Transcript of Craig Ellis Wills, Ph.D.

Date: June 17, 2025
Case: Home Depot U.S.A., Inc. -v- Ravenwhite Security, Inc. (PTAB)

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WORLDWIDE COURT REPORTING & LITIGATION TECHNOLOGY

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

- - -

HOME DEPOT U.S.A., INC.,	:	Case IPR2024-01316
Petitioner	:	
v.	:	U.S. Patent No.
	:	10,594,823
RAVENWHITE SECURITY, INC.,	:	
	:	
Patent Owner.	:	

- - -

DEPOSITION

DEPONENT: CRAIG WILLS, Ph.D.

DATE: Tuesday, June 17, 2025

TIME: 9:00 a.m.

LOCATION: One Liberty Place
1650 Market Street
Suite 5000
Philadelphia, PA 19103

REPORTER: Lisa Claud Neal, RPR, CSR, CLI
Notary PA-NJ-DE

- - -

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12
-- Ravenwhite Security, Inc.
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2 I N D E X
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6 RESPONDENT'S EVIDENCE
7 Witness Page
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9 By Mr. Pappas 5, 128
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2 E X H I B I T S

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5 PATENT OWNER'S

6 NUMBER DESCRIPTION MARKED

7 1 Abstract 26

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1 P R O C E E D I N G S
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3 - - -
4 CRAIG ELLIS WILLS, PH.D., having
5 been duly sworn, was examined and
6 testified as follows:
7 - - -
8 EXAMINATION
9 - - -
10 BY MR. PAPPAS:
11 Q. Good morning, Dr. Wills. How you
12 are today?
13 A. I'm doing well, thank you.
14 Q. Would you please state your full
15 legal name, for the record.
16 A. My full legal name is Craig Ellis
17 Wills.
18 Q. You understand that you're having
19 your deposition taken today in connection
20 with a declaration you provided in
21 IPR2024-01316?
22 A. I do.

1 Q. And this proceeding concerns U.S.
2 Patent No. 10594823. Does that sound right?
3 A. Yes. 823 certainly sounds right.
4 Q. If I refer to the patent as the
5 823 patent, will you understand what I'm
6 referring to?
7 A. Yes.
8 Q. I'm going to hand you Exhibit 1002
9 in this proceeding --
10 A. Okay.
11 Q. -- which is your declaration.
12 You're welcome to use a different copy as
13 long as it's clean.
14 A. This is just a clean copy of my
15 declaration (indicating).
16 Q. Is that your signature on the
17 cover page?
18 A. That is indeed my signature.
19 Q. Did you review your declaration in
20 preparing for this deposition?
21 A. I did indeed.
22 Q. In your review did you come across

1 any errors in your declaration?
2 A. I did come across that in one
3 place the word string appears when it should
4 be storing, but otherwise, I don't -- I
5 don't recall anything.
6 Q. Do you recall what paragraph of
7 your declaration that error occurs?
8 A. As I sit here, no. But I believe
9 if you search for the word "string," I don't
10 think "string" otherwise comes up, but I'm
11 sorry I didn't note that.
12 Q. That's all right. Are there any
13 other errors that you're aware of?
14 A. No.
15 Q. Are there any opinions in your
16 declaration that you would like to clarify
17 before we get started?
18 A. There are no opinions that I would
19 like to change or clarify. No.
20 Q. Do you understand that you are
21 under oath today?
22 A. I do understand that. Yes.

1 Q. And you understand that you are
2 here to give complete and accurate
3 testimony?
4 A. I do understand that, yes.
5 Q. Is there any reason why you can't
6 give complete and accurate testimony today?
7 A. There is not.
8 Q. You've been retained by the
9 petitioner in this proceeding Home Depot; is
10 that correct?
11 A. Yes.
12 Q. Are you aware that the 823 is
13 involved in a parallel district court
14 litigation involving the parties to this IPR
15 proceeding?
16 A. I am aware that there are other
17 proceedings, yes.
18 Q. Have you been retained by Home
19 Depot to assist with the parallel district
20 court proceeding?
21 MR. WOLFE: Objection.
22 THE WITNESS: As of right now,

1 no.
2 BY MR. PAPPAS:
3 Q. Have you been deposed before?
4 A. I have.
5 Q. Approximately how many times have
6 you been deposed?
7 A. I've probably been deposed 10, 12
8 sessions, I'll say.
9 Q. And approximately how many of
10 those depositions were for proceedings in
11 front of the United States Patent Trademark
12 Office?
13 A. I think the majority of them would
14 be.
15 Q. When you say the majority, more
16 than half of those proceedings?
17 A. Yes.
18 Q. And the other proceedings, were
19 those proceedings in Federal District Court?
20 A. There were one -- there was
21 also -- so some did not involve patent
22 infringement, some involved class action

1 lawsuits.
2 Q. What did the class action lawsuits
3 generally relate to?
4 A. Privacy concerns. I remember
5 there was one involving Hulu that tied in
6 directly to some of the research that I had
7 done.
8 Q. And when you say privacy concerns,
9 that's privacy for users on the Internet?
10 A. Yes.
11 Q. So I know you've been deposed
12 before, but I just want to go over a few
13 basic ground rules. Everything you say
14 today will be written down by the court
15 reporter so please try to give verbal
16 answers so the transcript is clear. Is that
17 fair?
18 A. That's clear, yes.
19 Q. If you don't understand any part
20 of a question today, will you let me know so
21 I can clarify?
22 A. Yes, I will.

1 Q. And if you answer my question, I'm
2 going to assume that you understood it. Is
3 that fair?
4 A. That is fair, yes.
5 Q. From time to time your counsel may
6 object to questions, but do you understand
7 that you still need to answer the question
8 unless your counsel instructs you not to?
9 A. I do understand that, yes. I
10 expect to take breaks every hour or so, but
11 if you need a break at a different time,
12 just let me know.
13 A. Okay.
14 Q. And I would just ask that you
15 answer any pending question before we take
16 the break. Is that fair?
17 A. Understood.
18 Q. Let's talk a little bit about your
19 preparation in writing the declaration. If
20 you can turn to your declaration, I won't
21 point you to anything specific yet, but
22 generally, did you write the declaration

1 yourself?
2 A. Yes, I drafted initial drafts of
3 it, and then had assistance with editing,
4 and bringing it to its final version.
5 Q. Did you draft the entire initial
6 version of your declaration?
7 A. I drafted substantial portions of
8 it, yes.
9 Q. Approximately how much time did
10 you spend preparing your declaration?
11 A. Many, many hours. Tens, hundreds,
12 hours. I don't know. I can't -- that was
13 back last fall. I don't remember the
14 specifics.
15 Q. Do you think it was more than a
16 hundred hours?
17 A. It may have been, it may have
18 been.
19 Q. At least close to a hundred hours?
20 A. Sure.
21 Q. Did you talk to anyone outside of
22 counsel for Home Depot in the process of

1 preparing your declaration?
2 A. No, I did not.
3 Q. Can you please turn to paragraph
4 30 of your declaration?
5 A. Yes.
6 Q. So here you say you reviewed
7 and/or considered at least the documents
8 cited in the list of exhibits in the
9 documents referenced in this declaration.
10 Do you see that?
11 A. Where are we? I'm not sure I'm in
12 the same spot as you. I'm on page 30?
13 Q. I'm sorry, paragraph 30, page 15.
14 A. Okay. I'm not sure I misheard
15 or -- materials considered, yes.
16 Q. So again in the first sentence you
17 say, "I have reviewed and/or considered at
18 least the documents cited in the list of
19 exhibits and the documents referenced in
20 this declaration." Do you see that?
21 A. Yes.
22 Q. Does the list of exhibits refer to

1 the index of exhibits at the beginning of
2 your declaration?
3 A. Yes, it does.
4 Q. Did you review any other materials
5 that are not cited in your declaration?
6 A. I believe as part of background
7 work I would have reviewed other documents,
8 materials I found on line, but ultimately
9 decided that were they were not useful to
10 include here. So there were certainly other
11 materials that I looked at that ultimately
12 did not end up cited in here.
13 Q. Did you review the Home Depot's
14 petition in preparing your declaration?
15 A. The Home Depot's petition, I did
16 not.
17 Q. Did you review Home Depot's
18 petition at any point after writing your
19 declaration?
20 A. I have not.
21 Q. Did you review Home Depot's
22 petition in preparation for this deposition?

A. I did not.
Q. So, let's talk a little bit about today's deposition. What did you do to prepare for the deposition today?
A. I looked at and reviewed and read my own declaration. I looked again at the 823 patent. I looked at the Hinton patent and Vargahse patent. I think those are the primary materials that I reviewed.
Q. Who did you meet with in preparing for your deposition today?
A. I met with Jennifer and Joe.
Q. Anyone else?
A. No.
Q. Were those meetings in person?
A. We had meetings both virtually and in person.
Q. Approximately how many -- how long did you spend preparing for your deposition?
A. You mean -- when are you -- when are you counting? Do you mean since I wrote the declaration, since I -- in the last

1 week?
2 Q. Let's start with approximately how
3 many hours did you spend meeting with
4 counsel in preparation for your deposition?
5 A. Maybe 15, give or take.
6 Q. And approximately how much time
7 did you spend reviewing documents in
8 preparation for your deposition?
9 A. You mean my -- me, myself
10 reviewing documents?
11 Q. Yes, aside from the meetings with
12 counsel.
13 A. Probably 15 to 20 hours.
14 Q. Did you talk to anyone outside of
15 counsel for Home Depot in preparing for your
16 deposition today?
17 A. I did not.
18 Q. All right. Let's turn to
19 paragraph 3 of your declaration.
20 And that would be on page 1.
21 A. Page what?
22 Q. One.

A. Okay. Thank you.
Q. I can refer to these any way that's easy for you.
A. Paragraph number is fine and good.
Q. So I just want to talk a little bit about your background. You are currently a professor at Worcester Polytechnic Institute; is that correct?
A. Yes.
Q. Did I pronounce that correctly because I have no idea how to pronounce it.
A. It was perfect.
Q. Thank you. That will be my --
A. WPI will work very well.
Q. We'll call it WPI. That will probably be my greatest accomplishment today, pronouncing that correctly. So you've been a -- how long have you have been a professor there?
A. I have been at WPI over 30 years.
Q. And what courses do you currently teach at WPI?

A. I typically teach courses on operating systems, networks, distributed systems. At one point I taught a course on web privacy. So those are kind of -- I would consider myself a systems and networks guy within the realm of computer science.

Q. You mentioned web privacy, in what time frame did you teach courses on web privacy?

A. I think it was in like the early 2010s.

Q. Okay. What was the prompting to teach courses on web privacy?

A. If you look at my record, so I'll step back, if I may.

So I did my Ph.D. work in what I'll call distributed systems, okay, distributed computing. When the World Wide Web came along in the latter part of the 1990 -- mid to late 1990s, I and a lot of other faculty -- people in computer science started looking at it for various aspects of

1 research. For me, I looked at the web as a
2 really large distributed system, and studied
3 it as such. And if you look at my
4 publication record, you will see in the late
5 1990 and the early 2000s, I did a lot of
6 work on performance, how well did things
7 perform, web performance, web caching, stuff
8 like that, all right -- content distribution
9 networks, we published one of the very first
10 papers looking at performance of content
11 distribution networks.
12 About 2004, 2005, one of the
13 things I and a colleague that I did a lot of
14 work with kind of started noticing and
15 trying to understand is when my web browser,
16 I'd go to a site like CNN, my web browser
17 was going to lots of other servers out there
18 besides CNN, okay, in terms of pulling in
19 objects, and so we began to study what
20 indeed these other sites were doing and why
21 my browser was going there.
22 Social networking sites were

1 coming along at this time, and so we started
2 studying the implications of, you know: Oh,
3 my goodness, my Facebook I.D. is getting
4 passed to Google. And so that is a privacy
5 concern, we were publishing papers along
6 this line, what could we do about it. And
7 so a period from 2004, probably 2005, in
8 terms of publication since, in terms of
9 looking at doing a lot of research in web
10 privacy, and it's not unusual at a
11 university that when you have some expertise
12 that you teach it. So this was a special
13 topics graduate course on web privacy that I
14 taught. I don't know -- I definitely taught
15 it once, whether -- I can't remember whether
16 I taught it a second time, but it was not an
17 unusual kind of course to offer for a
18 particular level of, you know, focusing on
19 one's level of expert -- you know, area of
20 expertise.
21 Q. So that when you were talking
22 about the -- you go to a website, and it

1 was, your browser was going to other
2 websites, that was the website passing
3 information to other third parties. Is that
4 what you were referring to?
5 A. Well, passing information to other
6 third parties is one of the things that
7 happened. Sometimes it could be going to
8 third parties and, you know, quote,
9 identifying information might not be passed,
10 but in other cases and we identified -- or
11 found and illustrated that in some cases
12 identifying information was being passed.
13 Q. In other cases was it information
14 that might be downloaded into the user's
15 cache from another website?
16 A. Well, if -- if my browser
17 contacted a third-party site then that third
18 party site could, in responding back to me,
19 set -- information set cookies that my
20 browser then stores in its cache.
21 Q. And that was one of the things you
22 were seeing in the 2004, 2005 time frame?

A. Yes, that was something that we were observing that third parties were -- were gaining information maybe through the URL that was being sent to them and through things like a referrer header, which is something as part of HTTP, that that refer header had information and whether that was intentional or whether that was inadvertent that identifying information was sent, I -- I don't know but we clearly identified and published that this indeed was happening. And that ended up in conferences, ended up, as I said, for a while there was a reporter at The Wall Street Journal I had regular conversations with and things like that.

Q. Got it. Do you still conduct research in the area of web privacy?

A. I do still conduct research, not at the same pace as I was doing in, say, 2005 to 2015, but yes, I still have projects that are ongoing in that direction.

Q. What aspects of web privacy does

1 your research involve today?
2 A. One of the things that I've had
3 projects of looking at, at ad blockers, how
4 effective are they or how effective are they
5 not. One of the things -- and also not just
6 looking at quote, web and web browser, but
7 also mobile applications and what kind of
8 privacy concerns is happening there, so that
9 would be a couple of examples.
10 Q. Do you still conduct research in
11 distributed systems?
12 A. Yes, although most of the work is
13 either web or more broadly Internet related.
14 Q. What else does your research today
15 focus on?
16 A. So I also have done -- sometimes I
17 do related to interface, user interface type
18 projects. Certainly with some of the
19 projects that I involve are kind of more
20 related to what I would call data science in
21 terms of trying to have data that may be
22 interdisciplinary, and analyzing that data

1 for what it says, and understanding how to
2 visualize the results. One of the things of
3 having done a lot of Internet performance
4 and a lot of measurement has always been an
5 issue of how to best an -- so collecting a
6 lot of data, of understanding what is
7 happening on the Internet, but that then
8 leading to the followup question of how to
9 best analyze that data and how to best
10 visualize it. So some of what I have
11 learned and done there applying to other
12 kinds of data that might be
13 interdisciplinary in nature.
14 Q. Let's turn to paragraph 9 of your
15 declaration. Yes, paragraph 9. This
16 paragraph goes on through page 4.
17 A. Yes.
18 Q. In the middle of page 4 you
19 discuss an article or mention an article
20 entitled "A Personalized Approach to Web
21 Privacy Awareness Attitudes and Actions," do
22 you see that"?

1 A. I do see that. Yes.
2 Q. When was that article written or
3 published?
4 A. Well, as it shows here it looks
5 like it was published in 2011.
6 Q. Do you recall when you were
7 writing that article?
8 A. In that time frame.
9 Q. What was the article generally
10 about?
11 A. I remember -- so the coauthor
12 there was a graduate student who I worked
13 with that we -- that -- the premise of the
14 project, the article, was to try to
15 demonstrate to users that they could come to
16 a website and understand what third parties
17 might be tracking them. The way we did that
18 is we used the CSS or stylesheet history
19 base cookies that we had a list of popular
20 websites that we wrote or, in this case the
21 graduate student wrote some, I believe,
22 JavaScript to go ahead and see whether or

1 not we could find in a user's history
2 whether or not they had visited a site, had
3 they visited CNN, is that a site that they
4 went to. And then combine that with
5 knowledge of what third parties those sites
6 again, such as CNN, might expose their
7 traffic to, so as it says here, awareness of
8 then reporting that information to users who
9 came to our sites, and then from that I
10 believe we had a -- if I recall a bit of a
11 survey aspect after we showed them this and
12 about potential actions that they could
13 take.
14 Q. And those potential actions were
15 to reduce the information that was shared
16 with third parties?
17 A. Reduce the information that was
18 shared, control, you know, cookies, perhaps
19 block third parties that -- from being --
20 blocking third-party cookies, sure. I
21 can't -- I can't remember all of the
22 specific actions.

1 But the idea was to -- the basic
2 premise that we could go ahead and use the
3 CSS history based cookies and be able to, if
4 a user came to our site, we could
5 essentially read their history of specific
6 URLs that we were looking for that we would
7 know. So if we had a hundred URLs that we
8 were looking for, we could say 37 of these
9 URLs, CNN, New York Times, Washington Post,
10 whatever, we could say okay, this browser
11 has gone there because we were looking in
12 the browser cache through these history
13 based cookies.
14 Q. Can you explain just a little how
15 the CSS based history cookie would work?
16 A. So, it's -- so the history based
17 cookie, so you could run some code that you
18 could determine whether or not a URL has
19 been previously visited. And this is a
20 feature that browsers provide because --
21 well, browsers maintain history, so one of
22 the things that happens with browsers is

1 when you or I our browsers goes and there's
2 a number of links on the page, browsers use
3 this history information in order to they
4 will show links in two different colors of
5 whether this is a link you've never visited
6 or oh, this is a link in your history, and
7 therefore you have previously visited this
8 link. So, browsers maintain this
9 information. There are ways, as I said,
10 like JavaScript code that can get at this
11 information.
12 Q. So it can essentially analyze the
13 CSS code that would be on the page to see if
14 a link has been visited or not visited?
15 A. So the Javascript code can ask a
16 question about any URL, has this URL
17 previously been visited.
18 Q. You said that information would be
19 stored in the browser cache?
20 A. That information is yes, part of
21 the browser cache, part of the history cache
22 of the browser.

1 Q. I want to hand you an exhibit. We
2 can mark this as Exhibit 1 to his
3 deposition.
4 ("A Personalized Approach to Web
5 Privacy - Awareness, Attitudes and
6 Actions," abstract, marked Respondent's
7 Exhibit No. Wills 1, for
8 identification.)
9 BY MR. PAPPAS:
10 Q. Dr. Wills, do you recognize the
11 document that you've been handed?
12 A. So it looks like the paper we just
13 discussed.
14 Q. So I think you said earlier as
15 part of this article you surveyed users
16 regarding their attitudes toward tracking;
17 is that correct?
18 A. That's my recollection of what we
19 did with the -- what we did after we made
20 users aware of tracking that had happened,
21 yes.
22 Q. And what did you find in your

1 survey results? And feel free to look in
2 the article if that's helpful.
3 A. So we certainly found that users
4 indicate that they are concerned about
5 third-party tracking. Looks like we broke
6 it down by different demographics, and
7 things like that, that we would have
8 gathered.
9 Q. So on the first page in the
10 findings paragraph, do you see it says we
11 found that 63 percent of users agreed with a
12 statement of concern for third parties
13 monitoring activities?
14 A. I do see that.
15 Q. So is it fair to say that users
16 were concerned with third parties monitoring
17 their online activities?
18 A. Yes, that is -- that they are
19 concerned about that, yes.
20 Q. And I think if you turn to page
21 10 --
22 A. 10, okay.

1 Q. -- you provide some results of
2 your survey here.
3 A. Yes, I see that in the middle of
4 the page there.
5 Q. The questions were concerned with
6 user attitudes toward tracking online
7 activity, monitoring location, and
8 demographics; is that right?
9 A. That appears to be correct, yes.
10 Q. And users were most concerned with
11 having their online activity monitored as
12 compared to location or demographics?
13 A. That appears that there's the
14 highest percentage agreeing with that first
15 one there, yes.
16 Q. Why do you think that was?
17 A. I don't know. I know the results
18 we have here are consistent with other
19 studies of -- showing that people were
20 concerned about third-party tracking. Why
21 that one was higher than the other two, I
22 don't know whether we said in here. I

1 certainly without -- and I can't remember if
2 we even offered a comparison between those
3 two here in the paper.
4 Q. Are there ways that users can opt
5 out of having their online activity
6 monitored?
7 A. There are, and I think if I leafed
8 ahead here there are different kinds of
9 actions that I believe, in just leafing
10 through here on page 14, I see a table that
11 has -- that has some results in the first
12 column of that table here, table, what is
13 that, here showing two different actions.
14 Q. Table 5 are you referring to?
15 A. Table 5, yes. Thank you.
16 Q. Do you think it is important for
17 users to have a choice of whether their
18 online activity is monitored?
19 A. It is, and this is having a choice
20 about what gets done with one's private
21 information, yes, that -- of having users
22 having control of that, I do think is

1 important.
2 Q. Do you think it's important then
3 for third parties to say respect user's
4 preferences if they opt out of having their
5 online activity monitored?
6 A. I'm sorry. Can you repeat?
7 Q. Sure. Do you think if a user opts
8 out of having their online activity
9 monitored, that it's important that third
10 parties respect that preference?
11 A. I certainly think it is desirable,
12 yes.
13 Q. Are you aware of any privacy laws
14 that govern activity monitoring by third
15 parties?
16 A. I think the most specific ones are
17 from Europe, over in Europe, and there
18 there's much more concern and much broader
19 scope in terms of the use of cookies.
20 Q. Is that GDPR that you're referring
21 to?
22 A. I think that yes, that's the

1 result of GDPR, yes.
2 Q. Just for the record, Exhibit 1 to
3 your deposition that we've been discussing
4 is the article that you coauthored called, A
5 Personalized Approach to Web Privacy
6 Awareness, Attitudes and Actions; is that
7 correct?
8 A. I'm sorry, are you asking is this
9 exhibit the one that I referred to in my
10 declaration?
11 Q. Yes, that's correct.
12 A. Yes. That's -- yes.
13 Q. And that exhibit, which we've
14 marked Exhibit 1 to your deposition is
15 titled A Personalized Approach to Web
16 Privacy Awareness, Attitudes and Actions,
17 correct?
18 A. Correct.
19 Q. And is this a complete and
20 accurate copy of that article that you
21 wrote?
22 MR. WOLFE: Objection.

1 THE WITNESS: It certainly
2 appears to be.
3 MR. PAPPAS: You have no reason
4 to think that this is not an accurate copy
5 of the article you wrote?
6 MR. WOLFE: Objection.
7 THE WITNESS: I have no reason
8 to think otherwise.
9 BY MR. PAPPAS:
10 Q. You can put that away for now, if
11 you would like. Let's turn to paragraph 11
12 of your declaration, The start of technology
13 background and let me know when you get
14 there.
15 A. Yes, I'm there.
16 Q. Here in paragraph 11 you discuss
17 different types of cookies; Is that right?
18 A. I believe in paragraph 11 I begin
19 to discuss different types of cookies.
20 Q. That's fair. You talk about a
21 browser cache in that paragraph?
22 A. Yes.

1 Q. Can you explain, generally, what a
2 browser cache is?
3 A. So a browser cache is or browser
4 storage area is somewhere where information
5 data are stored that can be accessed by the
6 browser that is running.
7 Q. And do browser applications
8 designate some particular storage area on
9 the local computer for that cache?
10 A. There is not one singular location
11 on the computer that would necessarily
12 encompass all of the browser storage area,
13 basically anything that can -- that the
14 browser can access while it is running would
15 be a browser storage or a browser cache.
16 Q. So, we'll come back to that, but
17 are you familiar with Google's chrome
18 browser?
19 A. I -- I use it occasionally.
20 Q. Chrome makes use of a browser
21 cache; is that correct?
22 A. All browsers have that, to the

1 extent that all browsers have a cache, yes.
2 Q. Are you aware of any details of
3 how Google chrome's browser cache is
4 implemented?
5 A. I'm not familiar with the
6 specifics of how its browser cache is
7 implemented.
8 Q. Do you know whether -- do you know
9 where Google chrome stores data that would
10 be directed to its disk cache, for example?
11 MR. WOLFE: Objection.
12 Foundation.
13 THE WITNESS: It may store
14 things in memory, it may store things that
15 it wants to retain long term out somewhere
16 in the file system around a disk, but --
17 out in the file system, but I don't know
18 the specifics of where.
19 BY MR. PAPPAS:
20 Q. Do you know where cookies are
21 stored as it relates to google chrome's
22 browser?

1 A. Not specifically.
2 Q. But cookies would normally be
3 stored in a browser cache. Is that fair?
4 A. Cookies would be stored in a
5 browser cache, yes.
6 Q. What else would be stored in a
7 browser cache?
8 A. For example, we just -- in the
9 exhibit here we talked about history, so
10 history would be stored as part of a browser
11 cache. Browsers store and remember contents
12 of objects that have been previously
13 downloaded, so if the user immediately comes
14 back to a same page that they were before,
15 there could be content that is already in
16 the part of the browser cache so that it, so
17 that your browser doesn't have to go back to
18 the server to re-retrieve that object.
19 Q. That content that is stored as
20 part of the browser cache, are those
21 temporary Internet files?
22 A. I believe -- yes, that would --

1 temporary Internet files in the vernacular
2 of A23 would be yes, the same.
3 Q. And the history you were talking
4 about or you spoke about, does that refer to
5 the user's browser history, browsing
6 history?
7 A. Right. This particular browser
8 history. So, just to be clear, it's browser
9 history for a user with one particular
10 browser, if I use Chrome for a while and
11 then decide to go use Internet Explorer,
12 those would be -- those two browsers would
13 have -- each their own browser cache.
14 Q. Does each browser application have
15 a directory structure on the file system
16 where it can store data relating to the
17 browser cache?
18 A. Each browser has places in the
19 file system where it is storing and storing
20 content, whether they be cookies or
21 temporary Internet files or browsing
22 history.

1 Q. Do you know whether those places
2 in the file system are specifically
3 associated with the browser application?
4 A. Well, there are places in the file
5 system that the -- that the browser can
6 access, and it has -- and the browser has
7 been configured that this is where it puts
8 particular kinds of cache content.
9 Q. So for example, I'll stick with
10 the Goggle chrome example. Does Google
11 chrome have a specific location where it
12 stores browsing history?
13 MR. WOLFE: Objection.
14 Foundation.
15 THE WITNESS: Again, without
16 knowing the specifics of the internals of
17 how Chrome works, it is likely the case
18 that, yes, there is a standard place that
19 if I install Chrome on my machine, that
20 Chrome is going to put particular kinds of
21 cache content in particular locations in
22 my file system.

1 BY MR. PAPPAS:
2 Q. And the same would hold true for
3 temporary Internet files?
4 A. Yes, the temporary Internet files
5 would have some place within the file system
6 that they are -- that Google chrome, when
7 that when Chrome is running, that is where
8 it is going to go to access those files.
9 Q. Is there any particular browser
10 application that you have familiarity with
11 in terms of the locations that it stores
12 these types of files?
13 A. In my report I -- I know, I think
14 I list a specific location from an article
15 where Flash cookies are stored, but beyond
16 that, I don't think I have, as we sit here I
17 don't believe it's in my report or do I know
18 specific file system location for other
19 browser cache information.
20 Q. For example, you don't know where
21 Mozilla Firefox would store browser cache
22 data on the user's file system; is that

1 right?
2 A. As I sit here, I don't know the
3 specific place in the file system in which
4 that is stored, no.
5 Q. And you don't know whether Mozilla
6 Firefox would store browser cache data
7 within a directory associated with Mozilla
8 Firefox?
9 MR. WOLFE: Objection.
10 Foundation.
11 THE WITNESS: I would expect
12 Firefox to store different aspects of a
13 browser cache in standard places as it is
14 configured relative to its installation.
15 But I don't know -- I don't know the
16 specifics of how that file structure is
17 set up.
18 BY MR. PAPPAS:
19 Q. What aspects of a browser cache
20 would you expect to be stored in standard
21 places?
22 A. Some of the things that -- so

1 cookies that persist over long periods of
2 time, temporary Internet files, I believe
3 history cache is in the file -- yeah, that
4 would be in the file system because we would
5 want that when the browser comes back.
6 That's not intended to be an exhaustive
7 list. It's a sampling of things.
8 Q. And those standard places you're
9 referring to, would be set by the
10 configuration of the installed browser
11 application?
12 A. Yes, I believe that -- where those
13 are installed are places that the browser
14 would expect to be able to access to put and
15 then subsequently access that information,
16 yes.
17 Q. So let's turn to paragraph 16 of
18 your declaration, paragraph 16.
19 A. Yep.
20 Q. And if you'd turn over to page 9,
21 here you mention cache cookies. Do you see
22 that?

1 A. I do that -- I do see that, yes.
2 Q. What are cache cookies?
3 A. Well, as I say here, it is a new
4 type of cookie which is a file. So reading
5 from the bottom of page 8, Such as MH being
6 written into the browser cache without
7 knowledge of the user.
8 Q. That would be different than a
9 standard cookie?
10 A. So again, when you say standard
11 cookie and I think I address this in here
12 that there's many phrases standard,
13 traditional, normal, whatever to refer to
14 cookies. So the cookies -- so this is
15 different than what I will call a standard
16 cookie or traditional cookie or normal
17 cookie. So, just that we have different
18 qualifiers on --
19 Q. Sure.
20 A. -- that I consider all the same.
21 Q. I'll clarify a little bit. So at
22 the beginning of paragraph 16, toward the

1 beginning.
2 A. Paragraph 16, yes.
3 Q. Yes, on page 8 now.
4 A. Yes.
5 Q. It says Felton and Snyder
6 introduced a new type of cookie. Do you see
7 that?
8 A. Yes.
9 Q. I'm asking what is the difference
10 between the cache cookie that you're
11 referencing and what was -- what you were
12 referring to that was before that?
13 A. So, what is that Felton and Snyder
14 here, this cache cookie, is -- that these
15 cache cookies are, I say here by forcing a
16 client to receive or to retrieve a specific
17 URL, the server can effectively write
18 entries into the client's cache, thus
19 storing the cookie. So, they're indicating
20 by, you know, having the client retrieve
21 this, and because there are temporary
22 Internet files, this is being -- this image

1 that was retrieved as part of loading the
2 page gets stored somewhere in the browser's
3 cache.
4 Q. So temporary Internet files would
5 be a piece of data that could be relied on
6 for a cache cookie?
7 A. So, yes a temporary Internet file
8 is a kind of cache cookie by this -- yes.
9 Q. Is there other data that a cache
10 cookie would rely on?
11 A. I don't know. Certainly here the
12 temporary Internet files would be one.
13 Q. And you say that cache cookies are
14 stored in the form of entries in the
15 client's web cache. Do you see that?
16 A. Cache cookies are stored in the
17 form of entries in the client's web cache,
18 yes. I see that.
19 Q. Is the web cache you're referring
20 to there the same as the browser cache we
21 have been discussing?
22 A. Yes, that web cache there would be

1 part of the browser cache.
2 Q. Let's go to paragraph 18. Here
3 you talk about Flash cookies; is that
4 correct?
5 A. I do. I reference a piece of
6 prior art, yes.
7 Q. And Flash cookies are different
8 from cache cookies?
9 A. Flash cookies are another type of
10 cookie separate from cache cookies, yes.
11 Q. Can you generally explain what a
12 Flash cookie is and how it operates?
13 A. So Flash is a technology that in
14 the 2000 time frame -- 2005 time frame, was
15 a wildly popular application that pretty
16 much every browser had loaded as an add-on.
17 Okay. Flash allowed software to be executed
18 within the user's browser, which allowed for
19 some very nice graphics and user
20 interaction, and things like that. Flash
21 also allowed files, okay, they called them
22 local shared objects, to be stored on the

1 client's device accessible to the browser,
2 okay, that when Flash software was running
3 in the -- in the browser would have
4 available to it, and when the Flash software
5 interacted and made requests to a back-end
6 server, that Flash information, these local
7 shared objects, that information would be
8 passed back to the server similar to what
9 standard cookies are done.
10 Q. You said in your testimony these
11 local shared objects were accessible to the
12 browser. Can you elaborate on what you mean
13 by that?
14 A. So wherever these local shared
15 objects were stored, they could be, as the
16 Flash software is running in the browser,
17 these local shared objects were accessible
18 in the same way that browser cookies or
19 temporary Internet files, or browser history
20 are accessible to the browser.
21 Q. So you said that there's Flash
22 software running in the browser; is that

1 correct?
2 A. Yes, the Flash software is running
3 in the browser.
4 Q. That Flash software is installed
5 as an application on the user's computer?
6 A. That Flash software is installed
7 as an add-on to the browser. So browsers at
8 that time allowed applications or add-ons to
9 be installed and Flash, as I said, was at
10 that point, in that 2005, 2010 time frame,
11 was probably the most popular application
12 because it allowed enhancements in terms of
13 the kind of interfaces and kind of websites
14 that could be built using it. So, to the
15 user, the user is not in accessing the
16 website is not even aware of that there's a
17 separate application. It is all the
18 browser.
19 Q. I'm going to hand you Exhibit 1014
20 in this proceeding. Do you recognize this
21 document?
22 A. Yes, I do.

1 Q. At the bottom of the introduction
2 on page 1, there's sentence that says
3 According to macro media, 9 8 percent of
4 computer have some version of Flash on their
5 computers. Do you see that?
6 A. I do see that, yes.
7 Q. Is Flash its own application
8 program?
9 A. I know that it can and was
10 installed as an add-on specifically to a
11 browser. Whether it has -- and I think it
12 has its own application, but I'm less
13 certain. It could have a separate
14 application, but I'm less certain of that.
15 Q. If it were installed as an add-on
16 to the browser, would that still install the
17 Flash application on the user's computer?
18 A. Yes, because there would need to
19 be a lot of software, and again, how the
20 file system is set up for storing things as
21 well.
22 Q. So in that example, on Windows,

1 let's take as an example, would there be a
2 directory within the program files of the
3 user's computer?
4 A. Yes, I would expect that somewhere
5 there is indeed in the same way that the
6 browser has standard places it expects to
7 put different kinds of information, so would
8 a Flash add-on here.
9 Q. So, just to be clear here, the
10 Flash software is not part of the browser's
11 software itself, right?
12 A. So, the, and as I believe as part
13 of the running software your could say it
14 perhaps is not, it is not out of the box.
15 As it comes, it may not have been there, but
16 as I said, 98 percent of the computers had
17 it there because people were running it.
18 So, for practical purposes, it is part of
19 the browser in this -- in that particular
20 time frame. If we are talking about today
21 and you asked me in 2025, is Flash
22 application part of the browser, I would say

1 not.
2 Q. Why would you say not today?
3 A. Because at later times, not in the
4 time frame that we're talking -- in the
5 two-thousand-teens, for various reasons
6 there were concerns with Flash, and Flash
7 grew out of practice of being widely used.
8 But again, in the time frame that we're
9 talking about here in the 2000s, Flash was
10 wildly popular.
11 Q. And you say for practical purposes
12 it's part of the browser, but from a
13 technical level is Flash its own
14 application, aside from the browser
15 application?
16 A. Once Flash is installed as an
17 add-on, it is part of the browser.
18 Q. Is the Flash application code
19 executed inside the browser application
20 code?
21 A. Yes, the Flash application code is
22 executed, as part of the -- along with the

1 browser native code.
2 Q. So is it your opinion that the
3 browser native code then is modified when
4 Flash application is installed?
5 A. When the Flash application is
6 installed, the software of the browser is
7 enhanced.
8 Q. When you say enhanced?
9 A. It's extended.
10 Q. I'm asking from a technical
11 standpoint, is the browser code modified to
12 include and execute the Flash application
13 code?
14 A. The browser, the native browser
15 code is written to allow add-ons such as
16 Flash to be installed and executed. Flash
17 is not the -- Flash was the most popular,
18 but Flash is not the only add-on that would
19 have been available at that time.
20 Q. So the native browser code is not
21 actually modified when the Flash application
22 is installed. Correct?

1 A. I don't believe that -- no, that
2 the browser code would have been modified.
3 Q. Do you know how the Flash
4 application software and the browser
5 application software communicate?
6 A. So, once the Flash application is
7 installed, if the browser code encounters
8 Flash software that needs to be executed,
9 then it calls within the browser the
10 Flash -- the Flash software that has been
11 installed.
12 Q. And how does the Flash software
13 communicate information to the browser
14 application, if at all?
15 A. There would be a mechanism set up
16 so that the two can communicate, but I don't
17 know the specifics of it. Obviously,
18 there's a way for the browser to invoke the
19 Flash execution and there would be a way for
20 the Flash execution to return back to the
21 browser doing other stuff.
22 Q. Would they communicate via an API,

1 an application programming interface?
2 MR. PAPPAS: Counsel, just to
3 let you know --
4 A. Again, I don't know the specifics,
5 and API may -- that's a reasonable --
6 reasonable guess, but I don't know. I don't
7 know the specifics of how that mechanism
8 works.
9 BY MR. PAPPAS:
10 Q. So you don't know specifically how
11 the Flash application and the browser
12 application communicate with each other?
13 A. I know that the two of them are
14 running in the same browser process. The
15 specifics of how they're communicating, I
16 don't know.
17 MS. NALL: We've been going for
18 more than an hour. I think it's a good
19 time to take a break.
20 MR. PAPPAS: There's a couple
21 more questions, if that's okay.
22 MS. NALL: Dr. Wills, do you

1 need a break?
2 THE WITNESS: I could -- a
3 couple more I can take.
4 BY MR. PAPPAS:
5 Q. Just to round that out, you said
6 they are running, the two of them are
7 running in the same browser process. Would
8 there be a separate process for the Flash
9 application when it's executing on the
10 user's computer?
11 A. If there was a Flash application
12 that was executing independent of the
13 browser, then I guess that would be
14 completely independent, and that would be a
15 separate process.
16 Q. If it's not independent of the
17 browser, do you know whether there would be
18 a separate process for Flash running on the
19 user's computer?
20 A. Can you restate that one? Sorry.
21 Q. Sure. So, on the user's computer,
22 there would be a number of processes that

1 would be executed at a particular time,
2 right?
3 A. Okay. There would be a number of
4 processes that would be executing.
5 Q. If the Flash application were
6 running in a browser, would there be a
7 process associated with Flash?
8 A. I don't believe that there would
9 be, that Flash would be running as part of
10 that -- as part of the browser.
11 Q. In your opinion, there would be no
12 separate process for the Flash application
13 that would be executing on the user's
14 computer aside from the browser application
15 process?
16 A. When we have a Flash application
17 as part of the browser, it would all be in
18 one process.
19 MR. PAPPAS: Okay. I'm happy to
20 take a break now. How long do you think
21 you need, ten minutes?
22 THE WITNESS: Sure.

1 - - -
2 (Recess.)
3 - - -
4 BY MR. PAPPAS:
5 Q. Welcome back, Dr. Wills. During
6 the break did you discuss any of the
7 substance of your testimony with counsel?
8 A. I did not.
9 Q. So, I just wanted to go back
10 something we were talking about earlier just
11 to clarify. We were talking about browsers
12 storing different aspects of a browser cache
13 in standard places on the user's computer.
14 Do you recall that?
15 A. I do recall it, yes.
16 Q. When we were talking about
17 standard places, we are talking about
18 locations on the file system. Is that
19 right?
20 A. So certainly when browser cache
21 information is stored in the file system,
22 there is typically configured places where

1 those files are stored, yes.
2 Q. And the configured places you're
3 talking about, that essentially is referring
4 to logical memory, not the physical bits on
5 disk?
6 A. Can you ask your question again?
7 Q. I guess I'm trying to clarify,
8 we're talking about, for instance,
9 directories and folders on the file system
10 and not necessarily the physical structure
11 of the memory underlying that. Is that
12 fair?
13 A. We're talking, we are talking
14 about files in the file system, yes. I will
15 agree there.
16 Q. Okay. Let's stick with Exhibit
17 1014 that you have in front of you. So in
18 the middle of page one, do you see where it
19 says Flash cookies provide the only method
20 by which a Flash movie can store information
21 on a user's computer?
22 A. Yes, I do see that.

1 Q. Can you explain that a bit?
2 A. Well, reading it as-is, it says if
3 we have a Flash movie, the way it is stored
4 on a user's computer is as a Flash cookie.
5 And by the way let me make clear, a Flash
6 cookie and local stored objects or local
7 shared objects are indeed the same.
8 Q. So, when Flash is running inside a
9 browser application, is a Flash movie being
10 executed?
11 A. If a -- if the Flash software
12 is -- not necessarily. I mean one of the
13 things that can be done with Flash is to
14 play a movie.
15 Q. And the movie refers to an SWF
16 file; is that correct?
17 A. Where are you getting the SWF
18 file?
19 Q. How would a Flash movie be stored?
20 A. How would a Flash movie be stored.
21 In some -- in some format that Flash
22 defines. I don't know the specifics.

1 Q. In Exhibit 1014, is this saying
2 that the Flash movie when executed is what
3 stores the information on the user's
4 computer?
5 A. The Flash movie is being shown.
6 The Flash movie is not being executed.
7 Maybe I misheard your question.
8 Q. So I guess my question then is
9 what is the relevance of the Flash movie in
10 this article?
11 A. A Flash movie is a kind of Flash
12 data, and it also indicates that Flash data
13 or Flash cookie can store it looking at the
14 next sentence, a user's name, favorite
15 color, progress in a game, things like that.
16 So a Flash movie is just -- it's just data.
17 It could be larger amount of data than the
18 user's name, but it is data that is stored
19 in one of these LSOs.
20 Q. So is the Flash movie then the
21 cookie that is -- the Flash cookie that is
22 being stored?

A. Right. Here it is showing -- it is saying the Flash movie is a way of storing -- Flash cookie is a way of storing Flash movie content. A Flash cookie stores content, it stores data.

Q. Are you saying that the Flash movie is storing the Flash cookie data?

A. No, I'm saying the Flash movie is Flash cookie data.

Q. So as part of the Flash cookie data, that can include Flash movies within it?

A. One of the type of Flash cookie data is a Flash movie in the same way it could be a user's name.

Q. And when the Flash software is running within a browser, is it the Flash software that saves the Flash cookie data?

A. Yes, it would be that Flash software within the browser that is either reading or writing data in one of these Flash cookies.

1 Q. So the Flash player software would
2 write the data to the location where the
3 Flash cookie is stored?
4 A. If it wanted to update or create
5 such data, yes, it would be that software
6 doing it.
7 Q. So it's not the browser
8 application software itself that would be
9 writing the Flash cookie data, it would be
10 the Flash software running within the
11 browser. Is that fair?
12 A. It is the software that is running
13 in the browser process that is writing that
14 data.
15 Q. That software that you're
16 referring to is the Flash software, correct?
17 A. Yes, the Flash software.
18 Q. And then if you go to page 2 of
19 Exhibit 1014 there's a section called Where
20 are Flash Cookies Stored? Do you see that?
21 A. I do see that.
22 Q. And where are they stored?

1 A. It says, it gives three bullets on
2 where Windows, where Macintosh OSX, and
3 where GNU Linux stores things, which
4 apparently it looks like in the file system
5 in all three cases.
6 Q. And those file system locations
7 are directories that are configured as part
8 of the Flash player software?
9 A. Right. So what my expectation
10 when the Flash software is added to the
11 browser, these are probably standard places
12 that that software would go to look for, for
13 either reading or writing these Flash
14 cookies.
15 Q. So, in practice, a Flash cookie
16 might be retrieved when a user visits a web
17 page, right?
18 A. Yes, the browser would retrieve in
19 the same way it -- the browser is going to
20 retrieve normal cookies, it's going to
21 retrieve Flash cookies if there is Flash
22 software that's being executed in the

1 browser.
2 Q. And so in that case the Flash
3 software would retrieve the Flash cookie
4 from its storage location and transmit that
5 to the server; is that right?
6 A. That would be -- yes, when -- if
7 the Flash software goes ahead and on the
8 browser or in the client device communicates
9 with the server, it would send along
10 appropriate Flash cookies.
11 Q. Do you know whether there are any
12 restrictions on what applications can access
13 local shared objects?
14 A. What do you mean by what
15 applications?
16 Q. So, for instance, if the web
17 browser was not running Flash software as
18 part of its process, could the web browser
19 itself access the data in local shared
20 objects?
21 A. So -- sorry. Can you repeat?
22 Q. Sure. For instance, if the web

1 browser was not running Flash software,
2 could the web browser itself access the data
3 in a local shared object?
4 A. So, if the web browser was
5 displaying a page that had nothing to do
6 with Flash, okay, the Flash add-on has been
7 added to the browser, but there are many
8 pages that the browser would access that
9 it's not -- that had nothing to do with
10 Flash. The browser would have file system
11 permissions to access these files, okay, but
12 that -- the browser may not be aware that
13 the, you know, the Flash portion of the
14 browser is the one that knows exactly where
15 these files are stored.
16 Q. Do you know that the browser has
17 file system permissions to access the data
18 within the Flash directory?
19 A. It has to because when the browser
20 then goes and is executing within -- the
21 browser process is executing the Flash code,
22 that Flash code has permissions and file

1 system permissions are granted on a process
2 basis.
3 Q. So it's your opinion those file
4 system permissions exist even if the Flash
5 code is not executing?
6 A. Yes, all files have permission.
7 So when these were -- when these are
8 created, a browser -- by "these" I mean when
9 these directory folders are created as shown
10 here in the exhibit, the browser software
11 would need to have access to these.
12 Q. A user can't clear Flash cookies
13 through the browser application; is that
14 right?
15 A. Flash cookies cannot be cleared
16 through the regular browser cookie
17 interface.
18 COURT REPORTER: I'm sorry. I'm
19 sorry Could you start over again?
20 A. Flash cookies cannot be cleared --
21 apologies.
22 Q. No problem.

1 COURT REPORTER: I'm sorry,
2 Counsel. I just lost that one. Cannot be
3 cleared --
4 A. Cannot be cleared through the same
5 mechanism that the browser clears
6 traditional cookies. That's not exactly
7 what you were asking. I believe, and this
8 is from memory, I believe that there is a
9 separate mechanism outside the browser for
10 clearing Flash cookies, but I don't --
11 that's from memory and I don't think that's
12 explicitly addressed in here.
13 Q. When you say separate mechanism,
14 that would be through a different
15 application?
16 A. I believe through a separate
17 application, yes.
18 Q. When a user clears cookies in a
19 browser, that would clear the cookies in the
20 browser cache; is that right?
21 A. That would -- yes. The cookies
22 that are cleared from within the browser,

1 whether that's all cookies or some cookies,
2 would come from the browser cache, yes.
3 Q. Let's turn to the patent for a
4 moment. I'm handling you Exhibit 1001, the
5 823 patent. I'm sure you're very excited at
6 this point.
7 Let's turn to paragraph 57 of your
8 declaration.
9 A. My declaration you want me to go
10 to --
11 Q. Paragraph 57, please.
12 A. Yes, I am at paragraph 57.
13 Q. This is mostly to orient you.
14 This is where you begin discussing the 823
15 patent, correct?
16 A. That is overview of the 823
17 patent, yes.
18 Q. I know, very tough question. If
19 you turn to paragraph 61.
20 A. Sixty-one. Okay.
21 Q. Here you say 823 Patent discloses
22 these two types of cache cookies stored in

1 different areas of the browser storage area.
2 Do you see that?
3 A. Paragraph 60?
4 Q. 61.
5 A. Sixty-one, okay. Yes, I do see
6 that.
7 Q. One of the cache cookies relates
8 to the user's browsing history; is that
9 right?
10 A. Yes. It's Figure 2 from 823.
11 Yes, one is a history cache, and one is
12 temporary Internet file. Yes.
13 Q. So you just answered the next
14 question, which is the other one relates to
15 temporary Internet files, right?
16 A. Sorry. Sorry.
17 Q. You don't have to be sorry. Just
18 putting it clear for the record. Those
19 cookies then would be stored in the browser
20 cache; is that right?
21 A. Well, as shown in the 823, they
22 are stored in the browser storage area,

1 although I believe the 823 says browser
2 cache is essentially the same as a browser
3 storage area.
4 Q. And the browser cache would
5 correspond to some designated storage
6 locations on the user's file system; is that
7 right?
8 A. Well, it would be a designated
9 location where it is stored in likely the
10 file system, but not solely the file system.
11 Q. When you say not solely the file
12 system, what do you mean by that?
13 A. Well, a portion of what the
14 browser stores, it also stores some cache
15 data in memory, in RAM.
16 Q. So that the portion that is stored
17 on disk and not in memory, that would be
18 stored in some designated storage area for
19 use by the browser on the user's file
20 system?
21 A. I think, and I don't -- I know I
22 quote this in my report somewhere and it's

1 somewhere in the 823. I think the key thing
2 for the browser storage area is one, it
3 doesn't need to be an explicit feature of
4 the browser, and it needs to be stored
5 somewhere that it can be provided to -- the
6 data can be provided to the server. I think
7 that that is my recollection of how the 823
8 defines a browser storage area.
9 Q. But when the browser application
10 is installed, there at least is a configured
11 location for the browser's cache associated
12 with that browser, right?
13 A. Correct. There would be a
14 configured or -- a place that the browser
15 expects to and does find that information.
16 Q. Can you turn in the 823 patent to
17 Claim One, which is all the way in column
18 15, starting at line 33. Do you see the
19 first element that begins with receive a
20 network resource request from a client
21 device? It starts at column 15, line 35,
22 and goes to line 54.

1 A. I do see that rather long claim
2 element, yes.
3 Q. All right. We're making progress.
4 I just want to clarify a few aspects of your
5 interpretation of this claim element. So
6 the claim first says -- this element first
7 says Receive a network resource request from
8 a client device, correct?
9 A. It does.
10 Q. And then it says wherein the
11 network resource request corresponds to a
12 first cookie of a first type that was caused
13 to be stored to the client device during a
14 first previous network session. Do you see
15 that?
16 A. I do.
17 Q. Does that mean that the first
18 cookie must have been stored during a
19 previous network session that occurred
20 before the network request is received?
21 A. Yes, that is my understanding,
22 that we're going backwards in time here.

1 Q. And then later within that same
2 long element, the claim says Wherein a
3 second cookie of a second type, different
4 from the first type, was caused to be stored
5 at the client device during a second
6 previous network session. Do you see that?
7 A. I know it's in here. I'm just
8 trying to find it.
9 Q. Begins at line 47, I believe.
10 A. Thank you. Thank you. That is
11 helpful. There you go. Yes, I do see that.
12 Q. So similarly, does that mean that
13 the second cookie must have also been stored
14 during a previous network session that
15 occurred before the claimed network resource
16 request is received?
17 A. It does, that is my understanding,
18 yes.
19 Q. Then at the bottom of that long
20 element, the claim recites a browser storage
21 area. Do you see that?
22 A. Line 53 here...

1 Q. Yes, I believe line 51 and 53 you
2 recite the term.
3 A. Okay. The first client device
4 browser storage area and a second client
5 device browser storage area, yes, I do see
6 those.
7 Q. So we've been talking a little bit
8 about this before. Is it your opinion that
9 any storage area on the client device that
10 is accessible to the browser application
11 would be a browser storage area?
12 A. Well, I think in terms of -- in
13 light of the 823 patent, the 823 patent also
14 indicates not only is it accessible to the
15 browser, but it is data that is communicated
16 and can be communicated the server.
17 Q. To any server?
18 A. To the web server.
19 Q. Do you see the term as more
20 limiting than that definition in any way?
21 A. I don't follow your question.
22 Q. So, I'm trying to sort of put the

1 bounds around a browser storage area and
2 what might be considered not to be a browser
3 storage area to orient you. So let's take a
4 simple example of a browser based email
5 application. So are you familiar with
6 Gmail?
7 A. Sure.
8 Q. And you can choose any example
9 that you would like in your head for these
10 questions. So in a browser based email
11 application, a user can download attachments
12 from an email, right?
13 A. Sure. Yes.
14 Q. And those attachments could be
15 saved to essentially any location on the
16 user's computer, right?
17 A. I believe applications, yes. They
18 say where do you want to put this.
19 Q. And then in another email a user
20 could upload that same document it
21 downloaded as an attachment to a new email,
22 right?

1 A. Yes. Typically, by explicitly
2 indicating where in the file system that
3 that document resides.
4 Q. So in that case to save or
5 retrieve the document from that file
6 location, the browser would presumably
7 access that file location, correct?
8 A. It could access that file
9 location, because, yes, it is being told by
10 the user that's where to put it or that's
11 where to get it.
12 Q. So, for example, the file location
13 could be the "My Documents" folder on
14 Windows. Is that a fair example?
15 A. Sure, that seems to be a fair
16 example.
17 Q. So in that case that a user
18 downloads an attachment to the My Documents
19 folder, do you consider that My Documents
20 folder a browser storage area?
21 A. It doesn't seem that it is in the
22 same way because again, based upon the 823

1 patent, 823 patent indicates that what is in
2 a browser storage area on the client is
3 shared with the server and available to the
4 server. So in this case the fact that I'm
5 attaching a file from somewhere in the file
6 system to pass along, that's part of the
7 Gmail web application.
8 Q. When you attach that file to an
9 email, does it not upload that attachment to
10 a Gmail associated server?
11 A. It does. It does upload it to the
12 Gmail server.
13 Q. So -- I think in view of your
14 previous answer would you agree that the
15 term browser storage area is at least more
16 limiting than a storage location that is
17 merely accessible to a browser application?
18 A. Well, a browser, the browser
19 storage area certainly needs to be
20 accessible to the browser, and I believe
21 needs to be shared with the server without
22 any explicit user intervention, which -- so

1 I will say user intervention in your Gmail
2 of adding an attachment is a user
3 intervention.
4 Q. So then to be clear, your
5 understanding of the term browser storage
6 area would be a storage area accessible to
7 the browser that is also shared with a
8 server without any explicit user
9 intervention?
10 A. My interpretation is what is in
11 the 823 patent. If you want, I can go look
12 for it. I don't know the specific phrase
13 that is there, but I do know it's in my
14 report here and in the 823 patent.
15 Q. Sure. You're happy to look. My
16 question is really getting at what are the
17 bounds around the term browser storage area
18 and what are the requirements of it. So, if
19 you would like to go look, you are more than
20 welcome to.
21 A. So in the 823 patent, column 5 --
22 where am I -- about line 13 as described in

1 more detail below the cache cookie is not an
2 explicit browser feature, but rather a form
3 of persistent state in the browser that the
4 server can access. So that is a -- what a
5 browser storage area should be. So there
6 needs to be persistent state, okay. It
7 doesn't need to be an explicit browser
8 feature that the server can access. So,
9 that is what I am -- when I see browser
10 storage area, that is what I'm looking at as
11 described by the 823 patent.
12 Q. Just to be clear, you're pointing
13 to column 5, starting at line 13; is that
14 right, of the 823 patent?
15 A. Yes. I believe that that column
16 is 13 there, right there.
17 Q. And you say there needs to be a
18 persistent state. Is that persistent state
19 referring to the cache cookie or the browser
20 storage area?
21 A. Well, that is -- so, a cache
22 cookie is an example of something that is in

1 a browser storage area, so a browser storage
2 area has a persistent state.
3 Q. I think I'm just a little
4 confused. You said a cache cookie is an
5 example of something that is in a browser
6 storage area, but the cache cookie is not
7 the browser storage area itself, right?
8 A. No, but it is representative of --
9 a cache cookie is representative of what is
10 stored in a browser storage area.
11 Q. So again, it's the cache cookie
12 that has to have -- be a persistent state,
13 according to your testimony; is that right?
14 A. Yes. And given that it is an
15 example, of something that is stored in a
16 browser storage area, I am using what is
17 here in terms of what the 823 intends as a
18 browser storage area, how it specifies.
19 Q. And looking at that sentence that
20 you are pointing to, it says the cache
21 cookie is not an explicit browser feature,
22 correct?

1 A. Correct, it does say that.
2 Q. But it doesn't say the browser
3 storage area is not an explicit browser
4 feature, does it?
5 A. Correct. So my interpretation is
6 that something in the browser storage area
7 does not need to be an explicit browser
8 feature. So if you want to go back to Flash
9 cookies and say, Oh Flash cookies are an
10 add-on, well, okay, it says right here that
11 we don't need to have an explicit browser
12 feature.
13 Q. But just to be clear, that
14 sentence about not needing to be an explicit
15 browser feature relates to the cache cookie
16 not being an explicit browser feature,
17 right?
18 A. But again, in this sentence is
19 giving an indication of what -- something,
20 the qualities of something in a browser
21 storage area. So if a cache cookie in a
22 browser storage area has these qualities,

1 then I would expect that other information
2 in the browser storage area has the same
3 qualities and characteristics.
4 Q. So, if I can try to roll some of
5 that up, is it your opinion that a browser
6 storage area would be a storage area
7 accessible by a browser that includes data
8 representing persistent state?
9 A. Yes, that is -- that is, I think,
10 consistent with what is said here, yes.
11 That that persistent state is being retained
12 in some way by the browser and that
13 persistent state is then accessible by in
14 this case the -- that the server can access.
15 Q. Are there browser storage areas
16 that would not include data representing
17 persistent state?
18 A. There are storage areas that I
19 would say would be less persistent and more
20 persistent, but there's some degree of
21 persistence in browser storage areas.
22 Q. Does everything that a browser

1 stores on the user's device relate to
2 persistent state?
3 A. I don't know everything that a
4 browser maintains, but again, by this kind
5 of -- as specified here, it needs to be
6 state that the server can access. So if
7 there's something that a browser is storing
8 that is not shared or not accessible by the
9 server, then by the definition here then
10 that would not be a browser storage area.
11 Q. Does the browser storage area need
12 to be managed in some way by the browser
13 application?
14 A. What do you mean managed?
15 Q. How would you understand the term
16 managed?
17 A. I don't know. Can you -- are you
18 asking can I modify it? Can I change it?
19 Can I add to it? Can I remove it? I am
20 not -- I mean manage, the word manage can
21 entail a whole -- a number of things and so
22 I'm not quite sure what you're asking when

1 you say manage.
2 Q. I'm still trying to get at what
3 are the limitations off a browser storage
4 area. And so I'll step back from that for a
5 minute. It sounds like a browser storage
6 area needs to be accessible by the browser
7 application and needs to store a particular
8 type of data. Is that what you are saying?
9 A. Well, there needs to be -- it
10 needs to store data with some persistence,
11 and it needs to be able to share or share
12 that with the server that the server can
13 access that data.
14 Q. And when you say with some
15 persistence, does that simply mean that the
16 data would persist when the browser
17 application is closed, for example?
18 A. Well, there's different kinds of
19 persistence that that we can define. So,
20 storing stuff in the file system is always
21 attractive to a browser or other things
22 because when the browser process goes away

1 or the -- the machine on which the browser
2 is running is shut down, anything stored on
3 the file system persists, and when we
4 return, when the machine comes back up, when
5 the browser reboots or when the browser gets
6 started up again, what is stored there in
7 the file system can be accessed again,
8 assuming that the user hasn't separately
9 done something that -- to somehow remove
10 that.
11 We also have "shorter term
12 persistence" so if we store stuff in the
13 computer's memory, okay, then that is -- in
14 RAM, then there is some persistence there
15 for that data, but when the browser goes
16 away or the machine shuts down, anything
17 stored in RAM, in memory, that data, that
18 data, is lost. So then that is a -- so it
19 is attractive to store things in memory
20 because it is faster to access than storing
21 things out on disk, but the downside is that
22 that -- what is stored in memory does not

1 persist forever.
2 Q. So could data stored in memory
3 then still be considered a browser storage
4 area --
5 MR. WOLFE: Objection. Vague.
6 MR. PAPPAS: -- the location of
7 the data stored in memory.
8 THE WITNESS: So, storing --
9 storing data in memory, could certainly be
10 a browser storage area, and there are
11 types of cookies that are only stored in
12 memory and not stored in disks.
13 BY MR. PAPPAS:
14 Q. So then it sounds like the only
15 restriction aside from the storage area
16 being accessible at the browser is that a
17 server would have access to the data in the
18 storage location without user intervention.
19 Is that fair?
20 A. That the browser, yes, shares or
21 makes available that data with again some
22 amount of persistence to the server.

1 Q. So, what makes it a browser
2 storage area is that there's not user
3 intervention to make that data available to
4 the server?
5 MR. WOLFE: Objection. Vague.
6 THE WITNESS: Sorry, ask your
7 question again.
8 BY MR. PAPPAS:
9 Q. Is it what makes a storage area a
10 browser storage area that user intervention
11 is not required to make the data in that
12 storage area available to the server?
13 MR. WOLFE: Objection. Form.
14 THE WITNESS: I cannot
15 immediately recall a kind of data that
16 would require user intervention. I guess
17 when I think of -- when I think of
18 different kinds of cookies, that they --
19 they happen without intervention, but I
20 would have to go and look at all types of
21 cookies and browser storage areas to say
22 with a hundred percent certainty.

BY MR. PAPPAS:

Q. If a browser application stores data as part of its operation, does it matter what that data is to make the storage location a browser storage area?

A. Well, I could certainly -- I could certainly believe and would expect that a browser would store data, even store data with some persistence out on, but that data is never accessible to the web server that the browser is communicating with.

Q. And so in that case you would not consider that a browser storage area?

A. Again, by the -- as laid out in the 823 patent that is if the data never can be accessed by the web server, then we do not have an example of a browser storage area.

Q. So in the context of the 823 patent, if the storage area is not accessed by a web server, then you would not consider it a browser storage area, correct?

1 A. A browser storage area as defined
2 by 823, the data contained in there needs to
3 be accessible by the web server.
4 Q. What parts of the 823 patent are
5 you relying on for that definition?
6 A. I'm looking at here how -- what
7 the characteristics of a cache cookie where
8 a cache cookie is something that is stored
9 in a browser storage area. With those
10 characteristics I would expect anything
11 stored in a browser storage area have those
12 characteristics.
13 Q. So your definition is based upon
14 the examples of data from the 823 patent
15 that are stored in the storage locations?
16 A. Certainly in trying to understand
17 the claims of the 823, I'm using the
18 specification as guidance.
19 Q. Would all local storage on the
20 client's device be accessible by a server?
21 MR. WOLFE: Objection. Vague.
22 THE WITNESS: Do you mean all --

1 everything on the file system? What do
2 you mean by local storage?
3 BY MR. PAPPAS:
4 Q. Well, we'll say everything on the
5 file system.
6 A. I would expect not because
7 everything on the file system -- one,
8 everything on the file system may not be
9 accessible to the browser. There may be
10 files that are owned by other users on this
11 same computer. There may be stuff that --
12 there may be data that the browser has
13 access to and can read and write, but it
14 doesn't -- it's not accessible to the web
15 server.
16 Q. What are examples of storage
17 locations that you would not consider a
18 browser storage location?
19 A. Anything where the data stored
20 there is not accessible by the web server.
21 Q. When you say the web server, that
22 would be the server associated with the

website that the user is browsing?

A. Yes. As first server, second server, in the -- in Figure 1A of the 823 patent.

Q. How does the web server get access to the client browser storage area?

A. Software in the browser as part of a request to the web server passes that information along or that's one way it does, I guess in the cache cookies, the -- basically, the browser sends, in some way it sends that information to the server.

Q. Are there restrictions on what locations the browser can send to the server?

A. It is what data that the software the browser is written to send to the server.

Q. And so then it's the browser application would define the storage areas that the web server could access?

A. I think it is known or understood

1 the kind of areas such as cookies, such as
2 temporary Internet files, such as history
3 that is generally available that browsers
4 make available, whether dealing with Chrome
5 or Firefox or whatever.
6 Q. So still in that case it's the
7 browser application that would define and
8 send the storage areas to the web server to
9 make them accessible to the web server,
10 correct?
11 A. Right. I guess what I would say
12 there are kind of standards or expectations
13 of what browsers are expected to send to the
14 web server.
15 Q. But those expectations don't
16 necessarily need to be cookies, correct?
17 A. Well, in -- do you mean
18 traditional cookies?
19 Q. Sure.
20 A. It doesn't need to just be
21 traditional cookies.
22 Q. You can have an add-on to a

1 browser that might have a storage location
2 for data unrelated to cookies. Is that
3 fair?
4 A. Unrelated to traditional cookies?
5 Q. Unrelated to any form of cookie.
6 A. You can have -- it could be
7 sending other types of cookies. We have
8 Flash cookies being sent.
9 Q. Could they be sending other types
10 of data aside from cookies?
11 A. They're sending out these local
12 shared objects which have come to be known
13 as Flash cookies in the same way that what
14 the 823 describes is a kind of -- what is
15 characterized as the phrase cache cookies
16 even though they're not cookies in the same
17 way that traditional cookies are.
18 Q. Could there be an add-on aside
19 from Flash where other types of data are
20 accessed and sent to the web server?
21 A. I'm not sure I immediately know of
22 any, but I believe yes, there could be other

1 add-ons that are added to the features of
2 the browser that do so.
3 Q. And if that were the case, then
4 the storage area storing that data would
5 still be a browser storage area, correct?
6 Q. If that was the case, then that
7 seems like that would be another type of
8 cookie.
9 Q. It would have to be considered a
10 cookie to meet the browser storage area
11 limitation?
12 A. If we had such a thing it would
13 probably be given reference to, but it would
14 not have to be explicitly called a cookie.
15 It just seems that the different types of
16 data that are accessible by server have been
17 coined -- to coin the phrase of different
18 kinds of cookies, but it could be that
19 there's data that are shared and they're
20 not, quote, explicitly called cookies.
21 Q. What about something like a
22 locally stored configuration file? Would

1 you consider that to be a cookie?
2 A. You mean a locally stored
3 configuration file on --
4 Q. The user's computer.
5 A. -- the user's computer?
6 I don't know that that would be
7 accessible to the server. I don't know of
8 any browser software that would share that
9 or send that to a computer, or to the
10 server.
11 Q. If it were sent to the web server,
12 would that make it storage area, browser
13 storage area?
14 MR. WOLFE: Objection. Form.
15 THE WITNESS: I don't know. You
16 seem to be getting into the well, we're
17 going to have a different kind of software
18 that gets added on, and I'm not really
19 sure what that software is doing or not
20 doing, so it's kind of hard for me to
21 really speculate or even answer your
22 question here because now we're getting

1 into something that doesn't exist, and I
2 don't know what those characteristics of
3 that something are or aren't.
4 BY MR. PAPPAS:
5 Q. So whether it's considered a
6 browser storage area then depends on the
7 type of data and whether that data is
8 transmitted from the user's client base to a
9 web server, correct?
10 A. It needs to be accessible to the
11 server. It needs to have persistence. It
12 needs to be available to the browser.
13 Q. When you say it needs that
14 persistence, the data inside the storage
15 area needs to have persistence; is that
16 right?
17 A. Yes. That is what the 823
18 indicates is important.
19 Q. Or do you mean that when it needs
20 to have persistence that the storage
21 location itself needs to allow the data to
22 persist?

1 A. Persist for how long? What do you
2 mean by persist? What is your -- persist
3 forever, persist for a period of time?
4 I'm -- I'm asking you to clarify your
5 question.
6 Q. Well, that's what I'm trying to
7 get at when you say it needs persistence,
8 I'm trying clarify does that relate to the
9 storage area and how it allows the data to
10 persist for a certain amount of time?
11 A. So where data are stored on a
12 user's computer factors into the duration of
13 the persistence of that data. So if I
14 store -- if the browser stores something in
15 memory, in RAM, okay, then the duration of
16 that data is only as long as that browser
17 process is running. And once the browser
18 process stops running, that data is gone.
19 So it persists for the duration of the
20 browser session. If I store -- if we have
21 browser storage area that is stored on disk
22 or longer term storage, then the expectation

1 is it continues to stay there unless
2 something like a user comes along or another
3 application comes along and removes that.
4 Or traditional cookies typically have -- can
5 have an expiration attached to them, and
6 they self destruct based upon that
7 expiration. That's just a feature of
8 traditional cookies.
9 Q. All those would be a type of
10 persistence, correct?
11 A. Yes. So that's why even storing
12 something on disk doesn't mean that it's
13 going to persist forever. It could get
14 removed explicitly. It could have an
15 expiration attached to it that says in 24
16 hours this goes away. And so even though
17 it's on disk, it doesn't stay there forever.
18 So that's why I say there is some amount of
19 persistence.
20 MR. WOLFE: We've been on the
21 record for a little over an hour now.
22 Just letting you know. When would you

1 like to break for lunch?
2 MR. PAPPAS: In the next five
3 minutes. Is that okay?
4 BY MR. PAPPAS:
5 Q. So is there any storage location
6 on the user's device that does not have some
7 form of persistence?
8 A. I think all storage areas,
9 irrespective of a browser, have some amount
10 of persistence. So memory has -- what is in
11 RAM has some amount of persistence. What is
12 on disk has typically some longer amount of
13 persistence.
14 MR. PAPPAS: We can take a
15 break.
16 MS. NALL: Want to have lunch?
17 (Discussion off the record.)
18 LUNCH RECESS 12:15.
19 - - -
20 (At 11:39 a.m., a recess was
21 taken until 12:15 p.m., of the same
22 day.)

1 - - -
2 BY MR. PAPPAS:
3 Q. Welcome back, Dr. Wills.
4 A. Thank you.
5 Q. How was your lunch on record?
6 A. On the record it was good.
7 Q. That's great. During the break,
8 did you discuss the substance of your
9 testimony with counsel?
10 A. I did not.
11 Q. All right. So I promise we won't
12 spend too much time on this. But I want to
13 wrap up what we talked about before the
14 break.
15 So, I just want to reiterate the
16 boundaries of, in your opinion what defines
17 a browser storage area. And feel free to
18 correct me if I mischaracterize anything
19 that you've said.
20 So the first is that the browser
21 storage area must be accessible to the web
22 server with which the browser is

1 communicating; is that right?
2 A. Content in the browser storage
3 area needs to be accessible to the server,
4 yes.
5 Q. And by saying content is
6 accessible, the web server would be able to
7 access the storage area where that content
8 is stored, right?
9 A. Not directly, but it is given data
10 by the browser.
11 Q. Okay. So, the storage area
12 doesn't itself need to be accessible to the
13 web server, but it needs to -- the web
14 server needs to be able to access data
15 within that storage location?
16 A. The web server needs to be able
17 to -- it needs to access that data meaning
18 it is shared by the web browser in some way,
19 shared with the web -- with the server in
20 some way.
21 Q. Does all the data in that storage
22 location need to be shared with the web

1 server in some way?
2 A. It seems that it needs to be
3 potentially shareable. There could be data
4 that are in the browser storage area for
5 which the browser never goes back to that
6 website and so that data are never shared
7 with the web server again. But -- so...
8 Q. So to reiterate then, the storage
9 area needs to contain data that is shared
10 with and accessible by the web server with
11 which the browser is communicating. Is that
12 fair?
13 A. The browser storage area needs to
14 have -- the data in the browser storage area
15 needs to be able to be or needs to be able
16 to be shared with the appropriate web
17 server.
18 Q. And the browser would direct the
19 storage area that is shared with an
20 accessible by the web server?
21 A. What do you mean by direct?
22 Q. The browser would define it for

1 the web server?
2 A. Browser software or part of the
3 installation would define where that data is
4 stored on the client device.
5 Q. And the data stored in the browser
6 storage area has persistent state. Is that
7 fair?
8 A. The data has yes, persistent to
9 some degree state, yes.
10 Q. And then finally, the data in the
11 browser storage area can be shared with the
12 web server without the user's intervention.
13 Is that fair?
14 A. It is certainly that is a
15 byproduct of user interactions that data
16 from the browser storage area may be sent or
17 accessible by the web server.
18 Q. Is it required to be considered a
19 browser storage area that the data stored in
20 the browser storage area may be sent or
21 accessible to the web server without the
22 user's intervention?

A. Can you say that one again? Sorry.

Q. To be considered a browser storage area, is it a requirement in your opinion that the data stored in the storage area may be sent to the server without the user's intervention?

MR. WOLFE: Objection. Vague.

THE WITNESS: Their user has initiated -- the user would have had to initiate an interaction, a request to a server, okay. The user may not be explicitly involved in every or even aware of every network resource request that happens as a result of the initial user request.

BY MR. PAPPAS:

Q. But we talked about earlier the example of a mail program where a user would upload an attachment in an email which would then send that attachment to the server, right?

1 A. Yes, we did talk about that.
2 Q. And that's not enough for that
3 storage area to be considered a browser
4 storage area, right?
5 A. I'd have to think about that more,
6 but that does not strike me as a browser
7 storage area, no, where that -- an arbitrary
8 My Documents folder on my computer.
9 Q. So is what differentiates that
10 storage location from a browser storage
11 location that the data can be accessed by
12 the web sever without the user explicitly
13 directing that data?
14 A. Again, and I think I answered this
15 similarly before, it certainly seems that
16 when I immediately think of browser storage
17 areas, that happens without direct request
18 of the user, but I would have to -- I would
19 have to look at other -- if -- so in the
20 case you have, that doesn't seem like that
21 that is a browser storage area.
22 Q. Okay. But sitting here today,

1 then, is it fair to say you haven't formed
2 an opinion on whether that location would be
3 considered a browser storage area?
4 A. I think that's correct. That's
5 not something that I considered as part of
6 writing my report. It's not a scenario that
7 I explicitly considered.
8 Q. So the requirements we just talked
9 about then, are there any additional
10 requirements in your opinion that would make
11 a storage location be considered a browser
12 storage location?
13 Let me just rephrase the question
14 because I used location instead of area,
15 just to be clear. So, aside from the
16 requirements we just talked about, are there
17 any additional requirements in your opinion
18 to make a storage location be considered --
19 a storage area be considered a browser
20 storage area?
21 A. Well, so, there needs to be
22 persistent state out the browser, okay, and

1 there needs to be accessibility of that
2 state to the server, okay, via the browser.
3 Q. And that's what makes a storage
4 area a browser storage area, in your
5 opinion?
6 A. Yes, based upon what is my reading
7 of what is considered here for cache cookies
8 in the 823, which is consistent with what
9 happens with traditional cookies, that they
10 have persistent state, that they are
11 accessible to the server, so...
12 Q. Let's move away from that for a
13 few moments, and I want to hand you the
14 Hinton reference which is Exhibit 1005. I
15 want to just start talking, generally, about
16 Hinton. You reviewed Hinton as part of your
17 preparation for this deposition?
18 A. Certainly.
19 Q. Is it your opinion that Hinton
20 discloses use of two cookies a domain
21 identity cookie and an E-community cookie?
22 A. Hinton certainly has both of those

1 cookies for domains, yes.
2 Q. And you are relying on those two
3 cookies in your analysis in this proceeding?
4 A. Yes, those are the two cookies for
5 different domains that I'm relying upon.
6 Q. Can you turn to paragraph 132 of
7 Hinton, and just let me know when you've
8 read the paragraph.
9 A. I did review the paragraph. Thank
10 you. 132, correct?
11 Q. Okay. I'll read it -- part of it
12 into the record for clarity. The first
13 sentence says Only the one instance within a
14 DNS domain that authenticates the user or
15 first receives an authentication vouch for
16 message sets an E-community cookie at the
17 user's browser. Do you see that?
18 A. I do.
19 Q. Then it says, As such, a user has
20 one E-community cookie set for each domain
21 at which it has a current authenticated or
22 vouched for session. Did I read that

1 correctly?
2 A. I think so.
3 Q. So in this paragraph is Hinton
4 saying that by setting an E-community cookie
5 for a domain, the user has an active session
6 corresponding to that domain?
7 A. It has a current authenticated
8 session.
9 Q. Corresponding to the domain?
10 A. Corresponding to the domain, yes,
11 sir.
12 Q. And then the active -- sorry, I'll
13 use your words. The current authenticated
14 session provides the user access across that
15 domain; is that right?
16 A. Right. Once a user has
17 authenticated with that domain, it may go on
18 and perform other actions.
19 Q. And those other actions might be
20 communicating with another server in that
21 domain?
22 A. I can't immediately remember

1 whether that means communicating with a
2 single server in the domain or other servers
3 within the domain.
4 Q. Let's go to paragraph 232 of
5 Hinton.
6 A. 232. I got that on page 10.
7 Starts out, The E-community memory cookies?
8 Q. Yeah, that's right.
9 A. Okay.
10 Q. So it says, The community memory
11 cookies contain security relevant
12 information such that possession of an
13 E-community cookie may provide access to a
14 particular session. Do you see that?
15 A. I do.
16 Q. When a user has an E-community
17 cookie set for a domain, the E-community
18 cookie would provide the user access to the
19 current session so the user can access
20 resources within that domain; is that right?
21 A. It can make subsequent requests to
22 that domain. Yes.

1 Q. Okay. Let's turn to paragraph
2 134, and this is all related.
3 A. This is the Acme.com paragraph?
4 Q. That's correct. So, I'll give you
5 have a moment to read it, and then we can
6 talk about it.
7 A. (Reading). Okay. I have now had
8 a chance to look at it. Sorry.
9 Q. Not a problem at all. So, in
10 paragraph 134 there's an example provided
11 for the domain www.acme.com, right?
12 A. There is.
13 Q. And in the middle of this
14 paragraph Hinton says, The user has a
15 domain-wide E-community cookie set, right?
16 A. It does say that, yes.
17 Q. So then in this example, when the
18 user goes to the accounting server in that
19 domain, the E-community cookie would
20 indicate that the user has current
21 authenticated session and that the
22 accounting server does not need

1 reauthenticate the user. Is that what
2 Hinton is saying?
3 A. That is what Hinton says there.
4 Q. So, then because the user already
5 has an active session with the domain, the
6 user can use that session to access the
7 accounting server in this example?
8 A. That seems to be what it is
9 saying, yes.
10 Q. Okay. Thanks. I just wanted to
11 clarify that paragraph. You can put away
12 Hinton for the moment. And I want to
13 provide you, Varheese. I'm not sure how to
14 pronounce it. I was saying Var-gese [ph].
15 A. I don't know.
16 Q. We'll go with Var-gee-see [ph]
17 because it seems to be more -- I trust you
18 more than myself.
19 A. No, no. I have no idea. You have
20 can say that's on the record.
21 Q. I'm handing you Exhibit 1004 in
22 this proceeding, Varghese you can keep that

1 along with your declaration. But I wanted
2 to start at paragraph 166 of your
3 declaration.
4 A. 166?
5 Q. Yes. In this paragraph you're
6 discussing the Varghese reference, correct?
7 A. I am indeed.
8 Q. Is it your opinion that Varghese
9 describes using both secure cookies and
10 Flash cookies to identify user devices?
11 A. It is -- that is indeed my
12 opinion. They are both secure and Flash
13 cookies.
14 Q. In the middle of paragraph 166,
15 you say Varghese further discloses that
16 cookies are routinely replaced with each
17 login, i.e., new network session. Do you
18 see that?
19 A. I do.
20 Q. Can you explain what you mean by
21 that? And feel free to look at Varghese, if
22 it's helpful.

1 A. So Varghese has the notion of
2 being able to log in as I describe earlier
3 and given that we're asking about a network
4 session, we're now talking about network
5 session coming from the 823.
6 So, in paragraph 166, we're
7 talking about a second previous network
8 session. So there was a first network
9 previous session in which some -- a page was
10 requested, maybe a Flash object was
11 downloaded as well. And now, we're in a
12 situation here that the Flash software, as
13 indicated just above here, has run and Flash
14 cookies have been created and stored onto
15 the device.
16 At the end of the authentication,
17 which would have consisted of the first and
18 the second previous network sessions, okay,
19 it's simply saying in Varghese discloses
20 that at the end of that, the cookies are
21 replaced, they're updated, their values in
22 terms of what is the device, what is the

1 time, the login, things like that. So, that
2 is -- and it says the word replaced and that
3 is indeed what Varghese does. It basically
4 updates the values at the end of what would
5 be the end of the login.
6 Q. Okay. And when you say that it
7 replaces the cookies, are you referring to
8 both the secure cookies and the Flash
9 cookies?
10 A. In -- and this is a matter of
11 trying to understand Varghese, and I -- let
12 me consult our P.C. here.
13 Q. If it helps, I believe you are
14 pointing to column 26, lines -- starting at
15 line 13.
16 A. Okay. Column 26, You suggested?
17 Q. Yes. In your paragraph, in your
18 declaration, it points to column 26, lines
19 13 to 14.
20 A. Yes. Okay. In this sense of yes,
21 I found it in Varghese.
22 Q. I can re-ask the question, if that

helps.
A. Okay. I think I completely lost the question. Sorry.
Q. So in column 26, the first sentence starting at line 13, the first sentence says a feature of the invention relates to the replacement of the cookie on the user's machine upon each login. Do you see that?
A. I do.
Q. So when Varghese is talking about the replacement of the cookie on the user's machine, is that referring to both Varghese's secure cookies and Flash cookies?
A. I don't believe Varghese is as clear on this, and I can't say with a hundred percent certainty, but it appears that it is both, okay. And this is not my patent, and it's -- clarity there is not -- it's not certain.
Q. Reading this as a person of ordinary skill in the art, is it your

1 opinion that Varghese would be talking about
2 both secure cookies and Flash cookies in
3 that paragraph?
4 A. I think it is talking about at
5 least secure cookies. Unfortunately, it
6 is -- yeah.
7 Q. Why do you say at least secure
8 cookies, but not Flash cookies?
9 A. Because that single sentence talks
10 about the cookie, and there's not a clear
11 cookie immediately preceding that that is
12 there. The previous paragraph talks about
13 device I.D. token, so -- and given the I.D.,
14 I would say it would be likely that it would
15 be both, but again, just from an English
16 language here, it's just the cookie. There
17 was not a singular cookie that was
18 previously referenced to get the cookie.
19 Q. The paragraph above that starts at
20 line 4, where it talks about standard cookie
21 or Flash cookie, does that indicate that the
22 cookie in the next paragraph could be either

one?
A. I mean, it's an "or" there, and then we have a "the cookie." So there wasn't a single cookie in the previous paragraph. So, I mean this is a little bit of -- this is conjecture. I don't think that -- I don't think Varghese provides clarity on that.
Q. Let's look at the next sentence in the paragraph starting at line 13, and it says, This provides further security so that even if a user's machine information is improperly acquired by a third party, even including that embodied in a previous cookie, the authentication system can identify that the user is not authorized and deny access to the system. Do you see that?
A. I do see that.
Q. So, is the replacement then of cookies upon login due to security concerns?
A. That is what that sentence seems to indicate, yes.

1 Q. So based on those security
2 concerns, would it then make sense to you
3 for Varghese to replace whatever previous
4 cookies existed?
5 A. I think that that would be the
6 most likely, that it would be replacing both
7 of them. That's a reasonable expectation
8 from what is written there.
9 Q. Okay.
10 MR. PAPPAS: Is it okay to take
11 a ten-minute break?
12 THE WITNESS: Sure.
13 MR. WOLFE: 1:00?
14 MR. PAPPAS: Or a little after
15 that works.
16 - - -
17 (Recess.)
18 - - -
19 BY MR. PAPPAS:
20 Q. Welcome back again, Dr. Wills.
21 During the break did you discuss the
22 substance of your testimony with counsel?

A. I did not.
Q. Dr. Wills, I appreciate you being here today and I have no further questions for you. I'll pass the witness.
MS. NALL: We'll take a break.
THE COURT: How long do you want?
MS. NALL: Twenty minutes.
- - -
(Recess.)
- - -
MS. NALL: Dr. Wills, are you ready?
- - -
EXAMINATION
- - -
BY MR. WOLFE:
Q. Dr. Wills, do you recall being asked about the definition of a browser storage area in the 823 patent?
A. I do.
Q. Did you use the plain and ordinary

1 meaning in light of the 823 specification of
2 the term "browser storage area" when
3 drafting your opinion?
4 MR. PAPPAS: Objection.
5 Leading.
6 THE WITNESS: I did.
7 BY MR. WOLFE:
8 Q. What is your opinion using that
9 definition as to whether Hinton's DIDC is
10 stored in a browser storage area?
11 A. The DIDC cookie is stored in a
12 browser storage area.
13 Q. What is your opinion using that
14 definition as to whether Hinton --
15 MR. PAPPAS: Objection. Scope.
16 THE WITNESS: It is my opinion
17 that the EEC cookie is stored in a browser
18 storage area.
19 BY MR. WOLFE:
20 Q. What is your opinion using that
21 definition as to whether Varghese's secure
22 cookie is stored in a browser storage area?

A. It is my opinion that the secured cookie is stored in a browser storage area.

Q. What is your opinion using that definition as to whether Varghese's Flash cookie is stored in a browser storage area?

MR. PAPPAS: Objection. Form.

THE WITNESS: It is my opinion that Varghese's Flash cookie is stored in a browser storage area.

BY MR. WOLFE:

Q. Dr. Wills, do you recall being asked about paragraph 132 of Hinton's disclosure regarding the vouch for process?

A. I do.

Q. I'm going to read part of element 1B of the 823 patent to you. B recites the network resource request corresponds to the first cookie of a first type that was caused to be stored to the client device during a first previous network session. In Hinton, what is the disclosure you rely on for the first previous network session?

1 MR. PAPPAS: Objection. Scope.
2 THE WITNESS: The first previous
3 network session is when a user device or
4 user goes to the home domain -- home
5 domain sever. That server directs the
6 user's computer to the other affiliated
7 domains in the electronic community, so
8 that at the end of the network session,
9 there will be -- and in each case placing
10 a DIDC cookie in the domain restoring a
11 DIDC cookie for the domain or that DIDC
12 cookie identifies the home domain for each
13 of the affiliated domains.
14 BY MR. WOLFE:
15 Q. Referring back to element 1B of
16 the 823 patent, the element 1B further
17 recites a second cookie of a second type
18 different from the first type was caused to
19 be stored at the client device during a
20 second previous network session. In Hinton,
21 what is the disclosure you rely on for that
22 element?

1 MR. PAPPAS: Objection to scope.
2 THE WITNESS: So, when the
3 user's computer goes to and seeks to
4 access one of the affiliated domains, it
5 goes to the server of that affiliated
6 domain. There is a DIDC cookie for that
7 domain. That cookie identifies the home
8 domain. At that point, the affiliated
9 domain causes a vouch for request for the
10 client to make a vouch for request to the
11 home domain where the user is
12 authenticated. The response, the result
13 of that vouch for request is a redirection
14 back to the -- back to the affiliated
15 domain at which point the affiliated
16 domain uses that successful authentication
17 to generate an ECC cookie, which is then
18 sent to the client device so now, the
19 client device has both a DIDC cookie and
20 an EEC cookie for that affiliated domain.
21 BY MR. WOLFE:
22 Q. Referring back to element 1B,

1 element 1B further recites receiving network
2 resource request from a client device. In
3 Hinton what is the disclosure you rely on
4 for that element?
5 A. So, Hinton discloses multiple
6 affiliated domains. So, another affiliated
7 domain, a -- the client's browser generates
8 a network resource request to another
9 affiliated domain. That request would
10 contain the DIDC cookie for that -- another
11 affiliated domain, and that is the -- that
12 would ultimately lead to another vouch for
13 request of the home domain, but that is the
14 network resource request.
15 Q. Turning to Varghese, do you recall
16 being asked about Varghese with respect to
17 each login session replacing the cookies?
18 A. I do.
19 Q. What was your opinion related to
20 whether the secure cookie is generated in a
21 different session than the Flash cookie?
22 MS. NALL: Strike that.

1 MR. WOLFE: Strike that.
2 BY MR. WOLFE:
3 Q. What was your opinion related to
4 whether the secure cookie is generated in a
5 different network session than the Flash
6 cookie?
7 A. It is my opinion that the secure
8 cookie and the Flash cookie are generated in
9 separate network sessions.
10 Q. Can you turn to figure 4B of
11 Varghese, please.
12 A. Four B. Yes.
13 Q. In -- is 4B, does 4B represent a
14 network session or a login session?
15 MR. PAPPAS: Objection to scope.
16 THE WITNESS: Figure 4B
17 represents a login session in Varghese,
18 which consists of two network sessions as
19 defined in the -- in the 823 patent.
20 MR. WOLFE: Pass the witness.
21 MR. PAPPAS: Can you give us a
22 couple minutes?

1 MS. NALL: Sure. You know how
2 long you need?
3 THE WITNESS: How long would you
4 like?
5 MS. NALL: We'll just wait.
6 MR. PAPPAS: Yeah. It won't be
7 too long.
8 - - -
9 EXAMINATION
10 - - -
11 BY MR. PAPPAS:
12 Q. Welcome back, Dr. Wills. So we
13 took a recess of about an hour approximately
14 between cross-examination and redirect.
15 What did you do during that hour?
16 MR. WOLFE: Objection. Attorney
17 work product. You can answer to the
18 extent it doesn't disclose anything we
19 discussed.
20 THE WITNESS: Talked about what
21 to do about redirect.
22

1 BY MR. PAPPAS:
2 Q. Did you talk with counsel during
3 that hour?
4 A. Yes.
5 Q. Who did you speak with
6 specifically?
7 A. Joe and Jennifer.
8 Q. Did you prepare testimony
9 alongside counsel during that hour?
10 MR. WOLFE: Objection. Instruct
11 him not to answer the question.
12 BY MR. PAPPAS:
13 Q. Are you going to follow your
14 counsel's instruction?
15 A. Yes.
16 MR. PAPPAS: Counsel, what basis
17 are you providing for instructing your
18 witness not to answer the question?
19 MR. WOLFE: Oh, work product.
20 BY MR. PAPPAS:
21 Q. Work, okay. How long did you
22 prepare with counsel your redirect

1 testimony?
2 A. I don't know. I wasn't -- I
3 wasn't keeping track of time.
4 Q. Was it for approximately the whole
5 hour?
6 A. It was certainly some amount of
7 it.
8 Q. Did you do anything else during
9 that hour?
10 A. Used the restroom. Got a drink,
11 just collected myself.
12 Q. Did you review any documents
13 during that hour in preparation for your
14 redirect testimony?
15 A. I don't recall reviewing any
16 documents.
17 Q. During your redirect I noticed
18 that you didn't consult any documents. Did
19 you prepare your answers for redirect
20 testimony before the testimony occurred?
21 MR. WOLFE: Objection. Calls
22 for attorney work product.

1 MR. PAPPAS: I'm asking if he
2 prepared his answers before he gave the
3 testimony.
4 MR. WOLFE: Same objection.
5 Instruct the witness not to answer.
6 MR. PAPPAS: You going to follow
7 your counsel's instruction?
8 THE WITNESS: Yes.
9 BY MR. PAPPAS:
10 Q. Where any of the answers you gave
11 during redirect provided by counsel?
12 A. The answers provided by me are
13 mine.
14 Q. So you formed your answers to
15 those questions without the assistance of
16 counsel during that hour?
17 MR. WOLFE: Objection. Calls
18 for attorney work product. Instruct the
19 witness not to answer.
20 MR. PAPPAS: Are you going to
21 follow your counsel's instructions?
22 THE WITNESS: Yes.

1 BY MR. PAPPAS:
2 Q. Do you recall being asked
3 questions about Varghese's Figure 4B during
4 redirect?
5 A. I do.
6 Q. And you did not consult Varghese
7 when you answered those questions; is that
8 correct?
9 A. I think I had it open here.
10 Q. Did you have an answer prepared
11 for the questions about Varghese's figures
12 4B before you looked to Varghese during your
13 redirect testimony?
14 MR. WOLFE: Objection. Attorney
15 work product. Instruct the witness not to
16 answer.
17 MR. PAPPAS: You going to follow
18 your counsel's instruction?
19 THE WITNESS: Yes.
20 BY MR. PAPPAS:
21 Q. Did you memorize any answers to
22 questions on redirect before you gave your

1 redirect testimony?
2 A. I did not.
3 Q. Were you aware of the questions
4 that were going to be asked on redirect
5 before you gave your redirect testimony?
6 MR. WOLFE: Objection. Attorney
7 work product. Instruct the witness not to
8 answer.
9 MR. PAPPAS: Dr. Wills, are you
10 going to follow your counsel's
11 instruction?
12 THE WITNESS: Yes.
13 BY MR. PAPPAS:
14 Q. Do you recall your testimony
15 during redirect discussing element 1BI,
16 which relates to receiving a network
17 resource request from a client device?
18 MR. WOLFE: Objection. Vague.
19 THE WITNESS: Yes, I recall
20 being asked about that.
21 BY MR. PAPPAS:
22 Q. And you discussed during redirect

1 your opinion of how Hinton teaches this
2 claim element, correct?
3 A. I recall questions about that,
4 yes.
5 Q. And you said that the client's
6 browser generates a network resource request
7 to another affiliated domain. Do you recall
8 that?
9 A. Something to that effect.
10 Q. And when you were referring to
11 another affiliated domain, is that a
12 different domain than you are relying on for
13 element 1B4? And you are welcome to consult
14 your declaration.
15 A. I'm sorry. I will. Can you ask
16 again? Only I'm now here, and I just needed
17 to refresh my memory of what 1B4 is.
18 Q. Sure. So when you were referring
19 to another affiliated domain for element
20 1B1, is that a different domain than you
21 were relying on for element 1B4?
22 MR. WOLFE: Objection. Vague.

1 THE WITNESS: So the resource
2 request for 1.B.1 is for a different
3 affiliated domain than the second previous
4 network -- than the domain affiliated
5 domain for the second previous network
6 session in 1.B.4.
7 BY MR. PAPPAS:
8 Q. And where in your declaration do
9 you say that?
10 A. So in my declaration in paragraph
11 84 of my declaration I talk about the --
12 that the network resource request triggers a
13 vouch-for process. And so this relates to
14 Hinton. Hinton has multiple affiliated
15 domains. Access to any of the affiliated
16 domains causes a vouch-for process to be
17 triggered if there is not already an ECC
18 cookie for that domain. So given that this
19 is a network 1B.I, a network resource
20 request that triggers a vouch-for process,
21 we know this has to be separate and distinct
22 from the second previous network session

1 because the second previous network session
2 for an affiliated domain resulted in an ECC
3 cookie for that domain.
4 Q. Do you say that in your
5 declaration?
6 A. It follows from the fact that at
7 this network resource request that I call
8 that a triggering -- a vouch-for process.
9 Q. Would Hinton ever check for a DIDC
10 if an ECC existed?
11 MR. WOLFE: Objection. Vague.
12 THE WITNESS: Clearly, if we
13 go -- if the user's browser goes to an
14 affiliated domain, it is going to check
15 for an ECC cookie. If the ECC cookie is
16 present, I don't recall whether Hinton
17 explicitly says that it looks for the DIDC
18 cookie or doesn't look for the DIDC
19 cookie. Obviously, if the ECC cookie is
20 not present, it absolutely makes use of
21 the DIDC cookie. But if you'r asking the
22 opposite of -- if both are present does it

1 go and look, I would have to go back to
2 Hinton to give you an answer.
3 BY MR. PAPPAS:
4 Q. Okay. So Hinton, is it fair to
5 say Hinton does not say if an ECC exists
6 whether it would also look for the existence
7 of a DIDC. Is that fair?
8 MR. WOLFE: Objection.
9 THE WITNESS: I didn't say that.
10 I didn't say that Hinton does or doesn't
11 say it. I'm saying I don't recall whether
12 or not it does or doesn't say.
13 BY MR. PAPPAS:
14 Q. So you're not relying on whether
15 it does or doesn't for your opinions in
16 these paragraphs, correct, with respect to
17 element 1B1?
18 A. Well, in 1B1, I know it use DIDC
19 cookie because in 1B1, the network resource
20 request triggers a vouch-for process and the
21 vouch-for process is only triggered if the
22 ECC cookie is not present for that

1 affiliated domain.
2 Q. For your answers to these
3 questions related to Hinton, did you discuss
4 your answers with counsel during the break?
5 MR. WOLFE: Objection.
6 THE WITNESS: No, I did not.
7 BY MR. PAPPAS:
8 Q. So you did not prepare for the
9 questions about Hinton with counsel during
10 the break?
11 MR. WOLFE: Objection. Work
12 product.
13 MR. PAPPAS: Are you instructing
14 the witness not to answer?
15 MR. WOLFE: Sure. You don't
16 have to answer.
17 MR. PAPPAS: Counsel, before we
18 close, can you explain the basis for your
19 objection and why you believe the
20 conversations between witness and counsel
21 between cross-examination and redirect are
22 covered by attorney work product?

1 MR. WOLFE: There is a case, I
2 believe we are able to communicate with
3 the witness between direct and redirect.
4 MR. PAPPAS: Do you know what
5 that case is?
6 MR. WOLFE: I don't recall off
7 the top of my head what the case is.
8 MR. PAPPAS: I guess my question
9 is why is the communication, the ability to
10 communicate with the witness covered by work
11 product if there's no materials produced?
12 MR. WOLFE: I don't believe that
13 was what our objection was about.
14 MR. PAPPAS: What was the
15 objection about?
16 MR. WOLFE: It seems like the
17 questioning got to what was communicated,
18 not whether we communicated with the
19 witness.
20 MR. PAPPAS: That's correct. And
21 I understand there's a case that says that
22 you are -- you may communicate with the

1 witness, but does that case say that -- that
2 was communications are not discoverable?
3 MR. WOLFE: They weren't
4 discoverable in that case.
5 MR. PAPPAS: Does the case say
6 that?
7 MR. WOLFE: They weren't
8 discovered in the case. I would have to
9 reference the opinion again.
10 MR. PAPPAS: So, just confirming
11 for the record then that the basis for you
12 instructing the witness not to answer
13 these questions is the work product
14 doctrine?
15 MR. WOLFE: And privilege, sure.
16 Yes.
17 MR. PAPPAS: And privilege, but
18 you didn't assert privilege for the
19 previous questions, correct?
20 MR. WOLFE: That's correct. We
21 said work product.
22 MR. PAPPAS: Okay. I think with

1 that, we can wrap up and let you go
2 wherever you would like to go.
3 MR. WOLFE: We reserve the right
4 to have the witness review the transcript.
5 MR. PAPPAS: Sure.
6 MR. WOLFE: No further
7 questions.
8 (At 2:56 p.m., proceedings were
9 concluded.)
10 - - -
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1 C E R T I F I C A T E

2

3 I, Lisa Claud Neal, Certified Reporter
and Notary Public do hereby certify:
4 That CRAIG ELLIS WILLS, Ph.D., the witness
whose deposition is hereinbefore set forth, was
5 duly sworn by me before the commencement of such
deposition and that such deposition was taken
6 before me and is a true record of the testimony
given by such witness.
7 I further certify that the adverse party,
RAVENWHITE SECURITY, INC., was represented by
8 counsel at the deposition.
I further certify that the deposition of
9 CRAIG ELLIS WILLS, Ph.D., occurred at the offices
of DLA PIPER One Liberty Place 1650 Market Street
10 Suite 5000 Philadelphia, PA 19103 on Tuesday
June 17, 2025 commencing at 9:00 a.m. to
11 2:56 p.m.
I furthter certify that I am not related to
12 any of the parties to this action by blood or
marriage, I am not employed by or an attorney to
13 any of the parties to this action, and that I am
in no way interested, financially or otherwise,
14 in the outcome of this matter.
IN WITNESS WHEREOF, I have hereunto set my
15 hand this 20th day of June, 2025.

16 Lisa Neal

17 _____

18 Lisa Claud Neal, RPR,

19 CSR, CLI Notary PA-NJ-DE

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A Personalized Approach to Web Privacy—Awareness, Attitudes and Actions

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Abstract

Purpose - Our research seeks to understand user attitudes and actions regarding Web privacy in the context of educating users on what information is obtained and inferred about them via behavioral tracking.

Design/methodology/approach - We take a novel approach to personalize user awareness by embedding JavaScript in a Web page to examine portions of a user's Web browser history to ascertain Web sites that the user has visited. We then personalize information reported to the user about what third-party sites are tracking the user's behavior along with demographic information these sites may be inferring from these visited sites and the user's geographic location. In this context users are then surveyed regarding their attitudes towards tracking and actions they take to control it.

Findings - We found that 63% of users agreed with a statement of concern for third parties monitoring activities, about half of our respondents agreed with a concern for knowledge about a user's location and a little more than half agreed to concern about inference of demographic information. We found that females are more concerned about these issues than males.

In terms of possible actions, a majority of users report using an ad blocker tool and even more delete cookies at least some amount of time. Using an opt-out mechanism or removing browser history are done by less than 20% of users. Despite expressing more concern for information known by third-parties, females are not significantly more likely to take actions that may limit what is leaked to these third parties. A contributor to this discrepancy is that females were much less likely to know their settings for many of the actions indicating less familiarity with them.

Social implications - Web privacy is an important social issue so helping users to better understand tracking of their actions along with what actions can be taken to limit tracking is important. The project Web site continues to exist and educate users.

Originality/value - The work takes an original approach to educating users on what third-parties learn about them and follows up that knowledge with a survey of user attitudes and actions on this important topic.

Keywords Web, Privacy, Behavioral Advertising, Tracking

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1 Introduction

As the Web has evolved, the use of "third-party" sites to serve advertisements on "first-party" sites that users choose to visit has continued to grow. The work of these third-party sites also has evolved as they move from *contextual* advertising where ads are served only on the basis of the first-party site that a user has visited to *behavioral* advertising where advertisers seek to track the behavior of users across first-party sites to build up a "profile" of user activity and interests. Tracking of a user's browsing behavior raises privacy concerns, particularly if such a profile can be linked with a user's identity. These concerns have become a public issue and are being examined in the media, by privacy rights groups and by governmental agencies concerned with consumer rights.

Recent studies have examined user attitudes towards behavioral advertising (McDonald and Cranor, 2009; TRUSTe, 2009; Turow et al., 2009). These studies have primarily collected user opinions via user surveys and interviews. A result from one of these surveys indicates that 68% of Americans would "use a browser feature that blocks ads, content and tracking code that doesn't originate from the site they're visiting" (TRUSTe, 2009). Tools have been created that show users what third-party sites are present on Web pages that they visit (Ghostery, 2009; Adblockplus, 2009). However these tools do not show users what these third-party sites do with this information nor are these tools widely available to users of all browser platforms. They also require installation by a user, which is an impediment to use for many users. Limitations such as these contribute to lack of understanding by many users on the implications of behavioral advertising for their own personal privacy.

A problem in Web privacy research is educating users on the privacy considerations of techniques such as behavioral advertising. If users do not understand what behavioral advertising means for them then any attitudes they express or actions they take are based on perception. This problem motivates our research to find ways to educate users on what behavioral advertising personally means for them while doing so in a manner to minimize impediments for participation by all users. Once users understand what behavioral advertising means for them then they are in a better position to express informed opinions on its use.

Our approach for tackling this problem is to design a tool that is accessible to a large segment of users while providing personalized information. The approach provides a Web page that any user can access via any browser from anywhere on the Internet. We are able to personalize the information provided to users by using JavaScript embedded in the Web page to examine portions of the user's Web browser history to ascertain Web sites that the user has visited. We then personalize information reported to the user about what third-party sites are tracking the user's behavior along with demographic information these third parties may be inferring from these visited sites and the user's geographic location. Our project is called "WhatTheyKnow" because it helps users understand what "they" (the third-parties) know about them.

Taking this approach, our research study seeks to answer the following questions:

1. Are we able to attract and educate a broad audience of users by providing personalized privacy *awareness* where users visit Web site without needing to install software or browser extensions? Our approach of providing benefits to participating users is in contrast to previous studies that have relied primarily on surveys.

2. What *attitudes* do educated users have on tracking and other information inferred about them when surfing the Web? Our approach allows us to survey users in the context of better understanding on what is known or inferred about them.

3. What, if any, privacy-related *actions* do users take to limit the capability of third-parties to track a user's activities? Previous work has found gaps between user intentions and behaviors when it comes to privacy (Norberg et al., 2007; Paine et al., 2007). This question allows us to understand how user concern for tracking of browsing behavior translates into actions for limiting its effectiveness.

The remainder of this paper begins with a discussion of related work that places our work in context in Section 2. We go on to discuss details of the approach for conducting our research study in Section 3 and the results that we obtain from it in Section 4. We conclude with a summary and future directions for our work in Section 5.

2 Related Work

There are many directions of work that provide context for our work. These include consumer concerns for privacy, differences in attitudes based on demographics, the growth of third-party advertising Web sites to track user behavior, the possible actions users can take to control tracking and the possible gaps between user concerns on privacy and the actions users actually take. We examine relevant work for each of these directions in this section.

Concern for monitoring of Web activity is not new, such as shown by a 2002 consumer research study (Graeff and Harmon, 2002). A more recent study looking at everyday tracking and recording technologies found that users expressed the most concern of any technology for recording of their Web activities (Nguyen et al., 2008). A number of recent studies have been published that examine user attitudes concerning tracking by third-party aggregators for behavioral advertising (McDonald and Cranor, 2009; TRUSTe, 2009; Turow et al., 2009). This work has primarily been done through surveys and interviews of user opinions based upon what users know about tracking of activities.

Studies have also examined differences in attitudes based on demographics such as age or gender. These studies include (Sheehan, 1999; Zukowski and Brown, 2007). A recent study examines evolution of online privacy values since 2002 (Anton et al., 2010). Our work contributes to the study of attitudes for different user demographics as well as studying differences between users based upon the specific Web sites that they visit.

A separate direction of work has examined the increasing presence of third-party sites used for advertising and analytics in a longitudinal study showing the penetration of the top-10 third-parties amongst popular first-party sites growing from 40% in 2005 to 70% in 2008 (Krishnamurthy and Wills, 2009b). Updated results show this penetration has increased to over 70% in September 2009 (Krishnamurthy and Wills, 2009c). A separate study shows that these third-parties are not only increasing their tracking of users, but the browsing behavior of users can be linked to personal information and identifiers via online social networking sites (Krishnamurthy and Wills, 2009a), which also employ these same third parties. These results indicate that tracking of user behavior is growing and that users need to better understand what it means for them.

Another direction of work has focused on developing tools that help users understand the extent of this tracking and provide means to control it. Making a single request to a third-party server may leak private information by encoding the information in the URL. Tools such as AdBlock Plus (Adblockplus, 2009) or Ghostery (Ghostery, 2009) allow syntactic string matching of the URL for monitoring and blocking requests from known aggregators. RequestPolicy (Samuel and Zhang, 2009) takes a white-listing approach. However these tools do not always detect hidden third-party servers that appear to be part of the first-party domain (Krishnamurthy and Wills, 2009b).

Information is also stored and passed to servers via cookies. Browsers do provide means for users to control the sending of first- and third-party cookies. However, the removal of cookies, particularly first-party, can lead to errors on some sites (Krishnamurthy et al., 2007).

A number of third-party sites now provide a mechanism for users to opt-out of targeted advertisements via third-party cookies. Some of these sites are part of the Network Advertising Initiative (NAI), a cooperative of online marketing and analytics companies (Network Advertising Initiative, 2009). Users can opt-out of receiving targets ads by any or all of the NAI members through the creation of an "opt-out" cookie. One weakness in this approach is that if a user removes all their cookies, the opt-out cookies are lost. The Firefox

TACO extension (Targeted Advertising Cookie Opt-Out, 2009) makes these opt-out cookies persistent.

It is possible for a Web site to determine if a browser has visited any given URL using a combination of CSS and JavaScript (Janc and Olejnik, 2010). This technique can produce a partial browsing history without the use of cookies, and may reveal private information, such as which bank and OSN sites a user visited. Users can prevent such attacks with the SafeHistory Firefox extension (Jackson et al., 2006).

Modern browsers have added features, such as InPrivate Browsing for Internet Explorer 8, incognito mode for Chrome, and Firefox Private Browsing. These features allow users to create a "private" browsing session, also known as "porn mode" for its suspected use (Keizer, 2008), where no history is recorded. In addition, Internet Explorer 8's InPrivate Filtering blocks requests to embedded objects that it encounters multiple times.

With many actions that are available for users to help control tracking of their activities, a key question in our research is to what degree these actions are employed by users. This question is particularly relevant when previous research has found gaps between user intentions and behaviors when it comes to privacy (Norberg et al., 2007; Paine et al., 2007). These studies have not specifically looked at actions taken in regard to tracking of behavior, but there is the potential that expressed user concern for tracking may not translate in actions to control it.

3 Approach

Our research seeks to understand user attitudes and actions regarding Web privacy in the context of educating users on what information is obtained and inferred about them via behavioral tracking. We take a novel approach for this research study by constructing a Web site that allows users to better understand what this tracking means for them and for them to share their opinions about it if they so choose. This approach was taken because we can personalize the experience for an individual user while minimizing what is needed from a user—simply visiting a Web site rather than requiring the user to install any tools.

To personalize the experience for each user we access the browser history of the user via JavaScript code to check if sites from a list of popular sites are included in the browser's history. Browsers maintain history information by default so that previously visited sites can be seen and their link color can be changed from the default when a page containing such a link is shown. It is not possible to list the contents of the history via such a script, but only to query whether or not specific URLs are contained within the history. For example, one of the sites in our list is `cnn.com`. If either the URL `http://cnn.com/` or `http://www.cnn.com/` is found in the browser history then the site `cnn.com` is marked as visited. The script works similarly for other sites in our list.

In the remainder of this section, we first provide an overview of a user's experience when visiting our Web site followed by further details of how the site works. The discussion references the architecture of our Web site shown in Figure 1.

3.1 Web Site Overview

Users visiting our site access its contents in two steps. In the first step, a user reads about the site and then clicks on a button, which invokes JavaScript code (step 1 of Figure 1) that probes the history of the browser for the presence of a list of popular Web sites. This list of visited sites is then sent to our server (step 2) where the third-parties used for each of the Web sites in the list is determined (step 3). A server-side script also uses demographic information about each site in the list to predict the gender and age range of the user. The JavaScript code is also used to determine a user's location via a service that maps Internet addresses to geographic locations. All of this information is then displayed to the user (step 4) as a personalized summary of what information is known and inferred about the user's behavior on the Web.

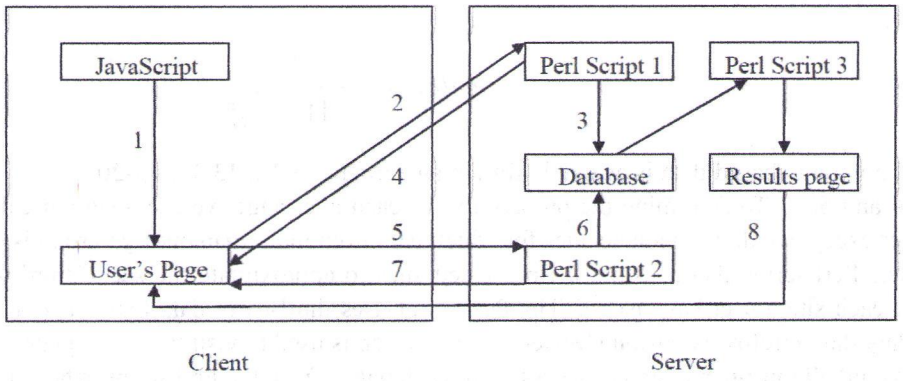

Figure 1: Site Architecture

Once the information is shown to a user, then the user has the choice to complete a second step. This step seeks feedback on the accuracy of age, gender and location information inferred about them as well as seeking feedback on the user's attitudes towards tracking and the user's use of actions that may prevent third-party sites from monitoring the user's browsing behavior. If a user provides this feedback then it is sent to our server, stored and acknowledged (steps 5-7). As an incentive for the user to complete this second step, the user can see the results for all users upon submission of results (step 8). More details on these steps are provided in the following.

3.2 Gathering User Data

We use modified JavaScript code (step 1 of Figure 1) from the work in (Raskin, 2009) with a different list of sites. We check each user's history for the top 1000 sites obtained from Quantcast (Quantcast, 2009) in July 2009 as well as additional lists of the most popular search engine, social networking and adult entertainment sites. The existence of such a scripting capability has been previously publicized for determining a user's social sites (Raskin, 2009) or a user's gender (Nolet, 2008). A more recent site checks a user's browser history against an extensive set of site lists from many categories of sites (Janc and Olejnik, 2010).

To obtain a user's location we use a script from (Find-IP-Address, 2009) to embed location data in the user's page based upon the Internet address. Our JavaScript code extracts country, state and city information. If the user agrees to participate in our study, then as shown in step 2 of the figure, the list of visited sites and location are submitted to our Web server via a HTTP POST command. We also send the browser type and list of browser plug-ins to understand how well these values uniquely identify a browser. The use of browser type, plug-ins and similar information for fingerprinting a browser has been studied extensively in another project (Eckersley, 2010).

3.3 Processing User Data

Once the user data is received by our server it is processed by a Perl script to first determine the user's gender and age based upon demographic data obtained from Quantcast for each of the sites in our list. The gender data contains the probability of being a male visitor for each site. If $p_1, p_2, ...p_n$ represent the probability of a user being male for each of n sites visited then similar to (Nolet, 2008) we use the formula that the probability of the user being male is

$$P(male) = \frac{1}{1 + \prod_{i=1}^{n} \frac{1-p_i}{p_i}}$$

Similar age-based data is available for ten age groups: 3-12, 13-17, 18-20, 21-24, 25-34, 35-44, 45-54, 55-64 and 65+. To determine the probability for each age range we use a similar calculation as done for gender except we do not include sites for which data from more than one age group is missing.

The Perl script also uses the list of visited sites to approximate the set of third-party sites that know about each site a user has visited. The Perl script uses third-party data that was obtained separately with the Pagestats Firefox extension (DeDeo, 2006), which is used to visit the home page of each site in our list and record all third-party servers accessed for each page. Once the Perl script obtains the list of visited sites then it simply looks up the stored third-party information for each site. It is important to understand that the set of third-party sites determined for a list of visited sites is intended for awareness and is likely only an approximation for any user for the following reasons:

1. The script cannot examine a user's entire history, but only query for specific sites. Therefore not all Web sites visited by a user containing third parties are likely to be queried by the script.

2. The set of third-party sites present on a visited site may change over time. The third-parties shown in the results were determined in October 2009.

3. Third-party sites typically use cookies to track users. If a user removes cookie information or blocks advertisements then the determined list of third-parties will not be accurate for the user.

4. While this script uses browser history to determine some of the sites a user visits, third-party tracking sites do not (to our knowledge) use browsing history to track a user's behavior, although (Raskin, 2009) suggests using it to determine a user's social networks. If a user periodically removes history then the list of visited sites determined by our JavaScript code may be smaller than the list of tracked sites.

Despite these approximations, the calculated set of third-party sites does provide a user with information on which third parties are tracking the user's Web browsing behavior. As shown in step 3 of Figure 1, the list of visited sites, location, the calculated gender, age and third-party sites, as well as the browser type and list of plug-ins are stored in a MySQL database.

3.4 Presenting Information to Users and Obtaining Feedback

In step 4 of Figure 1 the list of visited sites along with the known third-party sites for each visited site is shown to the user. A sample of this output is shown in Figure 2 where a user has visited two search engines, a social networking site and three other popular sites.

In addition to the list of visited sites and associated third-parties, a user is also shown the inferred location, gender and age. At this point the user can choose to stop or provide additional information as a follow-up to the reported data. We seek feedback via a survey from the user on three related aspects. First, we ask the user if the inferred location, gender and age range are "correct", "close to correct" or "incorrect". Second, we survey users about their attitudes concerning the information presented to them. We ask them to indicate if they "agree", are "not sure" or "disagree" with specific statements about concern for third-party monitoring of activities, concern that a user's location is known and concern that third-parties can infer demographic information.

Here is the list of **2 search engines** you have visited along with count and list of third-party tracking sites that know about you (list of site abbreviations).

Visited site	Count	Third-party sites
google.com	1	google
yahoo.com	3	yahoo, yimg, mplex

Here is the list of **1 social network** you have visited along with count and list of third-party tracking sites that know about you (list of site abbreviations).

Visited site	Count	Third-party sites
facebook.com	3	dblclick, atdmt, adv

Here is the list of **3 other popular sites** you have visited along with count and list of third-party tracking sites that know about you (list of site abbreviations).

Visited site	Count	Third-party sites
mail.yahoo.com	1	yimg
maps.google.com	0	
cnn.com	8	dblclick, omniture, scresearch, g-syndication, revsci, aol, dl-rms, vfive

Figure 2: Sample List of Visited Sites Along with Associated Third-Party Sites Reported to WhatTheyKnow Users

Finally, we ask users what, if any, actions they take to prevent or limit tracking of their browsing behavior. These six questions ask about use of ad blocker tools, cookie blocking, cookie deletion, opt-out mechanisms provided by third-party sites, browser history removal and private browsing session features.

Once a user has responded to each question (or chosen not to respond) and supplied "any additional comments about what you learned" in a text box then the user submits their responses to another Perl script on our site as shown in step 5 of Figure 1. This script locates the user's prior database record from step 3 by matching a recent record containing the same location, visited sites, browser type and list of plug-ins to update the record in step 6. The user is thanked with a confirmation in step 7 and as an enticement to participation the user is given a link to see the results of all participants in step 8 where the results page is generated by a Perl script from information stored in the database.

4 Results

The Web site at `http://whattheyknow.cs.wpi.edu/` went public in January 2010. We did not try to control the set of users with access to the site, but rather sought to encourage broad participation through a set of initial "seed" email messages to various groups with the expectation that word-of-mouth would extend use of the site to a much larger audience. This is a similar approach as used in (Anton et al., 2010). Broad participation was a key objective for the education aspect of the work. We expected that such a "seed-and-spread" approach would not necessarily lead to a representative sample group, but a large enough number of users would allow us to focus our results analysis on identifiable sub-groups of users rather than on the aggregate set of users. We are also able to profile the set of Web sites visited by our users relative to the population at large to better understand potential biases by our users.

We used a number of seed email messages beginning with an initial announcement of the site to faculty, students (primarily undergraduates) and staff at our institution. WPI is a private university with approximately 4000 full-time students and 300 faculty primarily in fields of science and engineering with support from 500 staff. Students and faculty are roughly 70% male with staff gender approximately balanced. Subsequently, we followed up this announcement with a message to a mailing list of over 2500 computer science educators from around the world, to a mailing list of over 100 people in an author's local neighborhood and

to approximately 50 people doing Internet measurement and Web privacy work. We have evidence that the existence of the site spread to many others that were never directly contacted by us.

3749 users had visited the site by the end of February 2010 and completed the first step of running the JavaScript program to see their personalized results. 1853 (49%) of these users then followed up these results by completing the survey step with most questions answered by between 1750 and 1800 users.

In the remainder of this section we provide results from our analysis for the roughly 1800 users taking the survey unless otherwise noted. We first provide a profile on respondents followed by their attitudes on various aspects of tracking. We then examine users actions taken to control tracking and finish with additional results.

4.1 Profile of Respondents

In our survey about Web privacy, we choose not to explicitly ask for user demographic information, but by correlating user responses on the correctness of location, gender and age inferences we can determine information about user demographics. We also characterize our set of users based upon the set of sites that they visit. We note that other potential factors affecting responses such as users' culture, abilities, personality and motivation are not explicitly examined in our work.

4.1.1 Location

Users were asked about the correctness of their location inferred from their Internet address. 64% responded that their location was correct, 23% indicated it was "close to correct" and 13% responded that it was incorrect. Although we choose the particular IP location service because it provided a script that integrated with our JavaScript code, we note that it provided reasonable performance given that 87% of users responded with correct or close to correct location.

Focusing on these users responding with correct or close to correct location, we find that 10% of our respondents are located in Worcester, the city in which WPI is located, 26% were in the state of Massachusetts, the state in which WPI is located, and 87% were in the United States. These results indicate a representation of users in and around WPI, but with the majority of users beyond WPI.

4.1.2 Gender

As part of the results, we displayed the gender predicted based upon the set of sites found in the browser history along with a confidence on the correctness of the prediction. For example, such a result might be "Based upon the sites you visit there is a 62% chance that you are male." In the case that there was equal chance of male and female, such as when no sites could be found in the browser history, then we arbitrarily reported "Based upon the sites you visit there is a 50% chance that you are female." By indicating a gender, even if uncertain, allows us to ask the user if it is correct.

Overall, we reported that 52% of users were more likely to be male, 33% of users were more likely to be female and 15% were of equal likelihood. Based on user feedback, our predicted gender was correct for 64% of the users. As expected, we observe better correctness values if more sites are detected in a browser's history and if there is greater confidence in the predicted gender. Combining the results on predicted gender and user feedback on the correctness, we determine that 72% of our respondents are male while 28% are female.

4.1.3 Age

We made a similar prediction on the age range of a user based on the set of sites visited where a result such as "Based upon the sites you visit there is a 45% chance that your age range is 35-44" was shown to the user.

Unfortunately the predicted age range of users was skewed to only four (out of the possible ten) predicted ranges: 42% for 25-34, 39% for 35-44, 4% for 13-17 and 15% for 3-12 where this latter value was the default (with 10% confidence) when no visited sites could be found in the browser history. We conjecture this skewness occurs for a couple of reasons. First, there are more categories and less prediction confidence in each when compared to gender prediction. Second, because the age ranges in the demographic data were not uniform in size, the two 10-year ranges consistently had the highest predicted confidence values. In hindsight, it would have been better to combine some of the ten age ranges to have more uniform sizes for each.

Overall, the age range was predicted correctly for 19% of users while being "close to correct" for 23% and incorrect for 58%—again these results improve when more sites are detected in the browser history. These results do not provide a means to obtain the age-range breakdown of all users in our data set as was possible for gender. However in subsequent analysis, we do examine responses from users in the 25-34 and 35-44 age ranges who reported that their age range is correct or close to correct.

4.1.4 Visited Sites

Another means of characterization that our data set affords is to examine the set of sites visited by our set of users. The mean number of visited sites for all 3749 users was 15 while the median was 8. Table 1 shows the top-10 most visited sites where `google.com` was found in the browser history for 59% of the users. In 13% of the cases, no sites from our list were found in the browser history. If we only consider cases where at least one site was found in the history then `google.com` was found 68% of the time.

Table 1: Top-10 Visited Sites

Rank	Visited Site	% of All Users	% with History
1	google.com	59	68
2	facebook.com	51	58
3	youtube.com	42	48
4	maps.google.com	31	36
5	cnn.com	24	28
6	weather.com	24	28
7	yahoo.com	24	27
8	ebay.com	23	27
9	twitter.com	20	23
10	apple.com	19	22

While this set of visited sites is interesting, a more important question is how this set compares with the set for a broader range of users. Such a comparison would allow us to understand how the characteristics of our users compare with this broader range. We make such a comparison in Figure 3 where we compare the proportion of WhatTheyKnow users who visit popular sites with the same percentages as reported by Quantcast for these same sites in January 2010. The sites are listed in order of popularity according to Quantcast. The list of sites includes the top-20 Quantcast sites that were in the list of sites we checked along with any remaining sites in the top-20 sites for our set of users.

The list of visited sites is shown for four sets of users in Figure 3. The WhatTheyKnow results are for all 3749 users. The Survey results are for only the set of users that submitted the survey. The closeness in results between these two sets of users is meaningful because most of our analysis is done for this smaller set. The results show that sites such as `yahoo.com`, `msn.com`, `live.com` have much less of a presence

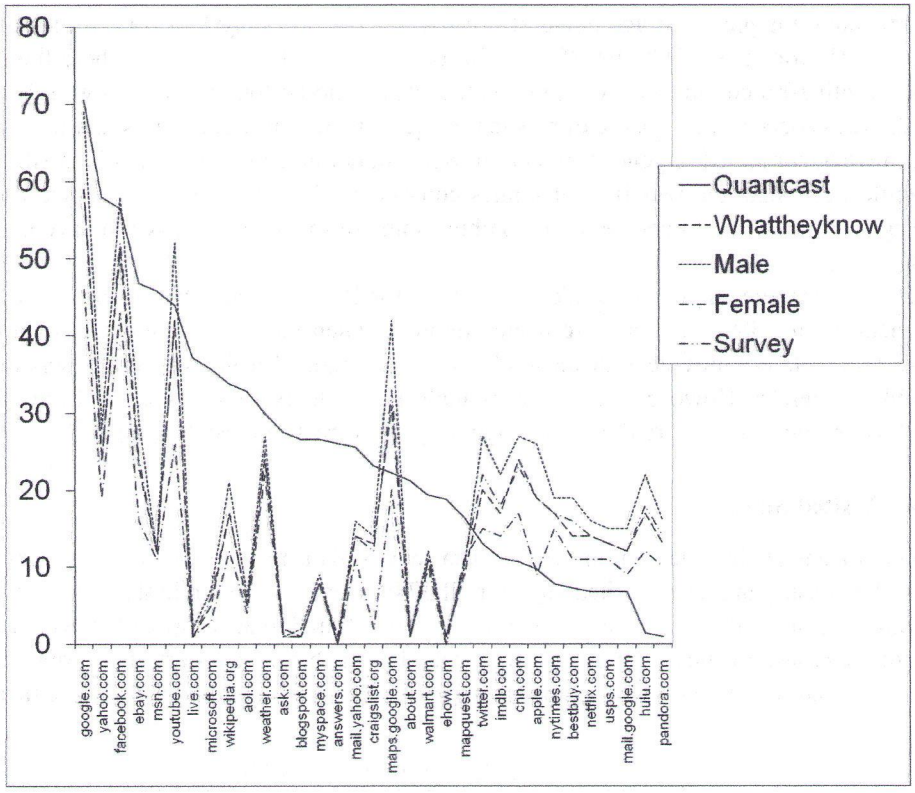

Figure 3: WhatTheyKnow User Profiles Relative to Published Profile

amongst our set of users. One reason for this discrepancy could be that our set of users simply do not have the same profile as those measured by Quantcast. Another reason might have to do with our methodology where we only test the presence of a site's home page in the browser history. If a user does not visit the home page of a site then our JavaScript code does not detect it. Despite this limitation, Figure 3 shows some sites detected at higher rates than observed by Quantcast. These sites include `maps.google.com`, `cnn.com` and `hulu.com`.

The figure also shows results for male and female users where males consistently have larger representation than females for the list of sites. The largest differences between the two genders are for the sites `craigslist.org`, `maps.google.com` and `apple.com`.

4.1.5 Third-Party Sites

We also determined the third-party sites that were most prevalent for our set of users. These results are shown in Table 2 where `doubleclick.net` was present on an average of 7.8 visited sites per user. As a comparison, in March 2010 we made use of the same methodology as described in (Krishnamurthy and Wills, 2009b) to obtain the list of third-parties used by a set of over 1000 popular sites. The rank ordering based on these separate results is shown for each site in Table 2.

As expected, the table shows much similarity between the top third-party sites for our WhatTheyKnow users and those sites found for a large list of popular sites. The lists contain seven common third-parties with the three other third-party sites falling just out of the top-10 in the other ranking.

Table 2: Top-10 Observed Third-Party Sites

Rank	Third-Party	Ave. # of Sites Per User	Rank in March'10 for Methodology of (Krishnamurthy and Wills, 2009b)
1	doubleclick.net	7.8	1
2	atdmt.com	3.9	6
3	google-analytics.com	3.9	2
4	omniture.com	3.8	7
5	quantserve.com	3.4	4
6	scorecardresearch.com	2.6	5
7	advertising.com	2.6	14
8	yieldmanager.com	2.1	9
9	revsci.net	1.7	11
10	yimg.com	1.6	13

4.2 User Attitudes on Tracking

Users were shown their list of detected visited sites and associated third-parties such as illustrated in Figure 2. We then asked users a number of questions, including three questions regarding user attitudes on various aspects of tracking. The results for all WhatTheyKnow users completing the survey and answering these three questions are:

1. I am concerned that third-party tracking sites have this level of monitoring of my activities.

   63% Agree
   25% Not sure
   12% Disagree

2. I am concerned that Web sites have this level of information about my location.

   48% Agree
   27% Not sure
   26% Disagree

3. I am concerned that third-party tracking sites can infer information about demographic information such as age and gender based on the sites I visit.

   54% Agree
   25% Not sure
   21% Disagree

With a sampling error of $\pm 2\%$ (95% confidence interval), these results show statistical significant differences between the three responses. Users are most concerned about monitoring of activities with 63% agreeing to a statement of concern on this issue and only 12% disagreeing. This result is similar to a survey by Turow et al. where 66% of Americans do not want behavioral advertising (Turow et al., 2009).

There is less concern about revealing a user's location, which is determined based upon the Internet address of the user's machine, although only 26% indicate no concern for this information. Concern for inference of demographic information lies between the other two pieces of information.

While the overall results represent a large number of respondents we have no control over the nature of these users—for example as reported in Section 4.1.2 we know that 72% of our respondents are male. In the next step of our work we took these three questions and analyzed their results based upon four independent

characteristics about a user: gender, age range (limited to a subset of users as described in Section 4.1.3), location and concern about monitoring of activities. This last characteristic is based on a user's response to the first question and is intended to understand how a user's level of concern correlates to other concerns and actions. The results of this analysis are shown in Table 3.

Table 3: Attitudes Based on Four User Characteristics

		Gender		Age		Location			Concerned w/ Monitoring	
Attitude	All	M	F	25-34	35-44	Worc	US-Worc	non US	Agree	Disagree
Concerned that third-party tracking sites monitor activities.										
Agree	63	*61*	*67*	63	**69**	**54**	65	65	100	0
Disagree	12	*14*	*7*	15	10	17	11	13	0	100
Concerned that Web sites have information about location.										
Agree	48	**45**	**55**	47	44	47	49	52	**69**	**5**
Disagree	26	**29**	**17**	30	27	30	24	23	**11**	**88**
Concerned that tracking sites can infer demographic info.										
Agree	54	*52*	*58*	53	53	48	54	57	**76**	**10**
Disagree	21	**24**	**15**	26	21	25	21	23	**7**	**81**

The table drops the "not sure" responses for each question and focuses on respondents that agree or disagree with each statement. The second column in Table 3 simply repeats the result of all users for easier comparison. Responses that are statistically significant at the 95% level in comparison with responses from users without the given characteristic are shown in **bold** font. Statistically significant results at the 90% level are shown in *italics* font.

The results show that for all three questions females have more concern about the information than males. In all cases this difference is statistically significant at the 90% or 95% level. Recent studies (TRUSTe, 2009; Turow et al., 2009) did not specifically report differences in attitudes between male and female users, although previous studies have generally found females to have more privacy concerns (Graeff and Harmon, 2002; Sheehan, 1999).

There are not strong distinctions in results based on the 21% of users we could identify as in or close to the 25-34 age range or the 19% of users in or close to the 35-44 age range. We did observe a statistically significant difference for the 35-44 age-range users that showed a concern for monitoring of activities by third parties.

In analyzing the results based on location we separated the users for whom the location was correct or close to correct into three groups: those located in Worcester, MA (Worc); those located outside of Worcester, but in the United States (US-Worc); and those located outside of the United States (non US). We expect the Worcester results to exclusively represent students, faculty and staff at WPI and thus wanted to explicitly separate out this population for study. As shown, the only statistically significant result is that Worcester users are less concerned with monitoring of activities than all other respondents. Although we do not know the age composition of WPI respondents we do know that 70% of the email messages sent to initially publicize the site went to undergraduate WPI students and results in (Turow et al., 2009) found this age group the most accepting of tailored ads. This finding likely explains the result we obtained.

Finally, we characterized users by their concern for monitoring of activities to see if this concern correlated to other concerns. By definition, the first result shows 100% values, but as expected the responses for the other two questions correlate to the answer for the first question with 69% of users who expressed concern for monitoring activities also expressing concern for Web sites having location information. Similarly, 76% of users expressing concern for monitoring also expressed concern about inferring demographic

information. Correlation between statements of disagreement were even stronger at 88% and 81%.

We next used our data set to understand the variation in user response according to the sites they visit. For this portion of the analysis we examined the characteristics for the set of users confirmed to have visited the most popular sites of our set of users in Figure 3. Table 4 shows selected results for the top few sites as well as other sites exhibiting significant differences for these responses or in the set of actions taken in the following section.

Table 4: Attitudes Based on a Sampling of Visited Sites

	Visited Site								
Action	Google	Facebook	CNN	Weather	Yahoo	Twitter	Hulu	Pandora	USPS
Concerned that third-party tracking sites monitor activities.									
Agree	63	63	**72**	62	65	62	61	**56**	60
Disagree	12	13	9	12	12	14	14	14	14
Concerned that Web sites have information about location.									
Agree	47	46	48	43	46	**42**	42	**38**	**38**
Disagree	28	29	25	28	25	**34**	*34*	**36**	30
Concerned that tracking sites can infer demographic info.									
Agree	52	50	55	49	54	**48**	**45**	**43**	47
Disagree	23	24	20	25	23	26	28	26	24

These results show few significant results for concern on the monitoring of activities with only CNN users at 72% (when compared with non-CNN users at 60%) more likely to agree with concern and Pandora users at 56% (when compared with non-Pandora users at 66%) less likely to agree with concern. Users of a number of sites were significantly less concerned that Web sites have information about their location when compared with non-users of these sites. These sites include Twitter, Hulu, Pandora and USPS (United States Postal Service). Users of three of these sites—Twitter, Hulu and Pandora—were also significantly less likely to be concerned about inference of demographic information.

4.3 User Actions on Tracking

In the next portion of our analysis, we examined how these attitudes towards privacy tracking translated into actions taken by users to control it. Preventing the disclosure of location based upon Internet address is difficult because a user's Internet address is contained in each Web request. One prevention method is to use a Web proxy that services requests from users in a number of locations and consequently anonymizes the location of users making use of it. Similarly preventing tracking sites from inferring demographic information once they know the set of sites a user visits is even more difficult. Other than preventing tracking altogether, users could try to "pollute" their profile by intentionally visiting sites that would cause their inferred profile to be inaccurate. While possible, we did not survey users if they took any of these actions

Rather we focused on six questions regarding actions discussed in Section 2 that users can take regarding blocking ads, blocking and deleting cookies, opting out of targeted ads, removing history and using private browsing. The specific questions and survey results for possible answers are as follows:

1. Use of ad blocker tools will prevent some tracking by third-parties identified for your set of visited sites. Do you use any ad blocker tools to prevent the display of advertisements in Web pages?

55% Yes
33% No
11% Don't know

2. Use of cookie blocking by your browser will prevent some tracking by third-parties identified for your set of visited sites. Do you:

   37% Allow all cookies (Internet Explorer and Firefox default)
   43% Allow cookies for only sites I visit (block cookies to third-party sites)
   3% Allow no cookies (block cookies for all sites)
   17% Don't know

3. How often do you delete cookies?

   21% Often
   52% Sometimes
   21% Never
   6% Don't know

4. Some third-party sites provide an "opt-out" mechanism to avoid receiving targeted ads. The Network Advertising Initiative (NAI) is a cooperative of such sites. Do you use opt-out cookies for third-party sites?

   16% Yes
   55% No
   29% Don't know

5. Periodic removal of browser history prevents scripts like this one from detecting what sites you visit, but will not prevent third-party sites from tracking your behavior (they typically use cookies). What browser history settings do you use:

   68% Use browser default for managing history
   15% Clear history when browser closes
   4% Set browser to not remember history
   12% Don't know

6. Newer versions of browsers have features to create a "private" browsing session where history is not recorded. These include InPrivate Browsing for Internet Explorer, incognito mode for Chrome and Firefox Private Browsing. Do you use any of these features?

   33% Yes
   57% No
   10% Don't know

The results show that a majority of users report using an ad blocker tool, although the result is less than the 68% of respondents of a previous survey (TRUSTe, 2009) indicating they would use such a browser feature. Nearly three-quarters of users delete cookies at least some amount of time. In contrast, less than 20% of users report using an opt-out mechanism or removing browser history.

For easier comparison across the set of possible actions, we determine the percentage of users that have changed from the default for each. For some actions, we compute the percentage based on one possible answer while for other actions we sum the percentages of two possible answers. In all cases, we treat an answer of "don't know" as using the default for the action. Using this approach, the six possible actions by a user and answers contributing to the percentage for each are: use ad blocker ("yes"), block cookies ("block cookies to third-party sites" + "block to all sites"), delete cookies ("often" + "sometimes"), use opt-out

("yes"), remove history ("clear history on close" + "not remember history"), and use private ("yes"). The second column in Table 5 summarizes the results for all users for these six actions. In addition, the table shows the results based on the same four user characteristics used for analysis in the previous section plus one additional characteristic.

Table 5: Actions Taken Based on Five User Characteristics

		Gender		Age		Location			Concerned w/ Monitoring		Use Ad Block
Action	All	M	F	25-34	35-44	Worc	US-Worc	non US	Agree	Disagree	
Use Ad Blocker	56	55	56	52	**48**	61	55	53	56	53	100
Block Cookies	46	46	44	**39**	43	42	46	48	47	40	**54**
Delete Cookies	73	74	71	69	71	67	75	70	74	70	**79**
Use Opt-Out	16	15	20	12	11	16	17	13	16	15	*19*
Remove History	19	20	19	14	**9**	13	19	19	21	17	**24**
Use Private	33	**40**	**13**	*39*	32	39	32	38	32	**42**	35

In examining each of the characteristics there are no significant differences between male and female users except for the use of browsers' private browsing modes. Males are substantially more likely to use this feature than females, which may be explained by the "porn mode" nickname for this feature (Keizer, 2008). The lack of statistical difference for the other five privacy-related actions is notable because females were much more likely to express concern for leakage of information in the results shown in Table 3. One possible explanation for this discrepancy is that for all six actions, females were significantly (at 95%-level for five, at 90%-level for one) more likely to answer "don't know" as to their use of an action. These significant differences (not shown in the table) suggest less familiarity with these actions by females, which may limit their use in translating concern into actions. They may also indicate a lack of motivation in following up concern with actions.

Looking at age ranges, we see that in all cases except one, users in the two age ranges are less likely than all of our users to use the available actions and in three of these cases the differences are significant. However, the results show that users ages 25-34 are more likely to use the private browsing feature.

There were no significant differences found due to location. However there is generally a weak, but not statistically significant, correlation between user concern for monitoring and actions taken. For all actions, users agreeing with concern for monitoring report using actions at the same or slightly higher levels than average for all users. Similarly, users disagreeing with this concern use actions at a lower level than average except for the private browsing mechanism where its use is at a significantly *higher* level than average. These overall results indicate that the use of the private browsing feature is not well correlated with other possible actions available to users.

The last column in Table 5 includes all users that report using an ad blocker. This characterization is introduced to understand whether the use of one action correlates with the use of other possible actions. The results show there is such a correlation for all other actions except for private browsing. The correlation for most actions confirms what we would expect to be the case.

We next analyzed differences in preventive actions taken compared with the same set of visited sites used in Table 4. These results are shown for five of the possible actions in Table 6. The sixth action, removal of history, is not shown because its results for all sites is relatively low due to our approach of using browser history to determine if users visit a site. It means that if we detect a site *is* visited then it is less likely that a user has removed history.

The most popular sites, such as Google and Facebook, are less likely to show distinguishing characteristics since they encompass a majority of WhatTheyKnow users. The remaining sites tend to have some

Table 6: Actions Taken Based on a Sampling of Visited Sites

	Visited Site								
Action	Google	Facebook	CNN	Weather	Yahoo	Twitter	Hulu	Pandora	USPS
Use Ad Blocker	54	55	53	53	56	54	58	53	56
Block Cookies	42	44	46	**38**	**38**	44	44	**37**	41
Delete Cookies	71	71	71	**65**	69	71	**65**	**66**	**65**
Use Opt-Out	14	14	16	13	15	**12**	13	14	16
Use Private	35	36	33	31	32	**42**	**42**	36	35

actions that show significantly less use than the average for all sites, although again the private browsing feature is reported to be used significantly more for users of Twitter and Hulu.

4.4 Additional Results

We examined information regarding accuracy of the determined location, potential fingerprinting of browsers based upon browser type and plug-ins and user written comments. Results for each of these additional examinations are provided in the following.

4.4.1 Location Correctness

We asked respondents in our survey about the type of their location and found 56% at work/school (combining these because work is the expected daytime location for adults and school the expected daytime location for students), 40% at home and 4% at a public location. We also looked at the correctness of the location information based on the type of their location. Focusing on incorrect location, we previously reported that 13% of respondents indicated their location was incorrect. However in correlating this figure with location type we found that 12% of work/school and 12% of home users reported an incorrect location while 33% of public location users reported an incorrect location. This significant difference indicates that at least the IP location service we employed yields much poorer performance for public locations. We also compared the correctness of locations known to be in the U.S. and outside of the U.S. finding that 11% of each type were incorrect for no net difference.

4.4.2 Browser Fingerprinting

We also examined the uniqueness of browser configurations by computing a fingerprint of the browser type and list of installed plug-ins. The values not only contain names, but also version numbers, which help to make these strings distinct for each browser. In computing this fingerprint for our 3749 users we found 3166 (84%) unique browser fingerprints. These results indicate that such a fingerprint is not unique, but it is a possible means to track users, particularly when combined with other information such as IP address, even if users employ preventive measures. These results are similar in tone with a related project (Eckersley, 2010).

4.4.3 Written Responses

135 (7%) of the respondents who took the survey added a written response when submitting their answers. A noticeable number of comments were about the age or gender being incorrect, which is not surprising as

these demographics were intended more to get people's attention than to necessarily make accurate predictions with what was limited data in many cases. The most common comment was an appreciation for the site and the awareness it brought to users. The following are a sample of comments submitted by users.

> "I think the privacy issue is overrated. The age distribution about me was a joke."
>
> "Curious where your demographics data come from? Also, would like to have more choices on the multiple choice. I just picked "not sure" because either answer is not what I want to say. That is, I am concerned at a broad level about the way that we categorize people into statistical buckets, but I also recognize that my use of free services on the internet - gmail, wowwiki, google, etc... - demands that those companies make some money off of me - and so I have come to the decision that I will to some extent pay for these services via my data, so I am not sortof angry/grumpy/concerned/surprised. Also wish the private browsing mode was more nuanced–I have used before, but very rarely. I answered no."
>
> "I used to limit cookies from non-third party sites, but found too many sites broke if I did that. I often use NoScript as a privacy measure (but have found it causes problems since many legit sites forward traffic elsewhere). I would use these features more if the controls were more accurate."
>
> "Thanks for the info. I'm changing some of my settings!"
>
> "Made me realize that I ought to think more about my privacy settings and cookie settings."
>
> "Nice tool"
>
> "Interesting (and timely) idea. I look forward to hearing more about this project."
>
> "this is a great program and I hope it gets lots of use by many people and raises awareness of the issues!!"
>
> "Your questions opened my eyes to new features and protection mechanisms available. Thank you!"
>
> "Very interesting and yet disturbing!"

5 Conclusions

In this work we undertook a research study based upon a novel approach that educates users on what information about their browsing behavior is sent to third-party aggregators and the information that is inferred based upon their behavior. Our approach can be used by any user from any browser simply by visiting our Web site where JavaScript code probes a browser's history to determine popular Web sites that have been visited. We then map the known third-parties of these visited sites, determine age and gender demographics based upon the list of visited sites and use an IP location service to look up a user's location. This information is shown to users with a follow-up survey used to gauge user attitudes towards the availability of this information to third-parties as well as find out what actions users take to protect their privacy.

We sought answers to three research questions in our study. Our first question was about the viability of this approach for attracting a broad representation of users. We had nearly 4000 participants use the site in the first couple of months it was available to learn what is known about them with nearly half of these participants responding to a follow-up survey. These numbers are significant representing a number of identifiable sub-groups. Written feedback from users yielded a number of comments from users who appreciated what they learned from the site.

Our second research question examined user attitudes in the context of this knowledge. We found that 63% of users agreed with concern for third parties monitoring activities while 12% disagreed and the

remainder were not sure. This level of concern is comparable to other studies that have been done. About half of our respondents agreed with a concern for knowledge about a user's location with a little more than half agreeing to concern about inference of demographic information. In examining these responses based on specific user characteristics we found that females are more concerned about these issues than males. We also found strong correlation between the responses of a user for each of these three issues. We found that users of sites such as Twitter and Pandora showed less concern for Web sites having location information or being able to infer demographics.

Our third research question focused on what actions users take to control tracking of their actions. A majority of users report using an ad blocker tool and even more report deleting cookies at least some amount of time. Using an opt-out mechanism or removing browser history is done by less than 20% of users. Users expressing concern for monitoring were only slightly more likely to take preventive actions. Users who blocked ads were more likely to take other actions.

Despite expressing more concern for information known by third-parties, females are not significantly more likely to take actions that may limit what is leaked to these third parties. A contributor to this gap between expressed concern and action is that females were much less likely to know their settings for many of the actions indicating less familiarity with them. Males were much more likely to use the so-called "porn mode" private browsing feature of browsers.

Moving forward, the WhatTheyKnow Web site continues to live and educate users. There are also a number of directions for future work. First, we could improve our ability for analysis by directly asking users for demographic information instead of trying to infer it. We could also improve our calculation of the age range and allow users to provide sites instead of only relying on browser history.

The tool could be further used in a teaching role to help educate students on privacy and security. One of the authors has already used the site in a social implications of computing course. Use of before and after testing would help assess any behavioral changes from use of the tool. While we did receive some user comments indicating what they learned, our own survey would have been improved if we had specifically asked users how their own attitudes and actions were changed based upon the results instead of simply asking about their attitudes and actions.

A related direction is to use ideas from this tool to explore how users make privacy-related decisions. Such a tool could help researchers better understand why users are concerned with monitoring of activities on the Web, yet do not necessarily take actions to control such monitoring.

A final direction is to not just ask users about what protective actions they take, but to develop a tool that can directly determine what actions are used and provide users personalized recommendations on what changes in protections they could make. Quantifying the potential benefits of privacy protection actions for individual users could lead to more effective use of these actions.

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