You Can Type, but You Can't Hide: A Stealthy GPU-based Keylogger

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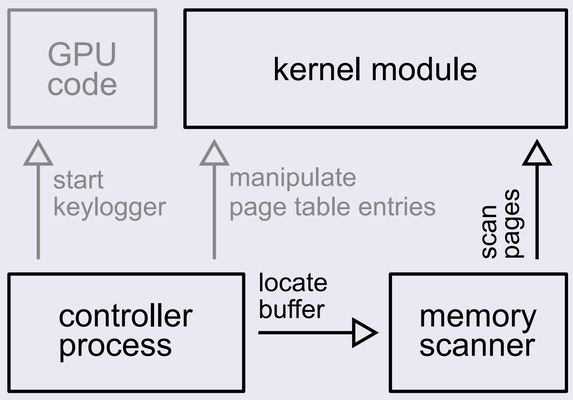
Motivation

- How can we hide malicious code from anti-virus and -malware software?
- Can we leverage the GPU to build stealthier malware?

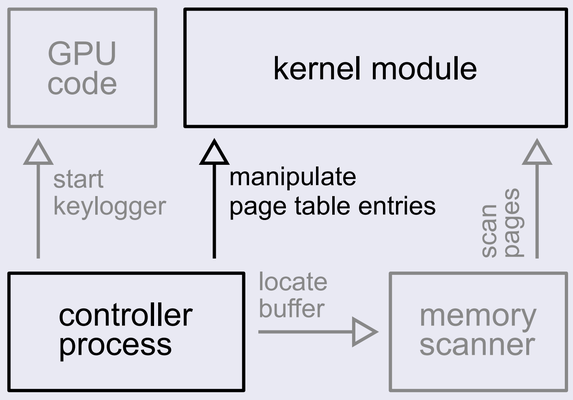
Approach Step by Step

1



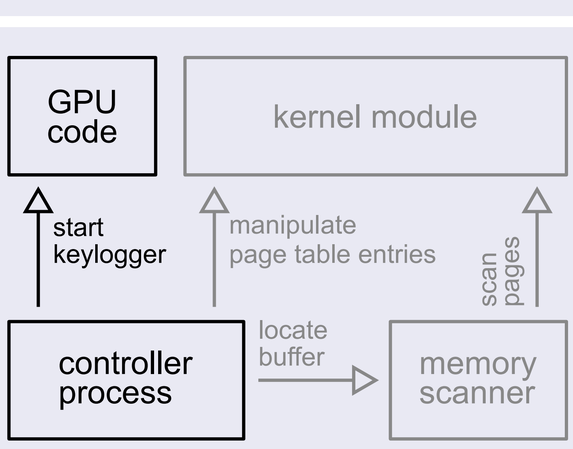
- Scan kernel memory to locate the keyboard buffer
  - Heuristics based on [3]

2



- Map the memory page of the buffer to user space
- Create a device mapping to its physical address using the CUDA API
- Unmap the memory in order to leave no traces
  - All further host accesses result in a segfault

3

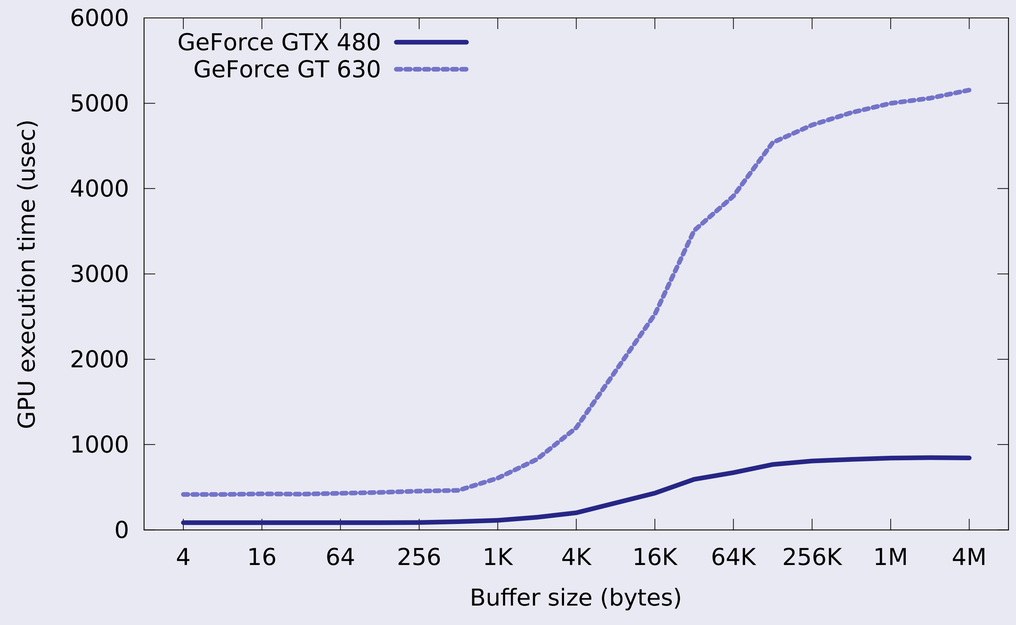


- Periodically spawn a GPU thread that reads the buffer and saves scan codes on device memory as ASCII characters
- Once the log is "big enough" do some computation

Countermeasures

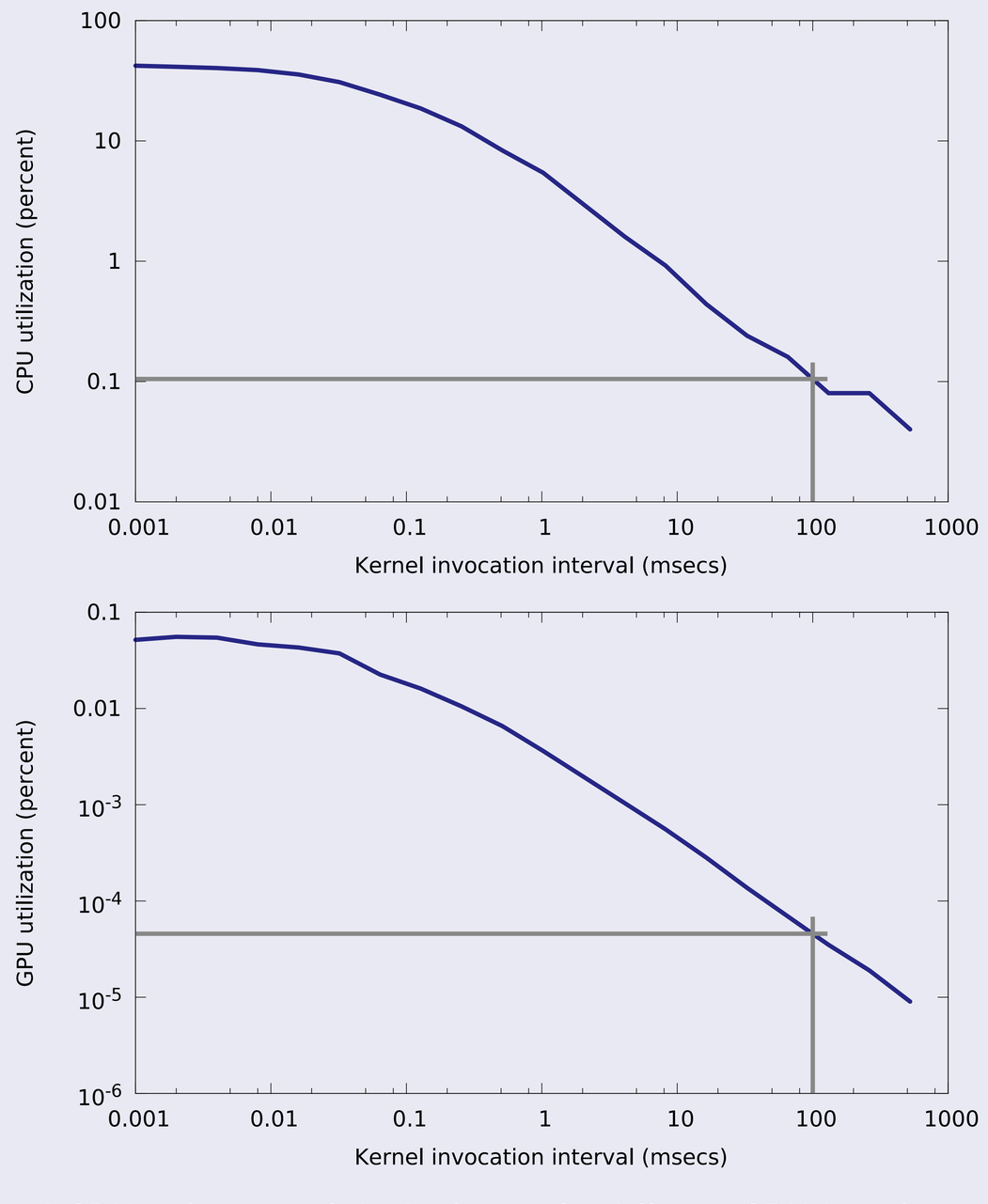
- Manual code analysis
  - Since CUDA version 5.0, `cuda-gdb` can attach to a running process, and inspect the state of the GPU at any point
- Monitor GPU access patterns to detect repeated DMAs between host and device memory
- Profile the GPU utilization

Grep Credit Card Numbers



Execution times for low-end (GT 630) and high-end (GTX 480) graphics cards, when extracting credit card numbers using regular expressions [4] for different captured data sizes.

Runtime Overhead



CPU and GPU utilization of the keylogger for different GPU kernel invocation intervals. Typically, the duration of a single keypress varies from 100 ms for faster typists, to over one second for slower typists [1].

Limitations and Future Work

- ✘ Requires a CPU process to control its execution
- ✔ An attacker can hide the CPU component by injecting its code into the address space of an existing benign process
- Figuring out a way to continue executing on the GPU without the presence of a host context is part of future work

- ✘ Administrative privileges are needed for initializing the environment
- ✔ The kernel module is completely removed afterwards
- ✔ Does not need to hook any code or manipulate any data structures for hiding its presence

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