Defending Computer Networks
Lecture 13: NIDS/HTTP

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Logistics

- No lecture Tuesday
- Quiz 2 next time (Thursday 15th)
  - Networking through DDOS
- Midterm November 3rd
- Guest lectures:
  - October 20th, Cornell ITSO
  - Nov 5th, Tim Dawson
  - One more pending from a security vendor

Revealed: The 100 car models at risk of being stolen due to security 'flaw'

A scientist from Birmingham has won a two-year legal battle to finally publish research that reveals a major security flaw that could leave scores of car models at risk of being stolen.

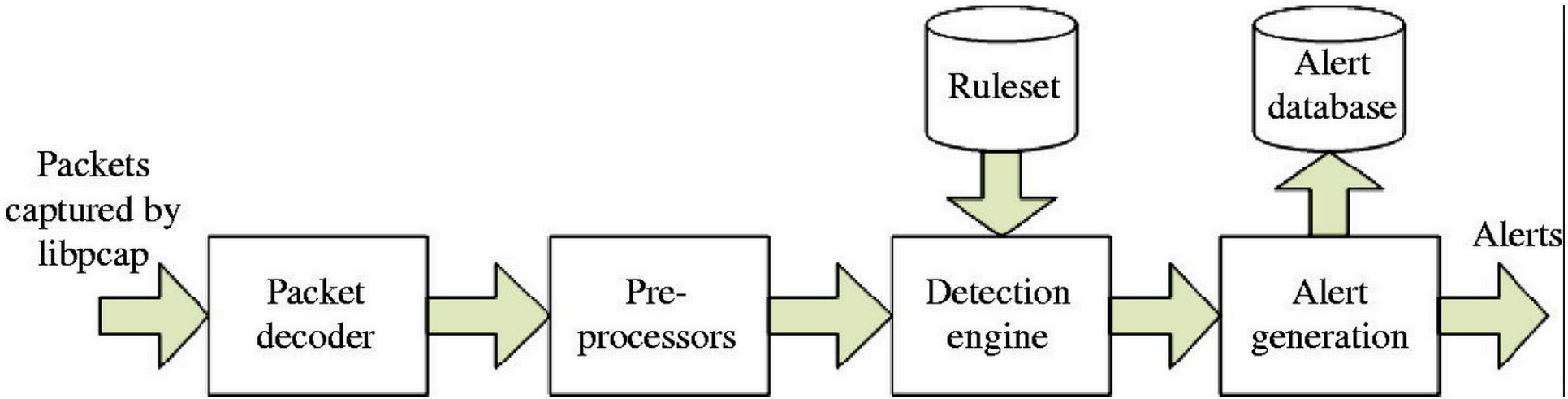
Volkswagen had used its lawyers to keep under wraps the research of University of Birmingham computer scientist Flavio Garcia and his colleagues Baris Ege and Roel Verdult from Radboud University Nijmegen in the Netherlands.

They discovered more than 100 models of cars produced by 26 car manufacturers are at risk of theft by hackers who could crack codes to produce fake keys - thanks to flaws in a device designed to prevent vehicles from being stolen.

Main Goals for Today

- More Network Intrusion Detection
- Start on HTTP

Overall Snort Architecture



Snort Detection Engine Data Structure

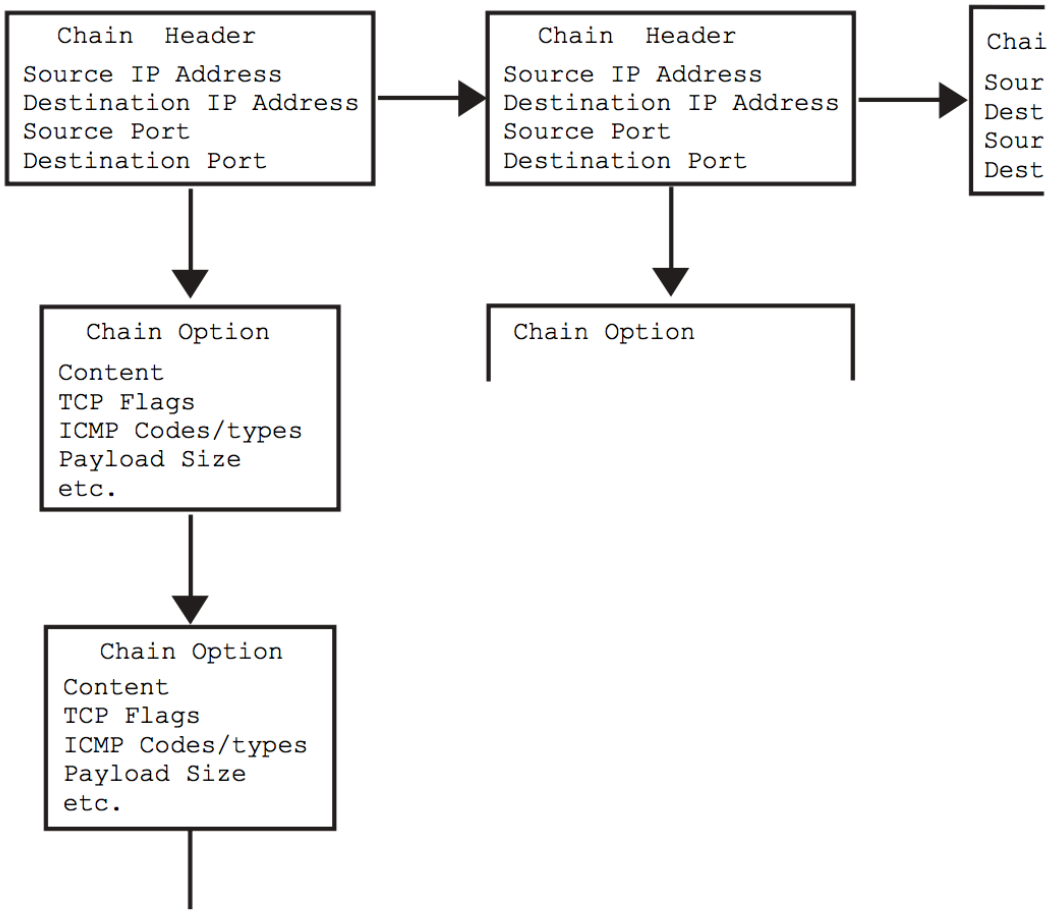
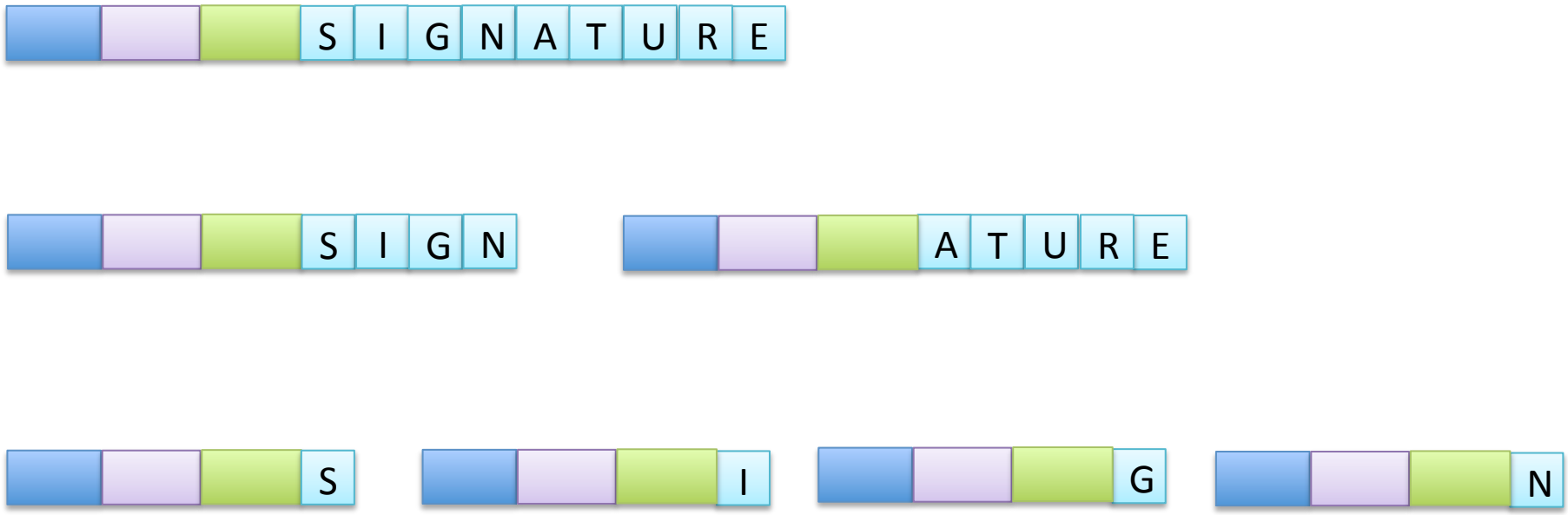


Figure 3: Rule Chain logical structure.

Snort Rule Example 1

alert tcp $EXTERNAL_NET any -> $HTTP_SERVERS $HTTP_PORTS (msg:"SERVER-WEBAPP HyperSeek hsx.cgi directory traversal attempt"; flow:to_server,established; content:"/hsx.cgi"; http_uri; content:"../../"; http_raw_uri; content:"%00"; distance:1; http_raw_uri; metadata:ruleset community, service http; reference:bugtraq,2314; reference:cve,2001-0253; reference:nessus,10602; classtype:web-application-attack; sid:803; rev:21;)

Variants

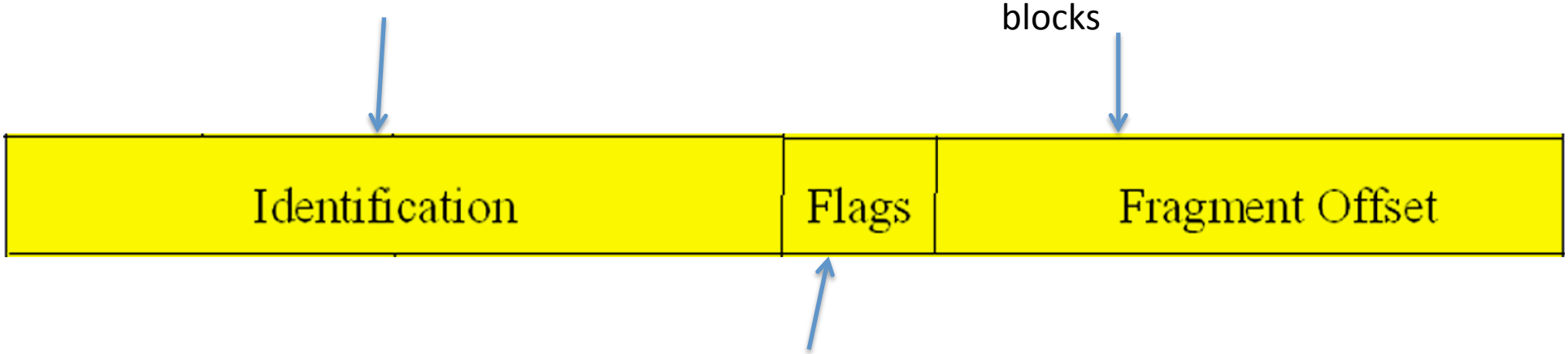


Clearly we have to reassemble TCP before looking for “SIGNATURE”

How Fragmentation Works

All fragments of a given packet have same id

Offset of this segment in the original ip data, in eight byte blocks



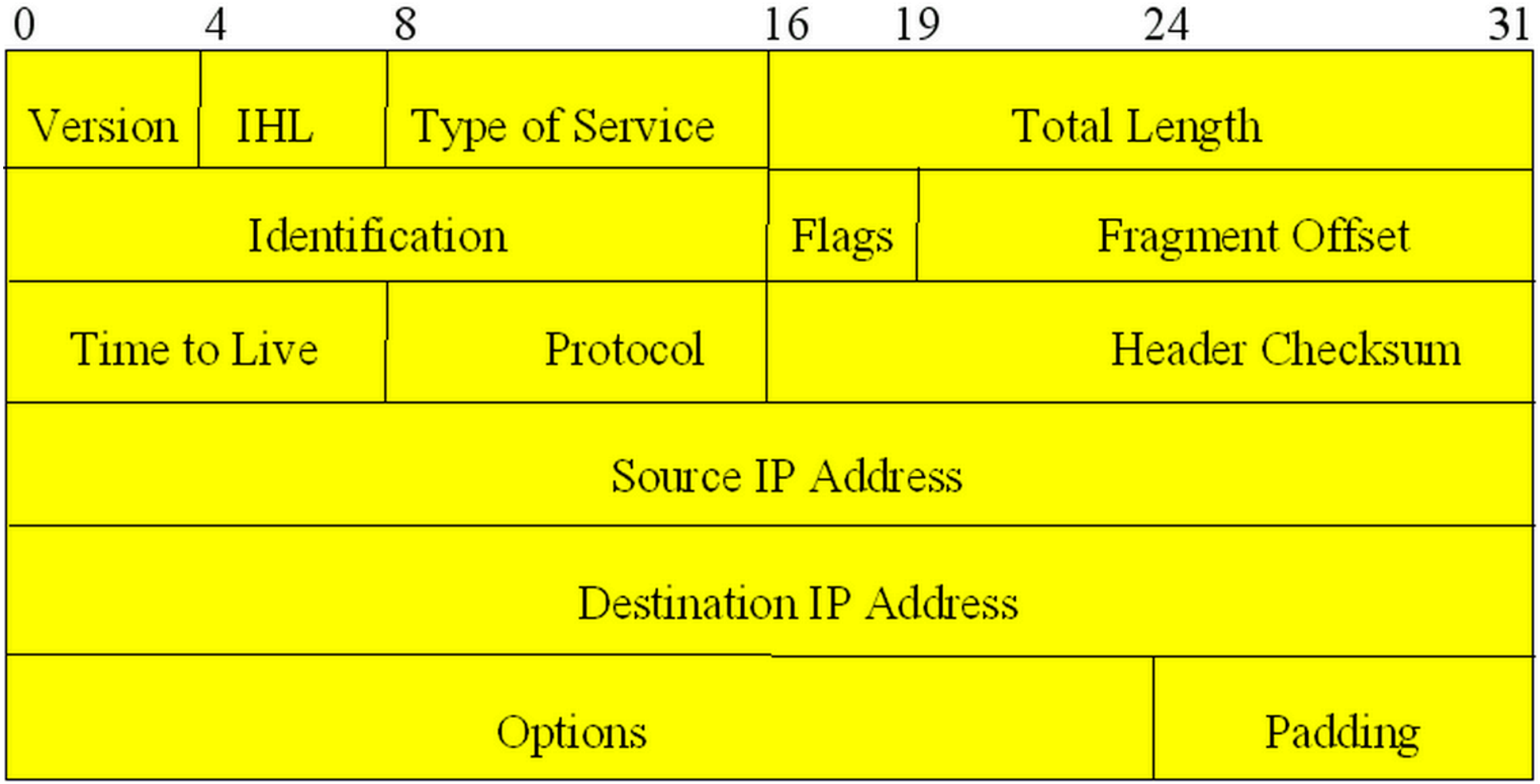
MF flag bit says whether to expect any more packets

Note that fragmentation can be used to break up the TCP header, not just the TCP data

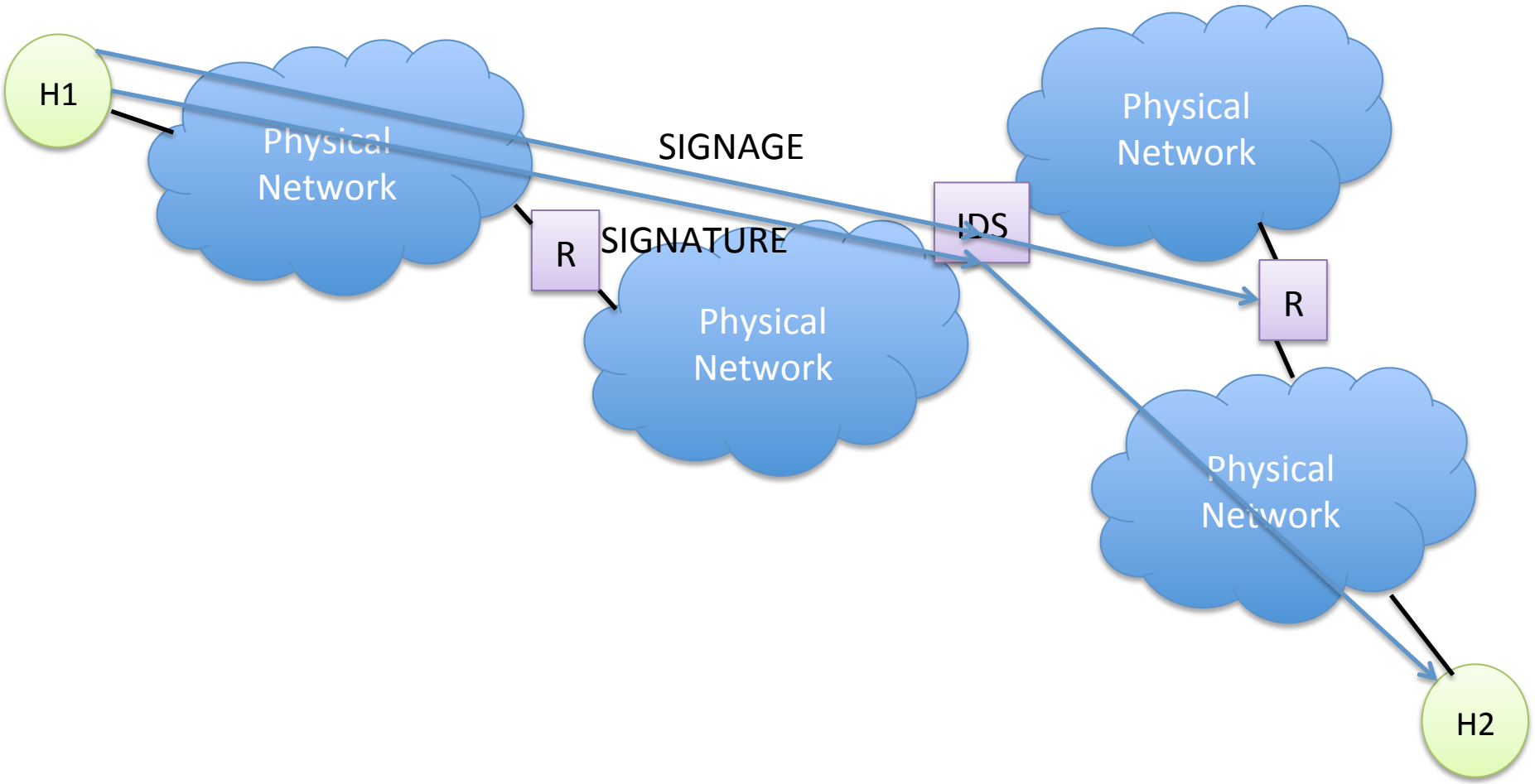
Evading NIDS: Mac address

- Only works if on same L2 network as NIDS
- Add extra packets directed to bad Mac address
  - But with correct destination IP
  - If IDS is not careful, it will process promiscuously
    - Where end-client won't
- Note there are possible legit reasons for Mac address to change during a connection
  - Eg route flapping
  - So just looking for a changing Mac will have some FPs.

Evading NIDS: TTL



Evading NIDS: TTL Field

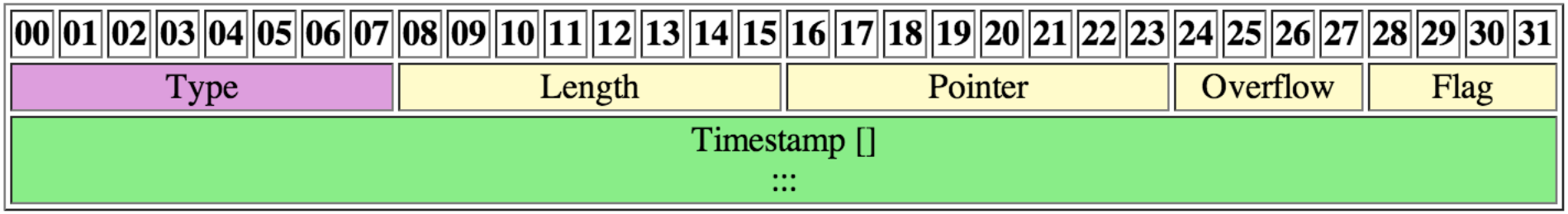


Fragmentation Variant Strategy

- Similar to TTL
- There is a DF bit in “Flags” field in IP header
- Means “Don’t Fragment”
- On certain packets, set this then set packet size greater than MTU at some part of route
- Routers will drop those packets, not deliver
- Can be used as an evasion strategy

IP Timestamp Option Evasion

- IP Options allow additional fields to be added to IP packet header
  - For special purposes
  - IHL field > 5 signals presence of options
- Timestamp recording (RFC 781)
- Packet will be dropped if timestamp option malformed



Effects of Evasions

- Force the IDS to know a great deal about the network
  - Distance to end points (TTL)
  - MTUs in physical networks (DF bit)
  - Nature of end-client (reassembly algorithms)
- OTOH
  - Many of these strategies are themselves somewhat suspicious
  - IDS can use them as evidence
    - maybe, care needed on FPs

Strategies for Defeating Evasions

- Target based
  - IDS needs to figure out nature of all machines on network
    - Active fingerprinting (integration with vuln scanner)
    - Passive fingerprinting
    - Manual, static
      - not scalable unless network pretty homogeneous
  - Do TCP, Frag, etc reassembly however appropriate
    - IDS implementors have a lot of work to do

Strategies for Evasions (2)

- Normalization
  - If IDS is inline (IPS = Intrusion Prevention System)
  - Then IPS can rewrite packet stream to make it unambiguous
  - Solves problem pretty well in principle
  - Places different set of demands on IPS
    - Better not break anything in rewriting those packets!
    - Latency
    - Reliability – MTF
      - Disks on box
    - Typically customers start in non-inline mode, and then move to inline as they gain confidence

08 OCT 15 At Experian, Security Attrition Amid Acquisitions

T-Mobile disclosed last week that some 15 million customers had their Social Security numbers and other personal data stolen thanks to a breach at **Experian**, the largest of the big American consumer credit bureaus. But this actually wasn't the first time that a hacking incident at Experian exposed sensitive T-Mobile customer data, and that previous breach may hold important clues about what went wrong more recently.

http://krebsonsecurity.com/2015/10/at-experian-security-attrition-amid-acquisitions/

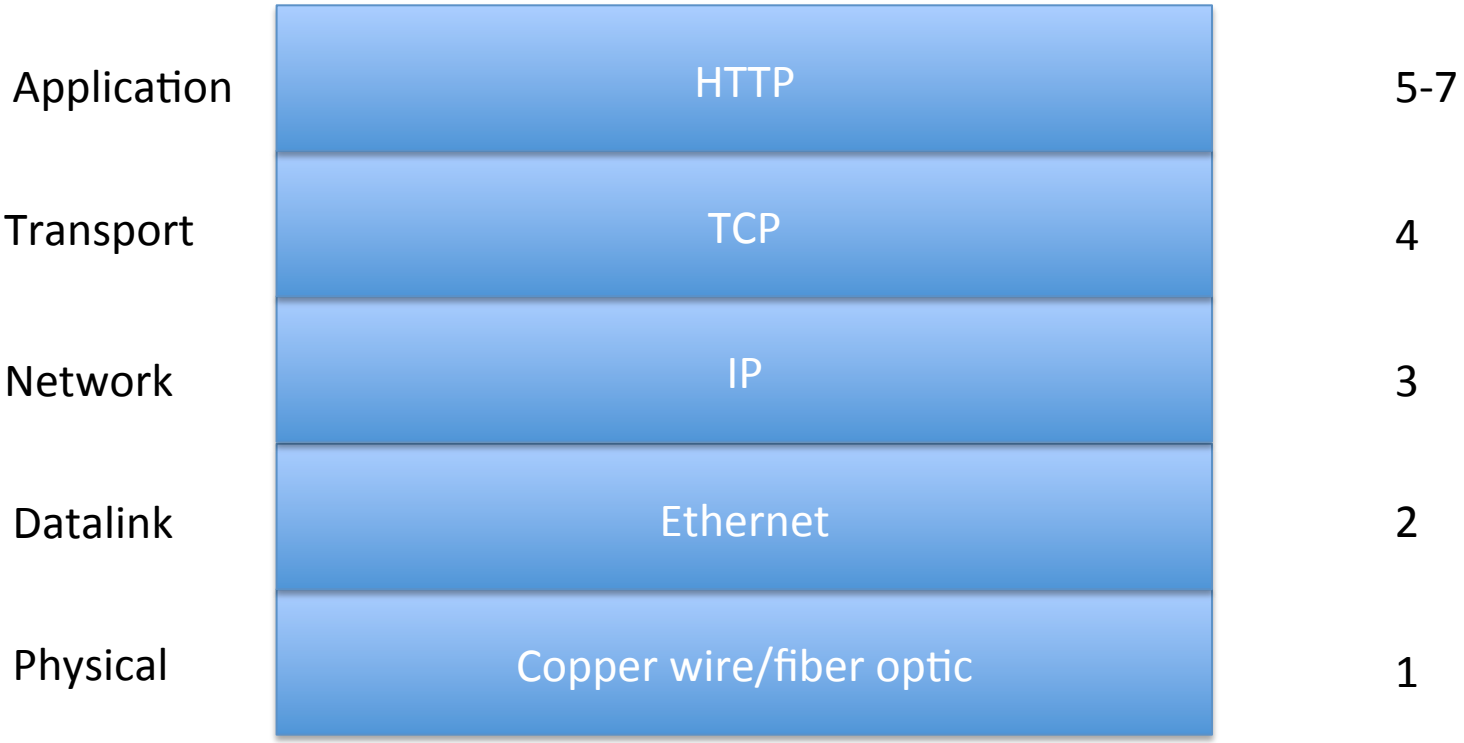
HTTP 1.1

- Main protocol that web runs over
- By far most important application protocol on Internet
- RFC 2616 (1999)
  - Obsoletes RFC 1945 for HTTP 1.0
  - HTTP originally dates back to Tim Berners Lee/CERT in 1991 (v 0.9)
- Text based request/response protocol
  - Originally primarily to identify/download files
  - Also provides for web applications

Protocol Layering

- HTTP runs over TCP
- In HTTP 1.1, one TCP connection can have a series of HTTP requests
  - Reverse direction carries responses
- NB: connection structure is not that meaningful to HTTP
  - Different browser may use one or multiple TCP connections
    - And spread requests between them differently.
  - Proxies can rearrange requests/responses to different connections.

Protocol Layering Names/Numbers



HTTP Request

GET /dumprequest HTTP/1.1\r\n
Host: djce.org.uk\r\n
Connection: keep-alive\r\n
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_8_5) AppleWebKit/537.36
(KHTML, like Gecko) Chrome/30.0.1599.101 Safari/537.36\r\n
DNT: 1\r\n
Referer: https://www.google.com/url?
sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0CD4QFjAC&url=http%3A%2F
%2Fdjce.org.uk
%2Fdumprequest&ei=835lUpjEM5Xb4APEgIGoDA&usg=AFQjCNEeAn5wSZMp_y_oTmOK
onq482sS9A&sig2=pSajtDK-YYIvE4HFDqmRfA&bvm=bv.54934254,d.dmg\r\n
Accept-Language: en-US,en;q=0.8\r\n
\r\n

Try it at http://www.procato.com/my+headers/

HTTP Header Basics

- Text lines separated by \r\n
  - Servers often accept "\n" only, but protocol is "\r\n"
- Header is terminated by a blank line (\r\n\r\n)
- Initial request line
  - GET /dumprequest HTTP/1.1\r\n
    - Other methods include POST, CONNECT, HEAD, DELETE, etc.
    - Focus on GET for now
- Followed by headers of form
  - Header: Value…\r\n
  - No request headers are actually required

Let’s try it

- Telnet to www.google.com 80 and try a manually entered request for nosuchpage.html

A Few Popular Request Headers

- Host:
  - Used to specify domain (server might have several).
- User-Agent:
  - Gives browser specifics (allows server to customize responses to browser)
- Referer:
  - What page (etc) sent us here
- Accept-Language:
  - We speak English, or…
- Accept:
  - media formats we accept (eg text/html)

HTTP Response Basics

- Text lines separated by \r\n
- Header is terminated by a blank line (\r\n\r\n)
- Initial response line
  - HTTP/1.1 404 Not Found\r\n
    - Indicates status of request.
- Followed by headers of form
  - Header: Value…\r\n
  - No response headers are actually required
    - Though hard to get much done without them…

Important Response Codes

- 200 OK
- 301 Moved Permanently
- 304 Not Modified
- 400 Bad Request
- 404 Not Found
- 500 Internal Server Error

A Few Popular Response Headers

- Content-Type:
  - Media-type of entity attached after header
- Content-Length:
  - Length of same (in bytes)
- Content-encoding:
  - ‘gzip’ means compression applied
- Date:
- Server: software being run on the server

Let's try it

- telnet on 80 to a few popular websites
  - www.cnn.com
  - www.yahoo.com
  - www.nytimes.com

Entity Body

- Follows header
  - either request or response, but more consistently in response direction
  - Can be any media type:
    - text/html, text/plain, image/jpeg, audio/mpeg
    - http://www.iana.org/assignments/media-types
  - Three methods to delineate length:
    - Content-length
    - Transfer-encoding: chunked
    - Connection: close

Detecting Attacks on Web Servers

- Has been a major industry for 15+ years
- Exploits on the servers themselves
- Exploits on cgi scripts,
  - other server-side plugins
- SQL Injection
- Cross-site scripting
- Also HTTP command-and-control
  - Similar issues of detecting bad HTTP requests

Top Snort Rule Files

```
Stuarts-MacBook-Pro:rules stuarts$ du -s -k *.rules |sort -n
-r |head -10
6152    deleted.rules
1216    browser-plugins.rules
792     malware-cnc.rules
688     blacklist.rules
568     server-webapp.rules
392     file-identify.rules
348     file-office.rules
344     server-other.rules
328     pua-adware.rules
316     browser-ie.rules
```

Snort Example 4

alert tcp $HOME_NET any -> $EXTERNAL_NET $HTTP_PORTS (msg:"MALWARE-CNC Win.Trojan.Zbot variant in.php outbound connection"; flow:to_server,established; urilen:7; content:"/in.php"; http_uri; content:".ru|0D 0A|User-Agent|3A 20|Mozilla/4.0|0D 0A|"; fast_pattern:only; http_header; content:"|0A|Content-Length|3A 20|"; http_header; metadata:policy balanced-ips drop, policy security-ips drop, ruleset community, service http; reference:url,zeustracker.abuse.ch/monitor.php?ipaddress=195.22.26.231; classtype:trojan-activity; sid:26023; rev:3;)

Snort Example 5

alert tcp $EXTERNAL_NET any -> $HOME_NET $HTTP_PORTS (msg:"SERVER-WEBAPP D-Link DIR-300/ DIR-600 unauthenticated remote command execution attempt"; flow:to_server,established; content:"POST"; depth:4; nocase; http_method; content:"/command.php"; fast_pattern:only; http_uri; content:"cmd="; nocase; http_client_body; metadata:policy balanced-ips drop, policy security-ips drop, service http; reference:bugtraq, 57734; reference:url,exploit-db.com/exploits/24453/; reference:url,osvdb.org/show/osvdb/89861; reference:url,www.s3cur1ty.de/m1adv2013-003; classtype:attempted-admin; sid:26953; rev:1;)

89861 : D-Link Multiple Router command.php cmd Parameter Remote Command Execution

Views This Week	Views All Time	Added to OSVDB	Last Modified	Modified (since 2008)	Percent Complete
18	574	9 months ago	about 1 month ago	14 times	100%

Timeline

Disclosure Date
2013-02-04

Time to Exploit	Time to Vendor Response
52 days	7 days

Description

Multiple D-Link routers contain a flaw that is triggered when input passed via the 'cmd' parameter is not properly sanitized before being used in the command.php script. This may allow a remote attacker to execute arbitrary commands.

Classification

Location: Remote / Network Access
Attack Type: Input Manipulation
Impact: Loss of Integrity
Solution: Solution Unknown
Exploit: Exploit Public
Disclosure: Vendor Disputed, Third-party Verified
OSVDB: Web Related

Solution

OSVDB is not currently aware of a solution for this vulnerability.

Products

D-Link Corporation/D-Link Systems, Inc.	DIR-300	2.12b02
		2.13b01
		2.14b01
	DIR-600	2.12
		2.13