Anglia Ruskin University

OWASP Open Web Application Security Project

OWASP Web Honeypot Project - Application Honeypot Threat Intelligence

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Bio – Adrian Winckles

- Director of Cyber Security, Networking & Big Data Research Group, Anglia Ruskin University, Cambridge.
- OWASP Activities
  - OWASP Cambridge Chapter Leader,
  - OWASP Europe Board Member
  - Project Leader – OWASP Web Honeypot Project
  - Project Leader – OWASP Application Security Curriculum Project
- Chair Cambridge Cluster of the UK Cyber Security Forum.
- Vice Chair of the BCS Cyber Forensics Special Interest Group.

Introduction to Honeypots

- A computer system setup to detect or lure attacks.
- Honeypot types:
  - Production (detect)
  - Research (lure)
- Honeypot interaction types:
  - Low - emulated services, limited to no emulated login capability (low risk).
  - Medium - emulated services, emulated login, emulated commands.
  - High - Actual services, system logins, and commands (very risky).

Introductions to Honeypots (cont’d)

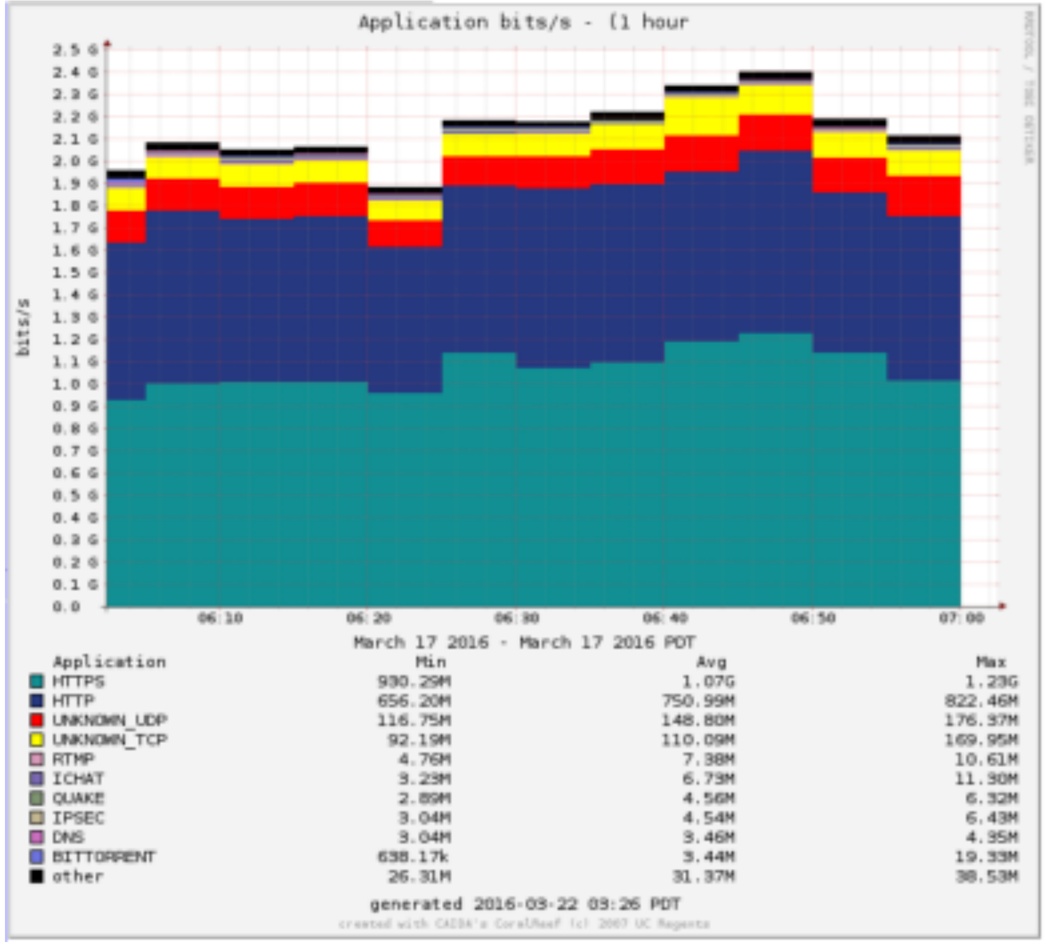
- A production honeypot has no legitimate business purpose and should never see any traffic, unless...
  - Something is misconfigured on the network
  - Someone is malicious on the network

Honeypot logs are low volume and high value

Why OWASP Web Honeypots (Part 1)?

- Sector focus is on HTTP(S) today
- According to CAIDA, (Center for Applied Internet Data Analysis) web is ~85% of total internet traffic.
- 92% of vulnerabilities now in the application (NIST/Gartner)

Why Web Honeypots?



Application	Min	Avg	Max
■ HTTPS	930.29M	1.07G	1.23G
■ HTTP	656.20M	750.99M	822.46M
■ UNKNOWN_UDP	116.75M	148.80M	176.37M
■ UNKNOWN_TCP	92.19M	110.09M	169.95M
■ RTMP	4.76M	7.38M	10.61M
■ ICHAT	3.23M	6.73M	11.30M
■ QUAKE	2.89M	4.56M	6.32M
■ IPSEC	3.04M	4.54M	6.43M
■ DNS	3.04M	3.46M	4.35M
■ BITTORRENT	638.17k	3.44M	19.33M
■ other	26.31M	31.37M	38.53M

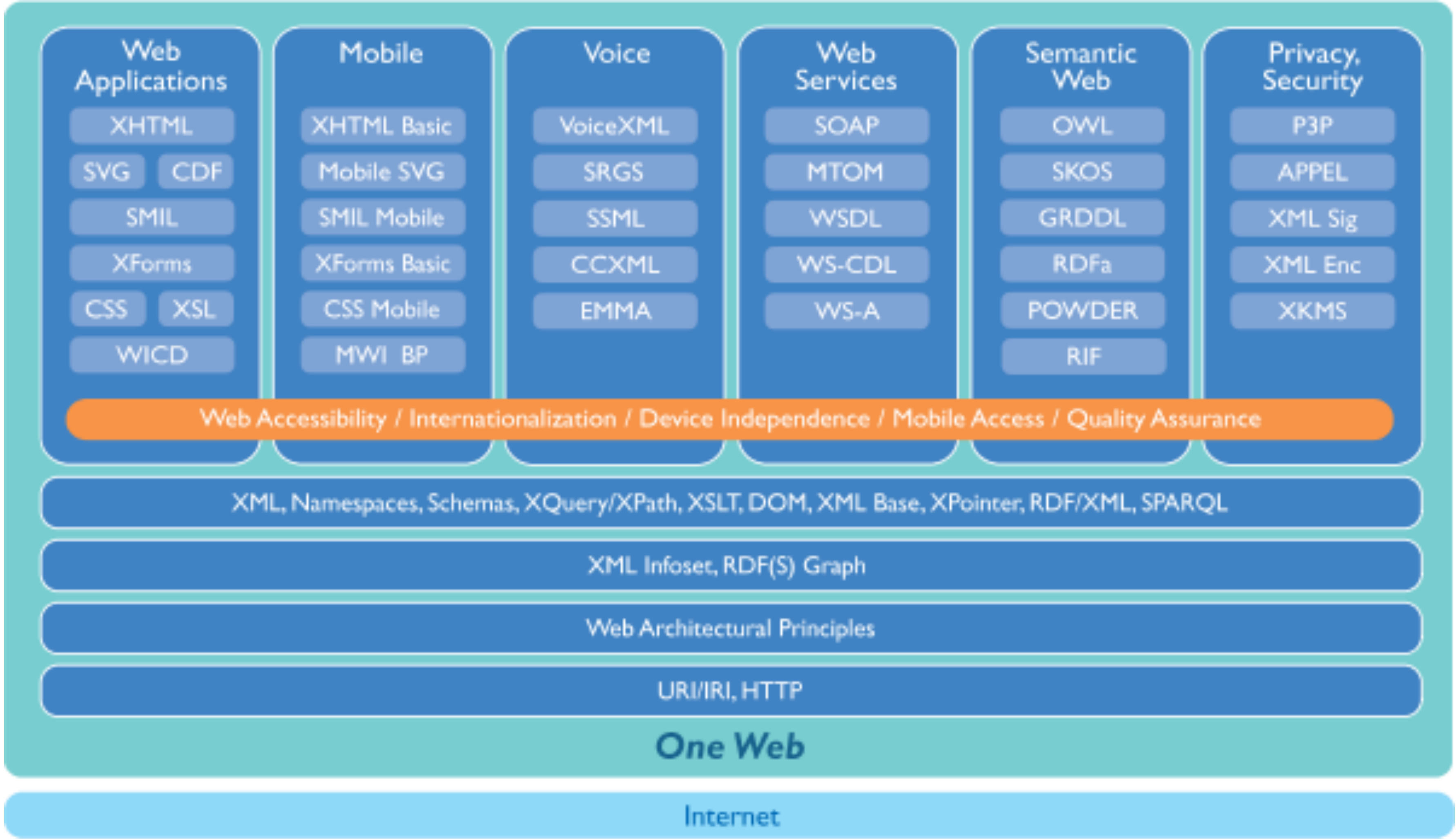
generated 2016-03-22 03:26 PDT

created with CAIDA's CoralReef (c) 2007 UC Regents

Why OWASP Web Honeypots (Part 2)?

- Focus is on HTTP(S) today
- According to CAIDA, (Center for Applied Internet Data Analysis) web is ~85% of total internet traffic.
- 92% of vulnerabilities now in the application (NIST/Gartner)
- Web architecture is complicated
- It also means complicated attacks are acceptable
- Attacks that will only work on 0.01% of users are valuable

The Web is Complicated



Web Applications
XHTML
SVG
CDF
SMIL
XForms
CSS
XSL
WICD

Mobile
XHTML Basic
Mobile SVG
SMIL Mobile
XForms Basic
CSS Mobile
MWI BP

Voice
VoiceXML
SRGS
SSML
CCXML
EMMA

Web Services
SOAP
MTOM
WSDL
WS-CDL
WS-A

Semantic Web
OWL
SKOS
GRDDL
RDFa
POWDER
RIF

Privacy, Security
P3P
APPEL
XML Sig
XML Enc
XKMS

Web Accessibility / Internationalization / Device Independence / Mobile Access / Quality Assurance

XML, Namespaces, Schemas, XQuery/XPath, XSLT, DOM, XML Base, XPointer, RDF/XML, SPARQL

XML Infoset, RDF(S) Graph

Web Architectural Principles

URI/IRI, HTTP

One Web

Internet

Why OWASP Web Honeypots (Part 3)?

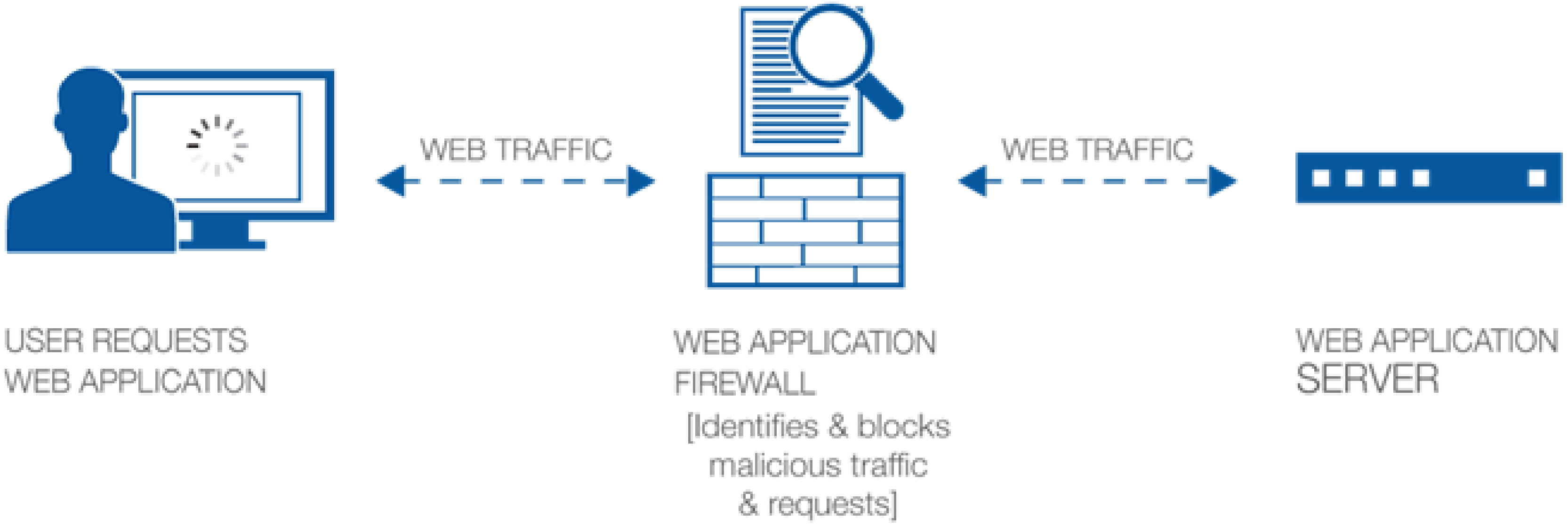
- Focus is on HTTP(S) Today
- Special care needs to be taken here
- According to CAIDA, (Center for Applied Internet Data Analysis) web is ~85% of total internet traffic
- As a result web architecture is complicated
- It also means complicated attacks are acceptable
- Attacks that will only work on 0.01% of users are valuable
- Diversity of attacks is high as well (number of variations)
  - Attacker on server / Attacker on client
  - Attacker on client via server
  - Attacker on server via server
  - Attacker on intermediary

What do we want to capture?

- Think about using existing tools so that you can catch automated web attack tools that are scanning IP network ranges looking for web ports.
- Instead of developing and deploying an entirely new honeypot web server or application, we can easily reuse the existing legitimate web server platform’s organisations are already running.

Consider the WAF - Web Application Firewall

- WAFs Come in multiple different forms



The WAF as a Honeypot or Probe?

- WAFs Come in multiple different forms
- Can be placed in several places on the network
  - Inline
  - Out-of-line
  - Load balancer mirror port
  - On the web server
- Different Technologies
  - Signatures
  - Heuristics
- Often driven by PCI requirements, as it’s an approved security control

- What is the difference between an IDS versus WAF?

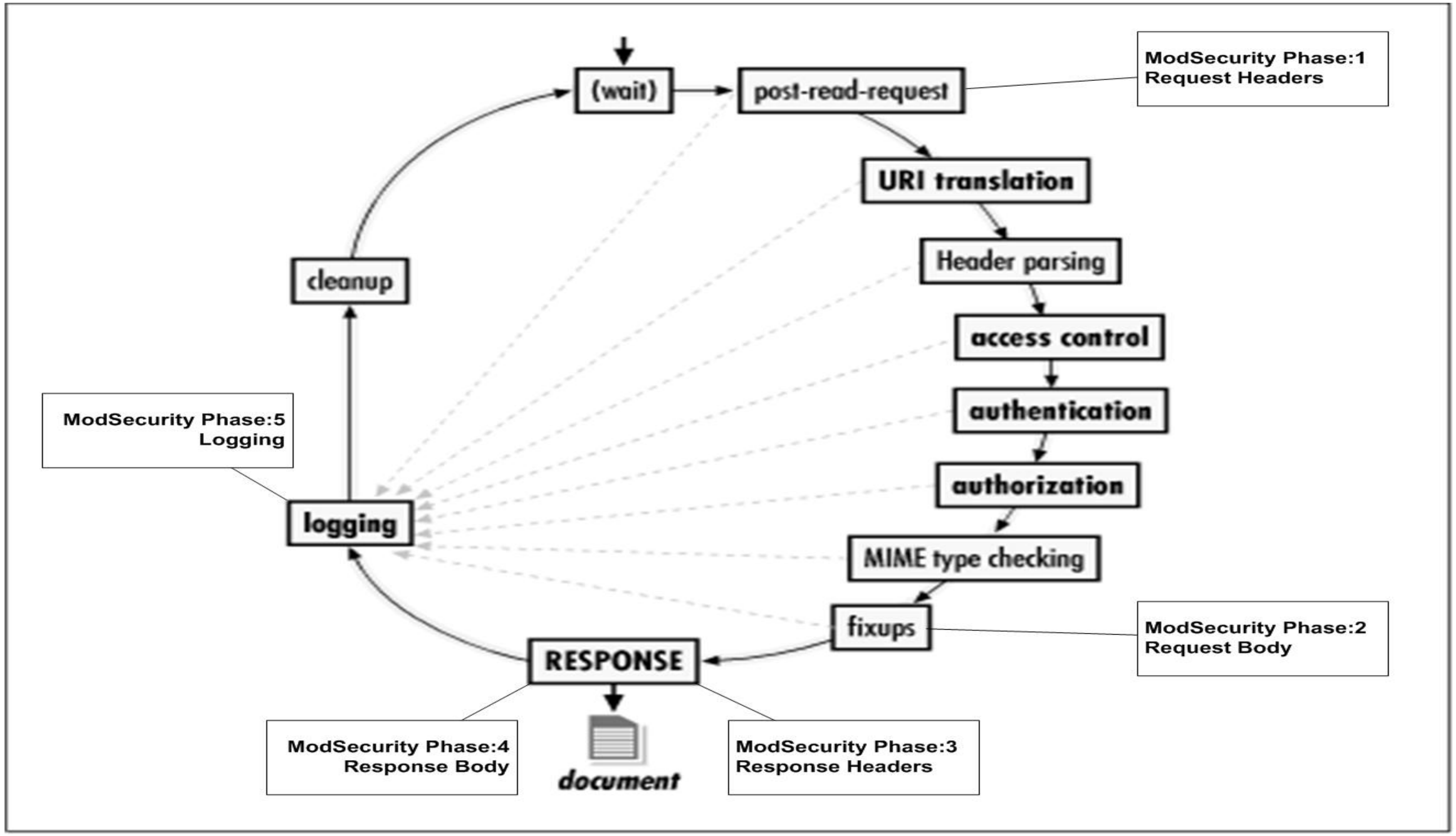
ModSecurity - An Open Source Web Application Firewall

- Probably the most popular WAF
  - Designed in 2002
  - Currently on version 2.9.1 with version 3.0 in the works

https://github.com/SpiderLabs/ModSecurity

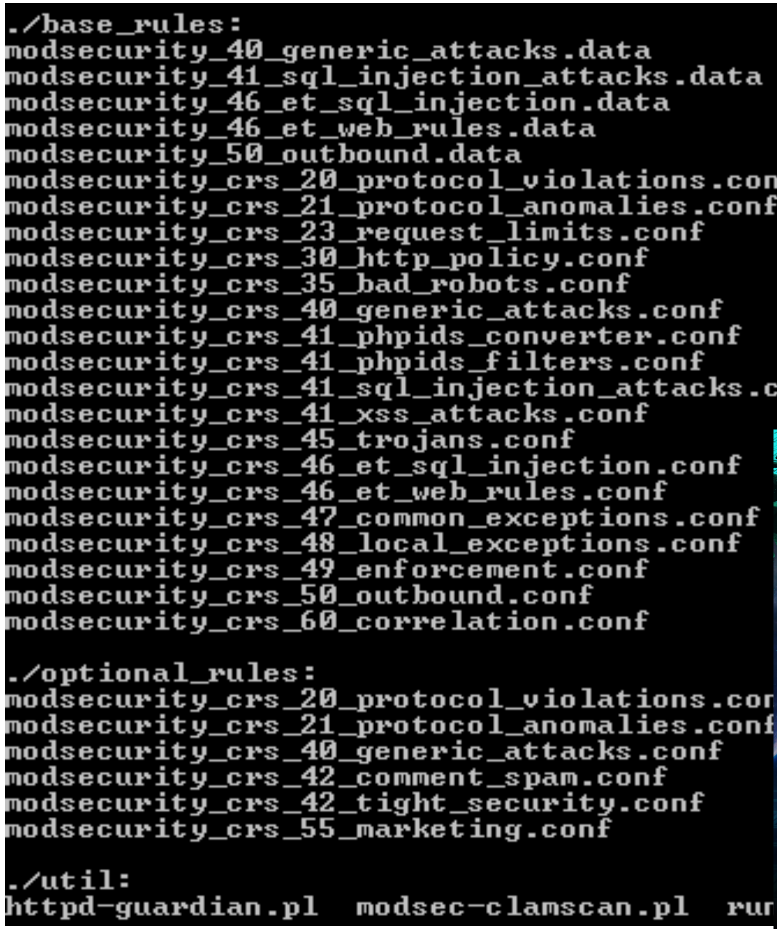
- Designed to be open and supports the OWASP Core Rule Set
  - First developed in 2009
  - An OWASP project meant to provide free generic rules to ModSecurity users
  - CRS v3.0 now deployed

ModSecurity's Apache Request Cycle Hooks



What is the OWASP Core Rule Set (CRS)?

- A generic, plug-n-play set of WAF rules
- Choose your mode of operation
  - Standard vs. Anomaly Scoring
- Detection Categories:
  - Protocol Validation
  - Malicious Client Identification
  - Generic Attack Signatures
  - Known Vulnerabilities Signatures
  - Trojan/Backdoor Access
  - Outbound Data Leakage
  - Anti-Virus and DoS utility scripts



```
./base_rules:
modsecurity_40_generic_attacks.data
modsecurity_41_sql_injection_attacks.data
modsecurity_46_et_sql_injection.data
modsecurity_46_et_web_rules.data
modsecurity_50_outbound.data
modsecurity_crs_20_protocol_violations.conf
modsecurity_crs_21_protocol_anomalies.conf
modsecurity_crs_23_request_limits.conf
modsecurity_crs_30_http_policy.conf
modsecurity_crs_35_bad_robots.conf
modsecurity_crs_40_generic_attacks.conf
modsecurity_crs_41_phpids_converter.conf
modsecurity_crs_41_phpids_filters.conf
modsecurity_crs_41_sql_injection_attacks.conf
modsecurity_crs_41_xss_attacks.conf
modsecurity_crs_45_trojans.conf
modsecurity_crs_46_et_sql_injection.conf
modsecurity_crs_46_et_web_rules.conf
modsecurity_crs_47_common_exceptions.conf
modsecurity_crs_48_local_exceptions.conf
modsecurity_crs_49_enforcement.conf
modsecurity_crs_50_outbound.conf
modsecurity_crs_60_correlation.conf

./optional_rules:
modsecurity_crs_20_protocol_violations.cor
modsecurity_crs_21_protocol_anomalies.conf
modsecurity_crs_40_generic_attacks.conf
modsecurity_crs_42_comment_spam.conf
modsecurity_crs_42_tight_security.conf
modsecurity_crs_55_marketing.conf

./util:
httpd-guardian.pl  modsec-clamscan.pl  rur
```

INCLUDES DR. FOLINI'S PARANOIA MODE
OWASP ModSecurity Core Rule Set
v3.0
BASED UPON A TRUE STORY!
CRS3
OWASP ModSecurity Core Rule Set v3.0
DIRECTED BY
CHAIM SANDERS
STARRING
WALTER HOP AS REGEX WIZARD, CHAIM SANDERS
ORIGINAL IDEA BY OFER SHEZAF AND RYAN BARNETT ALSO STARRING CHRISTIAN FOLINI, FRANZISKA BÜHLER, @EMPHAZER, RYAN BARNETT, FELIPE 'ZIMMERLE'
MANUEL LEOS, VLADIMIR IVANOV, CHRISTIAN PERON, @YGREK, @TOBY78, @JAMUSE, MATT KOCH, ACHIM HOFFMANN, MAZIN AHMED, NOËL ZINDEL
Trustwave Smart security on demand
COMING SOON TO A SERVER NEAR YOU!
OWASP Open Web Application Security Project

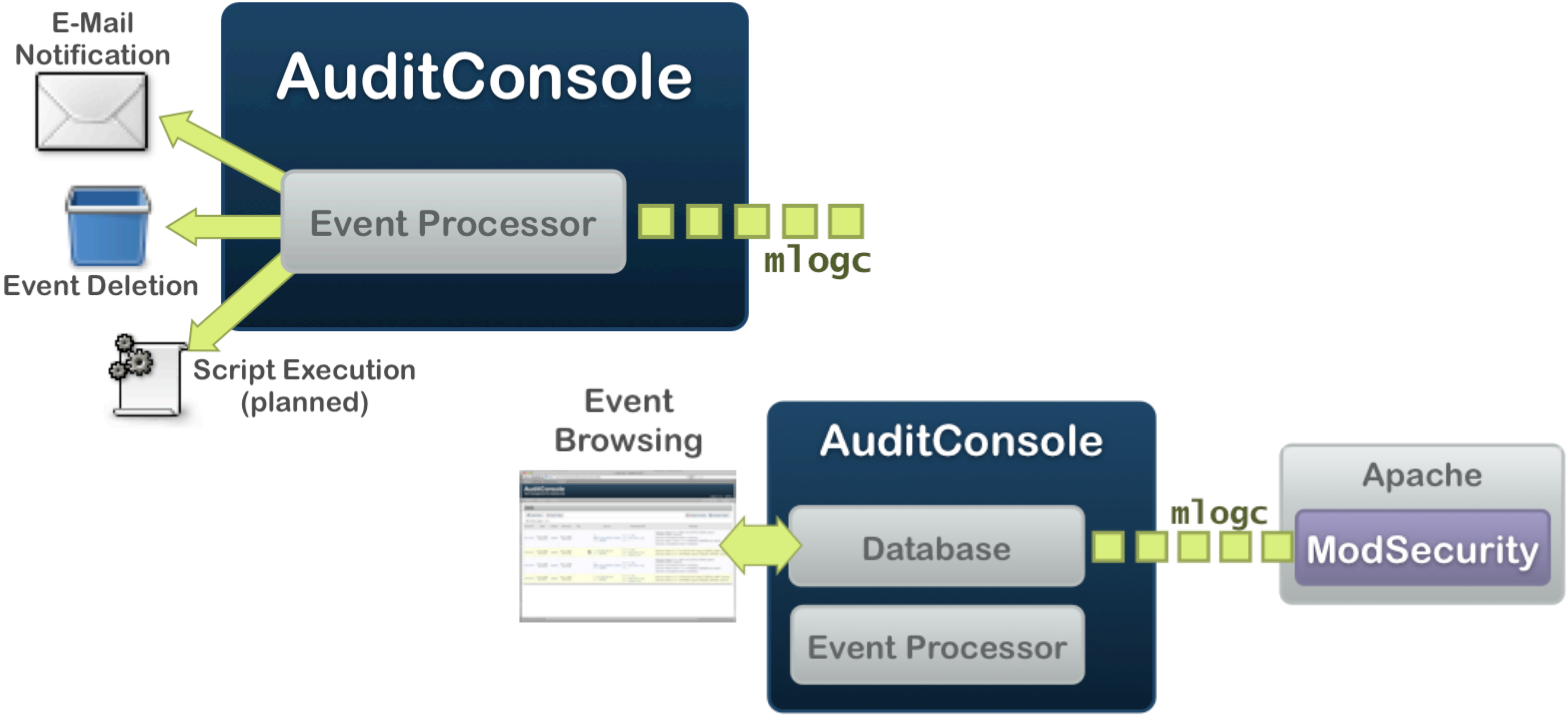
CRS Traditional Detection Mode – *Birth of a Honeypot Probe*

- IDS/IPS mode with “self-contained” rules
- Like HTTP itself – the rules are stateless
  - **No intelligence is shared between rules**
  - If a rule triggers, it will execute a disruptive/logging action
- Easier for the new user to understand
- Not optimal from a rules management perspective (handling false positives/exceptions)
- Not optimal from a security perspective
  - Not every site has the same risk tolerance
  - Lower severity alerts are largely ignored

Event Logging - *Standard vs. Correlated Events*

- Standard mode
  - Rules log event data to both the Apache error_log and the ModSecurity Audit log can be relayed using mlogc http/json
- Correlated mode
  - Basic rules are considered reference events and do not directly log to the Apache error_log
  - Correlation rules in the logging phase analyze inbound/outbound events and generate special events
  - `modsecurity_crs_60_correlation.conf`

Modsecurity Log Collector (mlogc) – Event Logging

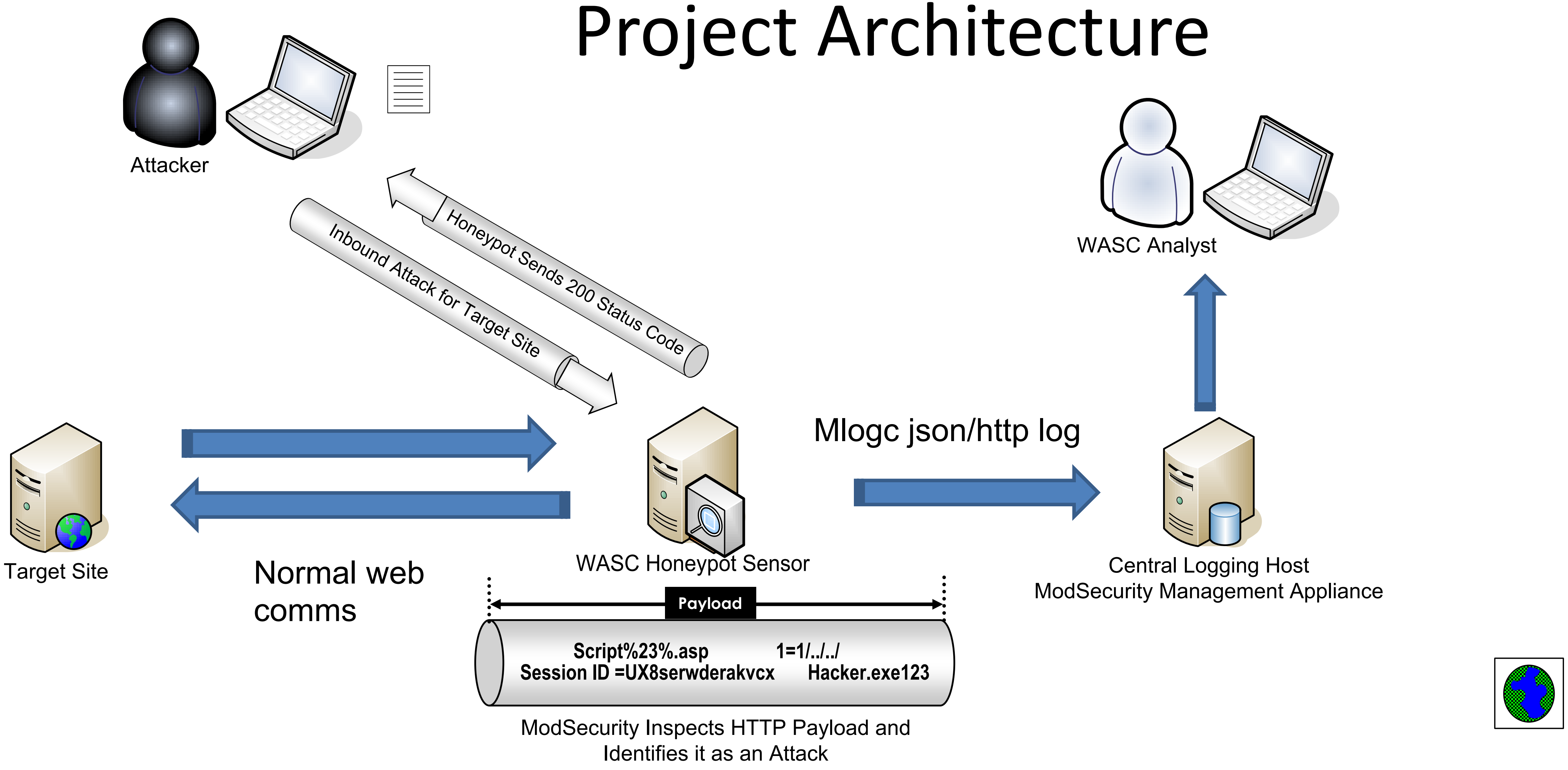


Project Aims & Objectives

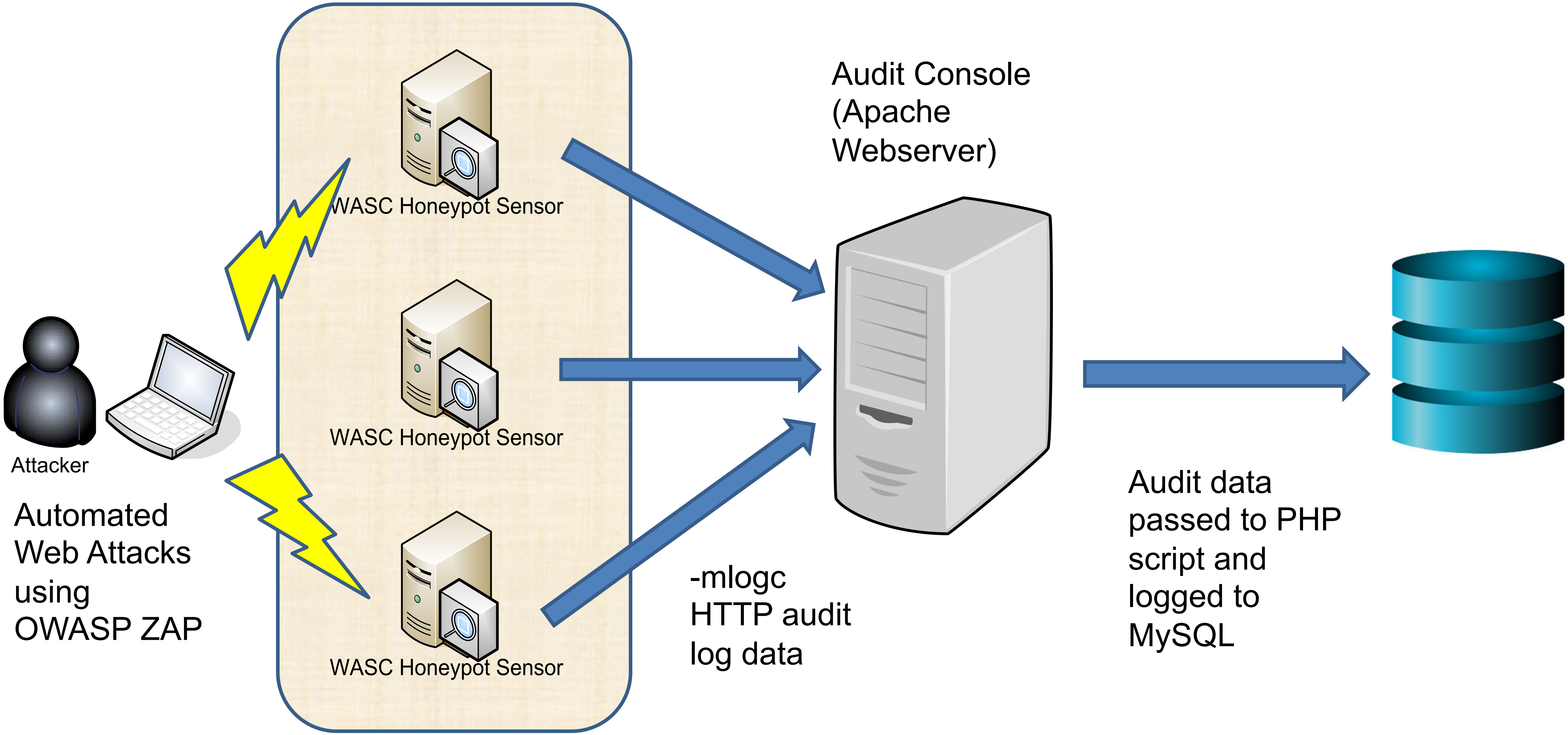
- The OWASP Honeypot Project provides:
  - Real-time, detailed Web Application Attack Data
  - Threat Reports to the community

- What do we need
  - Volunteers to run honeypots/probes in their network
  - Contributor’s to the project

Project Architecture


Attacker
Inbound Attack for Target Site
Honeypot Sends 200 Status Code
WASC Analyst
Target Site
Normal web comms
WASC Honeypot Sensor
Mlogc json/http log
Central Logging Host
ModSecurity Management Appliance
Payload
Script%23%.asp
1=1/../../
Session ID =UX8serwderakvcx
Hacker.exe123
ModSecurity Inspects HTTP Payload and Identifies it as an Attack

Project Test Bed



Automated Web Attacks using OWASP ZAP

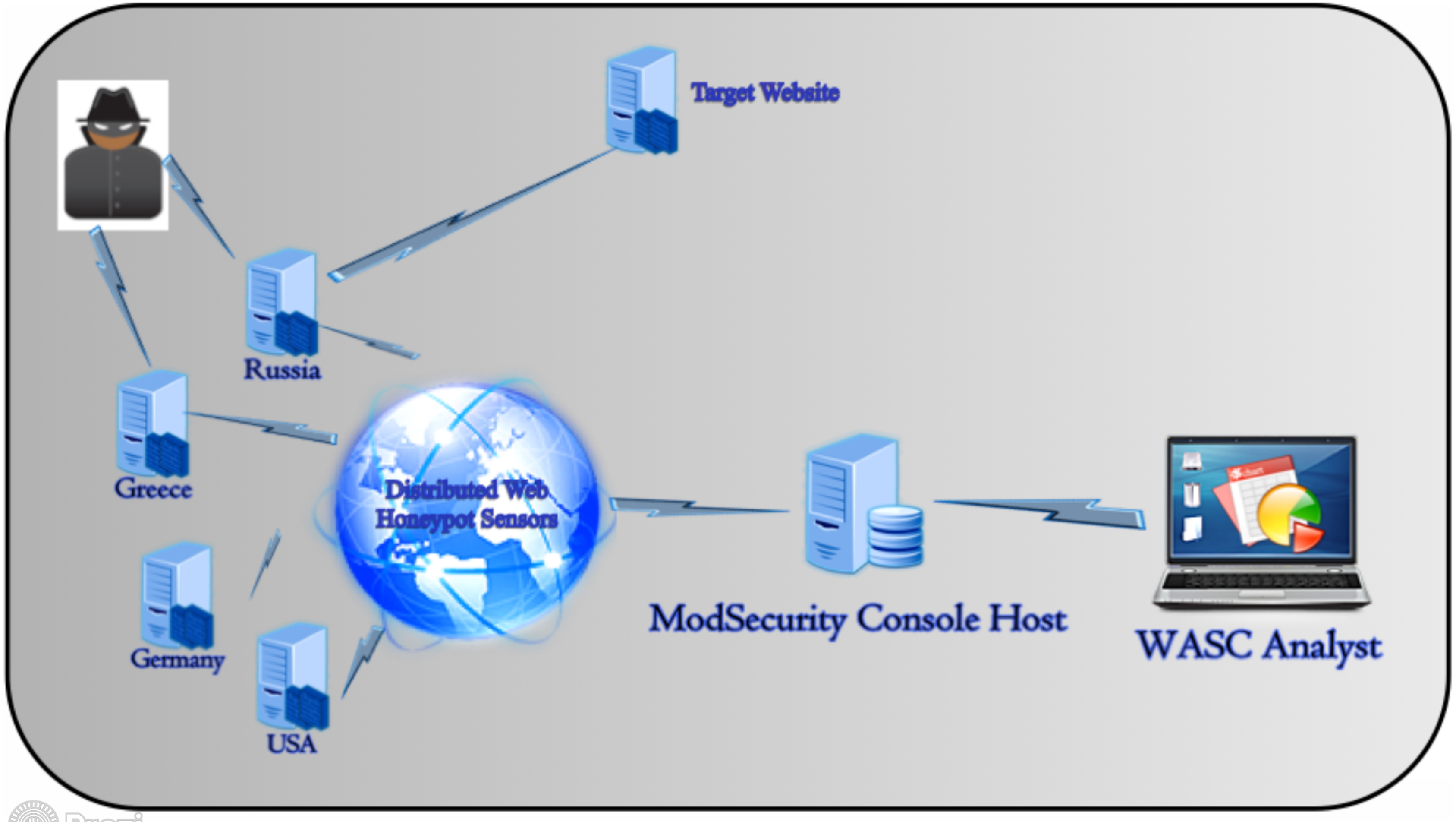
VM Based WAF Probes

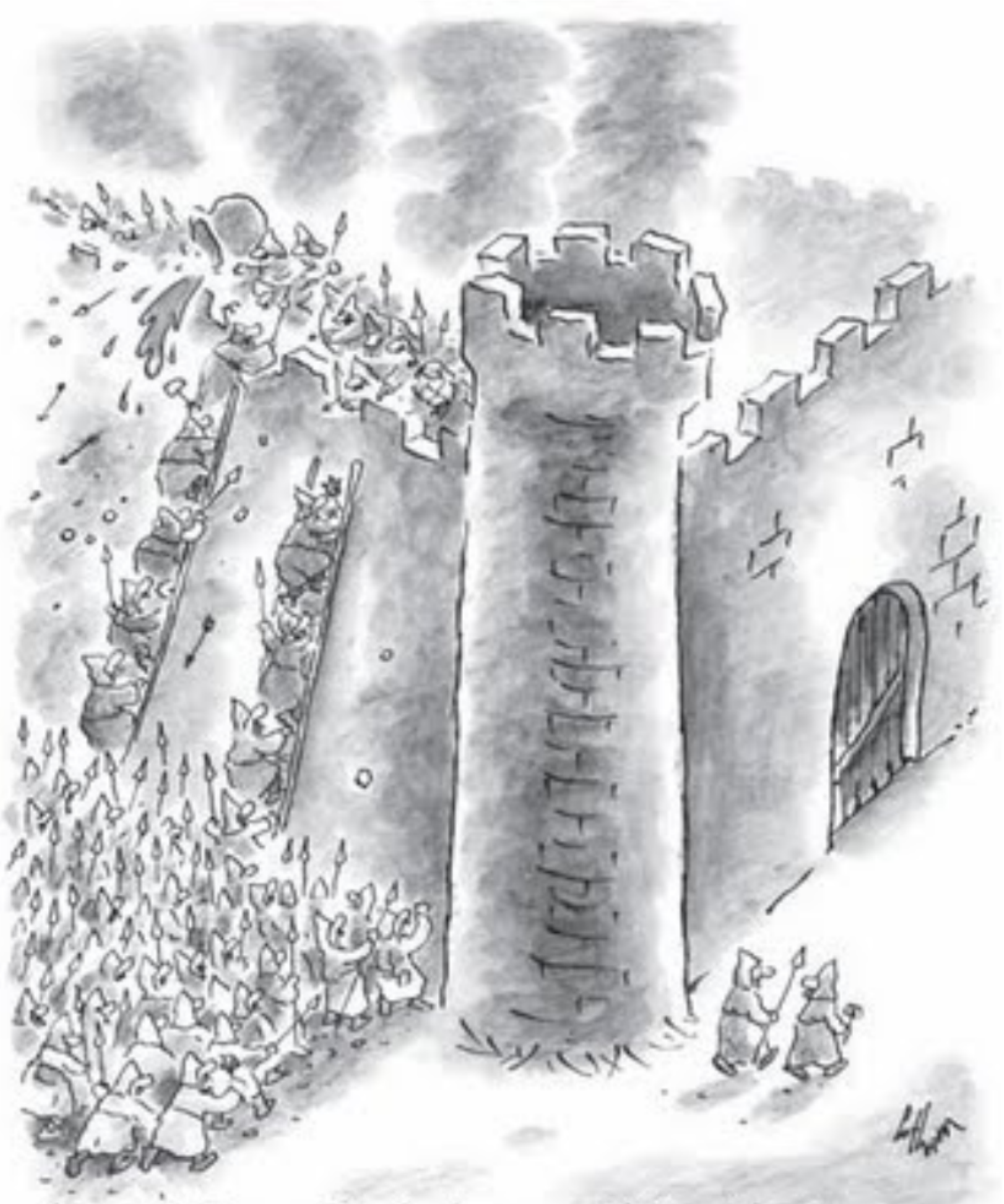
-mlogc HTTP audit log data

Audit Console (Apache Webserver)

Audit data passed to PHP script and logged to MySQL

Distributed Probes Model





"Security is lax on this side."

Ongoing & Future Work

- **Setup Proof of Concept to understand how Mod Security baed Honeypot/Probe interacts with a receiving console (develop a VM and/or Docker based test solution to store logs from multiple probes) DONE**
- **Evaluate console options to visualise threat data received from ModSecurity Honeypots/probes in ModSecurity Audit Console, WAF-FLE, Fluent and bespoke scripts for single and multiple probes. Ongoing**
- **Develop a mechanism to convert from stored MySQL to JSON format.**
- **Provide a mechanism to convert ModSecurity mlogc audit log output into JSON format.**
- **Provide a mechanism to convert mlogc audit log output directly into ELK (ElasticSearch/Logstash/Kibana) to visualise the data.**

Ongoing & Future Work (cont'd)

- **Provide a mechanism to forward honest output into threat intelligence format such as STIX using something like the MISP project (https://www.misp-project.org) to share Threat data coming from the Honeypots making it easy to export/import data from formats such as STIX and TAXII., may require use of concurrent logs in a format that MISP can deal with.**
- **Consider new alternatives for log transfer including the use of MLOGC-NG or other possible approaches.**
- **Develop a new VM based honeypot/robe based on CRS v3.0.**
- **Develop new alternative small footprint honeypot/probe formats utilising Docker & Raspberry Pi.**
- **Develop machine learning approach to automatically be able to update the rule set being used by the probe based on cyber threat intelligence received.**

Any Questions?