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The future of computing is at the edge

With so much data being produced, sending it all to cloud does not make economic sense



The overwhelming volume of data that will soon be generated by internet-connected cameras, autonomous cars and smartwatches upends the logic of data centralisation

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Richard Waters in San Francisco JUNE 6, 2018

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The economics of big data — and the machine learning algorithms that feed on it — have been a gift to the leading cloud computing companies. By drawing data-intensive tasks into their massive, centralised facilities, companies such as Amazon, Microsoft and Google have thrived by bringing down the unit costs of computing.

But artificial intelligence is also starting to feed a very different paradigm of computing. This is one that pushes more data-crunching out to the network "edge" — the name given to the many computing devices that intersect with the real world, from internetconnected cameras and smartwatches to autonomous cars. And it is fuelling a wave of new start-ups which, backers claim, represent the next significant architectural shift in computing.

While some complain that big technology platforms shut out competition in computing, Matt McIlwain, a start-up investor at Madrona Venture Group in Seattle, said that, in fact, "we're in one of the more open periods — especially around AI".

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Xnor.ai, an early-stage AI software start-up that raised \$12m this month, is typical of this new wave. Led by Ali Farhadi, an associate professor at University of Washington, the company develops machine learning algorithms that can be run on extremely lowcost gadgets. Its image recognition software, for instance, can operate on a Raspberry Pi, a tiny computer costing just \$5, designed to teach the basics of computer science.

Forecast growth of the internet of things

Number of applications in use by category (bn)



Source: Gartner © FT

That could make it more economical to analyse data on the spot rather than shipping it to the cloud. One possible use: a large number of cheap cameras around the home with the brains to recognise visitors, or tell the difference between a burglar and a cat.

The overwhelming volume of data that will soon be generated by billions of devices such as these upends the logic of data centralisation, according to Mr Farhadi. "We like to say that the cloud is a way to scale AI, but to me it's a roadblock to AI," he said. "There is no cloud that can digest this much data."

"The need for this is being driven by the mass of information being collected at the edge," added Peter Levine, a partner at Silicon Valley venture capital firm Andreessen Horowitz and investor in a number of "edge" start-ups. "The real expense is going to be shipping all that data back to the cloud to be processed when it doesn't need to be."

66

We like to say that the cloud is a way to scale AI, but to me it's a roadblock to AI. There is no cloud that can digest this much data

Ali Farhadi, Xnor.ai chief and co-founder

Other factors add to the attractions of processing data close to where it is collected. Latency — the lag that comes from sending information to a distant data centre and waiting for results to be returned — is debilitating for some applications, such as driverless cars that need to react instantly. And by processing data on the device, rather than sending it to the servers of a large cloud company, privacy is guaranteed.

Tobias Knaup, co-founder of Mesosphere, another US start-up, uses a recent computing truism to sum up the trend: "Data has gravity." In the new data-centric world of computing, there is a natural tendency for applications and resources to move to where the information is, he says, rather than the other way round.

This is not just pushing more machine learning to the endpoints that intersect with the real world, but to intermediate facilities that are best suited to aggregating information in a local area.

Mesosphere's technology, for instance, is used on cruise ships that can only connect to the internet through expensive satellite links, and it is working with carmakers in Germany to process information close to cell towers, where data from a number of vehicles nearby can be collected and processed without sending it back to a giant data centre.

Nor are the boundaries between cloud and edge distinct. Data collected locally is frequently needed to retrain machine learning algorithms to keep them relevant, a computing-intensive task best handled in the cloud. Companies such as Mesosphere - which raised \$125m this month, taking the total to more than \$250m - are betting that this will give rise to technologies that move information and applications to where they are best handled, from data centres out to the edge and vice versa.

Forecast spending on the internet of things



Source: Gartner © FT

The forces leading to more decentralisation in computing have not escaped the giant tech companies that control the main cloud computing platforms. Last week, Microsoft unveiled image-recognition software that was capable of running on a local device rather than its own data centres. This would be followed by other "cognitive services" that are currently only available in the cloud, the company said, such as speech recognition and sentiment analysis from language.

Satya Nadella, Microsoft chief executive, has been one of the main proponents of a mixed computing architecture for AI, supplementing the cloud with what he calls the "intelligent edge".

As giant rivals such as this try to move their own computing platforms to the edge, startups hoping to stand out have two hopes. One is that incumbents often find it hard to adapt to new approaches to computing, and the new ways of doing business they make possible.

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"It's always the case when you have these architectural shifts - it creates opportunities for a whole set of new companies," said Mr Levine, an investor in Mesosphere. By its nature, decentralisation also reduces the power of the incumbents, he added.

Mr McIlwain at Madrona, a backer of Xnor, also forecasts that the edge computing start-ups will benefit from a natural symbiosis with the tech giants. Companies such as Microsoft rely on other companies connecting applications

and devices to their computing platforms, he said: "They need more solution-oriented partners to bring data."

The hope for coexistence also rests on a belief that Microsoft, for one, is not the hyperaggressive competitor it was in the days when its Windows operating system ruled the computing world. But Mr McIlwain, while crediting Mr Nadella with bringing a "change in philosophy" to the company, said he is under no illusions about the ambitions of all the tech giants: "It's a very big market — there's no doubt they want to be the 'uber'

platforms."

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frederic_bastiat

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For anyone interested in a bit more depth on this topic I recommend this 30min presentation by Peter Levine https://a16z.com/2016/12/16/the-end-of-cloud-computing/

Report 🔻

McLeo92840

The pendulum swings again. There used to be mainframe that did most computing, now it is called cloud. Then we have the PC, in the future it will be called edge. Whatever the architecture, progress in computing has generated economic growth..

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Teller-Ulam device

The wheel of reincarnation is still with us.*

Myer and Sutherland authored a seminal paper on this phenomenon where processing is centralised and then distributed and then centralised again only to be distributed yet again.

(See http://cva.stanford.edu/classes/cs99s/papers/myer-sutherland-design-of-display-processors.pdf)

* Wheel of Reincarnation

[coined in a paper by T.H. Myer and I.E. Sutherland On the Design of Display Processors, Comm. ACM, Vol. 11, no. 6, June 1968)] Term used to refer to a well-known effect whereby function in a computing system family is migrated out to special-purpose peripheral hardware for speed, then the peripheral evolves toward more computing power as it does its job, then somebody notices that it is inefficient to support two asymmetrical processors in the architecture and folds the function back into the main CPU, at which point the cycle begins again.

Several iterations of this cycle have been observed in graphics-processor design, and at least one or two in communications and floating-point processors.

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MaxSense	Jun 7, 2018
One of the main reasons data is sucked into clouds (almost forcefully) is mode baked into chips many models can be run on a watch.	el building not modlel using. Onced
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Smashed Crab	Jun 6, 2018
Edge is the new IoT. That didn't last long.	
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Formerfrog	Jun 6, 2018
The centralized vs distributed conundrum is on again. This time it pits wareho	busing behomoths vs nimble,

powerful and sharply focused distibuted processing units. Hiding in the background is the cyber security and maintenance demons. Scale arguments ultimately will define the architecture and perhaps launch the days of mini clouds or pressure fronts. Data meteorology anyone?

4 Recommend | Reply

Jun 6, 2018

garyclarke27

I don't agree, in the 90's client server architecture, was all the rage

Mainframes were insanely expensive and alternative servers were too feeble for data processing, so the processing was shared with pc (edge) clients. Now though processing is moving back to the server, because they are now planty powerful apough and the advantages of controlication such as hotter security S control for botter

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iohnnvrotten73	Jun 7, 2018
That's where chips such as AzureSphere come into play. Ver including wrap around elements such as security are built of	ry clever strategy, edge-cloud respective benefits r being built into the architecture already.
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Harold Godwinson	Jun 6, 2018
"privacy is guaranteed".	
I don't buy that at all.	
I confess I am somewhat obsessive about online security but any rate of interface is pretty much irrelevant in security terms.	thing attached to the internet can be hacked. The
Report 🔻	4 Recommend Reply
Dubh	Jun 6, 2018
Couldn't it be that if data is stored on the device and proces to the internet? I'm no expert though.	sed on the device that you don't have to connect
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Harold Godwinson	Jun 6, 2018
@Dubh Unfortunately you will almost certainly connect thro stored and processed locally.	ough the internet regardless that some data is
Otherwise how would programmes or applications be updat	red?
Report 🔻	Recommend Reply
Dubh	Jun 6, 2018
You're probably right but if the device is doing something de least only happens rarely?	efined maybe that doesn't need to happen or at
I'm just hoping for some change that would allow us to prote	ect our privacy I guess.
Report 🔻	Recommend Reply
Twitchy meatbag	Jun 6, 2018
Good stuff but on a lighter note, the cloud is always going to wor	k best in the UK because of the weather here.
Report 🔻	5 Recommend Reply
Standalon	Jun 6, 2018
https://www.cambridge.org/core/books/stand-out-of-our-light	/3F8D7BA2C0FE3A7126A4D9B73A89415D
Former Google advertising strategist, now Oxford-trained philoso and to the tech industry to help ensure that the technology we al from pursuing our true goals in life. In this 'attention economy', w our new information environment on our lives in order to take ba persuasion is especially interesting way of looking at "tech giants	opher James Williams launches a plea to society Il carry with us every day does not distract us e need to recognise the fundamental impacts of ck control. The concept of AI enhanced industrial " - that are really advertising companies.

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Khudai Khidmatgar	Jun 7, 2018
@Standalon what a name for a philosopher	! Almost like being named Phyllis Sy and working in a similarly
ancient profession.	

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