

In a speech in July, [Andy Haldane](#), a senior policy maker at the Bank of England, commented on the extraordinary speed at which the trades are conducted. He noted that HFT increased the turnover of trades and reduced the timescale on which securities were held. "New trade technologies have progressively raised the speed limit for trading. Today, this is measured in microseconds – millionths of a second. Tomorrow, it may be measured in nanoseconds – billionths of a second. There is effectively a 'race to zero' among trading technologists, as market advantage lies in being the fastest," he said.

Andrew G Haldane: The race to zero

Speech by Mr Andrew G Haldane, Executive Director, Financial Stability, of the Bank of England, at the International Economic Association Sixteenth World Congress, Beijing, 8 July 2011.

The Race to Zero

Wireless Ultra Low Latency High Frequency Trading Networks

January 2012



It has been estimated that each millisecond that network latency is reduced can be worth up to \$100 million to a financial trading firm.

When I read about High Frequency Trading, most often the subject matter is focused on FPGA's, algorithms, fast switching, servers, co-location centers and technology improvements that shave microseconds from the latency calculation to execute trades. These improvements are important and necessary but what is the real bang for the buck of these incremental improvements in terms of total latency improvement? At NeXXCom Wireless we believe that more focus should be applied to the transport portion of latency between two data centers. We believe that multiple milliseconds (mS) can be eliminated from the end-to-end latency calculation. Let's use 165 Halsey St. Newark, NJ to 350 E. Cermak Road, Chicago, Il as an example.

Today the round trip latency for trades made between those two data centers is 13.33mS through the Spread Networks fiber facility. By comparison, a properly constructed 6GHz wireless network between the same facilities offers a 100 Mb/s duplex circuit with a round trip latency calculation of less than 10.0mS or 3.3mS faster. If the premise of increased trading profits of \$50 million per year is true than that 3.3mS latency improvement is quite valuable.

Upcoming latency improvements in NeXXCom's SkyData™ Layer 1 technology will enable wireless networks within 1.0mS of the Speed of Light.



UNMOLESTED BITS ©

2

Current Release SkyData L1-100Mb/s Duplex		
Item	Qty	Note
Distance	760.000000	MEP Miles
Per link Latency	0.000019	Seconds
Speed of Light	186,000	Miles per second
# links	45	Links in MEP
Air Latency	0.008172	Injected LAT SoL RT
Hardware Latency	0.001710	Injected LAT RT
Total RT Latency	0.009882	Seconds
TTL RT Latency	9.88	mS
Future Release SkyData L1-100Mb/s Duplex		
Item	Qty	Note
Distance	730.000000	MEP Miles
Per link Latency	0.000014	Seconds
Speed of Light	186,000	Miles per second
# links	35	Links in MEP
Air Latency	0.007849	Injected LAT SoL RT
Hardware Latency	0.000980	Injected LAT RT
Total RT Latency	0.008829	Seconds
TTL RT Latency	8.83	mS
Speed of Light	7.78	mS

The purpose of this position paper is not to compare wireless to fiber, that is an apples and oranges argument. Fiber offers the advantages of much higher bandwidth availability at 1Gb and higher. Wireless does offer lower latency potential however. At 100Mb/s, the available bandwidth is more than adequate for a firm's most strategic trades and or faster market data availability.

The purpose of this paper is to illustrate that in the race to zero latency in high frequency trading, wireless and more specifically NeXXCom's Layer 1 system architecture offers the best opportunity to approach the speed of light in the transport part of the network.

In a wireless ultra low latency network there are three main components that contribute to lowest latency:

1. Superior Radio / Modem Technology
2. The Most Efficient Path Design
3. Spectra

Radio / Modem Technology: After much testing and successfully implementing a <13.33mS wireless network between NY-CHI with a beta version of our SkyData™ L1 radio, NeXXCom Wireless is deploying today its 1st generation Layer 1 Low Latency microwave radio, SkyData™ L1, a split architecture, 100Mb/s duplex radio. This technology is capable of a NJ to CHI round trip latency of <10mS in a 45 link network. The latency through the radio is <20µS, the fastest commercially available radio today. To see how we calculate the round trip see the table in box 2 to the left.

Our next release of this radio technology will further reduce the radio latency to <15µS, will have new patent protected firmware optimized for low latency from the ground up and be capable of NY-CHI round trip in <9.0mS. Our third release will have further improvements to latency through the radio and further reduce NY-CHI round trip latency further to within 1.0mS of the Speed of Light.

Key to this outstanding performance is our patented Layer 1 architecture. At Layer 1 we do not add any framing or routing information to the data that is received from the Fast Ethernet Switch. We call this passing **"Unmolested Bits ©"**. Especially in a point-to point, wireless high frequency trading network, having the radios add switching and routing information is a waste of resource and serves only to inject unnecessary latency into the data stream. By not molesting the bits we receive the data frames and send them across the network at the speed of light with minimal latency injection by the radios along the path.



Pure Speed with Data Integrity

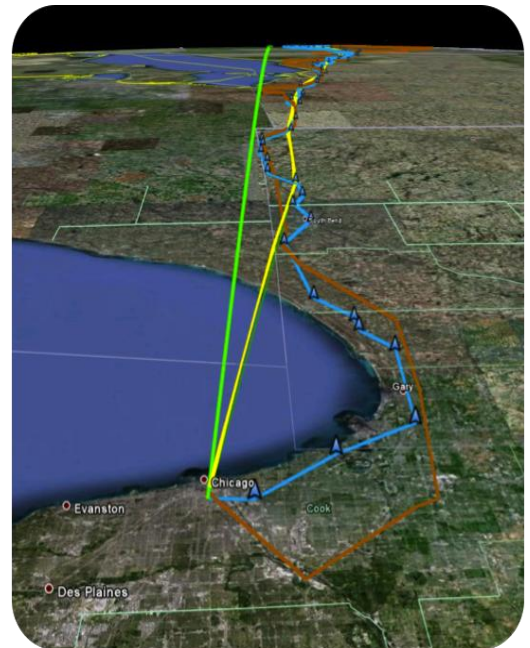
Of course being fast is not good enough; the radio also incorporates proprietary error correction to ensure carrier class performance and data integrity. Our designs guarantee 99.999% availability on a link basis and a 10^{-6} Bit Error Rate; this means the trades you execute are assured.

Path design & Spectra – Most Efficient Path (MEP): Because it's wireless there are inherent hurdles to the Most Efficient Path. Terrain, metro areas, tower availability, spectra availability and coordination may be limited making a MEP difficult to engineer and implement. NeXXCom's engineering design group has planned and installed wireless networks all over the globe; in fact we have installed more than 1,000,000 miles of terrestrial networks.

Path design for a "conceptual" straight path can be dangerously and carelessly over simplified. I constantly read and hear of claims by companies claiming to be experts and can beat fiber. Faster than fiber isn't the most important metric; Speed of Light with carrier class performance is the metric that should matter to HFT firms. We at NeXXCom Wireless understand that and engineer to those stringent parameters.

When we take on the project our team performs:

- **Topology Analysis** - We determine the best configuration for your network that meets your connectivity, reliability, and redundancy requirements.
- **Capacity Planning** - We ensure sufficient throughput on each network segment.
- **LOS Feasibility** - We evaluate LOS (line-of-sight) feasibility for each link based on clearance criteria and antenna height possibilities. We use advanced software tools for rapid LOS analysis based on terrain and building data (where available).
- **Band Selection** - We determine frequency band options based on path length, antenna size, and reliability objectives considering multipath and rain outage.
- **Path Survey** - We confirm LOS on planned links with field survey that identifies any potential obstructions (trees, structures, etc.). We document surveyed site coordinates and possible antenna heights for input into detailed design.
- **Detailed Path Engineering** - We conduct analysis to determine final equipment selection, antenna types and heights, transmission line lengths, and other operating parameters based on desired performance criteria.
- **Frequency Engineering** - We perform interference analysis to assign appropriate frequencies based on existing RF environment that ensures system will not be degraded by unwanted interference.
- **FCC Licensing** - We conduct FCC-required Prior Coordination with other wireless users, prepare FCC applications, and submit for electronic filing as necessary.



- **Tower site surveys**
- **Civil engineering and site improvement work**
- **Radio installation & alignment**
- **Network commissioning**
- **Service & Support**
- **Network Management Services with Service Level Agreement guarantees**

Additional NeXXCom Path Comparisons

PATH	SkyData Network	Fiber
NY - CHI	<10mS	13.33mS
NY - WAS	<3.2mS	3.71mS
CHI - WAS	<8.4mS	10.81mS
NY - TOR	<5.2mS	6.34mS
FRA - LON	<5.6mS	7.26mS
FRA - PAR	<4.4mS	5.48mS
LON-ZUR	<6.7mS	7.79mS



To learn more about the “RACE to ZERO” and how we can help you compete please contact us at:

About the author:

Sal S. Benti is the founder of NeXXCom Wireless LLC and has been involved with computing and communications networks since 1973 in various senior executive positions for both private and publicly traded technology companies.

He can be reached at:

sal.benti@nexxcomwireless.com

NeXXCom Wireless LLC

4365 Executive Drive, Suite 1500

San Diego, CA 92121 USA

619-870-0199

info@nexxcomwireless.com

www.nexxcomwireless.com

