

# **EXHIBIT B**

Oracle America v. Google – Report of Iain Cockburn – October 10, 2011 – Reply to Dr. Leonard’s Report  
Subject to Protective Order  
(Contains Confidential and Highly Confidential/Attorneys’ Eyes Only Material)

**IN THE UNITED STATES DISTRICT COURT  
FOR THE NORTHERN DISTRICT OF CALIFORNIA  
SAN FRANCISCO DIVISION**

_____	)	
ORACLE AMERICA, INC.	)	
	)	
Plaintiff,	)	
	)	
v.	)	Case No. 3:10-CV-03561-WHA
	)	
GOOGLE, INC.	)	
	)	
Defendant.	)	
_____	)	

**REPLY REPORT OF DR. IAIN M. COCKBURN  
REPLYING TO DR. GREGORY K. LEONARD**

**October 10, 2011 – ATTORNEYS’ EYES ONLY**

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## **I. Introduction**

1. My name is Iain Cockburn. I am currently the Richard C. Shipley Professor and Chair of the Strategy and Innovation Department in the School of Management at Boston University. My qualifications, recent report filings, and testimony are summarized in the expert report I submitted in this matter on September 12, 2011.<sup>1,2</sup>

2. I have been asked by Counsel to review and comment upon the expert report of Defendant’s expert Dr. Gregory K. Leonard, filed on October 3, 2011.<sup>3</sup> Dr. Leonard presents an opinion on patent damages which he calculates to be between \$13 and \$28 million. In this report, I evaluate Dr. Leonard’s analyses and present some illustrative variations to Dr. Leonard’s calculations. These alternative calculations are not intended to serve as an endorsement of his methods or replace my opinion summarized in my Opening Report.

3. In forming my opinions, I have reviewed additional materials not cited in my Opening Report. These include additional documents and data accompanying Dr. Leonard’s report, including certain Google data that Google had not produced previously, and various computer programs used by Dr. Leonard to generate his analysis. A list of the materials that I have relied upon is attached as Appendix A to this report.

4. I have had less than seven days to review and analyze Dr. Leonard’s report, supporting materials, and cited sources. I reserve the right to identify other errors in Dr. Leonard’s report, and disagreements with his opinions, up to the time of trial and at trial.

### **A. Summary of My Opening Report**

5. In my Opening Report, I calculated damages from patent infringement based on my assessment of a reasonable royalty arising from a hypothetical negotiation for a license that

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<sup>1</sup> Complaint for Patent and Copyright Infringement in *Oracle America, Inc. vs. Google, Inc.*, United States District Court in the Northern District of California, CV 10-03561 WHA (Dkt. No. 1).

<sup>2</sup> Expert Report of Dr. Iain M. Cockburn, September 12, 2011, revised September 15, 2011 (hereafter “Opening Report”).

<sup>3</sup> Expert Report of Dr. Gregory K. Leonard, Case No. 3:10-cv-03561-WHA, October 3, 2011 (hereafter “Leonard Report”).

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would enable Google’s use of the infringed intellectual property. To do this, I identified a reasonable starting point royalty, adjusted it upwards to reflect the “use made of the invention by the infringer,” apportioned the royalty to reflect the contributions of the patents-in-suit, and then further apportioned to limit damages to the consequences of infringing acts performed within the United States. I concluded that a reasonable royalty for the patents-in-suit, taken together and based only on those elements that I was able to quantify (not including the substantial, but likely irreparable and unquantifiable, harm from fragmentation caused by Android), is approximately \$202 million, through December 2011 (the date of trial).

**B. Summary of My Criticism of Dr. Leonard’s Opinions**

6. I have reviewed Dr. Leonard’s report on patent damages, and I have concluded that Dr. Leonard makes several substantive errors in reaching his opinions:

- Dr. Leonard ignores the importance of the rapid adoption of Android to Google, as supported by the contemporaneous documents and recent testimony. These time-to-market considerations would have placed substantial upward pressure on the hypothetical negotiation between Sun and Google. (See Section II.)
- Dr. Leonard’s opinions rely upon assertions that the patents-at-issue have little or no value and that Google had viable non-infringing alternatives. In so doing, he ignores relevant evidence and bases his opinions instead on unsubstantiated and at times, contradictory arguments. (See Sections II and III.A.)
- Dr. Leonard’s suggestion that Google had alternatives that would have been more attractive than the path Google actually took, by employing the infringing technology, is not economically rational and fails to address the question of why Google did not pursue better alternatives if it had them. (See Section III.B.)
- Dr. Leonard’s analysis of the *Georgia-Pacific* factors are not based on sound economic analysis but rather on unsubstantiated and at times, contradictory arguments. (See Section IV.)

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- Dr. Leonard’s analysis of the hypothetical negotiation based on the Sun-Google negotiations surrounding Project Armstrong suffers from oversights and data handling errors. (See Section V.)
  - Dr. Leonard begins with a starting value of \$28 million with no revenue share. This is problematic because the \$28 million offer was not clearly the final offer, and because it was contingent on proposed changes that were under discussion and do not appear to have been fully addressed or resolved by the parties at that stage of the negotiations. (See Section V.)
  - Next, Dr. Leonard adjusts the starting value upward to compensate Sun for lost license fees for commercial implementations, but Dr. Leonard made five separate errors in calculating the value of that upward adjustment. Correcting for these data handling errors alone increases Dr. Leonard’s upward adjustment to the starting value from \$28 million (on top of his \$28 million starting point) to \$357.5 million. The cumulative effect of correcting these errors alone increases Dr. Leonard’s patent damages from \$13 million to \$92.5 million. (See Section V and Exhibit 1.)
  - Dr. Leonard appears to accept my calculations for patent (30%) and geographic apportionment (80%) for the purposes of his calculation. However, in applying geographic apportionment, he ignores the fact that infringement in the United States has resulted in worldwide harm to Sun. Thus, Dr. Leonard should have only apportioned the starting value, not the upward adjustment. (See Section V.)
- Dr. Leonard’s analysis of the hypothetical negotiation based on Sun’s license with Danger appears to be based on a fundamental misreading or mischaracterization of that license. (See Section VI.) Dr. Leonard argues that incompatibility should only lead to a doubling of royalties, but he is only citing to a “Branding” section of the agreement, and the agreement otherwise appears to require compatibility for any Danger implementations.

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- My main responses to Dr. Leonard’s criticisms of my patent damages analysis (see Section VII) are as follows:
  - I disagree with Dr. Leonard that the starting point should be \$28 million, for the reasons noted above and explained in more detail below.
  - Dr. Leonard’s criticisms of my use of eBay data are unfounded, and I would note that Dr. Leonard appears to otherwise agree with the general premise of my econometric analysis for patent apportionment – the idea that consumer preferences for handset performance can provide a reasoned metric to isolate the portion of the license agreement attributable to the patent-in-suit.
  - With respect to certain miscoding identified by Dr. Leonard, I have re-run my estimation and have traced the effect of the change through to the end of my analysis. The end result of these changes, however, is not economically significant and as such, it remains my opinion that at least 30% of the value of the Java portfolio is attributable to the patents-in-suit. (See Section VII.D.b.)
  - Dr. Leonard’s computer code introduces two assumptions which I do not impose. As a result, the coefficient estimates he reports (in his Exhibit 6) are in fact not comparable to mine.

**C. Summary of Patent Damages**

7. Thus, based on my consideration of Dr. Leonard’s report, it is my opinion that his approach to patent damages is flawed and his criticisms of my patent analysis are unsupported and often misleading. Exhibit 4 summarizes my opinions on patent damages. In sum, my opinion is that patent damages are approximately \$176 million.

**II. Dr. Leonard Ignores the Importance To Google, as Early as 2005, of a Rapid Adoption of Android to Google**

8. In assessing the viability of non-infringing alternatives, one has to evaluate functionality, development costs, and timeliness. Dr. Leonard asserts that all of the available non-infringing alternatives would have provided at least comparable functionality, at no

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additional out of pocket costs, and with the same development time.<sup>4</sup> Putting aside for the moment whether Dr. Leonard has sufficient expertise or analysis to support these assertions, Dr. Leonard fails to consider the risks to Google of delaying the launching of Android, the strategic value of rapid adoption of Android to Google, as supported by the contemporaneous documents and recent testimony that underscore the importance to Google of quickly launching Android. It is my opinion that Dr. Leonard’s opinions are flawed because they do not adequately address or account for that evidence.

9. As described in my Opening Report, substantial contemporaneous evidence indicates that Google thought that rapid adoption of Android was necessary to ensure a widespread adoption of Android and avoid Google’s “lockout” from the mobile market. Rich Miner, cofounder of Android, Inc., explained in 2010 that “the time was right” for a Java and Linux-based, open-source mobile operating system: “we couldn’t have done that at any other point in time.”<sup>5</sup> Andy Rubin explained in his deposition “You have a window of opportunity in smartphones . . . . You have to ship as soon as feasibly possible. I mean, you go to extraordinary lengths to ship sooner, because it’s a very dynamic market. And it could shift directions at any time. So my job as . . . the architect of this business concept was to just do everything that I possibly could to get my solution to the market in the shortest time possible.”<sup>6</sup>

10. Google’s documents also stress the importance of getting Android to market quickly. For example, in 2005, Rich Miner wrote in response to an email stating that it was widely believed that “if an open platform is not introduced in the next few years then Microsoft will own the programmable handset platform” and stated that “[t]he only sentence I don’t like at the moment is ‘Assuming Android will take two years to develop and deploy . . .’”<sup>7</sup> Miner confirmed this understanding at his deposition, testifying that Google understood timing was

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<sup>4</sup> Leonard Report, pp. 12 and 18.

<sup>5</sup> Gregory T. Huang, “Google’s Rich Miner Says Timing Is Everything for Android: Three Thoughts from Mobile Monday,” Xconomy Boston, August 17, 2010, <<http://www.xconomy.com/boston/2010/08/17/google%E2%80%99s-rich-miner-says-timing-is-everything-for-android-three-thoughts-from-mobile-monday/>>.

<sup>6</sup> 7/27/2011 Rubin Dep. 180:1–12.

<sup>7</sup> GOOGLE-01-00019529 at 530.



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important for the success of Android.<sup>8</sup> These sentiments convey and confirm an urgency to get Android to market quickly, and before the end of 2008.

11. When Google acquired Android, Inc., it had only eight engineers and owned no intellectual property except the android.com domain name.<sup>9</sup> Android Inc. had not done any work on the development of a virtual machine.<sup>10</sup> Probably because of its scarce resources, quick time to market appears to have been a key motivation for Google to enter into a deal with Sun. In presentations given to Google executives at various stages of negotiating the deal with Sun, Andy Rubin stressed that the deal with Sun would “dramatically accelerate” Google’s schedule.<sup>11</sup> And when the deal started to fall apart in mid 2006, Rubin twice warned the Google executives that breaking off the deal would have a “schedule impact.”<sup>12</sup> Rubin testified that he was “under incredible schedule pressure” to launch Android.<sup>13</sup>

12. With the launching of Apple’s iPhone in 2007, the time-to-market issues became even more pronounced. At an Android Google Product Strategy (“GPS”) meeting on January 17, 2007, Andy Rubin described Android as a “technology project, with the goal of quick time to market ....”<sup>14</sup> Five months later, in May 2007, notes from an Android meeting show that the team felt that there was a “[r]isk that people may flock to other platforms if we wait too long.”<sup>15</sup> These documents indicate that Google believed that it needed to move quickly with Android, something that Dr. Leonard fails to adequately address in his report.

13. In this context, it is critical to recognize the strategic value to Google of launching Android as quickly as possible. These included the prevention of “lockout” of core Google

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<sup>8</sup> Miner 5/26/2011 Depo. Tr. at 261:11-262:10.

<sup>9</sup> GOOGLE-12-00000115; GOOGLE-03168864. Another document produced by Google indicates that there were nine Android, Inc. employees, of which only four were engineers. GOOGLE-58-00048925 at 927

<sup>10</sup> Miner 5/26/2011 Depo. Tr. at 33:14-16.

<sup>11</sup> GOOGLE-14-00042244.

<sup>12</sup> GOOGLE-26-00008366 at 374(March 28, 2008 presentation); GOOGLE-12-00080356 at 365 (April 20, 2006 presentation).

<sup>13</sup> Rubin 7/27/2011 Depo. Tr. at 179:14.

<sup>14</sup> GOOGLE-01-00025330 at 333.

<sup>15</sup> GOOGLE-29-00002338 at 339.

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services and products in the increasingly-important mobile space;<sup>16</sup> the ability to obtain favorable revenue sharing agreements with handset manufacturers;<sup>17</sup> and the ability to take advantage of other benefits such as network effects and optimal positioning to enter new markets.<sup>18</sup> These benefits to Google would have placed considerable upward pressure on the hypothetical negotiation between Sun and Google, yet Dr. Leonard fails to recognize them.

### **III. Dr. Leonard Makes Unsupported and Contradictory Assertions Regarding the Availability of Non-Infringing Alternatives**

14. Dr. Leonard asserts that for each of the infringed patents at issue, Google had “multiple acceptable and effective non-infringing alternatives.”<sup>19</sup> Dr. Leonard suggests that Google could have used a native compiler for the Java programming language, instead of the Dalvik virtual machine in Android;<sup>20</sup> that it could have used another programming language other than Java as the applications programming language for Android;<sup>21</sup> or that it could have not included the patented functionality at issue.<sup>22</sup> He asserts without contemporaneous support – let alone any attempt at actual quantification – that the alternatives would have provided equivalent functionality, required the same out of pocket costs, and required the same development time.<sup>23</sup> Where he does provide support, he cites mainly to his own recent interviews of various Google employees at Google.<sup>24</sup> He does so without addressing the substantial body of contemporaneous evidence from the 2005-2006 timeframe, much of which is authored by some of the same individuals whom Dr. Leonard cites, and by dismissing other recent evidence.<sup>25</sup>

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<sup>16</sup> Opening Report, pp. 47-51, 139-146.

<sup>17</sup> Opening Report, pp. pp. 55-56, 147-151.

<sup>18</sup> Opening Report, pp. 56-60.

<sup>19</sup> Leonard Report, p. 11.

<sup>20</sup> Leonard Report, pp. 11-13.

<sup>21</sup> Leonard Report, pp. 13-19.

<sup>22</sup> Leonard Report, pp. 19-24.

<sup>23</sup> Leonard Report, pp. 12 and 18.

<sup>24</sup> Dr. Leonard’s undated and undocumented interviews with five different Google employees appear to be central to his damages framework. In Sections III.A through III.B.3 of his report, where Dr. Leonard discusses Android and various non-infringing alternatives available to Google for the Android development, Dr. Leonard cites to interviews with Google employees 52 times, including 29 references to Dan Bornstein. By contrast, he cites contemporaneous evidence based on internal Google or Sun documents only 7 times.

<sup>25</sup> I disagree with Dr. Leonard’s dismissal of Mr. Lindholm’s August 2010 email regarding Google’s lack of alternatives and need for a license. (Leonard Report, p. 18.) Dr. Leonard’s conclusion that Mr. Lindholm’s email is

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15. In my opinion, it is more reliable to evaluate the parties’ expectations and beliefs at the time of the hypothetical negotiation with reference to contemporaneous documentary evidence, rather than post-litigation, undocumented, and undated interviews with employees of the company that is alleged to have infringed the intellectual property at issue in the lawsuit. Moreover, Dr. Leonard fails to recognize the substantial risk associated with reliance on any of the proposed alternative technologies, something that he fails to account for in his analysis. This risk would have been particularly unbearable for Google, given its pressing concerns about time-to-market and performance issues.

16. To arrive at his extreme assertions, Dr. Leonard relies on propositions that have no economic support or are at times, contradictory. He focuses almost exclusively on the value of the patents-in-suit to Sun and assumes they have little to no (or even negative) value to Google. As a result, he assigns no value or negative value to most of the Georgia-Pacific factors. I discuss each in turn.

**A. Dr. Leonard Makes Numerous Propositions with No Economic Support or Contradictory Support**

17. Dr. Leonard makes numerous propositions with no economic support or with contradictory support. I describe some notable examples here.

18. *Dr. Leonard’s primary support for his assertion that Google could have provided developers with a native compiler instead of the Dalvik Virtual Machine appears to be Apple’s successful development of a native compiler used by iOS, which is both distinguishable and insufficient to support Dr. Leonard’s opinions.*<sup>26</sup> In essence, Dr. Leonard is suggesting that

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irrelevant because there were “lock-in effects” by 2010 finds no support in Mr. Lindholm’s email, which nowhere refers to “lock-in” as the basis for Mr. Lindholm’s statements. The existence of any such lock-in would, of course, demonstrate Google’s infringement. Dr. Leonard fails to identify any other evidence supporting his conclusion that Google’s lack of alternatives was due only to some lock-in effects. Dr. Leonard also ignores evidence that Mr. Lindholm considered alternatives in 2005 or before, and Mr. Lindholm wrote in 2006 that he was helping Rubin negotiate a “critical license” from Sun for Android. (GOOGLE-12-00006964 at 964.) Nearly five years later, Mr. Lindholm wrote that Google still need to negotiate that license because it lacked alternatives. Mr. Lindholm did not answer questions at his deposition about the basis for his statements at his deposition, and it appears that Dr. Leonard is now simply trying to explain away those statements without any personal knowledge regarding the basis for Mr. Lindholm’s statements and without applying any expertise or analysis.

<sup>26</sup> Leonard Report, p. 11 (“Apple’s success using the native compiler approach demonstrate that it would have been an acceptable and effective non-infringing alternative for Google.”)

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Google could have built the iPhone – a complete phone with its own language, tools, and developer environment. However, the Apple comparison has little relevance here. Though Dr. Leonard observes in a passing footnote that “[t]he only potential downside to the compiler approach is that there may be less flexibility . . . .,” he forgets altogether that portability across hardware configurations is drastically more important for the open platform Google intended to build than it is for e.g. Apple’s ecosystem, which is restricted to Apple hardware and thus requires less flexibility.<sup>27</sup> As Eric Schmidt said when Android was announced, “[o]ur vision is that the powerful platform we’re unveiling will power thousands of different phone models.”<sup>28</sup>

19. *Dr. Leonard appears to assert that the relative project costs and lead times associated with a native compiler would have been comparable to those associated with the Dalvik Virtual Machine, yet he has no economic basis to do so.*<sup>29</sup> Contemporaneous internal emails and assessments of Dalvik do quantify, at least partially, the cost and delay of non-infringing alternatives. For example, an August 5, 2005 email from Urs Hoelzle to Alan Eustace demonstrates that Google recognized that building its own virtual machine was “likely to result in failure of the project” because it takes “2-3 years to get it right, if you have excellent people.”<sup>30</sup> Dr. Leonard ignores this documentary evidence. Further, to the extent that native compilers push costs to handset manufacturers, Google would be further disadvantaged. Yet, Dr. Leonard ignores this possibility.

20. *Dr. Leonard asserts that Google seriously considered a native compiler and that “in the late 2005 time frame, Google was considering both the native compiler approach and the virtual machine approach, and it was a close call for Google as to which direction to take”<sup>31</sup> yet he has no economic basis to do so.* Dr. Leonard relies upon an undated and undocumented

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<sup>27</sup> “The reason that Objective-C is suitable for iPhone and iPad applications is that Apple provides a single hardware platform that runs appropriately compiled native code. iPhone applications do not need to run on heterogeneous devices produced by multiple vendors.”, Mitchell Patent Report, pp. 41 – 42; See also GOOGLE-00298438.

<sup>28</sup> [http://www.google.com/intl/en/press/pressrel/20071105\\_mobile\\_open.html](http://www.google.com/intl/en/press/pressrel/20071105_mobile_open.html)

<sup>29</sup> Dr. Leonard simply states that “[t]he out-of-pocket cost and time to Google of developing a native compiler and associated tools would have been approximately the same as the cost and time of developing the Dalvik virtual machine,” citing only an undocumented and undated “Interview of Dan Bornstein.” Leonard Report, p. 12.

<sup>30</sup> GOOGLE-80-00081369 (8/5/2005 e-mail from Urs Hoelzle to Alan Eustace).

<sup>31</sup> Leonard Report, p. 11, emphasis added; citing Interview of Andy Rubin.

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“Interview of Andy Rubin” for this assertion. I am unaware of any contemporaneous documentation which suggests that Google seriously considered use of a native compiler instead of Dalvik VM during Android’s development.<sup>32</sup> To the contrary, various documents describe the virtual machine architecture as central to the Android ecosystem. For example, in an email from August 5, 2005, Google employee Brian Swetland explained that: “The JVM is going to be a central piece of the system we’re building, not some little add-on on the side – so we can provide some really good java application development and user experiences.”<sup>33</sup> In addition, Andy Rubin stated that the only other Java alternative worth considering was Microsoft’s virtual machine architecture, although going to that architecture would have resulted in abandoning their current work on Java and, presumably, setting the Android team back a substantial amount of time.<sup>34</sup> Another document prepared by Rubin indicates that Google planned for Android to integrate “major aspects of the JVM.”<sup>35</sup> In March 2006, Steve Horowitz wrote that “the JVM is core to our platform architecture and strategy.”<sup>36</sup> Dr. Leonard ignores this documentary evidence.

21. *Dr. Leonard asserts that Google could have effectively utilized an alternative programming language, such as C++, in terms of both time and cost, yet he provides no reliable factual or economic basis to do so.*<sup>37</sup> Here again, Dr. Leonard cites only undocumented and undated interviews with Google employees, and provides no cites to contemporaneous documents or communications discussing the cost and time requirements of pursuing such an alternative. However, the documentary evidence available to Dr. Leonard, which I have cited in my previous report, suggests that Google faced meaningful costs and delays if it pursued non-infringing alternatives to Java. For example, on August 16, 2006 – after the deal with Sun had fallen through – the Android engineers wrote a “manifesto” for Android, which stated: “we are

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<sup>32</sup> Note that there is substantial evidence which documents Google’s decision to go with Dalvik JVM. See ¶406-16 of my Opening Report.

<sup>33</sup> GOOGLE-12-00000537 at 539.

<sup>34</sup> GOOGLE-01-00019527 (Andy Rubin, 2005/10/11, to Larry Page: “If Sun doesn't want to work with us, we have two options: 1) Abandon our work and adopt MSFT CLR VM and C# language - or - 2) Do Java anyway and defend our decision, perhaps making enemies along the way”).

<sup>35</sup> GOOGLE-12-00000473 at 473.

<sup>36</sup> GOOGLE-01-00018428 at 428.

<sup>37</sup> According to Dr. Leonard, “the incremental cost and time to Google of going with C++ or another programming language other than the Java programming language would not have been significant.” Leonard Report, p. 18; Citing Interviews of Andy Rubin, Dan Bornstein, Brian Swetland.

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building a java based system: that decision is final” and “any significant change will disrupt the schedules.”<sup>38</sup> Other documents specifically reject the idea that C++ was a viable alternative. For example, on January 3, 2006, Brian Swetland – one of the Google employees whom Dr. Leonard appears to have interviewed – described many reasons why Java was superior to C++, and why Google decided to reject C++. He wrote that some of the “[r]easons to shift to a primarily Java API,” were that “[t]he nature of the cellular market is that we are \*required\* to have java due to carrier requirements, etc. . . . Java is more accessible [sic] than C++. There are more Java programmers. There is more standardization in tools and libraries. Debugging is much simpler . . . Java solves a lot of the portability issues C++ has. There is no fragile base class problem in the sense that it exists in C++. We can safely provide a modern object oriented api to third party developers without the scary ABI issues involved in C++. . . .”<sup>39</sup> Other documents discourage employees from writing anything for Android in C++, saying “[w]e will ship a more stable product sooner if we do as much as possible in Java. . . . In short, if you can do this simply and cleanly with basic Java, do it, and move on to the next thing. There is a lot of pressure on us to deliver, and we are falling behind.”<sup>40</sup>

22. *Dr. Leonard suggests that the expected effects from removing patented functionality are “small” or “minimal,” yet he has no factual or economic basis to do so.*<sup>41</sup>

Citing the Davidson Report, Dr. Leonard states that “sufficiently small differences in application speed are not noticeable to consumers.”<sup>42</sup> Dr. Leonard continues, “even noticeable performance differences may not be significantly valued by consumers as long as the smartphone yields an ‘acceptable’ level of performance.”<sup>43</sup> Yet Dr. Leonard has no basis for these opinions, and he

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<sup>38</sup> GOOGLE-04-00055169.

<sup>39</sup> GOOGLE-01-00019511 (1/3/2006 e-mail from Brian Swetland).

<sup>40</sup> GOOGLE-01-00075935 (4/4/2006 e-mail from Andy McFadden, specifically discussing why *not* to do C++); *see also* GOOGLE-04-00055169 (8/16/2006 e-mail titled “manifesto” noting: “write as much as possible in java – we are building a java based system: that decision is final – java is easier to debug (modulo vm stability) . . . java is denser – java is safer . . . favor C over C++ for native glue . . . write it in java first . . . Java not Sun . . . we are building a java based system, not pushing Sun’s agendas . . . Any significant change we make will disrupt the schedules.”).

<sup>41</sup> Leonard Report, p. 26; Leonard Report, p. 30 (“[OEMs] would have accepted small reductions in performance or somewhat more demanding handset specifications in order that they could still be able to offer Android smartphones”).

<sup>42</sup> Leonard Report, p. 26.

<sup>43</sup> Leonard Report, p. 26.



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has not provided any analysis of consumer valuation of performance improvements. In contrast, I have relied upon econometric and conjoint analyses of consumer preferences to *calculate* that which Dr. Leonard merely assumes away.

23. Dr. Leonard also appears to have ignored statements made by Dan Bornstein, someone whose recent interview he cites numerous times for other engineering propositions. In 2010, Mr. Bornstein wrote “As the tech lead for the Dalvik team within the Android project, I spend my time working on the virtual machine (VM) and core class libraries that sit beneath the Android application framework. This layer is mostly invisible to end users, but done right, it helps make Android devices run smoothly and improves developer productivity. The 2.2 release is particularly pleasing to me, as it is the first release since before 1.0 in which we have been able to deliver significantly new VM technology. And unlike much of what my team and I do, it is something that can be experienced directly by end users. ‘Dalvik’ isn’t exactly a household word (at least in my country), and most people wouldn’t know a virtual machine if it hit them in the face, but when you tell them you were able to make their existing device work better - run faster, use less battery - they will actually take notice! What Makes This Possible? We added a Just In Time (JIT) compiler to the Dalvik VM. The JIT is a software component which takes application code, analyzes it, and actively translates it into a form that runs faster, doing so while the application continues to run.”<sup>44</sup> Mr. Bornstein highlights the importance of the ‘205 patent. Contrary to Dr. Leonard’s assertion, it appears that Mr. Bornstein believed (at least before this litigation started) that consumers would notice the effects of removing the JIT.<sup>45</sup>

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<sup>44</sup> <http://android-developers.blogspot.com/2010/05/dalvik-jit.html>.

<sup>45</sup> Dr. Leonard states that the functionality included in the JIT compiler was “not added to Android until May 2010, and yet Android was successful prior to this time.” (Leonard Report, p. 78.) But Google *itself advertised* the performance benefits of the JIT when announcing its inclusions in Froyo, and in fact touted benefits – 2 to 5x speed improvement – that are entirely consistent with the benchmarking analysis performed by Oracle engineers. See Android Developers Blog Posting by Dan Bornstein (2010), available at <http://android-developers.blogspot.com/2010/05/dalvik-jit.html> (“We added a Just In Time (JIT) compiler to the Dalvik VM. . . . On the performance front in particular, we have seen realistic improvements of 2x to 5x for CPU-bound code, compared to the previous version of the Dalvik VM. This is equivalent to about 4x to 10x faster than a more traditional interpreter implementation.”).

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**B. Dr. Leonard Suggests that Google Has Not Profit Maximized**

24. In some cases, Dr. Leonard even suggests the alternatives would have been more attractive than the path Google actually took by employing the infringing Java technologies. For example, in comparing the Dalvik Virtual Machine to a native compiler, Dr. Leonard suggests, quoting Apple’s late chief executive, that “Java’s not worth building in. Nobody uses Java anymore. It’s the big heavyweight ball and chain.”<sup>46</sup> He also suggests that “Native code doesn’t have that middle translation. Some people have characterized that performance impact to be ten times slower than just executing the Native instruction.”<sup>47</sup> Dr. Leonard goes on to conclude that “[u]nder these circumstances, Google would not have been willing to pay much, if anything at all, for a royalty to obtain a license to the patents-in-suit.”<sup>48</sup>

25. This suggests that Google made a poor choice, and that Google had better alternatives that it failed to adopt. This, of course, is inconsistent with the contemporaneous evidence evaluating and rejecting alternatives. It also make little sense given Google’s motivations and awareness of those alternatives. If Dr. Leonard’s assertions are true, one wonders why Google decided to pursue the Dalvik Virtual Machine. If Google had better alternatives, why did it not pursue them? Not only would it have come up with a better product, it would have also avoided the risk of the present litigation.<sup>49</sup>

26. Dr. Leonard himself endorses this view in an article he wrote in 2007: an “infringer would claim that it would have costlessly ‘invented around’ the patented technology and produced the identical product at the same cost as using the patented technology. Whether

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<sup>46</sup> Leonard Report, p. 12, citing to Steve Jobs. In my view, the disparaging statements of a competitor are not a particularly reliable metric on which to base the critique of a platform.

<sup>47</sup> Leonard Report, p. 12, citing to Andy Rubin.

<sup>48</sup> Leonard Report, p. 12.

<sup>49</sup> Google was clearly aware that the path it took would “make enemies along the way.” GOOGLE-01-00019527 (Andy Rubin, 2005/10/11, to Larry Page: “If Sun doesn’t want to work with us, we have two options: 1) Abandon our work and adopt MSFT CLR VM and C# language - or - 2) Do Java anyway and defend our decision, perhaps making enemies along the way”).



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this claim is economically rational is questionable because the infringer rationally should have shifted to the alternative technology rather than risking having to pay patent damages.”<sup>50</sup>

27. Dr. Leonard also suggests that Google could compensate for speed and efficiency losses, resulting from a disabling of the patented functionality, with hardware and other improvements, though he does not provide concrete methods for doing so.<sup>51</sup> According to Dr. Leonard, “in an operating system such as Android, there are myriad ways to improve performance.” Dr. Leonard concludes: “[t]hus, there were numerous other ways to improve performance available to Google at the time of the hypothetical negotiation. These ways would all be non-infringing alternatives to the functionalities allegedly covered by the patents-in-suit.”<sup>52</sup> This statement is so broad-brush as to be without substance, and lacks economic support. If Google had numerous ways to improve the performance of the Android OS, at minimal costs as Dr. Leonard implies, it is likely that Google would use them. Evidence suggests that Google was intensely focused on Android’s performance and was willing to forego functionality and style to achieve higher performance. In strategy documents from 2006 through 2008, then-Google CEO Eric Schmidt repeated, “Speed matters – Slow products never win. ... Slow never wins. ... Speed is still important. ... Every test and every survey indicates that speed is one of the most important ‘features’ of a product; even milliseconds in response time seem to matter.”<sup>53</sup> He also argued that, “We should focus on speed first, then beauty. Speed without beauty is still a win.”<sup>54</sup> Larry Page, in the same meeting, demanded that all screens load in less than 200 milliseconds.<sup>55</sup> Given this level of attention to Android’s speed, how is it possible that Android still had a “myriad” untapped cost effective ways to improve its performance? Dr. Leonard ignores this contemporaneous evidence and provides no explanation.

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<sup>50</sup> Jerry A. Hausman, Gregory K. Leonard, and J. Gregory Sidak, “Patent Damages And Real Options: How Judicial Characterization of Noninfringing Alternatives Reduces Incentives to Innovate,” *Berkeley Technology Law Journal*, 22:825 (2007), pp. 825-853, at 835.

<sup>51</sup> Leonard Report, pp.19-24.

<sup>52</sup> These statements are largely unsubstantiated, as Dr. Leonard again cites only an undated “Interview of Dan Bornstein.” Leonard Report, p. 27; Citing Interview of Dan Bornstein; Unsupported)

<sup>53</sup> GOOGLE-10-00045531 at 8, 14, 23.

<sup>54</sup> GOOGLE-59-00030150 at 151 (notes from Android GPS).

<sup>55</sup> GOOGLE-59-00030150 at 151 (notes from Android GPS).

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28. Dr. Leonard goes as far as to claim that handset manufacturers “would have accepted small reductions in performance or somewhat more demanding handset specifications in order that they could still be able to offer Android smartphones. They could have offset any effect on consumer demand of reduced performance by offering other features or lower prices.”<sup>56</sup> Dr. Leonard’s speculation is contrary to Google’s own understanding of the basis for demand as expressed above, and does not suggest that the handset manufacturers actually thought a slower product would be acceptable. If handset manufacturers were indeed facing a worse-performing OS that would have forced them to lower phone prices, it would stand to reason that they would have required additional inducements from Google to maintain their current level of sales as opposed to working with Microsoft, Symbian, an alternative Java-based mobile stack developed by other third parties, or developing their own OS. These inducements could have been in the form of revenue sharing or additional developmental or promotional support. This would have been costly to Google and, therefore, Google would have had the incentive to pay Sun for a license to simply avoid these additional costs.<sup>57</sup> However, Dr. Leonard completely ignores the obvious economic implications of this suggested alternative and just makes the bald statement that such an outcome would have had minimal impact on Google, if any.

29. The idea that handset manufacturers might compensate for Android deficiencies is entirely consistent with my analysis of the ’720 and ’702 patents, presented in my Opening Report. There, I value the cost to the handset manufacturers of providing additional memory to compensate for the inefficiencies related to excising the functionality of the two patents from Android. Unlike Dr. Leonard, I analyzed actual data in reaching my conclusions on this point. Similarly, I estimated the impact on consumers’ willingness to pay for Android phones with reduced speed and increased application launch time. Dr. Leonard does not attempt to put a value on any of the patented features through any type of scientific method.

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<sup>56</sup> Leonard Report, p. 30.

<sup>57</sup> Alternatively, if handset manufacturers would not have asked for additional money to offset in this but-for world, it must be the case that Google is leaving money on the table in the actual world by putting as much development effort into Android as it does. If it could scale back on development and still enjoy the same position with OEMs, why wouldn’t it do so?

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30. In sum, by asserting the existence of non-infringing alternatives despite an abundance of evidence to the contrary, Dr. Leonard has, in effect, assumed away virtually all damages. This is both incorrect and contrary to my understanding of Judge Alsup’s instructions.<sup>58</sup>

#### **IV. Dr. Leonard’s Georgia-Pacific Analysis Is Unreliable**

31. Dr. Leonard’s discussion of the *Georgia-Pacific* factors is not based on sound economic analysis and suffers from many of the flawed and unsupported assumptions he makes regarding non-infringing alternatives and the importance of time to market referenced above. For example, in his discussion of Factor 2 (the royalty rates paid by the licensee for the use of other patents comparable to the patents-in-suit), Dr. Leonard observes that the only situation where Google agrees to a “revenue share” is a distribution agreement.<sup>59</sup> Android, in fact, helps Google attain wider and more favorable distribution. It also enables Google to negotiate more favorable distribution agreements because Google offers Android as a free platform. In some cases, Google has been able to eliminate revenue sharing entirely. For example, Google’s revenue sharing agreement with HTC is not applicable to HTC’s distribution of Google applications on Android.<sup>60</sup> The fact that the initial negotiations between Sun and Google discussed revenue sharing, as well as a partnership or joint platform, also indicate that both sides were clearly considering revenue sharing arrangements at some point during the negotiations. So does the fact that Google appears to use revenue sharing in contexts beyond distribution – for example, for content such as music<sup>61</sup> and video,<sup>62</sup> and for applications,<sup>63</sup> none of which Dr. Leonard takes into account. In my view, Factor 2 places significant upward pressure on the royalty rate for a license to Sun’s technology.

<sup>58</sup> Daubert Hearing Tx. at 31:15–32:5.

<sup>59</sup> Leonard Report, p. 67. Dr. Leonard does not identify specifically which licenses he reviewed, but the appendix to his report identifies licenses that appear to have not been produced.

<sup>60</sup> Opening Report, p. 149.

<sup>61</sup> GOOGLE-21-00008118 at 132 (“Android Music Opportunity - \$1.3-\$2B business by 2013. . . 70% revenue share to labels”).

<sup>62</sup> GOOGLE-77-00053555 at 575 (“Video P&L . . . ~78% revenues share to Partners”).

<sup>63</sup> GOOGLE-21-00008118 at 122 (“Google accounts ~5% revenues for App Sales and does not account for 70% that goes to the developers. . .”).

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32. In his discussion of Factor 4 (the licensor’s established policy and marketing program to maintain its patent monopoly by not licensing to others to use the invention; or by granting licenses under special conditions designed to preserve monopoly), Dr. Leonard asserts that “Sun had a policy of licensing as evidenced by its large number of licensing agreements. Sun was willing to license to anyone. This factor suggests a slightly lower rate, all else equal.” Dr. Leonard’s comments lack any economic analysis or foundation. In protecting its monopoly profits, the issue is not how many licensees one licenses to, but rather to whom and under what terms (or, as the court put it in *Georgia-Pacific*, what “special conditions”) one licenses. As I discussed in my Opening Report, Sun protected its patents and core operating principle of “write once, run anywhere” by ensuring that licensees passed the TCK, which prevented fragmentation, promoted growth of the Java ecosystem, and ensured the continuation of Sun’s Java revenue streams and control over the use of its intellectual property.<sup>64</sup> Sun’s licenses also contained a field of use provision specifying how the licensee could use the product.<sup>65</sup> These practices were designed to increase the total value of Java, both to Sun and other members of the Java ecosystem, and to protect Sun’s existing and future revenue streams. For Sun to relinquish control and requirements of compatibility to Google and to agree to license to would-be competitor, Sun would have required substantially more than its customary rate, not a “slightly lower rate.”

33. In his discussion of Factor 5 (the commercial relationship between the licensor and the licensee, such as whether they are competitors in the same territory in the same line of business; or whether they are inventor and promoter), Dr. Leonard claims “Sun and Google were not direct competitors in any line of business or territory.”<sup>66</sup> However, Dr. Leonard fails to acknowledge here (though he does in his upward adjustment of the starting point) that Google became a competitor by releasing Android. The fact that Google would not be realizing revenue from licensing Android does not make them less of a competitor. To the contrary, Google and

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<sup>64</sup> See, e.g., OAGOOGL0100004779-834 (Sony Ericsson Mobile Communications AB Java license) at 782 (“WHEREAS Sun wishes to license is Java™ technology, which *maintaining compatibility* among Java language based products”) (emphasis added).)

<sup>65</sup> Opening Report, Paragraphs 182-183, 186. See also, OAGOOGL0100004779-834.

<sup>66</sup> Leonard Report, p. 68.

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Sun would have competed over the same customers (handset manufacturers). This point is underscored by the market allocation provisions contemplated in the back and forth negotiations surrounding Project Armstrong. Further, by open sourcing Android in the way that it did, Google undermined licensing revenue that Sun would have otherwise earned from commercial implementations. And given that Sun was planning its own integrated mobile stack with Acadia, that competition would have occurred head-to-head. This factor should place upward pressure on the starting point royalty.

34. In his discussion of Factor 6 (the effect of selling the patented specialty in promoting sales of other products of the licensee; the existing value of the invention to the licensor as a generator of sales of his non-patented items; and the extent of such derivative or convoyed sales), Dr. Leonard also claims that Google could have achieved “essentially all of these revenues using the non-infringing patents-in-suit,” and concludes the royalty should be adjusted downward as a result.<sup>67</sup> As discussed above, this is an assertion with no support.

**V. Dr. Leonard’s Analysis of the Hypothetical Negotiation Based on the Sun-Google Negotiations Surrounding Project Armstrong is Incorrect**

35. For a starting point for the hypothetical negotiation, Dr. Leonard and I both look to the Sun-Google negotiations that took place in 2005 and 2006, referred to in some documents as “Project Armstrong.” The negotiations concerned the terms of a mutually acceptable license agreement that would have permitted Google’s *compatible* use of Sun’s Java intellectual property with some retention of control by Sun. As explained below, Dr. Leonard and I reach different conclusions. My review of Dr. Leonard’s affirmative analysis of the hypothetical negotiation reveals serious flaws which in my view render his opinion unreliable. The following three points summarize my reasoning.

36. **First**, Dr. Leonard chooses as his starting point for the hypothetical negotiation a value of \$28 million with no revenue share, based on an offer exchanged between Sun and Google on April 19, 2006. (As an aside, while Dr. Leonard claims to use \$28 million, he has

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<sup>67</sup> Leonard Report, p. 68.

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erroneously used \$26 million when adding up his numbers.<sup>68</sup>) Dr. Leonard’s effort to suggest that it is more appropriate to start at \$28 million than \$100 million is inconsistent with the Court’s order and evidence, and it gives undue weight to the unsettled bargaining positions of the companies at the time.

37. The starting point – whether \$28 million or nearly \$100 million – was premised on both parties’ understanding that Google’s payment of that amount would be for a compatible implementation of Java that would enable Sun to monetize the joint project to the tune of far more. There is evidence that to the extent Sun may have been prepared to accept \$28 million in April 2006, that was in the context of other deal terms. As noted in my Opening Report, the April 19, 2006 offer was accompanied by the following redline to the draft agreement: “[Need to discuss. We propose agreement to the price in return for Sun’s hosting & ISV leadership.]”<sup>69</sup>

38. I have not identified any contemporaneous documents reflecting changes to the projected commercial licensing revenues and other value to Sun from that redline change, which reasonably could have led to increased projections by Sun, had those discussions continued. In contrast, the offer of a license for nearly \$100 million was made at the same time that Sun created its Armstrong projections, which were circulated internally at Sun in March 2006. It is my opinion that the combined February 2006 offer to Google provides a more reliable starting point, which can then be matched to the projections reflected in the March 2006 presentation. But whether reflected in a higher starting point and matching Sun business model projections or a somewhat lower starting point and likely higher projections that would have resulted had the discussions continue, the overall valuation is likely about the same.

39. Further, as explained in my Opening Report, contemporaneous documents surrounding the Armstrong negotiations confirm that revenue sharing was very important to Sun and that Sun was seeking a license agreement that would have included some form of revenue sharing tied to the Android platform.<sup>70</sup> Back and forth communications between the parties also

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<sup>68</sup> Leonard Report, p. 65.

<sup>69</sup> GOOGLE-01-00056539-557 at 553.

<sup>70</sup> Certainly, early Armstrong proposals, including proposals from Sun to Google and vice versa, all included revenue sharing. OAGOOGL0000357494; OAGOOGL0016737281; OAGOOGL0000358127.

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indicate that the possibility of a revenue share was still under discussion at the time that a \$28 million deal was being considered.<sup>71</sup> Thus, in order to reliably use \$28 million as a reasonable starting point for the hypothetical negotiation, Dr. Leonard would need to incorporate some revenue sharing. His failure to do so is inconsistent with the contemporaneous evidence and renders his starting point unreasonable.

40. As I discuss in my Opening Report, the idea of revenue sharing is well-established in the area of licensing as a tool to align incentives and share risk. In this case, Sun faced business risk by licensing Java for use in Android; the more successful Android became, the more it would “submarine” Java’s revenue. The use of a revenue share would efficiently compensate Sun more in exactly the circumstances where it risked losing more Java revenues. In addition, Android faced business risk. As recognized by Dr. Leonard himself, “[a]t the time of the hypothetical negotiation, there was uncertainty as to whether Android would be successful at all, let alone as successful as it has actually been.”<sup>72</sup> Under revenue sharing, Google would pay less to Sun if Android were not as successful as expected. In this manner, revenue sharing helps mitigate the both parties’ risks. Contrary to these basic principles, Dr. Leonard suggests that to mitigate Google’s risk, Google should simply pay less.<sup>73</sup>

41. **Second**, Dr. Leonard agrees with the principle of an upward adjustment and incorporates one, based on Sun’s Armstrong business model showing \$471 million in projected operating profits from license fees for commercial implementations which Sun would have controlled, as compensation to Sun for harm due to Google’s infringement. However, Dr. Leonard inappropriately reduces this \$471 million to only \$28 million (matching his \$28 million starting point), through three separate adjustments. In my view, Dr. Leonard’s adjustment is unwarranted, and I use it here for the purposes of this discussion only.

42. The first adjustment applied by Dr. Leonard reduces Sun’s projected revenues by 55%, to what would have been realized given third party estimates of actual Android handset

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<sup>71</sup> OAGOOGL0001338191 at 193.

<sup>72</sup> Leonard Report, p. 66.

<sup>73</sup> Leonard Report, p. 66.



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sales.<sup>74</sup> This reduction is based on evidence post-dating the hypothetical license negotiations that directly conflicts with the forecasted revenues at that time. Dr. Leonard himself has said that “[f]rom the point of view of an economist, the hypothetical negotiation should be analyzed using the information that the parties had on hand at the time of the negotiation. Particularly useful are the parties’ forecasts regarding the future sales and profitability of the products at issue.”<sup>75</sup> Despite this, Dr. Leonard claims the adjustment is warranted because he believes the Armstrong projections to be “unreasonably optimistic.”<sup>76</sup> Dr. Leonard has not attempted to construct any other projections based on contemporaneous data or information; he is only relying on the evidence post-dating the negotiation. Google believed that a partnership with Sun would “dramatically accelerate” Google’s distribution strategy, and as such the difference between projected and realized handset sales may be the hit Google took by ultimately not partnering with Sun.<sup>77</sup> Dr. Leonard’s second adjustment modifies Sun’s projected share of commercial handsets to reflect Red Hat’s share in the Linux server market. In the Armstrong projections, Sun expected 63% of total projected Android units to be commercial implementations, while 37% were open source. By comparison, 33% of all Linux implementations in the server market were of Red Hat, while 67% were a mix of open source and other paid Linux.<sup>78</sup> Dr. Leonard’s third adjustment discounts the stream of annual operating profits back to January 1, 2006 – his assumed date for the hypothetical negotiation – using a discount rate of 15%.

43. Dr. Leonard has also made five separate errors in performing these adjustments, each of which has the effect of improperly reducing projected operating profits:

- a. Dr. Leonard has made two simple mathematical errors. First, instead of using \$28 million as his starting point, he appears to have inadvertently used \$26 million. Second he has made a mistake implementing his Red Hat adjustment. This mistake has the effect of double-counting the discount he intended to apply to Armstrong’s

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<sup>74</sup> Leonard Report, p. 86.

<sup>75</sup> “Comments of Gregory K. Leonard, Ph.D.,” *Evolving IP Marketplace – Comment*, Project No. P093900, available at <http://www.ftc.gov/os/comments/iphearings/540872-00033.pdf>, at p. 14.

<sup>76</sup> Leonard Report, p. 86.

<sup>77</sup> GOOGLE-12-00080356-367, at 358.

<sup>78</sup> Leonard Report, p. 86.



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- projected operating profits. Instead of calculating operating profits from commercial implementations as 33% of total operating profits (reflecting the Red Hat mix of Linux in the server market, as he intended), Dr. Leonard mistakenly applied the 33% to Sun’s expected 63% of the total market – a quantity that already excludes non-commercial versions. Correcting both of these mechanical errors alone increases Dr. Leonard’s version of Project Armstrong profits to \$47.7 million.
- b. Dr. Leonard also erred by focusing on Red Hat’s share of the Linux server market.<sup>79</sup> Red Hat is just one paid commercial implementation of Linux, out of many others in the server market; the share of all paid commercial implementations of Linux in the server market is 57%, with 43% being open source.<sup>80</sup> With Project Armstrong, Sun would have been the only source for commercial implementations of Android. Accordingly, to make a comparison with Project Armstrong, the relevant share is the paid share of the overall market (of 57%), not the Red Hat-specific share (of 33%). In this case, the overall share paid of Linux commercial implementations (57%) closely resembles and corroborates the expected share (63%) anticipated by Sun under Project Armstrong. Accordingly, I conclude that it is inappropriate to change the expected Project Armstrong mix between open source and paid, and I remove the Red Hat adjustment. This correction (along with the previous one) increases Dr. Leonard’s version of Project Armstrong profits to \$96.1 million.
- c. Dr. Leonard has made another error in discounting Sun’s expected operating profits by an annual discount rate of 15% to account for “risks inherent in the forecast,”<sup>81</sup> after he has already adjusted the Armstrong projections to reflect actual Android handset sales.<sup>82</sup> In so doing, Dr. Leonard has adjusted *twice* for the same business

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<sup>79</sup> Dr. Leonard only support for his use of Red Hat’s share of total Linux appears to be a Google presentation that says “Sun creates commercial implementation – becomes ‘Redhat.’” (See GOOGLE-12-00080356-367, at 361.)

<sup>80</sup> See <http://www.bizjournals.com/triangle/stories/2009/08/24/daily63.html>; and <http://www.gartner.com/it/page.jsp?id=1654914>.

<sup>81</sup> Leonard Report, p. 87.

<sup>82</sup> In any case, one would not want to discount back to the date of infringement because the violation is continuous. Fisher, Franklin and Craig Romaine, “Janis Joplin’s Yearbook and Theory of Damages,” *Journal of Accounting Auditing and Finance*, pp. 145-157.

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- risk (and possibly thrice, in the event that the Project Armstrong projections were already adjusted to reflect business risk). Even assuming as he does that the Project Armstrong projections need to be adjusted for project risk, the correct way to do so requires adjustment of the numerator (the expected operating profits, in this case). Undoing Dr. Leonard’s double adjustment (along with the previous corrections) increases his version of Project Armstrong profits to \$208.1 million.
- d. In reducing Armstrong projected revenues to reflect the number of actual Android handsets sold, Dr. Leonard uses an estimate of 105 million handsets, from a January 2011 forecast from Strategy Analytics. He should have used actual data from Google. Absent actual data, he should have used the most accurate data available for handset sales. In this context, I note that Strategy Analytics updated its forecast in March 2011 to 156 million Android handsets. Furthermore, two other third party vendors (IDC and Gartner) published estimates of 179 million and 180 million, respectively.<sup>83</sup> Elsewhere, Dr. Leonard uses data from Google where available; otherwise he uses data from IDC, presumably because they are borne out by the actual data, to which he has access (and I do not) from Google. By using the January Strategy Analytics estimate, Dr. Leonard is not using the most accurate (or conservative) estimate available.<sup>84</sup> Moreover, he is mixing and matching data sources. Using IDC data instead of Strategy Analytics (along with the previous corrections) increases Dr. Leonard’s version of Project Armstrong profits to \$357.5 million.

As a result of these errors, Dr. Leonard has substantially understated (by a factor of nearly 13) the upward adjustment to compensate Sun for lost commercial monetization due to Google’s infringement.

44. For the purpose of illustration, I have re-calculated Dr. Leonard’s estimation of patent damages correcting for only these data handling errors. These calculations are shown in

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<sup>83</sup> The IDC estimate is from March 2011 and the Gartner estimate is from April 2011.

<sup>84</sup> In my Opening Report, I used Strategy Analytics because their forecasts were conservative for my calculations.

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Exhibit 1. Column [1] presents Dr. Leonard’s calculation. Column [2] corrects for what appears to be Dr. Leonard’s transcription error in the starting value and his error in implementing the Red Hat adjustment. Column [3] eliminates the Red Hat adjustment in its entirety, for reasons stated above. Column [4] corrects for Dr. Leonard’s double adjustment for business risk. Column [5] uses IDC data instead of Strategy Analytics data to adjust the Armstrong projections. The cumulative effect of correcting these data handling errors is to increase Dr. Leonard’s estimated patent damages of \$13 million to \$92.5 million. (See Exhibit 1.)

45. **Third**, Dr. Leonard apportions the entire amount, the sum of his starting point value and the upward adjustment, to reflect lost commercial revenues for Sun, between the United States and the rest of the world, based on the distribution of Google’s mobile advertising revenues, to reflect damages to Sun from alleged infringement in the United States. Specifically, Dr. Leonard calculates that 80% of his estimated \$54 million (derived as the sum of the erroneous \$26 million starting value and \$28 million upward adjustment) is attributable to the United States.<sup>85</sup> Dr. Leonard ignores the fact that infringement in the United States has resulted in worldwide harm to Sun. Given the nature of the smartphone marketplace, infringement by Google in the United States has eroded Sun’s worldwide opportunities for commercial monetization. Accordingly, from an economic perspective, Dr. Leonard should only apportion the starting value, not the entire amount.

46. **Finally**, Dr. Leonard argues for three additional adjustments, which he does not implement, presumably because doing so would have resulted in numbers that are absurdly small, given the economic context and the evidence I have seen claiming the technical and commercial significance of the claimed inventions. These include: (1) a downward adjustment to reflect seven claimed devices (22%); (2) discounting to reflect that the upfront \$28 million would have been spread over a number of years; and (3) discounting for patent marking.<sup>86</sup> If Dr. Leonard were to make those adjustments his estimate of patent damages would reduce from damages from \$13 million to as little as \$2.5 million. That these adjustments when made in their

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<sup>85</sup> Dr. Leonard appears to have calculated his 80% figure for geographic apportionment as the average, over 2010 and 2011, of the percent of Android advertising revenue in the U.S., using the same data that I used for geographic apportionment.

<sup>86</sup> Leonard Report, p. 66.

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entirety serve to eliminate virtually all patent damages is an indicator of the unreasonableness of his approach.

**VI. Dr. Leonard’s Analysis of the Hypothetical Negotiation Based on the Sun’s Licenses with Danger and Handset Manufacturers Suffers from Conceptual Flaws that Render the Approach Unusable**

47. As an alternative calculation, Dr. Leonard assesses patent damages from the hypothetical negotiation based on Sun’s licenses with Danger and handset manufacturers. The Sun-Danger agreement, signed in August 2003, was a three year agreement<sup>87</sup> that, according to Dr. Leonard, “provided Danger with the right to develop its own virtual machine and corresponding mobile phone operating system that was compatible with Java virtual machine technology.”<sup>88</sup> In return, Danger paid Sun a per-unit royalty, according to a volume-based on price schedule. The agreement also specified that if Danger failed to comply with the branding requirements, it would have to double the per-unit rate it otherwise would have paid.<sup>89</sup>

48. The appeal of the agreement to Dr. Leonard appears to be the broad similarities between Danger and Google: “Both Danger and Google have developed their own operating systems for mobile phones that include a virtual machine and can run programs written in the Java programming language.”<sup>90</sup> Andy Rubin participated in the negotiation of that Danger license, which provided him with information regarding Sun’s licensing program at Sun and the necessity for a TCK license. It also appears that Dr. Leonard believes that the Sun-Danger agreement provides a way to price incompatibility.<sup>91</sup> According to Dr. Leonard, “the hypothetical Google-Sun license would not require that Android pass the TCK and be branded with the Sun Java trademark. A conservative way to adjust for this difference is to double the royalty rate in accordance with provision in the Danger-Sun agreement whereby the royalty rate would double if the Danger product was not branded with the Java trademark.”<sup>92</sup>

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<sup>87</sup> OAGOOGL0100006249-269, at 258.

<sup>88</sup> Leonard Report, p. 45.

<sup>89</sup> OAGOOGL0100006249-269, at 262.

<sup>90</sup> Leonard Report, pp. 46-47.

<sup>91</sup> Leonard Report, pp. 45-48.

<sup>92</sup> Leonard Report, p. 47.

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49. Although neither Dr. Leonard nor I are attorneys, Dr. Leonard’s interpretation of the Danger license appears to be erroneous based on my reading of the contract. The provision that he cites deals only with branding (the section is titled “Branding”) and the agreement otherwise repeatedly refers to and requires compatibility.<sup>93</sup> Dr. Leonard has conflated a **branding** provision, which provided optional price variation if Danger chose not to use the Java logo, with the **compatibility** provision, which was contained in a separate clause, and was not optional. Therefore, Dr. Leonard cannot simply double the royalty rate to account for incompatibility, and Dr. Leonard’s reliance on it is invalid.

50. Even if Dr. Leonard’s interpretation of the agreement were correct, there are a number of reasons to discount it. First, Danger’s market was significantly more limited than Android’s worldwide presence. Consistent with this, the highest volume specified in the Danger agreement is 35 million; by comparison Android handset sales in 2011 alone are expected to be nearly 200 million.<sup>94</sup> Given this difference in scale Sun would have reasonably understood that Google’s incompatible use of Sun’s technology would be more harmful than Danger’s would have been. Further, there is no reason to expect that Danger’s license terms would have continued had Danger grown significantly, perhaps to approach Android’s scale. For all of these reasons, I believe Sun’s agreement with Danger does not reflect the value of the license that would have emerged from a hypothetical negotiation between Sun and Google over the terms of a mutually acceptable *incompatible* license over which Sun had *no control*.

51. In addition, even if one were to rely on the Danger agreement as a comparable license for purposes of patent damages analysis, one would have to take into account the fact that

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<sup>93</sup> OAGOOGL0100006249-269. (“Original Contributor desires to license the Technology to a large community to facilitate research, innovation and product contribution while maintaining compatibility of such productions with the Technology as delivered by Original Contributor”); page 10 (commercial license “Subject to Your compliance with ... the TCK license”); license is for “Compliant Covered Code” which is defined as code “that complies with the requirements of the TCK”); page 11 (branding optional); page 13 (“All Ports and Implementations must be Compliant Covered Code”); page 14 (describes TCK requirements); page 16 (“You acknowledge and agree that Modifications, whenever created, are Covered Code and that You are authorized to distribute under this Agreement only Covered Compliant Code”); page 17 Attached E (TCK license). (See 249, 258-259, 261-262, 264-265)

<sup>94</sup> IDC, Ramon T. Llamas, “Worldwide Smartphone 2011 2015 Forecast and Analysis,” March 2011, available at <http://www.idc.com/>.

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the term of the license was three years, with a one year automatic renewal unless either party provided 60 days notice.<sup>95</sup> Had Google faced such a provision, Oracle would have been in the position to force a renegotiation some time in 2011. Given the popularity of Android, Google would have faced this renegotiation at a time when it was locked into using the patents-in-suit. Such a term would have been exceptionally advantageous to Oracle. Dr. Leonard fails to take this into account.

52. As a final step of his calculation, Dr. Leonard reduces his calculated patent damages based on the Danger agreement by an adjustment to account for the portion of damages attributable to just the seven specific Android devices.<sup>96</sup> In performing this calculation, he relies on device unit activations produced to him by Google. He divides the number of devices activated by overall unit sales as reported by IDC to arrive at an overall apportionment percentage of 22%.<sup>97</sup> I have two concerns about this calculation. First, the number of devices activated by Google will be necessarily lower than the number of devices shipped overall – some devices are never sold, some may never be activated through Google. Therefore, Dr. Leonard’s ratio is biased downward. Second, as I have already explained, Google’s business model is based around advertising revenues, not device shipments. To the extent that some devices are more likely to produce a higher volume of searches than others, using device sales may lead to error in devising the proper apportionment percentage.

53. In order to rectify the two concerns above, I use data from Localytics, which tracks the level of web activity by smartphones.<sup>98</sup> Localytics data are available by phone model, on a monthly basis. In each month, I calculate the percentage of web usage attributable to the seven devices in question. I then calculate an overall weighted average over all months by using Google’s actual monthly advertising revenues, on a worldwide basis, available from a Google

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<sup>95</sup> OAGOOGL0100006249-269 at 258.

<sup>96</sup> Leonard Exhibits 3a, b and c.

<sup>97</sup> IDC projection of US Android sales, from "IDC Data" tab supporting Exhibits 3a-c of Dr. Leonard's rebuttal report. Google data on activations of seven devices, from "Accused Models" tab supporting Exhibits 3a-c of Dr. Leonard's rebuttal report.

<sup>98</sup> Localytics platform, OS version, and device model application use data, January 2010 – July 2011, available at [www.localytics.com](http://www.localytics.com).

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P&L.<sup>99</sup> As a result, I determine that 27% of all Android ad revenues were attributable to the seven devices in question. (See Exhibit 2.)

## **VII. Dr. Leonard’s Criticisms of My Patent Damage Calculations Are Unsupported**

54. Dr. Leonard makes the following criticisms of the patent damages calculation in my Opening Report. He suggests that I have unfairly sought to give Oracle the benefit of lock-in effects that arose well after the date of the hypothetical negotiation.<sup>100</sup> He has suggested that my use of approximately \$100 million as the starting point of the hypothetical negotiation is unreasonable.<sup>101</sup> He criticizes my adjustments to the starting point, including my upward adjustment to compensate Sun for loss of control and compatibility and my downward adjustments based on my analyses of patent apportionment and geographic apportionment.<sup>102</sup> I have reviewed each of Dr. Leonard’s criticisms and am not persuaded by them to change any of my opinions. I discuss each in turn.

### **A. Avoiding a Lock-in-Effect**

55. In my Opening Report, I posit that the hypothetical negotiation would take place at some point at or immediately prior to the date of first infringement, which I understood to be around mid-2006. By contrast, Dr. Leonard suggests that the hypothetical negotiation should take place somewhat earlier – in late 2005 or early 2006 – so that the reasonable royalty does not reflect any “lock-in” value.<sup>103</sup> As a practical matter, I do not believe it makes any difference which date one chooses, because we both look to the Sun-Google negotiations in 2005-2006 to identify a reasonable starting point. In terms of lock-in, before it was even acquired by Google, Android, Inc. contemplated a Java-based platform with “Java licensed from Sun.”<sup>104</sup> Other

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<sup>99</sup> See Exhibit 3.

<sup>100</sup> Leonard Report, pp. 17-19.

<sup>101</sup> Leonard Report, pp. 72-73.

<sup>102</sup> Leonard Report, pp. 80-86, 95-98.

<sup>103</sup> Leonard Report, p. 10.

<sup>104</sup> GOOGLE-29-00004478.



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documents suggest that by late 2005, when Google acquired Android, Inc., there was already some lock-in.<sup>105</sup>

## **B. Starting value**

56. Dr. Leonard criticizes my starting value of approximately \$100 million, consisting of \$60 million in fixed payments spread over three years and a 10% revenue share capped annually at \$25 million – based on the February and April 2006 proposals between Sun and Google, as part of the Armstrong negotiations.<sup>106</sup> He suggests instead that I should have used a starting value of \$28 million with no revenue sharing, based a later exchange between the parties in the Armstrong negotiations. Contrary to Dr. Leonard’s suggestion that I “rejected” consideration of the subsequent negotiations in the negotiations in the report,<sup>107</sup> I place significant weight on the contemporaneous evidence from those negotiations which, as discussed above, confirm the importance of revenue sharing to Sun<sup>108</sup> and suggest that using a \$28 million starting point likely would require an increase to the upward adjustment for incompatibility because of changes in other deal terms that accompanied the proposal to reduce the Google payment to Sun. As discussed above, back and forth communications between the parties also indicate that the idea of revenue sharing was very much alive in the days before negotiations broke off.

57. Furthermore, as explained above, my use of the nearly \$100 million offer is consistent with the Court’s order and contemporaneous evidence. The evidence also makes clear that Sun was seeking a revenue share to mitigate risk from an agreement giving Google the rights to control and incompatibility. Such an agreement was going to be far more costly to Sun than a standard licensing agreement. Indeed, Google was asking Sun to: (a) offer Java ME with assigning less restrictive provisions regarding “virality”; (b) forego its own business plans to

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<sup>105</sup> See for example, GOOGLE-01-00019527, October 11, 2005 which suggests that Google would have had to “abandon our work” if they pursued a different path – suggesting there was already some lock-in as early as late 2005, with the acquisition of Android.

<sup>106</sup> Leonard Report, p. 72.

<sup>107</sup> Leonard Report, p. 72.

<sup>108</sup> Certainly early Armstrong proposals, including proposals from Sun to Google and vice versa, all included revenue sharing. OAGOOGL0000357494; OAGOOGL0016737281; OAGOOGL0000358127.



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release a competing stack; and (c) do all this in the aid of a potential competitor. From my experience and research in the licensing area, it is my opinion that in such a situation, the license emanating from the hypothetical negotiation would have involved revenue sharing. As I have explained, revenue sharing is well-established in the area of licensing, and it is widely used as a tool to align incentives and share risk. The use of a revenue share would address Sun’s business risk of losing Java revenues should Android become successful. At the same time, it would address Google’s business risk from the uncertainty over whether Android would be successful.

58. To the extent that one uses the fixed starting value of \$28 million, one must incorporate through appropriate upward adjustments compensation to reflect that what Sun was being asked to do. What form that adjustment would have taken is entirely unclear. Accordingly, I believe it is more reliable to use the approximately \$100 million starting value, emanating from the same negotiations, because it embodies both aspects (a fixed payment and revenue share) that would in my opinion inevitably have emerged.

### **C. Adjustments**

59. On fragmentation, Dr. Leonard appears not to believe that Google’s use of the patents in suit has resulted in any fragmentation.<sup>109</sup> His view is at odds with the evidence.<sup>110</sup> Even if Dr. Leonard’s statements were valid and supported, which they are not, I note that I do not quantify the value of fragmentation because I have found no way of quantifying or remedying it through an award of damages.

60. On geographic apportionment, Dr. Leonard observes that 57% of Android handset sales occur outside of the U.S. and criticizes me for making a “small downward adjustment to account for the fact that damages should be calculated only on alleged infringement in the United States.”<sup>111</sup> Dr. Leonard is making a distinction between the percent of Android handset sales in the U.S. (57%) and the percent of Android advertising revenues in the U.S. (80%), which is pointless. The fact is that Google’s business model is driven by advertising, not handset sales. As

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<sup>109</sup> Leonard Report, p. 34.

<sup>110</sup> GOOGLE-38-00009472; GOOGLE-17-00069037; GOOGLE-01-00028497.

<sup>111</sup> Leonard Report, p. 98.

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such, the economic impact of the infringement is appropriately metered by advertising revenue, not handset sales. Though Dr. Leonard draws attention to the 57% handset figure, his geographic apportionment calculation *actually* uses advertising revenues, just as I do.<sup>112</sup> Furthermore, Dr. Leonard offers no opinion on my view that geographic apportionment should only be applied to the starting value, not to lost Armstrong license revenues, because infringement in the U.S. caused worldwide harm to Sun.

61. On the litigation premium, Dr. Leonard calculates that with probability 0.02 (=  $0.5^6$ ) none of the patents would be found to be valid and infringed, and as such with probability 0.98 (=  $1 - 0.5^6$ ) at least one patent would be found to be valid and infringed.<sup>113</sup> Dr. Leonard’s suggestion that there is essentially no litigation premium (1-0.98 or 2%) is based on a predicate that each of the patents is a blocking patent.<sup>114</sup> However, this may not be the case. Although I explained in my opening report that some patents may be blocking patents, making the value of the portfolio equivalent to the value of any one of the patents, that does not necessarily mean that *any* patent is a blocking patent. In any event, my analysis is based on reduced performance of the Android platform and does not argue that any one of these patents (or some combination) would be sufficient to block Android from coming to market.

62. Despite having made his 2% litigation premium calculation, Dr. Leonard fails to actually increase his damages by the amount of the premium he calculates. Dr. Leonard’s measurement of the litigation premium is in any event unsound. It rests on assumptions that he otherwise rejects (e.g., Dr. Mitchell’s opinion that Android would be crippled if any of the six patents in suit were blocked), and essentially amounts to an exercise in mathematical sophistry. Dr. Leonard ultimately concludes that it would have been so obvious that at least one of the six patents in suit is valid and infringed that there would be almost no discount at all for uncertainty. Indeed, if Dr. Leonard’s analysis were sound, one would be able to conclude *on that basis alone* that, by July 20, 2010, Google knew with 98% certainty that it was infringing at least one of Oracle’s valid patents and copyrights. While that may be true for other reasons—it is an issue on

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<sup>112</sup> Leonard Report, pp. 65-66.

<sup>113</sup> Leonard Report, 90.

<sup>114</sup> Leonard Report, 90.

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which I offer no opinion—I am confident that neither Google nor Dr. Leonard is willing to accept that consequence of his analysis.

63. A litigation premium, as I explained in my report, reflects the fact that in a license negotiation, the parties cannot know whether a given patent (or copyright) would actually be found to be valid and infringed – both of which are necessarily true once liability is found. As a result, the price that parties would reach as a result of a business negotiation is at a discount to the price the parties would reach once validity and infringement are established. The price is further discounted by litigation costs and the asymmetric risks faced by the patent or copyright holder.

64. Given that I estimate damages for each of the patents separately (which I have explained is conservative given their likely complementarity in the patent portfolio), the litigation premium for each is affected by the probability that a given patent is valid. Therefore, if one were to use Dr. Leonard’s assumption that the probability of validity was 50%, the value of each patent should be doubled. On the other hand, if one were to assume that any of the patents is a blocking patent for Android, the apportionment for each patent is 100% (i.e. each patent is essential in and of itself). Finally, as I noted in my opening report, I find that a litigation premium would be too speculative to quantify and therefore do not attach any particular number to it, rendering my analysis conservative.

#### **D. Response to Dr. Leonard’s Criticisms of the Econometric Analysis**

65. The Econometric Analysis contained in my Opening Report is designed to measure the effect of the patents-in-suit on the willingness to pay and the demand for Android devices. Based on a large and well-established literature in economics, the analysis explicitly accounts for the fact that there are many smartphone attributes that influence willingness-to-pay and demand, some of which are related to the patents (such as speed) and some of which are not (such as high resolution LCD screens and cameras). As such, the analysis is able to isolate the effects of removing the patented features from Android devices on willingness-to-pay and demand. Dr. Leonard appears to agree with the general premise of my econometric analysis – the use of market data to infer consumers’ willingness to pay for handset performance and the

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use of this information for the purposes of patent apportionment. He disagrees with specific aspects of my implementation, which he suggests casts doubt on the reliability of the results. As I explain below, his arguments are flawed, misleading and sometimes contradictory.

**a. Dr. Leonard’s criticisms of my use of eBay data are unfounded**

66. Dr. Leonard suggests that eBay data are not representative of new smartphone purchases, based on his observation that many of the handsets on eBay are used and that some bidders in the data were involved in a large number of auctions.<sup>115</sup> Dr. Leonard’s concerns are unfounded. With regard to used handsets, while eBay data contain both new and used phones, the phones are properly labeled so that bidders know whether they are bidding on a new or a used phone. Thus, eBay data can be used reliably to study preferences of consumers who purchase new handsets. Moreover, my analysis controls for whether a phone is new or used and, in so doing, accounts directly for the fact that preferences may be different across phone vintage. With regard to the fact that some bidders were involved in large numbers of transactions, it is noteworthy that the vast majority of all bidders (about 95 percent) bid on less than 14 items over a period of 29 months.<sup>116</sup> Furthermore, to the extent bidders involved in large numbers of transactions are resellers, Dr. Leonard’s concern has even less merit. Resellers in a competitive environment must take the preferences of their end consumers into account when purchasing smartphones, on eBay and elsewhere. For example, if consumers were unwilling to pay a premium for smartphones with Wi-Fi capability, then profit-maximizing resellers would not be willing to pay a premium either.

67. Furthermore, Dr. Leonard is silent regarding the many factors that support my use of eBay data in the first instance. There is a body of peer-reviewed economic studies that rely upon data from eBay auctions to estimate models of willingness-to-pay and demand.<sup>117</sup> It is

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<sup>115</sup> Leonard Report, p. 99.

<sup>116</sup> The data cover the period January 2009 through to June 4, 2011.

<sup>117</sup> For example, Christopher Adams, “Estimating Demand from eBay Prices,” *International Journal of Industrial Organization*, 25(2007), pp. 1213-1232; Bajari, Patrick and Ali Hortascu, “Economic Insights from Internet Auctions,” *Journal of Economic Literature*, Vol. XLII (June 2004) pp. 457-486; Yannis Bakos, “The Emerging Landscape for Retail E-Commerce,” *Journal of Economic Perspectives*, Volume 15, No. 1 (Winter 2001), pp. 69-80; Brown, Jeffrey R. and Austan Goolsbee, “Does the Internet Make Markets More Competitive? Evidence from the Life Insurance Industry,” *Journal of Political Economy*, Volume 110, No. 3 (June 2002), pp. 481-507; Paarsch, Harry J. and Han Hong, 2006. “An Introduction to the Structural Econometrics of Auction Data.” The MIT Press.

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generally recognized in this literature that eBay auctions are very good reflections of ‘real life markets’ because they are so ubiquitous and popular. Currently, eBay is the largest online marketplace, with 94 million active users and \$62 billion in goods sold in 2010.<sup>118</sup> In addition, to my knowledge, eBay is the single largest and most comprehensive source of information on consumer willingness to pay for phones, and it is one of the only distribution channels in the U.S. where phones are sold without a carrier plan – a big advantage for studying demand for handset functionality. It is also noteworthy that there are few, if any differences between many eBay and non-eBay smartphones. For example, sellers on eBay often offer warranties and eBay sellers often operate on eBay and in physical stores.

68. Finally, in criticizing the representativeness of eBay data, Dr. Leonard ignores a fundamental economic principle –arbitrage. If prices and outcomes were very different on eBay relative to the rest of the population, the differences would be arbitrated away. For example, if the average eBay smartphone purchaser was willing to pay less for longer battery life than other smartphone purchasers, smartphones with longer battery life would be sold at a relative discount on eBay. Thus, some consumers would begin bidding on eBay to take advantage of the price discount and the price for smartphones with longer battery life would increase in response.

**b. Dr. Leonard’s criticisms of my computer code**

69. Dr. Leonard contends that my computer code includes two “significant” errors.<sup>119</sup> He claims that I misidentified the highest bidders in some auctions and used the wrong statistical distribution at one place in my estimation. I went back and reviewed my programming code to assess whether the miscoding exists and if so, the significance of this miscoding to my analysis of patent damages. Dr. Leonard has correctly identified two errors, but I disagree that those errors were significant. I have re-run my estimation and have traced the effect of the change through to the end of my analysis. I find that the Linpack coefficient in my base specification goes from 0.131 to 0.077; and the Linpack coefficient in my sensitivity specification goes from 0.122 to 0.094. The end result of these changes, however, is not economically significant. For the ‘104 and ‘205 patents, the average increase in consumers’ willingness to pay for handsets

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<sup>118</sup> Who We Are – eBay Inc, accessed October 6, 2011 at <http://www.ebayinc.com/who>.

<sup>119</sup> Leonard Report, p. 100.

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changes from \$31-\$37 to \$24-\$29, and the associated patent apportionment changes from 30%-40% to 20%-35%, affecting Exhibits 6 and 7 in my Opening Report. For the ‘720 patent, patent apportionment changes from approximately 9% to approximately 10%, affecting Exhibit 8 in my Opening Report. For the ‘702 patent, patent apportionment changes from approximately 6% to approximately 7%, affecting Exhibit 9 in my Opening Report. Accordingly, it remains my opinion (based on the combination of the Econometric Analysis and other analyses and evidence) that at least 30% of the Java portfolio value is attributable to the patents-in-suit, taken together. My opinion about each of the patents’ individual contributions also remains the same.

70. In investigating Dr. Leonard’s backup production, I realized that he estimates the parameters of the auction demand model using a pre-packaged estimation command from a commercially available software vendor.<sup>120</sup> The prepackaged command, however, imposes a restrictive assumption that the number of bidders is identical in every auction. This assumption is clearly unsupported in the actual data, as Dr. Leonard should know. There is a large degree of variation in the number of bidders per auction. An assumption of equal bidders may be appropriate for some auctions such as treasury bill auctions, where a stable (fixed) number of banks bid in every auction. However, the eBay auction market is much more dynamic, with different numbers of people bidding in different auctions at any moment. The more complex eBay setting requires more flexible programming code. Furthermore, I observe that the pre-packaged command imposes a different distributional assumption from the one I use.<sup>121</sup> For both of these reasons, Dr. Leonard’s estimation of consumer willingness to pay with eBay auction data introduces unintended differences between his results and mine.<sup>122</sup> See Exhibit 3 for a coefficient by coefficient comparison of differences, some of which are potentially large enough to affect the results of his specification tests. As a result, the estimates that Dr. Leonard reports as the “Cockburn model ” cannot be reliably attributed to me.

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<sup>120</sup> He uses proc QLIM from SAS.

<sup>121</sup> Dr. Leonard’s computer code imposes the assumption that the logarithm of bidders’ valuations is normally distributed, and I assume that bidder’s valuations are log-normally distributed. See Paarsch, Harry J. and Han Hong, 2006. “An Introduction to the Structural Econometrics of Auction Data.” The MIT Press; and Christopher Adams, “Estimating Demand from eBay Prices,” *International Journal of Industrial Organization*, 25(2007), pp. 1213-1232

<sup>122</sup> I note that I provided my more flexible program code to Dr. Leonard, though he decided not to use it.

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**c. Dr. Leonard incorrectly claims that my analysis fails several generally accepted econometric reliability tests**

71. Dr. Leonard claims that he ran certain reliability tests in an attempt to probe different aspects of my model. He argues that: a) I should have included both RAM and processor speed in my model specification; b) I have incorrectly pooled Android phones with other phones; c) I have failed to control for obsolescence; d) my model is incorrectly omitting product-specific indicator variables; e) the Linpack coefficient is not stable over time; and f) there is a flaw in my market share effects calculation. I have reviewed each of these claims and have found them for different reasons to be without merit. I discuss each of these in turn.

**a) RAM and Processor Speed**

72. Dr. Leonard claims that RAM and processor speed should have been included in my econometric specification in addition to the Linpack scores. This claim is incorrect. First, consumers care about *performance*, not RAM or processor speed. RAM and processor speed are sometimes included in models of willingness-to-pay but only because they serve as proxies for performance. Their inclusion is unnecessary in my analysis, as I include the Linpack score, which directly measures an important aspect of performance that is itself a function of RAM and processor speed.

73. Second, Dr. Leonard appears to be confusing the features of smartphones and personal computers, when insisting that RAM and processor speed should both be included in the econometric model. With personal computers, the inclusion of both RAM and processor speed might be sensible, as RAM and processor speed both vary significantly across desktop computers. This is not the case, however, for smartphones, where fewer combinations of RAM and processor speed are available due to the limited size of the devices. For instance, there is a 99.7 percent correlation between RAM and processor speed across different versions of the iPhone, because the newer versions of the iPhone tend to have both faster processors and more memory. Furthermore, processors in mobile devices are difficult to compare directly across operating systems – including a measure of clock speed for an iPhone likely has very different implications for performance than on a Blackberry device. Finally, I observe that Dr. Leonard himself lists the product attributes that affect the experiences of smartphone consumers. His list



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includes: pleasing design, price, ease of use, digital camera features, variety of features offered, large screen, touch screen, Wifi capability, brand reputation, email access, applications, QWERTY keyboard, battery life, and speed.<sup>123</sup> Nowhere do “RAM” or “processor speed” explicitly appear.

74. Because the engineering analysis finds that one of the performance improvements enabled by two of the patents in-suit directly affects RAM, I include RAM explicitly as a separate covariate – using a well-accepted technique to avoid problems created by collinearity.<sup>124</sup> This alternative specification allows me to measure (or apportion) on a patent by patent basis the direct contribution of the patents whose performance improvements are most easily measured through RAM. My estimation results for this alternative specification indicate the Linpack coefficient is 0.094, which is very consistent with my estimate of 0.077 in the base specification.

#### **b) Pooling Android Smartphones with Other Phones**

75. Dr. Leonard also claims that it is incorrect to pool Android smartphones with other smartphones in my econometric model, and he therefore dropped all other smartphones from his analysis sample (leaving only 13 of my original 50 phones). However, he has provided no compelling motivation for dropping other smartphones. All he says is “...consumers may respond differently to an attribute depending on whether it is an attribute of an Android phone or Blackberry.”<sup>125</sup> To that end, he ignores the fact that I have also included in my specification indicator variables for each of the platforms, to control for cross-platform effects.

76. Dr. Leonard reports that has re-estimated the auction demand model using only auctions only involving Android phones and finds the effect of the Linpack score on willingness-to-pay becomes *negative*.<sup>126</sup> Dr. Leonard appears to have given no thought to the effect of the sample change on model specification. To estimate his model, he has dropped certain explanatory variables, such as the indicator for the Android platform and the indicator for

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<sup>123</sup> Leonard Report, p. 25.

<sup>124</sup> Collinearity refers to the high degree of correlation between two characteristics included in the same model specification.

<sup>125</sup> Leonard Report, p. 103.

<sup>126</sup> Leonard Report, p. 103.



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JavaME, for which there is no within Android variation, reducing the total number of explanatory variables from 23 (in my specification) to 15. He keeps the remainder of the variables without any regard to whether they really belong in the Android only analysis. The results of his estimation are shown in the first column of Exhibit 4b. As evident from Exhibit 4b, Dr. Leonard’s model also has a number of other perverse results: improved screen resolution, longer battery standby time, the presence of data hotspots, and data tethering ability, which are generally perceived to be desirable attributes for smartphones, all have negative effects on the consumer’s willingness to pay. This pattern of perverse results is indicative of an underlying problem with Dr. Leonard’s specification.

77. To investigate, I evaluated each of the explanatory variables, one by one, to determine whether it was economically sound to include it in an Android only model. I find that while it is appropriate to include all 15 explanatory variables (and more) in my estimation using a larger set of smartphones, it is inappropriate to use all of them for the subsample of only 13 Android smartphones. One reason for this is that there is insufficient information - in essence Dr. Leonard is using a sample of only 13 smartphones to estimate 15 coefficients. This is what econometricians call an “identification problem.” Another reason is that some variables are highly correlated within the Android family, though they are not as correlated across the larger set of smartphones, spanning different operating systems. Diagnostics tests to evaluate the extent of collinearity show that several of the explanatory variables within the Android family of phones are almost entirely explained by a combination of other explanatory variables (See Exhibit 4a.) Furthermore, some explanatory variables have essentially no variation across phones within the Android family, though they have just enough to be retained by Dr. Leonard’s computer code. All of these problems stem from the fact that Dr. Leonard has not redesigned the model specification when restricting to Android only. In Exhibit 4b, I present some alternative specifications that illustrate the importance of these points. In all of my alternative specifications, the Linpack coefficient is always positive and noticeably bigger in magnitude than the estimate on which I base my opinion.

78. In my opinion, Dr. Leonard has provided no basis for dropping 37 of the 50 smartphones in the analysis, thereby eliminating meaningful information from the analysis

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sample. By ignoring the perverse results associated with several of his model variables, he has overlooked a symptom of an underlying specification problem. Addressing his misspecification, at least in part, restores the finding that consumers are willing to pay more for smartphones that are faster, as measured by Linpack. Moreover, the findings suggest that my analysis based on a broader set of smartphones is more conservative than one based on the Android only smartphones.

**c) Control for Obsolescence**

79. Dr. Leonard claims that my econometric analysis fails to control for variables that measure the effects of obsolescence on willingness-to-pay. On this count, Dr. Leonard is wrong. My model includes a control for the length of time each smartphone has been on the market. Time on the market serves the same purpose as the measures of obsolescence Dr. Leonard proposes.

**d) Omitted Product-Specific Indicators**

80. Dr. Leonard complains that I do not include indicator variables for each individual smartphone model in my econometric model. As a statistical matter, the inclusion of product indicator variables makes it impossible to identify consumers’ valuation of any of individual phone feature, such as the Linpack score – without which the model cannot be used to study apportionment. Accordingly, I have designed a work-around specification, one which controls for a rich set of product and platform level characteristics.

81. In order for Dr. Leonard to run his (Hausman) specification test to probe the importance of product indicators, he is forced to drop the Linpack and all but three remaining explanatory variables (time to market, the indicator variable for whether the phone is new, and the indicator variable for whether the phone is unlocked). By way of background, I observe that the specification test Dr. Leonard runs is only able to evaluate whether the common variables are reliably estimated. He is not able to make any inference about whether the other variables, which he was forced to drop, are reliably estimated. Thus, taking Dr. Leonard’s specification test at face value, the only thing he is able to test is a hypothesis that the coefficients on the three common explanatory variables (time to market, the indicator variable for whether the phone is

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new, and the indicator variable for whether the phone is unlocked) are reliably estimated. His conclusion says nothing about whether the Linpack coefficient is reliably estimated.

**e) Linpack score over time**

82. Dr. Leonard has claimed that the econometric model incorrectly assumes that the Linpack coefficient is stable over time and has estimated model parameters using monthly samples to support his point. (See Leonard Exhibit 6g.) However, Dr. Leonard has not used the correct approach to evaluate the stability of the Linpack coefficient over time. Among other errors, Dr. Leonard’s monthly samples are not representative of the overall market, making his criticism unsound. Although further time is necessary to complete the review, my quantitative analysis thus far indicates that correction of Dr. Leonard's methodological error eliminates the issue he claims to have found. (See Exhibit 5.)

**d. Dr. Leonard claims that the calculation of market share effect is flawed**

83. Dr. Leonard claims the calculation of market share effects, as presented in my report, are flawed for two reasons. First, Dr. Leonard concludes that “[b]ecause the market share analysis is based on the econometric analysis, which is demonstrably biased and unreliable; the market share analysis is similarly biased and unreliable.”<sup>127</sup> However, as I have explained above, Dr. Leonard is misguided in many of his criticisms and it is unclear what his testing actually shows.

84. Second, Dr. Leonard claims that the analysis should be limited to bidders who are purchasing smartphones for their own use. To probe this point, he restricts my eBay sample to bidders that won a single auction. This is akin to claiming that economists should not look at demand curves, only equilibrium prices. He then further restricts the eBay sample to individuals who won a single auction, an auction in which they bid for and won an Android device. Not surprisingly, Dr. Leonard finds that this final sample of Android purchasers appears to have a strong preference for Android devices. The fact that such bidders display high loyalty towards Android is perfectly consistent with my analysis. His finding is a pure artifact of the sample restrictions he has imposed and is, in fact, is a nonsensical argument to make.

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<sup>127</sup> Leonard Report, p. 106.

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85. Finally, Dr. Leonard claims the fact that some bidders bid on a great many auctions is evidence that arbitrage is happening. I take this admission by Dr. Leonard as evidence that the eBay data are likely representative of all smartphone purchases.

#### **E. Responses to Dr. Leonard’s Conjoint Criticisms**

86. In this section, I respond to criticisms made by Dr. Leonard of Professor Shugan’s Conjoint Analysis and my use of it for patent damages. I understand that Professor Shugan is independently responding to criticisms not addressed here.

87. Dr. Leonard criticizes my measurements of application launch times and my use of them to analyze consumer choices and, ultimately, the impact on Google’s profitability. I address each of these criticisms below.<sup>128</sup> In particular, Dr. Leonard complains that I “did not rely on Mr. Poore’s report in this case, but instead on a conversation with Mr. Poore. There is no indication as to what [I] learned from Mr. Poore or how [I] used what [I] learned to derive the figure used in [my] apportionment percentage calculations.”<sup>129</sup> I am puzzled by this criticism, particularly in light of Dr. Leonard’s overwhelming reliance on interviews. My Opening Report clearly states that “Oracle engineer Noel Poore has determined that the ‘702 patent enables the Android handset to save a minimum of 23 megabytes of RAM, for a base set of Android applications that would typically be running after the device is booted.”<sup>130</sup> I primarily relied upon the Poore Report – all of Poore’s analysis has been fully disclosed. From the Poore Report, I knew that the ‘702 patent enabled Android to decrease the size of Android files significantly<sup>131</sup> and in my conversation with Mr. Poore he explained that the impact on RAM memory would be at least 23 megabytes. My usage of this fact is also clearly laid out in my report – it is used as an input in my econometric analysis and I also quantify the cost impact of this additional memory on a smartphone OEM in my Exhibit 17, from my Opening Report. My findings with respect to the ‘702 patent are summarized in my Exhibit 9, of my Opening Report. This criticism also of

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<sup>128</sup> Dr. Leonard also notes that there is a disconnect between the “Impact on Android Sales” figures in Exhibit 5 and the results of Dr. Shugan’s conjoint analysis. (Leonard report, p. 96) This discrepancy was caused by a data entry error and has been corrected as of September 28, 2011. The corrected version of Exhibit 5 was available to Dr. Leonard before he filed his report.

<sup>129</sup> Leonard Report, p. 96.

<sup>130</sup> Cockburn September Report, pp. 102-103.

<sup>131</sup> Poore Report, August 6, 2011.

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course undermines *Dr. Leonard’s own report*, which cites to undated, undisclosed, undocumented interviews frequently for key facts (such as the presence or absence of non-infringing alternatives). Throughout his report, Dr. Leonard cites interviews 61 times but Google’s documents only 14 times.

88. Dr. Leonard further states that I provide “no basis to conclude that [my] start up time measurements for the two applications on the altered Nexus One handsets are sufficiently representative that they can be used to calculate an apportionment percentage that is then applied to the entire universe of Android phones.”<sup>132</sup> My decision to test the start-up times on just two applications was driven by practical concerns: the task of video-taping the launch sequence, processing the videos, and recording the accurate launch time is labor intensive and time consuming. I picked two applications that a typical consumer would use: e-mail and camera. The application launch time for a camera may be especially important to users, as a delay in launch time might mean that they miss their shot. Once I tested these two applications, I observed that the launch times across the two do not differ significantly. More importantly, the *changes* in launch time across different Android builds are very consistent between the two applications.<sup>133</sup> I have concluded that further testing is unnecessary. If Dr. Leonard demonstrates that certain widely-used applications would exhibit launch behavior substantially different from the two applications I focused on, I would consider such evidence.

89. With respect to the Nexus One phones being representative of other Android devices on the market, I rely on the statement by Oracle engineer Erez Landau that the “HTC Nexus One is a good test environment for any functionality at issue. One would expect that for any test performed, proportional results would occur on other Android phones running the same or similar versions of the Android OS.”<sup>134</sup>

90. Dr. Leonard contends that my “apportionment percentage calculations assume that the effect on consumer demand of the claimed increase in memory requirements that would result from deletion of the functionalities allegedly covered by the patents-in-suit is equivalent to

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<sup>132</sup> Leonard Report, p. 96.

<sup>133</sup> See Exhibit 5, Opening Report.

<sup>134</sup> Supplemental Summary and Report of Erez Landau, September 12, 2011.

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the effect on consumer demand of decreasing the amount of memory on the handset. This makes no economic sense if the memory constraint is not binding.”<sup>135</sup> In principle, I would agree with Dr. Leonard that if the memory constraint on a smartphone is not binding, an increase in memory requirements may have little impact on smartphone performance. However, as a matter of economics, the memory constraint *is* generally binding. Consumers do not buy smartphones as a bundle of features, such as processor speed or RAM size – the majority of consumers are not even aware of technical characteristics of their devices. What they pay for and what the OEMs are trying to deliver is a certain level of user experience, in terms of device speed, ability to perform various tasks, physical appearance etc.<sup>136</sup> Therefore, for a given level of user experience, OEMs will *always* try to minimize the cost of a device and would not include more memory than is necessary.<sup>137</sup> Additional RAM memory has costs in both direct input costs and also in terms of decreased battery life, so an OEM would always try to include just the amount of RAM necessary for a given level of performance. It follows that the memory constraint *will* be binding for any substantial decrease in operating system efficiency.<sup>138</sup>

91. Dr. Leonard argues that based on my calculations in Exhibit 5 (from my Opening Report), the ‘205 patent has “negative ‘incremental contribution’.”<sup>139</sup> While he is correct in observing a specific mechanical relationship, he ignores the larger issue that any single benchmark test is an unreliable indicator of value. Any given performance feature may show up in certain benchmarks, but not others. For example, as is obvious from Exhibit 5 of my Opening Report, disabling the ‘205 patent does not slow down application launch times – in fact,

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<sup>135</sup> Leonard Report, p. 97.

<sup>136</sup> Dr. Leonard agrees with me on this point: “End users likely do not care about the technical functionality... Instead, consumers generally care about the ‘user-facing’ attributes of the handset.” Leonard report, pp. 26-27.

<sup>137</sup> For example, a \$10 increase in the cost of a device is considered to be substantial enough to affect the competitive landscape among the Android smartphone manufacturers. <http://9to5google.com/2011/07/07/gloomy-prognosis-for-samsung-in-spite-of-impressive-phone-sales/>

<sup>138</sup> RAM memory is typically installed in discrete increments: 192MB, 256MB, 384MB, 512MB etc. Therefore, it is possible that for certain phone models the memory constraint is not binding. However, one has to keep in mind two effects. First, if an OEM is seeing unused memory in the device it is developing, it would have an incentive to fill up some or all of the additional room by enriching the phone’s user interface or including additional features. Second, the need for an increase of 23MB on a device that was previously operating near its memory constraint would trigger an actual RAM increase in excess of 23MB due to the lumpy nature of memory size adjustments – for example from 384MB to 512MB.

<sup>139</sup> Leonard Report, p. 79.

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application launch times decrease slightly. However, this decrease is small – less than 1 second<sup>140</sup> – and, more importantly, should be viewed in the overall context. The broader context suggests that Google itself viewed the introduction of the JIT functionality, enabled by the ‘205 patent, as a significant speed increase. For example, Dan Bornstein, on whom Dr. Leonard extensively relies, wrote at the time: “[we] were able to make [users’] existing device work better - run faster, use less battery – [the users] will actually take notice! What Makes This Possible? We added a Just In Time (JIT) compiler to the Dalvik VM.”<sup>141</sup>

92. The fact that any single benchmark can misrepresent the value of a feature is precisely the reason why I requested additional testing of the ‘205 impact through the Linpack benchmark, performed by Prof. Kemerer. His results are consistent with Google’s own conclusions.<sup>142</sup> In the end, I rely on these two benchmarks plus the documentary evidence in this case to arrive at my opinion with respect to the value of the ‘205 patent.

93. Overall, I find that the two methods (conjoint and econometrics) I used to evaluate the patents in suit produce a consistent result when the patents are analyzed as a portfolio. Given the disparate functionalities enabled by the patents and specificity of any particular benchmark measurement, the results are bound to become more stable when a whole set of functionalities is evaluated, as opposed to a single function. I find that the removal of the combination of ‘104, ‘205, ‘702, and ‘720 patents, evaluated based on econometrics, leads to a 43.2% decline in Google’s incremental profits from Android.<sup>143</sup> Similarly, I find that the

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<sup>140</sup> Dr. Leonard argues that “sufficiently small differences in application speed are not noticeable to consumers.” Leonard Report, p. 26.

<sup>141</sup> <http://android-developers.blogspot.com/2010/05/dalvik-jit.html>; Mr. Bornstein also noted that “the differences aren’t always dramatic, *nor do they apply uniformly to all applications*. ...On the performance front in particular, we have seen *realistic improvements of 2x to 5x* for CPU-bound code, compared to the previous version of the Dalvik VM. This is equivalent to about 4x to 10x faster than a more traditional interpreter implementation.” [emphasis added]

<sup>142</sup> Mr. Bornstein also noted that “the differences aren’t always dramatic, *nor do they apply uniformly to all applications*. ...On the performance front in particular, we have seen *realistic improvements of 2x to 5x* for CPU-bound code, compared to the previous version of the Dalvik VM. This is equivalent to about 4x to 10x faster than a more traditional interpreter implementation.” [emphasis added] Dan Bornstein, “Dalvik JIT,” Android Developers Blog, May 25, 2010, available at <http://android-developers.blogspot.com/2010/05/dalvik-jit.html>; Ben Cheng and Bill Buzbee, “A JIT Compiler for Android’s Dalvik VM,” May 2010, Google I-O Presentation, available at <http://www.google.com/events/io/2010/sessions/jit-compiler-androids-dalvik-vm.html>.

<sup>143</sup> See backup calculations in “Patent Contribution - Econometrics.xlsm.”



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removal of the combination of ‘104, ‘205, and ‘720 patents, evaluated based on the conjoint, leads to a 38.0% decline in Google’s incremental profits from Android.<sup>144</sup>

### **VIII. Revised and Alternative Calculations**

94. In my Opening Report, I presented estimates of past patent damages that extended out through December 2011. I have been asked to present additional calculations that: (a) show damages through September 2011; (b) account for the date at which the individual patents were marked; c) limit damages to the seven handsets: Google Nexus S, Google Nexus One, HTC Evo 4G, HTC Droid Incredible, HTC G2, Motorola Droid, and Samsung Captivate.

95. In order to calculate patent damages through September 2011, I apportion my calculated patent damages in 2011 based on Google’s distribution of Android advertising revenues over the year. Based on the Google P&L statement for 2011<sup>145</sup>, 59% of Android advertising revenues for 2011 are realized through September, so I adjust the 2011 patent damages by this factor. I report the adjusted patent damages, as well as damages calculated through December 2011 (expected trial date), by patent, in Exhibit 5.<sup>146</sup>

96. I understand that Google contends that Oracle did not mark its patents until July 20, 2010 and, therefore, Google is not liable for damages accumulated prior to that date. I also understand that the ‘205 patent does not require marking and, therefore, is not subject to the adjustment. To adjust the damages for patents that are subject to the marking adjustment, I again calculate the portion of 2010 Android advertising revenues that occurred from July 20, 2010 through the end of 2010. This portion, based on the Google P&L, is 67%. I adjust the 2010 damages by this factor and zero out damages due in prior years. The results of this adjustment are reported in Exhibit 5.

97. Finally, I understand that Google contends that Oracle can only collect damages attributable to the sales and use of just seven specific Android devices. As I have explained above, I calculate the proportion of advertising revenue attributable to these devices. This

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<sup>144</sup> See Exhibit 5, corrected as of September 28, 2011.

<sup>145</sup> Monthly Android P&L statement through Aug 2011, based on backup to Dr. Cox’s Exhibit 2a.

<sup>146</sup> Note that I also adjust my original calculations of patent damages by incorporating Project Armstrong operating expenses into the calculation of the upward adjustment based on Armstrong.

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proportion is equal to 27 percent, as shown in Exhibit 2. I apply this proportion to the calculated patent damages and report the result in Exhibit 5.



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Iain M. Cockburn  
October 10, 2011

**Exhibit 1**  
**Illustrative Corrections to Dr. Leonard's Damages Calculation**  
**Project Armstrong Analysis**

	[1] Original Reported	[2] Fix Calculation Errors	[3] Eliminate Red Hat Adjustment	[4] Fix Business Risk Double Count	[5] Use IDC projected Android Shipments
<b>Starting Point</b>	\$26.0M	\$28.0M	\$28.0M	\$28.0M	\$28.0M
<b>Upward Adjustment</b>	\$28.0M	\$47.7M	\$96.1M	\$208.1M	\$357.5M
Revenue Adjustments (for business risk true-up)	a. Adjust for projected Android shipments using Strategy Analytics b. Adjust for Red Hat Linux Share (with error)	a. Adjust for projected Android shipments using Strategy Analytics b. Adjust for Red Hat Linux Share	a. Adjust for projected Android shipments using Strategy Analytics	a. Adjust for projected Android shipments using Strategy Analytics	a. Adjust for projected Android shipments using IDC
Discounting (for business risk)	15%	15%	15%	n/a	n/a
<b>Subtotal</b>	\$54.0M	\$75.7M	\$124.1M	\$236.1M	\$385.5M
<b>US Adjustment</b>	80% (starting point + upward adjustment)	80% (starting point + upward adjustment)	80% (starting point + upward adjustment)	80% (starting point + upward adjustment)	80% (starting point + upward adjustment)
<b>Patent Apportionment</b>	30%	30%	30%	30%	30%
<b>Total<sup>A</sup></b>	\$13.0M	\$18.2M	\$29.8M	\$56.7M	\$92.5M

Notes:

[A] Modifications are cumulative.

[1] See Leonard Report, pp. 65 - 66. Additional apportionments suggested in footnote 240 are not calculated in Dr. Leonard's report or here.

[2] Fixes misstatement of starting point and misapplication of Red Hat Linux share adjustment.

[3] Eliminates adjustment to Red Hat share of paid Linux server market.

[4] Eliminates redundant application of discounting for business risk.

[5] Uses IDC rather than Strategy Analytics for projection of Android shipments.

**Exhibit 2**  
**Accused Models' Share of Worldwide Android Active Devices**  
**Weighted by Google's Android Worldwide Advertising Revenues**

		Share of Android Active Devices <sup>1</sup>							Accused Devices	Android Advertising Revenues <sup>2</sup>
Year	Month	HTC Droid Incredible	HTC Evo 4G	HTC G2	HTC Nexus One	Motorola Droid	Samsung Captivate	Samsung Nexus S		
<b>2010</b>	Jan	0.0%	0.0%	0.0%	1.1%	25.2%	0.0%	0.0%	<b>26.3%</b>	\$4.4M
	Feb	0.0%	0.0%	0.0%	1.8%	24.9%	0.0%	0.0%	<b>26.8%</b>	\$4.8M
	Mar	0.0%	0.0%	0.0%	1.8%	30.3%	0.0%	0.0%	<b>32.2%</b>	\$5.9M
	Apr	0.0%	0.0%	0.0%	1.0%	26.3%	0.0%	0.0%	<b>27.2%</b>	\$6.7M
	May	1.5%	0.0%	0.0%	0.9%	25.3%	0.0%	0.0%	<b>27.7%</b>	\$7.9M
	Jun	2.1%	1.9%	0.0%	0.9%	25.8%	0.0%	0.0%	<b>30.7%</b>	\$8.6M
	Jul	2.7%	3.5%	0.0%	0.8%	25.0%	0.0%	0.0%	<b>32.0%</b>	\$11.5M
	Aug	5.3%	5.1%	0.0%	1.3%	22.2%	0.9%	0.0%	<b>34.8%</b>	\$12.4M
	Sep	8.7%	5.2%	0.0%	1.6%	24.6%	1.5%	0.0%	<b>41.7%</b>	\$14.7M
	Oct	8.0%	6.1%	0.8%	1.5%	20.3%	1.7%	0.0%	<b>38.4%</b>	\$16.4M
	Nov	6.9%	8.1%	1.6%	1.4%	15.0%	1.7%	0.0%	<b>34.7%</b>	\$20.8M
	Dec	5.9%	7.8%	1.7%	1.3%	11.4%	1.7%	0.1%	<b>29.8%</b>	\$26.2M
<b>2011</b>	Jan	5.5%	7.8%	1.8%	1.1%	9.4%	1.6%	0.3%	<b>27.4%</b>	\$25.5M
	Feb	5.5%	7.9%	2.0%	0.9%	9.0%	1.7%	0.3%	<b>27.3%</b>	\$28.4M
	Mar	5.9%	11.0%	1.8%	0.6%	11.4%	1.5%	0.3%	<b>32.5%</b>	\$35.5M
	Apr	4.7%	10.1%	1.7%	0.5%	8.8%	1.5%	0.3%	<b>27.5%</b>	\$36.0M
	May	4.1%	8.1%	1.6%	0.5%	6.1%	1.4%	0.4%	<b>22.0%</b>	\$42.6M
	Jun	4.0%	7.1%	1.2%	0.4%	5.1%	1.3%	0.5%	<b>19.6%</b>	\$48.0M
	Jul	3.5%	6.4%	0.9%	0.5%	3.9%	1.2%	0.6%	<b>16.9%</b>	\$51.2M
<b>Accused Models' Share of Android Active Devices<sup>3</sup></b>									<b>27.0%</b>	

Notes and Sources

[1] Android active device shares, received from Localytics on August 29, 2011 (<http://www.localytics.com>). Localytics data is worldwide, but the service is maintained in English, and the biggest apps tracked are from the US. In August 2011, 69% of Android sessions recorded were from the US.

[2] Google's actual worldwide Android advertising revenues, from "P&L" tab supporting Exhibit 3b of Dr. Cox's rebuttal report.

[3] =  $\sum ([1] * [2]) / \sum [2]$

**Exhibit 3**  
**Model Estimates Based on eBay Data**  
**Comparison of Cockburn's Revised Model to Dr. Leonard's QLIM Model**

	Model Estimates			
	Cockburn	Leonard	Difference	%
	Revised Coefficients	QLIM Model		
	[1]	[2]	[3]	[4]
<b>Independent Variables</b>				
Intercept	0.697 *	0.018	-0.679	-97%
LN(Battery Standby Time in Hours)	0.033	0.054 *	0.022	67%
LN(Battery Talk Time in Hours)	0.145 ***	0.121 ***	-0.024	-17%
LN(Screen Resolution in Pixels)	0.260 ***	0.300 ***	0.040	15%
Touch Screen	0.068 ***	0.059 **	-0.010	-14%
Data Tethering	-0.049	-0.043	0.006	-13%
Unlocked Phone	0.206 ***	0.224 ***	0.017	8%
LN(Time on Market)	-0.209 ***	-0.194 ***	0.015	-7%
Mobile Hotspot	0.040	0.038	-0.003	-7%
4G Connectivity	0.166 ***	0.175 ***	0.009	6%
LN(Memory)	0.041 ***	0.043 ***	0.002	4%
Organic LED Screen	0.193 ***	0.200 ***	0.007	4%
Camera Autofocus	0.245 ***	0.237 ***	-0.008	-3%
New Phone	0.242 ***	0.249 ***	0.007	3%
GPS	0.231 ***	0.224 ***	-0.007	-3%
DLNA	0.097 ***	0.099 ***	0.002	2%
J2ME Compatible	0.504 ***	0.494 ***	-0.011	-2%
Monthly Time Trend	-0.037 ***	-0.037 ***	-0.001	2%
LN(Linpack)	0.077 ***	0.076 ***	-0.001	-2%
Wifi	0.581 ***	0.578 ***	-0.003	-1%
<b>Platform</b>				
Microsoft	0.072 *	0.055	-0.017	-23%
Blackberry	0.276 ***	0.290 ***	0.014	5%
iOS	0.883 ***	0.841 ***	-0.042	-5%
Android	0.165 **	0.157 **	-0.007	-4%
Sigma (Variance)	1.079 ***			

Notes:

- [A] Significance level indicated as: \* 10%, \*\* 5%, \*\*\* 1%
- [1] Cockburn base specification corrected for the errors identified in Section V.B of the Leonard report.
- [2] Dr. Leonard's "Version 1" specification using the proc QLIM pre-packaged estimation command from SAS.
- [3] = [1] - [2]
- [4] = [3] / [1]

Sources:

- [1] Smartphone auction data from eBay.
- [2] Phone characteristics data from Phone Scoop (<http://www.phonescoop.com>), and where unavailable from Phone Scoop, manufacturer websites, phone reviews, <http://pdadb.net/index.php?m=search> and <http://www.phonearena.com/phones>.

## Exhibit 4a

## Colinearity Diagnostics - All Potential Covariates - All Android Bids

Dependent Variable	LN(Linpack)	Data Tethering	Mobile Hotspot	4G Connectivity	LN(Total Pixels)	LN(Battery Standby)
R-Squared	0.977	0.975	0.972	0.929	0.830	0.702
<b>Independent Variables</b>						
LN(Linpack)	-	0.56 ***	0.45 ***	0.84 ***	0.13 ***	0.31 ***
LN(Battery Talk Time in Hours)	0.78 ***	0.37 ***	0.54 ***	0.94 ***	0.13 ***	0.05 ***
LN(Memory)	0.38 ***	0.17 ***	0.27 ***	0.39 ***	0.04 ***	0.26 ***
Oraganic LED Screen	0.21 ***	0.09 ***	0.24 ***	0.34 ***	0.00 ***	0.30 ***
Data Tethering	0.60 ***	-	0.38 ***	0.23 ***	0.13 ***	0.55 ***
DLNA	0.11 ***	0.29 ***	0.16 ***	0.02 ***	0.03 ***	0.25 ***
Mobile Hotspot	0.42 ***	0.34 ***	-	0.69 ***	0.01 ***	0.76 ***
LN(Screen Resolution in Pixels)	3.35 ***	3.10 ***	0.25 ***	1.94 ***	-	1.23 ***
LN(Battery Standby Time in Hours)	0.10 ***	0.17 ***	0.26 ***	0.20 ***	0.02 ***	-
4G Connectivity	0.75 ***	0.19 ***	0.66 ***	-	0.07 ***	0.56 ***
Monthly Time Trend	0.02 ***	0.01 ***	0.00 ***	0.00 ***	0.00 ***	0.02 ***
LN(Time on Market)	0.20 ***	0.11 ***	0.04 ***	0.01 ***	0.03 ***	0.17 ***
Unlocked Phone	0.08 ***	0.07 ***	0.08 ***	0.08 ***	0.02 ***	0.00 *
New Phone	0.01 ***	0.00 ***	0.01 ***	0.01 ***	0.00 ***	0.01 ***
Intercept	41.48 ***	40.55 ***	0.13	21.37 ***	12.83 ***	22.90 ***

Notes:

- [A] Significance level indicated as: \* 10%, \*\* 5%, \*\*\* 1%  
[B] Models are run across auctions for over 400K unique bids.

Sources:

- [1] Smartphone auction data from eBay.  
[2] Phone characteristics data from Phone Scoop (<http://www.phonescoop.com>), and where unavailable from Phone Scoop, manufacturer websites, phone reviews, <http://pdadb.net/index.php?m=search> and <http://www.phonearena.com/phones>.

**Exhibit 4b**  
**Correction to Dr. Leonard's Test for Pooling Android Phones with Other Phones**  
**Alternative Specifications**

<b>Model Specification</b>	<b>Dr. Leonard's Specification</b>	<b>[1]</b>	<b>[2]</b>	<b>[3]</b>	<b>[4]</b>	<b>[5]</b>	<b>[6]</b>
LN(Linpack)	-0.443 ***	0.238 ***	0.308 ***	0.356 ***	0.240 ***	0.358 ***	0.305 ***
<b>Dependent Variables</b>							
Intercept	31.515 ***	4.903 ***	4.922 ***	5.020 ***	5.129 ***	4.992 ***	5.119 ***
Monthly Time Trend	-0.055 ***	-0.052 ***	-0.061 ***	-0.061 ***	-0.058 ***	-0.064 ***	-0.066 ***
LN(Time on Market)	-0.170 ***	-0.182 ***	-0.112 ***	-0.115 ***	-0.143 ***	-0.096 ***	-0.082 ***
Unlocked Phone	0.167 ***	0.131 ***	0.185 ***	0.202 ***	0.186 ***	0.209 ***	0.229 ***
New Phone	0.162 ***	0.170 ***	0.169 ***	0.168 ***	0.171 ***	0.168 ***	0.170 ***
LN(Memory)	0.293 ***	0.045 ***	-0.011 ***	-0.013 ***	0.042 ***	-0.027 ***	-0.009 ***
LN(Battery Talk Time in Hours)	1.142 ***	0.433 ***	0.410 ***	0.336 ***	0.255 ***	0.354 ***	0.254 ***
Organic LED Screen	0.398 ***	0.246 ***	0.194 ***	0.162 ***	0.231 ***	0.160 ***	0.185 ***
Mobile Hotspot	-0.298 ***	-	0.222 ***	-	-	0.130 ***	0.206 ***
Data Tethering	-0.307 ***	-	-	0.228 ***	-	0.152 ***	-
DLNA	0.126 ***	-	-	-	0.110 ***	-	0.097 ***
LN(Screen Resolution in Pixels)	-2.171 ***	-	-	-	-	-	-
LN(Battery Standby Time in Hours)	-0.045 -	-	-	-	-	-	-
4G Connectivity	0.824 ***	-	-	-	-	-	-
Sigma (Variance)	-	1.059 ***	1.059 ***	1.058 ***	1.059 ***	1.058 ***	1.058 ***
Schwartz Criterion	142,753	1,295,730	1,295,227	1,295,177	1,295,417	1,295,076	1,294,990

Notes:

[A] Significance level indicated as: \* 10%, \*\* 5%, \*\*\* 1%

[B] Sigma is the variance of the bids, and is used to correct for potential censoring of bids in the auction model.

Sources:

[1] Smartphone auction data from eBay.

[2] Phone characteristics data from Phone Scoop (<http://www.phonescoop.com>), and where unavailable from Phone Scoop, manufacturer websites, phone reviews, <http://pdadb.net/index.php?m=search> and <http://www.phonearena.com/phones>.



**Exhibit 4b (continued)**  
**Correction to Dr. Leonard's Test for Pooling Android Phones with Other Phones**  
**Alternative Specifications**

<b>Model Specification</b>	<b>Dr. Leonard's Specification</b>	<b>[7]</b>	<b>[8]</b>	<b>[9]</b>	<b>[10]</b>	<b>[11]</b>	<b>[12]</b>
LN(Linpack)	-0.443 ***	0.337	0.324 ***	0.246 ***	0.347 ***	0.113 ***	0.243
<b>Dependent Variables</b>							
Intercept	31.515 ***	5.087 ***	5.108 ***	5.980 ***	5.820 ***	6.595 ***	6.302 ***
Monthly Time Trend	-0.055 ***	-0.062 ***	-0.066 ***	-0.055 ***	-0.058 ***	-0.045 ***	-0.037 ***
LN(Time on Market)	-0.170 ***	-0.111 ***	-0.082 ***	-0.184 ***	-0.155 ***	-0.272 ***	-0.287 ***
Unlocked Phone	0.167 ***	0.211 ***	0.230 ***	0.314 ***	0.311 ***	0.340 ***	0.137 ***
New Phone	0.162 ***	0.169 ***	0.169 ***	0.157 ***	0.159 ***	0.156 ***	0.179 ***
LN(Memory)	0.293 ***	-0.005	-0.016 ***	-0.023 ***	-0.033 ***	0.059	-
LN(Battery Talk Time in Hours)	1.142 ***	0.283 ***	0.263 ***	0.094 ***	0.072 ***	-0.202 ***	-
Organic LED Screen	0.398 ***	0.170 ***	0.174 ***	-	-	-	0.150 ***
Mobile Hotspot	-0.298 ***	-	0.174 ***	0.327 ***	-	-	-
Data Tethering	-0.307 ***	0.191 ***	0.057 ***	-	0.342 ***	-	-
DLNA	0.126 ***	0.042 ***	0.078 ***	-	-	0.142 ***	-
LN(Screen Resolution in Pixels)	-2.171 ***	-	-	-	-	-	-
LN(Battery Standby Time in Hours)	-0.045 -	-	-	-	-	-	-
4G Connectivity	0.824 ***	-	-	-	-	-	-
Sigma (Variance)	-	1.058 ***	1.058 ***	1.060 ***	1.059 ***	1.060 ***	1.063 ***
Schwartz Criterion	142,753	1,295,158	1,294,989	1,296,148	1,295,717	1,296,879	1,298,035

Notes:

[A] Significance level indicated as: \* 10%, \*\* 5%, \*\*\* 1%

[B] Sigma is the variance of the bids, and is used to correct for potential censoring of bids in the auction model.

Sources:

[1] Smartphone auction data from eBay.

[2] Phone characteristics data from Phone Scoop (<http://www.phonescoop.com>), and where unavailable from Phone Scoop, manufacturer websites, phone reviews, <http://pdadb.net/index.php?m=search> and <http://www.phonearena.com/phones>.

**Exhibit 5****Correction to Dr. Leonard's Test of Pooling Across Months**

<b>Month</b>	<b>Dr. Leonard's Results<sup>1</sup></b>		<b>Corrected Results<sup>2</sup></b>	
	<b>Linpack Coefficient</b>	<b>Adjusted Standard Error</b>	<b>Linpack Coefficient</b>	<b>Adjusted Standard Error</b>
Jan-10	--	--	0.167	0.054
Feb-10	--	--	0.213	0.062
Mar-10	--	--	0.208	0.058
Apr-10	--	--	0.237	0.056
May-10	--	--	0.207	0.055
Jun-10	-6.338	0.617	0.230	0.051
Jul-10	1.419	0.099	0.272	0.053
Aug-10	1.242	0.078	0.198	0.050
Sep-10	0.620	0.055	0.183	0.048
Oct-10	0.137	0.032	0.132	0.045
Nov-10	-0.044	0.025	0.130	0.042
Dec-10	-0.067	0.021	0.106	0.038
Jan-11	0.047	0.017	0.093	0.032
Feb-11	-0.017	0.016	0.091	0.034
Mar-11	0.077	0.015	0.101	0.030
Apr-11	0.141	0.023	0.078	0.040
May-11	0.090	0.064	0.062	0.049

Notes & Sources:

- [1] Leonard Report, Exhibit 6g.
- [2] I was able to complete 25 iterations of this test given the time constraint in delivering this report. Computer code continues to run additional test iterations for future reporting.
- [3] Smartphone auction data from eBay.
- [4] Phone characteristics data from Phone Scoop (<http://www.phonescoop.com>), and where unavailable from Phone Scoop, manufacturer websites, phone reviews, <http://pdadb.net/index.php?m=search> and <http://www.phonearena.com/phones>.

**Exhibit 6**  
**Summary of Apportionment Assessment**  
**Court Mandated Adjustments Applied to All Past Patent Damages**

	Patent Apportionment Percentage	Through December 2011			Through September 2011			
		Damages <sup>8</sup>	After Marking <sup>9</sup>	Accused Devices <sup>10</sup>	Damages <sup>11</sup>	After Marking <sup>12</sup>	Accused Devices <sup>13</sup>	
Patent '104	25%	\$146.6 M	\$130.5 M	\$35.3 M	\$100.7 M	\$84.7 M	\$22.9 M	[1]
Patent '205	25%	\$146.6 M	\$146.6 M	\$39.6 M	\$100.7 M	\$100.7 M	\$27.2 M	[2]
Patent '720	10%	\$58.7 M	\$52.2 M	\$14.1 M	\$40.3 M	\$33.9 M	\$9.1 M	[3]
Patent '702	7%	\$41.1 M	\$36.6 M	\$9.9 M	\$28.2 M	\$23.7 M	\$6.4 M	[4]
Patent '520	Up to 1%	Up to \$5.9 M	Up to \$5.2 M	Up to \$1.4 M	Up to \$4.0 M	Up to \$3.4 M	Up to \$0.9 M	[5]
Patent '476	Up to 1%	Up to \$5.9 M	Up to \$5.2 M	Up to \$1.4 M	Up to \$4.0 M	Up to \$3.4 M	Up to \$0.9 M	[6]
<b>Patents '104, '205, '720, '702, '520, and '476</b>	30%	\$176.0 M	\$172.7 M	\$46.7 M	\$120.9 M	\$117.7 M	\$31.8 M	[7]

Notes & Sources

- [1] Cockburn report, September 12, 2011, revised as of September 15, 2011, Exhibit 6.
- [2] Cockburn report, September 12, 2011, revised as of September 15, 2011, Exhibit 7.
- [3] Cockburn report, September 12, 2011, revised as of September 15, 2011, Exhibit 8.
- [4] Cockburn report, September 12, 2011, revised as of September 15, 2011, Exhibit 9.
- [5] Cockburn report, September 12, 2011, revised as of September 15, 2011, Exhibit 10.
- [6] Cockburn report, September 12, 2011, revised as of September 15, 2011, Exhibit 11.
- [7] Apportionment for a license including all 6 patents is not equal to the sum of the apportionment for each patent individually.
- [8] Calculated according to methodology laid out in Cockburn report, September 12, 2011, revised as of September 15, 2011, Exhibits 14 - 16. Includes additional adjustment for \$25.85 million cost of Armstrong operating expenditure. Original damages excluding this cost totalled \$201.8 million.
- [9] = [8] Adjusted to remove damages from before patent marking on July 20, 2010. According to "P&L" tab supporting Exhibit 3b of Dr. Cox's rebuttal report, 67% of 2010 Android advertising revenues were earned after this date.
- [10] = [9] Adjusted to limit damages to the seven accused devices. See Exhibit 2.
- [11] = [8] Adjusted to remove damages from the final quarter of 2011. According to "P&L" tab supporting Exhibit 3b of Dr. Cox's rebuttal report, 59% of 2011 Android advertising revenues will be earned through September.
- [12] = [11] Adjusted to remove damages from before patent marking on July 20, 2010. According to "P&L" tab supporting Exhibit 3b of Dr. Cox's rebuttal report, 67% of 2010 Android advertising revenues were earned after this date.
- [13] = [11] Adjusted to limit damages to the seven accused devices. See Exhibit 2.