The User Experience on a Project with over 50,000 I/O

While several wiring methods were used on the project, this presentation will focus on the use of Electronic marshalling

Reasons for using Electronic Marshalling on the Project:

- Emerson was the MIC and the MAC on the Project
- Emerson DeltaV DCS and SIS systems were used
- The DeltaV - SPI Interface was proposed for the Project
- Primary I/O was **CHARacterization Module (CHARM) I/O**
- Project Configuration of CHARM I/O employed:
  - Standardized Remote CHARM Field Enclosures
  - Redundant Fiber Optic Network to Control Centers
  - Wiring and Loop Diagrams to be SPI Enhanced Reports
Benefits of using Electronic Marshalling

- Redundant Ethernet topology
- Elimination of homerun wiring
- Reduced overall System Costs
- Flexibility:
  - Any type of I/O at any location
  - Reconfigurable at any time
  - Standard Ethernet hardware
  - Remote I/O Eliminate Wiring
  - Plug and Play Configuration
  - Single Channel Granularity
  - Each I/O Card can serve 4 controllers
DeltaV SPI Interface Workflow

- The diagram below provides an overview of the workflow that is supported by the interface.
The DeltaV I/O definitions are maintained by Emerson but downloaded using a link from Intergraph: http://forms.intergraph.com/Download_DeltaV_Definition_Files

This assures the definitions are the latest and provide information to improve the data transfer process.

The downloaded definitions appear in the Reference Explorer as SPI Objects.
Download I/O Definitions Into SPI

What is Downloaded?

- DeltaV Conventional I/O Definitions
- DeltaV S Series I/O Definitions
- Types CHARM Card Definitions:
  - AI 4-20 mA HART
  - RTD
  - Thermocouple / mV
  - AI 0-10V DC Isolated
  - AO 4-20 mA HART
  - DI NAMUR
  - DI 24V DC low-side sense
  - DI 24V DC Isolated
  - DO 24V DC High Side
  - DO 100mA Energy Limited
  - DO 24V DC Isolated
  - 24V DC Power
  - DI 120V AC Isolated
  - DI 120V AC Isolated Plus
  - DI 230V AC Isolated
  - DO V AC Isolated
Reference I/O Definitions

- Reference I/O Definitions include:
  - Wiring Equipment
    - Name
    - Description
    - Manufacturer
  - Terminal Strip
    - Name
    - Panel Name
    - Manufacturer
  - Terminals
    - 2 or 4 Terminals for connections

- Note: We eliminated unused CHARM cards from Reference Explorer

- Reference I/O can be used to build CHARM I/O Card (CIOC) Panels in the Wiring Module
CHARM I/O Card (CIOC) Configuration

- Each Field Panel has a redundant CIOC Carrier; I/O Cards with redundant Ethernet Communications Module and 24VDC Power Supply
- CHARM Base Plate; DIN rail-mounted with power, bus connectors, and Supports 12 CHARMs per Base Plate
- CHARM Terminal Block - removable terminal block providing connections to field wiring and physical latch for CHARM
- CHARMs - Characterization Module for each field signal - Provides basic analog to digital conversion and signal isolation to the redundant communication bus
- DIN rail mount for all CIOC components
Shown below is the proposed DCS FIE/RIE Hierarchy per Emerson CHARM white paper

- Panel
  - Rack
    - Slot (Branch)
      - CHARMM
      - Terminal Strip
      - Channel
      - Terminals

However this hierarchy resulted in the SPI Terminal Strip wiring report with adjacent connections having only one signal per drawing.
CHARM I/O Card (CIOC) FIE/RIE Wiring

- Actual Project DCS FIE Hierarchy
  - Panel
    - Rack
      - Slot
        - CHARM
          - Terminal Strip (Branch)
            - Channel
              - Terminals

- The Terminal Strip report now showed all 12 CHARM channels

- Con: The CHARM was above the branch now and lost unique CHARM data per channel
Benefits of using Field Enclosures:

- Allows for Electronic Marshalling and Remote I/O in one Cabinet
- Optimizes use of CHARM I/O Technology
- Reduce Overall System Footprint
- Eliminates I/O Home Run Cables
- Reduce design engineering workhours
- Safe for Hazardous Areas
- Fully Vendor Tested and Documented Enclosures
CHARM Field Enclosures

Field Enclosures Equipped as Follows:

- Power distribution and isolation components for primary and secondary 24V DC Power to CHARM I/O Cards.
- AC power feeds with redundant AC/DC 24V DC bulk power supplies.
- Grounding bars for CG (Chassis Ground) and DC Reference Ground
- Wire Ducts and Name Plates
- CIOC Carriers, Base Plates and Terminals.
CHARM Cards

◆ Analog Input 4-20 mA HART

CHARM Characteristics

- 2 wire Loop Powered
- Signal - 4-20 mA with or without HART
- Impedance - 250 Ω ±1%
- Accuracy - 0.1% of span (0-60°C)
- Repeatability - 0.05% of span
- Resolution - 16 bit A/D converter
- Calibration - None required
- Loop Power - 15 V at 20 mA @ 24V DC
CHARM Cards

- Analog Input 4-20 mA HART
- **CHARM Characteristics**
  - 2 wire Field Powered
  - Signal - 4-20 mA with or without HART
  - Impedance - 250 Ω ±1%
  - Accuracy - 0.1% of span (0-60°C)
  - Repeatability - 0.05% of span
  - Resolution - 16 bit A/D converter
  - Calibration - None required
  - Field Powered
CHARM Cards

◆ Analog Input 4-20 mA HART

CHARM Characteristics

- 3 wire CHARM Powered
- 24V DC Power CHARM
- Max Power 24V DC at 20mA
- Signal - 4-20 mA with or without HART
- Impedance - 250 Ω ±1%
- Accuracy - 0.1% of span (0-60°C)
- Repeatability - 0.05% of span
- Resolution - 16 bit A/D converter
- Calibration - None required
CHARM Cards

◆ Analog Output 4-20 mA HART CHARM

– Signal Range: 4 to 20 mA
– Full Signal Range: 0 to 24 mA
– Accuracy - 0.25% of span (0 to 60°C)
– Accuracy - 0.5% of span (-40 to 70°C)
– Resolution 16-bit D/A converter
– Calibration None required
– Available Field Power 20 mA at 15V DC supply into 750 Ω load
CHARM Cards

**RTD Input CHARM**
- 2 wire RTD
- Operating Range - -200 to 850°C
- Temperature drift - ± 0.02°C/°C
- Accuracy - ± 0.25°C
- Repeatability - 0.05% of span
- Resolution - 24 bit A/D converter
- Calibration - None required
- Common Mode Rejection - 90dB typical
- Open Sensor Detection
CHARM Cards

◆ RTD Input CHARM
  
  - 3 wire RTD
  - Operating Range - -200 to 850°C
  - Temperature drift - ± 0.02°C/°C
  - Accuracy - ± 0.25°C
  - Repeatability - 0.05% of span
  - Resolution - 24 bit A/D converter
  - Calibration - None required
  - Common Mode Rejection - 90dB typical
  - Includes Open Sensor Detection
CHARM Cards

**RTD Input CHARM**
- 4 wire RTD
- Operating Range - -200 to 850°C
- Temperature drift - ± 0.02°C/°C
- Accuracy - ± 0.25°C
- Repeatability - 0.05% of span
- Resolution - 24 bit A/D converter
- Calibration - None required
- Common Mode Rejection - 90dB typical
- Includes Open Sensor Detection
CHARM Cards

- **Discrete Input 24 V DC low-side sense (dry contact) CHARM**
  - Sensor Types 24V DC - Dry Contacts
  - On Detection Level - >2.25 mA
  - Off Detection Level - <1.75 mA
  - Channel Impedance - 4.8 KΩ
  - Wetting Voltage - 22.5Volts
  - Configurable Channel Types - Discrete Input or Pulse Count
CHARM Cards

**Discrete Output 24V DC High-Side CHARM**

- **On State Rating** - 100 mA @ 24V DC
- **Off State Leakage Current** - 1 mA

**Line Fault Detection**

- Short circuit: <50 Ω load
- Good status: 240 Ω to 10 kΩ load
- Open circuit: >20 kΩ load

**Configurable Output Behavior**

- Momentary Output
- Continuous Pulse Output
CHARM Cards

◆ 24V DC Power CHARM
  – Device Type 24V DC Power output
  – Status for Power Good >10V DC
  – Status for Power Bad <5V DC
  – Isolation - Status read back circuitry is optically isolated and factory tested to 1000V DC.
  – Field Circuit Protection 2 Amp fuse
  – CHARM Power - 12 mA max
  – Available Power - 1.01 Amps max
Enhanced CIOC Strip Report with adjacent Terminals shows:

- Field Wiring from the instrument to the CIOC
- Two Page report with 9 I/O on first and 3 on the second
- Cable Names
- Wire Colors
- Panel Number
- Strip Number
- Channel Numbers
- Terminal Numbers
- CS Tag Numbers

Displays per set Preferences
Due to lack of Marshalling Strip, Enhanced SPI Loop Diagram typically only shows the Device Panels Instrument and COIC Terminations.
Using Electronic Marshalling Conclusion

- CIOC is Configurable for:
  - Basic Process Control Systems (BPCS)
  - Safety Instrumented Systems (SIS)
  - Intrinsically Safe (IS) Systems

- CIOC Can be RIE or Field Mounted

- Instrument Wiring to CIOC can be Direct or by Junction Boxes and Homorun Cables

- Eliminates Marshalling Cabinets

- Eliminates need for Loop Diagrams

- Potential to replace other wiring methods
Wiring CHARM I/O in SPI

“"I prefer intellect and CHARM"”

~ Angie Everhart