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Q3 interface

Web services-based management services

Recommendation ITU-T Q.818



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For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T Q.818

Web services-based management services

Summary

Recommendation ITU-T Q.818 defines a set of services required to support service-oriented web services-based interfaces and along with Recommendation ITU-T X.782 composes a framework for web services-based network management interfaces. It specifies protocol requirements, how some well-known web services should be used in network management interfaces and defines some network management-specific support services. The WSDL interface definitions for the network management-specific support services are also provided.

History

Edition	Recommendation	Approval	Study Group
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Keywords

Distributed processing, extensible markup language (XML), managed objects, network management interfaces, service-oriented, universal description discovery and integration (UDDI), web services (WS), web services description language (WSDL), XML schema.

FOREWORD

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Recommendation ITU-T Q.818

Web services-based management services

1 Scope

The network management architecture defined in [ITU-T M.3010] introduces the use of multiple management protocols. So far, the GDMO/CMIP and CORBA GIOP/IOP are possible choices at the application layer. Based on the management interface specification methodology defined in [ITU-T M.3020], more technology-based paradigms can be introduced into network management interfaces, and web services/XML is now an additional paradigm for network management.

This Recommendation, together with [ITU-T X.782], sets out to define a framework for defining how interfaces supported by management systems and network elements should be modelled using web services/XML schema. It is the scope of this Recommendation to provide the following guidelines or instructions:

- protocol requirements for using web services in network management;
- how a web services-based notification service is used in network management interfaces;
- how a new service is registered and accessed using UDDI;
- how to monitor the availability of a web services notification forwarding mechanism;
- how to access multiple managed objects in one operation;
- compliance and conformance requirements.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T X.701] Recommendation ITU-T X.701 (1997), *Information technology – Open Systems Interconnection – Systems management overview*.
- [ITU-T X.703] Recommendation ITU-T X.703 (1997), *Information technology – Open Distributed Management Architecture*.
- [ITU-T X.782] Recommendation ITU-T X.782 (2012), *Guidelines for defining web services for managed objects and management interfaces*.
- [ITU-T M.3010] Recommendation ITU-T M.3010 (2000), *Principles for a telecommunications management network*.
- [ITU-T M.3020] Recommendation ITU-T M.3020 (2010), *Management interface specification methodology*.
- [ITU-T M.3702] Recommendation ITU-T M.3702 (2010), *Common management services – Notification management – Protocol neutral requirements and analysis*.
- [OASIS UDDI] OASIS Specification (2004), *Universal Description, Discovery and Integration (UDDI) v3.0.2*.
- [OASIS WSN] OASIS Specification (2006), *Web Services Base Notification v1.3*.

[W3C SOAP]	W3C Recommendation (2007), <i>SOAP Version 1.2 Part 1: Messaging Framework (Second Edition)</i> .
[W3C XML]	W3C Recommendation (2000), <i>Extensible Markup Language (XML) 1.0 Second Edition</i> .
[W3C XS-P1]	W3C Recommendation (2004), <i>XML Schema Part 1: Structures Second Edition</i> .
[W3C XS-P2]	W3C Recommendation (2004), <i>XML Schema Part 2: Datatypes Second Edition</i> .
[W3C WSDL]	W3C Recommendation (2001), <i>Web Services Description Language (WSDL) 1.1</i> .

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 agent [ITU-T M.3020]

3.1.2 managed object class [ITU-T X.701]

3.1.3 manager [ITU-T M.3020]

3.1.4 notification [ITU-T X.703]

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CMIP	Common Management Information Protocol
CORBA	Common Object Request Broker Architecture
GDMO	Guidelines for the Definition of Managed Objects
GIOP	General Inter-ORB Protocol
IIOF	Internet Inter-ORB Protocol
MO	Managed Object
MOC	Managed Object Class
MOO	Multiple Object Operation
SOAP	Simple Object Access Protocol
TMN	Telecommunications Management Network
UDDI	Universal Description Discovery and Integration
WS	Web Services
WSDL	Web Services Description Language

WSN	Web Services Notification
XML	extensible Markup Language
XSD	XML Schema Definition

5 Conventions

A few conventions are followed in this Recommendation to make the reader aware of the purpose of the text. While most of the Recommendation is normative, paragraphs succinctly stating mandatory requirements to be met by a management system (managing and/or managed) are preceded by a boldface "R" enclosed in parentheses, followed by a short name indicating the subject of the requirement, and a number. For example:

(R) EXAMPLE-1: An example mandatory requirement.

Requirements that may be optionally implemented by a management system are preceded by an "O" instead of an "R" For example:

(O) OPTION-1: An example optional requirement.

The requirement statements are used to create compliance and conformance profiles.

Many examples of WSDL and XML schema are included in this Recommendation, and WSDL specifying management specific services and supporting data types are included in a normative annex. The WSDL and XML schema are written in a 10 point courier typeface:

```
<!-- Example WSDL -->
<wsdl:message name="exampleMessage">
    <wsdl:part name="exampleRequest" type="exampleRequestType"/>
</wsdl:message>
```

6 Web services-based network management services goal and requirements

This clause describes the key goals of the services framework and the requirements that help the web services-based network management services support these goals. Clause 6.1 introduces the goals of the web services framework. Clause 6.2 then provides terminology and requirements. The requirements in this clause are requirements that the framework must satisfy and which are based on telecommunications management needs. Clauses 7, 8, 9 then describe a framework that meets these needs and defines how to achieve the requirements of this clause by using web services in a certain way.

6.1 Goals

This Recommendation sets out to define a framework for defining how interfaces supported by management systems and network elements should be modelled. Some key goals of the framework are identified here:

- application interoperability
- common usage of well-known web services.

This clause elaborates on these two goals.

6.1.1 Application interoperability

A key goal of the network management architecture and in particular the information architecture, is to promote a standard framework for providing interoperability and information exchange between systems from a diverse set of network management system suppliers. Interoperability between systems involves many aspects of development. At its lowest layer, a common communication mechanism must be in place to support a common syntax, the establishment of

connectivity and the exchange of operation requests/replies between systems. This aspect of interoperability is inherently supported by the web services specifications.

For network management, there is the need to provide application interoperability. That is, management systems from diverse suppliers will be utilized within a single administration's TMN to support different functions necessary to support the management of its networks. To simplify integration of these various suppliers' systems, they must agree on the semantics of the information being exchanged. This is accomplished with the specification of an information model. Guidelines for the definition of web services-based information models are specified in [ITU-T X.782], but the services defined here should support those guidelines.

6.1.2 Common usage of well-known web services

A second aspect of this framework is the definition of common usage and profiling of the distributed processing environment of choice. This aspect of the framework should indicate the reasonable expectations network management system suppliers may have for one another. Rather than redefining the interface capabilities needed to support common network management functions such as notification filtering with each information model, the modelling guidelines in [ITU-T X.782] rely upon a set of support services. These support services enable the information models to be simpler, and also enhance interoperability.

In defining these services, special effort will be taken to make use of some of the well-known web services. Specifically, this Recommendation will address the use of the web services notification as defined in [OASIS WSN] and web services UDDI service registration as defined in [OASIS UDDI] which will impact system interoperability (i.e., issues involving the use of web services within a single system are outside the scope of this Recommendation). Where network management needs cannot be met by the above mentioned well known web services, additional services will be defined.

6.2 Information modelling dependencies

As described in the previous clause, the explicit modelling of resources that are manageable across an interface is central to application interoperability. The guidelines for defining web services-based managed objects detailed in [ITU-T X.782] describe the rules for modelling manageable resources. They also embody several decisions that must be supported by the network management web services-based services framework. This clause summarizes those points.

6.2.1 Access granularity

Web services interface granularity refers to the relationship between the resources that are modelled on an interface and the means by which they are accessed using web services. [ITU-T X.782] uses a service-grain modelling approach which means each modelled resource is only accessible through a specific web service. The objects that represent manageable resources are called managed objects.

6.2.2 Representation of containment and naming

Containment is a logical representation of how modelled resources contain other modelled resources. Containment has traditionally been a very important relationship in network management applications because it is a convenient means of identifying the large number of resources that typically must be managed. [ITU-T X.782] guidelines require that a unique name be assigned to each managed object, based in part on the name of the object that contains it. The web services-based management services must provide the means to store these names (and hence the containment relationships they represent).

6.2.3 Object creation and deletion

The web services platforms do not provide clients with the means to create or delete objects on remote systems. Instead, these functionalities are provided by remote systems for clients to create or delete objects on the remote system. [ITU-T X.782] provides a common object accessing service, so object creation and deletion will be model-independent. When deleting an object that contains other objects, the containment relationship shall be kept, so that there will not be any orphan objects existing in the remote systems. The containment information should be stored in the remote system and be maintained when creation and deletion happen.

6.3 Scoping

The ability to perform complex queries (i.e., GET operations), updates (i.e., SET operations) and delete operations on a group of entities with a single operation request is a valuable component of TMN. Management systems may have to manage up to 10^7 instances of managed objects. Due to the size of the management information base, a managing system cannot efficiently perform ad hoc queries on individual instances of managed objects (i.e., entities). Rather, the managing system expects a level of intelligence to be supported by the managed system.

The intelligence in the managed system allows the managing system to select a group of managed entities on which an operation will be performed. Managed entity selection involves two phases: scoping. This managed entity selection process is supported by a service defined later in this Recommendation. This service allows a managing system to select a scope of objects to act on (scope is defined through containment relationships; see clause 6.2.2). Once the scope of entities is determined, the operation (specified by the scope request) is performed only on those entities.

The use of scoping in this framework supports:

- Scoped get: Returns the values (for a list of attributes) from each of the entities that meet the scope.
- Scoped update: Replaces an attribute value or adds/removes values to/from set-valued attributes, in the group of entities meeting the scope, to the values specified in the scoped request. May be used to update one or multiple attributes in a single object or multiple objects.
- Scoped deletion: Deletes all entities that meet the scope.

Scoping entails the identification of the entities to which a filter is to be applied. Scoping is applied based on the containment hierarchy as defined in clause 6.2.2. The scope is applied from a base managed entity down to a particular depth in the containment tree.

The base entity for the scope is defined as the root of the containment tree from which the search is to commence. A scoped request must specify the base managed entity of the scope. The depth of the scoping level can then be specified in one of four manners within the scoped request:

- 1) the base entity
- 2) the n-th level subordinates of the base entity
- 3) the base entity and all of its subordinates down to and including the n-th level
- 4) the base entity and all of its subordinates (i.e., the whole subtree).

6.4 Notifications

The framework needs to support the ability to:

- deliver notifications
- subscribe for notification types
- forward notifications to multiple destinations

- filter notifications
- uniquely identify the resource that emits the notification.

7 Framework overview and protocol requirements

7.1 Framework overview

This framework for web services-based management interfaces is a collection of capabilities. One part of the framework is a set of well-known web services. This framework defines their role in network management interfaces and defines conventions for their use. The framework also defines support services that have not been standardized in industry yet, but are expected to be standards on network management interfaces conforming to this framework. WSDL interfaces for these services are defined in Annex A.

To support the software objects representing manageable resources, the framework requires that they implement some common basic capabilities. Therefore, one base class is defined in [ITU-T X.782] for use in modelling network management resources. Managed object classes in information models must inherit and implement a basic set of capabilities from the base class in order to operate within this framework. Finally, some rules and conventions are defined for information modellers developing models for use with this framework. These consist of modelling guidelines and XML style idioms. All of these are depicted graphically in Figure 1.

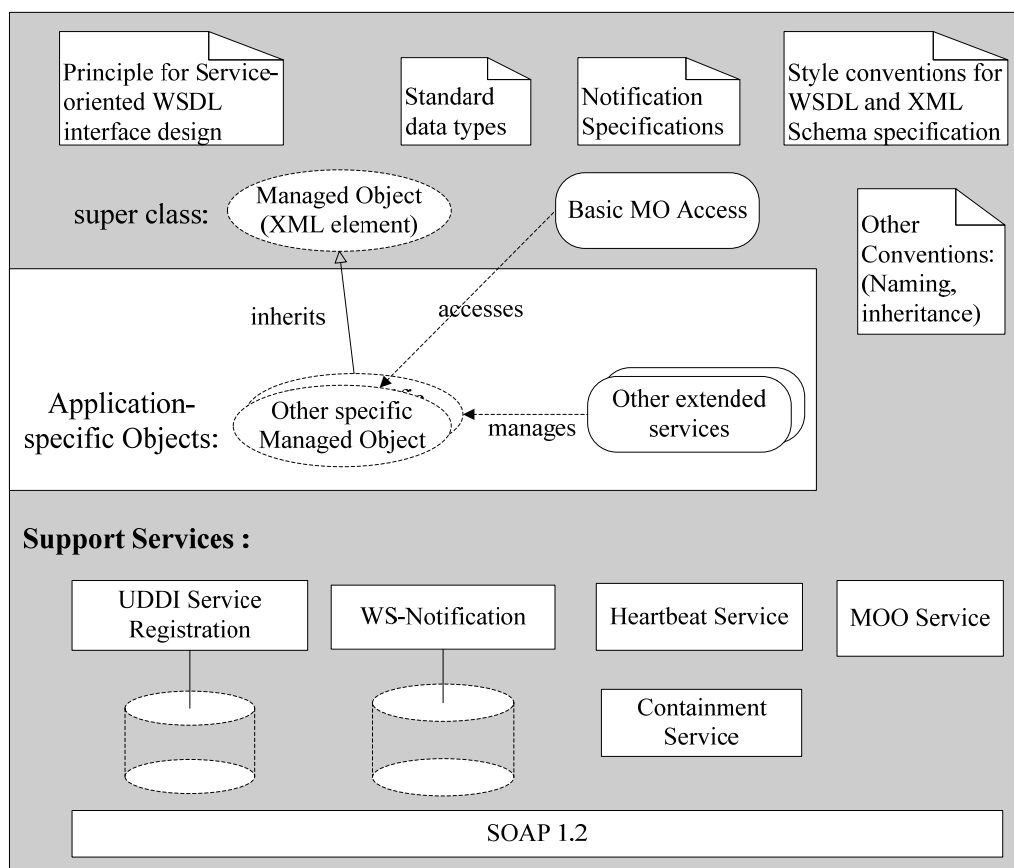


Figure 1 – Overview of a framework

Figure 1 shows the framework in grey. In the middle are the application-specific objects that are supported by the framework. Along the bottom is a box representing the communication protocol: SOAP. Above that are a number of boxes with names in them representing the services that compose the framework (some also have icons depicting the databases they would have to maintain

to perform their functions). Along the top of the figure are icons representing the super class managed object, and the basic MO accessing service. Each managed object supported by this framework must ultimately inherit from the super class. Also shown on Figure 1 are icons of pages with up-turned corners representing standard object modelling conventions.

The framework services, represented as boxes with square corners, are defined in this Recommendation. The super class, notifications, and object modelling conventions are defined in [ITU-T X.782].

7.2 Protocol, languages and services requirements

This clause defines the versions of the languages, protocol, and services that are required to support this framework. Web services basic technology and protocol specifications are defined by W3C, and two well-known services used in this framework are defined by OASIS. Table 1 shows which version (including subsequent versions released up until the date of this Recommendation) of the applicable specifications must be supported to comply with this framework.

Table 1 – Web services language, protocol and services versions

Service	Version
WSDL Recommendation (W3C)	1.1 (March, 2001)
XML schema Recommendation (W3C)	1.1 (October, 2004)
Web services base notification ([OASIS WSN])	1.3 (October, 2006)
UDDI specification ([OASIS UDDI])	3.0.2 (October, 2004)
SOAP (W3C)	1.2 (April 2007)

8 Usage of well-known web services

8.1 Web services base notification

This framework uses the OASIS web services base notification specification for transferring notifications needed in network management interfaces.

8.1.1 Web services base notification overview

Web services base notification (WSN) is a specification that define a standard web services approach to notification using a topic-based publish/subscribe pattern. The contents of WSN include standard message exchanges to be implemented by notification providers, operational requirements expected of service providers and requestors that participate in notifications, and an XML model that describes topics.

The web services base notification (WSN) supports the asynchronous exchange of event messages between clients using a subscribe-and-publish paradigm, as described in [OASIS WSN]. It also supports the filtering of notifications which are also needed in network management interfaces.

8.1.2 Mapping of operations from Recommendation ITU-T M.3702 and to WSN

The mechanisms and WSDL interfaces of the [OASIS WSN] specification will be used in this framework, but it is used as an internal functionality, which is not disposed to notification consumers directly. [ITU-T M.3702] provides protocol neutral requirements and analysis for generic notification management services, which define the generic functions that are to be implemented by a protocol-specific management paradigm. In this framework, the generic notification management model is mapped to WSDL/XML definitions and some of the WSDL operation are then mapped to [OASIS WSN] operations.

The following table indicates the mapping from [ITU-T M.3702] to the web services notification.

Table 2 – Mappings from [ITU-T M.3702] to this Recommendation and [OASIS WSN]

No.	[ITU-T M.3702]		ITU-T Q.818		[OASIS WSN]	
	Operation name		Operation name		Operation	
	Request/ response	Parameters	Request/ response	Parameters	Request/ response	Parameters
1	subscribeNotification		subscribeNotification		Subscribe	
	Input parameter	– managerId – notificationTypes – filteringCriteria – destination	Request	– managerId: type="nts:IdType" – notificationTypes: type="nts:Notification TypeListType" – filteringCriteria type="nts:FilterType" – destination: type= "wsa:EndpointReference Type"	Request	– consumerReference, – filter, – subscriptionPolicy, – initialTerminationTime
	Output parameter	– subscriptionId – status	Response	– subscriptionId: type="nts:IdType" – status: type="nts:StatusType"	Response	subscriptionReference
2	unsubscribeNotification		unsubscribeNotification		Unsubscribe	
	Input parameter	– managerId – subscriptionId	Request	– managerId type="nts:IdType" – subscriptionId type="nts:IdType"	Request	– subscriptionReference
	Output parameter	– status	Response	– status: type="nts:StatusType"	Response	NULL
3	suspendSubscription		suspendSubscription		PauseSubscription	
	Input parameter	– managerId – subscriptionId	Request	– managerId: type="nts:IdType" – subscriptionId: type="nts:IdType"	Request	– subscriptionReference
	Output parameter	– status	Response	– status type="nts:StatusType"	Response	NULL
4	resumeSubscription		resumeSubscriptions		ResumeSubscription	
	Input parameter	– managerId – subscriptionId	Request	– managerId: type="nts:IdType" – subscriptionId: type="nts:IdType"	Request	– subscriptionReference
	Output parameter	– status	Response	– status: type="nts:StatusType"	Response	NULL
5	getNotificationTypes		getNotificationTypes		---	
	Input parameter	– notificationIRPid	Request	– notificationIRPid: type="x782:NameType"		
	Output parameter	– status – notificationType List	Response	– notificationTypeList: type="nts:Notification TypeListType" – status type="nts:StatusType"		

Table 2 – Mappings from [ITU-T M.3702] to this Recommendation and [OASIS WSN]

No.	[ITU-T M.3702]		ITU-T Q.818		[OASIS WSN]	
	Operation name		Operation name		Operation	
	Request/ response	Parameters	Request/ response	Parameters	Request/ response	Parameters
6	querySubscription		querySubscription		–	
	Input parameter	– subscriptionId	Request	– subscriptionId: type="nts:IdType"		
	Output parameter	– subscribed NotificationType – subscriptionStatus – destination – filteringCriteria – status	Response	– notificationTypes: type="nts:Notification TypeListType" – subscriptionStatus: type="nts:Subscription StatusType" – destination: type="wsa: EndpointReference Type" – filteringCriteria: type= "nts:FilterType" – status type="nts:StatusType"		
7	modifySubscription		modifySubscription		--	
	Input parameter	– subscriptionId – filteringCriteria – destination – notificationTypes	Request	– subscriptionId: type="nts:IdType" – filteringCriteria: type="nts:FilterType" – destination: type= "wsa: EndpointReference Type" – notificationTypes: type="nts:Notification TypeListType"		
	Output parameter	– status	Response	– status type="nts:StatusType"		
8	listAllSubscriptionIds		listAllSubscriptionIds		--	
	Input parameter	– managerId	Request	– managerId: type="nts:IdType"		
	Output parameter	– subscriptionIdSet – status	Response	– subscriptionIdSet: type="nts:IdSetType" – status type="nts:StatusType"		
9	report notification:		– (Use WSN notify directly)		Notify:	
					notification Message	– SubscriptionReference – Topic – ProducerURL – Message
					Response	NULL

Table 3 gives additional descriptions for the mapping from the operations defined in this Recommendation to the ones defined in WS-Notification.

Table 3 – Additional descriptions for the mappings from the operations in [ITU-T M.3702]

Operation name	Request/ response	ITU-T Q.818	[OASIS WSN]
subscribe	Request	<i>managerId</i>	There is no such managerId parameter in WS-Notification and this parameter will only be processed and stored by an agent, not by WS-Notification.
		<i>filterCriteria</i>	<i>Filter</i>
		<i>destination</i>	<i>ConsumerReference</i>
		<i>NotificationTypes</i>	There is no direct mapping in WSN corresponding to this NotificationTypes, but the filter parameter in WSN can support the function of filtering supported notification types.
		–	<i>subscriptionPolicy</i> This parameter is optional in WSN, which can be raw or any value in Notify message. Notify message can provide more information in a message according to the WSN definition. In the mapping of such an operation, the value of subscriptionPolicy should always use the Notify message in this Recommendation.
		–	<i>initialTerminationTime</i> initialTerminationTime indicates the termination time of a subscription. When the value of attribute xsi:nil is true, there is no limit for the subscription. In this Recommendation, the default value for this parameter in WSN will be xsi:nil= true.
	Response	subscriptionId	subscriptionReference
unsubscribe	Request	managerId	There is no such concept as managerId in WSN which will be processed and stored in the agent itself. The type is a string at this moment.
		subscriptionId	subscriptionReference
suspendSubscription	Request	managerId	There is no such concept as managerId in WSN which will be processed and stored in the agent itself. The type is a string at this moment.
		subscriptionId	subscriptionReference
resumeSubscription	Request	managerId	There is no such concept as managerId in WSN which will be processed and stored in the agent itself. The type is a string at this moment.
		subscriptionId	subscriptionReference

Table 3 – Additional descriptions for the mappings from the operations in [ITU-T M.3702]

Operation name	Request/ response	ITU-T Q.818	[OASIS WSN]
getNotificationTypes			There are no corresponding operations defined in WSN, and they should be implemented by an agent itself.
querySubscription			
modifySubscription			
listAllSubscriptionIds			
notify			In this Recommendation, the notify operation from WSN is used directly in an agent.

A detailed interface definition can be found in clause A.1.

8.1.3 Notification format definitions

8.1.3.1 Notification format to be used in this Recommendation

The following table provides the notify operations defined in [OASIS WSN] which will be used in this Recommendation when sending notifications.

Table 4 – Notify operations from [OASIS WSN]

<pre> <wsnt:Notify> <wsnt:NotificationMessage> <wsnt:SubscriptionReference> wsa:EndpointReferenceType </wsnt:SubscriptionReference> ? <wsnt:Topic Dialect="xsd:anyURI"> {any} ? </wsnt:Topic>? <wsnt:ProducerReference> wsa:EndpointReferenceType </wsnt:ProducerReference> ? <wsnt:Message> {any} </wsnt:Message> </wsnt:NotificationMessage> + {any} * </wsnt:Notify> </pre>
--

In this Recommendation not all the above components will be used. More detailed descriptions of the above components which can or cannot be used in this Recommendation are shown below:

- The WS-Addressing [action] Message Addressing Property MUST contain the URI <http://docs.oasis-open.org/wsn/bw-2/NotificationConsumer/Notify>.

The components of the notify message are described as follows:

`/wsnt:Notify`

contains a collection of one or more NotificationMessages:

`/wsnt:Notify/wsnt:NotificationMessage`

This contains:

— a notification payload:

`/wsnt:Notify/wsnt:NotificationMessage/wsnt:SubscriptionReference`

This is an `EndpointReference` to the subscription that is associated with the notify message. This component is optional.

`/wsnt:Notify/wsnt:NotificationMessage/wsnt: ProducerReference`

This is an `EndpointReference` to the `NotificationProducer` that produced the notification artefact. This component is optional:

`/wsnt:Notify/wsnt:NotificationMessage/wsnt:Topic`

This is a `TopicExpression` describing exactly one topic, which **MUST** be the topic that is associated with the notification. This element describes the topic that matched to a subscription, causing the `NotificationProducer` to send the notify message to the `NotificationConsumer`. This component is also optional.

`/wsnt:Notify/wsnt:NotificationMessage/wsnt:Topic/@Dialect`

This is the dialect used in the `TopicExpression`. This **MUST** be the same dialect used by the subscriber when it created the subscription that yielded this notify message.

`/wsnt:Notify/wsnt:NotificationMessage/wsnt:Message`

This is a copy of the actual notification payload. This component is of any type, and will be replaced by predefined notification types, which are defined in clause A.5 and will be explained later.

and any metadata components:

`/wsnt:Notify/{any}`

The raw data shall not be used in this Recommendation.

The most simplified notification message format that can be used in this Recommendation is shown in Table 5.

Table 5 – Most simplified notification format in this Recommendation

<pre><wsnt:Notify> <wsnt:NotificationMessage> <wsnt:Message> {any} </wsnt:Message> </wsnt:NotificationMessage> + </wsnt:Notify></pre>

8.1.3.2 Common notification header definition

This clause provides the detailed common notification header described in [ITU-T M.3702].

The following table provides the definition of the parameters of the common notification header.

Table 6 – Common notification header definition

Parameter name	Qualifiers	XSD data type	Descriptions
objectClass	M	xsd:string	It is the class name of the MO which sends out this notification. See clause 7.3.5 of [ITU-T M.3702]
objectInstance	M	x782:NameType	It is the DN of the MO which sends out this notification. See clause 7.3.5 of [ITU-T M.3702]
notificationId	M	782:NotificationIdType	It is the Identifier of the notification for the purpose of notification correlation. See clause 7.3.5 of [ITU-T M.3702]
eventTime	M	xsd:dateTime	It is the time when this event happened. See clause 7.3.5 of [ITU-T M.3702]
systemDN	M	x782:NameType	It is the DN of the system which sends out this notification. See clause 7.3.5 of [ITU-T M.3702]
notificationType	M	nts:NotificationTypeType	It indicates the type of notification. See clause 7.3.5 of [ITU-T M.3702]. The possible common notification types defined in this Recommendation can be the following: – attributeValueChange – objectCreation – objectDeletion – stateChange – communicationsAlarm – environmentalAlarm – equipmentAlarm – processingErrorAlarm – qualityOfServiceAlarm – integrityViolation – operationalViolation – physicalViolation – securityViolation – timeDomainViolation – relationshipChange – heartbeat This list can be extended to include new notification types as and when they are defined.

8.1.3.3 Common notification contents definition

- 1) Notification contents for the objectCreation and objectDeletion notifications.

Table 7 – Notification contents for objectCreation and objectDeletion

Notification parameter	Qualifiers	Data type	Descriptions
correlatedNotifications	O	x782:CorrelatedNotificationType	List of correlated notifications.
additionalText	O	xsd:string	Text message.
additionalInfo	O	x782:AdditionalInformationSetType	Additional information not in text format.
sourceIndicator	O	x782:SourceIndicatorType	Cause of event.
attributeList	O	x782:AttributeNameAndValueType	Attribute values.

- 2) Notification contents for the attributeValueChange notification.

Table 8 – Notification contents for attributeValueChange

Notification parameter	Qualifiers	Data type	Descriptions
correlatedNotifications	O	x782:CorrelatedNotificationType	List of correlated notifications.
additionalText	O	xsd:string	Text message.
additionalInfo	O	x782:AdditionalInformationSetType	Additional information not in text format.
sourceIndicator	O	x782:SourceIndicatorType	Cause of event.
attributeChanges	M	x782:AttributeValueChangeSetType	Changed attributes.

- 3) Notification contents for the stateChange notification.

Table 9 – Notification contents for stateChange

Notification parameter	Qualifiers	Data type	Descriptions
correlatedNotifications	O	x782:CorrelatedNotificationType	List of correlated notifications.
additionalText	O	xsd:string	Text message.
additionalInfo	O	x782:AdditionalInformationSetType	Additional information not in text format.
sourceIndicator	O	x782:SourceIndicatorType	Cause of event.
stateChanges	M	x782:AttributeValueChangeSetType	Changed states.