L08 Early Detection of Misconfiguration

Markus Raab

Institute of Information Systems Engineering, TU Wien

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Points in Time

Learning Outcomes

Students will be able to

- recall points of time relevant in configuration management.
- remind some arguments about pull vs. push.
- remember various strategies for earlier reduction of misconfiguration.

When are settings used?

From the application's perspective:

Implementation-time: Configuration accesses are hard-coded in the source code. For example, architectural decisions [1] lead to implementation-time settings.

Compile-time: Configuration accesses are resolved by the build system while compiling.

Deployment-time: Configuration accesses are while the software is installed.

Load-time: Configuration accesses are during the start of applications.

Run-time: Configuration accesses are during execution after the startup procedure.

Detection of Misconfiguration

Viewpoint

Different viewpoint: now from configuration management perspective.

Phases when we can detect misconfigurations:

- Compilation stage in configuration management tool
- Writing configuration settings on nodes
- Starting applications (load-time)
- When configuration setting is actually used (run-time)
  $\rightarrow$ Latent Misconfiguration

Problem

Earlier versus more context.

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Push vs. Pull

Push vs. Pull

- Push is more interactive.
- Push cannot do its job if nodes are not reachable.
- Push needs additional techniques to scale with many nodes.
- Push demands access to servers from a single server.
- Pull needs additional monitoring to know when a patch has been applied.
- Pull needs resources even if nothing is to do.

Task

Do you prefer push or pull? What does your CM tool of choice use?

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Early Detection

As shown by Xu et al. [2]:

- 12 % – 39 % configuration settings are not used at all during the application's startup procedure.
- Applications often have latent misconfigurations (14 % – 93 %).
- Latent misconfigurations are particular severe (75 % of high-severity misconfigurations).
- Latent misconfiguration needs longer to diagnose.

Checkers as plugins

Using checkers as plugins exclude whole classes of errors such as:

- Invalid file paths using the plugin *"path"*.
- Invalid IP addresses or host names using the plugins *"network"* or *"ipaddr"*.

Because the checks occur before the resources are actually used, the checks are subject to race conditions.[1]
In some situations facilities of the operating system help[2], in others we have fundamental problems.[3]

[1] For example, a path that was present during the check, can have been removed when the application tries to access it.

[2] For example, we open the file during the check and pass `/proc/<pid>/fd/<fd>` to the application. This file cannot be unlinked, but unfortunately the file descriptor requires resources.

[3] For example, if the host we want to reach has gone offline after validation.

Example [2]

Squid uses `diskd_program` but not before requests are served. Latent misconfiguration caused 7h downtime and 48h diagnosis effort.

Finding

Configuration from all externals programs need to be checked, too.

Conclusion

- provide external specifications for other tooling and configuration management
- use code generation to keep internal specifications consistent with external specifications (e.g. for refactoring)
- implement checkers as plugins
- execute checkers as early as possible, also for external programs executed later
- keep important resources allocated after checking

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Meeting

[1] Neil B Harrison, Paris Avgeriou, and Uwe Zdun. Using patterns to capture architectural decisions. *Software, IEEE*, 24(4):38–45, 2007. ISSN 0740-7459. doi: 10.1109/MS.2007.124.

[2] Tianyin Xu, Xinxin Jin, Peng Huang, Yuanyuan Zhou, Shan Lu, Long Jin, and Shankar Pasupathy. Early Detection of Configuration Errors to Reduce Failure Damage. In *Proceedings of the 12th USENIX Symposium on Operating Systems Design and Implementation (OSDI'16)*, Savannah, GA, USA, November 2016.