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UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

OAKLAND DIVISON

MATTHEW CAMPBELL and MICHAEL HURLEY,

Plaintiffs,

v.

FACEBOOK, INC.,

Defendant.

Case No. C 13-05996 PJH (MEJ)

**PUTATIVE CLASS ACTION**

**DECLARATION OF DAN FECHETE IN SUPPORT OF DEFENDANT FACEBOOK, INC.'S OPPOSITION TO PLAINTIFFS' MOTION FOR CLASS CERTIFICATION**

I, Dan Fechete, declare as follows:

1. I have been employed as a software engineer at Facebook since October 2011, and my current title is Engineering Manager. I am over the age of 18. Since I joined Facebook, I have worked on Facebook's Developer Platform, and, until they were deprecated, my work encompassed Facebook's "Recommendations" and "Activity Feed" plugins and certain Facebook services related to those plugins. The following facts reflecting functionality prior to October 2011 are based on my review of the cited documents and related source code. The following facts reflecting functionality after October 2011 are based on my review of the cited documents and related source code, as well as my personal knowledge. If called and sworn as a witness, I could and would testify competently to these facts.

2. I provide this Declaration to explain certain facts regarding Facebook's software code as it relates to Facebook's "Recommendations" and "Activity Feed" plugins and certain Facebook services related to those plugins, particularly as they related to uniform resource locators ("URLs") in messages sent and received through the Facebook platform.

3. I understand that on November 13, 2015, Plaintiffs filed a Motion for Certification of the following proposed class:

> All natural-person Facebook users located within the United States who have sent, or received from a Facebook user, private messages that included URLs in their content (and from which Facebook generated a URL attachment), from within two years before the filing of this action up through the date of the certification of the class.

I understand that Plaintiffs filed their action on December 30, 2013, and that therefore the relevant period for Plaintiffs' new purported class is December 30, 2011 to present (the "Class Period").

4. I understand that Plaintiffs have submitted an expert report from Dr. Jennifer Golbeck in support of their Motion for Certification, which purports to describe Facebook's "interception and acquisition of the URL attachments in Private Messages," as well as purported "uses" of that data—including use in "External Recommendations," "Taste," and "Activity Feed." I also understand that her report (as well as her deposition testimony) included the statements cited herein.

**Overview of Recommendations Plugin and "Taste"**

8. Facebook's Recommendations Feed[1] was a social plugin offered to developers that displayed a list of URLs representing the most recommended webpages on that developer's site. If someone was logged into Facebook when he or she visited the developer's website, Recommendations Feed prioritized information that was subject to certain actions by that person's Facebook friends, including friends' clicking on a "Like" button on a given webpage. For example, a site that publishes articles might display the most recommended articles and those articles recommended by a friend of the viewer, as illustrated by the example below:


9. The general purpose of the Recommendations Feed was to help people discover web information that they were likely to want to view, enjoy, and interact with. It was part of a set of social plugins announced at the same time (April 2010), all of which were designed to personalize non-Facebook webpages with information that a particular person would find valuable, in order to personalize the internet at large with social context in order to facilitate information discovery and encourage social interaction.

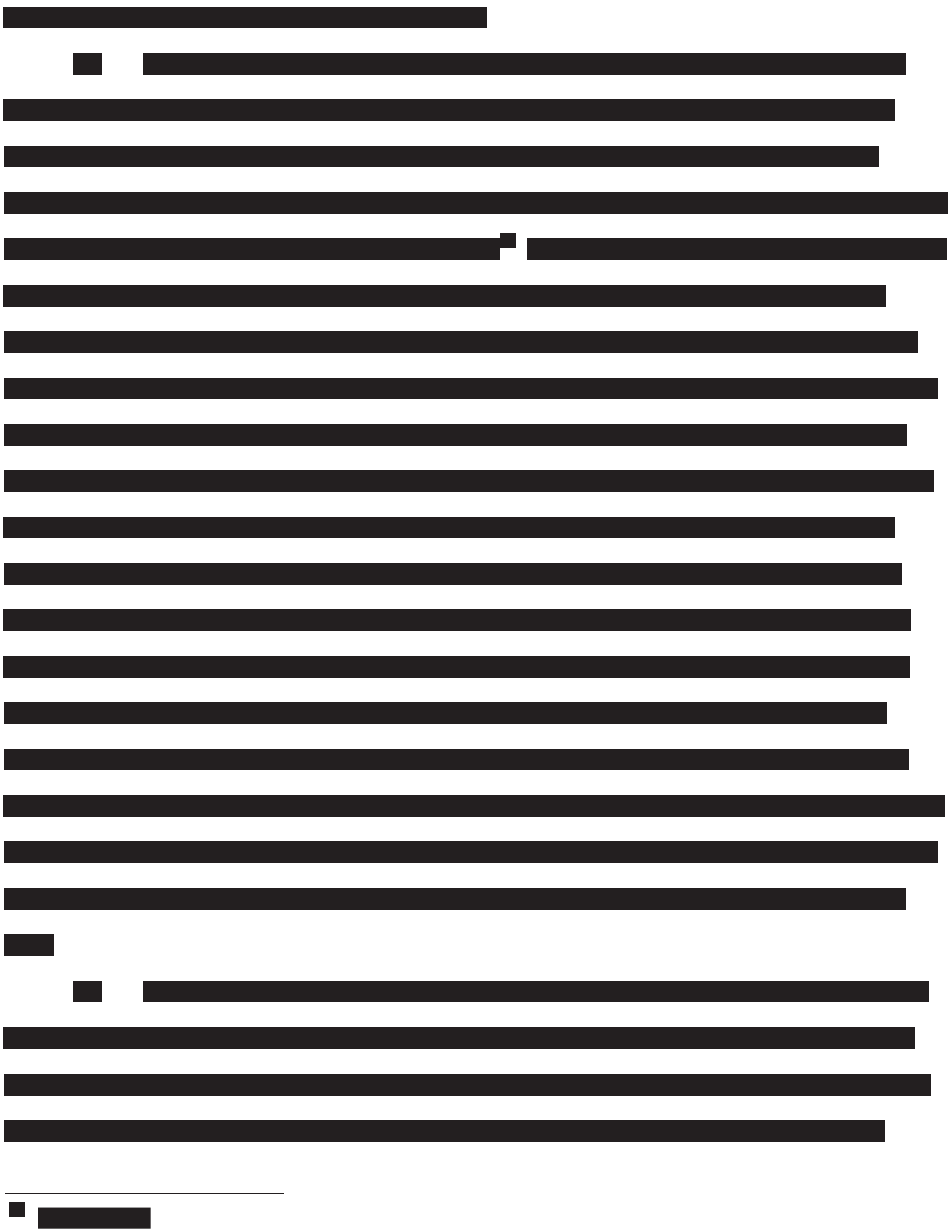
[1] Dr. Golbeck refers to this as the "Recommendations widget." (Golbeck Report ¶ 60.)

10. Facebook's Recommendations Feed was announced to the public at Facebook's F8 conference in April 2010 (a conference where Facebook announces new products and features). In addition to the Recommendations Feed, the Recommendations "API" was an interface on or from a Facebook webpage that allowed people to write queries to display the same information presented by the Feed.[2] Likewise, the Recommendations "Bar" was a later implementation of the same Recommendations Feed, but also added the ability for the viewer to "Like" or "Share" the Recommended information. It was introduced on July 26, 2012. Unless otherwise indicated below, the Recommendations API and Recommendations Bar reflected the same information displayed by the Recommendations Feed at a given time for a given URL viewed by a given person. The Recommendations Feed (and related Bar and API) were discontinued on June 23, 2015.

[redacted]

[2] Dr. Golbeck refers to this as "an API call in RecommendationsGetAPI.php." (*Id.*)

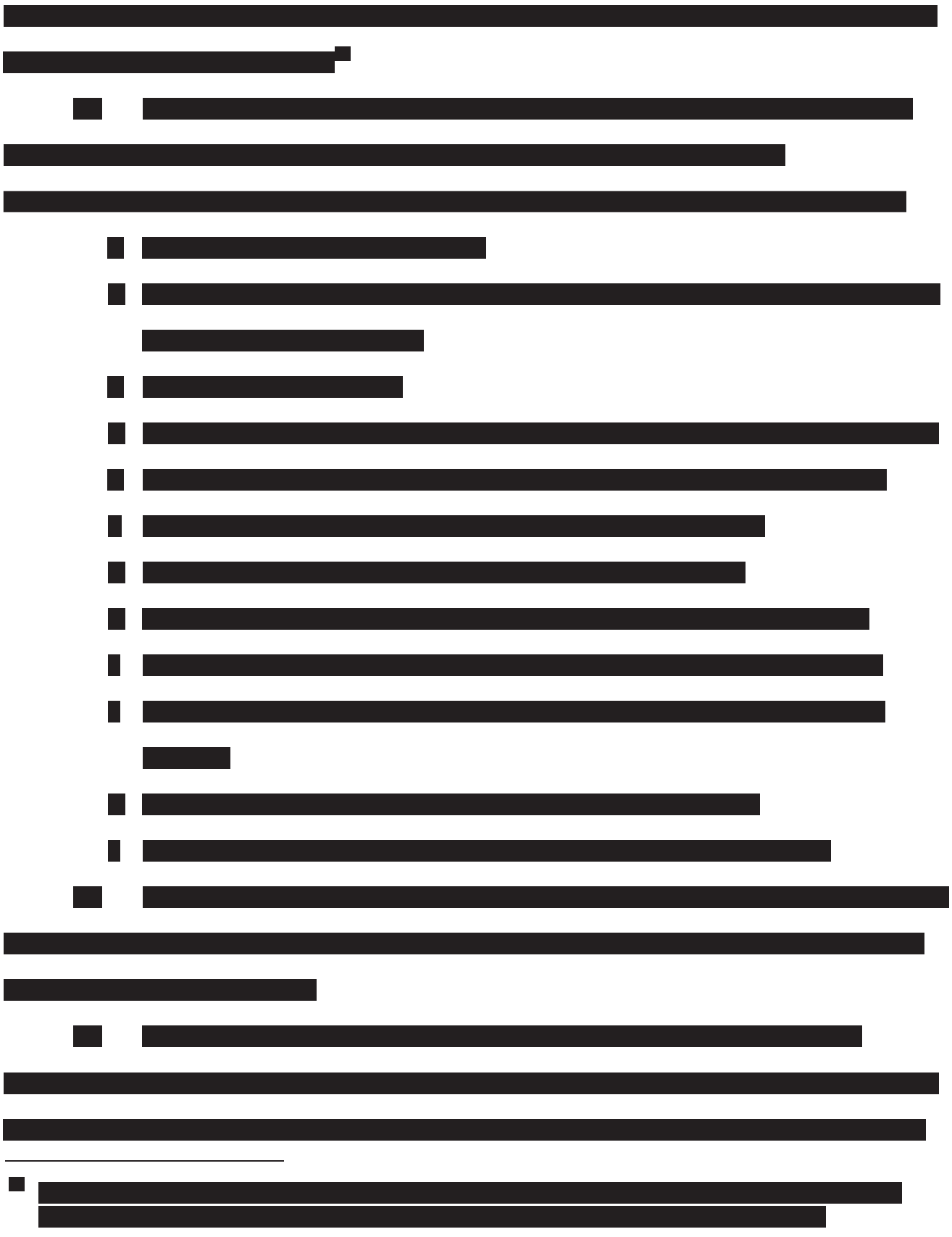
[redacted]



[redacted]

30. From June 23, 2015, when the Recommendations Feed was discontinued, to present, the Recommendations Feed has not existed.

[redacted]



**Activity Feed Plugin**

38. Facebook's Activity Feed was a social plugin offered to developers that displayed a list of recent activity taken on that developer's site. If someone was logged into Facebook when she visited the developer's site, Activity Feed prioritized actions by that person's Facebook friends, particularly friends' clicking on a "Like" button on a given webpage. If the person was not logged in, or there was not enough activity to fill the Activity Feed, the Activity Feed would have reflected URLs from the Recommendations Feed. Developers also could have configured the plugin to show both the Activity Feed and Recommendations Feed.

39. The general purpose of the Activity Feed was similar to the Recommendations Feed, to help people discover web information that they were likely to want to view, enjoy, and interact with.

40. Facebook's Activity Feed was announced to the public at Facebook's F8 conference in April 2010. The Activity Feed was discontinued on June 23, 2015.

[redacted]

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct and that this declaration was executed on January 15, 2016 in Menlo Park, California.

/s/ Dan Fechete
Dan Fechete

## ATTORNEY ATTESTATION

I, Christopher Chorba, attest that concurrence in the filing of this Declaration of Dan Fechete has been obtained from the signatory. I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed this 15th day of January, 2016, in Los Angeles, California.

Dated: January 15, 2016

*/s/ Christopher Chorba*
Christopher Chorba

# EXHIBIT PP

# App. 1710
# Filed Under Seal

# EXHIBIT QQ

# App. 1712-1749
# Filed Under Seal

# EXHIBIT RR

# App. 1751-1773
# Filed Under Seal

# EXHIBIT SS

# App. 1775-1792
# Filed Under Seal

# EXHIBIT TT

# App. 1794-1798
# Filed Under Seal

# EXHIBIT UU

# App. 1800-1825
# Filed Under Seal

# EXHIBIT VV

# App. 1827-1835
# Filed Under Seal

# EXHIBIT WW

# App. 1837-1843
# Filed Under Seal

# EXHIBIT XX

# App. 1845-1853
# Filed Under Seal

# EXHIBIT YY

# App. 1855-1899
# Filed Under Seal

# EXHIBIT ZZ

# App. 1901-1914
# Filed Under Seal

# EXHIBIT AAA

# App. 1916-1927
# Filed Under Seal

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UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

OAKLAND DIVISON

MATTHEW CAMPBELL and MICHAEL HURLEY,

Plaintiffs,

v.

FACEBOOK, INC.,

Defendant.

Case No. C 13-05996 PJH (MEJ)

**PUTATIVE CLASS ACTION**

**DECLARATION OF MICHAEL ADKINS IN SUPPORT OF DEFENDANT FACEBOOK, INC.'S OPPOSITION TO PLAINTIFFS' MOTION FOR CLASS CERTIFICATION**

I, Michael Adkins, declare as follows:

1. I have been employed as a software engineer at Facebook since May 2010, and my current title is Engineering Manager. I am over the age of 18. I have worked on the Facebook Messages product to build anti-abuse, security, and anti-phishing systems for the Facebook Messages product. My responsibilities generally involve ensuring the integrity of messages passing through Facebook's system to ensure that they are not malicious, fraudulent, or spam. My work thus encompasses [redacted] one of Facebook's suite of anti-abuse systems (also referred to as "Security" systems). Unless otherwise stated, the following facts are within my personal knowledge and, if called and sworn as a witness, I could and would testify competently to these facts.

2. I provide this Declaration to explain certain facts regarding Facebook's software code as it relates to Facebook's [redacted] and other Security-related systems, particularly as they relate to uniform resource locators ("URLs") in messages sent and received through the Facebook platform, in support of Facebook's Opposition to Plaintiffs' Motion for Class Certification.

3. As explained in further detail below, Facebook source code is configured to run [redacted] Accordingly, there are many instances when a URL or URL attachment generated in connection with a message will not lead to the creation of a [redacted]. Specifically, in those instances when a URL attachment is blocked by Sentry, no [redacted] will be created. Further, contrary to assertions I understand Plaintiffs have made in this case, [redacted] generated from URL attachments to messages for its security and anti-abuse functions.

**Overview of Sentry**

4. [redacted] to determine whether a message or post, or information included with it – such as a URL – is malicious, fraudulent, or otherwise harmful. For example, if a person using Facebook posts or sends a message with the URL http://clickmonkeys.com, [redacted] would analyze the URL to determine

whether it is a harmful link containing spam, malware, a virus, or the like, and whether it is likely that the sender's account has been hijacked (given that it sent a malicious or spammy URL or URLs). [redacted] can likewise run things like [redacted]

5. One general purpose of Facebook's Security systems (including [redacted], among others) is to protect people and their data when they use Facebook. For instance, Facebook encrypts user activity (whether that involves posting a status update or sending a message) so that third parties cannot access it in transit, and if an individual clicks on a spam post accidentally, Facebook's detection tools determine whether a virus has infected the individual's browser or computer and helps to remove it. [redacted] among other Security tools, was built to ward off attacks from cyber criminals, hackers, and other such individuals or entities, so that all people legitimately using Facebook can enjoy the site safely and confidently.

6. Sentry runs a series of various filters and other mechanisms by which to detect abuse or other fraudulent activity on Facebook; these include functions called [redacted] and "Sigma." [redacted] the URL typed in the text of the message [redacted]. Sigma, in turn, is a rules engine that runs a series of policies [redacted]

**Sentry and URLs in Messages**

7. As noted above in paragraph 3, Facebook code is configured such that [redacted]

8. *First*, during the period covered by discovery in this case (2010-2013), [redacted], Facebook would assess [redacted] This functionality can be seen [redacted] which specifically states that [redacted]

9. Specifically, if the sender typed a URL into the message and [redacted], which would in turn, [redacted] (which is contained in a system called [redacted]), it would tell [redacted]. Accordingly, no URL preview would be generated. So instead, [redacted]. This was true whether the person using Facebook was attempting to share the URL through a message or through a public post to their profile, a status message on their NewsFeed, a post to a friend's profile, or the like; [redacted] to generate a URL preview. [redacted]

10. *Second*, if a URL preview was successfully generated (and not deleted by the sender), the URL attachment would have been sent with the message when the sender pressed "Send." [redacted]

to determine and help resolve any abuse- or security-related issues. [redacted] detect large-scale automated abuse (e.g., spam, malware, phishing, and other abuse). For example, Sigma [redacted]. Likewise, the [redacted]. Further, [redacted] could be run through Facebook's [redacted]

11. [redacted], and that the sender was allowed to send messages to that recipient (i.e. the recipient had not blocked that sender). This would also include [redacted] qualify for delivery to the Inbox or whether it should be directed to the" Other" folder, based on the sender-recipient(s) relationship and the recipient's configured settings. The [redacted]. If such an error occurred, the [redacted]. If such an error occurred with respect to a URL attachment to a message, [redacted].

12. Further, the [redacted]. Accordingly, [redacted] may use [redacted]

[redacted]. Based on the [redacted] the sender might have seen the following security prompt:


13. [redacted], including [redacted] to perform their anti-abuse- and security-related functions. For instance, [redacted] – was available to and used by Sigma, [redacted].

14. *Third,* when a sender or a recipient tried to view the sent message, [redacted] It would once again run a [redacted] discussed in paragraphs 10-13 and if any of these threw an error, the message, part of the message, or its URL attachment may not have been rendered to the recipient. Of course, this set of checks would not occur if [redacted]

[redacted]

detect that a URL attachment to the message was potentially dangerous when the recipient (or sender) tried to view it in their inbox, it could have shown the following security protocol to the recipient (or sender) when they tried to view the message and its attachment:


15. Note that, if in this process, [redacted] it could not render its URL attachment to the recipient (or sender) trying to view that message. [redacted]

**Variability Among Class Members and Over Time in Connection with Sentry**

16. There was considerable variability in a given instance with respect to whether [redacted] on a message and any URL attachment associated with it.

17. For efficiency reasons, the Sigma [redacted]

[redacted]. Thus, [redacted] presented by each message. It is impossible to know precisely what [redacted] will do given the variability of the input and other data [redacted] at a given time.

18. Further, each individual [redacted], Sigma, [redacted] among others) could determine whether [redacted] For instance, if a sender attempted to upload a malicious file, [redacted]

19. Further, Facebook's [redacted]

20. Similarly, as described earlier above, if a sender sent a message to a recipient recognized as their Facebook friend, but the message contained a URL known to be a spammy link, [redacted]

21. Alternatively, [redacted] but was later determined by [redacted] so that it would not have rendered the URL preview attachment to the sender or recipient if they later reopened that message in their Inbox or Sent Messages folder.

22. Taking all of this variation together, at a minimum, determining whether a putative class member's share of a URL in a message actually resulted in [redacted], among other things, on whether the [redacted] Such a determination would require the following individualized inquiries *for each message*:

a. Was the message sent from the Facebook website, or was it sent using the Share Plugin on a third party website?

b. Did the sender either copy and paste a URL into the draft message text field, or type a URL into the draft text and press the space bar?

c. Was the URL to a third-party webpage (as opposed to a Facebook webpage)?

d. Was the sender using a browser that is JavaScript capable?

e. Did the sender have JavaScript enabled in her browser?

f. Did any of the [redacted]

g. When the message was sent, [redacted] or Sigma [redacted], among other things?

h. After the message had been sent, and the sender or recipient attempted to view it, was the URL attachment, or part of the message, or the whole message, [redacted]?

23. To my knowledge, neither Facebook nor any other entity possesses the data that would be required to ascertain the answers to the inquiries in paragraph 22(a)-(g), either on an individual or bulk basis, for putative class members.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct and that this declaration was executed on January 14, 2016, in Menlo Park, California.

*/s/ Michael Adkins*
Michael Adkins

**ATTORNEY ATTESTATION**

I, Christopher Chorba, attest that concurrence in the filing of this Declaration of Michael Adkins has been obtained from the signatory. I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed this 15th day of January, 2016, in Los Angeles, California.

Dated: January 15, 2016

*/s/ Christopher Chorba*
Christopher Chorba

**UNITED STATES DISTRICT COURT**
**NORTHERN DISTRICT OF CALIFORNIA**

MATTHEW CAMPBELL and MICHAEL HURLEY, on behalf of themselves and all others similarly situated,

Plaintiffs

v.

FACEBOOK, INC.,

Defendant

Case No. C 13-05996 PJH

**Expert Report of Dr. Benjamin Goldberg**

Table of Contents

## I. QUALIFICATIONS

1. I am a tenured Associate Professor in the Department of Computer Science of the Courant Institute of Mathematical Sciences, New York University ("NYU"), in New York, NY. I have held this position since September 1994. From 1987 to 1994, I was an Assistant Professor in the Department of Computer Science at NYU. Since September 2014, I have been the Director of Graduate Studies for the MS programs in the Department of Computer Science, having previously served in that role from September 2009 through August 2012. I served as the Director of Undergraduate Studies for the Department of Computer Science from September 1995 through August 1998 and from September 2003 through August 2006. In addition, I have held a one-year visiting professorship at the Institut National de Recherche en Informatique et en Automatique (INRIA), a national laboratory in France, and was twice appointed to a month-long position as an invited professor at the Ecole Normale Supérieure, a university in Paris.

2. I received my Doctoral degree in Computer Science from Yale University, New Haven, Connecticut in 1988, having previously received Master of Science and Master of Philosophy degrees in Computer Science from Yale in 1984. My undergraduate degree from Williams College in 1982 was a Bachelor of Arts degree with highest honors in Mathematical Sciences.

3. I have taught courses at the undergraduate and graduate level in, among other things, software development, programming languages, object oriented programming, hardware design, and operating systems (including networking). I have also published extensively in the areas of memory management and distributed and parallel computing, which involves computers connected by networks and data transmission between computers.

4. I have testified numerous times as an expert in computer science at trial in U.S. District Court, including in the U.S. District Court for the Northern District of California. I have

also provided two technology tutorials to the Court in the U.S. District Court for the Northern District of California. Additional information concerning the computer science courses that I have taught, my professional publications and presentations in the field of computer science, and cases in which I have testified as an expert at trial or deposition in the past four years are set forth in my current Curriculum Vitae, a copy of which is attached as Exhibit BBB.

## II. SUBJECT MATTER OF OPINIONS

5. I have been retained by Gibson Dunn, counsel for Facebook, to form opinions regarding the operation of the Facebook social networking service, to explain the meaning of computing terminology related to this matter, and to respond to certain assertions made by Dr. Jennifer Golbeck in her November 13, 2015 Report in Support of Plaintiff's Motion for Class Certification ("the Golbeck report"). (Dkt. No. 137-6.)

6. I am being compensated at a rate of $450 per hour for my work in this matter. My compensation is in no way conditioned on the nature of my opinions or on the outcome of this matter.

## III. MATERIALS REVIEWED

7. A complete list of the materials that I reviewed in forming my opinions set forth in this report is attached hereto as Exhibit CCC. As detailed further below, I also reviewed portions of Facebook's source code from the period of September 2009 to December 2012, which I understand to be the same source code to which Dr. Golbeck had access. Consequently, unless otherwise specified, my opinions are limited to the operation of Facebook's messaging service during that period.

## IV. SUMMARY OF OPINIONS

8. I disagree with Dr. Golbeck's conclusions that Facebook's implementation of what I or any other skilled computer scientist would consider routine programming functions are "interceptions" of message content using what she calls "code-based devices" (a term I have never heard before). Dr. Golbeck concludes that [redacted], is an "interception," but she does not draw the same conclusion about any of the other objects that are generated when a message is sent. [redacted] not unusual in object-oriented programming, and here, [redacted]

9. Dr. Golbeck also claims that [redacted] also constitute interceptions. However, [redacted] processes performed by nearly all software systems to track error rates, resource usage or congestion, and security concerns, among other things.

10. Even if Dr. Golbeck's characterization of these standard programming practices as "interceptions" were credited, an individual, message-by-message inquiry would be required to determine whether [redacted]

[redacted]

11. Similarly, to determine whether [redacted]

Facebook's "Insights" feature (an interface for website owners to view data about engagement with their sites); aggregate, anonymous Plugin Counters (numbers that website owners can display with Facebook's social plugins that reflect the level of engagement with those sites); aggregate, anonymous counters in the [redacted] Graph API (publicly available counts that reflect the level of engagement with a given URL); and Recommendations and Activity Feeds (which displayed a list of pages for a given website that the viewer may be interested in seeing). However, determining whether [redacted]

i. The date the message was sent, [redacted]

[redacted]

[redacted]

[redacted]

v. [redacted]

12. Dr. Golbeck cannot validly opine on the current operation of the messages product since she, like I, could have examined, and at most did examine, only Facebook source code operational until December 31, 2012 (per the agreement of the parties). Accordingly, while her report expresses conclusions about the *current* operation of Facebook software, I do not believe she has a factual basis for these conclusions since there is no way for her to have reliably determined the behavior of Facebook's software for any date after December 31, 2012. Her attempt to interpret internal Facebook emails allegedly bearing on potential practices (most or all of which appear to be written long before the beginning of the Class Period) does not form a valid basis for these conclusions about the operation of the current source code (or source code from any time period).

13. Dr. Golbeck also provides "sample" code for a database query of her own design, which she claims would yield a list of the Facebook IDs of everyone whose actions had [redacted] and she has stated that this would identify the members of Plaintiffs' proposed class. However, her proposed query is both under- and over-inclusive in a number of ways (all of which I understand she has conceded). First, it will be under-inclusive in that it will not identify:

[redacted]

[redacted]

iii. Senders and recipients whose accounts were deleted;

[redacted]

[redacted]

Dr. Golbeck's proposed query will also be over-inclusive in that it will include:

vii. Senders whose messages did not contain URLs in their text;

viii. [redacted]

ix. Senders and recipients outside the United States;

x. Senders of messages outside the Class Period; and

xi. Senders that were not subject to the challenged "uses."

Her proposed query also cannot identify senders:

[redacted]

14. As discussed below in further detail, [redacted]

15. I disagree with Dr. Golbeck's distinction between "memory" and "storage," in which she claims that, when a [redacted]

[1] [redacted]

[redacted], they are held in memory, not storage. I have never encountered such a distinction in my decades of experience as a computer scientist. Computer systems use different forms of electronic storage, including but not limited to CPU storage, CPU cache memories, random access memory (or RAM), and disk or flash memory; indeed, memory in computing is a form of storage. But even under Dr. Golbeck's unique definition of storage (with which I do not agree), [redacted]

16. Finally, I disagree with Dr. Golbeck's conclusion that Facebook's alleged interception, [redacted] was not necessary for the messaging functionality on Facebook. First, while I do not offer an opinion on illegality as a legal conclusion, I note that Dr. Golbeck appears to use an incorrect inquiry for determining whether any interception was performed in the ordinary course of Facebook's business. Dr. Golbeck assessed whether the alleged interception was "necessary." However, I understand the Court has instead stated that the relevant inquiry is whether there exists any nexus between the alleged interception and Facebook's ultimate business, which is to allow people to share information and connect with other people in a safe, efficient online space. Since my review of the source code and reliance on sworn testimony of Facebook's engineers indicate that Facebook's [redacted] both necessary and also have a clear nexus to Facebook's messaging service *and* its ultimate business.

## V. TECHNOLOGY OVERVIEW

17. The technology at issue in this matter relates to the messaging feature of the Facebook social networking platform. The specifics of the Facebook platform are described below in a subsequent section of this report. This section provides a general overview of the technology and defines various technical terms used throughout my report.

18. Facebook, like most services found on the Internet, utilizes a client-server architecture. In a client-server architecture, people on "client" devices, usually personal computers and mobile devices such as smart phones and tablets, interact with a user interface supported by software—generally referred to as "client software"—running on their client devices. More demanding computations, storage of larger amounts of data, and communication between different people are supported by server computers, which are larger, more powerful computers with large amounts of storage capacity. The software that the server computers run, generally referred to as "server software", usually responds to requests from numerous client devices, generates the data to be provided to the clients (often specifying the format of the display of the data), interacts with database management systems to store and retrieve data, and, in many cases, communicates with other server computers. The terms "client" and "server" are used to refer either to the client and server software or to the client and server machines—or both. In this report, unless stated otherwise, I will use "client" and "server" to refer to the software and hardware together. For example, when I discuss a "Facebook server", I am speaking of Facebook server software running on a Facebook server computer.

19. Clients and servers in many modern client-server systems use HTTP, the Hypertext Transport Protocol defined by the World Wide Web consortium (*see* http://www.w3.org/Consortium/) to communicate with each other, almost always over the Internet. Services provided by servers to clients using the HTTP protocol are usually referred to

as “web-based” services. Clients request resources, such as documents (e.g. web pages, audio files, and videos) and services (for shopping, travel, etc.), by issuing HTTP requests. An HTTP request is directed to the proper server—and specifies the desired document or service on that server—using a uniform resource locator (URL). Examples of URLs include https://www.google.com/, http://www.ford.com/new-cars/, and https://en.wikipedia.org/wiki/Webserver_directory_index.

20. People on client devices can communicate with each other in numerous different ways, such as via electronic mail (email), video chat, texting, and messaging. In each of these media, the data being transmitted is generally sent from a client to a server, which then may forward the data to another server, and so on, until the data is sent from a final server to the receiving client (of course, in some instances, there may only be a single server involved). When the data arrives at a server, it is stored on that server at least temporarily until it is forwarded to the next server or to the receiving client. In many cases, a server only forwards the data to the receiving client when the receiving client requests the data. For example, in many email and messaging systems, the email or message data is stored in the recipient’s “inbox” on a server until the email or messaging software on the client requests the data. The process of storing transmitted data on a server and forwarding the data to the next server or to a client is known as “store-and-forward”.

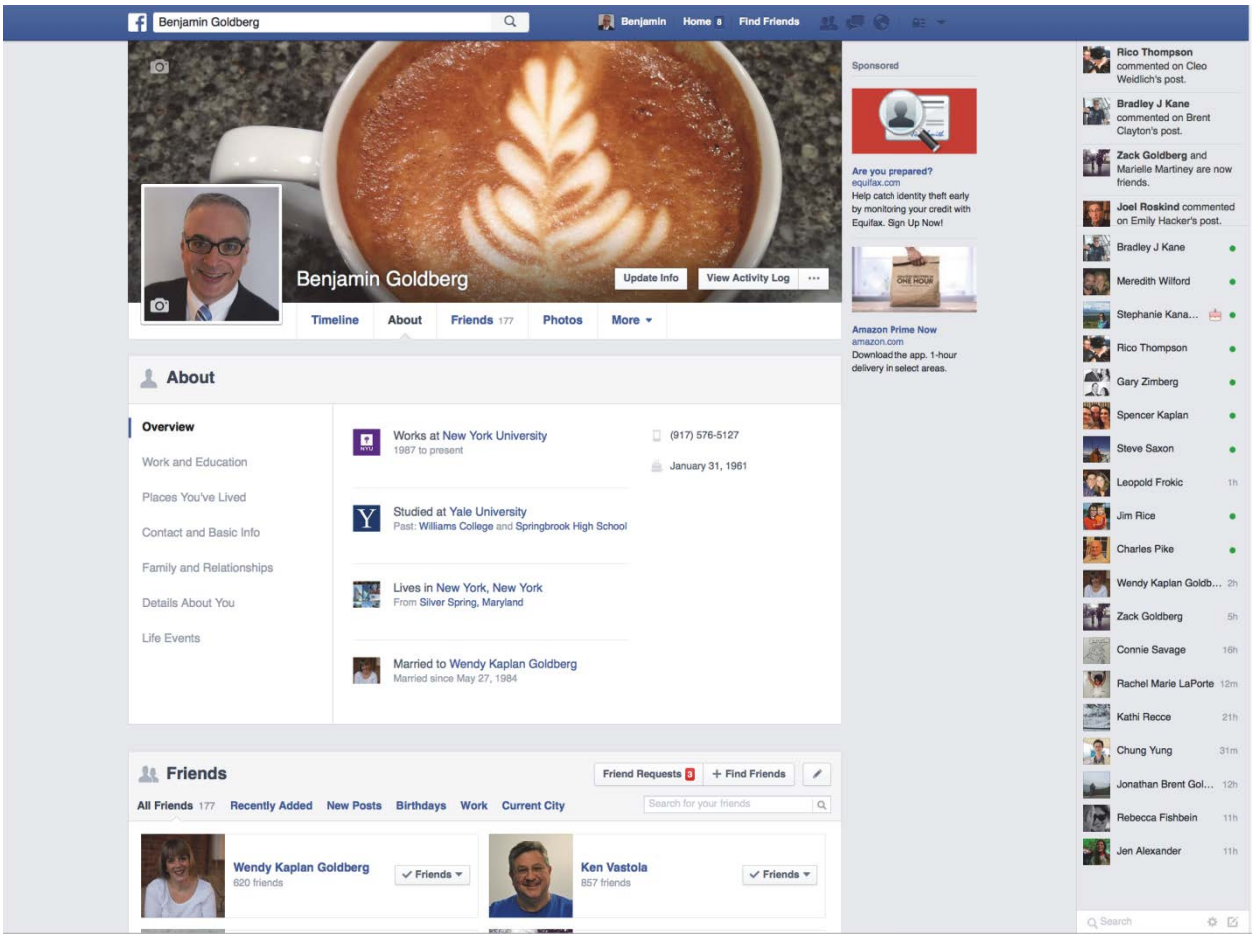
21. In most email systems and some messaging systems, the text of a message that someone has typed can be augmented by an “attachment.” An attachment is additional data that is transported to the recipient along with the main text of the email or message, but is often not visible within the display of the text of the email or message. Attachments are often in a different format from the text of the email or message, such as when the text is in plain text or

HTML format and the attachment is a document in PDF format, an image, or an audio or video file. In some cases, the attachment only becomes visible (or audible) when the sender or recipient clicks or taps on an icon or link displayed along with the message. In other cases—as in the Facebook messaging feature described below—the attachment may be displayed automatically when the text of the message is displayed.

22. In most web-based email and messaging systems, even when an email or message is forwarded to the client for display to the sender or recipient, the email or message (along with any attachment) remains in the "inbox" on the server. This way, emails or messages can be accessed by the senders and recipients at a later time or from a different client device and does not require a substantial amount of storage on the client devices. In such cases, the email or messaging service is said to be "hosted" on the server(s) supporting the service, because the server(s) provides the long-term storage for the emails and messages.

## VI. THE FACEBOOK SOCIAL NETWORKING SERVICE

23. Facebook is a free social networking service. The main purpose of the service, as stated in Facebook's mission statement, is to give people the power to share and make the world "more open and connected." When people join the service, they create a profile by providing Facebook with a variety of information such as Name, Age, Profile Picture, City, Education, and Work experience. As an example, below is an image of my profile on Facebook.




24. As individuals continue to use the service, they may post additional information that they wish to share. Some of this information may be user-generated, such as photos, videos or posts, and some of it may be information from other sources, such as web articles that someone finds interesting. People who use Facebook can also define other people on Facebook as "friends," and they can control who else on and off Facebook can see what they post (such as "friends," "friends of friends," the general public, and so on). These privacy settings can be configured individually by each person who uses Facebook.

25. In addition to posting and viewing information, people who use Facebook can interact with each other and with information in many different ways, for example:

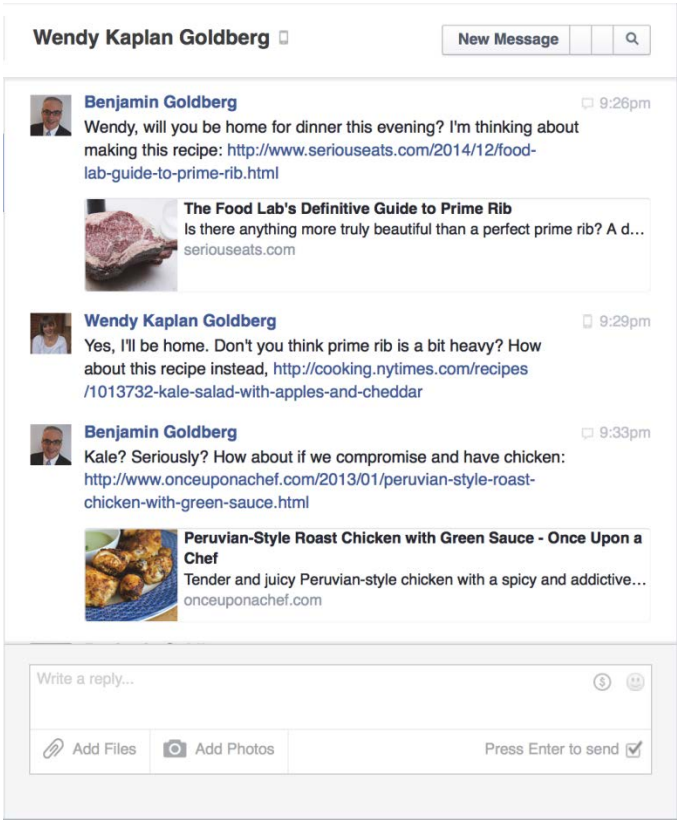
- Pages: Companies or businesses can create pages on Facebook, which enables them to communicate information to people who follow them.
- Groups: People who use Facebook can create groups on Facebook around specific interests or affiliations, which enables communication between members of the group, whether they are Facebook friends or not.
- Applications: Third-party developers can create applications that run on the Facebook platform; many of the most popular applications are games that people play with their friends on Facebook.

26. People who use Facebook to share what they are interested in can also use social plugins, which appear on third-party websites, to share these interests. Plugins like the "Share," "Like," and "Send" buttons let people seamlessly tell friends what has caught their attention, what is important to them, or what they enjoy, even when they are on third-party sites, so they can engage and connect with others on those topics, and so that they can receive other information tailored to their interests and preferences. This helps bring together what is otherwise a sprawling, disjointed network of activity across the Internet and allows people who use Facebook to have a richer, more meaningful connection to other people, ideas, and information. When someone is logged in to Facebook, Facebook can display personalized streams of information from her friends, such as life events, reviews, and comments, anywhere a site has incorporated Facebook plugins. Even when people who use Facebook are not logged in to Facebook, social plugins allow website owners to present information about aggregate engagement with different kinds of information, which can help people identify information that is popular and that they might find interesting. A list of the current Facebook social plugins can be found at https://developers.facebook.com/docs/plugins.

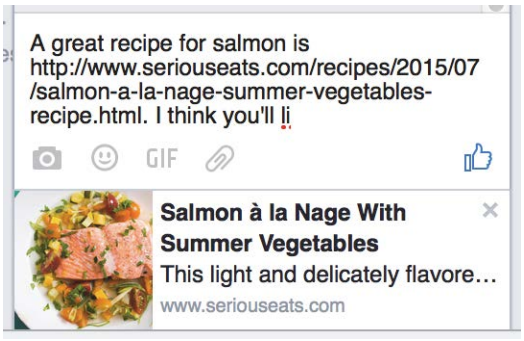
27. While most content on Facebook is a form of "one-to-many" communication, Facebook also provides means for "one-to-one" or "one-to-few" communication. Initially, this was performed through a function called "inbox" which behaved similarly to e-mail, enabling people to send messages to other people directly. This changed over time, and ultimately evolved into "Messages," which is Facebook's integrated communications platform. It enables people who use Facebook to send messages directly to other people, or to groups of people. This platform can currently be accessed through the Facebook website or through its standalone messaging application (Messenger). In addition to sending text, people can send documents and pictures, among other things. If the recipient of the message is currently browsing the Facebook website, the message will appear onscreen and enable her to respond, which can lead to a conversation with messages being sent and received in real time. If the recipient is not online, the message will appear the next time the recipient accesses Facebook. This can lead to asynchronous communication similar to e-mail, where messages are sent and received by the client device at different times. Messages are stored on Facebook servers, which enables people who use Facebook to conduct conversations seamlessly on multiple devices, for example, by beginning a conversation on a PC, and continuing it on a smartphone. It also enables senders and recipients to view messages they have sent or received in the past.

28. For a message sent from the Facebook website that contains a URL, [redacted] For example, if a sender types a URL for a webpage into a draft message, Facebook will sometimes generate a small preview of the webpage (referred to in this report as a "URL preview"), including both an image and some text from the web page. This process is done before a sender sends the message, giving the sender the option to remove the attachment if the

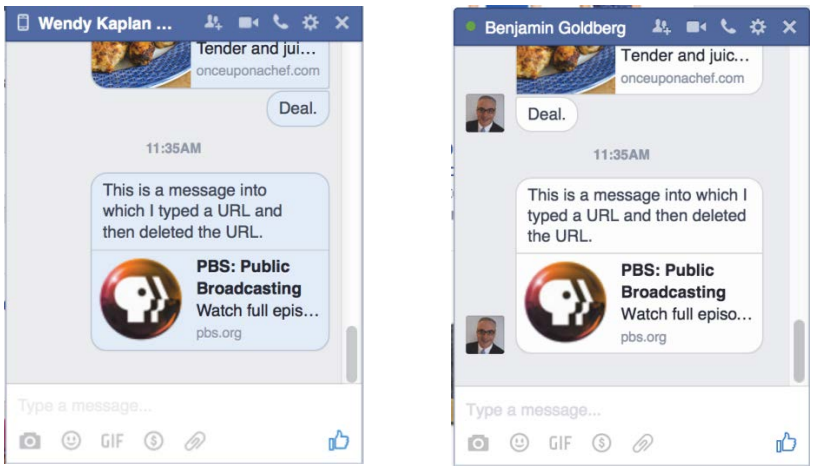
sender wishes. Below is an image of a messaging conversation that I had with my wife (though this one was created for the purposes of this report). Two of the shown messages contain URL previews, and one does not.




29. As mentioned above, a URL preview is displayed and the corresponding URL [redacted]. However, if the sender deletes the URL preview by clicking on an "x" in the corner of the displayed preview while the message is being composed, [redacted]. The URL preview display for a message being drafted, along with the "x" to click on to remove the preview, is shown below.




30. Similarly, if the sender decides to delete the text of the URL from the draft message, the URL preview [redacted] remain (unless the sender deletes it). Below is a message to my wife in which I originally typed a URL, but then deleted the URL. The URL preview for that deleted URL remains, [redacted]. Shown on the left is how the message, after being sent, appears in my inbox and on the right is the message as it appears in my wife's inbox.




This example shows that the URL [redacted] gets sent with the message, even though the URL is not in the message itself.

## VII. THE FACEBOOK SOFTWARE/SOURCE CODE

### A. URL Previews [redacted]

31. The Facebook source code that I examined in this matter, which was also available to Dr. Golbeck and was cited in her report, included code from September 2009 to December 2012 and was primarily written in two programming languages: [redacted] JavaScript, and [redacted] PHP. Both of these languages provide support for what is known to programmers as "object-oriented programming." Although a detailed discussion of object-oriented programming is beyond the scope of this report, a core feature of all object-oriented languages is the creation of "objects," which are data structures that both contain the data and specify the operations that can be applied to the data. A data structure is simply a way of aggregating distinct pieces of data so that they can be treated as a unit. For example, a data structure representing a personnel record may include fields for an employee's name, social security number, department, office address, phone, and salary. If that data structure were created in an object-oriented language, the data structure would be called an "object" and, in addition, might specify the operations that can be performed on a personnel record, such as "contact the employee," "adjust the salary of the employee," "change the employee's department," etc.

32. I describe here the functionality of Facebook messaging that is relevant to this matter, based on the source code that I examined and other documents provided to me (including deposition testimony, witness declarations, interrogatory responses, etc.). However, as discussed in subsequent sections of this report, I note that Facebook is a huge system comprising tens of millions of lines of code, [redacted] supporting over 1.5 billion people, and handling an average of over [redacted] requests each day. (*See* January 14, 2016 Declaration

of Alex Himel ("January 14 Himel Decl.") ¶ 28 n.3.) In such a huge system with that level of demand, there are bound to be software errors that lead to inconsistencies in the behavior of the system and [redacted]. Thus, my description below of the functionality of the Facebook code, particularly the code supporting Facebook messaging, reflects how the system was designed to operate generally—not necessarily how it actually operated at any given moment.[2]

33. Beginning in or around August 2010, Facebook [redacted]

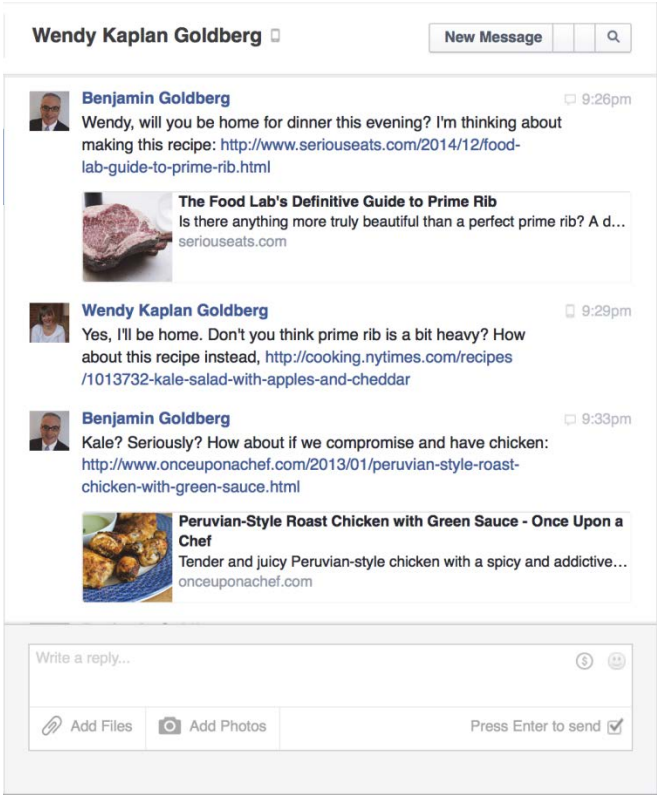
[2] I understand that certain Facebook engineers have submitted declarations in connection with this matter that explain and discuss variation among the practices and functionality challenged by Plaintiffs. Much of that variation is also discussed below.

[redacted] Web scraping is a normal technique used to extract data from websites for various reasons. [redacted] Declaration of Alex Himel being submitted simultaneously in support of Facebook's Opposition to Plaintiffs' Motion for Certification. (*See id*. ¶¶ 13-15; *id*. at Ex. B (Facebook's Supplemental Responses and Objections to Plaintiffs' First Set of Interrogatories ("Supp. Resp. to First Interrog.")) at 17-18.)

34. On the Facebook server, [redacted]

[redacted]

35. [redacted] Below is an example of preview images being displayed after the message was sent (*see also* paragraph 29 for an image of the preview being displayed before being sent).




36. [redacted]

37. I understand from Facebook's interrogatory responses that [redacted]

[redacted] (*See* Supp. Resp. to First Interrog. at 17.)

38. The use of [redacted] has many benefits. [redacted] (*See* January 14 Himel Decl. ¶ 14.)

39. In the case of Facebook messaging, [redacted] (*See* January 14 Himel Decl. ¶¶ 15-16; Supp. Resp. to First Interrog. at 18.)

40. When the sender had completed typing the message, she could send the message by clicking on or tapping a "Send" button or hitting the enter key. [redacted] in the inboxes of the sender and recipient so that they could view the message text as well as the URL attachment. (January 14 Himel Decl. ¶¶ 16-18; Supp. Resp. to First Interrog. at 18-19; January 14, 2016 Declaration of Michael Adkins ("Adkins Decl.") ¶¶ 10-14.) [redacted] (*See* January 14 Himel Decl. at Ex. A (Facebook's Second Supplemental Responses and Objections to Plaintiffs' Narrowed Second Set of Interrogatories ("Sec. Supp. Resp. to Sec. Interrog.")) at 18.)

41. [redacted]

[redacted]

(*See also* January 14 Himel Decl. ¶¶ 16-18.)

42. [redacted]

[redacted]

**B.** [redacted]

43. Like other complex websites, [redacted] Facebook must store the information shared on its site, at the very least in order to display that information when people use features that require it (e.g., viewing your messages inbox or a social plugin counter). Complex websites also log activity on their sites (with varying frequency and degree of detail) for other purposes, including maintaining site integrity and operability and detecting and deterring abuse. [redacted]

44. [redacted]

45. [redacted]

[redacted]

I understand

from the Facebook engineers that it was in fact changed over time. [redacted]

46. [redacted] *see also* January 14 Himel Decl. ¶ 54.)

## VIII. RESPONSE TO THE GOLBECK REPORT

47. I have been asked by counsel to respond to certain portions of the Golbeck report as augmented by Dr. Golbeck's deposition testimony. In this section, I provide my responses as well as the bases for my disagreements with Dr. Golbeck. I understand that the opinions I express in this report will be considered by the Court for class certification purposes; thus, it is not my intent to exhaustively respond to Dr. Golbeck with respect to topics that are unrelated to class certification. I reserve the right to respond to the Golbeck Report on such topics in the future if asked to do so.

### A. The Alleged "Interceptions"

48. Dr. Golbeck refers to several routine computer programming functions as "interceptions." I offer no opinion at this time on whether the practices Dr. Golbeck discusses could be deemed "interceptions" for purposes of wiretapping law (though it would seem odd to

me if they could be). As discussed below, however, there was considerable variation in these practices and in my opinion it would be necessary to conduct a message-by-message analysis to determine whether the purported "interceptions" occurred for any given message.

**1.** [redacted]

49. Dr. Golbeck characterizes as an "interception" or "redirection" the creation of a data structure, [redacted]) As someone who has been working and teaching in the field of computer science for more than 30 years, I disagree with these conclusions and the use of this terminology. As discussed above, the creation of "objects" is a standard part of object-oriented programming, and there is nothing unusual about [redacted] If Dr. Golbeck's characterization of an "interception" or "redirection" based on the creation of data structures (objects) were correct, there would be no way for the provider of a service involving communication between people to know when it was or was not performing an "interception."[3]

50. At her deposition, Dr. Golbeck attempted to [redacted] (Golbeck Deposition Transcript ("Golbeck Dep.")

[3] In her report, Dr. Golbeck says, [redacted]

[redacted]

51. At her deposition, Dr. Golbeck also stated that [redacted]

[redacted]

- collecting statistics about the geographical locations of senders and recipients to improve performance and reduce failures, e.g. by adding computing and

[4] [redacted]

communication resources to best reduce network congestion and balance the computing load on servers;

- saving web page images referred to in messages so that the web pages do not have to be repeatedly accessed at a cost of network congestion and server load; and
- for security by analyzing and saving patterns in the message content and traffic patterns to detect malevolent communications.

52. To the extent that Dr. Golbeck is characterizing the creation of an object (as opposed to other types of data structures) as an "interception" or "redirection," the creation of objects is a fundamental operation in all programs written in commonly used object-oriented languages, such as Java, C++, PHP, and JavaScript—[redacted]

53. Indeed, during her deposition, Dr. Golbeck could not identify [redacted]

54. Dr. Golbeck also states that she considers the [redacted] it would strike one of skill in the

field of computer science as odd to characterize [redacted]

**2.** [redacted]

55. Dr. Golbeck also opines that Facebook's [redacted] logging is a process performed by virtually all software systems and occurs for many reasons, including the recording of errors, interactions, resource usage, security issues, etc. If simply logging various aspects of person-generated data as part of providing a service to people can be considered an "interception," service providers would not be able to determine which logging might be considered an interception and which might not be.

56. Dr. Golbeck's report cites to a source code file [redacted] after that date. (*Id.*)

57. Dr. Golbeck's report also points to [redacted]

[redacted]

3. [redacted]

58. I understand that Plaintiffs have previously referred to [redacted]

therefore it cannot even be accused of being an interception.

**4. Code-Based "Devices"**

59. Dr. Golbeck's Report also refers to portions of Facebook code as "code-based devices" or simply "devices." (Golbeck Report ¶¶ 17.b., 55). According to Dr. Golbeck, the above-referenced "interceptions" are accomplished through the use of these "code-based devices." In my 33 years as a computer scientist, I have never heard the term "device" used to refer to software. Within the field, "device" is used to refer to hardware—and I note that Dr. Golbeck does not identify any hardware device as performing the interception such that the device (such as a Facebook server) is not used in the ordinary course of Facebook's business. At her deposition, Dr. Golbeck admitted she had never used the term "code-based device." (Golbeck Dep. 206:21-207:2):

> Q. Have you ever used the term "code-based devices" in your academic career?
>
> A. I don't think so.

Q. Why not?

A. This is not the kind of thing I study. I don't write about code at all, I don't think, yeah.

As someone whose publications have all been about code and programming, I can confirm that "code-based device" is not a term of art used to refer to code alone.[5]

**B. Variability in the Purported "Interceptions"**

60. While I find Dr. Golbeck's characterizations of routine and unremarkable computer science practices as "interceptions" and "redirections" to be unusual, I do not offer any opinion at this time regarding whether these practices could be deemed to constitute illegal wiretapping. However, even if Dr. Golbeck were correct in her characterization of routine programming practices, such as [redacted], as "interceptions," determining whether such alleged interceptions actually occurred would require a message-by-message analysis, in the following sense:

- [redacted]
- [redacted]

[5] Additionally, I performed a web search for "code-based device" and, in all the references I found, the "device" is a hardware device that executed code.

[redacted]

- [redacted] (*See supra* paragraph 30, 39; January 14 Himel Decl. ¶ 15.)
- The Facebook code—[redacted]

[redacted] Adkins Decl. ¶¶ 8-12, 16-23.)

- [redacted]

As stated in Facebook's interrogatory responses (*see* Supp. Resp. to First Interrog. at 35; Sec. Supp. Resp. to Sec. Interrog. at 16) and the testimony of Facebook witnesses (*see* January 14 Himel Decl. ¶¶ 28, 40; September 25, 2015 Deposition of Ray He 77:10-78:23, 156:15-157:1), [redacted]

[redacted]

- The same variability exists for Facebook's [redacted] Graph API. [redacted] Graph API count would have been incremented. [redacted] Graph API. (*See* January 14 Himel Decl. ¶¶ 27-29, 69, 73-78.) [redacted] or Graph API. (*Id.* ¶ )

- [redacted] (*Id.* ¶¶ 46-49.)
- [redacted]. (*See supra* ¶¶ 55, 57; January 14 Himel Decl. ¶¶ 52-57.)
- Moreover, as stated above, Dr. Golbeck has not examined any Facebook source code later than December 31, 2012, so she cannot tell from the Facebook code she examined [redacted]

[redacted]

61. In summary, because of the various scenarios under which an [redacted]

[redacted]

**C. Variability in the Alleged "Uses" of "Intercepted" Data**

62. For the reasons discussed in the Facebook fact declarations I have reviewed, the same variability that exists for the "interception" issue also exists for the "use" issue. For a variety of reasons, including changes of practices over time, it would be necessary to conduct a message-by-message inquiry to determine whether [redacted] and even then such a determination likely would not be possible. Further, I understand Dr. Golbeck acknowledged at her deposition that, other than one [redacted] (Golbeck Dep. 310:22-314:22.)

63. Examples of the variability inherent in any inquiry concerning each of the alleged "uses" include:

- **Insights, Related APIs, and Real-Time Analytics:** I understand that [redacted] visible to domain owners through Insights until October 11, 2012. [redacted] the Insights counter at all. [redacted] the owner of that domain might never have authenticated ownership and accessed Insights [redacted] Real-Time Analytics – a specialized system designed to provide Insights data even more rapidly. [redacted] Insights counter. (*See* January 14 Himel Decl. ¶¶ 58-65.)
- **Plugin Counts:** The [redacted] between August 16, 2010 and December 19, 2012. (*See id.* ¶¶ 37-43.) First, [redacted]

[redacted]

(*See id.* )

- [redacted] **& Graph API**: [redacted] API queries would have reflected [redacted] Graph API query. [redacted] Graph API query. [redacted] Graph API, [redacted]

[redacted]. (*See id*. ¶¶ 73-79.)

- **Recommendations and Activity Feeds**: There likewise was considerable variability over time, during certain periods, [redacted] For most of the proposed class period (from December 2011 to July 9, 2014) Recommendations and Activity Feeds, at most, [redacted] both the Recommendations and Activity Feeds were discontinued altogether on June 23, 2015. (*See* Fechete Decl. ¶¶ 23-34, 43-45.)

**D. Continuing Conduct**

64. Dr. Golbeck and I had access to the same Facebook source code produced in this matter, namely source code from the period of September 2009 to December 2012. However, the Golbeck report opines on the *current* operation of the Facebook software—without ever having reviewed current Facebook source code. One of skill in computer science would know there is no way to reliably determine the behavior of software—particularly when it comes to internal operations that are not visible to the sender or recipient, as is the case with the accused functionality—without examining source code. Thus, I do not believe Dr. Golbeck has a factual basis for the conclusions she reaches in Section V of the Golbeck report, entitled " Facebook's Conduct Continues to the Present" (Golbeck Report ¶¶ 94-97).

65. I also note that, in opining on several of Facebook's practices, Dr. Golbeck relies not on source code but on e-mails about potential practices. (*See, e.g.*, *id.* ¶¶ 46-49, 52-53, 66-71, 76-78, 86-93.) This is not a scientifically reliable manner on which to base conclusions about the operation of source code.

**E. Lack of Ascertainability of Class Members**

66. In her report, Dr. Golbeck says that "to retrieve a list of class members, the Code process should be relatively straightforward." (*Id.* ¶ 103.) In the next two paragraphs of her report, she provides "example" code that she contends would return a list of "Facebook user IDs of everyone [redacted]" and, in her deposition, she said that such a list would identify the class members. (Golbeck Dep. 331:2-8.)

67. That is incorrect. This query would return a list of people that is both under- and over-inclusive of the proposed class. In her deposition, Dr. Golbeck conceded each of these flaws in her proposed query:

68. This query will be under-inclusive in that it will not reflect recipients of messages [redacted]

69. This query will be under-inclusive in that it will not identify [redacted]

70. This query will be under-inclusive in that it will not identify senders and recipients whose accounts were deleted. (*Id*. at 335:25-336:10.)

71. This query will be under-inclusive in that it will not identify [redacted]

72. This query will be under-inclusive in that it will not identify [redacted]

73. This query will be under-inclusive in that it will not identify [redacted]

74. This query will be over-inclusive in that it will include senders whose messages did not contain URLs in their text. (*Id*. at 339:2-15.)

75. This query will be over-inclusive in that it will include [redacted]

76. This query will be over-inclusive in that it will include senders and recipients outside the United States. (Golbeck Dep. 340:22-341:1.)

77. This query will be over-inclusive in that it will include senders of messages outside the Class Period. (*Id*. at 341:2-7.)

[6] In her deposition, Dr. Golbeck proposed that this flaw could be remedied by looking at each message to ascertain who the recipient was, a woefully infeasible methodology if done manually, or trying to draft code to do the same, but does not propose any actual methodology for doing so. She assumes this is feasible. (Golbeck Dep. 334:3-335:18.)

78. Moreover, Dr. Golbeck's query is overbroad in that it will identify senders that were not subject to the challenged "uses." In her deposition, Dr. Golbeck conceded each of these flaws in her proposed query and said that identifying those that were subject to the challenged "uses" would be "case-specific:"

79. This query cannot identify senders [redacted]

80. This query cannot identify [redacted]

81. This query cannot identify [redacted]

82. This query cannot identify [redacted]

83. This query cannot identify [redacted]

84. This query cannot identify [redacted]

85. This query cannot identify [redacted]

86. This query cannot identify [redacted]

87. Finally, I understand from Facebook engineers that this query would not correctly [redacted] writing and executing even a corrected query would

be extremely burdensome and resource-intensive, if it were even possible, given the nature and breadth of Facebook's databases. (*See* January 14 Himel Decl. ¶ 8.)

**F. Variability in [redacted]**

88. As discussed in detail above, the [redacted] (*See* January 14 Himel Decl. ¶¶ 20-22, 27-30, 37-43, 46-50, 55-57, 62-65, 73-79; Fechete Decl. ¶¶ 20-38, 43-44; Adkins Decl. ¶¶ 8-12, 16-23.)

89. For all the reasons given above, it is my opinion that the Facebook messaging software did not treat the people identified by Dr. Golbeck as being a "class" substantially the same.

## IX. COMPUTER STORAGE

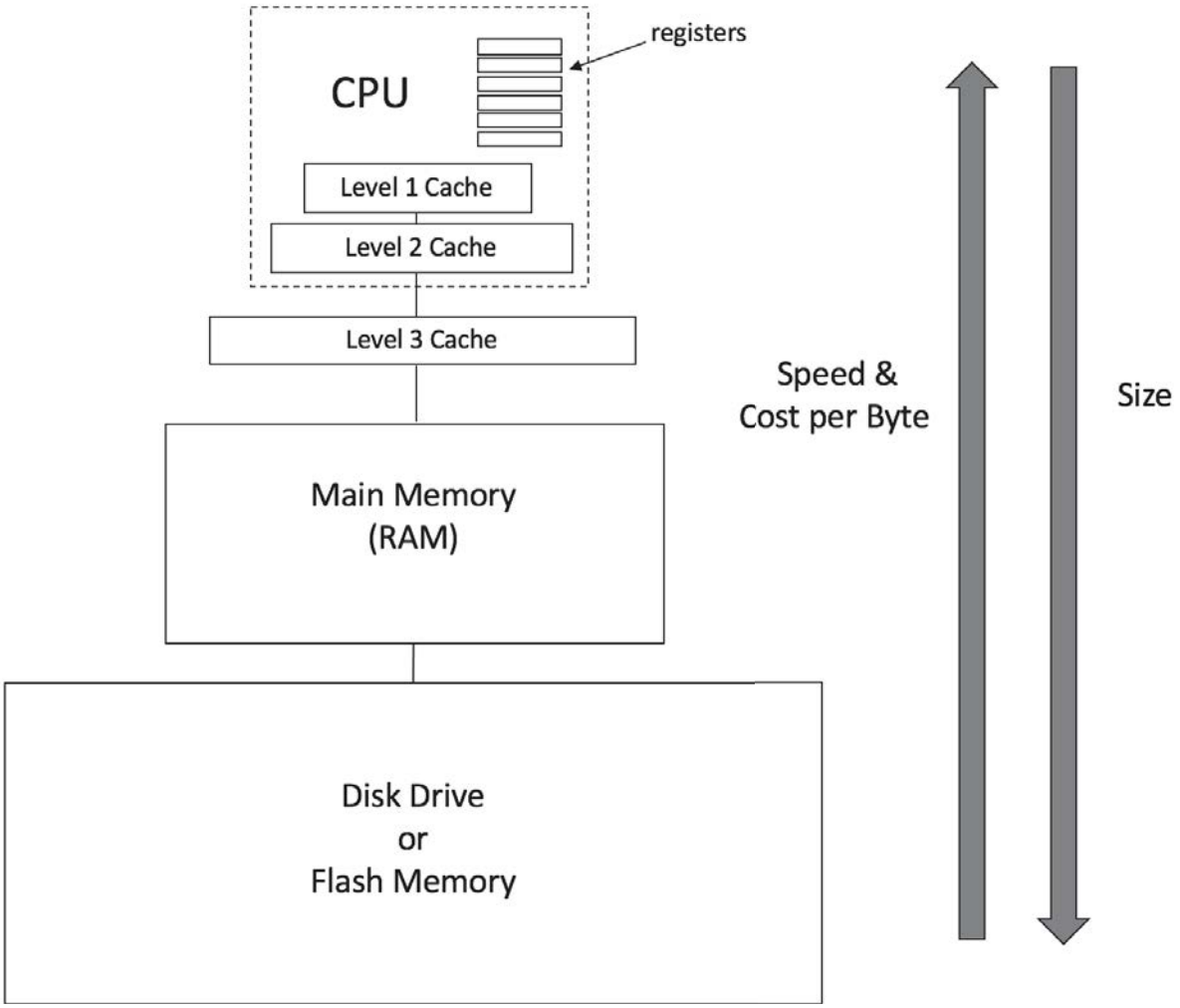
### A. Computer Storage Technology

90. I have been asked to explain the meaning of "storage" in the context of computer science. Simply put, "storage" refers to the electronic components in a computer system that hold (store) data so that the data can be (1) processed by the central processing unit (CPU), *e.g.* used for arithmetic, image processing, text formatting, etc., (2) held temporarily until the data is

sent over a network or is sent to a display device, printer or other output device, or (3) kept for a longer period of time (perhaps indefinitely) so that it can be accessed in the future. The amount of data stored on a computer or other computing device (e.g. smartphone or tablet) is measured in terms of bytes, where a single byte comprises eight bits (each bit being a zero or a 1), which was the amount of data historically required to represent a single character of text (e.g. letter, digit, punctuation mark). On modern computing devices, storage capacity is normally multiples of megabytes (millions of bytes), gigabytes (billions of bytes), or terabytes (trillions of bytes). Naturally, mobile devices such as smartphones and tablets generally have less storage than personal computers, which, in turn, have less storage than large servers.

91. Computer systems have a number of different forms of electronic storage, ranging from small, fast, and expensive (on a per-byte basis) to large, slow, and inexpensive. Below is a diagram that I created to illustrate the so-called *memory hierarchy*, i.e. the different types of storage found on computer systems, including registers (very fast, very small storage within a CPU), cache memories (small, fast memories, often within the CPU), RAM (random access memory, aka "main memory"), and disk drive or flash memory.[7]

[7] Historically, there has been another level at the bottom of the hierarchy, archival storage – generally consisting of backup tapes or optical media (e.g. DVD-ROMs) – that is not shown.




As shown in the diagram, the storage types near the top of the diagram are small and fast, and the storage types near the bottom are larger and slower.

92. Storage can also be divided into two categories, “volatile” and “non-volatile.” The term “volatile” means that the storage only retains the data while power is applied, so if the computer is turned off, the data is lost. Registers, cache memories, and RAM are examples of volatile electronic storage. The term “non-volatile” means that data is preserved in the storage even when no power is applied; thus, non-volatile electronic storage is often used for storing data for longer periods of time than volatile storage. Examples of non-volatile storage include disk storage, flash memory, magnetic tapes and optical media (CD-ROMs, etc.).

**B. The Incorrect Distinction Between "Memory" and "Storage"**

93. Dr. Golbeck appears to distinguish "memory" from "storage." [redacted]

[redacted] Any information in a computer system is in memory when it is not in storage; otherwise, it could not be in the computer at all.

(Golbeck Report ¶117).

94. Dr. Golbeck also testified about the distinction between "memory" and "storage:"

Q. What's the difference between memory and temporary storage?

A. Storage is -- so memory allows you to operate on some data if it's in memory. Storage, temporary or permanent, is a place where information is stored that it can't be operated on.

(Golbeck Dep. 287:3-9.)

95. Dr. Golbeck's characterization of memory and storage—namely that memory is not storage—is incorrect for the following reasons:

- This is not an accepted characterization—in fact, I have never encountered this distinction between memory and storage before now. Dr. Golbeck seems to be referring to the fact that the instructions of a CPU (such as those to perform arithmetic or logical operations) can directly access some forms of storage, e.g., registers, cache, and RAM, but can only access other forms of storage, e.g., disk drives and flash memory, indirectly by first loading the data from disk or flash memory into RAM. Dr. Golbeck's distinction between memory and storage has nothing to do with whether data is *stored* or not, only how the data is *accessed*.
- As evidence that "memory" in the computing field is a form of "storage," the Microsoft Computer Dictionary defines memory as follows (emphasis added):

> **memory** n. A device where information can be stored and retrieved. In the most general sense, memory can refer to external *storage* such as disk drives or tape drives; in common usage, it refers only to a computer's main memory, the fast semiconductor *storage* (RAM) directly connected to the processor. See also core, EEPROM, EPROM, flash memory, PROM, RAM, ROM. Compare bubble memory, mass storage. (Microsoft Computer Dictionary, 5th Ed., 2002 p. 333)

As the dictionary states, "memory," used in its general sense, refers to all types of storage and, in its common narrower sense, "memory" is used to refer to RAM, which is fast semiconductor storage.[8] In either case, of course, memory is a form of storage.

96. For these reasons, and as discussed extensively above, [redacted] message data is in *storage* as the term is used in computer science.

97. I understand that the Electronic Communications Privacy Act (18 U.S. Code § 2510) specifically defines "electronic storage" to include "any temporary, intermediate storage of a wire or electronic communication incidental to the electronic transmission thereof," and that communications in electronic storage are governed not by the Wiretap Act (18 U.S. Code § 2511) but by another law (the Stored Communications Act, 18 U.S. Code § 2701) not being asserted in this case. [redacted] the "temporary, intermediate storage" defined by the Act to be "electronic storage."

98. As a factual matter, Dr. Golbeck is incorrect when she states that the [redacted] – even given Dr.

[8] More recently the common use of "memory" is expanded to include "flash memory", which is a slower and cheaper form of semiconductor storage than RAM and has replaced disk drives in many computing devices.

Golbeck's definition of "storage" (which I disagree with). Upon reaching [redacted], the data would be in "storage" according to Dr. Golbeck's definition.

## X. ORDINARY COURSE OF BUSINESS

99. Dr. Golbeck's report also discusses whether Facebook's alleged "interception" [redacted] was "necessary for Facebook to deliver private messages" (Golbeck Report ¶ 17.b.) and ultimately "conclude[s] that the interception, [redacted] is not necessary for the functionality of message sharing in Facebook." (*Id.* at ¶ 109.) However, my understanding is that whether or not the alleged interception of message content was "necessary" is not relevant to the "ordinary course of business" inquiry.

100. Rather, for purposes of assessing whether the "ordinary course of business" exemption to the Wiretap Act should apply, I understand that the Court has stated that it must determine whether the interception is "related or connected to [the] electronic communication provider's service, even if it does not actually facilitate the service…[and whether there is] some nexus between the need to engage in the alleged interception and the subscriber's *ultimate* business, that is, the ability to provide the underlying service or good." (Order on Mot. to Dismiss (Dkt. 43) 11-12.) Accordingly, Dr. Golbeck's test for assessing whether Facebook's alleged "interceptions" fall within the "ordinary course of business" exemption appears to be inconsistent with the Court's order, and I think her conclusions are irrelevant. Instead, Dr. Golbeck should have inquired whether there exists some nexus between the alleged

"interceptions" and Facebook's ultimate business, or its ability to provide its underlying service. Of course, Facebook's underlying service is *not* merely to provide a messaging product but to provide a massive social network comprising various features allowing people to share information and ideas and to engage and connect with other people in a safe, efficient online environment. Based on my review of the source code, I believe any alleged "interception" (if indeed, one exists, which I do not believe it does) more than qualifies under the "nexus" test set out by the Court, since it is related to both the messaging feature as well as other features that make up the Facebook service.

101. First, as discussed above, my review of the source code indicates that [redacted]

102. Second, [redacted]

[redacted]

103. Third, [redacted]

104. Finally, [redacted] by providing data points for internal research and site maintenance, data points for site integrity analysis, and, in the case of the [redacted] Insights system, contributing to measures of engagement displayed with Facebook's social plugins and other features as part of its social platform extending to third-party websites, which help users identify information they may be interested in viewing and sharing.

## XI. RESERVATION OF RIGHTS

105. I reserve the right to supplement or amend my opinions in response to opinions expressed by Plaintiffs' experts, or in light of any additional evidence, testimony, discovery or other information that may be provided to me after the date of this report. In addition, I reserve the right to consider and testify about issues that may be raised by Plaintiffs' fact witnesses and

experts at trial. I also reserve the right to modify or to supplement my opinions as a result of ongoing expert discovery or testimony at trial.

Dated: January 14, 2016

DR. BENJAMIN GOLDBERG

# EXHIBIT BBB

Curriculum Vitae

# BENJAMIN F. GOLDBERG

Courant Institute of Mathematical Sciences
Department of Computer Science
New York University
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## Personal

Born January 31, 1961, Las Cruces, New Mexico.

U.S. Citizen.

## Education

Ph.D. in Computer Science, Yale University, 1988. Dissertation: "Multiprocessor Execution of Functional Programs."

M.S. and M.Phil in Computer Science, Yale University, 1984.

B.A. with Highest Honors in Mathematical Sciences, Williams College, Cum Laude, Phi Beta Kappa, Sigma Xi, June 1982. Honors Thesis: "Theory and Implementation of an Automatic Program Verifier."

## Employment

Associate Professor (Tenured), Courant Institute of Mathematical Sciences, Department of Computer Science, New York University. September 1994 – Present.

Invited Professor, Ecole Normale Supérieur, Paris, France. June 2007 – July 2007 and June 2003 – July 2003.

Director of Graduate Studies (for the MS programs), Department of Computer Science, New York University. September 2009 – August 2012 and September 2014 – present.

Director of Undergraduate Studies, Department of Computer Science, New York University. September 1995 – August 1998 and September 2003 – August 2006.

Visiting Professor, Institute National de Recherche en Informatique et en Automatique (INRIA), Rocquencourt, France. September 1994 – August 1995.

Assistant Professor, Courant Institute of Mathematical Sciences, Department of Computer Science, New York University. September 1987 - August 1994.

**Expert Testimony at Trial or Deposition in the Past Four Years**

Retained by Jones Day on behalf of Kyocera in the matter of *Wi-LAN v. Kyocera*, February 2015 – present.

Retained by Kaye Scholer on behalf of Google in the matter of *ContentGuard v. Google* (Covered Business Method patent review before the USPTO). August 2014-September 2015.

Retained by Orrick on behalf of EMC in the matter of *Oasis v. EMC et al.*, June 2014 – September 2015.

Retained by Fulbright & Jaworski on behalf of Qualcomm in the matter of *Certain Consumer Electronics and Display Devices with Graphics Processing and Graphics Processing Units Therein* (NVIDIA v. Qualcomm). International Trade Commission, December 2014 – June 2015.

Retained by Orrick on behalf of EMC and VMware in the matter of *Clouding v. EMC et al.* (*Inter Partes* Review before the USPTO), June 2014 – July 2015.

Retained by Quinn Emanuel and Perkins Coie on behalf of Samsung, Google, and HTC in the matter of *Smartflash v. Samsung et al*. April 2014 – present.

Retained by Kenyon & Kenyon on behalf of Advanced Ground Information Systems (AGIS) in the matter of *AGIS v. Life360* (Patent Litigation). August 2014 – November 2014.

Retained by Milbank Tweed on behalf of Apple in the matter of *Wi-LAN v. Apple*, February 2014 – September 2014.

Retained by Boies Schiller on behalf of InfoSpan in the matter of *InfoSpan v. Emirates NBD Bank*, September 2013 – present.

Retained by Boies Schiller on behalf of Apple in the matter of *Apple v. Personal Web Technologies* (*Inter Partes Review* before the PTO), August 2013 – July 2014.

Retained by Cooley on behalf of Apple in the matter of *GBT v. Apple,* October 2013 – June 2014.

Retained by Quinn Emanuel on behalf of Toshiba in the matter of *Certain Digital Media Devices, Including Televisions, Blu-Ray Disc Players, Home Theater Systems, Tablets and Mobile Phones, Components Thereof and Associated Software* (Black Hills Media v. Toshiba et al). International Trade Commission. September 2013 – February 2014.

Retained by Wilson Sonsini on behalf of Sasken in the matter of S*asken v. Spreadtrum*. American Arbitration Association. July 2013 – January 2014.

Retained by Sheppard Mullin on behalf of HTC and Apple in the matter of *Wi-LAN v. HTC et al.* June 2013 – October 2013.

Retained by Bingham McCutchen on behalf of Oracle America in the matter of *Oracle America v. Service Key et al.* March 2013 – September 2013.

Retained by Latham & Watkins on behalf of InterDigital Communications, Inc. in the matter of *Certain Wireless Devices with 3G Capabilities and Components Thereof* (InterDigital v. Huawei et al). International Trade Commission, December 2011 – February 2013.

Retained by Ballard Spahr on behalf of Go Daddy in the matter of *WhitServe v. Go Daddy.* August 2011 – June 2013.

Retained by Kenyon & Kenyon on behalf of Barnes & Noble in the matter of *Deep9 v. Barnes & Noble*. February 2012 – August 2012.

Retained by Gibson Dunn & Crutcher on behalf of Lawson Software in the matter of *ePlus v Lawson Software*. October 2011 – April 2013.

Retained by Kenyon & Kenyon on behalf of Barnes & Noble in the matter of *Certain Handheld Electronic Computing Devices, Related Software, and Components Thereof* (Microsoft v. Barnes & Noble), International Trade Commission. August 2011 – February 2012.

Retained by Morrison & Foerster on behalf of Oracle America in the matter of *Oracle America v. Google*. August 2011 – May 2012.

Retained by Jones Day on behalf of Nielsen in the matter of *comScore v. Nielsen et al*. May 2011 – November 2011.

## Teaching Awards

New York University "Golden Dozen" Award, 1992. Awarded to twelve faculty members in the entire College of Arts and Sciences for excellence in teaching.

## Professional Activities

Editorial Board, *The Computer Journal*. Published by Oxford University Press on behalf of the British Computer Society. 2007 – 2009.

Program Committee member: 2007 Symposium on Principles of Programming Languages (POPL)

External Review Committee member: 2013 Symposium on Principles of Programming Languages (POPL)

Program Committee member: 2001 Workshop on Practical Applications of Declarative Languages (PADL'01), ACM SIGPLAN'95 Conference on Programming Language Design and Implementation, 1995 ACM SIGPLAN Symposium on Partial Evaluation and Semantics-Based Program Manipulation (PEPM '95), 1995 International Workshop on Memory Management (IWMM'95), ACM SIGPLAN'93 Conference on Programming Language Design and Implementation.

Review Panel Member, National Science Foundation, January 1998 and January 2000.

Official Collaborator, Los Alamos National Laboratory, Computing and Communications Division.

Member, Association for Computing Machinery and ACM Special Interest Group on Programming Languages (SIGPLAN).

Referee for: ACM TOPLAS, IEEE Computer, International Journal of Parallel Programming, Software Practice and Experience, Computational Intelligence, ACM TOCS, ACM Computing Surveys, etc.

Referee for a variety of ACM and IEEE conferences.

## Journal Papers

"Translation and Run Time Validation of Optimized Code", with L. Zuck, A. Pnueli, C. Barrett, Y. Fang, and Y. Hu, *Formal Methods in System Design*. 27(3): 335-360, November 2005

"VOC: A Methodology for Translation Validaton of Optimizing Compilers", with L. Zuck, A. Pnueli, and Y. Fang. *Journal of Universal Computer Science*, March 2003.

"A Syntactic Method for Finding Least Fixed Points of Higher-Order Functions over Finite Domains", with Tyng-Ruey Chuang. *Journal of Functional Programming*. Vol. 7, No. 4, pp. 357-394, July 1997

"Functional Programming Languages", in ACM 50th Anniversary Issue of Computing Surveys. March 1996.

"Order-of-demand analysis for lazy languages", with Young-Gil Park. Information Processing Letters, Vol. 55, 1995, pp. 343-348.

"Static Analysis for Optimizing Reference Counting", with Young-Gil Park. Information Processing Letters, Vol. 55, 1995, pp. 229-234.

"Multiprocessor Execution of Functional Programs", International Journal of Parallel Programming, Vol. 17, No. 5, October 1988.

"Distributed Execution of Functional Programs Using Serial Combinators," with P. Hudak, IEEE Transactions on Computers, Vol. C-34, No. 10, October 1985, pp. 881-891.

**Books or Chapters in Books**

"Functional Programming Languages", in Handbook of Computer Science and Engineering, CRC Press, Inc. 1996.

**Publications in Proceedings of Refereed Symposia**

“Translation Validation of Loop Optimizations and Software Pipelining in the TVOC Framework”. Proceedings of the 17th International Static Analysis Symposium (SAS 2010), September 2010.

“TVOC: A translation validator for optimizing compilers”, with C. Barrett, Y. Fang, Y. Hu, A.Pnueli, and L. Zuck. Proceedings of the 17th International Conference on Computer Aided Verification (CAV '05), July 2005.

"Theory and algorithms for the generation and validation of speculative loop optimizations", with Y. Hu and C. Barrett. Proceedings of the 2nd IEEE International Conference on Software Engineering and Formal Methods (SEFM), September 2004.

"Into the Loops: Practical Issues in Translation Validation for Optimizing Compilers", with L. Zuck and C. Barrett. Proceedings of the Third International Workshop on Compiler Optimization meets Compiler Verification (COCV). April 2004.

"Run-Time Validation of Speculative Optimizations using CVC", with C. Barrett and L. Zuck. Proceedings of the Workshop on Runtime Verification 2003, ENTCS 89(2). July 2003.

"Software Bubbles: Using Predication to Compensate for Aliasing in Software Pipelines", with E. Chapman, C. Huneycutt, and K. Palem. Proceedings of the PACT-2002 International Conference on Parallel Architectures and Compilation Techniques, September 2002.

"Translation and Run-Time Validation of Optimized code", with L. Zuck, A. Pnueli, Y. Fang, and Y. Hu. Proceedings of the Workshop on Runtime Verification 2002, ENTCS 70(4). July 2002.

"VOC: A Translation Validator for Optimizing Compilers". Proceedings of the Workshop on Compiler Optimization Meets Compiler Verification (COCV) 2002, ENTCS 65(2). April 2002.

"Formal Models of Distributed Memory Management", with Cristian Ungureanu. Proceedings of the ACM International Conference on Functional Programming, June 1997.

"Partial Evaluation of Concurrent Programs", with Mihnea Marinescu. Proceedings of the ACM Symposium on Partial Evaluation and Program Manipulation, June 1997.

"Real-Time Deques, Multihead Turing Machines, and Purely Functional Programming", with T-R. Chuang. Proceedings of the 1993 ACM Conference on Functional Programming Languages and Computer Architecture, June 1993.

"Polymorphic Type Reconstruction for Garbage Collection without Tags", with M. Gloger. Proceedings of the 1992 ACM Conference on LISP and Functional Programming, June 1992.

"A Syntactic Approach to Fixed Point Computation on Finite Domains", with T.R. Chuang. Proceedings of the 1992 ACM Conference on LISP and Functional Programming, June 1992.

"Escape Analysis on Lists", with Y.G. Park. Proceedings of the 1992 ACM SIGPLAN Conference on Programming Language Design and Implementation, June 1992.

"Incremental Garbage Collection without Tags", Proceedings of the 1992 European Symposium on Programming, February 1992.

"Reference Escape Analysis: Optimizing Reference Counting based on the Lifetime of References", with Y.G. Park. Proceedings of the 1991 ACM/IFIP Conference on Partial Evaluation and Program Manipulation, June 1991.

"Tag-Free Garbage Collection for Strongly Typed Programming Languages", Proceedings of the ACM SIGPLAN'91 Conference on Programming Language Design and Implementation, June 1991.

"Higher Order Escape Analysis: Optimizing Stack Allocation in Functional Program Implementations", Proceedings of the 1990 European Symposium on Programming, May 1990. Springer-Verlag LNCS 432, pp. 152-160.

"Generational Reference Counting: A Reduced-Communication Distributed Storage Reclamation Scheme", Proceedings of the SIGPLAN'89 Conference on Programming Language Design and Implementation, June 1989.

“A Reduced-Communication Storage Reclamation Scheme for Distributed Memory Multiprocessors", Proceedings of the Fourth Conference on Hypercubes, Concurrent Computers, and Applications, January 1989.

"Buckwheat: Graph Reduction on a Shared Memory Multiprocessor", Proceedings of the 1988 ACM Symposium on Lisp and Functional Programming, July 1988, pp. 40-51.

"Executing Functional Programs on a Hypercube Multiprocessor", Proceedings of the Third Conference on Hypercube Concurrent Computers and Applications, January 1988.

"Detecting Sharing of Partial Applications in Functional Programs", Proceedings of the Conference on Functional Programming Languages and Computer Architecture, September 1987. Published in the Springer-Verlag Lecture Notes in Computer Science, Vol. 274, pp. 408-425.

"Serial Combinators: "Optimal" Grains of Parallelism", with P. Hudak, Proceedings of the IFIP Conference on Functional Programming Languages and Computer Architecture, September 1985. Published in the Springer-Verlag Lecture Notes in Computer Science, Vol. 201, pp. 382-389.

"Experiments in Diffused Combinator Reduction," with P. Hudak, Proceedings of the ACM Symposium on Lisp and Functional Programming, August 1984, pp. 167-176.

**Keynote Addresses, Invited Talks and Tutorials**

Keynote Address, "Software Pipelining and Loop Optimizations in the Presence of Memory Aliasing", 8th Workshop on Compiler Techniques for High Performance Computing, Hualien, Taiwan, March 2002.

Invited Talk, "Translation Validation of Loop Optimizations", Ecole Normale Supérieur, Paris. July 2003.

Invited tutorial, "The Trimaran Compiler Research Infrastructure", given at at the following conferences:

- IEEE Symposium on Parallel Architectures and Compiler Techniques (PACT'98), Paris, October 1998.
- IEEE Symposium on Microarchitecture (MICRO-31), Dallas, December 1998.
- 1999 ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI'99), Atlanta, June 1999.

Tutorial, "Functional Programming", 1994 ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI'94). Orlando, June 1994.

**Research Grants and Contracts**

“Property-Based Development of reactive and Embedded Systems”, with A. Pnueli and L. Zuck. National Science Foundation, August 2007 – May 2009.

“PTV: Translation Validation in the Phoenix Compiler Framework”, with A. Pnueli (coordinated proposal with L. Zuck of U. Illinois-Chicago). Microsoft, April 2006.

"A Methodology for Establishing the Dependability and Security of Telecommunication Protocols", with A. Pnueli and L. Zuck. Office of Naval Research, July 2003 – June 2005.

"Towards a Seamless Process for the Development of Embedded Systems", with A. Pnueli and L. Zuck. National Science Foundation, September 2002 - August 2005.

"Translation Validation of Advanced Compiler Optimizations", with L. Zuck and A. Pnueli. National Science Foundation, June 2001 – May 2006.

"Algorithmic Techniques for Compiler Controlled Caches", with K. Palem. Air Force, July 1999 - June 2002.

"Parallel Extensions of the MSTAR System", with E. Freudenthal. AFOSR, August 1999 - July, 2001.

"A Computational Laboratory for Automatic Target Recognition", with D. Geiger and E. Freudenthal. AFOSR, March 1998 - March 1999.

"Mobile and Stationary Target Acquisition and Recognition", DARPA/Air Force, June 1997-March 2000.

"An Integrated Parallel Programming Environment for High Performance Parallel Computing on Workstation Clusters", Department of Energy. May 1994. With Los Alamos National Laboratory and IBM.

"GRIFFIN - A Common Prototyping Language: Design, Implementation, and Assessment", with R. Dewar, M. Harrison, E. Schonberg and D. Shasha. DARPA/Office of Naval Research, May 1992 - April 1995.

"Research Training in Software Prototyping Languages and Environments". DARPA/ONR May 1992 - April 1995.

"Studies in Automatic Dynamic Load Balancing on Large Loosely-Coupled Multiprocessors", National Science Foundation Research Initiation Award. September 1989 - June 1992.

"GRIFFIN: a Common Prototyping Language", with R.Dewar, E. Schonberg, M. Harrison, and D. Shasha. DARPA/ONR September 1989 - April 1992.

**New Courses Developed**

“Object Oriented Programming”. An undergraduate course covering Java, C++, UML, and object oriented programming techniques. Also developed an MS-level OOP course.

"The Design and Programming of Embedded Systems". A graduate course addressing the computing hardware and software designs in handheld devices, cell phones, appliances, etc.

"Compilers for Advanced Computer Architectures". A graduate course in optimization techniques for emerging microprocessors.

"Honors Programming Languages". A Ph.D. course in Programming Language Design and theory.

# EXHIBIT CCC

## List of Materials Considered

Plaintiffs' Motion for Class Certification (filed November 13, 2015)

Report of Dr. Jennifer Golbeck In Support of Plaintiffs' Motion for Class Certification and Documents Cited Therein (filed November 13, 2015)

Facebook source code made available for review to Plaintiffs in this case

Publicly available Facebook Website

FB000014178-FB000014215

FB000027011-FB000027189

Facebook's Supplemental Responses to Plaintiffs' First Set of Interrogatories (September 8, 2015)

Facebook's Second Supplemental Responses and Objections to Plaintiffs' Narrowed Second Set of Interrogatories (October 29, 2015)

June 1, 2015 Declaration of Alex Himel and accompanying Exhibits A-G

October 6, 2015 Declaration of Dale Harrison

January 2016 Declaration of Michael Adkins (filed concurrently with this report)

January 2016 Declaration of Alex Himel (filed concurrently with this report)

January 2016 Declaration of Dan Fechete (filed concurrently with this report)

Deposition of Michael Adkins (October 28, 2015)

Deposition of Ray He (September 25, 2015)

Deposition of Ray He (October 28, 2015)

Deposition of Jennifer Golbeck (December 16, 2015)

Original Complaint (filed December 30, 2013)

Consolidated Amended Complaint (filed April 25, 2014)

Court's Order on Motion to Dismiss (December 23, 2014)

All documents cited in the body of this report

Expert Witness Report: *Campbell vs. Facebook, Inc.*

Catherine Tucker

January 15, 2016

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## I. INTRODUCTION

1. I am the Sloan Distinguished Professor of Management Science and Professor of Marketing at MIT Sloan at the Massachusetts Institute of Technology ("MIT") in Cambridge, Massachusetts. I received an undergraduate degree in Politics, Philosophy and Economics from Oxford University in the United Kingdom. I received a PhD in Economics from Stanford University in 2005. I have been at MIT since completing my PhD.

2. My academic specialty lies at the intersection between the economics of the new digital economy and advertising. I have conducted multiple studies on the diffusion of new advertising technologies and have published various papers which examine how marketing communications, in the form of advertising, perform, and which delineate the factors that relate to their performance.

3. I am Co-Editor of the Journal of Quantitative Marketing and Economics. I was an Associate Editor at Management Science and a Co-Editor of the recent National Bureau of Economics Research volume on the Economics of Digitization. I am also Associate Editor for the Information Systems Research Special Issue on Social Media and Business Transformation and Co-Editor of the Information Economics and Policy Special Edition on the Economics of Digital Media Markets. I have published multiple academic papers in leading marketing journals, including Marketing Science, the Journal of Marketing Research, Management Science and the Journal of Marketing. I received a National Science Foundation CAREER Award, which is the National Science Foundation's most prestigious award in support of junior faculty who "exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations." I teach the core class on "Strategic Marketing" to our Executive MBAs at MIT Sloan, as well as being the lead faculty for marketing of the MIT Sloan specialized executive education offerings on marketing, where senior executives come in for one or two day courses to refresh their skills and discuss the current state of the art in marketing. I also teach a specialized class on "Platform Strategy: Building and Thriving in a Vibrant Ecosystem" which discusses strategies for building data-rich digital platforms.

4. I have received a Paul Green Award for the paper "most likely to influence marketing practice" for research I did on new kinds of online targeting. I also received the 2015 Erin Anderson Award for the most notable Female Emerging Marketing Scholar and Mentor.

5. I have testified on factors influencing privacy regulation before Congress and have presented my research on privacy to the Federal Trade Commission, the Federal Communications Commission, the European Commission, and the OECD.

6. Further details of my experience are in my curriculum vitae, which I attach as Exhibit DDD to my report. A list of my prior testimony is attached as Exhibit EEE.

7. I am being compensated for my services in this matter at my customary hourly rate of $1,050. While preparing this report, I have been assisted by certain employees of Analysis Group. I receive compensation based on the professional fees of Analysis Group. No compensation is contingent on the nature of my findings or on the outcome of this litigation.

8. Since my work on this matter is ongoing, I may review additional materials produced subsequent to the issuance of this report, and/or conduct further analysis. I reserve the right to update, refine, or revise my opinions, or form additional opinions, including in response to further information from Plaintiffs' experts, further clarification of Plaintiffs' requested relief, and any additional information I may receive.

9. A list of the materials I have considered to date in developing the opinions contained in this report is attached as Exhibit FFF.

## II. ASSIGNMENT

10. I have been asked by counsel for Facebook to:

    a. Use my knowledge of the economics of digitization to lay out the appropriate economic framework for analyzing the use of aggregate behavioral information on Internet link-sharing behavior.

    b. Assess whether proposed class members were commonly affected by the practices challenged in the operative Complaint and the Motion for Class Certification, the use of counts of URL links that are formed as URL message attachments to

provide "recommendations" to people who use Facebook, to provide analytics to third-party websites and developers, as well as to increment the "Like" social plugin counter.[1]

c. Assess the framework for potential damages put forward in the Expert Report of Fernando Torres submitted in support of Plaintiffs' Motion for Class Certification.[2]

## III. SUMMARY OF CONCLUSIONS

11. Below is a summary of my opinions as of the date I submit this report. If additional documents or information become available after I submit this report, I will review the material and update my opinions as appropriate.

12. The use of popularity information to organize content on the Internet is both ubiquitous and helpful. It leads to a democratizing process, where content that may not usually have been highlighted is brought to potential readers' attention.

13. The alleged practices, including the incrementing of the social plugin counter next to the "Like" button, affected potential class members in a variety of ways. Though many of the proposed class members were unaffected, some may have benefited, and in a few cases some may have been harmed, individual inquiry is necessary to determine in which group individual class members belong.

14. Many potential class members were unaffected by the alleged practices. The fact that many websites did not have social plugins that display counters limits the effects of the practices. Furthermore, the aggregate and anonymous nature of the data means that any of the incremental data stored may have had no practical effect even if a social plugin

[1] *See* Plaintiffs' Consolidated Amended Complaint ¶¶ 2, 4, 31, 38; Plaintiffs' Motion for Class Certification at 2, 5-10.

[2] I understand that Mr. Torres has filed a second report in this case; however, I received it only two days prior to the filing of this report and my references and responses in this report are to his first report.

displaying a counter was present because these also relied on many potential other sources of activity which potentially dwarfed those associated with this practice.[3]

15. Many potential class members may have benefited from the alleged practices. Potential class members would benefit if they viewed the URL they shared in a message positively, and there was a chance – however remote - that the share boosted subsequent site visitation. This is especially true if the potential class member had a financial interest in the website associated with the URL.

16. Although it is theoretically possible that a few potential class members may not have benefited, such cases are hard to identify without individual inquiry. For example, there may be cases where class members may not have wished the website they shared in their message to receive an incremental boost to its social plugin count. However, to identify such cases requires knowledge of the motivations of the potential class member for including that URL in a message, which cannot be achieved without individual inquiry.

17. Mr. Torres's Report does not consider whether individuals were affected by the alleged practices. Instead the focus of the report is on estimating the *benefits* of the alleged practices to Facebook. Many third party websites never pay for advertising. However, the two methodologies proposed by Mr. Torres do not actually relate to the ways that Facebook could have benefited from the alleged practices:

    a. The first methodology proposed by Mr. Torres suggests that a measure of benefits could be the incremental enhancement in advertising revenue attributable to the increase in links in a "Social Graph" due to the alleged practices. However, none of the alleged practices was associated with enhancing advertising. So the assumed link between the alleged practices and an increase in Facebook's advertising revenue does not exist. There are also other technical and numerical flaws in Mr. Torres's analysis.

[3] *See* January 15, 2016, Declaration of Alex Himel ("Declaration of Alex Himel") ¶¶ 34 [redacted]

b. The second methodology proposed by Mr. Torres covers the period where social plugin counters were potentially incremented if a URL was included in a message. The proposed methodology, however, is disconnected from actual benefits to Facebook. Instead, it tries to use data on the price that a third-party website would have paid for a "Like" in a different context. However, this ignores again the fact that many websites did not have a social plugin displaying a counter so did not receive the benefits of the potential increment to the counter. Even in the limited circumstances that websites may have been willing to pay for additional "Likes" to be displayed on a social plugin counter, there is no evidence that their savings on "Like"-getting expenditures would have been diverted to Facebook in the form of advertising revenue as claimed by Mr. Torres in his Report.

## IV. BACKGROUND TO THE SPECIFIC FACTS IN THIS CASE

18. I understand from the Plaintiffs' Motion for Class Certification that the behavior in dispute is that Facebook allegedly "scanned" messages containing URLs and used the counts of URL links that are formed as URL message attachments "to provide 'recommendations' to people who use Facebook, to provide analytics to third-party websites and developers, as well as to increment the 'Like' social plugin counter."[4]

19. Therefore, in this report, I consider the ways that people who use Facebook could be affected by each of these challenged practices.

a. First, I consider the ways in which someone who uses Facebook could be affected if a URL he or she shared in a message were used to help identify relevant websites to highlight in recommendations if a website had a Facebook social plugin that reported such recommendations. I understand that such use of the

[4] Plaintiffs' Motion for Class Certification at 2. *See also* page 31 of the Expert Report of Jennifer Golbeck [redacted]); Plaintiffs' Consolidated Amended Complaint ¶ 2 ("[W]hen [Plaintiffs'] ostensibly private messages contained links to other websites, also known as 'URLs,' Facebook scanned those messages and then analyzed the URL in the link. If the website contained a Facebook 'Like' button, Facebook treated the content of Plaintiffs' private messages as an endorsement of the website, adding up to two 'Likes' to the page's count.").

aggregate and anonymous data only occurred when the primary system of providing such recommendations failed and that the practice ceased in 2014.[5]

b. Second, I consider the ways in which someone who uses Facebook could be affected if his or her gender, language, country, and age were part of the aggregate statistics that Facebook offered on URL-sharing behavior to website owners who accessed Insights or related APIs, as a consequence of the person sharing a URL in a message between December 2011 and October 2012.[6]

c. Third, I consider whether someone who used Facebook to share a URL in a message, and did not modify the associated attachment, would be affected by the possibility that between December 2011 and December 2012, Facebook may have incremented a counter for a website that had that specific social plugin counter by up to two "Likes".

20. I also understand from the Plaintiffs' Motion for Class Certification that the proposed class is defined as follows:

> All natural-person Facebook users located within the United States who have sent, or received from a Facebook user, private messages that included URLs in their content (and from which Facebook generated a URL attachment), from within two years before the filing of this action [December 30, 2011] up through the date of the certification of the class.[7]

21. In the next sections of this report I systematically consider whether these proposed class members were unaffected, affected positively, or affected negatively by these practices. By way of background, I first discuss the use of behavioral information to aid social discovery from an economics perspective.

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[5] *See* January 15, 2016, Declaration of Dan Fechete ("Declaration of Dan Fechete") ¶¶29, 34 [redacted]"

[6] I understand from the Declaration of Alex Himel that this practice ended in October 2012. ¶61 "[redacted]"

[7] Plaintiffs' Motion for Class Certification at 10-11.

## V. THE USE OF BEHAVIORAL INFORMATION TO ORGANIZE THE INTERNET

22. Over the past two decades, consumption of information has been revolutionized by the Internet. The Internet has, of course, directly reduced the cost of disseminating and receiving information, as digital data is virtually costless.[8] However, another key advance has been the use of user behavioral information to ease the process of social discovery of content.

23. Prior to the Internet, curation and recommendations were usually done by specialized experts in the field. For example, newspaper editors decided what stories to feature on the front page in order to attract occasional purchasers. Similarly, department store managers decided which products to highlight in a store entry display that would appeal most and induce browsing customers to purchase. Even in the non-digital world, organizations used popularity information to help them connect with customers. For example, musicians vied to make sure their songs ranked highly on the Billboard Hot 100 so they would receive more exposure.[9] National Public Radio (NPR Books) ranked books on the basis of anonymous sales counts at independent booksellers.[10] Similarly, toy shops would examine sales data to identify a "hot toy" and feature it more prominently on their display.[11]

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[8] Greenstein, Shane M., Avi Goldfarb, and Catherine E. Tucker, editors, *The Economics of Digitization*, Edward Elgar Publishing, 2013.

[9] As described here, the Billboard chart uses anonymized counts of streaming, sales and air-play to determine its rankings. *See* Trust, Gary, "Ask Billboard: How Does the Hot 100 Work?" *Billboard*, September 29, 2013, http://www.billboard.com/articles/columns/ask-billboard/5740625/ask-billboard-how-does-the-hot-100-work, viewed December 11, 2015.

[10] The NPR Bestseller Lists are compiled from weekly surveys of close to 500 independent book-stores nationwide in collaboration with the American Booksellers Association. *See, e.g.*, "NPR Bestseller List: Week of Oct. 1, 2015," *NPR*, http://www.npr.org/books/bestsellers/2015/week40/, viewed December 11, 2015.

[11] An evolution of this is Kmart's website: "2015 Fab 15 Toys," *Kmart*, http://www kmart.com/en_us/dap/fab-15-toys html, viewed January 3, 2016. For a discussion, *see* "Behind Kmart's Fab 15 List: How We Identify Hot Toy Trends," *SEARS HOLDINGS: SHC Speaks*, September 24, 2014, http://blog.searsholdings.com/inside-shc/behind-kmarts-fab-15-list-how-we-identify-hot-toy-trends/, viewed on January 15, 2016.

24. However, the Internet has both automated and further democratized this process of social discovery. Media websites can now organize their content based on popularity.[12] Recommendation systems on websites such as Amazon now display automated suggestions of products that might interest consumers based on other customers' purchasing behavior.[13]

25. Partly responding to and partly facilitating this general shift online in using digital behavioral data to organize the Internet and facilitate social discovery, has been the advent of electronic lists automatically recommending Internet content. A similar evolution has taken place in the form of "counters" of social media website activity surrounding a particular website. These counters take a variety of forms. The simplest form they might take is as a simple counter at the bottom of the webpage. Figure 1 depicts such a counter for a fetal health charity that I support.[14] Sadly, the Fetal Health Foundation is a small charity which does not receive much publicity or support from the general public, so its counts of social media support are negligible. However, if I shared the link on my Facebook page, retweeted the link using Twitter, shared the link on Google Plus or posted the website on my Pinterest page, I might be able to build interest and support for this charity, and also potentially inform those who are pregnant or who know people who are pregnant who may face such conditions.

26. I can achieve the aim of increasing interest and readership of this website from my sharing the URL through a Facebook message in two ways. The first way is the direct effect I would have from sharing the URL with my friends and relatives. The second way is the indirect effect I would have from an increment of the social plugin counter from "Likes" from three to four, should I have sent the email in the limited period such a share would have affected the count. Though individually my share is unlikely to have any

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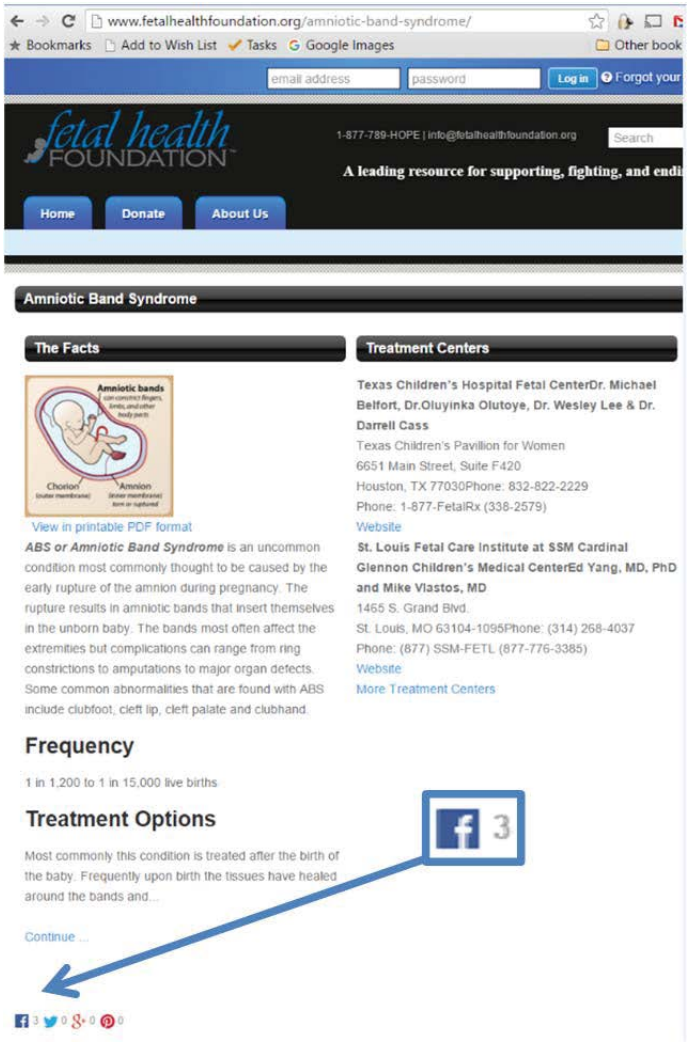
[12] Even news websites which stick to the traditional curation model also feature browsing and sharing information to help customers identify news articles. For example, the *New York Times* lists the ranking of the top ten most shared articles: "New York Times Most Popular Articles," *The New York Times*, http://www nytimes.com/most-popular, viewed December 11, 2015. For more details, *see* Berger, Jonah, and Katherine L. Milkman, "What Makes Online Content Viral?," *Journal of Marketing Research*, Vol. 49, No. 2, April 2012, pp. 192-205.

[13] *See* Resnick, Paul, and Hal R. Varian, "Recommender Systems," *Communications of the ACM*, Vol. 40, No. 3, March 1997, pp. 1-3.

[14] The Fetal Health Foundation is focused on advances in technology that help prevent babies dying *in utero*.

effect, if one hundred thousand people also shared this website it would help it gain more general prominence as visitors may take the website more seriously upon observing the high count when visiting the website.




**<u>Figure 1</u>: Snapshot of Social Media Counters from Charity Website**[15]

[15] "Amniotic Band Syndrome," *Fetal Health Foundation*, https://web.archive.org/web/20150910004526/http://www fetalhealthfoundation.org/amniotic-band-syndrome/, viewed January 6, 2016. Interestingly, I initially viewed the image for this URL on October 29, 2015. When I returned to the website in January 2016, the site had experienced a redesign – quite unrelated to anything to do with this case – and there was no longer this visible social plugin counter. This change illustrates the extent to which it can be problematic to identify whether or not a particular social plugin was or was not on a website over time, which I discuss below.

27. In general, this personal example shows three things:

28. First, the use of data and anonymous counts on the sharing of content online is ubiquitous. Social media platforms such as Facebook, Twitter, Google and other websites such as Pinterest all offer such data. Second, behavioral data relating to the sharing of website URLs is useful for identifying which websites may be of most interest. Third, the process is somewhat democratizing. Websites or niche causes such as the Fetal Health Foundation find it hard to attract attention, but if they can achieve shares and signal their popularity and relevance on social media this can help them spread their message. Indeed, my own research shows that the release of popularity information benefits niche products or less common websites most. Everyone expects a major website such as CNN.com to be visited, shared, and "Liked" a great deal; information that a smaller or unusual website is also visited, shared, and "Liked" a great deal is more surprising and can therefore attract more notice.[16]

29. This research builds on an older (and growing) economic literature about the effects of popularity information on people's behavior. This literature uses the insight that when quality of a product or service or piece of Internet content is uncertain, people may use others' behavior as a guide to quality.[17] Other academic papers have subsequently also noted the usefulness of such information for improving users' browsing experience online and decision making.[18] Other work has emphasized that such algorithmic rankings may improve a user's experience by reducing the potential for information overload.[19]

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[16] *See* Tucker, Catherine, and Juanjuan Zhang, "How Does Popularity Information Affect Choices? A Field Experiment," *Management Science*, Vol. 57, No. 5, 2011, pp. 828-842.

[17] The canonical academic works in this area are Bikhchandani, Sushil, David Hirshleifer, and Ivo Welch, "A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades," *Journal of Political Economy*, Vol. 100, No. 5, 1992, pp. 992-1026, and Banerjee, Abhijit V., "A Simple Model of Herd Behavior," *Quarterly Journal of Economics*, Vol. 107, No. 3, August 1992, pp. 797-817.

[18] *See* Tucker, Catherine, and Juanjuan Zhang, "Growing Two-Sided Networks by Advertising the User Base: A Field Experiment, *Marketing Science*, Vol. 29, No .5, 2010, pp. 805-814.

[19] *See* Ghose, Anindya, Panagiotis G. Ipeirotis, and Beibei Li, "Designing Ranking Systems for Hotels on Travel Search Engines by Mining User-Generated and Crowdsourced Content, *Marketing Science*, Vol. 31, No .3, May–June 2012, pp. 493-520.

Still more have shown explicitly that users make inferences from many different types of user behavior once that information is available online.[20]

## VI. MANY PROPOSED CLASS MEMBERS WERE UNAFFECTED, SOME BENEFITED, AND QUANTIFYING BENEFITS OR LACK THEREOF REQUIRES INDIVIDUALIZED INQUIRY

30. In order to assess whether the effect of the challenged practices was common across proposed class members, I evaluate how different types of proposed class members were affected. I conclude that many of the potential class members were unaffected by these practices and some may have benefited. However, identifying whether or not, and how, they are affected requires detailed individual inquiry.

### A. Some potential class members were unaffected by the challenged practices

31. To understand whether a potential class member was affected, it is useful to understand and assess the likelihood of the set of coinciding circumstances that are necessary for there to be any concrete effect from the alleged practices.

#### *1. Potential class members were unaffected if the website did not have a relevant social plugin*

32. There are many potential circumstances where a URL attachment was created but where there was no actual effect on visible social plugin or visible data and therefore, there is no concrete effect on a proposed class member. To illustrate this it is useful to consider an example from one of the Named Plaintiffs. This example is shown in Figure 2, which is a [redacted]:

[20] *See* Tucker, Catherine, Juanjuan Zhang, and Ting Zhu, "Days on Market and Home Sales," *The RAND Journal of Economics*, 2013.

**Figure 2: Message from Plaintiff Campbell, as produced by Plaintiffs**[21]

33. In this example, [redacted], which is shown in Figure 3. The message [redacted]. However, when I visit the indicated URL in 2016, I see no social plugin counter or any evidence of the incremental "Like" generated by this share being used in any way. (See Figure 3.) I also see no social plugin which could have shown recommendations. This suggests that it is not the case that the "Like count [is] publicly displayed"[22] on all websites for which a URL attachment was created as claimed in Plaintiff's Motion for Class Certification. Similarly, when I visited the page as it was posted on August 25, 2011 through the

[21] CAMPBELL000076-77.

[22] Plaintiffs' Motion for Class Certification at 9.

Wayback Machine,[23] no social plugin counter or plugin which could have shown recommendations was visible.[24]

**Figure 3: Not all websites had social plugins that featured a counter or Recommendations or Activity plugin**[25]

[23] A query on "https://web.archive.org/web/20110825191937/http://www.nytimes.com/2011/07/27/us/politics/27fiscal html" returns a page with no Facebook social plugin counter (viewed Jan. 6, 2016). However, the Wayback Machine reports that "[a]rchived web sites in the Wayback Machine do not always appear as they did on the live web for reasons such as the previously mentioned difficulties in archiving web sites," and further, "difficulties in archiving web sites include the use of JavaScript, server side image maps, orphan pages (web sites that are not linked to by any other web pages), and unknown sites." This only underscores the difficulty in determining if putative class members were affected by the alleged practices. Steinhauer, Jennifer, and Carl Hulse, "Vote on Boehner Plan Delayed Amid Opposition," *The New York Times*, July 26, 2011, https://web.archive.org/web/20110825191937/http://www nytimes.com/2011/07/27/us/politics/27fiscal.html, viewed January 6, 2016.

[24] The *New York Times* already offers a ranking of its most emailed stories as a way of using popularity information to inform readers what story they might most enjoy. *See* "New York Times Most Popular Articles," *The New York Times*, http://www nytimes.com/most-popular, viewed December 11, 2015 for the current list. This *New York Times* list of most popular emailed articles was studied in research from 2012. *See* "New York Times Most Popular Articles," *The New York Times*, http://www nytimes.com/most-popular, viewed December 11, 2015.

34. I understand that [redacted].[26] However, even making the assumption that the [redacted] would not have received any new information from Mr. Campbell sharing the URL in a message. This is because if Mr. Campbell had already visited the [redacted] website – which seems likely, as he shared the story – his demographics would have already been visible and accessible to the [redacted].[27] Obtaining information on whether proposed class members had already visited websites for which they included a URL in a message would be difficult, if not impossible, and determining whether or not such a potential class member had already visited the website requires individual inquiry regarding website visitation for the specific time period surrounding the sharing of the URL link.

35. This example illustrates that trying to determine whether or not a social plugin displaying a counter or recommendations is displayed, whether Insights or associated APIs was affected or how that has changed over time would require exhaustive effort at tracking down various permutations of a website's display choices over time for each individual link and the individual's own website visitation data. Such an inquiry may not even be possible,[28] and would inevitably result in a very time-consuming effort.

36. Moving from this example, motivated by one of the Named Plaintiffs, it seems important to understand how widespread such instances of lack of meaningful effects are. Though it is hard to obtain concrete retrospective data on how widespread such lack of visible social plugins containing counters or the Recommendations Feed are, one 2012 article

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25 [redacted].

26 Declaration of Alex Himel ¶ 63.

27 [redacted], viewed January 11, 2016.

28 *See* Declaration of Dan Fechete ¶¶ 32-33, 43-44; Declaration of Alex Himel ¶¶ 42-43, 64-65, 78-79.

suggests that at that time the number of websites with any social plugin was small, and that of the top 10,000 websites, 75.7 percent of them were not integrated with Facebook.[29]

37. One might conclude, therefore, that for approximately 75 percent of all Facebook messages with URL attachments sent in the December 2011-December 2012 period, there was no effect because there was no Facebook integration on the website, let alone a visible social plugin counter or Recommendations Feed. However, without actual data on site visitation and its relative spread over the 10,000 top websites (and websites not in this top 10,000), it is difficult to assess the extent to which the 75 percent figure applies to URLs shared in Facebook messages rather than simply the distribution of websites. Though it seems likely that smaller websites are less likely to have social plugins, it is worth noting too that many of the most popularly visited websites (as such Google, Twitter, Wikipedia, and YouTube) do not currently have Facebook integration.[30] The 75 percent figure may also understate the effect because there are many different types of social plugins, and if the website only had a "Like" button and not a counter next to the "Like" button, then obviously there would not have been the effects associated with counters.[31] The number of websites featuring a counter or a Recommendations Feed has

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[29] This website reports its methodology as follows: "We examined the HTML code of the home-pages of the top 10k sites in the world according to Alexa. To determine Facebook integration, we looked for the official ways of integrating Facebook on sites, with paths such as facebook.com/plugins, connect facebook net and graph facebook.com." "How Many Sites Have Facebook Integration? You'd Be Surprised," *Pingdom.com*, June 18, 2012, http://royal.pingdom.com/2012/06/18/how-many-sites-have-facebook-integration-youd-be-surprised/, viewed December 11, 2015.

Of course since this 2012 survey, it is likely that these statistics have changed. For example as reported by He, Ray C., "Introducing New Like and Share Buttons," *Facebook for Developers*, November 6, 2013, https://developers.facebook.com/blog/post/2013/11/06/introducing-new-like-and-share-buttons/, viewed December 11, 2015 by November 2013, the "Like" and "Share" buttons were being viewed over 22 billion times daily across more than 7.5 million websites.

[30] *See* "Top Sites in United States," *Alexa*, http://www.alexa.com/topsites/countries/US, viewed on January 15, 2016 for current top websites. Based on my review on January 11, 2016, Google.com, Youtube.com, Wikipedia.org, and Twitter.com do not have Facebook integration.

[31] "Social Plugins," *Facebook for Developers*, https://developers.facebook.com/docs/plugins, viewed December 12, 2015. There are not only "Like" buttons but also "Share," "Follow," and "Send" buttons available. The "Like" button is displayed at "Like Button for the Web," *Facebook for Developers*, https://developers.facebook.com/docs/plugins/like-button, viewed December 12, 2015. That is of course supposing I get the code from Facebook directly rather than using a template – as shown on "The Best WordPress Facebook Widgets," *Elegant Themes Blog*, January 15, 2015, https://www.elegantthemes.com/blog/resources/the-best-wordpress-facebook-widgets, viewed December 12, 2015, there are many other potential ways of including Facebook interactions on a website that do not involve a social plugin counter.