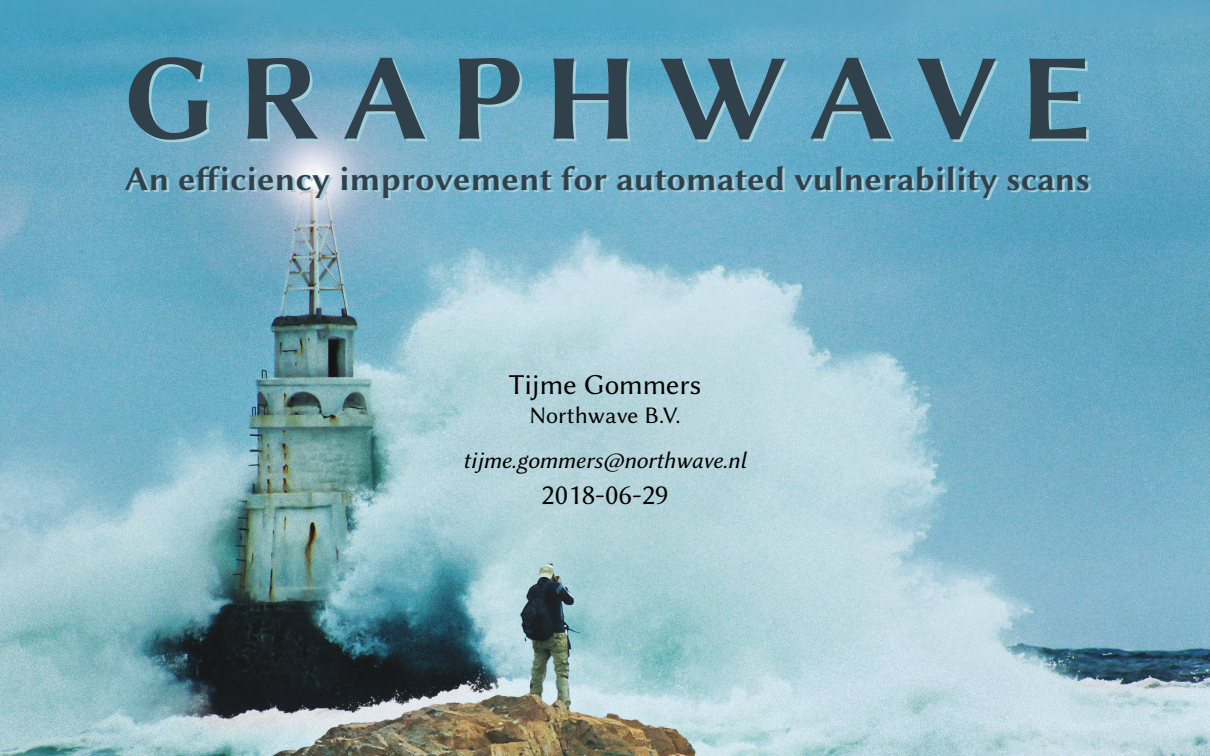
GRAPHWAVE

An efficiency improvement for automated vulnerability scans



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2018-06-29

Overview

Introduction
Context

Northwave

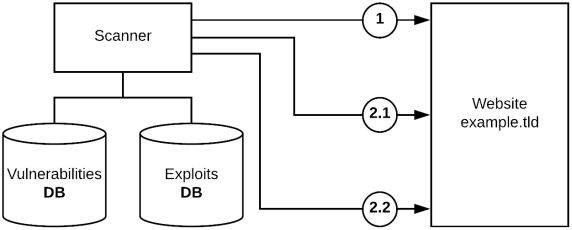
Northwave

Northwave Security Operations Centre

Introduction
Research

Automated Web Application Vulnerability Scanners

- 1. Crawling (reconnaissance)
- 2. Scanning
  - 2.1. Vulnerability database
  - 2.2. Exploit database



Problem

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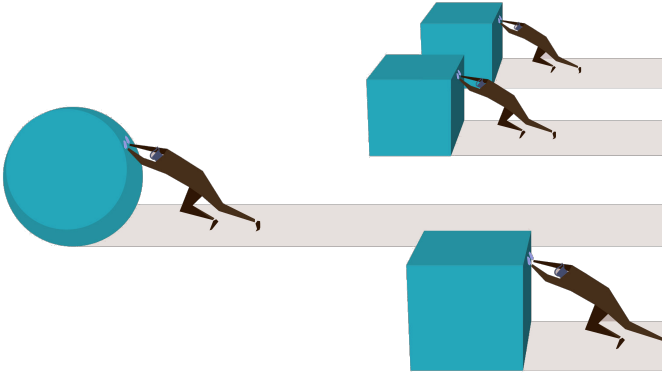
36 hours

That's the average duration of an automated scan at Northwave

Goal

- Improve efficiency
- Maintain effectiveness
- Generic open-source solution



Efficiency & Effectiveness

- Efficiency = Time to finish
- Effectiveness = Vulnerabilities found

Scope

- Only generic solutions, **not** scanner specific
- Improve efficiency, **not** effectiveness
- Only web application scanners, **not** all scanners
- Only scanners that allow behaviour modifications

Main question

- Which user friendly product can be developed to improve the efficiency of scanners while maintaining effectiveness?

Sub-questions 1

- Which key concept of the scanners is the most promising to improve efficiency?
- Which technology can be used to improve the most promising key concept in an automated way?
- In which user friendly way can the most efficient and effective technology be integrated with scanners?

Sub-questions 2

- Which key concept of the scanners is the most promising to improve efficiency?
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Sub-questions 3

- Which key concept of the scanners is the most promising to improve efficiency?
- Which technology can be used to improve the most promising key concept in an automated way?
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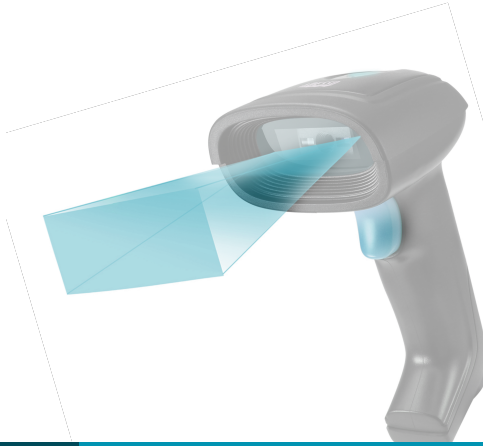
Theory
Automated Web Application Vulnerability Scanners

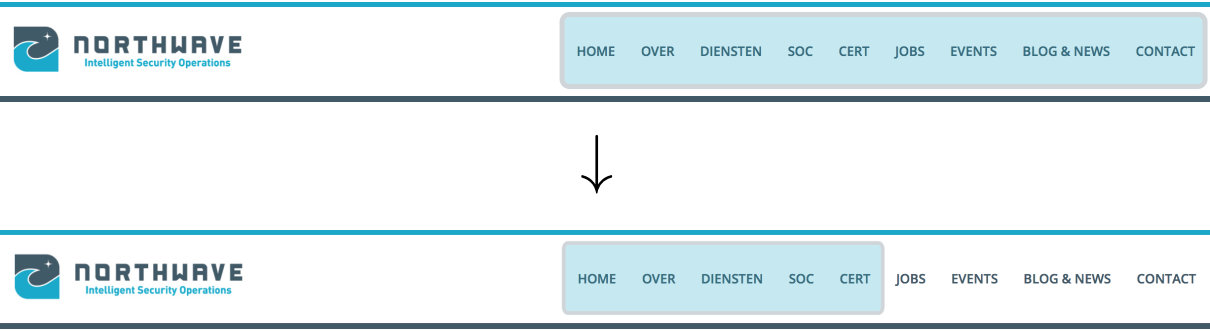
The three scanners

- Burp Suite
- Acunetix
- NYAWC

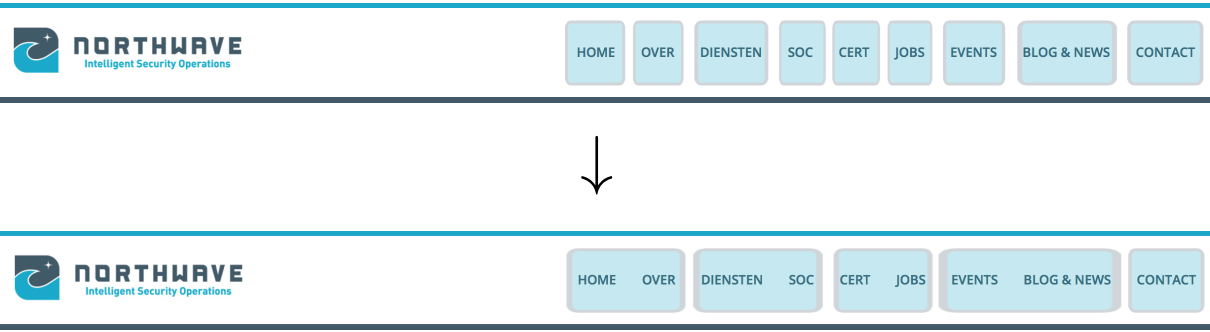


Theory
Key concepts

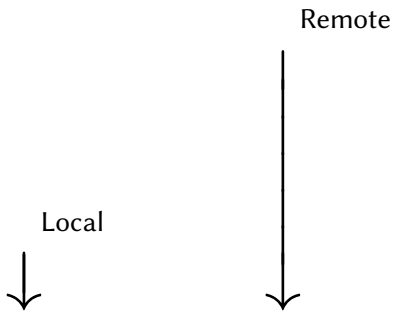
Target scope (reduction)



Multi-threading



Time To First Byte



Persistent HTTP connections

Research
Iterations

A promising key concept of the scanners

- For each key concept and web application
  - For each behavioural change
    - Gather effectiveness and efficiency data
    - Change behaviour of the key concept
- Analyse results empirically

A technology to improve the efficiency

- Determine technologies to improve efficiency
- Effectiveness and compatibility should be analysed
- Data should be analysed empirically

A user friendly product

- The user-friendliness should be investigated
- Amount of user interactions should be analysed
- Data should be analysed empirically

Results
A promising key concept of the scanners

Analysis

Key concept	Effectiveness	Efficiency
Basis (without modification)	100%	100%
Target scope reduction	83%	138,4%
Multi-threading	100%	16,4%
Persistent HTTP connections	N.A.	N.A.

Table: Promising measurements based on the research design

Analysis

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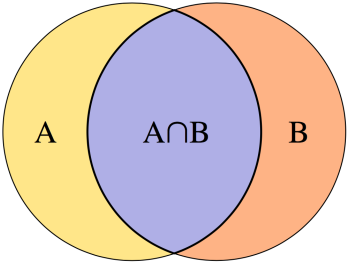
But why?

Why is target scope reduction promising?

Results
A technology to improve the efficiency

HTML tree similarity measure

- Proposed by the Northwave development team
- Jaccard similarity coefficient on HTML trees
- Can be used to measure similarity

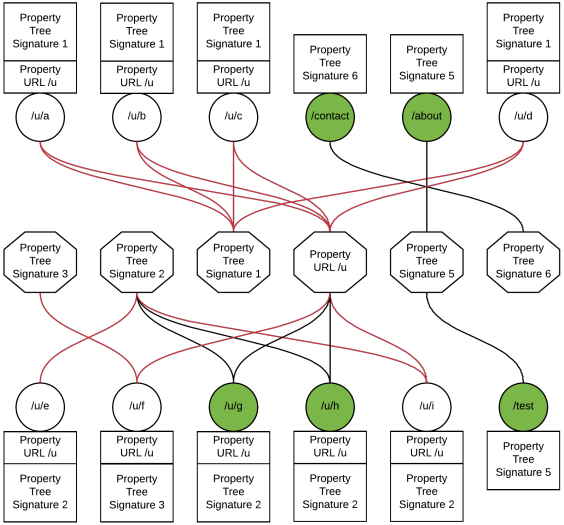


Piecewise response hashing

- Proposed by the Northwave development team
- Piecewise hashing on HTML trees
- Can be used to measure similarity

436:8dslkg48/f48fjoefjwfs:sfkjwfw8w
436:8dslkg48/f48fjoefjwfs:Dfkjwfw8w
Similarity: 99%

A self-developed undirected graph



Analysis

Prototype	Effectiveness	Efficiency
Basis (without modification)	100%	100%
HTML tree similarity measure	65,3%	155%
Piecewise response hashing	75%	148,7%
A self-developed undirected graph	72,3%	156%

Table: Prototype measurements based on the research design

Results
A user friendly product

Analysis

Solution	Extra interactions	Extra seconds	Without development
An extension for every scanner	N.A.	N.A.	×
Crawler that outputs URLs to a file	5	46	√
Available as an API	3	23	×
A scanner extension that outputs URLs to a file	4	43	√

Table: User-friendliness measurements based on the research design

Results
Conclusion

Improving the efficiency of scanners

The best solution is

GraphWave

But 100% effectiveness is not possible

Product Demo

GraphWave Demo

Future work

Advice for follow-up research

- Similar study to see if GraphWave can be tweaked in such a way that;
  - The graph thresholds and points options are set automatically
  - And the effectiveness can therefore be maintained at a higher level

Questions

Thank you