

DDoS Mitigation

Using BGP Flowspec

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Agenda

- Problem Statement
- Legacy DDoS Mitigation
- BGP Flowspec Overview
- Use Case Examples
- State of the Union



Problem Statement

Is DDoS Really an Issue?

“...taking down a site or preventing transactions is only the tip of the iceberg. A DDoS attack can lead to reputational losses or legal claims over undelivered services.”

Kaspersky Lab [1]

Verisign [2]

“Attacks in the 10 Gbps and above category grew by 38% from Q2 ... Q3.”

NBC News [3]

“...more than 40 percent estimated DDoS losses at more than \$1 million per day.”

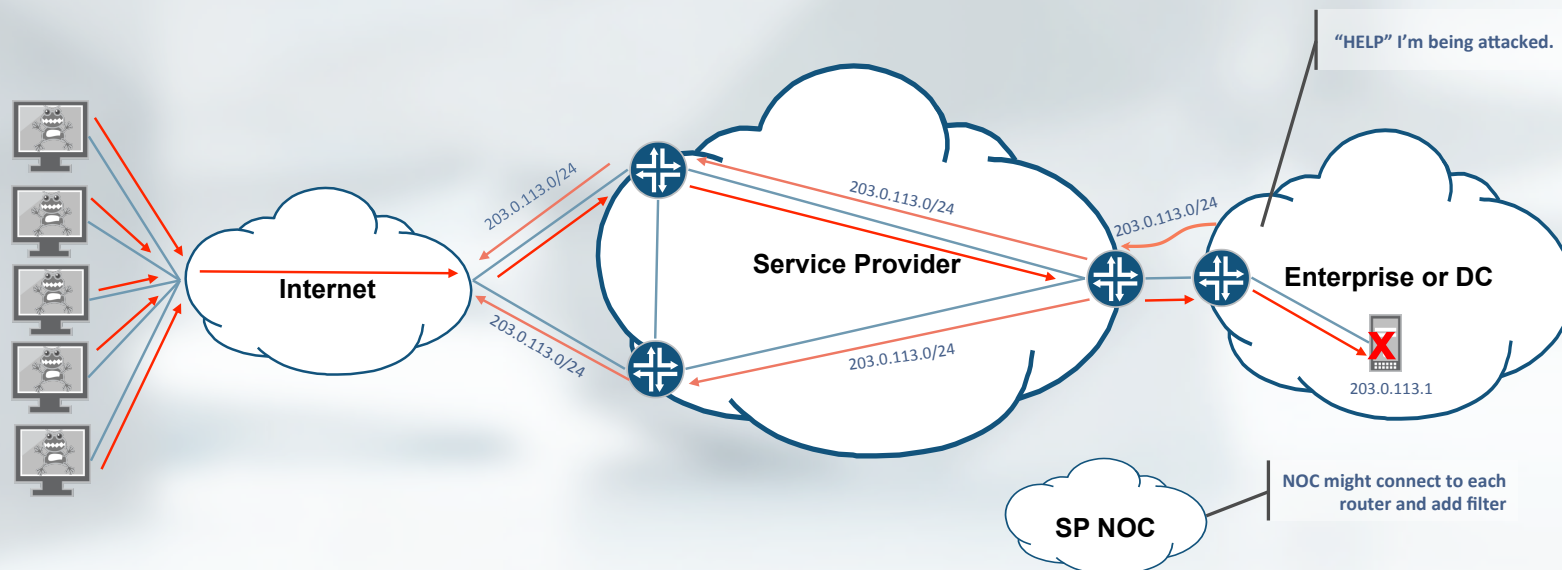
Tech Times [4]

“DDoS attack cripples Sony PSN while Microsoft deals with Xbox Live woes”



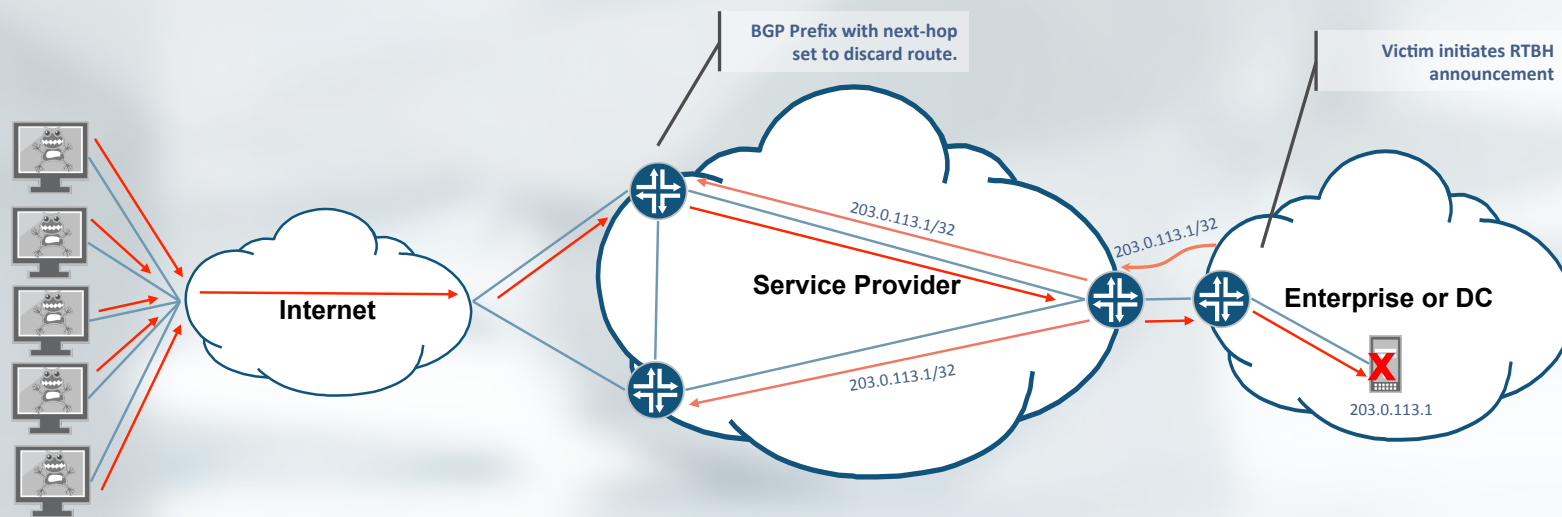
Legacy DDoS Mitigation

Blocking DDoS in the “Old” Days



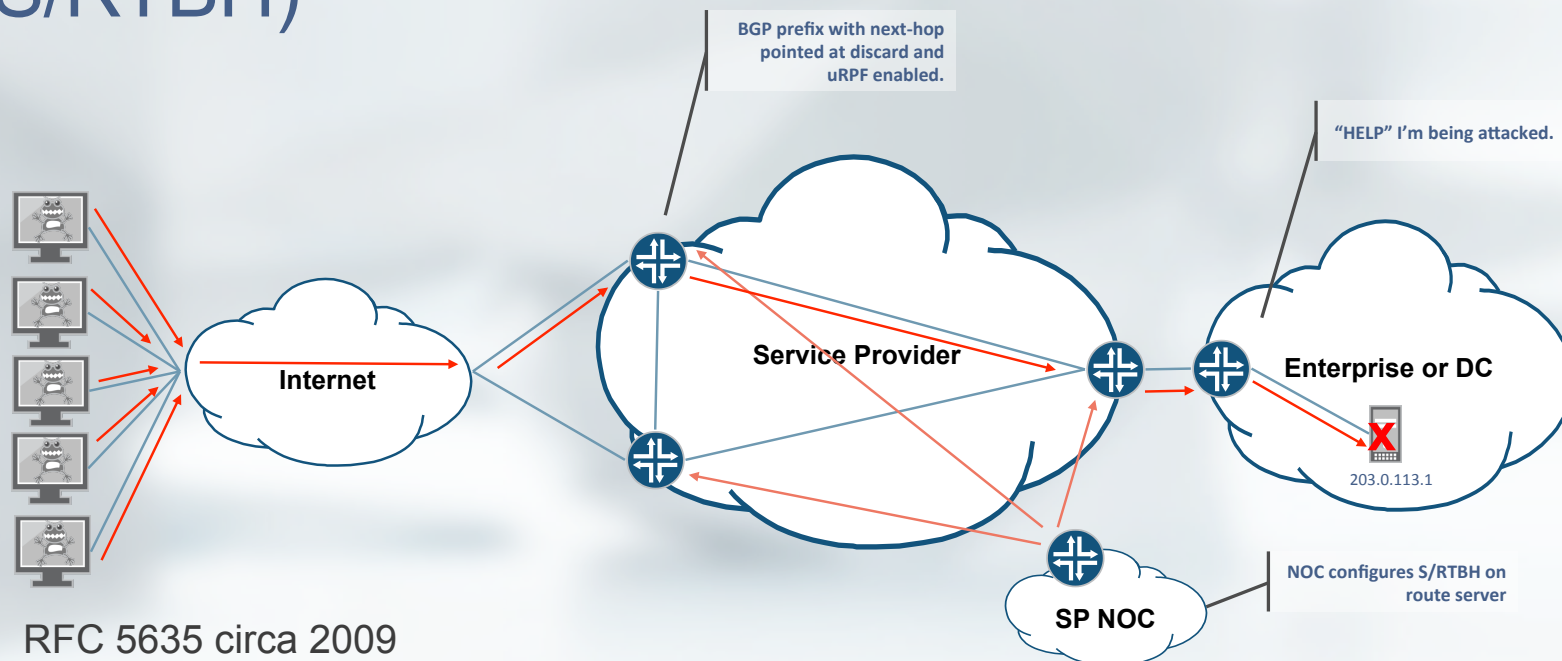
- Ease of implementation and uses well understood constructs
- Requires high degree of co-ordination between customer and provider
- Cumbersome to scale in a large network perimeter
- Mis-configuration possible and expensive

Destination Remotely Triggered Black Hole (D/RTBH)



- RFC 3882 circa 2004
- Requires pre-configuration of discard route on all edge routers
- Victim's destination address is completely unreachable but attack (and collateral damage) is stopped.

Source Remotely Triggered Black Hole (S/RTBH)



- RFC 5635 circa 2009
- Requires pre-configuration of discard route and uRPF on all edge routers
- Victim's destination address is still useable
- Only works for single (or small number) source.



BGP FlowSpec Overview

BGP Flow Specification

- Specific information about a flow can now be distributed using a BGP NLRI defined in RFC 5575 [5] circa 2009
 - AFI/SAFI = 1/133: Unicast Traffic Filtering Applications
 - AFI/SAFI = 1/134: VPN Traffic Filtering Applications
- Flow routes are automatically validated against unicast routing information or via routing policy framework.
 - Must belong to the longest match unicast prefix.
- Once validated, firewall filter is created based on match and action criteria.

BGP Flow Specification

- BGP Flowspec can include the following information:
 - Type 1 - Destination Prefix
 - Type 2 - Source Prefix
 - Type 3 - IP Protocol
 - Type 4 – Source or Destination Port
 - Type 5 – Destination Port
 - Type 6 - Source Port
 - Type 7 – ICMP Type
 - Type 8 – ICMP Code
 - Type 9 - TCP flags
 - Type 10 - Packet length
 - Type 11 – DSCP
 - Type 12 - Fragment Encoding

BGP Flow Specification

- Actions are defined using BGP Extended Communities:
 - 0x8006 – traffic-rate (set to 0 to drop all traffic)
 - 0x8007 – traffic-action (sampling)
 - 0x8008 – redirect to VRF (route target)
 - 0x8009 – traffic-marking (DSCP value)

Vendor Support

- DDoS Detection Vendors:
 - Arbor Peakflow SP 3.5
 - Accumuli DDoS Secure
- Router Vendors:
 - Alcatel-Lucent SR OS 9.0R1
 - Juniper JUNOS 7.3
 - Cisco 5.2.0 for ASR and CRS [6]
- OpenSource BGP Software:
 - ExaBGP

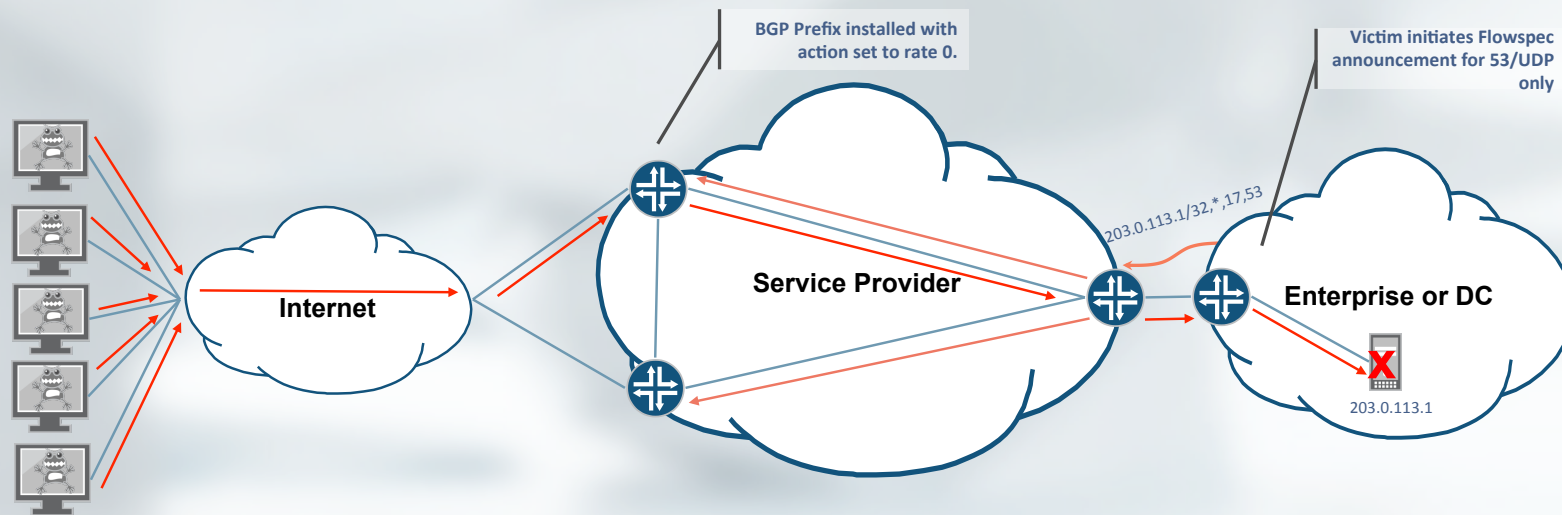
What Makes BGP Flowspec Better?

- Same granularity as ACLs
 - Based on n-tuple matching
- Same automation as RTBH
 - Much easier to propagate filters to all edge routers in large networks
- Leverages BGP best practices and policy controls
 - Same filtering and best practices used for RTBH can be applied to BGP Flowspec



Use Case Examples

Inter-domain DDoS Mitigation Using Flowspec



- Allows ISP customer to initiate the filter.
- Requires sane filtering at customer edge.

Edge Router Configuration

Alcatel-Lucent

```
router
  autonomous-system 64496
  bgp
    group "CUST-FLOWSPEC"
      neighbor 192.0.2.1
        family ipv4 flow-ipv4
        peer-as 64511
        no flowspec-validate
      exit
    exit
  no shutdown
exit
Exit
```

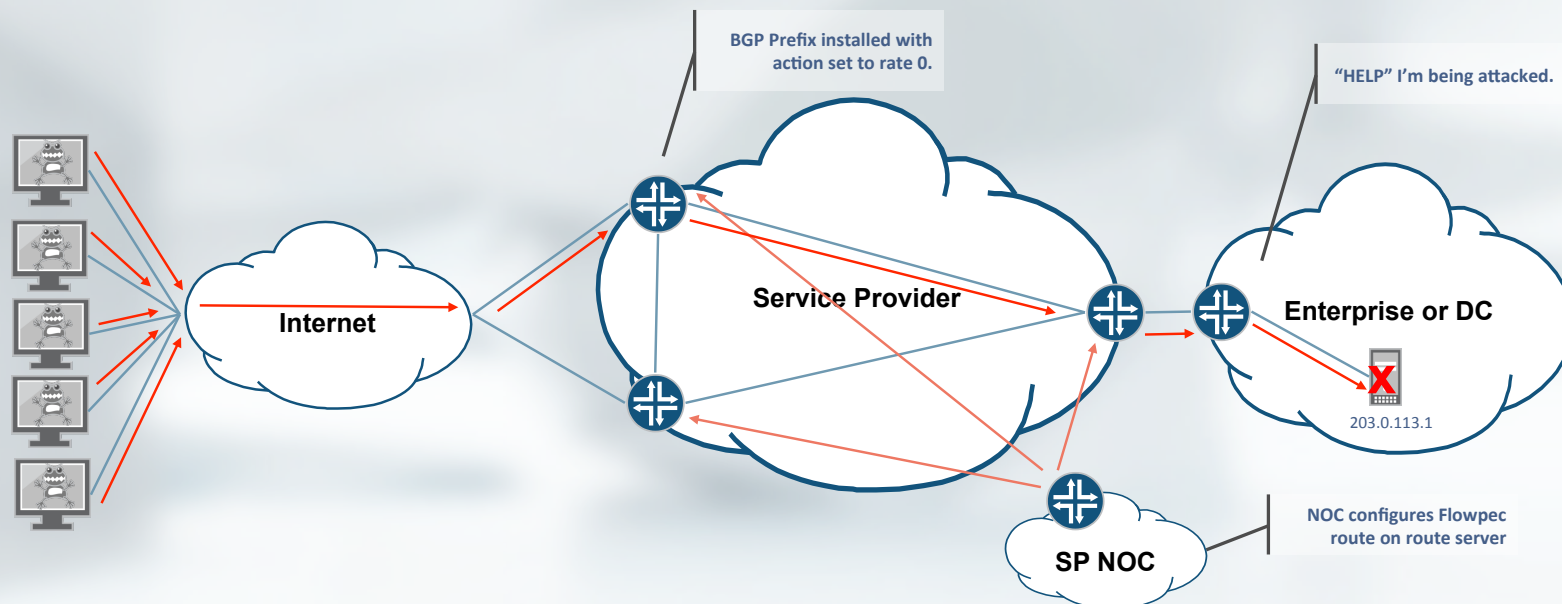
Cisco [7]

```
router bgp 64496
  ! Initializes the global address family
  address-family ipv4 flowspec
  !
  neighbor 192.0.2.1
    remote-as 64511
    ! Ties it to a neighbor configuration
  address-family ipv4 flowspec
```

Juniper

```
protocols {
  bgp {
    group CUST-FLOWSPEC {
      peer-as 64511;
      neighbor 192.0.2.1 {
        family inet {
          flow;
        }
      }
    }
  }
}
routing-options {
  flow {
    term-order standard;
  }
}
```

Intra-domain DDoS Mitigation Using Flowspec



- Could be initiated by phone call, detection in SP network, or a web portal for the customer.
- Requires co-ordination between customer and provider.

Edge Router Configuration

Alcatel-Lucent

```
router
  autonomous-system 64496
  bgp
    group "RR-CLIENT-FLOWSPEC"
      neighbor 198.51.100.1
        family ipv4 flow-ipv4
        peer-as 64496
      exit
    exit
  no shutdown
exit
exit
```

Cisco [7]

```
router bgp 64496
  ! Initializes the global address family
  address-family ipv4 flowspec
  !
  neighbor 198.51.100.1
    remote-as 64496
  ! Ties it to a neighbor configuration
  address-family ipv4 flowspec
```

Juniper

```
protocols {
  bgp {
    group RR-CLIENT-FLOWSPEC {
      type internal;
      neighbor 198.51.100.1 {
        family inet {
          flow;
        }
      }
    }
  }
}
routing-options {
  flow {
    term-order standard;
  }
}
```

Route Server Configuration

Alcatel-Lucent

```
router
  autonomous-system 64496
  bgp
    group "RR-CLIENT-FLOWSPEC"
      neighbor 198.51.100.2
        family ipv4 flow-ipv4
        peer-as 64496
      exit
    exit
  no shutdown
exit
exit
```

Cisco [7]

```
router bgp 64496
  ! Initializes the global address family
  address-family ipv4 flowspec
  !
  neighbor 198.51.100.2
    remote-as 64496
  ! Ties it to a neighbor configuration
  address-family ipv4 flowspec
```

Juniper

```
protocols {
  bgp {
    group RR-CLIENT-FLOWSPEC {
      type internal;
      neighbor 198.51.100.2 {
        family inet {
          flow;
        }
        export FLOWROUTES_OUT;
      }
    }
  }
}
```

Route Server Configuration

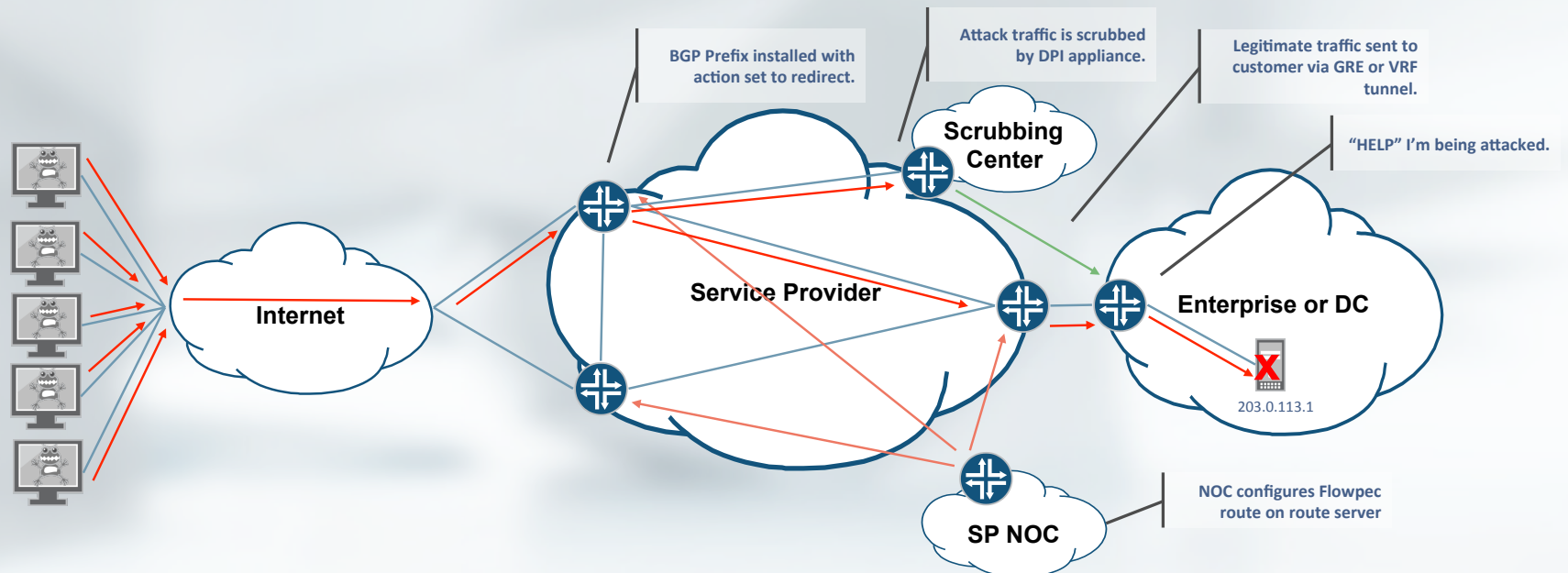
Cisco [7]

```
class-map type traffic match-all attack_fs
  match destination-address ipv4 203.0.113.1/32
  match protocol 17
  match destination-port 53
end-class-map
!
policy-map type pbr attack_pbr
  class type traffic attack_fs
    drop
  class class-default
end-policy-map
!
flowspec
  address-family ipv4
    service-policy type pbr attack_pbr
exit
```

Juniper

```
routing-options {
  flow {
    term-order standard;
    route attack_fs {
      match {
        destination 203.0.113.1/32
        protocol udp;
        destination-port 53;
      }
      then discard;
    }
  }
}
policy-options {
  policy-statement FLOWROUTES_OUT {
    from {
      rib inetflow.0;
    }
    then accept;
  }
}
```

DDoS Mitigation Using Scrubbing Center



- Could be initiated by phone call, detection in SP network, or a web portal for the customer.
- Allows for mitigating application layer attacks without completing the attack.

Edge Router Configuration

Alcatel-Lucent

```
router
  autonomous-system 64496
  bgp
    group "RR-CLIENT-FLOWSPEC"
      neighbor 198.51.100.1
        family ipv4 flow-ipv4
        peer-as 64496
      exit
    exit
  no shutdown
exit
exit
```

Cisco [7]

```
router bgp 64496
  ! Initializes the global address family
  address-family ipv4 flowspec
  !
  neighbor 198.51.100.1
    remote-as 64496
  ! Ties it to a neighbor configuration
  address-family ipv4 flowspec
```

Juniper

```
protocols {
  bgp {
    group RR-CLIENT-FLOWSPEC {
      type internal;
      neighbor 198.51.100.1 {
        family inet {
          flow;
        }
      }
    }
  }
}
routing-options {
  flow {
    term-order standard;
  }
}
```

Route Server Configuration

Alcatel-Lucent

```
router
  autonomous-system 64496
  bgp
    group "RR-CLIENT-FLOWSPEC"
      neighbor 198.51.100.2
        family ipv4 flow-ipv4
        peer-as 64496
      exit
    exit
  no shutdown
exit
exit
```

Cisco [7]

```
router bgp 64496
  ! Initializes the global address family
  address-family ipv4 flowspec
  !
  neighbor 198.51.100.2
    remote-as 64496
  ! Ties it to a neighbor configuration
  address-family ipv4 flowspec
```

Juniper

```
protocols {
  bgp {
    group RR-CLIENT-FLOWSPEC {
      type internal;
      neighbor 198.51.100.2 {
        family inet {
          flow;
        }
        export FLOWROUTES_OUT;
      }
    }
  }
}
```

Route Server Configuration

Cisco [7]

```
class-map type traffic match-all attack_fs
  match destination-address ipv4 203.0.113.1/32
  match protocol 17
  match destination-port 53
end-class-map
!
policy-map type pbr attack_pbr
  class type traffic attack_fs
    redirect nexthop 192.0.2.7
  class class-default
end-policy-map
!
flowspec
  address-family ipv4
    service-policy type pbr attack_pbr
exit
```

Juniper

```
routing-options {
  flow {
    term-order standard;
    route attack_fs {
      match {
        destination 203.0.113.1/32
        protocol udp;
        destination-port 53;
      }
      then discard;
    }
  }
}
policy-options {
  policy-statement FLOWROUTES_OUT {
    from {
      rib inetflow.0;
    }
    then {
      next-hop 192.0.2.7;
      accept;
    }
  }
}
```

How Do I Know It Is Working?

Alcatel-Lucent

- `show router bgp routes flow-ipv4`
- `show router bgp routes flow-ipv6`
- `show filter ip fSpec-0`
- `show filter ip fSpec-0 associations`
- `show filter ip fSpec-0 counters`
- `show filter ip fSpec-0 entry <entry-id>`

Cisco [7]

- `show processes flowspec_mgr location all`
- `show flowspec summary`
- `show flowspec vrf all`
- `show bgp ipv4 flowspec`

Juniper

- `show bgp neighbor <neighbor> | match inet-flow`
- `show route table inetflow.0 extensive`
- `show firewall filter __flowspec_default_inet__`

Where Are We Going?

- IPv6 Support
 - <http://tools.ietf.org/html/draft-ietf-idr-flow-spec-v6-06>
- Relaxing Validation
 - <http://tools.ietf.org/html/draft-ietf-idr-bgp-flowspec-oid-02>
- Redirect to IP Action
 - <https://tools.ietf.org/html/draft-ietf-idr-flowspec-redirect-ip-02>



State of the Union

Summary of Survey

- Great idea and would love to see it take off but...
- Enterprises and Content Providers are waiting for ISPs to accept their Flowspec routes.
 - Some would even be willing to switch to an ISP that did this.
- ISPs are waiting for vendors to support it.
 - More vendors supporting it
 - Specific features they need for their environment
 - Better scale or stability

References

- [1] Kaspersky Lab – Every Third Public Facing Company Encounters DDoS Attacks <http://tinyurl.com/neu4zzr>
- [2] Verisign – 2014 DDoS Attack Trends <http://tinyurl.com/oujgx94>
- [3] NBC News – Internet Speeds are Rising Sharply, But So Are Hack Attacks <http://tinyurl.com/q4u2b7m>
- [4] Tech Times – DDoS Attack Cripples Sony PSN While Microsoft Deals with Xbox Live Woes <http://tinyurl.com/kkdczjx>
- [5] RFC 5575 - Dissemination of Flow Specification Rules <http://www.ietf.org/rfc/rfc5575.txt>
- [6] Cisco - Implementing BGP Flowspec <http://tinyurl.com/mm5w7mo>
- [7] Cisco – Understanding BGP Flowspec <http://tinyurl.com/l4kwb3b>

Thank You!
