Problem Statement for Vehicle-to-Infrastructure Networking

(draft-jeong-its-v2i-problem-statement-02)

IETF 97, Seoul, Korea

November 16, 2016

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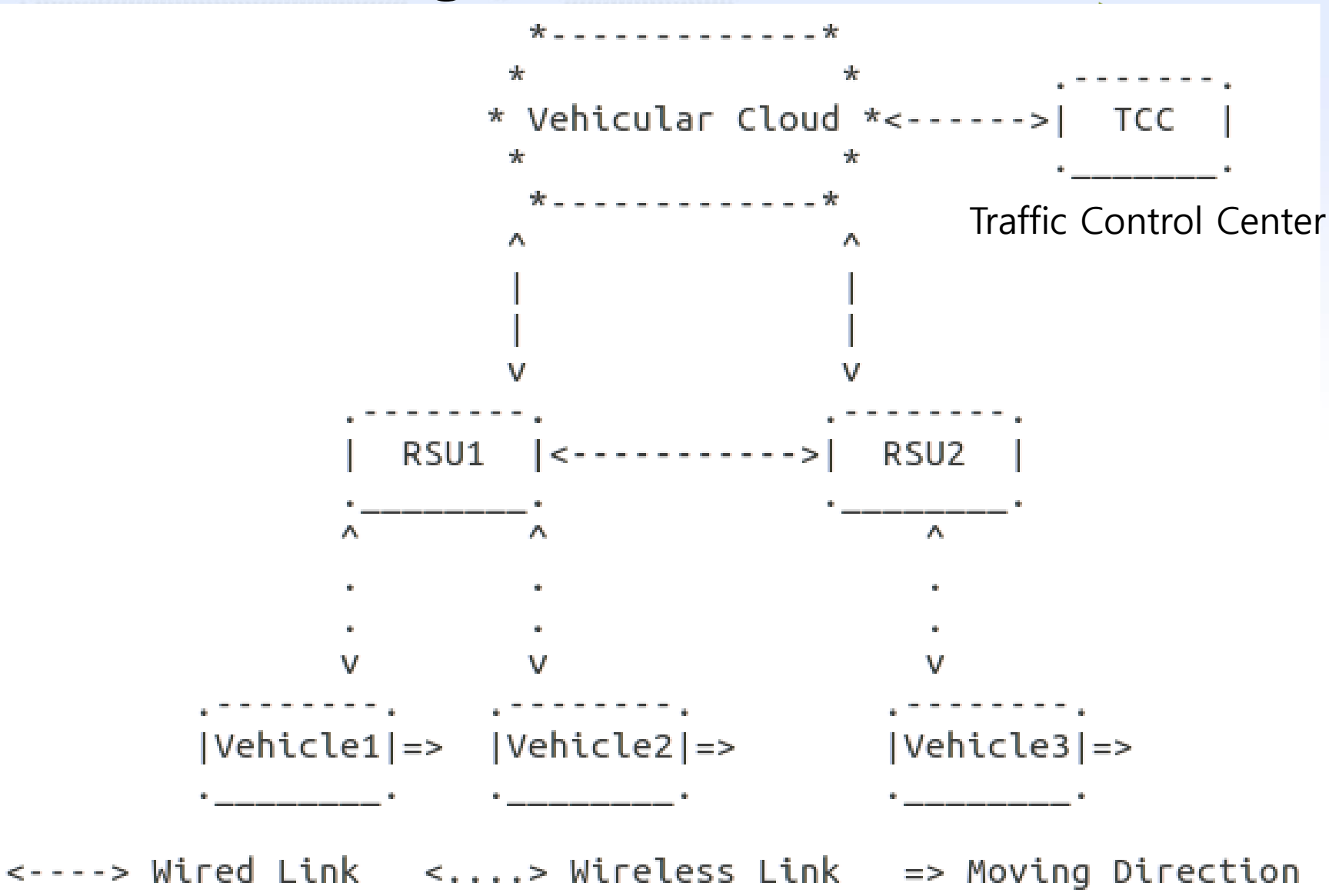
Updates from the Previous Version

- 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.

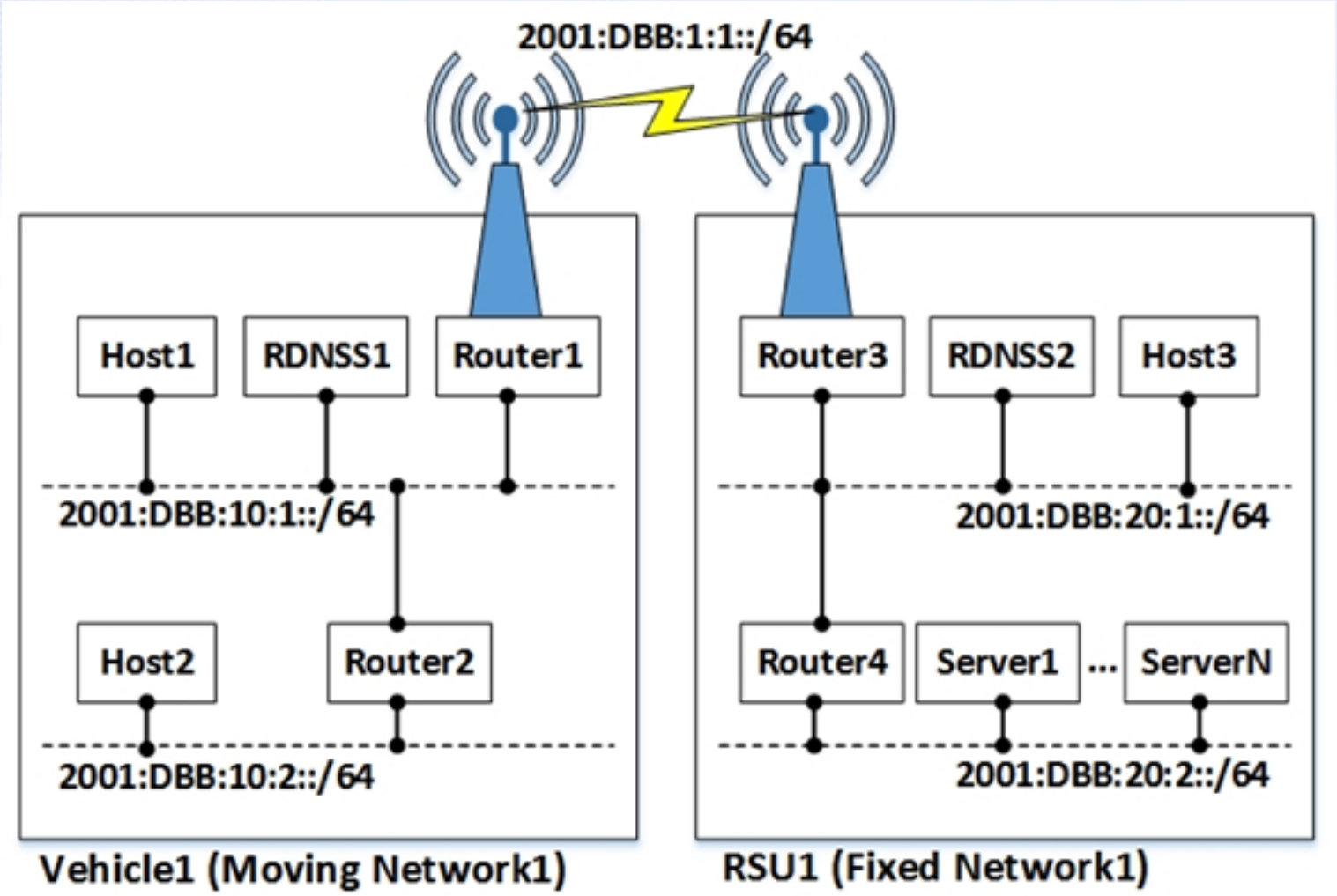
Introduction to V2I Networking

- 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



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)

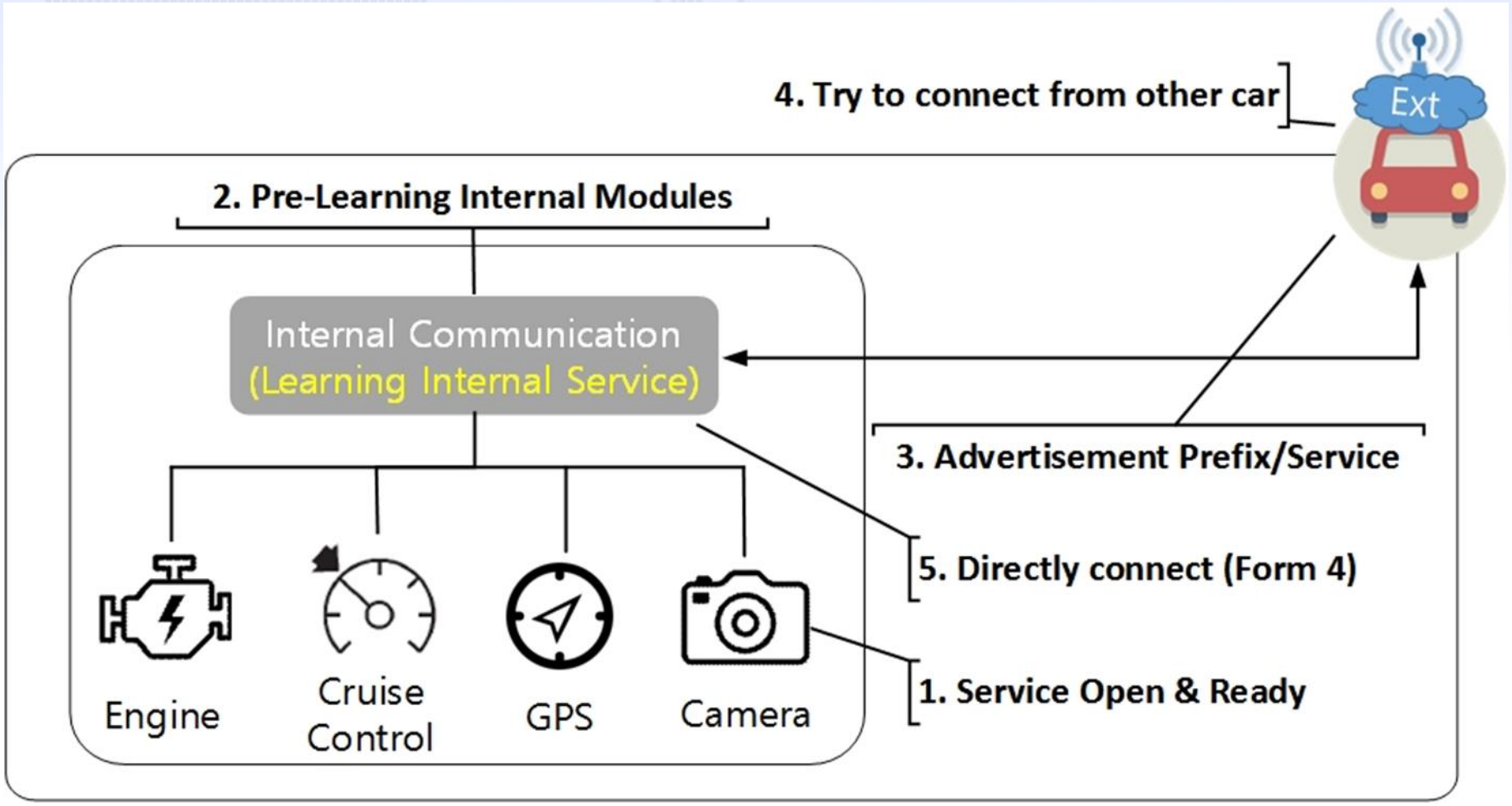
- IP Mobility Support
  - In a single subnet per RSU, vehicles keep crossing the communication coverages of adjacent RSUs.
  - During this crossing, TCP/UDP sessions can maintained by IP mobility support, such as Mobile IPv6 (MIPv6), Proxy MIPv6, and Distributed Mobility Management (DMM).
  - The parameter 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.

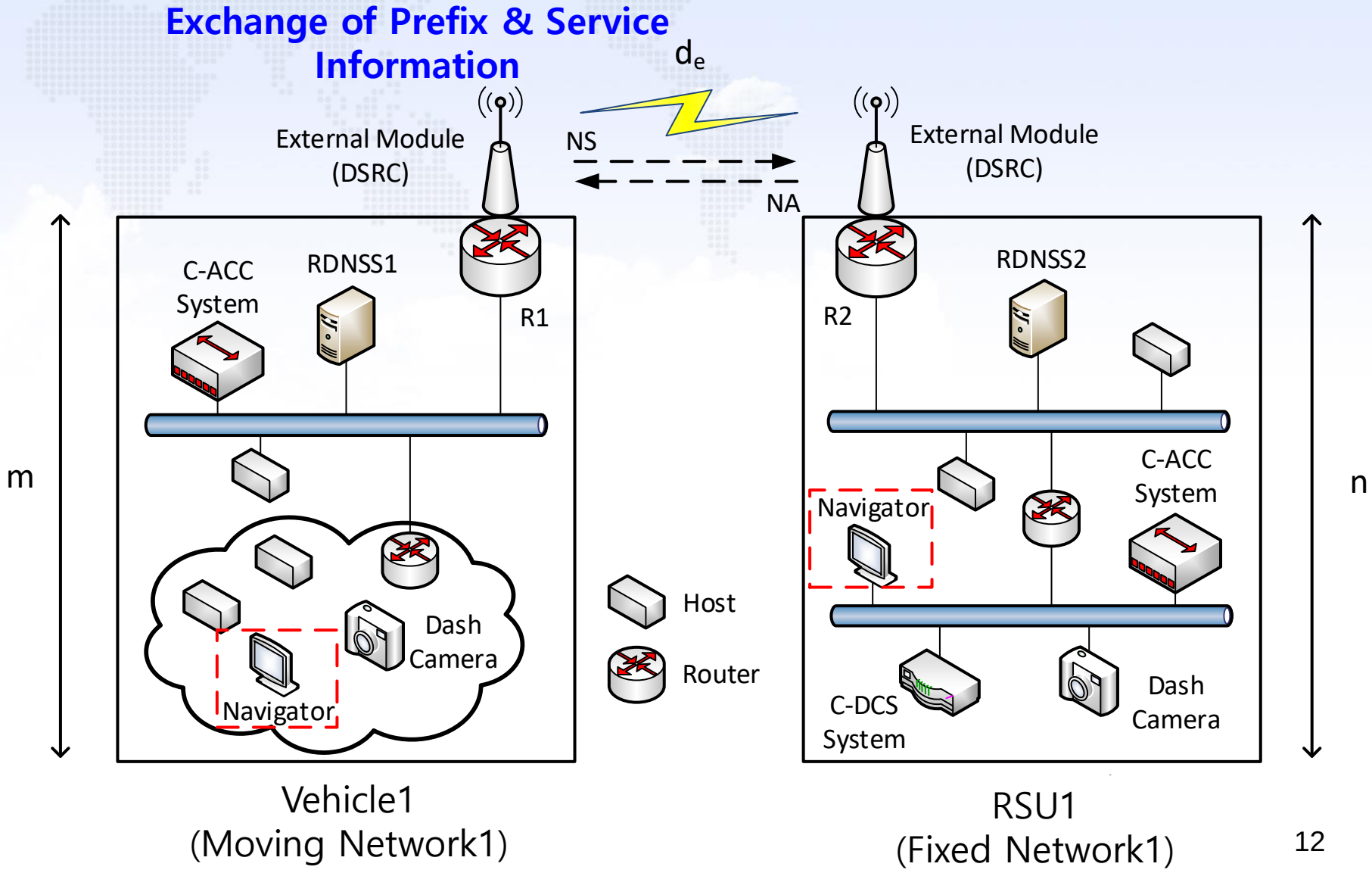
Service Discovery (1/2)

- Internal Service Registration in a Vehicle



Service Discovery (2/2)

- Service Discovery along with Prefix Discovery



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.