SCION: A Secure Internet Architecture

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The Internet is a network of Autonomous Systems (ASes).

Each AS is itself a network of routers run by an institution (e.g., Telco, ISP, company, or university).

There are 50,000+ ASes in the world.
Who controls Internet routing?

- Control over paths is completely distributed
- Border Gateway Protocol (BGP): all nodes flood path announcements
- Easy to hijack traffic due to lacking security mechanisms in BGP
BGP Hijacking in the wild

How 3ve’s BGP hijackers eluded the Internet—and made $29M
3ve used addresses of unsuspecting owners—like the US Air Force.
DAN GOODIN - 12/21/2018, 6:30 PM

Strange snafu misroutes domestic US Internet traffic through China Telecom
Telecom with ties to China’s government misdirected traffic for two and a half years.
DAN GOODIN - 11/6/2018, 3:05 PM

Russian-controlled telecom hijacks financial services’ Internet traffic
Visa, MasterCard, and Symantec among dozens affected by "suspicious" BGP mishap.
DAN GOODIN - 4/27/2017, 10:20 PM

Google goes down after major BGP mishap routes traffic through China
Google says it doesn’t believe leak was malicious despite suspicious appearances.
DAN GOODIN - 11/13/2018, 8:25 AM

Suspicious event hijacks Amazon traffic for 2 hours, steals cryptocurrency
Almost 1,300 addresses for Amazon Route 53 rerouted for two hours.
DAN GOODIN - 4/24/2018, 9:00 PM
We cannot solve our problems with the same thinking we used when we created them.

*Albert Einstein*
SCION in a Nutshell

Path-based Network Architecture

Control Plane - Routing
- Constructs and Disseminates Path Segments

Data Plane - Packet forwarding
- Combine Path Segments to Path
- Packets contain Paths
- Routers forward packets based on Path
  - Simple routers, stateless operation

Isolation Domains
Network Paths

Current Internet

- No assurance on and control over packets path across the internet
- Frequent prefix hijacking

SCION

- Geo-Fencing
  - Ensure that packet stays within certain jurisdiction
- Resilience against hijacking attacks

ETH Zürich
Routing & Forwarding

Current Internet

- BGP slow to converge to stable state
- Lack of separation between control and dataplane leads to outages

SCION

- Clean separation of control- and data-plane
- Increased availability of the Internet
Current Internet

- Either no trust model or global roots of trust
- Whoever controls the global root of trust can shutdown parts of the Internet

SCION

- Autonomy/Sovereignty for network infrastructure, e.g. at national level through isolation domains
- No global kill switches
Attacks on the Network

**Current Internet**

- DDoS or routing attacks prevent communication
- No communication guarantees on today’s internet

**SCION**

- Resilient to network DDoS attacks due to multipath communication and source authentication
- Global, dynamic bandwidth allocation system can ensure minimum bandwidth guarantees
How to Deploy SCION – Core Network

- Two components: SCION core services (control plane) and SCION border routers (dataplane)
- SCION reuses existing intra-domain networking infrastructure – no need to upgrade all networking hardware
How to Deploy SCION – End-Domains

- SCION IP Gateway enables seamless integration of SCION capabilities in end-domain networks
- No upgrades of endhosts or applications needed
- SCION is transport-agnostic thus can work over many different underlaying networks
Current Deployment Status

Commercial (Anapaya)
- ISPs: Deutsche Telekom, Swisscom, SWITCH, Init7
- Bank deployment: 4 major Swiss banks, some in production use
- Swiss Foreign Department: Interconnecting Swiss Embassies

Research (SCIONLab)
- ISPs: Swisscom, SWITCH, KDDI, GEANT, DFN
- Deployed 50 ASes worldwide
- Everyone can join the network
Anapaya Systems founded in June 2017 as ETH Zurich Spinoff

Mission: Build highly available, secure, flexible, and affordable wide-area networks based on SCION technology

Current customers include ISPs, Banks, and Governments

https://www.anapaya.net
Conclusion: SCION is a Disruptive Technology That Can Be Deployed Today

- Clean-slate Internet architecture built on solid security foundations
- New security properties
  - Geofencing
  - Network path verification
  - Verified protocols and code
- Improved communication efficiency
  - Increased bandwidth via multi-path communication
  - Decreased latency thanks to path optimization
  - Fast failover provides business continuity
SCION Resources

- SCION project website: https://www.scion-architecture.net
- Open Source implementation: https://github.com/scionproto/scion
- Sponsors: