Towards Adaptive Process Confinement Mechanisms

COMP5900I Literature Review

William Findlay

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Abstract

[Come back hither when done.]

1 Introduction

Restricting unprivileged access to system resources has been a key focus of operating systems security research since the inception of the earliest timesharing computers in the late 1960s and early 1970s [cite]. In its earliest and simplest form, access control in operating systems meant preventing one user from interfering with or reading the data of another user. The natural choice for these early multi-user systems, such as Unix [22], was to build access control solutions centred around the user model—a design choice which has persisted in modern Unix-like operating systems such as Linux, OpenBSD, FreeBSD, and MacOS. Unfortunately, while user-centric permissions offer at least some protection from other users, they fail entirely to protect users from *themselves* or from their own *processes*. It was long ago recognized that finer granularity of protection is required to truly restrict a process to its desired functionality [19]. This is often referred to as *the process confinement problem* or *the sandboxing problem*.

1.1 The Process Confinement Threat Model

To understand why process confinement is a desirable goal in operating system security, we must first identify the credible threats to system stability and security that process confinement addresses. To that end, I first describe three attack vectors (items A1 to A3), followed by five attack goals (items G1 to G5) which highlight just a few of the credible threats posed by unconfined processes running on a given host.

A1. Compromised processes. [Write this]

A2. Semi-honest software. [Write this]

A3. Malicious software. [Write this]

G1. Installation of backdoors/rootkits. [Write this]

G2. Compromise of trusted computing base. [Write this]

G3. Unauthorized access to files. [Write this]

G4. Denial of service. [Write this]

G5. Theft of computational resources. [Write this]

[Talk about how the internet has exacerbated this problem]

1.2 The Case for Adaptive Process Confinement

Despite decades of work since Lampson's first proposal of the process confinement problem in 1973 [19], the process confinement problem remains largely unsolved [5]. This begs the question as to whether our current techniques for process confinement are simply inadequate for dealing with an evolving technical and adversarial landscape. In this literature review, I present the status quo in process confinement, with an emphasis on Unix and modern Unix-like systems such as Linux. Further, I present a novel taxonomy, categorizing existing process confinement mechanisms into *maladaptive*, *semi-adaptive*, and *adaptive* solutions. Finally, I argue the case for the development and adoption of *adaptive process confinement mechanisms*.

Here, I define adaptive process confinement mechanisms as those which greatly help defenders confine their processes and are robust in the presence of attacker innovation. Roughly, this definition can be broken down into the following properties:

P1. Robustness to attacker innovation. **[Write this]**

P2. Low adoption effort. **[Write this]**

P3. High reconfigurability. **[Write this]**

P4. Transparency. **[Write this]**

P5. Usability. **[Write this]**

Ideally, an adaptive process confinement mechanism should have most—if not all—of the above properties.

1.3 Outline

The rest of this paper proceeds as follows. **[List sections and what is in them.]**

2 Traditional Process Confinement Approaches

3 Automating Policy Generation

4 Automating Policy Audit

5 Towards Truly Adaptive Process Confinement

5.1 Anomaly Detection Techniques

5.2 Extended BPF

6 Conclusion

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