A first step towards checking BGP routes in the dataplane

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Why checking routes in the dataplane?

When a router receives a new route, it is not sure if the sender is legitimate.

BGP was designed without regard to security.
The lack of security mechanism in BGP against attackers

Pakistan Blocks YouTube Video Access

By SADDAQAT JAN – 4 days ago

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KlaySwap crypto users lose funds after BGP hijack

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Chinese ISP hijacks the Internet

This morning many BGPmon.net users received an alert regarding a possible prefix hijack by a Chinese network. AS23724 is one of the Data Centers operated by China Telecom, China’s largest ISP. Normally AS23724 CHINANET-IDC-Bj/AP IDC, China Telecommunications Corporation only originates about 40 prefixes, however today for about 15 minutes they originated about ~37,000 unique prefixes that are not assigned to them. This is what we typically call a prefix hijack. This incident follows another concerning incident from China 2 weeks ago. Although it
The lack of security mechanism in BGP against misconfigurations

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As of 00:19 UTC on 6-Jul, AS3356 started announcing 2000::/12, the largest IPv6 (or IPv4 for that matter) prefix in the global routing table.

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The lack of security mechanism in BGP

Extensions has been proposed to secure BGP:

- RPKI Route Origin Authorizations (ROAs): RFC6811
  - Slowly getting adopted
- BGPSec: RFC8205
  - Not deployed
- Pretty Good BGP
  - Not adopted
- etc.
The lack of security mechanism in BGP

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These extensions do not solve all security issues!
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- Pretty Good BGP
  - Not adopted

- **Our solution:** Contact a destination to the target prefix to check if the route is reachable in the dataplane
The lack of security mechanism in BGP

Diagram:
- My AS
- Transit AS
- Stub AS1
- Stub AS2
- R1, R2
- Networks: a.b.0.0/16, a.b.c.0/24, a.b.d.0/24
The lack of security mechanism in BGP
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- My AS
- Transit AS
- Stub AS1
- Stub AS2

IP filter misconfigured!

Under DDoS Attack
The lack of security mechanism in BGP

The IP filter is not reflected the control-plane

Packet for a.b.d.e

Under DDoS Attack

IP filter misconfigured!
Requirements to validate BGP paths

To be secure, the solution requires:

1. A new RPKI object
   - To find out which device is responsible for the secure handshake
2. TLS certificates
   - To authenticate the secure handshake
3. Modifications to BGP to support the validation extension
4. A service to answer to the secure ping
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8.8.8.123 → [8.8.8.123]
3. Modification to BGP

Before importing it, the route must be validated

- I can reach 8.8.8.0/24
- Prefix validation service
- Import filters
- BGP decision process
- Export filters
- Main BGP thread
- 8.8.8.0/24 → [8.8.8.123]
- RTR
- RPKI cache
- TLS / DTLS / QUIC
3. Modification to BGP

Before importing it, the route must be validated.

8.8.8.0/24 → [8.8.8.123]
3. **Modification to BGP**

Before importing it, the route must be validated.
Requirements to validate BGP paths

4. The prefix validation service can be any device
   Either the router or an external device can be used

8.8.8.0/24 → [8.8.8.123]
A first prototype

The first prototype is implemented with ~1.1k LoC in FRRouting v8.2

The validation system:

- Is implemented in BGP directly
- Supports ICMP Pings and TLS
- Uses community to tag route to be validated

Configuring path validation is done through CLI

The network operator can choose what to do with the path validation.

The CLI is flexible.

```bash
route-map path_validation permit 10
  match path-validation notrequested
!
route-map path_validation permit 20
  match path-validation pending
  set community additive no-export
!
route-map path_validation permit 30
  match path-validation valid
  set community additive 65021:6
!
route-map path_validation deny 40
```
Early Evaluation

800k routes originated from C5

2% of the routes are tagged for validation check
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![Graph showing validated routes over time](image)
Conclusion: BGP Path Validation

BGP Path Validation complements the RPKI ROA validation

Querying the dataplane brings a lot of useful information to BGP

Make the control plane more aware of its environment

Future direction:
- Deploy and Experiment in a real environment
- Augmenting the BGP Decision process with dataplane intelligence
- Make BGP aware of the dataplane
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