VOLUME 4, ISSUE 1

January 2012.

IEEE POTENTIALS

NITK-IEEE

ACTIVITIES THIS MONTH

- Introduction and workshops for newly joined Student members
- Annual fest of NITK-IEEE Be-Tech 2012.
- Participation in IEEE Presidents change the world 2012.
- IEEE Bangalore section level awards.

ABOUT NITK-IEEE:

Started in 1988, NITK IEEE has progressed exponentially and involved itself in various regional and global technical activities. After a major revival in 2005, we recuperated strongly which won us the Best Student Branch Award in 2007. Now one of the largest student branches worldwide, our aim is to get bigger and better.

http://nitkieee.org

Contact: sb.nitk@ieee.org

RESEARCH ON SUDOKU USING 700 MILLION CPU HOURS ON SUPER COMPUTER

An Irish mathematician has used a complex algorithm and millions of hours of supercomputing time to solve an important open problem in the mathematics of Sudoku, the game popularized in Japan that involves filling out a 9X9 grid of squares with the numbers 1-9 according to certain rules.

Gary McGuire of University College Dublin shows in a proof posted online on 1 January that the minimum number of clues – or starting digits – needed to complete a puzzle is 17 (see sample puzzle, pictured, from McGuire's paper), as puzzles with 16 clues or less do not have an unique solution. In comparison most newspaper puzzles have around 25 clues, with the difficulty of the puzzle decreasing as more clues are given.

The emerging consensus among mathematicians at a conference in Boston on 7 January was that McGuire's proof is likely valid and an important advance in the growing field of Sudoku maths.

The clues are numbers that are filled in to begin with and enthusiasts have long observed that while there are a small number of puzzles with 17 clues, no one has been able to come up with a valid 16 clue puzzle. That lead to the conjecture that 16-clue puzzles with unique solutions simply do not exist. A potential way to demonstrate that could be to check all possible completed grids for every 16-clue puzzle, but that would take too much computing time. So McGuire simplified the problem by designing a so-called "hitting set algorithm". Having spent 2 years testing the algorithm McGuire and his team used about 700 million CPU hours at the Irish High End Computing Center in Dublin searching with the hitting set algorithm. "The only realistic way to do it was the brute force approach," says Gordon Royle, a mathematician at the University of Western Australian in Perth

			8		1			
						4	3	
5								
				7		8		
						1		
	2			3				
6							7	5
		3	4					
			2			6		

Go ahead, give it a try.

But he says that ironically as he dedicated more of his time to the maths of the conundrum he spent less time enjoying the puzzle. "I still find it a nice way to relax now and then but to be honest I prefer doing the crossword," he says

New finding could help circuits keep shrinking

One-Atom-Tall Wires Could Extend Life of Moore's Law

There may be a bit more room at the bottom, after all.

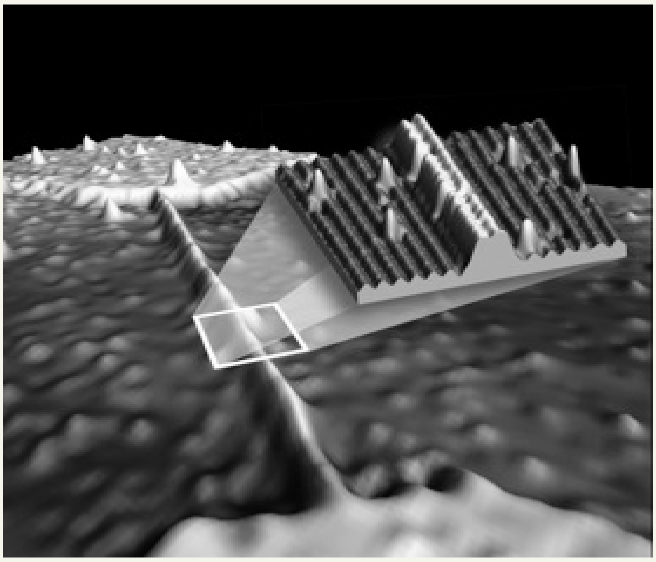
In 1959 physicist Richard Feynman issued a famed address at a meeting of the American Physical Society, a talk entitled "There's Plenty of Room at the Bottom." It was an invitation to push the boundaries of the miniature, a nanotech call to arms that many physicists heeded to great effect. But more than 50 years since his challenge (pdf), researchers have begun to run up against a few hurdles that could slow the progression toward ever-tinier devices. Someday soon those hurdles could threaten Moore's Law, which describes the semiconductor industry's steady, decades-long progression toward smaller, faster, cheaper circuits.

One issue is that as wires shrink to just nanometers in diameter, their resistivity tends to grow, curbing their usefulness as current carriers. Now a team of researchers has shown that it is possible to fabricate low-resistivity nanowires at the smallest scales imaginable by stringing together individual atoms in silicon.

The group, from the University of New South Wales (U.N.S.W.) and the University of Melbourne in Australia, and from Purdue University in Indiana, constructed their wires from chains of phosphorus atoms. The wires, described in the January 6 issue of *Science,* were as small as four atoms (about 1.5 nanometers) wide and a single atom tall. Each wire was prepared by lithographically writing lines onto a silicon sample with microscopy techniques and then depositing phosphorus along that line. By packing the phosphorus atoms close together and encasing the nanowires in silicon, the researchers were able to scale down without sacrificing conductivity, at least at low temperatures.

"What people typically find is that below about 10 nanometers the resistivity increases exponentially in these [silicon] wires," says Michelle Simmons, a U.N.S.W. physicist and a study co-author. But that appears not to be a problem with the new wires. "As we change the width of the wire, the resistivity remains the same," she says.

Phosphorus is often introduced into silicon because each phosphorus atom donates an electron to the silicon crystal, which promotes electrical conduction or even can serve as bits in quantum computation schemes. But those conduction electrons can easily be pulled away from duty, especially in tiny wires where the wire's exposed surface is large compared with its volume. By encasing the nanowires entirely in silicon, Simmons and her colleagues made the conduction electrons more immune to outside influence. "That moves the wires away from the surfaces and away from other interfaces," Simmons says. "That allows the electron to stay conducting and not get caught up in other interfaces."



WALKING A THIN LINE: Nanowires made from phosphorus atoms in silicon behave much like larger wires. Image: Courtesy of Bent Weber

Demonstrating electric transport in a wire so small "is quite an accomplishment," says Volker Schmidt, a researcher at the Max Planck Institute of Microstructure Physics in Halle, Germany. "And being able to fabricate metallic wires of such dimensions, by this theoretically microelectronics-compatible approach, could be a potentially interesting route for silicon-based electronics."

The wires, the researchers say, have the carrying capacity of copper, indicating that the technique might help microchips continue their steady shrinkage over time. The new finding might even extend the life of Moore's Law, Arizona State University in Tempe electrical engineer David Ferry wrote in a commentary in *Science* accompanying the research.