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'**'RACE TO ZERO'**

High-Speed Stock Traders Turn to Laser Beams

Anova to Use Laser Devices for Fast Communication of Market Data

CEO Michael Persico of Anova Technologies, which is linking stock-market data centers by laser. *Claudio Papapietro for The Wall Street Journal*

Anova Technologies is one of the companies aiming to linking stock-market data center by laser. Anova's CEO Michael Persico joins MoneyBeat to discuss the race to shave off nanoseconds in trading information.

By: Scott Patterson

As high-speed stock traders push to trade ever faster, their newest move involves harnessing a technology that U.S. military jets use to communicate as they soar across the sky: lasers.

In March, a small Chicago communications company plans to switch on an array of laser devices linking the New York Stock Exchange's data center in Mahwah, N.J., with the Nasdaq Stock Market's in another New Jersey community, Carteret.

The lasers, perched atop high-rise apartment buildings, towers and office complexes along the 35-mile stretch between the communities, are the first phase of a grid intended to link nearly all U.S. stock exchanges this way, zipping market data and rapid-fire trades.

It is the latest salvo in the "race to zero," traders' term for their efforts to whittle away the difference between the speed their orders travel at and the speed of light. Zero, the point at which that difference would disappear, has become a kind of holy grail to computerized traders, for whom nanoseconds—billionths of a second—can spell the difference between profit and loss in their algorithm-driven trades.

In recent years, so-called high-frequency trading firms, which account for about half of U.S. stock trading, have adopted first custom-built fiber-optic cables, then microwave and later millimeter-wave transmissions. Networks built on all three

technologies operate today, tying together exchanges around the U.S. Internationally, fiber-optic cables laid across the oceans link America's markets with Europe's and Asia's.

Devices Anova installed atop a senior housing facility in Elizabeth, N.J. *Claudio Papapietro for The Wall Street Journal*

Now come lasers.

"This is a never-ending race," said Michael Persico, founder and chief executive of Anova Technologies LLC, the company behind the plan to link the NYSE and Nasdaq data centers in New Jersey by laser.

Computerized trading firms will be able to take advantage of this technology by placing their servers—the machines that spit out their buy and sell orders based on algorithms—at the exchanges' data centers.

Anova also is working on a deal with the New York Stock Exchange under which the NYSE would offer its technology to the exchange's trading clients, according to people familiar with plans of the exchange, which is owned by IntercontinentalExchange Group Inc. ICE Group, already offers its clients a wireless network, one based on microwaves.

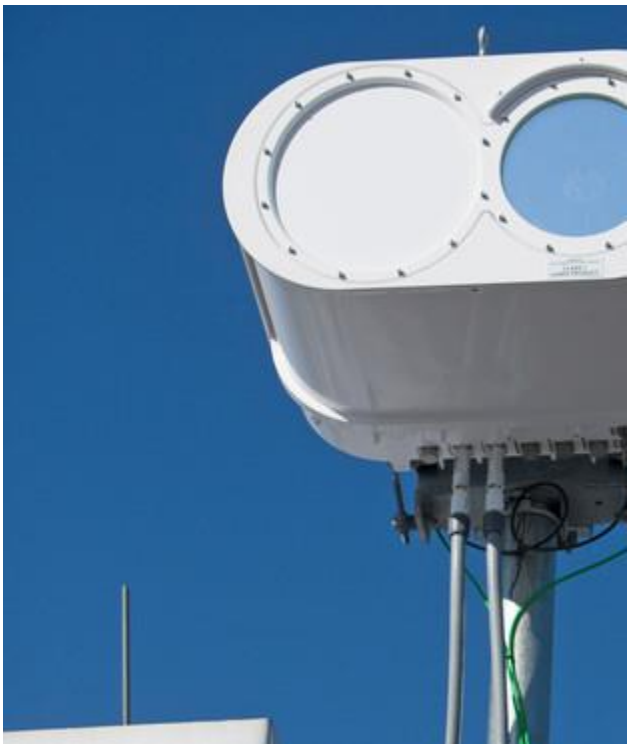
Some question whether Anova's lasers will provide a meaningful speed improvement over networks that are already in place, since microwave and millimeter-wave order transmissions also travel at near light speed. "The difference between networks is getting very small in the metro areas," said Stephane Tyc, co-founder of McKay Brothers LLC, an Oakland, Calif., company that provides fast trading networks. Still, firms such as Anova continue pushing to boost traders' speeds by increasingly tiny slivers of a second.

High-speed, computerized firms today trade everything from stocks to oil futures to government bonds, including securities whose prices move instantly when the government releases economic data such as jobs reports. To pare precious fractions of a second off the time it takes to transmit such data, Anova and other communications companies place networking equipment at a data center on 1275 K Street in Washington, physically close to government agencies.

In the latest tactic, some high-speed traders obtain news releases directly from distributors, avoiding the tiny time lag involved in going through the financial news media.

Federal regulators are wary of algorithmic traders' relentless push for speed, worried about the potential for future market shocks such as the "flash crash" of May 6, 2010—when heavy selling and waves of high-speed traders fleeing the market

triggered wild stock swings—and the loss of more than $460 million in 45 minutes by electronic-trading firm Knight Capital Group Inc. in August 2012.



Another device at the facility in Elizabeth, N.J. *Claudio Papapietro for The Wall Street Journal*

"We must think about why this technological arms race is happening and whether it poses any threats to our markets," said Kara Stein, a commissioner of the Securities and Exchange Commission, in a speech in November. "And we should candidly assess the costs and benefits to both investors and businesses."

The Treasury Department's Office of Financial Research in December labeled high-speed trading a "key source of operational risk across all markets."

Defenders of high-frequency trading say the millions of orders its practitioners churn out support the overall financial markets by providing liquidity, meaning the ability to buy or sell without moving prices much.

And rapid-fire traders can serve this function better with greater speed, defenders say. The argument is that the ability to jump in and out of positions more rapidly enables high-speed traders to place more-aggressive bids and offers—and these, in turn, help all investors get the prices they want.

"Speed makes markets way more efficient," said Peter Nabicht, a former high-speed trader who is now a senior adviser to Modern Markets Initiative, a trade group.

As the push for speed grows, it is increasingly expensive for traders, banks and brokerage firms to keep pace. Market players world-wide spent about $1.5 billion in 2013 on technology to increase trading speeds, nearly double the amount spent in 2009, according to estimates by research firm Tabb Group.

What regulators could do if they wanted to slow the race isn't clear. The SEC is considering whether exchanges should set up "kill switches" that could shut down a rogue trading algorithm threatening market havoc.

The competition revved up several years ago when Spread Networks LLC, a company backed by former Netscape Chief Executive Jim Barksdale, spent an estimated $300 million to build a fiber-optic network to transmit orders between Chicago and New York markets. Fiber-optic networks already existed, but Spread's, by using more-direct routes, claimed to shave about three milliseconds—thousandths of a second—off an order's round trip between New York and Chicago. Trading firms ponied

up millions of dollars a year to use the network.

Ordinary investors barely noticed the advent of Spread's network in August 2010, but it was a significant event for high-speed firms. Getco LLC, which used the network, saw its expenses shoot up, in part because of the fees charged by Spread, according to a regulatory filing.

Getco acquired Knight last year and now is called KCG Holdings Inc. KCG and Spread both declined to comment.

Spread's lead didn't last. Several companies set up chains of microwave dishes between financial-market data centers in Chicago and New Jersey. These could send orders slightly faster than signals sent through fiber-optic cables, which fly at about two-thirds the speed of light.

Next, several companies, including Anova, started to use millimeter waves, with shorter wavelengths. They can carry more information than standard microwave transmissions. But they don't travel as far, so they have to be reinforced with relay devices at more points.

In all, about a dozen microwave networks, some owned by trading firms, have been set up between the New Jersey data centers and Chicago.

Nasdaq offers one such network to its trading clients, from Strike Technologies LLC, a company whose ranks include former U.S. and Israeli military engineers. Strike says the network can send data between Nasdaq's New Jersey data center and CME Group Inc.'s in Aurora, Ill., in 4.13 milliseconds. The NYSE's possible arrangement to offer Anova's laser technology to clients would be similar, said the people familiar with the exchange's plans, who said they expect a deal in the coming weeks.

While faster than fiber-optic cable, microwave and millimeter-wave systems are vulnerable to rain, wind, solar activity and even flocks of birds, which can disrupt signals. That matters to firms that are trying to execute thousands of trades a minute on dozens of different markets.

At Anova, a major provider of millimeter-wave technology, Mr. Persico worried that some system could come along with better speed or reliability. He looked for a technology with a level of consistency telecom insiders call "five nines"—signal transmissions that are up and running 99.999% of the time.

In 2011, Mr. Persico read an article in a trade journal describing how a Silicon Valley company called AOptix Technologies Inc. had designed military technology using lasers to communicate in battlefield conditions. His first thought: "I wonder if they can put those on a tower?"

The technology traced back to the 1990s, when two scientists designed a method to gather images from outer space that corrected for atmospheric distortions. They developed technology for telescopes with flexible mirrors that could adjust thousands of times a second.

Soon, they realized the technology could also be used to transmit data using lasers. They formed AOptix and contracted with the U.S. government to provide communication devices for military aircraft.

Mr. Persico asked AOptix whether its laser system could be used to send stock-market data. The company was confident it could, because stock data would only

have to move from one fixed spot to another.

"Finding a tower isn't hard for us, because we can find airplanes" with the lasers, said the CEO of AOptix, Dean Senner.

Mr. Persico wasn't the only one who thought of adapting the lasers for stock orders. Several Wall Street firms also reached out to AOptix. After weighing offers, AOptix signed a deal with Anova in December 2012, partly, it says, because Anova had backing from a large Wall Street bank. The bank's identity couldn't be learned.

Mr. Persico set about securing rooftops and other spots to place his lasers between the New Jersey communities housing the NYSE and Nasdaq data centers. Anova said it has dozens of trading firms waiting to try the lasers when they go live.

He said the technology is expected to be largely free of weather-related consistency issues. The flexible mirror system weeds out atmospheric distortions, and a stabilizing system—first designed to let planes use the lasers while in flight—helps keep the devices in contact.

The stabilizing system also means the devices can be put in spots where other technology, such as microwave dishes, can't go. That lets the lasers send signals along a straighter path and thus speeds up transmissions, Mr. Persico said.

One firm that plans to use the system is XR Trading LLC of Chicago. It is a "very compelling technology," said XR's president, Matthew Haraburda. He said if it behaves as intended, it could be "a huge development" in trading technology.

Not that it will be the end of the race for speed, though, or will stop traders from trying to think up new ways to move their orders along quickly. Some dream of a replacement for the fiber-optic cables across the Atlantic and Pacific. The idea: Turbocharge intercontinental trading by floating balloons carrying microwave dishes over the ocean.