

AVENUE4 LLC
INTERNET ASSETS



2017

State of the IPv4 Market

Welcome to Avenue4's 2017 State of the IPv4 Market Report

We started 2017 as the market began to rally after a considerable decline in large block trading caused by supply scarcity. Although the total number of transactions in 2016 had tripled relative to the 2015 total, the volume of addresses sold had dropped by half.

The shortage of large blocks that shaped 2016 also impacted 2017. The forward momentum we saw in the latter part of 2016 yielded a vigorous recovery. Escalating prices for large blocks coupled with aggressive buyer acquisition strategies in the first half of 2017 stimulated considerable additional supply in the second half of the year. By the end of 2017, the total number of transactions, aggregate address space transferred, and prices were all up steeply over the prior year.

The volatility and heightened energy in the large block market isn't the only interesting storyline for 2017. Small block trading saw consistent and steady gains, with all signs pointing toward long-term robust performance even though the inter-RIR market has softened somewhat.

In 2017, Avenue4 achieved several key milestones. We launched ACCELR/8, an online trading platform that combines order-driven automation with our knowledge, expertise and mature processes to bring more trading efficiency to the small and mid-sized block market. And largely attributable to the strength of our large-block advisory services, we have now exceeded \$200 million in market value delivered to our clients.

Avenue4 is committed to consistently reading the market objectively, providing value-based guidance, sharing knowledge openly, and acting transparently and ethically in all of our dealings. These principles enable us to not just observe and report on the market but positively impact it. This third Annual Report closely examines 2017 market trends, encapsulates important insights, and looks ahead to what you should expect in 2018. We hope it provides you with actionable intelligence, whether you are an experienced participant or venturing into the market for the first time.



Marc Lindsey
President
Avenue4 LLC



Janine Goodman
Vice President
Avenue4 LLC



2017

36,001,024

Total volume of numbers transferred within ARIN



IPv4 block transfers within ARIN

36%
INCREASE

Total volume of IPv4 numbers transferred between ARIN and APNIC/RIPE

42%
DECREASE



IPv4 numbers transferred within ARIN

115%
INCREASE

Relative average price/number by block size, Q4

\$16.00

Blocks of ≤4k numbers

\$15.00

Blocks of 65K-130K numbers

\$17.00

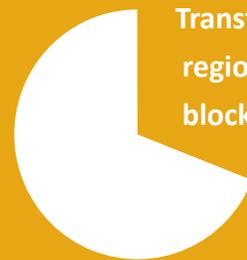
Blocks of ≥1m numbers

19,922,944



Traded volume in ARIN region involving blocks 1M+

903



Transfers in ARIN region involving blocks <4K



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2017: Running the Numbers

Overview of North American Market Activity in 2017¹

The IPv4 market finished 2017 with a burst of activity, both in terms of transaction volumes and overall number of intra- and inter-RIR transactions² involving organizations in the ARIN region.

Over the last 4 years, the number of IPv4 transactions has trended markedly upward. (See [Table 1.](#))³ In 2017, there were, on average, close to 80 transactions per month. By the end of the year, the total annual transaction count reached an all-time high of nearly 1,000. By comparison, there were only 65 transactions in all of 2014.

Most of the overall growth in number of transactions from 2014 to 2017 has been attributable to small block trades of less than 4,000 numbers. (See [Table 2.](#)) In contrast, only 1% of the increase from 2014 to 2017 was due to transactions of 1 million numbers or more.

There was greater variability in the volume of transferred numbers during this same time period. Between 2014 and 2015, the volume of numbers transferred increased by seven-fold to nearly 40 million. The annual volume dropped substantially in 2016, and for the first three quarters of 2017, volumes were barely keeping pace with the first three quarters of 2016 – a year that experienced a dip in total market activity. Then in Q4 2017, the volume of numbers traded took a sharp turn upward: 22.6 million IPv4 numbers were transferred within the ARIN region – far outstripping the largest volume of numbers transferred in a single quarter to date. (See [Table 3.](#)) More than 80% of those numbers were sold to two large block buyers (Amazon and Microsoft).

In our 2016 Annual Report, we concluded that the decrease in volume of transferred numbers between 2015 and 2016 was not due to a lack of buyer interest but rather a lack of available supply. At the time, there were hundreds of millions, perhaps a billion, IPv4 numbers previously allocated to

Table 1: Total Number of Transactions 2014-2017

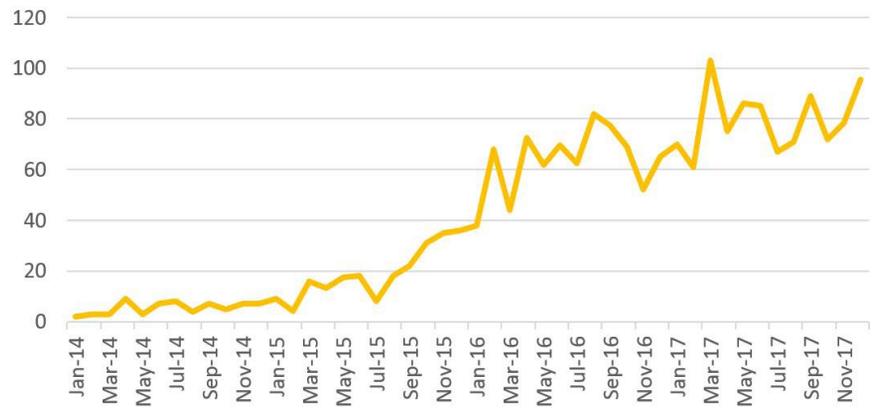


Table 2: Composition of Total IPv4 Transactions by Size

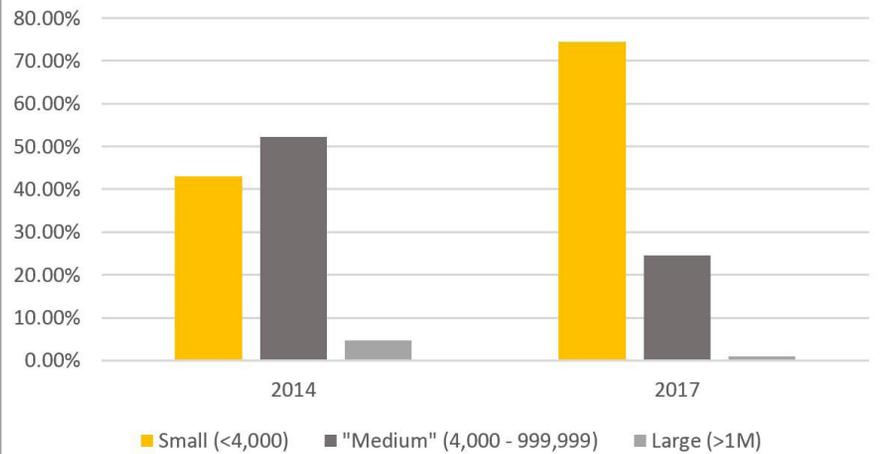
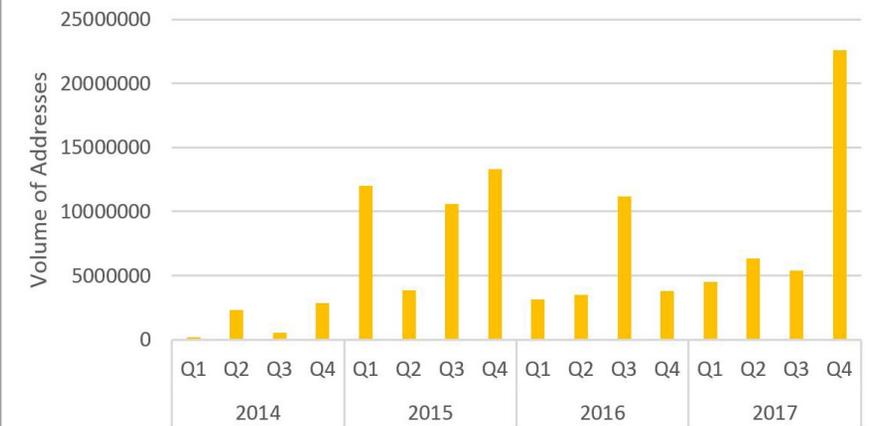


Table 3: IPv4 Addresses Transferred 2014-2017



organizations but not visible on the public internet. These figures, often relied upon by casual market observers, overstate the address space actually available to the market because they fail to account for the technical, organizational and financial barriers faced by companies holding legacy address space.

For example, many end users with large holdings have, over the years, divvied up their contiguous number blocks between business units and sites, resulting in fragmented and often inefficiently used address space. Renumbering to create more efficient retained address space and greater contiguous unused space involves a substantial investment of time and resources affecting multiple sites and

business units. In 2014 and 2015, when per number prices and ROI expectations were low, organizations found it difficult to justify making the necessary renumbering investment – particularly when IT and network departments pushed back on project work and network changes that were unnecessary to support existing network operations and enterprise initiatives more core to the business.

Escalating prices at the end of 2016 and over the course of 2017, greater market maturity (reducing transactional risks), and increased flexibility on the part of buyers willing to entertain contract structures that accommodate renumbering timelines enhanced large-block seller incentives and spurred more supply to enter the market in

2017. Not only were there more large block transactions in 2017 compared to 2016, but, on average, a significantly higher volume of numbers transferred with each transaction. (See [Table 4.](#)) This increase is partially attributable to new market entrants selling from their /8 blocks.⁴

The small block market is thriving and growing, and the data indicates that small blocks will continue to be traded at a healthy pace. In contrast, market indicators for the large block market suggest that it is unlikely to remain strong beyond the next two years.

There were 52 traded blocks of 500,000+ numbers sold as part of 8.3 and 8.4 transactions between 2014 and 2017. All but 2 of these trades involved legacy /8 address space. Although other commercial organizations in North America with substantial IPv4 inventories may decide to enter the market, particularly if prices continue to rise as expected (see [Pricing Trends](#) on page 4), /8 holders will likely remain in control of large block supply, and, by extension, the rise and fall of the large block market.

Of the 23 /8 blocks held by non-governmental/non-RIR organizations (see [note 4](#)), 10 have been partially or mostly sold in the market. It is unclear how many more numbers from these blocks will be made available for sale – likely some but certainly not all. Of the 13 remaining /8 blocks, 10 are registered to information technology companies. With one exception, all of these companies are publicly advertising substantially all of their /8 blocks. IBM, the one exception, has (through a subsidiary entity) been buying numbers in the market, which strongly suggests that IBM's /8 is in use for private network purposes and will not be made available in the market for external transfer. Another three non-governmental /8 holders are registered to companies that do not provide information technology services; however, one of these companies is advertising substantially all of its block. That leaves two legacy /8 holders with large blocks potentially available for the market. In short, the /8 address space is dwindling, and will disappear entirely very soon.

Table 4: Average Monthly Volumes/Transactions 2016-2017

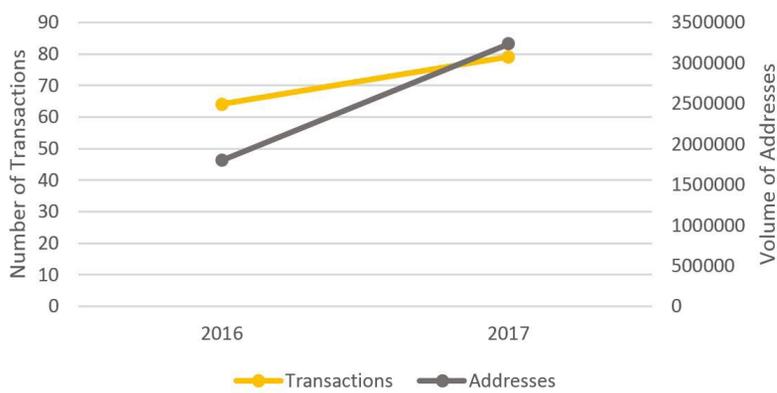
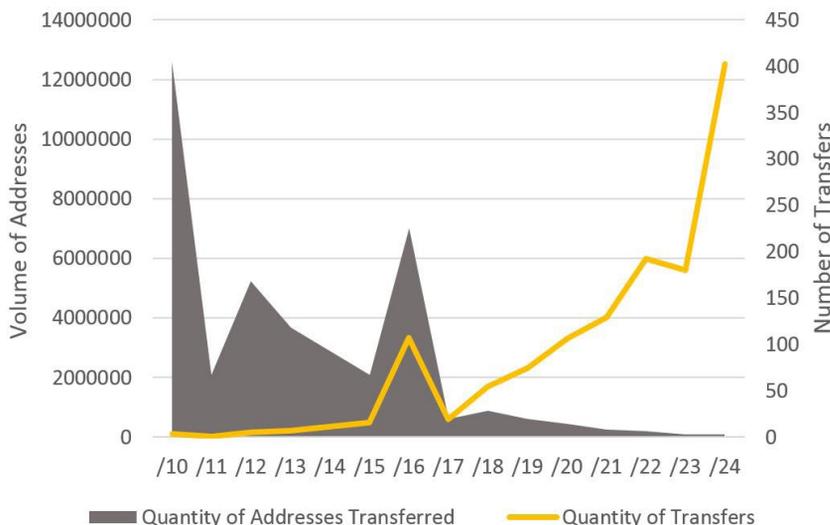


Table 5: Volume and Number of Transfers by CIDR



Impact of Block Size

The /16 block continues to grow in popularity. /16 block trades are responsible for the largest volume of numbers transferred in 2017, second only to /10 trades (4,194,184 numbers). (See [Table 5](#).) As in prior years, the most frequently transferred block size was the /24 (256 numbers). However, small block transactions still represent a minor portion of the overall numbers sold. Block sizes ranging from a /21 to /24 comprised 69% of transferred blocks in 2017, but contributed just 1.7% of the total annual volume of numbers transferred.

Continuing a trend from 2016, large block buyers were willing to accept smaller block sizes as part of their transactions in 2017. Our 2016 report noted that the composition of large block transactions shifted as some large block sellers took advantage of higher per number prices by selling their available fragmented blocks rather than investing in renumbering to produce larger aggregate space to sell at lower per-number prices. Between 2015 and 2016, there was a significant jump in the number of transactions involving large block buyer purchases of /16s (65,536 numbers) – from 3% to over 13%. In 2017, the percentage crept up even further to over 14%.

As further evidence of large block scarcity, for the first-time large block buyers have begun buying blocks as small as a /24 (256 numbers). (See [Table 6](#).) In 2015, none of the large block buyers purchased block sizes

smaller than a /16. In 2016, only one large block buyer dipped below the /16 block size to buy a handful of /17s (32,768 numbers). By 2017, 77 blocks ranging from /24s to /17s were purchased by large block buyers. We expect this trend to continue in 2018.

ARIN's Inter-RIR Market Loses Momentum

The muscle in the inter-RIR transfer market in 2016 weakened substantially in 2017. In 2016, there were 4 times more 8.4 transactions than in 2015. Although overall 8.4 transaction volumes lagged behind 2015 transaction volumes (though not substantially), the volume of numbers transferred in 2016 via 8.4 as a percentage of total volumes transferred in the ARIN region grew by nearly 60%. In part, our 2016 annual report attributed this development to the stable volume of numbers traded out of ARIN under the inter-RIR transfer policy in a year when domestic volumes dropped.

Although the quantity of inter-RIR transactions increased somewhat between 2016 and 2017, the quantity of numbers transferred fell by over 40%. The 2017 boom in the domestic market and lackluster inter-RIR market performance produced a very different picture: inter-RIR transactions are now comprising a smaller portion of the ARIN IPv4 market since we began tracking this data in 2014. (See [Table 7](#).)

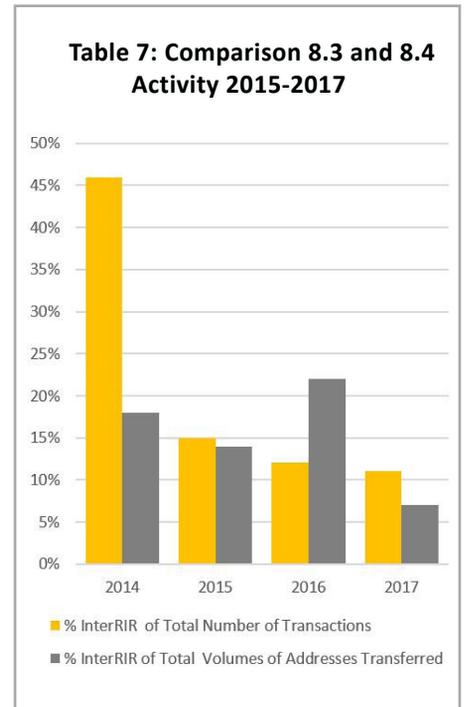
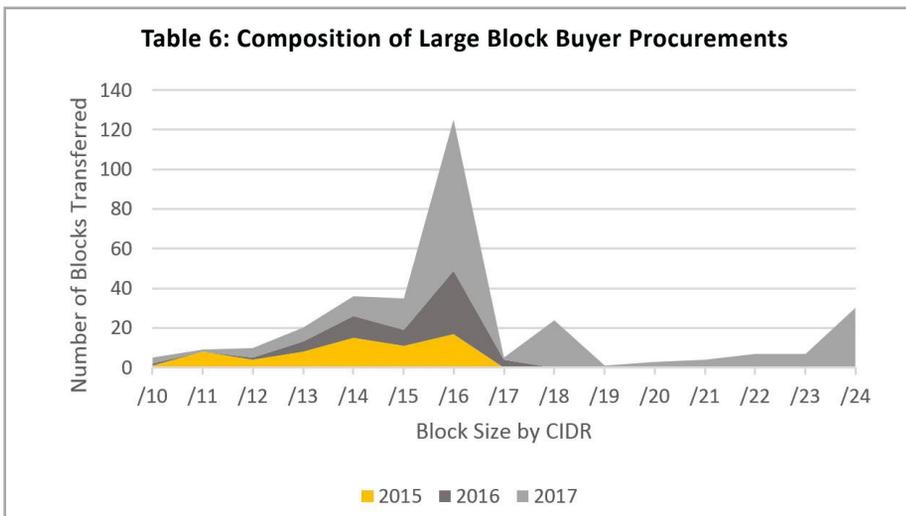
One major contributing factor for this shift is the absence of large block

buyers in the inter-RIR market. In prior years, at least one or two large block buyers participated in the inter-RIR market, including at least one large block transaction. In 2016, almost half of the IPv4 numbers transferred under Section 8.4 were sold to a single large block buyer (Reliance Jio). In 2017, none of the large block buyers participated in the inter-RIR transfer market and the largest block size purchased was a single /14 (262,144 numbers). All of the remaining transactions involved a /16 or below.

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Pricing Trends

Heavily influenced by conditions affecting large block trades, unit pricing for the entire market in 2017 continued the steep upward trajectory that began in 2016, and the gap between large and small block unit prices diminished even further as large block unit prices pushed upward with more vigor. In 2016, average pricing for small block ranges went from approximately \$10.50 to \$13.50 per number, and large block prices ended the year at around \$11.50 per number, nearly double the prior year's price point. This 2016 pricing data revealed that the formerly wide gap between small and large block pricing (favoring small blocks) was on track to narrow considerably and possibly even invert.

Table 8 shows median pricing in 2017 on a quarter by quarter basis across the various block categories. For all block sizes, prices on average increased \$3 to \$4 per number.

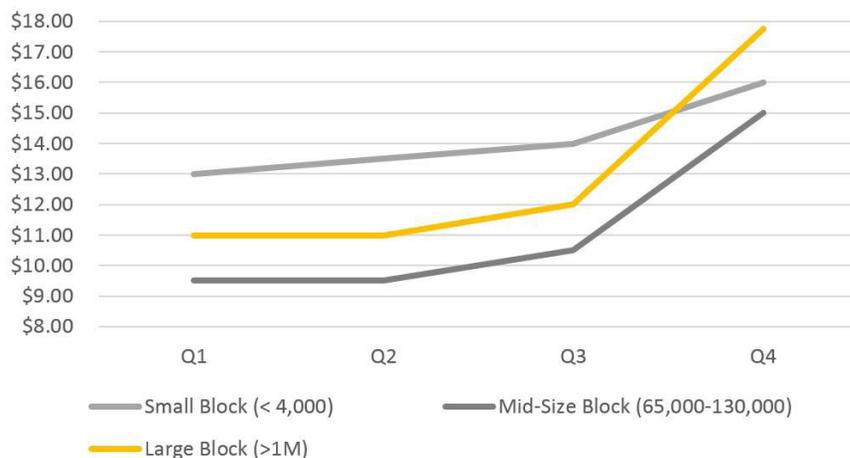
Relying on our primary source data as of the publication of this report,⁵ unit pricing for large blocks (now sitting in the \$17 to \$18.50 per number range) has already surpassed small and medium block unit pricing (trading in the \$15 to \$17/number range).

Although the heat in the large block market currently exceeds that of the rest of the market, there are signs this will not continue long term, and that small and medium block trading will remain robust and active longer. Because large block supply has been unable to meet the demand of the few remaining large block buyers, these buyers have been aggressively competing on price. This imbalance is expected to push large block prices to new heights over the next 12 to 18 months. These conditions are unlikely to last longer than another 24 months. We expect at least two of these large block buyers will leave the market, either because they have attained their acquisition targets, or abandoned growing their IPv4 networks further due to unsatisfactory and unreliable large block supply and/or IPv6 migration reaches critical mass at the top tiers in North America and Europe. At this point, prices will drop off precipitously.

The small and mid-sized block markets are sustained by more plentiful supply, and a large diverse pool of global buyers. These market sectors are, therefore, less susceptible to volatility, and should continue to be vibrant for at least four to five more years.

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Table 8: 2017 Pricing Trends



IPv6 Adoption and its Market Impacts

Global IPv6 deployment is progressing, but in fits and starts. (See [Table 9](#).) In the last quarter of 2016, the percentage of users connecting to the Internet via IPv6 grew by one percentage point per month, indicating that there was an overall acceleration in adoption between 2015 and 2016.⁶ In the first quarter of 2017, progress stalled. Between April and July 2017, global IPv6 adoption began moving at a percentage point per month. In the third quarter, adoption stalled again, moving up just slightly by 2.5% points over the course of the next 5 months to close the year at 22.6%. In the end, expectations of consistently accelerating IPv6 adoption based on the last few months of 2016 were frustrated. (See [Table 10](#)).⁷

Global IPv6 adoption is predicted to hit the 50% mark sometime between early 2020 and mid-2021, and 80% by 2023.⁸ There are, however, considerable regional variations underlying these global figures, spanning anywhere from 0% in parts of Asia and Africa to more than 50%⁹ in Europe.

Both Europe and North America have been long time leaders in IPv6 adoption. At the close of 2017, IPv6 adoption levels in the United States and Canada, the two countries that dominate the ARIN region market, surged to all-time highs of nearly 39% and 20%, respectively. Apart from Belgium, Greece, and Germany, IPv6 adoption in the United States has consistently outpaced other countries by considerable margins. IPv6 content in both the U.S. and Canada has already

reached just above 50%, and projections suggest that IPv6 adoption in the US should reach 80% within the next 3 to 4 years.¹⁰

Notwithstanding the progress in the U.S., we continue to find no correlation between growth in IPv6 adoption and the North American IPv4 market. (See [Table 11](#).) The path to full native IPv6 includes transitioning to dual stack environments (i.e., operating IPv6 and IPv4 networks concurrently) rather than a replacement and decommissioning of IPv4 networks. The lack of correlation between increased IPv6 adoption and IPv4 market activity is, therefore, unsurprising but will likely change when IPv6 becomes more firmly rooted as the dominant Internet protocol globally. ■

Table 9: Global IPv6 Adoption 2015-2017

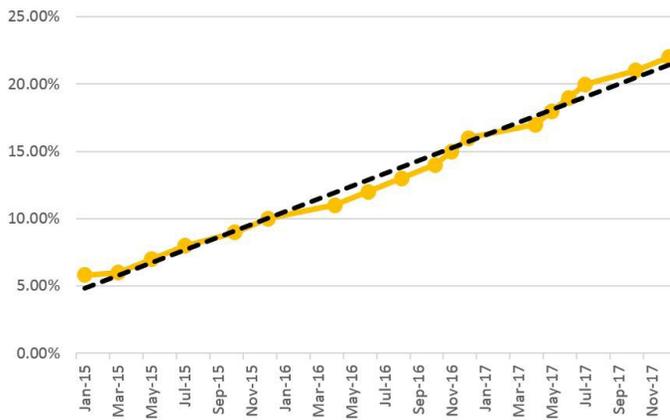


Table 10: Percentage Annual Progress in IPv6 Adoption

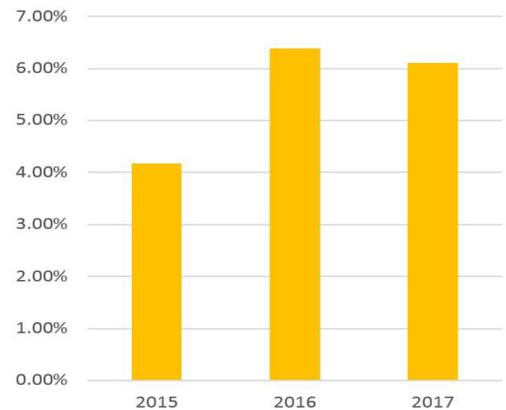
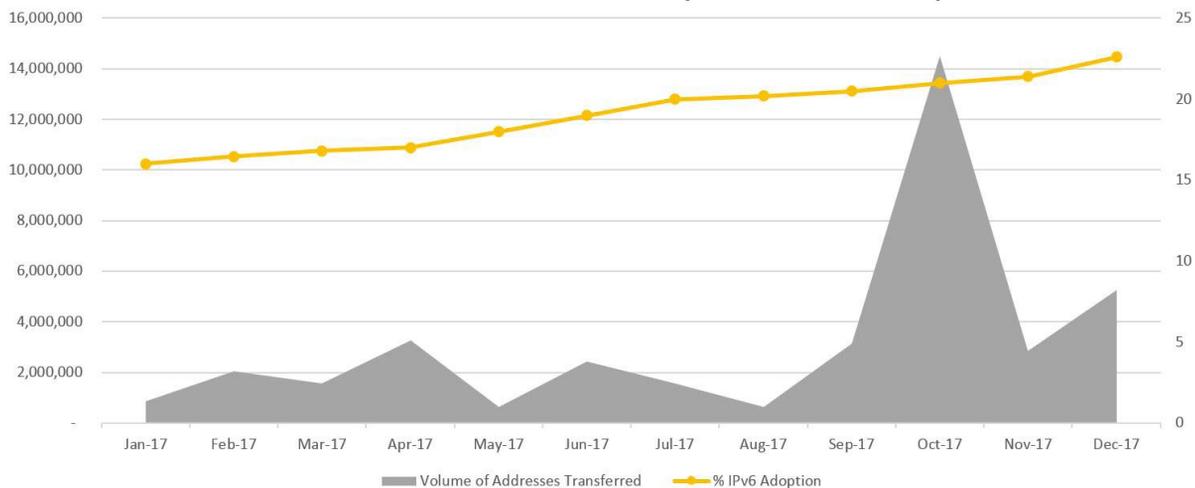


Table 11: Addresses Transferred Globally and Native IPv6 Adoption



Key Takeaways

- The small block market is thriving and represents a growing portion of the total IPv4 market.
- Spurred by significant price improvement and more flexible buyer purchase criteria, the supply of large blocks jumped in 2017 after a relative drought in 2016 but that market may be nearing its expiration as we head into 2019.
- Large block buyers have reduced their minimum block size requirements and are consuming a considerable portion of /16s (along with even smaller blocks) that enter the market.
- Unit prices across all block sizes rose steadily, and show signs of continuing the march upward through 2018.
- IPv6 adoption is making progress but continues to have little, if any, effect on the market demand for IPv4 address space.
- Inter-regional activity involving ARIN buyers and sellers is beginning to lag as large block buyers abandon the inter-RIR transfer market ...at least for now.

Predictions for 2018

- The aggregate number of ARIN intra-regional transactions will grow by 25%, yet the average transaction size will shrink as small blocks comprise an ever-increasing portion of the overall market activity.
- The total annual volume of numbers transferred will remain reasonably flat at the 2017 levels.
- The Inter-RIR market activity will recover from its dip in 2017 when at least one international buyer acquires a large collection of ARIN-sourced address space.
- By year end, prices for medium and large blocks will pass the \$20 per number mark.
- Global IPv6 deployment will reach a high of 29%.

How Accurate Were Our 2017 Predictions?

We predicted...

- Mid-size and large block pricing will converge and average \$15 per number by year end.
- The number of ARIN transactions will keep with 2016 trends.
- Global IPv6 adoption will reach a high of 24%.
- Market pricing for small blocks creeps up to \$20 per number.
- The IPv4 market will go fully global with the passage of inter-RIR transfer policies in AFRINIC and LACNIC.

At the end of 2017...

- Market pricing for large blocks hit \$15 by year end. Pricing for mid-sized block came in just under.
- The upward trajectory in transactions in 2016 continued into 2017, with a growth rate of 26%.
- Almost. Global IPv6 adoption peaked at 22.6%.
- Small block pricing rose above \$16.00 but didn't make it to \$20. Maybe next year...
- Sadly, it was not to be. AFRINIC abandoned its inter-RIR policy and LACNIC's proposal is still under discussion.

1. This report (other than pricing) uses publicly available data provided by three regional Internet registries: ARIN, RIPE-NCC and APNIC. Although many IPv4 transactions involve RIR approval, some transactions occur outside of the RIR transfer policies. Buyers and sellers occasionally decide, under various transaction structures, to trade numbers without seeking RIR approval or updating the registrant of record in the RIR registry. Although not insignificant, these “dark” transactions do not materially distort the rest of the market nor do they impair an effective analysis of it. For purposes of this report, we believe Avenue4 source data and the public RIR data, taken together, reasonably reflect the market even if they underestimate total market activity. ↑

2. We measure market activity both by the volume of IPv4 numbers transferred, and the volume of transactions. We count trades conducted solely within the ARIN region pursuant to Section 8.3 of ARIN’s Number Resource Policy Manual (NRPM) or inter-RIR trades conducted pursuant to Section 8.4

of the NRPM, where at least one party is in the ARIN region and the other party is either in the APAC or European regions. For purposes of the analysis in this report, a single transaction represents a transfer of numbers (which may include multiple blocks) between the same parties in the same time period. ↑

3. Unless otherwise noted, all Tables include data on both intra- and inter-RIR transactions under Sections 8.3 and 8.4 of the NRPM respectively. ↑

4. Prior to ARIN’s assumption of allocation and registration responsibilities, the IANA and other various Internet registries acting under contract with the United States Government, issued 110 “legacy” /8 blocks. Each /8 block contains 16,777,216 IPv4 addresses. Of these blocks, 23 were allocated to 20 non-governmental/non-RIR organizations. With the exception of the United Kingdom Government of Works and Pensions, which has sold approximately 30% of its /8 block, no other government entity has participated in the IPv4 market. ↑

5. Several years into the market, there is still a lack of transparency in connection with market pricing even though the market has matured as many of its participants experience success, and transactional norms gain wider acceptance. To provide our pricing guidance, we draw from our own extensive portfolio of active leads, bidding process results, open offers, and closed transactions. We augment our primary data with secondary sources, including print media research and direct interviews with our network of active market participants. ↑

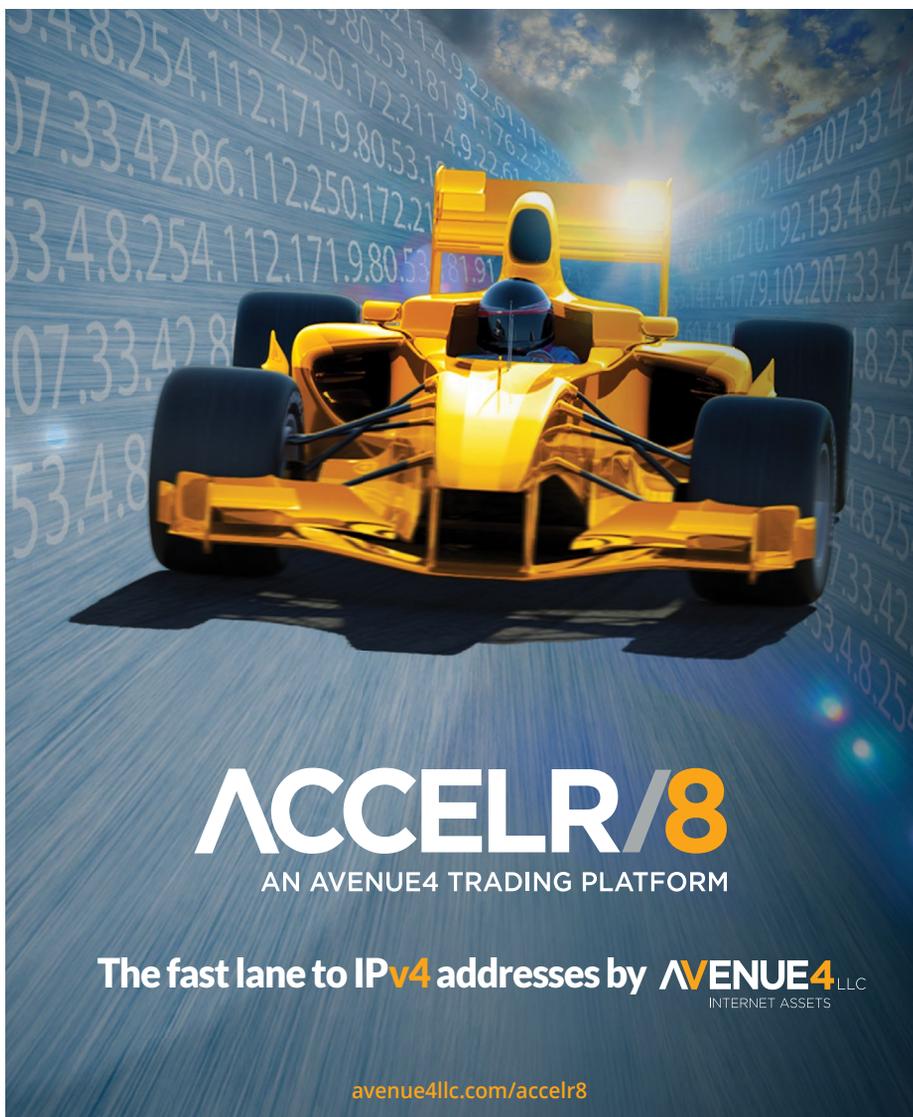
6. Unless otherwise noted, general references to IPv6 adoption measurements are based on the number of users connecting to IPv6 enabled websites as reflected in Google’s native IPv6 statistics at <https://www.google.com/intl/en/ipv6/statistics.html>. ↑

7. Table 10 measures IPv6 end user adoption from 1/1 to 12/31 of each year. In general, IPv6 traffic has been 3-4% higher on weekends and holidays than during business days. By using two days that are likely to be high traffic days each year, we are better assured a more accurate measurement of year to year progress. ↑

8. The model at <https://www.vyncke.org/ipv6status/project.php?metric=p&timeforward=365&timebackward=365&country=ww> provides the option to apply several different regression formulas to predict future IPv6 adoption measurements. The Quadratic 2nd Order regression predicts more delayed adoption (and reflects the later date above). The S-curve, which is commonly accepted as the best fit for a technology adoption pattern, projects a more aggressive IPv6 adoption timetable. ↑

9. See <http://6lab.cisco.com/stats/>. ↑

10. A significant increase in a particular country’s IPv6 adoption numbers may be influenced by the actions of one or two companies, and not necessarily indicative of progress across the board. For example, in 2016, Sky Broadcasting’s IPv6 network deployment rose by more than 50% through July. During this same time period, end user adoption statistics for the United Kingdom increased from below the 5% mark to nearly 13%. Similarly, as Rogers Communications’ IPv6 network deployment rose from less than 1% deployment to over 45% in 2016, Canada’s end user adoption statistics rose by nearly 11%. But when Rogers IPv6 rollout stagnated in 2017, registering only about 2.5% growth, so too did end user IPv6 adoption in Canada, which climbed by less than 2.5%. Still there are clear regional trends. ↑





Avenue4 was founded in September 2014 by Marc Lindsey and Janine Goodman. Together, Janine and Marc have consulted some of the most demanding market participants and closed many of the largest deals in the market to date. Avenue4 helps its clients strategize and execute IPv4 transactions in an opaque and rapidly evolving market. We provide advice on managing, preserving and monetizing IPv4 numbers as an asset.

We dedicate our reputation, knowledge, experience and resources to minimize risk and deliver value for our clients.

In 2017, Avenue4 brought this same knowledge, experience and expertise to the small and mid-size block markets with the launch of ACCEL8, a transformational IPv4 trading solution.

Our custom services include:

- Conducting due diligence
- Developing go-to-market strategies
- Matching buyers with sellers
- Identifying value enhancing opportunities
- Structuring, negotiating and closing transactions
- Facilitating registration transfers
- Maintaining IPv4 registry records and preserving entitlements