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# Oracle Database and IPv6 Statement of Direction

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## Executive Overview

Oracle Database 11g Release 2 supports IPv6 addressing for all features and components in single-instance mode, and Oracle Database 12c Release 1 extends that to allow client connectivity over public networks to Oracle Real Application Clusters (Oracle RAC). Oracle Database 12c Release 2 completes support for Oracle RAC private networks and Windows servers.

## Introduction

Internet Protocol Version 6 (IPv6) is a Network layer (OSI model) protocol for packet switched networks, designed to address the shortcomings of the currently used Internet Protocol Version 4. The primary benefit of IPv6 is a large seemingly inexhaustible address space, derived from the use of 128 bit addresses.

Oracle Database 11g Release 2 supports the standard IPv6 address notations specified by RFC2732. A 128bit IP address is generally represented as 8 groups of 4 hex digits, with the “:” symbol as the group separator. The leading zeros in each group are removed. For example, 1080:0:0:0:8:800:200C:417A would be a valid IPv6 address. One or more consecutive zero fields can optionally be compressed with the “::” separator. For example, 1080::8:800:200C:417A.

Another IPv6 address format represents the four lower order 8-bit pieces in standard IPv4 notation. The six higher-order 16 bit pieces are represented in the standard IPv6 notation. For example, ::FFFF:129.144.52.38

IPv6 addresses in URLs are enclosed by the “[” and “]” characters. For example, [1080:0:0:0:8:800:200C:417A] can be used in a standard URL string.

## Oracle Database 11g Release 2 and IPv6

This section provides an overview of IPv6 usage with Oracle Database 11g Release 2.

### Supported Host and Network Configurations

The table below summarizes the protocol used for client-server connectivity with various host and network configurations. A host – client or server – is labeled IPv6 capable if:

1. It has a configured IPv6 interface
2. It can connect to other hosts using IPv6 (Network and Routing support)

A host is labeled a dual-stack host if it supports connectivity through both IPv4 and IPv6.

	IPv4 ONLY SERVER	DUAL STACK SERVER	IPv6 ONLY SERVER
IPv4 ONLY CLIENT	Supported (v4)	Supported (v4)	<i>Not Supported</i>
DUAL STACK CLIENT	Supported (v4)	Supported (v4, v6)	Supported (v6)
IPv6 ONLY CLIENT	<i>Not Supported</i>	Supported (v6)	Supported (v6)

### Oracle Net Listener

Oracle Net Listener listens for incoming connection requests on all network interfaces when the default hostname is used with TCP protocol in listener.ora. Separate listen end-points are not required for IPv4 and IPv6 in the listener, however they can be configured if needed.

IP parameter can be optionally specified as part of ADDRESS in listener.ora in order to determine which IP address(es) the listener listens on when a host name is used. Supported values are FIRST, V4\_ONLY and V6\_ONLY. When the IP parameter is not specified, and default hostname is used, the expected behavior is to listen on all IP addresses corresponding to the host name.

### TNS Connect Address

With clients or middle-tier applications using the 11g Release 2 version of Oracle Client stack, IPv6 addresses and hostnames that resolve to IPv6 addresses can be used in the HOST parameter of a TNS connect address. The TNS connect address can be obtained through any of the supported Oracle Net naming methods.

The client attempts to connect to all IP addresses returned by Domain Name System (DNS) name resolution until a successful connection is established or all addresses have been attempted. For example, when using Easy Connect descriptor sales-server/sales.us.example.com

from a client running on a dual-stack host, suppose that `sales-server` is configured as an IPv4-only host, but DNS maps `sales-server` to the following IP addresses:

1. IPv6 address `2001:0DB8:0:0::200C:417A`
2. IPv4 address `192.168.2.213`

In this case, Oracle client first tries to connect on the IPv6 address because it is first in the DNS list. In this example `sales-server` does not support IPv6 connectivity, so this attempt fails. Oracle client then proceeds to connect to the IPv4 address, which succeeds.

## Easy Connect Naming

Easy Connect Naming has been enhanced to support IPv6 hostnames and addresses. The syntax conforms to the IPv6 URL syntax discussed earlier.

The format of the Easy Connect string will remain the same for hostnames and IPv4 addresses. The syntax is as follows, where `host` can be a hostname or an IPv4 address and the other parameters are optional:

```
[//]host[:port][/[service_name[:<server>]][/instance]]
```

The preceding syntax can be used for IPv6 addresses as well. To use the syntax, the host is replaced with the IP address enclosed by the “[” and “]” characters. The new syntax will work with hostnames and IPv4 addresses as well.

For example, the Easy Connect string,

```
[2001:fe8::12]:1522/sales.us.example.com
```

is equivalent to the following TNS connect string in `tnsnames.ora`:

```
salesdb =
  (DESCRIPTION=
    (ADDRESS=(PROTOCOL=tcp) (HOST=2001:fe8::12) (PORT=1522))
    (CONNECT_DATA=(SERVICES_NAME=sales.us.example.com)))
```

## TCP Connect Timeouts

A TCP connect timeout of 60 seconds is applied by default to each IP addresses in the connect descriptor, including each IP address to which the host names resolve.

Different values of this timeout can be specified either at a per- connect string level in `tnsnames.ora` (`TRANSPORT_CONNECT_TIMEOUT`), or applied to all connect strings at `sqlnet.ora` level (`TCP.CONNECT_TIMEOUT`).

## Limitations of IPv6 with Oracle Database 11g Release 2

All features and components in Oracle Database 11g Release 2 support IPv6, with the exception of Oracle RAC and Oracle Clusterware.

Additionally, neither ASM nor ONS-based FAN notifications are supported for single-instance databases running Oracle Restart in Oracle Database 11g Release 2.

## Oracle Database 12c Release 1 and IPv6

In addition to IPv6 addressing support for single-instance databases, Oracle Database 12c supports IPv6 client connectivity over public networks to Oracle RAC.

### Limitations of IPv6 with Oracle Database 12c Release 1

IPv6 client connectivity for Oracle RAC databases and Oracle Clusterware running on Windows is not supported in Oracle Database 12c Release 1 (12.1.0.2).

Additionally, neither ASM nor ONS-based FAN notifications are supported for single-instance databases running on Windows in Oracle Database 12c Release 1.

IPv6 is not supported on the private network required by Oracle RAC and Oracle Clusterware.

## Oracle Database 12c Release 2 and IPv6

In Oracle Database 12c Release 2, Oracle provides full IPv6 support for all components and features. Specifically:

IPv6 client connectivity over public networks to Oracle RAC and Clusterware running on Windows is now supported.

ASM and ONS-based FAN notifications for single-instance and RAC databases running on Windows is supported

IPv6 on the private network in an Oracle Clusterware configuration is now supported on all platforms

## Conclusion

Oracle Database 11g Release 2 supports IPv6 addressing for all features and components in single-instance mode, and Oracle Database 12c Release 1 extends that to allow client connectivity over public networks to Oracle RAC with a few limitations. These limitations are lifted in Oracle Database 12c Release 2, completing full support for IPv6.



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