ICN Hop-By-Hop Fragmentation Update: Begin-End Fragmentation (BEF)

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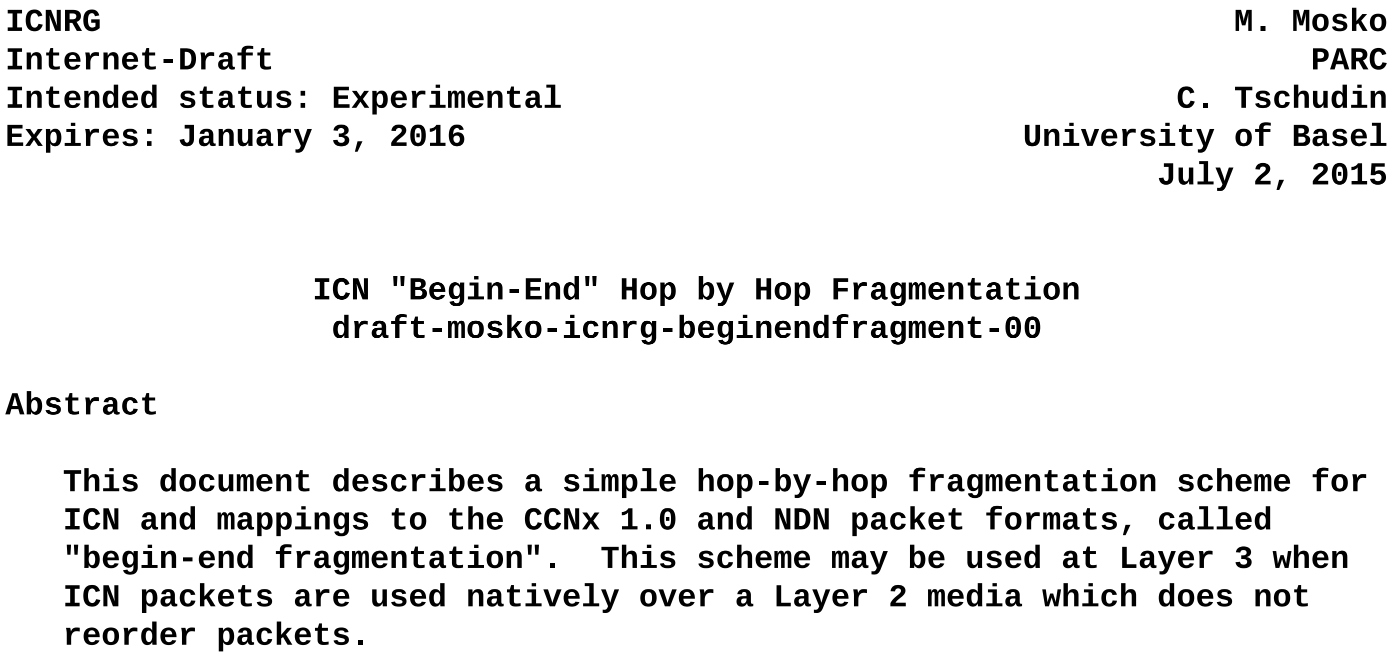
IRTF ICNRG interim meeting, Prague, CZ, July 19, 2015

Introduction

- Submitted IETF document
  - https://datatracker.ietf.org/doc/draft-mosko-icnrg-beginendfragment/
- CCNx implementation status
- Draft updated for NDNLPv2
- CCN-lite implementation

IETF document



```
ICNRG                                                           M. Mosko
Internet-Draft                                                      PARC
Intended status: Experimental                                C. Tschudin
Expires: January 3, 2016                             University of Basel
                                                            July 2, 2015


                ICN "Begin-End" Hop by Hop Fragmentation
                 draft-mosko-icnrg-beginendfragment-00

Abstract

   This document describes a simple hop-by-hop fragmentation scheme for
   ICN and mappings to the CCNx 1.0 and NDN packet formats, called
   "begin-end fragmentation".  This scheme may be used at Layer 3 when
   ICN packets are used natively over a Layer 2 media which does not
   reorder packets.
```

https://www.ietf.org/id/draft-mosko-icnrg-beginendfragment-00.txt

CCNx Implementation Status

- Basic protocol implemented
  - Current CCNx forwarder implements the “basic” format where fragmentation state encoded in the Fixed Header.
  - Extended format forthcoming.
- Used automatically for Ethernet links.
- UDP links still using IP fragmentation.

Begin-End Fragmentation for NDN

- Caveat:
  - Not NDN approved, not part of NDN code distribution
  - but aligned with ongoing NDN Link Protocol v2 discussion

```
NDNpacket      ::= Interest | Data | NDNLP
NDNLP          ::= NDNLP-TYPE TLV-LENGTH
                     NDNLPhdrFields*
                     NDNLPfragment?
NDNLPhdrFields ::= BeginEndField | (other NDNLP header fields)
BeginEndField  ::= BEGIN-END-FIELD-TYPE TLV-LENGTH
                     BYTE BYTE+
NDNfragment    ::= NDN-FRAGMENT-TYPE TLV-LENGTH
                     BYTE+
```

CCN-lite Implementation Status

- Supports BEF functionality, both for
  - CCNx encoding (basic format)
  - NDN encoding

  using the same fragmentation code
- Tested on RFduino hardware
  - Bluetooth Low Energy, 20 Bytes MTU
- Insights:
  - hard to use with fragmentation factor above x10 over BTLE
  - CCNx 1.0 fixed header hurts (in IoT), too many frags/chunk
  - a case for IoT-specific encoding? (going away from TLV)

Next Steps

- CCNx implementation
  - Implement Extended format
- CCN-lite implementation
  - open question: how to (de-)activate BEF on a link? → importance of link negotiation protocol
  - add support for “official” NDN indexed fragmentation, too
  - Interops
- Protocol
  - Define BE protocol that supports out-of-order packet reception for use in UDP environments

Appendix: NDN Format Specified

NDNLPv2 packets have a start type NDNLP-TYPE which distinguishes them from the classic Interest and Data packets. Inside the NDNLPv2 TLV structure, a sequence of NDNLPv2 header fields preceed the payload (fragment data) which is introduced by the type value NND-FRAGMENT-TYPE.

```
      NDNpacket      ::= Interest | Data | NDNLP
      NDNLP          ::= NDNLP-TYPE TLV-LENGTH
                           NDNLPhdrFields*
                           NDNLPfragment?
      NDNLPhdrFields ::= BeginEndField | (other NDNLP header fields)
      BeginEndField  ::= BEGIN-END-FIELD-TYPE TLV-LENGTH
                           BYTE BYTE+
      NDNfragment    ::= NDN-FRAGMENT-TYPE TLV-LENGTH
                           BYTE+
```

Appendix: NDN Example

We present an example of the basic fragment encoding for a payload of size larger than 253 Bytes and less than 64KB.

```
                     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
+---------------+---------------+---------------+---------------+
| type=NDNLP    | len=N+9                                       |
+---------------+---------------+---------------+---------------+
| type=BeginEnd | len=3         |B|E|        FragSequence...    |
+---------------+---------------+---------------+---------------+
| ..Number      | type=Fragment | len=N                         |
+---------------+---------------+---------------+---------------+
|               | FragmentData (N bytes) ...                    /
+---------------+---------------+---------------+---------------+
/                                                               /
+---------------+---------------+---------------+---------------+
/               |
+---------------+
```

o B: Begin flag.

o E: End flag.

o FragSequenceNumber: a 22-bit sequence number to identify the fragment.