



HVAC System Control

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HVAC System Control

Fundamentals of Automatic Control

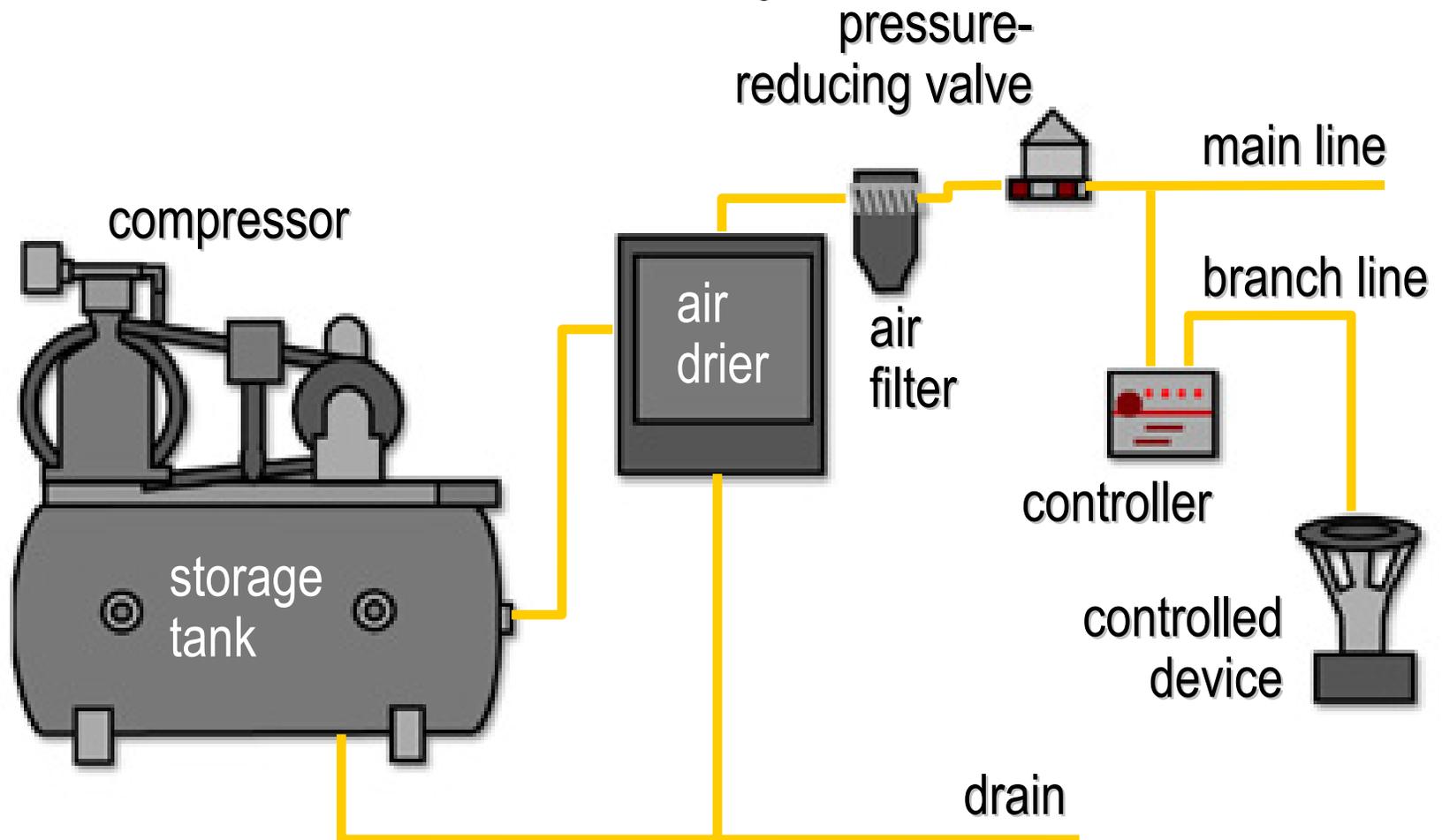


Controller Technologies

- Pneumatic
- Analog-electric
- Microprocessor-based

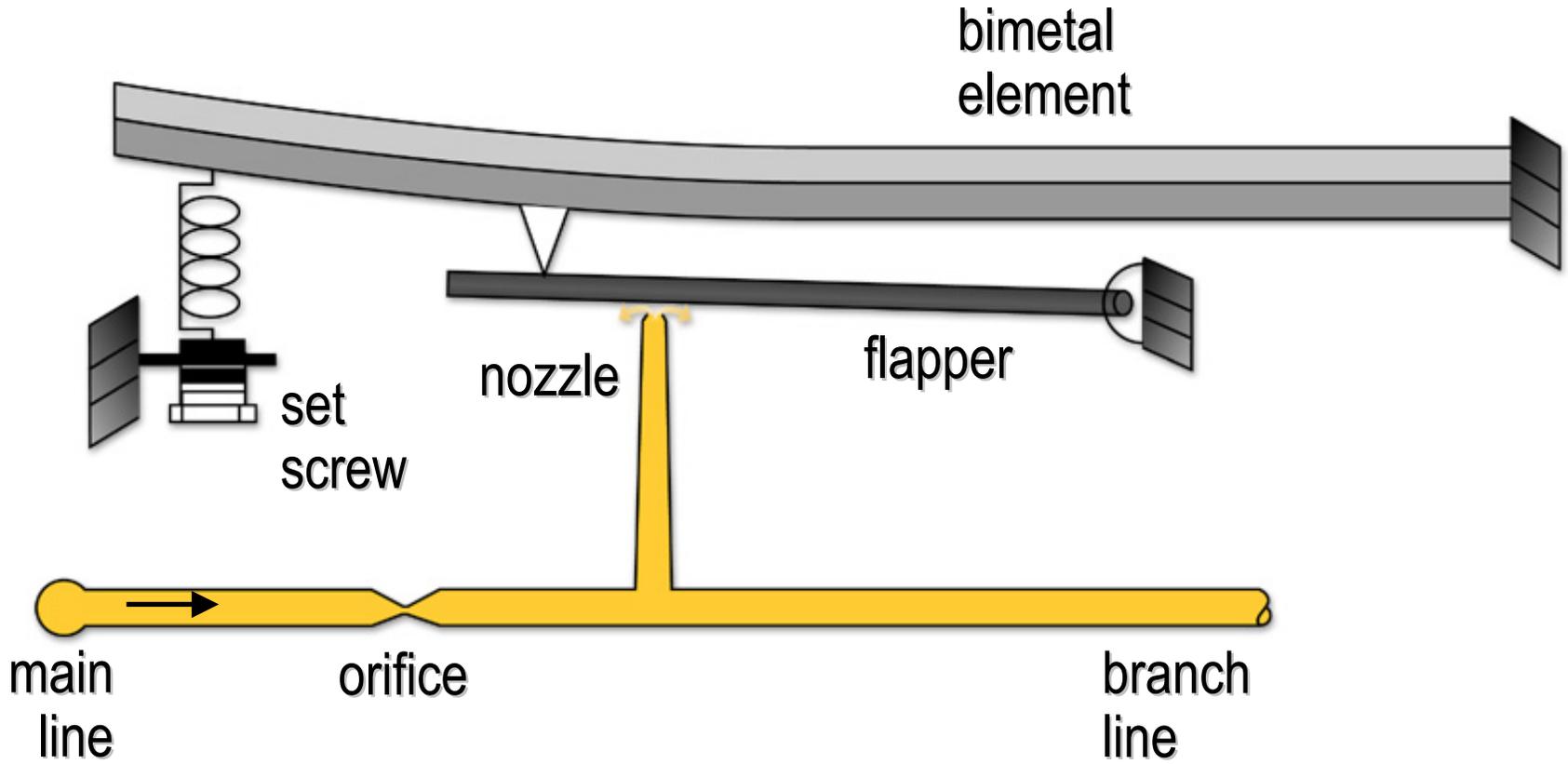


Pneumatic Control System



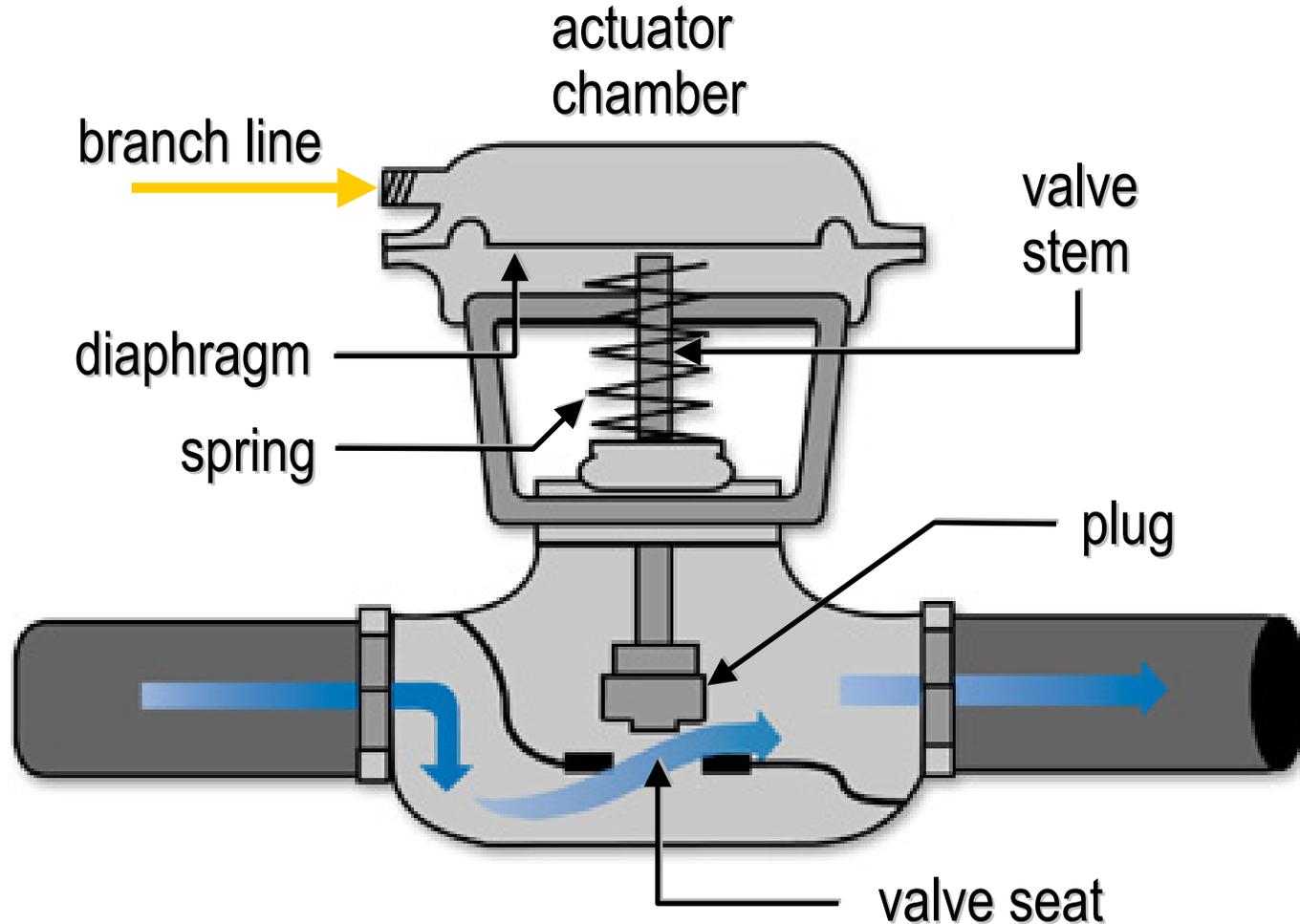


Pneumatic Controller



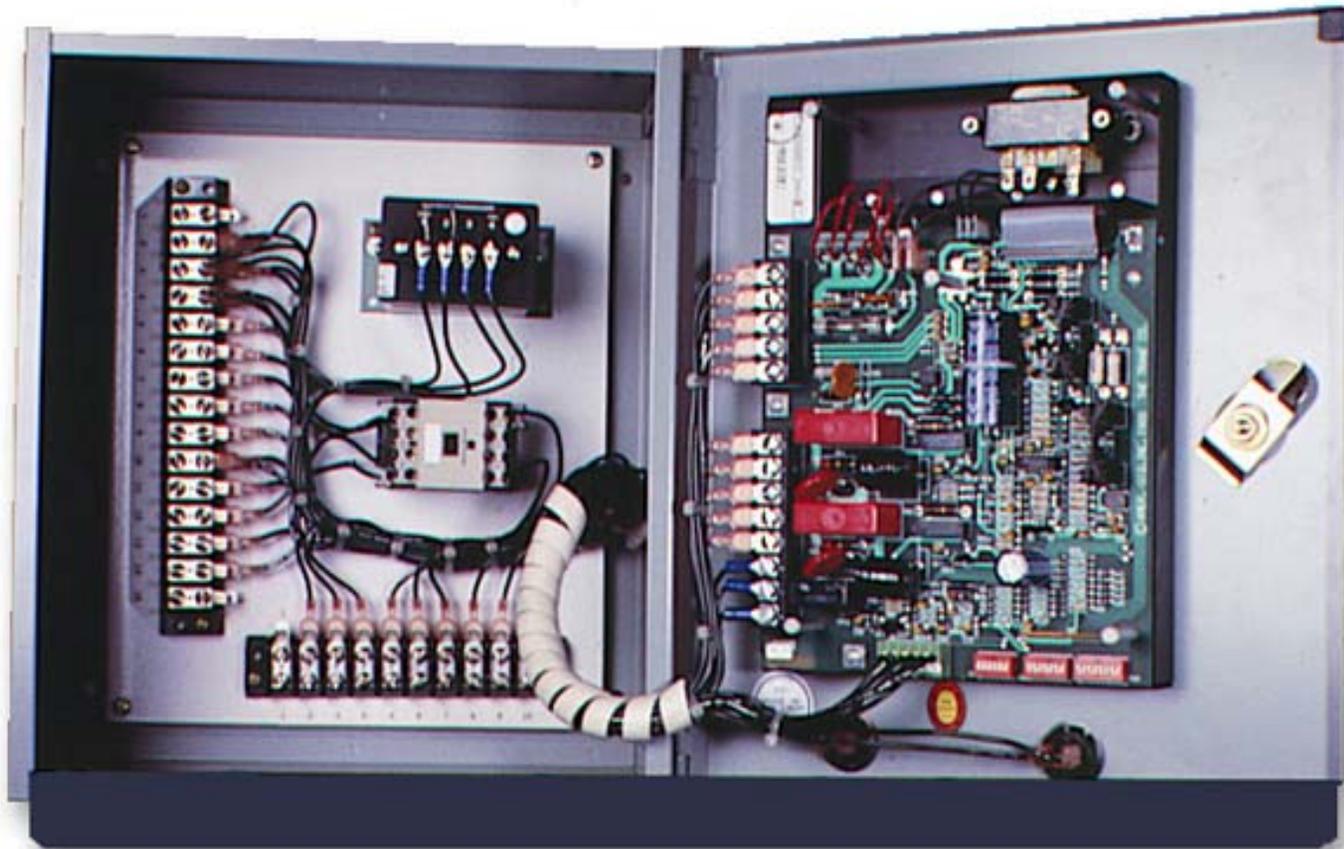


Pneumatic Controlled Device



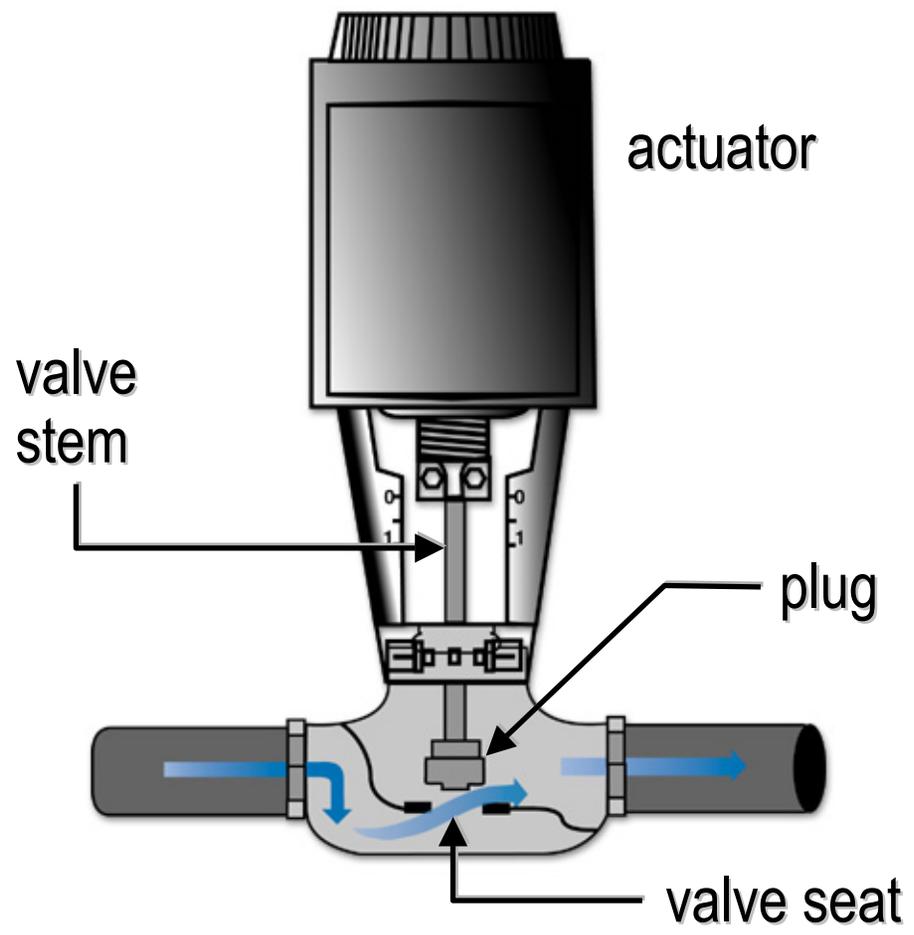


Analog-Electric Controller



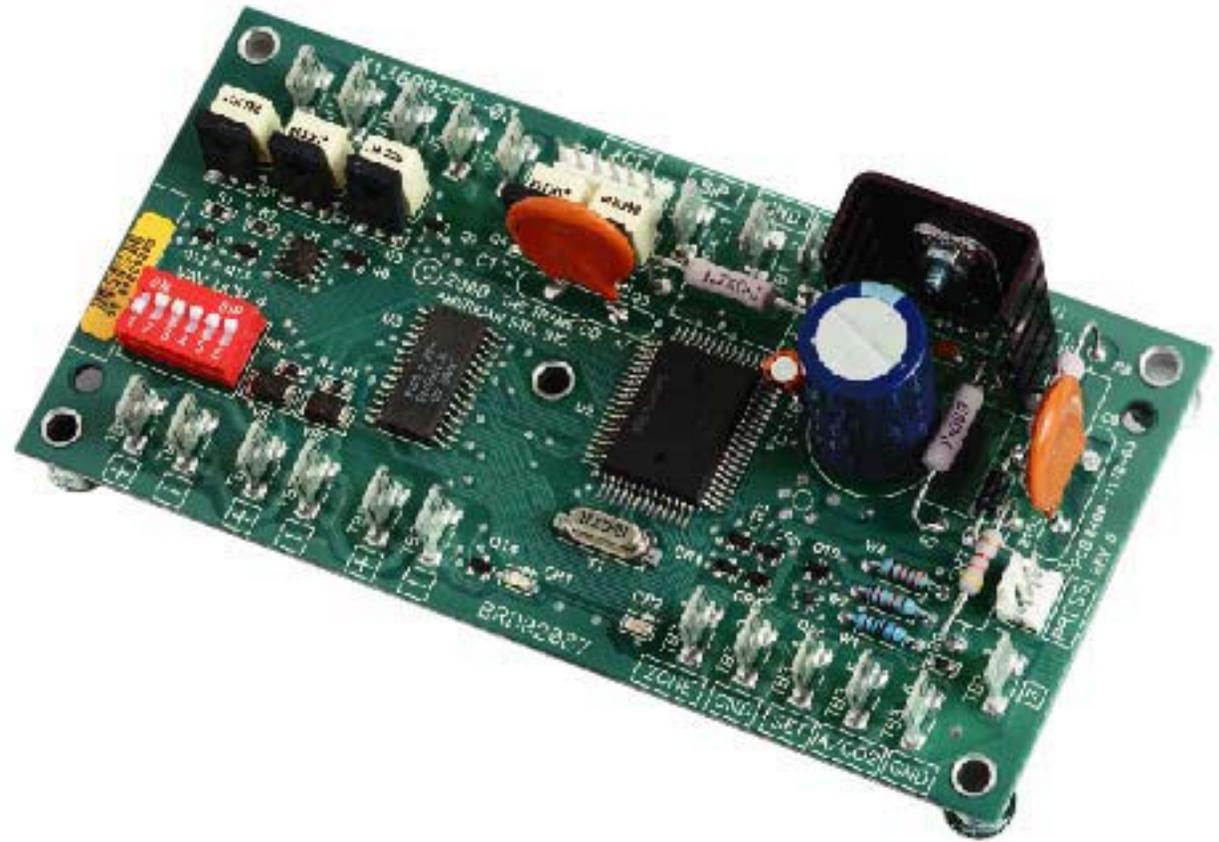


Electronic Controlled Device



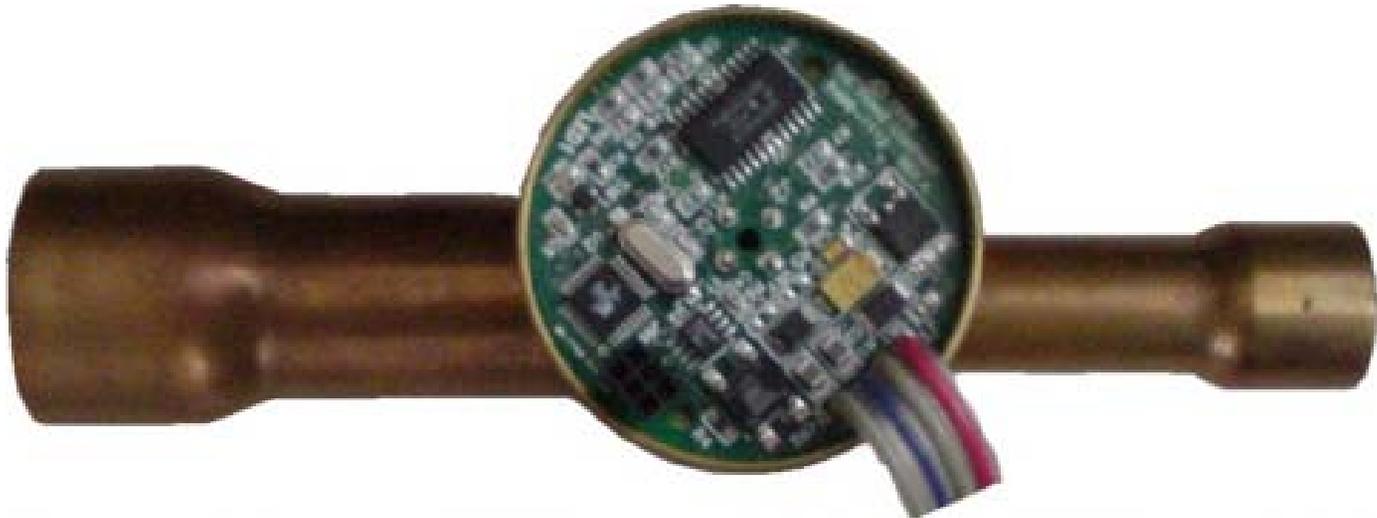


Microprocessor-Based Controller





DDC Controlled Device





Comparison of Technologies

Pneumatic

- No communication capabilities
- Expensive and complicated to provide complex control strategies
- Inherently proportional
- Extensive maintenance requirements
- Very sensitive to oil contamination

Microprocessor-based

- Allows system-wide communication
- Fewer hardware components
- Easily accommodates complex control strategies
- Provides many types of control action
- Fewer maintenance requirements



Comparison of Technologies

Pneumatic

- Not smart enough...could not distinguish control errors easily
- By today standards controlling parameters not accurate enough
- Humidity sensors hard to keep in calibration
- Hard to make 2 position control actions

Microprocessor-based

- Sensitive to power fluctuations, lighting....etc
- Keep controllers away from power lines
- Humidity sensors hard to keep in calibration
- Unit level controls



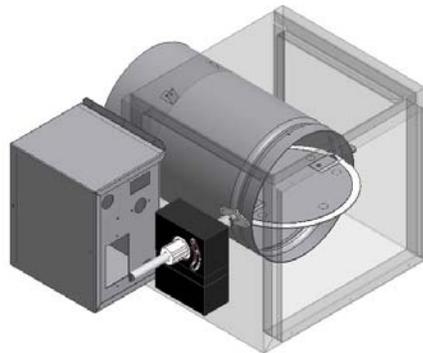
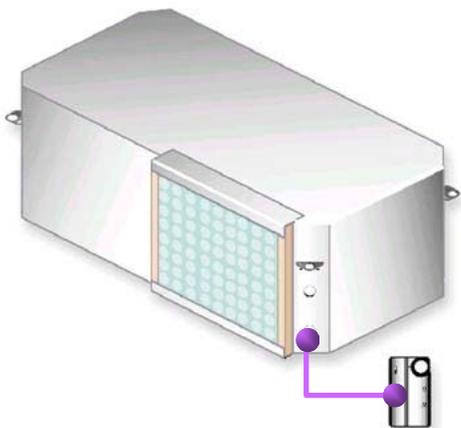
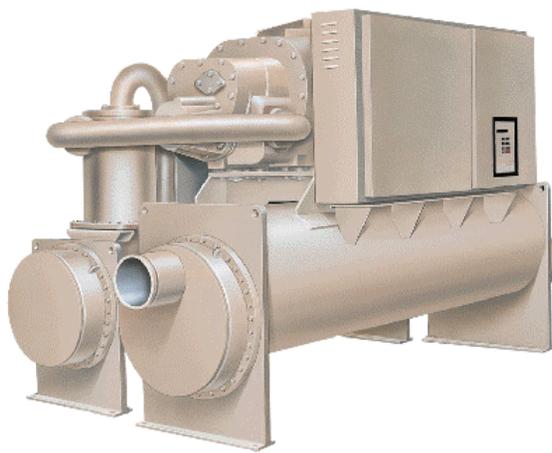
Benefits of Unit-Level Control

- Stand-alone control
- Safeties, alarms, and diagnostics
- Installed, tested, and commissioned in factory



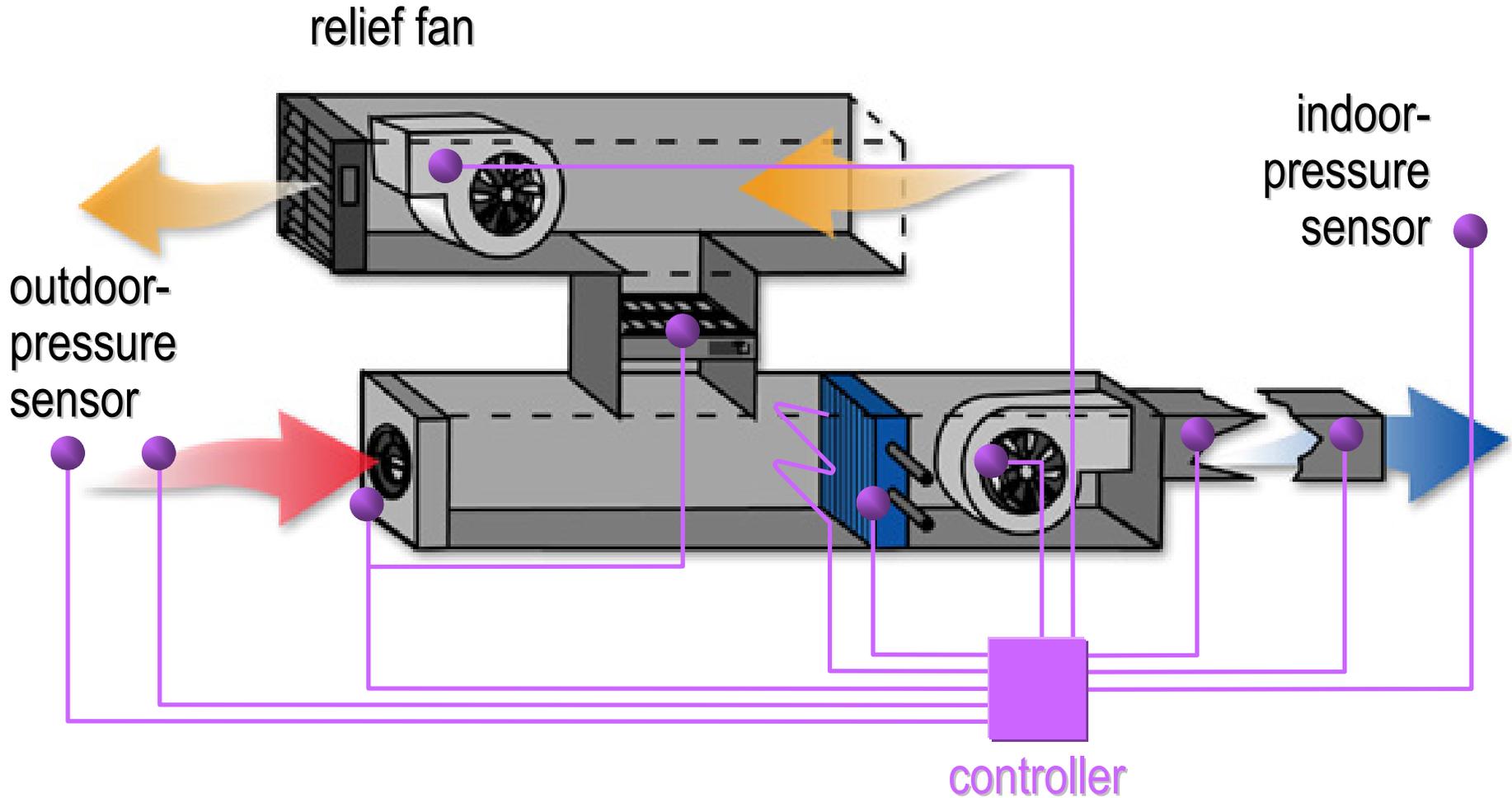


Unit-Level Control





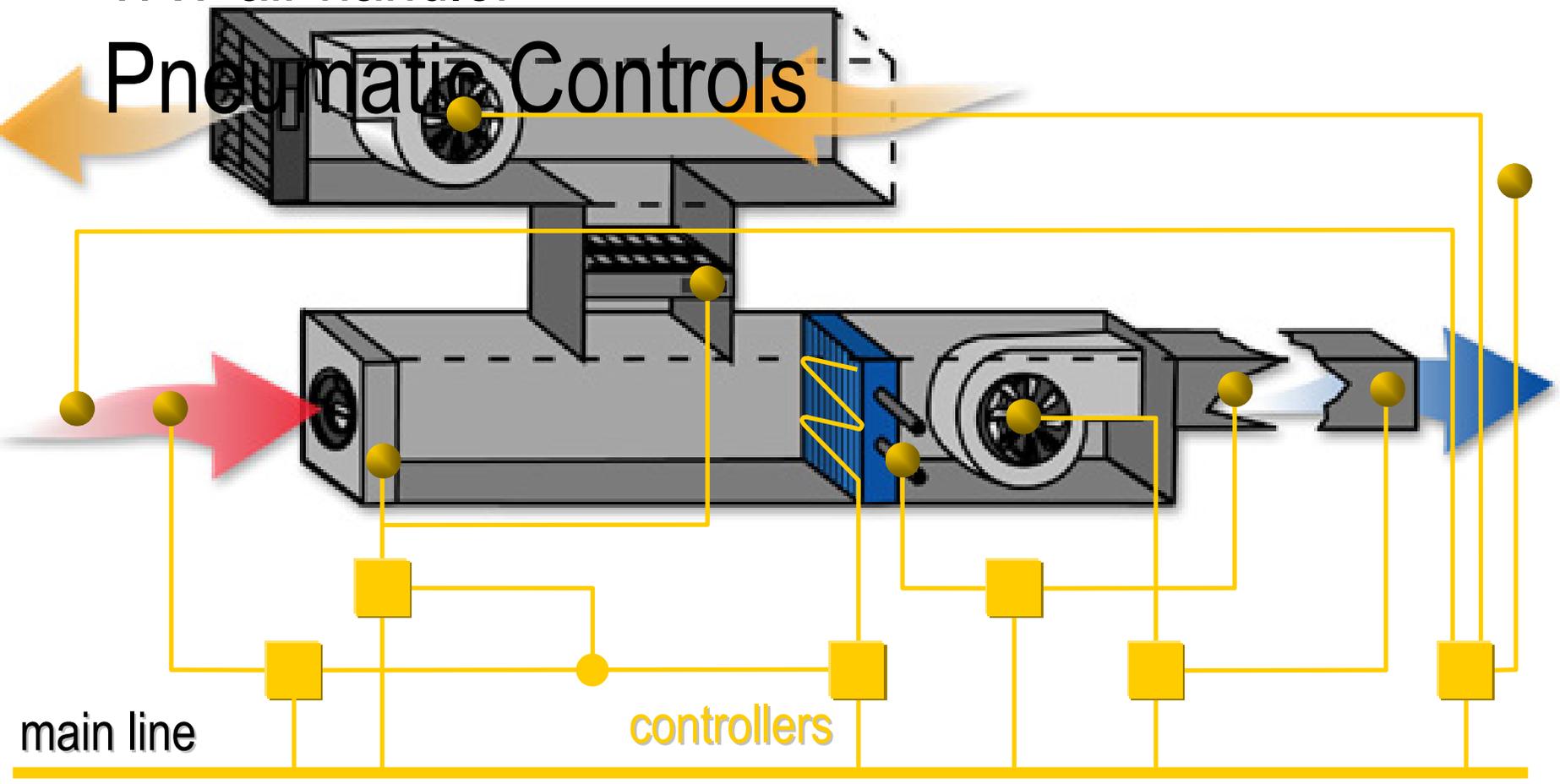
Building-Pressure Control Loop - VAV Air Handler





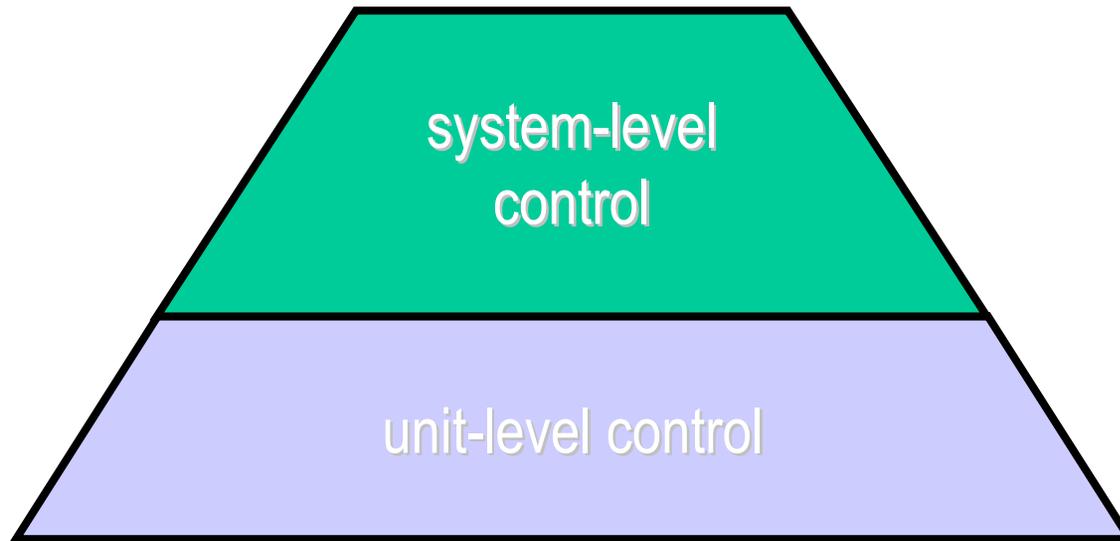
VAV air handler

Pneumatic Controls





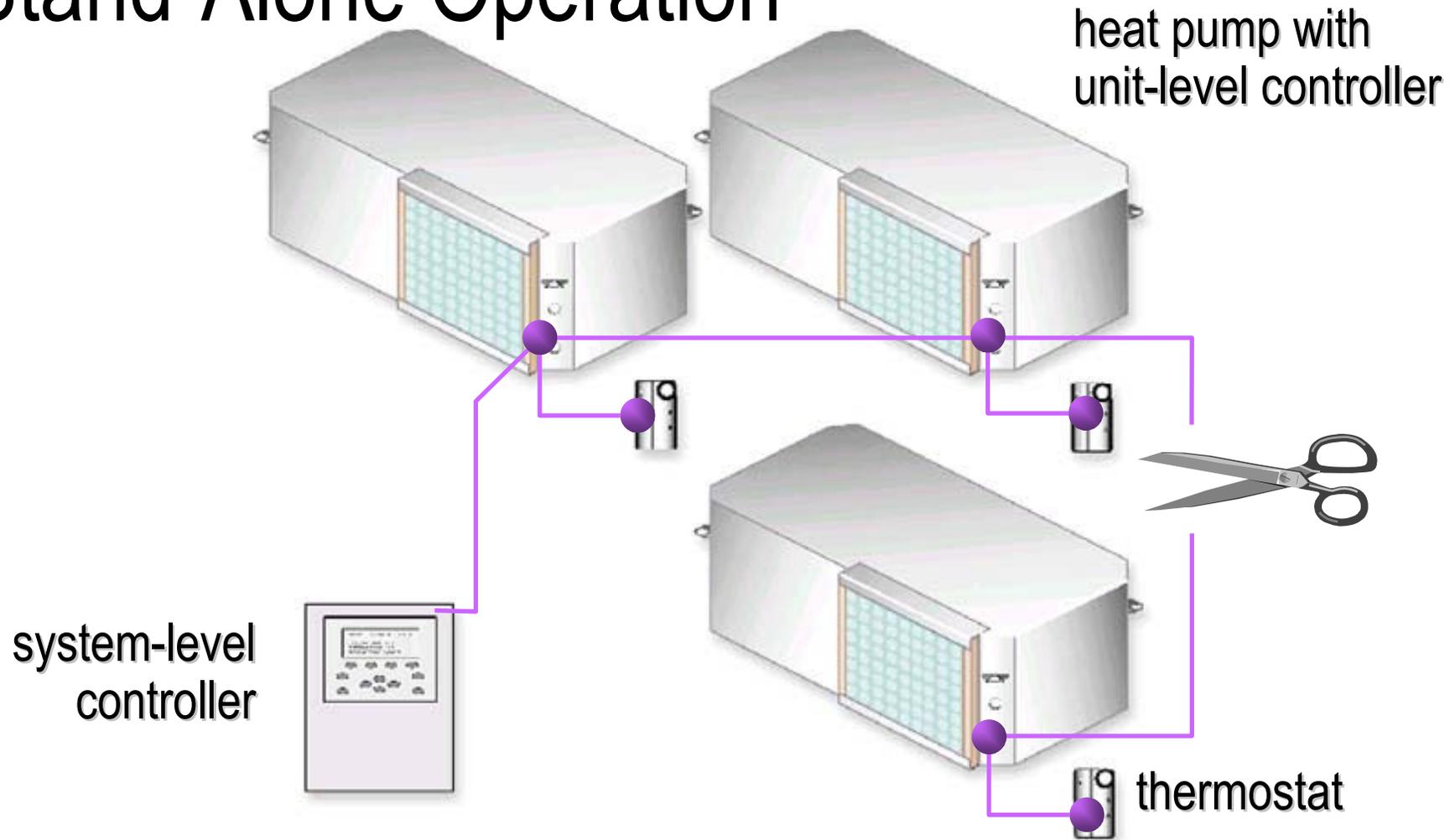
System-Level Control





failure recovery

Stand-Alone Operation





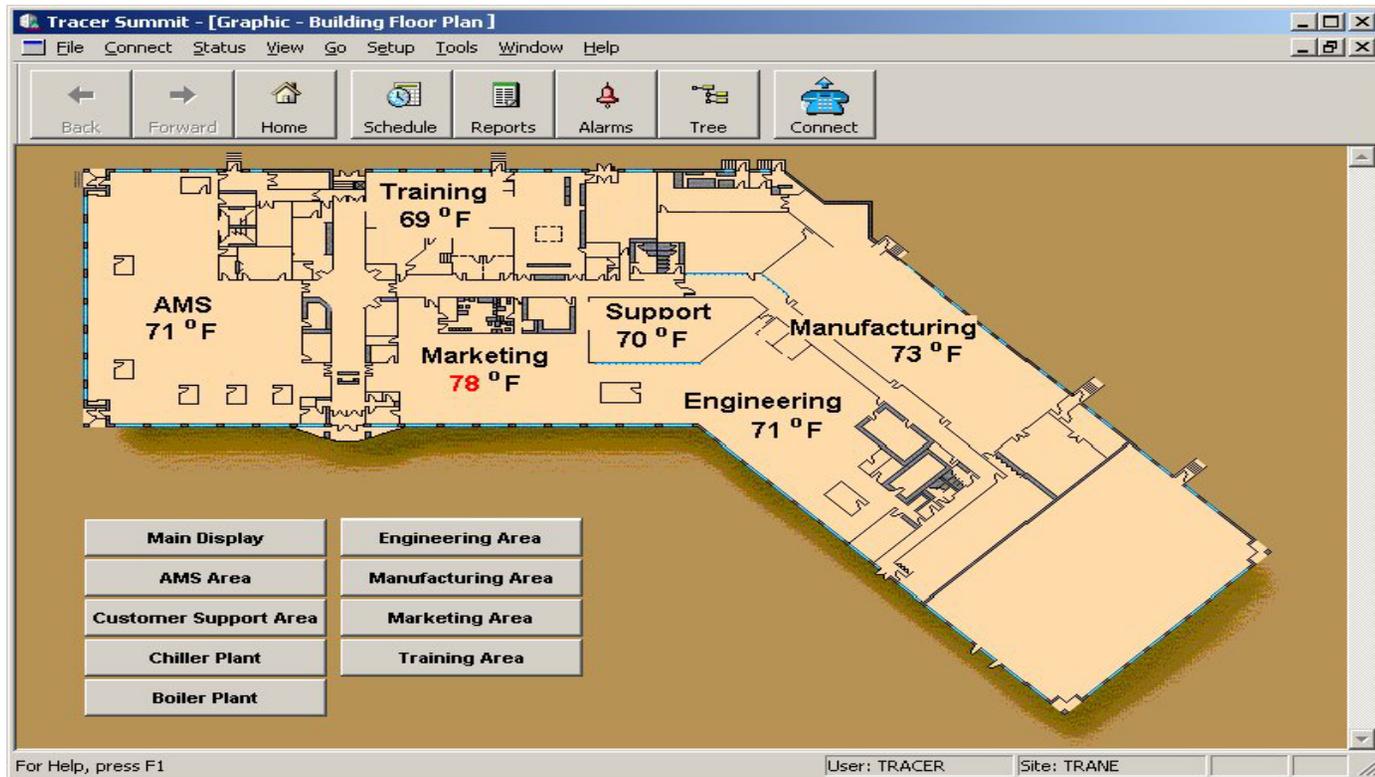
failure recovery

Selection of Controlled Devices

- Normally-closed actuator
- Normally-open actuator
- Position-maintained actuator



Responding to Comfort Complaints





Graphical User Interface

Tracer Summit - [Graphic - VAV AHU 1]

File Connect Status View Go Setup Tools Window Help

Back Forward Home Schedule Reports Alarms Tree Connect

VAV AHU 1

Outdoor Air Temp, F	83	Fan Status	ON
Mixed Air Temp, F	77	VFD, %	58
O.A Damper, % Open	32	Duct Static Pressure, Inch WC	2.3
O.A. Flow, CFM	436	Static Pressure Setpoint, Inch	2.4

Filter Status CLEAN

Cooling Valve %Open 83

Entering Water 41
Leaving Water 56

VAV #1 VAV #2 VAV #3



Time-of-Day Scheduling

Tracer Summit - [TOD - Marketing Dept.]

File Connect Status Edit View Go Setup Tools Window Help

Back Forward Home Schedule Reports Alarms Tree Connect

Schedule Name: Marketing Dept. March 2002

Sun	Mon	Tue	Wed	Thu	Fri	Sat
24	25	26	27	28	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

Schedule Members: Daily Event(s) for : Monday, Tuesday, Wednesday, Thursday, Friday.

- Marketing Dept-Night Economize
- Marketing Dept-Lighting
- Marketing Dept-Normal/Optimal

12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11

Exception Holiday Close Save Open Another... Help

For Help, press F1 User: TRACER Site: TRANE



Centralized Alarms and Diagnostics





Remote Access

- Alarm notification
- Dial-in access





Reports

- Trend logs
- Alarm activity
- Building energy use
- After-hours tenant occupancy
- Equipment diagnostics and performance
- Commissioning

Tracer Summit - [Reports - Centrifugal UCP2 ASHRAE Guideline 3]

File Connect Status View Go Setup Tools Window Help

Back Forward Home Schedule Reports Alarms Tree Connect

Print... Next Page Prev Page Two Page Zoom In Zoom Out Close

Centrifugal Chiller with UCP2 ASHRAE Guideline 3 Report

Current Value

Chiller Name	S-Series - CenTraVac
Present Value	Occupied
Refrigerant Type	R123
Operating Mode	Run: Normal
Chilled Water Setpoint - deg F	45.00
Current Limit Setpoint - % RLA	70.00
Compressor Data	
Discharge Refrig Temp - deg F	0.00
Compressor Run Time - hrs	373.31
Compressor Starts	55
Oil Data	
Oil Temperature - deg F	-40.00
Low Side Oil Pressure - psig	0.50
High Side Oil Pressure - psig	13.00
Oil Press: Differential - psid	12.50
Evaporator Data	
Saturated Refrig Temp - deg F	44.00
Saturated Refrig Press - psig	-7.90
Approach Temperature - deg F	0.80

Close Save Open Another... Help

Page 1 User: TRACER Site: TRANE



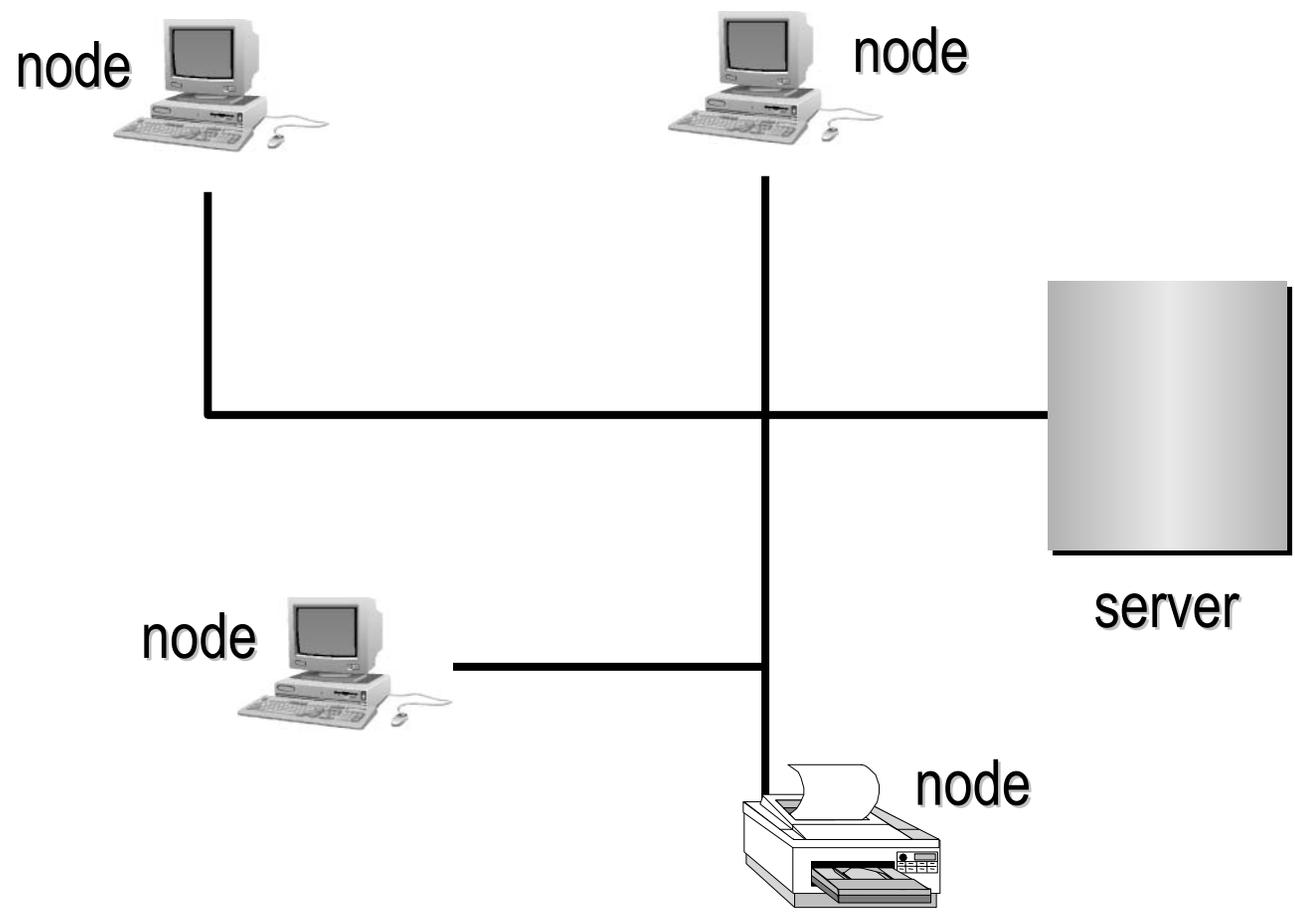
Connecting Multiple Sites

- Centralized monitoring
- Diagnose or predict problems with systems
- Combine energy usage for negotiating energy contracts





Network





Communications Protocols

- Proprietary
 - Used, produced, or marketed under exclusive legal right of an individual or organization
- Open
 - Available to public domain and is shared among vendors
- Standard
 - Open protocol that has been formalized by a governing body



Interchangeability

- Plug-and-play

