Token Attempt: The Misrepresentation of Website Privacy Policies through the Misuse of P3P Compact Policy Tokens

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ABSTRACT

Platform for Privacy Preferences (P3P) compact policies (CPs) are a collection of three-character and four-character tokens that summarize a website's privacy policy pertaining to cookies. User agents, including Microsoft's Internet Explorer (IE) web browser, use CPs to evaluate websites' data collection practices and allow, reject, or modify cookies based on sites' privacy practices. CPs can provide a technical means to enforce users' privacy preferences if CPs accurately reflect websites' practices. Through automated analysis we can identify CPs that are erroneous due to syntax errors or semantic conflicts. We collected CPs from 33,139 websites and detected errors in 11,176 of them, including 134 TRUSTe-certified websites and 21 of the top 100 most-visited sites. Our work identifies potentially misleading practices by web administrators, as well as common accidental mistakes. We found thousands of sites using identical invalid CPs that had been recommended as workarounds for IE cookie blocking. Other sites had CPs with typos in their tokens, or other errors. 98% of invalid CPs resulted in cookies remaining unblocked by IE under it's default cookie settings. It appears that large numbers of websites that use CPs are misrepresenting their privacy practices, thus misleading users and rendering privacy protection tools ineffective. Unless regulators use their authority to take action against companies that provide erroneous machine-readable policies, users will be unable to rely on these policies.

1. INTRODUCTION

The Platform for Privacy Preferences (P3P) is a World Wide Web Consortium (W3C) recommendation for specifying website privacy policies in a machine readable format. Developed as part of an industry self-regulatory effort and published in 2002, it provides two privacy policy formats: full policies and compact policies (CPs). P3P full policies are XML files that represent website privacy policies in detail. P3P CPs summarize website privacy policies regarding cookies using a string of three-character and four-character tokens [17]. Internet Explorer (IE) makes cookie-filtering decisions by comparing a website's CPs with user-configured privacy preferences [9]. If a CP does not reflect the website's actual privacy practices then that CP is not useful for decision making. In 2002, regulators from several countries agreed that a P3P policy is legally binding and "constitutes a representation to consumers on which they can be expected to rely" [7].

In this paper, we present the results of our automated evaluation of P3P CPs collected from 33,139 websites. Verifying the accuracy of CPs requires comparing the computer-readable statements in a CP with a website's actual privacy practices with respect to cookies. Sometimes this can be done by reading the statements that sites make in their privacy policies. However, sometimes privacy policies do not have sufficient details, and they may not be completely accurate. Even when accurate details are available, reviewing the accuracy of CPs is a very labor-intensive process. Therefore we looked for ways to identify errors in P3P CPs that can be determined based on the syntax errors and conflicting tokens within CPs themselves, without having to review thousands of privacy policies, and without requiring first-hand knowledge that these policies are accurate. We developed heuristics to detect three categories of CP errors: *invalid tokens*, *missing tokens*, and *conflicting tokens*.

We found that nearly 34% of the CPs evaluated in August 2010 have at least one error in these categories, and more than half of those with errors omit required information. In addition to syntax and semantic errors, we found that 79% of CPs lack a corresponding full P3P policy, which is required for P3P-compliance. Among the 100 most-visited websites[1] we found 48 sites with CPs, 21 of which exhibited CP errors that our automated analysis could detect. In addition, 41 of these popular sites with CPs did not have corresponding full P3P policies. The numbers reported in this paper should be considered a lower bound for the actual number of CPs with errors, as CPs may contain other types of errors that require manual comparison with human-readable privacy policies or other types of analysis to detect.

We analyzed the impact of CP errors on privacy and found that these errors could mislead users by misrepresenting privacy practices with respect to cookies. We also determined the implications of faulty CPs for user agent behavior. We analyzed practices that appear to be deliberately designed to bypass IE default privacy filters and found that more than 97% of incorrect CPs would bypass these default fil-

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[1]Most-visited websites as of August 2010, according to http://www.quantcast.com/top-sites-1.

ters. Our work identifies potentially misleading practices by web administrators, as well as common accidental mistakes.

This paper is organized as follows. In Section 2, we discuss the details of P3P and compact policies and review related work. In Section 3, we describe our study methodology. In Section 4, we introduce and define common P3P CP errors, present data on the frequency with which each type of error appears, and discuss the privacy implications of these errors. In Section 5, we analyze the impact of incorrect CPs on IE and discuss evidence that incorrect CPs are being used to bypass IE privacy filters. In Section 6, we analyze the CPs of three groups of websites: popular sites, network advertisers that offer opt-out cookies, and TRUSTe-certified sites. Finally, we present our conclusions in Section 7. We also include seven appendixes that provide detailed information about CP tokens and data from our analysis.

2. BACKGROUND AND RELATED WORK

In this section we provide an overview of the Platform for Privacy Preferences (P3P) 1.0. In addition, we provide background on P3P compact policies and discuss related work.

2.1 The P3P Specification

P3P is a standard for specifying websites' privacy policies in a machine-readable XML format that can be processed and acted upon by automated tools [2], [17]. P3P allows user agents to automatically evaluate privacy policies against users' preferences. For example, users can set up their privacy preferences using user agents embedded in their web browsers so that their browsers will warn about mismatches with privacy preferences or block cookies at sites where mismatches occur [4]. When P3P is embedded in search engines, search results can be annotated automatically with privacy information [3]. P3P enables automatic generation of standardized "nutrition label" privacy notices, which are more understandable and easier to read than conventional policies [8]. It also allows automated tools to collect privacy policy data for analysis [1].

Published in 2002, the P3P 1.0 specification defines two types of P3P policies: full policies and compact policies. P3P full policies are written in XML format and use a defined vocabulary and a data schema to represent human-readable privacy policies in a machine-readable language. Compact policies summarize privacy practices associated with the use of cookies; they are transmitted in response to HTTP requests using HTTP headers. Full P3P policies are the authoritative source for website information management practices. The P3P specification requires compact policies to have corresponding full P3P policy files [17].

The P3P specification defines a protocol for requesting and transmitting P3P policies via HTTP. Retrieving a P3P policy requires a two-step process. P3P user agents issue requests for P3P policy reference files stored in a "well-known" location and also check for P3P HTTP headers and P3P metadata embedded in HTML content. P3P policy reference files contain references to the location of full P3P policy files. After fetching a P3P policy reference file, user agents are able to locate and retrieve a full P3P policy file [17].

W3C maintains an online validation tool that checks for syntax errors in full P3P policies and CPs.[2]

[2]http://www.w3.org/P3P/validator.html

2.2 P3P Compact Policies

Compact policies (CPs) are defined in the P3P specification as an optional performance optimization. CPs are optionally served when a website transmits a cookie. They provide a lightweight mechanism to provide information about a website's privacy practices with respect to cookies and help user agents quickly decide how to process cookies. The P3P specification requires that sites that choose to deploy CPs make an effort to do so accurately. According to the P3P specification, "if a web site makes compact policy statements it MUST make these statements in good faith" [18]. Despite being an optional component of P3P, CPs are important because they are used by IE 6, 7, and 8 to determine whether to block or modify cookies.

P3P specifies a set of CP *tokens* associated with nine types of P3P policy elements. Valid CPs must have at least five of these elements. The valid *tokens* for each element, the corresponding full-P3P policy elements, and a short description of each are provided in Appendix A.

2.3 Internet Explorer Cookie Blocking

IE 6, 7, and 8 allow users to set their privacy preferences, which are then used to evaluate websites' CPs and perform cookie filtering. IE considers cookies that are used to collect personally identifiable information (PII) without providing users the choice to opt-in/opt-out to be *unsatisfactory cookies*. IE performs cookie filtering based on six privacy levels that the user can set up; namely, *Block All Cookies*, *High*, *Medium High*, *Medium* (default level), *Low*, and *Accept All Cookies* [9]. The vast majority of users do not change the default privacy settings, so analyzing filtering conditions at the *medium* level allows us to determine the privacy impact of invalid CPs that bypass IE filters. Under the medium setting, unsatisfactory first-party cookies are converted into session cookies and unsatisfactory third-party cookies are rejected. In addition, third-party cookies not accompanied by CPs are rejected. When cookies are rejected, website functionality may be impaired and sites may be unable to collect some of the data they use for operational or business purposes. Because of this cookie-blocking feature, many website administrators have implemented CPs on their websites.

2.4 Related Work

The first large-scale automated analysis of P3P policies found that approximately 10% of 5,739 websites tested in 2003 were P3P-enabled [1]. In addition, 85 websites had only compact policies and were therefore not P3P-compliant, and about a third of the full P3P policies had technical errors. Reay et. al. performed a study of over 3,000 full and compact P3P policies. They found high rates of websites posting CPs without corresponding full P3P policies, as well as many sites that had conflicts between full and compact P3P policies [14].

Cranor, et al. performed an error analysis on P3P full policies. They found that 73% of the 14,720 full P3P policies analyzed contained syntax errors. They compared full P3P policies with their corresponding natural language privacy policies at 21 popular websites and found conflicts between the P3P and natural language policy at each of these sites. Most conflicts were associated with the $PURPOSE$, $CATEGORIES$, and $RECIPIENTS$ elements [3].

Reidenberg and Cranor studied the accuracy of P3P user

agents [15]. They suggested that inaccurate representations by user agents could undermine the purpose of the P3P standard. From a legal standpoint, the enforceability of an agreement based on a P3P user agent's simplified representation of a website privacy policy is uncertain [6]. In the United States, the Federal Trade Commission Act of 2006 empowers the FTC to prevent "unfair or deceptive acts or practices in or affecting commerce...." The FTC has used this authority to take action against companies with deceptive privacy policies. While the FTC has not taken such actions on the basis of deceptive machine-readable privacy policies to date, it appears to be within the FTC's authority to do so [7].

3. METHODOLOGY

We collected CPs from four data sets. First, we collected 52,156 URLs containing CPs from the Privacy Finder search engine cache in January 2010. The cache was initially seeded in 2005 through a web crawl [3] and has grown over time as a result of Privacy Finder users' searches. Second, on July 3, 2010 we collected a list of the 3,417 websites holding TRUSTe privacy seals, as reported by the membership list posted on the TRUSTe website [16]. Third, we collected a list of the 100 most-visited websites from *www.quantcast.com* on August 10, 2010. Fourth, we collected a list of 75 network advertisers offering opt-out cookies that can be set using the Beef Taco (Targeted Advertising Cookie Opt-Out) Firefox extension as of June 23, 2010. We removed duplicate domains from multiple datasets, so we had a final list of 55,636 unique URLs.

In August 2010 we used our web crawler to visit our list of 55,636 URLs and attempt to download CPs. Some datasets had URLs that were not fully qualified (for example, foo.com instead of `http://www.foo.com`) so we prepended http:// and http://www. and tried again if sites failed. When we contacted sites that no longer responded, we retried twice. When we contacted sites that gave other errors, we retried up to ten times. Some of the sites on this list were no longer available, and some that previously had provided CPs were no longer providing them. We were able to collect CPs from 33,139 sites.

At sites with P3P CPs we also checked for full P3P policies. The crawler checked for a P3P policy reference file in the P3P well-known location, HTTP header, and page content. If found we parsed this file to retrieve the location of the full P3P policy (the policy is either embedded in the policy reference file or referenced by a URL in the policy reference file). We then retrieved the full P3P policy and file and verified that it contained a P3P policy. 7,016 of the sites with CPs also had full P3P policies.

Some domains we analyzed had more than one host on the domain with a compact policy in our Privacy Finder cache dataset, for example both `http://www.x.example.com` and `http://www.y.example.com`. We report data in both aggregated form where each domain is represented only once for each unique CP found regardless of the number of hosts (just one entry for example.com if all hosts in example.com have the same CP) and in non-aggregated form where each host is represented (x.example.com and y.example.com are separate). Furthermore, if a single domain exhibited different incorrect CPs, we reported them separately and count both of them in the aggregated data set. There are $19,820$ domains in our aggregated data set.

We define a set of P3P CP errors and group them into three categories: *invalid tokens*, *missing tokens*, and *conflicting tokens*. We define each type of error in Section 4. We developed scripts to parse CPs and detect each type of error we defined. We also developed a script to check each CP to determine whether it would be considered satisfactory by IE under the default privacy setting [9].

4. COMPACT POLICY ERRORS

In this section we present the results of our evaluation of 33,139 collected CPs. We define three categories of errors, and for each type provide data on the frequency of occurrence. We suggest probable underlying causes of these errors: typos, lack of understanding of the P3P specification, or attempts to avoid web browser cookie filtering. We further evaluate the impact of these errors on users' privacy.

We found 11,176 CPs with errors, about 34% of the URLs we analyzed. If we aggregate these invalid CPs by unique domain names, the number of incorrect CPs is reduced to 4,696. Domain names with more than one website account for at least 57% of the total invalid CPs. If companies hosting multiple sites correct their CPs, the CPs with errors could be reduced to less than 15% of the URLs we analyzed. Table 1 summarizes the CP errors we found.

According to the P3P specification, CPs must be accompanied by a full P3P policy. Therefore, we investigated how many of the collected CPs have a corresponding full P3P policy. We found that only 21% of those websites providing CPs also provided full P3P policies.

4.1 Invalid Tokens

4.1.1 Definition

All valid CP tokens are shown in Appendix A. Some tokens can optionally be accompanied by an attribute that specifies that a data practice is performed always, on an opt-in basis, or on an opt-out basis (a, i, or o). No other tokens or token-attribute combinations are valid. An *invalid token* error occurs when a CP includes an invalid token or an invalid token-attribute combination.

Tokens that do not specify the optional attribute default to the *always* attribute (a). The CUR (current purpose) token does not take an optional attribute, but we found $CURa$ is commonly used in CPs. As CUR is the only $PURPOSE$ element that does not allow an attribute, we believe web administrators may be mistakenly adding the invalid a attribute. Since CUR already means that data is always collected for the current purpose this does not change the semantics of the CP, though it is technically invalid. In this paper we report the frequency of $CURa$ separately from other invalid tokens and do not count this error in our overall error numbers.

4.1.2 Evaluation

Of the total CPs evaluated, 11.6% contained invalid tokens. An additional 16% contained the invalid and harmless CURa token and no other invalid tokens, but we do not include these URLs in our count of sites with invalid tokens. Companies publishing multiple websites under a single domain name account for 79% of the invalid token errors.

4.1.3 Analysis

Many invalid token errors are likely to be accidental. We found that several CPs include the CUS string which is not

Type of error	Number of URLs	Percent of URLs with Errors	Number of Domains	Percent of Domains with Errors
Any problem	11,176	33.7%	4,696	23.7%
Invalid tokens				
Invalid tokens	3,839	11.6%	794	4.0%
CURa (no other problems)	5,295	16.0%	2,557	12.907%
Missing tokens	6,402	19.3%	3,319	16.8%
Conflict between tokens				
IVA	3,977	12.0%	923	4.7%
CON	3,899	11.8%	835	4.2%
IVD	1,059	3.2%	669	3.4%
TEL	340	1.0%	178	0.9%
NID	366	1.1%	168	0.9%
NOR	345	1.0%	99	0.5%
NON	32	0.1%	27	0.1%
Total analyzed	33,139 URLs		19,820 Domains	

Table 1: Summary of CP errors. Some CPs have errors in more than one category. CPs that contain the invalid $CURa$ token and no other errors are not included in the "any problem" count.

a valid token. We believe that web administrators might have intended to use the TAI (tailoring) token but wrote CUS (customize) instead, which is an option that appeared in early drafts of the P3P specification. Another common syntax error is swapping letters within tokens. For example, web administrators tend to write OPT instead of OTP, TIA instead of TAI and so on. Web administrators commonly add attributes to tokens that do not accept them. For example, they use $CAOo$ instead of CAO (providing user access to contact information). Another common token found with invalid attributes was OUR, which is the only recipient token that does not accept an attribute. Some invalid CPs contain multiple valid tokens concatenated together without the required white-space separator. More concerning are the CPs that contain completely invalid strings such as $AMZN$ or $VPRT$.

While some of the invalid token errors are likely typos and many appear to be harmless, these errors may cause user agents to incorrectly interpret a CP, which could confuse and mislead users. In addition, it appears that some of the completely-invalid tokens are being used by sites to prevent their cookies from being blocked without providing a meaningful CP.

4.2 Missing Tokens

4.2.1 Definition

According to the P3P specification, each statement in a CP that does not include the NID (no user-identifiable data collected) token should include at least one *PURPOSE*, *RECIPIENT*, *RETENTION*, *CATEGORIES* and *ACCESS* token. A *missing tokens* error occurs when a CP without a NID token does not contain at least one token from each of the above five categories.

4.2.2 Evaluation

Missing-token errors are the most common type of error we found. These errors occur in 19% of the total analyzed CPs and account for more than 57% of the incorrect CPs.

4.2.3 Analysis

Missing tokens make it impossible to use the CP to determine a website's data practices with respect to cookies. For example, a CP that contains no *CATEGORIES* token fails to communicate the type of information associated with a cookie. Because P3P declarations are positive, the absence of a token is an indicator that a website does not engage in a particular practice. Therefore, sites that are missing *CATEGORIES* tokens are effectively stating that they do not collect any category of data. Furthermore, IE analyzes *CATEGORIES*, *PURPOSE* and *RECIPIENT* tokens to make cookie-blocking decisions. As we discuss later, if these tokens are omitted, IE may incorrectly accept a cookie that would otherwise be blocked.

4.3 Conflicting Tokens

4.3.1 Definition

The CP semantics should guarantee consistency between different tokens. For example if a CP includes the ALL token, indicating users have access to all of their personally identifiable information, the CP cannot include the NON token as well, as that means users have no access to their personally identifiable information. Similarly, if a CP includes the NOR token, which means the website does not store permanently the information collected, it cannot include any other *RETENTION* element tokens. If a website declares that it does not collect personally identifiable information (PII) then the CP should not include tokens that suggest collection of such information. Several conflicting token scenarios are defined in the following paragraphs.

Conflict with the NID token. The non-identifiable token NID should be used only when the website does not collect any type of PII and associate it with a cookie. There are many tokens that suggest collection of this information. In particular PHY (information to locate or contact an individual in the physical world), ONL (information to locate or contact an individual on the Internet, e.g. email address), FIN (financial information), LOC (physical location data) and GOV (government identifier, e.g. social security number) tokens are directly associated with the collection of PII. Similarly, CAO (contact and other information) and IDC (online and physical contact information) *ACCESS* tokens should appear only if PII is collected by the website and

associated with a cookie. Furthermore, the IVA (individual analysis), IVD (individual decision), CON (contact) and TEL (telemarketing) $PURPOSE$ tokens require PII and should not be in the CP if the NID token is also in the CP.

Conflict with the IVA/IVD tokens. Performing individual analysis (IVA) or making individual decisions (IVD) requires identifying a particular individual. The IVA and IVD tokens must be accompanied by at least one of the following $CATEGORIES$ tokens: PHY, ONL, FIN, PUR, GOV.

Conflict with the CON token. The contact token, CON, requires enough information to contact the individual either by electronic or physical means. CON must be accompanied by at least a PHY or ONL token.

Conflict with the TEL token. Telemarketing requires phone numbers, which are part of the physical category. Therefore, the TEL token must be accompanied by a PHY token.

Conflict with the NON/NOR tokens. The NON token indicates users are not allowed to access any data collected about them. None of the remaining tokens in the ACCESS element should appear in the CP with the NON token. Similarly, the NOR $RETENTION$ token means the website does not store permanently any kind of PII. If there is a NOR token the CP should not contain any other $RETENTION$ tokens.

4.3.2 Evaluation

The most common errors in this category are associated with the individual analysis (IVA) token. We found these errors in 12% of the analyzed CPs and 35% of the invalid CPs. The second most common type of error in this category is associated with the CON token, which represents more than 11% of the collected CPs and more than 34% of the total incorrect CPs. Conflicts involving the remaining tokens are relatively rare, each occurring in less than 4% of the CPs we analyzed.

4.3.3 Analysis

When a website incorrectly uses the NID token, users have conflicting information about whether or not their PII is being collected. Web administrators may misunderstand the definition of the NID token in the P3P specification and use it incorrectly. The most common NID conflict we found was with the ONL token (email address or other online contact information). This suggests that web administrators might be unaware that email addresses are considered identifiable information. Another common conflict is with the IVA token (individual analysis) which implies that identifiable information is used to perform an analysis. If the NID token is used and it is true that no PII is collected, the PSA token (pseudo-analysis) should be used instead of the IVA token.

The *NOR conflicting token* error leads to confusion about website retention practices. This is probably an accidental mistake, but could negatively affect users' decisions. We found that some CPs include NOR and IND tokens: while the company claims no retention of PII at the same time they claim that they store information indefinitely. Many of the invalid CPs in this error category include the BUS token, meaning the retention period is based on their business practices. While it might be the case that their business practices do not require the retention of personal information, including both of these tokens is confusing.

The *IVA, IVD, CON and TEL conflicting token* error categories can also lead to user confusion. These errors suggest either a lack of understanding of the P3P tokens or an attempt to misrepresent a site's practices.

Most of the websites in the *NON conflicting token* error category simultaneously include the CAO and NON tokens in their CPs. This suggests a possible misunderstanding of the NON token. It leaves users with uncertainty about the access options offered by the website.

Type of error	Number of CPs	Full P3P Policies	Ratio CPs/Full
None (valid CPs)	21,963	5,915	26.9%
Any problem	11,176	1,106	9.9%
Invalid tokens	3,839	255	6.7%
Missing tokens	6,402	469	7.03%
Conflicting tokens			
IVA	3,977	586	14.7%
CON	3,899	321	8.2%
IVD	1,059	424	40.0%
TEL	340	107	31.5%
NID	366	127	34.7%
NOR	345	64	18.6%
NON	32	1	3.1%

Table 2: Full P3P policies at websites with CPs.

4.4 CPs Without Full P3P Policies

The P3P specification requires websites implementing CPs to have a corresponding full P3P policy. Only 7,016 of the 33,139 URLs in our data set (21%) had full P3P policies. As shown in Table 2, CPs without errors were almost three times more likely to have full P3P policies than those with errors. 26.9% of error-free CPs had corresponding full P3P policies, while only 9.9% of CPs with errors had full P3P policies. For CPs with the two most common errors, invalid tokens and missing tokens, the percentage of URLs that present full P3P policies is even lower. This finding provides some evidence that websites with these types of errors may be providing inaccurate CPs to avoid having their cookies blocked.

We found full P3P policies for 17% of the 391 TRUSTe sites with CPs, 55% of the 11 network advertising sites with CPs, and 15% of the 48 most-visited sites with CPs. Appendices E, F, and G show the details on most-visited sites, network advertiser sites, and TRUSTe sites respectively.

The CPs with IVD, TEL, and NID conflicting tokens were more likely to have corresponding full P3P policies. This result suggests that many of these websites may be making good faith efforts to properly comply with the P3P specification and not just sending CPs to avoid cookie blocking. However, web administrators may not fully understand the meanings of these tokens.

4.5 Other Semantic Errors

In addition to the errors already discussed, CPs may contain other types of errors that we were unable to detect automatically. For example, CPs may be semantically inconsistent with human-readable policies posted on websites or with full P3P policies. In addition, CPs may fail to accurately represent website data practices. Evaluating semantic errors requires analyzing websites' human readable policies, which is not a task that can be automated. Given the large

scale of our study, reading human readable policies for the thousands of sites we evaluated is impractical. Furthermore, human-readable policies do not always contain detailed information about data collection and treatment associated with the use of cookies, so even reading these policies would not necessarily resolve questions of P3P accuracy. Thus, a complete evaluation of semantic errors is beyond the scope of our study. However, to gain some insights into the prevalence of semantic errors, we manually compared CPs with full P3P policies and human-readable policies at 41 sites, including 11 most-visited web sites. As detailed in Appendix C and D, 40 of these sites failed to provide full P3P policies, 15 failed to provide human-readable privacy policies, and 2 sites had CPs consisting only of meaningless, invalid tokens. When comparing the full policies and human-readable policies with their corresponding CPs, we found 4 sites with slight discrepancies, and 15 sites with major discrepancies. Furthermore, we were not able to compare 5 sites because their human-readable policies did not include any statement about cookies.

5. COMPACT POLICIES AND INTERNET EXPLORER

Microsoft helped drive P3P adoption by using P3P CPs to make cookie-blocking decisions. However, the large number of CP errors and low rate of full P3P compliance suggest that many websites are adopting P3P CPs in order to avoid cookie blocking, but are not presenting accurate representations of their privacy practices. To gain additional insights into CP adoption, we analyzed the CPs we collected to determine whether IE would classify them as *satisfactory* under the default medium setting. We found that 99% of CPs collected would be considered satisfactory by IE. Of the 33,139 CPs we examined, only 118 error-free CPs and 263 CPs with errors were considered unsatisfactory, and thus would likely be blocked when the cookie was used in a third-party context. All but three of the unsatisfactory CPs with errors had missing-tokens errors.

IE cookie filters only look for combinations of tokens considered unsatisfactory. They ignore invalid tokens and do not check to make sure the minimum required tokens are present. They also do not look for token conflicts. If IE performed the same sort of checks we did in our analysis and treated CPs with these errors as unsatisfactory, we would expect the error rate to be reduce over time because companies would have an incentive to correct the errors in their CPs (although it is possible that we would then see an increased rate of other types of errors that are less-easily detectable through automated analysis).

After observing a large number of identical CPs in our data set, we suspected that web administrators might be copying these CPs from a common source. We used a search engine to track down the source of some of the most common CPs in our data set.

We discovered that Microsoft's support website recommends the use of invalid CPs as a work-around for a problem in IE. Specifically, a FRAMESET or parent window that references another site inside a FRAME considers the referenced site as a third-party, even if it is first-party content located on the same server [10]. Microsoft suggests the following invalid CP: $CAO\ PSA\ OUR$. This CP is clearly invalid since it does not contain any $RETENTION$ or $CATEGORIES$ tokens. Even if the CP were valid, Microsoft's recommendation undermines the purpose of P3P since it encourages web administrators to use CPs that do not represent their actual data practices. We found several technical blogs recommending similar solutions [11], [19]. Some of them suggested the exact CP described above and referred to the Microsoft support website as the source of their advice [12]. This CP occurred 2,756 times in our data set. Only 31 of these CPs had corresponding full P3P policies. Nearly 25% of the invalid CPs used these tokens, representing 43% of invalid CPs in the missing-tokens error category. We did not find this CP at any of the 100 most-visited websites.

In an article titled "P3P in IE6: Frustrating Failure" posted in the O'Reilly blog, the author suggests another "trick" to bypass IE6 privacy filters. He recommends adding a P3P CP header that "enables your cookie to survive any privacy setting" [5]. The CP suggested is: $NOI\ ADM\ DEV\ PSAi\ COM\ NAV\ OUR\ OTRo\ STP\ IND\ DEM$. This CP does not contain any of the errors we tested for. However, if web administrators blindly post it without confirming that it matches their site's actual practices, they will mislead users. This CP occurred 4,360 times in our data, representing 13% of the CPs analyzed. Only 12 of these CPs had corresponding full P3P policies. We did not find this CP at any of the 100 most-visited websites.

We manually analyzed 30 privacy policies of websites that use the CP recommended by the O'Reilly blog. 14 of these 30 websites were randomly taken from the domains that present the most URLs with this CP. The remaining 16 evaluated websites were randomly chosen from the set of websites sending this CP. From the 30 manually-analyzed websites, only one had a valid P3P full policy. However, the valid full P3P policy did not match the corresponding CP, and when we returned to the website in September we discovered the full P3P policy had been removed. We were unable to locate any human-readable privacy policy at 15 of these websites. Furthermore, none of the human-readable privacy policies we found properly matched the corresponding CP. Apendix C summarizes the results of this manual evaluation.

From the 15 websites that exhibited a human-readable policy, only 10 mention the use of cookies. However, we found semantic inconsistencies between all of these policies and their corresponding CPs. Most of these policies made no mention of data practices related to the NOI access token; ADM, DEV, or $PSAi$ purpose tokens; STP or IND retention tokens; or DEM categories token. Many of them made references to other cookie-related data practices not captured by the CP.

We performed a Google search for "ie blocking iframe cookies" and found a number of sites suggesting similar solutions. For example, another blog post recommended a CP that we found 300 times in our data set [19]. On the other hand, we also found a popular question-and-answer site that advised web administrators to create CPs that accurately reflect their site's privacy policy: "The tags are not only a bunch of bits, they have real world meanings, and their use gives you real world responsibilities! For example, pretending that you never collect user data might make the browser happy, but if you actually collect user data, the P3P is conflicting with reality. Plain and simple, you are purposefully lying to your users...." Immediately under the

Compact Policy listed in http-stats.com/P3P	Number of occurrences in collected CPs	Errors	IE Satisfactory cookie?
CAO DSP COR CUR ADM DEV TAI PSA PSD IVAi IVDi CONi TELo OTPi OUR DELi SAMi OTRi UNRi PUBi IND PHY ONL UNI PUR FIN COM NAV INT DEM CNT STA POL HEA PRE GOV	2,738	None	YES
NOI ADM DEV PSAi COM NAV OUR OTRo STP IND DEM	4,360	None	YES
NON DSP CURa OUR NOR UNI	0	Missing tokens	YES
ALL CURa ADMa DEVa TAIa OUR BUS IND PHY ONL UNI PUR FIN COM NAV INT DEM CNT STA POL HEA PRE LOC OTC	102	None	YES
BUS CUR CONo FIN IVDo ONL OUR PHY SAMo TELo	293	Missing tokens	YES
CAO DSP COR CURa ADMa DEVa OUR IND PHY ONL UNI COM NAV INT DEM PRE	553	None	YES
NOI NID ADMa OUR IND UNI COM NAV	464	None	YES
ALL DSP COR CURa ADMa DEVa TAIa PSAa PSDa IVAa IVDa CONa TELa OUR STP UNI NAV STA PRE	24	Conflicting IVA, IVD, CON, and TEL tokens	YES
NOI DEVa TAIa OUR BUS UNI STA	359	None	YES
CAO PSA OUR	2,756	Missing tokens	YES

Table 3: Frequency of "common" CPs from http-stats.com in collected CPs

example CP was the warning: "Note that the combination of P3P headers in the example may not be applicable on your specific website; your P3P headers MUST truthfully represent your own privacy policy!" [13]. This warning must have been effective as we did not find the example CP in our data set.

We examined the top 10 P3P header values listed at http-stats.com, a website that crawls the web and compiles data on HTTP header values. These headers included the CPs recommended in the O'Reilly blog and on the Microsoft support website. As shown in Table 3, we found multiple instances of nine of these CPs in our data set and detected errors in four of these CPs. All of these CPs are considered satisfactory by IE.

6. COMPACT POLICIES AND POPULAR WEBSITES

In this section we present the results of our evaluation of the top-100 most-visited websites, 3,417 TRUSTe-certified websites, and 75 network advertising websites offering opt-out cookies that can be set using the Beef Taco Firefox extension. We found that only 391 of the evaluated TRUSTe sites had CPs and 134 of those had errors. 48 of the 100 most-visited sites had CPs and 21 had errors. 11 of the evaluated network advertising sites had CPs and only one had an error.

The top-visited domains with CPs are listed in Appendix E. We analyzed the errors in detail for the top 50 most-visited sites with CPs that contained errors. Because of the popularity of these sites, errors in their CPs have an impact on a large number of users. Table 4 shows the CPs and types of errors found. Only one of these websites, *microsoft.com,* displayed a full P3P policy.

The *facebook.com* CP is invalid because it is missing *PURPOSE*, *RECIPIENT*, *RETENTION*, *CATEGORIES* and *ACCESS* tokens. The included tokens, *DSP* and *LAW*, do not provide any information about the site's collection or use of data. This CP simply states that any privacy dispute will be resolved according to a law referenced in their privacy policy, and implies that the site collects no data associated with the cookie. When doing preliminary work for this study in 2009, the *facebook.com* compact policy contained only the single invalid token *HONK*. Both of these CPs are useless for communicating with user agents and users. It is likely that *facebook.com* is using their CP to avoid being blocked by IE.

Websites under the *msn.com* domain exhibited a CP that includes the invalid *CUSo* token. Two other Microsoft-owned sites, *microsoft.com* and *windows.com* use the same CP. These websites display the TRUSTe EU Safe Harbor Privacy seal. We believe that these websites are likely attempting to comply with P3P; however, they are not using P3P properly.

The *live.com* CP does not include any *ACCESS* tokens. This CP suggests collection of PII, but does not provide any information about whether users can access their personal information.

The *amazon.com* and *imdb.com* domains each contain a single invalid token and no other tokens, so they fall into the invalid-tokens and missing-tokens categories. It appears that these two websites use a CP only for the purpose of avoiding IE cookie filtering.

The *aol.com* domain's CP is invalid since it is missing *ACCESS* and *RETENTION* tokens. The *mapquest.com* domain is missing a *RETENTION* token. The *godaddy.com*

URL	Compact Policy	Errors found	Valid Full P3P Policy	IE Satisfactory cookie?	TRUSTe seal
facebook.com	DSP LAW	Missing tokens	NO	Yes	EU Safe Harbor
msn.com	BUS CUR CONo FIN IVDo ONL OUR PHY SAMo TELo	Missing tokens	NO	Yes	EU Safe Harbor
live.com	BUS CUR CONo FIN IVDo ONL OUR PHY SAMo TELo	Missing tokens	NO	Yes	EU Safe Harbor
amazon.com	*AMZN*	Invalid tokens, Missing tokens	NO	Yes	None
microsoft.com	ALL IND DSP COR ADM CONo CUR *CUSo* IVAo IVDo PSA PSD TAI TELo OUR SAMo CNT COM INT NAV ONL PHY PRE PUR UNI	Invalid tokens	YES	Yes	EU Safe Harbor
reference.aol.com	UNI INT STA NAV DEV CUR OUR	Missing tokens	NO	Yes	Web Privacy
atlas.mapquest.com	STA INT UNI CUR DEV NOI OUR	Missing tokens	NO	Yes	None
godaddy.com	IDC DSP COR LAW CUR ADM DEV TAI PSA PSD IVA IVD HIS OUR SAM PUB LEG UNI COM NAV STA	Conflicting IVA and IVD tokens	NO	Yes	EU Safe Harbor
imdb.com	*IMDB*	Invalid tokens, Missing tokens	NO	Yes	None
windows.com	ALL IND DSP COR ADM CONo CUR *CUSo* IVAo IVDo PSA PSD TAI TELo OUR SAMo CNT COM INT NAV ONL PHY PRE PUR UNI	Invalid tokens	NO	Yes	None
hulu.com	NOI DSP COR NID ADMa *OPTa* OUR NOR	Invalid tokens	NO	Yes	None

Table 4: CPs of 50 most-visited websites with errors, sorted by popularity. Invalid tokens are shown in italics.

domain has conflicting *IVA* and *IVD* tokens. This CP is confusing since it claims the site is using identifiable information to perform individual analysis and decisions; however, it does not include any *CATEGORIES* token associated with the collection of identifiable information.

Finally, the *hulu.com* domain contains the invalid *OPTa* token which presumably is intended to be *OTPa* instead. This makes it syntactically incorrect. More importantly, the CP includes the *NID* token, claiming that no PII is associated with cookies. We read the human-readable privacy policy of this website and found that it explicitly mentions linking PII to cookies.

All but one of these top websites do not have a full P3P policy, and several of them have CPs that appear to be well-crafted to bypass IE filtering. Further analysis will be needed to determine if they actually follow the data practices they claim through their CPs; however, as detailed in Appendix D, there are inconsistencies that suggest they do not follow the practices they claim.

Domains such as *facebook.com*, *msn.com*, *live.com* and *aol.com* exhibited TRUSTe privacy seals, despite displaying invalid CPs. Indeed, we found that 391 of the 3,417 TRUSTe-certified websites have CPs, but 134 (34.3%) of these had at least one problem with their CPs, as detailed in Appendix G. 28 out of the 48 top websites with CPs appeared on the list of TRUSTe websites and 11 (39.3%) of these had invalid CPs. This suggests TRUSTe is not reviewing websites' CPs when issuing privacy seals.

Network advertisers tend to make heavy use of third-party cookies in order to provide targeted advertising. Therefore, the use of CPs among network advertisers is of particular importance. Without CPs, many network advertising cookies would be blocked by IE because they are used in a third-party context. In addition, users are generally not aware of what third-parties are setting cookies on the sites they visit or what their privacy practices are. If used properly, P3P could provide information about privacy practices that would otherwise be difficult for users to obtain. We collected a list of 75 network advertisers offering opt-out cookies that can be set using the Beef TACO (Targeted Advertising Cookie Opt-Out) Firefox extension. As detailed in Appendix F, We found that only 11 of them delivered CPs with their opt-out cookie. However, we found errors in only one of these CPs.

Some of the most-visited domains host many websites in their domain, and thus have many invalid CPs. Table 5 lists the 6 domains responsible for at least 100 invalid CPs each. These 6 domains are accountable for nearly 40% of CPs with errors. These include two of the top 100 most-visited web domains: *tripod.com* and *msn.com*.

7. CONCLUSIONS

In this paper we present data on errors commonly found in P3P compact policies that are detectable through automated analysis. We evaluated CPs collected from 33,139 websites on 19,820 domains and found *invalid tokens, missing tokens,* or *conflicting tokens* at 34% of these sites. We found CP errors on a wide range of sites, including some of the most popular websites on the Internet and TRUSTe seal holders. We also reviewed the opt-out cookies of 75 network advertisers, and found errors in one of the 11 CPs collected. We were surprised by the large number of errors we were able

Host domain	Invalid CPs	Percent of total invalid CPs
tripod.com	2,575	23.0%
addresses.com	1,054	9.4%
msn.com	358	3.2%
cjb.net	247	2.2%
livedoor.biz	116	1.0%
ning.com	112	1.0%
Total invalid:	**4,462**	**39.92%**

Table 5: Domains accountable for most of the CP problems.

to detect in CPs through automated analysis alone. We expect that even more errors exist, but discovering them would require manual comparison with sites' human-readable privacy policies or first-hand knowledge of sites' actual privacy practices. The large number of CP errors is troubling and suggests that CPs cannot be relied on for accurate information about website privacy policies with respect to cookies.

We conducted a number of analyses to try to understand why such a large fraction of CPs contain errors. Our results suggest that while some errors are likely introduced through mistakes (e.g. typos or misunderstanding the P3P specification), most appear to result from web administrators writing CPs for the purpose of avoiding IE cookie filtering without considering the accuracy of their CPs. In addition, we found large numbers of websites sharing the same erroneous CPs, including groups of websites hosted on the same domain.

P3P is designed to provide website privacy policies in a computer-readable format that enables automated analysis and decision making. CPs provide a simple way for websites to offer a summary of their privacy practices with respect to cookies in a format that is easily processed by web browsers. The IE web browser uses CPs to make cookie blocking decisions. Thus, CP errors are likely to cause IE to allow cookies that should be blocked under a user's privacy settings to go unblocked, and users who rely on IE's cookie settings may be misled. This problem is exacerbated by the fact that the IE cookie-filtering implementation does not check for CP errors. Thus even the invalid- and missing-token errors, which are a clear violation of the P3P specification, go undetected by IE. Indeed, some websites appear to exploit this IE implementation loophole and publish CPs containing only bogus tokens or omitting tokens in the categories that would cause IE to filter their cookies. A number of online articles also suggest CPs that websites can use to avoid having their cookies blocked, and we found large numbers of sites that copied these suggested CPs verbatim.

CP errors would likely be reduced substantially if IE checked for these errors, and if the articles that informed web administrators about avoiding cookie blocking explained that CPs need to follow the P3P specification and accurately represent privacy practices with respect to cookies. In addition, if the administrators of domains that host large numbers of websites corrected the CPs for their domains, the number of errors would be significantly reduced.

The CP error data we report suggests that many websites are not taking P3P seriously and are behaving in ways that undermine the purpose of the P3P specification. Previous work suggests that errors in full P3P policies are also common [14] [3]. It appears that companies do not currently have sufficient incentives to provide accurate machine-readable privacy policies. Unless regulators use their authority to take action against companies that provide erroneous machine-readable policies, users will be unable to rely on these policies.

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APPENDIX

A. DESCRIPTION OF P3P COMPACT POLICY TOKENS

Element	Token	Full P3P Vocabulary	Plain Language Translation of P3P Policy Element [18]
Access	NOI	<nonident/>	We do not keep any information identified with you
	ALL	<all/>	We give you access to all of our information identified with you
	CAO	<contact-and-other/>	We give you access to your contact information and some of our other information identified with you
	IDC	<ident-contact/>	We give you access to only your contact information in our records
	OTI	<other-ident/>	We allow you to access some of our information identified with you, but not your contact information
	NON	<none/>	We do not give you access to our information about you
Disputes	DSP	There are some disputes	There are ways to resolve privacy-related disputes with us
Remedies	COR	<correct/>	We will correct any errors we make related to the commitments in our privacy policy
	MON	<money/>	We will compensate individuals if it is determined that we have violated our privacy policy
	LAW	<law/>	Our privacy policy references a law that may determine remedies for breaches of our policy
Non-Identifiable	NID	<NON-IDENTIFIABLE/>	We do not keep any information that could be used to identify you personally
Purpose	CUR	<current/>	To provide the service you requested
	ADM[attr]	<admin/>	To perform web site and system administration
	DEV[attr]	<develop/>	For research and development, but without connecting any information to you
	TAI[attr]	<tailoring/>	To customize the site for your current visit only
	PSA[attr]	<pseudo-analysis/>	To do research and analysis in which your information may be linked to an ID code but not to your personal identity
	PSD[attr]	<pseudo-decision/>	To make decisions that directly affect you without identifying you, for example to display content or ads based on links you clicked on previously
	IVA[attr]	<individual-analysis/>	To do research and analysis that uses information about you
	IVD[attr]	<individual-decision/>	To make decisions that directly affect you using information about you, for example to recommend products or services based on your previous purchases
	CON[attr]	<contact/>	To contact you through means other than telephone (for example, email or postal mail) to market services or products
	HIS[attr]	<historical/>	To aid in historical preservation as governed by a law or policy described in this privacy policy
	TEL[attr]	<telemarketing/>	To contact you by telephone to market services or products
	OTP[attr]	<other-purpose/>	For other uses described in the site's human readable policy
Recipient	OUR	<ours/>	Companies that help us fulfill your requests (for example, shipping a product to you), but these companies must not use your information for any other purpose
	DEL[attr]	<delivery/>	Delivery companies that help us fulfill your requests and who may also use your information in other ways
	SAM[attr]	<same/>	Companies that have privacy policies similar to ours
	UNR[attr]	<unrelated/>	Other companies whose privacy policies are unknown to us
	PUB[attr]	<public/>	People who may access your information from a public area, such as a bulletin board, chat room, or directory
	OTR[attr]	<other-recipient/>	Companies that are accountable to us, though their privacy policies may be different from ours

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Element	Token	Full P3P Vocabulary	Description
Retention	NOR	<no-retention/>	We do not keep your information beyond your current online session
	STP	<stated-purpose/>	We keep your information only long enough to perform the activity for which we collected it
	LEG	<legal-requirement/>	We keep your information only as long as we need to for legal purposes
	BUS	<business-practices/>	Our full privacy policy explains how long we keep your information
	IND	<indefinitely/>	We may keep your information indefinitely
Categories	PHY	<physical/>	Name, address, phone number, or other physical contact information
	ONL	<online/>	Email address or other online contact information
	UNI	<uniqueid/>	Website login IDs and other identifiers (excluding government IDs and financial account numbers)
	PUR	<purchase/>	Information about your purchases, including payment methods
	FIN	<financial/>	Financial information such as accounts, balances, and transaction history
	COM	<computer/>	Information about the computer you are using, such as its hardware, software, or Internet address
	NAV	<navigation/>	Which pages you visited on this web site and how long you stayed at each page
	INT	<interactive/>	Activities you engaged in at this web site, such as your searches and transactions
	DEM	<demographic/>	Information about social and economic categories that might apply to you, such as your gender, age, income, or where you are from
	CNT	<content/>	Messages you send to us or post on this site, such as email, bulletin board postings, or chat room conversations
	STA	<state/>	Cookies and mechanisms that perform similar functions
	POL	<political/>	Which groups you might be a member of such as religious organizations, trade unions, and political parties
	HEA	<health/>	Health information such as information about your medical condition or your interest in health-related topics, services, or products
	PRE	<preference/>	Information about your tastes or interests
	LOC	<location/>	Information about an exact geographic location, such as data transmitted by your GPS-enabled device
	GOV	<government/>	Government-issued identifiers such as social security numbers
	OTC	<other-category/>	Other types of data described in the site's human readable policy
Test	TST	<test/>	The CP is under test

Attributes [attr]: a = always, i = opt-in, o = opt-out

B. FREQUENCY OF TOKENS

Element	Token	always	opt-in	opt-out
Access	NOI	28%	NA	NA
	ALL	6%	NA	NA
	CAO	44%	NA	NA
	IDC	12%	NA	NA
	OTI	<1%	NA	NA
	NON	5%	NA	NA
Disputes	DSP	61%	NA	NA
Remedies	COR	54%	NA	NA
	MON	<1%	NA	NA
	LAW	3.4%	NA	NA
Non-identifiable	NID	6%	NA	NA
Purpose	CUR/CURa	58%	NA	NA
	ADM	73%	1%	1%
	DEV	70%	1%	1%
	TAI	37%	2%	<1%
	PSA	52%	16%	2%
	PSD	32%	1%	1%
	IVA	11%	27%	2%
	IVD	2%	23%	3%
	CON	1%	30%	12%
	HIS	3%	<1%	<1%
	TEL	<1%	1%	22%
	OTP	1%	22%	<1%
Recipient	OUR	96%	NA	NA
	DEL	3%	22%	<1%
	SAM	1%	22%	2%
	UNR	<1%	21%	<1%
	PUB	<1%	21%	<1%
	OTR	2%	23%	15%
Retention	NOR	7%	NA	NA
	STP	20%	NA	NA
	LEG	1%	NA	NA
	BUS	13%	NA	NA
	IND	67%	NA	NA
Categories	PHY	39%	NA	NA
	ONL	40%	NA	NA
	UNI	56%	NA	NA
	PUR	31%	NA	NA
	FIN	23%	NA	NA
	COM	61%	NA	NA
	NAV	61%	NA	NA
	INT	39%	NA	NA
	DEM	49%	NA	NA
	CNT	25%	NA	NA
	STA	45%	NA	NA
	POL	21%	NA	NA
	HEA	21%	NA	NA
	PRE	31%	NA	NA
	LOC	15%	NA	NA
	GOV	21%	NA	NA
	OTC	3%	NA	NA
Test	TST	<1%	NA	NA

This table shows the percentage of compact policies in our data set that contain each CP token.

C. EVALUATION OF FULL P3P AND HUMAN-READABLE POLICIES FOR WEB SITES USING THE CP SUGGESTED BY THE O'REILLY BLOG

URL	Valid Full P3P Policy?	Location of Human-readable Policy	Comments
alleghenyinstitute.org	NO	Not found	**No policies found to compare with CP**
bordellfuehrer.de	NO	Not found	**No policies found to compare with CP**
caidep.com	NO	*caidep.com*	**Policies do not match** - privacy policy does not mention any information associated with the NOI, ADM, DEV, $PSAi$, COM, $OTRo$, STP, IND or DEM tokens included in the CP; privacy policy mentions the use of cookies to store preferences and to perform customization but CP does not include PRE or TAI tokens
cakephp.org	NO	*cakephp.org/pages/privacy*	**Policies do not match** - privacy policy does not mention any information associated with the NOI, ADM, DEV, $PSAi$, STP, IND or DEM tokens included in its CP; privacy policy mentions the use of cookies to store preferences but CP does not include PRE token
campbell.house.gov	NO	Not found	**No policies found to compare with CP**
condusef.gob.mx	NO	Not found	**No policies found to compare with CP**
creditolo.de	NO	Not found	**No policies found to compare with CP**
dme.kerala.gov.in	NO	Not found	**No policies found to compare with CP**
economics.harvard.edu	NO	Not found	**No policies found to compare with CP**
equestrian.com.my	NO	*equestrian.com.my/ privacy-policy*	**Human-readable policy does not mention cookies**
gilldivers.com	NO	Not found	**No policies found to compare with CP**
gss.ucsb.edu	NO	Not found	**No policies found to compare with CP**
honor.unc.edu	NO	Not found	**No policies found to compare with CP**
itech-ny.com	NO	*itech-ny.com/ privacy-policy.html*	**Policies do not match** - privacy policy does not mention any information associated with NOI, ADM, DEV, STP, IND or DEM tokens included in its CP; privacy policy mentions the use of cookies to store preferences but CP does not include the PRE token
joomla.org	NO	*joomla.org/ privacy-policy.html*	**Human-readable policy does not mention cookies**
komodorock.com	NO	*www.komodorock.com/ privacy-policy/*	**Policies do not match** - privacy policy does not mention any information associated with NOI, ADM, DEV, STP, IND or DEM tokens included in CP; privacy policy mentions the use of cookies to store preferences and customize advertising but CP does not include the PRE or TAI tokens
laser.org	NO	Not found	**No policies found to compare with CP**
majorleague.com.au	NO	Not found	**No policies found to compare with CP**
megasearch.net	NO	*megasearch.net/ PrivacyPolicy.html*	**Policies do not match** - the use of cookies is not well detailed in the human-readable policy.

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URL	**Valid Full P3P Policy?**	**Location of Human-readable Policy**	**Comments**
navicat.com	NO	*navicat.com/en/privacy.html*	**Human-readable policy does not mention cookies**
ocean.tamu.edu	NO	*geosciences.tamu.edu/about-us/geonet-information-hub/web-site-policies/677-site-privacy-and-security-policy*	**Policies do not match** - privacy policy does not mention any information associated with NOI, DEV, $PSAi$, $OTRo$, STP, IND or DEM tokens included in CP
orange-pocket.com	NO	Not found	**No policies found to compare with CP**
parktrust.org	NO	Not found	**No policies found to compare with CP**
rcn.com	NO	*rcn.com/dc-metro/privacy-policy*	**Policies do not match** - the use of cookies is not well detailed in the human-readable policy - privacy policy does not mention any information associated with NOI, ADM, DEV, $PSAi$, STP, IND or DEM tokens included in CP; privacy policy mentions that cookies are used to provide seamless visit and expedite customer login but CP does not include CUR token
relevantmagazine.com	NO	*relevantmagazine.com/privacy-policy*	**Policies do not match** - the use of cookies is not well detailed in the human-readable policy
themacstore.com	NO	*themacstore.com/privacy/*	**Human-readable policy does not mention cookies**
theories.com	NO	*theories.com/index.php/Privacy-Policy.html*	**Policies do not match** - the use of cookies is not well detailed in the human-readable policy
topcities.com	NO	Not found	**No policies found to compare with CP**
womensmedia.com	NO	*womensmedia.com/new/privacy-policy.shtml*	**Human-readable policy does not mention cookies**
wsashow.com	NO	*wsashow.com/homepage/privacy_policy*	**Policies do not match** - privacy policy does not mention any information associated with NOI, DEV, STP or IND tokens included in its CP; privacy policy mentions that cookies are used for log-in, enable personalization, analytics, shopping cart, personalized service, and targeted advertisement, but CP does not include CUR, IVD, IVA, TAI or INT tokens

D. EVALUATION OF FULL P3P AND HUMAN-READABLE POLICIES FOR WEBSITES WITH CP ERRORS IN TOP 50 MOST-VISITED LIST

URL	Valid Full P3P Policy?	Location of Human-readable Policy	Comments
facebook.com	NO	*facebook.com/policy.php*	**Policies do not match** - CP contains only two tokens (DSP and LAW) but privacy policy mentions that cookies are used for several purposes, including the provision of services, advertising, easy log-in, etc., and that cookies are stored for an extended period
msn.com	NO	*privacy.microsoft.com/en-us/fullnotice.mspx*	**Slight differences between CP and privacy policy** - privacy policy mentions that cookies may be used to collect demographic information but CP does not include DEM token
safety.live.com	NO	*privacy.microsoft.com/en-us/fullnotice.mspx*	**Slight differences between CP and privacy policy** - privacy policy mentions that cookies may be used to collect demographic information but CP does not include DEM token
amazon.com	NO	*amazon.com/gp/help/customer/display.html/ref=footer_privacy/191-3583711-6331321?ie=UTF8&nodeId=468496*	**Invalid CP, unable to compare**
microsoft.com	YES	*privacy.microsoft.com/en-us/fullnotice.mspx*	**Slight differences between CP, full P3P policy, and privacy policy** - privacy policy mentions that cookies may be used to collect demographic information but CP and full P3P policy do not include DEM token
reference.aol.com	NO	*about.aol.com/aolnetwork/aol_pp*	**Policies do not match** - privacy policy mentions cookies are used to remember preferences, measure ad effectiveness, customize site, store demographic information, share info with ad networks and service providers, but CP does not include any PRE, ONL, TAI, DEM or SAM tokens.
atlas.mapquest.com	NO	*about.aol.com/aolnetwork/aol_pp*	**Policies do not match** - privacy policy mentions cookies are used to remember preferences, measure ad effectiveness, customize site, store demographic information, share info with ad networks and service providers, but CP does not include any PRE, ONL, TAI, DEM or SAM tokens.
godaddy.com	NO	*godaddy.com/Agreements/ShowDoc.aspx?pageid=PRIVACY&ci=20803&app_hdr=0*	**Policies do not match** - privacy policy mentions the collection of name, address, credit card numbers, government IDs, and collected information might be used to contact the user and to present co-branded offers on opt-in basis, but CP does not contain PHY, DEM, GOV, CON or $SAMo$
imdb.com	NO	*imdb.com/privacy*	**Invalid CP, unable to compare**
windows.com	NO	*privacy.microsoft.com/en-us/fullnotice.mspx*	**Slight differences between CP and privacy policy** - privacy policy mentions that cookies may be used to collect demographic information but CP does not include DEM
hulu.com	NO	*hulu.com/privacy*	**Policies do not match** - privacy policy mentions targeted advertising based on user's activity but CP does not include IVA; policy states: "We may use cookies and similar technologies to relate your use of the Hulu Services to personally identifiable information," yet CP includes the NID token, claiming that they do not collect PII

E. TOP VISITED DOMAINS USING CPS

Domain	Valid Full P3P Policy?	Errors found in CP
about.com	YES	None
amazon.com	NO	Invalid tokens; Missing tokens
angelfire.com	NO	Invalid tokens; IVA and CON conflicting tokens
aol.com	NO	Missing tokens
apple.com	NO	None
att.com	YES	None
bing.com	NO	None
bizrate.com	NO	Invalid tokens
blogspot.com	NO	None
careerbuilder.com	YES	IVA conflicting token
causes.com	NO	IVD, IVA and CON conflicting tokens
cnet.com	NO	None
cnn.com	NO	None
comcast.net	NO	None
dailymotion.com	NO	None
examiner.com	NO	NID conflicting token
facebook.com	NO	Missing tokens
flickr.com	NO	None
go.com	NO	Invalid tokens; Missing tokens
godaddy.com	NO	IVD and IVA conflicting tokens
google.com	NO	None
hulu.com	NO	Invalid tokens
ign.com	NO	None
imdb.com	NO	Invalid tokens; Missing tokens
latimes.com	YES	None
linkedin.com	NO	None
live.com	NO	Missing tokens
mapquest.com	NO	Missing tokens
match.com	NO	None
metacafe.com	NO	None
microsoft.com	YES	CON conflicting token
monster.com	NO	None
msn.com	NO	Invalid tokens
mybloglog.com	NO	None
nytimes.com	NO	Missing tokens
people.com	NO	None
simplyhired.com	NO	None
target.com	NO	None
thefind.com	YES	IVD and IVA conflicting token
tripod.com	NO	Invalid tokens; IVA and CON conflicting tokens
tumblr.com	NO	None
twitter.com	NO	None
washingtonpost.com	NO	TEL, IVD, IVA, and CON conflicting tokens
weatherbug.com	NO	None
wikipedia.org	NO	None
windows.com	NO	Invalid tokens
yahoo.com	YES	None
yellowpages.com	NO	None
Total	7/48	21/48

F. NETWORK ADVERTISING DOMAINS USING CPS

Domain	Valid Full P3P Policy?	Errors found in CP
247realmedia.com	YES	None
adsfac.sg	YES	None
atdmt.com	YES	None
casalemedia.com	NO	None
imiclk.com	YES	None
intellitxt.com	NO	None
navegg.com	NO	Invalid tokens
realmedia.com	YES	None
vizu.com	YES	None
weborama.fr	NO	None
zedo.com	NO	None
Total	6/11	1/11

G. DOMAINS HOLDING TRUSTE SEALS USING CPS

Domain	Valid Full P3P Policy?	Errors found in CP
10kscholarship.com	NO	None
1800mobiles.com	NO	None
192.com	YES	None
1choice4yourstore.com	NO	None
247realmedia.com	YES	None
2fixyourtraffic ticket.com	YES	None
3dcart.com	NO	None
abc.com	NO	None
abcnews.com	YES	None
activeinternational.ca	NO	IVD, IVA, and CON conflicting tokens
activeinternational.com	NO	IVD, IVA, and CON conflicting tokens
adt.com	NO	None
agilent.com	NO	Missing tokens
alladvertisingagencies.com	NO	None
aloharents.com	NO	None
alvenda.com	NO	None
amiastri.com	NO	Invalid tokens
angelfire.com	NO	Invalid tokens; IVA and CON conflicting tokens
aol.com	NO	Missing tokens
apothica.com	YES	Missing tokens; TEL and CON conflicting tokens
appexchange.com	NO	Missing tokens
apple.com	NO	None
asksanta.ca	NO	Missing tokens
att.com	YES	None
att.net	YES	Invalid tokens
attinteractive.com	NO	None
automationcontrols.com	NO	None
autonation.com	NO	None
avaline.com	NO	None
aviationarthangar.com	NO	None
bellsouth.com	NO	None
bic-gsa.com	NO	None
bicgsa.com	NO	None

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Domain	Valid Full P3P Policy	Errors found in CP
bicwarehouse.com	NO	None
bidezone.com	NO	Missing tokens
billhighway.com	NO	Invalid tokens; Missing tokens
billiardsaddiction.com	NO	None
billshrink.com	NO	IVD, IVA, and CON conflicting tokens
bing.com	NO	None
bizrate.com	NO	Invalid tokens
bizrate.de	NO	Invalid tokens
bluerazor.com	NO	IVD and IVA conflicting tokens
bodymedia.com	NO	None
boostflow.com	NO	None
boston.com	NO	None
burstnet.com	NO	None
buyingadvice.com	NO	None
buysafe.com	YES	IVD, IVA, and CON conflicting tokens
buysafeshopping.com	YES	IVD and IVA conflicting tokens
caliberlocal.com	NO	None
calibex.com	NO	None
candlewoodsuites.com	NO	Missing tokens
candywarehouse.com	NO	None
caoh.org	NO	None
careonecredit.com	YES	None
carid.com	NO	None
casalemedia.com	NO	None
caspio.com	NO	Missing tokens
caspio.net	NO	Missing tokens
cataloglink.com	NO	NID conflicting token
catchfirefunding.com	NO	None
cellstores.com	NO	None
ceu4u.com	NO	None
chatthreads.com	NO	Missing tokens
cheaptickets.com	NO	IVD and IVA conflicting tokens
chefsresource.com	NO	None
chegg.com	NO	None
chipin.com	NO	None
christmastreeforme.com	NO	None
cjhomeandoffice.com	NO	None
classmates.com	YES	IVD, IVA, and CON conflicting tokens
clcleather.net	NO	None
clubbing.com	NO	Missing tokens
code7contest.com	YES	None
comcast.net	NO	None
conair-store.com	NO	None
concreteexchange.com	NO	None
controlscan.com	YES	None
coremetrics.com	YES	None
costumecity.com	YES	None
couponbug.com	NO	None
coupons.com	NO	None
couponsinc.com	NO	None
cpp.com	NO	Missing tokens
crafta.com	NO	None
credit.com	NO	None
criteo.com	NO	None

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Domain	Valid Full P3P Policy	Errors found in CP
crowneplaza.com	NO	Missing tokens
cufflinksdepot.com	NO	None
datepad.com	NO	Missing tokens
dealsonhotels.com	NO	Missing tokens
debtgoal.com	NO	None
depositagift.com	NO	None
dexclusive.com	NO	None
digicert.com	YES	CON conflicting token
digilifestudios.com	NO	None
digitalimaginghq.com	NO	None
digitallanding.com	NO	IVD, IVA, and CON conflicting tokens
digitalspyders.com	NO	None
directfix.com	NO	None
directtextbook.com	YES	None
dreamlandweddingshoppe.com	NO	None
drugs.com	YES	None
duiattorney.com	NO	None
dynamiclogic.com	YES	None
e-miles.com	NO	None
e-rewards.com	NO	None
e-rewards.de	NO	None
e-rewards.fr	NO	None
e-rewards.nl	NO	None
ea.com	NO	Missing tokens
earnmydegree.com	NO	None
ebates.com	NO	None
ebooks.com	YES	Missing tokens; CON conflicting token
ecampustours.com	NO	None
echosign.com	NO	IVD, IVA, and CON conflicting tokens
educadium.com	NO	None
educationconnection.com	YES	IVD, IVA, and CON conflicting tokens
emeraldisland.com	NO	None
emergingmed.com	NO	None
enjoycpr.com	NO	None
epals.com	NO	None
eprooft.com	NO	None
espn.com	YES	None
ether.com	NO	None
eversave.com	NO	None
facebook.com	NO	Missing tokens
familyfun.com	NO	None
fansnap.com	NO	None
federaldebtreduction.com	NO	None
firstagain.com	NO	CON conflicting token
flemingoutdoors.com	NO	None
forzieri.com	NO	None
freeshop.com	NO	NID conflicting token
genealogytoday.com	NO	None
getaroom.com	NO	None
getinsurancequotes.ca	NO	None
globesmart.com	NO	None
go.com	YES	Invalid tokens; Missing tokens
godaddy.com	NO	IVD and IVA conflicting tokens
gotomypc.com	NO	Missing tokens

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Domain	Valid Full P3P Policy	Errors found in CP
gowearfit.com	NO	None
greenfieldonline.com	NO	None
greensherpa.com	NO	None
greenwayuniversity.com	NO	None
grovesite.com	NO	None
healthscout.com	YES	None
healthsquare.com	YES	None
hiexpress.com	NO	Missing tokens
higherone.com	NO	None
holiday-inn.com	NO	Missing tokens
homedecorhardware.com	NO	None
homegain.com	NO	None
hotbot.com	NO	CON conflicting token
hotelindigo.com	NO	Missing tokens
houstontexans.com	NO	None
htmlgear.com	NO	Invalid tokens; IVA and CON conflicting tokens
hyperstreet.com	NO	None
ibm.com	YES	None
ichotelsgroup.com	NO	Missing tokens
ideascale.com	NO	None
ifriends.net	YES	None
ifriendsv2.net	YES	None
ihg.com	NO	Missing tokens
ihgarmyhotels.com	NO	Missing tokens
importedblankets.com	NO	None
inksell.com	NO	None
inoutcash.com	NO	None
insightexpress.com	NO	None
intelius.com	NO	Missing tokens
intercontinental.com	NO	Missing tokens
intuit.com	NO	Missing tokens
itech-ny.com	NO	None
itwixie.com	NO	None
jackpotrewards.com	NO	Invalid tokens
jaman.com	NO	Missing tokens
jameslimousines.com	NO	None
jewelrywonder.com	NO	Missing tokens
jobtarget.com	NO	Invalid tokens; Missing tokens
justasktoday.com	NO	None
kanetix.ca	NO	None
kanetix.com	NO	None
karmacar.com	YES	None
keen.com	NO	None
keysurvey.com	NO	Missing tokens
kinglinen.com	NO	None
largestmall.com	NO	Missing tokens
legalmatch.com	NO	None
letstalk.com	NO	None
life360.com	NO	None
lifequote.com	NO	None
linkedin.com	NO	None
listyourdebt.com	YES	None
lithium.com	NO	None
live.com	NO	Missing tokens

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Domain	Valid Full P3P Policy	Errors found in CP
livemeeting.com	NO	CON conflicting token
loanio.com	NO	None
logcap4jobs.com	NO	None
lycos.com	NO	CON conflicting token
maghound.com	NO	None
mail2world.com	NO	Missing tokens; IVA and CON conflicting tokens
mailchimp.com	NO	Invalid tokens; Missing tokens
market2lead.com	YES	None
mate1.com	NO	None
maven.net	YES	None
mba.com	NO	None
mcmobileaccessories.com	NO	None
medelita.com	NO	None
medlink.com	YES	None
medsurvey.com	NO	None
mercedsystems.com	NO	None
mesh.com	NO	Missing tokens
microsoft-hohm.com	NO	None
microsoft.com	YES	CON conflicting token
microsoftfinancing.com	NO	None
microsofthohm.com	YES	None
mitto.com	NO	CON conflicting token
mndigital.com	NO	Invalid tokens
moneybookers.com	YES	None
monster.ch	NO	None
monster.com	NO	None
moversdeal.com	NO	None
msn.at	NO	Missing tokens
msn.be	NO	Missing tokens
msn.com	YES	Invalid tokens
msn.de	NO	Missing tokens
msn.dk	NO	Missing tokens
msn.es	NO	Missing tokens
msn.fi	NO	Missing tokens
msn.fr	NO	Missing tokens
msn.it	NO	Missing tokens
msn.nl	NO	Missing tokens
msn.no	NO	Missing tokens
msn.pt	NO	Missing tokens
msn.se	NO	Missing tokens
mybarstools.com	NO	None
myfreepaysite.com	NO	NID conflicting token
myhomepage.com	YES	CON conflicting token
mynewplace.com	YES	Missing tokens; CON conflicting token
napster.com	YES	None
napster.de	NO	None
nationalgamecity.com	NO	None
nextag.ca	NO	None
nextag.com	NO	None
nflflag.com	NO	None
nupplegal.com	NO	None
nytimes.com	NO	Missing tokens
oakcitygallery.com	NO	None
officedrop.com	NO	None

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Domain	Valid Full P3P Policy	Errors found in CP
omniture.com	NO	None
onebagoneearth.com	NO	None
onesky.com	NO	None
onetravel.com	NO	None
onetravelindia.com	NO	None
onewayfurniture.com	NO	None
opinion-central.com	NO	None
orbitz.com	NO	IVD and IVA conflicting tokens
orbitzforbusiness.net	NO	IVD and IVA conflicting tokens
paybycash.com	NO	IVD, IVA, and CON conflicting tokens
paycycle.com	NO	Missing tokens
payscale.com	NO	IVD, IVA, and CON conflicting tokens
pch.com	NO	None
pcicomplianceguide.org	YES	None
pensxpress.com	NO	None
peopleclick.com	NO	None
perfectmatch.com	NO	None
periogen.com	YES	None
permuto.com	NO	None
photosynth.net	NO	Invalid tokens
pictureyoursunique.com	NO	None
pinnaclesys.com	NO	None
platinumgalleria.com	YES	None
popularmedia.com	NO	None
posonlinestore.com	NO	None
pospaper.com	NO	None
precharge.com	YES	None
predictiveresponse.com	NO	None
press8.com	NO	None
priorityclub.com	NO	Missing tokens
priortax.com	YES	Invalid tokens; Missing tokens
prixmoinscher.fr	NO	None
prodebtsupport.com	NO	None
prosperitypublications.net	NO	None
qualityhealth.com	YES	None
quickenbillpay.com	NO	None
quikcondoms.com	NO	None
racingusa.com	NO	None
rapidrefund.net	NO	Invalid tokens; Missing tokens
rapidrepair.com	NO	None
rapidtax.com	YES	Invalid tokens; Missing tokens
rednel.com	NO	None
remington-store.com	NO	None
rent.com	NO	None
repequity.com	NO	None
rewardtv.com	NO	IVD and IVA conflicting tokens
rixty.com	YES	None
roblox.com	NO	None
rockstargames.com	NO	Missing tokens
rockyou.com	NO	None
rozee.pk	NO	None
safecount.net	NO	None
salesforcefoundation.org	NO	Missing tokens
sharefile.com	NO	Missing tokens

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Domain	Valid Full P3P Policy	Errors found in CP
shermanstravel.com	NO	None
shop.com	NO	NID conflicting token
shopbrita.com	NO	None
shopcompanion.com	NO	NID conflicting token
shopdeck.com	NO	None
shopiogear.com	NO	None
shopkitchenaid.com	NO	None
shopzilla.com	NO	Invalid tokens
shopzilla.de	NO	Invalid tokens
shopzilla.fr	NO	Invalid tokens
shustir.com	NO	None
simplifi.net	NO	None
simplybabyfurniture.com	NO	None
simplykidsfurniture.com	NO	None
sixcontinentsclub.com	NO	Missing tokens
skincarerx.com	YES	Missing tokens; TEL and CON conflicting tokens
skintreatment.com	NO	None
smartsourceonline.com	NO	None
snaglo.com	NO	None
snapfish.com	NO	None
soccernet.com	NO	None
spardeingeld.de	NO	Invalid tokens
spendgrowgive.com	NO	None
spiceworks.com	NO	None
spoke.com	NO	IVD, IVA, and CON conflicting tokens
spokesoftware.com	NO	IVD, IVA, and CON conflicting tokens
sportingnews.com	NO	None
spytown.com	NO	None
starfieldtech.com	NO	IVD and IVA conflicting tokens
starwars.com	NO	Missing tokens
staybridge.com	NO	Missing tokens
strands.com	NO	None
suresource.com	NO	None
surveillance-video.com	NO	None
sweatmonkey.org	NO	None
talentfilter.biz	NO	IVD, IVA, and CON conflicting tokens
taxact.com	YES	IVA and CON conflicting tokens
taxactonline.com	YES	IVA and CON conflicting tokens
taxcut.com	NO	None
taxpack.com	YES	Invalid tokens; Missing tokens
techbargains.com	NO	IVD, IVA, and CON conflicting tokens
techcctv.com	YES	None
theblueriverbabyshoppe.com	NO	None
theopenskyproject.com	YES	None
thesims2.com	NO	Missing tokens
thumbplay.com	NO	IVD, IVA, and CON conflicting tokens
toluna.com	NO	None
topdjgear.com	NO	None
toponeshop.com	NO	None
torbalscales.com	NO	None
treadmilldoctor.com	NO	None
tripit.com	YES	Missing tokens
tripod.com	NO	Invalid tokens; IVA and CON conflicting tokens
tycoonu.com	NO	Missing tokens

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Domain	**Valid Full P3P Policy**	**Errors found in CP**
ultimatepay.com	NO	IVD, IVA, and CON conflicting tokens
unbeatablesale.com	YES	None
unique-egifts.com	NO	None
us-appliance.com	NO	None
uscretailproducts.com	NO	None
verisign.com	NO	None
verizon.net	NO	IVD, IVA, and CON conflicting tokens
vermontgear.com	NO	None
viewpoint.com	YES	None
vitadigest.com	NO	None
vitamaker.com	NO	None
voice123.com	YES	None
w3i.com	NO	Invalid tokens; Missing tokens
wallpapers.com	NO	Invalid tokens; Missing tokens
waterpik-store.com	NO	None
weatherbug.com	YES	None
webtv.net	NO	Missing tokens
westfloridacomponents.com	NO	None
whitakertaylor.com	YES	None
whitesmoke.com	YES	Missing tokens
whowhere.com	NO	CON conflicting token
wildwestdomains.com	NO	IVD and IVA conflicting tokens
windowsmedia.net	NO	None
wine.com	YES	TEL and CON conflicting tokens
winferno.com	NO	None
wirefly.com	NO	None
wirelessground.com	NO	None
wisemanfinance.com	NO	None
wondertime.com	NO	None
wooddashexperts.com	NO	None
xbox.com	NO	Invalid tokens
yahoo.com	YES	None
yellowpages.com	NO	None
zocdoc.com	NO	Missing tokens
Total	63/391	134/391