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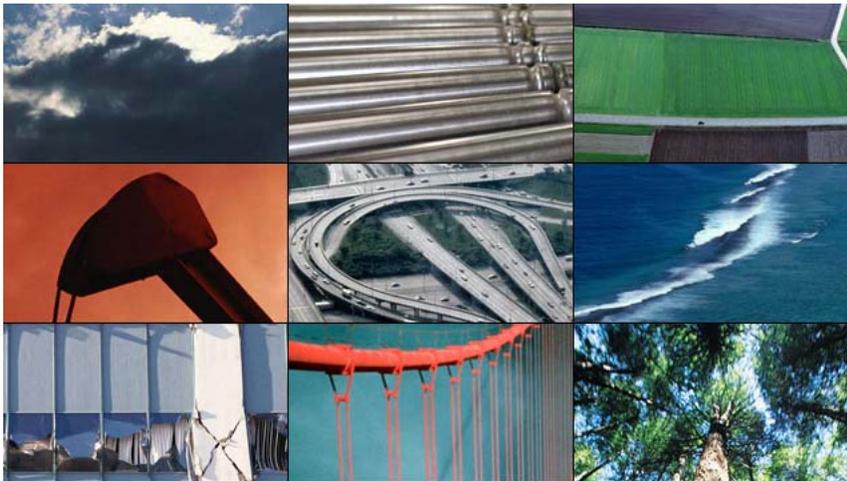
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# 'Smart dust' aims to monitor everything

By John D. Sutter, CNN  
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## Taking the Earth's pulse

What if we put tiny sensors on everything? That's the vision for "smart dust." We could learn about ourselves, our cities and the environment in a way that might help us live more efficiently. Click on each picture to learn more.

### STORY HIGHLIGHTS

'Smart dust' refers to tiny sensors that would monitor everything on Earth

The concept was dreamed up by an academic in the 1990s

But it is becoming increasingly real, as companies deploy wireless sensor networks

HP says it aims to put a trillion sensors all over the globe

**Palo Alto, California (CNN)** -- In the 1990s, a researcher named Kris Pister dreamed up a wild future in which people would sprinkle the Earth with countless tiny sensors, no larger than grains of rice.

These "smart dust" particles, as he called them, would monitor everything, acting like electronic nerve endings for the planet. Fitted with computing power, sensing equipment, wireless radios and long battery life, the smart dust would make observations and relay mountains of real-time data about people, cities and the natural environment.

Now, a version of Pister's smart dust fantasy is starting to become reality.

"It's exciting. It's been a long time coming," said Pister, a computing professor at the University of California, Berkeley.

"I coined the phrase 14 years ago. So smart dust has taken a while, but it's finally here."

Maybe not exactly how he envisioned it. But there has been progress.

The latest news comes from the computer and printing company Hewlett-Packard, which recently announced it's working on a project it calls the "Central Nervous System for the Earth." In coming years, the company plans to deploy a trillion sensors all over the planet.

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The wireless devices would check to see if ecosystems are healthy, detect earthquakes more rapidly, predict traffic patterns and monitor energy use. The idea is that accidents could be prevented and energy could be saved if people knew more about the world in real time, instead of when workers check on these issues only occasionally.

HP will take its first step toward this goal in about two years, said Pete Hartwell, a senior researcher at HP Labs in Palo Alto. The company has made plans with Royal Dutch Shell to install 1 million matchbook-size monitors to aid in oil exploration by measuring rock vibrations and movement, he said. Those sensors, which already have been developed, will cover a 6-square-mile area.

That will be the largest smart dust deployment to date, he said.

"We just think now, the technology has reached a point where it makes basic sense for us ... to get this out of the lab and into reality," Hartwell said.

#### Smart dust (minus the 'dust')

Despite the recent excitement, there's still much confusion in the computing industry about what exactly smart dust is.

For starters, the sensors being deployed and developed today are much larger and clunkier than flecks of dust. HP's sensors -- accelerometers like those in the iPhone and Droid phone, but about 1,000 times more powerful -- are about the size of matchbooks. When they're enclosed in a metal box for protection, they're about the size of a VHS tape.

So what makes a smart dust sensor different from a weather station or a traffic monitor?

Size is one factor. Smart dust sensors must be relatively small and portable. But technology hasn't advanced far enough to manufacture the sensors on the scale of millimeters for commercial use (although Berkeley researchers are [trying to make one](#) that's a cubic millimeter).

Wireless connections are a big distinguisher, too. A building's thermostat is most likely hard-wired. A smart dust sensor might gauge temperature, but it would be battery-powered and would communicate wirelessly with the internet and with other sensors.

The sheer number of sensors in the network is what truly makes a smart dust project different from other efforts to record data about the world, said [Deborah Estrin](#), a professor of computer science at the University of California, Los Angeles, who works in the field.

Smart dust researchers tend to talk in the millions, billions and trillions.

Some say reality has diverged so far from the smart dust concept that it's time to dump that term in favor of something less sexy. "Wireless sensor networks" or "meshes" are terms finding greater acceptance with some researchers.

Estrin said it's important to ditch the idea that smart dust sensors would be disposable.

Sensors have to be designed for specific purposes and spread out on the land intentionally -- not scattered in the wind, as smart dust was initially pitched, she said.

#### 'Real-world web'

Despite these differences, researchers say the smart-dust theory that monitoring everything will benefit humanity remains essentially



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unchanged.

And there are a number of real-world projects that, in one way or another, seek to use wireless sensors to take the Earth's vital signs.

Wireless sensors currently monitor farms, factories, data centers and bridges to promote efficiency and understanding of how these systems work, researchers said in interviews.

In all of these cases, the sensor networks are deployed for a specific purpose.

For example, a company called [Streetline](#) has installed 12,000 sensors on parking spots and highways in San Francisco. The sensors don't know everything that's going on at those parking spots. They are equipped with magnetometers to sense whether or not a huge metal object -- hopefully a car -- is sitting on the spot.

That data will soon be available to people who can use it to figure out where to park, said Tod Dykstra, Streetline's CEO.

It also tells the cities if the meters have expired.

Other sensors are equipped to measure vibration in factories and oil refineries to spot machine problems and inefficiencies before they cause trouble. Still others might pick up data about temperature, chemistry or sound. Tiny cameras or radars also can be tacked onto the data-collecting network to detect the presence of people or vehicles.

The power of these networks is that they eventually can be connected, said [David Culler](#), a computer science professor at UC Berkeley.

Culler says the development of these wireless sensor networks is analogous to the creation of the World Wide Web. What's being created with the smart dust idea is a "Real World Web," he said.

But he said we're still early on in that progression.

"Netscape [for the wireless sensor network] hasn't quite happened," he said.

### **Big Brother effect**

Even when deployed for science or the public, some people still get a Big Brother feeling -- the uncomfortable sense of being under constant, secret surveillance -- from the idea of putting trillions of monitors all over the world.

"It's a very, very, very huge potential privacy invasion because we're talking about very, very small sensors that can be undetectable, effectively," said [Lee Tien](#), an attorney at the Electronic Frontier Foundation, a privacy advocate.

"They are there in such numbers that you really can't do anything about them in terms of easy countermeasures."

That doesn't mean that researchers should stop working on smart dust. But they should be mindful of privacy as the work progresses, he said.

Pister said the wireless frequencies that smart dust sensors use to communicate -- which work kind of like Wi-Fi -- have security built into them. So the data is public only if the person or company that installed the sensor wants it to be, he said.

"Clearly, there are security concerns and [privacy](#) concerns," he said, "and the good news is that when the radio technology was being developed for this stuff, it was shortly after all of the big concerns about Wi-Fi security. ... We've got all the security tools we need

underneath to make this information private."

Further privacy concerns may arise if another vision for smart dust comes true. Some researchers are looking into making mobile phones into sensors.

In this scenario, the billions of people roaming the Earth with cell phones become the "smart dust."

**Bright future**

Smart dust researchers say their theory of monitoring the world -- however it's realized -- will benefit people and the environment.

More information is better information, Pister said.

"Having more sensors improves the efficiency of a system and reduces the demand and reduces waste," he said. "So all of that is just straight goodness."

Hartwell, the HP researcher, says the only way people can combat huge problems like climate change and biodiversity loss is to have more information about what's going on.

"Frankly, I think we have to do it, from a sustainability and environmental standpoint," he said.

Even though the first application of HP's "Central Nervous System for the Earth" project will be commercial, Hartwell says the motives behind smart dust are altruistic.

"People ask me what my job is, and I say, well, I'm going to save the world," he said.

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**Thedes**

Thedes

"Hartwell says the motives behind smart dust are altruistic."  
I'm sure Hartwell means it but as the old saying goes "The road to hell is paved with good intentions." Trust me, eventually someone will use this for evil purposes. It's the dark side of human nature.

1 day ago | [Like \(1\)](#) | [Report abuse](#)



**twinslow**

twinslow

Smart dust is dumb dust, sorry. They can't even stop the DHS computers from being hacked, so what about this stuff?

2 days ago | [Like \(4\)](#) | [Report abuse](#)



**NY156**

NY156

This will be awesome! Send me the smart dust. I can't wait to see what everyone is doing. Those who don't understand the technology will be the ones who end up getting taken advantage of (99% of the people who read this).

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**QBit**

QBit

Wonderful. More litter. Just exactly what we need. Keep those brilliant ideas coming in HP!

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**azagthoth15**

azagthoth15

wow, soon we'll have a thought police.

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**johnhoffmann**

johnhoffmann

If anyone here thinks this aims to help humanity.  
Then we really lost the battle...

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**2cence**

2cence

I've thought they should be peppering our southern border with these kind of sensors... detecting illegal crossings (no not jackrabbits). Have a crop duster flying the border and carpeting it with them. Easier border maintenance, maybe fewer deaths, too.

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**2cence**

2cence

But, yes, the potential for abuse is astounding. And Mr. Pister needs some kind of attitude adjustment... we don't necessarily want to do everything we -can- do. Some kind of environmental pollution too, huh?

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**DontBASucker**

DontBASucker

Just another example of Control Freaks and their un-ending appetite for Power9/11...We gotta have the "Patriot Act" ..(what a joke THAT title is)X-mas Day Panty Bomber..."Oh..We just happen to have these new fancy x-ray machines that would have seen the bomb...wanna buy some ?"Times Square Propane Pu ...more

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**timmaytimtim**

timmaytimtim

oohh kitchendevil thinks the technology is bad. Calm down, robots aren't gonna take over the world. No one's trying to force a totalitarian or socialistic or whatever junk people like to come up with to manipulate their worlds. There always has to be a reason for everything, someone's trying to do th ...more

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**Kitchendevil**

Kitchendevil

step 1, give the planet its own nerve system  
step 2, connect it all with computers  
step 3, let the thing run for a little while  
step 4, get ready, because earth's new brain is going to realize it's better off without us.

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**jfunny**

jfunny

sweet! i want front row tickets!

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**naball**

naball

Isn't that what we have satellites for, to monitor the environment and weather patterns (among many other reasons)? The only benefit that I saw was that hey it will help me find an empty parking space! If smart dust was only used as weather and traffic monitoring with no cameras/audio I might suppor ...more

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**Jaybird78**

Jaybird78

Scientists and engineers invent things to save people and the planet, governments and corporations will take this and use it for anything but this. Now as in the future, who ever controls the information controls mankind, just wait and watch, the developed world will use the information to control t ...more

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**invisifly2**

invisifly2

just make them so that they cant monater any kind of visual or audio information unless they have some sort of sign saying so in a clearly visable location and with the local people's approval

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**BetoMaton**

BetoMaton

HP SHOULD BE WORKING ON HOW TO MAKE THEIR INK CARTRIDGES LAST LONGER.. : p

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**thankyou2**

thankyou2

WHERE WILL WE AND OUR CHILDREN BATH AND SLEEP. WHERE WILL PARENTS JUMP UP AND DOWN?

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**thankyou2**

thankyou2

OOOH WHAT ASHAME.

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**HandsomeMan**

HandsomeMan

"They are there in such numbers that you really can't do anything about them in terms of easy countermeasures." Sure you can... If you see one, just smash a large rock on it. That's an effective countermeasure.

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**2cence**

2cence

I suggest you just use your lawnmower... it will Hoover the things up along with your grass clippings, once they get down to dust size that is. Mowing vcr tapes would be a little noisier... and take a lot more bags.

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**HandsomeMan**

HandsomeMan

Rhapsodist: If you'd bothered to read the article, you'd see that the so-called smart "dust" is actually the size of VHS tapes - it's not dust at all!

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**rhapsodist**

rhapsodist

Except that the surrounding dust will be kicked up by the force of your rock-smash, and will settle down again where you destroyed it. In any case it's the size of dust. Good luck noticing all of them.

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**akka69**

akka69

The more such technology goes, the more I feel we're turning ourselves into cattle...

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**kematian**

kematian

\$5 tinfoil hats here! \$5 tinfoil hats! Buy two get third free! (i'm gonna make a killing here!!)

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**HillBilly**

HillBilly

Never trust someone who says they want to save the world

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