

Intel Pentium Chip Flaw

Over the last twenty years technology has been growing at a rate that, before these times, had been unimaginable. A great amount of detail goes into these new technologies, so it is inevitable that something will go wrong every now and then. In 1994, Intel had one of these problems. The problem itself wasn't that bad, but the way that they went about fixing the problem, once they discovered it, was not good. This paper is going to talk about the Pentium chip flaw of 1994 and what Intel tried to do to deal with this problem. It is also going to discuss the rights and duties of Intel and the people buying and selling computers with these flawed chips. The paper will then go on to talk about possible solutions for the problem, and then weigh the costs and benefits of each solution, as well as the solution that Intel chose. Even a monopolistic company like Intel, that has many people working on and testing every product, can have major technological problems every now and then.

Based on information from Wikipedia.org, Intel was first founded in 1968 and has since grown into a major player in the semiconductor industry for the past 39 years. They created the first commercial microprocessor in 1971 and now are the leading manufactures of CPUs in the world. It is inevitable that large corporations such as Intel will run into ethical issues many times over the years. One of the most well-known ethical issues that Intel has had to deal with was the Pentium chip flaw in 1994 [1].

The following two paragraphs are based on information from Cindy William's paper, *Intel's Pentium Chip Crisis: An Ethical Analysis*. This issue started when Intel released a Pentium processor with a rounding error, which occurs during a division instruction. This rounding error didn't occur every time the instruction executed, just once in every 27,000 years, or so they thought. Intel knew about the problem but decided to release the product into consumer's hands anyways. There were a number of factors that they considered before deciding it was acceptable to release this flawed processor to the public. One factor involved in this decision was that since the instruction had such a small rounding error, along with it occurring once in a great while, they thought it would go unnoticed. Intel's plan was to release the chip and just fix the flaw on the future processors. This action would make Intel a great deal of profit, no one would find out, and once the processors sold out, the fixed ones would be released and everything would be normal. The only problem with these ideas was that someone found out about the error [2].

Thomas R. Nicely, a math professor at Lynchburg College, discovered the problem in June of 1994. He was running one of his computational programs on five computers. He first noticed the problem when four of the computers came up with the same result, and the fifth computer came up with a different result. He knew that something was obviously wrong, and after looking into the problem, he came to the conclusion that the only difference between the computers was that the computer with the different result had the Pentium processor [2].

According to *The Pentium Chip Story: A Learning Experience*, written by V. Emery, Nicely contacted Intel about the problem but Intel said that it was not a problem

and just ignored him. He was baffled by this problem and went back for the next three to four months to try and figure out what was wrong. After much research, he was sure about his findings, and *Electrical Engineering Times* published Thomas's conclusion about this particular Pentium processor. This was the first time the public was informed about the issue. Intel initially denied the problem until the glitch in the processor was widely known. Intel then admitted to the glitch, but said this problem was insignificant and it would not affect anybody [3]. Most people didn't accept this statement.

More people started looking into this issue and found out that this rounding error happens much more frequently than Intel anticipated. For most typical users, this rounding error will be noticed, on average, every 24 days [2]. Intel's response to this was to replace the flawed chips only if the consumer can prove to them that the rounding error affects them and they indeed need an unflawed chip [2]. There was a lot of outrage among the community about how Intel was handling the issue. This caused Intel to be the center of numerous jokes floating around the Internet and community [3]. The problem was so bad that IBM halted shipments on all of their computers that contained the Pentium processor [3]. Intel realized how the issue had gotten out of hand and knew they needed to do something to fix this problem.

Intel finally agreed to replace any of the flawed processors with an upgraded one for free [3]. Intel really didn't want to resort to this kind of answer because it would cost them a great deal of money. Even so, they proceeded because they wanted to let consumers know that they were a company that stood by their product and wanted them to have a processor that wouldn't cause any issues.

Only 10% of consumers ever asked for a new processor [2]. This is a surprisingly low amount that asked for a new processor with all of the debate and uproar flying about the Pentium chip. There could be numerous reasons to why this is. One, most people didn't want to go through the hassle of being without a computer and sending theirs in. Another reason could be that some users didn't even know about the issue.

There were numerous parties affected by Intel releasing ^a the processor ^V onto the market that wasn't 100% accurate all of the time. The first demographic that comes to mind is businesses that use computers to deal with numbers in their day-to-day activities. Examples of this are accounting firms, where customers trust the firm to do their taxes and other finances. This could be a major issue if the results from their programs are not right. Other fields in the business division are medical and research facilities that use computers to keep records of patients, or use programs that are number-intensive and need to be accurate. The other party that is affected is ^{individuals:} our own personal uses of the computer. We use computers for numerous reasons such as finances, schoolwork, and just general spreadsheets and calculations.

Of course it's the market that isn't accurate!

Intel has ^{with} their rights just ^(as) like we have our own rights. Intel does not have to fix the flawed chips. That is a right with being a company within the United States. However if they do not replace the chips or fix the problem at hand then Intel will lose their loyal consumers and eventually lose profit. So Intel has the right to choose whether or not they want to fix every chip that is flawed, fix only the processors when people need a non-flawed one, or they could also choose not to replace any of them. They could even go as far as making the consumer purchase a new processor for anyone that wanted one.

Another right that Intel has would be to fix the current design of the processor or future processors. They need to figure out if they can make a processor one hundred percent ^(correct?) working and try to get to that point. Intel could be happy enough where they are at and decide that they won't fix the design of it. Whatever they decide will affect the way consumers buy their chips. They have to look at their future in the market and make the best business decision that they can make. They also have ^{you right to?} to restore credibility that their product is still number one and that they will continue to make breakthroughs. I think the best way to look at the situation would be to ask yourself what would be the greater good to Intel and also to the consumers.

this is consequences thinking not rights/duties

Intel also ^{up} has duties to ~~with~~ hold if they ^{sense consistency} wanted to be a contender in the marketplace in the future. Duties are things that you do not have to do, but if you don't do them then you just won't make it in the industry. Duties come down to one thing, ethics.

Ethics tells a person the right thing to do in a situation. With that being said, Intel should have put a disclaimer on all of ^{new} these known flawed CPU's, or kept them from being released. From the moment that they found out that the chip was flawed, they should have put a disclaimer on the chips stating that the product would work in most cases, but there is a chance in some instances that the processor could be flawed. Because this is only a duty, they didn't have to put a disclaimer on the chip. A second option would have been to fix the flaw before selling the processor to consumers, or if it was too late they could have recalled all the flawed ones. Another duty that Intel has would be to fix their testing procedures. They need to know the chips are accurate when they are stating that these chips are 100% perfect. When they say that even the flawed CPU's would not work every 1 out of 27,000 years when actually it was 1 out of 24 days [2]. That is a major

clarify duty in general lessons: truthfulness in advertising? full disclosure? selling the truth?

fragment

error that put Intel's reputation on the line. Improving the testing procedures would also limit the probability that a flawed chip would get out to the consumers. One of the biggest duties that Intel has would be to treat the consumers as Intel would want to be treated. If Intel keeps that in the back of their mind when they are making decisions then the best decision will come out for both the consumer and the company.

With the rights and duties of Intel come rights and duties of consumers.

Consumers are a big deal to companies and consumers are aware of this, but consumers also need to not take advantage of this when dealing with problems that arise. One of the rights that a consumer has from the company is to know that the processor they are buying is flawed. If Intel does not state that then a consumer would think that they are buying a processor that works 100% of the time. The consumer should not think anything less. If Intel says that it should work 98% of the time and the consumer knows that when he/she is buying the chip, then the final decision is left up to ^{the} consumer. The consumer can demand a chip that is not flawed and choose to buy a different chip but at least the consumer knows it is flawed. It's like buying a pizza expecting 10 slices, when in reality the consumer only gets 9. If the consumer isn't happy with an unexpectedly flawed processor, then the consumer has the right to demand a new one that is 100% accurate. Buying a product not knowing if it is error free might make consumers take their business elsewhere. In this case, Intel did not give that option to the consumers because they tried to cover it up.

With consumer's ^(plural) rights, come consumer's ^R duties. The first duty was to report the problem to Intel when the consumer first found out about the flawed processor. This way Intel can determine what the issue is, and try to resolve it. This allows them to do tests

and hopefully come up with a solution. If for some reason Intel brushed the consumer off, saying that the problem is no big deal, and the consumer was not satisfied with this response, then he/she needs to let other consumers know about the problem. This way other consumers know what the issue is about, and hopefully Intel will realize that it is a larger issue than they initially thought. With that being said another duty is to cooperate with Intel in resolving the problem. Once again treat Intel as you would want to be treated. Give them time to look at the problem and try to come up with a solution, don't just run to the public back~~ing~~ mouthing Intel.

With every decision that Intel made in its process to fix this problem, there were costs and benefits involved. When encountering a problem that affect^s this many people, there are going to be two major types of costs involved in fixing the problem. The first cost is a monetary cost, (^{redundant} which is a cost that deals with money), and the second cost is nonmonetary, which deals with the consumers' perception rather than money. Intel encountered four main kinds of monetary costs: the time it took their engineers to locate and fix the flaw, the replacement of the chips for the customers once they decided to replace all of the chips, a loss in the loyal businesses that they had been selling their products to, and a decline in stock prices. The first cost, time of fixing the flaw, is a monetary cost because Intel ^{is} ~~is~~ paying their engineers to work for them. For every hour that Intel has its engineers working on these flawed chips, they are paying them to redo work which means that they are not working on new technology, which can hurt Intel in the long run. The cost of replacing the chips is a direct monetary cost to Intel because they needed to replace the flawed chips with corrected ones. If every customer would

have returned his/her computer with a flawed chip, it would have cost Intel approximately \$475 million to replace all of them [2]. It was good for Intel that only 10% of the computer owners requested new processors. There is no way to know how many loyal businesses chose not to purchase Intel chips after this incident, but it probably cost Intel a large amount of money. The last major monetary cost that Intel faced was a drop in their stocks. Over a two~~o~~week period, Intel's stock dropped 5%, which is a major drop for just a short period of time [5]. This caused many people to sell their stocks, because people thought it might be the downfall of Intel, which decreased the value of Intel even more as a company. The monetary costs may be bad for Intel, but in some cases the nonmonetary costs can be worse.

The main nonmonetary cost that Intel had was a decline in their reputation. At this time there were very few major processor companies and Intel was by far the largest. Their reputation was that they were the best and that they would do anything to stay the best. This really took a hit when users found out that they produced and released a flawed processor knowing that it didn't work 100% of the time. Two other things that hurt their reputation ^{were:} ~~was~~ Intel chose to initially ignore the problem and chose not to replace the chips once they did admit to the flaw [2]. Intel's reputation may have been hurt, but their mistake hurt the reputation of the companies/people that had costs involved with the flawed chips as well.

The retailers that sold these flawed chips in their computers, as well as the businesses and people that use these computers for mathematical use were also affected by these chips. There were many different retailers of these Pentium chips at the time such as Dell, Gateway, Hewitt Packard and Compaq, but the main retailer of the chips ^{Hewlett!}

was IBM. All of these companies faced two main costs, a decline in reputation with their customers which is a nonmonetary cost, and decline in sales and stock price which is a large monetary cost. In December 1, 2004, the computer manufacturers market took a big hit. IBM's stock fell \$1.25, Dell's stock fell \$3.31, Gateway's stock fell \$1.62, Hewlett Packard's stock fell \$2.75 and Compaq's stock fell \$0.87 by close of that day. This shows that the decision that Intel made didn't only risk the reputation and value of Intel, it put a great risk on all of their customers as well [5].

The businesses that bought the computers with the flawed chips, such as accountants, bankers, and researchers also had a decline in their reputation if these chips caused their calculations to be incorrect. A main nonmonetary cost that they encountered was the time it took for each of these people to find where the calculations were off and the time to re-work these calculations. A third party that encountered some nonmonetary costs were the people that had to go without a computer in order for the processor to be fixed. It also took time for these users to find and fix the errors in their mathematical calculations once they got the computer back from Intel.

*\$ often = time,
so this may
be monetary
as well.*

Intel had many difficult choices to make during the fixing of this problem, all of which had different benefits for the costs involved. One decision to release the chips with the flaw had benefits for Intel and the consumers. Intel was able to get away with not having to throw away all of the flawed processors and taking a \$475 million dollar expense to replace each and every chip. The main benefit for the consumer is that they were able to purchase a better technology months sooner than they would have if Intel would have choseⁿ to hold off on releasing the chips until they were flawless. Another way of preventing this problem would have been if Intel would have choseⁿ to fix the

chips before they were sent out to the public. This would have benefitted Intel by keeping people thinking that they were the best chip manufacturer by giving the user exactly what they thought they were getting with a flawless processor. The consumer^S would have benefitted by this decision because they would have gotten a processor that was accurate 100% of the time, which is something that most of the consumers find extremely important. This controversy was the first major controversy that Intel ran into, but it has not been the last.

In 1999, Intel announced the release of the Pentium III chip. This chip had the newest technology and was guaranteed to be faster than anything before it, but there was one major problem with it; it had a transmittable serial number that could be stored in a commercial or government database. This feature was automatically turned on when the user booted up the computer and could only be turned off during the boot. This brought on boycotts by privacy activists which made Intel re-think their decision. After much debate, Intel chose to have the tracking ID turned off until the user decided to have it turned on. Almost everyone agreed that this was a good move by Intel because it made the consumers happy, and kept Intel the largest producer of processors in the world [6].

The decision to listen to the consumers and turn off the tracking ID was definitely influenced by the chip flaw that they encountered in 1994. This shows that if a company, no matter how monopolistic, listens to its consumers' wants, they will continue to be a leader in their field. Even though the chip flaw in 1994 could have been devastating to Intel, they have learned from it and it has made them a smarter company.

In conclusion, the first mistake that Intel made in 1994 was to release the chips onto the market without a disclaimer, hoping that no one would find out that the chips

were flawed. The second mistake they made was to ignore Robert Nicely once he did find the flaw. The third major mistake that they made was that they initially refused to replace the chips to the users unless they could prove that they needed an unflawed chip. We believe that Intel could have saved their reputation by doing one of three things: pulling all of the processors that were flawed, choosing not to release the flawed chips, or releasing the flawed chips with a disclaimer saying that the processor is not accurate 100% of the time. We also think that it is not only ethically wrong, but morally wrong as well to release a chip to consumers with a known flaw and not telling them about it. This was a minor problem that was blown out of proportion because Intel was not responsible enough to own up to what they had done and let the public know that there was a flaw in the chips. Fortunately for Intel, this was just a small hit to their company, and they have since learned to put their consumer wants and needs before themselves.

good intro + facts description;
good research.
Rights/duties gets mixed up with
consequences/cost/benefits, ←
is weakest part of paper.
Bringing in 1999 Pentium III case
is helpful extra. Makes clear
the PR nature of this case.
Conclusion clarifies presumption of
duty to complete disclosure which
is arguable but clearly stated as
preclusion.

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sources 4.5

facts 5

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