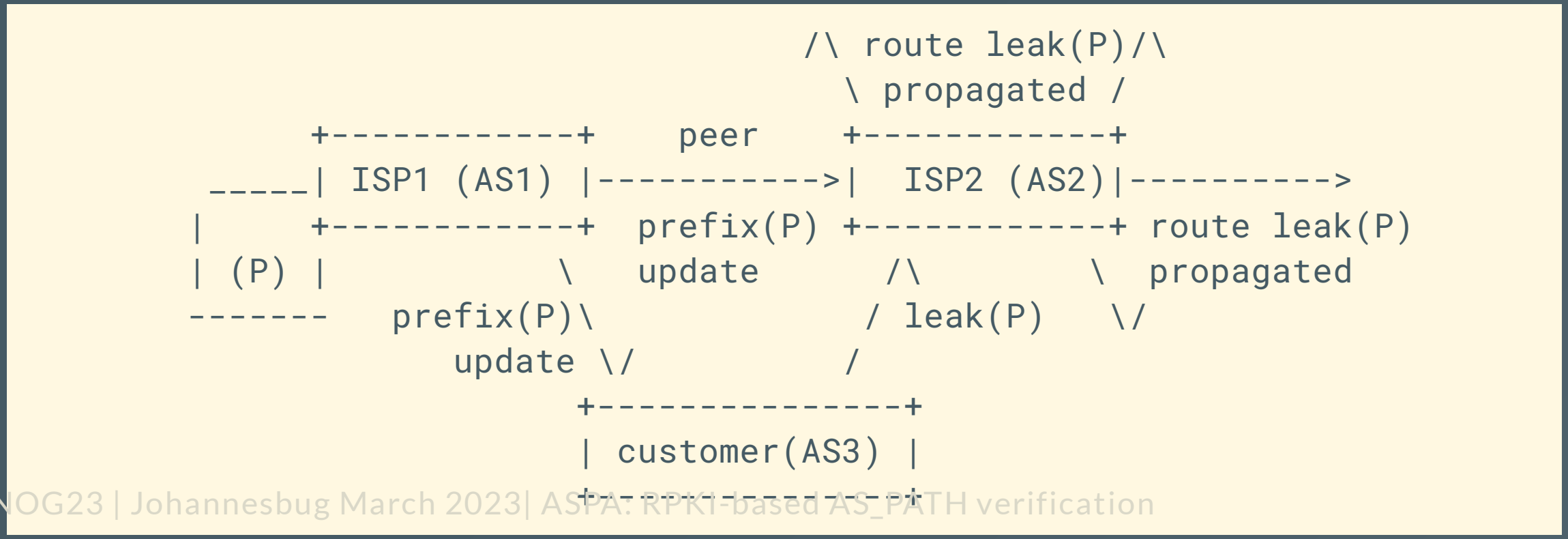
ASPA: RPKI-based AS_PATH verification

Ben Maddison
benm@workonline.africa

Background: BGP route leaks

“ A route leak is the propagation of routing announcement(s) beyond their intended scope - RFC7908 ”



Who gets to decide on "intended scope"?

- Prefix owner?
- Downstream AS?
- Upstream AS?
- Routing police?

Who gets to decide on "intended scope"? (cont.)

- Intuitively, a route has been leaked when no-one is paying the transit AS.
- Formalised in the "valley-free" model

Who gets to decide on "intended scope"? (cont..)

An observed `AS_PATH` is in agreement with intended routing policy when for each transit AS, either:

- the transit AS is authorised by the *sending* AS to announce the path upstream to non-customers; or
- the transit AS is authorised by the *receiving* AS to announce to it all the paths received from non-customers

ASPA RPKI signed object

- Authorisation by a *Customer AS (CAS)* of a *Set of Provider ASes (SPAS)*
- Based on RFC6488 object template
- CAS holder signs
- RP validates, aggregates, and sends to BGP speaker via RTR protocol

Object `eContent`

High level structure:

```
ASProviderAttestation ::= SEQUENCE {
     version [0]   INTEGER DEFAULT 0,
     customerASID  ASID,
     providers     ProviderASSet }

ProviderASSet ::= SEQUENCE (SIZE(1..MAX)) OF ProviderAS

ProviderAS ::= SEQUENCE {
     providerASID  ASID,
     afiLimit      AddressFamilyIdentifier OPTIONAL }
```

Object `eContent` - `version`

Familiar version construct. Nothing to see here.

```
version                 [0] INTEGER DEFAULT 0,
```

Object `eContent` - `customerASID`

AS number of the network providing and signing the authorisation.

Encoded as 32-bit integer.

```
customerASID        ASID,
```

Object `eContent` - `ProviderASSet`

- **Non-empty** set of authorised provider ASes
- No distinction between up/downstream authorisation
- `AS0` used to signal "transit-free"
- `afiLimit` used to limit authorisation to a single address family

```
ProviderASSet ::= SEQUENCE (SIZE(1..MAX)) OF ProviderAS

ProviderAS ::= SEQUENCE {
     providerASID  ASID,
     afiLimit      AddressFamilyIdentifier OPTIONAL }
```

ASPA object processing

- ASPA objects are produced by RPKI CAs
  draft-ietf-sidrops-aspa-profile
- RPKI-RTR is (usually) how the data gets to the router
  draft-ietf-sidrops-8210bis
- ASPA verification algorithm operates on the data contained in the RTR payload (aka **VAP**).
  draft-ietf-sidrops-aspa-verification

BGP Route Processing

Each BGP path gets an `AS_PATH` verification state:

- **Valid**: all transit ASes appearing in the `AS_PATH` were verified by ASPA data
- **Invalid**: at least one transit AS in the `AS_PATH` is acting in contravention of its neighbors' ASPA authorisations
- **Unknown**: insufficient ASPA data exists to arrive at either Valid or Invalid

BGP Route Processing (cont.)

`draft-ietf-sidrops-aspa-verification-12` defines two algorithms:

1. **Algorithm for Upstream Paths**
   For paths received from non-transits (customers, peers, etc).
   The entire `AS_PATH` is expected to contain only *customer-to-provider* adjacencies

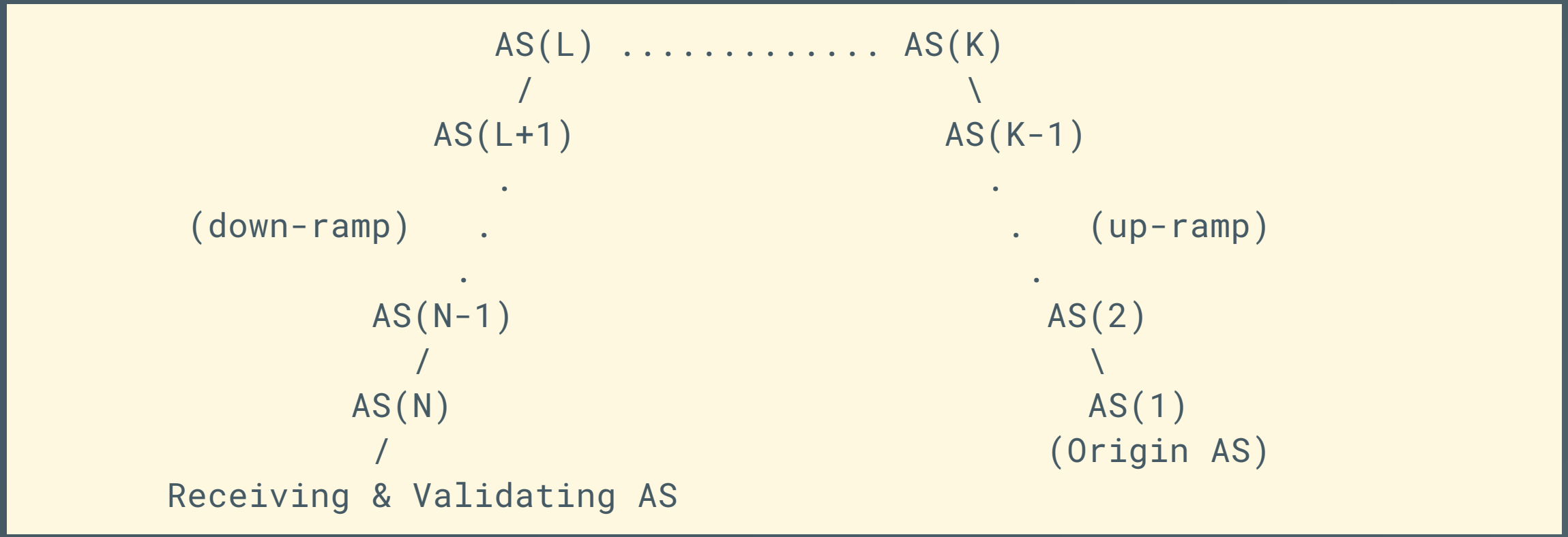
BGP Route Processing (cont..)

`draft-ietf-sidrops-aspa-verification-12` defines two algorithms:

2. **Algorithm for Downstream Paths**
   For paths received from transits.
   The `AS_PATH` is expected to contain:
   - An **up-ramp** of *customer-to-provider* adjacencies
   - A **down-ramp** of *provider-to-customer* adjacencies

BGP Route Processing (cont...)

Up-ramp / down-ramp visualisation



Alternatives?

- IRR data does not contain the necessary policy information (no `transit-via` in `autnum`)
- Peerlock has similar semantics, however:
  - No crypto (in general)
  - Highly manual
  - Requires bug-free `AS_PATH` regex ;-)
- BGPsec solves a different problem - truthfulness of `AS_PATH`, not verification of routing policy

Benefits

- Minimal topology information required: no public assertions about who your peers or customers are
- Far-end verification: leaks are detectable several hops away from the leak
- Orthogonal to other RPKI use cases: semantics of other objects don't change
- Correct granularity: policy is described at the AS level, no sessions or prefixes

Current Status - IETF

- draft-ietf-sidrops-aspa-profile and draft-ietf-sidrops-aspa-verification currently in WGLC.
  - Object profile is ~done.
  - Verification draft needs a revision
- draft-ietf-sidrops-8210bis awaiting RFC publication

Please review!

Current Status - Implementations

- CA implementations - Krill
- RP implementations - `rpki-client`, Routinator, RPSTIR2, StayRTR
- Tooling and testing - `rpkimancer`, various others
- BGP speaker implementations - `openbgpd`, NIST BGP-SRx

Still missing commercial NOS vendors

FIN