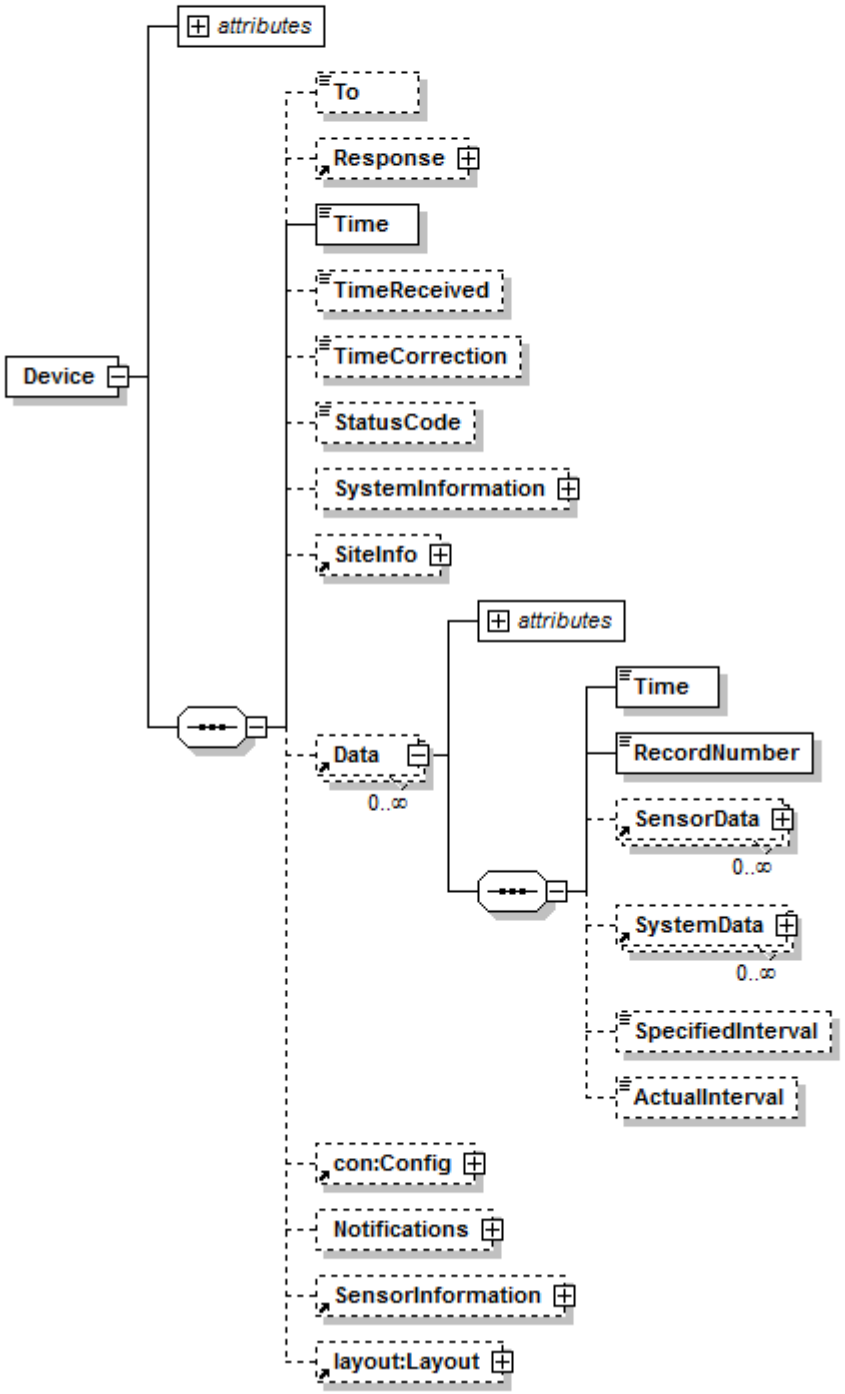
TD 267a AADI Real-Time Output Protocol



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Introduction

Purpose and scope

The purpose of this document is to describe the AADI Real-Time Output Protocol for

- The application engineer who will use this protocol to obtain and use the data transmitted from compliant AADI devices.
- The manager who needs to know the features and principles of the protocol down to the detail he or she chooses.

Related documents

TD268 AADI Real-Time Collector User's Manual

TD271 AADI Real-Time Communication

TD278 AADI Real-Time Programming Reference

CHAPTER 1 AADI Real-Time Output Protocol overview

The *AADI Real-Time Output Protocol* is used to transmit data from AADI devices in real-time.

The data messages from the device are framed to secure precise synchronisation. The frame includes a CRC16 checksum value which provides integrity control. Refer to CHAPTER 4 and CHAPTER 5 for a detailed description of the frame format.

The data is delivered as an XML formatted message. XML is a markup language designed to describe data and to focus on what data is (http://w3schools.com/xml/default.asp). XML is human readable although XML messages are generally read and interpreted by computer applications.

The precise definition of the protocol is given by the XML schema file *RTOutSchema.xsd*, which is available for download on www.aadi.no. Customers can register to get a user name and password required to gain access to manuals, technical notes and software. Please contact aadi.info@xyleminc.com for guidance.

Modern development tools such as *Microsoft Visual Studio* or *Altova XML Spy* provide several ways for quick and easy access to data in XML format using the defining schema file.

1.1 Message Types

There are three main scenarios in which data can be received from a connected device on the *AADI Real-Time Output Protocol*.

1.1.1 Non-polled data

A device can be set up to automatically transmit data recordings at regular intervals, i.e. non-polled mode. Each message contains all necessary information to identify the measured parameters and to be fully traceable down to every physical unit involved in the measurement.

The message content automatically adapts to the current configuration of the device.

1.1.2 Response to Control Messages

The *AADI Real-Time Control Protocol* may be used to remotely control supported devices. This includes starting and stopping the recorder, and changing the device configuration. Any response from the device will be formatted using the *AADI Real-Time Output Protocol*, but will usually just contain relevant return values rather than actual measurement data.

1.1.3 Notification Messages

A notification message is an asynchronous message sent by the device to notify about an event on the instrument. This notification message contains a *Notification* element, specifying the notification event, but may also contain associated measurement data, configuration or other information.

1.2 Protocol versioning

AADI reserves the right to update the protocol at any time. The current protocol version can be found in the *ProtocolVer* attribute of the root *Device* element in the schema. As of November 2011, the current protocol version is 6.0.

As a general rule, protocol updates will consist of adding new elements and attributes. Such changes should be considered non-breaking, and any custom protocol parsers should be able to handle those situations.

Breaking changes, such as the renaming or removal of existing elements, are avoided whenever possible.

The protocol version history may be found in CHAPTER 4.

CHAPTER 2 Protocol definition

The message body is a precisely defined XML structure. The primary reference must always be the XML schema file *RTOutSchema.xsd*, which is available for download on www.aadi.no.

Some of the attributes and elements in the Real-Time Output Protocol are optional; these attributes/elements are written inside dotted frames in the schema. Required attributes/elements are written inside solid line frames.

Some elements have the symbol 0..∞ attached, this indicate that the element can be absent or can occur in one or more parallel instances.

Some elements have the symbol 1..∞ attached, this indicate that the element will occur in at least one instance and possibly in several parallel instances.

The protocol definition is prepared for messages to be compiled in a full form version including optional content or as a reduced format including only the strictly required content.

A reduced format will consist of the required attributes/elements only, while the full form version also holds optional attributes and elements. Note that depending on the deployment context, not all optional attributes and elements will be present even in the full format version.

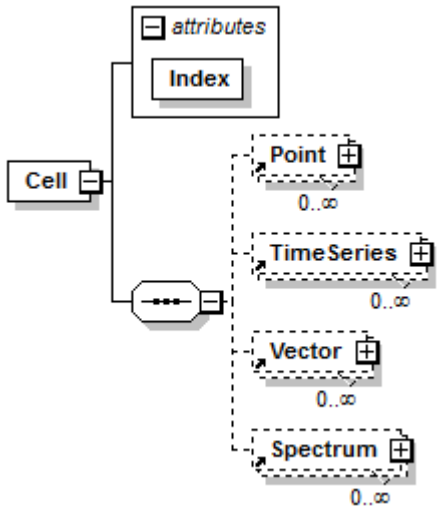
Each message starts with the standard XML declaration:

<?xml version="1.0" encoding="UTF-8"?>

This line defines the XML version (1.0) and the encoding used (UTF-8).

Elements	*Complex types*	*Simple types*
Cell	**DataNode**	**DeviceType**
CellAttributes	**Parameter**	
Column		
ConnectionInterface		
Data		
Device		
Notification		
NotificationValue		
Parameters		
Point		
Profile		
Response		
ReturnValue		
SensorData		
SensorDependency		
SensorInfo		
SensorInformation		
ServiceInfo		
SiteInfo		
Spectrum		
SystemData		
SystemInfo		
TimeSeries		
Vector		
VersionInfo		

element **Cell**

Diagram	
Properties	*content* complex
Children	**Point** **TimeSeries** **Vector** **Spectrum**
Used by	*element* **Column**

Attributes	*Name*	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
	Index	**xs:int**	required			The cell index in the current column. The index values spans from 0 to Column/NumCells – 1. Index 0 refers to the cell closest to the reference.

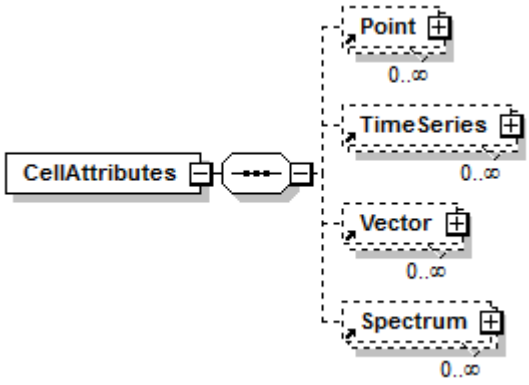
Annotation	Represents a single cell in a profiler column. Each cell contains one or more parameters. Each of these parameters are linked to the matching CellAttributes parameter by the parameter ID. The ID is the only attribute used for parameters below the Cell element.

attribute **Cell/@Index**

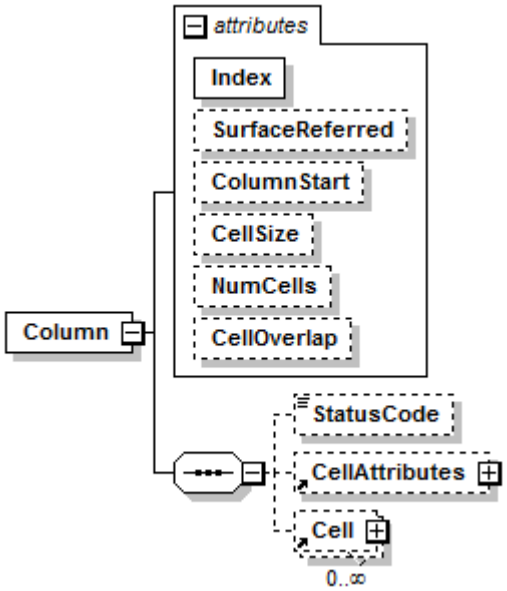
Type	**xs:int**	
Properties	*isRef*	0
	use	required

Annotation	The cell index in the current column. The index values spans from 0 to Column/NumCells – 1. Index 0 refers to the cell closest to the reference.

element **CellAttributes**

Diagram	
Properties	*content* complex
Children	**Point** **TimeSeries** **Vector** **Spectrum**
Used by	*element* **Column**
Annotation	Represents the metadata for each parameter in each cell in a profiler column.

element **Column**

Diagram	
Properties	*content* complex
Children	**StatusCode** **CellAttributes** **Cell**
Used by	*element* **Profile**

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
Index	**xs:int**	required			Column index (unique in this profile).
SurfaceReferred	**xs:boolean**	optional			Surface referred (true/false).
ColumnStart	**xs:double**	optional			Distance from reference (surface or device) in [m].
CellSize	**xs:double**	optional			Cell size in [m].
NumCells	**xs:int**	optional			Number of cells in the column.

	CellOverlap	**xs:double**	optional	Cell overlap in [%].
Annotation	Represents a profiler column, containing one or more cells.			

attribute **Column/@Index**

Type	**xs:int**	
Properties	*isRef*	0
	use	required
Annotation	Column index (unique in this profile).	

attribute **Column/@SurfaceReferred**

Type	**xs:boolean**	
Properties	*isRef*	0
	use	optional
Annotation	Surface referred (true/false).	

attribute **Column/@ColumnStart**

Type	**xs:double**	
Properties	*isRef*	0
	use	optional
Annotation	Distance from reference (surface or device) in [m].	

attribute **Column/@CellSize**

Type	**xs:double**	
Properties	*isRef*	0
	use	optional
Annotation	Cell size in [m].	

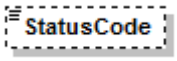
attribute **Column/@NumCells**

Type	**xs:int**	
Properties	*isRef*	0
	use	optional
Annotation	Number of cells in the column.	

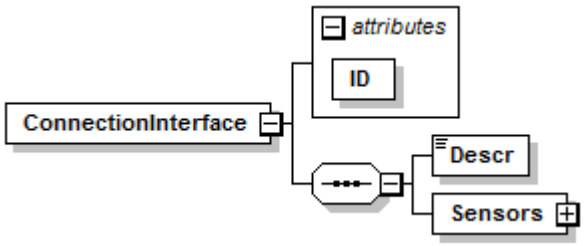
attribute **Column/@CellOverlap**

Type	**xs:double**	
Properties	*isRef*	0
	use	optional
Annotation	Cell overlap in [%].	

element **Column/StatusCode**

Diagram	
Type	**xs:int**
Properties	*isRef* 0 *minOcc* 0 *maxOcc* 1 *content* simple
Annotation	Column status code. Usually not present if everything is OK.

element **ConnectionInterface**

Diagram	
Properties	*content* complex
Children	**Descr** **Sensors**
Used by	*element* **SensorInformation/ConnectionInterfaces**
Attributes	*Name* *Type* *Use* *Default* *Fixed* *Annotation* *ID* **xs:int** required Connection interface ID.
Annotation	Represents a connection interface and the sensors that belong to it.

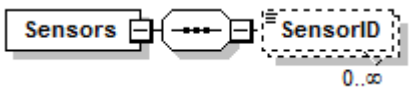
attribute **ConnectionInterface/@ID**

Type	**xs:int**
Properties	*isRef* 0 *use* required
Annotation	Connection interface ID.

element **ConnectionInterface/Descr**

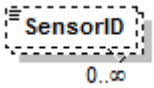
Diagram	
Type	**xs:string**
Properties	*isRef* 0 *content* simple
Annotation	Connection interface description.

element **ConnectionInterface/Sensors**

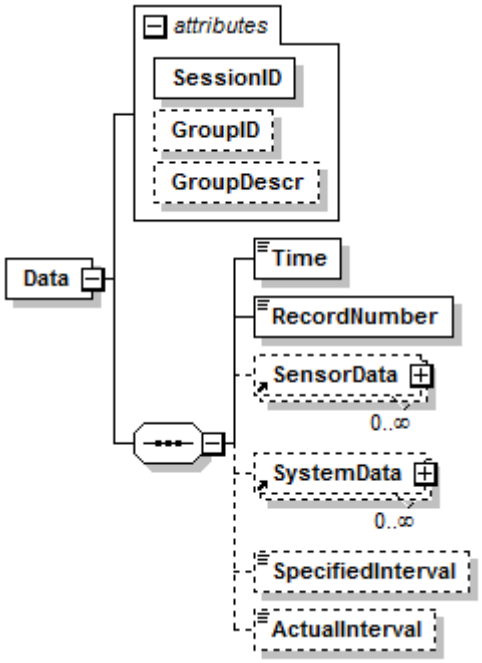
Diagram	

Properties	*isRef*	0
	content	complex
Children	**SensorID**	
Annotation	List of sensors on this connection interface.	

element **ConnectionInterface/Sensors/SensorID**

Diagram		
Type	**xs:string**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	unbounded
	content	simple
Annotation	Sensor ID.	

element **Data**

Diagram		
Properties	*content*	complex
Children	**Time** **RecordNumber** **SensorData** **SystemData** **SpecifiedInterval** **ActualInterval**	
Used by	*element*	**Device**

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
SessionID	**xs:string**	required			ID identifying a recorder session. Updated every time the recorder is restarted.
GroupID	**xs:int**				Value specifying which recording group that generated this dataset. Only relevant on devices with multi-group recorders.
GroupDescr					The name/description of the recorder group. Only relevant on devices with multi-group recorders.

Annotation	Represents a dataset with data from one or more sensors and/or system nodes.

attribute **Data/@SessionID**

Type	**xs:string**	
Properties	*isRef*	0
	use	required
Annotation	ID identifying a recorder session. Updated every time the recorder is restarted.	

attribute **Data/@GroupID**

Type	**xs:int**	
Properties	*isRef*	0
Annotation	Value specifying which recording group that generated this dataset. Only relevant on devices with multi-group recorders.	

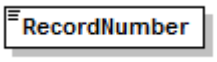
attribute **Data/@GroupDescr**

Properties	*isRef*	0
Annotation	The name/description of the recorder group. Only relevant on devices with multi-group recorders.	

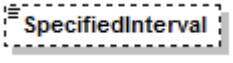
element **Data/Time**

Diagram		
Type	**xs:dateTime**	
Properties	*isRef*	0
	content	simple
Annotation	The time when the data were actually collected from the sensors. This may differ from the timestamp in the Device element.	

element **Data/RecordNumber**

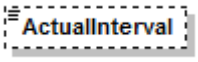
Diagram		
Type	**xs:int**	
Properties	*isRef*	0
	content	simple
Annotation	Data record number. The record number starts at 0 and increments by 1 for each new record. The upper limit is 2^31 (signed 32bit integer), at which point the sequence starts from 1 again.	

element **Data/SpecifiedInterval**

Diagram		
Type	**xs:double**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple

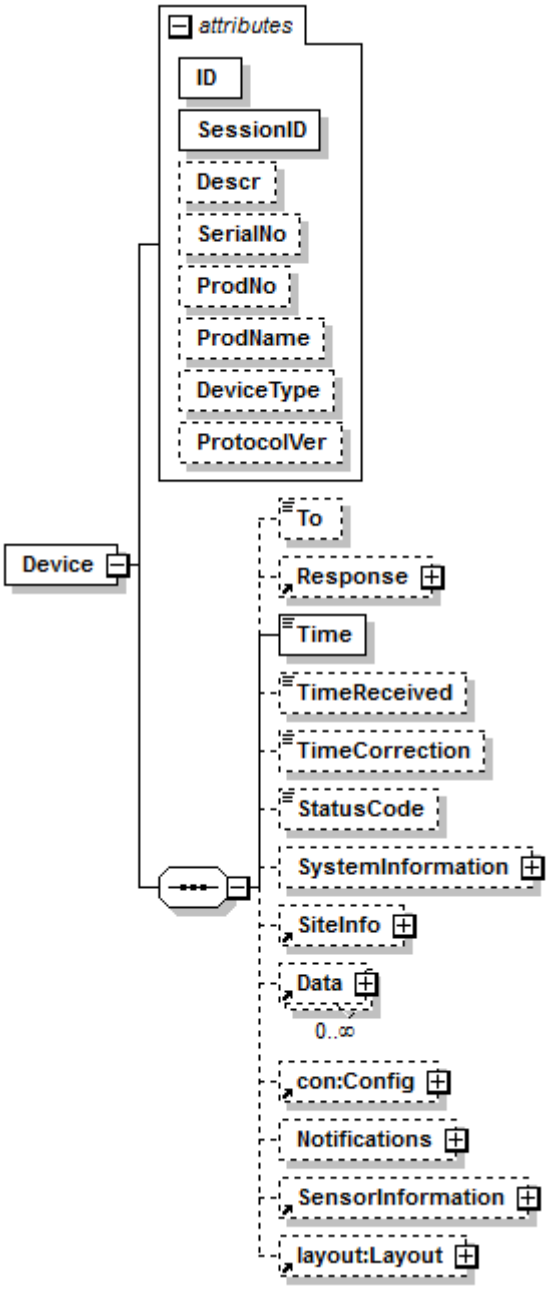
Annotation	The interval specified in the device configuration (decimal seconds). This may differ from the actual interval.

element **Data/ActualInterval**

Diagram		
Type	**xs:double**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	The actual interval since the previous recording (decimal seconds).	

element **Device**

Diagram



Properties	*content*	complex				
Children	**To Response Time TimeReceived TimeCorrection StatusCode SystemInformation SiteInfo Data Config Notifications SensorInformation Layout**					
Attributes	*Name*	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
	ID	**xs:string**	required			Globally unique device ID, usually built from the device product number and serial number.
	SessionID	**xs:string**	required			Session ID. updated when the device config changes.
	Descr	**xs:string**	optional			User-defined device description.
	SerialNo	**xs:string**	optional			Device serial number.
	ProdNo	**xs:string**	optional			Device product number.
	ProdName	**xs:string**	optional			Device product name.
	DeviceType	**DeviceType**	optional			Device type (Instrument or Sensor).
	ProtocolVer	**xs:double**	optional			Version number of the AADI Real-Time Output Protocol.
Annotation	Represents the root element in any device message.					

attribute **Device/@ID**

Type	**xs:string**	
Properties	*isRef*	0
	use	required
Annotation	Globally unique device ID, usually built from the device product number and serial number.	

attribute **Device/@SessionID**

Type	**xs:string**	
Properties	*isRef*	0
	use	required
Annotation	Session ID. updated when the device config changes.	

attribute **Device/@Descr**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	User-defined device description.	

attribute **Device/@SerialNo**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Device serial number.	

attribute **Device/@ProdNo**

Type	**xs:string**	
Properties	*isRef*	0

	use	optional
Annotation	Device product number.	

attribute **Device/@ProdName**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Device product name.	

attribute **Device/@DeviceType**

Type	**DeviceType**		
Properties	*isRef*	0	
	use	optional	
Facets	*Kind*	*Value*	*Annotation*
	enumeration	Instrument	
	enumeration	Sensor	
Annotation	Device type (Instrument or Sensor).		

attribute **Device/@ProtocolVer**

Type	**xs:double**	
Properties	*isRef*	0
	use	optional
Annotation	Version number of the AADI Real-Time Output Protocol.	

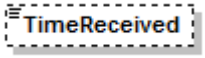
element **Device/To**

Diagram		
Type	**xs:string**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	The specific recipient of this message (if any). Typically used when the device sends a response to a control message.	

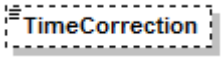
element **Device/Time**

Diagram		
Type	**xs:dateTime**	
Properties	*isRef*	0
	content	simple
Annotation	The UTC timestamp when the current message was compiled for transmission.	

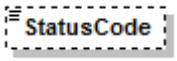
element **Device/TimeReceived**

Diagram		
Type	**xs:dateTime**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	UTC timestamp for when received by PC software such as the AADI RT Collector.	

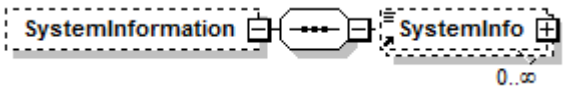
element **Device/TimeCorrection**

Diagram		
Type	**xs:double**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Accumulated time correction applied to device since last power-up (decimal seconds). Only relevant for devices that support time adjustment commands.	

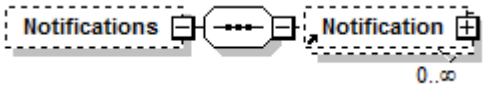
element **Device/StatusCode**

Diagram		
Type	**xs:int**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Device status code. Usually not present if everything is OK.	

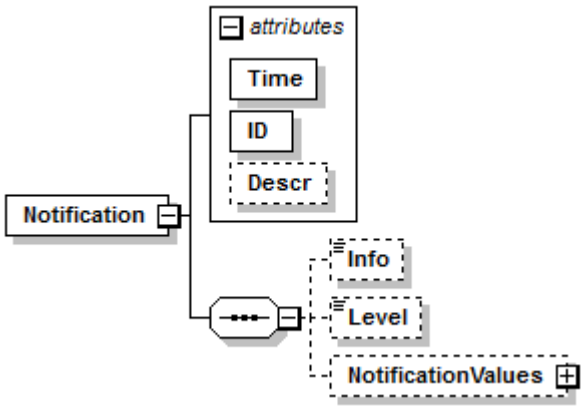
element **Device/SystemInformation**

Diagram		
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	complex
Children	**SystemInfo**	
Annotation	List of static system parameters, such as location of vertical position.	

element **Device/Notifications**

Diagram	
Properties	*isRef* 0 *minOcc* 0 *maxOcc* 1 *content* complex
Children	**Notification**
Annotation	Notifications or alarms from the device.

element **Notification**

Diagram	
Properties	*content* complex
Children	**Info** **Level** **NotificationValues**
Used by	*element* **Device/Notifications**

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
Time	**xs:dateTime**	required			Notification timestamp.
ID	**xs:int**	required			Notification ID.
Descr	**xs:string**	optional			Notification description (always same for the same ID).

Annotation	Represents a notification of some kind from the device.

attribute **Notification/@Time**

Type	**xs:dateTime**
Properties	*isRef* 0 *use* required
Annotation	Notification timestamp.

attribute **Notification/@ID**

Type	**xs:int**
Properties	*isRef* 0 *use* required
Annotation	Notification ID.

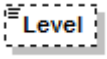
attribute **Notification/@Descr**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Notification description (always same for the same ID).	

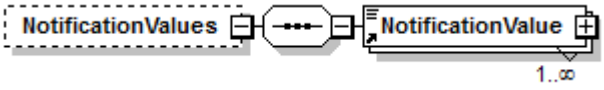
element **Notification/Info**

Diagram		
Type	**xs:string**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	A text describing this particular notification.	

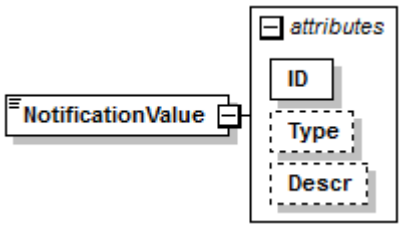
element **Notification/Level**

Diagram		
Type	**xs:int**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Notification level (0=System, 10=Information, 20=Warning, 30=Error).	

element **Notification/NotificationValues**

Diagram		
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	complex
Children	**NotificationValue**	
Annotation	List of additional notification data.	

element **NotificationValue**

Diagram	
Type	extension of **xs:string**
Properties	*content* complex
Used by	*element* **Notification/NotificationValues**

Attributes	*Name*	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
	ID	**xs:int**	required			Notification value ID.
	Type	**xs:string**	optional			Data type.
	Descr	**xs:string**	optional			Notification value description.

Annotation	Represents additional information or values in a device notification.

attribute **NotificationValue/@ID**

Type	**xs:int**
Properties	*isRef* 0 *use* required
Annotation	Notification value ID.

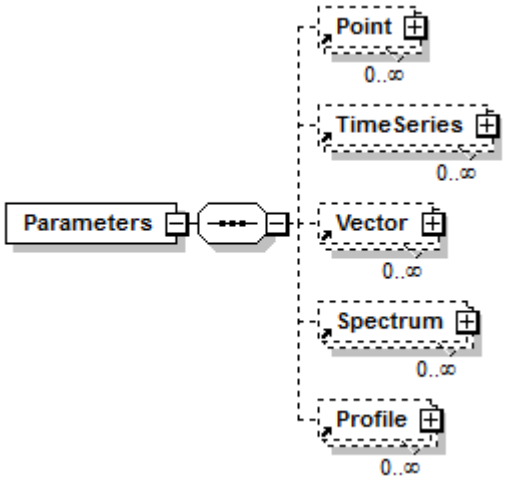
attribute **NotificationValue/@Type**

Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	Data type.

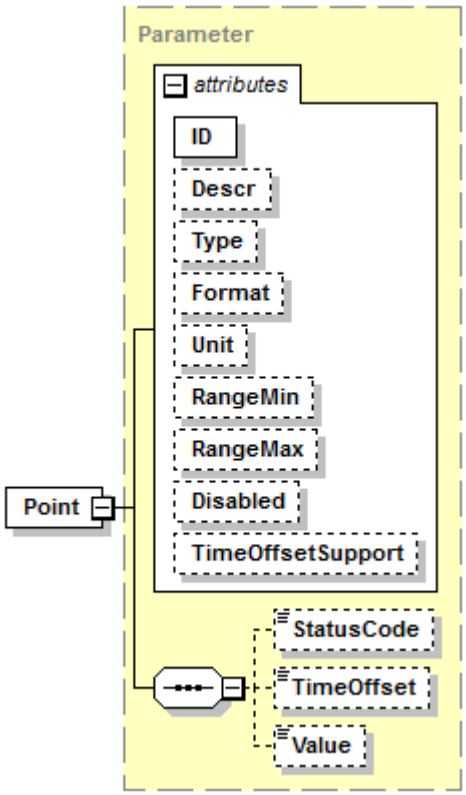
attribute **NotificationValue/@Descr**

Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	Notification value description.

element **Parameters**

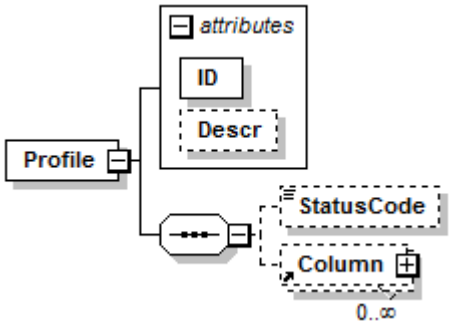
Diagram	
Properties	*content* complex
Children	**Point** **TimeSeries** **Vector** **Spectrum** **Profile**
Used by	*element* **SensorInfo** *complexType* **DataNode**
Annotation	Represents a list of measurement parameters (values).

element **Point**

Diagram	
Type	**Parameter**
Properties	*content* complex
Children	**StatusCode** **TimeOffset** **Value**
Used by	*element* **Cell** **CellAttributes** **Parameters**

Attributes	*Name*	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
	ID	**xs:string**	required			A unique ID (within the sensor) for this specific parameter.
	Descr	**xs:string**	optional			Parameter description, e.g. pressure or temperature.
	Type	**xs:string**	optional			The data type of the parameter value.
	Format	**xs:string**	optional			The number format of the parameter value.
	Unit	**xs:string**	optional			The physical unit of the parameter value, e.g. kPa or DegC.
	RangeMin	**xs:string**	optional			The minimum parameter value.
	RangeMax	**xs:string**	optional			The maximum parameter value.
	Disabled	**xs:boolean**	optional			Value indicating if the parameter is disabled (value not recorded).
	TimeOffsetSupport	**xs:boolean**	optional			Value indicating if time offset information is supported on this parameter (default is false).
Annotation	Represents a point parameter (single value measurement).					

element **Profile**

Diagram						
Properties	*content*	complex				
Children	**StatusCode** **Column**					
Used by	*element*	**Parameters**				
Attributes	*Name*	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
	ID	**xs:string**	required			A unique ID (within the sensor) for this specific parameter.
	Descr	**xs:string**	optional			Parameter description.
Annotation	Represents data from a profiler, containing one or more columns.					

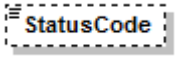
attribute **Profile/@ID**

Type	**xs:string**	
Properties	*isRef*	0
	use	required
Annotation	A unique ID (within the sensor) for this specific parameter.	

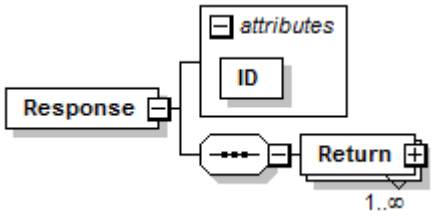
attribute **Profile/@Descr**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Parameter description.	

element **Profile/StatusCode**

Diagram		
Type	**xs:int**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Profile status code. Usually not present if everything is OK.	

element **Response**

Diagram		
Properties	*content*	complex
Children	**Return**	
Used by	*element*	**Device**

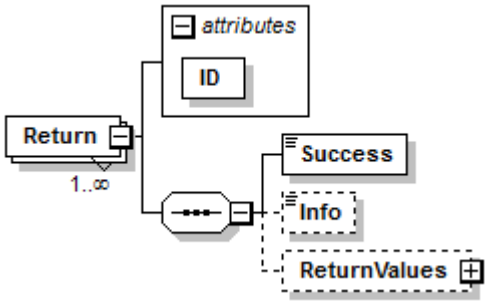
Attributes	*Name*	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
	ID	**xs:string**	required			Response message ID. Always equal to the Control message ID which triggered this response.

Annotation	Represents a response to a control message.

attribute **Response/@ID**

Type	**xs:string**	
Properties	*isRef*	0
	use	required
Annotation	Response message ID. Always equal to the Control message ID which triggered this response.	

element **Response/Return**

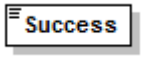
Diagram		
Properties	*isRef*	0
	minOcc	1

	maxOcc unbounded *content* complex					
Children	**Success Info ReturnValues**					
Attributes	*Name*	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
	ID	**xs:int**	required			Control command ID.
Annotation	List of responses to individual control commands in the response.					

attribute **Response/Return/@ID**

Type	**xs:int**
Properties	*isRef* 0 *use* required
Annotation	Control command ID.

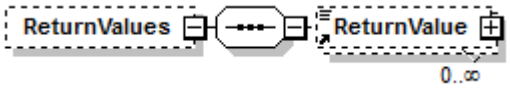
element **Response/Return/Success**

Diagram	
Type	**xs:boolean**
Properties	*isRef* 0 *content* simple
Annotation	Value indicating if the control command was successfully executed.

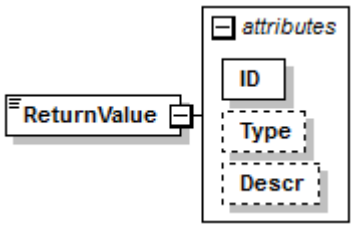
element **Response/Return/Info**

Diagram	
Type	**xs:string**
Properties	*isRef* 0 *minOcc* 0 *maxOcc* 1 *content* simple
Annotation	More info about the success status. May be empty if the command was successful.

element **Response/Return/ReturnValues**

Diagram	
Properties	*isRef* 0 *minOcc* 0 *maxOcc* 1 *content* complex
Children	**ReturnValue**
Annotation	List of return values.

element **ReturnValue**

Diagram	
Type	extension of **xs:string**
Properties	*content* complex
Used by	*element* **Response/Return/ReturnValues**

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
ID	**xs:int**	required			Return value ID.
Type	**xs:string**	optional			Data type.
Descr	**xs:string**	optional			Return value description.

Annotation	Represents a single return value in a response to a control message.

attribute **ReturnValue/@ID**

Type	**xs:int**
Properties	*isRef* 0 *use* required
Annotation	Return value ID.

attribute **ReturnValue/@Type**

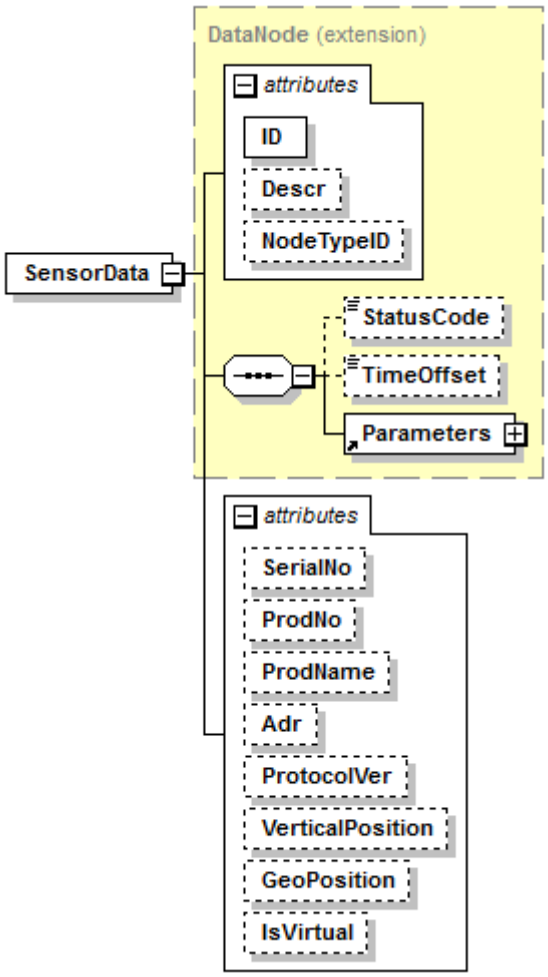
Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	Data type.

attribute **ReturnValue/@Descr**

Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	Return value description.

element **SensorData**

Diagram



Type extension of **DataNode**

Properties *content* complex

Children **StatusCode** **TimeOffset** **Parameters**

Used by *element* **Data**

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
ID	**xs:string**	required			Unique node ID. Usually built from the sensor product number and serial number.
Descr	**xs:string**	optional			Node description.
NodeTypeID	**xs:int**	optional			AADI node type (category) ID.
SerialNo	**xs:string**	optional			Sensor serial number.
ProdNo	**xs:string**	optional			Sensor product number.
ProdName	**xs:string**	optional			Sensor product name.
Adr	**xs:string**	optional			Internal AiCaP address.
ProtocolVer	**xs:double**	optional			Protocol version.
VerticalPosition	**xs:string**	optional			The deployment depth (negative value) or altitude (positive value) of this particular sensor.
GeoPosition	**xs:string**	optional			WGS-84 coordinates in Lat/Lon decimal degrees format (DD).
IsVirtual	**xs:boolean**	optional			True if the sensor is virtual, otherwise false.

Annotation Represents the data from a single sensor, i.e. one or more parameters.

attribute **SensorData/@SerialNo**

Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	Sensor serial number.

attribute **SensorData/@ProdNo**

Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	Sensor product number.

attribute **SensorData/@ProdName**

Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	Sensor product name.

attribute **SensorData/@Adr**

Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	Internal AiCaP address.

attribute **SensorData/@ProtocolVer**

Type	**xs:double**
Properties	*isRef* 0 *use* optional
Annotation	Protocol version.

attribute **SensorData/@VerticalPosition**

Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	The deployment depth (negative value) or altitude (positive value) of this particular sensor.

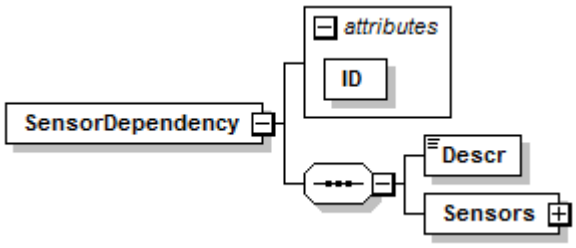
attribute **SensorData/@GeoPosition**

Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	WGS-84 coordinates in Lat/Lon decimal degrees format (DD).

attribute **SensorData/@IsVirtual**

Type	**xs:boolean**
Properties	*isRef* 0 *use* optional
Annotation	True if the sensor is virtual, otherwise false.

element **SensorDependency**

Diagram	
Properties	*content* complex
Children	**Descr** **Sensors**
Used by	*element* **SensorInformation/SensorDependencies**

Attributes	*Name*	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
	ID	**xs:int**	required			Dependency group ID.

Annotation	Represents a sensor dependency group (a group of sensors that must be in the same recorder group).

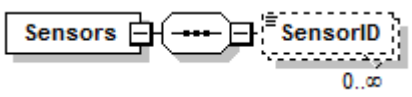
attribute **SensorDependency/@ID**

Type	**xs:int**
Properties	*isRef* 0 *use* required
Annotation	Dependency group ID.

element **SensorDependency/Descr**

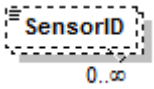
Diagram	
Type	**xs:string**
Properties	*isRef* 0 *content* simple
Annotation	Dependency group description.

element **SensorDependency/Sensors**

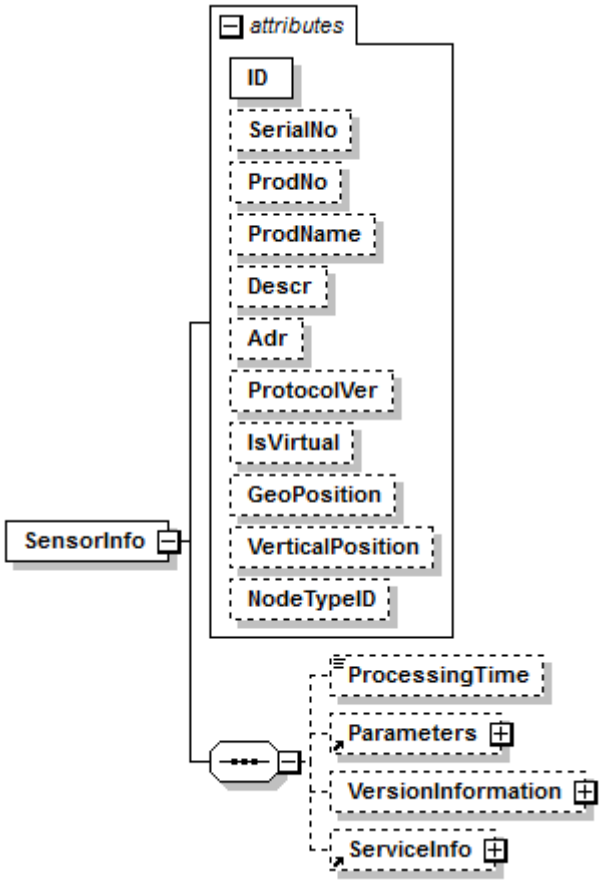
Diagram	
Properties	*isRef* 0 *content* complex
Children	**SensorID**

Annotation	List of sensors in this dependency group.

element **SensorDependency/Sensors/SensorID**

Diagram		
Type	**xs:string**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	unbounded
	content	simple
Annotation	Sensor ID.	

element **SensorInfo**

Diagram		
Properties	*content*	complex
Children	**ProcessingTime** **Parameters** **VersionInformation** **ServiceInfo**	
Used by	*element*	**SensorInformation**

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
ID	**xs:string**	required			Sensor ID.
SerialNo	**xs:string**	optional			Sensor serial number.
ProdNo	**xs:string**	optional			Sensor product number.
ProdName	**xs:string**	optional			Sensor product name.
Descr	**xs:string**	optional			Sensor description.

	Adr	**xs:string**	optional	Internal AiCaP address.
	ProtocolVer	**xs:double**	optional	Protocol version.
	IsVirtual	**xs:boolean**	optional	Value indicating if the sensor is virtual.
	GeoPosition	**xs:string**	optional	WGS-84 coordinates in Lat/Lon decimal degrees format (DD).
	VerticalPosition	**xs:string**	optional	Height (positive) or depth (negative) of sensor location.
	NodeTypeID	**xs:int**	optional	AADI node type (category) ID.
Annotation	Represents the metadata from a single sensor.			

attribute **SensorInfo/@ID**

Type	**xs:string**	
Properties	*isRef*	0
	use	required
Annotation	Sensor ID.	

attribute **SensorInfo/@SerialNo**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Sensor serial number.	

attribute **SensorInfo/@ProdNo**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Sensor product number.	

attribute **SensorInfo/@ProdName**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Sensor product name.	

attribute **SensorInfo/@Descr**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Sensor description.	

attribute **SensorInfo/@Adr**

Type	**xs:string**	
Properties	*isRef*	0

	use	optional
Annotation	Internal AiCaP address.	

attribute **SensorInfo/@ProtocolVer**

Type	**xs:double**	
Properties	*isRef*	0
	use	optional
Annotation	Protocol version.	

attribute **SensorInfo/@IsVirtual**

Type	**xs:boolean**	
Properties	*isRef*	0
	use	optional
Annotation	Value indicating if the sensor is virtual.	

attribute **SensorInfo/@GeoPosition**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	WGS-84 coordinates in Lat/Lon decimal degrees format (DD).	

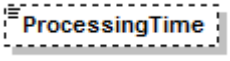
attribute **SensorInfo/@VerticalPosition**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Height (positive) or depth (negative) of sensor location.	

attribute **SensorInfo/@NodeTypeID**

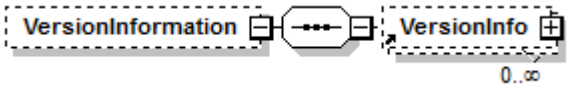
Type	**xs:int**	
Properties	*isRef*	0
	use	optional
Annotation	AADI node type (category) ID.	

element **SensorInfo/ProcessingTime**

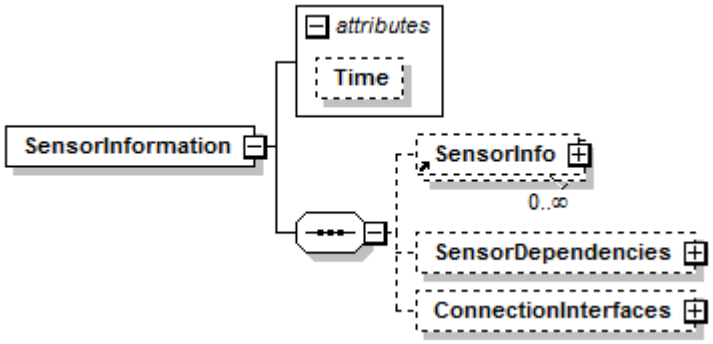
Diagram		
Type	**xs:int**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple

Annotation	Processing time in ms.

element **SensorInfo/VersionInformation**

Diagram	
Properties	*isRef* 0 *minOcc* 0 *maxOcc* 1 *content* complex
Children	**VersionInfo**
Annotation	List of version information for software and hardware components.

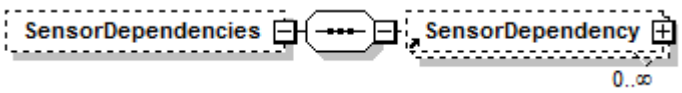
element **SensorInformation**

Diagram	
Properties	*content* complex
Children	**SensorInfo** **SensorDependencies** **ConnectionInterfaces**
Used by	*element* **Device**
Attributes	*Name* *Type* *Use* *Default* *Fixed* *Annotation* *Time* **xs:dateTime** Sensor information timestamp.
Annotation	Represents a collection of sensor metadata.

attribute **SensorInformation/@Time**

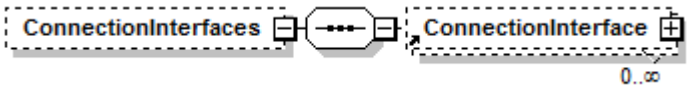
Type	**xs:dateTime**
Properties	*isRef* 0
Annotation	Sensor information timestamp.

element **SensorInformation/SensorDependencies**

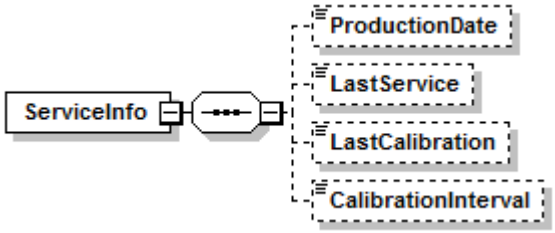
Diagram	
Properties	*isRef* 0 *minOcc* 0 *maxOcc* 1 *content* complex

Children	**SensorDependency**
Annotation	List of sensor dependency groups.

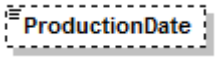
element **SensorInformation/ConnectionInterfaces**

Diagram		
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	complex
Children	**ConnectionInterface**	
Annotation	List of connection interfaces.	

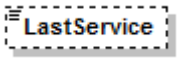
element **ServiceInfo**

Diagram		
Properties	*content*	complex
Children	**ProductionDate** **LastService** **LastCalibration** **CalibrationInterval**	
Used by	*element*	**SensorInfo**
Annotation	Represents service and calibration information for a sensor.	

element **ServiceInfo/ProductionDate**

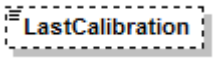
Diagram		
Type	**xs:date**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Sensor production date.	

element **ServiceInfo/LastService**

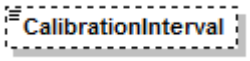
Diagram		
Type	**xs:date**	
Properties	*isRef*	0
	minOcc	0

	maxOcc	1
	content	simple
Annotation	Date of last service.	

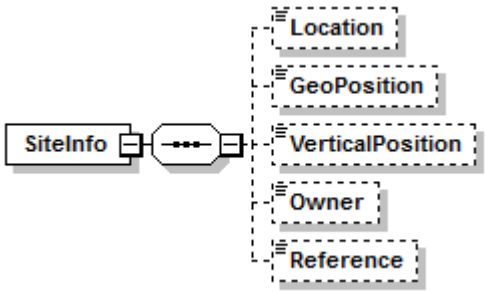
element **ServiceInfo/LastCalibration**

Diagram		
Type	**xs:date**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Date of last sensor calibration.	

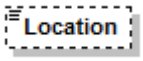
element **ServiceInfo/CalibrationInterval**

Diagram		
Type	**xs:int**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Recommended calibration interval in days.	

element **SiteInfo**

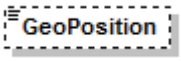
Diagram		
Properties	*content*	complex
Children	**Location GeoPosition VerticalPosition Owner Reference**	
Used by	*element*	**Device**
Annotation	OBSOLETE (replaced by the more generel SystemInfo element).	

element **SiteInfo/Location**

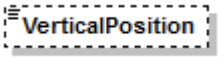
Diagram		
Type	**xs:string**	

Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	OBSOLETE	

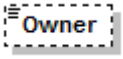
element **SiteInfo/GeoPosition**

Diagram		
Type	**xs:string**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	OBSOLETE	

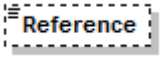
element **SiteInfo/VerticalPosition**

Diagram		
Type	**xs:double**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	OBSOLETE	

element **SiteInfo/Owner**

Diagram		
Type	**xs:string**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	OBSOLETE	

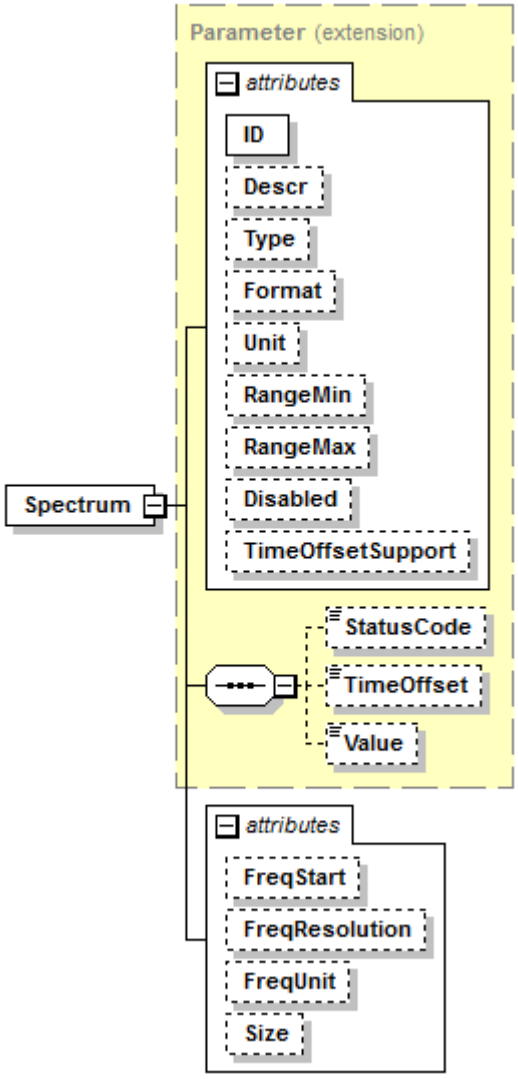
element **SiteInfo/Reference**

Diagram		
Type	**xs:string**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1

	content	simple
Annotation	OBSOLETE	

element **Spectrum**

Diagram



Type	extension of **Parameter**					
Properties	*content*	complex				
Children	**StatusCode** **TimeOffset** **Value**					
Used by	*element*	**Cell** **CellAttributes** **Parameters**				

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
ID	**xs:string**	required			A unique ID (within the sensor) for this specific parameter.
Descr	**xs:string**	optional			Parameter description, e.g. pressure or temperature.
Type	**xs:string**	optional			The data type of the parameter value.
Format	**xs:string**	optional			The number format of the parameter value.
Unit	**xs:string**	optional			The physical unit of the parameter value, e.g. kPa or DegC.
RangeMin	**xs:string**	optional			The minimum parameter value.
RangeMax	**xs:string**	optional			The maximum parameter value.
Disabled	**xs:boolean**	optional			Value indicating if the parameter is

	TimeOffsetSupport	**xs:boolean**	optional	disabled (value not recorded). Value indicating if time offset information is supported on this parameter (default is false).
	FreqStart	**xs:double**	optional	Absolute frequency of the first value in the spectrum.
	FreqResolution	**xs:double**	optional	Absolute difference in frequency between each value in the spectrum.
	FreqUnit	**xs:string**	optional	Frequency unit, e.g. Hz.
	Size	**xs:int**	optional	Number of values in the spectrum.
Annotation	Represents a spectrum parameter (multiple value spectrum measurement).			

attribute **Spectrum/@FreqStart**

Type	**xs:double**	
Properties	*isRef*	0
	use	optional
Annotation	Absolute frequency of the first value in the spectrum.	

attribute **Spectrum/@FreqResolution**

Type	**xs:double**	
Properties	*isRef*	0
	use	optional
Annotation	Absolute difference in frequency between each value in the spectrum.	

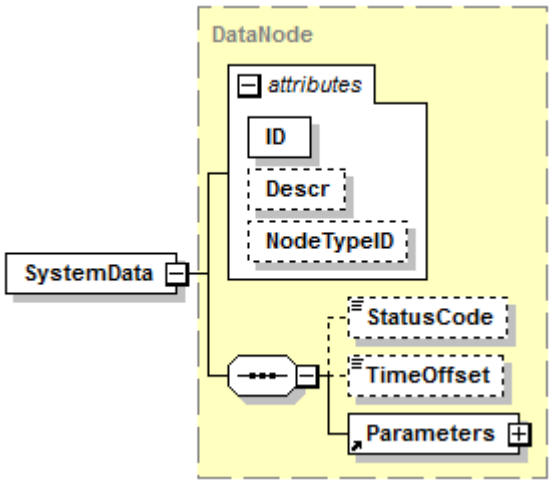
attribute **Spectrum/@FreqUnit**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Frequency unit, e.g. Hz.	

attribute **Spectrum/@Size**

Type	**xs:int**	
Properties	*isRef*	0
	use	optional
Annotation	Number of values in the spectrum.	

element **SystemData**

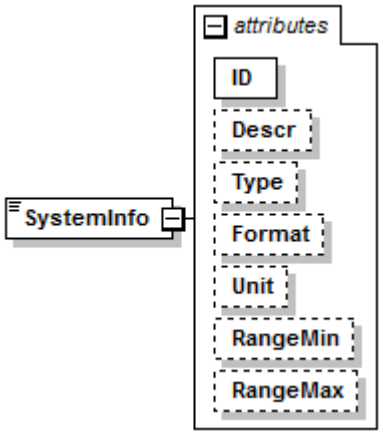
Diagram	
Type	**DataNode**
Properties	*content* complex
Children	**StatusCode** **TimeOffset** **Parameters**
Used by	*element* **Data**

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
ID	**xs:string**	required			Unique node ID. Usually built from the sensor product number and serial number.
Descr	**xs:string**	optional			Node description.
NodeTypeID	**xs:int**	optional			AADI node type (category) ID.

Annotation: Represents the data from a single system node (internal device "sensor"), i.e. one or more parameters.

element **SystemInfo**

Diagram	
Type	extension of **xs:string**
Properties	*content* complex
Used by	*element* **Device/SystemInformation**

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
ID	**xs:int**	required			System parameter ID.
Descr	**xs:string**	optional			System parameter description.
Type	**xs:string**	optional			Value data type.
Format	**xs:string**	optional			Value format.
Unit	**xs:string**	optional			Physical unit of parameter.

	RangeMin	**xs:string**	optional	Minimum valid value.
	RangeMax	**xs:string**	optional	Maximum valid value.
Annotation	Represents a static system parameter, such as deployment position or project name.			

attribute **SystemInfo/@ID**

Type	**xs:int**	
Properties	*isRef*	0
	use	required
Annotation	System parameter ID.	

attribute **SystemInfo/@Descr**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	System parameter description.	

attribute **SystemInfo/@Type**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Value data type.	

attribute **SystemInfo/@Format**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Value format.	

attribute **SystemInfo/@Unit**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Physical unit of parameter.	

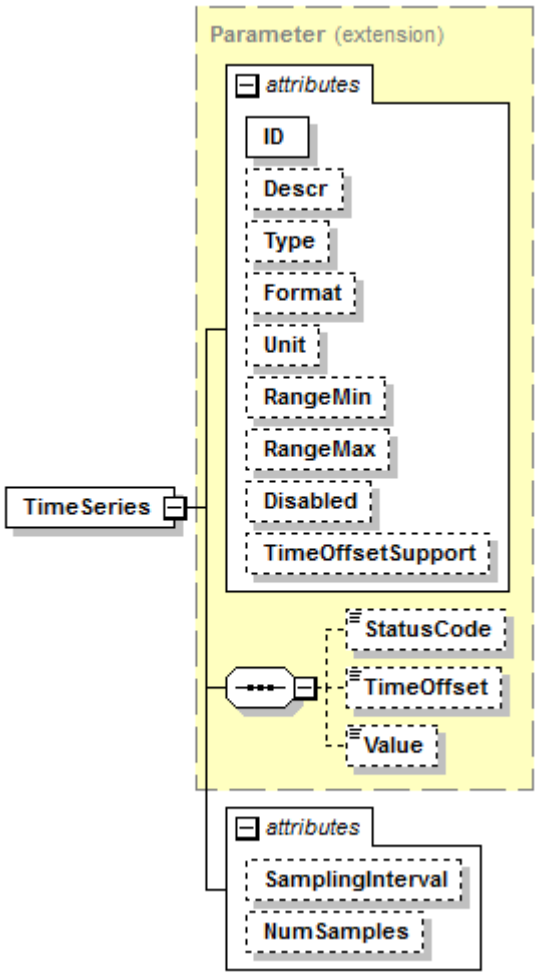
attribute **SystemInfo/@RangeMin**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Minimum valid value.	

attribute **SystemInfo/@RangeMax**

Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	Maximum valid value.

element **TimeSeries**

Diagram	
Type	extension of **Parameter**
Properties	*content* complex
Children	**StatusCode** **TimeOffset** **Value**
Used by	*element* **Cell** **CellAttributes** **Parameters**

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
ID	**xs:string**	required			A unique ID (within the sensor) for this specific parameter.
Descr	**xs:string**	optional			Parameter description, e.g. pressure or temperature.
Type	**xs:string**	optional			The data type of the parameter value.
Format	**xs:string**	optional			The number format of the parameter value.
Unit	**xs:string**	optional			The physical unit of the parameter value, e.g. kPa or DegC.
RangeMin	**xs:string**	optional			The minimum parameter value.
RangeMax	**xs:string**	optional			The maximum parameter value.
Disabled	**xs:boolean**	optional			Value indicating if the parameter is disabled (value not recorded).

	TimeOffsetSupport	**xs:boolean**	optional	Value indicating if time offset information is supported on this parameter (default is false).
	SamplingInterval	**xs:double**	optional	Sampling interval (decimal seconds).
	NumSamples	**xs:int**	optional	Number of samples in the time series.
Annotation	Represents a timeseries parameter (multiple value time series measurement).			

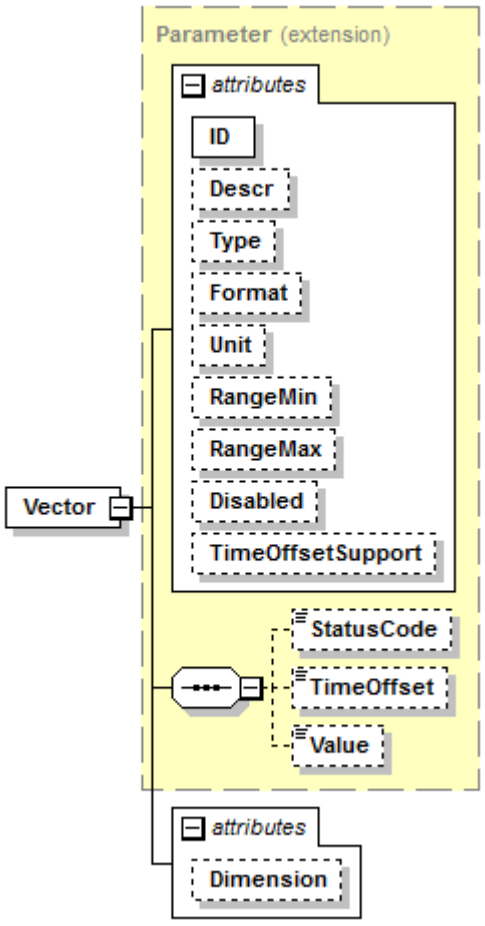
attribute **TimeSeries/@SamplingInterval**

Type	**xs:double**	
Properties	*isRef*	0
	use	optional
Annotation	Sampling interval (decimal seconds).	

attribute **TimeSeries/@NumSamples**

Type	**xs:int**	
Properties	*isRef*	0
	use	optional
Annotation	Number of samples in the time series.	

element **Vector**

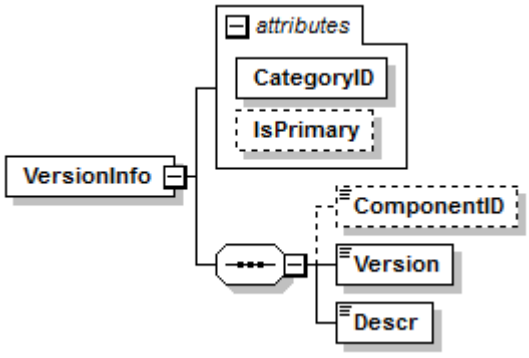
Diagram	
Type	extension of **Parameter**

Properties	*content*	complex				
Children	**StatusCode TimeOffset Value**					
Used by	*element*	**Cell CellAttributes Parameters**				
Attributes	*Name*	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
	ID	**xs:string**	required			A unique ID (within the sensor) for this specific parameter.
	Descr	**xs:string**	optional			Parameter description, e.g. pressure or temperature.
	Type	**xs:string**	optional			The data type of the parameter value.
	Format	**xs:string**	optional			The number format of the parameter value.
	Unit	**xs:string**	optional			The physical unit of the parameter value, e.g. kPa or DegC.
	RangeMin	**xs:string**	optional			The minimum parameter value.
	RangeMax	**xs:string**	optional			The maximum parameter value.
	Disabled	**xs:boolean**	optional			Value indicating if the parameter is disabled (value not recorded).
	TimeOffsetSupport	**xs:boolean**	optional			Value indicating if time offset information is supported on this parameter (default is false).
	Dimension	**xs:int**	optional			Vector dimension (number of values).
Annotation	Represents a vector parameter (multiple value vector measurement).					

attribute **Vector/@Dimension**

Type	**xs:int**	
Properties	*isRef*	0
	use	optional
Annotation	Vector dimension (number of values).	

element **VersionInfo**

Diagram		
Properties	*content*	complex
Children	**ComponentID Version Descr**	
Used by	*element*	**SensorInfo/VersionInformation**

Attributes	*Name*	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
	CategoryID	**xs:int**	required			Component category, e.g. software or hardware.
	IsPrimary	**xs:boolean**	optional			Value indicating if this is the primary version for a given category.
Annotation	Represents version information for a software of hardware component.					

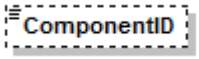
attribute **VersionInfo/@CategoryID**

Type	**xs:int**	
Properties	*isRef*	0
	use	required
Annotation	Component category, e.g. software or hardware.	

attribute **VersionInfo/@IsPrimary**

Type	**xs:boolean**	
Properties	*isRef*	0
	use	optional
Annotation	Value indicating if this is the primary version for a given category.	

element **VersionInfo/ComponentID**

Diagram		
Type	**xs:string**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Component ID.	

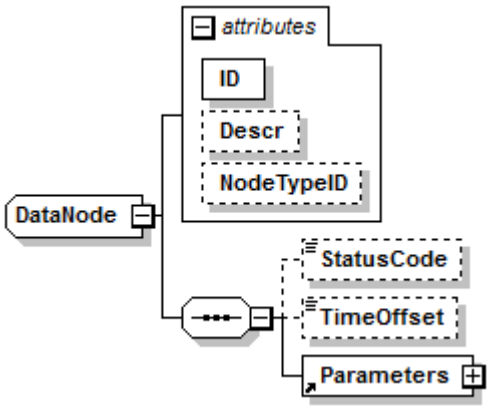
element **VersionInfo/Version**

Diagram		
Type	**xs:string**	
Properties	*isRef*	0
	content	simple
Annotation	Component version.	

element **VersionInfo/Descr**

Diagram		
Type	**xs:string**	
Properties	*isRef*	0
	content	simple
Annotation	Component description.	

complexType **DataNode**

Diagram	
Children	**StatusCode** **TimeOffset** **Parameters**
Used by	*element* **SensorData** **SystemData**

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
ID	**xs:string**	required			Unique node ID. Usually built from the sensor product number and serial number.
Descr	**xs:string**	optional			Node description.
NodeTypeID	**xs:int**	optional			AADI node type (category) ID.

Annotation: Represents the common base class for data from a single sensor or system node.

attribute **DataNode/@ID**

Type	**xs:string**
Properties	*isRef* 0 *use* required
Annotation	Unique node ID. Usually built from the sensor product number and serial number.

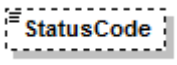
attribute **DataNode/@Descr**

Type	**xs:string**
Properties	*isRef* 0 *use* optional
Annotation	Node description.

attribute **DataNode/@NodeTypeID**

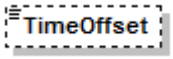
Type	**xs:int**
Properties	*isRef* 0 *use* optional
Annotation	AADI node type (category) ID.

element **DataNode/StatusCode**

Diagram	
Type	**xs:int**
Properties	*isRef* 0

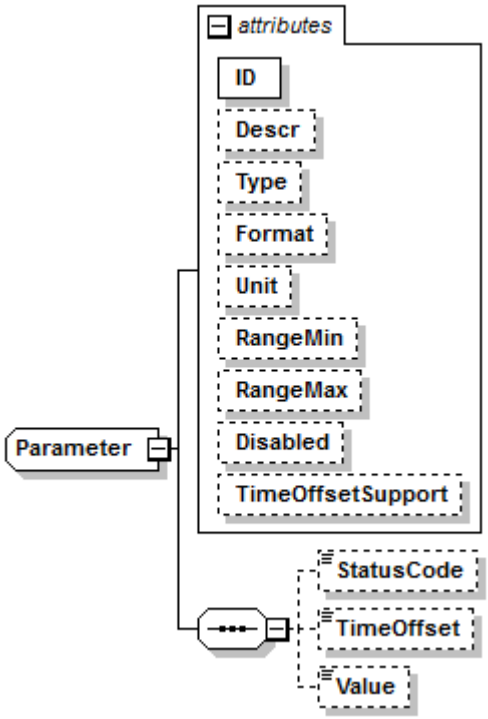
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Status code. Usually not present if everything is OK.	

element **DataNode/TimeOffset**

Diagram		
Type	**xs:double**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Time offset in relation to the data element timestamp (decimal seconds).	

complexType **Parameter**

Diagram



Children **StatusCode TimeOffset Value**

Used by *element* **Point Spectrum TimeSeries Vector**

Attributes

Name	*Type*	*Use*	*Default*	*Fixed*	*Annotation*
ID	**xs:string**	required			A unique ID (within the sensor) for this specific parameter.
Descr	**xs:string**	optional			Parameter description, e.g. pressure or temperature.
Type	**xs:string**	optional			The data type of the parameter value.
Format	**xs:string**	optional			The number format of the parameter value.
Unit	**xs:string**	optional			The physical unit of the parameter value, e.g. kPa or DegC.
RangeMin	**xs:string**	optional			The minimum parameter value.
RangeMax	**xs:string**	optional			The maximum parameter value.

	Disabled	**xs:boolean**	optional	Value indicating if the parameter is disabled (value not recorded).
	TimeOffsetSupport	**xs:boolean**	optional	Value indicating if time offset information is supported on this parameter (default is false).
Annotation	Represents the base class for all basic parameter types (Point, Vector, Spectrum and TimeSeries).			

attribute **Parameter/@ID**

Type	**xs:string**	
Properties	*isRef*	0
	use	required
Annotation	A unique ID (within the sensor) for this specific parameter.	

attribute **Parameter/@Descr**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	Parameter description, e.g. pressure or temperature.	

attribute **Parameter/@Type**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	The data type of the parameter value.	

attribute **Parameter/@Format**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	The number format of the parameter value.	

attribute **Parameter/@Unit**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	The physical unit of the parameter value, e.g. kPa or DegC.	

attribute **Parameter/@RangeMin**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	The minimum parameter value.	

attribute **Parameter/@RangeMax**

Type	**xs:string**	
Properties	*isRef*	0
	use	optional
Annotation	The maximum parameter value.	

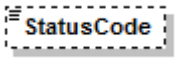
attribute **Parameter/@Disabled**

Type	**xs:boolean**	
Properties	*isRef*	0
	use	optional
Annotation	Value indicating if the parameter is disabled (value not recorded).	

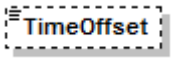
attribute **Parameter/@TimeOffsetSupport**

Type	**xs:boolean**	
Properties	*isRef*	0
	use	optional
Annotation	Value indicating if time offset information is supported on this parameter (default is false).	

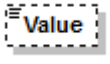
element **Parameter/StatusCode**

Diagram		
Type	**xs:int**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Parameter status code. Usually not present if everything is OK.	

element **Parameter/TimeOffset**

Diagram		
Type	**xs:double**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	Time offset in relation to the parent Data element timestamp, and possibly also the SensorData element timestamp (decimal seconds).	

element **Parameter/Value**

Diagram	

Type	**xs:string**	
Properties	*isRef*	0
	minOcc	0
	maxOcc	1
	content	simple
Annotation	The actual parameter value (measurement). The value may be missing or empty, depending on the device configuration and context.	

simpleType **DeviceType**

Type	restriction of **xs:string**		
Properties	*base*	xs:string	
Used by	**Device/@DeviceType**		
Facets	*Kind*	*Value*	*Annotation*
	enumeration	Instrument	
	enumeration	Sensor	
Annotation	Device type enumeration.		

CHAPTER 3 Frame Format

In the AADI Real-Time Protocol, a *packet* is the primary or outer envelope for the transmitted information. The packet uses ASCII characters in all fields, except the actual message which is encoded using UTF-8.

Each packet is framed by a *Start Sync* and an *End Sync*.

Start Sync tag = {{++!!

End Sync tag = !!--}}

Following the Start Sync tag is the *Packet Number* which locates each packet in the sequence of all packets transmitted from a particular device. 4 bytes are used to specify a 4 digit hexadecimal number (0000 through FFFF). Packet number 0000 is a special case, and is only used for the very first message the device transmits after a power-up. When 65 536 packets have been sent, the sequence start again from 0001 (*not* 0000).

The *Type* field denotes the type of message contained in the Message field (1 byte):

- Type 0 is reserved for low level system control messages.
- Type 1 is used for normal XML messages (*AADI Real-Time Output/Control Protocol*).
- Type 2 is used for compressed messages.
- Type 3 is used for file transfer messages.
- Type 4 is used for internal tests and calibration.

The *Message size* is the number of bytes actually contained in the *Message* field. 5 bytes for a hexadecimal number between 00001 and FFFFF allows UTF-8 messages up to 1 048 576 bytes to be transferred in one packet. A *Message size* = 0 is an error.

The *Message* field contains the message to be transferred (1 - 1 048 576 bytes), encoded using UTF-8.

The *CRC* field contains a CRC16 value spanning the *Packet No, Type, Message size* and *Message fields*. The CRC is 4 bytes and is positioned immediately before the End Sync tag.

The source code (C++ and C#) for the CRC16 algorithm is listed in the next section.

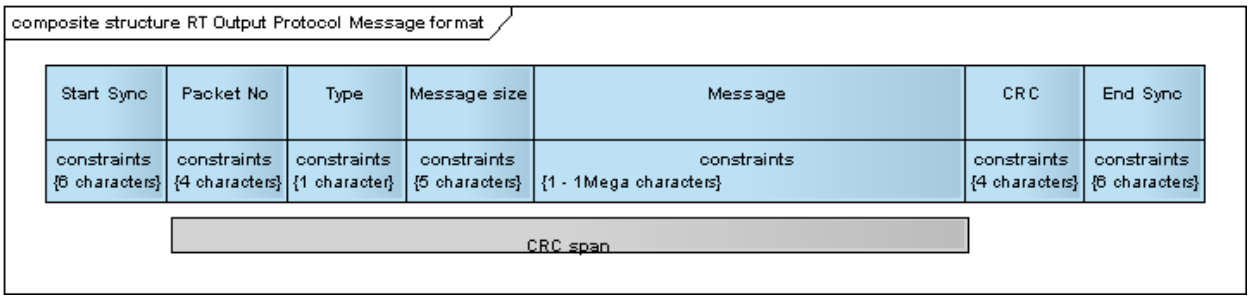


Figure 3-1 The frame format.

3.1 CRC16 Source Code

3.1.1 C++

```
unsigned short CCRC16_CCITT::GenCRC(unsigned char* pData, long lSize)
{
	unsigned short ccitt_h[] = {
	0x0000, 0x1081, 0x2102, 0x3183, 0x4204, 0x5285, 0x6306, 0x7387,
	0x8408, 0x9489, 0xa50a, 0xb58b, 0xc60c, 0xd68d, 0xe70e, 0xf78f};

	unsigned short ccitt_l[] = {
	0x0000, 0x1189, 0x2312, 0x329b, 0x4624, 0x57ad, 0x6536, 0x74bf,
	0x8c48, 0x9dc1, 0xaf5a, 0xbed3, 0xca6c, 0xdbe5, 0xe97e, 0xf8f7};

	unsigned short n, unCRC;

	unCRC = 0xFFFF;
	while(lSize-- > 0)
	{
		n = *pData++ ^ unCRC;
		unCRC = ccitt_l[n&0x0f] ^ ccitt_h[(n>>4)&0x0f] ^ (unCRC>>8);
	};

	return unCRC;
}
```

3.1.2 C# (CLS compliant)

```
int GenerateCrc(char[] buffer, int offset, int count)
{

	int[] ccitt_h = {
		0x0000, 0x1081, 0x2102, 0x3183, 0x4204, 0x5285, 0x6306, 0x7387,
		0x8408, 0x9489, 0xa50a, 0xb58b, 0xc60c, 0xd68d, 0xe70e, 0xf78f};

	int[] ccitt_l = {
		0x0000, 0x1189, 0x2312, 0x329b, 0x4624, 0x57ad, 0x6536, 0x74bf,
		0x8c48, 0x9dc1, 0xaf5a, 0xbed3, 0xca6c, 0xdbe5, 0xe97e, 0xf8f7};

	int crc = 0xFFFF;

	for (int i = offset; i < (offset + count); i++)
	{
		int n = buffer[i] ^ crc;
		crc = ccitt_l[n & 0x0f] ^ ccitt_h[(n >> 4) & 0x0f] ^ (crc >> 8);
	}

	return crc;
}
```

CHAPTER 4 Protocol version history

Changes in protocol version 6

- Added elements SpecifiedInterval and ActualInterval to the Data element.
- [Semi-breaking] Added element SystemInformation to the Device element. This renders the SiteInformation element obsolete.
- [Breaking] Removed the Status element (with code, level and description) and replaced it with element StatusCode (int). Applies to several places in the schema.
- Expanded the SensorInformation structure with various new elements and attributes. Removed some that was never in use (marked “reserved for future use”).
- Added element SystemData to the Data element.
- Extracted common base type NodeData for the SensorData and SystemData elements.
- Added attribute Descr to the Notification element.
- Added element Level to the Notification element.
- Added attribute GeoPosition to the SensorData element.
- Removed attribute Fixed from the Parameter base type (it was never in use).
- Added attribute TimeOffsetSupport to the Parameter base type.

Changes in protocol version 5

- [Breaking] In the Data element; changed the Time and RecordNumber members from attributes to elements.
- [Breaking] Changed the Status element from type string to an element containing status code, level and description.
- Added element Layout to the Device element.
- Added GroupID and GroupDescr attributes to the Data element.
- Added TimeOffset element to the SensorData and Parameter elements.
- Added TimeReceived element to the Device element.
- Added TimeCorrection element to the Device element.
- Added attribute NodeTypeID to the SensorData element.

Changes in protocol version 4

N/A

Changes in protocol version 3

N/A

Changes in protocol version 2

N/A

CHAPTER 5 Example Message (protocol version 6)

```
<?xml version="1.0" encoding="utf-8"?>
<Device ID="4430-13" ProdName="Seaguard RCM SW" ProdNo="4430" SerialNo="13" Descr="Platform" DeviceType="Instrument" SessionID="4430-13-2011-06-29T11:53:59Z"
xmlns="http://www.aadi.no/RTOutSchema" ProtocolVer="6">
	<Time>2011-06-29T11:54:16Z</Time>
	<TimeReceived>2011-06-29T11:54:16.46754Z</TimeReceived>
	<SystemInformation>
		<SystemInfo ID="13" Descr="Location" Type="VT_BSTR">Nesttun</SystemInfo>
		<SystemInfo ID="21" Descr="GeoPosition" Type="VT_BSTR">60.311048, 5.349331</SystemInfo>
		<SystemInfo ID="30" Descr="VerticalPosition" Type="VT_BSTR">24 m</SystemInfo>
	</SystemInformation>
	<Data SessionID="2011-06-29T11:54:02Z">
		<Time>2011-06-29T11:54:16Z</Time>
		<RecordNumber>3</RecordNumber>
		<SensorData ID="SN100-0" Descr="System Parameters" ProdName="System Node" ProdNo="SN100" SerialNo="0" Adr="-4" ProtocolVer="5">
			<Parameters>
				<Point ID="0" Descr="Battery Voltage" Type="VT_R4" Unit="V" RangeMin="0" RangeMax="15">
					<Value>2.142</Value>
				</Point>
				<Point ID="1" Descr="Memory Used" Type="VT_I4" Unit="Bytes" RangeMin="0" RangeMax="14213120">
					<Value>8372224</Value>
				</Point>
				<Point ID="2" Descr="Last Interval" Type="VT_I4" Unit="ms">
					<Value>4993</Value>
				</Point>
				<Point ID="3" Descr="Time Correction" Type="VT_R8" Unit="ms">
					<Value>0</Value>
				</Point>
			</Parameters>
		</SensorData>
		<SensorData ID="AN100-0" Descr="Analog Sensors" ProdName="Analog Sensors" ProdNo="AN100" SerialNo="0" Adr="-3" ProtocolVer="5">
			<StatusCode>18</StatusCode>
			<Parameters>
				<Point ID="0" Descr="Channel 1" Type="VT_R8" Unit="V" RangeMin="4" RangeMax="5">
					<StatusCode>81</StatusCode>
					<Value>-0.00146151</Value>
				</Point>
				<Point ID="1" Descr="Channel 2" Type="VT_R8" Unit="V" RangeMin="0" RangeMax="5">
					<StatusCode>81</StatusCode>
					<Value>-9.47714e-005</Value>
				</Point>
				<Point ID="2" Descr="Channel 3" Type="VT_R8" Unit="V" RangeMin="0" RangeMax="5">
```

```
                                        <Value>0.00273228</Value>
                                    </Point>
                                    <Point ID="3" Descr="Channel 4" Type="VT_R8" Unit="V" RangeMin="0" RangeMax="5">
                                        <Value>-0.000724197</Value>
                                    </Point>
                                </Parameters>
                            </SensorData>
                            <SensorData ID="4060-43" SerialNo="43" ProdNo="4060" ProdName="Temperature Sensor" Descr="Temperature Sensor" ProtocolVer="4">
                                <Parameters>
                                    <Point ID="0" Descr="Temperature" Type="VT_R4" Format="%0.3f" Unit="DegC" RangeMin="-5" RangeMax="40">
                                        <Value>19.119710</Value>
                                    </Point>
                                </Parameters>
                            </SensorData>
                            <SensorData ID="4319-62" SerialNo="62" ProdNo="4319" ProdName="Conductivity Sensor" Descr="Conductivity Sensor" ProtocolVer="4">
                                <Parameters>
                                    <Point ID="0" Descr="Conductivity" Type="VT_R4" Format="%0.3f" Unit="mS/cm" RangeMin="0" RangeMax="75">
                                        <Value>30.072829</Value>
                                    </Point>
                                    <Point ID="1" Descr="Temperature" Type="VT_R4" Format="%0.3f" Unit="Deg.C" RangeMin="-5" RangeMax="35">
                                        <Value>19.122464</Value>
                                    </Point>
                                </Parameters>
                            </SensorData>
                        </Data>
</Device>
```