



Fulcrum

Mission Manager's Brief for
Version 0.6



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2 INTRODUCTION

Fulcrum is a pro-active capability which facilitates the use of a controlled machine to pivot to another uncompromised target machine that is on the same remote LAN. The application will perform a man-in-the-middle attack on the target computer. The application will then monitor the target machine's HTTP traffic and redirect the target to the provided URL when the proper conditions are met.

To be clear, Fulcrum is not is an exploit or a worm. It will not gain arbitrary code execution on a remote machine nor will it perform privilege escalation on the pivot machine. Fulcrum will not replicate itself or automatically target machines on a LAN nor will it work across a router boundary (i.e. broadcast domain). Simply put, Fulcrum will direct a target machine's HTTP client traffic to the URL of the attacker's choice.

2.1 TERMINOLOGY

- **Pivot Machine** – The machine where Fulcrum will run.
- **Target Machine** – The machine that Fulcrum will target with its man-in-the-middle and HTTP traffic injection capabilities.
- **Deployment Preparation Machine** – The machine where Fulcrum is prepared and configured for deployment.

2.2 ANATOMY OF THE PIVOT

There are two basic components to this pivoting technique: the ARP based man-in-the-middle (MITM) and TCP session hijack for HTTP traffic injection. Specially crafted HTTP responses are sent to the target in response to HTTP requests made by the target by hijacking the TCP session. These responses deliver the originally requested content as well as the wax.

2.3 REQUIREMENTS FOR A SUCCESSFUL PIVOT

The following are the requirements for a successful pivot. Some of the requirements are due to technical limitations of the technique in general (e.g. both machines online at the same time) and some are limitations of the current implementation (e.g. English-only machines).

- The ability to deliver Fulcrum to the pivot machine.
- The ability to execute Fulcrum with Administrator privileges on the pivot machine.
- The pivot machine must be running Windows XP, Vista, or 7.
- The pivot machine must be using the English locale (i.e. no Cyrillic or Chinese)
- The LAN must use IPv4 and Ethernet.
- The MAC address of the LAN gateway for the network.
- The MAC address of the target machine.
- The URL to direct the target machine to.
- The pivot machine must be on the same LAN as the target machine.

- The pivot machine and the target machine must both be on the LAN that corresponds to the MAC address of the gateway provided to Fulcrum (e.g. if the home LAN MAC is provided, Fulcrum won't execute if the machine is on the local coffee shop's LAN)
- The target machine must generate web traffic (i.e. HTTP requests)
- The pivot machine must be on and connected to the network at the same time the target machine is online and generating HTTP requests.

3 RISKS AND CAVEATS

This section identifies known risks and caveats in the use of Fulcrum. Each risk is identified and described and any recommended mitigation steps are enumerated wherever possible.

3.1 FULCRUM DOES NOT MEASURE SUCCESS OR FAILURE BASED ON WAX SUCCESS

Description: Fulcrum does not measure its success or failure based on wax success. Fulcrum bases its success or failure on whether the target machine requests the injected URL.

Reason: Measuring the success or failure of the wax via Fulcrum is possible however it would require Fulcrum to contain too much sensitive information in order to do so.

Recommended Mitigation: If the wax success rate is low enough to cause concern for a successful injection but a failed wax, then there are two options. The first option is to use a wax with a higher success rate, if available. The second option is to consider using another delivery method in place of Fulcrum.

Additional Notes:

3.2 PIVOT MACHINE WILL BE DENIED NETWORK CONNECTIVITY IF IT CHANGES NETWORKS WHILE FULCRUM IS RUNNING.

Description: If the pivot machine is moved to another network while Fulcrum is running, the pivot machine will not be able to connect to the Internet or use networking in general.

Reason: This is because Fulcrum places a static ARP entry for the default gateway in the pivot machine's ARP table when the application starts up. The machine may switch networks in any number of ways, including switching network cables or wireless networks, or sleeping/hibernating the machine and moving it to a different location. When it does so, the static ARP entry for the default gateway will be wrong and none of their traffic will be routed.

Recommended Mitigation: Don't use machines that are likely to switch networks as a pivot machine. This includes laptops which might be put to sleep or into hibernation and moved from location to location. Any machine which is in a location that has multiple networks in use should also be carefully reviewed before being chosen as a pivot machine.

Additional Notes: If the pivot machine is rebooted, the static ARP entry will no longer be present and Fulcrum will not be running, so network connectivity will be returned to normal. If the pivot machine

connects to the same network with a different network interface (e.g. switches from wired to wireless) then Fulcrum will stop working but the pivot machine will remain online.

3.3 ARP SCANNING AND/OR ARP SPOOFING MAY ATTRACT ATTENTION FROM SECURITY PRODUCTS

Description: The use of ARP scans and ARP spoofs on a network may draw the attention of security products deployed on the pivot machine or anywhere on the network.

Reason: Fulcrum uses gratuitous ARP replies for its MITM attack and will sometimes use ARP requests in a scan like fashion in order to find the target. Various classes of security products including some Intrusion Detection Systems (IDS) and Personal Firewalls as well as purpose-built tools (e.g. arpwatch, arpfreeze) can detect ARP scans and/or ARP spoofs. Some tools even go a step further and thwart the spoofing attempt.

Recommended Mitigation: Don't use Fulcrum on networks which are likely to have IDS and/or network monitoring in place (e.g. corporate or enterprise networks). Whenever possible, identify which Personal Security Products (PSP) are running on the pivot machine to determine if there are any known issues with that product. If Fulcrum is untested against that specific PSP or version, then an in-house test mimicking the real environment should be done first in order to provide some measure of assurance.

Additional Notes: This is the same technique currently employed on wireless LAN engagements.

3.4 FULCRUM WILL STOP RUNNING IF THE PIVOT MACHINE IS REBOOTED

Description: If the pivot box which Fulcrum is running on reboots, Fulcrum will not auto-restart.

Reason: Fulcrum does not provide any persistent mechanisms.

Recommended Mitigation: Whatever mechanism is used to deliver, command, and control Fulcrum is responsible for either restarting Fulcrum or notifying the operator that the machine has been rebooted and a manual restart of Fulcrum is required.

Additional Notes:

3.5 POTENTIAL LOSS OF CONTROL OF FULCRUM

Description: Fulcrum may run indefinitely if communications are lost with the pivot machine.

Reason: Fulcrum does not implement any communications channel or have a suicide date. Fulcrum will run indefinitely until it either hits the target successfully, unsuccessfully tries 11 times, the pivot machine is rebooted, or the parent process dies (if run as a DLL via LoadLibrary). If the target machine is rarely or never online when the pivot machine is and the communications channel to the pivot machine is severed, then Fulcrum will run indefinitely until one of these conditions occur.

If Fulcrum is run via the LoadLibrary technique and the parent process dies (e.g. as a result of a suicide timer) then Fulcrum will stop running as well. However, if the parent process enters into a “min-ops” like state, Fulcrum will continue to run.

Recommended Mitigation: Run Fulcrum using the LoadLibrary technique from a process that has a suicide timer. If an event is approaching that may result in the loss of communications with the pivot machine or require a “min-ops” like state, then directly issue Fulcrum the shutdown command.

Additional Notes:

3.6 RUNNING FULCRUM INSIDE OF A VM CAUSES THE HOST TO DISPLAY AN ALERT

Description: If Fulcrum is run on a pivot machine which is actually a virtual machine and the host machine is running Linux and VMware, then a notification is displayed on the host system. The notification is a message box that states: *“The virtual machine’s operating system has attempted to enable promiscuous mode on adapter Ethernet0. This is not allowed for security reasons.”*

Reason: Fulcrum must specially craft packets for its attack. This requires administrative privileges from the operating system because the normal network APIs provided to a user-level process don’t allow these types of access. In the case of the pivot machine being a virtual machine, the host machine views that pivot machine as basically “just another process”. As a result, that process must also have administrative privileges on the host machine. By default, the virtual network adapters on the host machine are accessible only by the root user on Linux host machines.

Recommended Mitigation: Don’t run Fulcrum on a pivot machine that is a virtual machine.

Additional Notes:

3.7 THE TARGET AND/OR DEFAULT GATEWAY’S MAC ADDRESS IS UNKNOWN

Description: The MAC addresses of the target and the default gateway are both required parameters in order for Fulcrum to operate. If either of these parameters is missing or incorrect, Fulcrum will not work. These two pieces of information may be unknown to the Fulcrum operator.

Reason: Fulcrum uses the MAC addresses of the target and the default gateway in order to verify it is on the correct network and targeting the correct machine. The MAC address of the default gateway will nearly always be in the arp table cache (`arp -a`) of the pivot machine. However, the target machine’s MAC address may not be present if the pivot machine and target machine are not generating traffic between each other.

Recommended Mitigation: In addition to issuing an `arp -a` command on the pivot machine, on Windows Vista and later, the neighbor cache provides more detailed information and can be dumped using the following command: `netsh interface ipv4 show neighbors`

Additional Notes: