A Survey of PC Technology Royalty Rates

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Study finds rates tend to be relatively low; microprocessor software manufacture more profitable

As part of a recent analysis of certain aspects of the U.S. personal computer industry, the authors collected information related to technology transfers in the industry and the role of licensing. This article summarizes selected parts of that information. (Unfortunately, substantial amounts of the analysis were based on confidential information that cannot be disclosed. This article incorporates only information that is, in one way or another, in the public record.)

Recent surveys of licensing practice have discussed PC industry royalty rates generally, but have not provided real-world examples based on identified market transactions. This article describes the particulars of such transactions, and so should be of interest to licensing executives in the field.

Technology licensing in the PC industry is especially interesting because so little PC technology is truly proprietary. Apple Computer Inc.'s recent decision to license its proprietary Macintosh operating system is the exception in the industry. Even in an industry of essentially open design, however, technology licensing continues to play an important role.

TECHNICAL BACKGROUND

Proprietary Technology in the IBM PC

Although not the first to build a microprocessor-based microcomputer, Steven Jobs and Steve Wozniak basically created the commercial PC industry[1] in the late 1970s. Apple Computer's ability to dominate the industry that it created was seriously circumscribed, however. Although Apple could, and did, keep secret its own operating system design, it could not prevent other companies from independently designing and manufacturing microprocessor-based microcomputers.[2] In particular, Apple soon faced competition from IBM, one of the world's largest manufacturing corporations. Interestingly, IBM initially treated the PC phenomenon merely as an adjunct to its traditional business, failing to recognize how quickly microcomputers would devour much of that business. At its inception, IBM even designated its PC division as the "Entry Level Systems" division, viewing microcomputers as nothing more than intermediate steppingstones on the way to traditional "big iron" mainframes.

IBM unveiled its first personal computer product, based on Intel Corporation's 8088 microprocessor, in late 1981. The successor product, based on Intel's 80286 chip (and called the AT) was introduced in 1984, and 80386-based PCs were introduced in 1986. (The 80386 machine was introduced by Compaq Computer, which stole a seven-month march on IBM for this product.) By early 1988, there were more than 100 companies manufacturing 80386-based PCs, with new companies entering the market almost daily.[3]

There was very little proprietary technology associated with the first IBM PC. In order to get to market quickly, IBM chose to rely on generally available components and on a microprocessor and operating system software developed by others. Moreover, although the software system was initially developed to IBM specifications by Microsoft, IBM permitted Microsoft to retain the right to license the software to other manufacturers. Finally, IBM published the so-called bus architecture, that is, the specifications for the communications wiring that ties the components together.[4]

IBM retained ownership of one important element of the system. A part of the Microsoft DOS system is called the basic input/output system, or BIOS. IBM required Microsoft to design a slightly different BIOS for IBM than for the DOS versions that Microsoft could license to other manufacturers. IBM then wrote part of the BIOS onto a

1. The term "PC" (for personal computer) is sometimes used broadly, to refer to microcomputers of any manufacture, and at other times narrowly, to refer only to microcomputers with so-called IBM-compatible designs. Currently, Apple Computer Inc. is the only significant manufacturer of non-IBM compatible microcomputers, although in the early days of the industry, there were several other competing designs manufactured by such companies as Atari, Commodore, and Osborne. Their products and designs are, at the present time, essentially historical curiosities. This article uses the term PC to include all microcomputers, although for obvious reasons, IBM compatible technology tends to dominate the discussion.

2. The distinguishing feature of microcomputers as compared to minicomputers or mainframes (at least initially) is that microcomputers represent an adoption of a new integrated circuit technology, rather than a miniaturization of minicomputer or mainframe technology.

3. Satchell, Stephen and Sally Price, "Beyond the Desktop: 20MHz 386 Systems," *InfoWorld*, May 2, 1988.

4. Under a 1956 consent decree with the Department of Justice, IBM remains obligated to publish the technical specifications of its products. Even absent this decree, however, there were good business reasons for publishing the bus specifications. For the PC to be commercially viable, there would need to be a variety of add-in feature cards and boards developed. IBM did not have the resources internally to develop many of these, and chose to leave what it thought would be a low profit business to others. Cringely, Robert X., *Accidental Empires*, New York, Harper Business, 1992, pp. 136-137.

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read-only memory (ROM) chip, which it copyrighted.[5] Other manufacturers wishing to use the IBM BIOS would have to pay IBM a royalty.[6]

A substitute quickly developed for the IBM BIOS, however. Phoenix Technologies, a software company, "emulated" the IBM BIOS.[7] That is, by reverse engineering techniques, Phoenix was able to write software that accomplished essentially what IBM BIOS accomplished, but without infringing on the IBM copyright. The legality of such "clean room emulation" had been previously established.[8]

The absence of copyright or patent-protected technology does not mean that IBM did not possess valuable intangible assets. Even nonprotected aspects of computer design can incorporate valuable firm specific design know-how. So-called bus architecture is one example of this. Although IBM's basic bus specifications had been published, alternative bus architectures could be devised that would provide software compatibility and yet improve overall performance. The same is true of other elements of system architecture. Not all IBM-compatible computers are created equal.

Variation in Performance Across Similar Computers

Given the high degree of commonalty among components of personal computers, one might expect the products of all manufacturers to operate just about the same, to have similar capabilities and similar performance characteristics. In fact, however, there is a substantial degree of variation in performance even across machines with highly similar hardware configurations. Two different systems can perform quite differently, even if both use *identical* microprocessors and operating system software.

Several features lead to variation in system performance despite the similarity of hardware. These include:

1. Design differences in the bus — the wiring system that interconnects the various parts of the machine.

2. The degree to which components are integrated on the system, or motherboard, as opposed to requiring communication across boards.

3. The interaction of component design features. For example, a CPU may have the ability to process data faster than a memory chip can provide it.

There are a number of measures of system performance. Memory and storage capacities are obvious differences that are attributable entirely to component selection. Degree of compatibility also varies across machines. For example, some clones are not capable of running some IBM-compatible software applications because of design reasons.[9] Component and system reliability are other performance characteristics that differ across systems, although it is often difficult for the user to ascertain such differences at first.

By far the most frequently used performance indicator is speed. In the PC industry, the most widely-cited speed measure is the clock speed.[10] Every computer has a timer chip whose function is to signal the CPU that time is passing by cycling between low and high voltage. So long as the capacity of the system is not otherwise exceeded, the faster the timer chip, the faster the operations. The speed that the system is ultimately capable of achieving, however, depends on how well the various components of the machine are capable of achieving, however, depends on how well the various components of the machine are capable of working together. Clock speed is measured in hertz; one million hertz (one megahertz, or MHz) is one million cycles from low to high voltage per second. For a given type of microprocessor, a faster clock speed translates into a faster microprocessor speed (up to the limits of the microprocessor). But variation in the ability of different microprocessors to process instructions means that this generalization does not hold across microprocessors. Thus, an Intel 80486 processor operating at 25 MHz is faster than an Intel 80386 processor operating at 33 MHz because the newer processor can process many more instructions per cycle. One factor determining the significance of clock speed is the "wait state" architecture of the system. A wait state is a period of time during which a CPU "does nothing." The fewer the wait states, the faster the performance, but wait states are nevertheless sometimes necessary if the CPU can process data faster than memory can provide it.

Another factor creating performance differences is the bus design, or route that signals travel from the CPU to the memory chip. Virtually all 80286 machines used IBM's original bus architecture, called the ISA (or industry standard architecture). The 80386 chip used a 32-bit internal bus, which made the old ISA 16-bit design a bottleneck. IBM attempted to develop a proprietary bus design (called Micro Channel) for the 386. The industry responded by developing an alternative architecture called EISA (for extended ISA).[11] Neither dominated the industry. Currently, local bus architectures, in which high-speed peripherals bypass the expansion bus entirely, have become popu-

5. Langlois, Richard, "External Economies and Economic Progress: The Case of the Microcomputer Industry," *Business History Review* 66 (Spring 1992), pp. 23-24.

6. Other elements of PC design are also proprietary, in particular, elements of the bus design (see discussion below). Interestingly, IBM's practice in its license agreements is to leave the definition of IBM proprietary technology somewhat vague.

7. Langlois, *op. cit.*, p. 24.

8. Cringely, *op. cit.*, p. 137.

9. This problem gave rise to "compatibility alerts" in product reviews. See, for example, the review of 80286 systems in *PC Digest* 2 No. 5 (May 1988).

10. In addition to clock speed, common speed measures are the number of (millions of) instructions per second (MIPS) a processor can execute and the number of (millions of) floating point arithmetic operations per second (MFLOPS) a prcoessor can execute. For a discussion of computer speed, see "Pandit, Milind S., *How Computers Really Work*, Berkeley, California, Osborne McGraw-Hill, 1993.

11. EISA is not to be confused with VESA, the Video Electronics Standards Association. VESA publishes the protocols and standards specific to the display of computer *video* information, whereas EISA relates to the broader definition of how computer commands work and how data move around the entire computer system. The EISA definition includes such items as the rules for exchanging data between applications software and the operating system, and the communications protocols that allow hardware components (such as the hard-disk) to communicate with the rest of system.

lar.[12] "The bus has become, along with the microprocessor in a PC, the most critical factor in performance and in differentiation among classes of computers."[13]

TECHNOLOGY LICENSES IN THE PERSONAL COMPUTER INDUSTRY

There are a number of personal computer technology transactions about which some information is in the public record. In some cases, our information about these agreements is based on actual copies of the agreement, in other cases on reports in the trade press.

Macintosh Clock Speed Accelerator

In October 1989, Wells American Corporation (the licensee) entered into an agreement with Northeast American Enterprises (the licensor) under which Northeast American granted to Wells exclusive worldwide rights to manufacture and sell certain personal computer hardware developed by the licensor. Under this agreement the licensee introduced the "MegaMac CPU Performance Extender" board in July 1990. This was an enhancement board for Apple Macintosh computers that increased the clock speed of the Apple CPU, and also enhanced other system operating attributes such as disk drive and memory management. At the time the product was introduced, Apple Macintosh computers operated at between 8 and 30 MHz clock speeds, depending on the model. The MegaMac board increased clock speed to 50 MHz.

The agreement called for a running royalty of 5% of net sales. An initial lump-sum payment by the licensee was credited against future royalty liabilities. The term of the agreement was two years, but extended on a year-to-year basis thereafter unless terminated by either party.

Dell-IBM Agreement

In June 1988, Dell Computer entered into an agreement with IBM under which IBM licensed its XT class, AT class, and Micro Channel architecture to Dell in exchange for a running royalty.[14] The royalty that Dell paid to IBM varied with the type of computer. On XT- and AT-class machines, the royalty was as high as 3%. On Micro Channel architecture machines (certain 80386 machines), the royalty was as high as 5%.

IBM negotiated royalty agreements individually with different computer makers. The royalty paid by the manufacturers differed with varying factors, including whether the manufacturers had any technology of their own to cross license to IBM. Because Dell Computer was a pure assembly and resale business, it had no technology to cross license to IBM. Consequently, it paid the highest royalty rates.

IBM Licensing Policy Generally

The Dell-IBM agreement came as part of a generally increased emphasis on licensing by IBM, in response to its loss of market share to other manufacturers of IBM-compatible computers. Previously, IBM's top royalty rate had been only 1% of sales.[15] With the 1988 policy it was as high as 5% (although few manufacturers paid that rate, and then only on selected types of machines.)

The rate also varied with product destination. IBM licensed a number of Taiwanese clone manufacturers to use the XT and AT technology in exchange for a running royalty on net sales. The royalty rates were 2% of sales for machines sold outside of the United States and 3% of sales for machines sold in the United States.[16]

Computer Automation/IBM/Clone Makers

In 1987, IBM introduced its PS/2 computer line. Subsequently, it determined that its Micro Channel architecture apparently infringed on a 14-year-old patent held by Computer Automation Inc. In April 1990, IBM entered into a license with Computer Automation under which it would make royalty payments to the patent holder.[17]

Computer Automation also sought to license manufacturers of PS/2 system clones, for a royalty reported to be between \$8 and \$10 per machine. (The rate paid by IBM itself was thought to be substantially less than the clone-maker rate.) Although this is not expressed as a percentage of sales, the approximate corresponding royalty percentage can be estimated based on clone machine prices at the time. In early 1991, clones of the IBM PS/2 system retailed in the \$2000 range at large dealers or chains. Clone manufacturers typically sold to such chains through distributors. At the time, distributor and dealer gross margins were in the 10% range. By implication, the price at the point of sale from the clone manufacturer to the distributor would have been on the order of \$1600, and the implied royalty rate (using \$9 as the per-unit royalty would have been on the order of magnitude of 0.5%.

Computer Industry Royalty Rates in General

The range of royalty rates described above is similar to the general pattern of computer industry royalty rates. For example, a 1990 survey of royalty rates[18] reported that among the respondents to the survey,"...royalty rates among ... computer [industry] respondents tend to be the lowest." Although the reported survey did not report on the details of the individual agreements, it did summarize the range of observed rates. Figure 1 reports on the results of the survey.

The distribution in Figure 1 is confirmed by our own experience in the industry. In addition to the examples cited above, other examples from the same general industry include the following:

12. Mosley, J.D., "Local Bus Battle Begins in Earnest," *Electronic Business Buyer*, November 1993, pp. 47.
13. White, Ron, *How Computers Work*, Emeryville, Ca., Ziff-Davis Press, 1993, p. 105.
14. The full testament of the agreement was not made public but the agreement was widely reported in the press. See March, Richard, "Dell Agrees to Pay Royalties to IBM...," *PC Week*, June 7, 1988.
15. March, *loc., cit.*
16. Smith, Gordon V. and Russell L. Parr, *Intellectual Property: Licensing and Joint Venture Profit Strategies*, New York, John Wiley & Sons, 1993, p. 391.
17. *Licensing Economics Review*, January 1991, p.2.
18. McGavock, Daniel, David Haas and Michael Patin, "Licensing Practices, Business Strategy, and Factors Affecting Royalty Rates: Results of a Survey," *Licensing Law and Business Report*, 13 No. 6 (March-April 1991), 205-216.

DISTRIBUTION OF COMPUTER INDUSTRY ROYALTY RATES

	Licensing-Out Transactions	Licensing-In Transactions
0- 2%	42.5%	62.5%
2- 5%	57.5%	31.3%
5-10%	-	6.3%
	100.0%	100.0%

Figure 1

• A court determined that a reasonable royalty rate for single in-line memory modules (SIMMs) patented by Wang Corporation was 2.75 to 4% of sales. SIMMs are units of memory chips designed to be mounted vertically (or at an angle) on circuit boards, and hence economize on spae.[19] Caution must be used in interpreting court awards as market royalty rates. The statute governing such awards specifies that they shall be "... *in no event less than* a reasonable royalty ..."[20] Such awards often exceed an arm's-length royalty rate because of the court's desire to ensure that the infringer enjoys no benefits from his infringement. As a result, these rates should be interpreted as upper limits on estimates of market rates.

• A jury-determined royalty on Hayes-compatible modems for AT-class personal computers was 1.75% of sales.[21]

These industry norms indicate that personal computer technology royalty rates tend to be relatively low and are rarely in excess of 5%.

Trademark and tradename licenses in the computer industry are far less common than technology licenses. In almost all cases, when a computer trademark or tradename is the subject of a licensing arrangement, it is included as part of a license for computer technology. After an extensive search, we were able to identify only a single example of a trademark licensed separate from any computer-related technology. In 1981 Apple Computer entered into an agreement with Apple Corps Ltd., a U.K. corporation that owned certain rights to the Beatles' music. Under the agreement Apple Computer agreed not to enter the business of "reproducing or synthesizing music." In 1986 Apple introduced the Apple IIgs model computer, which carried a sound synthesis chip. Subsequent models of the Macintosh had similar chips and were promoted by Apple as music composition workstations. In February 1989 Apple Corps Ltd. sued Apple Computer, asking for royalties ranging from 1 to 5% of sales.[22] The companies settled out of court, and the settlement terms were not disclosed (but presumably were no greater than the requested rates). The name licensed here, of course, is not that of Apple Computer, but rather Apple Corps.

SUMMARY AND CONCLUSION

The transactions described in this paper provide specific evidence confirming the impression that PC technology royalty rates tend to be relatively low -- in the 1 to 5% range. These low rates appear to be due primarily to two related factors:

• The relative ease with which specific designs can be "invented around," given the nonproprietary nature of key elements of the technology.

• The shrinking profitability associated with PC manufacturing generally, as multiple competitors drive down industry profit margins.

Much of the profit in the PC industry has come to reside with the manufacturers of the microprocessors that are the "brains" of the system, or of their operating system software (Intel and Microsoft, respectively). The licensing and royalty rate dynamics of those industries are quite different from the PC industry.

19. *Licensing Economics Review*, April 1992, p. 5 and *Electronic News*, 37 No. 1874 (Aug. 19, 1991), p.8. The jury had recommended a rate of either 2.75 or 4%; the judge selected 2.75%.

20. 35 U.S.C. 284, emphasis added.

21. *MacWekk*, 5 no. 5 (February 5, 1991), p. 80.

22. Parker, Rachel, "Apple Computer Sued Over Name...", *InfoWorld*, February 27, 1989, p. 8.