DISCOVRE

Efficient Cross-Architecture Identification of Bugs in Binary Code

OUTLINE

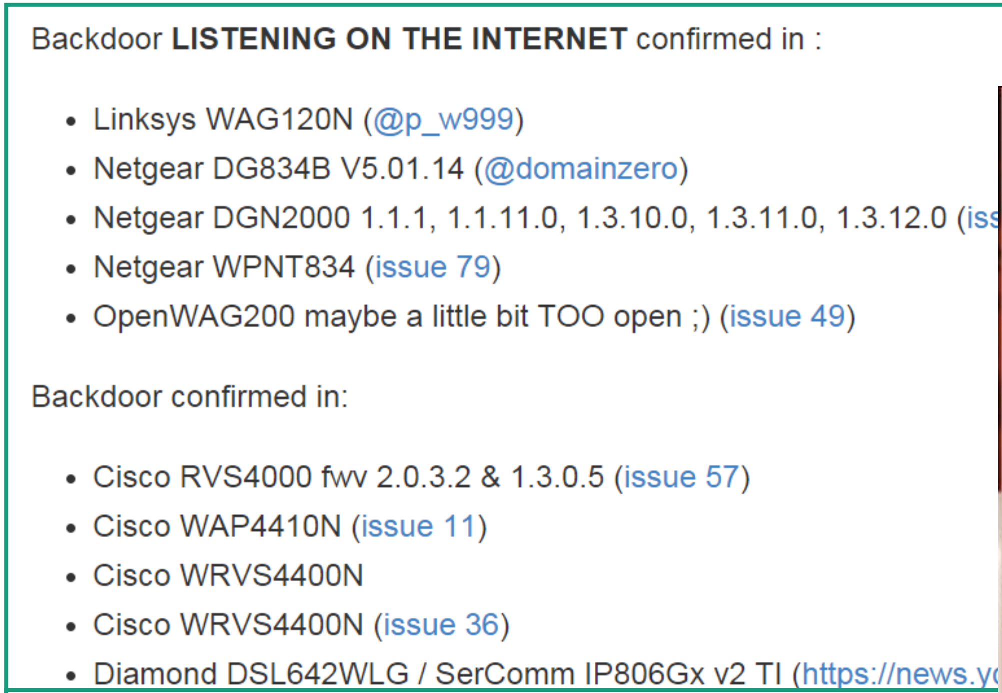
1. Motivation

2. Baseline

3. Derivation of discovRE‘s Key Properties

4. Cross-Architecture Bug Search

Motivation – Finding Firmware Bugs

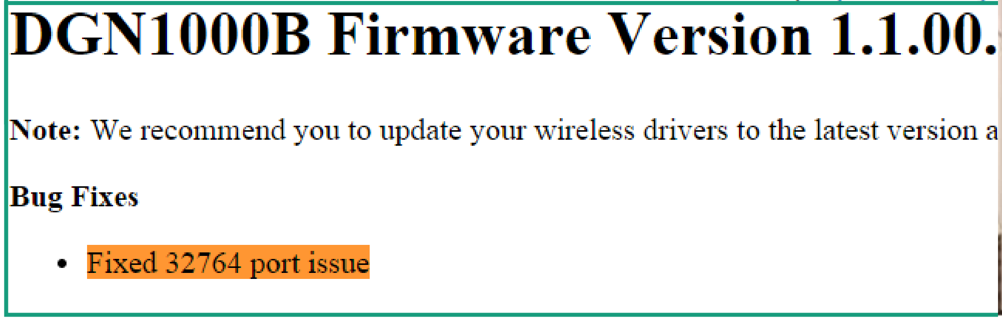


Backdoor **LISTENING ON THE INTERNET** confirmed in :

- Linksys WAG120N (@p_w999)
- Netgear DG834B V5.01.14 (@domainzero)
- Netgear DGN2000 1.1.1, 1.1.11.0, 1.3.10.0, 1.3.11.0, 1.3.12.0 (iss
- Netgear WPNT834 (issue 79)
- OpenWAG200 maybe a little bit TOO open ;) (issue 49)

Backdoor confirmed in:

- Cisco RVS4000 fwv 2.0.3.2 & 1.3.0.5 (issue 57)
- Cisco WAP4410N (issue 11)
- Cisco WRVS4400N
- Cisco WRVS4400N (issue 36)
- Diamond DSL642WLG / SerComm IP806Gx v2 TI (https://news.yc



DGN1000B Firmware Version 1.1.00.

Note: We recommend you to update your wireless drivers to the latest version a

Bug Fixes

- Fixed 32764 port issue

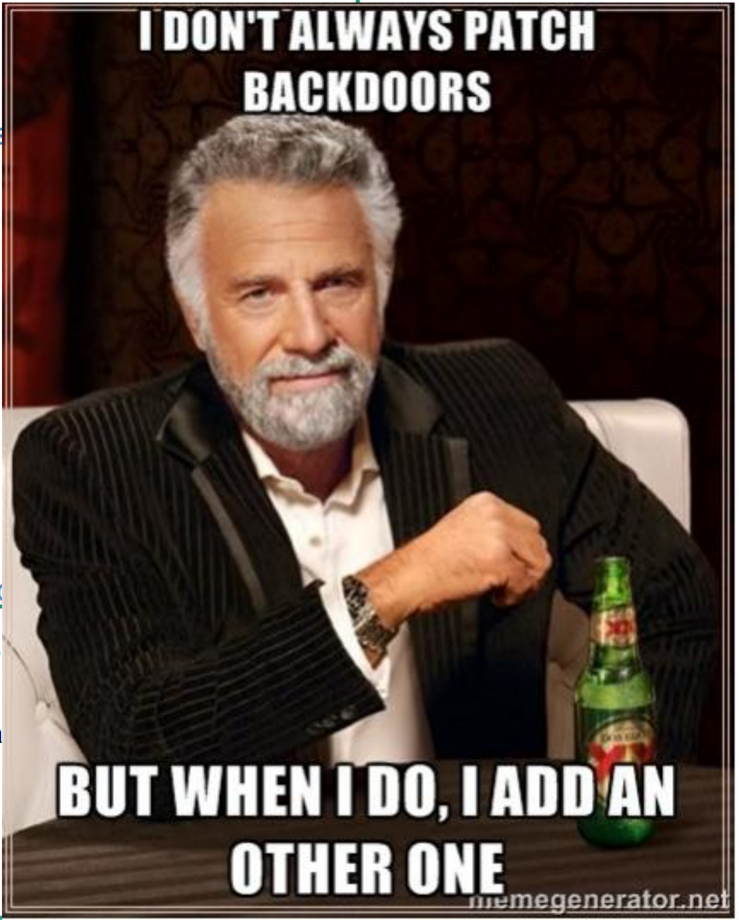

I DON'T ALWAYS PATCH BACKDOORS
BUT WHEN I DO, I ADD AN OTHER ONE
memegenerator.net

Image source: https://github.com/elvanderb/TCP-32764

Baseline

Image source: https://www.vectorstock.com/royalty-free-vector/1068869

Generation of a Ground Truth

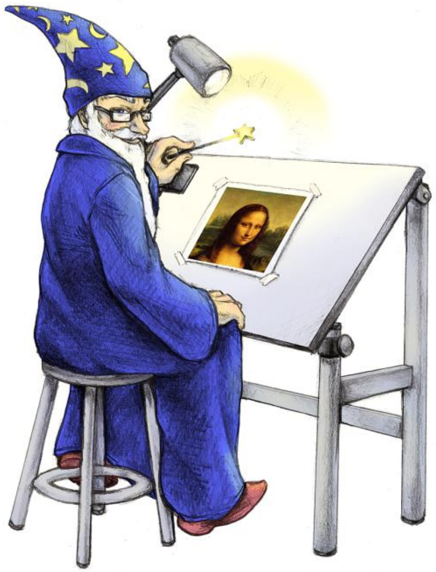


Image source: http://www.imagemagick.org/image/wizard.png

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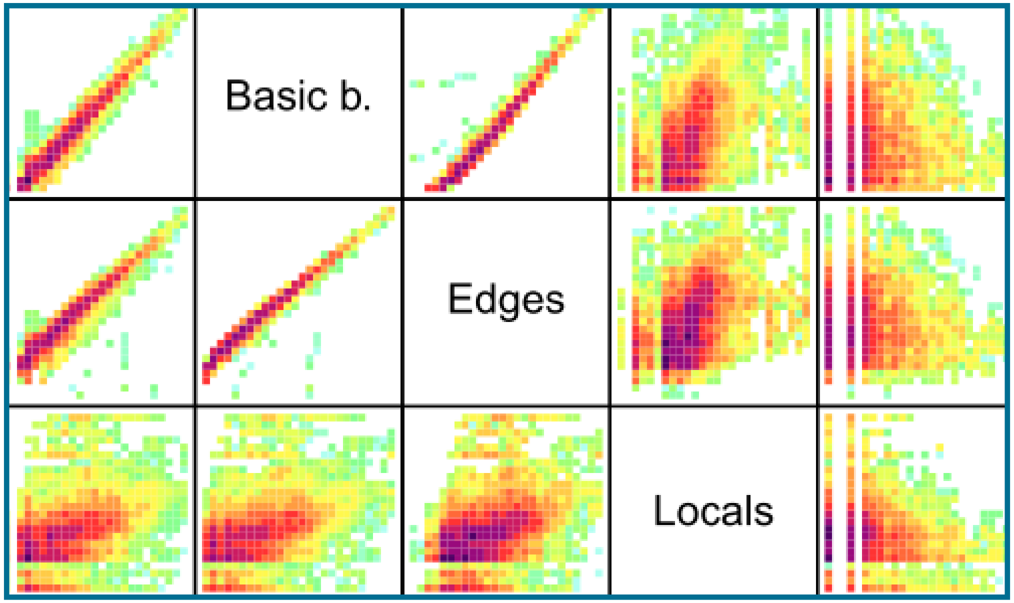
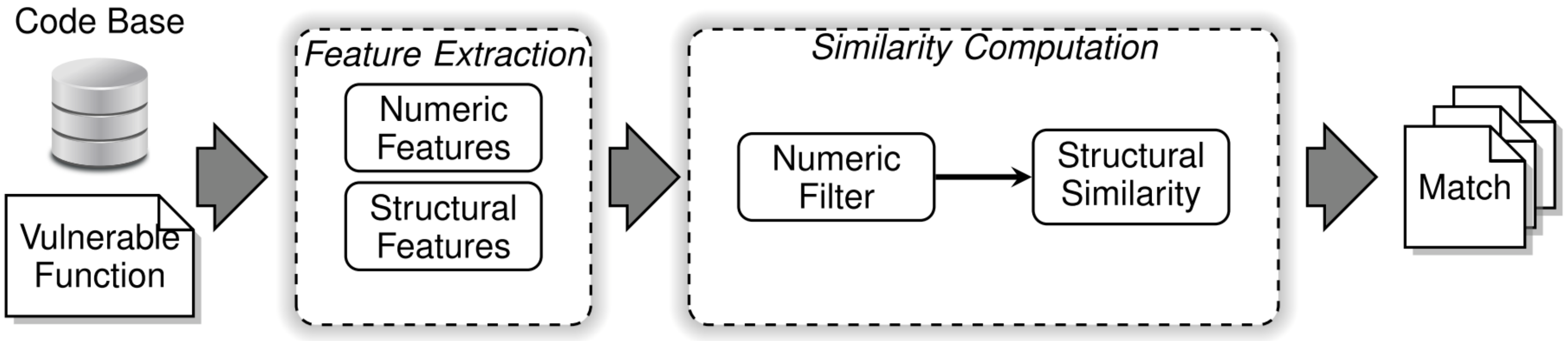
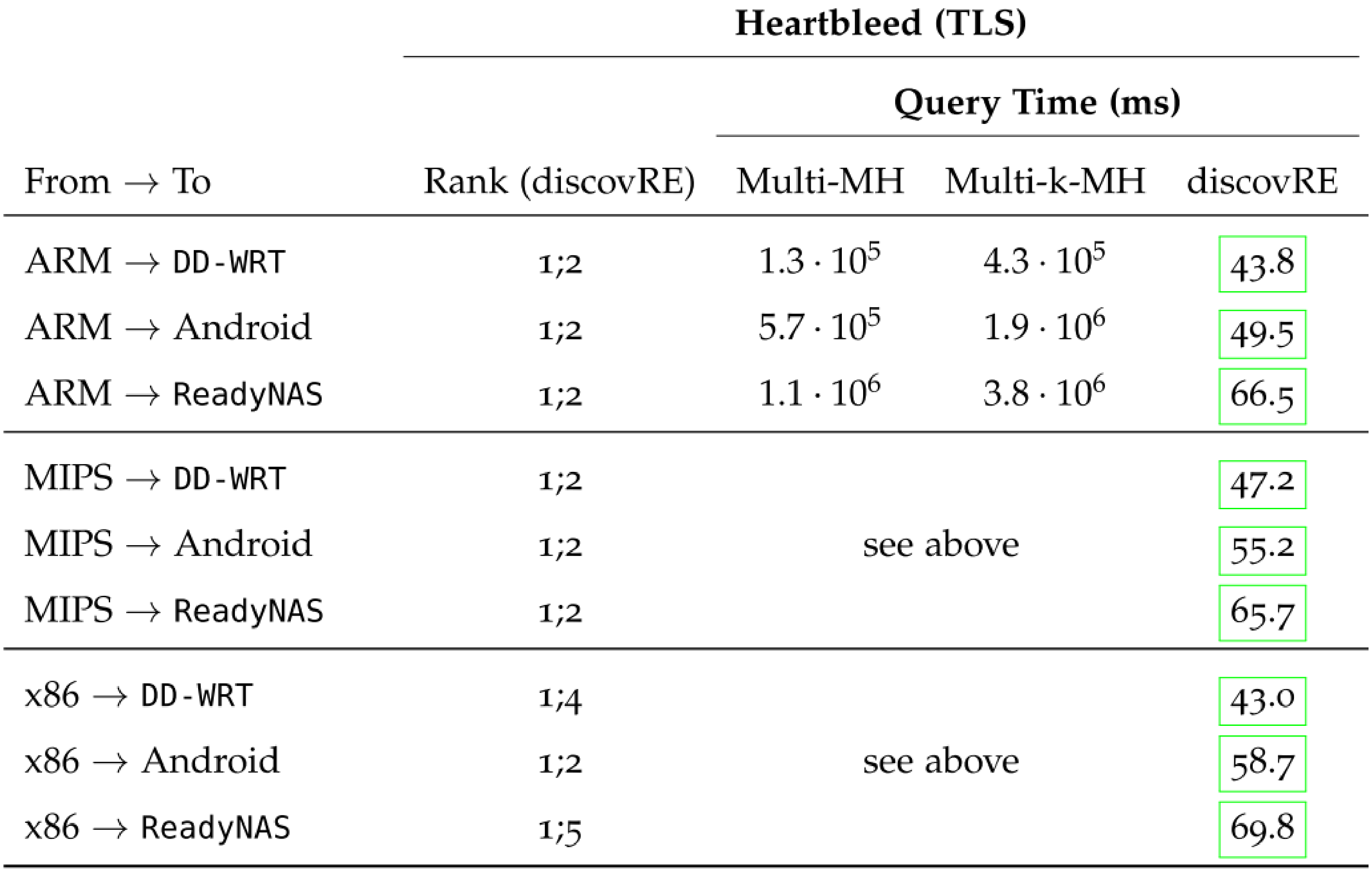
Derivation of discovRE's Key Properties



discovRE


Code Base
Vulnerable Function
Feature Extraction
Numeric Features
Structural Features
Similarity Computation
Numeric Filter
Structural Similarity
Match

Cross-Architecture Bug Search



	Heartbleed (TLS)			
		Query Time (ms)		
From → To	Rank (discovRE)	Multi-MH	Multi-k-MH	discovRE
ARM → DD-WRT	1;2	$1.3 \cdot 10^5$	$4.3 \cdot 10^5$	43.8
ARM → Android	1;2	$5.7 \cdot 10^5$	$1.9 \cdot 10^6$	49.5
ARM → ReadyNAS	1;2	$1.1 \cdot 10^6$	$3.8 \cdot 10^6$	66.5
MIPS → DD-WRT	1;2	see above		47.2
MIPS → Android	1;2			55.2
MIPS → ReadyNAS	1;2			65.7
x86 → DD-WRT	1;4	see above		43.0
x86 → Android	1;2			58.7
x86 → ReadyNAS	1;5			69.8

Conclusion

- Systematic analysis of a wide collection of function-level features

- Multi-staged approach to find similar functions in large code bases

- discovRE is able to discover vulnerable functions in complete firmware images fast:
  < 1 hour preparation time
  < 100 ms query time

THANK YOU FOR YOUR ATTENTION.