

NETCONF
Internet-Draft
Intended status: Standards Track
Expires: April 22, 2019

G. Zheng
T. Zhou
A. Clemm
Huawei
October 19, 2018

UDP based Publication Channel for Streaming Telemetry
draft-ietf-netconf-udp-pub-channel-04

Abstract

This document describes a UDP-based publication channel for streaming telemetry use to collect data from devices. A new shim header is proposed to facilitate the distributed data collection mechanism which directly pushes data from line cards to the collector. Because of the lightweight UDP encapsulation, higher frequency and better transit performance can be achieved.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <https://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on April 22, 2019.

Copyright Notice

Copyright (c) 2018 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

1. Introduction	3
2. Terminologies	4
3. Solution Overview	4
4. Transport Mechanisms	5
4.1. Dynamic Subscription	6
4.2. Configured Subscription	7
5. UDP Transport for Publication Channel	8
5.1. Design Overview	8
5.2. Data Format of the UPC Message Header	9
5.3. Options	10
5.3.1. Reliability Option	10
5.3.2. Fragmentation Option	11
5.4. Data Encoding	12
6. Using DTLS to Secure UPC	12
6.1. Transport	13
6.2. Port Assignment	14
6.3. DTLS Session Initiation	14
6.4. Sending Data	14
6.5. Closure	15
7. Congestion Control	15
8. A YANG Data Model for Management of UPC	16
9. YANG Module	16
10. IANA Considerations	18
11. Security Considerations	19
12. Acknowledgements	19
13. References	19
13.1. Normative References	19
13.2. Informative References	20
13.3. URIs	21
Appendix A. Change Log	21
Authors' Addresses	22

1. Introduction

Streaming telemetry refers to sending a continuous stream of operational data from a device to a remote receiver. This provides an ability to monitor a network from remote and to provide network analytics. Devices generate telemetry data and push that data to a collector for further analysis. By streaming the data, much better performance, finer-grained sampling, monitoring accuracy, and bandwidth utilization can be achieved than with polling-based alternatives.

Sub-Notif [I-D.ietf-netconf-subscribed-notifications] defines a mechanism that allows a collector to subscribe to updates of YANG-defined data that is maintained in a YANG [RFC7950] datastore. The mechanism separates the management and control of subscriptions from the transport that is used to actually stream and deliver the data. Two transports, NETCONF transport [I-D.ietf-netconf-netconf-event-notifications] and HTTP transport [I-D.ietf-netconf-restconf-notif], have been defined so far for the notification messages.

While powerful in its features and general in its architecture, in its current form the mechanism needs to be extended to stream telemetry data at high velocity from devices that feature a distributed architecture. The transports that have been defined so far, NETCONF and HTTP, are ultimately based on TCP and lack the efficiency needed to stream data continuously at high velocity. A lighter-weight, more efficient transport, e.g. a transport based on UDP is needed.

- o Firstly, data collector will suffer a lot of TCP connections from, for example, many line cards equipped on different devices.
- o Secondly, as no connection state needs to be maintained, UDP encapsulation can be easily implemented by hardware which will further improve the performance.
- o Thirdly, because of the lightweight UDP encapsulation, higher frequency and better transit performance can be achieved, which is important for streaming telemetry.

This document specifies a higher-performance transport option for Sub-Notif that leverages UDP. Specifically, it facilitates the distributed data collection mechanism described in [I-D.zhou-netconf-multi-stream-originators]. In the case of data originating from multiple line cards, the centralized design requires data to be internally forwarded from those line cards to the push server, presumably on a main board, which then combines the

individual data items into a single consolidated stream. The centralized data collection mechanism can result in a performance bottleneck, especially when large amounts of data are involved. What is needed instead is the support for a distributed mechanism that allows to directly push multiple individual substreams, e.g. one from each line card, without needing to first pass them through an additional processing stage for internal consolidation, but still allowing those substreams to be managed and controlled via a single subscription. The proposed UDP based Publication Channel (UPC) natively supports the distributed data collection mechanism.

The transport described in this document can be used for transmitting notification messages over both IPv4 and IPv6 [RFC8200].

While this document will focus on the data publication channel, the subscription can be used in conjunction with the mechanism proposed in [I-D.ietf-netconf-subscribed-notifications] with extensions [I-D.zhou-netconf-multi-stream-originators].

2. Terminologies

Streaming Telemetry: refers to sending a continuous stream of operational data from a device to a remote receiver. This provides an ability to monitor a network from remote and to provide network analytics.

Component Subscription: A subscription that defines the data from each individual telemetry source which is managed and controlled by a single Subscription Server.

Component Subscription Server: An agent that streams telemetry data per the terms of a component subscription.

3. Solution Overview

The typical distributed data collection solution is shown in Fig. 1. Both the Collector and the Publisher can be distributed. The Collector includes the Subscriber and a set of Receivers. And the Publisher includes a Subscription Server and a set of Component Subscription Servers. The Subscriber cannot see the Component Subscription Servers directly, so it will send the Global Subscription information to the Subscription Server (e.g., main board) via the Subscription Channel. When receiving a Global Subscription, the Subscription Server decomposes the subscription request into multiple Component Subscriptions, each involving data from a separate internal telemetry source, for example a line card. The Component Subscriptions are distributed to the Component Subscription Server. Subsequently, each data originator generates

its own stream of telemetry data, collecting and encapsulating the packets per the Component Subscription and streaming them to the designated Receivers. This distributed data collection mechanism may form multiple Publication Channels to the Receivers. The Receiver is able to assemble many pieces of data associated with one Global Subscription.

The Publication Channel supports the reliable data streaming, for example for some alarm events. The Collector has the option of deducing the packet loss and the disorder based on the information carried by the notification data. And the Collector may decide the behavior to request retransmission.

The rest of the draft describes the UDP based Publication Channel (UPC).

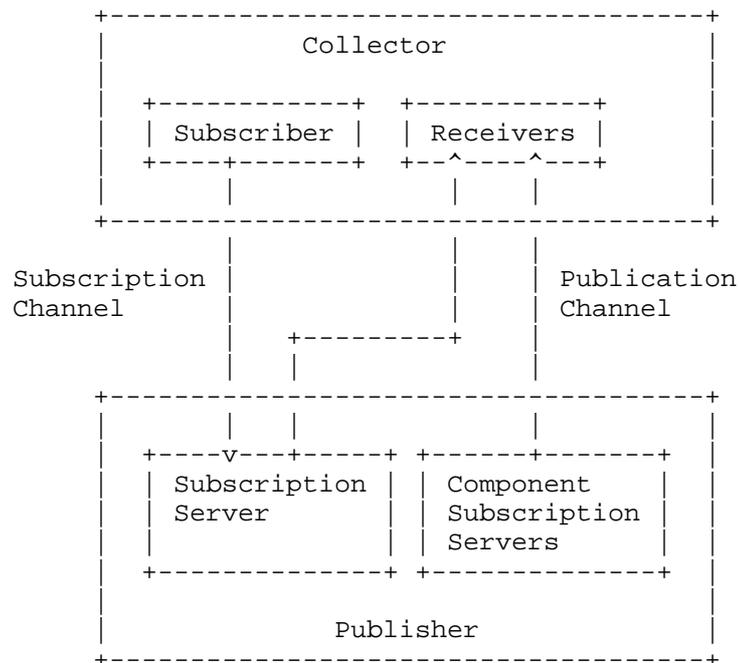


Fig. 1 Distributed Data Collection

4. Transport Mechanisms

For a complete pub-sub mechanism, this section will describe how the UPC is used to interact with the Subscription Channel relying on NETCONF or RESTCONF.

4.1. Dynamic Subscription

Dynamic subscriptions for Sub-Notif are configured and managed via signaling messages transported over NETCONF [RFC6241] or RESTCONF [RFC8040]. The Sub-Notif defined RPCs which are sent and responded via the Subscription Channel (a), between the Subscriber and the Subscription Server of the Publisher. In this case, only one Receiver is associated with the Subscriber. In the Publisher, there may be multiple data originators. Notification messages are pushed on separate channels (b), from different data originators to the Receiver.

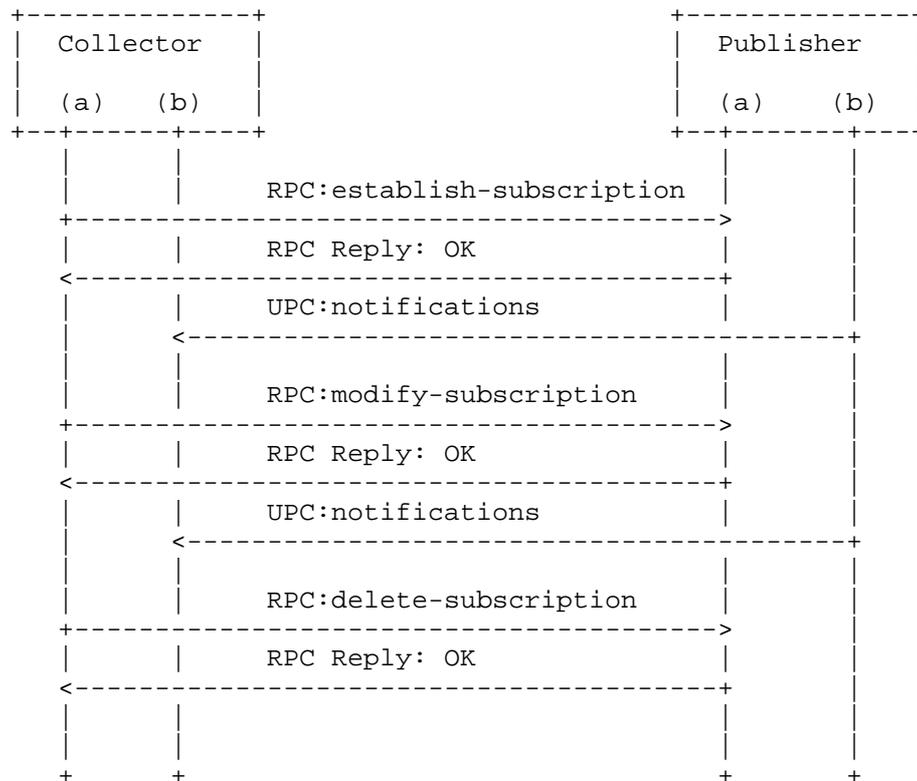


Fig. 2 Call Flow For Dynamic Subscription

In the case of dynamic subscription, the Receiver and the Subscriber SHOULD be colocated. So UPC can use the source IP address of the Subscription Channel as it's destination IP address. The Receiver MUST support listening messages at the IANA-assigned PORT-X or PORT-Y, but MAY be configured to listen at a different port.

For dynamic subscription, the Publication Channels MUST share fate with the subscription session. In other words, when the delete-subscription is received or the subscription session is broken, all the associated Publication Channels MUST be closed.

4.2. Configured Subscription

For a Configured Subscription, there is no guarantee that the Subscriber is currently in place with the associated Receiver(s). As defined in Sub-Notif, the subscription configuration contains the location information of all the receivers, including the IP address and the port number. So that the data originator can actively send generated messages to the corresponding Receivers via the UPC.

The first message MUST be a separate subscription-started notification to indicate the Receiver that the pushing is started. Then, the notifications can be sent immediately without any wait.

All the subscription state notifications, as defined in [I-D.ietf-netconf-subscribed-notifications], MUST be encapsulated to be separated notification messages.

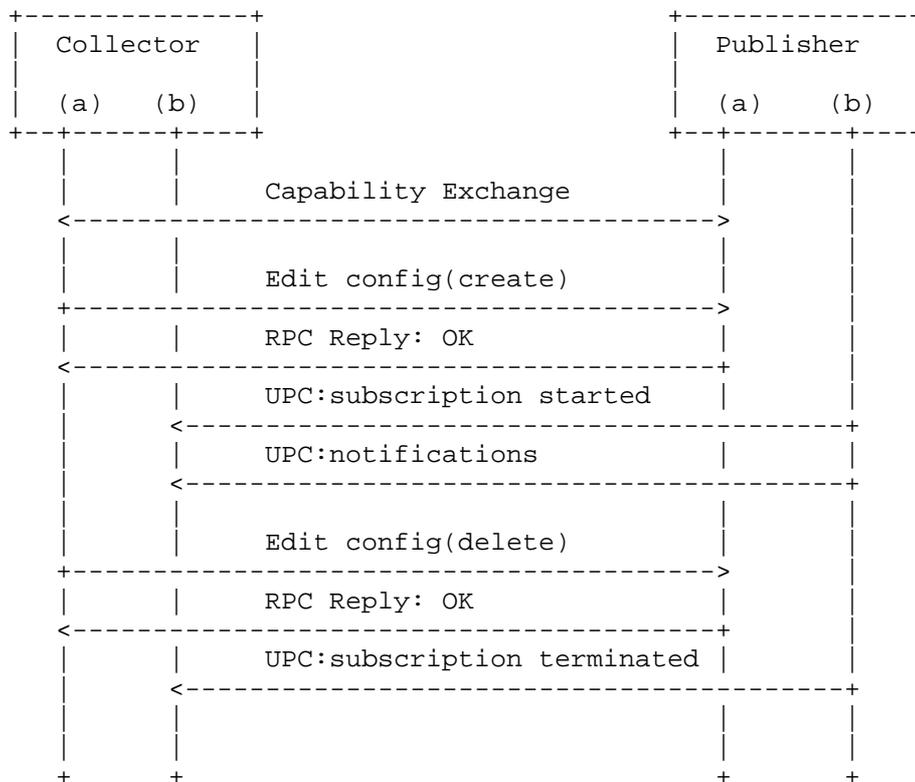


Fig. 3 Call Flow For Configured Subscription

5. UDP Transport for Publication Channel

5.1. Design Overview

As specified in Sub-Notif, the telemetry data is encapsulated in the NETCONF/RESTCONF notification message, which is then encapsulated and carried in the transport protocols, e.g. TLS, HTTP2. The following figure shows the overview of the typical UPC message structure.

- o The Message Header contains information that can facilitate the message transmission before de-serializing the notification message.
- o Notification Message is the encoded content that the publication channel transports. The common encoding method includes GPB [1], CBOR [RFC7049], JSON, and XML. [I-D.ietf-netconf-notification-messages] describes the structure

of the Notification Message for both single notification and multiple bundled notifications.

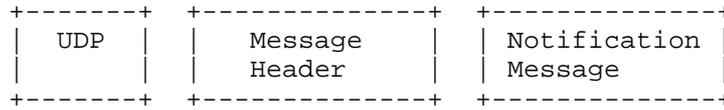


Fig. 4 UDP Publication Message Overview

5.2. Data Format of the UPC Message Header

The UPC Message Header contains information that can facilitate the message transmission before de-serializing the notification message. The data format is shown as follows.

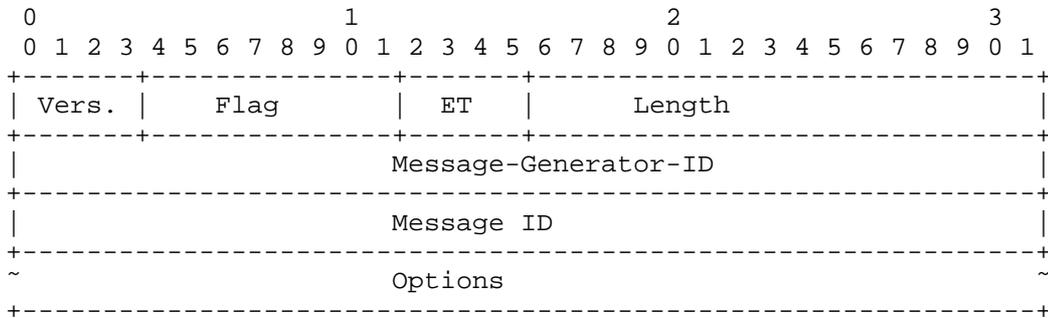


Fig. 3 UPC Message Header Format

The Message Header contains the following field:

- o Vers.: represents the PDU (Protocol Data Unit) encoding version. The initial version value is 0.
- o Flag: is a bitmap indicating what features this packet has and the corresponding options attached. Each bit associates to one feature and one option data. When the bit is set to 1, the associated feature is enabled and the option data is attached. The sequence of the presence of the options follows the bit order of the bitmap. In this document, the flag is specified as follows:
 - * bit 0, the reliability flag;
 - * bit 1, the fragmentation flag;

- * other bits are reserved.
- o ET: is a 4 bits identifier to indicate the encoding type used for the Notification Message. 16 types of encoding can be expressed:
 - * 0: GPB;
 - * 1: CBOR;
 - * 2: JSON;
 - * 3: XML;
 - * others are reserved.
- o Length: is the total length of the message, measured in octets, including message header.
- o Message-Generator-ID: is a 32-bit identifier of the process which created the notification message. This allows disambiguation of an information source, such as the identification of different line cards sending the notification messages. The source IP address of the UDP datagrams SHOULD NOT be interpreted as the identifier for the host that originated the UPC message. The entity sending the UPC message could be merely a relay.
- o The Message ID is generated continuously by the message generator. Different subscribers share the same notification ID sequence.
- o Options: is a variable-length field. The details of the Options will be described in the respective sections below.

5.3. Options

The order of packing the data fields in the Options field follows the bit order of the Flag field.

5.3.1. Reliability Option

The UDP based publication transport described in this document provides two streaming modes, the reliable mode and the unreliable mode, for different SLA (Service Level Agreement) and telemetry requirements.

In the unreliable streaming mode, the line card pushes the encapsulated data to the data collector without any sequence information. So the subscriber does not know whether the data is correctly received or not. Hence no retransmission happens.

The reliable streaming mode provides sequence information in the UDP packet, based on which the subscriber can deduce the packet loss and disorder. Then the subscriber can decide whether to request the retransmission of the lost packets.

In most case, the unreliable streaming mode is preferred. Because the reliable streaming mode will cost more network bandwidth and precious device resource. Different from the unreliable streaming mode, the line card cannot remove the sent reliable notifications immediately, but to keep them in the memory for a while. Reliable notifications may be pushed multiple times, which will increase the traffic. When choosing the reliable streaming mode or the unreliable streaming mode, the operate need to consider the reliable requirement together with the resource usage.

When the reliability flag bit is set to 1 in the Flag field, the following option data will be attached

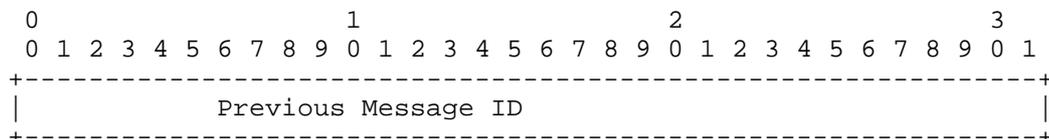


Fig. 4 Reliability Option Format

Current Message ID and Previous Message ID will be added in the packets.

For example, there are two subscriber A and B,

- o Message IDs for the generator are : [1, 2, 3, 4, 5, 6, 7, 8, 9], in which Subscriber A subscribes [1,2,3,6,7] and Subscriber B subscribes [1,2,4,5,7,8,9].
- o Subscriber A will receive [Previous Message ID, Current Message ID] like: [0,1][1,2][2,3][3,6][6,7].
- o Subscriber B will receive [Previous Message ID, Current Message ID] like: [0,1][1,2][2,4][4,5][5,7][7,8][8,9].

5.3.2. Fragmentation Option

UDP palyload has a theoretical length limitation to 65535. Other encapsulation headers will make the actual payload even shorter. Binary encodings like GPB and CBOR can make the message compact. So that the message can be encapsulated within one UDP packet, hence fragmentation will not easily happen. However, text encodings like

JSON and XML can easily make the message exceed the UDP length limitation.

The Fragmentation Option can help not Application layer can split the YANG tree into several leaves. Or table into several rows. But the leaf or the row cannot be split any further. Now we consider a very long path. Since the GPB and CBOR are so compact, it's easy to fit into a UDP packet. But for JSON or XML, it is possible that even one leaf will exceed the UDP boundary.

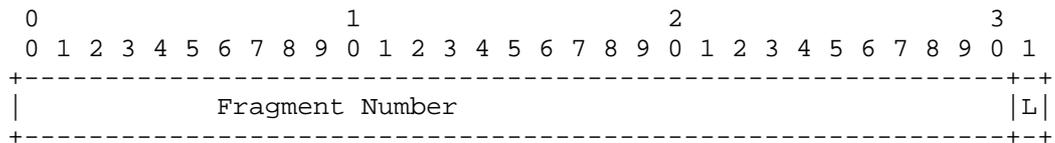


Fig. 5 Fragmentation Option Format

The Fragmentation Option is available in the message header when the fragmentation flag is set to 1. The option contains:

Fragment Number: indicates the sequence number of the current fragment.

L: is a flag to indicate whether the current fragment is the last one. When 0 is set, current fragment is not the last one, hence more fragments are expected. When 1 is set, current fragment is the last one.

5.4. Data Encoding

Subscribed data can be encoded in GPB, CBOR, XML or JSON format. It is conceivable that additional encodings may be supported as options in the future. This can be accomplished by augmenting the subscription data model with additional identity statements used to refer to requested encodings.

Implementation may support different encoding method per subscription. When bundled notifications is supported between the publisher and the receiver, only subscribed notifications with the same encoding can be bundled as one message.

6. Using DTLS to Secure UPC

The Datagram Transport Layer Security (DTLS) protocol [RFC6347] is designed to meet the requirements of applications that need secure datagram transport.

DTLS can be used as a secure transport to counter all the primary threats to UDP based Publication Channel:

- o Confidentiality to counter disclosure of the message contents.
- o Integrity checking to counter modifications to a message on a hop-by-hop basis.
- o Server or mutual authentication to counter masquerade.

In addition, DTLS also provides:

- o A cookie exchange mechanism during handshake to counter Denial of Service attacks.
- o A sequence number in the header to counter replay attacks.

6.1. Transport

As shown in Figure 6, the DTLS is layered next to the UDP transport is to provide reusable security and authentication functions over UDP. No DTLS extension is required to enable UPC messages over DTLS.

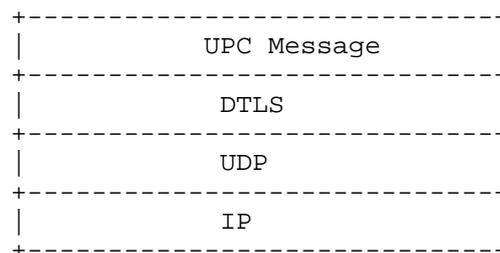


Fig. 6: Protocol Stack for DTLS secured UPC

The application implementer will map a unique combination of the remote address, remote port number, local address, and local port number to a session.

Each UPC message is delivered by the DTLS record protocol, which assigns a sequence number to each DTLS record. Although the DTLS implementer may adopt a queue mechanism to resolve reordering, it may not assure that all the messages are delivered in order when mapping on the UDP transport.

Since UDP is an unreliable transport, with DTLS, an originator or relay may not realize that a collector has gone down or lost its DTLS connection state, so messages may be lost.

The DTLS record has its own sequence number, the encryption and decryption will be done by the DTLS layer, the UPC Message layer will not concern this.

6.2. Port Assignment

The Publisher is always a DTLS client, and the Receiver is always a DTLS server. The Receivers MUST support accepting UPC Messages on the UDP port PORT-Y, but MAY be configurable to listen on a different port. The Publisher MUST support sending UPC messages to the UDP port PORT-Y, but MAY be configurable to send messages to a different port. The Publisher MAY use any source UDP port for transmitting messages.

6.3. DTLS Session Initiation

The Publisher initiates a DTLS connection by sending a DTLS Client Hello to the Receiver. Implementations MUST support the denial of service countermeasures defined by DTLS. When these countermeasures are used, the Receiver responds with a DTLS Hello Verify Request containing a cookie. The Publisher responds with a DTLS Client Hello containing the received cookie, which initiates the DTLS handshake. The Publisher MUST NOT send any UPC messages before the DTLS handshake has successfully completed.

Implementations MUST support DTLS 1.0 [RFC4347] and MUST support the mandatory to implement cipher suite, which is TLS_RSA_WITH_AES_128_CBC_SHA [RFC5246] as specified in DTLS 1.0. If additional cipher suites are supported, then implementations MUST NOT negotiate a cipher suite that employs NULL integrity or authentication algorithms.

Where privacy is REQUIRED, then implementations must either negotiate a cipher suite that employs a non-NUL encryption algorithm or else achieve privacy by other means, such as a physically secured network.

6.4. Sending Data

All UPC messages MUST be sent as DTLS "application_data". It is possible that multiple UPC messages be contained in one DTLS record, or that a publication message be transferred in multiple DTLS records. The application data is defined with the following ABNF [RFC5234] expression:

```
APPLICATION-DATA = 1*UPC-FRAME
```

```
UPC-FRAME = MSG-LEN SP UPC-MSG
```

MSG-LEN = NONZERO-DIGIT *DIGIT

SP = %d32

NONZERO-DIGIT = %d49-57

DIGIT = %d48 / NONZERO-DIGIT

UPC-MSG is defined in section 5.2.

6.5. Closure

A Publisher MUST close the associated DTLS connection if the connection is not expected to deliver any UPC Messages later. It MUST send a DTLS close_notify alert before closing the connection. A Publisher (DTLS client) MAY choose to not wait for the Receiver's close_notify alert and simply close the DTLS connection. Once the Receiver gets a close_notify from the Publisher, it MUST reply with a close_notify.

When no data is received from a DTLS connection for a long time (where the application decides what "long" means), Receiver MAY close the connection. The Receiver (DTLS server) MUST attempt to initiate an exchange of close_notify alerts with the Publisher before closing the connection. Receivers that are unprepared to receive any more data MAY close the connection after sending the close_notify alert.

Although closure alerts are a component of TLS and so of DTLS, they, like all alerts, are not retransmitted by DTLS and so may be lost over an unreliable network.

7. Congestion Control

Congestion control mechanisms that respond to congestion by reducing traffic rates and establish a degree of fairness between flows that share the same path are vital to the stable operation of the Internet [RFC2914]. While efficient, UDP has no build-in congestion control mechanism. Because streaming telemetry can generate unlimited amounts of data, transferring this data over UDP is generally problematic. It is not recommended to use the UDP based publication channel over congestion-sensitive network paths. The only environments where the UDP based publication channel MAY be used are managed networks. The deployments require the network path has been explicitly provisioned for the UDP based publication channel through traffic engineering mechanisms, such as rate limiting or capacity reservations.

8. A YANG Data Model for Management of UPC

The YANG model defined in Section 9 has two leafs augmented into one place of Sub-Notif [I-D.ietf-netconf-subscribed-notifications], plus one identities.

```
module: ietf-upc-subscribed-notifications
  augment /sn:subscriptions/sn:subscription/sn:receivers/sn:receiver:
    +--rw address?   inet:ip-address
    +--rw port?     inet:port-number
```

9. YANG Module

```
<CODE BEGINS> file "ietf-upc-subscribed-notifications@2018-10-19.yang"
module ietf-upc-subscribed-notifications {
  yang-version 1.1;
  namespace
    "urn:ietf:params:xml:ns:yang:ietf-upc-subscribed-notifications";
  prefix upcsn;
  import ietf-subscribed-notifications {
    prefix sn;
  }
  import ietf-inet-types {
    prefix inet;
  }

  organization "IETF NETCONF (Network Configuration) Working Group";
  contact
    "WG Web: <http://tools.ietf.org/wg/netconf/>
    WG List: <mailto:netconf@ietf.org>

    Editor: Guangying Zheng
    <mailto:zhengguangying@huawei.com>

    Editor: Tianran Zhou
    <mailto:zhoutianran@huawei.com>

    Editor: Alexander Clemm
    <mailto:alexander.clemm@huawei.com>";

  description
    "Defines UDP Publish Channel as a supported transport for subscribed
    event notifications.

    Copyright (c) 2018 IETF Trust and the persons identified as authors
    of the code. All rights reserved."
```

Redistribution and use in source and binary forms, with or without modification, is permitted pursuant to, and subject to the license terms contained in, the Simplified BSD License set forth in Section 4.c of the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>).

This version of this YANG module is part of RFC XXXX; see the RFC itself for full legal notices.";

```
revision 2018-10-19 {
  description
    "Initial version";
  reference
    "RFC XXXX: UDP based Publication Channel for Streaming Telemetry";
}

identity upc {
  base sn:transport;
  description
    "UPC is used as transport for notification messages and state
    change notifications.";
}

grouping target-receiver {
  description
    "Provides a reusable description of a UPC target receiver.";
  leaf address {
    type inet:ip-address;
    description
      "Ip address of target upc receiver, which can be IPv4 address or
      IPV6 address.";
  }
  leaf port {
    type inet:port-number;
    description
      "Port number of target UPC receiver, if not specify, system
      should use default port number.";
  }
}

augment "/sn:subscriptions/sn:subscription/sn:receivers/sn:receiver" {
  description
    "This augmentation allows UPC specific parameters to be
    exposed for a subscription.";
  uses target-receiver;
}
}
```

<CODE ENDS>

10. IANA Considerations

This RFC requests that IANA assigns three UDP port numbers in the "Registered Port Numbers" range with the service names "upc" and "upc-dtls". These ports will be the default ports for the UDP based Publication Channel for NETCONF and RESTCONF. Below is the registration template following the rules in [RFC6335].

Service Name: upc

Transport Protocol(s): UDP

Assignee: IESG <iesg@ietf.org>

Contact: IETF Chair <chair@ietf.org>

Description: UDP based Publication Channel

Reference: RFC XXXX

Port Number: PORT-X

Service Name: upc-dtls

Transport Protocol(s): UDP

Assignee: IESG <iesg@ietf.org>

Contact: IETF Chair <chair@ietf.org>

Description: UDP based Publication Channel (DTLS)

Reference: RFC XXXX

Port Number: PORT-Y

IANA is requested to assign a new URI from the IETF XML Registry [RFC3688]. The following URI is suggested:

URI: urn:ietf:params:xml:ns:yang:ietf-upc-subscribed-notifications

Registrant Contact: The IESG.

XML: N/A; the requested URI is an XML namespace.

This document also requests a new YANG module name in the YANG Module Names registry [RFC7950] with the following suggestion:

name: ietf-upc-subscribed-notifications
namespace: urn:ietf:params:xml:ns:yang:ietf-upc-subscribed-notifications
prefix: upcsn
reference: RFC XXXX

11. Security Considerations

TBD

12. Acknowledgements

The authors of this documents would like to thank Eric Voit, Tim Jenkins, and Huiyang Yang for the initial comments.

13. References

13.1. 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>>.
- [RFC2914] Floyd, S., "Congestion Control Principles", BCP 41, RFC 2914, DOI 10.17487/RFC2914, September 2000, <<https://www.rfc-editor.org/info/rfc2914>>.
- [RFC3688] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688, DOI 10.17487/RFC3688, January 2004, <<https://www.rfc-editor.org/info/rfc3688>>.
- [RFC4347] Rescorla, E. and N. Modadugu, "Datagram Transport Layer Security", RFC 4347, DOI 10.17487/RFC4347, April 2006, <<https://www.rfc-editor.org/info/rfc4347>>.
- [RFC5234] Crocker, D., Ed. and P. Overell, "Augmented BNF for Syntax Specifications: ABNF", STD 68, RFC 5234, DOI 10.17487/RFC5234, January 2008, <<https://www.rfc-editor.org/info/rfc5234>>.
- [RFC5246] Dierks, T. and E. Rescorla, "The Transport Layer Security (TLS) Protocol Version 1.2", RFC 5246, DOI 10.17487/RFC5246, August 2008, <<https://www.rfc-editor.org/info/rfc5246>>.

- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", RFC 6241, DOI 10.17487/RFC6241, June 2011, <<https://www.rfc-editor.org/info/rfc6241>>.
- [RFC6335] Cotton, M., Eggert, L., Touch, J., Westerlund, M., and S. Cheshire, "Internet Assigned Numbers Authority (IANA) Procedures for the Management of the Service Name and Transport Protocol Port Number Registry", BCP 165, RFC 6335, DOI 10.17487/RFC6335, August 2011, <<https://www.rfc-editor.org/info/rfc6335>>.
- [RFC6347] Rescorla, E. and N. Modadugu, "Datagram Transport Layer Security Version 1.2", RFC 6347, DOI 10.17487/RFC6347, January 2012, <<https://www.rfc-editor.org/info/rfc6347>>.
- [RFC7049] Bormann, C. and P. Hoffman, "Concise Binary Object Representation (CBOR)", RFC 7049, DOI 10.17487/RFC7049, October 2013, <<https://www.rfc-editor.org/info/rfc7049>>.
- [RFC7950] Bjorklund, M., Ed., "The YANG 1.1 Data Modeling Language", RFC 7950, DOI 10.17487/RFC7950, August 2016, <<https://www.rfc-editor.org/info/rfc7950>>.
- [RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", RFC 8040, DOI 10.17487/RFC8040, January 2017, <<https://www.rfc-editor.org/info/rfc8040>>.
- [RFC8200] Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", STD 86, RFC 8200, DOI 10.17487/RFC8200, July 2017, <<https://www.rfc-editor.org/info/rfc8200>>.

13.2. Informative References

- [I-D.ietf-netconf-netconf-event-notifications]
Voit, E., Clemm, A., Prieto, A., Nilsen-Nygaard, E., and A. Tripathy, "NETCONF Support for Event Notifications", draft-ietf-netconf-netconf-event-notifications-13 (work in progress), October 2018.
- [I-D.ietf-netconf-notification-messages]
Voit, E., Birkholz, H., Bierman, A., Clemm, A., and T. Jenkins, "Notification Message Headers and Bundles", draft-ietf-netconf-notification-messages-04 (work in progress), August 2018.

[I-D.ietf-netconf-restconf-notif]

Voit, E., Rahman, R., Nilsen-Nygaard, E., Clemm, A., and A. Bierman, "RESTCONF Transport for Event Notifications", draft-ietf-netconf-restconf-notif-08 (work in progress), October 2018.

[I-D.ietf-netconf-subscribed-notifications]

Voit, E., Clemm, A., Prieto, A., Nilsen-Nygaard, E., and A. Tripathy, "Customized Subscriptions to a Publisher's Event Streams", draft-ietf-netconf-subscribed-notifications-17 (work in progress), September 2018.

[I-D.zhou-netconf-multi-stream-originators]

Zhou, T., Zheng, G., Voit, E., Clemm, A., and A. Bierman, "Subscription to Multiple Stream Originators", draft-zhou-netconf-multi-stream-originators-03 (work in progress), October 2018.

13.3. URIs

[1] <https://developers.google.com/protocol-buffers/>

Appendix A. Change Log

(To be removed by RFC editor prior to publication)

A.1. draft-ietf-zheng-udp-pub-channel-00 to v00

- o Modified the message header format.
- o Added a section on the Authentication Option.
- o Cleaned up the text and removed unnecessary TBDs.

A.2. v01

- o Removed the detailed description on distributed data collection mechanism from this document. Mainly focused on the description of a UDP based publication channel for telemetry use.
- o Modified the message header format.

A.2. v02

- o Add the section on the transport mechanism.
- o Modified the fixed message header format.

- o Add the fragmentation option for the message header.

A.2. v03

- o Clarify term through the document.

- o Add a section on DTLS support.

A.2. v04

- o Add a section on UPC subscription model.

Authors' Addresses

Guangying Zheng
Huawei
101 Yu-Hua-Tai Software Road
Nanjing, Jiangsu
China

Email: zhengguangying@huawei.com

Tianran Zhou
Huawei
156 Beiqing Rd., Haidian District
Beijing
China

Email: zhoutianran@huawei.com

Alexander Clemm
Huawei
2330 Central Expressway
Santa Clara, California
USA

Email: alexander.clemm@huawei.com