Fast Path (aka Load Balancer)

# Overview

FastPath is the feature that switches traffic from using VIP-to-VIP connectivity (which involves transiting SLB MUXes), into using a direct path between VMs (direct PA to PA path).

# Definitions

|  |  |
| --- | --- |
| Acronym | Definition |
| VIP | Virtualized IP (load balanced IP) This is load balanced IP. |
| DIP/PA | Physical Address / Directly Assigned IP Actual physical address of the VM (underlay) |

# Architecture

Diagram

Description automatically generated

# How it works?

1. The VM begins communicating with a Service (or other VM) using VIP connectivity.  
   Source IP: VIP (of the source VM).  
   Destination IP: VIP (of destination service/VM).  
   In this case traffic in both directions transits SLB MUXes.
2. When traffic destined toward the VIP lands on SLB MUX (SYN packet), the MUX picks the actual destination VM (from a list of healthy VMs in the backend pool). It should redirect the packet accordingly (standard load balancing functionality).  
   Once the VM is selected, the SLB MUX forwards the packet to the destination VM.
3. The SLB MUX (in addition to forwarding packet to destination) **may** (often is!!!) sending the ICMP redirect packet towards the source VM from which the SYN packet originated.  
   This ICMP redirect will have information that the SLB MUX selected specific destination VM (will have VM PA information).
4. The Source side (currently VFP) listens for ICMP redirect packets, and once received performs “flow fixup” (updates the flow to redirect next packets not to Destination VIP, but directly to the Destination PA/DIP that arrived in the ICMP redirect packet from SLB MUX).
5. Once flow is “fixed up”, the next packets are direct and bypass the SLB MUX in that direction. This achieves high performance, as after initial connection handshake (SYN, SYN+ACK, ACK), the remaining traffic is direct between VMs and does not transit the SLB MUXes.

**Notes**:

* Two (2) MUXes are used for the VIP to VIP traffic.  
  The Destination SLB MUX is used to advertise destination VIP.  
  The Source SLB MUX is used to advertise the return VIP of the VM (to which VM SNATs the outbound traffic).
* Each SLB MUX *may* send ICMP redirect independently.
* Receiving ICMP redirects from single SLB MUX means that *only flows about that specific VIP* (either destination or source VIP) must be “fixed up” (updated to point to PA instead of VIP).
* ICMP redirect is sent by SLB MUX to both: source VM and destination VM.
* It is not guaranteed that SLB MUX will send ICMP redirect packets.
* It is not guaranteed that ICMP redirect packet will be sent after initial SYN (it might be sent later).
* The ICMP redirect packet might get *lost* (SLB MUX will resend it when next packet arrives on the SLB MUX and still uses VIP) *or possibly duplicated* (multiple packets that have VIP might arrive on SLB MUX, and SLB MUX may send ICMP redirect for all the packets that it receives as still using VIP).

# Packet signatures

TCP handshake uses VIP (52.184.168.32)

Text

Description automatically generated

ICMP Redirect packet

Text

Description automatically generated with medium confidence

After the ICMP redirect, the packets start using DIP/PA (100.110.225.76):

Text

Description automatically generated

Packet transformation

Diagram

Description automatically generated