



Lightweight M2M – Virtual Observe Notify

Candidate Version 1.0 – 03 Apr 2019

Open Mobile Alliance
OMA-TS-LwM2M_VirtualObserveNotify-V1_0-20190403-C

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1. Scope

This document defines an Object to be used to flexibly report resources across different objects in a single client notification message under different conditions and rules.

2. References

2.1 Normative References

- [RFC2119] “Key words for use in RFCs to Indicate Requirement Levels”, S. Bradner, March 1997,
[URL:http://www.ietf.org/rfc/rfc2119.txt](http://www.ietf.org/rfc/rfc2119.txt)
- [RFC4234] “Augmented BNF for Syntax Specifications: ABNF”. D. Crocker, Ed., P. Overell. October 2005,
[URL:http://www.ietf.org/rfc/rfc4234.txt](http://www.ietf.org/rfc/rfc4234.txt)
- [SCRRULES] “SCR Rules and Procedures”, Open Mobile Alliance™, OMA-ORG-SCR_Rules_and_Procedures,
[URL:http://www.openmobilealliance.org/](http://www.openmobilealliance.org/)

2.2 Informative References

3. Terminology and Conventions

3.1 Conventions

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in [RFC2119].

All sections and appendixes, except “Scope” and “Introduction”, are normative, unless they are explicitly indicated to be informative.

3.2 Definitions

3.3 Abbreviations

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4. Introduction

The Information Reporting Interface is used by a LwM2M Server to observe any changes of resources on a registered LwM2M Client, receiving notifications when new values are available. In LightweightM2M version 1.0, a single notification message can only include resources in a single object. In LightweightM2M version 1.1, the LwM2M Enabler can support a mechanism for atomic reporting of resources across different objects in a single notification. However, the conditions and rules of a notification message are too simple to satisfy complex scenarios that described as follows:

- The notification message can only be sent when multiple subscription conditions are met at the same time.
- Only some of the observed resources are included in the notification message, and other resources are only used as subscription conditions.
- Compared with the last notification message, this notification message only contains the changed resources.

In order to satisfy the requirements described above, this specification defines an Object to realize flexibly reporting resources across different objects in a single client notification message under different conditions and rules.

4.1 Version 1.0

Version 1.0 of the Virtual Observe Notify object is used to support following functionalities.

1. Reporting resources across different objects in a single client notification message.
2. Supporting AND conditions for subscription, that is, a single client notification can be sent just when multiple subscription conditions are met at the same time.
3. Using resources as only the condition for Observe operation.
4. Reporting changed resources by a notification message.

5 Virtual Observe Notify Use cases

5.1 Overview

The Virtual Observe Notify Object provides a mechanism to observe and notify multiple resources by less messages between LwM2M Client and Server which are in one object/object instance or across multiple objects/object instances. This mechanism can reduce the message numbers and improve communication efficiency between LwM2M Client and LwM2M Server.

5.2 Observe and Notify Multiple Resources

This use case describes the procedure when the LwM2M Server wants to get the report of multiple Resources of different Objects. It specifies the usage of Resource “ObserveLinks” and “Report”.

The LwM2M Server initiates a Write request for changes of the Resource ObserveLinks (/22/0/0), which includes the Resources within an Object or different Objects within the LwM2M Client.

For example, the LwM2M Server wants to get the report of the Radio Signal Strength (/4/0/2) and Battery Level (/3/0/9) resources when the Radio Signal Strength is less than -120dBm or the Battery Level is less than 50%.

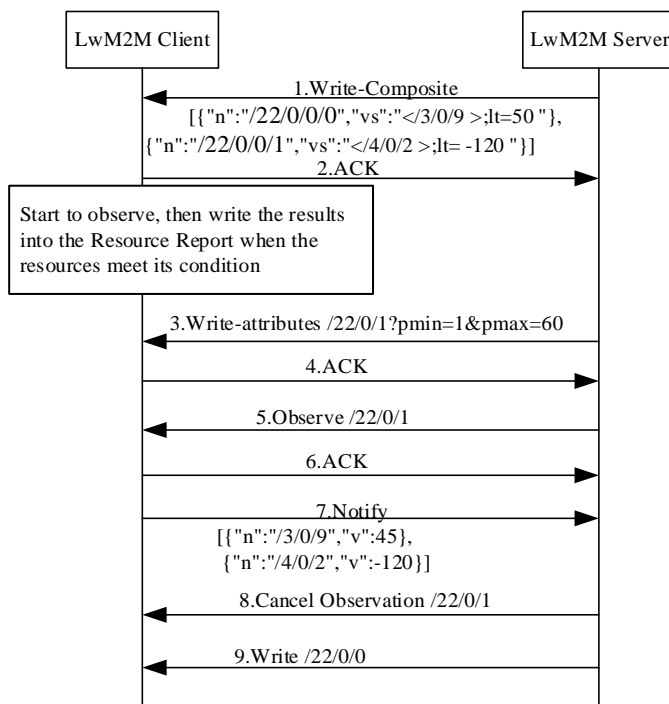


Figure 1 - Example flow for observing and notifying multiple Resources

Step 1: The LwM2M Server sends the Write-Composite request to LwM2M Client to observe multiple resources which are included in the Resource ObserveLinks (/22/0/0). The payload in the request is an array of application/link-format CoRE Links. In this example, the payload includes Radio Signal Strength (/4/0/2) and Batter Level (/3/0/9) with their “lt” Attributes.

Step 2: The LwM2M Client sends the ACK to the LwM2M Server and starts to observe the two resources. When any of the two resource meets its condition set by the LwM2M Server using R-Attributes, the LwM2M Client writes the two resources into the Resource Report (/22/0/1).

Step 3: The LwM2M Server sends the Write-attribute request to the LwM2M Client to update the Attributes attached to the Resource /22/0/1 (Report).

Step 4: The LwM2M Client sends the ACK to the LwM2M Server.

Step 5: The LwM2M Server initiates an observation request for changes of the Resource Report (/22/0/1) within the LwM2M Client.

Step 6: The LwM2M Client sends the ACK to the LwM2M Server.

Step 7: The LwM2M Client sends the Notify message to the LwM2M Server when the timer expires.

Step 8: The LwM2M Server sends Cancel Observation operation to the LwM2M Client to stop the observation of the Resource Report within the LwM2M Client.

Step 9: The LwM2M Server sends Write request to LwM2M Client to stop the observation of the resources which are included in the Resource ObserveLinks.

5.3 Observe Multiple Resources and Notify Changed Resources

This use case describes the procedure when the LwM2M Server wants to get the changed Resources in the multiple Resources. It specifies the usage of Resource “ResourceFilter”.

The LwM2M Server initiates a Write request for changes of the Object Instant (/22/0), the payload includes ObserveLinks (/22/0/0) and ResourceFilter (/22/0/2).

For example, the DM server (LwM2M Server) needs changed Resources of the Device Object (/3/0) and Connectivity Monitoring Object (/4/0) of the water meter (LwM2M Client) via NB-IoT to monitor the device.

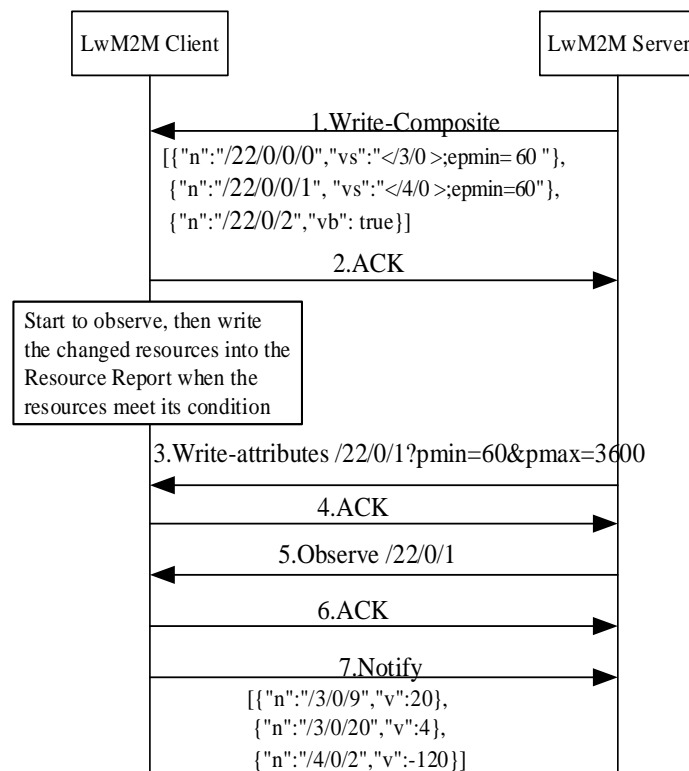


Figure 2 - Example flow for Observing Multiple Resources and Notifying Changed Resources

Step 1: The LwM2M Server sends the Write-Composite request to LwM2M Client to observe multiple resources which are included in the Resource ObserveLinks (/22/0/0). The request payload includes the Resource ObserveLinks (/22/0/0) and Resource ResourceFilter (/22/0/2). In this example, the value of the Resource ObserveLinks are Device Object Instance 0 and Connectivity Monitoring Object Instance 0; the value of the Resource ResourceFilter is 1.

Step 2: The LwM2M Client sends the ACK to the LwM2M Server and starts to observe the two object instance. When any Resource of two Objects is changed compared with the last notification message and meets its condition set by the LwM2M Server using R-Attributes, the LwM2M Client writes the changed Resources into the Resource Report (/22/0/1). The Resources which are not changed compared with the last notification aren't written into the Resource Report (/22/0/1).

Note: If any Resource of two Objects is not changed which is compared with the value in the last notification message, the LwM2M Client doesn't write any Resource into the Resource Report (/22/0/1).

Step 3: The LwM2M Server sends the Write-attribute request to the LwM2M Client to update the Attributes' values of Resource Report (/22/0/1).

Step 4: The LwM2M Client sends the ACK to the LwM2M Server.

Step 5: The LwM2M Server initiates an observation request for changes of the Resource Report (/22/0/1) within the LwM2M Client.

Step 6: The LwM2M Client sends the ACK to the LwM2M Server.

Step 7: The LwM2M Client sends the Notify message to the LwM2M Server including the changed resources in the Resource ObserveLink.

5.4 Observe Multiple Resources and Notify Different Resources

This use case describes the procedure when the LwM2M Server wants to get the different Resources from observed the multiple Resources. It specifies the usage of Resource "ReportLinks" and "ObserveRelation".

The LwM2M Server initiates a Write request for changes of the Object Instant (/22/0), the payload includes ObserveLinks (/22/0/0), ReportLinks (/22/0/3) and ObserveRelation (/22/0/4).

For example, the shared bike operator need protect the shared bike security. The LwM2M Server needs location (/6/0/1 and /6/0/2) of Device Object (/6/0) when the state of the lock is switched-off and the speed of the client is more than 1. The notification may trigger the LwM2M Server to trace the client and or do other processing.

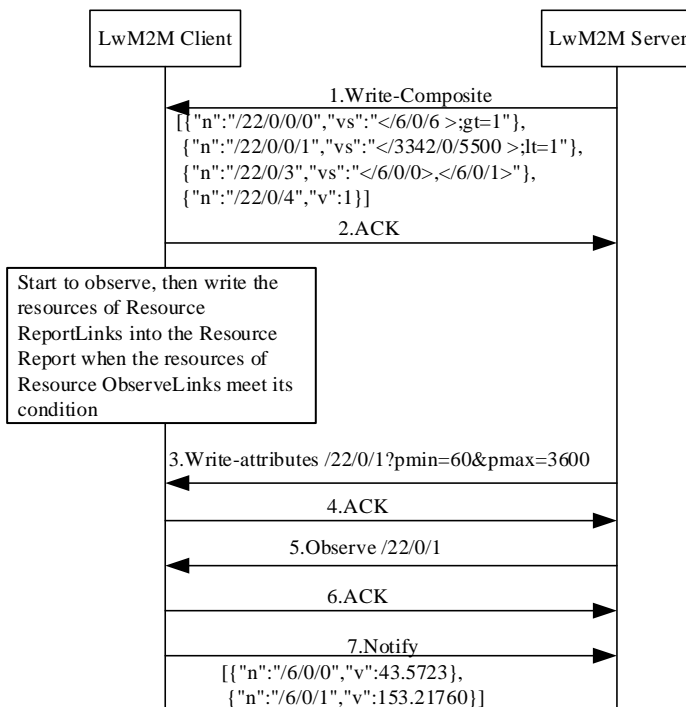


Figure 3 - Example flow for Observing Multiple Resources and Notifying Different Resources

Step 1: The LwM2M Server sends the Write-Composite request to LwM2M Client to observe multiple resources which are included in the Resource ObserveLinks (/22/0/0). The request payload includes the Resource ObserveLinks (/22/0/0), ReportLinks (/22/0/3) and ObserveRelation (/22/0/4). In this example, the value of the Resource ObserveLinks are the Resource Speed (/6/0/6) of Location Object (/6/0) with the “gt” attribute, and the Digital Input State resource (/3342/0/5500) of On/Off switch Object (/3342/0) with the “lt” attribute. The value of the Resource ReportLinks are the Resource Latitude (/6/0/0) and the Resource Longitude (/6/0/1). The value of ObserveRelation is 1.

Step 2: The LwM2M Client sends the ACK to the LwM2M Server and starts to observe the two resources. When the Digital Input State resource and the Resource Speed meet its condition set by the LwM2M Server using R-Attributes at the same time, that is the state of the lock is switched-off and the Speed of the bike is more than 1, the LwM2M Client writes the value of the Resource Latitude (/6/0/0) and Resource Longitude (/6/0/1) into the Resource Report (/22/0/1).

Step 3: The LwM2M Server sends the Write-attribute request to the LwM2M Client to update the Attributes' values of Resource /22/0/1 (Report).

Step 4: The LwM2M Client sends the ACK to the LwM2M Server.

Step 5: The LwM2M Server initiates an observation request for changes of the Resource Report (/22/0/1) within the LwM2M Client.

Step 6: The LwM2M Client sends the ACK to the LwM2M Server.

Step 7: The LwM2M Client sends the Notify message to the LwM2M Server including the resources in the Resource ReportLinks.

5.5 Observe Multiple Resources and Notify Partial Resources

This use case describes the procedure when the LwM2M Server wants to get the partial Resources in the multiple Resources. It specifies the usage of Resource “ReportLinks” and “ObserveRelation”.

The LwM2M Server initiates a Write request for changes of the Object Instant (/22/0), the payload includes ObserveLinks (/22/0/0), ReportLinks (/22/0/3) and ObserveRelation (/22/0/4).

For example, the LwM2M Server want to check the NB-IoT network coverage, and ask the LwM2M Client to report Radio Signal Strength when Network Bearer is NB-IoT and Radio Signal Strength is less than one threshold.

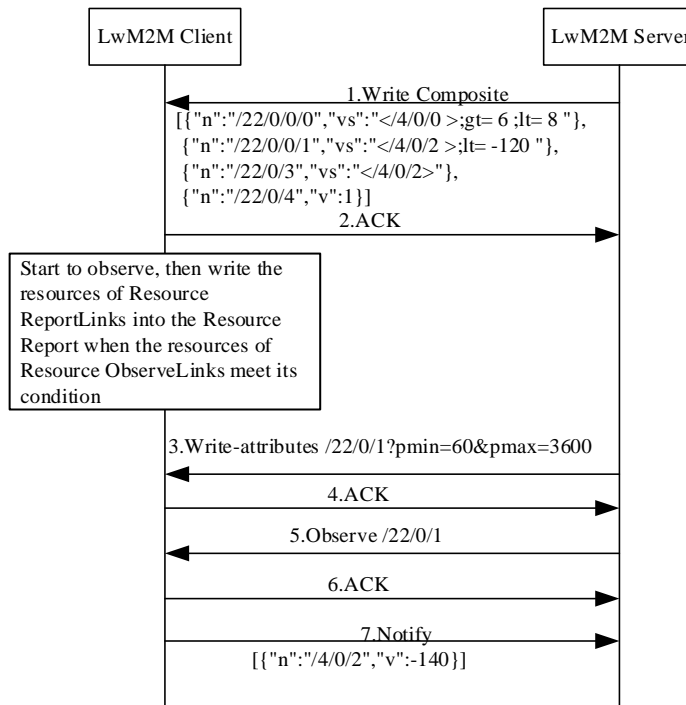


Figure 4 - Example flow for Observing Multiple Resources and Notifying Partial Resources

Step 1: The LwM2M Server sends the Write-Composite request to LwM2M Client to observe multiple resources which are included in the Resource ObserveLinks (/22/0/0). The request payload includes the Resource ObserveLinks (/22/0/0), ReportLinks (/22/0/3) and ObserveRelation (/22/0/4). In this example, the value of the Resource ObserveLinks are the Resource Network Bearer (/4/0/0) of Connectivity Monitoring (/4/0) with the “gt” and “lt” attribute, and the Resource Radio Signal Strength (/4/0/2) of Connectivity Monitoring (/4/0) with the “lt” attribute . The value of the Resource ReportLinks are the Resource Radio Signal Strength (/4/0/2). The value of ObserveRelation is 1.

Step 2: The LwM2M Client sends the ACK to the LwM2M Server and starts to observe the two resources. When the Network Bearer and Radio Signal Strength respectively meets its condition set by the LwM2M Server using R-Attributes and meets the report conditions which is the value of the ObserveRelation Resource, the LwM2M Client writes the value of the Resource Radio Signal Strength (/4/0/2) into the Resource Report (/22/0/1).

Step 3: The LwM2M Server sends the Write-attribute request to the LwM2M Client to update the Attributes’ values of Resource /22/0/1 (Report).

Step 4: The LwM2M Client sends the ACK to the LwM2M Server.

Step 5: The LwM2M Server initiates an observation request for changes of the Resource Report (/22/0/1) within the LwM2M Client.

Step 6: The LwM2M Client sends the ACK to the LwM2M Server.

Step 7: The LwM2M Client sends the Notify message to the LwM2M Server.

6 LWM2M Object: Virtual Observe Notify

Description

The Virtual Observe Notify Object provides a main function to notify multiple resources to a LwM2M Server in one notification message whether the resources are in one object/object instance or across multiple objects. The Virtual Observe Notify Object also provides some functions to implement more efficient multi-resource report.

Object definition

Name	Object ID	Object Version	LWM2M Version
Virtual Observe Notify	22	1.0	1.1
Object URN	Instances	Mandatory	
urn:oma:lwm2m:oma:22	Multiple	Optional	

Resource Definitions

ID	Name	Operations	Instances	Mandatory	Type	Range or Enumeration	Units	Description
0	ObserveLinks	RW	Multiple	Mandatory	CoreLink			<p>Array of Core Links where each element includes a Resource ID or Object Instance ID to be observed and its observation criteria (lt, gt, st, pmin, pmax).</p> <p>When the LwM2M Server write the resources or object instances to this Resource, the LwM2M Client starts to observe these resources.</p> <p>When the LwM2M Server write empty string to this Resource, the LwM2M Client stop to observe resources.</p>
1	Report	R	Single	Mandatory	String			<p>This resource is populated by the LwM2M Client each time an observed resource from ObserveLinks meets its observation criteria, thereby resulting in a notification to a LwM2M Server that is observing Report resource. The string format MUST be SenML JSON</p>
2	ResourceFilter	RW	Single	Optional	Boolean			<p>Used by the LwM2M Server to indicate that the LwM2M Client whether report send all resources instances of ObserveLinks or changed instances of ObserveLinks changed resources in the ObserverLinks.</p> <ul style="list-style-type: none"> •false: report all Resources, •true: report only changed Resources. <p>When it is absent, the LwM2M</p>

							Client shall report all Resources as default.
3	ReportLinks	RW	Multiple	Optional	Corelnk		<p>Array of Core Links where each element includes the Resources ID to be included in the notification.</p> <p>If ReportLinks Resource is absent, the notification sent to the LwM2M Server will only include the Resources in ObserveLinks.</p> <p>If the ReportLinks Resource is present, the notification sent to the LwM2M Server will only include the Resources that are listed in ReportLinks and not include the value of the Resource ObserveLinks.</p> <p>To provide maximum flexibility to the server the Notifications will not comprise the union of resources in ObserveLinks and ReportLinks when both present.</p>
4	ObserveRelation	RW	Single	Optional	Integer		<p>Used by the server to indicate the AND/OR logic relationship combination between or among resources included in ObserveLinks Resource.</p> <ul style="list-style-type: none"> •0: OR •1: AND •2 reserved value. <p>When it is absent, the relationship among the instances of ObserveLinks is OR as default.</p>

Notes:

- (1) When the ResourceFilter is set to TRUE, this condition takes precedence over any pmax. Namely, when the LwM2M Server set the Resource ResourceFilter to TRUE, whatever the pmax attribute is attached to any resource included in the ObserveLinks, the Report is only populated by the LwM2M Client each time the resources included in the ObserveLinks are changed.
- (2) Any default pmax and pmin values which have been configured in the Server Object should not apply to VirtualObserveNotify and each instance of this object should use explicit pmin and pmax as requested by the LwM2M Server when setting up notifications.

Appendix A. Change History (Informative)

A.1 Approved Version History

Reference	Date	Description
n/a	n/a	No prior version

A.2 Draft/Candidate Version 1.0 History

Document Identifier	Date	Sections	Description
Draft Versions OMA-TS- LwM2M_VirtualObserveNotify-V1_0	22 Oct 2018	Appendix C	OMA-IPSO-2018-0068R01- CR_Usecase_and_Object_for_VirtualObserveNotify
	22 Oct 2018	Section 5, 6, 7	OMA-IPSO-2018-0069R01- CR_example_for_VirtualObserveNotify_Object
	31 Oct 2018	Section 5,	Agreed CR; OMA-IPSO-2018-0076-CR_Bug_Fix_for_VirtualObserveNotify
	03 Feb 2019	Section 5, 6	Agreed CR; OMA-IPSO-2019-0003R01-CR_Bug_Fix_for_VirtualObserveNotify
	19 Feb 2019	Section 5, 6	Agreed CR; OMA-IPSO-2019-0031-CR_VirtualObserveNotify_Editorials
	03 Apr 2019	Sections 5.2 - 5.5	Agreed CR: OMA-IPSO-2019-0051R02-CR_Bug_Fix_for_VirtualObserveNotify
Candidate Version OMA-TS- LwM2M_VirtualObserveNotify-V1_0	03 Apr 2019	n/a	Status changed to Candidate by IPSO WG IPSO WG ref # OMA-IPSO-2019-0049R01- MINUTES_01Apr2019_F2F_Porto

Appendix B. Static Conformance Requirements (Normative)

The notation used in this appendix is specified in [SCRRULES].

B.1 SCR for XYZ Client

Item	Function	Reference	Requirement
XYZ-C-001-M	Something mandatory	Section x.y	(XYZ-C-004-O OR XYZ-C-003-M) AND XYZ-C-002-O
XYZ-C-002-O	Something optional	Section x.y	
XYZ-C-003-M	Dependencies on ZYX	Section x.y	ZYX:MCF
XYZ-C-004-O	Dependencies on ZYX	Section x.y	ZYX:OCF

B.2 SCR for XYZ Server

Item	Function	Reference	Requirement
XYZ-S-001-M	Something mandatory	Section x.y	XYZ-S-004-O OR XYZ-S-002-O OR XYZ-S-003-M
XYZ-S-002-O	Something optional	Section x.y	
XYZ-S-003-M	Dependencies on ZYX	Section x.y	ZYX:MSF
XYZ-S-004-O	Dependencies on ZYX	Section x.y	ZYX:OSF

Appendix C. Object Instance Example (Informative)

Object	Object ID	Object Instance ID
Virtual Observe Notify Object[0]	22	0

Table 1: Object Instances of the example

Resource Name	Resource ID	Resource Instance ID	Value	Notes
ObserveLinks	0	0	{</6/0/6>;gt="1"}	In this example, the resource link is the Resource Speed (/6/0/6) of Location Object (/6/0) with the "gt" attribute which is set to 1.
ObserveLinks	0	1	{</3342/0/5500>;pmin=60}	In this example, the resource link is the Resource Digital Input State resource (/3342/0/5500) of On/Off switch Object (/3342/0) with the pmin is 60.
Report	1		[{ "n": "/6/0/0", "v": "43.5723" }, { "n": "/6/0/1", "v": "153.23760" }]]]	In this example, the value of this Resource is the Resource Latitude (/6/0/0) whose value is 43.5723, and the Resource Longitude (/6/0/1) whose value is 153.23760.
ReportLinks	3	0	</6/0/0>	In this example, the value of this resource instance is the Resource Latitude (/6/0/0).
ReportLinks	3	1	</6/0/1>	In this example, the value of this resource instance is the Resource Longitude (/6/0/1).
ObserveRelation	4		1	

Table 2: Virtual Observe Notify Object Instance [0]