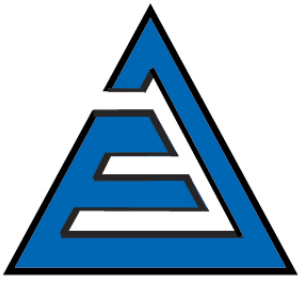
Delta Economics Group Inc.



REPORT

Assessment of the Impact of Overcharges on Canadian Direct and Indirect Purchasers of DRAM and Products Containing DRAM

Submitted to: **The Honourable Ian Binnie**

Submitted by: **Thomas W. Ross**
President and Senior Consultant
Delta Economics Group Inc.

Date: **June 28, 2013**

I. Introduction

1. I have been asked by CFM Lawyers, class counsel in this action, to provide advice to the Honourable Ian Binnie, in support of his work to propose an allocation and distribution of settlement funds secured from settling defendants in this matter. I have been asked to address two primary questions.

2. Those two questions are:
    a. What are the predominant distribution channels through which price-fixed DRAM would have flowed through the Canadian economy, during the class period, from defendants to final consumers in Canada?
    b. With respect to those channels, what is the likely incidence of the overcharge in Canada caused by this price-fixing; that is, at what stages of the various distribution channels was harm from the overcharge felt, and to what extent? This relates to the question of the "pass-through" of harm down the various distribution channels.

3. I have been asked to approach these questions in a broad way, understanding that the task of providing precise class member-by-class member estimates would be expensive and time consuming at this stage. This said, more precise estimates could be provided if desired.

4. I have not been asked to advise on any process or protocol for implementing a desired allocation.

5. In preparing this report I have been assisted by my Delta Economics Group associate Jennifer Ng.

II. Sources of Information

6. In preparing this report I have drawn on my own experience conducting research and consulting on competition policy matters, including work on price-fixing and pass-through issues.[1]

7. In addition, I have reviewed a considerable body of material and data, and conducted interviews with a number of participants in DRAM markets. Key sources of information were:

    a. Documents from the indirect purchaser class action case recently settled in the United States were made available to me. Significant among these were:

[1] For example, James A. Brander and Thomas W. Ross, "Estimating Damages from Price-Fixing", 3 *Canadian Class Action Review*, 2006, 335-369.

i. The report of the Special Master appointed in that matter,

as well as a number of reports prepared by economic and industry experts and submitted to the Special Master (as follows);

ii. The report of Dr. Roger Bohn, dated November 11, 2010;
iii. The report of Stephen Schroeder, dated November 9, 2010;
iv. The supplemental report of Dr. Bohn, dated February 18, 2011;
v. The report of Dr. Michael Harris dated July 10, 2007;
vi. The report of Dr. Kenneth Flamm dated December 15, 2010;
vii. The reports of Dr. Russell Mangum dated February 25, 2011 and April 7, 2011;
viii. The report of Dr. Gary French dated June 10, 2011;
ix. The supplemental reports of Dr. Russell Mangum dated May 9, 2011 and July 20, 2011; and
x. The second report of Dr. Gary French dated July 25, 2011.

b. I was also able to discuss the U.S. process and settlement with two members of the plaintiffs' counsel team, Josef Cooper and Tracy Kirkham (Cooper and Kirkham, San Francisco), in a conference call on March 18, 2013.

c. Reports prepared earlier in this case, by defendants' experts Margaret F. Sanderson (December 22, 2006) and Victor de Dios (December 21, 2006), as well as earlier affidavits of my own prepared for this case (June 26, 2006 and March 30, 2007).

d. A chapter titled "The DRAM Antitrust Litigation" prepared for an antitrust casebook by Professor Roger Noll, who was an economic expert for direct-purchaser plaintiffs in an American DRAM class action.

e. Data on the Canadian personal computer and server markets prepared by, and purchased from, a private firm, International Data Corporation (IDC) Canada.

f. Semi-structured interviews with industry participants knowledgeable about various aspects of DRAM distribution:

i. Roger D'Hollander, consultant and CEO, Skymeter Corporation (with considerable experience with a number of firms in the information technology and computer sectors, including White Box assemblers);
ii. Sam Wehbe, President, Cygnus Electronics Corporation (a manufacturer of memory modules and boards);

iii. Rob Wicik, Commodity Management Manager, Celestica (a leading international EMS – Electronic Manufacturing Services – company, with headquarters in Canada); and
iv. Herman Yeh, President Northern Micro (White Box assembler, selling mostly to government and education groups).

In these interviews, questioning focused on three main areas: (i) what was the interviewee's firm's place (or places) in the DRAM distribution channel (i.e. what did their business do that incorporated DRAM?); (ii) from where did they source DRAM or inputs incorporating DRAM and under what commercial conditions was this material purchased (e.g. spot markets or contracts, inventory sizes, price adjustment mechanisms, competitive conditions); and (iii) to what customers did they sell their DRAM-containing output, and under what commercial conditions?

III. Some background on DRAM

8. DRAM was first developed on an experimental basis in the late 1960s. It refers to a particular type of semiconductor device whose contents can be read or changed (i.e. "written to") at extremely high speed. DRAM semiconductor devices are often called "memory chips" or "DRAM chips". The chips are built into multi-chip modules that are often, in turn, incorporated into "motherboards", which are the main circuit boards in personal computers, workstations and servers. This DRAM is the computer's main memory. DRAM is now (and was during the Class Period) the most important form of memory used in personal computers. It is also used in printers, digital cameras, video recorders, televisions, mobile phones and other telecommunications devices, and other electronics products.

9. While there has been (and continues to be) a variety of DRAM products that differ according to, for example, their capacities and their embedded technologies, with respect to DRAM products of the same type and quality there is a high degree of substitutability between the products of the various manufacturers, giving each type and quality the attributes of a commodity. Working to common standards allows direct purchasers to choose between the offerings of various DRAM manufacturers for the most common applications.

10. Production of DRAM is carried out in an integrated global market and is highly concentrated in that most of the world's supply is produced by only a few producers. During the relevant period there were five large producers of DRAM. Samsung was the largest producer, with Hynix, Micron, Elpida (previously NEC and Hitachi) and Infineon being somewhat smaller (but still very large) and of comparable size to each other. Each of these five large producers was a network of companies connected by various parent and subsidiary relationships. For example, the defendants in this case include Samsung Electronics Co. Ltd., Samsung Semiconductor, Inc. Samsung Electronics America, Inc., and Samsung

Electronics Canada Inc. Normal practice in the industry is to report information on a consolidated basis in which "Samsung" is treated as a single entity.

11. Production of DRAM was, and remains, highly capital-intensive and involves a high degree of technological sophistication. In addition, various aspects of the production processes for particular types of DRAM are subject to patent protection. Due in large part to these factors, entry into the industry was very difficult. The industry has in fact experienced significant consolidation over the past ten or fifteen years.

12. Production facilities are located primarily in the United States, East Asia, and Europe. The Samsung and Hynix parent corporations are based in Korea. The Micron parent corporation is based in the United States, and the Infineon parent corporation is based in Germany. Elpida was based in Japan. DRAM has been strongly affected by rapid technological progress since its first development in the late 1960s. Over this period there have been enormous increases in the capacity of memory chips and dramatic continuing decreases in production cost per unit of memory.

13. The DRAM industry was strongly affected by a boom and bust cycle that occurred during the 1990s, with rising price-cost margins and rising profits in the early part of the decade and declining price-cost margins and profits in the latter part of the decade. Admitted collusion among DRAM producers began toward the end this period of decline (i.e. in 1999).[2]

14. In the United States, the Department of Justice (DOJ) pursued a price fixing conspiracy case against the major DRAM producers identified as defendants in this action. Micron cooperated with the DOJ, which obtained a guilty plea on a single obstruction of justice charge from one Micron executive. Subsequently, Samsung, Infineon, Hynix, and Elpida all agreed to plead guilty to criminal price fixing of DRAM. The period of the conspiracy specified in these guilty pleas is April 1, 1999 through June 30, 2002, a period, which I am told, corresponds to the “Class Period” in this case.

15. In addition, the European Commission’s competition authority charged ten DRAM manufacturers with price fixing and imposed fines of over €331 million. The Micron group of defendants were the amnesty applicants and received full immunity for their cooperation.

Downstream Industries: Computers

16. The characteristics of the downstream industries using DRAM are relevant in assessing pass-through of price overcharges. The most important downstream market is the computer market – defined here to include desktop computers, notebook/laptop computers, servers and other mainframe and other large

[2] See http://www.usdoj.gov/opa/pr/2005/October/05_at_540.html.

computers.[3] With respect to the use of DRAM, the largest part of the computer market is made up of personal computers, here defined to include desktop, laptop, and notebook computers.[4] In Canada it is worth distinguishing between two categories of personal computers. First there are "name brand" computers produced by large well-known companies such as Dell, Hewlett-Packard, IBM, and Apple. These large computer manufacturers, here referred to Computer OEMs, purchased the vast majority of their DRAM directly from DRAM manufacturers and sold assembled computers containing DRAM to customers in Canada either directly or through retail outlets. Second, another part of the market consists of personal computers assembled by local manufacturers who purchase components and assemble products locally, sometimes referred to as "White Box" firms. Local manufacturers may sometimes purchase DRAM directly but more generally purchase DRAM modules from DRAM resellers, or motherboards and other computer components with DRAM already installed.

17. In my opinion the market for personal computers in most parts of Canada is highly competitive. One reason for this high level of competition is the large number of local manufacturers who purchase computer components and assemble computers. Economic theory suggests that any mark-up by brand name producers above competitive levels would allow local manufacturers to undercut the prices charged by brand name producers. Adding to the competitive pressures felt in the computer market across Canada was, and remains, the significant presence of retailers, such as Dell, which sell computers to final consumers over the telephone and on-line at competitive prices.

18. One important consideration is that the supply of personal computers is what economists refer to as highly "elastic". This arises when producers are competitive and can produce additional computers without significant increases in unit cost. This implies that computer manufacturers would be highly responsive to slight increases in market price – they would quickly manufacture more computers. It is in this sense that supply is "elastic".

19. Furthermore, in my opinion the demand of computer manufacturers for DRAM is likely to be relatively "inelastic" in the sense that quantity demanded is likely not highly price sensitive for the industry as a whole.[5] That is, higher prices for DRAM as a result of the conspiracy would not lead to large reductions in the quantity of DRAM purchased by computer makers. This opinion follows in part from the observation that sales of new computers are driven largely by technological progress in the sense that many buyers replace earlier computers with new and more powerful computers for which larger amounts of DRAM

[3] In some cases, and in some of the data we have, the term "servers" is defined to include larger computers.
[4] Bohn, in his first report (Nov. 11, 201, at paragraph 68) estimated that 85% of DRAM going into computers in the US during the period would have gone into personal computers, with the remaining 15% going into servers and larger computers.
[5] Individual vendors of DRAM might experience significant demand elasticity as any slight increase in price might send customers to other vendors. However, for the DRAM industry as a whole, I expect demand to be relatively insensitive to price or "inelastic".

would therefore be essential to work with other advanced hardware components and to support ever more demanding software programs.

20. Furthermore, DRAM accounts for only a modest portion of the cost of a personal computer. I have reviewed a number of estimates in the documents of the share of DRAM costs in the total costs of personal computers during the period and, while there is some range in these numbers (and they vary a bit over time) most would put the fraction in the 3-10% range for desktop and notebook/laptop computers, and somewhat higher for servers.[6] As a result I would expect that, even if DRAM overcharges were passed down to final consumers as analyzed below, this would be with very little reduction in the quantity of final products purchased.[7]

Other Downstream Industries

21. As discussed in more detail below, most DRAM is used in personal computers and servers. However, significant amounts are used in other products such as cellular telephones, printers, personal digital assistants (PDAs), televisions, electronic games systems and a variety of industrial uses. The other relevant downstream industries (i.e. aside from personal computers) vary in market structure, implying some variation in demand and supply conditions and the likely amount of pass-through.

IV. DRAM Channels of Distribution in Canada

22. This section will rely, to a considerable extent, on data that are not specific to Canadian DRAM markets. In some cases, I will rely on data from analogous markets in the United States and in other cases I will be using global DRAM data. This said, based on my discussions with industry players, I do believe the picture that emerges from the U.S. data is a reasonable approximation to the Canadian situation and where we expected there would be some differences within the personal computer market we are fortunate to have some Canadian data from sources listed above.

---

[6] See, for example, the reports for the U.S. Special Master by Roger Bohn (February 18, 2011, paragraph 39) and Gary French (June 10, 2011, paragraph 34). The Sanderson (December 22, 2006, paragraph 64 and Exhibit F) and de Dios (December 21, 2006, paragraph 39, and Exhibits E and F) reports in this (Canadian) case reported some even lower numbers during some periods of lower DRAM prices and for notebook computers. From the Decision of the United States International Trade Commission, "DRAMS and DRAM Modules from Korea", Investigation No. 701-TA-431 (Final), USITC Publication No. 3616, August 2003, we have estimates of "3 to 15 percent of the cost of a PC or laptop and a slightly higher share of the total cost of a server; 10 to 20 percent of the total cost of game consoles; less than one percent of the cost of network equipment; 13 to 15 percent of the total cost of graphics cards; and 1 to 2 percent of the total cost of PDAs and DVD players."

[7] Reductions in the quantities demanded and consumed as a result of price increases create what economists refer to as "deadweight losses" (i.e. lost social value of the output that would have been produced absent the price increase) which constitute another harm flowing from the price increases. It would appear that such deadweight losses are unlikely to be large in this case and I do not measure them here.

23. In principle, it would be possible to create our own Canadian datasets but this would require a more expensive and time-consuming data collection from industry players and in my opinion it is not necessary. The structures of DRAM distribution channels are very similar between the United States and Canada. This is discussed more extensively below, but to preview some important points here:

    a. The DRAM manufactured during the relevant period was very much a commodity, produced by large multinational firms who sold the same products globally;
    b. A large fraction of the DRAM produced by those manufacturers was purchased by producers of computers and computer-related equipment and parts, and these companies, including Dell, Hewlett-Packard (HP), IBM, Apple and others, generally also operated globally selling substantially the same products in multiple countries;
    c. Another large segment of DRAM users included contract manufacturers and companies in the electronic manufacturing services (EMS) sector -- which provide components and even assembled products to the computer OEM operators – and the most important of these firms (by size) are also multinational operators selling in Canada, the United States and elsewhere. Indeed, much of the information in the documents from the American case came from a large Canadian firm (Celestica) that is a major player in this sector, and sells in both Canada and the United States;
    d. Canada and the United States both had important "white box" operator sectors (essentially non-branded computer assemblers/manufacturers) and while the Canadian white-box sector was relatively larger than its American counterpart, it played the same role in the distribution of DRAM-containing products; and
    e. The largest share of computers and computer products in Canada and the United States were distributed by resellers (mostly retailers) operating with very similar business models -- and the direct sales channel (from computer OEM to final consumer) dominated at the time by Dell was present in both countries as well.

24. It is for these reasons that I am of the opinion that the channels of DRAM distribution in Canada and the United States was very similar, though some channels may have been somewhat more or less important in one country compared to the other (and we do have useful data here which is discussed below).

The Uses of DRAM and DRAM Distribution Channel Participants

25. A very large portion of DRAM during the relevant period went into the production of computers, again including desktops, notebooks/laptops and servers (including large computers). The remainder went into a variety of products including video gaming equipment, telecommunications equipment, various

industrial electronics, and automotive navigation systems, among others. Global data reported by Bohn (February 18, 2011, Exhibit 4 – citing Gartner Dataquest) estimated DRAM shares by product class in 2001 as the following:

Table 1: DRAM Use by Product Category
Source: Bohn Report (February 18, 2011, Exhibit 4)[8]

Product Category	Percent of DRAM use
Computers*	84.4%
Consumer devices (e.g. games)	6.1%
Telecommunications	2.3%
"Other"	7.1%
Total (not 100 due to rounding)	99.9%

*Bohn's "Computers" category here includes desktop, laptop and notebook computers, as well as servers, larger computers, add-in modules and other information technology (IT).

26. The report by Schroeder (Exhibit B) provides a fairly similar breakdown of the share of DRAM going into computer (83.9%) versus non-computer (16.1%) uses, though in calculating these shares he excluded military and civil aerospace applications for reasons peculiar to the US case.

27. Schroeder (again at Exhibit B) also provides a much more detailed breakdown of the shares of DRAM uses that makes it clear that the non-computer channels are numerous and quite fragmented (i.e. most represent very small fractions of DRAM use). For this reason, this report will focus largely on understanding the computer channels. More work could be done to examine the non-computer channels or some of the results from the computer channels could be applied to those other channels as reasonable (and cost-effective) approximations.

28. Figure 1 illustrates the predominant paths DRAM takes from original production to final consumer, emphasizing the computer-related channels with one additional channel provided to capture all non-computer distribution. It also illustrates the point at which DRAM generally passes into Canada (the dashed line representing the Canadian border) and thereby reaches class members.

29. There are a few general categories of DRAM market participants illustrated here:

    a. **DRAM Manufacturers** (including defendants) which make the DRAM and, in some cases, the modules into which the DRAM is inserted. All of these firms are outside Canada.

[8] It is not clear from this report exactly from what year(s) these data come, though they do match data from Bohn's earlier report that he indicated was from 2001.

b. **DRAM Resellers, Module Makers and Other Computer Parts Manufacturers** are firms that, in the first case, simply inventory DRAM for resale to smaller purchasers who do not buy directly from the DRAM Manufacturers; in the second case, add some value to the product by taking the base DRAM and making their own modules; and, in the third case, manufacture graphics cards and other components for computers that might be distributed to final consumers (generally via resellers) without being sold to computer assemblers. Some of these firms will be in Canada, while others will not – therefore they are illustrated as being on both sides of the border.[9]

c. **Computer OEMs (Original Equipment Manufacturers)** are the major firms that buy the DRAM modules to insert into their computers. These Computer OEMs include companies such as IBM, Hewlett-Packard (HP), Apple and Dell. They are all located outside of Canada. They buy much of their DRAM requirements directly from DRAM Manufacturers. In some cases they will buy the DRAM on behalf of contract manufacturers (including EMS firms, more on them below) who will actually create the component or possibly even build the whole computer on behalf of the Computer OEM. In still other cases they will buy the DRAM indirectly embedded in products assembled for them by contract manufacturers. The Computer OEMs generally use one of two models to distribute their products. Most will use resellers (distributors, retailers etc.) but some, notably Dell, sell directly to final purchasers via telephone and (largely now) internet modes. The Computer OEM Direct sales share was smaller in Canada than the United States during the class period. While there certainly were some computer assemblers in Canada they were generally of the "White Box" variety (i.e. without a well-recognized brand, sometimes distributed as house brands by retailers) which I categorize separately below.

d. **White Box Manufacturers** are firms that assemble personal computers on a much smaller scale than Computer OEMs and without a well-recognized brand of their own. They may distribute directly to large purchasers such as governments and educational bodies (e.g. school boards) or through retailers (possibly marketed as the retailer's house brand). White Box manufacturers will, in general, not buy directly from DRAM manufacturers; rather they will source DRAM from DRAM module resellers or other module/component makers. These suppliers may be located in Canada or elsewhere. White Box Manufacturers selling to Canadian purchasers are virtually all Canadian-based themselves. This is a group that was much bigger in Canada than the U.S. during the class period, and one that has shrunk in market share considerably since that time.

[9] Just to be clear, there are two boxes in Figure 1 that could contain these firms: the DRAM Resellers/Module Makers box in Channels 1 and 2 and the Module/Graphics/Other Computer Parts manufacturers box in Channel 5.

e. **Contract Manufacturers and Electronics Manufacturing Services (EMS) Firms** are companies that produce computer components or even assemble full computers, typically (in our context) for Computer OEMs. They may also supply components or do assembly for Other Computer Parts manufacturers and for non-Computer OEMs. Some of these firms are Canadian-based, notably Celestica which is a large firm in this space, even by global standards. As noted above they can be both direct and indirect purchasers of DRAM and this DRAM may reach them via a variety of paths: (i) they may buy directly from DRAM manufacturers; (ii) they may have DRAM purchased for them by the Computer OEM client for specific orders; (iii) they may buy it from the Computer OEM client who has sourced it directly from the DRAM Manufacturers; and (iv) they may buy the DRAM from DRAM resellers or module makers.

f. **Computer and Computer Product Resellers** is a category of firms that includes all participants who are purely distributors of some sort. That is, they do not change the product itself; they merely facilitate its movement toward final consumers. Chief among these will be the retailers, including large chains such as Future Shop and London Drugs, but there are, in some cases, other distributors sitting between retailers and computer or component manufacturers. Most of this business involves selling fully assembled computers, but there are also sales of Computer-related products ("Computer Products" here) that consumers purchase to add to their systems themselves. These could include memory expansion modules and graphics cards for example.

g. **Non-Computer OEMs** is a broad category of firms that use DRAM in a wide variety of non-computer applications, such as games, telecommunications, industrial technology, etc. In some cases these firms will buy directly from DRAM manufacturers, but in others will purchase from other distributors. Some firms are based in Canada but most are not. They sell through a variety of distribution channels (here summarized as **Non-Computer Resellers**), in some cases (e.g. games) using some of the same channels as computer products. I would expect that most of this distributive activity would take place in Canada. As indicated above, I know much less about this part of DRAM distribution. With further work a more detailed picture could be prepared.

30. Not listed in the previous paragraph were final consumers. Final consumers in Canada will have purchased computer products from retailers including large retail chains, as well as directly from Computer OEMs and from White Box manufacturers. Data from IDC Data presented in Table 2 below indicate the approximate share of personal computer (excluding servers and large computers in this case) unit purchases by different final consumer groups.

Table 2: Desktop/Notebook/Laptop Final Consumer Unit Consumption Shares in Canada[10] Source: IDC (Canada) Data

Desktop/Notebook/Laptop Computers final consumer category	1999	2000	2001	2002	1999-2002
Education	8%	6%	8%	7%	7%
Government	8%	6%	8%	9%	8%
Home	35%	40%	37%	37%	37%
Business	50%	48%	48%	47%	48%
Total (not always 100 due to rounding)	101%	100%	101%	100%	100%

31. While it would appear that there is much more importing of DRAM than exporting of DRAM (in DRAM-containing products) it should be mentioned that there are some exports. Notably, EMS firms such as Celestica export some of their output to Computer OEMs which then send their products around the world; and some Canadian-based computer products manufacturers (e.g. ATI Technologies in graphics cards during the class period) shipped to Computer OEMs and non-Computer OEMs outside Canada as well as to foreign resellers (e.g. retailers in other countries).

32. We have some Canadian data that will help us determine the relative importance of the major channels. With respect to the channels through which personal computers move, IDC Canada data (Table 3) identifies the shares of Canadian personal computers, excluding servers and larger computers in this case, that:

    a. were produced by the global Computer OEM brands and sold using at least one reseller;
    b. were produced by the global Computer OEM brands and sold directly to final consumers;
    c. were produced by firms other than the global Computer OEM brands and sold using at least one reseller (e.g. White Box manufacturers' indirect sales)[11]; and

[10] These numbers do not include servers, which will be disproportionately purchased by users in the non-home categories. Bohn (November 11, 2010, Exhibit 7) estimated that servers and workstations were purchased in the U.S. (during the period) 15% for governments/education and 85% by "nongovernmental enterprises."

[11] We are using the "other vendors" category plus the company Seanix in the IDC data to represent White Box manufacturers -- these are the major manufacturers of computers other than OEMs.

d. were produced by firms other than the global Computer OEM brands and sold directly to final consumers (e.g. White Box manufacturers' direct sales).

Table 3: Desktop/Notebook/Laptop Channel Unit Shares 1999-2002
Source: IDC Canada

Desktop/Notebook/ Laptop Channels	Channel Numbers (Figure 1)	1999	2000	2001	2002	Share 1999-2002
White Box using resellers	1	33%	29%	27%	24%	28%
White Box direct	2	5%	11%	9%	11%	9%
Global Computer OEM using resellers	3	45%	41%	39%	38%	41%
Global Computer OEM direct	4	17%	20%	25%	27%	22%
Total (not always 100 due to rounding)		100%	101%	100%	100%	100%

33. Table 4 provides similar data for servers, which in the IDC data includes larger computers (though it is not broken down as finely).

Table 4: Server Channel Unit Shares 1999-2002
Source: IDC Canada

Server Channels	Channel Numbers (Figure 1)	1999	2000	2001	2002	Shares 1999-2002
White Box – servers – direct/indirect	1 & 2	11%	10%	9%	8%	9%
Global OEM servers – direct/indirect	3 &4	89%	90%	91%	92%	91%
Total		100%	100%	100%	100%	100%

34. Table 5 combines these data to provide approximate computer channel shares including desktop, laptop and notebook computers and servers.[12]

[12] This is simply based on number of units of desktop/notebook/laptop computers and servers and not on the amount of DRAM contained or the value of the personal computers and servers. As the data do not provide breakdowns of direct vs indirect sales of servers we have allocated these sales according to the direct/indirect shares from desktop/notebook/laptop sales as revealed by the data in Table 3. For example,

Table 5: Computer Channel Unit Shares
Source: IDC Canada Data

Computer Channel	Channel Numbers (Figure 1)	Share 1999-2002
White Box using resellers	1	28%
White Box direct	2	9%
Global OEM using resellers	3	41%
Global OEM direct	4	22%
Total		100%

35. The two largest differences between Canadian and American DRAM distribution in computer channels, during this period, that I have observed were: (i) the Canadian White Box share is larger than the corresponding share in the U.S.; and (ii) the Canadian Global Computer OEM Direct share is lower than the corresponding share in the U.S.[13]

36. In his report in the American case, Bohn (February 18, 2011, at Exhibit 4) estimated (based on Gartner data) that the 84.4% of DRAM going into computer uses could be broken down into 66.3% of all DRAM going directly into computers and servers with 18.1% going into "Add-In Modules and Other IT", roughly corresponding to channel 5 in Figure 1. To the extent that we can apply these figures (which are based on global numbers) -- and in my opinion this is reasonable -- to the Canadian context we can create estimates of the share of DRAM flowing through all 6 of the channels of Figure 1. These are given in Table 6 with some rounding. A key assumption, necessary but rough, is that shares of computers and servers correspond to shares of DRAM.

---

approximately 76.1% of Global OEM desktop/notebook/laptop sales were indirect, and the indirect share for White Box sellers was 64.8%.

[13] In the Bohn report (at paragraph 70, November 11, 2010) it is indicated that about "20 percent of PC Base DRAM did not pass through an OEM PC maker." (Bohn excludes servers from his PC category.) This 20% then would roughly correspond to the White Box share of personal computers in the U.S. during the period compared to 37% in Canada (see Table 3 above). Bohn (February 18, 2010, at paragraph 42) cites data from Gartner-Dataquest that "in 2000, 42.7% of computer sales in the U.S. were direct by OEMs" which we can compare with the IDC number for Canada of about 22% (see Table 5 above).

Table 6: DRAM Channel Shares for Canada (Estimated)[14]

DRAM Channel	Estimated Share
Channel 1 (White Box using resellers)	18%
Channel 2 (White Box direct)	6%
Channel 3 (Computer OEM using resellers)	27%
Channel 4 (Computer OEM direct)	15%
Channel 5 (Computer Parts & add-ins sold separately)	18%
Channel 6 (non-computer use)	16%
Total	100%

37. As indicated above, EMS firms have a complex position in DRAM distribution. They are both direct and indirect purchasers and they may both buy and sell DRAM (indirectly) to Canada OEMs. They also sell to Other Computer Parts manufacturers and non-Computer OEMs. Some data from the first Mangum report (February 25, 2011, paragraph 9, and Tables 1 and 2) is useful to get a sense of the scale of EMS operations, on a global basis. Some key points:

    a. Between 2000 and 2002, about 25.7% of DRAM is used (at some point) by EMS firms. These data are from Gartner.
    b. One key EMS firm (the Canadian firm Celestica) reported that the fraction of its DRAM purchasers for U.S. uses that were purchased indirectly was 73.1%.[15]
    c. EMS DRAM purchases were 72.9% for computers and 27.1% for non-computers.[16]

V. Economics of Pass-Through

38. "Pass-through" refers to the extent to which a producer who pays an overcharge for an input is able to pass through that overcharge to its own customers via higher prices for its output. In this case, we are concerned, for example, with the

[14] Numbers in Table 6 are based on the following: the 84% share going to all computers (from Bohn, February 18, 2010, Exhibit 4) would be the sum of channels 1-5, so the remaining 16% goes through channel 6. As noted above, approximately 18% goes to channel 5 (see Bohn Exhibit 4). This leaves 66% for the other channels which we can allocate using Canadian IDC data (from Table 5). Channel 1 gets 28% of the remaining 66% computer group based on the values in Table 5. Similarly Channels 2, 3 and 4 get their shares of 9%, 41% and 22%, respectively, of the remaining 66% based on their shares in Table 5.

[15] This fraction was slightly lower (71.1%) based on global data for Celestica companies.

[16] These numbers are from Mangum's July 25, 2011 report. I could not find a clear definition in this report as to what is included in "computer" category here, but I believe it includes desktop and notebook/laptop computers as well as servers.

extent to which computer manufacturers who paid an overcharge for DRAM were able to pass on that overcharge in the form of higher computer prices and how indirect purchasers were able to pass on the amount of overcharge they faced to other indirect purchasers further down the distribution chain.[17]

39. To begin with an obvious point, all firms in the DRAM (or any) distribution channel will have to recover all their costs and earn a reasonable return on invested capital if they are to be sustainable. This means that all costs incurred at one stage will in general have to be recovered via sales to the next level, suggesting near complete pass-through over time. However, this does not mean that changes in prices at one level must be fully passed through, and certainly not fully passed through immediately. In some cases, for example, firms at a particular stage might be earning monopoly type profits. If such firms face increased prices for their inputs they might choose to absorb some of those increases rather than risk losing more of their profitable sales by passing them on fully. That is, larger profits of a firm in the distribution chain can provide a "buffer" that may allow them to absorb some increases in input prices.

40. Estimation of pass-through of cost increases is commonly done and well-established methods for estimating pass-through exist. In this case we are concerned with how an overcharge for an input (DRAM) affects downstream pricing of computers and other products. More generally, we might ask how any change in costs (due to taxes, labour costs, input overcharges or whatever) affects downstream prices. This general problem has been extensively studied by public finance economists in the context of the imposition of commodity-specific taxes. This is referred to as the question of the "incidence" of the tax. The basic principles of tax incidence analysis are described in most public finance textbooks. There has also been extensive study of the question of how exchange rate changes are passed through to product prices for various imported products. In addition, there are many examples of the context described here, where we are concerned with the extent to which an input price overcharge is passed on.[18]

41. The extent to which higher costs due to taxes, overcharges for inputs, or to other factors will translate into higher prices downstream depends on a number of factors which determine the shape of firms' cost curves and the shape of the market demand curve in the downstream markets, such as the market for personal

[17] Brander and I discussed pass-through in our joint article cited above (Brander and Ross, 2006) and the present discussion is partly based on that work.

[18] Agricultural economists, in particular, have studied the relationship between input prices (e.g. the prices farmers get for their products) and prices further down the distribution chain. Closer in spirit to the questions considered here, C. Robert Taylor studied the pass-through of (price-fixed) lysine price increases on the price of animal feed (the main use of synthetic lysine): C. Robert Taylor, "Indirect Damages from Price-Fixing: The Alabama Lysine Case", 18 *Review of Industrial Organization*, 2001, 33-43. For a short discussion of pass-through in price-fixing cases, see Bryan Ray and Steven Schwartz, "Monopoly Overcharges, Pass-Through Pricing, and Economic Damages", *Antitrust Insights* (NERA Economic Consulting), March/April 2006. 1-7.

computers. Also important are the competitive conditions in the market in question.[19]

42. In perfectly competitive markets, in order for the full cost increase to be passed on to the next stage, either the supply curve must be infinitely elastic (horizontal) or the demand curve must be perfectly inelastic (vertical). Supply curves will be horizontal (infinitely elastic) in the relevant region when the product at that stage can be produced with unchanging unit (marginal) costs. This is often a reasonable assumption when the stage is simply a distributive one (i.e. it is not a manufacturing or product improvement stage) and even manufacturing stages can have this property if input costs do not increase with larger amounts of outputs and capacity constraints are not important (in the relevant range).

43. In order for the full cost increase to be absorbed at any level in competitive markets, either the supply curve must be perfectly inelastic (vertical) or the demand curve must be perfectly elastic (horizontal). This is the opposite extreme to the case described in the previous paragraph and would generally be unlikely to be realized in many real markets, including that for DRAM.[20]

44. When we leave the model of perfect competition, we find that the degree of pass-through will also depend on the nature of competition – again, in combination with cost and demand conditions. For example, a monopolist buyer facing a linear demand curve from its own customers and having constant unit costs would be expected to pass on 50% of input cost increases. On the other hand, if that demand curve is of the constant elasticity form (which yields a shape that is "convex to the origin") the firm will maintain a constant price/cost margin, implying that any input price increases is passed on with that mark-up; i.e. greater than 100% pass-through.

45. Some business models, even in highly competitive markets, can include simple mark-up pricing under which products are bought and then resold at prices that reflect a relatively stable mark-up (that may nevertheless be forced to be quite low by competitive pressures.) This would be common, for example, among firms which are pure resellers (i.e. whose role in the distribution chain is not to add to the product's value through further processing, customization or enhancement,

---

[19] Change in price given one dollar change in cost per unit = $e_s / (e_s + e_d)$ where e_s is the elasticity of supply and e_d the (absolute value of the) elasticity of demand. For small cost changes this formula is exact. For cost changes large enough to move to a point on the demand or supply curve where the elasticity differs from the base level, it is approximate. From this formula we see (as in the text) that when the elasticity of supply is very small (near zero, i.e. the supply curve is near vertical) or the elasticity of demand is very great (i.e. the demand curve is near horizontal), the price increase caused by a one dollar increase in costs will be very small. On the other hand, when the elasticity of supply is very great (supply curve near horizontal) or the elasticity of demand very low (demand curve near vertical) the price increase will approach 1 – that is a one dollar increase in costs will translate into nearly a one dollar increase in price.

[20] One situation in which it could arise is when the cost increase is only imposed on some downstream firms while others are exempt. The exempt firms (assuming they are still competitive among themselves) will not raise downstream prices, leaving the non-exempt firms to choose between absorbing the full cost increase or not selling.

but rather just to provide improved product availability to clients) or brokers (who may not even take possession of a product).

46. For full and immediate pass-through, it must also be the case that prices adjust immediately after cost increases are realized. To the extent that it is difficult for a firm to change prices to its customers – perhaps because its prices are specified in contracts that cover an extended period of time – some cost increases will be absorbed by that firm.

47. To be clear, as described in paragraph 55 below, this is more than just delayed recovery through pass-through, it is possible that there will be limited recovery of cost increases during the contract period.

VI. Pass-Through in this Case

48. Based upon my review of the information described above, I am of the view that there would likely be a very high degree of pass-through in DRAM distribution channels, all the way down to final consumers. This conclusion is based principally on a review of the structure of the various markets together with an application of standard economic theory. I also draw on pass-through analyses done by a number of experts in the U.S. action, recognizing that they are clearly contradictory on some key points.

Evidence from the U.S. Case

49. Let me begin with a brief review of the work done by economists for various parties in the American action.

    a. In his report Michael Harris (July 10, 2007) estimated pass-through from top to bottom rather than just at one stage. That is, he looked to see if increases in the price of base DRAM were passed all the way down the distribution channels and increased computer prices. In one test he estimated that there was more than 100% pass-through of base DRAM price increased to final computer purchasers. In a second test he studied the effect of increases in spot market DRAM prices on aftermarket DRAM prices. Again, he found more than 100% pass-through.[21]

    b. Professor Kenneth Flamm, in his report (December 15, 2010) provided estimates of the pass-through from retailers to final consumers using data from four major U.S. retailers (Best Buy, Office Depot, CDW, and Tech Depot) for various categories of computer products (desktops, notebooks, servers, memory, printers and graphics). Most pass-through estimates were in a range between 90% and 113%, the desktop and notebook rates were all within a few points above or below 100% with one exception.

[21] An expert (Gary French) for reseller class members took issue with some of Mr. Harris' approach and conclusions. I will not dwell on those arguments here.

c. In a series of reports and amended reports, Russell Mangum provides estimates of the pass-through rates from EMS firms to Computer OEMs. The estimate in his first report (April 7, 2011) indicated a pass-through of only 29%. Supplemental reports (May 9, 2011 and then July 20, 2011) increased this estimate to 35.5% and then 38%. The relationship between EMS firms and Computer OEMs is complicated by flows of inputs and products going both ways and so it is a bit hard to interpret these numbers. While it is hard to believe that any firm in a competitive industry working on slim margins could afford to absorb almost two thirds of cost increases imposed on it, less than complete pass-through (of some magnitude) may be a product here of contractual commitments that do not allow rapid price adaptations.

d. Gary French, an expert retained by resellers, provided his own estimates of the pass-through from retailers to final consumers. In his first report (June 10, 2011) he makes some adjustments to the "Flamm model" which greatly reduces estimates of pass-through (except for memory modules from retailer Best Buy which still have approximately 100% pass-through). For example, pass-through by the retailer Best Buy on desktop computers is reduced from 103% in the Flamm report to 61.5% here; for notebook computers from 96% to 55%. For the retailer Office Depot pass-through rates for a product category that includes desktop computers falls from 149% in the Flamm report to 33% here; and for notebooks from 120% to 43% here. In his second report (July 25, 2011), Dr. French offers another version of the Flamm model as well as his own model. In his further adjustment of the Flamm model he finds pass-through rates of 62% for desktops, 56% for notebooks and 90% for memory modules. His own model is different in approach. It looks at the effect of DRAM cost on final retail prices -- so effectively the pass-through down the whole chain -- and finds that through the chain pass-through rates are approximately 27% for desktops, 47% for notebooks and 110% for memory modules.

50. Clearly these experts have their points of disagreement; however, I am not in a position to resolve them here.

Characteristics of the Canadian Markets

51. As noted above, for a distribution channel to be stable (i.e. for participants at all stages to remain economically viable) it must be the case that firms at all stages are fully recovering their costs and earning a normal rate of return on their invested capital.[22] This is somewhat inconsistent with the idea of less than 100% pass-through which suggests that some costs incurred at one stage will not be

[22] It is not necessary here for every firm at every stage to remain viable – we can certainly have more and less successful firms at each stage with some exit of less successful firms. I mean only that some firms at each stage remain viable such that the particular distribution channel continues to exist.

passed on (and thereby recovered). Indeed, over the long run in channels that are holding onto their share of distribution we would expect very high rates of pass-through in most industries.

52. This said, and as discussed briefly above, there are a variety of reasons why pass-through may not be complete at some stages, particularly in the short run. Let me review these reasons and discuss their application in this case.

53. **Less elastic supply:** In perfectly competitive markets pass-through will not be complete if the supply curve is not perfectly elastic (or horizontal in the traditional illustration) or the demand curve is not perfectly inelastic (vertical in the traditional illustration). There are various reasons why supply may not be highly elastic. For example:

    a. As with agricultural and mining industries, some producers have access to better assets (more fertile soil, richer veins) with finite capacities, with the result that higher prices allow less well-endowed firms to supply the market (giving the supply curve a positive slope).
    b. It could be that technologies are such that firms become less productive (marginal costs rise) at higher rates of output. This could be because key input prices are pushed up when the firms expand output and hence their demand for this input. (This is very similar to the previous point but can be applied to manufacturing in some cases and can apply to all firms in a market equally.)
    c. It could be that firms have some fixed capacity that is binding both before and after the price increase in which case they will not change their rate of output and prices (i.e. zero pass-through).

    I do not think that these kinds of arguments for incomplete pass-through are very compelling in this case. I have not seen any evidence of these kinds of characteristics in DRAM markets, with the possible exception of capacity issues at the DRAM production level, but that is not an intermediate stage where pass-through is relevant. In any case, the DRAM demand elasticity is likely to be very small which also pushes us toward full pass-through.

54. **Imperfect competition:** If there is imperfect competition at a particular stage in the distribution channel it is very possible that firms will be making positive economic profits. In such cases, those firms can afford to pass on less than 100% of cost increases – covering some of the increase out of profits. This does not mean that they will choose to do so – indeed as noted above some models of imperfect competition can yield greater than 100% pass-through depending on the shape of demand curves. That said, I see reason here to see two groups who may have surrendered some profits as a result of incomplete pass-through. The EMS firms are arguably in a less than perfectly competitive industry – their services (particularly the top tier firms), are somewhat less "commoditized" than others in the various distribution channels and much of their work is governed by relatively

complicated contracts (see below). Second, White Box manufacturers were being badly squeezed by a number of forces during this period and indeed their numbers and share of market have fallen dramatically. I recognize that this is a slightly different point since White Box firms were indeed in a very competitive struggle, but I describe their situation here as another example of firms absorbing, to some extent, cost increases, at the expense of their own profits, even when they were perfectly able to adjust their prices, in principle. White Box firms had the further problem in many cases of being contractually bound to fixed prices for some period of time (see next point).

55. **Contracts:** In some cases firms will be contractually committed to their output prices but will be subject to changing prices on their inputs. In such cases, the firms are squeezed during a period in which they face higher input prices due to price fixing but cannot adjust their contracted output prices.[23] As noted above, this is typically not just a case of having to wait longer but getting all their costs back later – assuming that competition forces prices back down as soon as the price-fixing ends, the firm will permanently lose profits on the sales during the period during which it paid higher input prices but was committed to its output prices by contract. In my review of these markets, contracts figured prominently in only a few places. Again the EMS and contract manufacturing firms are often connected with their client Computer OEMs (and possibly other clients) through a complicated set of contracts that in many cases would not permit them to pass on input cost increases quickly. Second many sales by White Box manufacturers and some resellers were by longer (one and two year, even two + two year renewal) contracts to large final purchasers in the government and educational sectors. These contracts did not typically have any price escalation clauses to allow for input price increases.

56. **Lagged Price Adjustments:** In some markets prices can move moment by moment, in which case changes in input costs can be rapidly translated into changes in output prices. In most cases, however, the reaction of prices to changes in costs will be at least slightly delayed. This could be because output prices are fixed by contract as just discussed, but it can also be because making output price changes can be a somewhat costly process for firms. For example, it could be that output price changes necessitate changes to published price lists and marketing materials.[24] It may also be simply that output prices are determined by careful consideration of a large number of factors (e.g. many different input prices, customers' potential reaction to price changes etc.) by a group of company officials. As with the delayed response due to contractual obligations, these lags will delay the pass-through with the result that pass-through over the full class

[23] In negotiating their contracts, the firms will take into account the normal factors that will affect input price levels over the contract term – i.e. the absorbing of some normal cost increases would be built into the contracts. However, here we are discussing the impact on their profits of input price increases they would not normally anticipate and factor into their contract prices.

[24] For an even more specific example, a retail chain may have already advertised the availability of a product for a certain price over a certain time period that could stretch to weeks.

period is incomplete – even if it eventually gets to a 100% level. I expect these kinds of issues to be more important when DRAM is a small fraction of the costs of what is being sold – for example it is likely to matter more to resellers of personal computers than to module makers and DRAM resellers.

VII. Results and Conclusions

57. Taking this all together, I would offer the following opinion as to the degree of pass-through of the harms to Canadian direct and indirect purchasers as a result of the price-fixing of DRAM during the class period.

58. It remains my opinion that the large majority of harm would make its way down to final consumers.

59. In particular I would expect virtually complete pass-through by DRAM resellers and module makers.[25]

60. That said, in my opinion, White Box manufacturers in Canada and EMS/Contract Manufacturers in Canada will have suffered some harm by virtue of the competitive dynamics of their markets and the fact that they were in many cases tied into contracts that prevented them from passing on cost increases for up to two years. For example, IDC data indicate that about 11% of White Box sales of desktop and notebook/laptop computers were direct to governmental and educational bodies (between 1999 and 2002) and these were generally covered by contracts, some of them two years long and longer. A White Box firm that sold only to this sub-market could then find itself unable to pass on any cost increases for one or two thirds of the class period.

61. Finally, I believe that some small amount of harm would have been suffered by resellers (principally retailers) mostly through delays in price adjustments, though I would expect their effective pass-through rates to be higher than the EMS/White Box rates.

62. Turning this language – i.e. “some harm” and “small amount of harm” – into specific numbers is clearly a challenge in the absence of robust empirical analysis of data from these markets. What I offer here then, are suggestions that I find reasonable and consistent with the analysis I have provided above.

63. As a first step I would allocate the available funds to each of the channels according to the shares of DRAM that went down this channel as reported in

[25] It may be the case that DRAM resellers and module makers had a presence in some channels not represented in Figure 1. For example resellers and module makers may have provided some supply to EMS/Contract Manufacturers, Other Computer Parts Manufacturers and Non-Computer OEMs. Since it is my opinion that resellers and module makers virtually completely passed through any overcharges, even if some of these firms were located in Canada, this would not alter my recommendations below.

Table 6 above. This is already an approximation as DRAM moving down some channels will go through more steps before reaching Canada than that moving down other channels. As a result, some DRAM may reach Canada with some of the overcharge already absorbed, but this would be challenging to estimate and in any case I do not expect the absorption to be great at those stages.

64. As a practical matter I expect that it will be best to create buckets, one for each of the major categories of class members, into which portions of the available funds can be placed for subsequent distribution. I further expect it will be best to treat participants in each category identically even if it is true that their individual circumstances may have been somewhat different. I would therefore propose buckets be created for the following categories of market participants whom I believe bore some of the overcharges:

    a. **Final consumers** – while some of these purchased product that had gone through fewer distribution stages and may have had less overcharge absorbed above them, I expect it would be very difficult with available data to distinguish between them.
    b. **White Box manufacturers** – noting that some of these from the period are no longer in business.
    c. **Resellers** (of Computers, Computer products and non-Computer products) – these will largely be retailers but I would include other pure distributors here as well. Again, they will likely differ from each other to some extent, but assessing these differences would be a costly exercise.
    d. **EMS/Contract Manufacturers** – to be included if they are in Canada. For multinational firms in this category, I would expect them to get recovery based only on DRAM brought into Canada. The question naturally arises as to whether EMS firms should be entitled to any recovery for partially absorbing cost increases on product they make in Canada but then export to the U.S. or elsewhere. I expect that this requires a legal interpretation, but from an economic perspective these are still harms suffered in Canada and so compensation would seem reasonable.
    e. **Other Computer Parts (including graphics cards) Manufacturers** – to some extent this group will compete with the EMS-Computer OEM channels as they provide add-on products competing with built-in alternatives in Computer OEM channels. For this reason, if there is less than complete pass-through in the Computer OEM channels they may also not be able pass-through input price increases completely. To the extent they are in Canada, then, firms in this category may have absorbed a small amount of the overcharge.

65. In summary, in my opinion the analysis presented above -- which is based on a review of the expert reports prepared in the American action, expert reports prepared earlier in this matter in Canada, the available Canadian data, as well as upon information provided in my interviews with industry experts, my own

experience and the application of economic theory – supports the conclusion that there would be a very high rate of pass-through of overcharges imposed by defendants on their sales of DRAM. Indeed, in my opinion, there would be a very high rate of pass-through down the various distribution channels to final consumers. This said, there are a number of factors that would prevent that pass-through from being complete, including conditions of imperfect competition, the presence of fixed-price contracts and the normal lags associated with price adjustments in some markets. These factors will affect some channel participants more than others.

Recommended Allocations

66. In my opinion, the above analysis supports the following allocation of the available funds attributable to each channel into each of the buckets:

    a. **Channel 1:** I would recommend allocating 10% of this channel's portion to the White Box bucket and 5% to the Resellers bucket. The remaining 85% would remain in the Final Consumers bucket.
    b. **Channel 2:** Since many of these White Box direct sales were under contract to governments and educational groups, I would recommend allocating 15% to the White Box bucket with the remaining 85% allocated to the Final Consumers bucket.
    c. **Channel 3:** Channels 3-6 are more challenging. These will be the channels through which most DRAM that EMS and contract manufacturers used will flow. If (as suggested above based on information from the U.S. case) about 26% of DRAM went through EMS firms and it was all through these three channels then approximately 34% (26/76 where 76 is the sum of channels 3, 4, 5 and 6 DRAM shares) of product going through these channels would have passed through EMS/Contract Manufacturers. I would recommend allocating 6% of the Channel 3 portion to EMS/Contract manufacturers operating in Canada.[26] Allocating 6% of the full Channel 3 funds to EMS/Contract manufacturers reflects an effective absorption rate by these firms of about 18% on the product actually handled by EMS/Contract Manufacturers.[27] This allowance is intended to reflect both their direct and indirect purchases of DRAM.[28] I would again allocate 5% to the Resellers bucket. This leaves 89% for the Final Consumers bucket

[26] This is based in part on the assumption that EMS firms will be allowed to recover for products they absorbed some overcharge on but then exported. If exports must be excluded and EMS firms are only able to claim on units they could prove they shipped to Canadian customers, this fund should be smaller.
[27] If they are getting 6% on the four channels combined when they really only participated on 34% of the product going down those channels, this is effectively like retaining 17.6% (i.e. 0.06/0.34) on the units on which they actually worked.
[28] It is not a simple matter to distinguish between direct and indirect purchases for EMS firms given that some DRAM is acquired by EMS firms under instructions from Computer OEMs and possibly with their assistance (to secure better prices, presumably.)

d. **Channel 4:** As with Channel 3, I would recommend allocating 6% to the EMS/Contract Manufacturer bucket. There are no resellers in this channel so this leaves 94% for Final Consumers.
e. **Channel 5:** As with Channel 3, I would recommend allocating 6% to the EMS/Contract Manufacturer bucket. I would recommend allocating 5% to the Resellers bucket, 5% to the Other Computer Parts Manufacturers bucket and the remaining 84% to the Final Consumers bucket.
f. **Channel 6:** As with Channel 3, I would recommend allocating 6% to the EMS/Contract Manufacturer bucket. I would recommend allocating 5% to the Resellers bucket and the remaining 89% to the Final Consumers bucket. See my comments below about this channel.

Non-Computer Markets

67. With respect to the non-computer channel (channel 6 in Figure 1), representing approximately 16% of DRAM consumption, I have very little information with which to work. I have certainly not had an opportunity to study all the various markets that make up the distribution channels for those alternative uses for DRAM (e.g. games, telecommunications equipment etc.).

68. As a starting assumption, I would again expect that much of the harm would make its way down to final consumers. As a result, it might make sense to set aside an allowance for final consumers down that channel but to take the position that the harms at higher levels of those distribution channels are likely too small and are almost certainly too diverse to assess without considerably more research. However, in the allocation above, I suggested allocations be made to Final Consumers and Non-Computer Resellers in this channel, as I believe many of the resellers in this channel to not be so dissimilar from the other computer and computer product resellers.

Summing up the Allocations

69. Given the allocations described above it is straightforward to calculate what shares of the total available fund will go to each of the buckets:

    a. The **White Box** allocations amount to **2.7%** of the total fund.
    b. The **Reseller** allocations amount to **3.95%** of the total fund.
    c. The **EMS/Contract Manufacturer** allocations amount to **4.56%** of the total fund.
    d. The **Other Computer Parts Manufacturers** allocations amount to **0.9%** of the total fund**.**
    e. The **Final Consumers** allocations amount to **87.89%** of the total fund.

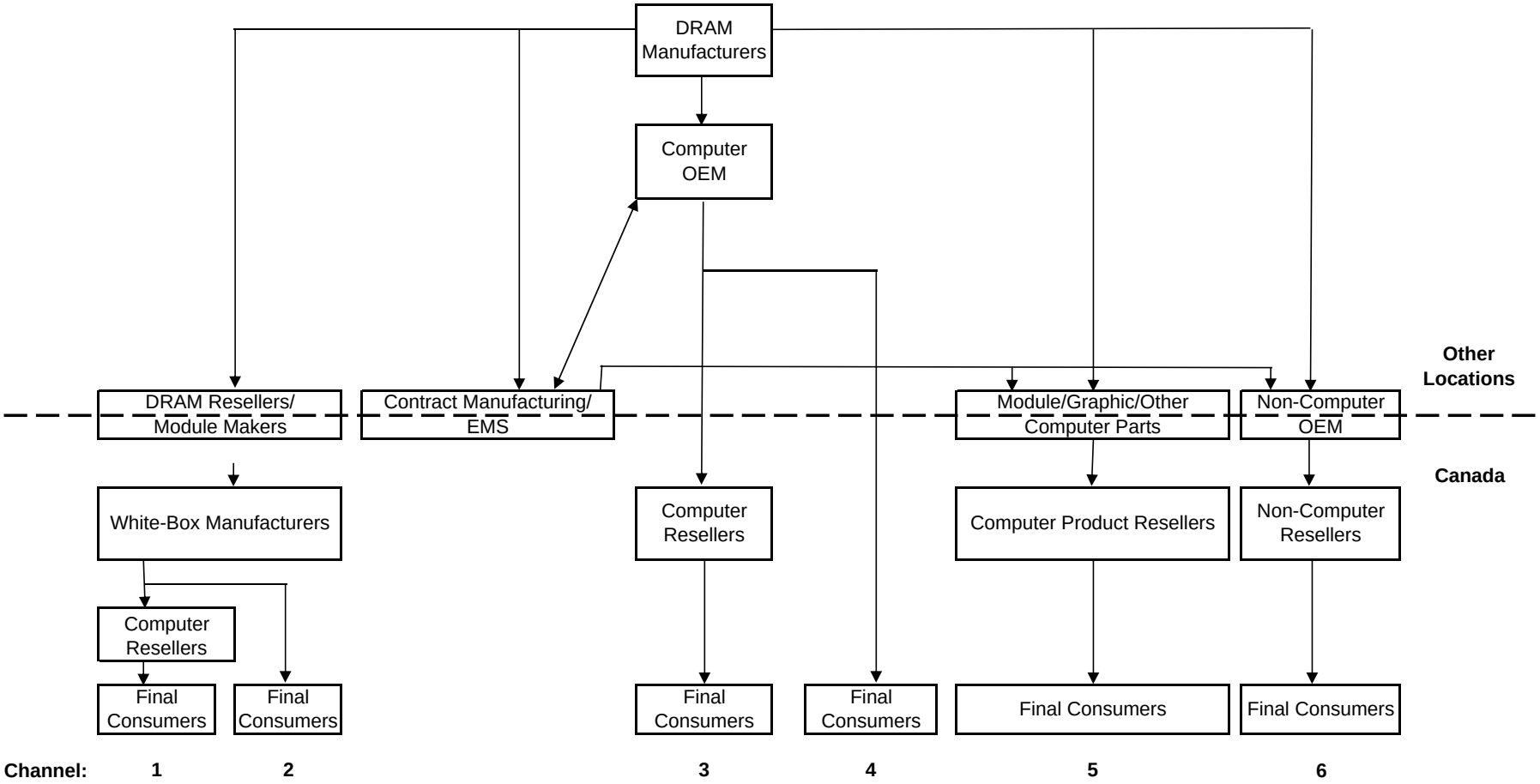


Figure 1: DRAM Distribution Channels through Canada

Version: June 21, 2013