DDoS Mitigation

Using BGP Flowspec

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Background

- Who is this guy?
  - http://www.linkedin.com/in/justinryburn
- Why this topic?
  - Experience tracking DDoS “back in the day”.

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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"

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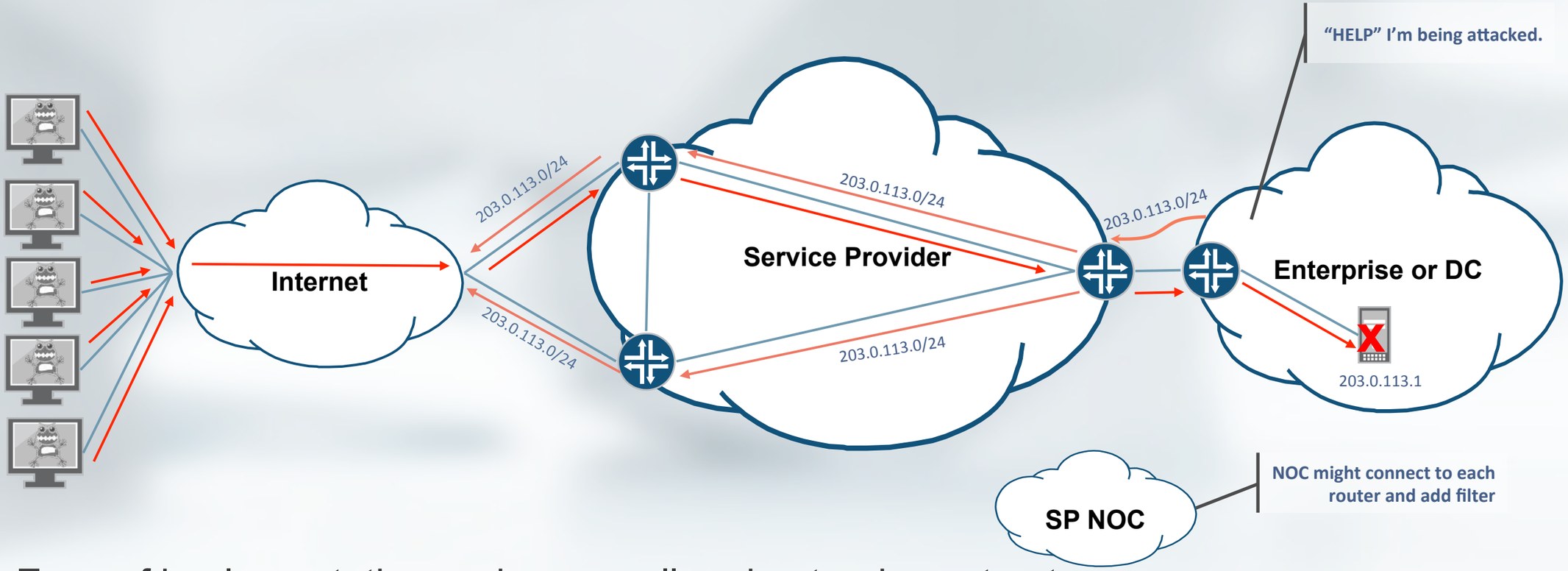
Blocking DDoS in the “Old” Days



- 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

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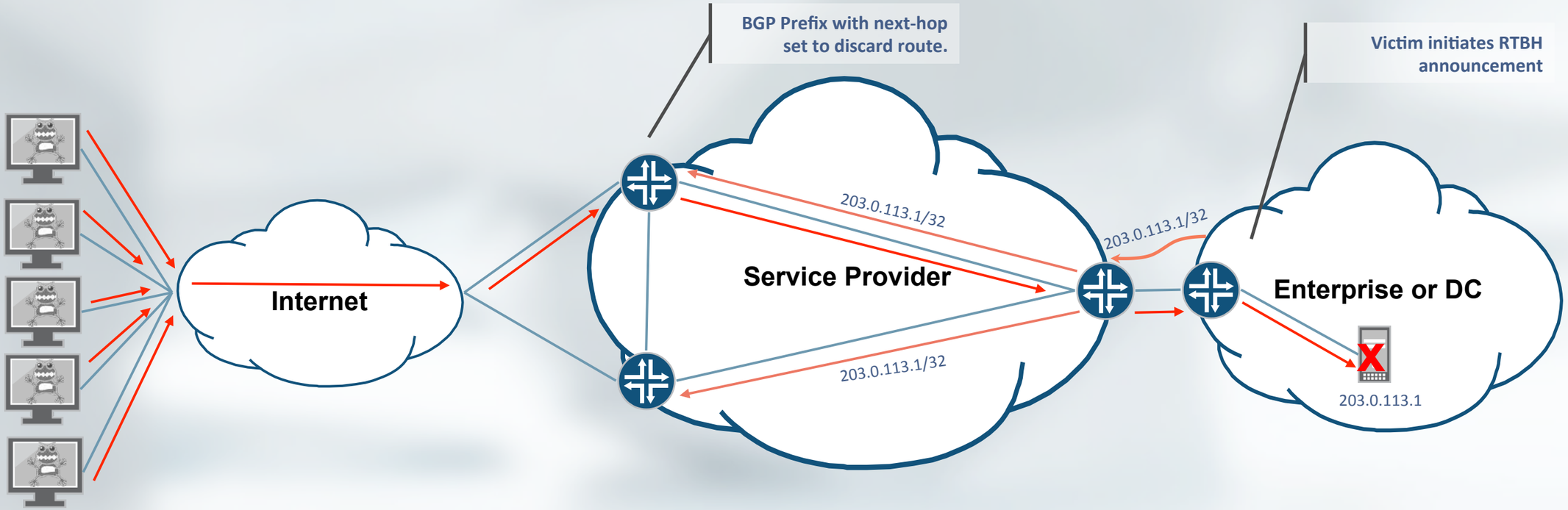
Destination Remotely Triggered Black Hole (D/RTBH)



- 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.

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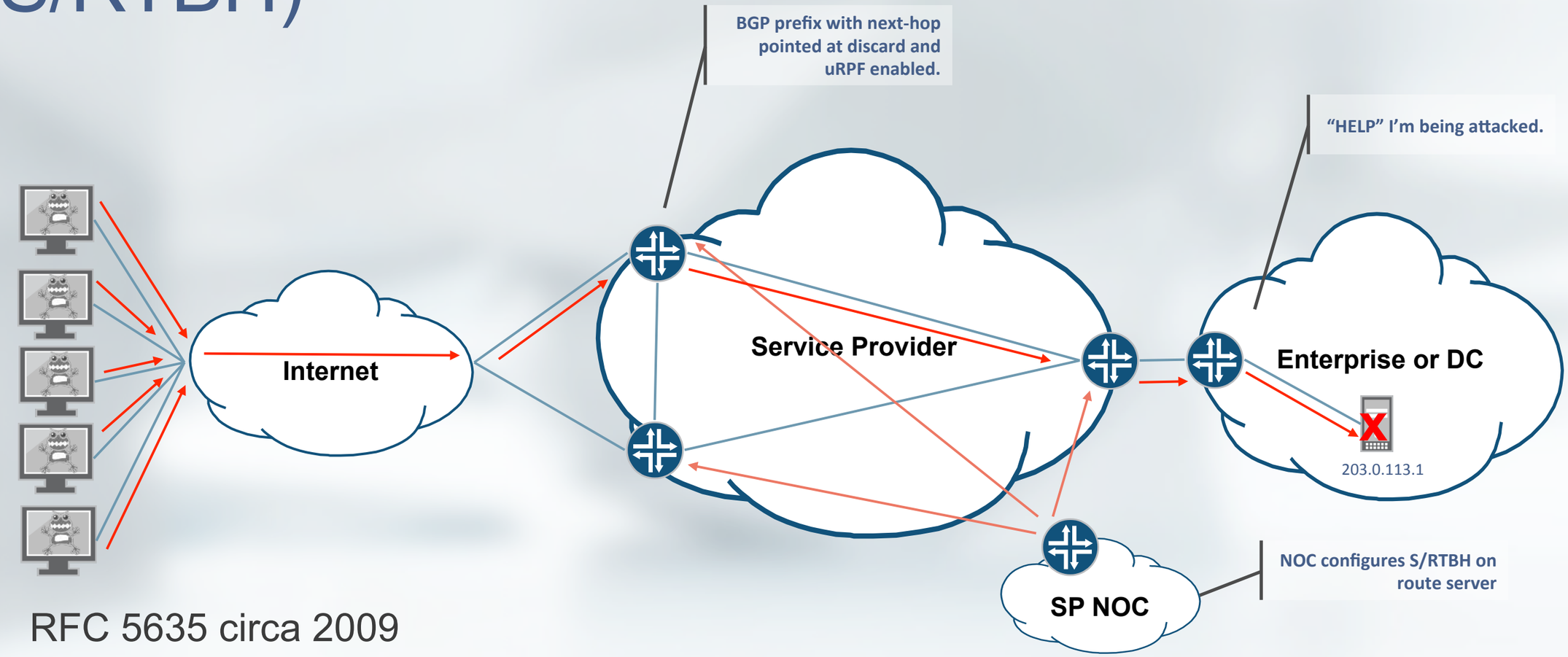
Source Remotely Triggered Black Hole (S/RTBH)



- 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.

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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.

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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

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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)

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Vendor Support

- DDoS Detection Vendors:
  - Arbor Peakflow SP 3.5
  - Juniper DDoS Secure 5.14.2-0
- Router Vendors:
  - Alcatel-Lucent SR OS 9.0R1
  - Juniper JUNOS 7.3
  - Cisco 5.2.0 for ASR and CRS [6]

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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

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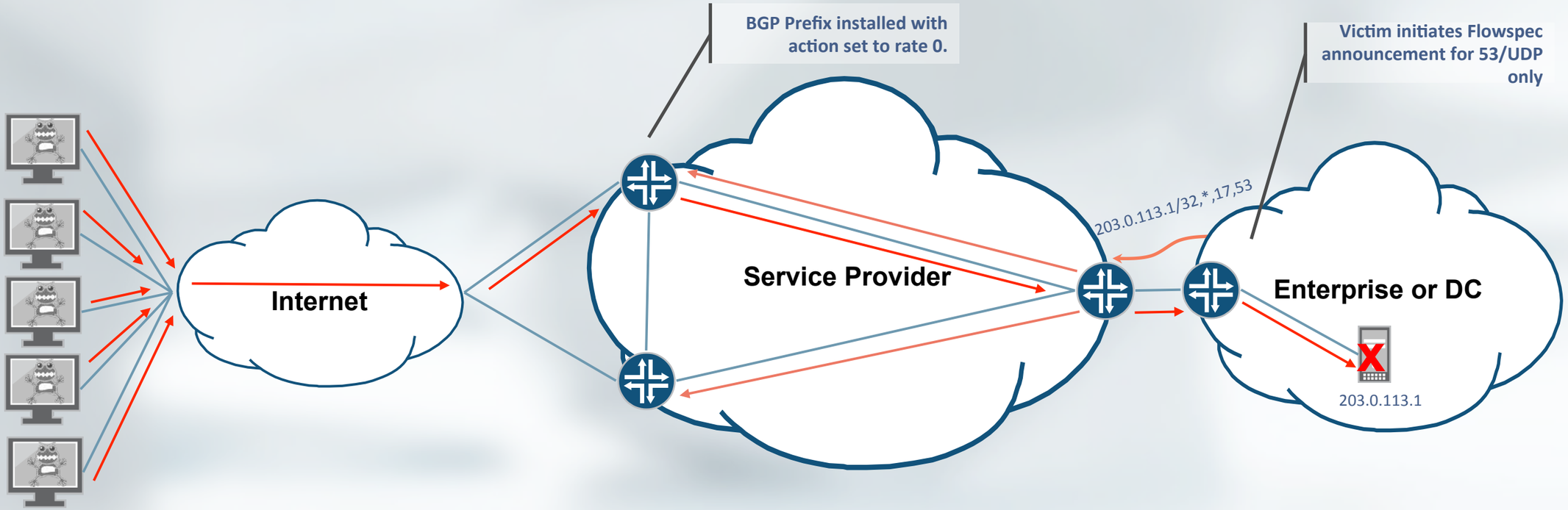
Inter-domain DDoS Mitigation Using Flowspec



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

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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;
    }
}
```


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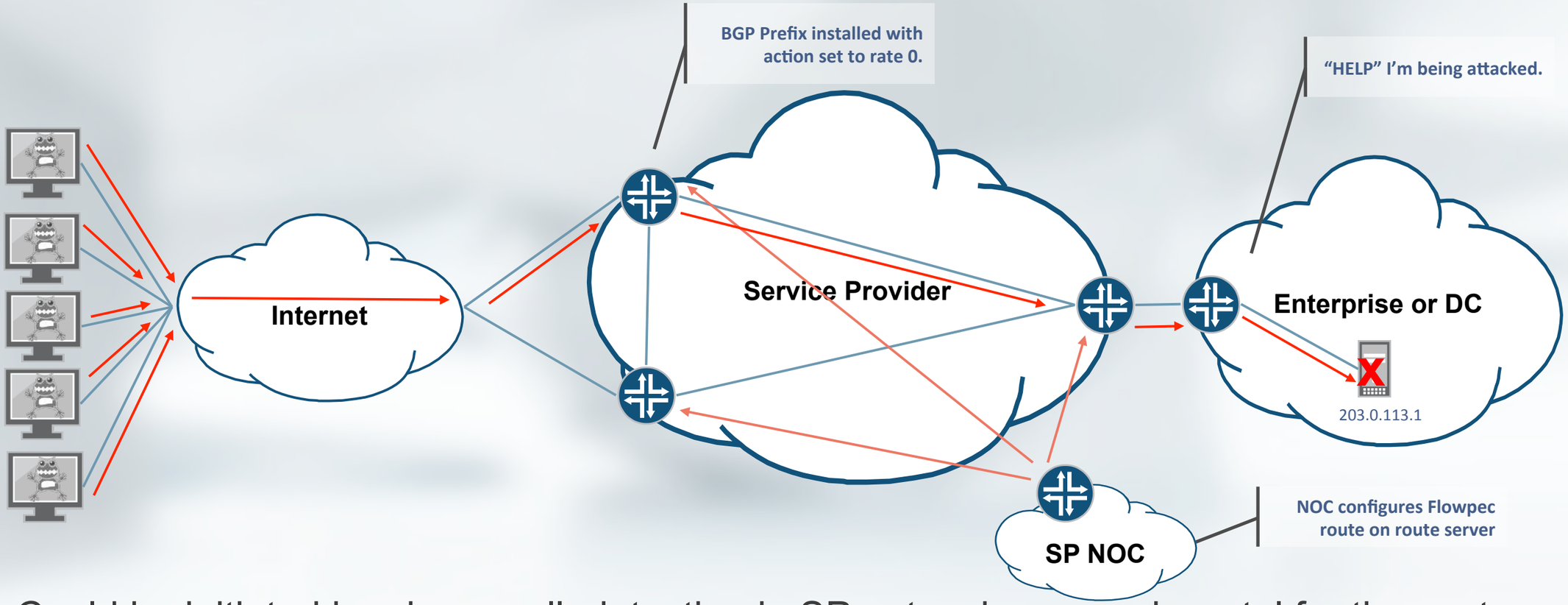
Intra-domain DDoS Mitigation Using Flowspec



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

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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;
    }
}
```


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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;
            }
        }
    }
}
```


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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;
    }
}
```


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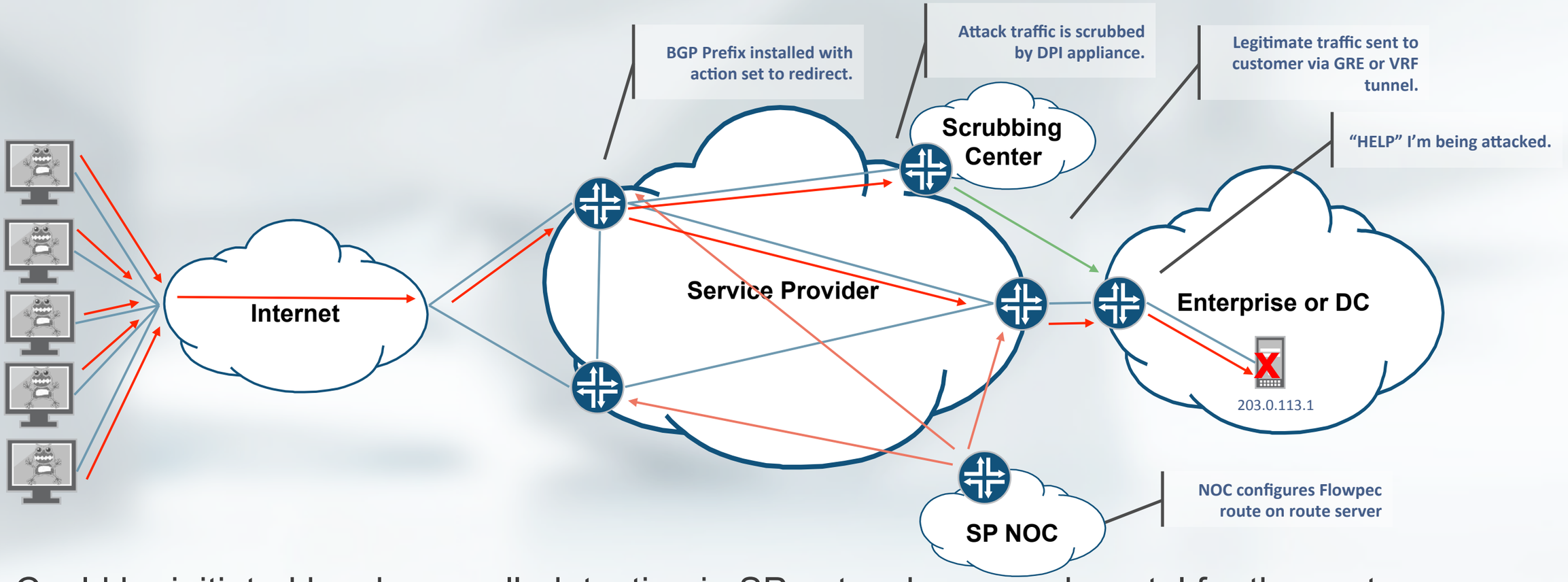
DDoS Mitigation Using Scrubbing Center



- 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.

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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;
    }
}
```


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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;
            }
        }
    }
}
```


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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;
        }
    }
}
```


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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__

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Where Are We Going?

- IPv6 Support
  - http://tools.ietf.org/html/draft-ietf-idr-flow-spec-v6-03
- Relaxing Validation
  - http://tools.ietf.org/html/draft-ietf-idr-bgp-flowspec-oid-00
- Redirect to IP Next-Hop Action
  - http://tools.ietf.org/html/draft-simpson-idr-flowspec-redirect-02

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State of the Union

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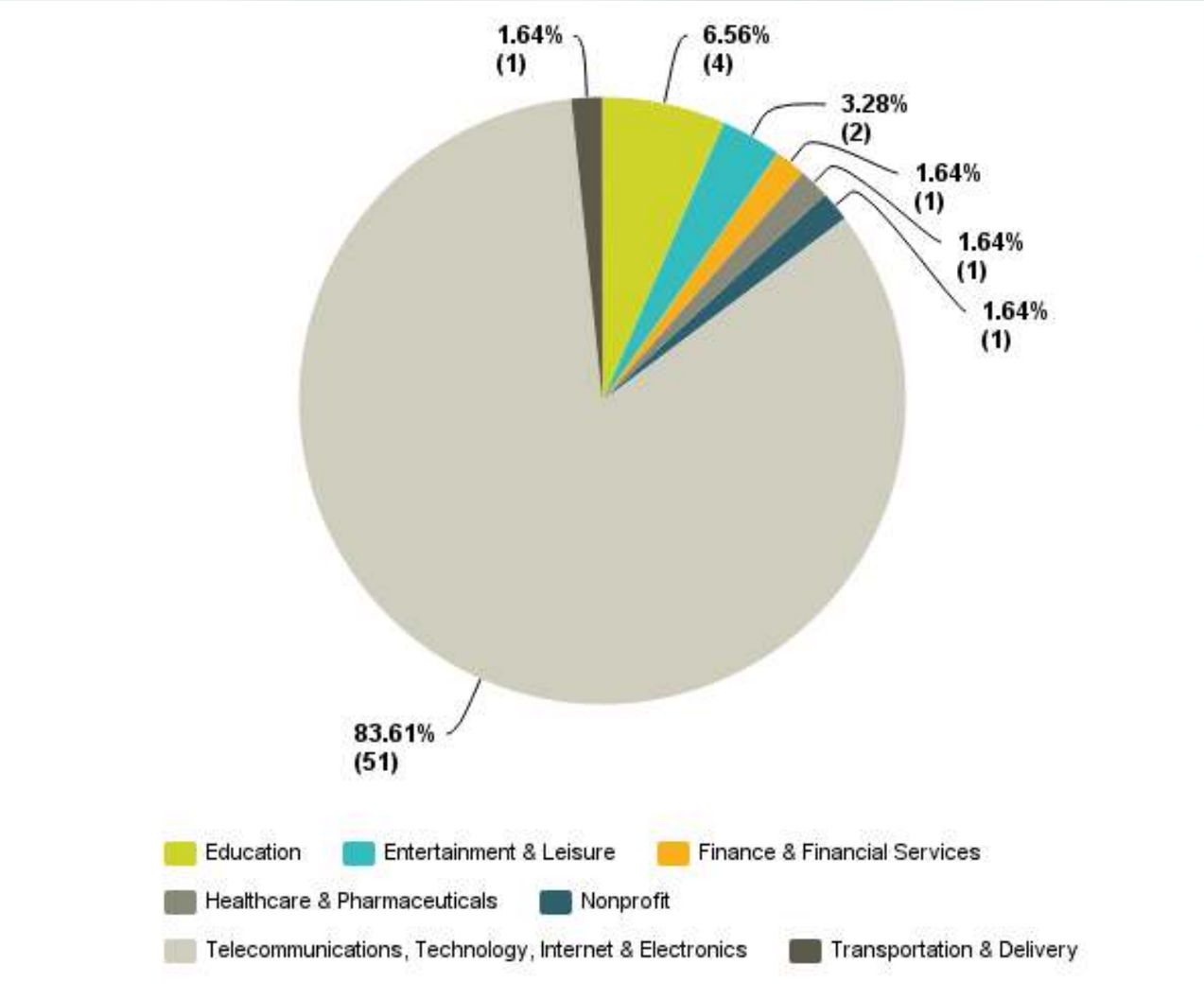
Industries Responding



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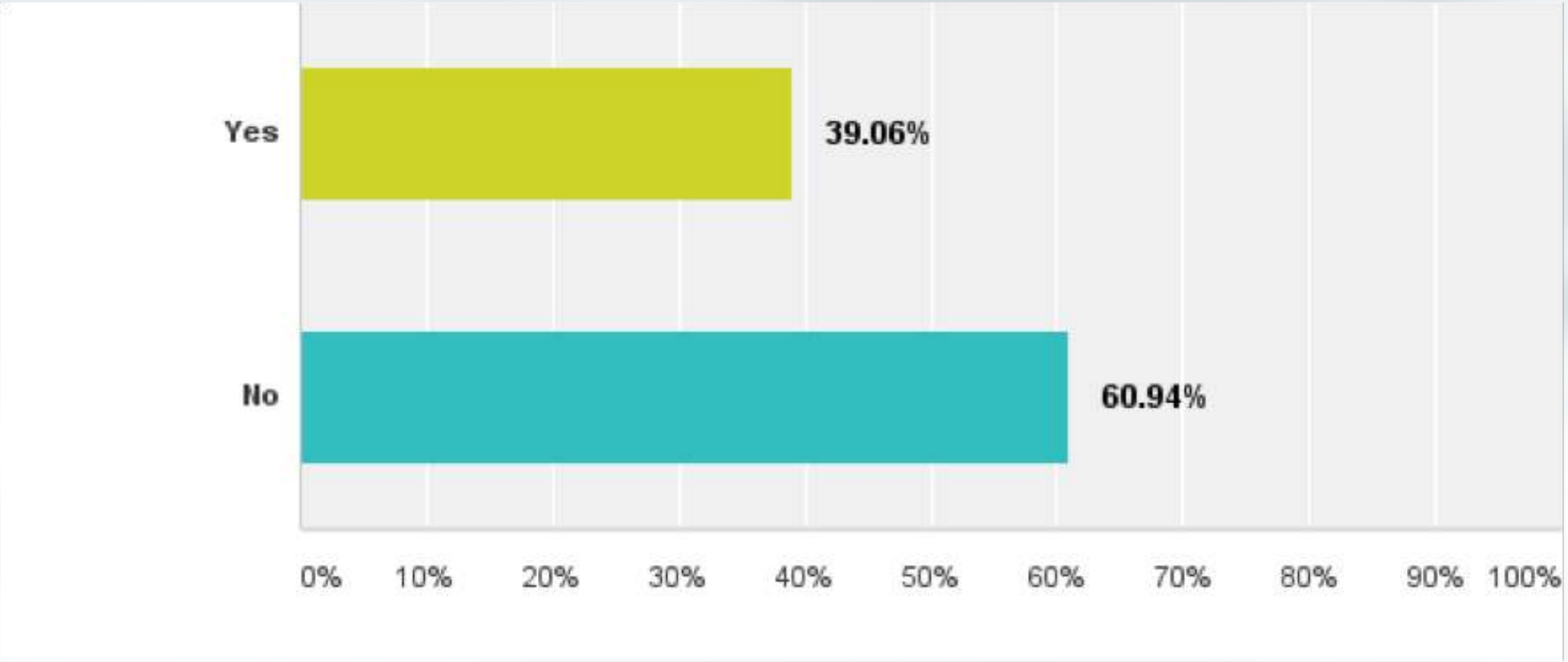
Do you have, or have you ever had, BGP Flowspec enabled in any part of your network?



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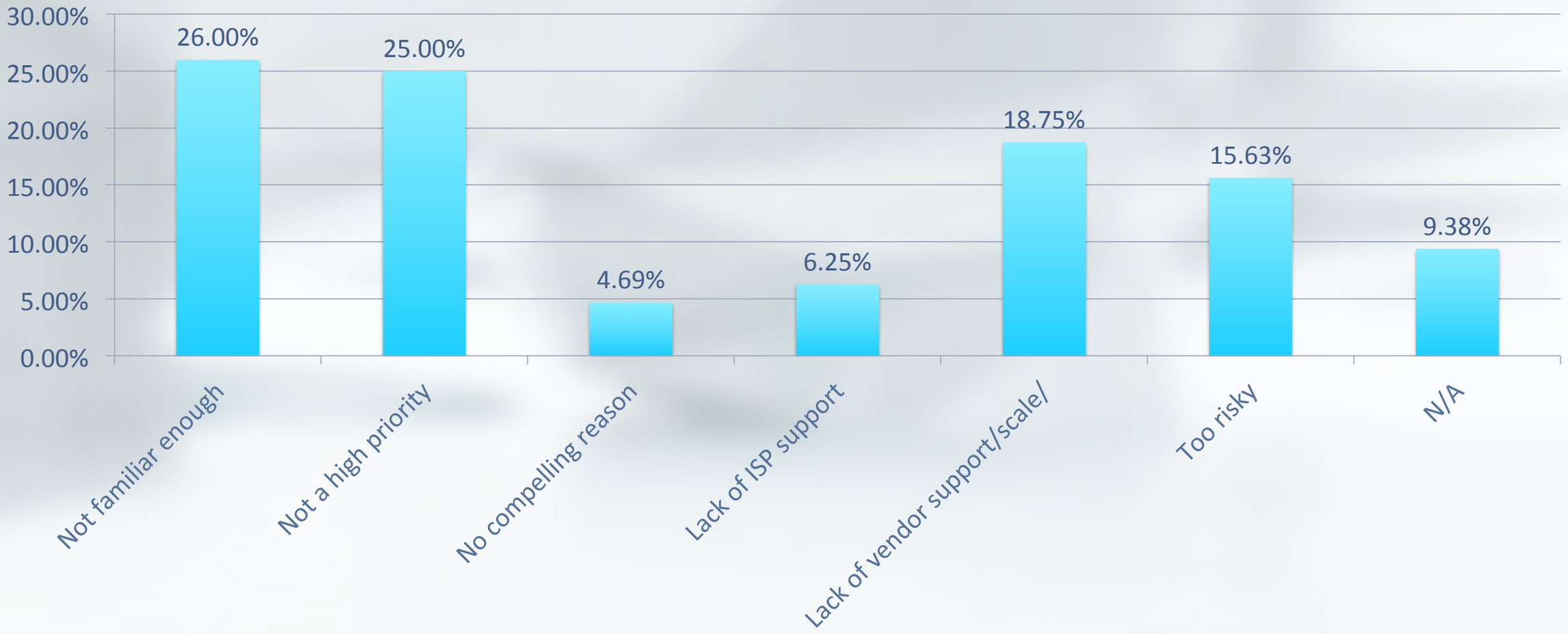
If you have not enabled it, why not?



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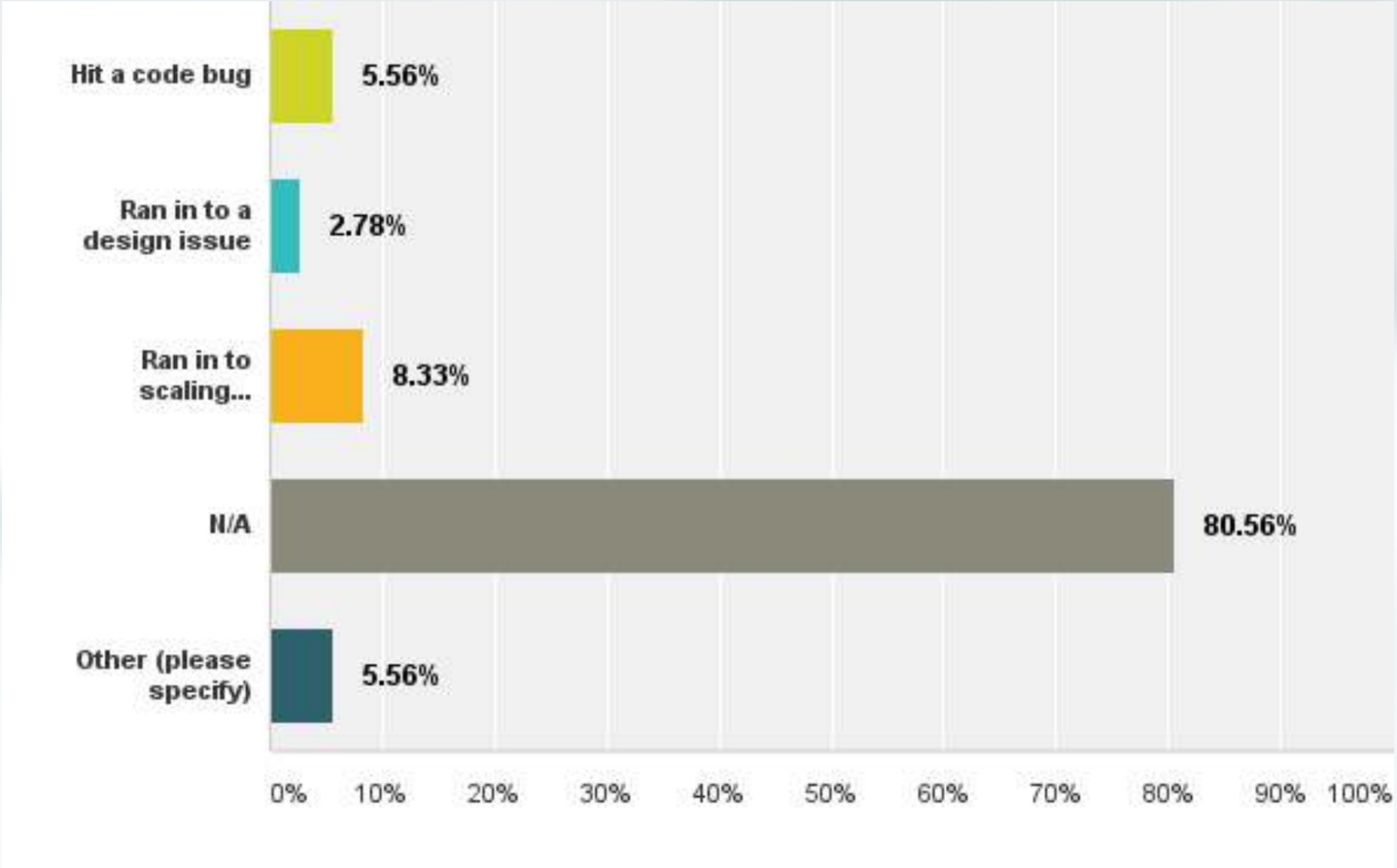
If you enabled it but have since disabled it, why?



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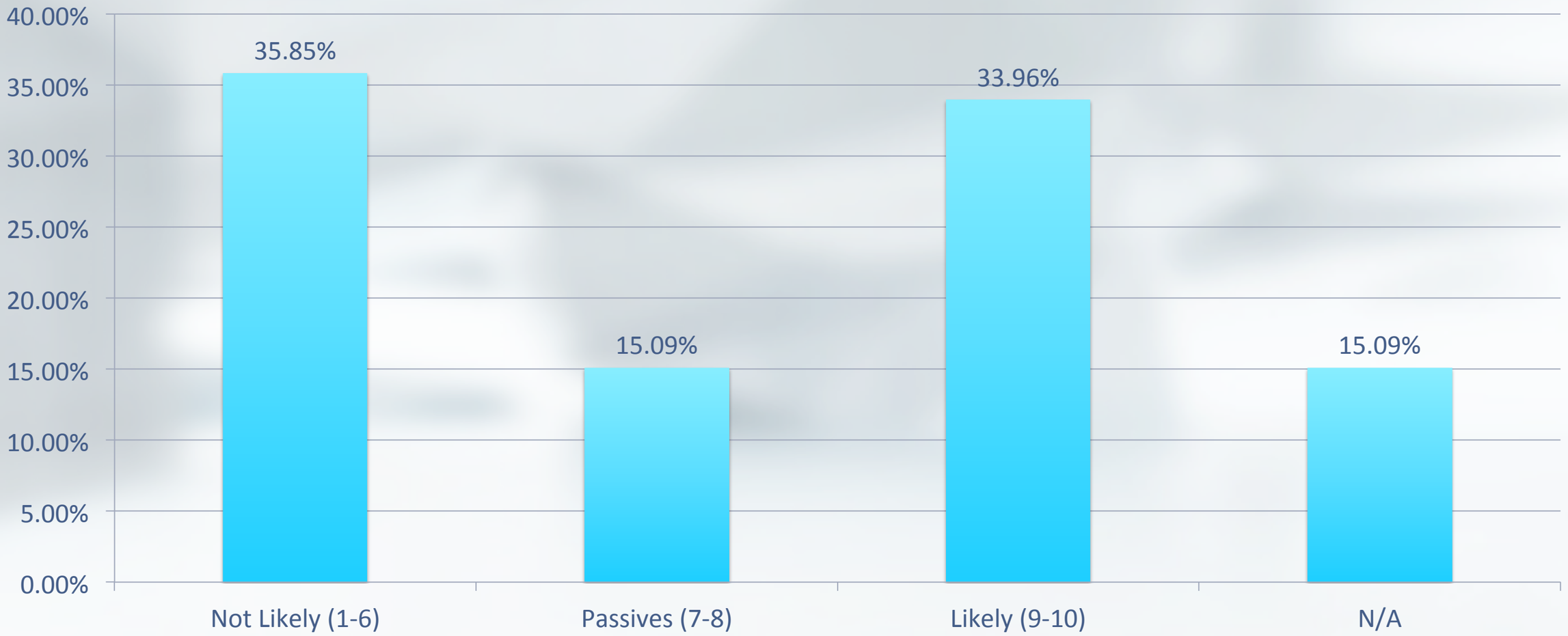
If you do not have it enabled currently, how likely are you to enable BGP Flowspec in the future?



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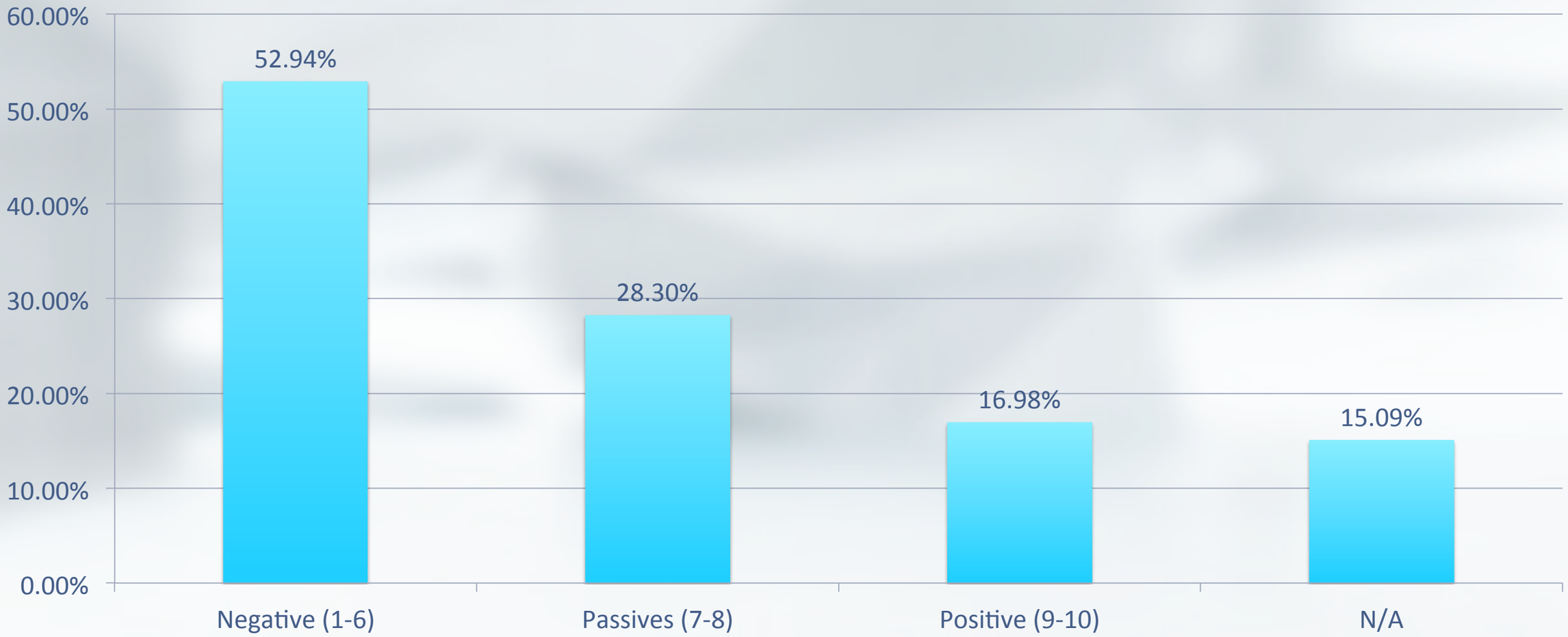
Overall, how would you rate your experience with BGP Flowpsec?



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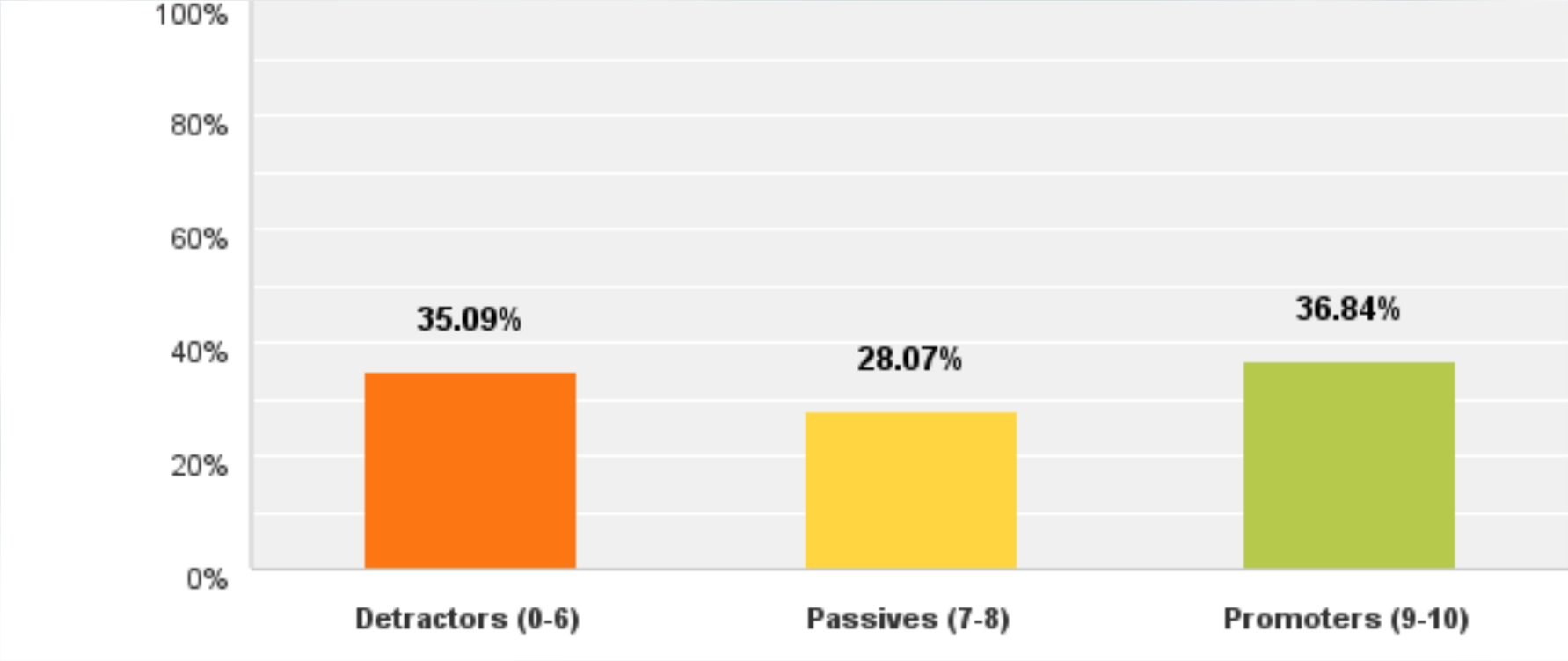
How likely is it that you would recommend BGP Flowspec to a friend or colleague?



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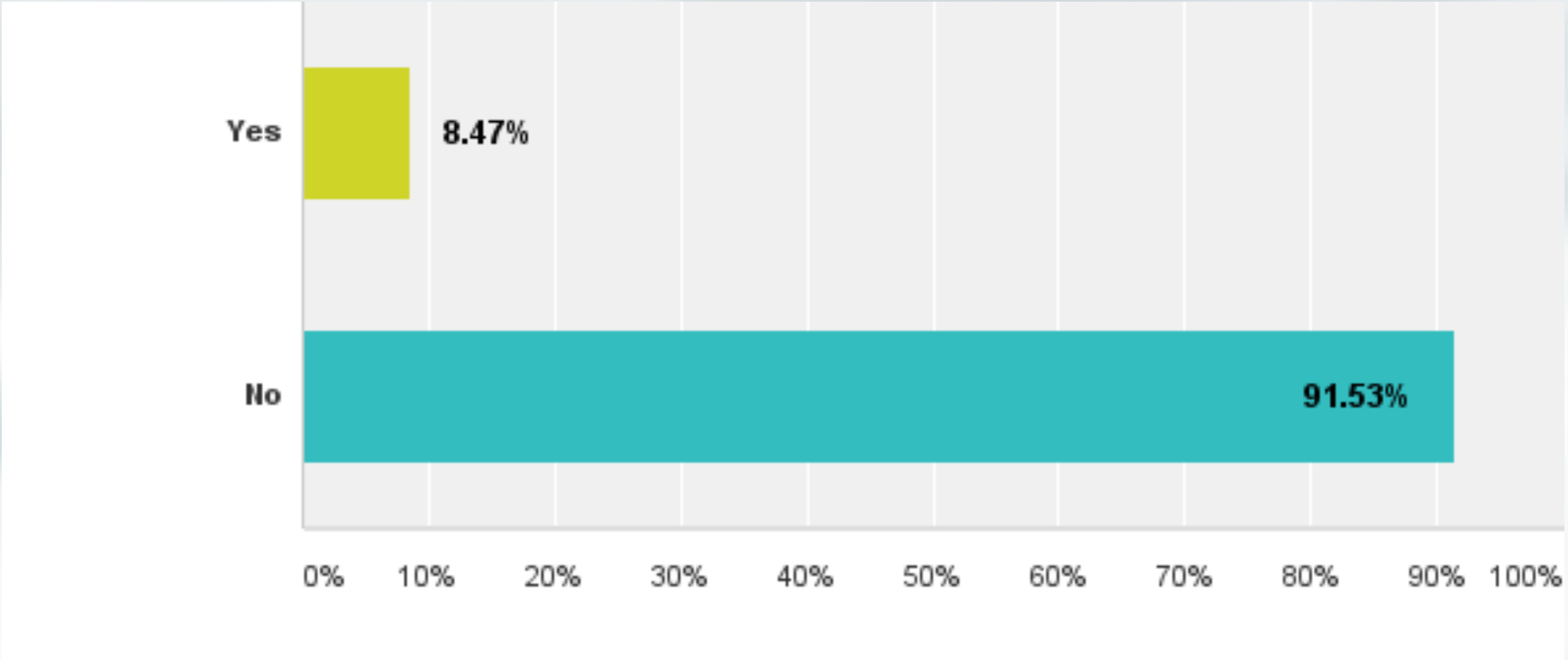
Do you allow your customers to send you BGP Flowspec routes via BGP?



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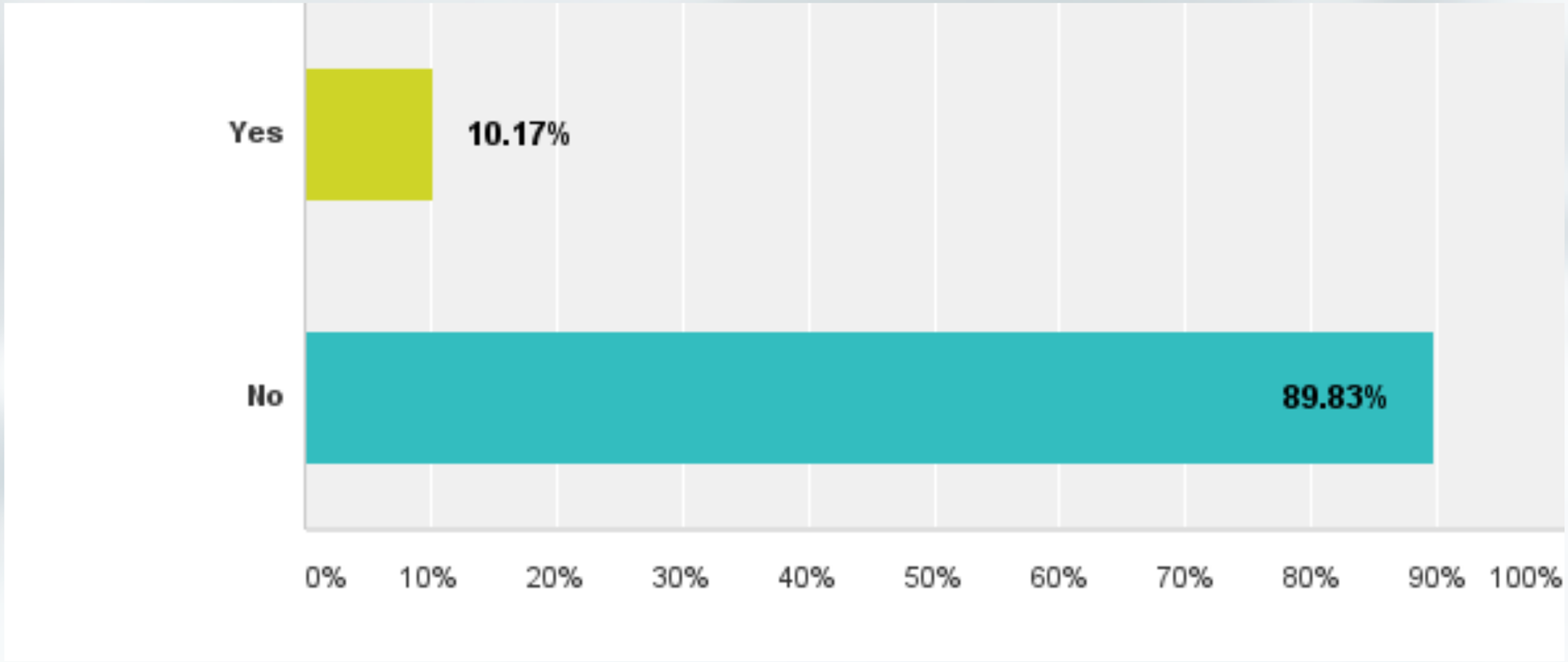
Do you have a web portal where customers can inject BGP Flowspec routes into your IBGP?



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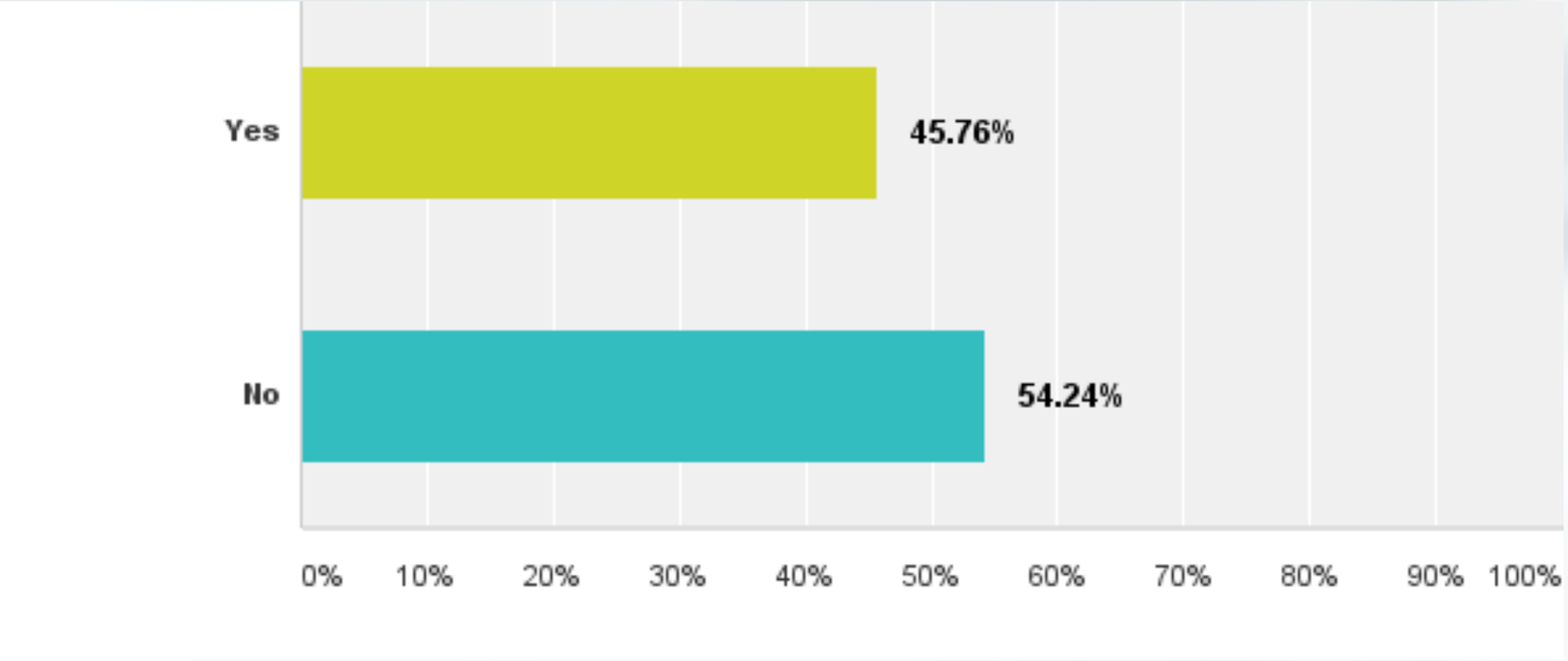
Do you have a central router from which you inject your BGP Flowspec routes?



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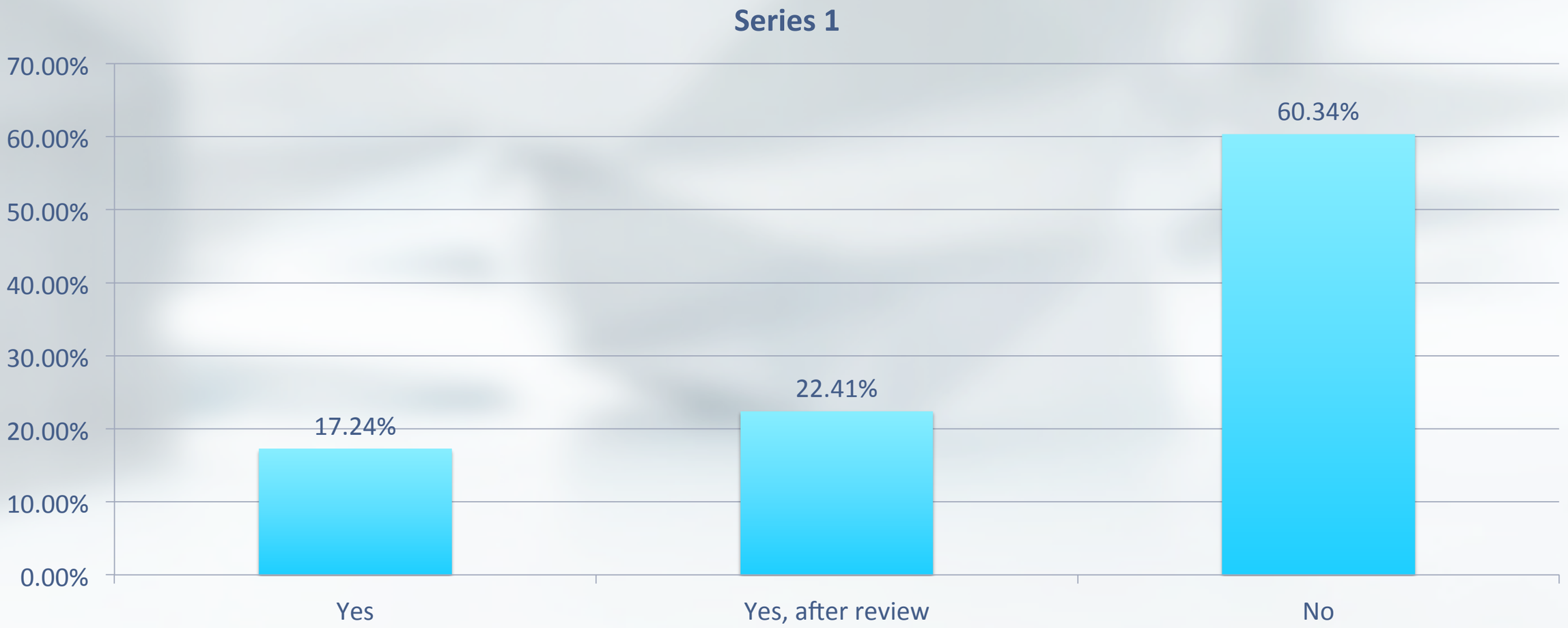
Do you allow a DDoS detection tool (e.g. Arbor) to send BGP Flowspec routes into your IBGP?



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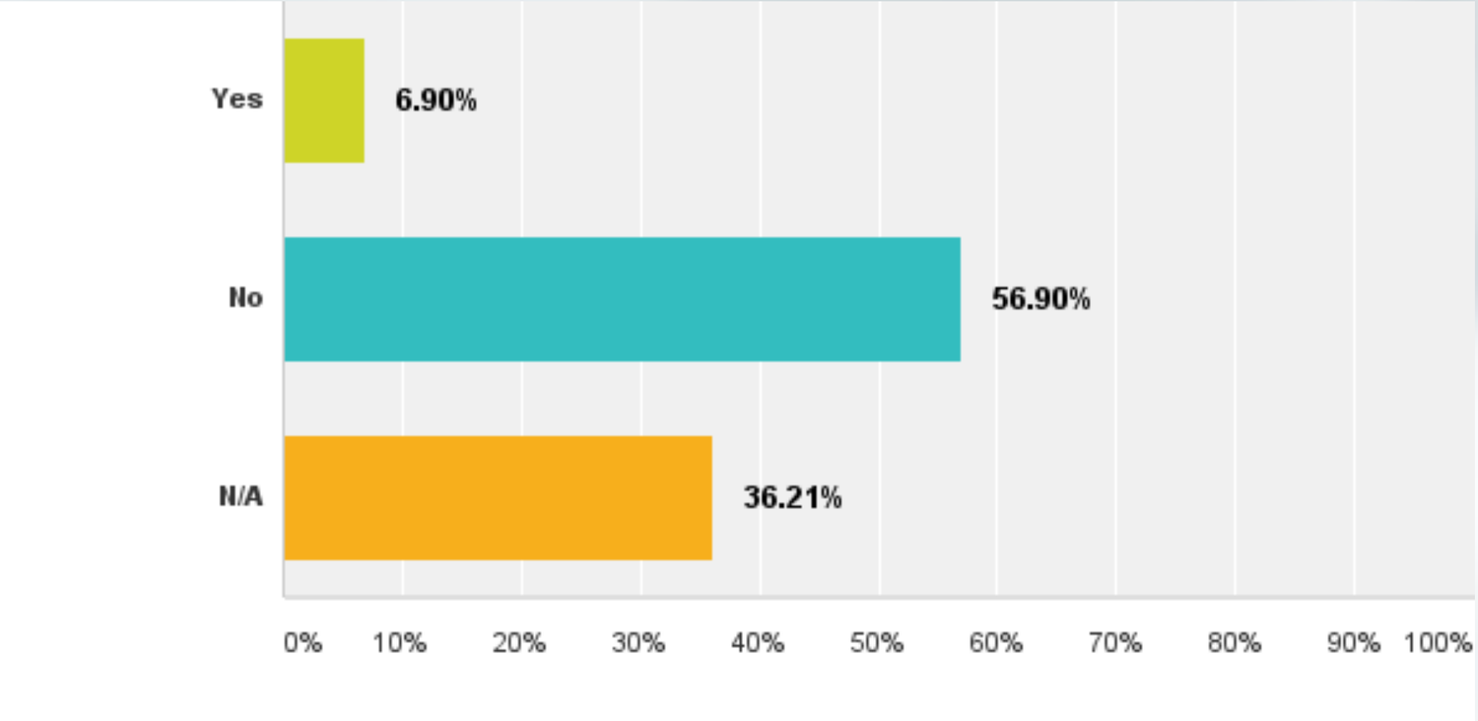
Do you charge for DDoS mitigation using BGP Flowspec?



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Summary of Comments

- 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

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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**

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Thank You!