APNIC

IPv6 Transition: East Asia Perspective

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21/April/2022

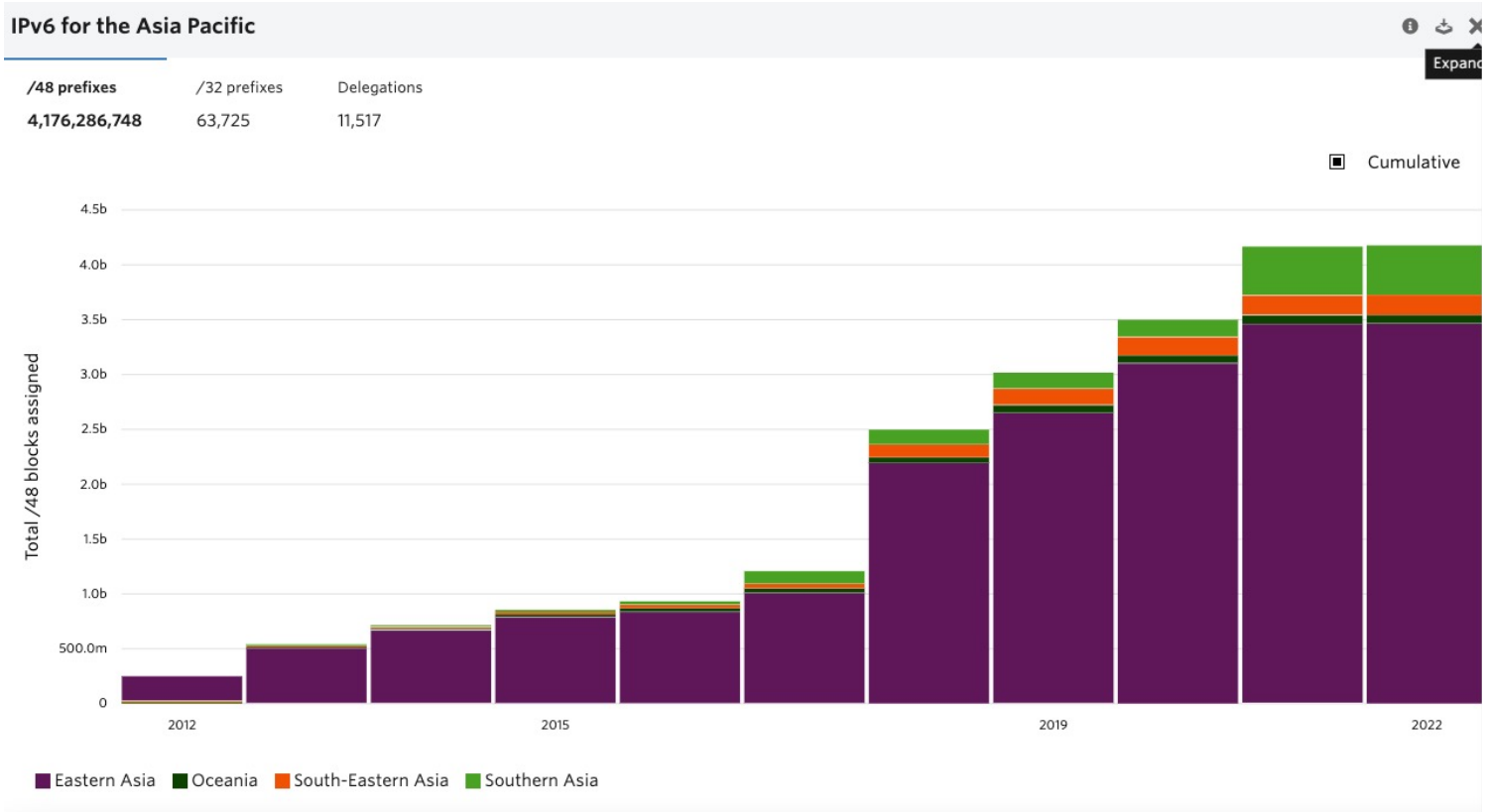
Contents

- IPv6 address allocation – East Asia
- IPv6 BGP prefixes – East Asia
- IPv6 end-user readiness – East Asia
- IPv6 transition driving force
- IPv6 transition techniques

IPv6 Transition

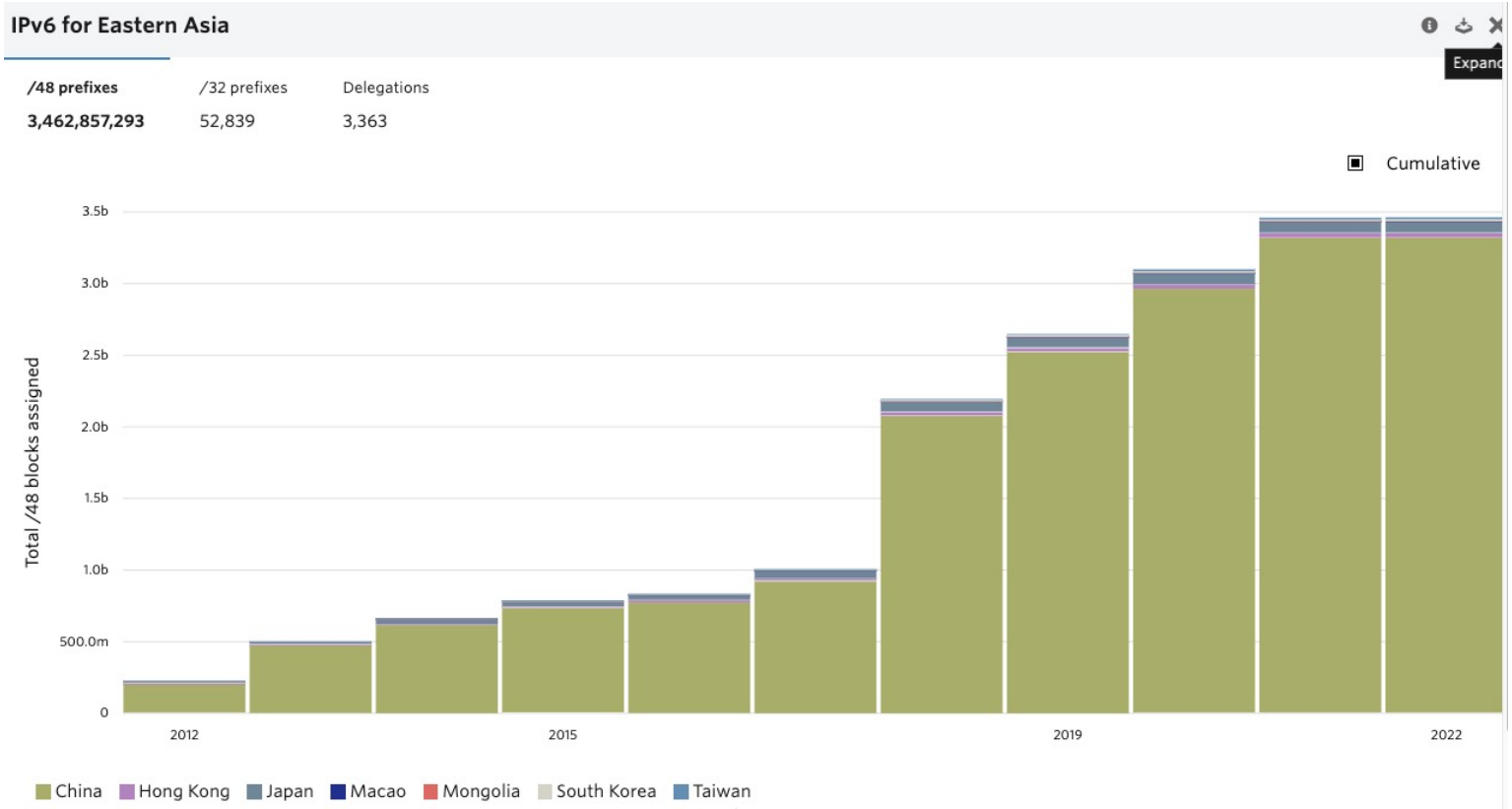
IPv6 Address Allocation – East Asia

IPv6 Address Allocation – Asia Pacific



https://rex.apnic.net/delegations?allocationType=ipv6&region=ap (19/04/2022)

IPv6 Address Allocation – East Asia



https://rex.apnic.net/delegations?allocationType=ipv6&subregion=Eastern%20Asia (19/04/2022)

IPv6 Address Allocation – East Asia

Till 04/2022

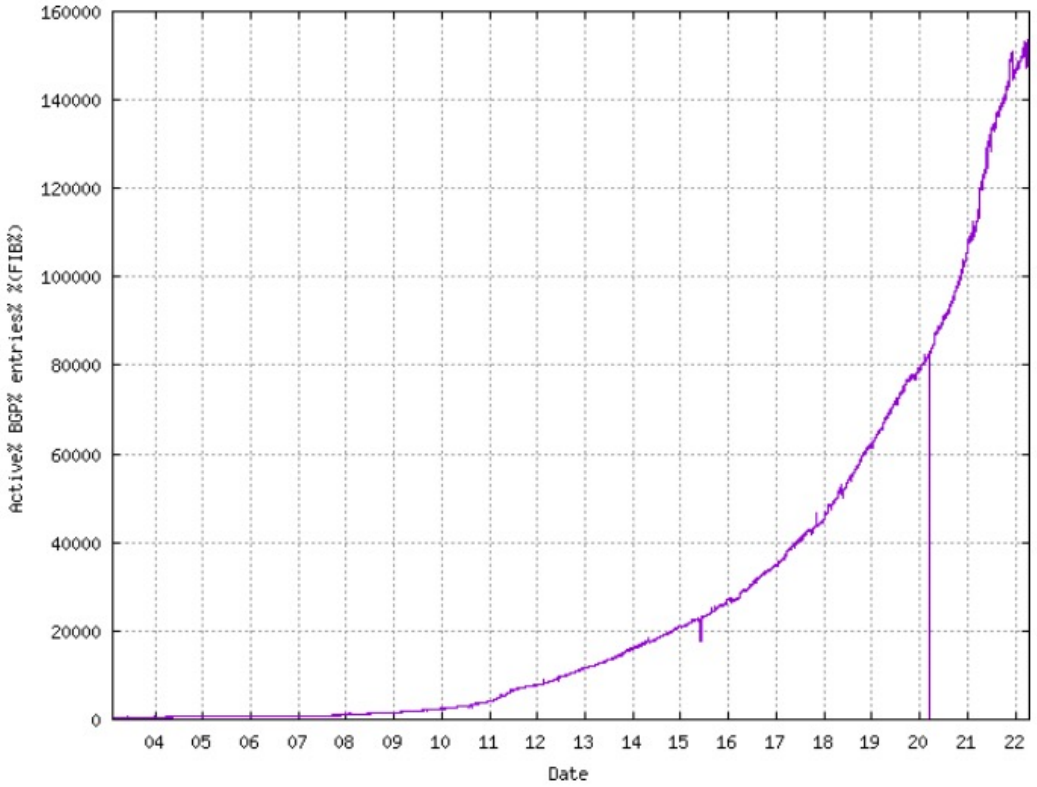
Economy	Delegates	IPv6 /48 prefixes
China	1872	3,320,184,959
Hong Kong	753	31,981,874
Taiwan	328	20,643,853
Japan	316	85,655,668
South Korea	57	3,080,202
Mongolia	31	1,048,591
Macao	6	262,146

https://rex.apnic.net/delegations?allocationType=ipv6&subregion=Eastern%20Asia (19/04/2022)

IPv6 Transition

IPv6 BGP Prefixes – East Asia

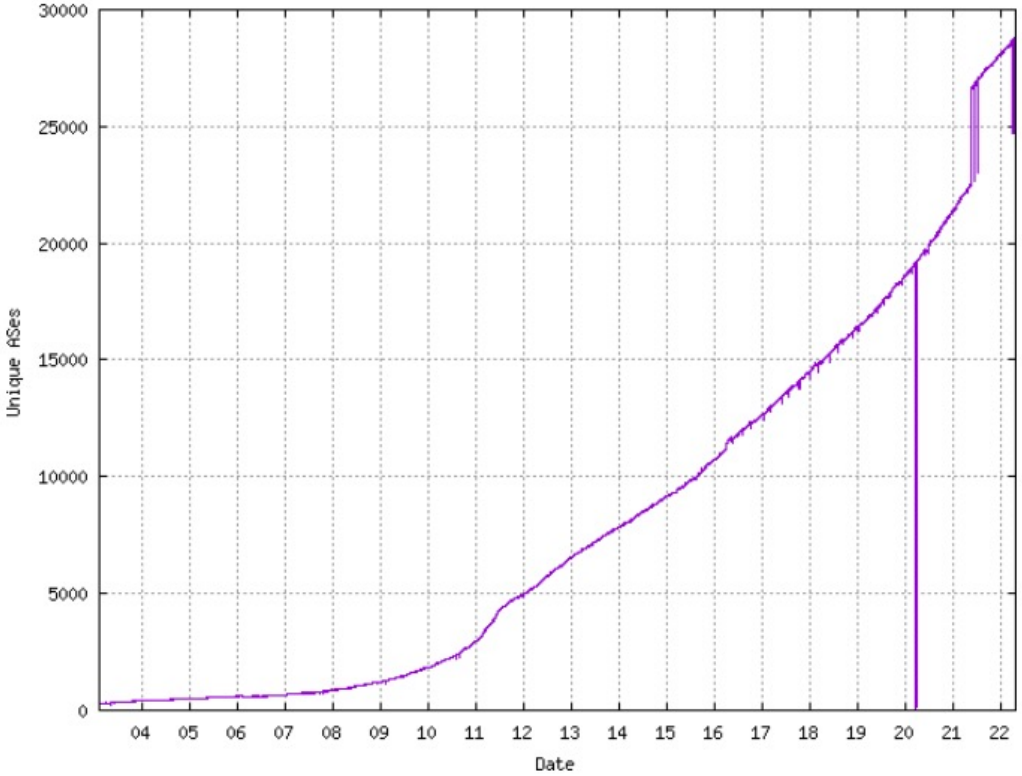
IPv6 Routing Table - Global



>150,000

https://www.cidr-report.org/v6/as2.0/ (19/04/2022)

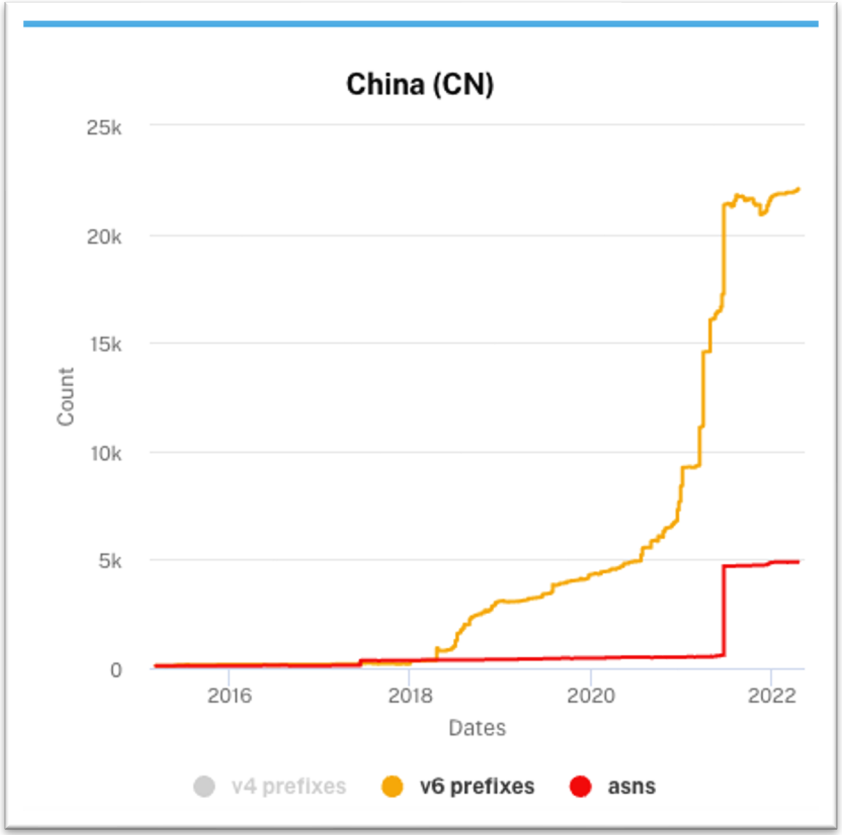
IPv6 AS Count - Global



>28,000

https://www.cidr-report.org/v6/as2.0/ (19/04/2022)

IPv6 BGP Prefixes - China



2022-04-17 14:00

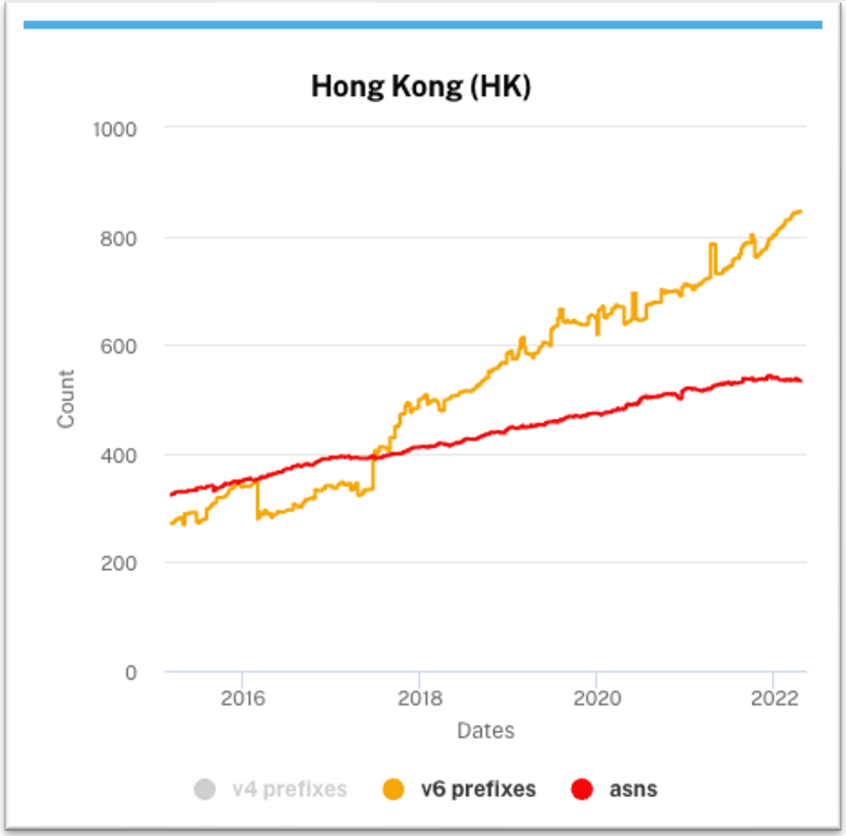
v6 prefixes: 22091

asns: 4888

Note: the number of ASN is about the total ASN, not IPv6 specific

https://stat.ripe.net/app/launchpad/S1_CN_C5_TMAST1425823200000ET1650290400000 (19/04/2022)

IPv6 BGP Prefixes – Hong Kong



2022-04-17 14:00

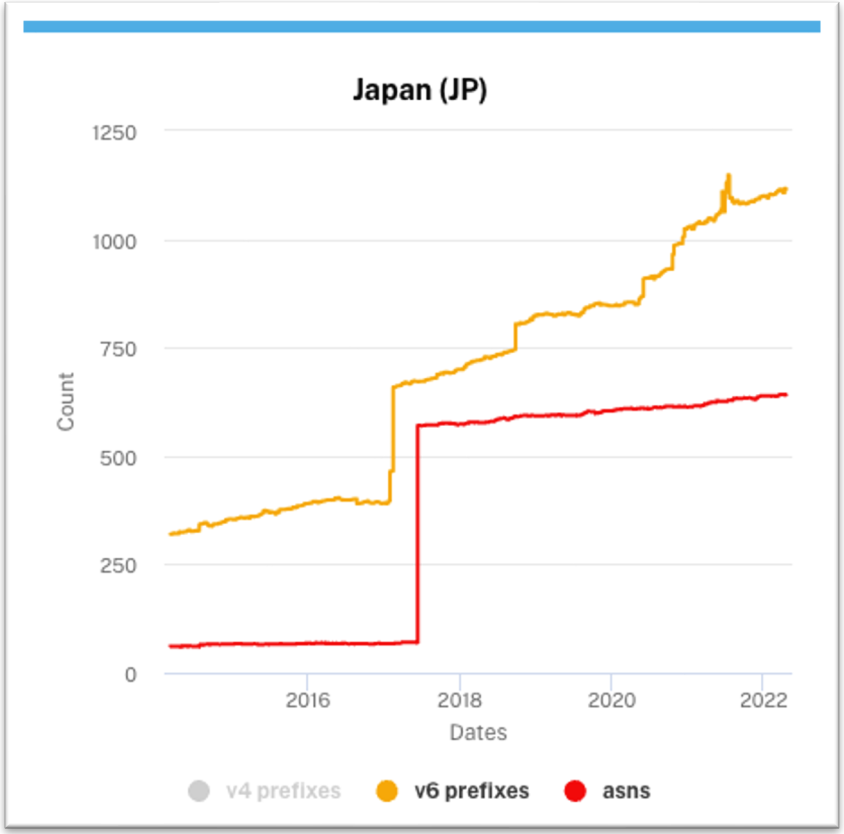
v6 prefixes: 846

asns: 535

Note: the number of ASN is about the total ASN, not IPv6 specific

https://stat.ripe.net/app/launchpad/S1_hk_C5_TMAST1425823200000ET1650290400000 (19/04/2022)

IPv6 BGP Prefixes - Japan



2022-04-17 14:00

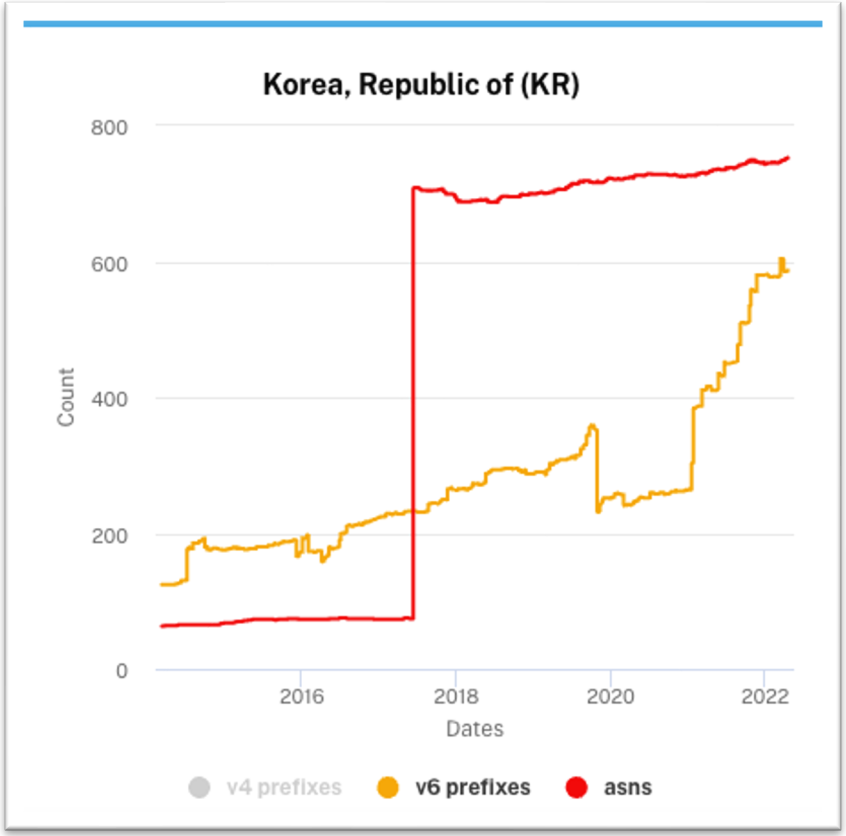
v6 prefixes: 1114

asns: 642

Note: the number of ASN is about the total ASN, not IPv6 specific

https://stat.ripe.net/app/launchpad/S1_jp_C5_TMAST1425823200000ET1650290400000 (19/04/2022)

IPv6 BGP Prefixes - Korea



2022-04-17 14:00

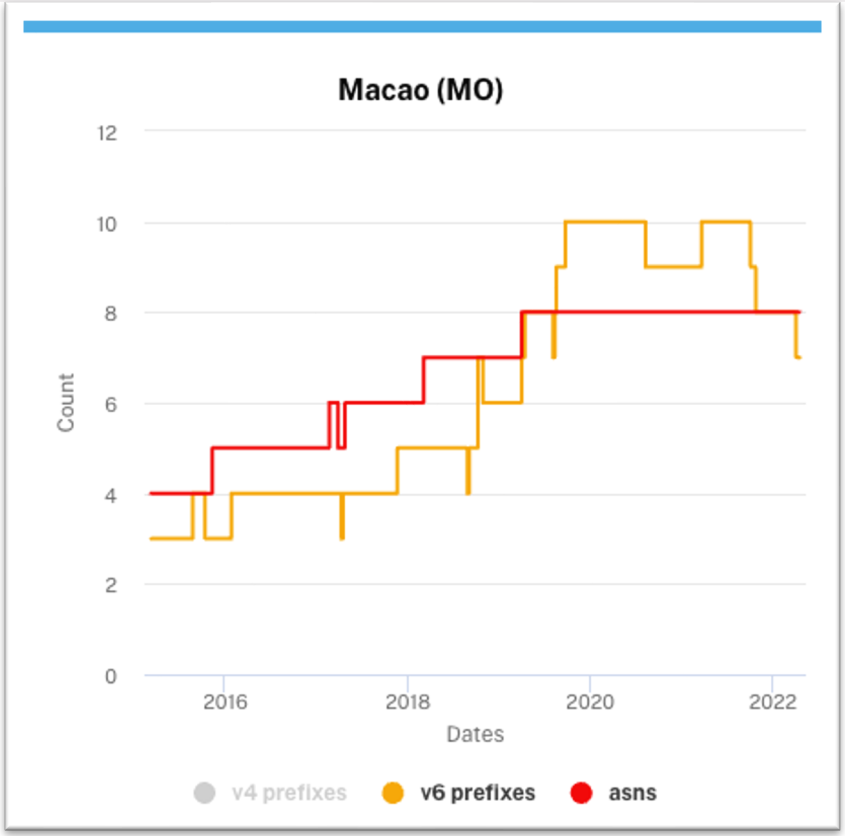
v6 prefixes: 587

asns: 753

Note: the number of ASN is about the total ASN, not IPv6 specific

https://stat.ripe.net/app/launchpad/S1_kr_C5_TMAST1425823200000ET1650290400000 (19/04/2022)

IPv6 BGP Prefixes - Macao



2022-04-17 14:00

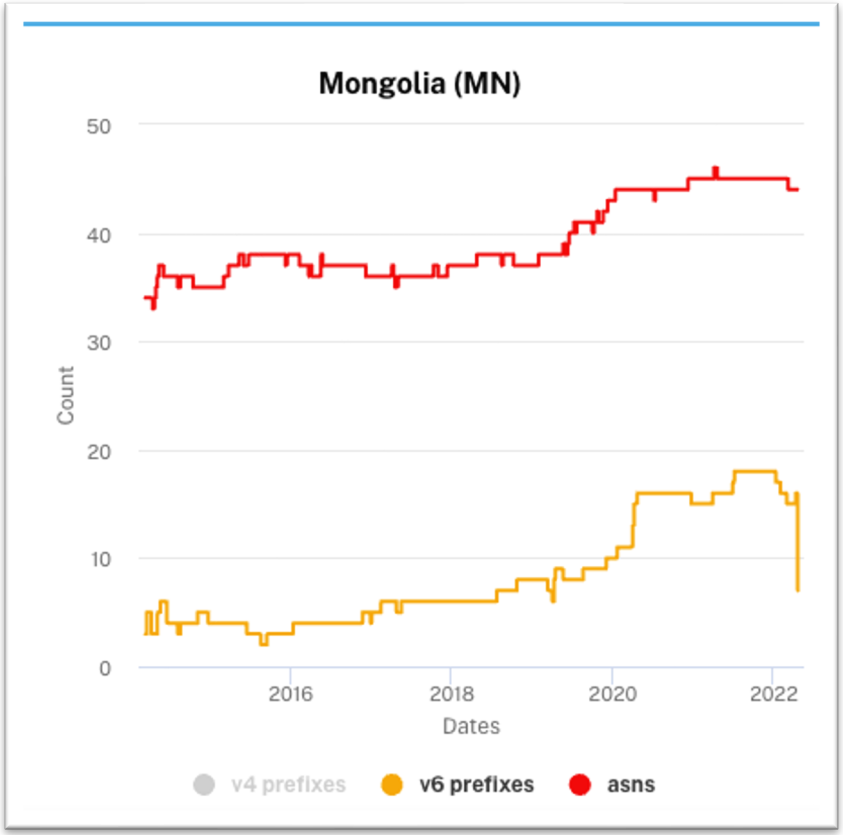
v6 prefixes: 7

asns: 8

Note: the number of ASN is about the total ASN, not IPv6 specific

https://stat.ripe.net/app/launchpad/S1_MO_C5_TMAST1425823200000ET1650290400000 (19/04/2022)

IPv6 BGP Prefixes - Mongolia



2022-04-17 14:00

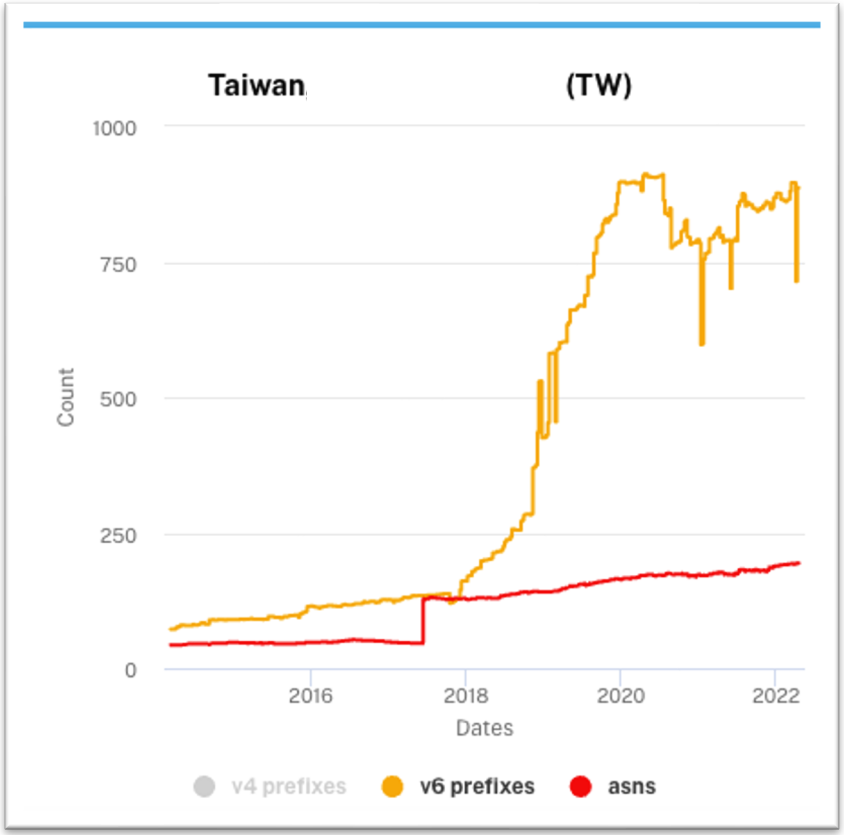
v6 prefixes: 7

asns: 44

Note: the number of ASN is about the total ASN, not IPv6 specific

https://stat.ripe.net/app/launchpad/S1_mn_C5_TMAST1425823200000ET1650290400000 (19/04/2022)

IPv6 BGP Prefixes - Taiwan



2022-04-17 14:00

v6 prefixes: 887

asns: 194

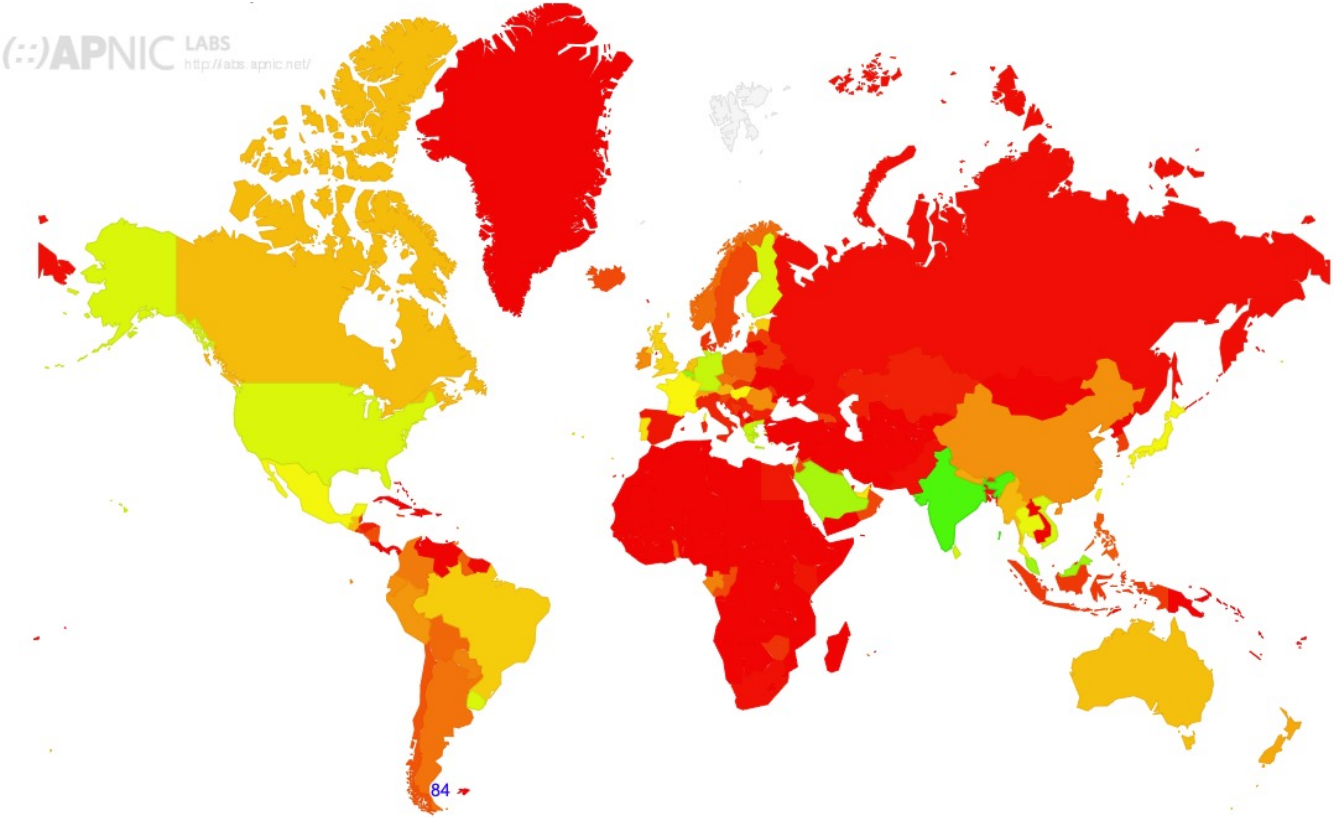
Note: the number of ASN is about the total ASN, not IPv6 specific

https://stat.ripe.net/app/launchpad/S1_tw_C5_TMAST1425823200000ET1650290400000 (19/04/2022)

IPv6 Transition

IPv6 End-User Readiness – East Asia

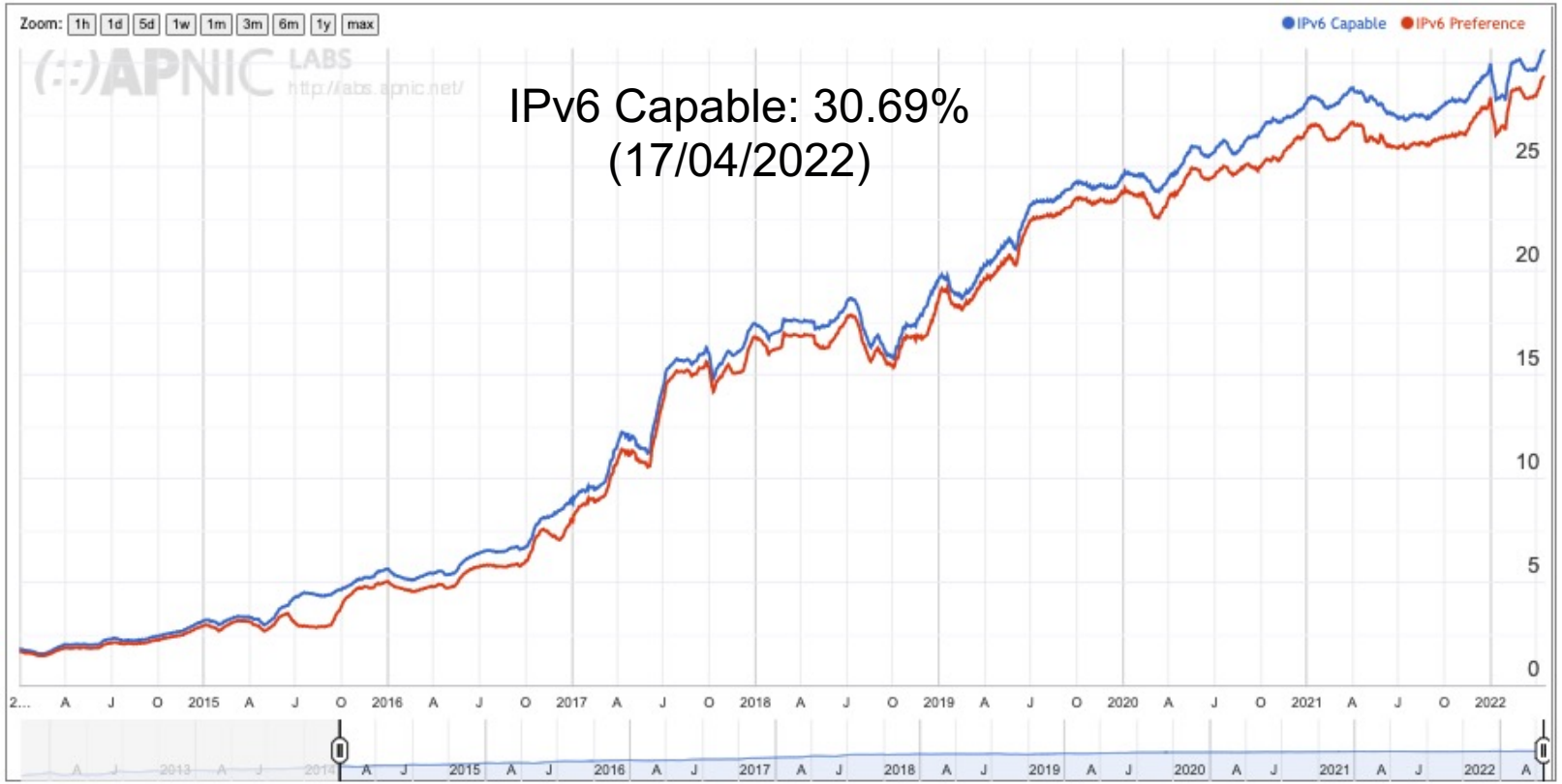
Global IPv6 End-User Readiness



Results are generated from the samples collected by APNIC Lab from Internet.

Source: https://stats.labs.apnic.net/ipv6/ (19/04/2022)

Global IPv6 End-User Readiness



https://stats.labs.apnic.net/ipv6/XA (19/04/2022)

Global IPv6 End-User Readiness

CC	Economy	IPv6 Capable	IPv6 Preferred
IN	India	77.53%	76.59%
BE	Belgium	63.93%	63.56%
MY	Malaysia	60.77%	60.14%
SA	Saudi Arabia	58.53%	57.21%
MS	Montserrat	57.84%	57.58%
DE	Germany	52.92%	51.08%
GR	Greece	52.89%	52.73%
LK	Sri Lanka	50.76%	50.42%
VN	Vietnam	49.93%	49.58%
FI	Finland	49.48%	47.37%
UY	Uruguay	49.32%	49.09%

https://stats.labs.apnic.net/ipv6/XA (19/04/2022)

IPv6 End-User Readiness in Asia

https://stats.labs.apnic.net/ipv6/XD?o=cXSw30x1r1 (19/04/2022)

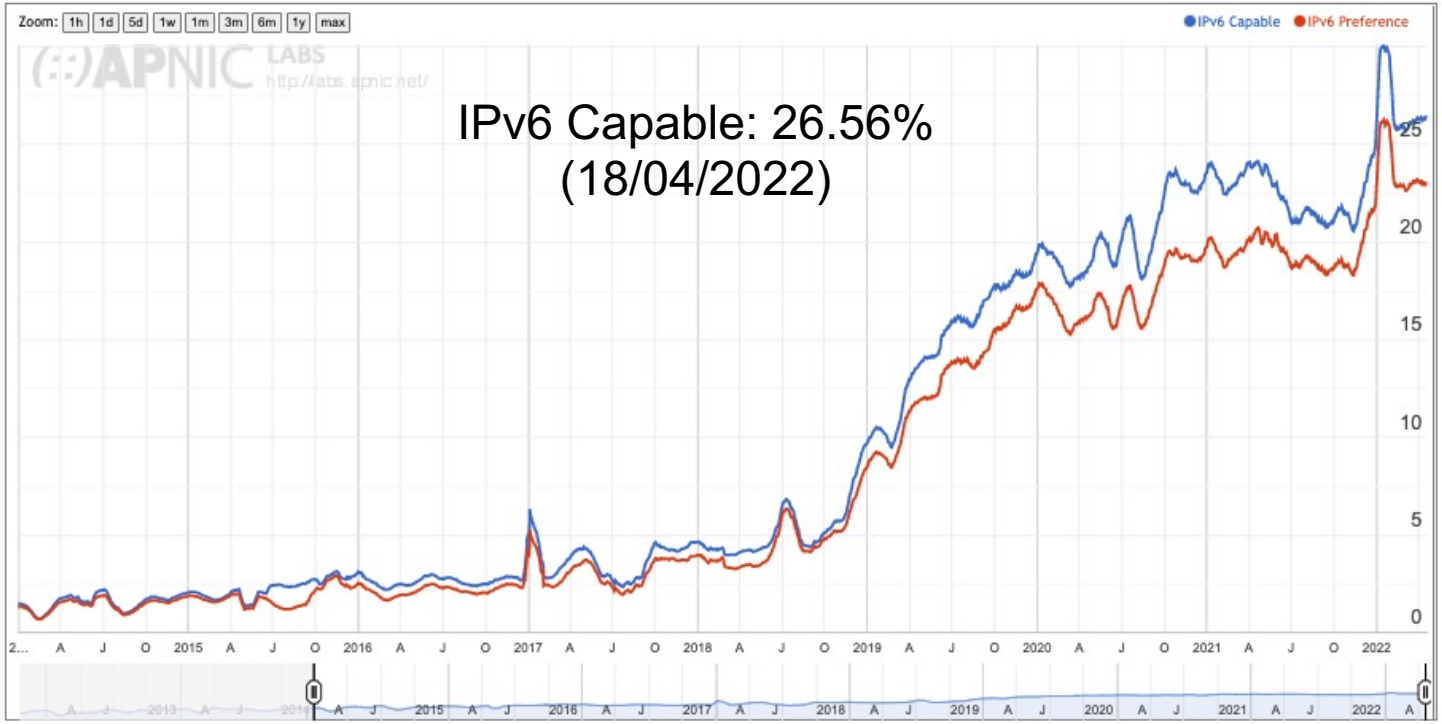
IPv6 End-User Readiness in Asia

CC	Economy	IPv6 Capable	IPv6 Preferred
IN	India	77.53%	76.59%
MY	Malaysia	60.77%	60.14%
SA	Saudi Arabia	58.53%	57.21%
LK	Sri Lanka	50.76%	50.42%
VN	Vietnam	49.93%	49.58%
TH	Thailand	46.07%	45.85%
JP	Japan	43.89%	41.78%
TW	Taiwan	42.47%	41.73%
IL	Israel	41.40%	39.88%
AE	United Arab Emirates	39.33%	38.94%
MM	Myanmar	31.77%	31.55%
NP	Nepal	28.91%	28.11%

https://stats.labs.apnic.net/ipv6/XD?o=cXSw30x1r1 (19/04/2022)

IPv6 End-User Readiness in East Asia

Use of IPv6 for Eastern Asia (XS)



https://stats.labs.apnic.net/ipv6/XS?o=cXDw30x1r1 (19/04/2022)

IPv6 End-User Readiness in East Asia

CC	Economy	IPv6 Capable	IPv6 Preferred
JP	Japan	43.89%	41.78%
TW	Taiwan	42.47%	41.73%
CN	China	24.83%	20.92%
MO	Macao Special Administrative Region of China	18.85%	18.43%
KR	Republic of Korea	11.00%	10.84%
HK	Hong Kong Special Administrative Region of China	1.62%	0.62%
MN	Mongolia	0.06%	0.06%

https://stats.labs.apnic.net/ipv6/XS?o=cXDw30x1r1 (19/04/2022)

Activity

1. Let’s find the IPv6 capable index of your economy or company.
2. Let’s find the (IPv6 capable) leading ASNs of each economy in East Asia.

https://stats.labs.apnic.net/ipv6/

IPv6 Transition

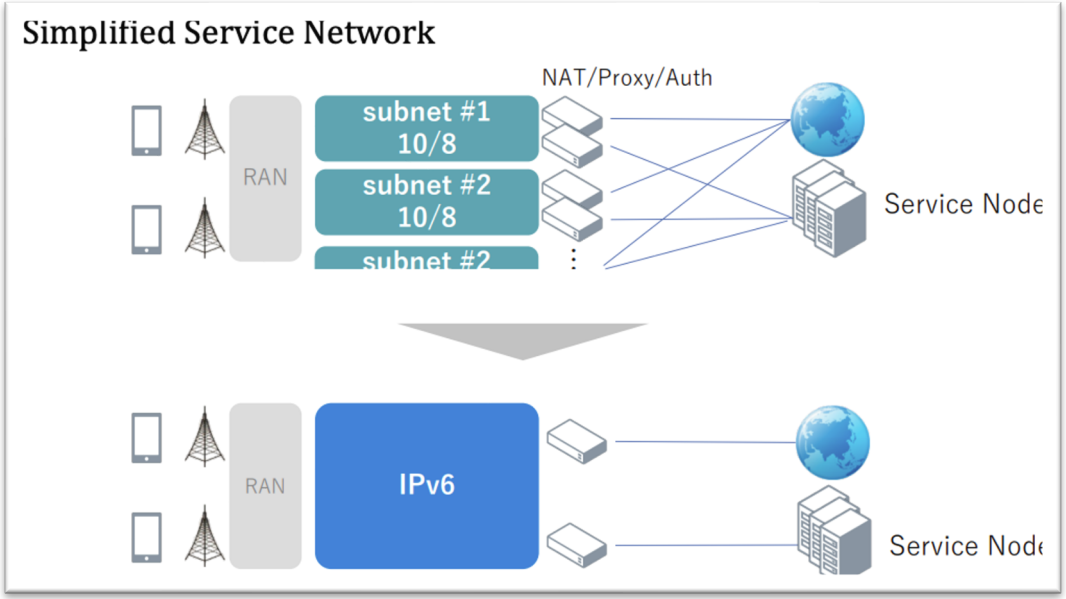
IPv6 Transition Driving Force

Driving Force

- Simplify network design
- Capability to support growth, IoT, Smart Cities, future services
- Government Encouragement
- Reduce load on CGN (Carrier-grade NAT)
- Lower CAPEX for NAT equipment

Simplify Network Design

- Simplify network design



https://conference.apnic.net/48/assets/files/APIC778/IPv6-deployment-for-Mobile-Network-in-Japan%20.pdf

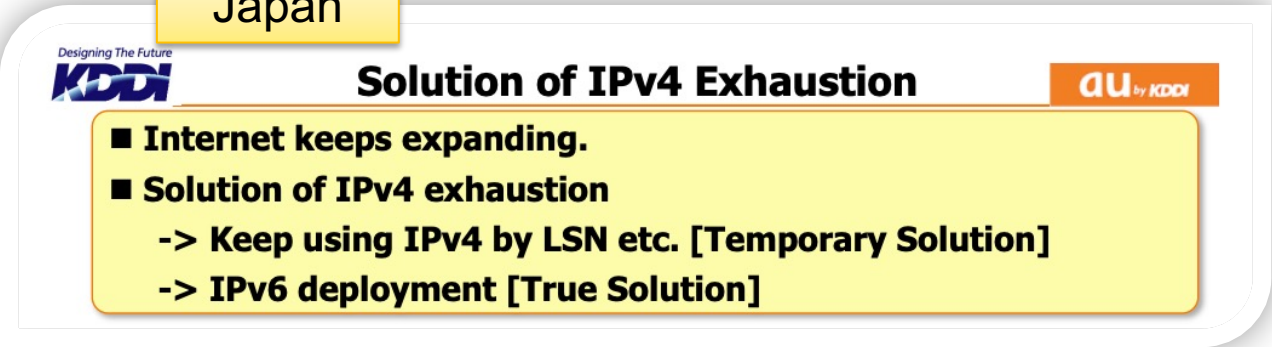
Business Growth

- Capability to support growth, IoT, Smart Cities, future services
  - 5G
  - LTE
  - IoT

Business Growth

- Capability to support growth, IoT, Smart Cities, future services
  - 5G
  - LTE
  - IoT

Japan

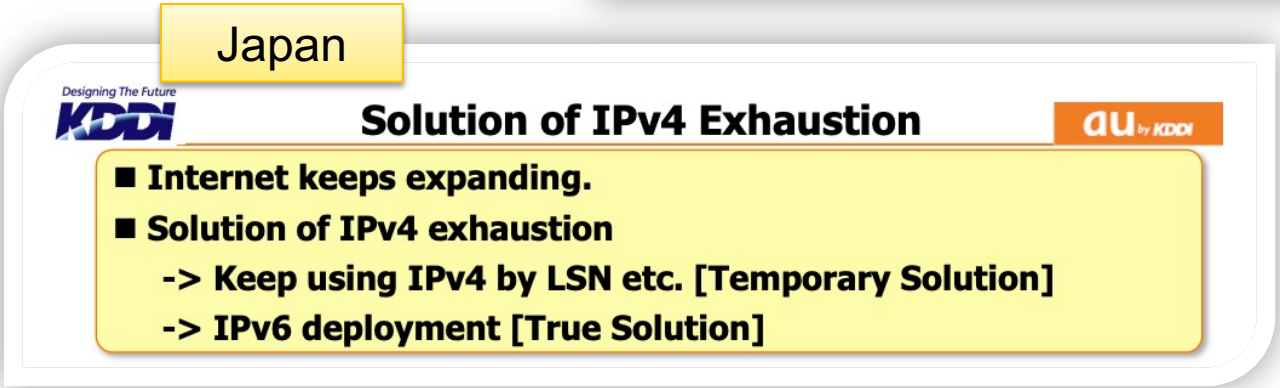


https://meetings.apnic.net/33/pdf/ipv6_deployment.pdf

https://conference.apnic.net/47/assets/files/APKS756/hanwoong-lim-ipv6-in-skt-4-g-5-g-2.pdf

Business Growth

- Capability to support growth, IoT, Smart Cities, future services
  - 5G
  - LTE
  - IoT



https://meetings.apnic.net/33/pdf/ipv6_deployment.pdf

https://conference.apnic.net/47/assets/files/APKS756/hanwoong-lim-ipv6-in-skt-4-g-5-g-2.pdf

Government Encouragement

http://ipv6event2015.vn/download/2-SKT-ApplyingIPv6ToLTENetworks.pdf
http://www.cac.gov.cn/2017-11/26/c_1122012798.htm

Government Encouragement

Why Did SKT Decide to Adopt IPv6 ?

Korea

Korean government's encouragement

China
26 November 2017

http://ipv6event2015.vn/download/2-SKT-ApplyingIPv6ToLTENetworks.pdf
http://www.cac.gov.cn/2017-11/26/c_1122012798.htm

IPv6 Transition

IPv6 Transition Techniques

Transition Techniques

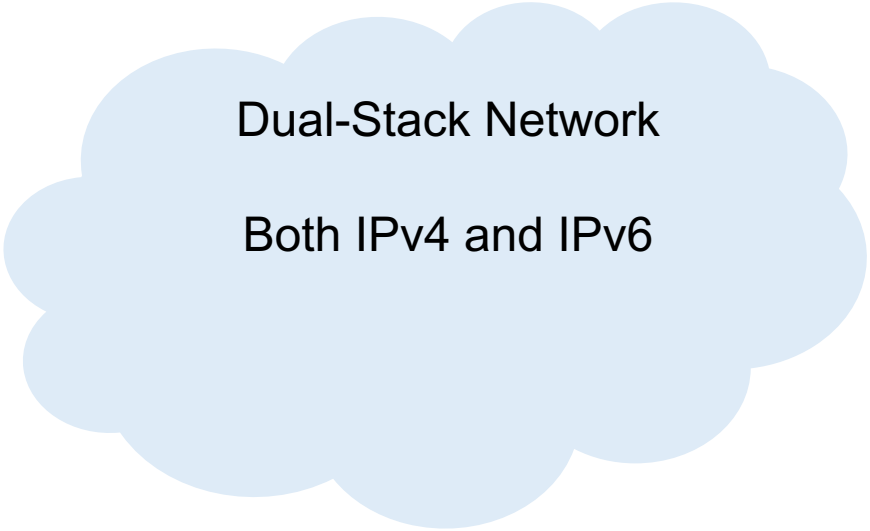
- There are some common transition techniques:
  - Dual-Stack
  - Tunnel
  - Translation

Dual-Stack

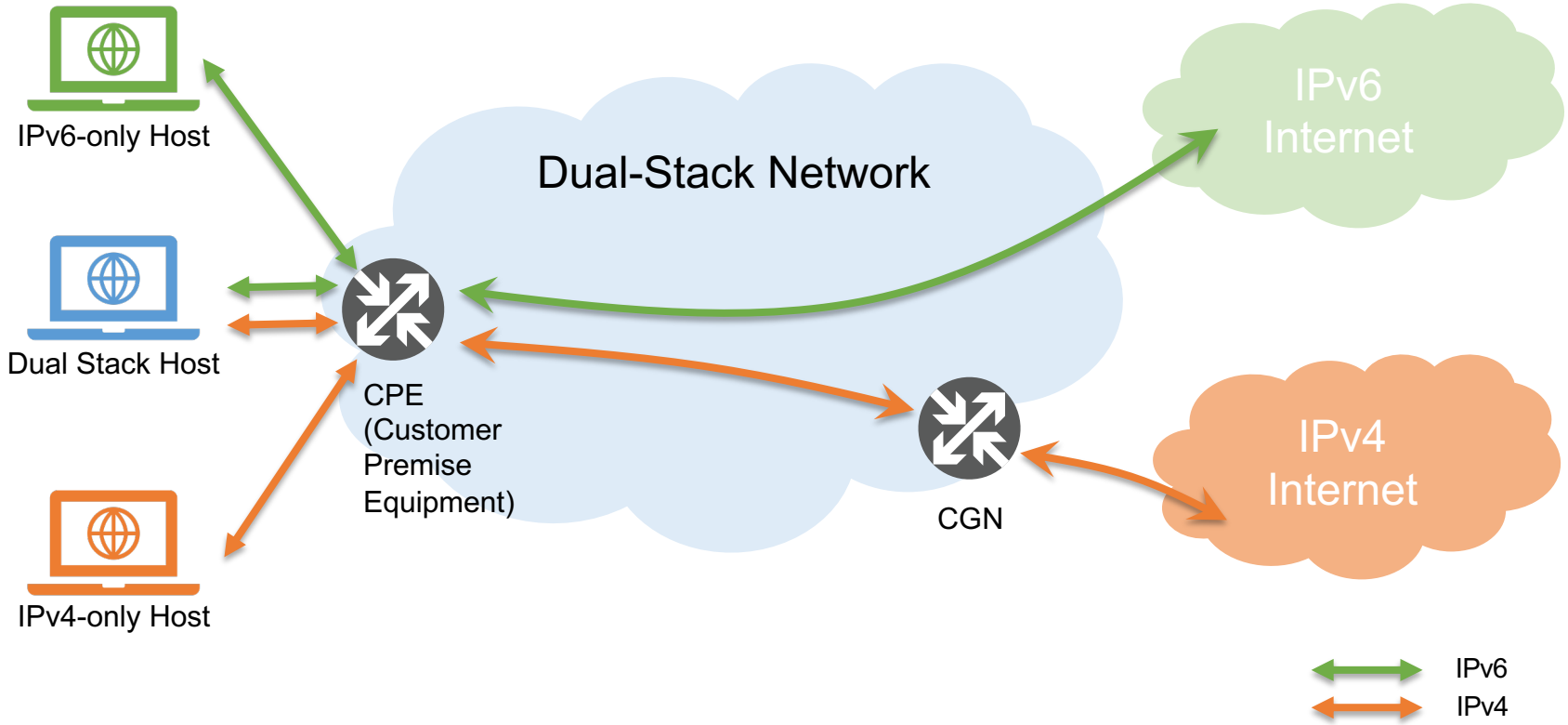
IPv6-only Host

Dual Stack Host

IPv4-only Host

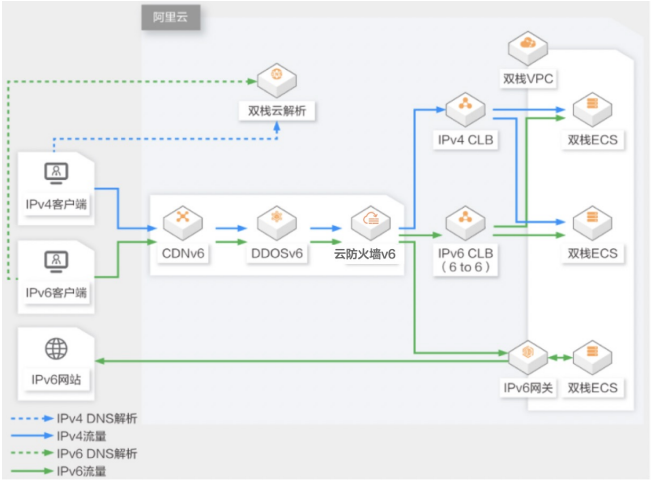


Dual-Stack


IPv6-only Host
Dual Stack Host
IPv4-only Host
Dual-Stack Network
CPE
(Customer
Premise
Equipment)
CGN
IPv6
Internet
IPv4
Internet
IPv6
IPv4

Use Case – Dual-Stack

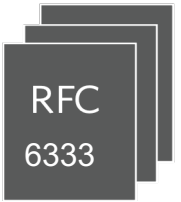
- Taiwan – Chunghwa Telecom
- Taiwan – Taiwan Mobile
- China – China Mobile
- China – Taobao (Alibaba)
- China – Alibaba Cloud (Alibaba)



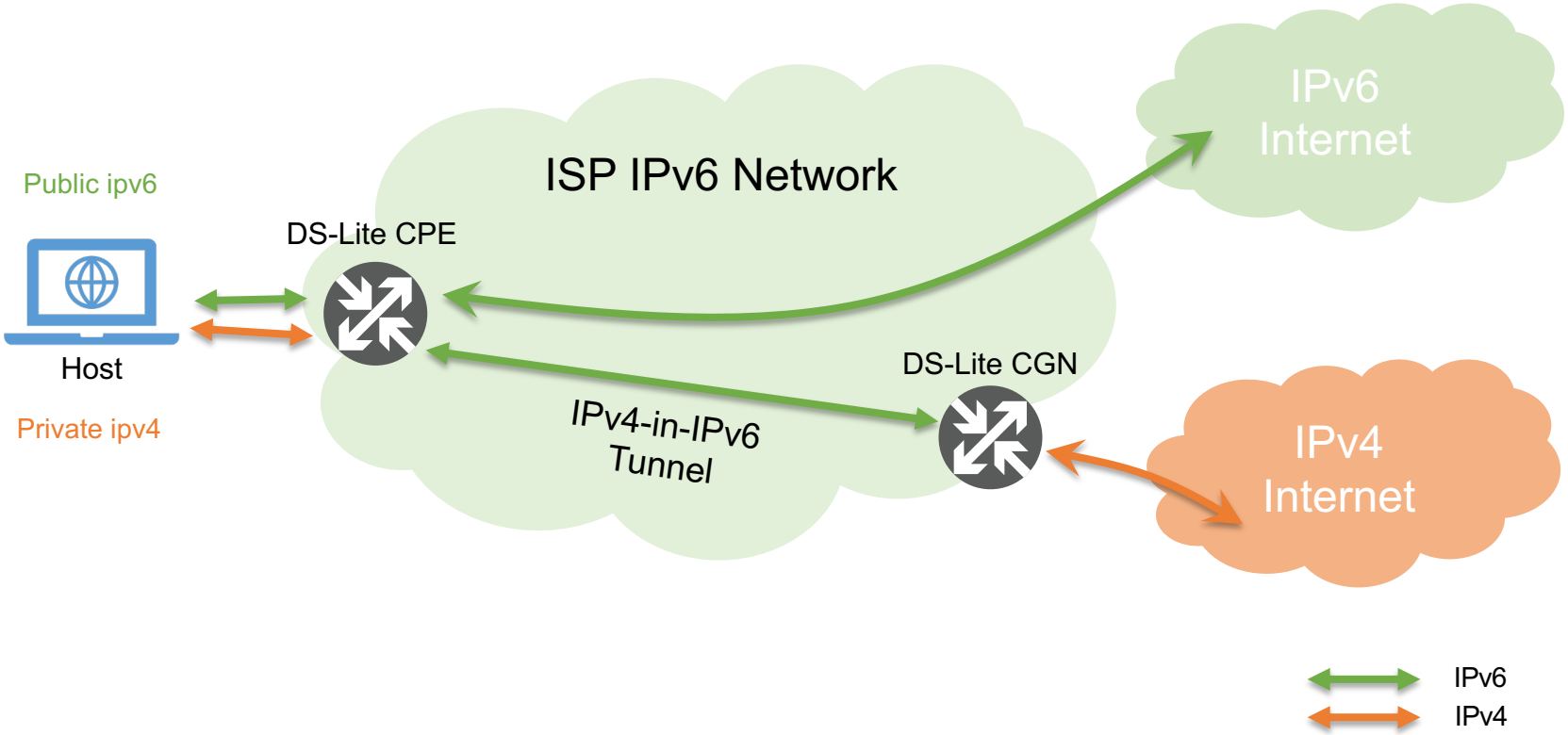
https://conference.apnic.net/47/assets/files/APKS756/cht%20ipv6%20deployment%20-%20v.3_1551155798.pdf
http://www.ipv6.org.tw/summit2015/doc/b4-2.pdf
http://www.cac.gov.cn/2021-11/25/c_1639439850145095.htm
http://www.cac.gov.cn/2022-03/18/c_1649210670013195.htm
http://www.cac.gov.cn/2022-03/18/c_1649210954546225.htm

Dual-Stack Lite

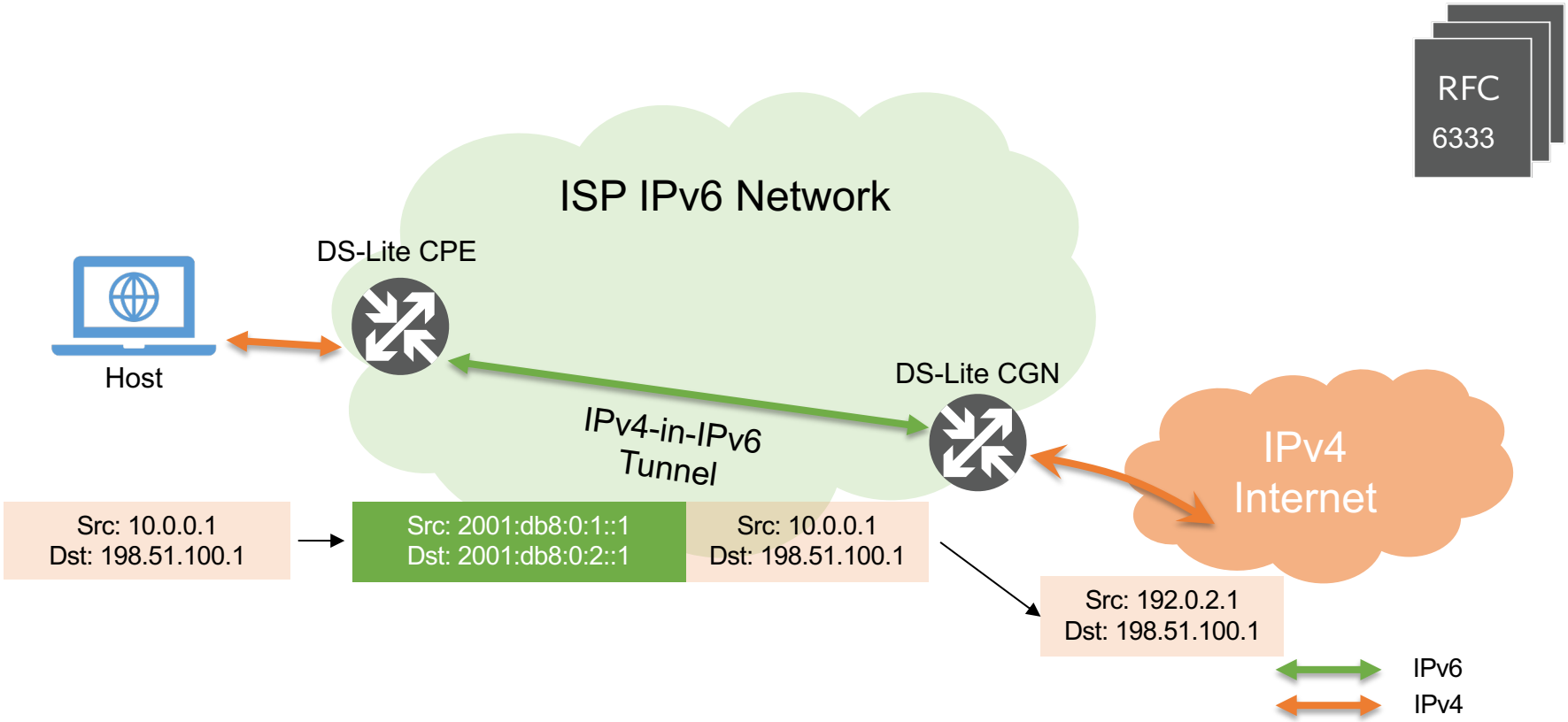
- Dual-Stack Lite enables a broadband service provider to share IPv4 addresses among customers by combining two well-known technologies: IP in IP (IPv4- in-IPv6) and Network Address Translation (NAT).



Dual-Stack Lite

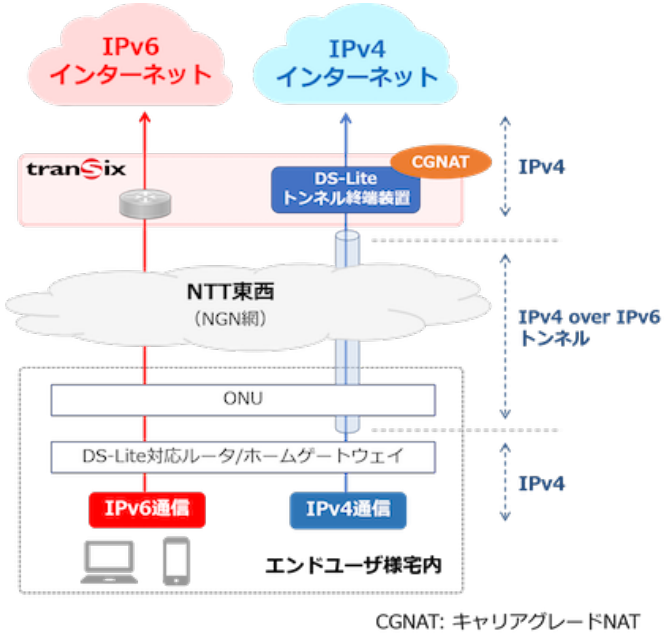


Dual-Stack Lite



Use Case - Dual-Stack Lite

- Japan – Transix
- Netherlands - Vodafone-Ziggo



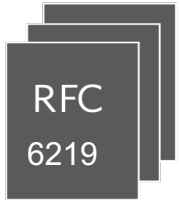
CGNAT: キャリアグレードNAT

Commonly used in Fixed Broadband Networks

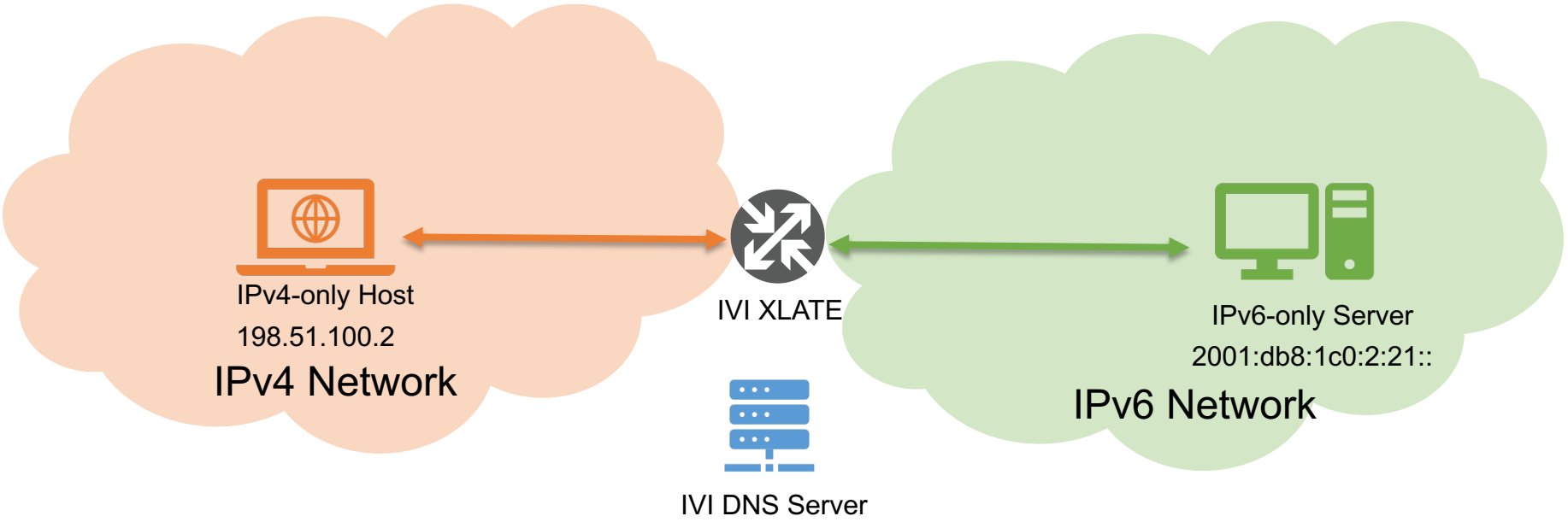
https://www.mfeed.ad.jp/transix/dslite/dslite.html
https://docs.google.com/spreadsheets/d/1ksOoWOaRdRyjZnjLSikHf4O5L1OUTNOO_7NK9vcVApc/edit#gid=0

Translation – IVI

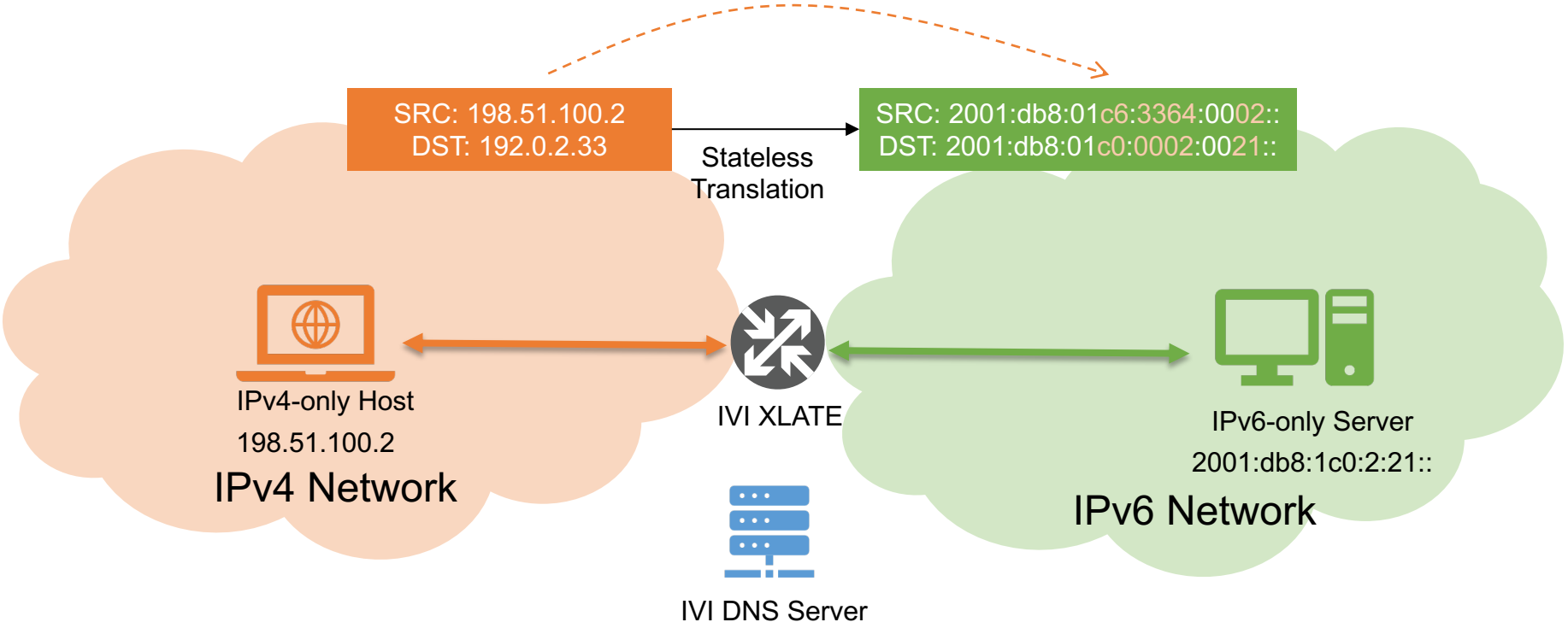
- The IVI is a prefix-specific and stateless address mapping mechanism for "an IPv6 network to the IPv4 Internet" and "the IPv4 Internet to an IPv6 network" scenarios.
- In Roman numerals, the "IV" stands for 4, and "VI" stands for 6, so "IVI" stands for the IPv4/IPv6 translation.



Translation – IVI



Translation – IVI



Further Development of IVI

IVI: IPv4/IPv6 translation

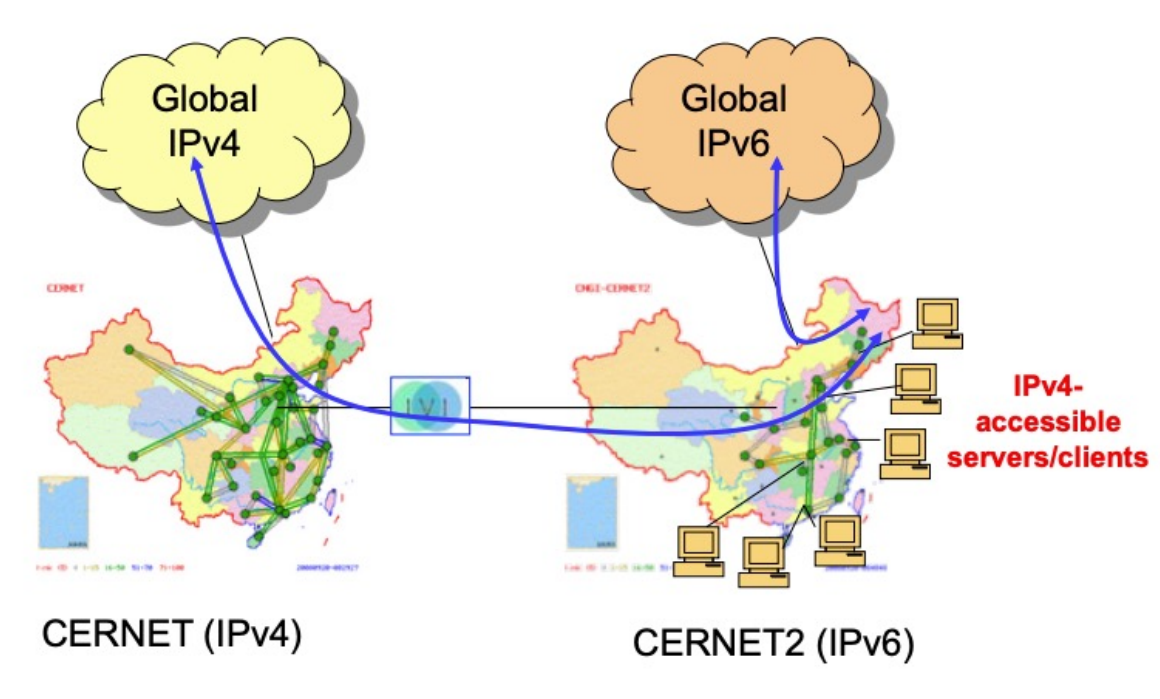
dIVI: Dual-Stateless IPv4/IPv6 Translation

MAP-T: Mapping of Address and Port using Translation

MAP-E: Mapping of Address and Port with Encapsulation

Use Case – IVI

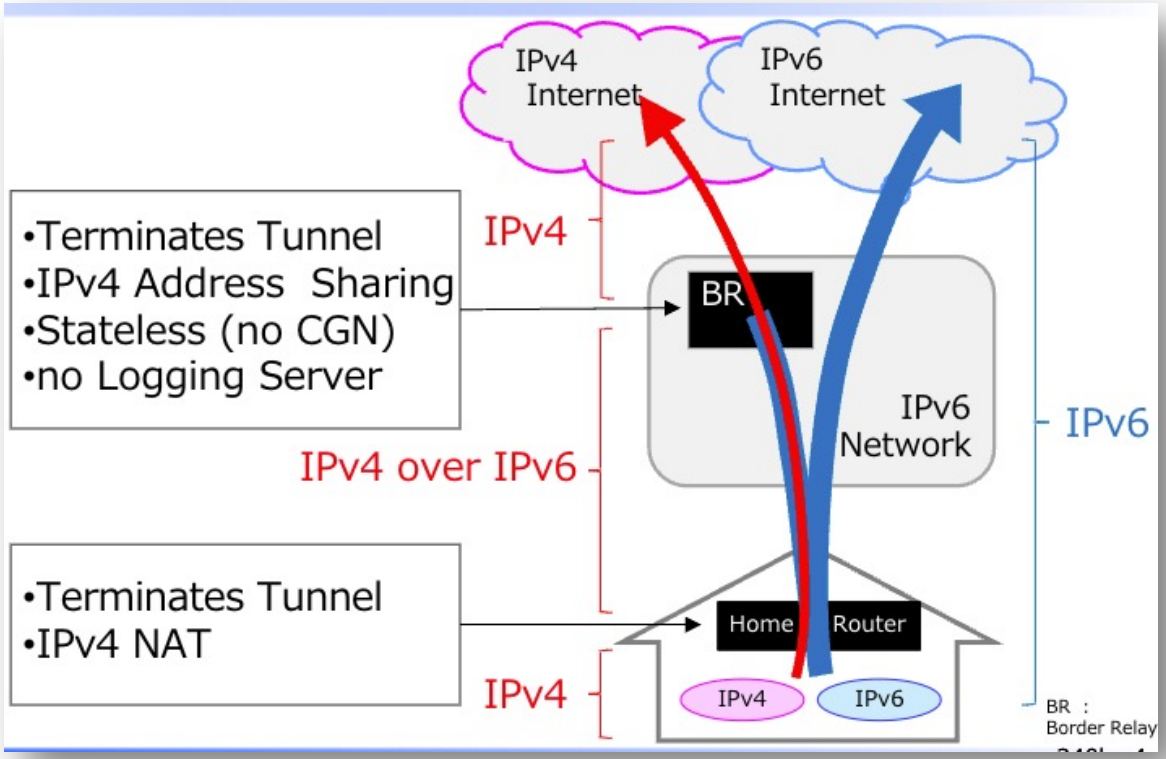
- China – China Education and Research Network (CERNET)



https://meetings.apnic.net/31/pdf/Xing-Li-CERNET2-IPv6-experience-2011-v2.pdf

Use Case – MAP-E

- Japan - JPNE

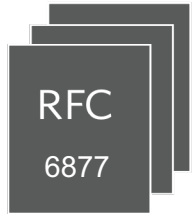


https://dokumen.tips/internet/map-e-as-ipv4-over-ipv6-technology-with-some-operational-experiences.html?page=4

Translation – 464XLAT

- 464XLAT is for providing limited IPv4 connectivity across an IPv6-only network by combining existing and well-known stateful protocol translation in the core and stateless protocol translation at the edge.

CLAT	Customer-side translator
PLAT	Provider-side translator

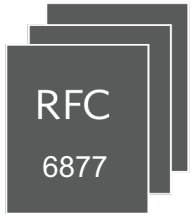


464XLAT: Combination of Stateful and Stateless Translation

Translation – 464XLAT

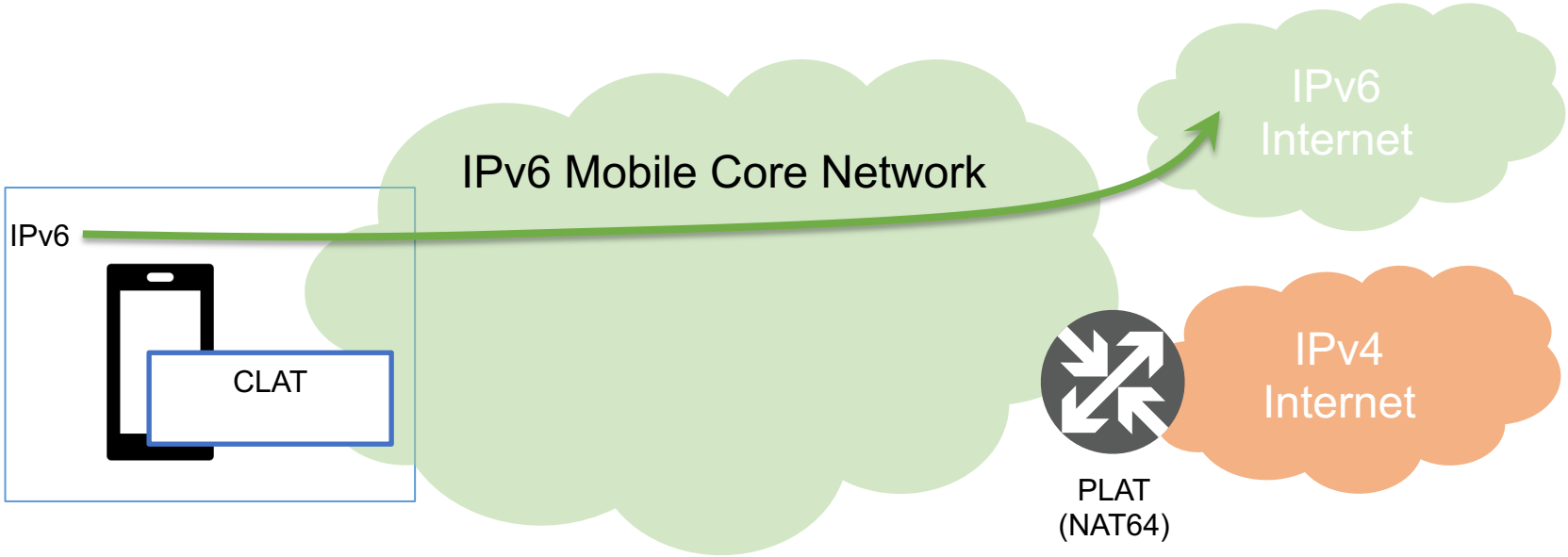
- 464XLAT is for providing limited IPv4 connectivity across an IPv6-only network by combining existing and well-known stateful protocol translation in the core and stateless protocol translation at the edge.

Server	Application and Host	Traffic Treatment	Location of Translation
IPv6	IPv6	End-to-End IPv6	None
IPv4	IPv6	Stateful Translation	PLAT
IPv4	IPv4	464XLAT	PLAT/CLAT

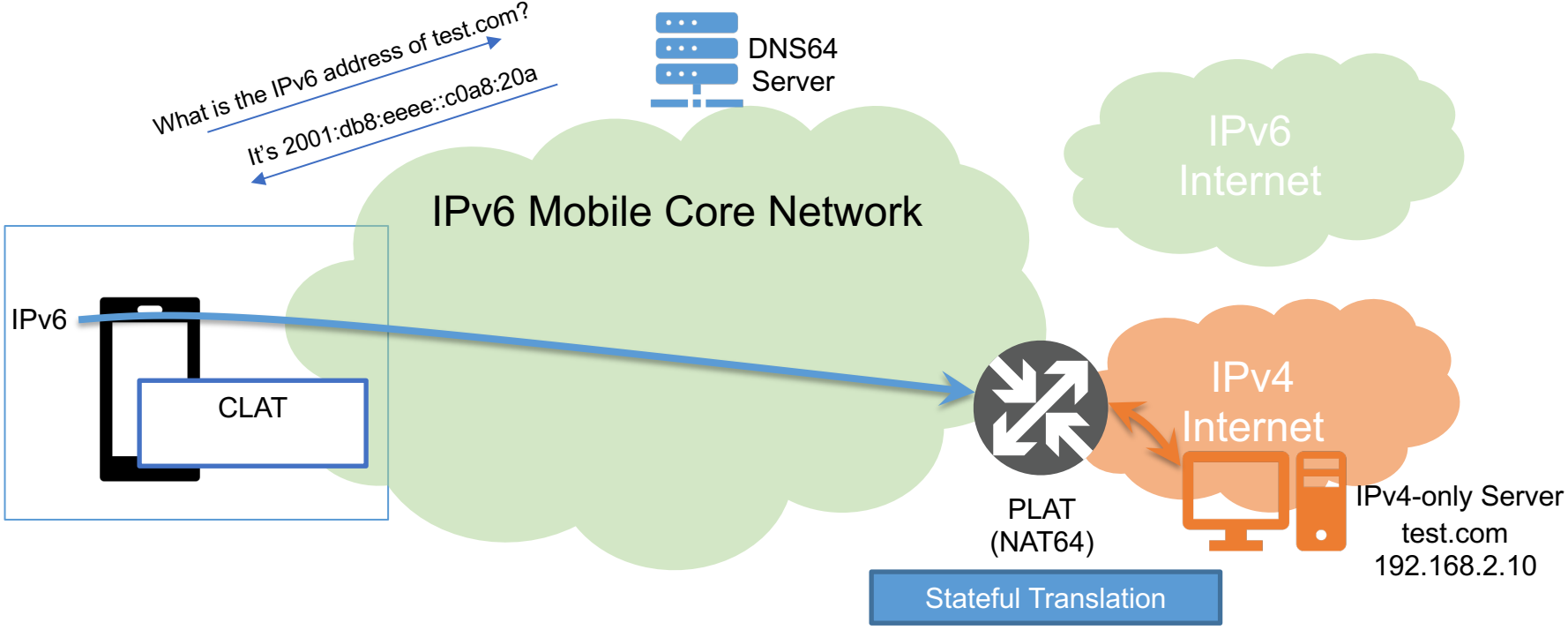


464XLAT: Combination of Stateful and Stateless Translation

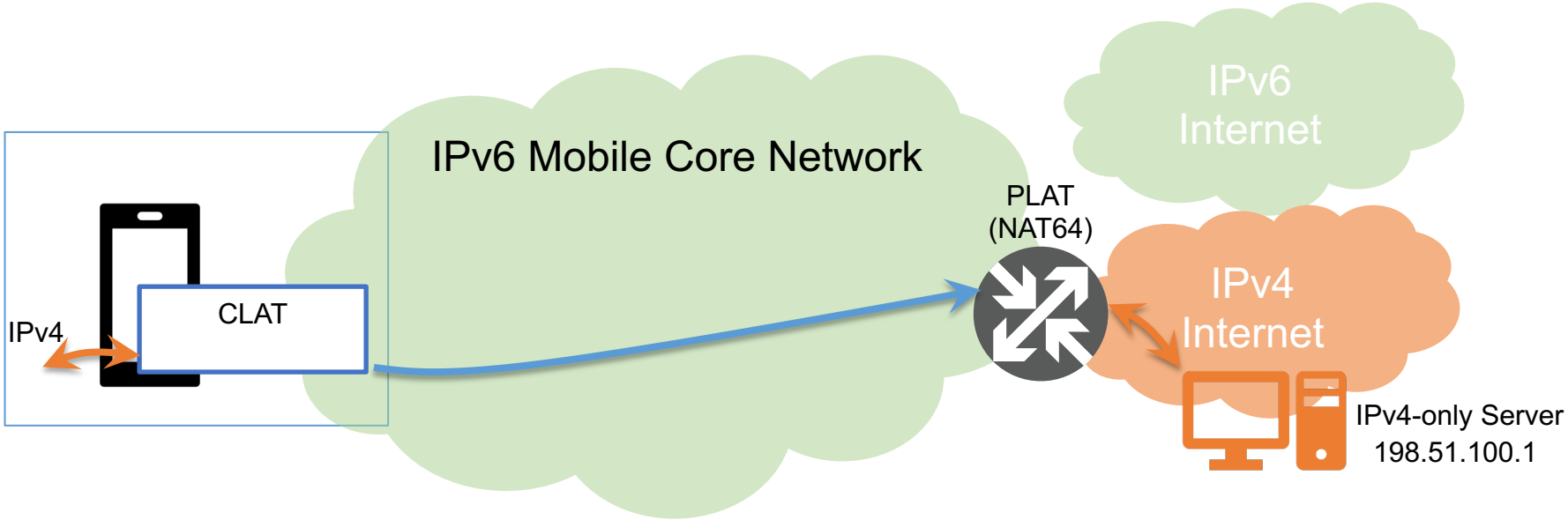
464XLAT – Scenario 1



464XLAT – Scenario 2

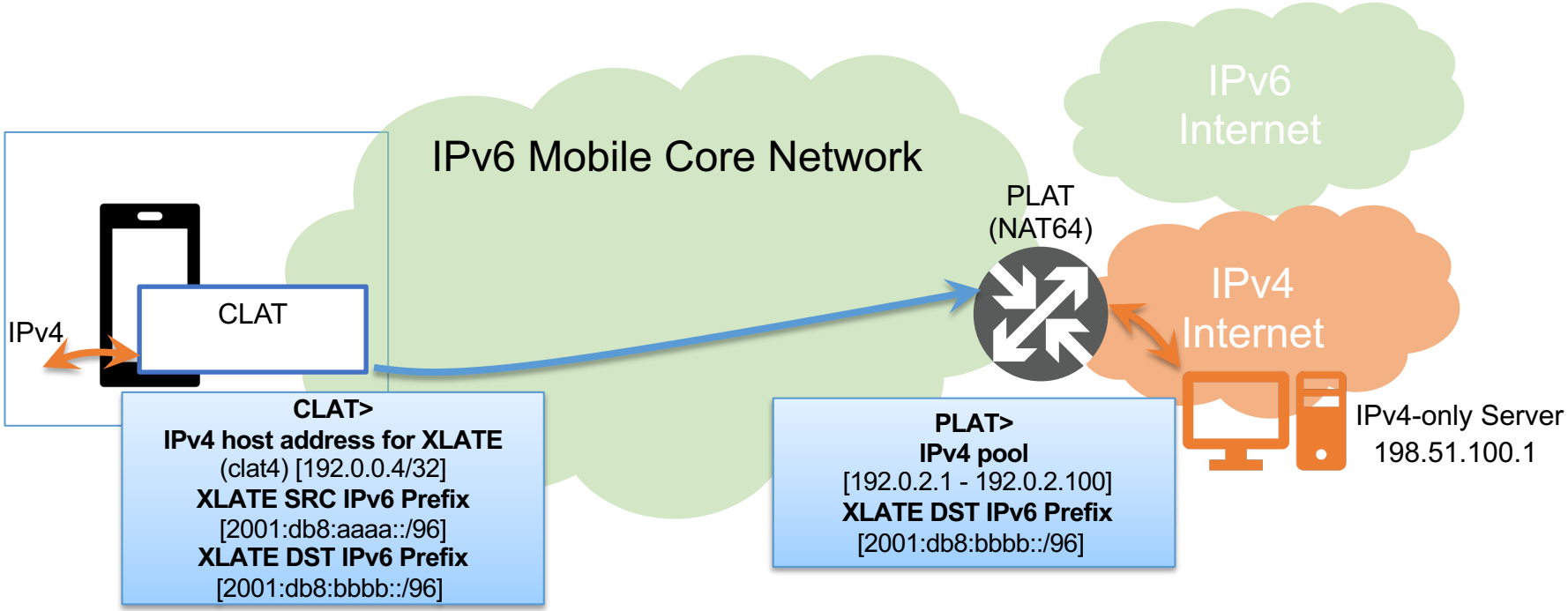


464XLAT – Scenario 3



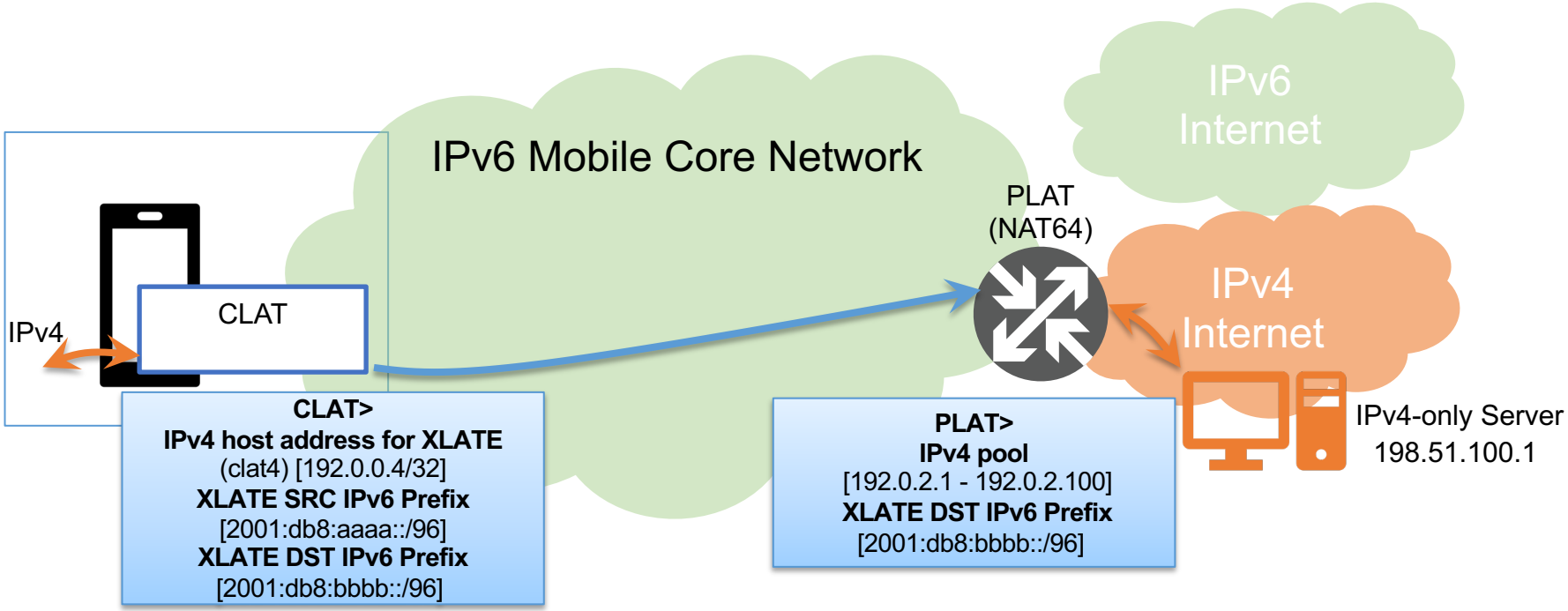
https://conference.apnic.net/44/assets/files/APCS549/IPv6-in-Cellular-Networks.pdf

464XLAT – Scenario 3



https://conference.apnic.net/44/assets/files/APCS549/IPv6-in-Cellular-Networks.pdf

464XLAT – Scenario 3




```
SRC: 192.0.0.4
DST: 198.51.100.1
```

Stateless XLATE

```
SRC: 2001:db8:aaaa::192.0.0.4
DST: 2001:db8:bbbb::198.51.100.1
```

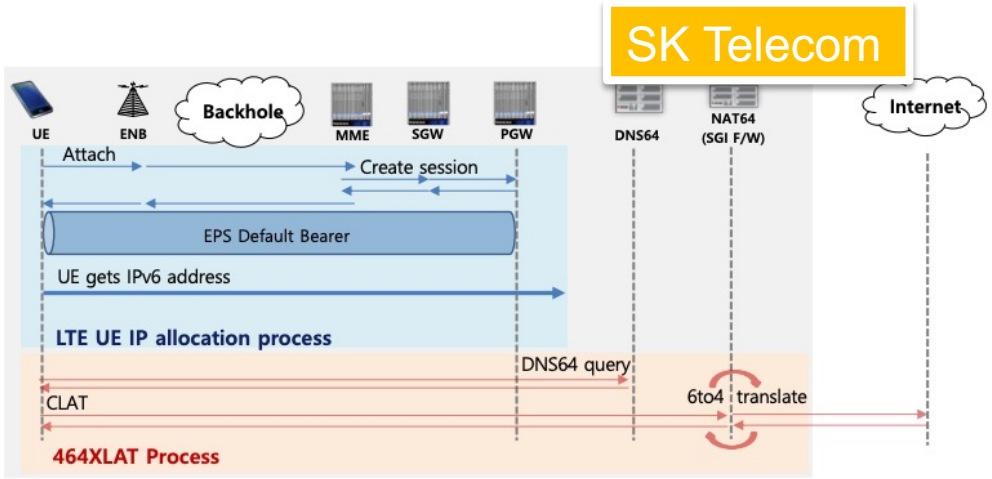
Stateful XLATE

```
SRC: 192.0.2.1
DST: 198.51.100.1
```

https://conference.apnic.net/44/assets/files/APCS549/IPv6-in-Cellular-Networks.pdf

Use Case – 464XLAT

- Korea – SK Telecom
- Japan – JPIX
- USA – T-Mobile
- Australia – Telstra



Commonly used in Mobile Networks

https://apricot.net/apricot2012/__data/assets/pdf_file/0020/45542/jpix_464xlat_apricot2012_for_web.pdf
https://docs.google.com/spreadsheets/d/1ksOoWOaRdRyjZnjLSikHf4O5L1OUTNOO_7NK9vcVApc/edit#gid=0
https://conference.apnic.net/47/assets/files/APKS756/hanwoong-lim-ipv6-in-skt-4-g-5-g-2.pdf

Review

- IPv6 address allocation – East Asia
- IPv6 BGP prefixes – East Asia
- IPv6 End-User Readiness – East Asia
- IPv6 transition driving force
- IPv6 transition techniques

Virtual Labs for Further Learning

- Dual-Stack
  - Deploying OSPF Labs
  - Deploying IS-IS Labs
  - Deploying BGP Labs
- Translation
  - Stateful NAT64 with DNS64 Lab

QUESTIONS?

Thank You!