

1 SEDA: Scalable Embedded Device Attestation

1.1 Introduction

1.1.1 Overview

We design SEDA, Scalable Embedded Device Attestation, which is, to the best of our knowledge, the first attestation scheme for large-scale swarms. SEDA represents the first step in a new line of research on multi-device attestation. Although SEDA adheres to the common assumption – made in most (single-prover) attestation techniques – of ruling out physical attacks on devices, we discuss mitigation techniques for such attacks in Section 9.

1.1.2 Contributions

- First Swarm Attestation Scheme
- Security Model & Analysis
- Two Working Prototypes
- Performance Analysis

1.2 Swarm Attestation

1.2.1 Requirements

- Support the ability to remotely verify integrity of the swarm (S) as a whole.
- Be more efficient than individually attesting each device (D) in S.
- Not require the verifier (VRF) to know the detailed configuration of S.
- Support multiple parallel or overlapping attestation protocol instances.
- Be independent of the underlying integrity measurement mechanism used by devices in S.

1.2.2 Adversary Model

As common in the attestation literature [16, 24, 47, 48] we consider software-only attacks. This means that, although the adversary, denoted as ADV, can manipulate the software of (i.e., compromise) any device D in S, it cannot physically tamper with any device. However, ADV can eavesdrop on, and manipulate, all messages between devices, as well as between devices and VRF. Furthermore, we rule out denial-of-service (DoS) attacks since ADV typically aims to remain stealthy and undetected while falsifying the attestation result for VRF.

1.2.3 Protocol Description

SEDA has two phases: (1) an off-line phase whereby devices are introduced into the swarm, and (2) an on-line phase performing actual attestation. The off-line phase is executed only once and consists of device initialization and device registration. The on-line phase is executed repeatedly for every attestation request from a verifier VRF.

1.2.4 Swarm Attestation

VRF starts attestation of S by sending an attestation request $attest$ (containing a random challenge) to D_1 . VRF can randomly choose any device in S as D_1 or depending on its location or preference. Recall that VRF might be remote, or within direct communication range of one or more swarm devices. Eventually, VRF receives an attestation report from D_1 . VRF outputs a bit $b = 1$ indicating that attestation of S was successful, or $b = 0$ otherwise. VRF starts the protocol by sending a nonce N to D_1 . It, in turn, generates a new q and runs $attdev$ with all its neighbors, which recursively run $attdev$ with their neighbors. Note that N prevents replay attacks on communication between VRF and D_1 while the purpose of q is to identify the protocol instance and to build the spanning tree. Eventually, D_1 receives the accumulated attestation reports of all other devices in S .