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Context-Aware Navigation Protocol for IP-Based Vehicular Networks  
draft-jeong-ipwave-context-aware-navigator-05

## 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).

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Internet-Draft

Context-Aware Navigation Protocol

February 2022

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## [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 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 services 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.

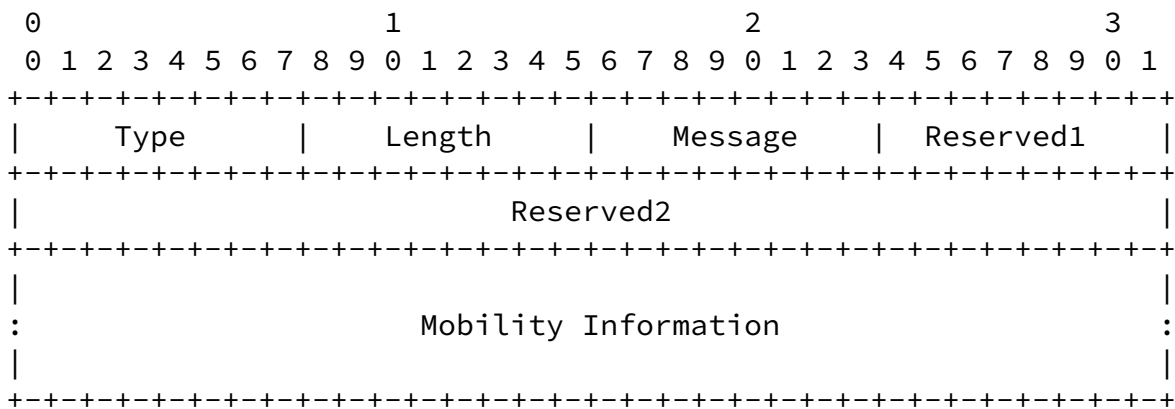


Figure 1: Vehicle Mobility Information (VMI) Option Format

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

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## 7. References

### 7.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997, <<https://www.rfc-editor.org/rfc/rfc2119>>.
- [RFC4861] Narten, T., Nordmark, E., Simpson, W., and H. Soliman, "Neighbor Discovery for IP Version 6 (IPv6)", [RFC 4861](#), September 2007, <<https://www.rfc-editor.org/rfc/rfc4861>>.
- [RFC3971] Arkko, J., "SEcure Neighbor Discovery (SEND)", [RFC 3971](#), March 2005, <<https://www.rfc-editor.org/rfc/rfc3971>>.

- [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, <<https://www.rfc-editor.org/rfc/rfc8691>>.
- [ID-IPWAVE-PS] Jeong, J., "IPv6 Wireless Access in Vehicular Environments (IPWAVE): Problem Statement and Use Cases", Work in Progress, Internet-Draft, [draft-ietf-ipwave-vehicular-networking-26](#), February 2022, <<https://datatracker.ietf.org/doc/html/draft-ietf-ipwave-vehicular-networking-26>>.

### 7.2. Informative References

[ID-Vehicular-ND]

Jeong, J., Ed., Shen, Y., Xiang, Z., and S. Cespedes, "Vehicular Neighbor Discovery for IP-Based Vehicular Networks", Work in Progress, Internet-Draft, [draft-jeong-ipwave-vehicular-neighbor-discovery-13](https://datatracker.ietf.org/doc/html/draft-jeong-ipwave-vehicular-neighbor-discovery-13), February 2022, <<https://datatracker.ietf.org/doc/html/draft-jeong-ipwave-vehicular-neighbor-discovery-13>>.

[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.

[WAVE]

IEEE 1609 Working Group, "IEEE Guide for Wireless Access in Vehicular Environments (WAVE) - Architecture", IEEE Std 1609.0-2013, March 2014.

[IEEE-802.11-OCB]

"Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications", IEEE Std 802.11-2016, December 2016.

[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.

[Appendix A](#). Changes from [draft-jeong-ipwave-context-aware-navigator-04](#)

The following changes are made from [draft-jeong-ipwave-context-aware-navigator-04](#):

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\* This version has fixed typos from the previous version to maintain the active status of the document.

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