

# VERACODE

You change the world, we'll secure it.



Niels Tanis

## The Rise of Software Supply-Chain Attacks

How Secure is your .NET Application?

# Who am I?

- Niels Tanis
  - Security Researcher @ Veracode
  - Background in .NET Development
  - Application Security Consultancy
  - Pen-testing & Ethical Hacking
  - ISC<sup>2</sup> CSSLP



# The Rise of Software Supply-Chain Attacks

How Secure is your .NET Application?



# Agenda

- Hacker History
- Definition Software Supply-Chain
  - Development of .NET application
  - Building / Releasing / Deploying
- Securing our Software Supply-Chain
- Conclusion and Q&A

# Hacking History

- Started out with phreaking in late '50-'60.



# Getting connected!

- SATAN (Security Administrator Tool for Analyzing Networks) by Wietse Venema and Dan Farmer released 1995.
- NMAP (Network Mapper) by Gordon Lyon released in 1997

```
Starting Nmap 7.60 ( https://nmap.org ) at 2018-01-14 11:05 CET
Nmap scan report for scanme.nmap.org (45.33.32.156)
Host is up (0.16s latency).
Other addresses for scanme.nmap.org (not scanned): 2600:3c01::f03c:91ff:fe18:bb2f
Not shown: 996 closed ports
PORT      STATE    SERVICE
22/tcp    open     ssh
25/tcp    filtered smtp
80/tcp    open     http
9929/tcp  open     nping-echo
```

# Smashing the Stack...

- Phrack #49 in November 1996

Aleph One wrote about buffer overflows

.oo Phrack 49 Oo.

Volume Seven, Issue Forty-Nine

File 14 of 16

BugTraq, r00t, and Underground.Org  
bring you

XXXXXXXXXXXXXXXXXXXXXXXXXXXX  
Smashing The Stack For Fun And Profit  
XXXXXXXXXXXXXXXXXXXXXXXXXXXX

by Aleph One  
aleph1@underground.org

`smash the stack` [C programming] n. On many C implementations it is possible to corrupt the execution stack by writing past the end of an array declared auto in a routine. Code that does this is said to smash the stack, and can cause return from the routine to jump to a random address. This can produce some of the most insidious data-dependent bugs known to mankind. Variants include trash the stack, scribble the stack, mangle the stack; the term mung the stack is not used, as this is never done intentionally. See spam; see also alias bug, fandango on core, memory leak, precedence lossage, overrun screw.

# SQL Injection

- Phrack #54 in December 1998

Rain Forest Puppy wrote about  
SQL injection

----[ ODBC and MS SQL server 6.5

Ok, topic change again. Since we've hit on web service and database stuff, let's roll with it. Onto ODBC and MS SQL server 6.5.

I worked with a fellow WT'er on this problem. He did the good thing and told Microsoft, and their answer was, well, hilarious. According to them, what you're about to read is not a problem, so don't worry about doing anything to stop it.

- WHAT'S THE PROBLEM? MS SQL server allows batch commands.

- WHAT'S THAT MEAN? I can do something like:

```
SELECT * FROM table WHERE x=1 SELECT * FROM table WHERE y=5
```

Exactly like that, and it'll work. It will return two record sets, with each set containing the results of the individual SELECT.

- WHAT'S THAT REALLY MEAN? People can possibly piggyback SQL commands into your statements. Let's say you have:

```
SELECT * FROM table WHERE x=%criteria from webpage user%
```

Now, what if %criteria from webpage user% was equal to:

```
SELECT * FROM sysobjects
```

It would translate to:

```
SELECT * FROM table WHERE x=1 SELECT * FROM sysobjects
```

# Code Red & SQL Slammer

- Microsoft Internet Information Server, July 2001

```
GET /default.ida?NNNNNNNNNNNNNNNNNNNNNNNNNNNN  
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  
%u9090%u6858%ucbd3%u7801%u9090%u6858%ucbd3%u7801  
%u9090%u6858%ucbd3%u7801%u9090%u9090%u8190%u00c3  
%u0003%u8b00%u531b%u53ff%u0078%u0000%u00=a HTTP/1.0
```

# Bill Gates – Email to all MS FTE

BILL GATES BUSINESS 01.17.02 12:00 PM

## Bill Gates: Trustworthy Computing

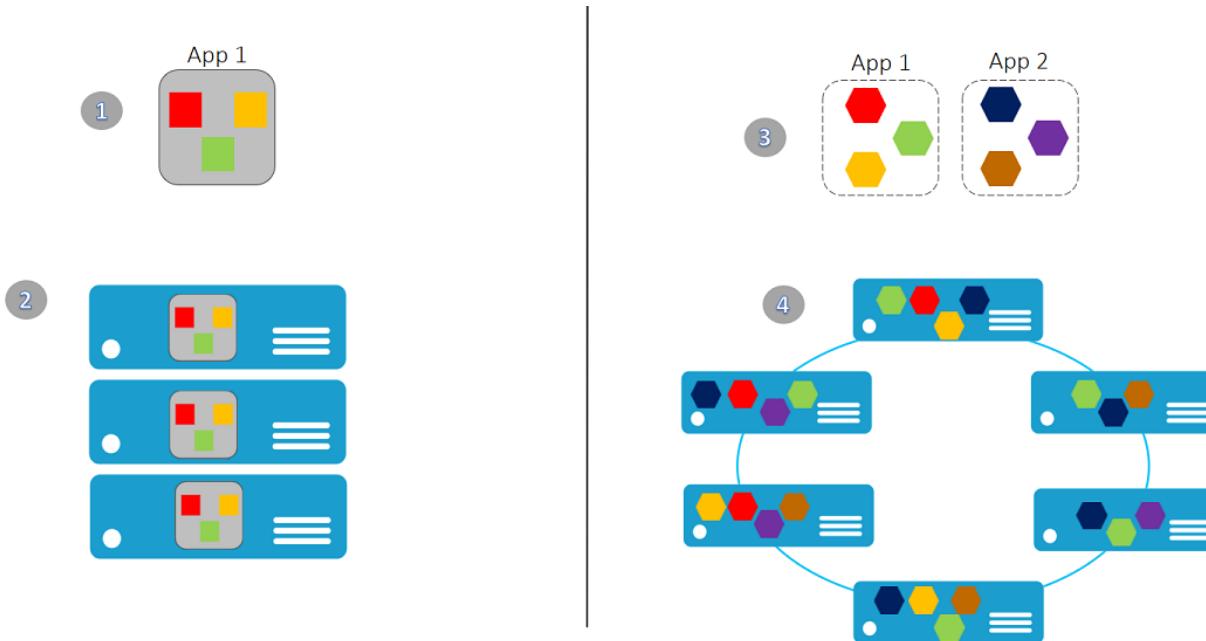
\*This is the e-mail Bill Gates sent to every full-time employee at Microsoft, in which he describes the company's new strategy emphasizing security in its products.\*From: Bill Gates  
Sent: Tuesday, January 15, 2002 5:22 PM

To: Microsoft and Subsidiaries: All FTE  
Subject: Trustworthy computing

Every few years I have sent out a memo talking about the highest priority for Microsoft. Two years ago, it was the kickoff of our .NET strategy. Before that, it was several memos about the importance of the Internet to our future and the ways we could make the Internet truly useful for people. Over the last year it has become clear that

# Changes in Software Architecture

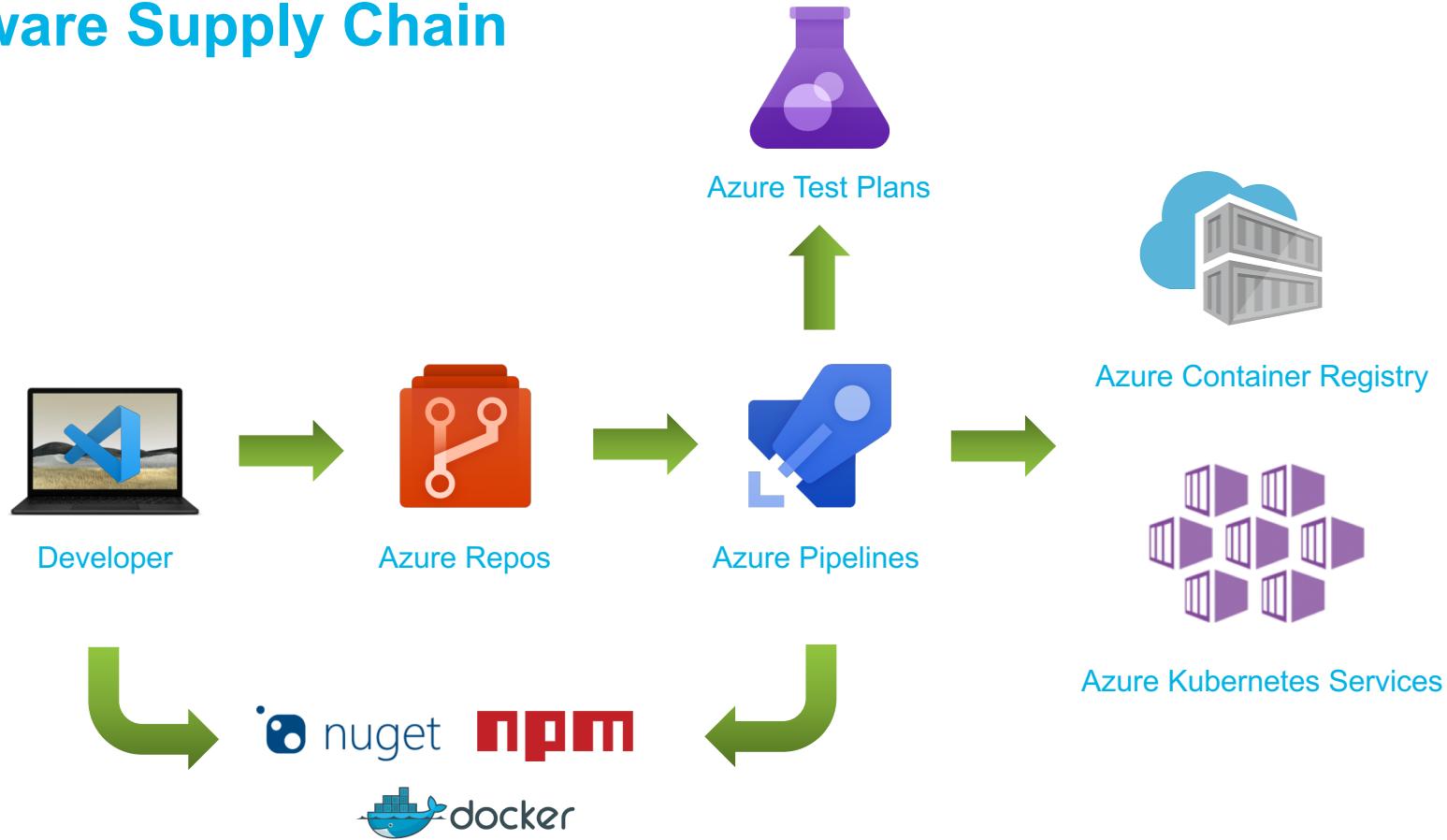
- Monolith → Microservices → Serverless



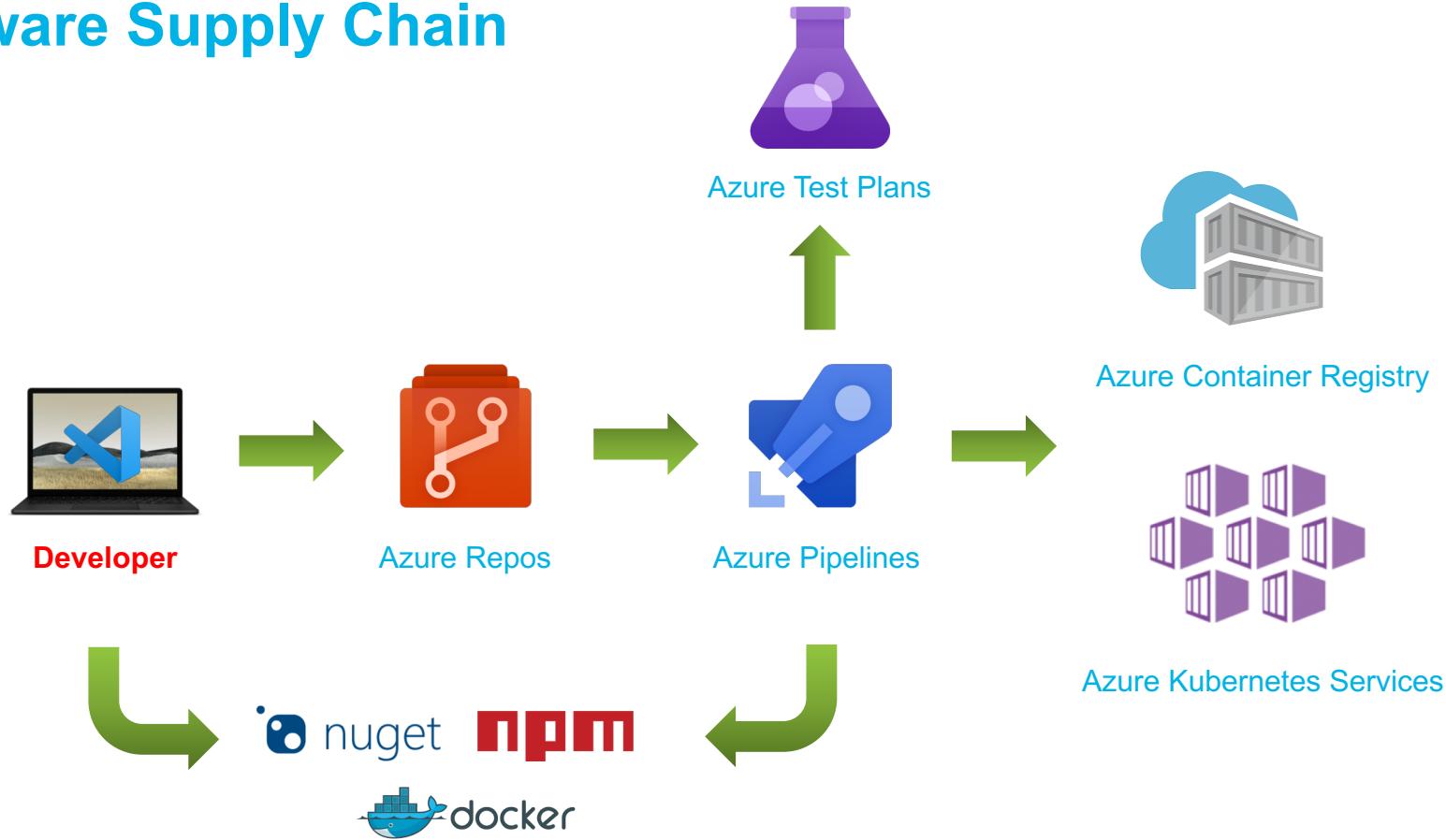
# What's a Supply-Chain?



# Software Supply Chain



# Software Supply Chain

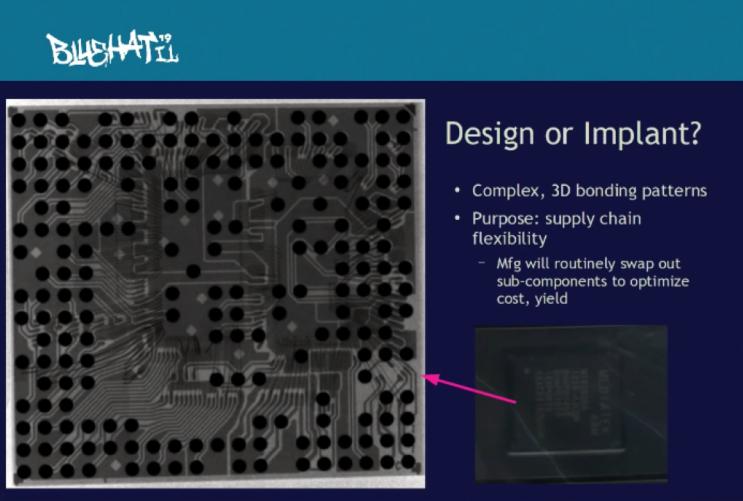


# Development Machine

- Secure Boot & Trusted Platform Module (TPM)
- Encrypt disk, harden operating system install updates
- But can you trust the hardware?



# Hacking Hardware



BLUEHAT IL

Microsoft

## Design or Implant?

- Complex, 3D bonding patterns
- Purpose: supply chain flexibility
  - Mfg will routinely swap out sub-components to optimize cost, yield

Andrew "bunnie" Huang - Supply Chain Security: "If I were a Nation State..."

12,251 views • 14 Feb 2019

234 2 SHARE SAVE ...

Up next

ToorCamp 2018 - Keynote: MAKING AND BREAKING... ToorCon 2.9K views • 1 year ago

AUTOPLAY

# Development Machine



- Installs on machine – HomeBrew on Mac
  - `curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/install.sh`

# Development Machine



- Installs on machine – Chocolatey on Windows

## Chocolatey Install:

Individual   Organization

1. First, ensure that you are using an [administrative shell](#) - you can also install as a non-admin, check out [Non-Administrative Installation](#).
2. Install with powershell.exe

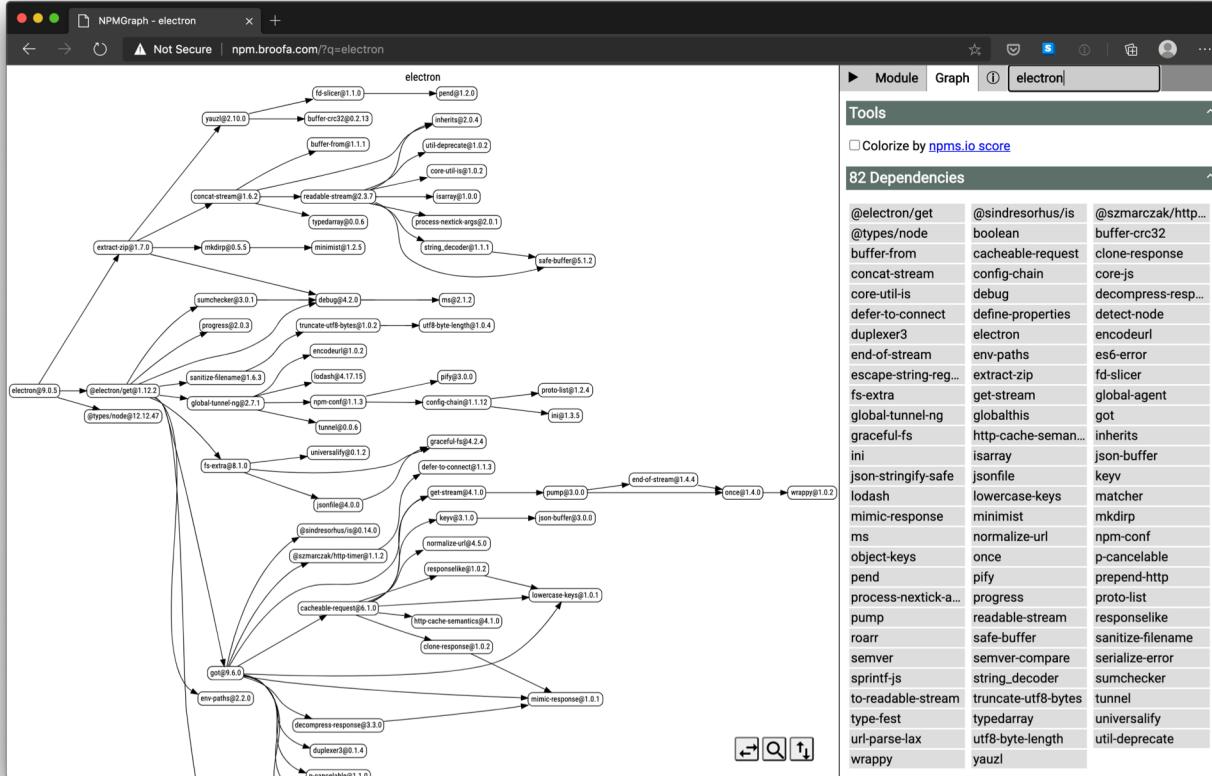
**NOTE:** Please inspect <https://chocolatey.org/install.ps1> prior to running any of these scripts to ensure safety. We already know it's safe, but you should verify the security and contents of *any* script from the internet you are not familiar with. All of these scripts download a remote PowerShell script and execute it on your machine. We take security very seriously. [Learn more about our security protocols](#).

# Octopus Scanner - NetBeans

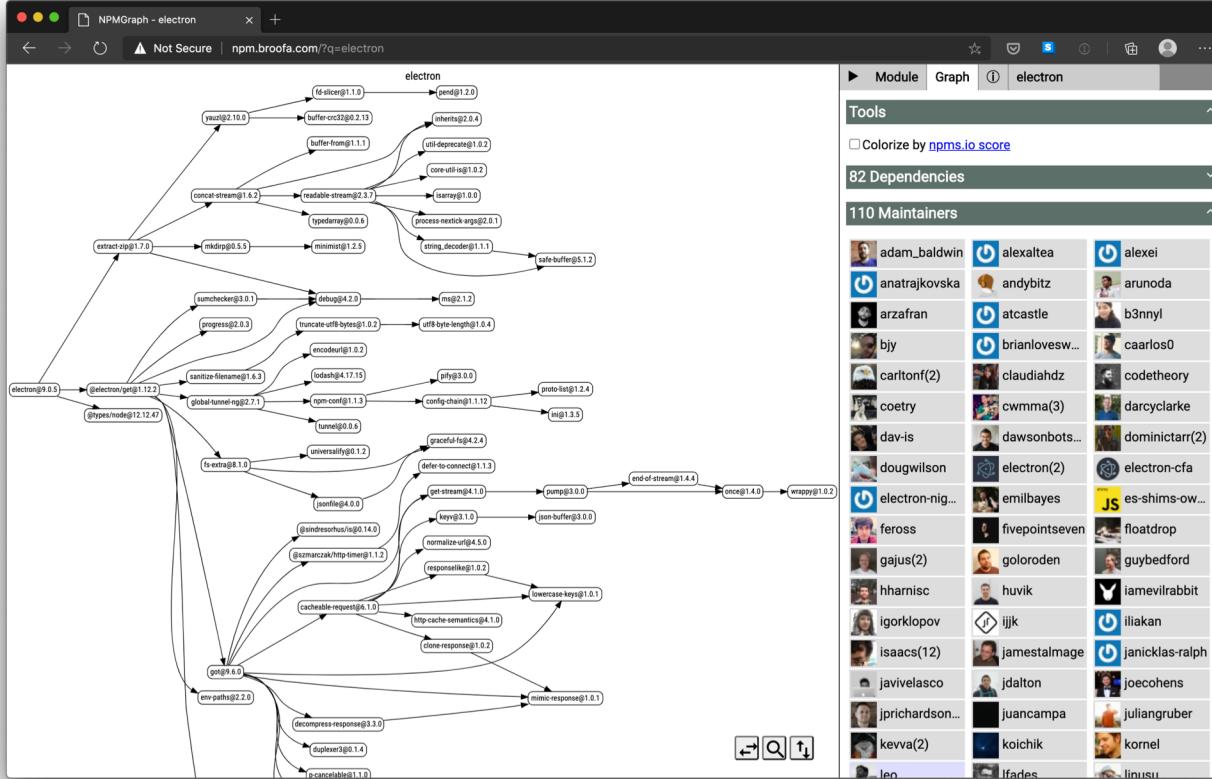
The screenshot shows a GitHub Security Lab page. At the top, there's a navigation bar with links: "Back to GitHub.com", "Security Lab", "Bounties", "CodeQL", "Research" (which is underlined in blue), "Advisories", "Get Involved", and "Events". Below the navigation is a large, partially visible image of a document or presentation slide. In the center of the slide, the date "May 28, 2020" is visible. Below the date, the title of the article is displayed in a large, bold, black font: "The Octopus Scanner Malware: Attacking the open source supply chain". To the left of the title is a small circular profile picture of the author, Alvaro Muñoz.

Securing the open source supply chain is an enormous task. It goes far beyond a security assessment or just patching for the latest CVEs. Supply chain security is about the integrity of the entire software development and delivery ecosystem. From the code commits themselves, to how they flow through the CI/CD pipeline, to the actual delivery of releases, there's the potential for loss of integrity and security concerns, throughout the entire lifecycle.

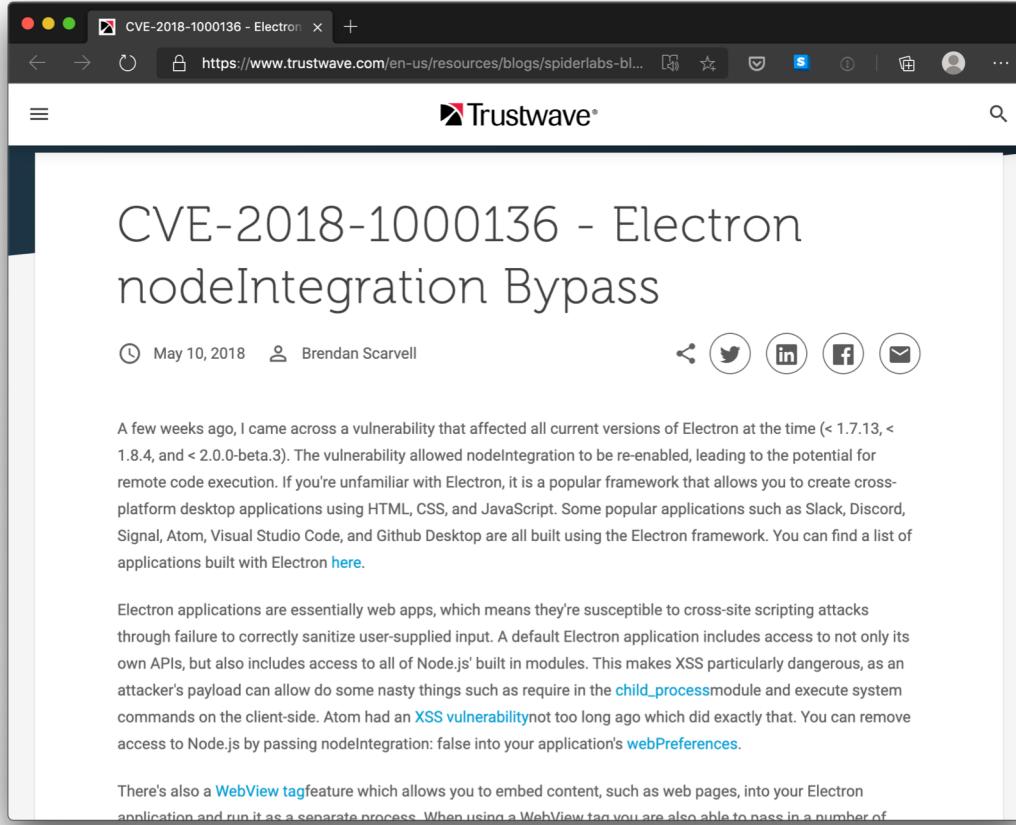
# Visual Studio Code



# Visual Studio Code



# Visual Studio Code



The screenshot shows a web browser window with a dark theme. The title bar reads "CVE-2018-1000136 - Electron" and the URL is "https://www.trustwave.com/en-us/resources/blogs/spiderlabs-bl...". The page content is from Trustwave's blog, featuring a large heading "CVE-2018-1000136 - Electron nodeIntegration Bypass". Below the heading are publication details: "May 10, 2018" and "Brendan Scarvell". To the right of the author are sharing icons for Twitter, LinkedIn, Facebook, and Email. The main text discusses a vulnerability in Electron that allowed nodeIntegration to be re-enabled, leading to remote code execution. It mentions that Electron is a popular framework for creating cross-platform desktop applications like Slack, Discord, Signal, Atom, Visual Studio Code, and Github Desktop. A link to a list of Electron-built applications is provided. The text then explains that Electron apps are web apps susceptible to XSS attacks due to lack of input sanitization and access to Node.js APIs. It notes a specific XSS vulnerability in Atom and provides instructions on how to disable nodeIntegration in the application's webPreferences. Finally, it mentions the WebView tag feature.

CVE-2018-1000136 - Electron nodeIntegration Bypass

May 10, 2018 Brendan Scarvell

A few weeks ago, I came across a vulnerability that affected all current versions of Electron at the time (< 1.7.13, < 1.8.4, and < 2.0.0-beta.3). The vulnerability allowed nodeIntegration to be re-enabled, leading to the potential for remote code execution. If you're unfamiliar with Electron, it is a popular framework that allows you to create cross-platform desktop applications using HTML, CSS, and JavaScript. Some popular applications such as Slack, Discord, Signal, Atom, Visual Studio Code, and Github Desktop are all built using the Electron framework. You can find a list of applications built with Electron [here](#).

Electron applications are essentially web apps, which means they're susceptible to cross-site scripting attacks through failure to correctly sanitize user-supplied input. A default Electron application includes access to not only its own APIs, but also includes access to all of Node.js' built in modules. This makes XSS particularly dangerous, as an attacker's payload can allow do some nasty things such as require in the `child_process` module and execute system commands on the client-side. Atom had an [XSS vulnerability](#) not too long ago which did exactly that. You can remove access to Node.js by passing `nodeIntegration: false` into your application's `webPreferences`.

There's also a [WebView tag](#) feature which allows you to embed content, such as web pages, into your Electron application and run it as a separate process. When using a `WebView tag` you are also able to pass in a number of

# Visual Studio Code

The screenshot shows a Microsoft Edge browser window with the title bar "CVE-2020-1192 | Visual Studio". The URL in the address bar is [https://portal.msrc.microsoft.com/en-US/security-guidance/advisory/...](https://portal.msrc.microsoft.com/en-US/security-guidance/advisory/). The page content is as follows:

**CVE-2020-1192 | Visual Studio Code Python Extension Remote Code Execution Vulnerability**

**Security Vulnerability**

Published: 05/12/2020  
[MITRE CVE-2020-1192](#)

A remote code execution vulnerability exists in Visual Studio Code when the Python extension loads workspace settings from a notebook file. An attacker who successfully exploited the vulnerability could run arbitrary code in the context of the current user. If the current user is logged on with administrative user rights, an attacker could take control of the affected system. An attacker could then install programs; view, change, or delete data; or create new accounts with full user rights.

To exploit this vulnerability, an attacker would need to convince a target to open a specially crafted file in Visual Studio Code with the Python extension installed.

The update address the vulnerability by modifying the way Visual Studio Code Python extension enforces user settings.

**On this page**

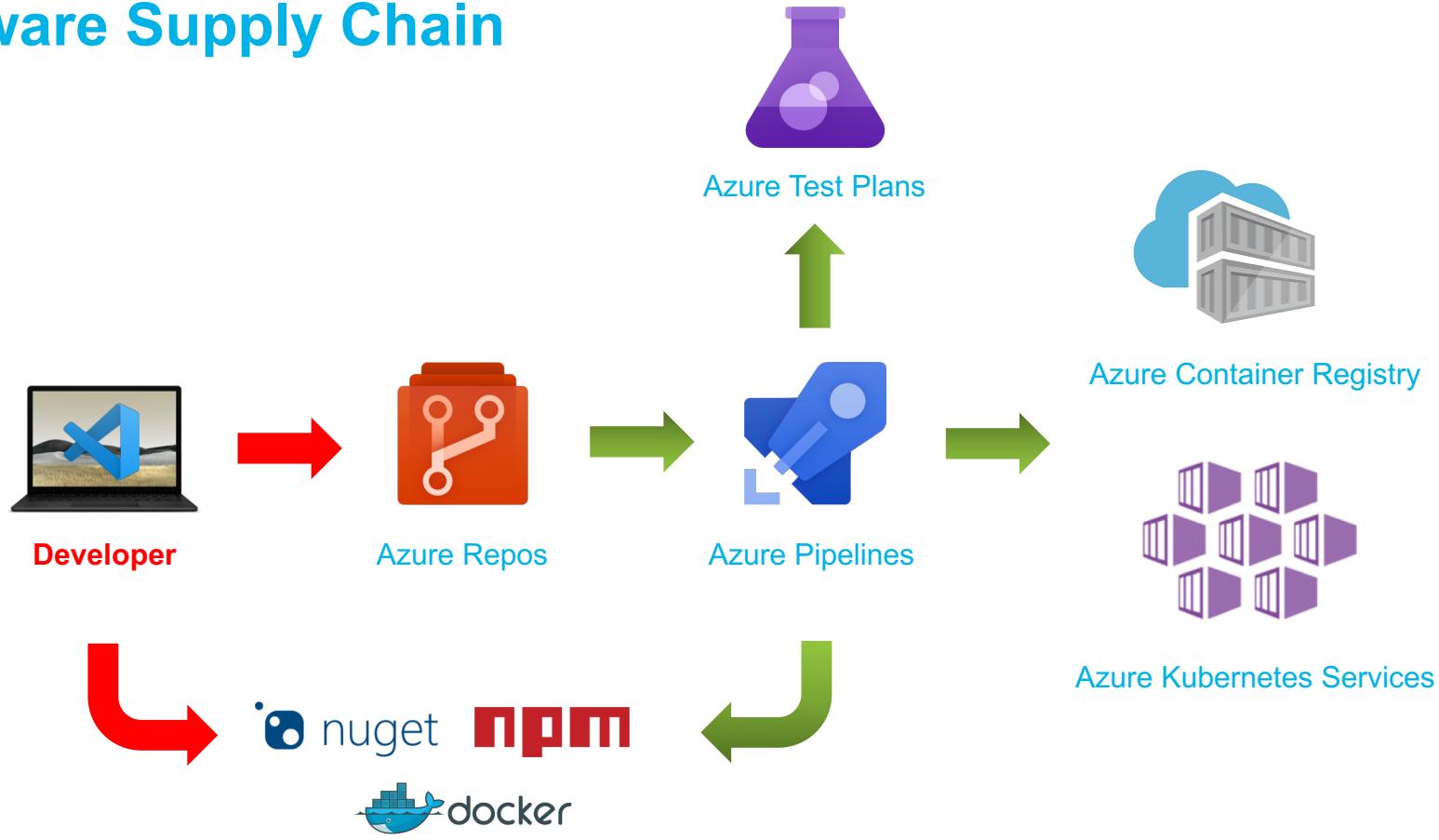
- [Executive Summary](#)
- [Exploitability Assessment](#)
- [Security Updates](#)
- [Mitigations](#)
- [Workarounds](#)
- [FAQ](#)
- [Acknowledgements](#)
- [Disclaimer](#)
- [Revisions](#)

## Exploitability Assessment

The following table provides an [exploitability assessment](#) for this vulnerability at the time of original publication.

Publicly Disclosed	Exploited	Latest Software Release	Older Software Release	Denial of Service

# Software Supply Chain



# Development Machine

- Package manager e.g. NuGet / NPM
- Transport-Layer Security (TLS)
  - Root Authority Trust
  - Downgrade, TLS 1.0 – 1.1 deprecated on NuGet
- Domain Name Service (DNS)
  - DNSSEC → NuGet.org and GitHub.com don't support it



# Canonical GitHub Account

The screenshot shows a news article from ZDNet. The header includes the ZDNet logo, a search bar, a menu icon, a user profile icon, and a 'EU' link. A red banner at the top reads 'MUST READ: Windows 10 critical process failure: Microsoft admits June updates are triggering reboots'. The main headline is 'Canonical GitHub account hacked, Ubuntu source code safe'. Below it, a subtext states 'Ubuntu source code appears to be safe; however Canonical is investigating.' Social sharing icons for LinkedIn, Facebook, Twitter, and Email are present. The author is Catalin Cimpanu, dated July 7, 2019, 10:38 GMT. The article preview shows a GitHub profile for Canonical Ltd, featuring their logo, location (London, UK), website (http://www.canonical.com), and repository statistics. It highlights a repository named 'CAN\_GOT\_HAXXD\_10' and lists 'Top languages' (Python, Go, Shell, C++) and 'Most used topics' (ubuntu, canonical, ceph, kubernetes).

# Microsoft GitHub Account

**threatpost**

Podcast: Shifting Cloud Security Left With Infrastructure-as-a-Service → Hackers Breach 3.5 Million MobiFriends Dating App Credentials →

## Report: Microsoft's GitHub Account Gets Hacked



The Shiny Hunters hacking group said it stole 500 GB of data from the tech giant's repositories on the developer platform, which it owns.

Author: Elizabeth Montalbano  
May 8, 2020 / 11:36 am

INFOSEC INSIDER

**Helping Remote Workers Overcome Remote Attacks**  June 10, 2020

**Understanding the Payload-Less Email Attacks Evading Your Security Team**  June 4, 2020

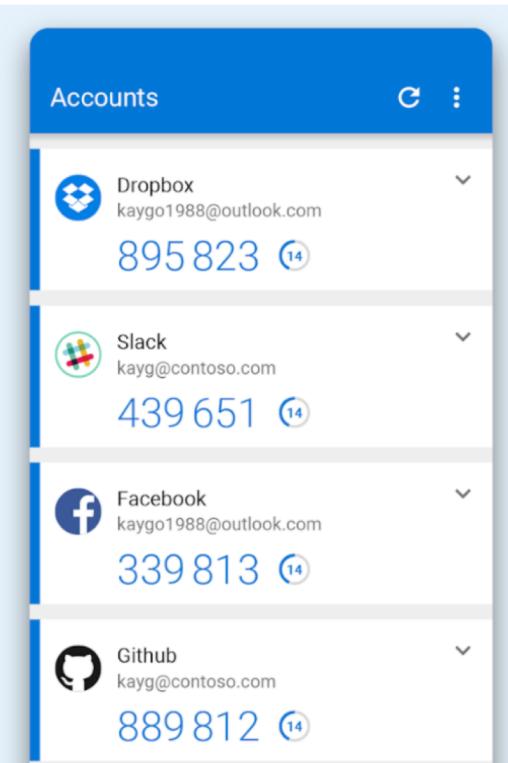
**Long Tail Analysis: A New Hope in the Cybercrime Battle**  May 21, 2020

**The Windows 7 Postmortem: What's at Stake**  May 19, 2020

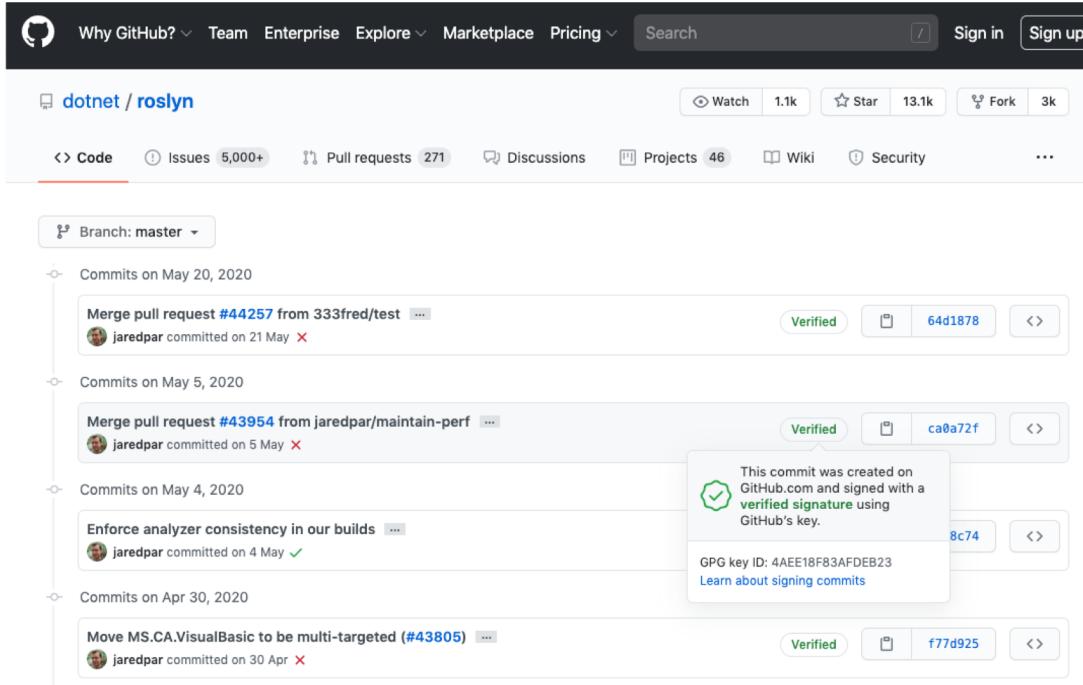
**VPN Concerns with Unplanned Remote Employees**  May 5, 2020

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# Use MFA on source-repository



# GIT Commit Signing



The screenshot shows a GitHub repository page for `dotnet / roslyn`. The repository has over 5,000 issues, 271 pull requests, 46 projects, and 3k forks. A specific commit from `jaredpar` on May 21, 2020, is highlighted as verified. A tooltip for this commit provides details about the verification process:

This commit was created on GitHub.com and signed with a [verified signature](#) using GitHub's key.

GPG key ID: 4AEE18F83AFDEB23

[Learn about signing commits](#)



# EvenStream NPM

- November 2018
- Is transitive dependency of 2000 other libraries



Gary Bernhardt  
@garybernhardt

Follow

An NPM package with 2,000,000 weekly downloads had malicious code injected into it. No one knows what the malicious code does yet.



I don't know what to say. · Issue #116 · dominictarr...

EDIT 26/11/2018: Am I affected?: If you are using anything crypto-currency related, then maybe. As discovered by @maths22, the target seems to have b...

[github.com](https://github.com)

9:44 am - 26 Nov 2018

2,736 Retweets 3,193 Likes



69 2.7K 3.2K

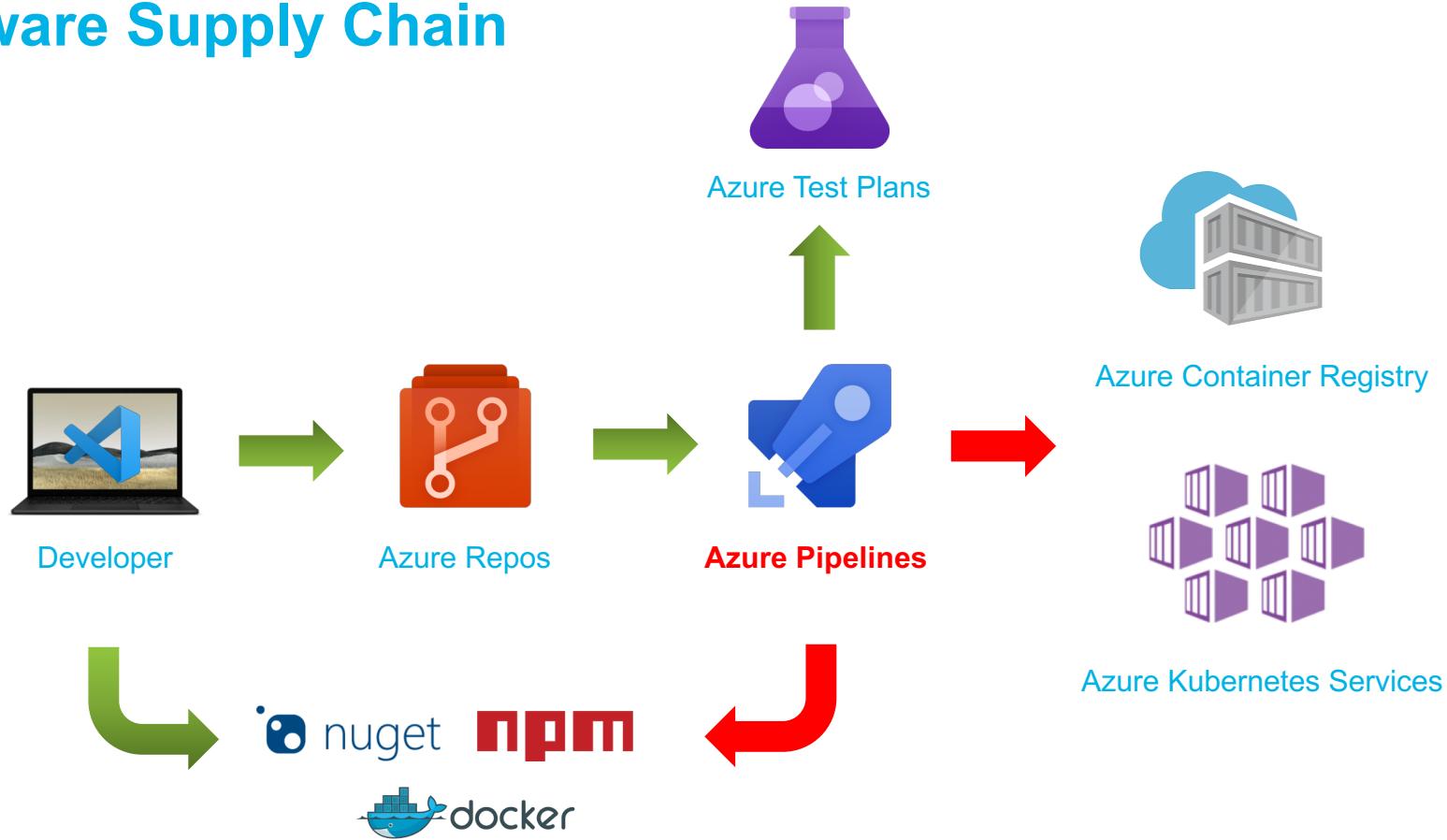


Gary Bernhardt @garybernhardt · 26 Nov 2018

There are basically two camps in that thread.

1) This is the original maintainer's fault for transferring ownership to someone they didn't know or trust.

# Software Supply Chain



# Build / Deployment

- What about hardware? Vendor trust?
- TLS issues?
- Compromised Docker Images
  - Two-Factor authentication in beta
- Build Server can be compromised



# XCodeGhost

The screenshot shows a web browser displaying a blog post from Malwarebytes LABS. The title of the post is "XcodeGhost malware infiltrates App Store". The author is Thomas Reed, Director of Mac & Mobile. The post discusses the discovery of XcodeGhost malware, which infiltrates the App Store. The Malwarebytes logo is visible at the top left, and a "FREE DOWNLOAD" button is at the top right. The "ABOUT THE AUTHOR" section includes a small cartoon illustration of a cowboy wearing a hat and holding a lasso.

XcodeGhost malware infiltrates App Store

Posted: September 21, 2015 by Thomas Reed  
Last updated: March 31, 2016

Late last week, Claud Xiao, a researcher at Palo Alto Networks, announced the discovery of new malware that he calls XcodeGhost.

As the story has developed over the weekend, it turns out that this malware has

# Webmin Backdoor

The screenshot shows the official Webmin website at [www.webmin.com](https://www.webmin.com). The top navigation bar includes links for Home, Downloads, Documentation, Usermin, Virtualmin, Cloudmin, and Community. The main content area features a heading about the "Webmin 1.890 Exploit - What Happened?". It discusses how the exploit was introduced in version 1.890 and continued through 1.920. The sidebar on the left contains links for downloading Webmin (RPM, Debian Package, TAR file, Solaris Package, Development Versions, Third-Party Modules) and various Webmin Links (Introduction To Webmin, Supported Systems, Module Documentation, Screenshots, Standard Modules, Supported Languages, Updated Modules).

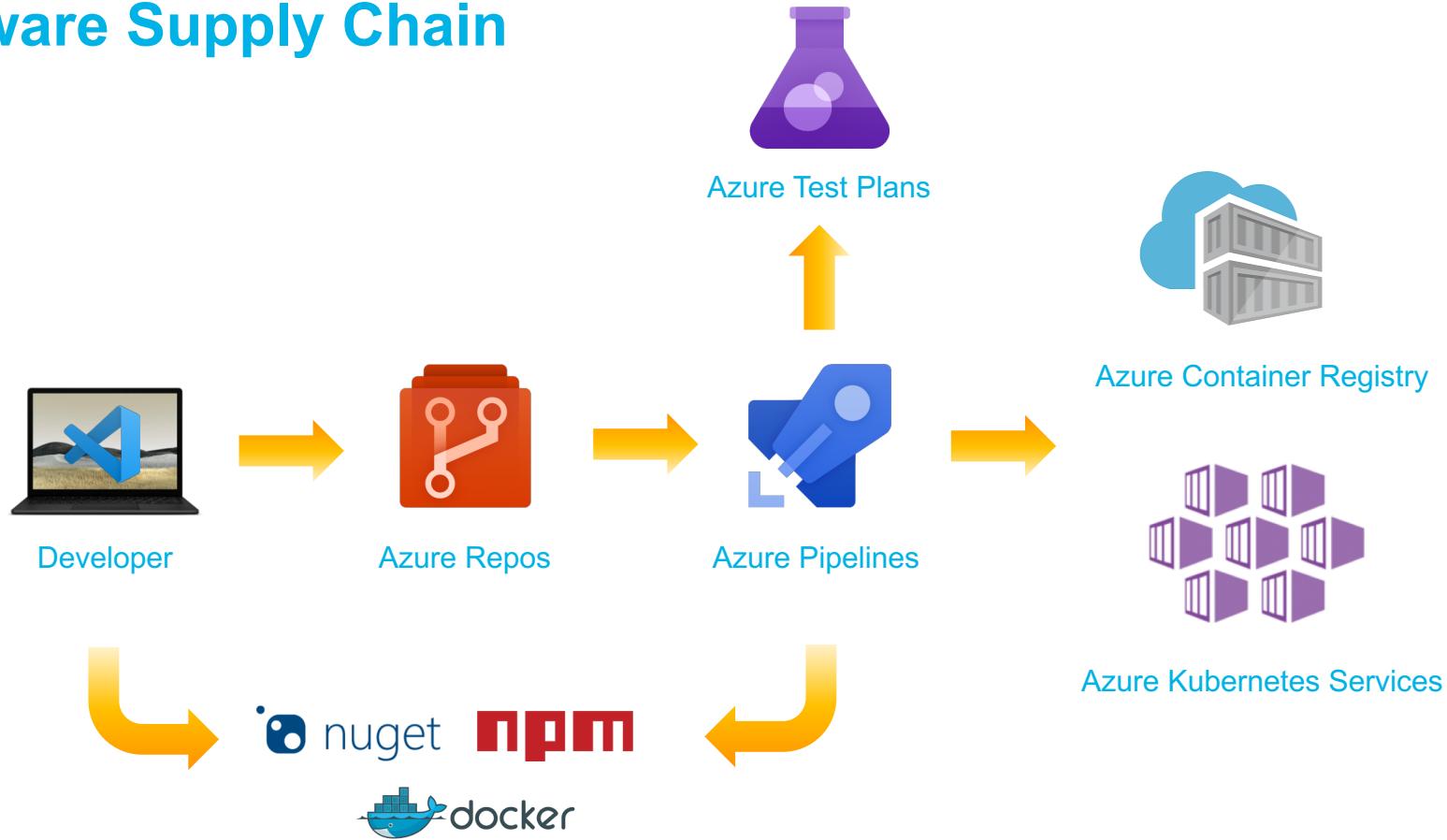
## Webmin 1.890 Exploit - What Happened?

Webmin version 1.890 was released with a backdoor that could allow anyone with knowledge of it to execute commands as `root`. Versions 1.900 to 1.920 also contained a backdoor using similar code, but it was not exploitable in a default Webmin install. Only if the admin had enabled the feature at Webmin -> Webmin Configuration -> Authentication to allow changing of expired passwords could it be used by an attacker.

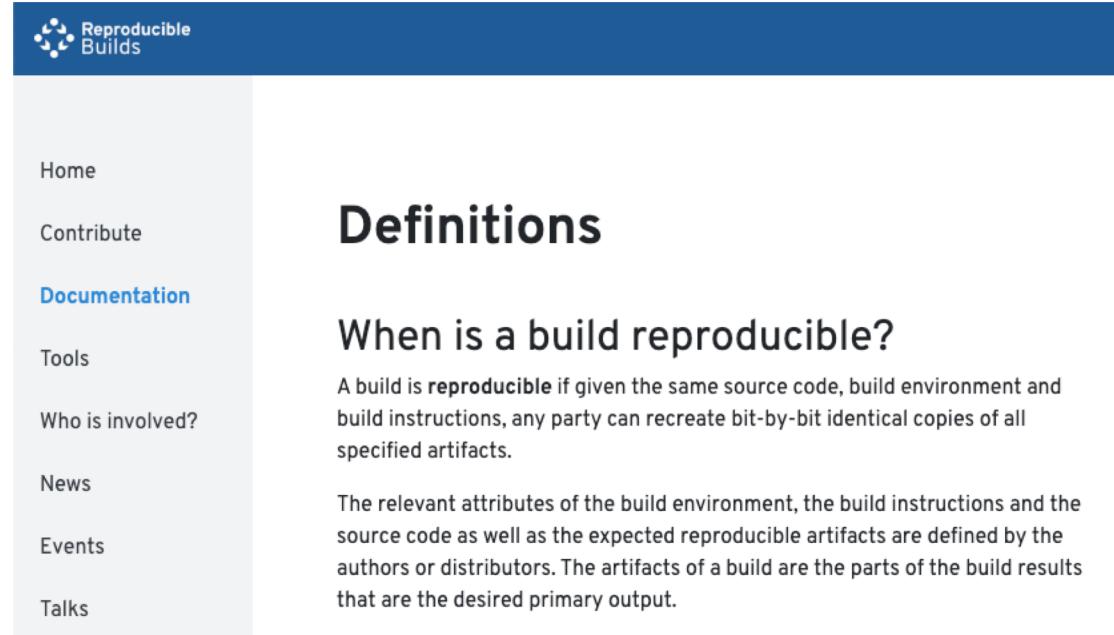
Neither of these were accidental bugs - rather, the Webmin source code had been maliciously modified to add a non-obvious vulnerability. It appears that this happened as follows :

- At some time in April 2018, the Webmin development build server was exploited and a vulnerability added to the `password_change.cgi` script. Because the timestamp on the file was set back, it did not show up in any Git diffs. This was included in the Webmin 1.890 release.
- The vulnerable file was reverted to the checked-in version from Github, but sometime in July 2018 the file was modified again by the attacker. However, this time the exploit was added to code that is only executed if changing of expired passwords is enabled. This was included in the Webmin 1.900 release.

# Software Supply Chain



# Reproducible/Deterministic Builds



The screenshot shows a website for "Reproducible Builds". The header features a blue bar with the "Reproducible Builds" logo, which consists of four white dots arranged in a diamond shape, followed by the text "Reproducible Builds". Below this is a light gray sidebar containing links: Home, Contribute, Documentation (which is highlighted in blue), Tools, Who is involved?, News, Events, and Talks. The main content area has a dark blue header with the title "Definitions" in large, bold, black font. Below the title is a section titled "When is a build reproducible?" with a detailed explanation.

## Definitions

### When is a build reproducible?

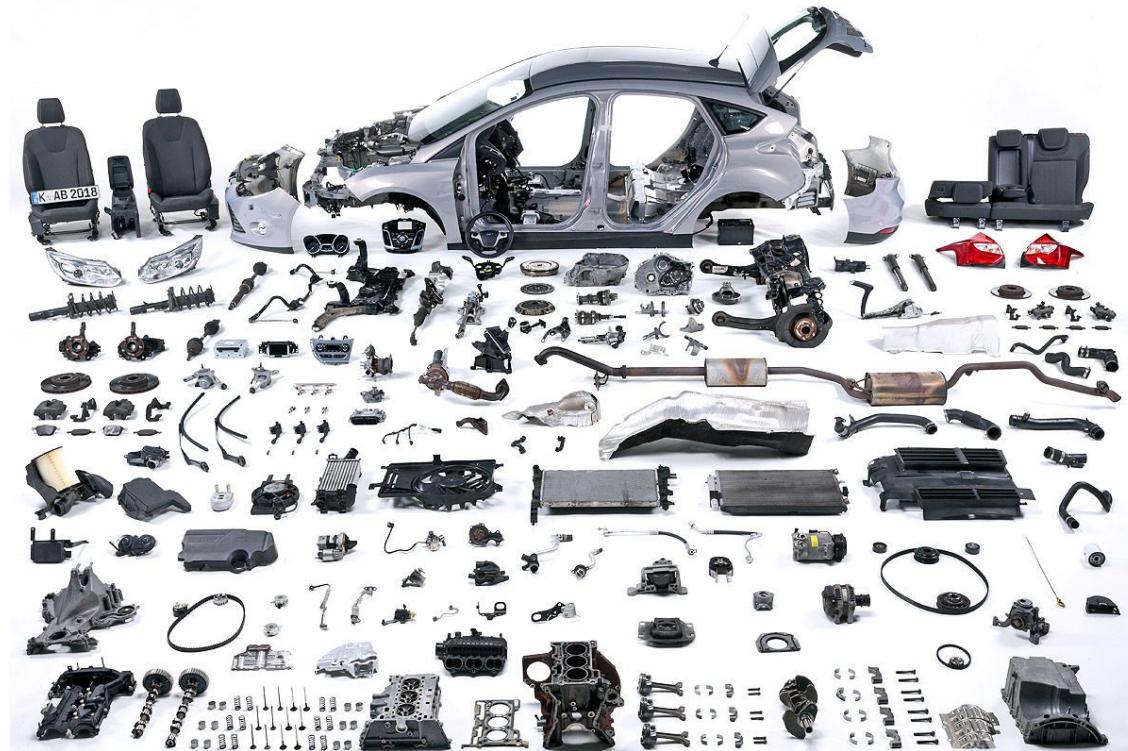
A build is **reproducible** if given the same source code, build environment and build instructions, any party can recreate bit-by-bit identical copies of all specified artifacts.

The relevant attributes of the build environment, the build instructions and the source code as well as the expected reproducible artifacts are defined by the authors or distributors. The artifacts of a build are the parts of the build results that are the desired primary output.

# Reproducible/Deterministic Builds

- Roslyn v1.1 started supporting some kind of determinism on how items are emitted
- Given same inputs, the compiled output will always be deterministic
- Inputs can be found in Roslyn compiler docs ‘Deterministic Inputs’
  - Current full directory path influences PDB location embedded in PE Header
- PE Header has values that need MSBuild **/deterministic** flag set (default .NET Core)
  - MVID: GUID identifying the PE which will be generated by compiler
  - PDB ID: GUID identifying the generated PDB matching PDB generated on each build
  - Date / Time stamp: Seconds since epoch, calculated on every build

# Automotive Industry



# Car Supply Chain



## Tata Steel Factory

- Iron Ore from Sweden
- ISO 6892-1 Tested/Certified
  - Batch #1234



## Bosch Factory

- Steel Batch #1234 Tata
- ECE-R90 Tested/Certified
  - Serie #45678
- Used by Ford, Volkswagen and KIA



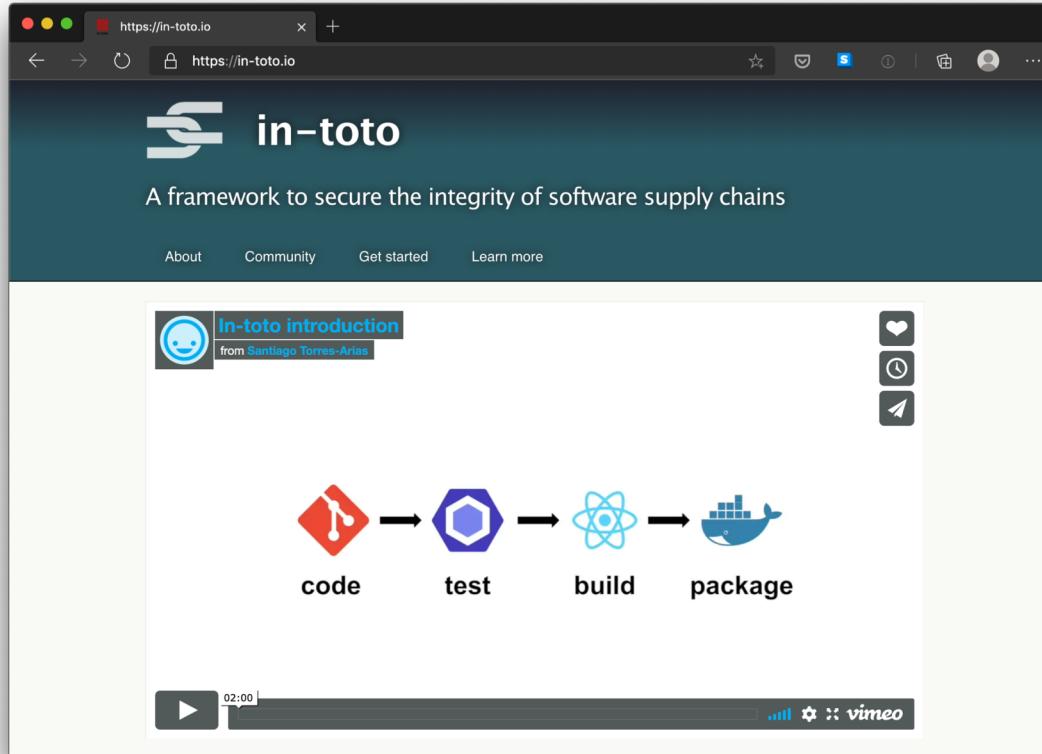
## Ford Manufacturing

- Bosch Disk #45678
- Bosal Exhaust #RE9876
- Goodyear Tires #GY8877
- Focus VIN 1234567890

# Software Bill of Materials (SBOM) & Policy

- Industry standard of describing the software
  - Producer Identity – Who Created it?
  - Product Identity – What's the product?
  - Integrity – Is the project unaltered?
  - Licensing – How can the project be used?
  - Creation – How was the product created? Process meets requirements?
  - Materials - How was the product created? Materials/Source used?
- CycloneDX – Lightweight SBOM with dependency graph

# In-Toto



# In-Toto – Demo - Terminology

- **Functionaries** that are identified by public key our supply chain.  
Niels (Project-Owner), Aimee (Developer) and Noud (Packager)
- **Project-Owner** defines a **(Supply Chain) Layout** that describes **what** happens and by **who** and what the produced **Materials** and **Byproducts** are.
- Link metadata is output of executed step in the **Layout**  
**Materials** are input, **Products** are output and can be used as **Materials** in later steps
- With executing the **Verification** all end-products and associated **Link** metadata will be verified

# DataDog & In-Toto

The screenshot shows a web browser displaying a blog post from DataDog's website. The title of the post is "Secure Publication of Datadog". The main heading on the page is "End-to-end verification with in-toto". Below this, there is a detailed explanation of how In-Toto is used to verify the software supply chain. A diagram illustrates the flow of data and signatures between Developers, CI/CD, and Agent stages.

To set such a standard, we must prevent tampering at any step in the *software supply chain* between the development and the publication of the software. A step may be, for example, a developer writing source code, or a CI/CD job packaging this source code into a zip file. We use in-toto to specify our supply chain as a fixed series of steps, each of which must produce signed metadata about the input it received, and the output it produced. When a client such as the Datadog Agent puts together the signed metadata, it is able to inspect whether a package was produced following this prescribed series of steps, by only the designated parties.

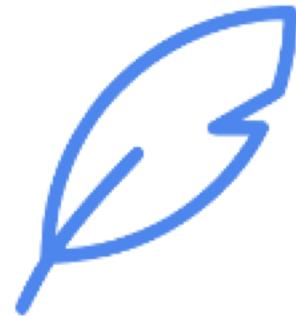
The diagram shows the following components and their interactions:

- DEVELOPERS:** TAG → YUBIKEYS → TAG-LINK (containing "dd-check/ setup.py: 0xA").
- CI/CD:** WHEELS-BUILDER → WHEELS-BUILDER KEY → WHEELS-BUILDER.LINK (containing "dd-check/ setup.py: 0xA" and "dd-check whl: 0x8").
- CI/CD:** WHEELS-SIGNER → WHEELS-SIGNER KEY → WHEELS-SIGNER.LINK (containing "dd-check whl: 0x8").
- AGENT:** UNZIP → UNZIP.LINK (containing "dd-check whl: 0x8" and "dd-check/ setup.py: 0xA").

Signatures are exchanged between the TAG-LINK and WHEELS-BUILDER.LINK, between WHEELS-BUILDER.LINK and WHEELS-SIGNER.LINK, and between WHEELS-SIGNER.LINK and UNZIP.LINK. Each component also has a self-contained "dd-check" step.

# Grafeas and Kritis by Google

- Grafeas – Component Metadata API
  - Container Analysis API on Google Cloud Platform
- Kritis – Deployment Authorization for Kubernetes Applications
  - Binary Authorization on Google Cloud Platform



# Azure Pipelines Artifact Policy

The screenshot shows a Microsoft Docs page titled "Artifact policy checks" under the "Azure Pipelines" section. The page content includes a sidebar with navigation links for various artifact types and pipeline tasks, and a main article body with a note about supported artifact types.

**Version**  
Azure DevOps Services

**Filter by title**

- > Configure security & settings
- > Migrate
- > Pipeline tasks
- > Troubleshooting
- > Reference
  - YAML schema
  - Expressions
  - File matching patterns
  - File and variable transform
  - Logging commands
  - Artifact policy checks**
- > Case studies & best practices
- > Developer resources

**Download PDF**

## Artifact policy checks

11/05/2019 • 2 minutes to read • 📄 🎨 🎯 +1

**In this article**

[Prerequisites](#)  
[Creating custom policies](#)

Artifact policies are enforced before deploying to critical environments such as production. These policies are evaluated against all the deployable artifacts in the given pipeline run and block the deployment if the artifacts don't comply. Adding a check to evaluate Artifact requires the custom policy to be configured. This guide describes how custom policies can be created.

**Note**

Currently, the supported artifact types are for container images and Kubernetes environments

## Prerequisites

Use Rego for defining policy that is easy to read and write.

# Conclusion

- Be aware of your own (and other used) software supply chain(s).
- Know what you're consuming and pulling into software projects.
- Use MFA on all accounts!
- Integrate security into your software lifecycle.
- Learn more on Software Bill of Materials (SBOM).



Thanks! Questions?

**VERACODE**

You change the world, we'll secure it.

<https://github.com/nielstanis/dncse2020>

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