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## The Application Exchange (APEX) Option Party Pack, Part Deux!

### Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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### Abstract

Application Exchange (APEX), at its core, provides a best-effort application-layer datagram service. Options are used to alter the semantics of the core service. This memo defines various options to change the default behavior of APEX's "relaying mesh".

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## 1. The attachOverride Option

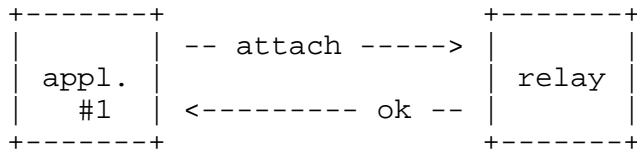
Section 5.1 contains the APEX option registration for the "attachOverride" option.

The default behavior of the APEX relaying mesh, in the absence of processing options, is to allow at most one application to attach as a particular endpoint, on a "first come, first served" basis. The "attachOverride" option provides gives preference to the current application trying to attach.

If this option is present in the "attach" operation (c.f., Section 4.4.1 of [1]) and if any application is already attached as the specified endpoint, that endpoint has its attachment terminated (c.f., Section 4.4.3 of [1]) concurrently with processing of that "attach" operation. The "code" attribute of the resulting "terminate" operation is set to 556.

Note that any data being expected by the previously-attached application may instead be delivered to the last application to successfully attach. Accordingly, applications should take care to properly deal with incoming data having unrecognized transaction-identifiers (c.f., Section 6.1.1 of [1]).

This option provides for a new attachment to automatically terminate any existing attachment for the same endpoint. For example, this might be helpful when a new attachment is required from a different device while a previously-used device is still attached e.g.,

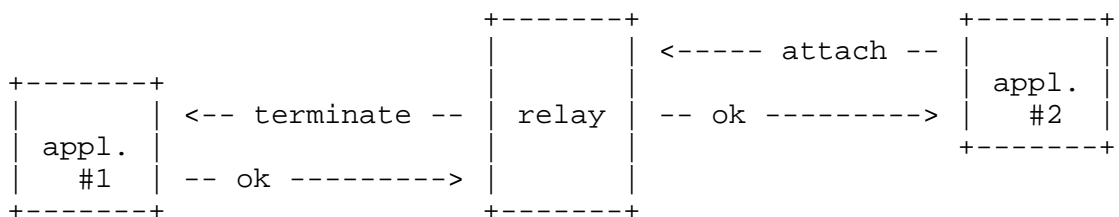


```

C: <attach endpoint='fred@example.com' transID='1' />
S: <ok />

```

... some time later appl #2 starts on a different computer ...



```

C: <attach endpoint='fred@example.com' transID='2'>
  <option internal='attachOverride' transID='3' />
  </attach>
S: <ok />

```

```

C: <terminate transID='1' code='556'>overriden</terminate>
S: <ok />

```

## 2. The dataTiming Option

Section 5.2 contains the APEX option registration for the "dataTiming" option. This option contains a "dataTiming" element (c.f., Section 6).

The default behavior of the APEX relaying mesh is "immediate, best effort", and expects that all relays and endpoints are able to process and transfer data without delay -- in the absence of processing options, if a relay is unavailable, then data is silently dropped. The "dataTiming" option provides for controlled queuing delays in processing, whilst providing reasonable deterministic behavior for the originator.

There are two types of delays addressed by the "dataTiming" option:

- o delays in transit through the relaying mesh, possibly due to intermittent or slow connections, or congested relays; and,
- o delays because the intended endpoint is not available to receive the data, when used in conjunction with the hold4Endpoint option (Section 3).

Accordingly, the "dataTiming" option allows for:

- o data to be discarded if not delivered within a finite amount of time as specified using the "noLaterThan" attribute (Section 2.1);
- o a "statusResponse" message (c.f., Section 5.1 of [1]) to be generated if data is not delivered within a known amount of time as specified using the "reportAfter" attribute (Section 2.2); and,
- o an upper limit on the amount of time for the "statusResponse" message to be delivered using the "returnTrip" attribute (Section 2.1.1), after which the sender may presume the message to be lost.

This option does not provide any functionality with respect to the priority of the data. Nor does this option have any effect on other parts of the relaying process.

Further, note that because this option is processed on a per-hop basis, the originator must set the "targetHop" attribute to the value "all" and the "mustUnderstand" attribute to the value "true".

## 2.1 Upper-Bounds on Delivery

The "noLaterThan" attribute of the "dataTiming" option provides for control over delays that may occur in transit through the relaying mesh or to the recipient endpoint.

If this option is present in the "data" operation (c.f., Section 4.4.4 of [1]) and the value of the "noLaterThan" attribute is non-zero, then:

- o For Step 5.2 of Section 4.4.4.1 of [1]:

Immediately prior to sending the data to the next relay, the value of the "noLaterThan" attribute is adjusted to reflect the processing time of the data at the local relay (e.g., the time required to determine the next relay, to successfully issue a "bind" operation, and then be ready to immediately issue a "data" operation).

If the value of the "noLaterThan" attribute becomes less than or equal to zero, an error in processing has occurred, the data element is not sent to the next relay, and if the "reportErrors" attribute is true, the APEX report service is invoked to send a timing error report.

- o For Step 5.3 of Section 4.4.4.1 of [1]:

If the relay does not receive an "ok" element from the recipient endpoint within the number of milli-seconds indicated by the value of the "noLaterThan" attribute, an error in processing has occurred, and if the "reportErrors" attribute is true, the APEX report service is invoked to send a timing error report.

Otherwise, if the data is successfully transmitted to the recipient, and the "returnTrip" attribute is non-zero, the APEX report service is invoked to send a final hop report.

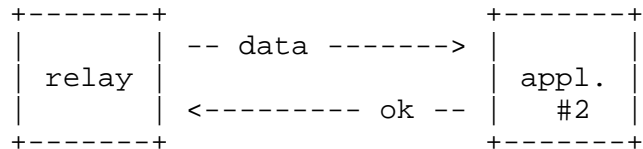
Note that in some cases, a relay may be able to predict this outcome without actually connecting to the next relay; if so, a timing error report may be sent without connecting to the next relay.

#### 2.1.1 Final Hop Report

If the APEX report service (c.f., Section 6.2 of [1]) is invoked to send a final hop report, it issues a data operation with:

- o its originator identifying the report service associated with the issuing relay
- o its recipient identifying the endpoint address of the originator associated with the "dataTiming" option
- o a new "dataTiming" option having:
  - \* its "noLaterThan" attribute equal to the "returnTrip" attribute of the original "dataTiming" option
  - \* and no other attributes present
- o its content consisting of a "statusResponse" element having:
  - \* its "transID" attribute equal to the "transID" attribute of the "dataTiming" option
  - \* and identifying the original recipient with a permanent success indicator

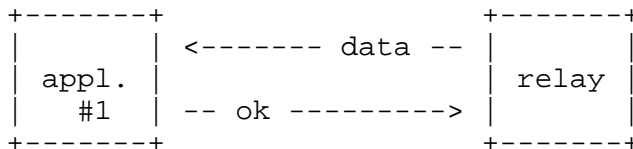
For example:



```

C: <data content='cid:1@example.com'>
    <originator identity='fred@example.com' />
    <recipient identity='barney@example.com' />
    <option internal='dataTiming' targetHop='all'
        mustUnderstand='true' transID='86'>
        <dataTiming noLaterThan='10000' returnTrip='20000' />
    </option>
</data>
S: <ok />

```



```

C: <data content='#Content'>
    <originator identity='apex=report@example.com' />
    <recipient identity='fred@example.com' />
    <option internal='dataTiming' targetHop='all'
        mustUnderstand='true' transID='99'>
        <dataTiming noLaterThan='20000' />
    </option>
    <data-content Name='Content'>
        <statusResponse transID='86'>
            <destination identity='barney@example.com'>
                <reply code='250' />
            </destination>
        </statusResponse>
    </data-content>
</data>
S: <ok />

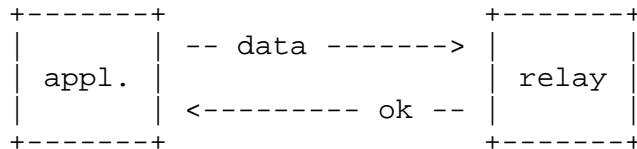
```

### 2.1.1.2 Timing Error Report

If the APEX report service (c.f., Section 6.2 of [1]) is invoked to send a timing error report, it issues a data operation with:

- o its originator identifying the report service associated with the issuing relay
- o its recipient identifying the endpoint address of the originator associated with the "dataTiming" option
- o its content consisting of a "statusResponse" element having:
  - \* its "transID" attribute equal to the "transID" attribute of the "dataTiming" option
  - \* and identifying the original recipient with a permanent failure indicator

For example:

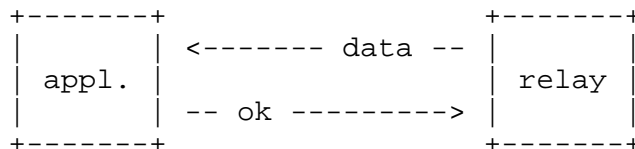


```

C: <data content='cid:1@example.com'>
    <originator identity='fred@example.com' />
    <recipient identity='barney@example.com' />
    <option internal='dataTiming' targetHop='all'
        mustUnderstand='true' transID='86'>
        <dataTiming noLaterThan='6000' reportErrors='true' />
    </option>
</data>
S: <ok />

```

... some time later ...



```

C: <data content='#Content'>
    <originator identity='apex=report@example.com' />
    <recipient identity='fred@example.com' />
    <data-content Name='Content'>
        <statusResponse transID='86'>
            <destination identity='barney@example.com'>
                <reply code='550' />
            </destination>
        </statusResponse>
    </data-content>
</data>
S: <ok />

```

## 2.2 Reporting on Delayed Delivery

The "reportAfter" attribute of the "dataTiming" option provides for the originator to be notified if delivery is delayed beyond a specified time. Delivery of the data is not affected. Note that if the value of the "noLaterThan" attribute is non-zero, then it provides the operational upper-bounds for the "reportAfter" attribute.



If this option is present in the "data" operation (c.f., Section 4.4.4 of [1]) and the value of the "reportAfter" attribute is non-zero, then:

- o For Step 5.2 of Section 4.4.4.1 of [1]:

Immediately prior to sending the data to the next relay, the value of the "reportAfter" attribute is adjusted to reflect the processing time of the data at the local relay (e.g., the time required to determine the next relay, to successfully issue a "bind" operation, and then be ready to immediately issue a "data" operation).

If the value of the "reportAfter" attribute becomes less than or equal to zero, then its value is set to zero and the APEX report service is invoked to send a transient timing report; regardless, the data element is sent to the next relay.

- o For Step 5.3 of Section 4.4.4.1 of [1]:

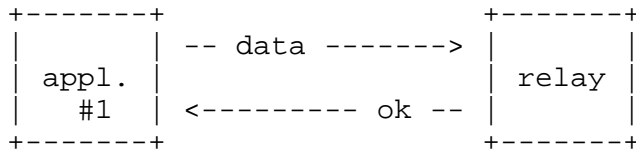
If the relay does not receive an "ok" element from the recipient endpoint within the number of milli-seconds indicated by the value of the "reportAfter" attribute, then its value is set to zero and the APEX report service is invoked to send a transient timing report.

### 2.2.1 Transient Timing Report

If the APEX report service (c.f., Section 6.2 of [1]) is invoked to send a transient timing report, it issues a data operation with:

- o its originator identifying the report service associated with the issuing relay
- o its recipient identifying the endpoint address of the originator associated with the "dataTiming" option
- o its content consisting of a "statusResponse" element having:
  - \* its "transID" attribute equal to the "transID" attribute of the "dataTiming" option
  - \* and identifying the original recipient with a transient success indicator

For example:

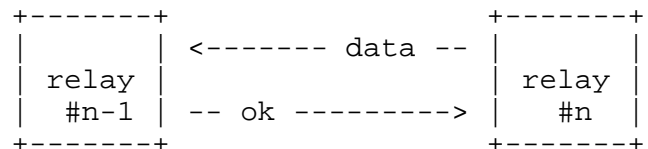


```

C: <data content='cid:1@example.com'>
    <originator identity='fred@example.com' />
    <recipient identity='barney@example.com' />
    <option internal='dataTiming' targetHop='all'
        mustUnderstand='true' transID='86'>
        <dataTiming reportAfter='60000' />
    </option>
</data>
S: <ok />

```

... some time later ...



```

C: <data content='#Content'>
    <originator identity='apex=report@example.com' />
    <recipient identity='fred@example.com' />
    <data-content Name='Content'>
        <statusResponse transID='86'>
            <destination identity='barney@example.com'>
                <reply code='350' />
            </destination>
        </statusResponse>
    </data-content>
</data>
S: <ok />

```

### 3. The hold4Endpoint Option

Section 5.3 contains the APEX option registration for the "hold4Endpoint" option.

The default behavior of the APEX relaying mesh, in the absence of processing options, is to silently drop data for a recipient if its endpoint isn't attached. The "hold4Endpoint" option provides for data to be queued if the recipient endpoint is not attached.

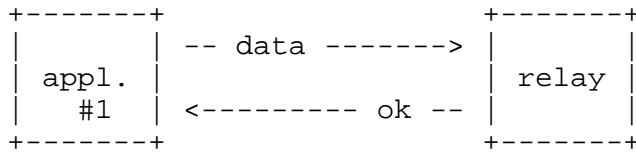
If this option is present in the "data" operation (c.f., Section 4.4.4 of [1]), and the value of the "hold4Endpoint" attribute is true then:

- o For Step 5.3 of Section 4.4.4.1 of [1]:

If the recipient's endpoint is not currently attached, the relay will queue the data waiting for an application to attach as that endpoint.

Note that in the absence of an upper-bounds on delivery, such as limits provided by the dataTiming option (Section 2), the data will be queued indefinitely for the endpoint.

For example:

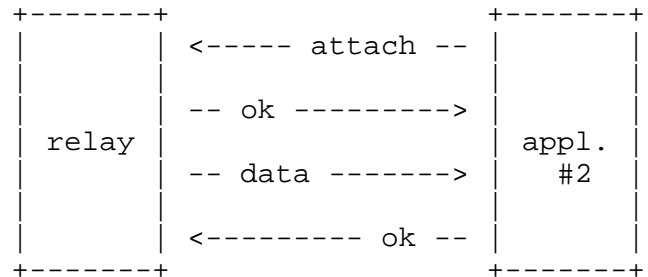


```

C: <data content='cid:1@example.com'>
    <originator identity='fred@example.com' />
    <recipient identity='barney@example.com' />
    <option internal='hold4Endpoint' />
    <option internal='dataTiming' targetHop='all'
        mustUnderstand='true' transID='86'>
        <dataTiming noLaterThan='60000' />
    </option>
</data>
S: <ok />

```

... some time later the recipient's endpoint attaches ...



```

C: <attach endpoint='barney@example.com' transID='2'>
    <option internal='attachOverride' transID='3' />
</attach>
S: <ok />

```

```

C: <data content='cid:1@example.com'>
    <originator identity='fred@example.com' />
    <recipient identity='barney@example.com' />
    <option internal='hold4Endpoint' />
    <option internal='dataTiming' targetHop='all'
        mustUnderstand='true' transID='86'>
        <dataTiming noLaterThan='18000' />
    </option>
</data>
S: <ok />

```

#### 4. The dataHopping Option

To detect misconfigurations that cause forwarding loops in the APEX relaying mesh, the APEX pubsub service re-introduces a mechanism similar to the IP TTL [2] mechanism, in the form of an APEX option. Section 5.4 contains the APEX option registration for the "dataHopping" option.

If this option is present in the "data" operation (c.f., Section 4.4.4 of [1]) and the value of the "noMoreThan" attribute is non-zero, then:

- o For Step 5.2 of Section 4.4.4.1 of [1]:

Immediately prior to sending the data to the next relay, the value of the "noMoreThan" attribute is reduced by 1.

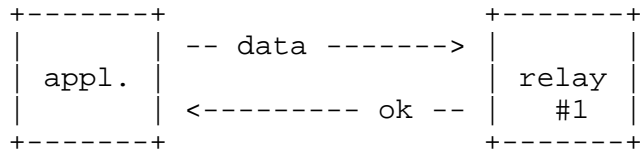
If the value of the "noMoreThan" attribute becomes less than or equal to zero, an error in processing has occurred, the data element is not sent to the next relay, and if the "reportErrors" attribute is true, the APEX report service is invoked to send an error report.

Further, note that because this option is processed on a per-hop basis, the originator must set the "targetHop" attribute to the value "all" and the "mustUnderstand" attribute to the value "true".

If the APEX report service (c.f., Section 6.2 of [1]) is invoked to send an error report, it issues a data operation with:

- o its originator identifying the report service associated with the issuing relay
- o its recipient identifying the endpoint address of the originator associated with the "dataHopping" option
- o its content consisting of a "statusResponse" element having:
  - \* its "transID" attribute equal to the "transID" attribute of the "dataHopping" option
  - \* and identifying the original recipient with a permanent failure indicator

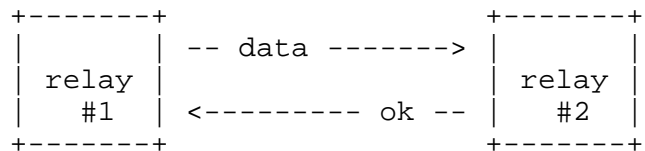
For example:



```

C: <data content='cid:1@example.com'>
    <originator identity='appl=pubsub/topic=fred@example.com' />
    <recipient identity='barney@example.com' />
    <option internal='dataHopping' targetHop='all'
        mustUnderstand='true' transID='86'>
        <dataHopping noMoreThan='2' reportErrors='true' />
    </option>
</data>
S: <ok />

```

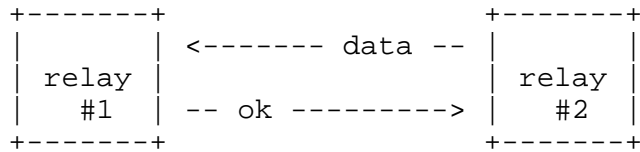


```

C: <data content='cid:1@example.com'>
    <originator identity='appl=pubsub/topic=fred@example.com' />
    <recipient identity='barney@example.com' />
    <option internal='dataHopping' targetHop='all'
        mustUnderstand='true' transID='86'>
        <dataHopping noMoreThan='1' reportErrors='true' />
    </option>
</data>
S: <ok />

```

relay #2 determines that further relaying is necessary:



```

C: <data content='#Content'>
    <originator identity='apex=report@example.com' />
    <recipient identity='appl=pubsub/topic=fred@example.com' />
    <data-content Name='Content'>
        <statusResponse transID='86'>
            <destination identity='barney@example.com'>
                <reply code='550' />
            </destination>
        </statusResponse>
    </data-content>
</data>
S: <ok />

```

## 5. Initial Registrations

The APEX option registration template is defined in Section 7.1 of [1].

### 5.1 Registration: The attachOverride Option

Option Identification: attachOverride

Present in: APEX's "attach" element

Contains: nothing

Processing Rules: c.f., Section 1

Contact Information: c.f., the "Authors' Addresses" section of this memo

## 5.2 Registration: The dataTiming Option

Option Identification: dataTiming

Present in: APEX's "data" element

Contains: dataTiming (c.f., Section 6)

Processing Rules: c.f., Section 2

Contact Information: c.f., the "Authors' Addresses" section of this memo

## 5.3 Registration: The hold4Endpoint Option

Option Identification: hold4Endpoint

Present in: APEX's "data" element

Contains: nothing

Processing Rules: c.f., Section 3

Contact Information: c.f., the "Authors' Addresses" section of this memo

## 5.4 Registration: The dataHopping Option

Option Identification: dataHopping

Present in: APEX's "data" element

Contains: dataHopping (c.f., Section 6)

Processing Rules: c.f., Section 4

Contact Information: c.f., the "Authors' Addresses" section of this memo



## 6. The APEX Party Pack DTD

&lt;!--

DTD for the APEX option party pack, as of 2001-05-14

Refer to this DTD as:

```
<!ENTITY % APEXPARTY PUBLIC "-//IETF//DTD APEX PARTY//EN" "">
%APEXPARTY;
```

--&gt;

```
<!ENTITY % APEXCORE PUBLIC "-//IETF//DTD APEX CORE//EN"
%APEXCORE;
```

&lt;!--

DTD data types:

entity =====	syntax/reference =====	example =====
hopcount HOPS	0..255	17
milli-seconds MILLISECS	0..2147483647	60000

--&gt;

&lt;!ENTITY % HOPS "CDATA"&gt;

```
<!ENTITY % MILLISECS
"CDATA">
```

&lt;!ELEMENT dataHopping EMPTY&gt;

```
<!ATTLIST dataHopping
noMoreThan %HOPS; "0"
reportErrors
(true|false) "false">
```

&lt;!ELEMENT dataTiming EMPTY&gt;

```
<!ATTLIST dataTiming
noLaterThan %MILLISECS; "0"
returnTrip %MILLISECS; "0"
reportAfter %MILLISECS; "0"
reportErrors
(true|false) "false">
```

## 7. Security Considerations

Consult [1]'s Section 11 for a discussion of security issues.

In addition:

- o The dataTiming option (Section 2) may be used to expose private network topology. Accordingly, an administrator may wish to choose to disable this option except at the ingress/egress points for its administrative domain.
- o The hold4Endpoint option (Section 3) may be used to facilitate denial-of-service attacks. Accordingly, an administrator may wish to impose administrative limits on this attribute (e.g., always require that the "dataTiming" option also be present with a short-lived "noLaterThan" attribute).

## References

- [1] Rose, M., Klyne, G. and D. Crocker, "The Application Exchange Core", RFC 3340, July 2002.
- [2] Postel, J., "Internet Protocol", STD 5, RFC 791, September 1981.
- [3] Newman, D., "Deliver By SMTP Service Extension", RFC 2852, June 2000.

## Appendix A. Acknowledgements

The authors gratefully acknowledge the contributions of Chris Newman and Bob Wyman. Further, the dataTiming option is similar in function to "Deliver By" SMTP service extension defined by Dan Newman in [3].

## Appendix B. IANA Considerations

The IANA completed the registrations specified in Section 5.

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