DLEP DiffServ Aware Credit Window Extension
draft-ietf-manet-dlep-da-credit-extension-04

Abstract

   This document defines an extension to the DLEP protocol that enables
   a DiffServ aware credit-window scheme for destination-specific and
   shared flow control. The extension is logically composed of two
   mechanisms. The first provides credit window control, the second
   identifies how flows are identified and mapped to a credit window.

Status of This Memo

Copyright Notice

Table of Contents

1. Introduction

   The Dynamic Link Exchange Protocol (DLEP) is defined in [RFC8175].
   It provides the exchange of link related control information between
   DLEP peers. DLEP peers are comprised of a modem and a router. DLEP

defines a base set of mechanisms as well as support for possible
extensions. This document defines one such extension.

The base DLEP specification does not include any flow control
capability. There are various flow control techniques theoretically
possible with DLEP. For example, a credit-window scheme for
destination-specific flow control which provides aggregate flow
control for both modem and routers has been proposed in
[I-D.ietf-manet-credit-window].

This document defines a DLEP extension which provides a flow control
mechanism for traffic sent from a router to a modem. Flow control is
provided using one or more logical "Credit Windows", each of which
will typically be supported by an associated virtual or physical
queue. Traffic sent by a router will use traffic flow classification
information provided by the modem to identify which traffic is
associated with each credit window. (For general background on
traffic classification see [RFC2475] Section 2.3.) Credit windows
may be shared or dedicated on a per flow basis. The extension is
structured to allow for reuse of the defined credit window based flow
control with different traffic classification techniques.

This document defines traffic classification based on DLEP
destination and DiffServ [RFC2475] DSCPs (differentiated services
codepoints). The defined mechanism allows for credit windows to be
shared across traffic sent to multiple DLEP destinations and DSCPs,
or used exclusively for traffic sent to a particular destination and/
or DSCP. The extension also supports the "wildcard" matching of any
DSCP. Traffic classification information is provided such that it
can be readily extended to support non-DSCP related traffic
classification techniques, or be used by non-credit window related
extensions, such as [I-D.ietf-manet-dlep-pause-extension].

The extension defined in this document is referred to as "DiffServ
Aware Credit Window" or, more simply, the "DA Credit" extension.
Future extensions are expected to define traffic classification
techniques other than DiffServ, e.g., IEEE 802.1 Q priority code
points or even 5-tuple IP flows.

This document defines a new DLEP Extension Type Value in Section 3
which is used to indicate support for the extension. Two new
messages are defined in Section 4.2 and five new DLEP data items in
Section 4.3 are defined to support credit window control. A single
data item is defined in Section 5.1 to support traffic classification
in general, as well as identification of flows based on DSCPs.

1.1. Key Words

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and
"OPTIONAL" in this document are to be interpreted as described in BCP
14 [RFC2119] [RFC8174] when, and only when, they appear in all
capitals, as shown here.

2. Extension Overview

The DA Credit extension can be used to support credit based flow
control of traffic sent from a router to a modem. The extension can
be used to support DiffServ and per DLEP destination based flow
control. Both types of DLEP endpoints, i.e., a router and a modem,
negotiate the use of extension during session initialization, see
Section 5.2 [RFC8175]. When using this extension, data traffic is
allowed to be sent by the router to the modem only when there are
credits available.

Credits are managed on a per logical "Credit Windows" basis. Each
credit window can be thought of as corresponding to a queue within a
modem. Modems pass to the router information on their credit windows
and identify each via a "Credit Window Identifier", or "CID". In
addition to the CID, credit window information includes an initial
credit window size, as well as the maximum size of the logical queue
associated with each CID. The maximum size is included for
informative and potential future uses.

Modems provide an initial credit window size at the time of "Credit
Window Initialization". Such initialization can take place during
session initiation or any point thereafter. It can also take place
when rate information changes. Additional "Credit Grants", i.e.,
increments to Credit Window size, are provided using a Destination Up
or the new "Credit Control" Message. A router provides its view of
the Credit Window, which is known as "Status", in Destination Up
Response and the new "Credit Control Response" Messages. Routers can
also request credits using the new "Credit Control" Message.

When modems provide credits to a router, they will need to take into
account any overhead of their attached transmission technology and
map it into the credit semantics defined in this document. In
particular, the credit window is defined below to include per frame
(packet) MAC headers and this may not match the actual overhead of
the modem attached transmission technology. In that case a direct
mapping or an approximation will need to be made by the modem to
provide appropriate credit values.

As mentioned above, traffic classification supported by this document
is performed on a per {destination, DSCP} tuple basis. (Per
destination traffic classification is also supported.) This means
that, routers need the combination of the DLEP identified destination
and one or more DSCPs associated with a CID in order to match traffic
they send to specific credit windows. Modems provide the mapping of
DSCPs to CIDs in sets, each of which is identified via a "Traffic
Classification Identifier" or "TID". When a destination becomes
reachable, a modem "Associates" (identifies) the TID to be used for
traffic sent by the router to that destination. This use of CIDs,
TIDs and association of a TID to a DLEP destination enables a modem
to share or dedicate resources as needed to match the specifics of
its implementation and its attached transmission technology.

3. Extension Usage and Identification

The extension defined in this document is composed of the mechanisms
and processing defined in Section 4 and Section 5. To indicate that
the DiffServ Aware Credit Window Extension is to be used, an
implementation MUST include the DiffServ Aware Credit Window Type
Value in the Extensions Supported Data Item. The Extensions
Supported Data Item is sent and processed according to [RFC8175].

The DiffServ Aware Credit Window Extension Type Value is TBA1, see
Section 9.

4. Credit Window Control

This section defines additions to DLEP for the control of credit
based flow control. As mentioned above, the definition is made in
the context of credit windows which can be thought of as representing
different logical queues. Two new messages and five data items are
defined to support credit window control. Credit window control also
impacts the data plane.

4.1. Data Plane Considerations

When the use of the extension defined in this document is agreed upon
per standard DLEP processing, see Section 3, a router MUST NOT send
data traffic to a modem for forwarding when there are no credits
available in the associated Credit Window. This document defines
credit windows in octets. A credit window value MUST be larger than
the number of octets contained in a packet, including any MAC headers
used between the router and the modem, in order for the router to
send the packet to a modem for forwarding. The credit window is
decremented by the number of sent octets.

A router MUST identify the credit window associated with traffic sent
to a modem based on the traffic classification information provided
in the data items defined in this document. Note that routers will
typically view a DLEP destination as the next hop MAC address.

4.2. Extension Messages

Two new messages are defined by this extension: the Credit Control
and the Credit Control Response Message. Sending and receiving both
message types MUST be supported by any implementation that advertises
use of this extension per Section 3.

4.2.1. Credit Control Message

Credit Control Messages are sent by modems and routers. Each sender
is only permitted to have one message outstanding at one time. That
is, a sender (modem or router) MUST NOT send a second (or any
subsequent) Credit Control Message until a Credit Control Response
Message is received from its peer (router or modem).

Credit Control Messages are sent by modems to provide credit window
increases. Modems send credit increases when there is transmission
or local queue availability that exceeds the credit window value
previous provided to the router. Modems will need to balance the
load generated by sending and processing frequent credit window
increases against a router having data traffic available to send, but
no credits available.

Credit Control Messages MAY be sent by routers to request credits and
provide window status. Routers will need to balance the load
generated by sending and processing frequent credit window requests
against a having data traffic available to send, but no credits
available.

The Message Type value in the DLEP Message Header is set to TBA2.

A message sent by a modem, MUST contain one or more Credit Window
Grant Data Items as defined below in Section 4.3.3. A router
receiving this message MUST respond with a Credit Control Response
Message.

A message sent by a router, MUST contain one or more Credit Window
Request Data Items defined below in Section 4.3.5 and SHOULD contain
a Credit Window Status Data Item, defined in Section 4.3.4,
corresponding to each credit window request. A modem receiving this
message MUST respond with a Credit Control Response Message based on
the received message and data item and the processing defined below,

which will typically result in credit window increments being
provided.

Specific processing associated with each Credit Data Item is provided
below.

4.2.2. Credit Control Response Message

Credit Control Response Messages are sent by routers to report the
current Credit Window for a destination. A message sent by a router,
MUST contain one or more Credit Window Status Data Items as defined
below in Section 4.3.4. Specific receive processing associated with
the Credit Window Status Data Item is provided below.

Credit Control Response Messages sent by modems MUST contain one or
more Credit Window Grant Data Items. A data item for every Credit
Window Request data item contained in the corresponding Credit
Control Response Message received by the modem MUST be included.
Each Credit Grant Data Item MAY provide zero or more additional
credits based on the modem's transmission or local queue
availability. Specific receive processing associated with each Grant
Data Item is provided below.

The Message Type value in the DLEP Message Header is set to TBA3.

4.3. Credit Window Control Data Items

Five new data items are defined to support credit window control.
The Credit Window Initialization Data Item is used by a modem to
identify a credit window and set its size. The Credit Window
Association Data Item is used by a modem to identify which traffic
classification identifiers (flows) should be used when sending
traffic to a particular DLEP identified destination. The Credit
Window Grant is used by a modem to provide additional credits to a
router. The Credit Request is used by a router to request additional
credits. The Credit Window Status is used to advertise the sender's
view of number of available credits for state synchronization
purposes.

Any errors or inconsistencies encountered in parsing data items are
handled in the same fashion as any other data dtem parsing error
encountered in DLEP, see [RFC8175]. In particular, the node parsing
the data item MUST terminate the session with a Status Data Item
indicating Invalid Data.

The defined data items and operations have similar objectives as
those found in [I-D.ietf-manet-credit-window]. One notable

   difference from this extension is that in this document credits are
   never provided by the router to the modem.

4.3.1. Credit Window Initialization

   The Credit Window Initialization Data Item is used by a modem to
   identify a credit window and set its size. This Data Item SHOULD be
   included in any Session Initialization Response Message that also
   contains the DiffServ Aware Credit Window Extension Type Value in the
   Extensions Supported Data Item. Updates to previously identified
   credit windows or new credit windows MAY be sent by a modem by
   including the data item in Session Update Messages. More than one
   data item MAY be included in a message to provide information on
   multiple credit windows.

   The Credit Window Initialization Data Item identifies a credit window
   using a Credit Window Identifier, or CID. It also provides the size
   of the identified credit window. Finally, a queue size (in bytes) is
   provided for informational purposes. Note that to be used, a CID
   must be associated with in a Traffic Classification Identifier via a
   Credit Window Association Data Item.

   The format of the Credit Window Initialization Data Item is:

```
     0                   1                   2                   3
     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Data Item Type                | Length (16)                   |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Credit Window Identifier (CID)|         Reserved              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                         Credit Value                          :
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    :                         Credit Value                          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |    Scale      |          Credit Window Size                   |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Data Item Type: TBA4

   Length: 16

      Per [RFC8175] Length is the number of octets in the data item. It
      MUST be equal to sixteen (16).

   Credit Window Identifier (CID):

A 16-bit unsigned integer identifying a credit window. The value
of 0xFFFF is reserved and MUST not be used in this data item.
There is no other restriction on values used by a modem, and there
is no requirement for sequential or ordered values.

Reserved:

MUST be set to zero by the sender (a modem) and ignored by the
receiver (a router).

Credit Value:

A 64-bit unsigned integer representing the credits, in octets, to
be applied to the Credit Window. This value includes MAC headers
as seen on the link between the modem and router.

Scale:

An 8-bit unsigned integer indicating the scale used in the Credit
Window Size fields. The valid values are:

```
Value  Scale
------------
    0   B - Bytes     (Octets)
    1  KB - Kilobytes (B/1024)
    2  MB - Megabytes (KB/1024)
    3  GB - Gigabytes (MB/1024)
```

Credit Window Size:

A 24-bit unsigned integer representing the maximum size, in the
octet scale indicated by the Scale field, of the associated credit
window.

A router that receives a Credit Window Initialization Data Item MUST
locate the credit window that is associated with the CID indicated in
each received data item. If no associated credit window is found,
the router MUST initialize a new credit window using the values
carried in the data item. When an associated credit window is found,
the router MUST update the credit window using the values carried in
the Data Item. It is worth noting, that such updates can result in a
credit window size being reduced, for example, due to a transmission
rate change on the modem.

4.3.2. **Credit Window Associate**

   The Credit Window Associate Data Item is used by a modem to associate
   traffic classification information with a destination. The traffic
   classification information is identified using a TID value that has
   previously been sent by the modem or is listed in a Traffic
   Classification Data Item carried in the same message as the data
   item.

   A single Credit Window Associate Data Item MUST be included in all
   Destination Up and Destination Update Messages sent by a modem when
   the use of the extension defined in this document is agreed upon, see
   Section 3. Note that a TID will not be used unless it is listed in a
   Credit Window Associate Data Item.

   The format of the Credit Window Associate Data Item is:

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Data Item Type                | Length (2)                    |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |Traffic Class. Identifier (TID)|
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Data Item Type: TBA5

   Length: 2

      Per [RFC8175] Length is the number of octets in the data item. It
      MUST be equal to two (2).

    Traffic Classification Identifier (TID):

      A 16-bit unsigned integer identifying a traffic classification set
      that has been identified in a Credit Window Traffic Classification
      Data Item, see Section 5.1. Unknown TID values SHOULD be reported
      and result in associated traffic being dropped.

   A router that receives the Credit Window Associate Data Item MUST
   locate the traffic classification information indicated by the
   received TID. If no corresponding information can be located, the
   data item MUST be treated as an error as described above. Once the
   traffic classification information is located, it MUST be associated
   with the destination and the router MUST ensure that any data plane
   state, see Section 4.1, that is associated with the TID is updated as
   needed.

4.3.3. Credit Window Grant

   The Credit Window Grant data item is used by a modem to provide
   credits to a router. One or more Credit Window Grant Data Items MAY
   be carried in the DLEP Destination Up, Destination Announce Response,
   Destination Update, Credit Control Messages, and Credit Control
   Response Messages. Multiple Credit Window Grant Data Items in a
   single message are used to indicate different credit values for
   different credit windows. In all message types, this data item
   provides an additional number of octets to be added to the indicated
   credit window. Credit window are identified via using CID values
   that have been previously been sent by the modem or are listed in a
   Credit Window Initialization Data Item carried in the same messages
   as the data item.

   The format of the Credit Window Grant Data Item is:

```
     0                   1                   2                   3
     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Data Item Type                | Length (12)                  |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Credit Window Identifier (CID)|           Reserved           |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                     Additional Credits                       :
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    :                     Additional Credits                       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Data Item Type: TBA6

   Length: 12

      Per [RFC8175], Length is the number of octets in the data item.
      It MUST be equal to twelve (12).

   Credit Window Identifier (CID):

      A 16-bit unsigned integer identifying a credit window that has
      been identified in a Credit Window Initialization Data Item, see
      Section 4.3.1. Unknown CID values SHOULD be reported and ignored.

   Additional Credit:

      A 64-bit unsigned integer representing the credits, in octets, to
      be added to the Credit Window. This value includes MAC headers as
      seen on the link between the modem and router. A value of zero
      indicates that no additional credits are being provided.

When receiving this data item, a router MUST identify the credit window indicated by the CID. If the CID is not known to the router, it SHOULD report or log this information and discard the Data Item. It is important to note that while this data item can be received in a destination specific message, credit windows are managed independently from the destination identified in the message carrying this Data Item, and the indicated CID MAY even be disjoint from the identified destination.

Once the credit window is identified, the credit window size MUST be increased by the value contained in the Additional Credits field. If the increase results in a window overflow, i.e., the size of the credit window after the increase is smaller than the original credit window size, the Credit Window must be set to its maximum (0xFFFFFFFFFFFFFFFF).

No response is sent by the router to a modem after processing a Credit Window Grant Data Item received in a Credit Control Response Message. In other cases, the receiving router MUST send a Credit Window Status data item or items reflecting the resulting Credit Window value of the updated credit window. When the Credit Grant data item is received in a Destination Up Message, the Credit Window Status data item(s) MUST be sent in the corresponding Destination Up Response Message. Otherwise, a Credit Control Message MUST be sent.

4.3.4. Credit Window Status

The Credit Window Status data item is used by a router to report the current credit window size to its peer modem. One or more Credit Window Status data items MAY be carried in a Destination Up Response Message or a Credit Control Response Message. As discussed above, the Destination Up Response Message is used when the data item is sent in response to a Destination Up Message, and the Credit Control Response Message is sent in response to a Credit Control Message. Multiple Credit Window Status data items in a single message are used to indicate different sizes of different credit windows. Similar to the Credit Window Grant, credit windows are identified using CID values that have been previously been sent by the modem.

The format of the Credit Window Status Data Item is:

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Data Item Type                | Length (12)                   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Credit Window Identifier (CID)|           Reserved            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                         Credit Window Size                    :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   :                         Credit Window Size                    |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Data Item Type: TBA7

Length: 12

   Per [RFC8175] Length is the number of octets in the data item. It
   MUST be equal to twelve (12).

Credit Window Identifier (CID):

   A 16-bit unsigned integer identifying a credit window that has
   been identified in a Credit Window Initialization Data Item, see
   Section 4.3.1.

Credit Window Size:

   A 64-bit unsigned integer, indicating the current number of
   credits, in octets, available for the router to send to the modem.
   This is referred to as the Modem Receive Window in
   [I-D.ietf-manet-credit-window].

When receiving this data item, a modem MUST identify the credit
window indicated by the CID. If the CID is not known to the modem,
it SHOULD report or log this information and discard the data item.
As with the Credit Window Grant Data Item, the CID MAY be unrelated
to the Destination indicated in the message carrying the data item.

Once the credit window is identified, the modem SHOULD check the
received Credit Window Size field value against the outstanding
credit window's available credits at the time the most Credit Window
Initialization or Grant data item associated with the indicated CID
was sent. If the values significantly differ, i.e., greater than can
be accounted for based on observed data frames, then the modem SHOULD
send a Credit Window Initialization Data Item to reset the associated
credit window size to the modem's current view of the available
credits. As defined above, Credit Window Initialization Data Items
are sent in Session Update Messages. When multiple data items need

   to be sent, they SHOULD be combined into a single message when
   possible. Alternatively, and also in cases where there are small
   differences, the modem MAY adjust the values sent in Credit Window
   Grant data items to account for the reported Credit Window.

4.3.5. Credit Window Request

   The Credit Window Request Data Item is used by a router to request
   additional credits for particular credit windows. Credit Window
   Request Data Items are carried in Credit Control Messages, and one or
   more Credit Window Request Data Items MAY be present in a message.

   Credit windows identified using a CID as defined above in
   Section 4.3.1. Multiple CIDs MAY be present to allow for the case
   where the router identifies that credits are needed in multiple
   credit windows. The special CID value of 0xFFFF is used to indicate
   that a credit request is being made across all queues.

   The format of the Credit Window Request Data Item is:

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Data Item Type                | Length                        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Credit Window Identifier (CID)|              ...              :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   :              ...              | Credit Window Identifier (CID)|
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Data Item Type: TBA8

   Length: Variable

      Per [RFC8175] Length is the number of octets in the data item,
      excluding the Type and Length fields. It will equal the number of
      CID fields carried in the data item times 2 and MUST be at least
      2.

   Credit Window Identifier (CID):

      One or more 16-bit fields used to indicate a credit window that
      has been identified in a Credit Window Initialization Data Item,
      see Section 4.3.1. The special value of 0xFFFFFFFF indicates that
      the request applies to all CIDs.

   A modem receiving this data item MUST provide a Credit Increment for
   the indicated credit windows via Credit Window Grant Data Items

carried in a new Credit Control Message. Multiple values and queue
indexes SHOULD be combined into a single Credit Control Message when
possible. Unknown CID values SHOULD be reported or logged and then
ignored by the modem.

5. Traffic Classification

Traffic classification is supported by the Traffic Classification
Data Item defined below. The base data item and sub data item
structure is intended to be independent of any specific usage of the
flow identification provided within the data item. It is designed to
be extensible for future traffic classification types. While the
structure of the data items is extensible, actual flow information is
expected to be used in an extension dependent manner.

In the context of the DiffServ Aware Credit Window Extension, the
Traffic Classification Data Item is used by a modem to identify
groups of DSCPs which are to be mapped to a credit window. A DLEP
destination address is also needed to complete the traffic
classification information. This address is provided by a modem when
it identifies the traffic classification set in a Destination Up
Message using the Credit Window Associate Data Item defined above.

5.1. Traffic Classification Data Item

This sections defines the Traffic Classification Data Item. This
data item is used by a modem to provide a router with traffic
classification information. When an extension requires use of this
data item the Traffic Classification Data Item SHOULD be included by
a modem in any Session Initialization Response Message that also
contains the corresponding Extension Type Value in the Extensions
Supported Data Item. Updates to previously provided traffic
classifications or new traffic classifications MAY be sent by a modem
by including the data item in Session Update Messages. More than one
data item MAY be included in a message to provide information on
multiple traffic classifiers.

The set of traffic classification information provided in the data
item is identified using a Traffic Classification Identifier, or TID.
Addition information, e.g., the list DSCPs associated with a credit
window, is provided in a variable series of Queue Parameter sub-data
items.

The format of the Traffic Classification Data Item is:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Data Item Type                | Length                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Traffic Class. Identifier (TID)|   Num SDIs    |   Reserved    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Traffic Classification Sub Data Item 1            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
:                              ...                              :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Traffic Classification Sub Data Item n            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Data Item Type: TBA9

Length: Variable

   Per [RFC8175] Length is the number of octets in the data item,
   excluding the Type and Length fields.

 Traffic Classification Identifier (TID):

   A 16-bit unsigned integer identifying a traffic classification
   set. There is no restriction on values used by a modem, and there
   is no requirement for sequential or ordered values.

Num SDIs:

   An 8-bit unsigned integer indicating the number of Traffic
   Classification Sub Data Items included in the data item. A value
   of zero (0) is allowed and indicates that no traffic should be
   matched against this TID.

Reserved:

   MUST be set to zero by the sender (a modem) and ignored by the
   receiver (a router).

Traffic Classification Sub Data Item:

   Zero or more Traffic Classification Sub Data Items of the format
   defined below MAY be included. The number MUST match the value
   carried in the Num SDIs field.

A router receiving the Traffic Classification Data Item MUST locate
the traffic classification information that is associated with the
TID indicated in each received data item. If no associated traffic

classification information is found, the router MUST initialize a new
information set using the values carried in the data item. When
associated traffic classification information is found, the router
MUST update the information using the values carried in the Data
Item. In both cases, a router MUST also ensure that any data plane
state, see Section 4.1, that is associated with the TID is updated as
needed.

5.1.1. Traffic Classification Sub Data Item

All Traffic Classification Sub Data Items share a common format that
is patterned after the standard DLEP data item format, see [RFC8175]
Section 11.3. There is no requirement on, or meaning to sub data
item ordering. Any errors or inconsistencies encountered in parsing
sub data items are handled in the same fashion as any other data item
parsing error encountered in DLEP.

The format of the Traffic Classification Sub Data Item is:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Sub Data Item Type            | Length                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                              Value...                         :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Sub Data Item Type:

   A 16-bit unsigned integer that indicates the type and
   corresponding format of the data item's Value field. Sub Data
   Item Types are managed according to the IANA registry described in
   Section 9.4.

Length: Variable

   Copying [RFC8175], Length a 16-bit unsigned integer that is the
   number of octets in the sub data item, excluding the Type and
   Length fields.

5.2. DiffServ Credit Window Traffic Classification Sub Data Item

The DiffServ Credit Window Traffic Classification Sub Data Item is
used to identify the DSCPs associated with a specific credit window.
Credit windows are identified using CID values that have been
previously been sent by the modem or are listed in a Credit Window
Initialization Data Item carried in the same messages as the sub data
item. DSCPs are identified in a list of DiffServ fields. An

implementation that does not support DSCPs, and wants to use credit
window flow control for all traffic to a destination or destinations,
would indicate with 0 DSCPs.

The format of the DiffServ Credit Window Traffic Classification Sub
Data Item is:

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Must be two (2)               | Length                        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Credit Window Identifier (CID)|   Num DSCPs   |  DS Field 1   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |   DS Field 2  |      ...      |   DS Field n  |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Length: Variable

   Length is the number of octets in the sub data item. It is equal
   to three (3) plus the value of the Num DSCPs field.

Credit Window Identifier (CID):

   A 16-bit unsigned integer identifying a credit window that has
   been identified in a Credit Window Initialization Data Item, see
   Section 4.3.1. Unknown CID values SHOULD be reported and result
   in associated traffic being dropped.

Num DSCPs:

   An 8-bit unsigned integer indicating the number of DSCPs carried
   in the sub data item. A zero (0) indicates a (wildcard) match
   against any DSCP value.

DS Field:

   Each DS Field is an 8-bit whose definition is the same as
   [RFC2474].

```
           0   1   2   3   4   5   6   7
         +---+---+---+---+---+---+---+---+
         |         DSCP          | CU    |
         +---+---+---+---+---+---+---+---+

            DSCP: differentiated services codepoint
            CU:   currently unused, MUST be zero
```

A router receiving the DiffServ Traffic Classification Sub Data Item
MUST validate the information on receipt prior to the information and
data plane update described earlier in this section. The credit
window associated with the CID indicated in each data item must be
located. It is important to note that the CID value may be present
in a Credit Window Initialization Data Item carried in the same
message as the sub data item. If the CID is not located, then it
MUST be treated as an error as described above.

When there are no unknown CIDs, the receiver MUST ensure that each DS
Field value is listed only once across the whole Traffic
Classification Data Item. Note, this check is across the data item
and not the individual sub data item. If the same DS Field value is
listed more than once within the same Traffic Classification Data
Item, the data item MUST be treated as an error as described above.

In all cases, the router MUST use validated DSCPs in data plane
credit window identification as described in Section 4.1.

6. Compatibility

Sessions established with both peers identified as supporting the
DiffServ Aware Credit Window Extension Type, see Section 3, MUST NOT
use the [I-D.ietf-manet-credit-window] defined Credit data items. If
a node supporting the extension defined in this document, receives a
[I-D.ietf-manet-credit-window] defined data item, the recipient MUST
ignore the received information.

7. Management Considerations

This section provides several network management guidelines to
implementations supporting the DiffServ Aware Credit Window
Extension.

The use of the extension defined in this document SHOULD be
configurable on both modems and routers.

Modems SHOULD support the configuration of DSCP to credit window
(queue) mapping.

Modems MAY support the configuration of the number of credit windows
(queues) to advertise to a router.

Routers may have limits on the number of queues that they can support
and, perhaps, even limits in supported credit window combinations,
e.g., if per destination queues can even be supported at all. When
modem-provided credit window information exceeds the capabilities of
a router, the router MAY use a subset of the provided credit windows.

Alternatively, a router MAY reset the session and indicate that the
extension is not supported. In either case, the mismatch of
capabilities SHOULD be reported to the user via normal network
management mechanisms, e.g., user interface or error logging.

8. Security Considerations

The extension introduces a DiffServ awareness to the mechanisms
defined in [I-D.ietf-manet-credit-window]. The extension does not
inherently introduce any additional threats above those documented in
[RFC8175]. The approach taken to Security in that document and
[I-D.ietf-manet-credit-window] apply equally when running the
extension defined in this document.

9. IANA Considerations

This document requests the assignment of 5 values by IANA. All
assignments are to registries defined by [RFC8175].

9.1. Extension Type Value

This document requests 1 new assignment to the DLEP Extensions
Registry named "Extension Type Values" in the range with the
"Specification Required" policy. The requested value is as follows:

```
+------+------------------------------+
| Code | Description                  |
+------+------------------------------+
| TBA1 | DiffServ Aware Credit Window |
+------+------------------------------+
```

Table 1: Requested Extension Type Value

9.2. Message Values

This document requests 2 new assignments to the DLEP Message Registry
named "Message Values" in the range with the "Specification Required"
policy. The requested values are as follows:

```
+-----------+-------------------------+
| Type Code | Description             |
+-----------+-------------------------+
| TBA2      | Credit Control          |
|           |                         |
| TBA3      | Credit Control Response |
+-----------+-------------------------+
```

Table 2: Requested Message Values

9.3. Data Item Values

   This document requests the following new assignments to the DLEP Data
   Item Registry named "Data Item Type Values" in the range with the
   "Specification Required" policy. The requested values are as
   follows:

```
            +-----------+-----------------------------+
            | Type Code | Description                 |
            +-----------+-----------------------------+
            | TBA4      | Credit Window Initialization |
            |           |                             |
            | TBA5      | Credit Window Association    |
            |           |                             |
            | TBA6      | Credit Window Grant          |
            |           |                             |
            | TBA7      | Credit Window Status         |
            |           |                             |
            | TBA8      | Credit Window Request        |
            |           |                             |
            | TBA9      | Traffic Classification       |
            +-----------+-----------------------------+
```

                   Table 3: Requested Data Item Values

9.4. DLEP Sub Data Item Registry

   Upon approval of this document, IANA is requested to create a new
   DLEP registry, named "Sub Data Item Type Values". The registry shall
   identify the type code value, the Data Item which may use the value,
   and a description of the value. While the same value may be reused
   in different data items, this is not recommended at this time.

   The following table provides initial registry values and the
   [RFC8126] defined policies that should apply to the registry:

```
+-------------+----------------------------+---------------------+
| Type Code   | Valid Data Items           | Description         |
+-------------+----------------------------+---------------------+
| 0           | N/A                        | Reserved            |
|             |                            |                     |
| 1           | N/A                        | Reserved (for pause |
|             |                            | sub-DI)             |
|             |                            |                     |
| 2           | DiffServ Credit Window     | DiffServ Traffic    |
|             | Traffic Classification     | Classification      |
|             |                            |                     |
| 2-65407     |                            | Specification       |
|             |                            | Required            |
|             |                            |                     |
| 65408-65534 |                            | Private Use         |
|             |                            |                     |
| 65535       |                            | Reserved            |
+-------------+----------------------------+---------------------+
```

                    Table 4: Initial Registry Values

10. References

10.1. Normative References

   [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
              Requirement Levels", BCP 14, RFC 2119,
              DOI 10.17487/RFC2119, March 1997,
              <https://www.rfc-editor.org/info/rfc2119>.

   [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC
              2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174,
              May 2017, <https://www.rfc-editor.org/info/rfc8174>.

   [RFC8175] Ratliff, S., Jury, S., Satterwhite, D., Taylor, R., and B.
              Berry, "Dynamic Link Exchange Protocol (DLEP)", RFC 8175,
              DOI 10.17487/RFC8175, June 2017,
              <https://www.rfc-editor.org/info/rfc8175>.

10.2. Informative References

   [I-D.ietf-manet-credit-window]
              Ratliff, S., "Credit Windowing extension for DLEP", draft-
              ietf-manet-credit-window-07 (work in progress), November
              2016.

[I-D.ietf-manet-dlep-pause-extension]
          Cheng, B., Wiggins, D., and L. Berger, "DLEP Control Plane
          Based Pause Extension", draft-ietf-manet-dlep-pause-
          extension-02 (work in progress), October 2017.

[IEEE.802.1Q_2014]
          IEEE, "IEEE Standard for Local and metropolitan area
          networks--Bridges and Bridged Networks", IEEE 802.1Q-2014,
          DOI 10.1109/ieeestd.2014.6991462, December 2014,
          <http://ieeexplore.ieee.org/servlet/
          opac?punumber=6991460>.

[RFC2474] Nichols, K., Blake, S., Baker, F., and D. Black,
          "Definition of the Differentiated Services Field (DS
          Field) in the IPv4 and IPv6 Headers", RFC 2474,
          DOI 10.17487/RFC2474, December 1998,
          <https://www.rfc-editor.org/info/rfc2474>.

[RFC2475] Blake, S., Black, D., Carlson, M., Davies, E., Wang, Z.,
          and W. Weiss, "An Architecture for Differentiated
          Services", RFC 2475, DOI 10.17487/RFC2475, December 1998,
          <https://www.rfc-editor.org/info/rfc2475>.

[RFC8126] Cotton, M., Leiba, B., and T. Narten, "Guidelines for
          Writing an IANA Considerations Section in RFCs", BCP 26,
          RFC 8126, DOI 10.17487/RFC8126, June 2017,
          <https://www.rfc-editor.org/info/rfc8126>.

Appendix A. Acknowledgments

The sub data item format was inspired by Rick Taylor's "Data Item
Containers". He also proposed the separation of credit windows from
traffic classification at IETF98. Many useful comments were received
from contributors to the MANET working group.

Appendix B. Notional Support for Ethernet Priority Code Points

This document is intended to allow for use of the credit control
mechanisms defined in Section 4 with different flow identification
techniques. This section explores the viability of this through the
notional definition of credit control with Ethernet Priority Code
Points. Ethernet Priority Code Point support is defined as part of
the IEEE 802.1Q [IEEE.802.1Q_2014] tag format and includes a 3 bit
"PCP" field. The tag format also includes a 12 bit VLAN identifier
(VID) field.

In theory only one new Traffic Classification Sub Data Item is
required to enable support for the traffic classification of a new

flow type. This section defines such a sub data item. This
definition is not a full Extension definition, but may serve as the
foundation for such in the future; in a new document.

B.1. Notional Ethernet Credit Window Traffic Classification Sub Data Item

The Ethernet Credit Window Traffic Classification Sub Data Item is
used to identify the VLAN and PCPs associated with a specific credit
window. Credit windows are identified using CID values that have
been previously been sent by the modem or are listed in a Credit
Window Initialization Data Item carried in the same messages as the
sub data item. PCPs are identified in a list of priority fields. An
implementation that does not support PCPs, and wants to use credit
window flow control for all traffic to a destination or destinations,
would indicate with 0 PCPs. Such an implementation could identify a
VLAN to use per destination.

The format of the Ethernet Credit Window Traffic Classification Sub
Data Item is:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| TBD                           | Length (8)                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Credit Window Identifier (CID)|NumPCPs| VLAN Identifier (VID) |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Pri. 1| Pri. 2| Pri. 3| Pri. 4| Pri. 5| Pri. 6| Pri. 7| Pri. 8|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Length: Variable

   Length is the number of octets in the sub data item. It is equal
   to eight (8).

Credit Window Identifier (CID):

   A 16-bit unsigned integer identifying a credit window that has
   been identified in a Credit Window Initialization Data Item, see
   Section 4.3.1. Unknown CID values SHOULD be reported and result
   in associated traffic being dropped.

Num PCPs:

   A 4-bit unsigned integer indicating the number of PCPs carried in
   the sub data item. A zero (0) indicates a (wildcard) match
   against any PCP value.

VLAN identifier (VID):

   A 12-bit unsigned integer field indicating the VLAN to be used in
   traffic classification. A value of all ones (0xFFF) indicates a
   wild card and any VID is to be accepted during traffic
   classification. Zero (0) and any other value are valid values.

Priority:

   Each Priority Field is an 4-bit whose definition includes the PCP
   field defined in [IEEE.802.1Q_2014]

```
   0   1   2   3
   +---+---+---+---+
   |    PCP    |DEI|
   +---+---+---+---+

   PCP: Priority code point
   DEI: currently unused, MUST be zero
```

A router receiving the Ethernet Traffic Classification Sub Data Item
MUST validate the information on receipt prior to the information and
data plane update described earlier in this section. The credit
window associated with the CID indicated in each data item must be
located. It is important to note that the CID value may be present
in a Credit Window Initialization Data Item carried in the same
message as the sub data item. If the CID is not located, the it MUST
be treated as an error as described above.

When there are no unknown CIDs, the receiver MUST ensure that each
Priority Field value is listed only once across the whole Traffic
Classification Data Item. Note, this check is across the data item
and not the individual sub data item. If the same Priority Field
value is listed more than once within the same Traffic Classification
Data Item, the data item MUST be treated as an error as described
above.

In all cases, the router MUST use validated PCPs in data plane credit
window identification as described in Section 4.1.

B.2. Other Considerations

A full definition for the support of an Ethernet Credit Window
Extensions would need to assign a new Extension Type Value as well as
the Ethernet Credit Window Traffic Classification Sub Data Item
Value. It would also need to fully document the implications of
multiple VLAN support, including configuration implications, e.g.,
limiting value to 0 to indicate PCP-only usage.

Authors' Addresses

    Bow-Nan Cheng
    Lincoln Laboratory
    Massachusetts Institute of Technology
    244 Wood Street
    Lexington, MA 02421-6426

    Email: bcheng@ll.mit.edu

    David Wiggins
    Lincoln Laboratory
    Massachusetts Institute of Technology
    244 Wood Street
    Lexington, MA 02421-6426

    Email: David.Wiggins@ll.mit.edu

    Lou Berger
    LabN Consulting, L.L.C.

    Email: lberger@labn.net