"The Core Rule Set":

Generic detection of application layer attacks

Ofer Shezaf

OWASP IL Chapter leader

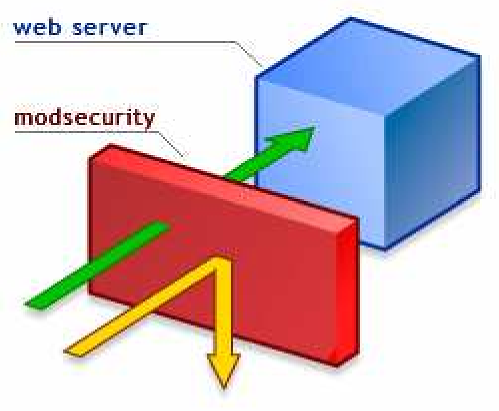
CTO, Breach Security

Breach & the Community

- ModSecurity – open source WAF
  - Recently purchased and kept as open source
  - Most popular Web Application Firewall on the globe
  - Ivan Ristic who wrote it and Ryan Barnett community leader joined us
- Web Application Security Consortium:
  - Web Application Firewall Evaluation Criteria - Ivan
  - Web Attacks Honeypot Project - Ryan
  - Web Hacking incidents Database – Ofer
  - Member of the board of directors - Ofer
- OWASP IL chapter leadership

Breach Security

ModSecurity Community



ModSecurity 2.0

- Long awaited update to ModSecurity
- Significantly enhanced analysis engine
- XML parsing

ModSecurity Console

- Provides GUI event viewing
- Consolidation from multiple ModSecurity sensors

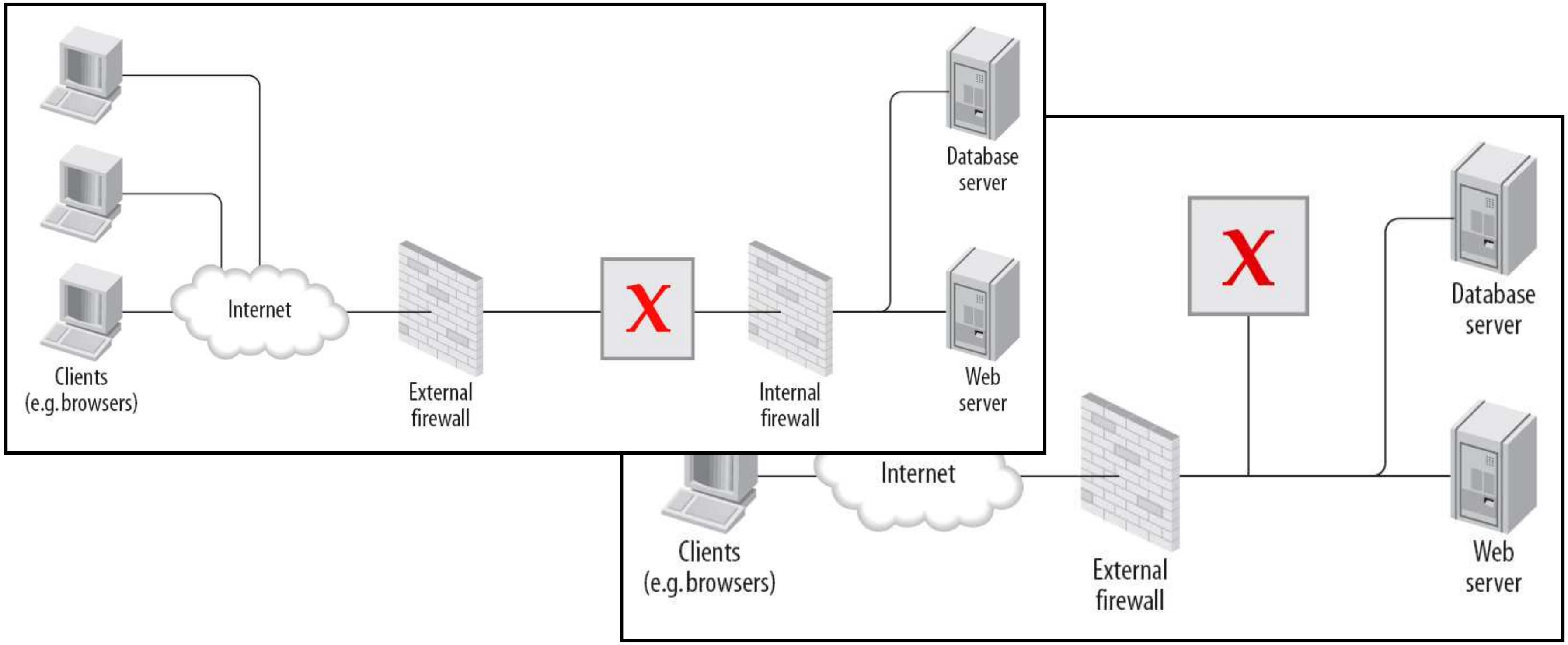
ModSecurity Core Rules

- Package of signatures certified to be efficient and accurate by Breach Labs
- Coverage for most common web application threats

BREACH

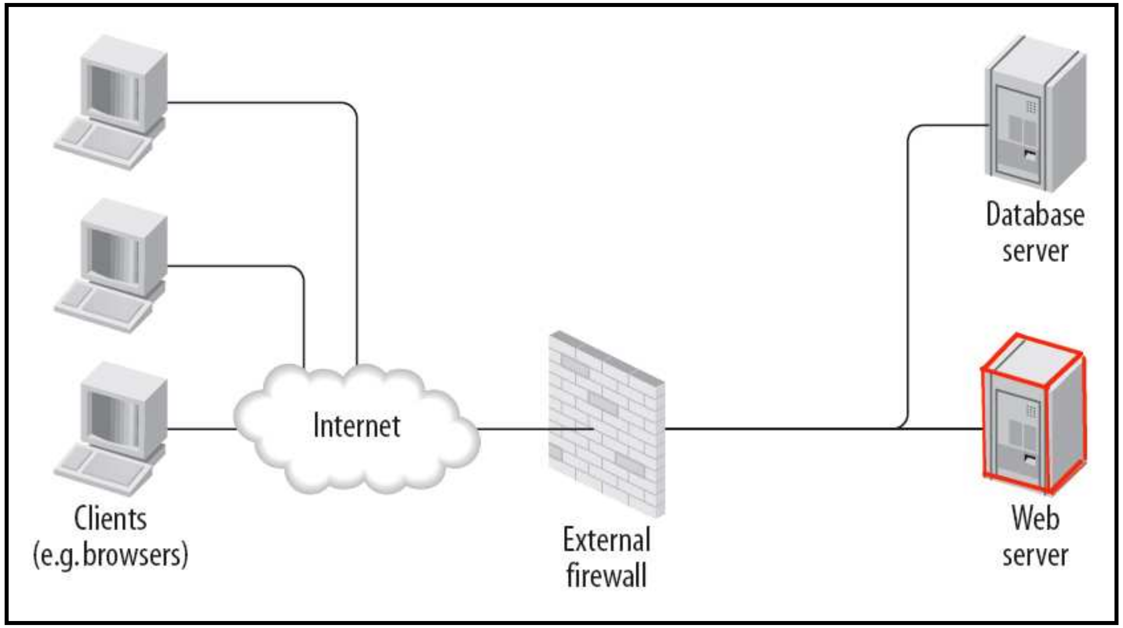
Web Application Firewalls
vs.
Intrusion Prevention Systems

Deployment - Network-level device



Does not require network re-configuration.

Deployment - Embedded



Does not require network re-configuration.

Three Protection Strategies for WAFs

1. **External patching**
   - Also known as "just-in-time patching" or "virtual patching".
2. **Positive security model**
   - An independent input validation envelope.
   - Rules must be adjusted to the application.
   - Automated and continuous learning (to adjust for changes) is the key.
3. **Negative security model**
   - Looking for bad stuff,
   - Mostly signatures based.
   - Generic but requires some tweaking for each application.

IPS?

Virtual Patching

- Testing reveals that the login field is vulnerable to SQL injection.
- Login names cannot include characters beside alphanumerical characters.
- The following rule will help:

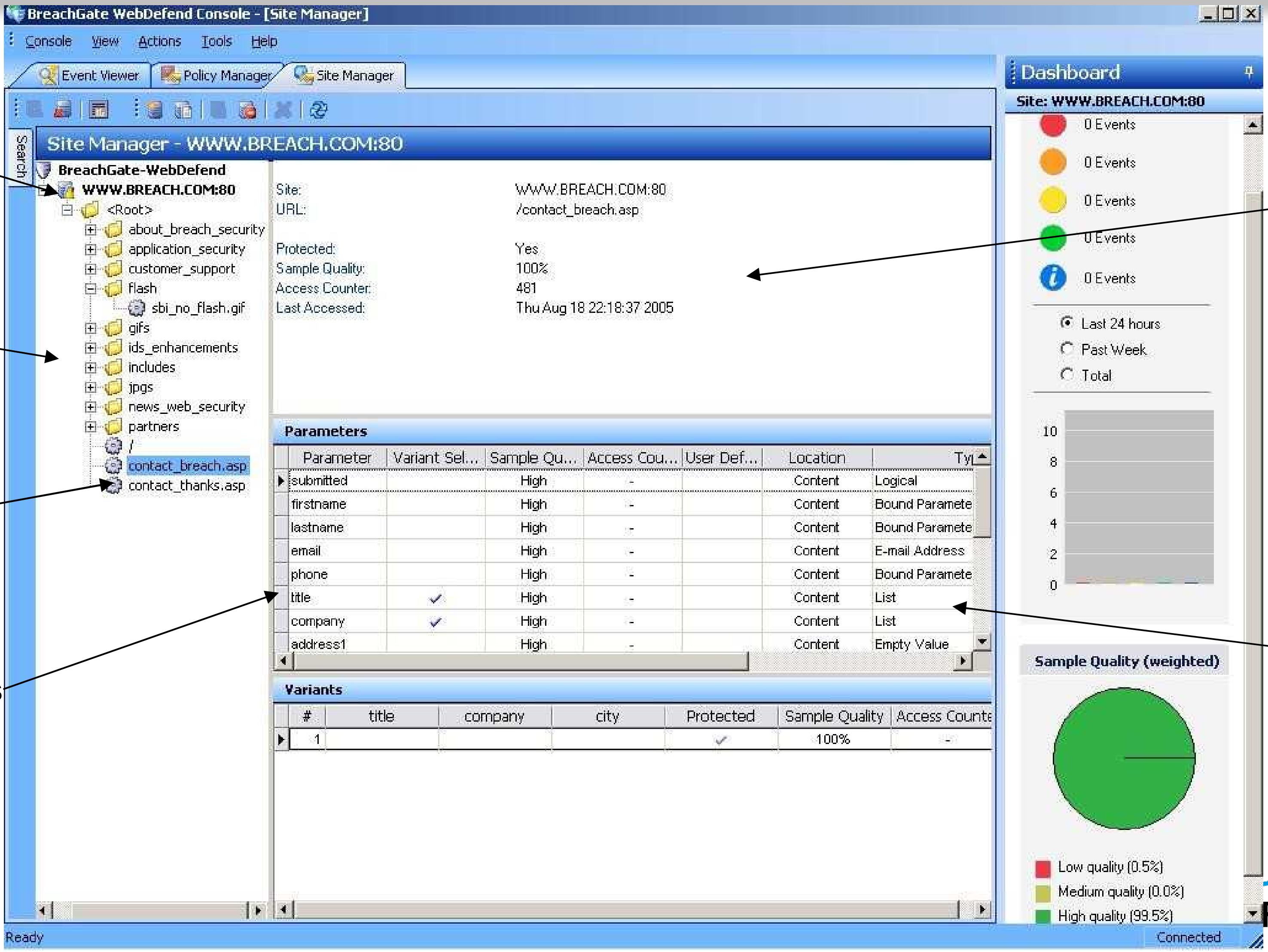
```
<LocationMatch "^/app/login.asp$">
      SecRule ARGS:username "!^\w+$" "deny,log"
</LocationMatch>
```

Positive security

```
<LocationMatch "^/exchweb/bin/auth/owaauth.dll$">
  SecRule REQUEST_METHOD !POST "log,deny"
  SecRule ARGS:destination “URL" "log,deny,t:urlDecode,t:lowercase"
  SecRule ARGS:flags "[0-9]{1,2}"
  SecRule ARGS:username "[0-9a-zA-Z].{256,}"
  SecRule ARGS:password ".{256,}"
  SecRule ARGS:SubmitCreds "!Log.On"
  SecRule ARGS:trusted "!(0|4)"
</LocationMatch>
```

- The same, but for every field in every application
- Very hard to create, requires learning by:
  - Monitoring outbound traffic (match input to web server request)
    - Caveats: JavaScript, Web Services
  - Monitoring inbound traffic (normal behavior):
    - Caveats: Statistics, attacks in learning period.

Positive Security



Site Manager - WWW.BREACH.COM:80

- BreachGate-WebDefend
  - WWW.BREACH.COM:80
    - <Root>
      - about_breach_security
      - application_security
      - customer_support
      - flash
        - sbi_no_flash.gif
      - gifs
      - ids_enhancements
      - includes
      - jpgs
      - news_web_security
      - partners
      - /
      - contact_breach.asp
      - contact_thanks.asp

Site:	WWW.BREACH.COM:80
URL:	/contact_breach.asp
Protected:	Yes
Sample Quality:	100%
Access Counter:	481
Last Accessed:	Thu Aug 18 22:18:37 2005

Parameters

Parameter	Variant Sel...	Sample Qu...	Access Cou...	User Def...	Location	Ty
submitted		High	-		Content	Logical
firstname		High	-		Content	Bound Paramete
lastname		High	-		Content	Bound Paramete
email		High	-		Content	E-mail Address
phone		High	-		Content	Bound Paramete
title	✓	High	-		Content	List
company	✓	High	-		Content	List
address1		High	-		Content	Empty Value

Variants

#	title	company	city	Protected	Sample Quality	Access Counte
1				✓	100%	-

Dashboard

- 🟥 0 Events
- 🟧 0 Events
- 🟨 0 Events
- 🟩 0 Events
- ℹ 0 Events

● Last 24 hours
○ Past Week
○ Total

Sample Quality (weighted)

- 🟥 Low quality (0.5%)
- 🟨 Medium quality (0.0%)
- 🟩 High quality (99.5%)

Site

Site Map

URLs

Parameters

Site Status

Parameter Types

Negative Security

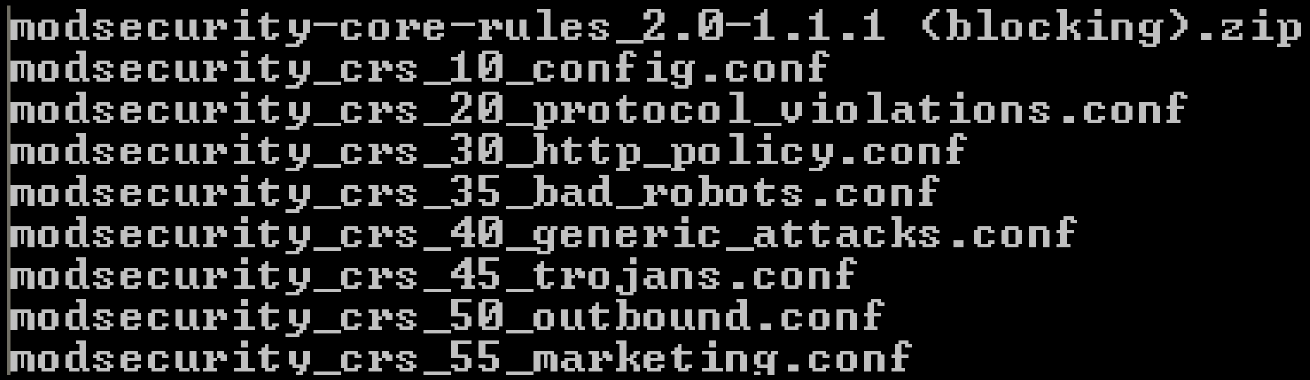
<u>An IPS, but:</u>

- **Full parsing & validation of HTTP:**
  - Request, Headers, Content
  - Validation to individual fields (field content, length, field count, etc).
  - both request and response.
  - Uploaded files.
- **Anti Evasion features:**
  - Decoding
  - Path canonizations
  - Robust parsing (apache request line delimiters…)

Rules instead of signatures

- **Signatures**
  - Simple text strings or regular expression patterns matched against input data.
  - Not very flexible.
- **Rules**
  - Flexible.
  - Multiple operators.
  - Rule groups.
  - Anti-evasion functions.
  - Logical expressions.
  - Custom variables.

The Core Rule Set



```
modsecurity-core-rules_2.0-1.1.1 (blocking).zip
modsecurity_crs_10_config.conf
modsecurity_crs_20_protocol_violations.conf
modsecurity_crs_30_http_policy.conf
modsecurity_crs_35_bad_robots.conf
modsecurity_crs_40_generic_attacks.conf
modsecurity_crs_45_trojans.conf
modsecurity_crs_50_outbound.conf
modsecurity_crs_55_marketing.conf
```

Detection of generic app layer attacks

- Core Rule Set available for ModSecurity at:
  - http://www.modsecurity.org/projects/rules/index.html
  - Probably translatable to any App Firewall
- Benefits from ModSecurity features:
  - Anti Evasion
  - Granular Parsing
- Detection Mechanisms:
  - Protocol Violations
  - Protocol Policy
  - Generic Attack Signatures
  - Known Vulnerabilities
  - Bad Robots
  - Trojans & Anti-Virus
  - Error conditions

Protocol Violations

- Headers:
  - All required headers are there: Host, Accept, User-Agent
  - Host is not an IP address
  - Content length a must for none GET/HEAD methods
- Characters:
  - Valid encoding
  - Only printable for headers
  - Printable and formatting for parameters
  - Only NULL not allowed in international applications
- Requires minimal tweaking
  - Exceptions for automated software used by the application

Protocol Policy

- Allowed and blocked:
  - HTTP versions
  - Methods
  - File extensions
  - Content-Types (request AND reply)
- Global limitations:
  - Request size, Upload size,
  - # of parameters, length of parameter.
- Requires setting, but easy to set:
  - We offer tailored settings for common development environments.
- An easy (not generic) addition: envelope on valid URLs.

Signatures for generic attacks

- Signatures require knowing the attack vectors and therefore are usually used for known vulnerabilities.
- Web applications are custom, and attacks may be targeted.
- Variations on attack vectors are very easy
- Hence, normal signatures are not suitable for application layer protection.
- In many cases few exceptions can make signatures vary effective:
  - substring

Case study: 1=1

- Classic example of an SQL injection attacks.
- Used many times as a signature.
- But, can be avoided easily using:
  - Encoding: 1%3D1
  - White Space: 1   =%091
  - Comments 1 /* This is a comment */ = 1
  - All of the above

“1=1” continued

- And is actually not required at all. Any true expression would work:
  - 2 > 1
- An not necessarily a comparison or even an expression. In MS-Access all the following are true: 1, “1”, “a89”, 4-4

Rules instead of signatures

- *All these are attack indicators:*
  - xp_cmdshell
  - “<“ valid but stinks
  - *select*, *union*, *delete*, *drop & script* are valid English words
  - Single quote is very much needed to type *O'Brien*
  - *“1”*
- The following rules can help:
  - Sequence: *union* …. *Select,*
  - Amount**:** *script*, *cookie* and *document* appear in the same input field
  - Learning*: select* and a *single quote (‘)* in a field it never appeared in.
  - Amount & learning: three *triangular brackets (< or >)* appear in a field leaned as free text.

Known Vulnerabilities

A recent snort rule - bugtraq 9349

Exploit: `http://www.example.com/athenareg.php?pass=%20;whoami`

Snort Rule:

```
alert tcp
$EXTERNAL_NET any -> $HTTP_SERVERS $HTTP_PORTS
(
 msg: "BLEEDING-EDGE WEB Athena Web Registration Remote
Command Execution Attempt";
 flow: to_server,established;
 uricontent:"/athenareg.php?pass=%20\;"; nocase;
 reference:cve,CAN-2004-1782;
 reference:bugtraq,9349;
 classtype: web-application-attack;
 sid: 2001949; rev:4;
)
```

The Core Rule Set: generic detection

```
# Command injection
SecRule REQUEST_FILENAME|ARGS|ARGS_NAMES|REQUEST_HEADERS
"(?:(?:[\;\|]\W*?\b(?:c(?:h(?:grp|mod|own|sh)|md|pp|c)|p(?:
asswd|ython|erl|ing|s)|n(?:asm|map|c)|f(?:inger|tp)|(?:kil|
mai)l|g(?:\+\+|cc)|(?:xte)?rm|ls(?:of)?|telnet|uname|echo|i
d)|\/(?:c(?:h(?:grp|mod|own|sh)|pp|c)|p(?:asswd|ython|erl|i
ng|s)|n(?:asm|map|c)|f(?:inger|tp)|(?:kil|mai)l|g(?:\+\+|cc
)|(?:xte)?rm|ls(?:of)?|telnet|uname|echo|id))\b|\b(?:(?:n(?
:et(?:\b\W*?\blocalgroup|\.exe)|(?:map|c)\.exe)|t(?:racer(?
:oute|t)|elnet\.exe|clsh8?|ftp)|w(?:g(?:uest\.exe|et)|sh\.e
xe)|(?:rcmd|ftp)\.exe|echo\b\W*?\by+)\b|c(?:md(?:(?:32)?\.e
xe\b|\b\W*?\\\/c)|hmod\b\.{1,100}?\+.{1,3}x|d\b(?:\W*?\\\/|
\W*\b..))))" \
        "deny,log,id:950006,severity:2,msg:'System Command
Injection'"
```

The Core Rule Set: Virtual Patching

```
<LocationMatch :"/athenareg.php$">
       SecRule ARGS:pass "\;" \
       "deny,log,t:urlDecodeUni,t:htmlEntityDecode, \
       t:lowercase,t:removeWhitespace,t:removeComments"
</LocationMatch>
```

Or:

```
<LocationMatch :"/athenareg.php$">
       SecRule ARGS:pass "!\w+" \
       "deny,log,t:urlDecodeUni,t:htmlEntityDecode, \
       t:lowercase,t:removeWhitespace,t:removeComments"
</LocationMatch>
```

Bad robots

- Based on modifiable elements of the request:
  - User-Agent header
  - URL
  - Generic headers
- Therefore:
  - Not a real security measurement
  - Offloads a lot of cyberspace junk & noise
  - Effective against comment spam
- Can use RBL:
  - Potential for FPs.

Trojans and Anti-Virus

- Check uploaded for Trojans:
- Check for access to Trojans:
  - Known signatures (x_key header)
  - Generic file management output (gid, uid, drwx, c:\)
- Major problem at hosting environments
  - Uploading is allowed.

Error conditions

- If all else fails
- Important for customer experience
- Makes life for the hacker harder

BREACH™

Thank You!

Ofer Shezaf

ofers@breach.com