IPv6 Deployment Status

draft-vf-v6ops-ipv6-deployment-02

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Background

- This document aims to investigate what is missing and how to improve the current IPv6 deployment strategies of the network operators, service providers and enterprises

- The objective is to give an updated view of the practices and plans already described in [RFC6036].

- The IPv6 incentives are presented but the general IPv6 challenges are also reported in particular in relation to Architecture, Operations, Performance and Security issues

- Also, IPv4 exhaustion is discussed

Changes from version -01

- Draft -01 presented at IETF 109
- Since then received feedback both privately and in the mailing list
- Added new specific sections:
  - IPv4 exhaustion
  - IPv6 in Cloud Service Providers' networks/DCs
  - Updated table on the status of IPv6
  - Added further parts in "Call for action"

Updated status of IPv6

Different analytics have been made available by many agencies and institutions worldwide

	Dec-16	Dec-17	Dec-18	Dec-19	Dec-20	CAGR
Est. IPv6 users	300,845,933	473,141,741	543,039,134	990,187,097	1,201,092,420	41%

Estimated IPv6 users

IPv6 allocations per Registry

Allocations	Dec-16	Dec-17	Dec-18	Dec-19	Dec-20	Cumulated 2016-2020	CAGR
AFRINIC	116	112	110	115	109	562	48%
APNIC	1,681	1,369	1,474	1,484	1,498	7,506	45%
ARIN	646	684	659	605	644	3,238	50%
LACNIC	1,009	1,549	1,448	1,614	1,801	7,421	65%
RIPENCC	2,141	2,051	2,620	3,104	1,403	11,319	52%
Total	5,593	5,765	6,311	6,922	5,455	30,046	52%

Allocations	Dec-16	Dec-17	Dec-18	Dec-19	Dec-20	Cumulated 2016-2020	CAGR
IPv6	5,593	5,765	6,311	6,922	5,455	30,046	52%
IPv4	10,515	9,437	10,192	14,019	7,437	51,600	49%

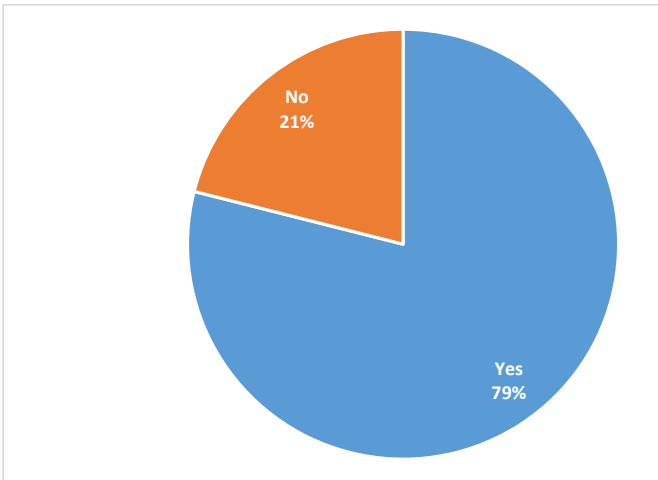
Allocations per address family

Percentage of IPv6-capable ASes

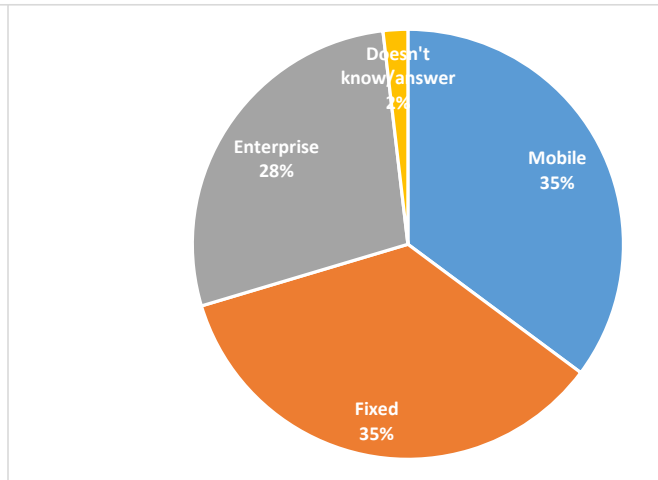
Advertized ASNs	Dec-16	Dec-17	Dec-18	Dec-19	Dec-20	CAGR
IPv6-capable	12,700	14,500	16,470	18,600	21,400	14%
Total AS	56,100	59,700	63,100	66,800	70,400	6%
Ratio	22.6%	24.3%	26.1%	27.8%	30.4%	

Network Operators Survey on IPv6

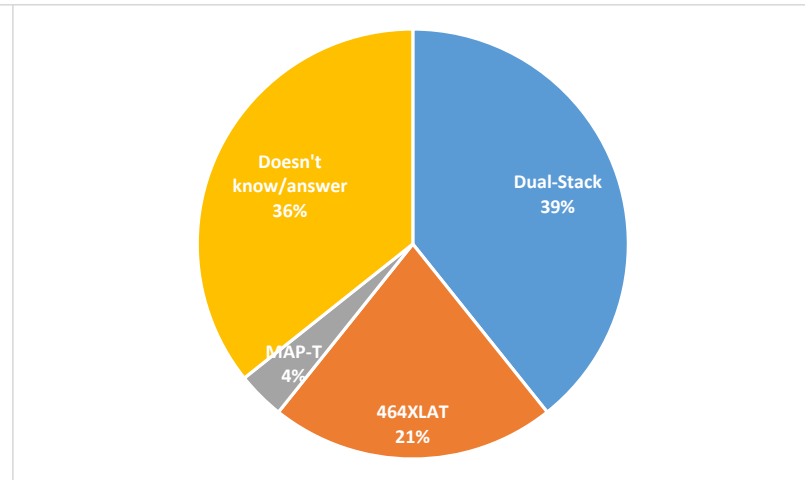
- Survey shared with more than 50 Operators in Europe
- Questions and Answers reported in the draft. Mainly related to the plans to deploy/move to IPv6, which technology to rely on, the timeline
- Global IPv4 address depletion is reported by most operators as the driver for IPv6 deployment. The main reason for IPv6 deployment is related to the run out of private 10.0.0.0/8 space (RFC1918). 5G and IoT service deployment is another incentive.
- A major IPv6 migration will happen in next 2 years. Dual Stack is always the most adopted solution and the transition to IPv6-only is motivated in particular by business reasons like the 5G and IoT requirements.



Do you have plans to move more users (fixed, mobile or enterprise) to IPv6 in the next 2 years?



If so, in fixed, or mobile, or enterprise?



Which transition solution will you use: Dual-Stack, DS-Lite, 464XLAT, MAP-T/E? [Mobile]

Considerations for Enterprises, CSPs, Vertical Industries

Enterprises

- The overall problem for many enterprises is to handle IPv6-based connectivity to the upstream providers, while supporting a mixed IPv4/IPv6 domain in the internal network.
- The most common drivers are on the external network due to the fact that Internet service providers will provide native IPv6 and non-native IPv4.

Could Service Providers

- Most of the major players are at different stages in the transition to IPv6-only in their DC infrastructure.
- In some cases, the transition already happened and the DC infrastructure of these hyperscalers is completely based on IPv6.

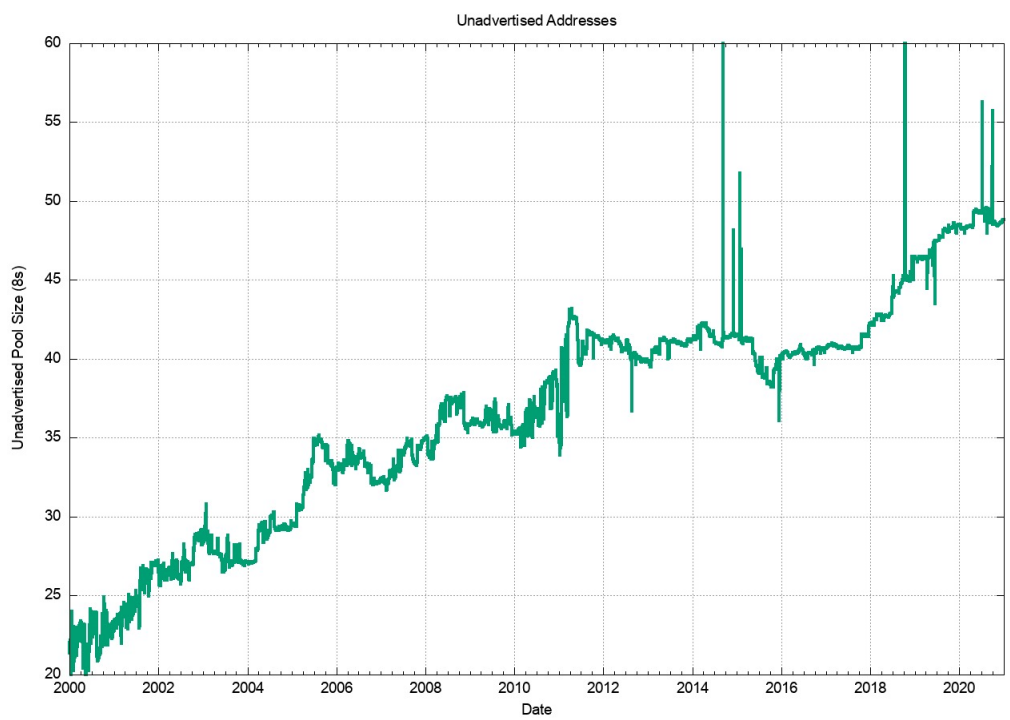
Industrial Internet

- There are potential advantages for implementing IPv6 for IIoT applications, in particular the large IPv6 address space, the automatic IPv6 configuration and resource discovery.
- However, there are still many obstacles that prevent its pervasive use, such as the incomplete or immature tool support, the dependency on manual configuration and the poor knowledge of the IPv6 protocols among insiders.

IPv4 Exhaustion

- New section introduced as requested by the list
- Excellent source of information: "Addressing 2020" https://www.potaroo.net/ispcol/2021-01/addr2020.html, RIRs statistics
- How to interpret the "Unadvertised addresses"?
- Seems good for IPv6 - or is it due to increased use of NAT?

	Available IPv4 addresses		Reserved IPv4 addresses	
RIR	2019	2020	2019	2020
APNIC	2,937,088	4,003,072	4,398,848	2,483,968
RIPE NCC	1,536	328,448	1,072,608	965,728
ARIN	4,096	4,352	6,137,600	5,509,888
LACNIC	50,688	-	1,416,448	266,240
AFRINIC	2,638,848	1,925,888	1,920,256	2,853,888
TOTAL	5,632,256	6,261,760	14,945,760	12,079,712



Call for Action: Transition Choice and Network Operations (1/2)

- There are some areas for improvement, often mentioned in the literature and during the discussions on IPv6 deployment (Section 10 of the draft)
- The intention is to take them into consideration and provide arguments or actions to support IPv6
- Topics already introduced at IETF 109:
  - **Transition choices for Service Providers and Enterprises**,
  - **Operations and Performance**,
  - **Security**
- New additions:
  - **Cloud Providers and Data Centers**: they have adopted IPv6 in their internal infrastructure but are also active in gathering IPv4 addresses on the transfer market to serve the current business needs of IPv4 connectivity.
    - Several enterprises do not consider the transition to IPv6 as a priority, but if CSPs start struggling to buy IPv4 addresses this may turn into a fee to enterprises
  - **Industrial Internet**: IPv6 is frequently mentioned in relation to Internet of Things and Industry 4.0, however, its adoption has been much slower than expected.
    - Important to provide an easy way to familiarize with the IPv6 protocol and its role in the application development life cycle

Call for Action: Transition Choice and Network Operations (2/2)

- New additions:
  - **IIoT applications**: it would be desirable to implement a truly distributed system without dependencies to central components like a DHCP server
    - In this regard the distributed IIoT applications can leverage the configuration-less characteristic of IPv6 and in this regard all the possible problems and compatibility issues with IPv6 link local addresses, SLAAC needs to be investigated
  - **Government and Regulators**: "stimulate if you can, regulate if you must". The deployment of IPv6 worldwide is not uniform - countries where either market conditions or local regulators have stimulated the adoption of IPv6 show clear sign of growth:
    - In the European Union area, Belgium, France and Germany are well ahead in terms of IPv6 adoption
    - The French National Regulator, Arcep, introduced an obligation for the operators awarded with a license to use 5G frequencies (3.4-3.8GHz) in France to be IPv6 compatible: "the goal is to ensure that services are interoperable and to remove obstacles to using services that are only available in IPv6". A slow adoption of IPv6 could prevent new Internet services to widespread or create a barrier to entry for newcomers to the market. "IPv6 can help to increase competition in the telecom industry, and help to industrialize a country for specific vertical sectors"

Next Steps

- Get inputs from the Working Group
  - Anything missing?
  - Opinions on IPv4 exhaustion
  - More incentives or issues still pending?
- Open to new contributors
- Comments are welcome

Thank you