IPv4/v6 dual-stack migration for in-house Software Load Balancer in Private Cloud

LINE Corporation, Verda Network Development Team

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LINE

About Me

- Software Engineer at LINE Corporation

    - Working as a developer of in-house Software LB for Private Cloud

- Previously I was working as an OSS developer including network proxy,

    distributed system.

What is LINE?

- LINE is known as a messaging application
- LINE has many services, including messaging, fintech, healthcare etc…
- We have many customers in several countries.

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The requirements for network infrastructure by services are complex.
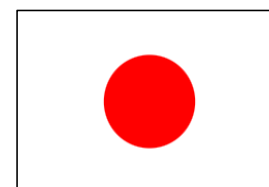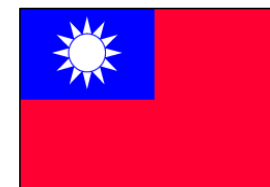
What is LINE?

- LINE messaging is especially widely used by several countries.
- As for four major markets of LINE messaging, it has very large MAU.

▼

We have massive and wide variety of traffics.
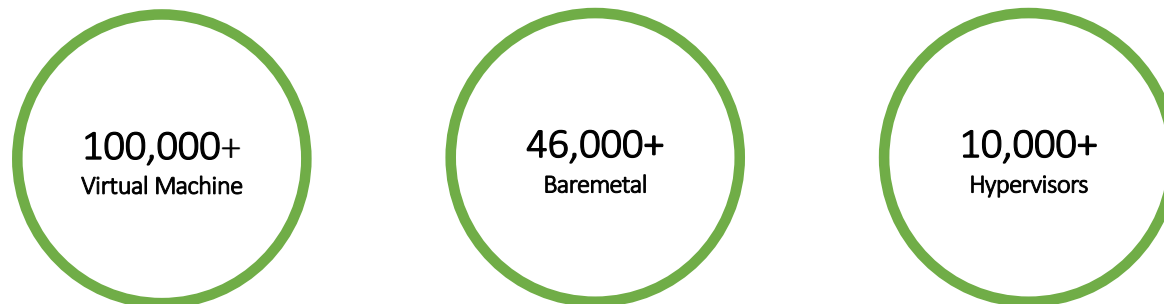
94M	22M
53M	7M

What is Verda?

- Verda is the Private Cloud Platform for LINE

- It hosts many of LINE's services.

- It provides high level of abstraction of compute / network / storage resources, and many services which accelerates service development (e.g. CDN, Kubernetes, Kafka)

100,000+
Virtual Machine

46,000+
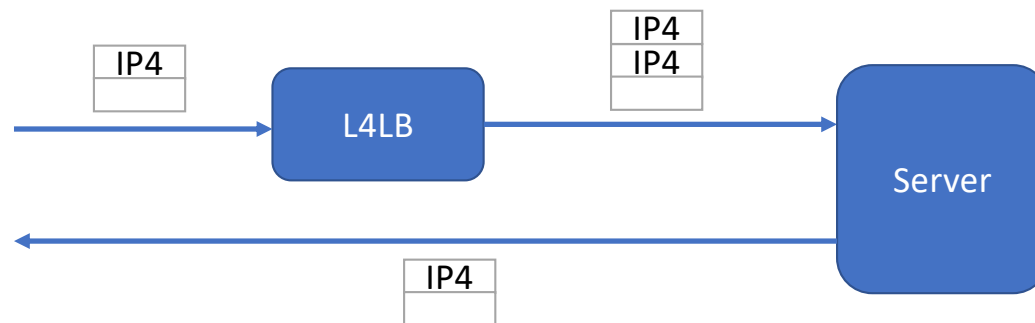Baremetal

10,000+
Hypervisors

Verda LB

- High-Performance / High-Scalability

- Two types of LBs: L4/L7

- Both D-Plane and C-Plane are developed from scratch.

 - Easy to extend Verda LB quickly by user's requirements

Verda L4LB

- Software Based. Developed from Scratch

- IPIP encapsulation / L3-DSR (Direct Server Return)
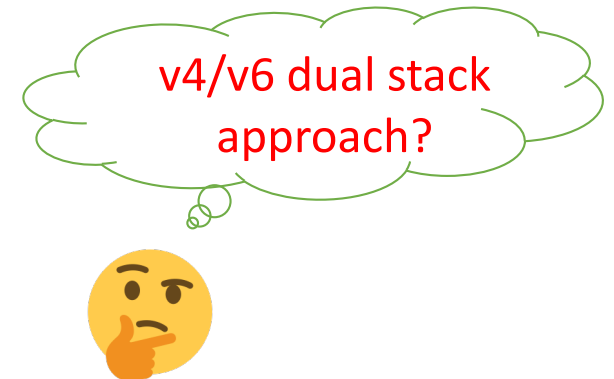
- Both IPv4 / IPv6 Support

CLOS Network

- Easy to Scale network capacity
- Full L3 Network
  - All the switches and baremetals speak eBGP

Ref: https://speakerdeck.com/line_developers/a-story-to-adopt-sonic-in-lines-clos-network
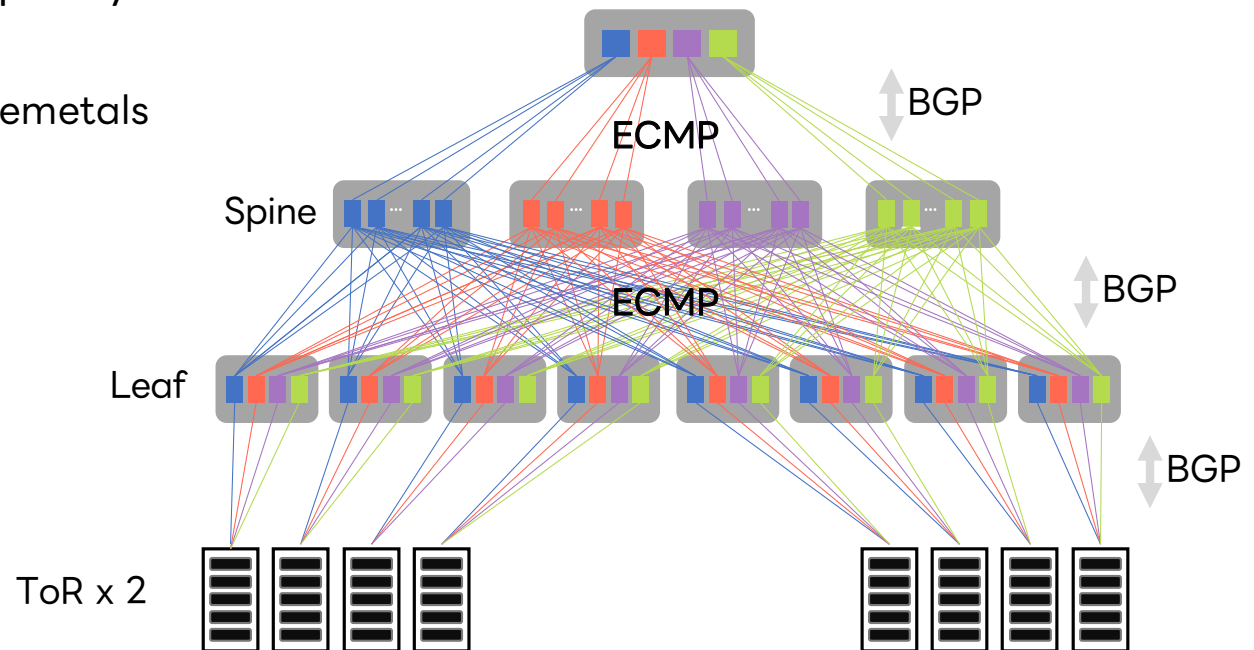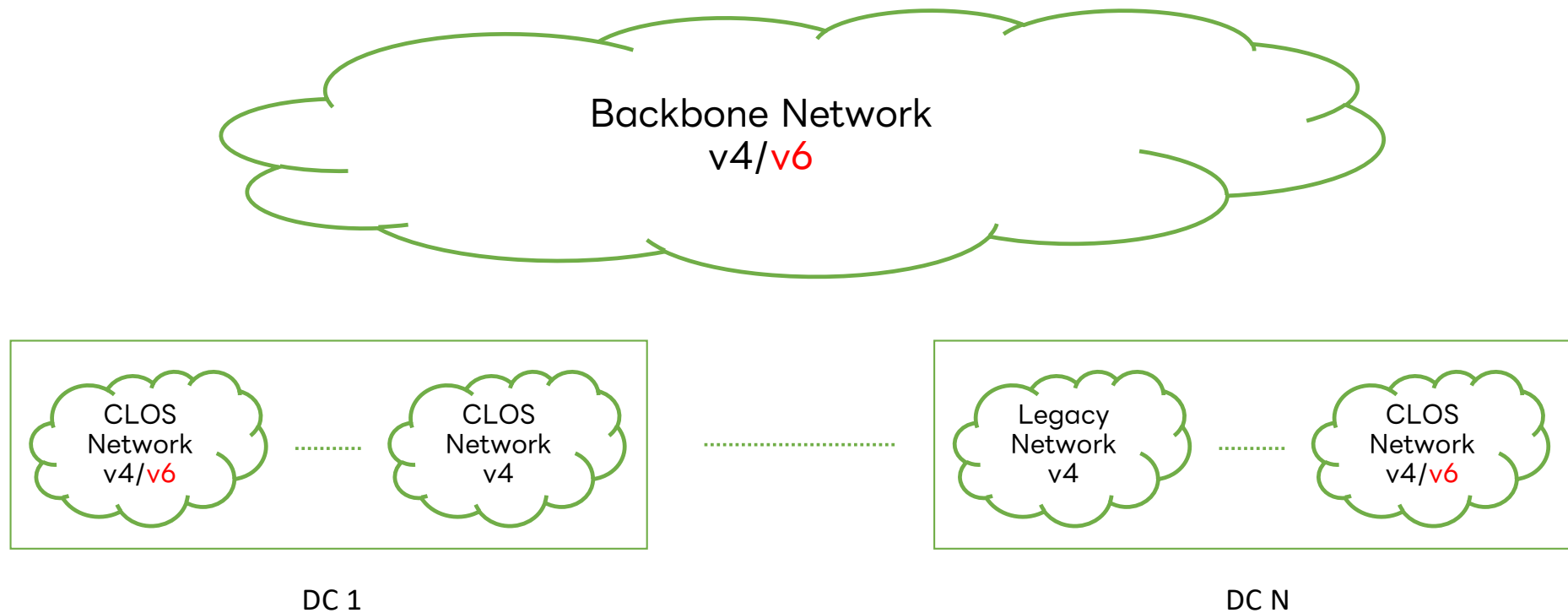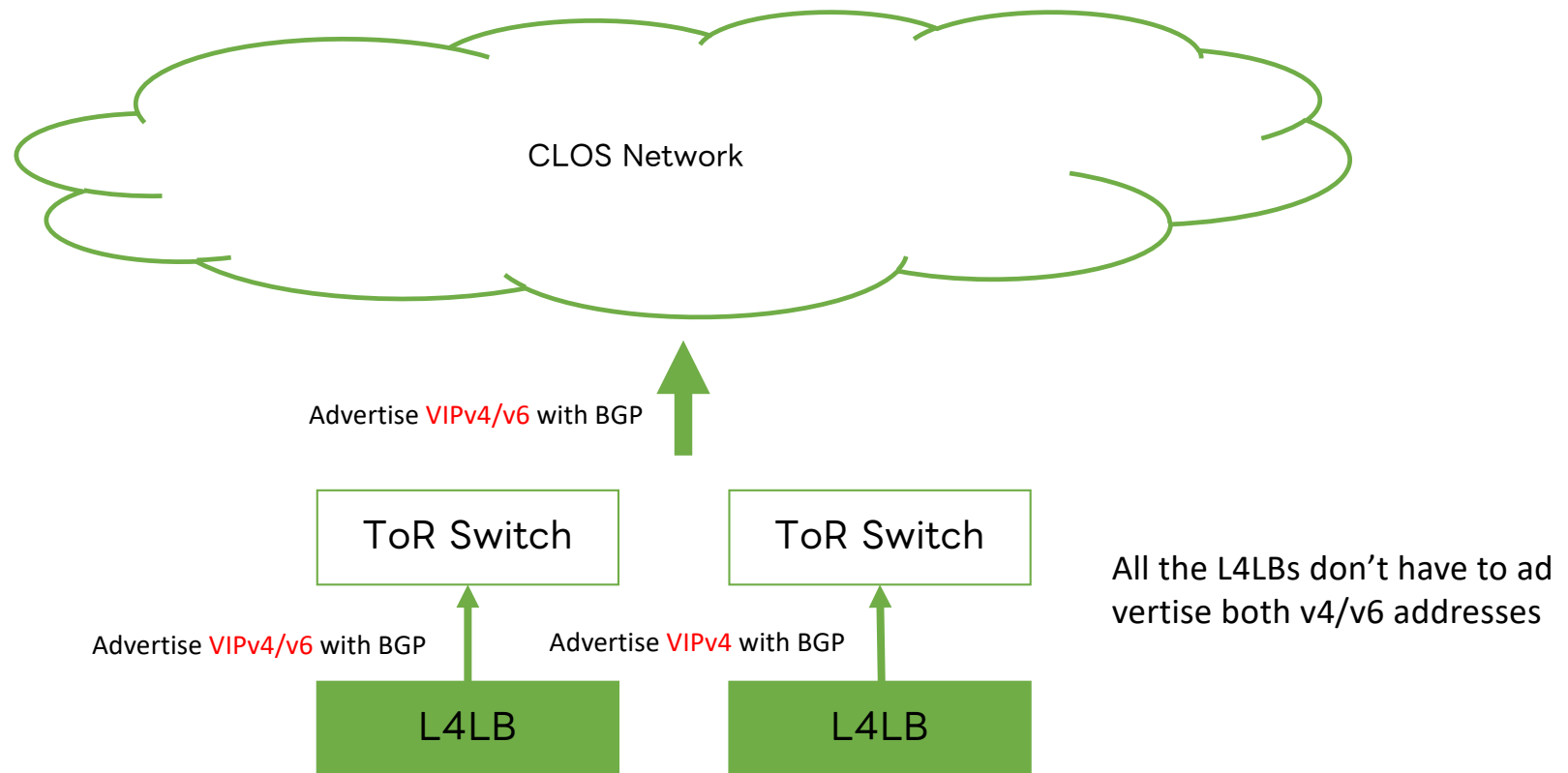
Why IPv6?

- IPv4 single-stack network is not enough for large-scale contents provider

  - Many ISP / Mobile Carrier are using IPv6 network.

  - They should use NAT64/DNS64 accessing to contents provider's network.

  - Supporting IPv6 is desirable by contents provider side.

- An ISP in Taiwan requested us to support IPv6 in 2019

  - LINE messaging app is used by many users in Taiwan

    ▼

    - We don't have to support IPv6 for all the DCs.

    - We don't have to support IPv6 for all the LINE services.

LINE

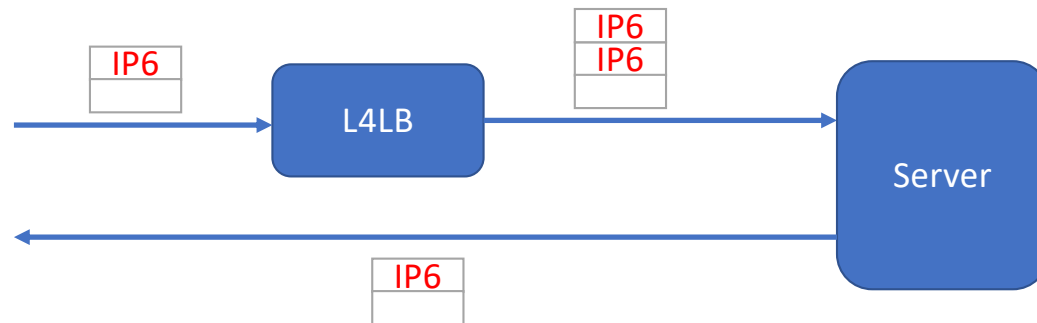v4/v6 dual stack approach?

🤔

Network Architecture at LINE with IPv4/v6

Backbone Network
v4/v6

CLOS
Network
v4/v6

CLOS
Network
v4

Legacy
Network
v4

CLOS
Network
v4/v6

DC 1

DC N

We no longer don't have to operate v4 and v6 for all the DCs

Verda L4LB dual-stack network architecture

CLOS Network

Advertise VIPv4/v6 with BGP

ToR Switch   ToR Switch

Advertise VIPv4/v6 with BGP   Advertise VIPv4 with BGP

All the L4LBs don't have to advertise both v4/v6 addresses

L4LB   L4LB

© LINE

11

Verda L4LB **with IPv4/v6**

IP6IP6 Encapsulation

IP6IP Encapsulation

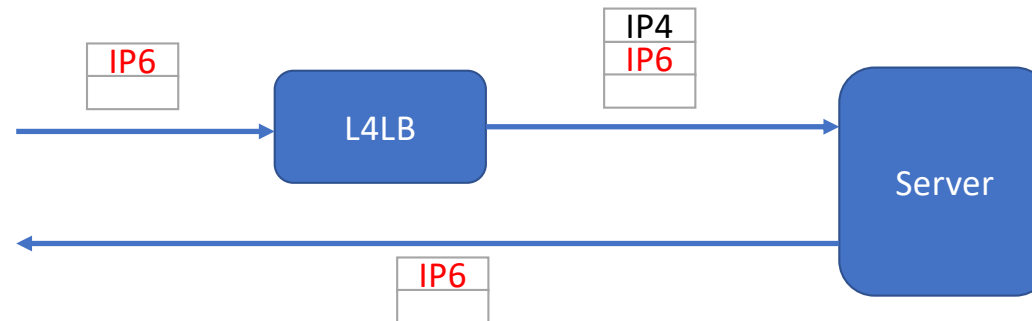Which approach is better for our usecase?

Verda L4LB with IPv4/v6

- Currently, many services are using IPv4. LINE messaging is not also an exception.

- LB system requires DNS resolution during LB deployment. But the resolution mechanism is developed only for A Record.
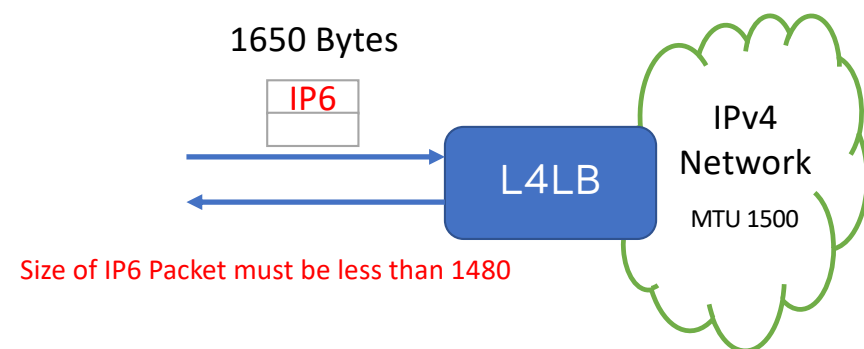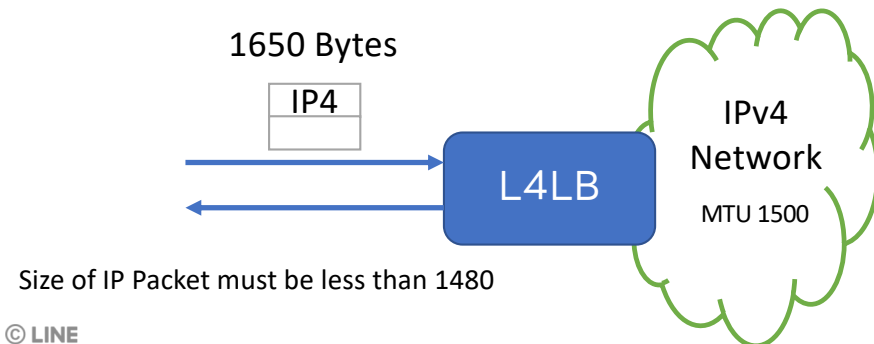
▶ IPIP6 encapsulation is better approach for our usecase

IP6

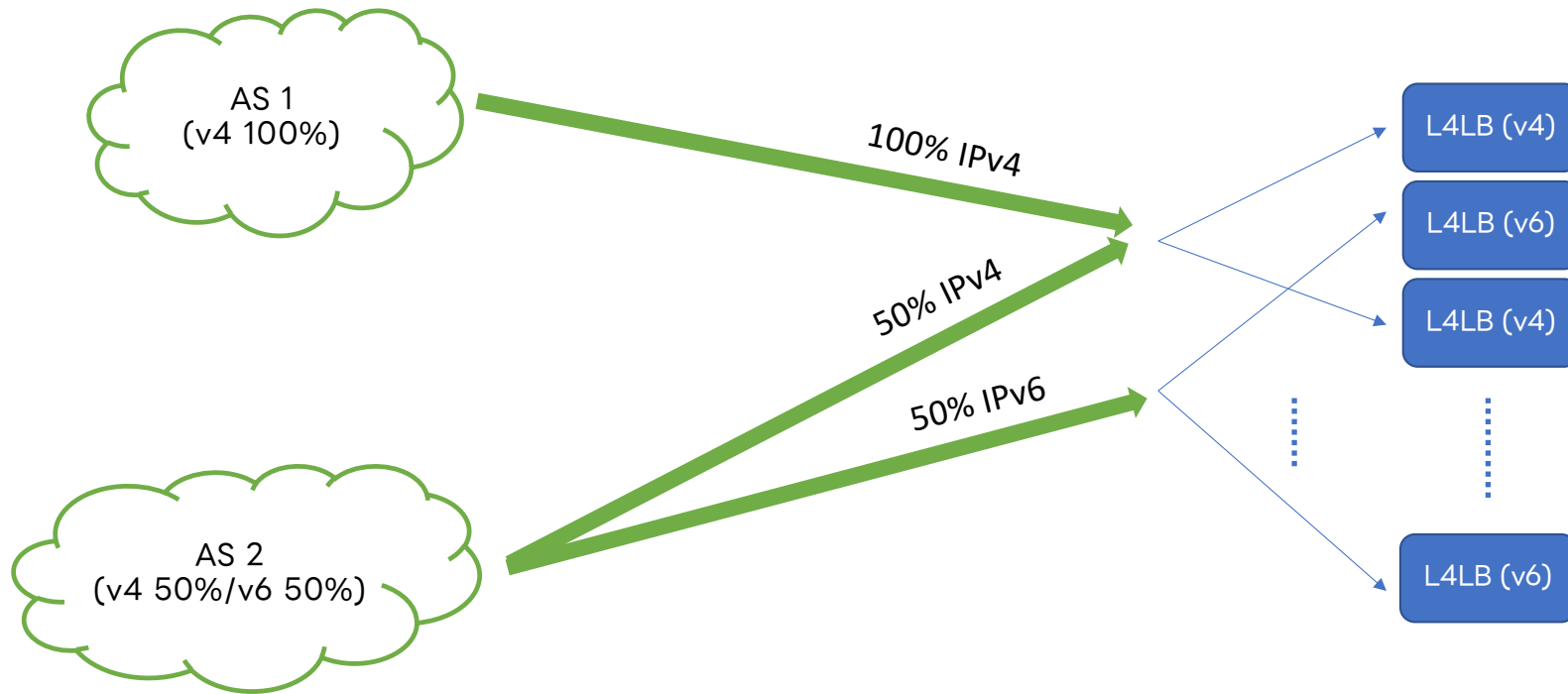| IP4 |
| --- |
| IP6 |

L4LB

Server

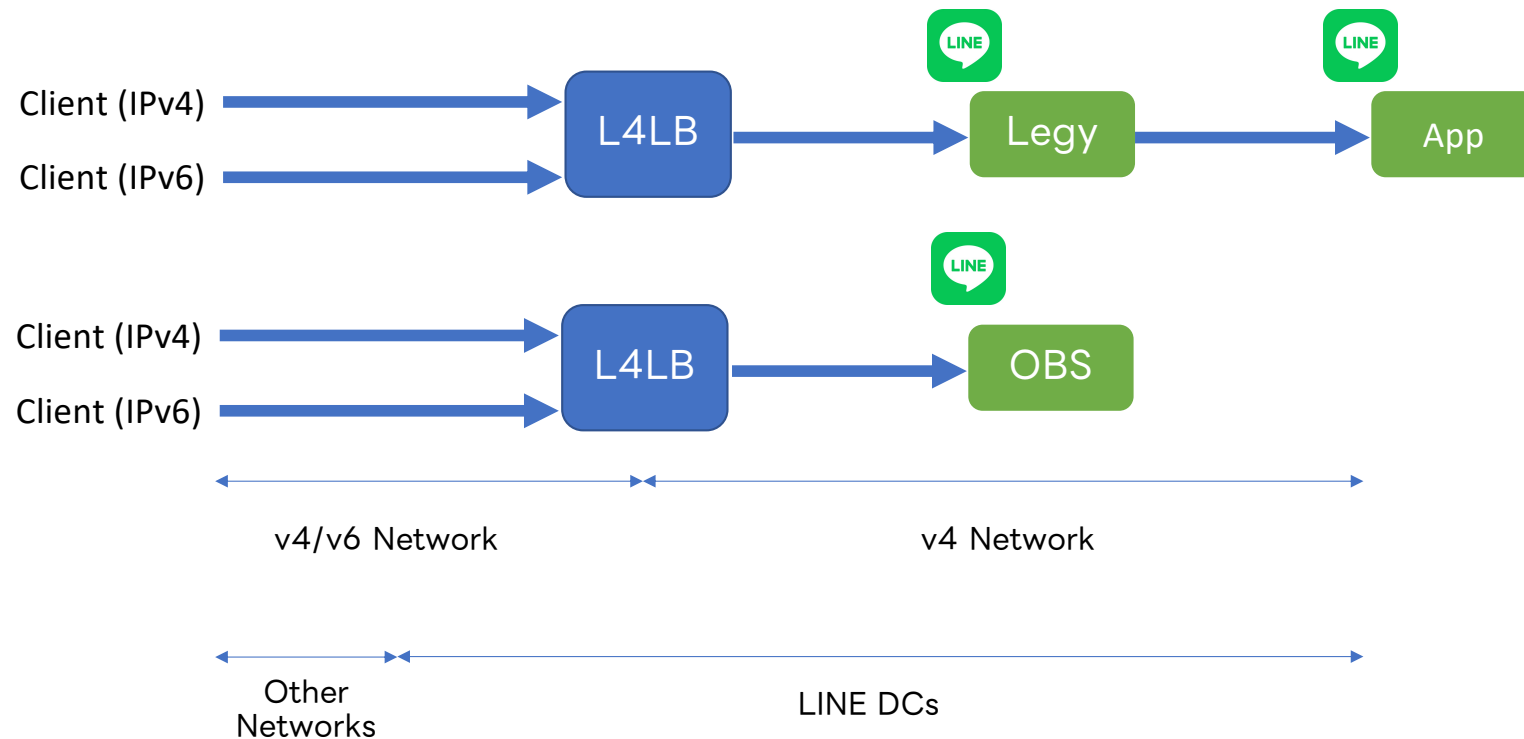| IP6 |
| --- |
| |

Path MTU Discovery by Verda L4LB

- Verda L4LB must support Path MTU Discovery (PMTUD) because it uses IPIP encapsulation.

- Verda L4LB supports to send ICMP Too Big for PMTUD.

- We also need to have to send ICMP6 Too Big from L4LB. When L4LB received IPv6 packets.

- Implementation was easy (within a few days) thanks to that L4LB is developed with XDP

1650 Bytes

IP4

L4LB

IPv4 Network

MTU 1500

Size of IP Packet must be less than 1480

1650 Bytes

IP6

L4LB

IPv4 Network

MTU 1500

Size of IP6 Packet must be less than 1480

14

Step-by-step dual-stack migration

LINE messaging service architecture with IPv4/v6

Client (IPv4) → L4LB → Legy → App

Client (IPv6) →

Client (IPv4) → L4LB → OBS

Client (IPv6) →

v4/v6 Network ← → v4 Network

Other Networks ← → LINE DCs

Legy: LINE Event Delivery Gateway
OBS: Object Storage

© LINE

16

Legend: IPv4, IPv6

per 10 minutes
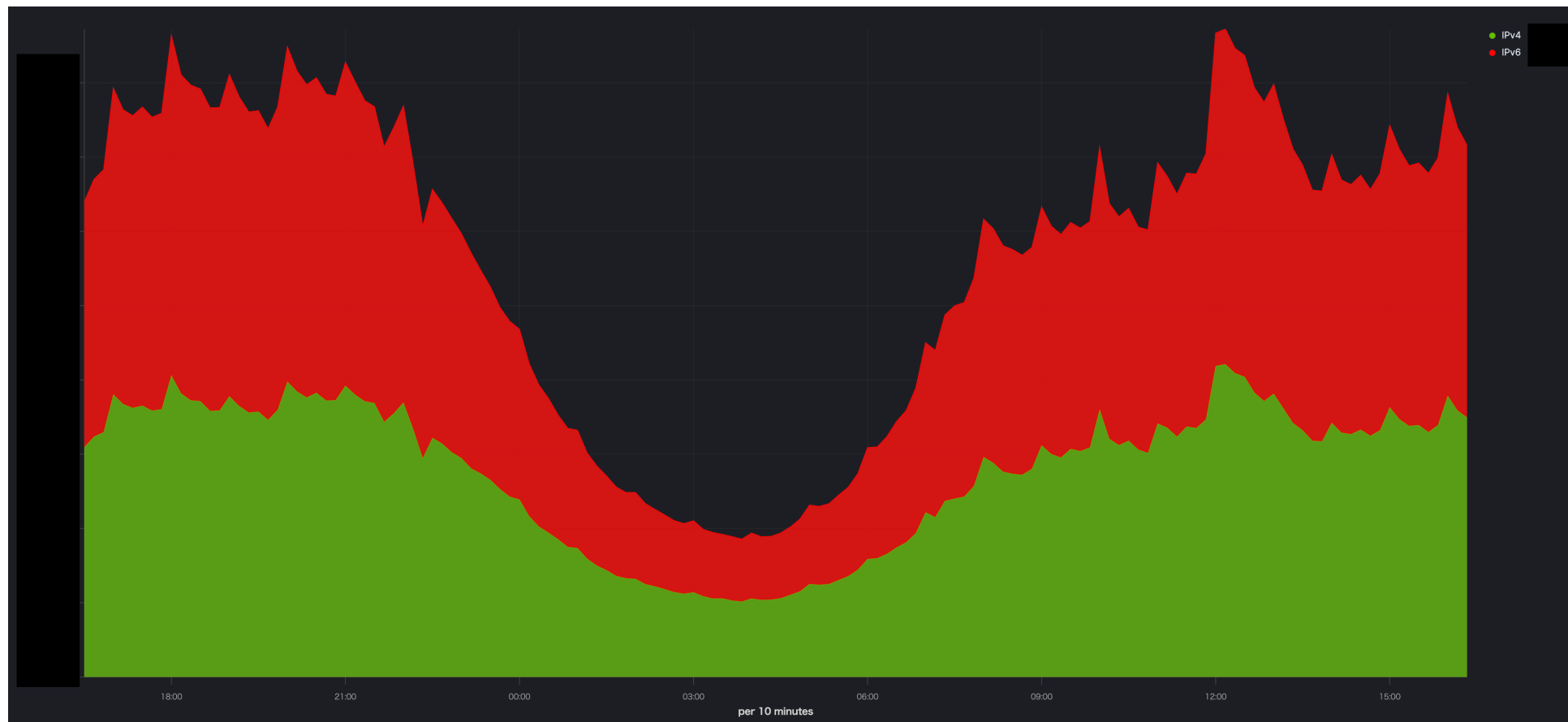
Verda L7LB with IPv4/v6

- Not Yet. No Plan to support IPv6 at the moment.

- As I said, performance of Verda L7LB is limited. And, IPv6 is required by services which receives massive traffic.

  - We don't have to stick to support IPv6 for Verda L7LB!

Service-oriented consideration is very important for IPv6 migration?

Lessons Learned

- Supporting IPv6 for in-house Software LB is relatively reasonable thanks to highly-distributed L4LB architecture.

- We introduces IPv6 features quickly to Verda L4LB because it is software-based.

- Service-oriented consideration may be the best first-step for IPv6 migration.

References

「LINE」をIPv4/IPv6 Dual Stack環境に変更した話 (only in Japanese)

https://www.janog.gr.jp/meeting/janog50/wp-content/uploads/2022/06/janog50-line_dualstack-%E4%B8%AD%E6%BA%9D%E7%A7%81%E6%AD%8C.pdf

A story to adopt SONiC in LINE's CLOS Network

https://speakerdeck.com/line_developers/a-story-to-adopt-sonic-in-lines-clos-network

THANK YOU