(APNIC ISIF Project)

An Extension of the Ongoing Project "Developing a Collaborative BGP Routing Analyzing and Diagnosing Platform" Project

Technical Report

Tsinghua University

November 19th, 2024

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Contents

- Updates
  - Developed data plan detection method
  - Developed path hijacking detection method
  - Finished middle project report
- Future Work Plan
  - Continue software development
  - Continue community development
  - Continue to secure new funds
- Demo of New Functions

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Data Plan Detection

108.165.54.3 — 2024-11-06T03:45:12.000Z — 0.76

Probe AS	Economy	Time(UTC)	From	Min RTT	Packet Loss
AS34549 H		2024-11-06T03:45:12.000Z	185.150.98.36	No reply	100.00%
AS49420		2024-11-06T03:45:12.000Z	91.212.242.241	No reply	100.00%
AS17639 H		2024-11-06T03:45:14.000Z	161.49.13.234	No reply	100.00%
AS3333 H		2024-11-06T03:45:12.000Z	193.0.0.165	No reply	100.00%
AS48362 H		2024-11-06T03:45:12.000Z	94.199.170.201	No reply	100.00%
AS204092 H		2024-11-06T03:45:13.000Z	80.67.190.218	No reply	100.00%
AS49673 H		2024-11-06T03:45:12.000Z	94.247.111.19	No reply	100.00%
AS34800		2024-11-06T03:45:12.000Z	194.50.99.201	No reply	100.00%
AS1403		2024-11-06T03:45:12.000Z	198.16.163.75	13.81ms	0.00%
AS20205		2024-11-06T03:45:12.000Z	38.67.212.178	16.77ms	0.00%
AS7018		2024-11-06T03:45:14.000Z	162.225.60.96	22.56ms	0.00%
AS3549		2024-11-06T03:45:13.000Z	66.162.17.4	23.65ms	0.00%
AS1299		2024-11-06T03:45:12.000Z	62.115.192.103	27.96ms	0.00%
AS13830		2024-11-06T03:45:12.000Z	161.129.155.179	41.25ms	0.00%
AS3356		2024-11-06T03:45:13.000Z	4.8.13.234	42.41ms	0.00%

- Choose probes in certain ASes
- Choose destinations from the hijacked prefixes
- Do Probing
- Calculate Correlation Coefficient

Correlation Coefficient:

$$r(X,Y) = \frac{Cov(X,Y)}{\sqrt{Var[X]\,Var[Y]}}$$

- Vector X:

For each prober, set to 0 if located in the affected AS; otherwise, set to 1.

- Vector Y:

For probe result from each prober, set to 1 if reachable; otherwise, set to 0.

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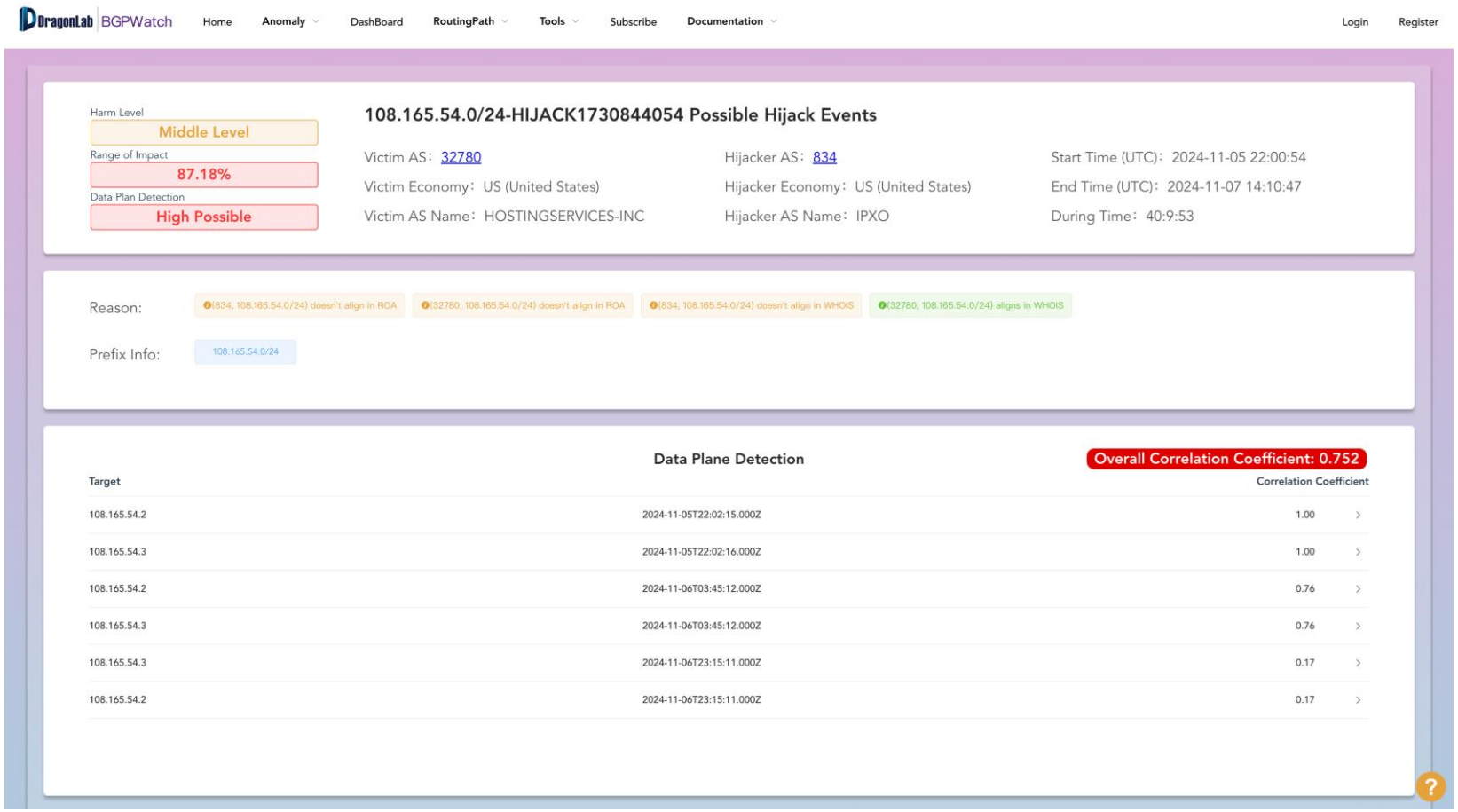
Anomaly – Detail



- **Data Plane Detection**
  - Not Done:
    No measurable target found
  - No Result:
    Probed, but received no results
  - Not Hijack:
    Correlation Coefficient = 0
  - Low Possible:
    Correlation Coefficient < 0.6
  - High Possible:
    Correlation Coefficient >= 0.6

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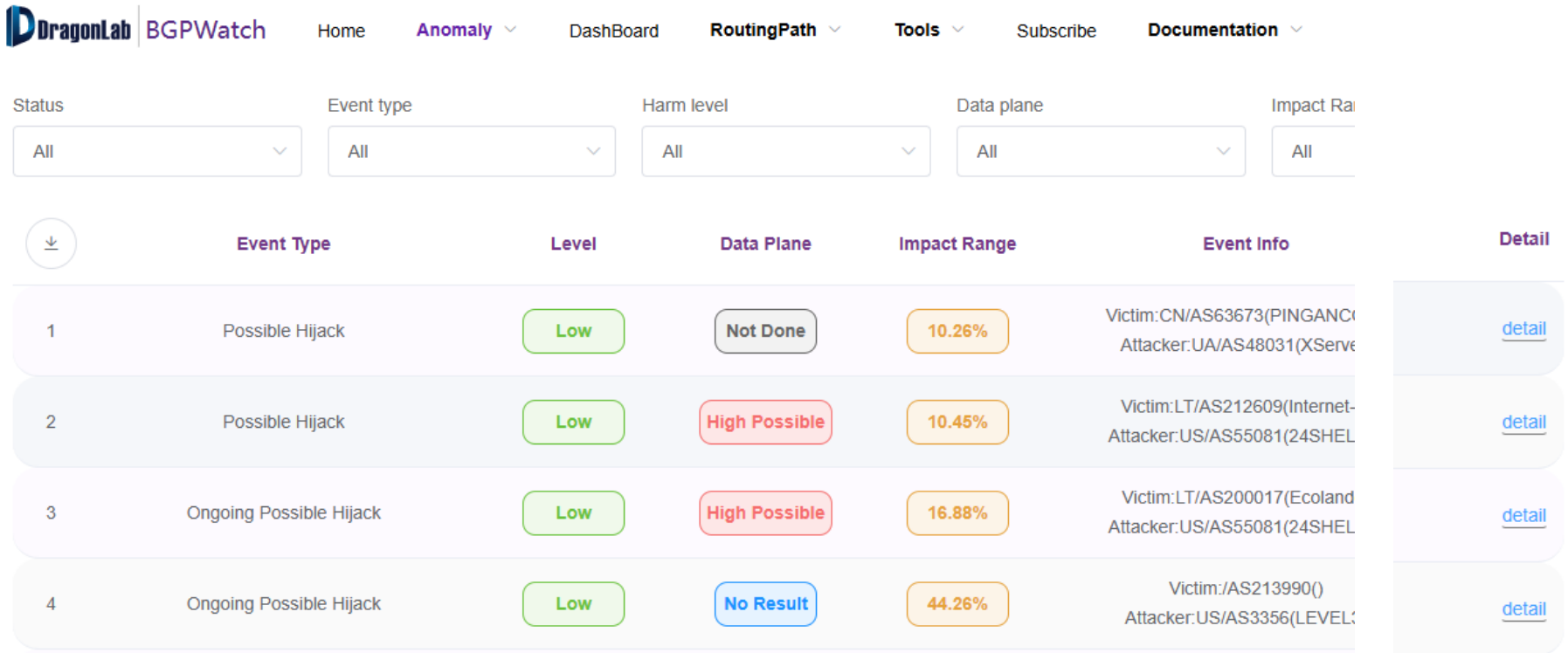
Anomaly



- **Impact Range**
  - <10%: Fewer than 10% of ASNs in the replay path are affected.
  - >=10%: More than 10% of ASNs in the replay path are affected.
  - >=50%: More than 10% of ASNs in the replay path are affected.

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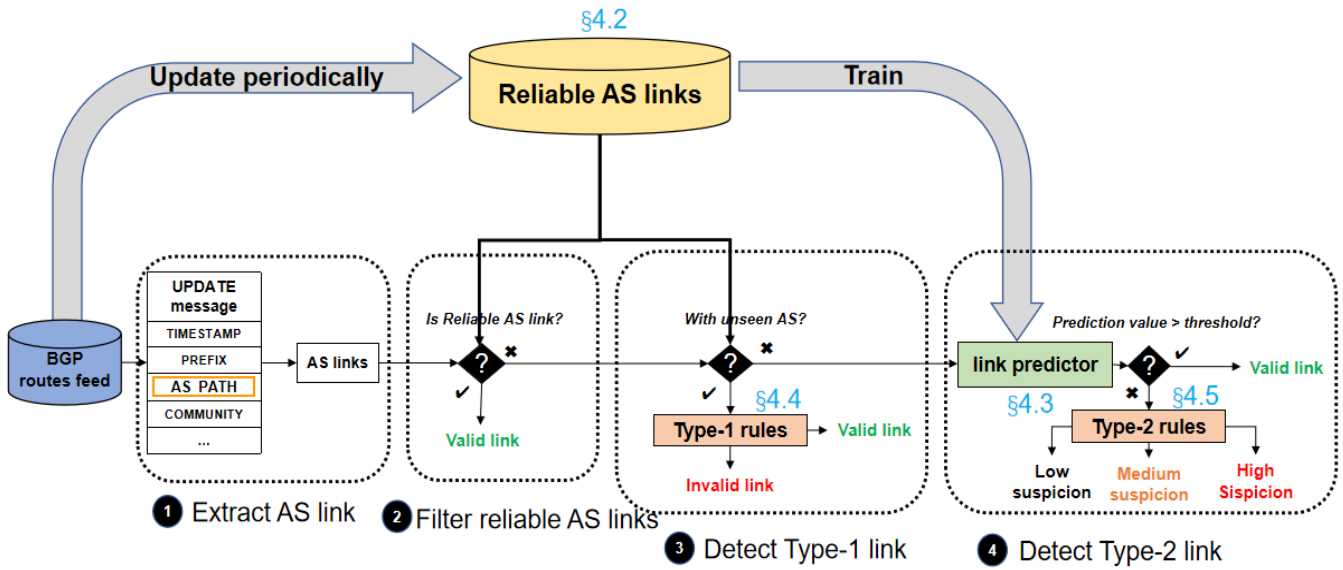
Path Anomaly Detection: Combining Link Prediction and Rules



- Link prediction is used to find suspicious unseen links, and rules are used to improve the confidence level.
- Two Type Events:
  - New Link: New and Suspicious Link
  - New AS: New and Suspicious AS

- Possible
  - Low Possible: Confidence level < 0
  - Middle Possible: Confidence level = 0
  - High Possible: Confidence level > 0

Reason	Confidence level
new link	
AS-PATH is too long	+1
The last hop is single-digital ASN	+1
The edit distance of ASNs in the link is 1	+1
There exists loop in the AS-PATH and the suspicious link is in the loop.	+1
The AS-PATH violates valley-free rule:'({a},{b},{c}).	+1
Domestic traffic ({country},{asn1},{asn2}) detour.	+1
Suspicious links is at the end of the AS-PATH and a demostic link ({irr_dict.get(self._u)}).	-4
Suspicious links is same country ({irr_dict.get(self._u)}).	-2
new as	
ASN{asn} is not registered.(new AS)	+1
ASN{asn} is reserved ASN.(new AS)	+1
ASN{asn} is not the last hop.(new AS)	+1

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Path Anomaly

	Event Type	Level	Possible	Impact Range	Event Info	Prefix Num	Example Prefix	Start Time
61	Ongoing New Link	Low	Low Possible	<=1 path	New Link: 11014(AR) -> 269818(AR) Reason:The suspicious link is at the end of the AS-PATH and is a domestic link (AR)	1	45.184.152.0/24	2024-11-13 15:05:30
62	Ongoing New AS	Low	High Possible	>5 path	New AS: 31196 Reason:ASN31196 is not the last hop	1	202.36.221.0/24	2024-11-13 14:40:48
63	Ongoing New Link	Low	Low Possible	<=1 path	New Link: 32307(US) -> 400707(US) Reason:The suspicious link is at the end of the AS-PATH and is a domestic link (US)	1	38.109.250.0/24	2024-11-13 14:29:20
64	Ongoing New Link	Low	High Possible	<=1 path	New Link: 58212(DE) -> 214309(GB) Reason:Detour of domestic traffic (34854,GB) (1299,SE) (199524,LU) (58212,DE) (214309,GB)	1	45.151.91.0/24	2024-11-13 14:14:44
65	Finish New Link	Low	Low Possible	<=1 path	New Link: 52863(BR) -> 264485(BR) Reason:The suspicious link is at the end of the AS-PATH and is a domestic link (BR)	1	189.91.147.0/24	2024-11-13 14:10:47

Path Anomaly Detail – Suspicious New Link

Harm Level
Low
Range of Impact
<=1 path
Possible
High Possible

AS6762-AS58173-TYPE2-1731344495 New Link Events

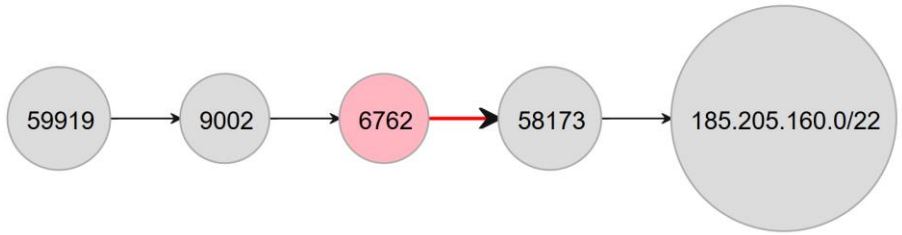
Suspicious AS: 6762 | Victim AS: 58173 | Start Time (UTC): 2024-11-12 01:01:35
Suspicious Economy: IT | Victim Economy: GB | End Time (UTC): 2024-11-12 01:26:35
Suspicious AS Name: SEABONE-NET | Victim AS Name: ONWAVE | Duration: 0:25:0

Time Lines:

Reason: Detour of domestic traffic (58173,GB) (6762,IT) (9002,GB)

Prefix Info: 185.205.160.0/22

Reason:
Detour of domestic traffic
(58173,GB) (6762,IT) (9002,GB)



The suspicious AS and link are marked red.

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Path Anomaly Detail – Suspicious New AS

Harm Level
High

Range of Impact
>5 path

Possible
High Possible

AS61974-TYPE1-1731583577 New AS Events

Suspicious AS: 61974
Suspicious Economy: IR
Suspicious AS Name: LOTUSNET

Prefix Count: 1
Path Count: 13
Possible: High Possible

Start Time (UTC): 2024-11-14 19:26:16
End Time (UTC): -
Duration: -

Reason: ASN61974 is not the last hop

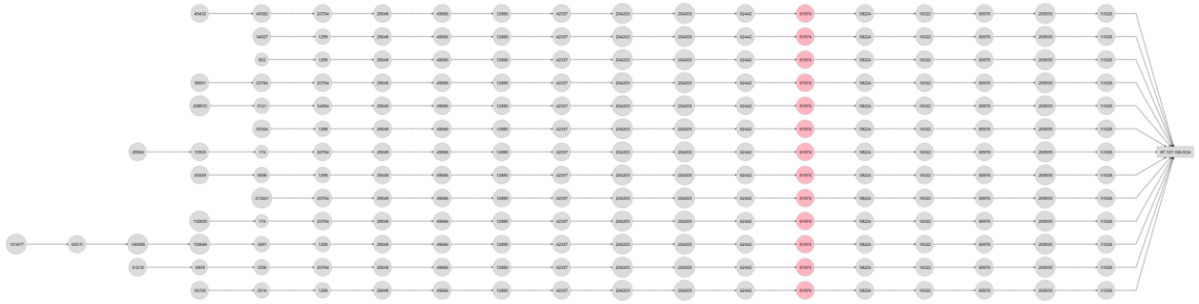
Prefix Info: 87.107.166.0/24

Website: looksfile.com | optimist.style | mimt.gov.ir | seanalisa.shop | m0nalisa.ir | karafariniomid.ir

87.107.166.0/24

Reason:
ASN61974 is not the last hop.

All the paths affected.



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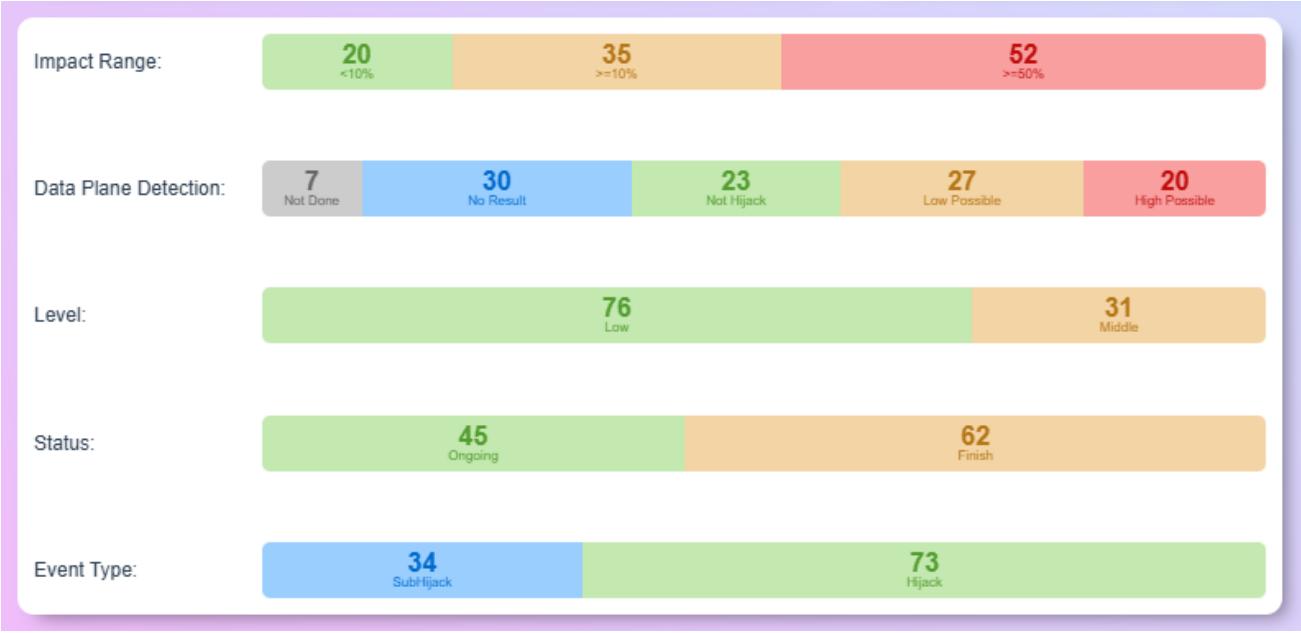
Homepage



- Impact Range
  - <10%, >=10%, >=50%
- Data Plane Detection
  - Not Done, No Result, Not Hijack, Low Possible, High Possible
- Level
  - Low, Middle, High
- Status
  - Ongoing, Finish
- Event Type
  - Subhijack, Hijack

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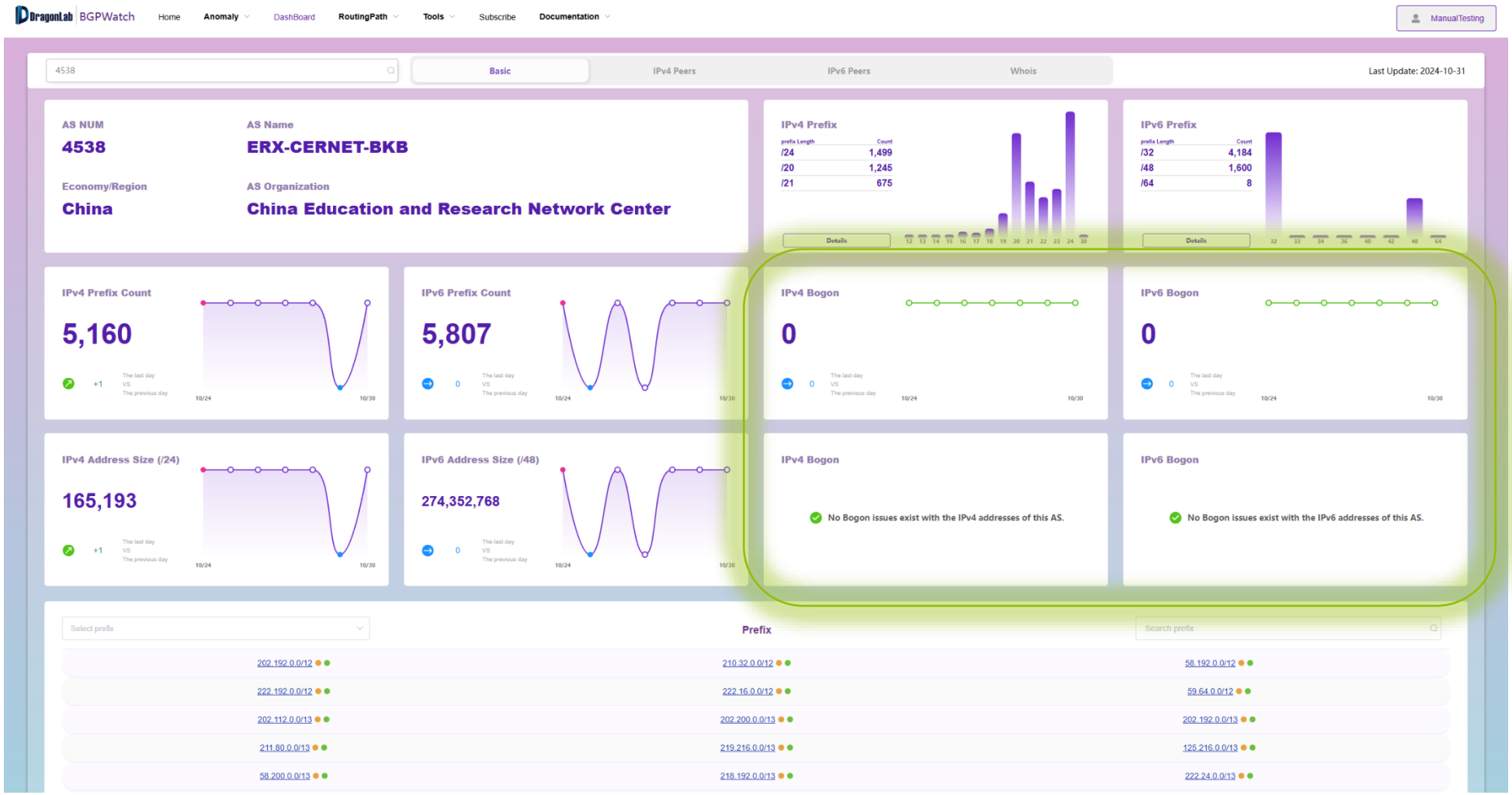
Dashboard



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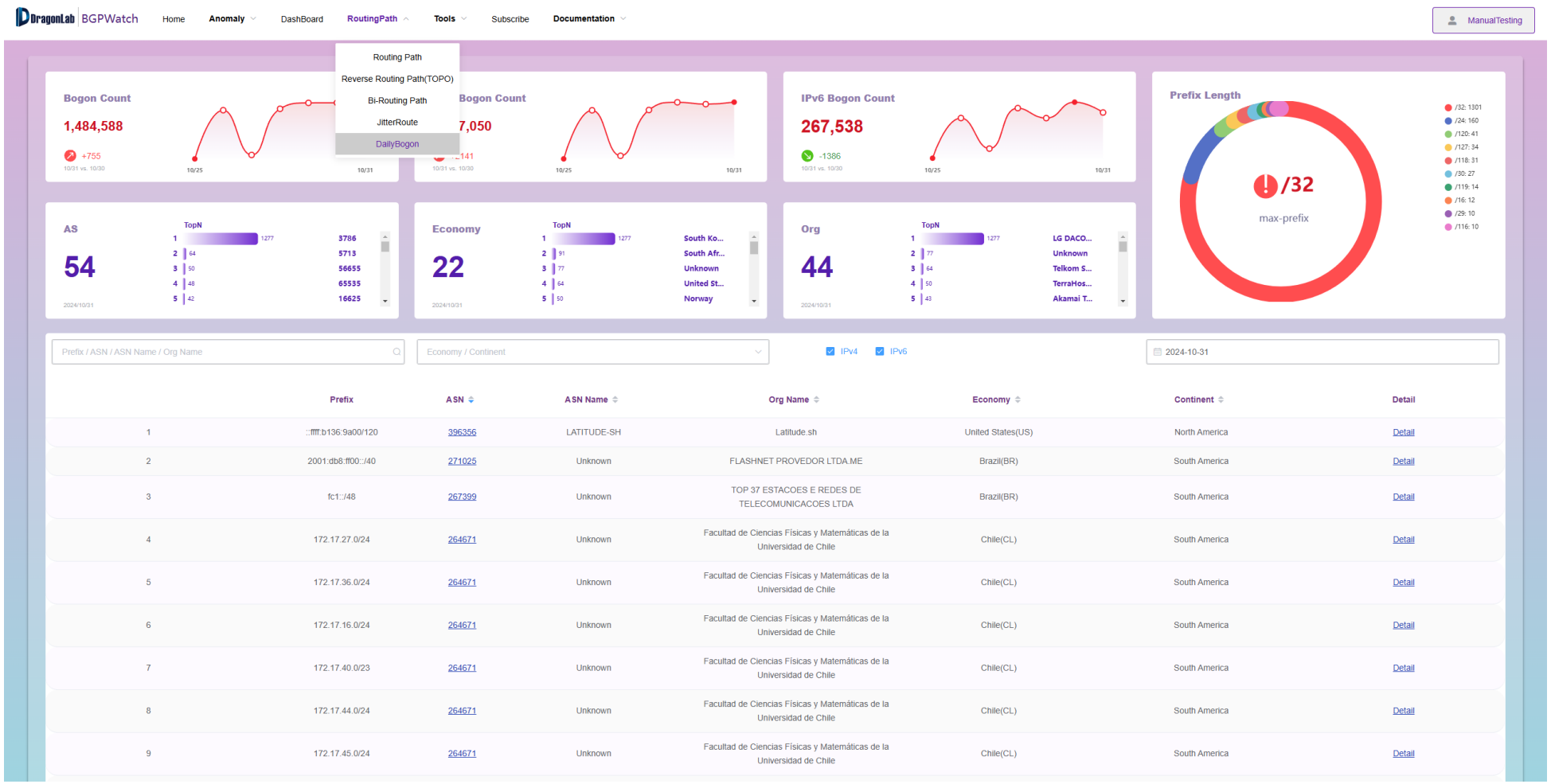
Routing Path – Daily Bogon



Support searching by continent, economy, and ASN

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Future Work Plan

Objectives	Work Plan	Tentative Timeline
Develop an integrated Looking Glass platform	Find obscure Looking Glass VP regularly	Dec. 2023 Done
	Develop integrated Looking Glass platform	Feb. 2024 Done
	Develop Looking Glass API	Mar. 2024 Done
Use Looking Glass to further check routing hijacking at the data plan	Develop data plan detection method and decision algorithm	June 2024 Done
	Integrate the algorithm to the system	Aug. 2024 Done
Implement path hijacking detection and routing leak detection methods	Develop path hijacking detection method	Nov. 2024 Done
	Develop routing leak detection method	Jan. 2025
Continue to maintain and fix bugs in the BGPWatch platform	Continually test and get suggestions from user	Throughout the entire project duration
Continue community development and engagement, and international collaboration	The second phase of the project (**Dec.06, 2023 – June 06, 2025 (18 months))** **Welcome new partners to join!**	Throughout the entire project duration

Continue to Secure New Funds

- Two topics are considered:
  - Source Address Validation deployment measurement
  - Achieving realistic routing policy through multiple resources

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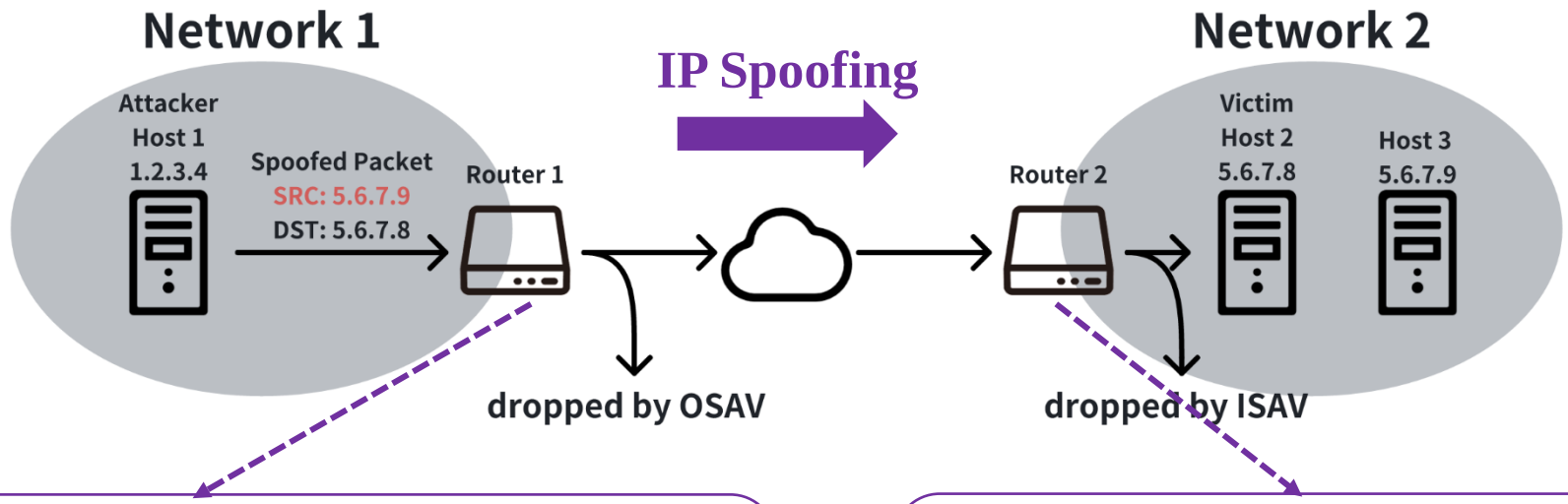
Source Address Validation (SAV)

- **IP spoofing**: Use fake source address for attack
- **SAV**:
  - Filter spoofed packets
  - Defined in RFC 2827 (BCP 38) and RFC 3704 (BCP 84)

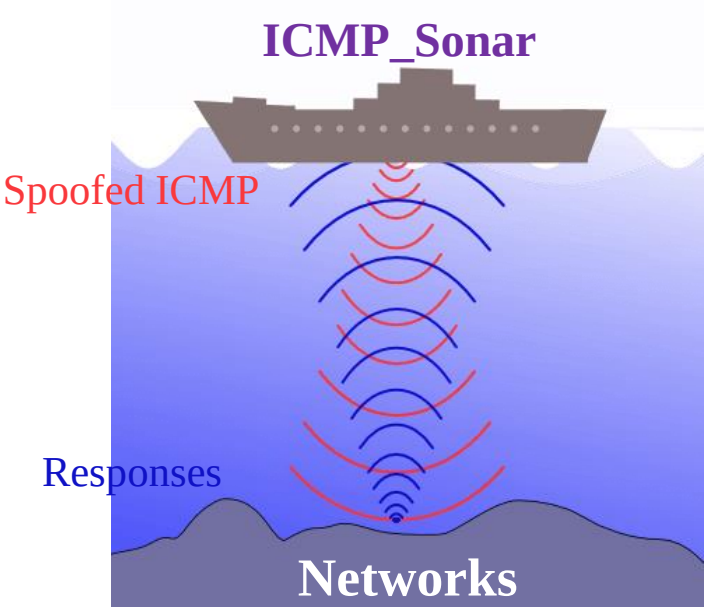


- **OSAV**:
  - Filter outbound packets
  - Block the source of an attack

- **ISAV**:
  - Filter inbound packets
  - Protect victims

ISAV Deployment Measurement

- Two novel methods
  - **ICMP unreachable method**
  - **ICMP fragmentation method**
- **Goal**: Send "**Rumors**" to find the "**Wise**"



Spoofed ICMP Messages

Networks with ISAV

ICMP unreachable method

- Supported by a wider range of target operating systems

ICMP fragmentation method

- Does not require an open TCP port of the target

Complementary

Rumors Stop with the Wise: Unveiling Inbound SAV Deployment through Spoofed ICMP Messages, IMC2024

ISAV Detection Results

IP Version	Level	No ISAV	ISAV	Partial ISAV	Sum
IPv4	AS	23,700	6,509	28,682	58,891
	Subnet /24	1,406,663	1,161,444	959,344	3,527,451
IPv6	AS	4,518	1,115	2,731	8,364
	Subnet /40	12,775	6,062	5,886	24,723

- About **60% IPv4 ASes** and **46% IPv6 ASes** have deployed (or partially deployed) ISAV, much higher than previously reported.
- Widely distributed targets help capture deployment status more accurately.

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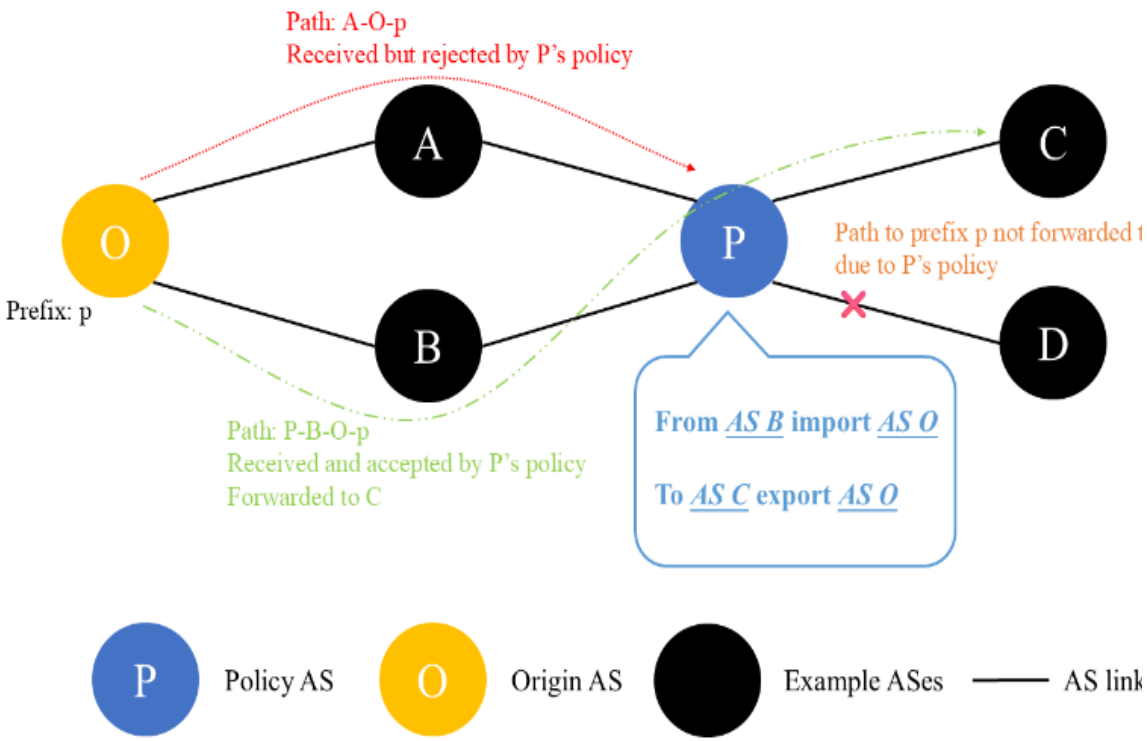
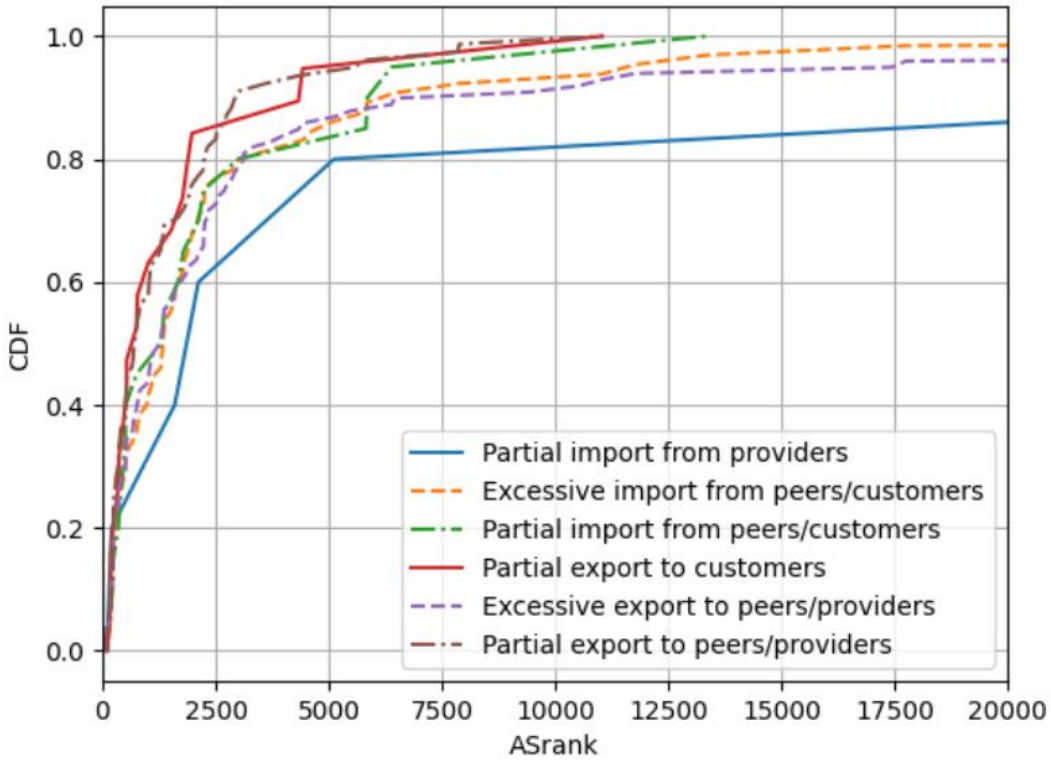
Achieving Realistic Routing Policy through Multiple Resources



Example of routing policy



CDF of ASes with different routing policy

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Comments / Suggestions?

Contact us at:

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