



CAE Tech Talk



National Centers of Academic Excellence

Apache Metron and Apache Spot – big data tools for cybersecurity

Presenter: Dr. Alex Rudniy from Fairleigh Dickinson University

About the Project

- **Cybersecurity Workforce Education - CNAP Initiatives**
- NSA Grant No. H98230-17-1-0321 conducted at FDU

Full title:

Developing Hands-on Exercises for Secure Embedded System Design & Security Data Analytics for Computing and Engineering Students

– PI Kalyan Mondal, Ph.D.

1. Secure Embedded Systems

Co-PI Ravi Rao, Ph.D.

2. Advanced Systems Programming

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3. Big Data Analytics & Cybersecurity

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- Graduate assistant Pooja Surapaneni, Fall 2017
- Graduate assistant Suhag Raval, Spring 2018

Project Goals and Status

Task	Status
1. Integrate Apache Metron	<input checked="" type="checkbox"/>
2. Integrate Apache Spot	Pending
3. Add more nodes to the cluster	<input checked="" type="checkbox"/>
4. Load sybersecurity datasets into a big data warehouse	<input checked="" type="checkbox"/>
5.1 Design lab assignments	<input checked="" type="checkbox"/>
5.2 Use lab assignments in the Cybersecurity course	<input checked="" type="checkbox"/>
6.1. Setup a cluster in a public cloud	<input checked="" type="checkbox"/>
6.2. Design and evaluate labs	In progress
6.3. Prepare documentation	In progress
7. Dissemination	In progress

Note: Multiple additional unplanned tasks completed.

Apache Hadoop



- Open-source big data ecosystem allowing:
 - Distributed processing of large datasets
 - Cluster scalability from one node to thousands
 - Supports data redundancy
 - Works on premises
 - Physical vs. virtual environments, e.g. VMware
 - Works in the cloud, e.g. AWS or MS Azure
 - Hadoop distributions are available from several vendors, e.g. Hortonworks, Cloudera, etc.
 - Comes with a variety of applications: YARN, Ambari, Hive, Spark, Storm, Hbase, Kafka, Oozie...
- + Metron + Spot**



Hadoop at FDU



FAIRLEIGH
DICKINSON
UNIVERSITY

- A five-node hardware cluster is up since Fall 2015
 - Performed maintenance, tune ups, user management, etc.
 - Acquired skills necessary for the current project
 - Taught students new technologies, students got jobs
- A five-node VMware cluster added in Fall 2017
- Used in a big data class for hands-on assignments
- Taught MapReduce paradigm, HDFS, Ambari, Hive, Pig, Hbase, Spark, etc.

Possibilities for academic institutions:

- Cloudera Academic Partnership (free)
- Hortonworks Academic Program (free)

Part 2 Apache Metron



APACHE
METRON

- **Metron** evolved from **OpenSOC**
 - = Open Security Operations Center
 - = big data security analytics framework for consumption and monitoring **network traffic** and **machine exhaust data** (log files) of a data center.
 - Works on the Hadoop platform
 - Uses Kafka, Storm, and Elasticsearch
 - Supported features:
 - Unstructured data and streaming data ingestion
 - Interactive query, real-time search, scalable compute
 - Real-time alerts, anomaly detection, data correlation
 - Rules and reports, predictive modeling via UI and applications

Apache Metron Evolution



September 2013

- OpenSOC First Prototype

December 2013

- Hortonworks joins the OpenSOC project

2014-
April 2015

- OpenSOC platform development finished, first beta test conducted at a customer site

June 2015

- OpenSOC became a community edition

July 2015

- Cisco stops support for OpenSOC

October 2015

- James Sirota, Cisco Chief Data Scientist and Lead of OpenSOC joins Hortonworks

December 2015

- Metron accepted into Apache Incubator

April 2016

- First release of Metron 0.1

April 2017

- Metron graduated Apache Incubator

2018

- Metron's latest version: 0.4.3

Apache Metron

- is a cyber security application framework
 - that allows to ingest, process and store diverse security data feeds at scale
 - to detect cyber anomalies and enable a rapid response.
- Has four key features:
 1. Security Data Lake / Data Vault
 - Cost effectively stores enriched telemetry data
 2. Pluggable Framework
 - Supports pcap, netflow, bro, snort, fireeye, sourcefire, ...
 3. Security Application
 - Has standard **security information and event management (SIEM)** capabilities
 4. Threat Intelligence Platform
 - Contains anomaly detection and machine learning algorithms for real-time data

Metron Functional Themes

Platform

- Hardened platform for performance, scale, extensibility and maintainability, provisioning, managing and monitoring Metron

Data Collection

- Metron can stream, ingest and parse into the platform (e.g. using Kafka, etc.)

Data Processing

- Storm topologies allow real-time processing, such as normalization of telemetry data, enrichment, cross reference with threat intel feeds, alerting, indexing, and storing data

User Interface

- Portal, dashboard and user interfaces for different personas

Another look at Metron

- Metron is a centralized tool for security monitoring and analysis.
- Metron integrates several open source big data technologies
 - Kafka, Storm, Kibana, Elasticsearch, and others.
- Metron is capable of:
 - log aggregation, full packet capture indexing, storage, advanced behavioral analytics and data enrichment
- Metron applies threat intelligence information to security telemetry

Metron has ... (1)

- **A mechanism to capture, store, and normalize any type of security telemetry at extremely high rates.**
- Security telemetry is constantly being generated
- It should be ingested at high speeds and pushed to appropriate processing units for advanced computation and analytics

Metron has ... (2)

- **Real time processing and application of enrichments**
- For example, adding threat intelligence, geolocation, and DNS information to telemetry being collected.
- Near real-time application of this information to incoming telemetry provides the **context** and **situational awareness**,
 - as well as the **who** and **where** information critical for investigation

Metron has ... (3)

- **Efficient information storage**

- Logs and telemetry are stored such that they can be efficiently mined and analyzed
- Due to the ability to extract and reconstruct full packets, an analyst can answer questions such as **who the true attacker was, what data leaked, and where**
- Long-term storage also enables advanced analytics
 - Apply machine learning techniques to build models
 - Incoming data can then be scored against stored models for advanced anomaly detection.

Metron has ... (4)

- **An interface for centralized view of data and alerts passed through the system.**
- Metron's interface contains **alert summaries** with **threat intelligence** and **enrichment** data for that alert **on a single page.**
- Advanced search and full packet extraction are available in the same interface.

Metron Architecture (1)

- Parsers : Parsing data from Kafka
- Enrichment : Enriching data after parsing, capability to tag a message as an alert, and assign a risk triage level via a custom rule language.
- Indexing : with Elasticsearch or Solr into HDFS

Metron Architecture (2)

- Stellar : A custom data transformation language used for simple field transformation, expressing triage rules, etc.
- Model as a Service : YARN application which can deploy machine learning / statistical models into a Hadoop cluster
- Data management: saves data in HBase for further use.
- Profiler : A feature extraction that can generate a profile describing the behavior of an entity (a server, user, subnet or application).

Apache Metron Deployment

- Several deployment scenarios
 - Vagrant-based install
 - Amazon Web Services using EC2 instances
 - Manual install on CentOS 6
 - Ambari Management Pack
 - Ansible-Docker container
 - RPM-Docker
 - RPM packages
 - DEB packages
 - Packer and Virtualbox
 - Single virtual machine

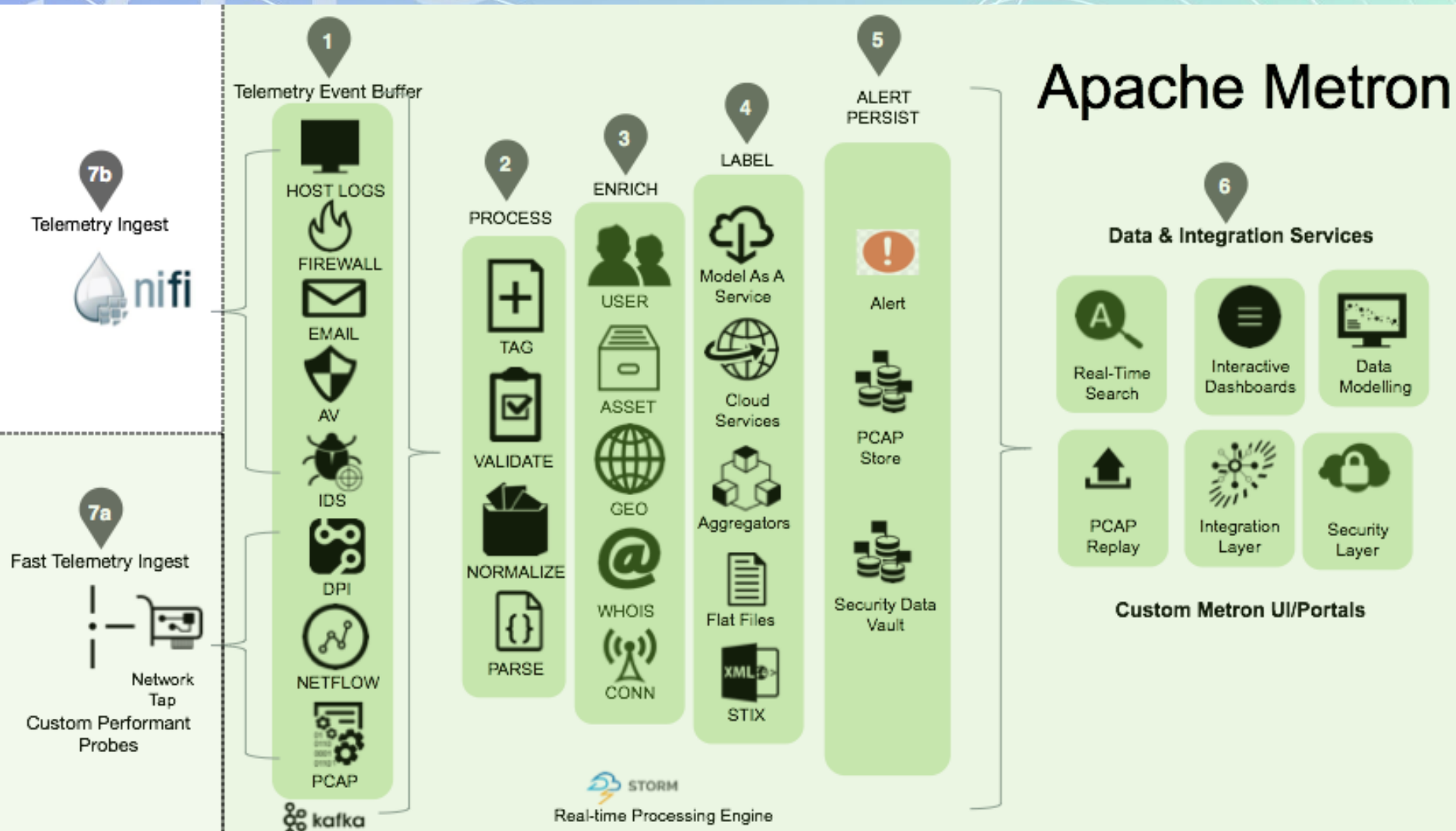
Metron Deployment (more)



CYBERSECURITY

- Metron with Kibana and Elasticsearch are included into Hortonworks Cybersecurity Platform
 - Which is an add-on to Hortonworks Data Platform
 - Current versions HDP 2.4.6 & HCP 1.4.1
 - Metron is tested by developers to work with HDP 2.4.5
- HDP & HCP is the best solution for students
 - Due to Ambari graphical user interface
- HCP 1.4.1 does not include the latest Metron
- We built Ambari management pack with the latest Metron
 - Ambari Mpack with Metron, Kibana & Elasticsearch is an analogy to HCP
 - We followed instructions posted in Metron documentation

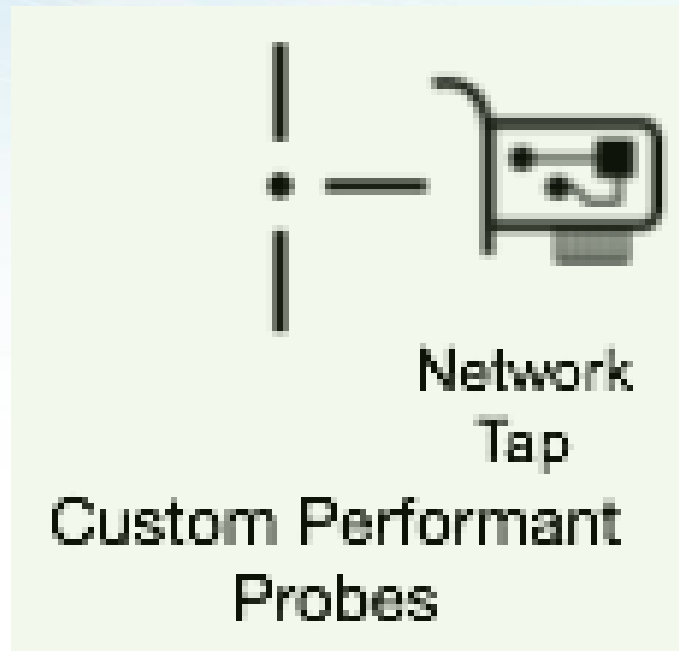
Metron Logical Architecture



Steps 1 to 5: ingest, parse, normalize, enrich, label, index and store all security telemetry data from diverse data sources in an enterprise security data vault.

Metron Step A: Fast Telemetry Ingest

- Data input for high volume network telemetry
 - Packet capture PCAP
 - Netflow / YAF
 - Bro/DPI
 - Custom Metron probes ingesting from network tap



Metron Step A: Fast Telemetry Ingest

Example of raw Bro event captured by Bro probe

```
{
  "http": {
    "id.orig_p": 49206,
    "status_code": 200,
    "method": "GET",
    "request_body_len": 0,
    "id.resp_p": 80,
    "uri": "\img\style.css",
    "tags": [],
    "uid": "CqNi7P3HekrXW10Zh8",
    "referrer": "http://7oqnsnzwwnm6zb7y.gigapaysun.com/11iQmfg",
    "resp_mime_types": [
      | "text/plain"
    ],
    "trans_depth": 1,
    "host": "7oqnsnzwwnm6zb7y.gigapaysun.com",
    "status_msg": "OK",
    "id.orig_h": "192.168.138.158",
    "response_body_len": 4492,
    "user_agent": "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 6.1; WOW64; ...",
    "ts": 1.459533852098545E9,
    "id.resp_h": "95.163.121.204",
    "resp_fuids": [
      | "FyAcd62K4Ui32inIc9"
    ]
  }
}
```

Metron Step B: Telemetry Ingest



- Metron uses Apache NiFi to ingest data from most telemetry data sources:
 - File
 - Syslog
 - REST
 - HTTP
 - Custom API, etc.
- An example would be capturing data from a FireEye appliance with [Nifi's SysLog Processor](#). The raw Fireeye event captured would look something like the following:

-

Metron Step B: Telemetry Ingest

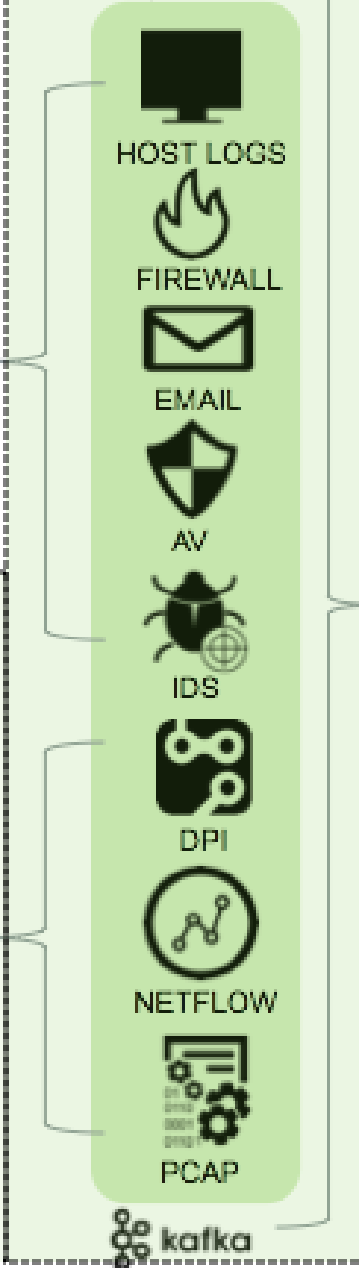


- Example: capturing data from a FireEye appliance with NiFi SysLog Processor
- Raw captured FireEye event:

```
<164>Mar 19 05: 24: 39 10.220.15.15
fenotify-851983.alert: CEF:0|FireEye|CMS|7.2.1.244420|DM|domain-match|1|rt=Feb 09 2015 12: 28:
dvc=10.201.78.57
cn3Label=cncPort
cn3=53
cn2Label=sid
cn2=80494706
shost=dev001srv02.example.com
proto=udp
cs5Label=cncHost
cs5=mfclk001.org
dvchost=DEVFEYE1
spt=54527
dvc=10.100.25.16
smac=00: 00: 0c: 07:ac: 00
cn1Label=vlan
cn1=0
externalId=851983
cs4Label=link
cs4=https://DEVCMS01.example.com/event_stream/events_for_bot?ev_id\\=851983 dmac=00:1d:a2:af:3
cs1Label=sname
cs1=Trojan.Generic.DNS
```


Metron Step 1: Telemetry Event Buffer

Telemetry Event Buffer



- Raw events from telemetry security data sources
- Will be captured by Apache Nifi or custom Metron probe
- Then pushed into each own Kafka topic
- The arrival into the ingest buffer becomes the beginning of Metron processing

Metron Step 2: Process

2

PROCESS



TAG



VALIDATE



NORMALIZE



PARSE

- Parse, Normalize, Validate and Tag
- Each raw event will be parsed and normalized into a standardized flat JSON format.
- Every event will be standardized into at least a 7-tuple JSON structure.
- This enables the **topology correlation engine** to work with messages from different topologies using fields such as:
 - **ip_src_addr**: layer 3 source IP
 - **ip_dst_addr**: layer 3 dest IP
 - **ip_src_port**: layer 4 source port
 - **ip_dst_port**: layer 4 dest port
 - **protocol**: layer 4 protocol
 - **timestamp** (epoch)
 - **original_string**: A human friendly string representation of the message
- This step allows validation of a raw event and tagging it with additional metadata, which will be used by downstream processing.

Metron Step 2: Process Example

2

PROCESS



TAG



VALIDATE



NORMALIZE



PARSE

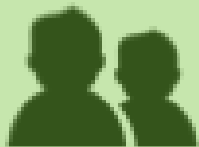
```
{
  "timestamp": 1459533852098,
  "protocol": "http",
  "ip_src_addr": "192.168.138.158",
  "ip_src_port": 49206,
  "ip_dst_addr": "95.163.121.204",
  "ip_dst_port": 80,
  "original_string": "HTTP | id.orig_p:49206 status_code:200 method:GET request_b

  "bro_timestamp": "1.459533852098545E9",
  "status_code": 200,
  "method": "GET",
  "request_body_len": 0,
  "uri": "\\img\\style.css",
  "tags": [],
  "uid": "CqNi7P3HekrXW10Zh8",
  "referrer": "http:\\\\7oqnsnzwwnm6zb7y.gigapaysun.com\\l1iQmfg",
  "resp_mime_types": [
    "text\\plain"
  ],
  "trans_depth": 1,
  "protocol": "http",
  "host": "7oqnsnzwwnm6zb7y.gigapaysun.com",
  "status_msg": "OK",
  "response_body_len": 4492,
  "user_agent": "Mozilla\\4.0 (compatible; MSIE 8.0; Windows NT 6.1; WOW64; ...",
  "resp_fuids": [
    "FyAcd62K4Ui32inIc9"
  ]
}
```

Standard 7 tuple that every element will have

3

ENRICH



USER



ASSET



GEO



WHOIS



CONN

Metron Step 3: Enrich



Real-time Processing Engine

Example

- An external IP address is enriched with GeoIP information
 - lat/long coordinates & City/State/Country
- or HOST enrichment where an IP gets enriched with Host details
 - IP corresponds to Host X which is part of a web server farm for an e-commerce application

3

Metron Step 3: Enrich



Real-time Processing Engine

ENRICH



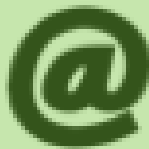
USER



ASSET



GEO



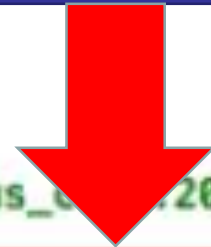
WHOIS



CONN

```
{  
  "timestamp": 1459533852098,  
  "protocol": "http",  
  "ip_src_addr": "192.168.138.158",  
  "ip_src_port": 49206,  
  "ip_dst_addr": "95.163.121.204",  
  "ip_dst_port": 80,  
  "original_string": "HTTP | id.orig_p:49206 status_c:200 method
```

Geo enrichment for
destination and source IPs



```
"enrichments.geo.dip.location_point": "41.789029, -88.1333654",  
"enrichments.geo.dip.latitude": "41.789029",  
"enrichments.geo.dip.longitude": "-88.1333654",  
"enrichments.geo.dip.country": "US",  
"enrichments.geo.dip.city": "Naperville",  
"enrichments.geo.dip.postalCode": "60563",  
"enrichments.geo.sip.location_point": "38.635952, -90.223868",  
"enrichments.geo.sip.latitude": "38.635952",  
"enrichments.geo.sip.longitude": "-90.223868",  
"enrichments.geo.sip.country": "US",  
"enrichments.geo.sip.city": "St. Louis",  
"enrichments.geo.sip.postalCode": "63103",
```

```
"bro_timestamp": "1.459533852098545E9",  
"status_code": 200,  
"method": "GET"
```



LABEL

Metron Step 4: Label



Real-time Processing Engine

- Labeling includes **threat intel cross reference checks**
 - elements of a telemetry are looked up against threat intel feed data sources like Soltra Edge, produced by Stix/Taxii feeds or other threat intel aggregators
 - These threat intel services will then label the telemetry event with threat intel metadata when a hit occurs.
- Also possible to apply analytical models for scoring to telemetry events that are flowing in

Example of a bro event producing a threat intel hit

```
"threatintels.hbaseThreatIntel.ip_src_addr.malicious_ip" : "alert",
"enrichments.hbaseEnrichment.ip_src_addr.malicious_ip.source-type" : "STIX",
"enrichments.hbaseEnrichment.ip_src_addr.malicious_ip.indicator-type" : "address:IPV_4_ADDR",
"enrichments.hbaseEnrichment.ip_src_addr.malicious_ip.source" : "some xml snipeet from STIX file"
```



Model As A Service



Cloud Services



Aggregators



Flat Files



STIX

Metron Step 5: Alert Persist

5

ALERT
PERSIST



Alert



PCAP
Store



Security Data
Vault

- Certain telemetry events can initiate alerts
 - Then indexed in an alert index store
- Triggering factors:
 - Event type: e.g. any event generated by Snort is an alert
 - Threat intel hit
- All enriched and labeled telemetry events
 - **Indexed** by Elasticsearch or Solr
 - **Preserved** in Hadoop HDFS
 - This forms an enterprise **data vault**

Metron Step 5: Event stored in HDFS

```
"timestamp": 1459533852098,  
"protocol": "http",  
"ip_src_addr": "192.168.138.158",  
"ip_src_port": 49206,  
"ip_dst_addr": "95.163.121.204",  
"ip_dst_port": 80,  
"original string": "HTTP | id.orig_o:49206 status code:200 method:GET request_body_len:0 id.resp_p:80 uri:\img\style.css ...",  
"enrichments.geo.dip.location_point": "41.789029, -88.1333654",  
"enrichments.geo.dip.latitude": "41.789029",  
"enrichments.geo.dip.longitude": "-88.1333654",  
"enrichments.geo.dip.country": "US",  
"enrichments.geo.dip.city": "Naperville",  
"enrichments.geo.dip.postalCode": "60563",  
"enrichments.geo.sip.location_point": "38.635952, -90.223868",  
"enrichments.geo.sip.latitude": "38.635952",  
"enrichments.geo.sip.longitude": "-90.223868",  
"enrichments.geo.sip.country": "US",  
"enrichments.geo.sip.city": "St. Louis",  
"enrichments.geo.sip.postalCode": "63103",  
"enrichments.hbaseEnrichment.ip_src_addr.malicious_ip.source-type": "STIX",  
"enrichments.hbaseEnrichment.ip_src_addr.malicious_ip.indicator-type": "address:IPV_4_ADOR",  
"enrichments.hbaseEnrichment.ip_src_addr.malicious_ip.source": "..some xml snipect from STIX file",  
"hbase_timestamp": "14595338520984550",  
"status_code": 200,  
"method": "GET",  
"request_body_len": 0,  
"uri": "\img\style.css",  
"tags": [],  
"uid": "CqNi7P3HekrXW10Zh8",  
"referrer": "http://7oqnsnzwnm6zb7y.gigapaysun.com/v11iQmfg",  
"resp_mime_types": [  
  "text/plain"  
],  
"trans_depth": 1,  
"protocol": "http",  
"host": "7oqnsnzwnm6zb7y.gigapaysun.com",  
"status_msg": "OK",  
"response_body_len": 4492,  
"user_agent": "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 6.1; WOW64; ...",  
"resp_fuids": []
```

Standard 7 Tuple

Enrichment data

Threat Intel Data

Other Metadata / Labels

Metron Step 6: UI Portal & Data Integration

Metron platform provides with a set of services:

- Real-time Search and Interactive Dashboards / Portals
 - single interface for security operation analysts to view alerts and correlate to telemetry events that caused them.
- Data Modeling / Feature Engineering Services by tools such as Jupyter, IPython and Zeppelin.
- Integration and Extensibility Layers - customization for own needs/requirements such as:
 - Ingesting new data sources
 - Adding new parsers
 - Adding new enrichment services
 - Adding new Threat Intel feeds
 - Building, deploying and executing new analytical models
 - Integration with enterprise workflow engines
 - Customizing the Security Dashboards and portals



Real-Time
Search



PCAP
Replay



Interactive
Dashboards



Integration
Layer



Data
Modelling



Security
Layer

Metron UI Portal Example 1

Pinned ▶

● alerts

● Yaf

● All Events

● All Alerts

● Bro Events

QUERY ▶

● ✕ `_type:snort_doc`

Pinned ▶

● alerts

● Yaf

● All Events

● All Alerts

● Bro Events

● Bro Alerts

FILTERING ▶

QUERY ▶

● ✕ `is_alert=true`

Pinned ▶

● Yaf

All (1) / **Current (41)**

Type to filter...

`_id`

`_index`

`_type`

`adapter.geoadapter.begin.ts`

`adapter.geoadapter.end.ts`

_type ▶

snort_doc

snort_doc

snort_doc

snort_doc

snort_doc

◀ **msg**

"Sample

"Sample

"Sample

"Sample

"Sample

Metron UI Portal Example 2

PCAP DATA

Source Port

49210



Destination Port

80

Source IP

192.168.138.158

Destination IP

95.163.121.204

Protocol

http

Include Reverse Traffic



Search

FILTERING ▾

time must ●



field : timestamp

from : now-24h

to : now

querystring must ●

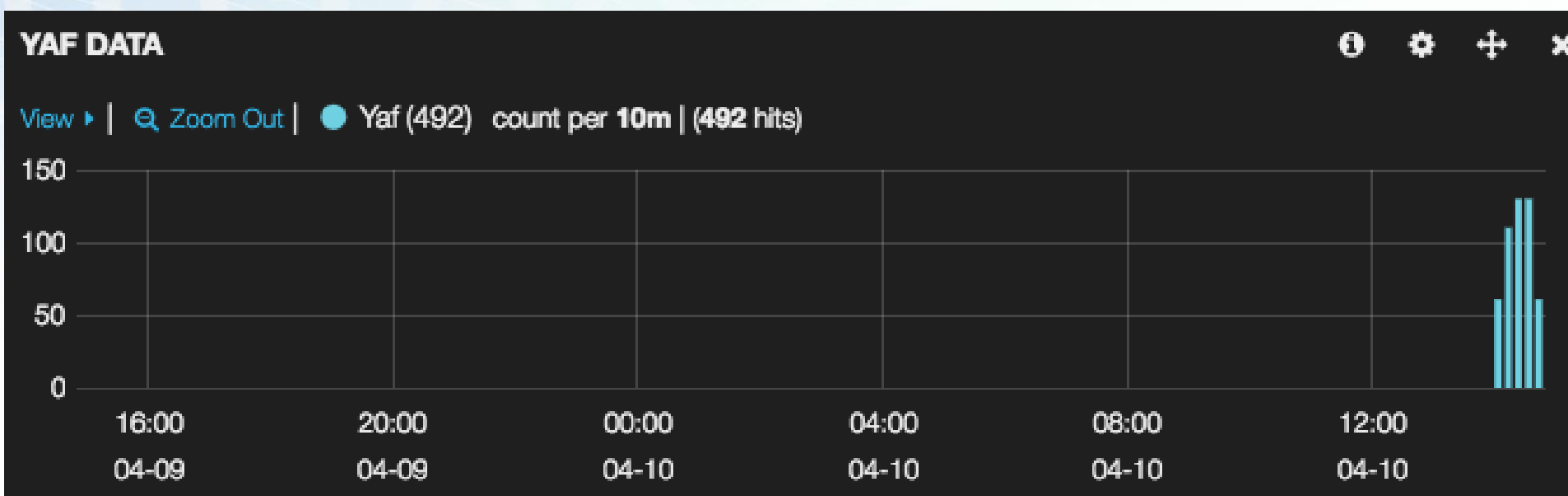
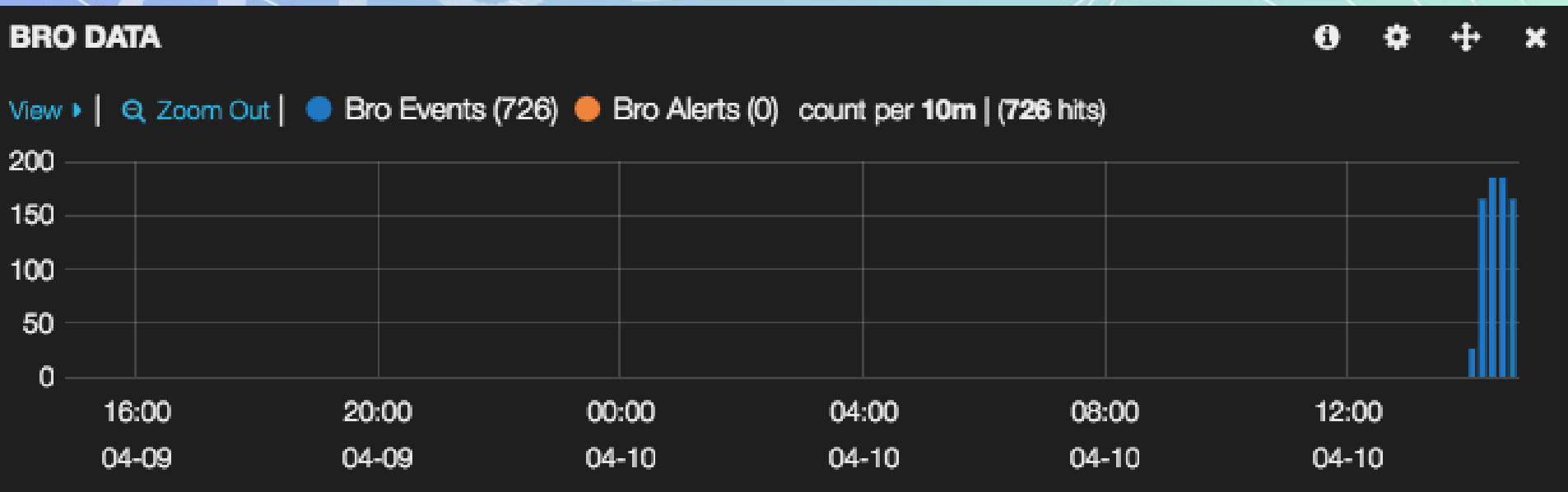


query : ip_dst_port:80

querystring must ●

query : protocol:http

Metron UI Portal Example 3



Metron UI Portal Example 4

ALERTS



0 to 10 of 1000 available for paging



_type ▶	msg ▶	ip_src_addr ▶	ip_src_port ▶	ip_dst_addr ▶	ip_dst ▶
snort_doc	"Sample Metron Message from Snort"	192.168.138.158	49189	62.75.195.236	80
snort_doc	"Sample Metron Message from Snort"	192.168.138.158	49186	62.75.195.236	80
snort_doc	"Sample Metron Message from Snort"	192.168.138.158	49189	62.75.195.236	80
snort_doc	"Sample Metron Message from Snort"	192.168.138.158	49206	95.163.121.204	80
snort_doc	"Sample Metron Message from Snort"	192.168.138.158	49201	204.152.254.221	80
snort_doc	"Sample Metron Message from Snort"	192.168.138.158	49201	204.152.254.221	80
snort_doc	"Sample Metron Message from Snort"	192.168.138.158	49201	204.152.254.221	80
snort_doc	"Sample Metron Message from Snort"	192.168.138.158	49201	204.152.254.221	80
snort_doc	"Sample Metron Message from Snort"	192.168.138.158	49186	62.75.195.236	80
snort_doc	"Sample Metron Message from Snort"	192.168.138.158	49189	62.75.195.236	80

0 to 10 of 1000 available for paging



Metron Dashboard Panel 1

</> Enrichment

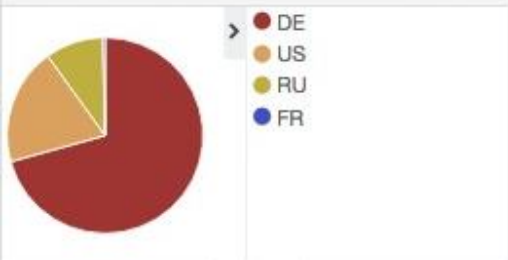
Apache Metron can perform real-time enrichment of telemetry data as it is consumed. To highlight this feature, all of the IP address fields collected from the default sensor suite were used to perform geo-ip lookups. This data was then used to pinpoint each location on the map.

Geo-IP Locations

5

Unique Location(s)

By Country



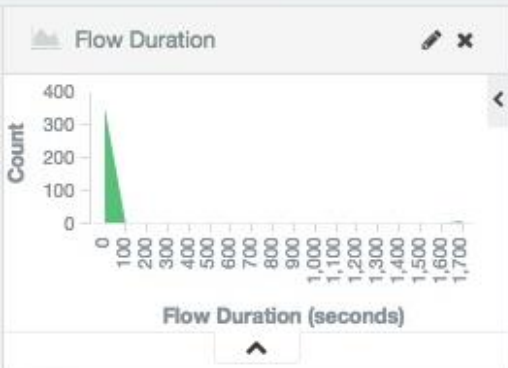
Flow Locations



Metron Dashboard Panel 2

YAF

YAF can be used to generate Netflow-like flow records. These flow records provide significant visibility of the actors communicating over the target network.



YAF

1 2 3 4 5 ...8 »

Time	ip_src_addr	ip_src_port	ip_dst_addr	ip_dst_port	protocol
▶ June 21st 2016, 11:11:35.878	192.168.138.158	50,509	192.168.138.2	53	UDP
▶ June 21st 2016, 11:11:30.092	192.168.138.158	50,683	192.168.138.2	53	UDP
▶ June 21st 2016, 11:11:29.303	192.168.138.158	60,078	192.168.138.2	53	UDP
▶ June 21st 2016, 11:11:30.092	192.168.138.158	65,315	192.168.138.2	53	UDP
▶ June 21st 2016, 11:11:35.225	192.168.138.158	53,571	192.168.138.2	53	UDP
▶ June 21st 2016, 11:11:35.641	192.168.138.158	61,720	192.168.138.2	53	UDP
▶ June 21st 2016, 11:11:36.064	192.168.138.158	56,753	192.168.138.2	53	UDP
▶ June 21st 2016, 11:12:13.923	192.168.138.158	50,329	192.168.138.2	53	UDP
▶ June 21st 2016, 10:54:49.185	192.168.138.158	49,186	62.75.195.236	80	TCP
▶ June 21st 2016, 11:11:30.250	192.168.138.158	49,186	62.75.195.236	80	TCP
▶ June 21st 2016, 11:05:14.851	192.168.138.158	49,186	62.75.195.236	80	TCP
▶ June 21st 2016, 11:07:19.985	192.168.138.158	49,186	62.75.195.236	80	TCP
▶ June 21st 2016, 10:58:59.455	192.168.138.158	49,186	62.75.195.236	80	TCP
▶ June 21st 2016, 11:19:50.779	192.168.138.158	49,186	62.75.195.236	80	TCP
▶ June 21st 2016, 11:15:40.515	192.168.138.158	49,186	62.75.195.236	80	TCP
▶ June 21st 2016, 10:56:54.323	192.168.138.158	49,186	62.75.195.236	80	TCP

Metron Dashboard Panel 3

Snort

Snort is a Network Intrusion Detection System (NIDS) that is being used to generate alerts identifying known bad events. Snort relies on a fixed set of rules that act as signatures for identifying abnormal events.

Snort Alert Types

1

Alert Type(s)

Top Alerts By Host

Source	Destination	Count
62.75.195.236	192.168.138.158	2,201
192.168.138.158	62.75.195.236	1,253
192.168.138.158	95.163.121.204	321
192.168.138.158	72.34.49.86	284

Snort Alerts

1 2 3 4 5 ...10 »

Time	msg	sig_id	ip_src_addr	ip_src_port	ip_dst_addr	ip_dst_port
June 21st 2016, 11:21:44.769	"snort test alert"	999,158	95.163.121.204	80	192.168.138.158	49,202
June 21st 2016, 11:21:44.640	"snort test alert"	999,158	192.168.138.158	49,209	95.163.121.204	80
June 21st 2016, 11:21:44.552	"snort test alert"	999,158	192.168.138.158	49,189	62.75.195.236	80
June 21st 2016, 11:21:44.529	"snort test alert"	999,158	192.168.138.158	49,206	95.163.121.204	80
June 21st 2016, 11:21:44.390	"snort test alert"	999,158	62.75.195.236	80	192.168.138.158	49,189
June 21st 2016, 11:21:42.398	"snort test alert"	999,158	192.168.138.158	49,209	95.163.121.204	80
June 21st 2016, 11:21:42.277	"snort test alert"	999,158	95.163.121.204	80	192.168.138.158	49,202
June 21st 2016, 11:21:41.086	"snort test alert"	999,158	72.34.49.86	80	192.168.138.158	49,202
June 21st 2016, 11:21:41.061	"snort test alert"	999,158	192.168.138.158	49,202	72.34.49.86	80
June 21st 2016, 11:21:40.880	"snort test alert"	999,158	72.34.49.86	80	192.168.138.158	49,202

Metron Dashboard Panel 4

Web Request Header

The Bro Network Security Monitor is extracting application-level information from raw network packets. In this example, Bro is extracting HTTP(S) requests being made over the network.

Web Requests

445

Count

Web Request Type

GET
POST

Web Requests

Time	method	host	uri	referrer
June 21st 2016, 11:20:53.147	GET	7oqnsnzwwnm6zb7y.giga paysun.com	/img/button_pay.png	http://7oqnsnzwwnm6zb7y.gi gapaysun.com/11iQmfg
June 21st 2016, 11:20:53.146	GET	7oqnsnzwwnm6zb7y.giga paysun.com	/img/bitcoin.png	http://7oqnsnzwwnm6zb7y.gi gapaysun.com/11iQmfg
June 21st 2016, 11:20:51.040	GET	7oqnsnzwwnm6zb7y.giga paysun.com	/img/style.css	http://7oqnsnzwwnm6zb7y.gi gapaysun.com/11iQmfg
June 21st 2016, 11:20:48.304	POST	7oqnsnzwwnm6zb7y.giga paysun.com	/11iQmfg	http://7oqnsnzwwnm6zb7y.gi gapaysun.com/11iQmfg

Metron Dashboard Panel 5

</> DNS Requests



Bro is extracting DNS requests and responses being made over the network. Understanding who is making those requests, the frequency, and types can provide a deep understanding of the actors present on the network.

☰ DNS Requests



96

Count



DNS Requests



1 2 »

Time ▾	query	qtype_name	answers	ip_src_addr	ip_dst_addr
▶ June 21st 2016, 11:20:34.452	7oqnsnzwwnm6zb7y.giga paysun.com	A	95.163.121.204	192.168.138.158	192.168.138.158
▶ June 21st 2016, 11:19:56.592	comarksecurity.com	A	72.34.49.86	192.168.138.158	192.168.138.158
▶ June 21st 2016, 11:19:56.407	kritischerkonsum.uni- koeln.de	A		192.168.138.158	192.168.138.158
▶ June 21st 2016, 11:19:56.169	runlove.us	A	204.152.254.221	192.168.138.158	192.168.138.158
▶ June 21st 2016, 11:19:55.753	ip-addr.es	A	188.165.164.184	192.168.138.158	192.168.138.158
▶ June 21st 2016, 11:19:50.622	r03afd2.c3008e.xc07r. b0f.a39.h7f0fa5eu.vb8 fbl.e8mfzdgfr7g0.grou pprograms.in	A	62.75.195.236	192.168.138.158	192.168.138.158
▶ June 21st 2016, 11:19:50.621	ubb67.3c147o.u806a4.w 07d919.o5f.f1.b80w.r0 faf9.e8mfzdgfr7g0.gro upprograms.in	A	62.75.195.236	192.168.138.158	192.168.138.158
▶ June 21st 2016, 11:19:49.832	va872g.g90e1h.b8.642b 63u.j985a2.v33e.37.pa 269cc.e8mfzdgfr7g0.gr oupprograms.in	A	62.75.195.236	192.168.138.158	192.168.138.158
▶ June 21st 2016, 11:18:29.320	7oqnsnzwwnm6zb7y.giga paysun.com	A	95.163.121.204	192.168.138.158	192.168.138.158

Metron Users & Application

- **SOC Analyst:** Don't spend days looking at alerts created by rules when only a few alerts matter
- **SOC Investigator:** Metron enables massive amounts of data to identify and triage anomalies
- **SOC Manager:** Automatically create incidents/cases with integrated workflow systems
- **Forensic Investigator:** “Just-in-time evidence collection response” transforms data in real-time
- **Security Platform Engineer:** Single platform to manage and operate the ingestion, processing of cyber data
- **Security Data Scientist:** Perform data science activities: train, evaluate and score analytical models

- Index Patterns **+ Add New**
- ★ bro*
 - .
 - snort*
 - squid***
 - yaf*

squid*

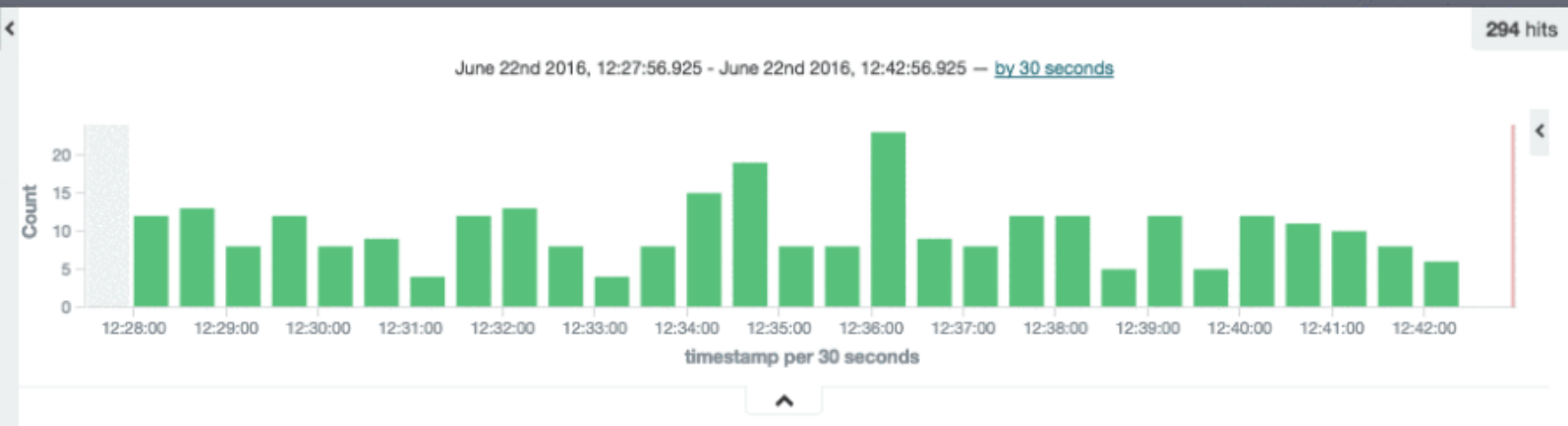
This page lists every field in the squid* index and the field's associated core type as recorded by Elasticsearch. While this list allows you to view the core type of each field, changing field types must be done using Elasticsearch's [Mapping API](#)

Filter

Fields (24) Scripted fields (0)

name	type	format	analyzed	indexed	controls
full_hostname	string			✓	
code	string			✓	
_index	string				

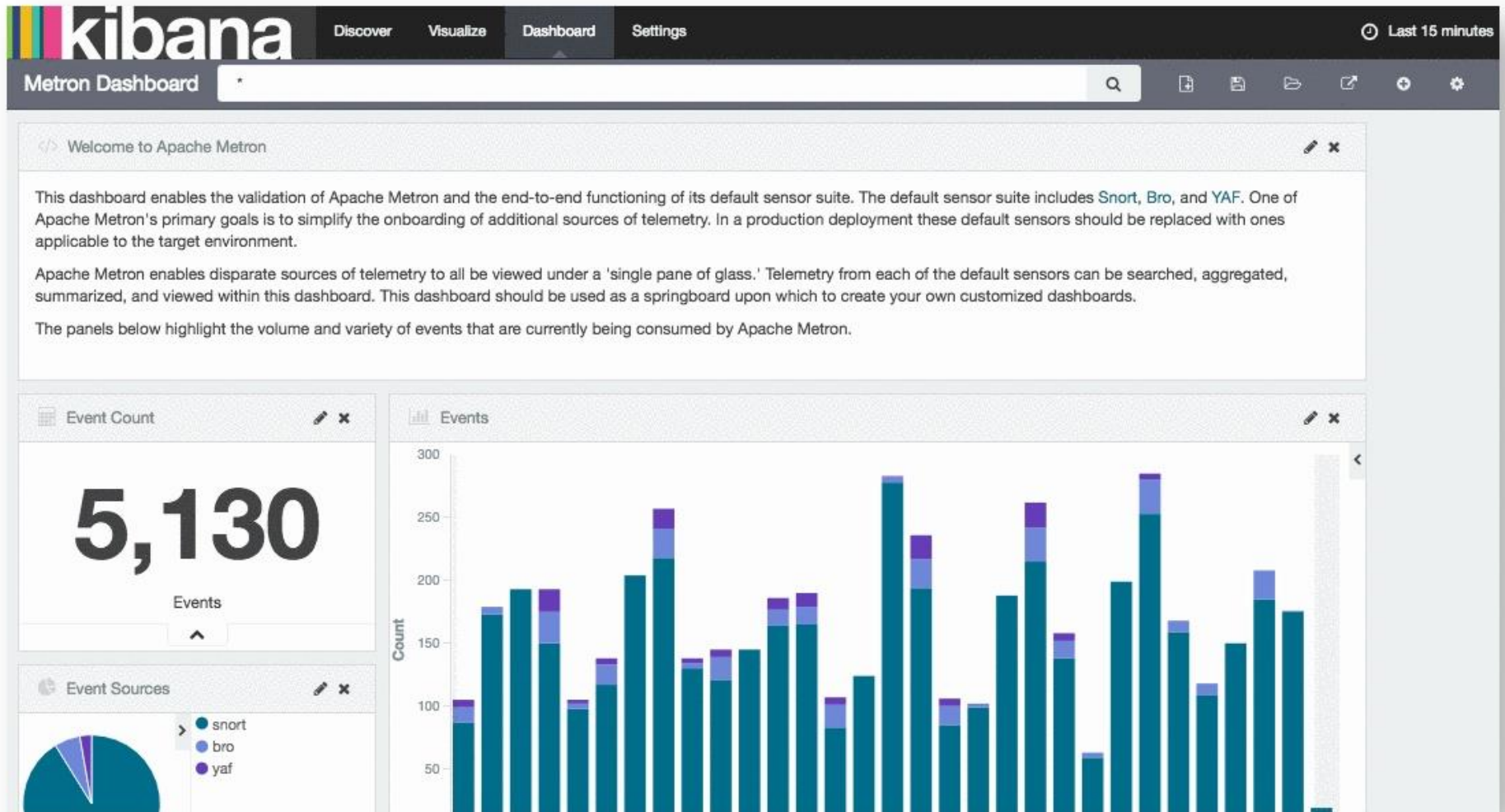
- squid***
- Selected Fields
- ? _source
- Available Fields
- ↑ _id
 - ↑ _index
 - # _score
 - ↑ _type
 - ↑ action
 - # bytes
 - ↑ code **add**
 - ↑ domain_without_subdomains



Time **Time** | **_source**

June 22nd 2016, 12:42:18.720	full_hostname: amazon.com code: 301 method: GET threatinteljoinbolt:joiner:ts: 1466613739304 enrichmentenlitterbolt:enlitter:ts: 1466613739304 enrichmentenlitterbol
------------------------------	---

Metron Dashboard in Kibana



Part 3 Apache Spot



<http://spot.incubator.apache.org>

Apache Spot Architecture



TELEMETRY

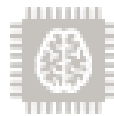
- Network Flows (nfcapd)
- DNS (PCAP)
- Proxy



PARALLEL INGEST FRAMEWORK

- Open source decoders
- Load data in Hadoop
Data transformation

Visualization, attack
heuristics noise filter



MACHINE LEARNING

- Filter billions of events
to a few thousand
- Unsupervised learning



OPERATIONAL ANALYTICS

- Open-source software for analysis of telemetry data flow and packet analysis
- Provides with insight on networks
- Identifies potential security threats or happening attacks
- Accelerates exposing suspicious connections and previously unseen attacks
 - using flow and packet analysis technologies
- Status: development in Apache Incubator
 - Version 1.0 is the latest release (on August 7, 2017)
 - Newest under-development code is on GitHub

Apache Spot UI with sample data

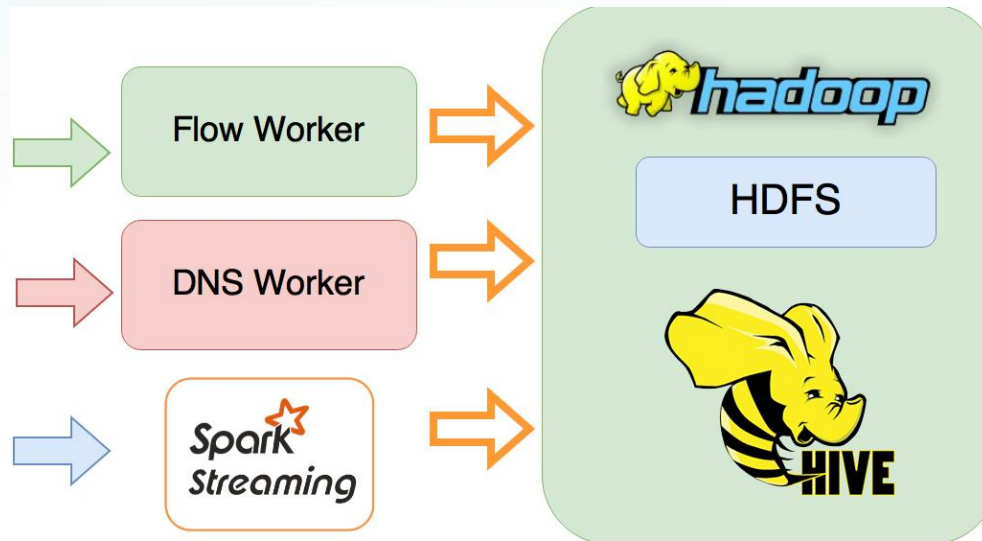
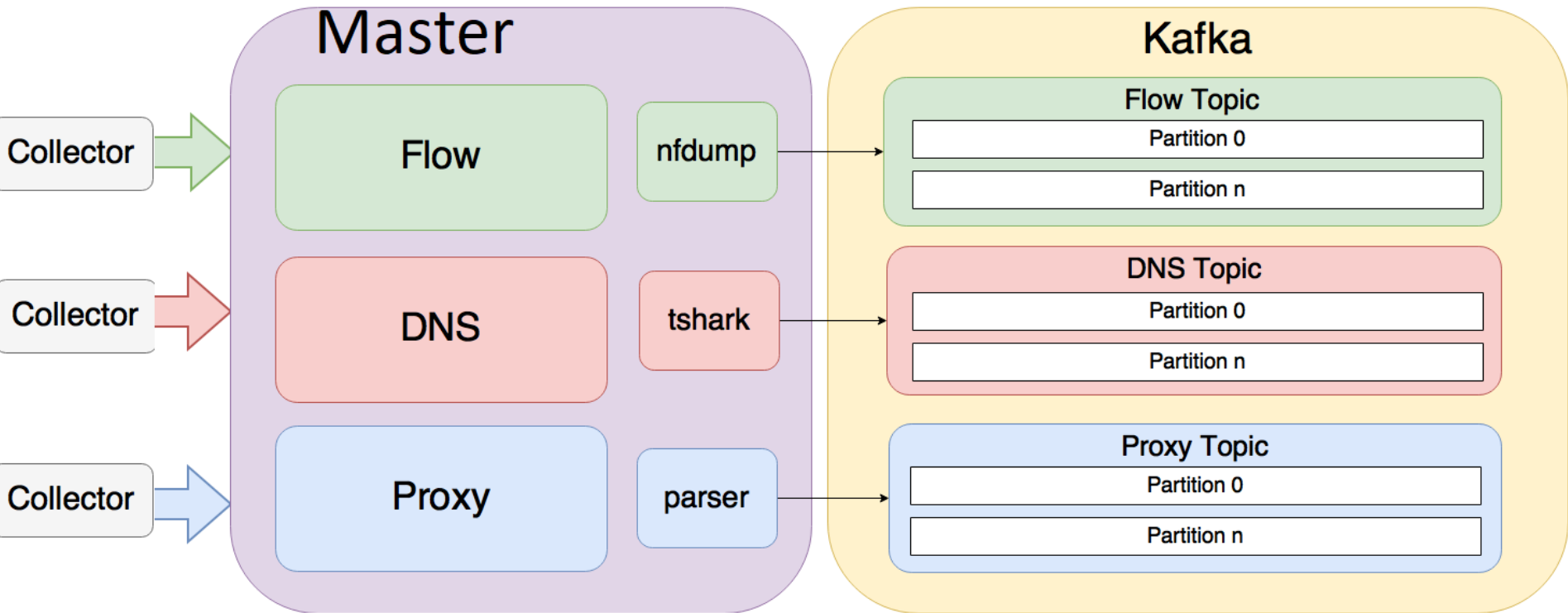
- Running Demo on Docker
 - Install Docker for your platform
 - Run the container:

```
docker run -it -p 8889:8889 apachespot/spot-demo
```
- visit URL in your browser to get started:
<http://localhost:8889/files/ui/flow/suspicious.html#date=2016-07-08>
- For the full instructions visit the spot on Docker hub
<https://hub.docker.com/r/apachespot/spot-demo/>

Apache Spot Modules

- **spot-ingest**
 - Ingest data is captured or transferred into the Hadoop cluster, where they are transformed and loaded into solution data stores.
- **spot-ml**
 - contains routines for performing *suspicious connections* analyses on netflow, DNS or proxy data gathered from a network.
- **spot-oa**
 - Operational Analytics (OA) is a collection of modules, which includes both the data processing and transformation as well as the GUI module for data visualization.
- **spot-setup**
 - Technical aspects of the setup installation process of the Apache Spot solution.

Apache Spot Ingest



Apache Spot Interface

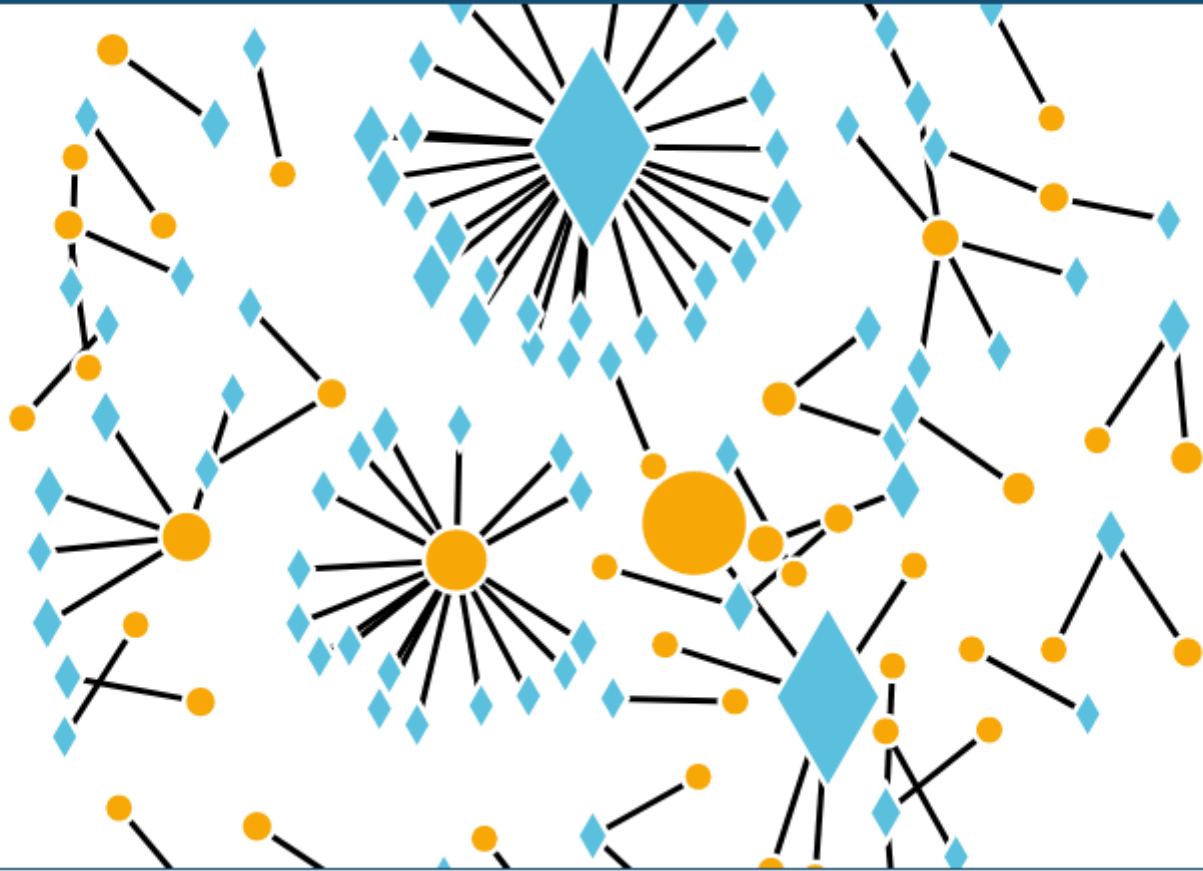
Suspicious



Rank	Time	Source IP		Destination IP		Source Port	Destination Port	Protocol	Input Packets	Input Bytes	Output Packets	Output Bytes
0	2016-10-05 15:33:33	.19.10		.164.56		64006	447	TCP	3	940	0	0
1	2016-10-05 03:07:17	.124.44		.96.99		62055	447	TCP	2	597	0	0
2	2016-10-05 05:38:21	.203.157		.164.56		4805	447	TCP	4	2136	0	0
3	2016-10-05 02:22:11	.38.72		.198.240		0	20893	ICMP	1	139	0	0
4	2016-10-05 14:26:52	59.63.28.146		192.102.198.240		0	26205	ICMP	1	156	0	0
5	2016-10-	28.136		.198.240		0	62171	ICMP	1	133	0	0

Apache Spot Interface

Network View



Apache Spot Interface

Quick IP scoring...

Rating: High Medium Low

<input type="button" value="Score"/>	<input type="button" value="Save"/>	<input type="button" value="Reset Scoring"/>	
<input type="text" value="Source Ip"/> <input type="button" value="Q"/>	<input type="text" value="Dest IP"/> <input type="button" value="Q"/>	<input type="text" value="Src Port"/> <input type="button" value="Q"/>	<input type="text" value="Dst Port"/>
<ul style="list-style-type: none">- Select -19.100.124.44203.15738.728.1468.13654.70.74	<ul style="list-style-type: none">- Select -164.5696.99198.2404.40169.1420.899.2270.184	<ul style="list-style-type: none">- Select -64006620554805043500015617456004	<ul style="list-style-type: none">- Select -447208932620562171603846423267304

Apache Spot Interface

Suspicious

5	2016-10-05 15:45:30	.28.136		.198.240		0	62171	ICMP	1	133
6	2016-10-05 02:31:47	.254.7		.198.240		0	60384	ICMP	1	150
7	2016-10-05 18:05:06	.58.74		.54.40		43	64232	TCP	2	80
8	2016-10-05 06:13:24	.230.29		.169.14		50001	673			132
9	2016-10-05 16:48:58	.151.44		.20.8		56174	81	TCP	11	452
10	2016-10-05 16:48:58	.151.44		.20.8		56174	81	TCP	11	452

Row Selected

Apache Spot Interface

Suspicious

5	2016-10-05 15:45:30	28.136		.198.240		0	62171	ICMP	1	133
6	2016-10-05 02:31:47	254.7		.198.240		0	60384	ICMP	1	150
7	2016-10-05 18:05:06	.58.74		.54.40		43	64232	TCP	2	80
8	2016-10-05 06:13:24	.230.29		.169.14		50001	673			132
9	2016-10-05 16:48:58	.151.44		.20.8		56174	81	TCP	11	452
10	2016-10-05 16:48:58	.151.44		.20.8		56174	81	TCP	11	452

Row Selected

Apache Spot Interface

Suspicious																					
	10-05																				
	02:31:47																				
7	2016-10-05	.58.74			.54.40			43	64232	TCP	2	80	0								
	18:05:06																				
8	2016-10-05	.230.29							3	TCP	3	132	0								
	06:13:24																				
9	2016-10-05	.151.44			.20.8			56174	81	TCP	11	452	0								
	16:48:58																				
10	2016-10-05	.151.44			.20.8			56174	81	TCP	11	452	0								
	16:48:58																				
11	2016-	.58.74			.54.40			43	62199	TCP	4	204	0								

Geo location: England;Gosport
Dedicated Server Hosting
Domain: redstation.net.uk

Apache Spot Interface

Suspicious



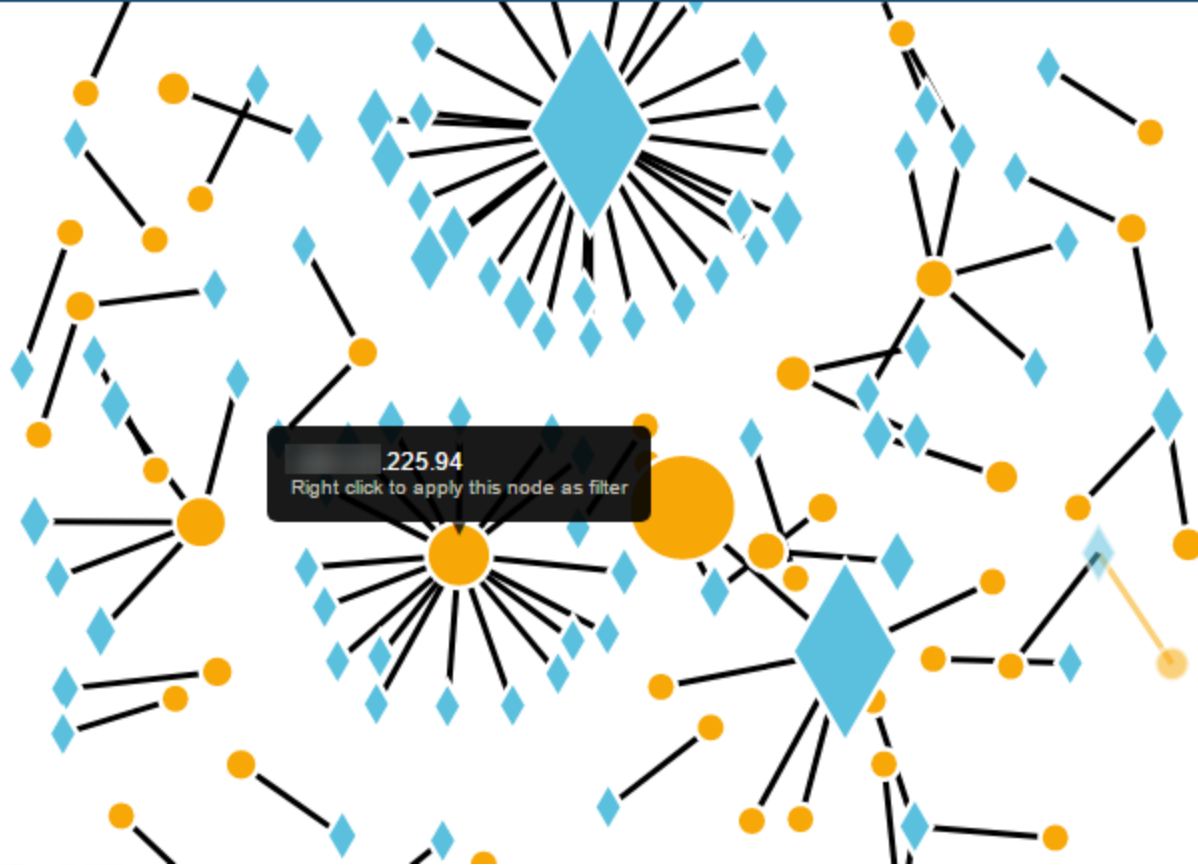
10-05
02:31:47

7	2016-10-05 18:05:06	.58.74		.54.40		43	64232	TCP	2	80	0
8	2016-10-05 06:13:24	.230.29					3	TCP	3	132	0
9	2016-10-05 16:48:58	.151.44		.20.8		56174	81	TCP	11	452	0
10	2016-10-05 16:48:58	.151.44		.20.8		56174	81	TCP	11	452	0
11	2016-	.58.74		.54.40		43	62199	TCP	4	204	0

Geo location: England;Gosport
Dedicated Server Hosting
Domain: redstation.net.uk

Apache Spot Interface

Network View



References

- <http://spot.incubator.apache.org>
- <http://opensoc.github.io>
- <https://community.hortonworks.com/articles/26812/metron-ui-finding-a-needle-in-a-haystack.html>
- <https://metron.apache.org/>
- <https://github.com/apache/metron>
- <https://github.com/apache/incubator-spot>