Internet Service Provider Address Coalitions (ISPACs)
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1. Introduction

   The introduction of CIDR [1, 2] substantially changed the way that
   address allocation was performed in the Internet. The result is that
   address allocation is provider-based: the address used by a host
   depends on which service provider is used by the host. One of the
   unfortunate implications is that if a host changes provider, it must
   renumber. In many cases this is awkward, expensive, and difficult.

   This note describes an organization that may be formed to help reduce
   the need for user renumbering while still providing the benefits of
   CIDR to the remainder of the network. Such organizations do not
   currently exist, so this note is at best a discussion of the
   foreseeable future and is not a catalog of existing experience.

   These organizations are formed by grouping Internet Service Providers
   (ISPs) into topologically connected sets, each of which shares one or
   more IP address prefixes. Such an organization is called an ISP
   Address Coalition (ISPAC, pronounced "ice pack"). To simplify the
   discussion, we assume that the ISPAC shares a single prefix. The
   discussion generalizes to multiple shared prefixes in the obvious
   manner.

[2](#). Creation of an ISPAC

An ISPAC can be created from a set of ISPs which are willing to share an address prefix and are willing to meet certain technical and administrative requirements. There may also be additional legal requirements, such as anti-trust issues, that are beyond the scope of this document.

The primary technical requirement is that all members of the ISPAC be willing to cooperate and each treat the shared prefix as a common resource. Further, each member of the ISPAC should perform aggregation on the shared prefix address space when advertised outside of the ISPAC. Note that this aggregation may be performed in accordance with normal CIDR procedures, so this does not necessarily imply that only the aggregated prefix is advertised. This exceptional case is discussed in more detail below.

Because all members of an ISPAC are advertising the aggregated shared prefix, any member may attract traffic for portions of the shared prefix that need to be routed to another member. For this reason, it is essential that all members of the ISPAC be able to route to any other member of the ISPAC without leaving the ISPAC (i.e., the ISPAC is connected). One way that this requirement could be satisfied is for all members of the ISPAC to be present at a common interconnect.

The primary administrative requirement to form an ISPAC is the selection of an addressing authority for the shared prefix. A complete discussion of the issues in the selection of such an authority are beyond the scope of this document, but may include renumeration for providing for address space administration and impartiality of the authority. Once an addressing authority is selected, it is necessary to acquire the shared prefix. This would be done according to the normal address allocation procedures. The address space request from an ISPAC should be regarded as if it came from any ISP with the properties of the union of the members. No special privileges are accorded to requests from ISPACs, so normal justifications for address space would apply.

[3](#). Operation of an ISPAC

The day to day operations of an ISPAC has certain special considerations which impact all of the members of the ISPAC. Because sites may change providers within the ISPAC, intra-ISPAC routing must be carefully managed. A user should be able to be assured that they are the only ones using a component in the shared prefix and that their routing reliability is comparable to that provided to users within the ISP assigned address prefixes. To accomplish this, the

members of the ISPAC must exchange routing information about
components of the shared prefix. The exact mechanisms that are used
to accomplish this are beyond the scope of this document, but there
are many possibilities, including a common IGP, or via BGP. Members
of the ISPAC should agree on a particular set of mechanisms for
exchanging routing information about the shared prefix, including
protocols and any administrative filtering for sanity checking.

Because components of the shared prefix are generally not advertised
outside of the ISPAC, if the ISPAC itself is internally partitioned,
it will cause an outage between users of the shared prefix. To
prevent this, members of the ISPAC are strongly encouraged to insure
that the ISPAC is biconnected or triconnected. One way that this can
be accomplished is to have multiple interconnects at which all
members of the ISPAC are present. These may be private or public
interconnects. Alternately, increased connectivity can be provided
by a number of pairwise interconnects.

For inter-ISPAC routing, each member of the ISPAC must advertise the
shared prefix. Normally, this will be done with BGP, so the shared
prefix may appear to have multiple source autonomous systems. For
this reason, advertising the existence and membership of the ISPAC
and the particular prefix to the administrators of other domains is
useful to help eliminate false alarms in interdomain sanity checking
systems.

By default, simple advertisement of the shared prefix will cause all
traffic to enter the ISPAC at the nearest member. This will only be
optimal for sites which have their optimal connection to that
neighbor. In many cases, it would be preferable to determine optimal
entry points for components of the shared prefix. At the same time,
it is essential to not advertise all components to the remainder of
the network, as this would defeat the aggregation of the prefix. To
preserve aggregation and provide more optimal routing, there is a
useful technique which can be borrowed from normal interdomain
routing. In this application, this technique a member of the ISPAC
may advertise some of the components of the shared prefix, but the
member must insure that the scope of these advertisements is
carefully restricted. The restriction of scope is usually
accomplished by administrative filtering and careful coordination the
receiver of the advertisements.

Because any advertisement of the shared prefix by a member of the
ISPAC may attract traffic, it may be the case that a member may end
up providing transit service to other members of the ISPAC. It is up
to the members of the ISPAC to determine their own policy regarding
this transit traffic. It may be that such traffic is equally
distributed, in which case responsibilities are shared equally.
Alternately, due to customer dissimilarities, the traffic loads may
be highly skewed. In this case, the shared prefix may only be
advertised to external providers at interconnects where all members

and external providers are present. In this case, it is likely that
members would not advertise the shared prefix across their private
interconnects. This will affect the quality of the routing for sites
within the shared prefix.

Note that nothing in this discussion precludes a provider from
joining multiple ISPACs. Further, these ISPACs may share members in
any fashion. ISPACs may be disjoint, may overlap, may be tangential
or may intersect freely.

[4]. **Benefits of an ISPAC**

        The primary benefit of an ISPAC is to reduce the requirement
on renumbering when a site changes provider. This benefit only
occurs when the site changes providers within the ISPAC. As a
result, a site gains the most benefit from the ISPAC when there are
many providers within the ISPAC. Further, a site may have
substantial costs if changing to a provider which is distant. Thus,
a site derives the most benefit if there are multiple providers
within the same geographic area. Note that this is most effective if
the different members of the ISPAC are closely comparable
competitors. The site will consider reliability, bandwidth and
service when selecting an alternate provider, in addition to
considering membership in the ISPAC.

Note that the end site itself is not a member of the ISPAC and has no
obligation whatsoever to change to another provider within the ISPAC.

Another benefit of an ISPAC is for sites that wish to be multi-homed
through multiple providers. If such sites are numbered from the
shared prefix and are connected through multiple providers that are
all members of the ISPAC, then no extra routing information needs to
be injected into global routing. This is a significant benefit
because even with CIDR, the scalability of global routing can fall
victim due to the number of prefixes injected due to multi-homed
sites.

Another benefit that aids in the aggregation of routing information
is the ability of the ISPAC to take multiple smaller providers and
advertise only the shared prefixes. Without the ISPAC, each ISP
would be forced to inject their own routes. The additional
aggregation resulting from membership in the ISPAC should greatly
improve the level of aggregation that can happen across small
providers, both by allowing the ISPAC a larger block of addresses and
by automatically aggregating the ISPAC shared prefixes at the border
of the ISPAC. An ISPAC also allows a smaller provider to receive
significant amounts of address space which is not allocated through
an upstream provider. This is advantageous as the smaller provider
may wish to be associated with one or more larger providers. An
association with any single larger provider might result in inferior

routing, and an inability to leave that large provider without
renumbering. With an ISPAC, such a member would instead be dependent
on the continued existence of the ISPAC.

[5](#). Drawbacks of an ISPAC

   Along with these many benefits, there are also a number of drawbacks
   to membership in an ISPAC. The primary difficulty stems from the
   inability to perform aggregation on the shared prefix within the
   ISPAC. As noted above, this implies that members of the ISPAC must
   be willing to devote a certain amount of resources to supporting
   ISPAC routing. Also as mentioned above, the quality of routing for a
   shared prefix may suffer as compared to a private prefix due to the
   aggregation at the ISPAC boundary. Due to this aggregation, traffic
   will tend to enter the nearest border of the ISPAC. Without
   aggregation, traffic would seek the closest entry to the ISP. In
   cases in which these two entries differ, the routing may be
   suboptimal.

   Another extremely important point about ISPACs is that they do not
   eliminate the need to renumber. If a site chooses to leave the
   ISPAC, they will have to renumber, just as if they left a non-ISPAC
   provider. As with the normal renumbering case, certain
   accommodations may be made to ease the transition to the sites new
   prefix. These circumstances and operations are part of normal CIDR
   prefix management and are not detailed here.

   Similarly, if an ISP leaves an ISPAC, then any of the ISP's customers
   which are numbered out of the shared prefix will have to make a
   difficult decision. If they choose to remain with the ISP or change
   to a ISP not in the ISPAC, then they will have to renumber.
   Alternately, they can change to another provider within the ISPAC.
   In both this and the above case, the end user ends up renumbering.
   It is important to note these cases as the primary benefit of an
   ISPAC is to decrease, but not eliminate, the need for site
   renumbering.

   If an ISPAC is composed of ISPs of differing sizes, there may be some
   difficulty with inequities of responsibilities to the ISPAC. To see
   this clearly, consider a case where a very large provider and a very
   small provider form an ISPAC. In this case, the small provider may
   have to provide transit service for the very large provider's
   traffic. Yet in return, the small provider may receive little
   transit traffic through the very large provider. Similarly, the very
   large provider may consume a much larger percentage of the shared
   prefix.

[6](#). Generalization

So far, we have described the simplest and smallest forms of an
ISPAC. These consist of a small number of providers aligned around a
small number of interconnects. In this section we consider some of
the situations which can occur with larger ISPACs. Note that these
examples are used solely to illustrate the scalability of the concept
and are not a recommendation for particular ways of using ISPACs.

An obvious opportunity to use ISPACs is in metropolitan areas,
grouping providers around population centers. If the metropolitan
area has a sufficiently large population, it probably also has a
significant amount of traffic, one or more interconnects, and a
number of ISPs. An ISPAC in this situation bears a superficial
resemblance to geographic addressing. However, there are significant
differences. Unlike geographic addressing, participation in the
ISPAC is wholly voluntary. This maximizes the choices that the site
has, and so this should be considered a significant advantage.
Further, this allows competition between ISPACs, which is vital in
ensuring that the ISPAC provides quality service to its sites.
Finally, the ISPAC would easily allow private interconnects from
members to non-members, which may or may not advertise the shared
prefix. Scaling the number of interconnects is key to insuring high
connectivity in the topology, for distributing traffic, and for
optimizing routing.

ISPACs may be further generalized along topological or geographic
boundaries, although neither of these directions is required. For
example, if there are several providers which are at a number of
major interconnects, they may wish to form an ISPAC, even though the
interconnects may be widely separated. Such an ISPAC should be more
robust since it would not partition without the failure of several
interconnects. With this size of ISPAC, it is also possible for a
company to place both its headquarters and its remote offices within
the ISPAC shared prefix. This is beneficial in that the company does
not inject multiple prefixes into global routing.

If we continue this generalization to its logical extreme, we end up
with a global ISPAC which all providers belong to. The shared prefix
is similar to the provider independent address space that exists
today. However, there is one subtle difference in that the address
space is independently managed under the direction of the ISPAC.

7. Conclusions

To summarize, Internet Service Provider Address Coalitions (ISPACs)
are ad hoc organizations which can be formed by groups of ISPs.
There are significant technical and administrative difficulties to be
overcome in forming and maintaining these organizations. However,
the benefits that result from these organizations can be significant
both to end users and providers alike. At the same time, if executed

correctly, ISPACs are not detrimental to the scalability of Internet
routing, and may, in some cases, aid that scalability.

The primary benefit of an ISPAC is a reduction in the need for end
sites to renumber. This need is not eliminated with the application
of ISPACs, but can be significantly reduced, depending on the exact
deployment of ISPACs. The benefits to the ISP include the ability to
offer a desired service to interested sites, the ability to utilize
address space that is independent of larger providers, and the
ability to decrease the number of prefixes that it advertises.

7. Security Considerations

Security issues are not discussed in this document.

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