APNIC 62

APNIC Policy Proposal prop-170

Nibble-boundary alignment for IPv6 allocations

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Problem Statement

Current Section 8 policy can produce valid but non-aligned allocation outcomes

- **Current policy:** Section 8.1 sets a /32 minimum allocation and allows larger initial allocations with comprehensive documentation.
- **Subsequent allocations:** Section 8.3.4 normally doubles the holder's IPv6 address space, using adjacent space where possible.
- **Policy gap:** Section 8 does not establish a general principle for nibble-boundary alignment when an LIR explicitly requests it.
- **Operational issue:** Outcomes such as /21, /23, /27, /29, /30 or /31 can complicate IPAM, customer addressing, routing templates, security records, audit systems, reverse DNS, and future expansion.
- **Sparse allocation:** Reservation helps contiguous growth, but it may not solve the need to plan the internal structure from day one.

Objective of Policy Change

Add a conditional alignment mechanism while preserving APNIC's assessment model

- **Introduce:** A clear mechanism for LIR IPv6 allocations to be aligned on nibble boundaries where the applicant requests this.
- **Preserve:** APNIC's existing needs-based assessment process, resource stewardship, and operational flexibility.
- **Outcome:** APNIC normally delegates the smallest nibble-boundary aligned block that can satisfy the calculated address requirement.
- **Limit:** Nibble-boundary alignment creates no unconditional entitlement to additional address space.
- **Scope:** The proposal applies to Section 8 allocations and does not amend Section 9 IPv6 assignments.

Situation in Other Regions

ARIN provides the clearest nibble-boundary example

ARIN

• NRPM Section 6 defines a nibble boundary as a mask aligned on a 4-bit boundary.
• ***ARIN policy states that IPv6 allocations are made on nibble boundarie***s.
• The model still uses justified need and controls for larger allocation sizes.

RIPE NCC and others

•RIPE-690 (IPv6 Address Allocation and Assignment Policy) To keep addressing plans usable and understandable, and to align with DNS reverse zone delegations, ***the size of the delegated prefix should align with a nibble boundary***.
• RIPE policy objectives still emphasize aggregation and minimizing administrative overhead.
• LACNIC and AFRINIC do not provide the same general example for this proposal.

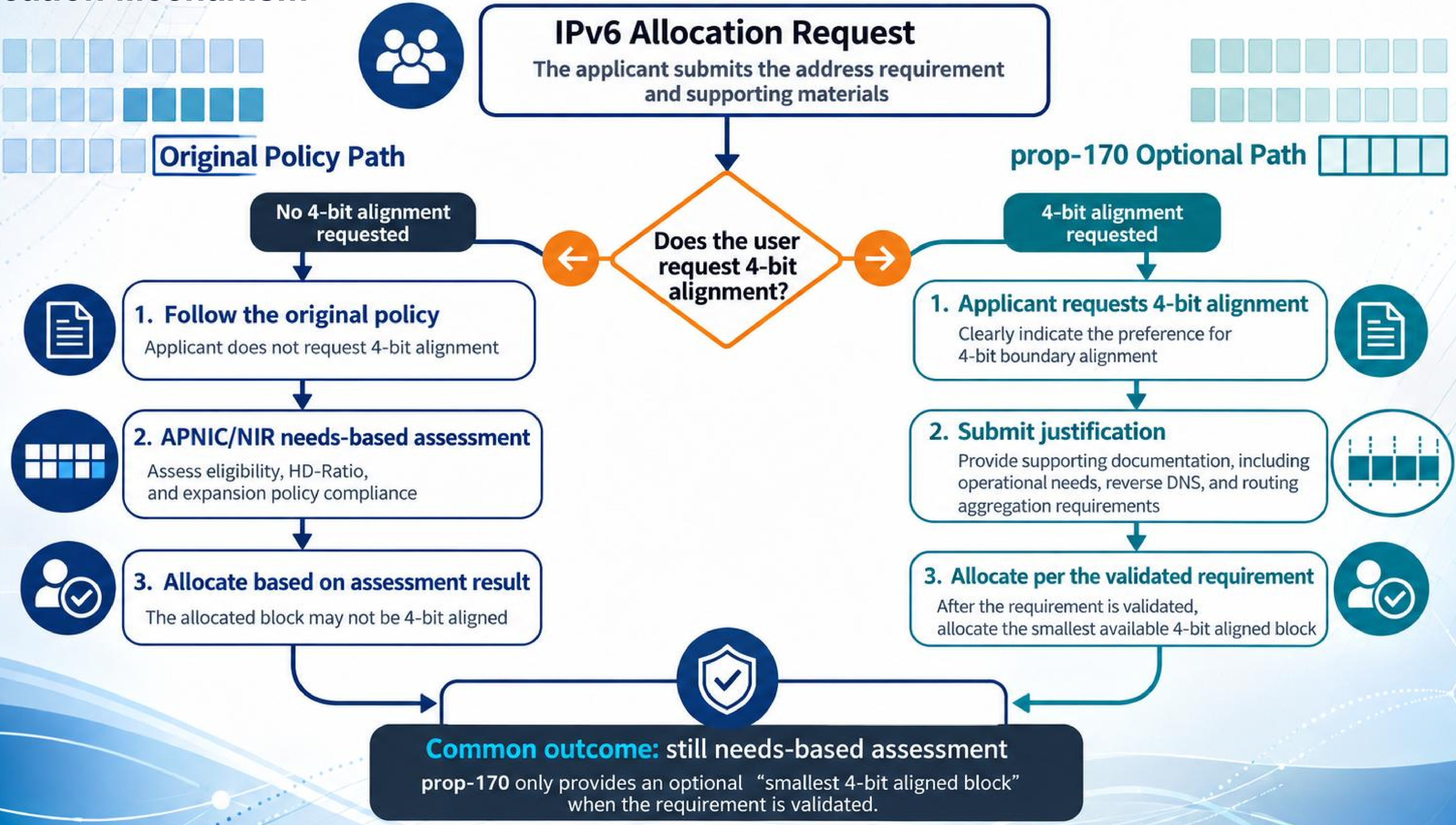
prop-170 adapts the ARIN lesson to APNIC as a conditional request, proof, assessment, and smallest-aligned-block mechanism.

Proposed Policy Solution

Three focused text changes in Section 8

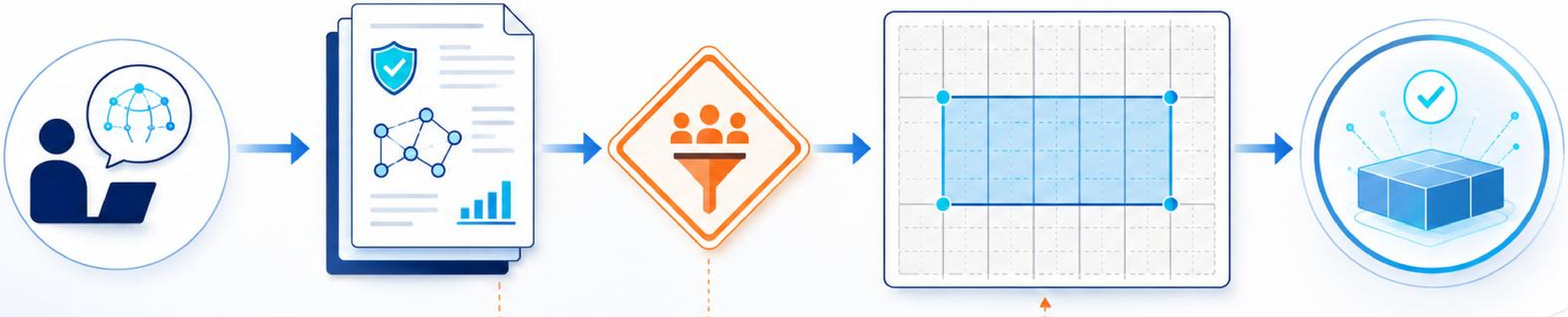
- **Section 8.0:** Add definitions and scope for nibble-boundary alignment and the supporting 4-bit alignment demand proof.
- **Section 8.1:** For initial allocations, allow alignment when the applicant explicitly requests it and the calculated requirement supports the aligned result.
- **Section 8.3.4:** For subsequent allocations, keep one-bit doubling as the default and add a conditional path for larger justified aligned expansion.
- **Definition:** A nibble boundary is a prefix length evenly divisible by four, such as /20, /24, /28 or /32.
- **Review rule:** Alignment applies only after the address requirement has been assessed under the existing policy.

Allocation Mechanism



prop-170 requires proof of alignment need

The key evidence is a 4-bit alignment demand proof, followed by the existing needs-based assessment process.



1 **Applicant requests it**
optional, not mandatory

2 **4-bit alignment demand proof**
show operational, reverse-DNS and aggregation need

3 **Existing needs-based assessment**
validate real address need before alignment

4 **Smallest aligned block**
the smallest nibble-boundary aligned block

Alignment proof must be technical and reviewable

It should explain why a smaller non-aligned block or reservation alone cannot meet the operational need from day one.

Automation and troubleshooting

Evidence 1: map regions, services, access, customers, cloud pools, SRv6 SIDs or security domains to hexadecimal layers.
Evidence 2: show added complexity in templates, ACLs, logs and human troubleshooting.

IPv6 reverse DNS

Evidence 1: ip6.arpa is organized by nibbles, so non-4-bit boundaries complicate delegation and zone cuts.
Evidence 2: show impact on DNS management, automation scripts or customer reverse-DNS needs.

Routing aggregation and alternatives

Evidence 1: show how the smallest aligned block reduces future expansion fragmentation.
Evidence 2: explain why a smaller non-aligned block or sparse reservation cannot satisfy day-one planning.

Make readability reviewable, not a one-sentence reason for extra space.

Why Nibble Alignment Matters for IPv6

Aligned with operational practice and established standards (e.g., RFC 3596, RFC 6177, RIPE-690)

IPv6 Reverse DNS (ip6.arpa)

IPv6 reverse mapping uses hexadecimal nibbles

1 hexadecimal digit = 4 bits = one nibble

4 bits = 1 nibble

Example

IPv6 prefix: **2001:db8::/32**

2 0 0 1 : d b 8 0 : : : : :

8 nibbles
= 32 bits (/32)

0 . 8 . b . d . 1 . 0 . 0 . 2 . ip6.arpa.

IPv6 reverse mapping follows nibble-based hierarchy, with one label per hexadecimal digit.

Operational Challenge

Address boundary affects reverse DNS delegation

Nibble-aligned prefixes (e.g. /32, /36, /40)

- Boundaries match hexadecimal digits
- Clean ip6.arpa delegation (whole labels)
- Easier address planning and automation
- Maintains aggregatable, hierarchical structure

Example: /36

2 0 0 1 : d b 8 0 : 0 : : :

9 nibbles = 36 bits (/36)

Clean delegation

Non-nibble-aligned prefixes (e.g. /35, /37)

- Boundaries do not match hexadecimal digits
- Require splitting nibble in reverse DNS
- More complex delegation and operational handling
- Increases chance of fragmentation and errors

Example: /35

2 0 0 1 : d b 8 0 : 0 : :

8.75 nibbles = 35 bits (/35)

Split nibble (more complex)

Benefits

Operational, scalable and sustainable IPv6

Easier ip6.arpa delegation

arpa

- Delegation on clear nibble boundaries
- Simpler DNS management
- Fewer operational errors

Better address planning and automation

- Aligns with hexadecimal structure
- Simplifies provisioning and tooling
- More consistent and scalable operations

Improved aggregation and operational simplicity

- Maintains hierarchical address structure
- Supports route aggregation
- Reduces fragmentation and long-term operational overhead

Nibble alignment improves operational efficiency while preserving needs-based IPv6 allocation principles.

Scope and Unchanged Mechanisms

prop-170 does not rewrite APNIC IPv6 policy

No text change

- Section 8.2.1 and Section 8.2.2
- Section 8.3.1, 8.3.2 and 8.3.3
- All IPv6 assignment policy under Section 9

No mechanism change

- /32 minimum IPv6 allocation
- HD-Ratio and utilization thresholds
- Default one-bit doubling
- Sparse Allocation Framework
- Treatment of multiple discrete networks

Existing resource holders are not required to renumber, return, or resize previously delegated IPv6 prefixes.

Advantages and Disadvantages

The proposal adds operational clarity, with resource safeguards

Advantages

- Clear Section 8 basis for considering 4-bit alignment requests
- Easier IPAM, automation, reverse DNS, routing policy, security segmentation, logging, and audit
- Cleaner hierarchical planning and stronger conditions for aggregation
- Lower risk of repeated small expansions, fragmentation, and later renumbering

Disadvantages and controls

- Some allocations may be larger than the exact non-aligned calculated requirement
- APNIC and NIRs may need updated procedures, tools, systems, and guidance
- Adjacent expansion may not always be possible under sparse allocation
- Fee tier impact should be checked before the applicant accepts the allocation

Main safeguard: explicit request, 4-bit alignment demand proof, needs-based assessment process, and the smallest nibble-boundary aligned block.

Impact on APNIC, NIRs and Holders

The Secretariat impact assessment treats this as implementable with process updates

- **Existing holders:** No required renumbering, return, or resizing of existing allocations.
- **Initial allocations:** Existing eligibility and needs-based assessment remain unchanged before the aligned outcome is selected.
- **Subsequent allocations:** Default doubling remains; larger aligned requests require documentation and validation.
- **APNIC and NIR operations:** Request evaluation procedures, registration systems, internal tools, and guidance may need updates.
- **Implementation:** APNIC Secretariat indicated APNIC-127 changes, internal guidance updates, no material legal issue, and about six months implementation if consensus is reached.

Summary and Questions

The proposal creates a controlled, optional path for justified 4-bit alignment

- **Problem:** APNIC policy does not currently provide a clear general basis for nibble-boundary aligned IPv6 allocations.
- **Solution:** Applicants may request alignment, submit 4-bit alignment demand proof, and go through the needs-based assessment process.
- **Allocation result:** APNIC delegates the smallest nibble-boundary aligned block that can satisfy the validated requirement.
- **Main gain:** Better long-term IPv6 planning for automation, troubleshooting, reverse DNS, routing aggregation, and future expansion.
- **Discussion:** Comments, concerns, and suggested text refinements are welcome.

APNIC 62

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#apnic62

IPv6 consumption remains very low

185,134
Global growth in 2021-2025 /32-equivalent

0.0345%
Share of 2000::/3 used by that five-year growth

1,522,333
APNIC available space /32-equivalent

37,027/year
Five-year global average /32-equivalent

Scenario	Multiplier	Annual volume (/32-equivalent)	Years to consume 2000::/3	Years at full IPv6-space scale
2025 actual	actual	10,332	51,962	415,696
2021-2025 average / 1x	1x	37,027	14,499	115,996
4x recent average	4x	148,108	3,625	28,999
16x recent average	16x	592,432	906	7,250

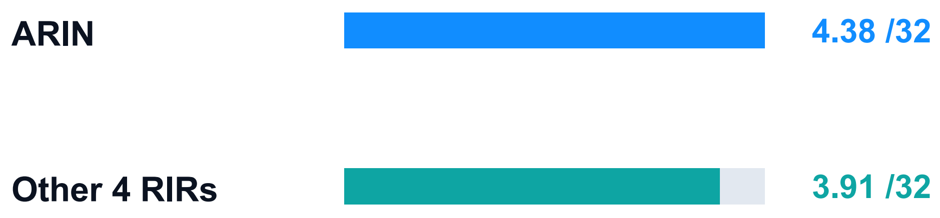
Formula: years = address-space denominator / annual /32-equivalent allocation volume

16x: about 906 years within 2000::/3
Full IPv6-space scale comparison: about 7,250 years

ARIN experience does not show runaway allocation size

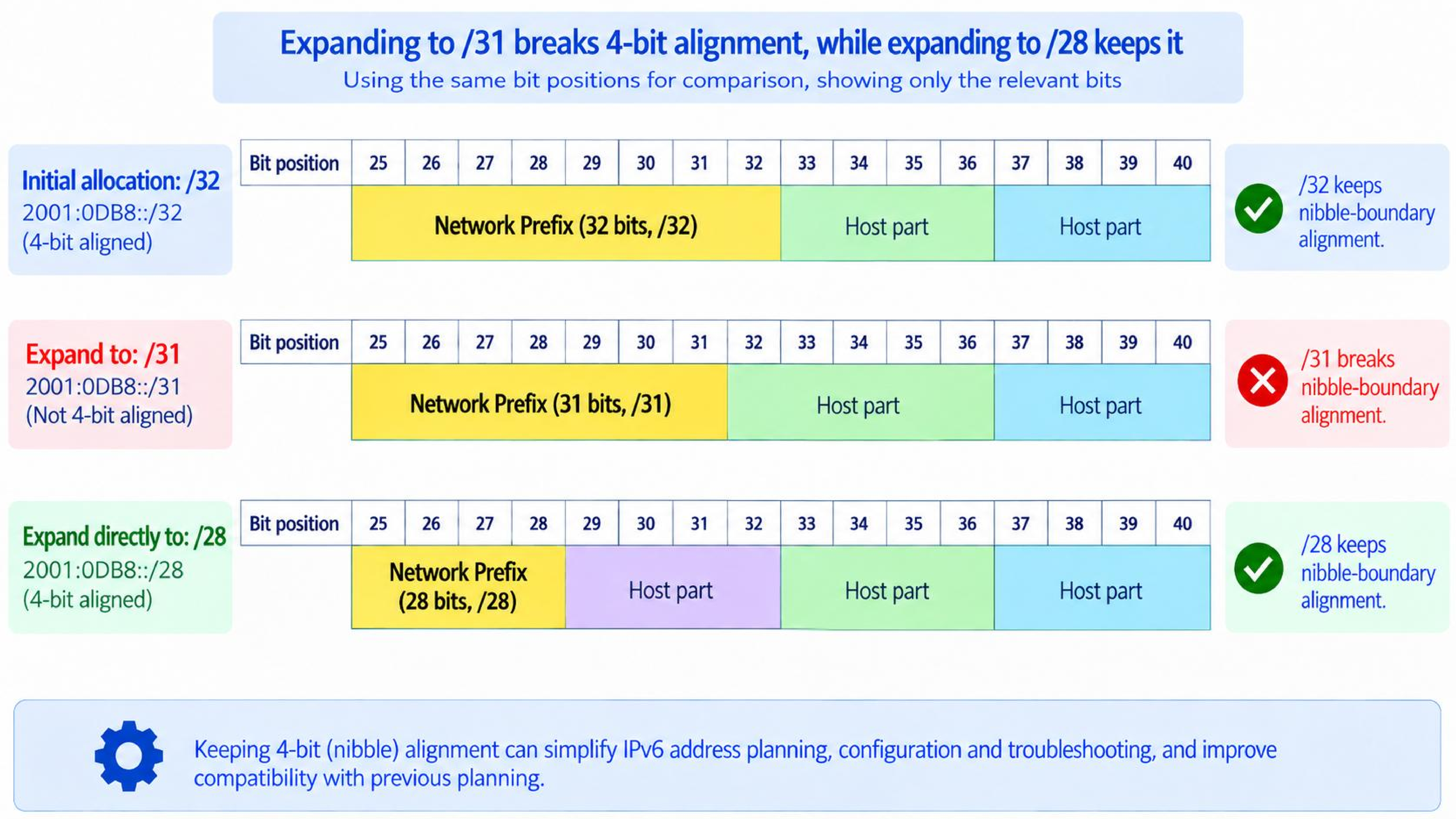
Routing visibility is an auxiliary indicator, not a utilization audit.

Average allocation size



about +12%

median allocation-size difference


Expanding to /31 breaks 4-bit alignment, while expanding to /28 keeps it
Using the same bit positions for comparison, showing only the relevant bits
Initial allocation: /32
2001:0DB8::/32
(4-bit aligned)
Bit position
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Network Prefix (32 bits, /32)
Host part
Host part
/32 keeps nibble-boundary alignment.
Expand to: /31
2001:0DB8::/31
(Not 4-bit aligned)
Bit position
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Network Prefix (31 bits, /31)
Host part
Host part
/31 breaks nibble-boundary alignment.
Expand directly to: /28
2001:0DB8::/28
(4-bit aligned)
Bit position
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Network Prefix (28 bits, /28)
Host part
Host part
Host part
/28 keeps nibble-boundary alignment.
Keeping 4-bit (nibble) alignment can simplify IPv6 address planning, configuration and troubleshooting, and improve compatibility with previous planning.

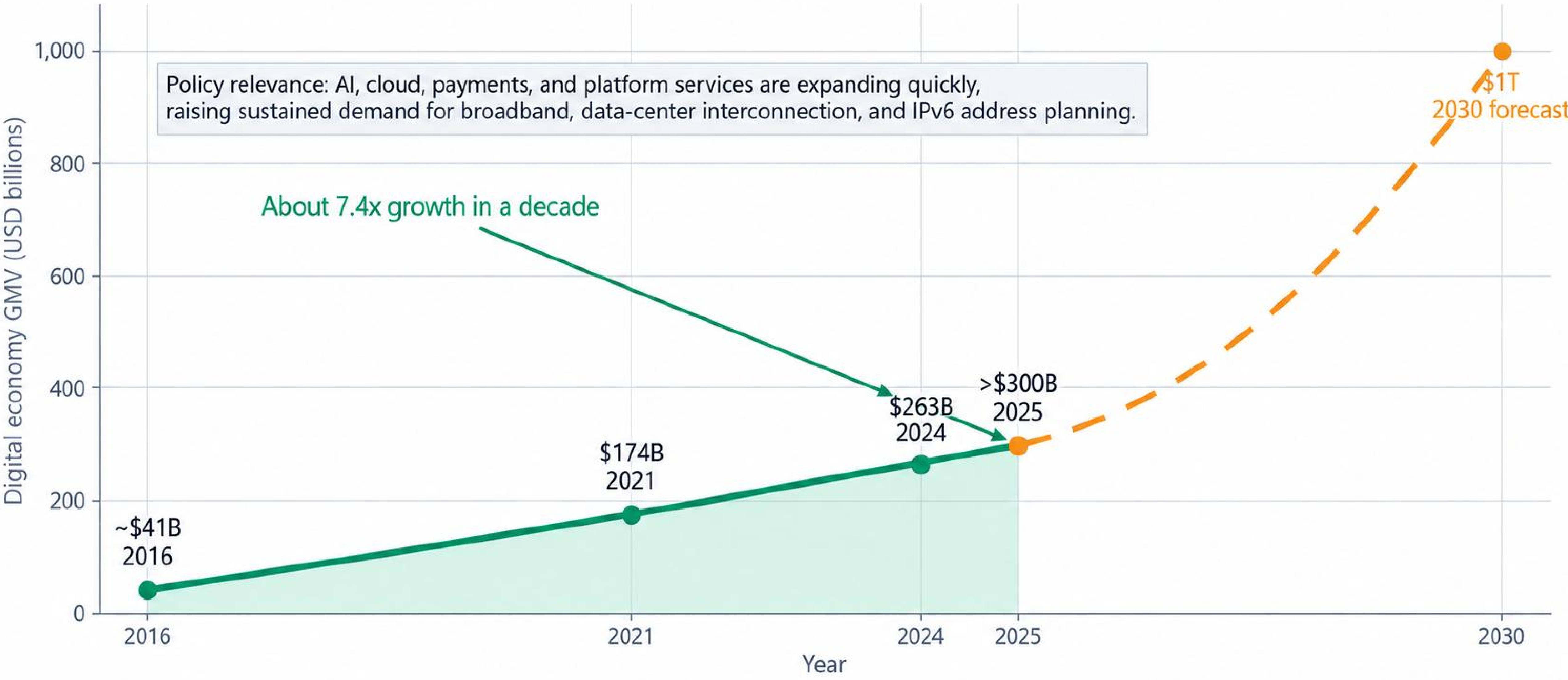
APNIC: Largest User Base, Latest Second /12

The x-axis shows when IANA allocated a second /12 to each RIR; bubble size shows estimated global Internet-user share by RIR service-region proxy.

Sources: IANA IPv6 Global Unicast Address Space; Geoff Huston/Potaroo IPv6 Resource Allocations (regional aggregates, 09 Sep 2026).
Proxy mapping: APNIC = Eastern/Southern/South-Eastern Asia + Oceania; RIPE NCC = Europe + Central/Western Asia; ARIN = Northern America.

Asia's Digital Economy Is Accelerating: Asia GMV Trend

Asia GMV is used as a clear public proxy for Asia's broader digital-services, payments, e-commerce, and AI-ll-infrastructure expansion.



Sources: Google/Temasek/Bain e-Conomy SEA 2024 and 2025; ADB SEADS 2021. 2025 uses the lower bound of "over USD 300B"; 2030 is a long-term forecast.