

ARM Continues to Rule Tablets, Now Eyeing Auto, Servers

Companies: AAPL, AMD, INTC, LON:ARM/ARMH, MIPS, MSFT, NVDA, QCOM, TXN

January 27, 2011

Research Question:

Outside of tablets and netbooks, where will ARM see its next and best design wins?

Summary of Findings

- [ARM Holdings plc](#) (LON:ARM/ARMH) is expected to have multiple areas of growth outside of its firm hold on smartphones and tablets. ARM chips are becoming an industry standard, creating momentum for its designs as the company pushes its technology into automobiles, TV, medical devices, and industrial purposes.
- Sources were split on whether ARM could compete in the server market. Those who give ARM a chance say it is because of data centers' need for low-powered chips to keep energy costs and consumption down. Other sources said [Intel Corp.](#)'s (INTC) technology is the standard and will be too difficult to replace, making ARM more of a niche player than a category owner.
- ARM likely will continue its dominant position in the tablet market, which sources expect to be this year's "it" device.
- ARM could even establish a presence in PCs and desktops. Apple Inc. (AAPL) is rumored to be considering ARM across all its platforms. [Microsoft Corp.](#) (MSFT) includes ARM support in Windows 8, and also has realized that supporting ARM may help it enter the mobile market.
- Intel and [Advanced Micro Devices Inc.](#) (AMD) still are struggling to compete with ARM designs in the mobile market. ARM has become the industry's hot name with which all companies want to do business and promote as a piece of their technology.

Silo Summaries

1) ARM LICENSEES

Three sources said ARM continues to gain recognition and credibility, with opportunity to grow. The smallest and most energy-efficient processors are extremely popular. **Sources cited growth potential in markets like security cameras and non-consumer handheld mobile devices for medical and inventory purposes. ARM continues to position itself to dominate the table market.**

2) CHIPMAKERS

Two sources said opportunities abound for use of ARM's technology. **One believes ARM-designed chips have a place in the server market because of their low power.** The other source said ARM is more likely to expand uses in the medical, automotive and industrial fields. **ARM's partnership with Windows could open the door to its inclusion in desktops.**

3) COMPONENT SUPPLIERS

Three sources said ARM has many uses in addition to mobile devices, namely in the automotive industry and anything Android related in the coming years. **One source said his company is planning to use ARM's architecture in the PC and server markets.**

4) DATA CENTER EXPERTS

Three sources said lowering energy costs and consumption are key initiatives for data centers. **One source said ARM is well-positioned for this with its lower-power chips.** Another source said ARM is likely to become only a niche player on the server market.

5) INDUSTRY EXPERTS

Two sources said ARM continues to grow and distance itself from competitors. Whether it can leverage this for success remains to be seen. **Intel and AMD have fallen behind ARM in low-power chip technology while Intel's competitive advantage is threatened by the increasing difficulty in smaller chip fabrication.**

6) CHIP DESIGN FIRM

One source said ARM's presence is beginning to hurt other competitors, leaving just Intel to compete in the mobile computing space. ARM appears to have the edge in tablets, while Intel continues its strength in PCs and servers.

7) HARDWARE MANUFACTURER

One source said ARM has become universally recognized in mobile computing with growing dominance in tablets. **He said ARM's growth markets are in autos and TVs but not in servers.**

	ARM Growing Outside Mobile	ARM Can Compete in Server Market	ARM Dominates Tablets
ARM Licensees	↑	N/A	↑
Chipmakers	↑	→	↑
Component Suppliers	↑	→	↑
Data Center Experts	N/A	↑	N/A
Industry Experts	↑	→	↑
Chip Design Firm	↑	↓	→
Hardware Manufacturer	↑	↓	↑

Background

Blueshift Research's [September report on ARM](#) found that the company was expanding into new product areas, particularly in the server space. IT journalists and industry experts expect ARM to use its [Cortex-A15](#) processor to enter the server market, in which it already had made a limited foray. In December, ARM CEO D. Warren A. East announced that server manufacturers already are [considering](#) chips based on ARM's technology, but cautioned that he did not expect to start gaining server share from Intel until 2014. In November, [ZT Systems announced](#) what it calls the first commercially available ARM-based development platform for the server market, moving away from previous [x86](#) servers using Intel or AMD and toward ARM based on its superior energy consumption. Initial usage is expected to be primarily for evaluation.

CURRENT RESEARCH

In this next study, Blueshift assessed the market for ARM technology beyond tablets and netbooks, investigating the use of ARM in servers in particular.

Blueshift employed its pattern mining approach to establish and interview sources in eight independent silos:

- 1) ARM licensees (3)
- 2) Chipmakers (2)
- 3) Component suppliers (3)
- 4) Data center experts (3)
- 5) Industry experts (2)
- 6) Chip design firm (1)
- 7) Hardware manufacturer (1)
- 8) Secondary sources (10)

Blueshift interviewed 15 primary sources, including five repeat sources, and included 10 of the most relevant secondary sources focused on design wins for ARM and its potential in the server market.

Silos

1) ARM LICENSEES

Three sources said ARM continues to gain recognition and credibility, with plenty of opportunity to grow. The smallest and most energy-efficient processors are extremely popular. Sources cited growth potential in markets like security cameras and non-consumer handheld mobile devices for medical and inventory purposes. ARM continues to position itself to dominate the table market.

► U.S.-based developer of mixed-signal integrated circuits

This repeat source said ARM's smallest and most energy-efficient processor design, the [Cortex-M0](#), has been exceptionally popular with customers in the burgeoning area of consumer product controls. The ARM name continues to gain recognition and credibility among device makers, and even quasi-competitors are moving to ARM-based designs.

- "We've just seen more [interest in ARM products] in human interface applications—high-volume, consumer applications."
- "Lots of these customers are very excited about the Cortex-M0. They just needed a microcontroller inside their system-on-a-chip [SOC]. Some of them were debating going with something more esoteric and wondering about long-term support, and now it's just a no-brainer to go with the ARM M0."
- "The way you control your products, whether you touch them or rotate them, that's just exploding. How do humans control their devices? Buttons are going away."
- "We used to have to explain to everyone, but now everyone explains to us why ARM is the right choice. For them, they recognize it's going to be well-supported and that it gives them a marketing check mark. People are starting

People are starting to say, 'Oh, it's got ARM inside.' That means more than it did even a year ago. And because of Android and the things ARM is doing there, there's a 'cool' factor to using ARM from a development point of view. Customers are actually marketing that they've got an ARM processor in their product.

Mixed-signal Circuits Developer

to say, 'Oh, it's got ARM inside.' That means more than it did even a year ago. And because of [Google Inc.'s] Android and the things ARM is doing there, there's a 'cool' factor to using ARM from a development point of view. Customers are actually marketing that they've got an ARM processor in their product."

- "Our customers are saying they're very pleased with the development ecosystem and the support levels they see out of an ARM development."
- "The competition is extremely fragmented. It's basically MIPS [Technologies Inc./MIPS] or Texas Instruments [Inc./TXN] or Maxim [Integrated Products Inc./MXIM], but ... it's fixing to turn into a Coke vs. Coke Zero competition because those competitors are also becoming strong proponents of ARM solutions."
- "The response [to our first ARM-based chip design] has been excellent. It has been a catalyst to get many of our customers talking about their own custom designs. We embed an ARM Cortex-M0 in their own custom design."
- "Most of these applications are predominantly analog. They don't benefit from being at 65 nanometer or 28 nanometer. They're at larger process nodes, so having a capable tiny processor is a big win for these mainly analog chips."

► The VP of business development for a company that uses ARM cores for security camera chipsets

This source said ARM has a small share of the security camera market but is gaining visibility through several chipmakers, including Texas Instruments. His company could produce chipsets without using ARM but would have to rewrite software. He expects ARM to continue to target mainly high-volume applications, such as phones and media players, but believes the company should consider devoting more time to lower-volume but higher-profit devices like security cameras.

- "Everything we've ever sold [has used an ARM-based processor], the [ARM7](#) or [ARM9](#), depending on the chip."
- "The decision to use ARM was made in 2001. There were four players we evaluated at the time. ARM had the best combination of the deal they offered us, the cores we needed, the cost we needed and the support we needed."
- "Sony [Corp./TYO:6758/SNE] is our biggest competitor for camera chipsets. I would guess that ARM has single-digit share [of the security camera market] at best. Sony has about 90% of the market, and they don't use ARM."
- "There's increasing awareness [in the security camera market] of Texas Instruments, which has ARM-based chips. There's also some growing awareness of [WT Microelectronics Co. Ltd.'s/TPE:3036] Ambarella, which also uses ARM processors."
- "We compete on image quality, low light and wide dynamic range, so the camera can be used in basically any application. We could do that on any microcontroller. The ARM is more or less a traffic cop in our system. It's not in the data path, so it's not doing the imaging."
- "In our next generation, we could use just about any core. It's just that it's a hassle to switch. That's why [ARM] gets embedded in a product and stays there. We'd have to recompile software to use another engine."
- "They've got to go for volume, so any application that appears to be hundreds of millions [of unit sales] or greater should be a target [for ARM]. If I were the guy managing ARM's product line, I'd start with the biggest [markets] and come down ... 'dumb phones' and then smartphones and then handheld gaming machines and then iPods or audio players—just go down the list."
- "Security is less interesting [as a market for ARM] only because there are only 40 or 50 million cameras sold a year in security and there's 1.4 billion phones sold a year. But the reason we don't make cameras for phones, and the reason we only make cameras for security, is because you can charge a lot more. The value of the image quality is more appreciated. The question is whether ARM could target lower volume apps where they could provide more of the perceived value of the end system. There's a nice multiplier there. I think as much profit is made in security imagers as phone imagers even though security is 100 times less volume—100 times more profit is made per camera."

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*VP of Business Development
ARM Licensee*

► A representative for a major semiconductor manufacturer and ARM licensee

This source said his company is targeting tablets and other mobile devices with its ARM-based processors and has no interest in going after Intel in the PC and server markets. He believes ARM can control the tablet market as it has with smartphones, but also sees opportunities in other mobile devices, such as those used for inventory control and medical applications.

- “We’ve got [ARM-based] products that are targeted at motor control applications, things as common as TV remotes, thermostat controllers, medical supplies like glucometers. On the higher end, now you see all these treadmills with touch screen displays, airline terminal ticketing kiosks, hospital bedside applications. At the highest end, you’ve got smartphones and tablets.”
- “Our products [going into smartphones and tablets] all have ARM cores today and will in the future.”
- “Customers like the fact that [some of our products] have an ARM core. The market has evolved to the point where customers like that.”
- “Tablets are obviously the big one [for future opportunities]. I think people would consider that relatively new. We believe ARM will dominate tablets and we hope it will be the case, but that story is not yet written.”
- “We’re not interested in going after the server and desktop and traditional notebook market. Microsoft wants to get their operating system in more portable applications. Certainly, tablets are high on their list as it is on ours, but they also want to get into other portable devices, whether it’s a handheld device that a FedEx guy would use for inventory control or a medical EMS application. They’d like to be in those types of applications, and that’s where we’re interested in taking that technology.”
- “You look at Nvidia with their Tegra chip, and they want to go head-to-head in the notebook and desktop space with their product line. We’ve got such a tremendous opportunity in our core wireless products that we’ll let others go after Intel’s home turf.”
- “Several of our competitors have decided to get an architectural license [allowing them to customize ARM cores]. Imagine you need an engine; you go to Cummins Diesel and say, ‘I want to buy that engine but I don’t want the off-the-shelf one. I want your blueprint. I’m going to make the cylinders a little bigger and add a different carburetor on it and try to eke out 5% more performance than the base model.’ Our view is, there are a lot of ways to use our resources to differentiate our products outside of tweaking the core, so we’ll just buy that core [from ARM].”
- “I’m not saying that our competitors’ strategy [to buy an architectural license] is a bad one. For us, we don’t believe it’s worth the dollar investment for the performance gain.”
- “On the wireless side, which is the heart and soul of where our [key product] resides, you’ve seen our progression from an ARM7 to ARM9, ARM11, going up to Cortex A9 and then the license of ARM’s A15 for our next-generation.”
- “[Licensing ARM designs for some products] really comes down to a ‘make vs. buy’ decision. We were a very early licensee of ARM, and we’ve worked with them for at least 15 years. They have been a very good supplier, and we’ve had a very good relationship. It really comes down to our view of where the value inside of a system comes from. The core is important and its performance is important, but in [one of our products] you’ve got the core [ARM] CPU but you’ve got seven other processing engines and the software support on top of them. That’s where we look to differentiate ourselves, not coming up with a new core architecture that the world probably doesn’t need.”

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*Representative,
Semiconductor Manufacturer*

2) CHIPMAKERS

Two sources said opportunities abound for use of ARM’s technology. One believes ARM-designed chips have a place in the server market because of their low power. The other source said ARM is more likely to expand uses in the medical, automotive and industrial fields while Intel’s x86 will remain the standard code for servers. ARM’s partnership with Windows could open the door to its inclusion in desktops as well as help push Microsoft forward in the mobile environment.

➤ Software engineer at a major chipmaker

This source reported a solid use case for low-power ARM chips in the server market. Cloud computing brokerages are arising, in which customers can purchase processing power from a broker. He points to this trend as a sign of how processing power may become commoditized, prompting a race to lower costs at server farms.

- “There are very solid use cases for that kind of market for low-priced cloud computing. I haven’t done development on an ARM chip, but looking at the languages we write in, for a lot of developers ARM’s

development language is not something they have to think about. A lot of the high-end computer languages never get into the lower-level hardware architecture. They don't deal with memory addresses in the device. For most developers, I'd be surprised if they're even aware of the differences."

- "I see a little bit of a direct effect of the low-power approach to servers. ARM has made headways into mobile because of low power. If you look at what's going on in the cloud/server market, we're starting to see cloud brokerages pop up. As a consumer I need X amount of processing power and I'll go to a broker to determine the cheapest provider. Service brokerages are popping up, so server providers are going to have to compete on price and are sensitive to what they're charging. The biggest cost for a data farm is cooling costs, and they have to bring that down. That brokerage concept is taking hold. The ability to say as an end user that you need so much performance at so much cost is exciting."
- "I haven't heard of any ARM-based server farm. Their desire to get into that market makes perfect sense given what's happening with big server farms. The brokerage I've seen is [SpotCloud](#). The way it works is that you ask for a certain number of cores and you have the ability to sift through that based on price. What's nice is that they act as a clearinghouse. Cloud service providers come to them."

➤ A representative at a leading manufacturer of ARM-based PSOCs

This repeat source said the PSOC (programmable system-on-a-chip) market continues to have new opportunities across multiple fields including medical, automotive and industrial, and that all of its PSOC chips include ARM designs. He did not think ARM could penetrate the server market because of the entrenched nature of Intel's x86 code. In terms of Microsoft Windows 8's support for ARM, he cited a potential for ARM chips in desktops but also a play for Microsoft to better position itself in mobile, where ARM controls much of the market.

- "One of the other good things about the ARM core specifically, and in our new architecture more generally, is that it lets us address multiple markets—medical, automotive, industrial. All of those are sources of potential growth for us. There are lots of handheld medical devices out there that are key. Picture a glucose meter, for example, and you can see the potential of the market. We wouldn't have to license a design. We have the PSOC chip; we can just create or help our customers create the design. We sell the chip, and they program it themselves for the function they need. Every single chip we sell on the PSOC side has an ARM core on it. They would receive royalties based on the agreement we sign."
- "The same reason ARM is so strong in smartphones is the same reason it'll be hard in the desktop/server space. There's so much momentum with x86 in the server space. That takes a lot of relearning if you want to change. The reason everyone wants to jump on ARM's PSOC is the same reason people may not want to jump on an ARM processor for x86 and the server/desktop space."
- "Just look at where ARM is going. How important is the battery life on smartphones? It's important. The touch controller is not the most power-hungry chip on the phone, but everyone who produces a battery-powered product is going to be concerned with battery life."
- "The great thing about ARM is that everyone is familiar with it. There are so many third-party tools. It's a great platform to be on. You can look at the Windows 8 announcement two ways: ARM chips could power a PC, or Windows 8 could go on non-PC platforms like smartphones and tablets. Mobile is certainly a place that everyone has to be at some point."
- "Right now there are things that are not touch screen that will be like thermostats. On the industrial side we see manufacturing equipment needing PSOCs—mailing machines, general stuff that your average Joe doesn't buy that's targeted for a specific business need. PSOC has all this flexibility to be analog or digital or to make adjustments to simplify or add a feature. There's also system management control. ... We're seeing interest in PSOC to handle the actual data processing but also the coordination within a computer, coordinating the disk drive with the processors and managing power. We'd sell that kind of chip to a server manufacturer."

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Manufacturer of ARM-based PSOCs*

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*Representative
Manufacturer of ARM-based PSOCs*

3) COMPONENT SUPPLIERS

Three sources said ARM has many uses in addition to mobile devices, namely in the automotive industry and anything Android related in the coming years. One source said his company is planning to use ARM's unparalleled architecture in the PC and server markets, while another uses it for advancements in audio. ARM will maintain its leadership position in tablets, though one source said it will not rule tablets at the same level as it has dominated smartphones.

➤ The head of marketing for an ARM partner that develops virtualization software for mobile and embedded applications

This source said her company is seeing interest in ARM designs in tablets, digital home uses, the auto market and in networking. She expects ARM to do exceptionally well in tablets, but will cede some market share to MIPS and Intel. The rise of tablets should not cut into smartphone growth nor ARM's dominance of handsets.

- "From our ecosystem partners, we are seeing interest and also design starts for ARM in tablets, digital home, automotive and networking—all markets with opportunities and requirements for embedded virtualization. These segments look to ARM for a rich mix of price, performance, lower energy consumption, and for scalability in a single architecture."
- "The tablet market is still getting started, with iPad occupying the pole position. At CES, four or five dozen tablets debuted—the lion's share based on Android—but most received lukewarm receptions from the press and potential end-users."
- "ARM is likely to dominate this nascent mobile/wireless segment but probably not as completely as it does the handheld space. There are more potential niches where performance and software interoperability will sustain tablet designs based on MIPS, especially gaming, and Intel's Atom, for interoperability and productivity."
- "We believe that tablets fill a need for productivity on the road and around the home, one partially met today by notebooks and sub-notebook desktop-type computers. The rise of tablets will ultimately have more impact on already-threatened revenues and growth in the PC market and much less on mobile phones. They are driven by different user needs—mobile phones for communications and tablets for productivity. As such, they are going to grow together without significant cannibalization."
- "We have the technology to target other types of CPUs/cores, such as MIPS, but are currently only shipping for ARM-based silicon and in ARM-based devices."
- "The ARM architecture is already quite dominant in handheld mobile/wireless, and in that segment our software already ships on 1.1 billion devices."
- "We offer a mobile virtualization platform—a small, configurable hypervisor optimized for embedded and mobile applications. It has the right combination of performance and CPU support to target handheld telephony and other mobile applications. Our platform is distinguished by supporting mobile virtualization, componentization and security, enabling a new generation of applications and capabilities with impact across the mobile ecosystem."
- "We work closely with ARM to optimize support for shipping ARM cores and to support new ones out of the chute, as we did for the ARM Cortex-A15 last fall."
- "We also partner with ARM licensees—especially Qualcomm [Inc./QCOM] and STMicroelectronics N.V. [EPA:STM/STM]—which embed [our platform] in their leading chipset reference designs, streamlining design-in for intelligent devices."

➤ A representative for a leading maker of graphics processing chips

This source said his company plans to use ARM-based processors in PC and server chips. The company's next-generation ARM-based smartphone and tablet processors also will have a large opportunity in the automotive market but not until 2012.

- "We [have] intentions to take ARM into the broader computing markets. As a computer technology company, we can leverage our many years of developing expertise in every facet of the PC market to take ARM top to bottom. ARM should do well in servers."
- "ARM's design is an industry-leading ultralow-power design with tremendous software support. No other architecture comes close to having both."
- "Combining ARM's power efficiency and capabilities and marrying it to a powerful GPU will make it one of the most elegant heterogeneous computing architectures for cloud-based computing. Current architectures have too much legacy to carry, which provides no benefit to the way we will use computers in the future."

ARM Holdings plc

- “[Our ARM-based processor] is the heart of our mobile computing product line and our embedded automotive initiatives. The big opportunities for [our ARM-based processor] is mostly smartphone and tablets. Automotive can be large but will not drive any revenue for another year or so.”
- “ARM is the most widely supported architecture for mobile devices. Both smartphones and tablets are computers. For each OEM—Motorola [Mobility Holdings Inc./MMI], LG [Electronics Inc.], Samsung [Electronics Co. Ltd./SEO:005930], Dell [Inc./DELL], etc.—having a contiguous infrastructure will leverage the massive amounts of investment made in software development. It will be a natural for the tablet market to be dominated by ARM.”
- “[One mobile computing chip] uses ARM11. [The second-generation of that chip] uses ARM’s Dual A9 Cortex. We just announced a license for ARM15, which will be the basis for our next-generation device.”

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*Representative
Graphics Processing Chip Maker*

► The head of sales for a developer of audio software used in phones and other devices

This source expects ARM to build a very strong position in the tablet market, while expanding into the automotive market and on any device that uses Google’s Android operating system. Technical improvements will also help ARM gain in audio and video applications.

- “We have been a member of the [ARM Connected Community](#) for many years. ARM is used in many of the applications we target, such as GPS navigation devices, car radios, etc. Because we are doing very intensive signal processing, we prefer one of the more powerful ARM cores with a higher clock rate or one with DSP extensions. We are in production today on the ARM9, ARM9e, ARM11, and Cortex A8. We are also used in non-ARM processors, such as the CSR BC5-MM Bluetooth chip and various Texas Instrument DSPs [digital signal processors]. We have also ported to various other DSPs and processors over the 13 years we have been in business.”
- “I see ARM continuing to dominate in smartphones and likely will establish and maintain leadership in the tablet space.”
- “I actually think [smartphones and tablets] can grow together. Everyone needs a phone and tablets will not replace that. However, many smartphone users also recognize and value that a tablet can bring with a larger, easier to read and easier to use display. Each device has distinct functions that it was optimized for and they will co-exist, with many people owning both.”
- “As ARM signal processing capabilities grow and they continue to offer more performance with higher clock speeds, I see them being used even for signal processing audio and video applications. They will likely see a lot of growth in automotive and, of course, anything Android-based.”
- “Our software is targeted at improving voice quality for hands-free calls. We are different from the competition in a few keys ways. First, we take an overall system approach to this problem with [our voice quality software], tools for audio tuning and analysis and our expert audio consulting services. Many disciplines needs to come together to deliver the best voice quality. Within our software, we deliver a complete solution that includes the echo cancellation, noise reduction, full-duplex control, voice activity detection, noise level monitors, voice enhancement, etc. The complete solution is a fully adaptive bi-directional voice systems that continuously monitors and adapts to always deliver the best voice quality. Our focus is on voice quality even in the presence of noise or with harsh echo conditions, meaning when the echo to near-end talker level is very high.”

4) DATA CENTER EXPERTS

Three sources said lowering energy costs and consumption are key initiatives for data centers and that the company that provides a low-powered chip for these centers’ servers stands a chance to gain market share. One source said ARM is well-positioned for this with its lower-power chips despite competition from Intel and AMD. Another source said ARM is likely to become only a niche player on the server market.

➤ IT consultant

This source said ARM is positioned to take share in the server market but will have to deal with projects at Intel and AMD aimed at producing low-power chips. Data centers are under significant pressure from energy providers and their own bottom lines to lower power consumption, and the trend is toward multiprocessor servers.

- “ARM is positioned to innovate the server market, but the reality is that AMD or Intel could do it as well. Intel’s Atom line is in line with what I’m thinking of. ARM is becoming the kind of company that can flourish in this environment. I’m not trying to weigh down the system with software. ARM is the other side of the coin. They provide efficient architectures that are now more powerful.”
- “A lot of my clients are having me come in with solutions for lower energy costs. That’s one of the trends in IT. ... Energy efficiency is becoming important. In California there are areas where data centers have reached limits on what they can draw. Customers have filled data centers halfway and are not allowed to put more servers up. There’s no alternative at that point than to become more efficient. That’s where I think ARM has huge potential. It would have to be paired with the correct software. That’s ARM’s challenge.”
- “Current software will run on ARM’s processors, but it’s not geared toward efficiency. The software is where things have to get fixed so it’s lighter and more efficient to take advantage of multiple cores. We can then run more workload per watt than AMD or Intel. There are people looking at performance per watt. What can my data center do in terms of workload per watt? Once you look at that, then AMD and Intel become very unattractive. The negative effect could be commoditization of semiconductors even more than now. People won’t want specialized chips. They just want something that can handle the workload. You’re seeing netbooks with ARM chips. They’re trying to make the play. ARM is what we should be using—deploying low-power processors, but we’re not. You can’t keep rewarding AMD or Intel for producing inefficient software and chips.”
- “The root of the issue with computing in general is that due to the rise of the Microsoft platform, we moved away from mainframes and that has made software inefficient. That’s driven the need for high-power processors and more energy consumption. In general, we’re powering inefficient software. The cloud is bringing back more efficient software. The era of looking at things in terms of RAM and processors will be over. ... We’ll be looking at things in aggregate. For example, I’ve got 50,000 GHz of processing and 8 TB of RAM. How I dole those out is what makes the whole system work? That’s where the cloud is heading. The amount of multiprocessor software out on the market is small versus single-threaded 32-bit software. But now that we can use multiple processors, things will change. Our software will become multiprocessor-aware and will handle the splitting of workloads. At some point I as a customer will come and say, ‘I want to buy this application and I’ll pay based on CPU cycles.’”
- “The answer to this question lies on the data center side ... the Googles and the Facebooks of the world where the data center engineers are concerned about efficiency and warehouse/aggregate computing. They will tell you if they’re testing ARM servers. They’ll know if they’re testing workloads. If ARM produces servers with the [Cortex-]A15 and it is put in production by Google and Facebook and they test it on the workload with efficiency increases, you’ll see bulk orders. They don’t care about Intel or AMD. They’re not brand-loyal. They care about cost control. If they can consume 50% less power, you’re talking about real savings. That’s who you have to get to. I’m sure ARM has given them demo servers.”

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Data Center IT Consultant

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Data Center IT Consultant

➤ CEO, cloud computing company

This source said ARM may pick up a niche part of the server market, but he does not believe the company truly can gain a foothold there. Others, from IBM Corp. (IBM) to Nvidia Corp. (NVDA), have failed in their attempts to take server share.

ARM Holdings plc

- “ARM has a very sharp firm, and they’re very focused. I don’t think they will beat Intel. IBM has tried it. [Oracle Corp.’s/ORCL] Sun [Microsystems] has tried it. As much as it’s sexy, they’ll pick up a niche of the market but they’ll burn capital and resources that are not conducive for them. Server farms will always try to reduce cost.”
- “This is the second round of the cycle. Nvidia and others with their GPUs were trying to crack the server market. They started in the high-performance computer space. It didn’t fully get there.”
- “They’re trying to adopt a Google/eBay model where they assemble their own systems and customize their configurations rather than buying big solutions off the shelf. Those companies have good engineers. But there are issues in managing that type of approach. It’s the ‘Do I buy or build?’ and ‘Where do I invest my expertise?’”

➤ Energy specialist building energy-efficient tools for data centers

This source said a lower-power chip would be the “Holy Grail” for data centers that could then begin to reduce their cooling costs. Although data centers may become energy-efficient, they will continue to be built because mobile computing is driving demand.

- “Power is an industrywide issue addressed by the [Green Grid](#), the [U.S. Green Building Council](#), the [Critical Facilities Round Table](#). Of all the power that goes into the data center, 45% is used to cool the servers and what’s called the power distribution portion. Only 55% of power going into the data center actually gets to the computing equipment. The industry is looking at 1) raising the temperature capabilities of centers, 2) reducing electricity consumption by looking at how we cool the centers, 3) making the equipment that cools the data center more efficient, or 4) how we make the server more efficient.”
- “The answer is that the Holy Grail is a server that uses less power. A server is just a box that electricity flows to and heat comes out the other side of. You have to have air conditioning to keep that cool. You have to have air conditioning to bring cooling more closely to the rackspace itself rather than cooling the whole room. Our approach is operating based on today’s high-energy, high-heat chips.”
- “If you build a processor chip that uses less energy and produces less heat, it means I sell less air conditioning and the AC that is used pulls less electricity and has lower operation expenditures. An engineer will tell me he’s building a data center with 500 racks and a power consumption of 4 kW–30 kW/rack. A 3,000-square-foot house uses 4 kW/day. A rack of 42 servers uses 30 kW in just one rack times 500. That’s what we’re talking about with data center consumption. I’m working on a data center with 12 megawatts’ consumption with 800 racks. If you can even bring that down by 5%, that’s a huge impact on operating expenditures. PG&E [Corp./PGE] is writing big checks—six figure checks—to those companies that reduce energy consumption.”
- “The lower-power chip is a critical aspect of this. Every time you hit copy and paste on your laptop, you’re creating more storage. Every time you download a YouTube video, you’re creating more storage. Data centers aren’t going to get any smaller. Everyone wants access to their iPhone and their app store. They’re just going to get bigger. The amount of electricity will be huge. The consumption of an individual data center may go down, but there will be more. The efficiency is a big issue.”
- “The major players are building their data centers in eastern Washington, North Carolina. Apple has just completed a large data center. Yahoo [Inc./YHOO] has one in Nebraska. Oracle has one in Utah. It doesn’t matter where they are. What matters is how much the electricity costs and whether you can get. In California PG&E is very stingy.”

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Data Center Energy Specialist

5) INDUSTRY EXPERTS

Two sources said ARM continues to grow and distance itself from competitors in the low-power chip market, as evidenced by its inclusion in Windows 8, use in Nvidia’s chips in desktops, and rumors that Apple is going to use ARM chips across all platforms. Whether it can leverage this for success in the server market remains to be seen. Intel and AMD have fallen behind ARM in low-power chip technology while Intel’s competitive advantage is threatened by the increasing difficulty in smaller chip fabrication.

► U.K.-based technology journalist

This repeat source identified the Windows 8 move to ARM compatibility as well as the potential for ARM-based Nvidia chips to crack the desktop/laptop market as key trends to watch. He noted a rumor that Apple is considering going to ARM chips across its entire platform. He also said Intel has conceded it cannot match ARM in performance per watt.

- “There are still companies selling multicore ARM servers with older chips. I’m almost sure there are ARM A15 production samples out there, but I just haven’t heard of anyone testing them.”
- “A couple of things that have come up is that Windows 8 is going to be running on ARM and x86. In the past it’s only been on x86. Knowing that Microsoft will support ARM is a huge shot in the arm. Whatever they end up calling the Windows 8 will be ARM-compatible on desktop and server. What we predicted in terms of ARM in server with focus also on computers/desktops is happening. OEMs are free to design hardware for ARM, which has Intel understandably worried.”
- “There are some companies out of China producing ARM-based netbooks and some larger laptops. The big rumor at the moment is that Apple is considering moving to ARM across their platform. The rumor is that they’re investing millions of dollars to design a chip that would go across Macbooks and thus offer binary compatibilities across all platforms. One program could run across all of their platforms from iPhone to Macbooks. Whether they do it is another matter. Only five years ago they moved from PowerPC to Intel. Whether they’ll risk the ire of developers is a question, but they’ve done stranger things. If they do that, it’s the beginning of the end for Intel. Apple is an innovation leader, and a lot of other companies will follow. If they say ARM’s the future, that means ARM’s the future.”
- “Consider looking at Apple’s [Project Aquarius](#). That was many years ago when they were using 6800 Motorola processors. Their plan was to use ARM processors originally. The rumor is they’ve resurrected Aquarius. Now that ARM is looking at server, it’s given thought to the rumor that Aquarius could get resurrected.”
- “[Intel CEO] Paul Otellini has said that where they are with low-power chips, they can’t touch ARM in performance per watt. They’ve basically admitted that. With data warehousing where it is with raw performance less important than power efficiency, ARM has a big lead. A lot of these warehouses have used up the available energy. The ARM designs at the moment have the ability to be scaled. An ARM Cortex-A15 versus Intel—Intel is twice as fast but uses four times the power. ARM can’t compete in the short term with rendering and processing intensive stuff, but per watt it’s there.”
- “Intel designs and builds the chips. They farm out some to Taiwan Semiconductor [Mfg. Co. Ltd./TPE:2330/TSM]. They’re stuck with the design until it pays off. That’s two to three years before they can ditch the design. ARM doesn’t design anything. They just license. They’re immediately getting an upfront sum. As soon as they design and ship, they can immediately get it paid. They can leave that monetization up to the fabricator which give them flexibility that Intel lacks.”
- “With Google TV the original set-top boxes were based on the [Intel] Atom chip designed for consumer electronics. That’s a market where ARM has been a big player. The Atom range was Intel’s low-power chips. But what’s come out in the last month is that the next-generation Google set-top boxes will use ARM instead of Atom. Although nobody is saying it, it’s Google saying to Intel, ‘Your chips aren’t as good as ARM’s.’”
- “One of the interesting things that came out before CES was from Nvidia, which produces about half of the gaming chips. They’ve announced [Project Denver](#), which is an Nvidia chip with an embedded ARM processor. You used to be able to offload graphics to GPU from the CPU. Then you had general purpose CPU/GPU where you could do parallel processing on a GPU so you could do CPU type work there.”
- “Now, you’re starting to use the GPU as a processor. Nvidia wants to ditch the CPU altogether and integrate a CPU into the GPU. Nvidia has ARM experience with the [Tegra](#) processors. They know what they’re doing. Intel has mocked Nvidia because they don’t make a CPU, they don’t have an x86 license. They do have a license for

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U.K.-based Technology Journalist

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U.K.-based Technology Journalist

ARM chips though. If ARM takes over on the desktop, then Project Denver becomes the next major step in that evolution. The CPU industry is putting GPUs on the CPUs. That's what Intel's [Sandy Bridge](#) does. AMD with its [Project Fusion](#) is doing the same with Radeon chips. For a lot of the tasks you don't need a dedicated graphics card. Dedicated GPUs will become just for games. Nvidia doesn't have that option. AMD bought ATI, so it's doing the GPU itself. Nvidia is doing the opposite and saying, 'We don't need processors.' Project Denver is taking Tegra chips to the smartphone/tablet market and [Maxwell](#) will be for desktops and possibly low-end servers."

► A microprocessor architect

This repeat source said ARM's success in the server market will depend on whether the extensive software built on current server designs can be ported effectively to ARM architecture. ARM continues to make strides in the SOC market and distance itself from the competition in the low-power chip market. Intel's and AMD's low-power chips are a cycle behind ARM's in quality, which will prove difficult to overcome. Also, chip fabrication could become more complicated in the coming years, potentially eroding Intel's competitive advantage.

- "The success of ARM in the server space still depends hugely on attitudes to porting software. The OS for the majority of these servers is Linux, which shouldn't be an issue and I wouldn't expect a major change due to Microsoft saying there will be an ARM release of Windows 8. This is the client OS, rather than the server OS, and it's not necessarily going to run on the specific hardware that's in server farms. Obviously, the added PR hasn't hurt!"
- "Windows 8 on ARM is highly dependent on precisely what platforms Microsoft targets. It's not just the x86 that Windows targets; it's a whole platform of bits and pieces—graphics adaptor, 3D graphics accelerators, system chips, etc. There's a huge range of these—everything from tablets (rather unsuccessful ones at the moment) to laptops, desktops and servers."
- "For ARM, Microsoft has only said that they'll support a few specific SOCs: Nvidia [Tegra], TI [\[OMAP 4\]](#) and Qualcomm [\[Snapdragon\]](#). These are all aimed at smartphones and tablets—areas where it is clear that current Windows on x86 designs aren't going well if they exist at all. It looks like Microsoft is trying to cover the possibility that Intel/AMD will continue to fail in these areas. Say they, Intel in particular, are addressing these markets, but so far they don't seem to have really come up with something truly competitive. Just compare a Windows 7 Tablet—such as an Archos [\[EPA:JXR\] 9](#)—against an iPad."
- "Minor trends continue, with maybe SOCs looking more decisively in ARM's favor and AMD looking weaker in these markets than Intel. AMD decapitated itself over server failure and hasn't even begun to address smartphone/tablet. Indeed, it sold off most of its lower power capabilities earlier."
- "There are no truly low-power AMD chips, and the Intel chips are poor. Neither company makes a decent single system on a chip for smartphones or tablets. Again, look inside the Archos 9, which runs on Windows 7. There's nothing like the Apple A4, Tegra 2, Snapdragon or OMAP 4 in there. Of course, Intel have the technical know-how, but they don't seem to have come out with something yet."
- "Nvidia looks stronger compared to AMD/ATI since they've actually done something that is shipping. It is, of course, not good enough for Intel/AMD to cogitate and put forth something that's as good as Tegra 2. By the time they've done that, Nvidia, TI and Qualcomm will have moved the game along. Qualcomm in particular has a 28nm ARM device coming this year."
- "However, as you move into areas where Intel/AMD earn their bread and butter, things are the other way around. The AMD Fusion and Intel Sandy Bridge provide significantly more powerful systems and, thus, are condemned to be powered by very large batteries or the mains. I don't see convergence here. In the business model, Intel is sustained by relatively modest numbers of high-margin chips. Can they change to have a large part (much larger than Atom alone) of their output be large numbers of low-margin chips?"
- "A slightly hidden thing is the difference in strategy over Java. Intel/AMD assume that a heavyweight JIT [just in time] compiler will be run. ARM has, with its [Jazelle](#) technology, a much lighter platform for executing Java, and this was important in phones. Maybe that matters. Maybe not. Clearly, the trend is away from running program development on the client device and toward more managed devices. Apple is pushing this."
- "Beyond 28nm is looking quite hard—maybe so hard that the permanent lead in process that Intel has had is eroded somewhat. That would somewhat destabilize things if it happened. You'll only see this over the next three, four, five years. And it will depend on the competition getting their act together."

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Microprocessor Architect

6) CHIP DESIGN FIRM

One source said ARM's presence is beginning to hurt other competitors, leaving just Intel to compete in the mobile computing space. ARM appears to have the edge in tablets, while Intel continues its strength in PCs and servers.

➤ The president of a developer of IP cores for high-bandwidth applications

This source said ARM's competitors are slowly falling by the wayside, leaving a battle in the mobile computing space between ARM and Intel's Atom processor. He expects ARM to continue its success in consumer applications and said it should do well against Intel in tablets, but will have trouble eating into Intel's dominance in desktop PCs and servers.

- "I don't have much visibility into ARM's market share, but it seems like their historical competition—MIPS, [PowerPC](#), [Tensilica \[Inc.\]](#), [Intel's] 8051, is fading. Their competition going forward is clearly Intel, with Atom."
- "ARM is already the dominant CPU in consumer apps. I expect this to continue for all new consumer markets."
- "The only market ARM isn't dominant in is the computing space—desktop, servers, etc. I don't see ARM supplanting Intel in desktop and server. The real battle is in tablets. Intel is not going to cede that space easily."
- "In the end, I think they will have some success in the tablet market, but Intel is too strong of a competitor for them to dominate it."
- "ARM doesn't create chips; its customers do. For ARM to succeed in the server space, one of its customers needs to create and manufacture a server chip better than Intel. That will be a challenge. I think it is doable but not for the faint of heart. Intel has a significant manufacturing advantage. The ARM CPU advantage over Intel's CPU, if it exists at all, must be greater than the Intel manufacturing advantage. That is a big gap to overcome."
- "We supply [PCI Express](#) and [memory controller](#) cores. These cores are commonly used in high-bandwidth applications—networking, storage, video, etc. Our key differentiators are more configurable IP, higher performance, strong [FPGA](#) support, more flexible business engagement and typically lower price."
- "We have integrated our memory controller with ARM's DDR PHY [double data rate physical interface layer] to provide a complete memory interface solution. We also fully support their AXI [advanced extensible interface] standard."
- "I can say the adoption of ARM's AXI is proceeding full force. It is now the de facto interconnect standard. The old interconnect standard was [AHB](#), also from ARM. However, AHB did not achieve the penetration that AXI is achieving. The significance is that there is now truly a standard for interconnecting IP blocks on a chip. Since everyone is using it, it doesn't necessarily have a material impact on market share."

The only market ARM isn't dominant in is the computing space—desktop, servers, etc. ... For ARM to succeed in the server space, one of its customers needs to create and manufacture a server chip better than Intel. That will be a challenge. I think it is doable but not for the faint of heart. Intel has a significant manufacturing advantage. The ARM CPU advantage over Intel's CPU, if it exists at all, must be greater than the Intel manufacturing advantage. That is a big gap to overcome.

*President
IP cores Developer*

7) HARDWARE MANUFACTURER

One source said ARM has become universally recognized in mobile computing with growing dominance in tablets. He said ARM's growth markets are in autos and TVs but not in servers.

➤ A product executive for an Android tablet manufacturer

This repeat source said ARM architecture is almost universal in the mobile computing environment, especially where Android tablets are concerned. He attributes this success to the company's relationship with Nvidia. Beyond mobile computing, he is not too optimistic about ARM's ability to compete in the server market, but admits that this is largely a personal bias. He noted ARM's growth potential in the automotive world and TVs.

- “ARM is everywhere. You couldn’t move at CES this year without hitting a machine that ran on Tegra, and every single one of those machines pushed money back to ARM.”
- “Moving down, Tegra is in the next generation of smart or ‘super’ phones from Motorola in particular. These are interesting little machines because, in theory, they can be docked to power a tablet or even a desk-resident workstation. If anything, I see them cannibalizing some of the excitement around tablets if they catch on.”
- “I do not really see tablet taking over from smartphones. You still need a phone and if you have to carry one device, why not just carry a really smart phone and leave the tablet at home? But the smartest smartphones run ARM architecture via Tegra, so I guess it really isn’t relevant for your thesis today.”
- “I can’t think of anyone on the tablet side who’s looking at an Intel system. I’m sure they’re out there, maybe in the Windows world, but within Android none come to mind. ... Someone like an Intel can still deliver raw performance in a desktop environment, but that’s not what it’s about anymore.”
- “I’m not too optimistic on their ability to crack the server market, but I don’t know if it matters. Nobody faults Apple for not having a real server business, or Qualcomm or any other wildly successful enterprise. But I’m not intimately aware of developments on that side.”
- “ARM has excelled in innovative engineering, which has allowed it access to the multiplicity of mobile platforms out there today. I believe it’s getting a lot of traction in the vehicular applications, the smart cars. I know Nvidia runs BMW’s dashboard now, and suspect you’ll see a lot more wins there as more car manufacturers catch on.”
- “Likewise, I fully expect ARM to be in the next generation of TVs because I expect the next generation of TVs to be big tablets. The tablet isn’t going to cannibalize the smartphone; the tablet is moving up to become that living room display unit unless, of course, you get a scenario where I just pop out my phone, have it talk to the wall screen and there you have instant TV on demand. In that world, the tablet is as irrelevant as the desktop.”
- “This is the year of the tablet. Next year, smarter phones and maybe a late flourishing of super-high-end desktops and laptops as those vendors pull out all the stops to protect their home turf. Tablets mean ARM. Smarter phones mean ARM if they stay on the Android reservation. In theory, Qualcomm and other players could make a convincing show of force in the non-Android world or even make some inroads into Android, but for now, Tegra is king and ARM is riding with it.”

I can’t think of anyone on the tablet side who’s looking at an Intel system. I’m sure they’re out there, maybe in the Windows world, but within Android none come to mind. Someone like an Intel can still deliver raw performance in a desktop environment, but that’s not what it’s about anymore.

*Product Executive
Android Tablet Manufacturer*

I believe [ARM] is getting a lot of traction in the vehicular applications, the smart cars. I know Nvidia runs BMW’s dashboard now, and suspect you’ll see a lot more wins there as more car manufacturers catch on. ... Likewise, I fully expect ARM to be in the next generation of TVs because I expect the next generation of TVs to be big tablets.

*Product Executive
Android Tablet Manufacturer*

Secondary Sources

Industry articles described design wins for ARM, new partnerships and the company’s potential uses in various fields, including over-the-top TV, servers and across all Apple platforms.

➤ A Jan. 19 ITProPortal.com article

The article highlighted Apple’s resurrection of Project Aquarius, which may lead to Apple’s complete adoption of ARM technology across all platforms.

<http://www.itproportal.com/2011/01/19/apple-spend-39-billion-reviving-project-aquarius/>

- “Tim Cook, the acting CEO for Apple, confirmed yesterday that the company will be spending nearly four billion dollars over the next 24 months in what it calls long term component contracts—and we believe that Apple might be on the verge of bringing back Project Aquarius.”

ARM Holdings plc

- “Back in 1986, Apple wanted to replace its ageing 68000 line with a four core RISC processor. That project was codenamed Aquarius and was personally approved by Apple’s then CEO John Sculley, as well as Steve Jobs’ replacement as head of Macintosh development Jean Louis Gassée (ed : We asked Mr Gassée about his thoughts on Aquarius and we will update this article if we receive an answer).”
- “Fast forward to today and Apple looks very, very close to achieving the goal of designing its own processors, not only for mobiles, but also for the rest of its range of computers with an RISC-based, multi-GHz, multi-core architecture one from ARM.”
- “There have been a few hints along the way; when Steve Jobs launched the iPhone 4 in July 2010, he said that the company would not go into any business where it did not own or control the primary technology because ‘if you don’t the people who do own it will beat you’.”
- “Then there’s the fact that in November 2010, Apple dropped the Xserve server family without any [prior warning](#), saying that the company was just transitioning away from the massive Xserve servers to the Mac Mini.”
- “There’s also the acquisitions of [PA Semi](#) and [Intrinsity](#) over the past three years, together with a significant investment in ex-Videologic graphics powerhouse, [Imagination Technologies](#).”
- “Ultimately, Jobs’ obsession with controlling the whole ecosystem means they won’t stop at the software part of it, which is why we believe that sooner or later Apple [will ditch Intel](#) and possibly the x86 platform. Buying [AMD](#) would not give them enough leeway.”
- “Another hint? What about the [launch](#) of the Mac App store a few weeks ago, essentially bringing one of the most seminal aspects of iOS to the Mac OS X.”
- “ARM gives Apple the independence that it has sought for so long; obviously Apple is in ARM’s DNA as one of the three founding members with VLSI technology and Acorn.”
- “With the combined expertise of ImgTec, PA Semi and Intrinsity, Apple has the capacity to build a formidable hardware platform that spans from the iPod Touch all the way to an iMac; one GPGPU (General Purpose Graphics Processing Unit) to rule them all.”
- “The Cupertino giant is sitting on a cash reserve of nearly \$60 billion. It now has the money to [finance](#) a 25-year old dream that it could not afford to do back then. Tim Cook said in yesterday’s revenue update: ‘From our point of view on design side, we design components where we believe we can innovate beyond the market. Most recent example, A4 chip. With the A4 chip, we didn’t think we had to invest in a fab, so we focused on design.’”
- “So how will Apple spend the \$3.9 billion? Investing in R&D and securing enough bleeding edge capacity from a chip manufacturing facilities for the next couple of years. For example, TSMC confirmed in April 2010 that it has plans to go below 14nm (intel is currently at 28nm and the Apple A4 at 45nm) and plans to invest \$4.8 billion to reach that aim. A little financial help could go a long, long way.”
- “For more background information about Project Aquarius and its genesis, do check Lowendmac.com [here](#) and [here](#).”

➤ A Jan. 19 Think.co.uk article

The article stated that Apple’s resurrection of Project Aquarius means Apple could be targeting ARM for all of its future Macs, ditching Intel in the process.

<http://www.think.co.uk/2011/1/19/could-apple-be-looking-arm-future-macs/>

- “Rumour has it that Apple is planning to shift its Mac line back to RISC processors, ditching Intel for industry darling ARM—but would it really make such a major change so soon after adopting CISC?”
- “Our colleagues over at [ITProPortal](#) say that Apple has earmarked a whopping \$3.9 billion on bringing the dream of Project Aquarius to life, 25 years after the idea was first approved by the company’s management.”
- “Back in the dark days of 1986, Apple started Project Aquarius as a way of updating its Motorola 68000-based machines with new hardware—a four-core RISC-based chip. While that heady aim was never achieved—Apple opted to go for IBM’s PowerPC line instead, and then dropped RISC altogether in favour of CISC processors from x86 giant Intel—Apple’s growing interest in the works of British chip designer ARM suggest that it could be getting resurrected.”
- “It’s a theory that makes a certain amount of sense: Apple has developed its own ARM-based A4 processor based on the Cortex-A8 design, which it uses in its iPhone and iPad products, meaning it’s got the engineering expertise to pull off a complete transition.”
- “Further, it’s got the experience: five years ago, the company announced that it was ditching IBM’s PowerPC architecture to use the faster, cheaper x86 processors from Intel—a move which meant that all software had to be rewritten to support a CISC, rather than RISC, architecture.”
- “For those who think that ARM’s low-power designs are unsuited to the high-performance demands of modern desktop computing, think again: ARM’s latest creation, the [Cortex-A15 ‘Eagle’](#), includes many performance-

boosting features aimed directly at desktop and server use—plus a reference design clock-speed of up to 2.5GHz.”

- “A four-core chip based on a Cortex-A15 design running at 2.5GHz would certainly give Apple’s purported Mac Aquarius a running start in the performance-per-watt stakes, but could it really be looking to ditch Intel so soon?”
- “With just five years having passed since Apple forced its developers to retrain on writing programmes for the x86 instruction set instead of the old familiar PowerPC architecture, it’s hard to imagine that the company would ask its developers to rewrite for yet another architecture—and while an abstraction layer would allow backwards compatibility with older software as during the PowerPC to Intel transition era, programmers would still need to rewrite large portions of the code at Apple’s behest.”
- “Despite the company’s almost cult-like following, that’s something which would likely make a lot of its followers extremely unhappy—but there could be a plus side to the move.”
- “With Apple already using ARM-based processors in its mobile devices, a move to the same architecture on the desktop would allow developers to produce binary-compatible packages for use across the entire Apple ecosystem: single programs that would work on desktops, laptops, mobiles, and tablets.”
- “Better yet, it would allow Apple to merge the iOS App Store and the Mac App Store into one giant software repository. While some applications, such as those that rely on the target device having smartphone functionality, wouldn’t translate to the new universal app model, many others would—and offer developers a far larger market for their wares.”
- “With Apple keeping quiet on its plans, it remains to be seen if Project Aquarius will truly be achieving its aim, 26 years after the idea was first raised.”

➤ A Dec. 23, 2010, OSNews.com article

The article claimed that ARM’s partnership with Windows is really about servers more than anything else.

http://www.osnews.com/story/24165/Windows_NT_on_ARM_It_s_a_Server_Thing

- “The [rumours](#) about Windows possibly being ported to ARM has left a lot of people bewildered; why would you port Windows NT when Windows CE 6.0 is a perfectly capable operating system? Putting all the pieces together, it’s actually quite clear why you would want Windows NT on ARM: servers.”
- “It makes zero sense for Windows NT to be ported to ARM so it can power phones and tablets. Microsoft already has the very modern and capable Windows CE 6.0 to do so; it’s the operating system, powering the Zune OS and Windows Phone 7. The latter, of course, is what most likely will become Microsoft’s tablet operating system—it’s designed for touch, after all.”
- “It’s an additional story about this subject which gives a very important clue as to why Windows on ARM would make sense. The Wall Street Journal [states](#) that the release of such an ARM-powered Windows NT is about two years away—which left consumer-flashy-gadgets-zomg-sparkles oriented folk like John Gruber [confused](#).”
- “It doesn’t leave us OSNewsians—the more nitty-gritty type of geeks—confused, of course. About two years from now? That would coincide with the release of Windows 8, which makes sense when you think about it; that way, the developers can take ARM into account when developing Windows 8. If they were to port the current Windows 7 codebase alongside the development of Windows 8, the ARM team would have to do the porting all over again when Windows 8 hits the streets. This could be avoided by making the porting process to ARM a major bullet point in the Windows 8 development process.”
- “But why would you want Windows NT on ARM? Simple: [servers](#). ARM is [currently developing](#) very cool multicore chips for servers (virtualisation built-in), which could, potentially, revolutionise the server world. I’d much rather have a few passively cooled and very efficient ARM processors in my server than overpowered, energy-sucking, incredibly hot x86 chips which need complicated cooling systems to operate.”
- “On top of that, Windows servers run a much narrower array of software than desktops, most of which is either owned by Microsoft (and thus easily ported by Microsoft itself), or open source (and thus most likely already available for ARM anyway). As such, the application problem doesn’t exist.”
- “I’m fairly sure that if this ARM-Windows rumour is indeed true—and according to additional sources from Ars, [it is](#)—then we’re most likely talking about Windows Server for ARM, most likely as complete packages. I can also imagine Windows Home Server using such an ARM version of Windows Server, since it could mean cheaper, smaller, more efficient devices.”

➤ A Jan. 19 Xbitlabs.com article

The article reported that Nvidia’s newest graphic processor unit will feature ARM general-purpose cores.

http://www.xbitlabs.com/news/cpu/display/20110119204601_Nvidia_Maxwell_Graphics_Processors_to_Have_Integrated_ARM_General_Purpose_Cores.html

- “Nvidia Corp. will integrate general-purpose ARM processing core(s) into a chip that belongs to Maxwell family of graphics processing units (GPUs), the company revealed in an interview. The Maxwell-generation chip will be the first commercial physical implementation of Nvidia’s project Denver and will also be the company’s first accelerated processing unit (APU).
- “‘The Maxwell generation will be the first end-product using Project Denver. This is a far greater resource investment for us than just licensing a design,’ said Mike Rayfield, general manager of mobile solutions for Nvidia, in an interview with [Hexus](#) web-site.”
- “Nvidia’s initiative code-named Denver describes an Nvidia CPU running the ARM instruction set, which will be fully integrated on the same chip as the Nvidia GPU.”
- “Nvidia Maxwell will be launched in 2013, it was revealed at Nvidia’s GPU Technology Conference in September, 2010. Given the timeframe, it is logical to expect 20nm process technology to be used for manufacturing of Maxwell. The architecture due in almost three years from now will offer whopping 14–16GFLOPS of double-precision performance per watt, a massive improvement over current-generation hardware.”
- “‘Between now and Maxwell, we will introduce virtual memory, pre-emption, enhance the ability of GPU to autonomously process, so that it’s non-blocking of the CPU, not waiting for the CPU, relies less on the transfer overheads that we see today. These will take GPU computing to the next level, along with a very large speed up in performance,’ said Jen-Hsun Huang, chief executive of Nvidia, at GTC 2010.”
- “This is the first time when Nvidia publicly reveals timeframes for project Denver. Unfortunately, not all the details are clear at this point and it is unknown whether all members of the Maxwell family will have integrated GP ARM cores. General-purpose processing cores will bring mosts benefits for compute applications and therefore Nvidia may omit ARM from low-cost designs.”

➤ **A Jan. 19 CityAM.com article**

The article discussed ARM’s new partnership with IBM to design low-powered processors for mobile devices.

<http://www.cityam.com/news-and-analysis/arm-and-ibm-sign-new-alliance>

- “UK Chipmaker ARM will work with IBM on the next generation of microprocessors, the firm announced yesterday.”
- “It will work with the computing giant on a new range of low powered processors for mobile devices.”
- “The deal comes after ARM received a major boost from Microsoft at the Consumer Electronics Show earlier this month, with the US firm announcing ARM chips will be the basis for a new version of its Windows operating system.”
- “ARM has already cornered the market for mobile processors, storming ahead of more established rival Intel.”
- “IBM and ARM have collaborated since 2008 on a range of 32 nanometer (nm) and 48nm processors. The latest venture will focus on 14nm chips and will solidify ARM’s position as the market leader in mobile microprocessors by allowing extended battery life and better internet access.”

➤ **A Dec. 1, 2010, LinuxForDevices.com article**

The article reported that ZT Systems has the first ARM-based development platform for the server market.

<http://www.linuxfordevices.com/c/a/News/ZT-Systems-R1801e/>

- “ZT Systems announced what it says is the first commercially available ARM-based development platform for the server market. The Ubuntu Linux-based R1801e 1U rackmount server employs SSD (solid state disk) storage and eight ARM Cortex-A9-based computer-on-modules (COMs), providing 16 600MHz cores while using less than 80 Watts, the company says.”
- “ZT Systems has previously specialized in x86 servers using Intel Xeon or AMD Opteron CPUs. Now, it’s giving ARM a try, via Phytex COMs equipped with SPEAr1310 Cortex-A9-based system-on-chips (SoCs) from STMicroelectronics (ST).”
- “The key motivator is ARM’s superior energy consumption. Data centers spend billions on electricity for servers, including energy used for cooling, and they have a significant CO2 emission footprint, say the partners. According to the U.S. Environmental Protection Agency (EPA), data centers account for 1.5 percent of total U.S. electricity consumption at a cost of \$4.5 billion annually, an amount that is expected to almost double over the next five years.”
- “As an early ARM server platform, the R1801e is expected to be used primarily for evaluation, at least for now. The R1801e offers ‘the right balance of features and scalability to enable software development, porting, and ARM-based server concept evaluation,’ say the partners.”

- “The R1801e is yet another sign that ARM is being taken more seriously in the server world. Last month, Calxeda (formerly Smooth-Stone) announced it is making a major push [to build Cortex-A9-based SoCs for low-power servers.](#)”
- “Also last month, Marvell officials demonstrated its quad-core, ARM v7 architecture [Armada XP](#) SoC, aimed at web servers, cloud computing, and high-volume home servers. The 1.6GHz SoC offers such enterprise-class features as up to 2MB of Level 2 cache, high-end networking ports and PCI-Express Gen 2.0 units.”
- “Server vendors are even more interested in ARM’s upcoming 2.5GHz [Cortex-A15 MPCore](#) processors. Using 32nm and 28nm fabrication processes, the Cortex-A15 is touted as offering enhanced virtualization support, 1TB memory access, plus five times the performance of current smartphone processors—all with similar power consumption.”

➤ A Jan. 18 EETimes.com article

The article reported that Toshiba Corp. (TYO:6502) is unveiling its first ARM Cortex microcontrollers with an on-chip USB device for high efficiency and low-power consumption.

<http://www.eetimes.com/electronics-products/processors/4212264/Toshiba-announces-its-first-ARM-Cortex-microcontrollers-with-on-chip-USB-Device>

- “Toshiba Electronics Europe will be using Embedded World 2011 to showcase its range of 32-bit ARM Cortex-M3 microcontrollers including its first members to feature on-chip full-speed (12Mbps) USB-Device connectivity, targeting industrial control to office automation.”
- “The TMPM366 devices are supplied in LQFP100 packaging, the TMPM366FDFG, TMPM366FYFG and TMPM366FWFG combine on-board Flash program memory with comparatively high levels of on-board RAM.”
- “Respective Flash/RAM capacities are 512Kbytes/64Kbytes, 256Kbytes/48Kbytes and 128Kbytes/32Kbytes. An integrated static memory controller allows a further 16Mbytes of external memory to be added to embed designs without the need for additional components.”
- “All of the new microcontrollers incorporate a 12-channel, 12-bit analogue-to-digital converter (ADC) with a conversion time of 1µs, a 10-channel, 16-bit timer and a watchdog timer (WDT).”
- “As well as the single-channel USB-Device controller, the devices provide a 2-channel serial bus interface that can be configured for I2C or synchronous mode communication and a 3-channel synchronous serial interface (SSP).”
- “A 2-channel general-purpose serial interface allows either UART mode or synchronous mode to be selected, while a built-in single-channel UART offers both UART and IrDA 1.0 support.”
- “Toshiba’s TMPM366 range operates with voltages from 2.7V to 3.6V and core frequencies of up to 48MHz and features an internal oscillator running at 10MHz.”
- “The ARM Cortex-M3 core allows designers to create highly efficient code and keep power consumption to a minimum. Each device has three levels of standby mode (‘IDLE’, ‘STOP1’ and ‘STOP2’), while a clock gear function can divide the on-chip high-speed clock into 1/1, 1/2, 1/4 or 1/8.”
- “Development support for the new microcontrollers includes evaluation boards and starter kits that allow designers to create and test working programs and key functionality.”

➤ A Jan. 17 EETimes.com article

The article stated that Freescale Semiconductor Inc. will use ARM processors for automotive and gaming uses.

<http://www.eetimes.com/electronics-products/processors/4212225/Multicore-SoCs-provide-computing-power-to-driver-assistant-systems-and-consumer-devices>

- “With its new i.MX 6 application processor family, Freescale aims at automotive infotainment systems, driver assistant systems and other embedded applications requiring high number crunching capacity. The SoCs come with one, two or four ARM Cortex A9 processor cores”
- “The Cortex A9 offers high computing power with clock rates of up to 1.2 GHz; the choice of up to four cores offers designers excellent scalability. According to Freescale, the i.MX 6 family thus exceeds the predecessor generation of application processors by a factor of five. Potential applications are 3D-enabled video players, game consoles, augmented reality applications for automotive environments and content creation. In addition, the SoCs enable designers to reduce space requirements and power consumption of the devices.”
- “The i.MX 6 application processors are among the first ones at the market to offer hardware support for the VP-8 video codec, Freescale claims. Other features include ARMv7, Neon, VFPv3 and Trustzone support.”
- “Sampling is said to start later this year. The vendor plans to make reference designs for multiple applications available, along with software and turnkey design technology.”

➤ **A Jan. 5 EETimes.com article**

The article highlighted ARM's partnership with a software company that will enable delivery of over-the-top TV capabilities.

<http://www.eetimes.com/electronics-news/4211892/ARM-NDS-team-on-OTT-delivery>

- "Digital rights management and conditional access software company NDS Ltd. has announced that it has entered into a partnership with processor IP licensor ARM Holding plc to enable the delivery of content and services to internet-connected TVs using NDS' Infinite TV."
- "The Infinite TV suite enables delivery and optimization of so-called over-the-top (OTT) content. The details of the ARM-NDS partnership were not disclosed. OTT is typically used to refer to programming delivered over the internet to a set-top-box that is used for the broadcast decoding such as terrestrial or satellite."
- "'Building on ARM's momentum in the home entertainment market, we believe that a platform based around a dual ARM Cortex-A9 processor and ARM Mali-400 MP GPU will provide connected TV manufacturers with the very best in performance and outstanding graphics capability. We look forward to working with NDS to drive OTT opportunities in this space,' said Lance Howarth, senior vice president and general manager of the media processing division at ARM, in a statement issued by NDS."
- "Jonathan Beavon, director of segment marketing at NDS, said: 'Infinite TV provides an end-to-end delivery mechanism for OTT services on connected devices. With a thin-client approach, the possibilities for manufacturers are taken to a new level; easy integration and a sophisticated architecture will ensure an optimal service with a short time to market.'"

➤ **An advertisement for a design summit using ARM systems**

From March to April, a summit will be held in 11 North American cities to discuss and learn design strategies for ARM systems, showing the ubiquity and various uses of ARM's technology.

<http://www.webboom.com/avnet2011/index.html>

- "The rapid diversification and proliferation of ARM technology is impacting designers of a wide array of products. As technology options increase, many designers are turning to channel partners like Avnet for technical solution recommendations that are unbiased and impartial and that address performance and functionality requirements specific to a project, end application or industry segment."
- "To address the needs of our customers, Avnet will host a global series of technical trainings, representing a unique multi-manufacturer collaboration that features an entire ecosystem of providers showcasing the latest design solutions for ARM systems."

Next Steps

Blueshift's next report on ARM will assess the company's progress as the low-cost, efficient processor in the server market. We will gauge the potential size and scope of ARM's inclusion in the auto and TV markets and pursue the possibility of Intel's competitive advantage erosion based on the difficulty in chip fabrication beyond 28 nanometers, as raised by one industry expert source. We also will look into Apple's Project Aquarius and what it means for ARM, as well as the effect of the Windows 8 inclusion of ARM.

Additional research by Seth Agulnick, Adam Lesser and Scott Martin

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