How chips became the new nukes

Military capability, economic strength and even political independence increasingly depend on computing power. Charles Clover on the data arms race — and what countries outpaced in AI can do to hold their own

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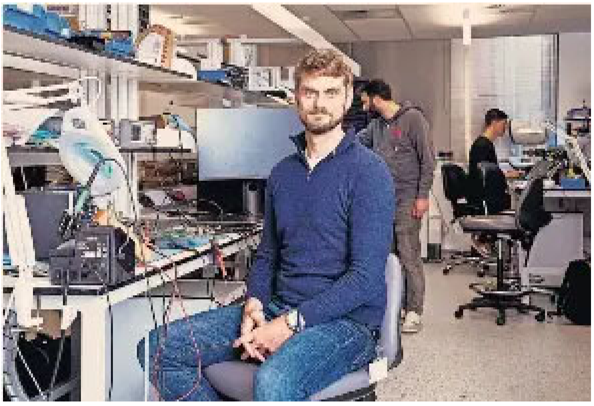
On one screen, a normal street scene plays out in downtown Sydney. On the other, cars and pedestrians have turned into ghosts. The background is dark and indistinct, with only spectral outlines of movement shown.



The second feed is the world viewed through a neuromorphic "event camera" demonstrated at the Neuroware Centre at University College London (UCL) in January. Neuromorphic computing is inspired more by biology than mathematics, designed to mimic how a human brain computes. It uses bursts of electrical activity modelled on neurons, acting only when input data changes rather than constantly processing full data streams, and consuming a fraction of the power and bandwidth. The human brain uses only 20 watts of electricity, the power of a dim lightbulb.

"You've compressed this cluttered scene that was megabytes of data to a few kilobytes, and you've extracted the things that are important," says Tony Kenyon, professor of nanoelectronic and nanophotonic materials at UCL and director of the Neuroware Centre.

Some versions of neuromorphic computing, known as wetware, even use biological brain cells integrated with silicon hardware. But here researchers are looking to augment conventional hardware rather than replace it. "The whole point is that neuromorphic tech is compatible with what we already use for microelectronics," says André van Schaik of the University of Manchester, which developed algorithms for the camera.

As AI fuels the creation of ever-larger data centres, are strange machines like these an answer to the physical limitations in bandwidth, memory and energy use we are running up against? One day, suggests Kenyon, neuromorphic chips could work in the same data centres as part of a "hybrid computing" approach.

From AI-assisted battlefield systems and autonomous drones to cyber security and intelligence analysis, advanced military power increasingly depends on access to computing. Governments are beginning to treat it as earlier generations treated oil and electricity grids: as infrastructure on which economic strength, military capability and political independence depend. Some even see computing power as a prerequisite for sovereignty itself, much as nuclear technology defined geopolitical power in the 20th century.

But for technological "middle powers" such as the UK, there is a problem.

The overwhelming majority of global AI computing power — experts reckon 90 per cent — is controlled by companies in the US and China, leaving others searching for ways to secure a foothold in what policymakers and executives now call the "compute stack" — the chips, networks, data centres and specialised hardware that underpin modern AI.

"Semiconductor chips are such an integral part of modern high-speed computing technology that they should be thought of as critical to a nation's future in the way that water or clean air are," says Kenyon.

Experimental technologies are playing a growing role in Britain's search for computing sovereignty. The Ministry of Defence (MoD) has trialled systems for tracking satellites and space junk that use the neuromorphic vision sensor from van Schaik's company Optera, and has discussed using the technology for drone tracking. The MoD also bought an experimental quantum computer from London-based ORCA computing in 2022 — probably the first quantum omputer bought by a defence ministry. The interest comes as a new generation of weaponry depends on AI. The latest fighter planes generate terabytes of sensor data every hour they fly, processed by classified models. Submarine hunting relies on analysis of acoustic data that used to be done by humans wearing headphones, but now the ocean can be listened to by algorithms looking for anomalies.

Digital battlefield brains such as the Maven Smart System, software designed by Palantir, already play a huge role in warfare, while computing will determine the effectiveness of autonomous weapons.

For some, Britain's dependence on foreign — mainly American — providers for AI and cloud services is dangerous. "Take an extreme example," says Nigel Toon, chief executive of Graphcore, a Bristol-based chip designer. "Let's say you were dependent on a large foreign hyperscaler for your compute. The way the security codes work, they could effectively brick the whole data centre wherever it was in the world."

Situated in the King's Cross area of London, the Neuroware Centre is surrounded by symbols of Britain's prowess in computing. Nearby is the Alan Turing Institute — named after the man who invented modern computing and, in the process, saved the free world. Around the corner in St Pancras Square is DeepMind, Google's AI research arm.

It is a reminder that Britain's secondtier status in AI was not inevitable. The UK produced many of the intellectual foundations of modern AI and remains home to some of the world's strongest academic research. But the UK has long struggled to convert that scientific talent into technology companies capable of competing with US and Chinese giants. The problem, executives and investors say, is not ideas but capital. No sooner does a promising British start-up mature beyond its early stages than it is absorbed by deeper-pocketed foreign investors or tech groups.

DeepMind is the clearest example. Founded in London in 2010, it was acquired by Google just four years later.

Although DeepMind has remained in Britain, where it has been central to the development and running of Google's Gemini AI models, ownership migrated overseas.

"[Google's acquisition of] DeepMind was a huge blow to British AI," says one expert who asked to remain anonymous. "Yes, they are still in London. But we missed a chance to make a great British company."

Researchers and executives argue, however, that the next technological shift could offer Britain a second chance.

"The UK, if one is honest, has probably lost the race in AI," says Sebastian Weidt, chief executive of Universal Quantum, a quantum computing start-up in Haywards Heath, south of London, and a professor at the nearby University of Sussex. "In quantum computing, there is a unique opportunity, once in a generation, that we can build a trillion-dollar company here in the UK."

Weidt began working on quantum computing 15 years ago. Back then, he says, the field still felt borderless and open, "like a commune". Researchers swapped ideas openly as they sought to make fragile quantum "qubits" — ionised atoms or single photons stable enough to perform calculations impossible for conventional computers.

Today, that world has vanished, as the technology has become enmeshed in the politics of technological sovereignty and national security.

In March, the UK government announced a £2bn quantum funding initiative aimed at building domestic capability. Around the world, states are pouring billions into national quantum programmes while tightening controls on talent, intellectual property and collaboration. Weidt's start-up is developing a €67mn quantum computer for the German space agency.

"There's world-leading stuff going on in this country in quantum," says Weidt. "Double down on that now and we do something great."

He adds: "AI, it's too late. They all talk about AI, they want to build more data centres and so on, which is fine. But the danger is the same thing happening in quantum. There's already consolidation happening, there are already quantum companies leaving the UK."

Last year, for example, Oxford Ionics, a leading UK quantum company, was bought by Maryland-based quantum hardware company IonQ for more than $1bn.

Quantum computing may not live up to expectations. But already there are proposals to use it in systems such as the UK-Italian-Japanese next-generation fighter, the Global Combat Air Programme, while scientists have shown that a quantum computer will eventually be able to break traditional encryption, rendering everything from cryptocurrency to national secrets vulnerable.

The shift to a quantum arms race is visible even in Weidt's own academic network. He still tries to stay in contact with former graduate students scattered across the global industry. But it has become harder to keep in touch with some of those who have returned to China. "In some cases, it seems like they have vanished," potentially working for sensitive state-backed programmes, where collaboration is no longer possible, he says.

China now spends roughly $17bn in government funding on quantum programmes, compared with $9bn each for the US and Japan, according to data assembled by Qureca, a quantum technology research organisation.

This quantum push is likely to be driven by fear of technological dependence, experts say, in the wake of a US ban on advanced chip exports that has fuelled a drive for self-sufficiency.

Toon reckons that 2022 legislation denying China access to powerful Graphics Processing Units (GPUs) may have forced it to adapt by learning to make AI models five to 10 times as efficient. "They're designing these models in such a way that they burn less compute."

The consequences of the US using chips as leverage are now felt globally. Today, in the wake of President Donald Trump's efforts to prise Greenland from Denmark earlier this year, US allies say they have every right to fear that their access to US chips could be threatened. "I wouldn't be surprised to see them use GPUs as leverage to some degree. And they could use that in any way they like," says Dave Grimm of AlbionVC, a UK venture firm.

During Trump's visit to the UK last September, he arrived with executives from Nvidia, Microsoft and other US technology giants. Supporters argued that the partnerships announced — more than $100bn in commitments — would cement Britain's place inside the global AI economy, but they also deepened unease that Britain risked becoming less a sovereign AI power than a downstream customer of American digital masters, giving Washington leverage it might eventually use.

While Jensen Huang, Nvidia's chief executive, insisted that buying his company's graphics processors would provide "sovereign AI", others are sceptical. "It is sovereign until a future American president decides that you can't have it," said James Regan, founder and chief executive of Oriole Networks, a British photonic networking start-up.

Instead, he says: "I am seeing a whole bunch of countries, between China and the US, who are very interested in gaining some degree of control over their own destiny."

In an April speech, UK technology secretary Liz Kendall announced a domestic AI hardware initiative to secure Britain's capability in chips and semiconductor technologies, adding that she would not accept "defeatism" from those claiming the AI race has been lost. In the same month the government launched a £500mn fund, known as Sovereign AI, to support homegrown AI start-ups. This month it also pushed pension funds to drastically raise investments in private markets — including technology venture capital.

"There is a long-term ambition to do as much as the government can do to anchor UK start-ups and UK technology in the UK for UK impact," says Michael Cuthbert, director of the National Quantum Computing Centre.

For countries that have missed the AI train, there is hope that some of the new technologies will provide leverage to get back into the game.

Before roughly 2014, Kenyon says, demand for computing power was doubling every 18 months — keeping pace with supply as governed by Moore's Law, which predicts that the number of transistors on a microchip will double every two years and has held for decades. But recently demand has been doubling at a much faster rate. "So even if Moore's Law was working, it still wouldn't keep up."

The question for the next generation of AI, Kenyon says, is: "How do you process these huge, massive models as they bloat ever further? You're going to need solutions for bandwidth — moving data around — and memory. They're starting to wake up to that."

Then there are the astronomical energy costs — roughly 156GW of electricity-generating capacity by 2030, according to an estimate last year by the consultancy McKinsey, about 1.5 times the installed capacity of Australia. "When you're having discussions where you're saying we need to build either a nuclear reactor or we need to develop fusion to power our data centres, you've got to question your underlying technology," Kenyon says.

For the near future, the GPU — the current workhorse of the AI data centre — will continue to dominate AI computing, experts say. "At the moment, your AI program is only as good as how many Nvidia GPUs you have. This is the position we are at now," argues Grimm.

However, he says, "the pendulum is beginning to swing away from that situation", adding that alternatives are already being explored.

US AI company Anthropic, for example, is reportedly in early-stage talks to purchase specialised highperformance AI chips from Fractile, a London-based AI chip start-up. Meanwhile Oriole, which uses photons of light to operate networks more efficiently, said it was working with AMD, the second-largest GPU maker worldwide, to build a system for the UK's Scaling Inference Lab, a test bed for AI hardware technologies.

"We're always going to have to buy bits of the AI stack from other nations," says Grimm. "But if we've got some leverage in that conversation, if we've got the best networking solution or the best memory capability, then they can't turn around and turn off the GPUs, if they need our memory or our DRam [dynamic random-access memory] or our networking solution to make their part work."

Sitting on a key piece of the "compute stack" is increasingly important for countries such as the UK. South Korea, for example, dominates key parts of the semiconductor ecosystem, especially advanced memory chips through conglomerates Samsung and SK Hynix. The country is not just a customer buying GPUs, but a vital supplier to the global AI infrastructure.

Taiwan is another country that sits on a node in the AI economy: TSMC, the semiconductor manufacturer that fabricates most of Nvidia's advanced GPUs. The Netherlands, meanwhile, has membership in the same club through ASML, whose extreme ultraviolet lithography machines are essential for producing the world's most advanced chips. ASML has also spawned a slew of industries around silicon.

"No one can replicate the entire AI ecosystem," says Boudewijn Wijnands, chief executive of Fortaegis, a Dutch digital security start-up. "No one can start on day zero and say: 'let's build TSMC'. What we can do is say 'here is the best of Europe, we need the best of America or the best of Korea'."

"Right now a new generation of choke points is being created," he says. "You can call them choke points. You could call it interdependence."

Increasingly, governments understand that having even one indispensable national champion can provide influence in the AI economy, which rewards countries that can protect and scale strategic industries long enough for them to become unavoidable parts of the global system.

The risk is that, without sufficient domestic capital and industrial policy, newer breakthrough start-ups are absorbed into larger overseas conglomerates before they become national champions.

"You're basically fighting against gravity," says Josh Burch, co-founder of Gallos Technologies, a London-based venture capital company. "If we're to nurture these sovereign capabilities, we need much more ready availability of sovereign capital."

Weidt says that new measures "are just in the nick of time". But in the meantime, Universal Quantum has established a small subsidiary in Germany. "If you are a British company, largely supported by international players like Germany or international investors, you can only play that game so long until someone buys you up or someone encourages you to relocate as part of a bigger deal."