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**Credit Windowing extension for DLEP
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Abstract

This draft describes an extension to the DLEP protocol to provide a credit-windowing scheme analogous to that in [RFC5578](#) for destination-specific flow control.

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1. Introduction

In the world of radio-based networking, there are modems that need fine-grained flow control over traffic ingressing from a LAN connection, bound for transmission over the RF. The need for such fine-grained control can exist for multiple reasons. For example, radio devices are typically connected to the network by Ethernet. The capacity of an Ethernet link is normally far superior to that of the RF, leading to the possibility of overruns and dropped traffic. This is exacerbated by the fact that RF link capacity can vary from moment to moment, for an indeterminate amount of time. Additionally, the capacity of the link can vary greatly depending on the destination, due to factors such as obstructions or multipath fading.

These challenges motivate the requirement for a fine-grained flow control in radio-based communications - one that can support different window sizes for each destination accessed across the RF network. To address this requirement, this document describes an extension to the Dynamic Link Event Protocol ([\[DLEP\]](#)), allowing for a

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Credit windowing scheme to be implemented on a destination-by-destination basis.

2. Requirements

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](#), [RFC 2119](#) [[RFC2119](#)].

3. Overview

This protocol extension to DLEP describes a credit windowing scheme analogous to the one documented in [[RFC5578](#)]. In this scheme, data plane traffic flowing between the router and modem is controlled by the availability of credits. Credits are expressed as if two unidirectional windows exist between the modem and router. This document identifies these windows as the 'Modem Receive Window', or MRW, and the 'Router Receive Window', or RRW. The responsibility of granting credits lies with the receiver on a window - that is, on the MRW, the modem is responsible for granting credits to the router, allowing it (the router) to send data plane traffic to the modem. Likewise, the router is responsible for granting credits on the RRW, which allows the modem to send data plane traffic to the router.

Credits represent the number of data plane octets, or an increment in the number of data plane octets, that can be sent on a given window at the MAC layer to the receiver.

4. Terminology

In general, the draft uses the same terminology as specified in the core DLEP draft [[DLEP](#)]. In addition, the draft uses the following terms:

- o Modem Receive Window, or MRW. The MRW represents a logical, unidirectional window for traffic flowing from the router to the modem.
- o Router Receive Window, or RRW. The RRW represents a logical, unidirectional window for traffic flowing from the modem to the router.

5. Operation

DLEP peers supporting this extension MUST include a DLEP 'Extensions Supported' data item, including the value TBD representing this extension in the appropriate DLEP Session Initialization and Session Initialization Response messages.

Credits are managed on a destination-specific basis - separate credit counts MUST be maintained for each destination requiring the service. Credits MUST NOT be applied to the DLEP session that exists between routers and modems; they are applied only to the data plane traffic. There are no default values for either the initial credit window or the credit increments.

When DLEP peers desire to employ the credit-windowing extension, the peer originating the Destination Up or Destination Announce message MUST supply a Credit Grant data item with an initial, non-zero value as the increment of the window the originator controls (i.e., the MRW, or RRW).

When receiving a Credit Grant data item on a Destination Up or Destination Announce message, the receiver MUST take one of the following actions:

1. Reject the use of credits for this destination, via the Destination Up Response or Destination Announce Response message containing a Status data item with a status code of 'Credit Use Rejected', or
2. Initialize the appropriate window value of zero, then apply the increment specified in the Credit Grant data item.

If the initialization completes successfully, the receiver MUST respond to the Destination Up/Destination Announce message with a response message that contains a Credit Grant data item, initializing its receive window.

Data plane traffic would then flow between the DLEP peers, with said peers accounting for the traffic sent/received by decrementing the appropriate credit counts.

The number of credits needed for a given transmission is the length of the data portion of the packet at the MAC layer. When sending data to a credit enabled peer, the sender MUST decrement the appropriate window by the size of the data being sent, prior to encapsulation at the MAC layer. When traffic is received, the receiver MUST decrement its own window after decapsulation at the MAC layer.

When the number of available credits to the destination reaches 0, the sender MUST stop sending data plane traffic to the destination, until additional credits are granted by the receiver.

6. DLEP Messages for Credit-Window Extension

The credit-windowing extension does not introduce any additional DLEP signals or messages.

7. DLEP Status Codes for Credit-Window Extension

The credit-windowing extension introduces two additional DLEP status code:

Status Code	Value	Failure Mode	Reason
Credit Window Out of Sync	TBD	Continue	Credit counts are out-of-sync between sender and receiver on the destination.
Credit Use Rejected	TBD	Continue	Credit counts cannot be used for the destination.

8. DLEP Data Items for Credit-Window Extension

The extension introduces 3 DLEP data items:

Type Code	Description
TBD	Credit Grant (Section 9.1)
TBD	Credit Window Status (Section 9.2)
TBD	Credit Request (Section 9.3)

Descriptions of the data items are included below. The credit-windowing data items are inserted into DLEP messages as follows:

8.1. DLEP Destination Up Message

If use of credits is required for the destination, then the Destination Up message MUST contain one Credit Grant ([Section 9.1](#)) data item. The value of the credit increment is at the discretion of the implementation. The receiver of the Destination Up message MUST use the value in Credit Grant as the initial value for the appropriate window.

If the Destination Up message does not contain the Credit Grant data item, credits MUST NOT be used for that destination.

8.2. DLEP Destination Announce Message

If use of credits is required for the destination, then the Destination Announce message MUST contain one Credit Grant ([Section 9.1](#)) data item. The value of the credit increment is at the discretion of the implementation. The receiver of the Destination Announce message MUST use the value in Credit Grant as the initial value for the appropriate window.

If the Destination Announce message does not contain the Credit Grant data item, credits MUST NOT be used for that destination.

8.3. DLEP Destination Up Response Message

If the corresponding Destination Up message contained a Credit Grant ([Section 9.1](#)) data item, the Destination Up Response message MUST also contain a Credit Grant ([Section 9.1](#)) data item.

Likewise, if the corresponding Destination Up message did not contain a Credit Grant ([Section 9.1](#)) data item, the Destination Up Response message MUST NOT contain a Credit Grant ([Section 9.1](#)) data item.

The receiver of Destination Up Response MUST use the received Credit Grant value to initialize the appropriate window (e.g., the MRW value for routers, the RRW value for modems).

When an implementation detects a mismatch in the presence or absence of credit window data items between the DLEP Destination Up and Destination Up Response messages, the implementation detecting the mismatch MUST terminate the session by issuing a Peer Termination message with a status code of 'Credit Window Out of Sync', and transition to the Session Termination state.

8.4. DLEP Destination Announce Response Message

If the corresponding Destination Announce message contained a Credit Grant ([Section 9.1](#)) data item, the Destination Announce Response message MUST also contain a Credit Grant ([Section 9.1](#)) data item.

Likewise, if the corresponding Destination Announce message did not contain a Credit Grant ([Section 9.1](#)) data item, the Destination Announce Response message MUST NOT contain a Credit Grant ([Section 9.1](#)) data item.

The receiver of Destination Announce Response MUST use the received Credit Grant value to initialize the appropriate window (e.g., the MRW value for routers, the RRW value for modems).

When an implementation detects a mismatch in the presence or absence of credit window data items between the DLEP Destination Announce and Destination Announce Response messages, the implementation detecting the mismatch MUST terminate the session by issuing a Peer Termination message with a status code of 'Credit Window Out of Sync', and transition to the Session Termination state.

8.5. DLEP Destination Update Message

If the corresponding Destination Up or Destination Announce message contained the Credit Grant data item, the Destination Update message MAY contain one of each of the following data items:

- o Credit Grant ([Section 9.1](#))
- o Credit Window Status ([Section 9.2](#))
- o Credit Request ([Section 9.3](#))

DLEP peers supporting the extension MAY format and send a DLEP Destination Update message solely for the purposes of maintaining the credit windows. In cases where a peer already has information requiring a Destination Update message, (e.g., a change in Latency on the link), the credit data items MAY be included in addition to that information.

8.6. DLEP Link Characteristics Request Message

If the corresponding Destination Up or Destination Announce message contained the credit Grant data item, the Link Characteristics Request message MAY contain the following data item:

- o Credit Request ([Section 9.3](#))

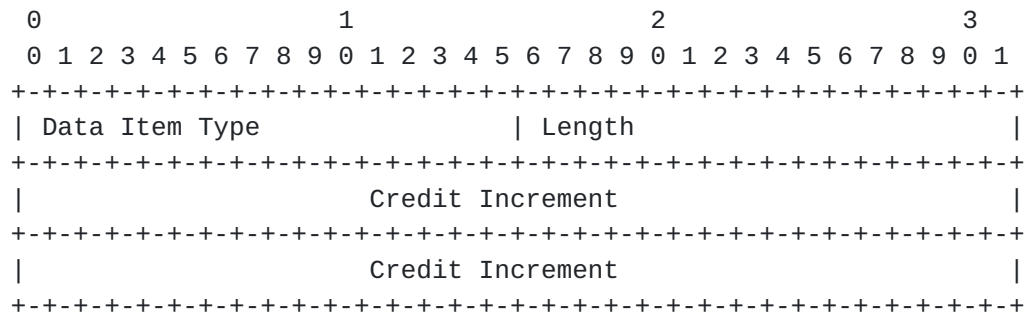
DLEP peers supporting the extension MAY format and send a DLEP Link Characteristics Request message solely for the purposes of maintaining the credit windows. In cases where a peer already has information requiring a Link Characteristics Request message, the Credit Request data MAY be included in addition to that information.

9. Credit Window Data Item Definitions

9.1. Credit Grant

The Credit Grant data item is sent from a DLEP participant to grant an increment to credits on a window. The Credit Grant data item MAY appear in the DLEP Destination Up, Destination Announce, and Destination Update messages. The value in a Credit Grant data item represents an increment to be added to any existing credits available on the window. Upon successful receipt and processing of a Credit Grant data item, the receiver MUST respond with a message containing a Credit Window Status data item to report the updated aggregate values for synchronization purposes, and if initializing a new credit window, granting initial credits.

The Credit Grant data item contains the following fields:



Data Item Type: TBD

Length: 8

Credit Increment: A 64-bit unsigned integer representing the additional credits, in octets, to be assigned to the credit window.

Since credits can only be granted by the receiver on a window, the applicable credit window (either the MRW or the RRW) is derived from the sender of the grant. The Credit Increment MUST NOT cause the window to overflow; if this condition occurs, implementations MUST set the credit window to the maximum value contained in a 64-bit quantity.

9.2. Credit Window Status

During normal operation, DLEP session peers may disagree about the number of available credits. Operational credit mismatches can occur due to packets in transit on the wire. DLEP session peers MAY use the Credit Window Status data item to maintain synchronization of credit counts. This data item is informational only; it is used to inform the receiving peer of the current credit counts for both the MRW and RRW, from the perspective of the sender.

Upon receipt of a Credit Window Status data item, an implementation SHOULD compare its own credit counts with that of the originator. If the receiver of Credit Window Status detects that the local credit counts are not synchronized with the originator, the receiving implementation MAY either: o Attempt resynchronization using an additional Credit Grant, if applicable, or o Issue a DLEP Destination Down message, to clear credit counts on the session.

Implementations issuing Destinaton Down MUST supply a DLEP Status item, with the status code of 'Credit Window Out of Sync', as defined in this document.

If a DLEP message contains both the Credit Grant (Section 9.1) data item and the Credit Window Status (Section 9.2) data item, implementations MUST first apply the Credit Grant (Section 9.1) data item before comparing the credit counts contained in Credit Window Status (Section 9.2).

It is recommended that implementations issue a DLEP Destination Update with a Credit Window Status data item at a configurable multiple of the DLEP Heartbeat timer, to serve as a continuing check on synchronization of the credit windows for a destination.

The Credit Window Status data item contains the following fields:

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	2	3	4	5	6	7	8	9
Data Item Type										Length																													
Modem Receive Window Value										:																													
Modem Receive Window Value																																							
Router Receive Window Value										:																													
Router Receive Window Value																																							

Data Item Type: TBD

Length: 16

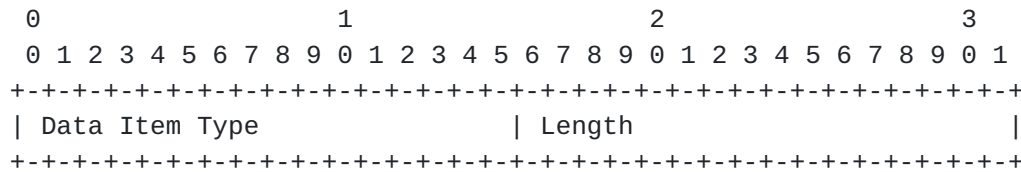
Modem Receive Window Value: A 64-bit unsigned integer, indicating the current number of credits, in octets, available on the Modem Receive Window, for the destination referred to by the message.

Router Receive Window Value: A 64-bit unsigned integer, indicating the current number of credits, in octets, available on the Router Receive Window, for the destination referred to by the message.

9.3. Credit Request

The Credit Request data item MAY be sent from either DLEP participant, as a data item in a DLEP Destination Update message, or a Link Characteristics Request message, to indicate the desire for the partner to grant additional credits in order for data transfer to proceed on the session. If the corresponding DLEP Destination Up or Destination Announce message for this session did not contain a Credit Grant data item, indicating that credits are to be used on the session, then receipt of the Credit Request data item MUST be considered as an error by the receiver, requiring termination of the DLEP peer session.

The Credit Request data item contains the following fields:



Data Item Type: TBD

Length: 0

10. Security Considerations

The extension introduces a mechanism for destination-specific flow control between a router and modem supporting the DLEP protocol. The extension does not introduce any additional threats above those documented in [DLEP]. The mitigation strategy documented in that document is sufficient to secure operation of this extension.

11. IANA Considerations

This section specifies requests to IANA.

11.1. Registrations

This specification defines three (3) new entries in the repository entitled "Data Item Type Values for the Dynamic Link Event Protocol (DLEP)". Assignments from that registry are requested for:

- o Credit Grant
- o Credit Request
- o Credit Window Status

The specification also defines an extension to the DLEP protocol. An assignment from the repository entitled "Extension Type Values for the Dynamic Link Event Protocol (DLEP)" is requested for:

- o Credit Windowing

In addition, the specification defines two (2) new DLEP status codes. Assignments from the repository entitled "Status Code Values for the Dynamic Link Event Protocol (DLEP)" are requested for:

- o Credit Window Out of Sync
- o Credit Use Rejected

12. Acknowledgements

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13. References

13.1. Normative References

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