

# Specifying DDC Systems for Commissioning

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## We Will Discuss...

- Five Principles of Controls Design/Specification
- Need for Prescriptive Specifications
  - Sequences
  - Interoperability
  - Terminology
  - Everything else.....
- Opportunity to assist Controls Design
  - Key Specification Issues
- Role of the DDC system in Cx
  - Programming type impacts
  - Remote use
  - Use of graphics, trends & related network issues
- Non-example and current practice

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## Principle 1

- The control system must first and foremost provide effective and reliable control, commensurate with the systems it is controlling.
  - Architecture, networking
  - Controllers
  - Stand alone capability
  - Redundancy

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## Principle 2

- The manufacturer and installer must be highly qualified with extensive experience and must be committed/bound to a thorough Commissioning of the system
  - Qualifications of installer equally important as the product
  - Committed to commissioning process
  - Research into the products and local capabilities of installer is necessary

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## Principle 3

- The control installation must be fully documented as consistently as practical with nothing required to fully operate and maintain the system withheld from the owner
  - Specifications must cover these issues
  - Details like graphics, point naming conventions, programming logic, network configuration, documentation
  - Owner has all software tools and owns their own sequences

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## Principle 4

- The system must be interoperable to the appropriate level
  - The control industry has oversold the procurement related benefits of interoperability and open protocol
  - Review reasons for interoperability and make sure they are well founded
  - Specify reality

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## Principle 5

- The sequence of operation must be clearly and completely communicated for each system.
  - Performance specifications – punting
  - Generic sequences are subject to interpretation
  - FPT's are challenging to write for gray sequences
  - Consider logic diagrams
  - Clarify sequences as soon as possible in the process

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## Criteria for Quality Specifications

- Prescriptive, Prescriptive, Prescriptive
  - The more well defined the specification, the easier (in theory) the commissioning
  - More functional testing, less refereeing
  - Enforcement
    - Design Phase
    - Submittals
    - Installation
- DEFINITIONS

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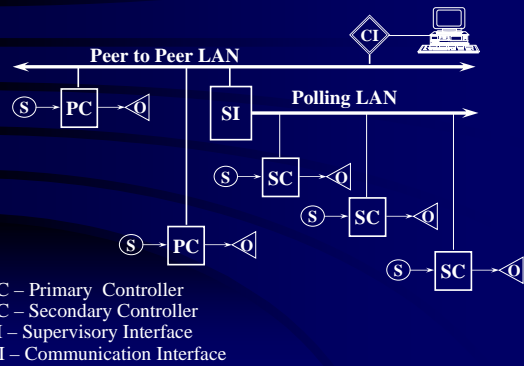
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## Typical DDC Architecture



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## Key Specification Issues

- System Architecture
  - Robustness for project
    - Maximum Configurations
      - Especially on lower level networks
    - Peer to Peer versus Polling networks
    - Performance specify event criteria
      - Speed of alarm, command, status, graphic update, etc.
  - Capability of trending
    - Long term
    - Commissioning related
    - Impact on normal control functions

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## Key Specification Issues

- Control Hardware
  - Specify controllers for applications
  - Know potential bidders limitations
  - Design system around that reality
  - Consider 4 application categories
    - Peer to Peer only
    - Secondary controller on very limited polling network
    - Secondary controller on limited polling network
    - Terminal controller on limited polling network

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## Key Specification Issues

- Interoperability, interface to existing systems and procurement limitations, criteria
  - Define terms
  - Make sure interoperability goals are realistic
  - Procurement issues
  - Define level of integration to existing
  - If interoperability is desired to a high degree, research capabilities of vendors further
  - If interoperability is being used as a procurement solution, reconsider
  - If all these interoperability criteria, review one more time

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### Key Specification Issues

- Software
  - Numerous software programs are needed for full functionality of DDC system
  - Vendors package these differently
  - Difficult to keep up
  - Specify vendor provide all software to perform common functions
    - Add hardware, edit database
    - Alarming, trending, reporting
    - Graphics, programming, upload/download, etc.

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### Key Specification Issues

- System Setup
  - Capabilities are one thing...
  - Setup is another
  - Details of the capabilities of trending, scheduling, alarming, password protection, graphic software are typically not discriminators
  - Focus on setup of these features
  - Easier to enforce if defined

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### DDC Changes over the Years

- 20 years ago, we had Open Protocol, Interoperability, Plug & Play
- Early DDC/EMS - proprietary and expensive
- Move to distributed DDC
- Today
  - Networked Systems, Internet
  - More power at lower levels
  - Open Protocol.....Interoperability\*#1,3,5
- We haven't kept up..... (who's we?)

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## Tool & Cx Requirement

- The DDC system is the most important tool available to the Commissioning provider.
  - The DDC system can provide the means for analysis, measurement and verification of commissioning activities.
  - Use in functional testing
  - "Readiness assessment"
- Is also the most significant system to be commissioned.
  - It contains the sequence of operation that must be validated during commissioning.

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## Use of the DDC System

- Dramatic changes in DDC in recent years
- More powerful, more robust (more information – faster)
- Internet accessibility, server based systems (remote use)
- Operator interfaces less expensive, more options (more information)
- Increased use of graphical programming tools (changes Cx approach)

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## Programming Types

- Line Code
- Template or Database
- Configurable, Canned, "Fill-in-the-blank"
- Graphical

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## Programming Types

- Line Code
  - Must test logic in field along with all other parameters
- Graphical
  - Simulation capabilities
  - Test logic “off-line” before going to field
  - Field testing primarily I/O or tuning
- Submittal specifications vary accordingly
- Commissioning approach varies
- Software?

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## Remote Use of DDC System

- Access and evaluate the HVAC and Control system remotely
- Check for system “readiness” – important practical Cx business issue
- Continued remote checking
- May need system software or terminal emulation software
- Web-based systems are making this easier
- Details to specify, coordinate
  - IT connection
  - Local Access – operator interfaces

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## Use of Graphics

- Big picture overview
- Reasonableness check at current conditions
- Override system to check for expected results or sensor coordination
- Assess “readiness”
- DDC system set-up
  - Point information
  - Alarms
  - Trends
  - Default Parameters
- Graphics must be specified and scheduled

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## Trending

- Pre-commissioning trends
- Loop-tuning trends
- Acceptance period trends
- Permanent trends
- Specify time interval, data types (instantaneous or averaged)
- Trending capacity (network issues)
- Know system limitations, burden for setup
  - Specifications may need to be modified to accommodate

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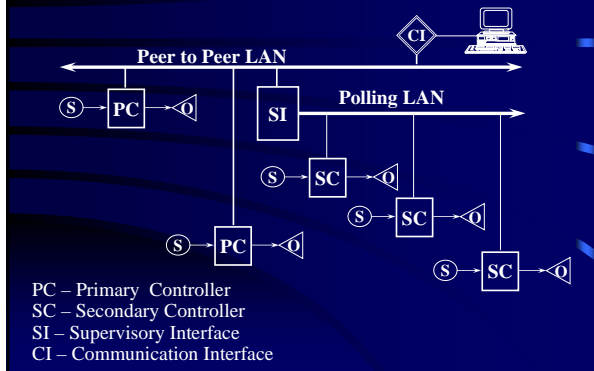
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## Typical DDC Architecture



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## Controls Design

- Commissioning Provider role/opportunity in controls design
- Clarify Sequences of Operation
- Clarify other gray areas of specifications
  - Open protocol, interoperability requirements
  - Controller "robustness"
  - Performance criteria
  - Areas covered earlier

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## Classic Non-example...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

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## Current Practice

- HVAC Controls are Performance Specified
- Specifications aren't very *specific*
- Controls are typically “Design/Built” by 3<sup>rd</sup> 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

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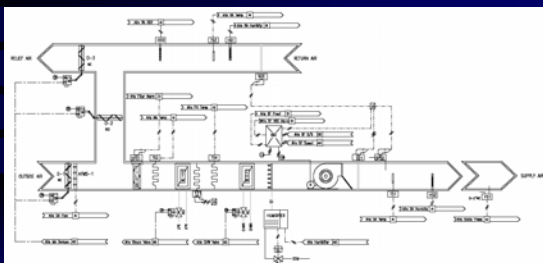
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## Typical Documentation - Schematic



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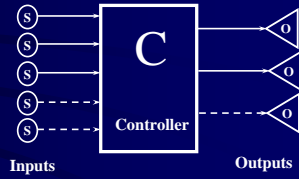
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## Typical Documentation

- Shop Drawing
- Sequence of Operation
  - Original
  - Control Engineer
  - Operator Version
  - Current Operation




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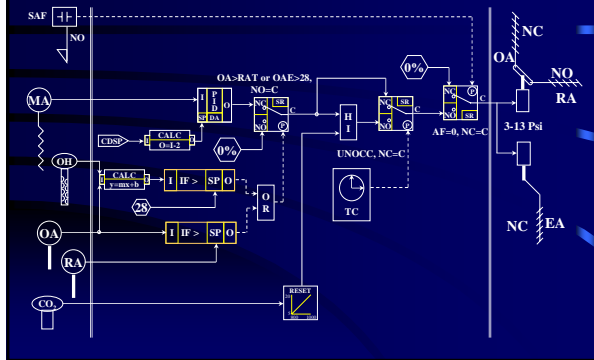
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## Logic Diagram (mixed air)




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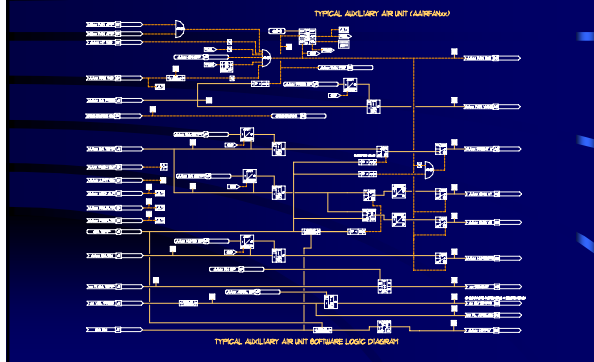
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## Control Logic Diagram




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## Practical Issues

- Resource Limitation
- Education/Training Required
- Experience Based Learning
- Numerous Proprietary DDC Systems
- Open Protocol Issues – 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

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## Summary

- Prescriptive Control Specifications
  - Sequences Very Important
  - Other areas as well
- Commissioning process must reflect realities of specific DDC system
- DDC system important tool
  - Requires DDC system knowledge
  - Specifications to match

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