Taking Back Netcat

Ever since Symantec added Netcat's signature to their virus database, there have been repeated outcries against the detection of Netcat as a "Hack Tool"; while Netcat is a very useful networking utility, like many useful tools, it can be used for both good an evil. This paper will show how to locate the signature used to identify Netcat, and modify it so that the executable no longer matches Symantec's signature, without interfering with any of the program's functionality. This is not an act of defiance against Symantec, but rather an exercise in identifying and modifying sections of code (aka, signatures) that are used by anti virus programs to identify malicious code; the tools and techniques used here can be applied to any program that is marked as malicious by AV applications.

Changing File Signatures

While there are some easy ways of changing the signature of a program (packers, encryptors, etc), they may not always be viable options for those wishing to bypass anti virus applications. Additionally, it would be easy for anti virus companies to run a program such as Netcat through a few popular packers/encryptors and add signatures for the resulting binaries to their virus databases as well. As such, we will be manually examining and editing the Netcat program in order to create a custom "version" of the Netcat utility.

There are two basic ways of editing a program: either by changing the original source code and recompiling it, or by using a hex editor to change various bytes in the compiled binary; in either case, in order to invalidate an AV signature, you must know what parts of the code are used to identify the signature. Thus, regardless of the availability of source code, one still needs to know how to find an AV signature in order to thwart it. While Netcat source code is available, we will be using the hex editor approach; this allows us the opportunity to see how closed-source programs are changed in order to slip past anti virus protection (i.e., when creating new virus strains, modifying shellcode, etc).

Tools Needed

The following tools will be used in this paper. Note that only the first three tools are required. If you have a preference for different programs, feel free to use them instead of the listed applications, just as long as they can provide the same basic functionality:

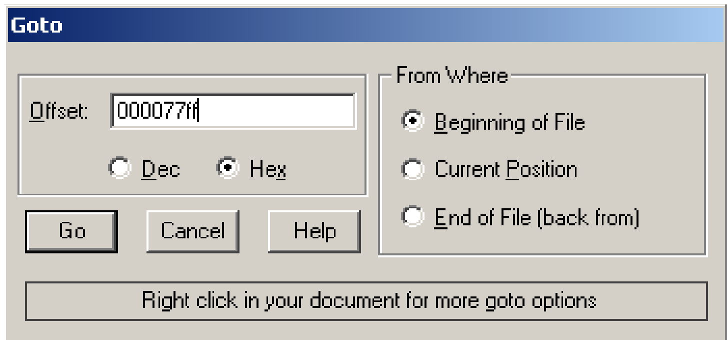
1. Netcat for Windows v1.11 (http://www.vulnwatch.org/netcat)
2. Norton Anti-Virus 2006 (http://www.symantecstore.com)
3. HexWorkshop v4.23 (http://www.bpsoft.com/downloads)
4. Olly Debugger (http://www.ollydbg.de)

In addition, a familiarity with disassembly, ASM, and PE editing will help you to further obfuscate an AV signature, but they are not necessarily prerequisites for this paper. You will, however, be able to follow along much better if you have at least some understanding of ASM, hex editing, and PE headers.

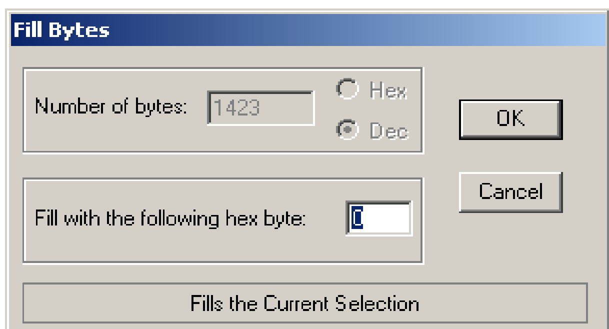
Identifying a Signature

Once your AV agent has identified a file as a virus, trojan, worm, or other malicious program, you need to locate the section of the file that is used by the AV application to identify the program as malicious. The easiest way to do this is through bracketing (aka, brute force, trial and error, or whatever you'd like to call it). If you open the program in a hex editor and replace, say, the second half of the file with a string of 0's, and the AV application no longer identifies the file as a malicious program, then the AV signature (or at least part of it) is located in the second half of the file. Conversely, if it is still identified as a malicious program, then the signature is located in the first half of the file. This halving technique can be used again and again to narrow down the location of the signature, until you can positively identify the exact location and length of the signature.

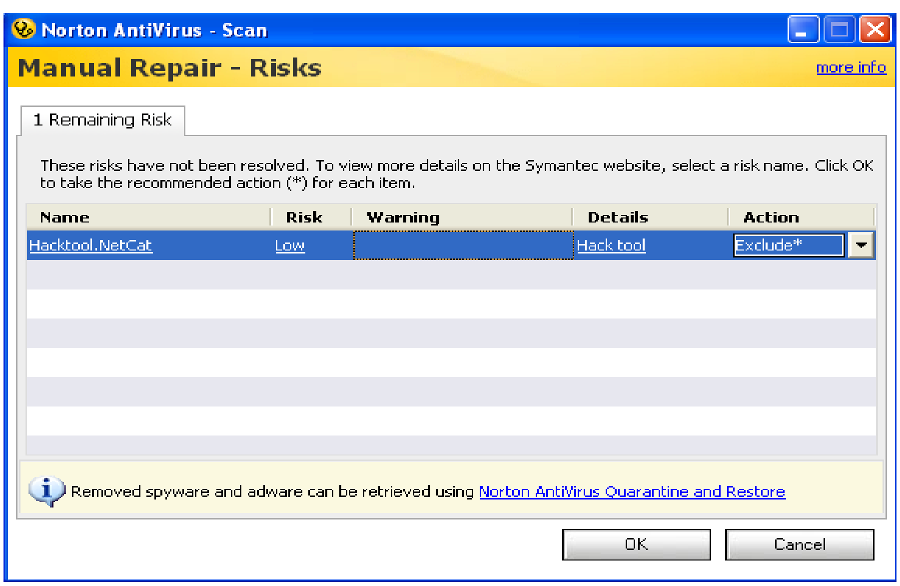
To do this, first open up Netcat with Hex Workshop (right click nc.exe and select 'Hex edit with Hex Workshop'). If you scroll to the bottom of the hex dump, you see the last byte is located at offset EFFF. Divide EFFF in half and you get 77FF; open up a goto box (Ctl+G) and go to the offset 77FF from the beginning of the file:



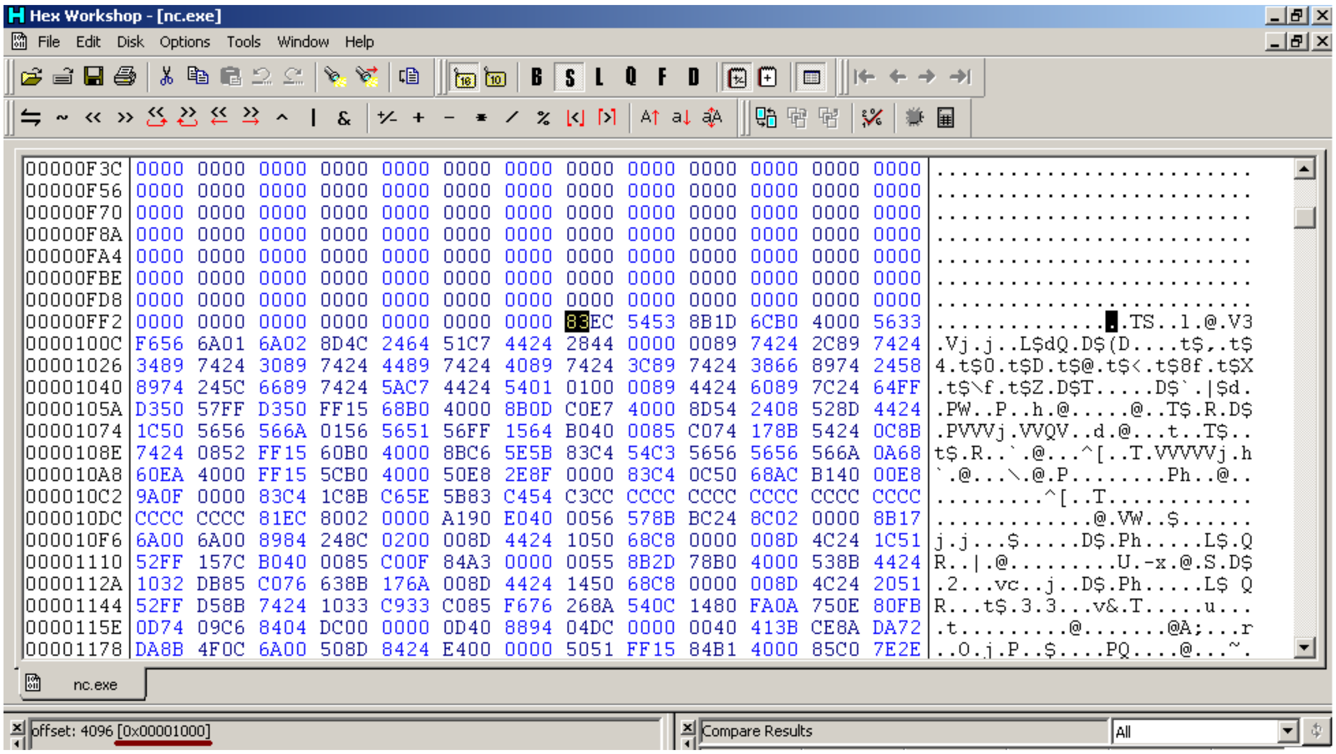
Select everything from 77FF to the end of the file (EFFF), right click, select 'Fill', and fill the selected section with 0s:



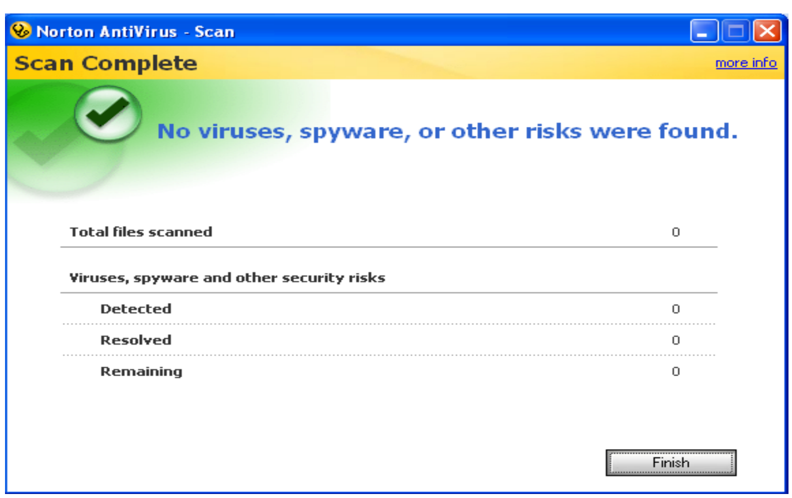
Save your changes; when prompted to make a backup, say yes. Now, have Norton scan nc.exe again, and it should still detect the file as a “Hack Tool”:



This indicates that the signature is somewhere in the first half of the binary file. Click Cancel on the Norton repair window, delete the nc.exe file and rename nc.BAK (the backup made by Hex Workshop) to nc.exe. Open up nc.exe with Hex Workshop and let's examine the first half of the hex dump. You'll notice a few text strings such as “This program cannot be run in DOS mode”, “.text”, “.data” and “.rdata”, followed by several hundred bytes of 0s. This is the PE header section of the program; the actual program instructions begin immediately after the section of 0s at offset 1000:



We can safely eliminate the PE header, as it would not be used as part of a virus signature. Thus, we know that the signature must be somewhere between offsets 1000 and 77FF; this can be confirmed by zeroing out all the file contents between these two addresses as we did with the second half of the file, and running a virus scan on nc.exe again:



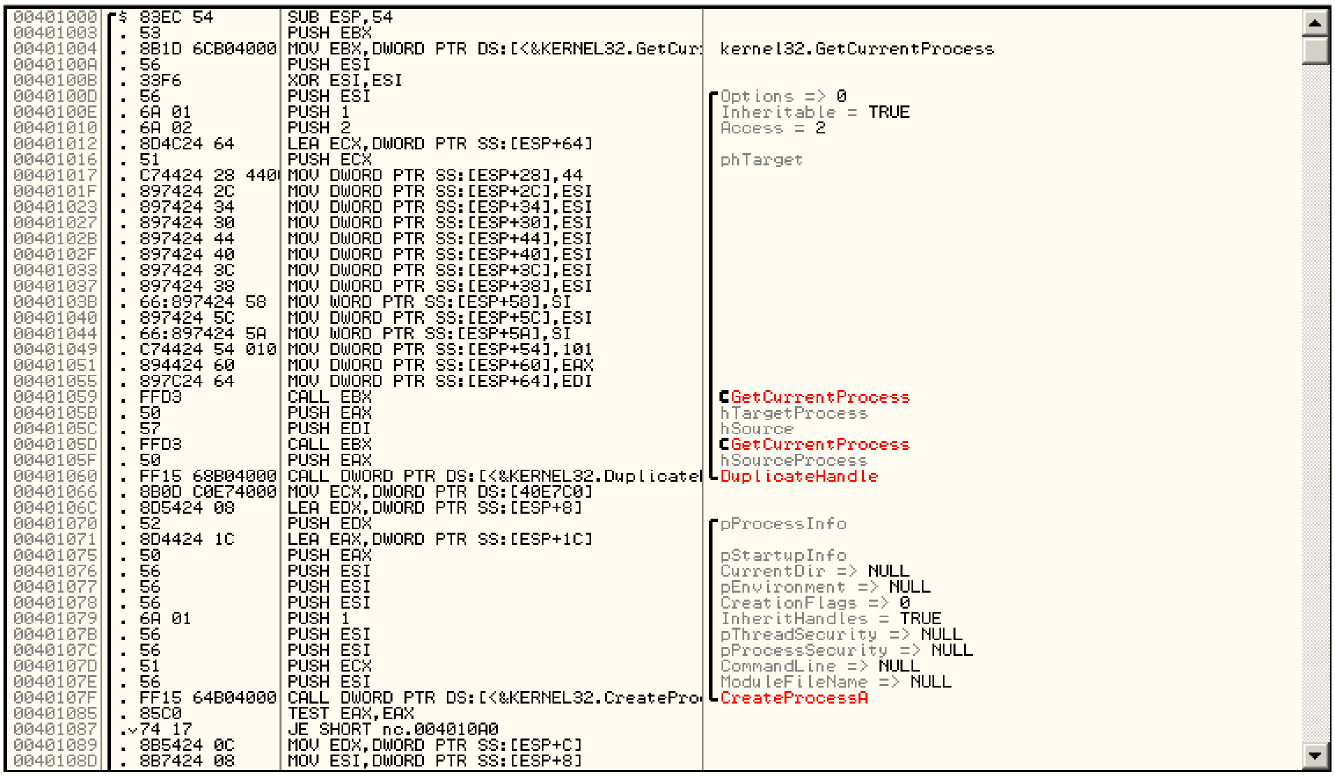
We can continue this process of elimination by systematically modifying sections of code between 1000 and 77FF and testing the resulting file against Norton. If the file is still detected as the Netcat "Hack Tool", then we know that the section that was modified was not used as part of the signature; if it is not detected, then we know that the modified section was used as part of the signature. Of course, it is important to delete the modified file after each modification and make any new changes to a copy of the original file (just as we did in the previous example), or else your results may be skewed and you will have a non-functioning program to boot. For brevity, I will simply list the sections that I zeroed out and the results that each modification had on the AV detection:

Action Taken	Result
Zero out bytes 1000 through 29FE	Not detected
Zero out bytes 1000 through 1CF7	Not detected
Zero out bytes 1734 through 1CF7	Detected
Zero out bytes 12AC through 1734	Detected
Zero out bytes 1000 through 111C	Not detected
Zero out bytes 1000 through 10CC	Not detected
Zero out byte 1130	Not detected
Zero out byte 1220	Detected
Zero out byte 120C	Detected
Zero out byte 11F8	Not detected
Zero out byte 1210	Detected
Zero out byte 120F	Detected
Zero out byte 1203	Detected
Zero out byte 1202	Detected
Zero out byte 11FE	Not detected
Zero out byte 1201	Detected
Change byte 1200 from 0 to 1	Detected
Zero out byte 11FF	Not detected <---This is the end of the signature

Now that we've found the end of the signature, we need to identify where it begins:

Action Taken	Result
Zero out byte 10B8	Not detected
Zero out byte 1040	Not detected
Zero out byte 0FFF	Detected
Zero out byte 1000	Not detected <---Beginning of the signature

As you can see, the code located between offsets 1000 and 11FF are used by Norton as a signature to uniquely identify this program as Netcat. Modifying any given byte in between these addresses will cause the signature in Norton's database to not match the code in the program. The problem is, if we modify the wrong byte, or modify it the wrong way, the program won't work anymore. The easiest way to identify where and how to change the program code is to open it up in a disassembler/debugger and analyze the resulting assembly code; for this we will use OllyDbg. Open up the original copy of nc.exe in Olly, and scroll up to the top of the code window. Notice that the code starts at offset 1000, and that the hex dump of the code located there matches the hex dump at offset 1000 in Hex Workshop. This confirms our previous assumption that this offset was the beginning of the actual program instructions:



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00401000 $ 83EC 54          SUB ESP,54
00401003 . 53               PUSH EBX
00401004 . 8B1D 6CB04000    MOV EBX,DWORD PTR DS:[<&KERNEL32.GetCur:  kernel32.GetCurrentProcess
0040100A . 56               PUSH ESI
0040100B . 33F6             XOR ESI,ESI
0040100D . 56               PUSH ESI                                  Options => 0
0040100E . 6A 01            PUSH 1                                    Inheritable = TRUE
00401010 . 6A 02            PUSH 2                                    Access = 2
00401012 . 8D4C24 64        LEA ECX,DWORD PTR SS:[ESP+64]
00401016 . 51               PUSH ECX                                  phTarget
00401017 . C74424 28 440    MOV DWORD PTR SS:[ESP+28],44
0040101F . 897424 2C        MOV DWORD PTR SS:[ESP+2C],ESI
00401023 . 897424 34        MOV DWORD PTR SS:[ESP+34],ESI
00401027 . 897424 30        MOV DWORD PTR SS:[ESP+30],ESI
0040102B . 897424 44        MOV DWORD PTR SS:[ESP+44],ESI
0040102F . 897424 40        MOV DWORD PTR SS:[ESP+40],ESI
00401033 . 897424 3C        MOV DWORD PTR SS:[ESP+3C],ESI
00401037 . 897424 38        MOV DWORD PTR SS:[ESP+38],ESI
0040103B . 66:897424 58     MOV WORD PTR SS:[ESP+58],SI
00401040 . 897424 5C        MOV DWORD PTR SS:[ESP+5C],ESI
00401044 . 66:897424 5A     MOV WORD PTR SS:[ESP+5A],SI
00401049 . C74424 54 010    MOV DWORD PTR SS:[ESP+54],101
00401051 . 894424 60        MOV DWORD PTR SS:[ESP+60],EAX
00401055 . 897C24 64        MOV DWORD PTR SS:[ESP+64],EDI
00401059 . FFD3             CALL EBX                                  GetCurrentProcess
0040105B . 50               PUSH EAX                                  hTargetProcess
0040105C . 57               PUSH EDI                                  hSource
0040105D . FFD3             CALL EBX                                  GetCurrentProcess
0040105F . 50               PUSH EAX                                  hSourceProcess
00401060 . FF15 68B04000    CALL DWORD PTR DS:[<&KERNEL32.Duplicate   DuplicateHandle
00401066 . 8B0D C0E74000    MOV ECX,DWORD PTR DS:[40E7C0]
0040106C . 8D5424 08        LEA EDX,DWORD PTR SS:[ESP+8]
00401070 . 52               PUSH EDX                                  pProcessInfo
00401071 . 8D4424 1C        LEA EAX,DWORD PTR SS:[ESP+1C]
00401075 . 50               PUSH EAX                                  pStartupInfo
00401076 . 56               PUSH ESI                                  CurrentDir => NULL
00401077 . 56               PUSH ESI                                  pEnvironment => NULL
00401078 . 56               PUSH ESI                                  CreationFlags => 0
00401079 . 6A 01            PUSH 1                                    InheritHandles = TRUE
0040107B . 56               PUSH ESI                                  pThreadSecurity => NULL
0040107C . 56               PUSH ESI                                  pProcessSecurity => NULL
0040107D . 51               PUSH ECX                                  CommandLine => NULL
0040107E . 56               PUSH ESI                                  ModuleFileName => NULL
0040107F . FF15 64B04000    CALL DWORD PTR DS:[<&KERNEL32.CreatePro   CreateProcessA
00401085 . 85C0             TEST EAX,EAX
00401087 .v74 17            JE SHORT nc.004010A0
00401089 . 8B5424 0C        MOV EDX,DWORD PTR SS:[ESP+C]
0040108D . 8B7424 08        MOV ESI,DWORD PTR SS:[ESP+8]
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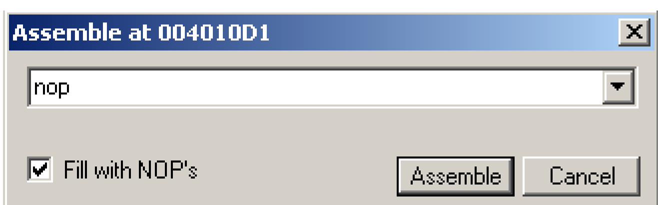
If we scroll down the code a little bit, we find a string of INT3 instructions starting at offset 10D1:

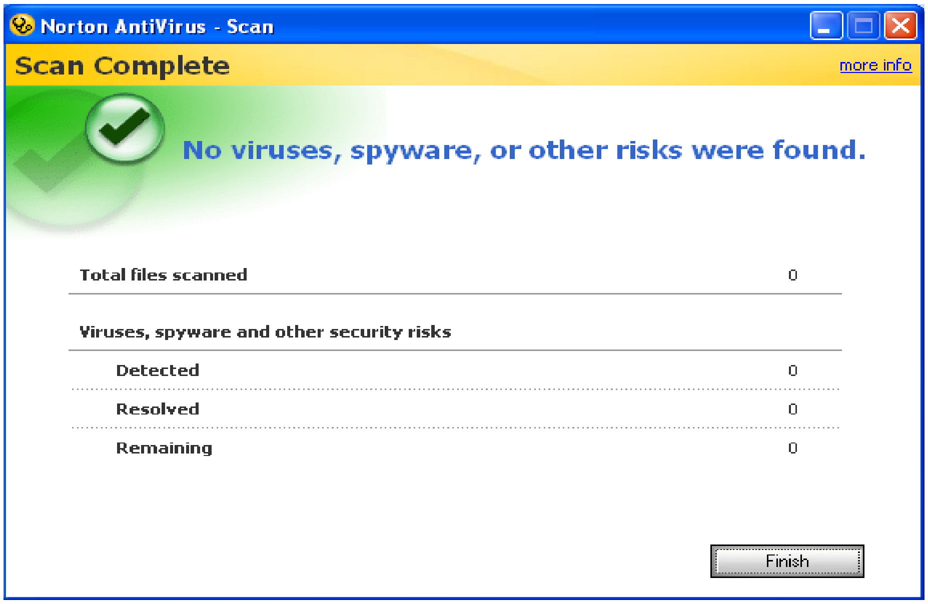
INT3 is a software interrupt that is used by debuggers to pause program execution. Since Netcat obviously doesn't pause indefinitely during execution, these bytes are just filler and can be modified without worrying about affecting the program execution flow. Additionally, they are within the signature code which we need to modify. If you are using Olly, select one of these INT3 instructions (I chose the first one at 10D1), and press the space bar. In the 'Assemble' text box that appears, enter 'nop' (no quotes) and click assemble:



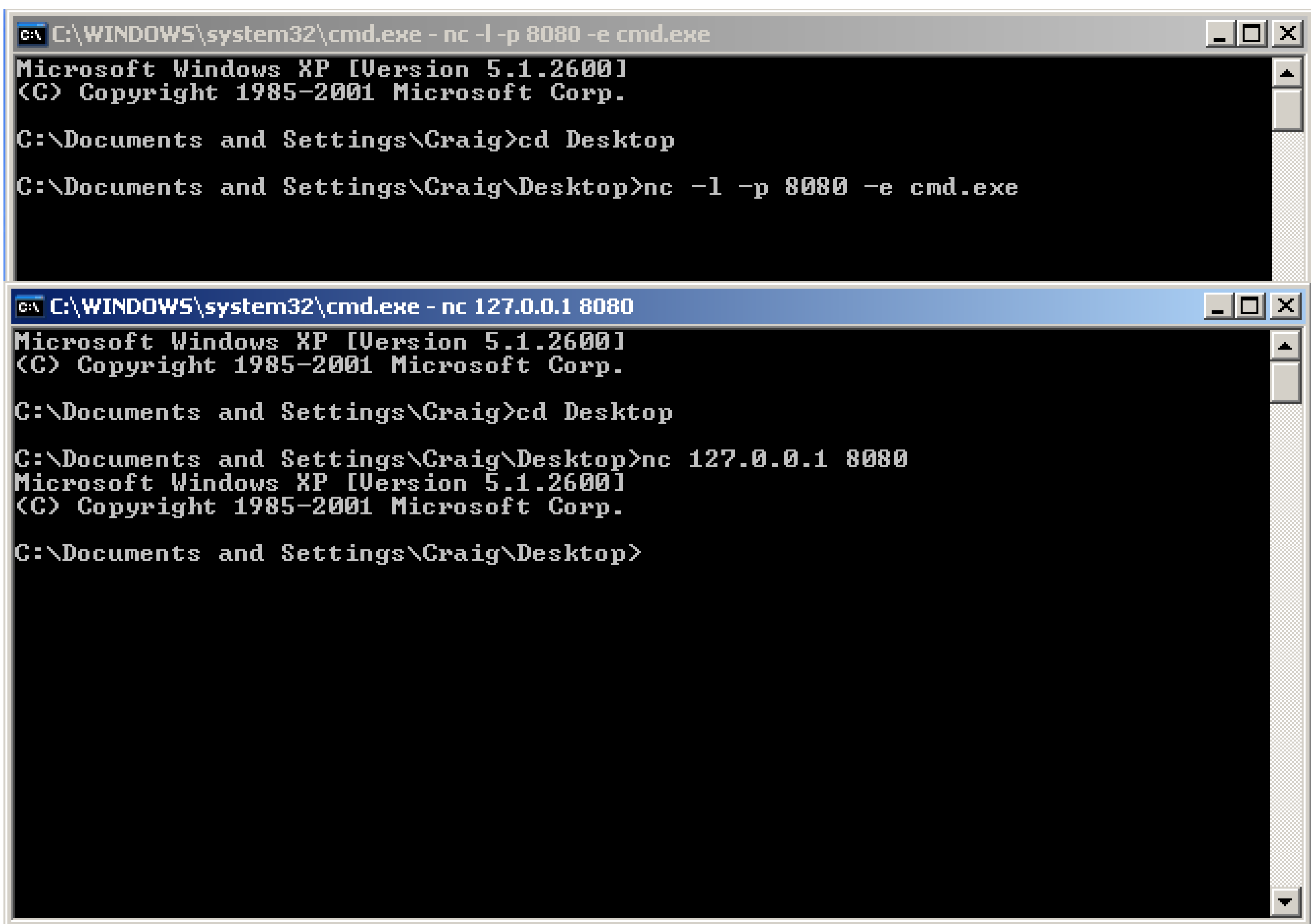
Now right click the code window, and select 'Copy to executable -> All modifications' (if prompted to “Copy selection to executable?”, select 'Copy'). Right click the new window that appears and select 'Save file', then save the program as an executable file.

If you do not have OllyDbg, you can still make the above observations and modifications. The hexadecimal equivalent of the INT3 instruction is CC and the hex equivalent of the NOP instruction is 90. Using Hex Workshop, you can go to offset 10D1 and see that the same string of INT3 instructions (they are just displayed in their hexadecimal format of 'CC'); change one of those CC's to 90 and save the changes.

The final test of course is to see if Netcat does indeed evade detection by Norton, and still functions properly. First, let's scan the file with Norton:



So far so good, now let's create one instance of Netcat to listen for connections and spawn a command shell when one is received ('nc.exe -l -p 8080 -e cmd.exe'), and a second instance of Netcat to connect to the first ('nc.exe 127.0.0.1 8080'):



Closing Thoughts

As this paper has demonstrated, it is quite simple for someone with even a rudimentary understanding of assembly code to take a potentially malicious program and modify it to bypass anti virus protection mechanisms, using nothing more than a hex editor. This is by no means a groundbreaking conclusion, and has been going on for many years. However, it is my hope that this paper has achieved at least one of three things:

1. Shown to the average user, even if they were not able to follow the paper in detail, that anti virus is not an end-all security solution, as seems to be the common belief among both consumers and vendors (or, at the very least, vendor marketing).
2. Provided, in detail, an example of how easy it is to invalidate an AV signature to those with little or no experience with binary file modification.
3. Proven to all the script kiddies who keep whining about Symantec, that unfortunately, their “133t h4x0r” days with Netcat are not over...