Using Forwarding Commitments (FCs) to Describe Routing Intents

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IETF 122 SIDROPS

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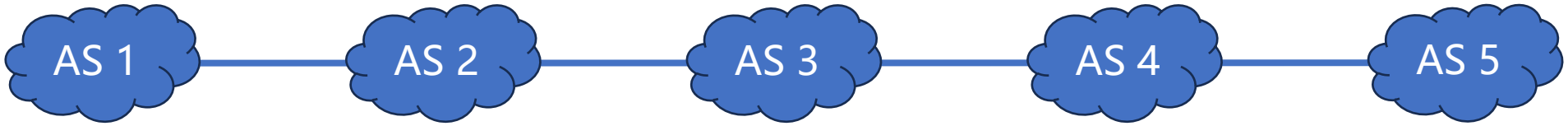
BGP Model

- Basic BGP route propagation pattern:
  - Receive routes from Previous hop and accept them.
  - Advertise routes to Next hop according to local routing policy.

- Only three hops are involved in this pattern:
  - Previous, can be null
  - Local, the issuer
  - Next, can be null

Goals

- Detect route propagation that violates local routing intent
- Verify the validity of BGP AS_PATH



Motivation

- BGPsec
  - On-path AS path forgery detection and prevention
  - Costly and prefixes cannot aggregate (one prefix, one update)
- OTC
  - Only to Customer path attribute
  - Route Leak prevention, but not authenticated.
- ROA/SPL
  - Prefix Origin Validation
- ASPA/ASRA
  - Relying on business relationship
  - Coarse grained

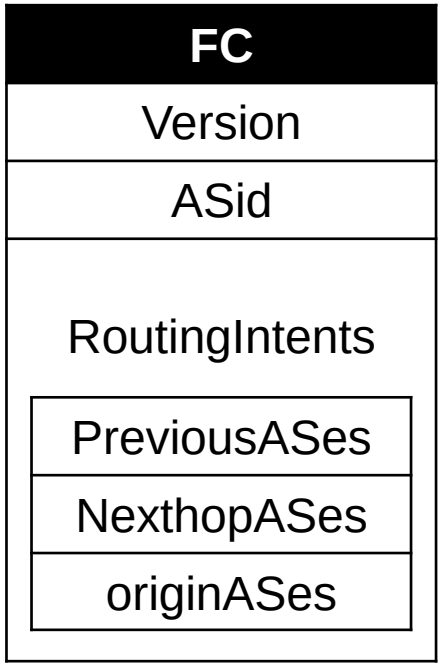
A New Object?

- Shall we design a **low cost, fine grained, and authenticated** AS_PATH protection mechanism?
  - Low cost: verification has offloaded to validator, not in router
  - Fine grained: different route origin can traverse different path
  - Authenticated: no one can forced modify others routing intent information

- We would like to propose FC signed object in RPKI.

FC Profile

- **Forwarding Commitment**
  - **Version**: 0
  - **ASid**: local AS number, issuer's AS number
  - **RoutingIntents**: routing intent description, i.e., receiving routes from *PreviousASes* and sending to *NexthopASes*
    - RoutingIntents is a list of routing intent of one AS.
    - ***PreviousASes***: upstream ASes
      - If it is None, it means local AS is originator of routes.
    - ***NexthopASes***: downstream ASes
      - If it is None, it means local AS is terminator of routes.
    - ***originASes***: origination ASes, refer to ROA/SPL
      - It binds the ROA/SPL with route path.
      - Default is None for any.

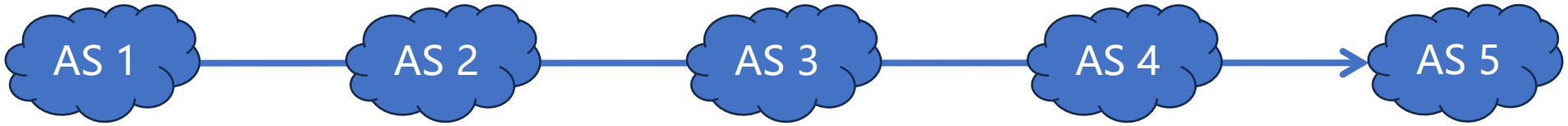


Verification Results

- Verification Results:
  - ***Totally Valid****:* each AS in AS_PATH has FC and each FC's *originASes* field is specified.
  - **Valid**: each AS in AS_PATH has FC but some FCs' *originASes* field are NONE/ANY.
  - **Unknown**: none of AS in AS_PATH has FC.
  - **Invalid**: some AS in AS_PATH does not have FC.

Verification Results: Totally Valid

- **Totally valid**: each AS in AS_PATH has FC and each FC's *originASes* field is specified.

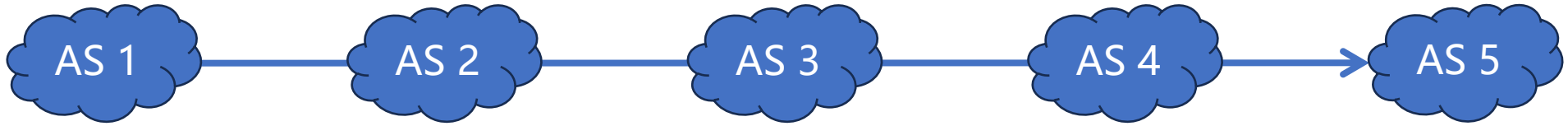


	FC 1	FC 2	FC 3	FC 4	FC 5
AS	AS 1	AS 2	AS 3	AS 4	AS 5
PAS	NIL	AS 1	AS 2	AS 3	AS 4
NAS	AS 2	AS 3	AS 4	AS 5	NIL
ROA	AS 1	AS 1	AS 1	AS 1	AS 1

ROA 1
AS 1
10.0.0.0/20
Max-length: 24

Verification Results: Valid

- **Valid**: each AS in AS_PATH has FC but some FCs' *originASes* field are NONE/ANY; or the originator doesn't issue ROA/SPL.

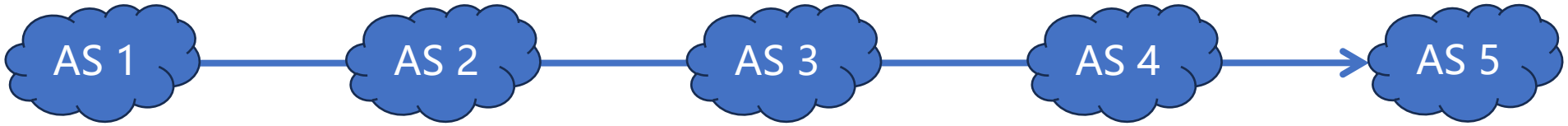


	FC 1	FC 2	FC 3	FC 4	FC 5
AS	AS 1	AS 2	AS 3	AS 4	AS 5
PAS	NIL	AS 1	AS 2	AS 3	AS 4
NAS	AS 2	AS 3	AS 4	AS 5	NIL
ROA	AS 1	—	AS 1	—	AS 1

ROA 1
AS 1
10.0.0.0/20
Max-length: 24

Verification Results: Unknown

- **Unknown**: none of AS in AS_PATH has FC.



AS

PAS

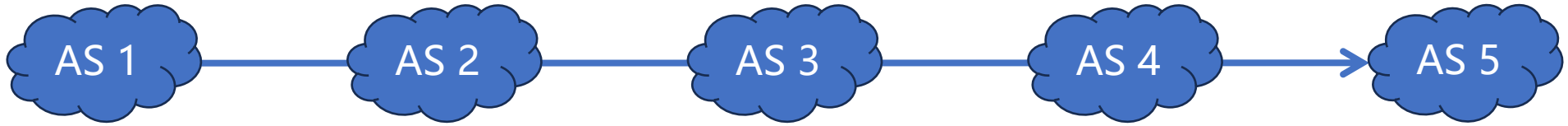
NAS

ROA

ROA 1
AS 1
10.0.0.0/20
Max-length: 24

Verification Results: Invalid

- **Invalid**: some AS in AS_PATH does not have FC.



	FC 1	FC 3	FC 4	FC 5
AS	AS 1	AS 3	AS 4	AS 5
PAS	NIL	AS 2	AS 3	AS 4
NAS	AS 2	AS 4	AS 5	NIL
ROA	AS 1	AS 1	AS 1	AS 1

ROA 1
AS 1
10.0.0.0/20
Max-length: 24

Conclusion

- Forwarding Commitment (FC) aims at detecting route propagation that violates local routing intent.
- It can
  - Protect the business relationship.
  - Be incrementally deployable, benefiting early adopters.
  - Provide fine management for TE.
- Limitations
  - Totally Valid is a new concept that is not widely accepted.
  - It eliminates business relationship ...
    - Cannot prevent route leaks [RFC7908].

Routes from	To provider	To peer	To customer
From provider	Type 1	Type 3	Normal
From peer	Type 4	Type 2	Normal
From customer	Normal	Normal	Normal

Next Steps

- We’re planning to implement it.

- WG adoption or throw it away?

Questions? Feedback?

Comments are welcomed.

https://datatracker.ietf.org/doc/draft-guo-sidrops-fc-profile

https://datatracker.ietf.org/doc/draft-xu-sidrops-fc-verification

Please email feedback to

guoyangfei@zgclab.edu.cn

or, open issues at

https://github.com/FCBGP/fc-profile

https://github.com/FCBGP/fc-verification

Thank you!

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Estimation: total number of FCs

- $Total\ FC\ objects\ = AVG_P * N_S * AVG_D \approx 4\ * 65000\ * 3.28 = 852{,}800$
  - AVG_P: average AS Path Length
  - N_S: number of Stub ASes
  - AVG_D: average degree
- RPKI has approximately 670,000 ROAs now, queried from https://console.rpki-client.org/rpki.json

- BGP in 2022 – the routing table | APNIC Blog