Problem Statement for Vehicle-to-Infrastructure Networking
(draft-jeong-its-v2i-problem-statement-02)

IETF 97, Seoul, Korea
November 16, 2016

Jaehoon (Paul) Jeong and Tae (Tom) Oh
Updates from the Previous Version

• Changes from the previous draft
  – In Service Discovery Section (i.e., Section 11), an extension of IPv6 ND is added for service discovery along with prefix discovery.
  – For Local IPv6 Addresses for vehicular networks, only Unique Local IPv6 Unicast Addresses (ULAs) are considered.
    • Site-local addresses are removed from the text.
  – Most of sections have more details than the previous version.
  – The editorial corrections are made.
Introduction to V2I Networking

• Objective of this draft
  – To specify the problem statement for IPv6-based Vehicle-to-Infrastructure networking.

• Assumptions for V2I
  – IEEE 802.11p is considered as MAC protocol.
  – IPv6 is considered as Network-layer protocol.
  – Road-Side Unit (RSU) is connected to the Internet as an access point for vehicles.

• Focus of this draft
  – Networking issues in one-hop communications between RSU and vehicles.
  – Internetworking between a vehicle’s internal network (i.e., moving network) and an RSU’s internal network (i.e., fixed network).
Network Configuration for V2I Networking

```
*                 *  
*  Vehicular Cloud  *<-------->| TCC |
*                 *  
*                 *  
^                 ^  
|                 |  
| RSU1            |<------->| RSU2 |
|                 |  
^                 ^  
.                 .  
.                 .  
.                 .  
V                 V  

|Vehicle1|=>  |Vehicle2|=>  |Vehicle3|=>

<----> Wired Link  <....> Wireless Link  => Moving Direction
```
Internetworking between Vehicle’s Moving Network and RSU’s Fixed Network
Issues for IPv6 V2I Networking (1/5)

• IPv6 Addressing
  – Two policies for IPv6 addressing
    • Local IPv6 addresses for vehicular networks
    • Global IPv6 addresses for internetworking
  – Local IPv6 addresses
    • Usage for road network services (e.g., emergency notification and navigation)
    • e.g., Unique Local IPv6 Unicast Addresses (ULAs)
  – Global IPv6 addresses
    • Usage for general Internet services (e.g., email, web surfing, and entertainment)
  – Policies for global IPv6 addresses
    • Multi-link subnet for multiple RSUs
    • Single subnet per RSU
Issues for IPv6 V2I Networking (2/5)

• Neighbor Discovery
  – Adjusts for ND time-related parameters (e.g., router lifetime and NA interval), considering high-speed vehicles and vehicle density.

• IP Address Autoconfiguration (SLAAC and DHCPv6)
  – Supports the fast configuration, considering high-speed vehicles.
  – RSU can perform IP address autoconfiguration including the DAD proactively for the sake of the vehicles as an ND proxy.
  – DHCPv6 (or Stateless DHCPv6) needs to be adapted for fast moving vehicles in the vehicular network whose RSUs have different subnets.
Issues for IPv6 V2I Networking (3/5)

- **DNS Naming Service**
  - **IPv6 host DNS configuration** for Recursive DNS Server (RDNSS) and DNS Search List (DNSSL)
    - Through RA Options (RFC 6106) and DHCP Options (RFC 3646).
  - **DNS name resolution** through an appropriate RDNSS
    - Within a vehicle’s moving network or an RSU’s fixed network.
  - **DNS name autoconfiguration** of vehicle and in-vehicle devices
    - Through DNSNA (draft-jeong-its-iot-dns-autoconf-01), mDNS (RFC 6762), and DNS Update (RFC 2136).
    - In-vehicle devices or hosts need to register their DNS name and IPv6 address into a local DNS server in a vehicle or an RSU.
Issues for IPv6 V2I Networking (4/5)

• IP Mobility Support
  – In a single subnet per RSU, vehicles keep crossing the communication coverages of adjacent RSUs.
  – During this crossing, TCP/UDP sessions can maintained by IP mobility support, such as Mobile IPv6 (MIPv6), Proxy MIPv6, and Distributed Mobility Management (DMM).
  – The parameter adjustment is required for high-speed vehicles.
  – With the periodic reports of the mobility information from the vehicles, TCC can coordinate RSUs for the proactive mobility management of the moving vehicles.
Issues for IPv6 V2I Networking (5/5)

• Service Discovery
  – Vehicles need to discover services (e.g., road condition notification, navigation, and infotainment) provided by internal nodes in an RSU’s network.
  – Possible Solutions
    • DNS-based Service Discovery (DNS-SD)
      – Uses Service (SRV), Pointer (PTR), and Text (TXT) records
    • IPv6 ND Extension for the Prefix and Service Discovery
      – A piggyback service discovery during the prefix exchange of network prefixes for the networking between a vehicle's moving network and an RSU's fixed network.
Service Discovery (1/2)

- Internal Service Registration in a Vehicle

2. Pre-Learning Internal Modules

- Internal Communication
  (Learning Internal Service)

3. Advertisement Prefix/Service

4. Try to connect from other car

5. Directly connect (Form 4)

1. Service Open & Ready

- Engine
- Cruise Control
- GPS
- Camera
Service Discovery (2/2)

- Service Discovery along with Prefix Discovery

Exchange of Prefix & Service Information

Vehicle1
(Moving Network1)

RSU1
(Fixed Network1)

External Module
(DSRC)

Navigator

Dash

Camera

Host

Router

C-ACC System

RDNSS1

R1

C-DCS System

NS

NA

d

Moving Network 1 (vehicle 1)
Moving Network 2 (vehicle 2)

External Module
(DSRC)

Navigator

Dash

Camera

m

n
Next Steps

• Merging with the **V2V Problem Statement draft** of draft-petrescu-its-problem-03 for "Problem Statement" draft in IPWAVE WG.

• Security Considerations Enhancement
  – The use of TLS certificates for secure vehicle communications
  – Privacy considerations by a new ETSI activity (e.g., in-vehicle device’s identifier generation)

• Terminology Update
  – With ISO 21217 (ITS station/communication architecture) and ISO 21210 (IPv6 networking for ITS)

• We will welcome comments from IPWAVE WG.