

# Container Network - FIB Network Functionality Explained



## Task

### FIB NETWORK TOPOLOGY

## FIB (Forward Information Base)

### *How FIB network architecture generally works:*

#### FIB Overview:

The Forwarding Information Base (FIB) is a table used by routers to determine packet forwarding.

It contains mappings of destination network addresses to the next-hop router or interface.

#### Populating the FIB:

FIB entries are populated through routing protocols such as OSPF, RIP, and BGP.

These protocols exchange routing information among routers to build and update the FIB.

#### Forwarding Decisions:

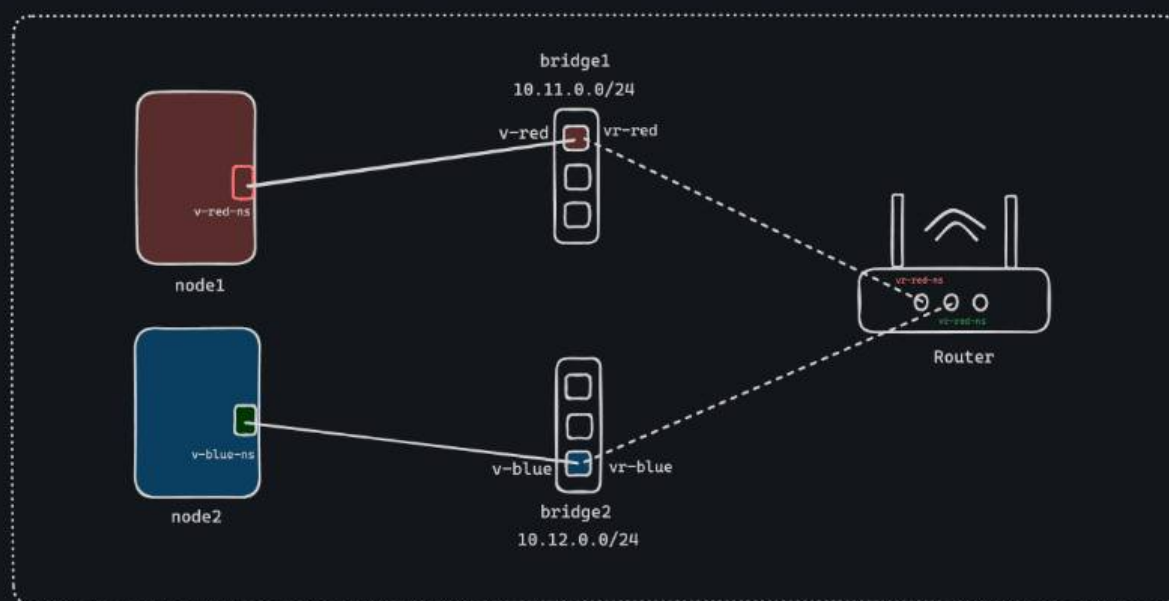
When a router receives an incoming packet, it examines the destination IP address.

The router looks up the destination address in its FIB.

If a matching entry is found in the FIB, the router forwards the packet based on the next-hop information specified in the FIB entry.

If no matching entry is found, the router typically either drops the packet or forwards it to a default route if configured.

## Proposed network topology:



## How the FIB works in our environment:

### 1. Router Configuration:

In our setup, the `router` namespace is acting as a router between the `red` and `blue` namespaces.

The router's FIB contains information about the next-hop IP addresses for each destination network.

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When a packet arrives at the router, it consults its FIB to determine the next-hop interface and IP address for the packet.

#### Routing Table:

The routing table in the `router` namespace contains the routing information used to populate the FIB.

Entries in the routing table specify the destination network (e.g., `10.11.0.0/24` for the `red` namespace and `10.12.0.0/24` for the `blue` namespace) and the next-hop IP address for each network.

The router uses this routing table to populate its FIB with the necessary forwarding information.

#### Mac Address table:

```
term@ubuntu-1mq8o9-7fd9d698bc-dxdfr:~$ sudo ip netns exec red arp -n
Address          HWtype  HWaddress      Flags Mask    Iface
10.11.0.1         ether    8e:e7:0a:8b:36:28 C              v-red-ns
term@ubuntu-1mq8o9-7fd9d698bc-dxdfr:~$ sudo ip netns exec blue arp -n
Address          HWtype  HWaddress      Flags Mask    Iface
10.12.0.1         ether    fa:61:a9:c6:40:3f C              v-blue-ns
```

Information.

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Address          HWtype  HWaddress      Flags Mask    Iface
10.12.0.1         ether    fa:61:a9:c6:40:3f C              v-blue-ns
term@ubuntu-1mq8o9-7fd9d698bc-dxdfr:~$ sudo ip netns exec router arp -n
Address          HWtype  HWaddress      Flags Mask    Iface
10.11.0.2         ether    4a:ce:e1:73:34:4e C              vr-red-ns
10.12.0.3         ether    fe:cc:77:09:5c:e1 C              vr-blue-ns
term@ubuntu-1mq8o9-7fd9d698bc-dxdfr:~$
```

### Routing table:

```
term@ubuntu-1mq8o9-7fd9d698bc-dxdfr:~$ sudo ip netns exec red route
Kernel IP routing table
Destination      Gateway         Genmask        Flags Metric Ref    Use Iface
default          10.11.0.1      0.0.0.0        UG      0      0      0 v-red-ns
10.11.0.0        0.0.0.0        255.255.255.0 U        0      0      0 v-red-ns
term@ubuntu-1mq8o9-7fd9d698bc-dxdfr:~$ sudo ip netns exec blue route
Kernel IP routing table
Destination      Gateway         Genmask        Flags Metric Ref    Use Iface
default          10.12.0.1      0.0.0.0        UG      0      0      0 v-blue-ns
10.12.0.0        0.0.0.0        255.255.255.0 U        0      0      0 v-blue-ns
term@ubuntu-1mq8o9-7fd9d698bc-dxdfr:~$ sudo ip netns exec router route
Kernel IP routing table
Destination      Gateway         Genmask        Flags Metric Ref    Use Iface
10.11.0.0        0.0.0.0        255.255.255.0 U        0      0      0 vr-red-ns
10.12.0.0        0.0.0.0        255.255.255.0 U        0      0      0 vr-blue-ns
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### Packet Forwarding:

When a packet arrives at the router, it performs a lookup in its FIB to determine the next-



```

Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
default          10.12.0.1       0.0.0.0         UG    0      0      0 v-blue-ns
10.12.0.0        0.0.0.0         255.255.255.0   U      0      0      0 v-blue-ns
term@ubuntu-1mq8o9-7fd9d698bc-dxdfr:~$ sudo ip netns exec router route
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```

### Packet Forwarding:

When a packet arrives at the router, it performs a lookup in its FIB to determine the next-hop interface and IP address for the packet's destination.

Based on the information in the FIB, the router forwards the packet to the appropriate interface.

If the packet's destination is within the same network (e.g., from **red** to **router**), the router forwards the packet directly to the destination host without further routing.

### Connectivity:

```

term@ubuntu-1mq8o9-7fd9d698bc-dxdfr:~$ make ping
PING 10.12.0.3 (10.12.0.3) 56(84) bytes of data.
64 bytes from 10.12.0.3: icmp_seq=1 ttl=63 time=0.064 ms
64 bytes from 10.12.0.3: icmp_seq=2 ttl=63 time=0.066 ms
64 bytes from 10.12.0.3: icmp_seq=3 ttl=63 time=0.094 ms
64 bytes from 10.12.0.3: icmp_seq=4 ttl=63 time=0.055 ms

--- 10.12.0.3 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3053ms
rtt min/avg/max/mdev = 0.055/0.069/0.094/0.014 ms
term@ubuntu-1mq8o9-7fd9d698bc-dxdfr:~$

```

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Proposed network topology:  
topology

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Routing Table:

The routing table in the router namespace contains the routing information used to populate the FIB.

Entries in the routing table specify the destination network (e.g., 10.11.0.0/24 for the red namespace and 10.12.0.0/24 for the blue namespace) and the next-hop IP address for each network.

The router uses this routing table to populate its FIB with the necessary forwarding information.

Mac Address table:

Arp Table

Routing table:

Routing Table

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Connectivity:

Connectivity

explain these for a simple child in a very easiest manner in details with basics also correct any error

Let me explain this in a very simple way, like telling a story to a child. I'll also correct any errors and make it as easy as possible to understand.

## What is a FIB (Forward Information Base)?

Imagine you are in a **big school**, and you need to find your classroom. But instead of asking every person in the hallway, you check a **notice board** that tells you **where your classroom is**.

A **FIB (Forward Information Base)** is like that **notice board** in a school, but for the internet! It is a **table** inside a **router** (a special computer that helps send messages on the internet). This table tells the router where to send data (like messages or videos) so that it reaches the right place.

## How Does FIB Work?

Let's say you want to send a letter to your friend, but you don't know their exact house address. You go to the school **notice board (FIB)** and look for your friend's name. The board tells you that your friend is in **Class 2, Seat 5**. Now you know exactly where to deliver the letter.

In the same way:

1. **A router receives a message** (like when you click on a YouTube video).
2. **It looks at the FIB** to see where the message should go.
3. **It sends the message to the correct place** (another router or computer).

If the router **doesn't find the address**, it either:

- Sends it to a **default route** (like asking a teacher if you are lost).
- **Drops the message** (like throwing away a letter if there's no address).

## How Does a Router Learn Where to Send Messages?

Routers **don't know everything** at first. They **learn** using special **rules** called **routing protocols**. Think of them like **teachers sharing student lists** with each other so that all notice boards (FIBs) are up-to-date.


The most common **rules (protocols)** routers use are:

- **OSPF** (Open Shortest Path First) – like choosing the shortest road to your house.
- **RIP** (Routing Information Protocol) – like old maps that update slowly.
- **BGP** (Border Gateway Protocol) – like a GPS for the internet!


## How Does This Work in Our Network?

Let's imagine a **magical city** with three places:

1. **Red Town** (red namespace) – like a school area.
2. **Blue Town** (blue namespace) – like a library area.
3. **A router in the middle** – like a mailman who delivers letters between Red Town and Blue Town.

 The **router is smart** because it has a FIB (the notice board). So, when a letter (message) comes, it checks the FIB and sends it to the right place.

## MAC Address & Routing Table (How the Router Finds the Address)

 Every computer and device on the internet has a special **ID card** called a **MAC address** (just like every student has a roll number).

To keep track of where everyone is sitting, the **router keeps a list of these MAC addresses**. This is called the **MAC address table**.

Also, the router has a **Routing Table**, which is like a **school map** showing where each class is located.

## How Messages Travel (Packet Forwarding)

Imagine you are sending a **paper airplane (message) to your friend**. This is what happens:

1. You throw the airplane (send a message).
2. The airplane lands at the router (mailman).
3. The mailman checks the **FIB (notice board)**.
4. The mailman **delivers the airplane** to the right class (destination).

If the **friend is in the same classroom**, the router doesn't need to do anything extra—it just delivers the message **directly**.

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## Checking if Everything Works (Connectivity Test)

At the end, we **test if the message was delivered** using a **ping command**. It's like calling your friend to ask, "Hey, did you get my letter?" If they answer **"Yes!"**, we know that everything is working.

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## Final Summary

- The **FIB (Forward Information Base)** is like a **notice board** for the internet.
  - It helps **routers** decide **where to send messages**.
  - Routers learn addresses using **routing protocols** (like teachers sharing student lists).
  - **MAC addresses** are like **student roll numbers**, and the **routing table** is like a **school map**.
  - Messages travel like **paper airplanes**, using the router as a **mailman**.
  - We test the network by using **ping**, like asking **"Did you get my letter?"**.
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I hope this explanation makes it super easy to understand! Let me know if you need me to make it even simpler! 