INPUT CONTRIBUTION

Group Name:*	WG2
Title:*	Discussions on Triggering Aspects in oneM2M
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Abstract:*	This paper provides illustration on different triggering models in oneM2M. The paper provides some recommendations on how oneM2M device triggering for 3GPP Underlying Networks can be realized.
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0. Introduction:

This paper addresses some issues related to device triggering aspects, such as the following:

- What entities/Nodes should be capable of receiving device trigger? The requirement has been to allow ADN-AE, ASN-CSE, MN-CSE, ASN-AE and MN-AE to be able to receive triggers.
- Should the Infrastructure Node be able to initiate device trigger only for refreshing (stale) IP addresses or also for the case when there is no IP address (pointOfAccess) for the triggered entity is available? The first case relates to refreshing "pointOfAccess" from previous registration of an AE/CSE. The second case relates to when no such registration for the target entity is available at the IN-CSE
- How do the oneM2M Infrastructure Node and the device trigger receiving entities (ADN-AE, ASN-CSE, MN-CSE, ASN-AE and MN-AE) agree on the value of Application Port Identifier field? Such Application Port ID is used by many Devices that are currently deployed, e.g., by the MTC-UEs deployed in 3GPP networks.
- What parameters are used by oneM2M Infrastructure Node in the message used for Device Trigger Request to the Interworking-IWF in the Underlying Network (over Mcn reference point). The point of discussion mainly relates to "Application Port Identifier" and the "code value(s)" to be used for Application Port Identifier.

Some other issues have also been raised, such as the following:

- Should proxying be permitted/enabled and for which scenarios?

On the question: what functionality may be enabled through the information included in the device trigger "payload", e.g., if the purpose of the trigger is to renew the IP address or to perform some other action - such as for the case when no IP address is available, please see the Recommendations section at the end of the paper.

1. Background:

Two types of oneM2M Nodes are supported by oneM2M - CSE-capable Nodes and non-CSE-capable Nodes. Examples of CSE-capable Nodes include ASNs, MNs and INs. Examples of non-CSE-capable Nodes include ADNs, Node-less-AEs. Figure-1 shows possible configurations supported by oneM2M.

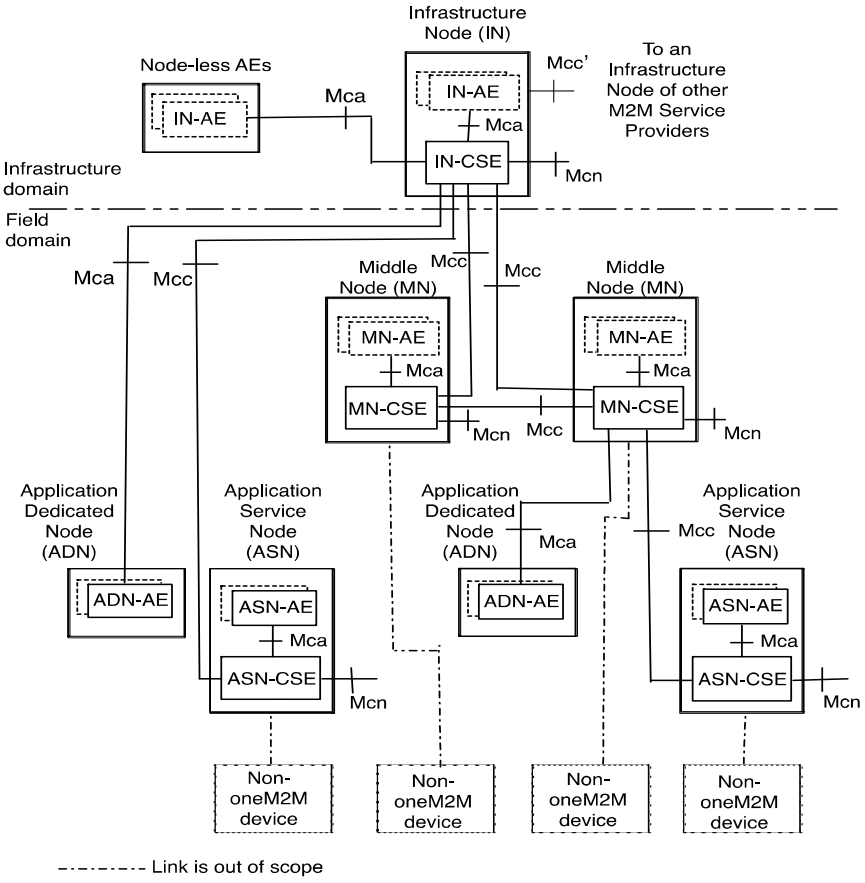


Figure-1: Configurations supported by oneM2M Architecture

It should be possible for the Infrastructure Node (IN) to trigger both types of Nodes - the CSE-capable Nodes and non-CSE-capable Nodes. It should also be possible to trigger specific AEs on such Nodes.

A typical M2M Device should be able to support oneM2M specific AEs, and other non-oneM2M APPs and capabilities as well. Such other capabilities include SMS, IMS, Voice and Video etc. Examples of other non-oneM2M APPs are APPs such as those supported on typical smart-devices. In summary, the following are capabilities for device triggering that need to be supported:

1. Model-1: Ability to trigger AEs on CSE-capable oneM2M Nodes (ASN, MN).
2. Model-2: Ability to trigger AEs on non-CSE-capable oneM2M nodes (ADNs).
3. Along with (1) and (2), the ability to trigger non-oneM2M APPs on both, the CSE-capable and non-CSE capable oneM2M nodes.
4. Model-3: The ability for an IN-CSE to trigger a oneM2M Node to cause such Node to initiate registration with the IN-CSE. In this case, individual AEs on target Nodes are not triggered. The trigger is directed to the Node itself.

2. Which Model of Device Triggering?

2.1 Model-1:

AEs local on an ASN or an MN, register with the local CSE. Such CSE (ASN-CSE, MN-CSE) in turn registers with IN-CSE, resulting in the creation of <remoteCSE> resource (under CSEBase) at both registering entities. Such <remoteCSE> resource provides "pointOfAccess" attribute, the physical address that is used for the routing of CRUD messages between the respective Nodes. In case the physical address in "pointOfAccess" attribute is non-routable (e.g., stale IP address), device triggering can be used to initiate communications with the target AE.

Model-1 of device triggering is applicable for such scenarios. In this model, AEs on ASNs and MNs should be able to be triggered.

Model-1 of device triggering is also applicable for AEs on non-CSE capable Nodes (ADNs) that are registered with a CSE on an ASN or on an MN.

2.2 Model-2:

For AEs on non-CSE capable Nodes (ADNs) that register directly with the IN, the above stated model does not apply. In this case Model-2 of device triggering is used.

The following discussions provide some further details on these two device triggering models.

2.3 Model-3:

Model-3 is similar to Model-1, except the device trigger is directed to the Node itself (ASN, ADN. MN). Individual AEs on such Nodes cannot be triggered.

3. Model-1 Device Triggering Illustration

3.1. Non-oneM2M Devices:

Figure A-1 is an example illustration of a typical smart-device. The focus of this illustration is on the non-oneM2M APPs. Triggering for such APPs (e.g., by the use of SMS) is described in specifications such as those being developed by 3GPP (TS23.682). Individual APPs are triggered by the use of Application Port ID that is carried in the header of the device trigger message (e.g, SMS). The objective of this paper is to examine how such device triggering model can be used for oneM2M Nodes as well. The objective includes the capability of being able to trigger both oneM2M specific AEs and non-oneM2M APPs on the same Device.

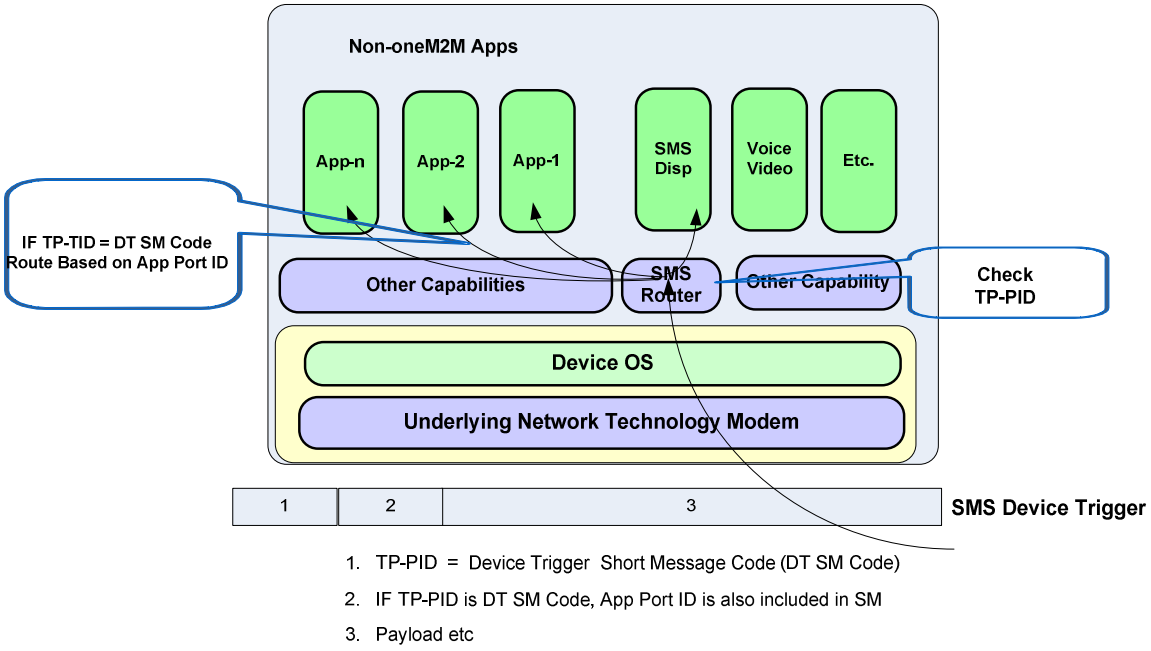


Figure A-1: An example Illustration of Non-oneM2M Device

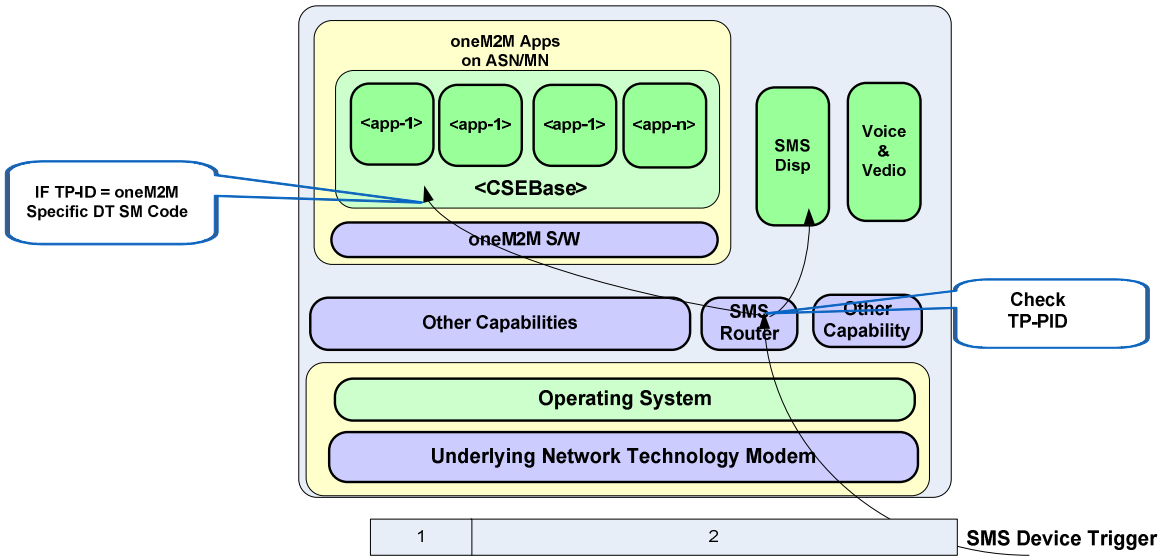
3.2 CSE-capable oneM2M Devices:

Figure B-1 is an example illustration of a CSE-capable oneM2M Device. The focus of this illustration is on the "AEs" and the routing aspects for the device trigger (e.g., SMS) messages. There is no attempt to illustrate specific internal construct of such devices.

In addition to supporting oneM2M CSE and AEs, it is assumed that such devices provide other capabilities as well, such as SMS, IMS, Voice, Video etc.

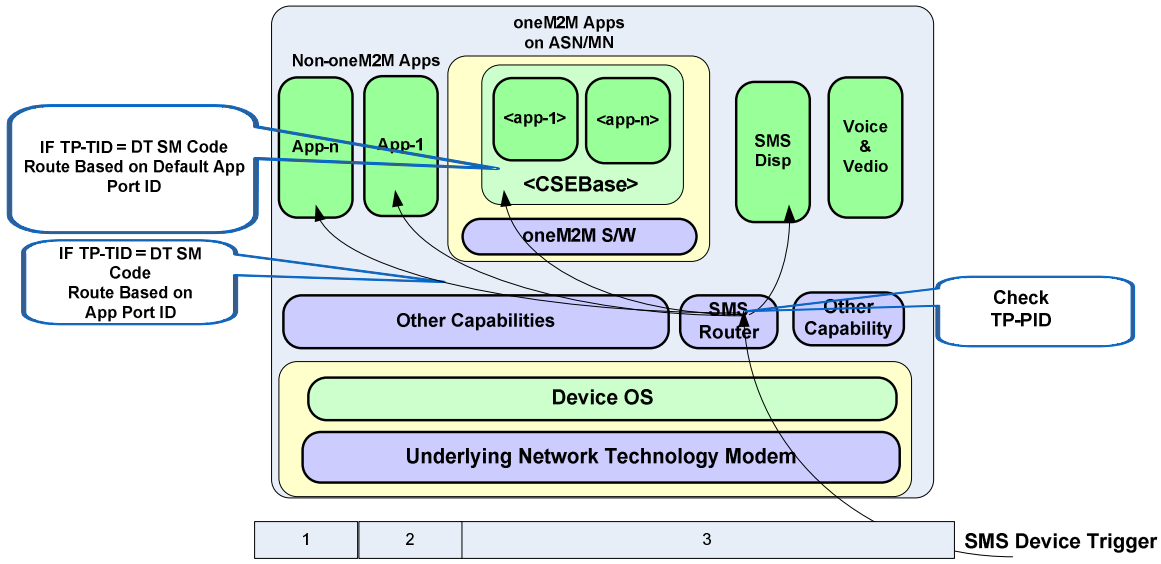
Figure B-2 is an illustration of a similar M2M Device, except that such device supports non-oneM2M APPs as well.

Within oneM2M paradigm, such devices can be categorized as ASNs and MNs. One or more AEs local on ASNs and MNs register with the local CSE (ASN-CSE and MN-CSE). A corresponding <application> resource is created under <CSEBase> locally for each such registered AE - e.g., <application-1>, <application-2> .. <application-n>. Each such <application-n> resource and the associated attributes can be reached via the URI assigned to such <application-n> resource. E.g, an AE at an Infrastructure Node (IN) needs to send a CRUD message to <application-n> registered on an ASN-CSE with **to**: {/ASN-CSEBase/application-n/attribute-x} parameter in the CRUD message. The message will first reach <ASN-CSEBase>. It will then be forwarded internally to the <application-n>/attribute-x within ASN-CSE. For the purpose of forwarding such CRUD message on an Underlying Network from IN-CSE in the Infrastructure Domain to an MN or ASN in the Field Domain, the "pointOfAccess" (routable address) of <ASN-CSEBase> / <MN-CSEBase> is used.



1. TP-PID = oneM2M specific DT SM Code
2. Payload etc.

Figure B-1: Example Illustration of CSE-capable M2M Device.
No non-oneM2M APPs supported



1. TP-PID = Device Trigger Short Message Code (DT SM Code)
2. IF TP-PID is DT SM Code, App Port ID is also included in SM
3. Payload etc

Figure B-2: Example Illustration of a CSE-capable M2M Device.
Non-oneM2M APPs also supported

If the "pointOfAccess" of <ASN-CSEBase> / <MN-CSEBase> is not routable (stale IP address etc.) and the Underlying Network supports device triggering; device trigger will be routed to the M2M External Address (M2M-Ext-ID) that can be mapped from <ASN-CSE-ID> / <MN-CSE-ID>. It may be noted that for such CSE-capable oneM2M Nodes, even if the trigger is to a specific AE at ASN-CSE/ MN-CSE, the trigger reaches the <CSEBase> where the AE is registered. The CRUD message included in the trigger payload, is forwarded to the appropriate AE based on its URI within the "**to**" parameter in the header of such CRUD message.

The same method applies for the case of AEs on ADNs that are registered with CSE on ASNs/MNs. Such trigger reaches the associated <application> resource within the ASN-CSE/MN-CSE as described above.

3.2.1 Some Open Issues with Model-1:

There are some issues that need to be resolved for Model-1.

3.2.1.1 CSE-Capable oneM2M Devices:

Considering the case where a CSE-capable oneM2M Device supports other non-oneM2M APPs as well (Figure B-2). In addition to oneM2M AEs (that are reachable via the <CSEBase>), other non-oneM2M APPs need to be addressable as well. For example some device trigger capable networks, such as those specified by 3GPP and 3GPP2, support SMS for device triggering. Regular SMS messages are differentiated from device-triggering SMS messages based on the coding of "TP-ID" field in SMS message headers. Once the SMS message has been identified to be device-trigger related (TP-ID = Device Trigger Short Message) - the device trigger, including payload if available, should be able to be forwarded to the appropriate AE, and to non-oneM2M APPs as well, as needed. "Application Port ID" in such device-trigger SMS is used for the purpose of forwarding the device trigger SMS by the SMS Router to the appropriate non-oneM2M APPs.

However, for oneM2M AEs that are registered with <CSEBase>, there is no exposed Application Port Id. How to route device-trigger, and associated payload, if any, to such oneM2M AEs?

3.2.1.1.1 Solution Option-1:

For the case of M2M Devices that support oneM2M capable AEs only. Non-oneM2M APPs are not supported such as in the illustration in Figure B-1:

- In this case all device triggers are routed to <CSEBase> by default, irrespective of the coding of "Application Port ID".
- A possible refinement for this solution is not to include Application Port ID in such SMSs used for device triggering.
- With such refinement, the TP-ID field in the SMS header is assigned a code that is unique for oneM2M. Such oneM2M specific code in the TP-ID field will enable the SMS Router to route the device trigger, and associated payload if any, to the <CSEBase>
- <CSEBase> can then forward the device trigger to the target AE based on the URI.

For realizing this Solution Option-1 for 3GPP systems; the following actions should be taken:

1. Work with industry organizations (e.g., 3GPP) for assigning a unique TP-ID for device triggering oneM2M CSE-capable Nodes.
2. No Application Port ID is included in Device Trigger Request sent from the Infrastructure Node (IN-CSE) over Tsp interface.

3.2.1.2 CSE-capable and NonOneM2M Capable M2M Devices:

The limitation for the M2M Device to be oneM2M capable only is likely not an attractive market proposition. Service Providers would want to support both; oneM2M capable AEs and other (non-oneM2M capable) APPs as well on such devices. An illustration of such configuration is in Figure B-2. For this, configuration, solution in Option-2 is proposed.

3.2.1.2.1 Solution Option-2:

A possible solution for device triggering for this configuration is to assign a well-known/default Application Port ID for triggering oneM2M capable AEs. For triggering non-oneM2M APPs, their respective Application Port IDs is used (as in the current practice).

For realizing this Solution Option-2 for 3GPP systems; the following actions shiuld be taken:

- Work with organizations that are responsible for assigning Application Port Ids, for the assignment of a default Application Port ID for triggering in oneM2M.
- Two possibilities:
- First:
  - No Application Port ID is needed in Device Trigger Request sent from IN-CSE over Tsp interface.
  - The 3GPP Interworking-IWF inserts/uses the assigned default oneM2M Application Port ID for internal use.
- Second:
  - oneM2M IN-CSE includes the default oneM2M Application Port ID in all Device Trigger Requests sent over the Tsp interface for triggering CSE-capable Nodes.

The recommendation is favour of solution in Option-2.

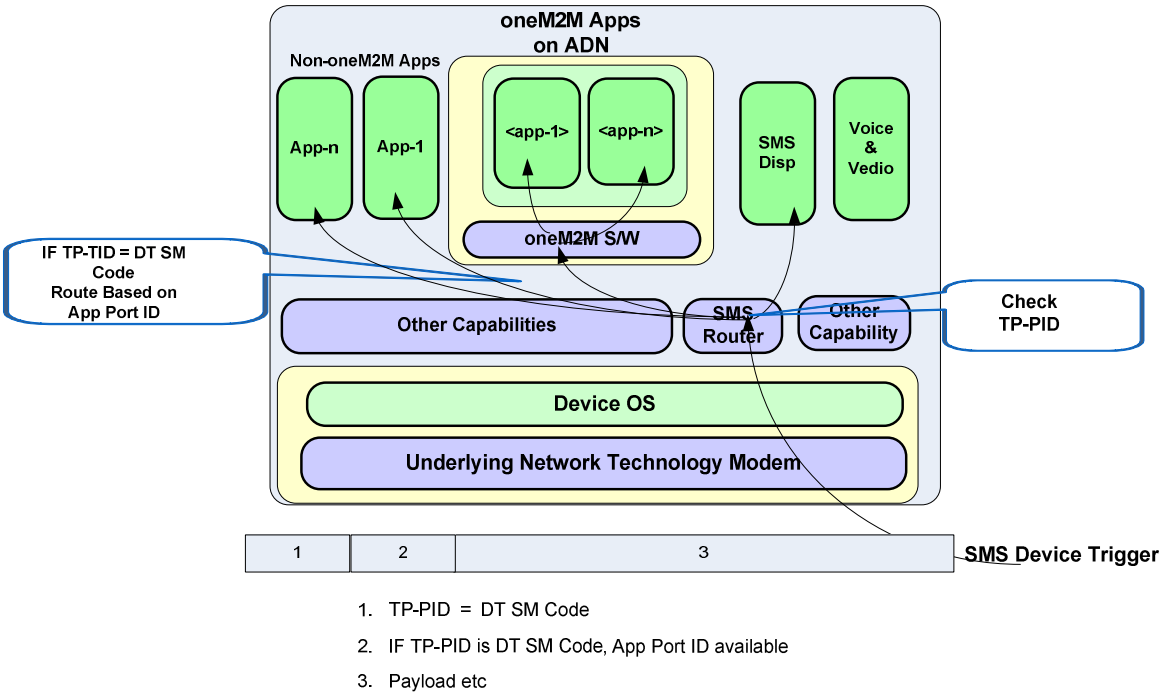
- An open Item for oneM2M in this case will be to write LS to organizations that are responsible for the assignment of a default oneM2M Application Port ID for triggering CSE-capable Nodes.

4. Model-2 Device Triggering Illustration

4.1 Non-CSE-capable oneM2M Devices

Figure C-1 is an example illustration of a non-CSE-capable oneM2M device (e.g ADNs). The focus in this illustration is on the AEs and the routing aspects for the device trigger (e.g., SMS) messages.

Figure C-2 also illustrates similar configuration. The difference is with regards to how a device trigger to an AE and ADN is routed by the device trigger message/SMS Router.



1. TP-PID = DT SM Code
2. IF TP-PID is DT SM Code, App Port ID available
3. Payload etc

Figure C-1: Example Illustration of a non-CSE-capable Device (ADN).
Non-oneM2M APPs also supported

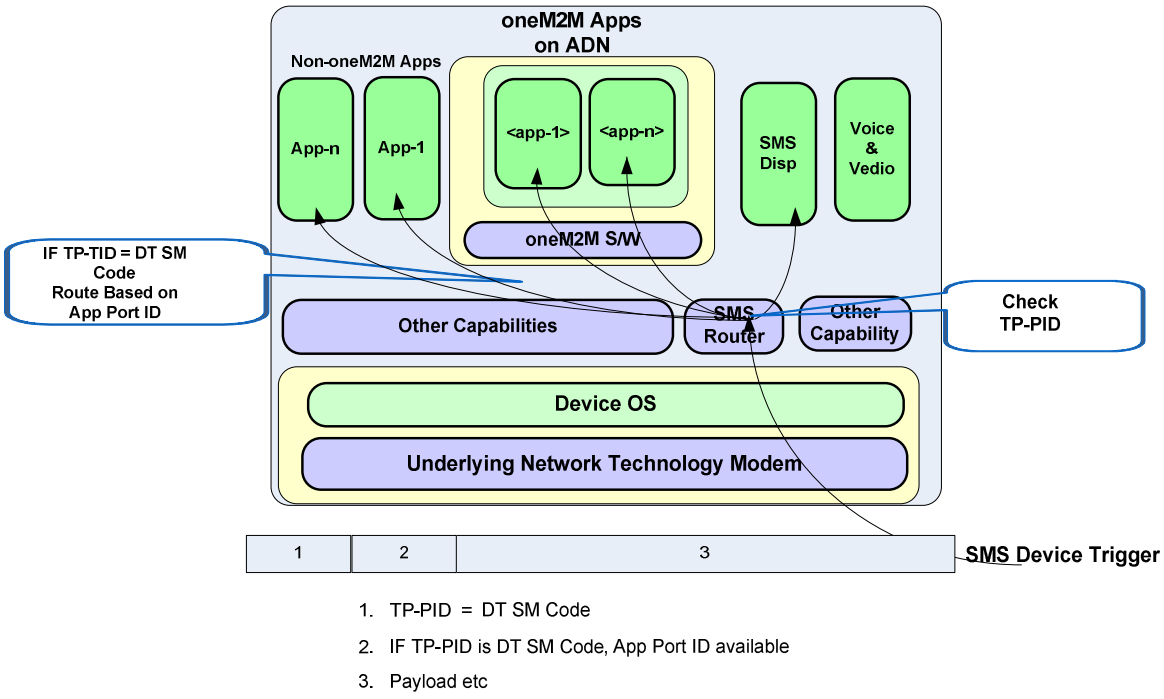


Figure C-2: Another Example Illustration of a non-CSE-capable Device (ADN). Non-oneM2M APPs also supported

Internal aspects of such ADNs are out of scope of oneM2M. In order to support triggering AEs on such ADNs, a physical identifier of such ADNs is needed; such as an identifier that is valid in the Underlying Network domain (e.g., M2M-Ext-ID). The following enhancements are needed in oneM2M for realizing Model-2 device triggering:

- Provide "M2M-Node-ID" as another attribute in the <application> resource for such ADN-AEs at the IN-CSE. Such M2M-Node-ID is needed for ADN-AEs that need to be capable of being triggered.
- Support mapping of "M2M-Node-ID" of such ADNs to respective M2M-Ext-ID

With such enhancements, ADN-AEs can be triggered just like AEs registered on CSE-capable oneM2M Nodes. Device trigger is able to reach the ADNs on which such AEs are hosted.

- Stated differently: Model-1 and Model-2 device triggering becomes similar from IN-CSE perspective.

4.2.1 One open issue though

How such device trigger is routed to the individual AEs. As stated earlier, the internal aspects of ADNs are not within the scope of oneM2M. Not knowing the internal implementation of ADNs, two possible solutions are discussed for triggering ADN AEs:

1. In the illustration in Figure C-1. Application Port ID in the device trigger is set to the default Application Port ID assigned to oneM2M. Device trigger message (e.g., SMS) is routed to the

oneM2M s/w at ADN. oneM2M s/w within the ADN then forwards the device trigger to the appropriate AE.

2. In the illustration in Figure C-2: the IN sets Application Port ID to the App-Inst-ID assigned to the ADN-AE. The message router (e.g., SMS router) then routes the device trigger to individual ADN-AEs via the ADN-AE specific Application Port ID received in the trigger message header.

5. Proposal:

A.

1. Provide "M2M-Node-ID" as another attribute in the <application> resource for ADN-AEs at the IN-CSE. Such M2M-Node-ID is needed for ADN-AEs that need to be capable of being triggered.
2. Support mapping of M2M-Node-ID of such ADNs to respective M2M-Ext-ID
3. Support mapping of M2M-Node-ID to physically routable IP address (e.g. IP address) via DNS infrastructure

B.

1. Work with organizations that are responsible for assigning Application Port Ids, for the assignment of a default Application Port ID for triggering in oneM2M.
2. IN-CSE includes the default Application Port ID in all Device Trigger Requests sent over the Tsp interface for triggering CSE-capable Nodes.
3. For triggering AEs on non-CSE capable M2M Nodes, set Application Port ID to App-Inst-ID for such ADN-AEs.
4. For Model-3 triggering; i.e., triggering the Node itself (ASN, ADN. MN) set Application Port ID to the default oneM2M Application Port ID

6. Recommendation

As regards the issues presented in the "Introduction" section, this paper recommends the following:

1. What entities/Nodes should be capable of receiving device trigger? The requirement has been to allow ADN-AE, ASN-CSE, MN-CSE, ASN-AE and MN-AE to be able to receive triggers.

- Recommendation: All the above stated entities should be capable of receiving device triggers.

2. Should the Infrastructure Node be able to initiate device trigger only for refreshing (stale) IP addresses or also for the case when there is no IP address (pointOfAccess) for the triggered entity is available? The first case relates to refreshing "pointOfAccess" for previous registration of a AE/CSE. The second case relates to when no such registration for the target entity is available at the IN-CSE

- Recommendation: Both above stated scenarios can be supported.

3. How do the oneM2M Infrastructure Node and the device trigger receiving entities (ADN-AE, ASN-CSE, MN-CSE, ASN-AE and MN-AE) agree on the value of Application Port Identifier field? Such Application Port ID is used by many Devices that are currently deployed, e.g., by the MTC-UEs deployed in 3GPP networks.

- Recommendation: Refer to section 5.B (Proposal) above

4. What parameters are used by oneM2M Infrastructure Node in the message used for Device Trigger Request to the Interworking-IWF in the Underlying Network (over Mcn reference point). The point of discussion mainly relates to "Application Port Identifier" and the "code value(s)" to be used in Application Port Identifier.

- Recommendation: Refer to section 5.B (Proposal) above

5. Should proxying be permitted/enabled and for which scenarios?

- Recommendation: The Use Case for such proxying is not understood hence no suggestion has been made for addressing this issue. Also, As per conclusion in this paper, all entities in oneM2M (ADN-AE, ASN-CSE, MN-CSE, ASN-AE and MN-AE) are able to receive device triggers, hence the need for such "proxying" may be a moot question.

6. On the question: what functionality may be enabled through the information included in the device trigger "payload", e.g., if the purpose of the trigger is to renew the IP address or to perform some other action - such as for the case when no IP address is available, this paper recommends the following:

- Recommendation: For the case of renewing IP address (stale IP address) for an existing CSE/AE registrations arises when IN-CSE initiates communication with a remote entity over Mcc reference point by the use of some CRUD operation. Accordingly, the payload in the device trigger will be the message associated with such CRUD operation.

- Recommendation: For the case when no IP address is available at IN-CSE: the content of the payload is currently not addressed in TS-0001. The proposal here is to use a CRUD Request such as the following:

  - **op:** any of C/R/U/D. Preference is for "C" though.

  - **to:** URI of target Node (ADN, ASN, MN)

  - **fm:** ID of the Originator (IN-CSE)

  - **cn:** empty (if C/R/U are used)

  - **ty:** null code point if "C" is used (a new code point to be defined for instructing the Receiver Node to initiate Registration towards the Originator)

  - For the case "R/U/D" operation is used: define a new meta-information "**mi**" parameter that is understood by the Receiver as an instruction for initiating Registration towards the Originator. Such new parameter may be termed as :**reg** (for Registration)

- other parameters, such as those relating to timestamp, timers etc are set as per policy

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