DENIM GROUP

the leading secure software development firm

Hybrid Analysis Mapping: Making Security and Development Tools Play Nice Together

Dan Cornell
CTO, Denim Group
@danielcornell

This presentation contains information about DHS-funded research:
Topic Number: H-SB013.1-002 - Hybrid Analysis Mapping (HAM)
Proposal Number: HSHQDC-13-R-00009-H-SB013.1-002-0003-I

My Background

- Dan Cornell, founder and CTO of Denim Group
- Software developer by background (Java, .NET, etc)
- OWASP San Antonio

Denim Group Background

- Secure software services and products company
  - *Builds secure software*
  - *Helps organizations assess and mitigate risk of in-house developed and third party software*
  - *Provides classroom training and e-Learning so clients can build software securely*
- Software-centric view of application security
  - *Application security experts are practicing developers*
  - *Development pedigree translates to rapport with development managers*
  - ***Business impact: shorter time-to-fix application vulnerabilities***
- Culture of application security innovation and contribution
  - *Develops open source tools to help clients mature their software security programs*
    - *Remediation Resource Center, ThreadFix*
  - *OWASP national leaders & regular speakers at RSA, SANS, OWASP, ISSA, CSI*
  - *World class alliance partners accelerate innovation to solve client problems*

So You Want To Run an AppSec Program?

Spans Multiple Disciplines

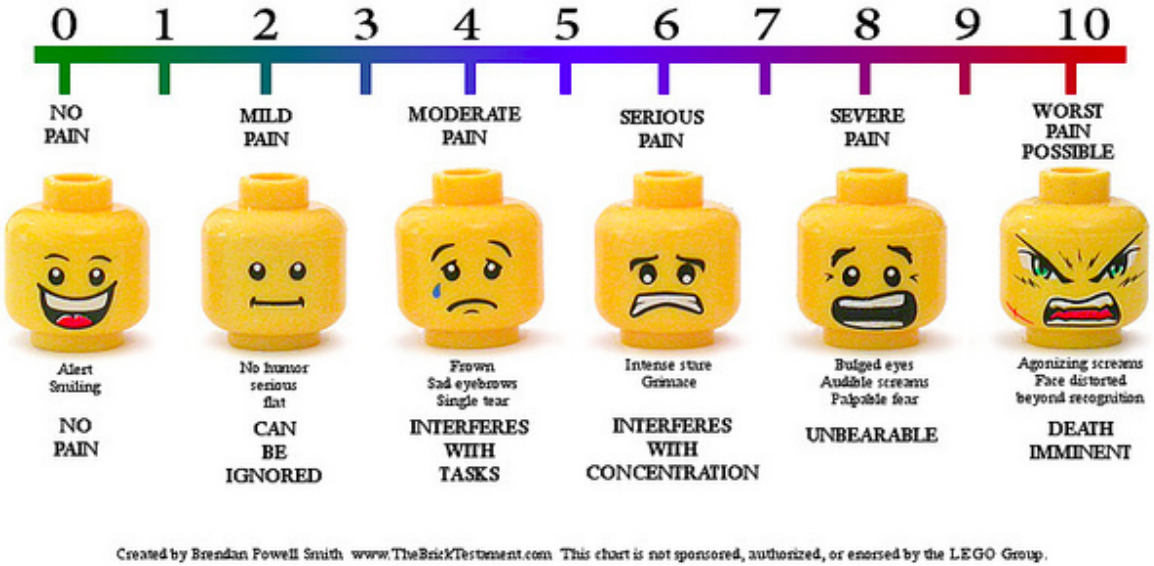
- Information Security
  - *Application Security*
- Audit and Compliance
- Risk Management

- (Oh Almost Forgot: Software Development)
- (And . . . Software Development Is Where Most of the Magic Has to Happen)

Comparatively New Discipline

- Physical Security: Old
- Information Security: Kinda New
- Application Security: Really New
- New Discipline Means Immature Metrics
  - *Possibly non-existent, certainly not generally-accepted*
  - *Don't know how to talk about the problem*
- New Discipline Means New Tools
  - *No standards for interaction*

Scale of the Problem



- “Legacy” Lines of Code
- Quantity of Applications
- Dearth of Qualified Professionals

So . . .

We Have a Huge Multidisciplinary Problem

In An Area We Can't Properly Characterize

Where We're Horribly Outnumbered

What to Do About It?

- Gather Data
- Communicate to Stakeholders
- Automate the Heck Out of Whatever Possible
- Repeat

Application Vulnerability Management

- Application security teams uses automated static and dynamic test results as well as manual testing results to assess the security of an application
- Each test delivers results in different formats
- Different test platforms describe same flaws differently, creating duplicates
- Security teams end up using spreadsheets to keep track manually
- It is extremely difficult to prioritize the severity of flaws as a result
- Software development teams receive unmanageable reports and only a small portion of the flaws get fixed

The Result

- Application vulnerabilities persist in applications:

  ***Average serious vulnerabilities found per website per year is 79*

  ***Average days website exposed to one serious vulnerability is 231 days*

  ***Overall percentage of serious vulnerabilities that are fixed annually is only 63%*

- Part of that problem is there is no easy way for the security team and application development teams to work together on these issues

- Remediation quickly becomes an overwhelming project

- Trending reports that track the number of reduced vulnerabilities are impossible to create

****WhiteHat Statistics Report (Summer 2012):**
https://www.whitehatsec.com/assets/WPstats_summer12_12th.pdf

Vulnerability Fun Facts:

Industry	Annual Avg. Vulnerabilities	Avg. Time-to-Fix (Days)	Average Remediation	Window of Exposure (Days)
ALL	79	38	63%	231
Banking	17	45	74%	185
Education	53	30	46%	261
Financial Services	67	80	63%	227
Healthcare	48	35	63%	239
Insurance	92	40	58%	211
IT	85	35	57%	208
Manufacturing	30	17	50%	252
Retail	121	27	66%	238
Social Networking	31	41	62%	264
Telecom	52	50	69%	271
Non-Profit	37	94	56%	320
Energy	31	4	40%	250

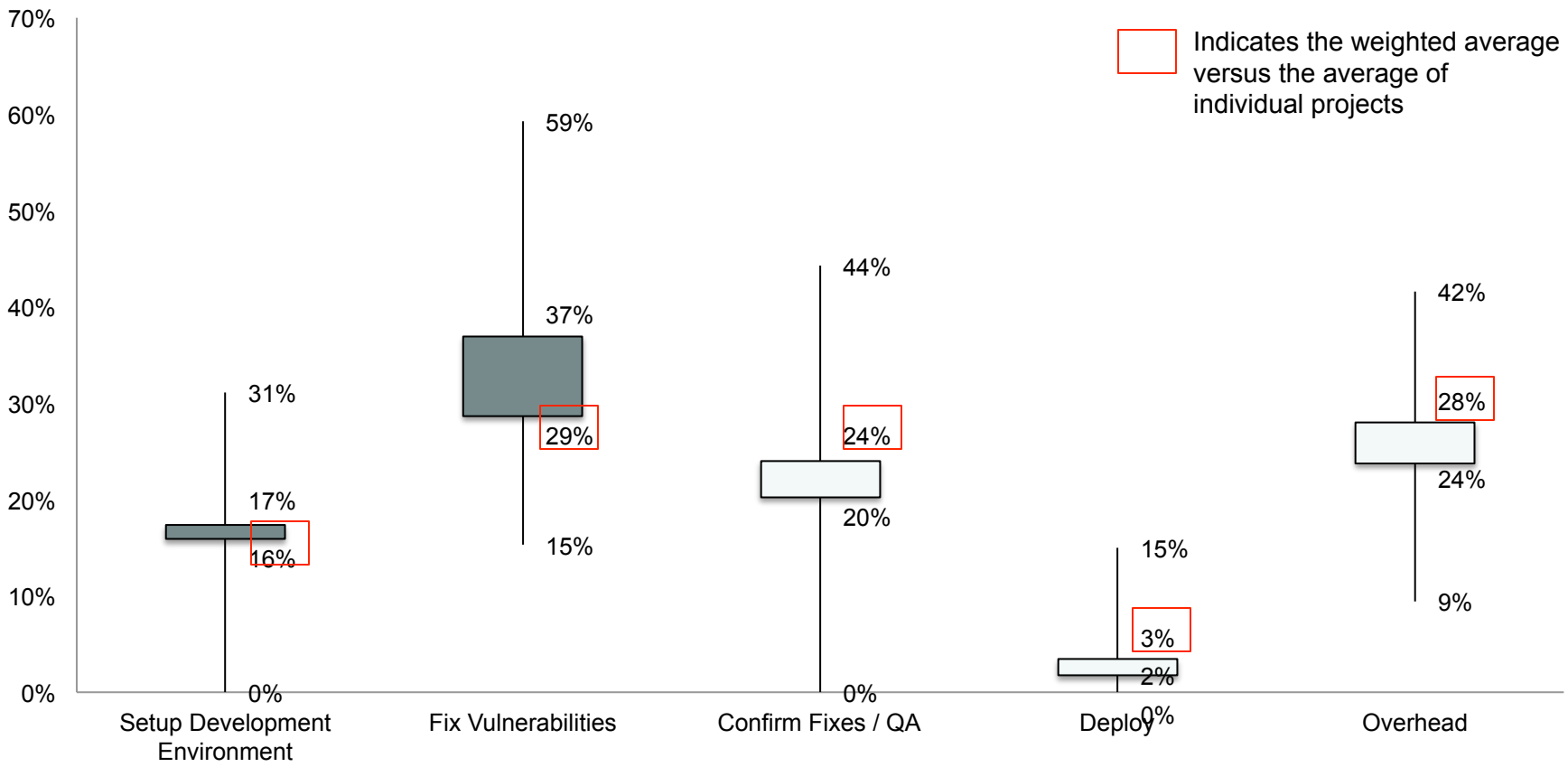
- Average number of serious vulnerabilities found per website per year is 79 **
- Serious Vulnerabilities were fixed in ~38 days **
- Percentage of serious vulnerabilities fixed annually is only 63% **
- Average number of days a website is exposed, at least one serious vulnerability ~231 days

WhiteHat Statistics Report (Summer 2012):
https://www.whitehatsec.com/assets/WPstats_summer12_12th.pdf

Vulnerability Remediation Data

Vulnerability Type	Sample Count	Average Fix (minutes)
Dead Code (unused methods)	465	2.6
Poor logging: system output stream	83	2.9
Poor Error Handling: Empty catch block	180	6.8
Lack of Authorization check	61	6.9
Unsafe threading	301	8.5
ASP.NET non-serializable object in session	42	9.3
XSS (stored)	1023	9.6
Null Dereference	157	10.2
Missing Null Check	46	15.7
XSS (reflected)	25	16.2
Redundant null check	21	17.1
SQL injection	30	97.5

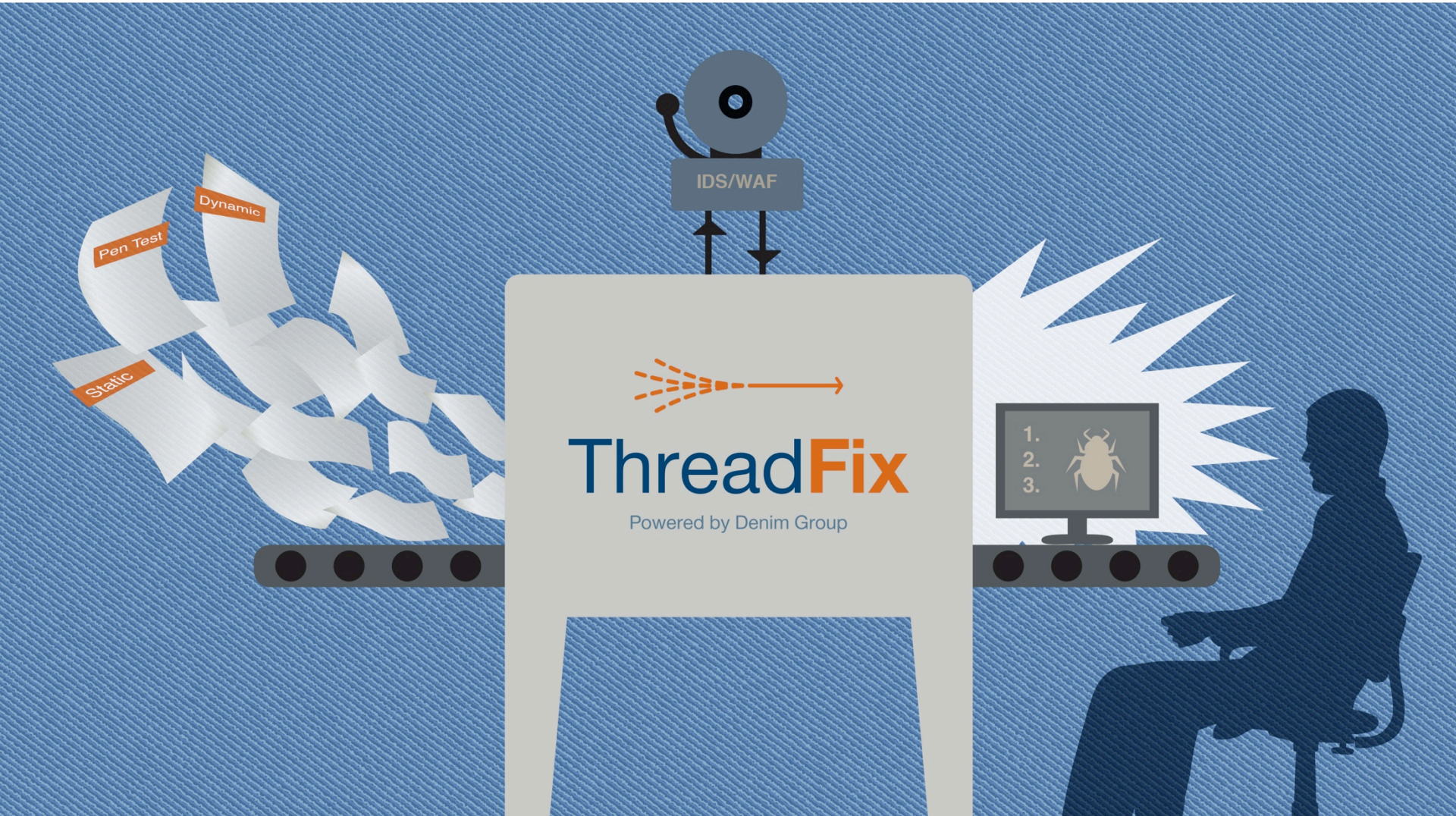
Where Is Time Being Spent?



ThreadFix

Accelerate Software Remediation

ThreadFix is a software vulnerability aggregation and management system that helps organizations aggregate vulnerability data, generate virtual patches, and interact with software defect tracking systems.



- **Open source vulnerability management and aggregation platform:**
  - *Allows software security teams to reduce the time to remediate software vulnerabilities*
  - *Enables managers to speak intelligently about the status / trends of software security within their organization.*

- **Features/Benefits:**
  - *Imports dynamic, static and manual testing results into a centralized platform*
  - *Removes duplicate findings across testing platforms to provide a prioritized list of security faults*
  - *Eases communication across development, security and QA teams*
  - *Exports prioritized list into defect tracker of choice to streamline software remediation efforts*
  - *Auto generates web application firewall rules to protect data during vulnerability remediation*
  - *Empowers managers with vulnerability trending reports to pinpoint issues and illustrate application security progress*
  - *Benchmark security practice improvement against industry standards*

- Freely available under the Mozilla Public License (MPL) 2.0
- Download available at: www.denimgroup.com/threadfix

List of Supported Tools / Technologies:

Dynamic Scanners

Acunetix
Arachni
Burp Suite
HP WebInspect
IBM Security AppScan Standard
IBM Security AppScan Enterprise
Mavituna Security Netsparker
NTO Spider
OWASP Zed Attack Proxy
Tenable Nessus
Skipfish
w3aF

Static Scanners

FindBugs
IBM Security AppScan Source
HP Fortify SCA
Microsoft CAT.NET
Brakeman

SaaS Testing Platforms

WhiteHat
Veracode
QualysGuard WAS

IDS/IPS and WAF

DenyAll
F5
Imperva
Mod_Security
Snort

Defect Trackers

Atlassian JIRA
Microsoft Team Foundation Server
Mozilla Bugzilla

Known Vulnerable Component Scanner

Dependency Check

ThreadFix
Powered by Denim Group

Large Range of Tool Compatibility

What is a Unique Vulnerability?

- (CWE, Relative URL)
  - *Predictable resource location*
  - *Directory listing misconfiguration*
- (CWE, Relative URL, Injection Point)
  - *SQL injection*
  - *Cross-site Scripting (XSS)*
- Injection points
  - *Parameters – GET/POST*
  - *Cookies*
  - *Other headers*

Why Common Weakness Enumeration (CWE)?

- Every tool has their own “spin” on naming vulnerabilities
- OWASP Top 10 / WASC 24 are helpful but not comprehensive

- CWE is exhaustive (though a bit sprawling at times)
- Reasonably well-adopted standard
- Many tools have mappings to CWE for their results

- Main site: http://cwe.mitre.org/

What Can We Do With ThreadFix?

- Create a consolidated view of your applications and vulnerabilities
- Prioritize application risk decisions based on data
- Translate vulnerabilities to developers in the tools they are already using

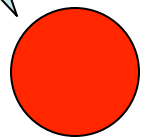
ThreadFix

Powered by Denim Group

Create a consolidated view of your applications and vulnerabilities

What Is Your Software Attack Surface?

Software You Currently Know About

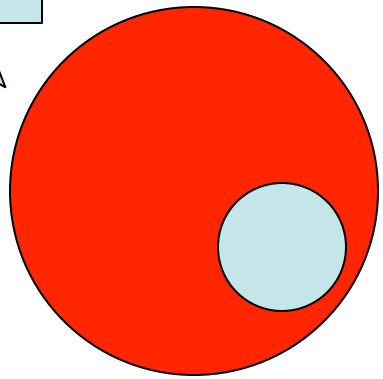


What?
- Critical legacy systems
- Notable web applications

Why?
- Lots of value flows through it
- Auditors hassle you about it
- Formal SLAs with customers mention it
- Bad guys found it and caused an incident (oops)

What Is Your Software Attack Surface?

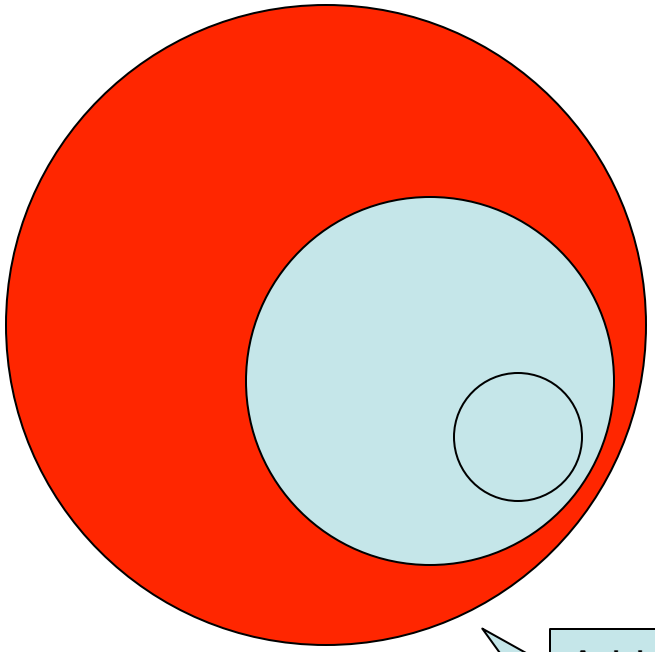
Add In the Rest of the Web Applications You Actually Develop and Maintain



What?
- Line of business applications
- Event-specific applications

Why Did You Miss Them?
- Forgot it was there
- Line of business procured through non-standard channels
- Picked it up through a merger / acquisition

What Is Your Software Attack Surface?

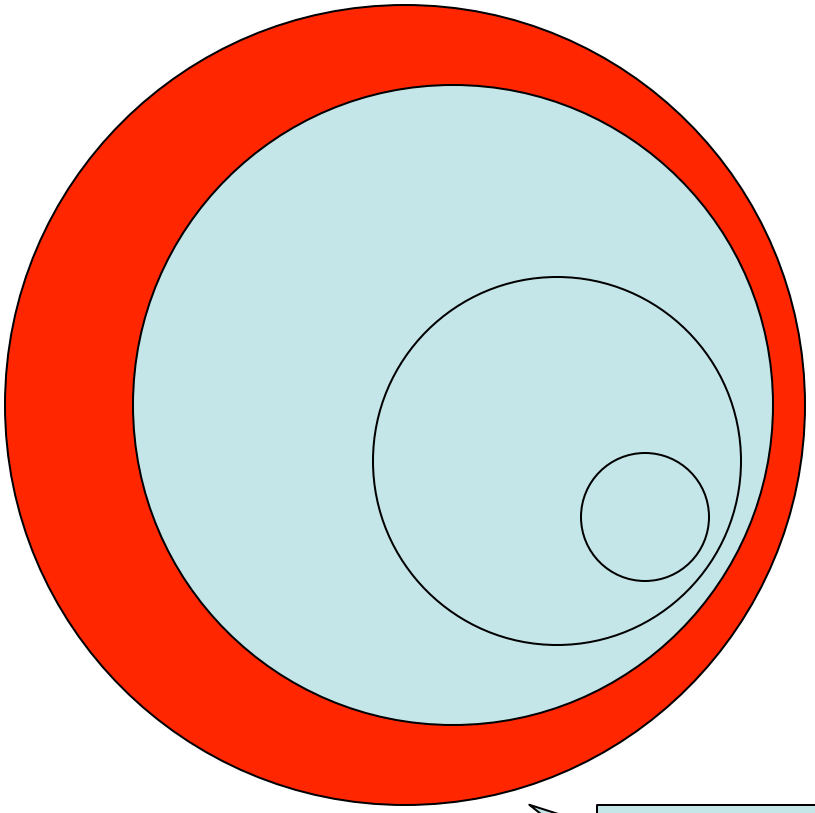


Add In the Software You Bought from Somewhere

What?
- More line of business applications
- Support applications
- Infrastructure applications

Why Did You Miss Them?
- Most scanner only really work on web applications so no vendors pester you about your non-web applications
- Assume the application vendor is handling security

What Is Your Software Attack Surface?



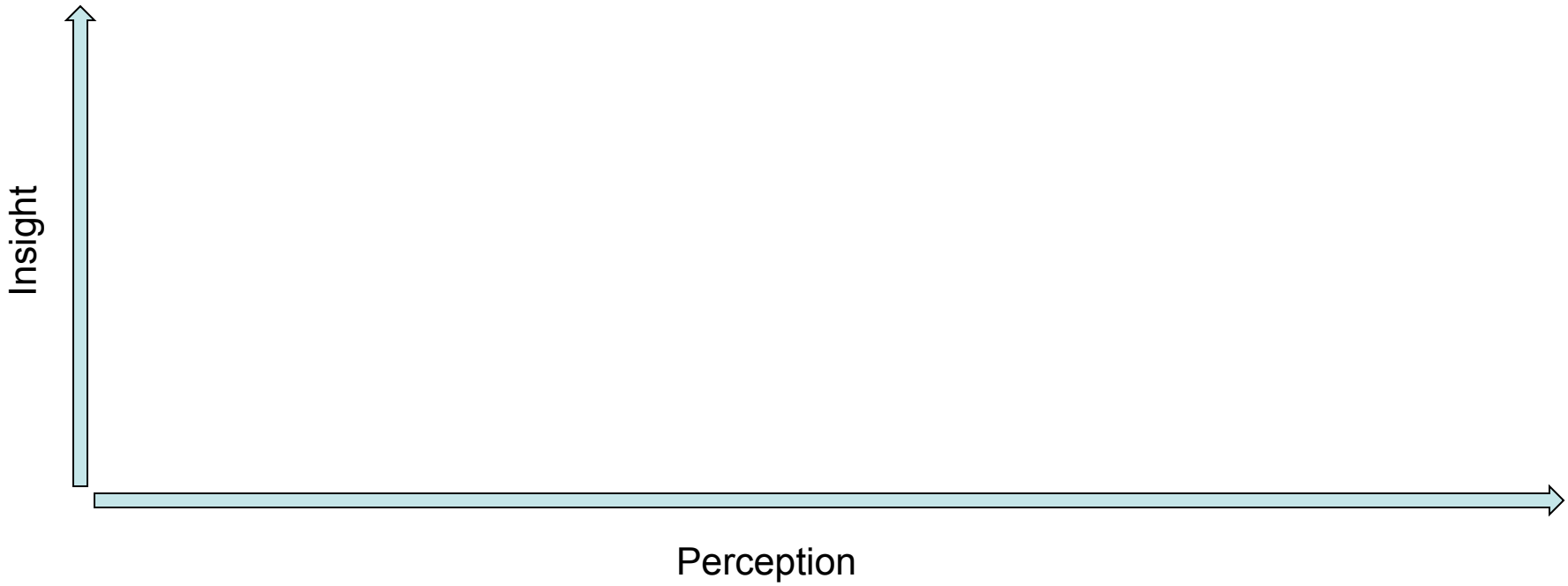
MOBILE!
THE CLOUD!

What?
- Support for line of business functions
- Marketing and promotion

Why Did You Miss Them?
- Any jerk with a credit card and the ability to submit an expense report is now runs their own private procurement office

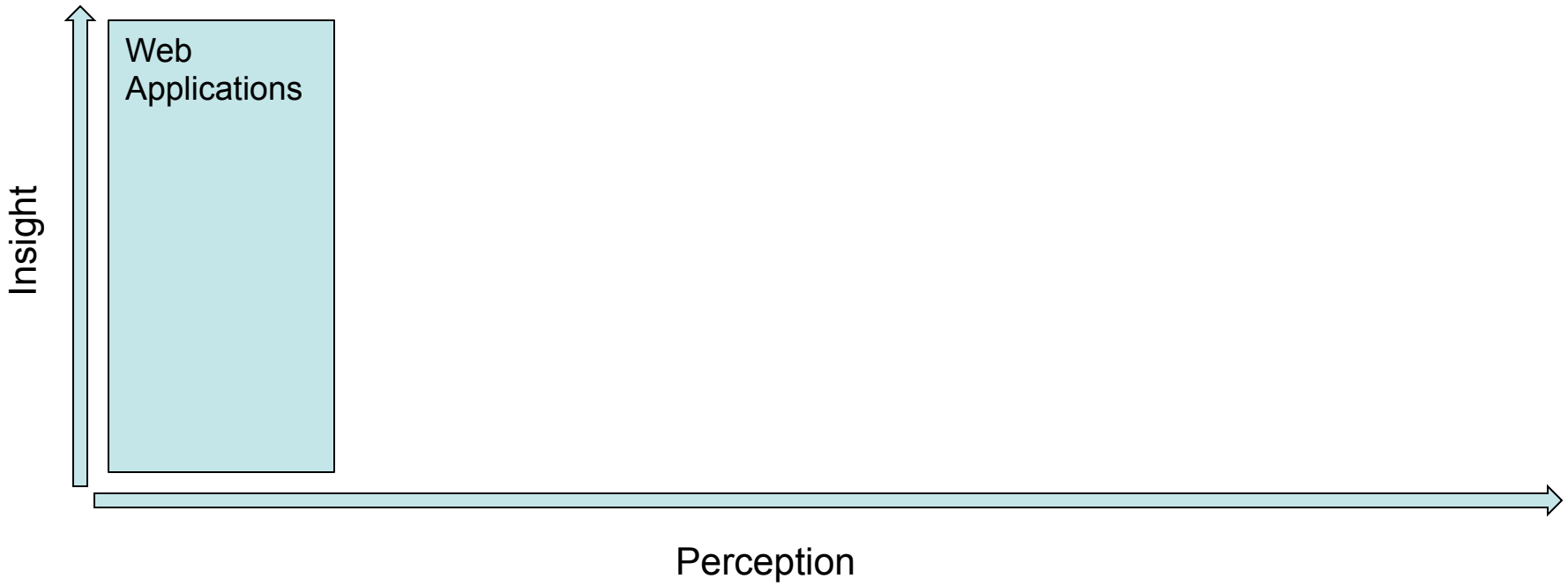
Attack Surface: The Security Officer's Journey

- Two Dimensions:
  - *Perception of Software Attack Surface*
  - *Insight into Exposed Assets*



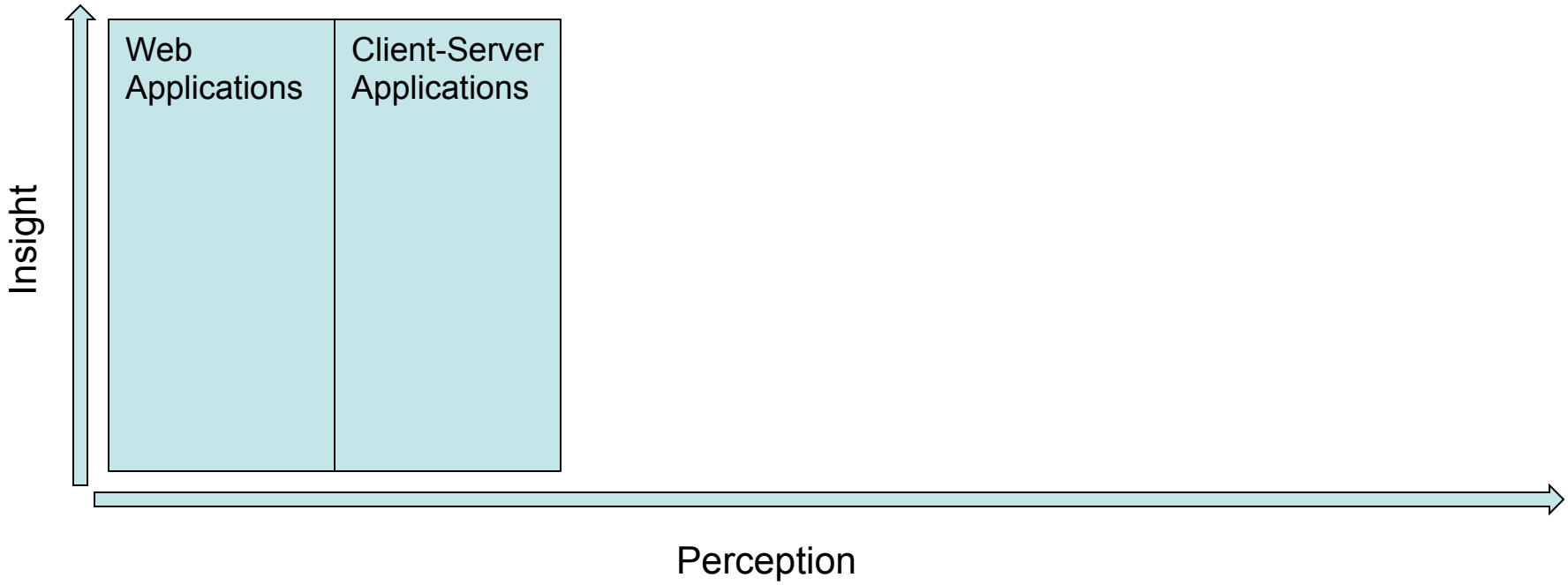
Attack Surface: The Security Officer's Journey

- As perception of the problem of attack surface widens the scope of the problem increases



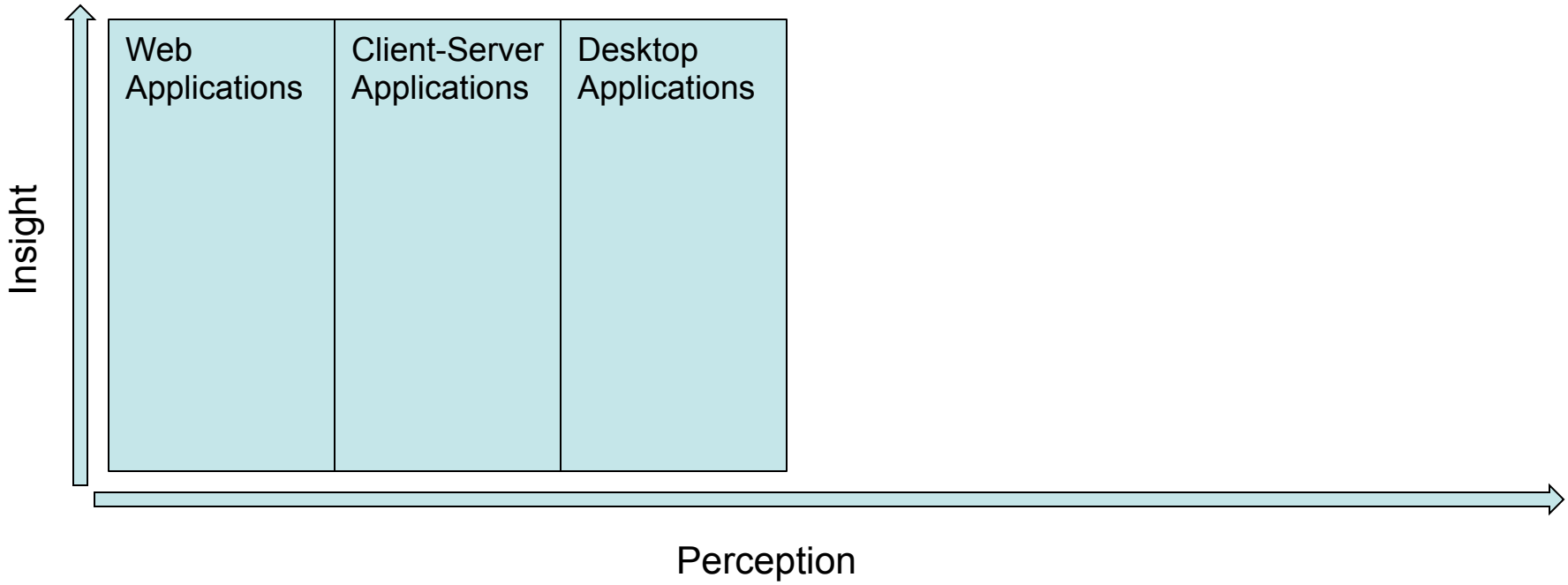
Attack Surface: The Security Officer's Journey

- As perception of the problem of attack surface widens the scope of the problem increases



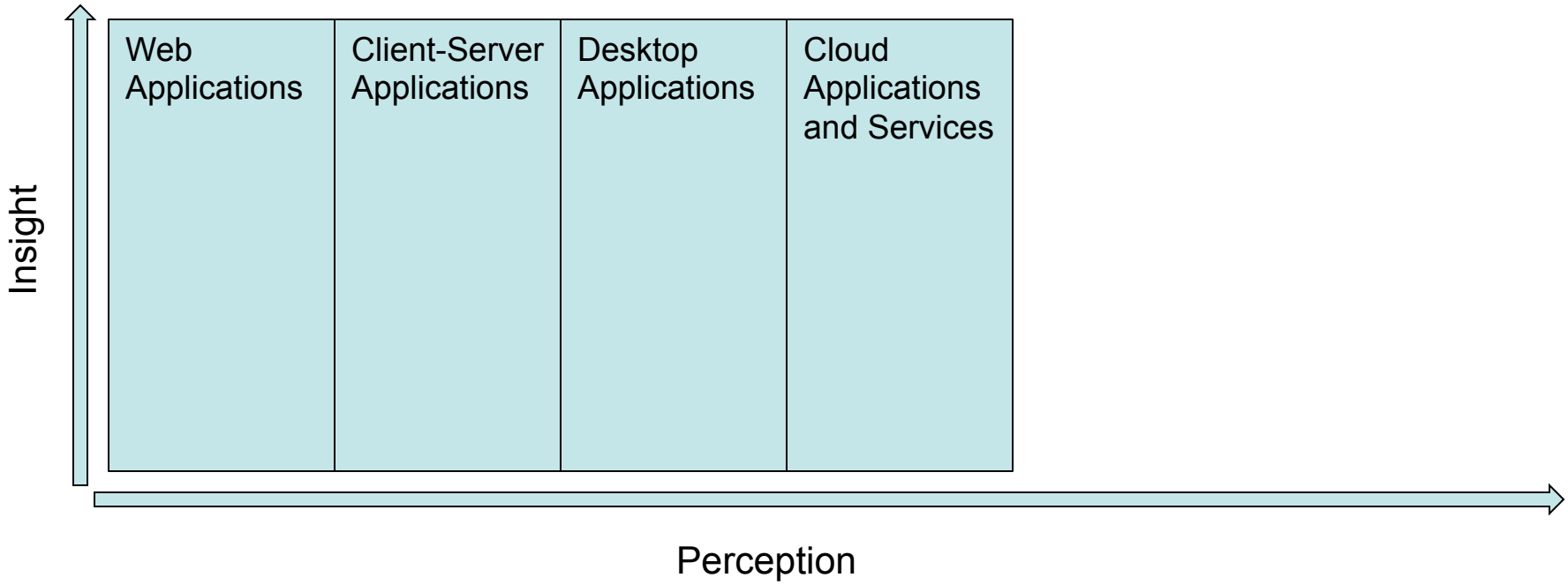
Attack Surface: The Security Officer's Journey

- As perception of the problem of attack surface widens the scope of the problem increases



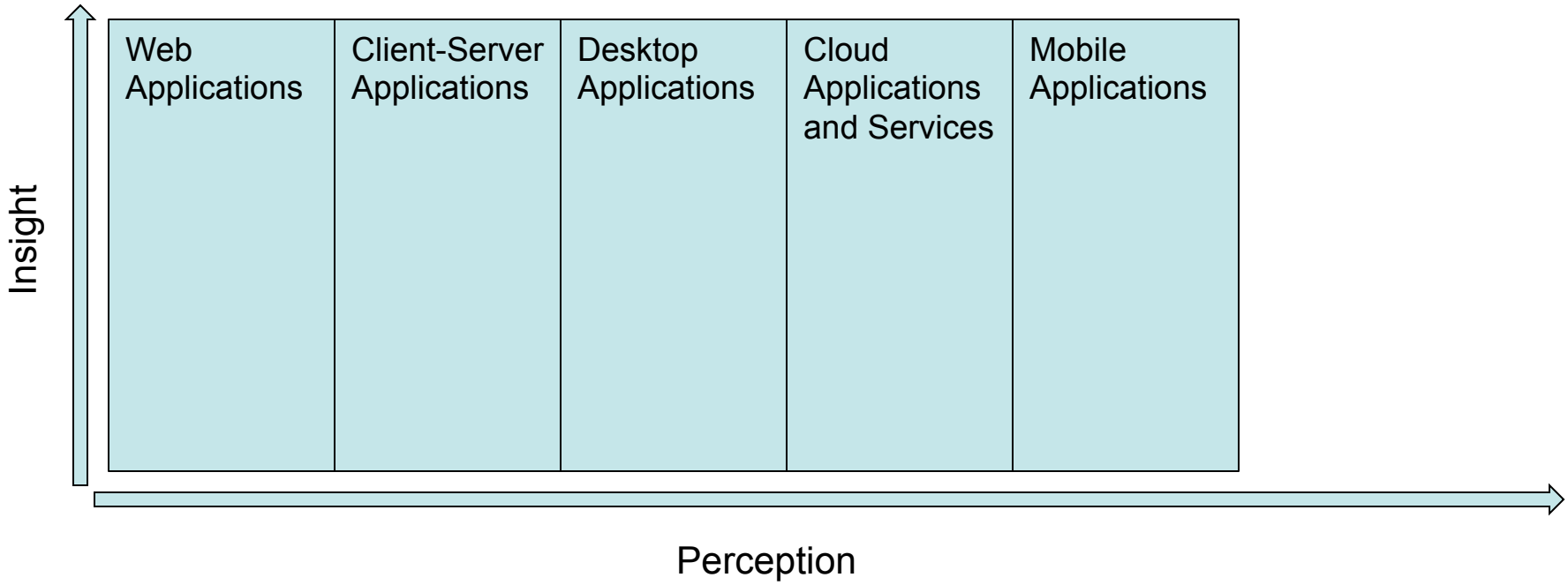
Attack Surface: The Security Officer's Journey

- As perception of the problem of attack surface widens the scope of the problem increases



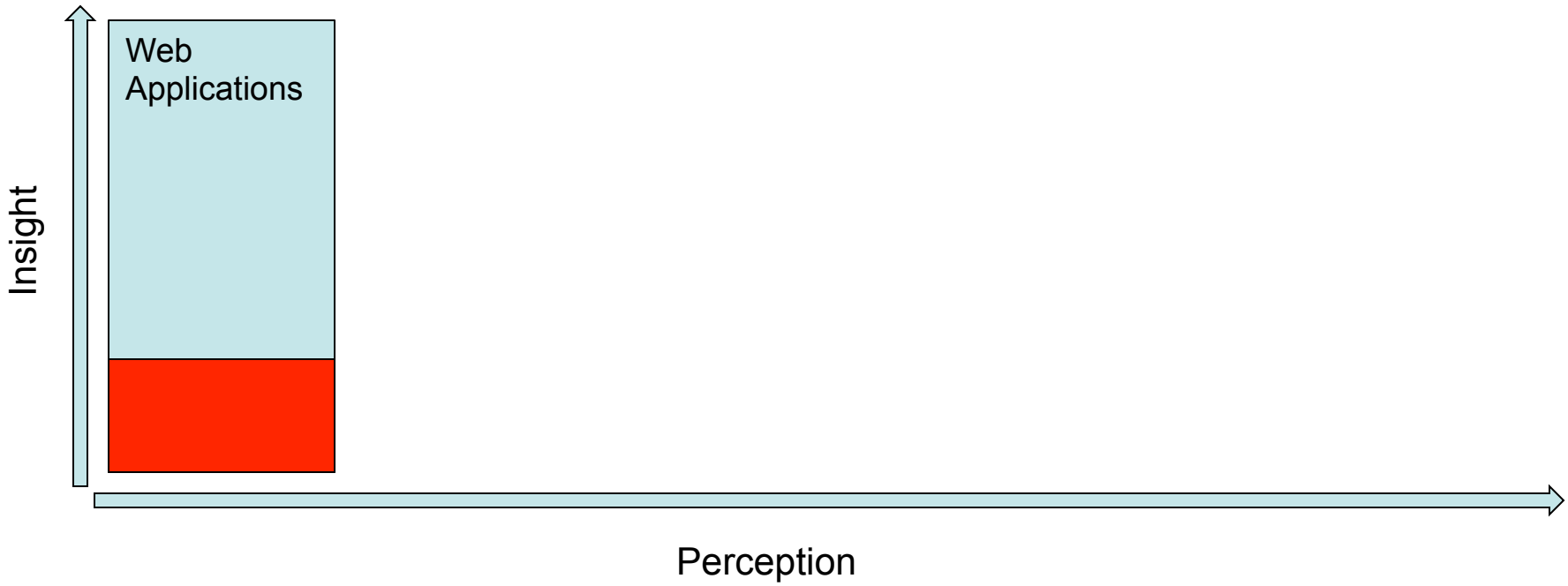
Attack Surface: The Security Officer's Journey

- As perception of the problem of attack surface widens the scope of the problem increases



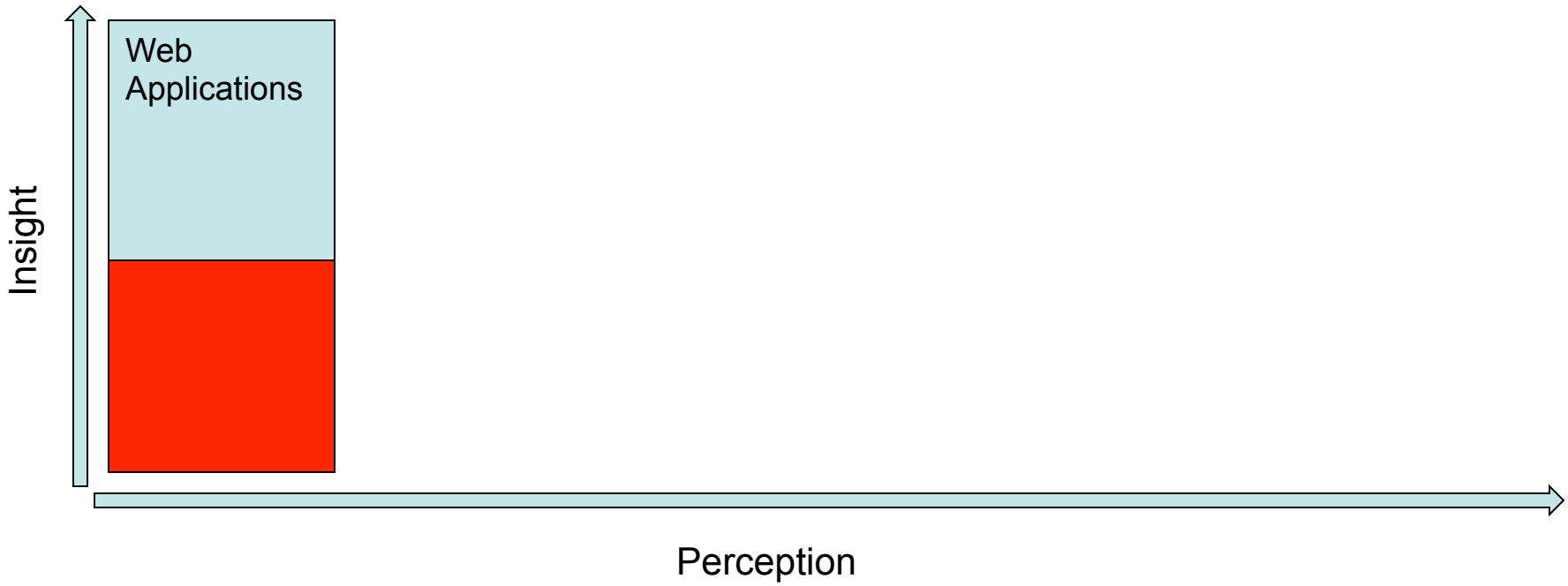
Attack Surface: The Security Officer's Journey

- Discovery activities increase insight



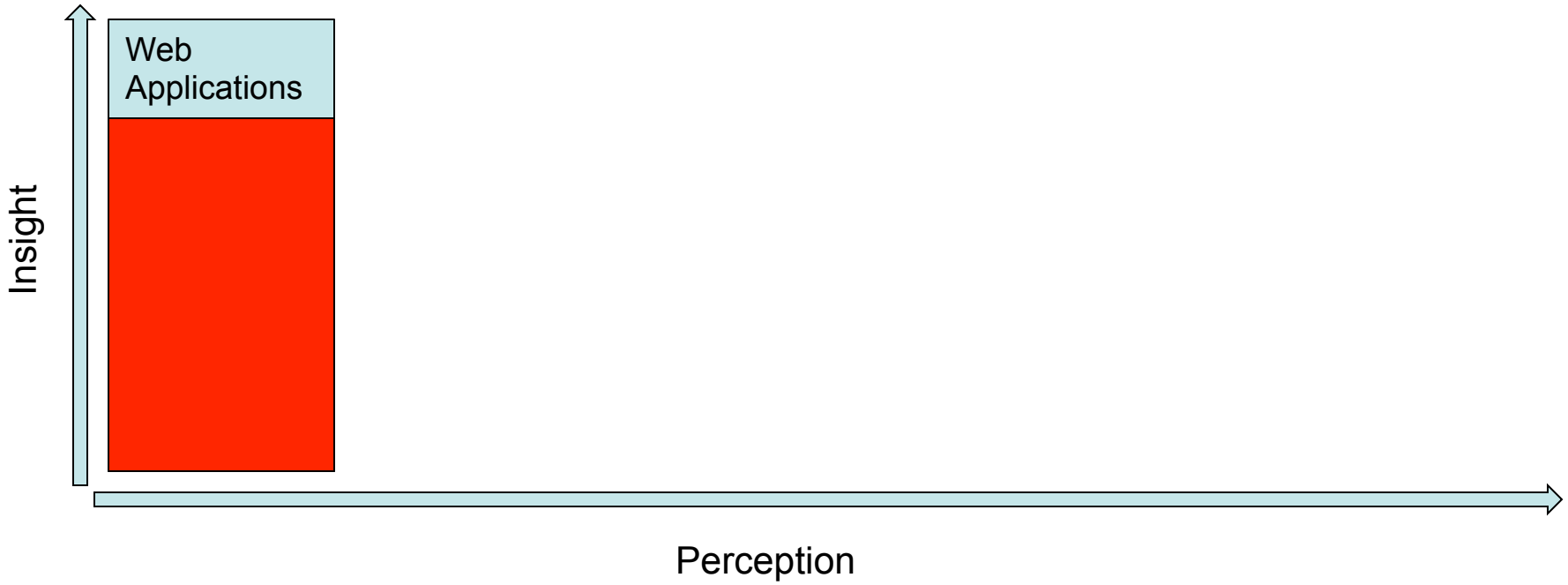
Attack Surface: The Security Officer's Journey

- Discovery activities increase insight



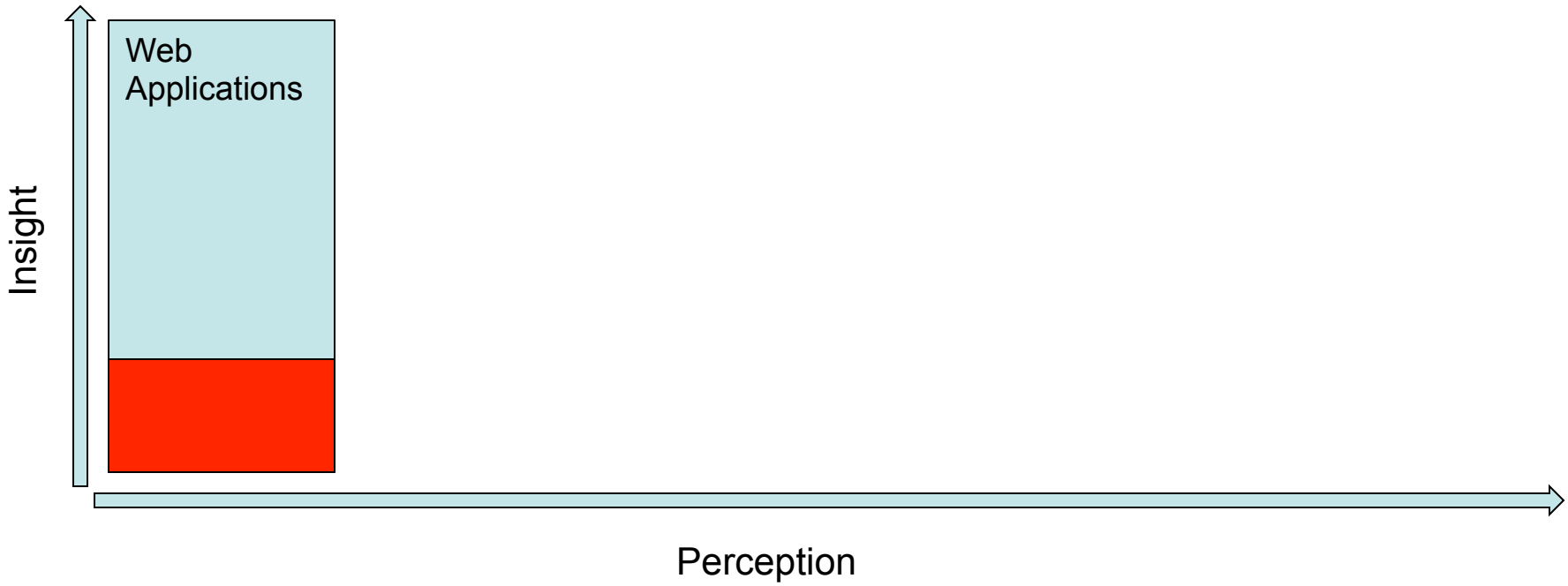
Attack Surface: The Security Officer's Journey

- Discovery activities increase insight



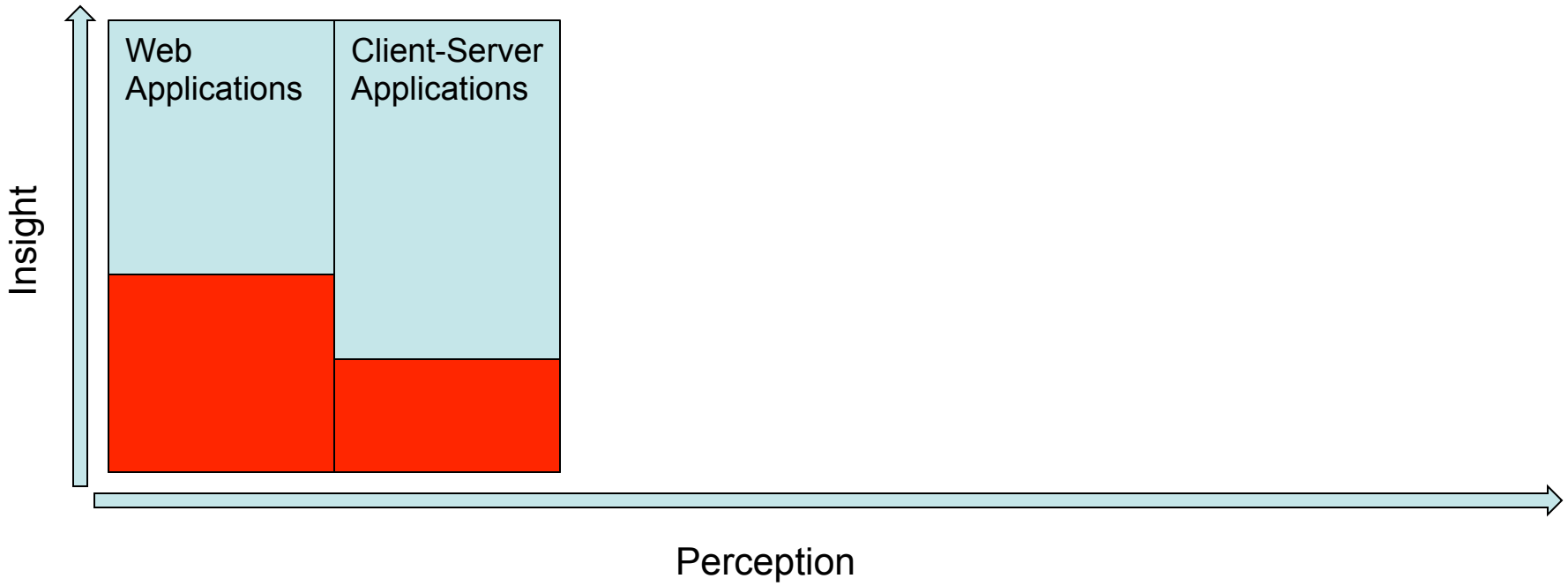
Attack Surface: The Security Officer's Journey

- Over time you end up with a progression



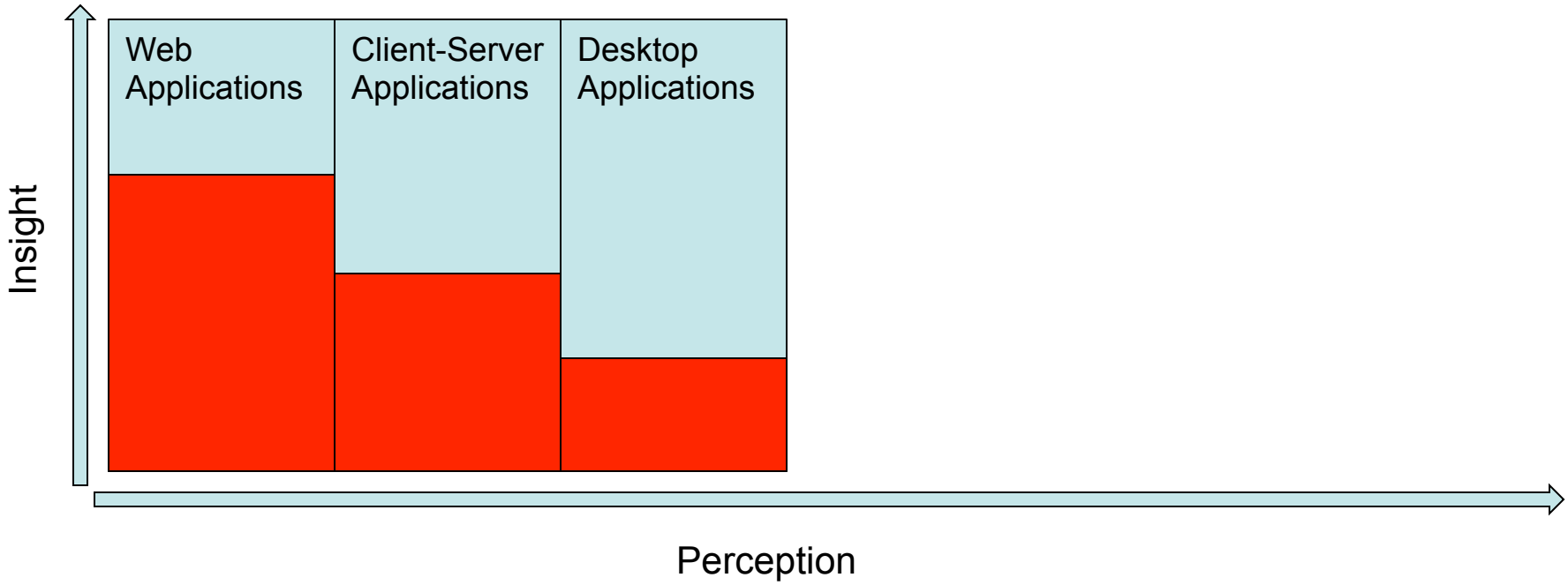
Attack Surface: The Security Officer's Journey

- Over time you end up with a progression



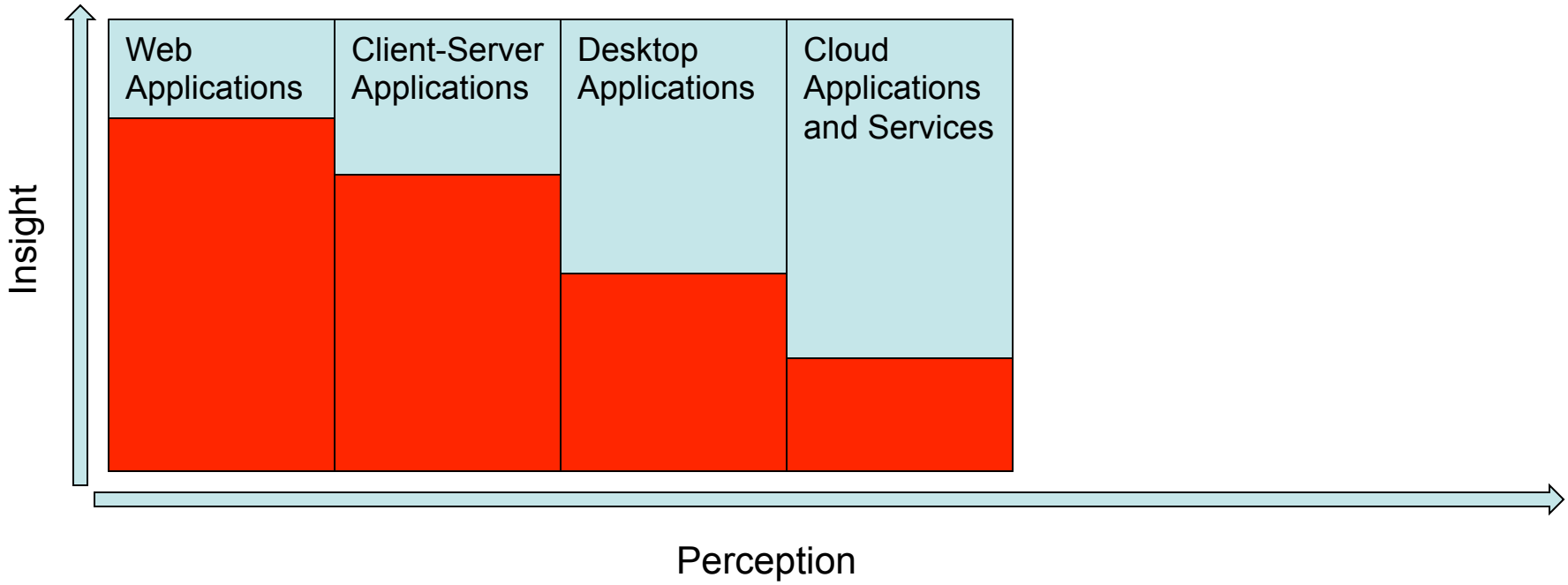
Attack Surface: The Security Officer's Journey

- Over time you end up with a progression



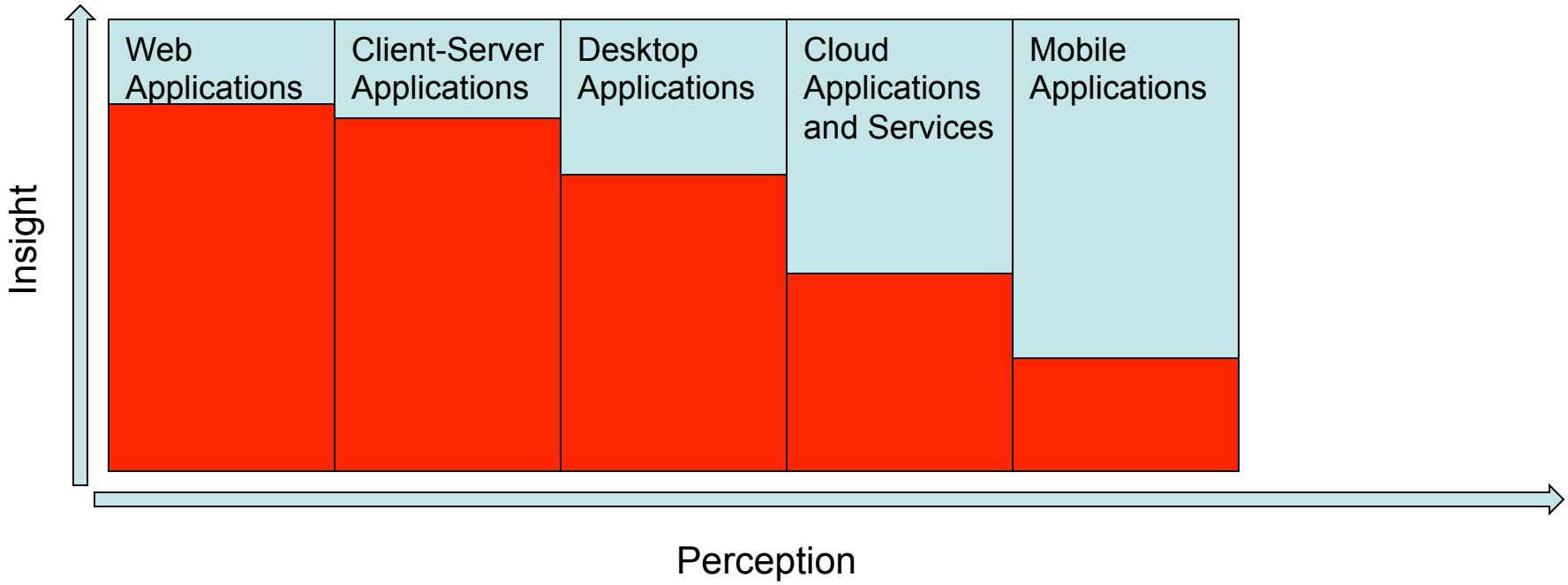
Attack Surface: The Security Officer's Journey

- Over time you end up with a progression



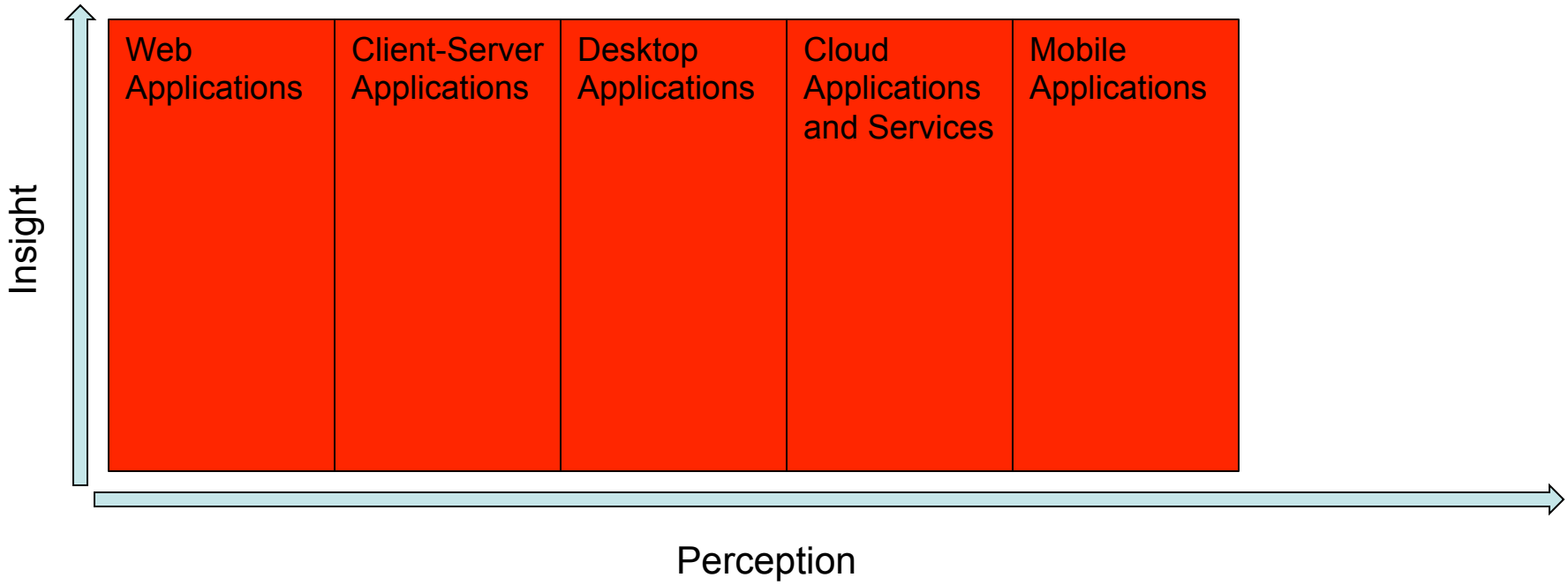
Attack Surface: The Security Officer's Journey

- Over time you end up with a progression



Attack Surface: The Security Officer's Journey

- When you reach this point it is called "enlightenment"
- You won't reach this point



Value and Risk Are Not Equally Distributed

- Some Applications Matter More Than Others
  - *Value and character of data being managed*
  - *Value of the transactions being processed*
  - *Cost of downtime and breaches*

- Therefore All Applications Should Not Be Treated the Same
  - *Allocate different levels of resources to assurance*
  - *Select different assurance activities*
  - *Also must often address compliance and regulatory requirements*

Do Not Treat All Applications the Same

- Allocate Different Levels of Resources to Assurance
- Select Different Assurance Activities

- Also Must Often Address Compliance and Regulatory Requirements

What Goes Into An Application Test?

An Application Test

What Goes Into An Application Test?

Dynamic Analysis

Static Analysis

What Goes Into An Application Test?

Automated Application Scanning

Manual Application Testing

Static Analysis

What Goes Into An Application Test?

Automated Application Scanning	Automated Static Analysis
Manual Application Testing	Manual Static Analysis

What Goes Into An Application Test?

Unauthenticated Automated Scan	Authenticated Automated Scan	Automated Static Analysis
Blind Penetration Testing	Informed Manual Testing	Manual Static Analysis

What Goes Into An Application Test?

Unauthenticated Automated Scan	Authenticated Automated Scan	Automated Source Code Scanning	Automated Binary Analysis
Blind Penetration Testing	Informed Manual Testing	Manual Source Code Review	Manual Binary Analysis

How To Allocate Scarce Resources?

- What Do You HAVE To Do?
  - *What discretion do you have within these constraints?*
- What Is Left Over?
- Strategies
  - *Breadth-first*
  - *Depth-first*
  - *Hybrid*

Breadth-First

- Do Base-level Security Testing of Everything
  - *Well, everything you can find*
  - *And everything you test with automation*
- Automation is key
- Understand the limitations
  - *Some applications cannot be effectively scanned*
  - *Often scans are unauthenticated*
  - *Whole classes of vulnerabilities are out of testing scope*

Depth-First

- Do Deeper Testing of Critical Applications
- Typically Combination of Automation and Manual Testing
- Understand the Limitations
  - *Some applications remain unexamined*
  - *And breaches to those applications put shared resources and infrastructure at risk*

Hybrid

- Combination of Automation and Manual Testing Across Portfolio
- This is where most organizations end up
  - *Often because regulatory and compliance mandates*
- Know Your Gaps

Application Portfolio Tracking

- Track multiple “Teams”
  - *Arbitrary distinction – geography, line of business, common tools and practices*
- Track multiple “Applications” per “Team”
  - *Unit of scanning or testing*
- Track Application metadata
  - *Criticality, hosted URL, source code location*
- Reporting can be done at the organization, Team or Application level

Demo: Application Portfolio Tracking

Applications | ThreadFix

localhost:8080/threadfix/teams

ThreadFix Powered by Denim Group

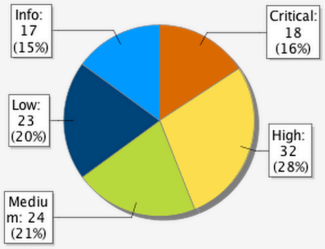
Dashboard | Teams | Scans | Analytics | user

Teams

Add Team | Expand All | Collapse All

Name	Total	Critical	High	Medium	Low	Info		
e-Commerce	114	18	32	24	23	17	Add Application	View Team

	Total	Critical	High	Medium	Low	Info	
AppScan	19	0	9	1	1	8	Upload Scan
Bad Scan Example	10	0	5	3	0	2	Upload Scan
Merge	59	13	3	14	22	7	Upload Scan
Partner Portal	12	3	9	0	0	0	Upload Scan
WH Demo	14	2	6	6	0	0	Upload Scan



HAM Demo	686	99	84	53	326	124	Add Application	View Team
Scan Agent Demo	104	0	4	17	53	30	Add Application	View Team
ThreadFix	183	34	54	15	16	64	Add Application	View Team

Fill ThreadFix Up With Vulnerability Data

- Manual file upload
- REST API
  - https://github.com/denimgroup/threadfix/wiki/Threadfix-REST-Interface
- Command Line Interface (CLI)
  - https://github.com/denimgroup/threadfix/wiki/Command-Line-Interface
  - *JAR can also be used as a Java REST client library*
- Jenkins plugin
  - *Contributed from the ThreadFix community (yeah!)*
  - https://github.com/automationdomination/threadfix-plugin

What Does ThreadFix Do With Scan Results

- Diff against previous scans with same technology
  - *What vulnerabilities are new?*
  - *What vulnerabilities went away?*
  - *What vulnerabilities resurfaced?*
- Findings marked as false positive are remembered across scans
  - *Hopefully saving analyst time*
- Normalize and merge with other scanners' findings
  - *SAST to SAST*
  - *DAST to DAST*
  - *SAST to DAST via Hybrid Analysis Mapping (HAM)*

Demo: Vulnerability Merge

Vulnerability Details | Thre

localhost:8080/threadfix/organizations/2/applications/7/vulnerabilities/10670?nonce=B38E3E86CF70...

ThreadFix
Powered by Denim Group

Dashboard | Teams | Scans | Analytics | user

Applications Index / Team: e-Commerce / Application: Merge / Vulnerability 10670

Vulnerability Details

Toggle More Info

Basic Information

Type	Severity	Path	Parameter
Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting') (CWE Entry)	Critical	/demo/EvalInjection2.php	command

Findings

Scanner Name	Severity	Vulnerability Type	Path	Calculated URL Path	Calculated Source Path	Parameter	Native ID	
IBM Rational AppScan	High	Cross-Site Scripting	/demo/EvalInjection2.php	/demo/EvalInjection2.php	/demo/EvalInjection2.php	command	eb6aa5598d20a3468754f36b9d2755d6	View Finding
Arachni	HIGH	Cross-Site Scripting (XSS)	/demo/EvalInjection2.php	/demo/EvalInjection2.php	/demo/EvalInjection2.php	command	1fb87c361a9a8e5e948461438440ab23	View Finding
w3af	Medium	Cross site scripting vulnerability	/demo/EvalInjection2.php	/demo/EvalInjection2.php	/demo/EvalInjection2.php	command	70729a13c08ec2be98fedf7903f63ae2	View Finding

Comments

User	Date	Comment

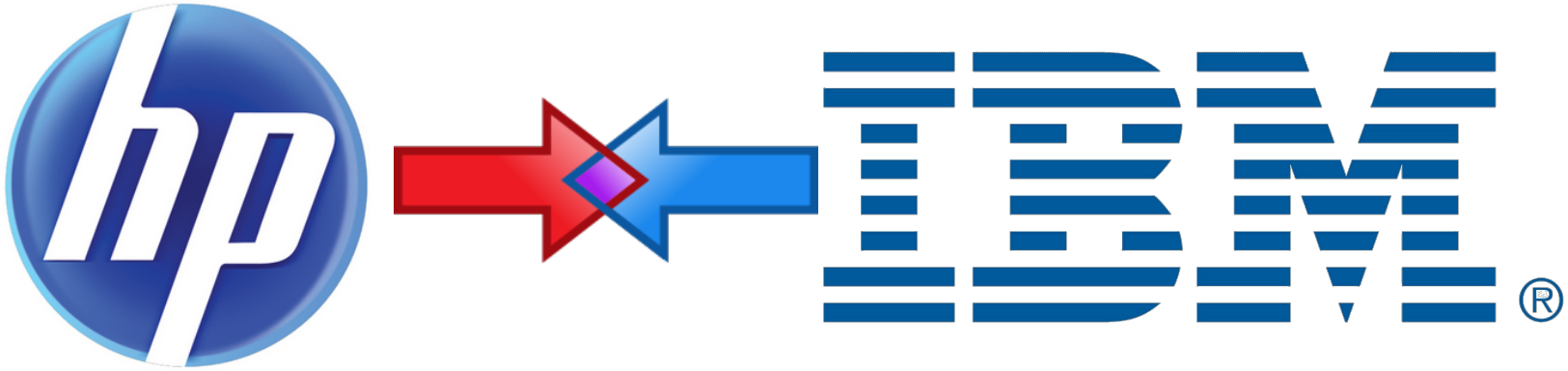
Hybrid Analysis Mapping (HAM)

- Initial research funded by the US Department of Homeland Security (DHS) Science and Technology (S&T) Directorate via a Phase 1 and (now) Phase 2 Small Business Innovation Research (SBIR) contract
  - *Acronyms!*

- Initial goal: SAST to DAST merging
- Results: That, plus other stuff

Hybrid Analysis Mapping – Phase 1 Goal

- **Determine the feasibility of developing a system that can reliably and efficiently correlate and merge the results of automated static and dynamic security scans of web applications.**



HP Fortify SCA *IBM AppScan Standard*

Dynamic Application Security Testing

- Spider to enumerate attack surface
- Fuzz to identify vulnerabilities based on analysis of request/response patterns

Static Application Security Testing

- Use source or binary to create a model of the application
  - *Kind of like a compiler or VM*
- Perform analysis to identify vulnerabilities and weaknesses
  - *Data flow, control flow, semantic, etc*

```
String username = request.getParameter("username");
String sql = "SELECT * FROM User WHERE username = '" + username + "'";

Statement stmt;
stmt = con.createStatement();
stmt.execute(sql);
```

Hybrid Analysis Mapping – Phase 1 Sub-Goals

- Standardize vulnerability types
- Match dynamic and static locations
- Improve static parameter parsing

Hybrid Analysis Mapping
Phase 1 - Technical Objectives

- **Technical Objective 1: Create common data structure standards for both automated static and dynamic security scanning results.**
  - *Task 1: Create a Data Structure for Automated Dynamic Security Scanning Results*
  - *Task 2: Create a Data Structure for Automated Static Security Scanning Results*

- **Technical Objective 2: Research and prototype methods of mapping the results of automated static and dynamic security scanning.**
  - *Task 1: Create a Structured Model for Hybrid Analysis Mapping*
  - *Task 2: Investigate Approaches for Vulnerability Type Mapping*
  - *Task 3: Investigate Approaches for Mapping Source Code Files to URLs*
  - *Task 4: Investigate Approaches for Determining Injection Points*

Information Used

- Source Code (Git URL)
- Framework Type (JSP, Spring)
- Extra information from Fortify (if available)

Vulnerability Types

- Successful CWE standardization
- Investigation into trees and Software Fault Patterns
  - *Meant to correct for human errors*
  - *Hard to do in an automated fashion*

Unified Endpoint Database (Static and Dynamic)

- EndpointQuery
  - *dynamicPath*
  - *staticPath*
  - *Parameter*
  - *httpMethod*
  - *codePoints [List<CodePoint>]*
  - *informationSourceType*

- EndpointDatabase
  - *findBestMatch(EndpointQuery query): Endpoint*
  - *findAllMatches(EndpointQuery query): Set<Endpoint>*
  - *getFrameworkType(): FrameworkType*

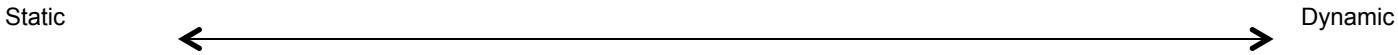
Parsing Attack Surface Locations

- JSP: Start with root JSP folder
- Spring: Parse @Controller classes

Parsing Parameters

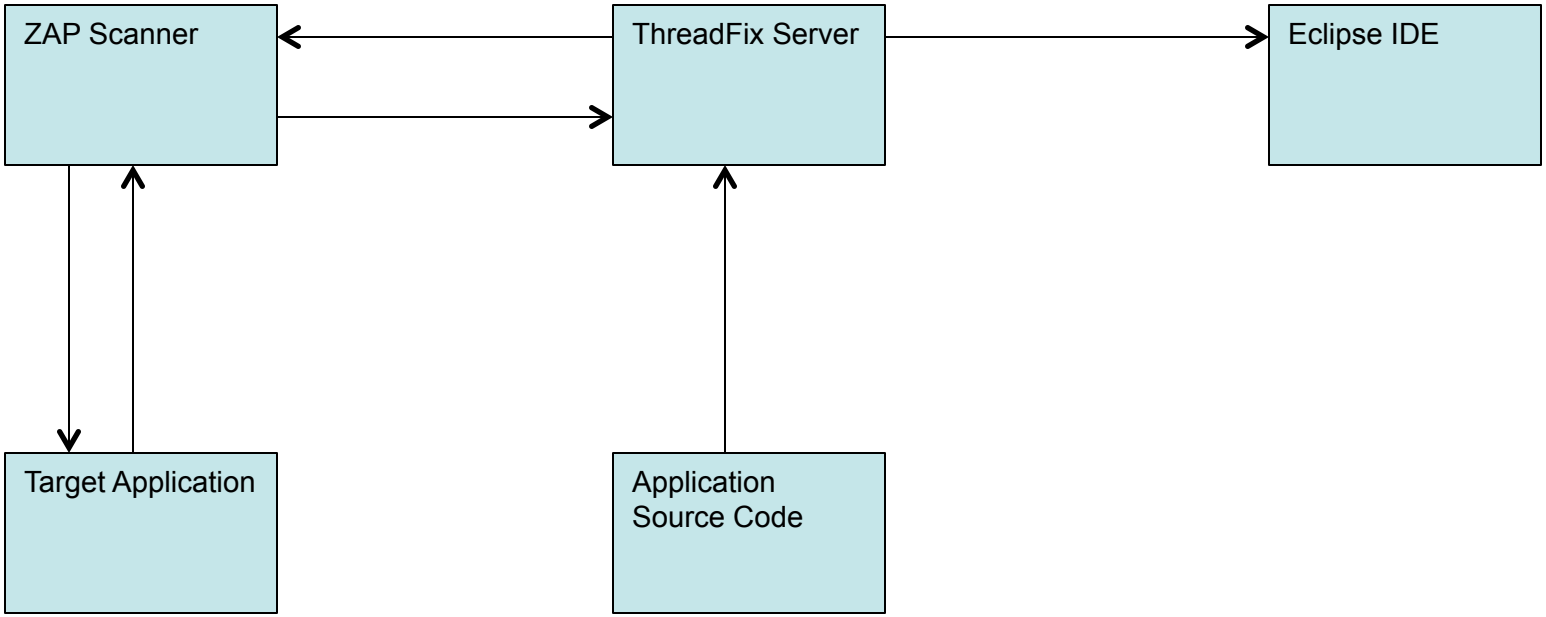
- JSP: Look for request.getParameter() calls
  - *Coupled with lightweight dataflow analysis*
- Spring: Parse @RequestParam, @PathVariable, @Entity annotations

HAM Bridge



- EndpointDatabase enables more than merging
- Scanner integration allows smarter scanning
- IDE plugin shows all vulnerabilities inline

System Structure



Demo: Merging Static and Dynamic Scanner Results

Bodgeit | ThreadFix | The Bodgeit Store

localhost:8080/threadfix/organizations/1/applications/1?nonce=8B1A8A51836EE9F593CC7575C55B9497

Critical	Synchronization ('Race Condition')	/product.jsp		View More
Critical	Concurrent Execution using Shared Resource with Improper Synchronization ('Race Condition')	/register.jsp		View More
Critical	Concurrent Execution using Shared Resource with Improper Synchronization ('Race Condition')	/score.jsp		View More
Critical	Concurrent Execution using Shared Resource with Improper Synchronization ('Race Condition')	/search.jsp		View More
Critical	Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')	/basket.jsp	productid	View More
Critical	Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')	/contact.jsp	anticsrf	View More
Critical	Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')	/contact.jsp	comments	View More

Scan History

Channel	Scan Date	User
IBM Rational AppScan	6/19/13 9:18:47 AM	user
Fortify 360	6/19/13 12:41:39 AM	user

Comments

User	Date	Comment
	No comments found.	

Add Comment

Critical	Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')	/contact.jsp	user1@thebodgeitstore.com	View More
Critical	Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')	/login.jsp	username	View More
Critical	Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')	/product.jsp	prodid	View More
Critical	Improper Neutralization of Input During Web Page Generation	/register.jsp	password1	View More

Demo: Merging Static and Dynamic Scanner Results

Vulnerability Details | Thre × The Bodgelt Store ×

localhost:8080/threadfix/organizations/1/applications/1/vulnerabilities/28?nonce=7FEF0E60ECF6CABF857C29D3D5C6...

ThreadFix Powered by Denim Group

Dashboard | Applications | Scans | Reports | user

Applications Index / Team: HAM Demo / Application: Bodgelt / Vulnerability 28

Vulnerability Details

Toggle More Info

Basic Information

Type	Severity	Path	Parameter
Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting') (CWE Entry)	Critical	/bodgeit/contact.jsp	comments

Findings

Scanner Name	Severity	Vulnerability Type	Path	Calculated URL Path	Calculated Source Path	Parameter	Native ID	
IBM Rational AppScan	High	Stored Cross-Site Scripting	/bodgeit/contact.jsp	/contact.jsp	/contact.jsp	comments	aa113d21429a4e5fdb6a189c3ab23c79	View Finding
Fortify 360	Critical	Cross-Site Scripting: Reflected	root/contact.jsp	/contact.jsp		comments	4AC2C441CFC0081776F519B90EBE6650	View Finding

Data Flow

File Name root/contact.jsp

Line number 37

Line text String comments = (String) request.getParameter("comments");

File Name root/contact.jsp

Line number 37

Merging Static and Dynamic Results Is Cool…

…But I want more

- Problem: Many DAST scanners handle applications with RESTful URLs poorly
- Problem: Many applications have “hidden” landing pages and parameters that will not be found by standard crawling
- Problem: DAST scanner results can be hard for developers to act on

- What else can we do with this attack surface model / database?
  - *Clean up scanner results*
  - *Enumerate application attack surface*
  - *Map dynamic results to specific lines of code*

Demo: De-Duplicate Dynamic RESTful Scanner Results

PetClinic (vulnerable) | Thr

localhost:8080/threadfix/organizations/1/applications/4?nonce=CDB343B3C8A8F5428F447AAFDDA51CE8

Severity	Type	Path	Parameter	
Critical (11)				
Critical	Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')	/owners	lastName	View More
Critical	Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')	/owners/{id}/pets/{id}/visits/new	new	View More
Critical	Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')	/owners/{id}/pets/{id}/edit	name	View More
Critical	Improper Neutralization of Special Elements used in an SQL Command ('SQL Injection')	/owners/{id}/pets/new	birthDate	View More
Critical	Improper Neutralization of Special Elements used in an SQL Command ('SQL Injection')	/owners/{id}/pets/{id}/visits/new	description	View More

Scan History

Channel	Scan Date	User
IBM Rational AppScan	6/4/13 10:57:15 AM	user
IBM Rational AppScan	6/4/13 10:57:15 AM	user

Comments

	User	Date	Comment
1	user	10:44:04 11/20/2013	The app uses a REST-style URL scheme so AppScan is multi-reporting vulnerabilities. They seem to have been properly de-duped, however.

Add Comment

Critical	Improper Neutralization of Special Elements used in an SQL Command ('SQL Injection')	/owners/{id}/edit	firstName	View More
Critical	Improper Neutralization of Special Elements used in an SQL Command ('SQL Injection')	/owners/{id}/edit	lastName	View More
	Improper Neutralization of Special Elements used in an			

Demo: De-Duplicate Dynamic RESTful Scanner Results

Vulnerability Details | Thre

localhost:8080/threadfix/organizations/1/applications/4/vulnerabilities/10982?nonce=C1E9E2E479E2D82DA5AB27724...

ThreadFix Powered by Denim Group

Dashboard | Applications | Scans | Reports | user

Applications Index / Team: HAM Demo / Application: PetClinic (vulnerable) / Vulnerability 10982

Vulnerability Details

Toggle More Info

Basic Information

Type	Severity	Path	Parameter
Improper Neutralization of Special Elements used in an SQL Command ('SQL Injection') (CWE Entry)	Critical	/petclinic/owners/10/pets/12/visits/new	description

Findings

Scanner Name	Severity	Vulnerability Type	Path	Calculated URL Path	Calculated Source Path	Parameter	Native ID	
IBM Rational AppScan	High	Blind SQL Injection	/petclinic/owners/10/pets/12/visits/new	/owners/{id}/pets/{id}/visits/new	/src/main/java/org/springframework/samples/petclinic/web/VisitController.java	description	1a07468c95c11f782dee9ab5b7fb6c05	View Finding
IBM Rational AppScan	High	Blind SQL Injection	/petclinic/owners/4/pets/5/visits/new	/owners/{id}/pets/{id}/visits/new	/src/main/java/org/springframework/samples/petclinic/web/VisitController.java	description	4054c867b8ead825d4e4468b3e7ac9a	View Finding

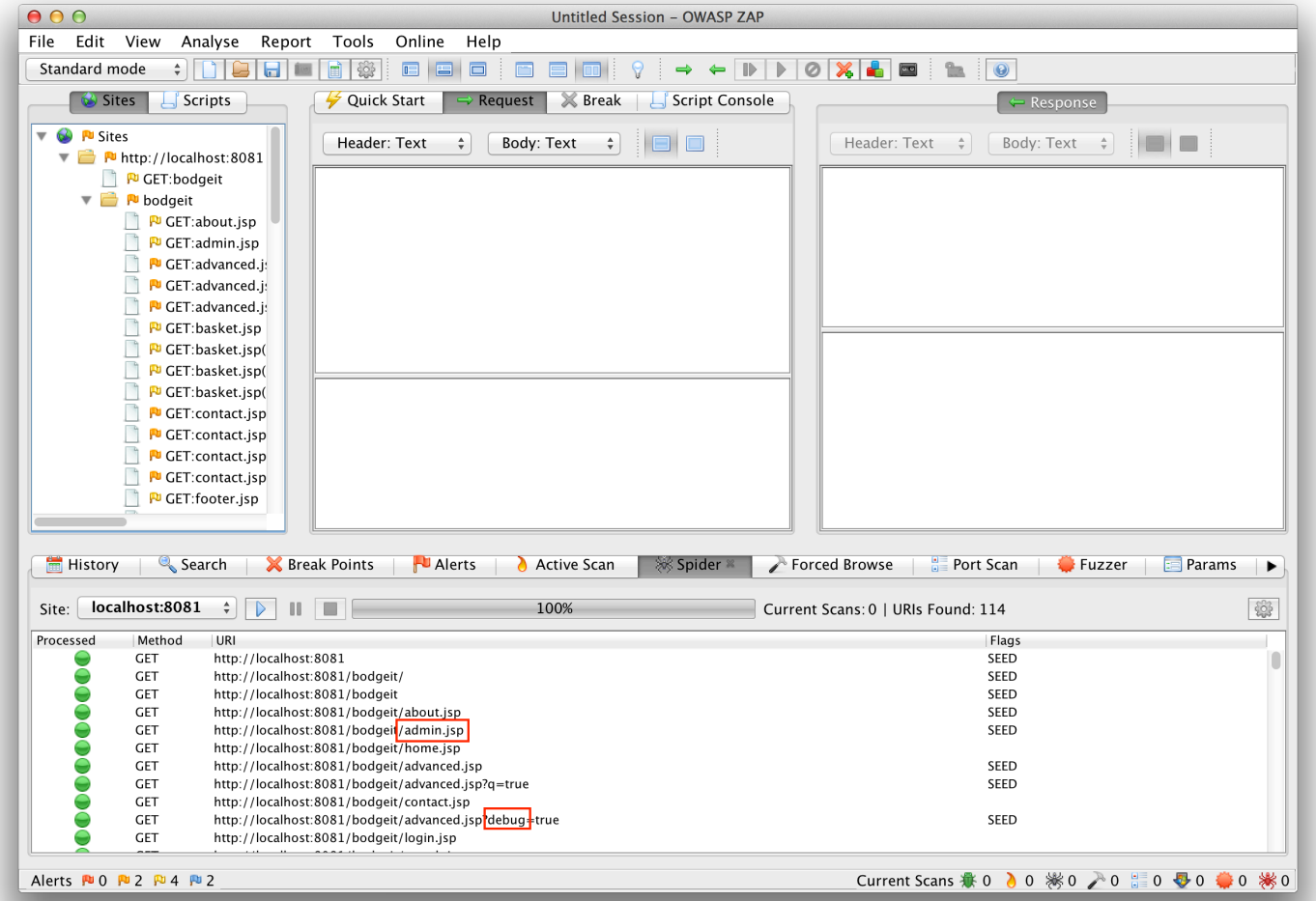
Comments

Demo: Application Attack Surface (CLI)

ham — bash — 124×40

```
Dans-MacBook-Pro:ham dcornell$ java -jar endpoints-experimental-20131106.jar ~/git/bodgeit/root/
INFO [main] MergeConfigurationGenerator.getDatabase(20) | Attempting to calculate framework type based on project contents.
INFO [main] MergeConfigurationGenerator.getType(16) | Attempting to guess Framework Type from source tree.
INFO [main] MergeConfigurationGenerator.getType(17) | File: /Users/dcornell/git/bodgeit/root
INFO [main] ServletMappings.guessApplicationType(175) | About to guess application type from web.xml.
INFO [main] ServletMappings.guessApplicationType(217) | Determined that the framework type was JSP
INFO [main] MergeConfigurationGenerator.getType(34) | Source tree framework type detection returned: JSP
INFO [main] MergeConfigurationGenerator.getDatabase(24) | Calculated framework : JSP.
INFO [main] GeneratorBasedEndpointDatabase.<init>(54) | Using generic EndpointGenerator-based translator.
INFO [main] GeneratorBasedEndpointDatabase.buildMappings(69) | Building mappings.
INFO [main] GeneratorBasedEndpointDatabase.buildMappings(82) | Done building mappings. Static keys: 0, dynamic keys: 16
[POST, GET],/about.jsp,[]
[POST, GET],/admin.jsp,[]
[POST, GET],/advanced.jsp,[q, debug]
[POST, GET],/basket.jsp,[update, productid, quantity, debug]
[POST, GET],/contact.jsp,[anticsrf, debug, comments]
[POST, GET],/footer.jsp,[]
[POST, GET],/header.jsp,[debug]
[POST, GET],/home.jsp,[debug]
[POST, GET],/init.jsp,[]
[POST, GET],/login.jsp,[username, debug, password]
[POST, GET],/logout.jsp,[]
[POST, GET],/password.jsp,[password1, password2]
[POST, GET],/product.jsp,[typeid, prodid, debug]
[POST, GET],/register.jsp,[password1, username, password2, debug]
[POST, GET],/score.jsp,[debug]
[POST, GET],/search.jsp,[q, debug]
Dans-MacBook-Pro:ham dcornell$
```

Demo: Seed Scanner with Attack Surface



Prioritize application risk decisions based on data

Vulnerability Filtering

- Filter vulnerability data
  - *Scanner, scanner count*
  - *Vulnerability type*
  - *Path, parameter*
  - *Severity*
  - *Status*
  - *Aging*

- Save filters for future use

Demo: Vulnerability Filtering

Analytics | ThreadFix

localhost:8080/threadfix/reports

ThreadFix
Powered by Denim Group

Dashboard | Teams | Scans | Analytics | user

Analytics

Trending | Snapshot | Comparison | Vulnerability Search

Results

Critical 52
52 Cross-site Scripting

10 | 25 | 50 | 100 | First | 1 | 2 | 3 | 4 | 5 | Last

Application / Merge Example - Bodgeit
Path /basket.jsp
Parameter productid
IBM Rational AppScan
0 0 View More

Application / Bodgeit
Path /basket.jsp
Parameter productid
IBM Rational AppScan
0 0 View More

Application / Merge Example - Bodgeit
Path /contact.jsp
Parameter user1@thebodgeitstore.com
IBM Rational AppScan
0 0 View More

Filters

Filters | Load Filters

XSS over 90

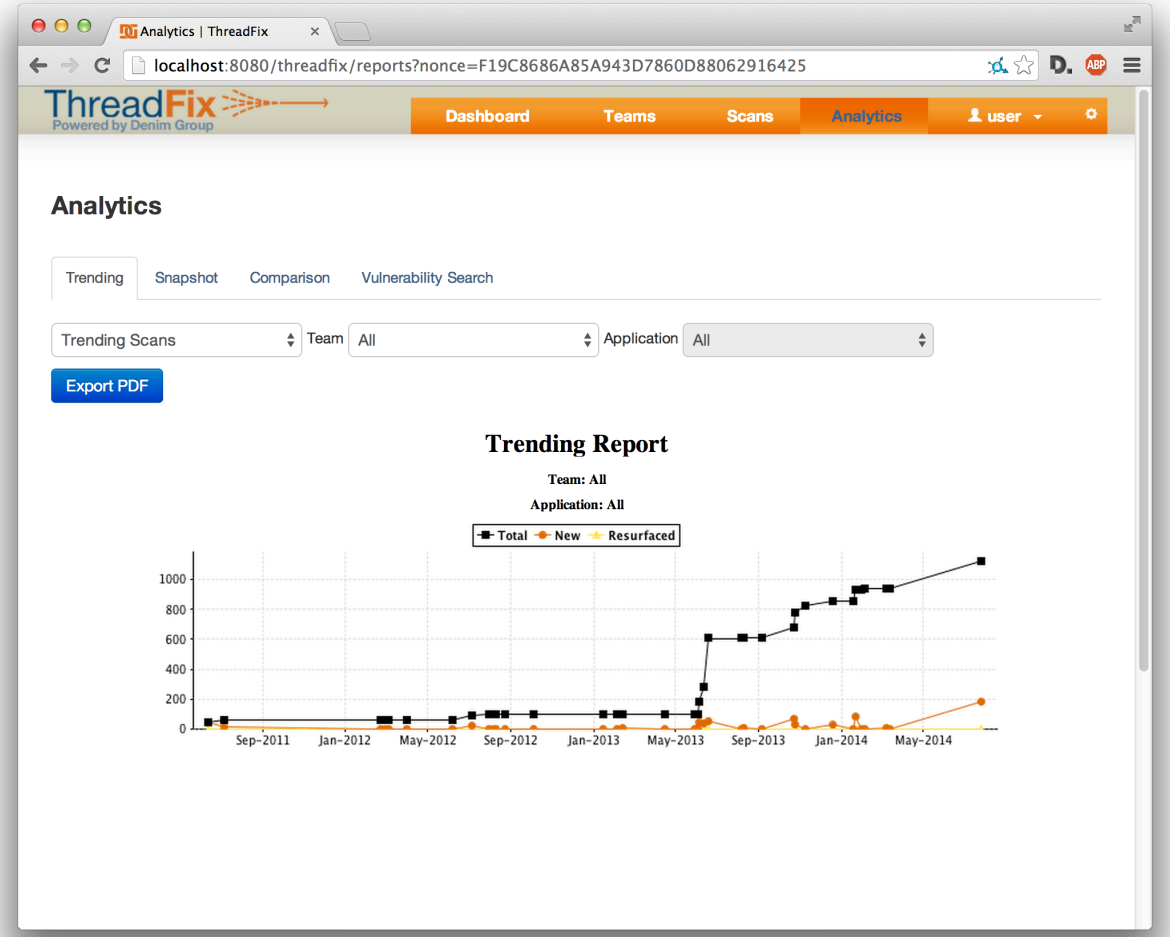
Delete Selected Filter

Clear Filter

Reporting

- Trending
- Progress by Vulnerability
  - *For program benchmarking*
- Portfolio Report
  - *For resource prioritization*
- Comparison
  - *For scanner/technology benchmarking*

Demo: Reporting



Translate vulnerabilities to developers in the tools they are already using

Mapping Vulnerabilities to Defects

- 1:1 mapping is (usually) a horrible idea
  - *500 XSS turned into 500 defects?*
  - *If it takes longer to administer the bug than it does to fix the code…*
- Cluster like vulnerabilities
  - *Using the same libraries / functions*
  - *Cut-and-paste remediation code*
  - *Be careful about context-specific encoding*
- Combine by severity
  - *Especially if they are cause for an out-of-cycle release*
- Which developer “owns” the code?

Defect Tracker Integration

- Bundle multiple vulnerabilities into a defect
  - *Using standard filtering criteria*
- ThreadFix periodically updates defect status from the tracker

Demo: Defect Tracker Integration

Partner Portal | ThreadFix

localhost:8080/threadfix/organizations/2/applications/2?nonce=EBA570CE004BAADD1330D55D962F1...

Results

Critical 3
- 2 SQL Injection

10 25 50 100

Path /owners
Parameter lastName
File java/org/springframework/samples/petclinic/repository/jpa/JpaOwnerRepositoryImpl.java
Fortify 360
Issue THREAD-145 (Open)
0 0 View More

Path /owners
Parameter lastName
File java/org/springframework/samples/petclinic/repository/jpa/JpaOwnerRepositoryImpl.java
Fortify 360
Issue THREAD-145 (Open)
0 0 View More

- 1 Authentication Bypass by Spoofing

High 9
- 6 Authorization Bypass Through User-Controlled SQL Primary Key

10 25 50 100

Path /owners/{id}
Parameter ownerId
File java/org/springframework/samples/petclinic/repository/jpa/JpaOwnerRepositoryImpl.java
Fortify 360
Issue THREAD-146 (Closed)
0 0 View More

Path /owners/{id}/pets/new

Filters

Filters Load Filters

Expand All Clear

+ Scanner and # Merged
+ Field Controls
+ Aging
+ Date Range
+ Save Current Filter

Export CSV

IDE Plug Ins

- Import vulnerability data to integrated development environments (IDEs)

- Static (SAST) scanners
  - *Easy*
- Dynamic (DAST) scanners
  - *Possible using Hybrid Analysis Mapping (HAM)*

Map Dynamic Scan Results to LoC in IDE

Java EE – petclinic/src/main/java/org/springframework/samples/petclinic/repository/jpa/JpaVisitRepositoryImpl.java – Spring Tool Suite

Project Explorer
- bodgeit [bodgeit master]
  - lib
  - root
  - src
  - build.xml
  - local.properties
  - zap-build.xml
- petclinic [petclinic master]
- Servers
- wavsep

login.jsp | JdbcOwnerReposi | CallMonitoringA | JpaOwnerReposit | JpaVisitReposit

```
    private EntityManager em;

    @Override
    public void save(Visit visit) {
        if (visit.getId() == null) {
            this.em.persist(visit);
        }
        else {
            this.em.merge(visit);
        }
    }

    @Override
    @SuppressWarnings("unchecked")
    public List<Visit> findByPetId(Integer petId) {
        Query query = this.em.createQuery("SELECT visit FROM Visit v where v.pets.id= " + petId);
        return query.getResultList();
    }

}
```

Markers | Properties | Servers | Data Source Explorer | Snippets | ThreadFix Vulnerabilities

0 errors, 219 warnings, 0 others (Filter matched 100 of 219 items)

Resource	Location	Parameter	CWE	CWE Name	Defect Url
JpaOwnerR...	line 64	null	566	Authorization Bypass Through User-Controlled SQL Primary Key	
JpaOwnerR...	line 64	null	89	Improper Neutralization of Special Elements used in an SQL...	
JpaOwnerR...	line 64	ownerId	566	Authorization Bypass Through User-Controlled SQL Primary Key	
JpaOwnerR...	line 64	ownerId	566	Authorization Bypass Through User-Controlled SQL Primary Key	
JpaOwnerR...	line 64	ownerId	566	Authorization Bypass Through User-Controlled SQL Primary Key	
JpaVisitRep...	line 60	null	566	Authorization Bypass Through User-Controlled SQL Primary Key	
JpaVisitRep...	line 60	null	89	Improper Neutralization of Special Elements used in an SQL...	
JpaVisitRep...	line 60	pet	566	Authorization Bypass Through User-Controlled SQL Primary Key	
OwnerCont...	line 84	dti	550	Information Exposure Through Server Error Message	

Writable | Smart Insert | 60 : 98

Important Links

- Main ThreadFix website: www.threadfix.org
  - *General information, downloads*
- ThreadFix GitHub site: www.github.com/denimgroup/threadfix
  - *Code, issue tracking*
- ThreadFix GitHub wiki: https://github.com/denimgroup/threadfix/wiki
  - *Project documentation*
- ThreadFix Google Group: https://groups.google.com/forum/?fromgroups#!forum/threadfix
  - *Community support, general discussion*

Questions / Contact Information

Dan Cornell
Principal and CTO
dan@denimgroup.com
Twitter @danielcornell
(210) 572-4400

www.denimgroup.com
www.threadfix.org