2STiC: Future internet technologies

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Outline

- Some SCION principles...

- SCION at SIDN Labs...

- Challenges in hardware...

Some SCION principles

SCION

- Scalability, Control, and Isolation On Next-generation Networks

- New inter-networking architecture

- Routes authenticated both in control and data plane

  - Path control by sender: transparency

  - Multiple paths: stable

- Scalability and security through Isolation Domains (ISDs)

  - Isolation of compromise: security

  - For instance per country or jurisdiction: transparency

- Research at ETH Zürich

Isolation Domains

- PKI organised per Isolation Domain (ISD)
- core ASes managing the ISD core
  - For instance per country or jurisdiction
- Hierarchical control plane
 - Inter-ISD control plane
  - Intra-ISD control plane
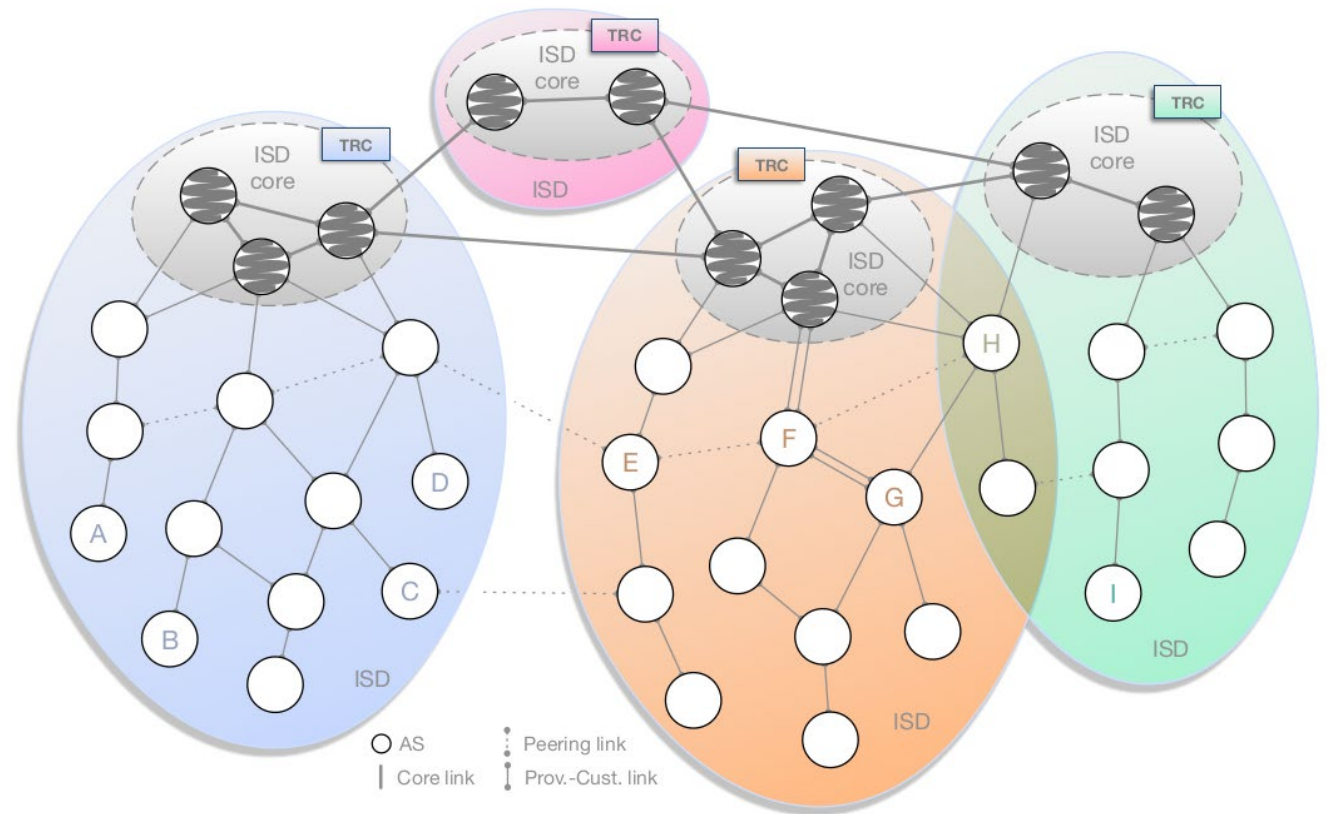
Source: The SCION Internet Architecture: An Internet Architecture for the 21st Century, Barrera et al., 2017

Path discovery

- Inter-ISD

  - Performed by core ASes

  - Flooding similar as with BGP

  - Less ASes involved (only core ASes)

- Intra-ISD...

  - Downstream multi-path flooding

Intra-ISD path discovery

- Path Construction Beacons (PCBs) sent downstream using multi-path flooding

  - Initiated by ISD core nodes

  - Extended and forwarded by receiving ASes

  - Add IN and OUT interface and optional peerings

- Eventually all nodes know how ISD core can be reached

- AS registers preferred down-segments (path from ISD core to AS) with Path Server in the ISD core

- Preferred up-segments registered with Local Path Server
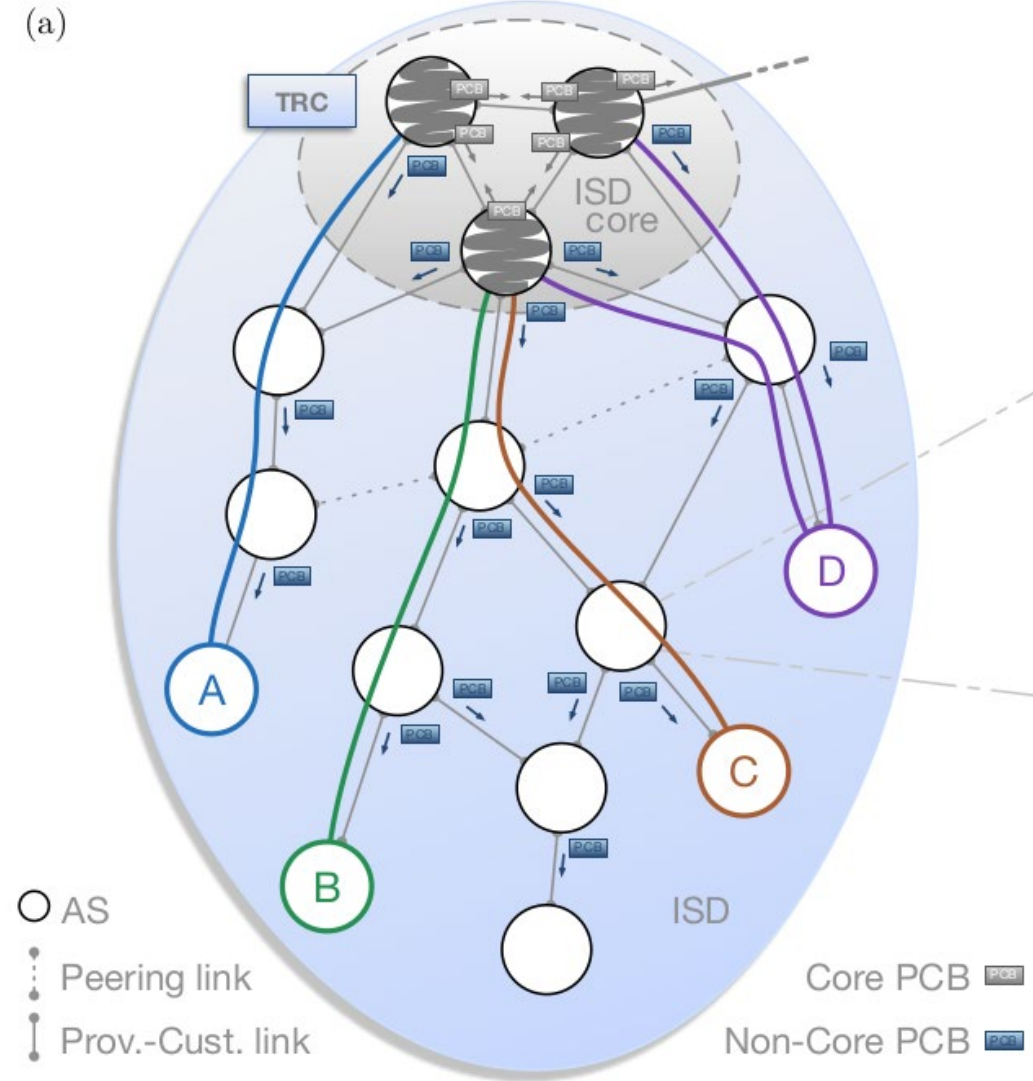
Isolation of compromise

- Path Construction Beacons are signed by every AS along the path:
  - Can be verified within ISD
- Contain Hop-Fields (HF) for use in later select paths
  - Contain Message Authentication Code (MAC) computed using Hop-Field key
  - Only processed locally by AS
- Provides security (DDoS, route hijacking)

Path control by sender

- Path construction performed by sender

- Request route to (ISD, AS) from Local Path Server

- Local Path Server replies with lists of

  - up-path segments to local ISD core

  - core-path segments to connect up-path and down-path segments

  - down-path segment in remote ISD from ISD core to destination AS

- Sender combines segments to determine path

- Provides transparency

Routing

Path information included in SCION packet header

    Corresponding Hop-Field included

        Contain Message Authentication Code (MAC) computed using Hop-Field key

        Only processed locally

    No forwarding tables necessary at routers
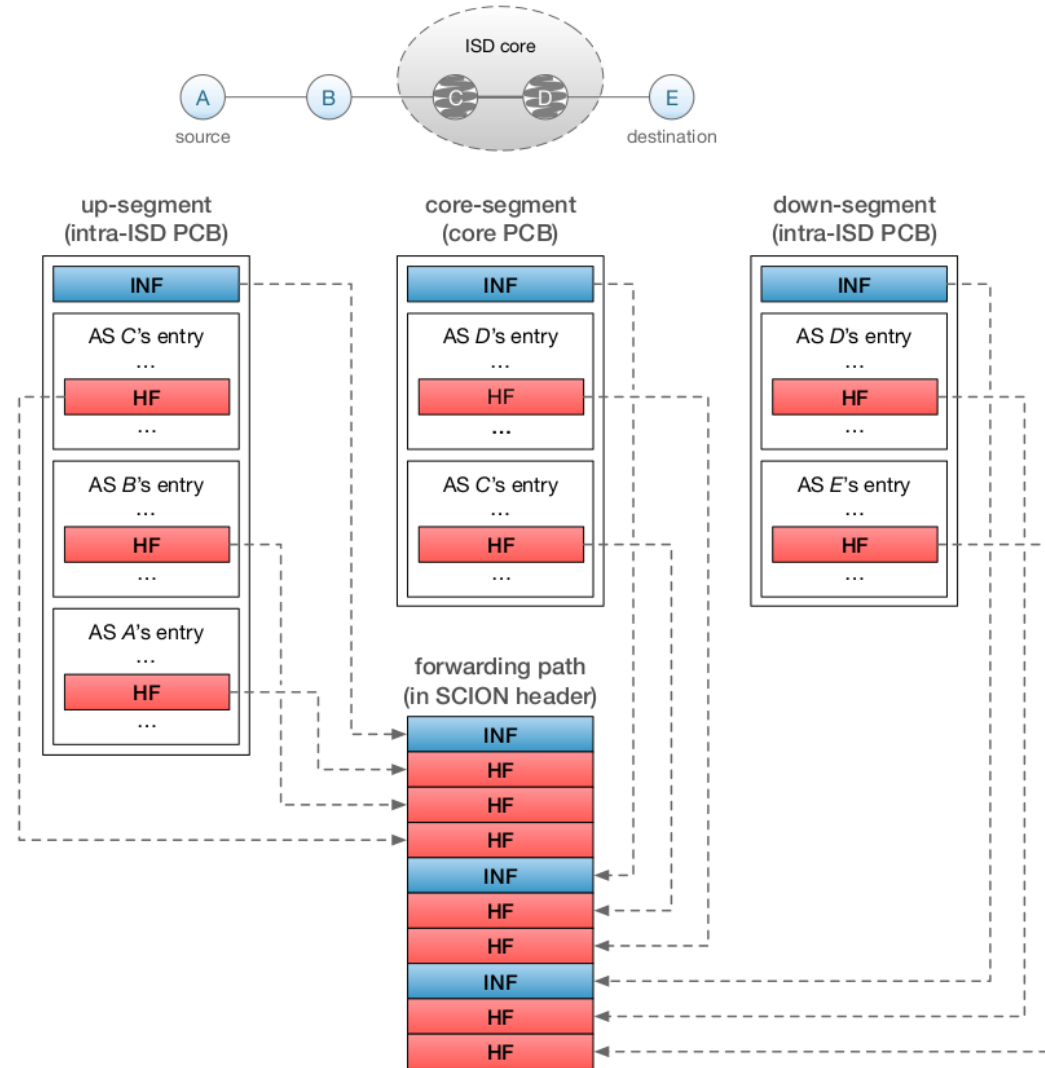
    Packet-carried forwarding state (PCFS)

Sender selects the path

    Possible to use multiple paths

Recipient address no longer used to route between ASs
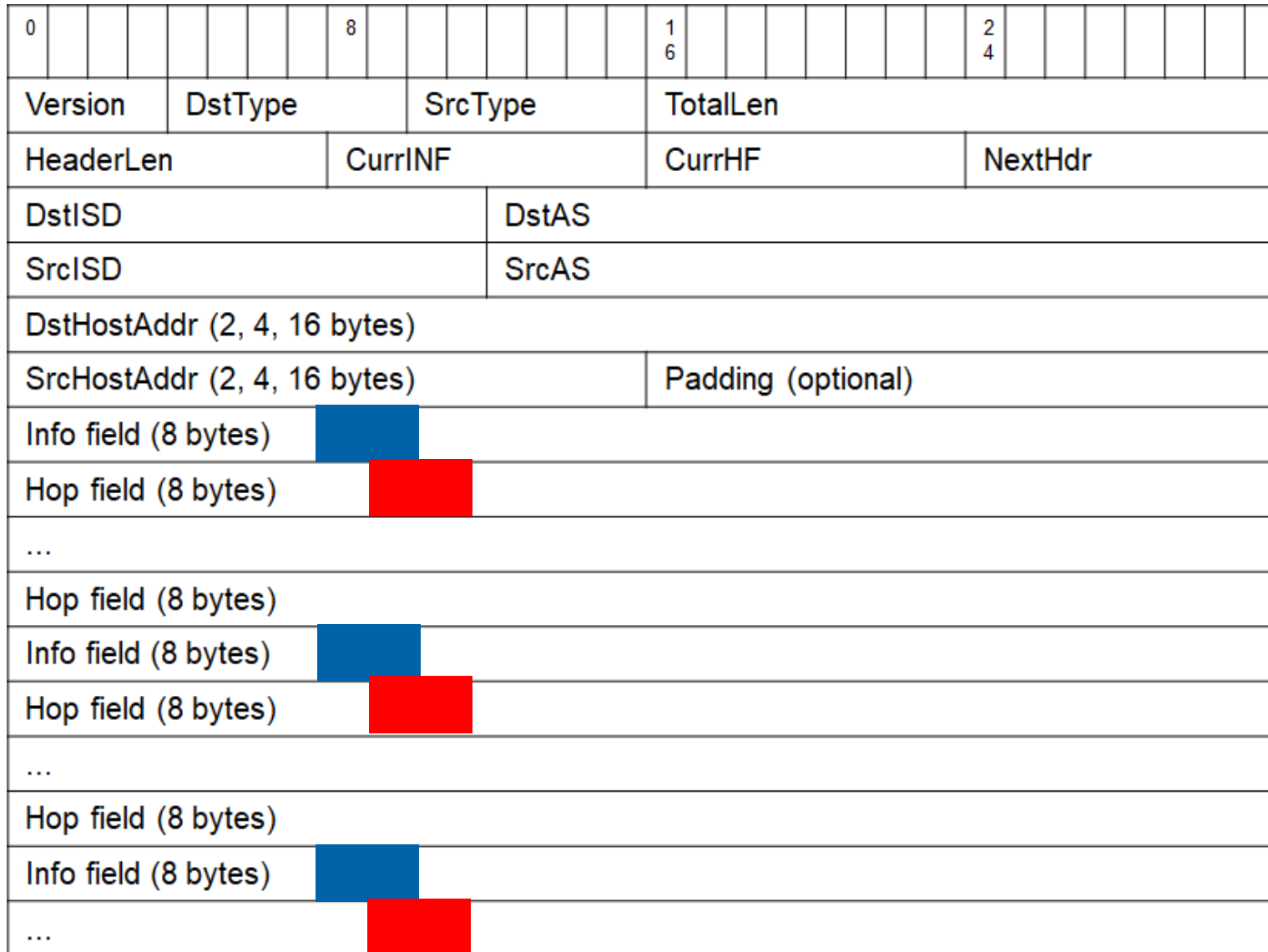
    Only used by the destination AS

Routing

Source: SCION: A Secure Internet Architecture, Perrig et al., 2017

SCION packet header

0				8				1 6				2 4		
Version	DstType		SrcType			TotalLen								
HeaderLen		CurrINF			CurrHF			NextHdr						
DstISD				DstAS										
SrcISD				SrcAS										
DstHostAddr (2, 4, 16 bytes)														
SrcHostAddr (2, 4, 16 bytes)				Padding (optional)										
Info field (8 bytes)														
Hop field (8 bytes)														
…														
Hop field (8 bytes)														
Info field (8 bytes)														
Hop field (8 bytes)														
…														
Hop field (8 bytes)														
Info field (8 bytes)														
…														

SCION at SIDN Labs

SCION at SIDN Labs

- Connected to international testbed SCIONLab

- Developed SCION application: Snetcat

- Visualisation of SCION paths

- Implementation of SCION in P4

  - Implementation working in P4 simulation (simple_switch)

  - Implementation for hardware work in progress...
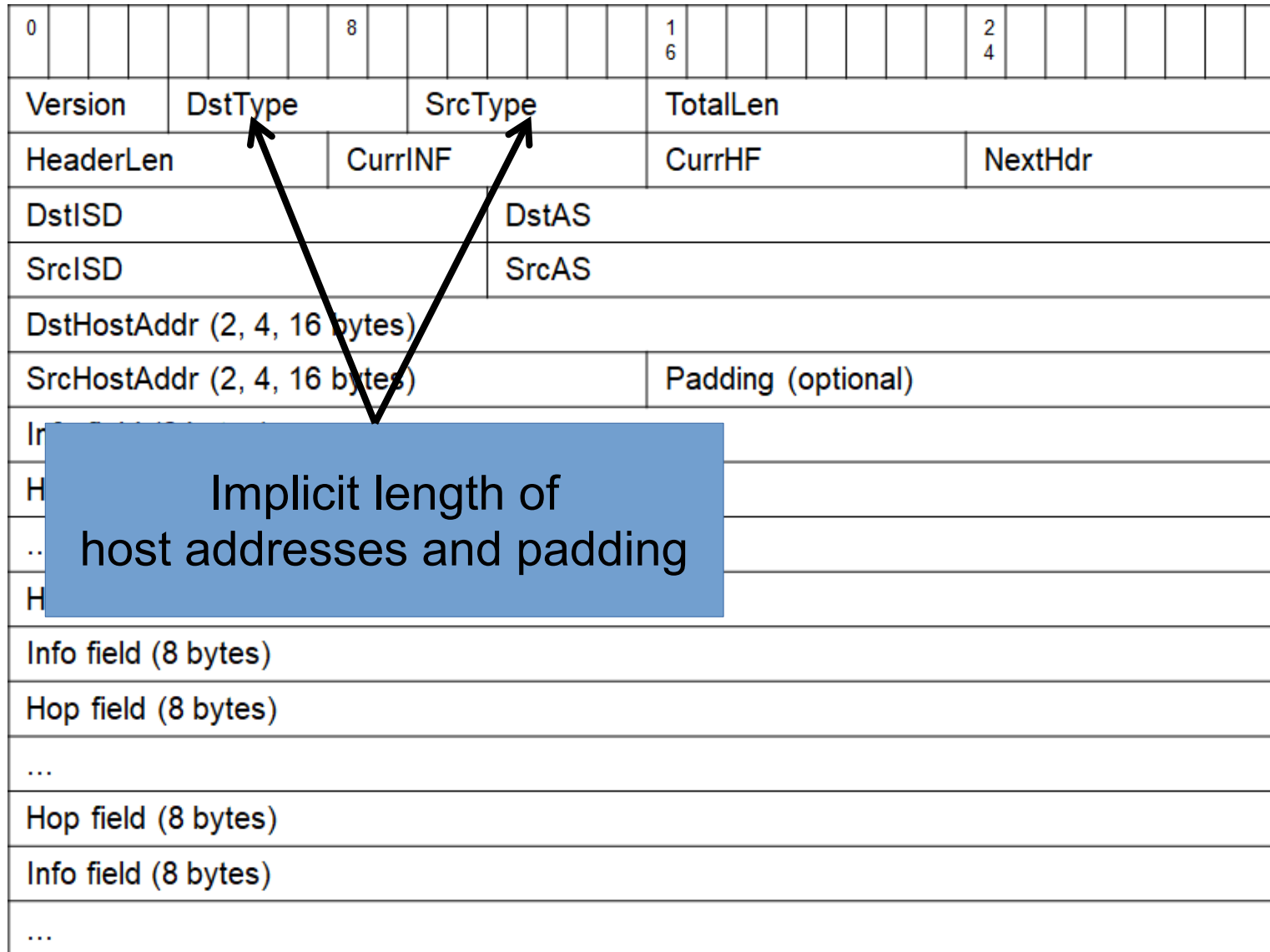
    - Both at ETH Zürich and SIDN Labs

Challenges in hardware
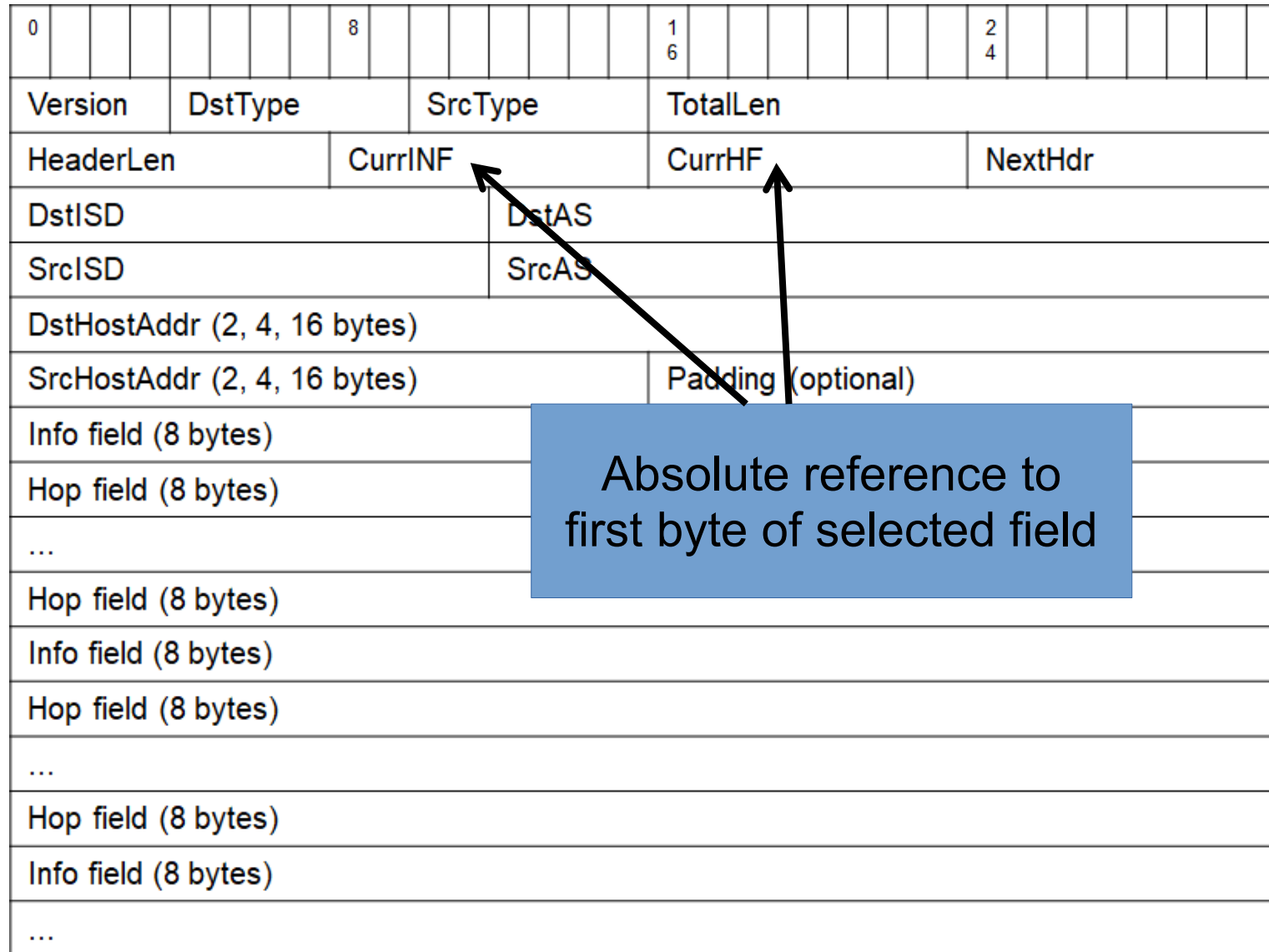
Challenges in hardware

- Implicit lengths of addresses

- Absolute reference

- Implicit number of Info-Fields

- Selection of Info-Fields and Hop-Fields
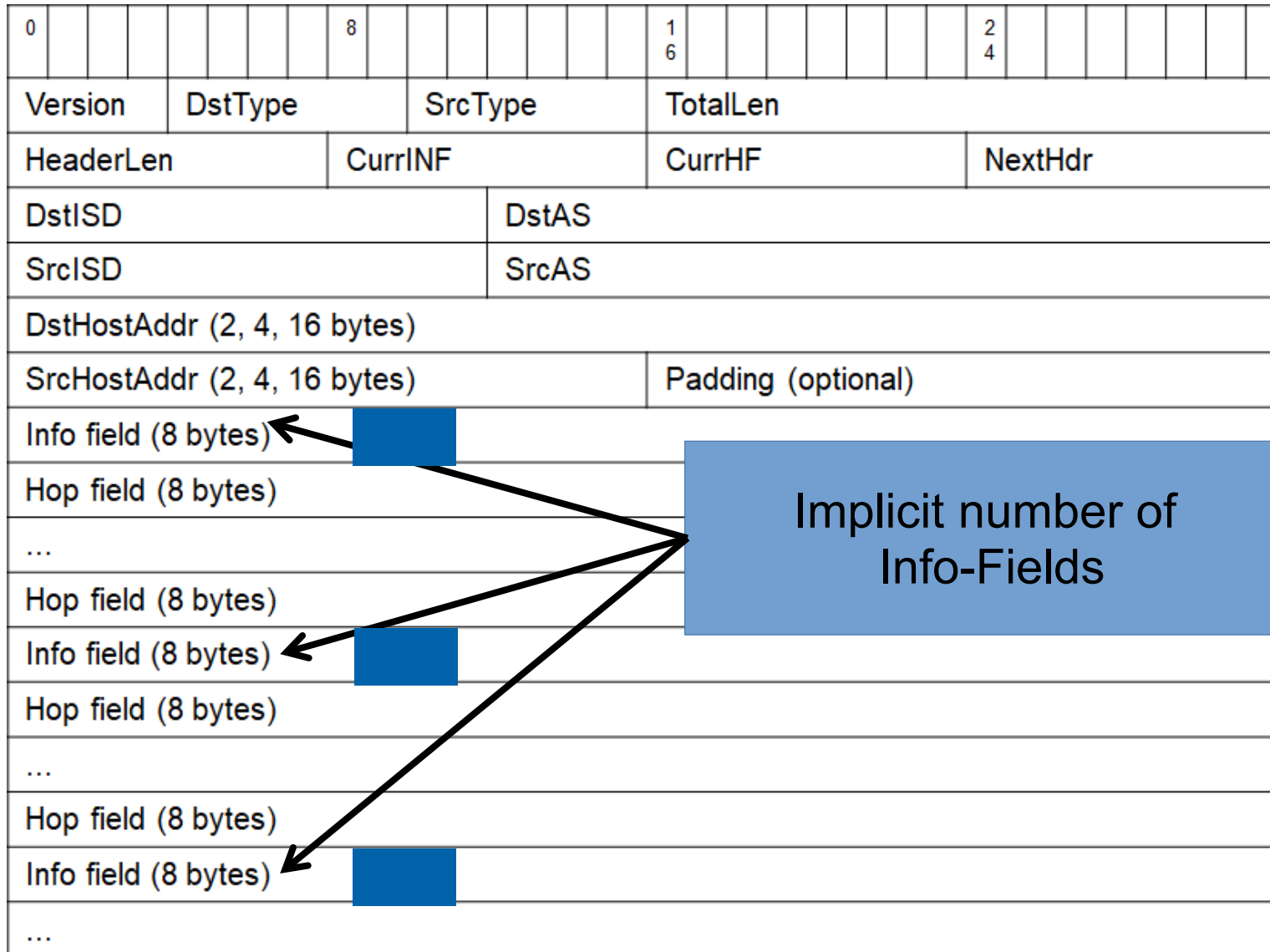
- Number of Hop-Fields variable

SCION headers – Implicit length of addreses

SCION headers – Absolute reference

Absolute reference to first byte of selected field

SCION headers – Implicit number of Info-Fields

SCION headers – Selection of Info-Field and HF

Selected Info-Field and Hop-Field variable

SCION headers – Number of HFs variable

Questions?

- Do people know about guidelines how to defined protocols with hardware in mind?

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Thanks for your attention!

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