1. What is the paper about? What is/are the vulnerability? What causes the vulnerability?

The authors of the paper propose an automatic detection and defense against Internet worm attacks on buffer overrun, format string vulnerabilities, and other overwrite attacks. These vulnerabilities target important information such as return addresses, function pointers, or format strings on the target machine and can be used to do many malicious things from crash a program to execute harmful code.

1. What is/are the contributions of the paper? How was the vulnerability or insecurity discovered?

Existing defenses can require source code or special complication of the binaries it uses. These constraints make it impossible to use when source code is not available and inconvenient to use when a wide range of applications are in use (recompiling each application is time consuming). Fine-grained detectors can be costly and are not always deployable on every vulnerable host. Since fast filters are key to securing a host/program before the vulnerability reaches it, many existing systems use content-based signatures to pattern-match when determining if the packet payload contains a specific attack. Unfortunately, these signatures are all part of a database that is manually generated. This lends to a slow reaction time, which can be devastating in the case of a worm set to infect thousands of machines in just a few hours.

TaintCheck does not require source code or the special compilation of binaries it uses. It operates on the existing binary program, making it simple to use even on proprietary programs or programs in which no source code is available. This makes TaintCheck easy to deploy across a wide range of applications. TaintCheck also boasts that it detects format string attack and overwrite attacks targeting return address pointers, function pointers, or offsets for function pointers. There were no false positives in the experiments performed with the default policy. They claim any false positives that do appear reduced or eliminated through TaintCheck configuration.

1. The detailed techniques to solve the problem.

The TaintCheck software identifies which parts of the payload could be useful in an attack signature and performs automatic semantic analysis. At the processor-instruction level, TaintCheck monitors every byte of every attack payload is used by the vulnerable program. This analysis can be used to generate an attack signature directly instead of relying upon signatures generated from content pattern extraction. Since the semantic analysis provides information about not only the possible vulnerability, but also how the vulnerability may be exploited, less payloads would be necessary to generate an accurate signature then with content pattern extraction. This could help minimize the damage caused by a newly introduced work by catching the exploit/vulnerability much earlier and allowing defenses to be put in place to contain it.

1. What are the strength/weaknesses of the paper?

The first weakness I could see with the TaintCheck software slows server execution 1.5 to 40 times. This is not only a large range that could depend on many factors, but most programs would consider a server running at 40 times slower than normal to be unacceptable for performance standards.

The second weakness is that the TaintCheck software detects the attack at the time of use instead of the time of write. This means that the exploit could be in place and undetected for a long time before the software determines that it was designed for an attack. This puts the vulnerable system in the precarious situation where it is trying to stop an attack in progress instead of trying to prevent it from occurring in the first place.

One strength of the paper is that in their testing of the TaintCheck software they used synthetic exploits to test the programs for vulnerabilities. In this case, they could exercise threads of execution that would not normally be touched during runtime. This could help to expose possible vulnerabilities in programs before the program is delivered, released, or put into production.

Another strength is using TaintCheck in conjunction with a honeypots. A honeypot is a way of drawing in potential attackers and therefore useful in detecting new attacks. Using the TaintCheck software to monitor the honeypot network activity and verify whether the requests are exploits can provide valuable information about detected attacks. This information can be used to help protect the system against specific attackers wishing to gain access to perform malicious activity.

1. What can you do better?

One improvement to TaintCheck would be to share any the signatures generated between programs. This would help other programs detect the attack and keep other vulnerable programs or systems from being infected in the first place.

In addition, the paper also mentions how TaintCheck could be used in conjunction with other programs such as Program Shepherding. If the TaintCheck software could share its analysis and/or generated signatures with other programs that can prevent attacks, this could vastly improve both programs ability to detect and protect systems from attacks.