BGP Large Communities for IXPs

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IXP Members Use BGP Communities

- RFC 1997 style communities have been available for the past 20 years
  - Encodes a 32-bit value displayed as: “16-bit ASN:16-bit value”
  - Designed to simplify Internet routing policies
  - Signals routing information between networks so that an action can be taken
- Broad support in BGP implementations
- Widely deployed and required by members for Internet routing

Community	Description
0:peer-as	Prevent announcement of a prefix to a peer
43760:peer-as	Announce a route to a certain peer
0:43760	Prevent announcement of a prefix to all peers
43760:43760	Announce a route to all peers

INEX RFC 1997 Communities Examples

Source: https://www.inex.ie/technical/route-servers/

Needed RFC 1997 Style Communities, but Larger

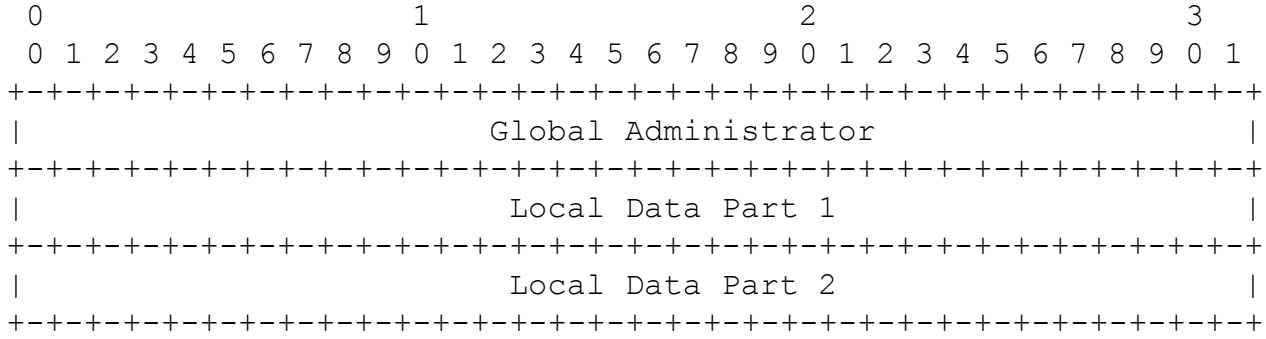
- We knew we'd run out of 16-bit ASNs eventually and came up with 32-bit ASNs
  - RIRs started allocating 32-bit ASNs by request in 2007, no distinction between 16-bit and 32-bit ASNs now
- However, you can't fit a 32-bit value into a 16-bit field
  - Can't use native 32-bit ASNs with RFC 1997 communities
- Needed an Internet routing communities solution for 32-bit ASNs for almost 10 years
  - Parity and fairness so everyone can use their globally unique ASN

The Solution: RFC 8092
"BGP Large Communities Attribute"

- Idea progressed rapidly from inception in March 2016
- First I-D in September 2016 to RFC publication on February 16, 2017 in just seven months
- Final standard, plus a number of implementation and tools developed as well
- IXPs and their members can test and deploy the new technology now

Cake and photo courtesy of the NTT Communications NOC.

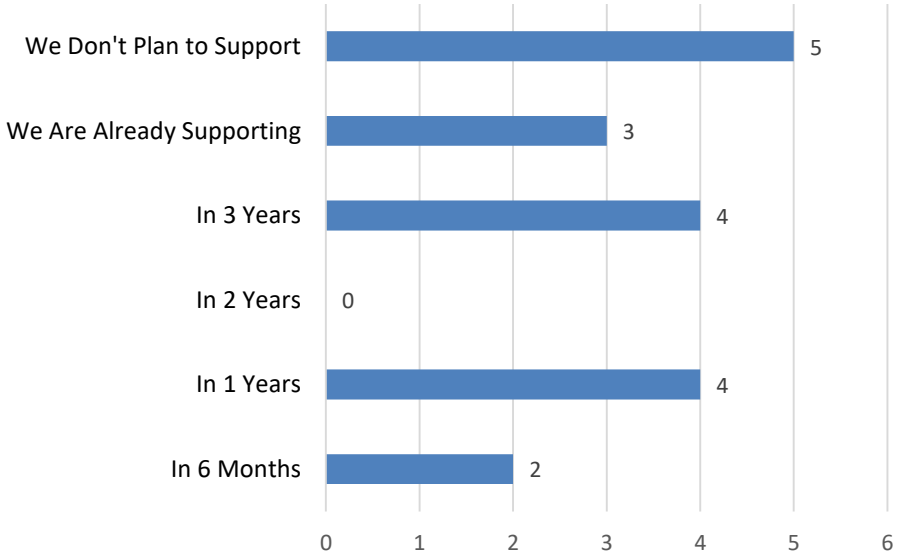
Encoding and Usage



- A unique namespace for all 16-bit and 32-bit ASNs
  - No namespace collisions between ASNs
- Large communities are encoded as a 96-bit quantity and displayed as “32-bit ASN:32-bit value:32-bit value”
- Canonical representation is $Me:$Action:$You

Demand for BGP Large Communities at CIX

- CIX 2016 members survey
- 18/31 members responded
- “When do you plan to support BGP large communities?”
- Results show existing use and near-term demand



Source: Mario Klobučar, CIX

Planning for Large Communities

- The entire network ecosystem needs to support large communities in order to provision, deploy and troubleshoot them
- Ask your vendors and implementers for software support
- Update your tools and provisioning software
- Extend your routing policies, and openly publish this information
- Train your technical staff

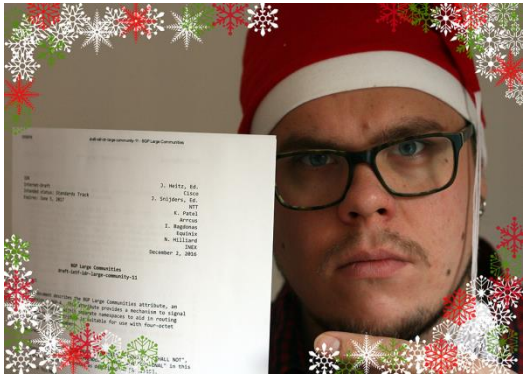


Image sources: https://www.sunet.se/blogg/all-i-want-for-christmas-is-large-bgp-communities/
"All i want for christmas is … Large BGP Communities" by Fredrik "Hugge" Korsbäck

Develop a Comprehensive Communities Policy

- Classic RFC 1997 communities will continue to be used together with large communities
  - There's no flag day to convert, large communities simply provide an additional way to signal information
- Your existing routing policy with classic communities is still valid
- Well-known communities such as "no-advertise", "no–export", "blackhole", etc. are still used
- Extend your policy with large communities that allow members to signal the same information as they can with classic communities

Communities Policy Development

- draft-ietf-grow-large-communities-usage is a new RFC 1998 style I-D in the IETF GROW Working Group
- Provides examples and inspiration for network operators to use large communities
- Also provides many examples on how to develop a communities policy
  - Informational communities
  - Action communities

Informational Communities

- An informational label to mark a route with
  - Its origin: ISO 3166-1 numeric country ID and UM M.49 geographic region
  - Relation or propagation: internal, member, peer, transit
- Provides information for debugging or capacity planning
- The Global Administrator field is set to the ASN that labels the routes
- Most useful for downstream networks and the Global Administrator itself

Information Communities Example

ISO 3166-1 Country ID	
Large Community	Description
64497:1:528	Netherlands
64497:1:392	Japan
64497:1:840	USA

+

UN M.49 Region	
Large Community	Description
64497:2:2	Africa
64497:2:9	Oceania
64497:2:145	Western Asia
64497:2:150	Europe

+

Relation	
Large Community	Description
64497:3:1	Internal
64497:3:2	Member
64497:3:3	Peering
64497:3:4	Transit

- For example, a communities value of “64497:1:528 64497:2:150 64497:3:2” would indicated that is was learned in the Netherlands, in Europe, from a member

CDN / Eyeball Example – You do a lot with 32 bits!

British Postal Codes (~31 Bits)	
Large Community	Postal Code
64497:9:849701135	E1W 1LB (London)
64497:9:1345374681	M90 1QX (Manchester)

or

GPS Coordinates	
Large Community	Location
64497:10:1281024	Amsterdam (52.37783, 4.87995)

- Location encoding can be used to provide very accurate location information attached to more-specific routes announced to CDN caches
- British postal codes can be encoded by stripping the whitespace and doing a simple base36 to base10 conversion
- GPS coordinates can be encoded with Geohash
  - For example 52.37783, 4.87995 (Amsterdam) encoded with 600 meter precision
  - Python: import Geohash; Geohash.encode(52.37783, 4.87995, precision=6)
  - Geohash result: “u173zp”
  - Convert “u173zp” from base32 to base10 = 1281024

Action Communities

- An action label to request that a route be treated in a particular way within an AS
  - Propagation characteristics: export, selective export, no export
  - Local preference: influence ingress traffic within the AS
  - AS Path: influence traffic from outside the AS
- The Global Administrator field is set to the ASN which has defined the functionality of the community
  - Also is the AS that is expected to perform the action
- Most useful for transit providers taking action on behalf of a member or the Global Administrator

Action Communities Example

- Selective no export
  - ASN based selective no export
  - Location based selective no export
- Selective AS path prepending
  - ASN based selective AS path prepending
  - Location based selective AS path
- Blackhole
  - Local blackhole
  - Remote blackhole

ASN Based No Export	
Large Community	Description
64497:4:64498	AS 64498
64497:4:64499	AS 64499
64497:4:65551	AS 65551

Location Based No Export	
Large Community	Description
64497:5:528	Netherlands
64497:5:392	Japan
64497:5:840	USA

Getting Started With Large Communities

- 2018 is the year of large BGP communities
  - Preparation, testing, training and deployment can take some time
  - Start the work now, so you are ready when members want to use large communities
- Lots of resources are available to help IXPs learn about large communities
  - BGP speaker implementations
  - Analysis and ecosystem tools
  - Presentations (http://largebgpcommunities.net/talks/)
  - Documentation for each implementation
  - Configuration examples (http://largebgpcommunities.net/examples/)

Large Communities Beacon Prefixes

- The following prefixes are announced with AS path 2914_15562$
  - 192.147.168.0/24 (looking glass)
  - 2001:67c:208c::/48 (looking glass)
  - BGP Large Community: 15562:1:1

Cisco IOS Output (Without Large Communities Support)

```
route-views>show ip bgp 192.147.168.0
BGP routing table entry for 192.147.168.0/24, version 98399100
Paths: (39 available, best #30, table default)
  Not advertised to any peer
  Refresh Epoch 1
  701 2914 15562
    137.39.3.55 from 137.39.3.55 (137.39.3.55)
      Origin IGP, localpref 100, valid, external
      unknown transitive attribute: flag 0xE0 type 0x20 length 0xC
        value 0000 3CCA 0000 0001 0000 0001
      rx pathid: 0, tx pathid: 0
```

BIRD Output (With Large Communities Support)

```
COLOCLUE1 11:06:17 from 94.142.247.3] (100/-) [AS15562i]
Type: BGP unicast univ
BGP.origin: IGP
BGP.as_path: 8283 2914 15562
BGP.next_hop: 94.142.247.3
BGP.med: 0
BGP.local_pref: 100
BGP.community: (2914,410) (2914,1206) (2914,2203) (8283,1)
BGP.large_community: (15562, 1, 1)
```

BGP Speaker Implementation Status

Implementation	Software	Status	Details
Arista	EOS	Planned	Feature Requested BUG169446
Cisco	IOS XR	✓ Done!	Beta (perhaps in 6.3.2 for real?)
cz.nic	BIRD	✓ Done!	BIRD 1.6.3 (commit)
ExaBGP	ExaBGP	✓ Done!	PR482
FreeRangeRouting	frr	✓ Done!	Issue 46 (commit)
Juniper	Junos OS	Planned	Second Half 2017 (perhaps 17.3R1?)
MikroTik	RouterOS	Won't Implement Until RFC	Feature Requested 2016090522001073
Nokia	SR OS	Planned	Third Quarter 2017
nop.hu	freeRouter	✓ Done!	
OpenBSD	OpenBGPD	✓ Done!	OpenBSD 6.1 (commit)
OSRG	GoBGP	✓ Done!	PR1094
rtbrick	Fullstack	✓ Done!	FullStack 17.1
Quagga	Quagga	✓ Done!	Quagga 1.2.0 875
Ubiquiti	EdgeOS	Planned	Internal Enhancement Requested
VyOS	VyOS	Requested	Feature Requested T143

Route Servers are Done!

Visit http://largebgpcommunities.net/implementations/ for the Latest Status

Tools and Ecosystem Implementation Status

Implementation	Software	Status	Details
DE-CIX	pbgpp	✓ Done!	PR16
FreeBSD	tcpdump	✓ Done!	PR213423
Marco d'Itri	zebra-dump-parser	✓ Done!	PR3
OpenBSD	tcpdump	✓ Done!	OpenBSD 6.1 (patch)
pmacct.net	pmacct	✓ Done!	PR61
RIPE NCC	bgpdump	✓ Done!	Issue 41 (commit)
tcpdump.org	tcpdump	✓ Done!	PR543 (commit)
Yoshiyuki Yamauchi	mrtparse	✓ Done!	PR13
Wireshark	Dissector	✓ Done!	18172 (patch)

Visit http://largebgpcommunities.net/implementations/ for the Latest Status

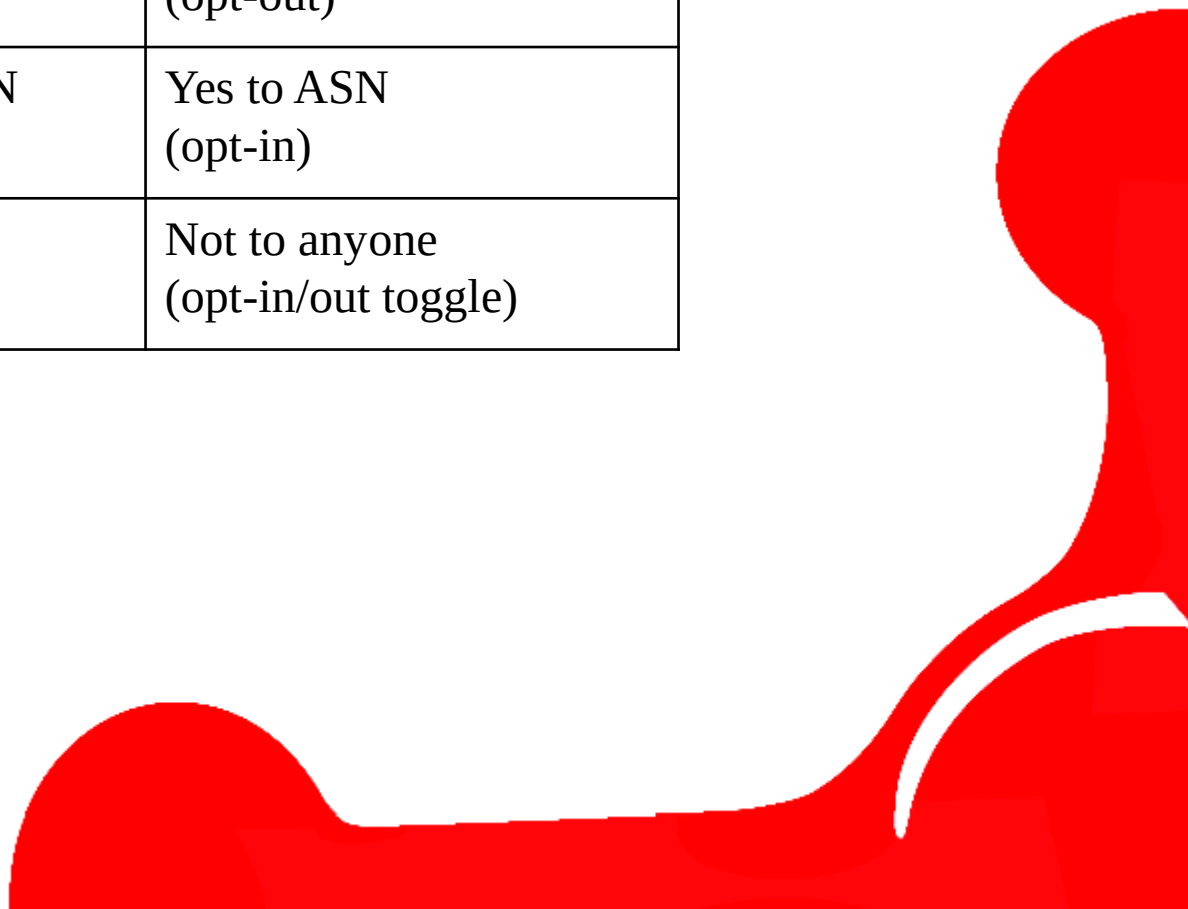
Testing Large Communities

- The BGP Large Communities Playground provides an easy way run several implementations together in a lab environment
- Supports BIRD, ExaBGP, GoBGP, Quagga and pmacct
- Docker images are available
- Use the playground to
  - Become familiar with large communities
  - Test interoperability with your vendor's BGP implementations
  - Design, configure and verify your new community policies

BGP Large Communities Playground: https://github.com/pierky/bgp-large-communities-playground

LARGE COMMUNITIES @ TREX

197032:0:ASN	Not to ASN (opt-out)
197032:65534:ASN	Yes to ASN (opt-in)
197032:0:65534	Not to anyone (opt-in/out toggle)



bird.conf diff

```
@@ -43,8 +43,11 @@
 function does_community_block(int peeras)
 {
       if (0,peeras) ~ bgp_community then return true;
+       if (myas,0,peeras) ~ bgp_large_community then return true;
       if (annas,peeras) ~ bgp_community then return false;
+       if (myas,annas,peeras) ~ bgp_large_community then return false;
       if (0,annas) ~ bgp_community then return true;
+       if (myas,0,annas) ~ bgp_large_community then return true;
       return false;
 }
```

Communities on INEX Route Servers – RFC 1997

Description	Community
Prevent announcement of a prefix to a peer	0:peer-as
Announce a route to a certain peer	43760:peer-as
Prevent announcement of a prefix to all peers	0:43760
Announce a route to all peers	43760:43760

Large Communities on INEX Route Servers – RFC 8092

Description	Community
Prevent announcement of a prefix to a peer	43760:0:peer-as
Announce a route to a certain peer	43760:1:peer-as
Prevent announcement of a prefix to all peers	43760:0:0
Announce a route to all peers	43760:1:0

Large Communities Implementation at INEX

- Canonical representation is $me:$action:$you
- LC check must occur before RFC1997 check
- BIRD immediately fails if ASN32 is subject to ASN
- Working code available on https://git.io/vSPwq

Large Communities Implementation at INEX

```
<?php if ($t->router->bgpLargeCommunities()) { ?>
        # support for BGP Large Communities
        if (routeserverasn, 0, peerasn) ~ bgp_large_community then
                return false;
        if (routeserverasn, 1, peerasn) ~ bgp_large_community then
                return true;
        if (routeserverasn, 0, 0) ~ bgp_large_community then
                return false;
        if (routeserverasn, 1, 0) ~ bgp_large_community then
                return true;
<?php } ?>
```

Large Communities Implementation at INEX

```
# unwise to conduct a 32-bit check on a 16-bit value
if peerasn > 65535 then
        return true;

# Implement widely used community filtering schema.
if (0, peerasn) ~ bgp_community then
        return false;
if (routeserverasn, peerasn) ~ bgp_community then
        return true;
if (0, routeserverasn) ~ bgp_community then
        return false;

return true;
```

Questions?

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Visit http://LargeBGPCommunities.net/ for the Latest Info

Reuse of this slide deck is permitted and encouraged!

Configuration and Output Examples

BIRD Configuration

```
# match
if ((8283, 1, 2) ~ bgp_large_community) then return true;

# scrub / delete
bgp_large_community.delete([(8283, *, *)]);
bgp_large_community.delete([(8283, 0, 1)]);

# set
bgp_large_community.add((8283, 0, 100));
bgp_large_community.add([(8283, 0, 100), (8283, 2, 333)]);
```

IOS XR Configuration
(EFT – Beta “Just Like Community”)

```
# match
route-policy set-something
  if large-community matches-any (8283:4:3) then
    set local-preference 120
  endif
end-policy

# scrub / delete
route-policy set-something
  delete large-community in (8283:*:*)
  delete large-community in (8283:4:3)
end-policy

# set
route-policy set-something
  set large-community (8283:45:29)additive
end-policy
```

Nokia SR OS Configuration

```
policy-options
    community "set" members "8283:45:29"
    community "match" members "8283:4:3"
    community "delete" members "8283:4:3"
```

```
policy-statement "set-something"
    entry 10
        description "match"
        from
            community "match"
        exit
        action accept
            local-preference 120
        exit
    exit
    entry 20
        description "scrub / delete"
        action accept
            community remove "delete"
         exit
    exit
    entry 30
        description "set"
        action accept
            community add "set"
        exit
    exit
exit
```

OpenBGPD Configuration

```
# match
allow from any large-community 8283:1:2
match from any large-community 8283:1:2 set localpref 300
deny to any peer-as neighbor-as \
       large-community 8283:6:neighbor-as

# scrub / delete
match from any set { large-community delete 8283:*:* }
match from any set { large-community delete 8283:1:2 }

# set
match from any set { large-community 8283:1:2 }
match from any set { large-community 8283:1:2 \
                     large-community 8283:4034:24824 }
```

tcpdump 4.9.0 Packet Capture

```
# ./tcpdump -i eth3 -n -v -c 1 src port 179
tcpdump: listening on eth3, link-type EN10MB (Ethernet), capture size 262144 bytes
16:22:08.992920 IP (tos 0xc0, ttl 64, id 41807, offset 0, flags [DF], proto TCP (6), length 181)
 94.142.247.3.179 > 94.142.247.6.33785: Flags [P.], cksum 0xabce (incorrect -> 0x1e40), seq
58743671:58743800, ack 2012368616, win 2270, options [nop,nop,TS val 857977378 ecr 149127175],
length 129: BGP
          Update Message (2), length: 129
            Origin (1), length: 1, Flags [T]: IGP
            AS Path (2), length: 34, Flags [T]: 38930 1299 3910 721 27065 1554 1555 1501
            Next Hop (3), length: 4, Flags [T]: 94.142.247.3
            Multi Exit Discriminator (4), length: 4, Flags [O]: 0
            Local Preference (5), length: 4, Flags [T]: 100
            Atomic Aggregate (6), length: 0, Flags [T]:
            Aggregator (7), length: 8, Flags [OT]:  AS #1501, origin 144.105.202.0
            Community (8), length: 8, Flags [OT]: 1299:20000, 8283:14
            Large Community (32), length: 12, Flags [OTP]:
              8283:6:14
            Updated routes:
              136.210.249.0/24
```

Wireshark 2.3.0 (Prerelease) Packet Capture