Implementing and Evaluating **MPTCP** on the **SCION** Future Internet Architecture

Presentation master thesis

Michael A. Flückiger

August 28, 2020

On the menu

- Introduction
- Functionality of Shila
- Performance evaluation
- Future work

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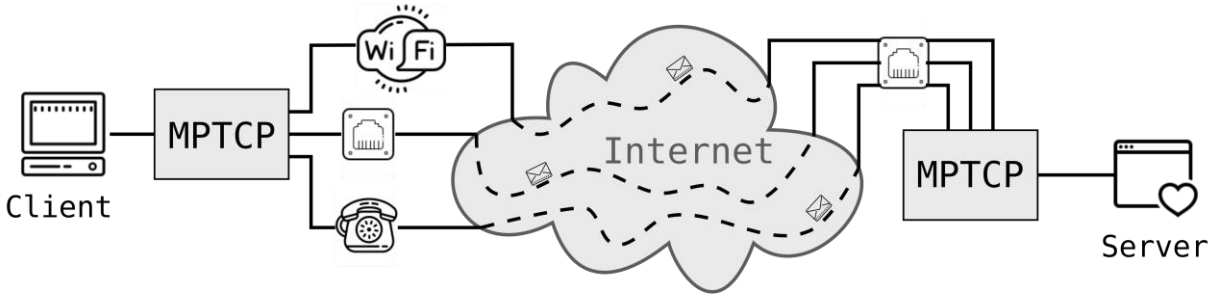
Ingredients?

TCP (Transmission Control Protocol)

- Dominant transport protocol in today's Internet
- One path per connection

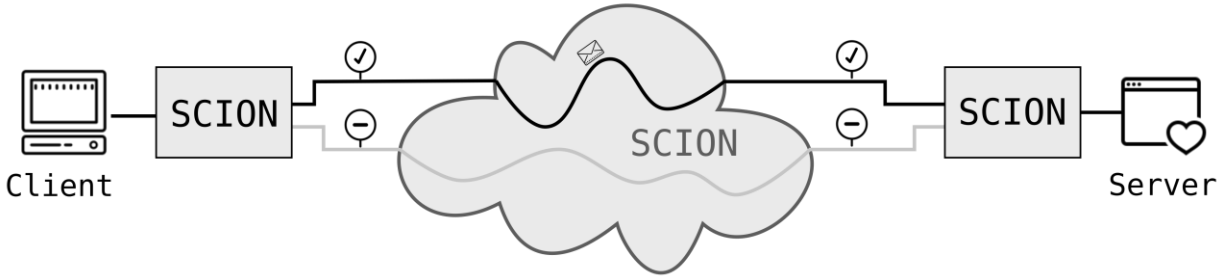
MPTCP (Multipath TCP)

- Extension to TCP
- Multiple paths (flows) per connection



SCION (Scalability, Control and Isolation on next-generation networks)

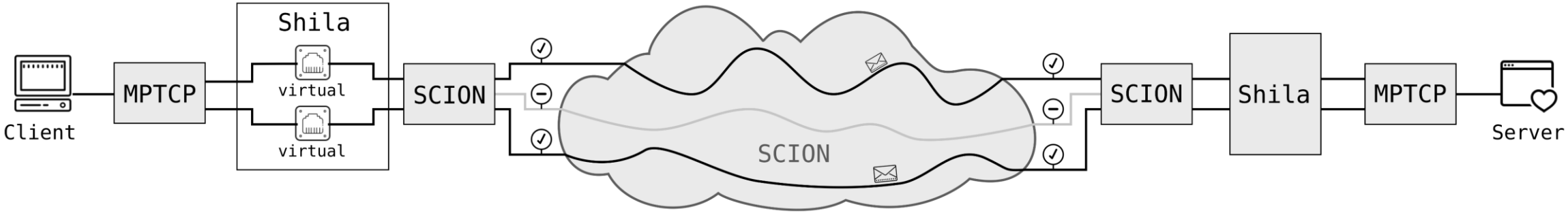
- More secure network architecture
- Implements path transparency
- Support for multiple paths



What?

Main objective and contribution of the presented work:

Implementation (and evaluation) of a shim layer that allows the usage of MPTCP over SCION.



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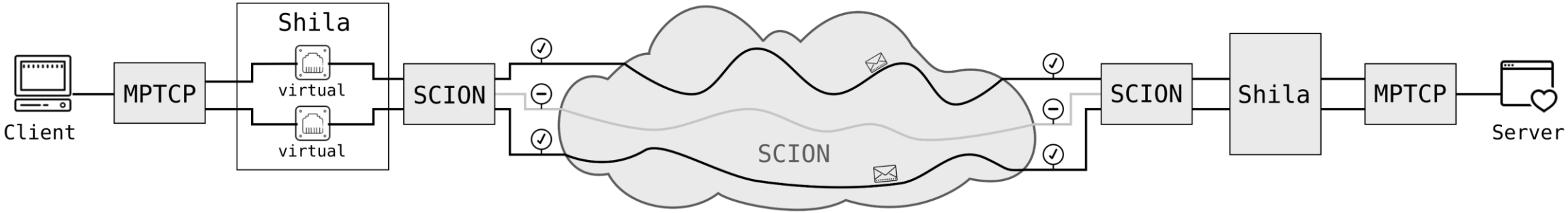

Why?

Facilitates promotion and development of SCION

› Straightforward use TCP applications over SCION

Benefit for endpoints with MPTCP support

› Increase of redundancy thanks to multiple paths

Potential through mediating role of Shila in between

› Shila is aware and under control of paths used through SCION

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- **Functionality of Shila**
- Performance evaluation
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Three Parts

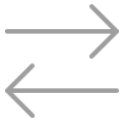
Setup

› Getting Shila ready to mediate between MPTCP and SCION

Connection establishment

› Establish the connection between the client and server of a TCP application

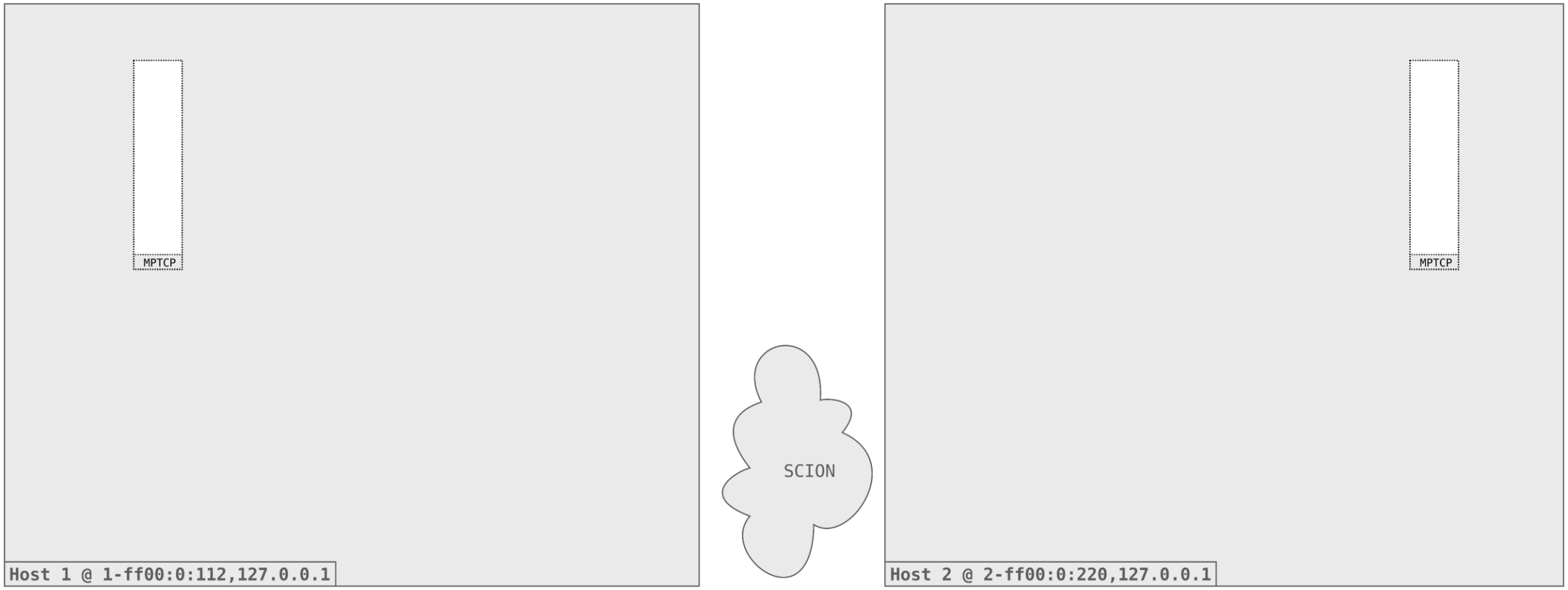
› Main-Flow and Sub-Flows



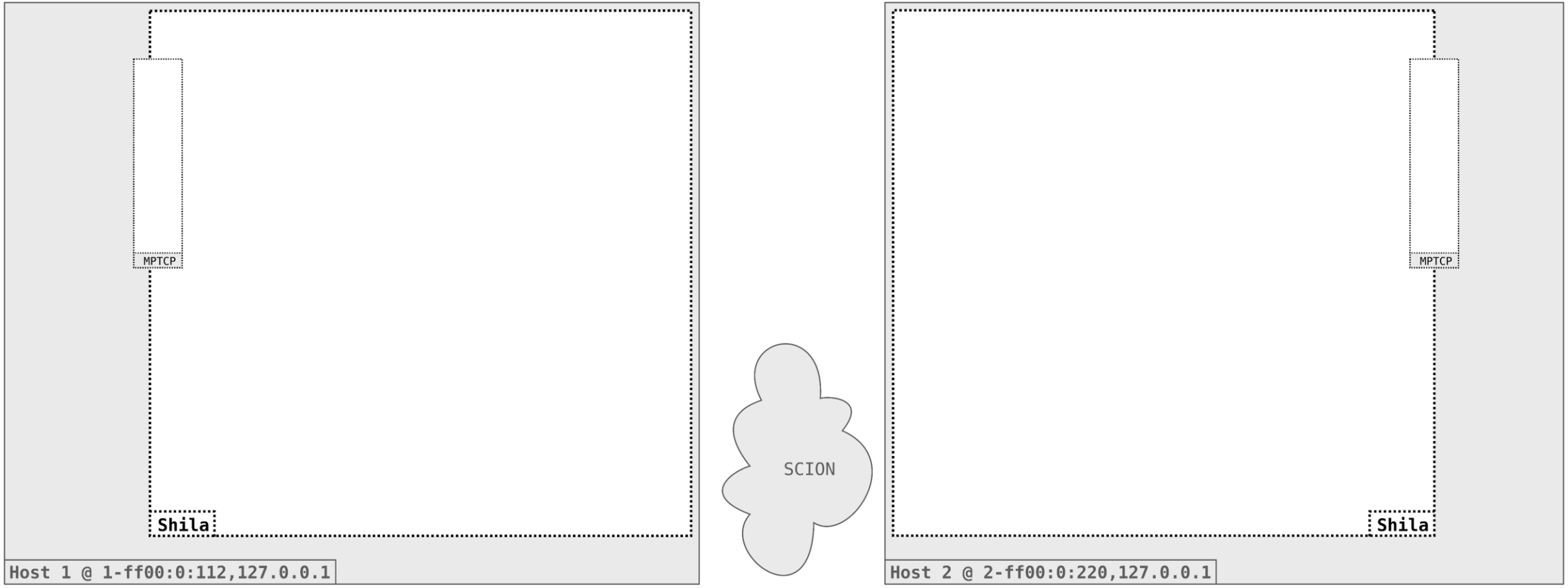
Data exchange

› Operational mode once connection is up

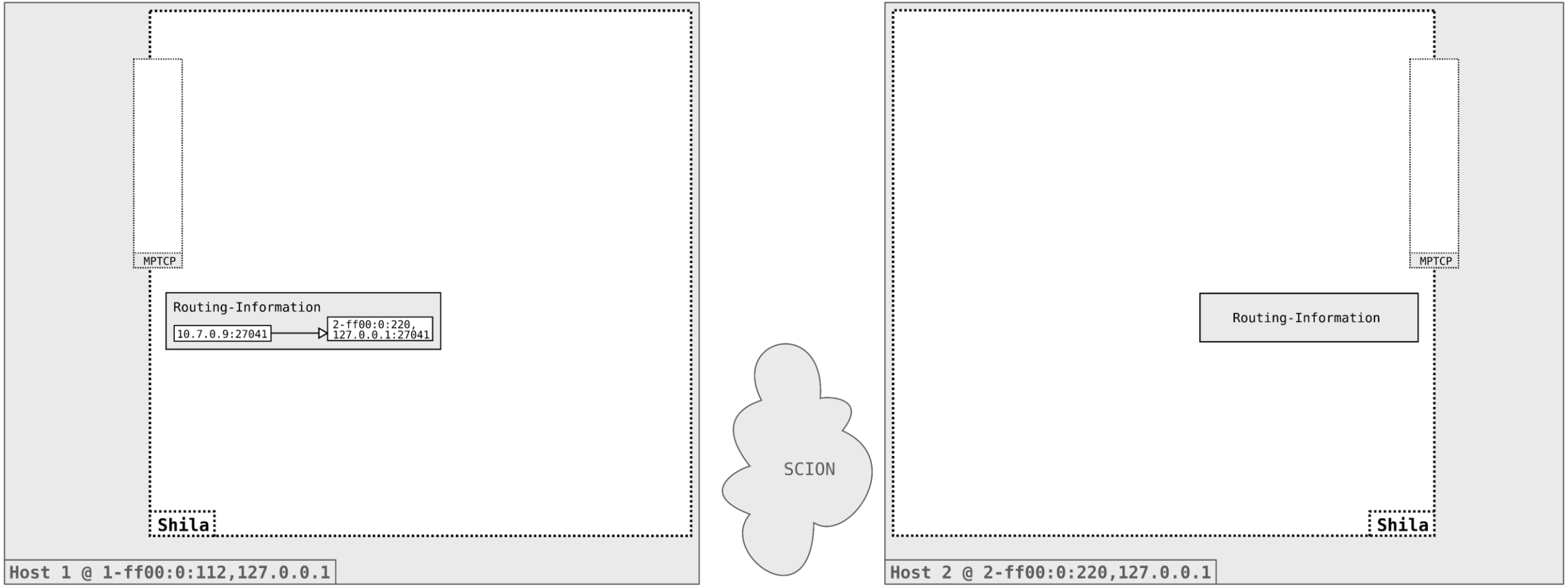
Initial situation



Setup


MPTCP
Shila
Host 1 @ 1-ff00:0:112,127.0.0.1
SCION
MPTCP
Shila
Host 2 @ 2-ff00:0:220,127.0.0.1

Setup


MPTCP
Routing-Information
10.7.0.9:27041
2-ff00:0:220,
127.0.0.1:27041
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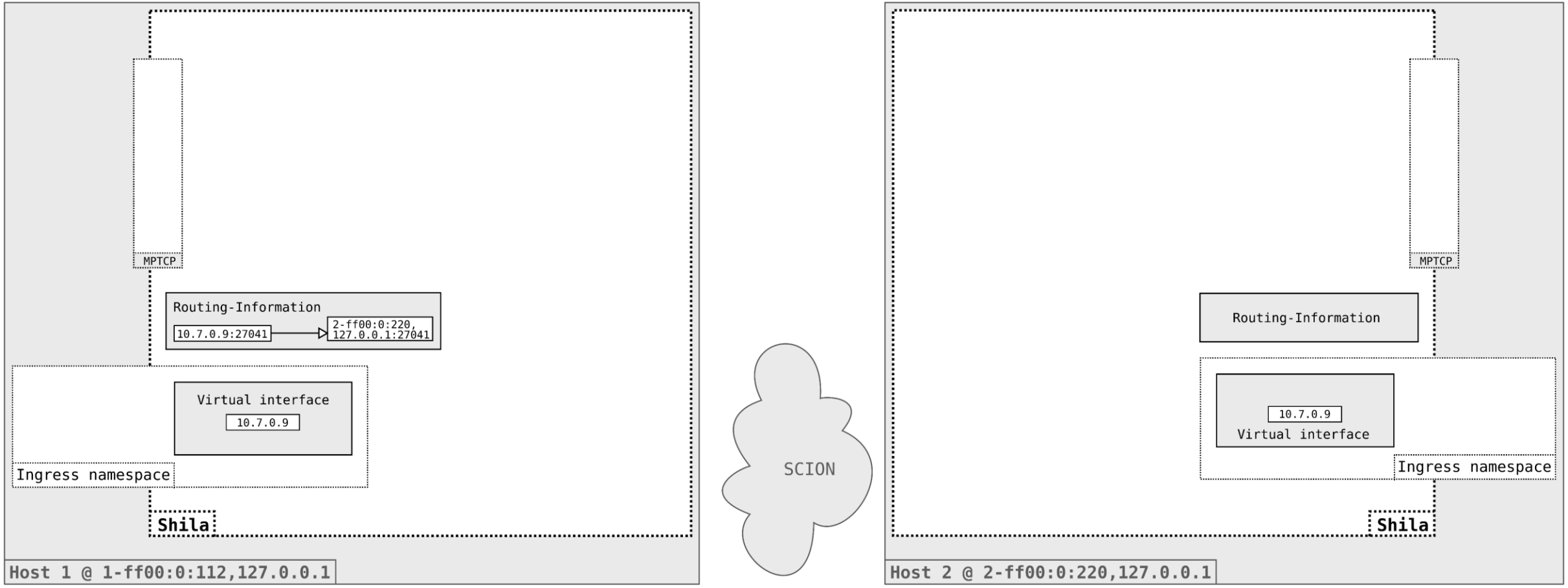
Setup


MPTCP
Routing-Information
10.7.0.9:27041
2-ff00:0:220,
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Virtual interface
10.7.0.9
Ingress namespace
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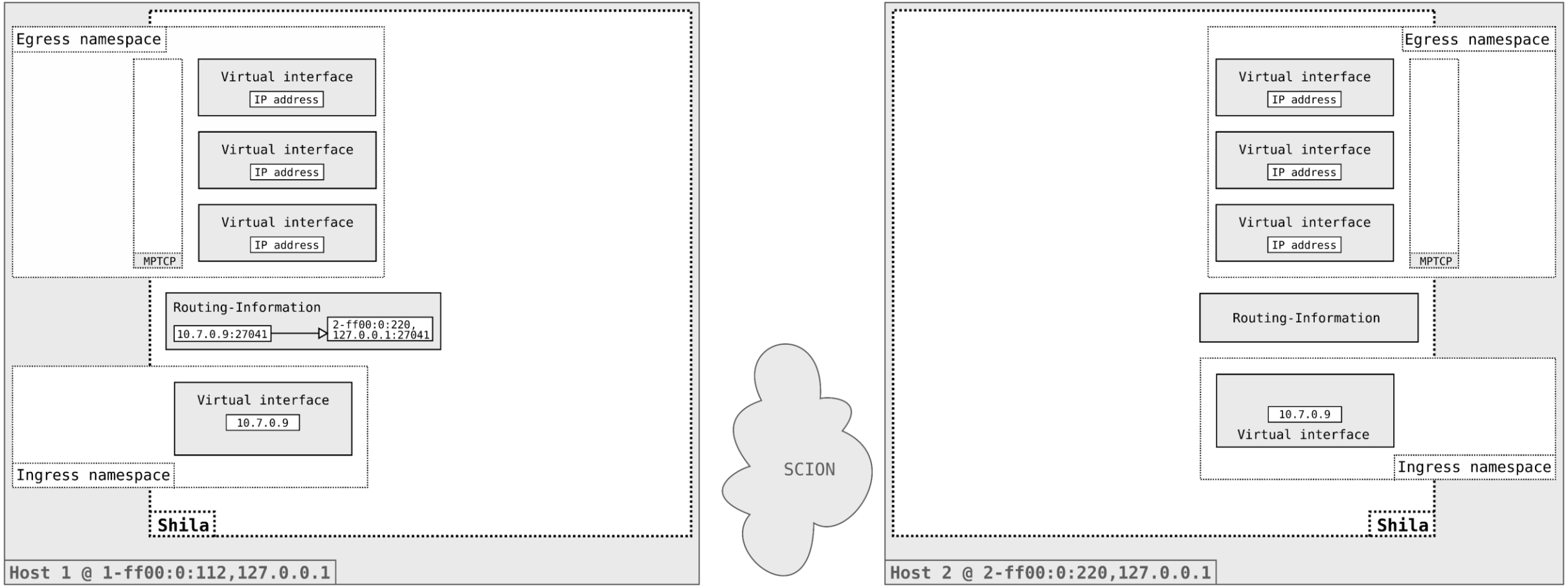
Egress namespace
Virtual interface
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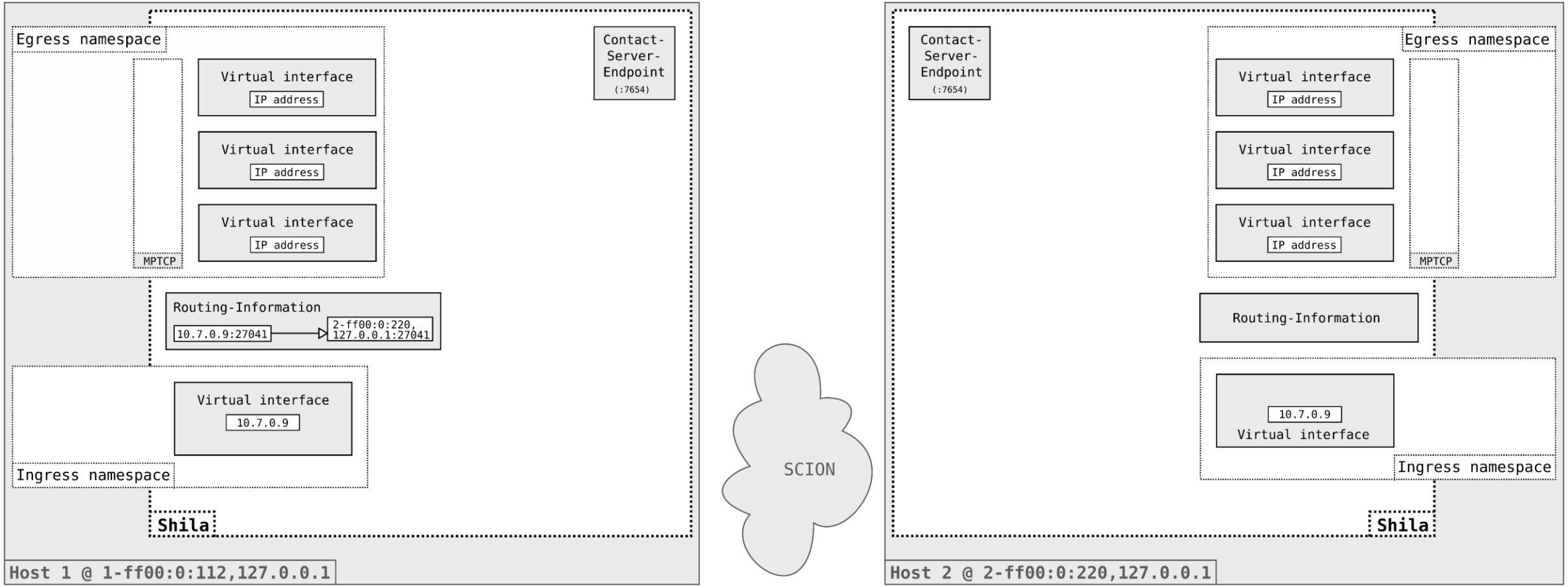
Egress namespace
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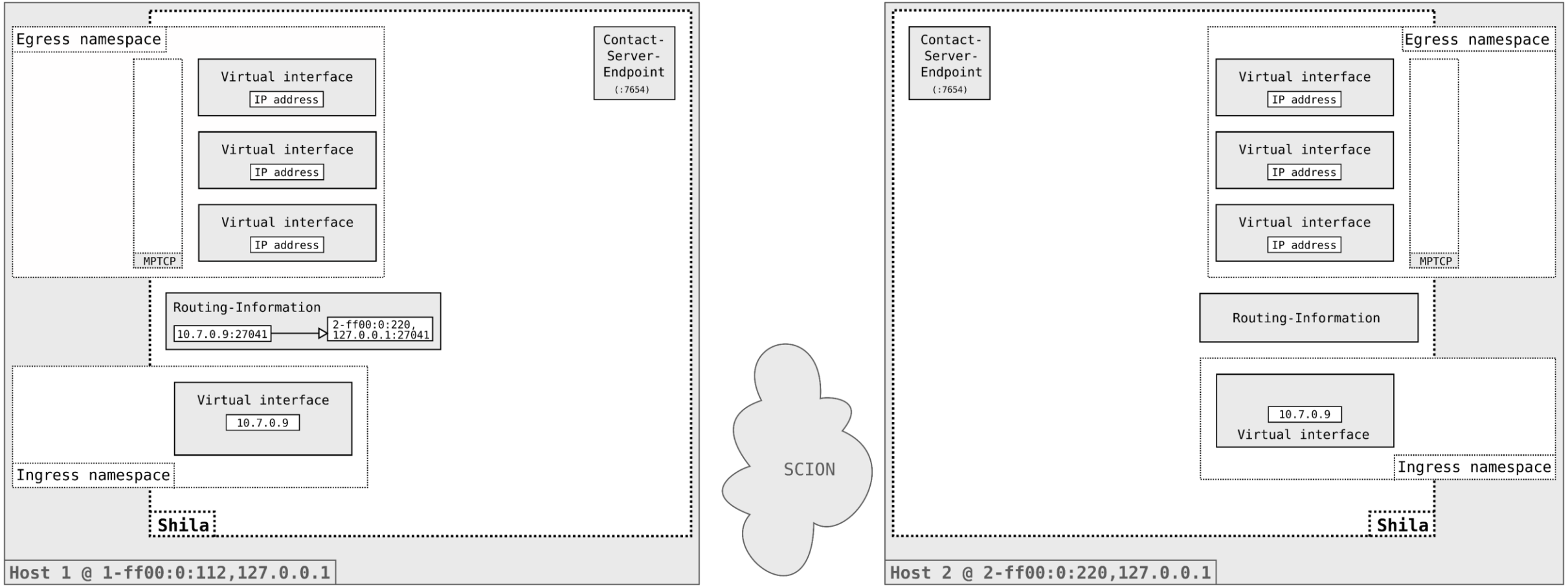
Main-Flow Establishment



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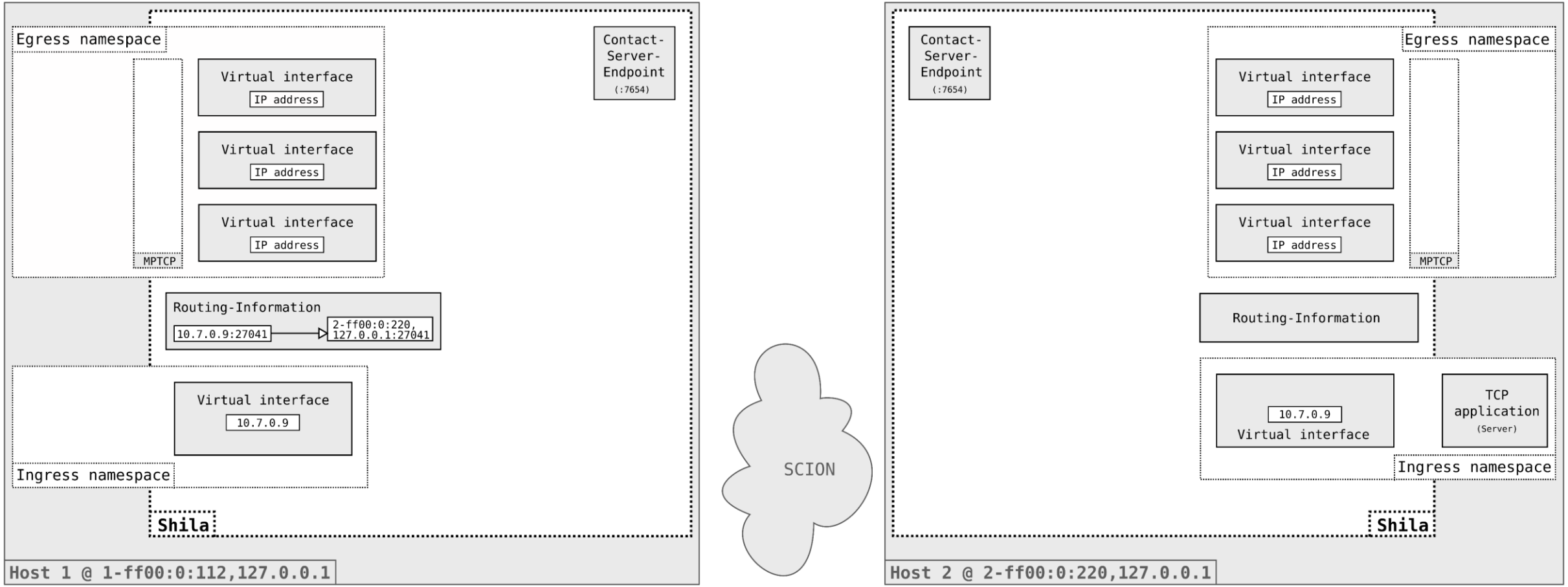

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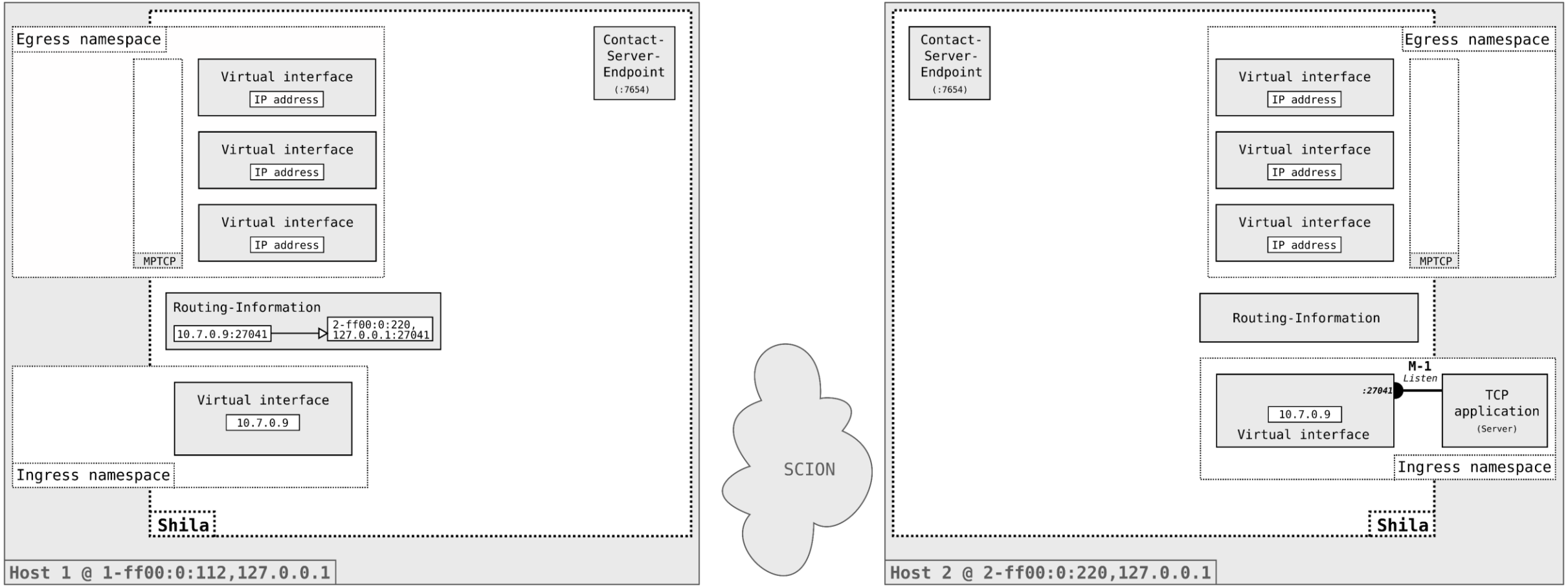

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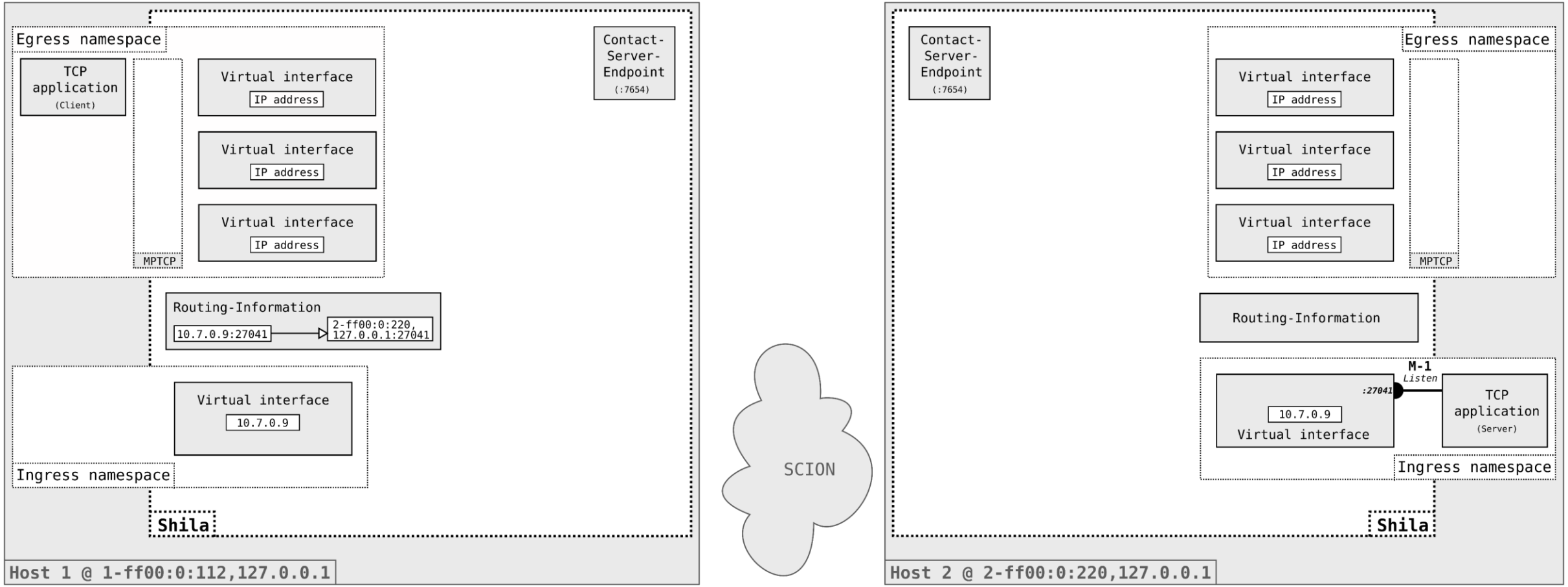

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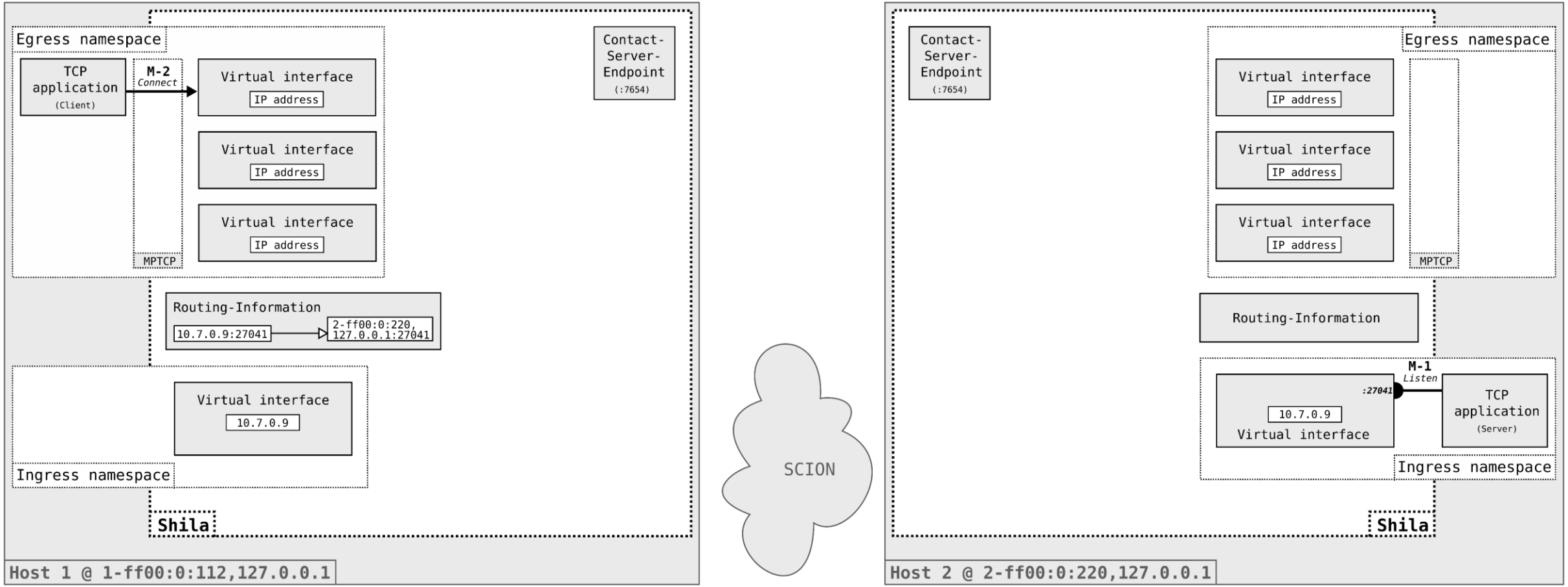

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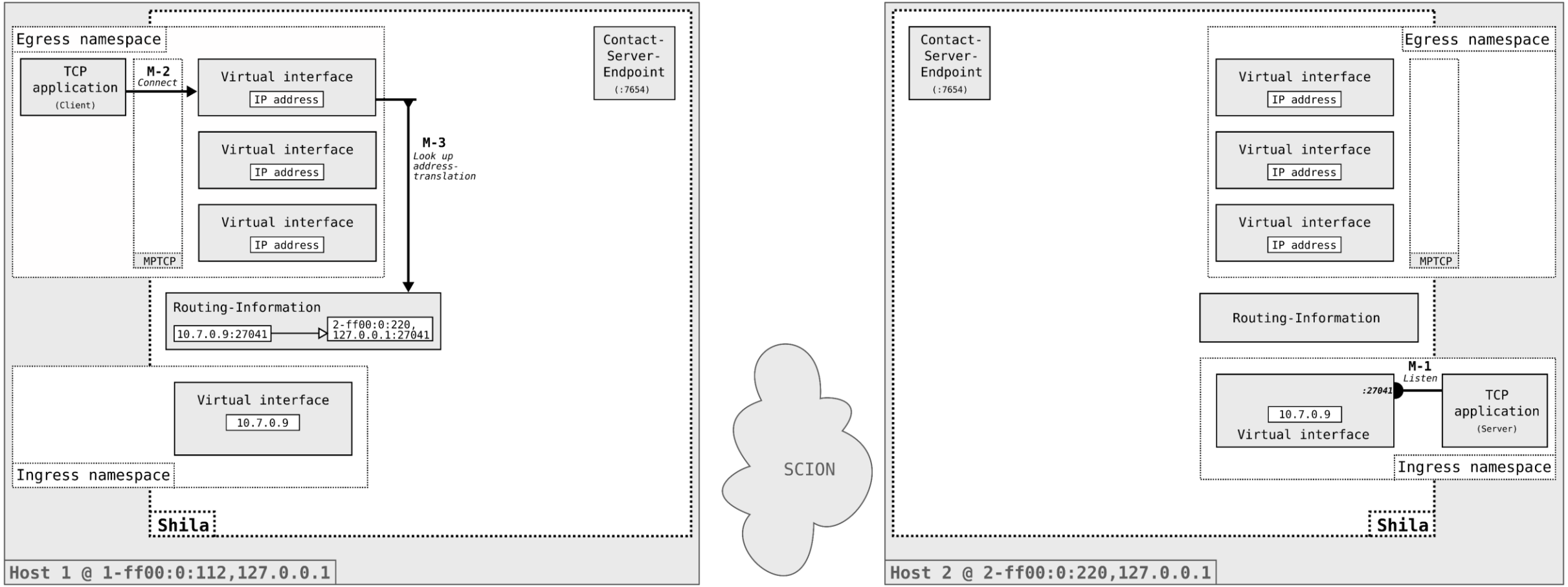

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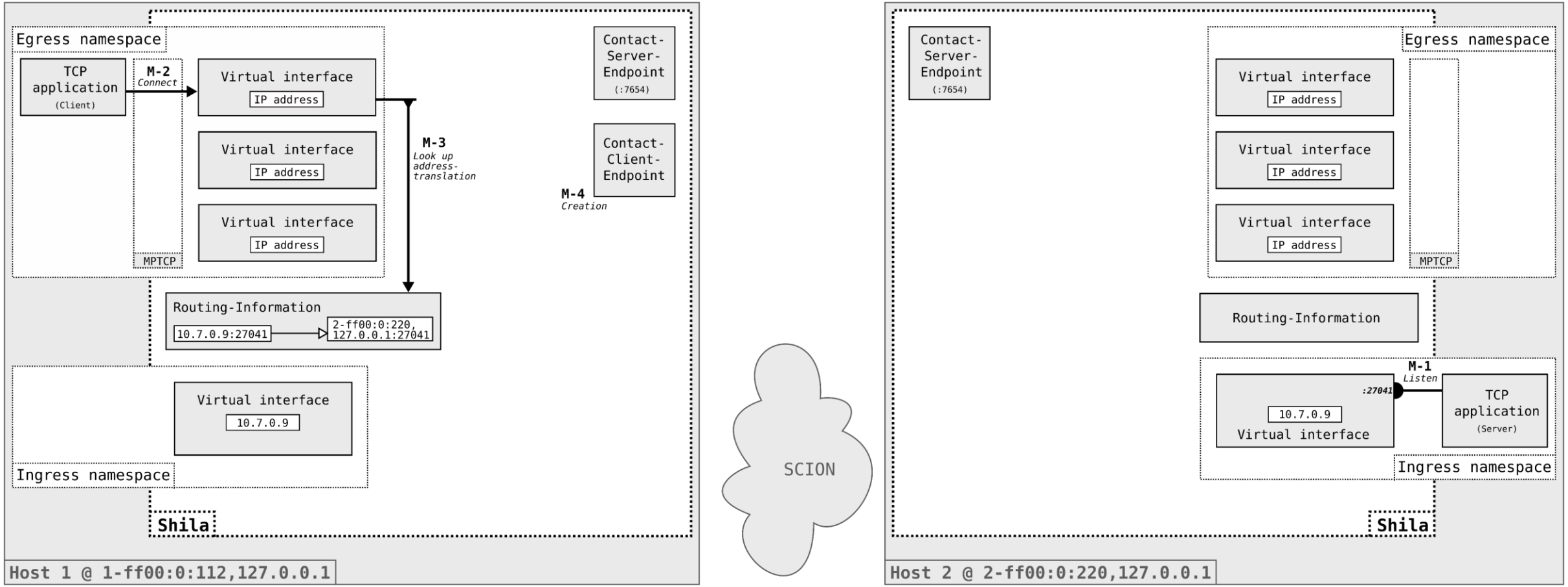

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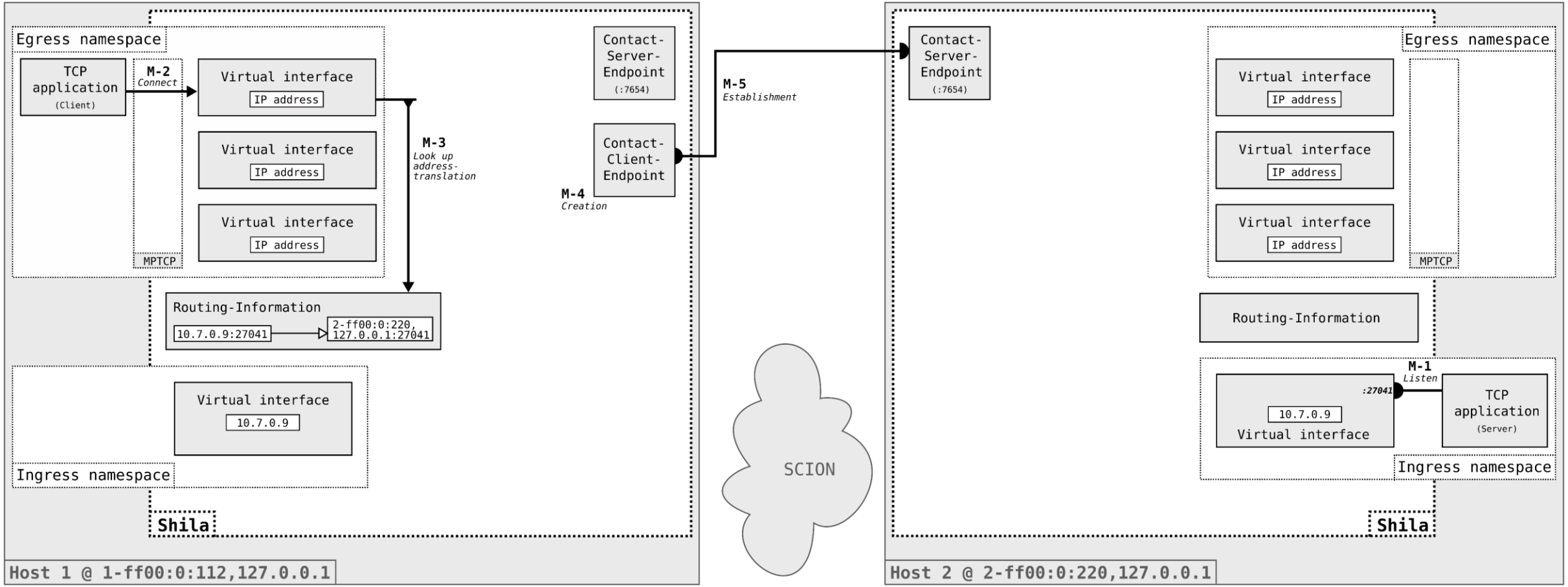

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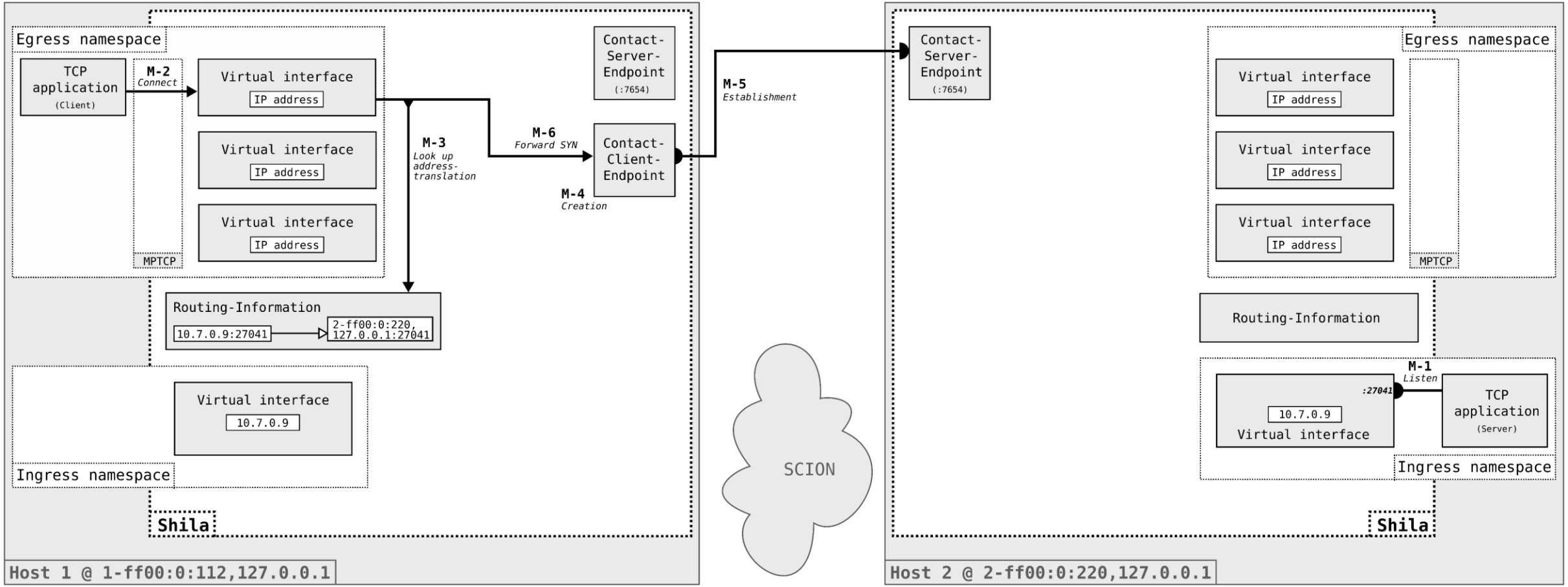

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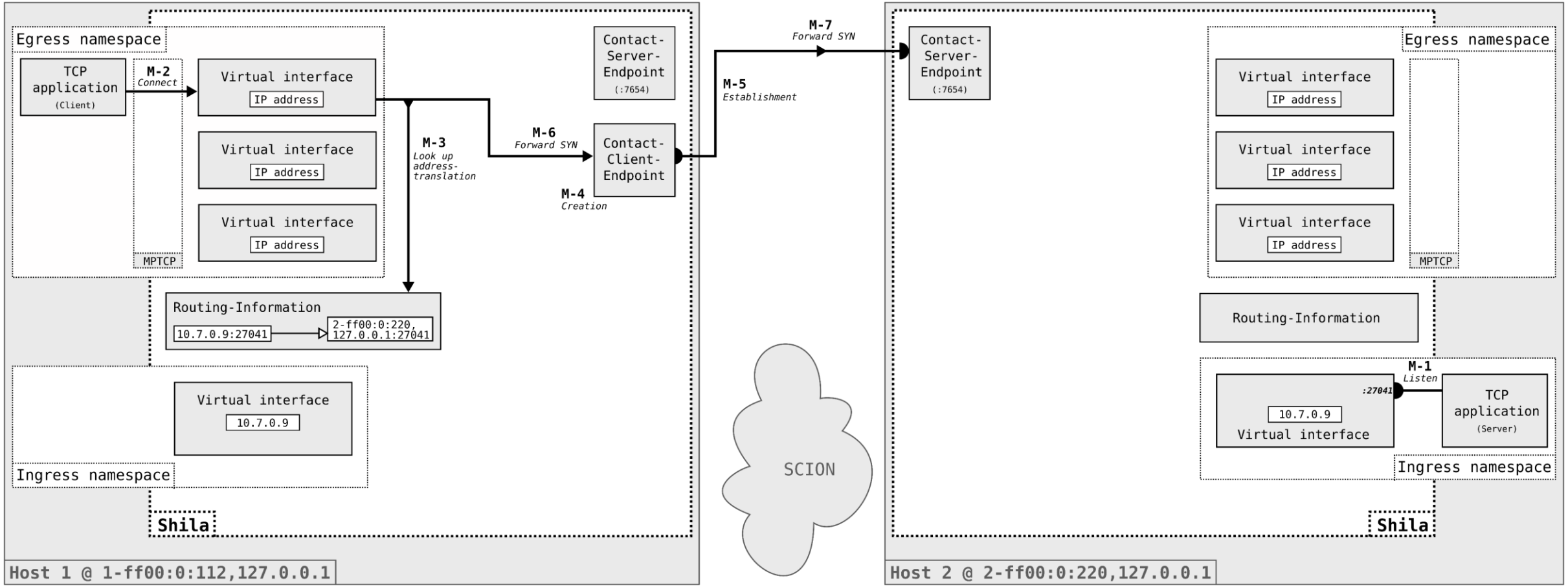

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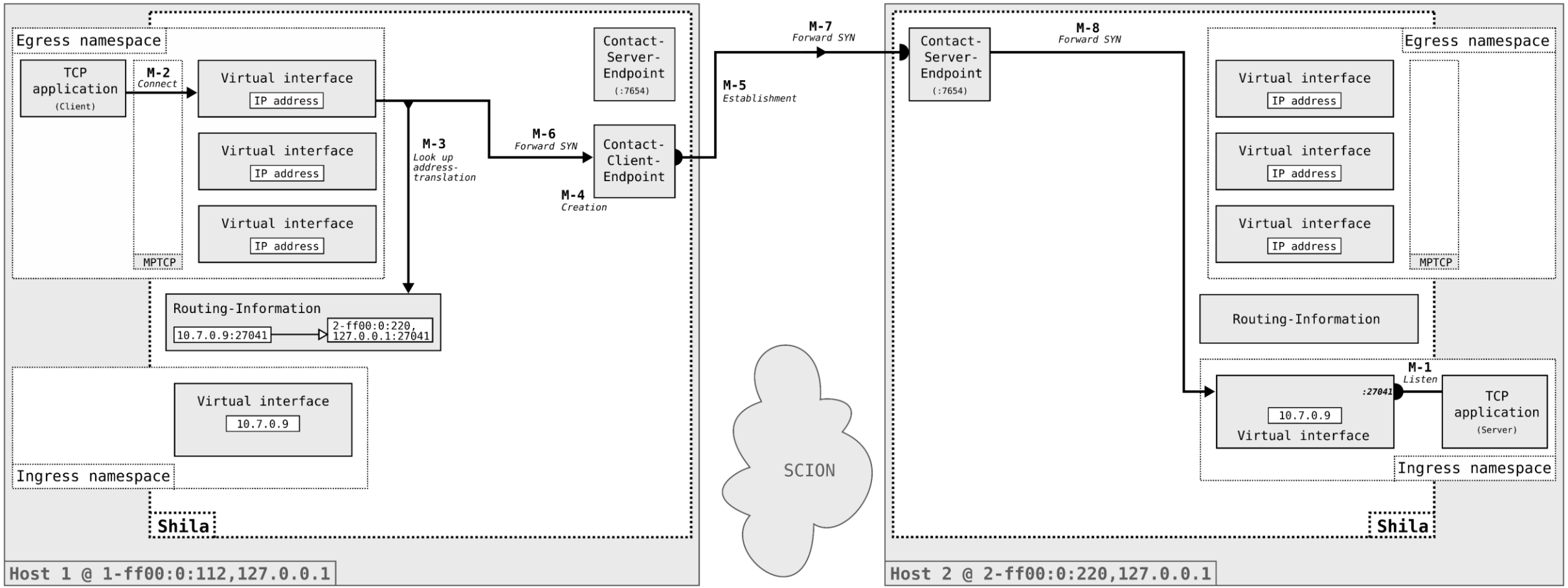

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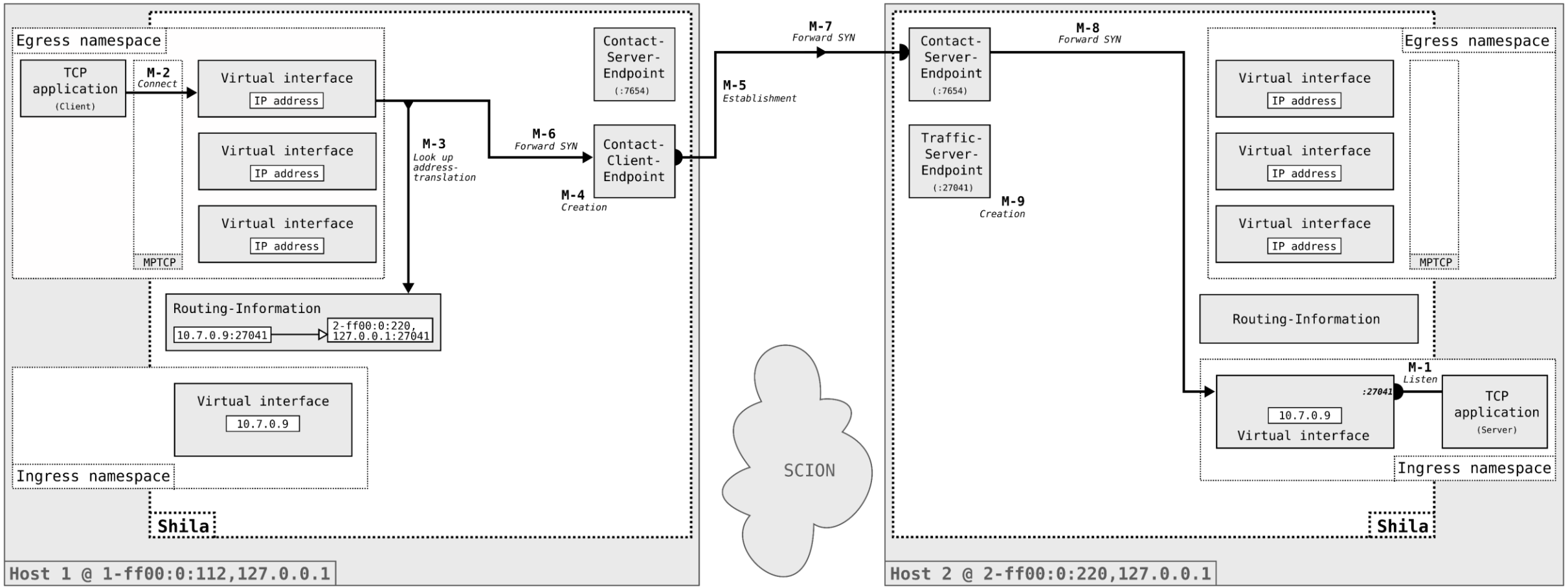

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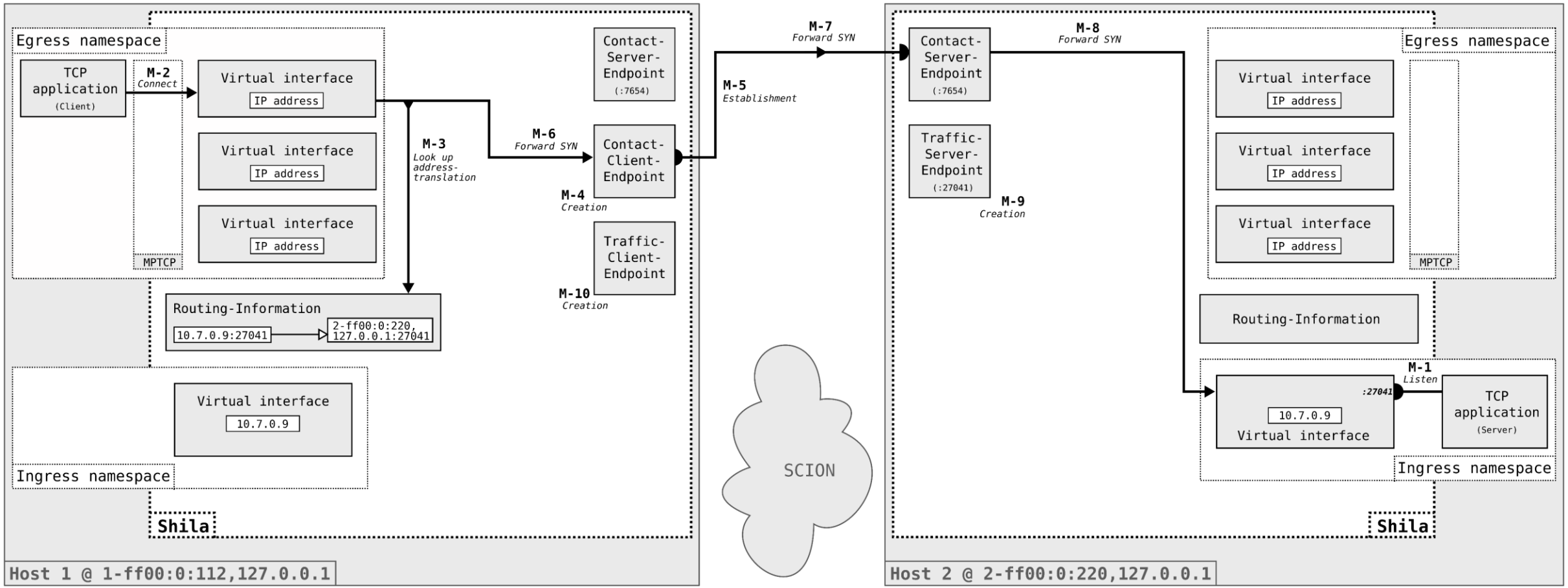

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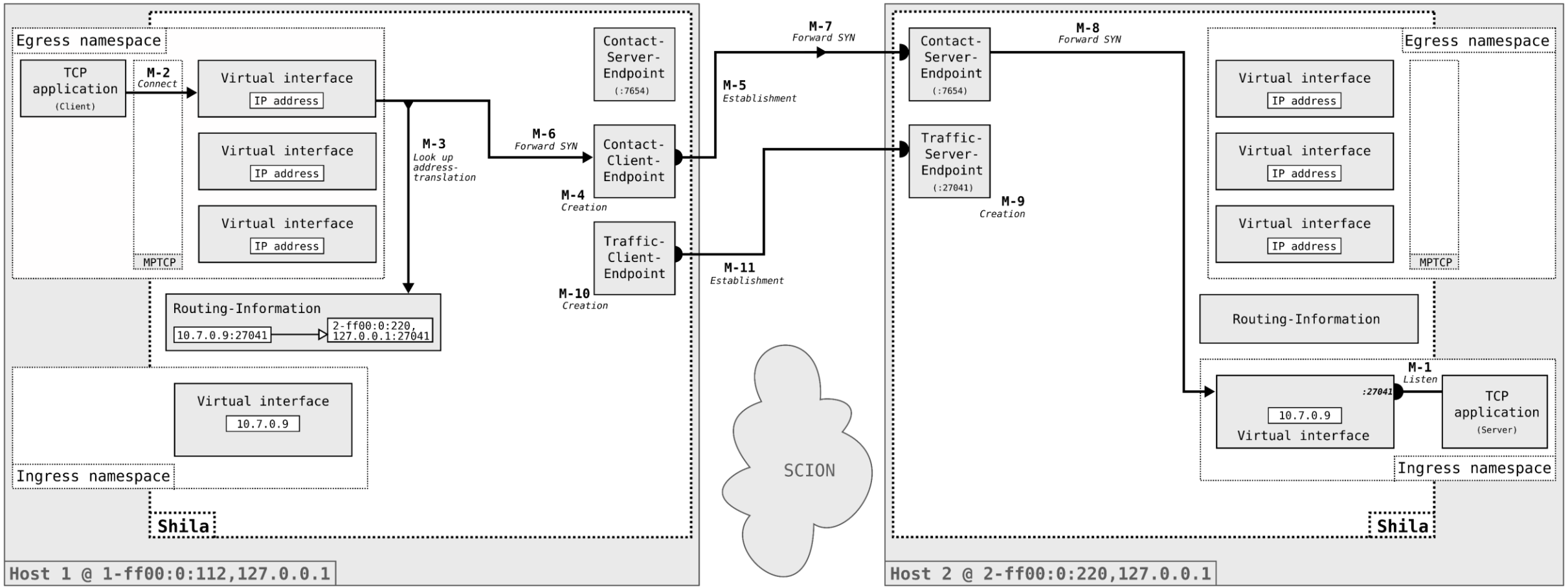

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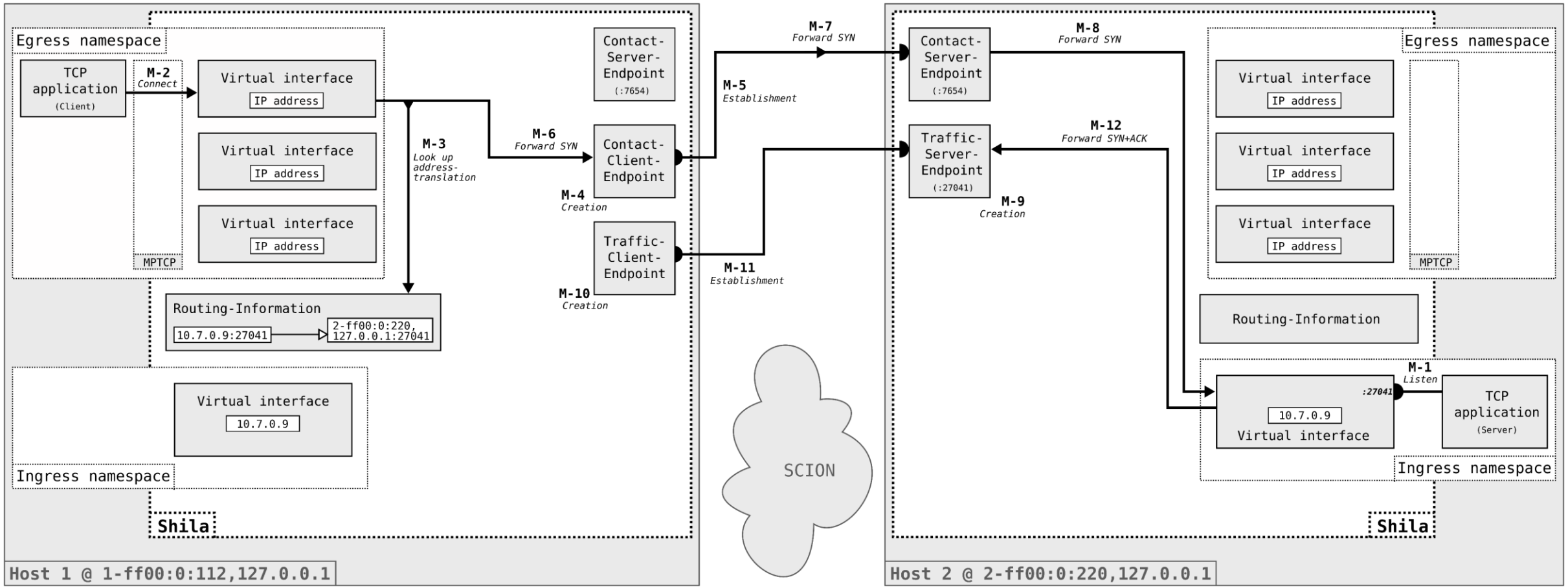

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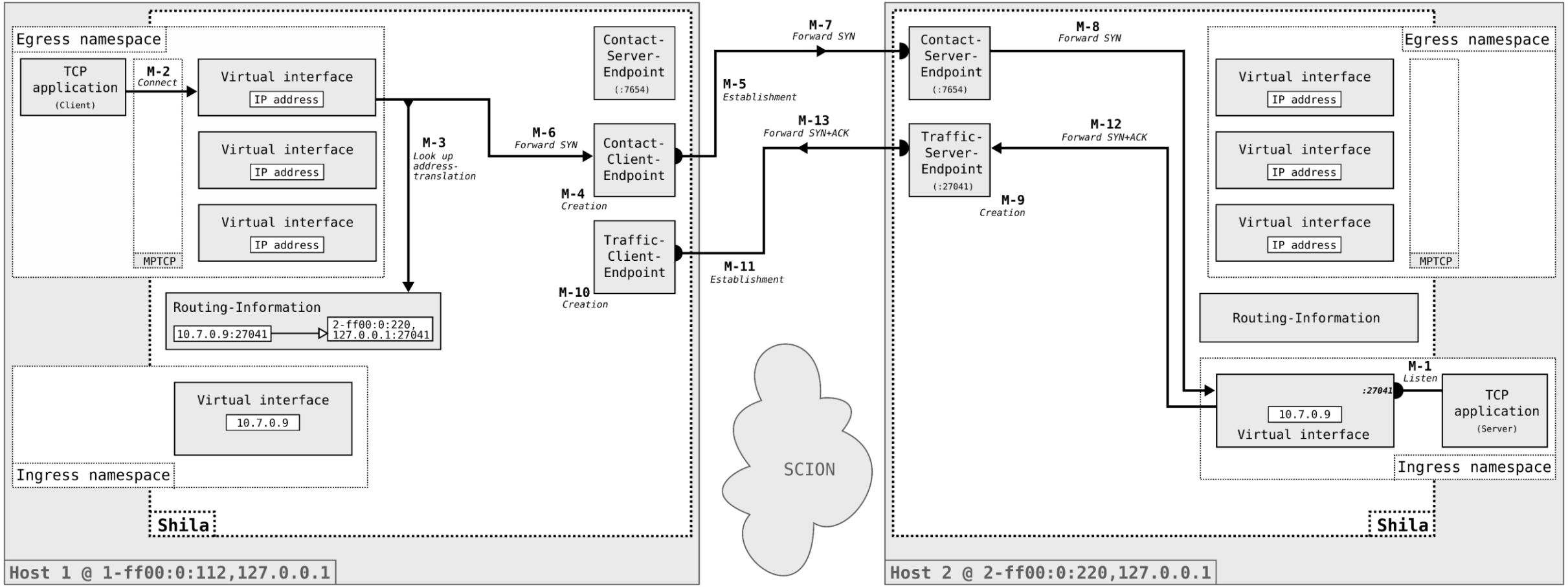

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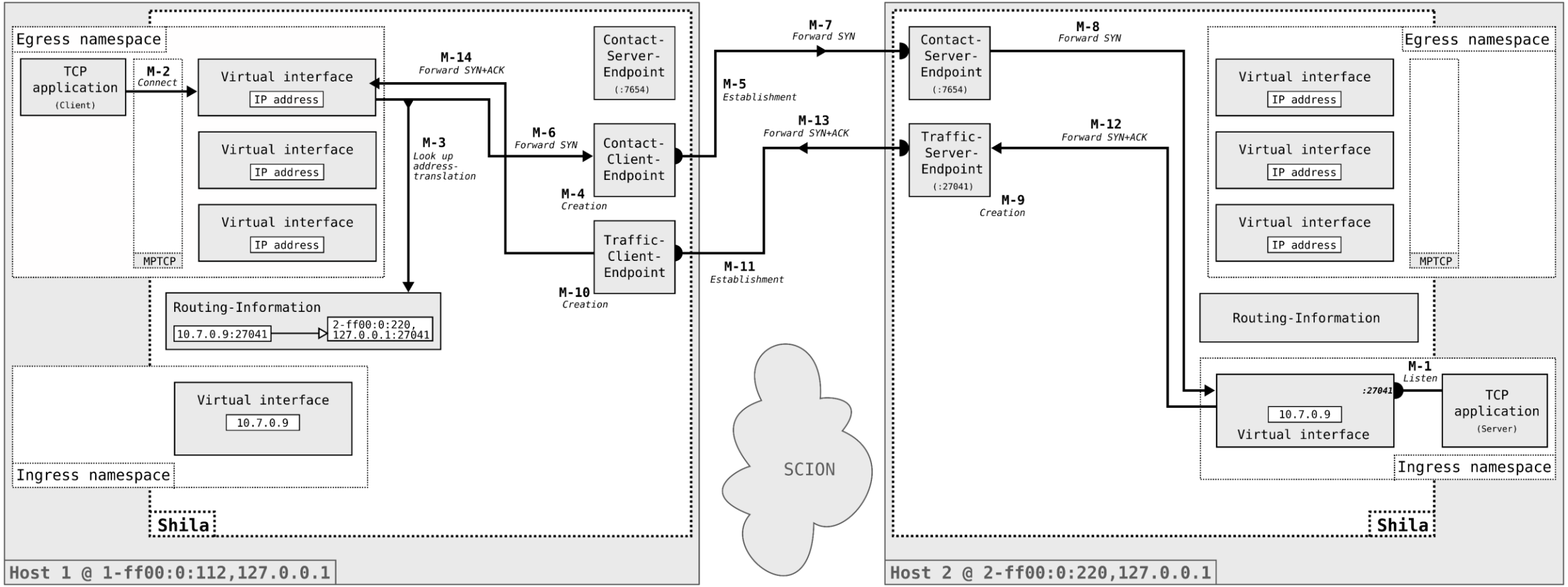

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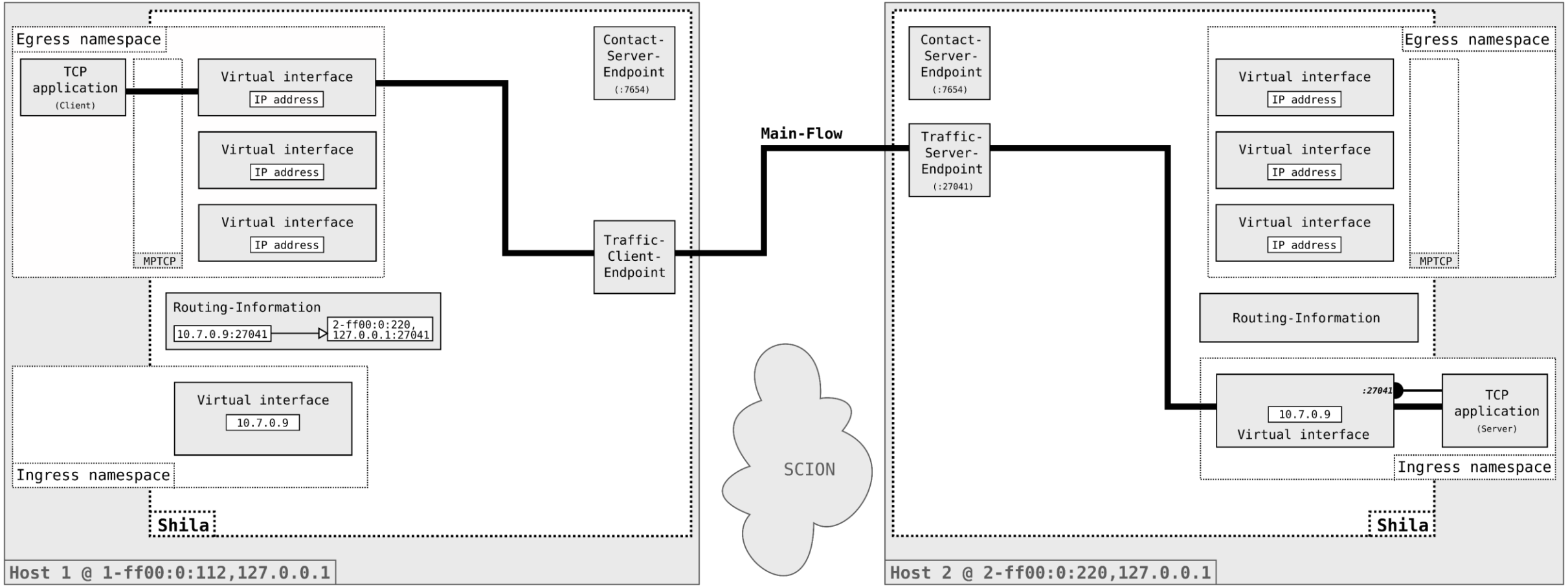

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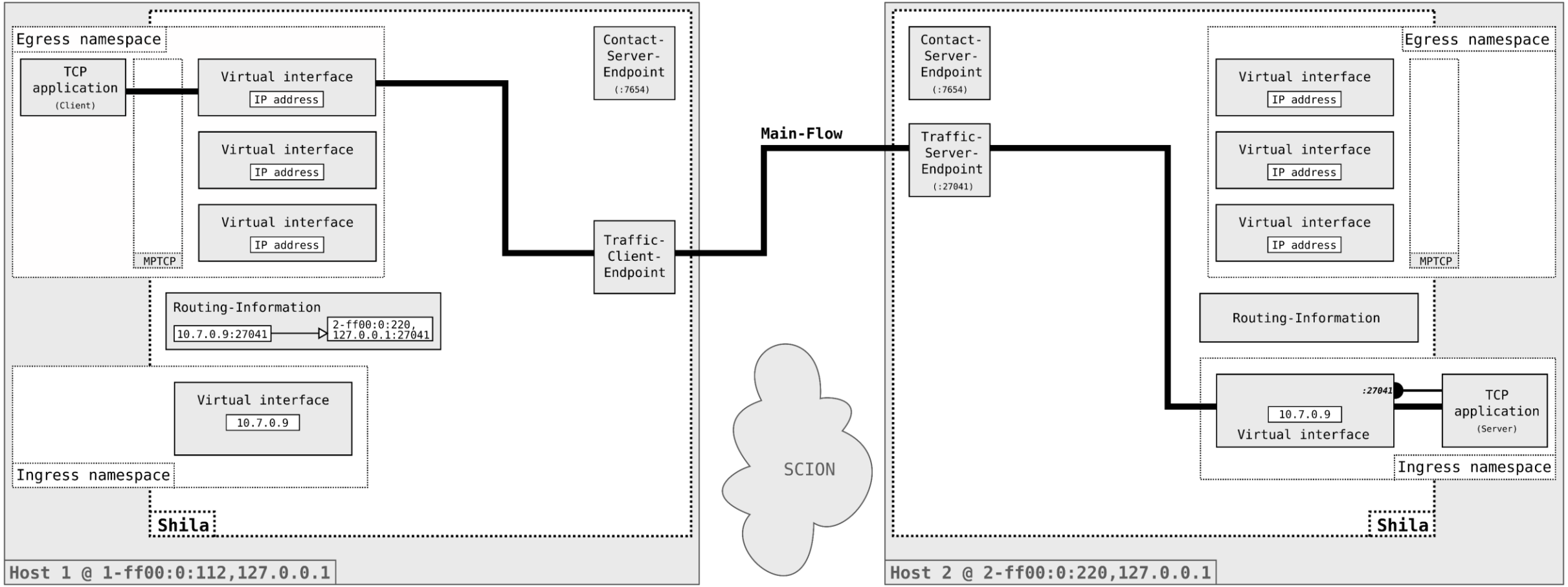

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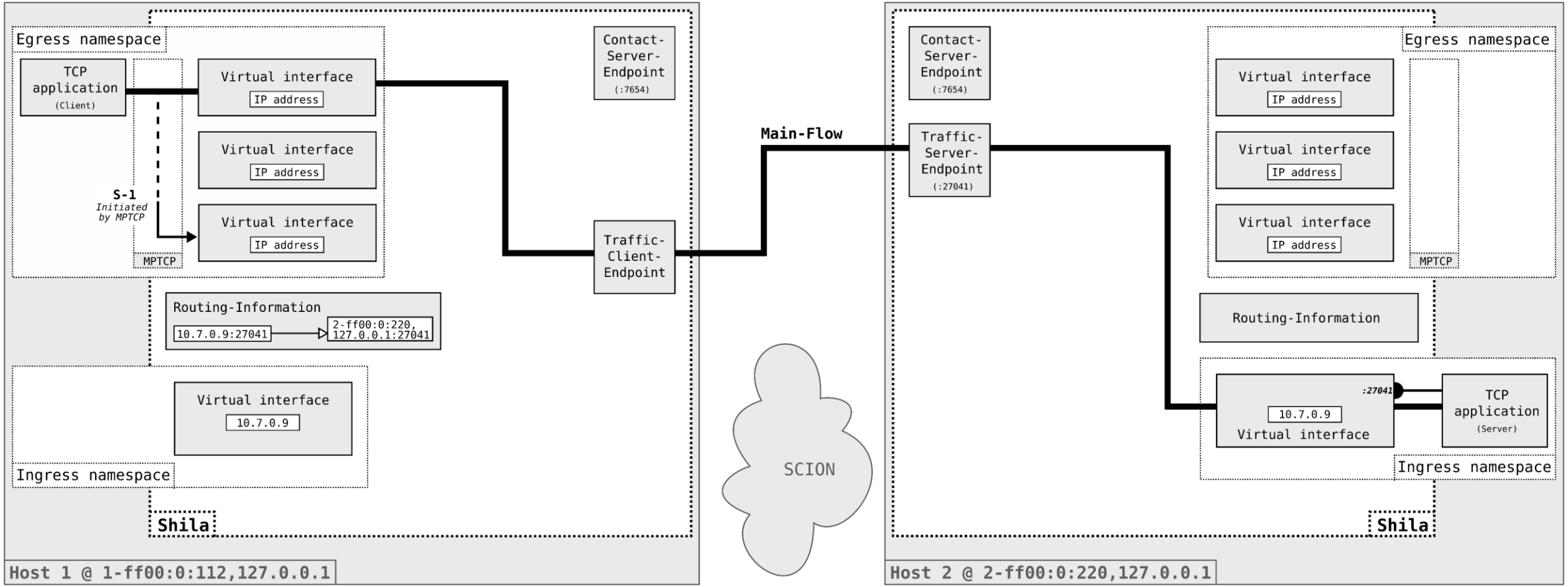

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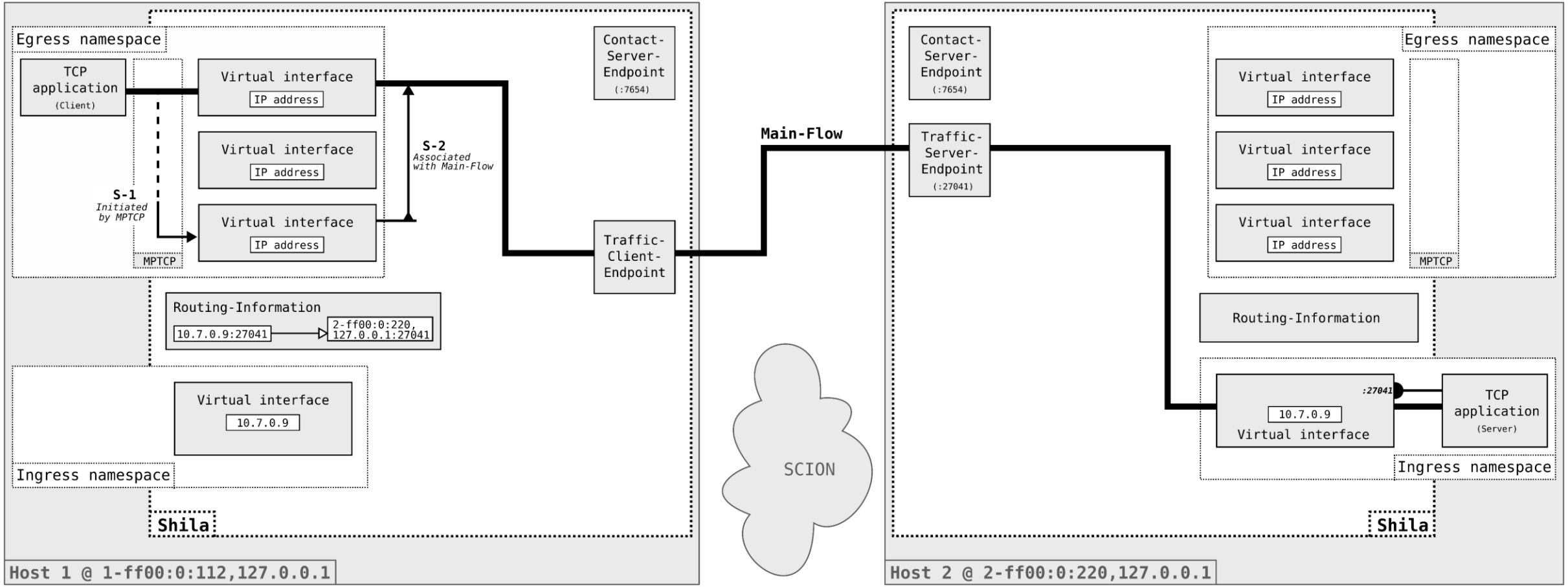

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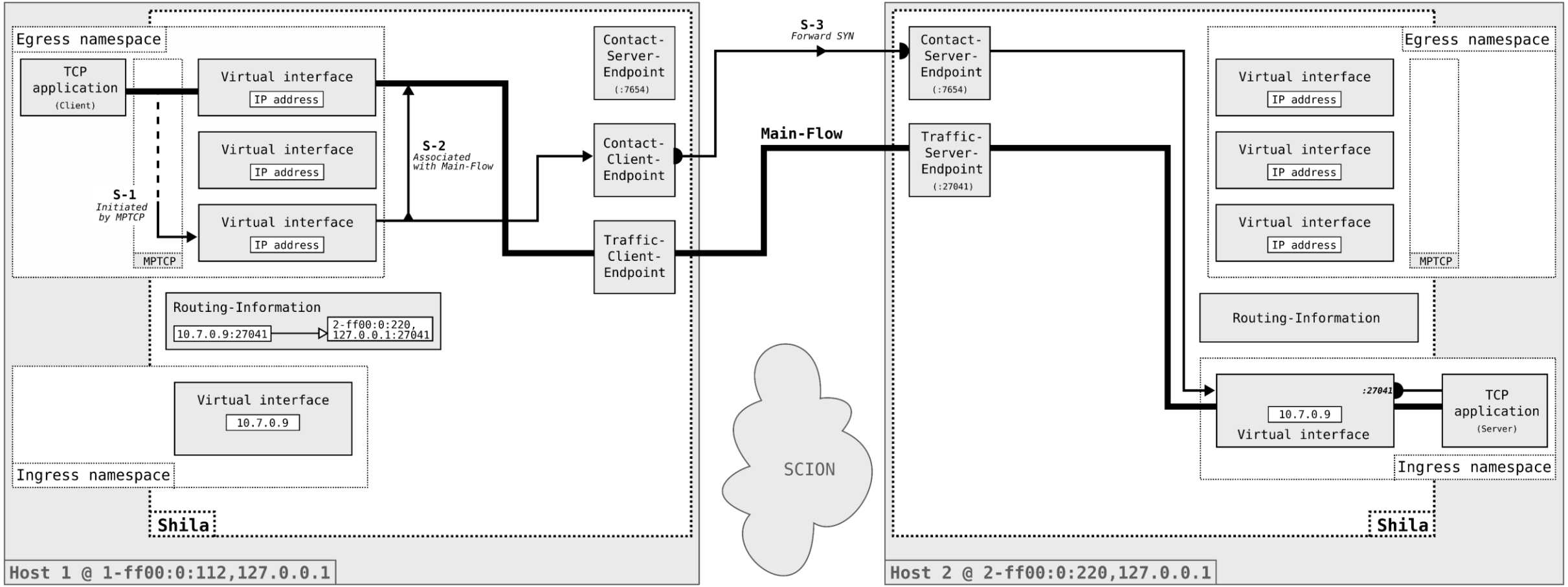

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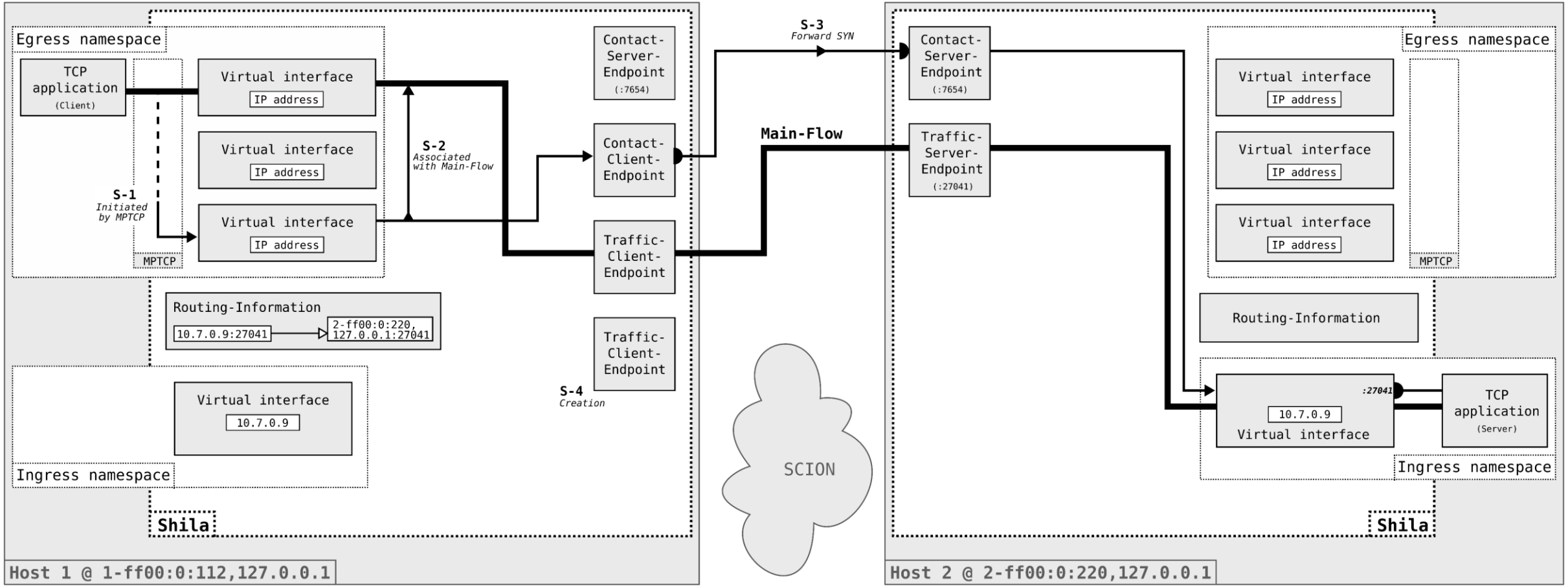

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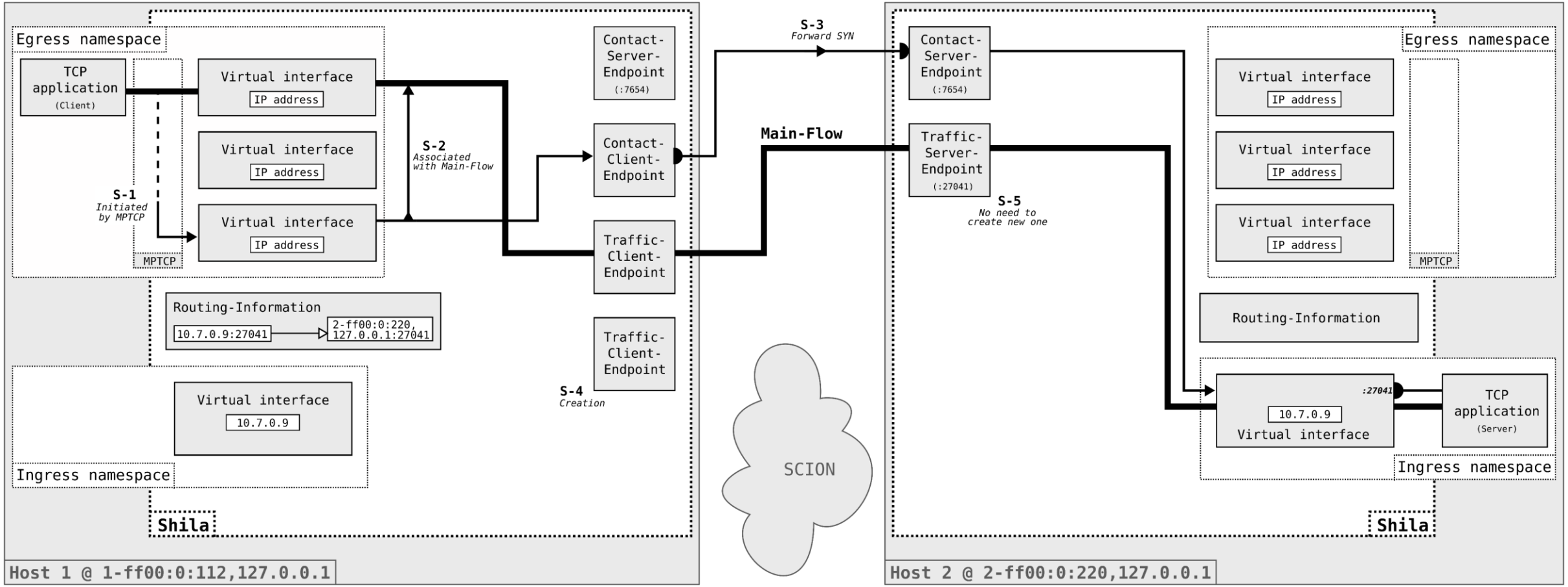

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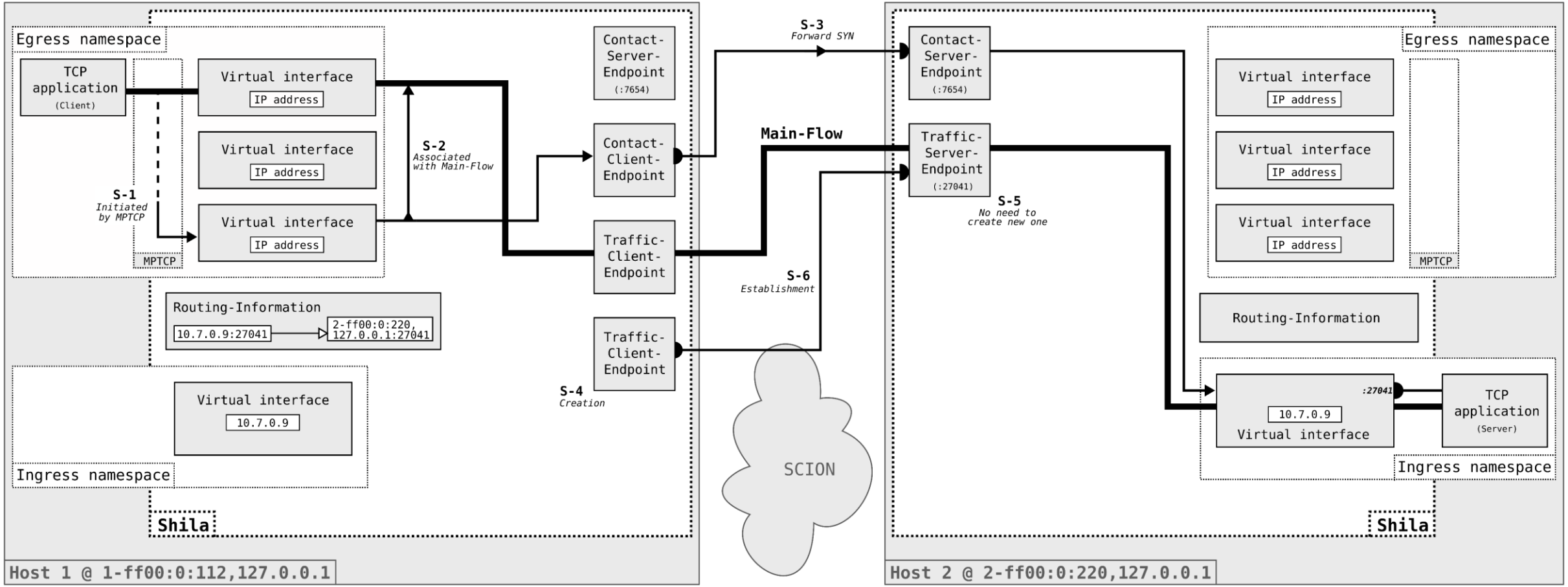

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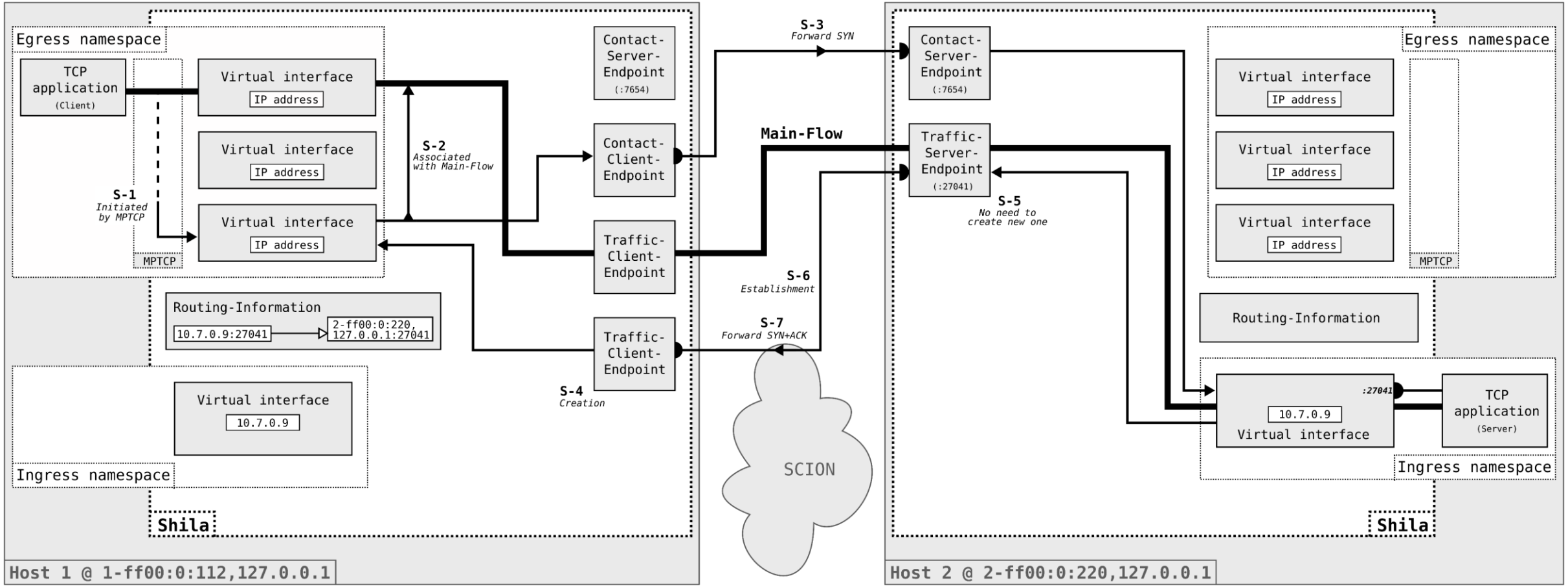
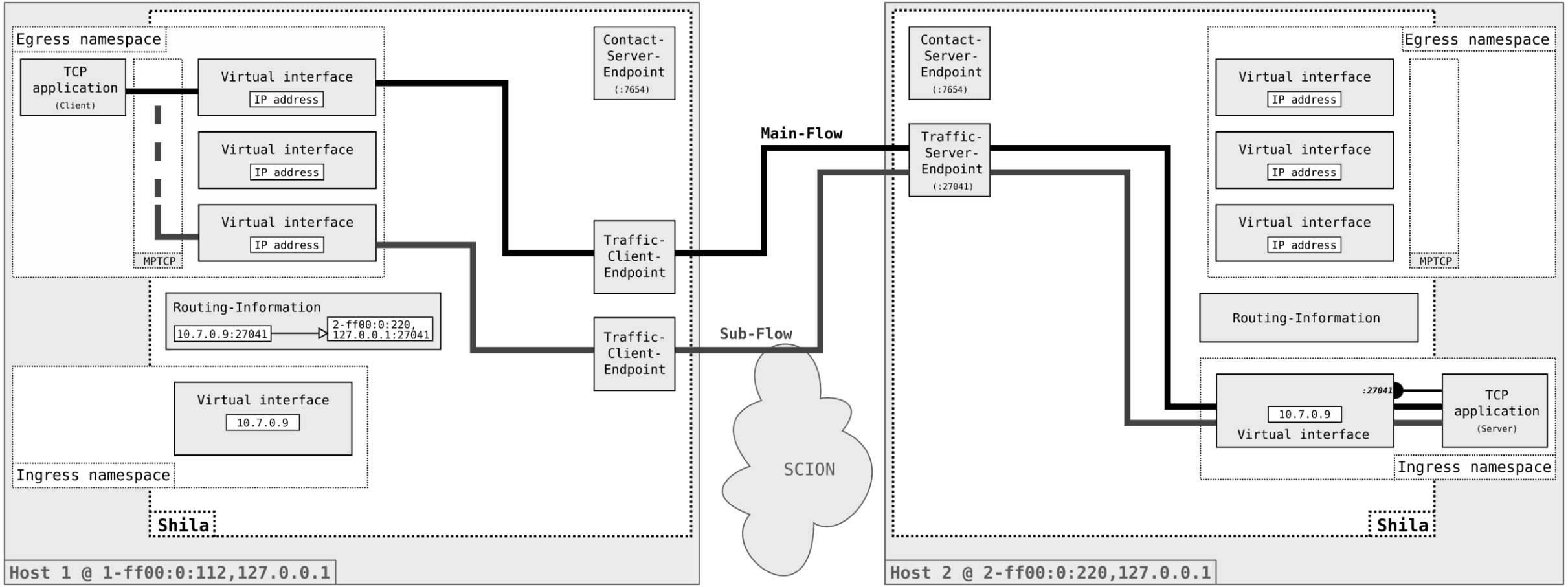


Data Exchange



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Questions of interest

How does the performance behave in relation to the number of paths used for a connection?

How well does Shila perform compared to QUIC over SCION?

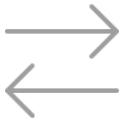
Setup

Infrastructure

- Three custom ASes within the SCIONLab
- Shorter inter-European and longer overseas connection

Measure

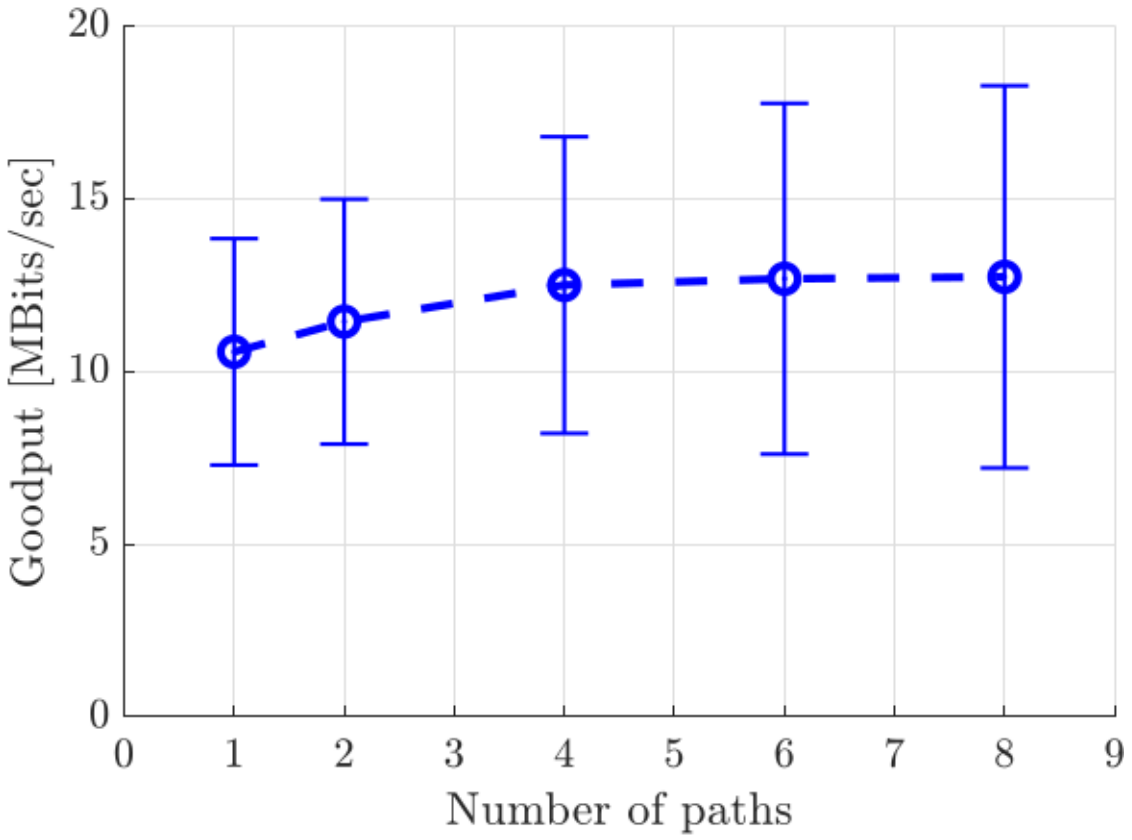
- Goodput with iPerf3 as TCP application
- Throughput computed offline from packet capture



Methodology

- Data exchange for 30s between dinstinct ASes
- Variation in the number of paths used (1,2,4,6,8)
- 10 repetitions per fixed set of parameters, random order

Result



How does the performance behave in relation to the number of paths used for a connection?

An increase in the number of paths leads to an increase of the average goodput.

Result

Paths	Shila		QUIC over SCION	
	Goodput	Throughput	Goodput	Throughput
1	10.75 ± 3.28	17.45 ± 5.91	33.31 ± 3.28	36.82 ± 3.62
8	12.74 ± 5.53	19.37 ± 8.36	-	-

MBits/s

$\approx 2.6\times$

How well does Shila perform compared to QUIC over SCION?

Shila gets outperformed by QUIC over SCION with respect to goodput as well as overhead.

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What is next?

Conduction of revision cycles

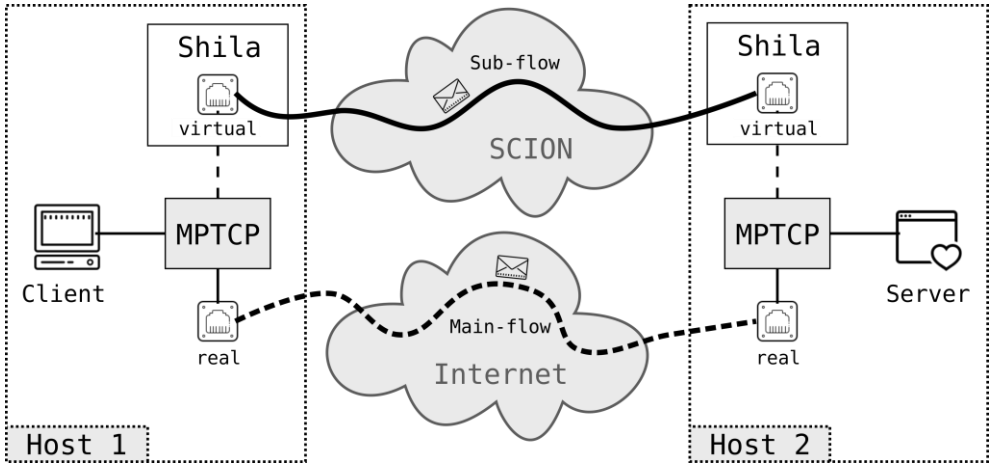
- Improve implementation of Shila
- Further testing

Addition of flexibility

- Provide mapping betwenn TCP and SCION destination address upon connection establishment
- Remove need for namespaces

Side-by-side approach

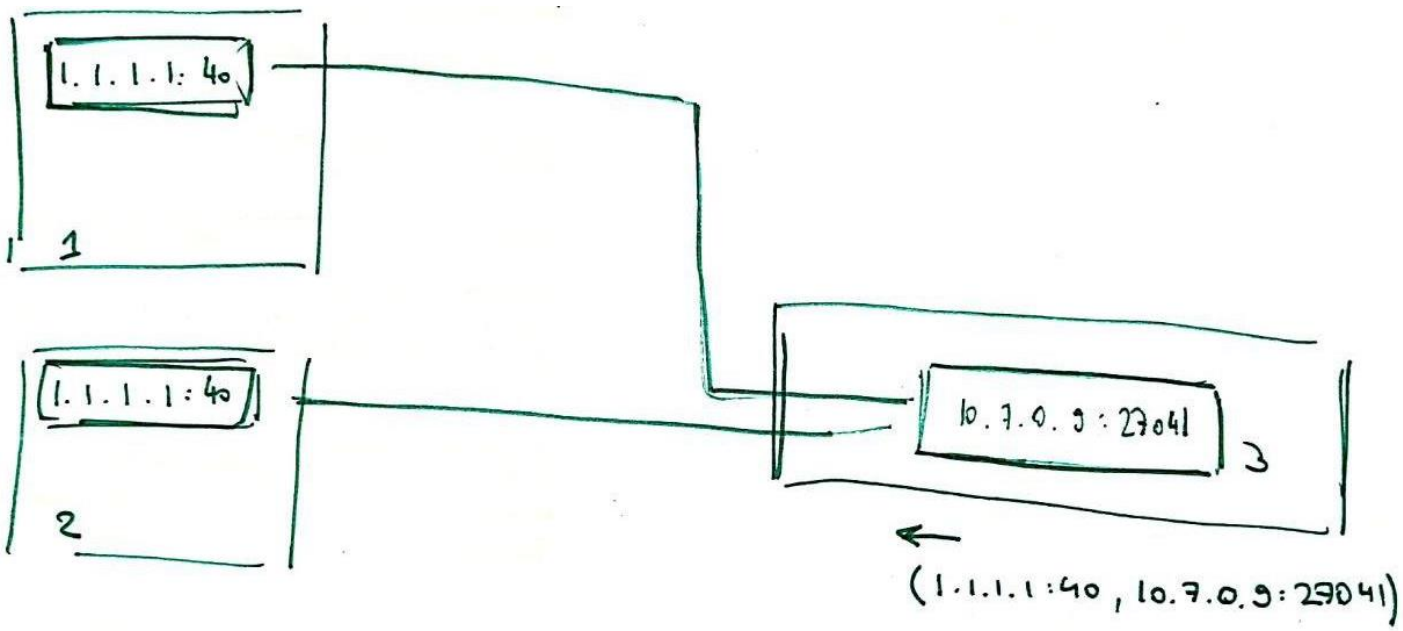
- Main-flow over conventional Internet
- Sub-flow(s) over SCION



Thank you.

Notes

Random Egress IP's

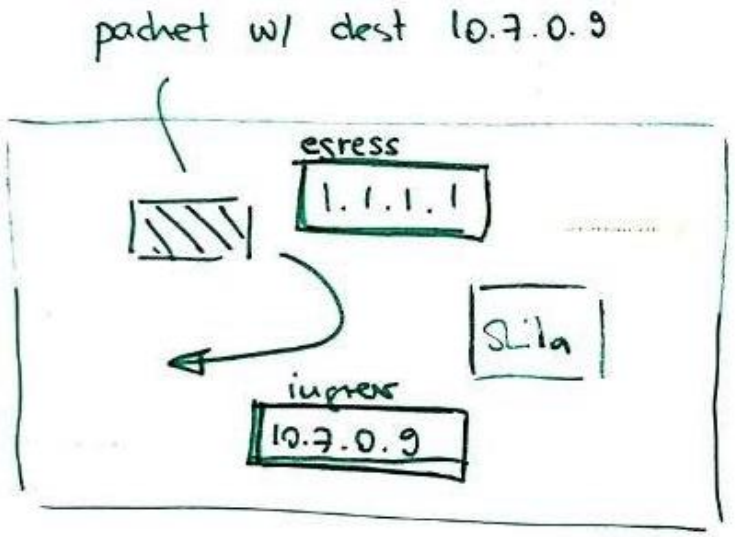


↳ need to be able to map TCP to Backbone-Connection.

↳ SCION host (does) could not accept request from different SCION with already observed src TCP address.

Notes

Why namespaces?



→ is possible, but needs unique ip for every hosts ingress virtual interface.

→ ip address part of SCION not necessarily unique between different ASes

→ not scalable

→ don't wanted to mix w/ local routing.

↳ if inside namespace choice doesn't matter.