

Smart Commissioning

Smart Commissioning is a technology-enabled approach for streamlining the commissioning of field instrumentation connected to a DeltaV Distributed Control System (DCS) or Safety Instrumented System. It reduces the effort and time for commissioning HART devices by automating some of the associated tasks involved. The benefits of Smart Commissioning extend beyond the site work; it changes the way automation projects are executed by reducing schedule dependencies between engineering and field work. That is, by effectively decoupling the physical I/O design from the functional design, Smart Commissioning reduces the time and effort for commissioning field devices, and positively impacts the overall project execution schedule. This whitepaper describes the features available in DeltaV v13.

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Decoupling the I/O Physical Design

Smart Commissioning changes the way automation projects are executed by enabling control logic configuration to proceed independently from the installation of the physical I/O and field instrumentation. There are three key features of a DeltaV DCS that enables the decoupling of the physical I/O design from the control strategy design:

1. Control strategies can be configured using just the Device Signal Tags (DST), eliminating the need to define the physical location of the I/O. DeltaV DSTs are unique identifiers for device signals.
2. When controls strategy and physical I/O designs are merged, the logical signal references are automatically bound to the physical I/O references without any additional configuration by the user.
3. Virtualization capabilities enable testing of control logic without physical control hardware present.

As soon as the initial process design is available, typically on a Piping and Instrumentation Diagram (P&ID), the project team can start configuring control strategies based only on the DSTs. Each I/O function block is linked to a DST that is not assigned to any particular I/O channel. In a traditional configuration approach, I/O references within the control strategies are bound to specific channels creating unnecessary dependencies in the project schedule. Smart Commissioning enables late binding; delaying the binding of I/O references until the field devices are installed and commissioned on site.

Smart Commissioning simplifies the late binding of I/O references by providing the ability to bind field device references to control strategies using the instrument tag configured within the field device. For HART devices, the binding of I/O references is performed automatically once the device is connected to a physical I/O channel and has been discovered by DeltaV system.

Virtualization has changed the way projects are executed and Factory Acceptance Tests (FAT) are conducted. Traditionally, control system hardware was required for system configuration and testing. This increased facility space requirements and delayed the shipping of the equipment to site. However, virtualization allows the FAT to be conducted without the need for control system hardware to be present. Virtualization reduces the space requirements and removes schedule dependencies since hardware can be shipped directly to the site, reducing the overall project schedule.

Installation of Field Enclosures

While the system configuration is being done at the project office, and the field devices are being specified and procured by the engineering firm, field installation activities can be executed in parallel. Specifically, Configure-To-Order (CTO) field enclosures can be procured and sent to the site for installation early in the design cycle. The use of standard field enclosures eliminates custom cabinet design thereby reducing engineering labor and shortening the schedule. However, the use of CTO cabinets is not required in order to reap the benefits of Smart Commissioning.

Based on the physical location of the field enclosures, field devices can be associated with a given enclosure. Thanks to the broad range of I/O types, practically all field devices can be connected to the DeltaV CHARacterization Module (CHARM) I/O subsystem without the need of external components. A large variety of signal types (e.g. RTD, T/C, 120VAC, etc.) can all be used within the same field enclosure. The installer only needs to select the proper CHARM, based on the signal type. All this field work can be done without any information about the logical I/O assignment within the control strategies. One key feature of Electronic Marshalling is the ability for the DeltaV controllers to utilize I/O from any CHARM I/O Card (CIOC), which further simplifies design consideration for allocating devices to field enclosures.

Once all the CHARMs have been installed and the device wiring terminated, the next step is to auto-sense the CHARMs. Each CHARM is automatically identified by the DeltaV system with no need for the user to define the type for each I/O channel. Then, HART devices can automatically be identified.

Automatic Binding of HART Devices

DeltaV can auto-sense HART devices and extract relevant device information. This includes the manufacturer, type, and revision, as well as the tag and description unique to each device. If the discovered field device tag matches a configured DST within the system, the proper I/O function block is automatically bound to the right field device.

There are three main approaches for handling tags within HART instruments:

Device is the Tag Master

In this approach, HART devices are either pre-tagged at the factory or tagged on-site prior to installation. When the channel is auto-sensed the tag in the device becomes the channel DST. The advantages of this approach are:

- Devices can be connected to any CHARM of the proper type. Smart devices are automatically detected based on their tag. Ringing the wire to confirm the smart device is connected to the right I/O channel is no longer needed.
- There is no need to configure the DST under specific channels. The DST is generated from the device tag and bound to the proper control strategy automatically.

DeltaV system is the Tag Master

In this approach, devices are not pre-tagged before delivery to site and connection to the system. Instead, the device tag is written by the DeltaV system to the instrument based on the DST name configured on the channel. The advantages of this approach are:

- Devices can be purchased in bulk and installed in any applicable location. This simplifies warehousing and management of instruments during construction since there is no need to track individually tagged devices.
- CHARMS must be configured with the DST of the appropriate device. When the channel is autosensed the DST is written to the device and the device information (manufacturer, type, and revision) is uploaded to the DeltaV system.

Hybrid

In this approach, devices are pre-tagged at the factory or on-site before installation. The CHARM channels are also configured with the DST that has been assigned to the channel. When the channel is auto-sensed, the DST names should agree confirming that the proper device has been installed in the proper location. Any discrepancies can be resolved on the spot and corrected in either the device or the channel configuration.

Smart Commissioning supports all of these approaches, so the user can select the method that best fits the specific project.

Automatic Configuration of HART devices

One of the most time-consuming activities during instrument commissioning is the configuration and setup of individual devices. Traditionally, this is done one device at a time using either AMS Device Manager or a hand-held communicator. As intelligent field devices become more complex, the number of parameters that must be configured increases dramatically, resulting in a corresponding increase in the amount of configuration time required and the risk of errors.

The phrase “define once, use many times” describes a more efficient method of configuring HART devices using AMS Device Manager Bulk Transfer. The AMS Device Manager Bulk Transfer process consists of four major elements:

1. **User Configuration Development** - the development of standardized user configurations that define the specific configuration of a particular device class. Each of these user configurations is associated with a particular Manufacturer, Type and Revision. There can be multiple user configurations for each manufacturer, type, and revision that reflects the different ways that the device might be used. User configurations can be created far ahead of the installation of field devices, and used as configuration standard beyond the project timeline and across different sites.
2. **Device Mapping** - the mapping of individual devices to a particular user configuration. This is done in an Excel file and loaded into AMS Device Manager with the Bulk Transfer Utility.
3. **Configuration Transfer** - When a device is auto-sensed and a valid user configuration mapping exists, the user configuration can automatically be sent to the device. Alternatively, multiple devices can be selected and their User Configurations will be transferred with the Bulk Transfer Utility, which is the preferred method for configuring multiple devices.
4. **Device Verification** - Reporting tools provided with the Bulk Transfer Utility and the QuickCheck Snap-On can be used to validate that transmitter configurations match the user configurations.

Bulk transfer of device configurations using the AMS Device Manager Bulk Transfer functionality has been shown to reduce some instrument commissioning activities by more than 75%. This offers significant opportunity to reduce the overall commissioning schedule, leading to earlier start-ups.

Computer-Assisted Loop Tests

Once the device tag has been bound with the control strategies and the devices have been properly configured, a final loop test is typically performed. This is designed to test the entire loop from the transmitter to the output of the module function block, so the range of the process variable is validated to be accurate in the process control graphics and faceplates. This has traditionally been done using two technicians; one in the field and the other at the DCS console. The field technician would simulate an analog value at the transmitter and the console technician would check the corresponding value at the DCS. This approach is time consuming and manpower intensive.

Using the computer-assisted loop test functionality available in AMS Device Manager and the QuickCheck Snap-On tool, the field technician can be eliminated and the test time can be reduced. This results in manpower savings of more than 50%.

With computer-assisted loop testing, a single technician at a DeltaV workstation can remotely signal a single HART device to drive its output to a specified value. The tester can then check the function block output to confirm proper operation of the entire loop. With the QuickCheck Snap-On tool, the user can force the transmitter to go through a series of pre-configured outputs to confirm proper operation of the loop. The QuickCheck Snap-On tool supports the simultaneous testing of multiple transmitters to assist in the testing of complicated multivariable control strategies.

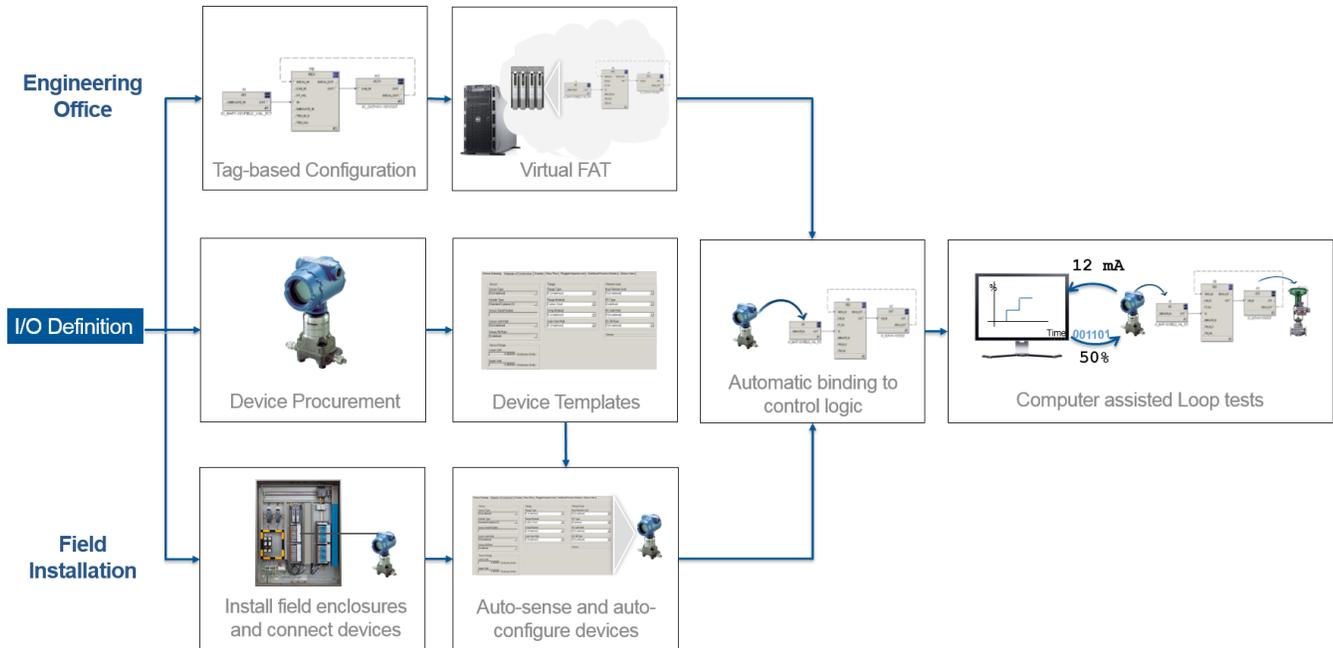


Figure 1. Project Execution with Smart Commissioning (I/O relevant tasks)

Applicability to SIS

DeltaV SIS does not support the simulation of safety logic if the I/O references have not been bound to specific I/O channels. However, users can still benefit from the automatic configuration of HART devices through the AMS Bulk Transfer functionality as well as the computer assisted loop tests and proof tests.

Computer-Assisted Proof Tests

The QuickCheck Snap-on application facilitates and accelerates shutdown interlock verification. It allows monitoring and fixing the output of multiple HART transmitters from an AMS Device Manager workstation. This substantially reduces commissioning time when testing voting strategies such as 2oo3. This application allows the required checks to be performed in less time with fewer people. Also, it automatically documents all of the steps, which saves time producing proof test reports.

Detailed Workflows for Commissioning HART devices

Workflow 1 – Device is the tag master (Use of pre-tagged HART devices)

Assumptions:

- HART devices have been pre-tagged at either the factory or before installation.
- Configuration has been completed and tested. Configuration of control strategies only include DST references rather than assignments to specific I/O channels.

Device Installation and Wiring	Devices are installed and verified to ensure the right device is installed in the right process connection. Device is wired to the proper field enclosure as defined in a device allocation list per field enclosure. Installer selects the proper terminal block and CHARM based on the device list for the enclosure. Devices are wired per a typical wiring diagram.
Auto-sensing CHARMS	Once the proper CHARMS have been inserted, the DeltaV system identifies the type for each CHARM so channel configuration is minimized.
Auto-Sensing HART Devices	User selects the first HART CHARM, right clicks and selects 'auto-sense.' The DeltaV system displays device information such as Manufacturer, Model, Revision, HART tag and HART Long Tag. User selects to upload the device information. The device tag becomes the DeltaV DST and the device references are automatically bound to the control strategies. User repeats the process for the next HART device. All this work is done by one technician from a DeltaV workstation.
Bulk Device Configuration	From the DeltaV workstation, user initiates the bulk transfer for a selected number of devices (e.g. all HART devices within a field enclosure).
Loop Tests	From the DeltaV workstation, AMS Device Manager is used to generate device signals in step increments (e.g. 0, 25, 50, and 100 percent of the process variable). The user verifies that appropriate indication is correct on the DeltaV at each test point. A single technician can set and check functionality from a DeltaV DCS/AMS Device Manager workstation. The audit trail automatically documents the loop checks steps. Optionally, a manual event can be entered into the Audit Trail to signify completion of the loop test.
Interlock Tests	The QuikcCheck Snap-on application simplifies, accelerates, and document interlock checkout. It allows to group devices for each interlock test and fixes the output of each device from an DeltaV DCS/AMS Device Manager workstation. Once each associated output is fixed, verify the expected interlock condition. Adjust each output, one at a time, to verify that each one affects the process as defined in the test scheme. Return each device to its normal mode of operation (verified visually on AMS Device Manager or by running a report). The Audit Trail automatically documents these steps. Enter a manual event into the Audit Trail of the device to signify completion of the interlock checkout.

Workflow 2 – DeltaV DCS is the Tag Master (Use of untagged HART devices)**Assumptions:**

- HART devices are not tagged prior to connecting to control system.
- Configuration has been completed and tested prior to shipment to site. Configuration of control strategies includes DST references assigned to specific I/O channels.

Device Installation and Wiring	Devices are installed and verified that right device (device from the right class) is installed in right process connection. The device is wired to the proper I/O CHARM, based on the cable schedule. Installer selects the proper terminal block and CHARM based on cable schedule. Device is wired per a typical wiring diagram.
Auto-sensing HART devices	User selects the first HART CHARM, right clicks and selects auto-sense. The DeltaV system displays device information such as Manufacturer, Model, Revision, HART tag and HART Long Tag. User selects to download the DST to the device. The DST becomes the device tag (all device references bound to the control strategies are preserved). User repeats the process for the next HART device. All this work is done by one technician from a DeltaV workstation.
Bulk Device Configuration	Same as workflow 1.
Loop Tests	Same as workflow 1.
Interlock Tests	Same as workflow 1.

Workflow 3 – Hybrid (Use of pre-tagged devices and predefined DSTs)

Assumptions:

- HART devices has been pre-tagged at either the factory or before installation.
- Configuration has been completed and tested prior to shipment to site. Configuration of control strategies includes DST references assigned to specific I/O channels.

Device Installation and Wiring	Devices are installed and verified that right device (device from the right class) is installed in right process connection. Device is wired to proper I/O CHARM based on the cable schedule. Installer selects the proper terminal block and CHARM, based on cable schedule. Device is wired per a typical wiring diagram.
Auto-sensing HART Devices	User selects the first HART CHARM, right clicks and selects auto-sense. User verifies that auto-sensed device tag matches the configured DST to validate the proper device has been installed in the proper location. Any discrepancies can be resolved on the spot and corrected in either the device or the channel configuration. All this work is done by one technician from a DeltaV workstation.
Bulk Device Configuration	Same as workflow 1 and 2.
Loop Tests	Same as workflow 1 and 2.
Interlock Tests	Same as workflow 1 and 2.

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