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

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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.

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.
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)
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.
Network Architecture at LINE with IPv4/v6

We no longer don’t have to operate v4 and v6 for all the DCs
Verda L4LB dual-stack network architecture

Advertise VIPv4/v6 with BGP

ToR Switch

Advertise VIPv4 with BGP

L4LB

ToR Switch

L4LB

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

Size of IP Packet must be less than 1480

Size of IP6 Packet must be less than 1480
Step-by-step dual-stack migration

AS 1 (v4 100%)

100% IPv4

50% IPv4

50% IPv6

AS 2 (v4 50%/v6 50%)

L4LB (v4)

L4LB (v6)

L4LB (v4)

L4LB (v6)
LINE messaging service architecture with IPv4/v6

Client (IPv4) → L4LB → Legy → App
Client (IPv6) → L4LB → Legy → App
Client (IPv4) → L4LB → OBS
Client (IPv6) → L4LB → OBS

v4/v6 Network → v4 Network

Other Networks (LINE DCs) → LINE Event Delivery Gateway
OBS: Object Storage
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

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