

# Mitigating Browser Fingerprint Tracking: Multi-level Reconfiguration and Diversification



Pierre Laperdrix, Walter Rudametkin, Benoit Baudry  
Seams – May, 19th 2015



# Table of contents

- 1) What is fingerprint-based tracking?
- 2) Presentation of Blink
- 3) Experimental validation
- 4) Conclusion and perspectives

# Device fingerprinting

- Successor of cookies
- Side-effect of software diversity
- Collection of information on the device
  - ✓ Browser
  - ✓ Operating system
  - ✓ Hardware



Firefox OS

# Example of a fingerprint

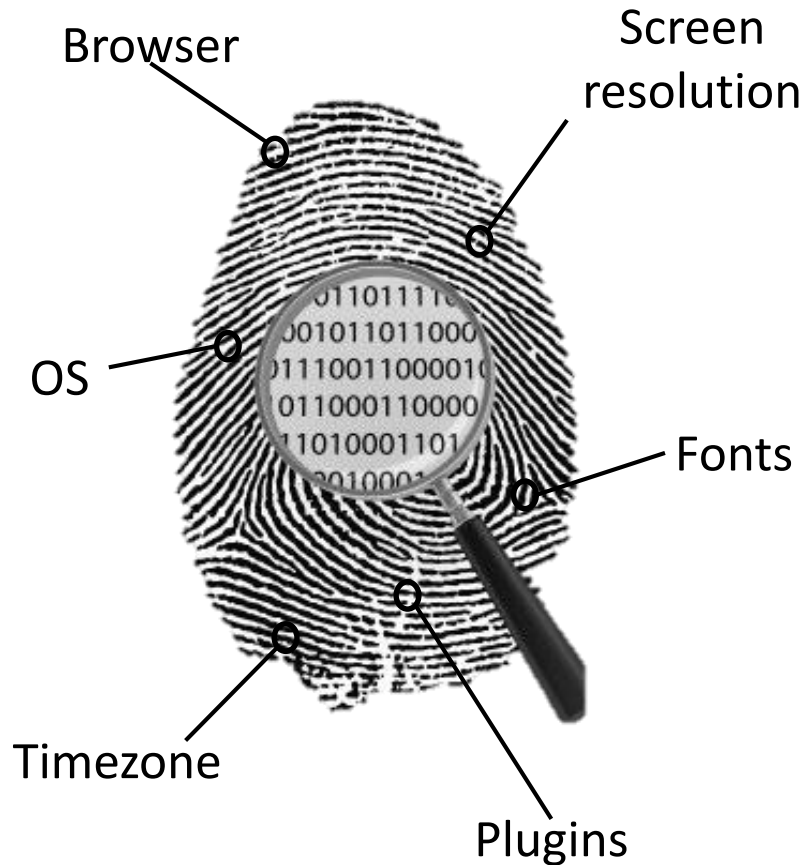
Attribute	Value
User agent	Mozilla/5.0 (X11; Linux i686; rv:25.0) Gecko/20100101 Firefox/25.0
HTTP accept	text/html, application/xhtml+xml, application/xml;q=0.9,*/*;q=0.8 gzip, deflate en-US,en;q=0.5
Plugins	Plugin 0: QuickTime Plug-in 7.6.6; libtotem-narrow-space-plugin.so; Plugin 1: Shockwave Flash; Shockwave Flash 11.2 r202; libflashplayer.so;
Fonts	Century Schoolbook, Source Sans Pro Light, DejaVu Sans Mono, Bitstream Vera Serif, URW Palladio L, Bitstream Vera Sans Mono, Bitstream Vera Sans, ...
HTTP DoNotTrack	1
Cookies enabled	Yes
Platform	Linux i686
OS	Linux 3.14.3-200.fc20.x86 32-bit
Screen resolution	1920x1080x24
Timezone	-480
DOM Session storage	Yes
DOM Local storage	Yes
I.E. User data	No



*Maverick*  
*Ocean Front Villas*  
*mandarin tea*  
**Regency**  
*Sassafas & Ginger*  
*Dollhouse*  
*Athletics Dept.*



# How unique are we?



- 83.6% of unique fingerprints

Am I Unique?

- 86.4% of unique fingerprints

# How unique are we?



We can be tracked!



- 83.6% of unique fingerprints

Am I Unique?

- 86.4% of unique fingerprints

# How widespread is fingerprinting?

## Google

- o **Device information**

We may collect **device-specific information** (such as **your hardware model, operating system version, unique device identifiers** and mobile network information including phone number). Google may associate your **device identifiers or phone number** with your Google Account.

## Amazon

### Automatic Information

Examples of the information we collect and analyze include the Internet protocol (IP) address used to connect your computer to the Internet; login; e-mail address; password; computer and connection information such as **browser type, version, and time zone setting, browser plug-in types and versions, operating system, and platform**; purchase history, which we sometimes aggregate with similar information

## Advertising companies





# Device fingerprinting

- Silent
- Complement usage of cookies
- Hard to detect and block fingerprinting scripts
- Already adopted by major web actors
- Track users without their knowledge
- Real privacy problem

# Table of contents

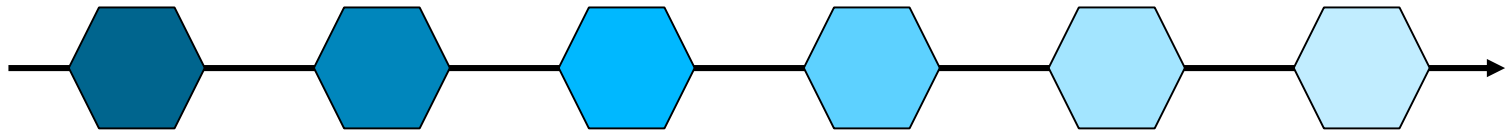
- 1) What is fingerprint-based tracking?
- 2) Presentation of Blink
- 3) Experimental validation
- 4) Conclusion and perspectives

# Properties of a fingerprint

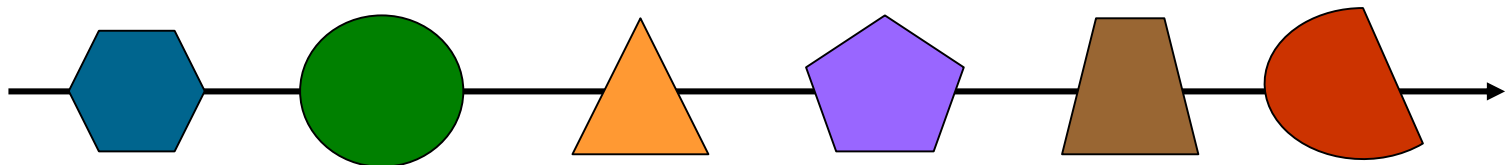
- Uniqueness: we can precisely identify a device thanks to its unique combination of features
- Stability: a fingerprint does not drastically change over time
- These two properties combined are the source of a real privacy problem.

# Blink

- Increase temporal diversity of fingerprints.
- Reconfigure platform at runtime.
- Browsing without Blink

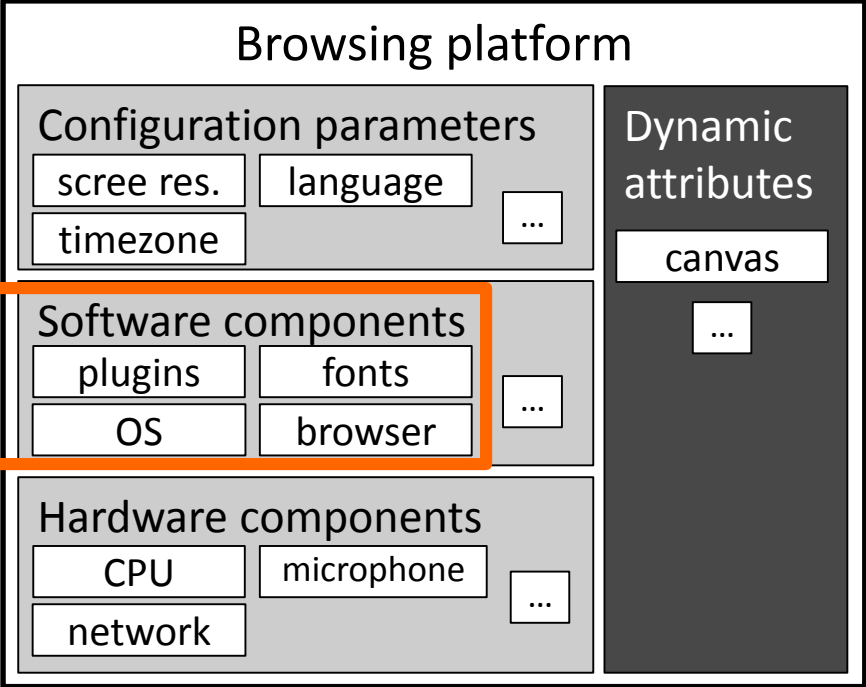


- Browsing with Blink

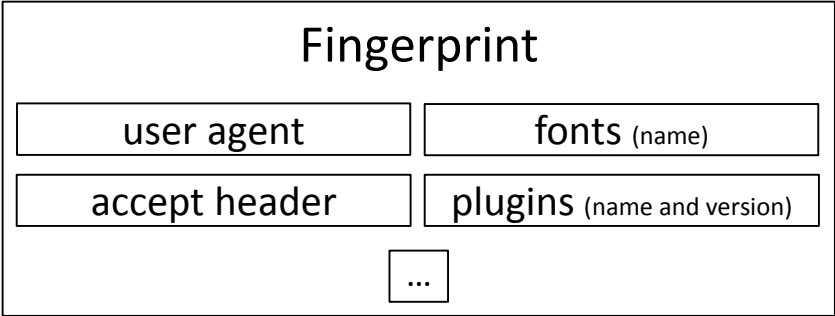


# Browsing platform

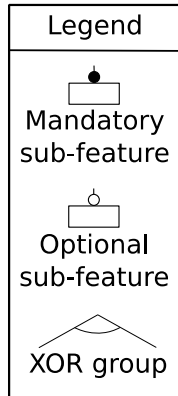
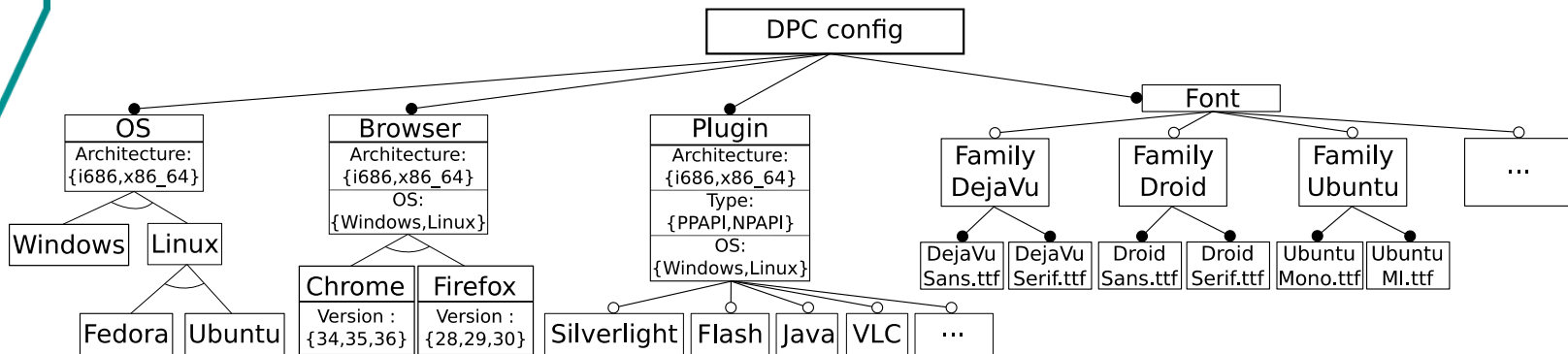
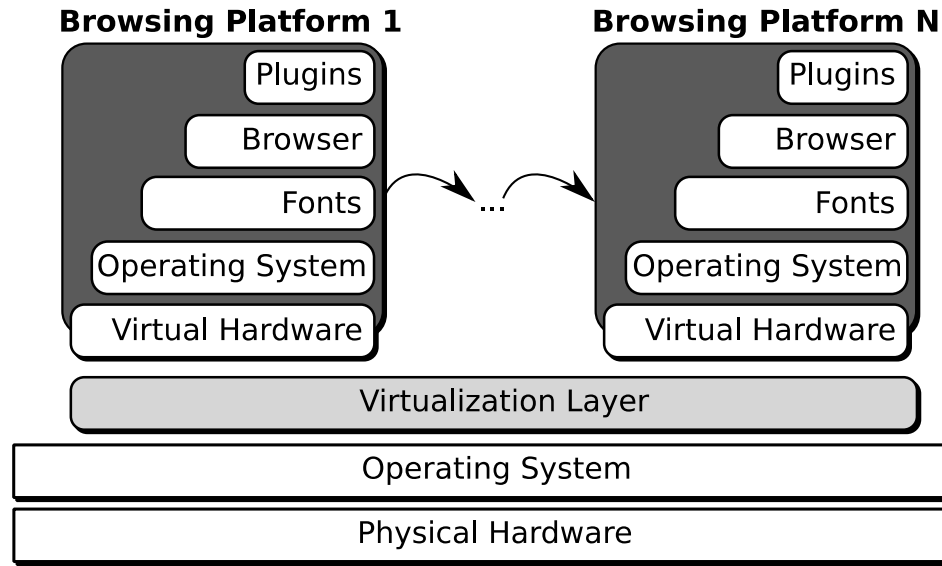
Diversifiable elements



exhibits



# Browsing platform

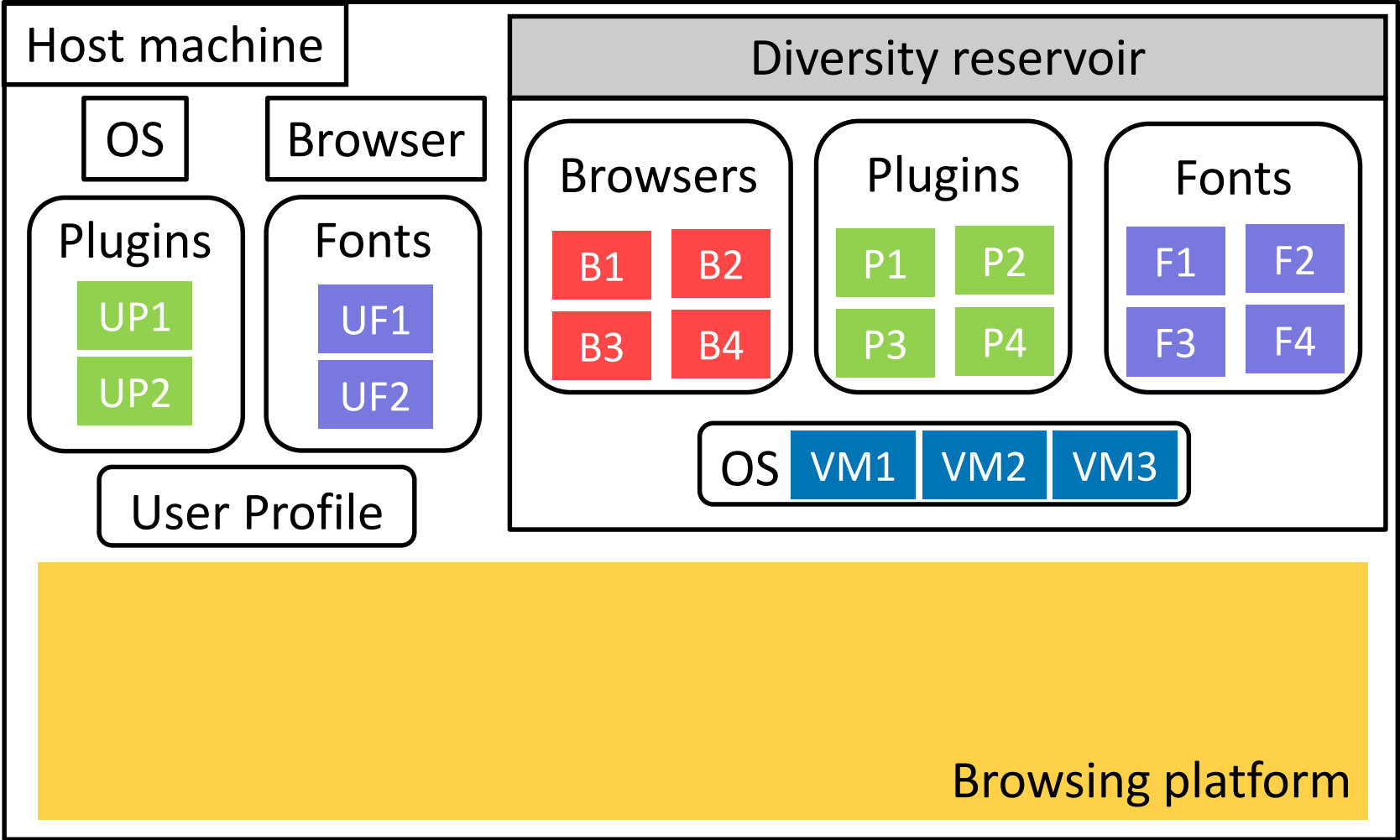


Browser.arch = 64 ⇒ OS.arch = 64  
 Browser.arch = 64 ⇔ Plugin.arch = 64  
 Browser.arch = 32 ⇔ Plugin.arch = 32

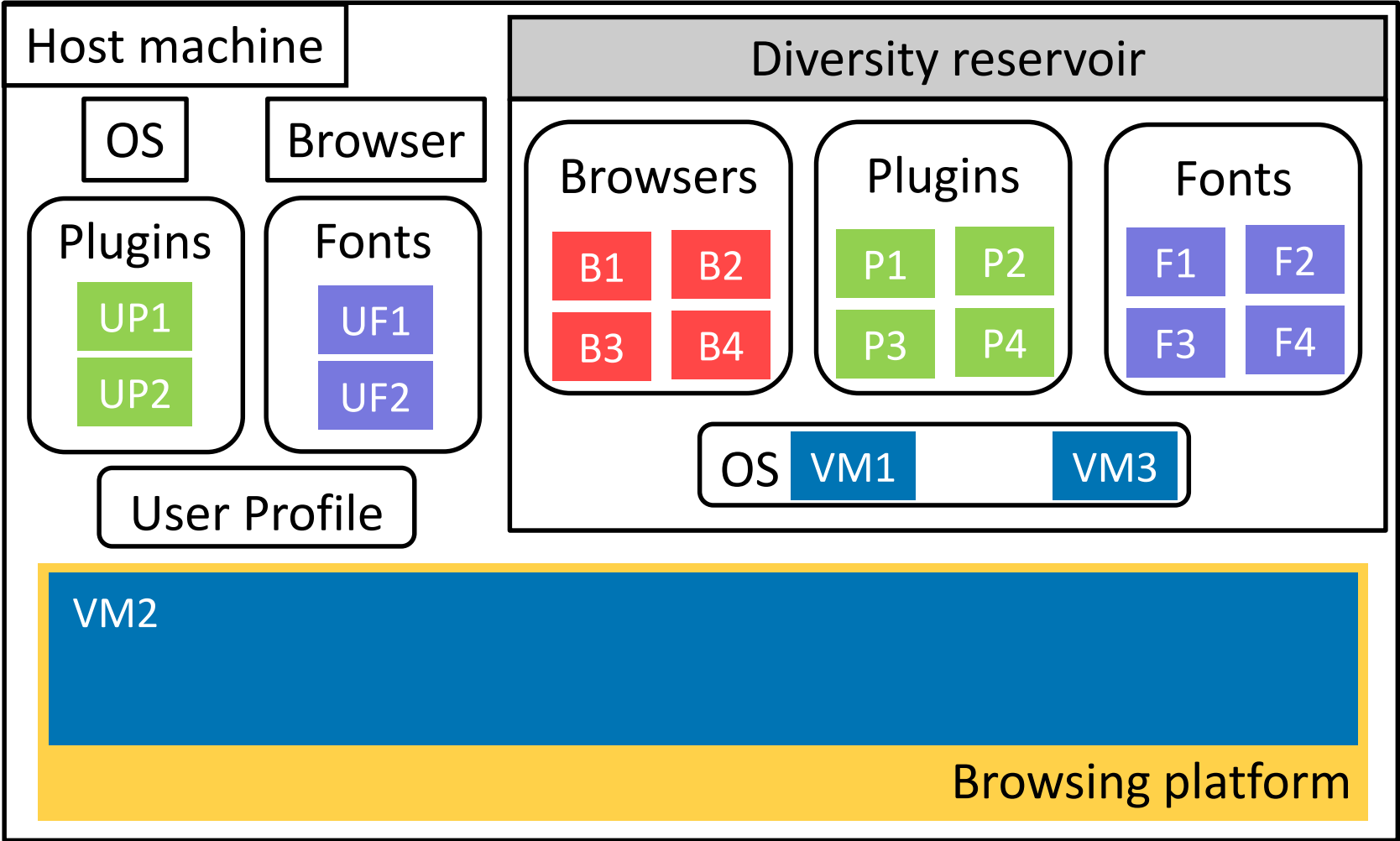
Windows ⇔ Browser.OS = Windows  
 Windows ⇔ Plugin.OS = Windows  
 Linux ⇔ Browser.OS = Linux  
 Linux ⇔ Plugin.OS = Linux

Chrome ⇔ Plugin.type = PPAPI  
 Firefox ⇔ Plugin.type = NPAPI  
 Silverlight ⇔ Windows  
 Ubuntu ⇔ Family Ubuntu

# Blink's generation process

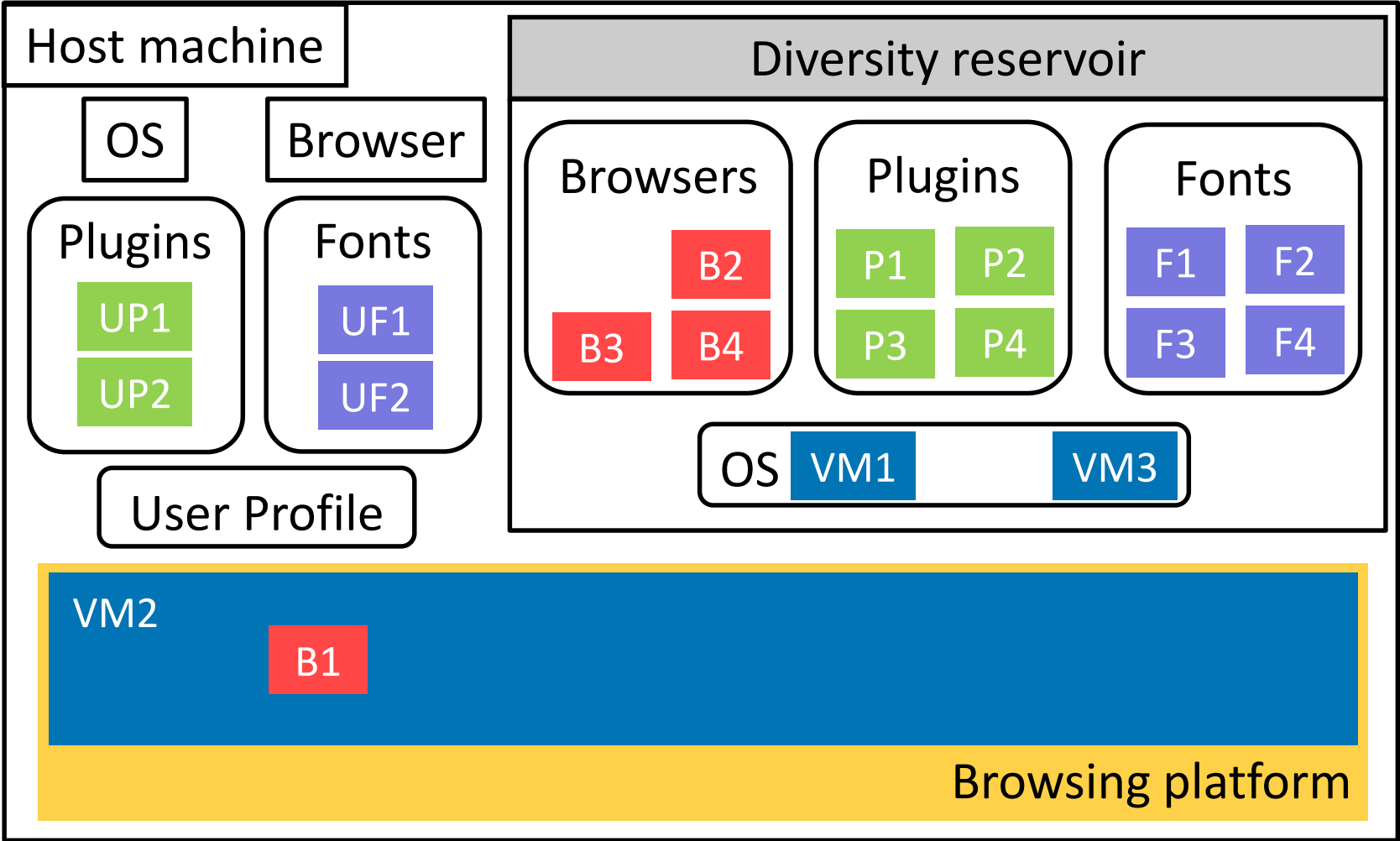


# Blink's generation process

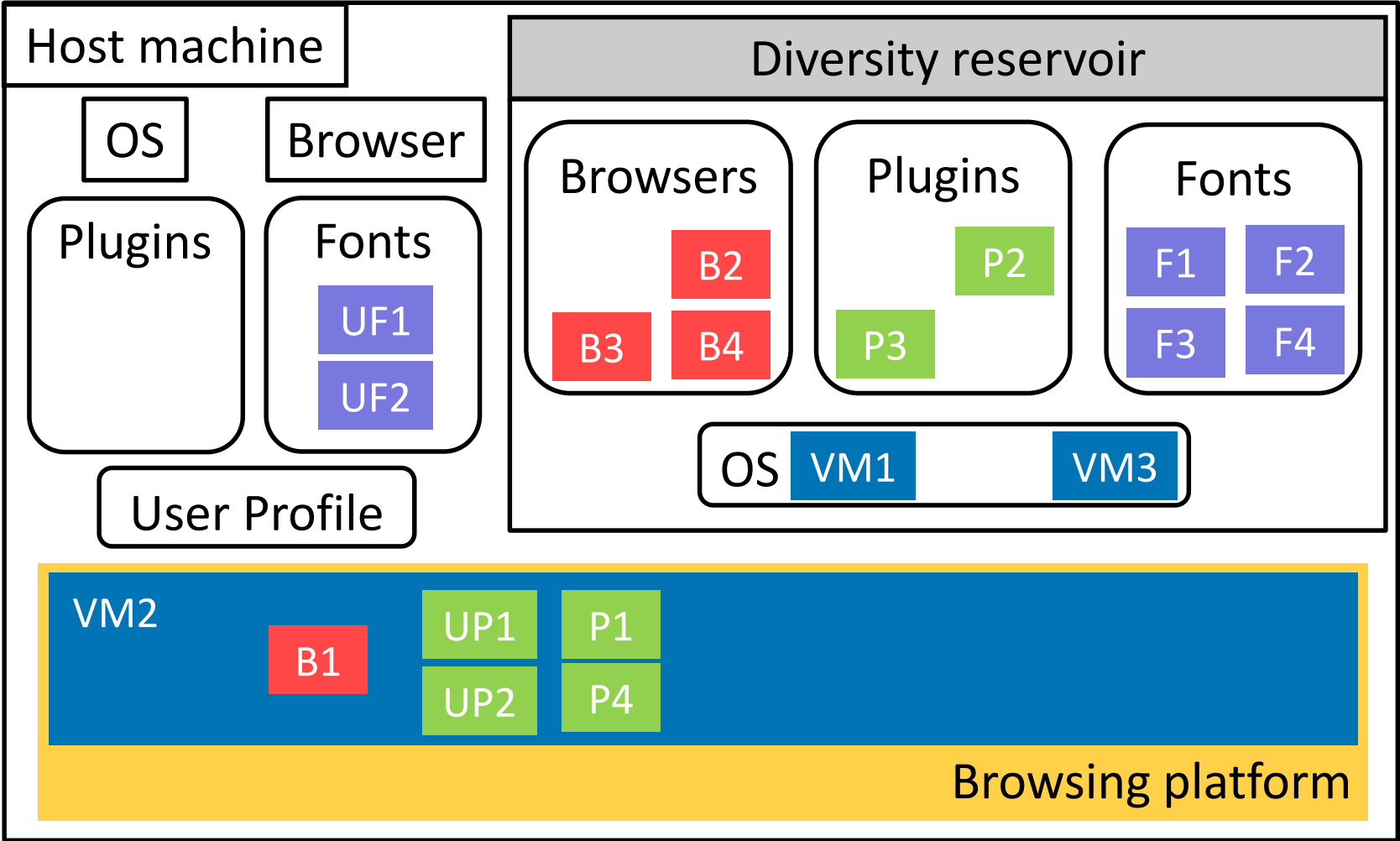




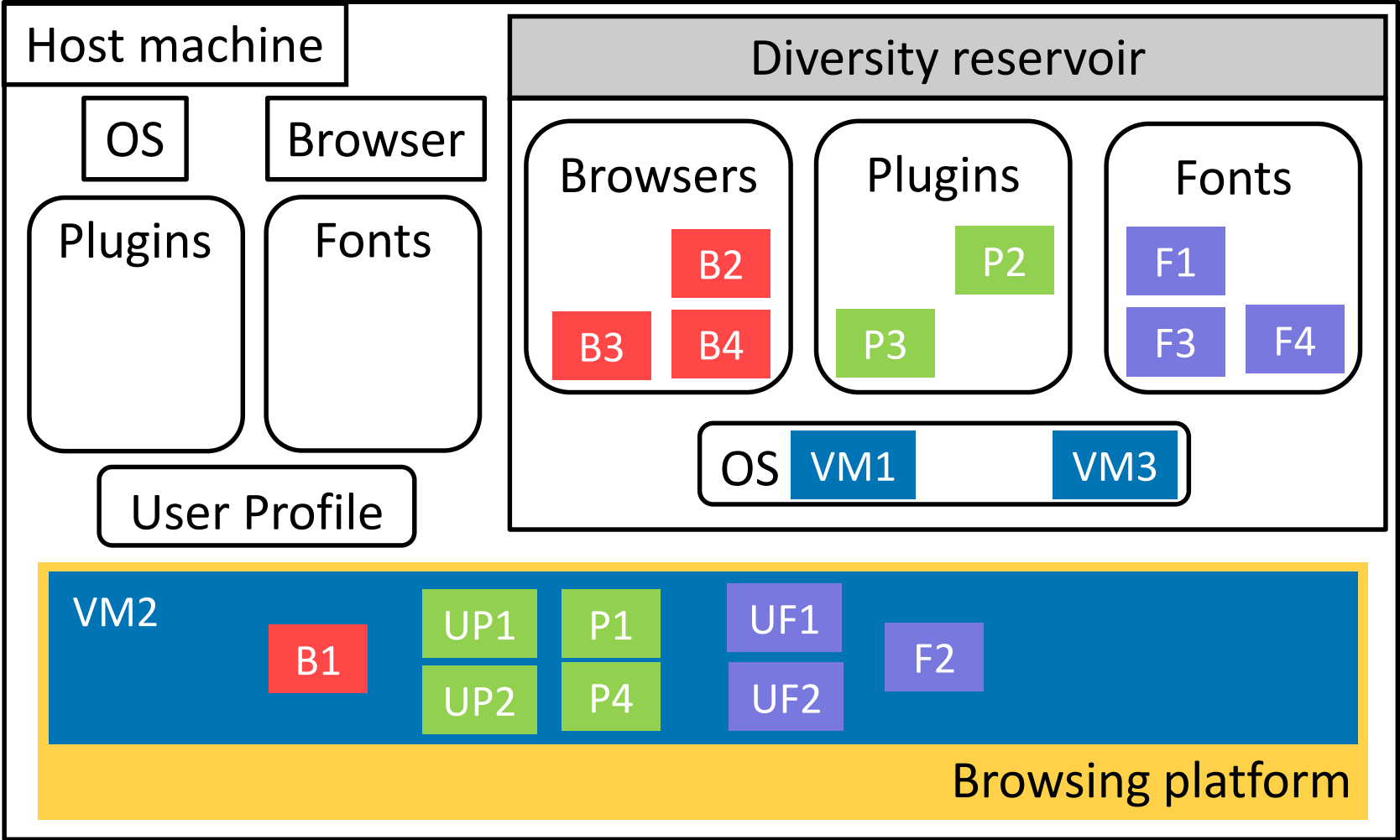
# Blink's generation process



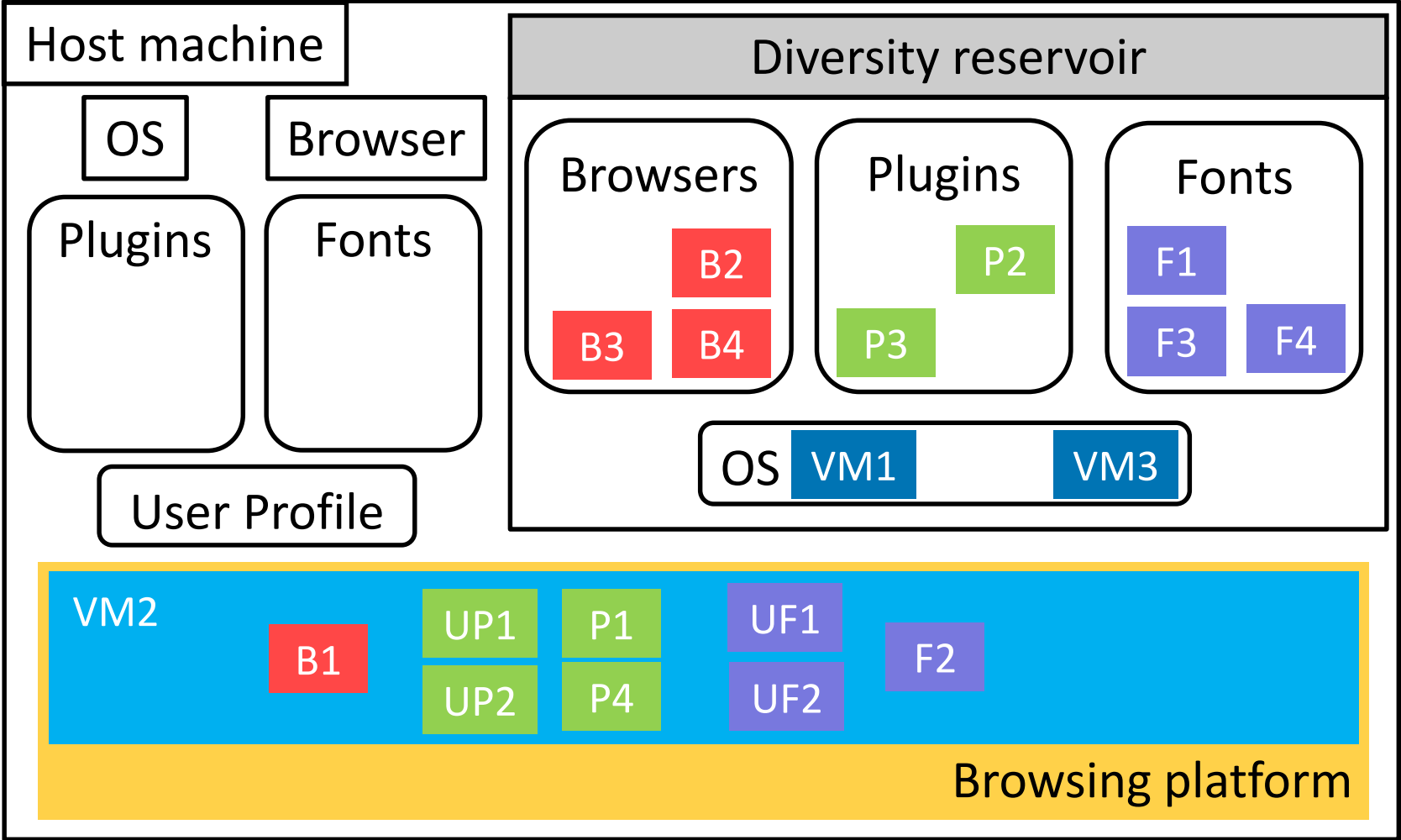
# Blink's generation process



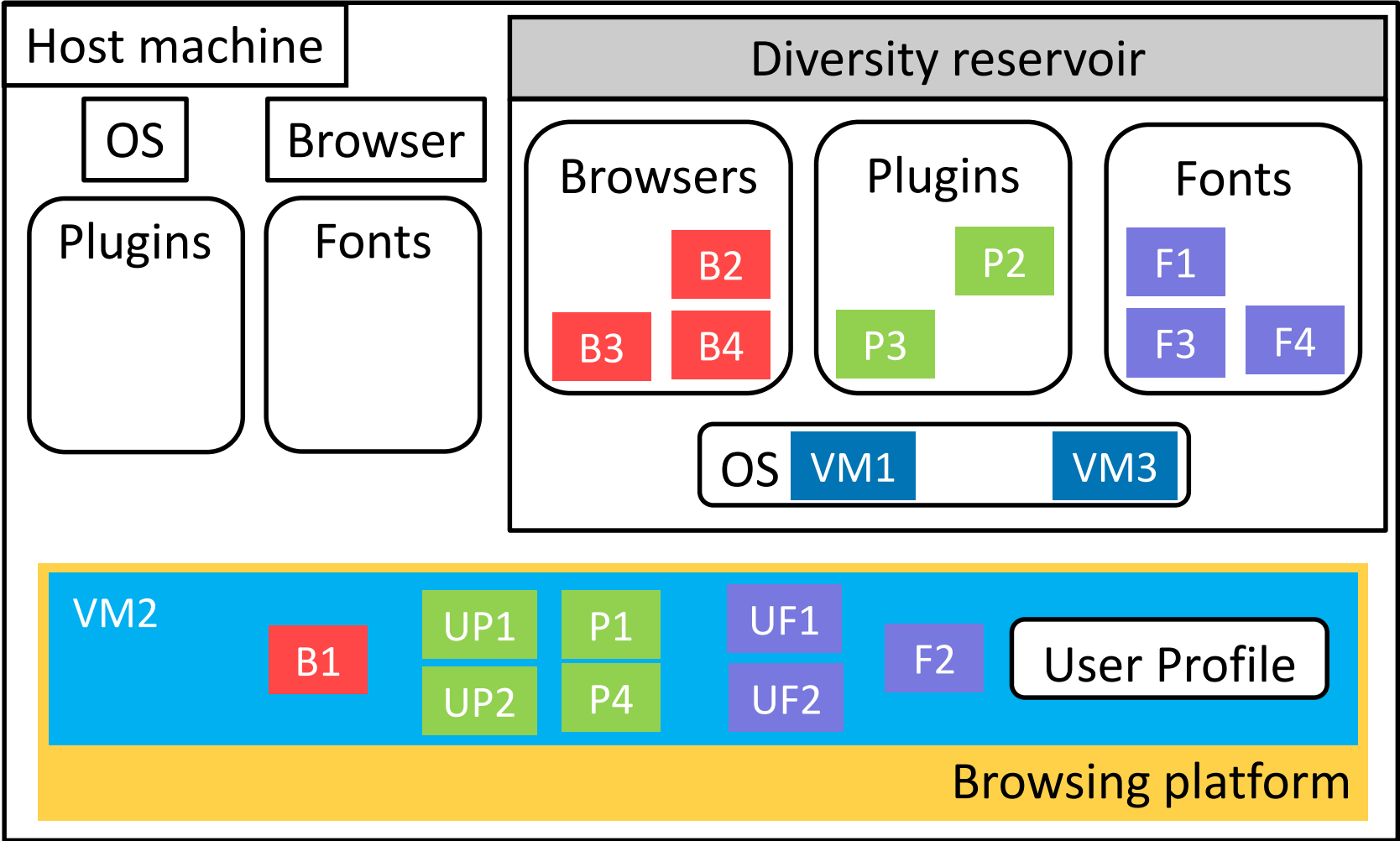
# Blink's generation process



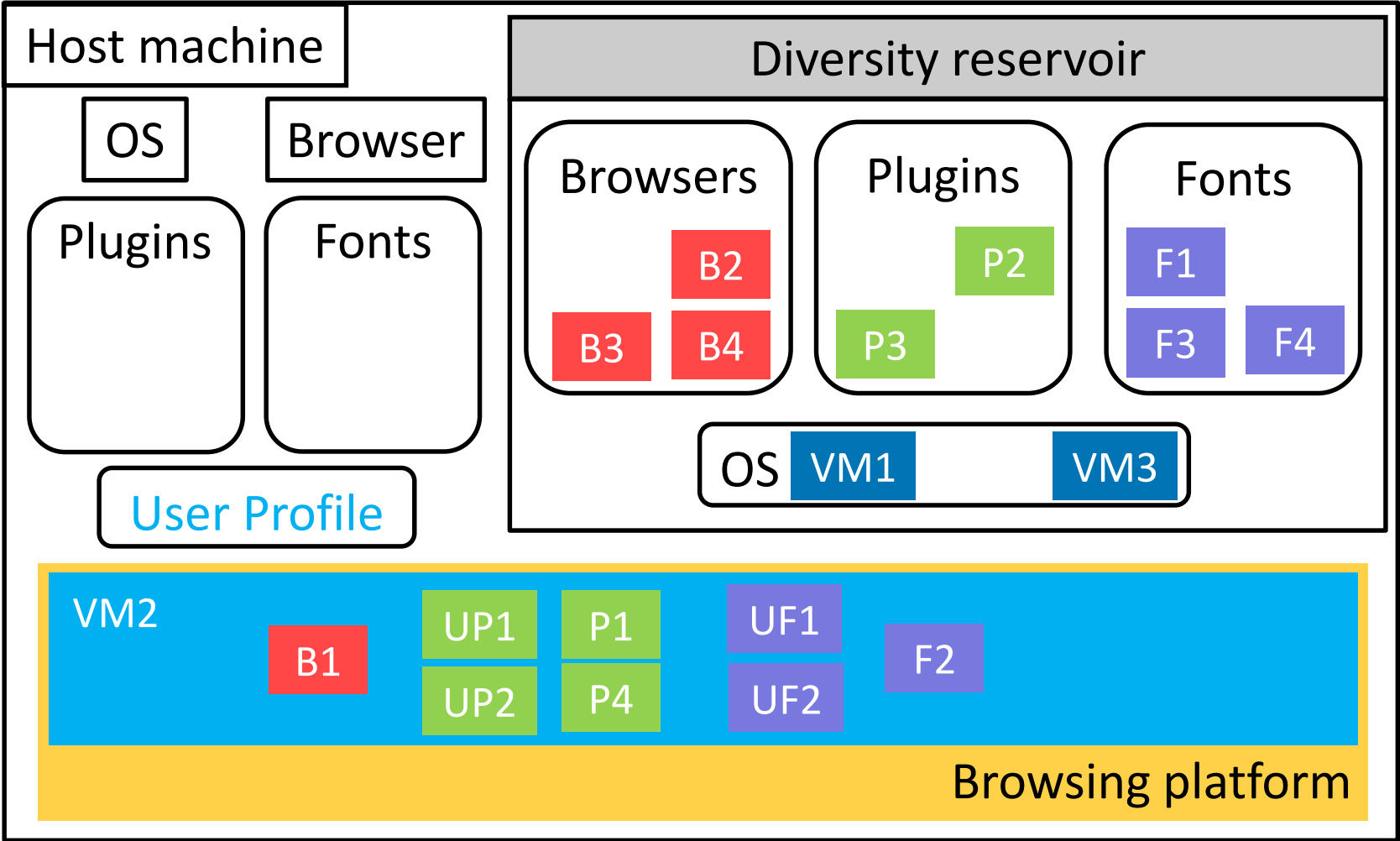
# Blink's generation process



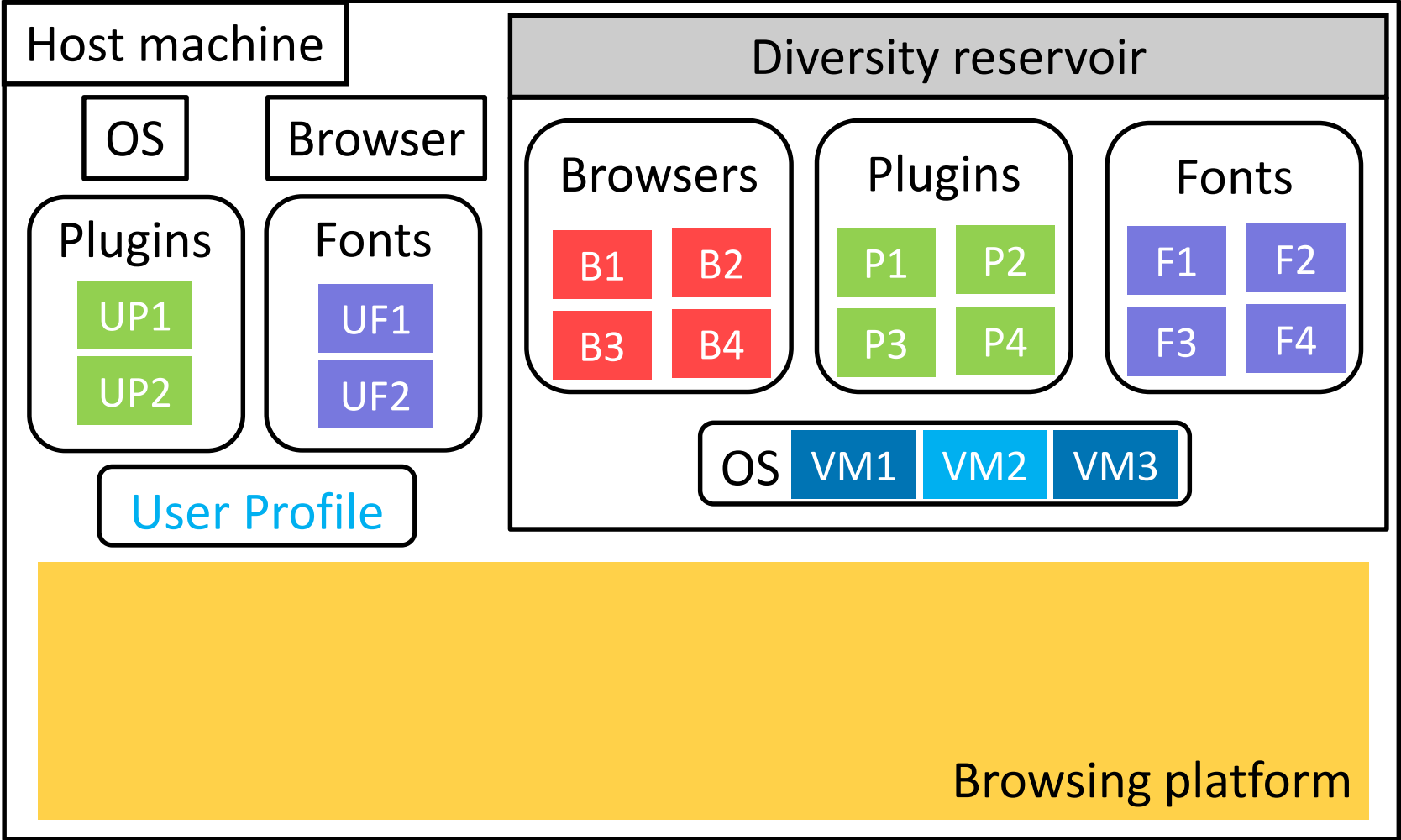
# Blink's generation process



# Blink's generation process



# Blink's generation process



# Table of contents

- 1) What is fingerprint-based tracking?
- 2) Presentation of Blink
- 3) Experimental validation
- 4) Conclusion and perspectives



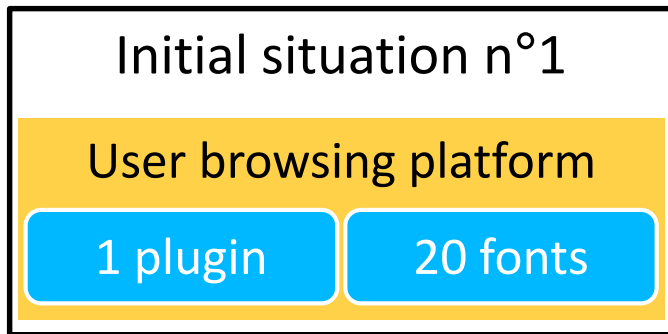
# Objectives

1. Does dynamic reconfiguration break fingerprint stability?
2. What is the impact of the user's plugins and fonts on global diversity?

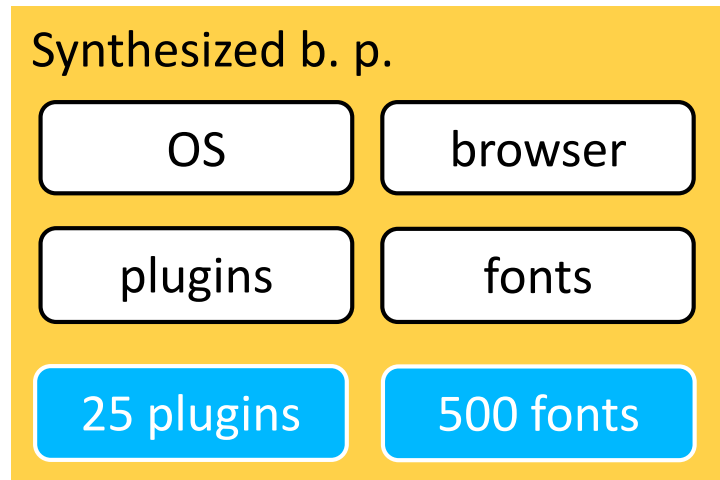
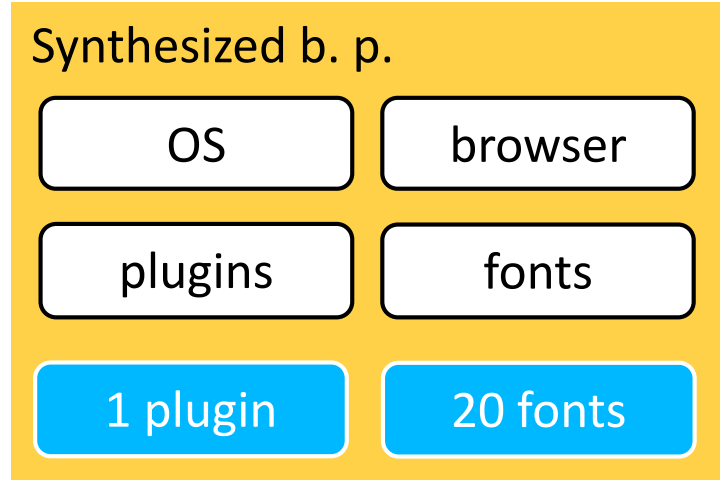
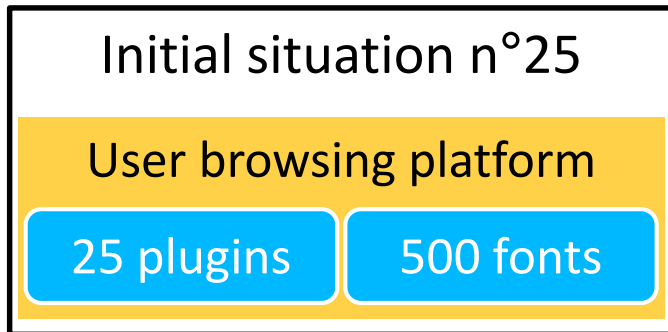
## Requirements

- A fingerprinting script
- A metric to quantify the difference between two synthesized platforms

# Experimental protocol



•  
•  
•



# Experimental protocol

Initial situation n°1

User browsing platform

1 plugin      20 fonts

100 synthesized b.p.

1	5		97
2	6		98
3	7		99
4	8		100

•  
•  
•

Initial situation n°25

User browsing platform

25 plugins      500 fonts

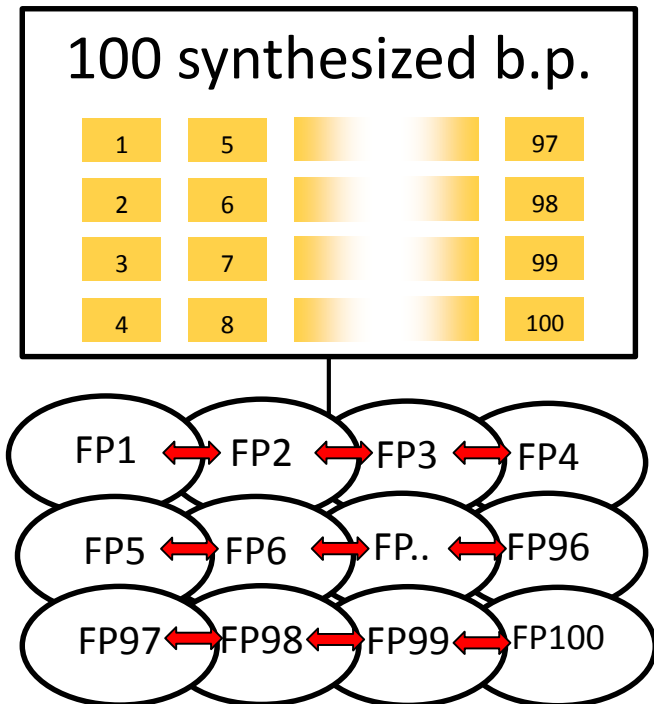
100 synthesized b.p.

1	5		97
2	6		98
3	7		99
4	8		100

2500 synthesized browsing platforms

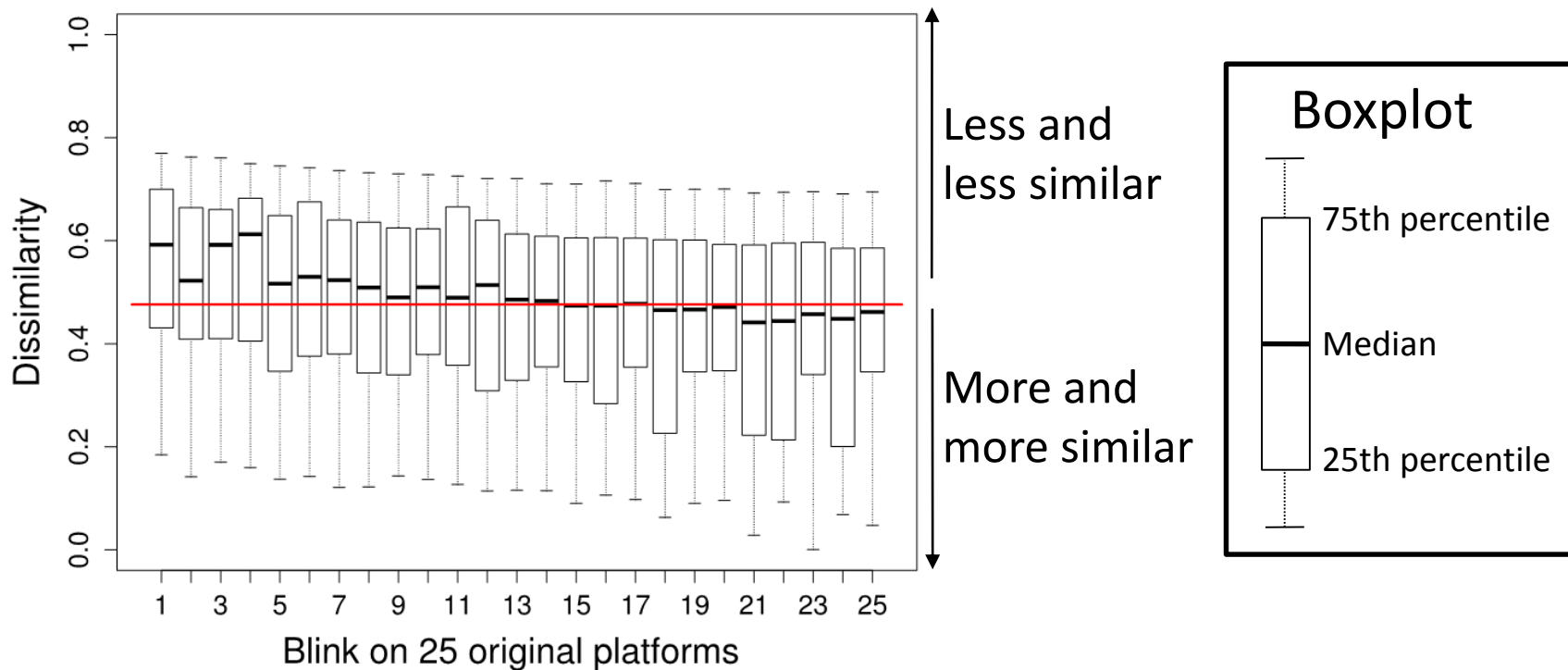
# Research questions

1. How diverse is the set of fingerprints exhibited by the synthesized platforms?



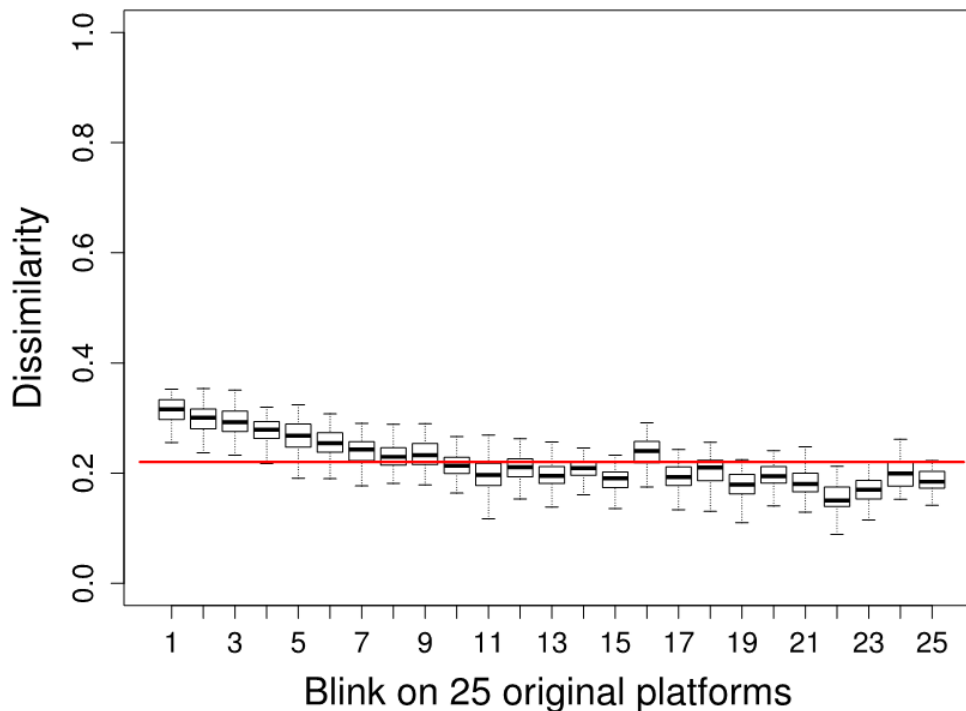
# Research questions

1. How diverse is the set of fingerprints exhibited by the synthesized platforms?



# Research questions

1. How diverse is the set of fingerprints exhibited by the synthesized platforms?



- Coffee-break mode
  - Faster mode
  - Modify fonts and plugins
  - OS and browser are not changed

# Research questions

## 2. How diverse are the platforms in the eyes of actual fingerprinters?



<http://bluecava.com/opt-out/>



[BLOG](#) | [PRIVACY PROMISE](#) | [CONTACT](#) | [CLIENT LOGIN](#)

[HOW IT WORKS](#) | [PRODUCTS](#) | [SOLUTIONS](#) | [COMPANY](#) | [CROSS-SCREEN UNIVERSITY](#)

### BlueCava Opt-out Preferences

#### Choice Mechanisms

BlueCava wants you to be in control of your experience while online. We help our Clients provide you with digital advertising that's meaningful and supports the Sites you use for free, so everyone wins. We offer two choice mechanisms: an opt-out mechanism as well as the ability to reset your BlueCava advertising ID. If you want to exercise choice via either or both mechanisms, please follow the instructions below. To learn more about our technology platform, please visit our [privacy policy](#).

#### Opt Out Of Being Tracked

If you choose to opt out we will not share the identity of your device with our Clients for the purpose of enabling online behavioral advertising. Note that we do have some Clients who use our technology on their own web sites, including for things like fraud prevention, which are not subject to opt-out choice. To opt-in or out of tracking click the button to the right.

[Opt-out >](#)

#### Reset Your Advertising ID

You can reset the advertising ID we generate when we recognize your device. This will unlink your device from any of the data that has been accumulated and assigned to that ID. The effect is the same as if you had just gotten a new computer or phone. To reset your advertising ID click the button to the right. Note, that if you reset your advertising ID we will automatically apply the opt-out setting from the old ID to the new one when we create the new one, so if you have opted out above you won't have to do that again.

[Reset >](#)

Your ID: E309-5DF0-8109-0A81-53B6-7887-D615-8EBA

#### Do Not Track, Other Choice Mechanisms

Our Technology is designed to recognize a Do Not Track (DNT) signal, but we do not control how our Clients respond to DNT signals. To opt-out from other companies that provide online behavioral advertising services, you can visit the following online advertising industry websites.

- The Digital Advertising Alliance: <http://www.aboutads.info/choices/>
- The Network Advertising Initiative: <http://www.networkadvertising.org/choices/>

# Research questions

2. How diverse are the platforms in the eyes of actual fingerprinters?



<http://bluecava.com/opt-out/>

More than 99% of unique IDs!



# Table of contents

- 1) What is fingerprint-based tracking?
- 2) Presentation of Blink
- 3) Experimental validation
- 4) Conclusion and perspectives

# Conclusion and perspectives

- Blink: break fingerprint stability thanks to automatic and complete synthesis of a new browsing platform for each browsing session
- AmlUnique.org: Collection of fingerprints to refine Blink's randomization algorithms  
<https://amiunique.org>
- Blink on Docker: Fast and lightweight prototype already available  
<https://github.com/plaperdr/blink-docker>



Thank you for listening!

Any questions?