The background of the slide features a large, faint watermark of the Uppsala University seal. The seal is circular with a sunburst in the center, surrounded by the Latin text "HIGRATIACADEMIAE" at the top and "VERITAS NATURAE" at the bottom.

Providing Access Control and Copy-on-Write for Content Distribution Network Assets

Researching Copy-on-Write solutions

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Department of Information Technology
Uppsala University

April 8, 2016



Outline

1 Background

- Uprise
- BattleBinary
- CDN
- Copy-on-Write
- Related Work

2 Problem

- BattleBinary
- Problem
- Private Content
- Solutions Idea

3 Perius

- Model
- Implementation



Background

Uprise

BattleBinary

CDN

Copy-on-Write

Related Work

Problem

Perius



GHOST



Background

Uprise

BattleBinary

CDN

Copy-on-Write

Related Work

Problem

Perius

- A management system for CDN assets

What Uprise wanted:

- Possibility to handle private assets
- Migration to their current technology stack
- Features like snapshots and branching



Content Distribution Network (CDN)

Background

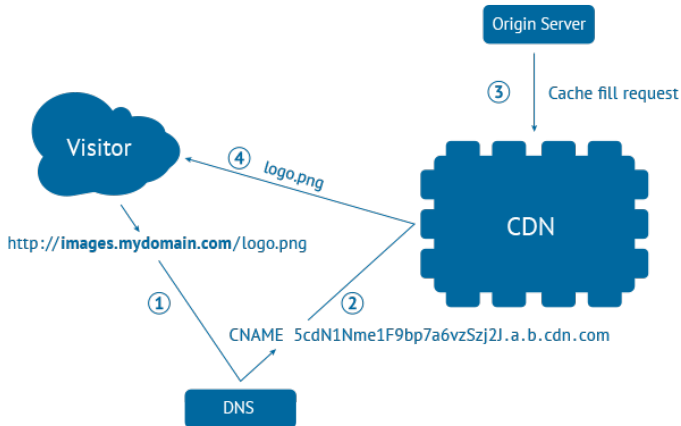
Uprise
BattleBinary

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Copy-on-Write

Background

Uprise

BattleBinary

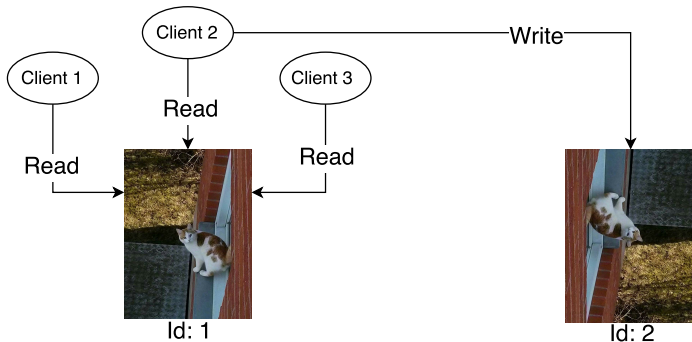
CDN

Copy-on-Write

Related Work

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Perius



*IDs are GUIDs in real implementations



Effects of COW

Background

Uprise

BattleBinary

CDN

Copy-on-Write

Related Work

Problem

Perius

- No accidental incremental changes or race conditions
- No locks needed → Scalability
- Take snapshots of system in constant time
- Needs some form of garbage collection/awareness



Effects of COW

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Related Work

Background

Uprise
BattleBinary
CDN
Copy-on-Write
Related Work

Problem

Perius

- Mach kernel
- Btrfs
- Programming Languages



Related Work

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Uprise
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Related Work

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BattleBinary

Virtual file system to organise CDN assets

Background

Problem

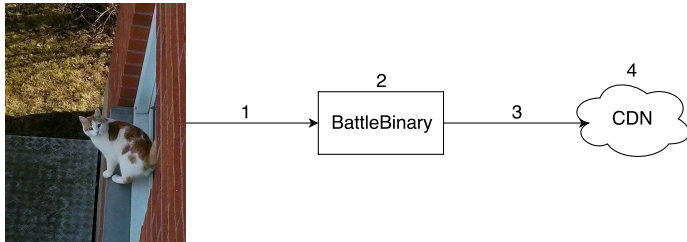
BattleBinary

Problem

Private Content

Solutions Idea

Perius



- 1. Image is uploaded to BattleBinary
- 2. Filename + Part of file's hash = Asset Identifier
- 3. Upload image to CDN
- 4. Image is available to everybody with link
<http://ea.akamaihd.net/cat-f1ee0283b6accd6.jpg>



BattleBinary

Virtual file system to organise CDN assets

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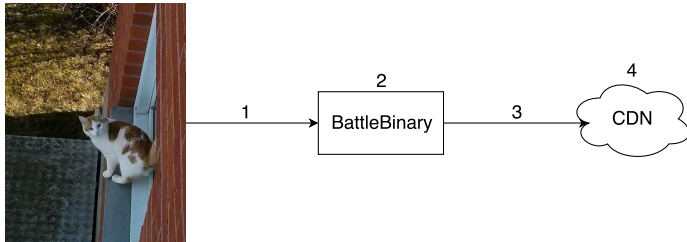
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BattleBinary

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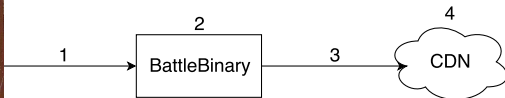
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BattleBinary

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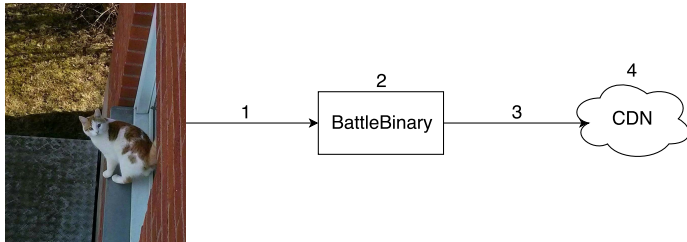
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Problem

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Problem

BattleBinary

Problem

Private Content

Solutions Idea

Perius

- Insecure
- Impractical
- Wont scale
- Lacks necessary features like access control and snapshots



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BattleBinary

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BattleBinary

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Private Content

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Private Content

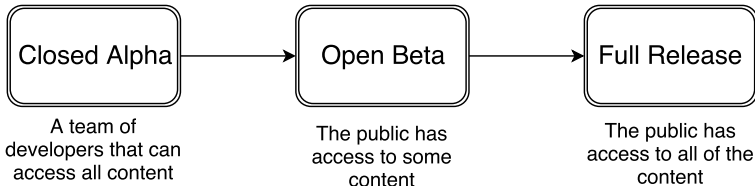
Background

Problem

BattleBinary
Problem

Private Content
Solutions Idea

Perius





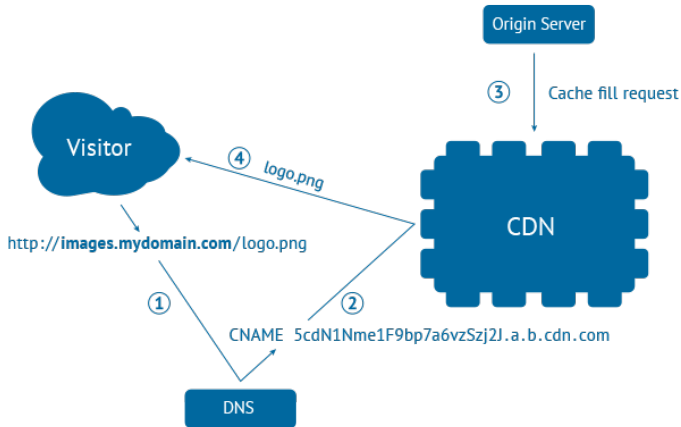
Solutions Idea

Background

Problem

BattleBinary
Problem
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Perius





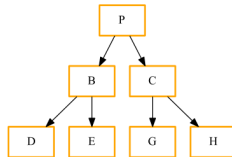
Example Operation

Background

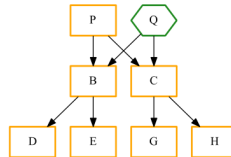
Problem

BattleBinary
Problem
Private Content
Solutions Idea

Perius



(a) Tree T_p



(b) T_p cloned to T_q

BTRFS: The Linux B-Tree Filesystem, O. Rodeh et al



Virtual Filesystem

Background

Problem

Perius

Model

Implementation



Filename: krafta.jpg

Filename:	krafta.jpg
Dimensions:	1920x1080
Size:	264.57 KB
Last modified:	07/04/2016, 14:43:46
Tags:	future art winter

CloudFront

<http://perius.se:81/projects/5706554b98b798008105fd5a/files/5706560298b79>

Akamai

<http://perius.se:81/projects/5706554b98b798008105fd5a/files/5706560298b79>

S3

<http://perius.se:81/projects/5706554b98b798008105fd5a/files/5706560298b79>



krafta.jpg

[Edit content](#) [Download](#) [Delete](#)



Model

Background

Problem

Perius

Model

Implementation

- Describes the system that is to be implemented
- Model informally checked through JPF
- Inspired by Biba. et al



Model

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Stack

Background

Problem

Perius

Model

Implementation

**Front-end
(Perius-front)**

Browser

Javascript

React

Reflux

SuperAgent

1

**Back-end
(Perius)**

Server

Scala

Spray

3 REST API

2

Logic code

4

Casbah

5

MongoDB



Security Settings

Background

Problem

Perius

Model

Implementation

- **Public** - The content can be reached by anybody
- **Protected** - The content can only be reached by a range of IP addresses
- **Private** - The content can only be reached by users with a signed cookie



Security Settings

Background

Problem

Perius

Model

Implementation

- **Public** - The content can be reached by anybody
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Security Settings

Background

Problem

Perius

Model

Implementation

- **Public** - The content can be reached by anybody
- **Protected** - The content can only be reached by a range of IP addresses
- **Private** - The content can only be reached by users with a signed cookie



Snapshots (and branching)

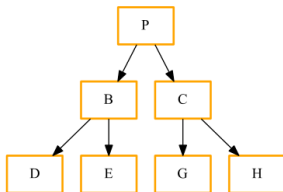
Background

Problem

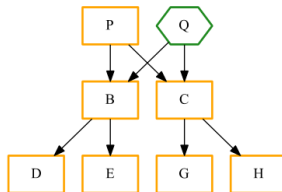
Perius

Model

Implementation



(a) Tree T_p



(b) T_p cloned to T_q



Load Testing

Background

Problem

Perius

Model

Implementation

- **Rigorous Load Testing was done on the back-end**
- Wrk and Apache Bench was used
- Result: About 60000 clients/back-end node before congestion



Load Testing

Background

Problem

Perius

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Implementation

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- Rigorous Load Testing was done on the back-end
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Scalability

Background

Problem

Perius

Model

Implementation

- Unlimited scaling on width
 - Optional Non-Blocking I/O with Reactive Mongo
 - Some heavy operations can be solved with caching



Scalability

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- Some heavy operations can be solved with caching



Open Source

Background

Problem

Perius

Model

Implementation

- `https://github.com/spydon/perius`
- `https://github.com/spydon/perius-front`



Background

Problem

Perius

Model

Implementation

Questions?



Thank you for listening