



SOFTWARE ANALYSIS AND FORENSIC ENGINEERING CORPORATION

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Online Intellectual Property Protection

Protecting Your Online Intellectual Property

Software Analysis and Forensic Engineering (SAFE Corporation) can protect your online IP—social games, online application software, website content—with our unique and proven system of software and expertise. SAFE offers two types of IP screening. *Pervasive IP Screening* determines whether your IP appears anywhere online. *Competitive IP Screening* compares your IP with that of a specific competitor. Read further to understand how SAFE Online IP Screening works and why you need it.

Background

Intellectual property theft is an issue that all businesses must face. This excerpt from a recent article on Intellectual property theft from a study from the Center for Education Research Information Assurance and Security (CERIAS) at Purdue University quantifies the problem.

Purdue University's Center for Education and Research in Information Assurance and Security surveyed 800 companies on intellectual property theft. These 800 companies estimated that they lost a combined \$4.6 billion worth of intellectual property last year alone, and spent approximately \$600 million repairing damage from data breaches. "Companies are grossly underestimating the loss, and value, of their intellectual property", said Eugene Spafford, professor of computer science at Purdue University and executive director of CERIAS. "Just like gold, diamonds or crude oil, intellectual property is a form of currency that is traded internationally, and can have serious economic impact if it is stolen." Intellectual property can account for as much as 85 percent of a company's value.

According to the U.S. Commerce Department, intellectual property theft costs U.S. businesses roughly \$250 billion every year while also eliminating almost 750,000 U.S. jobs. Everyone agrees that the problem is big and getting bigger, and for companies where their IP must be online, the problem might seem insurmountable. But in reality, companies publishing their IP online have a unique advantage since their competitors also publish online. Fortunately, the exposure works both ways, which means that anyone stealing your online IP must also expose the copied or derivative work online. This changes the game in IP protection; because of easy online access we can examine your competitor's online offerings for possible infringement.

This case study shows how SAFE Corporation's Online Intellectual Property Screening ServicesSM provides you a proactive solution for protecting your IP. SAFE offers two types of IP Screening—Pervasive IP Screening and Competitive IP Screening.

Challenge

There are three main challenges with developing a process to screen your online IP. The first challenge is the diversity of content in online IP, since it is more than just the core product itself but can also include the infrastructure to present it, including web pages, scripts, images, and more. The second challenge is capturing the online IP for comparison. The third challenge is the actual comparison. In this case study we use online Adobe® Flash games as an example and show how each of these challenges is overcome.

Methodology

Diverse Content

The challenge with online IP is that the content comes in many forms and is presented through a single interface, the web browser. Dealing with the comparison of diverse online IP content requires splitting and organizing the content. SAFE has developed tools to help with the task of deconstructing and organizing web content. SAFE's HTML preprocessor splits web pages into basic elements including pure HTML, scripts, text content, comments, images, and audio and video media. The HTML preprocessor captures the web page structure by generating pseudocode that can then be analyzed independently of the content.

One popular vehicle for delivery of online IP is Flash. Flash is often made up of a variety of content elements such as images, code (ActionScript), text, video, and audio. It can accept user input from keyboard, mouse, microphone, and web cam. It is an important tool for delivery of rich Internet applications (RIA). For these reasons no online IP screening can be complete without a solution to analyze Flash content, which SAFE has.

Downloading Online IP

The challenge with downloading online IP is that it's dynamic; in other words as you interact with the content, additional content is displayed and old content disappears. SAFE uses specialized tools (and our years of experience) to record the IP and to further dig content out of the browser cache.

Comparison

In the case of complete copying, almost any kind of comparison can work. However the more typical case is that pieces of IP are taken and embedded within other IP. It is for these reasons that SAFE developed our CodeSuite® forensic software to find correlation among different set of online IP. This proven and patented technology in particular differentiates SAFE's Online IP Screening from all other approaches. SAFE offers two types of Online IP screening. Pervasive IP Screening determines whether

your IP appears anywhere online and if so, where. Competitive IP Screening compares your IP with that of a specific competitor to check for even small amounts of copying. Both approaches are described below.

Pervasive IP Screening

The purpose of Pervasive IP Screening is to locate any unauthorized posting of content or conversely to show that your content is *not* found elsewhere on the Internet. In this case study we use the popular social game Farmville by Zynga as the source for our Pervasive IP Screening example.

For this study we have only screened the key content, the ActionScript software that controls the game. The steps followed to generate the final screening report are:

1. First Flash SWF files were downloaded to a client computer and extracted from the web browser cache.
2. The ActionScript code that controls user interaction and display was then decompiled from the SWF files.
3. SAFE's CodeMatch® program was then run to extract all the program elements from the ActionScript.
4. SAFE's SourceDetective® program was used to search the Internet for the program elements.
5. A spreadsheet was generated and used to identify the elements found on the Internet.
6. The final step was a manual screening performed by SAFE's trained and experienced engineers. The table from the final screening report is shown below:

Identifier	Original Hits	Alert	App and identifier search	Identifier search - other source code references
amount_mc	15		0	ActionScript forums
body_tf	15		0	ActionScript forums
categoryButton2	15		0	Koders - ClassificationResultWindow.java
CLAIMED_OK	15		0	
collectReward	15		0	Facebook Castle_Age posts
COLLISION_ALL	15		0	Koders - sgiseeq.h: Defines for the Seeq8003 ethernet controller
configLoaderError	15		0	lpython config.loader
coverUp_mc	15		0	Flash forum
description_tf	15		0	Adobe forums
getHelperNames	15		0	Koders: HelperConfigTool.java , php uses, Eclipse uses
HarvestableResource	15	Source posted	1	

hierState	15	0	Adobe forums: URI Class
interfaceParams	15	0	Koders: section.users.php
isJumbo	15	5	Gamebot post Hack post Gamebot post Hack post Gamebot post
isObjectSelectable	15	0	rhinoscript function
isWithinViewport	15		game developer forum
m_authorId	15	0	SQL use
m_bundleId	15	0	Koders: InstanceCreator.java
m_defaultTab	15	0	Java list boxes
m_FromUser	15	0	messagereceivertask.cpp android open source project ...
m_headerFrame	15	0	kdeplasma addons
m_petName	15	0	Runuo
m_postTime	15	0	referenced in code found on Asian bb sites
m_showArrow	15	0	referenced in MythTV
m_subcategory	15	0	referenced in asp.net
NewOveralls	15	9	Source posted
objectOverlay	15	1	Source posted
objectTypeCollection	15	0	adobe package use
onCBClick	15	0	reference in Delphi code
onGetUser	15	0	reference in adobe pacakage
onLoadIcon	15	0	reference in Delphi code on Koders.com uLoaders.pas
origin_mc	15	0	referenced on ActionScript forums
present_bt	15	0	no source code references
producedItem	15	0	refrence in Nokia forum stack.cpp
resetGameBoard	15	0	references to a number of games and flash tutorials
rollOverScale	15	0	references in a number of flash discussions and in code at Koders.com ToolBarButton.java
showLoadStatus	15	0	number of refrences in php, cpp, jquery
SocialNetworkEvent	15	0	no source code references
updateImageState	15	0	referenced in nslmageLoadingContent.cpp for firefox
updateItemDisplay	15	0	referenced in a number of code references

The manual screening uncovered a number of hacker bulletin board sites and game bot sites where sections of the code were posted. Below is one post that was found when the manual screen was performed on the identifier `HarvestableResource`.

Step 7: Now you need to figure out how to edit the byte code based on the information I provided in the previous post. To figure this out yourself you will need some programming knowledge, and experience translating byte code. I will try to explain some of the basic stuff so that you can try do this yourself. Make a duplicate copy of the search byte code that you can edit. What you'll do is find the code in the P-Code/byte code mix, then search for that code in the search byte code, and edit it accordingly.

a: You first need to find the spot where we need to insert our subtraction. In the source code this is the red highlight. That is the only place in the function where you see the `getTimer()` function being called. So just look through the P-Code until you find it.

```
//5e f6 07
_as3_findproperty Classes:HarvestableResource::m_plantTime
//60 85 02
_as3_getlex GlobalEngine
//46 96 1c 00
_as3_callproperty getTimer(param count:0)
//68 f6 07
_as3_initproperty Classes:HarvestableResource::m_plantTime
```

From the source code this is the line: `m_plantTime = GlobalEngine.getTimer();`

The value gets set by the '63 f6 07' '_as3_initproperty' code, so we need to insert our subtraction right before that. Find the '68 f6 07' code in your search byte code, and insert the correct '2d XX aX' for the amount of time you want to subtract from this.

The same post also showed excerpts of decompiled code from the Farmville game. SAFE can provide further analysis to determine more information about any discovered code if requested.

The Pervasive IP Screening report includes a full search spreadsheet on all program elements of the scanned content, a detailed scan table including hyperlinks to actual findings, and a representative example of at least one of the source code online postings if any are found.

Competitive Screening

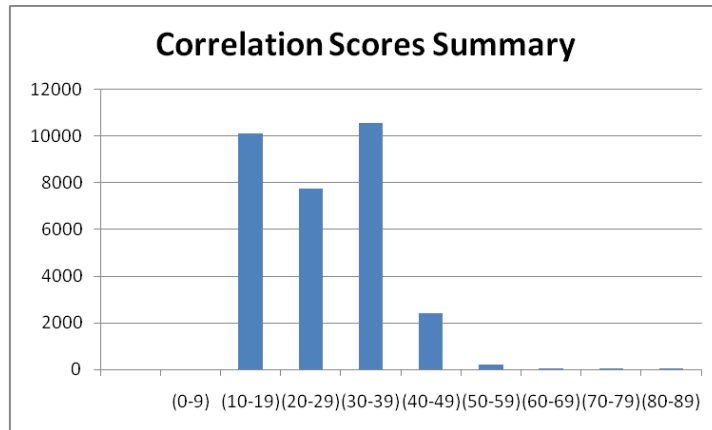
Competitive IP Screening is a comparison of two specific sets of online IP to determine whether one was copied, in full or in part, from the other. This case study looks at the results of a competitive comparison using two social games, Farmville by Zynga and Happy Aquarium by CrowdStar. The online content for both games was captured using the methodology described above, and the table below summarizes the number of files for each content category to be analyzed.

	HTML, XML, & CSS content	JavaScript	PHP	SWF	Images (png,jpg,gif)	Sound
Farmville	12	11	8	33	406	28
Happy Aquarium	16	10	0	87	31	42

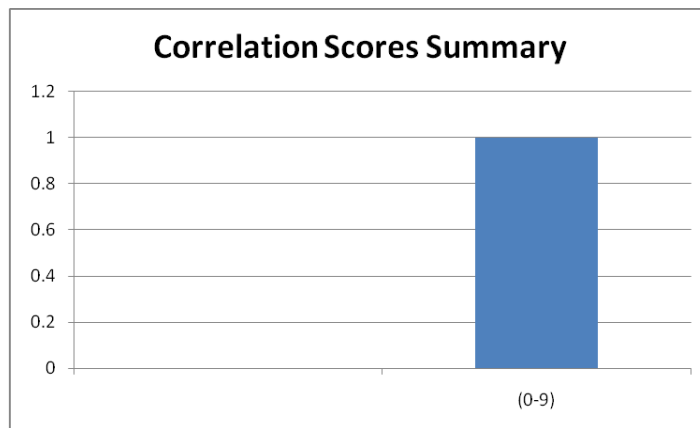
SWF/ActionScript Comparison

After decompiling the SWF files for both games a comparison was done using CodeMatch on the resulting ActionScript files, then filtering was done to eliminate matches caused by third party code,

common identifiers, common algorithms, common authors, or code generation tools. The first graph shows a plot of how many file pairs (y-axis) had correlation scores within the ranges plotted on the x-axis. There were a total of 31,136 file pairs with correlation reported.



The graph of the correlation scores summary after the filtering shows that only 1 file pair was reported with a correlation that fell in the 0-9 range.



The correlation score for the file pair was 3 out of a possible 100. This correlation indicates that even after filtering there are still matches remaining. The detailed report for the file pair is shown below.

S.A.F.E.

Code Match CodeMatch Detailed Report
Version: 5.3.1 | Date: 09/02/10 | Time: 23:45:43

BACK NEXT **SCORE 3**

SETTINGS

Compare file 1:	I:\Farmville_isolated\Farmville_as\static.farmville.com\embedsv42071\FarmGame.release-10-08-31_42071\Scripts\Display\FarmGameSprite.as
To file 2:	I:\HappyAquarium_isolated\as_HappyAquarium\cdn\aquarium.crowdstar.com\swf\main_deploy_preloaded\Scripts\crowdstar.as
Links to results:	Matching Statements Matching Comments and Strings Matching Instruction Sequences Matching Identifiers Partially Matching Identifiers Score

RESULTS

Matching Statements
*** NONE ***
TOP

Matching Comments and Strings
*** NONE ***
TOP

Matching Instruction Sequences
*** NONE ***
TOP

Matching Identifiers

m_normalScale	m_rollOverScale	m_toolTipObj
---------------	-----------------	--------------

TOP

Partially Matching Identifiers
*** NONE ***
TOP

SCORE 3

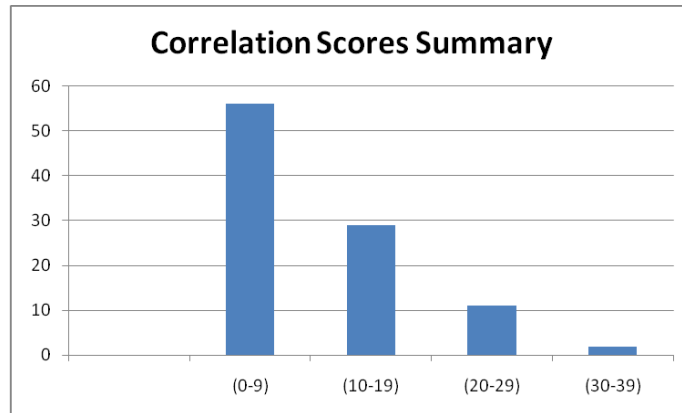
This correlation identifies matches due to unique identifiers `m_normalScale`, `m_rollOverScale`, and `m_toolTipObj` in the source code of both programs that could not be explained and filtered out. Further analysis showed that 116 lines out of 160 lines were exact matches for the Farmville routine and 116 lines out of 192 lines were exact matches for the Happy Aquarium routine. A more detailed investigation is needed to determine whether or not any copying or copyright infringement occurred. SAFE recommends that further analysis of files be performed by experienced IP experts when the correlation cause is not understood by the IP owner.

SWF to Images & Sound Comparison

In addition to the SWF decompiling into ActionScript files, the decompiling also produced a number of image files and sound files that were part of each game. Included in the Competitive IP Screening is a comparison of image files and sound files. In this comparison no matches were found and there was no need for further investigation.

JavaScript Comparison

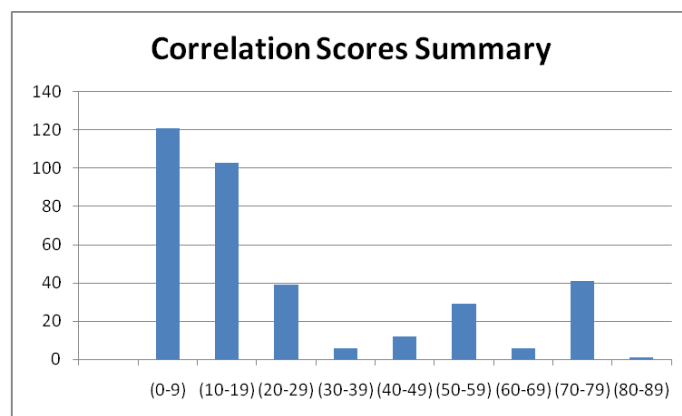
The graph of the correlation scores summary for the initial comparison of the JavaScript files is shown below. There were 98 file pairs reported with a non-zero correlation.



After filtering to eliminate matches caused by third party code, common identifiers, common algorithms, common authors, or code generation tools, there were no file pairs remaining with a non-zero correlation, so no further investigation was required.

HTML, CSS, XML Comparison

The graph of the correlation scores for the comparison of the web files is shown below. The initial comparison reported 358 file pairs with correlation. After filtering these results for third party code, common identifiers, common algorithms, common authors, and code generation tools, there were no file pairs remaining with any correlation and no further investigation of these files was recommended.



Summary

These case studies show how SAFE Corporation's Online IP Screening Services use our unique forensic software technology to analyze and screen competitive products and the Internet for unauthorized use of your online IP. A screening report can be used as compelling evidence of copyright infringement and can enable faster action by a court, should you decide to take legal action to stop continuing infringement. Alternatively, a screening report can be used as part of a due diligence procedure, and can also avoid costly and prolonged legal action if no infringement is found.