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A Network Debugger for FABRIC Experiments

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Introduction

- FABRIC, as a testbed, affords significant flexibility compared to other deployment environments.
- This flexibility allows for new techniques that are much more general, supporting any components, topology, or protocols.

Motivation

- Debugging is a significant barrier to developing experiments on FABRIC.
- A research-friendly debugger should not be reliant on hardware or protocol support, since that is often the focus of the research.
- Data collection could pave the way for automated assistance in tracking down and solving bugs.

Acknowledgement

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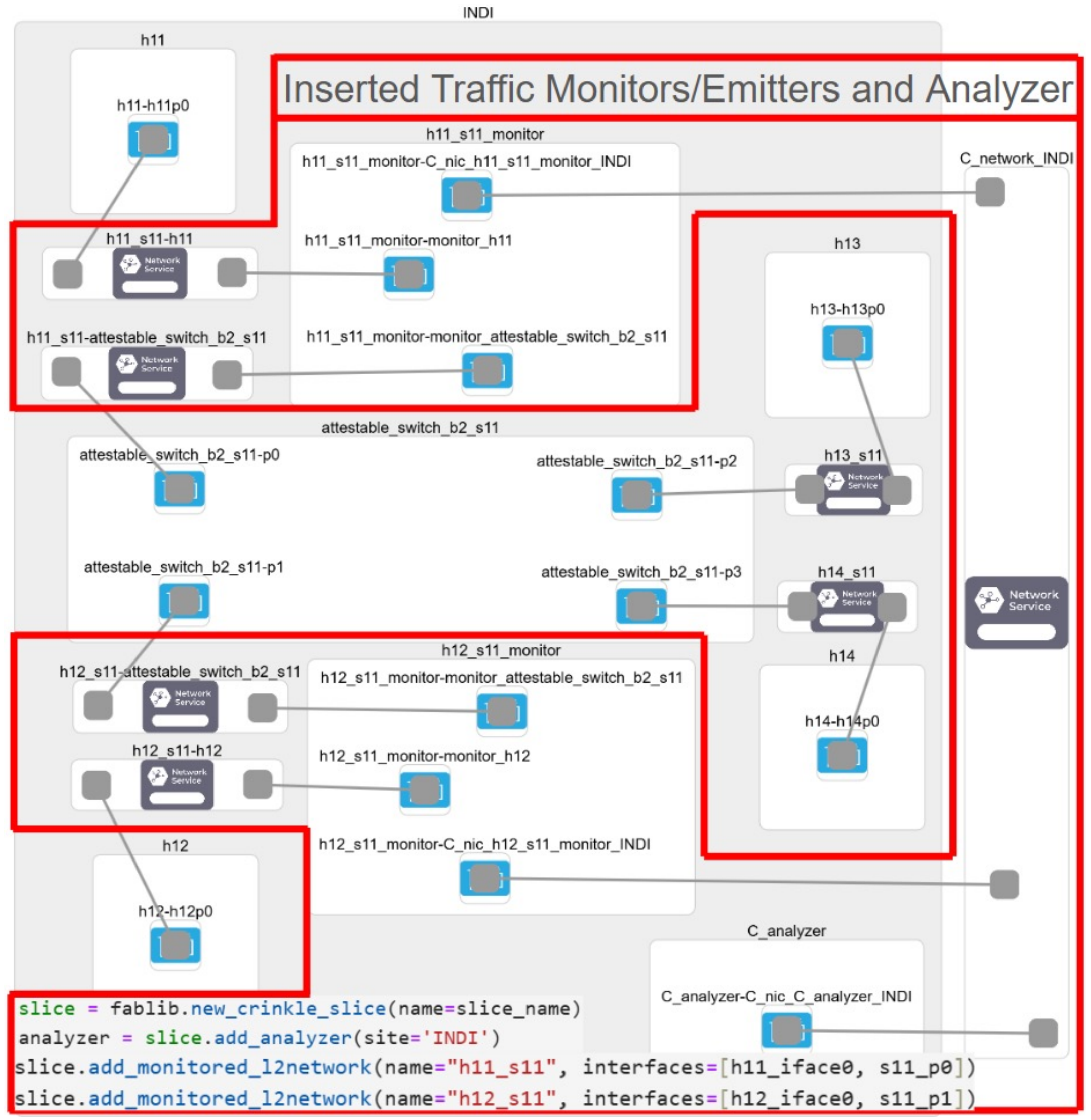
Approach

- We extended Fablib to support adding VMs as “smart” bump-in-the-wire monitors.
- Monitors communicate with an analyzer out-of-band, and insert unique IDs to frames.
- Analyzer collects information on packet headers, ID, and location into database.
- Database contains flow-level data, position, and packet-specific ID.

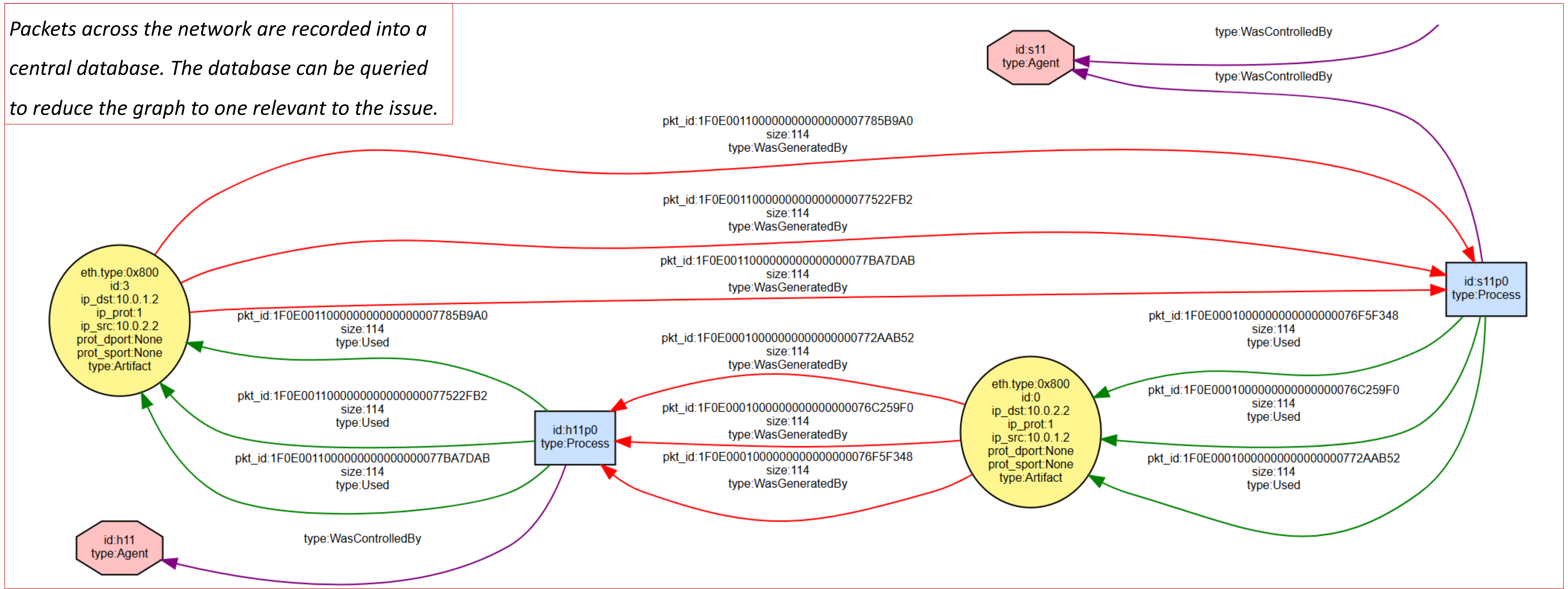

INDI
h11
h11-h11p0
Inserted Traffic Monitors/Emitters and Analyzer
h11_s11_monitor
h11_s11_monitor-C_nic_h11_s11_monitor_INDI
C_network_INDI
h11_s11-h11
Network Service
h11_s11_monitor-monitor_h11
h13
h13-h13p0
h11_s11-attestable_switch_b2_s11
h11_s11_monitor-monitor_attestable_switch_b2_s11
attestable_switch_b2_s11
attestable_switch_b2_s11-p0
attestable_switch_b2_s11-p2
h13_s11
attestable_switch_b2_s11-p1
attestable_switch_b2_s11-p3
h14_s11
h12_s11_monitor
h14
h12_s11-attestable_switch_b2_s11
h12_s11_monitor-monitor_attestable_switch_b2_s11
h14-h14p0
h12_s11-h12
h12_s11_monitor-monitor_h12
h12
h12_s11_monitor-C_nic_h12_s11_monitor_INDI
h12-h12p0
C_analyzer
C_analyzer-C_nic_C_analyzer_INDI

```
slice = fablib.new_crinkle_slice(name=slice_name)
analyzer = slice.add_analyzer(site='INDI')
slice.add_monitored_l2network(name="h11_s11", interfaces=[h11_iface0, s11_p0])
slice.add_monitored_l2network(name="h12_s11", interfaces=[h12_iface0, s11_p1])
```

Results

- Packet tracing can be done from a central point or the Jupyter instance, with significantly fewer commands than spawning and analyzing tcpdump jobs.
- Devices which do not support capturing their interfaces can be monitored as easily as any node.
- Lays a foundation for more active debugging by enabling anywhere probing and on-the-fly editing of header field values.

Packets across the network are recorded into a central database. The database can be queried to reduce the graph to one relevant to the issue.


id:s11
type:Agent
type:WasControlledBy
type:WasControlledBy
pkt_id:1F0E0011000000000000000007785B9A0
size:114
type:WasGeneratedBy
pkt_id:1F0E0011000000000000000077522FB2
size:114
type:WasGeneratedBy
pkt_id:1F0E00110000000000000000077BA7DAB
size:114
type:WasGeneratedBy
eth.type:0x800
id:3
ip_dst:10.0.1.2
ip_prot:1
ip_src:10.0.2.2
prot_dport:None
prot_sport:None
type:Artifact
id:s11p0
type:Process
pkt_id:1F0E0011000000000000000007785B9A0
size:114
type:Used
pkt_id:1F0E0001000000000000000000772AAB52
size:114
type:WasGeneratedBy
pkt_id:1F0E00010000000000000000076F5F348
size:114
type:Used
pkt_id:1F0E0011000000000000000077522FB2
size:114
type:Used
id:h11p0
type:Process
pkt_id:1F0E00010000000000000000076C259F0
size:114
type:WasGeneratedBy
eth.type:0x800
id:0
ip_dst:10.0.2.2
ip_prot:1
ip_src:10.0.1.2
prot_dport:None
prot_sport:None
type:Artifact
pkt_id:1F0E00010000000000000000076C259F0
size:114
type:Used
pkt_id:1F0E00110000000000000000077BA7DAB
size:114
type:Used
pkt_id:1F0E00010000000000000000076F5F348
size:114
type:WasGeneratedBy
pkt_id:1F0E0001000000000000000000772AAB52
size:114
type:Used
id:h11
type:Agent
type:WasControlledBy