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A complete system integration of stream-based IP flow-record querier

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June 2012

[January 10, 2012 at 22:56]

## ABSTRACT

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Short summary of the contents in English...

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## LISTINGS

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## ACRONYMS

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IPFIX Internet Protocol Flow Information Export



## Part I

### INTRODUCTION

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## TRAFFIC MEASUREMENT APPROACHES

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1.1 CAPTURING PACKETS

1.2 CAPTURING FLOWS

1.3 REMOTE MONITORING

1.4 REMOTE METERING



## FLOW EXPORT PROTOCOLS

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### 2.1 NETFLOW

### 2.2 IPFIX

### 2.3 SFLOW



## LANGUAGES AND TOOLS

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### 3.1 SQL-BASED QUERY LANGUAGES

#### 3.1.1 *NetFlow exports as relational DBMS*

#### 3.1.2 *Data Stream Management System*

#### 3.1.3 *Gigascopy*

#### 3.1.4 *Tribeca*

### 3.2 FILTERING LANGUAGES

#### 3.2.1 *flow-tools*

#### 3.2.2 *nfdump*

### 3.3 PROCEDURAL LANGUAGES

#### 3.3.1 *FlowScan*

#### 3.3.2 *Clustering NetFlow Exports*

#### 3.3.3 *SiLK Analysis Suite*



## LEGAL CONSIDERATION

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## Part II

### STATE OF THE ART

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## FLOWY

Flowy [2][3] is the first prototype implementation of a stream-based flow record query language [4][1][5]. The query language allows to describe patterns in flow-records in a declarative and orthogonal fashion, making it easy to read and flexible enough to describe complex relationships among a given set of flows.

## 5.1 PROCESSING PIPELINE

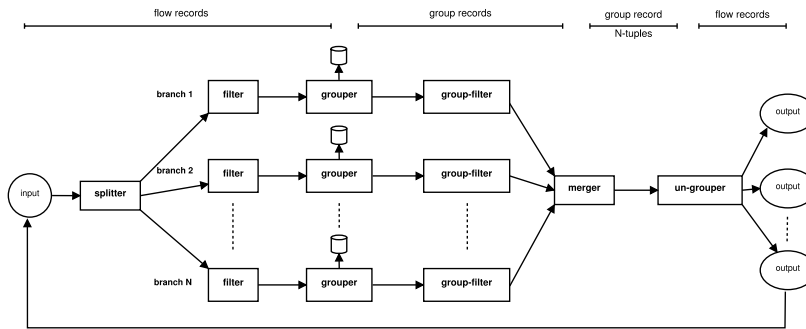


Figure 1: Flowy: Processing Pipeline [1]

The pipeline consists of a number of independent processing elements that are connected to one another using UNIX-based pipes. Each element receives the content from the previous pipe, performs an operation and pushes it to the next element in the pipeline. Figure 1 shows an overview of the processing pipeline. The flow record attributes used in this pipeline exactly correlate with the attributes defines in the Internet Protocol Flow Information Export (IPFIX) Information Model specified in RFC 5102 [6]. A complete description on the semantics of each element in the pipeline can be found in [4]

## 5.1.1 Splitter

The splitter takes the flow-records data as input in the flow-tools compatible format. It is responsible to duplicate the input data out to several branches without any processing whatsoever. This allows each of the branches to have an identical copy of the flow data to process it independently.

### 5.1.2 *Filter*

The filter performs *absolute* filtering on the input flow-records data. The flow-records that pass the filtering criterion are forwarded to the grouper, the rest of the flow-records are dropped. The filter compares separate fields of a flow-record against either a constant value or a value on a different field of the *same* flow-record. The filter cannot relatively compare two different incoming flow-records

### 5.1.3 *Grouper*

The grouper performs aggregation of the input flow-records data. It consists of a number of rule modules that correspond to a specific subgroup. A flow-record in order to be a part of the group should be a part of at-least one subgroup. A flow-record can be a part of multiple subgroups within a group. In addition a flow-record cannot be part of multiple groups. The grouping rules can be either absolute or relative. The newly formed groups which are passed on to the group filter can also contain meta-information about the flow-records contained within the group using the aggregate clause defined as part of the grouper query.

### 5.1.4 *Group-Filter*

### 5.1.5 *Merger*

### 5.1.6 *Ungrouper*

## 5.2 PYTHON FRAMEWORK

### 5.2.1 *PyTables and PLY*

### 5.2.2 *Records*

### 5.2.3 *Filters and Rules*

### 5.2.4 *Branches and Branch Masks*

## FLOWY IMPROVEMENTS USING MAP/REDUCE

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## FLOWY: APPLICATIONS

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- 8.1 IPV6 TRANSITION FAILURE IDENTIFICATION
- 8.2 CYBERMETRICS: USER IDENTIFICATION
- 8.3 APPLICATION IDENTIFICATION USING FLOW SIGNATURES
- 8.4 TCP LEVEL SPAM DETECTION



## Part III

# MOTIVATION



## Part IV

### WORK PLAN

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## PERFORMANCE EVALUATION

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## CONCLUSION

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## Part V

### IMPLEMENTATION AND EVALUATION

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## FUTURE WORK

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## CONCLUSION

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Part VI

APPENDIX





## APPENDIX

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## BIBLIOGRAPHY

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- [1] Vladislav Marinov and Jürgen Schönwälder. Design of a Stream-Based IP Flow Record Query Language. In *Proceedings of the 20th IFIP/IEEE International Workshop on Distributed Systems: Operations and Management: Integrated Management of Systems, Services, Processes and People in IT, DSOM '09*, pages 15–28, Berlin, Heidelberg, 2009. Springer-Verlag.
- [2] Kaloyan Kanev. Flowy - Network Flow Analysis Application. Master's thesis, Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany, 2009.
- [3] Kaloyan Kanev, Nikolay Melnikov, and Jürgen Schönwälder. Implementation of a stream-based IP flow record query language. In *Proceedings of the Mechanisms for autonomous management of networks and services, and 4th international conference on Autonomous infrastructure, management and security, AIMS'10*, pages 147–158, Berlin, Heidelberg, 2010. Springer-Verlag.
- [4] Vladislav Marinov. Design of an IP Flow Record Query Language. Master's thesis, Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany, 2009.
- [5] Vladislav Marinov and Jürgen Schönwälder. Design of an IP Flow Record Query Language. In *Proceedings of the 2nd international conference on Autonomous Infrastructure, Management and Security: Resilient Networks and Services, AIMS '08*, pages 205–210, Berlin, Heidelberg, 2008. Springer-Verlag.
- [6] J. Quittek, S. Bryant, B. Claise, P. Aitken, and J. Meyer. Information Model for IP Flow Information Export. RFC 5102 (Proposed Standard), January 2008. Updated by RFC 6313.





## DECLARATION

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*Bremen, Germany, June 2012*

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