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 "HIGRATIACADEMIA" 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 4, 2016



# Outline

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Background

What has  
been done

How to  
proceed

- 1 **Background**
  - Uprise
  - CDN
  - BattleBinary
  - Problem
  - Copy-on-Write
  - Related Work
  - Solutions Idea
- 2 **What has been done**
- 3 **How to proceed**



UPPSALA  
UNIVERSITET

# UPRISE

## Background

Uprise

CDN

BattleBinary

Problem

Copy-on-Write

Related Work

Solutions Idea

## What has been done

## How to proceed



G H O S T



# Content Distribution Network (CDN)

## Background

Uprise

CDN

BattleBinary

Problem

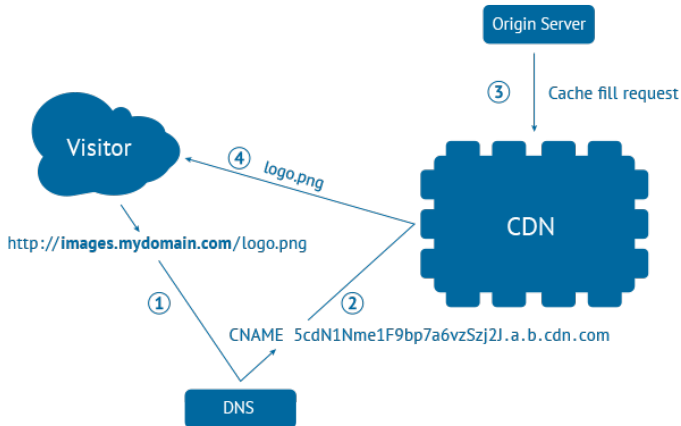
Copy-on-Write

Related Work

Solutions Idea

## What has been done

## How to proceed





# BattleBinary

## Background

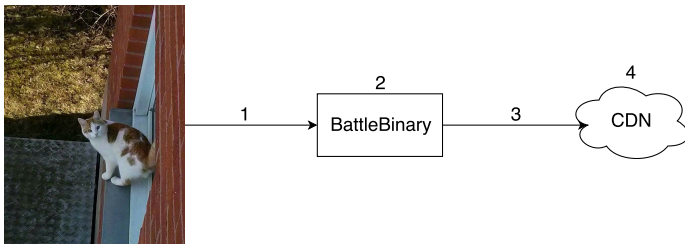
Uprise  
CDN

## BattleBinary

Problem  
Copy-on-Write  
Related Work  
Solutions Idea

## What has been done

## How to proceed



- 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

## Background

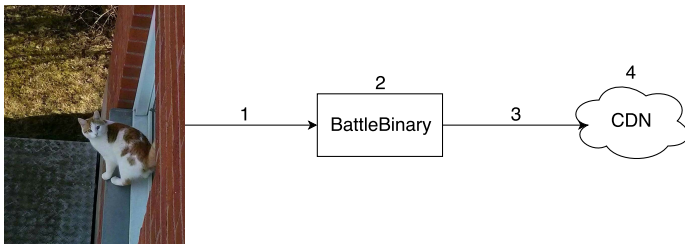
Uprise  
CDN

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Copy-on-Write  
Related Work  
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# BattleBinary

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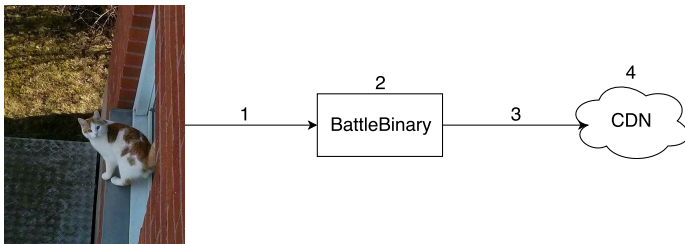
Uprise  
CDN

### BattleBinary

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# BattleBinary

## Background

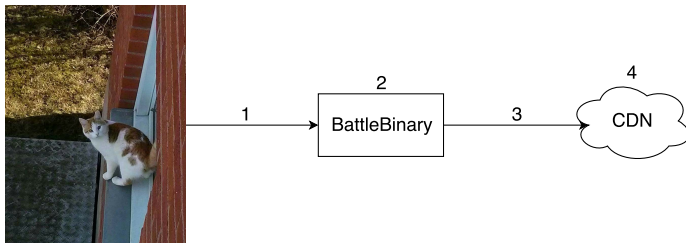
Uprise  
CDN

### BattleBinary

Problem  
Copy-on-Write  
Related Work  
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# Problem

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## Background

Uprise

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BattleBinary

Problem

Copy-on-Write

Related Work

Solutions Idea

## What has been done

## How to proceed

- insecure
- impractical
- wont scale



# Problem

---

## Background

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CDN

BattleBinary

Problem

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Related Work

Solutions Idea

## What has been done

## How to proceed

- insecure
- impractical
- wont scale



# Problem

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## Background

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CDN

BattleBinary

Problem

Copy-on-Write

Related Work

Solutions Idea

## What has been done

## How to proceed

- insecure
- impractical
- wont scale



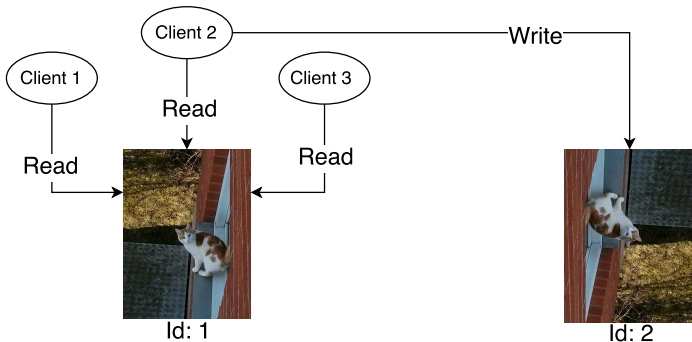
# Copy-on-Write

## Background

Uprise  
CDN  
BattleBinary  
Problem  
Copy-on-Write  
Related Work  
Solutions Idea

## What has been done

## How to proceed



\*IDs are GUIDs in real implementations



# Effects of COW

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## Background

Uprise

CDN

BattleBinary

Problem

Copy-on-Write

Related Work

Solutions Idea

## What has been done

## How to proceed

- 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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# Effects of COW

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# Related Work

---

## Background

Uprise  
CDN  
BattleBinary  
Problem  
Copy-on-Write

Related Work  
Solutions Idea

## What has been done

## How to proceed

- Mach kernel
- Btrfs
- Programming Languages



# Related Work

---

## Background

Uprise  
CDN  
BattleBinary  
Problem  
Copy-on-Write

Related Work  
Solutions Idea

## What has been done

## How to proceed

- Mach kernel
- Btrfs
- Programming Languages



# Related Work

---

## Background

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Problem  
Copy-on-Write

Related Work

Solutions Idea

## What has been done

## How to proceed

- Mach kernel
- Btrfs
- Programming Languages



# Solutions Idea

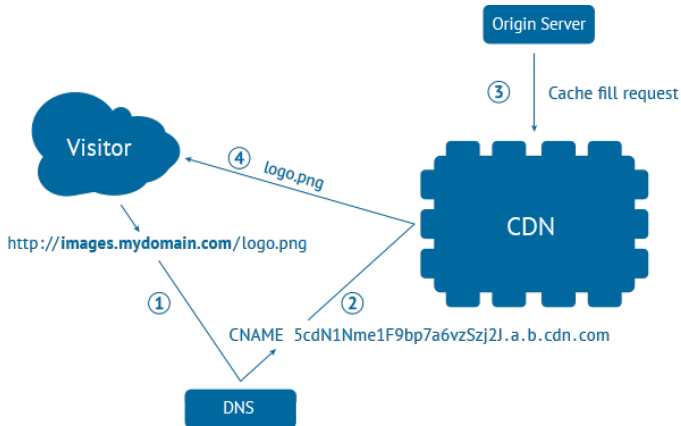
## Background

Uprise  
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Copy-on-Write  
Related Work

Solutions Idea

## What has been done

## How to proceed





# Example Operation

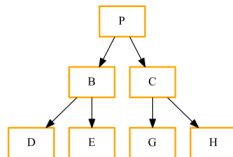
## Background

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Related Work

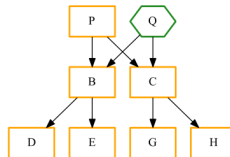
Solutions Idea

What has  
been done

How to  
proceed



(a) Tree  $T_p$



(b)  $T_p$  cloned to  $T_q$

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



# What has been done

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Background

What has  
been done

How to  
proceed

- Researching Copy-on-Write implementation
- Model checking implementation idea in JPF
- Implemented the fundamental back-end parts



# What has been done

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# How to proceed

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Background

What has  
been done

How to  
proceed

- **Comparing Copy-on-Write implementations**
  - Fully implement and test the system
  - Writing more on the report...



# How to proceed

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Background

What has  
been done

How to  
proceed

- Comparing Copy-on-Write implementations
- Fully implement and test the system
- Writing more on the report...



# How to proceed

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