

Network Working Group  
Internet-Draft  
Intended status: Standards Track  
Expires: January 8, 2017

J. Jeong  
Sungkyunkwan University  
S. Lee  
KETI  
J. Park  
ETRI  
July 7, 2016

**DNS Name Autoconfiguration for Internet of Things Devices**  
**draft-jeong-its-iot-dns-autoconf-01**

**Abstract**

This document specifies an autoconfiguration scheme for the global (or local) DNS names of Internet of Things (IoT) devices, such as sensors, actuators, and in-vehicle units. By this scheme, the DNS name of an IoT device can be autoconfigured with the device's model information in wired and wireless target networks (e.g., vehicle, road network, home, office, shopping mall, and smart grid). This DNS name lets IoT users (e.g., drivers, passengers, home residents, and customers) in the Internet (or local network) easily identify each device for monitoring and remote-controlling it in the target network.

**Status of This Memo**

This Internet-Draft is submitted to IETF in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

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."

The list of current Internet-Drafts can be accessed at <http://www.ietf.org/ietf/1id-abstracts.txt>.

The list of Internet-Draft Shadow Directories can be accessed at <http://www.ietf.org/shadow.html>.

This Internet-Draft will expire on January 8, 2017.

## Copyright Notice

Copyright (c) 2016 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 (<http://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="#">3</a>
<a href="#">1.1.</a>	Applicability Statements . . . . .	<a href="#">4</a>
<a href="#">2.</a>	Requirements Language . . . . .	<a href="#">4</a>
<a href="#">3.</a>	Terminology . . . . .	<a href="#">4</a>
<a href="#">4.</a>	Overview . . . . .	<a href="#">4</a>
<a href="#">5.</a>	DNS Name Autoconfiguration . . . . .	<a href="#">5</a>
<a href="#">5.1.</a>	DNS Name Format with Object Identifier . . . . .	<a href="#">5</a>
<a href="#">5.2.</a>	Procedure of DNS Name Autoconfiguration . . . . .	<a href="#">6</a>
<a href="#">5.2.1.</a>	DNS Name Generation . . . . .	<a href="#">6</a>
<a href="#">5.2.2.</a>	DNS Name Collection . . . . .	<a href="#">7</a>
<a href="#">5.2.3.</a>	DNS Name Retrieval . . . . .	<a href="#">8</a>
<a href="#">6.</a>	Location-Aware DNS Name Configuration . . . . .	<a href="#">9</a>
<a href="#">7.</a>	Macro-Location-Aware DNS Name . . . . .	<a href="#">10</a>
<a href="#">8.</a>	Micro-Location-Aware DNS Name . . . . .	<a href="#">10</a>
<a href="#">9.</a>	DNS Name Management for Mobile IoT Devices . . . . .	<a href="#">10</a>
<a href="#">10.</a>	Security Considerations . . . . .	<a href="#">11</a>
<a href="#">11.</a>	Acknowledgements . . . . .	<a href="#">11</a>
<a href="#">12.</a>	References . . . . .	<a href="#">11</a>
<a href="#">12.1.</a>	Normative References . . . . .	<a href="#">11</a>
<a href="#">12.2.</a>	Informative References . . . . .	<a href="#">12</a>
<a href="#">Appendix A.</a>	Changes from <a href="#">draft-jeong-its-iot-dns-autoconf-00</a> . . .	<a href="#">14</a>



## 1. Introduction

Many Internet of Things (IoT) devices (e.g., sensors, actuators, and in-vehicle units) have begun to have wireless communication capability (e.g., WiFi, Bluetooth, and ZigBee) for monitoring and remote-controlling in a local network or the Internet. According to the capacity, such IoT devices can be categorized into high-capacity devices and low-capacity devices. High-capacity devices have a high-power processor and a large storage, such as vehicles, road infrastructure devices (e.g., road-side unit, traffic light, and loop-detector), appliances (e.g., television, refrigerator, air conditioner, and washing machine), and smart devices (smartphone and tablet). They are placed in environments (e.g., vehicle, road network, home, office, shopping mall, and smart grid) for the direct use for human users, and they require the interaction with human users. Low-capacity devices have a low-power processor and a small storage, such as sensors (e.g., in-vehicle units, light sensor, meter, and fire detector) and actuators (e.g., vehicle engine, signal light, street light, and room temperature controller). They are installed for the easy management of environments (e.g., vehicle, road network, home, office, store, and factory), and they do not require the interaction with human users.

For the Internet connectivity of IoT devices, a variety of parameters (e.g., address prefixes, default routers, and DNS servers) can be automatically configured by Neighbor Discovery (ND) for IP Version 6, IPv6 Stateless Address Autoconfiguration, and IPv6 Router Advertisement (RA) Options for DNS Configuration [[RFC4861](#)][[RFC4862](#)][[RFC6106](#)].

For these IoT devices, the manual configuration of DNS names will be cumbersome and time-consuming as the number of them increases rapidly in a network. It will be good for such DNS names to be automatically configured such that they are readable to human users.

Multicast DNS (mDNS) in [[RFC6762](#)] can provide DNS service for networked devices on a local link (e.g., home network and office network) without any conventional recursive DNS server. mDNS also supports the autoconfiguration of a device's DNS name without the intervention of the user. mDNS aims at the DNS naming service for the local DNS names of the networked devices on the local link rather than the DNS naming service for the global DNS names of such devices in the Internet. However, for IoT devices accessible from the Internet, mDNS cannot be used. Thus, a new autoconfiguration scheme becomes required for the global DNS names of IoT devices.

This document proposes an autoconfiguration scheme for the global (or local) DNS names of IoT devices. Since an autoconfigured DNS name



contains the model identifier (ID) of a device, IoT users in the Internet (or local network) can easily identify the device. With this model ID, they will be able to monitor and remote-control each device with mobile smart devices (e.g., smartphone and tablet) by resolving its DNS name into the corresponding IPv6 address.

### **1.1. Applicability Statements**

It is assumed that IoT devices have networking capability through wired or wireless communication media, such as Ethernet [[IEEE-802.3](#)], WiFi [[IEEE-802.11](#)][[IEEE-802.11a](#)][[IEEE-802.11b](#)][[IEEE-802.11g](#)][[IEEE-802.11n](#)], Dedicated Short-Range Communications (DSRC) [[IEEE-802.11p](#)], Bluetooth [[IEEE-802.15.1](#)], and ZigBee [[IEEE-802.15.4](#)] in a local area network (LAN) or personal area network (PAN).

Also, it is assumed that each IoT device has a factory configuration (called device configuration) having device model information by manufacturer ID and model ID (e.g., vehicle, road-side unit, smart TV, smartphone, tablet, and refrigerator). This device configuration can be read by the device for DNS name autoconfiguration.

## **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 [[RFC4861](#)] and [[RFC4862](#)]. In addition, four new terms are defined below:

- o Device Configuration: A factory configuration that has device model information by manufacturer ID and model ID (e.g., vehicle, road-side unit, smart TV, smartphone, tablet, and refrigerator).
- o DNS Search List (DNSSL): The list of DNS suffix domain names used by IPv6 hosts when they perform DNS query searches for short, unqualified domain names [[RFC6106](#)].
- o DNSSL Option: IPv6 RA option to deliver the DNSSL information to IPv6 hosts [[RFC6106](#)].

## **4. Overview**

This document specifies an autoconfiguration scheme for an IoT device using device configuration and DNS search list. Device configuration has device model information (e.g., device's manufacturer and model).



DNS search list has DNS suffix domain names that represent the DNS domains of a network having the IoT device [[RFC6106](#)].

As an IPv6 host, the IoT device can obtain DNS search list through IPv6 Router Advertisement (RA) with DNS Search List (DNSSL) Option [[RFC4861](#)][[RFC6106](#)] or DHCPv6 with Domain Search List Option [[RFC3315](#)][[RFC3736](#)][[RFC3646](#)].

The IoT device can construct its DNS name with the concatenation of manufacturer ID, model ID, and domain name. Since there exist more than one device with the same model, the DNS name should have a unique identification (e.g., unique ID or serial ID) to differentiate multiple devices with the same model.

Since both RA and DHCPv6 can be simultaneously used for the parameter configuration for IPv6 hosts, this document considers the DNS name autoconfiguration in the coexistence of RA and DHCP.

## 5. DNS Name Autoconfiguration

The DNS name autoconfiguration for an IoT device needs the acquisition of DNS search list through either RA [[RFC6106](#)] or DHCPv6 [[RFC3646](#)]. Once the DNS search list is obtained, the IoT device autonomously constructs its DNS name(s) with the DNS search list and its device information.

### 5.1. DNS Name Format with Object Identifier

A DNS name for an IoT device can have the following format with object identifier (OID), which is defined in [[oneM2M-OID](#)], as in Figure 1:

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|  unique_id.object_identifier.OID.domain_name  |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

Figure 1: IoT Device DNS Name Format with OID

Fields:

unique_id	unique identifier to guarantee the uniqueness of the DNS name in ASCII characters. The identifier MAY be alphanumeric with readability, e.g., product name plus a sequence number.
-----------	--





`object_identifier` device's object identifier that consists of a higher arc, that is, M2M node indication ID (i.e., the concatenation of the managing organization, administration, data country code, and M2M node) and a sequence of four arcs (i.e., manufacturer ID, model ID, serial ID, and expanded ID) as defined in [\[oneM2M-OID\]](#). The fields are separated by an underscore '\_'.

`OID` subdomain for the keyword of OID to indicate that `object_identifier` is used.

`domain_name` domain name that represents a DNS domain for the network having the IoT devices.

Note each subdomain (i.e., `unique_id`, `object_identifier`, `OID`, and `domain_name`) in the domain name format in Figure 1 is expressed using the name syntax described in [\[RFC1035\]](#).

## **[5.2.](#) Procedure of DNS Name Autoconfiguration**

The procedure of DNS name autoconfiguration is performed through a DNSSL option delivered by either RA [\[RFC6106\]](#) or DHCPv6 [\[RFC3646\]](#).

### **[5.2.1.](#) DNS Name Generation**

When as an IPv6 host a device receives a DNSSL option through either RA or DHCPv6, it checks the validity of the DNSSL option. If the option is valid, the IPv6 host performs the DNS name autoconfiguration with each DNS suffix domain name in the DNSSL option as follows:

1. The host constructs its DNS name with the DNS suffix domain name along with device configuration (i.e., manufacturer ID, model ID, and serial ID) and a selected identifier (as `unique_id`) that is considered unique, which is human-friendly, as shown in Figure 1.
2. The host constructs an IPv6 unicast address as a tentative address with a 64-bit network prefix and the last 64 bits of the MD5 hashed value of the above DNS name.
3. The host constructs the solicited-node multicast address in [\[RFC4861\]](#) corresponding to the tentative IPv6 address.
4. The host performs Duplicate Address Detection (DAD) for the IPv6 address with the solicited-node multicast address [\[RFC4861\]](#) [\[RFC4862\]](#).



5. If there is no response from the DAD, the host sets the IPv6 tentative address as its IPv6 unicast address and regards the constructed DNS name as unique on the local link. Otherwise, since the DAD fails because of DNS name conflict, go to Step 1 for a new DNS name generation with another identifier for `unique_id`.
6. Since the DNS name is proven to be unique, it is used as the device's DNS name and the DNS autoconfiguration is done for the given DNS suffix domain name. Also, the host joins the solicited-node multicast address for the verified DNS name in order to prevent other hosts from using this DNS name.

When the DNS search list has more than one DNS suffix domain name, the IPv6 host repeats the above procedure until all of the DNS suffixes are used for the DNS name autoconfiguration along with the IPv6 unicast autoconfiguration corresponding to the DNS name.

#### **5.2.2. DNS Name Collection**

Once as IPv6 hosts the devices have autoconfigured their DNS names, as a collector, any IPv6 node (i.e., router or host) in the same subnet can collect the device DNS names using IPv6 Node Information (NI) protocol [[RFC4620](#)].

For a collector to collect the device DNS names without any prior node information, a new NI query needs to be defined. That is, a new ICMPv6 Code (e.g., 3) SHOULD be defined for the collection of the IPv6 host DNS names. The Data field is not included in the ICMPv6 header since the NI query is for all the IPv6 hosts in the same subnet. The Qtype field for NI type is set to 2 for Node Name.

The query SHOULD be transmitted by the collector to a link-local multicast address for this NI query. Assume that a link-local scope multicast address (e.g., all-nodes multicast address, FF02::1) SHOULD be defined for device DNS name collection such that all the IPv6 hosts join this link-local multicast address for the device DNS name collection service.

When an IPv6 host receives this query sent by the collector in multicast, it transmits its Reply with its DNS name with a random interval between zero and Query Response Interval, as defined by Multicast Listener Discovery Version 2 [[RFC3810](#)]. This randomly delayed Reply allows the collector to collect the device DNS names with less frame collision probability by spreading out the Reply time instants.

After the collector collects the device DNS names, it resolves the



DNS names into the corresponding IPv6 addresses by NI protocol [RFC4620] with the ICMPv6 Code 1 of NI Query. This code indicates that the Data field of the NI Query has the DNS name of an IoT device. The IoT device that receives this NI query sends the collector an NI Reply with its IPv6 address in the Data field.

For DNS name resolution service, the collector can register the pair(s) of DNS name and IPv6 address for each IPv6 host into an appropriate designated DNS server for the DNS domain suffix of the DNS name. It is assumed that the collector is configured to register DNS names into the designated DNS server in a secure way based on DNSSEC [RFC4033][RFC6840]. This registration of the DNS name and IPv6 address can be performed by DNS dynamic update [RFC2136]. Before registering the DNS name into the designated DNS server, the collector SHOULD verify the uniqueness of the DNS name in the intended DNS domain by sending a DNS query for the resolution of the DNS name. If there is no corresponding IPv6 address for the queried DNS name, the collector registers the DNS name and the corresponding IPv6 address into the designated DNS server. On the other hand, if there is such a corresponding IPv6 address, the DNS name is regarded as duplicate (i.e., not unique), and so the responder notifies the corresponding IoT device with the duplicate DNS name of an error message of DNS name duplication using NI protocol. When an IoT device receives such a DNS name duplication error, it needs to construct a new DNS name and repeats the procedure of device DNS name generation along with the uniqueness test of the device DNS name in its subnet.

The two separate procedures of the DNS name collection and IPv6 address resolution in the above NI protocol can be consolidated into a single collection for the pairs of DNS names and the corresponding IPv6 addresses. For such an optimization, a new ICMPv6 Code (e.g., 4) is defined for the NI Query to query the pair of a DNS name and the corresponding IPv6 address. With this code, the collector can collect the pairs of each IoT device's DNS name and IPv6 address in one NI query message rather than two NI query messages.

### **5.2.3. DNS Name Retrieval**

A smart device like smartphone can retrieve the DNS names of IoT devices by contacting a global (or local) DNS server having the IoT device DNS names. If the smart device can retrieve the zone file with the DNS names, it can display the information of IoT devices in a target network, such as home network and office network. With this information, the user can monitor and control the IoT devices in the Internet (or local network).



## 6. Location-Aware DNS Name Configuration

If the DNS name of an IoT device includes location information, it allows users to easily identify the physical location of each device. This document proposes the representation of a location in a DNS name. In this document, the location in a DNS name consists of two levels for a detailed location specification, such as macro-location for a large area and micro-location for a small area.

To denote both macro-location (i.e., `mac_loc`) and micro-location (i.e., `mic_loc`) into a DNS name, the following format is described as in Figure 2:

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| unique_id.object_identifier.OID.mic_loc.mac_loc.LOC.domain_name |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

Figure 2: Location-Aware Device DNS Name Format

Fields:

<code>unique_id</code>	unique identifier to guarantee the uniqueness of the DNS name in ASCII characters. The identifier MAY be alphanumeric with readability, such as product name plus a sequence number.
<code>object_identifier</code>	device's object identifier that consists of a higher arc, that is, M2M node indication ID (i.e., the concatenation of the managing organization, administration, data country code, and M2M node) and a sequence of four arcs (i.e., manufacturer ID, model ID, serial ID, and expanded ID) as defined in <a href="#">[oneM2M-OID]</a> . The fields are separated by an underscore '_'.
<code>OID</code>	subdomain for the keyword of OID to indicate that <code>object_identifier</code> is used.
<code>mic_loc</code>	device's micro-location, such as center, edge, and corner.
<code>mac_loc</code>	device's macro-location, such as road segment.
<code>LOC</code>	subdomain for the keyword of LOC to indicate that <code>mac_loc</code> and <code>mic_loc</code> are used.
<code>domain_name</code>	domain name that represents a DNS domain for





the network having the IoT devices.

Note each subdomain (e.g., mic\_loc and mac\_loc) in the domain name format in Figure 2 is expressed using the name syntax described in [\[RFC1035\]](#).

## **7. Macro-Location-Aware DNS Name**

If location information (such as cross area, intersection, and road segment in a road network) is available to an IoT device, a keyword, coordinate, or location ID for the location information can be used to construct a DNS name as subdomain name. This location information lets users track the position of mobile devices (such as vehicle, smartphone, and tablet). The physical location of the device is defined as macro-location for DNS naming.

A subdomain name for macro-location (denoted as mac\_loc) MAY be placed between micro-location (denoted as mic\_loc) and the keyword LOC of the DNS name format in Figure 2. For the localization of macro-location, a localization scheme for indoor or outdoor can be used [\[SALA\]](#).

## **8. Micro-Location-Aware DNS Name**

An IoT device can be located in the center, edge, or corner in a place that is specified by macro-location. For example, assume that a loop-detector is located in the start or end position of a road segment. If the DNS name for the loop-detector contains the start or end position of the living room, a road network administrator can find it easily. In this document, for this DNS naming, the detailed location for an IoT device can be specified as a micro-location subdomain name.

A subdomain name for micro-location (denoted as mic\_loc) MAY be placed between the keyword OID and macro-location (denoted as mac\_loc) of the DNS name format in Figure 2. For the localization of micro-location, a localization scheme for indoor or outdoor can be used [\[SALA\]](#).

## **9. DNS Name Management for Mobile IoT Devices**

Some IoT devices can have mobility, such as vehicle, smartphone, tablet, laptop computer, and cleaning robot. This mobility allows the IoT devices to move from a subnet to another subnet where subnets can have different domain suffixes, such as coordinate.road\_segment.road, coordinate.intersection.road, living\_room.home and garage.home. The DNS name change (or addition) due to the mobility should be considered.



To deal with DNS name management in mobile environments, whenever an IoT device enters a new subnet and receives DNS suffix domain names, it generates its new DNS names and registers them into a designated DNS server, specified by RDNSS option.

When the IoT device recognizes the movement to another subnet, it can delete its previous DNS name(s) from the DNS server having the DNS name(s), using DNS dynamic update [[RFC2136](#)]. For at least one DNS name to remain in a DNS server for the location management in Mobile IPv6 [[RFC6275](#)], the IoT device does not delete its default DNS name in its home network in Mobile IPv6.

## **10. Security Considerations**

This document shares all the security issues of the NI protocol that are specified in the "Security Considerations" section of [[RFC4620](#)].

To prevent the disclosure of location information for privacy concern, the subdomains related to location can be encrypted by a shared key or public-and-private keys. For example, a DNS name of vehicle1.oid1.OID.coordinate1.road\_segment\_id1.LOC.road can be represented as vehicle1.oid1.OID.xxx.yyy.LOC.road where vehicle1 is unique ID, oid1 is object ID, xxx is a string of the encrypted representation of the coordinate (denoted as coordinate1) in a road segment, and yyy is a string of the encrypted representation of the road segment ID (denoted as road\_segment\_id1). Thus, the location of the vehicle1 can be protected from unwanted users by encryption.

## **11. Acknowledgements**

This work was supported by Institute for Information & communications Technology Promotion (IITP) grant funded by the Korea government (MSIP) (No.R-20160222-002755, Cloud based Security Intelligence Technology Development for the Customized Security Service Provisioning) and (10041244, Smart TV 2.0 Software Platform).

## **12. References**

### **12.1. Normative References**

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC4861] Narten, T., Nordmark, E., Simpson, W., and H. Soliman, "Neighbor Discovery for IP Version 6 (IPv6)", [RFC 4861](#), September 2007.
- [RFC4862] Thomson, S., Narten, T., and T. Jinmei, "IPv6



Stateless Address Autoconfiguration", [RFC 4862](#), September 2007.

- [RFC6106] Jeong, J., Park, S., Beloeil, L., and S. Madanapalli, "IPv6 Router Advertisement Options for DNS Configuration", [RFC 6106](#), November 2010.
- [RFC3315] Droms, R., Ed., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", [RFC 3315](#), July 2003.
- [RFC3736] Droms, R., "Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6", [RFC 3736](#), April 2004.
- [RFC3646] Droms, R., Ed., "DNS Configuration options for Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", [RFC 3646](#), December 2003.
- [RFC1035] Mockapetris, P., "Domain Names - Implementation and Specification", [RFC 1035](#), November 1987.
- [RFC4033] Arends, R., Ed., Austein, R., Larson, M., Massey, D., and S. Rose, "DNS Security Introduction and Requirements", [RFC 4033](#), March 2005.
- [RFC6840] Weiler, S., Ed. and D. Blacka, Ed., "Clarifications and Implementation Notes for DNS Security (DNSSEC)", [RFC 6840](#), February 2013.

## **[12.2.](#) Informative References**

- [RFC6762] Cheshire, S. and M. Krochmal, "Multicast DNS", [RFC 6762](#), February 2013.
- [RFC4620] Crawford, M. and B. Haberman, Ed., "IPv6 Node Information Queries", [RFC 4620](#), August 2006.
- [RFC3810] Vida, R. and L. Costa, "Multicast Listener Discovery Version 2 (MLDv2) for IPv6", [RFC 3810](#), June 2004.
- [RFC2136] Vixie, P., Ed., Thomson, S., Rekhter, Y., and J. Bound, "Dynamic Updates in the Domain Name System (DNS UPDATE)", [RFC 2136](#), April 1997.
- [RFC6275] Perkins, C., Ed., Johnson, D., and J. Arkko, "Mobility Support in IPv6", [RFC 6275](#), July 2011.



- [IEEE-802.3] IEEE Std 802.3, "IEEE Standard for Ethernet", December 2012.
- [IEEE-802.11] IEEE Std 802.11, "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications", March 2012.
- [IEEE-802.11a] IEEE Std 802.11a, "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications - High-speed Physical Layer in the 5 GHz Band", September 1999.
- [IEEE-802.11b] IEEE Std 802.11b, "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications - Higher-Speed Physical Layer Extension in the 2.4 GHz Band", September 1999.
- [IEEE-802.11g] IEEE P802.11g/D8.2, "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications - Further Higher Data Rate Extension in the 2.4 GHz Band", April 2003.
- [IEEE-802.11n] IEEE P802.11n/D9.0, "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications - Amendment 5: Enhancements for Higher Throughput", March 2009.
- [IEEE-802.11p] IEEE Std 802.11p, "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications - Amendment 6: Wireless Access in Vehicular Environments", July 2010.
- [IEEE-802.15.1] IEEE Std 802.15.1, "Part 15.1: Wireless Medium Access Control (MAC) and Physical Layer (PHY) specifications for Wireless Personal Area Networks (WPANs)", June 2005.
- [IEEE-802.15.4] IEEE Std 802.15.4, "Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)", September 2011.
- [oneM2M-OID] oneM2M, "Object Identifier based M2M Device Identification Scheme", February 2014.
- [SALA] Jeong, J., Yeon, S., Kim, T., Lee, H., Kim, S., and S. Kim, "SALA: Smartphone-Assisted Localization Algorithm for Positioning Indoor IoT Devices", Springer Wireless Networks, June 2016.





**Appendix A. Changes from [draft-jeong-its-iot-dns-autoconf-00](#)**

The following changes were made from  
[draft-jeong-its-iot-dns-autoconf-00](#):

- o A DNS name format with device\_category and device\_model is deleted to unify two DNS name formats into one DNS name format with object identifier, oid.
- o A keyword LOC is added to a DNS name format to explicitly indicate that the location subdomains of mac-loc and mic-loc are used.

**Authors' Addresses**

Jaehoon Paul Jeong  
Department of Software  
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>

Sejun Lee  
Korea Electronics Technology Institute  
25, Saenari-Ro, Bundang-Gu  
Seongnam-Si, Gyeonggi-Do 13509  
Republic of Korea

Phone: +82 31 789 7535

EMail: prosejun14@gmail.com

Jung-Soo Park  
Electronics and Telecommunications Research Institute  
218 Gajeong-Ro, Yuseong-Gu  
Daejeon, 34129  
Republic of Korea

Phone: +82 42 860 6514

EMail: pjs@etri.re.kr

