BBC NEWS

HP outlines memory of the future

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The fundamental building blocks of all computing devices could be about to undergo a dramatic change that would allow faster, more efficient machines.

Researchers at computer firm Hewlett Packard (HP) have shown off working devices built using memristors - often described as electronics' missing link.

These tiny devices were proposed 40 years ago but only fabricated in 2008.

HP says it has now shown that they can be used to crunch data, meaning they could be used to build advanced chips.

That means they could begin to replace transistors - the tiny switches used to build today's chips.

And, crucially, the unique properties of memristors would allow future chips to both store and process data in the same device.

Today, these functions are done on separate devices, meaning data must be transferred between the two, slowing down the computation and wasting energy.

"The processor and memory could be exactly the same thing," Professor Stan Williams of HP told BBC News. "That allows us to think differently about how computation could be done."

Professor Leon Chua - the first person to propose memristors - said the work was "conceptually, just the tip of the iceberg".

He compared the devices to the human brain's synapses and axons.

"In the near future we can use memristors to make real brain-like computers, he told BBC News.

Researchers at the University of Michigan recently showed that the devices can mimic synaptic activity in the brain.

The HP work is published in the journal Nature.

Tower chips

Despite being proposed by Professor Chua in 1971, it too almost forty years for a working memristor to be built, by Professor Williams and his team.

The tiny devices are the "fourth" basic building block of circuits, after capacitors, resistors and inductors.

"I'm delighted because I never thought this would happen in my lifetime," said Professor Chua.

The devices get their name from their ability to "remember" the amount of charge that has flowed through them after the power has been switched off.

This means they are suited for building computer memory and storage; an application that Professor Williams believes could be on the market within three years.

"Our immediate goal is to make a competitor to flash memory for cameras, iPods and devices like that," said Professor Williams.

"Our aspiration is for it to have twice as much available memory as an equivalent sized flash memory device."

The team has also shown that the memristors can be stacked on top of each other to form 3-D arrays.

"In theory we can connect thousands of layers in a very straightforward fashion," said Professor Williams.

"It could provide a way of getting a ridiculous amount of memory on a chip."

Future path

Further into the future, Professor Williams said that he hoped that they could be used to build a single device for storage and computation.

"That would allow a huge speed saving and energy saving," he said.

However, he said, that kind of device was more than a decade away.

Memristors could also help with a problem that continues to challenge the chip industry, continuing to pack more and more computational power into smaller and smaller spaces.

Currently, chip makers follow a path defined by Moore's Law, which states that the number of transistors it is possible to squeeze in to a chip for a fixed cost doubles every two years.

This is currently achieved by producing transistors with ever smaller feature sizes. Current cutting edge chips have transistors with feature sizes as small as 22 nanometres (22 billionths of a metre).

But this miniaturisation cannot continue forever, experts say.

Memristors offer an alternative path.

"We can continue to make them smaller even past the point where people think that transistors cannot shrink any further," said Professor Williams.

Crucially, said Prof Williams, they can be built using "materials commonly available in any fab [chip fabrication plant]".

Professor James Tour of Rice University in Houston said the memristor's ability to be compatible with existing transistor based technologies was a "critical parameter to permit rapid implementation into present chip manufacturing processes".

Professor Williams said he had already made "crude" prototypes with features as small as 3nm.

"The functional equivalent of Moore's Law could go on for decades after we hit the wall where we can no longer shrink transistors," he said.