Provisional URI Scheme IANA Registration Application

iotdisco

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Abstract. This document contains the formal application for registering a provisioninal Uniform Resource Identifier (URI) Scheme named `iotdisco`, a URI scheme to be used to identify, not locate, things on the internet using conceptual meta-data about the thing.

Keywords: Internet of Things, Security, Installation, Configuration, Discovery.

1 Introduction

When creating things to be mass-manufactured and sold off-the-shelf for use with the Internet of Things, and taking their entire life-cycle into account, a problem arises where a thing's physical identity, which is known at the time of production, needs to be matched with its communication or network identity, created during installation, and the match given to its owner, and only its owner, to avoid malicious third parties to claim the thing for their own. Only the physical (or conceptual) identity of the thing is known during the time of manufacture, not the network identity or the identity of the owner.

In the article "Securing the Life Cycle of Things in the Internet of Things using Thing Registries" [1], an architecture is described where a thing is preprogrammed with *meta-data* about itself, uniquely identifying it. Once the thing has been physically installed and connected to a network, a network identity is created by the thing. The thing then searches for a *Thing Registry*, to which it later registers itself, its *meta-data* and newly created network identity. Later, the *meta-data* is *transferred* to the owner of the thing. The owner, perhaps using a smart-phone, finds the same *Thing Registry* and *claims* the thing by providing the same *meta-data* earlier registered by the thing. This claiming process provides the thing with the network identity of its owner, and the owner with the network identity of its thing. The thing cannot be claimed again, unless it has been disowned again.

The article also presents a physical implementation of this architecture, where devices are installed in an IP network, and later use the XMPP protocol [2] [3] [4] to find a *Thing Registry* and perform the registration. The *meta-data* is transferred to the owner using a QR-code which encodes the corresponding key-value pairs, which has previously been serialized into a string. XEP-0347 [5] and XEP-0348 [6] provide

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more detailed information about the network identity creation process, how the *Thing Registry* is found and how the thing registers itself and how it is claimed in this example. QR codes can be presented to owners either from a sticker on the device or its box, or on its screen if it has one.

2 Justification for this registration application

During the work in ISO/IEC/IEEE working group 21451-1-4, where this architecture is an integral part, and other groups, a more formal definition, structure and encoding of the conceptual identity of a thing, or its *meta-data*, is required. Since there is a desire to use Automatic identification and data capture (AIDC) technologies, such as RFID and 2-dimensional optical symbologies, for instance QR-codes, for transferring this information, and since such technologies are capable of containing URIs, the proposed manner to formalizing this string, is to register a new URI scheme for the conceptual identity of a thing. QR-codes are used in this document only as an example. URIs using this URI scheme can then be recognized, by smartphones for instance – while residing in the same network environment as the corresponding thing – can use the same methods of finding the thing registry and claiming the thing for its own, and at the same time obtain the network identity of the thing.

The URI scheme proposed in this application differs slightly from what has been described in [1] and [5] to better match requirements in BCP 35 [7] and RFC 3986 [8]. Once accepted as a provisional URI scheme, [1] and [5] will be updated.

3 URI Scheme Registration

Following is the formal application for the registration of the provisional URI scheme `iotdisco`.

URI scheme name

`iotdisco`

Status

provisional

URI scheme syntax

Using the format defined in RFC 3986 [8], and some of its base classes, a formal definition of the iotdisco URI scheme syntax is as follows:

```
iotdisco-uri = "iotdisco:" tags
tags         = tag *( ";" tag )
```

```
tag          = stringtag / numericaltag
stringtag    = key "=" strvalue
numericaltag = "#" key "=" numvalue
key          = 1*( unreserved / pct-encoded )
strvalue     = *( unreserved / pct-encoded )
numvalue     = [ "+" / "-" ] 1*DIGIT [ "." *DIGIT ]
```

Example:

```
iotdisco:SN=394872348732948723;MAN=www.ktc.se;
    MODEL=IMC;#V=1.2;KEY=4857402340298342
```

A line-break has been inserted for readability. The corresponding URI as a QR-code would look as follows:

Fig. 1. QR-code containing URI based on the `iotdisco` scheme.

The meta-data encoded in the QR-code and URI is shown in the following table. Descriptions of the tags used are given in Table 2.

Table 1. Meta-data encoded in example.

Tag Key	Type	Value
SN	String	394872348732948723
MAN	String	www.ktc.se
MODEL	String	IMC
V	Numeric	1.2
KEY	String	4857402340298342

URI scheme semantics

An `iotdisco` URI defines a set of one or more meta-data *tags*. Each tag has a *key* name and either a *string value* or a *numerical value*. The reason for specifying numerical values separately is because they imply a numerical order to the value set.

The set of tags is *unordered*. This means that in order to compare two `iotdisco` URIs for equality, the tags must be ordered first, using the same ordering.

Tag keys are also *case insensitive*. Values, however, are *case sensitive*.

Encoding considerations

Since tag keys and string values can be human readable, it is important to encode characters outside of the `unreserved` character set correctly. The way to do this, is to first normalize such characters using Unicode Normalization Form C [9], then encode them using UTF-8 [10], and then percent-encoding them according to §2.1 and §2.5 in RFC 3986 [8].

Applications/protocols that use this URI scheme name

This URI scheme does not specify underlying transport protocol, and is not limited to a particular protocol. A variant of this scheme is used together with the XMPP protocol [2] [3] [4] and XEP-0347 [5], which will be updated as soon as this provisional URI scheme has been approved.

Interoperability considerations

It is not the intent of this document to limit the amount or types of tags thing manufacturers might want to encode using this URI scheme, or their semantic meanings. But, to provide some guidance and foster interoperability, on the side of thing registries, especially if public, XEP-0347 [5] proposed a set of predefined tags manufacturers can use (in §5.2). This table is duplicated here:

Table 2. Predefined tag keys.

Tag Key	Type	Description
ALT	Numeric	Altitude (meters)
APT	String	Apartment associated with the Thing
AREA	String	Area associated with the Thing
BLD	String	Building associated with the Thing
CITY	String	City associated with the Thing
CLASS	String	Class of Thing
COUNTRY	String	Country associated with the Thing
KEY	String	Key, shared between thing and owner.
LAT	Numeric	Latitude (degrees)
LON	Numeric	Longitude (degrees)
MAN	String	Domain name owned by the Manufacturer
MLOC	String	Meter Location ID
MNR	String	Meter Number
MODEL	String	Name of Model
NAME	String	Name associated with the Thing
PURL	String	URL to product information for the Thing.
REGION	String	Region associated with the Thing
ROOM	String	Room associated with the Thing

SN	String	Serial Number
STREET	String	Street Name
STREETNR	String	Street Number
V	Numeric	Version Number

Security considerations

Collecting and storing meta-data about things may both be very valuable, as a tool to organize, discover and interconnect things in the network, but also dangerous if not considering various security aspects. Many of these security considerations must be dealt with on a protocol-by-protocol level, as is done in XEP-0347 [5], section 6. There, an architecture consisting of both *public* and *private* things is defined, and how to manage meta-data in searches, including meta-data that is constantly being updated by things. It also specifies that only claimed things, whose owners have approved of their meta-data being published, should have their meta-data being searchable.

While the meta-data being encoded using this URI scheme is used by the owner of a thing to claim it, the meta-data must pass a *Thing Registry* in order to match conceptual identity with network identity. In doing so, the *Thing Registry* is free to store the meta-data. Care should therefore be made in publishing meta-data of a sensitive nature.

There is also a special tag named `KEY`. This provides a means to include private random information into the meta-data that can be used to make sure the meta-data is unique. *Thing Registries* must be aware of the meaning of this key, and not publish it or make it searchable. While a thing can only be claimed by one owner at a time, Thing Registries should erase the KEY tag from its internal records once a thing has been claimed. This avoids the possibility of others to learn the value of the KEY tag, and claim the corresponding thing using searchable meta-data or extracting the information by other means, once the thing has become disowned. The thing in turn must report a new KEY tag if being disowned, to make sure it can be re-claimed.

Contact

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Peter Waher is the author of this document, and is authorized to change it in case changes have to be made for approval of application.

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