Telecommunication Development Sector
Study Groups

Second Meeting of ITU-D Study Group 1
Geneva, 23-27 October 2023

Question 1/1:	**Strategies and policies for the deployment of broadband in developing countries**
SOURCE:	American Registry for Internet Numbers (ARIN)
TITLE:	Considerations in Broadband Deployment – Critical Internet infrastructure, Security, and Support Mechanisms
Action required:	Participants are invited to consider this contribution and associated mechanisms regarding broadband deployment within their borders or organizations.
Keywords:	*IPv6, IXP, RPKI, broadband*

Abstract:

This information contribution provides ITU Member States and Associate Members with updates relevant to Q1/1 strategies and policies for the deployment of broadband in developing countries. This contribution will address the topics of IPv6, Internet Exchange Points (IXPs), Resource Public Key Infrastructure (RPKI)/Secure Routing, and Grant and Fellowship programs. It is essential that members are aware of the services their Regional Internet Registry (RIR) can provide in the evolving development of the Internet. While this contribution is from a single RIR, members may wish to engage their respective RIR on similar topics if they have not already. Participants are invited to consider and discuss this contribution. These tools and resources are not only beneficial to broadband deployment, but also foster digital transformation supporting digital independence as part of sustainable economic development and growth.

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IPv6

The deployment of IPv6 is the protocol essential to the future growth of the Internet. Google reports that almost 40% of global Internet traffic connected to its services are over IPv6[1]. Since implementation is well underway throughout the world, it is vital that Internet services and applications be available to the entire Internet via both IPv4 **and** IPv6. This implies providing online services and content over both protocols. For those Member States and Associate Members that already have IPv4 address space from an RIR such as ARIN, receiving IPv6 address space may be available at no additional cost. In some instances, organizations may find they require IPv4 addresses to help transition to IPv6. To that end, one of ARIN's community developed policies, 4.10 Dedicated IPv4 Block to Facilitate IPv6 Deployment[2], may be used by organizations to obtain IPv4 address space to specifically support their deployment of IPv6. While most of the RIRs have depleted their IPv4 resources for allocation, IPv4 blocks may have been reserved for IPv6 deployment as a result of one of the many community-established policies. It's worth noting that networks vary in size, even with IPv6. While IPv6 address space is vast, it is still a finite resource and RIRs offer to assist organizations in efficient use.

ARIN maintains a community blog (https://www.arin.net/blog/) as a public service to inform individuals, businesses, civil society, and governments on topics of interest to the Internet community. ARIN also features a library of IPv6 case studies which offer detailed accounts from organizations that have already made progress on their IPv6 journey.

Guest authors from different organizations, including government, private sector, and academia, provide insight on IPv6 deployment challenges for all levels, and share any opportunities related to IPv6 implementation to encourage others to adopt IPv6. These case studies share experiences and business processes regarding IPv6 implementation and may be useful to those seeking such information. The posts are also relevant to broadband deployment, as the continued development and growth of the Internet is dependent on the deployment of IPv6.

The case studies are available here: https://www.arin.net/blog/ipv6/

Internet Exchange Points (IXPs)

IXPs help keep Internet traffic local to the extent possible, and therefore helps reduce dependency on backhaul and associated latency and networking costs. Additional benefits of IXPs include network resiliency and efficiency, since traffic is routed more directly. There is a vast array of IXP-related content available on the Internet that highlights business cases, experiences, and best common practices regarding IXP deployment. There are over 1100 IXPs[3] globally, though certain areas are still in need of Internet growth and development. Member States and Associate Members should consider the merits of possible deployment of IXPs in their geography. In a similar manner of supporting critical Internet infrastructure as IPv6, ARIN Policy 4.4 Micro-Allocation Policy[4] provides IPv4 address space in support of the deployment of IXPs. IXPs may be deployed using IPv4 and/or IPv6 addresses.

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[1] Google IPv6 Adoption Statistics, https://www.google.com/intl/en/ipv6/statistics.html, 19 September 2023

[2] ARIN Number Resource Policy Manual, 4.10 Dedicated IPv4 Block to Facilitate IPv6 Deployment, https://www.arin.net/participate/policy/nrpm/#4-10-dedicated-ipv4-block-to-facilitate-ipv6-deployment, 21 September 2023

[3] Packet Clearing House (PCH) website, https://www.pch.net/services/internet_exchange_points, 21 September 2023

[4] ARIN Number Resource Policy Manual, 4.4 Micro-Allocation Policy, https://www.arin.net/participate/policy/nrpm/#4-4-micro-allocation, 21 September 2023

Resource Public Key Infrastructure (RPKI)/Secure Routing

In the early Internet, routing was dependent on network relationships based on mutual trust. This model proved sufficient when each party expected that transmitted information was safe, accurate, and not affected by accidental or malicious activity. As the Internet has grown from a simple platform for sharing information to a commercial platform, it has become increasingly vulnerable to abuse and attack.

RPKI uses cryptographically verifiable statements to ensure that Internet number resources are certifiably linked to the stated holders of those resources. This enables resource holders to attest which Autonomous System Numbers (ASNs) should originate their prefixes (i.e. blocks of IP addresses). Network operators can compare Border Gateway Protocol (BGP) announcements from the global Internet routing table with RPKI validity data to make informed decisions to enhance their routing security.

To authorize an ASN to route a set of prefixes, the resource holder must first obtain a resource certificate from their issuing RIR that verifies the IP addresses allocated to them. After receiving a resource certificate, the resource holder creates signed Route Origin Authorizations (ROAs) that specify the ASN authorized to originate their IP addresses. ROAs are then used by other network operators to make decisions on routing. The ROAs provide verification that the routes being advertised are valid and can be used safely in routing tables.

RPKI has gained significant traction in its deployment; approximately 45% of globally allocated IPv4 address space announced to the Internet is marked RPKI-valid[5]. Continued deployment of RPKI, along with other measures, will improve Internet routing security.

ARIN, along with the other RIRs, provides the tools and training to help secure routing through RPKI.

Community Grant Program

The ARIN Community Grant Program provides financial grants in support of initiatives that improve the overall Internet industry and Internet user environment. ARIN awards grants to support qualified operational and research projects that advance ARIN's mission, and broadly benefit the Internet community. ARIN has funded more than 20 projects since the program's launch in 2019. Grants have supported valuable Internet research as well as critical infrastructure deployment, such as IXPs in the Caribbean. To be eligible for funding, projects much fit into one of more of the following categories: Internet technical improvements, registry processes and technology improvements, informational outreach, and/or research. Grant recipients are required to provide written reports on project status and outcomes as well as a final written report which is made publicly available. In 2023, the ARIN Community Grant Program had a budget of $60,000 (USD) to provide funding to successful applicants in varying amounts based on project need. ARIN wishes to highlight this program to those interested; more information is available at https://arin.net/grants

Fellowship Program

Internet governance and number resource policy are powered by community participation. To encourage and foster new voices, policy and governance leadership, and active members within the community, the ARIN Fellowship Program provides a specialized, interactive learning opportunity to individuals interested in these aspects of the Internet and their professional growth

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[5] National Institute of Standards and Technology – U.S. Department of Commerce, https://rpki-monitor.antd.nist.gov/, 21 September 2023

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in the industry. Fellows have not only contributed to important Internet governance and ARIN policy-related matters, but some have also been elected to both ARIN's Board of Trustees and Advisory Council.

A group of Fellows is selected twice a year to participate in the month-long program before and during an ARIN Public Policy and Members Meeting. Fellows receive an in-depth, expert-guided introduction to the workings of the ARIN organization and Policy Development Process (PDP), along with opportunities for networking and direct participation in the PDP. With the personal support of an ARIN community member mentor, Fellows progress through an engaging and approachable agenda of presentations, discussions, and Q&As with ARIN leadership, including ARIN staff and Advisory Council members. The sessions provide an overview of Internet governance, Internet number resource policy and its development, ARIN services and operations, and the Internet Number Registry System. Fellows can ask questions, get feedback, and gain the knowledge and confidence to join in community discussions, propose new ideas, and become part of the future of Internet governance and policy in the ARIN region. More information regarding the fellowship program can be found at https://arin.net/fellowships; ARIN encourages this opportunity to all interested parties in the ARIN service region.

ARIN Background

ARIN is responsible for the management and distribution of Internet number resources, such as IP addresses and ASNs within its service region[6]. ARIN provides services to over 39,000 customers, and has approximately 17,500 members. Throughout the service region, its customers include federal, state, and municipal governments and related agencies, commercial for-profit and non-profit organizations, educational and health care institutions, public safety organizations, and more. A few of the many services ARIN offers include reverse DNS (Domain Name Services), RPKI, Whois and WhoWas, an authenticated Internet Routing Registry, and facilitation of an inclusive, bottoms-up Policy Development Process. ARIN is one of five RIRs that cooperate in the provision of global Internet Number Registry Services. Specific to Member States and Associate Members, ARIN coordinates with LACNIC, the Caribbean Telecommunications Union (CTU), the Caribbean Network Operators Group (CaribNOG), the North American Network Operators Group (NANOG), CARICOM, and CANTO, as well as public safety and law enforcement agencies, by providing speakers, meeting support, and informational outreach.

ARIN coordinates the development of fair, impartial, and technically sound policies by the Internet community for the management of number resources. These policies establish the criteria for assignment of number resources and related Internet number administration. Additional information about ARIN can be found at www.arin.net.

In addition to considering this update, participants are encouraged to reach out to ARIN for any assistance by contacting Einar Bohlin, Vice President of Government Affairs, at einarb@arin.net, and Nate Davis, Senior Government Affairs Analyst, at ndavis@arin.net.

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[6] ARIN serves Anguilla, Antarctica, Antigua and Barbuda, Barbados, Bermuda, Bouvet Island, Canada, Cayman Islands, Dominica, Grenada, Guadeloupe, Heard and McDonald Islands, Jamaica, Martinque, Monserrat, Puerto Rico, Saint Barthelemy, Saint Helena, Saint Kitts and Nevis, Saint Lucia, Saint Pierre and Miquelon, Saint Vincent and the Grenadines, Saint Martin, The Bahamas, Turks and Caicos, Virgin Islands (British and U.S.) and the United States.