

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.

Access Control for Content Distribution Network Assets

Researching Copy-on-Write solutions

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Outline

1 Background

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

2 Problem

- BattleBinary
- Problem
- Private Content
- Solutions Idea

3 Perius

- Model
- Implementation

Background

Problem

Perius



Background

Uprise

CDN

BattleBinary

Copy-on-Write

Related Work

Problem

Perius



G H O S T



Content Distribution Network (CDN)

Background

Uprise

CDN

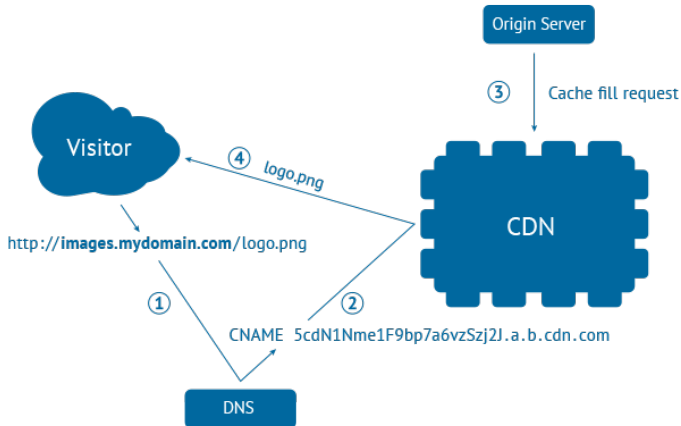
BattleBinary

Copy-on-Write

Related Work

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BattleBinary

Background

Uprise
CDN

BattleBinary

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



Copy-on-Write

Background

Uprise

CDN

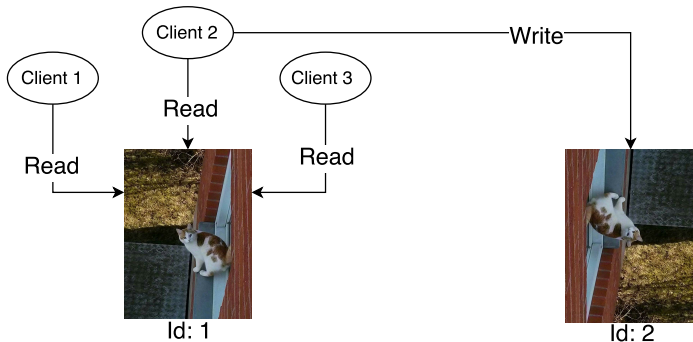
BattleBinary

Copy-on-Write

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*IDs are GUIDs in real implementations



Effects of COW

Background

Uprise

CDN

BattleBinary

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

CDN

BattleBinary

Copy-on-Write

Related Work

Problem

Perius

- Mach kernel
- Btrfs
- Programming Languages



Related Work

Background

Uprise

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BattleBinary

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Related Work

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Related Work

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BattleBinary

Copy-on-Write

Related Work

Problem

Perius

- Mach kernel
- Btrfs
- Programming Languages



BattleBinary

Virtual file system to organise CDN assets

Background

Problem

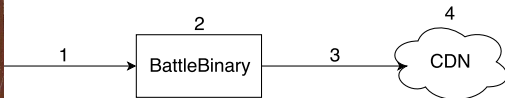
BattleBinary

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

Background

Problem

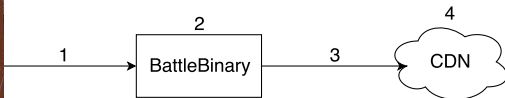
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BattleBinary

Virtual file system to organise CDN assets

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Problem

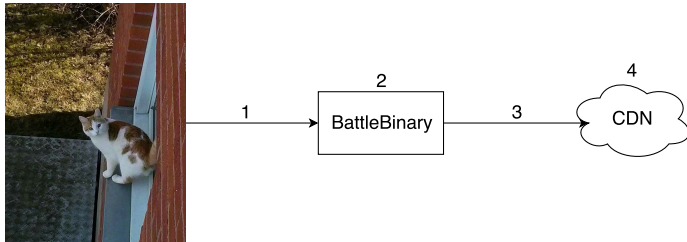
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BattleBinary

Virtual file system to organise CDN assets

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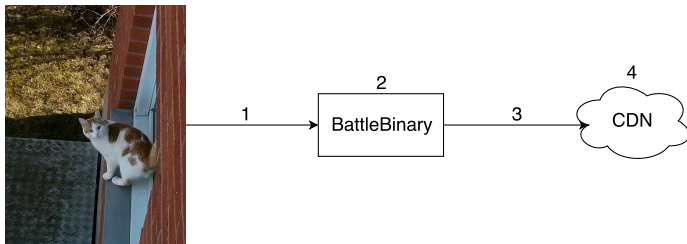
BattleBinary

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Problem

Background

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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Background

Problem

BattleBinary

Problem

Private Content

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Perius

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Private Content

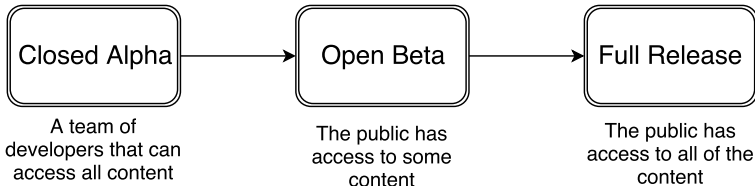
Background

Problem

BattleBinary
Problem

Private Content
Solutions Idea

Perius





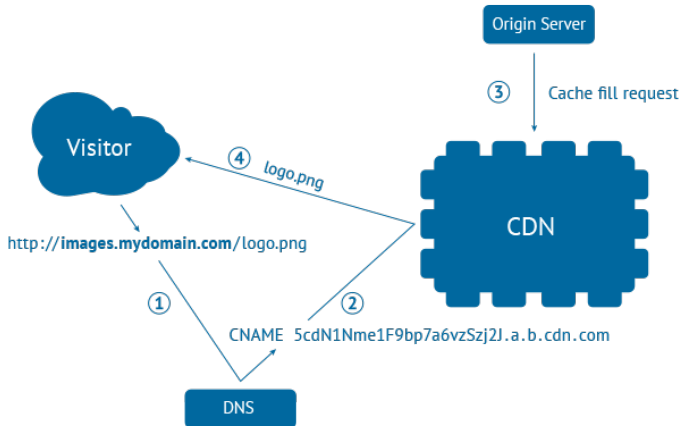
Solutions Idea

Background

Problem

BattleBinary
Problem
Private Content
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Perius





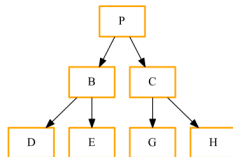
Example Operation

Background

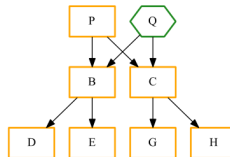
Problem

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

 Projects Search About






GameName

Assets

Secret

 krafta.jpg

winter art future

Videos

Images

Cat.jpg

animal cat

logo.jpg


logo

Filename: krafta.jpg

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


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
- Defines the core operations
- Model informally checked through JPF
- Inspired by Biba. et al



Model

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Problem

Perius

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Implementation

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Model - Sets

Background

Problem

Perius

Model

Implementation

Set	Name	Relation	Type
C	Containers	$\mathbf{C} \supseteq C \ni c$	$\mathbf{C} = P_{fin}(P_{fin}(C \cup M))$
M	Content	$\mathbf{M} \supseteq M \ni m$	$\mathbf{M} = P_{fin}(M)$
F	Files	$\mathbf{F} \supseteq F \ni f$	$\mathbf{F} = P_{fin}(F)$



Model - File Creation

Background

Problem

Perius

Model

Implementation

Rule of Inference

$$\frac{C \ni c \quad A[u, c] \quad m \notin c \quad \neg \text{readOnly}(c)}{(C \cup \{c\}, F) \xrightarrow{u, \text{create}(m, c)} (C \cup \{c \cup \{m\}\}, F \cup \{m.\text{file}\})} \quad (1)$$



Persistent Storage

Background

Problem

Perius

Model

Implementation



`{ name: mongo, type: DB }`

- Unaware of Copy-on-Write
- JSON (sort of) documents stored instead of tables



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

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Security Settings

Background

Problem

Perius

Model

Implementation

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Snapshots (and branching)

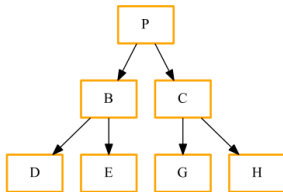
Background

Problem

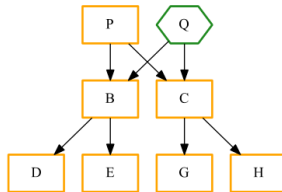
Perius

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

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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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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