

GRID AUTOMATION PRODUCTS

MicroSCADA X SYS600 10.2

Workplace X Data Model





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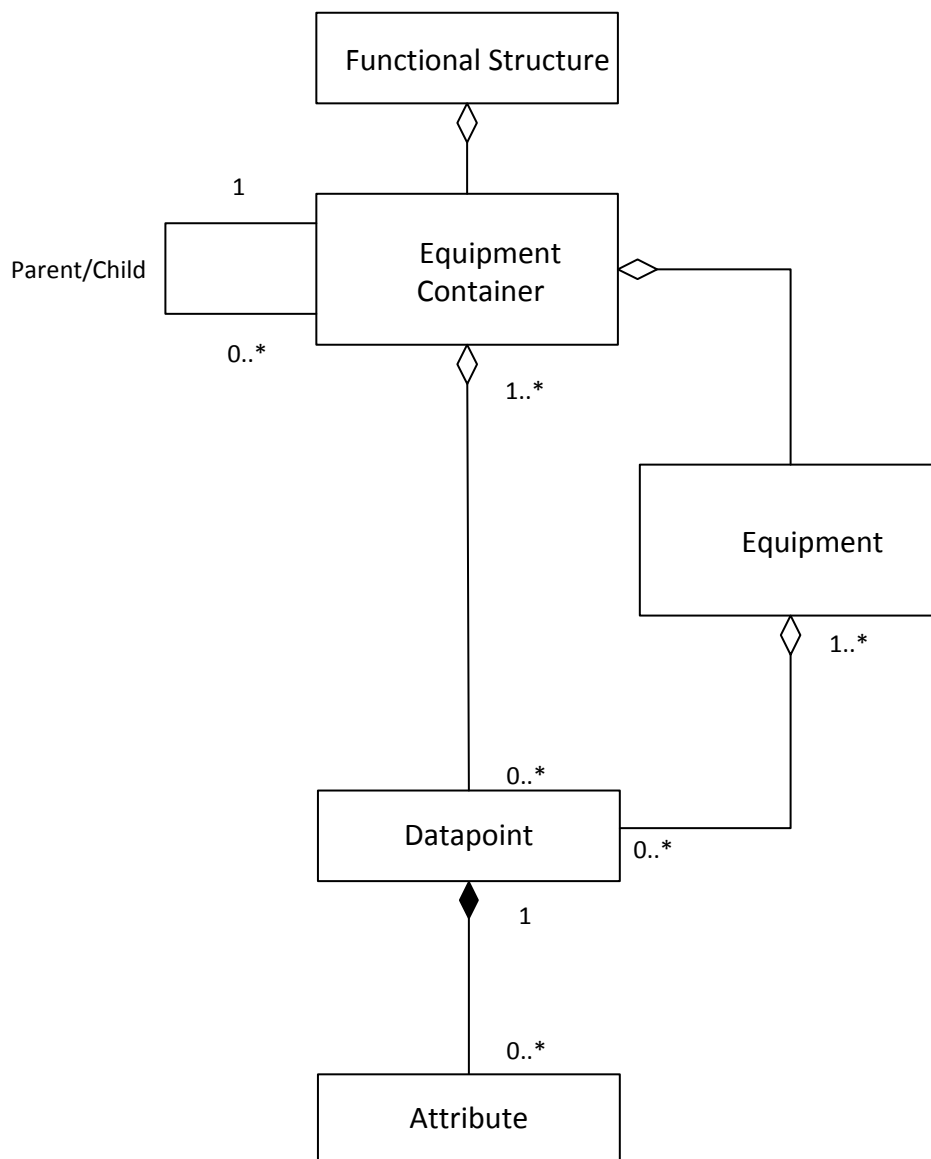
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Section 1 Data model

1.1 Overview

The data model of the system is created when operator user interface views are created with the View Builder. This model specifies how the objects and their properties are organized in a hierarchical functional data structure that is used for accessing data from the views. When the View Builder is launched, a model is created or updated from the process object information with specified rules.

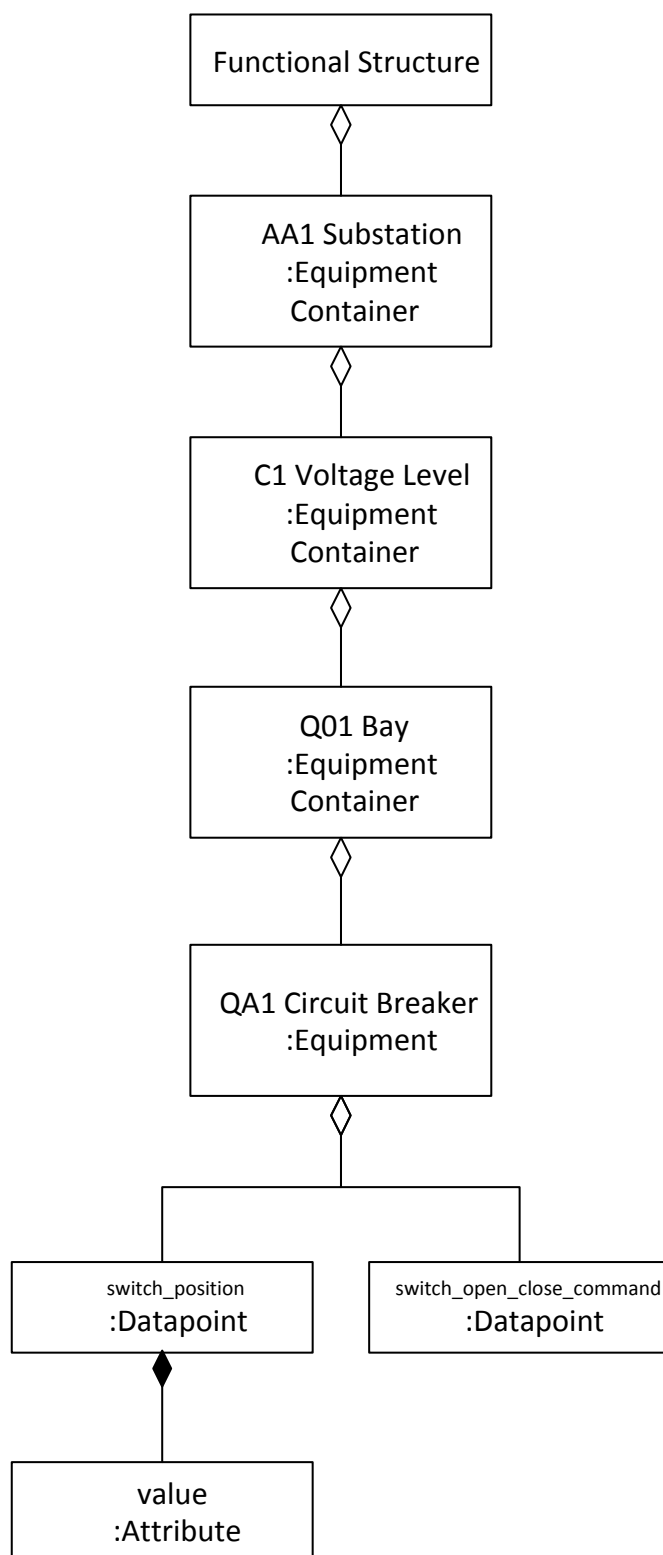
[Figure 1](#) shows the high level concept of the functional structure.



IEC19000301-1-en.vsd

Figure 1: Overview of functional structure conceptual model

[Figure 2](#) shows an example of functional structure for a substation, voltage level, bay and circuit breaker.



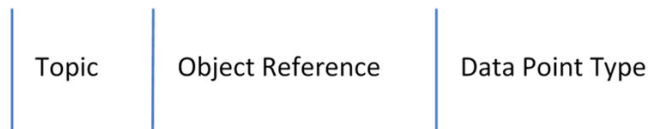
IEC19000302-1-en.vsdX

Figure 2: Example of simple functional structure

1.2 Addressing data from views

Data from the functional structure is addressed from the views using cda namespace.

```
x-cda:Domain:AA1.C1.Q01.QA1.switch_position
```



IEC19000303-1-en.vsdX

Figure 3: cda namespace

Topic

Topic specifies the source namespace. Following topics are defined:

- *Domain*: used for most of the process data, for example, switch positions and measurements.
- *Alarm*: used for information related to alarms.
- *Control*: used for control related information, for example, circuit breaker open/close or tap changer raise/lower control request status updates.

Object Reference

Object Reference is the part of the address that specifies the equipment or equipment container where the data is related. In the example, it specifies the circuit breaker **AA1.C1.Q01.QA1**.

Data Point Type

Data point type specifies the semantical data point type of data point. In the example, the type is `switch_position` which specifies that the data point value contains the switch position state as an integer value with agreed values for switch open, closed, intermediate and faulty position. There are pre-defined data point types that are specified for different equipment types. These can be found from the tables in *Appendix A*. More information about data point type and related data point group concept are in data point types and groups chapter.

When a data point is subscribed to a view, the server sends the data point data structure containing a value, timestamp, and quality. A detailed description of the data point data structure can be found from *Appendix B*.

Besides the built-in value, timestamp and quality attributes of a data point structure, it is possible to subscribe to additional attributes related to a data point. For example, alarm, blocking, measurement limit value and authorization information. These are addressed using slash notation.

x-cda:Domain:AA1.C1.Q01.QA1.switch_position/active



IEC19000304-1-en.vsd

Figure 4: Additional Attribute

In [Figure 4](#), information about the alarm state is addressed. The response will return FALSE when the alarm is inactive and TRUE when the alarm is active for the switch position data point. List of supported additional attributes are listed in [Appendix C](#).

There are exceptions when data point data structure is not used. For example, the control inhibit reason information has a structure that contains a list of reasons that prevents control. The used data structure for each data point type and an additional attribute is documented in [Appendix A](#) and [Appendix C](#).

1.3 Data point types and groups

Data point types are organized to data point groups and these data point groups collect the data point types that logically belong together. For example, **Tap changer automatic operation** group contains data point types that are related to tap changer automatic operation. Data point groups are not visible in the addressing of the data. Data point groups are used to ease the engineering and to document whether certain group/feature is supported by the functional structure object or the product. Some groups are shared for many types of equipment, for example, all switching device equipment (circuit breaker, disconnector, truck and so on) share the **Switch basic** group.

Data point groups and data point types in the groups are classified as mandatory, default or optional. For example, for circuit breaker equipment the **Switch basic** group is mandatory, but **Auto-reclosing** as optional. Within the **Switch basic** group, the switch_position data point type is mandatory, but the group_alarm_state is optional.

Appendix A

Following tables describe the predefined data point types for supported equipment and equipment containers.

Table 1: Common Data Point Types for All Equipment and Equipment Containers

Data point group	Group classification	Data point type	Data point classification	Description	Value semantics
	default	group_alarm_state	optional	Summary alarm state of data points below equipment (for example, circuit breaker) or equipment container (for example, bay).	0 = no alarm, 1 = active unacknowledged, 2 = active acknowledged, 3 = inactive unacknowledged
	default	group_alarm_blocked	optional	Indicates whether alarm generation is blocked for datapoints of the equipment or equipment container	FALSE = not blocked, TRUE = blocked
	default	group_control_blocked	optional	Indicates whether controls are blocked for datapoints of the equipment or equipment container	FALSE = not blocked, TRUE = blocked
	default	group_event_blocked	optional	Indicates whether event generation is blocked for datapoints of the equipment or equipment container	FALSE = not blocked, TRUE = blocked
		group_update_blocked	optional	Indicates whether data updates are blocked for datapoints of the equipment or equipment container	FALSE = not blocked, TRUE = blocked

Table 2: Circuit breaker equipment

Data point group	Group classification	Data point type	Data point classification	Description	Value semantics
Switch basic	mandatory	switch_position	mandatory	Switch position	0 = INTERMEDIATE, 1 = OPEN, 2 = CLOSED, 3 = FAULTY
Switch operation	default	switch_open_close_command	mandatory	Switch open/close command. Command request is sent using this data point. Subscribing the data point will give status information about the command execution.	For control value FALSE = open TRUE = close See Control API documentation for details
Switch operation	default	allow_close	default	User specific summary state whether the user subscribing the information is allowed to execute switch close operation. Takes into account user permissions, current switch state, control blocking and so on.	false = inhibits, true = allows
Switch operation	default	allow_open	default	User specific summary state whether the user subscribing the information is allowed to execute switch open operation. Takes into account user permissions, current switch state, control blocking and so on.	false = inhibits, true = allows
Switch operation	default	forced_clear_pending_selections_command	default	Forcefully clears pending command selections on system level that can be left, for example, due to abruptly closed user session after selection.	Control value 1 = clear selections
Circuit Breaker operation restrictions due to process	default	close_blocked	mandatory	Switch close operation blocked at device level. For example, blocked due to spring does not charge	false = control allowed, true = control blocked
Circuit Breaker operation restrictions due to process	default	open_blocked	mandatory	Switch open operation blocked at device level. For example, blocked due to spring does not charge	false = control allowed, true = control blocked
Auto-reclosing (binary)	default	autoreclosing_mode	mandatory	Switch auto-reclosing function disabled or enabled	0 = off, 1 = on
Auto-reclosing (binary)	default	autoreclosing_mode_set_value_command	optional	Disable/enable switch auto-reclosing function	Control value 0 = off, 1 = on

Table 3: *Disconnecter equipment*

Data point group	Group classification	Data point Type	Data point classification	Description	Value semantics
Switch basic	mandatory	switch_position	mandatory	Switch position	0 = INTERMEDIATE, 1 = OPEN, 2 = CLOSED, 3 = FAULTY
Switch operation	default	switch_open_close_command	mandatory	Switch open/close command. Command request is sent using this data point. Subscribing the data point will give status information about the command execution.	For control value FALSE = open TRUE = close See Control API documentation for details
Switch operation	default	allow_close	default	User specific summary state whether the user subscribing the information is allowed to execute switch close operation. Takes into account user permissions, current switch state, control blocking and so on.	false = inhibits, true = allows
Switch operation	default	allow_open	default	User specific summary state whether the user subscribing the information is allowed to execute switch open operation. Takes into account user permissions, current switch state, control blocking and so on.	false = inhibits, true = allows
Switch operation	default	forced_clear_pending_selections_command	default	Forcefully clears pending command selections on system level that might have been left, for example, due to abruptly closed user session after selection	Control value 1 = clear selections
Switch operation restrictions due to process	default	close_blocked	mandatory	Switch close operation blocked at device level. For example, due to spring does not charge	false = inhibits, true = allows
Switch operation restrictions due to process	default	open_blocked	mandatory	Switch open operation blocked at device level. For example, due to spring does not charge	false = inhibits, true = allows

Table 4: Double-sided truck equipment

Data point group	Group classification	Data point type	Data point classification	Description	Value semantics
Truck basic	mandatory	switch_position	mandatory	Switch position	0 = INTERMEDIATE, 1 = OPEN, 2 = CLOSED, 3 = FAULTY
Switch operation	default	switch_open_close_command	mandatory	Switch open/close command. Command request is sent using this data point. Subscribing the data point will give status information about the command execution.	For control value FALSE = open TRUE = close See Control API documentation for details
Switch operation	default	allow_close	default	User specific summary state whether the user subscribing the information is allowed to execute switch close operation. Takes into account user permissions, current switch state, control blocking and so on.	false = inhibits, true = allows
Switch operation	default	allow_open	default	User specific summary state whether the user subscribing the information is allowed to execute switch open operation. Takes into account user permissions, current switch state, control blocking and so on.	false = inhibits, true = allows
Switch operation	default	forced_clear_pending_selections_command	default	Forcefully clears pending command selections on system level that might have been left, for example, due to abruptly closed user session after selection	Control value 1 = clear selections
Switch operation restrictions due to process	default	close_blocked	mandatory	Switch close operation blocked at device level. For example, due to spring does not charge	false = control allowed, true = control blocked
Switch operation restrictions due to process	default	open_blocked	mandatory	Switch open operation blocked at device level. For example, due to spring does not charge	false = control allowed, true = control blocked

Table 5: Single-sided truck equipment

Data point group	Group classification	Data point type	Data point classification	Description	Value semantics
Truck basic	mandatory	switch_position	mandatory	Switch position	0 = INTERMEDIATE, 1 = OPEN, 2 = CLOSED, 3 = FAULTY
Switch operation	default	switch_open_close_command	mandatory	Switch open/close command. Command request is sent using this data point. Subscribing the data point will give status information about the command execution.	For control value FALSE = open TRUE = close See Control API documentation for details
Switch operation	default	allow_close	default	User specific summary state whether the user subscribing the information is allowed to execute switch close operation. Takes into account user permissions, current switch state, control blocking and so on.	false = inhibits, true = allows
Switch operation	default	allow_open	default	User specific summary state whether the user subscribing the information is allowed to execute switch open operation. Takes into account user permissions, current switch state, control blocking and so on.	false = inhibits, true = allows
Switch operation	default	forced_clear_pending_selections_command	default	Forcefully clears pending command selections on system level that might have been left, for example, due to abruptly closed user session after selection.	Control value 1 = clear selections
Switch operation restrictions due to process	default	close_blocked	mandatory	Switch close operation blocked at device level. For example, due to spring does not charge.	false = control allowed, true = control blocked
Switch operation restrictions due to process	default	open_blocked	mandatory	Switch open operation blocked at device level. For example, due to spring does not charge.	false = control allowed, true = control blocked

Table 6: Load-break switch equipment

Data point group	Group classification	Data point type	Data point classification	Description	Value semantics
Switch basic	mandatory	switch_position	mandatory	Switch position	0 = INTERMEDIATE, 1 = OPEN, 2 = CLOSED, 3 = FAULTY
Switch operation	default	switch_open_close_command	mandatory	Switch open/close command. Command request is sent using this data point. Subscribing the data point will give status information about the command execution.	For control value FALSE = open TRUE = close See Control API documentation for details
Switch operation	default	allow_close	default	User specific summary state whether the user subscribing the information is allowed to execute switch close operation. Takes into account user permissions, current switch state, control blocking and so on.	false = inhibits, true = allows
Switch operation	default	allow_open	default	User specific summary state whether the user subscribing the information is allowed to execute switch open operation. Takes into account user permissions, current switch state, control blocking and so on.	false = inhibits, true = allows
Switch operation	default	forced_clear_pending_selections_command	default	Forcefully clears pending command selections on system level that might have been left, for example, due to abruptly closed user session after selection	Control value 1 = clear selections
Switch operation restrictions due to process	default	close_blocked	mandatory	Switch close operation blocked at device level. For example, due to spring does not charge	false = control allowed, true = control blocked
Switch operation restrictions due to process	default	open_blocked	mandatory	Switch open operation blocked at device level. For example, due to spring does not charge	false = control allowed, true = control blocked

Table 7: Tap changer equipment

Data point group	Group classification	Data point type	Data point classification	Description	Value semantics
Tap changer basic	mandatory	tap_position	mandatory	Tap changer position	
Tap changer basic	mandatory	tap_changer_max_position_value	default	Tap changer maximum position value	
Tap changer basic	mandatory	tap_changer_min_position_value	default	Tap changer minimum position value	
Tap changer operation	default	tap_value_raise_or_lower_command	mandatory	Tap changer raise/lower command. Command request is sent using this data point. Subscribing the data point will give status information about the command execution.	0 = READY, 1 = RAISE, 2 = LOWER
Tap changer operation	default	forced_clear_pending_selections_command	default	Forcefully clears pending command selections on system level that might have been left, for example, due to abruptly closed user session after selection	1 = clear selections
Tap changer automatic operation	default	auto_manual_operation_mode	mandatory	Tap changer control auto/manual mode	0 = manual, 1 = auto
Tap changer automatic operation	default	auto_manual_set_operation_mode_command	mandatory	Set tap changer control auto/manual mode	Control Value 0 = set to manual, 1 = set to auto
Tap changer automatic operation	default	voltage	optional	Voltage measurement	
Tap changer automatic operation	default	reference_voltage	mandatory	Reference voltage value for automatic tap changer control	
Tap changer automatic operation	default	reference_voltage_set_value_command	default	Set reference voltage value for automatic tap changer control	
Parallel operation	optional	co_operation_mode	default	Tap changer control co-operation mode	0 = INDEPENDENT, 1 = MINIMIZE CURRENT, 2 = PARALLEL

Table continues on next page

Data point group	Group classification	Data point type	Data point classification	Description	Value semantics
Parallel operation	optional	co_operation_mode_set_value_command	default	Set tap changer control co-operation mode	
Parallel operation	optional	co_operation_role	optional	Tap changer co-operation role in parallel co-operation mode	0 = FOLLOWER, 1 = MASTER
Parallel operation	optional	co_operation_role_set_value_command	optional	Set tap changer co-operation role in parallel co-operation mode	0 = FOLLOWER, 1 = MASTER

Table 8: Substation equipment container

Data point group	Group classification	Data point type	Data point classification	Description	Value semantics
Substation basic	mandatory	station_local_remote	mandatory	Station local/remote switch state	0 = (none), 1 = Station, 2 = remote (NCC), 3 = reserved (can be used for 2nd NCC)
Substation operation	default	station_local_remote_command	mandatory	Control station local/remote switch state	0=Station, 1=Remote

Table 9: Diameter equipment container

Data point group	Group classification	Data point type	Data point classification	Description	Value semantics
Feeder basic	default	ied_local_remote_abb	default	IED local/remote state	0 = disabled, 1 = local, 2 = remote, 3 = Mimic

Table 10: Bay equipment container

Data point group	Group classification	Data point type	Data point classification	Description	Value semantics
Feeder basic	mandatory	ied_local_remote_abb	default	IED local/remote state	0 = disabled, 1 = local, 2 = remote, 3 = Mimic
Feeder measurements	optional	total_active_power	default	Active power (total) measurement	
Feeder measurements	optional	total_apparent_power	optional	Apparent power (total) measurement	
Feeder measurements	optional	voltage_L1_L2	default	Voltage measurement between L1 and L2 lines	
Feeder measurements	optional	voltage_L2_L3	default	Voltage measurement between L2 and L3 lines	
Feeder measurements	optional	voltage_L3_L1	default	Voltage measurement between L3 and L1 lines	

Table continues on next page

Data point group	Group classification	Data point type	Data point classification	Description	Value semantics
Feeder measurements	optional	current_L1	default	Current measurement of L1	
Feeder measurements	optional	current_L2	default	Current measurement of L2	
Feeder measurements	optional	current_L3	default	Current measurement of L3	
Feeder measurements	optional	power_factor	default	Power factor	

Appendix B

Following tables represent the data structure of the data point. The detailed data structure that is transferred on the wire is documented in the *CommonDataModel* proto buffer definition file. This same structure is also used for additional data point attributes.

Table 11: Data point data structure

Attribute	Data type	Comment
value	varies depending the datapoint type.	Contains the value of the data point. This can be, for example, float value for a voltage measurement data point or integer value for switch position.
datatype	string	Value data type as string
quality	uint32	Quality of the value as encoded integer value. See value quality bitmask table below for details. Workplace X framework has number of built-in functions for decoding the quality information. For example, resolve DataPointQuality. For more information refer <i>View writer's guide</i> .
timestamp	timestamp structure	Timestamp related to the value. For example, time when data point was updated with the value. See timestamp structure table below. Workplace X framework has number of built-in functions for handling the timestamp (for example, date). For more information refer <i>View writer's guide</i> .
unit	string	concatenated prefix + unit as string. For example, kV

Table 12: Value quality bitmask

Quality Item	Bit position 0..31	Comment	Mapping to SYS600 process object attributes
validity	0,1	0=GOOD, 1=INVALID, 2=UNDEFINED VALIDITY 3=QUESTIONABLE	GOOD OS = 0 INVALID OS=1 or OS=10 UNDEFINED VALIDITY not used QUESTIONABLE OS=2
overflow	2		OF
outOfRange	3		OR
badReference	4		
oscillatory	5		N/A
failure	6		OS = 1
oldData	7		OS = 2
inconsistent	8		N/A
inaccurate	9		N/A
source	10	0=PROCESS, 1=SUBSTITUTED	SB, SU, SS, UN
test	11		TM = 1
Table continues on next page			

Quality Item	Bit position 0..31	Comment	Mapping to SYS600 process object attributes
blocked	12		BL = 1, UB = 1
derived	13		Not supported
reserved	14, 15		Not supported
substitutedAt	16,17	0=UNDEFINED, 1=PROCESS_BUS_IED, 2=STATION_BUS_IED, 3=SIMULATED_AT_STATION_IED 4=SUBSTITUTED_AT_STATION_IED When value is simulated at SYS600, the substituted bit is set to 1 and substitutedAt is set to 3 When value is substituted at SYS600 with SU attribute, the substituted bit is set to 1 and substitutedAt is set to 4	SB, SU, SS, UN

Table 13: *Timestamp structure*

Timestamp Item	Data type	Comment
nanoseconds_since_epoch	int 64	UTC timestamp in nanoseconds since epoch
quality	uint32	time quality, see time quality table below
scid	uint64	Optional 8 Byte SCID of the Clock the Timestamp is referring to

Simplified representation of quality information is supported and applicable.

Table 14: *Timestamp quality structure*

Quality Item	Bit position 0..31	Comment
validity	0	0=GOOD, 1=INVALID,

Appendix C

Appendix C includes common additional attributes shared for data point types.

Table 15: Additional attributes

Data point Base type	Attribute name	Topic	Data Point Data Type	Description	Value definitions	Related MicroSCADA attribute
(all)	alarm_blocked	Alarm	bool	Indicates whether alarm generation is blocked for the data point	FALSE = not blocked, TRUE = blocked	AB
(all)	alarm_blocking_permitted	Domain	bool	Indicates whether the alarm blocking is permitted based on the user permissions	FALSE = not permitted, TRUE = permitted	Calculated
(all)	event_blocked	Event	bool	Indicates whether event generation is blocked for the data point	FALSE = not blocked, TRUE = blocked	HB
(all)	event_blocking_permitted	Domain	bool	Indicates whether event blocking is permitted based on user permissions	FALSE = not permitted, TRUE = permitted	Calculated
(all)	printout_blocked	Domain	bool	Indicates whether printout is blocked for the data point	FALSE = not blocked, TRUE = blocked	PB
(all)	update_blocked	Domain	bool	Indicates whether the updating of the data point value from process is blocked	FALSE = not blocked, TRUE = blocked	UB
(all)	update_blocking_permitted	Domain	bool	Indicates whether the update blocking is permitted based on the user permissions	FALSE = not permitted, TRUE = permitted	Calculated
Control	level_permitted	Domain	bool	Indicates whether the control is permitted based on the control originator level (for example, remote, station, bay and so on)	FALSE = not permitted, TRUE = permitted	Calculated
Control	control_permitted	Domain	bool	Indicates whether the control is permitted based on user permissions	FALSE = not permitted, TRUE = permitted	Calculated
Control	control_inhibit_reason	Domain	Control proto Reason message	List of reasons why control is inhibited	List of reasons enumeration values and custom reasons	Calculated
(all)	simulation_permitted	Domain	bool	Indicates whether the simulation is permitted based on user permissions	FALSE = not permitted, TRUE = permitted	Calculated

Table continues on next page

Data point Base type	Attribute name	Topic	Data Point Data Type	Description	Value definitions	Related MicroSCADA attribute
(all)	local_substitution_permitted	Domain	bool	Indicates whether the substitution locally in SYS600 is permitted based on user permissions	FALSE = not permitted, TRUE = permitted	Calculated
(all)	remote_substitution_permitted	Domain	bool	Indicates whether the substitution in IED connected to SYS600 is permitted based on user permissions	FALSE = not permitted, TRUE = permitted	Calculated
(all)	active	Alarm	bool	Alarm active information	FALSE = alarm inactive, TRUE = alarm active	AL
(all)	acknowledged	Alarm	bool	Alarm acknowledgement information	FALSE = Alarm unacknowledged, TRUE = alarm acknowledged Normal state for data point is active = FALSE and acknowledged = TRUE, even though the alarm was never acknowledged. When alarm is activated the active state changes to TRUE and acknowledged to FALSE. For fleeting alarms the active state is FALSE and acknowledged is FALSE.	AS, AR, RC
(all)	severity	Alarm	int	Alarm severity information	0 = no alarm, 1 = lowest severity, higher value = higher severity measurement warning limit severity 1, alarm limit severity 2 or greater	AS, AR, RC
(all)	name	Domain	string	Functional name related to the data point E.g. QA1 or Q1		last part of OI, LN
(all)	path	Domain	string	Functional structure path related to the data point E.g. AA1.C1.Q01.QA1 or Rivers.20kV.H01.Q1		OI
(all)	customer_text	Domain	string	Customer text for the data point E.g. Switch Position		TX (OX)
(all)	state	Domain	string	Value state as human readable string For example, Open		SX
Measurement	high_2_limit	Domain	float	Measurement high 2 limit value (typically high alarm)		HI
Table continues on next page						

Data point Base type	Attribute name	Topic	Data Point Data Type	Description	Value definitions	Related MicroSCADA attribute
Measurement	high_1_limit	Domain	float	Measurement high 1 limit value (typically high warning)		HW
Measurement	low_1_limit	Domain	float	Measurement low 1 limit value (typically low warning)		LW
Measurement	low_2_limit	Domain	float	Measurement low 2 limit value (typically low alarm)		LO

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