RSMP Specification

Release 3.1.5

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Contents

Chapter 2

Definitions

SXL Signal exchange list. Defines which messages types (signals) which is possible to send to a specific equipment or object. E.g. alarms, statuses and commands

NTS National Traffic management system. Replaces CTS

Maximo STA's support system for maintenance

ITS site Road side equipment. Covers both field level and local level

Site See ITS site

Local road side equipment See ITS site

Supervision system Control and supervision system for regional and/or national level

Object An object is a abstract term which is used in control and supervision systems. An object can have on or more statuses that may change depending on changes of circumstance of the object or control of the object from external source. Communication with the object is made using exchange of signals, e.g. commands, status and alarms.

An object can represent physical equipment or abstract concepts E.g. a camera, a control flow alorithm or a group of signs.

An object is identified using the objects component id. *Please note that an object is not necessarily the same thing as an NTS object.*

Aggregated object An aggregated object consists of one or many other objects. E.g. Component group (CG)

Object type An object type is a classification of objects that controls the properties of all the objects of the same object type. The object type determines how the object is presented in supervision system, how it is grouped and which functional positions, alarm codes, commands and statuses that exists that object type.

NTS Object Used for objects in NTS

All control and supervision related functions in NTS consist of NTS objects.

An NTS object can represent on or many objects.

An NTS objects is identified in the communication interface using "externalNtsId". NTS can not use the format used in component-id.

An object and NTS object and use the same component-id.

NTS-Object type A NTS object type is a classification of NTS objects. Determines among other things which functional positions that are possible for the NTS object.

Component A component is a object or NTS object.

A component is identified using component-id.

Component-ID A component-id identifies components.

The format used for the STA's sites is specified in the STA publication TDOK 2012:1171, e.g. AA+BBCDD=EEEFFGGG.

XML eXtensible Markup Language

JSON JavaScript Object Notation

TCP/IP Transfer Control Protocol/Internet Protocol

W3C World Wide Web Consortium

DATEX II European standard for message exchange between traffic systems (www.datex2.eu)

RSMP Road Side Message Protocol

STA Swedish Transport Administration

RSMP Nordic Organization for maintaining and develop the RSMP protocol. Collaboration between the Swedish Transport Administration, Vejdirektoratet, Stockholms Stad and Københavns Kommune

Chapter 3

Introduction

This document presents a general protocol for communication between supervision systems and road side equipment, and direct communication between road side equipments. The aim is to offer a standardized protocol that works the same way regardless of supplier or type of road side equipment.

Chapter 4

Purpose

The purpose of this protocol is to create a standardized way to communicate between systems at the local level and systems at the regional level regardless of supplier and technology. The goal is to be able to easily add and remove signals in new facilities and applications without having to expand or change the standards and guidelines. This means that the protocol, as opposed to many other standards and protocols do not include detailed information about the signal exchange but is focused on defining the types of signals which are then described construction or items specifically. The goal is that in the long term, based on installed systems and objects, is to be able to produce signal exchange lists of type object that can be reused in new contracts so that alarm messages, commands, etc. have the same names regardless of facility or provider.

The purpose of the signal exchange is to provide information relating to, for example, traffic control managers and administrators. E.g. the information needed to monitor and control the road side equipment, as well as the information that can be used for statistics and analysis of traffic and equipment's status. For instance, alarms contains sufficient information to be able to create a work order in Maximo which is then sent to the operating contractor, ie. sufficient information about the type of skills and equipment necessary to correct the error. Additional detailed information about an alarm (e.g. which I/O card has broken, the LED chain that is out of order, etc.) can read on site via vendor-specific web interface or operator panel.

4.1 Identified requirements

In order to provide an information exchange that is not dependent of technology area or vendor specific information - four message types have been identified that cover all types of information that the Swedish Transport Administration needs. The information in each message is dynamic and is defined by technical area or specific equipment using a specific signal exchange list (SXL). The SXL also represents the interface between the supervision system / other facilities and equipment. The four message types are:

- **Alarm**. System, traffic- or monitoring alarms that require action by the traffic operator or traffic engineer. Usually sent from the equipment to the monitoring system when they occur.
- **Aggregated status**. An aggregated status that gives an overview glance of the status of the road side equipment. Usually sent from the equipment as soon as it changes to the monitoring system.
- **Status**. Status changes, indications and detailed information should be logged or made visible at the monitoring system. Sent upon request from the supervision system / other facility or using subscription (either at status change or at set time interval).
- **Command**. Commands sent from a supervision system or other facility to alter the equipment / object status or control principle.

Chapter 5

Applicability

5.1 Scope

This document is a generic protocol specification for RSMP interface that describes the protocol transfer mechanisms and function. The document is a specification that allows for many use cases within and outside the Swedish Transport Administration. The document is provided for those who need to implement a RSMP interface.

5.1.1 Responsibility

RSMP Nordic is providing this interface specification as information only. RSMP Nordic is not responsible for any consequences that implementation of the specification can lead to for the supplier or any third party.

5.2 Object model

This protocol uses the Datex II (datex2.eu) meta-model for its object model. Meta model consists of a set of rules that describe how classes and objects are defined. The reason why the Datex II meta- model has been adopted is that it will eventually provide the possibility for this protocol to become an international standard that can later be included with the object model for Datex II.

The object model is technology independent, ie can be implemented in various ways such as using **ASN.1**, **JSON** or **XML**. However, the communication between the site and supervision systems / other sites uses **JSON** format.

5.3 Transport of data

The message flow is different between different types of messages. Some message types are event driven and are sent without a request (push), while others are interaction driven, i.e. they sent in response to a request from a host system or other system (client-server).

To ensure that messages reach their destinations a message acknowledgment is sent for all messages. This gives the application a simple way to follow up on the message exchange.

To communicate between sites and supervision systems a pure TCP connection is used (TCP/IP), and the data sent is based on the JSon format, i.e. formatted text.

Messages can be sent asynchronously, i.e. while the site or supervision system is waiting for an answer to a previously sent message it can can continue to send messages. The exception in the RSMP / SXL version message (see section *RSMP/SXL Version*).

5.3.1 Security

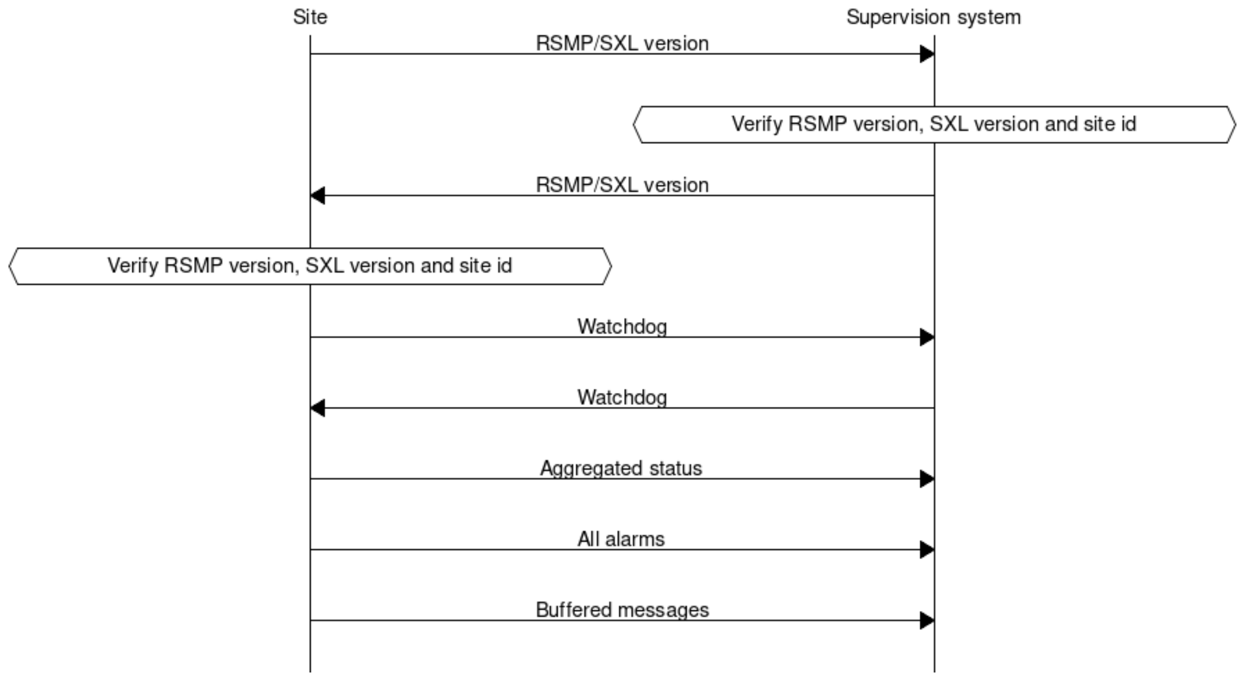
Implementing encryption is not required unless otherwise stated. However, if encryption is used than the following applies:

- Encryption settings needs to be configurable in both the supervision system as well as the site.
- For the encrypted communication, SSL 3.0/TLS 1.0 or later is used.
- Certificates should be used to verify the identities of equipments.
- Equipment which uses RSMP should contain a user interface for easy management of certificates.
- The issuing and renewal of certificates should should be made in cooperation with the purchaser unless other arrangement is agreed upon.

5.3.2 Communication establishment between sites and supervision system

When establishing communication between sites and supervision system, messages are sent in the following order.

Message acknowledgement (see section *Message acknowledgement*) is implicit in the following figure.



1. Site sends RSMP / SXL version (according to section *RSMP/SXL Version*).
2. The supervision system verifies the RSMP version, SXL version and site id. If there is a mismatch the sequence does not proceed. The system responds with a MessageNotAck and closes the connection (see section *Message acknowledgement*)
3. The supervision system sends RSMP / SXL version (according to section *RSMP/SXL Version*).

4. The site verifies the RSMP version, SXL version and site id. If there is a mismatch the sequence does not proceed. The site responds with a MessageNotAck and closes the connection. (see section *Message acknowledgement*)
5. The site sends a Watchdog (according to section *Watchdog*)
6. The system sends a Watchdog (according to section *Watchdog*)
7. Aggregated status (according to section *Aggregated status message*). If no object for aggregated status is defined in the signal exchange list then no aggregated status message is sent.
8. All alarms (incl. active, inactive, suspended, unsuspended and acknowledged) are sent. (according to section *Alarm messages*).
9. Buffered messages in the equipment's outgoing communication buffer are sent, incl. alarms, aggregated status and status updates.

The reason for sending all alarms including inactive ones is because alarms might otherwise incorrectly remain active in the supervision system if the alarm is reset and not saved in communication buffer if the equipment is restarted or replaced.

The reason for sending buffered alarms is for the supervision system to receive all historical alarm events. The buffered alarms can be distinguished from the current ones based on their older alarm timestamps. Any buffered alarm events that contains the exact same alarm event and timestamp as sent when sending all alarms should not be sent again.

Since only one version of the signal exchange list is allowed to be used at the communication establishment (according to the version message), each connected site must either:

- Use the same version of the signal exchange list via the same RSMP connection
- Connect to separate supervision systems (e.g. using separate ports)
- Connect to a supervision system that can handle separate signal exchange lists depending on the RSMP / SXL version message from the site

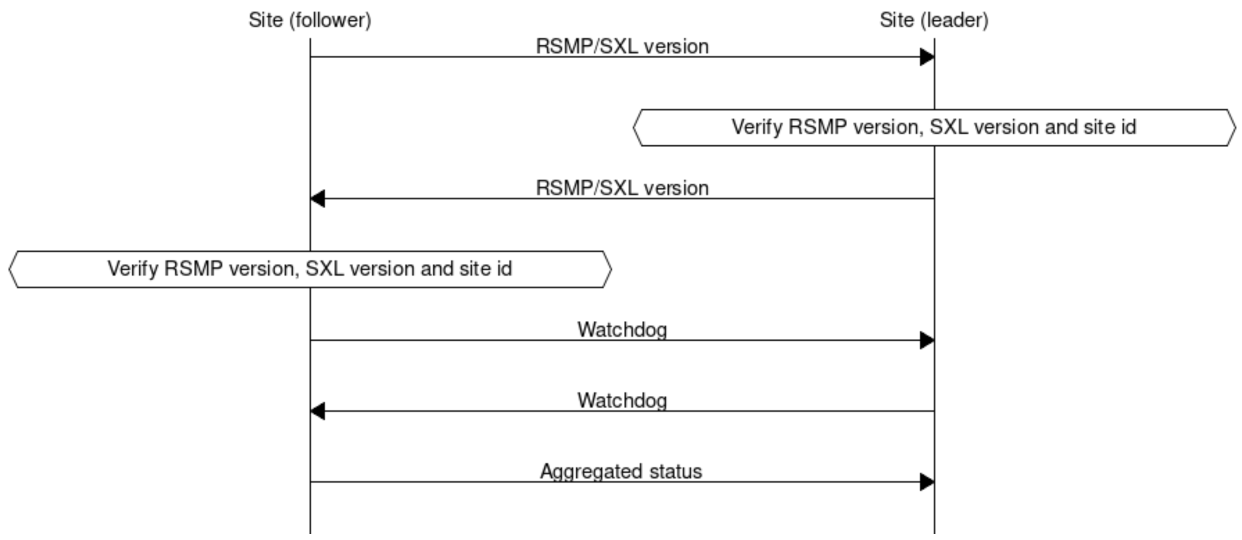
5.3.3 Communication establishment between sites

Implementing support for communication between sites is not required unless otherwise stated. However, if communication between sites is used than the following applies.

One site acts as a leader and the other one as a follower.

When establishing communication between sites, messages are sent in the following order.

Message acknowledgement (see section *Message acknowledgement*) is implicit in the following figure.



1. The follower site sends RSMP / SXL version (according to section *RSMP/SXL Version*).
2. The leader site verifies the RSMP version, SXL version and site id. If there is a mismatch the sequence does not proceed. The leader site responds with a MessageNotAck and closes the connection. (see section *Message acknowledgement*)
3. The leader site sends RSMP / SXL version (according to section *RSMP/SXL Version*).
4. The follower site verifies the RSMP version, SXL version and site id. If there is a mismatch the sequence does not proceed. The follower site responds with a MessageNotAck and closes the connection. (see section *Message acknowledgement*)
5. The follower site sends Watchdog (according to section *Watchdog*)
6. The leader site sends Watchdog (according to section *Watchdog*)
7. Aggregated status (according to section *Aggregated status message*) If no object for aggregated status is defined in the signal exchange list then no aggregated status message is sent.

For communication between sites the following applies:

- The SXL used is the SXL of the follower site
- The site id (siteId) which is sent in RSMP / SXL version is the follower site's site id
- If the site id does not match with the expected site id the connection should be terminated. The purpose is to reduce the risk of establishing connection with the wrong site
- The component id which is used in all messages is the follower site's component id
- Watchdog messages does not adjust the clock
- Alarm messages are not sent
- No communication buffer exist

5.3.4 Communication disruption

In the event of an communication disruption the following principles applies:

- If the equipment supports buffering of status messages, the status subscriptions remains active regardless of communication disruption and the status updates are stored in the equipment's outgoing communication buffer.

- Active subscriptions to status messages which does does not support buffering ceases if the communication disruption occurs.
- Once communication is restored all the buffered messages are sent according to the communication establishment sequence.
- The communication buffer is stored and sent using the FIFO principle.
- In the event of communications failure or power outage the contens of the outgoing communication buffer must not be lost.
- The internal communication buffer of the device must at a minimum be sized to be able to store 10000 messages.

The following message types should be buffered in the equipment's outgoing communication buffer in the event of an communication disruption.

Message type	Buffered during communication outage
Alarm messages	Yes
Aggregated status	Yes
Status messages	Configurable
Command messages	No
Version messages	No
Watchdog messages	No
MessageAck	No

Table 5.1: Message types that should be buffered

The following configuration options should exist at the site:

- It should be possible configure which status messages that will be buffered during communication outage
- The site should try to reconnect to the supervision system/other site during communications failure (yes/no). This configuration option should be activated by default unless anything else is agreed upon.
- The reconnect interval should be configurable. The default value should be 10 seconds.

5.3.5 Wrapping of packets

Both Json and XML packets can be tricky to decode unless one always know that the packet is complete. Json lacks an end tag and an XML end tag may be embedded in the text source. In order to reliably detect the end of a packet one must therefore make an own parser of perform tricks in the code, which is not very good.

Both Json and XML could contain tab characters (0x09), CR (0x0d) and LF (0x0a). If the packets are serialized using .NET those special characters does not exist. Therefore it is a good practice to use formfeed (0x0c), e.g. 'f' in C/C++/C#. Formfeed won't be embedded in in the packets so the parser only needs to search the incoming buffer for 0x0c and deal with every packet.

Example of wrapping of a packet:

```
{
    "mType": "rSMsg",
    "type": "Alarm",
    "mId": "d2e9a9a1-a082-44f5-b4e0-6c9233-a204c",
```

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```
     "ntsOId": "AB+81102=881WA001",
     "xNId": "23055",
     "cId": "AB+81102=881WA001",
     "aCId": "A001",
     "xACId": "Lamp error #14",
     "xNACId": "3052",
     "aSp": "acknowledge",
     "ack": "Acknowledged",
     "aS": "active",
     "sS", "notSuspended",
     "aTs": "2009-10-02T14:34:34.345Z",
     "cat": "D",
     "pri": "2",
     "rvs": [
      {
          "n": "color",
          "v": "red"
      }]
 }<0x0c>
```

JSon code 1: An RSMP message with wrapping

The characters between <> is the bytes binary content in hex (ASCII code), ex <0x0c> is ASCII code 12, e.g. FF (formfeed).

The following principles applies:

- All packets must be ended with a FF (formeed). This includes message acknowledgement (see section *Message acknowledgement*). For example if NotAck is used as a consequence for signal exchange list mismatch during communication establishment
- Several consecutive FF (formeed) must not be sent, but must be handled
- FF (formeed) in the beginning of the data exchange (after connection establishment) must not be sent, but must be handled

5.3.6 Transport between site and supervision system

Supervision system acts a socket server and waits for the site to connect. If the communication were to fail it is the site's responsibility to reconnect.

5.3.7 Transport between sites

One site acts as leader and the other one as a follower.

- The leader site initiates the connection to the following site.
- The follower sites implements a socket server and waits for the leader site to connect.
- If the communication were to fail it is the follower site's responsibility to reconnect.

5.4 Basic structure

Unicode (ISO 10646) and UTF-8 are used for all messages. Please note that the JSon elements are formatted as JSon string elements and not as JSon number elements or as JSon boolean elements, with the exception of the message type “aggregated status” and “status subscribe” where JSon boolean elements are used.

The reason why JSon string elements are heavily used is to simplify deserialisation of values where the data type in unknown before casting is performed, for instance for the values in “return values”. Parsing is recommended to be performed case insensitive.

Empty values are sent as **“”** for simple values and as [] for arrays. Optional values can be omitted, but can not be sent as **null** unless otherwise stated.

In the following example the message type is an alarm message.

```
{
    "mType": "rSMsg",
    "type": "Alarm",
    "mId": "E68A0010-C336-41ac-BD58-5C80A72C7092",
    "ntsOId": "F+40100=416CG100",
    "xNId": "23055",
    "cId": "AB+84001=860SG001",
    "aCId": "A0001",
    "xACId": "Serious lamp error",
    "xNACId": "3143",
    "aSp": "Issue",
    "ack": "notAcknowledged",
    "aS": "Active",
    "sS": "notSuspended",
    "aTs": "2009-10-01T11:59:31.571Z",
    "cat": "D",
    "pri": "2",
    "rvs": [
        {
            "n": "color",
            "v": "red"
        }
    ]
}
```

JSon code 2: An RSMP message

The following table is describing the variable content of all message types.

Element	Value	Description
mType	rSMsg	RSMP identifier
type	Alarm	Alarm message
	AggregatedStatus	Aggregated status message
	StatusRequest	Status message. Request status
	StatusResponse	Status message. Status response
	StatusSubscribe	Status message. Start subscription
	StatusUpdate	Status message. Update of status
	StatusUnsubscribe	Status message. End subscription
	CommandRequest	Command message. Request command
	CommandResponse	Command message. Response of command
	MessageAck	Message acknowledegment. Successful
	MessageNotAck	Message acknowledegment. Unsuccessful
	Version	RSMP / SXL version message
	Watchdog	Watchdog message
mId *(or)* oMId	*(GUID)*	Message identity. Generated as a GUID (Globally unique identifier) in the equipment that sent the message. Only version 4 of Leach-Salz UUID is used. • **mId** is used i all messages as a reference for the message ack • **oMId** is used in the message ack to refer to the message which is being acked

Table 5.2: Variable content

The following table describes the variable content in all message types which is defined by the signal exchange list (SXL), except version messages, message acknowledgement messages and watchdog messages.

The *SXL element* column describes the correlation between the JSon elements and the titles in the SXL.

Element	SXL element	Description
ntsOId	NTSObjectId	Component id for the NTS object which the message is referring to.
xNId	externalNtsId	Identity for the NTS object in communcation between NTS and other systems. The format is 5 integers. Defined in cooperation with representatives from NTS. Unique for the site.
cId	componentId	Component id for the object which the message is referring to.

Table 5.3: Variable content defined by SXL

5.4.1 Alarm messages

An alarm message is sent to the supervision system when:

- An alarm becomes active / inactive
- An alarm is requested
- An alarm is acknowledged
- An alarm is being suspended / un-suspended

An acknowledgment of an alarm does not cause a single alarm event to be acknowledged but all alarm events for the specific object with the associated alarm code id. This approach simplifies both in implementation but also in handling - if many alarms occur on the same equipment with short time intervals.

The ability to request an alarms is used in case the supervision system looses track of the latest state of the alarms.

A suspend of an alarm causes all alarms from the specific object with the associated alarm code id to be suspended. This means that alarm messages stops being sent from the site as long as the suspension is active. As soon as the suspension is inactivated alarms can be sent again.

Suspending alarms does not affect alarm acknowledgment. This means that when unsuspending an alarm an alarm can be inactive and not acknowledged.

Alarm messages are event driven and sent to the supervision system when the alarm occurs. Acknowledgement of alarms and alarm suspend messages are interaction driven.

Alarm events are referring to 'active' (aSp:Issue), 'suspended' (aSp:Suspend) and 'acknowledged' (aSp:Acknowledged).

The timestamp (aTs) reflects the individual event according to the element 'aSp'.

Message structure

Structure for an alarm message

An alarm message has the structure according to the example below.

```json
{
    "mType": "rSMsg",
    "type": "Alarm",
    "mId": "E68A0010-C336-41ac-BD58-5C80A72C7092",
    "ntsOId": "F+40100=416CG100",
    "xNId": "23055",
    "cId": "AB+84001=860SG001",
    "aCId": "A0001",
    "xACId": "Serious lamp error",
    "xNACId": "3143",
    "aSp": "Issue",
    "ack": "notAcknowledged",
    "aS": "Active",
    "sS": "notSuspended",
    "aTs": "2009-10-01T11:59:31.571Z",
    "cat": "D",
    "pri": "2",
    "rvs": [
        {
            "n": "color",
            "v": "red"
        }
    ]
}
```

JSon code 3: An alarm message

The following table describes the variable content of the message which is defined by the SXL.

The *SXL element* column describes the correlation between the JSon elements and the titles in the signal exchange list (SXL).

Element	SXL element	Description
aCId	alarmCodeId	Alarm suffix with in combination with the component id identifies an alarm. The examples in this document are defined according to the following format: *Ayyyy*, where *yyyy* is a unique number.
xACId	externalAlarmCodeId	Manufacturer specific alarm code and alarm description. Manufacturer, model, alarm code och additional alarm description.
xNACId	externalNtsAlarmCodeId	Alarm code in order to identify alarm type during communication with NTS

Table 5.4: Alarm message

The following table describes additional variable content of the message.

Element	Value	Origin	Description
aSp	Issue	Site	An alarm becomes active/inactive.
	Request	Supervision system	Request the current state of an alarm
	Acknowledge	Supervision system	Acknowledge an alarm
		Site	An alarm becomes acknowledged.
	Suspend	Supervision system	Suspend an alarm
		Site	An alarm becomes suspended/unsuspended
	Resume	Supervision system	Unsuspend an alarm

Table 5.5: Alarm status change

Alarm status

Alarm status are only used by alarm messages (not by alarm acknowledgement or alarm suspend messages).

Element	Value	Description
ack	Acknowledged	The alarm is acknowledged
	notAcknowledged	The alarm is not acknowledged
aS	inActive	The alarm is inactive
	Active	The alarm is active
sS	suspended	The alarm is suspended
	notSuspended	The alarm is not suspended
aTs	*(timestamp)*	Timestamp for when the alarm changes status. See the contents of aSp to determine which type of timetamp is used - aSp: Issue: Timestamp for when the alarm gets **active** or **inactive** - aSp: Acknowledge: Timestamp for when the alarm gets **acknowledged** or **not acknowledged** - aSp: Suspend: Timestamp for when the alarm gets **suspended** or **not suspended** The timestamp uses the W3C XML **dateTime** definition with 3 decimal places. All timestamps are set at the local level (and not in the supervision system) when the alarm occurs (and not when the message is sent). All timestamps uses UTC.

Table 5.6: Alarm status

Fig. 5.1 show possible transitions between different alarm states.

Continuous lines defines possible alarm status changes controlled by logic and dashed lines defines possible changes controlled by user.

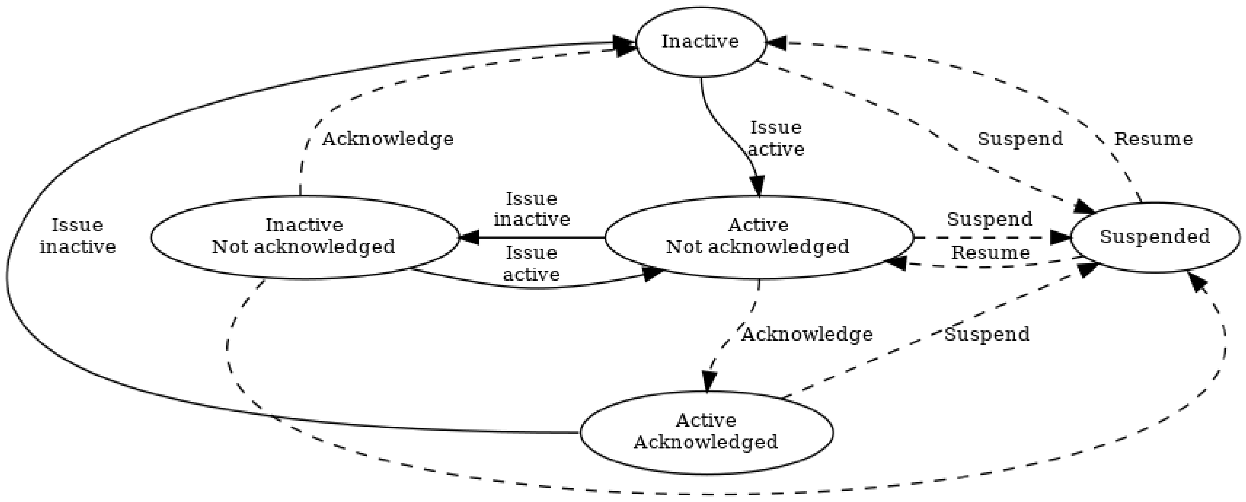

Fig. 5.1: Alarm transitions

Alarms should not be sent unless:

- Alarms are unblocked and it's state changes
- Alarms are sent as part of *Communication establishment between sites and supervision system*
- Alarms are explicitly requested using *Structure for alarm request message*

The following table describes the variable content of the message which is defined by the SXL.

The *SXL element* column describes the correlation between the JSon elements and the titles in the signal exchange list (SXL).

Element	SXL element	Description
cat	category	A character, either **T** or **D**. An alarm belongs to one of these categories: - T. Traffic alarm - D. Technical alarm **Traffic alarm:** Traffic alarms indicate events in the traffic related functions or the technical processes that effects traffic. A couple of examples from a tunnel: - Stopped vehicle - Fire alarm - Error which affects message to motorists - High level of CO_2 in traffic room - Etc. **Technical alarm:** Technical alarms are alarms that do not directly affect the traffic. One example of a technical alarm is when an impulse fan stops working.
(not sent)	description	Description of the alarm. Defined in SXL but is never actually sent. The format of the description is free of choice but has the following requirements: • The text is unique for the object type • The text is defined in cooperation with the Purchaser before use
pri	priority	The priority of the alarm. The following values are defined: 1. Alarm that requires immediate action. 2. Alarm that does not require immediate action, but action is planned during the next work shift. 3. Alarm that will be corrected during the next planned maintenance shift.

Table 5.7: Alarm status details defined by SXL

Return values

Return values ("rvs") are used by alarm messages (but not by alarm acknowledgment or alarm suspend messages) and is always sent but can be empty (i.e. []) if no return values are defined.

Element	Value	Description
rvs	*(array)*	Return values. Contains the element **n** and **v** in an array

Table 5.8: Alarm return values

The following table describes the content for each return value which is defined by the signal exchange list (SXL).

The *SXL element* column describes the correlation between the JSon elements and the titles in the SXL.

Element	SXL element	Description
n	name	Unique reference of the value
(not sent)	type	The data type of the value. Defined in the SXL but is not actually sent General definition: **string**: Text information **integer**: Numerical value (16-bit signed integer), [-32768 – 32767] **long**: Numerical value (32-bit signed long) **real**: Float (64-bit double precision floating point) **boolean**: Boolean data type **base64**: Binary data expressed in base64 format according to RFC-4648 Point (“.”) is always used as decimal mark
v	value	Value from equipment

Table 5.9: Alarm return value defined by SXL

Structure for alarm request message

An alarm request message has the structure according to the example below.

```
{
    "mType": "rSMsg",
    "type": "Alarm",
    "mId": "3d2a0097-f91c-4249-956b-dac702545b8f",
    "ntsOId": "",
    "xNId": "",
    "cId": "AB+84001=860VA001",
    "aCId": "A0004",
    "xACId": "",
    "xNACId": "",
    "aSp": "Request"
}
```

JSon code 4: An alarm request message

Structure for alarm acknowledgement message

An alarm acknowledgement message has the structure according to the example below.

```
{
    "mType": "rSMsg",
    "type": "Alarm",
    "mId": "3d2a0097-f91c-4249-956b-dac702545b8f",
```

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```
    "ntsOId": "",
    "xNId": "",
    "cId": "AB+84001=860VA001",
    "aCId": "A0004",
    "xACId": "",
    "xNACId": "",
    "aSp": "Acknowledge"
}
```

JSon code 5: An alarm acknowledgement message which acknowledges an alarm

An alarm acknowledgement response message has the structure according to the example below.

```
{
    "mType": "rSMsg",
    "type": "Alarm",
    "mId": "f6843ac0-40a0-424e-8ddf-d109f4cfe487",
    "ntsOId": "",
    "xNId": "",
    "cId": "AB+84001=860VA001",
    "aCId": "A0004",
    "xACId": "",
    "xNACId": "",
    "aSp": "Acknowledge",
    "ack": "Acknowledged",
    "aS": "Active",
    "sS": "notSuspended",
    "aTs": "2015-05-29T08:55:04.691Z",
    "cat": "D",
    "pri": "3",
    "rvs": [
        {
            "n": "Temp",
            "v": "-18.5"
        }
    ]
}
```

JSon code 6: Response of an alarm acknowledgement message

Structure for alarm suspend message

An alarm suspend message has the structure according to the example below.

```
{
    "mType": "rSMsg",
    "type": "Alarm",
    "mId": "b6579d6d-3a9d-4169-b777-f094946a863e",
    "ntsOId": "",
    "xNId": "",
    "cId": "AB+84001=860VA001",
    "aCId": "A0004",
    "xACId": "",
    "xNACId": "",
    "aSp": "Suspend"
}
```

JSon code 7: Suspending an alarm using an alarm suspend message

```
{
     "mType": "rSMsg",
     "type": "Alarm",
     "mId": "2ea7edfc-8e3a-4765-85e7-db844c4702a0",
     "ntsOId": "",
     "xNId": "",
     "cId": "AB+84001=860VA001",
     "aCId": "A0004",
     "xACId": "",
     "xNACId": "",
     "aSp": "Suspend",
     "ack": "Acknowledged",
     "aS": "Active",
     "sS": "Suspended",
     "aTs": "2015-05-29T08:56:25.390Z",
     "cat": "D",
     "pri": "3",
     "rvs": [
         {
             "n": "Temp",
             "v": "-18.5"
         }
     ]
}
```

JSon code 8: Response of alarm suspend message

```
{
     "mType": "rSMsg",
     "type": "Alarm",
     "mId": "2a744145-403a-423f-ba80-f38e283a778e",
     "ntsOId": "",
     "xNId": "",
     "cId": "AB+84001=860VA001",
     "aCId": "A0004",
     "xACId": "",
     "xNACId": "",
     "aSp": "Resume"
}
```

JSon code 9: Resuming an alarm using an alarm suspend message

```
{
     "mType": "rSMsg",
     "type": "Alarm",
     "mId": "3313526e-b744-434a-b4dd-0cfa956512e0",
     "ntsOId": "",
     "xNId": "",
     "cId": "AB+84001=860VA001",
     "aCId": "A0004",
     "xACId": "",
     "xNACId": "",
     "aSp": "Suspend",
     "ack": "Acknowledged",
     "aS": "Active",
     "sS": "notSuspended",
```

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```
    "aTs": "2015-05-29T08:58:28.166Z",
    "cat": "D",
    "pri": "3",
    "rvs": [
        {
            "n": "Temp",
            "v": "-18.5"
        }
    ]
}
```

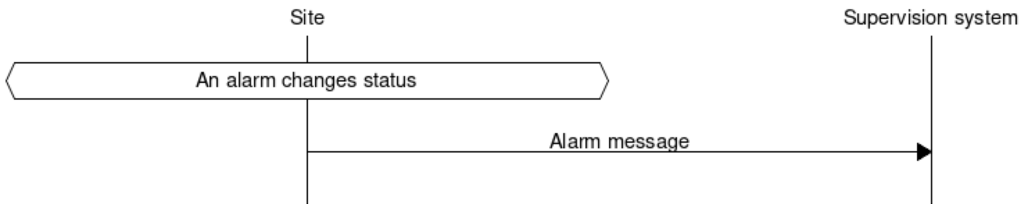
JSon code 10: Response of a resume message

Allowed content in alarm suspend message is the same as for alarm messages (See *Structure for an alarm message*) with the exception for alarm status (See *Alarm status*) and (See *Return values*).

Message exchange between site and supervision system

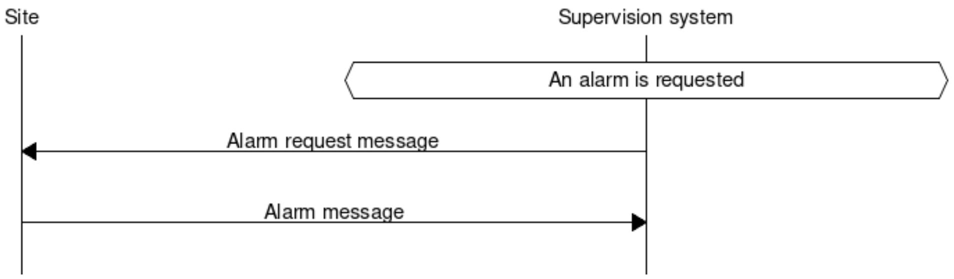
Message acknowledgement (see section *Message acknowledgement*) is implicit in the following figures.

An alarm is active/inactive



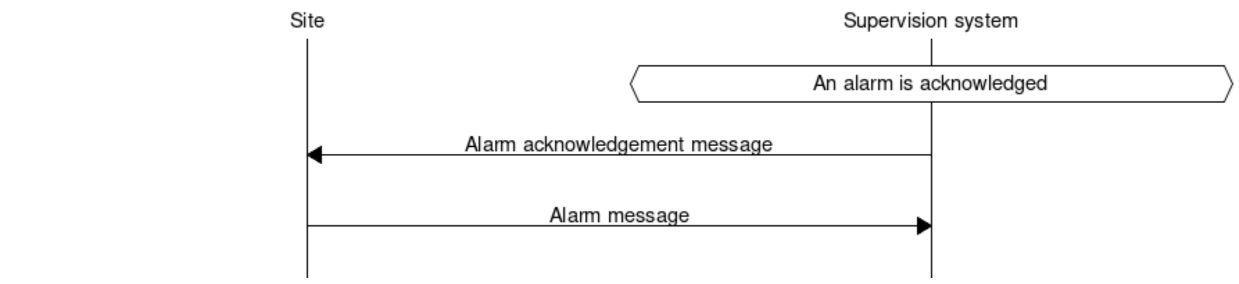
1. An alarm message is sent to supervision system with the status of the alarm (the alarm is active/inactive)

An alarm is requested



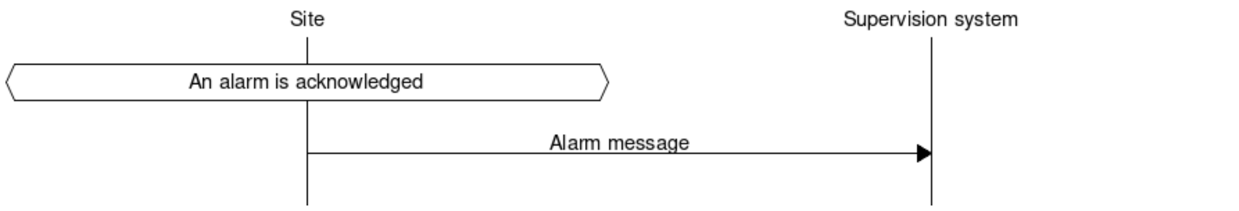
1. An alarm is requested from the supervision system
2. An alarm message is sent to supervision system with the status of the alarm

An alarm is acknowledged at the supervision system



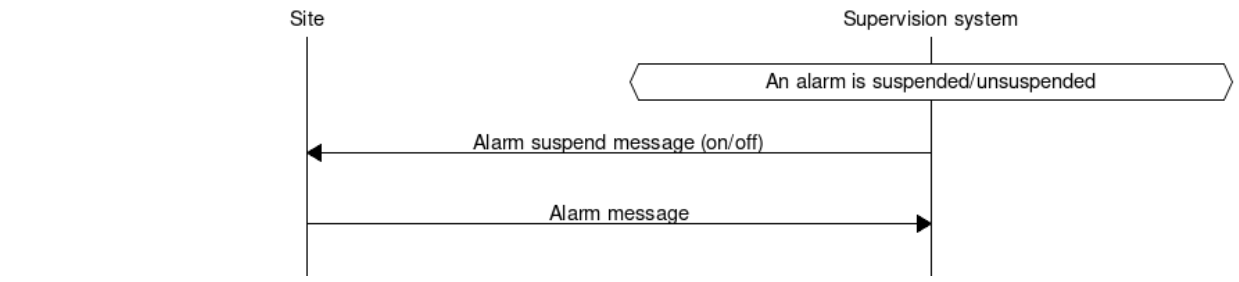
1. An alarm acknowledgement message is sent to the site
2. An alarm message is sent to the supervision system (that the alarm is acknowledged)

An alarm is acknowledged at the site



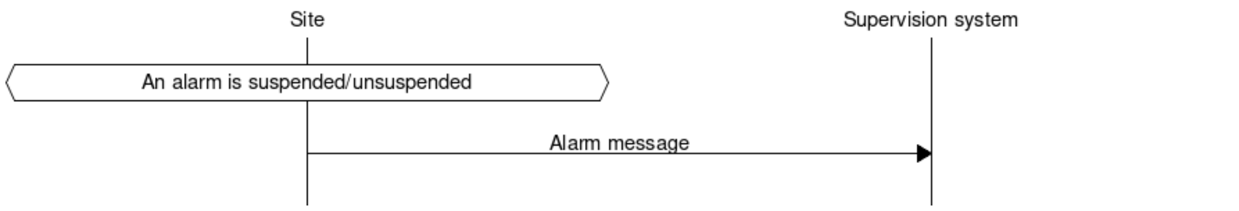
1. An alarm message is being sent to the supervision system with the status of the alarm (that the alarm is acknowledged)

An alarm is suspended/unsuspended from the supervision system


Site
Supervision system
An alarm is suspended/unsuspended
Alarm suspend message (on/off)
Alarm message

1. An alarm suspend message is being sent to the site
2. An alarm message is sent to the supervision system with the status of the alarm (that the suspension is activated/deactivated)

An alarm is suspended/unsuspended from the site



1. An alarm message is sent to the supervision system with the status of the alarm (that suspension is activated/deactivated)

5.4.2 Aggregated status message

This type of message is sent to the supervision system to inform about the status of the site. The aggregated status applies to the object which is defined by **ObjectType** in the signal exchange list. If no object is defined then no aggregated status message is sent.

Aggregated status message are interaction driven and are sent if state bits, functional position or functional status are changed at the site.

Message structure

An aggregated status message has the structure according to the example below.

```
{
     "mType": "rSMsg",
     "type": "AggregatedStatus",
     "mId": "be12ab9a-800c-4c19-8c50-adf832f22420",
     "ntsOId": "O+14439=481WA001",
     "xNId": "",
     "cId": "O+14439=481WA001",
     "aSTS": "2015-06-08T08:05:06.584Z",
     "fP": null,
     "fS": null,
     "se": [
            true,false,false,false,false,false,false,false
           ]
}
```

JSon code 11: An aggregated status message

The following tables are describing the variable content of the message:

Element	Value	Description
aSTS	*(timestamp)*	The timestamp uses the W3C XML dateTime definition with a 3 decimal places. All timestamps are set at the local level (and not in the supervision system) when the event occurs (and not when the message is sent). All timestamps uses UTC.

Table 5.10: Aggregated status

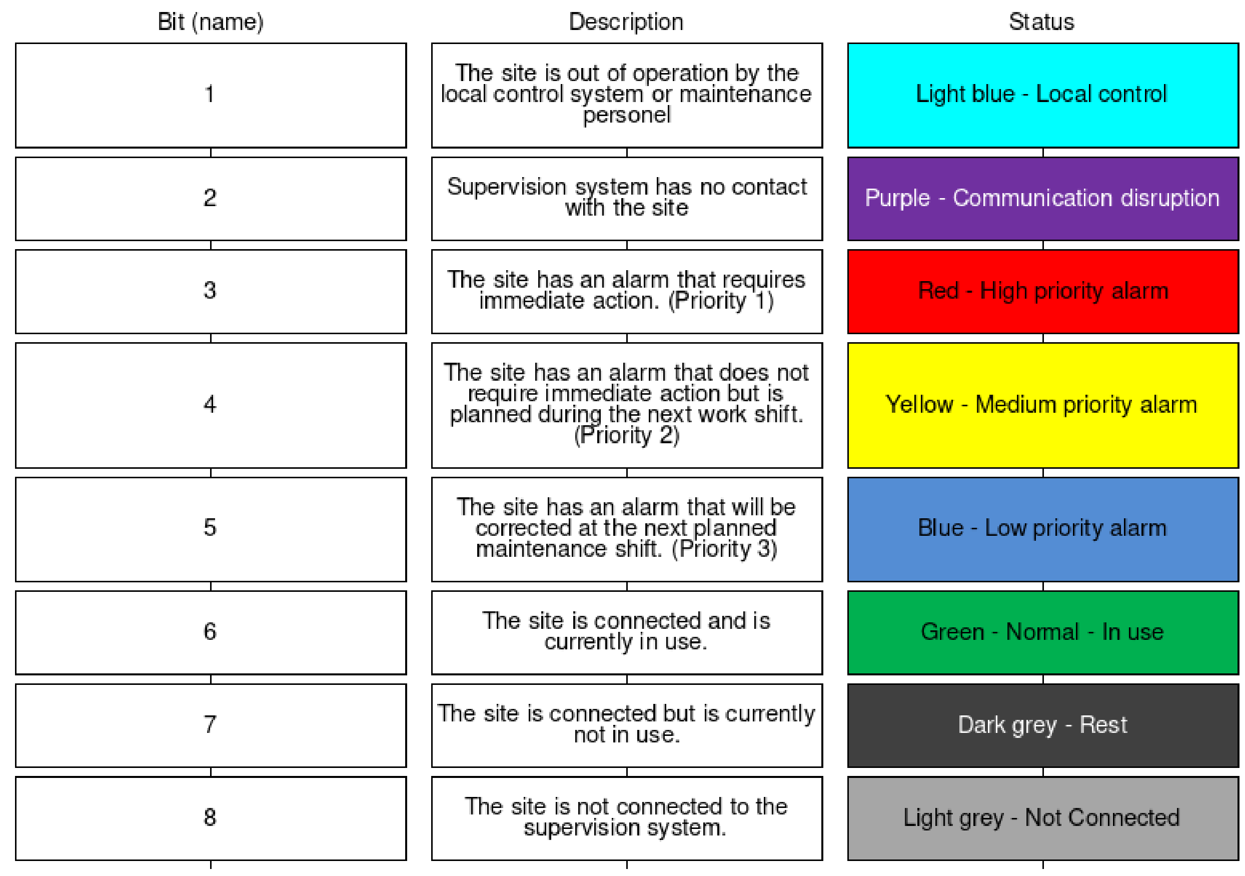
The following table describes the variable content defined by the signal exchange list (SXL). The *SXL element* column describes the correlation between the JSon elements and the titles in the SXL.

Element	SXL element	Description
fP	functionalPosition	Functional position. Is **null** if no value is defined in SXL.
fS	functionalState	Functional state. Is **null** if no value is defined in SXL.
se	State	Status bits. 8 bit status bit array, where each element is defined as either **true** or **false**. This status bit array defines the status of the site to NTS

Table 5.11: Aggregated status SXL content

Status bits (state)

The principle of aggregating of statuses for each bit is defined by the associated comments in the signal exchange list (SXL). A generic description of each bit is presented in the figure below



Bit (name)	Description	Status
1	The site is out of operation by the local control system or maintenance personel	Light blue - Local control
2	Supervision system has no contact with the site	Purple - Communication disruption
3	The site has an alarm that requires immediate action. (Priority 1)	Red - High priority alarm
4	The site has an alarm that does not require immediate action but is planned during the next work shift. (Priority 2)	Yellow - Medium priority alarm
5	The site has an alarm that will be corrected at the next planned maintenance shift. (Priority 3)	Blue - Low priority alarm
6	The site is connected and is currently in use.	Green - Normal - In use
7	The site is connected but is currently not in use.	Dark grey - Rest
8	The site is not connected to the supervision system.	Light grey - Not Connected

5.4.3 Aggregated status request message

This type of message is sent from the supervision system to request the latest aggregated status, in case the supervision system has lost track of the current status.

Message structure

An aggregated status request message has the structure according to the example below.

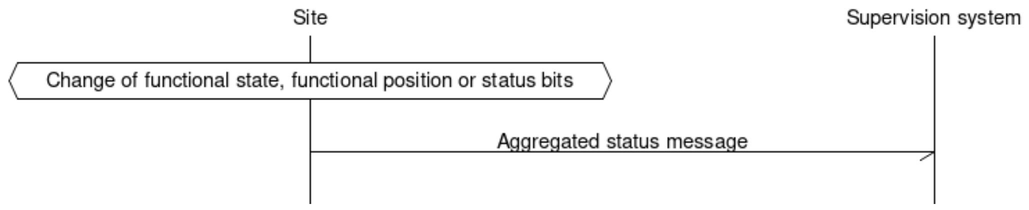
```json
{
     "mType": "rSMsg",
     "type": "AggregatedStatusRequest",
     "mId": "be12ab9a-800c-4c19-8c50-adf832f22425",
     "ntsOId": "O+14439=481WA001",
     "xNId": "",
     "cId": "O+14439=481WA001",
}
```

JSon code 12: An aggregated status request message

Message exchange between site and supervision system

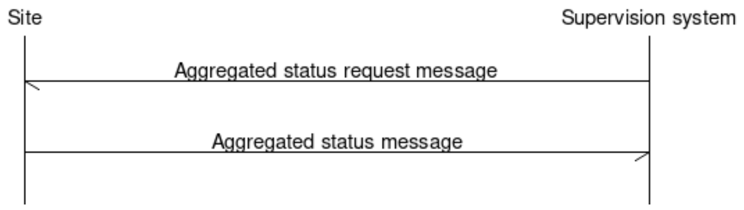
Message acknowledgement (see section *Message acknowledgement*) is implicit in the following figures.

Functional state, functional position or status bits changes at the site


Site
Supervision system
Change of functional state, functional position or status bits
Aggregated status message

1. An aggregated status message is sent to the supervision system.

The supervision system request aggregated status



1. An aggregated status request message is sent to the site.
2. An aggregated status message is sent to the supervision system.

5.4.4 Status Messages

The status message is a type of message that is sent to the supervision system or other equipment with the status of one or more requested objects.

The status message can both be interaction driven or event driver and can be sent during the following prerequisites:

- When status is requested from the supervision system or other equipment.
- According to subscription – either by using a fixed time interval or when the status changes.

Message structure

Structure for a request of a status of one or several objects

A status request message has the structure according to the example below.

```
{
     "mType": "rSMsg",
     "type": "StatusRequest",
     "mId": "f1a13213-b90a-4abc-8953-2b8142923c55",
     "ntsOId": "O+14439=481WA001",
     "xNId": "",
     "cId": "O+14439=481WA001",
     "sS": [
         {
             "sCI": "S0003",
```

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```
            "n": "inputstatus"
        },{
            "sCI": "S0003",
            "n": "extendedinputstatus"
        }
    ]
}
```

JSon code 13: A status request message

The status code id (**sCI**) and name (**n**) are placed in an array (**sS**) in order to enable support for requesting multiple status at once. The following table is describing the variable content of the message.

The *SXL element* column describes the correlation between the JSon elements and the titles in the SXL.

Element	SXL element	Description
sCI	statusCodeId	The Status code id. The examples is this document are defined according to the following format: *Syyyy*, where *yyyy* is a unique number.
n	name	Unique reference of the value

Table 5.12: Status request

Structure for a message with status of one or several objects

A message with status of one or several objects has the structure according to the example below.

If the component (**cId**) is not known, then the site must not disconnect but instead answer with this type of message where **q** is set to **undefined**.

```
{
    "mType": "rSMsg",
    "type": "StatusResponse",
    "mId": "0a95e463-192a-4dd7-8b57-d2c2da636584",
    "ntsOId": "O+14439=481WA001",
    "xNId": "",
    "cId": "O+14439=481WA001",
    "sTs": "2015-06-08T09:15:18.266Z",
    "sS": [
        {
            "sCI": "S0003",
            "n": "inputstatus",
            "s": "100101",
            "q": "recent"
        },{
            "sCI": "S0003",
            "n": "extendedinputstatus",
            "s": "100100101",
            "q": "recent"
        }
    ]
}
```

JSon code 14: A status response message

The following table is describing the variable content of the message:

Element	Value	Description
sTs	*(timestamp)*	Timestamp for the status. The timestamp uses the W3C XML dateTime definition with a 3 decimal places. All timestamps are set at the site (and not in the supervision system) when the status is fetched (and not when the message is sent) All timestamps uses UTC.

Table 5.13: Status response

Return values (returnvalue)

Return values ("sS") are always sent but can be empty if no return values exists.

Element	Value	Description
sS	*(array)*	Return values. Contains the elements "sCI", "s", "n" and "q" in an array.

Table 5.14: Return values (returnvalue)

Element	SXL element	Description
sCI	statusCodeId	The Status code id. The examples in this document are defined according to the following format: *Syyyy*, where *yyyy* is a unique number.
n	Name	Unique reference of the value
(not sent)	Type	The data type of the value. Defined in the SXL but is not actually sent General definition: **string**: Text information **integer**: Numerical value (16-bit signed integer), [-32768 – 32767] **long**: Numerical value (32-bit signed long) **real**: Float (64-bit double precision floating point) **boolean**: Boolean data type **base64**: Binary data expressed in base64 format according to RFC-4648
s	Value	Value
(not sent)	Comment	Description for the status request. Defined in the SXL but is not actually sent.

Table 5.15: Return values (returnvalue)

The following table describes additional variable content of the message.

Element	Value	Description
q	recent	The value is up to date
	old	The value is not up to date
	undefined	The component does not exist and no subscription will be performed. **s** should be set to **null**.
	unknown	The value is unknown and no subscription will be performed. **s** should be set to **null**.

Table 5.16: Return value quality

Structure for a status subscription request message on one or several objects

A message with the request of subscription to a status has the structure according to the example below. The message is used for constructing a list of subscriptions of statuses, digital and analogue values and events that are desirable to send to supervision system, e.g. temperature, wind speed, power consumption, manual control.

```
{
     "mType": "rSMsg",
     "type": "StatusSubscribe",
     "mId": "d6d97f8b-e9db-4572-8084-70b55e312584",
     "ntsOId": "O+14439=481WA001",
     "xNId": "",
     "cId": "O+14439=481WA001",
     "sS": [
         {
             "sCI": "S0001",
             "n": "signalgroupstatus",
             "uRt": "5",
             "sOc": false
         },{
             "sCI": "S0001",
             "n": "cyclecounter",
             "uRt": "5",
             "sOc": false
         },{
             "sCI": "S0001",
             "n": "basecyclecounter",
             "uRt": "5",
             "sOc": false
         },{
             "sCI": "S0001",
             "n": "stage",
             "uRt": "5",
             "sOc": false
         }
     ]
}
```

JSon code 15: A status subscribe message

The following table is describing the variable content of the message:

Element	Value	Description
uRt	*(string)*	updateRate. Determines the interval of which the message should be sent. Defined in seconds with decimals, e.g. ”2.5” for 2.5 seconds. Dot (.) is used as decimal point. If “0” it means that the value should not be sent according to an interval
sOc	boolean	sendOnChange. Determines if the message should be sent when the value changes.

Table 5.17: Status Request

The **updateRate** (uRt) and **sendOnChange** (sOc) determines when a status update should be sent. **updateRate** defines a specific interval when to send updates. If **updateRate** is set to “0” it means that no update is sent using an interval. **sendOnChange** defines if an status update should be sent as soon as the value changes.

It is possible to combine **updateRate** and **sendOnChange** to send an update when the value changes and at the same time using a specific interval.

Structure for a response message with answer to a request for status subscription for one or several objects

A response message with answer to a request for status subscription has the structure according to the example below. This response is always sent immediately after request for subscription regardless if the value recently changed or as an effect of the interval for the subscription. The reason for sending the response immediately is because subscriptions usually are established shortly after RSMP connection establishment and the supervision system needs to update with the current statuses and events. If an subscription is already active then the site must not establish a new subscription but use the existing one. This message type should not be sent if the subscription already exist. If the object is not known then the site must not disconnect but instead answer with this type of message where **q** is set to **undefined**.

```
{
     "mType": "rSMsg",
     "type": "StatusUpdate",
     "mId": "dabb67f9-2601-4db9-bb8a-c7c47f57e100",
     "ntsOId": "O+14439=481WA001",
     "xNId": "",
     "cId": "O+14439=481WA001",
     "sTs": "2015-06-08T09:33:04.735Z",
     "sS": [
         {
             "sCI": "S0001",
             "n": "signalgroupstatus",
             "s": "A021BC01",
             "q": "recent"
         },{
             "sCI": "S0001",
             "n": "cyclecounter",
             "s": "20",
             "q": "recent"
         },{
             "sCI": "S0001",
             "n": "basecyclecounter",
             "s": "10",
             "q": "recent"
```

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```
        },{
            "sCI": "S0001",
            "n": "stage",
            "s": "1",
            "q": "recent"
        }
    ]
}
```

JSon code 16: A status update message

The allowed content is described in Table *Status response* and *Return values*.

Since different UpdateRate can be defined for different objects it means that partial StatusUpdates can be sent.

```
{
    "mType": "rSMsg",
    "type": "StatusSubscribe",
    "mId": "6bbcb26e-78fe-4517-9e3d-8bb4f972c076",
    "ntsOId": "",
    "xNId": "",
    "cId": "O+14439=481WA001",
    "sS": [
        {
            "sCI": "S0096",
            "n": "hour",
            "uRt": "120",
            "sOc": false
        },{
            "sCI": "S0096",
            "n": "minute",
            "uRt": "60",
            "sOc": false
        }
    ]
}
```

JSon code 17: A subscription request to subscribe to statues with different update rates

```
{
    "mType": "rSMsg",
    "type": "StatusUpdate",
    "mId": "b6bd7c96-f150-4756-9752-47a661e116db",
    "ntsOId": "",
    "xNId": "",
    "cId": "O+14439=481WA001",
    "sTs": "2015-05-29T13:47:56.740Z",
    "sS": [
        {
            "sCI": "S0096",
            "n": "minute",
            "s": "47",
            "q": "recent"
        }
    ]
}
```

JSon code 18: A partial status update. Only a single status is updated

Structure for a status unsubscription message on one or several objects

A message with the request of unsubscription to a status has the structure according to the example below. The request unsubscribes on one or several objects. No particular answer is sent for this request, other than the usual message acknowledgement.

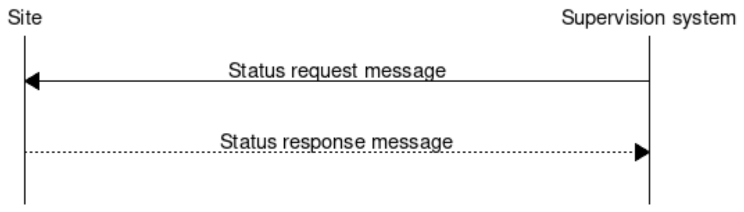
```
{
     "mType": "rSMsg",
     "type": "StatusUnsubscribe",
     "mId": "5ff528c5-f2f0-4bc4-a335-280c52b6e6d8",
     "ntsOId": "O+14439=481WA001",
     "xNId": "",
     "cId": "O+14439=481WA001",
     "sS": [
         {
             "sCI": "S0001",
             "n": "signalgroupstatus"
         },{
             "sCI": "S0001",
             "n": "cyclecounter"
         },{
             "sCI": "S0001",
             "n": "basecyclecounter"
         },{
             "sCI": "S0001",
             "n": "stage"
         }
     ]
}
```

JSon code 19: A status unsubscribe message

The allowed content is described in Table *Status Request*

Message exchange between site and supervision system/other equipment - request

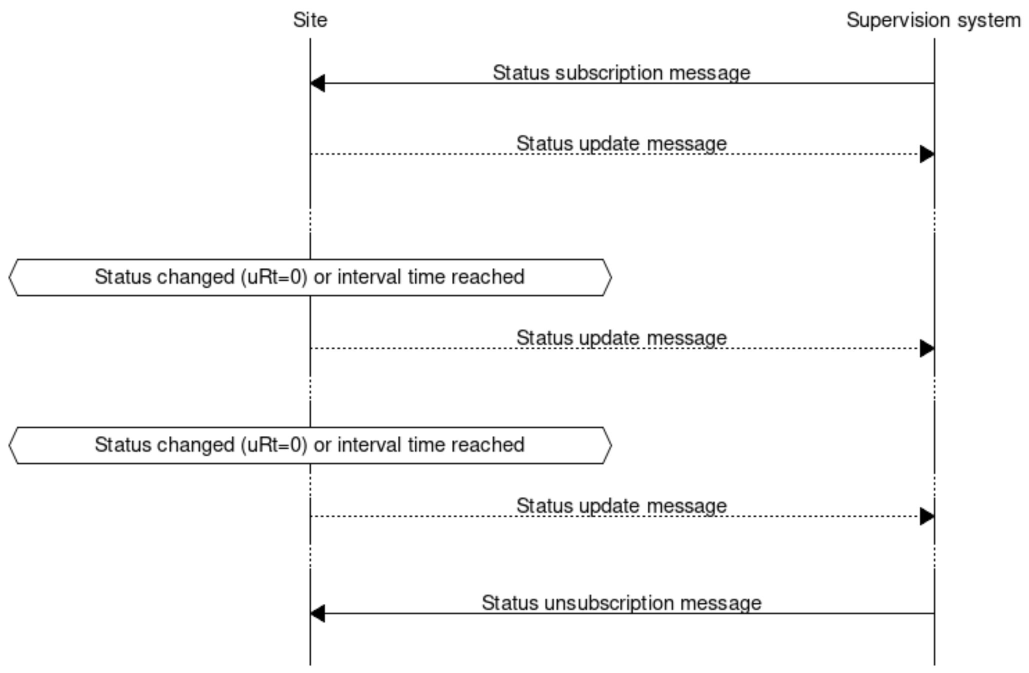
Message acknowledgement (see section *Message acknowledgement*) is implicit in the following figure.



1. Request of status for an object
2. Response with status of an object

Message exchange between site and supervision system/other equipment - subscription

Message acknowledgement (see section *Message acknowledgement*) is implicit in the following figure.


Site
Supervision system
Status subscription message
Status update message
Status changed (uRt=0) or interval time reached
Status update message
Status changed (uRt=0) or interval time reached
Status update message
Status unsubscription message

Example of message exchange with subscription, status updates and unsubscription.

5.4.5 Command messages

Command messages are used to give order to do something at the site. The site responds with a command acknowledgement.

Command messages are interaction driven and are sent when command are requested on any given object by the supervision system or other equipment

Message structure

Structure of a command message request

A command request message has the structure according to the example below. A command request message with the intent to change a value of the requested object

```
{
     "mType": "rSMsg",
     "type": "CommandRequest",
     "mId": "cf76365e-9c7b-44a4-86bd-d107cdfc3fcf",
     "ntsOId": "O+14439=481WA001",
     "xNId": "",
     "cId": "O+14439=481WA001",
     "arg": [
         {
             "cCI": "M0001",
             "n": "status",
             "cO": "setValue",
             "v": "YellowFlash"
         },{
             "cCI": "M0001",
             "n": "securityCode",
```

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```
            "cO": "setValue",
            "v": "123"
        },{
            "cCI": "M0001",
            "n": "timeout",
            "cO": "setValue",
            "v": "30"
        },{
            "cCI": "M0001",
            "n": "intersection",
            "cO": "setValue",
            "v": "1"
        }
    ]
}
```

JSon code 20: A command request message

The following table is describing the variable content of the message:

Values to send with the command (arguments)

Element	Value	Description
arg	*(array)*	Argument. Contains the element **cCI**, **n**, **cO**, **v** in an array

Table 5.18: Command argument

The following table describes the variable content of the message which is defined by the SXL.

The *SXL element* column describes the correlation between the JSon elements and the titles in the signal exchange list (SXL).

Element	SXL element	Description
cCI	commandCodeId	The uniqe code of a command request. The examples in this document are defined according to the following format: *Myyyy*, where *yyyy* is a unique number.
(not sent)	Description	Description for the command request. Defined in the SXL but is not actually sent.
n	Name	Unique reference of the value
cO	Command	Command
(not sent)	Type	The data type of the value. Defined in the SXL but is not actually sent General definition: **string**: Text information **integer**: Numerical value (16-bit signed integer), [-32768 – 32767] **long**: Numerical value (32-bit signed long) **real**: Float (64-bit double precision floating point) **boolean**: Boolean data type **base64**: Binary data expressed in base64 format according to RFC-4648
v	Value	Value

Table 5.19: Command arguments defined by SXL

Structure of command response message

A command response message has the structure according to the example below. A command response message informs about the updated value of the requested object. If the object is not known then the site must not disconnect but instead answer with this type of message where **age** is set to **undefined**.

```
{
     "mType": "rSMsg",
     "type": "CommandResponse",
     "mId": "0fd63726-be19-4c09-8553-48451735cb0b",
     "ntsOId": "O+14439=481WA001",
     "xNId": "",
     "cId": "O+14439=481WA001",
     "cTS": "2015-06-08T11:49:03.293Z",
     "rvs": [
          {
             "cCI": "M0001",
             "n": "status",
             "v": "YellowFlash",
             "age": "recent"
          },{
             "cCI": "M0001",
             "n": "securityCode",
             "v": "123",
             "age": "recent"
          },{
             "cCI": "M0001",
```

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```
            "n": "timeout",
            "v": "30",
            "age": "recent"
         },{
            "cCI": "M0001",
            "n": "intersection",
            "v": "1",
            "age": "recent"
         }
    ]
}
```

JSon code 21: A command response message

The following table is describing the variable content of the message:

Element	Value	Description
cTS	*(timestamp)*	The timestamp uses the W3C XML dateTime definition with a 3 decimal places. All timestamps are set at the local level (and not in the supervision system) when the alarm occurs (and not when the message is sent). All timestamps uses UTC.

Table 5.20: Command response

Return values (returnvalue)

Return values (**rvs**) is always sent but can be empty if not return values are defined.

Element	Value	Description
rvs	*(array)*	Return values. Contains the elements **cCI**, **v**, **n** and **q** in an array.

Table 5.21: Command return values

The following table describes the variable content defined by the signal exchange list (SXL). The *SXL element* column describes the correlation between the JSon elements and the titles in the SXL.

Element	SXL element	Description
cCI	commandCodeId	The uniqe code of a command. The examples in this document are defined according to the following format: *Myyyy*, where *yyyy* is a unique number.
n	Name	Unique reference of the value
(not sent)	Type	The data type of the value. Defined in the SXL but is not actually sent General definition: **string**: Text information **integer**: Numerical value (16-bit signed integer), [-32768 – 32767] **long**: Numerical value (32-bit signed long) **real**: Float (64-bit double precision floating point) **boolean**: Boolean data type **base64**: Binary data expressed in base64 format according to RFC-4648
v	Value	Value

Table 5.22: Command return value defined by SXL

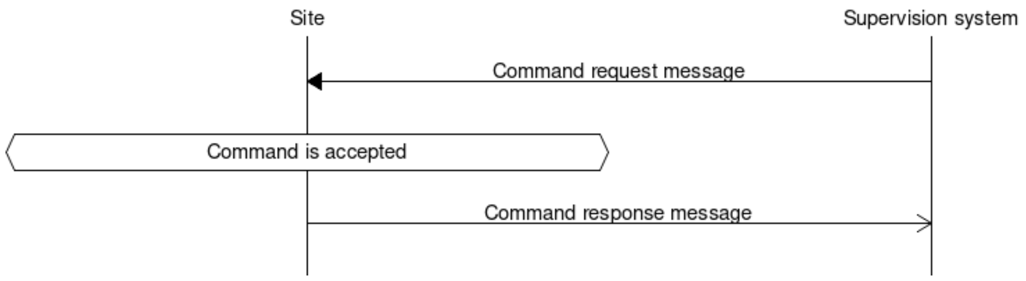
The following table describes additional variable content of the message.

Element	Value	Description
age	recent	The value is up to date
	old	The value is not up to date
	undefined	The component does not exist. **v** should be set to **null**.
	unknown	The value is unknown. **v** should be set to **null**.

Table 5.23: Command return value

Message exchange between site and supervision system/other equipment

Message acknowledgement (see section *Message acknowledgement*) is implicit in the following figure.



1. Command request for an object
2. Command response of an object

5.4.6 Message acknowledgement

Message acknowledgement is sent as an initial answer to all other messages. This type of message should not be mixed up with alarm acknowledgement, which has a different function. The purpose of message acknowledgement is to detect communication disruptions, function as an acknowledgment that the message has reached its destination and to verify that the message was understood.

There are two types of message acknowledgement – **Message acknowledgment** (MessageAck) which confirms that the message was understood and **Message not acknowledged** (MessageNotAck) which indicates that the message was not understood.

- If no message acknowledgement is received within a predefined time, then each communicating party should treat it as a communication disruption. (See *Communication disruption*)
- The default timeout value should be 30 seconds.
- If the version messages has not been exchanged according to communication establishment sequence (See *Communication establishment between sites and supervision system* and *Communication establishment between sites*) then message acknowledgement (MessageAck/MessageNotAck) should not be sent as a response to any other messages other than the version message (See *RSMP/SXL Version*). The lack of acknowledgement forces the other communicating party to treat it as communication disruption and disconnect and reconnect, ensuring that the connection restarts with communication establishment sequence.

The acknowledgement messages are interaction driven and are sent when any other type message are received.

Message structure – Message acknowledgement

An acknowledgement message has the structure according to the example below.

```
{
     "mType": "rSMsg",
     "type": "MessageAck",
     "oMId": "49c6c824-d593-4c16-b335-f04feda16986"
}
```

JSon code 22: An acknowledgement message

Message structure – Message not acknowledged

A “not acknowledgement” message has the structure according to the example below.

```
{
     "mType": "rSMsg",
     "type": "MessageNotAck",
     "oMId": "554dff0-9cc5-4232-97a9-018d5796e86a",
     "rea": "Unknown packet type: Watchdddog"
}
```

JSon code 23: A not acknowledgement message

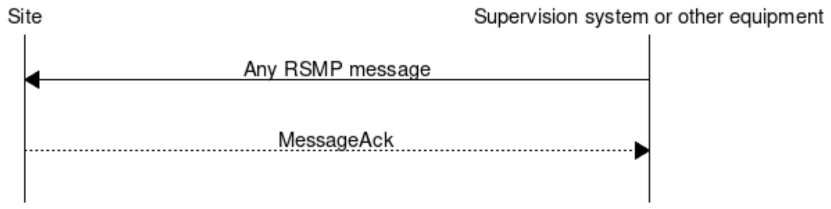
The following table is describing the variable content of the message:

Element	Value	Description
rea	*(optional)*	Error message where all relevant information about the nature of the error can be provided.

Table 5.24: Message not ack

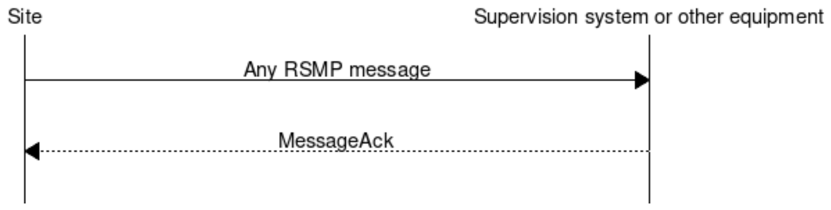
Message exchange between site and supervision system/other equipment

Supervision system sends initial message



1. A message is sent from supervision system or other equipment
2. The site responds with an message acknowledgement

Site sends initial message



1. A message is sent from the site
2. The supervision system or other equipment responds with an message acknowledgement

5.4.7 RSMP/SXL Version

Version of RSMP and revision of SXL are always sent directly after establishing communication. Both communicating systems send this as their first message and waits for message response until any other messages are sent. Information regarding all supported RSMP versions should be included in the version message. The version message should be implemented in such a way that is should be possible to add additional tags/variables (e.g. date) without affecting existing implementations.

If any discrepancies with the version numbers are detected between the two communicating systems this should be set using a MessageNotAck. The communication is terminated after that and an internal alarm is activated in both communicating system. If both communicating systems support several RSMP versions it is always the latest version that should be used.

The principle of the message exchange is defined by the communication establishment (See *Communication establishment between sites and supervision system* and *Communication establishment between sites*).

Message structure

A version message has the structure according to the example below. In the example below the system has support for RSMP version **3.1.1**, **3.1.2** and SXL version **1.0.13** for site **O+14439=481WA001**.

```
{
     "mType": "rSMsg",
     "type": "Version",
     "mId": "6f968141-4de5-42ff-8032-45f8093762c5",
     "RSMP": [
         {
             "vers": "3.1.1"
         },{
             "vers": "3.1.2"
         }
     ],
     "siteId": [
         {
             "sId": "O+14439=481WA001"
         }
     ],
     "SXL": "1.0.13"
}
```

JSon code 24: A RSMP / SXL message

The following table describes the variable content of the message which is defined by the SXL.

The *SXL element* column describes the correlation between the JSon elements and the titles in the signal exchange list (SXL).

Element	SXL element	Description
sId	SiteId	Site identity. Used in order to refer to a "logical" identity of a site. At the STA, the following formats can be used: • The site id from the STAs component id standard TDOK 2012:1171 e.g. "40100". • It is also possible to use the full component id (TDOK 2012:1171) of the grouped object in the site in case the site id part of the component id is insufficient in order to uniquely identify a site. All the site ids that are used in the RSMP connection are sent in the message using an array (**siteId**)
SXL	SXL revision	Revision of SXL. E.g "1.3"

Table 5.25: Version information defined by SXL

The following table describes additional variable content of the message.

Element	Description
vers	Version of RSMP. E.g. "3.1.2", "3.1.3" or "3.1.4". All the supported RSMP versions are sent in the message using an array (**RSMP**).

Table 5.26: Version information

5.4.8 Watchdog

The primary purpose of watchdog messages is to ensure that the communication remains established and to detect any communication disruptions between site and supervision system. For any subsystem alarms are used instead.

The secondary purpose of watchdog messages is to provide a timestamp that can be used for simple time synchronization.

- Time synchronization using the watchdog message should be configurable at the site (enabled/disabled)
- If time synchronization is enabled, the site should synchronize its clock using the timestamp from watchdog messages – at communication establishment and then at least once every 24 hours.
- The interval duration for sending watchdog messages should be configurable at both the site and the supervision system. The default setting should be (1) once a minute.

Watchdog messages are sent in both directions, both from the site and from the supervision system. At initial communication establishment (after version message) the watchdog message should be sent.

Message structure

A watchdog message has the structure according to the example below.

```
{
     "mType": "rSMsg",
     "type": "Watchdog",
     "mId": "f48900bc-e6fb-431a-8ca4-05070016f64a",
     "wTs": "2015-06-08T12:01:39.654Z"
}
```

JSon code 25: A watchdog message

The following table is describing the variable content of the message:

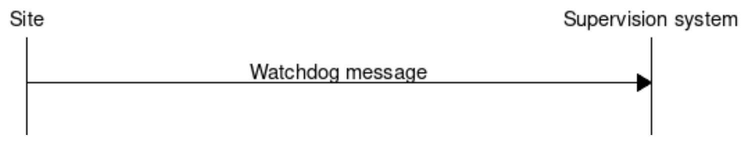
Element	Value	Description
wTs	*(timestamp)*	Watchdog timestamp. The timestamp uses the W3C XML dateTime definition with a 3 decimal places. All timestamps are set at the local level (and not in the supervision system) when the event occurs (and not when the message is sent). All timestamps uses UTC.

Table 5.27: Watchdog

Message exchange between site and supervision system/other equipment

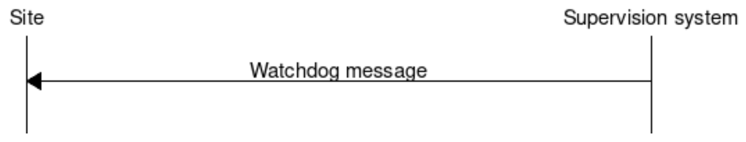
Message acknowledgement (see section *Message acknowledgement*) is implicit in the following figures.

Site sends watchdog message



1. Watchdog message is sent from site

Supervision system/other equipment sends watchdog message



1. Watchdog message is sent from supervision system/other equipment

5.5 Signal Exchange List

The signal exchange list an important functional part of RSMP. Since the contens of every message using RSMP is dynamic, a predefined signal exchange list (*SXL*) is prerequisite in order to be able to establish communication.

The signal exchange list defines which message types (signals) which is possible to send to a specific equipment or object. It is formatted according to predefined principles which is defined below.

5.5.1 Structure

The following sections presents the format and contens of the SXL. Each section corresponds to the names of each sheet in the SXL.

First page

The sheet “First page” defines site(s), revision and date of the SXL.

Object types and object

The “object types” sheet defines the types of object that can exist in a site, i.e. “LED”.

The object sheet defines the number of each type of object that exists in the site. If more that one site is defined in the SXL; then one object sheet needs to be defined for each site.

If more that one site is defined in the same SXL; then the object sheet is renamed to the name of the site.

The status for an object is suitable to be transmitted to NTS if the NTS identity (externalNtsId) is defined.

Object definitions

Depending on applicability, each object type can either have it’s own series or common series of alarm suffix (alarmCodeId), status codes (statusCodeId) and command codes (commandCodeId).

Single and grouped objects

An object can either be categorized as a **single object** or **grouped object**.

An object is defined under the title **group object** if the object is a component group according to TDOK 2012:1171. Other objects are defined under **single object**.

If the **externalNtsId** field is used; it means that the object is adapted to be sent to NTS.

Other sheets

The sheets **Alarm**, **Aggregated status**, **Status** and **Command** corresponds to the respective message type which is defined in the RSMP specification.

- Italic text which is used as title in columns is not part of the protocol, but is only used as a guiding explanation text.
- Return values and argument are optional and there is no limitation on how many return values and arguments which can be used for a single message.

Overview on functional differences between different message types

The following table defines the functional differences between different message types.

Message type	Sent when	Adapted to be transmitted to NTS
Alarm	On change	Yes
Aggregated status	On change	Yes
Status	On request *or* according to subscription	No
Command	On request	Yes, partly (functional status)

Table 5.28: Functional differencies

5.5.2 Definitions

The following notions are used as titles from the columns in the SXL. All the notions corresponds to the element with the same name in the basic structure.

The following table defines the different versions of command messages.

Notion	Description
Functional position	Designed for NTS. Provides command options for an NTS object. In order to get the status the corresponding status functionalPosition in Aggregated status is used.
Functional state	Not used
Manouver	Possible command options for individual objects for groups of objects from management system (not NTS). May also apply to automatic control. For instance, “start” or “stop”
Parameter	Used for modification of technical or autonomous traffic parameters of the equipment

Table 5.29: Commands - different versions

5.5.3 Functional relationships in the signal exchange list

Functional states

The functional states which an object can enter should also be possible to control. The commands which are defined in **“Functional states** in the **Commands** sheet should correlate to the functional states which are defined in **functionalPosition** in “**Aggregated status**”.

Arguments and return values

Argument and return values makes it possible to send extra information in messages. It is possible to send binary data (base64), such as bitmap pictures or other data, both to a site and to supervision system. The signal exchange list must clarify exactly which data type which is used in each case. There is no limitation of the number of arguments and return values which can be defined for a given message. Argument and return values is defined as extra columns for each row in the signal exchange list.

- Arguments can be sent with command messages
- Return values can be send with response on status requests or as extra information with alarm messages

The following table defines the message types which supports arguments and return values.

Message type	Argument	Return value
Alarm	No	Yes
Aggregated status	No	No
Status	No	Yes
Commands	Yes	No

Table 5.30: Support for arguments and return values

5.5.4 Version mangement

Version of RSMP

The version of RSMP defines the overall version of RSMP. All documents which are part of the RSMP specification refers to version of RSMP. The following table defines the principles for version numbering for each document.

Document	Principles of versioning
RSMP specification	Version of RSMP
Signal exchange list (SXL)	Own version *and* version of RSMP

Table 5.31: Version management

The document “RSMP specification” uses the version of RSMP, for instance, “1.0”.

The signal exchange list (SXL) has it’s own version but which version RSMP that the SXL uses must de defined.

When a new version RSMP is established all associated documents need to be updated to reflect this.

Revision of SXL

Revision of SXL is unique for a site. In order to uniquely identify a SXL for a supervision system the identity of the site (siteId) and it’s version of SXL (SXL Revision) needs to be known. In each SXL there must defined which version of RSMP which it is conforms to.

In order to support a common SXL for many sites where the alarms, status, and command message types are mostly shared - but there is a risk of differences can emerge; it is recommended that a table is added on the front page of each SXL the sites are using. The following table defines an example for the design of the table.

Site	Revision of SXL which is used
Site 1	1.1
Site 2	1.0
Site 3	1.1

Table 5.32: Revision of SXL

The purpose is to be able to update the SXL with a new revision and at the samt time inform about which sites which the revision applies to.

5.5.5 Required signals

Status messages

Version of component

To make sure that the site is equipped with the correct version of components and to simplify troubleshooting there need to exists a special status to request version of a component.

Current date and time

To make sure that the site is configured with the correct date and time there needs to be a special status to request this. This type of status is especially important for those implementations where the equipment's protocol interface and the rest of it's logic doesn't share the same clock. Please note that UTC should be used.

Command messages

Change date and time

If the automatic time synchronization is missing or disabled there should be a possibility to set the date and time using a special command. Please note that UTC should be used.

5.5.6 Best practices

In order to fit as many technical areas as possible there some flexibility while designing a signal exchange list. Below are some suggested recommendations.

Definition of object types

The level of detail in the definition of object types determines the level of detail of which:

- Messages can be sent, e.g. alarms and status
- Commands of individual object can be performed
- Information can be presented about the site for maintenance engineers in supervision system.

The benefits with a high level of details is:

- Provides the possibility to directly with the component identity be able to identify which object the status/alarm is relevant to, which help when troubleshooting equipment
- Provides the possibility to block alarm for each object identity

The benefit with a low level of detail is:

- Reduced need to update the signal exchange list due to changes at the site

The disadvantage with the being able to determine to component identity due to a lower level of detail can be compensated with arguments and return values.

Reading and writing data

Read and write operations uses different message types in RSMP.

Read operation

Status messages are used for read operations. Read operations works as "Process value".

Sequence for a read operation:

1. When data is about to be read a status request is sent from supervision system or other site to the relevant site.
2. The site responds by sending the value from the equipment. The value is attached as a return value.

Write operation

Commands messages are used for write operations. Write operations works as "Set point"/Desired value.

Sequence for a write operation:

1. When data is about be written a command request is sent from supervision system or other site the relevant site. The new value is attached as an argument.
2. The site is responding with returning the new value from the site, using the corresponding command response. The value from the site is attached as a return value.
3. The supervision system/other site compares the sent value (desired) with the new value from the site (actual value/process value) and can determine if the new value could be sent or or not.

Chapter 6

Change log

Version	Date	Change	Name (initials)
1.0	2011-05-20	Protocol clarified and watchdog revised	DO
3.0	2011-11-04	Protocol revised	DO
3.1.1	2011-12-23	Minor revision	DO
3.1.2	2012-02-29	Minor revision	DO
3.1.3	2014-11-24	Minor revision	DO
3.1.4	2017-11-03	Protocol revised	DO
3.1.5	2020-10-30	Protocol revised	DO

Table 6.1: Changelog