Virtual Network Diagnosis as a Service

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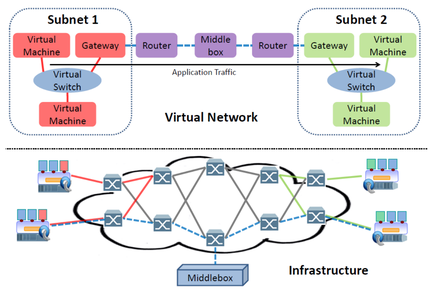
Virtual Networks



Virtual Network Diagnosis

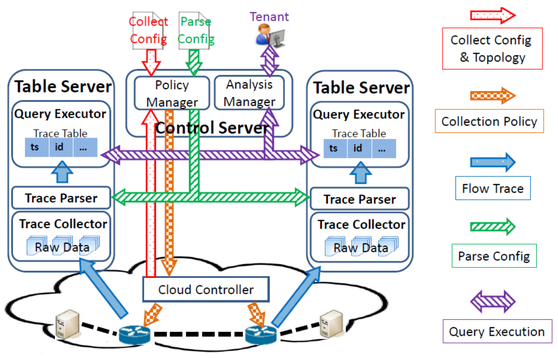
- Multiple layers in the cloud may have various problems
- Isolation and abstraction make it difficult for the tenants to diagnose their virtual networks
  - They cannot touch infrastructure
  - They do not have access to some logic components

Solution & Challenges

- The cloud provider offers a virtual network diagnostic service to tenants
- Tenants use interfaces to analyze their application traffic
- Challenges
  - Preserve abstractions
  - Low overhead
  - Scalability
  - Flow correlation

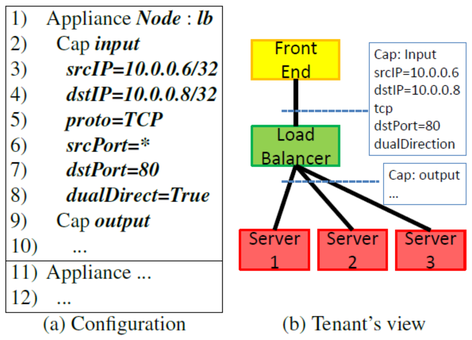
Architecture

- One Control Server
  - Communication hub
  - Decide data collection policy
- Multiple Table Servers
  - Data Collection
  - Data parse
  - Query Execution

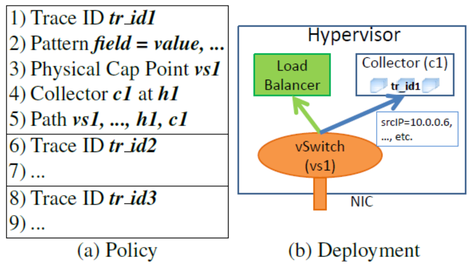


Data Collection

- The tenant submits a diagnosis request

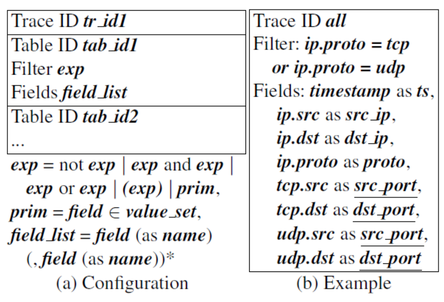


- Translate the request into a diagnosis policy
- Set up collectors and configure routing

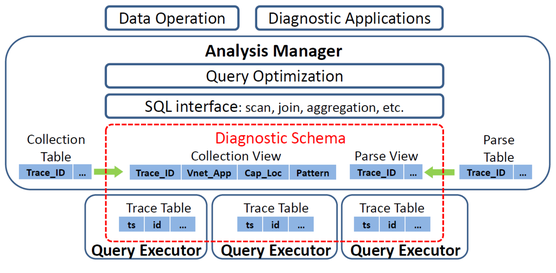


Data Parse

- Parse packets and extract packet fields
- Dump results into trace tables locally



- View all tables as a distributed database
- Provide SQL interface to the tenant



Data Analysis

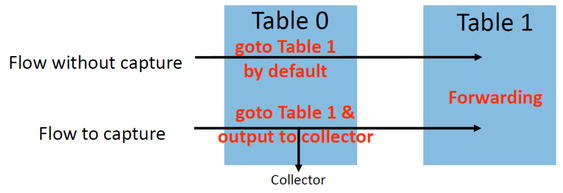
- Throughput

```
# assume the timestamp unit is second
select ceil(ts), sum(payload_length) from table group
        by ceil(ts)
```

- RTT
  1. *create view F as select * from T where srcIP=IP1 and dstIP=IP2*
  2. *create view B as select * from T where dstIP=IP1 and srcIP=IP2*
  3. *create view RTT as select F.ts as t1, B.ts as t2 from F, B where F.seq + F.length = B.ack*
  4. *select avg(t2-t1) from RTT group by ceil(t1)*

Optimizations

- Put data collectors locally with capture points
- Separate flow collection rules from routing rules
  - Openflow multi-table feature

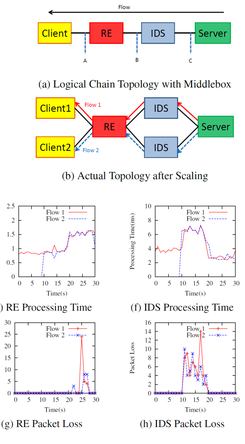


Flow Correlation

- Make use of unique fields in packet headers
  - IP identification, TCP sequence number
- Use the packet payload as the fingerprint
  - hash(payload)
- Other cases
  - layer-4 load balancer: connection built sequence

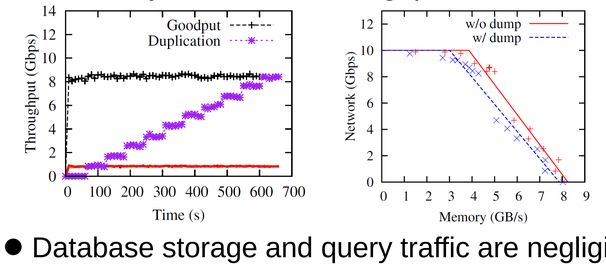
Functional Validation

- Start flow 1 in a chain topology (0s)
- Start flow 2 (10s)
- Find bottleneck
- Scale IDS (20s)



Overhead

- Transfer data between VMs on two hypervisors
  - Flow capture – Throughput
- VMs perform data transfer and memory copy
  - Memory – Network Throughput



- Database storage and query traffic are negligible

Conclusions

- Cloud providers should offer the tenants a virtual network diagnosis service
- We propose VND framework (architecture, interfaces and operations) to provide this service
- VND optimizations make it scalable to many tenants
- Our implementation, experiments and simulation demonstrate the feasibility of VND framework