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Intel's server processor business will be a key growth driver over time, but keep an eye on mobile.



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Analyst Note

[Micron and Intel Joint Venture Announce 3D XPoint Memory; Maintain Very High Uncertainty for Micron](#)
by Abhinav Davuluri, 07/28/2015

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Analyst Note 07/28/2015

IM Flash (the NAND joint venture between Micron and Intel) announced on July 28 a new development in memory technology called 3D XPoint (cross-point), which is projected to be up to 1,000 times faster than current NAND flash technologies and 10 times denser than today's DRAM products. As a result, shares of Micron rose about 9%, closing in on \$20 per share. Although shares are in 4-star territory, we reiterate our very high uncertainty relative to the volatile memory space in addition to our view that Micron will not begin materially recovering until early 2016.

3D XPoint is slated to be the latest class of memory since the 1989 introduction of NAND flash memory. While production has already begun in the joint venture's dedicated fabrication plant in Lehi, Utah, commercial shipments aren't expected until 2016. Previously, it was announced that the latest 3D NAND

would also ramp in 2016. We see the potential for cannibalization in certain memory markets, primarily in functions that require a massive in-memory database, fast system recovery, low latency, and high endurance. High-performance computing is the primary target application, including high-fidelity pattern recognition (facial, speech, biometrics, etc.) but there is also the potential for more advanced gaming and scientific uses that need to access immense amounts of data at high speeds.

With respect to the technology itself, IM Flash representatives described the cost for 3D XPoint to be somewhere between that of NAND and DRAM. 3D XPoint uses a crosspoint structure that allows denser packing, in addition to newer materials with unique properties that are able to store memory in a fundamentally different way than current memory products. The proposed specifications look impressive at face value, but we are reluctant to significantly recognize additional growth on just this announcement.

Investment Thesis 04/09/2015

Intel is the pre-eminent leader in the integrated design and manufacturing of microprocessors found in traditional personal computers. With the rise in interconnectivity of devices ranging from PCs to smartphones and tablets, Intel strives to provide the most powerful and energy-efficient silicon solution to any product "smart and connected." Additionally, the data centers used to facilitate the information stored, analyzed, and accessed by various front-end devices are largely run with Intel server chips.

Intel differentiates itself first and foremost via the continued execution of Moore's law, which predicts transistor density on integrated circuits will double about every two years, meaning subsequent chips have substantial power, cost, and size improvements. This scaling advantage is perpetuated through a higher than peer average R&D and capital expenditure budget that allows Intel to control the entire design and manufacturing process in an industry where the majority of competition focuses on only one phase.

In recent years, Intel has seen a shifting competitive landscape resulting from the proliferation of mobile devices, at the expense of the mature PC market, with ARM replacing Advanced Micro Devices as chief rival. Consequently, Intel has been forced to shift its characteristic approach of offering high-performance, power-

Morningstar's Take INTC

Analyst		
Price 08-19-2015	Fair Value Estimate	Uncertainty
28.34 USD	31 USD	Medium
Consider Buy	Consider Sell	Economic Moat
21.7 USD	41.85 USD	Wide

Stewardship Rating
Standard

Bulls Say

- Intel is the largest semiconductor company in the world. The firm has sustained its position at the forefront of technology by investing heavily in R&D, and this trend should continue.
- The firm holds a roughly four fifths share in the microprocessor market.
- Intel has an immense budget for capital expenditures, allowing it to maintain the most cutting-edge semiconductor manufacturing technologies in the world.

Bears Say

- PC industry growth has slowed from the heady rates of the 1990s. As a result, Intel's opportunities to expand may be limited.
- Intel must successfully maintain its technology lead in the processor market. Any missteps by the firm could trigger market share loss to AMD.
- AMD's purchase of ATI in 2006 has given Intel's smaller rival the know-how and technology to offer platform solutions as well.

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hungry processors in lieu of variants similar to ARM's low-power consuming designs that inhabit most smartphones and tablets. Intel's latest Atom processor, running on its Silvermont architecture 22-nanometer platform, has bridged that gap to become comparable in power efficiency relative to ARM offerings. We believe this progress will be rewarded with more design wins for the Atom over the next year, which should mitigate ARM's current stronghold in the space.

As cloud computing continues to garner significant investment, Intel's server processor business will be an indirect beneficiary. Tablets are becoming the preferred device to perform computing tasks and access data via cloud infrastructures that require considerable server buildouts, which will provide tailwinds for Intel's lucrative server processor business.

Economic Moat 04/09/2015

We believe Intel's wide moat emanates from its superior cost advantages realized in the design and manufacturing of its cutting-edge microprocessors. This in-house capability supports a streamlined supply chain, shorter time to market, and the ability to scale promising products more rapidly. Semiconductor manufacturing is inherently capital-intensive thus requires methodical planning and execution to keep the cost per chip at a reasonable level. Intel accomplishes this through investments in the latest process equipment technologies. However, in order for the economics of the business to be pragmatic, there needs to be strong demand via differentiated products that can be sold at high margins, which Intel achieves with its massive research and development budget that averaged \$10.7 billion annually from 2012 to 2014.

Following along the pathway prescribed by Moore's law, coined by one of Intel's chief founders Gordon Moore, the number of transistors per unit area doubles approximately every two years. As process technologies develop, the cost per unit area increases while the unit area per transistor decreases. Thus, by netting these two trends, Intel is able to decrease the cost per transistor with each successive technology node. This fundamental realization is at the core of Intel's one- to two-year lead over the rest of the chip industry. We believe Intel's moat is encapsulated in its "tick-tock" strategy, in which the firm advances its technology node every two years (the tick), while it launches a new architecture for its microprocessors during the years in between (the tock).

Server processors are manufactured with the same technology and many identical process steps as chips designated for PCs. Therefore, we believe that as the product mix offered by Intel shifts from the PC to servers, there will be minimal requirement to overhaul any portion of wafer fabrication equipment. Generally, server processors favor performance over power efficiency, which we believe is Intel's forte and justifies its strong presence in the market. However, different classes of data centers have separate needs, and the potential for ARM-based server chips making a push into microservers is a plausible scenario. We see the lessons learned by Intel in mobile carrying over across other domains, as its Atom chips for microservers are now much more energy efficient than the Haswell and Broadwell variations.

While previous mobile processor efforts have failed to make a meaningful impact, Intel has yet to fully exert its manufacturing prowess on a market laden with ARM process designs. We believe that Intel's Silvermont Atom chips, manufactured on its 22-nanometer process technology, will help increase its presence in the mobile device market. Looking further, any significant design wins would set up the 14-nanometer Airmont Atom chip quite nicely for next year. In addition, Intel has been building its wireless connectivity portfolio with multiple acquisitions to give it in-house Wi-Fi, Bluetooth, GPS, and near field communication technologies. The logic behind this strategy is to combine these components on an LTE modem chipset with an application processor to increase its footprint in mobile devices. These investments have the potential to make an impact not only in mobile, but also in adjacent products ranging from tablets to the Internet of Things. Although these developments don't move the needle for us just yet, we believe Intel is making a step in the right direction to establishing its presence in the mobile space.

Furthermore, the x86 ecosystem (in which Intel's core products coexist), is

representative in the majority of PC and server chips. Network effects have played a big role in its dominance, as proprietary computer software has been written specifically for the x86 architecture, leading to significant switching costs to shift architectures. The growth in the PC market allowed Intel to invest heavily in R&D to fuel continued progress in the x86 architecture. However, with the PC market stagnating and ARM architecture exhibiting a commanding lead in mobile devices, x86 has continued to flourish in server processors, as x86-based server revenue accounted for 82% of the total server market in 2014, according to Gartner. ARM has announced plans to enter the server market by way of microservers, a class of server tailored for energy efficiency, which results in a smaller footprint and lower total cost of ownership relative to traditional servers. Intel's Atom processors are incumbent in today's microservers, and we believe the x86 ecosystem coupled with the newer versions of the Atom developed with 14-nanometer technology will thwart offerings by ARM.

Valuation 04/09/2015

Our fair value estimate is \$31 per share, up from \$29 as we take into account slightly higher revenue projections for the data center group. As the PC market continues to decline, we see server processors supplanting sales in PC processors, ultimately leading to overall revenue growth in the mid-single-digits in the near-term. As a relatively smaller growth driver, we believe mobile chip sales will be approximately 5% of revenue by 2018, after representing a nominal percentage in 2014. The PC market experienced a temporary revival in 2014 with a 6% revenue increase stemming from an enterprise refresh. In the near-term, we see Intel's PC-derived revenue declining in the low-single-digits. However, the proliferation of cloud computing and big data trends will provide tailwinds for the data center group, which we see growing by about 13% annually until 2019. By then, we believe the PC and data center groups will converge in percentage of total revenue, with both accounting for about 40% each. Intel's lead in process technology benefits from sizable R&D expenses (20% of revenue on average) and we believe this rate must continue to sustain its advantage. Gross margins in 2014, at almost 64%, benefited from higher desktop and notebook unit sales as well as higher average selling prices in the data center group. Going forward, we believe lower ASPs for PC chips will be partially offset by increasing unit sales of server chips, which as a segment have gross margins in excess of 70%. As Intel shifts its focus toward server and mobile chips, utilization of its fabrication plants will become more efficient, which will alleviate margin depression from PC-related headwinds. Operating margins were relatively high in 2014 (28%) mainly attributed to strong PC and server chip sales, but we see margins normalizing to 25% in the long run. Intel's dominant manufacturing operations require massive capital outlays for expensive equipment, fabrication plant construction, and the maintenance of a clean room environment. Our estimates utilize historical patterns and the expected progression of Moore's law to attain an average capital expenditure of \$10.75 billion in the near term. Approximately 70% of this outlay is for maintaining existing capacity, with the rest split between process development and wafer size transition from 300 millimeters to 450 in order to have more chips on a sole substrate to mitigate cost challenges with 10-nanometer and beyond.

Risk 04/09/2015

The cyclical industry in which Intel operates will cause its profitability to fluctuate regardless of how successful it is in tailoring its processors to new markets. Our uncertainty rating is medium and reflects the underlying risk faced by Intel regarding the proliferation of mobile devices at the expense of personal computers, the expanding role of server processors in its product mix, and the advancement of technology nodes to 10-nanometer, 7-nanometer, and so on. In the PC space, any misstep by Intel will lead to AMD capturing market share. While it is more likely that ARM-based processors could begin to steal server market share from Intel, it is also theoretically possible ARM processing power catches up to Intel core processors. Any prolonged delay in process technology by Intel would allow other semiconductor manufacturers to quell Intel's lead and offer processors at the same node as Intel or even surpass it.

Management 01/16/2015

We view Intel's stewardship of shareholder capital as standard. Brian Krzanich took over as CEO in May 2013 from Paul Otellini, who retired. Krzanich was previously COO and has been with the firm since 1982. Before becoming COO in January 2012, he held leadership positions in Intel's manufacturing organization. Stacy Smith became CFO in 2007. Smith joined Intel in 1988 and has held various positions at the company, including finance, information technology, and sales and marketing roles. Former CFO Andy Bryant remains at Intel and is now chairman of the board. We consider the firm to have a deep management bench.

Management has made the right moves to allow Intel to maintain its dominant position in computer processors in recent years, but the success of the firm's recent forays into new markets is still up for debate. Intel has been making a concerted effort to break into smartphone and tablet processors, which has traditionally been the stronghold of ARM, with its Atom chips, and even paid \$1.4 billion to acquire Infineon's wireless connectivity chip business in 2011 to support the endeavor. Although Intel has seen limited success so far, there are signs that it is starting to make some progress on that front. In addition, Intel acquired antivirus and security software maker McAfee for \$6.7 billion (net of cash) in 2011, with the vision of adding security features to its chips and hardware, which when integrated with software will provide more effective security solutions. Although strategically sound, we think it remains to be seen whether Intel can successfully execute its vision for McAfee.

Overview

Profile:

Intel is the world's largest chipmaker. It develops and manufactures microprocessors and platform solutions for the global personal computer, mobile computing, and data center markets. Intel pioneered the x86 architecture for microprocessors.

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