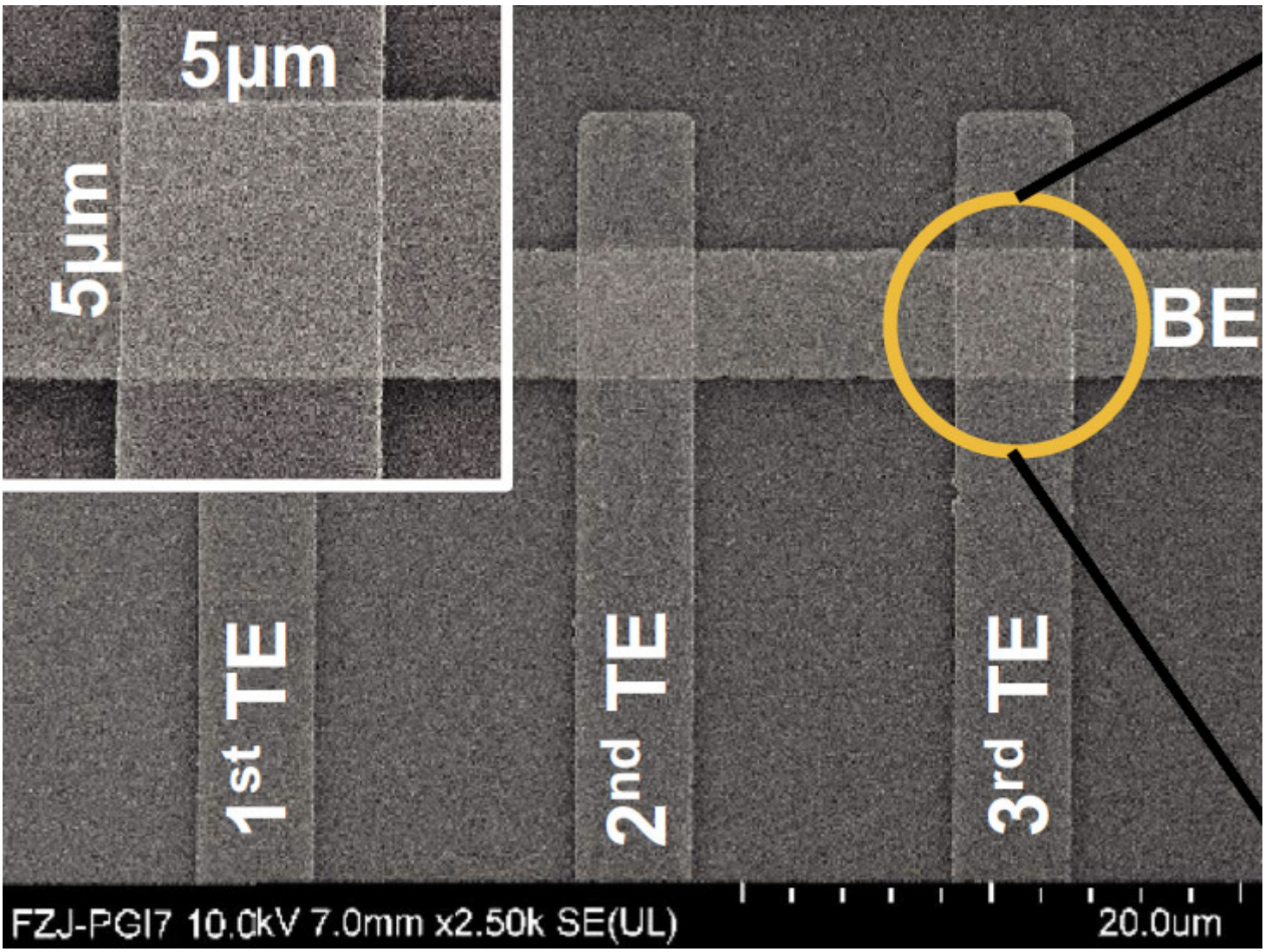
New ReRAM Technology is Turning Memory into a CPU

9 hours ago by krnel (/@krnel) 73 in technology (/trending/technology)

A revolution is on its way: turning memory power into computing power!

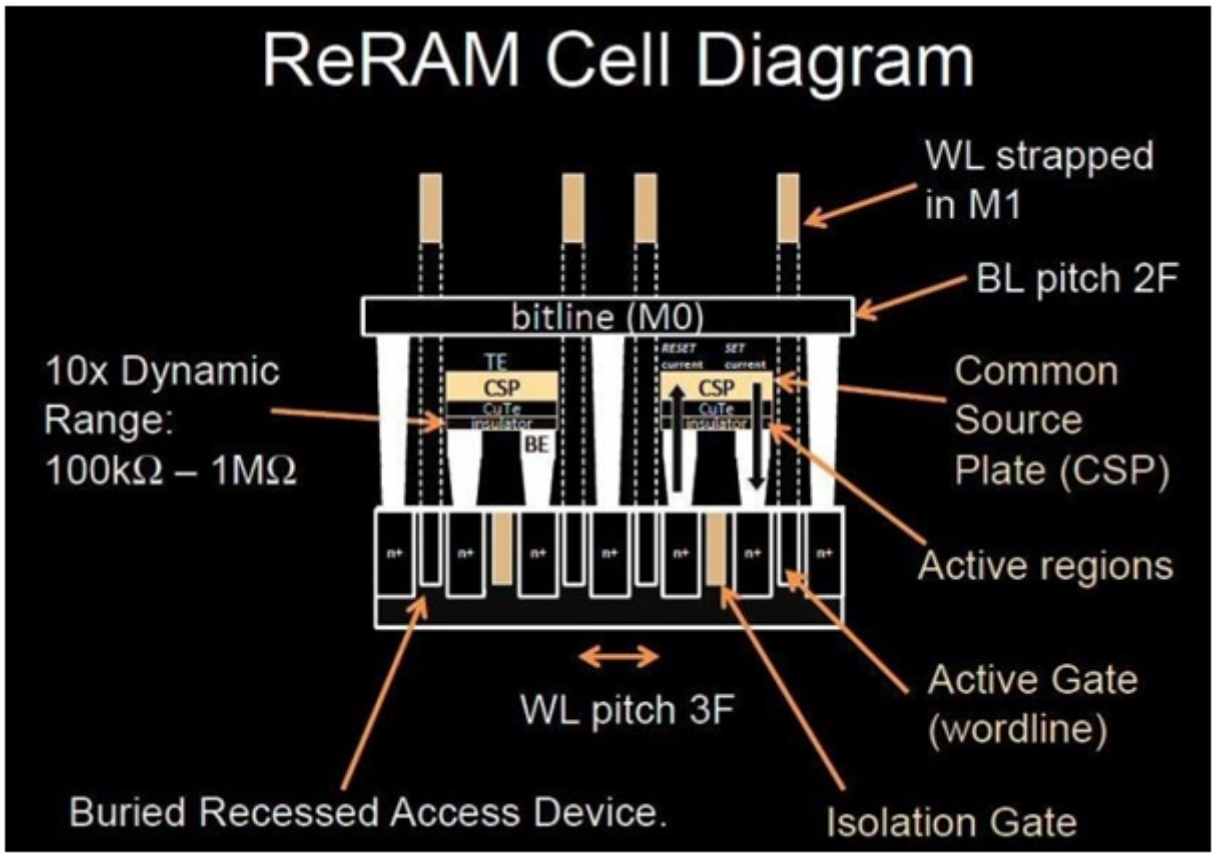
This is going to change the game for processing data. Normally computational tasks are done by the *processor* itself. This new technique can lead to *data being processed in the same location that is stored*. This means faster and thinner technology all around!



source (http://www.nature.com/articles/srep36652)

Scientific Reports published the new research (http://www.nature.com/articles/srep36652) on November 11 2016, detailing how the new new computing circuit was developed by Nanyang Technological University, Singapore, and another university and research center in Germany.

Redox-based resistive switching random access memory (ReRAM) is what this new memory is called. There currently developed by global chipmakers like SanDisk and Panasonic, and they will soon be available commercially.



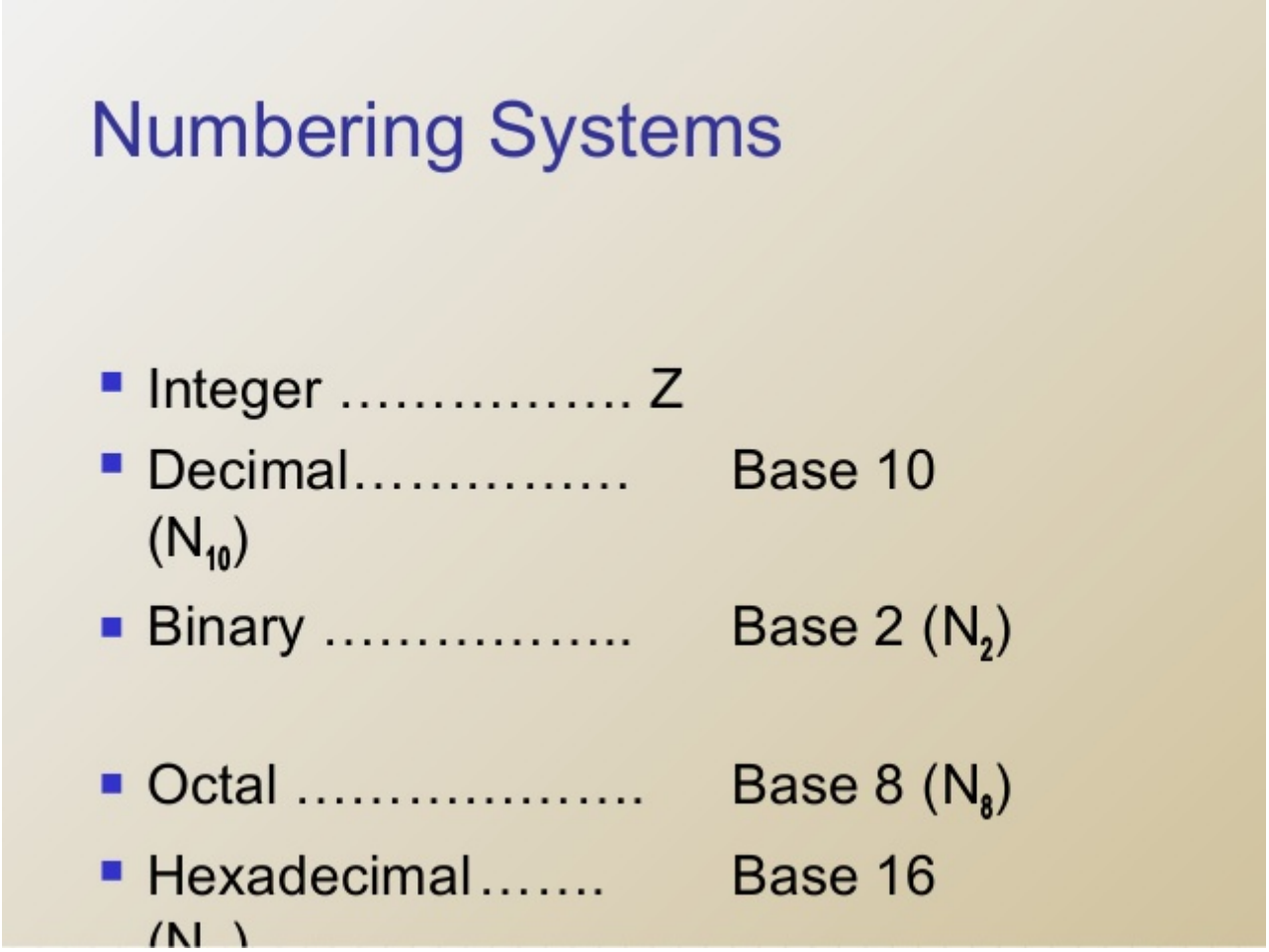
source (http://www.businesskorea.co.kr/english/news/ict/13818-chasing-intel-samsung-successfully-develops-3d-cross-point-memory)

The research reports the use of "seven-states Tantalum Oxide Devices, which enable the realization of an intrinsic modular arithmetic using a ternary number system."

Modular arithmetic (https://en.wikipedia.org/wiki/Modular_arithmetic) is the type of math used to represent a clock for instance, where numbers wraparound certain value, such as 12 or 24. 7 o'clock plus 8 hours later, gives you 15 out of 24, or 3 out of 12.

These multistate devices drastically reduce data storage consumption, and also allow for in memory operations, such as computations using high-radix number systems (https://en.wikipedia.org/wiki/Radix).

High radix just means number systems with a high base, or root. Two-state devices can't compute in the higher bases. Examples of higher number-based systems is the 10-based system, 0-9, is also the hexadecimal system. In the most basic or low radix is the binary system, 0-1.



source (http://www.slideshare.net/janakadias/number-system-part-1)

The advantage of using a high Radix number system that reduces the computational complexity by reducing the number of digits needed. For example, 213 decimal notation base-10 we are used to, is 11010101 in binary base-2. Going higher to a base-16 hexadecimal, turns 213 into D5. Notice the difference? From 8 digits, to 3, to 2? **This reduces the number of calculating operations and the number of logic devices required to do those calculations.**

Two state devices can only store is zero or one, the prototype ReRAM circuit built by the researchers can process for states instead of two. Instead of just a 0 and 1, there is also 2 and 3 that is possible. It's not up to a base-10 system, or even 8 or 6, but it's climbing!

As mentioned before, currently transfers have to go back and forth and convert data.

"This is like having a long conversation with someone through a tiny translator, which is a time-consuming and effort-intensive process," explains Assistant Professor Anupam Chattopadhyay.

The new NTU circuit saves time and energy by keeping the data in one place instead of it moving around back and forth through data transfers. It can boost the speed of current processors by two times or more.

Reducing the size, weight and power requirements means this opens up new design possibilities, such as wearable technology.

Couple this with "2D" materials like graphene which can conduct electricity, this could mean we have some extremely thin electronics in the near future.

source (http://electronics360.globalspec.com/article/4297/flexible-plastic-logic-

pursues-wearables-display-market)

The prospects for ReRAM in producing nanoscale level technology has drawn the interest of semiconductor companies to invest in this research. The research team is now looking to leverage more industries to adopt this forthcoming technology. Further development needs to be done to improve the computing speeds beyond four-states, as well as test the performance in realistic computing environments.

References:

- Scientists turn memory chips into processors to speed up computing tasks (https://techxplore.com/news/2017-01-scientists-memory-chips-processors-tasks.html)
- Multistate Memristive Tantalum Oxide Devices for Ternary Arithmetic (http://www.nature.com/articles/srep36652)

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