

SmartPlant[®]
Instrumentation

**and Emerging
Instrument Technologies**

FLUOR
SmartPlant[®]
Implementation Team

By John Dressel



FLUOR[®]

INTERGRAPH

The Challenge of Emerging Technologies



- ◆ New and emerging technologies bring new challenges to the Instrumentation Design Engineering discipline when building system data matrices using SmartPlant Instrumentation (SPI)
- ◆ Emerging Digital Data Management Systems must be supported by the Instrument Automation System's data acquisition capabilities
- ◆ SPI needs to be able to Specify and Document new hardware required by wired and wireless instrument system networks
- ◆ Once new Process Control Systems and Instruments are Specified the challenge of Documentation and Handover to Suppliers, Vendors, Integrators, Constructors and Owner Operators must be addressed
- ◆ Future releases of SmartPlant Instrumentation will need to focus on emerging instrument technologies and new infrastructure requirements



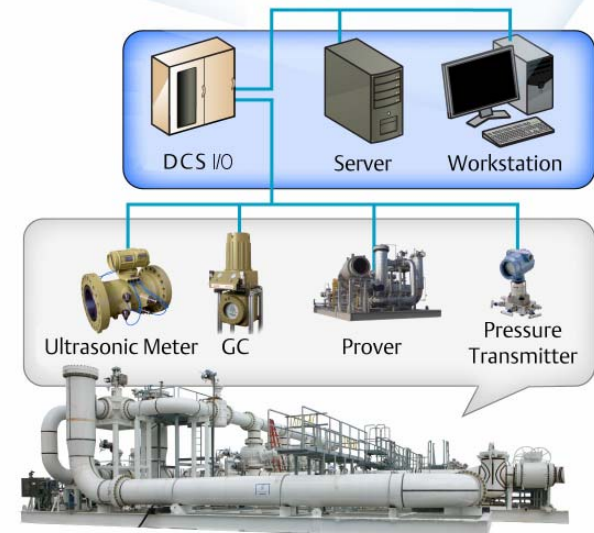
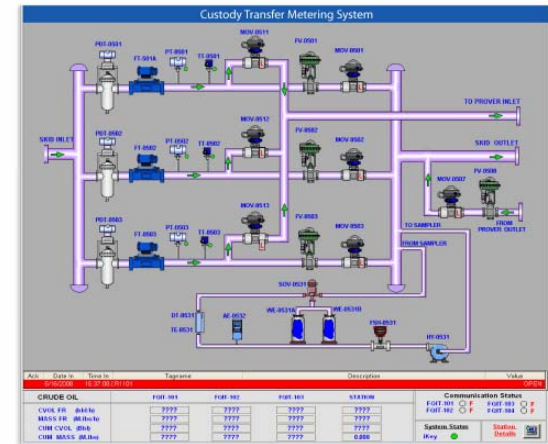
Emerging Instrument Systems Technologies

◆ Process Control Systems Challenges

- Distributed Control Systems
- Programmable Logic Controllers
- Safety Instrumented Systems
- Equipment Protection Systems
- Fire and Gas Monitoring Systems

◆ Digital Data Management Systems

- Plant Asset Management Systems
- Process Monitoring Systems
- Process Data Historian Systems
- Energy Management Systems
- Preventative Maintenance Systems



Process Control Systems Challenges



◆ **Distributed Control Systems**

- Proprietary I/O requires unique SPI card libraries for every DCS vendor
- SPI Libraries and Interfaces have only been developed for a few DCS vendors

◆ **Programmable Logic Controllers**

- Ladder diagram Input and Output wiring with series and parallel wiring is difficult to document using SPI Loops

◆ **Safety Instrumented Systems**

- Requires additional SPI data fields for SIL ratings, Interlock Numbers, Certifications and Testing Requirements

◆ **Equipment Protection Systems**

- Design must define unique wiring requirements for elements and monitors

◆ **Fire and Gas Monitoring Systems**

- Series and parallel wiring of components are difficult to wire in SPI
- Require additional custom spec sheets for some devices



Digital Data Management Systems

- ◆ The introduction of Digital Data with HART or Smart Instruments provides new opportunities for the utilization of process data
 - **Plant Asset Management Systems**
 - The SPI - SAP interface, Calibration Module and the Smart Instrument data allow robust data gathering and handover to Plant Asset Management Systems
 - **Process Monitoring Systems**
 - Real time process monitoring of process conditions extend the capabilities of the Basic Process Control Network
 - **Process Data Historians Systems**
 - Off-Line Analysis of historical process data is an integral part of process optimization and production tracking
 - **Energy Management Systems**
 - New instrumentation is being added beyond the normal process instrumentation to support production of energy trend analysis and annual consumption forecasts
 - **Preventative Maintenance Systems**
 - Monitoring the health of the Instrument System provides new methods of being proactive in the development of predictive maintenance programs

Emerging Wiring Network Technologies

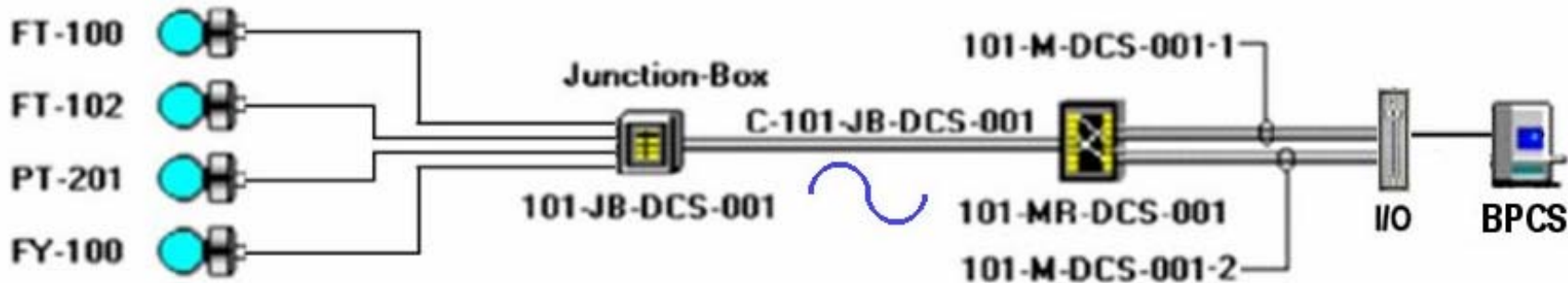


- ◆ **Specifying and Documenting Conventional Instrument Systems**
 - New treatments for old Analog Instrument Data
- ◆ **Specifying and Documenting HART or Smart Instruments**
 - Introduction of Digital Instrument Data
- ◆ **Specifying and Documenting Bus Instruments**
 - Considerations for Process Control over Bus Wiring Systems
- ◆ **Specifying and Documenting Wireless Instruments**
 - Using Wireless technology for Process Control and monitoring
- ◆ **Combined Technology Instrument Systems**
 - Selected for best fit to project and system requirements



Conventional Instrument Systems

- ◆ **Primarily 4-20 mA Analog or Discrete Signal Types**
- ◆ **Uses standard instrument hardware components**
 - Loop or local powered Instruments with 4-20 mA or on/off signals
 - Junction boxes, Marshaling Racks - single pair and multi-pair cables
 - Standard or Remote I/O connections to Process Control System
- ◆ **Easily Specified and Documented in SmartPlant Instrumentation**



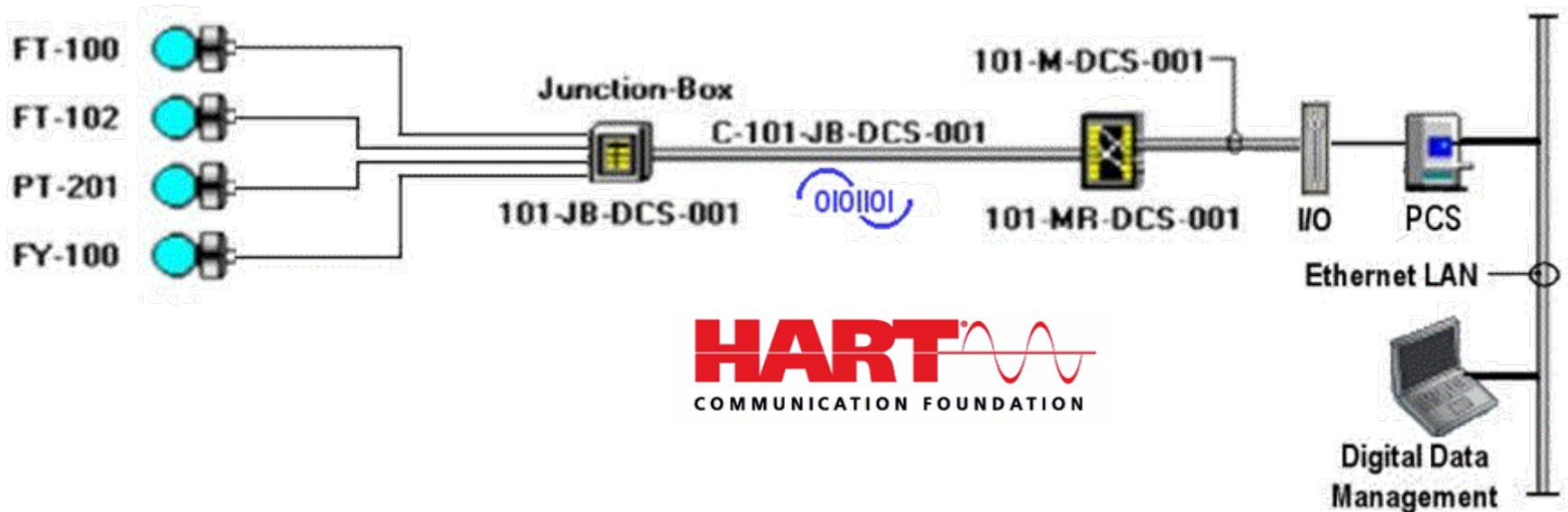
Conventional Instrument Systems



- ◆ While conventional analog and discrete instrumentation has been around for some time, there are still challenges with recent changes in instrument technology
 - New measurement technologies required the creation of new spec sheet forms in the SPI spec catalog
 - Many Instruments that previously required field power can now be loop powered due to more efficient electronics and measurement technology
 - There is a resistance to move away from conventional analog instrumentation by some clients due to hardware costs and system redesign requirements
 - Converting an analog instrument to a digital device often requires a change in the measurement technology

HART or Smart Instrument Systems

- ◆ Added Digital Component to Analog Signal Types
- ◆ Uses standard instrument wiring hardware components
- ◆ Easily documented in SmartPlant Instrumentation
- ◆ Allows access to Digital Data Management via LAN



HART or Smart Instrument Systems

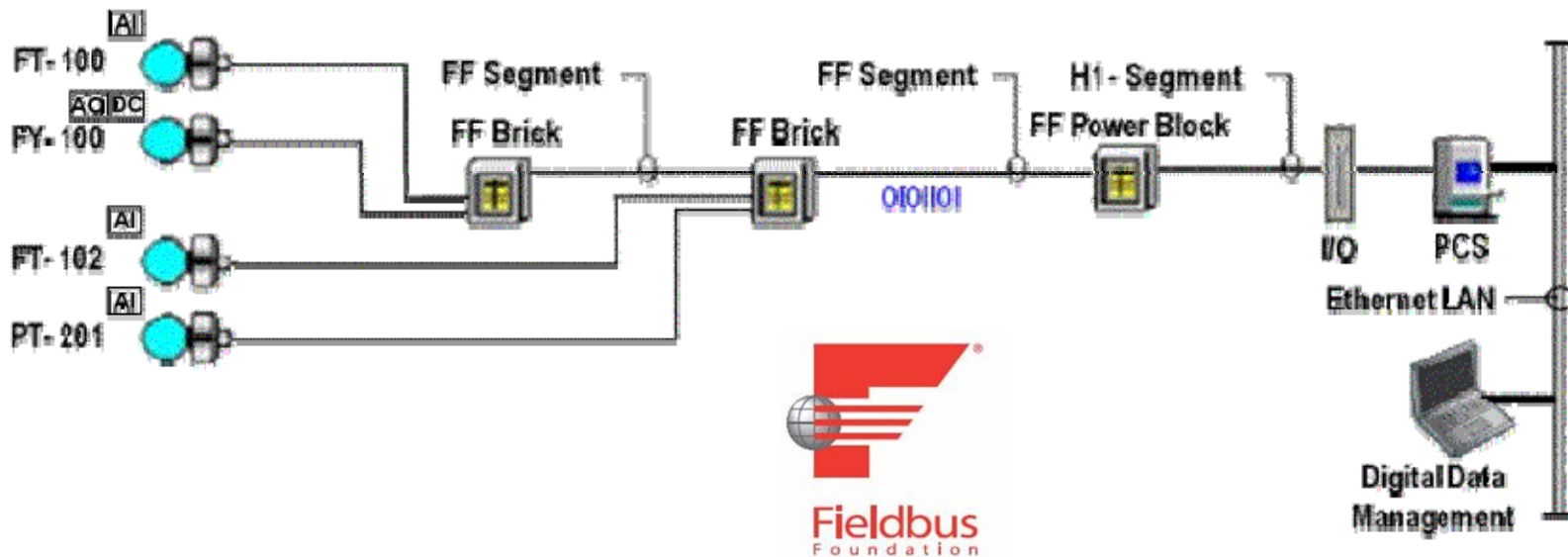


- ◆ Introduction of Digital Instrument Data to the Control Systems network resulted in several changes in how the Process Control system is designed
 - The HART protocol uses Frequency Shift Keying to encode digital information on top of the 4-20 mA analog signal
 - The HART protocol enables two-way digital communication with smart instruments without disturbing the 4-20 mA analog signal
 - The HART protocol passes additional information to or from a DCS, PLC, or PC based central control or monitoring system
 - The digital component carries additional measurements, process parameters, device configuration, calibration, and diagnostics information as well as primary variable and control signal



Fieldbus Instrument Systems

- ◆ Uses only the Digital Component of the Instrument Signal
- ◆ Adds new instrument hardware and virtual soft components
- ◆ Documented in SPI using Fieldbus Specs and Segment Manager
- ◆ Allows access to Digital Data Management via Ethernet LAN



Fieldbus Instrument Systems

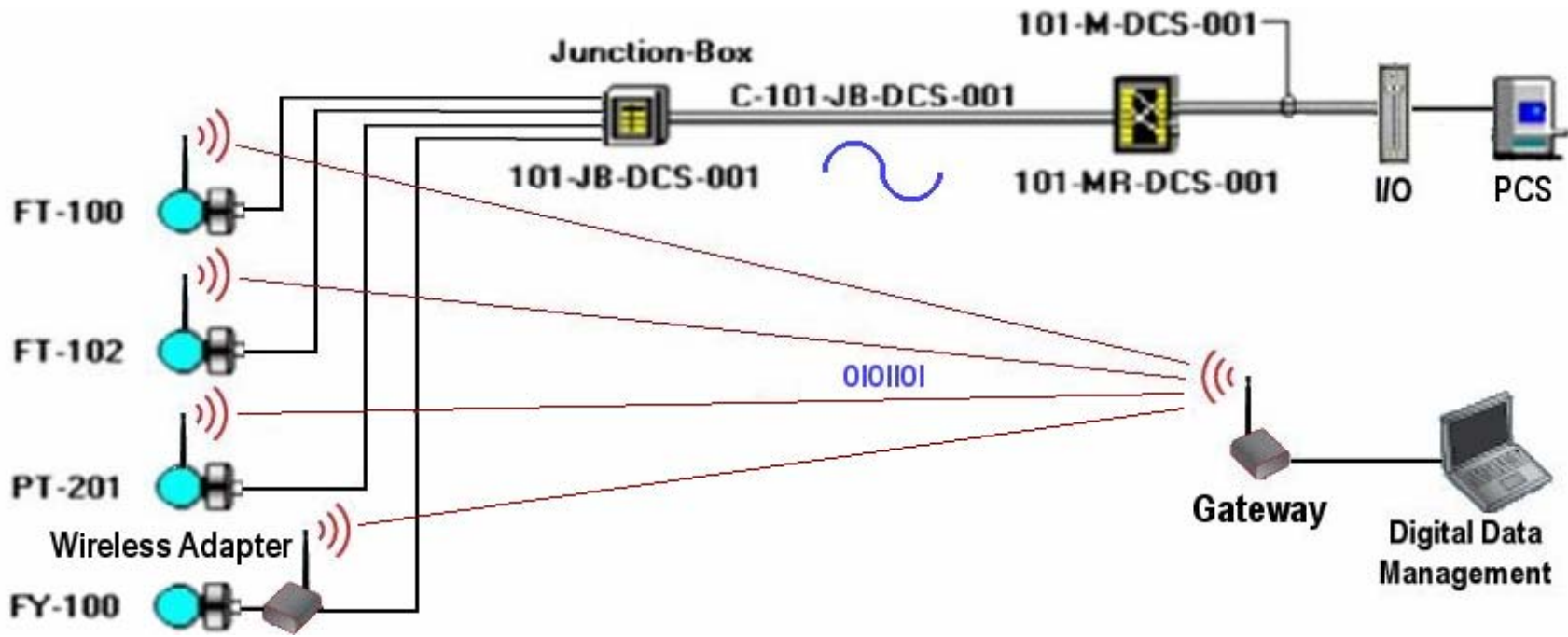


- ◆ The Fieldbus technologies include Foundation Fieldbus, Modbus, Profibus-PA, DeviceNet, TCP/IP and Ethernet systems.
 - Fieldbus systems are more complex, so SPI users and System Developers need to be more extensively trained or highly qualified
 - Fieldbus function block and virtual devices require definition in SPI
 - Slightly longer process control reaction times with Fieldbus depending on the system architecture
 - Device manufacturers have to offer different versions of their devices due to the number of different Fieldbus standards. This increases cost and adds difficulty of device selection and availability.
 - Technical risk - one or more Fieldbus standards may predominate in future and others may become obsolete.



HART Wireless Instrument Systems

- ◆ Conventional wiring for Process Control and Monitoring System
- ◆ Uses Wireless Instruments or Adaptors for Digital Hart Data
- ◆ Allows access to Digital Data Management via Wireless Network



FLUOR[®]

HART Wireless Instrument Systems

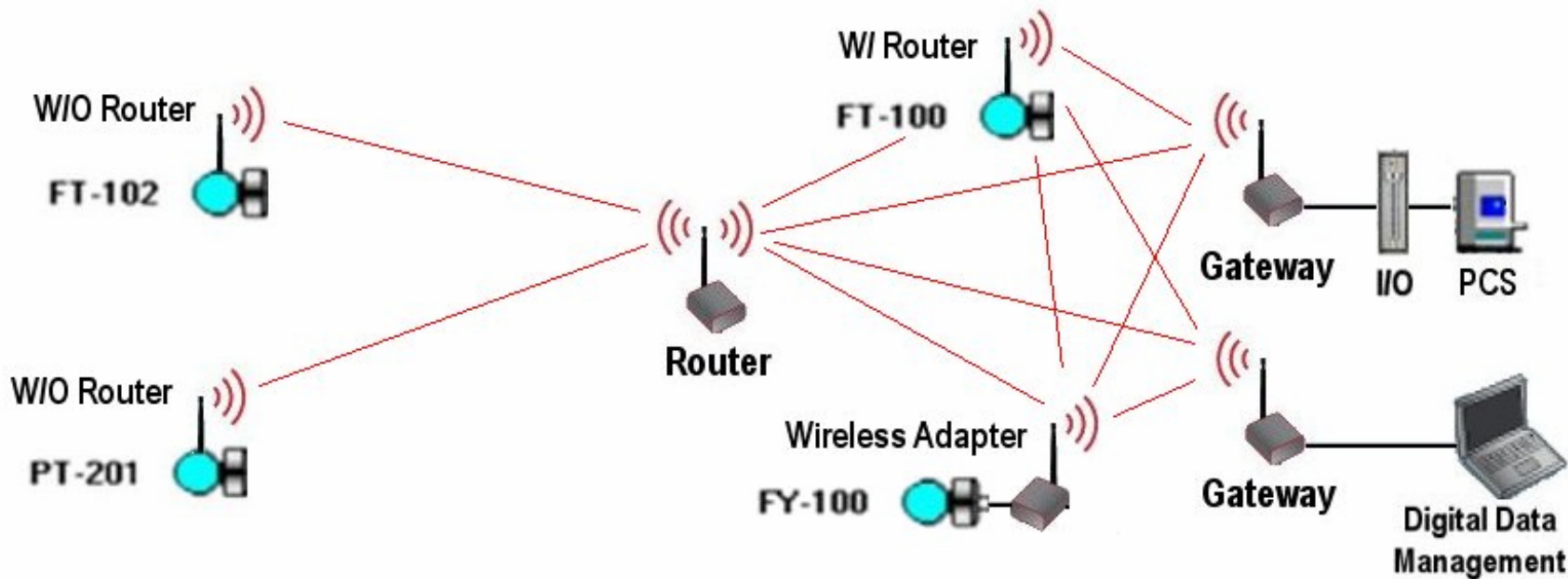


- ◆ Both Fieldbus and HART wireless system hardware introduce: Adaptors, Hubs, Repeaters, Blocks, Bridges, Switches, Routers Conditioners, Gateways, Hosts, Segments, Trunks and Spurs that must be specified and accounted for in SPI
 - Wireless Instrument system require specs and data fields for wireless transmitters, gateways and device manager requirements
 - Field surveys are required to assure line of sight connectivity
 - System may require routers or repeaters to assure connectivity
 - Remote or battery powered device requirements need to be defined
 - Wired components are connected using the SPI Wiring Module but wireless devices will require CAD, PDS or SP3D location plans



Wireless Mesh Network Instrument Systems

- ◆ Uses Instruments with routers for self configuring networks
- ◆ Uses Wireless Instruments or Adaptors for Process Control System
- ◆ Access to Process Control System and Digital Data Management via Wireless Network



Wireless Network Instrument Systems

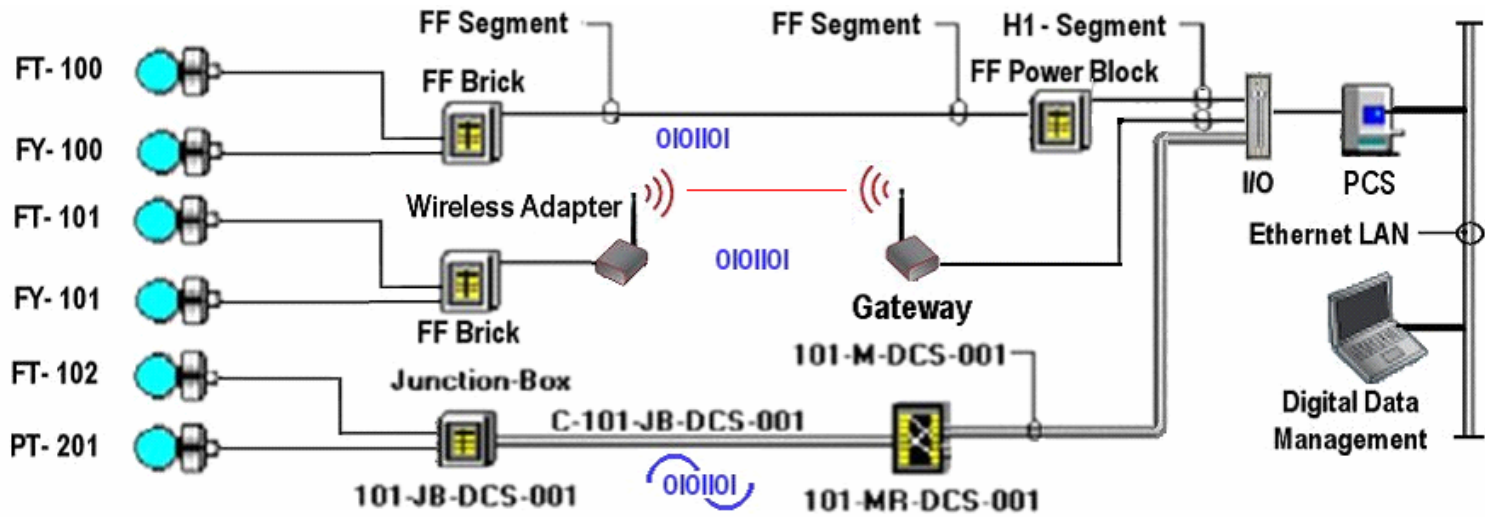


- ◆ The ISA100 standards committee is developing a comprehensive standard for industrial wireless communications for process data acquisition and Industrial Process control
 - Wireless HART 7.1 IEC 62951 and ISA SP100 standards are based on different protocols and may not be interoperable.
 - Wireless Network technology brings problems of dependability, security and privacy to Process Control and Industrial networks
 - Wireless devices power requirements need to be specified in SPI and wired to wireless devices
 - Availability of mesh Network Wireless field instruments is improving
 - On large wireless networks adequate bandwidth margins need to be considered
 - Wireless network utilization today is concentrated on logging, monitoring, alerting and open loop control applications



Combined Technology Instrument Systems

- ◆ Most SPI projects today use a combination of Conventional, Bus wiring and Wireless technology selected for best fit to project and system requirements
- ◆ Finding the right balance between system requirements and applied technology are day-to-day choices facing engineers working in both large and small engineering companies



SmartPlant Instrumentation Challenges



◆ SPI meeting the Challenge of Emerging Technologies

- SPI could use a “Parent Tag” to properly associate Integrated Instrument auxiliary devices that are purchased with the primary device and be able to create a Spec with multiple Tags from different Process Functions.
- SPI could provide the ability to index non signaled devices connected to field devices or elements like multiplexers, analyzers or machinery protection monitors and show on the loops and segment diagrams
- Spec forms could be provided in the SPI libraries for specialty devices such as Adaptors, Hubs, Repeaters, Blocks, Bridges, Switches, Routers, Conditioners, Gateways, Pull Stations, Diagnostic Modules, Etc....
- Intergraph is developing additional standard data fields for SIS, Fire and Safety, Machinery Protection, and Wireless networks as they are identified by the user community and system manufactures.
- The use of SPI Telecom Module will allow users to better document bus and network topography

The Data Challenge of Emerging Technologies



- ◆ **New and Emerging Technologies bring new challenges to the Instrumentation Design Engineering discipline when developing the spec and wiring matrix in SmartPlant Instrumentation**
- ◆ **The data requirements are changing faster than the ability of most automated engineering systems to package and deliver the data associated for these Emerging Technologies**

