

White Paper: Intel and RISC-V

So it seems everywhere these days you hear the rumblings of what is wrong with Intel. From the financial to the tech worlds there are numerous statements predicting Intel's inevitable decline and fall. For example: <https://stratechery.com/2021/intel-problems/> or <https://seekingalpha.com/article/4404485-intel-everyone-relax#comments> . And many of the authors of these articles rightly make cogent accurate assessments of Intel's current predicament.

Most of the analysis largely distills down to old technology, old processes, and old management models. Again much of it accurate. In particular articles like the Stratechery one noted above are especially clear in regard to how Intel got to its current difficult situation and notes that a lot of the problems became most obvious with Intel's massive failure(s) in mobile computing.

As much as the financial reports would like to assert that it is solely Intel's management that is at fault for the current situation, most of these reports largely elide a larger problem that is now impacting Intel. Namely that for years Intel was able to innovate its ancient technology along and reap huge returns while all the while building layer upon layer of self interested corporate hubris around a monopoly money pipe tied to a single architectural choice. And when a sea change finally did show up the entire edifice was fragile, inflexible, and unable to adapt to the change. There is plenty of blame to go around.

This same thing has happened again and again in technology often over the past 30 years and some companies like IBM or Microsoft have been able to shift and adapt to industry changes that challenge their once dominate platform(s), while others like Digital Equipment Corp(DEC) end up in the trash bin of tech history.

Knowing The Foe

One of the key factors in technology is knowing where the trend line is and executing on that. When companies grow large with massive self-interested internal bureaucracies it becomes increasingly difficult not only navigate potential change, but in many cases to even see it coming. The foe is within. This increases the likelihood that rather than seeing the coming trend, companies get caught up in pointless internecine skirmishes with like minded pseudo-foes, while a tsunami of sea change is looming.

Intel's current "struggle" with AMD is of this internecine sort. It is reminiscent of the period when Sun Micro Systems was going to battle with HP and DEC over the workstation market whilst missing the fact entirely that the PC --a different platform-- was winning the war so to speak. The fact that Intel has been largely shut out of the mobile revolution is a worrying sign for many in the industry.

For Intel (as well as Microsoft) the growth of the cloud and aggregation of mobile traffic has obscured some of the revolution's force. In the case of Intel though this has been far more impactful than its software peers. Arm RISC based processors absolutely dominate the burgeoning mobile market it is a fact. And more than that, Arm IP has become a leading force in embedded applications from auto to telecom to IoT. Arm's leadership in these domains and their expansion outward leaves companies like Intel and AMD to joust over the mostly slow growing old school desktop/laptop computing market crumbs.

Most of Arm's market leadership is not about performance in the classic sense the kind of Moore's law model bandied about in the media. Rather, Arm's rise has often been built around doing more with less. First from a technical standpoint Arm based designs tend to be stingy in power consumption this is a key feature especially in mobile where battery life is paramount. And Arm's RISC architecture leads directly to this advantage. And yes, Intel had some competing products to Arm like Atom but it carried the same traits as other x86 cores with the long-term brittleness and high long term cost.

Second, as is well known, Arm really does not make anything in the classic sense, rather its designs are in the form of IP that is licensed to others. And, more often than not, these licensees themselves are fabless i.e. they don't make anything physically either. These next stage companies in turn add their intellectual input into the Arm designs and then they farm out the final specialized fine-tuned design to a company or companies that specialize in the actual manufacture of the devices.

In many ways Arm's global model is similar in some respects to the Intel and AMD relationship though reconfigured. AMD after all has some old school license of the Intel x86 design technology and in some respects AMD follows an Arm like manufacturing trajectory. The primary difference is Intel has for many years vertically integrated this entire process and this of course has been mightily profitable and dominate while it lasted. And the license model with AMD is mostly begrudging instead of perpetuating. But now with a changing technological landscape this has left Intel with an increasingly vulnerable high cost development model in a world that is no longer predominated by x86.

What It Is

There is plenty of media out there about Intel's problems but there is little in the way of how to fix it. <https://stratechery.com/2021/intel-problems/> went so far as to propose a government bailout which, in my mind, is tantamount to throwing in the towel. Intel needs to innovate out of this on their own, the tech world is just not bipolar with the US and Japan like it was when the Reagan administration protected the US semi-conductor sector years ago.

The x86 architecture while wildly successful for many years seems to be coming to the end of its cycle. That Arm with a substantially smaller footprint was able to displace the large and dominate force in mobile computing so completely is telling. This isn't to say Intel should end-of-life x86 immediately but rather recognize that a different architecture will be needed to re-assert dominance in the changing landscape. This landscape will be largely be about smaller efficient widely distributed computing "things" that will be everywhere.

Arm has a powerful foothold in mobile and embedded and its power thrifty IP is widely used but Arm's business model leaves it in a somewhat vulnerable position of a different sort. Since it produces IP rather than actual chips and its revenue is generated by licenses, that means others with equivalent "intellect" can compete without a large investment in physical hardware. It also should be noted that Arm has a significant channel of service support and development to sustain its business model and support customers. But this part is not a feature that is distinguishing or far more substantial than others in the industry.

One recent newer competing architecture that has created some stir in the industry as well as within Arm itself is RISC-V (pronounced "risk 5"). It has been developed by industry vets and academics and its model is capable of allowing others to produce similar products to Arm and a key advantage: RISC-V follows the opensource licensing model. Of course the opensource model is widely utilized in the software world but in the semi-conductor world --which still presents value in terms of "intellectual property"-- this is something of an earthquake.

Opensource means that the source code and designs are largely open to use, inspect, and modify by anyone as long as the terms of the opensource license are respected. This is vastly different than the notion of a paid for proprietary licensed to access IP. Opensource has been hugely successful in the world of mobile on the software side but has failed, to this point, to gain significant traction in the semi-conductor design world.

Moreover, the arrival of the concept of RISC-V is not exactly brand new, in the late 90s and early 2000s Opencores pioneered opensource hardware designs and got some traction --but like many opensouce projects timing is everything. And other architectures such as MIPS and PowerPC have tried to hop on to the opensource model bandwagon with limited success. But the timing for Intel and RISC-V might just be one of those good timing sweet spot moments.

How To Fix It

Intel has a huge opportunity to adopt RISC-V right now. Since RISC-V is opensource Intel would not have to make a huge investment in buying a company similar to the failed approach Nvidia took with Arm. There would of course be a large investment in internal resources but it could easily be imagined that Intel might be able to divide itself into server/desktop and mobile/embedded business units with the server/desktop continuing with x86 while the mobile/embedded unit drives new RISC-V opensource development particularly targeting Arm's core strength in power efficient cores. (Even if Intel decided to buy expertise, inexpensive small development houses for RISC-V are in their infancy and relatively inexpensive)

Moreover Intel by using opensource licensing rather than a complex and convoluted IP license system could solve a problem that continues to bother Arm's customers. License grief and its associated costs. Using RISC-V like this would also provide Intel with at least two options for mobile/embedded customers an outsourced version which would be processed through non vertical method or an in-house version with the usual Intel vertical depending on what level of support the customers need. Either way the customer should be able to gain the benefits of such options.

Regaining a foothold in mobile and embedded will not be easy and it will be costly. And the culture of Intel's management will need to accept the the days of near monopoly are long over. The adoption of an opensource model means relinquishing some degree of control over the customer's use of the product and a dismantling of ways of doing business normalized over forty years . Companies like Google and Red Hat have shown the model can be done successfully, the trick will be if the big old dog can master a new trick.

Conclusion

In order for Intel to overcome stagnation and market decline it needs a migration away from the x86 architecture which locks it into a lose lose battle with AMD for a declining share of the market. This distraction, coupled with the changing world of mobile computing has allowed Arm to eclipse Intel in the largest segment of the processor market.

By adopting the opensource RISC-V architecture, Intel could develop the right technical tools to compete with Arm whilst at the same time changing its own business model. As noted, Intel could start this in the embedded segment with low power, low cost, opensource licensed offerings as an alternative to Arm. An approach into this part of Arm's key segment with offerings that allow the customers turnkey opensource solutions would allow Intel possibilities in embedded and mobile with some competitive advantages.

Furthermore, the new business model would have to be far more service oriented, rather than and old-school vertical and this would likely require a long needed cultural change in Intel's management. It will be interesting to see if Intel can make the change and move forward or will if it end up like DEC i.e. a once significant tech force and now largely forgotten.