CSP Is Dead, Long Live CSP! On the Insecurity of Whitelists and the Future of Content Security Policy

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CSP Is Dead, Long Live CSP! On the Insecurity of Whitelists and the Future of Content Security Policy

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Abstract

Content Security Policy is a web platform mechanism designed to mitigate cross-site scripting (XSS), the top security vulnerability in modern web applications. In this paper, we take a closer look at the practical benefits of adopting CSP and identify significant flaws in real-world deployments that result in bypasses in 94.72% of all distinct policies. We base our Internet-wide analysis on a search engine corpus of approximately 100 billion pages from over 1 billion hostnames; the result covers CSP deployments on 1,680,867 hosts with 26,011 unique CSP policies – the most comprehensive study to date. We introduce the security-relevant aspects of the CSP specification and provide an in-depth analysis of its threat model, focusing on XSS protections. We identify three common classes of CSP bypasses and explain how they subvert the security of a policy. We then turn to a quantitative analysis of policies deployed on the Internet in order to understand their security benefits. We observe that 14 out of the 15 domains most commonly whitelisted for loading scripts contain unsafe endpoints; as a consequence, 75.81% of distinct policies use script whitelists that allow attackers to bypass CSP. In total, we find that 94.68% of policies that attempt to limit script execution are ineffective, and that 99.34% of hosts with CSP use policies that offer no benefit against XSS. Finally, we propose the 'strict-dynamic' keyword, an addition to the specification that facilitates the creation of policies based on cryptographic nonces, without relying on domain whitelists. We discuss our experience deploying such a nonce-based policy in a complex application and provide guidance to web authors for improving their policies.

Research Areas

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Security, Privacy and Abuse Prevention