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Autonomous System Provider Authorization and RFC 9234 for BGP Route Leak Detection and Prevention

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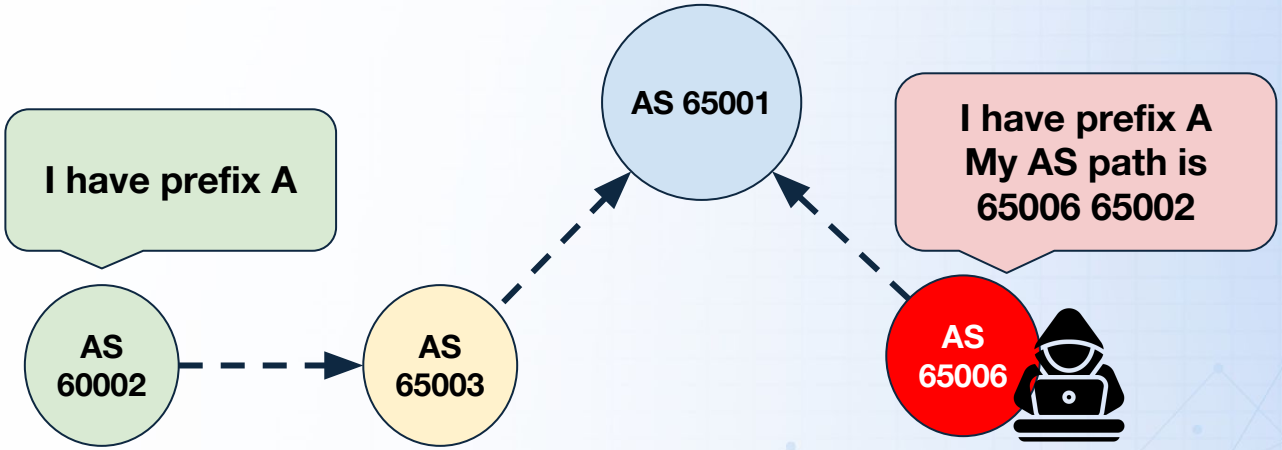
BGP is Based on Trust



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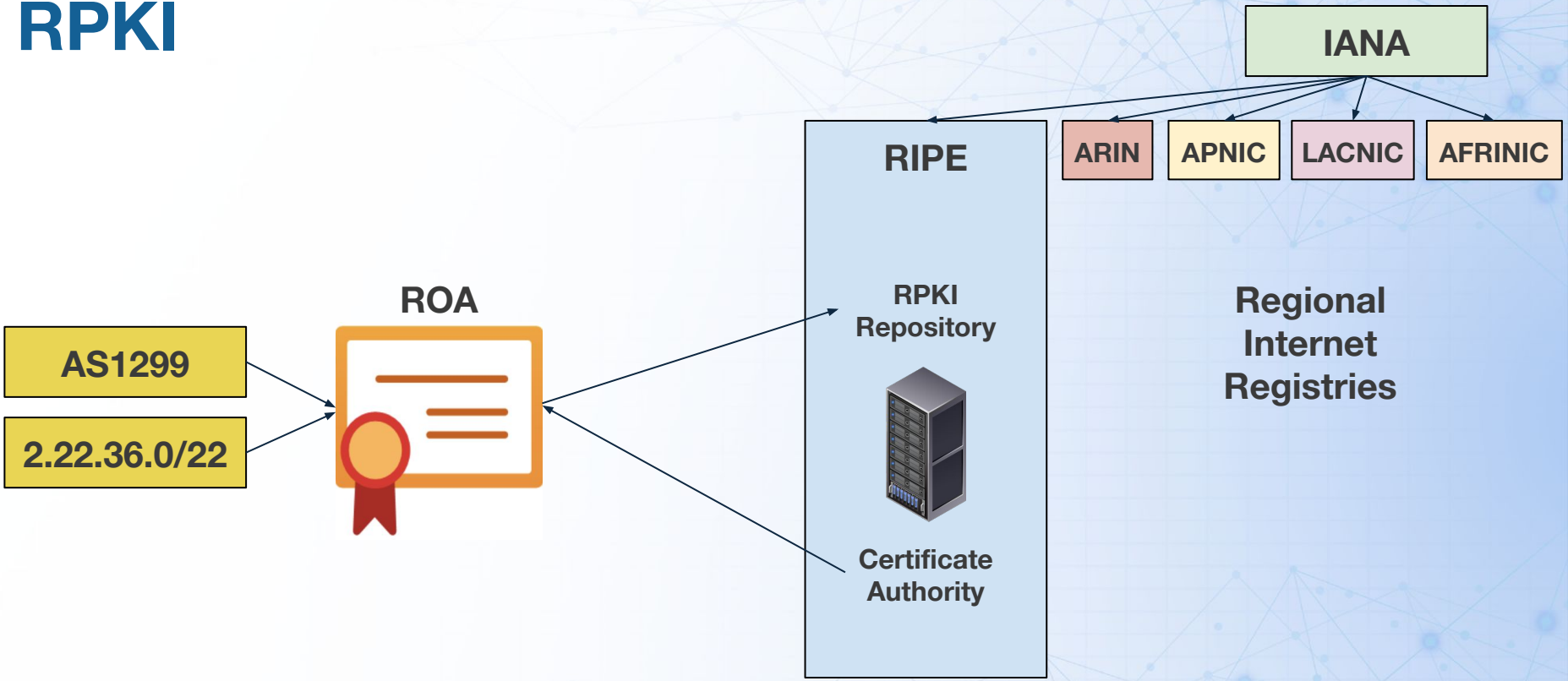
RPKI


IANA
RIPE
ARIN
APNIC
LACNIC
AFRINIC
ROA
AS1299
2.22.36.0/22
RPKI
Repository
Certificate
Authority
Regional
Internet
Registries

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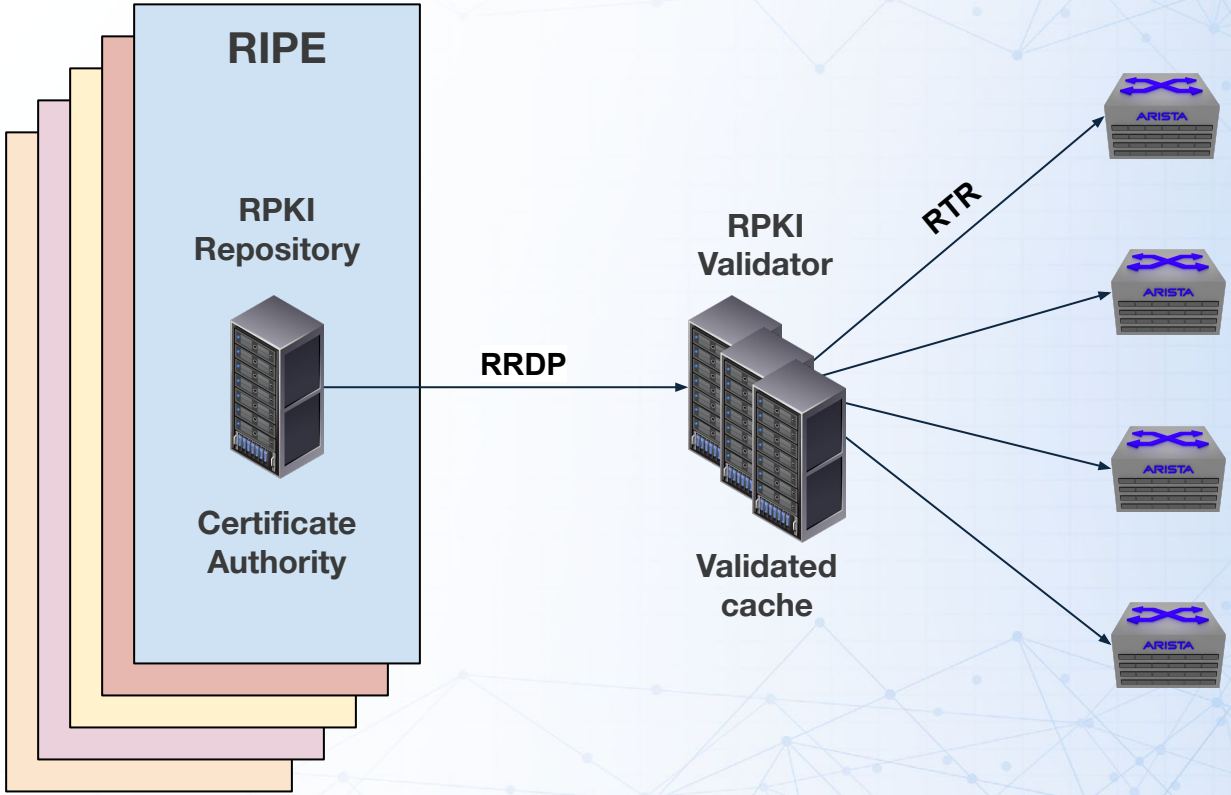
RPKI


RIPE
RPKI
Repository
Certificate
Authority
RRDP
RPKI
Validator
Validated
cache
RTR
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RPKI

```
Arista#show bgp ipv4 unicast
...
            Network          Next Hop       ...  Path
 * >     V 1.0.0.0/24      192.168.0.0    ...  680 13335 i
 * >     U 1.0.16.0/24     192.168.0.0    ...  680 30781 2497 2519 i
 * >     V 1.0.64.0/18     192.168.0.0    ...  680 30781 2497 2519 7670 18144 i
 * >     V 1.0.128.0/17    192.168.0.0    ...  680 6939 38040 23969 i
...
```


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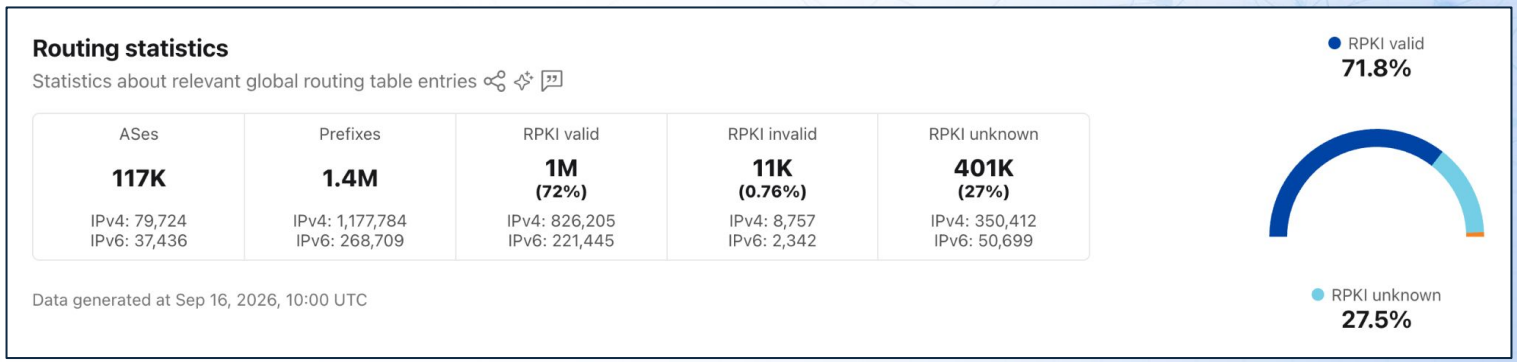
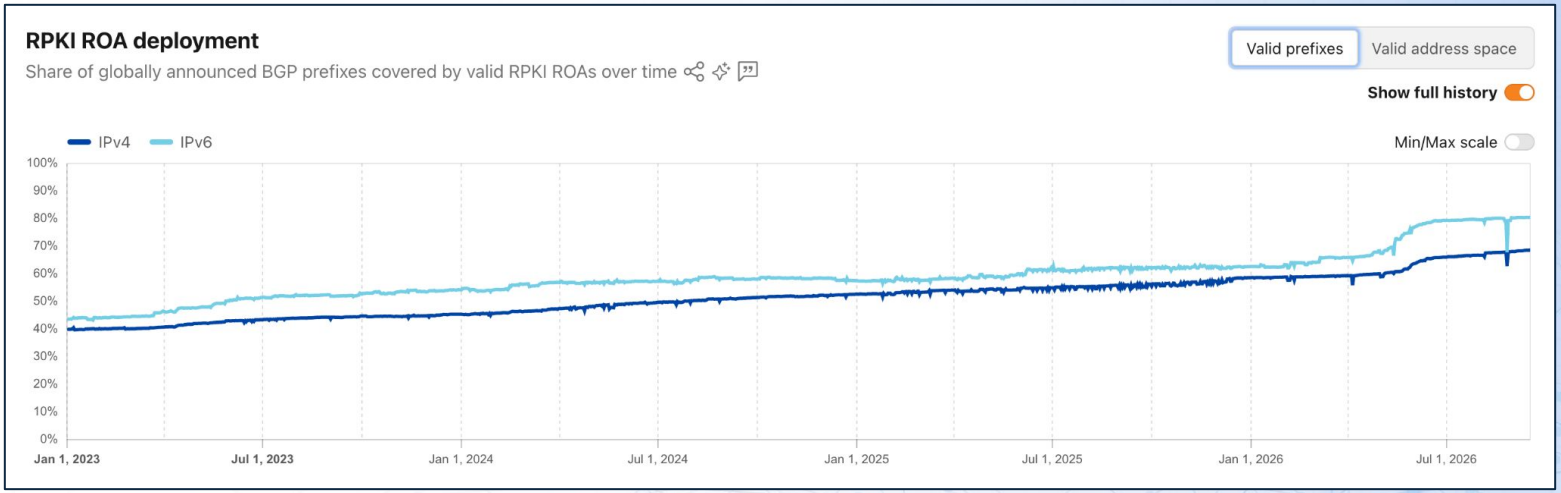
Status of RPKI





Source: https://radar.cloudflare.com/routing/rpki

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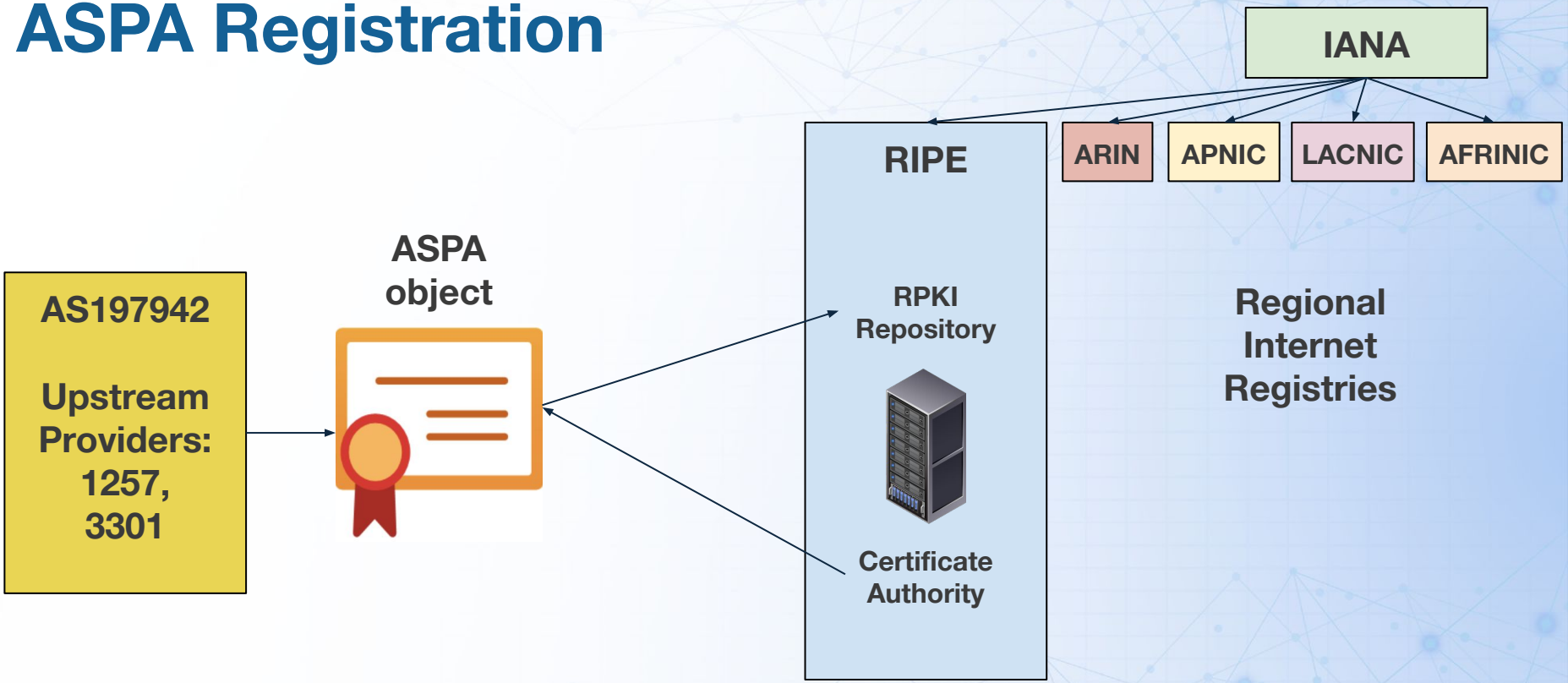
ASPA Registration



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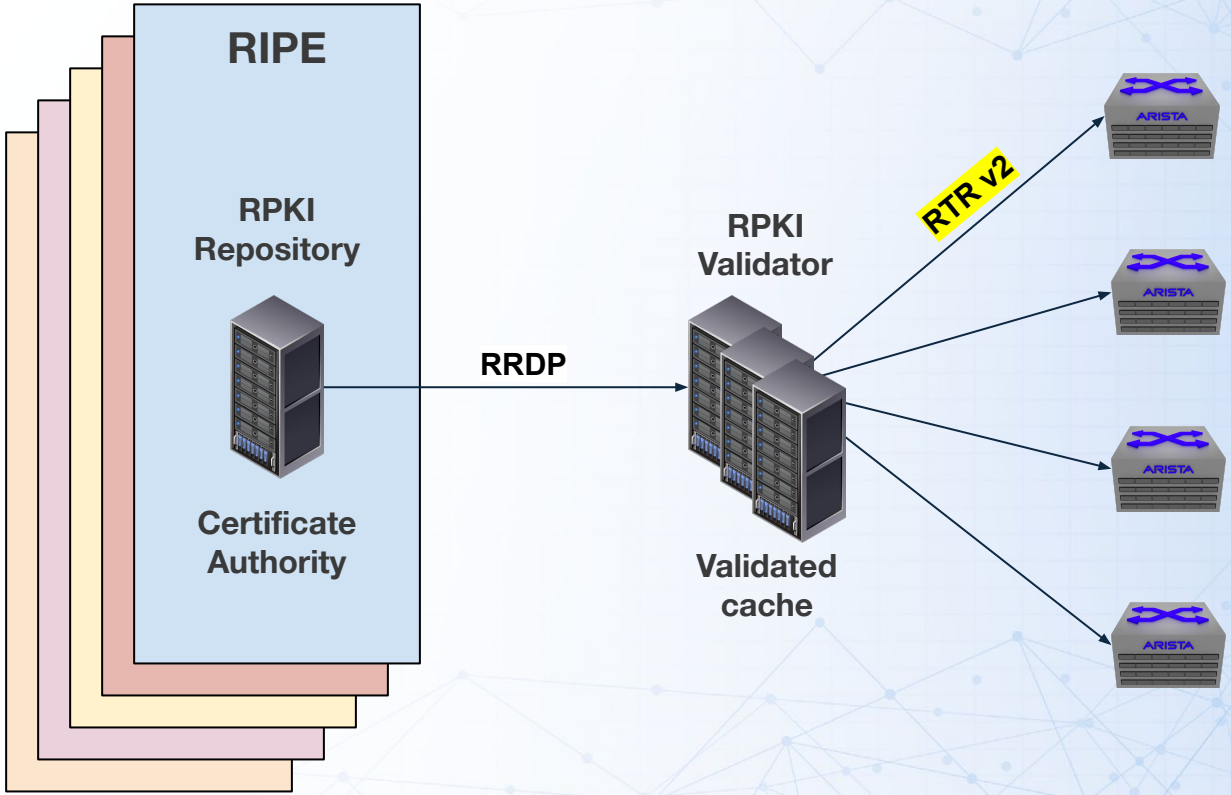
ASPA Validation



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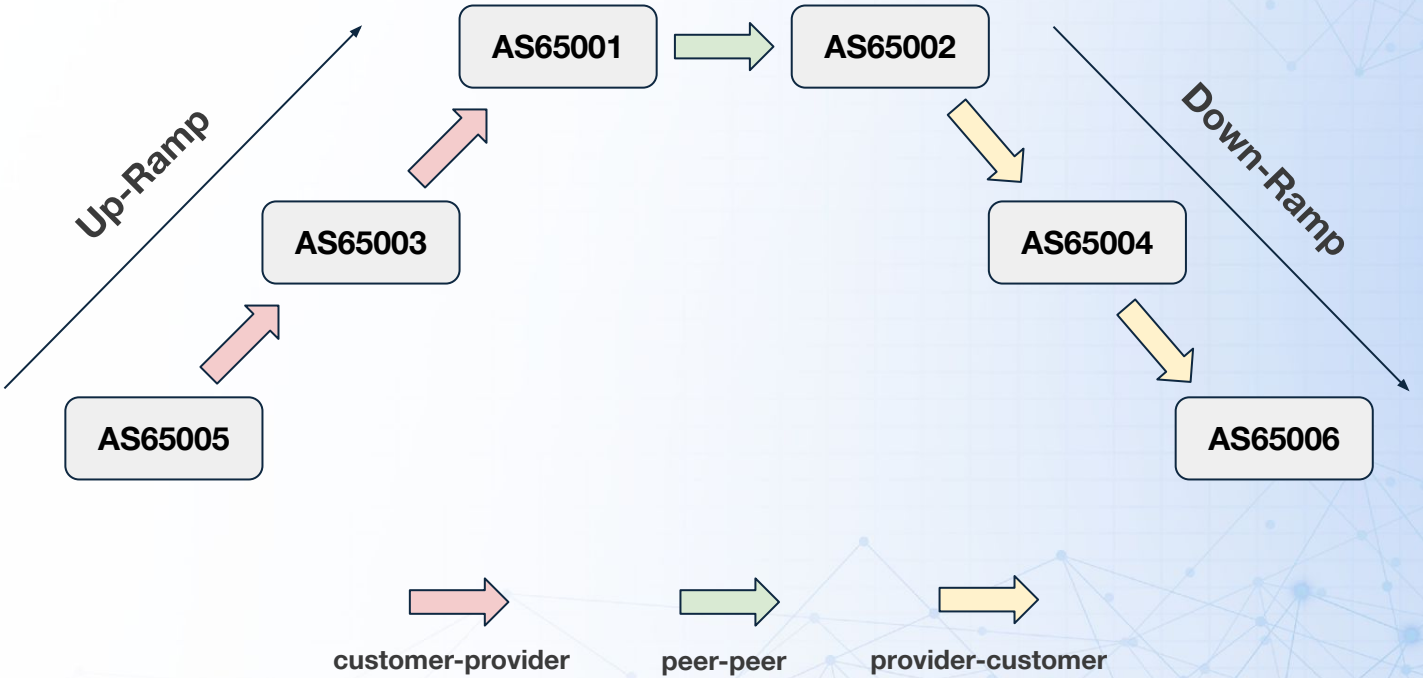
ASPA - Relies on Internet hierarchy



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ASPA - How does validation work?

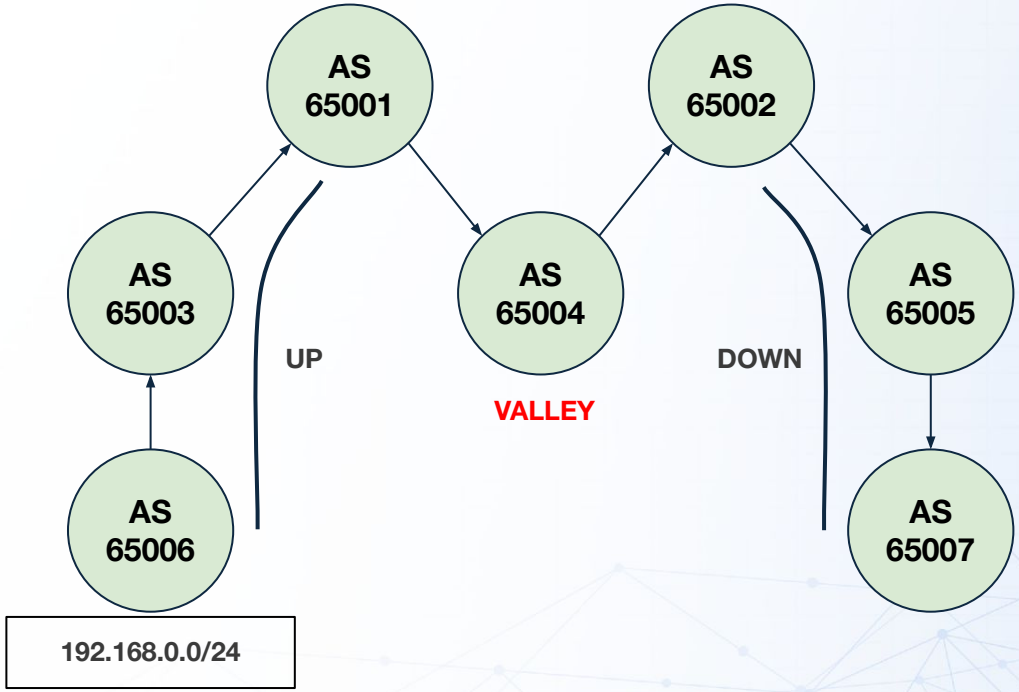
- **Checking the Up-Ramp:**
  - Starts at the origin and moves forward
  - At every hop, verify that the next-hop is an authorized provider of the customer network.
  - Keep going until the Up-Ramp stops.

- **Checking the Down-Ramp**
  - Start at the destination of a BGP update and do the same verification, moving backwards

- If the Up-Ramp and the Down-Ramp covers the entire AS path, the route is **valid**, otherwise the route is **invalid**.

- If ASPA information is missing in parts of the Up- or Down-Ramp the route is **unknown**

ASPA - Validation Example



Prefix announced from AS6

AS1 and AS2 are Tier1s and have no provider (AS0)

AS7 sees the following path:
5 2 4 1 3 6

AS4 is not a provider for AS1:
- Up path: 1 3 6

AS4 is not a provider for AS2:
- Down path: 5 2

The entire path is not covered. AS4 is a valley.

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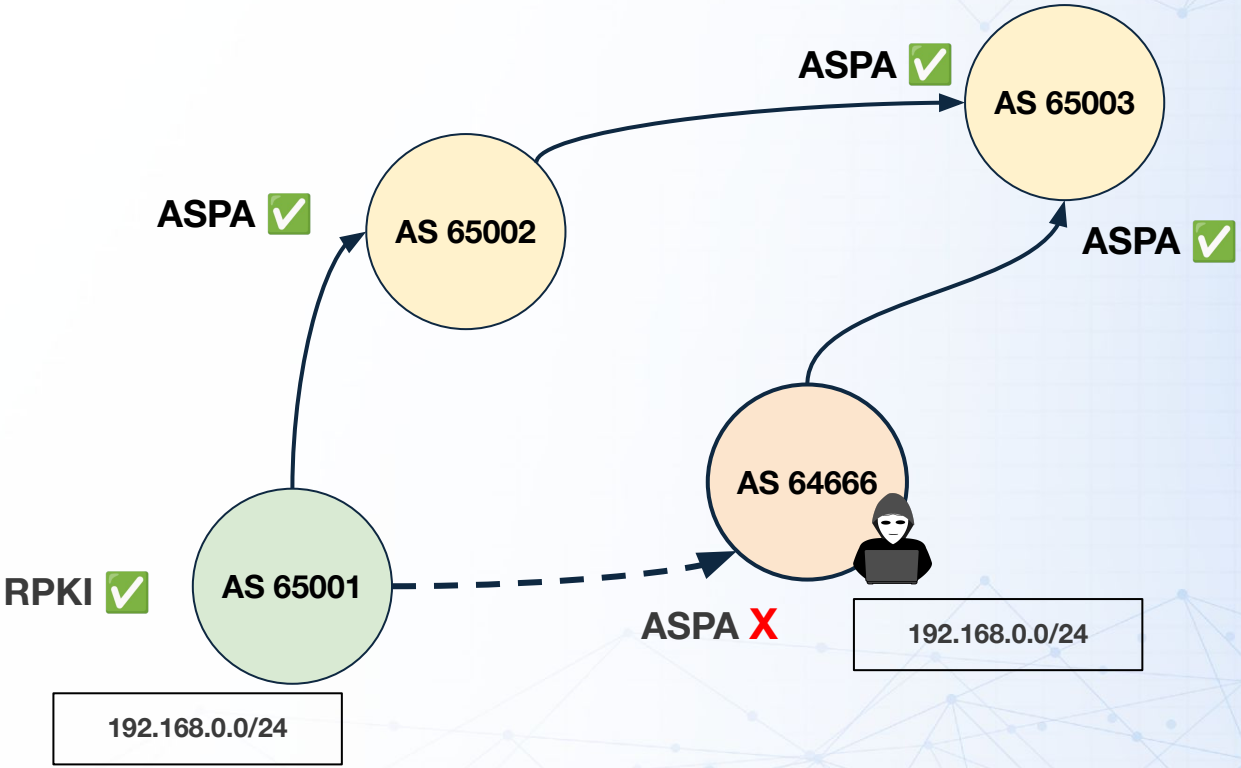
ASPA - blocking forged-origin hijacks



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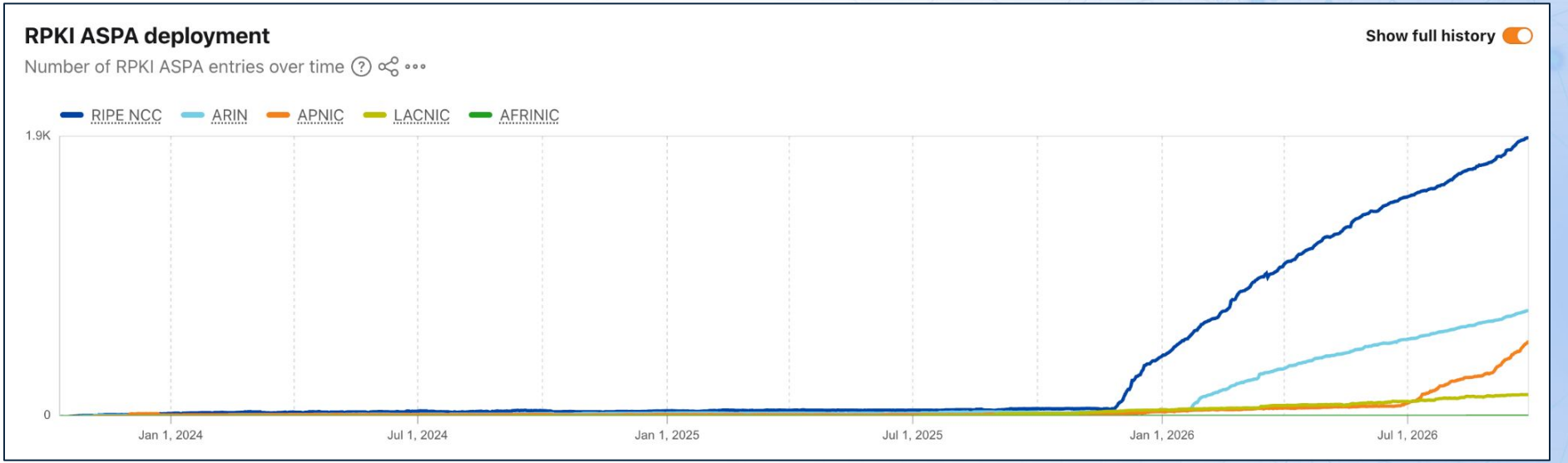
Status of ASPA - Worldwide



Source: https://radar.cloudflare.com/routing/rpki

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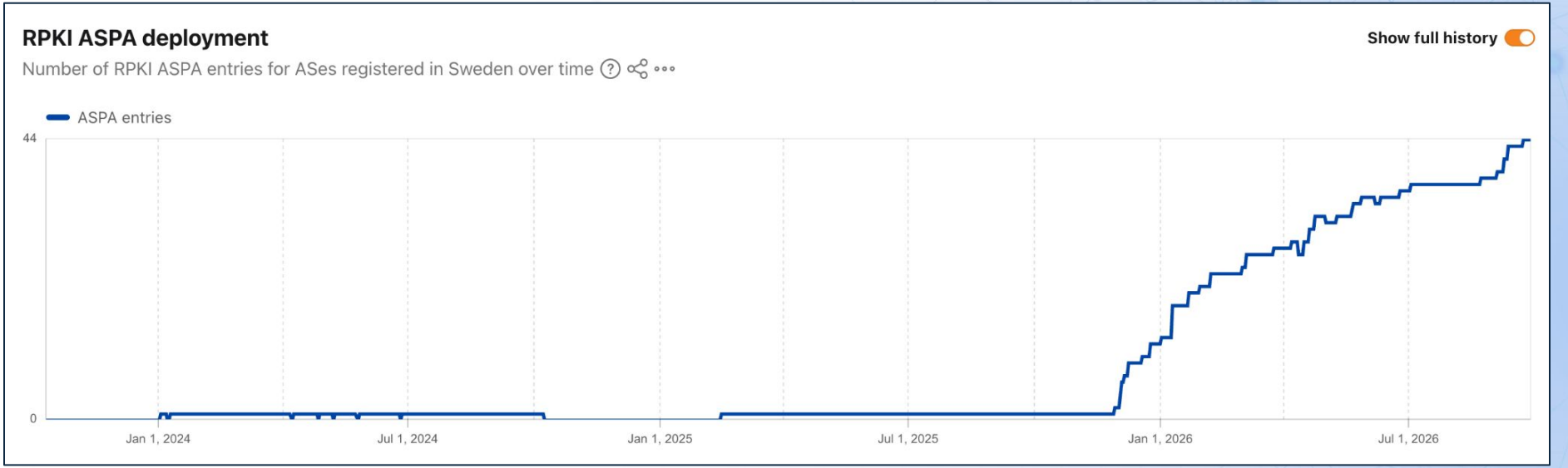
Status of ASPA - Sweden



Source: https://radar.cloudflare.com/routing/rpki

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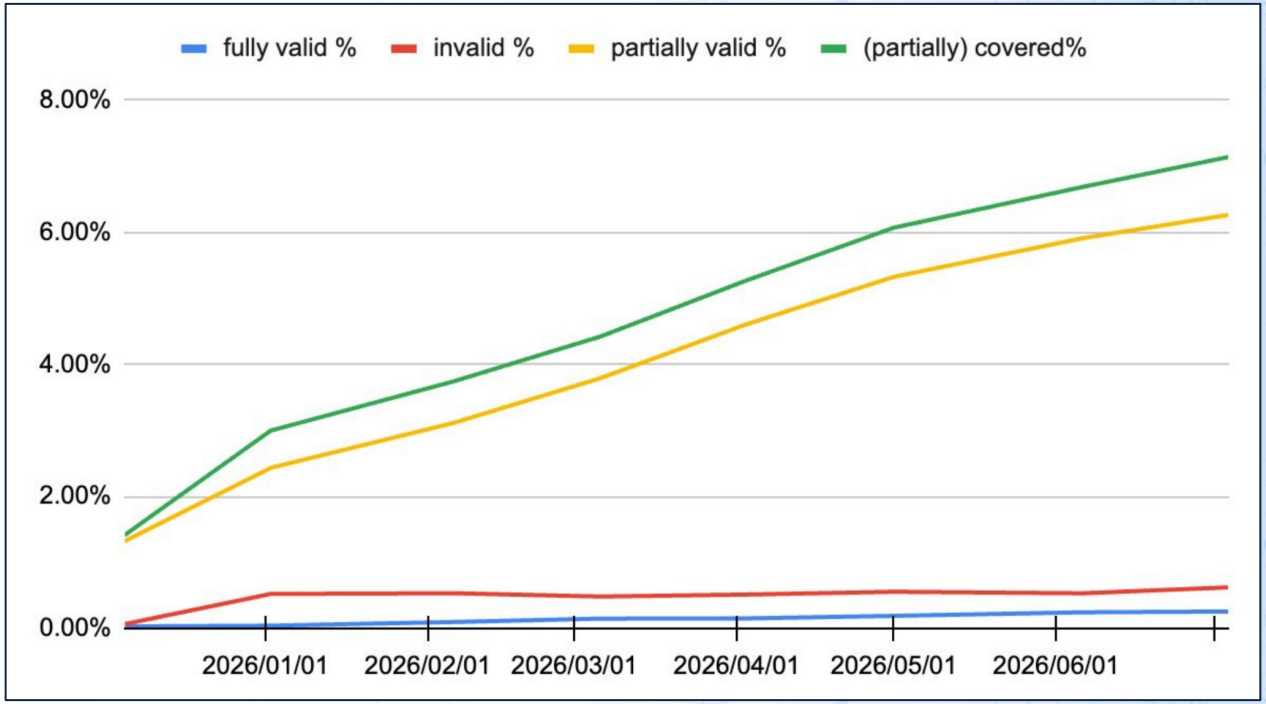
ASPA Path Validity to AS0 Networks



Source: Tim Bruijnzeels, RIPE NCC.
Presented at NLNOG Day on September 4, 2026

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RFC 9234 - Route Leak Prevention and Detection Using Roles in UPDATE and OPEN Messages

RFC 9234

- **BGP Role Capability**
  - Peers explicitly negotiate their relationship type, enabling automatic detection of misconfigured sessions.

- **Only-to-Customer Attribute**
  - Marks routes that should only flow toward customers, preventing accidental upstream propagation.

BGP Role Capability

```
router bgp 65001
   bgp role-based peering [strict]
   neighbor 10.0.0.1 remote-as 65002
   neighbor 10.0.0.1 local-role provider
```

EBGP

```
router bgp 65002
   bgp role-based peering [strict]
   neighbor 10.0.0.0 remote-as 65001
   neighbor 10.0.0.0 local-role customer
```

```
Border Gateway Protocol – OPEN Message
   Marker: ffffffffffffffffffffffffffffffff
   Length: 60
   Type: OPEN Message (1)
   Version: 4
   My AS: 65001
   Hold Time: 180
   BGP Identifier: 10.10.10.1
   Optional Parameters Length: 31
   Optional Parameters
      Optional Parameter: Capability
         Parameter Type: Capability (2)
         Parameter Length: 29
         Capability: Route refresh capability
         Capability: Enhanced route refresh capability
         Capability: Support for 4-octet AS number capability
         Capability: Multiprotocol extensions capability
         Capability: Graceful Restart capability
         Capability: Support for Additional Paths
         Capability: BGP Role
            Type: BGP Role (9)
            Length: 1
            BGP Role: Provider (0)
```

OPEN →

← OPEN

```
Border Gateway Protocol – OPEN Message
   Marker: ffffffffffffffffffffffffffffffff
   Length: 60
   Type: OPEN Message (1)
   Version: 4
   My AS: 65002
   Hold Time: 180
   BGP Identifier: 10.10.10.2
   Optional Parameters Length: 31
   Optional Parameters
      Optional Parameter: Capability
         Parameter Type: Capability (2)
         Parameter Length: 29
         Capability: Route refresh capability
         Capability: Enhanced route refresh capability
         Capability: Support for 4-octet AS number capability
         Capability: Multiprotocol extensions capability
         Capability: Graceful Restart capability
         Capability: Support for Additional Paths
         Capability: BGP Role
            Type: BGP Role (9)
            Length: 1
            BGP Role: Customer (3)
```


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BGP Role Capability

Allowed role pairings

Local Role		Remote Role
Provider	⟷	Customer
Customer	⟷	Provider
Peer	⟷	Peer
Route Server	⟷	Route Server Client
Route Server Client	⟷	Route Server

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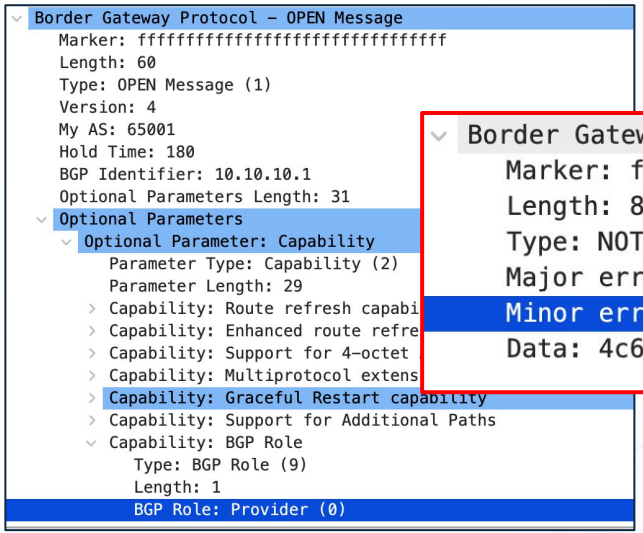
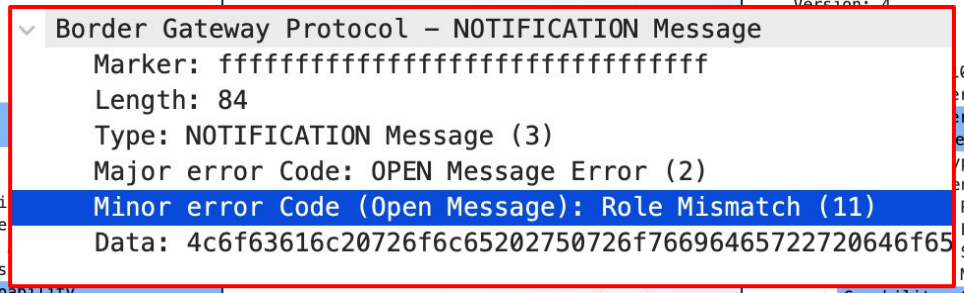
BGP Role Capability

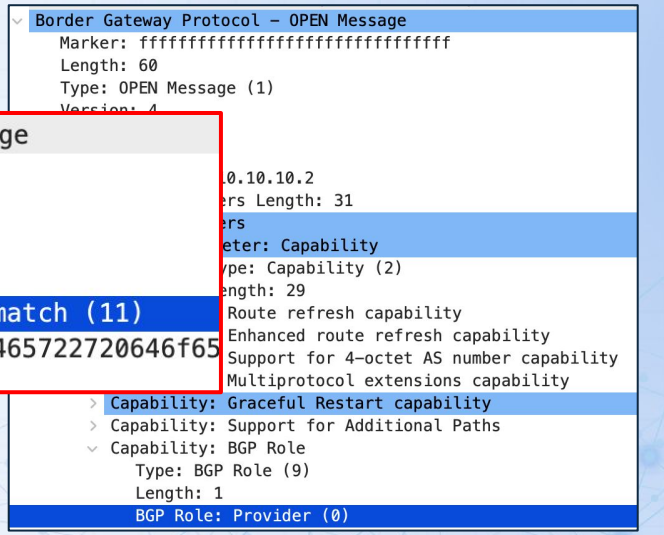
```
router bgp 65001
   bgp role-based peering
   neighbor 10.0.0.1 remote-as 65002
   neighbor 10.0.0.1 local-role provider
```

EBGP

```
router bgp 65002
   bgp role-based peering
   neighbor 10.0.0.0 remote-as 65001
   neighbor 10.0.0.0 local-role provider
```







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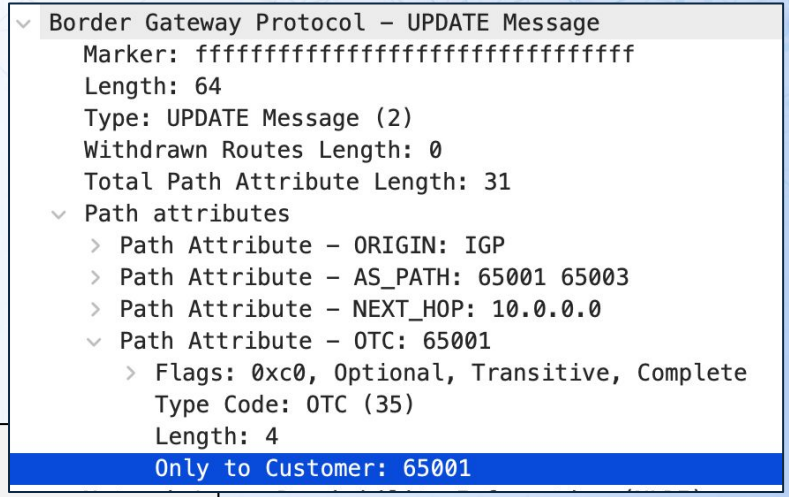
Only-to-Customer Attribute

- Optional transitive attribute
- The value is an AS number
- Set by the first AS that first sends a route sideways or downwards




```
Arista#sh bgp ipv4 unicast detail
BGP routing table information for VRF default
Router identifier 10.10.10.2, local AS number 65002
BGP routing table entry for 10.0.0.2/31
 Paths: 1 available
  65001 65003
    10.0.0.0 from 10.0.0.0 (10.10.10.1)
      Origin IGP, metric 0, localpref 100, IGP metric 0, weight 0, tag 0
      Received 00:00:23 ago, valid, external, best, OTC 65001
      Rx SAFI: Unicast
```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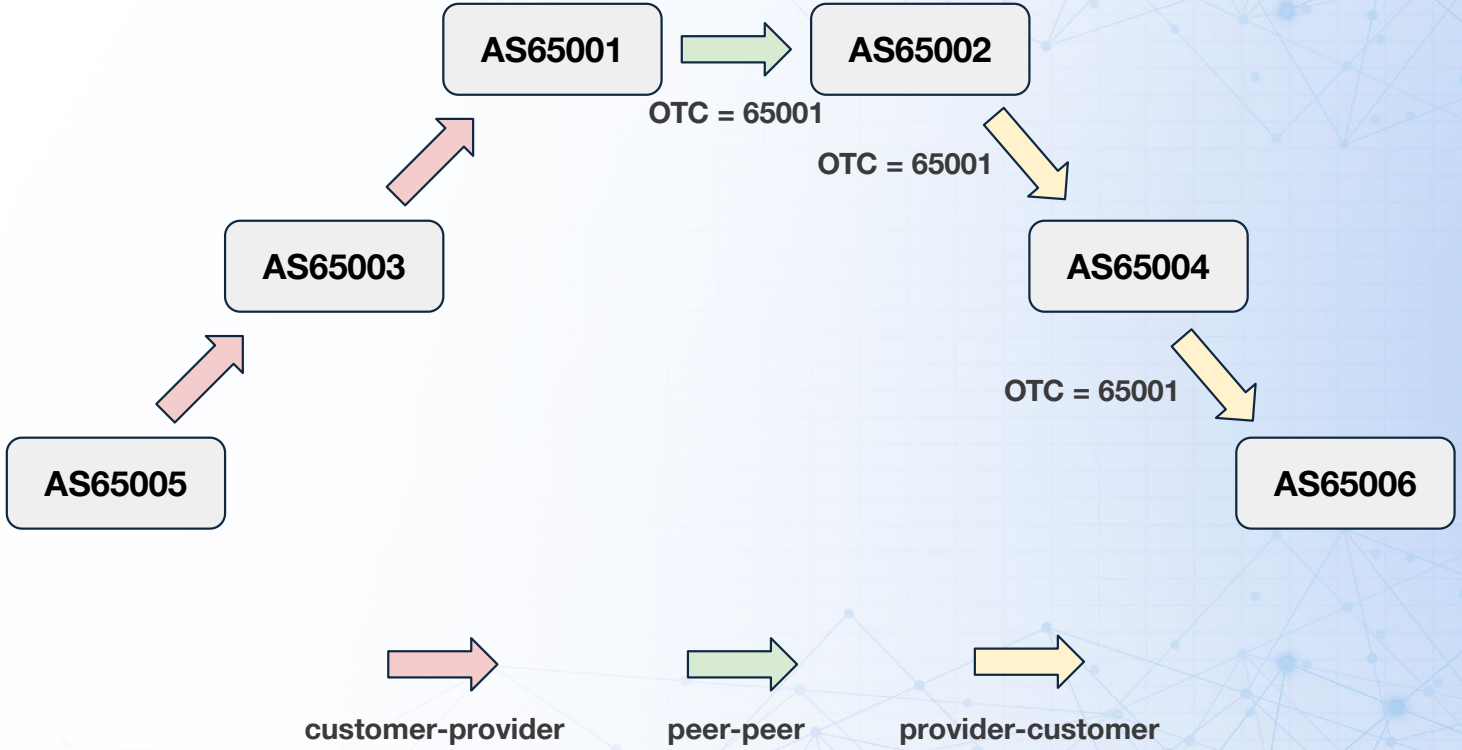
Only-to-Customer Attribute



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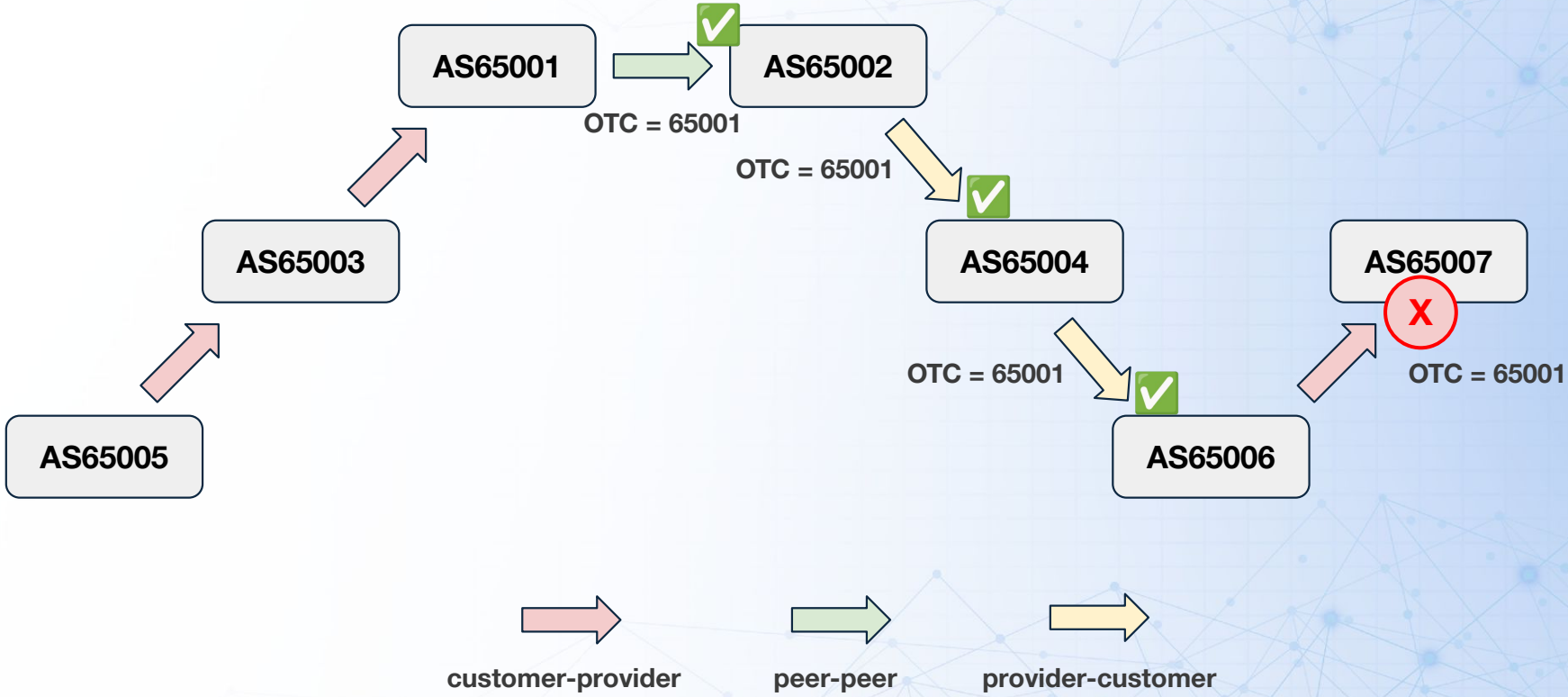
Only-to-Customer Attribute



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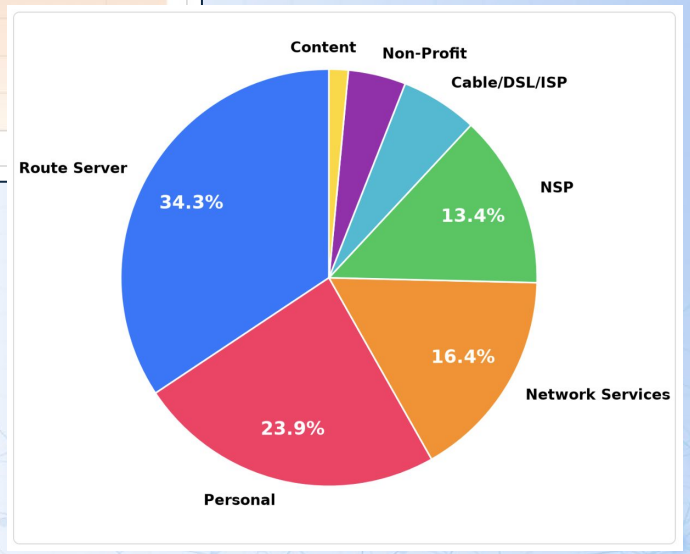
Adoption of OTC





Source: https://blog.cloudflare.com/rfc9234-bgp-role-model/

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Thank You

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