High Frequency Trading Turns to High Frequency Technology to Reduce Latency

For financial companies engaged in high frequency trading, profitability depends on how quickly trades are executed. Now, new millimeter microwave radio transmitters speed connections between data centers and their markets

Financial markets have always been high-speed, high-return activities. The ability to execute a transaction before your competitors determines who gets the profit from a deal. But we are a long ways from the days of ticker tape and phone calls were fast enough. With billions of dollars on the line, markets and traders have invested heavily in technologies to help them rapidly access and analyze data and conclude a sale.

For high frequency trading (HFT) response times have gone from milliseconds to microseconds. In such an environment, even fiber optic connections can be too slow. Microwave connections, with latency measured in nanoseconds, can provide the necessary speed.

The New Market Maker

HFT grew out of the SEC's 1998 decision to allow electronic exchanges to compete with the NYSE and other marketplaces. By 2010, HFT was accounting for more than 70% of the trades in U.S. equity markets, and a growing percentage of trades in other countries.

Unlike other types of stock strategies that try to profit from large changes in the prices of a stock over a period of time, HFT involves analyzing massive amounts of information and locating even minute opportunities for profit that may have otherwise been overlooked. By executing thousands or millions such transactions daily, billions of dollars in profit can be made. The HFT is usually not interested in holding onto a stock for more than a few seconds and will start each day without any holdings.

Say, for example, there is a momentary difference in the exchange value of the Euro between the London and Frankfurt markets. Even if that difference just lasts a second or two, if the HFT system is fast enough, it can execute trades between those two markets and make a profit. Or if the HFT system identifies one company looking to sell an equity and another looking to buy, it can step in to purchase from the one and sell to the other.

Even if the HFT doesn't make a direct profit on the sale of the equity, it can still make money since exchanges will typically pay the HFT a small amount, say ¼ cent per share, for the transaction. All those pennies add up. According to Tabb Group, a financial markets research and strategic advisory firm, by 2008 traders earned $21 Billion in profits off HFT.

Building a Faster Infrastructure

HFT can generate huge profits, but only with the right infrastructure to support it. Trading companies, therefore, have heavily invested in the hardware, software and personnel necessary to gather and analyze momentary changes in market data and then execute based on that data.

To make this possible, exchanges have implemented systems which brought down the latency to about 3 milliseconds on average.

In a network, latency, a synonym for delay, is an expression of how much time it takes for a packet of data to get from one designated point to another. In some usages, latency is measured by sending a packet that is returned to the sender and the round-trip time is considered the latency.

Contributors to network latency include the time it takes for a packet to travel between one place and another at the speed of light; the medium itself (optical fiber, wireless), and the size of the packet since larger packets take longer to receive and return than smaller ones.

Other conditions that affect latency are the speed of processing through a router or other gateway node, which may take time examining and possibly changing the header in a packet. Packets may also experience storage and hard disk access delays at intermediate devices such as switches and bridges.

In 2009 the London Stock Exchange bought the technology firm MillenniumIT which has a software platform Millennium Exchange that can execute more than 500,000 transactions per second with a latency of “well under 100 microseconds.”

Now, the speed of the exchanges and the speed of the HFT traders’ computers are two parts that make HFT work. But no matter how fast those computers, they can never operate faster than the network that connects the two. While fiber optic cables operate at about 2/3s the speed of light in a vacuum, even that is not necessarily fast enough, when you are looking at shaving microseconds from a transaction.

Light travels at 186,000 miles per second in a vacuum, so it takes a bit over eight microseconds to travel one mile in a fiber optic cable. To cut down the distance and reduce latency, therefore, trading firms have placed their computers as close as possible to those of the exchange.

But that is a risky proposition. Particularly after 9/11, many firms decided to move their data centers out of Manhattan and placed them in non-descript buildings in New Jersey or on Long Island, without even the company name on the building, so the data centers are not a target for terrorists.

While this did make the data centers more secure, and greatly lowered rental costs, this move increased the distance between the HFT computers and the trading systems on Wall Street, sometimes adding hundreds of microseconds to each round trip. It is not just the direct distance that matters, but the cable distance. They can’t just string a direct line under from the data center, under the streets buildings and water over to Manhattan, so they have to take a more circuitous route through the city.

“Running fiber often isn’t practical in an urban environment,” says Wayne Pleasant, a business development consultant for Renaissance Electronics’ HXI subsidiary. “To install fiber, you have to disrupt local infrastructure like digging up streets or hanging it on pre-existing structures, which is expensive and time consuming.”

But the distance of the cable is not the only factor adding to the latency. Each and every relay device along the route adds its own latency to the journey. A decade ago, those extra milliseconds and microseconds wouldn’t have mattered, but they make a huge difference where HFT is concerned.

When Nanoseconds Count

In their quest for secure, high bandwidth, low latency connections, HFT firms are increasingly turning to millimeter microwave transmission systems to connect their data centers to the exchanges.

In the May 30, 2012 issue of the Wall Street Journal entitled “Networks Built on Milliseconds” by Anton Troianovski, “Trading firms, angling for even a split-second advantage over rivals, are rushing to build chains of microwave dishes to provide higher-speed links between financial markets in Chicago and New York.”

The article goes on to give an example of a trading firm Tradeworx Inc., that said that the 2.3 milliseconds it would save users using their microwave network, “are worth $1,350 a day for a trader trying to profit from some price differences between S&P 500 futures in Chicago and a corresponding security in New York.”

Millimeter microwave is a wireless transmission technology that operates in the 60-80 GHz band. Because the high-frequency provides a large bandwidth, millimeter microwave systems are ideal for carrying huge quantities of data needed for HFT.

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The cellular backhaul and wireless point-to-point radio market is expected to surpass $11 billion by 2016, according to the “Wireless Backhaul Market from an All-IP Perspective” report.

According to Elias Aravantinos, author of the report, “All vendors have already realized the need for pure packet outdoor radios, especially in the 60 GHz and 80 GHz bands. The solutions in the market are becoming very competitive both in price and added features…”

An example of this in the HFT arena is Renaissance Electronics & Communications’ recently upgraded versions of its Extremely Low Latency GigaLink Light Speed radios. These millimeter wave transmitter/receiver units are available in light licensed and unlicensed versions for the U.S. European and Japanese markets. The light licensed U.S. and European models operate in the 71-76/81-86 GHz bands and can transmit over distances up to 8200 meters (5 miles). The lower power unlicensed radios at 60 GHz can be used over shorter distances, typically up to 1 km.

Because of the high frequency, these links operate with a full duplex throughput of 1.25 Gbps and higher, thereby offering plenty of bandwidth for the millions of daily transactions.

A trading company can install one if these microwave radio links on top of its data center in New Jersey and use it to create a direct connection over to Manhattan. Or, if the distance is too great for a single link, or if there are obstructions that would block the signal, a series of radio links can be used to relay the signal. By using microwave instead of fiber optic cables, an HFT firm can establish a much shorter path to the marketplace, reducing latency and so it can gather information and execute trades faster.

But, not only do these radio links provide a more direct path, but they are also designed to minimize the latency introduced by the equipment.

“The latencies are so minimal they’re very difficult to measure accurately,” says Pleasant. “We can only say for sure they are less than 20 nanoseconds, billionths of a second, from the input of one radio to the output of the second radio back to back. We have calculated that the latency for each radio is 2 nanoseconds or less.”

With this type of microwave system in place, HFT firms can place their data centers further from the market without compromising their trading speed.

“Lower latency equals faster trading speeds which equals more money to be made for the end user,” says Pleasant. “In this industry nanoseconds count, so having the lowest latency connections is a big deal.”

For more information about Renaissance Electronics & Communications, call 978-772-7774; or visit us online at www.rec-usa.com.