Preventing Route Leaks using a Decentralized Approach: An experimental Evaluation

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Context

Border Gateway Protocol (BGP)

- Routing protocol that **glues** the Internet
- Provides **reachability** and **path selection**

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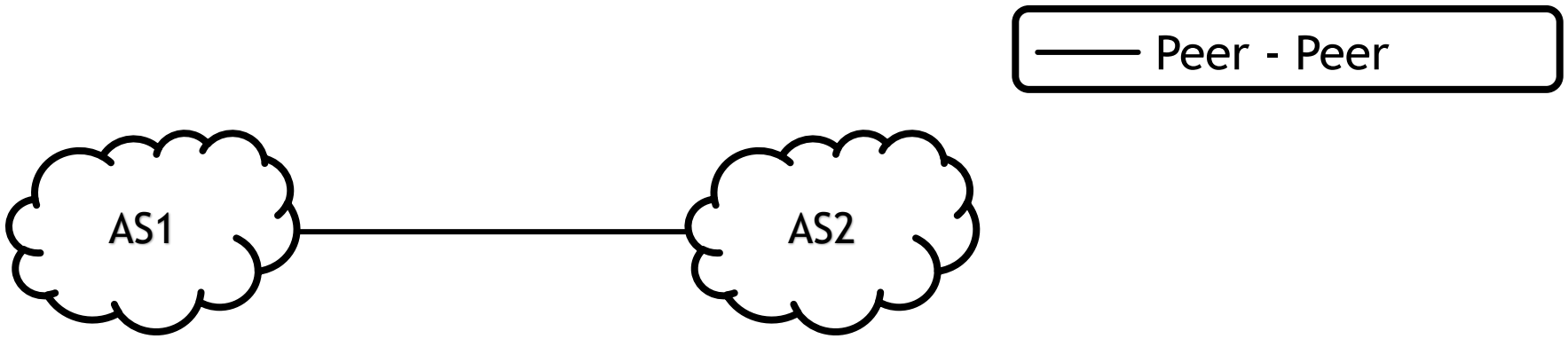
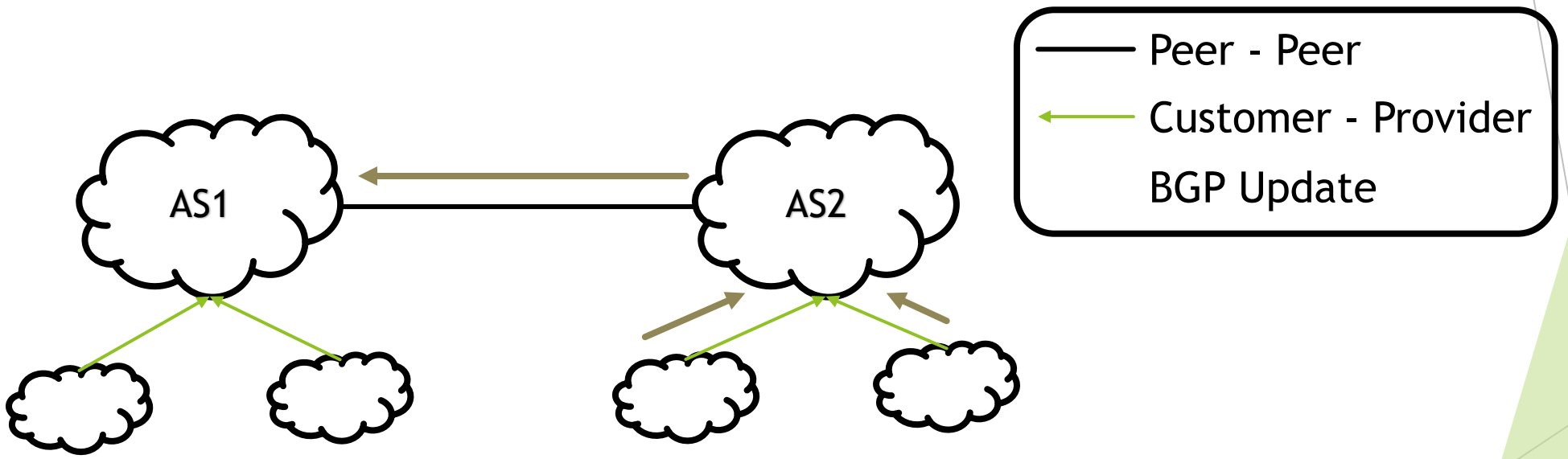
- Routing protocol that **glues** the Internet
- Provides **reachability** and **path selection**
- As the Internet and **business-oriented** Autonomous Systems(AS) began to provide connectivity, the different polices started to be:
  - More **complex**
  - More **rich**
  - More **fine-grained**

Example



Example



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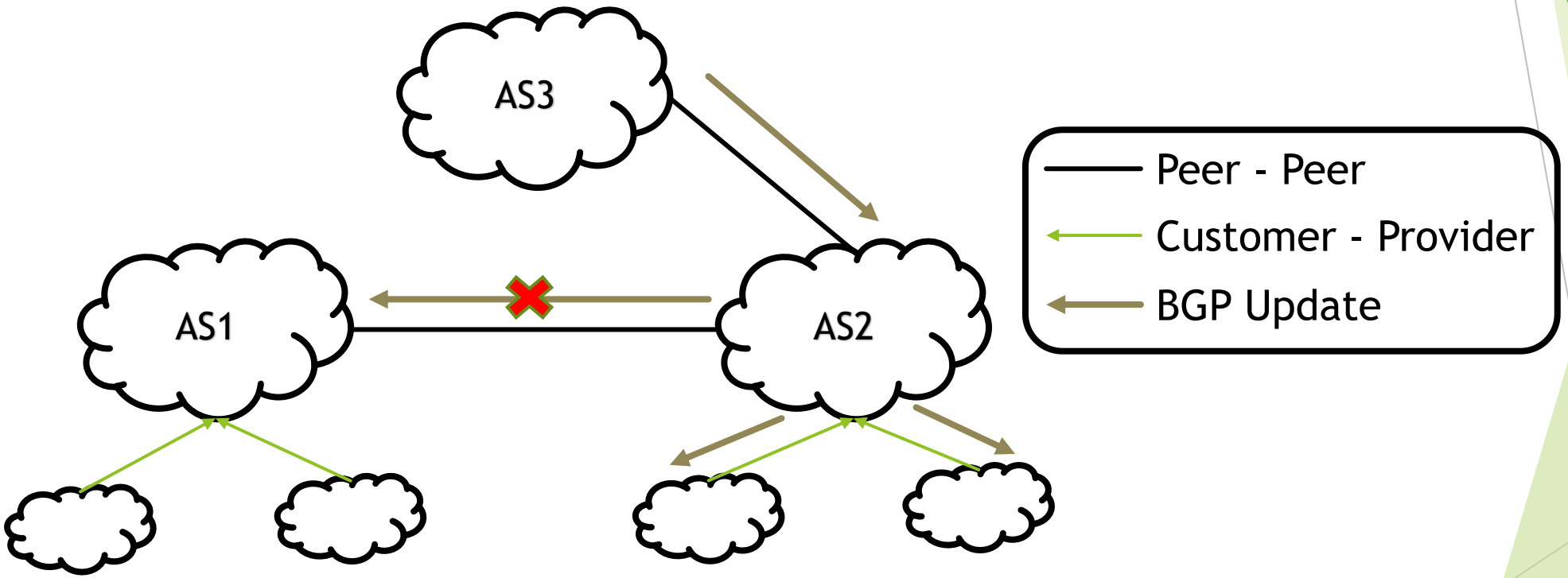


Example

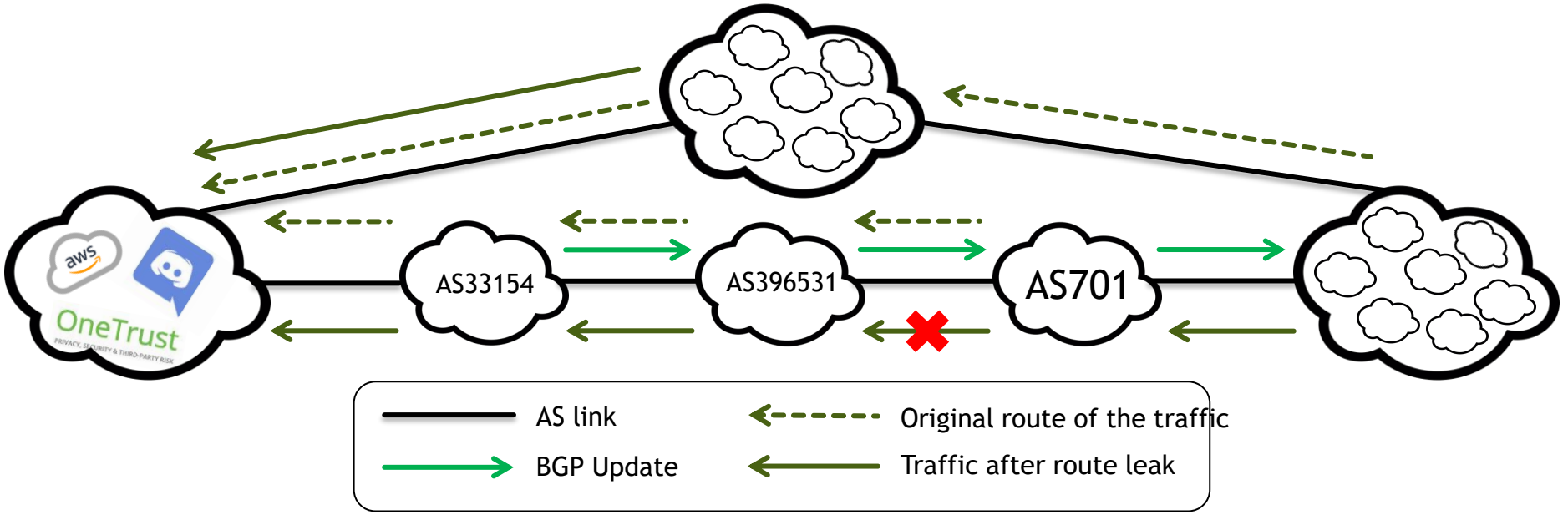
- BGP is based on **trust**
- This protocol is **vulnerable** to a different number of **security threads**
- An important BGP security threat are **Route Leaks**

Route Leaks

Route Leaks

- Route leaks occur when one AS **violates** the routing policies agreed with another AS
- This policies are based according to the **business relationship** between them
- This violations can lead to:
  - Traffic redirection, traffic loss, traffic hijacking, prefix blackholding…

Route Leaks


aws
OneTrust
AS33154
AS396531
AS701
AS link
BGP Update
Original route of the traffic
Traffic after route leak

Route Leaks

- Route leaks are a **simple** problem but **hard** to fix:
  - BGP protocol lacks of cryptographic-based security mechanisms
  - Inter-domain routing lacks a standard mechanism to communicate routing policy

BGP Communities

- **Transitive attribute** attached to BGP messages
- Used for **tagging** routes and for **modifying** BGP routing decisions
- Can be **added**, **removed**, or **modified** as the message travels from AS to AS
- Represent an important **attack vector**

Proposed Solution

Architecture

- Take **advantage of BGP communities** to address the challenges of route leaks
- Propose an architecture that provides a **formal definition** of routing policy
- **Secure mechanism** to communicate it to participating ASes (**Block-chain based**)

Formal language

- Contains 5 parameters:
  - **ASN**: AS number
  - **CN**: Community number
  - **Rule**: The policy to be applied (e.g., LOCALPREFERENCE, PREPEND…)
  - **Value** (optional): It normally defines the quantity of a given effect.
  - **To:** what the rule refers to.

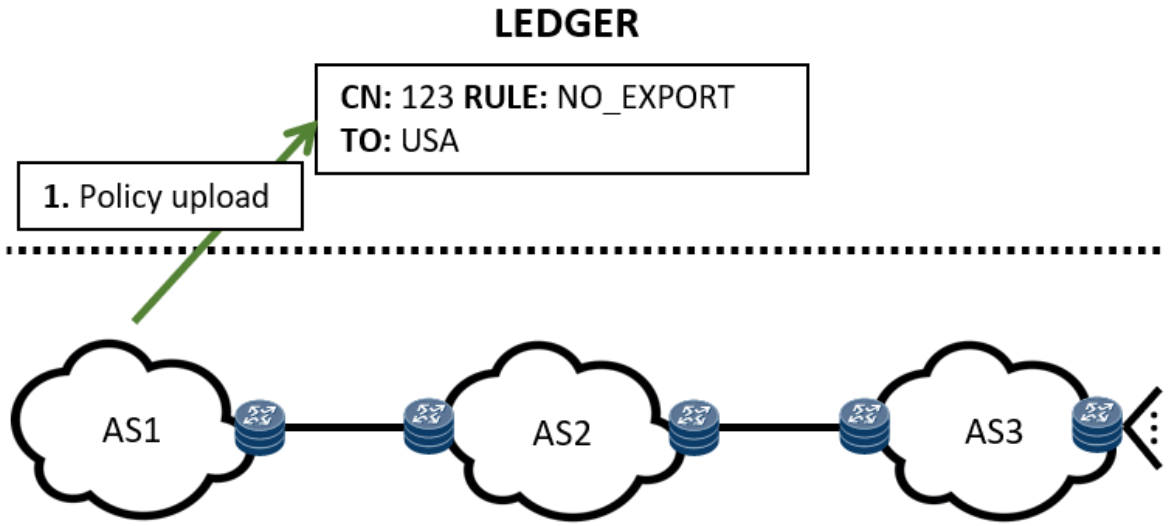
Distributed ledger

- Set of requirements:
  - **Authentication**
  - **Permissioned**
  - **Privacy and confidentiality**

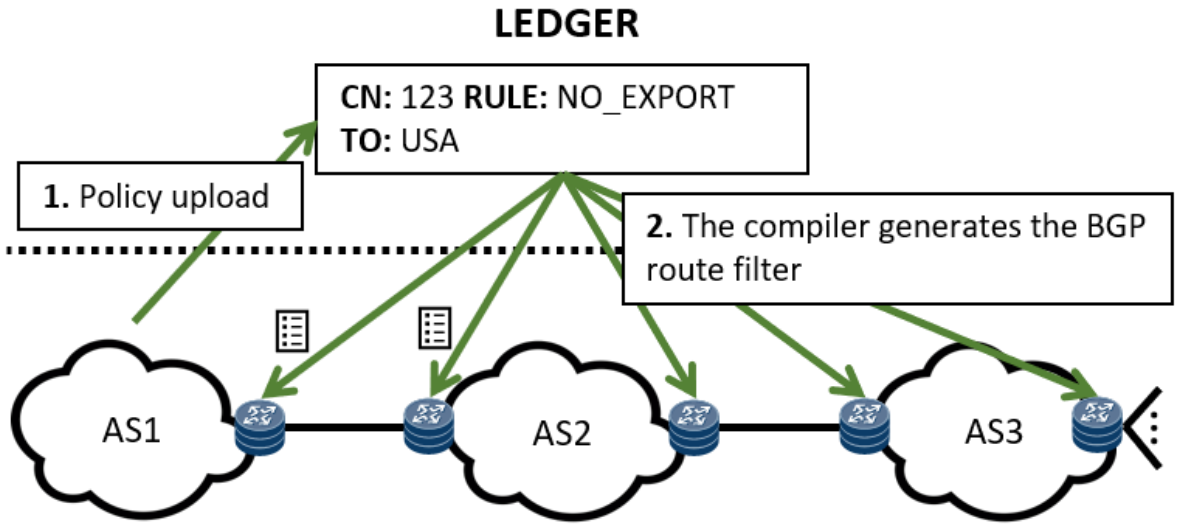
How the policies are uploaded to the Distributed Ledger?

- **Execute** a transaction and verify its **correctness**
- Order transactions via a **consensus protocol**
- **Validate** a transaction against a specific **endorsement policy** before committing them to the ledger

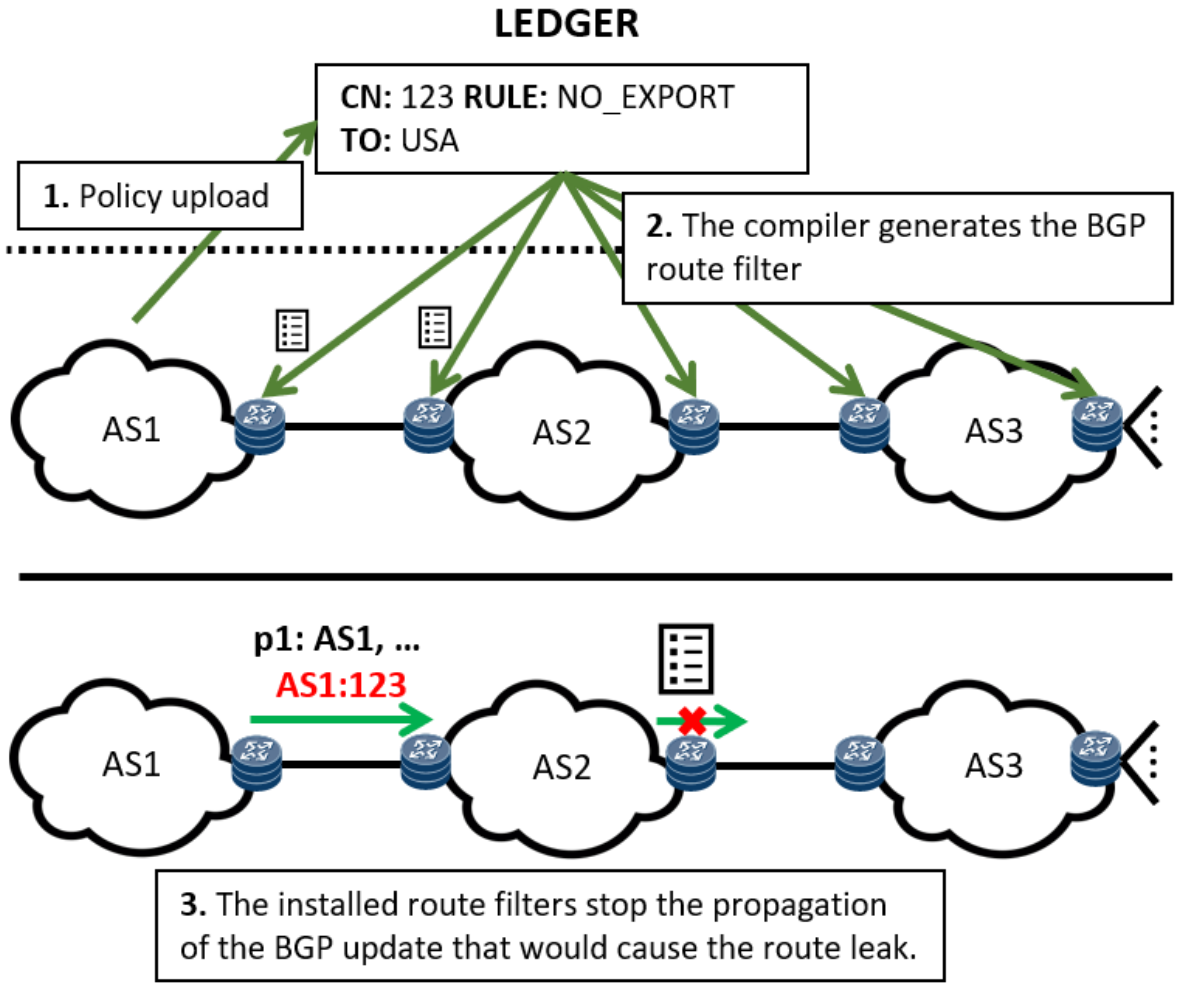
Architecture



Architecture



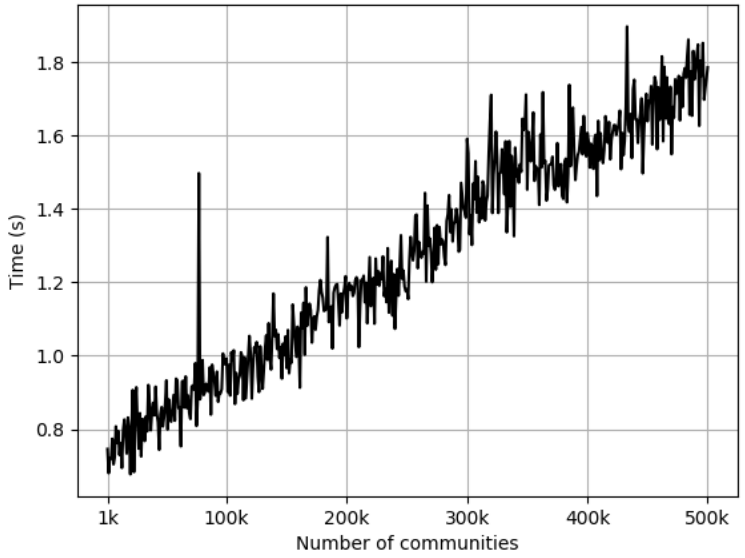
Architecture

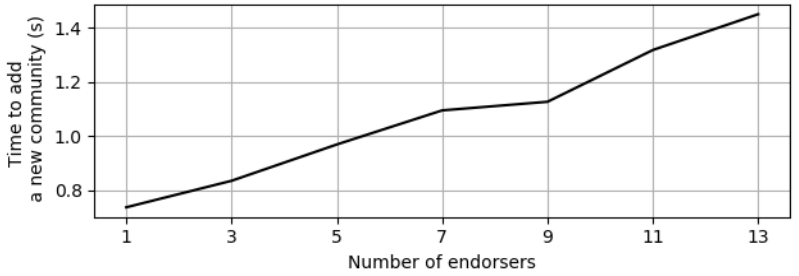


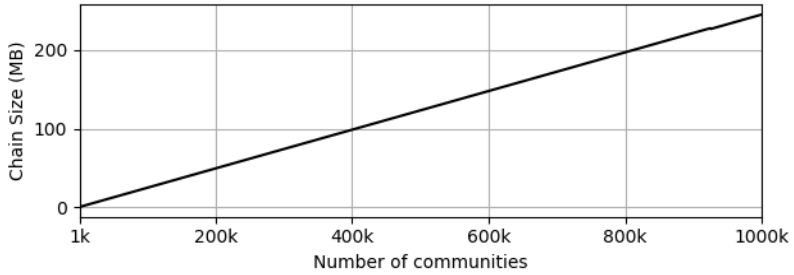
Experimental Evaluation

Prototyping the Distributed Ledger

How scalable is the ledger?



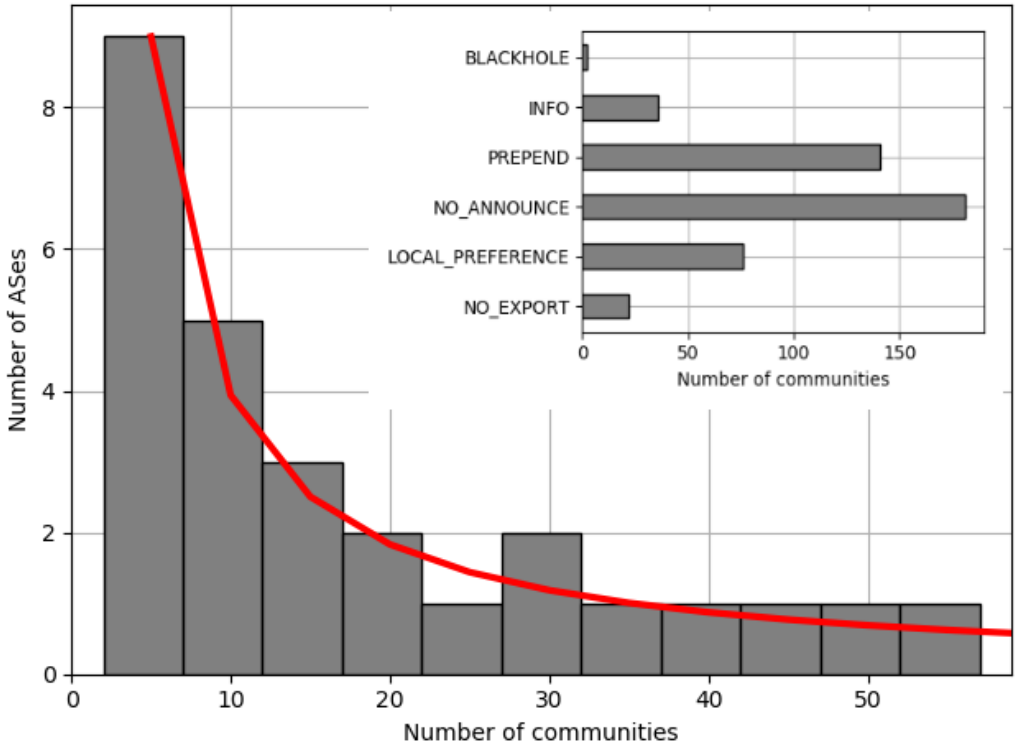




Variable 1	Variable 2	Relationship
Chain size	Number of communities	Linear
Time to add a new community	Number of endorsers	Linear
Compiling time	Number of communities	Linear

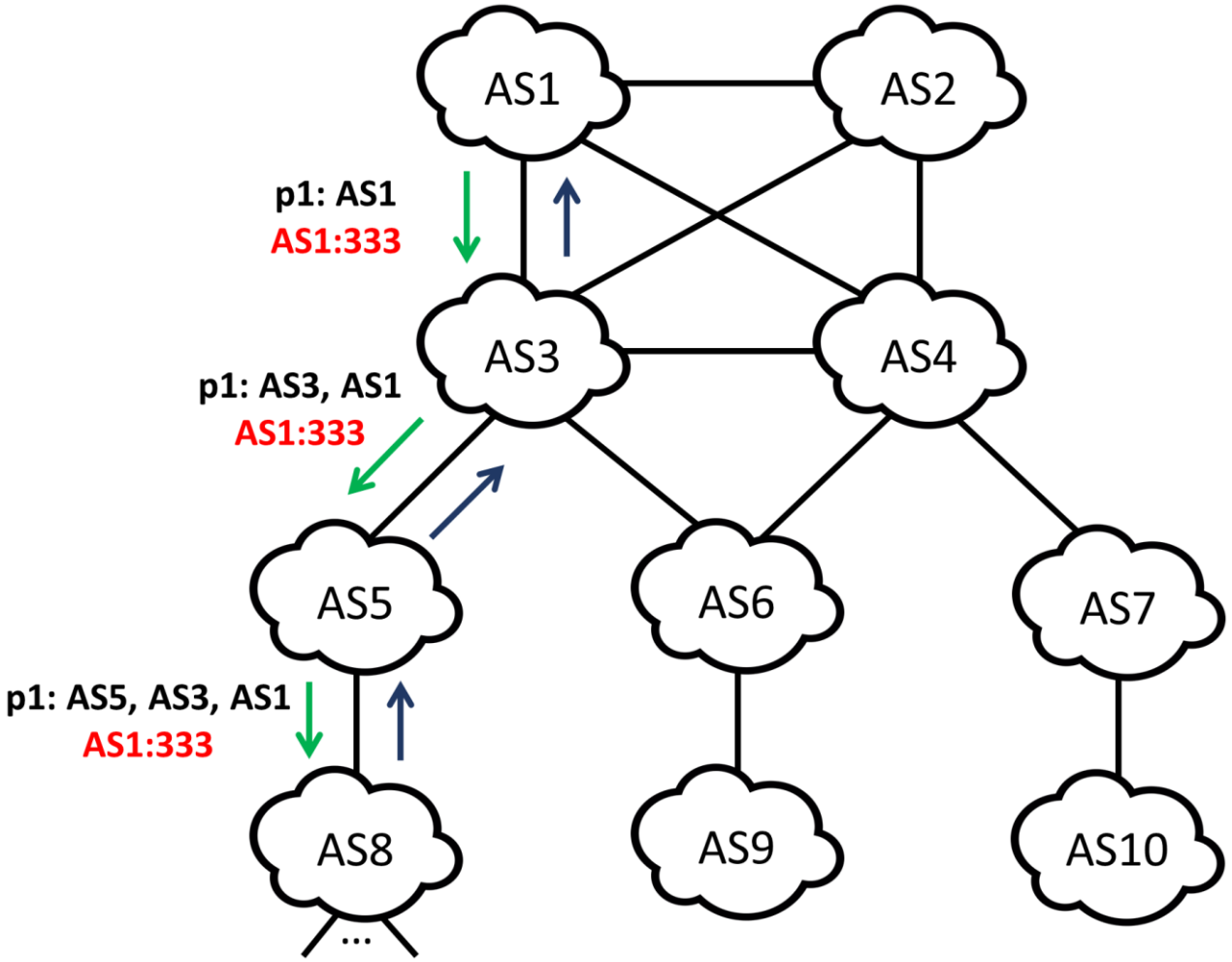
Preventing Route Leaks in a Realistic Topology

Dataset

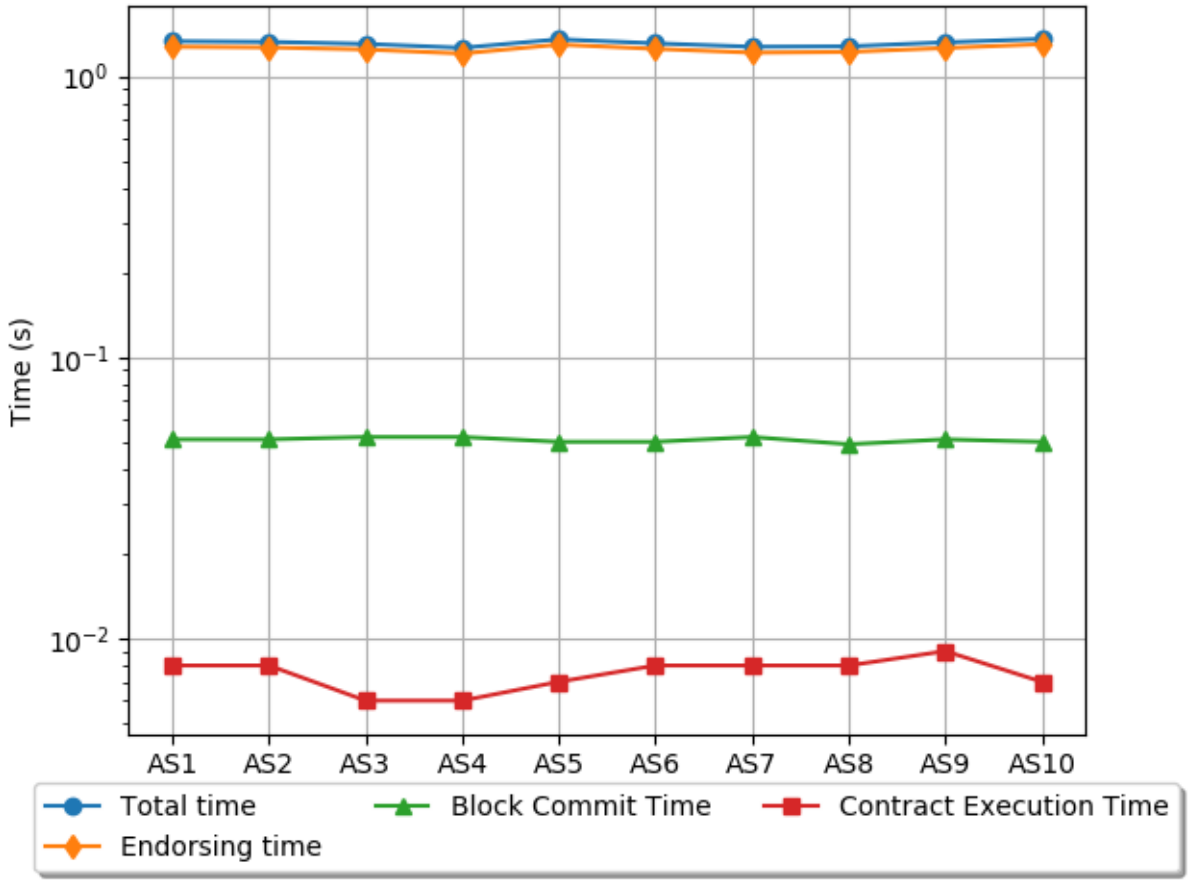


- 27 Ases
- 458 BGP Communities
- Transformed to the formal language

Real Topology



Experimental Results



Conclusions

- Open-source[1] prototype of **a blockchain-based solution** to prevent route leaks
- **Scales linearly** with respect to relevant metrics and that introduces **negligible** delay
- Prototype in a **real-world scenario** by preventing a route-leak in a 10 ASes topology

[1] https://github.com/MiquelFerriol/SecuringBGP

Thank you for watching