2STiC

Experimenting with the SCION Internet architecture

Caspar Schutijser, Ralph Koning (SIDN Labs)
Advanced Networking guest lecture, UT
Oct. 18th, 2021

2STiC program

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

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

SIDNfonds

SIDN LABS

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

Maarten Wullink
Research Engineer

Marco Davids
Research Engineer

Marisca van der Donk
Managementassistente

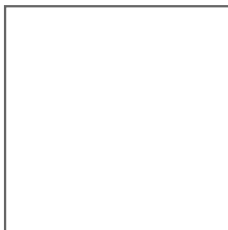**Moritz Müller**
Research Engineer

Ralph Koning
Research Engineer

Thijs van den Hout
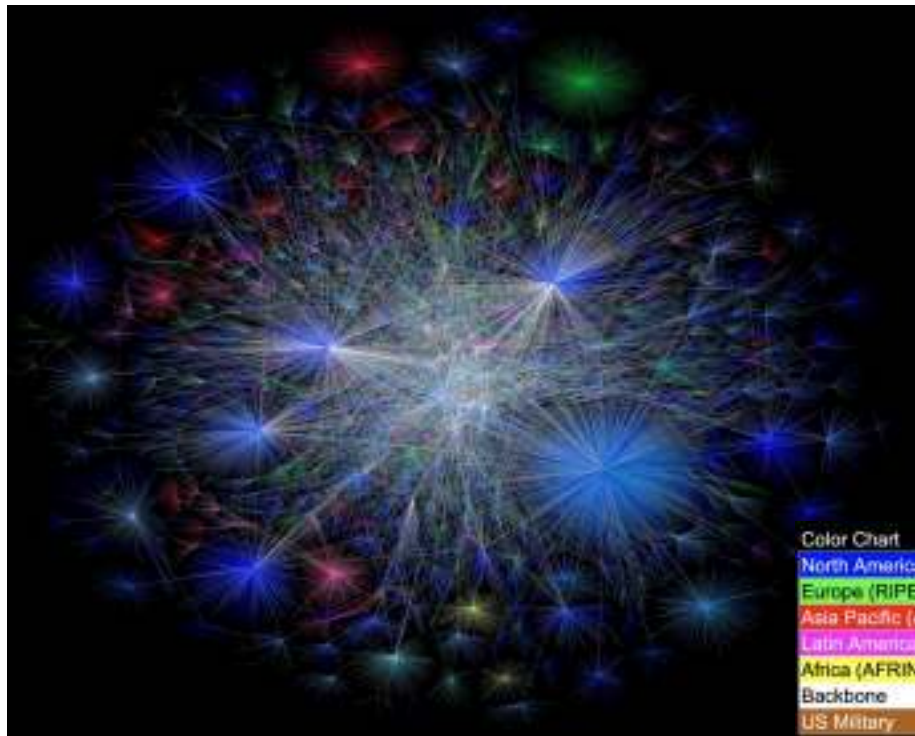Research Engineer

Thymen Wabeke
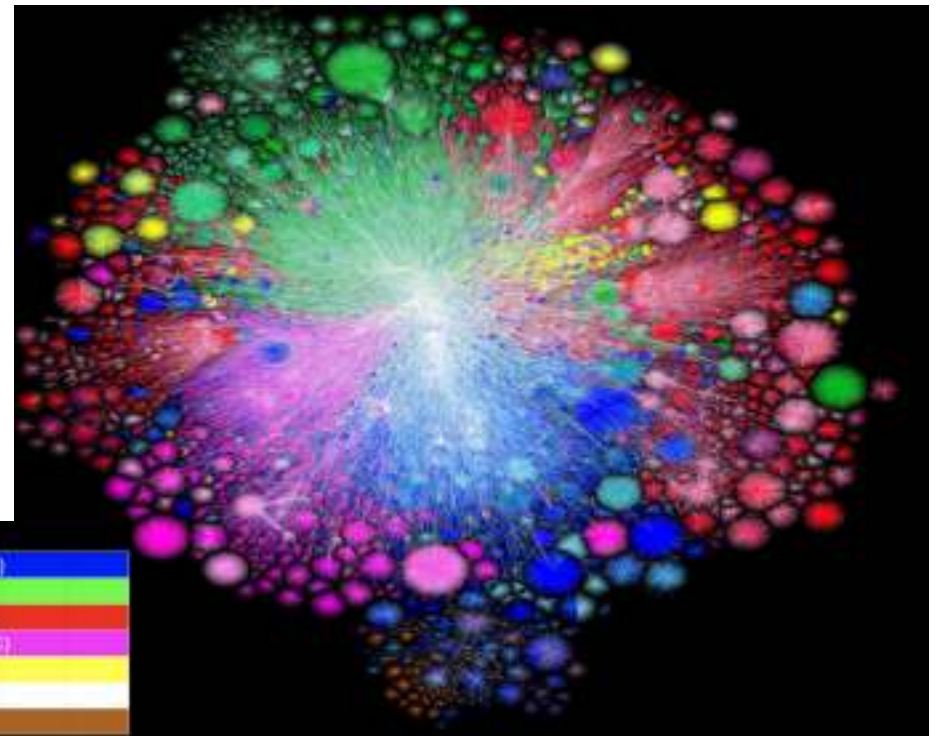Research Engineer

Jouw naam hier?
Research Engineer

Cristian Hesselman
Directeur SIDN Labs

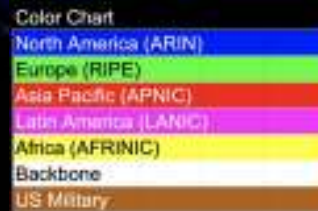- Technical experts, diverse in seniority and nationality

- 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

The Internet

Color Chart
- North America (ARIN)
- Europe (RIPE)
- Asia Pacific (APNIC)
- Latin America (LANIC)
- Africa (AFRINIC)
- Backbone
- US Military

1997

2021

source: https://www.opte.org
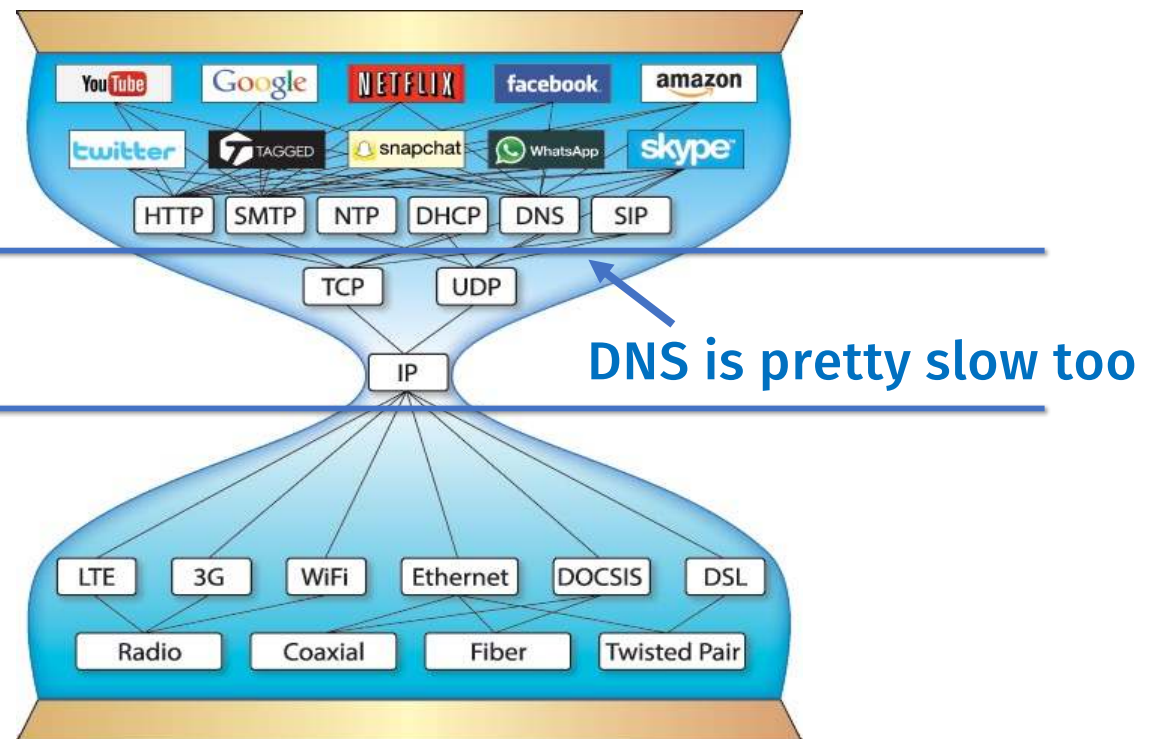
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Rate of change

Fast

Slow!

Fast

DNS is pretty slow too

New Requirements

- New applications have new **security**, **stability** and **transparency** requirements
    - More interaction with physical space (e.g., transport, smart grids, drones, remote surgery)

- To provide **trust** and and **confidence** in communication we need a **responsible** internet
    - Control over routing and verification of operational behavior

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

Some new inter-domain networked architecture.

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 dataplane 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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SCION

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SCION

- 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

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SCION

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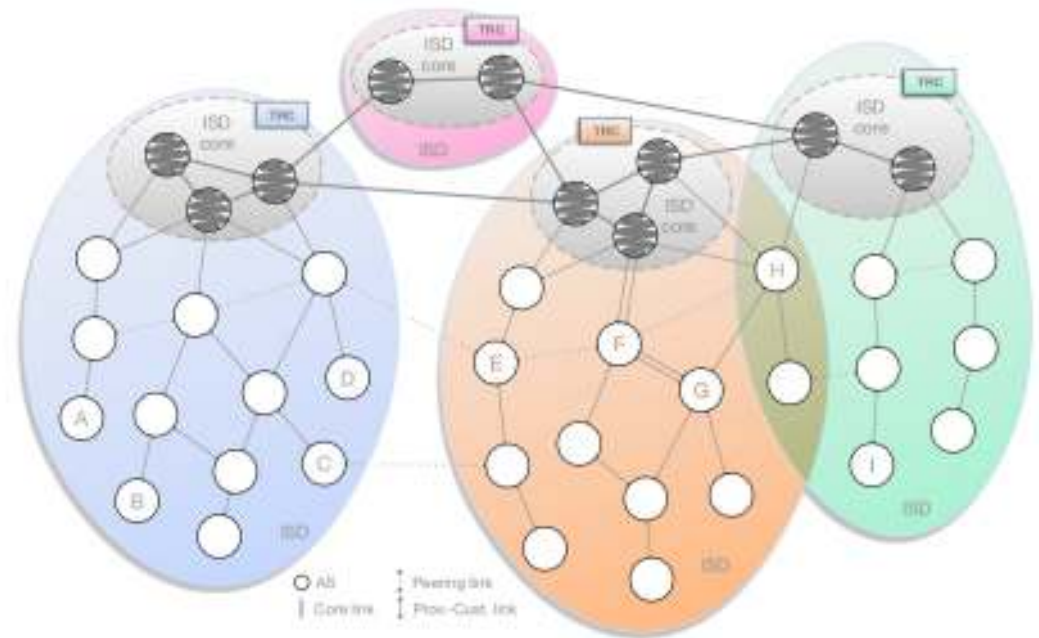
Source: The SCION Internet Architecture: An Internet
Architecture for the 21st Century, Barrera et al., 2017

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

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Deployment

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

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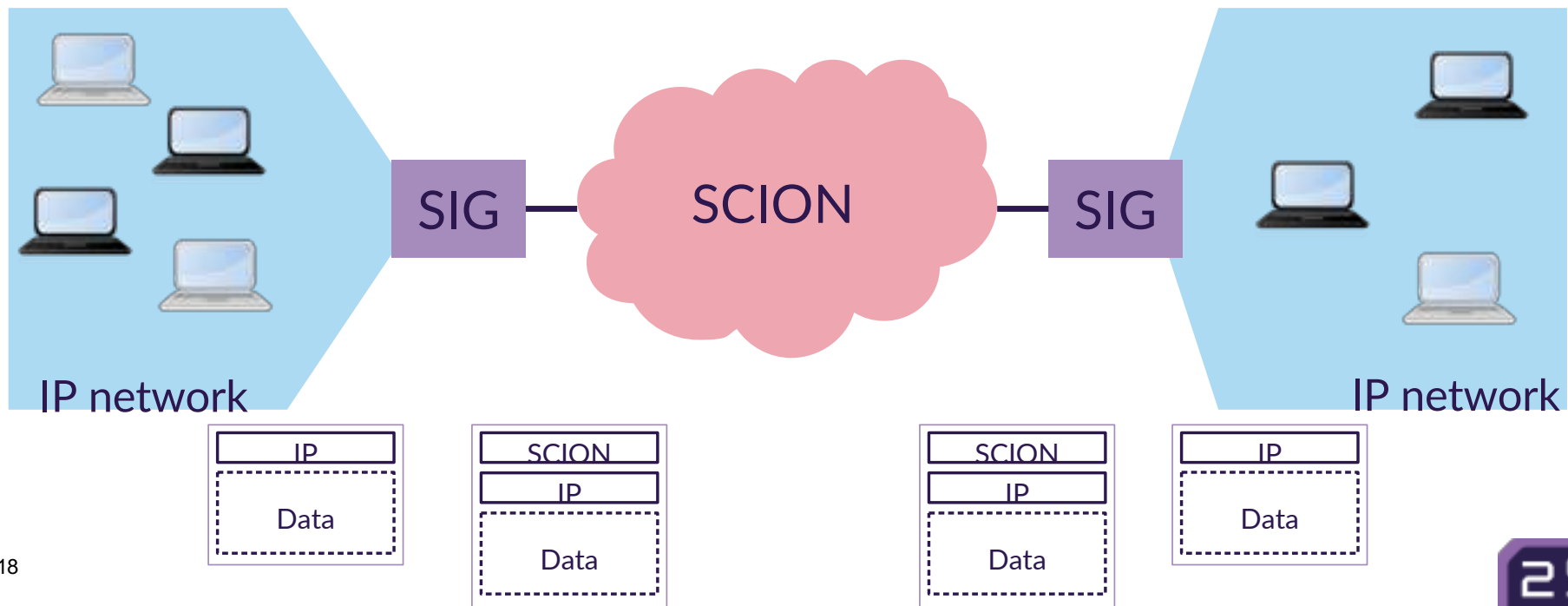
SCION and P4

- 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: sidnlabs.nl/en/news-and-blogs/future-internet-at-terabit-speeds-scion-in-p4
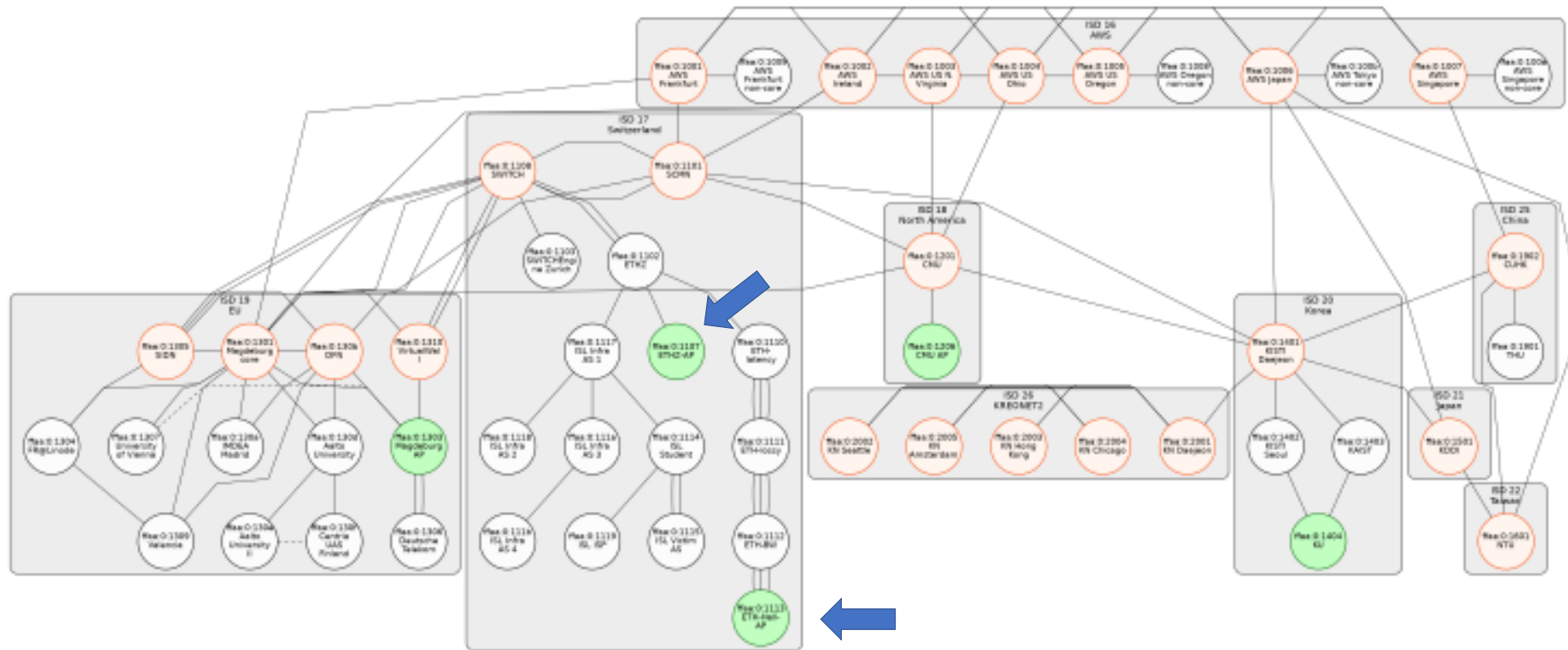- Source code: github.com/sidn/p4-scion
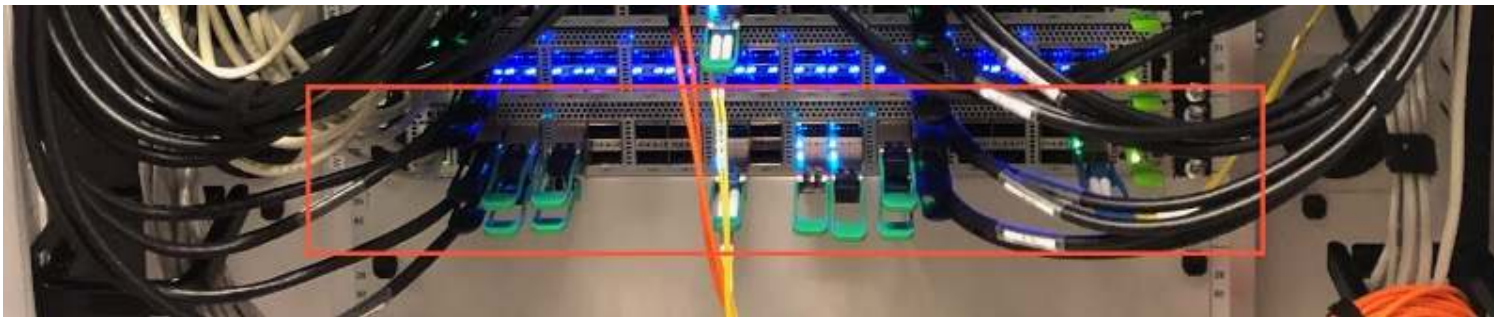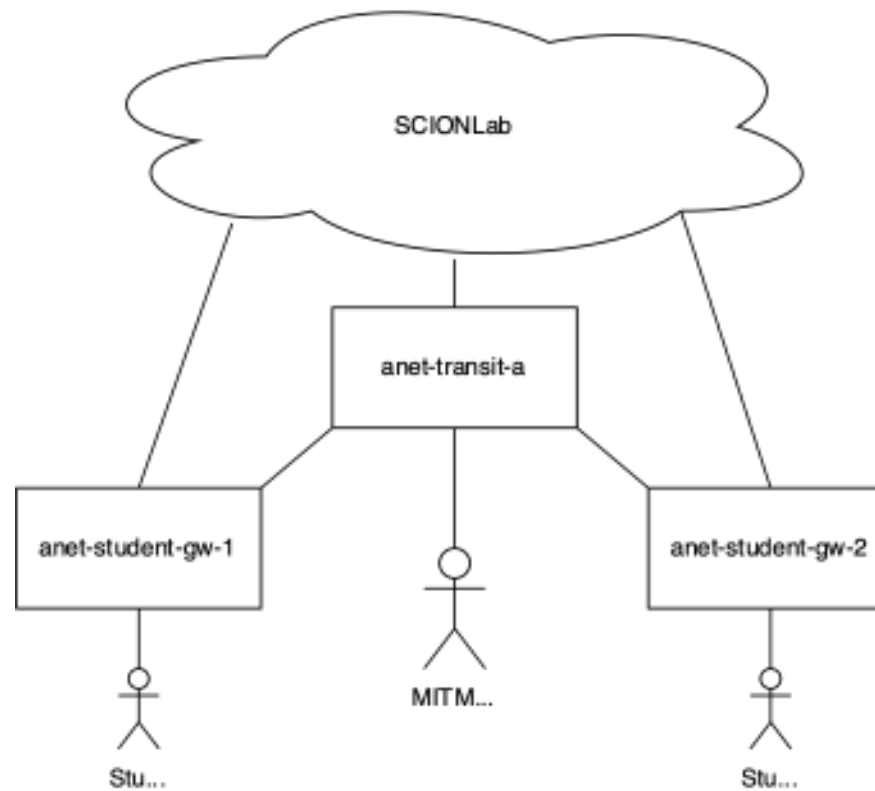
SCION address structure

- 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]`

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SCIONLab testbed

SCIONLab exercises

SCIONLab

anet-transit-a

anet-student-gw-1

anet-student-gw-2

MITM...

Stu...

Stu...

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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/scion-netcat.gz

- https://www.scionlab.org

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Thanks for your attention!

Caspar Schutijser, Ralph Koning
sidnlabs.nl
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