



# Bridging the Privacy Gap: Enhanced User Consent Mechanisms on the Web

**Carl Magnus Bruhner\***, **David Hasselquist\*†**, **Niklas Carlsson\***

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We and our partners store and/or access information on a device, such as cookies and process personal data, such as unique identifiers and standard information sent by a device for personalised ads and content, ad and content measurement, and audience insights, as well as to develop and improve products. With your permission we and our partners may use precise geolocation data and identification through device scanning. You may click to consent to our and our partners' processing as described above. Alternatively you may click to refuse to consent or access more detailed information and change your preferences before consenting. Please note that some processing of your personal data may not require your consent, but you have a right to object to such processing. Your preferences will apply to this website only. You can change your preferences at any time by returning to this site or visit our privacy policy.

### Microsoft Cares About Your Privacy

Microsoft and our third-party vendors use cookies to store and retrieve information about your preferences, such as language and user settings, and to enhance your navigation on our website. You can control how these cookies affect your navigation by visiting the preferences section of our settings menu. You can also control how these cookies affect your navigation by visiting the preferences section of our settings menu. You can control how these cookies affect your navigation by visiting the preferences section of our settings menu. You can control how these cookies affect your navigation by visiting the preferences section of our settings menu.

### Before you continue to Google Search

Google uses cookies and data to: Deliver and maintain services, like tracking outages and protecting against spam, fraud, and security threats.

We use cookies on our websites for a number of purposes, including: functionality and advertising. [Learn more about Redd](#)

Reject non-essential

Show personalised or generic ads, depending on your settings, on Google and across our network of sites.

For non-personalised content and ads, what you see may be influenced by things like the device you are currently viewing and your location (ad serving is based on general location). Personalised content and ads include things like more relevant results and recommendations, a customised homepage, and ads that are tailored to your interests.

Click 'Customise' to review options, including controls to reject the use of cookies for personalised content and ads. You can also visit our [privacy policy](#) for more information about browser-level controls to reject some or all cookies for other uses. You can also visit our [privacy policy](#) for more information about browser-level controls to reject some or all cookies for other uses.

Privacy · Terms

### Did someone say ... cookies?

Twitter and its partners use cookies to provide you with a better, safer and faster service and to support our business. Some cookies are necessary to use our services, improve our services, and make sure they work properly. [Show more about your choices.](#)

[twitter.com](#)

Create a personalised content profile, Select personalised content, Measure content performance, Apply market research to generate audience insights, Develop and improve products, Select basic ads and Measure ad performance. [Privacy Policy](#)

Processing of a cookie and/or the "Remember me" cookie is optional. You can control how these cookies affect your navigation by visiting the preferences section of our settings menu. You can also control how these cookies affect your navigation by visiting the preferences section of our settings menu. You can control how these cookies affect your navigation by visiting the preferences section of our settings menu. You can control how these cookies affect your navigation by visiting the preferences section of our settings menu.

Manage Cookies

**yahoo!**

## Your information, your experience

We, Yahoo, are part of the [Yahoo](#) family of brands.

By clicking '**Accept all**' you agree that Yahoo and [our partners](#) will process your personal information, and use technologies such as cookies, to display personalised ads and content, for ad and content measurement, audience insights, and product development.

### The personal information that may be used

- Information about your device and internet connection, like your IP address
- Browsing and search activity while using Yahoo websites and apps
- Your [precise location](#)

Click '**Manage settings**' for more information and to manage your choices. You can change your choices at any time by visiting [your privacy controls](#). Find out more about how we use your information in our [privacy policy](#) and [cookie policy](#).

**Accept all**      **Manage settings**

[yahoo.co.uk](#)



EN

SIGN IN

### Information from Facebook on this browser?

Information from Facebook on this browser? Information from Facebook on this browser? Information from Facebook on this browser? Information from Facebook on this browser? Information from Facebook on this browser?

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Only allow essential cookies

Allow essential and optional cookies

Allow non-essential cookies

[facebook.com](#)

[amazon.com](#)

## Control how we and our partners use your personal information

You can set your privacy preferences using the controls below. Once you set your preferences, you can change them later by visiting [your privacy controls](#). Find out more about how we use your information in our [privacy policy](#) and [cookie policy](#).

### How we use your personal information

Accept all

**To provide and protect our products:** We will use cookies and similar technologies, and process your personal information when necessary, to...[more](#)

ALWAYS ACTIVE

**Advertising on our sites and apps:** With your consent (permission), we will use cookies and similar technologies to provide ads that we think you'll find...[more](#)

OFF

**Precise location information:** With your consent, we will use your precise location to tailor the ads and content we provide to you on Yahoo and our...[more](#)

OFF

**Personalised advertising on partner sites:** With your consent, we will provide you with relevant ads and content on our partners' sites. We will also diet...[more](#)

OFF

**Device linking:** With your consent, we will link your devices using common identifiers. This allows us to understand when you and your household use...[more](#)

OFF

**Audience matching:** With your consent, we will use your identifiers and personal information to display relevant and personalised ads to audience...[more](#)

OFF

**Personalised content on our sites and apps:** With your consent, we will combine and use information we have about you to provide tailored conte...[more](#)

OFF

### How our partners use your personal information

#### Content and social-media partners

Yahoo works with partners who provide features on our products to personalise content, for example by providing content and links to social-media platf...[more](#)

OFF

Show content and social-media partners

#### IAB framework partners

We work with partners that use the IAB Transparency & Consent Framework, which is an advertising-industry framework that gives you control over how these partners use your personal information. You can tailor your preferences by purpose or feature, or by individual partner.

View by purpose/feature View by partner

**Consent:** Next to each purpose/feature below is a **consent** toggle. Turn this 'ON' to allow all partners to process your data where they rely on consent.

**Legitimate Interest:** Next to some purposes below is a **legitimate interest** toggle. Some partners do not require your consent to process your data for these purposes. Set this toggle 'OFF' to opt out from this purpose for partners who rely on legitimate interest.

### VIEW BY PURPOSE/FEATURE

LEGITIMATE INTEREST

CONSENT

Reject all

Accept all

#### Store and/or access information on a device

OFF

Cookies, device identifiers, or other information can be stored or accessed on your device for the purposes presented to you.

#### Select basic ads

ON

OFF

Ads can be shown to you based on the content you're viewing, the app you're using, your approximate location, or your device type.

#### Create a personalised ads profile

OFF

A profile can be built about you and your interests to show you personalised ads that are relevant to you.

#### Select personalised ads

OFF

Personalised ads can be shown to you based on a profile about you.

#### Create a personalised content profile

OFF

A profile can be built about you and your interests to show you personalised content that is relevant to you.

#### Select personalised content

ON

OFF

Personalised content can be shown to you based on a profile about you.

#### Measure ad performance

ON

OFF

The performance and effectiveness of ads that you see or interact with can be measured.

#### Measure content performance

ON

OFF

The performance and effectiveness of content that you see or interact with can be measured.

#### Apply market research to generate audience insights

ON

OFF

Market research can be used to learn more about the audiences who visit sites/apps and view ads.

#### Develop and improve products

ON

OFF

Your data can be used to improve existing systems and software, and to develop new products

#### Special purposes

##### Ensure security, prevent fraud, and debug

Your data can be used to monitor for and prevent fraudulent activity, and ensure systems and processes work properly and securely.

#### Technically deliver ads or content

Your device can receive and send information that allows you to see and interact with ads and content.

#### Features

##### Match and combine offline data sources

Data from offline data sources can be combined with your online activity in support of one or more purposes

##### Link different devices

Different devices can be determined as belonging to you or your household in support of one or more of purposes.

##### Receive and use automatically-sent device characteristics for identification

Your device might be distinguished from other devices based on information it automatically sends, such as IP address or browser type.

#### Special features

##### Use precise geolocation data

Your precise geolocation data can be used in support of one or more purposes. This means your location can be accurate to within several meters.

OFF

Accept all

Save choices

Reject all





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>90%

Sanchez-Rola et al. (2019) show that more than 90% of visited websites use cookies that could identify users.

# ICO to call on G7 countries to tackle cookie pop-ups challenge

Date **07 September 2021**

Type **News**

The UK Information Commissioner's Office (ICO) will today call on fellow G7 data protection and privacy authorities to work together to overhaul cookie consent pop-ups, so people's privacy is more meaningfully protected and businesses can provide a better web browsing experience.

[ico.org.uk](https://ico.org.uk) (2021)

## ***noyb* aims to end “cookie banner terror” and issues more than 500 GDPR complaints**

Today, *noyb.eu* sent over 500 draft complaints to companies who use unlawful cookie banners - making it the largest wave of complaints since the GDPR came into force.

[noyb.eu](https://noyb.eu) (2021)

Why?

**General**

**Data**

**Protection**

**Regulation**

**California**

**Consumer**

**Privacy**

**Act**

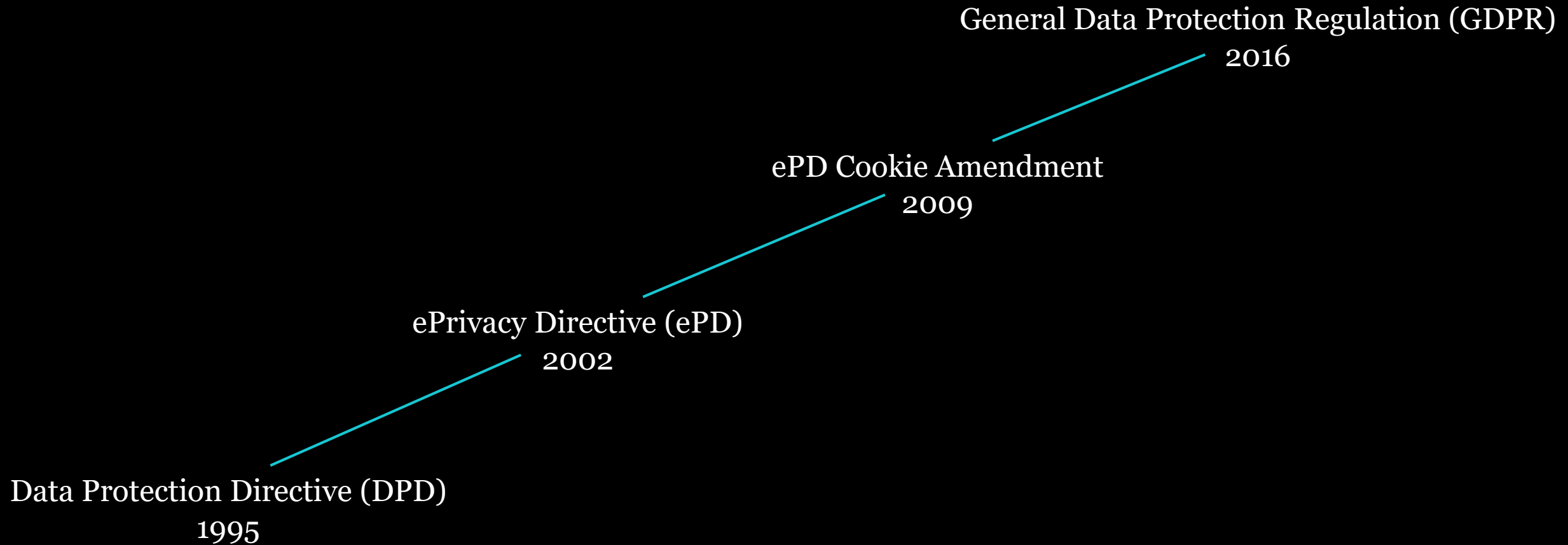
**Is there no better solution?**  
*Well...*



# Contributions

- We **identify current gaps in user data control** through an extensive review and **present ten consent mechanism properties**
- We **review existing browser-based consent mechanisms** and compare them with regards to the derived properties
- We **suggest five features designed as improvements** to the Advanced Data Protection Control (ADPC), including an implementation roadmap

# European privacy legislation



*”any freely given, specific, informed and unambiguous indication of the data subject’s wishes by which he or she, by a statement or by a clear affirmative action, signifies agreement to the processing of personal data relating to him or her”*

**GDPR on 'consent'**

# Consent mechanisms

- Browser-based
  - Older:
    - Platform for Privacy Preferences Project (P3P)
    - Do Not Track (DNT)
  - Newer:
    - Global Privacy Control (GPC)
    - Advanced Data Protection Control (ADPC)
- Provider-based

# Proposed properties

P1	No prior storing/sending
P2	Freely given consent
P3	Specific separate consent
P4	Informed consent
P5	Unambiguous consent
P6	Readable and accessible
P7	Changeable
P8	Standardized
P9	No abuse of necessary
P10	Browser-controlled

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Mechanism	Properties									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
P3P <sup>†</sup>	◐	◐	◐	◐	◐	◐	●	●	○	●
DNT <sup>†</sup>	○	◐	○	◐	○	○	◐	◐	○	●
GPC <sup>*</sup>	○	◐	◐	◐	○	◐	◐	◐	○	●
ADPC <sup>*</sup>	○	◐	◐	◐	◐	◐	◐	◐	○	●
ADPC enhancement	●	◐	●	●	●	◐	●	◐	●	●
Data controllers	-	●	-	-	-	●	-	-	-	-
Legislation	-	-	-	-	-	-	-	●	●	-
Combined effects	●	●	●	●	●	●	●	●	●	●

● = fulfills property; ◐ = partly fulfills property or usage-dependent;  
○ = does not fulfill property; - = not applicable

† = W3C official standard; \* = unofficial draft

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	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
P3P <sup>†</sup>	◐	◐	◐	◐	◐	◐	◐	●	○	●
DNT <sup>†</sup>	○	◐	○	◐	○	○	◐	◐	○	●
GPC*	○	◐	◐	◐	○	◐	◐	◐	○	◐
ADPC*	○	◐	◐	◐	◐	◐	◐	◐	○	◐
ADPC enhancement	●	◐	●	●	●	◐	●	◐	●	●
Data controllers	-	●	-	-	-	●	-	-	-	-
Legislation	-	-	-	-	-	-	-	●	●	-
Combined effects	●	●	●	●	●	●	●	●	●	●

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DNT <sup>†</sup>	○	◐	○	◐	○	○	◐	◐	○	◐
<b>GPC*</b>	○	◐	◐	◐	○	◐	◐	◐	○	●
<b>ADPC*</b>	○	◐	◐	◐	◐	◐	◐	◐	○	●
ADPC enhancement	●	◐	●	●	●	◐	●	◐	●	●
Data controllers	-	●	-	-	-	●	-	-	-	-
Legislation	-	-	-	-	-	-	-	●	●	-
Combined effects	●	●	●	●	●	●	●	●	●	●

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P3P <sup>†</sup>	●	○	●	●	●	●	●	●	○	●
DNT <sup>†</sup>	○	●	○	●	○	○	●	●	○	●
GPC*	○	●	●	●	○	●	●	●	○	●
ADPC*	○	●	●	●	●	●	●	●	○	●
<b>ADPC enhancement</b>	●	●	●	●	●	●	●	●	●	●
<b>Data controllers</b>	-	●	-	-	-	●	-	-	-	-
<b>Legislation</b>	-	-	-	-	-	-	-	●	●	-
Combined effects	●	●	●	●	●	●	●	●	●	●

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GPC*	○	◐	◐	◐	○	◐	◐	◐	○	●
ADPC*	○	◐	◐	◐	◐	◐	◐	◐	○	●
ADPC enhancement	●	◐	●	●	●	◐	●	◐	●	●
Data controllers	-	●	-	-	-	●	-	-	-	-
Legislation	-	-	-	-	-	-	-	●	●	-
<b>Combined effects</b>	●	●	●	●	●	●	●	●	●	●

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# HOW STANDARDS PROLIFERATE: (SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC.)

SITUATION:  
THERE ARE  
14 COMPETING  
STANDARDS.

14?! RIDICULOUS!  
WE NEED TO DEVELOP  
ONE UNIVERSAL STANDARD  
THAT COVERS EVERYONE'S  
USE CASES.



YEAH!

**SOON:**

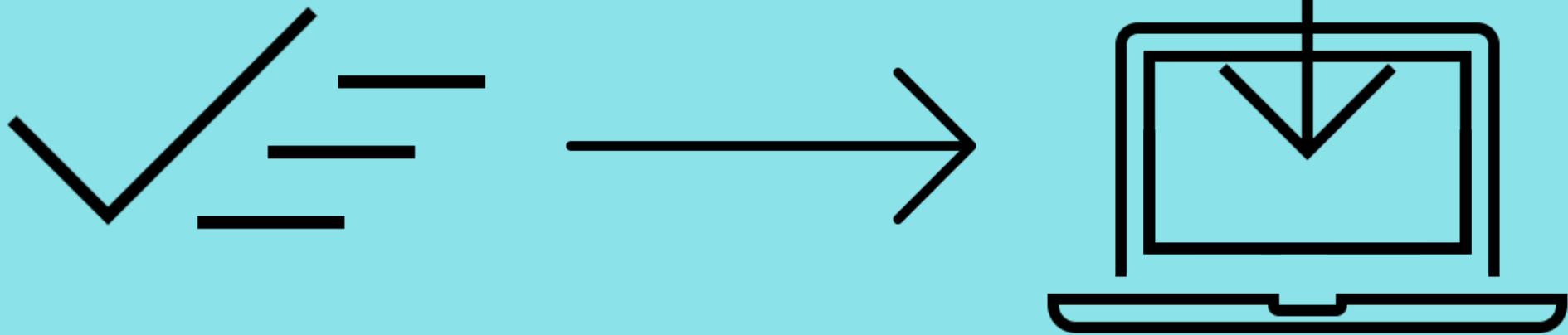
SITUATION:  
THERE ARE  
15 COMPETING  
STANDARDS.

xkcd.com #927

# Suggested features

Feature 1:

# No prior storing/sending of data



Feature 2:

# Present complete and required information

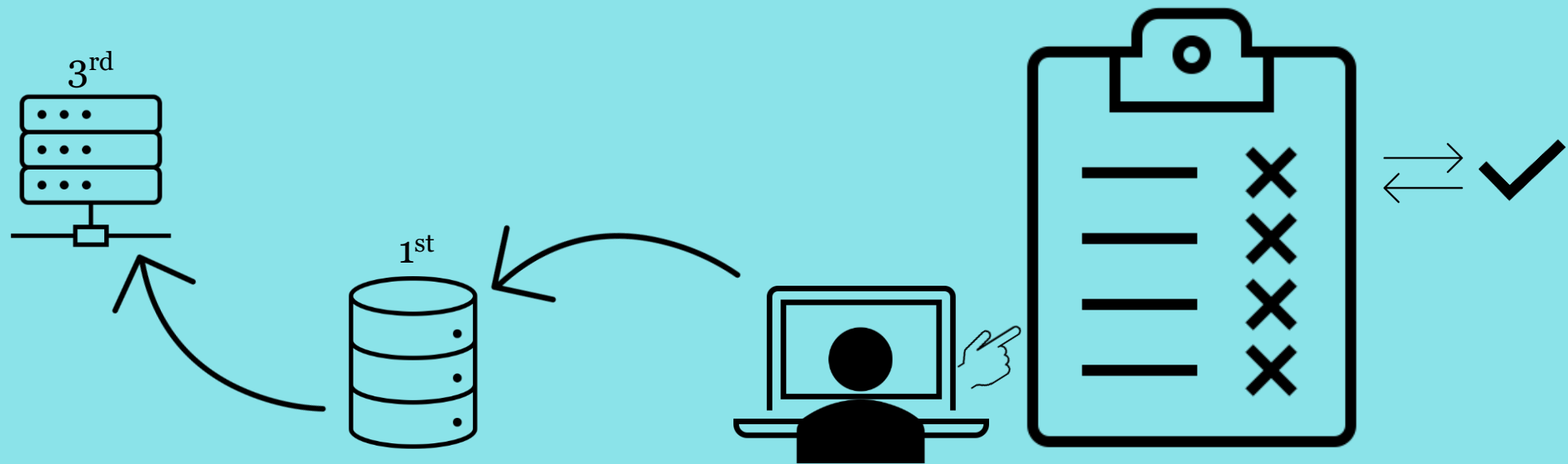
`/.well-known/privacy`



1. User visits website
2. Browser queries server
3. Server provides consent info
4. Browser presents in consent UI

Feature 3:

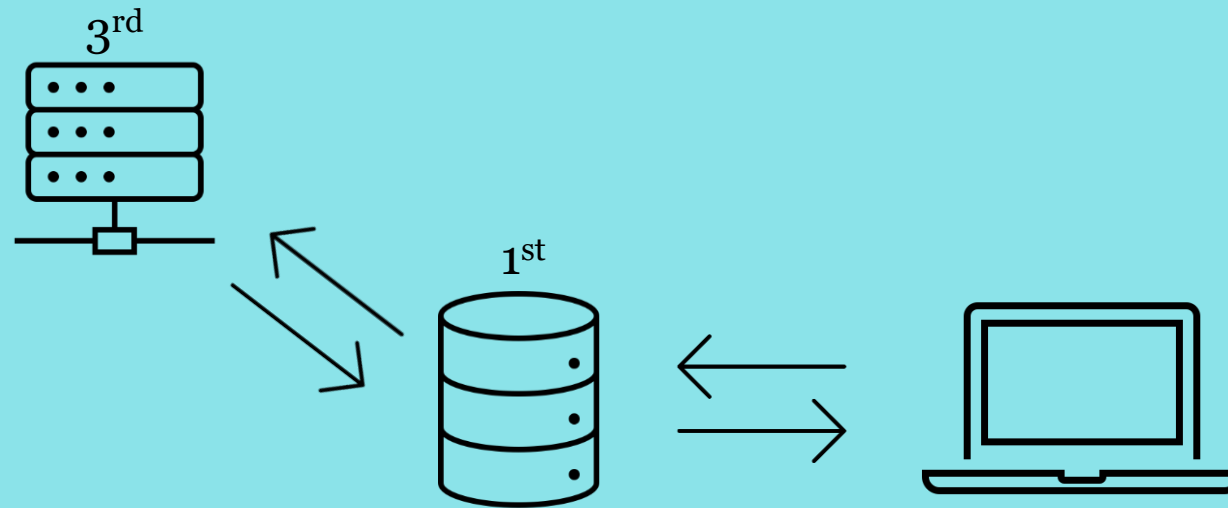
# Configurable and changeable specific consent per purpose





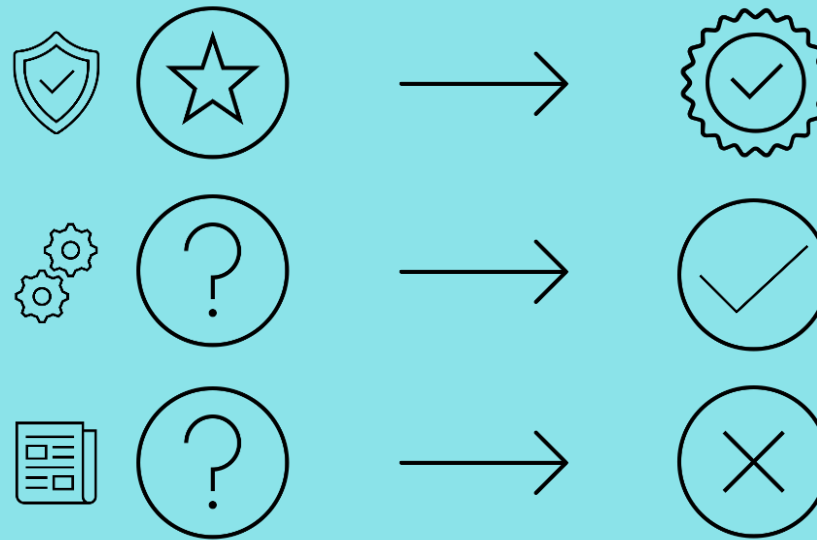
Feature 4:

# Browser-server and server-server communication

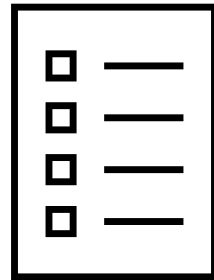
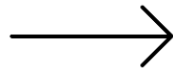


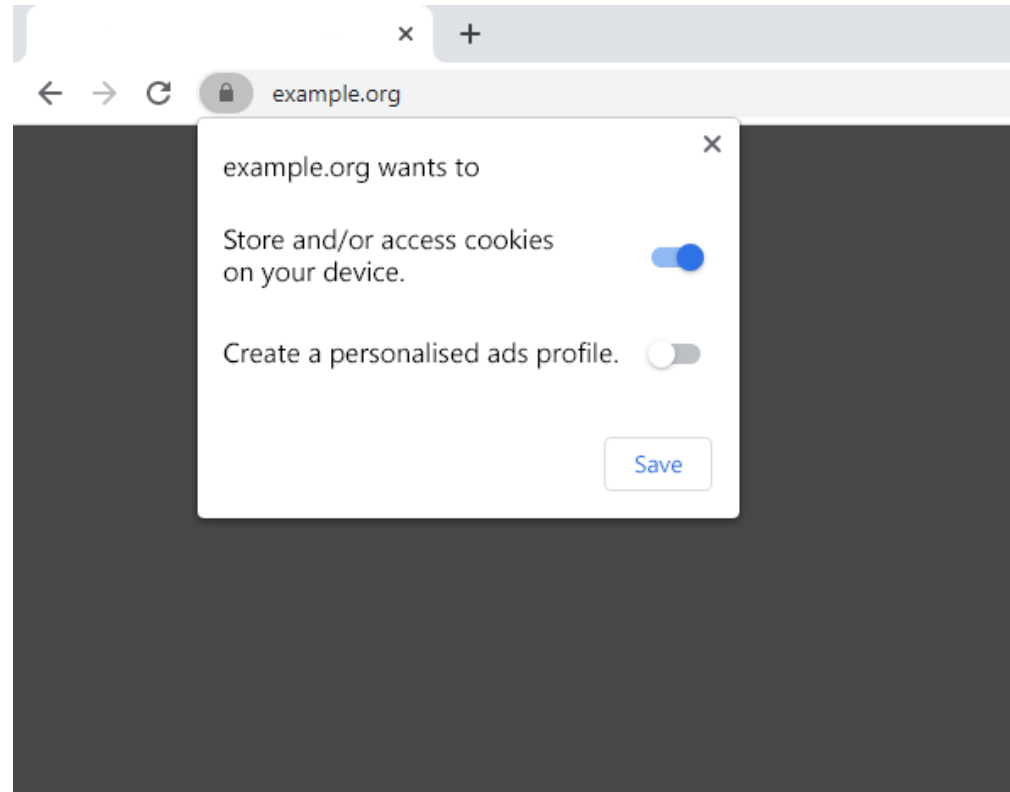
Feature 5:

# Require consent for cookies without **Necessary** attribute

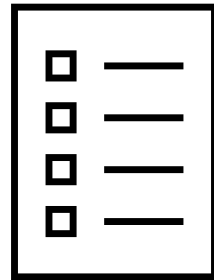
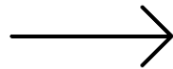


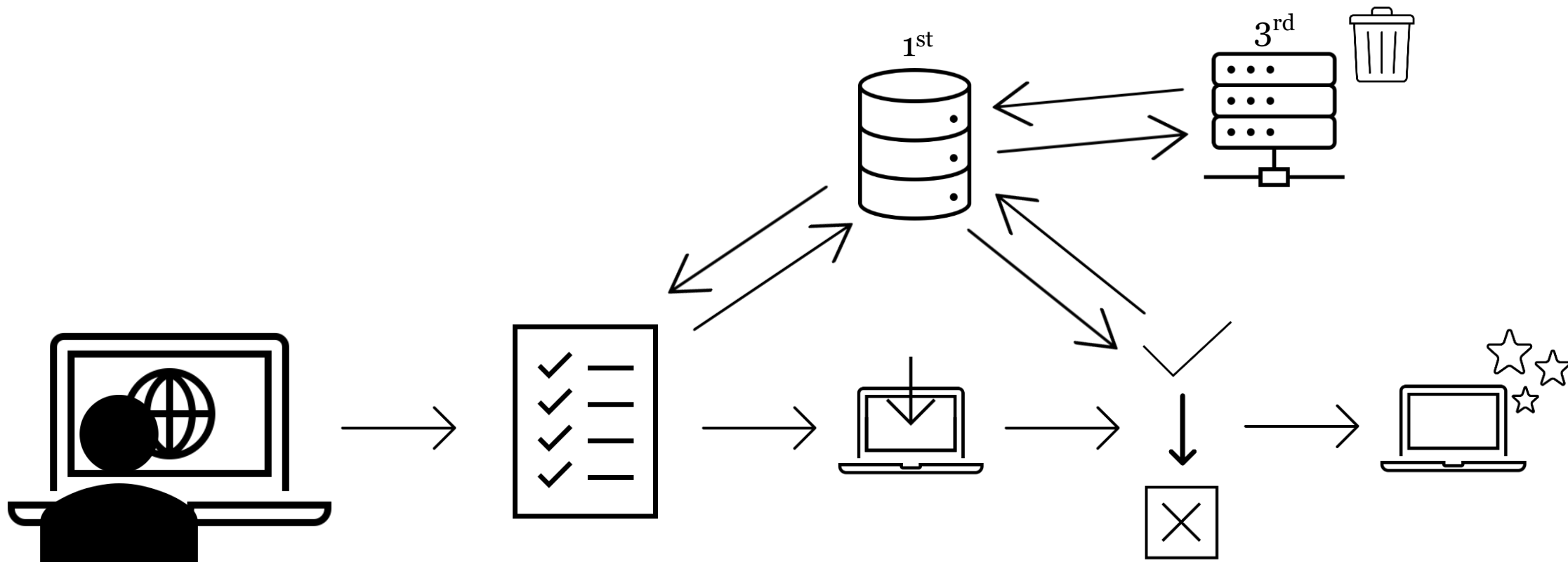
Putting it all together





*Possible presentation of a consent request by the web browser (ADPC draft, CC BY 4.0)*





# Implementation roadmap





# Conclusions

- We **identify current gaps in user data control** through an extensive review and **present ten consent mechanism properties**
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