The benefits of BGP for every service provider

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> Whatever a speaker is missing in depth he will compensate for in length
>
> *Montesquieu*

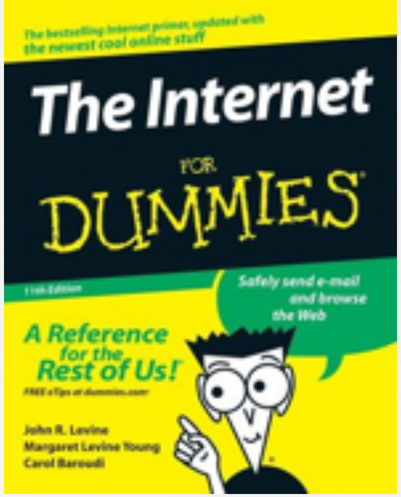
NO Networking 101

I WILL NOT COVER

How to configure a BGP router for general purpose
(But you can grab me after the talk)
What is an IGP (Internal Gateway Protocol)

I ASSUME THAT ...

You have basic networking knowledge (connected, static routes)
Your organisation use some routers you can break
You know what IPs, netmasks, gateways are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I WILL COVER AS MUCH AS I CAN

What is BGP, the Border Gatway Protocol
Why BGP is a great protocol for sysadmins

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Truth is more valuable if it takes you a few years to find it.
Renard

Border Gateway Protocol ?

NOT

A Protocol to share routing information between ISPs

Many RFCs (main one being 4271), many optional features
http://www.bgp4.as/

Open Source implementation in BIRD, Quagga, OpenBGPD

To use it, you do **NOT** need to :

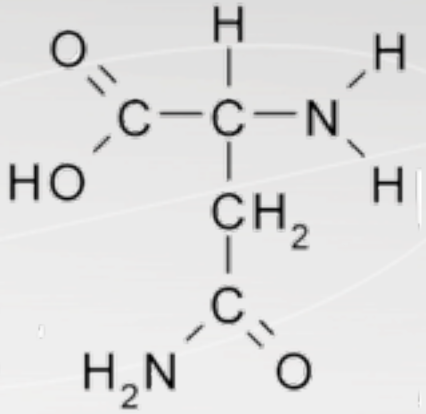
- ✓ be connected to the internet
- ✓ have real world IPs
- ✓ be or ask an ISP anything (but it can be useful)

Use TCP with its own failure detection mechanism.
-> minimum 3s for failure detection

BGP only has one active route for a prefix at a time but the IGP may use multiple paths to get to the next-hop.

There are many true statements about complex topics that are too long to fit on a PowerPoint slide
Edward Tufte

Autonomous System Numbers



Unique Network identifier

30740 Exa Networks http://as30740.peeringdb.com/
2856 BT UK http://as2856.peeringdb.com/

initially 16bits, now extended to 32 bits (RFC 4893)
32 bits usage is a negotiated feature

Like RFC 1918, its reserves some IPs

Some ASNs are reserved for documentation (like the 192.0.2.0/24 range)

The range 64496-64511

Some ASNs are reserved for private use

The range 64512-65532

Given to LIR (LOCAL INTERNET REGISTRY)

In the UK, this means RIPE members
does not mean ISP only

A little learning is a dangerous thing
Alexander Pope

BGP transmits Routes

What makes a route

A PREFIX (a block of IP) – the “destination IP regex”

A DESTINATION (called next-hop)

with many optional information (called ATTRIBUTES)

use to select one route over another

The next-hop is a machine that should know how to contact any IP in the prefix, it does not have to be locally connected but just “known”.

Some of the attributes are

LOCAL PREFERENCE, a value to distinguish two 'identical routes'

AS PATH, the chain of ISP who have seen and transmitted the route

BGP will make sure

that the data is always sent to a machine nearer to the end point than itself

that the decision process between multiple routes does not cause loops

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Logic will get you from A to B. Imagination will take you everywhere
Albert Einstein

Options for service resilience ?

HSRP, VRRP

resilience for the gateway, not the host

Linux-HA solutions (Heartbeat, Pacemaker, Wackamole,..)

Need both machine in the same Layer 2
Lack of IPv6 support !

ARP (relation MAC/IP) expiry 4 to 6 hours ..
MAC (relation ARP/Port) expiry 5 minutes
some kit only allow configuration per interface, not VLAN
enabling gratuitous ARP is a security risk

Yahoo! L3DSR load balancing solution

Layer 3 Load Balancing, encoding the destination IP in the DSCP field
http://www.nanog.org/meetings/nanog51/presentations/Monday/NANOG51.Talk45.nanog51-Schaumann.pdf

BGP ....

Be regular and orderly in your life, so that you may be violent and original in your work
Flaubert

Where does BGP fit ?

External BGP : connecting to other networks
protection from ISP outages

EBGP or IBGP
Anycast : announce the same IP at different location (CDN, DNS, ...)
DDOS "mitigation" : prevent bad traffic to reach servers
Flow Routes (firewall rules deployment using BGP)

Internal BGP : fully controlled BGP
block/redirect some traffic (customers, countries, organisations, ...)
Servers announcing some Service IPs

I love fools' experiments. I am always making them.
Charles Darwin

Be your own ISP

RIPE Membership

Become your own ISP

IPV4 – running out !

do not wait too long if you want to do it !

Provider Aggregate versus Provider Independant

PA: a block of IP owned by the LIR (often the ISP)

changing ISP forces you to renumber

PI : a block of IP owned by the end users

changing ISP is a routing change

Announce your network to the world via BGP

Not as hard as it sounds

Ask you ISP

OFF-TOPIC FOR THIS TALK

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I have always believed that to succeed in life, it is necessary to appear to be mad and to act wisely

Montesquieu

AnyCast

Split personality ..

- Announcing the same IP with BGP in different location
- Another RFC (4786)
- The network finds the nearest server
- Not best suited for long lived TCP connections
  - routing can change

On the internet used by

- Root servers (UDP mainly)

Within a networks

- caching DNS (UDP)
- CDN local DNS (UDP)
- Proxies (TDP, near DSL exit points, very stable routing)

RTBH

Tell your provider to stop sending you traffic for some IPs

Announce some more specific routes (/32, ...) part of your network
and TAG the route with communities
so it can be filtered (dropped by the router)

Most useful when you have a public ASN and buy transit
Traffic is dropped before it is billed

Many Talks (NANOG, APRICOT, ...) on the topic and an RFC (5635)
> google RTBH or REMOTELY TRIGGERED BLACKHOLE

The goal is to skip the transit provider NOC and NOC response time in time of emergency.

Each ISP implements it differently ..
level3 `> whois -h whois.ripe.net AS3356 | grep -B1 -A15 Blackhole`

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It is dangerous to be right in matters on which the established authorities are wrong
Voltaire

Flow Routes

Use BGP to transmit firewall like rules

RFC 5575, Juniper routers only (atm)
Can be used to transproxy in the core things like ... spammers

Match possible components making the flow

Prefix (source and destination)
IP Protocol (list of <action, value>)
Port (source, destination, either)
ICMP (type, code)
TCP flag
Packet Len
DSCP value
Fragment (don't, is, first, last)

Then take action

Drop, Rate-limit, Redirect

exabpg is the only OSS application to support Flow Routes

The secret of business is to know something that nobody else knows
Aristotle Onassis

Block / Redirect traffic

Intercept some traffic injecting BGP routes

- the route must be more specific or have an higher LOCAL PREF

Your own IPs

- Move a machine to another geographical location
  - connected traffic always preferred to a gateway
- Intercept traffic
  - web server (using another server with destination NAT)

Another network IPs

- Block bad sources of traffic : spammers, proxies, TCP scanners, ...
  - You are affecting the return packets
    - it will not stop a UDP, SYN flood attack
    - will prevent TCP 3 way handshake (block the SYN-ACK)

- Force outgoing traffic to use one upstream over another
  - even if default routes and do not use BGP today

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Success is a result, not a goal
Flaubert

Service IPs announcement

Use BGP to announce service IP

An extra IP added to a server for the purpose of providing a public service (ie: pop, imap, web, reverse proxy, vpn IP, ...)

provide IP stability, not physically bound to a location/machine

people SHOULD use DNS entries ... but don't
- firewall configuration, etc ...

Have servers announcing their own service IP
- Server outage means the IP stops to be routed

Or provision service IPs from a centralised location

LET'S SPEAK ABOUT THIS

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Montesquieu

Service IPs announcement

Single server

Use GRACEFUL RESTART so the router does not forget the route for a programmed number of seconds when BGP goes down unexpectedly

Active / Passive

Use LOCAL PREFERENCE (BGP route preference)
Use ipvsadm on the active to still balance traffic

Active/Active

For machine within the same Layer 2, look at using OSPF
Otherwise ANYCAST (if suitable)

In revolution there are only two sorts of men, those who cause them and those who profit by them
Napoleon Bonaparte

Active / Passive Scenario

Configure IP /32 on the loopback interface, linux (debian/Ubuntu)

```
/ETC/NETWORK/INTERFACES
            AUTO LO:SERVICE
            IFACE LO:SERVICE INET STATIC
                ADDRESS 192.0.2.1
                NETMASK 255.255.255.255
                NETWORK 192.0.2.1
                BROADCAST 192.0.2.1
```

Control ARP broadcast (as more than one machine has one IP on its loopback) and RPF check

```
/ETC/SYSCTL.CONF
            NET.IPV4.CONF.ALL.ARP_FILTER = 1
            NET.IPV4.CONF.ALL.ARP_IGNORE = 1
            NET.IPV4.CONF.ETH0.ARP_IGNORE = 1
            NET.IPV4.CONF.ALL.ARP_ANNOUNCE = 2
            NET.IPV4.CONF.ETH0.ARP_ANNOUNCE = 2
```

Active / Passive Scenario

Active Server : an exabgp configuration (version 1.2.0 +)

```
GROUP ANNOUNCE-MY-SERVICE-IP-OF-192.0.2.1 {
    # ETH0 10.0.0.1/24 GATEWAY 10.0.0.254 (HSRP/VRRP)
    LOCAL-ADDRESS 10.0.0.1;

    # WE SETUP AN IBGP CONNECTION
    LOCAL-AS 64520;
    PEER-AS 64520;

    STATIC {
        # 150 IS A BETTER LOCAL-PREFERENCE VALUE THAN 100 (DEFAULT VALUE)
        ROUTE 192.0.2.1/32 NEXT-HOP 10.0.0.1 LOCAL-PREFERENCE 150;
    }
    NEIGHBOR 172.16.0.1 {
        DESCRIPTION "BGP ROUTER 1 RUNNING HSRP/VRRP";
    }
    NEIGHBOR 172.16.0.2 {
        DESCRIPTION "BGP ROUTER 2 RUNNING HSRP/VRRP";
    }
}
```

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Active / Passive Scenario

Passive Server : an exabgp configuration (version 1.2.0 +)

```
GROUP ANNOUNCE-MY-SERVICE-IP-OF-192.0.2.1 {
	# ETH0 10.0.0.2/24 GATEWAY 10.0.0.254 (HSRP/VRRP)
	LOCAL-ADDRESS 10.0.0.2;

	# WE SETUP AN IBGP CONNECTION
	LOCAL-AS 64520;
	PEER-AS 64520;

	STATIC {
		# 100 (DEFAULT VALUE) IS A WORSE LOCAL-PREFERENCE VALUE THAN 150
		ROUTE 192.0.2.1/32 NEXT-HOP 10.0.0.1 LOCAL-PREFERENCE 100;
	}
	NEIGHBOR 172.16.0.1 {
		DESCRIPTION "BGP ROUTER 1 RUNNING HSRP/VRRP";
	}
	NEIGHBOR 172.16.0.2 {
		DESCRIPTION "BGP ROUTER 2 RUNNING HSRP/VRRP";
	}
}
```

Active / Passive Scenario

Router : Router 1 (cisco) BGP configuration example

```
!
BGP 64520
    NO SYNCHRONIZATION
    BGP ROUTER-ID 172.16.0.1

    NEIGHBOR SERVICE-IP PEER-GROUP
    NEIGHBOR SERVICE-IP REMOTE-AS 64520
    NEIGHBOR SERVICE-IP DESCRIPTION SERVICE IPS
    NEIGHBOR SERVICE-IP EBGP-MULTIHOP 5
    NEIGHBOR SERVICE-IP UPDATE-SOURCE LOOPBACK1
    NEIGHBOR SERVICE-IP DEFAULT-ORIGINATE
    NEIGHBOR SERVICE-IP ROUTE-MAP BGP-SERVICE-IP IN
    NEIGHBOR SERVICE-IP ROUTE-MAP DENY-ANY OUT

    NEIGHBOR 10.0.0.1 PEER-GROUP SERVICE-IP
    NEIGHBOR 10.0.0.2 PEER-GROUP SERVICE-IP

    NO AUTO-SUMMARY
!
```

Active / Passive Scenario

Router : Router 1 (cisco) BGP configuration example

```
!
INTERFACE LOOPBACK1
 DESCRIPTION BGP
 IP ADDRESS 172.16.0.1 255.255.255.255
!
IP PREFIX-LIST SERVICE-IP SEQ 10 PERMIT 192.0.2.1/32
IP PREFIX-LIST SERVICE-IP SEQ 99999 DENY 0.0.0.0/0 LE 32
!
IP ACCESS-LIST STANDARD MATCH-ANY
 PERMIT ANY
!
ROUTE-MAP BGP-SERVICE-IP PERMIT 10
 MATCH IP ADDRESS PREFIX-LIST SERVICE-IP
 SET COMMUNITY NO-EXPORT ADDITIVE
!
ROUTE-MAP DENY-ANY DENY 10
 MATCH IP ADDRESS MATCH-ANY
!
```

Resilience with IPv6

Resilience with IPv6

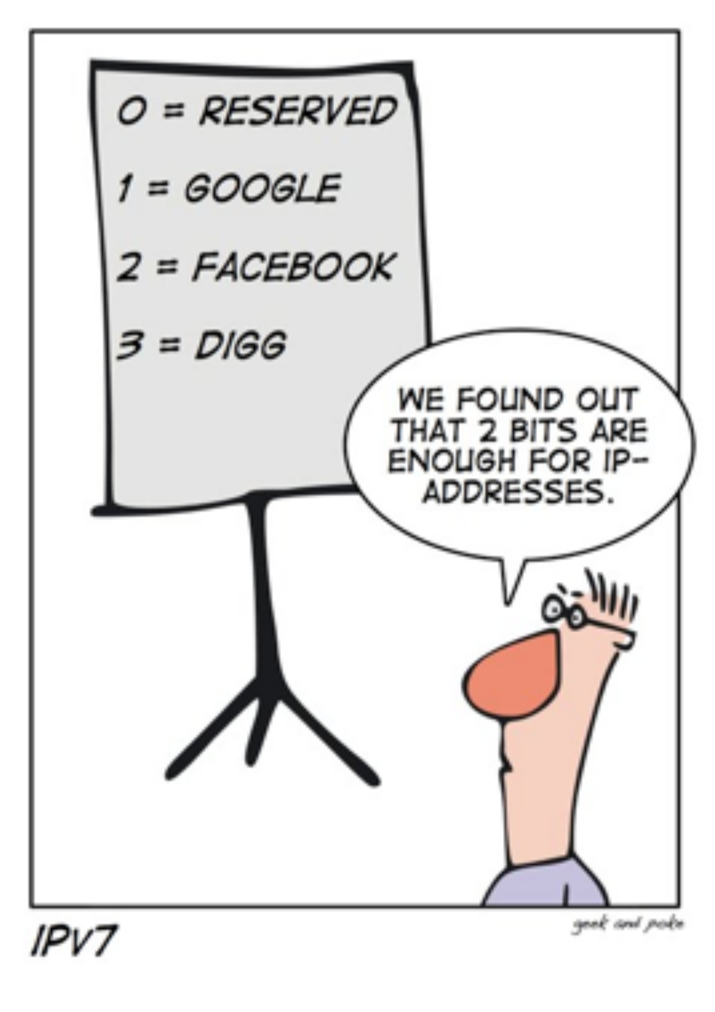
2x Router Advertisement

-> two default routes

BGP (over an IPv4 or IPv6 TCP connection)

-> announce the IPv6 service IP

AVAILABLE TODAY



It is easier to ask for forgiveness than permission

Stewart's law of retraction

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Questions ?

Thank you for coming and listening.

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http://code.google.com/p/exabgp/

Judge a man by his questions rather than by his answers

Voltaire

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