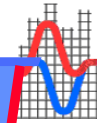


Fundamentals of DDC



Overview

Instructors:

J. Jay Santos, P.E.

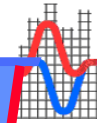
Steve Briggs, PhD.

David Sellers, P.E.



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Monday



Monday

Welcome and Introduction

Introduction to DDC - Part 1

First Morning Break

Introduction to DDC - Part 2

Second Morning Break

Introduction to DDC - Part 3

Load Dynamics

Lunch Break

Interactive Exercise - Tailoring the Process to the System Dynamics

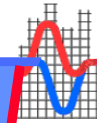
First Afternoon Break

Inputs and Outputs

Second Afternoon Break

System Architecture - Part 1

Tuesday



Tuesday

System Architecture - Part 2

First Morning Break

IT Considerations

Second Morning Break

Open Protocols

LON Architecture

Lunch Break

BACnet Architecture - Part 1

First Afternoon Break

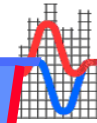
BACnet Architecture - Part 2

Open Discussion with a Guide Spec Primary Author

Second Afternoon Break

Inputs and Outputs and BACnet - the Field Perspective

Wednesday



Wednesday

Programming Tools

First Morning Break

PID Control

Open vs. Closed Loop Tuning

Second Morning Break

Lags

Davis Hall lag example

Loop tuning/commissioning rules

Ripple effects and integration and interaction

Application Requirements

Lunch Break

System Diagrams and the System Concept

Variable Flow Primary Secondary Chiller Plant Example

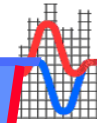
First Afternoon Break

Controlling the Mixed Air Section

Second Afternoon Break

Controlling the Air Handling Unit Section

Thursday



Thursday

Controlling the Fan

Controlling Constant Volume Systems

First Morning Break

Controlling Central Plants - The Field Perspective

Central Plant Equipment - Controlling Different Technologies

The Two Thirds Rule

Second Morning Break

Pump Interactions and the Affinity Laws

A Field Perspective on Economizer Control - Part 1

The Perfect Economizer

Lunch Break

A Field Perspective on Economizer Control - Part 2

Le Conte Annex AHU Example

Controlling VAV Systems - The Field Perspective

Controlling VAV Systems - Terminal Unit Damper/Sensor Interactions

Controlling VAV Systems - Minimum and Maximum Flow Settings

First Afternoon Break

Tying it All Together

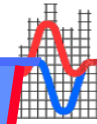
Defining your System

Second Afternoon Break

Specifying Your System

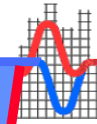
Wrap-up

HVAC Controls



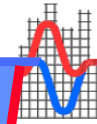
DESIGN PROCESS

How “NOT” to Design a Control System



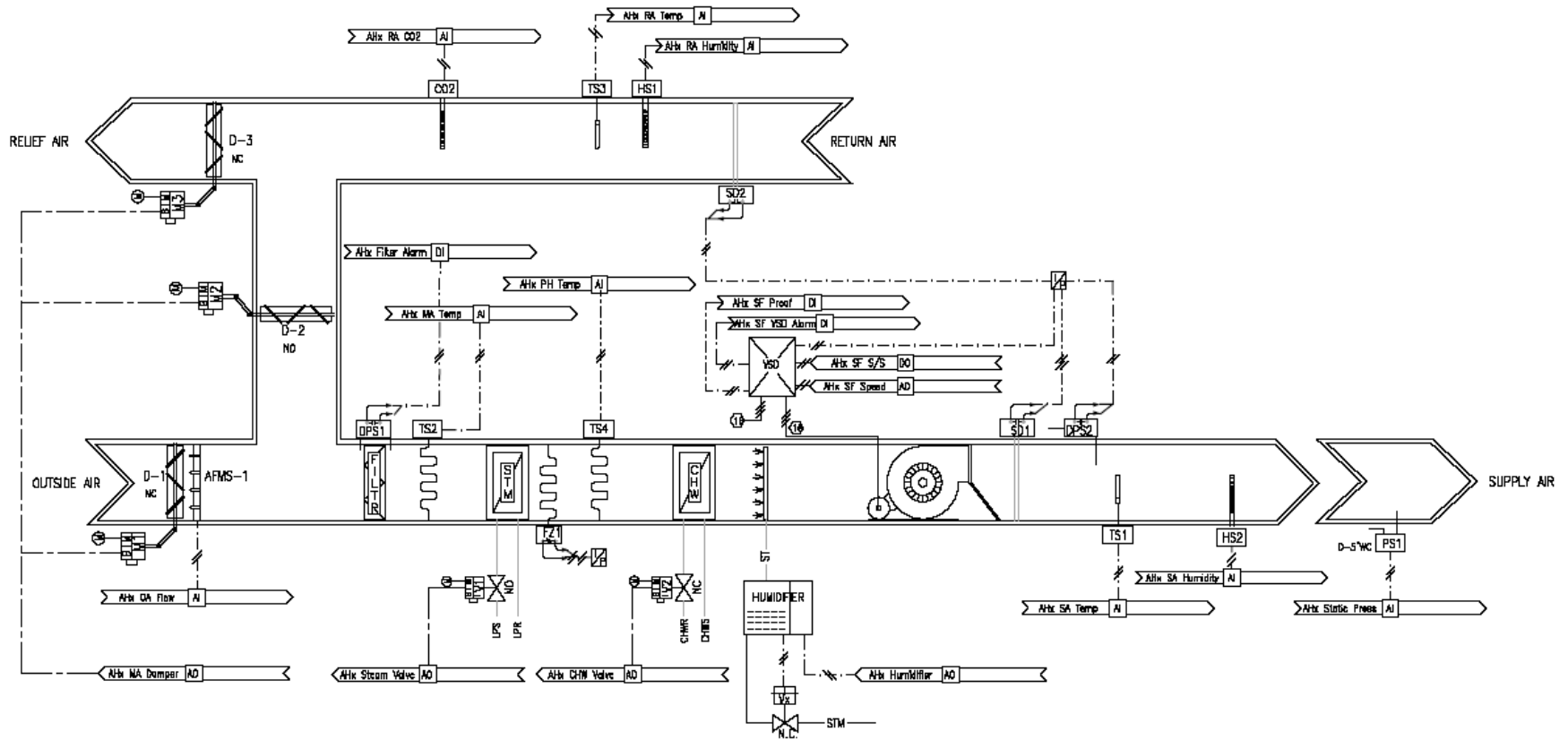
- ❑ **Don't Design it - Delegate the control design responsibility to someone else in the process.**
- ❑ **Make it as complex as possible. Confuse the maximum number of people.**
- ❑ **Forget about documentation or document it in a language not understood by the operators. (Use a foreign language with metrics)**
- ❑ **Ignore maintainability features.**
- ❑ **Trust the contractor totally**

Current Practice



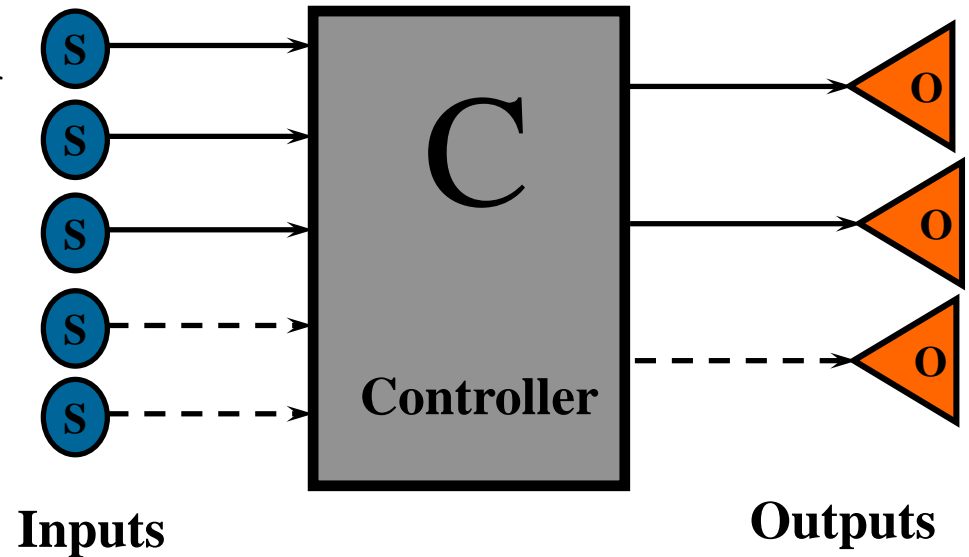
- ❑ HVAC Controls are Performance Specified
- ❑ Specifications aren't very *specific*
- ❑ Controls are typically “Design/Built” by 3rd tier subcontractor
- ❑ Application Engineer for vendor is key
- ❑ Documentation quality varies
- ❑ **Resources are limited**, enforcing good specs are a challenge
- ❑ Training is critical
- ❑ Difficult to get a system to work as planned
- ❑ Commissioning becomes necessary

Typical Documentation - Schematic



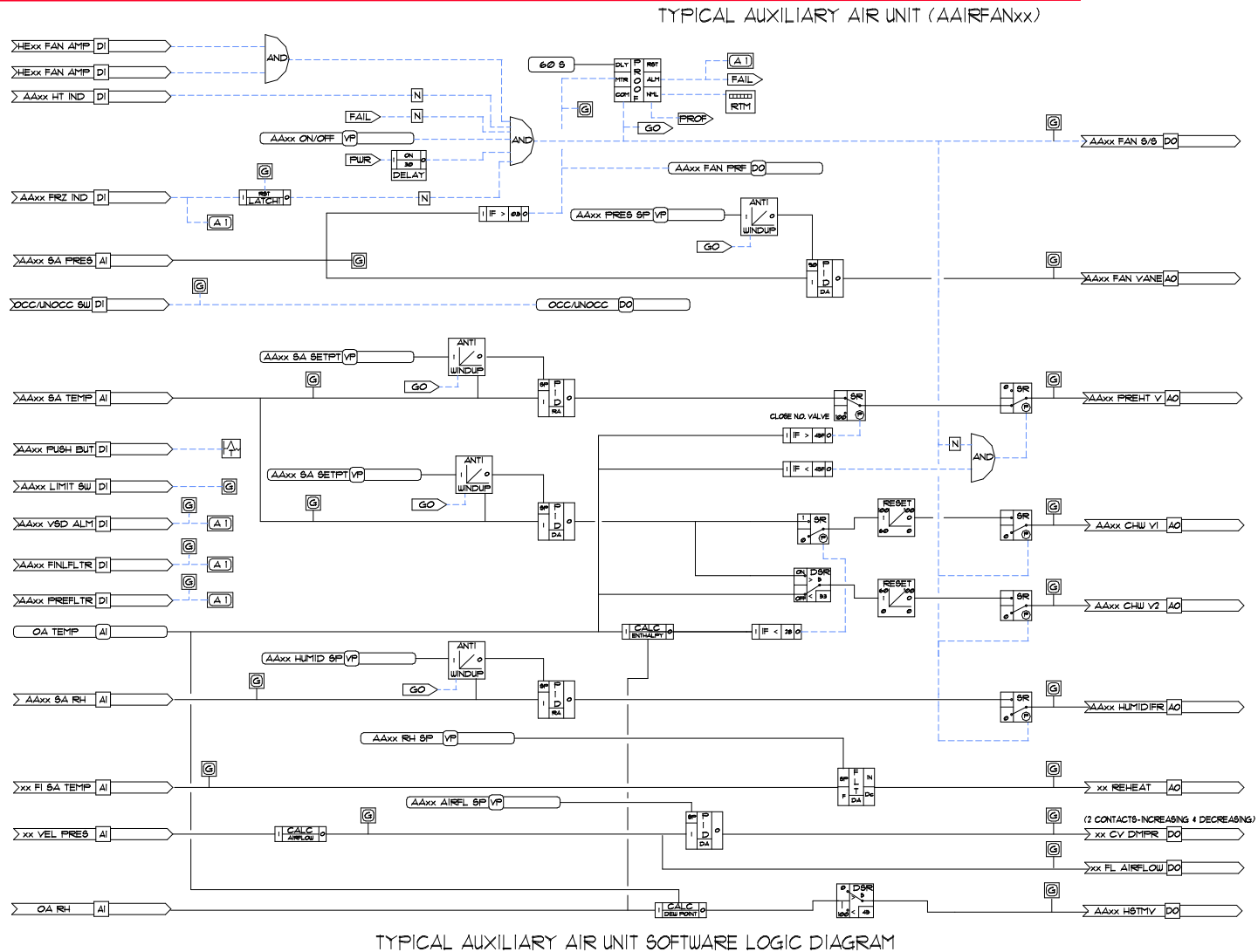
Typical Documentation

- **Shop Drawings**
- **Sequence of Operation**
 - **Original**
 - **Control Engineer**
 - **Operator Version**
 - **Current Operation**
- **Programming**
 - **Line Code**
 - **Graphical Program**

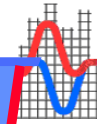




Control Logic Diagram

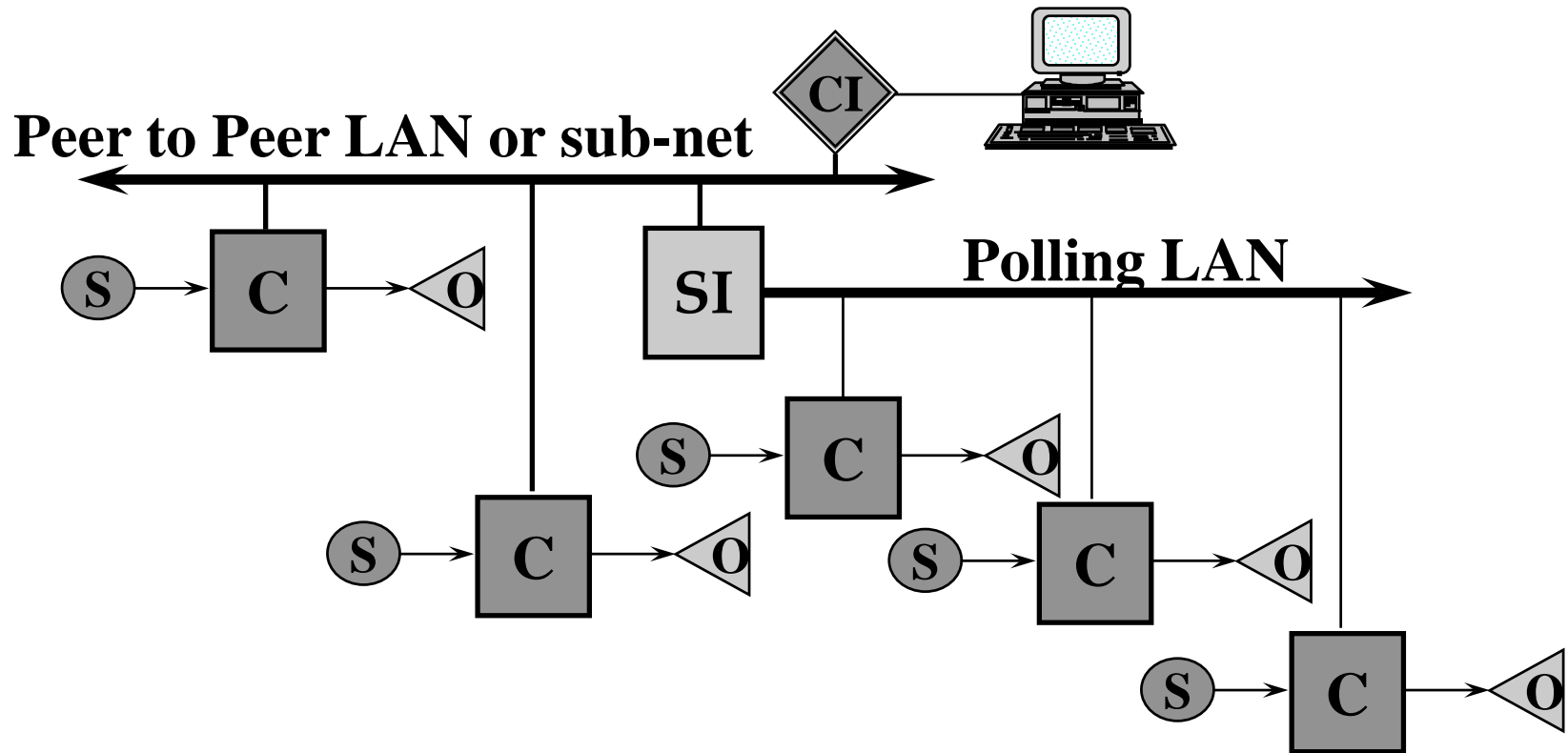


Practical Issues



- ▣ **Resource Limitation – consulting, installing, owner**
 - ▣ **Education/Training Required**
 - ▣ **Experience Based Learning**
- ▣ **Numerous Proprietary DDC Systems already in place**
- ▣ **Open Protocol Issues – great potential - new complication**
- ▣ **Other Design Issues**
 - ▣ **Specifications not specific (trend is for less detail)**
 - ▣ **Especially true relative to sequences**
 - ▣ **System Architectures are quite different**
 - ▣ **Many specifications do not cover this well**

Architecture



CI – Communication Interface
SI – Supervisory Interface
C - Controller