

TITLE

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By
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CERTIFICATE

This is to certify that the dissertation entitled “**TITLE**” submitted by **STUDENT NAME** bearing Reg. No. XXXXXXXX, in partial fulfillment of the requirements for the award of Master of Technology in Computer Science, is a bona fide work carried out by him/her under my/our supervision and guidance.

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Chapter 1

Related Work

Flow monitoring protocols like NetFlow[1] and sFlow[2] can provide important information about traffic that passes through a network. However, contemporary networking with its 10Gbps and higher NICs is outpacing the ability to monitor them efficiently. As data centers are getting virtualized with virtual software switches and scaling to thousands of nodes, it is an immediate requirement to have monitoring systems that can scale effectively. There are not many solutions proposed that provide scalable flow monitoring in data center networks. In this chapter, we review some of the literature that deals with scalable flow monitoring in data center networks.

1.1 Edge Monitoring and Collection for Cloud (EMC2)[5]

Edge Monitoring and Collection for Cloud (EMC2) is a scalable network-wide monitoring service for data centers. EMC2 stays inside the host computer to monitor virtual switches. Monitoring at virtual switch is scalable due to the distributed nature of the storage of the collected information.

1.1.1 Architecture

Figure 1.1 shows the architecture of EMC2.

EMC2 is a multi-threaded application that contains the following modules:

1. Flow-Table : Flow-Table is an in-memory 2-level hash table.
2. NetFlowParser : It parses the NetFlow datagrams and updates the Flow-Table.
3. sFlowParser : It parses the sFlow datagrams and updates the Flow-Table.

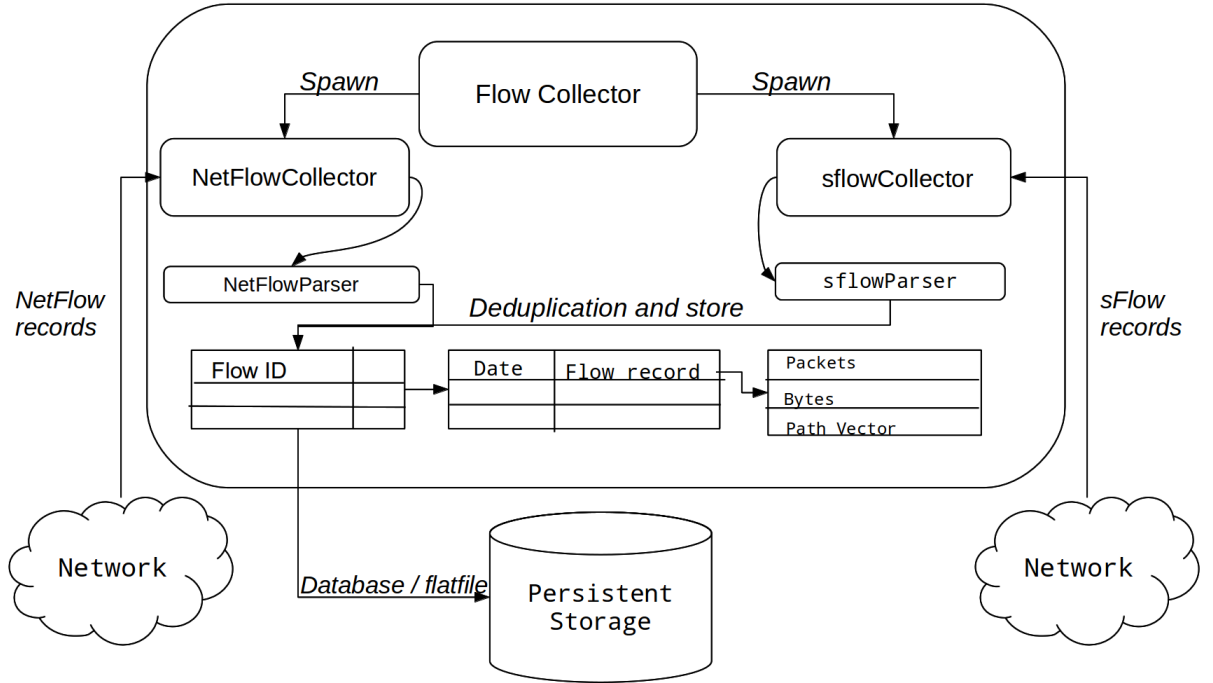


Figure 1.1: Architecture of EMC2.

4. **NetFlowCollector** : It accepts the NetFlow datagrams and creates the parser thread upon receiving NetFlow datagrams.
5. **sFlowCollector** : It does the same task like the NetFlowCollector but for sFlow datagrams.
6. **FlowCollector** : It invokes two thread – NetFlowCollector and sFlowCollector – for accepting flow datagrams.

1.1.1.1 Flow-Table

Flow-Table is a 2-level in-memory hash table. The primary key for the hash table is the Flow ID which is formed based on the layer 3 source and destination addresses. Flow ID maps to another hash table where timestamp is the key and flow record is the value. Each flow record contains number of packets, number of bytes and optional path vector.

1.1.1.2 NetFlowParser/sFlowParser

NetFlowCollector and sFlowCollector create these two parser threads upon receiving a NetFlow/sFlow datagram respectively. These parser threads parse the datagram and update the Flow-Table. They also perform two important tasks:

1. Deduplication.
2. Data rate prediction in presence of sampling.

Deduplication: Deduplication prevents duplicate flow records from being added to the Flow-Table. It uses the following algorithm.

Algorithm 1: Detect Duplicate Flow

```
if  $flow - ID$  not exist then
    add flow to the flow table.
    return
else
    if Same exporter then
        update the flow table.
        return
    else
        report duplicate flow.
        update path vector.
        return
    end if
end if
```

Data Rate Prediction in Presence of Sampling: Sampling rate is specified in flow datagrams. Parser thread predicts the data rate by multiplying sampling rate with the length of the packet.

1.1.1.3 NetFlowCollector/sFlowCollector

NetFlowCollector/sFlowCollector are collector thread that wait for new NetFlow or sFlow datagrams and spawn a new NetFlowParser/sFlowParser thread upon receiving a datagram.

1.1.2 Advantages and Limitations

The authors state the following advantages of EMC2:

- Scalable monitoring as EMC2 monitors host *vswitches* in a distributed fashion by storing the information as flat files in those hosts itself instead of sending them to a centralized collector.

However, flat files are not really built for scalability unlike many other distributed databases available today such as Cassandra, Big Table etc.. Therefore, it is not clear how much of performance can be obtained by storing the information in flat files in the host itself. Considering that most data centers work with SANs rather than local disks, this may not be as scalable as claimed.

1.2 Scalable Internet Traffic Measurement and Analysis with Hadoop[4]

Hadoop is a distributed computing platform that uses distributed file system(HDFS) and MapReduce programming model. Hadoop consists of commodity hardware that can scale hundreds of nodes to store massive data. It can perform massive data analytics operations on the available data using MapReduce. Storing NetFlow data on Hadoop and analysis using MapReduce offers scalable traffic measurement and analysis.

1.2.1 Architecture

Traffic measurement and analysis system with Hadoop consists of following modules

1. Traffic collector.
2. IP packet and NetFlow reader in Hadoop.
3. Analysis in MapReduce.
4. Interactive query interface with Hive.

1.2.1.1 Traffic collector

Traffic collector reads trace files on the disk and writes into HDFS. Trace files contains Netflow packets or IP packets.

1.2.1.2 IP packet and NetFlow reader in Hadoop

Storing binary trace file into Hadoop specific sequence file

Bibliography

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