Distributed Forensics and Incident Response in the Enterprise

By

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Distributed Forensics and Incident Response in the Enterprise

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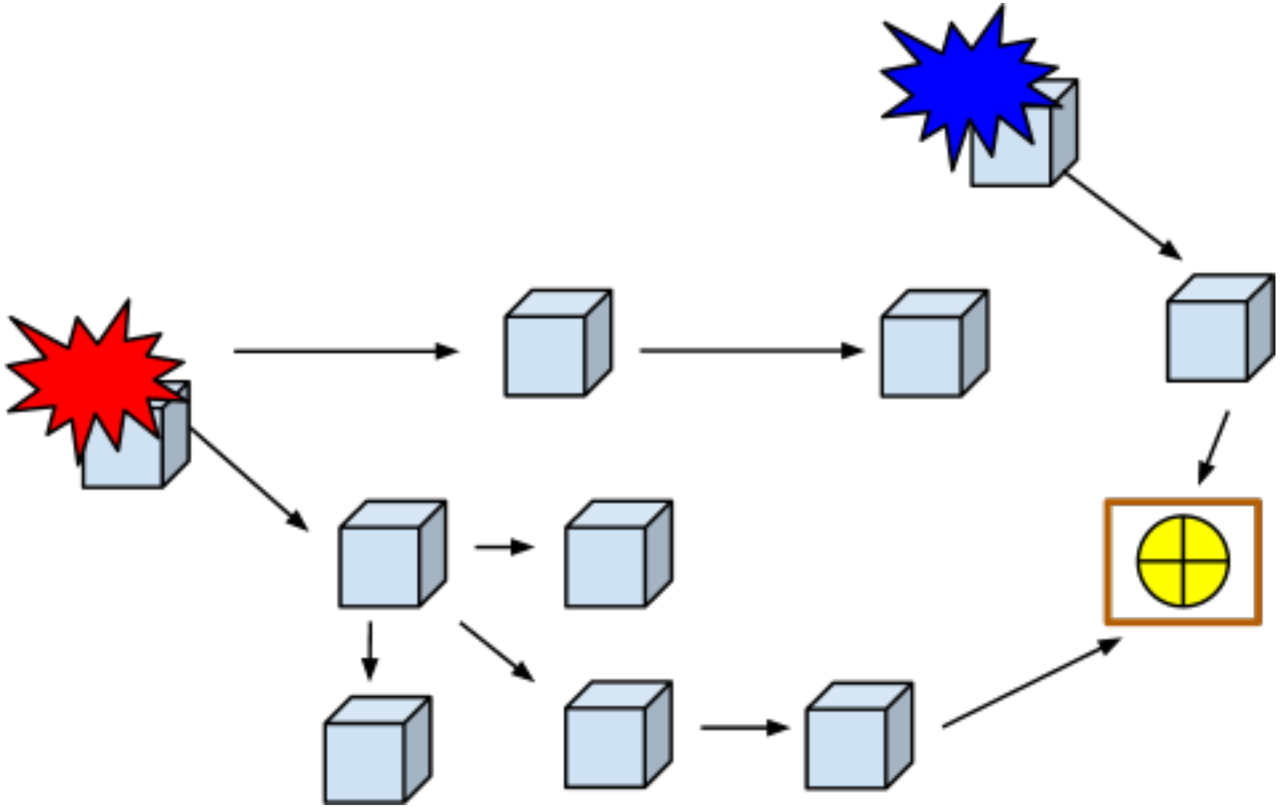
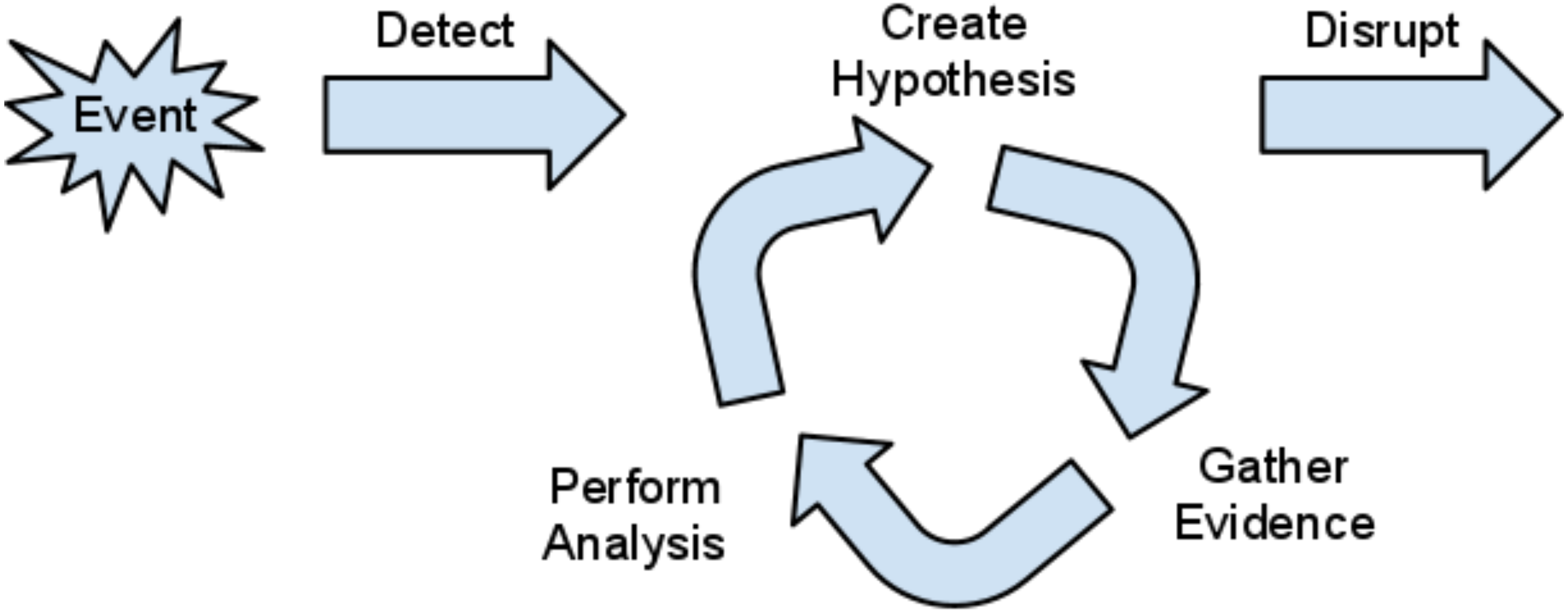
Investigation Goals

- What is the scope of the incident?
- What occurred on our systems/network?
- What was the entry point ?



The Response Cycle



- Hypothesize, Gather, Analyze
- Your time to execute the cycle determines your success in complex incidents
- Tools must reduce the duration of the cycle

The Challenges

- Distributed offices / timezones
- Scalability 2, 200, 20'000 machines
- System diversity
- Roaming / travelling users
- Limited number of skilled responders
- Intelligent attackers

Live Response - GRR

Incident Response is a Search Problem!

- You need an agent on the host
- You need to be able to access it over the Internet
- You need a system that scales
- You need to automate response

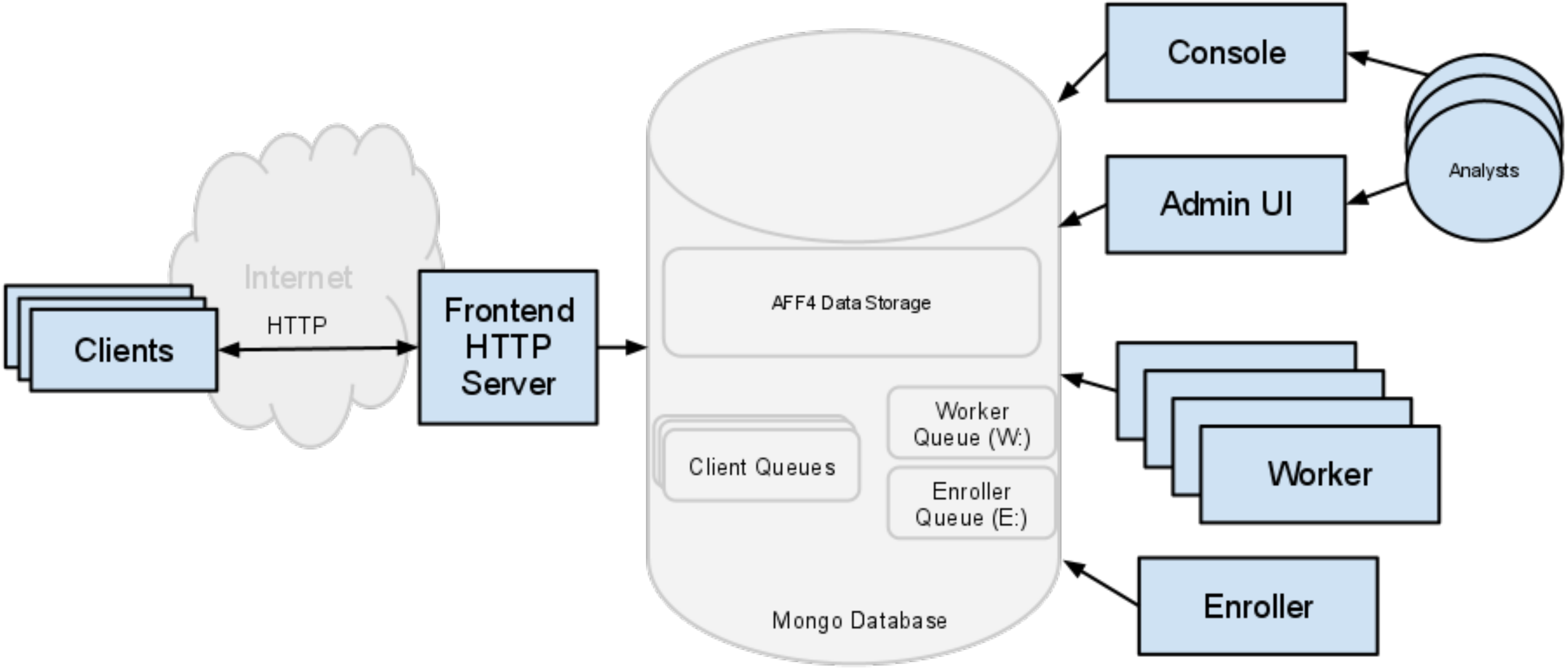
Wishlist:
"Find me any machine that has a wiped event log in the last 10 hours"
"Find me all machines with a driver signed by Realtek in % SYSTEMDIR% that contain the string "labarumY"

Not as easy as it sounds

- Scaleable processing (1000's of machines)
- Data model
- Subverting live forensics
- Unreliable client connections
- Intelligent automation

- Security (Discussed in the paper)
- Privacy (Discussed in the paper)
- ...

GRR Overview



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Scaleable Processing

- Traditional forensic model 1:1 server -> client won't scale
  - Need to move some work to the client
  - More workers to scale analysis
  - Messaging protocol and queueing
  - Client maybe offline
    - Offline analysis
    - Evidence collection scheduling
  - Suspendable flows - no resources used on server when client is not available.

- Large quantities of data:
  - Sharded database
  - Map Reduce

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Data Model

- GRR deals with a lot of data in a uniform way
    - Many hosts we want to access
    - Partial information about each host
    - Billions of objects

- This model is suitable for AFF4
    - AFF4 - one universal data model
    - Object Oriented
    - A way of organizing forensic information
    - Based on RDF or NoSQL models:
        - All objects have a unique ID (AFF4 URN).
        - Objects can be sharded across many servers
        - RDF allows cross referencing

Data Model: AFF4 Objects Examples

aff4:/C.91dcaaa12616af24

aff4:/C.91dcaaa12616af24/fs/os/c/Windows/
...Prefetch/DEFRAG.EXE-273F131E.pf

aff4:/C.91dcaaa34616af24/registry/
...HKEY_LOCAL_MACHINE/SOFTWARE/pidgin/Version

aff4:/C.91dcaaa34616af24/dev/PhysicalDrive0/2048
.../Windows/system32/Config/SOFTWARE/pidgin/Version

aff4:/C.91dcaaa34616af24/processes/1182/exe

Data Model: AFF4 Attributes

aff4:/C.91dcaaa12616af24 aff4:hostname "foobar"

aff4:/C.91dcaaa12616af24 aff4:os_version "5.1.2600"

Data Model: AFF4 Extensions

- □Original AFF4 specifications were aimed at storing static forensic data in a forensic volume.
    - We do not need to create a AFF4 storage, but we use the AFF4 data model within the RDF data store

- Data is dynamic - a directory listing today is not the same as the same directory listing in the future.
    - All attributes now have an Age:
        - We still retain all the data, but sort by age
        - Incoherency is inherent in the entire system and must guide our reasoning
    - Age of data is important for historical diffs

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Subverting Live Forensics

- We can never fully protect the agent from subversion

- We can make it harder for the attacker:
  - Agent has multiple ways to access the same forensic data, e.g. through the APIs, forensic analysis of raw devices.

- What can an attacker do with our agent?
  - Hook OS APIs
  - Hook raw disk access
  - Replace our agent with one which reports "All is well"
  - Intercept and replay communications

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Unreliable Client Connections

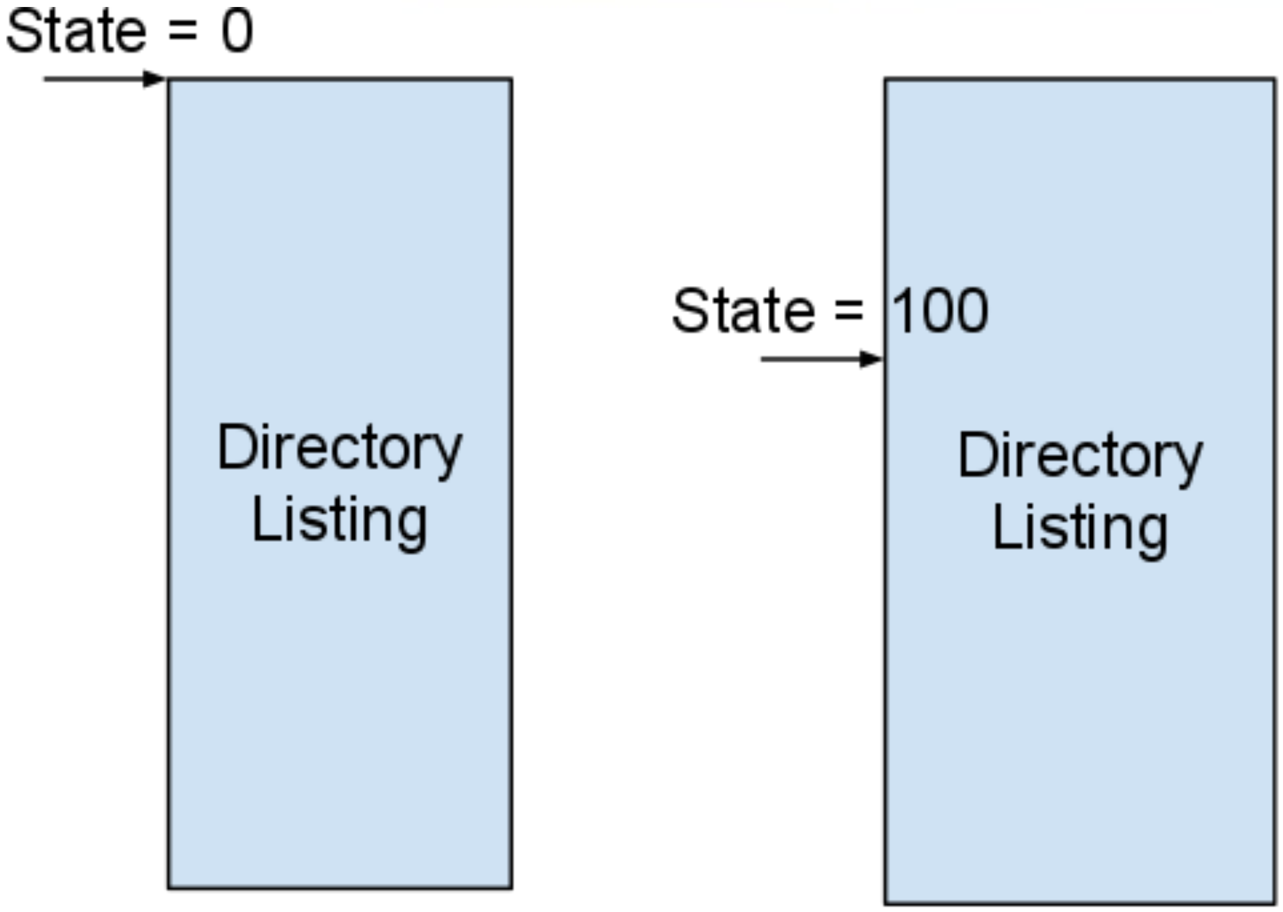
- Client keeps very little state
  - Small footprint
  - Simplicity

- Some actions take a long time
  - e.g. Search the entire filesystem

- Big problem when machines disappear

- Solution: Iterated Flows
  - Client actions maintain internal state in a data structure
  - Data structure is periodically returned to the server flow
  - Automatic checkpoints progress

Example: Iterated Grep



Request 1: Search directory for signature, start at first file. Only search first 100 files.

Request 2: Search directory for signature, start at 100'th file.

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Intelligent Automation

- Automating analysis can help to reduce response time, and increase fleet coverage.
    - There is a *Foreman* flow which all clients call to periodically.
    - The Foreman distributes jobs to each client depending on certain criteria. For example:
        - All Windows 7 machines from a certain department run flow "CheckForBadMalware".
        - All systems with a running service named "srv.exe", retrieve their memory image.
- Automation can be initiated from other systems such as Security Event Manager (SEM) or Intrusion Detection System (IDS)

What We Have So Far

- Proof of Concept code
- Open Source Apache Licensed

- Basic automated analysis e.g. Get Browser History
- File system raw read e.g. $MFT, deleted files
- Memory retrieval on Windows
- Web UI
- Windows, OSX, Linux clients

- Protobufs for serialization
- MongoDB NOSQL database backed
- Python + libraries
- Sleuthkit, PyTSK
- OpenSSL for encryption

Future Work

- Extend automated analysis
- We have great tools but no way to apply them against remote systems.
    - GRR is a framework to extend analysis to remote systems

- Extend existing tools to the enterprise:
    - volatility
    - regripper
    - log2timeline

- Privacy controls

Questions?

http://code.google.com/p/grr

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