VPP PLUS Middlebox

Tobias Bühler - 30.01.2018

Cambridge Mami meeting

https://github.com/mami-project/vpp-plus

measurement and architecture for a middleboxed internet

measurement | architecture | experimentation

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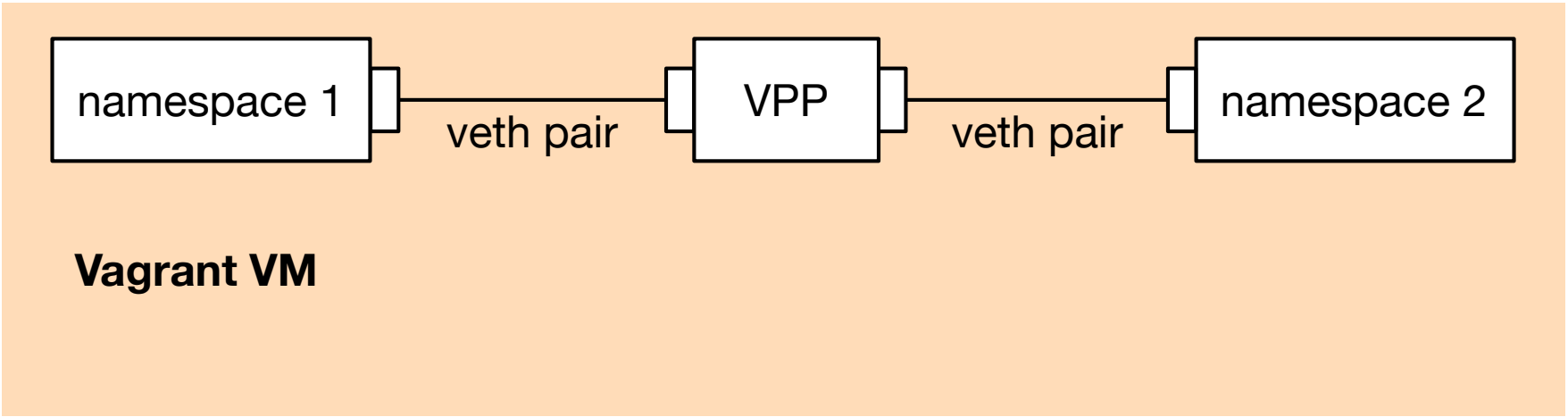
Current Setup

- VPP (17.10) is running in a Vagrant VM (Ubuntu 16.04)



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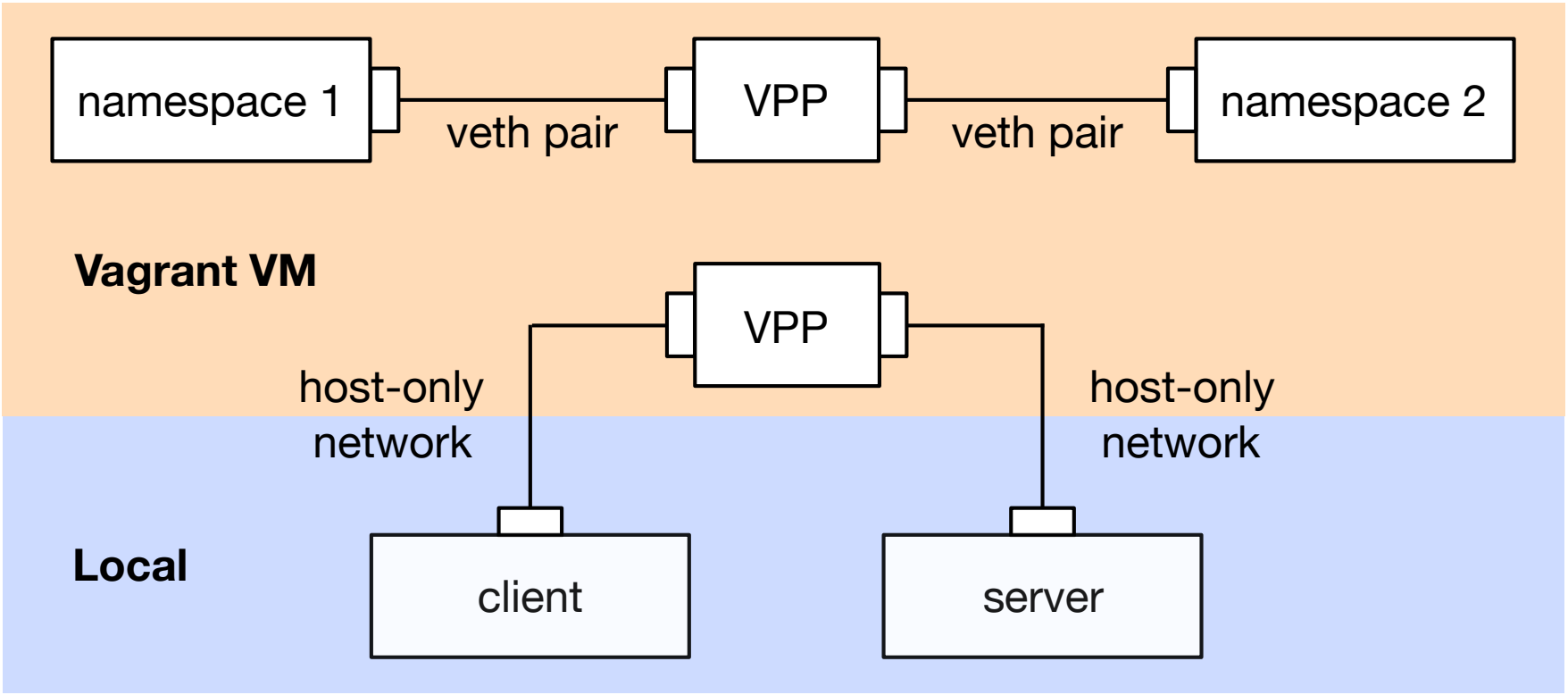
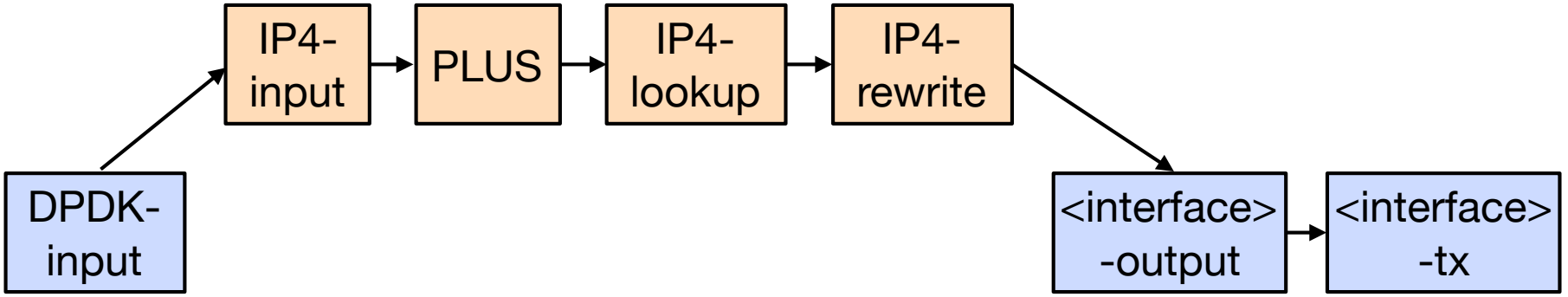


VPP Tree - PLUS Node Placement

- Can easily be moved (plugin runs before/after …)
- Currently, we get only valid packets
- Before any forwarding decisions (important for e.g. QoS)

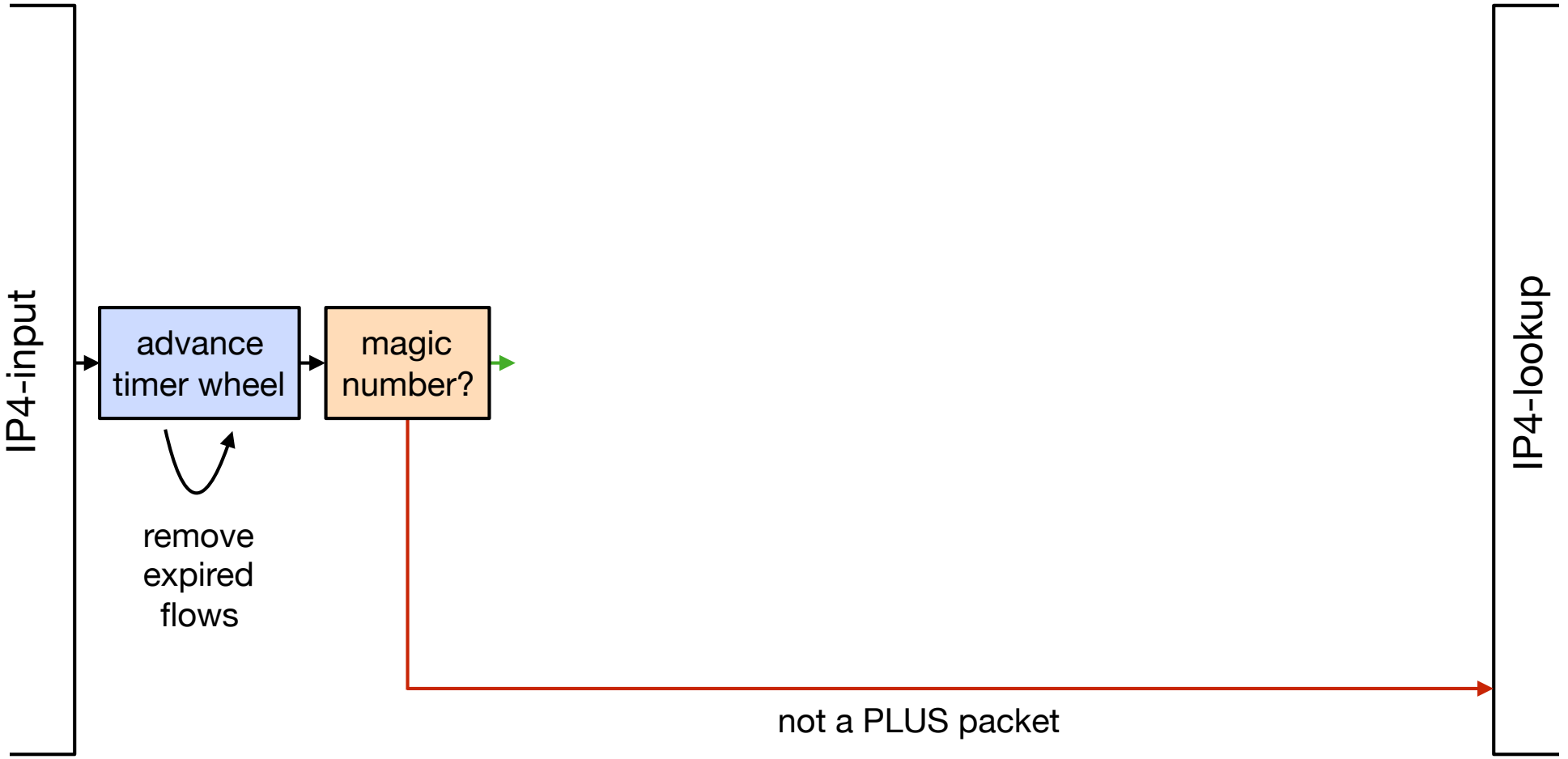


PLUS Node - Workflow

IP4-input

IP4-lookup

PLUS Node - Workflow



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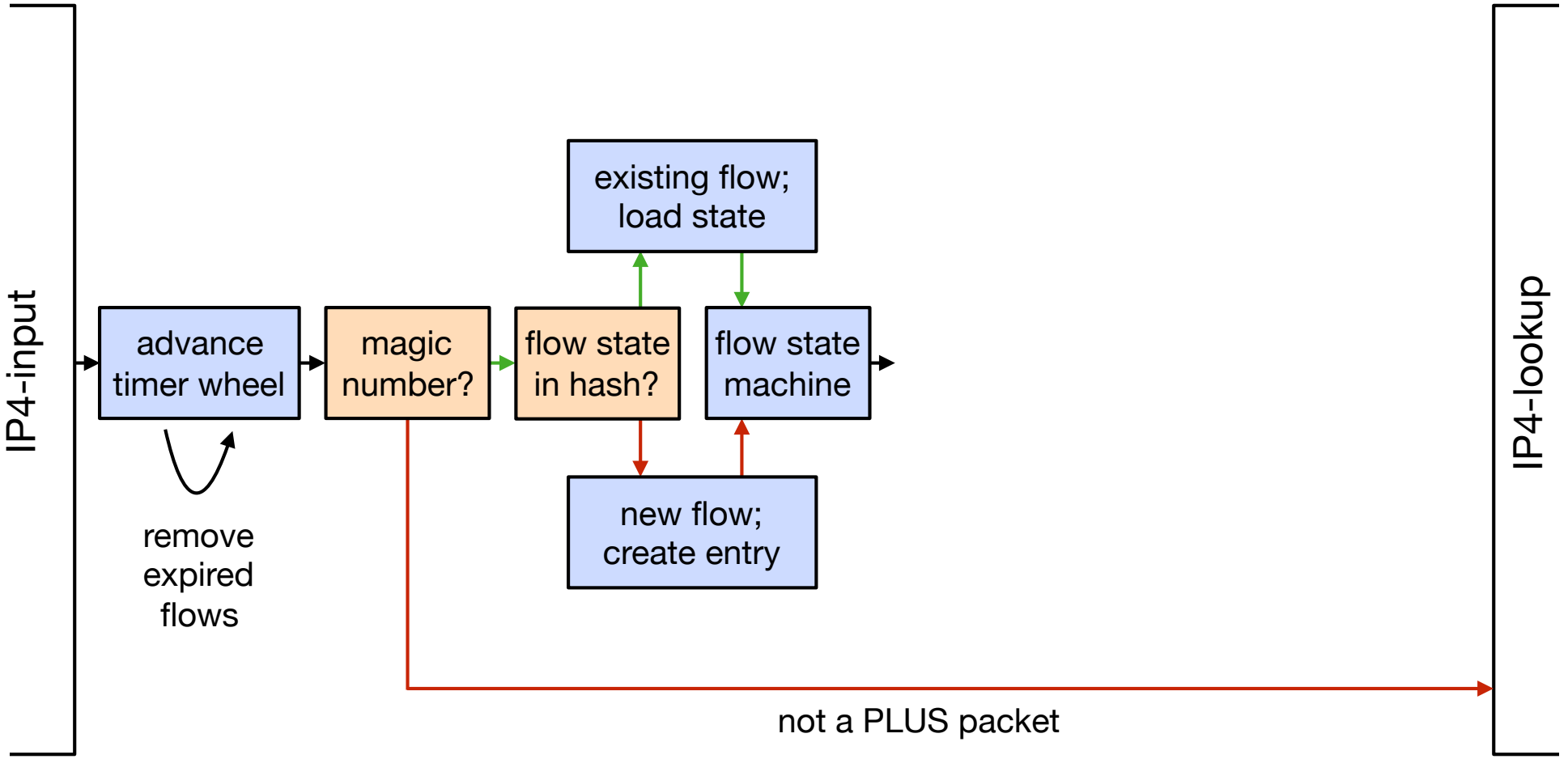

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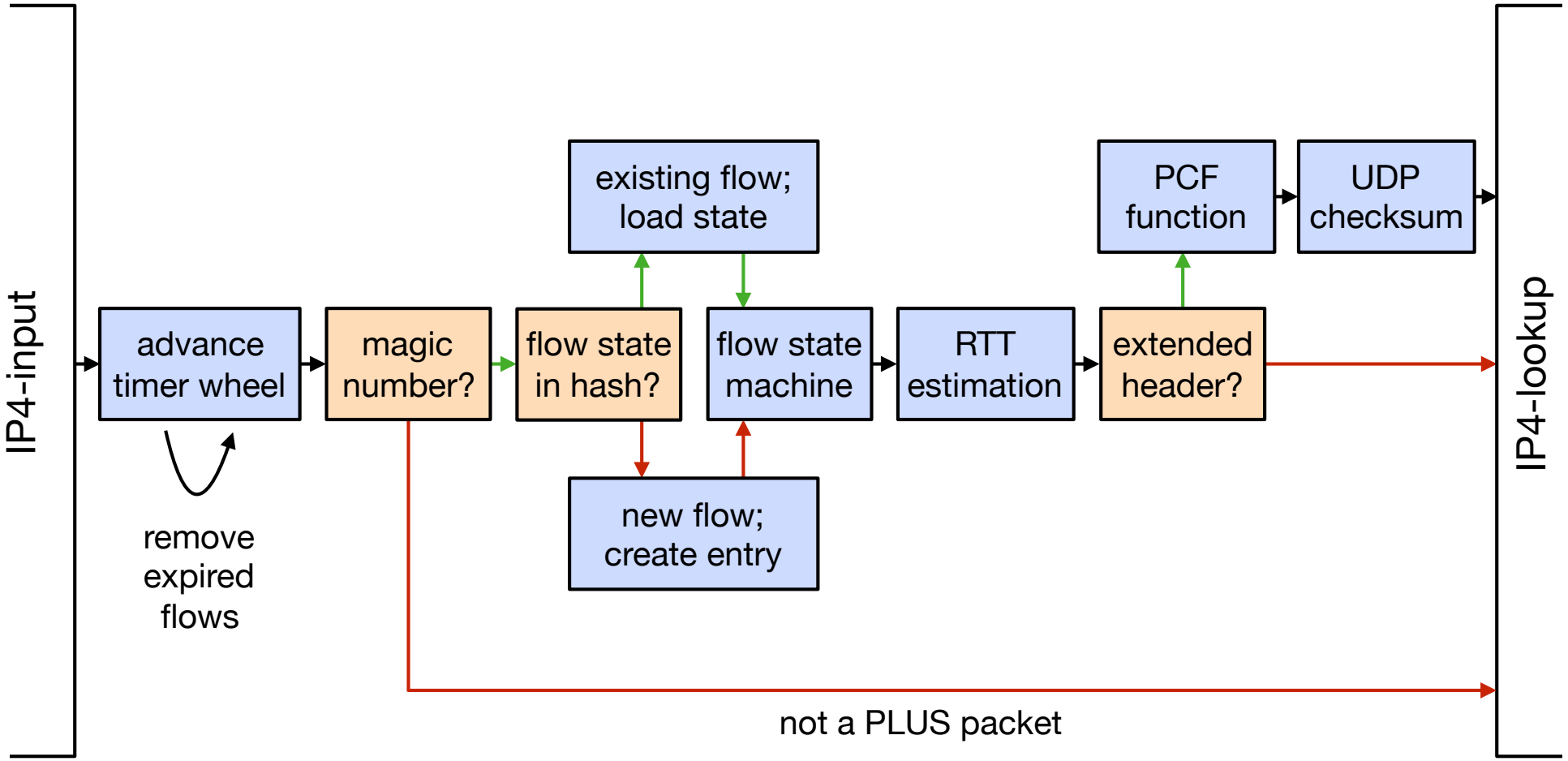
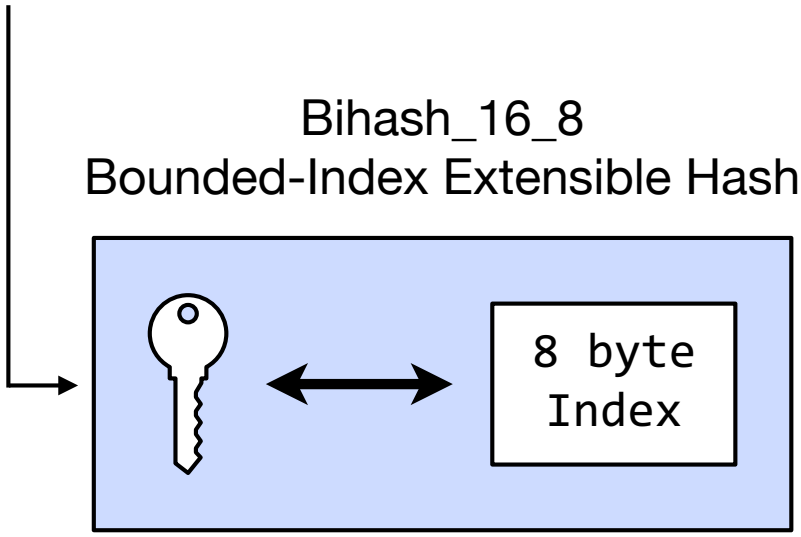


State Management

Key: 5-Tuple (IPv4) + CAT

src IP	XOR	dst IP		4 bytes
src port	XOR	dst port		2 bytes
protocol			(1)	2 bytes
CAT				8 bytes
				16 bytes

Bihash_16_8
Bounded-Index Extensible Hash



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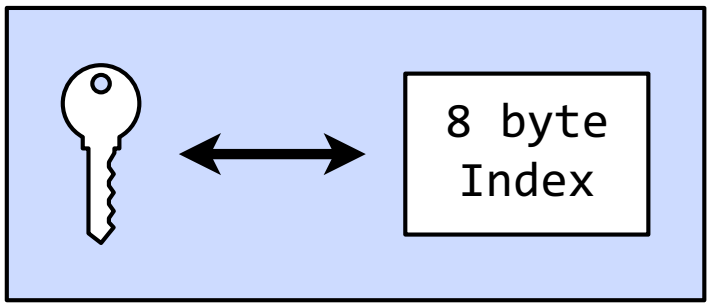
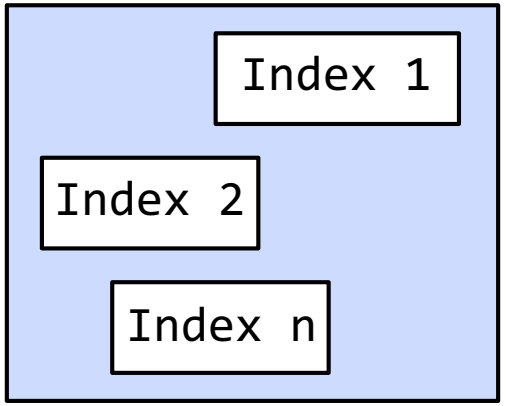
Flow state

```
State (UNIFLOW, …)
PSN and PSE
RTT estimation
Packet counter
...
```

Bihash_16_8
Bounded-Index Extensible Hash



Pool



Supported Features

- Activate each interface separately
- Full state machine with timers
- RTT estimation based on PSN/PSE pairs
- Optional header „**path accumulator**“:
  - PCF Type = 1, PCF Len = 1, PCF_II = 0
    PCF Value: counter increased by each PLUS MB
- Full flow output at any time
- Full packet traces

VPP in Action - Packet Trace

- Full packet trace through all VPP nodes

```
00:00:53:314457: ip4-input
  UDP: 192.168.100.1 -> 192.168.101.1
  …

00:00:53:314463: plus
  PLUS packet: CAT: 11154013587666973726, PSN: 434598561, PSE: 0
  Current state: UNIFLOW, stop bit: 0, extended bit: 1
  PCF type: 1, PCF len: 1, PCF II: 0, PCF hop count value: 1

00:00:53:314475: ip4-lookup
  fib 0 dpo-idx 3 flow hash: 0x00000000
  …
```

VPP in Action - Statistics

- At any time via CLI command: *sudo vppctl plus stat*

```
Total flows: 17, total active flows: 3
==================================================
Flow CAT: 11154013587666973726, observed packets: 648
Current state: ASSOCIATED, estimated RTT: .002135988s
==================================================
Flow CAT: 5834098447867823, observed packets: 2048
Current state: STOPPING, estimated RTT: .001189906s
==================================================
Flow CAT: 273818860780310528O, observed packets: 47
Current state: ASSOCIATED, estimated RTT: .009428921s
==================================================
```

Some Numbers

- Average time in PLUS node: **~3µs** (in VM on laptop)
  - Longest task: extended header with checksum update
- Currently support for **2'048** concurrent flows
  - Extensible: larger/multiple timer wheels, hashes & pools
- A lot of possibilities for code optimizations
  - E.g. double-loop, multiple threads
- Does not look too bad for a first version

Current Work

- Tests with the PLUS Go code from ZHAW (PLUS-lib)
  - Roman and Stephan
- Detected problems:
  - Go does not like virtual namespaces
  - Code bugs — UDP checksum was not always correctly updated after changes in extended header
  - Newest code not pushed to GitHub ;-)

Planned Experiments

- VPP setup on an ETHZ server (after SIGCOMM deadline)
- Tests with the plus-quic-go code:
  - https://github.com/mami-project/plus-quic-go
  - Webserver & crawler
  - Concurrent connections, RTT estimation, full load, …
- Support for LRS bits
  - Need matching setup/network
- RTT comparisons with ping/TCP (compare QUIC work)