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For \$150, Third-World Laptop Stirs a Big Debate

By JOHN MARKOFF

CAMBRIDGE, Mass. — When computer industry executives heard about a plan to build a \$100 laptop for the developing world's children, they generally ridiculed the idea. How could you build such a computer, they asked, when screens alone cost about \$100?

Mary Lou Jepsen, the chief technologist for the project, likes to refer to the insight that transformed the machine from utopian dream to working prototype as "a really wacky idea."

Ms. Jepsen, a former Intel chip designer, found a way to modify conventional laptop displays, cutting the screen's manufacturing cost to \$40 while reducing its power consumption by more than 80 percent. As a bonus, the display is clearly visible in sunlight.

That advance and others have allowed the nonprofit project, One Laptop Per Child, to win over many skeptics over the last two and a half years. Five countries — Argentina, Brazil, Libya, Nigeria and Thailand — have made tentative commitments to put the computers into the hands of millions of students, with production in Taiwan expected to begin by mid-2007.

The laptop does not come with a



Microsoft Windows operating system or even a hard drive, and the screen is small. And the cost is now closer to \$150 than \$100. But the price tag, even compared with low-end \$500 laptops now widely available, transforms the economic equation for developing countries.

That has not prevented the effort, conceived by Nicholas Negroponte, a prominent computer researcher, from becoming the focal point of a debate over the value of computers to both learning and economic development.

The detractors include two computer industry giants, Intel and Microsoft, pushing alternative approaches. Intel has developed a \$400 laptop aimed at schools as well as an education program that focuses on teachers instead of students. And Bill Gates, Microsoft's chairman and a leading philanthropist for the third world, has questioned whether the concept is "just taking what we do in the rich world" and assuming that

that is something good for the developing world, too.

Mr. Negroponte, the founding director of the M.I.T. Media Laboratory, said he was amused by the attention his little machine was getting. It is not the first time he has been challenged for proclaiming technology's promise.

"It's as if people spent all of their attention focusing on Columbus's boat and not on where he was going," he said in an interview here. "You have to remember that what this is about is education."

Seymour Papert, a computer scientist and educator who is an adviser to the project, has argued that if young people are given computers and allowed to explore, they will "learn how to learn." That, Mr. Pa-

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\$150 Laptop Computer For the Third World Stirs a Big Debate

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pert argues, is a more valuable skill than traditional teaching strategies that focus on memorization and testing.

The idea is also that children can take on much of the responsibility for maintaining the systems, rather than relying on or creating bureaucracies to do so.

"We believe you have to leverage the kids themselves," Ms. Jepsen said. "They're learning machines." As an example, she pointed to the backlight used by the laptop. Although it is designed to last five years, if it fails it can be replaced as simply as batteries are replaced in a flashlight. It is something a child can do, she said.

That philosophy, at the heart of the project's world view, has stirred criticism for its focus on getting equip-

Some critics ask if the computers are the best use of educational resources.

ment to students rather than issues like teacher training and curriculum.

"I think it's wonderful that the machines can be put in the hands of children and parents, and it will have an impact on their lives if they have access to electricity," Larry Cuban, a Stanford University education professor, said in an interview. "However, if part of their rationale is that it will revolutionize education in various countries, I don't think it will happen, and they are naïve and innocent about the reality of formal schooling."

The debate is certain to enter a new phase when the machines go into full-scale production by Taiwan-based Quanta Computer, the world's second-largest laptop maker. (The manufacturer, unlike the project itself, will make a profit.) Overnight, even though it will not be available to

consumers, the laptop could become the best-selling portable computer in the world.

The project now has tentative commitments for three million computers and will begin large-scale manufacturing when it reaches five million with separate commitments from at least one country each in Africa, Latin America and Asia. Based on current negotiations, Mr. Negroponte says he expects that goal to be reached by mid-2007.

It got a significant boost on Nov. 15 when the Inter-American Development Bank signed an agreement to supply both loans and grants to buy the machines.

"Several years ago, I thought it was an illusion or a utopian idea," said Juan José Daboub, managing director of the World Bank and an independent economic-development expert. "But this is now real and encouraging."

Mr. Negroponte said the manufacturing cost was now below \$150 and that it would fall below \$100 by the end of 2008.

One factor setting the project apart from earlier efforts to create inexpensive computers for education is the inclusion of a wireless network capability in each machine.

The project leaders say they will employ a variety of methods for connecting to the Internet, depending on local conditions. In some countries, like Libya, satellite downlinks will be used. In others, like Nigeria, the existing cellular data network will provide connections, and in some places specially designed long-range Wi-Fi antennas will extend the wireless Internet to rural areas.

When students take their computers home after school, each machine will stay connected wirelessly to its neighbors in a self-assembling "mesh" at ranges up to a third of a mile. In the process each computer can potentially become an Internet repeater, allowing the Internet to flow out into communities that have not previously had access to it.

"The soldiers inside this Trojan horse are children with laptops," said Walter Bender, a computer researcher who served as director of the Media Laboratory after Mr. Neg-



One Laptop Per Child

Michael Bleetsas, the chief connectivity officer for One Laptop Per Child, plays with some potential computer users in Nigeria.

roponete and now heads software development for the laptop project.

Each machine will come with a simple mechanism for recharging itself when a standard power outlet is not available. The designers experimented with a crank, but eventually discarded that idea because it seemed too fragile. Now they have settled on several alternatives, including a foot pedal as well as a hand-pulled device that works like a salad spinner.

Ms. Jepsen's display, which removes most of the color filters but can operate in either color or monochrome modes, has made it possible to build a computer that consumes just 2 watts of power, compared with the 25 to 45 watts consumed by a conventional laptop. The ultra-low-power operation is possible because of the lack of a hard drive (the laptop uses solid-state memory, which has no moving parts and has fallen sharply in cost) and because the Advanced Micro Devices microprocessor shuts down whenever the computer is not processing information.

The designers have also gambled in designing the laptop's software, which is based on the freely available Linux operating system, a rival to Microsoft's Windows. Dispensing with a traditional desktop display, the software substitutes an iconic interface intended to give students a simpler view of their programs and documents and a maplike view of other connected users nearby.

A video-camera lens sits just to the right of the display, for use in video-conferencing and taking digital still photos of reasonable quality. The computer comes with a stripped-down Web browser, a simple word processor and a number of learning programs. For e-mail, the designers intend to use Google's Web-based Gmail service.

Only one program at a time can be viewed on the laptop because of its small 7.5-inch display.

Mr. Negroponete has been a globe-trotting salesman for the project,

Out of the Box

A new laptop designed by the One Laptop Per Child project contains a number of innovations that help keep its cost low — below \$150 — and make it practical for children in developing countries.

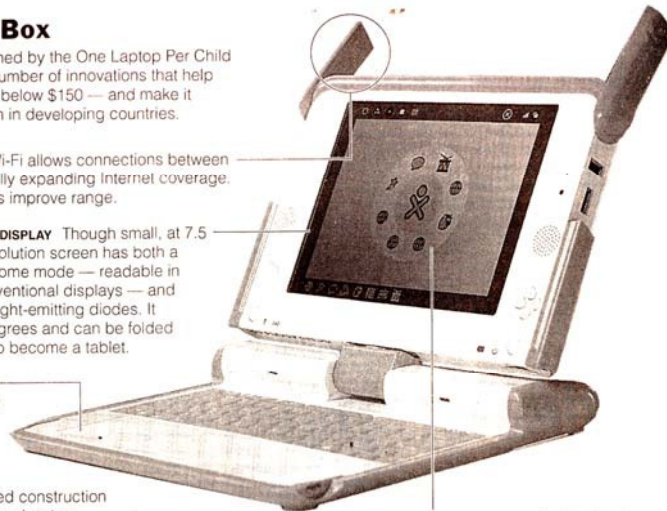
WI-FI NETWORKING Wi-Fi allows connections between computers, potentially expanding Internet coverage. Two flip-up antennas improve range.

AN UNCONVENTIONAL DISPLAY Though small, at 7.5 inches, the high-resolution screen has both a low-power monochrome mode — readable in sunlight, unlike conventional displays — and backlit color using light-emitting diodes. It also swivels 180 degrees and can be folded over the keyboard to become a tablet.

NO HARD DRIVE Using flash memory instead of a drive eliminates moving parts. Sealed rubber keyboard and rugged construction protect against dirt and water.

LOW POWER, HAND-POWERED Most laptops use an average of 25-45 watts of electricity; this one averages 2. An external manual generator recharges the battery enough for 10 minutes of use for every minute of exertion.

Source: One Laptop Per Child



USER INTERFACE An intuitive, icon-based interface was developed to give children a simpler view of programs and documents.

The New York Times/Photograph by Jodi Hilton for The New York Times

winning Libya's participation when he was summoned by Col. Muammar el-Qaddafi to a meeting in a desert tent on a sweltering August night. But there have also been setbacks. The Indian Education Ministry rejected a proposal to order a million computers, noting that the money could be better spent on primary and secondary education.

Mr. Negroponete said he had been re-energized by the recent arrival of the first 1,000 working prototypes. The prototypes, he said, will give him new ammunition to convince government leaders that his tiny machines can be a positive force for social de-

velopment. [On a visit to Brazil on Nov. 24, Mr. Negroponete presented one of the prototypes to President Luiz Inácio Lula da Silva.]

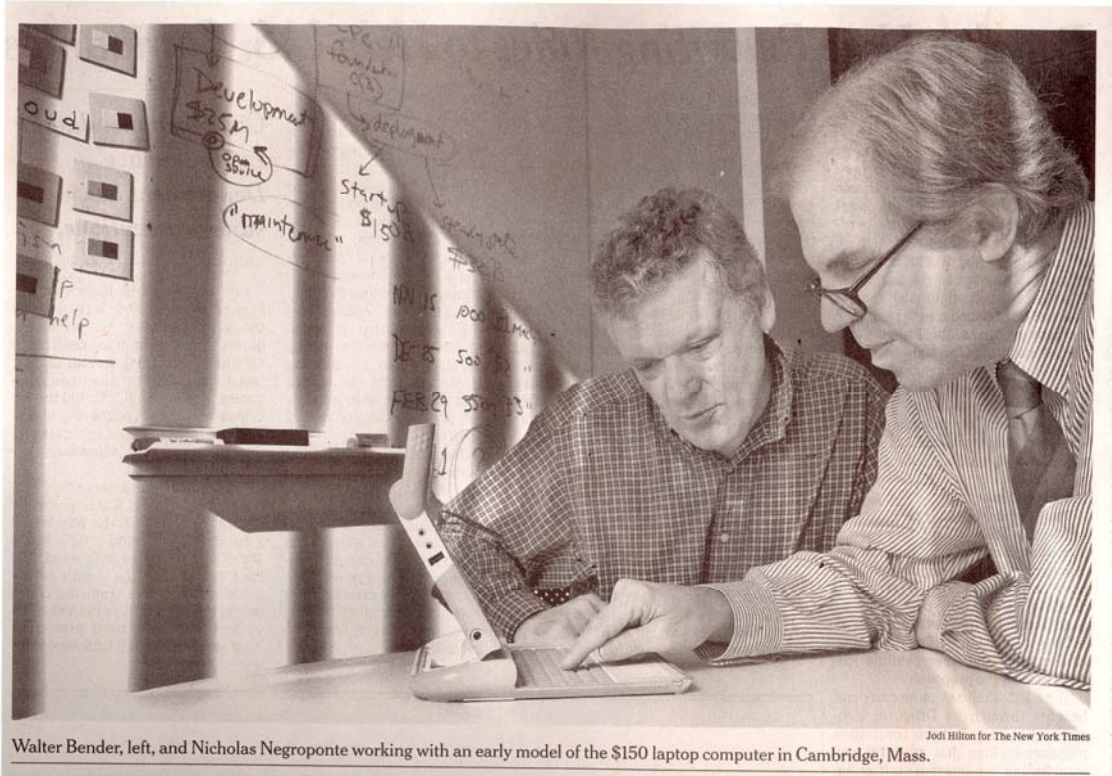
He said a program would be created to enable those in the developed world to underwrite a laptop for a child in a designated country and to correspond with the recipient by e-mail as a sort of "glorified pen-pal program." But however attractive the idea of a \$100 or \$150 laptop, he said there were no plans to make it generally available to consumers.

"They should buy Dell's \$499 laptop for now," he said. "Ours is really designed for developing nations —

dusty, dirty, no or unreliable power and so on."

In his two decades as director of the Media Laboratory, Mr. Negroponete often faced criticism because the institution's impressive demonstrations of technology only occasionally led to commercial applications.

"He has spent his whole career being accused of being all icing and no cake," said Michael Hawley, a computer scientist and one of Mr. Negroponete's former students. To that kind of scoffing, he said, the laptop's success would be Mr. Negroponete's best retort.



Walter Bender, left, and Nicholas Negroponte working with an early model of the \$150 laptop computer in Cambridge, Mass. Jodi Hilton for The New York Times