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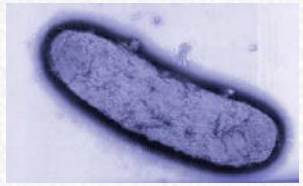
Yersinia

Framework for layer 2 attacks

Introduction



- Why Yersinia?

No other bacteria, perhaps organism, had so much of an effect on human history as Yersinia pestis, the bacteria that causes plague.

Many outbreaks of plague have caused death and population reduction throughout history. The most famous, however, was the notorious Black Death of medeival times that killed one third of the population of 14th century Europe. People watched their family and friends die with sickly buboes (swollen lymph nodes) on their necks and a color near black all over their bodies, caused by respiratory failure. People who contracted the disease and were unable to fight it off died within three to five days.

(taken from http://members.aol.com/omaryak/plague/

Introduction

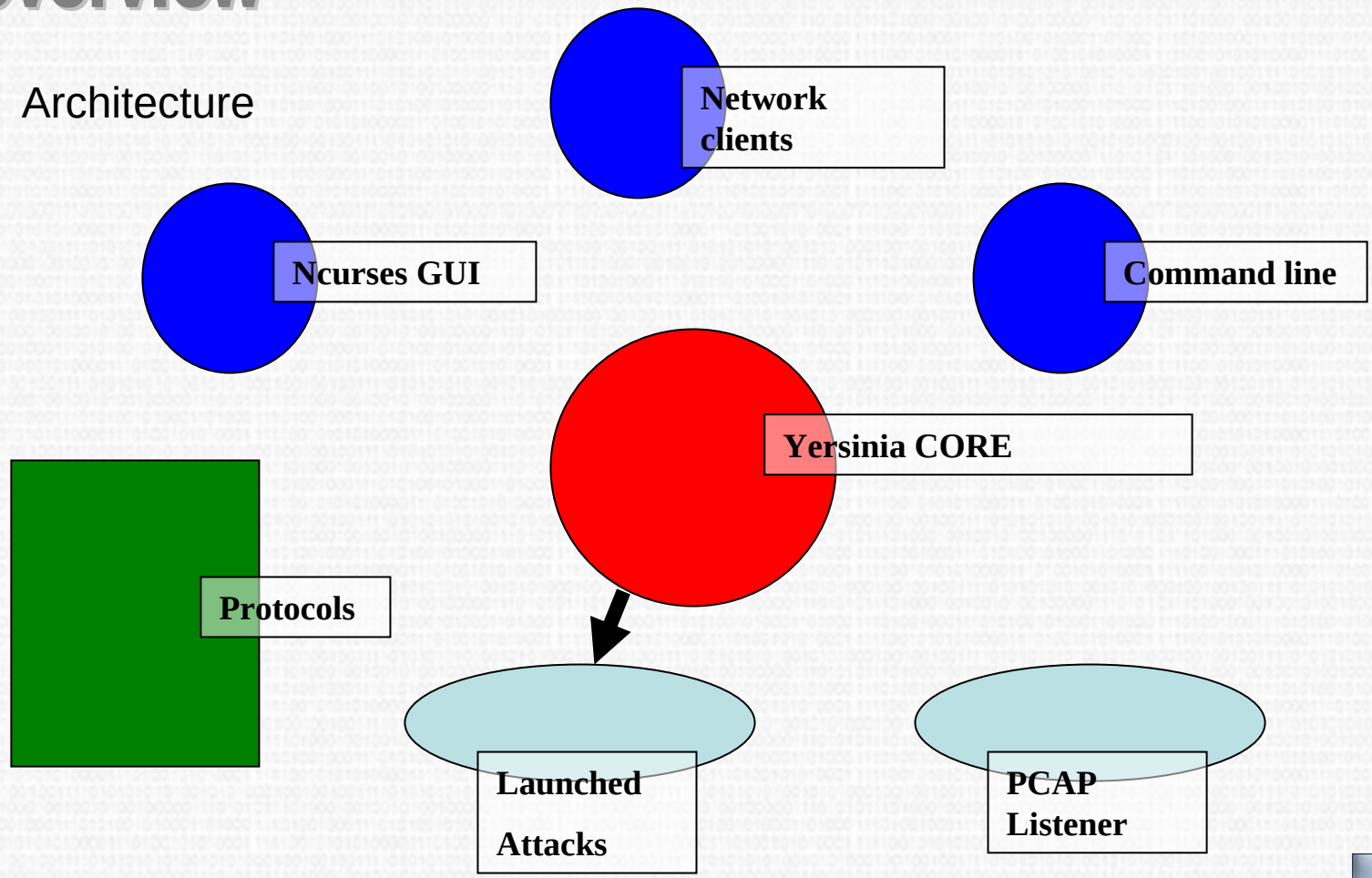
- Who we are
  - Colleagues working in the Information Security Field from Spain.
  - Company: S21sec (http://www.s21sec.com)
  - Interested in network protocols and how to assess customer networks (or how to protect your networks from the bad guys)
  - Open to help the IS community.

Overview

- Reasons
  - We were tired of doing always the same Layer 2 attacks (ARP Poisoning, CAM Flooding, ...)
  - We were tired of watching the same interesting packets flowing in our customers networks and not being able to play with them.
  - We were tired of check that, very often, routers and switches configuration are poorly set up and rarely hardened.
  - We were tired of seeing theorical attacks against these protocols but without any public information.
  - So, it was time for a change ☺

Overview

- Architecture



Overview

- Features.
  - 100% written in C. It uses libpcap, libnet and ncurses.
  - Runs in Linux, *BSD and Solaris
  - Multithreaded: it supports multiple users and multiple attacks per user.
  - Examine, analyze and watch your packets
  - Edit each protocol's fields
  - Capture your network data in pcap format.
  - **Current protocols enabled: STP, CDP, DTP, DHCP, HSRP, 802.1Q and VTP.**
  - Customize your preferences in a configuration file.
  - Learn packets from the network and replay them with your modifications.
  - Listens to your network!!
  - Three main modes: command line, network client and ncurses GUI.

Command line client

- Usage

```
Usage: yersinia [-hVID] [-l logfile] protocol
[protocol_options]
        -V   Program version.
        -h   This help screen.
        -I   Interactive mode (ncurses).
        -D   Daemon mode.
        -l logfile   Select logfile.
        -c conffile  Select config file.
  protocol   Can be one of the following: cdp, dhcp, dot1q,
dtp, hsrp, stp, vtp.

Try 'yersinia protocol -h' to see protocol_options help

Please, see the man page for a full list of options and many
examples.
Send your bugs & suggestions to the Yersinia developers
<yersinia *AT* wasahero.org>
```

Command line client

- Features
  - Easy, fast to run
  - Friendly shell script integration (pen-testing stuff)
  - No fancy $TERM needed, just the command line.

Network client

- Usage.

```
yersinia –D
```

(-D stands for Daemon)

- Features
  - Listens to default port 12000/tcp
  - Authentication (login & enable)
  - CLI similar to Cisco one (with some addons!!!)
  - Allows to set up a Yersinia server in each network segment so that the network administrators can assess their networks
  - Easy to manage if you have Cisco administration experience
  - Help MS Windows users to run Yersinia!! ☺

Ncurses GUI

- Usage

```
yersinia –I
```

(-I stands for Interactive)

- Features
  - Fancy, visual, and powerful GUI
  - Ncurses compatible with Linux, *BSD and Solaris (curses)
  - Examine and analyze your interesting network packets, and learn how to take advantage of the misconfigurations.
  - Watch Yersinia's wonderful features in a glance!
  - Beautiful colours ☺

Ncurses GUI

Eterm

Eterm Font Background Terminal

yersinia 0.5.1 by Slay & tomac - STP mode [20:28:07]

BridgeId RootId PortId Iface Last seen

Chaos Internetwork Operating System Software
yersinia (tm) Software (i686), Version 0.5.1, RELEASE SOFTWARE
Copyright (c) 2004-2004 by tomac & Slay, Inc.
Compiled Sun 27-Feb-2005 20:27 by someone
yersinia uptime is 02 seconds

Running Multithreading Image on
Linux 2.6.9 supporting:

01 console terminal(s)
02 tty terminal(s)
05 vty terminal(s)

Total Packets: 0 STP Packets: 0 MAC Spoofing [X]

STP Fields

Source MAC 00:00:00:00:00:00 Destination MAC 00:00:00:00:00:00
Id 0000 Ver 00 Type 00 Flags 00 RootId 0000.000000000000 Pathcost 00000000
BridgeId 0000.000000000000 PortId 0000 Age 0000 Max 0000 Hello 0000 Fwd 0000

SECOND ACT

Protocols and attacks

Hands on keyboard!

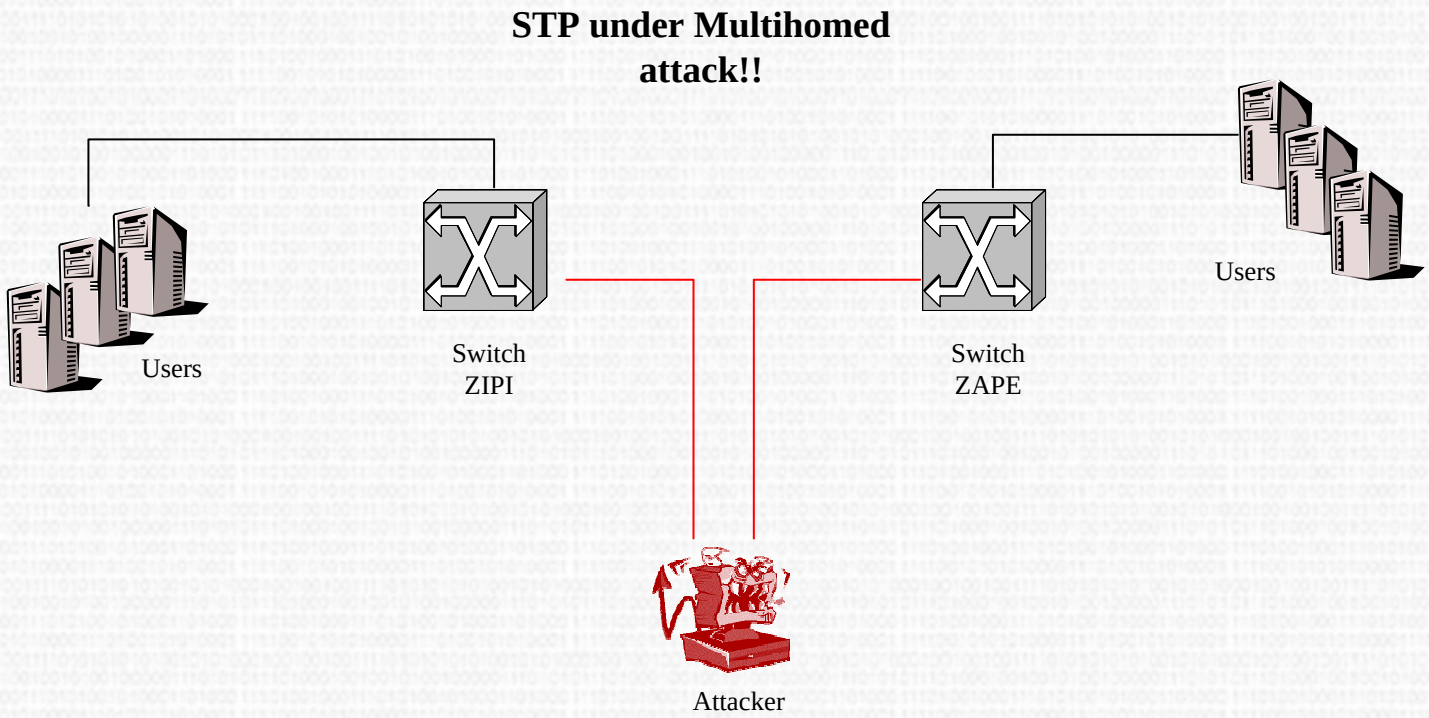
(Rapid) Spanning Tree

- Overview.
  - Takes care of your network loops
  - Spanning Tree Protocol (STP) and Rapid Spanning Tree Protocol (RSTP) support
  - Two different BPDU formats: Configuration BPDU and TCN BPDU
  - No authentication
  - Widely implemented in medium/big companies
  - Easy to play with

(Rapid) Spanning Tree

- Attacks implemented
  - Send a RAW configuration BPDU
  - Send a RAW TCN BPDU
  - DoS generated by sending different configuration BPDU
  - DoS generated by sending different TCN BPDU
  - Becoming the Root Role in the Spanning Tree
  - Becoming other active switch in the Spanning Tree
  - Becoming the Root Role with a MiTM attack

(Rapid) Spanning Tree



(Rapid) Spanning Tree

- Mitigations (Cisco only)
  - Use **port security and disable STP** in those ports that don't require STP. For information about port security, please check the following url: http://www.cisco.com/en/US/products/hw/switches/ps628/products_configuration_guide_chapter09186a0080150bcd.html
  - If you are using the portfast feature in your STP configuration, enable also the **BPDU guard** for avoiding these attacks when the port automatically enters the forwarding state: http://www.cisco.com/warp/public/473/65.html
  - Use the **root guard** feature for avoiding rogue devices to become root: http://www.cisco.com/en/US/tech/tk389/tk621/technologies_tech_note09186a00800ae96b.shtml

Cisco Discovery Protocol

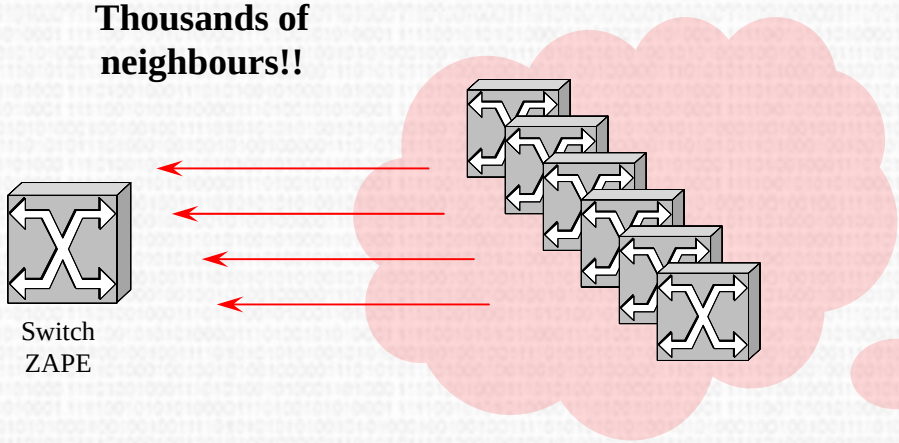
- Overview
  - Cisco Propietary Procotol
  - Cisco devices use it for communicating to each other
  - It carries some interesting data (IOS Version, Platform, VLAN Domain, ...)

Cisco Discovery Protocol

- Attacks implemented
  - Sends a RAW CDP packet
  - DoS flooding CDP table (first implemented by FX from Phoenolit)
  - Sets up a virtual device (useless, but can annoy network administrators)

Cisco Discovery Protocol

Thousands of neighbours!!



Switch
ZAPE

Attacker

Cisco Discovery Protocol

- Mitigations
  - Disable CDP ☺

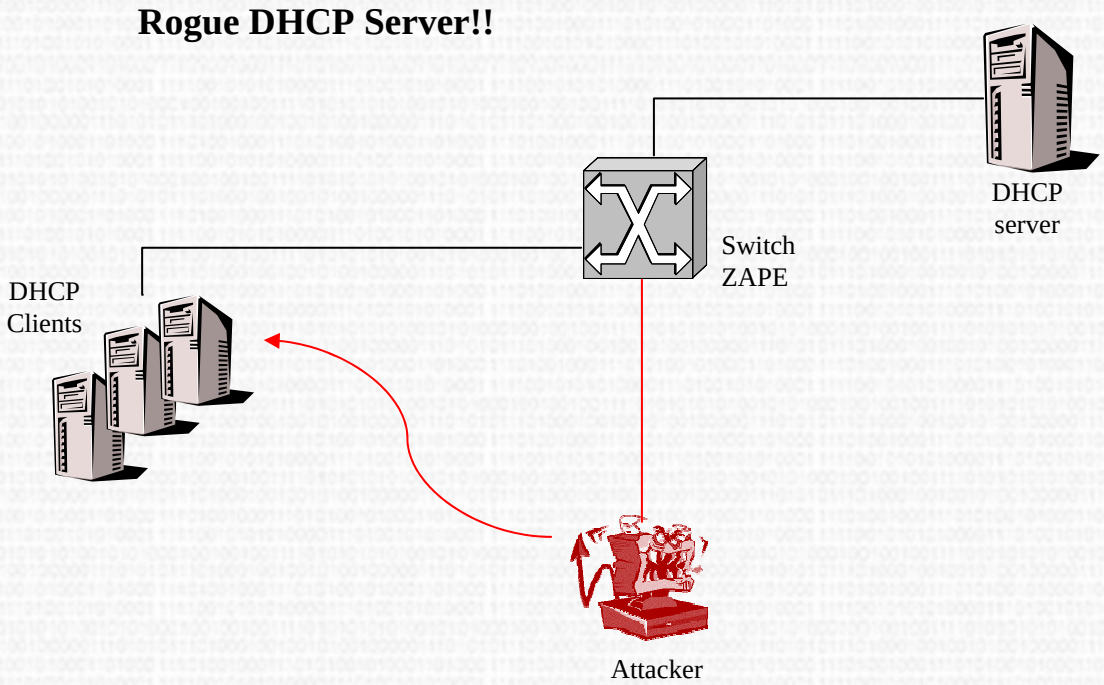
Dynamic Host Configuration Protocol

- Overview
  - Client / Server model
  - Assigns IP Addresses and other network information (DNS servers, gateway, WINS servers, netmask, ...)
  - Widely spread
  - No authentication
  - Can cause a severe damage to an organization
  - Uses UDP protocol (port 68/udp and 67/udp)

Dynamic Host Configuration Protocol

- Attacks implemented
  - Sends a RAW packet
  - Sends a DISCOVER
  - Sends an OFFER packet
  - Sends a REQUEST packet
  - Sends a RELEASE packet
  - Sends a DECLINE packet
  - Sends an INFORM packet
  - DoS exhausting available ip address from the DHCP pool
  - Sets up a rogue DHCP Server to configure clients with nasty IP settings (can be used for MiTM attacks or for creating chaos)

Dynamic Host Configuration Protocol



Dynamic Host Configuration Protocol

- Mitigations
  - Use Port Security (again!)
  - DHCP Snooping: set up which interfaces can answer for DHCP requests (trusted/untrusted) For more information, please visit http://www.cisco.com/en/US/products/hw/switches/ps4324/products_configuration_guide_chapter09186a008011c8ac.html

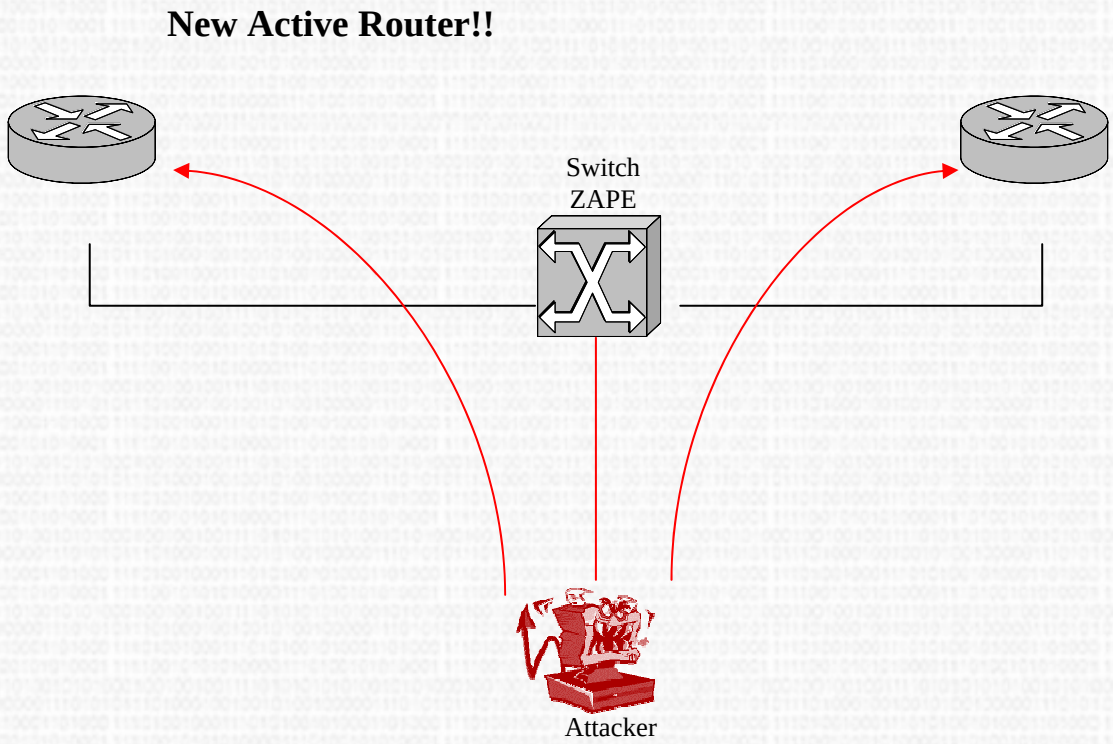
Hot Standby Router Protocol

- Overview
  - HA model (Active/Passive)
  - Plain text authentication (default: cisco)
  - Sends datagrams to multicast
  - Uses UDP Protocol (port 1985/udp)

Hot Standby Router Protocol

- Attacks implemented
  - Sends a raw HSRP packet
  - Becomes the ACTIVE element with a fake IP address
  - Becomes the ACTIVE element with your real IP address (MiTM)

Hot Standby Router Protocol



Hot Standby Router Protocol

- Mitigations
  - Use MD5 authentication (available from 12.3(2)T)
  - IPSEC

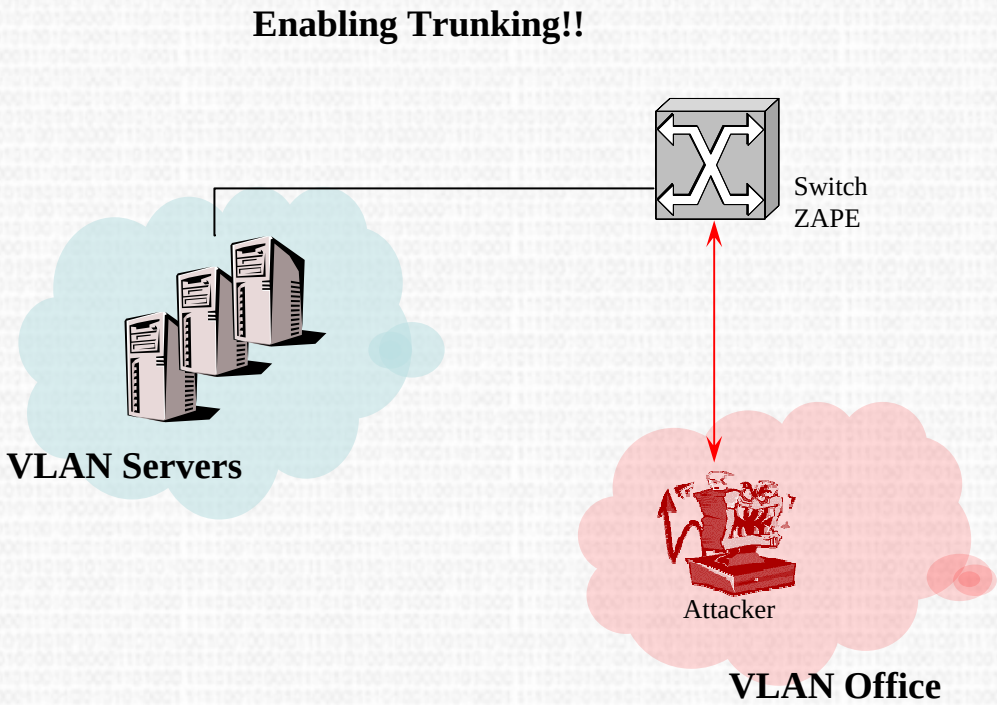
Dynamic Trunking Protocol

- Overview
  - Cisco Propietary Protocol
  - Sets up trunking between switches
  - By default, trunking is NEGOTIABLE

Dynamic Trunking Protocol

- Attacks implemented
  - Sends a RAW DTP packet
  - Enables trunking

Dynamic Trunking Protocol



Dynamic Trunking Protocol

- Mitigations
  - Set all ports to DTP off (no more auto!!)

VLAN Trunking Protocol

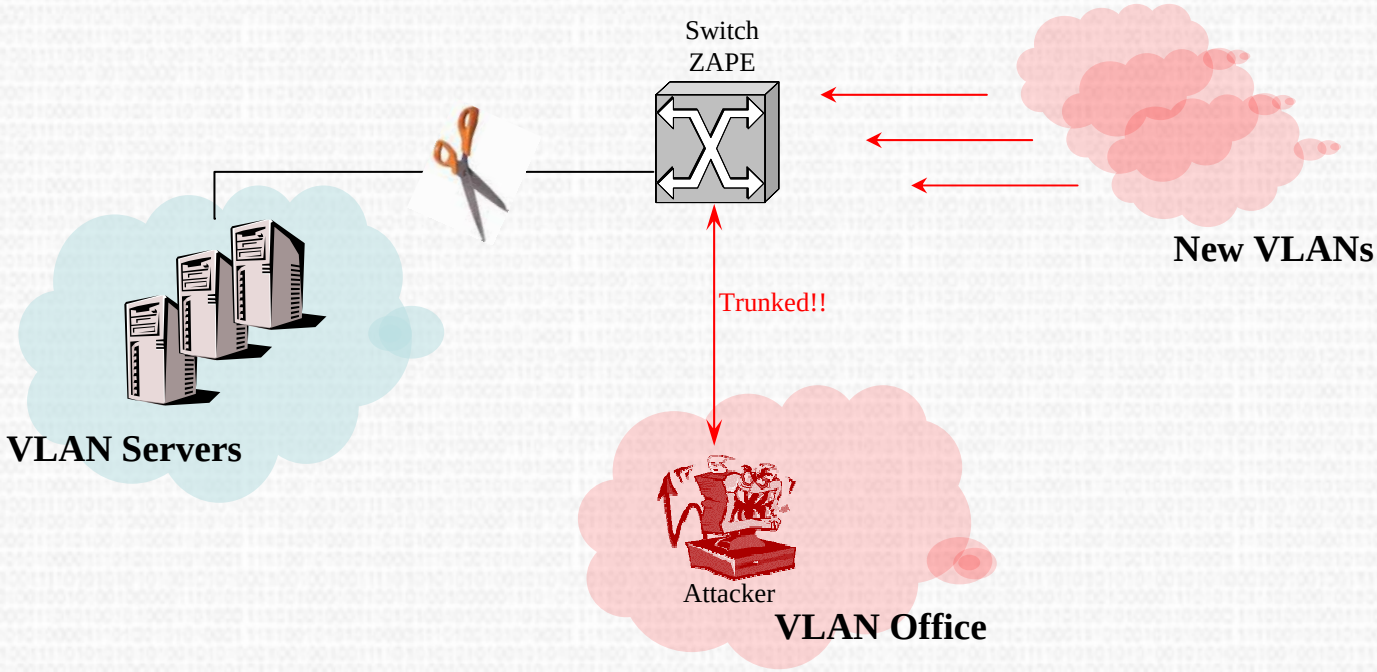
- Overview
  - Cisco Propietary Protocol
  - Allows adding/deleting VLANs from a centralized point

VLAN Trunking Protocol

- Attacks implemented
  - Sends a RAW VTP packet
  - Deletes all VTP vlans
  - Deleting one vlan
  - Adds one vlan

VLAN Trunking Protocol

Adding/deleting VLANs!!



VLAN Trunking Protocol

- Mitigations
  - Use a password!!! (we are still trying to find out how the MD5 field works with a password enabled)
  - Disable it if not needed

IEEE 802.1Q

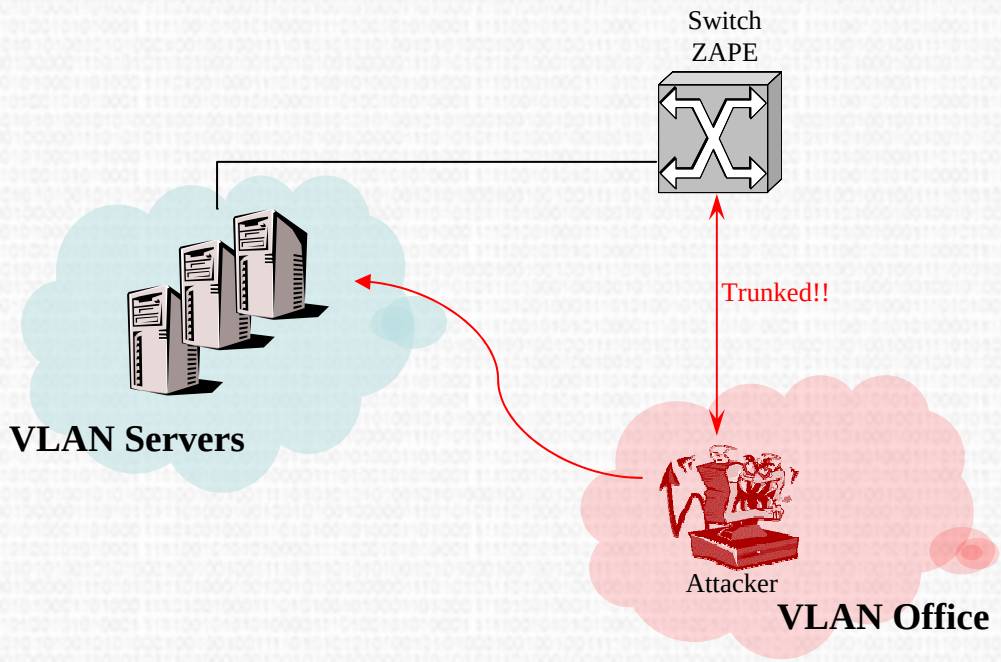
- Overview
  - Needed for passing frames between switches (trunking)
  - Adds an extra layer (802.1Q)
  - Tags packets with their VLAN Information

IEEE 802.1Q

- Attacks implemented
  - Sends a RAW 802.1Q packet
  - Sends a RAW 802.1Q double encapsulated packet
  - THE VLAN attack, or how to become the VLANs Master!!

IEEE 802.1Q

Sending 802.1Q packets!!



IEEE 802.1Q

- Mitigations
  - Same as DTP

THIRD ACT

Next steps

One step beyond!

Next steps

- Addition of new layer 2 protocols: ISMP, ISL, VQP/VMS
- Once the framework is totally finished, is time for the research
- Play with more complex network devices and different vendors (currently we are mostly focused on Cisco, since it is easy to get one in Ebay!!!)
- Authors expectations
- We need your help!! (it is becoming such a huge project!)

References / Further Reading

- Guillermo Marro thesis: http://seclab.cs.ucdavis.edu/papers/Marro_masters_thesis.pdf
- Sean Convery presentation: http://www.blackhat.com/presentations/bh-usa-02/bh-us-02-convery-switches.pdf
- CDP vulnerability by FX: http://www.phenoelit.de/stuff/CiscoCDP.txt
- vlan gsec paper
- Cisco Spanning-Tree Portfast BPDU Guard Enhancement: http://www.cisco.com/warp/public/473/65.html
- CISCO Technotes.Spanning-Tree Protocol Root Guard Enhancement: http://www.cisco.com/en/US/tech/tk389/tk621/technologies technote09186a00800ae96b.shtml
- Understanding and Configuring VLAN Trunk Protocol: http://www.cisco.com/warp/public/473/21.html

References / Further Reading

- Configuring VLAN Trunks: http://www.cisco.com/univercd/cc/td/doc/product/lan/cat6000/sw_5_2/cofigide/e_trunk.htm
- Cisco frames format: http://www.cisco.com/en/US/tech/tk389/tk390/technologies_tech_note09186a0080094665.shtml
- Tcpdump. http://www.tcpdump.org
- Ethereal: http:/www.ethereal.com
- 802.1q: IEEE standard for local and metropolitan area networks: Virtual Bridged Local Area Networks.
- Oleg K. Artemjev, Vladislav V. Myasnyankin: Fun with the Spanning Tree Protocol: http://www.phrack.org/show.php?p=61&a=12

Many thanks for your attention

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