Welcome!

Our presentation will begin shortly…

Audio for today's presentation will be streamed through your computer speakers.

All participants are in listen-only mode.

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Performance Rules Creation

VRT Rules Methodology

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What madness today?

- Review VRT's rule generation methodology
- Examine preprocessors
  - Why they are used
  - How they impact detection
  - Configuration of key preprocessors
- Detection engine
  - How the rules are parsed
  - Performance considerations
  - 2.8.2 Update

What is a DQOH?

Matthew Olney

(irc nick: dqoh)

VRT Security Analyst for two years

Primary Responsibilities:

- Snort rules generation
- QA for SEU and VRT rules feed
- Purveyor of bad ideas

Past life:

- Network and Security Engineer
  - Cisco
  - Snort
  - Open source security products

VRT Rules Methodology

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The Goal

Write a rule that protects against the triggering conditions of the vulnerability, rather than specific exploits.

Step 1: Research the vulnerability

For example, for an overflow:

- What data structures are involved?
- How are those structures populated?
- What checks protect those structures?
- How do you get data to those structures?
- And of course: What pointers can be overwritten?

Step 2: Modeling the protocol

How is the attack delivered?

- How is data transferred across the network?
  - What overarching protocol and port?
  - How is the data laid out in the packet?
- How do we key in to the part of the data we need to examine?
- What obfuscation and evasions options are available to an attacker?

Step 3: Identify the triggering conditions

- Combine the information from steps 1 and 2
- Make the detection as precise as possible:
  - TCP or UDP
  - Port number
  - Established connection?
  - Direction of traffic (to_server or to_client)?
  - Target the field that contains the problematic data
  - Check that the field will be processed
- Make any modifications necessary to account for false-positives or evasions.

Step 4: Testing and verification

- Analyst test
  - Once the rule is written, the analyst will test it in a limited test environment.
  - Provide final rule to Team Lead.
- Test Suite
  - Automated test cases
  - 16 million checks
  - Looking for:
    - Performance issues
    - False positives
    - False negatives

Detection Methodology Summary

- To write a successful rule we need to know:
  - How the attack affects the targeted system
  - How the data for that system is transferred across the wire
  - What the triggering conditions are
  - Rule has to be functional and not impact performance
- To really do the last point, we need to understand more about how Snort works…

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Snort Architecture
(Preprocessors)

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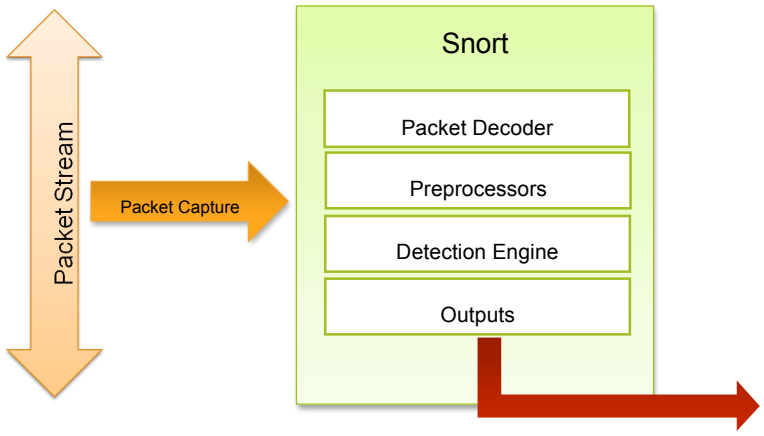
Why Architecture is Important

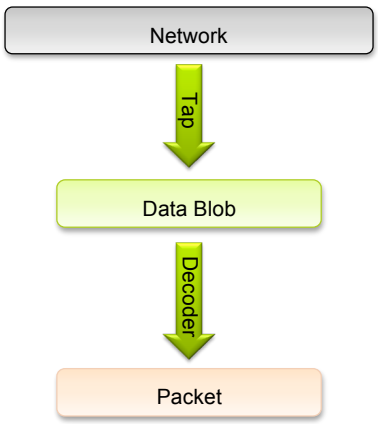
- For a given detection problem there is often more than one solution:
  - Preprocessor
  - Content
  - PCRE (or not…)
- Understanding the architecture enables us to build the correct rule to maintain performance and maximize detection.
- We need to know how to configure Snort to support our detection

Snort Basics Architecture



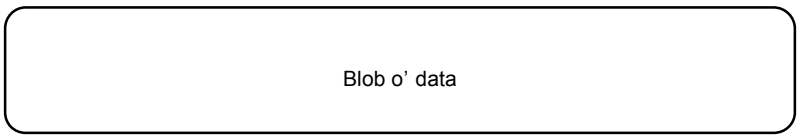
Decoder Functionality

- Decoder receives a blob of data
- Decoder adds pointers to critical data locations
  - Ethernet header
  - IP header
  - TCP header
  - Payload
- Small set of sanity checks are made here



Decoder Function

Blob of data in:



Decoded packet structure out:

Preprocessors

- Preprocessors do one or more of the following:
- Provide detection for attacks and activity not able to be done by standard snort rules
- Provide normalization services to present data in a standardized format
- Provide reassembly services so that detection can be performed against a complete message

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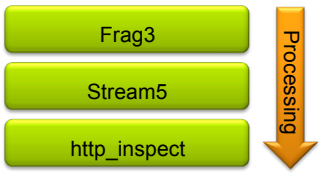
Preprocessors: Important Thing to Know

- Preprocessors are loaded in the order they occur in your snort.conf (or equivalent)
- Packets flow through preprocessors in the order they are loaded
- Ensure the preprocessors are loaded in a rational manner:



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Frag3

- Provides target based IP defragmentation
- Reassembles fragmented packets into a pseudo-packet
- Pseduo-packet is fed back into decoder for processing
- Original fragmented packets continue through the detection sequence also
- Also provides alerts (GID:123) for certain fragmentation based attacks

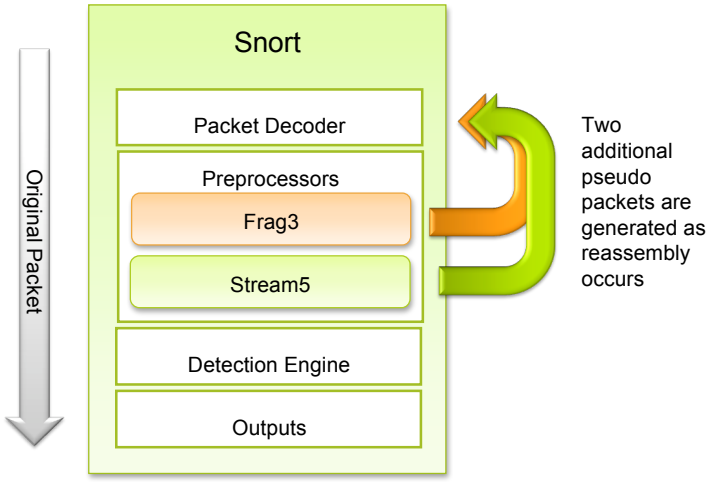
Stream5

- Provides target-based TCP reassembly
- Provides state tracking for TCP, UDP and ICMP
- Reforms TCP messages into a pseudo-packet and forwards back into the decoder for full detection
- Provides alerts for certain TCP reassembly attacks (GID: 129)

Stream5 Configuration

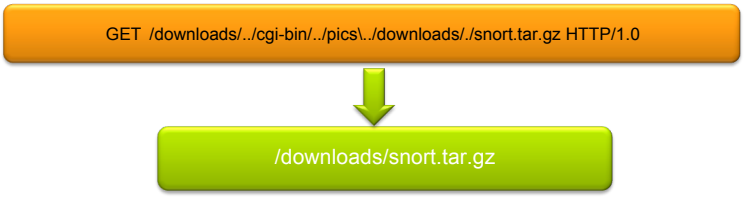
- "Ports"
  - Specifies the ports for reassembly
  - Configuration default:
    - ports client 21 23 25 42 53 80 110 111 135 136 137 139 143 445 513 514 1433 1521 2401 3306
  - Port numbers provided are always server side port numbers
  - 'client' in this case meaning 'traffic originating from the client'
  - To add port 80 client side reassembly:
    - ports both 80
    - ports server 80
- Detection impact
  - Modification to the configuration may be necessary to support additional ports or to reassemble for client-side attacks.

Amazing Snort Packet Generator!



http_inspect

- Provides normalization support for the URI
- Places the normalized version of the uri in the “URI” buffer
- Also provides alerts (GID: 119/120) for a set of evasions and attacks



http_inspect: flow_depth

- Performance tunes snort to ignore portions of the HTTP response (traffic to client only)
- Default value is to look at only the 300 bytes of the response
- Max configurable size of flow_depth is 1460
- flow_depth can cause false negatives
- flow_depth: 0 will cause snort to process the entirety of the HTTP response
- This can lead to performance issues

Detection concerns based on preprocessors

- Preprocessors can significantly impact what you see
  - Normalization
  - Truncation
  - Reassembly
- Preprocessors can also provide detection capability for certain problematic traffic

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Snort Architecture
(Detection Methodology)

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Optimized Rule Evaluation

- Rules are loaded into data structures built to make Snort run as quickly as possible
- Goal is to evaluate packets only with rules with a chance to fire
- Before Snort 2.0, rules were organized into “rule chains”:
  - Chains of rules were built with common headers:
    - src IP / dst IP / src Port / dst Port
  - Packets only ran on chains with matching headers
- Snort 2.0 introduced the fast pattern matcher

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Fast Pattern Matcher

- Rules are parsed into categories based on the protocol and the destination port (port groups)
- Within any given pair, the fast pattern matcher parses the rule looking for the first, longest, non-negative content match:
  - (content:”a”; content:”bc”; content:”de”; content:!”biscuits”;)
  - Results in the fast pattern using “bc”
- Rules are only run on packets that have matching content

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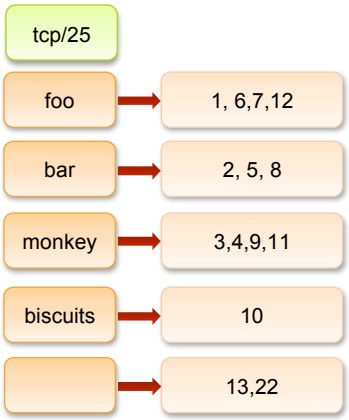
Fast Pattern Matching Example



- Bottom category is for rules with no content
- So…if we all send an email to the blue monkey bar we will evaluate only:
  - 2,3,4,5,8,9,11,13, 22
- Every packet sent to tcp/25 will be evaluated against the rules with no content

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Rule Options List

- Rules are parsed into a sequence of options
- When evaluation occurs, options are checked in sequence
- When developing rules look for ways to “bail early”
- Dsize, flow and flowbit checks are fast ways to terminate rule processing
- Example options list:
  - flow: to_server, established
  - flowbits: isset, haz.biscuits
  - content: “gravy”
  - byte_test:2,>,15,relative;
- Rule header information is also checked:
  - tcp $external_net any -> $home_net any

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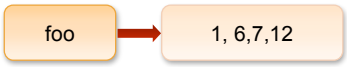
This just in…Snort 2.8.2

- Instead of a list of rules to process:



- Snort 2.8.2 returns a tree intended to speed through redundancies in detection between multiple rules
- During initialization, for each longest content (and for the set of rules with no content), a tree is built

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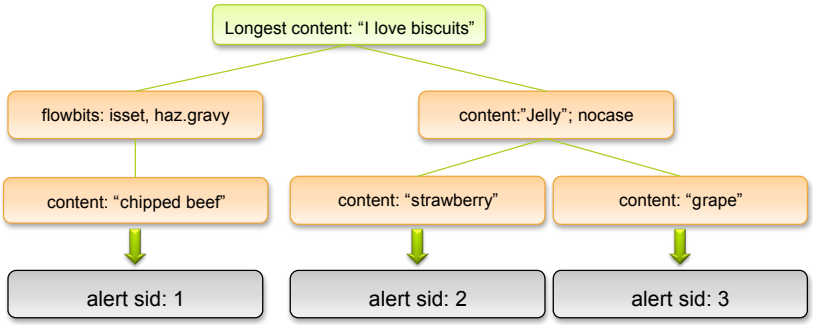
If a rule alerted in a forest…



(flowbits: isset, haz.gravy; content:”I love biscuits”; content:”chipped beef”; sid: 1)
(content:”I love biscuits”; content:”Jelly”; nocase; content: “strawberry”; sid: 2)
(content:”I love biscuits”; content:”Jelly”; nocase; content: “grape”; sid: 3)

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Detection criteria based on architecture

- In all cases, if possible, have a content match
- Make the match as long as possible
- Where multiple rules offer similar detection, mirror the detection for as long as possible
- Ensure that checks involving the header or stream state (for example, flow and flowbits) are done first in the rule

Questions?

- If you have questions in general:
  - snort-sigs mailing list
  - snort-users mailing list
  - #snort on freenode irc
  - research@sourcefire.com
- If you have qeustions or comments on this presentation:
  - molney@sourcefire.com

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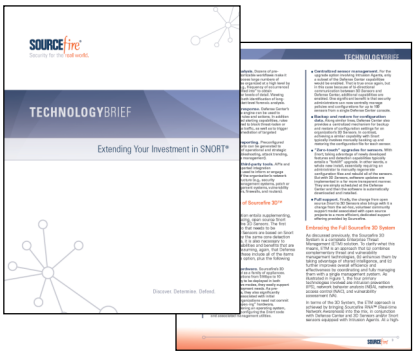
For More Information…

Sourcefire 3D System Flash Demo

"Extending Your Investment in Snort" Technology Brief



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