

The background of the image consists of several overlapping diagonal bands of different shades of blue, ranging from a light sky blue to a deep navy blue. The bands create a sense of depth and movement. Centered on this background is the text "APNIC" in a bold, white, sans-serif typeface. The letters are clean and modern, with the 'A' and 'P' being slightly wider than the 'N' and 'I'.

APNIC



IPv6 Transition: East Asia Perspective

Jessica Wei

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

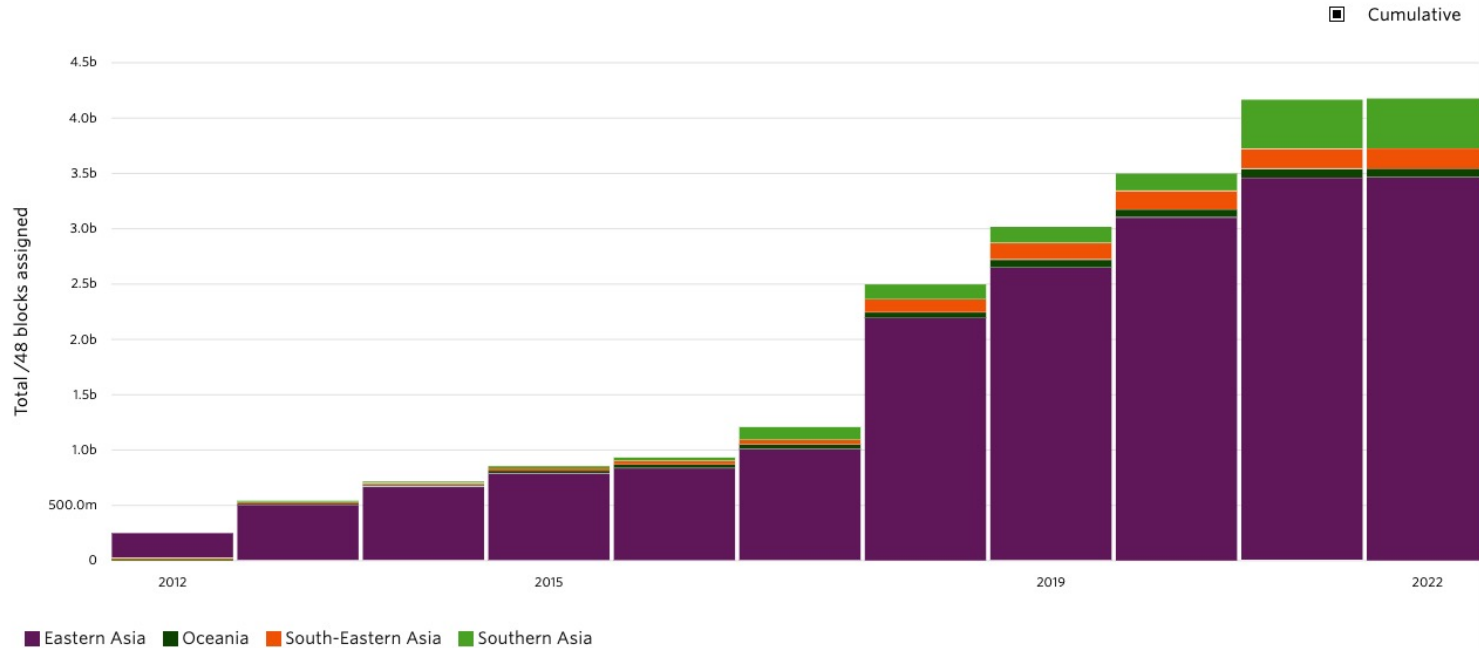
IPv6 Address Allocation – East Asia

IPv6 Address Allocation – Asia Pacific



IPv6 for the Asia Pacific

/48 prefixes	/32 prefixes	Delegations
4,176,286,748	63,725	11,517



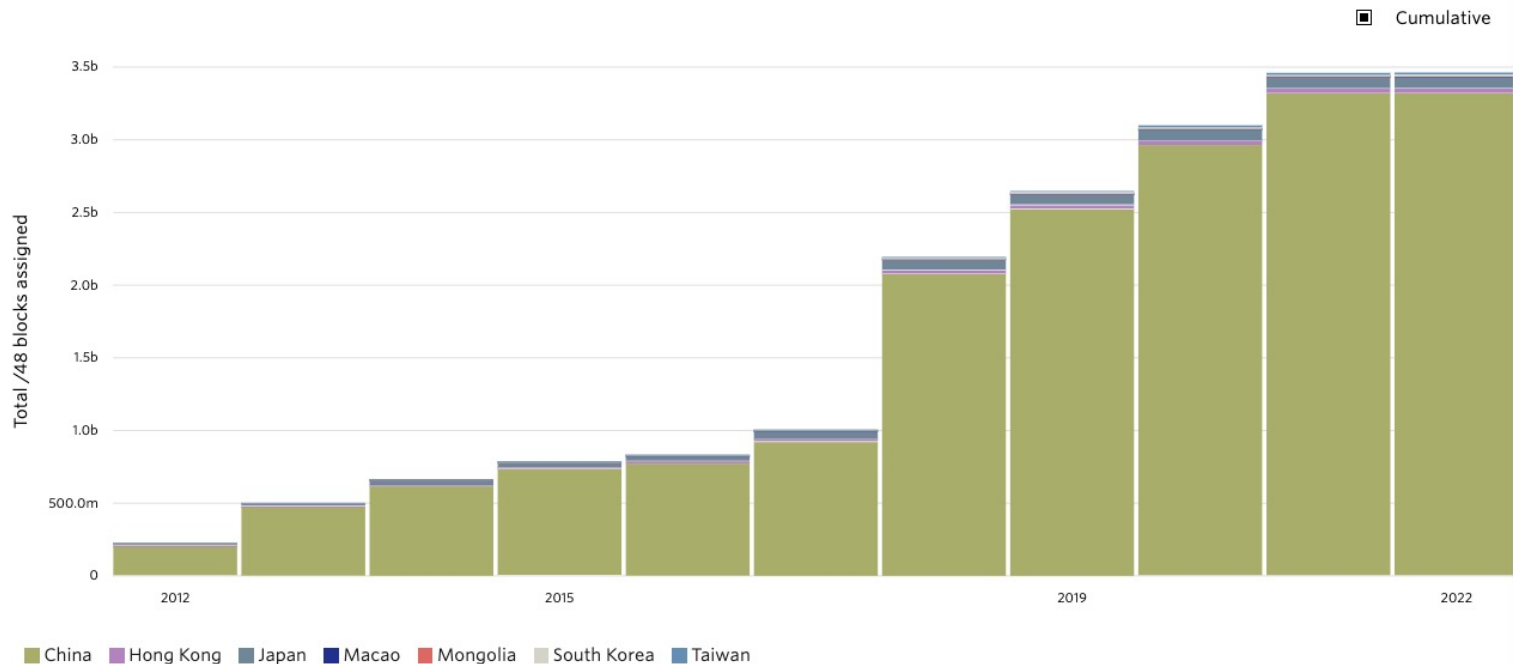
<https://rex.apnic.net/delegations?allocationType=ipv6®ion=ap> (19/04/2022)

IPv6 Address Allocation – East Asia



IPv6 for Eastern Asia

/48 prefixes	/32 prefixes	Delegations
3,462,857,293	52,839	3,363



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

IPv6 Address Allocation – East Asia



Till 04/2022

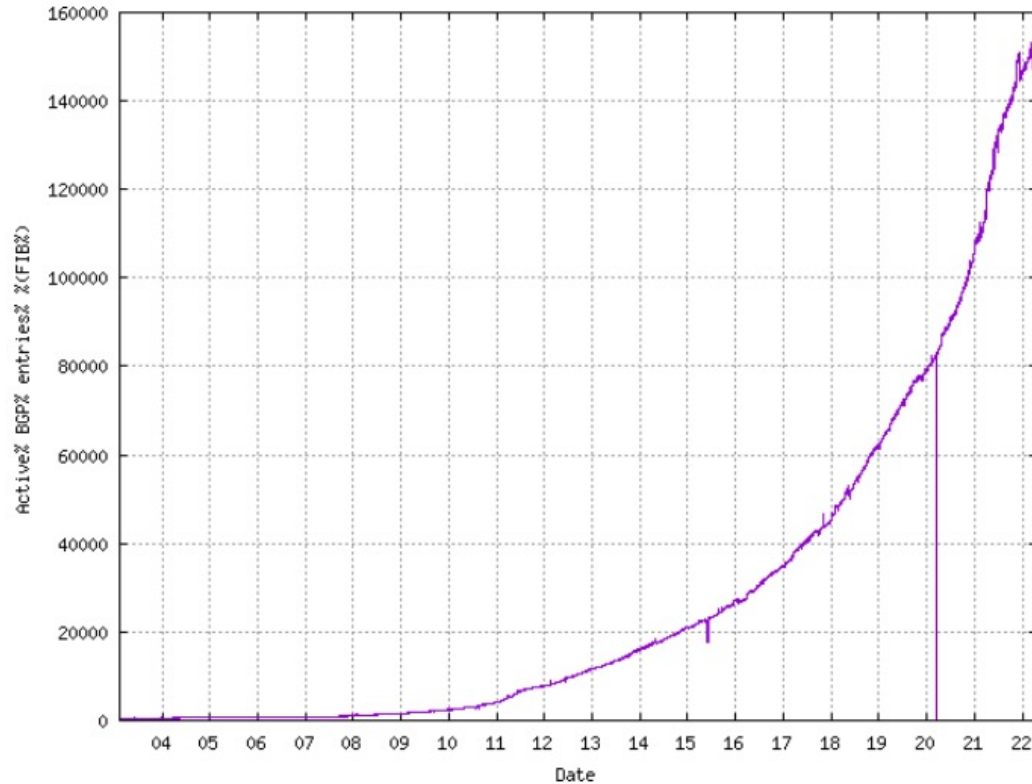
Economy	Delegates	IPv6 /48 prefixes
China	1872	3,320,184,959
Hong Kong	753	31,981,874
Taiwan	328	20,643,853
Japan	316	85,655,668
South Korea	57	3,080,202
Mongolia	31	1,048,591
Macao	6	262,146

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

IPv6 Transition

IPv6 BGP Prefixes – East Asia

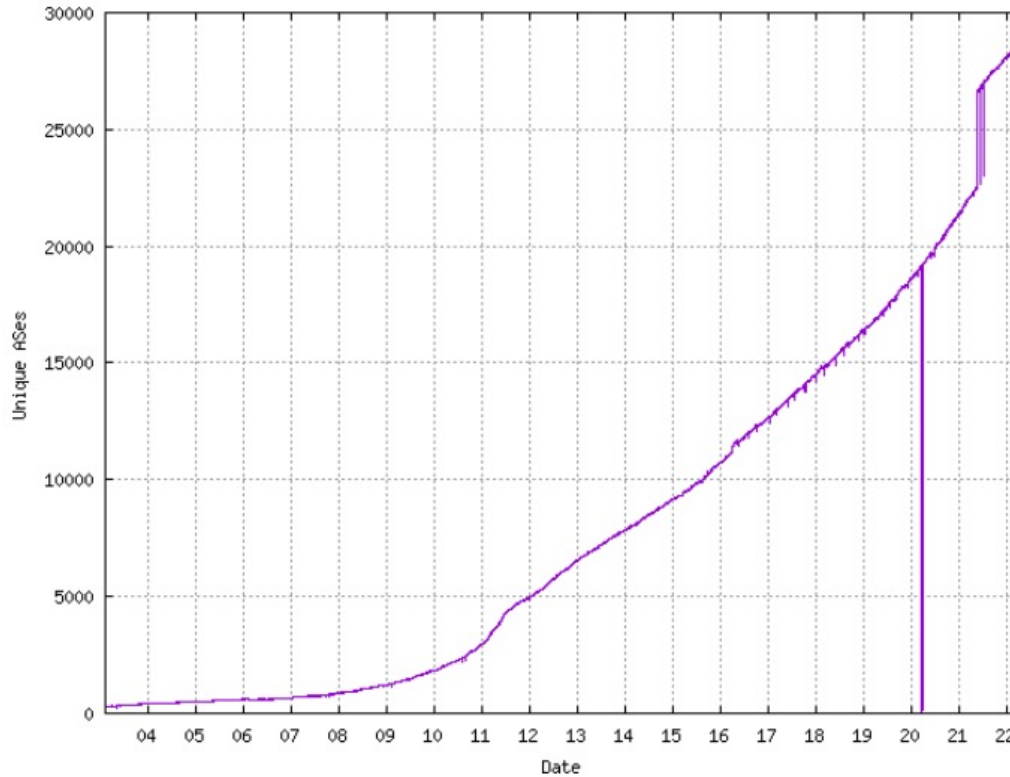
IPv6 Routing Table - Global



>150,000

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

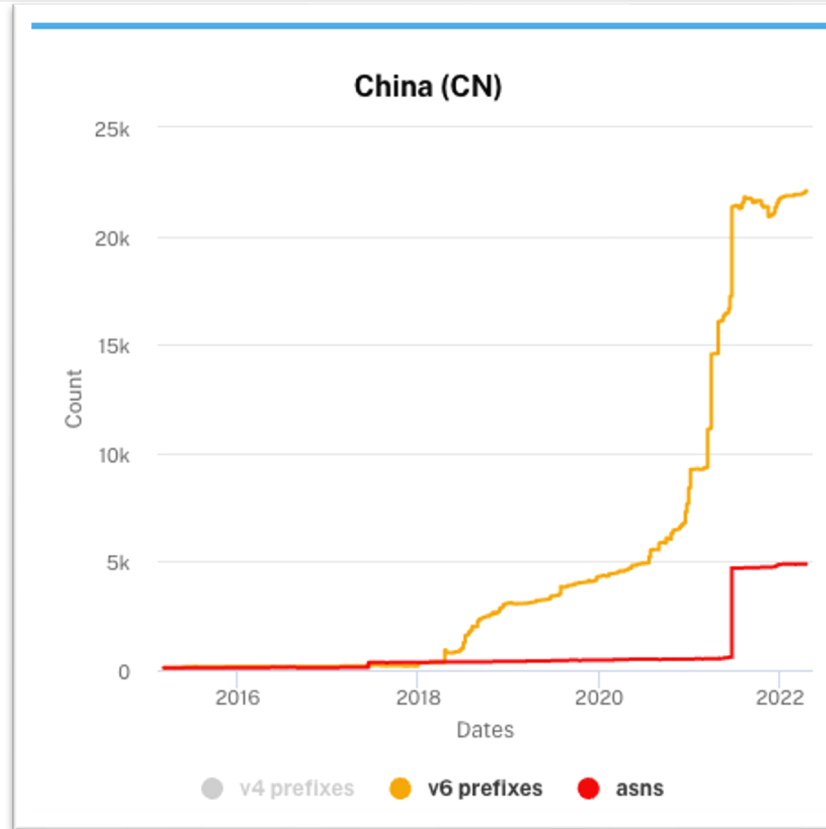
IPv6 AS Count - Global



>28,000

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

IPv6 BGP Prefixes - China



2022-04-17 14:00

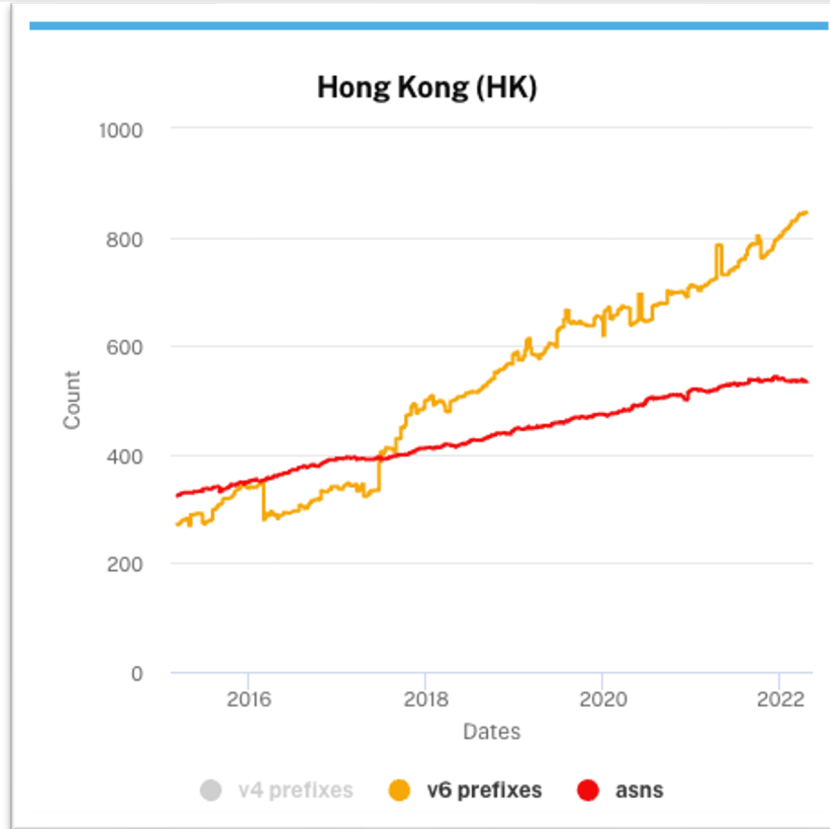
v6 prefixes: 22091

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

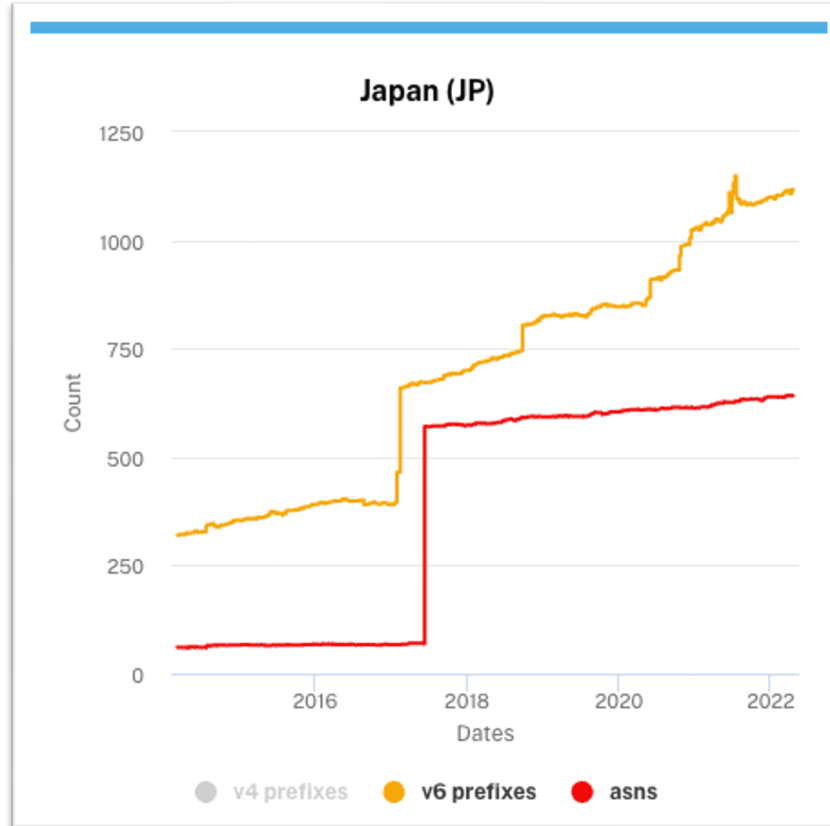
v6 prefixes: 846

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

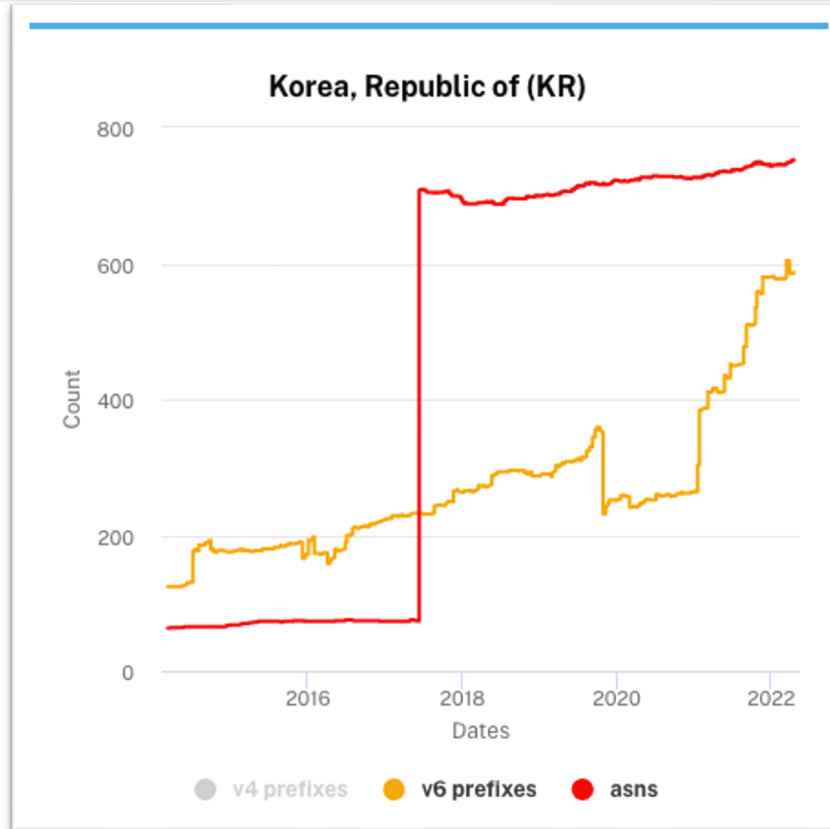
v6 prefixes: 1114

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

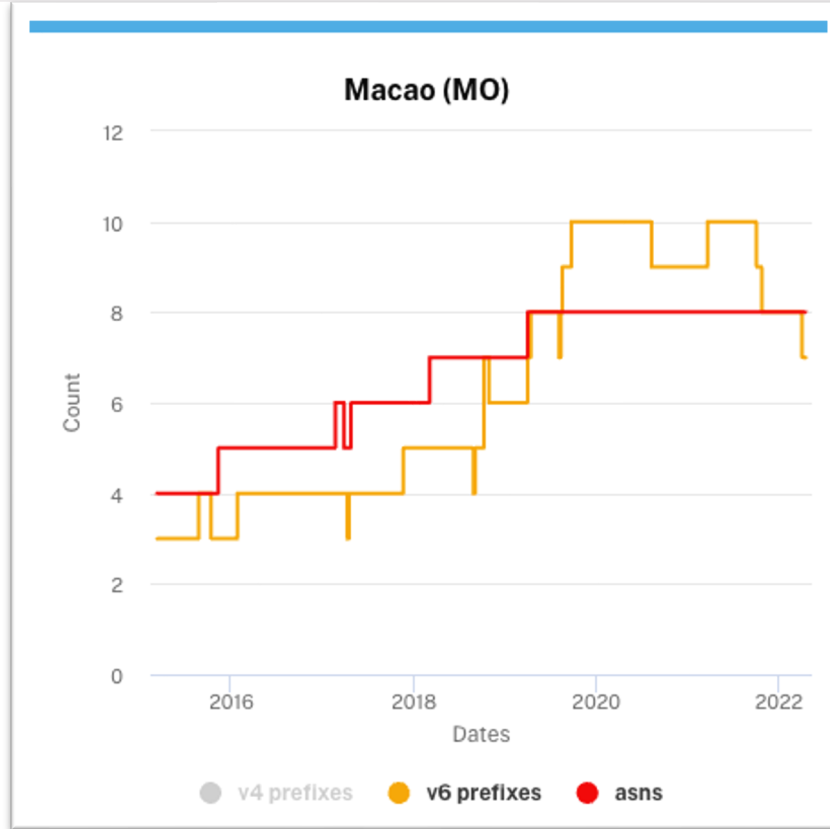
v6 prefixes: 587

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

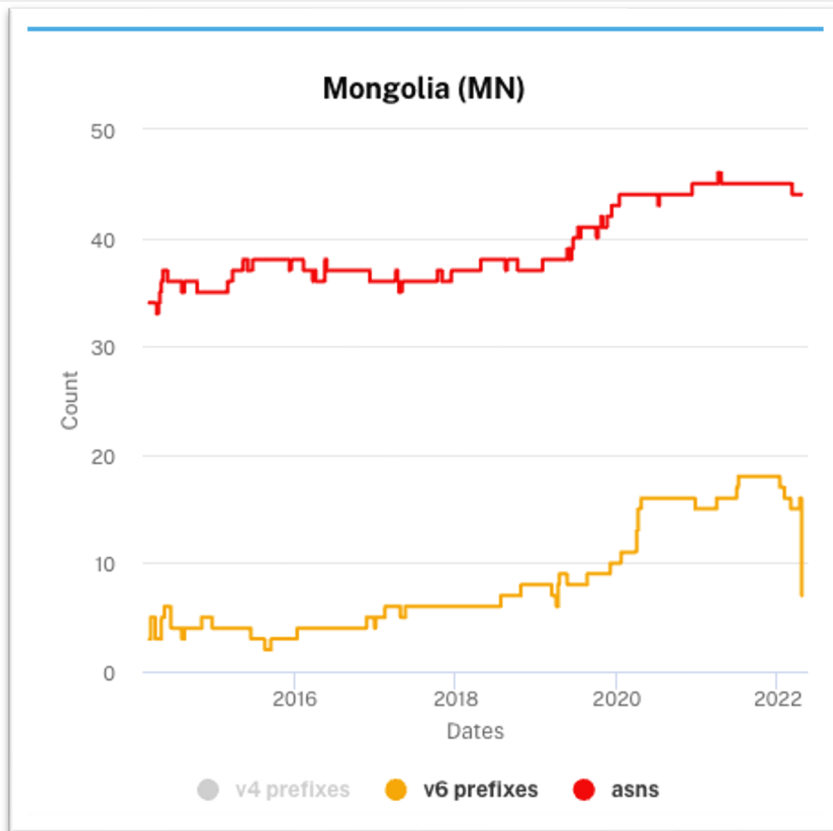
v6 prefixes: 7

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



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

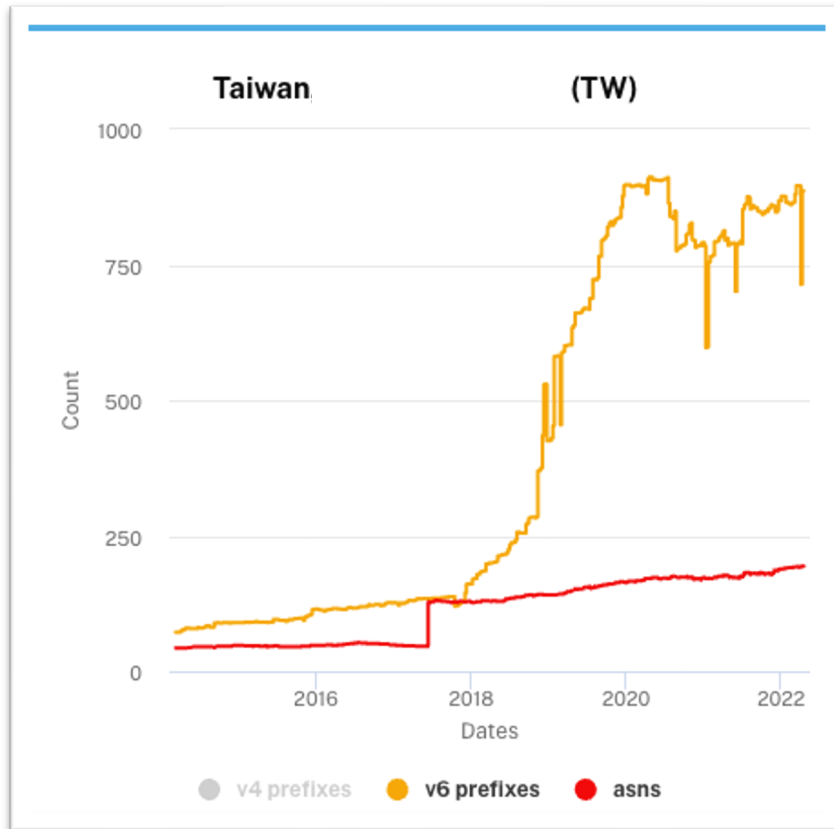
2022-04-17 14:00

v6 prefixes: 7

asns: 44

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)

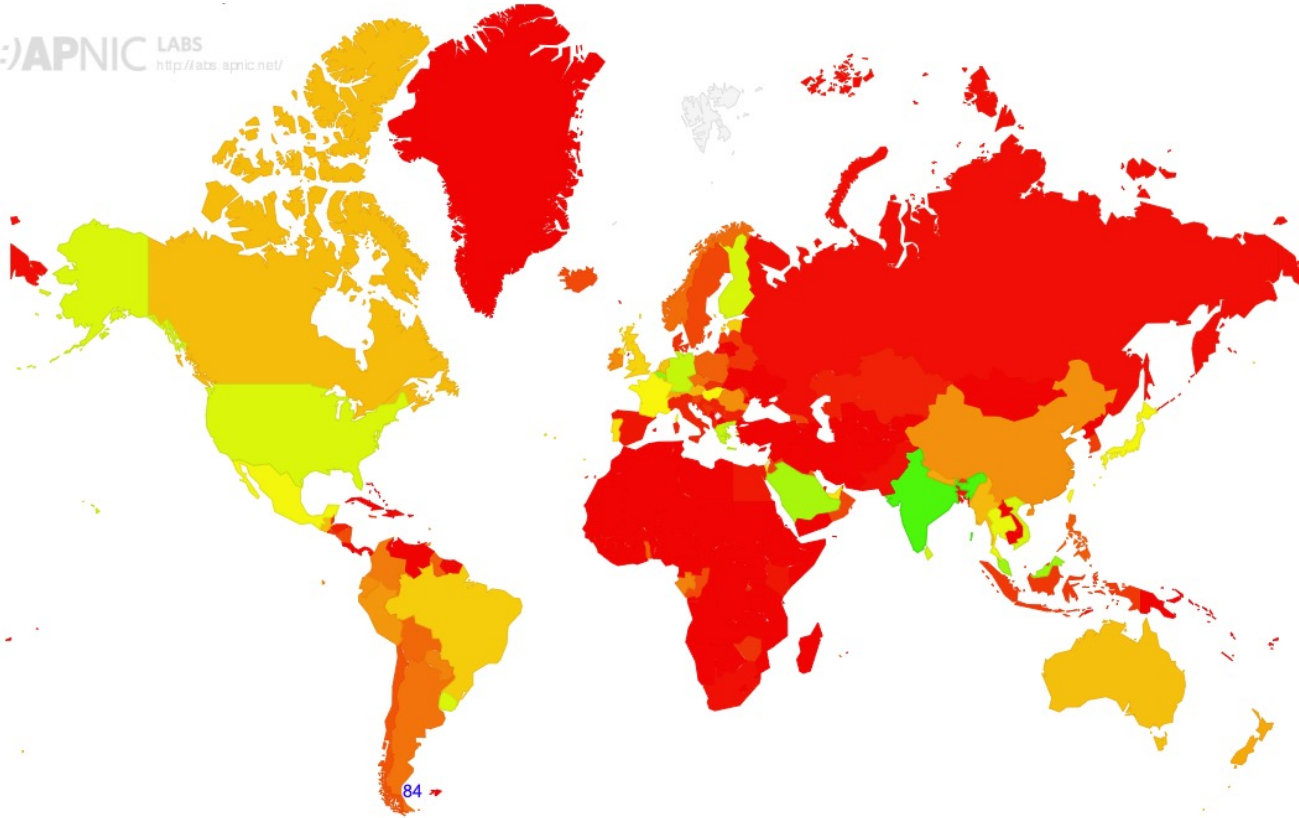
IPv6 Transition

IPv6 End-User Readiness – East Asia

Global IPv6 End-User Readiness



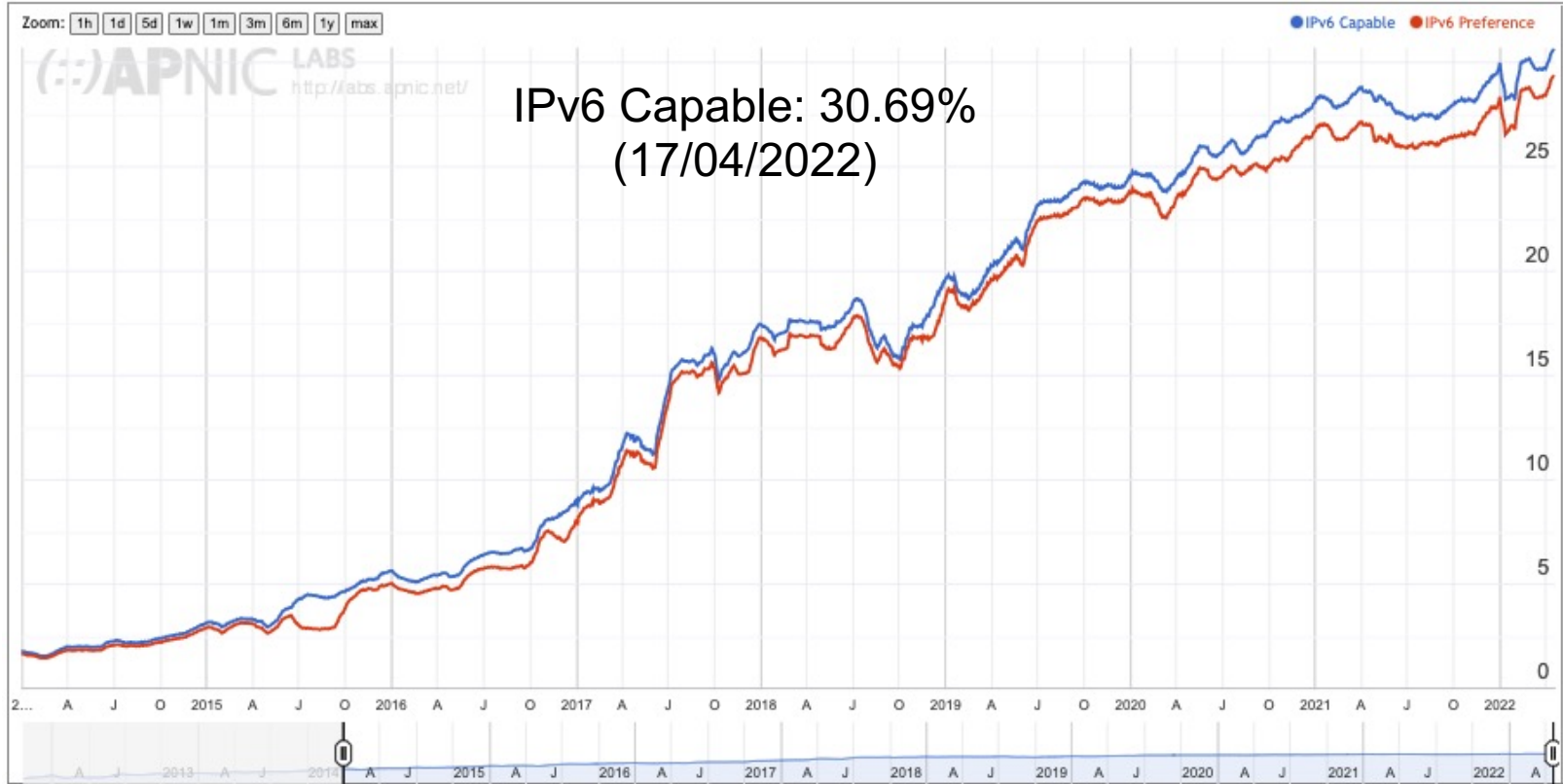
APNIC LABS
<http://stats.apnic.net/>



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



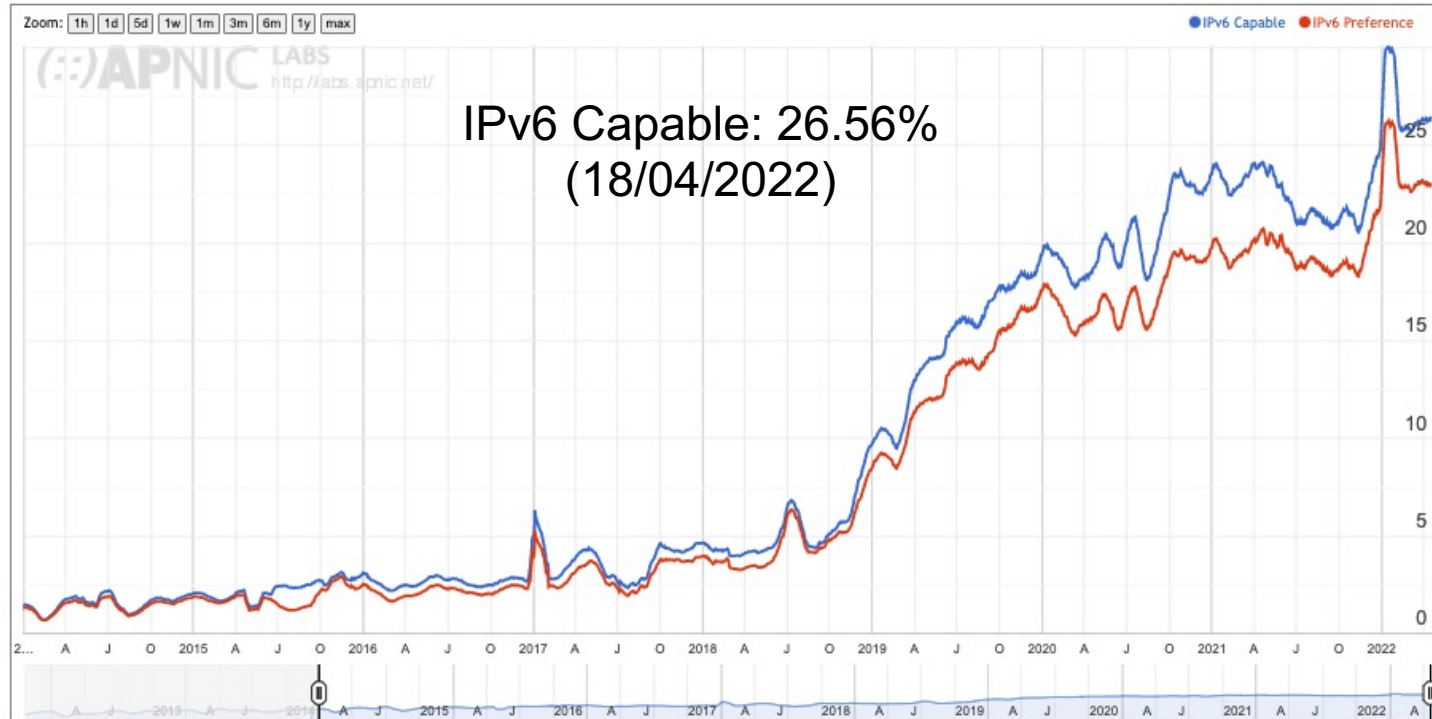
CC	Economy	IPv6 Capable	IPv6 Preferred
IN	India	77.53%	76.59%
MY	Malaysia	60.77%	60.14%
SA	Saudi Arabia	58.53%	57.21%
LK	Sri Lanka	50.76%	50.42%
VN	Vietnam	49.93%	49.58%
TH	Thailand	46.07%	45.85%
JP	Japan	43.89%	41.78%
TW	Taiwan	42.47%	41.73%
IL	Israel	41.40%	39.88%
AE	United Arab Emirates	39.33%	38.94%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

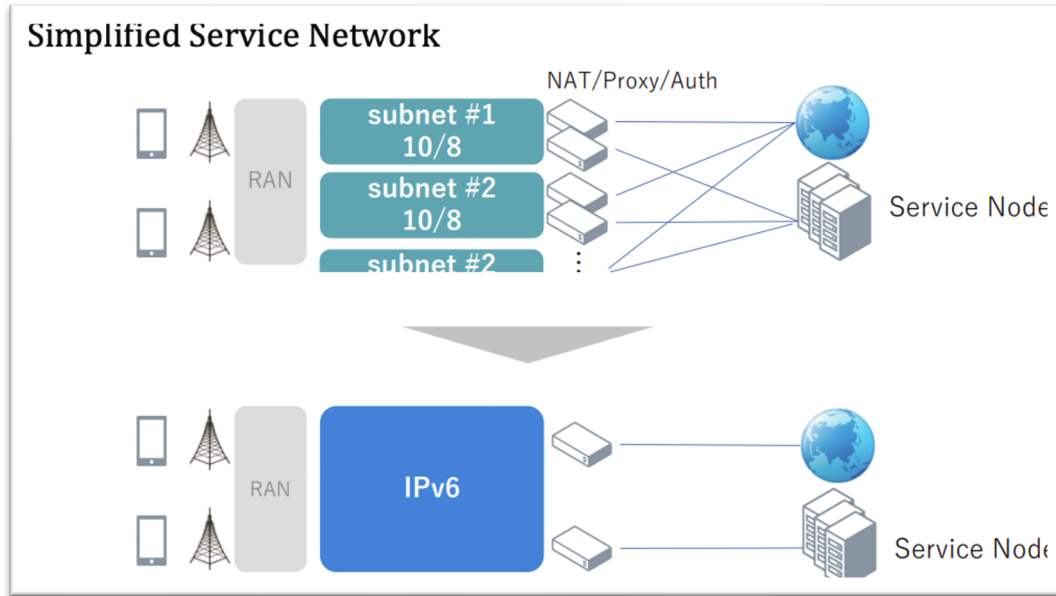


- Simplify network design
- Capability to support growth, IoT, Smart Cities, future services
- Government Encouragement
- Reduce load on CGN (Carrier-grade NAT)
- Lower CAPEX for NAT equipment

Simplify Network Design



- Simplify network design



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

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

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

Japan



Solution of IPv4 Exhaustion

au by KDDI

- Internet keeps expanding.
- Solution of IPv4 exhaustion
 - > Keep using IPv4 by LSN etc. [Temporary Solution]
 - > IPv6 deployment [True Solution]

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

Reasons for IPv6 Migration

To solve depletion problem of IP address for LTE users and providing IoT service platform



Japan

Korea



Solution of IPv4 Exhaustion

au by KDDI

- Internet keeps expanding.
- Solution of IPv4 exhaustion
 - > Keep using IPv4 by LSN etc. [Temporary Solution]
 - > IPv6 deployment [True Solution]

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



Why Did SKT Decide to Adopt IPv6 ?

Korea

Korean government's 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

The screenshot shows the official website of the Cyberspace Administration of China (CAC). The header features the national emblem and the text '中华人民共和国国家互联网信息办公室' (Cyberspace Administration of China) and 'WWW.CAC.GOV.CN'. A navigation bar includes links for '首页' (Home), '权威发布' (Authoritative Release), '办公室工作' (Office Work), '网络安全' (Network Security), '信息化' (Informatization), '网络传播' (Network Propagation), '国际交流' (International Exchange), '地方网信' (Local Network and Information), '执法督查' (Law Enforcement and Supervision), '政策法规' (Policy and Regulations), '互动中心' (Interaction Center), '教育培训' (Education and Training), '业界动态' (Industry Dynamics), and '工作专题' (Work Special Topics). The main content area displays a notice titled '中共中央办公厅 国务院办公厅印发《推进互联网协议第六版（IPv6）规模部署行动计划》' (The General Office of the Central Committee of the Communist Party of China and the General Office of the State Council issued the 'Action Plan for Large-scale Deployment of Internet Protocol Version 6 (IPv6)'). The notice is dated 2017年11月26日 20:00 and sourced from Xinhua. The text of the notice states that the General Office of the Central Committee and the General Office of the State Council have issued the 'Action Plan for Large-scale Deployment of Internet Protocol Version 6 (IPv6)' and issued a notice requiring various regions and departments to combine actual conditions and implement it seriously. A blue box at the bottom of the screenshot contains the text '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



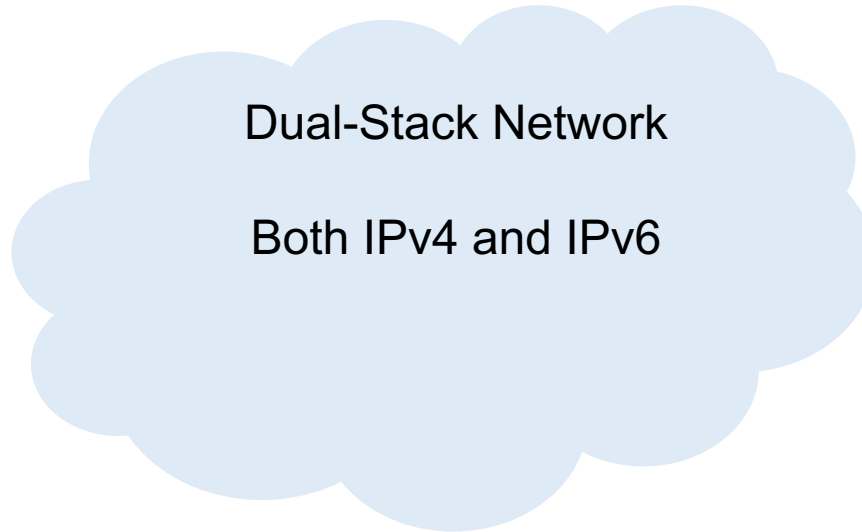
IPv6-only Host



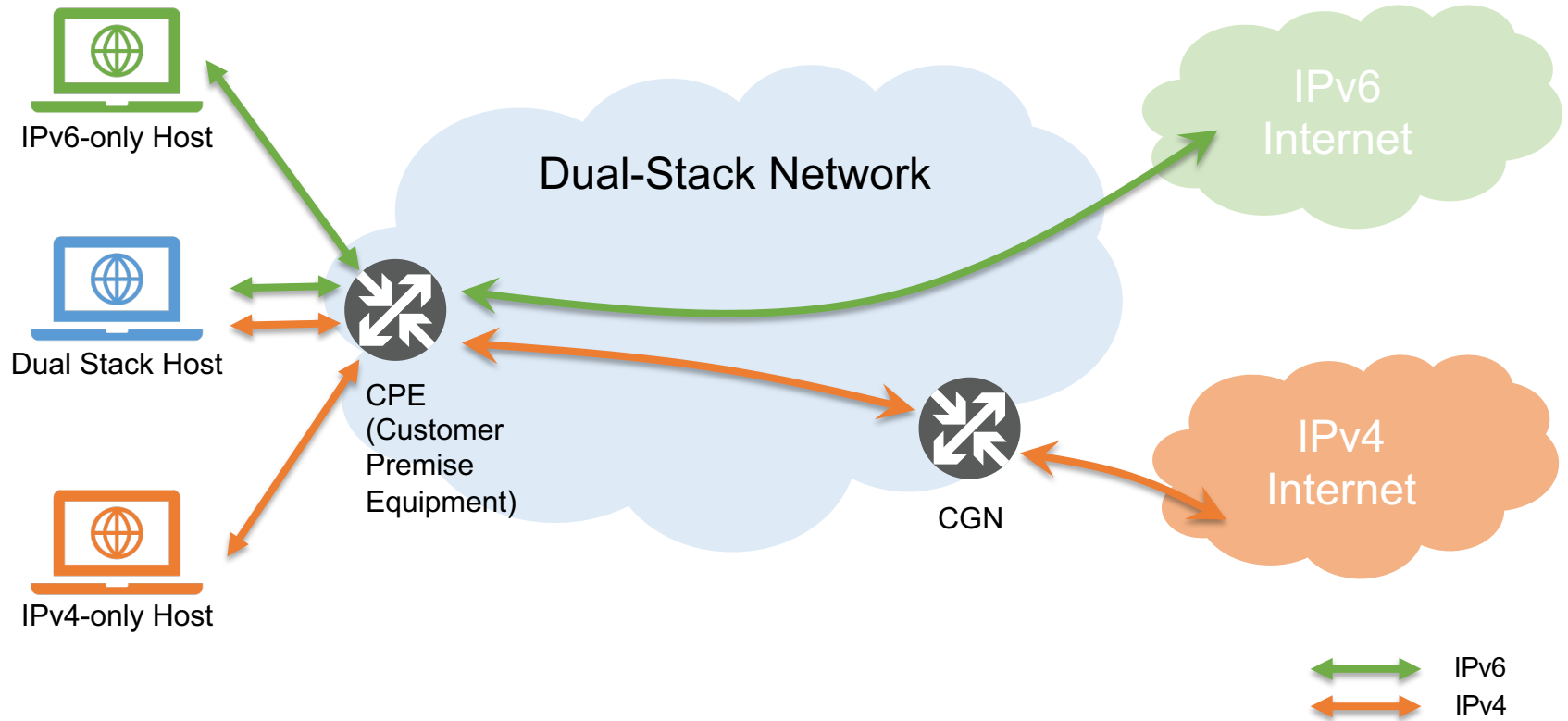
Dual Stack Host



IPv4-only Host



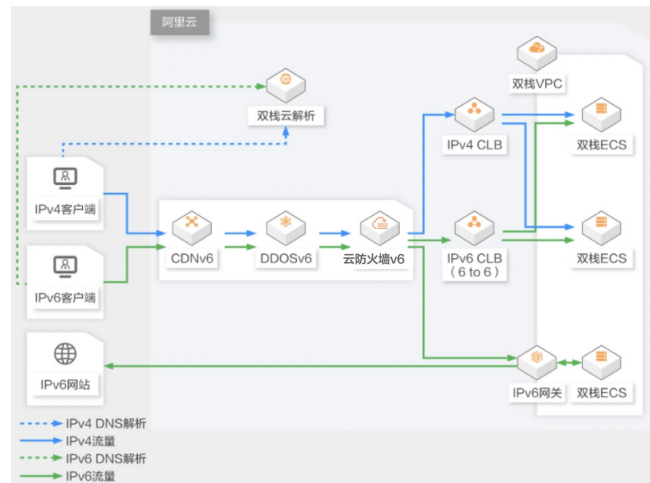
Dual-Stack



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

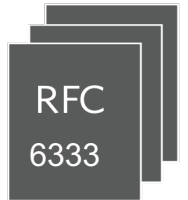
http://www.cac.gov.cn/2022-03/18/c_1649210670013195.htm

http://www.cac.gov.cn/2022-03/18/c_1649210954546225.htm

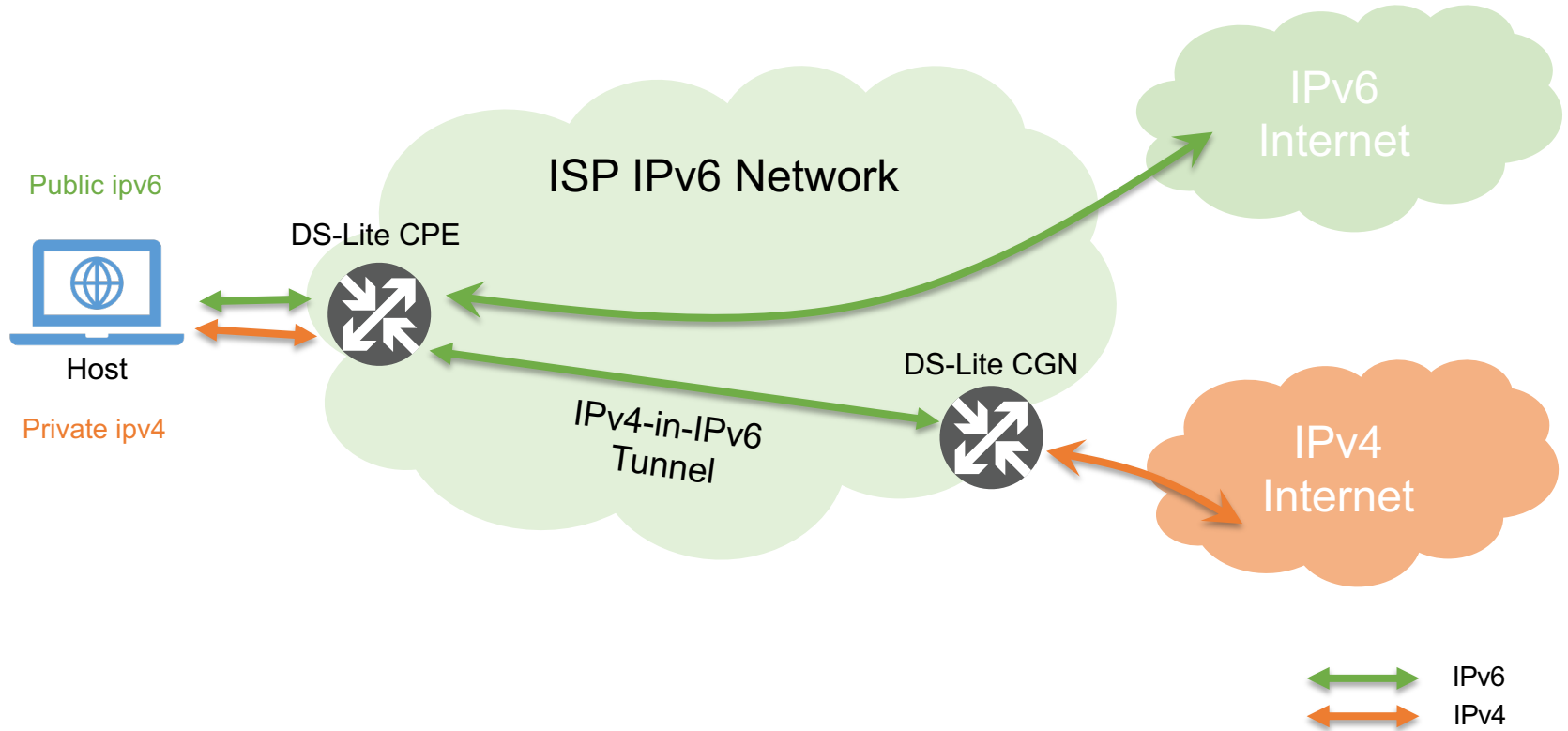
Dual-Stack Lite



- 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).



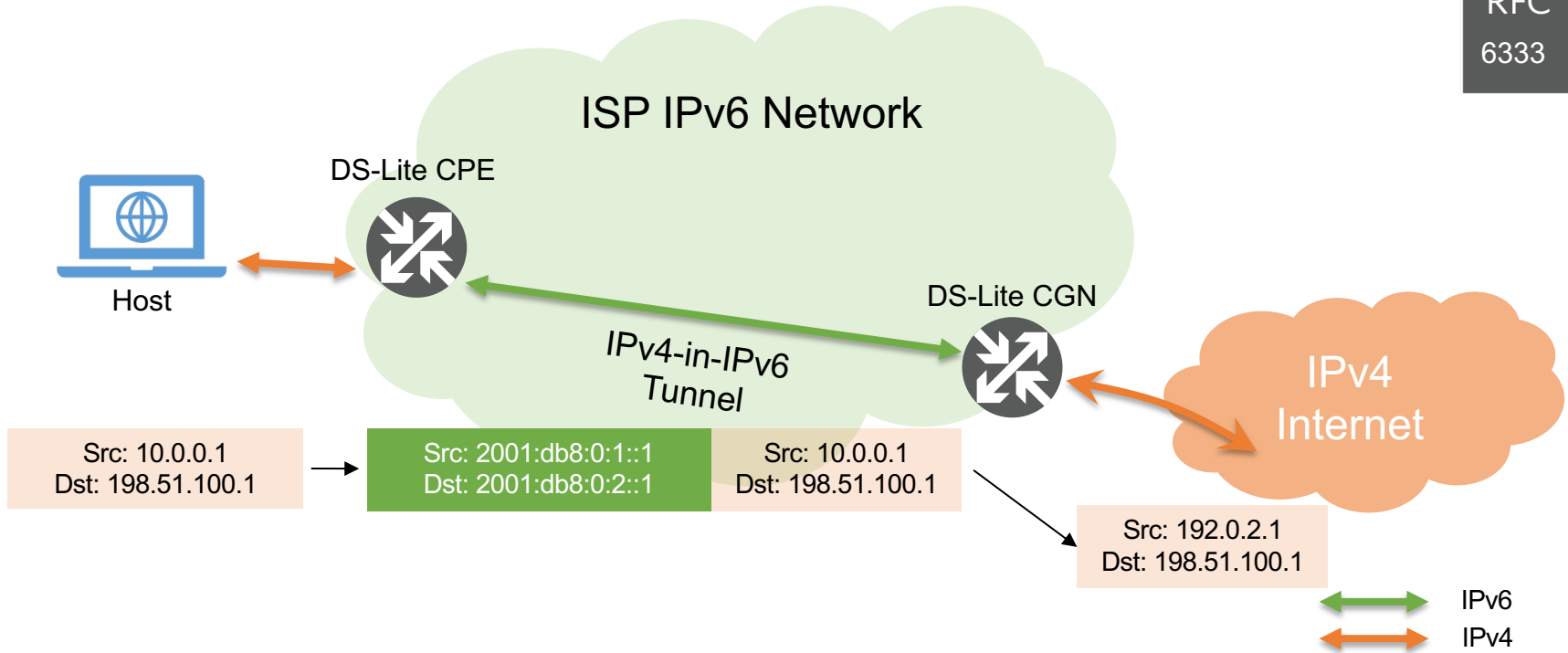
Dual-Stack Lite



Dual-Stack Lite



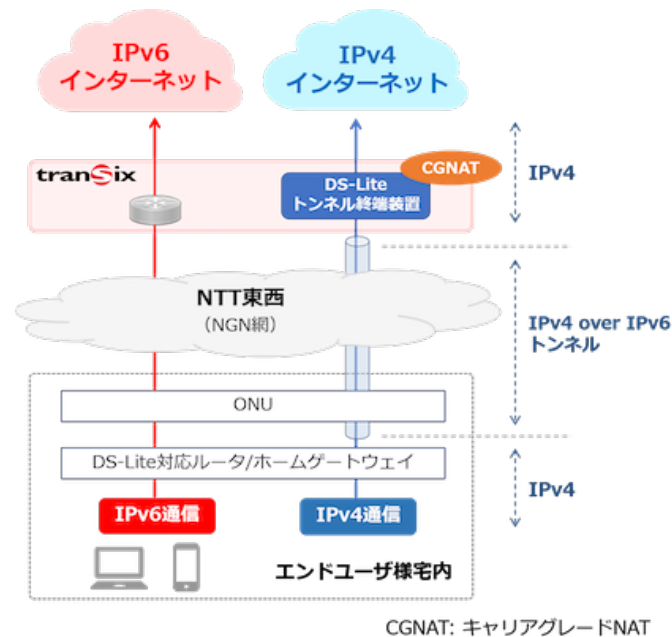
RFC
6333



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

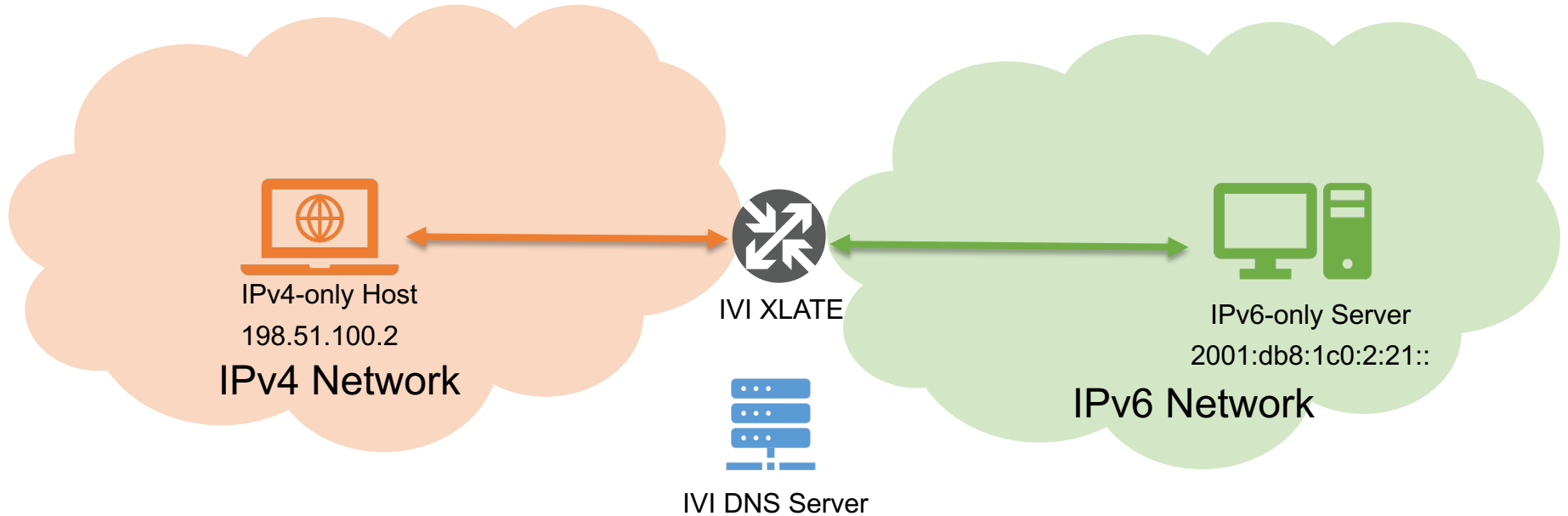
Translation – IVI



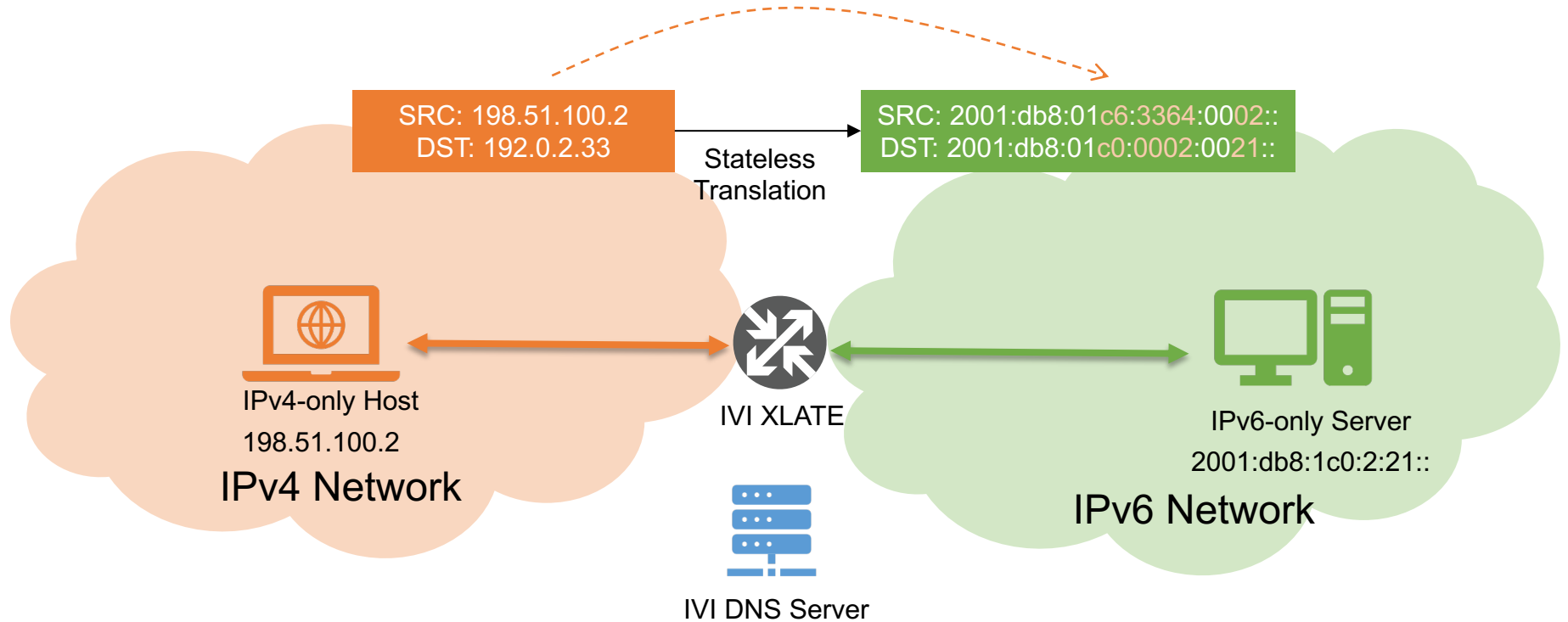
- The IVI is a prefix-specific and stateless address mapping mechanism for "an IPv6 network to the IPv4 Internet" and "the IPv4 Internet to an IPv6 network" scenarios.
- In Roman numerals, the "IV" stands for 4, and "VI" stands for 6, so "IVI" stands for the IPv4/IPv6 translation.



Translation – IVI



Translation – IVI



Further Development of IVI



IVI: IPv4/IPv6 translation

dIVI: Dual-Stateless IPv4/IPv6 Translation

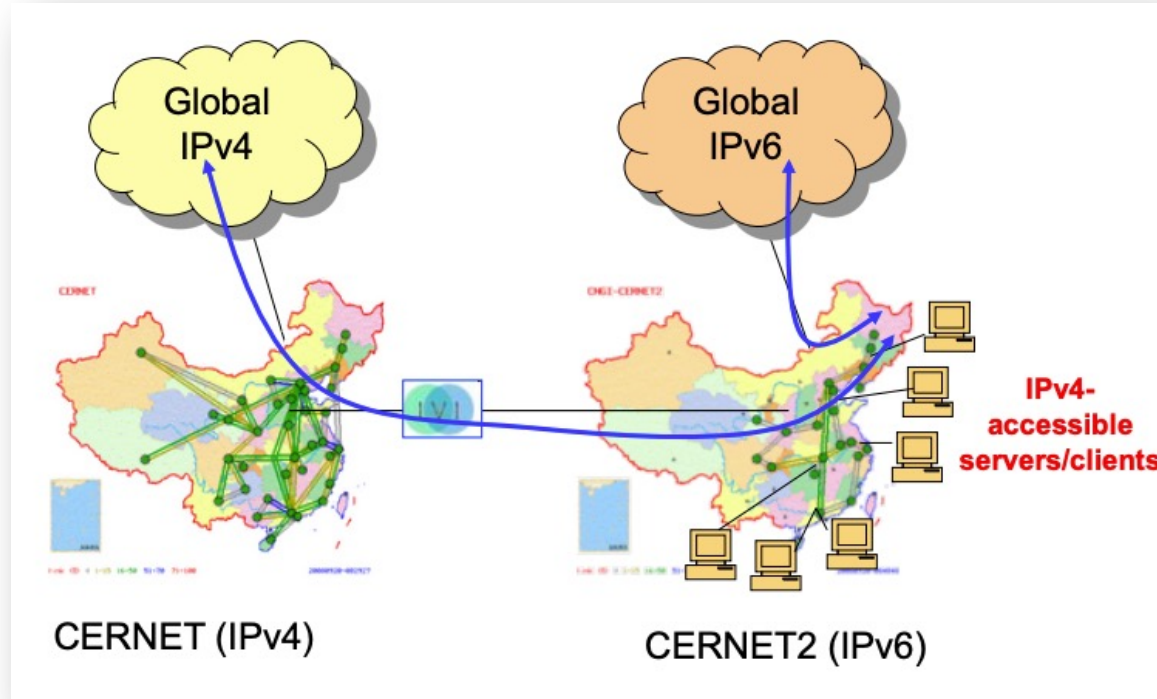
MAP-T: Mapping of Address and Port using Translation

MAP-E: Mapping of Address and Port with Encapsulation

Use Case – IVI



- China – China Education and Research Network (CERNET)

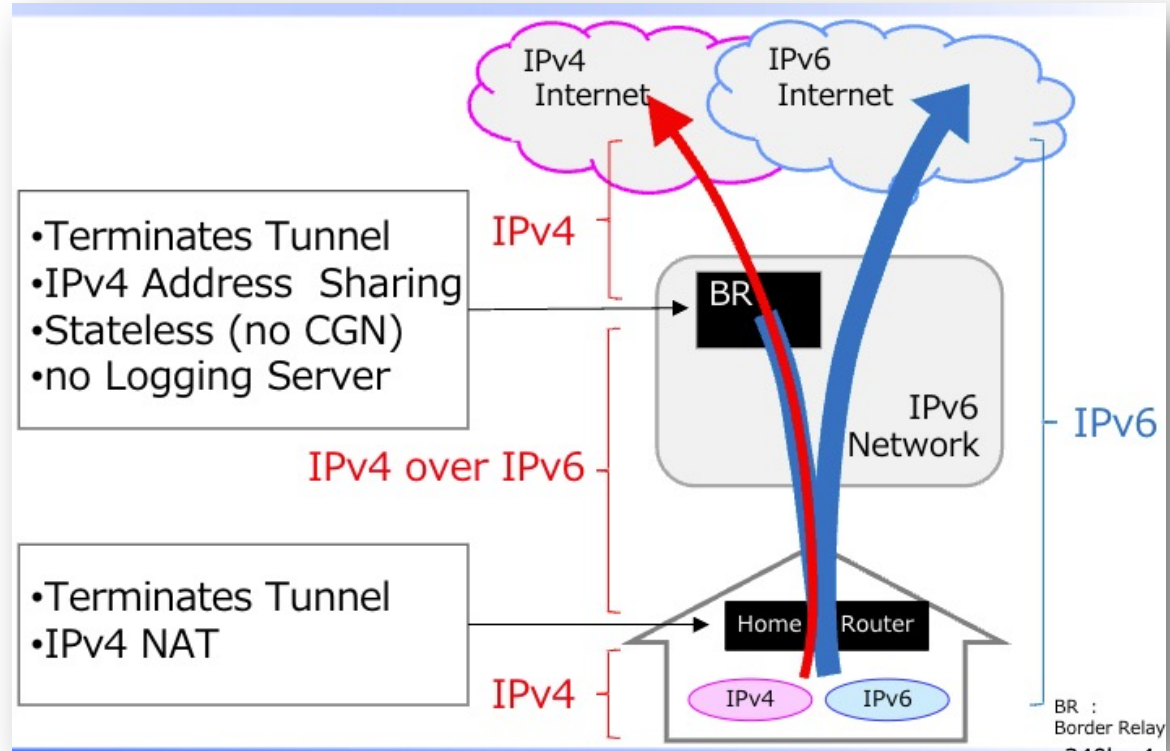


<https://meetings.apnic.net/31/pdf/Xing-Li-CERNET2-IPv6-experience-2011-v2.pdf>

Use Case – MAP-E



- Japan - JPNE



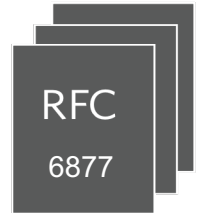
<https://dokumen.tips/internet/map-e-as-ipv4-over-ipv6-technology-with-some-operational-experiences.html?page=4>

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



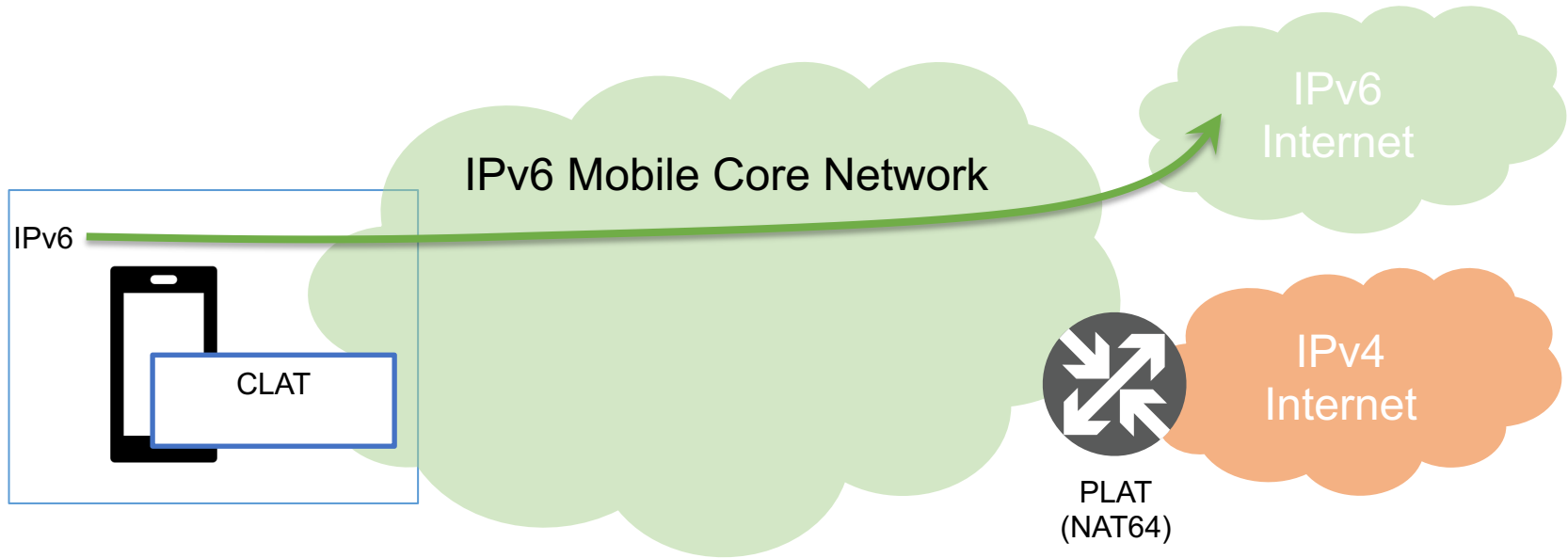
- 464XLAT is for providing limited IPv4 connectivity across an IPv6-only network by combining existing and well-known stateful protocol translation in the core and stateless protocol translation at the edge.

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

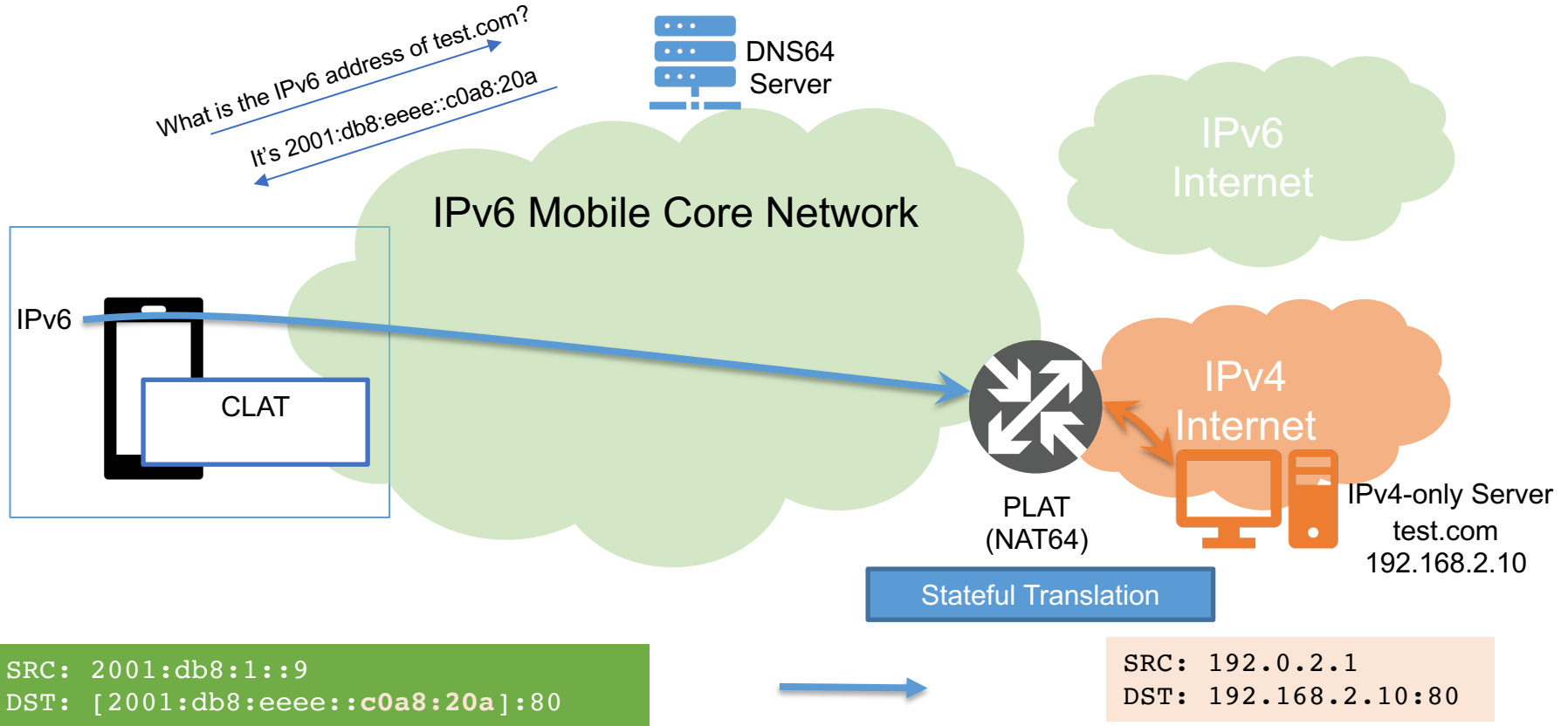


464XLAT: Combination of Stateful and Stateless Translation

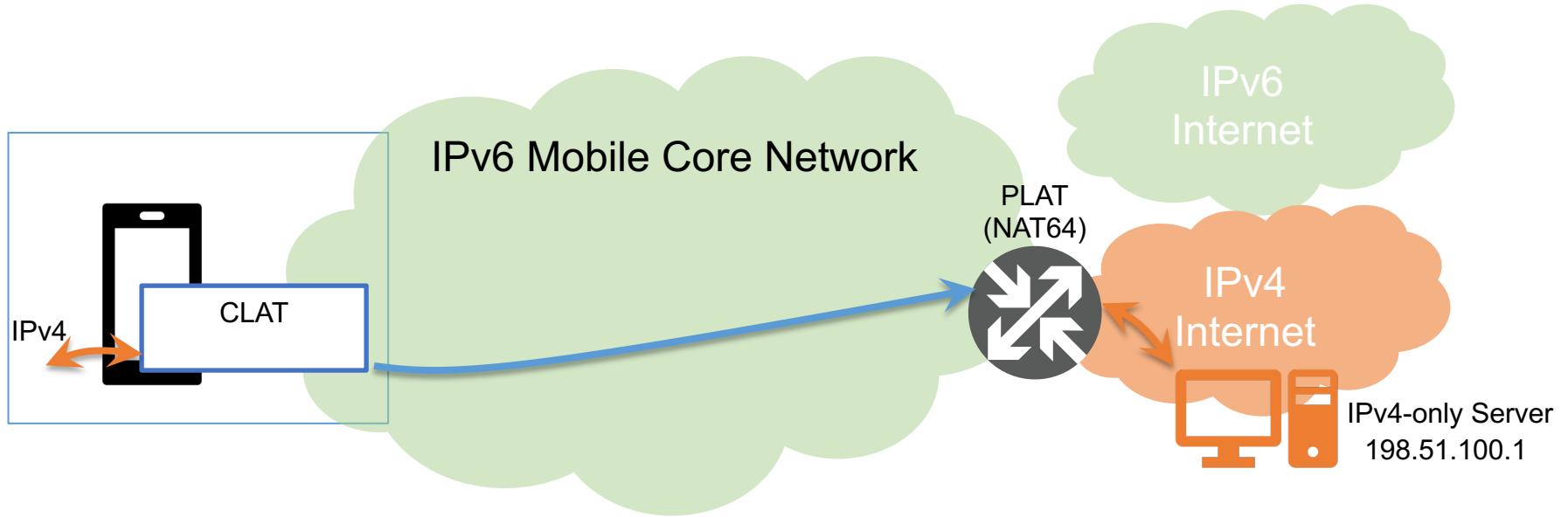
464XLAT – Scenario 1



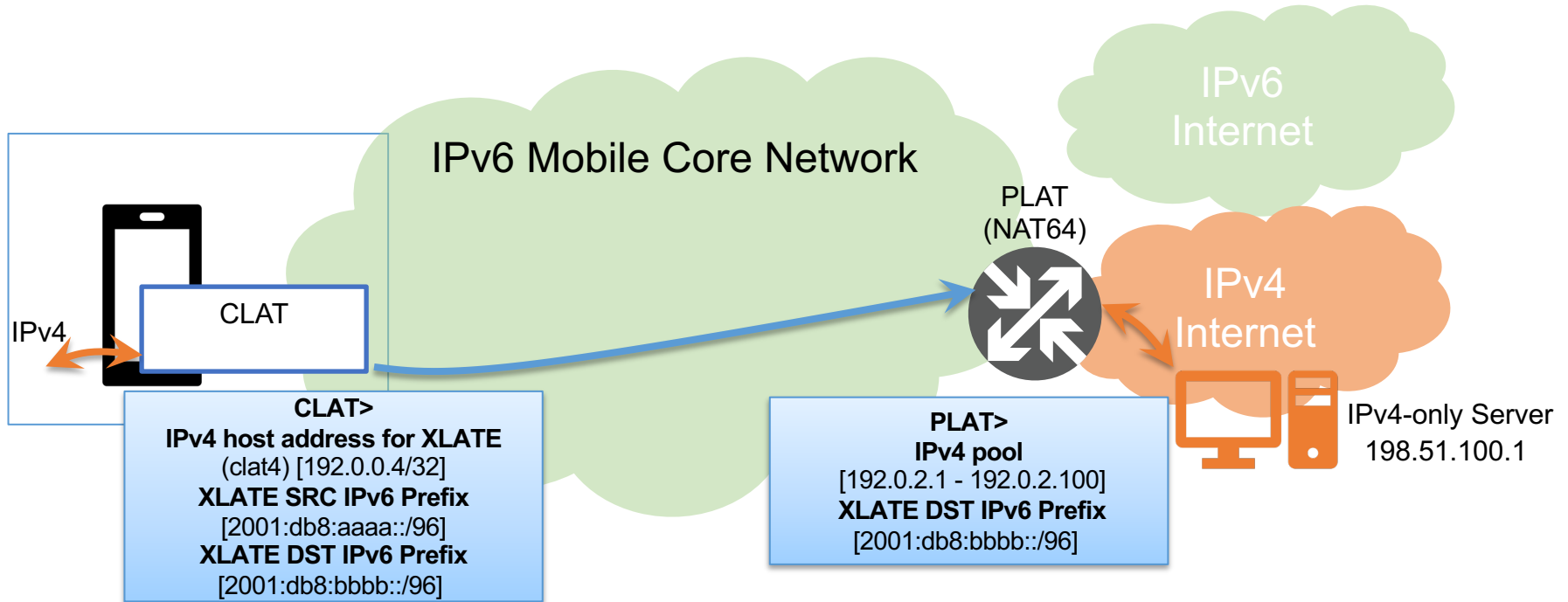
464XLAT – Scenario 2



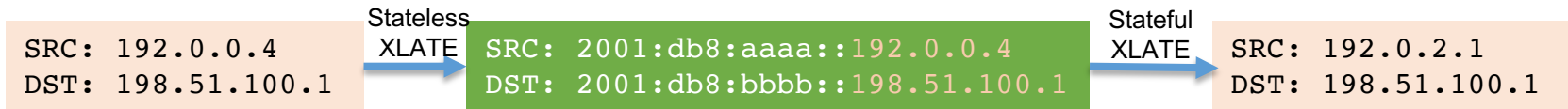
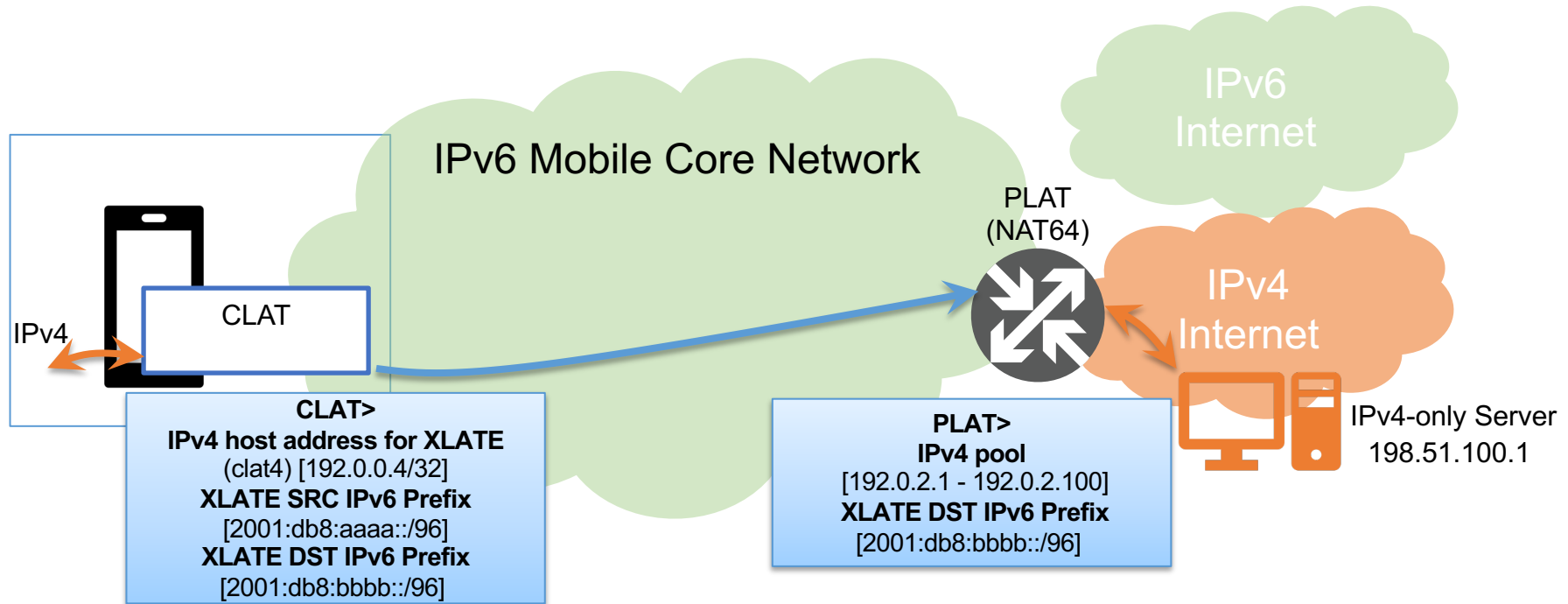
464XLAT – Scenario 3



464XLAT – Scenario 3



464XLAT – Scenario 3

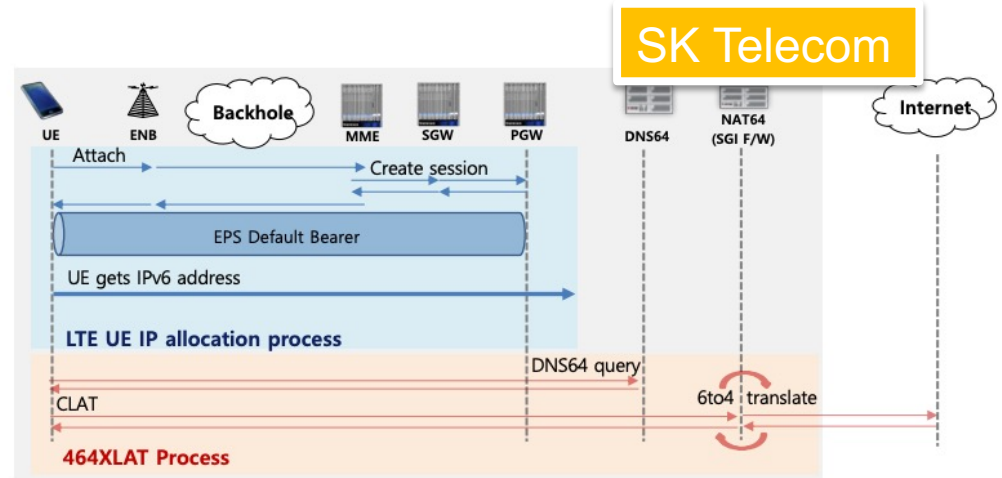


<https://conference.apnic.net/44/assets/files/APCS549/IPv6-in-Cellular-Networks.pdf>

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!

