May 2023

RELIABLE INTERESTS IN INFORMATION-CENTRIC NETWORKING

Michele Papalini

Mauro Sardara

Giulio Grassi

Luca Muscariello

RELIABLE INTERESTS IN INFORMATION-CENTRIC NETWORKING

AUTHORS:
Michele Papalini
Mauro Sardara
Giulio Grassi
Luca Muscariello

ABSTRACT

In an information-centric networking (ICN) environment, an interest may be dropped by a network for any number of reasons. However, if an interest is lost then the corresponding data cannot be received, thereby reducing the performance of a network. Techniques are presented herein that make ICN interests more resilient to potential losses by adding certain state information into an interest payload. That state information may be used to keep track of the previous interests that have been sent by a forwarder face for a specific name. To encode the sequence numbers of the interests that have been previously sent, a first aspect of the presented techniques employs a list of sequence numbers while a second aspect of the presented techniques employs a bitmap. The presented techniques may be used to reduce the possibility that interests are not dropped during transit when using ICN.

DETAILED DESCRIPTION

Information-centric networking (ICN) employs a request-reply semantic. For every interest (i.e., a request) packet that is sent, a data (i.e., a reply) packet is received. Interests may be dropped by a network for any number of reasons, including, for example, poor Wi-Fi connectivity, congestion, etc. However, if an interest is lost then the corresponding data cannot be received, thereby reducing the performance of a network.

In order to address such issues, techniques are presented herein that make ICN interests more resilient to potential losses by adding certain state information into an interest payload. That state information may be used to keep track of the previous interests that have been sent by a forwarder face for a specific name. To encode the sequence numbers of the interests that have been previously sent, a first aspect of the presented

Published by Technical Disclosure Commons, 2023

techniques employs a list of sequence numbers while a second aspect of the presented techniques employs a bitmap.

The techniques presented herein may be explicated through an illustrative example. Under that example, the interest 10(8,7,5) has been received. Here, the received interest has the sequence number 10 and the previously sent interests are 8, 7, and 5. All of the indicated sequence numbers refer to the same name that is carried in a hybrid ICN (hICN) header of a packet.

Figures 1A and 1B, both below, depict elements of an exemplary interest packet showing how the above-described information may be carried according to the two different aspects of the techniques presented herein – first, in Figure 1A, through the use of a list and second, in Figure 1B, through the use of a bitmap. In both figures, the main sequence number 10 is indicated in the hICN header in addition to the other fields such as name, etc.

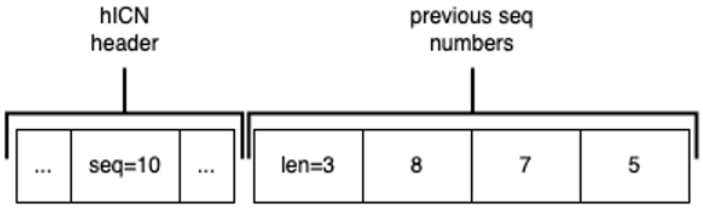

Figure 1A: Exemplary Interest Packet -- List

As shown in Figure 1A, above, the previous sequence numbers (i.e., 8, 7, and 5) may be encoded using a list, where the first value indicates the size of the list (3 in the instant case) and then all of the sequence numbers are separately listed in the payload.

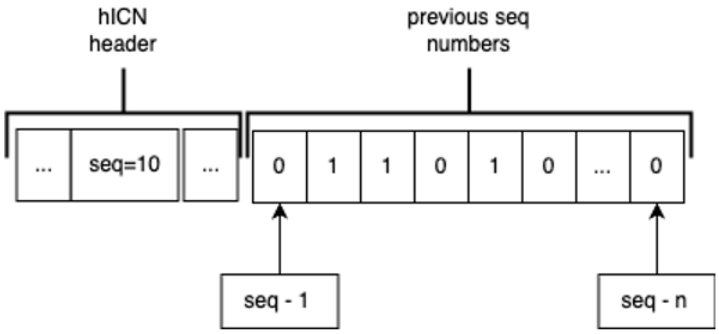

Figure 1B: Exemplary Interest Packet -- Bitmap

As shown in Figure 1B, above, a bitmap of size N is employed. In the bitmap, the bit at position M indicates the sequence (seq – M). Thus, the first bit (i.e., bit number 1) in the bitmap represents the sequence number (seq – 1) or, in the instant example, (10 – 1) or 9 and the second bit (i.e., bit number 2) in the bitmap represents the sequence number (seq – 2) or, in the instant example, (10 – 2) or 8. The value of an individual bit may be set to 1 if the corresponding sequence number was previously sent. Thus, the bitmap 0110100... indicates the previous sequence numbers 8, 7, and 5.

Continuing with the example that was introduced above, when the interest 10(8,7,5) is received a forwarder may, according to the techniques presented herein, process the packet through a series of steps.

First, the forwarder may process the interest 10 as a standard interest. Then, for each sequence number in the payload the forwarder may check its pending interest table (PIT) to see whether a pending interest with the same name and the same sequence number exits. If a matching interest is found in the PIT, the forwarder may check if the incoming face of the interest is already stored in the list of incoming faces. If not, the face from where the interest 10 was received needs to be added. Instead, if no PIT entry exists then the receiver may add a new PIT entry for that sequence number with the incoming face of interest 10.

The above-described operations recover the state of any interests that were lost, and, when a matching data is received, it may then be delivered to the correct next hop. No additional packets need to be sent to the next hop since all of the information for potentially lost interests is stored in the payload of interest 10.

Figure 2, below, presents an exemplary workflow that may be executed by a forwarder, following the reception of a packet, according to the techniques presented herein and reflective of the above discussion.

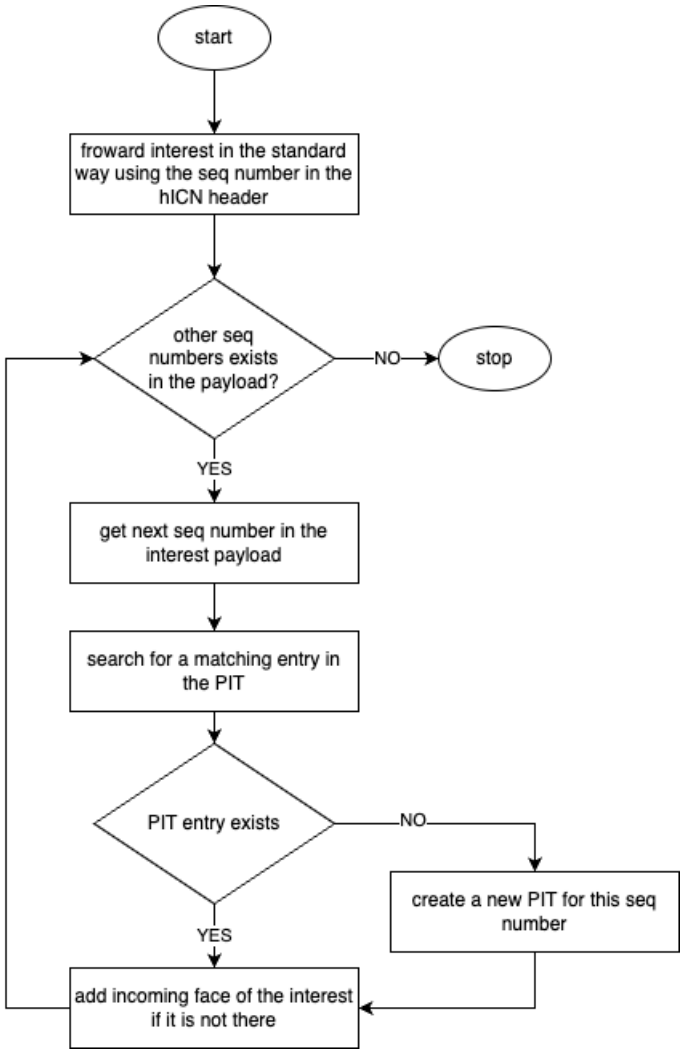

Figure 2: Exemplary Workflow

As depicted in Figure 2, above, on the sending of an interest the forwarder needs to update the list in the payload. This may be accomplished by including in the list the most recent sequence numbers and, if the list is full, removing the old sequence numbers from the end of the list. This operation may be performed by the forwarding strategy of the forwarder that, for each name, knows which sequence number was sent out on each face.

In summary, techniques have been presented herein that make ICN interests more resilient to potential losses by adding certain state information into an interest payload. That state information may be used to keep track of the previous interests that have been sent by a forwarder face for a specific name. To encode the sequence numbers of the interests that have been previously sent, a first aspect of the presented techniques employs a list of sequence numbers while a second aspect of the presented techniques employs a bitmap. The presented techniques may be used to reduce the possibility that interests are not dropped during transit when using ICN.