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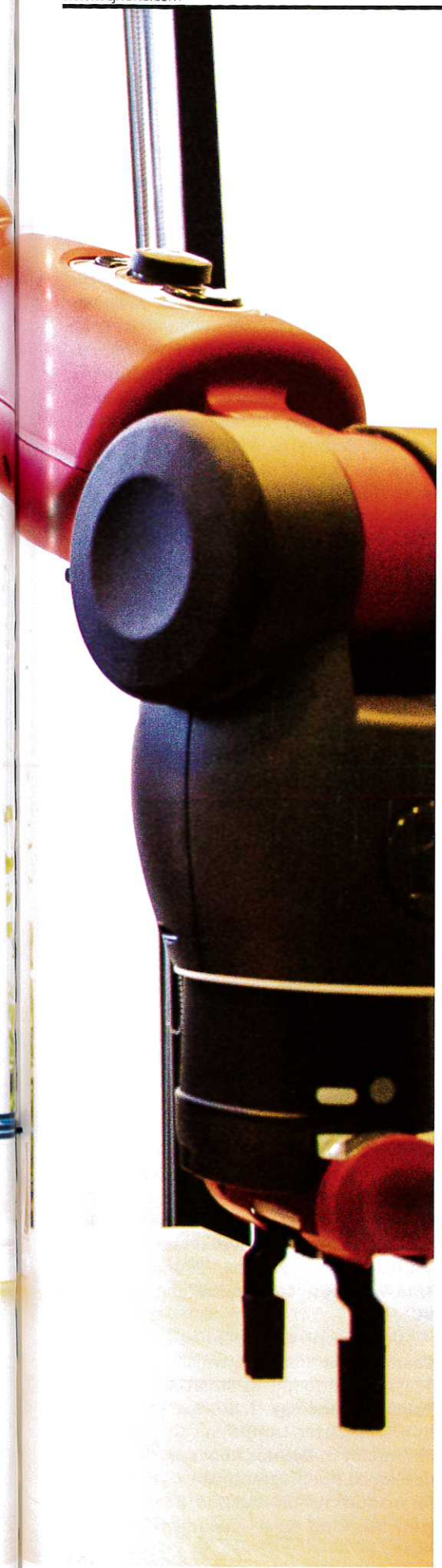

FALLING IN LOVE WITH HARDWARE

Hardware could be the next big thing in venture and VCs are scrambling to understand the new, lean business model

Mark Boslet
Senior Editor

Kickstarter. Google Glass. Nest. Baxter the learning robot. Hardware investing isn't what it used to be.

Gone is the network- and chip-centric mindset of a decade ago, and in its place are lean, services-oriented business models, rapid prototyping, high-speed mobile networking…and venture capitalists are quickly falling in love.

Fundings haven't yet reached a social-media-like frenzy. But connected hardware could be the next big thing in venture and this year investor interest has taken off. Suddenly hardware companies can raise money again.

Fueling the new interest is a confluence of technological transformations: mobile computing, crowdfunding, lower component pricing. The potential market is huge. **ABI Research** estimates 30 billion wirelessly connected devices will be in use in seven years, up from about 10 billion today. No one wants to miss the growth curve.

"This is a fundamental shift right now, and it is emerging as an interesting and larger investment category than people think," says **Rob Coneybeer**, managing director at **Shasta Ventures**. "It has gone from being an interesting niche to a category."

Yet tempering the excitement is an uncertainty about picking winners, particularly in the fickle space of consumer hardware. Few companies can replicate the **Steve Jobs** mantra that design is as much an art as a science. And business models are anything but settled.

Many investors refer to "software wrapped in plastic" to convey the idea that an inexpensive device can be sold at low margin and accompanied by software-based services to generate a lucrative revenue stream. But putting the plan into practice remains a work in progress.

Companies today can be placed in one of two broad categories: connected devices, where relatively simple electronics enable devices to wirelessly talk to one another and the cloud; and robotics, where more complicated hardware enables motion, interaction and task completion.

In the first bucket are wearable computers, smart watches, health and fitness monitoring products, such as those from Fitbit, and the so-called Internet of things,

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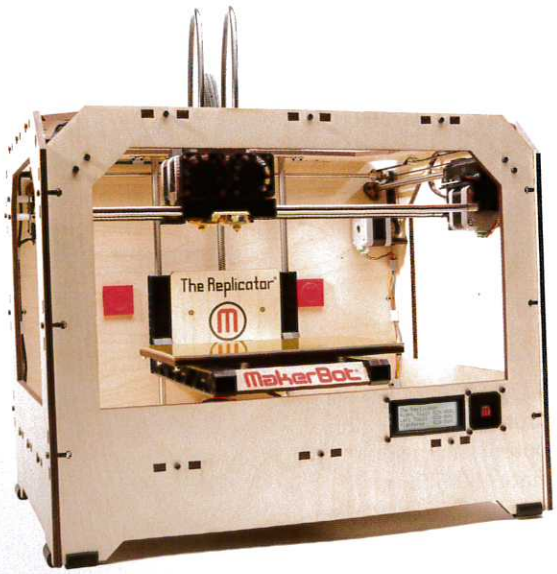
"VCs are still struggling to categorize what they are investing in, and many don't really understand the business economics, how the hardware and software are intermingled. ... It's complicated stuff that continues to change, and is very different from the last wave of hardware investing in storage and networking equipment."

Brad Feld
Managing Director
Foundry Group

which includes not just computers, but smart meters, the **Nest Labs** thermostat, lights, video cameras, security systems, cars, refrigerators and essentially anything that can incorporate an Internet radio.

In the second are robots, 3D printers and drones.

The technology convergence permitting all this is powerful. Wireless networks continue to get faster, more ubiquitous and mesh architectures link far-flung sensors and devices into intelligence-gathering swarms. The increasing spread of connected devices—**August Capital** is working on a connected door lock—adds to the network effect and makes data consolidation in the cloud increasingly compelling. Smartphones now in the pockets consumers act as mobile servers, controlling devices and processing data from an array of things.



Some investors believe the rewards could be significant. MakerBot, which makes the 3D printer shown here, was acquired for a deal valued up to $600 million in June, as VCJ went to press.

REUTERS/MAKERBOT INDUSTRIES/HANDOUT

On the company level, startups are pushing the bounds of capital efficiency with new tools for rapid, low-cost prototyping and easier access to flexible low-volume Asian supply chains. The costs of components, such as sensors, chips, wireless radios and screens have fallen sharply as rising smartphone and tablet production has driven down unit costs. Crowdfunding campaigns on **Kickstarter** and **Indiegogo** help locate early customers and enable products designs to be validated.

The excitement is easy to see. At **Bolt** more than 800 startups applied for the 10 to 15 spots in the hardware accelerator's first six-month class, says co-founder **Ben Einstein**.

Venture capitalists also have knocked on Bolt's door. Einstein says the Boston-based organization has met with from **Kleiner Perkins Caufield & Byers**, **Sequoia Capital**, **RRE Ventures** and **Union Square Ventures**. "A lot of [their outreach] is about trying to understand hardware," he says. "VCs are trying to cut through the crap and find their real interest in the space."

Entrepreneurial interest in production-stage projects also is on the rise. **Dragon Innovation**, which helps companies connect to Asian factories, now receives two to three inquires a day from potential customers compared with an average of two a week a year ago, says co-founder **Scott Miller**, who also is a co-founder of Bolt.

Some VCs believe the rewards could be significant.

"What I think is going to happen in this category is there will be a relatively small group of players that are huge winners," Coneybeer says. "It will unfold in ways that look remarkably similar to how social media has unfolded, where you have a few major winners, like **LinkedIn** and **Facebook** and **Twitter**, and hundreds of entrants."

Among the VCs active in the space are Shasta, Kleiner Perkins, **Foundry Group**, **True Ventures**, **Lux Capital** and **SoftTech VC**.

Another firm interested in hardware is **Charles River Ventures**, which in May led a $15 million round in smart watchmaker **Pebble Technology**, following the company's Kickstarter campaign. The firm also has money in **Rethink Robotics**, which has developed the programmable Baxter robot for manufacturing, and **Jibo**, a stealth company working on a consumer, or social, robot.

"We're going to look at as many things as we can and we will pick out one or two a year that are really special and we will invest," Partner **Bruce Sachs** says. "I don't think it's going to be as big as consumer Internet or social networking, but there clearly is a rising interest in the new wave of hardware investing."

And yet picking winners is no easy task.

"A lot of [their outreach] is about trying to understand hardware," he says. "VCs are trying to cut through the crap and find their real interest in the space."

Ben Einstein
Co-founder
Bolt

Money clearly will flow to gimmicky ideas as well as clever ones. Google Glass, with its in-your-face design, may be an example of the former. The Nest machine-learning thermostat is probably the latter. The compact shape of the **GoPro** camera also gives it the chance to find lasting success.

"VCs are still struggling to categorize what they are investing in, and many don't really understand the business economics, how the hardware and software are intermingled, what the supply chain issues are, or how to think about retail distribution," says **Brad Feld**, a managing director at the Foundry Group, an investor in 3D printer **MakerBot**. "It's complicated stuff that continues to change, and is very different from the last wave of hardware investing in storage and networking equipment."

Paying attention to venture basics will help. Target markets need to be big and products must address user problems, no matter how cool they look. **Kiva Systems** addressed a problem with its warehouse robots and **Amazon** bought it for $775 million. However, Kickstarter is rife with companies pushing product "features" rather

Changing the Game in Hardware

The proliferation of crowdfunding sites and hardware-focused accelerators have helped

Venture capitalists are excited by the huge potential for connected devices, consumer robotics and other new-generation hardware opportunities.

Fueling this new enthusiasm are profound changes in the way hardware companies are built. Capital-efficient approaches to company formation are leading to leaner business models and lower-risk experimentation.

Perhaps the most important change is the widespread use of crowdfunding sites, such as **Kickstarter** and **Indiegogo**.

"That's what in my opinion triggered this" wave of new entrepreneurial activity, says **Babak Kia**, an adjunct professor in the engineering department at **Boston University**. Companies can run campaigns on Kickstarter to validate product designs before raising several millions of dollars to enter production.

But changes in the engineering ecosystem are also significant. For instance, **iRobot** needed three years, millions of dollars and 20 people to get its vacuum-cleaning robot Roomba to a functioning prototype, says **Scott Miller**, co-founder of **Dragon Innovation** and a former employee of iRobot. Today it might take one year, five people and $500,000 to get a similar project to a functioning prototype.

That's in part because components costs have dropped dramatically as the rising sales of smartphones, tablets and other portable devices have pushed factories to increase component volumes and lower unit costs. An accelerometer that once cost $300 now sells for $1. Wireless radios, computing chips, batteries, cameras, screens, packaging and sensors have followed suit, even as they consume less power.

A decade long trend toward commoditization and away from custom boards, chassis and ASICs also has led to standardization and easier product layout. This has been aided by systems-on-a-chip designs that have simplified engineering.

Meanwhile, more rapid prototyping is possible with 3D mechanical printers and

An iRobot executive demonstrates its explosive ordinance detection "PackBot" device at its headquarters in Burlington, Mass. Changes in the engineering ecosystem and reduced costs are proving significant for the new generation of hardware. Today it might take one year, five people and $500,000 to get a functioning prototype up and running. REUTERS/BRIAN SNYDER

an array of online sites providing engineering building blocks, such as **Arduino**, **Raspberry Pi** and **GitHub**. Startups also can turn to the San Francisco-based development shop **TechShop** for access to prototyping machinery.

Startup accelerators also are taking root, including **Bolt**, **Lemnos Labs** and **HAXLR8R**.

Once prototyping is complete, access to a low-cost production run also has improved. "It has gotten a lot easier in the past five years for a startup to get connected to a cost efficient supply chain in Asia," says **Bruce Sachs**, a partner at **Charles River Ventures**. "If you just go back 10 years, the idea of getting a low-volume, high-quality supplier out of Asia wasn't realistic."

The result is that companies can now target price points on consumer gear that they couldn't think of five years ago.

A startup with three to five engineers and $200,000 can get a project underway now, says **Dmitry Grishin**, founder of **Grishin Robotics**, a $25 million fund with four robotics investments so far.

This has freed companies to put their effort where it counts. "People are starting to focus more and more on design," Grishin says. "I am starting to see more and more innovation."—*Mark Boslet*

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New Generation of Hardware Investments

Company	Founded	City	Funding Raised ($M)	Last Round Received	Investors
Jawbone (Aliph)	n/a	San Francisco	$195.80	3/9/12	Andreessen Horowitz, JPMorgan Chase & Co, Khosla Ventures, Kleiner Perkins Caufield & Byers, Mayfield Fund, Sequoia Capital
Liquid Robotics Inc.	2007	Sunnyvale, Calif.	$87.00	3/19/13	Riverwood Capital Group, Schlumberger, VantagePoint Capital Partners
Nest Labs Inc.	2010	Palo Alto, Calif.	$80.00	1/29/13	Google Ventures, Kleiner Perkins Caufield & Byers, Lightspeed Venture Partners, Shasta Ventures, Venrock
Restoration Robotics Inc.	n/a	Mountain View, Calif.	$73.29	8/3/11	Alloy Ventures, Clarus Ventures, InterWest Partners, Sutter Hill Ventures
Aethon Inc.	1997	Pittsburgh	$54.42	4/9/12	Ascension Health Ventures, Draper Triangle Ventures, Innovation Works, Medicis Capital, Nexus Medical Partners, Pacific Venture Group, Radius Ventures, Robert Bosch Venture Capital, Salix Ventures, Trident Capital
iWalk Inc.	2006	Bedford, Mass.	$50.31	9/13/12	General Catalyst Partners, Gilde Healthcare Partners, Sigma Partners, WFD Ventures LLC
Anki Inc.	2010	San Francisco	$50.00	6/10/13	Andreessen Horowitz, Index Ventures
Shapeways Inc.	2007	New York	$46.40	4/23/13	Andreessen Horowitz, Index Ventures, Lux Capital, Partnership for New York City Fund, Union Square Ventures
RedZone Robotics Inc.	1987	Pittsburgh	$36.97	2/23/12	ABS Capital Partners, Innovation Works, Smithfield Equity Associates
Leap Motion Inc.	2010	San Francisco	$32.75	12/31/12	Andreessen Horowitz, Founders Fund, Highland Capital Partners, SOSventures Investments
Fitbit Inc.	2008	San Francisco	$30.05	1/24/12	Felicis Ventures, Foundry Group, Softtech VC, True Ventures
iRobot Corp.	1990	Bedford, Mass.	$38.05	11/22/04	Fenway Partners, Gleacher & Company Securities Inc, iD Ventures America, Trident Capital
Kiva Systems Inc.	2003	North Reading, Mass.	$22.36	8/12/08	Bain Capital Ventures, Clearwater Capital Management, Meakem Becker Venture Capital
Tibion Corp.	2002	Sunnyvale, Calif.	$19.83	3/1/11	Claremont Creek Ventures, Saratoga Ventures, Tekla Capital Management, Three Arch Partners
Harvest Automation Inc.	n/a	Billerica, Mass.	$16.45	2/25/13	Cultivian Ventures, Founder Collective, Life Sciences Partners, Mass Ventures
Pebble Technology Corp.	n/a	Palo Alto, Calif.	$15.00	5/16/13	Charles River Ventures
OUYA Inc.	2012	Santa Monica, Calif.	$15.00	5/9/13	Kleiner Perkins Caufield & Byers, Mayfield Fund, Shasta Ventures
Thalmic Labs Inc.	n/a	Kitchener, Ontario	$14.03	6/5/13	First Round Capital, Formation 8 Partners, FundersClub, Intel Capital Corp, Spark Capital
E la Carte Inc.	2009	Palo Alto, Calif.	$13.90	6/24/13	SV Angel, Intel Capital, Romulus Capital, Lightbank
Sifteo Inc.	2009	San Francisco	$13.00	3/2/12	Foundry Group, True Ventures
Orbotix Inc.	2010	Boulder, Colo.	$11.59	5/6/13	Foundry Group, Highway 12 Ventures
MakerBot Industries LLC	2009	Brooklyn, N.Y.	$10.08	8/24/11	Foundry Group, True Ventures
VGo Communications Inc.	2007	Nashua, N.H.	$9.14	10/26/12	Castile Ventures
Romotive Inc.	n/a	Las Vegas, Nevada	$5.00	10/16/12	CrunchFund, Sequoia Capital, SV Angel
3D Robotics Inc.	2009	San Diego	$3.08	11/2/12	O'Reilly Alphatech Ventures LLC, True Ventures
Physical Graph Corp	2012	Minneapolis	$3.00	3/31/13	CrunchFund, First Round Capital, Lerer Ventures, SV Angel
CyPhy Works Inc.	2008	Danvers, Mass.	$2.95	7/11/11	General Catalyst Partners
ByteLight	2011	Cambridge, Mass.	$1.25	10/16/12	VantagePoint Capital Partners
CellScope Inc.	n/a	Menlo Park, Calif.	$1.10	6/11/12	Khosla Ventures
Seegrid Corp	2003	Pittsburgh	$0.10	5/10/12	Innovation Works
Lark Technologies Inc.	2010	Mountain View, Calif.	n/a	10/9/12	Undisclosed Investor
Woodman Labs Inc. (GoPro)	2002	Half Moon Bay, Calif.	n/a	3/10/11	Riverwood Capital Group, Sageview Capital, Steamboat Ventures, US Venture Partners, Walden International

than full-blown items, so discrimination is critical. On top of that "it's still very challenging to get from a functioning prototype to high volume," Miller says.

The question of business model also is key. One proponent of the software wrapped in plastic approach is Feld.

"Once you buy the hardware, you effectively have the same phenomenon that you have with an **Apple** product: there are regular software updates that enhance and extend the value of your hardware; there are continuous opportunities to purchase software or subscriptions directly from the company; and there are indirect opportunities to purchase software, content or subscriptions."

Foundry company **Orbotix** should have a 50% margin hardware business at scale and already has more than 20 apps, many of which are free, says Feld. **Sifteo**, another Foundry company, has a library of third-party games users can buy. Revenue is shared with the game publishers.

"Hardware is a tough business. We have a very high bar when companies have low margins."

Todd Chaffee
General Partner
Institutional Venture Partners

But Coneybeer is cautious when it comes to a software-focused game plan. "The plastic matters; the texture of the item matters," he says. "The balance and the physicality of it are incredibly important. I think a lot of people miss that…I think it is a mistake to advise a company to think of what they are doing as software wrapped in plastic."

Another investor with a careful approach to software-focused business models is **Todd Chaffee**, a general partner at **Institutional Venture Partners**.

"Hardware is a tough business," he says. "We have a very high bar when companies have low margins."

That's because low margin investments don't perform as well at IVP, he says. Still new-generation hardware is exciting, adds Chaffee, and, if the actions of a growing number of VCs are an indication, clearly worth a look.

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Ask The Experts: The New Hardware Cycle

A roundtable of VCs chat about trends they're seeing in hardware investing

VCJ reached out to top venture investors for their views on the new wave of hardware investing. Here's what our panel of experts had to say. Included are **Shasta Ventures** Managing Director **Rob Coneybeer**, **Foundry Group** Managing Director **Brad Feld**, **Charles River Ventures** Partner **Bruce Sachs** and **Canaan Partners** Venture Partner **Ross Fubini**.

VCJ: Where are we in the hardware investment cycle?

Rob Coneybeer: I think we're going through an initial wave of enthusiasm. It may or may not be sustainable. But this is a fundamental shift right now, and it is emerging as an interesting and larger investment category than people think. It has gone from being an interesting niche to a category.

VCJ: Investor interest in hardware has grown this year. How has the investment environment changed?

Brad Feld: The primary change in the investment environment is that VCs are now interested in investing in these types of companies. There is much more activity, at early stages and later stages.

VCs are still struggling to categorize what they are investing in, and many don't really understand the business economics, how the hardware and software are intermingled, what the supply chain issues are, or how to think about retail distribution. It's complicated stuff that continues to change, and is very different from the last wave of hardware investing in storage and networking equipment.

VCJ: What do you see as the venture opportunity?

Ross Fubini: Every single piece of hardware I look at, I now ask the question, what are you doing as a connected device? There is no product I look at without ask-

Brad Feld

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Rob Coneybeer

ing, what else can you do if you are connected real time?

VCJ: What kinds of outcomes should we expect in this sector?

Coneybeer: What I think will happen in this category is there will be a small group of players that are huge winners. It will unfold in ways that look remarkably similar to how social media has unfolded, where you have a few major winners, like **LinkedIn** and **Facebook** and **Twitter**, and hundreds of entrants.

VCJ: What is your current investment interest in new generation hardware?

Feld: We don't view these as "hardware companies." We are focused on software wrapped in plastic. We view these companies as part of our human computer interaction theme (see the Foundry Group Website for human computer interaction portfolio companies). We will continue to steadily invest in companies in this theme.

VCJ: Do you plan to ramp up your investment pace?

Bruce Sachs: We are making some investments that are really early in the emerging wave of robotics innovation. We're looking for things that have unique intellectual property, like social robots. It is a category that doesn't exist today.

I'm not saying we're going to do 100 investments in robotics. But we think it is an interesting area that has not been focused on by the rest of the venture community. However, venture capitalists in general need to be careful.

VCJ: How successful are robotics companies at turning their innovations into businesses?

Sachs: One of the things I've found is there are a lot of great technologists in the robotics space, but a lot fewer mature business people with experience in robotics. There is very little talent experienced with business models and how to take a robotics product to market. You have to find people from adjacent industries who you recruit to a robotics project.

VCJ: Components costs have come way down. How important is this to the resurgence of hardware investing today?

Coneybeer: The bill of materials in the typical hardware product now is incredibly attractive. It is incredibly cheap. You start to look at unit economics that look like what software looked like when it was distributed on CD-ROMs.

VCJ: Does hardware investing have the potential to become capital-intensive the way cleantech did?

Coneybeer: This is completely different than what happened with cleantech. You can build capital-efficient companies here. For a few million dollars you can build interesting prototypes and interesting initial production runs and prove something out. Then you raise money to scale production and drive down costs. And you spend money on marketing and user acquisition

Ross Fubini

Bruce Sachs

and to push the technology forward. It is a product category that is extremely well suited to venture capital.

VCJ: Do VCs need to be careful?

Sachs: Number one is that the projects need to be focused on large markets. There are plenty of interesting robotics products, but the question is how big are the markets they address?

I've spent time at **Carnegie Mellon**, **Stanford University** and **MIT**. I've seen a lot of stuff that's fascinating, with interesting technology. But most of it doesn't address large markets that make for interesting venture investments.

Number two is that there is a difference between getting it almost right and getting it right. Anything that touches consumers is very complex and risky. Not only does it have to function, but it has to have a great user interface.

VCJ: In regards to the Internet of things, what do you expect the market to ultimately look like?

Fubini: We are all asking ourselves when is **Tony Stark**'s home (from "Iron Man") going to be mine? New hardware products are going to be connected to create awe-inspiring moments when you use them.

The jury is still out on the right approach for enabling every device in your office, but it's going to happen. Your Web cam will automatically record up to the cloud. Your car is going to know your way to work. Your lights are going to know that you are just about to come home, and turn on just before you get there.