

Let's talk about numbers:

The IANA Numbering Services

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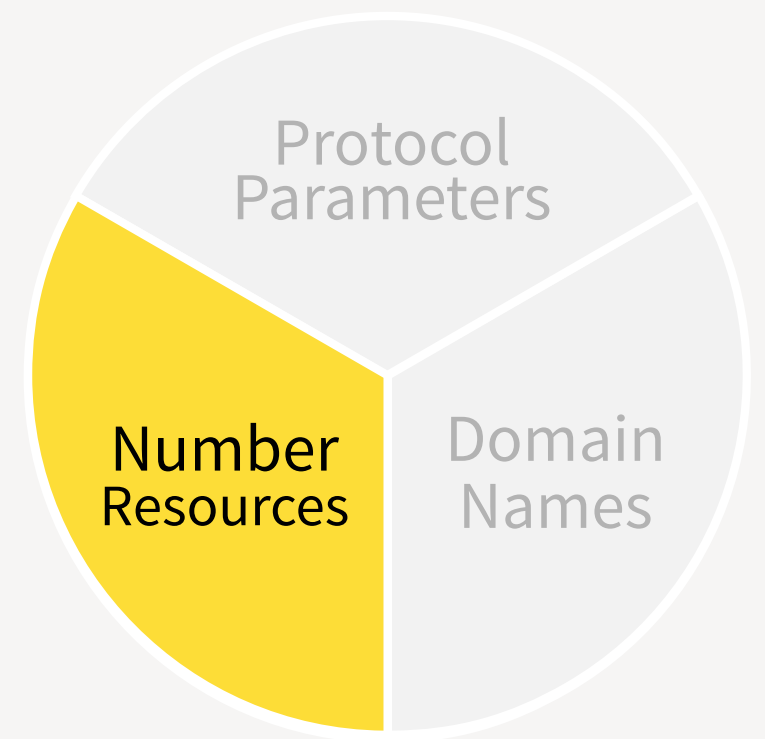
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PTI | An ICANN Affiliate



What are IANA and PTI?

- The Internet Assigned Numbers Authority (IANA) functions involve maintaining the definitive records for assignment of unique identifiers, typically divided into three areas:
 - Names — DNS root zone and other key domains
 - Numbers — global IP address and AS number spaces
 - Protocol parameters — codes and parameters used by around 3,000 different Internet technologies

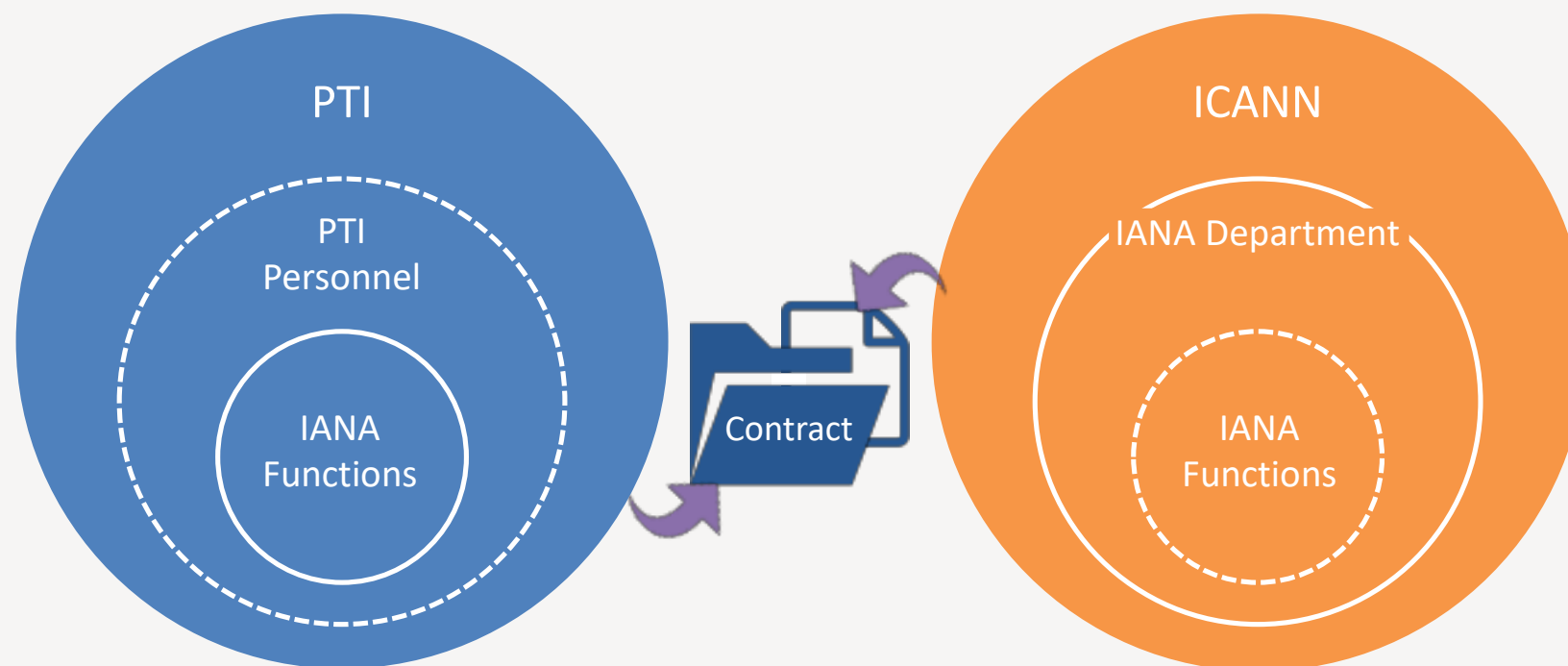


<https://iana.org/>

<http://pti.icann.org>

What are IANA and PTI?

- Public Technical Identifiers (PTI) is a not-for-profit organization that performs the IANA functions
 - Created in 2016
 - Affiliated with ICANN; Fully funded by ICANN
 - Created as one of the measures designed in the IANA stewardship transition process, previously IANA functions performed directly by ICANN



<http://pti.icann.org>

Allocation of Number Resources

- The IANA Services is tasked with allocating blocks of IP addresses and ASNs to the five RIRs
- Allocations are made according to global policies.
- Allocations are made in compliance with service level agreements (SLAs) defined in the Service Level Agreement for the IANA Numbering Services
 - <https://pti.icann.org/agreements>

4.3 IANA Numbering Service Operational Requirements

The Operator shall perform the IANA Numbering Service in a requirements:

Process for handling of requests to the Operator by an RIR:

(a) A requesting RIR will submit an initial request by email (e-mail), or in a format mutually agreed upon. The request of an individual RIR under this SLA shall be held in confidence by ICANN and not disclosed to the other RIRs without the prior written consent of the ICANN. ICANN may disclose such requests without the consent of the RIR (i) to the extent disclosure thereof is required by law or (ii) to the extent disclosure thereof is required by the ICANN.

IPv4 Addresses

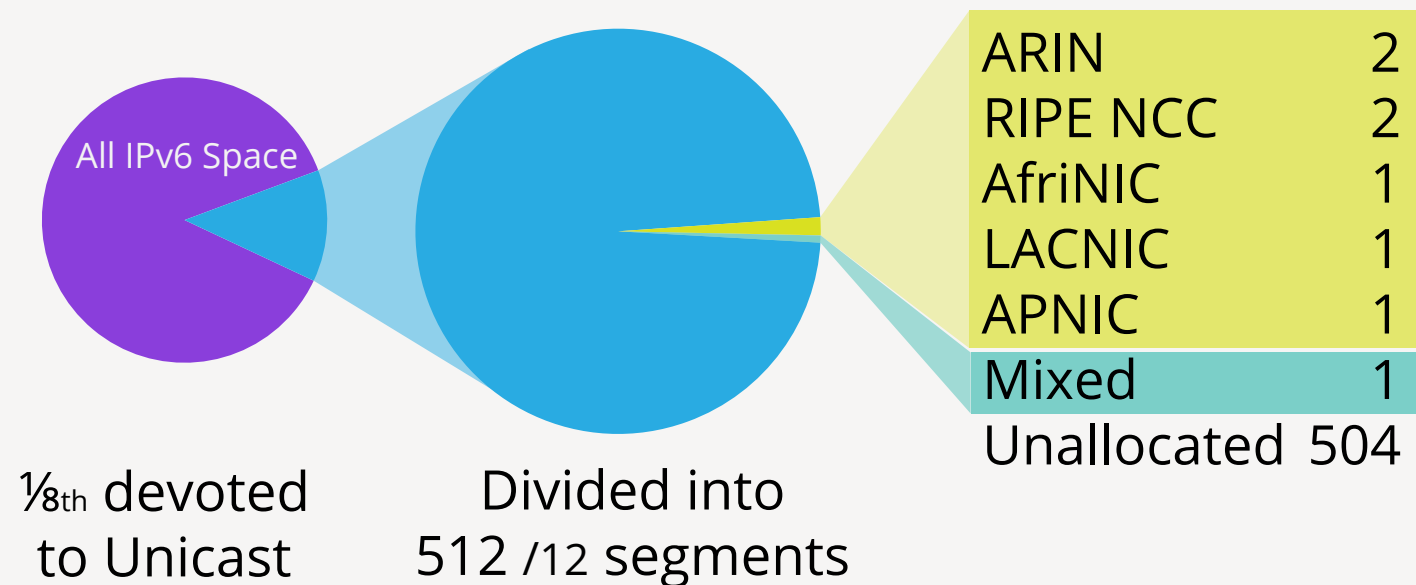
- 32-bit address space (≈ 4 billion addresses)
- 222 /8s designated for unicast use ($\approx 86\%$)
- The last 5 of these /8s were allocated on 3 February 2011 to the RIRs
- Exhausted!

Prefix	Designation	Date	WHOIS	RDAP
000/8	IANA - Local Identification	1981-09		
001/8	APNIC	2010-01	whois.apnic.net	https://rdap.apnic.net
002/8	RIPE NCC	2009-09	whois.ripe.net	https://rdap.ripe.net
003/8	Administered by ARIN	1994-05	whois.arin.net	https://rdap.arin.net
004/8	Level 3 Parent, LLC	1992-12	whois.arin.net	https://rdap.arin.net
005/8	RIPE NCC	2010-11	whois.ripe.net	https://rdap.ripe.net
006/8	Army Information Systems Center	1994-02	whois.arin.net	https://rdap.arin.net
007/8	Administered by ARIN	1995-04	whois.arin.net	https://rdap.arin.net
008/8	Administered by ARIN	1992-12	whois.arin.net	https://rdap.arin.net
009/8	Administered by ARIN	1992-08	whois.arin.net	https://rdap.arin.net
010/8	IANA - Private Use	1995-06		
011/8	DoD Intel Information Systems	1993-05	whois.arin.net	https://rdap.arin.net
012/8	AT&T Bell Laboratories	1995-06	whois.arin.net	https://rdap.arin.net
013/8	Administered by ARIN	1991-09	whois.arin.net	https://rdap.arin.net
014/8	APNIC	2010-04	whois.apnic.net	https://rdap.apnic.net
015/8	Administered by ARIN	1994-07	whois.arin.net	https://rdap.arin.net
016/8	Administered by ARIN	1994-11	whois.arin.net	https://rdap.arin.net
017/8	Apple Computer Inc.	1992-07	whois.arin.net	https://rdap.arin.net
018/8	Administered by ARIN	1994-01	whois.arin.net	https://rdap.arin.net
019/8	Ford Motor Company	1995-05	whois.arin.net	https://rdap.arin.net

<https://iana.org/assignments/ipv4-address-space>

IPv6 Addresses

- 128-bit address space
- Minimal allocation to date of available space (≈1.2% of unicast, ≈0.1% of total)



<https://iana.org/assignments/ipv6-unicast-address-assignments>

Prefix	Designation	Date	WHOIS
2001:0000::/23	IANA	1999-07-01	whois.iana.org
2001:0200::/23	APNIC	1999-07-01	whois.apnic.net
2001:0400::/23	ARIN	1999-07-01	whois.arin.net
2001:0600::/23	RIPE NCC	1999-07-01	whois.ripe.net
2001:0800::/23	RIPE NCC	2002-05-02	whois.ripe.net
2001:0a00::/23	RIPE NCC	2002-11-02	whois.ripe.net
2001:0c00::/23	APNIC	2002-05-02	whois.apnic.net
2001:0e00::/23	APNIC	2003-01-01	whois.apnic.net
2001:1200::/23	LACNIC	2002-11-01	whois.lacnic.net
2001:1400::/23	RIPE NCC	2003-02-01	whois.ripe.net
2001:1600::/23	RIPE NCC	2003-07-01	whois.ripe.net
2001:1800::/23	ARIN	2003-04-01	whois.arin.net
2001:1a00::/23	RIPE NCC	2004-01-01	whois.ripe.net
2001:1c00::/22	RIPE NCC	2004-05-04	whois.ripe.net
2001:2000::/20	RIPE NCC	2004-05-04	whois.ripe.net

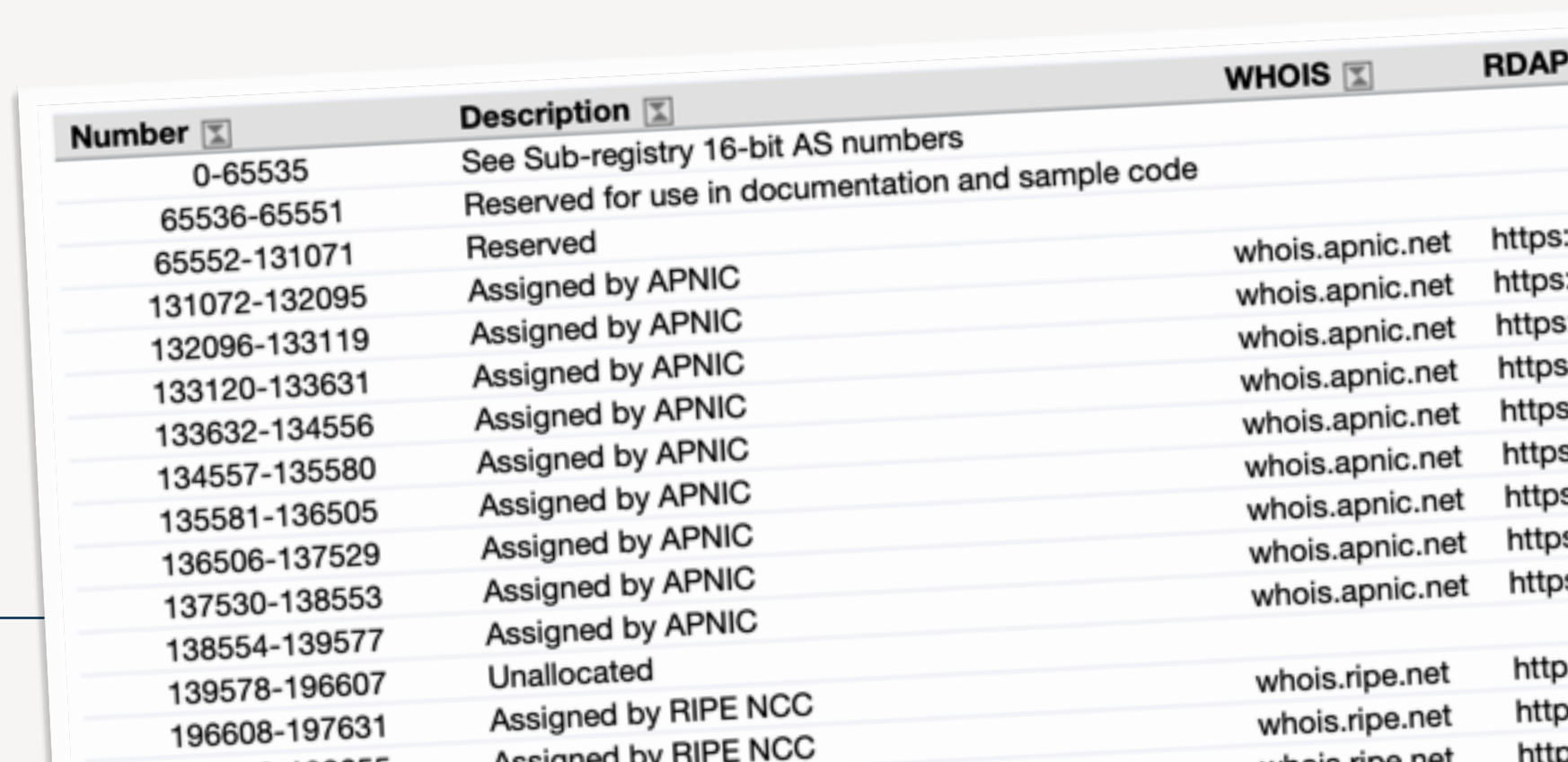
IPv6 Addresses — Allocation Method

- Allocations are governed by the *Policy for Allocation of IPv6 Blocks to Regional Internet Registries* (ratified 7 September 2006):
 - An RIR is eligible for additional space when
 - their available space is <50% of a /12 ($\approx 0.2\%$ of unicast space); or
 - their available space will be exhausted in less than 9 months
 - Allocation size is at least a /12, and sufficient to last at least 18 months
- Allocations are rare due to the allocation size
 - First /12 allocations made in 2006
 - Two subsequent /12 allocations made in 2019

AS Numbers

- Identifiers that aggregate IP address collections for whole networks, simplifies routing
- 32-bit address space (≈ 4 billion addresses)
 - Originally a 16-bit ("2-byte") address space (65,536 addresses)
 - Expanded to 32-bit in 2007 by RFC 4893
- All two-byte AS numbers have been allocated or reserved
 - Last allocation was made 2021
- Approximately 98% remains unallocated

<https://iana.org/assignments/as-numbers>



Number	Description	WHOIS	RDAP
0-65535	See Sub-registry 16-bit AS numbers		
65536-65551	Reserved for use in documentation and sample code		
65552-131071	Reserved	whois.apnic.net	https://
131072-132095	Assigned by APNIC	whois.apnic.net	https://
132096-133119	Assigned by APNIC	whois.apnic.net	https://
133120-133631	Assigned by APNIC	whois.apnic.net	https://
133632-134556	Assigned by APNIC	whois.apnic.net	https://
134557-135580	Assigned by APNIC	whois.apnic.net	https://
135581-136505	Assigned by APNIC	whois.apnic.net	https://
136506-137529	Assigned by APNIC	whois.apnic.net	https://
137530-138553	Assigned by APNIC	whois.apnic.net	https://
138554-139577	Assigned by APNIC		
139578-196607	Unallocated	whois.ripe.net	http://
196608-197631	Assigned by RIPE NCC	whois.ripe.net	http://
	Assigned by RIPE NCC	whois.ripe.net	http://

AS Numbers — Allocation Method

- Allocations are governed by the *Global Policy for Allocation of ASN Blocks to Regional Internet Registries*:
 - An RIR is eligible for additional blocks when
 - they have assigned/allocated 80% of their previous block; or
 - their available space will be exhausted in less than 2 months
 - Allocation size is sufficient to last at least 12 months

Reverse DNS (RDNS)

- Reverse DNS maps IP addresses to domain names
- IANA operates in-addr.arpa and ip6.arpa for these purposes
- Allocations are aligned with number resource allocations, so if a block is allocated to an RIR, the associated block in the DNS is allocated too
- IANA administers a private API with RIRs to keep the Reverse DNS updated

Registration Data Directory Services (RDDS)

WHOIS

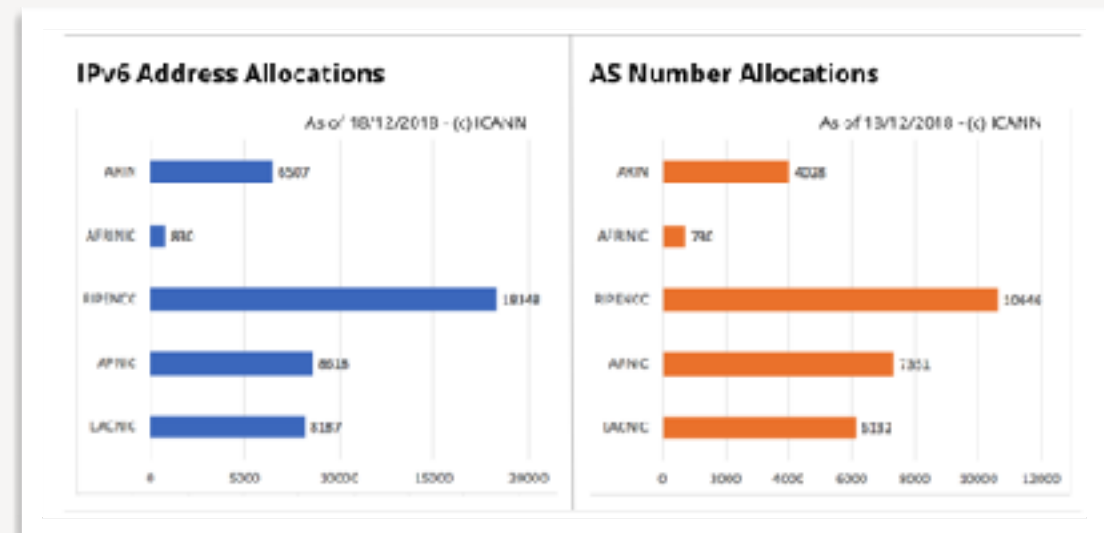
- IANA WHOIS server published IANA-level allocation data
- For unicast provides a “referral” to RIR WHOIS
- Plain text, designed for humans, but broadly unstructured

RDAP

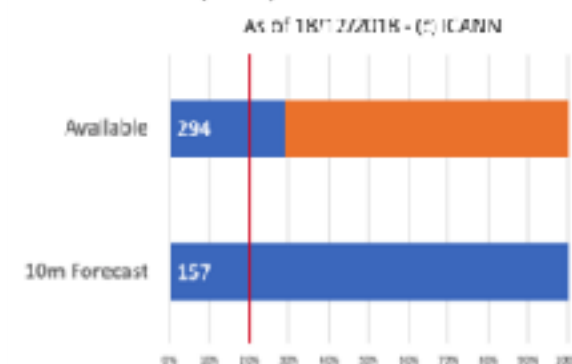
- Intended to be a successor to WHOIS
- Designed for modern web technologies
- IANA bootstraps RDAP lookups by providing top-level registries to RDAP clients for IPv4, IPv6, AS number lookups
- IANA building its own RDAP server for domains and IP addresses it has reserved or directly administers (e.g. multicast)

RIR Allocation Dashboard

- Targeted presentation of qualifying criteria for RIR allocation
 - INR Allocations by RIR
 - Drill-down into average monthly allocations, INR availability, supply forecast



AS Number (ASN) Allocations

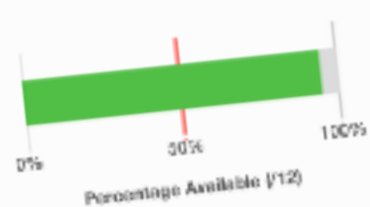


Total Allocated ASNs:	2302
Eligibility:	Not eligible
Monthly Average:	15,670 ASNs (based on last 6 months)
Two month need:	31,340 ASNs
Last Block Request:	1 of 1024 ASNs
Block(s) allocated on 10/8/2017	
Next Block Request:	1 of 1024 ASNs
Predicted allocation on 12/6/2019	

LACNIC IPv6 Allocations

Allocations of IPv6 address space are made to regional Internet registries according to their needs, based on allocation rates they publish. Specifically, RIRs are eligible for further allocations if their available space of existing allocations is less than 50% of a /12 address block, or less than their necessary space for the following 9 months.

Current Space and Eligibility

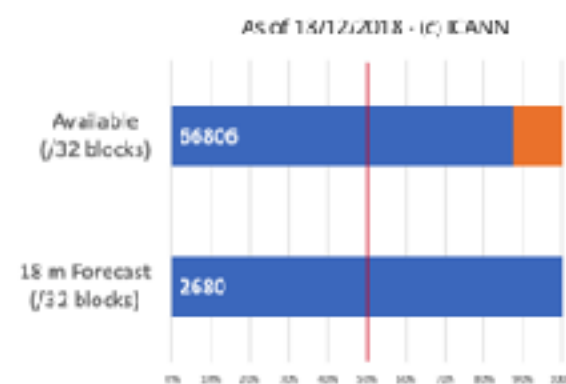


24 Month Forecast

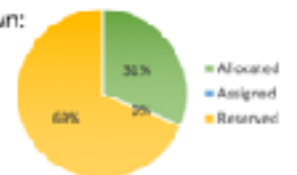
The chart below uses LACNIC's current average allocation rate to forecast their available IPv6 space over the next 24 months. This can be used to estimate if LACNIC will become eligible to apply for additional IPv6 space in the near future.



IPv6 Address Allocations

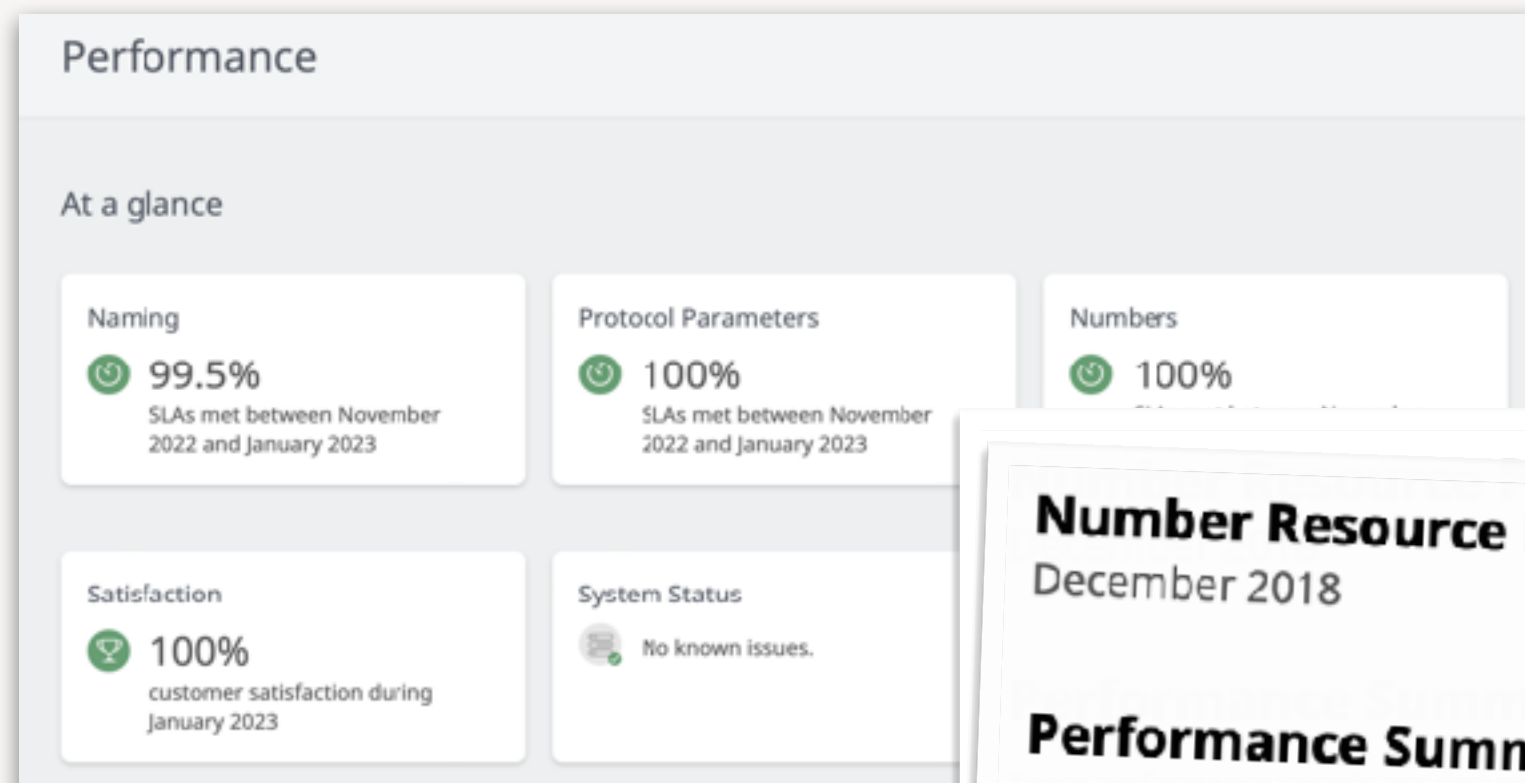


Total Allocated Addresses: (in /32 blocks)	9132
Eligibility:	Not eligible
Monthly Average:	148,888 allocations (based on last 6 months)
Nine month need:	1340 (in /32 blocks)
Current Allocation Breakdown:	
Allocated:	604
Assigned:	0
Reserved:	1340



Performance

- We adhere to a set of Service Level Agreements in making these allocations, reported monthly.



Number Resource Performance December 2018

Performance Summary

These performance targets are derived from section 4.3 of the Service Level Agreement for the IANA Numbering Services for the allocation of unicast IP addresses and AS numbers to the five Regional Internet Registries.

- ✓ Requests acknowledged on time (100%)
- ✓ Responded on time (100%)
- ✓ Implemented on time (100%)
- ✓ Implemented accurately (100%)

Individual Requests to Regional Internet Registries

Date	Request Type	Request Processing Details
2018-12-06	AS Number	✓ Responded on time (0.0 days)

<https://iana.org/performance>

Information Security Audits

- IANA has had 12 consecutive years of exception-free audits.
- These information security audits, conducted by a third-party auditing firm, evaluate IANA's service organization controls (SOCs) against the "Trust Services Principles and Criteria".
- Both the SOC2 and SOC3 audits demonstrate that IANA remains committed to ensuring the security and stability of the Internet's unique identifier systems.
- The audits also strengthen key operations within IANA through ever-evolving controls and maturing department practices.
- SOC2 results are provided to the NRO EC annually

<https://iana.org/audits>

Summary

- For number resources, IANA's responsibility is for the global address space for the three identifiers types - IPv4, IPv6 and ASNs
 - For most applications, allocated through the RIR system using global policies with objective eligibility criteria
 - For speciality applications, direct allocation by IANA (according to pertinent IETF RFCs)
- These functions are one component of the broader portfolio of registries managed as part of the IANA functions
- IANA's general accountability measure, including comprehensive performance reporting, SLAs, audits, community review and the like are applied for these services.

Thank you!

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