Improving the Efficiency of Dynamic Malware Analysis

Ulrich Bayer, Engin Kirda, Christopher Kruegel

Yang Yang

CISC850
Cyber Analytics

1. Introduction

- mutations of only a few malware programs
- reduce time
- 10,922 randomly chosen executable files

2. BACKGROUND: ANALYSIS TIME

$$OverallAnalysisTime = (|B| \cdot \sum_{b \in B} t_a(b))/I$$

$$t_a(b) = t_s(b) + t_e(b) + t_p(b)$$

3. REDUCING THE OVERALL ANALYSIS TIME

- Checkpoint time T_c
- $t_e(b)$: $Tc << t_e(b)$

- $t_{pre\text{–}empted}(b) = t_s(b) + T_c$

- $t_a(b) – t_{pre\text{–}empted}(b)$

3.1 Behavioral Profiles

- Timing information (timestamp value)

3.2 Comparison

- dist(bp(a), bp(b)) < d

- Jaccard distance:

$$J(a,b) = 1 - |a \cap b| / |a \cup b|$$

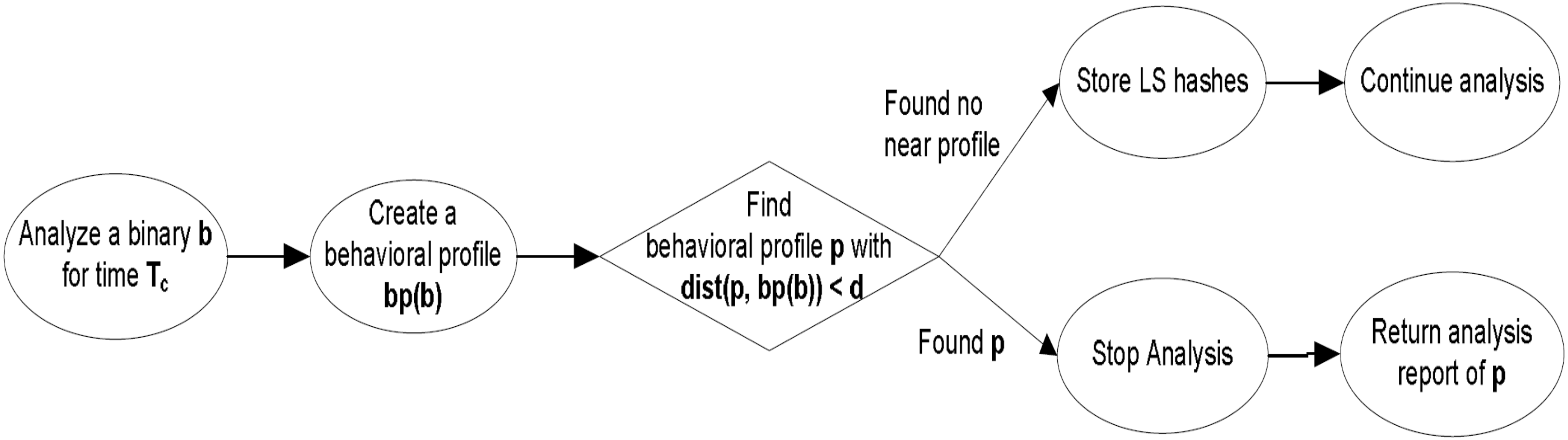
- Extended Jaccard Distance

3.3 Efficient Nearest Neighbor Search

- Locality Sensitive Hashing (LSH)

$$Pr[collision(a,b)] = 1 - (1 - (sim(a,b)^k))^l$$

3.4 The Analysis Process



Analyze a binary **b** for time T_c

Create a behavioral profile **bp(b)**

Find behavioral profile **p** with **dist(p, bp(b)) < d**

Found no near profile

Store LS hashes

Continue analysis

Found **p**

Stop Analysis

Return analysis report of **p**

4.1 Prototype Implementation

- On-the-fly generation of the behavioral profile
- Timestamps
- LSH
- Mapping feature strings to integer values
- LSH configuration

4.2 Experiment with a Reference Set

- *Virut*
- *Allaple.1*
- *Allaple.2*
- *Trojan-PWS.Win32.LdPinch*

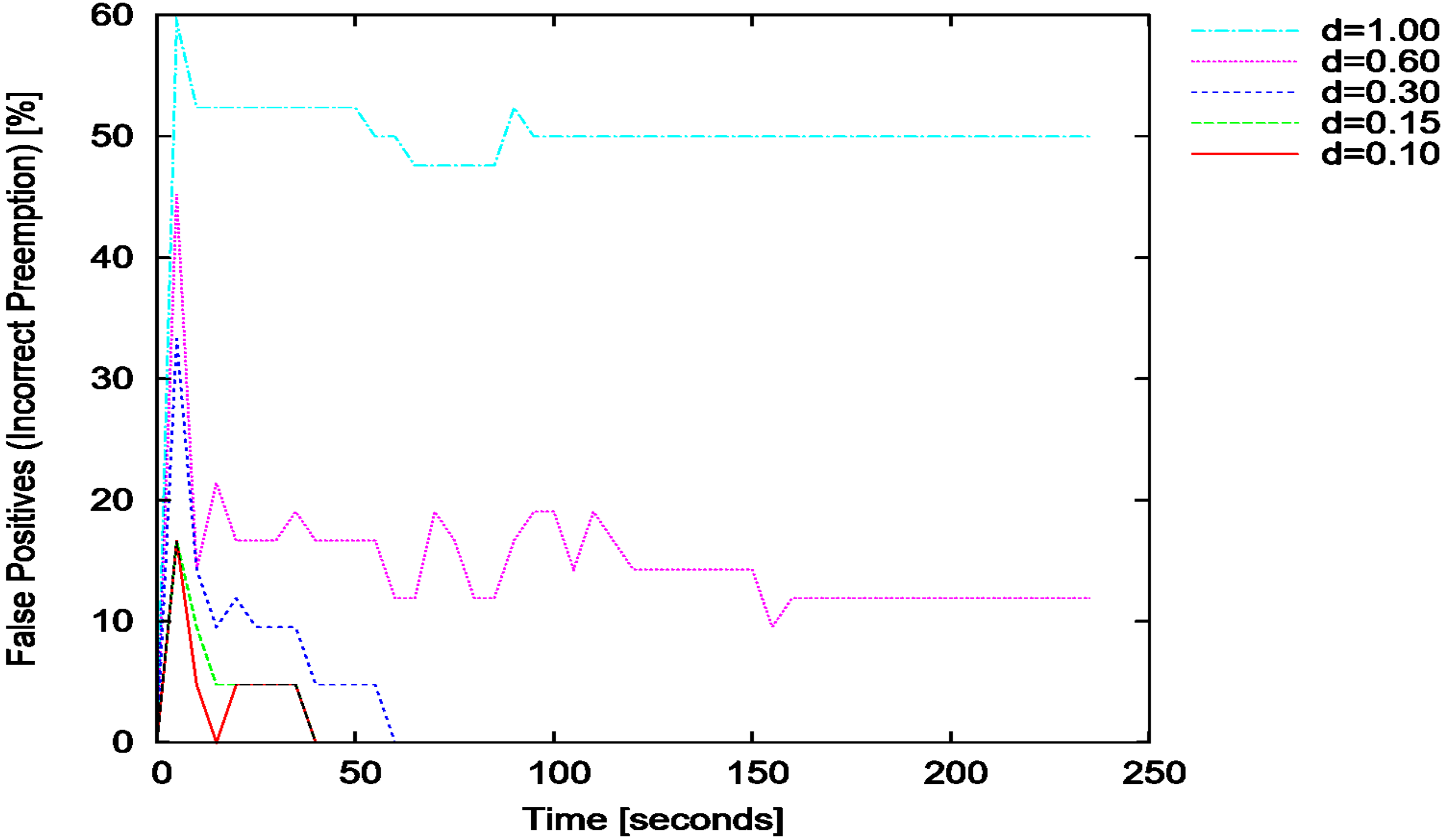


Figure 2: False Positives

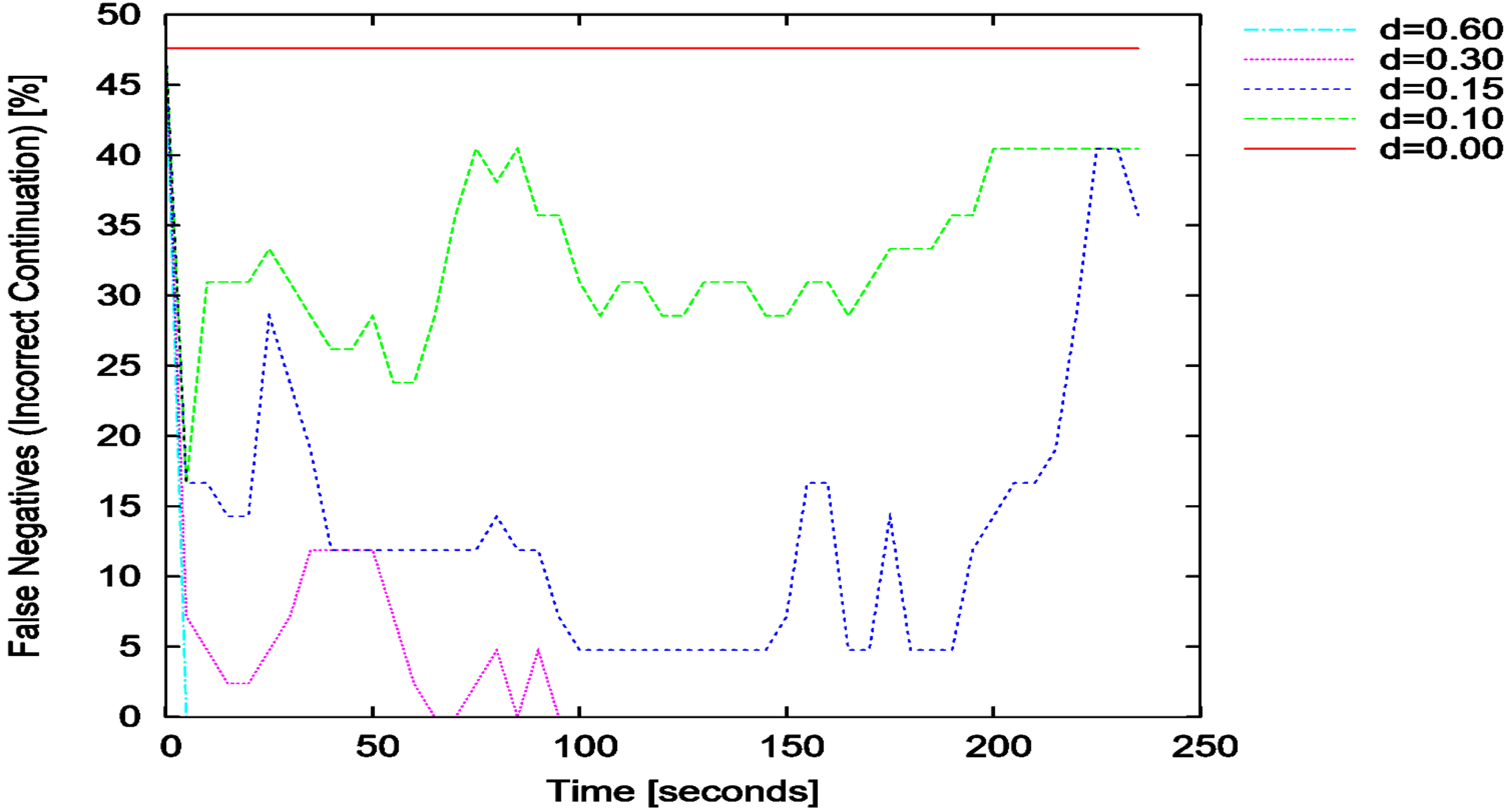
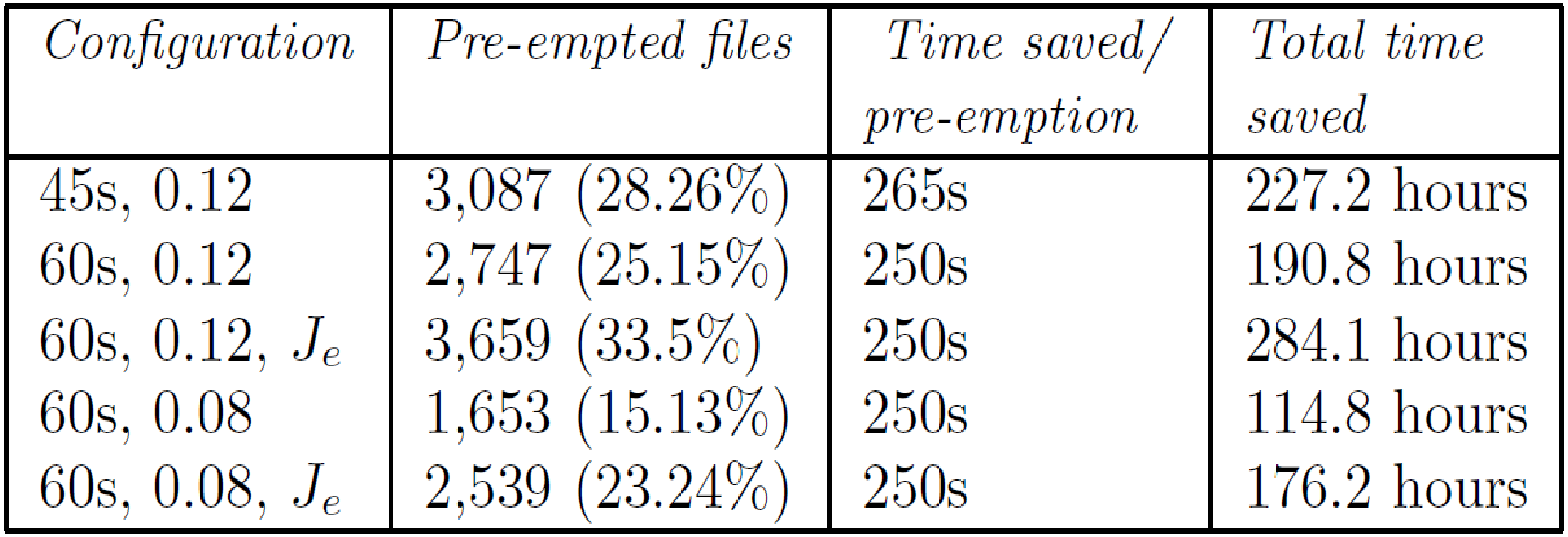


Figure 3: False Negatives

4.3 Real-World Experiments



Configuration	*Pre-empted files*	*Time saved/ pre-emption*	*Total time saved*
45s, 0.12	3,087 (28.26%)	265s	227.2 hours
60s, 0.12	2,747 (25.15%)	250s	190.8 hours
60s, 0.12, J_e	3,659 (33.5%)	250s	284.1 hours
60s, 0.08	1,653 (15.13%)	250s	114.8 hours
60s, 0.08, J_e	2,539 (23.24%)	250s	176.2 hours

Table 1: Results of testing our approach in different configurations on a set of 10,922 binaries

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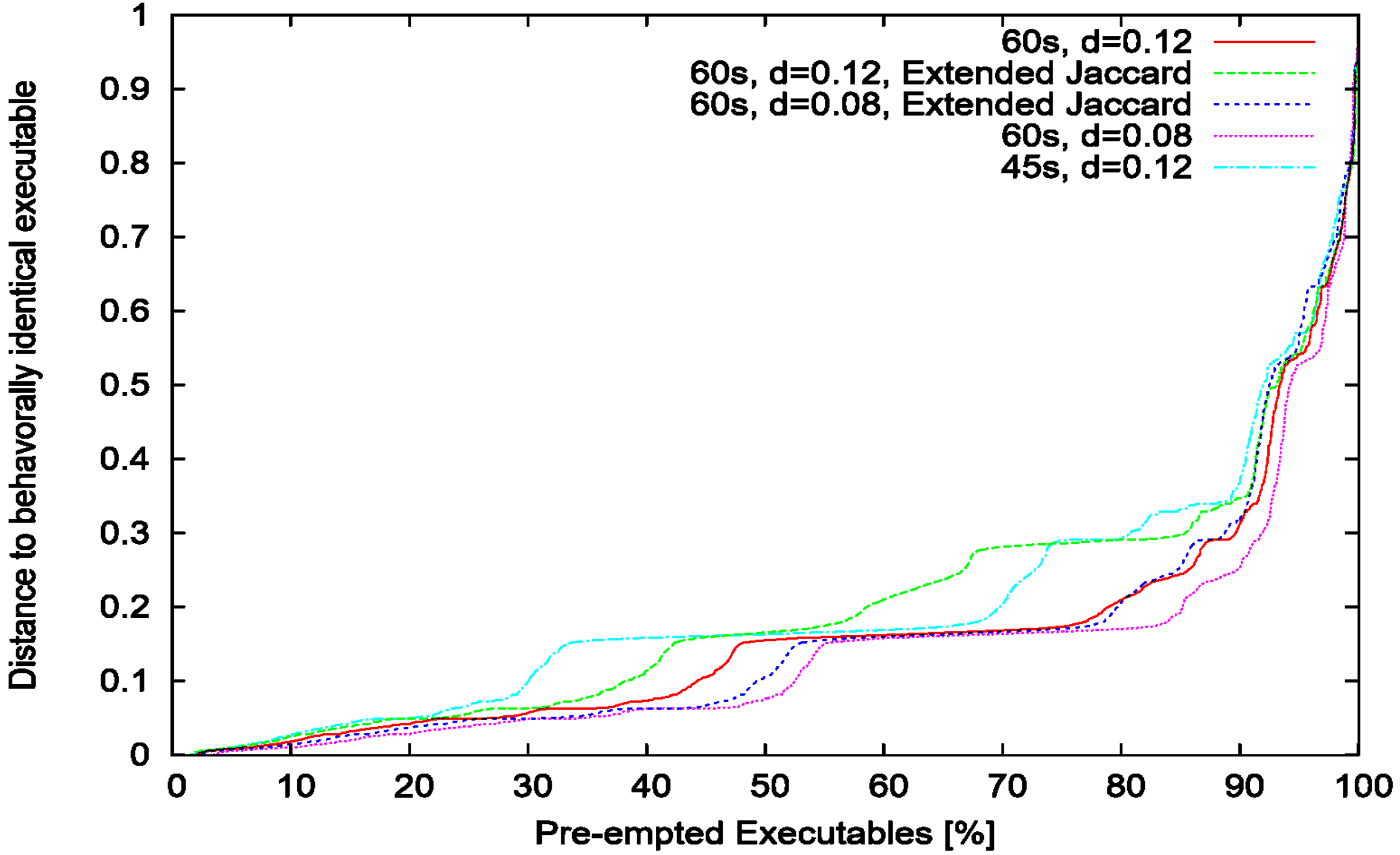

Figure 4: CDF in [%] of distances $J(b_i, s_i)$ at time t_e

5. LIMITATIONS

- do not reveal true behavior during the short period
- against specific attacks

6. CONCLUSIONS

- 10,922 randomly chosen executable files
- 2,747 files (25.25%)
- 190.8 hours saved

Thank you!