number of points that can be implemented is a function of the point-type mix.

Most data being processed for communication over the UCN is transferred at a 1/2-second rate, while the ladder logic is performed independently at a much faster rate (typically in the range of 50 ms).

A wide selection of I/O modules is available for connection to a variety of field devices. Up to 2048 real I/O connections can be handled.

The Logic Manager, like all other standard TDC 3000X devices, communicates fully with operators and engineers at the Universal Station, and supports high-level control strategies through Application Modules and host computers connected to the Local Control Network.

Section 6 – Data Hiway and Data Hiway Devices

6.1 Data Hiway and Data Hiway Devices

Data Hiway

The Data Hiway is a proprietary communications network that links a wide selection of process-connected devices that were originally introduced as part of TDC 2000. The Data Hiway is connected to the LCN through the Hiway Gateway. Like the other networks, the Data Hiway uses bit-serial communications and an active/backup cable scheme. It uses a command/response message technique with commands and data words transmitted at a rate of 250,000 bits-per-second.

Basic Controller (CB)

The Basic Controller is a self-contained controller that handles eight regulatory control loops. Each loop is processed three times a second. There are eight additional analog inputs and 16 alarm outputs.

Setpoints, control modes, and other parameters can be sent over the Data Hiway from modules on the LCN, and modules can read the values stored in each controller slot. Advance supervisory control strategies can be implemented using a combination of AMs and Basic Controllers.

Basic Controllers can be backed up by Uninterrupted Automatic Control (UAC) subsystems. These subsystems consist of Reserve Controller Directors and reserve controllers that back up as many as eight primary controllers. If any of the eight primary controllers fails, the reserve controller takes over its functions.

Extended Controller (EC)

The Extended Controller is a self-contained controller that is physically and functionally similar to the Basic Controller. Major differences are:

- the Extended Controller has 16 slots that accept both analog and digital inputs and produce both analog and digital outputs;
- the EC provides several more powerful algorithms, including a Ramp/Soak Generator and Logic algorithms;
- each EC slot is processed twice each second.

Like the Basic Controller, Extended Controllers can also be backed up, in groups of up to eight, by Uninterrupted Automatic Control subsystems.

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Multifunction Controller (MC)

This process-connected device is a self-contained controller that can control both continuous and discontinuous operations by integrating regulatory or modulating control, sequence control, and input/output monitoring control. The Multifunction Controller handles up to 16 regulatory control loops in modulating slots. The Multifunction Controller also handles up to 16 sequence slots. Each sequence slot contains one sequence program for controlling one batch operation in the process.

The input/output-monitoring section of the Multifunction Controller monitors analog, digital, and counter inputs and outputs, and updates the database with the results. It also checks feedback on digital points, sets alarms, and executes up to 128 logic blocks independent of logic in sequence programs.

Peer-to-peer communication between up to 8 controllers is possible through an optional communication link called the C-Link. The Uninterrupted Automatic Control option is also available for backing up Multifunction Controllers in the same manner as described above for Basic and Extended Controllers.

Advanced Multifunction Controller (A-MC)

The Advanced Multifunction Controller is a self-contained controller that is functionally similar to the Multifunction Controller. It provides the same algorithms, logic, and Control Language capabilities. Slot processing occurs twice per second, as compared to once per second for the Multifunction Controller. Peer-to-peer communication through an optional C-Link is also available.

Packaging of the Advanced Multifunction Controller is more compact than that of the MC. This results in savings in both space and power requirements.

Optional one-on-one control and analog I/O redundancy are also available with the Advanced Multifunction Controller. Both front and remote termination options are available.

Process Interface Units (PIUs)

PIUs are primarily data acquisition devices that accept analog and digital inputs from the process. They also provide digital outputs to the process, and analog-current outputs suitable for driving instruments such as meters and trend pens.

Continued on next page

Basic and Enhanced Operator Stations

The Basic Operator Station (BOS) and Enhanced Operator Station (EOS) are human interfaces that enable an operator to monitor and manipulate processes controlled by a TDC 3000X Data Hiway-based system.

Hiway Interface Module (HIM)

The Hiway Interface Module serves as the Data Hiway interface for two products—Honeywell's 620 line of logic controllers, and the Critical Process Controller manufactured by the Triconex Corporation. In both cases, the HIM provides high database capacity and fast throughput.

The **Honeywell 620 Logic Controller (620LC)** provides a full range of PLC functions. Five types of points are processed—digital input, digital output, analog input, analog output, and timer/counter/system status points.

The **Triconex Fault Tolerant Controller** enables the user to maintain reliable control of a process in the presence of a controller failure. It is frequently used in such applications as burner management, turbine control, and safety shutdown systems.

Data Hiway Port (DHP)

The Data Hiway Port provides an interface between the Data Hiway and process devices, such as programmable controllers, from other vendors.

6.2 Smart Transmitters

Description

The performance of TDC 3000X is further enhanced by the integration of Honeywell’s family of smart transmitters, known as Smartline 3000. The Smart Transmitter Interface I/O Processor in the Process Manager and Advanced Process Manager uses digital technology, with resulting increases in accuracy, stability, and flexibility. The result is tighter control and reduced costs. The smart transmitter line includes the following products:

- ST 3000 Smartline Differential Pressure Transmitters,
- MagneW 3000 Smartline Magnetic Flowmeter,
- STT 3000 Smartline Temperature Transmitter,
- SCM 3000 Smartline Coriolis Mass Flow Meter, and
- SCT Smartline Color Transmitter.

6.3 UDC 6000 Process Controller

Description

Honeywell’s UDC 6000 controller is also digitally integrated into TDC 3000X. UDC 6000 is a single-loop controller that provides high speed loop processing capability. Operating as s subsystem of a PM or APM controller, it provides a panel-mounted local operator interface, and serves as a robust auto/manual backup station for the PM/APM.

Section 7 – Plant Information Network (PIN)

7.1 Plant Information Network

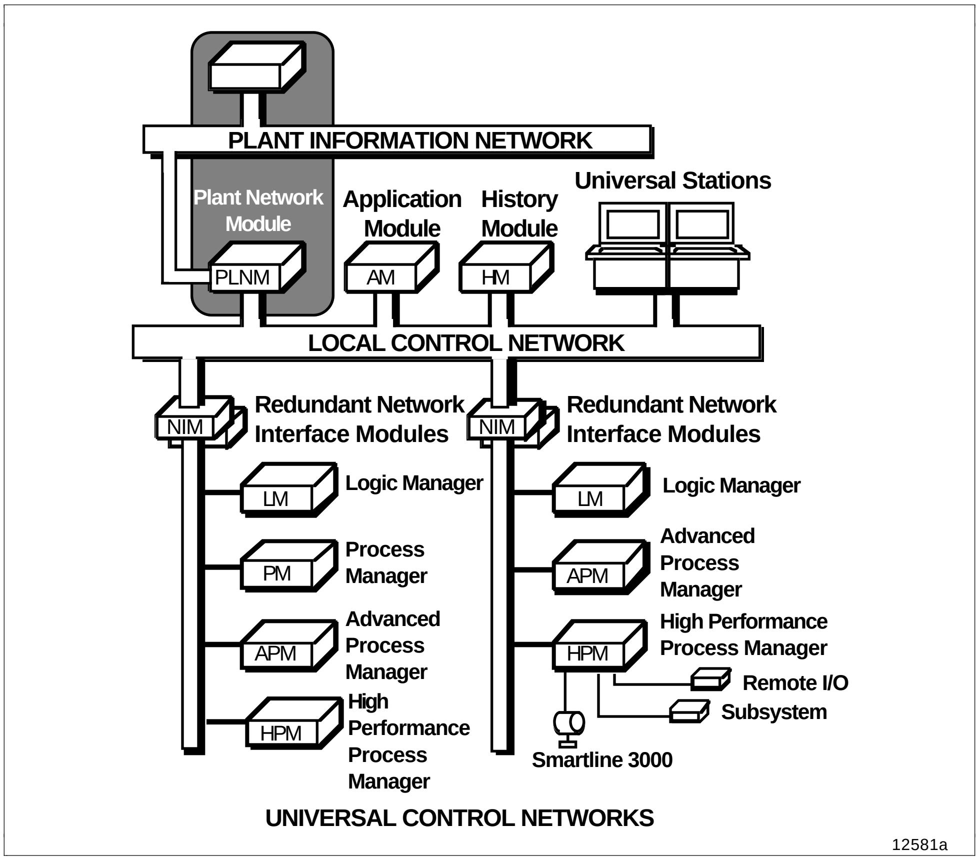
Description

“Plant Information Network” is Honeywell’s term for an external multipurpose network that is capable of sharing information with a Local Control Network through an appropriate dual-ported interface module. This information may consist of process-generated data, or it may consist of information that originates at any device connected to the Plant Information Network that adheres to specified interface requirements.

The physical characteristics of the network are determined by the requirements of the specific application. It may consist of twisted pair, coax, or fiber optic cable, and it may include an rf link. One or more communication protocols may be employed.

One example of a Plant Information Network application is the interconnection of one or more DEC VAX computers with the LCN (see Figure 7-1). This network uses Ethernet LAT and DECnet protocols for communicating with VAX computers.

Figure 7-1 Adding a Plant Network Module with Computer

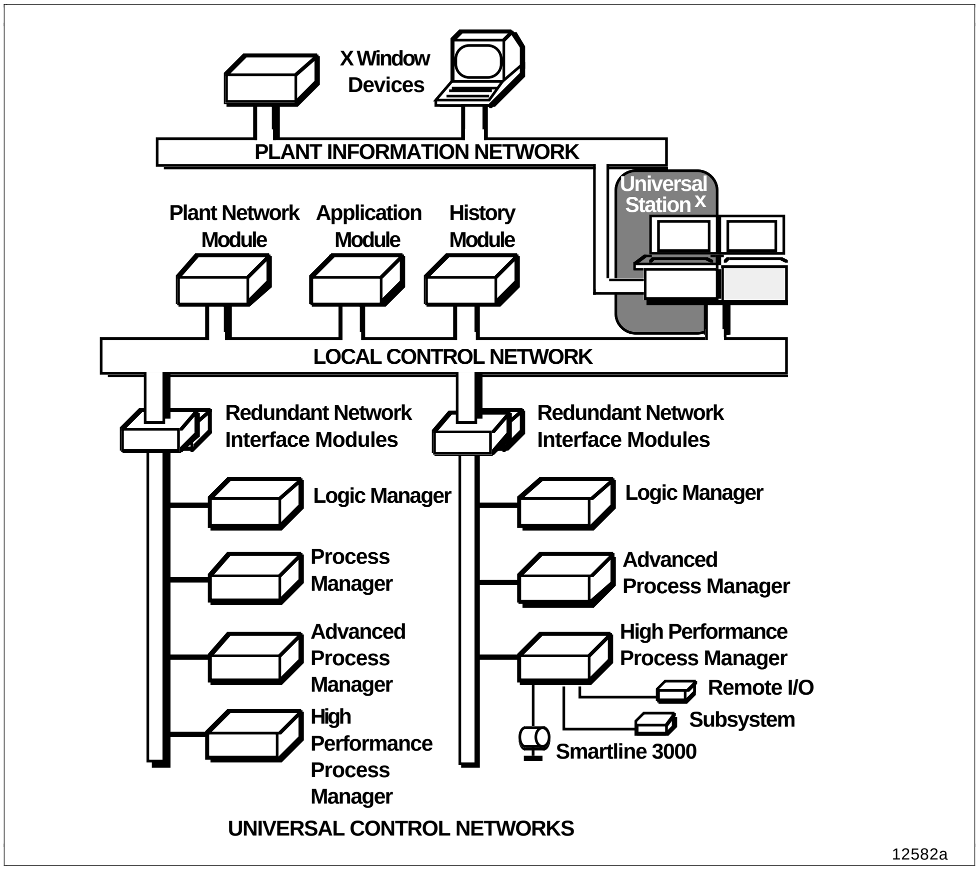


Continued on next page

Description, continued

Honeywell's Universal Station^{X} (U^{X}S) is another example of a dual-ported device that provides an interface between an LCN and a Plant Information Network (see Figure 7-2). Workstations, PCs, and other devices that operate under the X Window system environment can provide data through the Plant Information Network for display on the screen at the Universal Station^{X}.

Figure 7-2 TDC 3000^{X} with Universal Station^{X}

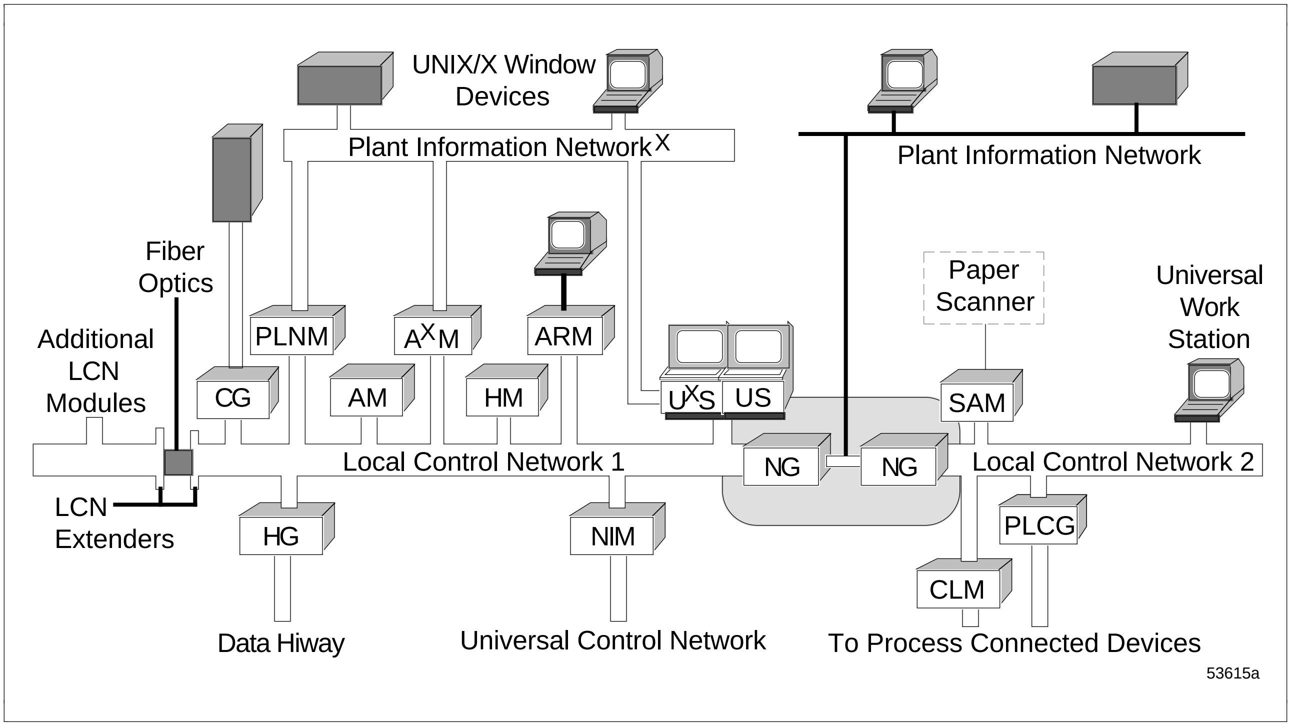


A third example of a PIN application is the interconnection of two Local Control Networks through Network Gateways (Figure 7-3). The PIN that connects one Network Gateway to another uses broad band technology as described in IEEE specifications 802.4 and 802.7.

Continued on next page

Description, continued

Figure 7-3 TDC 3000X with LCNs Connected by Network Gateways



Section 8 – Specification and Technical Data References

8.1 References

Introduction

Following are the Specification and Technical Data publications that describe in detail each TDC 3000X product.

Local Control Network (LCN)

The following table provides the document name and the document number for each Local Control Network-related product.

Spec. and Tech. Pub. Name	Pub. Number
Local Control Network	LC03-500
Application Module	AM03-500
Application ModuleX	AX03-501
Archive Replay Module	AR03-400
CM50S	CM03-550
Computer Gateway	CG03-500
EPLC Gateway	EP03-500
History Module	HM03-500
Hiway Gateway	HG03-500
Multiple Schematics	ML03-100
Network Gateway	NG03-500
Network Interface Module (UCN)	UN03-500
Operator Window Manager	OW03-100
Personal Computer Network Manager	NM03-500
Plant Network Module	PN03-500
PLC Gateway	PL03-500
Processor Gateway	PG03-500
RULA	RL03-400
TotalPlant Desktop/**TotalPlant** History	TH03-500
Universal Station	US03-500
Universal StationX	UX03-400
Universal Work Station	UW03-500

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8.1 References, Continued

Universal Control Network (UCN)

The following table provides the document name and the document number for each Universal Control Network-related product.

Spec. and Tech. Pub. Name	Pub. Number
Universal Control Network	UN03-500
Advanced Process Manager	AP03-400
High Performance Process Manager	HP03-500
Logic Manager	LM03-400
Process Manager	PM03-400
Safety Manager	SM03-500

Data Hiway

The following table provides the document name and the document number for each Data Hiway-related product.

Spec. and Tech. Pub. Name	Pub. Number
Data Hiway	HO-10-01
Advanced Multifunction Controller	BC-03-05
BASIC Controller	CB-10-02
BASIC Operator Station	DS-03-11
Data Hiway Port	HL-03-02
Enhanced Operator Station	DS-03-12
Extended Controller	CB-03-05
General Purpose Computer Interface	HO-10-05
High-Level PIU	PCRH-S
Hiway Coupler	HO-03-07
Hiway Interface Module	620 HIM
Hiway Traffic Director	HO-10-02
Honeywell Logic Controller	SL-53-169
Low-Energy PIU	PCRS-S
Low-Level PIU	PCRL-S
Multifunction Controller III	BC-03-04
Personal Computer Serial Interface	HC-03-01

Section 9 – Selecting a TDC 3000^X System to Meet Your Needs

9.1 Introduction

Overview

The mix of products that should be selected for a TDC 3000^X system is determined by careful consideration of the specific requirements of your process, plant, and business. This section provides guidance in the selection process. It does not cover specific systems for specific applications, but instead covers the topics to be considered and the information needed to make selection decisions. Detailed technical information is also included.

The topics of this section are

- The Fundamental System
- Is Extensive Advanced Control Required?
- Is Computing Power or Integration of Plant-Wide Information Required?
- Is There a Need for the Operator to View External Network Data Alongside LCN Process data?
- Is more than one UCN Required?

Once you are familiar with the material under "The Fundamental System," you will be in a position to consult the material under the remaining headings and to make a preliminary list of products for further consideration. Then you should consult the individual product publications for further information. These publications are listed under "References" in the previous section.

TDC 3000^X is designed to accommodate any combination of devices or modules described in these pages. You are free to select the mix of products and the quantities of each one that meet your requirements for information, control, and redundancy—provided only that specified overall limitations are not exceeded. This includes maximums of 64 modules on an extended LCN (40 on a single LCN coax segment), 32 redundant devices on a UCN, and 63 devices on a Data Hiway, and up to 64 LCNs connected through Network Gateways. Your Honeywell representative will be pleased to assist you in determining the optimum mix of products to meet your needs.

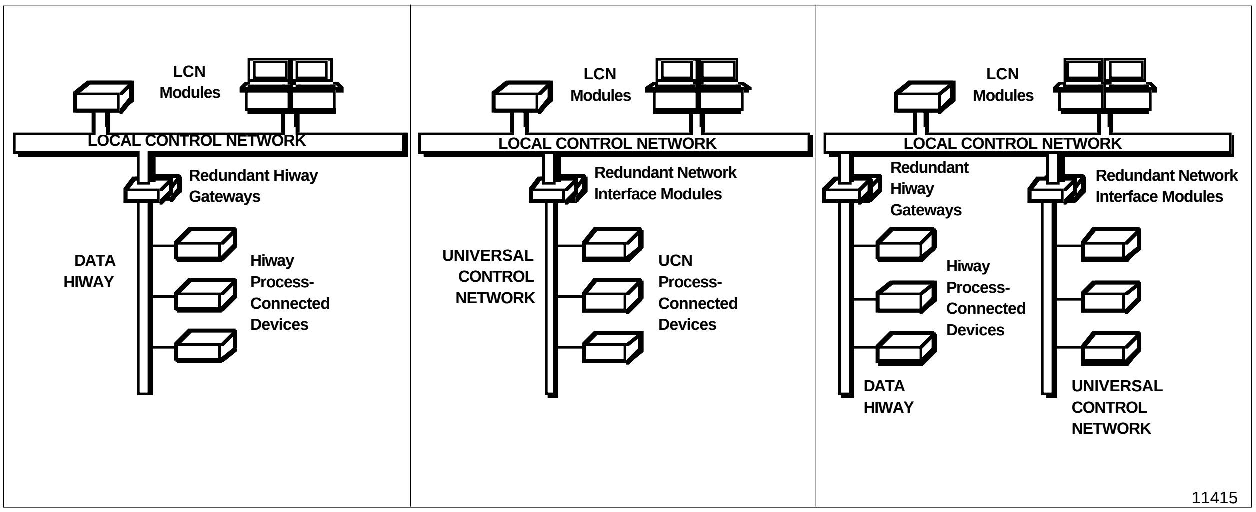
9.2 The Fundamental System

Overview

As illustrated in Figure 9-1, The fundamental system can consist of the following network configurations:

- Local Control Network plus Data Hiway(s),
- Local Control Network plus Universal Control Network(s), or
- Local Control Network plus both Data Hiway(s) and Universal Control Network(s).

Figure 9-1 Configurations for a Fundamental TDC 3000X System



Which of these options you select will depend on whether you already are using a Data Hiway system, and which combination of the process devices described earlier best meets your overall objectives.

Continued on next page

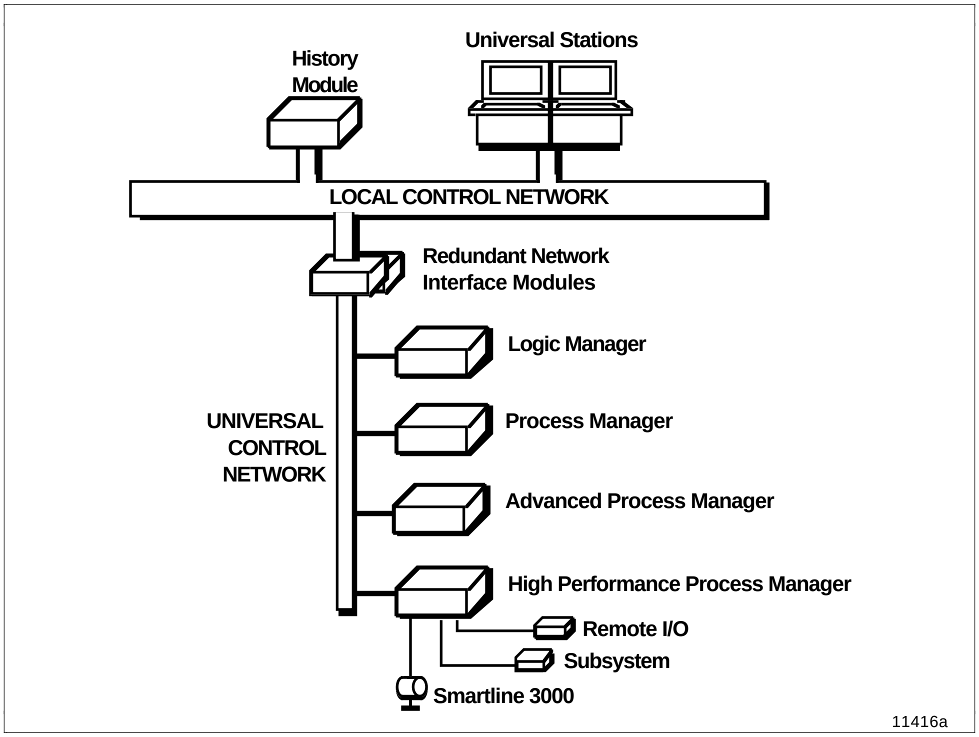
A fundamental system to meet typical requirements

Following is a TDC 3000^X configuration that meets the typical requirements for a fundamental system:

- Process data acquisition
- Control of continuous and/or discontinuous operations
- Single window to the process
- Convenient historical and database storage

Figure 9-2 illustrates a fundamental system that can meet those typical requirements. Included are an Operator Console and a History Module on a Local Control Network; a redundant Network Interface Module; and several process-connected devices on a Universal Control Network.

Figure 9-2 Example of Fundamental TDC 3000^X System



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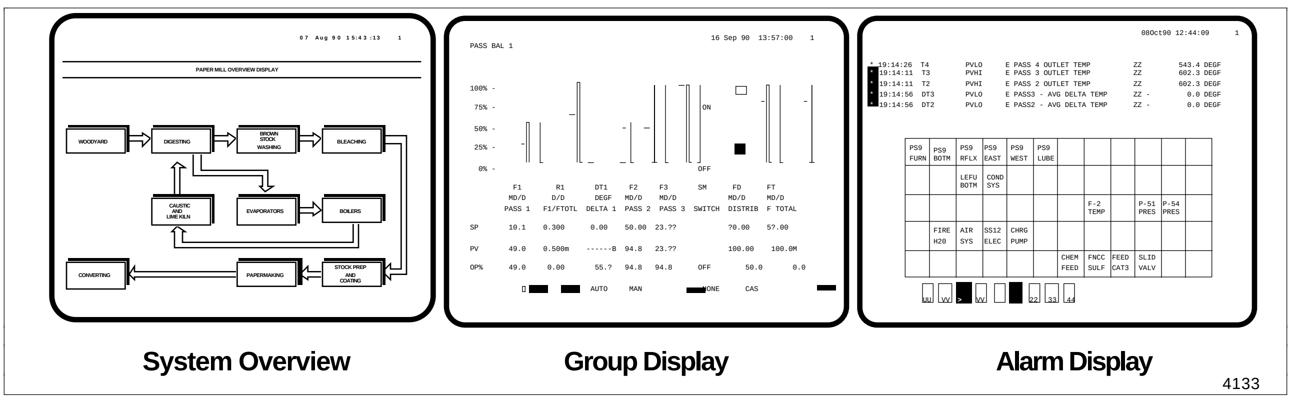
Equipment Rationale

Universal Stations - A single Universal Station can perform all the operating, engineering, and maintenance functions necessary to manage a process area. A minimum of two stations per Operator Console is recommended, because this provides ongoing operations capability if one station is needed for process engineering or system maintenance, or if one should fail.

For maximum operator efficiency, three stations per console is preferred. Typically, one console serves one process operator and one process area of a size that can be handled comfortably by the operator. During normal operation with three stations, the operator typically uses one station for an overview of the process area, another for a more detailed view of a unit or part of a unit in the area, and the third for an alarm summary display (see Figure 9-3). If one of the stations is being used for process engineering or maintenance, the other two can take over its functions.

Figure 9-3 Sample Console Display Grouping



History Module - Most control systems today require the collection of significant volumes of historical data, and provision for retrieving this data in a variety of displayed and printed formats, and for making it available to integrated host computers. The History Module performs the requisite file management and data storage functions for TDC 3000X.

In addition, the History Module can considerably reduce the time and effort to load and restore device databases, and to save and retrieve custom graphics and custom program source code.

A History Module can be configured with one or two nonredundant disk drives, or with one or two redundant disk drives. Extra History Modules can be added to further increase storage capacity. History Module space is allocated by the engineer during system configuration to meet the specific system requirements.

Continued on next page

Equipment Rationale, continued

Universal Control Network - The technologically advanced Universal Control Network was selected for the fundamental system example in Figure 9-2. However, where Data Hiway devices already exist at a plant site, or otherwise are determined to be the optimum choice at a given location, the Data Hiway, connected to the LCN through a Hiway Gateway, could be the preferred network. For added flexibility, both types of networks can coexist on a TDC 3000 system. See Figure 9-1.

Network Interface Module - Figure 9-2 shows redundant Network Interface Modules connecting the UCN to the LCN. One of these is designated as primary and the other as secondary. The use of backup interface modules and gateways is strongly recommended in TDC 3000X systems to maximize availability. Each Network Interface Module has the connections and facilities to accommodate the dual Local Control Network and the dual Universal Control Network cables.

Process-Connected Devices - Figure 9-2 shows a Process Manager, an Advanced Process Manager, a High Performance Process Manager, and a Logic Manager, although even a single PM/APM/HPM or LM can easily meet the needs of many small applications.

The actual mix of process-connected devices selected for a TDC 3000X system, whether they be on a Universal Control Network or a Data Hiway, is determined by considering the number and types of process variables to be monitored and controlled, the types of control schemes required, and the type of equipment already implemented at the site. As requirements change, additional devices and additional networks can be implemented without making those already in service obsolete.

9.3 Is Extensive Advanced Control Required?

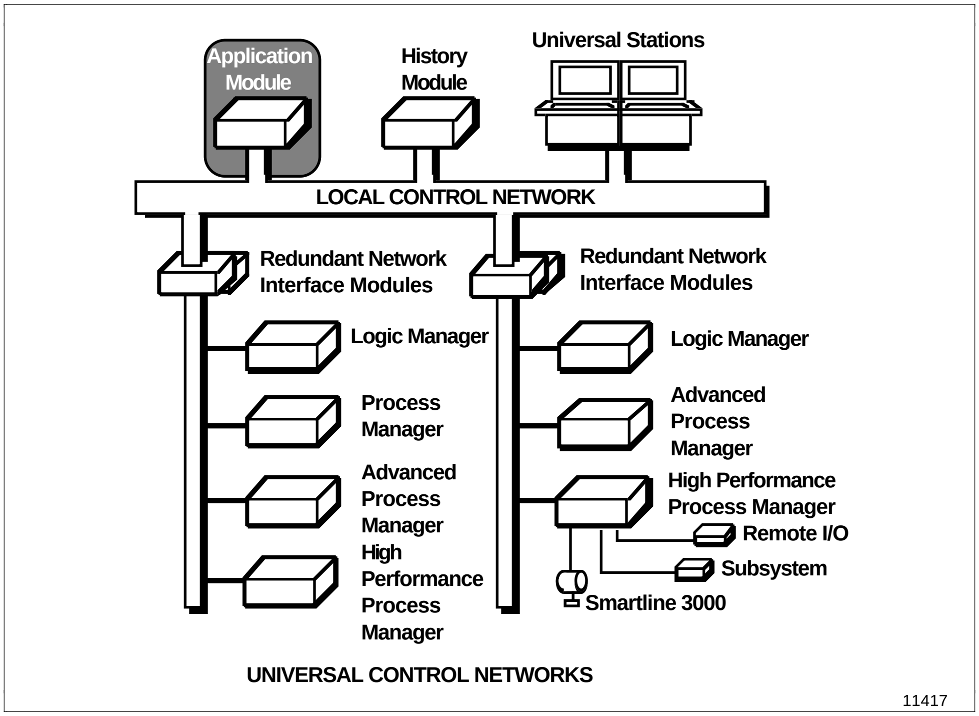
Introduction

This sample TDC 3000X system meets these requirements:

- Process data acquisition,
- Primary control of continuous and discontinuous operations,
- Single window to the process,
- History collection and miscellaneous data storage, and
- **Extensive advanced control.**

The system shown in Figure 9-4 is the same as the one in Figure 9-2, except that a second Universal Control Network and an Application Module are added.

Figure 9-4 Adding an Application Module



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Control Rationale

As described earlier, the TDC 3000X system offers the opportunity for selection of the degree of control complexity required. In determining the control schemes to be implemented, the process engineer considers a number of factors. Some of the most significant are the processing rate, the amount of memory needed, the sophistication of the control needed, and the scope (plant, area, unit, loop) of the inputs to the controllers.

Application Module - The technologically advanced Process Manager, Advanced Process Manager, and High Performance Process Manager are by themselves capable of some highly sophisticated control techniques. Some control strategies, however, rely on the capabilities of the Application Module.

Examples are control strategies that require inputs from more than one Universal Control Network or Data Hiway, or calculations with some especially unique requirements. The Application Module also handles many more control loops than any process-connected device. In addition, the Application Module offers a wider selection of data point scheduling intervals.

The standard algorithms in the PM/APM/HPM and in the Application Module (examples are given in Table 9-1), and standard processing of data points, are sufficient to cover many control needs. When custom algorithms or semicustom or custom processing routines are needed, Application Modules also provide these capabilities. The tool used for this customizing is the Application Module Control Language (CL/AM).

Table 9-1 Examples of Application Module Standard Algorithms for Continuous Control

Regulatory PV Algorithms	Regulatory Control Algorithms
Null Data Acquisition Flow Compensation Middle-of-Three Selector HI/LO/Average Selector Summer Multiplier/Divider Sum of Products Variable Dead Time (with Lead/Lag) Totalizer General Linearization Custom PV Algorithm	Null PID Normal PID External Reset Feedback PID With Feedforward Incremental Summer Lead/Lag Auto Manual Summer Multiplier/Divider Ratio Selector/Override Switch Ramp Soak Custom Control

Continued on next page

Control Rationale, continued

Control Language - CL/AM is a high-level, process-oriented language designed specifically for process and application engineers to use in implementing special control schemes. Engineers who are not experienced programmers will find CL/AM easy to use. Those who are experienced will find it powerful enough to accommodate many of their advanced control needs.

An outstanding advantage of CL/AM is that it is executed as an integral part of point processing. Because of this, blocks of the language can easily be inserted at insertion points in the standard processing routines. A data point can be instructed to execute such a block every time the point is processed or only under specific conditions. An engineer might, for example, insert a block of CL to be executed only when the point goes into high alarm.

Security features include checks to make sure that parameters and storage destinations are valid and that there are no time overruns.

Options - Additional Application Modules can be added to increase point-processing capacity.

Application Programs - Numerous powerful software application programs that take advantage of the AM's programming capabilities are available from Honeywell. For example:

- *LOOPTUNE*™ — optimally tunes PID control loops.
- *Real-time Statistical Process (and Quality) Control* — uses statistical control methods for early detection of quality problems.
- *Horizon Predictive Control*™ — a multiple input/single output control algorithm that can be tuned to control the 5% to 10% of loops in a plant that typically cannot be controlled with PID algorithms.
- *Batch Supervisor* — fully automates batch processes, and is menu-driven for ease in introducing new batch products or making recipe changes.

See your Honeywell representative regarding other programs that are available to meet specific applications.

9.4 Are Computer Applications and Integration of Plant-Wide Information Required?

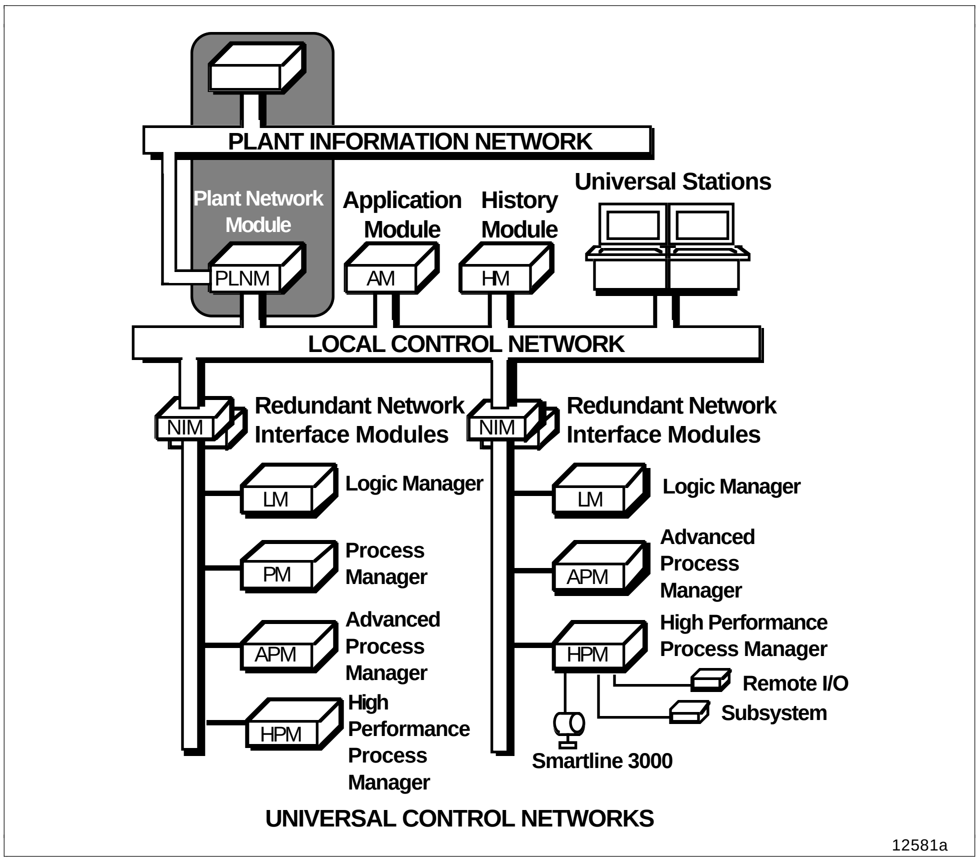
Introduction

This sample TDC 3000X system meets these requirements:

- Process data acquisition,
- Primary control of continuous and discontinuous operations,
- Single window to the process,
- History collection and miscellaneous data storage,
- Extensive advanced control, and
- **Execution of user programs written in high level languages, and integration of plant-wide information.**

The system shown in Figure 9-5 is the same as the one in Figure 9-4, except that a Plant Network Module and associated DEC computer have been added.

Figure 9-5 Adding a Plant Network Module with Computer



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9.4 Are Computer Applications and Integration of Plant-Wide Information Required?, Continued

Introduction

Some control strategies require calculations beyond those possible with even the Application Module. Such calculations may require, for example: extensive file handling, linear programming, matrix inversions, or rapid background processing. They generally do not need to be synchronized with algorithm execution. In addition, collection, storage, and manipulation of exceptionally large quantities of historical data may be required. For those applications where such extensive number crunching and data manipulation is a necessity, the TDC 3000X system provides interfaces to outside-vendor computers, or through the Application ModuleX, provides a RISC-based UNIX co-processor that lets you use a wide range of software applications from a variety of suppliers.

The TDC 3000X system software allows user-written computer programs to have access to any information anywhere in the system. Information from these programs can also be displayed at the operating center, and the programs can send messages to the operating center.

A computer connected to the TDC 3000X system can in turn exchange information with other external computers. This makes it feasible to establish a system-wide information network to make timely data available at all levels of decision-making within your organization.

Products to allow for these capabilities

Application ModuleX - The Application ModuleX (AXM) is a TDC 3000X advanced applications platform that combines the security necessary for advanced process control and optimization with the power to run complex applications from Honeywell and third-party suppliers. Existing Application Module (AM) functions - point processing, broad Proportional Integral Derivative (PID) algorithm handling, and Control Language (CL) capabilities - are expanded in the Application ModuleX with the addition of a powerful RISC-based UNIX co-processor that lets you use a wide range of software applications from a variety of suppliers. The AXM is designed to operate with system software Release 430 or later, and interfaces with all other node types and personalities that are compatible with R430. OpenDDA is the tool in the AXM that allows applications to be integrated with LCN data.

Figure 9-6 illustrates the Application ModuleX dual hardware interface that allows it to serve as a module on the TDC 3000X Local Control Network as well as a node on the Plant Information Network (PIN). Accordingly, it can communicate with other modules on single or multiple LCNs; with process-connected devices on Universal Control Networks and Data Hiways; and with PCs, workstations and other devices that reside on the PIN and communicate using industry standard network communications.

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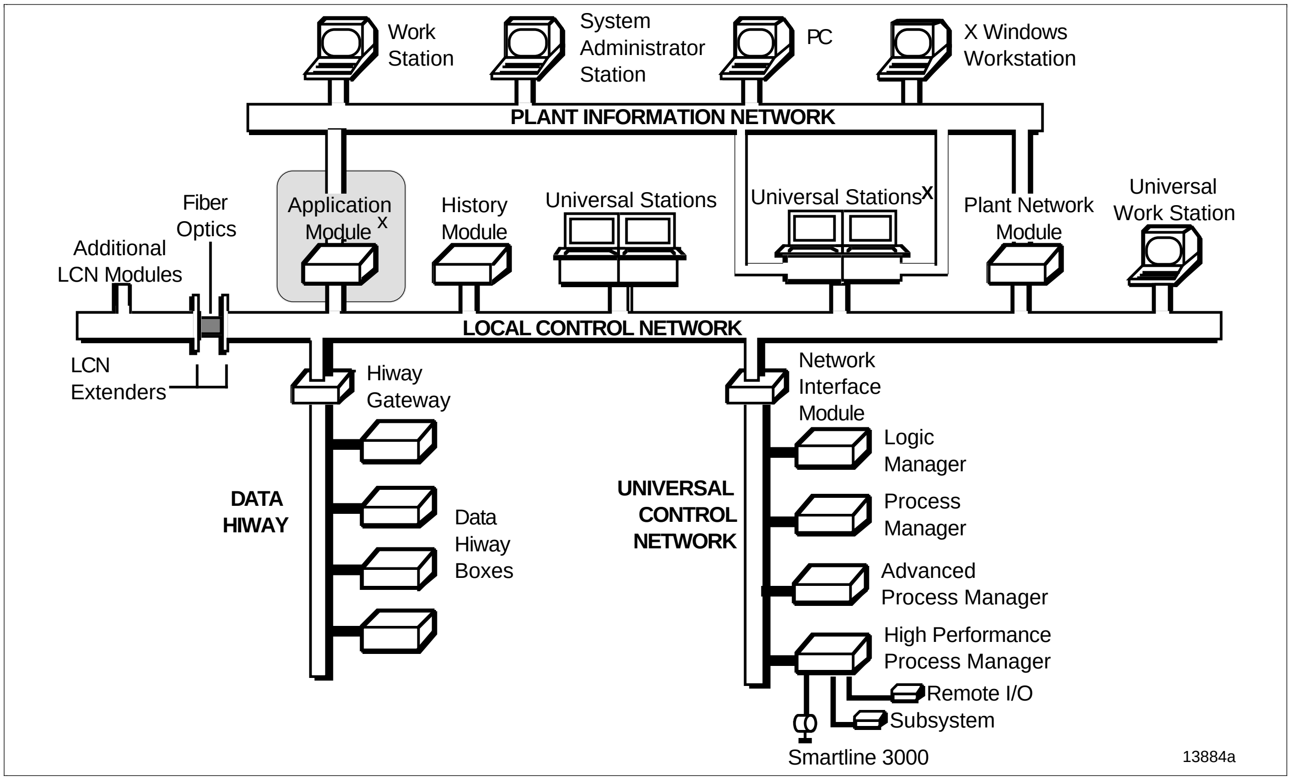
Products to allow for these capabilities, continued

Figure 9-6 TDC 3000X with an the Application ModuleX



Plant Network Module - The Plant Network Module is designed as an interface to DEC VAX and AlphaAXP computer systems. CM50S software can be used on either the DEC VAX or AlphaAXP.

Computer Gateway (CG)- The Computer Gateway is another LCN module that is available for integrating a computer into TDC 3000X. It functions in a similar manner to the Plant Network Module, but uses an HDLC communication link. Computers from a number of outside vendors have been implemented using Computer Gateways.

Continued on next page

9.4 Are Computer Applications and Integration of Plant-Wide Information Required?, Continued

Products to allow for these capabilities, continued

VAX Application Packages - A number of software application packages have been developed for ready implementation on the VAX. Examples are:

- *Plant Information System* —provides tools to collect, archive, and view data, and distribute it over a network for engineering and management data analysis and decision support.
- *Application Builder and Executive* — provides the tools to build on-line applications in a real-time VMS environment, using a menu driven interface.
- *Process Modeling and Optimization* — a software system for real-time modeling, optimization and analysis of process and plant operations.
- *TDC 3000 Expert* — an advisory expert system shell that allows a user to capture operator or engineer expertise, and makes that knowledge available to less experienced personnel 24 hours a day.

Consult your Honeywell representative regarding other packages that are available.

9.5 Is There a Need for the Operator to View External Network Data Alongside LCN Process Data?

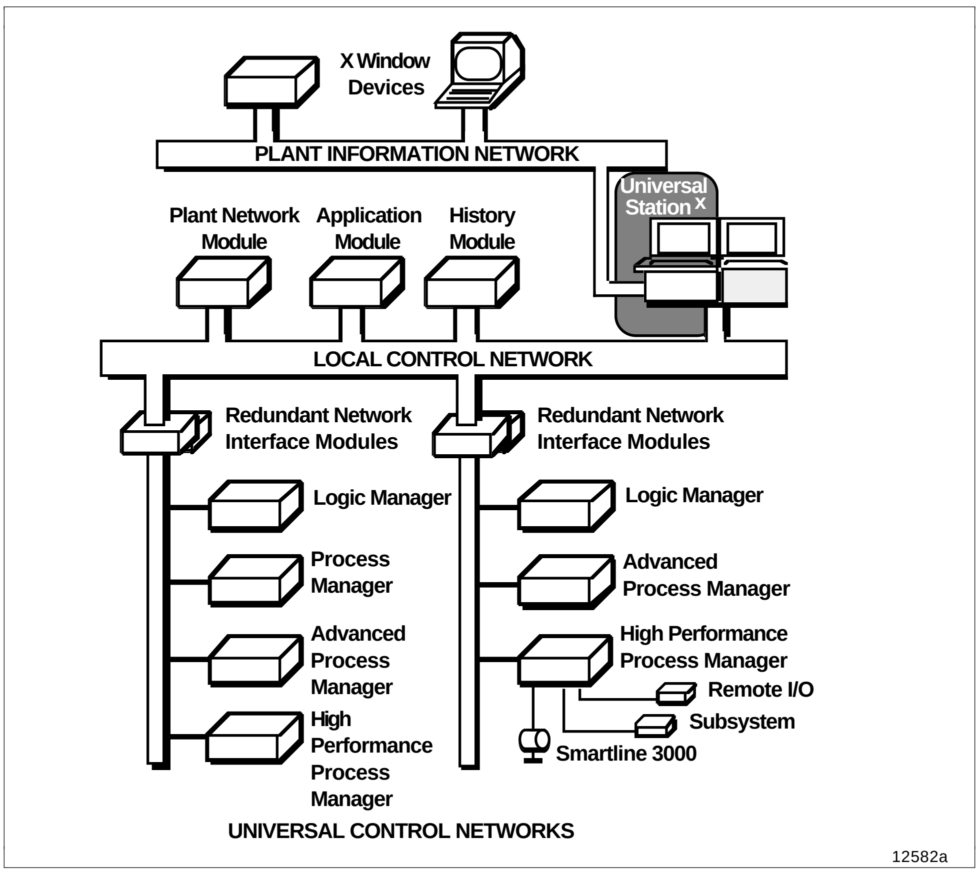
Introduction

Your plant may already be wired with a Local Area Network that enables plantwide communication of many kinds of data between individuals and between departments, or you may wish to establish such a network to disseminate information needed for more timely decision making. Now TDC 3000X includes the capability for the operator to view pertinent externally supplied data on the Universal Station simultaneously with the process display.

Using the Universal StationX

Figure 9-7 shows how Universal StationX provides this capability through a port that connects to the LAN (Plant Information Network). Workstations, PCs, and other devices that operate under the UNIX/X Window System software environment can send information over the Plant Information Network to the Universal StationX for display on the operator's screen.

Figure 9-7 Universal StationX Attached to Plant Information Network



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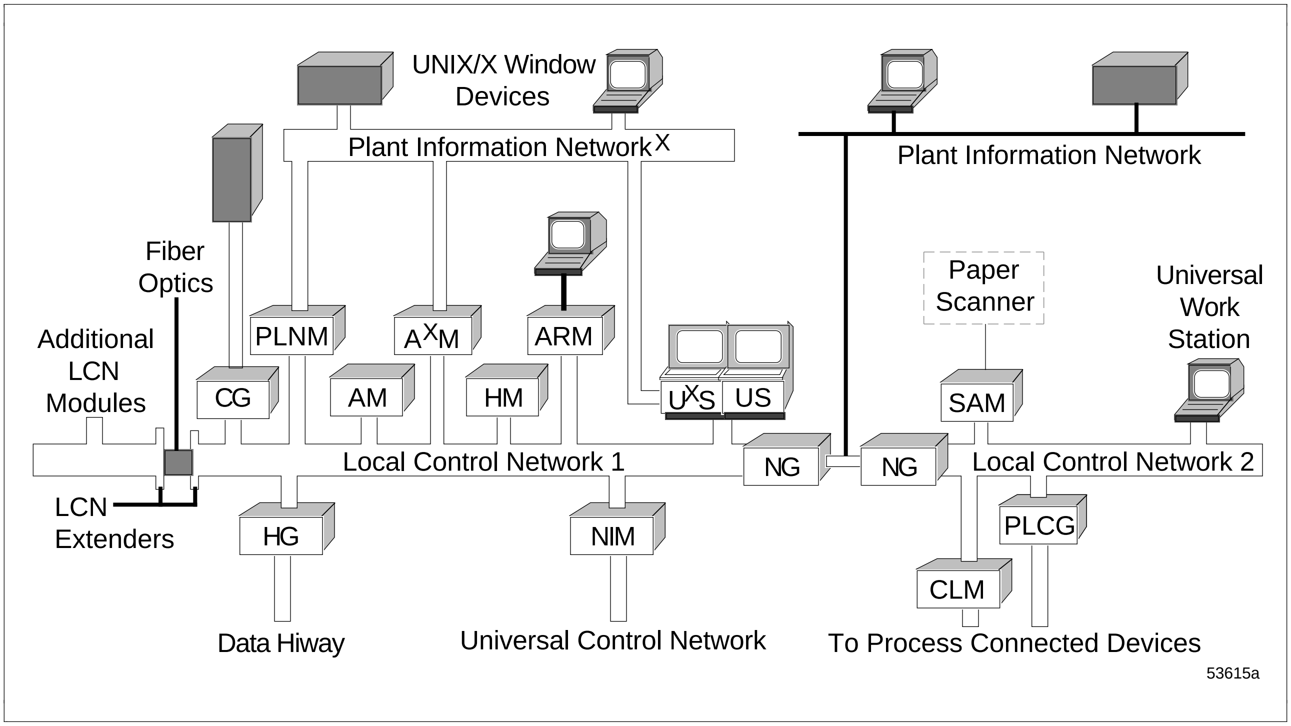
9.6 Is More than One LCN Required?

Network Gateway

If you have a requirement for exchanging control information between two or more control room sites, particularly if separated by long distances, the Network Gateway makes it possible to do so by securely interconnecting two or more LCNs.

As illustrated in Figure 9-8, at least one Network Gateway is located at each local site, where it connects the LCN at that site to a Plant Information Network. The PIN is a broad band network that adheres to IEEE 802.4 (ISO 8802/4) and IEEE 802.7 communication standards. It can consist of either single or redundant coax or fiber optic cables, along with head-end remodulators and repeaters as required.

Figure 9-8 TDC 3000X with Dual LCNs



Data is transmitted over the PIN at 10 mbps, and is normally received within seconds. The individual LCNs will continue to operate independently in the event of PIN failure.

Availability can be enhanced by the addition of a second Network Gateway on an LCN. Assigned as “alternate,” this Network Gateway takes over the communication task if an error occurs in the “responsible” Network Gateway’s electronics module.

Section 10 – Characteristics of a Process Management System

10.1 Dependability, Maintainability, and Support

Introduction

Regardless of the number of requirements that a process-management system satisfies, there are three fundamental characteristics that it must have to be able to perform most effectively:

- Dependability,
- Maintainability, and
- Support.

Dependability

Put very simply, TDC 3000X is a dependable system because it works when you need it. Several factors contribute to its **high availability**. A fundamental factor is the design of the system, which strives to prevent faults and to correct errors in both the hardware and the software. Errors that do persist are tolerated with little or no degradation of system performance, and they typically affect only the device or module in which they occur. If one of these devices fails, some capacity, throughput, or functions may be lost, but the system continues to operate.

A second factor contributing to the high availability of the system is the degree of **redundancy** attainable. In the TDC 3000X system, redundancy is a standard feature for data-communications cables. In addition, redundancy with automatic backup is available for:

- Network Interface Modules,
- Hiway Gateways,
- Application Modules,
- History Module disks,
- Logic Managers,
- Process Manager Modules,
- Advanced Process Manager Modules,
- PM/APM analog input processors,
- PM/APM analog output processors,
- PM/APM Smart Transmitter Interface processors, and
- Several Data Hiway devices.

Continued on next page

Dependability, continued

A third contributor to the high availability of the system is its **ease of use**. Displays on the video monitors are designed to easily guide the operator, engineer, and maintenance technician through the proper procedures. This increases useful time spent with the system. Training courses and the comprehensive technical publications that are provided are oriented toward how to use the system, rather than how it works.

TDC 3000X is also dependable because it is **secure**. It provides several keylock-protected levels of access to the process database and thus prevents unauthorized changes. The data in the TDC 3000X system database is secure in another way because of the extensive diagnostics and cross-checking that the system does to assure that the proper type of data is entered or requested and that requests for data come from legitimate sources.

Maintainability

Maintainability is specifically designed into the TDC 3000X system to ensure (1) that the amount of system maintenance is minimized and (2) that users themselves can do most of any system maintenance that is needed.

The commonalty of hardware and software in the TDC 3000X system is a major contributor to maintainability. For example, modules use the same common boards.

Software also is standardized as much as possible, both to reduce development costs and to increase processing efficiency; standardized software, used in many systems, stands a better chance of minimizing problems on delivery. The basic operating software, as well as network communications software, is the same in all the modules. In addition, each module contains the software that performs the functions of its type.

The system performs extensive integrity checks to detect and correct errors in data transmission. Moreover, the system records and analyzes both hardware and software errors and makes recommendations to replace devices it suspects of impending failure. In addition, the built-in tests in all TDC 3000X process-connected devices and modules diagnose a very high proportion of failures without human intervention, then make specific recommendations to the operator to test, verify, or replace failed ORUs. Most of these tests run while the system is on-line and controlling the process.

Continued on next page

Maintainability, continued

Occasionally, the self-diagnostics cannot pinpoint a problem to the responsible ORU. In this case, the maintenance technician is provided with off-line tests for the device or devices that might logically be the cause of the problem.

For maintenance or repairs, any module, any peripheral device, and any process-connected device can be removed from service and returned to service while the remainder of the system is on-line. All on-site repairs are made by replacing ORUs.

System Support

One of the most important support features of TDC 3000X systems is Honeywell's longstanding policy of standing behind its products. Honeywell is known throughout the industry for producing quality products and systems, and for offering any service necessary to get them running and to keep them running.

One of the design goals for the TDC 3000X family of systems was for customers, who so desire, to be able to install the system themselves, using only the normal training and documentation provided by Honeywell. Recently introduced modular, self-paced training courses permit each individual trainee to select those topics of study that meet his or her specific needs, and to proceed at a pace determined by his/her particular background and experience. Called *FLEXTRAINING*™, this approach includes intensive, hands-on lab experience. Professional Course Managers are present at all times to answer questions and to provide assistance as needed. Courses can be held at IAC's training facilities or at your location. Special courses to meet specific needs can also be arranged.

The standard written documentation for TDC 3000X systems is supplied in one or more booksets consisting of a series of binders. These are organized by information content to make information easy to locate. Liberal use is made of illustrations, examples, and scenarios to make the information easy to understand and use.

In addition, Honeywell offers the TDC 3000 LCN/UCN Bookset in an electronic edition, supplied on CD Rom.

Continued on next page

System Support, continued

For those users who desire assistance, Honeywell provides a full range of project services and application expertise. Many of our personnel have come from the process industries, bringing with them specialized experience and knowledge in applications, process control, and operations. This automation expertise is available to help you to realize the full potential of your TDC 3000X. Included are such activities as:

- control strategy design and implementation,
- custom hardware integration,
- assistance with engineering tools,
- site planning,
- operator interface design,
- project management,
- systems analysis, and
- custom software design.

Software packages are also available to assist you in configuring your system:

- *WORKBOOK* enables you to configure your TDC 3000X system independent of the system itself by using an IBM-compatible PC. It can serve multiple users on a network, and enables point building for LCN, UCN, and Data Hiway devices.

- *The Engineering Bridge*™ is a comprehensive software product that provides configuration management from Plant Design Engineering to the TDC 3000X and back. Configurable data for UCN devices can be specified in P&ID drawings and/or advanced control loop drawings and then used to configure the TDC 3000X. Subsequent changes can be transferred back to the drawings. The Engineering Bridge operates on single or networked PCs.

Honeywell provides a number of services for *on-going* system support. Among these is the Technical Assistance Center (TAC), which provides expert assistance in diagnosing failures that are not quickly resolved on-site. The TAC staff has extensive stored information on symptoms and successful remedies and offers expert help in running test programs and analyzing test data.

Other services for on-going system support include flexible field-maintenance programs, fast delivery from field-located parts depots, and parts exchange.

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