ISO 11783-11
Mobile Data Element Dictionary
DDE Request Form

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DDIdentifier$_{(10)}$	**DDEName**
289	Setpoint Work State
290	Setpoint Condensed Work State (1-16)
291	Setpoint Condensed Work State (17-32)
292	Setpoint Condensed Work State (33-48)
293	Setpoint Condensed Work State (49-64)
294	Setpoint Condensed Work State (65-80)
295	Setpoint Condensed Work State (81-96)
296	Setpoint Condensed Work State (97-112)
297	Setpoint Condensed Work State (113-128)
298	Setpoint Condensed Work State (129-144)
299	Setpoint Condensed Work State (145-160)
300	Setpoint Condensed Work State (161-176)
301	Setpoint Condensed Work State (177-192)
302	Setpoint Condensed Work State (193-208)
303	Setpoint Condensed Work State (209-224)
304	Setpoint Condensed Work State (225-240)
305	Setpoint Condensed Work State (241-256)

The individual Setpoint Work State DDI and Setpoint Condensed Work State DDIs are the control command counterparts to the Work State DDI (141) and Condensed Work States DDIs (161 – 176). The separation of the control commands through one DDI from the actual state communicated through another DDI enables verification of the transmission of the control commands independent from the effectuation of the requested control actions.

Control Functions that support this set of Setpoint Work State DDIs use the Work State DDIs as actual work states. These actual work state DDIs may be used in process data reported by the Control Function and shall not have the “settable” attribute specified.

With the introduction of these Setpoint Work State DDIs, the earlier defined Work State DDIs will further be referred to as Actual Work State DDIs.

The introduction of this set of work state control DDIs has implications for Control Functions that use the earlier defined Work State and Condensed Work States for work state control purposes. In order to define backwards compatibility, the following rules apply to Control Functions that use these Setpoint Work State DDIs:

1. The support of the Setpoint Work State DDIs is introduced with the AEF TC-SC functionality. The AEF TC-SC functionality specifies the process data version message to be version 3 or higher. Control Functions shall query the

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process data version message to determine which set of DDIs can be used for section control.

2. Task Controllers that support the Setpoint Work State DDIs for section control shall be able to fall back to using the Actual Work State DDIs if a Working Set is connected that does not support the Setpoint Work State DDIs. In this case, the Working Set shall specify the process data that contain controllable Actual Work State DDIs as “settable”.

3. Working Sets that support the Setpoint Work State DDIs for section control shall be able to fall back to using the Actual Work State DDIs when connecting to a Task Controller that does not support the Setpoint Work State DDIs. In this case, the working set shall specify the process data that contain controllable Actual Work State DDIs as “settable”.

4. Working Sets that support the Setpoint Work State DDIs for section control and connect to a Task Controller that also supports the Setpoint Work State DDIs shall not specify the process data that contain the Actual Work State DDIs as “settable”.

Example Device Description Object Pools (DDOPs).

The following examples are provided to guide the implementation of the Setpoint and Actual Work State DDIs in implement controllers that support section control and in task controllers that provide section control functionality. The examples cover the most common types of implements. The symbols used in these examples are described in following legends:

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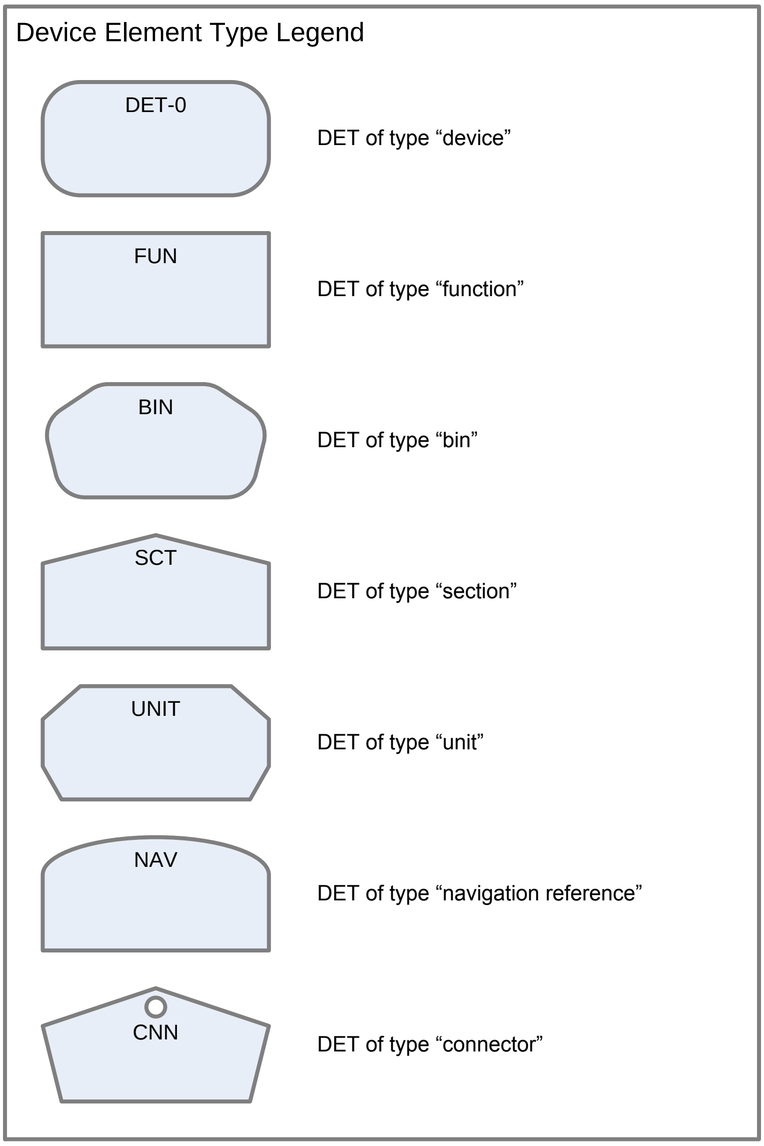

Figure 1 Device Element Type Legend

Device Element Attribute Legend

DDI		Property
DDI		Process Data (read only)
DDI		Setable Process Data
DDI		Time Interval Measurement
DDI		On Change Measurement
DDI		Distance Interval Measurement

Figure 2 Device Element Attribute Legend

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Example 1. Single operation Device without a Function Device Element, geometry specified in Device Properties.

This example is one of the most basic DDOP layouts required for Section Control. The use of the Setpoint Condensed Work State and Actual Condensed Work State is mandatory, even for a boom that contains a single section. The device geometry is in this example specified in Device Element Properties, which means that if the geometry of the Device changes during its lifetime, a new DDOP with a structure label that uniquely identifies each specific geometry, needs to be provided. The DDOP layout for this Device is provided in following figure.

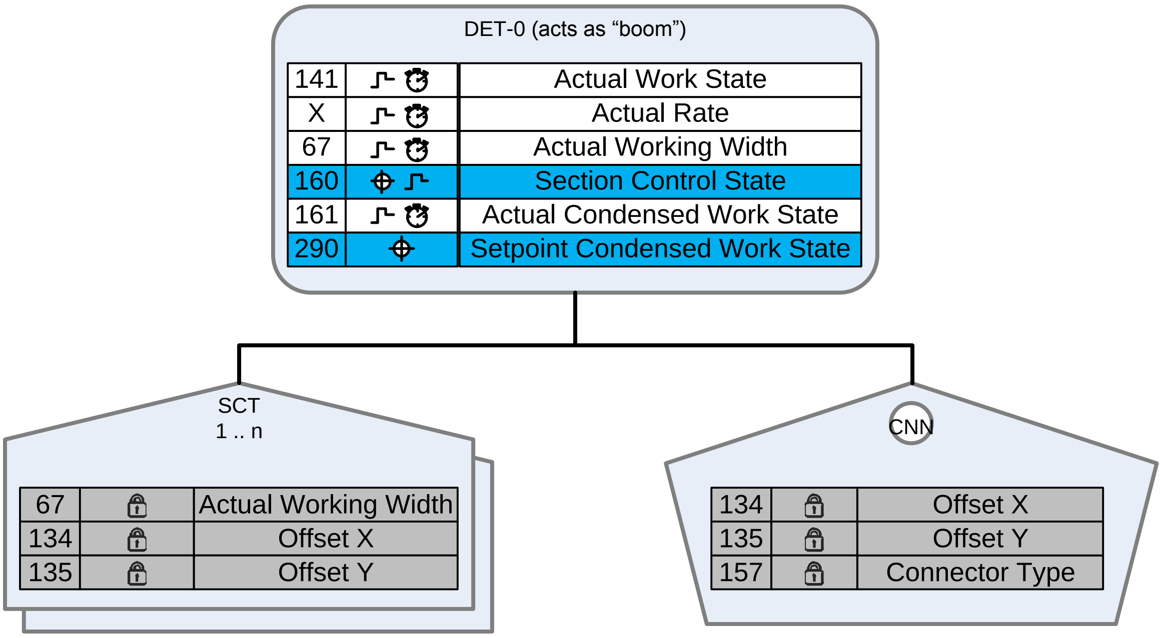

Figure 3 Single operation Device, no Function, geometry in Properties

In this example, the root Device Element acts as the Boom and thus a specific Device Element of type Function to represent a boom is not mandatory. To correctly calculate the offsets between a navigation device and the sections of this device, a Device Element of type Connection is required in the DDOP. This Connection Device Element shall at least provide X and Y offsets and a Connector Type attribute.

Note that the sections that are represented by a Condensed Work State do not contain Work States themselves. Thus, any duplicate control or measurement methods are prevented.

The measurement types “On Change” and “Time Interval” are required for the Actual Work States and Actual Condensed Work States.

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Each Section Device Element shall at least provide one type of Working Width. If more than one type of Working Width is provided, then the Section Controller shall be capable to use the different Working Width types with the following priority:

1. Actual Working Width (DDI 67)
2. Maximum Working Width (DDI 70)
3. Default Working Width (DDI 68)

The Actual Working Width of a Section shall not depend on the Actual Work State of that Section. An Actual Working Width at Device or Function level may depend on the Actual Work States of its underlying sections. This enables a Device or Function to report the Actual Working Width as the sum of the working widths of the sections that are on, while the Section Controller uses the section Working Widths to determine when section Work States need to be turned on or off.

The Actual Work State values along a hierarchy of Device Elements need to be combined to determine the work state of each section. In the above example, if the Actual Work State in the root Device Element has the value Off, then even when the Actual Condensed Work State(s) of the boom have a value On, then the resulting work state for the sections of this boom is processed as Off by the TC-SC.

Further recommendations from ISO11783-10 and the AEF TC-SC functionality definition define that the Element Numbers of the Section Device Elements increase from left to right across a machine and that the section Device Elements that belong to one boom need to be geometrically positioned in a single row, exactly next to each other and without overlap.

Example 2. Single operation Device without a Function Device Element, geometry specified in Device Process Data.

Devices that have the capability to modify the geometry or section layout of the DDOP often present their geometry in Device Process Data attributes rather than in Device Properties. The same example DDOP as discussed in example 1 but with the majority of the geometry defined by Device Process Data attributes is given in following figure.

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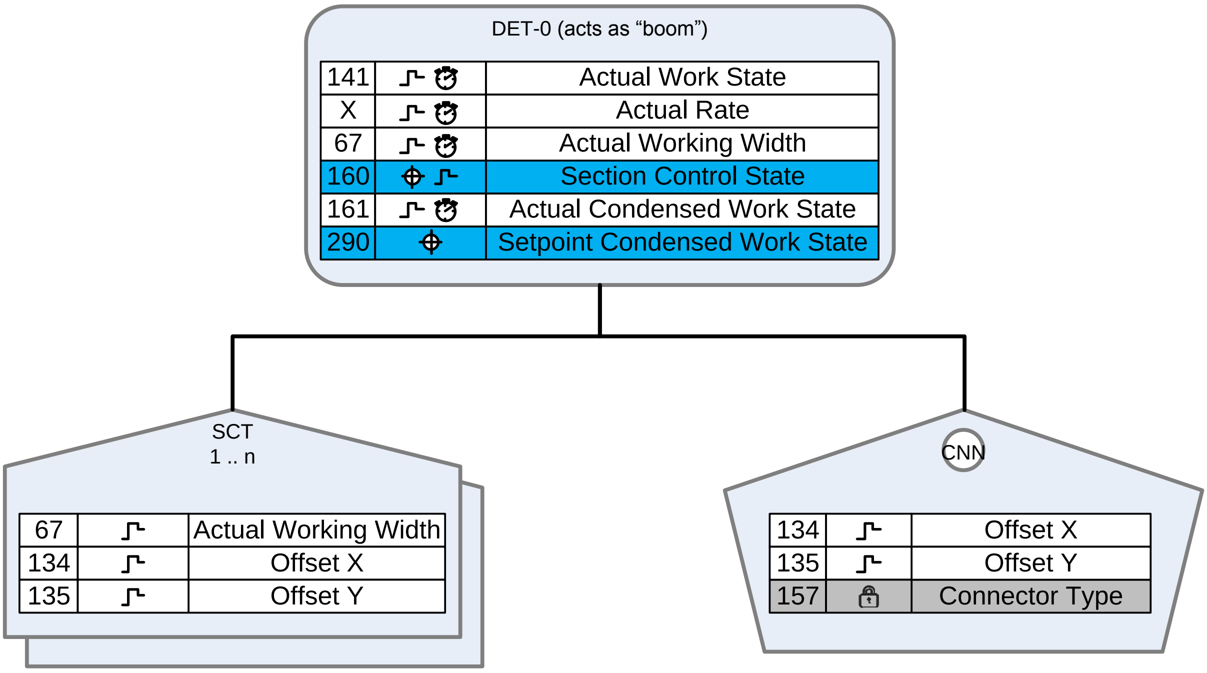

Figure 4 Single operation Device, no Function, geometry in Process Data.

The measurement types "On Change" are recommended for the geometry process data. Upon system startup, a TC-SC shall query the Device for its initial geometry DDI values to ensure that the correct geometry is used to determine coverage and section control commands.

A mix between process data and properties is allowed in the DDOP. In this example, the Connector Type attribute is a property which will not change over the lifetime of the DDOP structure, whereas the rest of the geometry attributes may change upon e.g. Device configuration modifications.

Example 3. Single operation Device with a Function Device Element, geometry specified in Device Process Data.

Next to the previous basic examples, the more versatile approach to define a single operation is to use a Device Element of type Function as the boom definition. For a single operation type Device this example is given in following figure.

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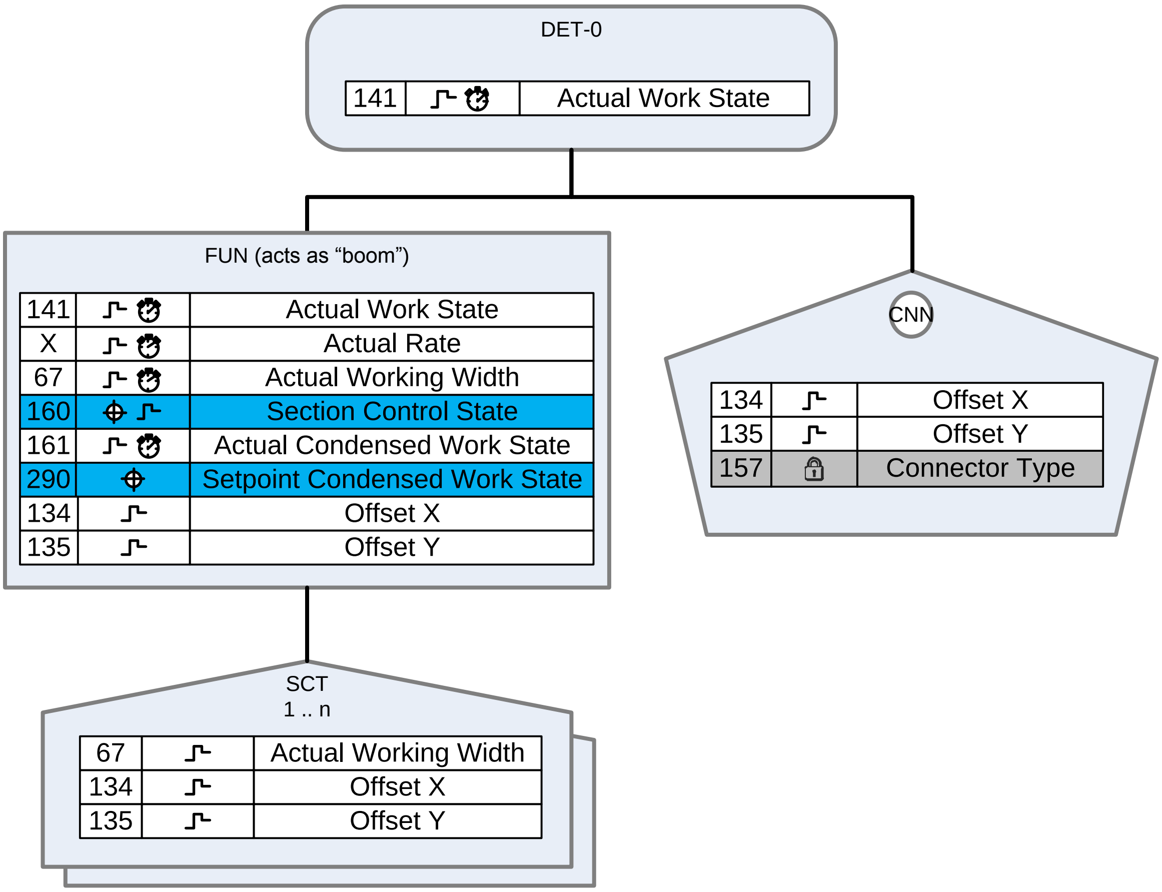

Figure 4 Single operation Device, separate Function as boom, geometry in Process Data

The Actual Work State values along a hierarchy of Device Elements need to be combined to determine the work state of each section. In this example, if the Actual Work State in the root Device Element has the value Off, then even when the Actual Condensed Work State(s) in the boom have a value On, the resulting work state for these sections is processed as Off by the TC-SC.

One important variation regarding the section and boom geometry definition in this example is the possibility to leave the Offset X definition out of the section Device Element definitions.

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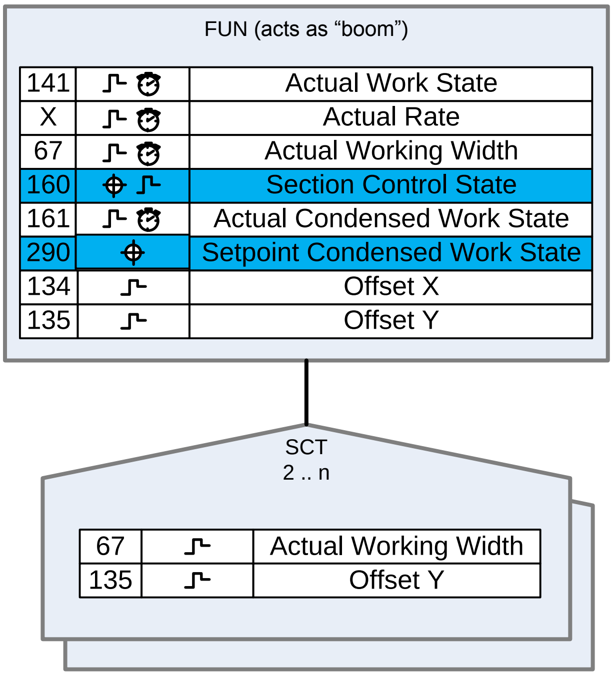

Figure 5 Offset X can be left out of the Section geometry definition

The general requirement regarding geometry definitions is that all Device Elements that contain Process Data other than configuration or total values shall provide a working width and offsets to specify their geometry. At a minimum, geometry is defined by Properties or Process Data for Offset X, Offset Y and Working Width DDIs.

For the relation between a boom and sections only, one (1) exception is allowed from this minimum definition of geometry:

1. The section Device Element does not need to provide an Offset X if its parent Device Element has an Offset X defined. In this case, the Offset X from the parent Device Element is valid for all its child section Device Elements. This optimizes the size of the section Device Elements.

Example 4. Single operation Device with a Function Device Element, geometry specified in Device Process Data and Section Control Delays are specified.

Specific for the adjustment of the timing of section control commands, separate Turn Off and Turn On data dictionary elements have been defined. These SC Turn On Time and SC Turn Off Time DDIs can be added to the Device Element that represents the boom, above the sections. The values of these DDIs are valid for all sections under that boom. Following figure elaborates the previous example to include these DDIs. The default value for these boom parameters is 0, when these

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DDIs are not present in a boom Device Element, then the TC-SC uses the default values of 0 ms for the Turn On and Turn Off times for that boom.

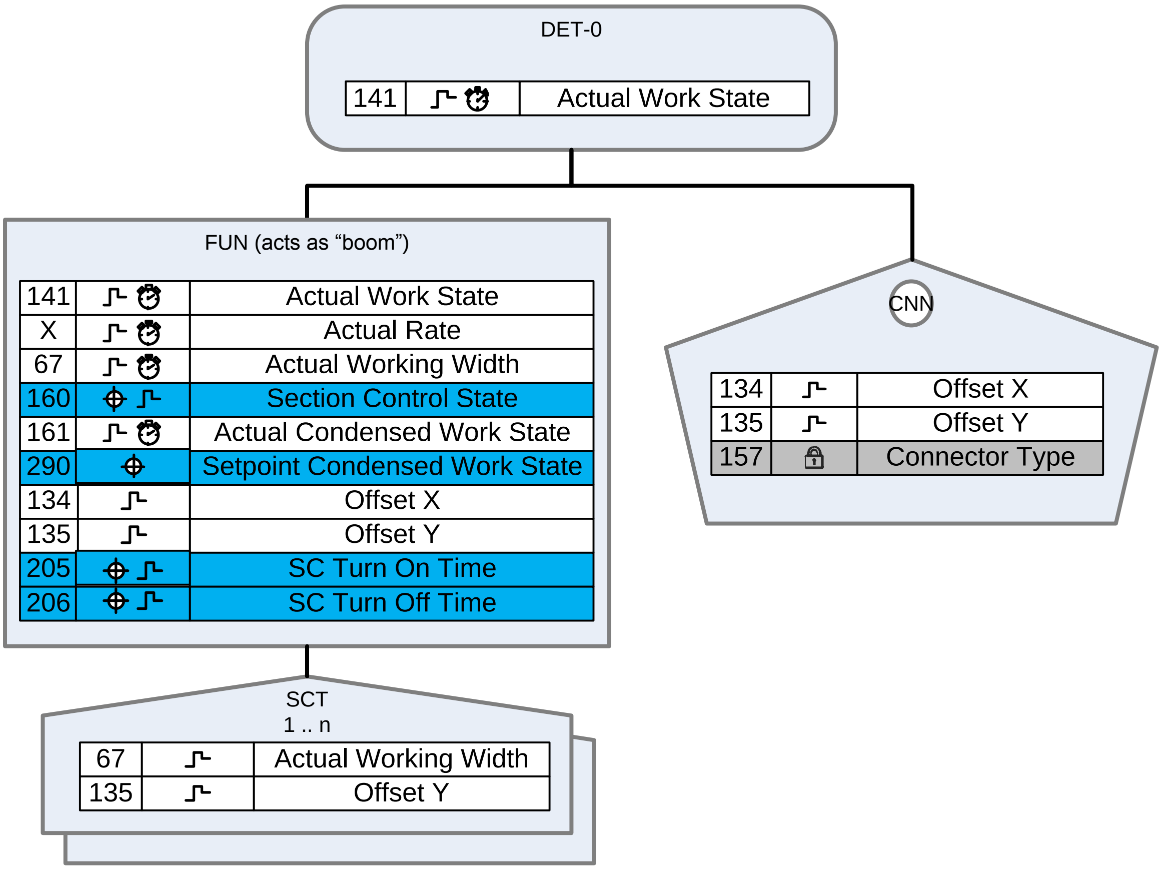

Figure 6 Single operation Device, separate Function as boom, geometry in Process Data, with Condensed Work States and SC Turn On and Off Times

The SC Turn On and Turn Off Time values are recommended to be defined as settable Process Data in the boom Device Element. Thus, the values of these parameters can be adjusted in the TC-SC operator interface and stored in the TC-SC capable Device.

The TC-SC shall use the SC Turn On Time to advance its section Turn On control command by the amount of time specified in this process data value. A positive value causes the TC-SC to send its section Turn On command earlier to the Device to compensate for the Device’s Turn On latency.

The TC-SC shall use the SC Turn Off Time to advance its section Turn Off control command by the amount of time specified in this process data value. A positive value causes the TC-SC to send its section Turn Off command earlier to the Device to compensate for the Device’s Turn Off latency.

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For Devices that provide SC Turn On / Turn Off Time configuration means on their operator interface, it is recommended to support an On Change measurement type for these values and transmit updates to the TC-SC when the operator adjusts these values.

Backwards compatibility note: in case the section Device Elements also contain the Physical Setpoint Time Latency (DDI 142), the TC Turn On and Turn Off Time values have higher priority and the Physical Setpoint Time Latency value has to be ignored for section control commands. If only the Physical Setpoint Time Latency is present in a section Device Element then it shall be used by the TC SC to advance the section Turn On and Off control commands with the specified latency. Figure 9 depicts the boom and section Device Elements for this variant of this example.

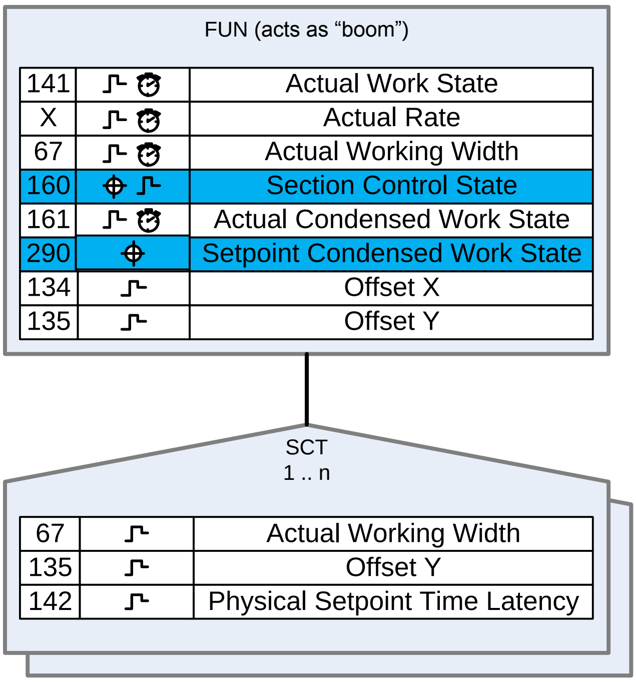

Figure 7 Section Device Element contains Physical Setpoint Time Latency DDI

Example 5. Multi operation Device containing 2 Section Control Booms, each with its own Rate Control.

For Devices that can apply multiple products, basically 2 different configurations exist. The first configuration has applies the multiple products completely independent. This example depicts the layout of such a Device.

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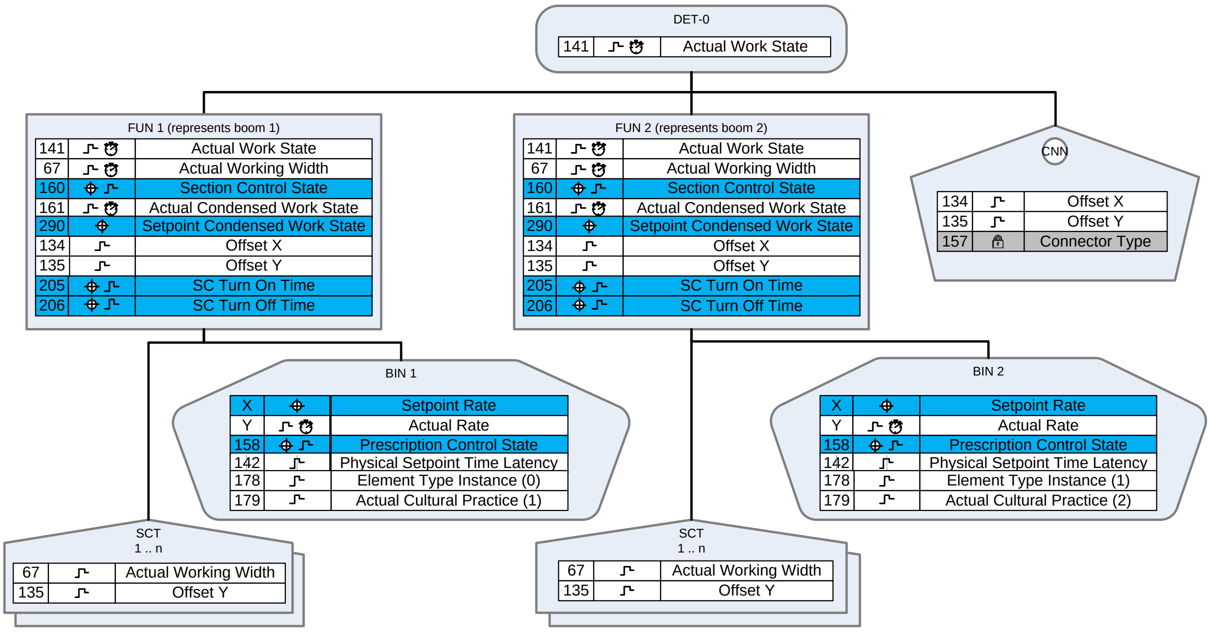

Figure 8 Multi operation Device, 2 Section Control Booms, each with Rate Control

The first function represents a fertilizer operation (Actual Cultural Practice is 1), the second function represents a seeding or planting operation (Actual Cultural Practice value is 2).

Both functions have their own physical boom and set of sections. The number of sections of the first function can be different from the number of sections of the second function.

Controlling this device would from a TC-SC perspective be identical to controlling 2 single operation Devices that are both connected to (or towed behind) one tractor.

Example 6. Multi operation Device containing 1 Section Control Boom distributing products from multiple Rate Control Channels.

The second configuration of a Device that performs multiple operations contains a single boom and set of functions which distribute the products that are controlled through multiple rate channels or come from multiple product bins. This example is depicted in following figure.

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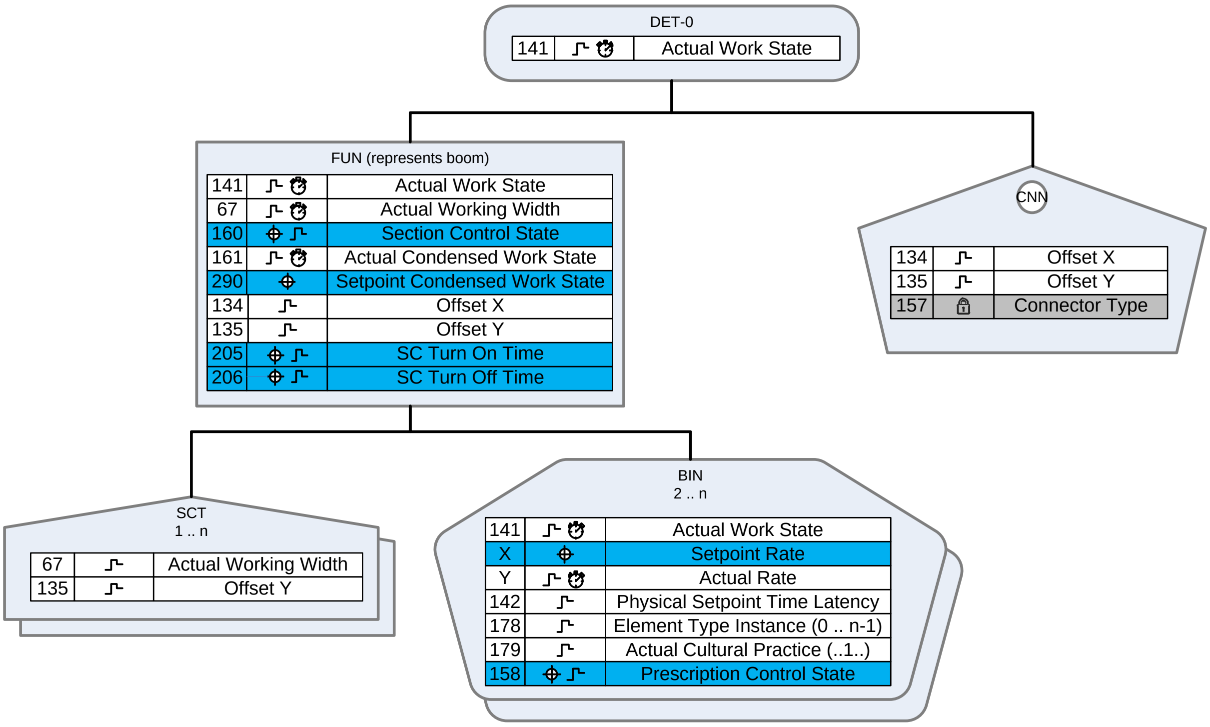

Figure 9 Multi operation Device, 1 Section Control Boom with multiple Bins

The single function Device Element on the left hand side of figure 9 represents the boom. The location of the Bin Device Elements as children of the boom specifies that the products from these bins all are distributed through this boom.

Example 7. Single operation device with multiple rate controllers, device has left half and right half independent rates, section control operates over sub-booms.

Certain device configurations require the TC-SC to be able to operate across one (1) level of a subboom. The following example contains such a device where 2 rate controllers each have a number of sections underneath them.

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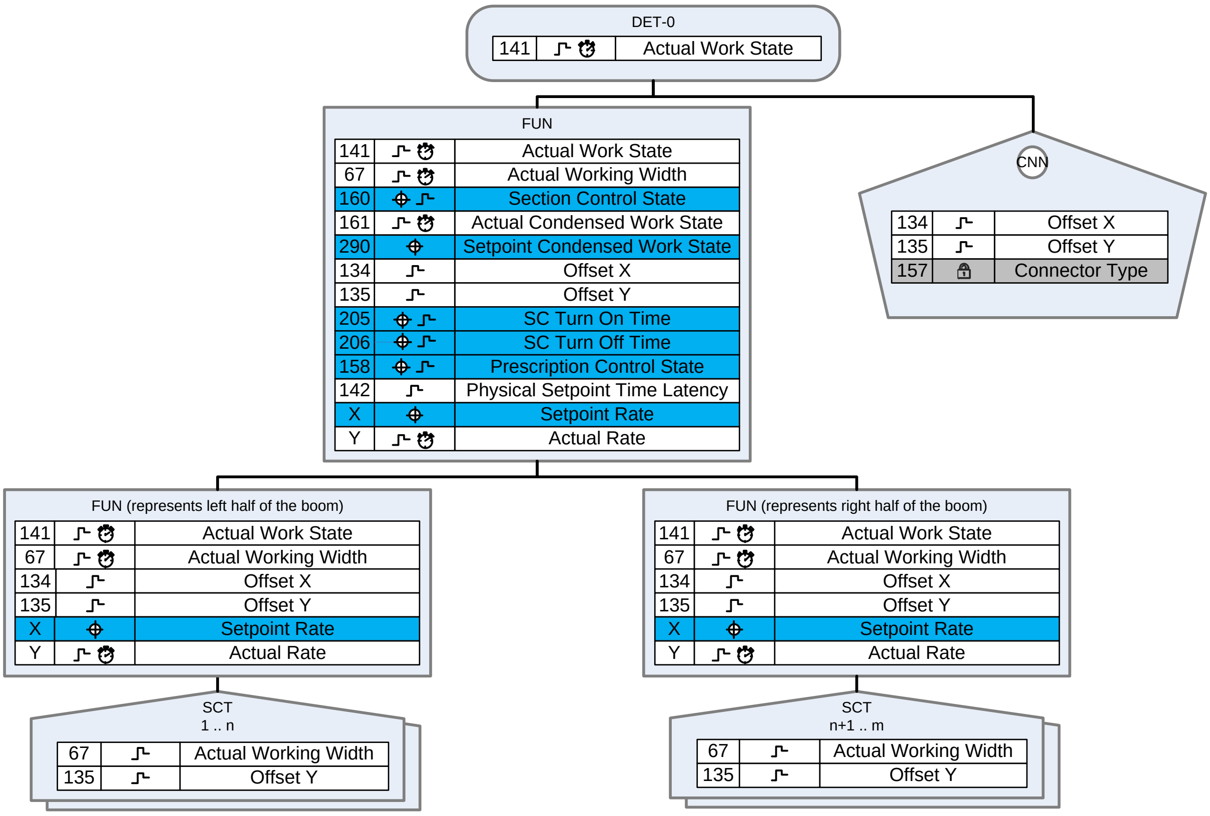

Figure 10 Separate rate controllers for left and right halves of a machine require the TC-SC DDI's to be at the machine function level.

In order to minimize the number of section control booms, the Section Control State and the Condensed Work States are moved to the common root of both rate controllers and the sections appear one level deeper. At maximum one (1) subboom level is allowed in a TC-SC capable DDOP.