

Cyber Injection Points in the DevOps CI/CD Pipeline

GLOBAL PRODUCT DATA
INTEROPERABILITY
S U M M I T
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Keith is a lifelong learner and has always been interested in understanding the bigger picture. Keith has a BS in Computer Science from SDSU and an MBA from a local university in San Diego, Alliant International Univ.

- Cyber certifications include Certified Information Systems Security Professional (CISSP), Certified Ethical Hacker (CEH), Security+, and a certified pentester (penetration tester) through Offensive Security (OSWP).**
- Programming certifications include Oracle Java Developer and Amazon Web Services (AWS) Cloud Solutions Architect.**
- INCOSE Certified Systems Engineering Professional (CSEP) and has served two years on the INCOSE San Diego board of directors.**

Cyber Injection Points in the DevOps CI/CD Pipeline

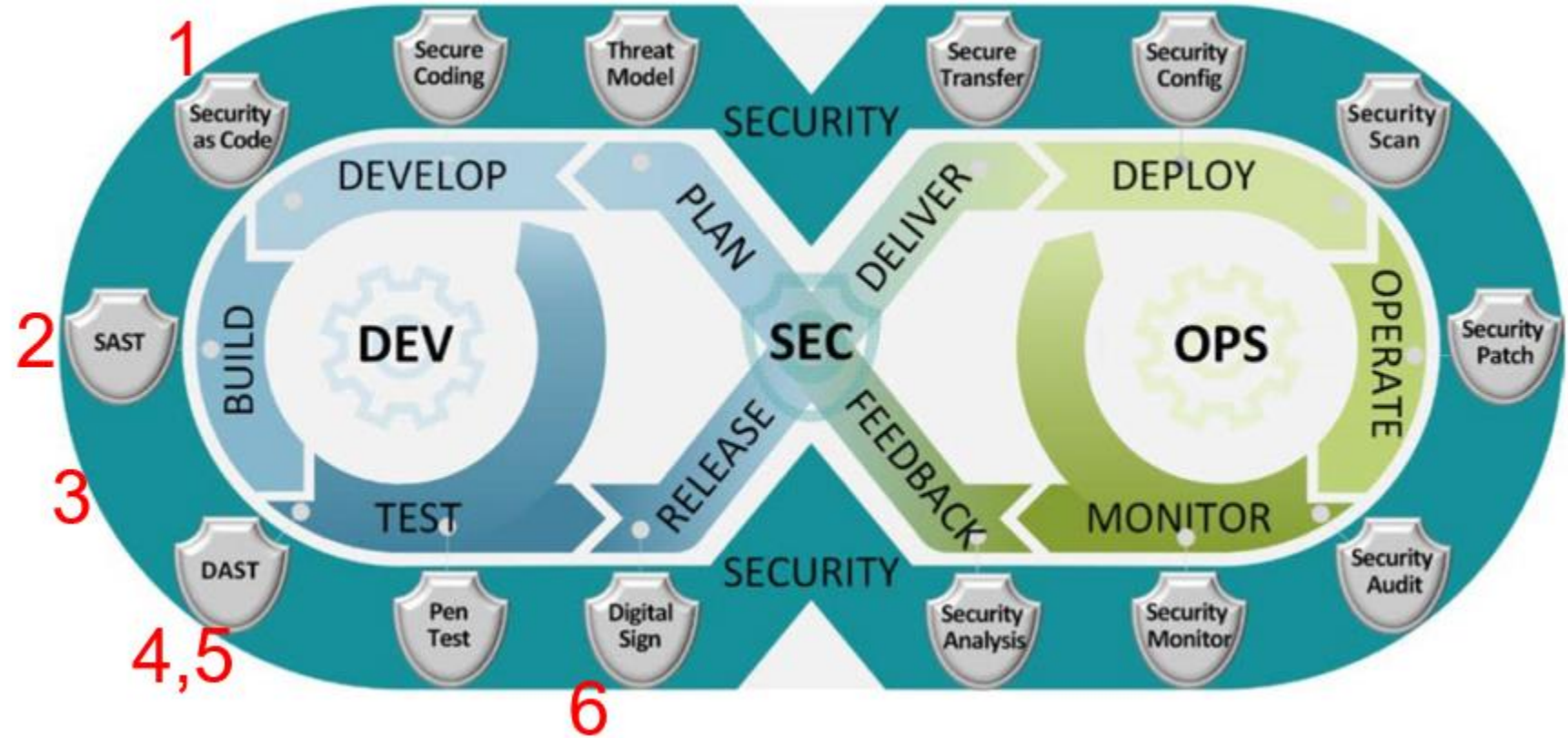
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- **Continuous Integration (CI)**
 - **Continuous Deployment (CD)**
 - **Development to Operations (DevOps)**
 - **Cyber – very generic term that will not be answered today**
-
- **My role is to identify and document cyber related best practices that could be used as a starting point for new programs or incorporated into existing programs. (slide 22)**

DevOps overview picture

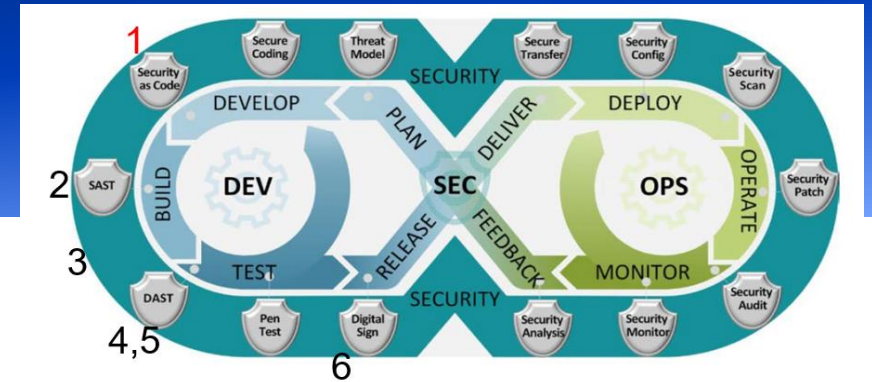
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1. Unit Test
2. Code Quality
3. Build Image
4. Deploy Staging
5. E2E Tests
6. Release



Automated Unit Tests

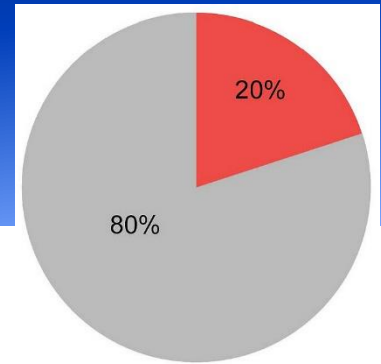
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- **Automated Unit Tests** - In computer science, test coverage is a measure used to describe the degree to which the source code of a program is executed when a particular test suite runs. A program with high test coverage, measured as a percentage, has had more of its source code executed during testing, which suggests it has a lower chance of containing undetected software bugs compared to a program with low test coverage.
- Atlassian is quoted – ‘it is generally accepted that 80% coverage is a good goal to aim for.’

Automated Unit Test

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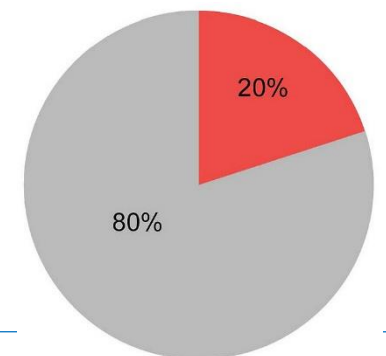


Unit tests are performed on individual classes and methods to ensure that they properly satisfy their API contracts with other classes. At this level, unit tests must be tested as isolated units without any interaction or dependency on other classes or methods. Unit tests are typically written by the developers themselves to verify the behavior of their code.

<https://owasp.org/www-pdf-archive/AutomatedSecurityTestingofWebApplications-StephendeVries.pdf>

Input Validation:

When testing security functionality it is important that both valid input is accepted (a functional requirement), and also that invalid and potentially dangerous data is rejected. Testing boundary and unexpected conditions is essential for security tests.



Automated Unit Test

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OWASP top 10 that are tied to input validation:

- **#1 – Injection**
- **#4 – XML external entities (XXE)**
- **#7 – Cross Site Scripting (CSS)**
- **#8 – Insecure Deserialization**

T10 OWASP Top 10 Application Security Risks – 2017

A1 – Injection	Injection flaws, such as SQL, OS, and LDAP injection occur when untrusted data is sent to an interpreter as part of a command or query. The attacker's hostile data can trick the interpreter into executing unintended commands or accessing data without proper authorization.
A2 – Broken Authentication and Session Management	Application functions related to authentication and session management are often implemented incorrectly, allowing attackers to compromise passwords, keys, or session tokens, or to exploit other implementation flaws to assume other users' identities (temporarily or permanently).
A3 – Cross-Site Scripting (XSS)	XSS flaws occur whenever an application includes untrusted data in a new web page without proper validation or escaping, or updates an existing web page with user supplied data using a browser API that can create JavaScript. XSS allows attackers to execute scripts in the victim's browser which can hijack user sessions, deface web sites, or redirect the user to malicious sites.
A4 – Broken Access Control	Restrictions on what authenticated users are allowed to do are not properly enforced. Attackers can exploit these flaws to access unauthorized functionality and/or data, such as access other users' accounts, view sensitive files, modify other users' data, change access rights, etc.
A5 – Security Misconfiguration	Good security requires having a secure configuration defined and deployed for the application, frameworks, application server, web server, database server, platform, etc. Secure settings should be defined, implemented, and maintained, as defaults are often insecure. Additionally, software should be kept up to date.
A6 – Sensitive Data Exposure	Many web applications and APIs do not properly protect sensitive data, such as financial, healthcare, and PII. Attackers may steal or modify such weakly protected data to conduct credit card fraud, identity theft, or other crimes. Sensitive data deserves extra protection such as encryption at rest or in transit, as well as special precautions when exchanged with the browser.
A7 – Insufficient Attack Protection	The majority of applications and APIs lack the basic ability to detect, prevent, and respond to both manual and automated attacks. Attack protection goes far beyond basic input validation and involves automatically detecting, logging, responding, and even blocking exploit attempts. Application owners also need to be able to deploy patches quickly to protect against attacks.
A8 – Cross-Site Request Forgery (CSRF)	A CSRF attack forces a logged-on victim's browser to send a forged HTTP request, including the victim's session cookie and any other automatically included authentication information, to a vulnerable web application. Such an attack allows the attacker to force a victim's browser to generate requests the vulnerable application thinks are legitimate requests from the victim.
A9 – Using Components with Known Vulnerabilities	Components, such as libraries, frameworks, and other software modules, run with the same privileges as the application. If a vulnerable component is exploited, such an attack can facilitate serious data loss or server takeover. Applications and APIs using components with known vulnerabilities may undermine application defenses and enable various attacks and impacts.
A10 – Underprotected APIs	Modern applications often involve rich client applications and APIs, such as JavaScript in the browser and mobile apps, that connect to an API of some kind (SOAP/XML, REST/JSON, RPC, GWT, etc.). These APIs are often unprotected and contain numerous vulnerabilities.

Automated Unit Test

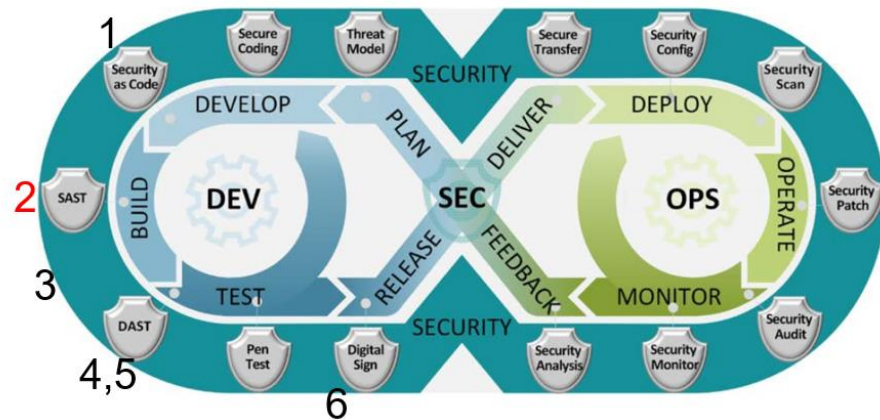
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Questions?

Code Security / Static Code Analysis

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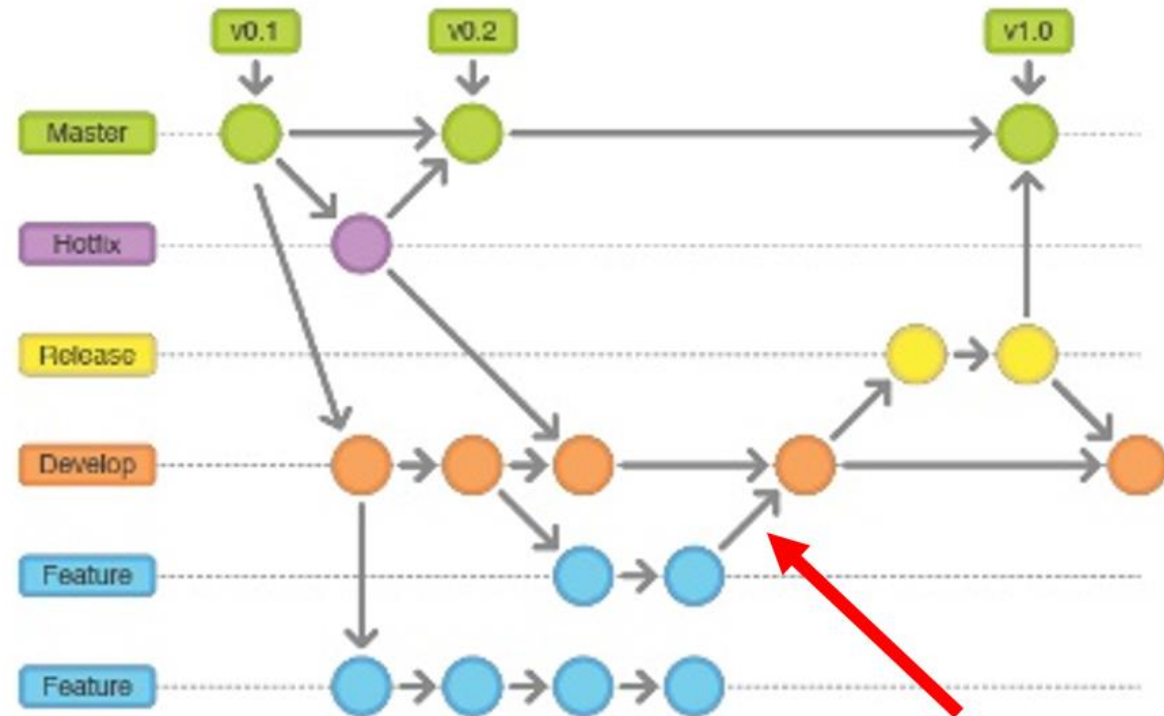
- **Stop the leak**
 - [Water Leak Changes the Game for Technical Debt Management \(sonarsource.com\)](https://sonarsource.com)
 - High Level Overview – stop rule violating code from being checked into the repository.
 - Addressing rule violating code that is already checked in is a different task.
- The main point is to discuss a security gate or a analysis to be required for a peer review.



Code Security / Static Code Analysis

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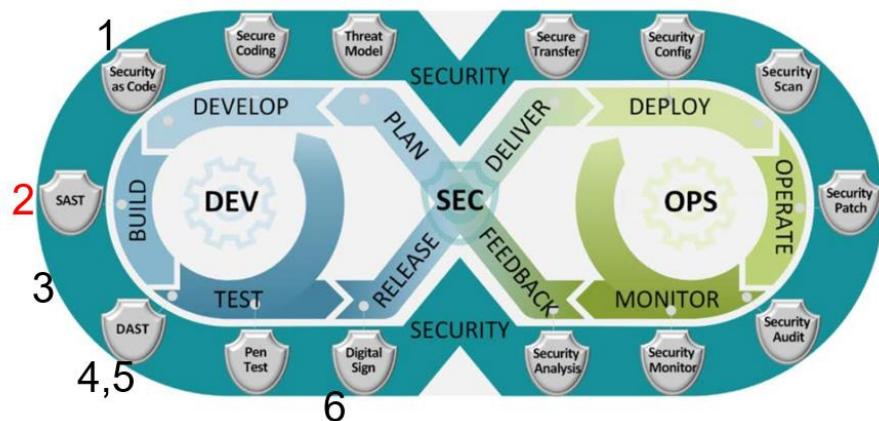
- Master
 - The holy grail aka Production
- Hotfix
 - maintenance outside of dev
- Release
 - ready for UAT
- Develop
 - main development stream
- Feature
 - individual feature / story



Code Security / Static Code Analysis

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- **Ways to stop rule violating code from being checked into the repo:**
 - 1. Quality Gate**
 - Automated way to stop rule violating code from being checked into the repo.
 - 2. Peer Review**
 - Could have Code Security / Static Code Analysis report requirement



- Master
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Code Security / Static Code Analysis

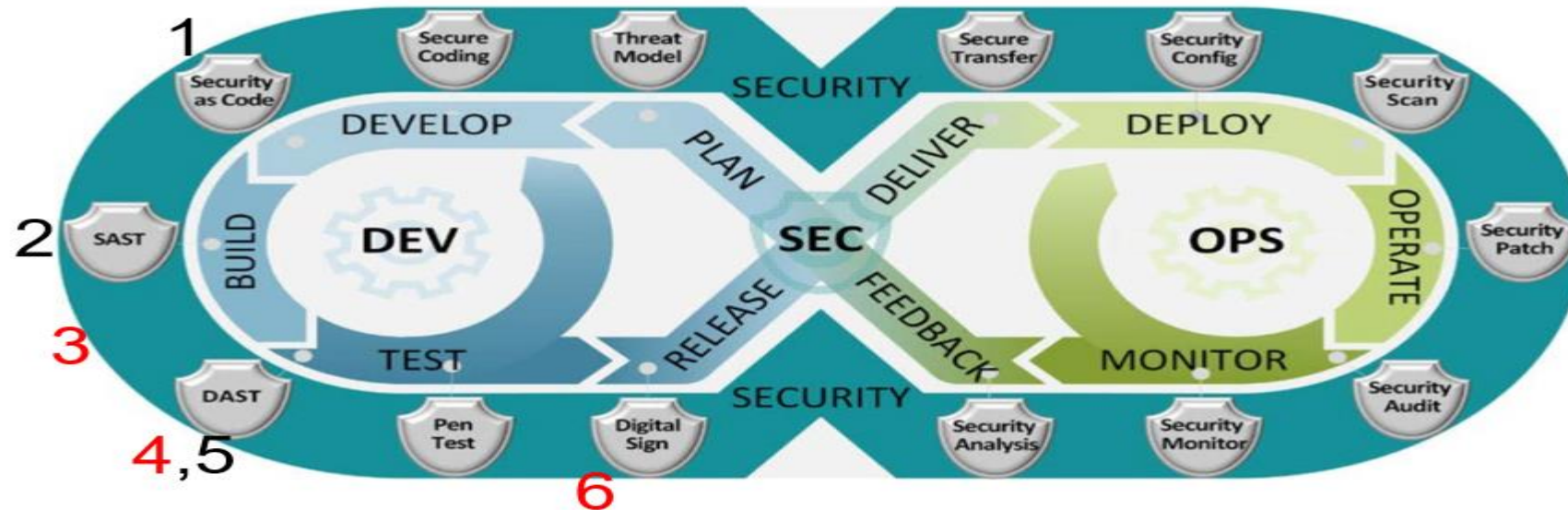
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- **Any questions on the static code analysis process?**



Build Image / Deploy Staging / Release

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Build Image: (Development)
Deploy Staging: (Integration)
Release: (Operations)



- [What is Infrastructure as Code? - Azure DevOps | Microsoft Docs](#)
- **Environment drift – maintain the settings of individual deployment environments – becoming a snowflake – a unique configuration.**
 - **With snowflakes, administration and maintenance of infrastructure involves manual processes which are hard to track and contributed to errors.**



- **Idempotence is a principle of Infrastructure as Code. Idempotence is the property that a deployment command always sets the target environment into the same configuration, regardless of the environment's starting state.**
 - *Idempotency is achieved by either automatically configuring an existing target or by discarding the existing target and recreating a fresh environment.*

Hardened Operating System

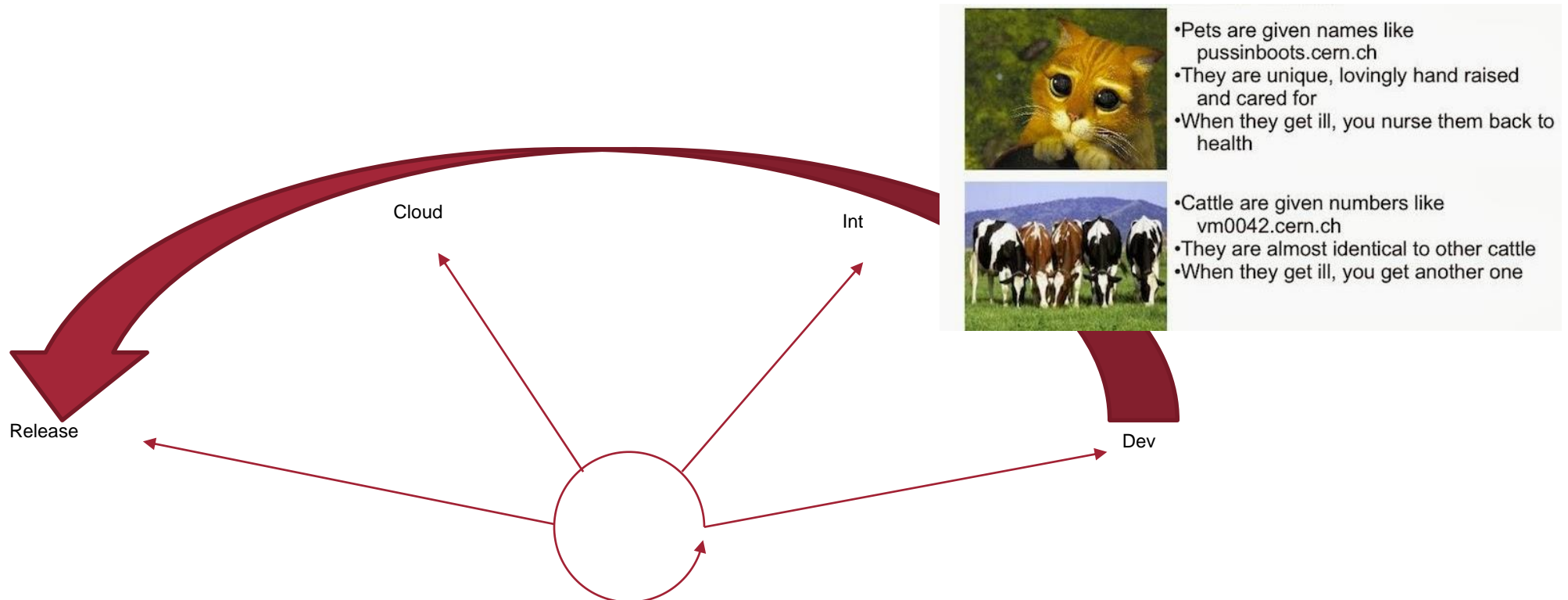
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- **Hardened Operating System can be used by Development, different levels of Integration, and Operations.**
 - **Hardened VM can be copied to different areas: Dev, Int, Ops**
 - **Hardened Operating System will be versioned and can be used for either VM/container or bare metal : Dev, Int, Ops**
 - **Hardening via STIGs: will need to confirm that each environment is consistent: Dev, Int, Ops**



DevOps Hardened VM Deployment

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During a schedule a new hardened VM can be pushed to: Dev, Int, Cloud, Ops. Schedule could be 7, 15, 30, 60, 90 day.

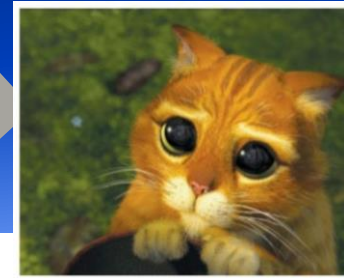
Automated script used to install/configure service on new hardened VM.

Automated installation script developed / configured / tested on Dev/Int network – alleviates manual one time configurations at Release site (Snowflake vs Idempotent).

Hardened Operating System CI/CD DevOps Pipeline

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Pets vs Cattle



Pros:

- No upstream configuration issues as each phase of dev / test is using same operating system

- Can be used for third party integrators as well

- * No ownership of machine – which can be changed out when a new configuration managed operating system is generated.

Cons:

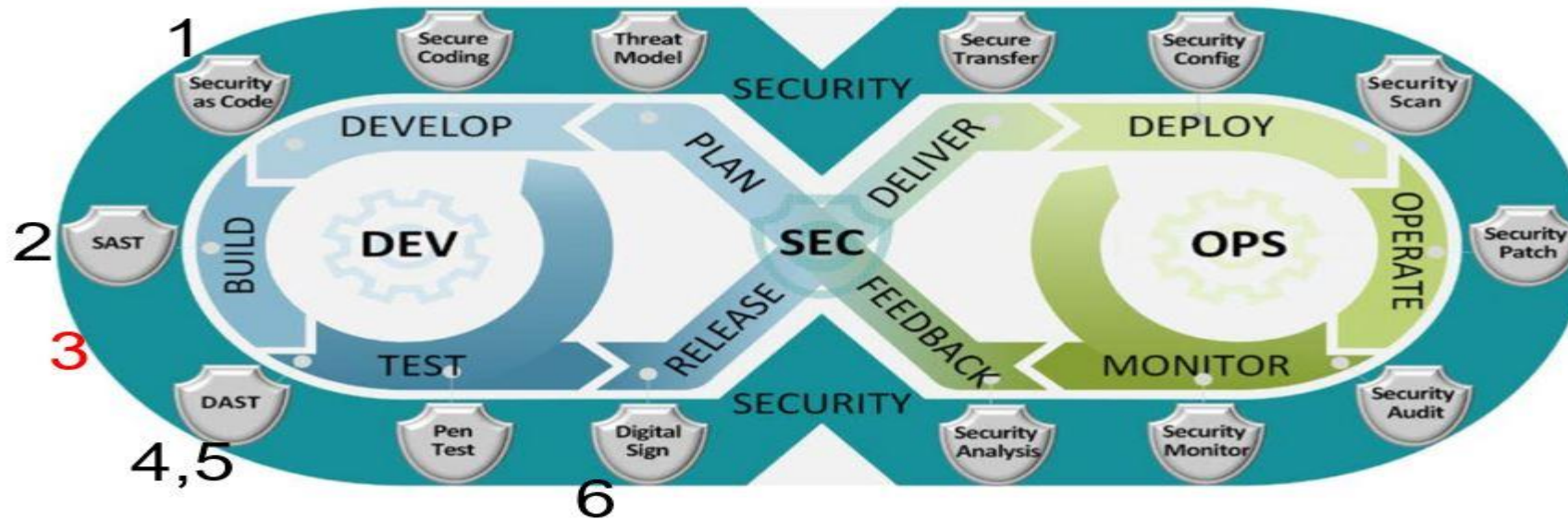
- Generating configuration managed operating system takes time to develop

- Development is slower because operating system changes go through change control board

- * No ownership of machine – which can be changed out when a new configuration managed operating system is generated.

Build Image

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Build Image: (**Development**) This is where the software build is installed on an approved hardened operating system image via an automated script.

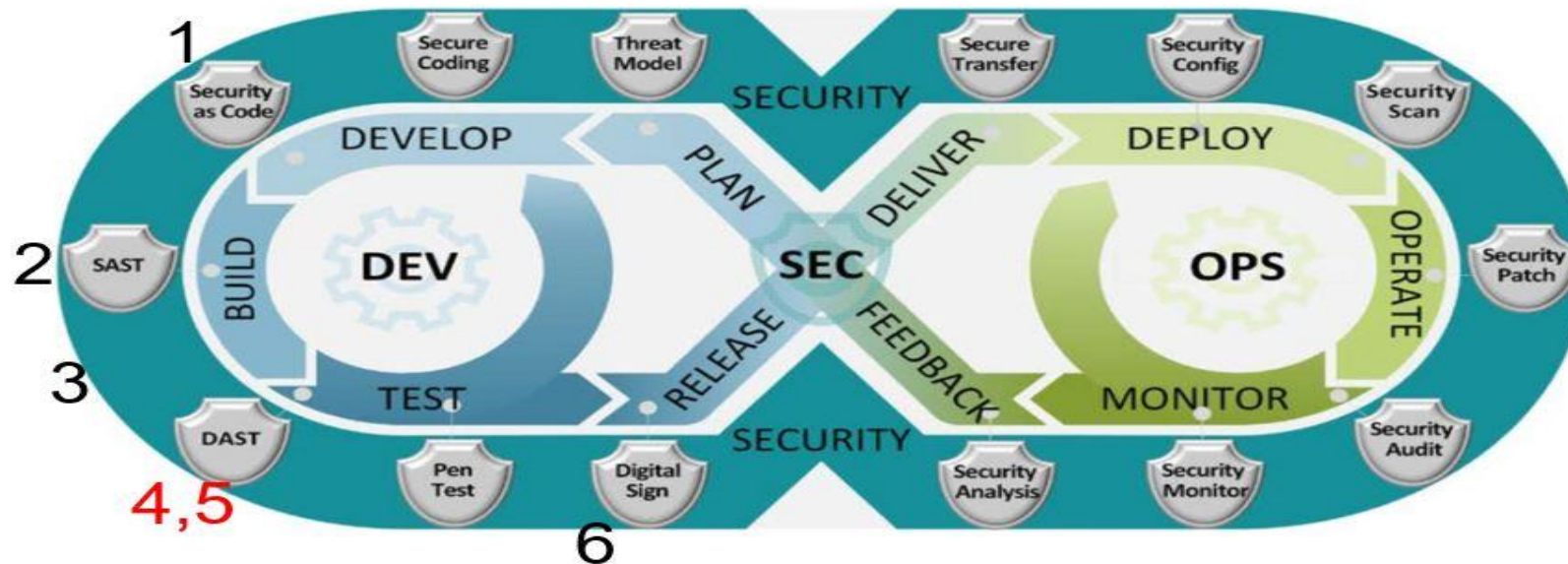
- Hardened operating system could be a VM, a container, or a operating system installation disk (gold image)

We will need to have the approved hardened operating system image available via a repository.

We will need to identify what type of script language to use to install the software service.

Deploy Staging

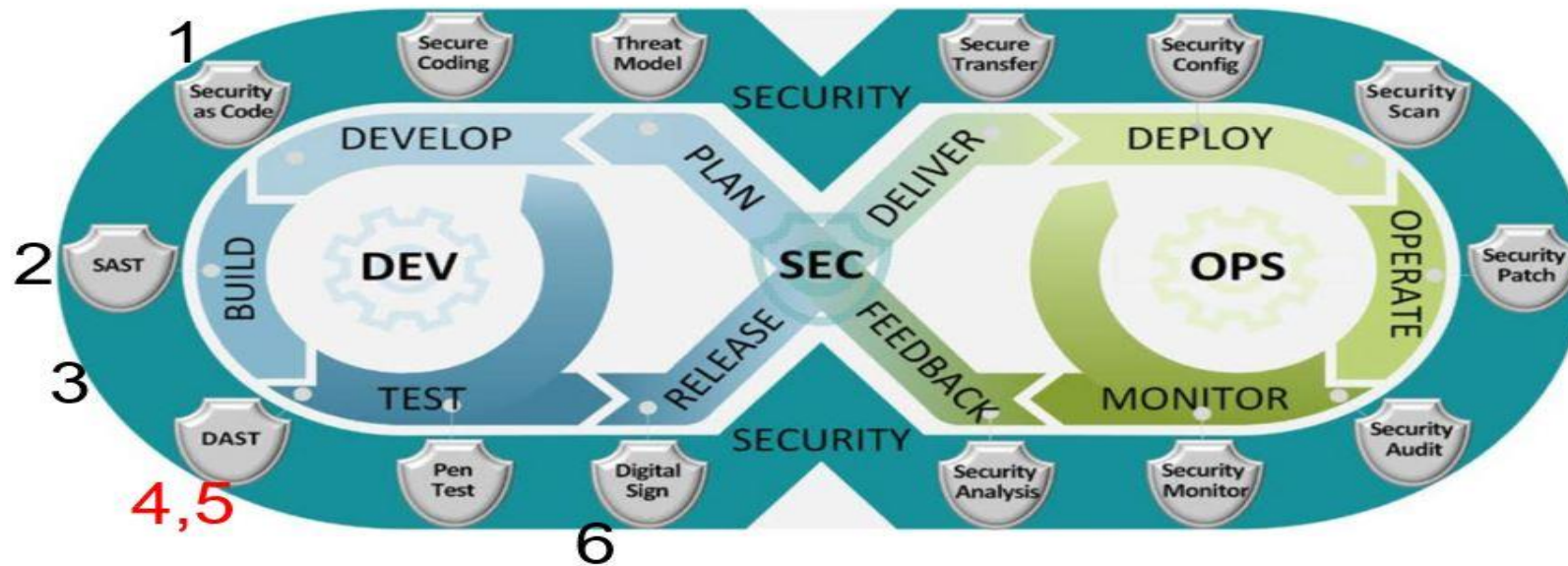
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Deploy Staging: (**Integration**) This is where the software build (application or service) is installed on a approved hardened VM image via an automated script. The software build and automated script are supplied – the hardened VM needs to be part of an integration server (not owned by the software developer).

Deploy Staging and E2E Tests

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E2E Tests: End to End

Could be an automated test to pass a security requirement.

<https://owasp.org/www-project-application-security-verification-standard/>

Security architecture has almost become a lost art in many organizations. The days of the enterprise architect have passed in the age of DevSecOps. The application security field must catch up and adopt agile security principles while re-introducing leading security architecture principles to software practitioners. **Architecture is not an implementation, but a way of thinking about a problem that has potentially many different answers, and no one single "correct" answer.** All too often, security is seen as inflexible and demanding that developers fix code in a particular way, when the developers may know a much better way to solve the problem. There is no single, simple solution for architecture, and to pretend otherwise is a disservice to the software engineering field.

- **The primary aspects of any sound security architecture:**
 - **Availability**
 - **Confidentiality**
 - **processing integrity**
 - **non-repudiation**
 - **privacy.**



Release

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Release: (Operations) This is when the VM/Container created from the Deploy Staging phase is transitioned to operations.