

## PART : 1

### Understanding Your `ip a` Output in WSL (Kali Linux)

The command `ip a` (short for `ip address`) shows network interfaces and their assigned IP addresses. Here's what your output means:

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## 1 Loopback Interface (`lo`)

```
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group
default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet 10.255.255.254/32 brd 10.255.255.254 scope global lo
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
```

- **Interface:** `lo` (Loopback)
  - **Purpose:** A virtual interface for the local system to communicate with itself.
  - **Key IPs:**
    - `127.0.0.1/8` → Standard loopback IP (for localhost).
    - `10.255.255.254/32` → A non-standard loopback IP (possibly assigned by WSL).
    - `::1/128` → IPv6 loopback address (equivalent to `127.0.0.1`).
  - **State:** UNKNOWN but UP, meaning it is active.
  - **MTU:** 65536 → The maximum transmission unit for this interface.
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## 2 Ethernet Interface (`eth0`)

```
sql
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2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group
default qlen 1000
    link/ether 00:15:5d:3a:e4:21 brd ff:ff:ff:ff:ff:ff
    inet 172.29.16.248/20 brd 172.29.31.255 scope global eth0
        valid_lft forever preferred_lft forever
    inet6 fe80::215:5dff:fe3a:e421/64 scope link
        valid_lft forever preferred_lft forever
```

- **Interface:** `eth0` (WSL's main network interface, simulating an Ethernet connection).
- **Purpose:** This is how WSL connects to the internet through Windows.
- **MAC Address:** `00:15:5d:3a:e4:21` (WSL assigns a virtual MAC address).
- **IPv4 Address:** `172.29.16.248/20`
  - Private IP assigned by **Windows' Virtual Network (Hyper-V)**.
  - Subnet: /20 (meaning the range is `172.29.16.1 - 172.29.31.254`).

- Broadcast Address: 172.29.31.255 (used to send packets to all devices in the subnet).
  - **IPv6 Address:** fe80::215:5dff:fe3a:e421/64
    - Link-local IPv6 address (used for local network communication).
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## Why Does WSL Have These Addresses?

- **WSL2 uses a virtual network bridge** to connect to Windows and the internet.
  - **Windows provides a private IP (172.29.x.x)** through a virtual adapter.
  - **Your WSL instance is isolated from Windows**, but you can still access the internet.
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## Useful Commands

### 1 Check default gateway (how WSL connects to the internet):

```
ip route show
```

You'll see something like:

```
default via 172.29.16.1 dev eth0 proto dhcp metric 100
```

This means WSL routes internet traffic through 172.29.16.1.

## PART: 2

### Will My WSL Network Credentials (IP, MAC) Stay the Same?

Short Answer:  **No, your IP address and MAC address may change after restarting WSL.**

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## What Changes in WSL?

### 1 WSL2 Assigns a New IP Address on Restart

- Every time you restart WSL (`wsl --shutdown` or reboot your PC), your **IP address (172.29.x.x)** **will likely change** because WSL uses **Dynamic Host Configuration Protocol (DHCP)**.
- You can check your IP again using:

```
ip a
```

### 2 MAC Address (eth0) May Change

- WSL **randomly assigns a MAC address** on each startup.
- If your MAC address changes, your **IP address may also change** (since DHCP assigns IPs based on MAC).

### 3 Loopback IP (127.0.0.1) Stays the Same

- Your `127.0.0.1` loopback address will **always remain the same**, as it's tied to your machine.

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## How to Keep Your IP Address the Same?

If you need a **static IP in WSL**, you have two options:

### 1 Assign a Static IP to WSL (Temporary)

You can manually set an IP inside WSL (**resets on reboot**):

```
bash
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sudo ip addr add 172.29.16.100/20 dev eth0
```

This assigns `172.29.16.100`, but it won't persist after a restart.

### 2 Use Windows to Assign a Permanent IP

Since WSL gets its IP from Windows' Virtual Network, you can **assign a static IP in Windows**:

1. Open **PowerShell (as Admin)** and run:

```
Get-NetAdapter | Where-Object {$_ .Name -Like "vEthernet*"}  
Get-NetIPConfiguration | Where-Object {$_ .InterfaceAlias -Like "vEthernet*"}
```

This shows WSL's virtual adapter name (e.g., `vEthernet (WSL)`).

## 2. Set a static IP for the adapter:

```
New-NetIPAddress -InterfaceAlias "vEthernet (WSL)" -IPAddress  
172.29.16.100 -PrefixLength 20 -DefaultGateway 172.29.16.1
```

Now, WSL should always get 172.29.16.100.

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## 📌 How to Keep Your MAC Address the Same?

Since WSL generates a **random MAC address** each time, to make it persistent:

### 1. Manually set a MAC address in WSL:

```
sudo ip link set dev eth0 address 00:15:5D:3A:E4:21
```

But this **resets on restart**.

### 2. Modify Windows Network Settings

- In Windows Device Manager:
  - Go to **Network Adapters** → **WSL Virtual Ethernet Adapter**
  - Click **Advanced** → **Network Address**
  - Set a custom MAC address (e.g., 00155D3AE421).

Now, WSL will always use the same MAC, ensuring the same IP.

## PART: 3

### Is It Good to Assign an IP Manually in WSL?

👉 Short Answer: ✗ No, manually assigning an IP inside WSL (`ip addr add`) is not a reliable solution.

Why?

## 1 WSL Uses a Virtual Network Managed by Windows

- WSL **does not control its own networking**; instead, Windows provides it through a **virtual adapter** (`vEthernet (WSL)`).
- If you manually set an IP inside WSL, Windows may **override it** or cause network issues.

## 2 Changes Won't Persist

- If you assign an IP manually (`ip addr add`), it **resets after a restart**.
- To make it permanent, you'd need a script to reapply it every time.

## 3 Conflicts with DHCP

- Windows **dynamically assigns WSL an IP** using DHCP.
  - If you manually set an IP that is already taken, you might cause **network conflicts**.
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## ✓ What's the Best Solution?

Instead of assigning an IP inside WSL, do this from Windows:

### 1 Assign a Static IP for WSL in Windows (Best Method)

If you need a **permanent IP for WSL**, use PowerShell in Windows:

```
New-NetIPAddress -InterfaceAlias "vEthernet (WSL)" -IPAddress 172.29.16.100  
-PrefixLength 20 -DefaultGateway 172.29.16.1
```

- ✓ Ensures that WSL always gets the same IP.
  - ✓ Avoids conflicts with DHCP.
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### 2 Use Windows Hosts File for Easier Access

If your goal is **accessing WSL from Windows easily**, instead of assigning an IP, do this:

1. Open Notepad as Administrator.
2. Edit the **Windows hosts file**:

```
C:\Windows\System32\drivers\etc\hosts
```

3. Add this line:

```
172.29.16.100 wsl.local
```

4. Now, you can access WSL using `wsl.local` instead of an IP.

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## 💡 When Should You Manually Assign an IP?

- **If you are testing something short-term.**
- **Not for permanent setups** (because it resets and can conflict with Windows networking).