
ARM REACHING INTO NEW AREAS INCLUDING SERVERS

(AMD, ARMH, INTC, MIPS, NVDA, QCOM)

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BACKGROUND/DESCRIPTION

- ▶ ARM Holdings plc (ARMH) licenses its technology to manufacturers that then turn it into chips for a vast array of applications. It is most prevalent and well-known in smartphones, though ARM technology is increasingly present in devices such as tablets, led by Apple Inc.'s iPad. The new Apple TV will carry ARM-designed chips, an unusual and eye-opening use for an ARM processor. This begs the question of where else ARM is getting design wins and what new uses for ARM-designed chips are being explored.

RESEARCH QUESTION

- ▶ Will new architectures adopted from ARM find more leverage outside of present design wins?

INITIAL FINDINGS

- ▶ ARM is expanding into new product areas, with particular interest in the server space. One hardware maker directly stated interest in pursuing possibilities with ARM. ARM's low-power design with high performance per watt can help companies save on the cost of cooling systems and overall energy costs.
- ▶ Other areas mentioned for ARM include smart meters, set-top boxes, solar panels, handheld medical devices and 3D graphics on portable devices.
- ▶ ARM's advantages include being flexible in which suppliers it can work with, producing low power microprocessors that are less expensive than competitors' chips, and a growing ecosystem of support and development in the microprocessor industry that makes switching to a competitor chip expensive.
- ▶ ARM is becoming the standard chip design in wireless consumer devices and is making a leap into tablets.
- ▶ ARM's rise has positioned the company as more of a competitor to Intel Corp. (INTC) and Advanced Micro Devices Inc. (AMD). Two sources said competitors are losing share to ARM because it can produce new cores more quickly and at a lower cost.

INITIAL DATA

Silos: ARM licensees (2), chip design firms (2), hardware manufacturers (2), chip makers (2), industry experts (2), component suppliers (2)

Secondary Sources: Industry publications (2) and technology blog (1)

SILOS

ARM Licensees

- ▶ **Head of marketing and technical sales, U.S.-based developer of mixed-signal circuits**
This source said ARM is expanding into new markets, including personal medical devices and solar panels. ARM's name recognition in these markets has increased significantly in just the past year, and its stability and development partnerships have nurtured a movement toward its technology.

- “There’s been a groundswell of people moving towards ARM, even in the last year.”
- “With the new cores ARM is introducing, the take-up rate in the marketplace has been much, much faster than it was in the past. It used to take them a few years before people started using their new cores. Now, they’ll have 30 people having licensed a new core in 12 months.”
- “I don’t see it as technical superiority. I don’t know if it’s an economy of scale or a bandwagon effect, but the alternatives out there have been getting weaker while ARM has been getting stronger. People are asking: ‘What’s going to be around for the next five or 10 years. Where can I get good third-party support? Who’s got good tools?’ It’s all those things together as much as the technical features of the microprocessors themselves.”
- “ARM chose us. ARM is proud of saying they own 85% of 25% of the market. But as they started looking into how to penetrate markets where the ARM name doesn’t mean as much, they approached us to be a partner.”
- “Initially, we weren’t all that excited. Our customers were using 8051s [the most widely used cores for microcontrollers]. So it wasn’t a set of technical choices that won the day. But we saw where ARM was going from a marketing and business perspective.”
- “As little as a year and a half ago, we would go into customers and they would say, ‘ARM who?’ Now, even in the deeply embedded [processor] environment, ARM has turned into ‘you can’t get fired for picking ARM.’ There seems to be a swell where people out there that use [PowerPC](#), people that use MIPS [Technologies Inc./MIPS], there’s nothing out there with a stable foundation, and ARM’s got the ecosystem and the development environment.”
- “They made it into that market, and once they started getting used there was a lot of momentum to continue getting used. That worked in the cell phone market because the development teams are gargantuan and you’re making a product that’s going to sell instantly in the \$20 million to \$50 million range, so you could afford a lot of investment to get there.”
- “Gigantic projects could afford ARM to make these big cell phone systems-on-a-chip. Everyone else in the world that doesn’t make cell phones makes [ASICs](#) or chips that still have to do the work, but they couldn’t afford all the investment. So when ARM came to us, we said, ‘If you’re going to make it in this market, there needs to be a different business model.’ We’re a way for customers to do these kinds of chips without spending \$10 million to get there. Where it normally takes a company two years to get a chip done, we’ll get it done in six months at about 20% of the cost.”
- “We provided our customers a way to get access to ARM technology for markets that ARM just traditionally had been totally out of scale on from a cost perspective.”
- “We’re doing very well in personal medical devices, which are precision analog microprocessors, Bluetooth stacks. All those things coming together meant that ARM was a good fit. ARM’s got the microprocessor side down, and we do very well on the precision analog side.”
- “Another market where we’re seeing a similar confluence of features coming together is in automatic meter reading—the misused umbrella for that is ‘smart grid circuits.’ Where we’re really a good fit is in microinverters or solar panels. Every single solar panel in an array on a roof needs a good bit of intelligence and a processor. And then human interface products, things where people control products by touching them.”
- “Normally, it takes two years and a couple million dollars to make your own custom chip with an ARM-based processor in it. We’ll do it for a couple hundred thousand dollars and six months. So ARM saw us as a way for customers in these mixed-signal markets to get exposed to their technology and then when they grow up, so to speak, to become a bona fide licensee of ARM.”

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*Head of Marketing & Technical Sales,
U.S.-based developer of mixed-signal circuits*

▶ **Executive, midlevel chip maker**

This source believes ARM has a great deal of momentum behind it and is becoming the standard code set for many vendors. He sees ARM gaining additional traction with the move from 8-bit to 32-bit design. He believes

ARM will have a hard time going up against Intel in the server market because most servers are built on [x86](#) architecture and would require recoding.

- “ARM is important because people want to look at a standard set. No matter what vendor they choose, they can operate the core controller. Whether you’re a customer of Cypress [Semiconductor Corp./CY] or Renesas [Electric Corp./TYO:6723] for your actual semiconductor, if the ARM controller is the same you can reuse their code. As it becomes more and more standardized, you get a snowball effect. Everyone then wants to be in that area where you know how to operate. There are tools to support it and so forth.”
- “A big trend we’re watching now is 8-bit versus 32-bit. There’s a lot of momentum for 32-bit design. Microcontrollers are ubiquitous. As people are designing new systems, you’re seeing the cost difference narrowing; 32-bit costs are getting into the realm of the 8-bit. That’s another point in ARM’s favor because all their cores are 32-bit.”
- “ARM has a good reputation. I don’t hear a lot of complaints. You don’t see them in tussles with customers that you see other IP houses having.”
- “ARM works with Taiwan Semiconductor [Manufacturing Co. Ltd./TPE:2330/TSM] and GlobalFoundries [Inc.] just to make sure those guys know how to sell their product. For example, we’re an ARM partner. Our PSoC [programmable system on a chip] has an ARM processor in it. They give us the IP, and we’re responsible for manufacturing it.”
- “I’m not sure ARM can pull off the server space. I think it’s going to be really hard. Basically it would follow the same logic, that the server space is just so widely not in ARM code. Intel won the battle against [Oracle Corp.’s/ORCL] Sun. It’s basically all x86. All the peripherals, storage is based on that architecture. There’s a lot of inertia that way.”

Chip Design Firms

▶ The CEO of an ARM design services partner focused on multicore embedded software

This source said demand for ARM technology is strong in the company’s core markets of handsets and consumer devices, but he does not believe ARM is making great inroads in new areas such as networking and servers. ARM’s advantage is that it allows device makers to choose a certain processor design but still get their chips from any supplier.

- “The use of the ARM architecture in its traditional markets—wireless handsets, consumer, etc.—is as strong as ever, and since those markets are growing, then so is demand for ARM. Other multicore markets—networking, automotive, etc.—continue to use other architectures, and I don’t see ARM making significant advances here.”
- “ARM’s strength lies in the fact that software developers can choose a particular target architecture but can still get their silicon from multiple sources. This was ARM’s original uniqueness, and I think it is still an important factor today. Other architectures such as MIPS offer the same capability, but ARM had a lead in the market. ... Low power is a factor too, but I think the wide availability of silicon suppliers is the key advantage.”
- “Fundamentally, the tablet applications are not really very far away from ARM’s roots and core strengths in wireless and consumer. I am not aware of any specific technical hurdles ARM has overcome to win those design sockets.”
- “The server market is an interesting one. From what I am aware of, this market is dominated by high-end Intel devices. Low power is important but not as fundamentally essential as it is in wireless/consumer devices. I suspect that ARM will be a significant player in microcontrollers and other low-power and cost-sensitive markets such as automotive and industrial, but the server market will be a much tougher nut for them to crack.”

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CEO, ARM Design Services Partner

▶ Vice president, sales and marketing for a chip design automation firm

This source said demand for ARM processors has been steady among his customers. ARM appears to be gaining business in the market for 3D graphics on portable devices.

- “[Demand for ARM processors] is holding tight. Many of our customers are building commercial multifunction printers, and ARM is everywhere there. I do see them making some inroads into 3D graphics with [Mali](#) [software].”
- “[ARM’s competitive advantage includes] a mountain of software that has been written for them and is now ‘legacy.’ That means if you want to change to a new processor, you have to convert or rewrite and certainly retest a decade of software.”
- “We help customers design the custom logic that hangs off of an ARM bus. Our synthesis technologies provide ARM customers with a more productive path to create the custom logic, often accelerators or other custom coprocessors, when compared to traditional hardware design processes. This allows the customer to offload the main processor to have specific tasks accelerated. It often means that they can reduce their costs over large volumes—smaller processor/core—and improve other design aspects. Fewer tasks running on the main processor often equal lower power usage. We also provide various configurations of ARM bus models to make this easier for the customers.”

Hardware Manufacturers

▶ Marketing executive, data storage device maker

This source said ARM technology is getting a lot of interest from cloud computing companies because of the high access speeds and low power requirements of the ARM processors.

- “ARM architecture is definitely getting play among cloud operators looking for ways to scale their server farms while conserving overall power drain. Short of the sheer weight of the heavy iron involved in a cloud farm, thermodynamics is the main limit on distributed data today. There are signs that ARM runs at lower power and, thus, cooler, and multiplied by thousands of servers this becomes a very tempting proposition.”
- “There are rumors that the Nokia [Corp./BIT:NOK1V/NOK]/ARM architecture will be ready for commercial deployment in the cloud space in about five years. That is a fairly long time away. I suspect that in the meantime ARM will remain more or less where it is: strong in the mobile applications space but not so much a large factor in the more fixed-device form factors.”
- “Nokia is working with the [\[École Polytechnique Fédérale de Lausanne\]](#) and ARM on a three-year trial project that uses the [Cortex-A9](#) processor. This processor is relatively exciting because the architecture minimizes the number of input-output interfaces on the memory level, which is where these chips tend to run hot and hungry for power.”
- “We are watching developments on the cloud front very closely. ARM is only one approach to reducing the power drain and heat output on server farms. Simply adopting steady-state storage is another, and it is much farther along developmentally.”
- “Business is all about power drain and access speed. Platters can always be built with more density, but the very fact that you are spinning all these platters on a massive scale can be a huge expense for data centers. A very minor improvement in the amount of electricity that each platter draws will not be noticeable to the retail customer, but becomes a factor when you move into mobile devices where battery life is increasingly important. And, of course, in mass applications that incremental improvement can save literally millions of dollars in both input and cooling costs.”
- “ARM architecture is extremely flexible in terms of not only the specific chip set choices but also the way those chips are arranged. This can provide strategic performance advantages as the Nokia project is demonstrating. They are able to simply stack the memory in order to maximize the number of pathways to and from core processing. This is exciting, but again many vendors will feel that as [SIMM](#) gets cheaper, the performance add from solid state will handle this well enough for practical purposes.”
- “I’m told ARM is competing directly with Qualcomm [Inc./QCOM] on the tablets. Basically, this is just a big mobile application, so the mobile players are running that space. Naturally, this is all solid-state storage anyway, so these systems can run very quickly and for fairly long periods without destroying battery life.”

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Marketing Executive, Data Storage Device Maker

▶ **Vice president, computer manufacturer**

This source is very interested in ARM's ability to enable more advanced mobile computing and media processing in particular. He said ARM already is a major player in the tablet space.

- "You can think of ARM as an Android-native architecture in so far as the company's processors are OS-dependent. That seems obvious when you think about how ARM has evolved alongside the handset market, but now that handsets—and mobile operating systems like [Google Inc.'s/GOOG] Android—are evolving into areas historically dominated by desktop or laptop, you can't ignore it."
- "The next generation of tablets are basically smartphones with a larger tablet form factor. The ARM Cortex processors already run smartphones, and app developers already develop for the ARM architecture. It's only logical that ARM will be an integral piece of the tablet also."
- "In terms of chipset, AMD has stayed away from the mobile applications and Intel has been slow to move in. Nvidia [Corp./NVDA] is happily swimming in that market, notably in cooperation with ARM architecture. Nvidia is especially exciting where the tablets are concerned because of the graphical processing advantages their technology provides. You can truly get high-definition video playback on their systems."
- "Naturally, high-definition video is fairly battery-intensive, so you need to conserve power wherever possible. Intel is learning how to do this with [Atom](#), but other than Dell [Inc./DELL], I am not sure they are getting much high-profile pickup there. Again, AMD really doesn't even play here."
- "The migration path right now is from phone to tablet and not from desktop/laptop to tablet. What this means is that people are moving from an Android or iPhone environment to the tablet and will expect an Android or iPhone experience."
- "The real question is what else that migration path entails. Apple is definitely moving its consumers from the iPod through the handset, back to the laptop and eventually to the tablet and beyond. As those consumers move through the product line, they want reverse compatibility with their initial experience, which means the mobile device, which means iPhone or Android. There's no reason why ARM architecture can't ride that trend back into fixed devices."
- "Because ARM is so versatile in terms of form factor, it allows OEMs to be creative with form factor. This is not just mobility. It could theoretically entail thinner and thinner computing or media devices. As long as the screen is big enough, the back end can get very small and light. This also plays into the migration path: This is an entire new data ecosystem based on mobile, rather than the other way around."

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Vice President, Computer Manufacturer

Chip Manufacturers

▶ **Vice president, semiconductor manufacturer**

This source believes ARM's advantage lies in its ability to provide an excellent power vs. efficiency tradeoff in the microprocessor industry. He said ARM is good at listening to customers' needs and providing tailored chips. ARM has a shot in the server space along with venture capital support although porting servers from x86 will provide a challenge. ARM needs to do a better job branding itself as a chip of choice. Intel is likely to bring some brand visibility into the smartphone market. Semiconductor demand remains strong in Europe and North America, but the PC market has been somewhat soft in Asia.

- "I do think the Cortex-A15 has real potential. From a software compatibility, you have to make sure the x86 stuff can port seamlessly to the cloud or special purposes. This is the challenge that Nvidia faces as well with graphics chips. At the beginning, you need to be focused on a few customers. [ATIC](#) [Abu Dhabi's Advanced Technology Investment Co.] is a big investor in [Smooth-Stone](#) with \$50 million in venture capital to take ARM-based processors into the cloud. That would be a mini-core environment with multiple ARM-based processors in a cluster."
- "Our customers want ARM because power efficiency comes first. ARM knows how to pack bang for

the buck and give specialized features. Intel has x86 and wants to push it into handsets. They want to tell you what to do. ARM is better at taking the pulse of customers and maximizing the microprocessor they need. Every ARM customer says ARM knows and understands their requirements. They approach their customers differently. Intel has more of a brute force approach.”

- “The biggest thing is the opportunity for ARM to diversify into the server space. That would be a game changer. The ARM server stuff is in its infancy, but it’s there.”
- “ARM is not going to be the size of Intel anytime soon. But can they push up and grow? Yes.”
- “One of the problems with ARM is that they don’t do external marketing. Most consumers don’t know anything about ARM. Intel does a good job creating brand association.”
- “ARM is one of the best kept secrets in tech. ARM needs to educate people. On the communications side I’ve seen blips, but I haven’t seen a real effort. AMD and Intel have visibility there. When you buy a cell phone, you don’t know the chip and that could change because Intel will try to brand there.”
- “We just did a test chip for ARM’s A9. That allows us to present a prototype for other manufacturers to come in and use as a baseline. We can get to high-volume manufacturing very fast.”
- “The amount of time we put into ARM is significant. We wouldn’t have invested to work with ARM on the A9 unless we saw the market opportunity. The growth is good. PC is growing but not as aggressive. The wireless consumer devices is where we see the biggest growth.”
- “To give you some perspective, we partnered with ARM on 28-nm [nanometer] tech, and it’s not high volume yet. But ARM having access to us as a partner is very important, particularly because of Intel and competition from the Atom processors. Intel is the only IDM [integrated device manufacturer] left. They make everything itself.”
- “Working with ARM is very much like an IDM. We’ve created a prototype chip type that allows unprecedented performance in terms of efficiency and power. The chip prototype allows us to link with customers.”
- “Today the market in high volume is 40-nm and 45-nm. Twenty-eight comes out later this year with high volume next year. By 2012 we’ll see 22-nm fabrication. For the next few years, the trajectory is clear with greater power/performance yields being the focus. It’s getting more difficult to do.”
- “[Twenty-eight] nm is going to be important in the smartphone space. Tablets are another one. The other focus is graphics processors for netbooks and notebooks. At 28 nm, that’s a lot of real estate. ARM sees the battle coming with Intel and they wanted a partner who can deliver that and compete with Intel. ARM knew that and came to us because our biggest customer is AMD and we know how to compete with Intel.”
- “On the PC side, the netbook space is robust. That plays in x86 and non-x86 space. Netbooks and mobile is where our growth is. The other big area for growth is digital TV and consumer. The back half of this year we’re seeing some softness in Asia. Nothing major but a bit of softness. It’s in the PC market. Europe and North America remain growth drivers.”

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► **Software engineer, chipmaker and data warehouse company**

The source said ARM chips have the advantage of easier development and testing, leading to quicker and cheaper production cycles. It has a strong reputation for low-power/low-cost chips, and he reasons that ARM will make a push that its chips can be used in new environmentally friendly data centers. He does not believe the technical hurdles to moving to ARM architecture on the server side are insurmountable.

- “ARM processors are RISC [reduced instruction set computer] processors, basically a computer on a chip. Using an RISC processor is an alternative to designing bespoke hardware for a task. The advantage is that development and testing is much simpler. Development cycles are much shorter

and much cheaper. The downside is generally performance. ... However, if you're using an RISC, it's probably because the performance you need does not warrant a specially built chip."

- "ARM is well-known for being low power and low cost, hence their use in handheld devices. With the major push toward 'green' datacenters, it stands to reason that ARM is pushing the idea of ARM-based servers as opposed to PowerPC, Power, [SPARC](#) or x86."
- "One of the advantages of ARM processors is how widespread they are. As a result, there are plenty of compilers out there that allow you to write your code in, say, [C++](#) and then compile for execution on ARM. This means that all the debug and development tools that abound for C++ are available to you as an ARM developer."
- "The question I'd be asking is, what's their hook? They're trying to push into a heavily populated market ... so what are they bringing? ... My guess would be the low-power angle."
- "The only code that won't port directly to ARM is stuff that is written to be platform-specific ... That is really going to depend on your OS and application. It is a fact that Linux can run on ARM processors. If you have code that only talks to the operating system, then you may not even need to recompile it. ... Or, if you do, it's to pull in libraries that already work on ARM processors. Device drivers might be a bit tricky, but if ARM has any sense, they'll try to do that porting or encouraging authors to do it themselves. Still ... if it's pure [C](#), I see no reason for there to be any problems."

Industry Experts

▶ Information technology journalist and a former systems administrator

This source believes ARM is aggressively pursuing the server environment. He described ARM's advantage as centered around chips that use significantly less power. While this had always been important in mobile, he sees a trend toward multiple, low-power cores in the server space as its demand for powerful processors diminishes. This will accelerate as cloud computing takes off during the next 18 months. He adds that the ability to be passively cooled without fans is a reason ARM architecture is making its way into [set-top boxes](#) like the new Apple TV.

- "The next big thing for ARM with Cortex-A15 is server environments. It's already happening on a small scale, but someone like Google with a warehouse of ARM servers could save a ton of money in power. I think you're going to see ARM making a splash in the server market."
- "One of the big expenses in the server markets isn't the servers themselves or the power, it's cooling the systems. For every watt in, you get a watt of energy out. If you can cut that in half, you need less air conditioning and a smaller room. It saves an awful lot of money."
- "With cloud computing, the shift is from processing to data storage. You've got AMD with up to 48 cores, but it draws a lot of power. We're seeing companies now producing Atom servers with 512 processing cores."
- "The excitement for ARM in cloud computing is that the Cortex is getting faster to 2.5 GHz and massive multiprocessing. They're definitely looking at the server market because the Cortex-A15 can address up to 10 TB of memory. That's not for smartphones. Clearly, ARM thinks the next battle is on the server side, and the market agrees."
- "ARM has two advantages in terms of power. First, they're huge in the mobile market. They do the best in terms of performance per watt. Intel has admitted their Atom processors don't approach ARM's."
- "Second, simplicity. ARM runs RISC. The chip is inherently simpler than Intel's CISC [complex instruction set computer], and can be made smaller and cheaper to draw less power."
- "[Hewlett-Packard Co./HPQ] and Dell could build chips with ARM processors if the time comes. Dell has already produced a massively low-power server based on an Intel chip. The company that has anything to fear from ARM is Intel. Their CEO has said they're not scared of ARM and that's a sign that they, in fact, have a problem. When you're name-dropping your smaller competitor, that's not a good

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IT Journalist & Former Systems Administrator

- sign. It could cause a headache for software manufacturers who would have to rewrite software for ARM. Intel, AMD, IBM [Corp./IBM] are the companies they'd compete with."
- "Set-top boxes are interesting because it's an embedded market. It's a small box without a noisy fan and doesn't draw so much power. That's an advantage in a sound-sensitive environment like a home theater. Even an Intel Atom chip requires a cooling fan and you don't want that. It's not clear how hot the Cortex-A15 will be. Previous ARM chips, though, can be passively cooled."
 - "The big problem ARM has with desktop computing and netbooks at the consumer level is that Microsoft [Corp./MSFT] Windows isn't available for ARM. Microsoft only supports XA6, so Intel and AMD are the only options. Ninety-eight percent of netbooks run Windows. Until Microsoft decides to support ARM processing, they'll struggle to break in there."
 - "I know Microsoft is in talks with ARM to license some of their designs. The Windows Mobile operating system runs on ARM already. We may well see a version of Windows that runs on ARM. Microsoft could make a full desktop version of Windows for ARM, which is unlikely. Or they could build an upscale version of Windows Mobile, which they already have running on ARM. The question is, do they think the market is big enough for that? We've already seen with Apple, on nonstandard form-factor devices, mobile OS can work. Consumers will be happy with that if that's what they've been led to expect."
 - "The big trend at the moment is toward multiple core processing. It's moving away from very powerful processors toward more smaller processors. That trend will continue in the next 12 to 18 months. Traditional server architecture can't provide that. But ARM and Atom are perfect for that. Microsoft, Amazon[.com Inc./AMZN], Google ... the demand will rise. Within 18 months, you'll see the major server manufacturers providing stuff based on ARM and Atom as standard, not a custom build."
 - "The cloud is not about massive computation. The power of the processor doesn't matter. What matters is having enough processors. That's where the lower-power, high-density stuff that ARM has works."
 - "ARM has a deal with TSM to exclusively license and co-develop the next generation of ARM chips. They're not developing themselves, but they're starting to move closer to becoming a traditional manufacturer."
 - "I see tablets growing at the expense of netbooks. A lot of people are already disappointed with what a netbook can do. The tablets are significantly easier to carry around. And ARM will be involved with that because the majority of new tablets are Android, which is based on ARM. Only the HP Slate is based on an Intel processor."
 - "It would take someone with big pockets to buy ARM outright. If a chip or server manufacturer bought ARM, all of a sudden ARM customers can't be sure that what they're licensing isn't last year's model. Right now, there's no advantage for ARM to hold everything back. We've seen that in the video game sector with companies that both license out video game code and then produce their own tweaked games that are better. It left a lot of people upset. That could happen if ARM became a manufacturer."

The company that has anything to fear from ARM is Intel. Their CEO has said they're not scared of ARM and that's a sign that they, in fact, have a problem. When you're name-dropping your smaller competitor, that's not a good sign.

IT Journalist & Former Systems Administrator

▶ **Microprocessor architect**

This source believes ARM continues to make gains, particularly against MIPS and PowerPC, thanks to its advances to the quick turnover cycles in its processors, which allow the company to invest more in its products while offering newer updates for its customers. Although ARM may pursue the enterprise server market based on its strong power vs. performance tradeoff, it faces technical hurdles in moving to multiple low-power processors, which favor Intel and AMD.

- "Clearly, ARM is pushing forward. MIPS and PowerPC don't have as much turnover, so can't afford to invest as much as ARM can. So ARM grows and [the competitors] shrink, dramatically so in MIPS' case, or at best stand still. PowerPC seems to have a firm hold on some networking controllers.
- "It is, of course, difficult to grow past 50% market share in some of these areas since designers like

- having at least two choices, but the slowing of the introduction of competitors parts has an effect over longer timescales.”
- “ARM, of course, is everywhere—inside disc controllers, Wi-Fi, Bluetooth as well as the more obvious Cortex-A8 application processors in mobile. But also smaller application processors—Nintendo DS2, practically every MP3 player.”
 - “Indeed, these smaller things are the traditional stronghold from where ARM is breaking out. The move to strong application processors is quite recent as is the Cortex line. The change from [ARM11](#), such as the one in my phone, even in its microprocessor core guise to Cortex-A8, A9 and A15 seems to have made ARM much more obvious, but their volume is at the low end still [ARM7TDMI, Cortex-M and Cortex-R].”
 - “Other significant established areas are smart cards ([TrustZone](#)) and some other aspects of security, some automotive control, some networking products and multimedia controllers. But in these markets MIPS or PowerPC can also be found in significant numbers. ARM isn’t the giant here.”
 - “The other factors are things like code portability; can people move the code easily to the ARM architecture? Compilers won’t help if there are lots of other dependencies on system facilities that aren’t in the ARM platform, like a Windows to Unix port. And running on a larger number of lower-powered processors versus running on a smaller number of higher-powered one—this is a problem area generally. There’s stuff like ray tracing and Web serving that parallelizes well, but a lot of other things that you might want to run on servers doesn’t parallelize so easily. I think these are both things that are inhibitors—help Intel/AMD, harm ARM.”
 - “The only thing pushing toward ARM is performance/power and possibly performance/price though less likely when comparing with AMD. So these problems in the eyes of the installers have to be smaller.”
 - “Even with the right business model it took ARM a long time to gain the momentum leading to its current success since about 2005. Of course, it also wouldn’t have become a success without having the right technical qualities. It was one of the smallest processors around, and that lead to it appearing in the world’s first systems on chip [SoC], which was part of coming up with the conditions for a successful business. And, clearly, ARM-powered SoCs have become immensely important even if the A4 chip in the iPhone and iPad seems to be better known than the identity of the Cortex-A8 inside it.”
 - “Technically, there’s nothing to prevent ARM from actively pursuing the server market. It’s a matter of business choices. I would think the issues are ones of code portability, the applicability of code to running on a large number of lower-powered processors rather than fewer higher-powered ones and the precise sensitivity to power/performance. There will clearly be a lot of pressure placed on power/performance, and the technical issues favor more low processors rather than fewer higher-powered ones in attaining the best power/performance, but other factors also matter.”

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Microprocessor Architect

Component Suppliers

▶ **Director of mobile devices for a handset component maker**

This source said the use of ARM technology in the iPad and other tablets is just a logical extension of the company’s dominance in wireless markets. Some of the best opportunities for ARM may come with advances in home automation.

- “Our own processors run on ARM Cortex architecture, so we may be biased, but many or even most of our wins are for devices that also incorporate ARM technology. This might simply be a question of the OEMs we are associated with; those who want or need to break out of the AMD or Intel world are probably more willing to work with a larger universe of suppliers.”
- “ARM technology is crucial to tablets because it allows vendors to turn this type of product into a truly mass-market product. The real goal here is not to beat Apple at its high-end game but to become the next Hewlett-Packard or Nokia or Dell. That means a cheaper tablet, and that’s what ARM allows.”

- “I believe you could manufacture a tablet computer for half the price using ARM technology. Intel is a noncompetitor here as far as I can tell.”
- “What is interesting is how ARM is being aligned in some vendors’ eyes with Android or [Google’s] [Chrome](#). Obviously, the architecture works fine under the Apple operating system and so on, but this may be how Google gets its code off phones and into a somewhat more traditional mobile computing environment.”
- “In theory, someone could make some incredibly high-performance desktops or servers using an ARM architecture. I’m not aware of anyone who’s doing this, or even how it would stack up to a comparable Intel or AMD product.”
- “ARM is already in a lot of nonstandard phone or mobile devices already. Their position in the 32-bit embedded space is pretty good already.”
- “Our apps processors are in all e-book readers. So every one of the e-books out there today—[Amazon’s] Kindle, [Barnes & Noble Inc.’s] Nook—have [our processor] with an ARM inside of it. Texas Instruments [Inc./TXN], with their ARM-based [OMAP](#), have been selling into the security surveillance business for years. It’s not sexy, but it certainly generates a lot of revenue.”
- “ARM is focusing on the very low-end entry-level products, their [Cortex-]M series of cores, to help further solidify their position in the embedded space, but they’re also going up with their Cortex-A8, A9, and the A15 they announced recently, where you’re now looking at single-core, dual-core, quad-core. I certainly expect them to be 8-core and 16-cores in the future.”
- “It’s only been a matter of time before [ARM and Intel] went head to head. ARM has been working at it coming from small die-size, low-power consumption. Intel’s been coming at it from the desktop, where you have cooling fans. They’re certainly starting to meet in the middle.”
- “In the past, the applications processors and the modem were all on a single chip. But now what you’re seeing [with tablets] is effectively a modem on one chip and an apps processor on another chip. So I don’t necessarily view tablets as being any different space [for ARM].”
- “Qualcomm, with their Snapdragon processors running at a gigahertz, is an ARM core. An apps processor like Snapdragon is run on its own processor chip. TI has been in the apps processor business for years with their OMAP processor. Having apps processors that are ARM-based has been in the industry for a longtime, but it’s just getting more visibility because of some of the high-profile devices [like the iPad]. It’s not new, it’s just higher visibility.”
- “ARM’s already in automobiles. We’re shipping [our ARM-based processors] into the [Ford Sync](#) today.”
- “As the home becomes more digital, everybody talks about ‘smart meters’ but there’s not a lot of talk about how that information gets conveyed to the end consumer. At some point there’s going to be a more intelligent hub in your house than just your thermostat that you punch up or down. There’s going to be a lot more data available to you and most of those devices, including prototypes based on [our processors] are all ARM-based.”
- “Does that mean that Intel or MIPS couldn’t compete in those areas? Certainly, they can. These are all fertile new grounds that are just starting to take off.”
- “When my group was hot and heavy in the cellular chipset business, we obviously used ARM. Our family of application processors are all ARM-based processors. Earlier this year we introduced a new family of processors for the industrial space that are ARM-based.”
- “Before Intel got into this space, there was always MIPS, so companies have always had a choice for their

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embedded solutions. Just over and over and over, everyone was licensing the ARM core. ARM has had a very good roadmap in terms of the processing capabilities they've offered, the die size and the current consumption. It's become the de facto standard."

- "I honestly don't see anyone switching over from ARM to MIPS. The question would become, why? If you already have your modem code proven on an ARM core, you're not going to switch cores. It's not the switching cost, it's the going out and requalifying and recertifying all of your modem software. ... There's just not a lot of reason for people to switch in this space."

▶ **Vice president of business development for a battery maker**

This source said customers concerned with battery life prefer to utilize ARM processors.

- "Our partners mention battery life as a concern. Most of those that do mention battery life are at least actively exploring an ARM processor in order to smooth power usage. I believe Dell has been one of the biggest exceptions."
- "Battery life is a hard limit. There is only so much we can do to enhance the amount of charge that a mobile device can carry, and the software developers constantly drive toward more charge-intensive applications."
- "Android devices and the smartbooks are more power-intensive than previous generations of handsets because they employ more continuous functions: streaming music, games, video. Power usage will only become more crucial as the technology grows more sophisticated."

ADDITIONAL SOURCES

Industry Publications

- ▶ A Sept. 9 article in *The Wall Street Journal* chronicled ARM's new A15 chip, listing its potential uses in cell phones, servers and data centers.
<http://blogs.wsj.com/digits/2010/09/09/arms-eagle-chip-will-spread-wings-in-a-while/>
- "When ARM Holdings executives announced a new chip called Eagle, they couldn't exactly say it has landed. But they weren't shy about suggesting that the fledgling design could help the British company eventually fly into some new markets."
 - "The company said the new chip, formally called the Cortex-A15, will offer a five-fold jump in computing power. Among other changes to drive higher performance, the chip is expected to operate at 2.5 gigahertz, compared with a 1-gigahertz peak for ARM chips now used in the most advanced smartphones."
 - "Remi El-Ouazzane—a vice president at Texas Instruments, which has long built chips based on ARM designs—called the performance boost 'massive.' Where today's technology pulls up a Web page on a phone in 4.3 seconds, he said, the new chip could achieve the same speed at two thirds of the power consumption, or be configured to pull up a page at twice the speed while still drawing less power, he said."
 - "But the more surprising disclosures were features in ARM's roadmap for the chip that have little to do with smartphones. Where dual-core Eagle models are expected to be used in handsets, ARM executives discussed models of the Eagle line with four or eight calculating engines, virtualization and other features that could allow the chips to be used in server systems as well as infrastructure gear for managing wireless networks."
 - "That thrust—which would help propel ARM into Intel's stronghold in corporate data centers—was underscored by the presence on a customer panel Wednesday of executives from Dell and Hewlett-Packard, two big Intel customers that are better known for their sales of servers than cellphones. They didn't say much about their plans, but Dell strategic processor technologist Mitch Markow said he was looking at the technology 'closely.'"
- ▶ A Sept. 19 article in *The New York Times* stated that ARM is preparing for wider demand.
http://www.nytimes.com/2010/09/20/technology/20arm.html?_r=2&ref=business
- "ARM, which designs the low-power chips that go into just about every cellphone sold today, commands a prime position when it comes to one of the next major technological revolutions."
 - "Some analysts say, Intel's familiar jingle ... will fade as the central soundtrack of computing. Instead,

people will hear nothing, or rather the understated silence that has accompanied ARM's rise as one of the most important technology companies."

- "ARM bases its business on licensing chip designs to companies like Apple, Samsung and Qualcomm, which often tweak them to suit their needs. In addition to cellphones, a host of other devices these days run on ARM chips, including TVs from Sony, the Kindle from Amazon and products as varied as hotel door locks, printers, slot machines and cars."
- "Last year, ARM's revenue came in at \$490 million, while Intel posted revenue of \$35 billion. Still, [ARM CEO Warren] East pointed out, the total value of chips sold by ARM's licensees just about matched those of Intel. 'We don't look like Intel,' he said. 'We're never going to be a \$100 billion outfit.'"
- "Yet ARM just unveiled new chip designs that could carry its products into servers and networking equipment—Intel's turf. And Intel, seeing a future dominated by the smaller, cheaper chips that are ARM's stock in trade, and has started a forceful move into smartphones, TVs and consumer electronics through new lines of low-power chips."
- "ARM executives agree that the future is with the billions of coming things—cars, refrigerators, TVs, clothes, buildings—that will have full-blown chips or at least Web-ready sensors inside them."
- "In many cases, they say, these things will need the lowest-power chips possible because they will be out in the world and away from a plug. Energy has replaced horsepower as the prime concern, and it is here, ARM executives said, that the company's skills will really shine."
- "The company offers choice to customers through various types of licenses. A customer can take ARM's basic design at face value or choose a license that allows it to create custom products. In a blow to its longtime partner Intel, Microsoft recently acquired one of the those custom licenses, signaling that it too may go so far as to build its own ARM chip for phones and other devices."

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The New York Times Article

Blogs

- ▶ A Sept. 9 entry on AppleInsider highlighted Intel losing ground to ARM with Apple's decision to use ARM processors over Intel chips in its new Apple TV, setting up a battleground between Apple TV and Intel-powered Google TV set-top boxes.
http://www.appleinsider.com/articles/10/09/09/rivals_and_partners_comment_on_apples_recent_moves.html
- "In an [interview](#) with the *Journal*, Intel CEO Paul Otellini criticized the recently announced Apple TV, saying Jobs took a 'step backward' with it. Intel is partnering with Google to launch a rival set top box platform, Google TV, which will begin shipping this month with units from Sony and Logitech."
- "Otellini promoted Google TV as having the 'full internet,' unlike Apple TV. He sees Apple TV as appealing to his mom because of its simplicity, while Google TV would appeal to his son."
- "When questioned about the growing popularity of the iPad, Otellini remarked that the industry would not 'let Apple run away with this one.'"
- "Although Intel provides chips for all of Apple's Macs, the company has steadily lost ground in non-PC markets. The Apple TV, which used to use an Intel processor, now [sports](#) the same custom-built [A4](#) ARM-based processor as the iPad, iPhone 4 and fourth-generation iPod touch."

NEXT STEPS

In our next report, Blueshift will further pursue the possibility of ARM expanding into the server market, its ability to challenge the x86 architecture and the timeline involved with potential implementation. We also will monitor whether Apple will continue to use ARM chips in next year's iPads and iPhones as well as the success of Apple TV.

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