Name Service of the Internet of Things (IoT)

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- **Problem Statement**

There are already multiple code standards for things related with the IoT such as EPC (Electronic Product Code) and uCode (ubiquitous Code). In the future, there may be more code standards for things, for example some self-designed code standards designed by different industries or countries. These existing standards not only have their own encoding rules but also resolution protocols. For example, EPC uses ONS (Object Naming Service) as its resolution protocol, and uCode uses ucodeRP (Ucode Resolution Protocol) as its resolution protocol while Handle (RFC3652) uses Handle System Protocol to resolve IoT identifiers. The IoT identifiers that emerge in the future may also adopt new or customized unique identification resolution protocols.

Thus, IoT identifiers have heterogeneous conflicts not only in identification coding, but also in corresponding heterogeneous identification resolution protocols, making it impossible to reach a unified resolution between different IoT identification resolution protocols. And therefore they are standalone infrastructure and have low interoperability.

- **Solution**

Our intention is to provide a description mechanism dedicated to resolution protocols for heterogeneous IoT identifier, and protocol rules for heterogeneous IoT resolution in URN namespace. Registration and binding of such protocol rules and the corresponding heterogeneous IoT identifier allow them to be used in resolving IoT identifications. The present method also proposes a unified IoT compatible identification using an embedded IoT identification resolution protocol. By querying IoT resolution for a standard identification code, user can not only obtain coding rules for the heterogeneous IoT identifier, but more importantly also the corresponding heterogeneous identification coding rules and resolution protocol. Using this rule, heterogeneous IoT

identification can be converted into a unified IoT compatible identification that includes information for IoT identification resolution protocol (such as resolution protocol name, entry port address for the resolution server, the port number resolution server, query type in resolution protocol, etc.). A heterogeneous IoT identification server can identify the IoT identification resolution protocol in the unified IoT compatible identification, and can initiate correct query for IoT identification resolution based on the IoT identification resolution protocol corresponding to the heterogeneous IoT identification. The name service system comprises a heterogeneous IoT identification resolver, a standard identification resolution server, and a heterogeneous IoT identification resolution server.

For example, an EPC code is 2308765432, and the standard identification code assigned to it is 001 (these codes are for illustration purpose only). The standard identification code is converted into a compatible unified IoT identification code according to the default standard identification coding rules and standard identification resolution protocol rules: DNS://niot.cn:53/1.0.0.snsroot.cn?type=NAPTR. Specific resolution steps are described as follows:

1) A identification resolver converts the standard identification code to a unified IoT identification code based on a specific IoT identification resolution protocol, namely, DNS://niot.cn:53/1.0.0.snsroot.cn?type = NAPTR. The identification resolver sends a query to a standard identification resolution server "niot.cn" to get the resource record of "1.0.0.snsroot.cn" with the data type of NAPTR.

2) The standard identification resolution server returns, to the identification resolver, the heterogeneous identification coding rules and heterogeneous identification resolution protocol corresponding to EPC 2308765432. For example: the description mechanism can employ a regular expression, or a standard format such as XML or JSON.

    a) Using the example of a regular expression, the heterogeneous identification resolution protocol rules can be described as follows: the name of the resolution

protocol "://". The entry address of the resolution server. ":". The port number of the resolution server"./".\0. "?". The name of the resolution protocol query type"."=". "value of the resolution protocol query type".

b) The description mechanism for heterogeneous coding rules is similar as above.

3) The heterogeneous IoT identification resolver converts the heterogeneous IoT identifier into a second unified IoT identification code compatible with EPC ONS resolution protocol according to heterogeneous IoT identification coding rules and heterogeneous identification resolution protocol rules. For example, EPC code 2308765432 is converted to: ONS://epcons.cn:53/432.8765.230.epc.com?type=NAPTR. The heterogeneous IoT identification resolver sends a query to the ONS heterogeneous IoT identification resolution server according to the second unified IoT identification code.

4) The ONS heterogeneous IoT identification resolution server returns registration information (the address for IoT information server 1) associated with the heterogeneous IoT identification to the heterogeneous IoT identification resolution module.

5) Using the address for IoT information server 1, the heterogeneous IoT identification resolver exchanges information.

- **Conclusion**

In our opinion, TNS will be one of essential and key elements in the IoT, which can provide a uniform and public name service for IoT, just like DNS in the Internet. Some implementation problems related to TNS should be considered by IETF, and other problems in terms of TNS should be considered by IRTF as long term research items.