Advanced SiLK Analysis
FloCon 2014

Geoffrey Sanders
Tim Shimeall

Modules

SiLK Prefix Maps

YAF Flow Table Timeouts

SiLK Flow Attributes

SiLK Application Labels

SiLK Prefix Maps

This material is based upon work funded and supported by Department of Homeland Security under Contract No. FA8721-05-C-0003 with Carnegie Mellon University for the operation of the Software Engineering Institute, a federally funded research and development center sponsored by the United States Department of Defense.

DM-0000764

Learning Objectives

At the end of this module, analysts will have the knowledge and skills to perform the following tasks:

- Create prefix maps
- Display prefix maps
- Use prefix maps

Contents

Overview of prefix maps

Benefits of prefix maps

Prefix map modes

Common statements

Address mode statements

Protocol-Port mode statements

Creating and displaying prefix maps

Querying prefix maps

Using prefix maps

Overview of Prefix Maps

Commonly referred to as “pmap”

Map field values to text labels

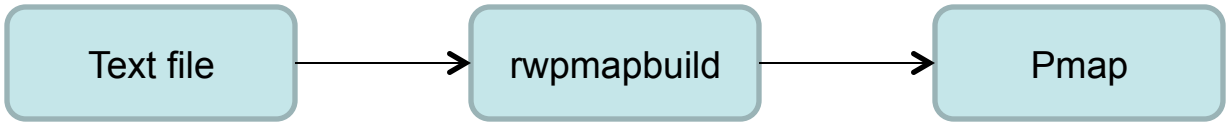
- IP addresses, ports, and protocols

Binary file created from text input statements

- rwpmapbuild(1)

Flow record operations

- Partition, sort, count, and display



Benefits of Prefix Maps

Partition flow records using text labels for:

- IP addresses
- Ports and protocols

Display text labels for flow record:

- IP addresses
- Ports and protocols

Prefix Map Modes

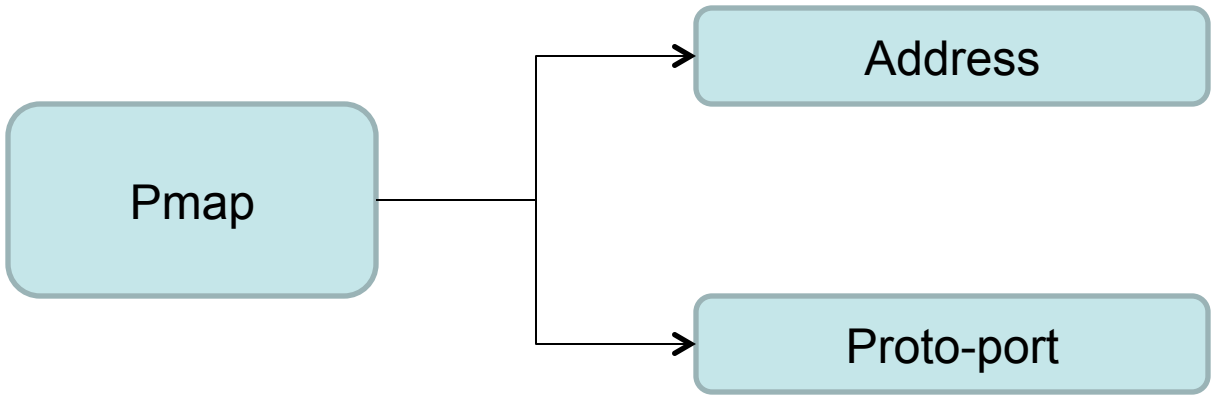
Prefix maps have two modes

Address mode

- Map IPv4/v6 address CIDR or range to text label

Protocol/port mode

- Maps protocol or protocol/port range to text label



Common Statements

Input file statements common to all prefix maps

map-name

- Creates a name for the data in a pmap file
- ***map-name simple-string*** format
- Simple-string is used to generate filtering switch names (rwfilter) or field names (rwcut, rwgroup, rwsort, rwstats, rwuniq)

label

- Associates a numeric identifier with a text label
- ***label num label-text*** format
- Must appear before the *default* or range definitions

Common Statements (cont'd)

default

- Provides a default label for ranges not explicitly defined
- ***default label-value*** format
- UNKNOWN is assigned if a default statement does not appear

mode

- Specifies how to process the pmap file
- ***mode { ipv4 | ipv6 | proto-port }*** format

Address Mode Statements

Input file statements unique to address prefix maps

cidr-block

- Associate a label or label identifier with a CIDR block
- ***cidr-block label-value*** format

low-ip high-ip

- Associate a label or label identifier with an IP address range
- ***low-ip high-ip label-value*** format

low-int high-int

- Treat low-int/high-int as 32 bit values
- Convert values to IPv4 addresses
- Associate label with the converted IPv4 range
- ***low-int high-int label-value*** format

Protocol-Port Mode Statements

Input file statements unique to protocol-port prefix maps

proto/port

- Associate a label or label identifier with all protocols and port numbers between two inclusive values
- ***proto/port proto/port label-value*** format

proto

- Associated a label or label identifier with all protocols between two values
- ***proto proto label-value*** format

Example Protocols/Port Input File

```
default NONE
mode proto-port
map-name protocols
1 1 icmp
6 6 tcp
17 17 udp
6/0 6/1023 tcp/generic-reserved
6/20 6/20 tcp/ftp-data
6/21 6/21 tcp/ftp
6/22 6/22 tcp/ssh
```

Example Address Input File

```
label 0 non-routable
label 1 internal
label 2 apple
label 3 NONE
default NONE
mode ipv4
map-name networks
0.0.0.0/8 non-routable
172.16.0.0/12 non-routable
192.168.1.0/24 internal
17.0.0.0/8 apple-inc
```

Creating and Displaying Prefix Maps

Pmaps are created by compiling a text file into a binary pmap using *rwpmapbuild*

- `rwpmapbuild --input-file=protos.pmap.txt --output-file=protos.pmap`
- `rwpmapbuild --input-file=protos.pmap.txt > protos.pmap`

Pmaps are displayed by printing their contents using *rwpmapcat*

- `rwpmapcat protos.pmap`

Country code prefix maps from GeoIP data are also supported

- `gzip -d -c GeoIP.dat.gz | rwgeoip2ccmap --encoded-input > country_codes.pmap`

Querying Prefix Maps

Prefix map keys and values are queried using *rwpmaplookup*

To query the value of a protocol/port

- `echo "6/22" | rwpmaplookup --map-file=protos.pmap`

To query the value of an IP address

- `echo "17.0.0.1" | rwpmaplookup --map-file=networks.pmap`

To query the country code of an IP address

- `echo "2.22.230.1" | rwpmaplookup --country-code`

Using Prefix Maps

Prefix maps can be used with multiple SiLK tools

- rwfilter, rwcut, rwuniq, rwgroup, rwsort, rwstats, rwpmaplookup

rwfilter

- *`rwfilter --pmap-file=[MAPNAME:]FILENAME [--pmap-src-MAPNAME=LABELS]`*
- `rwfilter --pmap-name=protocols:protos.pmap --pmap-src-protocols=tcp/ssh --pass=stdout`

rwcut

- *`rwcut --pmap-file=[MAPNAME:]FILENAME --fields=fields`*
- `rwcut --pmap-file=networks:networks.pmap --fields=dip,dst-networks`

Additional References

Analyst's Handbook: Using SiLK for Network Traffic Analysis

- http://tools.netsa.cert.org/silk/analysis-handbook.pdf

Manual pages

- pmapfilter(3), rwcut(1), rwfilter(1), rwgroup(1), rwpmapbuild(1), rwpmapcat(1), rwpmaplookup(1), rwsort(1), rwgeoip2ccmap(1)

Summary

Benefits of prefix maps

Creating prefix maps

Displaying prefix maps

Using prefix maps

Hands-On

Apply the knowledge from this module with use cases in the *SiLK Prefix Maps Workbook*

YAF Flow Table Timeouts

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Learning Objectives

At the end of this module, analysts will have the knowledge and skills to perform the following tasks:

Identify flow table timeouts

Identify how flow table timeouts effect network flow records

Contents

Overview of flow table timeouts

Benefits of flow table timeouts

Idle timeout

Active timeout

Overview of Flow Table Timeouts

Network flow records begin in the YAF sensor '*flow table*'

The flow sensor monitors packets for a five-tuple session and updates the respective flow table entry

Flow table timeouts determine when five-tuple sessions should be finalized (*flushed*) from the table and written to a flow record

YAF implements two types of flow table timeouts

- Idle
- Active

Benefits of Flow Table Timeouts

Timeouts help to record flow records in the repository

- Persistent sessions are finalized periodically

Timeouts help the sensor with stateless protocols

- UDP, ICMP, others
- Finalize flow records when packets on the wire stop

Timeouts indicate to an analyst packet activity between source and destination IP addresses

- Packets occurred until a defined period

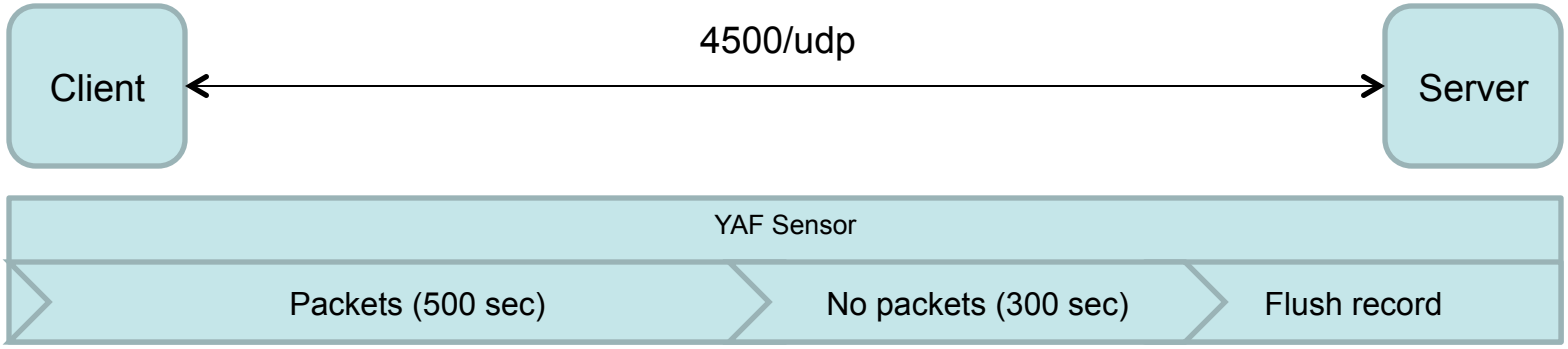
Idle Timeout

Flow sensor monitors five-tuple session for *'packet inactivity'*

If packets are not seen for a specified time period, the flow record is flushed from the table

- Default time period is 300 seconds (5 minutes)

Idle timeout is configurable (*yaf --idle-timeout*)



Active Timeout

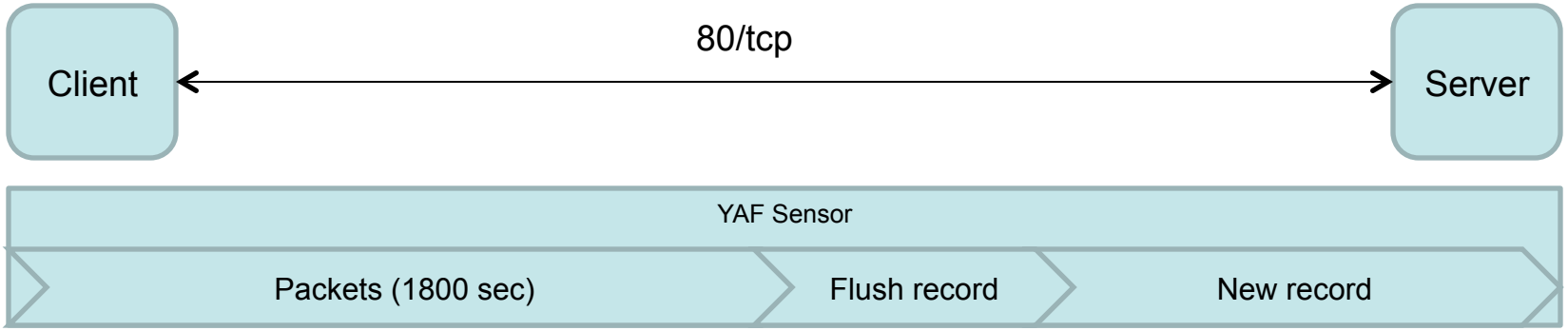
Flow sensor monitors five-tuple sessions for '*continued packet activity*'

All flow records meeting a specified time period are flushed from the table

- Default time period is 1800 seconds (30 minutes)
- Adds timeout attribute to flow record

New record is created with same five-tuple for new period

Active timeout is configurable (*yaf --active-timeout*)



Additional References

Analyst's Handbook: Using SiLK for Network Traffic Analysis

- http://tools.netsa.cert.org/silk/analysis-handbook.pdf

Manual pages

- yaf(1), rwfilter(1), rwgroup(1), rwmatch(1)

Summary

Benefits of flow table timeouts

Identify flow table timeouts

Identify how flow table timeouts effect network flow records

Hands-On

Apply the knowledge from this module with use cases in the *YAF Flow Table Timeouts Workbook*

SiLK Flow Attributes

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Learning Objectives

At the end of this module, analysts will have the knowledge and skills to perform the following tasks:

Identify flow record attributes

Mask flow record attributes

Partition flow records using attributes

Display flow record attributes

Contents

Overview of flow attributes

Benefits of flow attributes

Flow attribute values

Unique flow attributes

Flow attribute masks

Partitioning flow records using flow attributes

Displaying flow record attributes

Overview of Flow Attributes

Attributes are a field in SiLK flow records

Describe characteristics of

- Flow record generation
- Packets that comprise a flow record

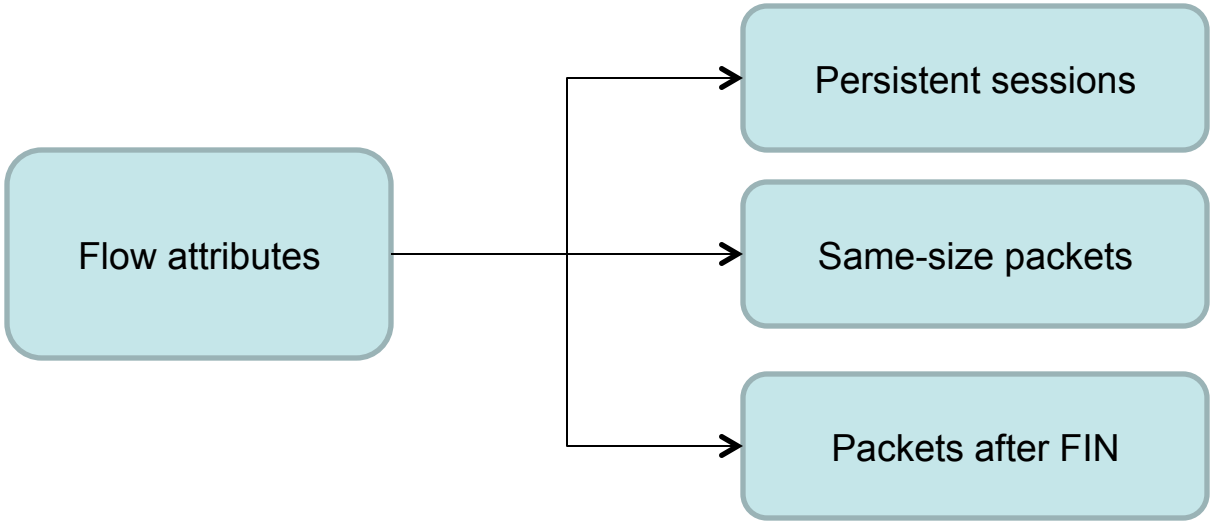
Attributes are set by the flow sensor - Yet Another Flowmeter (YAF)

Provides analysts with an understanding of what occurred between source and destination IP addresses

Benefits of Flow Attributes

Flow attributes provide analysts insight into sessions between two IP addresses

- Persistent (long-running) sessions
- Sessions with all packets the same size
- Sessions with packets that follow a TCP FIN (excluding ACK packets)



Flow Attribute Field Values

There are five flow attribute field values

- *Null/empty*
  - There are no attributes for the flow record
- *'S'*
  - All packets for the flow record were the same size
- *'T'*
  - The flow record reached an initial active timeout
- *'C'*
  - The flow record was a continuation of an initial active timeout
- *'F'*
  - Additional packets were seen following a packet with a FIN flag (excluding ACK packets)
  - TCP flows only

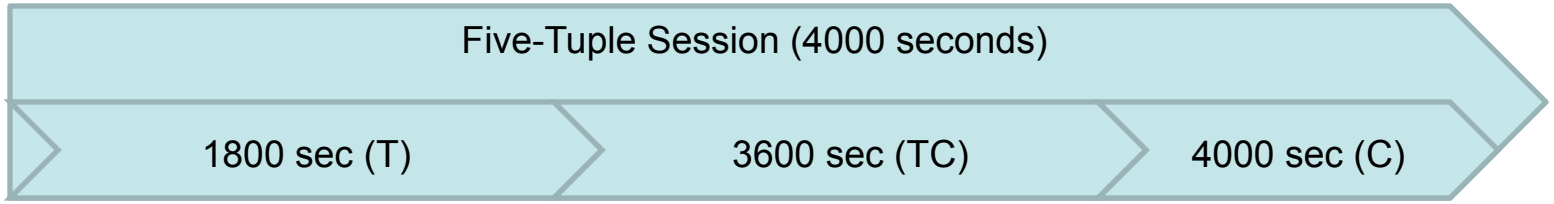
Unique Flow Attributes

Persistent (long-lived) sessions have unique combinations of flow attributes

First flow record will have the *'T'* attribute

Second through next-to-last flow records will have combined *'TC'* attributes

Last flow record will have the *'C'* attribute



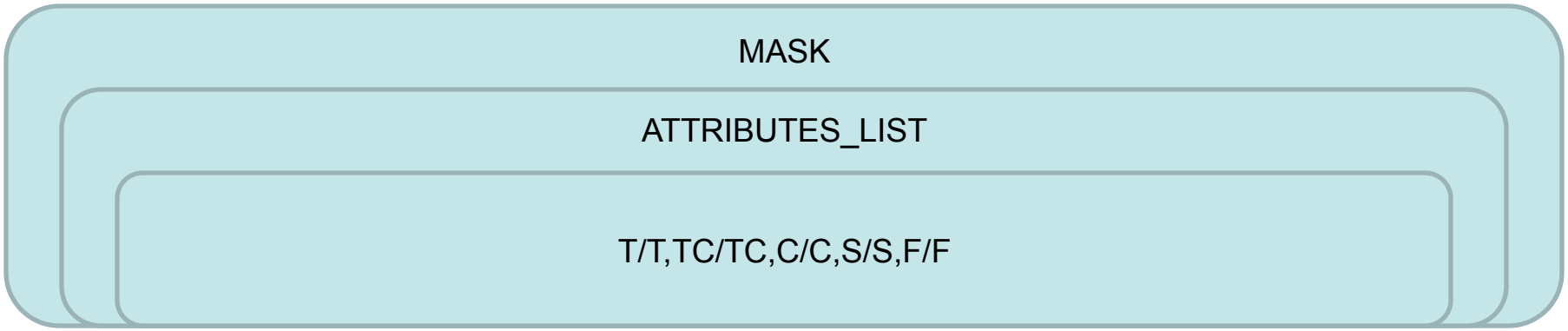
Flow Attribute Masks

Attribute *'masks'* are used to partition flow records based on attribute values

Similar to SiLK TCP flag masks

Masks are defined in an *'ATTRIBUTES_LIST'*

An ATTRIBUTES_LIST is a comma separated list of one or more HIGH_ATTRIBUTES/MASK_ATTRIBUTES pairs



Example Attribute Masks

Identify flow records with active timeout attributes

- T/T

Identify flow records where all packets are of equal size

- S/S

Identify flow records with second to next-to-last active timeouts

- TC/TC

Identify flow records with a final active timeout

- C/C

Identify flow records without attributes

- /SCTF

Partition Flow Records Using Attributes

Flow records are partitioned using *rwfilter* with the *--attributes* option

- *rwfilter --attributes=ATTRIBUTES_LIST*

Example usage

- Partition outweb TCP flow records on 2012/01/01 with initial active timeouts and second through next-to-last active timeouts
- *rwfilter --start-date=2012/01/01 --proto=6 --type=outweb --attributes=T/T,TC/TC*

Sort and Display Flow Record Attributes

Flow records can be sorted and displayed using the *'attributes'* field of rwuniq, rwsort, rwcut, rwstats, and other rw* tools

- *rwuniq --fields=attributes*
- *rwsort --fields=attr*

Example usage

- Display unique sip, dip, and attribute field bins
- *rwuniq --fields=sip,dip,attributes*

Additional References

Analyst's Handbook: Using SiLK for Network Traffic Analysis

- http://tools.netsa.cert.org/silk/analysis-handbook.pdf

Manual pages

- rwstats(1), rwcut(1), rwfilter(1), rwsort(1), rwgroup(1), rwuniq(1)

Summary

Benefits of flow attributes

Identify flow record attributes

Mask flow record attributes

Partition flow records using attributes

Display flow record attributes

Hands-On

Apply the knowledge from this module with use cases in the *SiLK Flow Attributes Workbook*

SiLK Application Labels

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Learning Objectives

At the end of this module, analysts will have the knowledge and skills to perform the following tasks:

Identify application labels

Use application labels

Use the app-mismatch plugin

Contents

Overview of application labels

Benefits of application labels

Application label values

Partition flow records using applabels

Display applabels

Application Mismatch Plugin

Overview of Application Labels

Application labels are a numeric field in SiLK flow records

Also referred to as “applabels”

Flow sensors examine packet payloads and tag the flow with an application number

Applabels are set by the flow sensor - Yet Another Flowmeter (YAF)

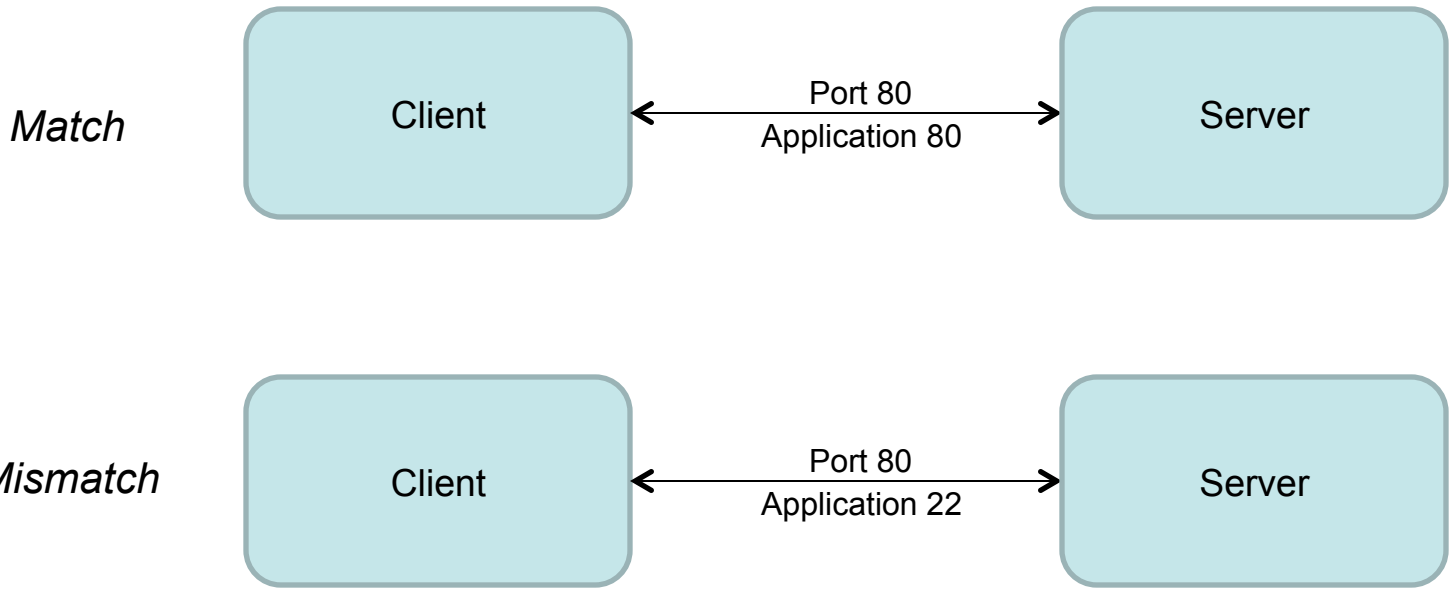
Provides analysts with an understanding of the application traversing a port

Presently considered ‘*experimental*’ and may not be 100% accurate

Benefits of Application Labels

Application labels provide analysts insight into an application that traverses a port

- Applications that match the IANA assigned port (match)
- Applications that do not match the assigned port (mismatch)



Application Field Values

There are a fixed number of total possible field value

- 0 – 65535 (inclusive)

Common values

- 0 (Undetermined)
- 80 (HTTP)
- 22 (SSH)
- 53 (DNS)
- 194 (IRC)
- 443 (SSL/TLS)
- 65534 (Poison Ivy)
- Many others

Complete list of default values

- http://tools.netsa.cert.org/yaf/applabel.html

Partition Flow Records Using Applabels

Flow records can be partitioned using application labels

- *rwfilter --application=INTEGER_LIST*

Example

- Partition outweb TCP client flow records on 2012/01/01 with SSH and TLS application numbers
- *rwfilter --start-date=2012/01/01 --type=outweb --proto=6 --flags-initial=S/SURFPACE --application=22,443*

Sort and Display Flow Record Applabels

Flow records can be sorted and displayed using the *'applications'* field of rwuniq, rwsort, rwcut, rwstats, and other rw* tools

- *rwuniq --fields=application*
- *rwsort --fields=app*

Example usage

- Sort using destination IP, destination port, and application bins
- *rwsort --fields=dip,dport,app*

Application Mismatch Plugin

SiLK provides the application mismatch plugin

- Used with *rwfilter*
- Identifies flows where the '*application*' field does not match the source or destination port value
- *'FAILS'* flow records where the application field value = 0
- *'FAILS*' flow records that are not TCP or UDP
- *rwfilter --plugin=app-mismatch.so*

Example usage

- Identify out type TCP flow records on 2012/01/01 that do not match destination port 80
- *rwfilter --plugin=app-mismatch.so --start-date=2012/01/01 --proto=6 --type=out --dport=80 --pass=stdout*

Additional References

YAF Application Labeling

- http://tools.netsa.cert.org/yaf/applabel.html

Manual pages

- rwstats(1), rwcut(1), rwfilter(1), rwsort(1), rwgroup(1), rwuniq(1), applabel(1)

NetSA Tooltip: Identifying Tunnels Using Application Labels

- https://tools.netsa.cert.org/confluence/display/tt/Identifying+Tunnels+Using+Application+Labels

Summary

Benefits of application labels

Application label values

Partition flow records using application labels

Displaying application labels

Application Mismatch Plugin

Hands-On

Apply the knowledge from this module with use cases in the *SiLK Application Labels Workbook*

Contact Information

netsa-contact@cert.org
Geoffrey Sanders – **gtsanders@cert.org**
Tim Shimeall — **tjs@cert.org**
Software Engineering Institute
Carnegie Mellon University
Arlington, VA / Pittsburgh, PA