

# Phishing signatures creation HOWTO

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## 1 Database file format

### 1.1 PDB format

This file contains urls/hosts that are target of phishing attempts. It contains lines in the following format:

```
R[Filter]:RealURL:DisplayedURL[:FuncLevelSpec]  
H[Filter]:DisplayedHostname[:FuncLevelSpec]
```

**R** regular expression, for the concatenated URL

**H** matches the `DisplayedHostname` as a simple pattern (literally, no regular expression)

- the pattern can match either the full hostname
- or a subdomain of the specified hostname
- to avoid false matches in case of subdomain matches, the engine checks that there is a dot(.) or a space( ) before the matched portion

**Filter** an (optional) 3-digit hexadecimal number representing flags that should be filtered.

- flag filtering only makes sense in .pdb files. (however clamav won't complain if you put flags in .wdb files, it will just skip them)
- for details on how to construct a flag number see section Section 1.7

**RealURL** is the URL the user is sent to

**DisplayedURL** is the URL description displayed to the user, that is where it is *claimed* they are sent, the most obvious example is that of an html anchor (<a>tag): its href attribute is the REALURL, and its contents is the DISPLAYEDURL

**DisplayedHostname** is the hostname portion of the [DisplayedURL]

**FuncLevelSpec** an (optional) functionality level, 2 formats are possible:

- `minlevel` all engines having functionality level  $\geq$  `minlevel` will load this line
- `minlevel-maxlevel` engines with functionality level  $\geq$  `minlevel`, and  $<$  `maxlevel` will load this line

## 1.2 WDB format

This file contains whitelisted url pairs It contains lines in the following format:

```
X:RealURL:DisplayedURL[:FuncLevelSpec]
M:RealHostname:DisplayedHostname[:FuncLevelSpec]
```

**X** regular expression, for the ENTIRE URL, not just the hostname

- The regular expression is by default anchored to start-of-line and end-of-line, as if you have used `^RegularExpression$`
- A trailing `/` is automatically added both to the regex, and the input string to avoid false matches
- The regular expression matches the CONCATENATION of RealURL, a colon(`:`), and DisplayedURL as a single string. It doesn't separately match RealURL and DisplayedURL!

**M** matches hostname, or subdomain of it, see notes for H above

## 1.3 Hints

- empty lines are ignored
- the colons are mandatory
- Don't leave extra spaces on the end of a line!
- if any of the lines don't conform to this format, clamav will abort with a Malformed Database Error
- see section 1.4.3 on the following page for more details on REALURL/DISPLAYEDURL

### 1.3.1 Example

The following line:

```
R http://www\google\.(com|rolit) www\google\.com
```

Means: R - this is a regex.

Example of url pairs matching: `http://www.google.com www.google.com, http://www.google.it www.google.com.`

Example of url pairs not matching: `http://www.google.c0m www.google.com`

## 1.4 How matching works

### 1.4.1 RealURL, displayedURL concatenation

The phishing detection module processes pairs of realURL/displayedURL, and the matching against `daily.wdb/daily.pdb` is done as follows: the realURL is concatenated with a space, and with the displayedURL, then that *line* is matched against the lines in `daily.wdb/daily.pdb`

So if you have a line like

```
www.google.ro www.google.com
```

and a href like: `<a href="http://www.google.ro">www.google.com</a>`, then it will match, but: `<a href="http://images.google.com">www.google.com</a>` will not match.

If you use the **H** flag, then the 2nd href will match too.

### 1.4.2 What happens when a match is found

In the case of the whitelist, a match means that the realURL/displayedURL combination is considered CLEAN, and no further checks are performed on it.

In the case of the domainlist, a match means that the realURL/displayedURL is going to be checked for phishing attempts. This is only done if you don't run clamav with the *alldomains* option (since then all urls are checked). Furthermore you can restrict what checks are to be performed by specifying the 3-digit hexnumber.

### 1.4.3 Extraction of REALURL, DISPLAYEDURL from HTML tags

The html parser extracts pairs of REALURL/DISPLAYEDURL based on the following rules:

**a** (anchor) the *href* is the REALURL, its *contents* is the DISPLAYEDURL

**contents** is the tag-stripped contents of the <a> tags, so for example <b> tags are stripped (but not their contents)

nesting another <a> tag withing an <a> tag (besides being invalid html) is treated as a </a><a..

**form** the *action* attribute is the REALURL, and a nested <a> tag is the DISPLAYEDURL

**img/area** if nested within an <a> tag, the REALURL is the *href* of the a tag, and the *src/dynsrc/area* is the DISPLAYEDURL of the img

if nested withing a *form* tag, then the action attribute of the *form* tag is the REALURL

**iframe** if nested withing an <a> tag the *src* attribute is the displayedURL, and the *href* of its parent *a* tag is the REALURL

if nested withing a *form* tag, then the action attribute of the *form* tag is the REALURL

### 1.4.4 Example

Consider this html file:

```
<a href="evilurl">www.paypal.com</a>
<a href="evilurl2" title="www.ebay.com">click here to sign in</a>
<form action="evilurl_form">
Please sign in to <a href="cgi.ebay.com">Ebay</a> using this form
<input type='text' name='username'>Username</input>
....
</form>
<a href="evilurl"></a>
```

The resulting REALURL/DISPLAYEDURL pairs will be (note that one tag can generate multiple pairs):

- evilurl / www.paypal.com
- evilurl2 / click here to sign in
- evilurl2 / www.ebay.com
- evilurl\_form / cgi.ebay.com
- cgi.ebay.com / Ebay
- evilurl / image.paypal.com/secure.jpg

## 1.5 Simple patterns

Simple patterns are matched literally, i.e. if you say:

`www.google.com`

it is going to match `www.google.com`, and only that. The `.` (*dot*) character has no special meaning (see the section on regexes 1.6 for how the `.` (*dot*) character behaves there)

## 1.6 Regular expressions

POSIX regular expressions are supported, and you can consider that internally it is wrapped by `^`, and `$`. In other words, this means that the regular expression has to match the entire concatenated (see section 1.4.1 on page 2 for details on concatenation) url.

It is recommended that you read section 2 on page 6 to learn how to write regular expressions, and then come back and read this for hints.

Be advised that clamav contains an internal, very basic regex matcher to reduce the load on the regex matching core. Thus it is recommended that you avoid using regex syntax not supported by it at the very beginning of regexes (at least the first few characters).

Currently the clamav regex matcher supports:

- `.` (*dot*) character
- `\` (escaping special characters)
- `|` (pipe) alternatives
- `[]` (character classes)
- `()` (parenthesis for grouping, but no group extraction is performed)
- other non-special characters

Thus the following are not supported:

- `+` repetition
- `*` repetition
- `{ }` repetition
- backreferences

- lookaround
- other “advanced” features not listed in the supported list ;)

This however shouldn’t discourage you from using the “not directly supported features”, because if the internal engine encounters unsupported syntax, it passes it on to the POSIX regex core (beginning from the first unsupported token, everything before that is still processed by the internal matcher). An example might make this more clear:

```
www\google\.(com|rolit) ([a-zA-Z])+\google\.(com|rolit)
```

Everything till `([a-zA-Z])+` is processed internally, that paranthesis (and everything beyond) is processed by the posix core.

Examples of url pairs that match:

- `www.google.ro images.google.ro`
- `www.google.com images.google.ro`

Example of url pairs that don’t match:

- `www.google.ro images1.google.ro`
- `images.google.com image.google.com`

## 1.7 Flags

Flags are a binary OR of the following numbers:

**HOST\_SUFFICIENT** 1

**DOMAIN\_SUFFICIENT** 2

**DO\_REVERSE\_LOOKUP** 4

**CHECK\_REDIR** 8

**CHECK\_SSL** 16

**CHECK\_CLOAKING** 32

**CLEANUP\_URL** 64

**CHECK\_DOMAIN\_REVERSE** 128

**CHECK\_IMG\_URL** 256

**DOMAINLIST\_REQUIRED** 512

The names of the constants are self-explanatory.

These constants are defined in `libclamav/phishcheck.h`, you can check there for the latest flags.

There is a default set of flags that are enabled, these are currently: `(CLEANUP_URL|DOMAIN_SUFFICIENT|CHECK_SSL)` ssl checking is performed only for a tags currently.

You must decide for each line in the domainlist if you want to filter any flags (that is you don’t want certain checks to be done), and then calculate the binary OR of

those constants, and then convert it into a 3-digit hexnumber. For example you decide that `domain_sufficient` shouldn't be used for `ebay.com`, and you don't want to check images either, so you come up with this flag number:  $2|256 \Rightarrow 258(\text{decimal}) \Rightarrow 102(\text{hexadecimal})$

So you add this line to `daily.wdb`:

- `R102 www.ebay.com .+`

## 2 Introduction to regular expressions

Recommended reading:

- <http://www.regular-expressions.info/quickstart.html>
- <http://www.regular-expressions.info/tutorial.html>
- `regex(7)` man-page: <http://www.tin.org/bin/man.cgi?section=7&topic=regex>

### 2.1 Special characters

[ the opening square bracket - it marks the beginning of a character class, see section 2.2 on the following page

\ the backslash - escapes special characters, see section 2.3 on the next page

^ the caret - matches the beginning of a line (not needed in clamav regexes, this is implied)

\$ the dollar sign - matches the end of a line (not needed in clamav regexes, this is implied)

· the period or dot - matches *any* character

| the vertical bar or pipe symbol - matches either of the token on its left and right side, see section 2.4 on the following page

? the question mark - matches optionally the left-side token, see section 2.5 on the next page

\* the asterisk or star - matches 0 or more occurrences of the left-side token, see section 2.5 on the following page

+ the plus sign - matches 1 or more occurrences of the left-side token, see section 2.5 on the next page

( the opening round bracket - marks beginning of a group, see section 2.6 on the following page

) the closing round bracket - marks end of a group, see section 2.6 on the next page

## 2.2 Character classes

## 2.3 Escaping

Escaping has two purposes:

- it allows you to actually match the special characters themselves, for example to match the literal +, you would write \+
- it also allows you to match non-printable characters, such as the tab (`\t`), newline (`\n`), ..

However since non-printable characters are not valid inside an url, you won't have a reason to use them.

## 2.4 Alternation

## 2.5 Optional matching, and repetition

## 2.6 Groups

Groups are usually used together with repetition, or alternation. For example: `(com|it)+` means: match 1 or more repetitions of `com` or `it`, that is it matches: `com`, `it`, `comcom`, `comcomcom`, `comit`, `itit`, `ititcom`,... you get the idea.

Groups can also be used to extract substring, but this is not supported by the clam engine, and not needed either in this case.

# 3 How to create database files

## 3.1 How to create and maintain the whitelist (daily.wdb)

If the phishing code claims that a certain mail is phishing, but its not, you have 2 choices:

- examine your rules `daily.pdb`, and fix them if necessary (see: section 3.2 on the following page)
- add it to the whitelist (discussed here)

Lets assume you are having problems because of links like this in a mail:

```
<a href="http://69.0.241.57/bCentral/L.asp?L=XXXXXXXX">http://www.bcentral.it/</a>
```

After investigating those sites further, you decide they are no threat, and create a line like this in `daily.wdb`:

```
R http://www\.\bcentral\it/.+ http://69\.\0\241\.\57/bCentral/L\asp?L=.
```

Note: urls like the above can be used to track unique mail recipients, and thus know if somebody actually reads mails (so they can send more spam). However since this site required no authentication information, it is safe from a phishing point of view.

## 3.2 How to create and maintain the domainlist (daily.pdb)

When not using `-phish-scan-alldomains` (production environments for example), you need to decide which urls you are going to check.

Although at a first glance it might seem a good idea to check everything, it would produce false positives. Particularly newsletters, ads, etc. are likely to use URLs that look like phishing attempts.

Lets assume that you've recently seen many phishing attempts claiming they come from Paypal. Thus you need to add paypal to daily.pdb:

```
R.+ .+\paypal\.com
```

The above line will block (detect as phishing) mails that contain urls that claim to lead to paypal, but they don't in fact.

Be carefull not to create regexes that match a too broad range of urls though.

## 3.3 Dealing with false positives, and undetected phishing mails

### 3.3.1 False positives

Whenever you see a false positive (mail that is detected as phishing, but its not), you need to examine *why* clamav decided that its phishing. You can do this easily by building clamav with debugging (`./configure --enable-experimental --enable-debug`), and then running a tool:

```
$contrib/phishing/why.py phishing.eml
```

This will show the url that triggers the phish verdict, and a reason why that url is considered phishing attempt.

Once you know the reason, you might need to modify daily.pdb (if one of yours rules inthere are too broad), or you need to add the url to daily.wdb. If you think the algorithm is incorrect, please file a bugreport on [bugzilla.clamav.net](http://bugzilla.clamav.net), including the output of *why.py*.

### 3.3.2 Undetected phish mails

Using *why.py* doesn't help here unfortunately (it will say: clean), so all you can do is:

```
$clamscan/clamscan --phish-scan-alldomains undetected.eml
```

And see if the mail is detected, if yes, then you need to add an appropriate line to daily.pdb (see section 3.2).

If the mail is not detected, then try using:

```
$clamscan/clamscan --debug undetected.emlless
```

Then see what urls are being checked, see if any of them is in a whitelist, see if all urls are detected, etc.

## 4 Hints and recomandations

## 5 Examples