Creating Secure Software

Benefits from Cloud Thinking

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Kraków, 9-11 May 2018

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Security benefits from cloud thinking?

Cloud concepts

Twelve-factor app

- **Codebase**
  One codebase tracked in revision control, many deploys
- **Dependencies**
  Explicitly declare and isolate dependencies
- **Config**
  Store configuration in the environment
- **Backing services**
  Treat backing services as attached resources
- **Build, release, run**
  Strictly separate build and run stages
- **Processes**
  Execute the app as one or more stateless processes
- **Port binding**
  Export services via port binding
- **Concurrency**
  Scale out via the process model
- **Disposability**
  Maximize robustness with fast startup and graceful shutdown
- **Dev/prod parity**
  Keep development, staging, and production as similar as possible
- **Logs**
  Treat logs as event streams
- **Admin processes**
  Run admin/management tasks as one-off processes

https://12factor.net

Cloud-native

*A **cloud-native** application is an application that has been **designed** and implemented to run on a **Platform-as-a-Service** installation and to embrace **horizontal elastic scaling**.*

Kevin Hoffman, Beyond the Twelve-Factor App

What we’ll cover today

- Configuration
- Separate processes
- Logging
- The three R’s of enterprise security

Configuration

“Store configuration in the environment”

Configuration

Configuration in code

Configuration

Configuration in code

```
public class DatabaseConnection {

    private static final int PORT_NUMBER = 1521;
    private static final Duration CONNECTION_TIMEOUT = ofSeconds(5);

    // ...
}
```

Configuration

Configuration in code

```
public class DatabaseConnection {

    private static final int PORT_NUMBER = 1521;
    private static final Duration CONNECTION_TIMEOUT = ofSeconds(5);
    private static final String USERNAME = "service-A";
    private static final String PASSWORD = "yC6@SX50";

    // ...
}
```

Configuration

Configuration in code — challenges

- Anyone with access to the code can read the secrets
- No audit trail

Configuration

Configuration in resource files

```
environments:
    dev:
      database:
          port: 1521
          connection-timeout: 5000
          username: dev-service-A
          password: spring2019
    prod:
      database:
          port: 1521
          connection-timeout: 1000
          username: service-A
          password: yC6@SX5O
```

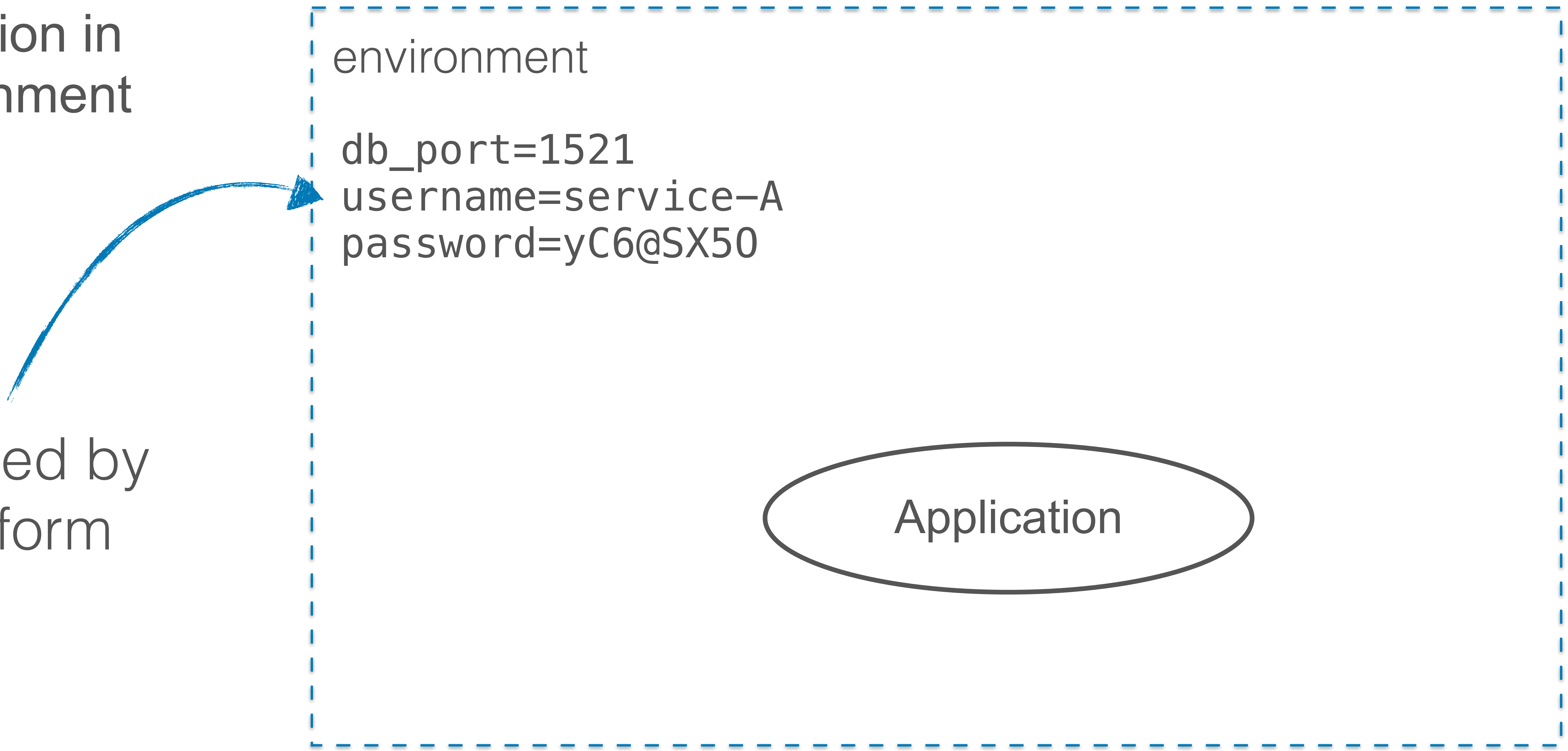
Configuration

Configuration in resource files — challenges

- Anyone with access to the conf can read the secrets
- No, or very limited, audit trail
- Encrypting values creates new problems

Configuration

Configuration in the environment



```
db_port=1521
username=service-A
password=yC6@SX50
```

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Configuration

Configuration in the environment - solved security challenges

- Audit trail
  Responsibility put on the platform. Some aspects can be solved with IAM.

- Sharing secrets
  Minimized. Only managed by platform admins.

- Encryption
  Not completely solved. Can be solved with ephemeral secrets.

What we’ll cover today

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- Separate processes
- Logging
- The three R’s of enterprise security

Separate processes

Run apps as separate stateless processes

Separate processes

- Run the app as multiple **stateless processes**
- **Separate** the **deployment** and **running** of the application
- Only **communicate via backing services**

Separate processes

Run the app as multiple stateless processes

- Security benefit: increased **availability** and **integrity**

CIA

- **Confidentiality** — data must only be disclosed to authorized users
- **Integrity** — data modification is only allowed in an authorized manner
- **Availability** — data must be available when needed

Separate processes

Run the app as multiple stateless processes

- Security benefit: increased **availability** and **integrity**

Separate processes

Separate the deployment and running of the application

- Security benefit: **principle of least privilege**

Separate processes

Only communicate via backing services

- Security benefit: improves **availability** and **integrity** by allowing apps to be **stateless**

What we'll cover today

- ✓ Configuration
- ✓ Separate processes
- Logging
- The three R's of enterprise security

Logging

Use logging as a service

Logging

Logging to disk - challenges

- Confidentiality
  - May contain sensitive information
  - Hard to control access
  - Hard to get a good audit trail
  - Hard prevent illegal access

Logging

Logging to disk - challenges

- Integrity
  - Maintaining integrity often overlooked
  - Write access to log files usually not restricted or audited

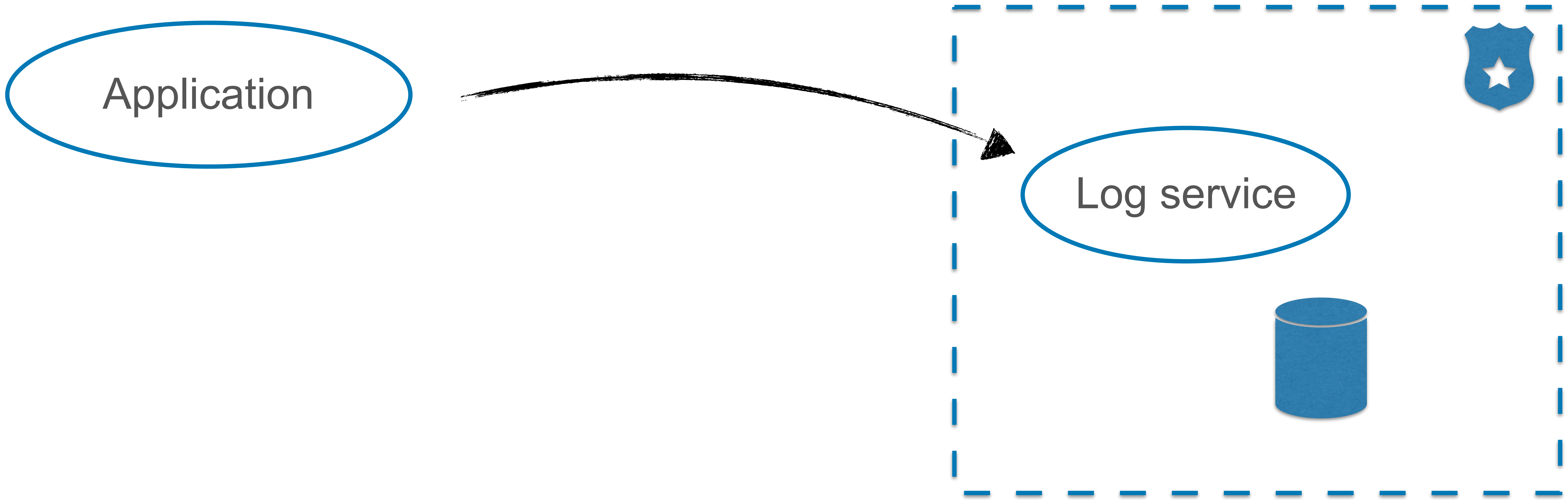
Logging

Logging to disk - challenges

- Availability
  - Log files are lost when servers are replaced
  - Disk space runs out

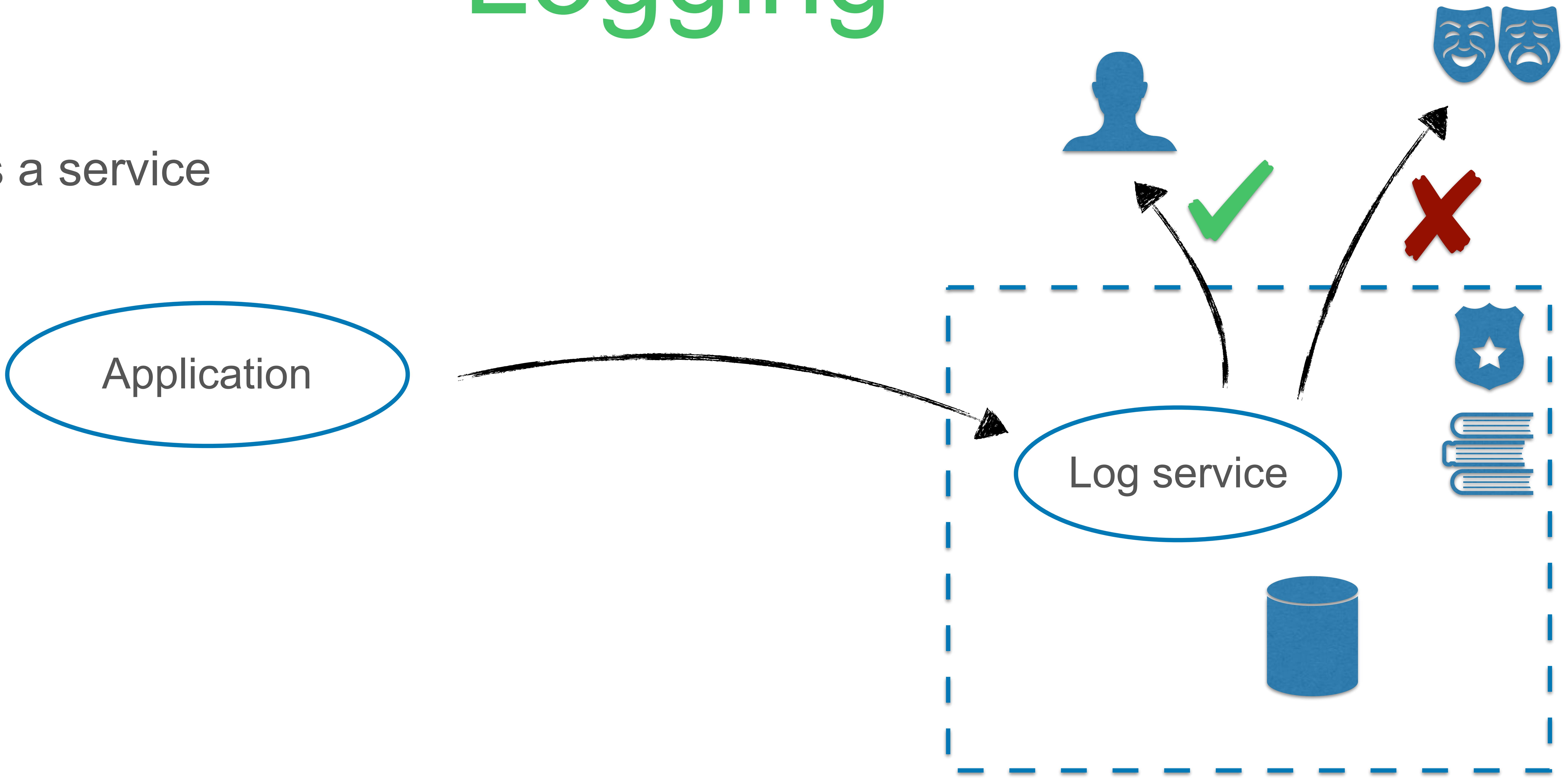
Logging

Logging as a service



Logging

Logging as a service



Logging

Logging as a service - solved security challenges

- Confidentiality
  Easy to restrict access and prevent illegal access.
  Audit trail.

- Integrity
  Mutating operations not exposed/implemented.
  Can even digitally sign log events

- Availability
  Log storage is handled explicitly so no log files can go missing
  Storage is a primary concern so no accidental shortage of disk space.

What we'll cover today

- ✓ Configuration
- ✓ Separate processes
- ✓ Logging
- The three R's of enterprise security

The three R’s

The three R’s of enterprise security

Justin Smith, 2016

The three R’s

The three R’s of enterprise security

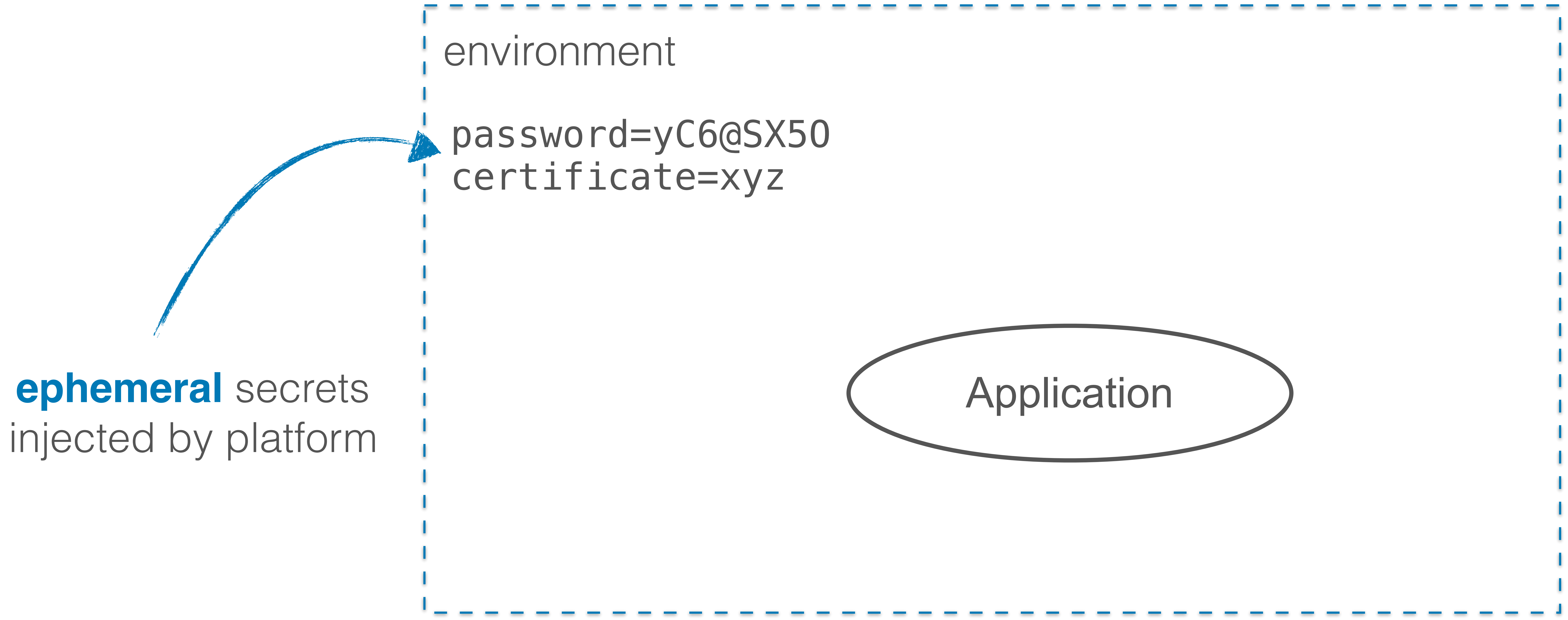
- Rotate
  Rotate secrets every few minutes or hours
- Repave
  Repave servers and applications every few hours
- Repair
  Repair vulnerable software a few hours after patch is available

The three R’s

Increase change to reduce risk

The three R’s

Rotate secrets every few minutes or hours



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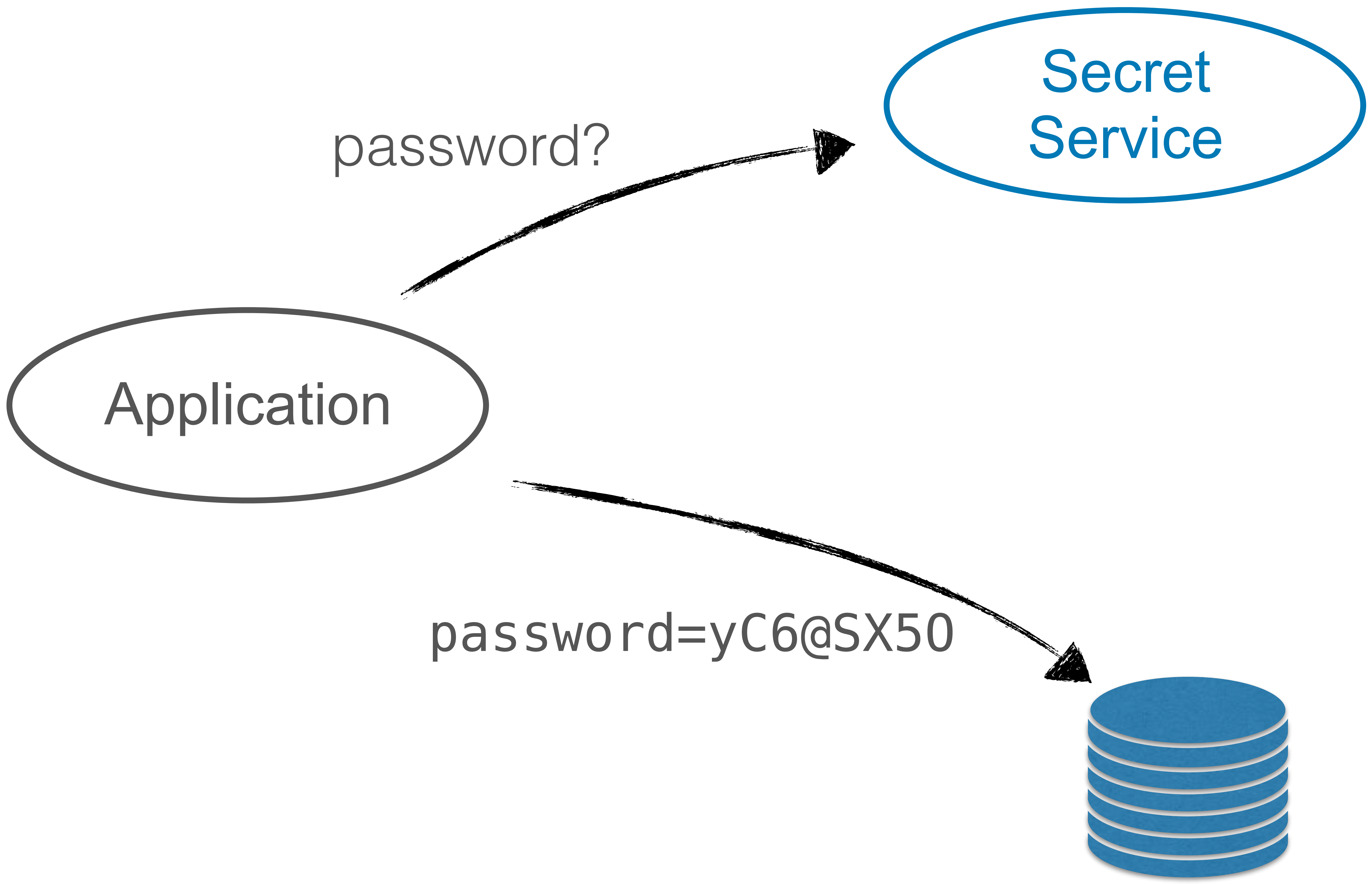
The three R's

Rotate secrets every few minutes or hours



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The three R's

Rotate secrets every few minutes or hours

- Passwords
- Certificates
- Access tokens
- …

The three R’s

Repave servers and applications every few hours

- Recreate servers and apps from a know good state
- Use rolling deployments to eliminate downtime
- Burn old instances to the ground
- If running containers, consider also repaving the host

The three R’s

Repair vulnerable software a few hours after patch is available

- Applies to both operating systems and applications
- No incremental updates, repave instead

The three R’s

Repair vulnerable software a few hours after patch is available

The three R's

Repair vulnerable software a few hours after patch is available

Patch available → New known good state → Repave

The three R's

Repair vulnerable software a few hours after patch is available

- Applies to both operating systems and your own applications
- No incremental updates, repave instead
- CI/CD enables you to repair your own applications
- Don't forget 3rd party dependencies

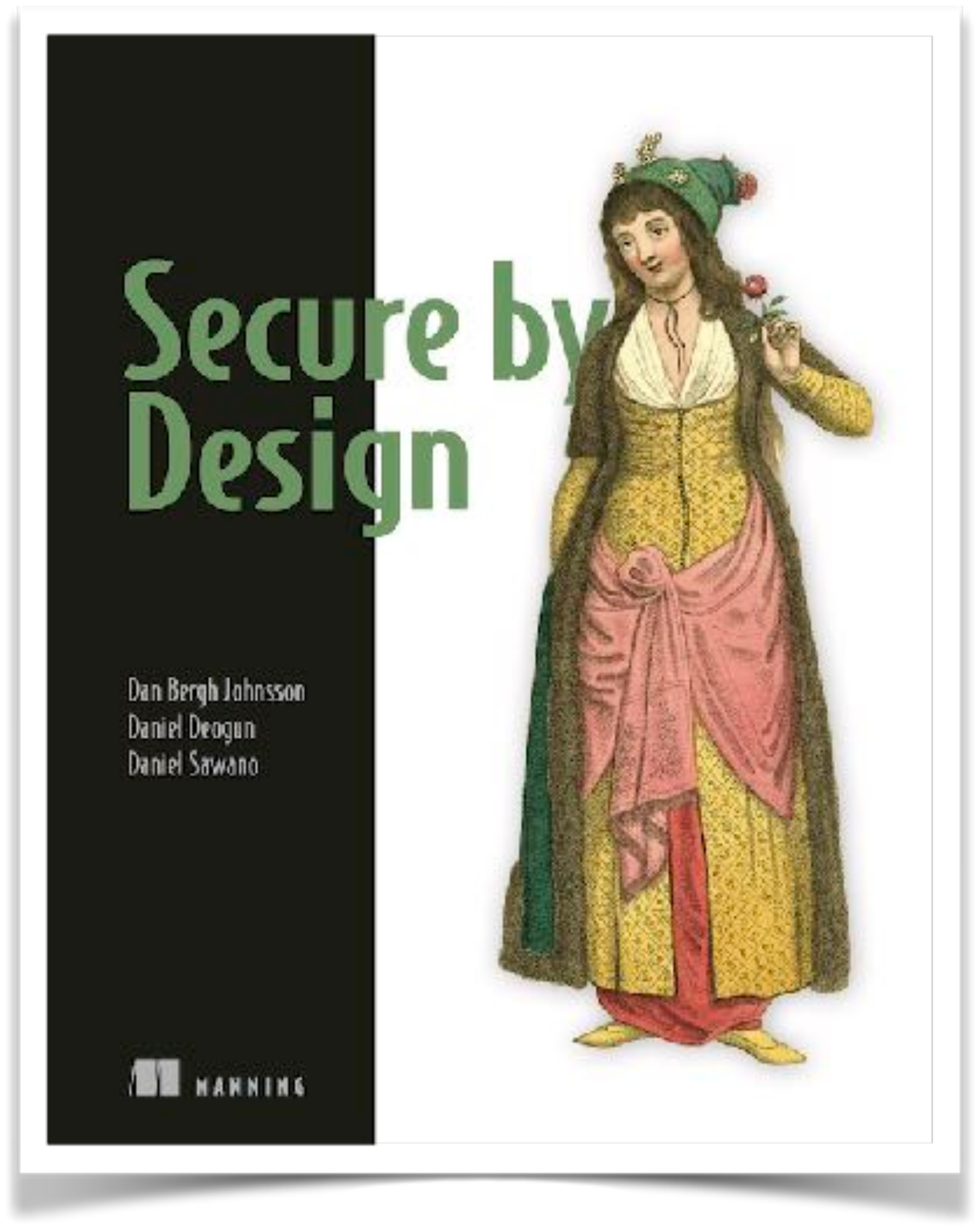
The three R’s

Ever-changing software is the nemesis of persistent threats

Summary

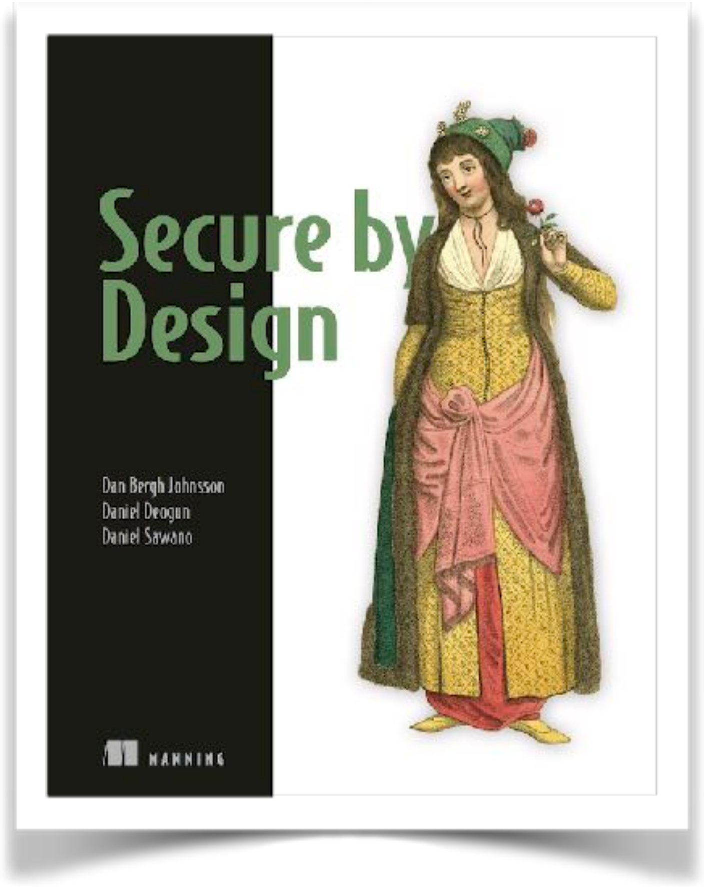
- ✓ Configuration
- ✓ Separate processes
- ✓ Logging
- ✓ The three R’s of enterprise security

Manning Publication



bit.ly/secure-by-design

Q&A


Secure by Design
Dan Bergh Johnsson
Daniel Deogun
Daniel Sawano
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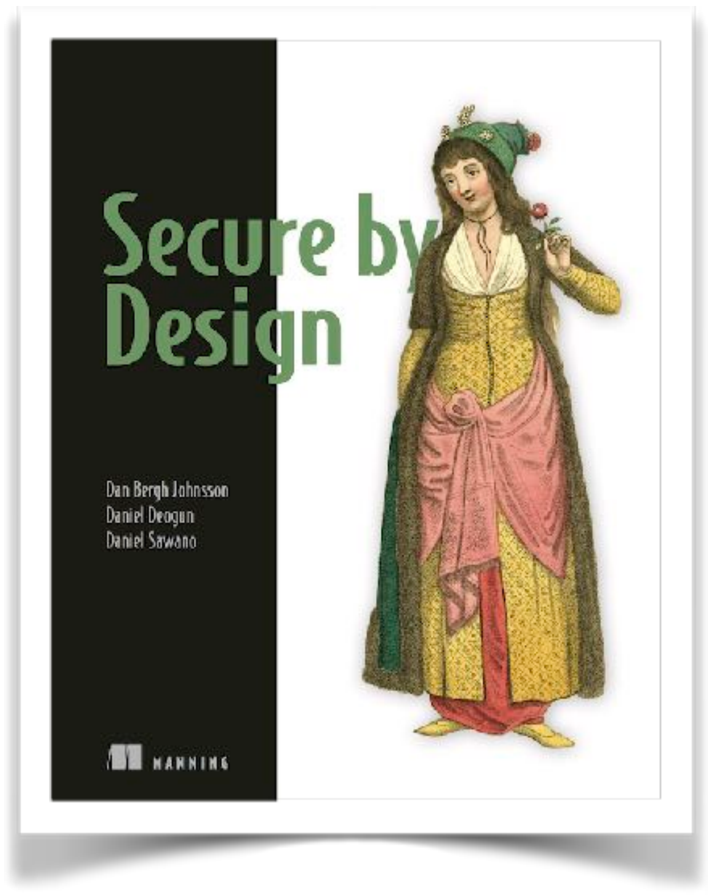

Thanks!