# Linux and NIST SP 800-171 or: How I Learned To Stop Worrying and Love Compliance Enforcement

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# Agenda

Challenges and Background

- What is the problem?
- How can we solve it?

Technology high-level overview

- What Puppet can do
- What Splunk can do

Examples of NIST SP 800-171 enforcement

- 3.4.2, 3.4.6, 3.4.9
- visualizing conformance with Splunk

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# Challenges and background

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About us:

- A team of 4 people that manages:
  - 500+ Linux servers
  - Many mission-critical enterprise services
- There’s always more to do
- We try to do the #devops thing, but we have lots of silos
- We try hard to leverage existing technologies
- We need administrator amplification
  - We don’t have the time or manpower for artisanal hand-crafted hosts or services
  - “Cattle not pets”

# Challenges and background

The goal: comply with NIST SP 800-171

- But how?

Issues:

- NIST SP 800-171 dialog is Windows user endpoint-centric
- Few automated compliance enforces/checkers for Linux
- We don’t have just Windows hosts
- Linux isn’t typically discussed

# Challenges and background

Potential Solutions?

Apply configuration changes manually or at build?

- Doesn’t scale
- How to detect configuration drift?

Is there a better way?

# Challenges and background

How about a configuration management system (CMS)?

- The point of a CMS is to *apply* and *enforce* a desired state

Disadvantages:

- Initial setup is more complex

Advantages?

- Can scale to many hosts
- Should be able to detect (and correct!) drift

# Challenges and background

What CMS to use?

Should you write your own?

- Spoiler alert: *NO*.

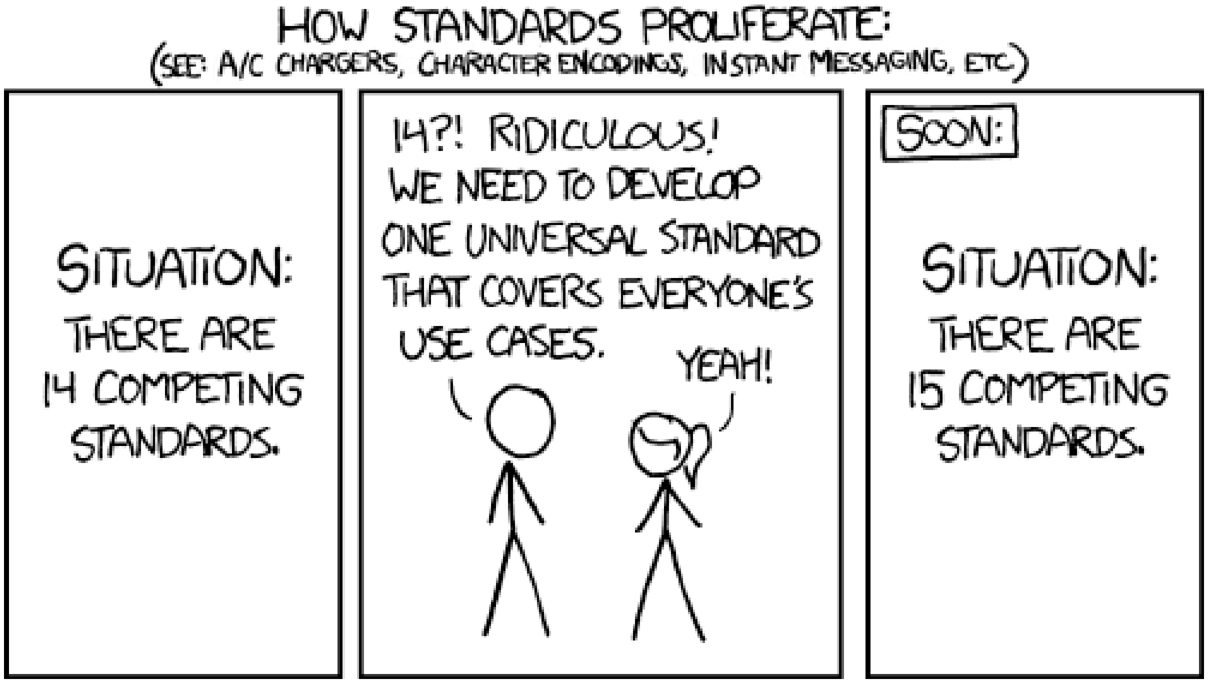
HOW STANDARDS PROLIFERATE:
(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)
SITUATION: THERE ARE 14 COMPETING STANDARDS.
14?! RIDICULOUS! WE NEED TO DEVELOP ONE UNIVERSAL STANDARD THAT COVERS EVERYONE'S USE CASES.
YEAH!
SOON:
SITUATION: THERE ARE 15 COMPETING STANDARDS.

Image credit: xkcd

# Challenges and background

So, which one?

Some potential options:

- Ansible
- Chef
- Otter
- Puppet
- Salt

“The nice thing about standards is that you have so many to choose from.” – Andrew S. Tanenbaum

# Challenges and background

We chose Puppet. Why?

- We needed to replace our aging, custom CMS
- At the time (early 2011), Puppet seemed like the most mature solution
- We didn’t agonize over the choice… and you shouldn’t, either

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# Puppet and Splunk overview

# Puppet overview

Puppet uses a client/server model

- A Puppet agent runs on each client
- The agent periodically enforces that the actual state of the system matches its intended state
- The agent obtains the client's intended state from the Puppet server

# Puppet overview

How do you describe the intended state of a client?

Using a declarative language

- a package that should be installed
- the contents of a configuration file
- a service that should be running

Descriptions are called *resources*.

- Resources can be ordered via dependencies
- Puppet will respect those dependencies when making changes to the system

# Puppet overview

A *class* contains one or more resource declarations

A *module* is a collection of classes, data, files, templates, and so forth, laid out in a specific directory structure

The Puppet Forge contains thousands of freely-available Puppet modules

- So don’t reinvent the wheel!

The Puppet server knows which modules should be applied to which clients

# Puppet overview

What is the update process?

- The client agent gathers facts about the system
- The agent gives those facts to the Puppet server
- The server takes the facts, the list of modules the client should use, and other configuration data, and produces a *catalog*
- The catalog describes the desired state of the system
- The server sends the catalog to the agent
- The agent applies whatever actions are necessary to ensure the state of the client matches the catalog
- The agent sends a report of its actions to the server

# Splunk overview

What is Splunk?

- A tool for analyzing and visualizing machine data
- Can consume almost any type of data you can throw at it
  - System logs, audit logs, server logs, network logs
- Helps address the paradox of machine data
  - Machine data itself is rarely valuable…
  - …but the derivative information is

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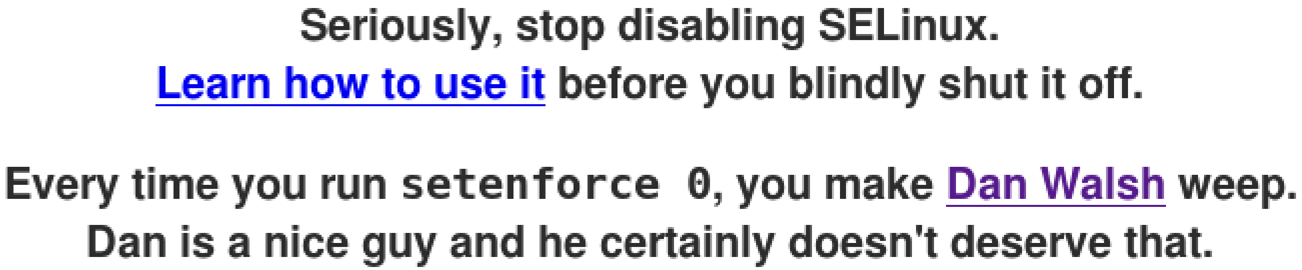
# Examples of NIST SP 800-171 enforcement

# NIST SP 800-171 requirement 3.4.2

3.4.2 states: “Establish and enforce security configuration settings”

- An example of this is SELinux.
- Developer attitude toward SELinux: “that NSA security thing that breaks my applications, so I turn it off.”
- IT attitude:



Seriously, stop disabling SELinux.
Learn how to use it before you blindly shut it off.

Every time you run `setenforce 0`, you make Dan Walsh weep.
Dan is a nice guy and he certainly doesn't deserve that.

https://stopdisablingselinux.com/

# NIST SP 800-171 requirement 3.4.2

Problem: we’re IT, so no one listens to us.

- Solution: use Puppet to ensure that SELinux runs in enforcing mode.
- When users realize they can't “solve” their SELinux problems by disabling SELinux, they ~~complain~~ come to us.

# NIST SP 800-171 requirement 3.4.2

```
class selinux (
  Enum['enforcing', 'permissive'] $selinux_mode = 'enforcing',
) {

   file { '/etc/selinux/config':
    ensure  => file,
    owner   => root,
    group   => root,
    mode    => '0644',
    content => "SELINUX=${selinux_mode}\nSELINUXTYPE=targeted\n",
  }

   if $facts['os']['selinux']['current_mode'] != $selinux_mode {
    exec { "setenforce ${selinux_mode}":
      path => ['/bin', '/usr/bin', '/usr/sbin', '/sbin'],
    }
  }

}
```

# NIST SP 800-171 requirement 3.4.6

3.4.6 states: “Employ the principle of least functionality by configuring the information system to provide only essential capabilities.”

- Firewall policy contributes to 3.4.6:
  - Permit authorized connections
  - Deny all other connections
- Problem: define “authorized”
  - How do you know whether a particular firewall allowance is intended/authorized to be there?

# NIST SP 800-171 requirement 3.4.6

Our approach:

- A firewall allowance is authorized if an included Puppet module contributes the rule.
- If an allowance isn't authorized, Puppet will remove it
- How to implement this?
  - Use the firewall module from the Puppet Forge
  - https://forge.puppet.com/puppetlabs/firewall

# NIST SP 800-171 requirement 3.4.6

```
class iptables {
  firewallchain { 'INPUT:filter:IPv4':
    purge  => true,
    policy => 'drop',
  }
}

class openssh::server {
  firewall { '500 IPv4 permit incoming ssh connections':
    provider  => iptables,
    proto     => tcp,
    dport     => 22,
    tcp_flags => 'FIN,SYN,RST,ACK SYN',
    action    => 'accept',
  }
}
```

# NIST SP 800-171 requirement 3.4.9

3.4.9 states: “Control and monitor user-installed software.”

- Just a wee bit Windows centric
- Monitoring individual packages is a challenge of scale

```
$ rpm -qa | wc -l
1478
```

- Our approach: use Splunk to enumerate and report

# NIST SP 800-171 requirement 3.4.9

The nuts and bolts:

- Write a Splunk input script that enumerates installed packages and sends that machine data to Splunk
- Use Puppet to ensure:
  - All hosts have the Splunk forwarder installed
  - All hosts have the Splunk input script installed

# NIST SP 800-171 requirement 3.4.9

Forwarder script:

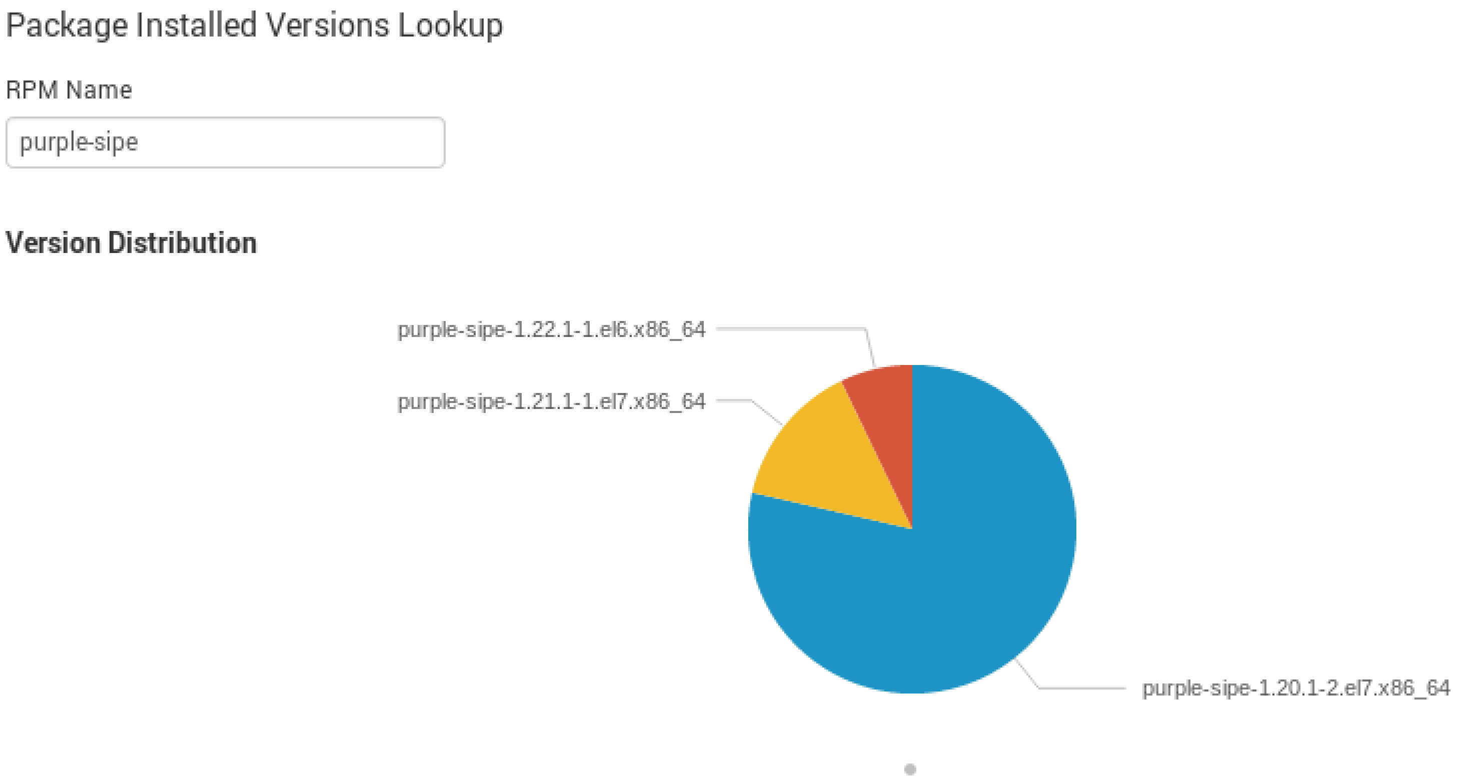
```
#! /bin/sh
# Yes, we could do it in one line. But readability is better.
TIMESTAMP=$(date "+%b %d %T")
FORMAT="rpmname=%{name},rpmvers=%{version}-%{release}.%{arch}"
rpm -qa --qf "${TIMESTAMP} ${FORMAT}\n"
```

Forwarder script configuration:

```
[script://$SPLUNK_HOME/bin/scripts/rpmInventory.sh]
interval = 1800
sourcetype = rpm_inventory
```

# NIST SP 800-171 requirement 3.4.9

Visualization:



Package Installed Versions Lookup

RPM Name

purple-sipe

**Version Distribution**

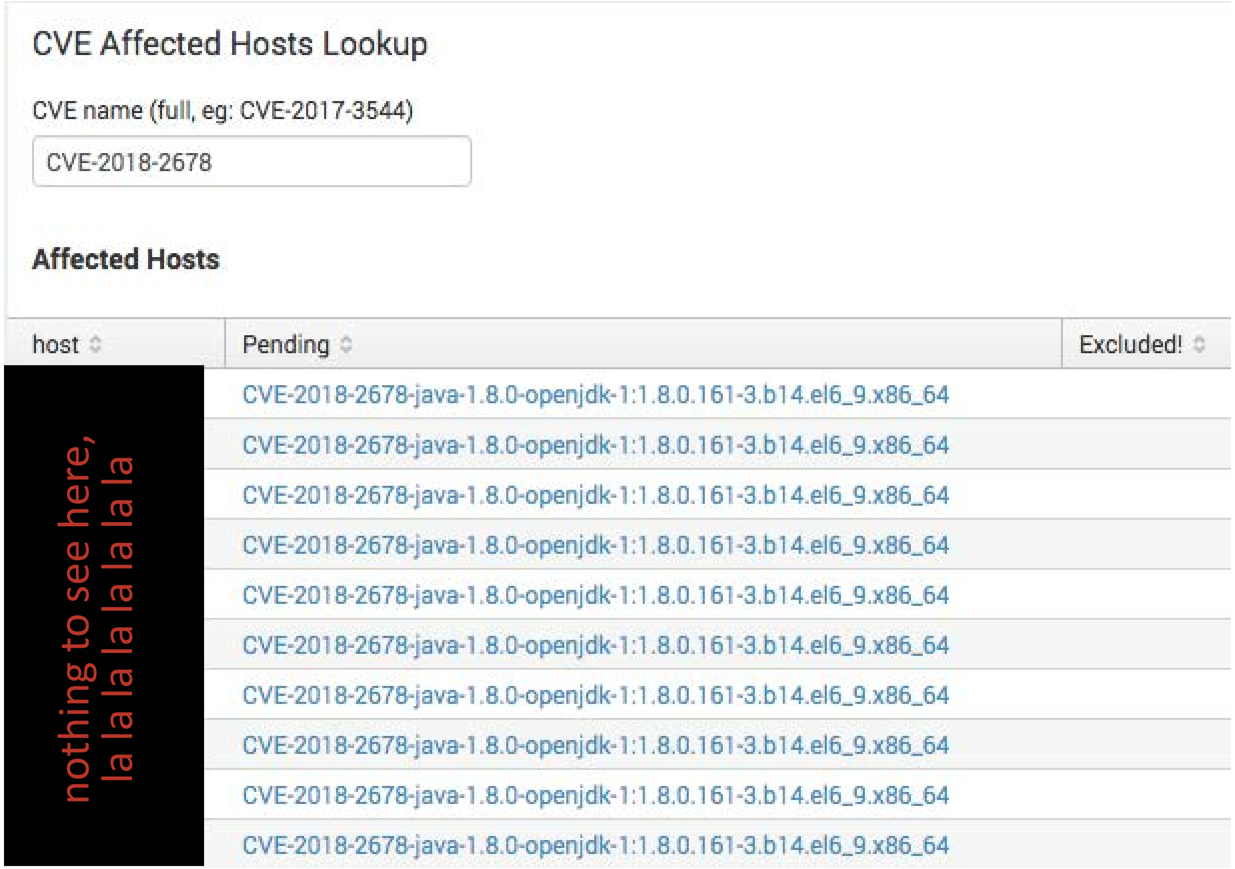
purple-sipe-1.22.1-1.el6.x86_64
purple-sipe-1.21.1-1.el7.x86_64
purple-sipe-1.20.1-2.el7.x86_64

# Other Puppet/Splunk uses

- By leveraging this simple workflow:
  - Use Puppet to install a script to log the data you want
  - Use Splunk to collect that data and present it
- It is possible to speak to other NIST SP 800-171 requirements:
  - 3.11 Risk assessment
  - 3.12 Security assessment strategy
- For example, the output of this command…
  - **`yum updateinfo list cves`**
- When aggregated into Splunk…

# Other Puppet/Splunk uses

…can tell you whether you missed applying security updates:



CVE Affected Hosts Lookup

CVE name (full, eg: CVE-2017-3544)

CVE-2018-2678

**Affected Hosts**

| host | Pending | Excluded! |
|---|---|---|
| [redacted] | CVE-2018-2678-java-1.8.0-openjdk-1:1.8.0.161-3.b14.el6_9.x86_64 | |
| [redacted] | CVE-2018-2678-java-1.8.0-openjdk-1:1.8.0.161-3.b14.el6_9.x86_64 | |
| [redacted] | CVE-2018-2678-java-1.8.0-openjdk-1:1.8.0.161-3.b14.el6_9.x86_64 | |
| [redacted] | CVE-2018-2678-java-1.8.0-openjdk-1:1.8.0.161-3.b14.el6_9.x86_64 | |
| [redacted] | CVE-2018-2678-java-1.8.0-openjdk-1:1.8.0.161-3.b14.el6_9.x86_64 | |
| [redacted] | CVE-2018-2678-java-1.8.0-openjdk-1:1.8.0.161-3.b14.el6_9.x86_64 | |
| [redacted] | CVE-2018-2678-java-1.8.0-openjdk-1:1.8.0.161-3.b14.el6_9.x86_64 | |
| [redacted] | CVE-2018-2678-java-1.8.0-openjdk-1:1.8.0.161-3.b14.el6_9.x86_64 | |
| [redacted] | CVE-2018-2678-java-1.8.0-openjdk-1:1.8.0.161-3.b14.el6_9.x86_64 | |
| [redacted] | CVE-2018-2678-java-1.8.0-openjdk-1:1.8.0.161-3.b14.el6_9.x86_64 | |

nothing to see here,
la la la la la la la

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# Conclusions

# Conclusions

- Conformance involves dull, repetitive tasks
  - Computers are pretty good at performing dull, repetitive tasks
  - Phrased differently: *your* time is order of magnitudes more valuable than a *machine’s* time.
  - Therefore, leverage tools to achieve conformance more efficiently

# Conclusions

- *What* tool you use isn't important, as long as you use it
  - Incremental improvement is better than no improvement

Spectre Server
@sadserver

optimisim in 2018 is hoping that the interface for launching the missles is better than the one for sending the alerts.

8:10 AM - 16 Jan 2018

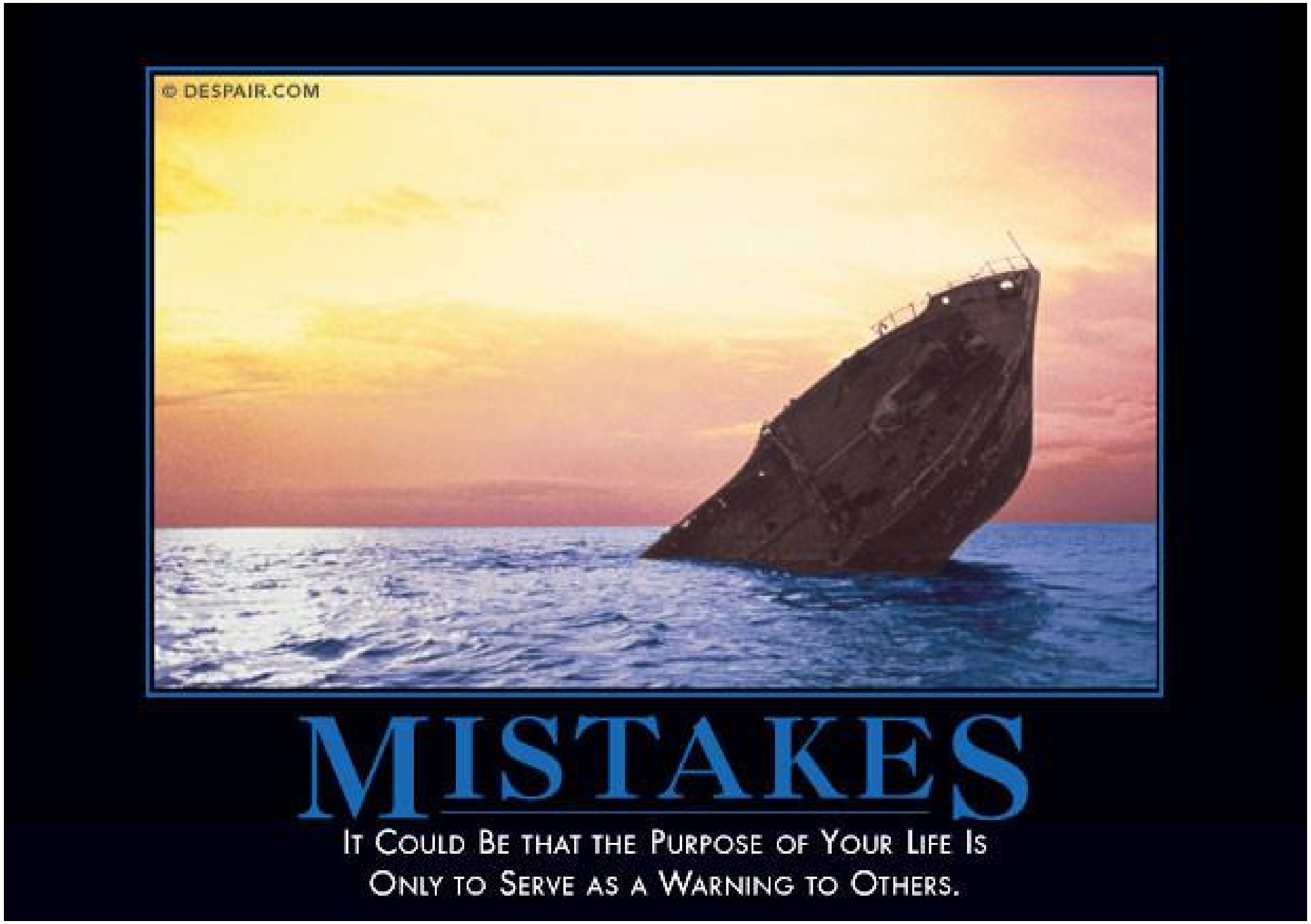
968 Retweets 1,627 Likes

# Conclusions

- You may not receive much recognition for employing best security practices and being good at conformance…

# Conclusions

- …but you’ll receive plenty of recognition if you’re bad at it.


© DESPAIR.COM
MISTAKES
It Could Be that the Purpose of Your Life Is
Only to Serve as a Warning to Others.

# Resources and links

- Puppet and the Puppet Forge:
  - https://www.puppet.com/
  - https://forge.puppet.com/
- Splunk:
  - https://www.splunk.com/
- Open Source Puppet modules for NIST, STIG, et. al. compliance:
  - https://simp-project.com/

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# Questions?