## **2STIC** Experimenting with the SCION Internet architecture

Caspar Schutijser, Ralph Koning (SIDN Labs) Advanced Networking guest lecture, UT Oct. 17th, 2022



### 25TiC program



Goal: put Dutch and European internet communities in a leading position in the field of secure, stable and transparent inter-network communication







UNIVERSITY OF AMSTERDAM

### UNIVERSITY **OF TWENTE**.



### Operator of the .nl TLD

- Stichting Internet Domeinregistratie Nederland (SIDN)
- Critical infrastructure services
  - Lookup IP address of a domain name (almost every interaction)
  - Registration of all .nl domain names
  - Manage fault-tolerant and distributed infrastructure
- Increase the value of the Internet in the Netherlands and elsewhere
  - Enable safe and novel use of the Internet
  - Improve the security and resilience of the Internet itself



### .nl = the Netherlands

17M inhabitants 6.2M domain names 3.4M DNSSEC-signed 2.5B DNS queries/day 8.6B NTP queries/day

### **SIDN fonds**





### SIDN Labs = research team

- Goal: increase the trustworthiness (security, stability, resilience, and transparency) of our society's internet infrastructure, for .nl and the Netherlands in particular
- Strategies:
  - Applied technical research (measurements, design, prototyping, evaluation)
  - Make results publicly available and useful for various target groups
  - Work with universities, infrastructure operators, and other labs
- Three research areas: network security (DNS, NTP, BGP), domain name & IoT security, trusted future internet infrastructures







### SIDN Labs team



**Caspar Schutijser Research Engineer** 



**Elmer Lastdrager Research Engineer** 



**Giovane Moura** Data Scientist



Jelte Jansen Research Engineer



Marco Davids **Research Engineer** 



Marisca van der Donk Managementassistente



Moritz Müller **Research Engineer** 



**Ralph Koning Research Engineer** 



Thymen Wabeke **Research Engineer** 



Cristian Hesselman Directeur SIDN Labs



Maarten Wullink **Research Engineer** 



Thijs van den Hout **Research Engineer** 

- Technical experts, diverse in seniority and nationality
  - Help SIDN teams, write open-source software, analyze large amounts of data, conduct experiments, write articles, collaborate with universities
- M.Sc students help us advance specific areas







### 1997

source: https://www.opte.org

### The Internet

2021



## Rate of change











## New Requirements

- requirements
  - surgery)
- responsible internet
  - Control over routing and verification of operational behavior

### New applications have new security, stability and transparency

• More interaction with physical space (e.g., transport, smart grids, drones, remote

### To provide trust and and confidence in communication we need a



SCION NDN RINA ManyNets XIA MobilityFirst Nebula Service-centric networking FII B4

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Some new inter-domain networked architectures.

## Opening up

- Adoption of new protocols in technologies was slow, but network devices are opening up.
- (ONIE) Open Network Install Environment offers OS choice on network equipment.
- OpenFlow/SDN offer control plane programmability.
- P4 provides data plane programmability.



### Potentially promising clean slate architectures

- RINA
  - Everything is IPC
  - WIP implementations: ProtoRINA, OpenIRATI
- NDN
  - Data centric
  - Stateful, lots of caching in the network
  - Implementation: named-data.net
- SCION
  - Path selection
  - Active community
  - Implementation: github.com/scionproto





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- Scalability, Control, and Isolation On Next-generation Networks
- New internet architecture
- Network Security Group, ETH Zurich
- Goal: improve security of inter-domain routing and isolation of compromise
- Scalability and security through Isolation Domains (ISDs)
  - Group of autonomous systems
  - E.g., per country or jurisdiction



## 





- Security by design
  - Routes authenticated both in control and data plane
- Path-aware networking
  - Sender selects path
  - Enables, for example, geofencing
- Multi-path communication
  - Can be used, for example, for redundancy
- Existing application can still be used

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## Isolation domains

- Group of autonomous systems
  - E.g., per country or jurisdiction
- ISD core: ASes managing the ISD
- Core AS: AS part of the ISD core
- PKI organised per ISD
- Hierarchical control plane
  - Inter-ISD control plane
  - Intra-ISD control plane



Source: The SCION Internet Architecture: An Internet Architecture for the 21st Century, Barrera et al., 2017







## Deployment

- Open source implementation available
  - https://github.com/scionproto/scion
- International testbed SCIONLab
  - https://www.scionlab.org/
- Production network managed by spin-off Anapaya
- In use at banks, government and hospitals
- Talks with research & education networks for a production deployment





## Deployment

### Can be combined with existing applications using SCION-IP Gateway





## SCION and P4

- Implementation of SCION in P4 for the Intel Tofino
- Shared experiences with SCION team
  - Challenging to go from software to hardware implementation
  - Implementing scion in hardware required changes to protocol headers
- Blog post: <u>sidnlabs.nl/en/news-and-blogs/future-internet-at-terabit-</u> speeds-scion-in-p4
- Source code: <u>github.com/sidn/p4-scion</u>





## SCIDN address structure

- An AS: ISD-AS
- A host inside an AS: **ISD-AS**, [address]
- Examples:
  - 19-ffaa:0:1305
  - 19-ffaa:0:1305, [127.0.0.1]
  - 19-ffaa:0:1305, [::1]



### SCIONLab testbed



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### Break





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## SCIONLab exercises

- Make groups of (min) 2 students.
- Instructions at https://check.sidnlabs.nl/ralph/anet-lab/
- Scion-netcat at: https://check.sidnlabs.nl/ralph/anet-lab/scionnetcat.gz
- https://www.scionlab.org



# **2STIC** Thanks for your attention!

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