

IPWAVE Working Group  
Internet-Draft  
Intended status: Standards Track  
Expires: August 25, 2021

J. Jeong  
B. Mugabarigira  
Y. Shen  
Z. Xiang  
Sungkyunkwan University  
Z. Kim  
Hyundai Motor  
February 21, 2021

Context-Aware Navigation Protocol for IP-Based Vehicular Networks  
draft-jeong-ipwave-context-aware-navigator-03

## Abstract

This document proposes a Context-Aware Navigation Protocol (CNP) for IP-based vehicular networks for cooperative navigation among vehicles in road networks. This CNP aims at the enhancement of driving safety through a light-weight driving information sharing method. The CNP 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).

## 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 August 25, 2021.

## Copyright Notice

Copyright (c) 2021 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

<a href="#">1.</a>	Introduction . . . . .	<a href="#">2</a>
<a href="#">2.</a>	Requirements Language . . . . .	<a href="#">3</a>
<a href="#">3.</a>	Terminology . . . . .	<a href="#">3</a>
<a href="#">4.</a>	Vehicle Mobility Information Option . . . . .	<a href="#">3</a>
<a href="#">5.</a>	Security Considerations . . . . .	<a href="#">5</a>
<a href="#">6.</a>	Acknowledgments . . . . .	<a href="#">5</a>
<a href="#">7.</a>	References . . . . .	<a href="#">5</a>
<a href="#">7.1.</a>	Normative References . . . . .	<a href="#">5</a>
<a href="#">7.2.</a>	Informative References . . . . .	<a href="#">6</a>
<a href="#">Appendix A.</a>	Changes from <a href="#">draft-jeong-ipwave-context-aware-navigator-02</a> . . . . .	<a href="#">7</a>
	Authors' Addresses . . . . .	<a href="#">7</a>

## [1.](#) Introduction

The enhancement of driving safety is one of objectives of 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 maneuvers 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 navigation where each vehicle can display its neighboring vehicles, pedestrians, and obstacles in its navigation system [[CASD](#)]. With this CNP, 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 CNP 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 CNP 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.

Internet-Draft

Context-Aware Navigation Protocol

February 2021

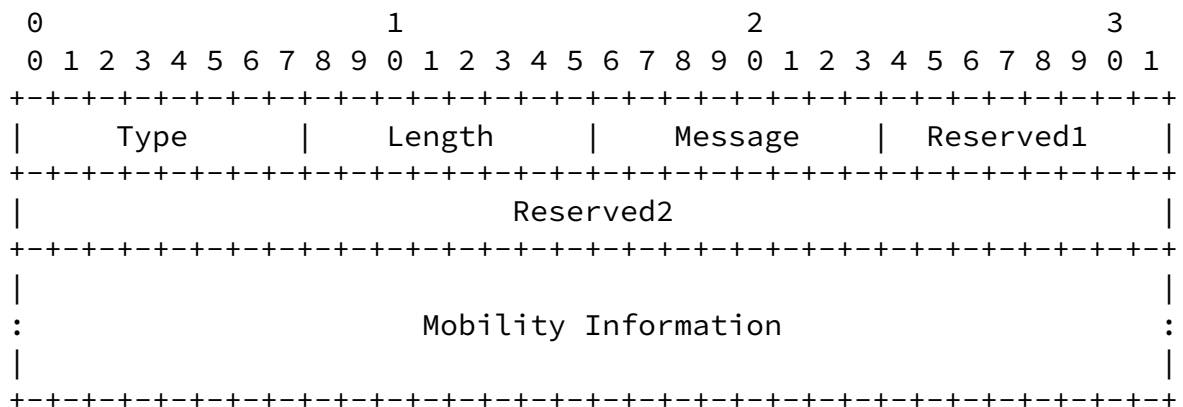


Figure 1: Vehicle Mobility Information (VMI) Option Format

## 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.

## [6.](#) Acknowledgments

This work was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2017R1D1A1B03035885).

This work was supported in part by Institute of Information & Communications Technology Planning & Evaluation (IITP) grant funded by the Korea MSIT (Ministry of Science and ICT) (R-20160222-002755, Cloud based Security Intelligence Technology Development for the Customized Security Service Provisioning).

This work was supported in part by the MSIT under the ITRC (Information Technology Research Center) support program (IITP-2020-2017-0-01633) supervised by the IITP.

## 7. References

### 7.1. Normative References

[ID-IPWAVE-PS]

Jeong, J., "IPv6 Wireless Access in Vehicular Environments (IPWAVE): Problem Statement and Use Cases", [draft-ietf-ipwave-vehicular-networking-19](#) (work in progress), July 2020.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.

[RFC3971] Arkko, J., "SEcure Neighbor Discovery (SEND)", [RFC 3971](#), March 2005.

Jeong, et al.

Expires August 25, 2021

[Page 5]

---

Internet-Draft

Context-Aware Navigation Protocol

February 2021

[RFC4861] Narten, T., Nordmark, E., Simpson, W., and H. Soliman, "Neighbor Discovery for IP Version 6 (IPv6)", [RFC 4861](#), September 2007.

[RFC8691] Benamar, N., Haerri, J., Lee, J., and T. Ernst, "Basic Support for IPv6 Networks Operating Outside the Context of a Basic Service Set over IEEE Std 802.11", [RFC 8691](#), December 2019.

### 7.2. Informative References

[CASD] Shen, Y., Jeong, J., Oh, T., and S. Son, "CASD: A Framework of Context-Awareness Safety Driving in Vehicular Networks", International Workshop on Device Centric Cloud (DC2), March 2016.

- [DSRC] ASTM International, "Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems - 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications", ASTM E2213-03(2010), October 2010.
- [ID-Vehicular-ND] Jeong, J., Ed., Shen, Y., Xiang, Z., and S. Cespedes, "Vehicular Neighbor Discovery for IP-Based Vehicular Networks", [draft-jeong-ipwave-vehicular-neighbor-discovery-11](#) (work in progress), February 2021.
- [IEEE-802.11-OCB] "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications", IEEE Std 802.11-2016, December 2016.
- [WAVE] IEEE 1609 Working Group, "IEEE Guide for Wireless Access in Vehicular Environments (WAVE) - Architecture", IEEE Std 1609.0-2013, March 2014.

[Appendix A](#). Changes from [draft-jeong-ipwave-context-aware-navigator-02](#)

The following changes are made from [draft-jeong-ipwave-context-aware-navigator-02](#):

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

## Authors' Addresses

Jaehoon (Paul) Jeong  
Department of Computer Science and Engineering  
Sungkyunkwan University  
2066 Seobu-Ro, Jangan-Gu  
Suwon, Gyeonggi-Do 16419  
Republic of Korea

Phone: +82 31 299 4957  
Fax: +82 31 290 7996  
EMail: pauljeong@skku.edu  
URI: <http://iotlab.skku.edu/people-jaehoon-jeong.php>

Bien Aime Mugabarigira  
Department of Electrical and Computer Engineering  
Sungkyunkwan University  
2066 Seobu-Ro, Jangan-Gu  
Suwon, Gyeonggi-Do 16419  
Republic of Korea

Phone: +82 10 5964 8794  
Fax: +82 31 290 7996  
EMail: bienaime@skku.edu

Yiwen (Chris) Shen  
Department of Electrical and Computer Engineering  
Sungkyunkwan University  
2066 Seobu-Ro, Jangan-Gu  
Suwon, Gyeonggi-Do 16419  
Republic of Korea

Phone: +82 31 299 4106  
Fax: +82 31 290 7996  
EMail: chrisshen@skku.edu



Department of Electrical and Computer Engineering  
Sungkyunkwan University  
2066 Seobu-Ro, Jangan-Gu  
Suwon, Gyeonggi-Do 16419  
Republic of Korea

Phone: +82 10 9895 1211  
Fax: +82 31 290 7996  
EMail: xz618@skku.edu

Zeung Il (Ben) Kim  
Electric Energy Control Test Team  
Hyundai Motor  
150 Hyundaiyeonguso-ro, Namyang-eup  
Hwaseong, Gyeonggi-Do 18280  
Republic of Korea

Phone: +82-10-8805-3810  
Fax: +82-31-5172-3134  
EMail: ben.kim@hyundai.com