Chapter 1

Introduction

EMS DEFINED

EMS defined: A system which employs microprocessors, building field panels, communication cables between field panels, control equipment, and software application programs configured into a network with control functions at multiple locations and a point of operator supervision and control (see Figure 1-1).

Central EMSs are of various levels of sophistication depending on the size of the building and desired operational function. The simplest system allows an operator to check the operational status of the heating, ventilating and air conditioning (HVAC), fire and security systems, and control various equipment remotely from a central console. The next level system ("direct digital control"—DDC) has a digital computer to perform most of the work normally done by the operator, plus other optimization and control functions.

Previously, EMS terminology included statements such as "communication" between the field panels and the Central Processing Unit (CPU). Current EMSs no longer require a CPU, nor do they rely on a CPU for system operation!

CONVENTIONAL PNEUMATIC CONTROLS

Conventional pneumatic controls have been the traditional form of control used in most commercial and institutional facilities for environ-

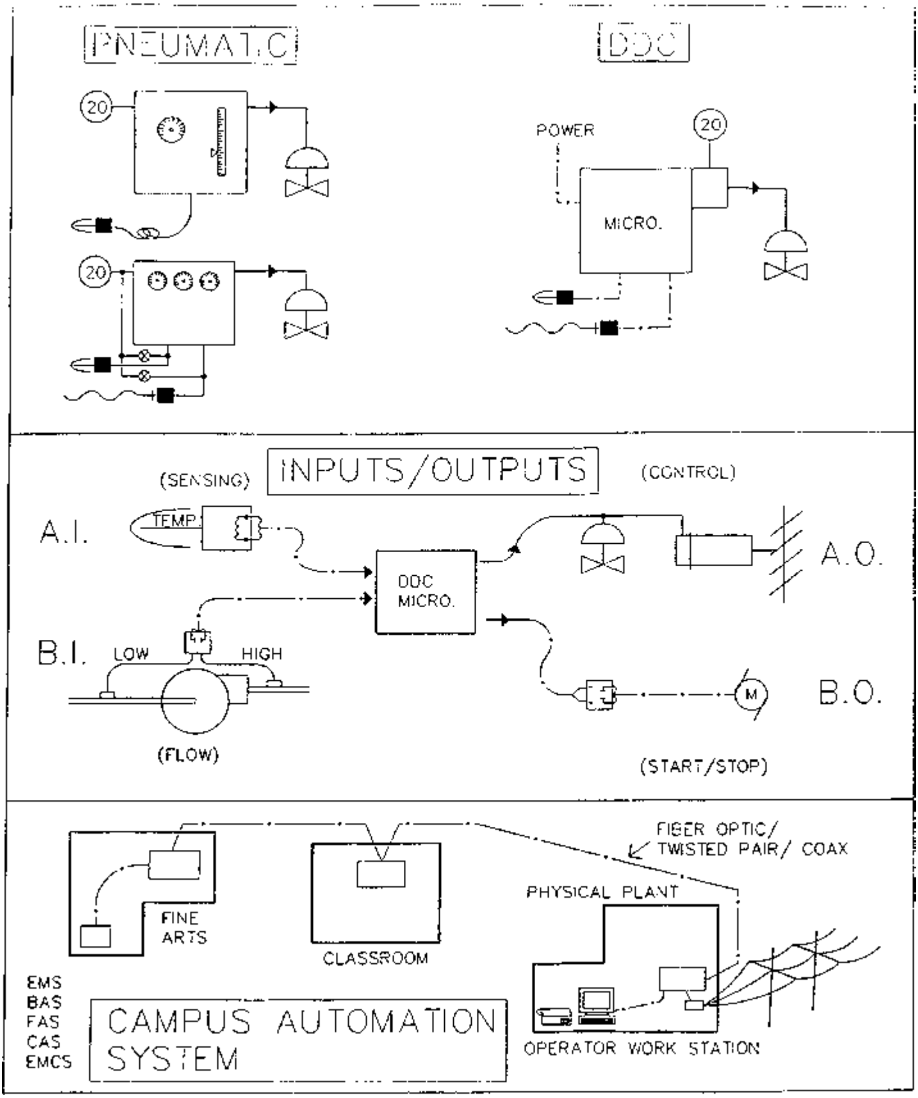

Figure 1-1. Pneumatic to Automation Via DDC

mental control. The control function is performed by a pneumatic controller which receives its inputs from pneumatic sensors and sends control signals to pneumatic actuators (see Figure 1-2).

In the 1970's, a supervisory system was often interfaced to the pneumatic control system to allow remote control (remote set point or control point adjustment) of pneumatic receiver controllers and centralized monitoring through electronic sensors. The remote electronic panels communicate to a central computer; however, if the communications line was broken, or if the computer failed, the entire system was OFF (see Figure 1-3).

DIRECT DIGITAL CONTROL (DDC)

Direct Digital Control (DDC), although used for years in the process industry, entered the HVAC industry in the late 1980's. DDC utilizes a programmable microprocessor as the primary controller. The HVAC system variable (temperature) is measured by electronic sensors. The control functions are performed by a microprocessor which transmits an electronic or transduced pneumatic control signal directly to the controlled device (damper or valve actuator).

DDC is a form of closed-loop control. The term "Direct" means the microprocessor is directly in the control loop and the term "Digital" means control is accomplished by the digital electronics of the microprocessor. As opposed to electronic controls, which are much like pneumatic controls where each controller handles one control loop in a fixed manner, DDC can control numerous control loops and be reprogrammed for different control functions without hardware changes (see Figure 1-4).

Distributed DDC consists of several DDC units located throughout a building complex. Although, each DDC can operate independently, they are all connected to a central operator station for centralized control and monitoring. A measure of a true distributed DDC system is whether the remote DDC units continue to perform full control and energy management, without the central operator station (see Figure 1-5). DDC will be covered in greater detail in Chapter 5.

Refer to Table 1-1 for a comparison of pneumatics and DDC.

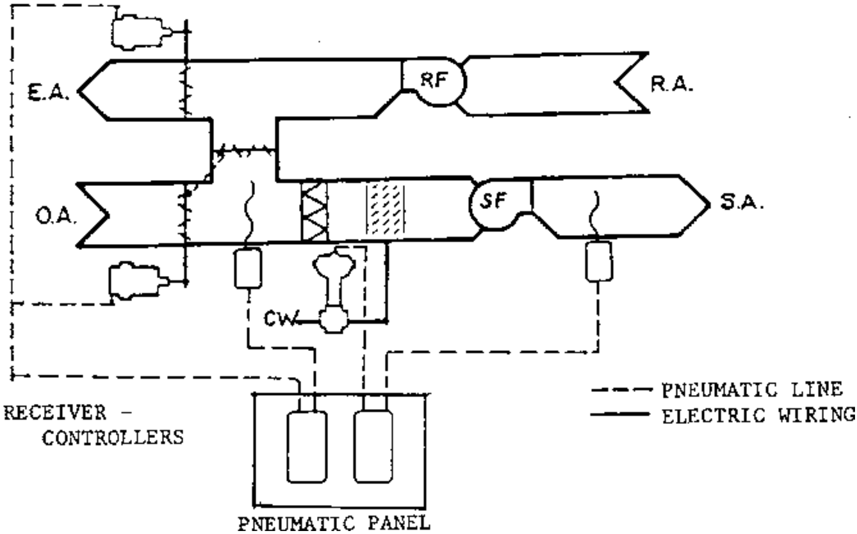

Figure 1-2. Pneumatic Control

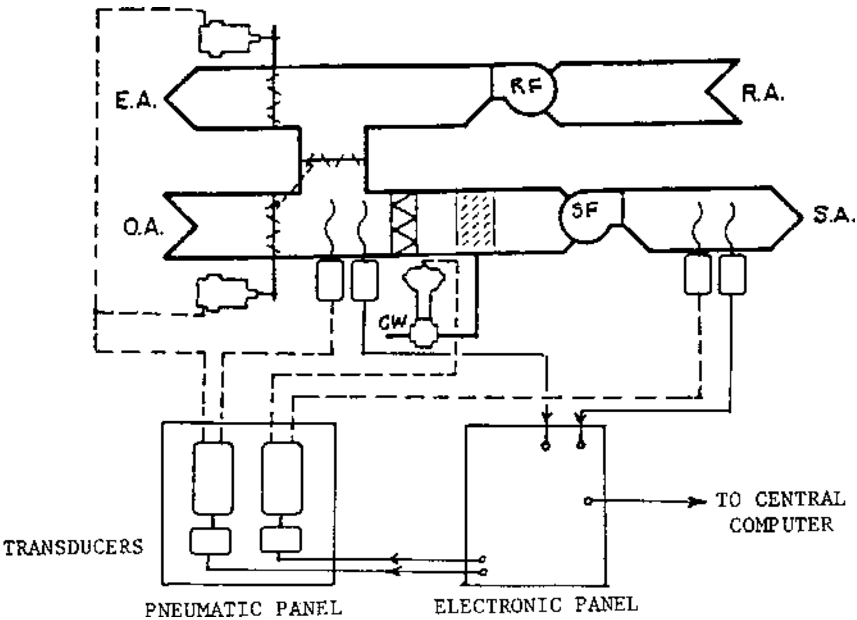

Figure 1-3. Supervisory Automation System

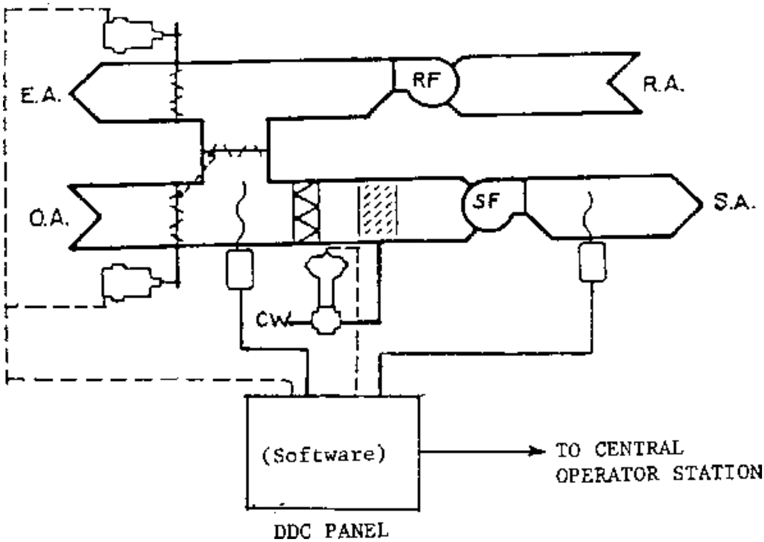

Figure 1-4. Direct Digital Control

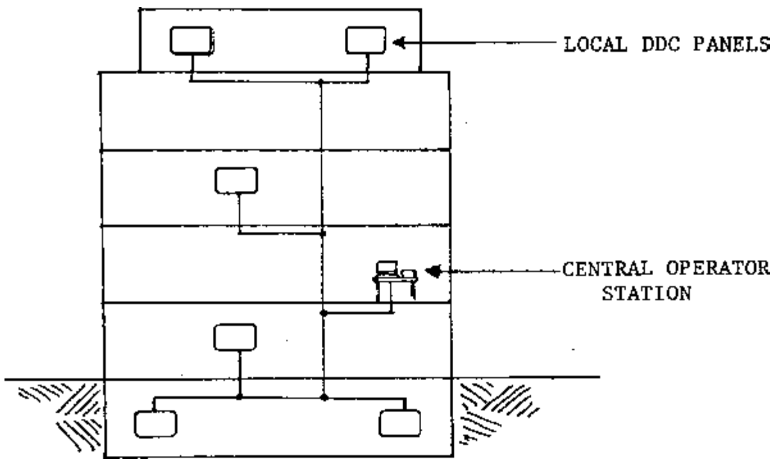

Table 1-1. Comparison of Pneumatics and Direct Digital Control

COMPARISON CATEGORY	CONVENTIONAL PNEUMATIC CONTROLS	DIRECT DIGITAL CONTROL	BEST CONTROL SYSTEM
Performance	• Proportional control only. • Single loop controllers. • Complex control is difficult or costly. • Adequate control.	• Full PID control and more. • Multi-loop controller. • Easy to define complex sequences. • Closer control.	DDC
Initial Cost	• Cost rises with number of control loops. • Complex control is very expensive.	• Once cost of DDC controller is absorbed, cost rises with number of sensors and actuators. • Capable of most complex control.	Comparable
Reliability	• Proven reliability over many years, however, control system must be well maintained and recalibrated regularly. • Relies on air supply.	• Proven reliability in process industry and many commercial HVAC applications. • Each DDC controller can stand alone.	DDC
Maintainability	• Relatively easy to maintain. • Require regular recalibration due to drift.	• Automatic as-builts. • Built-in diagnostics. • Fewer components. • No drift. • Service by board replacement.	DDC

Table 1-1. Comparison of Pneumatics and Direct Digital Control (*Continued*)

COMPARISON CATEGORY	CONVENTIONAL PNEUMATIC CONTROLS	DIRECT DIGITAL CONTROL	BEST CONTROL SYSTEM
Flexibility	• Changes or additions require new or different controllers re-piping and often wiring, and then recalibration.	• Programmable controller. • New control strategies defined at central. • New control easily added.	DDC
Ease of Use	• All operator interaction at local control panels. • Can read temperatures and change set-point.	• Full English language reports. • Color Graphic Displays • Automatic Records of all control strategies.	DDC
Life Cycle Cost	• Requires regular recalibration. • Modification and expansion require additional controllers.	• Easy to maintain. • Easy to modify. • Easy to expand.	DDC
Cost to Add Energy Management	• Each new function usually requires additional equipment and labor.	• New functions are easily defined by operator.	DDC