Context-Aware Navigator Protocol for IP-Based Vehicular Networks
draft-jeong-ipwave-context-aware-navigator-01

Abstract

   This document proposes a Context-Aware Navigator Protocol (CAN) for
   IP-based vehicular networks for cooperative navigation among vehicles
   in road networks. This CAN aims at the enhancement of driving safety
   through a light-weight driving information sharing method. The CAN
   protocol uses an IPv6 Neighbor Discovery (ND) option to convey
   driving information such as a vehicle's position, speed,
   acceleration/deceleration, and direction, and a driver's driving
   action (e.g., braking and accelerating).

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1. Introduction

The enhancement of driving safety is one of objectives in cooperative
driving in vehicular networks. Dedicated Short-Range Communications
(DSRC) is for vehicular communications [DSRC]. IEEE has standardized
a family standard suite of Wireless Access in Vehicular Environments
(WAVE) [WAVE]. Also, IETF has standardized an IPv6 packet delivery
protocol over IEEE 802.11-OCB (Outside the Context of a Basic Service
Set) [RFC8691], which is a MAC protocol for vehicles in WAVE.

A vehicle equipped with various sensors and the a DSRC device can
sense its surrounding environment including its neighboring vehicles,
and share the sensed data and its mobility information (e.g.,
position, speed, acceleration/deceleration, and direction) with its
neighboring vehicles. This information sharing allows vehicles to
assess the collision risk and make their maneuver change to avoid an
accident in a prompt way. That is, the capability of sensing,
computing, and communication of vehicles enables them to understand
the driving environment and situation (i.e., context), and cooperate
with each other during their navigation.

The driving information sharing enables Context-Aware Navigator (CAN)
where each vehicle can display its neighboring vehicles, pedestrians,
and obstacles in its navigation system [CASD]. With this CAN, a
driver can make a better decision on driving to avoid an accident,
and an autonomous vehicle can control its maneuver to escape from a
possible fatality in advance.

For this CAN service, this document proposes a light-weight data
sharing protocol using a new IPv6 Neighbor Discovery (ND) option for
Vehicle Mobility Information, which is called Vehicle Mobility
Information (VMI) option. This VMI option can be included by a
Neighbor Advertisement (NA) message in Vehicular Neighbor Discovery
(VND) [ID-Vehicular-ND].

There are two messages for the CAN service with the VMI option such
as Cooperation Context Message (CCM) and Emergency Context Message
(ECM). The CCM is a message to deliver a vehicle's motion
information (e.g., position, speed, acceleration/deceleration,
direction) and a driver's driving action (e.g., braking and
accelerating) to its neighboring vehicles for cooperative driving.
The ECM is a message to notify a vehicle's neighboring vehicles of an
emergency situation (e.g., an accident and dangerous situation). The
ECM has a higher priority than the CCM such that the ECM needs to be
disseminated faster than the CCM in vehicular networks.

2. 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].

3. Terminology

This document uses the terminology described in [ID-IPWAVE-PS].

4. Vehicle Mobility Information Option

Vehicle Mobility Information (VMI) option is an IPv6 ND option to
convey either a CCM or ECM. Figure 1 shows the format of the VMI
option.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |     Length    |    Message    |   Reserved1   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Reserved2                            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                              |
:                    Mobility Information                      :
|                                                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
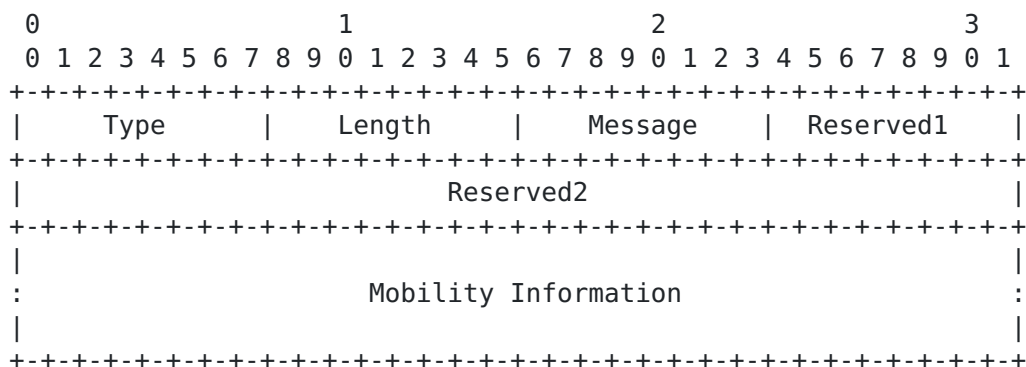
        Figure 1: Vehicle Mobility Information (VMI) Option Format

Fields:
  Type   8-bit identifier of the VMI option type as assigned
                  by the IANA: TBD

  Length   8-bit unsigned integer. The length of the option
                  (including the Type and Length fields) is in units of
                  8 octets. The value is 3.

  Message   8-bit identifier of the VMI message type as CCM (0)
                  and ECM (1).

  Reserved1   This field is unused. It MUST be initialized to
                  zero by the sender and MUST be ignored by the
                  receiver.

  Reserved2   This field is unused. It MUST be initialized to
                  zero by the sender and MUST be ignored by the
                  receiver.

  Mobility Information
                  128-bit mobility information. It contains a vehicle's
                  motion information (e.g., position, speed,
                  acceleration/deceleration, direction) and a driver's
                  driving action (e.g., braking and accelerating) for
                  CCM. Also, it contains a vehicle's emergency
                  information (e.g., obstacle information and accident
                  information).

   A CCM in a VMI option can be included in an NA message that a vehicle
   transmits periodically to announce its existence and routing
   information to its one-hop neighboring vehicles [ID-Vehicular-ND].

   An ECM in a VMI option can be included in an NA message that a
   vehicle transmits to immediately announce an emergency situation to
   its one-hop neighboring vehicles [ID-Vehicular-ND].

   To let the vehicles take an immediate action on an emergency
   situation, the ECM has a higher priority than the CCM. Thus, if a
   vehicle has an ECM and a CCM to send, it SHOULD transmit the ECM
   earlier than the CCM.

5. Security Considerations

   This document shares all the security issues of the IPv6 ND protocol.
   This document can get benefits from Secure Neighbor Discovery (SEND)
   [RFC3971] in order to protect exchanged messages from possible
   security attacks.

7.   References

7.1.   Normative References

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7.2.   Informative References

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Appendix A. Changes from draft-jeong-ipwave-context-aware-navigator-00

The following changes are made from draft-jeong-ipwave-context-aware-navigator-00:

o This version has a submission date update to maintain the active status of the draft.

o This version updates the version numbers of the referenced drafts.

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