BGP Security: Update from Yandex

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Yandex: BGP Security Status

- Prefixes are signed with ROA!
- ROA invalids are rejected;
- Route hijacks are monitored with BMP + ROA;
- Route leaks are monitored with BMP + ASPA;

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Wait, what is ASPA?

Autonomous System Provider Authorization

ASPA

- customer_asn – signer
- provider_asns – authorized to send routes to upper providers or peers
- AFI – IPv4 or IPv6

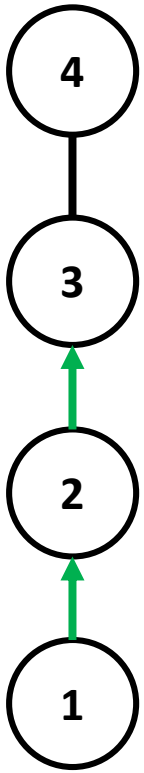
ASPA Pair Verification

1. Retrieve all cryptographically valid ASPAs in a selected AFI with a customer value of AS1. This selection forms the set of **candidate ASPAs**.
2. If the set of **candidate ASPAs** is empty, then the procedure exits with an outcome of **unknown**.
3. If there is at least one candidate ASPA where the provider field is AS2, then the procedure exits with an outcome of **valid**.
4. Otherwise, the procedure exits with an outcome of **invalid**.

Terms

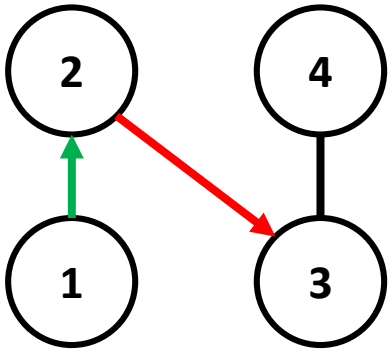
- Line goes up – route is announced from customer to provider;
- Line goes down – route is announced from provider to customer;
- Line goes straight – route is announced from peer to peer;
- The arrow shows the order of the ASPA check, not the route advertisement!

Route Received from Customer



(1, 2), (2,3) are **Valid**

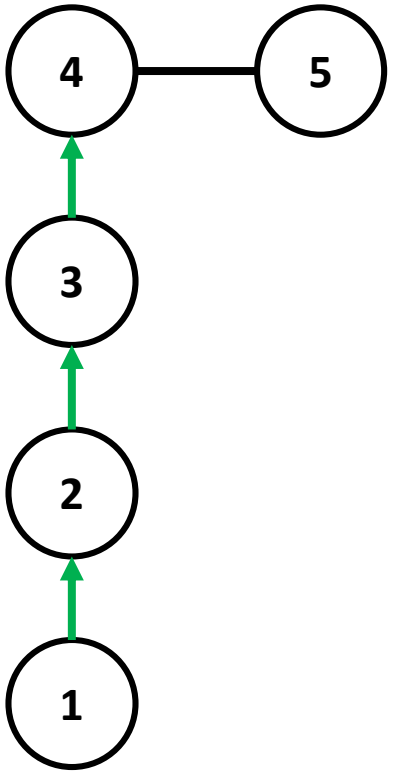
The path is **Valid**



(1, 2) is Valid, (2, 3) is **Invalid**

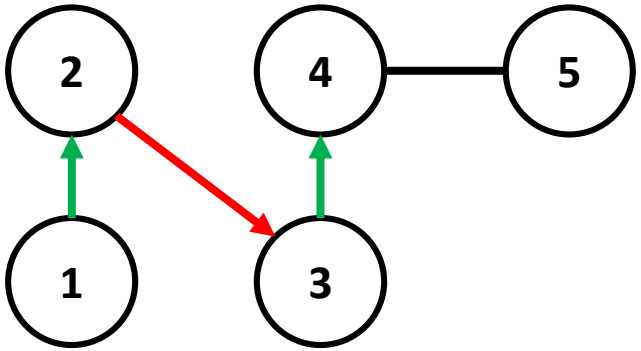
The path is **Invalid**

Route Received from Peer



(1, 2), (2,3), (3,4) are **Valid**

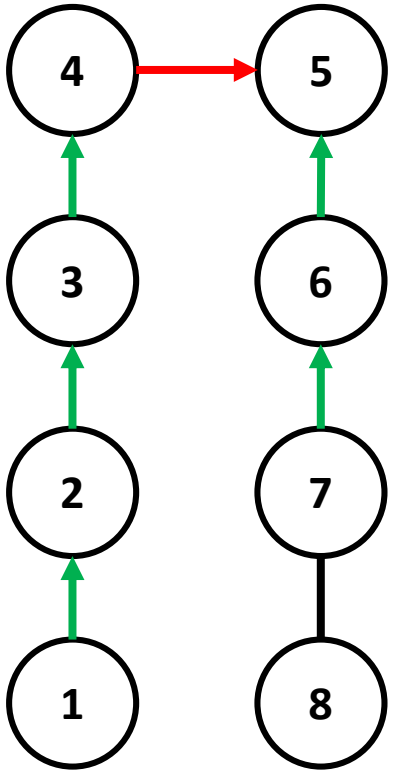
The path is **Valid**



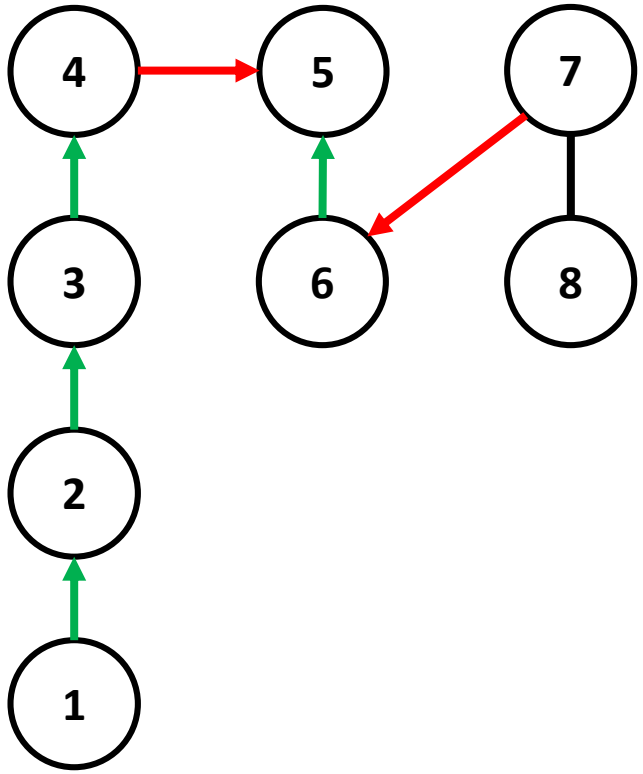
(1, 2) is Valid, (2, 3) is **Invalid**

The path is **Invalid**

Route Received from Provider



(1, 2), (2,3), (3,4) are **Valid**
(4,5) is **Invalid**, but it's **OK!**
(6,5), (7,6) are **Valid**
The path is **Valid**



(1, 2), (2,3), (3,4) are **Valid**
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(6,5) is **Valid**, (7,6) is **Invalid**
The path is **Invalid**

We Need Your Contribution

AS_PATH verification procedure:

draft-ietf-sidrops-aspa-verification

ASPA profile:

draft-ietf-sidrops-aspa-profile

ASPA

ASPA Verification Can be Used to:

- filter **mistake** route leaks from customers, peers and providers;

ASPA Verification + ROA Validation Can be Used to :

- filter **mistake** and **malicious** hijacks;
- filter **mistake** and **malicious** route leaks;

In reality:

- It already works!

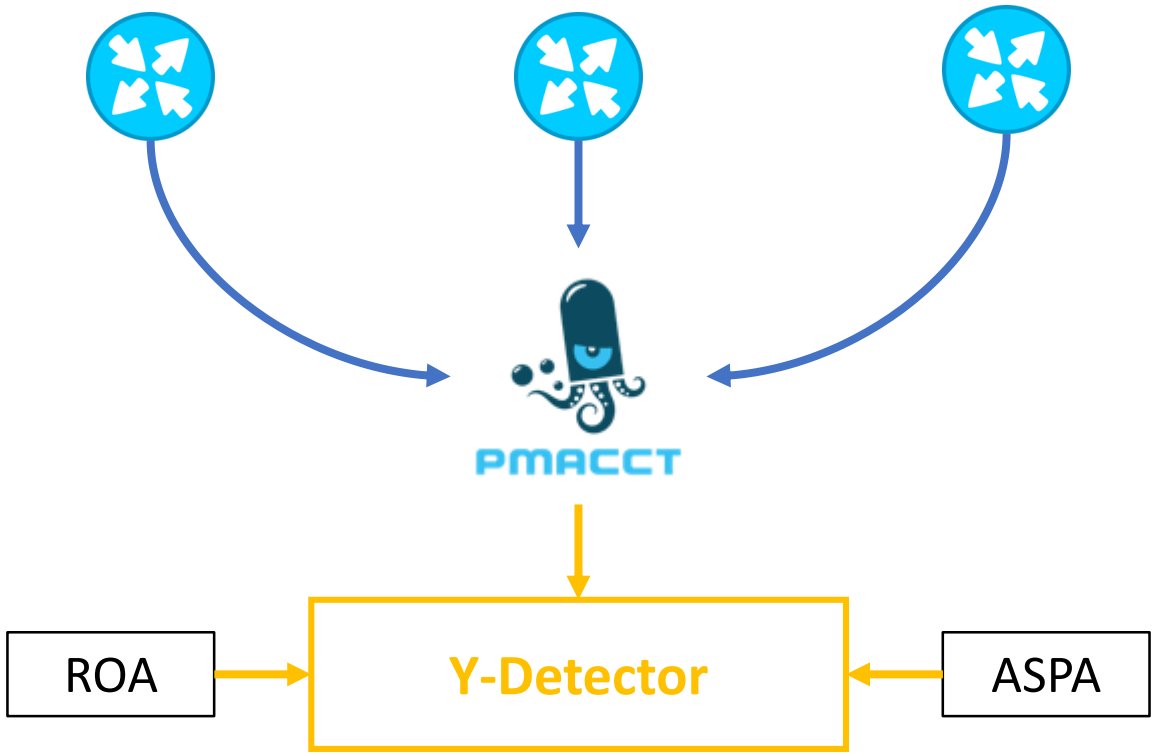
How It Works: NTT Peering Lock

- Uses AS Path regular expression;
- Uses known default free networks;
- Uses known customer-provider pairs;
- Detects leaks from customers and peers.

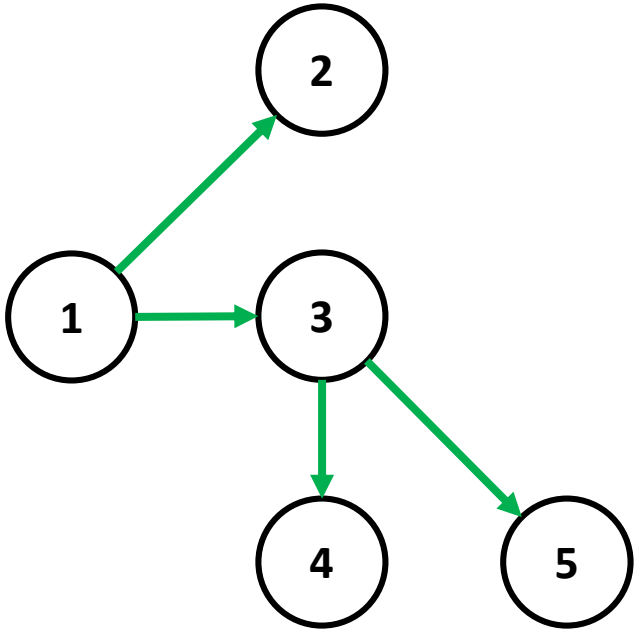
```
$bignetwork ASN anywhere in the AS_PATH. H

ip as-path access-list 99 permit \

_(174|209|286|701|1239|1299 \

|2828|2914|3257|3320|3356 \

|3549|5511|6453|6461|6762 \

|7018|12956)_

route-map ebgp-customer-in deny 1

match as-path 99
```

How It Works: Yandex BMP Monitor

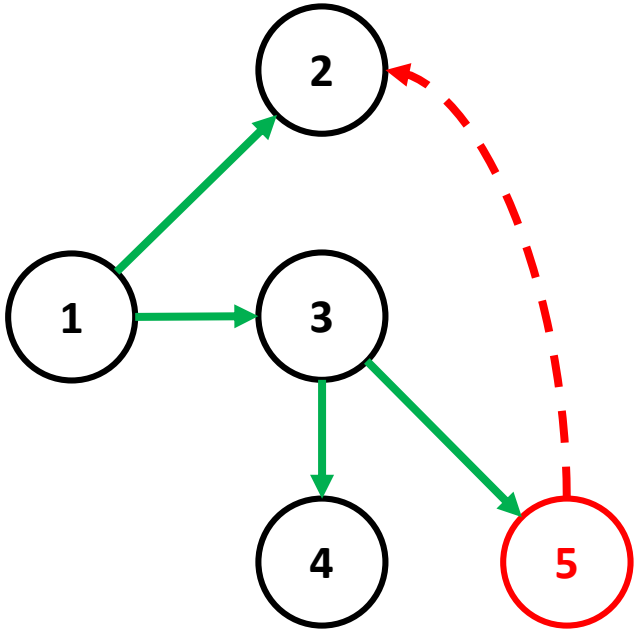
- Uses BMP as a source (pmacct);
- Uses known default free networks;
- Uses known customer-provider pairs;
- Full support of ASPA algos: capable to detect leaks from all directions;
- Can detect anomalies for Yandex itself!



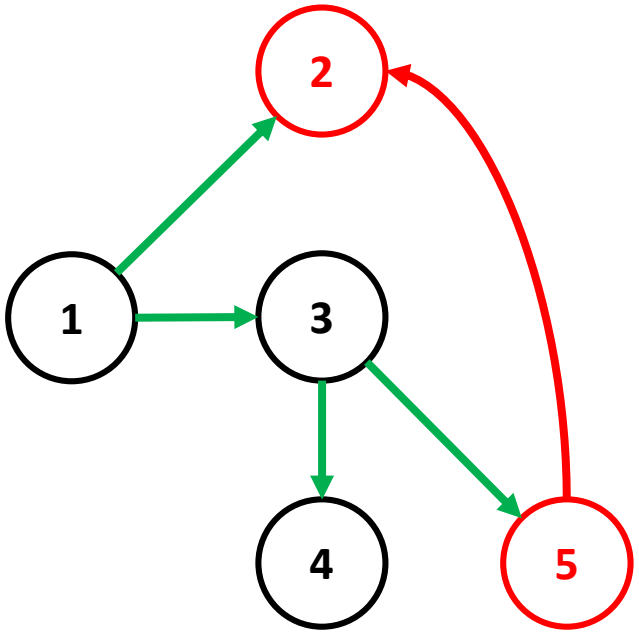
No Leaks – Good Leaks



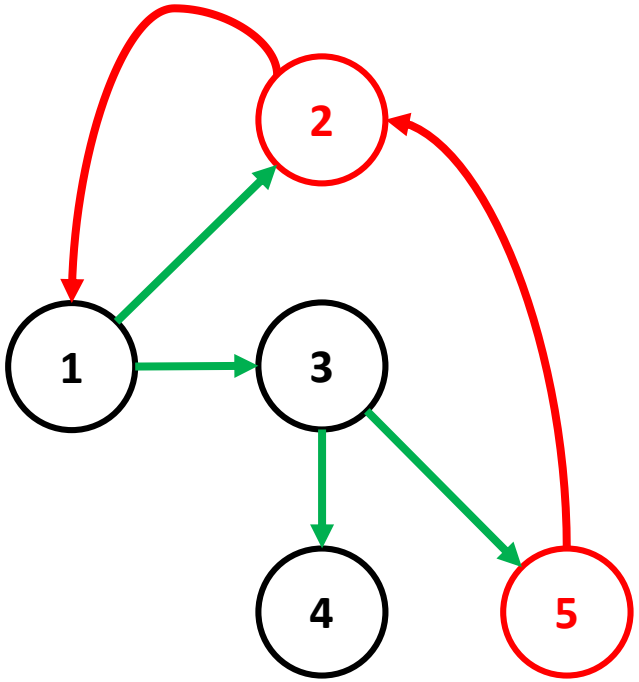
Not Propagated Leaks – Good Leaks

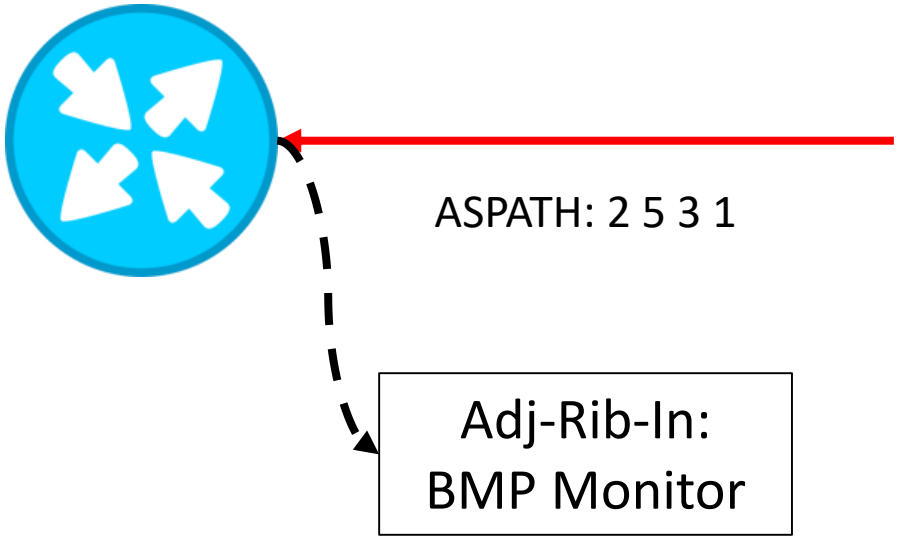


Propagating Leaks – Detection is Needed



Y-Detector: Key Idea





If your neighbor accepts leaked/hijacked prefix, it will send it to you.

It will send you your own address space too!

How Many ASPA Records Do You Need?

<=50

50..100

>100

How Many ASPA Records Do You Need?

36

Proof of Concept

	CRIT	bmp_monitor_4_Leaks prefix: 213.180.202.0/24, peer_ip: 38.122.63.37, aspath: 174 31133 13238
14h	CRIT	bmp_monitor_4_Leaks prefix: 213.180.202.0/24, peer_ip: 149.11.124.73, aspath: 174 31133 13238
14h	CRIT	bmp_monitor_4_Leaks prefix: 213.180.202.0/24, peer_ip: 185.70.202.152, aspath: 6762 174 31133 13238
14h	CRIT	bmp_monitor_4_Leaks prefix: 213.180.202.0/24, peer_ip: 213.242.69.249, aspath: 3356 174 31133 13238
14h	CRIT	bmp_monitor_4_Leaks prefix: 213.180.202.0/24, peer_ip: 213.248.90.186, aspath: 1299 174 31133 13238
14h	CRIT	bmp_monitor_4_Leaks prefix: 213.180.202.0/24, peer_ip: 4.14.97.241, aspath: 3356 174 31133 13238
14h	CRIT	bmp_monitor_4_Leaks prefix: 213.180.202.0/24, peer_ip: 62.115.54.165, aspath: 1299 174 31133 13238
14h	CRIT	bmp_monitor_4_Leaks prefix: 213.180.202.0/24, peer_ip: 87.245.248.8, aspath: 9002 3356 174 31133 13238

Processing: ASPA Check

Prefix: 213.180.202.0/24

ASPATH: **3356** 174 31133 13238

Type: **Downstream path**

Processing: ASPA Check

Prefix: 213.180.202.0/24

ASPATH: 3356 174 **31133 13238**

Type: Downstream path

ASPA(13238, 31133) = **Invalid**

Processing: ASPA Check

Prefix: 213.180.202.0/24

ASPATH: 3356 **174 31133** 13238

Type: Downstream path

ASPA(13238, 31133) = Invalid

ASPA(174, 31133) = **Invalid**

Yandex: BGP Security Status & Plans

- Prefixes are signed with ROA!
- ROA invalids are rejected;
- Route hijacks are monitored with BMP + ROA;
- Route leaks are monitored with BMP + ASPA;
- ASPA invalids are rejected – 2021Q2;