ANAPAYA

Next-Generation Internet. Reliable. Secure.

SCION AS Numbering Practices

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SCION - Overview

Isolation domains (ISD) – Hierarchical routing + trust scoping

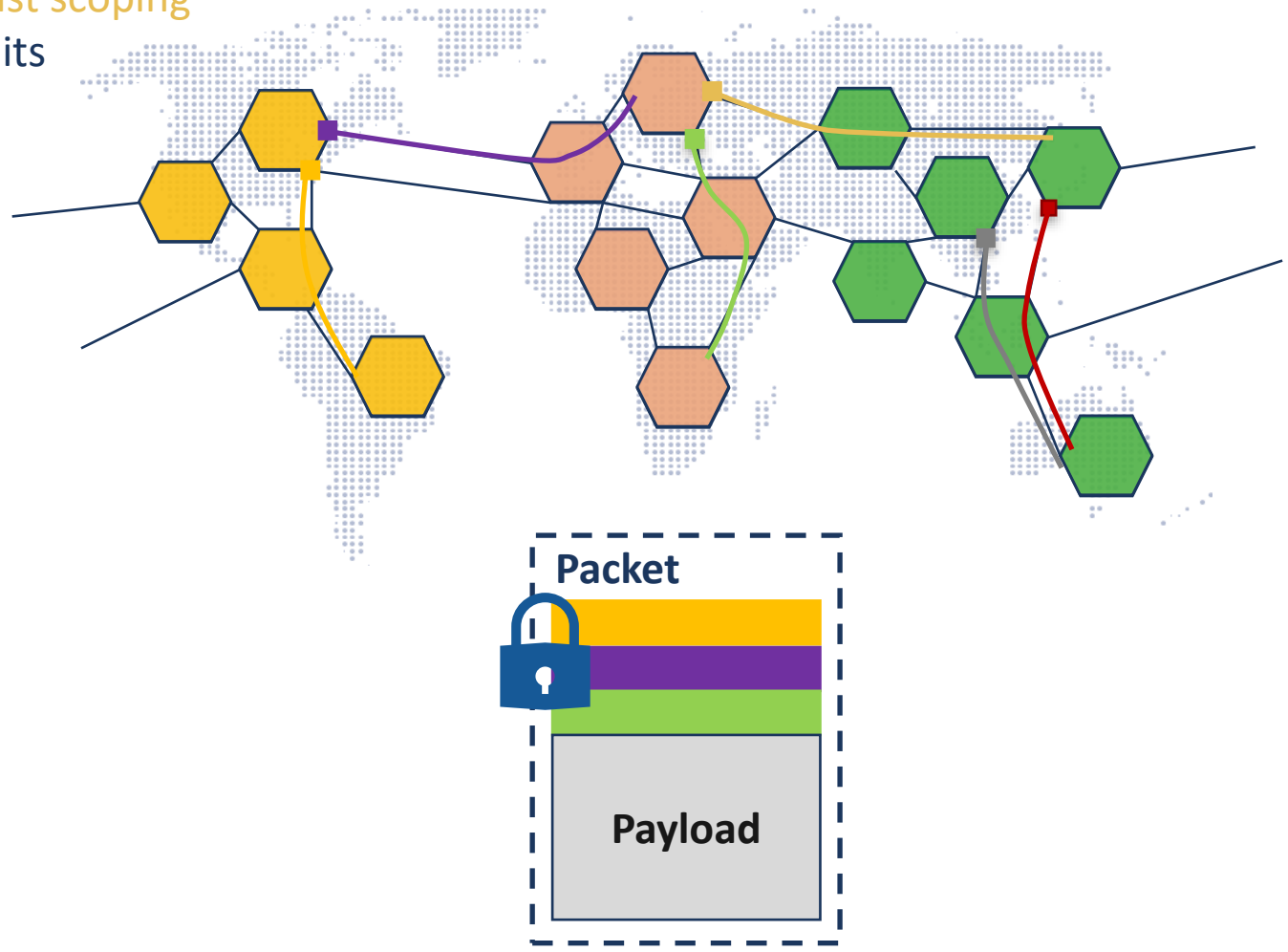
- Group Autonomous Systems (AS) into logical units
- Two levels of routing: intra-ISD and inter-ISD
- Define root of trust for control plane

Control plane – Routing

- Constructs and disseminates path segments
- Two hierarchy levels: intra- and inter-ISD
- Routing is cryptographically secured

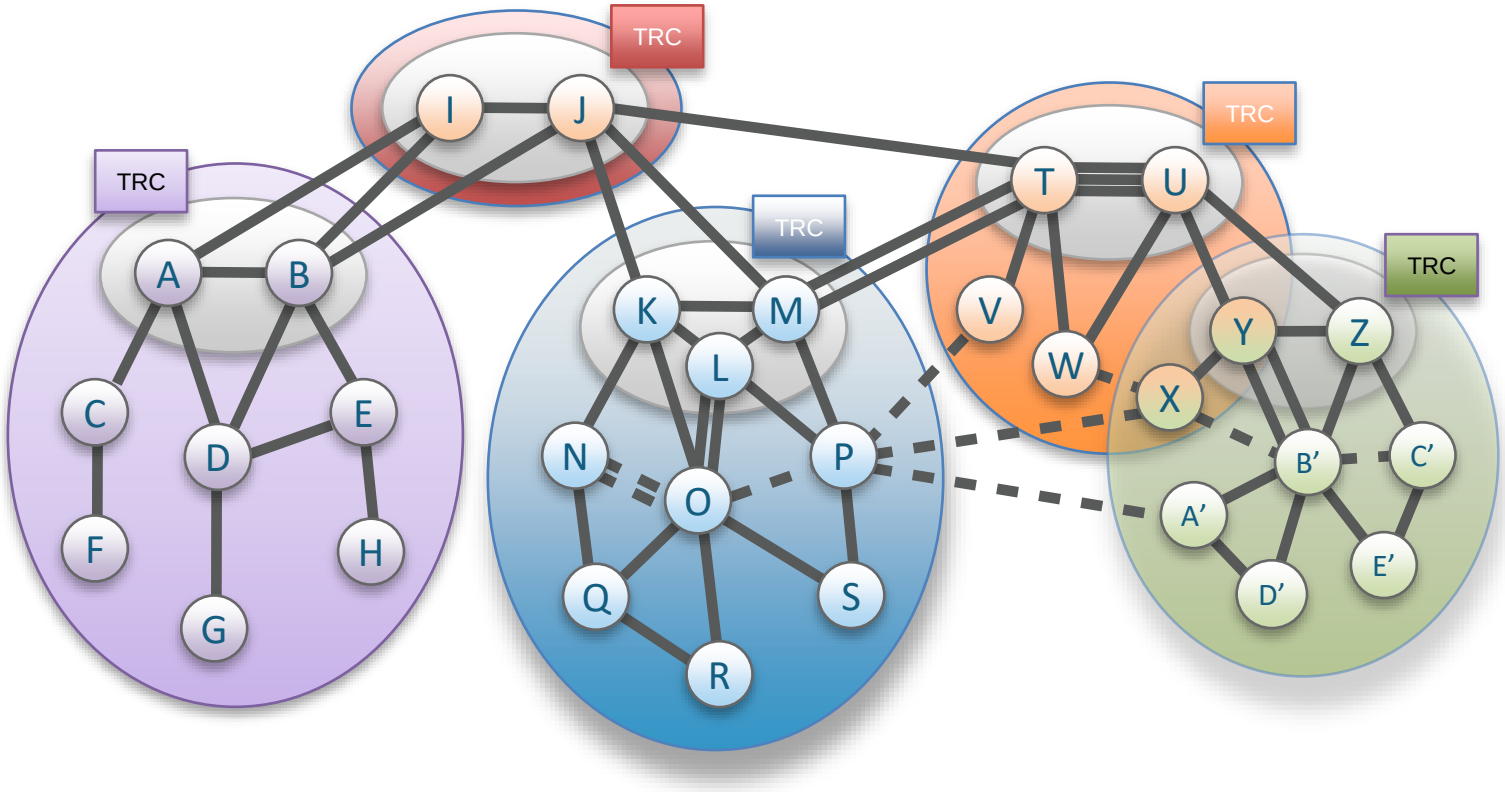
Data plane – Packet Forwarding

- Combine path segments to end-to-end paths
- Data packet contains path and payload
- Forwarding is cryptographically secured
- Router forwards packet along AS path in header
  → Stateless and efficient forwarding



Isolation Domains – Overview

- The SCION network consists of interconnected isolation domains (ISD). An ISD consists of interconnected ASes.
- Each isolation domain defines a trust root configuration (TRC) and a routing hierarchy
- Each AS needs a certificate to be a member of an ISD. This enables access control and policy enforcement for ISDs.
- Isolation Domains are by default per jurisdiction (≅ country), but also industry vertical isolation domains exist, e.g., a banking isolation domain



Numbering Considerations

- Every ISD needs a globally unique number (16-bit namespace)
- AS identities are in principle scoped to Isolation Domains
  - The tuple (ISD Number, AS Number) needs to be unique
  - Current practice is to assign globally unique AS numbers (more on this later)
  - AS numbers use a 48-bit namespace

- There are numbering authorities for the BGP Internet
  - Can they also take a role for numbering in the SCION Internet?
- Need to adapt to a future with (potentially) many more ASes
  - Large BGP ASes might split into multiple SCION ASes
  - SCION makes it easy and useful to be dual-homed, even for micro- and nano-sites
  - Potentially needs another layer of delegation, e.g., “PA AS numbers”

Current Numbering Practices - ISDs

- Anapaya is the global numbering authority
  - We don’t want it!

ISD	Description
0	The wildcard ISD.
1 - 15	Reserved for documentation and sample code [0].
16 - 63	Private Use [1]. They can be used for testing and private deployments.
64 - 4094	Public ISDs. They should be allocated in ascending order, without gaps and "vanity" numbers.
4095 (2^{12}-1)	Reserved.
4096 - 65535	Reserved.

https://github.com/scionproto/scion/wiki/ISD-and-AS-numbering

Current Numbering Practices - ASes

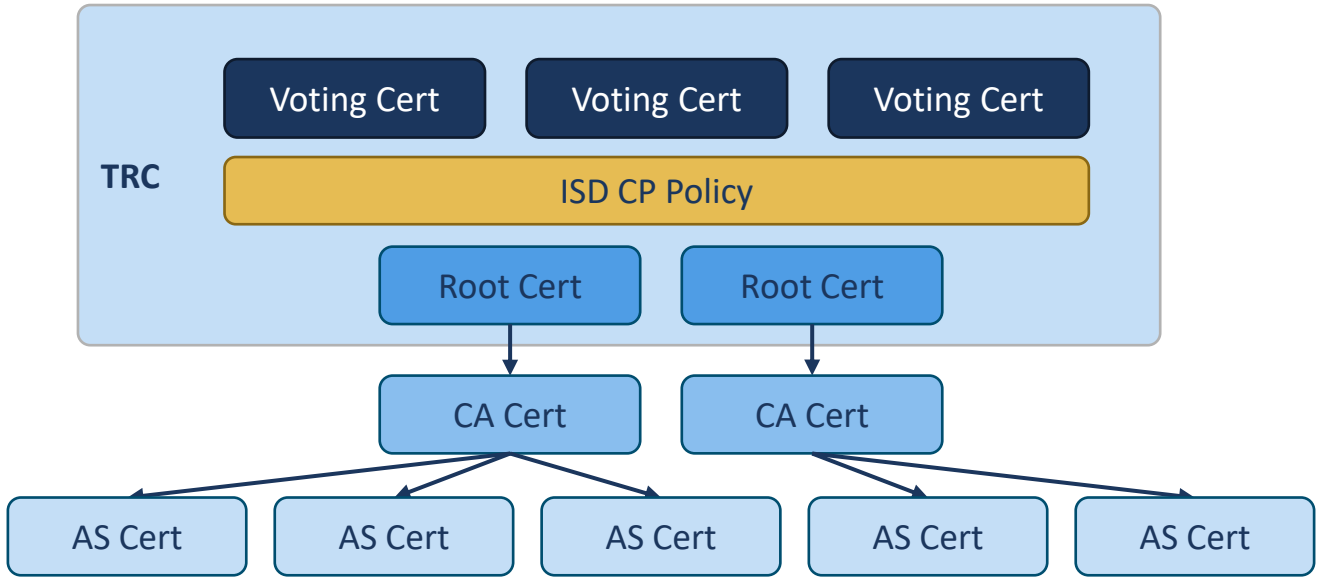
- Anapaya is the global numbering authority
  - We don’t want it!
- Current Practice: AS numbers are globally unique!

AS	Size	Description
0	1	The wildcard AS.
1 - 4294967295 (~ `0:0:0/16`)	~4.3 bil	32-bit BGP AS numbers [2], formatted as decimal. If a BGP AS deploys SCION, it has the same AS number for both BGP and SCION.
`1:0:0`	1	Reserved.
`2:0:0/16`	~4.3 bil	Public SCION-only ASes (i.e. ASes that are created for SCION, and aren’t existing BGP ASes). They should be allocated in ascending order, without gaps and "vanity" numbers.
`ff00:0:0/32`	65535	Reserved for documentation and test/sample code [0].
`ffaa:0:0/24`	~16.8 mil	Reserved for Private Use [1]. They can be used for testing/private deployments.
`ffff:ffff:ffff`	1	Reserved.

https://github.com/scionproto/scion/wiki/ISD-and-AS-numbering

What about Certificates?

- Each AS needs a certificate per ISD to participate in the SCION control plane (signing path information)
- A SCION AS certificate binds a public key to an AS identity, i.e., ISD-AS tuple
- SCION AS Certificates are issued by CAs of ISDs



The SCION Control Plane PKI

Certificate Issuing Considerations

- For ISDs without strict governance Anapaya plays the role of the CA
  - We don’t want it!
- An example of an ISD with strict governance is the Secure Swiss Finance Network (SSFN)
  - Fritz Steinmann will tell you more about their experience as a CA for the SSFN
- Numbering and Certificate Issuance are related
  - A SCION AS Certificate binds the public key to an ISD-AS identity
  - A new AS will need an AS number and an AS certificate per ISD it wants to join
- Today, numbering authorities also play a role in resource attestation (RPKI)
- How could that look like in the SCION Internet?

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