RFC 209 – Network Interface Information Service

Draft

35 Pages

Abstract

This document defines the Java API that provides the information of network interfaces in an OSGi environment. The bundles can get not only information of network interfaces but notification when the configuration of network interfaces to be changed to use this API.

0 Document Information

0.1 License

DISTRIBUTION AND FEEDBACK LICENSE, Version 2.0

The OSGi Alliance hereby grants you a limited copyright license to copy and display this document (the “Distribution”) in any medium without fee or royalty. This Distribution license is exclusively for the purpose of reviewing and providing feedback to the OSGi Alliance. You agree not to modify the Distribution in any way and further agree to not participate in any way in the making of derivative works thereof, other than as a necessary result of reviewing and providing feedback to the Distribution. You also agree to cause this notice, along with the accompanying consent, to be included on all copies (or portions thereof) of the Distribution. The OSGi Alliance also grants you a perpetual, non-exclusive, worldwide, fully paid-up, royalty free, limited license (without the right to sublicense) under any applicable copyrights, to create and/or distribute an implementation of the Distribution that: (i) fully implements the Distribution including all its required interfaces and functionality; (ii) does not modify, subset, superset or otherwise extend the OSGi Name Space, or include any public or protected packages, classes, Java interfaces, fields or methods within the OSGi Name Space other than those required and authorized by the Distribution. An implementation that does not satisfy limitations (i)-(ii) is not considered an implementation of the Distribution, does not receive the benefits of this license, and must not be described as an implementation of the Distribution. "OSGi Name Space" shall mean the public class or interface declarations whose names begin with "org.osgi" or any recognized successors or replacements thereof. The OSGi Alliance expressly reserves all rights not granted pursuant to these limited copyright licenses including termination of the license at will at any time.

EXCEPT FOR THE LIMITED COPYRIGHT LICENSES GRANTED ABOVE, THE OSGi ALLIANCE DOES NOT GRANT, EITHER EXPRESSLY OR IMPLIEDLY, A LICENSE TO ANY INTELLECTUAL PROPERTY IT, OR ANY THIRD PARTIES, OWN OR CONTROL. Title to the copyright in the Distribution will at all times remain with the OSGi Alliance. The example companies, organizations, products, domain names, e-mail addresses, logos, people, places, and events depicted therein are fictitious. No association with any real company, organization, product, domain name, email address, logo, person, place, or event is intended or should be inferred.

THE DISTRIBUTION IS PROVIDED "AS IS," AND THE OSGi ALLIANCE (INCLUDING ANY THIRD PARTIES THAT HAVE CONTRIBUTED TO THE DISTRIBUTION) MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, OR TITLE; THAT THE CONTENTS OF THE DISTRIBUTION ARE SUITABLE FOR ANY PURPOSE; NOR THAT THE IMPLEMENTATION OF SUCH CONTENTS WILL NOT INFRINGE ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADEMARKS OR OTHER RIGHTS.
NEITHER THE OSGi ALLIANCE NOR ANY THIRD PARTY WILL BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR RELATING TO ANY USE OR DISTRIBUTION OF THE DISTRIBUTION.
(
Implementation of certain elements of this Distribution may be subject to third party intellectual property rights, including without limitation, patent rights (such a third party may or may not be a member of the OSGi Alliance). The OSGi Alliance is not responsible and shall not be held responsible in any manner for identifying or failing to identify any or all such third party intellectual property rights.

The Distribution is a draft. As a result, the final product may change substantially by the time of final publication, and you are cautioned against relying on the content of this Distribution. You are encouraged to update any implementation of the Distribution if and when such Distribution becomes a final specification.

The OSGi Alliance is willing to receive input, suggestions and other feedback (“Feedback”) on the Distribution. By providing such Feedback to the OSGi Alliance, you grant to the OSGi Alliance and all its Members a non-exclusive, non-transferable,

worldwide, perpetual, irrevocable, royalty-free copyright license to copy, publish, license, modify, sublicense or otherwise distribute and exploit your Feedback for any purpose. Likewise, if incorporation of your Feedback would cause an implementation of the Distribution, including as it may be modified, amended, or published at any point in the future ("Future Specification"), to necessarily infringe a patent or patent application that you own or control, you hereby commit to grant to all implementers of such Distribution or Future Specification an irrevocable, worldwide, sublicenseable, royalty free license under such patent or patent application to make, have made, use, sell, offer for sale, import and export products or services that implement such Distribution or Future Specification. You warrant that (a) to the best of your knowledge you have the right to provide this Feedback, and if you are providing Feedback on behalf of a company, you have the rights to provide Feedback on behalf of your company; (b) the Feedback is not confidential to you and does not violate the copyright or trade secret interests of another; and (c) to the best of your knowledge, use of the Feedback would not cause an implementation of the Distribution or a Future Specification to necessarily infringe any third-party patent or patent application known to you. You also acknowledge that the OSGi Alliance is not required to incorporate your Feedback into any version of the Distribution or a Future Specification.

I HEREBY ACKNOWLEDGE AND AGREE TO THE TERMS AND CONDITIONS DELINEATED ABOVE.

0.2 Trademarks

OSGi™ is a trademark, registered trademark, or service mark of the OSGi Alliance in the US and other countries. Java is a trademark, registered trademark, or service mark of Oracle Corporation in the US and other countries. All other trademarks, registered trademarks, or service marks used in this document are the property of their respective owners and are hereby recognized.

0.3 Feedback

This document can be downloaded from the OSGi Alliance design repository at https://github.com/osgi/design The public can provide feedback about this document by opening a bug at https://www.osgi.org/bugzilla/.

0.4 Table of Contents

0.5 Terminology and Document Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY" and "OPTIONAL" in this document are to be interpreted as described in 10.1.

```
Source code is shown in this typeface.
```

0.6 Revision History

The last named individual in this history is currently responsible for this document.

Revision	Date	Comments
Initial	Nov 18, 2013	Initial version Shigekuni Kondo, NTT Corporation, kondo.shigekuni@lab.ntt.co.jp
0.2	Feb 10, 2014	Based on the last meeting, the section 5 has changed. Changed the design to service repository model. Shigekuni Kondo, NTT Corporation, kondo.shigekuni@lab.ntt.co.jp

Revision	Date	Comments
0.3	Feb 28, 2014	Based on the last meeting, the following points have been modified. nwif.disprayname is changed to OPTIONAL. Interface name is changed. NwIfInfo --> NetworkAdapter, NwIfInetAddress --> NetworkAddress IPAdress Type is divided to IPAdresVersion and IPAdressScope. The functionality of configuration is removed. Shigekuni Kondo, NTT Corporation, kondo.shigekuni@lab.ntt.co.jp
0.4	Mar 6, 2014	Based on the last meeting, the following points have been modified. Update IPAdress Version and Scope. The order of registering (unregistering) NetworkAdapter and NetworkAddress is changed. Shigekuni Kondo, NTT Corporation, kondo.shigekuni@lab.ntt.co.jp
0.5	Mar 14, 2014	Based on the last confference call, the following points have been modified. Adding new service properties to NetworkAdapter service and NetworkAddress. Some service property names are modified. NetworkAadapterException class is removed. JavaDoc update. Some sentences are modified. Shigekuni Kondo, NTT Corporation, kondo.shigekuni@lab.ntt.co.jp
0.6	Mar 19, 2014	Fixed some sentences based on the comments from Evgeni. Added Chapter 8 Considered Alternatives section. Shigekuni Kondo, NTT Corporation, kondo.shigekuni@lab.ntt.co.jp
0.7	Apr 9, 2014	Fixed the packagename (Java doc). Added Chapter 9 Added Security section. Some sentences are modified. Shigekuni Kondo, NTT Corporation, kondo.shigekuni@lab.ntt.co.jp

Revision	Date	Comments
0.8	Apr 30, 2014	Based on the last CPEG confference call, the following points have been modified. Remove "service." prefix from service properties key. The constants “LAN” and “WAN” of Network Adapter Type are defined. The description of use case 2 and 3 is modified. All of service properties in NetwoekAdapter are changed to Required. Some sentences correction. Shigekuni Kondo, NTT Corporation, kondo.shigekuni@lab.ntt.co.jp
final	Jul 4, 2014	Finalized version Shigekuni Kondo, NTT Corporation, kondo.shigekuni@lab.ntt.co.jp

1 Introduction

Java standard APIs (i.e. java.net.NetworkInterface, java.net.InetAddress) provide functions that allow IP network interface information, such as the IP address and MAC address to be obtained.

However, the bundle that wants to get network interface information has to monitor whether the information has changed or not for a certain period of time. Changes in network interface can be pushed to the bundles concerned, the need for polling by bundles can be eliminated.

In addition, some information cannot be obtained via Java standard APIs.

This RFC

defines the Java API that provides the information of network interfaces in an OSGi environment. The bundles can get not only information of network interfaces but notification when the configuration of network interfaces to use this API.

2 Application Domain

There are many bundles that use the IP network to communicate with other networked devices. In paticular, since a Residential Gateway (RGW) may have a number of network interfaces, each bundle running on the RGW needs to obtain an IP address and confirm whether the network interface associated with the allocated IP address suits the bundle's requirements or not.

For example, a protocol adapter needs the IP address of a network interface on the wide area network side to communicate with an external server. UPnP device service bundle needs the IP address that can be used to communicate with devices in a local area network.

These bundles can acquire information about the network interface via the following Java standard APIs.

- java.net.NetworkInterface
- *java.net.InetAddress*

3 Problem Description

Many application bundles on the RGW provide services on IP networks. For example, a protocol adapter for DMT Admin Service, a http server established by HTTP Service bundle and UPnP device service bundle use IP networks. In those cases, the bundles need to get information about the network interface on the RGW such as IP address, MAC address, network interface name, and so on.

The information about the network interface can be obtained by using Java standard APIs which are java.net.NetworkInterface and java.net.InetAddress. However, these APIs fail to provide the features needed by the bundles when they use the IP network in the following situations:

[Problem 1] There is no feature that sends a notification when information of the network interface (i.e. IP address) changes during runtime, e.g. the connection status or the assigned IP address.

[Problem 2] There is no feature that can acquire the subnet mask of the network interface.

[Problem 3] Operating System specific bundles must be prepared because some information about network interface depends on the Operating System.

If these functions were available, it would be very useful for bundles that need to use the IP network. However, a standard API does not exist at this time, so it must be prepared for each environment.

3.1 Use Cases

Use case 1

The TR-069 protocol adapter bundle on a RGW needs to communicate with an Auto Configuration Server (ACS). The ACS needs to know the public IP address of the Residential Gateway to send a UDP packet to the protocol adapter bundle for a connection request. In this case, the bundle has to provide the IP address to the ACS when the bundle is started or the IP address has changed.

Use case 2

When an HTTP Service bundle is available, at least one HTTP server is expected to run. When the HTTP server needs to be assigned to a specific network interface, the HTTP Service bundle has to know the information of the network interface. The configurator bundle (For example, management agent) implemented the policy of the execution envionment will detect the changes of IP address of the network interface and update the configuration of HTTP Service bundle.

Use case 3

The UPnP Device Service bundle needs to create the DatagramSocket for receiving and sending M-search messages. In the case of devices such as Residential Gateway, which has multi network interfaces, the UPnP bundle has to create a DatagramSocket that is bound to an appropriate local IP address. The configurator bundle (For example, management agent) implemented the policy of the

execution envionment will detect the changes of IP address of the network interface and update the configuration of UPnP Device Service bundle.

Use case 4

An application bundle wants to obtain the subnet mask of the IP address to cover the situation in which the bundle needs to execute the Wake-up-On-LAN process.

Use case 5

An application wants to obtain information about available network services, such as available DNS Server, Log Server, NTP Server, or network characteristics, such as domain names, ARP cache timeouts, broadcast address, etc. For this, the local DHCP server can be queried to get those information.

Use case 6

A device running an OSGi framework in an mixed IPv4/IPv6 environment needs to get specific information about the network interface(s) in order to provide, for example, different services for the IPv4 and IPv6 environments.

4 Requirements

[REQ_1] The solution MUST provide means to send notifications to interested bundles whenever the information of network interface has changed.(i.e. The bundle is notified the information of IP address change from Network Interface Information Service implemented bundle)

[REQ_2] The solution MUST provide an API that can obtain information from a multiple network interfaces. Each network interface can provide information about multiple addresses. (An application bundle needs to know whether the network interface is a LAN interface or a WAN interface.).

[REQ_3] The solution MUST provide a mechanism that can provide the network interface information needed regardless of the Operating System type.

[REQ_4] The solution MUST provide the means of configuring network interface type. It will be defined for each environment (i.e. “LAN”, “WAN” that is bound to each logical interface) .

[REQ_5] The solution MUST provide an API that can obtain the subnet mask of each IP address.

[REQ_6] The solution MUST support both IPv4 and IPv6 environments (mixed or separately) and the corresponding characteristics, for example IPv4 and IPv6 addresses, multi-prefixes, multicast etc. .

[REQ_7] The solution SHOULD support the retrieval of MAC addresses for network interfaces.

[REQ_8] The solution MAY provide an API that allows alteration of network interface configurations.

[REQ_9] The solution MAY provide an API that can obtain the capability of network interface. (e.g. the physical type of network interface, list of BOOTP/DHCP command options, DNS server address, Default Gateway address, etc.)

5 Technical Solution

5.1 Introduction

When the IP address is changed, the bundles utilize the IP address information (i.e. Http Service bundle running HTTP Servers) is necessary to detect the fact of the change. When using a standard Java API, such as java.net.InetAddress and java.net.NetworkInterface, calles to confirm the IP address at regular intervals are required from the bundle itself. Since this is a process common to all bundles that need to detect any change in IP address information, provision of services to notify a change in IP address is very effective.

Therefore an API that provides a change notification feature for each piece of network interface information (including the IP address information) is investigated in this RFC document. In addition, this RFC defines APIs that provide the functionalities to obtain the network interface information and the information of IP address bound to the network interface .

The name of the network interface is dependent on the operating system. To allow the bundle implementation that uses the Network Interface Information Service is unaware of the differences in operating systems, a mechanism of identifying the network interface is necessary in a format that does not depend on the operating system. This is also defined in this RFC.

5.2 Entities

- Network Interface
  Available and activated network interfaces provided in the execution environment. In this specification, the unit of the network interface is the logical interface, not the physical interface.

- NetworkAdapter
  The OSGi service that provides information related to the Network Interface. This service provides functionalities corresponding to “java.net.NetworkInterface”.

- NetworkAddress
  The OSGi service that provides information of IP addresses available on the execution environment in which a Network Interface Information Service bundle is running.

- NetworkAdapterType
  An identifier of the network interface. It is independent of the operating system. The two type of identifier string is specified in this specification. This specification allows that Network Adapter type other than them can be defined by the platform provider in each environment. This identifier is used by user bundle to specify the network interface to be monitored.

- IPAdressVersion
  An identifier indicating the IP address version (i.e. Ipv4, IPv6). This identifier is defined in this specification. This identifier is used by a user bundle to specify the network interface to be monitored.

- IPAdressScope
  An identifier indicating the scope of IP address (i.e. GLOBAL, PRIVATE). This identifier is defined in this specification. This identifier is used by a user bundle to specify the network interface to be monitored.

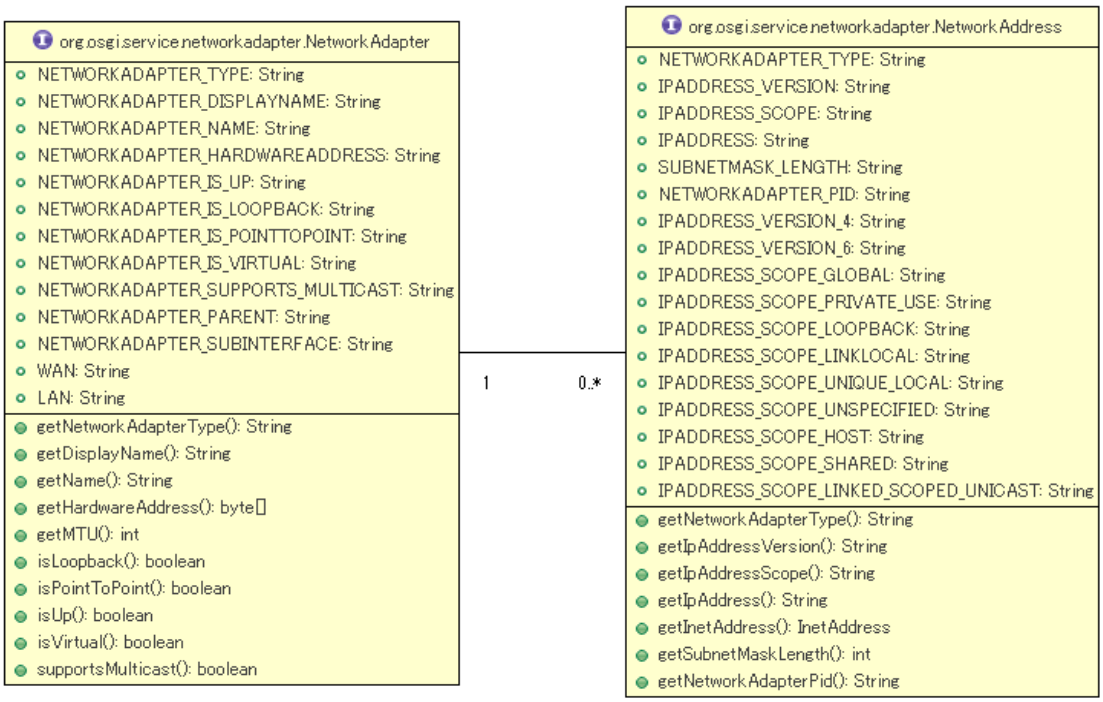

Fig.1 Class structure of Network Interface Information Service

<Network Interface Information Bundle>

To register two kinds of services.

NetworkAdapter service provides network interface information, this bundle registers each logical interface as OSGi service.

NetworkAddress service provides each IP address information, this bundle registers each IP address as OSGi service.

NetworkAddress service is associated with specific NetworkAdapter service.

When information of network interface is changed, service properties of NetworkAdapter setvice and NetworkAddress service will be modified.

<User bundle>

Tracking necessary NetworkAdapter service and NetworkAddress service (using filter).This bundle is notified of a change in network interface information via Service Event.

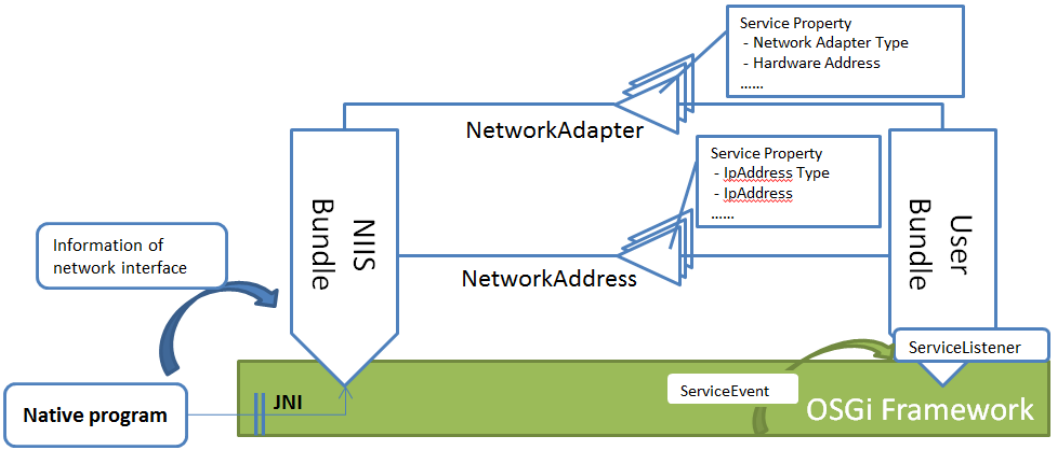

Fig.2 Overview of Network Interface Information Service

5.3 NetworkAdapter Service

NetworkAdapter is an interface that provides information about single network interfaces provided by the execution environment. If multiple network interfaces are present, NetworkAdapter Services that correspond to each network interface must be registered.

NetworkAdapter service is registered with the service repository with service properties as shown in the following table.

Table 1. Service properties of NetworkAdapter Service

The key of service property	Description
networkAdapter.type	Required property. Network interface type is set to a value.
networkAdapter.hardwareAddress	Required property. Hardware address (MAC address) is set to a value. This property can also be obtained from getHardwareAddress().
networkAdapter.name	Required property. Network interface name is set to a value. This property can also be obtained from getName().
networkAdapter.displayName	Required property. Network interface display name is set to a value. This property can also be obtained from getDisplayName().

networkAdapter.isUp	Required property. The value is true when a network interface is up and running, otherwise it is false.
networkAdapter.isLoopback	Required property. The value is true when a network interface is a loopback interface, otherwise it is false.
networkAdapter.isPointToPoint	Required property. The value is true when a network interface is a point to point interface, otherwise it is false.
networkAdapter.isVirtual	Required property. The value is true when a network interface is a virtual interface, otherwise it is false.
networkAdapter.supportsMulticast	Required property. The value is true when a network interface supports multicasting, otherwise it is false.
networkAdapter.parent	Required property. Service PID of the NetworkAdapter service which is parent of this NetworkAdapter is specified.
networkAdapter.subInterface	Required property. Service PID of the NetworkAdapter service which is subinterface of this NetworkAdapter is specified.

When a network interface becomes available, NetworkAdapter service associated with the network interface is registered with the service repository. If the network interface becomes unavailable, the corresponding NetworkAdapter service is unregistered.

When the attribute values of the network interface are set to the service property changes, NetworkAdapter service is updated. NetworkAdapter interface provides a method corresponding to java.net.NetworkInterface in order to provide information on the associated network interface. However, this interface method does not support the Static method. In addition, because NetworkInterface object or InetAddress object is registered in the service repository as NetworkAdapter and NetworkAdress, the NetworkAdapter interface does not provide a method to get those objects. NetworkAdapter provides a method to retrieve the value of an attribute of a network interface.

Table 2. Investigation of the method to be adopted based on Java standard API

Method in java.net.NetworkInterface	Adoption status
getByInetAddress(InetAddress)	Not adopted in this interface because NetworkAdapter service is registered.
getByName(String)	Not adopted in this interface because NetworkAdapter service is registered.
getDisplayName()	Adopted in this interface.
getHardwareAddress()	Adopted in this interface.
getInetAddresses()	Not adopted in this interface because InetAdress object is provided

	by NetworkAdress service.
getInterfaceAddresses()	Not adopted in this interface because InetAdress object is provided by NetworkAdress service.
getMTU()	Adopted in this interface.
getName()	Adopted in this interface.
getNetworkInterfaces()	Not adopted in this interface because NetworkAdapter service is registered.
getParent()	Not adopted in this interface because NetworkAdapter service is registered.
getSubInterfaces()	Not adopted in this interface because NetworkAdapter service is registered.
isLoopback()	Adopted in this interface as service property.
isPointToPoint()	Adopted in this interface as service property.
isUp()	Adopted in this interface as service property.
isVirtual()	Adopted in this interface as service property.
supportsMulticast()	Adopted in this interface as service property.

5.4 NetworkAddress Service

NetworkAddress interface provides information of IP addresses available in which execution environment on a Network Interface Information Service bundle is running.

NetworkAddress service is registered with the service repository together with service properties as shown in the following table.

Table 3. Service properties of NetworkAddress Service

The key of service property	Description
networkAdapter.type	Required property. Network interface type is set to a value.
ipAddress.version	Required property. IP address version is set to a value.
ipAddress.scope	Required property. IP address scope is set to a value.
ipAddress	Required property. IP address String is set to a

	value.
subnetmask.length	Required property. subnet mask length of the required properties IPv4, or IPv6 prefix length is set to a value.
networkAdapter.pid	Required property. Service ID of the NetworkAdapter service corresponding to the network interface binding this IP address is set to a value.

NetworkAddress service is registered with the service repository for each available IP address.

When associated IP addresses are deled, or the network interface to which the IP address is bound becomes unavailable, the NetworkAddress service is unregistered. When the associated IP address changes, NetworkAddress service is updated. The user bundle can detect the change of IP address by monitoring the registration or unregistering, updating of NetworkAddress service.

Because IP addresses are bound to the network interface, if any, Service PID of the associated NetworkAdapter service and its network interface type are set to service property.

NetworkAdapter service MUST be registered after the all associated NetworkAddress services are registered. On the other hand, when unregistering services, after associated NetworkAdapter service is unregistered, NetworkAddress of all related services are unregistered..

5.5 Network adapter type, IP address version and IP address scope

5.5.1 Network adapter type

Identifying the network interface is possible by using the network interface name.

However, since the network interface name is an identifier that is dependent on the operating system, if network interface name is used as identifier, user bundles must be implemented to be aware of the operating system. Therefore, in this specification, “network interface type” which is independent of the operating system, is used to identify the network interface. The network interface type string of “LAN” and “WAN” are defined in this specification. This specification allows that Network Adapter type other than “LAN” and “WAN” can be defined by the platform provider in each environment. It may be provided by the platform provider on which Network Interface Information Service bundle is running. Network interface type “LAN” indicates the network interface connects to a local area network. Network interface type “WAN” indicates the network interface connects to an external network (i.e. Internet). If a bundle wants to obtain the information of the network interface connected to the Internet, the bundle is able to get it by obtaining NetworkAdapter service which sets "SERVICE_NETWORKADAPTER_TYPE = WAN" to service property from the service repository.

Table 4. Network Adapter Type

Network Interface Type	Description
LAN	The network interface to connect to a local area network.
WAN	The network interface to connect to an external network (i.e. Internet).

5.5.2 IP address version and IP address scope

This specification defines “IP address version” and “IP address scope” as IP address version and IP address scope to be narrowed down the IP address by user bunde as follows.

Table 5. IP Address Version

IP Address Version	Description
IPV4	IP address version which means IPv4 address.
IPV6	IP address version which means IPv6 address.

Table 6. IP Address Scope (T.B.D)

IP Address Scope	Description
GLOBAL	IP address scope which means global address.
PRIVATE_USE	IP address scope which means private address.
LOOPBACK	IP address scope which means loopback address.
LINKLOCAL	IP address scope which means linklocal address.
UNIQUE_LOCAL	IP address scope which means unique-local address.
UNSPECIFIED	IP address scope which means the absence of an address.

If a bundle which wants to check for an IP address of the IPv4 global, the bundle is able to confirm by obtaining NetworkAddress service which sets "SERVICE_IPADDRESS_VERSION = IPV4" and "SERVICE_IPADDRESS_SCOPE = GLOBAL" to service property from service repository.

6 Data Transfer Objects

This RFC will not provide Data Transfer Objects.

7 Javadoc

OSGi Javadoc

14/07/04 18:59

Package Summary		Page
org.osgi.service.networkadapter		19

Package org.osgi.service.networkadapter

Interface Summary		Page
NetworkAdapter	NetworkAdapter is an interface that provides information about single network interfaces provided by the execution environment.	20
NetworkAddress	This interface represents an IP address information.	27

Interface NetworkAdapter

org.osgi.service.networkadapter

```
public interface NetworkAdapter
```

NetworkAdapter is an interface that provides information about single network interfaces provided by the execution environment.

If multiple network interfaces are present, NetworkAdapter Services that correspond to each network interface must be registered. Network interface information service is set the following information as service property.

1. NETWORKADAPTER_TYPE : Network Adapter Type
2. NETWORKADAPTER_DISPLAYNAME : Network Interface Display Name
3. NETWORKADAPTER_NAME : Network Interface Name
4. NETWORKADAPTER_HARDWAREADDRESS : Hardware Address
5. NETWORKADAPTER_IS_UP : Running status of Network Interface
6. NETWORKADAPTER_IS_LOOPBACK : To check loopback interface
7. NETWORKADAPTER_IS_POINTTOPOINT : To check point to point interface
8. NETWORKADAPTER_IS_VIRTUAL : To check virtual interface
9. NETWORKADAPTER_SUPPORTS_MULTICAST : To check supports multicasting
10. NETWORKADAPTER_PARENT : The PID of parent Network Interface
11. NETWORKADAPTER_SUBINTERFACE : The PID of sub Network Interface

When a network interface becomes available, NetworkAdapter service associated with the network interface is registered with the service repository. If the network interface becomes unavailable, the corresponding NetworkAdapter service is unregistered.

When the attribute values of the network interface are set to the service property changes, NetworkAdapter service is updated. NetworkAdapter interface provides a method corresponding to java.net.NetworkInterface in order to provide information on the associated network interface. However, this interface method does not support the Static method. In addition, because NetworkInterface object or InetAddress object is registered in the service repository as NetworkAdapter and NetworkAdress, the NetworkAdapter interface does not provide a method to get those objects. NetworkAdapter provides a method to retrieve the value of an attribute of a network interface.

Field Summary		Page
String	**LAN** The string of networkadapter type which means the network interface to connect to a local area network.	23
String	**NETWORKADAPTER_DISPLAYNAME** The key string of "networkAdapter.displayName" service property.	21
String	**NETWORKADAPTER_HARDWAREADDRESS** The key string of "networkAdapter.hardwareAddress" service property.	22
String	**NETWORKADAPTER_IS_LOOPBACK** The key string of "networkAdapter.isLoopback" service property.	22
String	**NETWORKADAPTER_IS_POINTTOPOINT** The key string of "networkAdapter.isPointToPoint" service property.	22
String	**NETWORKADAPTER_IS_UP** The key string of "networkAdapter.isUp" service property.	22
String	**NETWORKADAPTER_IS_VIRTUAL** The key string of "networkAdapter.isVirtual" service property.	22
String	**NETWORKADAPTER_NAME** The key string of "networkAdapter.name" service property.	22

String	**NETWORKADAPTER_PARENT** The key string of "networkAdapter.parent" service property.	23
String	**NETWORKADAPTER_SUBINTERFACE** The key string of "networkAdapter.subInterface" service property.	23
String	**NETWORKADAPTER_SUPPORTS_MULTICAST** The key string of "networkAdapter.supportsMulticast" service property.	23
String	**NETWORKADAPTER_TYPE** The key string of "networkAdapter.type" service property.	21
String	**WAN** The string of networkadapter type which means the network interface to connect to an external network (i.e.	23

Method Summary		Page
String	**getDisplayName**() Returns the network interface display name of "networkAdapter.displayname" service property value.	24
byte[]	**getHardwareAddress**() Returns the MAC address of "networkAdapter.hardwareAddress" service property value.	24
int	**getMTU**() Returns the Maximum Transmission Unit (MTU) of this interface.	24
String	**getName**() Returns the network interface name of "networkAdapter.name" service property value.	24
String	**getNetworkAdapterType**() Returns the network interface type of "networkAdapter.type" service property value.	23
boolean	**isLoopback**() Returns whether a network interface is a loopback interface.	25
boolean	**isPointToPoint**() Returns whether a network interface is a point to point interface.	25
boolean	**isUp**() Returns whether a network interface is up and running.	25
boolean	**isVirtual**() Returns whether this interface is a virtual interface (also called subinterface).	25
boolean	**supportsMulticast**() Returns whether a network interface supports multicasting or not.	26

Field Detail

NETWORKADAPTER_TYPE

```
public static final String NETWORKADAPTER_TYPE = "networkAdapter.type"
```

The key string of "networkAdapter.type" service property. Network Interface Type is specified.

NETWORKADAPTER_DISPLAYNAME

```
public static final String NETWORKADAPTER_DISPLAYNAME = "networkAdapter.displayName"
```

The key string of "networkAdapter.displayName" service property. Network Interface Display Name is specified.

NETWORKADAPTER_NAME

```
public static final String NETWORKADAPTER_NAME = "networkAdapter.name"
```

The key string of "networkAdapter.name" service property. Network Interface Name is specified.

NETWORKADAPTER_HARDWAREADDRESS

```
public static final String NETWORKADAPTER_HARDWAREADDRESS = "networkAdapter.hardwareAddress"
```

The key string of "networkAdapter.hardwareAddress" service property. Hardware Address is specified.

NETWORKADAPTER_IS_UP

```
public static final String NETWORKADAPTER_IS_UP = "networkAdapter.isUp"
```

The key string of "networkAdapter.isUp" service property. The value is true when a network interface is up and running, otherwise it is false.

NETWORKADAPTER_IS_LOOPBACK

```
public static final String NETWORKADAPTER_IS_LOOPBACK = "networkAdapter.isLoopback"
```

The key string of "networkAdapter.isLoopback" service property. The value is true when a network interface is a loopback interface, otherwise it is false.

NETWORKADAPTER_IS_POINTTOPOINT

```
public static final String NETWORKADAPTER_IS_POINTTOPOINT = "networkAdapter.isPointToPoint"
```

The key string of "networkAdapter.isPointToPoint" service property. The value is true when a network interface is a point to point interface, otherwise it is false.

NETWORKADAPTER_IS_VIRTUAL

```
public static final String NETWORKADAPTER_IS_VIRTUAL = "networkAdapter.isVirtual"
```

The key string of "networkAdapter.isVirtual" service property.
The value is true when a network interface is a virtual interface, otherwise it is false.

NETWORKADAPTER_SUPPORTS_MULTICAST

```
public static final String NETWORKADAPTER_SUPPORTS_MULTICAST = "networkAdapter.supportsMulticast"
```

The key string of "networkAdapter.supportsMulticast" service property.
The value is true when a network interface supports multicasting, otherwise it is false.

NETWORKADAPTER_PARENT

```
public static final String NETWORKADAPTER_PARENT = "networkAdapter.parent"
```

The key string of "networkAdapter.parent" service property.
Service PID of the NetworkAdapter service which is parent of this NetworkAdapter is specified.

NETWORKADAPTER_SUBINTERFACE

```
public static final String NETWORKADAPTER_SUBINTERFACE = "networkAdapter.subInterface"
```

The key string of "networkAdapter.subInterface" service property.
Service PID of the NetworkAdapter service which is subinterface of this NetworkAdapter is specified.

WAN

```
public static final String WAN = "WAN"
```

The string of networkadapter type which means the network interface to connect to an external network (i.e. Internet).

LAN

```
public static final String LAN = "LAN"
```

The string of networkadapter type which means the network interface to connect to a local area network.

Method Detail

getNetworkAdapterType

```
String getNetworkAdapterType()
```

Returns the network interface type of "networkAdapter.type" service property value.

Returns:
Network Interface Type

---

getDisplayName

```
String getDisplayName()
```

Returns the network interface display name of "networkAdapter.displayname" service property value.

Returns:
Network Interface Display Name

---

getName

```
String getName()
```

Returns the network interface name of "networkAdapter.name" service property value.

Returns:
Network Interface Name

---

getHardwareAddress

```
byte[] getHardwareAddress()
```

Returns the MAC address of "networkAdapter.hardwareAddress" service property value.

Returns:
Hardware Address

---

getMTU

```
int getMTU()
    throws SocketException
```

Returns the Maximum Transmission Unit (MTU) of this interface.

Returns:
The value of the MTU for that interface.

Throws:
`SocketException` - If an I/O error occurs.

---

isLoopback

```
boolean isLoopback()
            throws SocketException
```

Returns whether a network interface is a loopback interface.

Returns:
true if the interface is a loopback interface.

Throws:
`SocketException` - If an I/O error occurs.

---

isPointToPoint

```
boolean isPointToPoint()
                throws SocketException
```

Returns whether a network interface is a point to point interface.

Returns:
true if the interface is a point to point interface.

Throws:
`SocketException` - If an I/O error occurs.

---

isUp

```
boolean isUp()
      throws SocketException
```

Returns whether a network interface is up and running.

Returns:
true if the interface is up and running.

Throws:
`SocketException` - If an I/O error occurs.

---

isVirtual

```
boolean isVirtual()
```

Returns whether this interface is a virtual interface (also called subinterface). Virtual interfaces are, on some systems, interfaces created as a child of a physical interface and given different settings (like address or MTU). Usually the name of the interface will the name of the parent followed by a colon (:) and a number identifying the child since there can be several virtual interfaces attached to a single physical interface.

Returns:
true if this interface is a virtual interface.

---

supportsMulticast

```
boolean supportsMulticast()
                  throws SocketException
```

Returns whether a network interface supports multicasting or not.

Returns:
true if the interface supports Multicasting.

Throws:
`SocketException` - If an I/O error occurs.

Interface NetworkAddress

org.osgi.service.networkadapter

```
public interface NetworkAddress
```

This interface represents an IP address information.

NetworkAddress interface provides information of IP addresses available in which execution environment on a Network Interface Information Service bundle is running. IP address information service is set the following information as service property.

1. NETWORKADAPTER_TYPE : Network Interface Type
2. IPADDRESS_VERSION : IP Address Version
3. IPADDRESS_SCOPE : IP Address Scope
4. IPADDRESS : IP Address
5. SUBNETMASK_LENGTH : Subnet Mask Length(IPv4) or Prefix Length(IPv6)
6. NETWORKADAPTER_PID : Service PID of the NetworkAdapter service to which this service belongs

NetworkAddress service is registered with the service repository for each available IP address. When associated IP addresses are deleted, or the network interface to which the IP address is bound becomes unavailable, the NetworkAddress service is unregistered. When the associated IP address changes, NetworkAddress service is updated. The user bundle can detect the change of IP address by monitoring the registration or unregistering, updating of NetworkAddress service. Because IP addresses are bound to the network interface, if any, Service PID of the associated NetworkAdapter service and its network interface type are set to service property. NetworkAdapter service MUST be registered after the all associated NetworkAddress services are registered. On the other hand, when unregistering services, after associated NetworkAdapter service is unregistered, NetworkAddress of all related services are unregistered.

Field Summary		Page
String	**IPADDRESS** The key string of "ipAddress" service property.	29
String	**IPADDRESS_SCOPE** The key string of "ipAddress.scope" service property.	28
String	**IPADDRESS_SCOPE_GLOBAL** The string of IP address scope which means global address.	29
String	**IPADDRESS_SCOPE_HOST** The string of IP address scope which means "This host on this network".	30
String	**IPADDRESS_SCOPE_LINKED_SCOPED_UNICAST** The string of IP address scope which means "Linked-Scoped Unicast".	31
String	**IPADDRESS_SCOPE_LINKLOCAL** The string of IP address scope which means "Link Local".	30
String	**IPADDRESS_SCOPE_LOOPBACK** The string of IP address scope which means "Loopback".	30
String	**IPADDRESS_SCOPE_PRIVATE_USE** The string of IP address scope which means "Private-Use Networks".	30
String	**IPADDRESS_SCOPE_SHARED** The string of IP address scope which means "Shared Address Space".	31
String	**IPADDRESS_SCOPE_UNIQUE_LOCAL** The string of IP address scope which means "Unique-Local".	30
String	**IPADDRESS_SCOPE_UNSPECIFIED** The string of IP address scope which means "Unspecified Address".	30

String	**IPADDRESS_VERSION** The key string of "ipAddress.version" service property.	28
String	**IPADDRESS_VERSION_4** The string of IP address version which means IP address version 4.	29
String	**IPADDRESS_VERSION_6** The string of IP address version which means IP address version 6.	29
String	**NETWORKADAPTER_PID** The key string of "networkAdapter.id" service property.	29
String	**NETWORKADAPTER_TYPE** The key string of "networkAdapter.type" service property.	28
String	**SUBNETMASK_LENGTH** The key string of "subnetmask.length" service property.	29

Method Summary		Page
InetAddress	**getInetAddress**() Returns the InetAddress object of this IP address.	32
String	**getIpAddress**() Returns the IP address of "ipaddress" service property value.	31
String	**getIpAddressScope**() Returns the IP address scope of "ipaddress.scope" service property value.	31
String	**getIpAddressVersion**() Returns the IP address version of "ipaddress.version" service property value.	31
String	**getNetworkAdapterPid**() Returns the "networkadapter.pid" service property value.	32
String	**getNetworkAdapterType**() Returns the network interface type of "networkAdapter.type" service property value.	31
int	**getSubnetMaskLength**() Returns the "subnetmask.length" service property value.	32

Field Detail

NETWORKADAPTER_TYPE

```
public static final String NETWORKADAPTER_TYPE = "networkAdapter.type"
```

The key string of "networkAdapter.type" service property. Network Interface Type is specified.

IPADDRESS_VERSION

```
public static final String IPADDRESS_VERSION = "ipAddress.version"
```

The key string of "ipAddress.version" service property. IP Address Type is specified.

IPADDRESS_SCOPE

```
public static final String IPADDRESS_SCOPE = "ipAddress.scope"
```

The key string of "ipAddress.scope" service property.
IP Address Type is specified.

IPADDRESS

```
public static final String IPADDRESS = "ipAddress"
```

The key string of "ipAddress" service property.
IP Address is specified.

SUBNETMASK_LENGTH

```
public static final String SUBNETMASK_LENGTH = "subnetmask.length"
```

The key string of "subnetmask.length" service property.
Subnet Mask Length(IPv4) or Prefix Length(IPv6) is specified.

NETWORKADAPTER_PID

```
public static final String NETWORKADAPTER_PID = "networkAdapter.pid"
```

The key string of "networkAdapter.id" service property.
Service PID of the interface information service to which it belongs is specified.

IPADDRESS_VERSION_4

```
public static final String IPADDRESS_VERSION_4 = "IPV4"
```

The string of IP address version which means IP address version 4.

IPADDRESS_VERSION_6

```
public static final String IPADDRESS_VERSION_6 = "IPV6"
```

The string of IP address version which means IP address version 6.

IPADDRESS_SCOPE_GLOBAL

```
public static final String IPADDRESS_SCOPE_GLOBAL = "GLOBAL"
```

The string of IP address scope which means global address.
The global address is defined as the address other than the address defined in the RFC6890.

IPADDRESS_SCOPE_PRIVATE_USE

```
public static final String IPADDRESS_SCOPE_PRIVATE_USE = "PRIVATE_USE"
```

The string of IP address scope which means "Private-Use Networks".
See RFC6890 for the definition of "Private-Use Networks".

IPADDRESS_SCOPE_LOOPBACK

```
public static final String IPADDRESS_SCOPE_LOOPBACK = "LOOPBACK"
```

The string of IP address scope which means "Loopback".
See RFC6890 for the definition of "Loopback".

IPADDRESS_SCOPE_LINKLOCAL

```
public static final String IPADDRESS_SCOPE_LINKLOCAL = "LINKLOCAL"
```

The string of IP address scope which means "Link Local".
See RFC6890 for the definition of "Link Local".

IPADDRESS_SCOPE_UNIQUE_LOCAL

```
public static final String IPADDRESS_SCOPE_UNIQUE_LOCAL = "UNIQUE_LOCAL"
```

The string of IP address scope which means "Unique-Local".
See RFC6890 for the definition of "Unique-Local".

IPADDRESS_SCOPE_UNSPECIFIED

```
public static final String IPADDRESS_SCOPE_UNSPECIFIED = "UNSPECIFIED"
```

The string of IP address scope which means "Unspecified Address".
See RFC6890 for the definition of "Unspecified Address".

IPADDRESS_SCOPE_HOST

```
public static final String IPADDRESS_SCOPE_HOST = "HOST"
```

The string of IP address scope which means "This host on this network".
See RFC6890 for the definition of "This host on this network".

IPADDRESS_SCOPE_SHARED

```
public static final String IPADDRESS_SCOPE_SHARED = "SHARED"
```

The string of IP address scope which means "Shared Address Space". See RFC6890 for the definition of "Shared Address Space".

IPADDRESS_SCOPE_LINKED_SCOPED_UNICAST

```
public static final String IPADDRESS_SCOPE_LINKED_SCOPED_UNICAST = "LINKED_SCOPED_UNICAST"
```

The string of IP address scope which means "Linked-Scoped Unicast". See RFC6890 for the definition of "Linked-Scoped Unicast".

Method Detail

getNetworkAdapterType

```
String getNetworkAdapterType()
```

Returns the network interface type of "networkAdapter.type" service property value.

Returns:
Network Interface Type

---

getIpAddressVersion

```
String getIpAddressVersion()
```

Returns the IP address version of "ipaddress.version" service property value.

Returns:
IP Address Version

---

getIpAddressScope

```
String getIpAddressScope()
```

Returns the IP address scope of "ipaddress.scope" service property value.

Returns:
IP Address Scope

---

getIpAddress

```
String getIpAddress()
```

Returns the IP address of "ipaddress" service property value.

Returns:
IP Address string

---

getInetAddress

```
InetAddress getInetAddress()
```

Returns the InetAddress object of this IP address.

Returned object is created from "ipaddress" service property value.

Returns:
InetAddress

---

getSubnetMaskLength

```
int getSubnetMaskLength()
```

Returns the "subnetmask.length" service property value.

Returns:
Subnet Mask Length(IPv4) or Prefix Length(IPv6)

---

getNetworkAdapterPid

```
String getNetworkAdapterPid()
```

Returns the "networkadapter.pid" service property value.

Returns:
Service ID of the interface information service to which it belongs

---

8 Considered Alternatives

8.1 Whiteboard pattern model

<NwInfo Bundle>

Provides (exports) Listener service interface, and gets the Listener services provided from user bundle. When information of a network interface is changed, this bundle prepares list of network interface information and calls back the Listener services. This bundle will provide a filter mechanism. User bundle can get only the information necessary to use the functionality.

<User bundle>

Registers a Listener service, and waits for notification of network interface information.

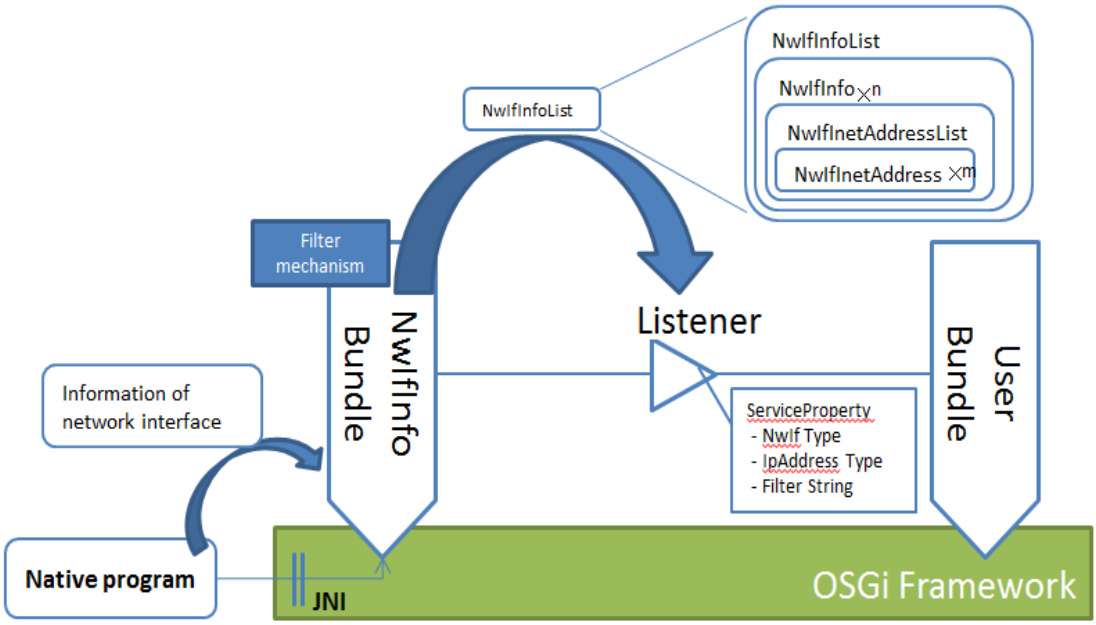

Fig. 3 Overview of Network Interface Information Service

(Whiteboard pattern model)

9 Security Considerations

The user bundles that want to know information of one or more Network Interfaces should be assigned ServicePermission[NetworkAdapter, GET] and ServicePermission[NetworkAddress, GET].

Filter Based Permissions can also be utilized for assigning ServicePermission. If the platform provider wants to control a bundle's access to the service, the following example of ServicePermission can be set.

ServicePermission["&(objectClass=org.osgi.service.networkadapter.NetworkAdapter)(networkAdapter.type=LAN)", GET]

ServicePermission["&(objectClass=org.osgi.service.networkadapter.NetworkAddress)(networkAdapter.type=LAN)(ipAddress.version=IPV4)(ipAddress.scope=PRIVATE_USE)", GET]

10 Document Support

10.1 References

[1]. Bradner, S., Key words for use in RFCs to Indicate Requirement Levels, RFC2119, March 1997.

[2]. Software Requirements & Specifications. Michael Jackson. ISBN 0-201-87712-0

10.2 Author's Address

Name	Shigekuni KONDO
Company	NTT Corporation
Address	1-1, Hikari-no-oka, Yokosuka-shi, 238-0847, Kanagawa, Japan
Voice	+81 46 859 3444
e-mail	kondo.shigekuni@lab.ntt.co.jp

10.3 Acronyms and Abbreviations

10.4 End of Document