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IPv6 Deployment:
Latest Status and
Remaining Challenges

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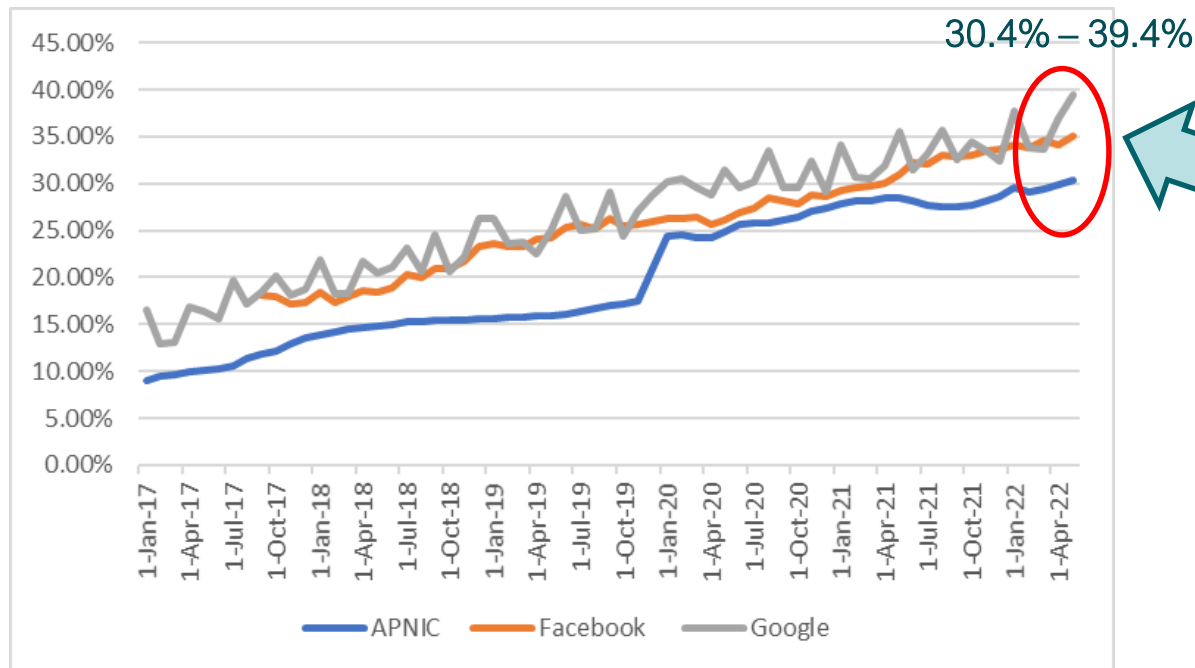European Standardization and Industry Development (SID)

Huawei Technologies

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Background of This Presentation

- "IPv6 Deployment Status" is a work started at the v6ops WG of IETF around two years ago

- Goals of the paper:
  - To overview latest IPv6 deployment status (obsoleting RFC 6036)
  - To analyze the remaining challenges to the transition to IPv6

- Early results presented at RIPE 82

- Scope of this presentation:
  - Provide an update on the main findings a year later
  - Discuss the remaining challenges
  - Listen from the RIPE community if anything is missing, or there are ideas that may lead to further analysis on the topic.

IPv6 Positive Momentum

30.4% – 39.4%

IPv6 connections

- IPv6 CAGR (2018-2022) 23.9% >> Internet population CAGR 4.3%
- View from the "Western World"
- Economies such as China are **not** fully represented
- Roughly, add **+5-7%** [ChStats]
- This brings to **~45%** (best case).

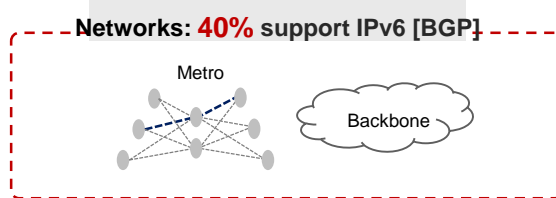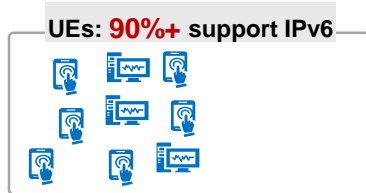- Data from [APNIC1], [ChStats], [Facebook], [Google], [Potaroo].

IPv6 Value Chain Ready: User - Network - Applications

IETF transition solutions ready by 2010; UEs & big applications ready by 2017; public clouds getting ready in 2022 to move SMEs to IPv6

Windows Vista

Apple iOS 4.1

Start IPv6 service (Akamai)

Start IPv6 service (NETFLIX)

IAB Statement

IPv6-only DCs

Azure aws support IPv6

YouTube Start IPv6 service

Android 4.0

Start IPv6 service (facebook)

Applestore all Apps

2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2022
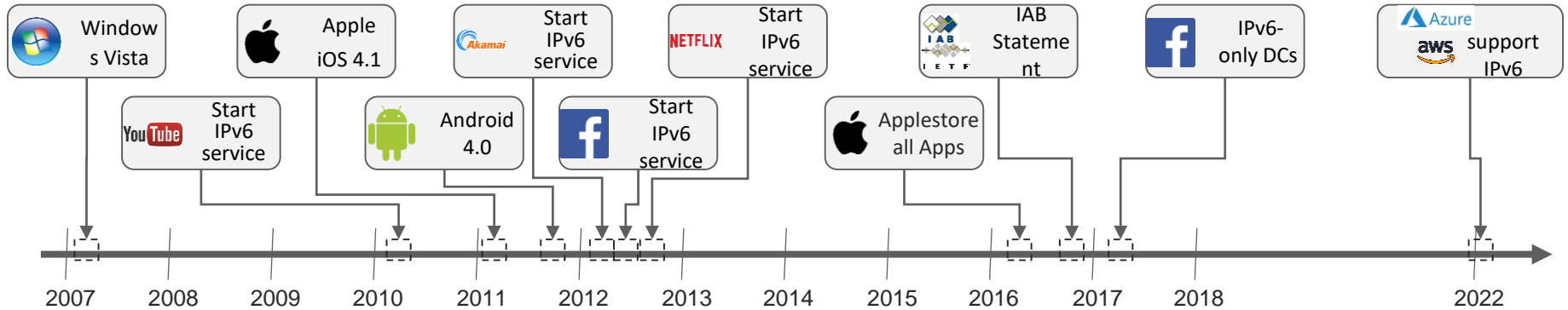
In IPv6 value chain, networks slightly behind UEs and big applications/clouds

2021

UEs: 90%+ support IPv6

Networks: 40% support IPv6 [BGP]

Metro

Backbone

Clouds: 50%+ support IPv6

Public Actions Are a Driver for IPv6 in Europe
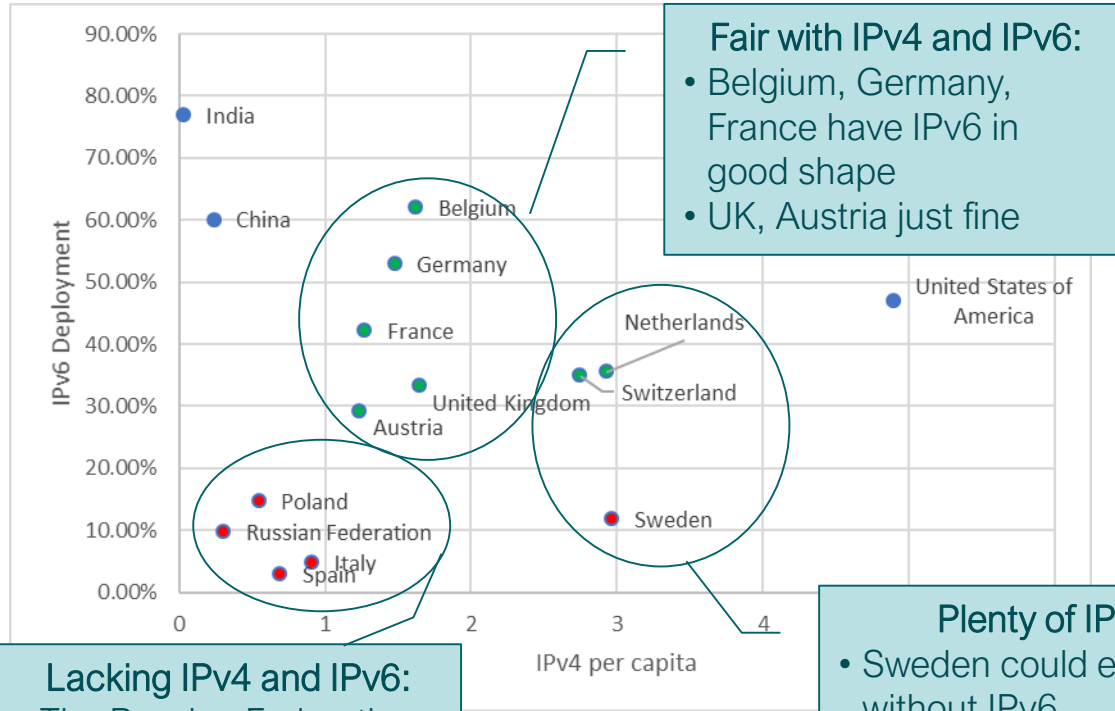
Fair with IPv4 and IPv6:
- Belgium, Germany, France have IPv6 in good shape
- UK, Austria just fine

Lacking IPv4 and IPv6:
- The Russian Federation, Poland, Spain and Italy need IPv4 but are not moving to IPv6!

Plenty of IPv4:
- Sweden could even live without IPv6
- Netherlands, Switzerland aligned with IPv6 trends

- Is the availability/lack of IPv4 addresses in a country a reason for (not) deploying IPv6?
- Direct correlation not straightforward
- What we observe is that in general **where/when governments, industry, market take actions then IPv6 moves ahead** (see US, China, India)
  - Red Country: quite below the world IPv6 trends (lack of actions)
  - Green Country: close or above the world trends (achieved after public or service provider's actions)
- Monitoring of such policies part of our job at Huawei Datacom SID. Available for offline talk
- Acknowledgements to work of Dr. Huston and APNIC [APNIC2].

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Despite IPv6 Steady Progress, Enterprises Lag Behind

Advertised ASNs	Jan-18	Jan-19	Jan-20	Jan-21	Jan-22	CAGR
IPv6-capable	14,500	16,470	18,650	21,400	28,140	18%
Total AS	59,700	63,100	66,800	70,400	72,800	5%
Ratio	24.3%	26.1%	27.9%	30.4%	38.7%	

- The CAGR of IPv6-capable Autonomous System (AS) Supporting IPv6 looks fine
  - +18% across the 5-years period, growing faster than IPv4
- Question: who is not supporting IPv6?
  - Researches indicate that enterprises are lagging behind in IPv6 deployment
  - How to handle the inaction of enterprises?

  - Data from [APNIC3], [APNIC4]

Challenge Analysis – An Overview

IPv6 experience sharing from **leading carriers, IPv6 councils** can help. **Public agencies** can drive

Motivation
- Lack the business case, motivation or pressure to make the transition.
- Think that IPv6 may be delayed with NAT or IPv4 purchase.

Knowledge
- Technical staffs not aware of IP standards, progress and deployment.
- Even worse, think IPv6 still has many issues to be solved.

Ecosystem
- Classes of devices still not supporting IPv6 (e.g. old CPEs, smart TVs).
- Cloud providers moving to IPv6, but many SMEs aren't.
- Incompatible vendor roadmap.

Technology
- Difficulty to identify transition path and technologies, in particular for SMEs.
- Some IPv6 features not field proven yet.
- Technical areas should need more investigation, or more knowledge sharing.

ICT industry as a whole can act here

IETF, Ripe… can lead to solve the technical issues

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IPv6 Challenges in Enterprises

- IPv6 in enterprises network is not a technical priority
  - In particular, in small and medium enterprises
  - Organizations driven by cost and risk models, hence no relevance to ICT unless key to the core business
- Speaking technically/operationally, some specific topics need to be considered anyway
  - For example, NAT become part of network architecture thinking
- How to move on: listen to and involve enterprises into discussion
  - Work together with enterprises to educate and identify suitable solutions to start with
  - Public agencies also have a role to push IPv6 further.

IPv6 Performance not yet Convincing

- IPv6 performance statistics still a bit worse than IPv4
  - IPv6 packet loss, e2e latency still higher
  - A few academic publications also indicate IPv6 is still catching up
- Good performance could be a real driver for IPv6 adoption
  - In particular, if end users would perceive the difference
- How to move on:
  - Would it make sense to think of a multi-players cooperation in this area?
  - E.g. field measurement or collaboration for a performance analysis.

Code	Region	Avg RTT Diff (V6-V4)	Avg V6 Fail Rate
XA	World	0.93 ms	0.97%
XB	Africa	6.74 ms	0.74%
XD	Asia	4.72 ms	0.87%
XF	Oceania	3.50 ms	1.03%
XE	Europe	-4.19 ms	1.04%
XC	Americas	-9.96 ms	1.32%

Performance varies greatly, e.g. IPv6 performs better IPv4 in Europe and NA. Note, due to averaged values, a single region can drag down the world's measure [APNIC5].

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Conclusion: More Can Still Be Done

- The progression of IPv6 deployment is still hindered by challenges
- A single or few stakeholders cannot make the difference
  - A combined joint effort by Governments, Industry players, Forums, Communities could
- Great to hear your opinion
  - There is a lot of knowledge that can be shared across the community
  - Operational guidelines, best current practices, ideas for new works…
  - For example, is there anything you feel should be really fixed in IPv6?
  - If there is interest, happy to talk about it.

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Many thanks!

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Questions?

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