Secure Sovereign Connectivity with SCION

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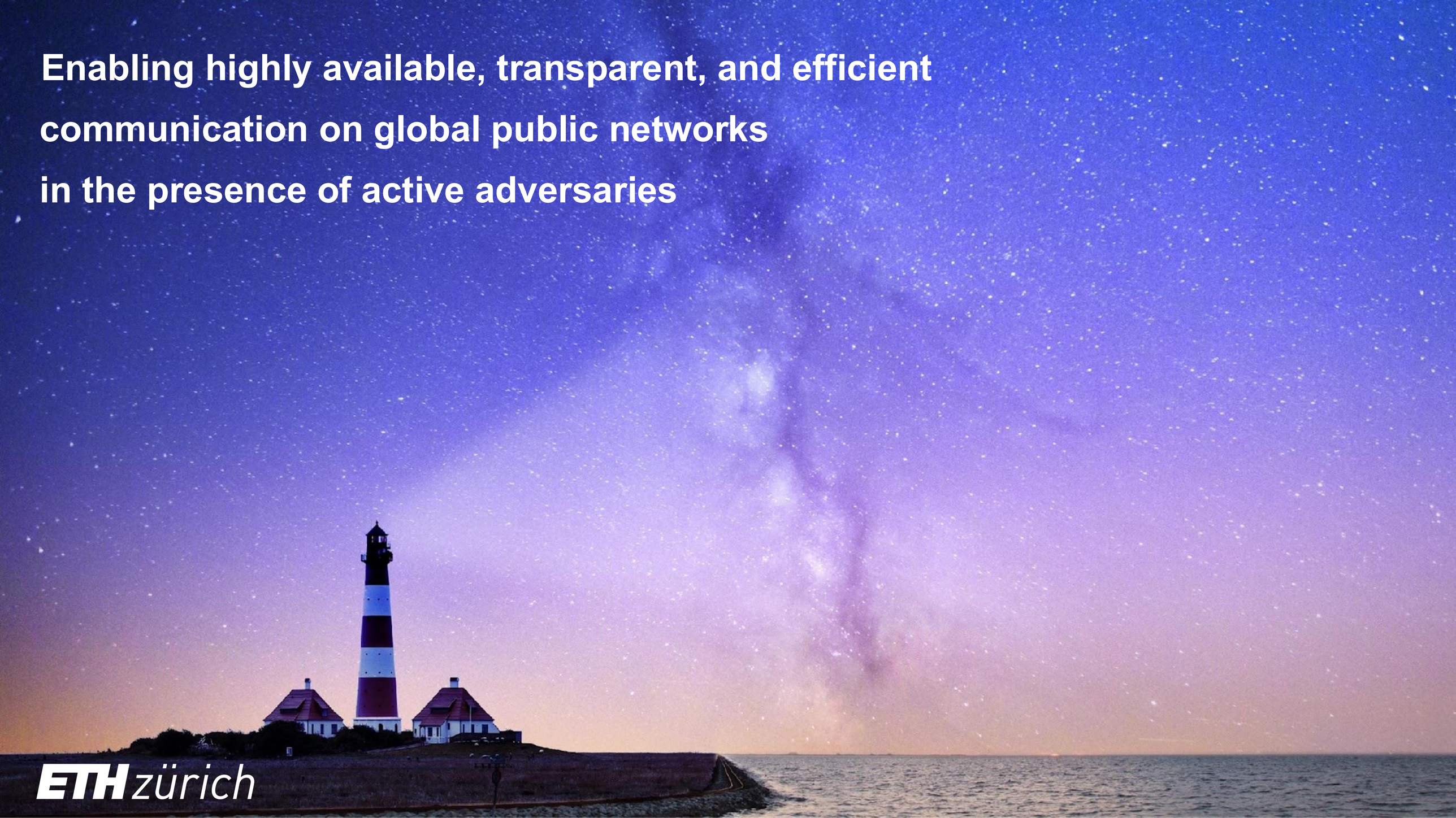
SCION

Enabling highly available, transparent, and efficient communication on global public networks in the presence of active adversaries



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SCION Overview in One Slide

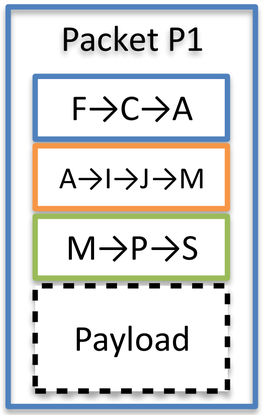
Path-based Network Architecture

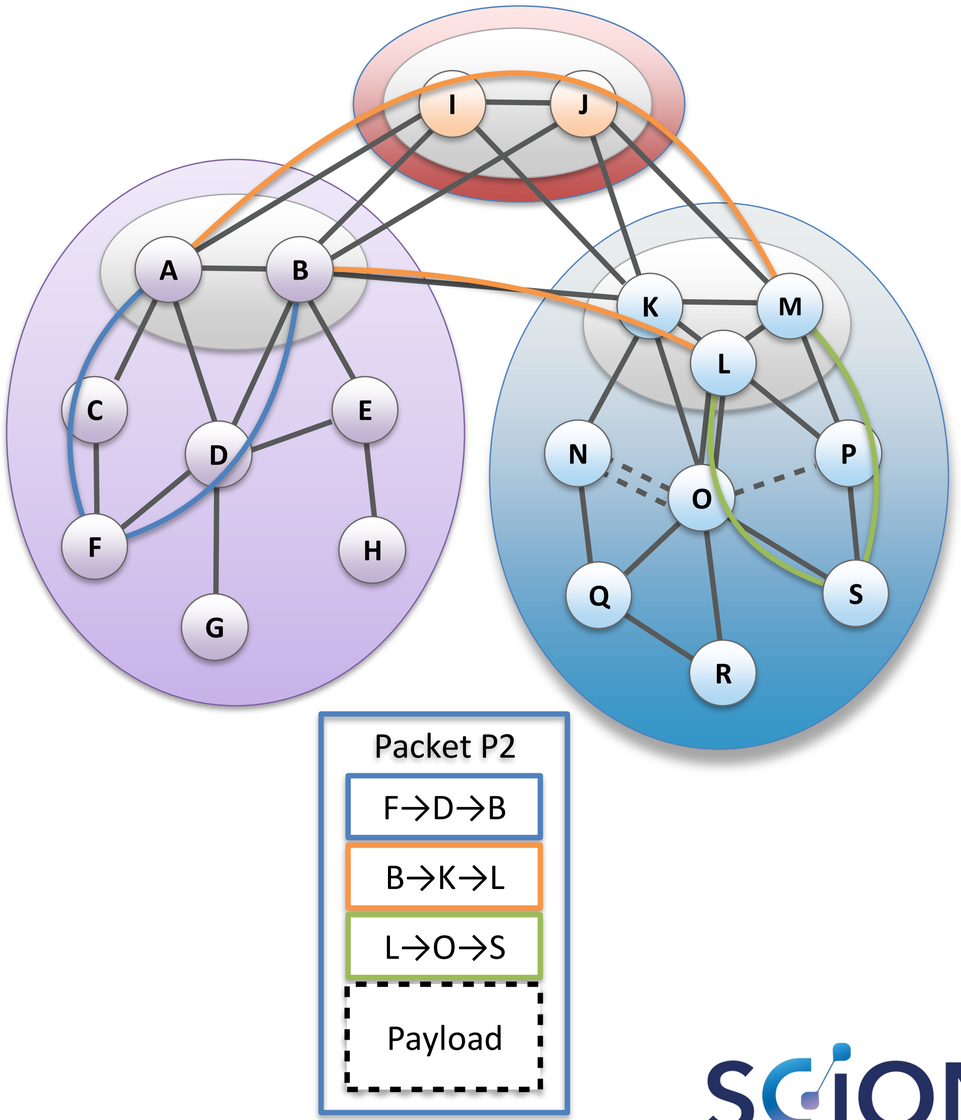
Control Plane - Routing

- Constructs and Disseminates Path Segments

Data Plane - Packet forwarding

- Combine Path Segments to Path
- Packets contain Path
- Routers forward packets based on Path
  - Simple routers, stateless operation





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Benefits of a SCION Connection

Sovereignty: Local definition of trust roots. Local protected connectivity

Security: Authenticated control plane prevent routing attacks & path hijacks

Stability: Native multipath capability at the network level with rapid path failover ensures high stability despite link failures at the physical layer

Control: Path-awareness for end hosts enables application-specific path control and optimization

E.g., possibility for traffic geofencing determined by the sender

Protection: Hidden paths and sender-based path selection protect against DDoS attacks

Performance: SCION applications can select the best paths based on latency, bandwidth, loss, or jitter

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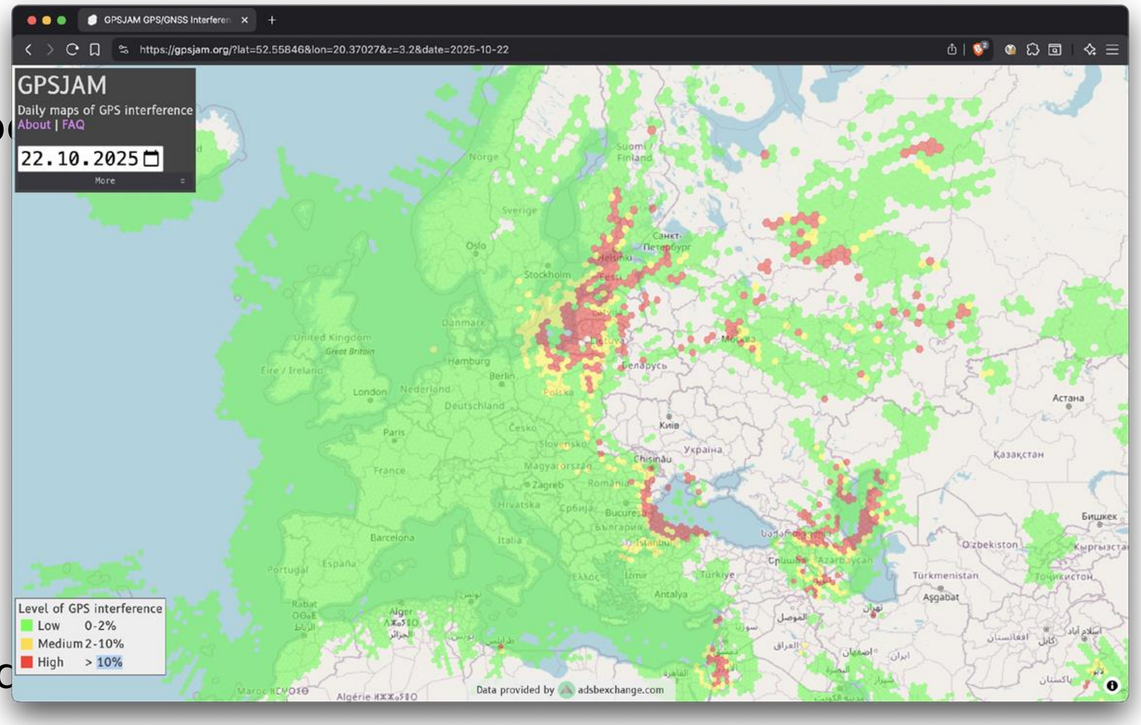
SCION for Sovereign Connectivity

- SCION's isolation domains (ISD) create a sovereign network infrastructure
  - Network operators define ISD trust roots
  - Communication free of external influence
- Further support for sovereignty
  - Private ISDs facilitate creation of sovereign domains
  - Sovereign DNS infrastructure
  - Clockwire: sovereign time synchronization
  - Hummingbird: guaranteed bandwidth with reservations

Sovereignty for Time Synchronization

- Precise time is critical:
  - Power grid: maintain synchronization and troublesho
  - Telecom networks: 5G tower synchronization
  - Finance: trading, auditing (log timestamping)
  - Transportation
  - Broadcasting

- Current solutions:
  - Satellites (e.g., GPS), but signals increasingly blocked
  - Dedicated terrestrial networks (fibers, radio links)
    - 0.5-1.5 BN Market niche, growing ~7-8% CAGR



E.g. GPS blocking on 22.10.2025.
Source: https://gpsjam.org/

- **Secure time synchronization remains a challenge over legacy Internet: Opportunity for SCION**

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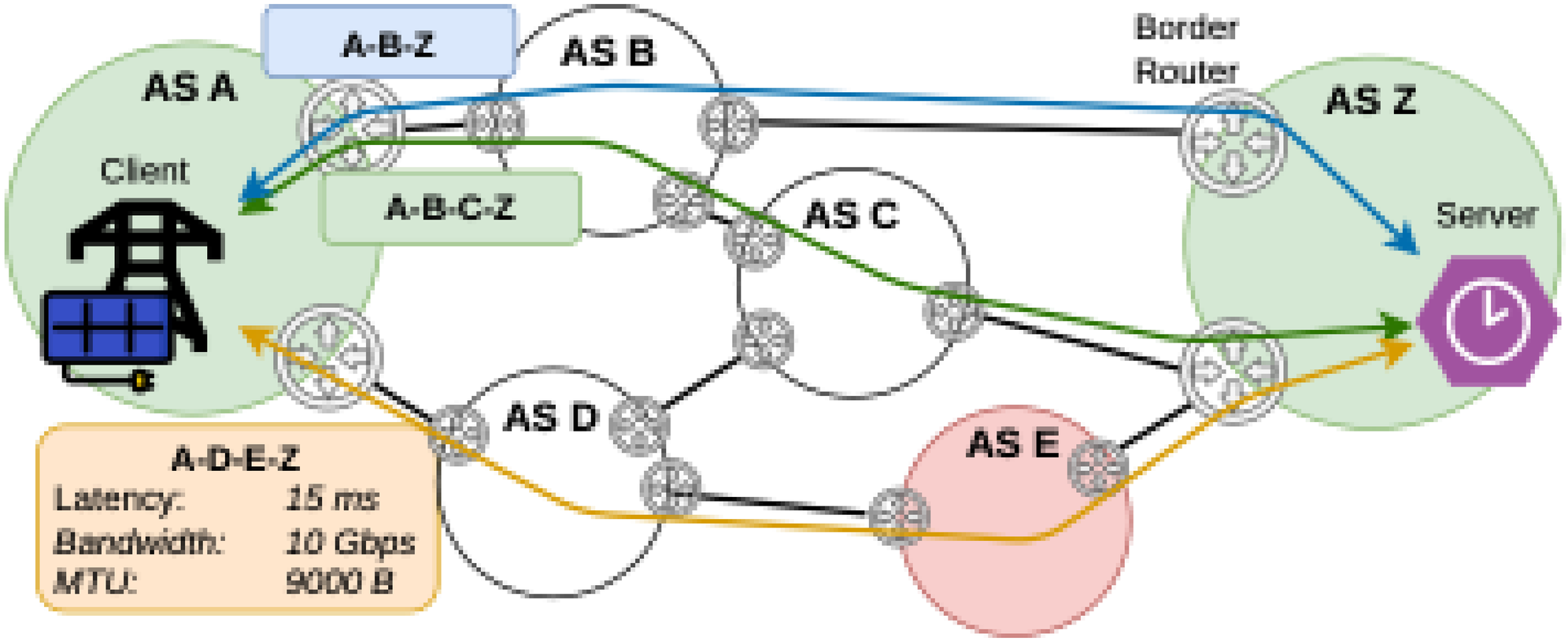
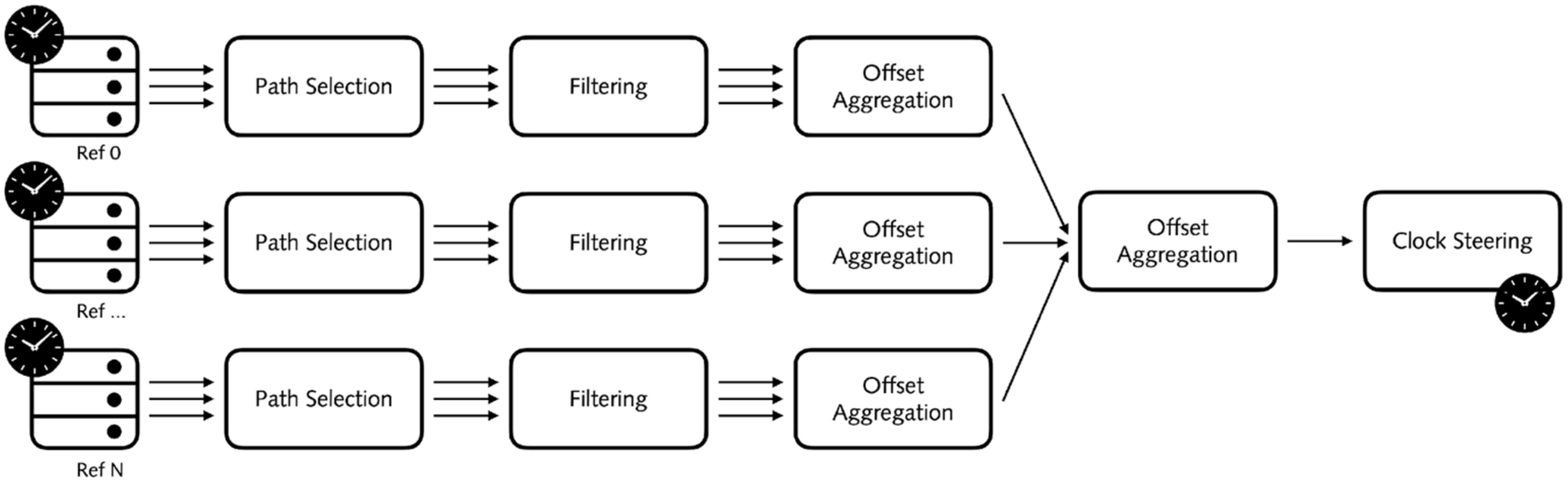
Connectivity Options for Time Distribution

	Public Internet	Dedicated Networks	SCION
Flexibility	✓	✗	✓
Security	✗	✓	✓
Cost	✓	✗	✓
Control	✗	✓	✓

Time Distribution over SCION

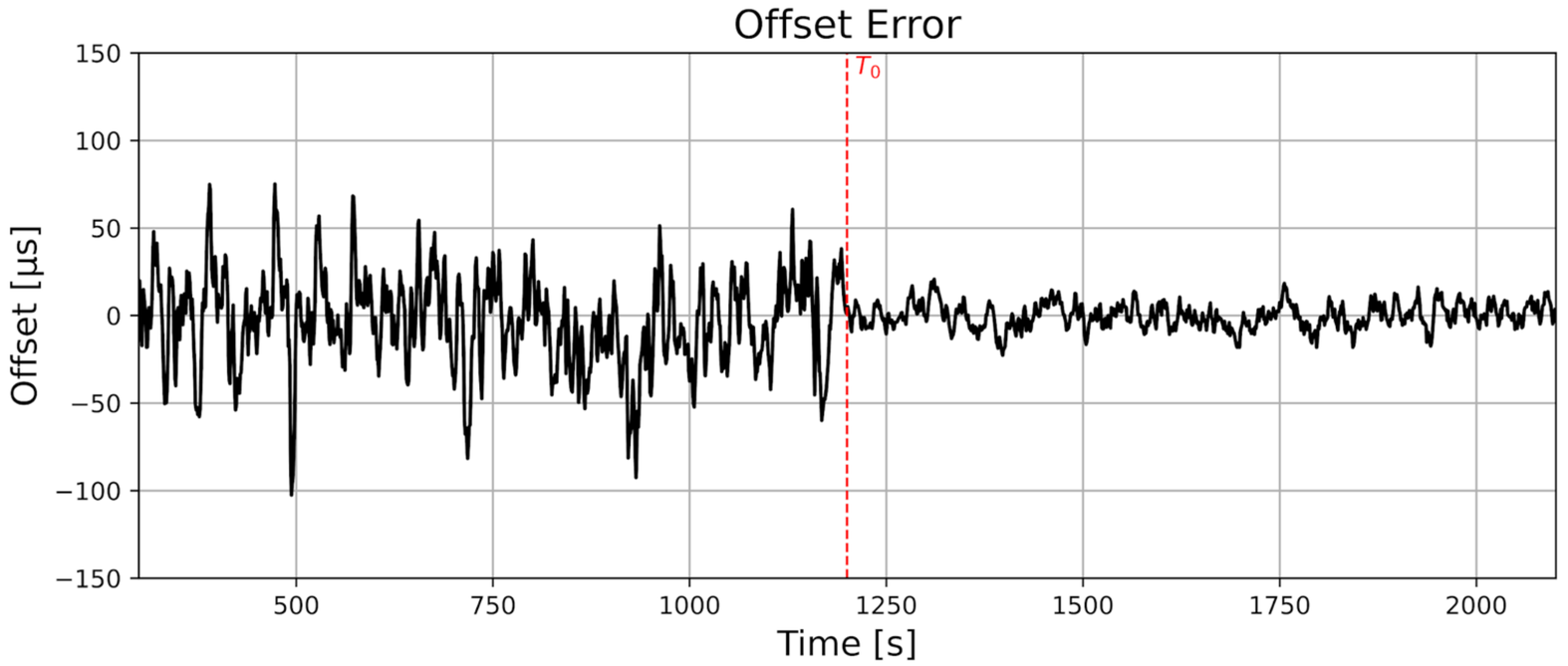


Clockwire: Multi-path Synchronization Pipeline



Clockwire: Dynamic Path Selection

Offset error improvement: at T0, synchronization switches from initial paths to alternatives with better symmetry, identified through continuous background evaluation



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NetTimeLogic AIONYX Hive: Overview

- **Modular Platform specific for Time Synchronization and Networking**:
  - Core Module around an AMD SoC Architecture with 4 x ARM CPU plus large FPGA on a custom Baseboard
  - Interface Modules for many synchronization mechanisms: GNSS, PPS, PTP, NTP, IRIG, DCF77, etc. as source and sink
  - 4 x RJ45 or 4 x SFP Ethernet
  - High stability oscillators

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Clockwire on AIONYX Hive

- Ongoing pilot deployments as a stepping stone **towards full-scale production quality**.
- Aiming at resilient time-as-a-service in an **open ecosystem for SSFN, SSUN**, etc.
- We invite interested partners to **contact us regarding potential collaborations**.

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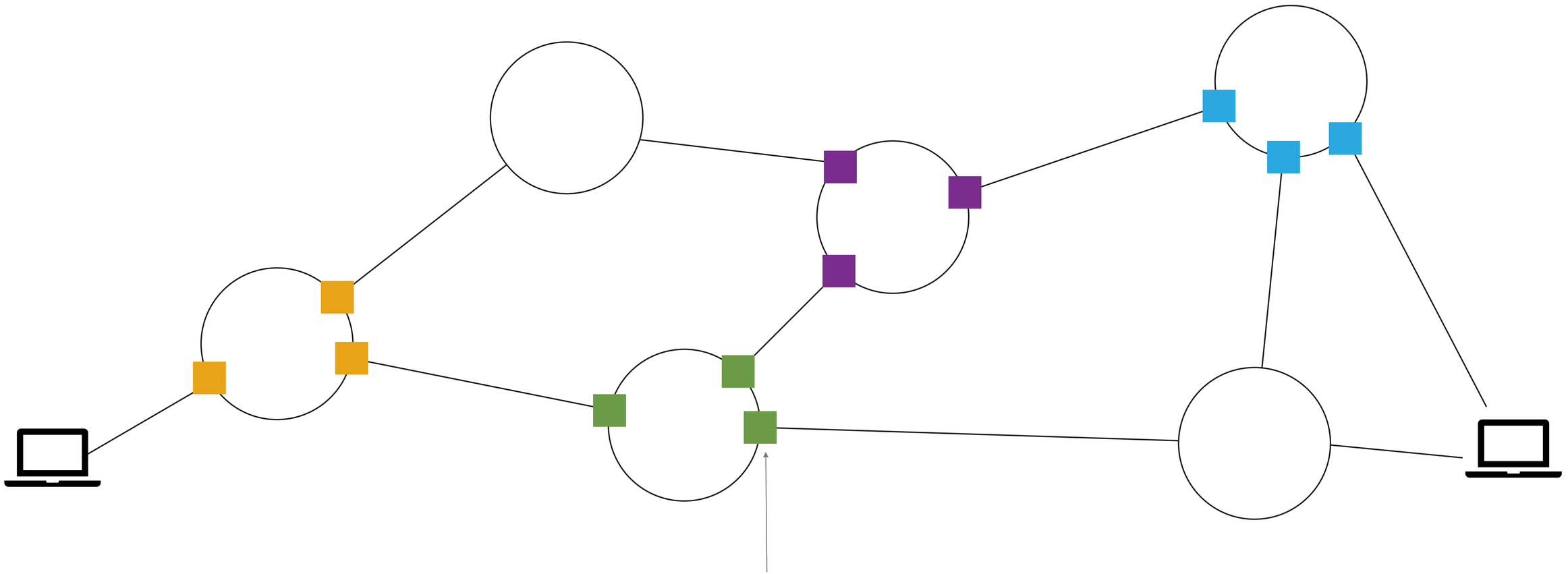
Clockwire: Pilot Deployment in Swiss ISD

Hummingbird: QoS on SCION Network

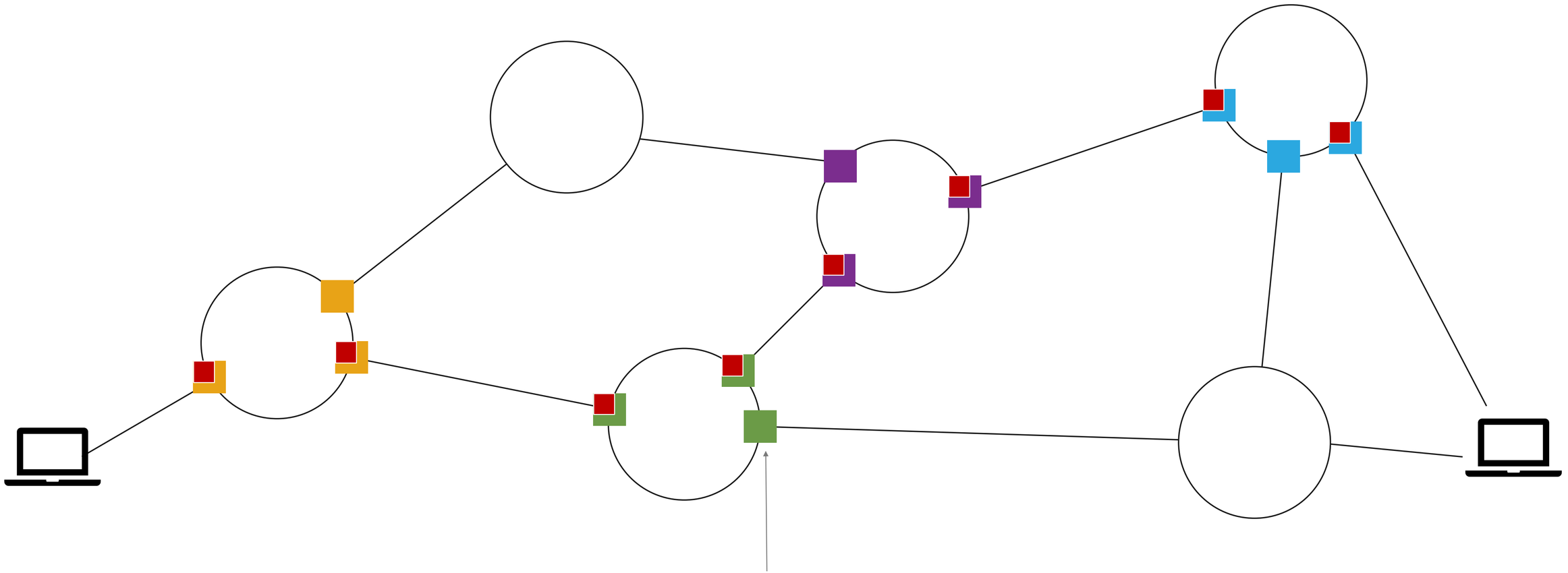
- Hummingbird enables bandwidth reservations to traverse an AS
- Flexible allocations: max bandwidth and time duration
- With a Hummingbird reservation, we can achieve bandwidth guarantees despite congestion, DDoS, etc.
- An end-to-end Hummingbird reservation transforms a SCION path into a virtual leased line

Hummingbird Overview (1/3)



Ingress/egress asset sold on the market
(start, end, size)

Hummingbird Overview (2/3)



Ingress/egress asset sold on the market
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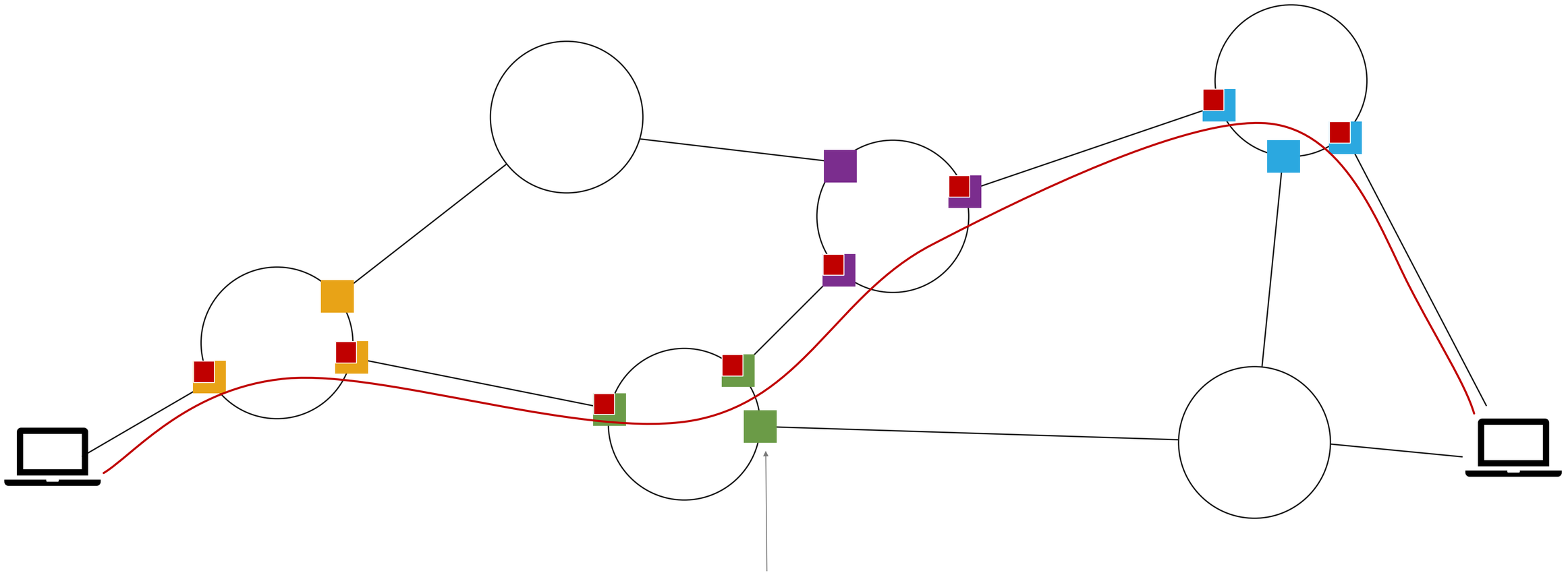
Hummingbird Overview (3/3)



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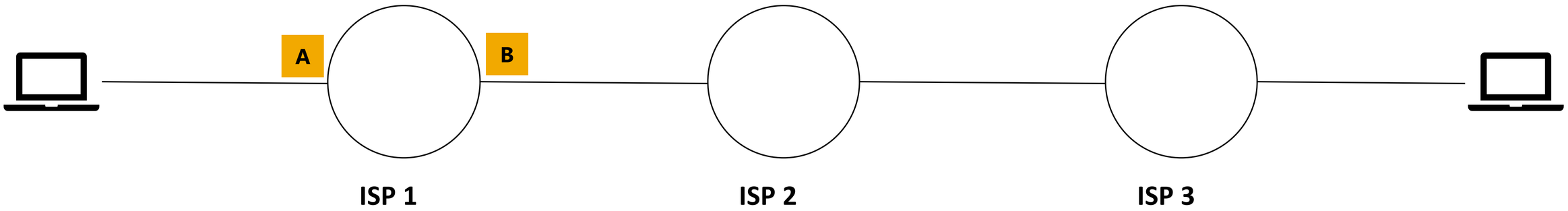
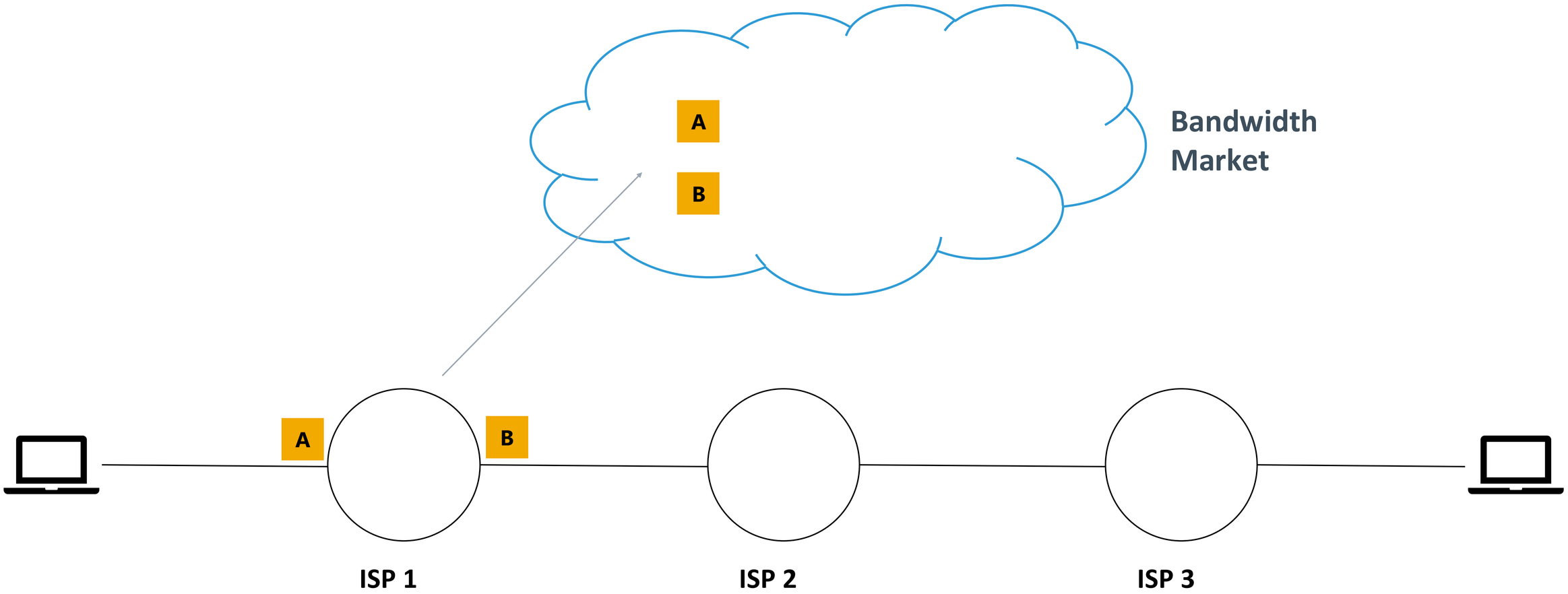
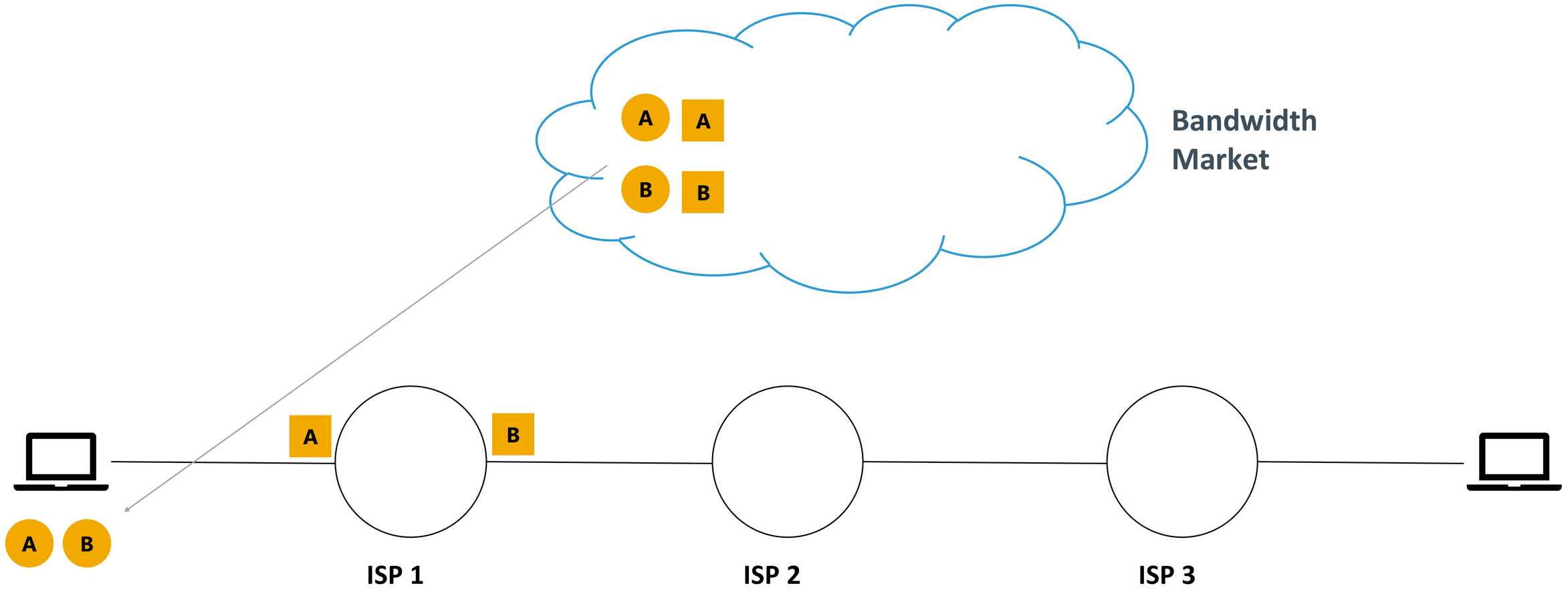
Hummingbird Example (1/5)



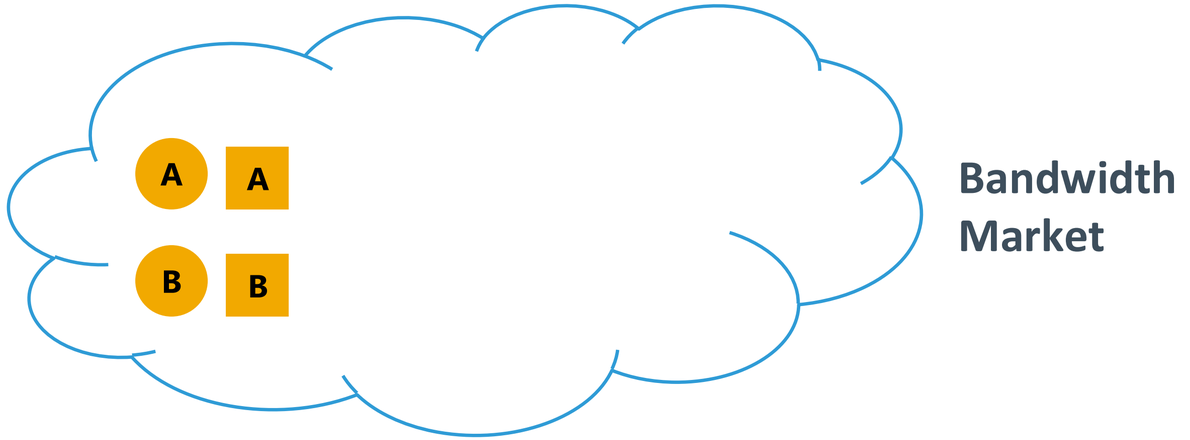
Hummingbird Example (2/5)

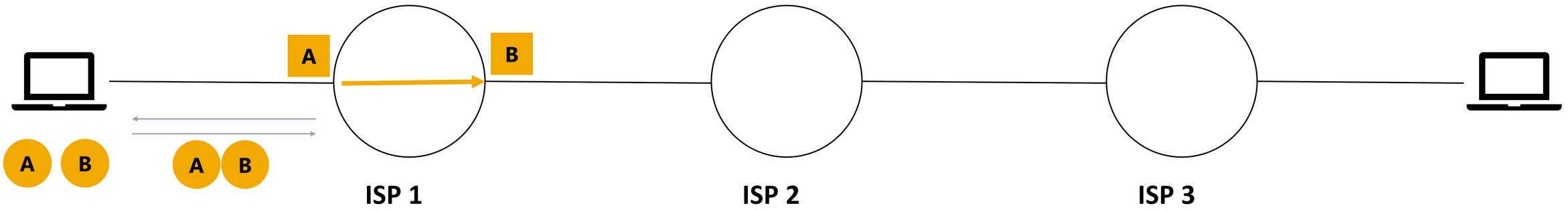


Hummingbird Example (3/5)

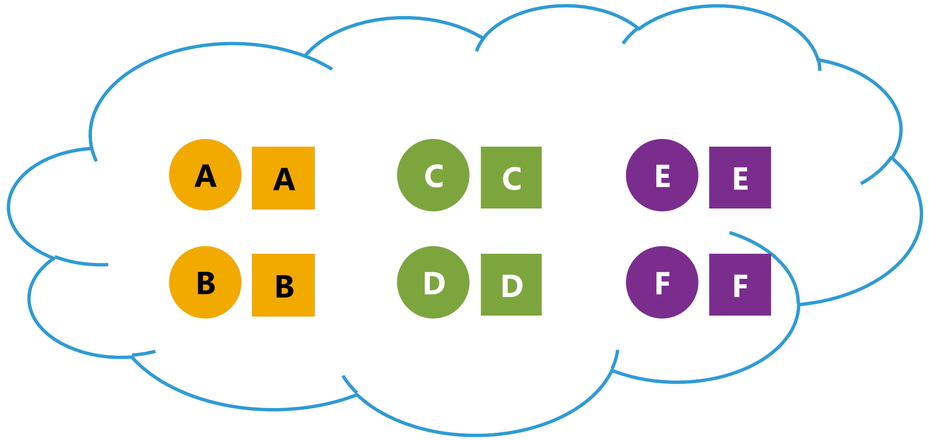


Hummingbird Example (4/5)

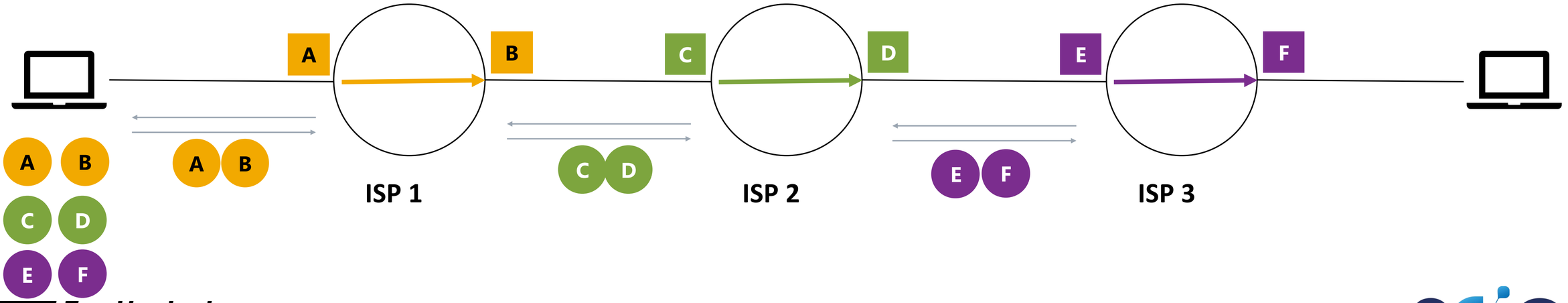




Hummingbird Example (5/5)



Bandwidth Market



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Hummingbird: Pilot Deployment in Swiss ISD

Conclusion

SCION can provide sovereign connectivity

- Local definition of trust roots
- Path transparency
- Geofencing
- Private ISDs
- Clockwire
- Hummingbird: virtual leased line