

MCP-FSD: Detecting Filesystem Capability Laundering in MCP Servers at Scale (My Credentials, Please)

PRIMARY

Publisher	arXiv
Published	2026-10-15
Retrieved	2026-10-19
Cite key	arxiv2026mcpfsd
URL	https://arxiv.org/abs/2610.22301

Assessment. Primary. Front matter read from arxiv.org/html/2610.22301v1; affiliations taken from the work's own author block.

Claims drawn from this source. CLAIM-2026-10-19-01, CLAIM-2026-10-19-02, CLAIM-2026-10-19-03, CLAIM-2026-10-19-04, CLAIM-2026-10-19-07, CLAIM-2026-10-19-08, CLAIM-2026-10-19-09, CLAIM-2026-10-19-14, CLAIM-2026-10-19-15

Abstract (verbatim from the work)

The Model Context Protocol (MCP) standardizes how AI agents invoke external tools. MCP servers expose tools through a declared contract consisting of a name, description, and argument schema. In typical local deployments, client-side approval of a tool call grants the underlying server process broad host filesystem permissions rather than restricting it to the declared operation. We study the resulting vulnerability class, filesystem capability laundering, where attacker-steered arguments cause a tool to access sensitive host files outside its declared contract and deployment scope. We analyze this capability gap across three layers: server-category screening (L1), per-tool contract analysis (L2), and bypassable path-validation checks (L3). We design MCP-FSD to catalog MCP servers, infer least-privilege boundaries per tool, plant credential fixtures outside those boundaries, and evaluate exploitability and sandbox containment via paired dynamic execution. Across 21,097 MCP servers from nine registries, 787 of 4,806 triaged servers (16.4%) exhibit filesystem capabilities despite non-filesystem functional classifications. Dynamic three-case validation confirms 150 vulnerable instances under tested sandbox policies. Coordinated disclosure yielded 13 security advisories, including two CVEs in Anthropic's Git MCP Server.

Front matter — authors and affiliations

Zeqian Huang (Independent Researcher); Mingyue Tang (University of Illinois Urbana-Champaign); Aonan Guan (Independent Researcher); Qiming Sun (Santa Clara University); Pengzhou He (Auburn University at Montgomery). Licence CC BY 4.0. arXiv:2610.22301v1 [cs.CR], 15 Oct 2026.

Section 4.1 — the authors' own caveat on the 16.4%

"...and absent external ground-truth labels across the entire catalog, this category mismatch serves as a coarse initial screening signal rather than a definitive violation metric."

Section 4.3 — RQ2: Confirmed Instances

"MCP-FSD confirms 150 instances, each adjudicated under the three-case dynamic validation against the inferred least-privilege boundary. For 136 of the 150 instances, adjudication relies on exact credential-marker matching: PoC 1's response contains the planted secret string, whereas PoC 3's response contains no marker bytes. For the remaining 14, the adjudicator evaluates corresponding evidence from other transcript features (write side-effects, response-shape changes, or external-CLI outputs)."

Section 4.4 — RQ3: Disclosed Outcomes

"We reported 13 findings, including two CVEs in Anthropic's Git MCP Server. MCP-FSD dynamically validates `git_add` with a full three-case PoC. The `git_init` finding is static because its disclosure is indirect: it seeds a repository that downstream Git tools then read. Both CVEs have been patched upstream. Among the 13 packages, 11 cite source-level mechanisms or configuration as evidence... Two packages rely on contract-implied scope boundaries without explicit path validation at the read sink."

Section 4.5 — RQ4: Violation Distribution

"At the sink level, 54.3% of emissions are Node-ecosystem files and 42.6% are Python files. All other languages together account for under 3.1%. Python leads PT-001 missing-validation (53.8% within-rule share), while Node leads every bypass-style rule at 57%-63%. This distribution reflects structural tooling gaps: the MCP TypeScript SDK provides no built-in path-containment [check]." Static emission level: 10,304 findings across 2,818 flagged servers (65.7% of the 4,292 with results); defence-bypass rules PT-002-PT-005 account for 61.6% against 36.4% for PT-001 missing validation.

Section 6.1 — Mitigations

"At L3, developers should enforce canonical-path containment, validate schema fields, and address symlink races at access time. An SDK-level containment helper would reach the many Node servers that currently ship no such check. At L2, a protocol extension could expose a per-tool `fs_scope` field in `tools/list`, allowing clients to inspect the requested read/write scope before approval and enforce the approved policy on server execution... Our three-case validation demonstrates that operating-system process isolation reliably enforces least-privilege boundaries without disrupting benign tool functionality. At L1, registry screening can identify filesystem capabilities for further review."

Section 6.2 — Limitations (carried into the edition)

"First, the pipeline only validates servers it can install and run. The dynamic results are conditional on successful startup and the selected runtime configurations. Second,

dynamic validation may miss a violation whose out-of-scope effect never appears in a response... Third, we do not measure the accuracy of the inferred boundaries themselves. A policy that is too restrictive can flag legitimate access, while one that is too permissive can miss a violation."

Case studies

5.1 Case 1 (L2): Unscoped Repository Creation in `git_init` (CVE-2025-68143). 5.2 Case 2 (L2): Path-Traversal Staging in `git_add` (CVE-2026-27735). A separate Memory MCP Server report demonstrated configuration injection through a persistence write when an attacker controls the launch-time persistence path; its fix was merged upstream without a CVE.