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About matasano

- An Indie Product and Services Security Firm: Founded Q1'05, Chicago and NYC.
- Research:
  - Hardware Virtualized Root-Kits
  - Endpoint Agent vulnerabilities
  - Windows Vista (on contract to msft)
  - Firefox (on contract to Mozilla)
  - Storage Area Networks (broke Netapp)
  - A Protocol debugger
  - 40+ pending advisories

The Problem of Info Leaks

- Privacy Rights Clearinghouse** cites more than 150 million personal records leaked in incidents between 2005-2007.
- Unintentional leakage
  - Boston.com employees wrap newspapers with paper found in recycling bin. Papers contained customer records.
- Data theft
  - July 5th 2007: A senior database administrator at payment firm Certegy Check Services secretly copies 2.3 million records containing bank-account and credit-card information and sold it to marketing firms

- ** Much more at:
- http://www.privacyrights.org/ar/ChronDataBreaches.htm

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Goals of Extrusion Detection

- Identify sensitive data and stop it from leaving the enterprise.
- Implement monitors between enterprise workstations and the “outside world”.
- Gather forensic data associated with alerts.
- May block illegal transactions based on alerts to achieve “prevention”.
- Be secure and resistant to attack, evasion, and tampering.

Types of E-D Solutions

- Network Based Solutions
  - Think NIDS in reverse
  - Worst case: tcpdump | strings | grep
  - Best case: Wireshark | file_format_decoder | grep
  - Force Multiplier
  - Not effective against workstation -> external storage
- Agent Based
  - Think HIDS in reverse
  - Monitoring agents on each workstation
  - Some products wear the policy enforcement hat
  - Local I/O as well as network traffic
- Hybrids
  - Combines elements of Network and Agent based solutions to "leverage the strengths of each" (and expose you to problems of both).

Why We're Here

- We reversed and audited (4-8) DLP products
  - Commercially released
  - Mainstream, market-leading
  - Mostly endpoint-based
- We found "tens" of vulnerabilities
  - No product emerged completely unscathed

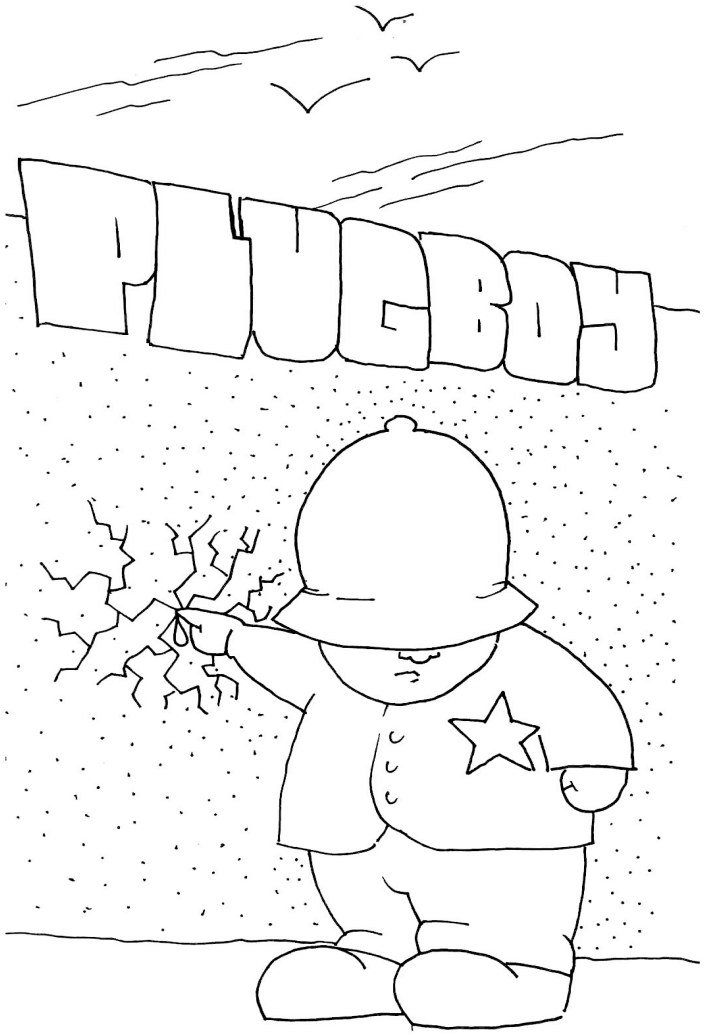
What We Found

- Not evasion attacks
  - Take evasion as a given. All of these systems can be evaded
  - Like the IDS problem, but the target is you
- Real Vulnerabilities:
  - Compromise of sensitive information
  - Agent takeover attacks
  - Management console takeover
- Installing a bad ED product can be like:
  - Installing a latent botnet on your network
  - Creating an open file share with your most sensitive information in it

What We Can Tell You

- www.matasano.com/log/mtso/ethics
  - Can't disclose vulnerabilities that don't have patches
  - Can't violate NDAs
- Rationalize: you don't care about the specifics
  - You haven't operationalized these products yet
  - The individual vulnerabilities will get fixed
- We want you to know what questions to ask your vendor before you deploy a data loss prevention botnet file share
- So we did something a little different:

Introducing: PlugBoy



- PlugBoy 0.6.6.6
- “Cutting-Edge” imaginary Extrusion Detection from the minds at Matasano
- Agent-Based Extrusion Detection Solution
- Plug your leaky information dyke…. TODAY

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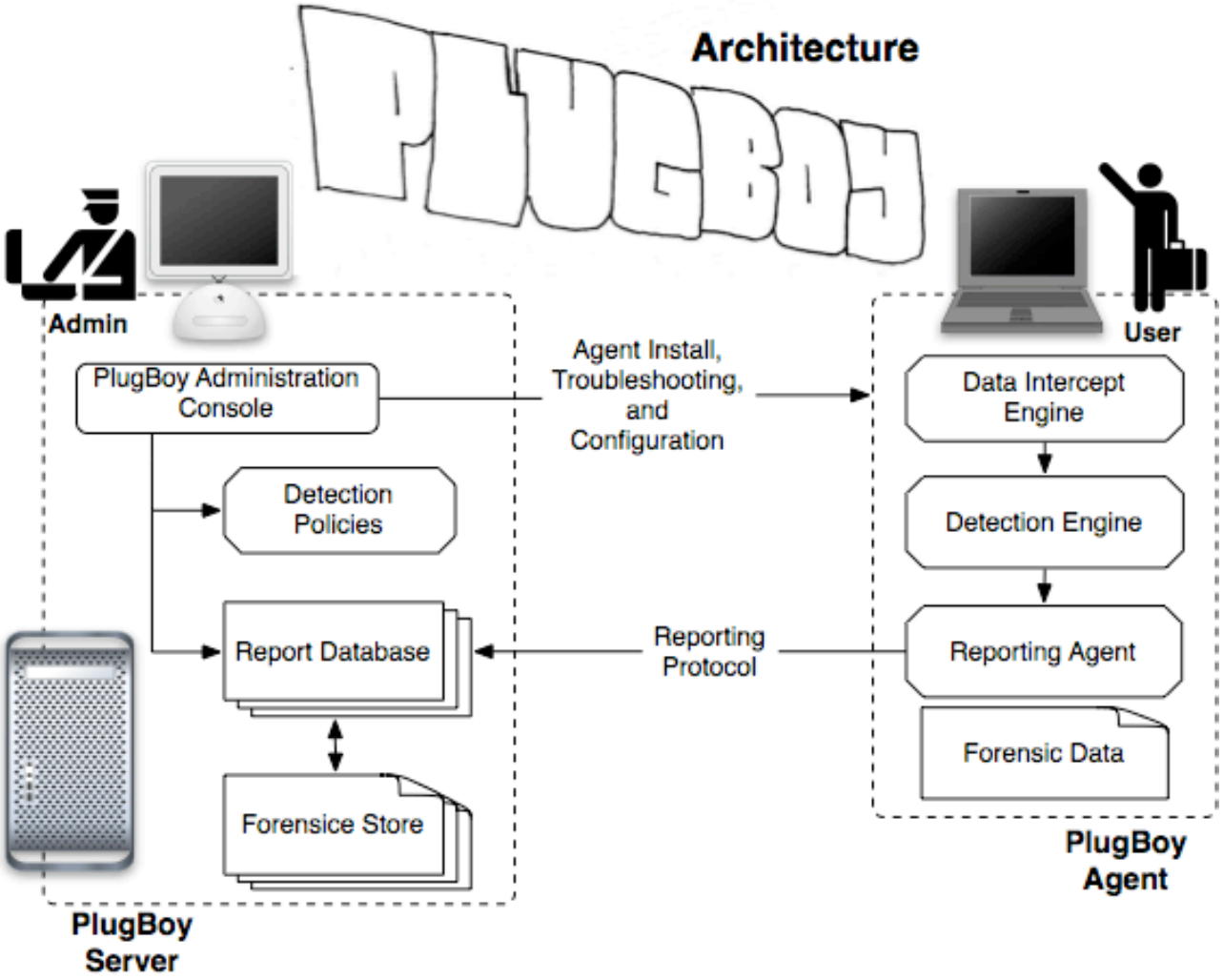
PlugBoy: Our Made Up ED System



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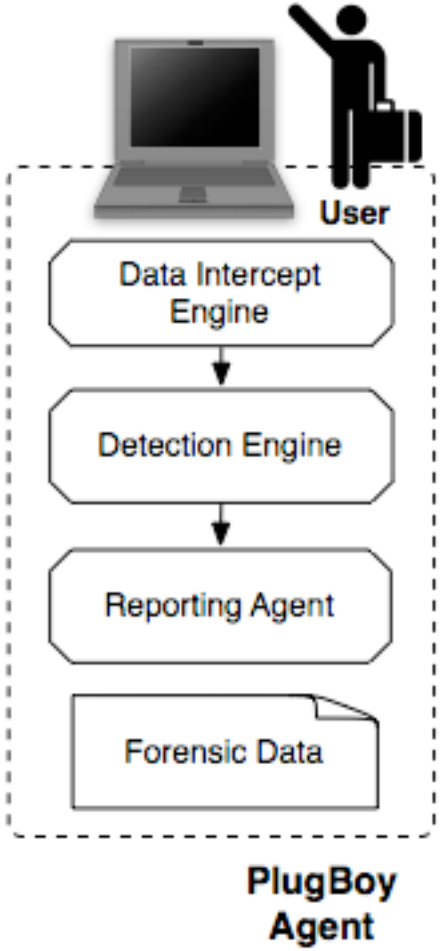
PlugBoy Agent

- Installed on every workstation.
- Responsible for:
  - Data interception
  - Extrusion Detection
  - Reporting.
  - Can wear the IPS hat - blocking extrusion
- Catches forensic data included in alerts



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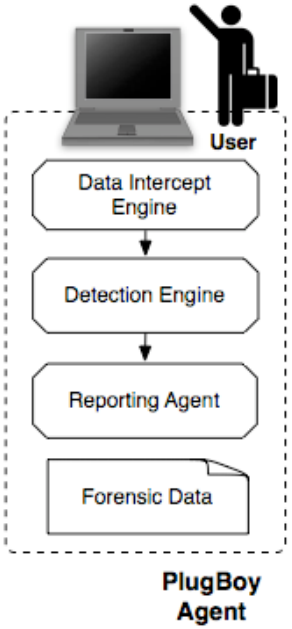
Agent Security Issues

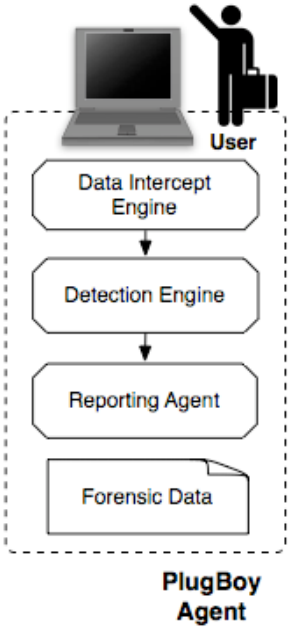
- Agents Are Scary.
  - Common-codebase/common-binary
  - Homogenous installs on thousands of machines
  - Complex communication patterns
    - Agent-server
    - Server-agent
    - “Push” v Pull
  - Sensitive functionality
    - Software update
    - OS queries



- DLP Agents Are Scarier
  - You can’t ask Windows to feed you credit card numbers; you have to hack the kernel to do it.
  - Every bug in kernel code is ring-0 game over. Worse than losing “Administrator”.

Agent Questions

- How much of the agent is in-kernel?
- How does the server talk to the agent?
- Can the server update the agent's software?
- Do the agents broadcast their presence?



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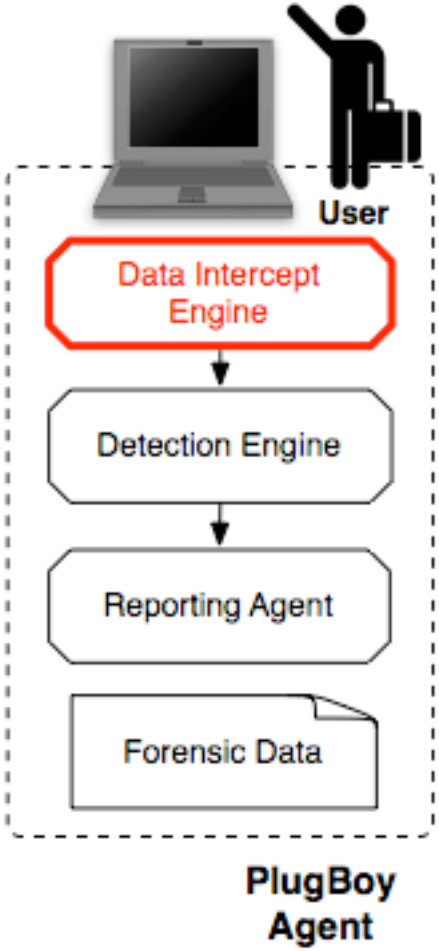
PlugBoy Data Intercept Engine

- Monitors and intercepts I/O
  - Network, USB, peripherals, files, clipboard, screenshots, etc.
- Decodes file formats and network protocols.
- Passes content to Detection Engine
- May also block extrusion based on Detection Engine
  - Think IPS vs. IDS



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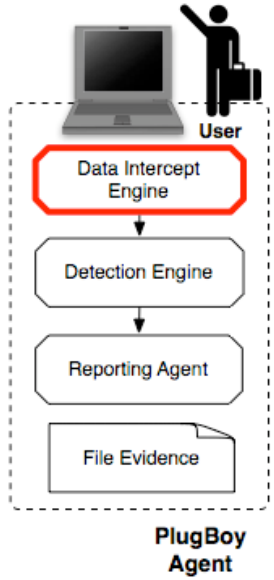
PlugBoy Data Intercept Vulnerability

- Decodes AIM/OSCAR protocol in kernel
- FLAP/SNAC headers with bogus length: integer overflow.
- Anyone who can create a direct IM session with a machine running the agent owns the kernel.
- Any software installed on the machine can bust the kernel by making fake IM connections.



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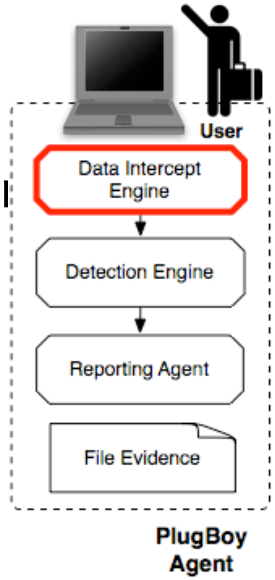
Data Intercept Questions

- What file formats do you handle?
  - To what depth?
  - Just regexing streams? Trivially evadable even by uninitiated.
  - Full parse? Good luck with integer overflows.
- Are file formats parsed in-kernel? Which ones?
- What archive formats do you unpack?
  - What are the *specific version numbers* of the unpacking libraries you use: *extremely common vulnerability!*
- Do you install browser "helpers" that can monitor data inside SSL sessions?
  - Does your chain of custody from that point on comply with HIPAA?
- What protocols do you parse?
  - To what depth?
- Where do you intercept network traffic?

Data Intercept Evasion

- Encryption
  - ED may even want you to hobble your enterprise encryption standards. (hint: Don't tell your SOX/PCI/COBIT auditors)
- Conversion, compression, archiving
  - UUENCODE, Base64, EBCDIC, ZIP, ARC, LHARC, DMG
  - Roll your own format with extra sneaky sauce.
- Format mangling
  - What will the parser do with a mangled word doc?
- Combine and Nest
  - "Something" is bound to break.



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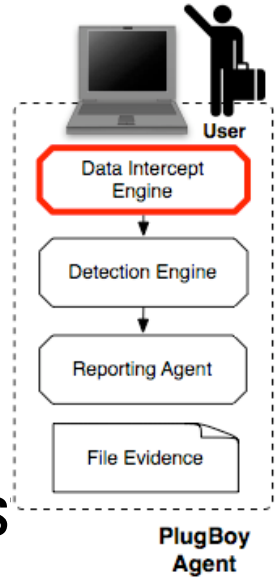
Data Intercept Questions

- E-D and Encryption Are At Odds
  - There is no good way for E-D systems to “look inside” of PGP.
  - If not, how does PlugBoy handle keys, pass-phrases, and cleartext?
- What file formats the PlugBoy engine unders
  - Can it handle N-number nested formats?
    - Mixed?
  - How well tested are PlugBoy’s parsing routines?



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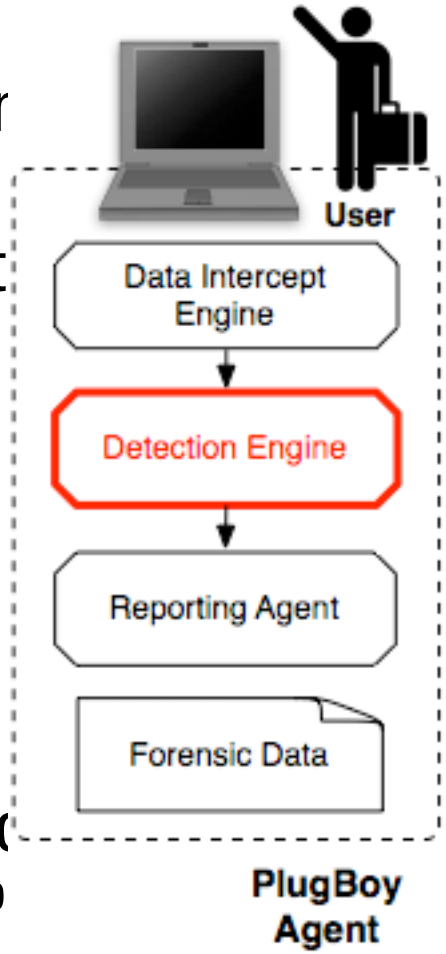
PlugBoy Detection Engine

- Receives data from the Intercept Engir
- Scans data against known REGEX patt sensitive data.
  - Example: SSN's look like…
    - \d{3}[-]?\d{2}[-]?\d{4}
  - … which matches …
    - "123-45-6789",
    - "321 54 9876",
    - or "987654321"
- On match, sends Extrusion alert with fo
  - False positives are a big problem. Patterns must b and specificity.



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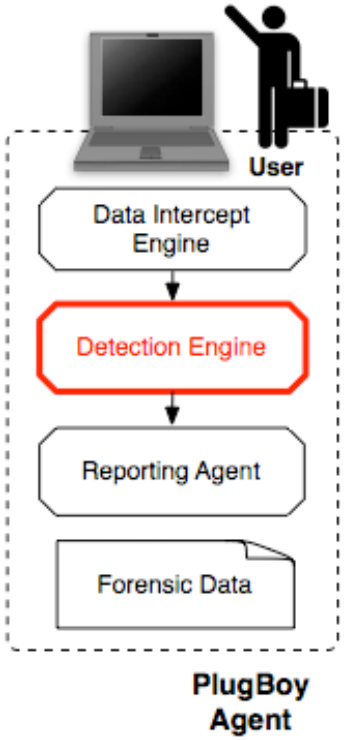
PlugBoy Detection Evasion

- Evasion is trivial
  - Attacker controls both origination and destination.
  - Possibilities are endless. Unlike IDS evasion, your targ
- Use encryption
  - Probably don't even need "good" encryption.
- Or just absurdly simple obfuscation.
  - Search and replace every digit uniquely. Reverse on the receiver.
- Add stego to really mess with ED.
  - How many SSNs can you fit in a GIF?
- Add fragmentation if you wear tinfoil
  - (or just for kicks).



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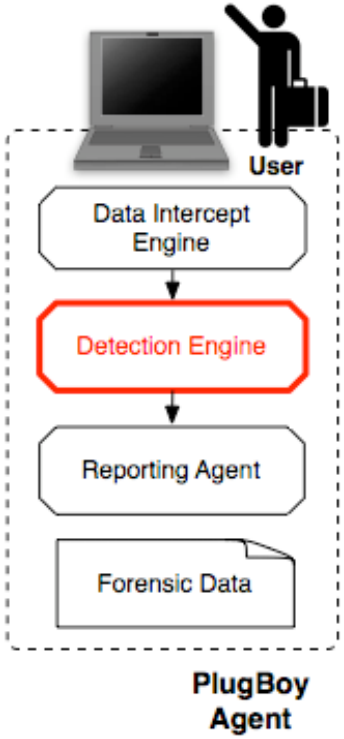
Detection Questions

- How customizable is the pattern matching?
  - Can you at least see the rules under the hood?
  - Can you add rules?
- What pattern matching engine is used? (EBNF, PCRE, GLOB, etc.)
  - Does your pattern matching syntax offer you enough granularity and flexibility (like PCRE)?
  - Will the engine crack under high load?



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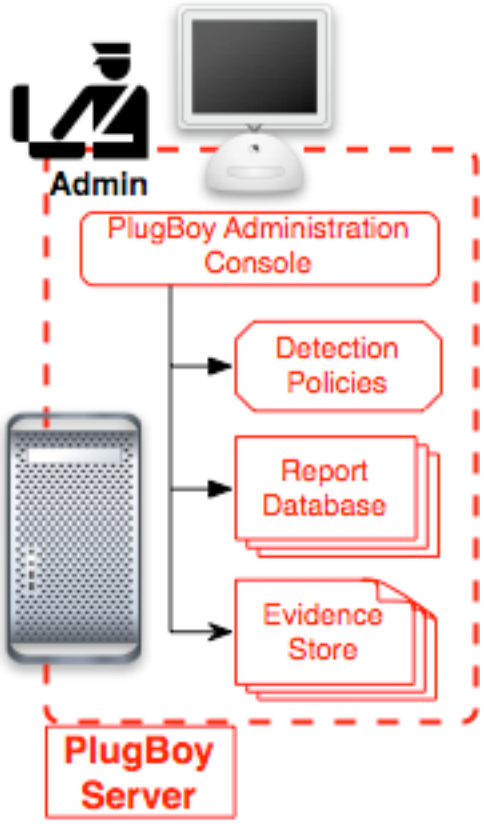
PlugBoy Server

- Server initiates to agent
  - Heartbeat monitoring
- Pushes configuration changes
- Agent software push



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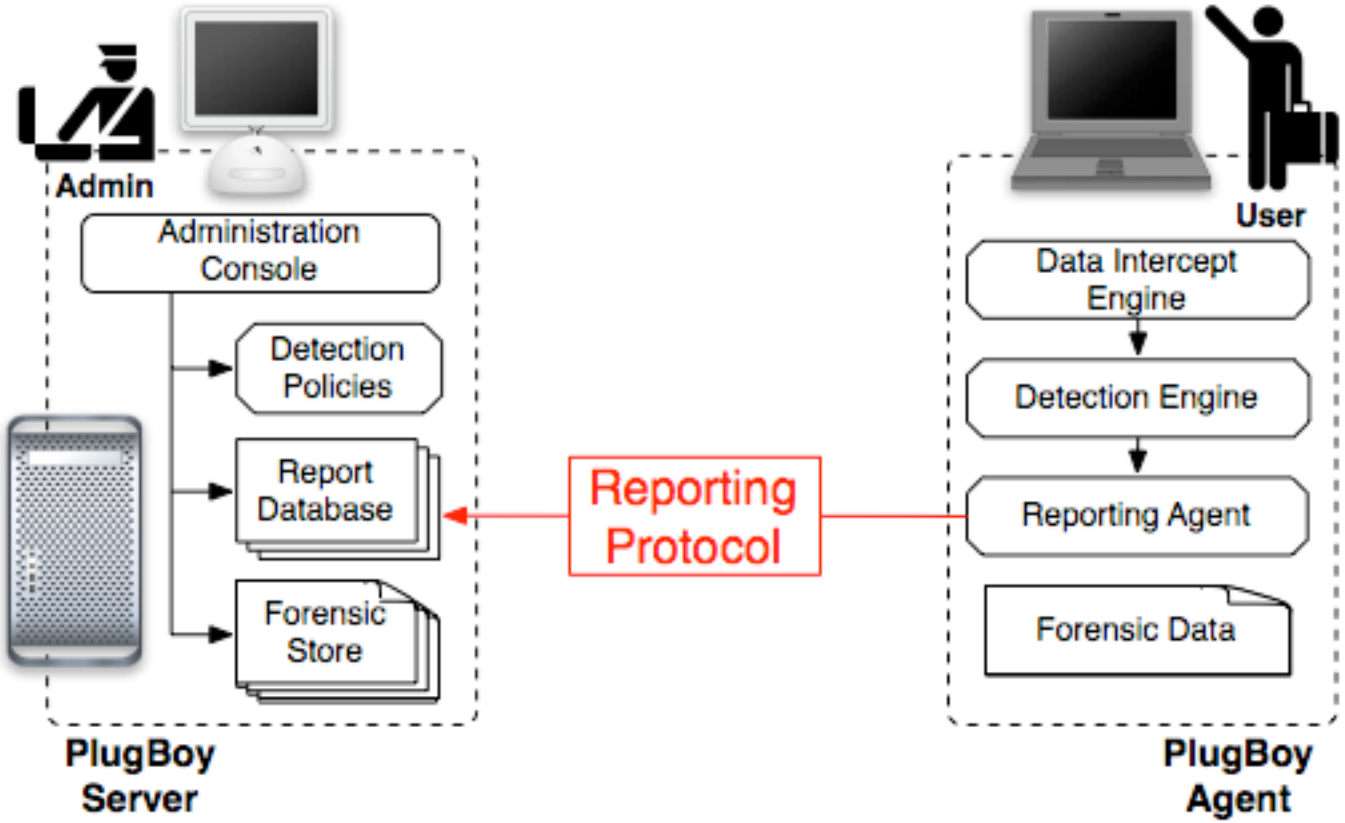
PlugBoy Reporting Protocol



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How PlugBoy Reporting Works

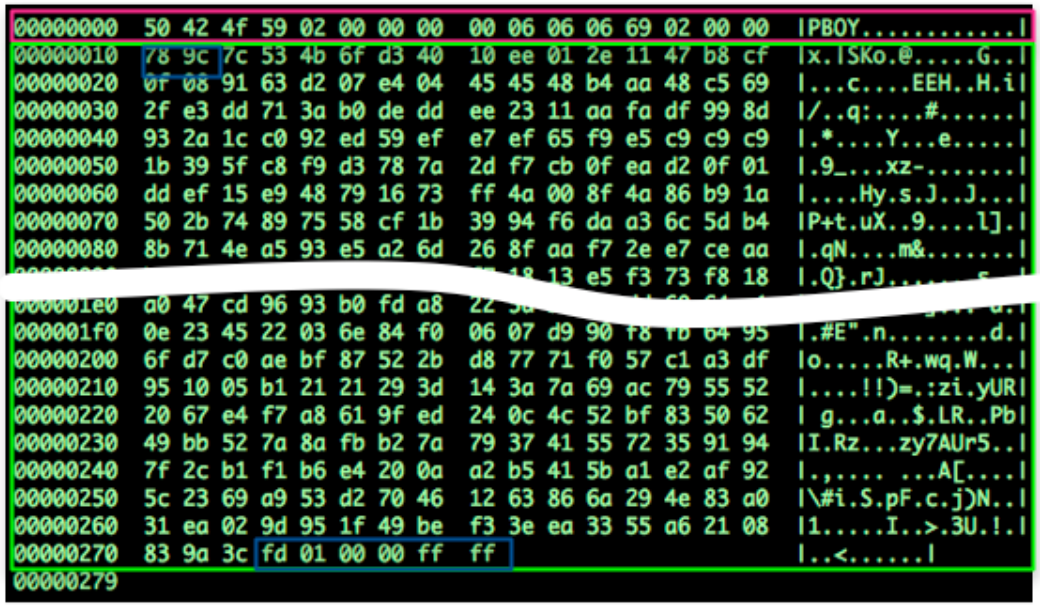
- Agent initiates to Server
  - Not authenticated
- Uses a proprietary message protocol
  - Binary format with alert/event information fields
  - Consists of header, then data segment
  - Data Segment Compressed with ZLib
  - Base64 Encoded
- Event types include:
  - Heartbeats
  - Administrative activity logs
  - Extrusion Incident
  - Extrusion Forensic Updates

Protocol Reversing

- Sniffing and a hex editor reveals all!
- 90% Educated guessing/Trial and error
- Scripting language of choice for protocol implementation and attacks
- Blackbag for prototyping and attacks at the network

PlugBoy's Raw Reporting Frames

- Raw Message - Extrusion Alert
- (b64_decoded)
- Msg Header:
  - PBOY msg name
  - Msg type: 2 (0x000002)
  - Version 0.6.6.6
  - Data length: 129 (0x000081)
- Msg data ???
  - ZLib header and adler32 tail




```
#!/usr/bin/env ruby
require 'zlib'
zs = Zlib::Inflate.new
buf = STDIN.read
STDOUT.write( zs.inflate( buf ) )
```

Some quick ruby to try ZLib:

Or use blackbag's "deezee"

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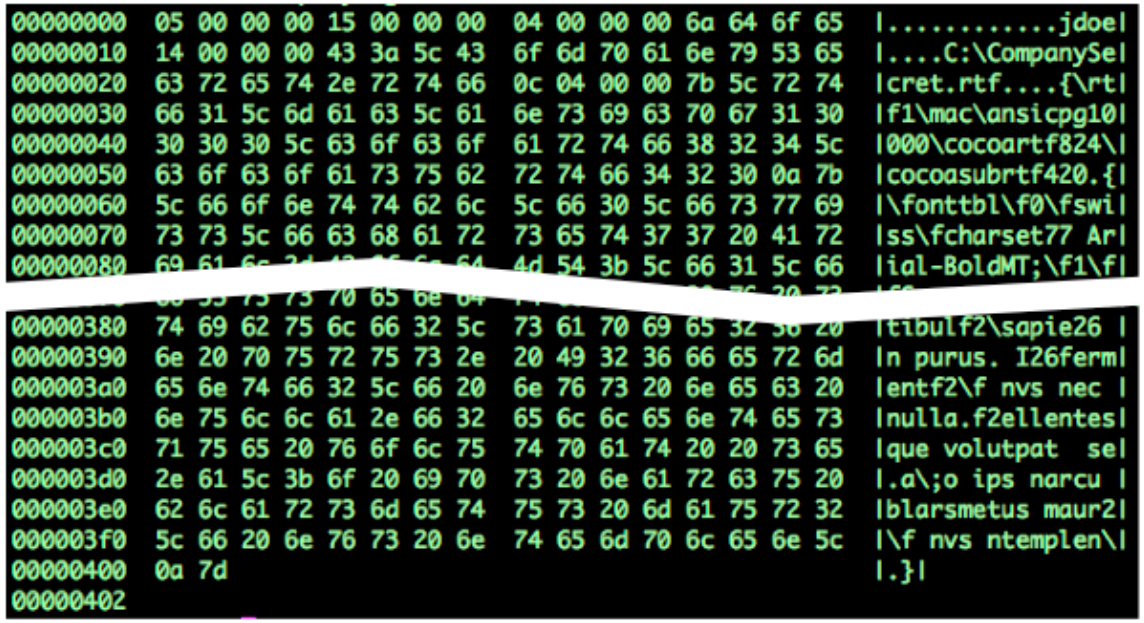
Reporting Frame In the Clear

- With the extracted protocol, we can see and modify content
- Transmit forged alerts with BlackBag (or socat/netcat/etc.)



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PlugBoy Reporting Vulnerabilities

- “Being an agent” lets you:
  - Generate arbitrary events (malicious ones)
  - Ends up in SQL without authentication: Injection
- No authentication
- No encryption

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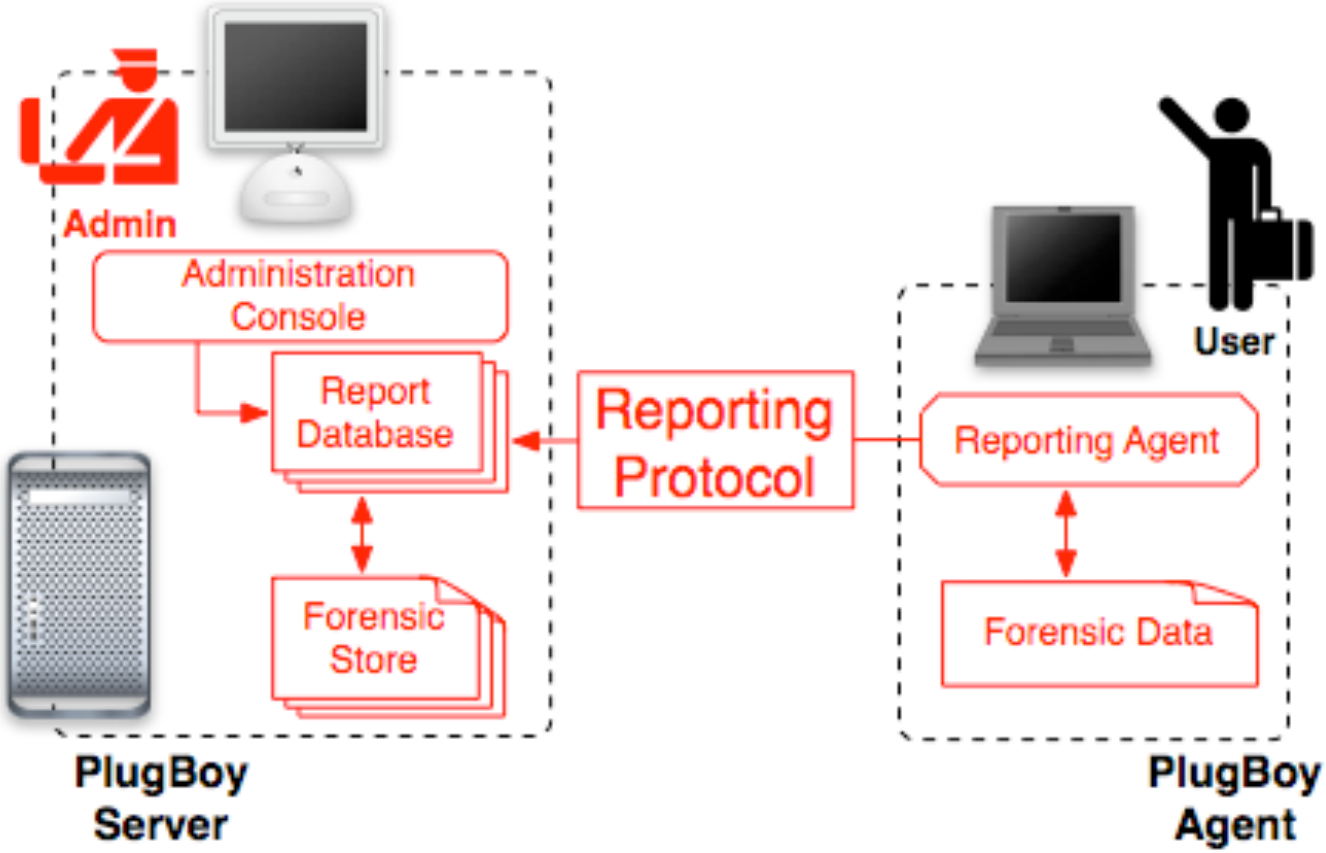
Reporting Protocol Questions

- How is the protocol authenticated?
  - None by design?
  - Windows Domain Credentials?
  - Windows MACHINE Credentials?
  - Public Key
  - SSL
- Is the protocol encrypted?
  - Yes?
    - How are keys handled?
    - Hard-coded keys?
  - Or just obfuscated?
- What operations does the protocol support?
  -

PlugBoy Forensics Storage



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How PlugBoy Forensics Works

- Detailed logs associated with alerts by ID.
- Individual alerts can have “secondary” alerts that convey more information.
- Information can include inferred username, OS information, network location, along with full file snapshots.
- Administrators get access to forensics through the web interface and through SQL.

PlugBoy Forensics Vulnerabilities

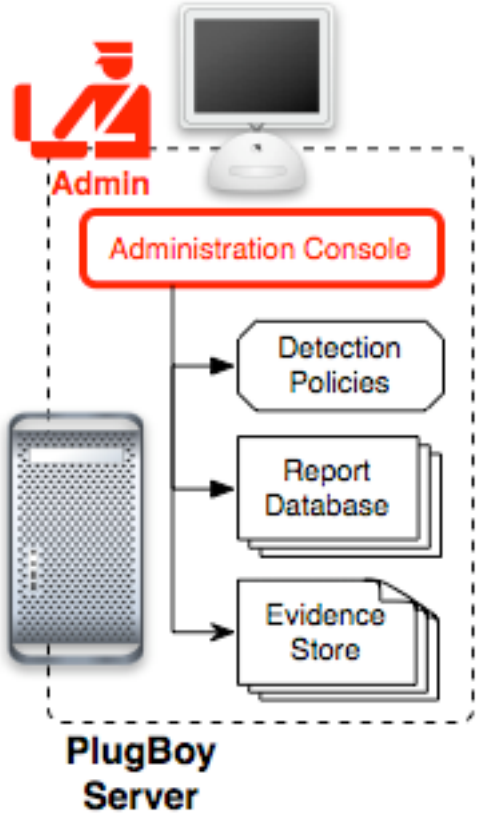
- Follow-on alerts can alter or manipulate forensics!
  - Violates chain of custody; anybody who can spoof an alert can erase previous events.
  - Forge malicious logs (in conjunction with event spoofing)
- The server is a store of nothing but confidential data
  - Read access == tons of juicy data from past alerts.
- Forensic data is vulnerable to tampering or destruction while in agent's queue.
  - Endpoint agents are on "the honor system".

Forensics Storage Questions

- How is the agent authenticated for forensics pushing?
- Can forensics be “updated” (read: overwritten)?
  - Is forensics “quarantined” as soon as it arrives?
- Is forensics queued by the agent if the server is unavailable?
  - If so:
    - How?
    - What mechanisms are used to protect queued forensics?
  - If Not:
    - What happens to alerts when server’s down?
- Complies with PCI, COBIT, SOX, etc., organization encryption policies?

PlugBoy Admin Interface

- Web based management interface
- Reports back ended by SQL
- Uses windows-integrated authentication.
- Allows admin to open and view forensics files associated with events



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Plugboy UI Vulnerability

- Alerts include forensic detail, such as snapshots of files with credit card info.
- This detail is rendered as HTML in the admin interface.
- Because the input didn't come through an HTML form, nobody thought to scrub it for tags.
- Attackers can seize control of admin logins through XSS "submarined" in spoofed data loss alerts.

Admin UI Questions

- Has the web interface been audited?
  - Who did the audit?
- At what points in the UI is input filtered?
  - Alerts
  - Logs
  - Form fields
  - OS version information (common!)
- What classes of information are output filtered?
- Does the UI launch file viewers?
  - Are they hardcoded into the program?
  - How does the vendor deal with malicious files?
- All the classic web app questions
  - Authentication,

Conclusions

- Extrusion Detection products tackle the wrong problem
  - Trying to hold onto sensitive info after it's already in the wrong hands.
- ED vulnerabilities may undermine other security controls
- Evasion is often trivial
  - The simplest attacks are the most likely to succeed
- The answer to leakage is definitely not just monitoring
- The most effective ways to prevent info leaks are still:
  - Well designed access controls
  - Sane information gathering and retention policies
  - Strong encryption!
- But… ED is still not a complete loss:
  - It's really good at catching accidents (and stupidity)

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