

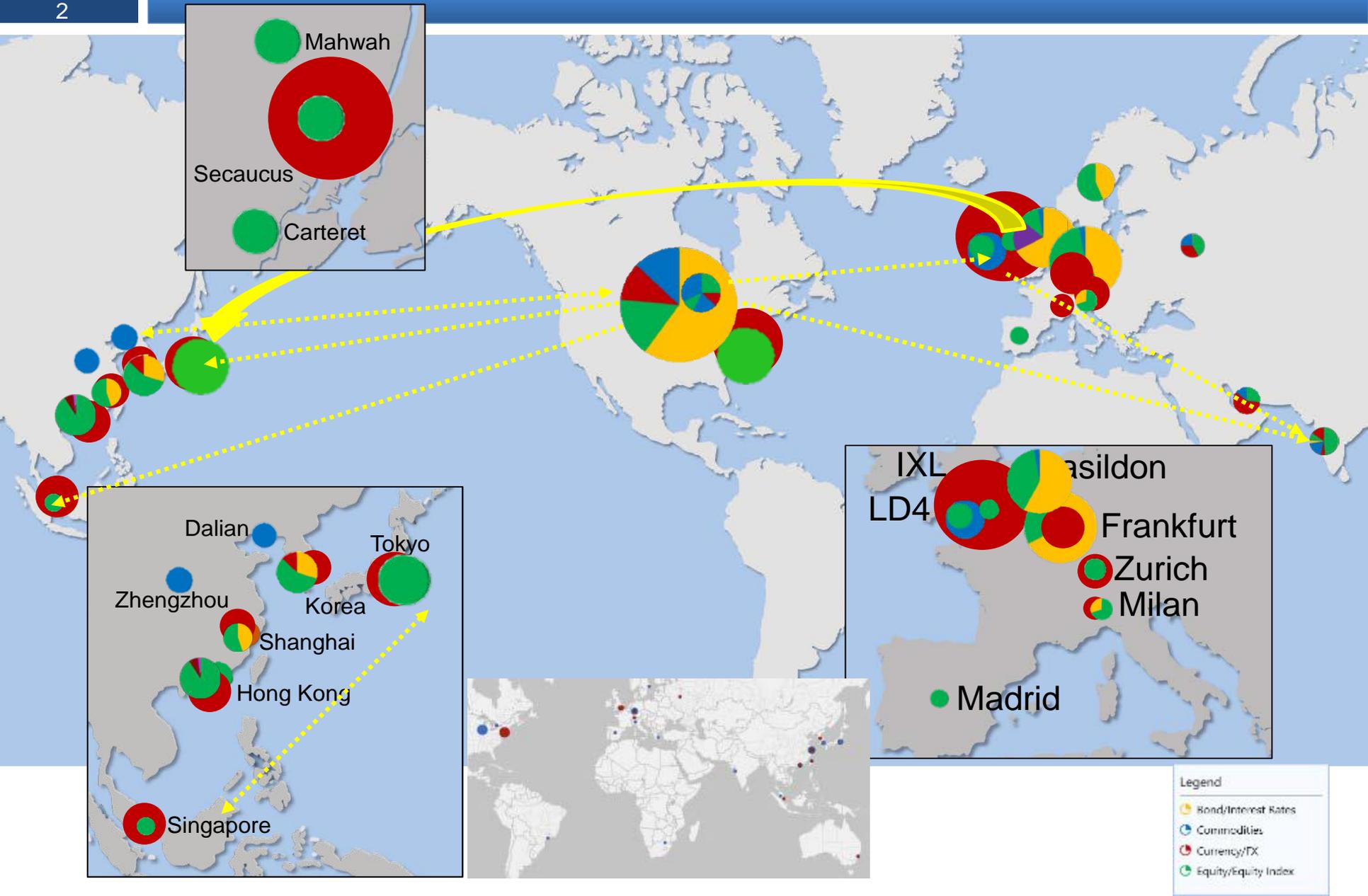
Global Perspective on Low Latency

May 9, 2018

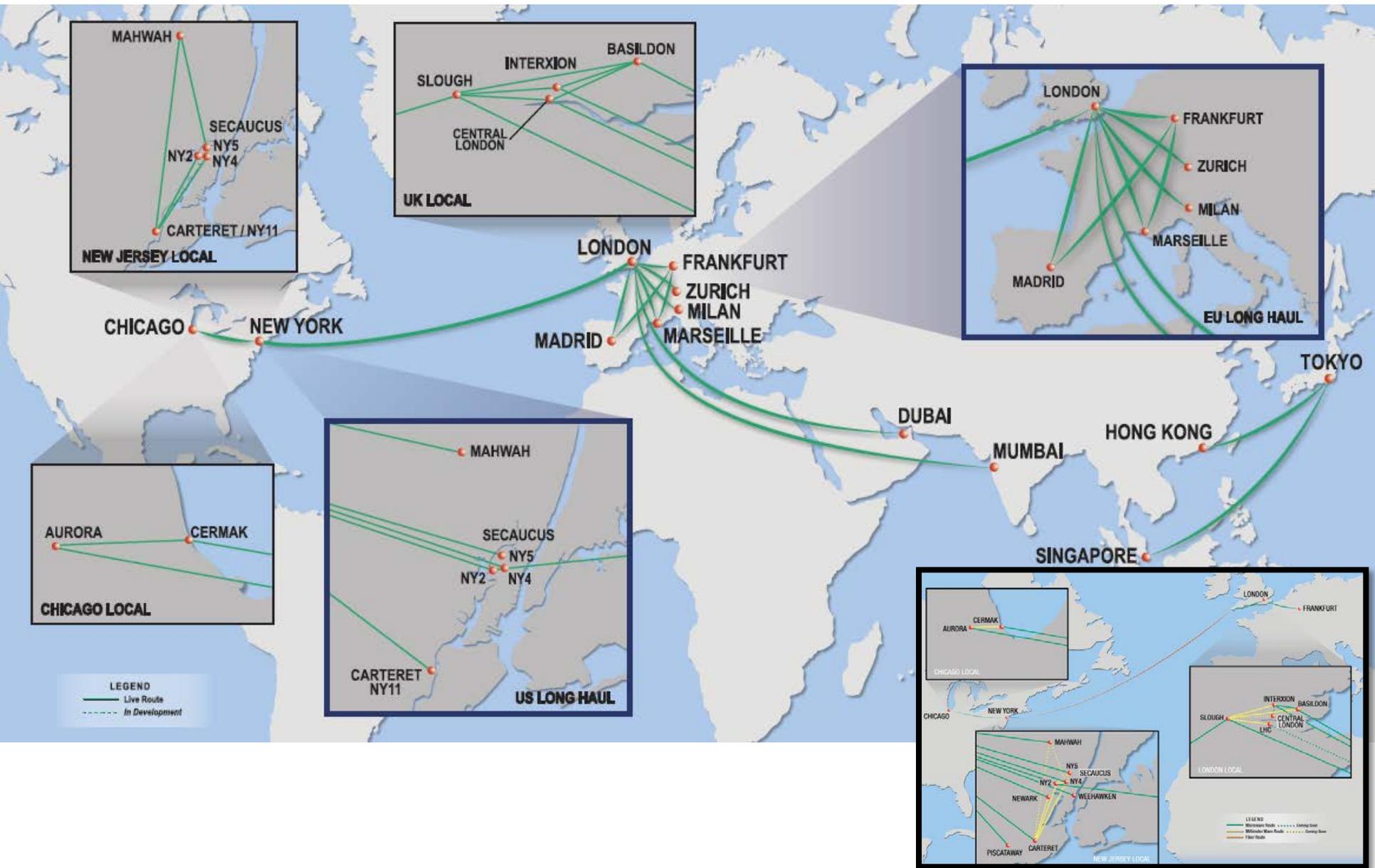
Stéphane Tyc

World trading volumes scaled to guide the eye

2



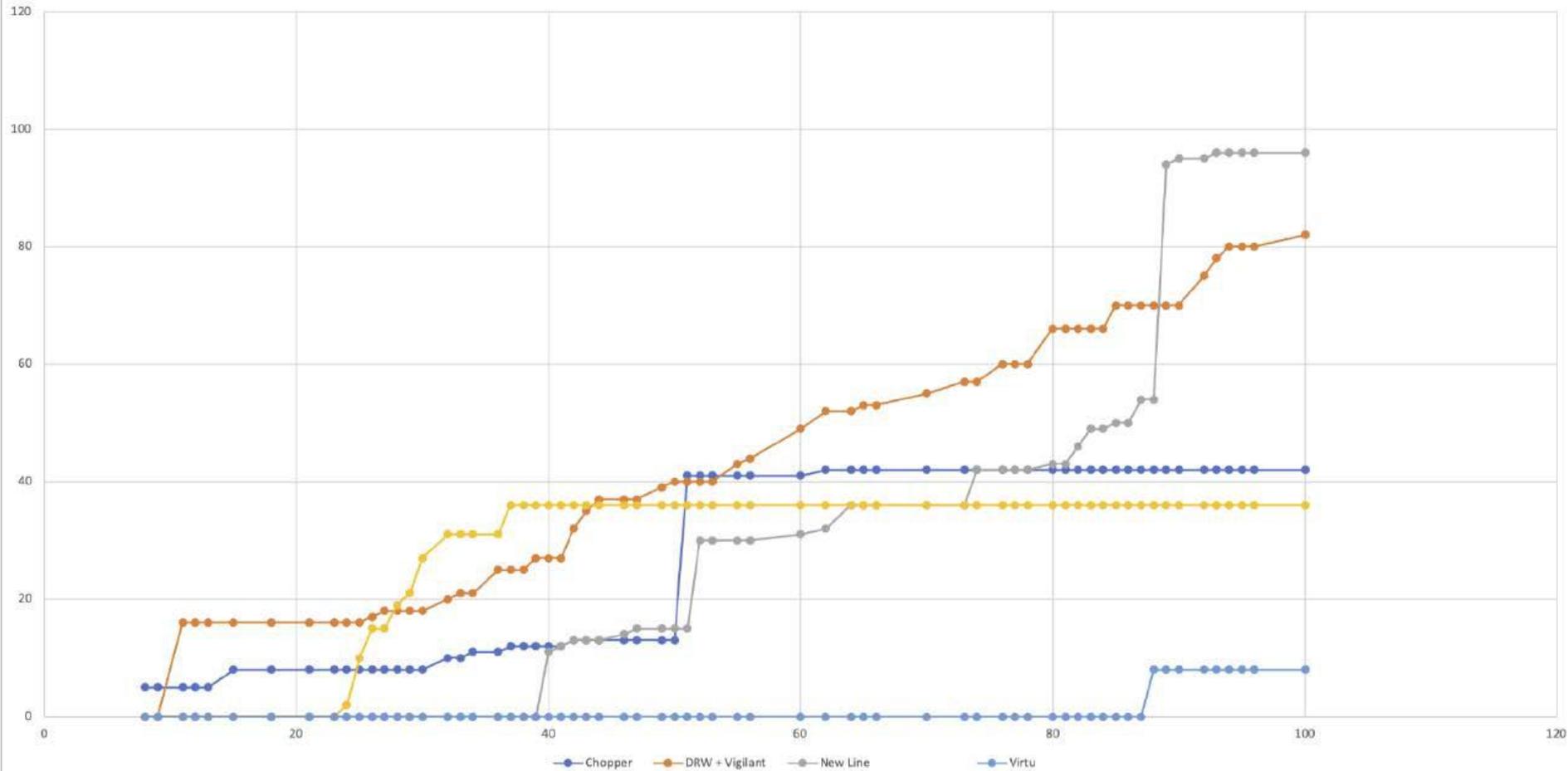
McKay & Quincy Data Map



Washington DC to the CME

4

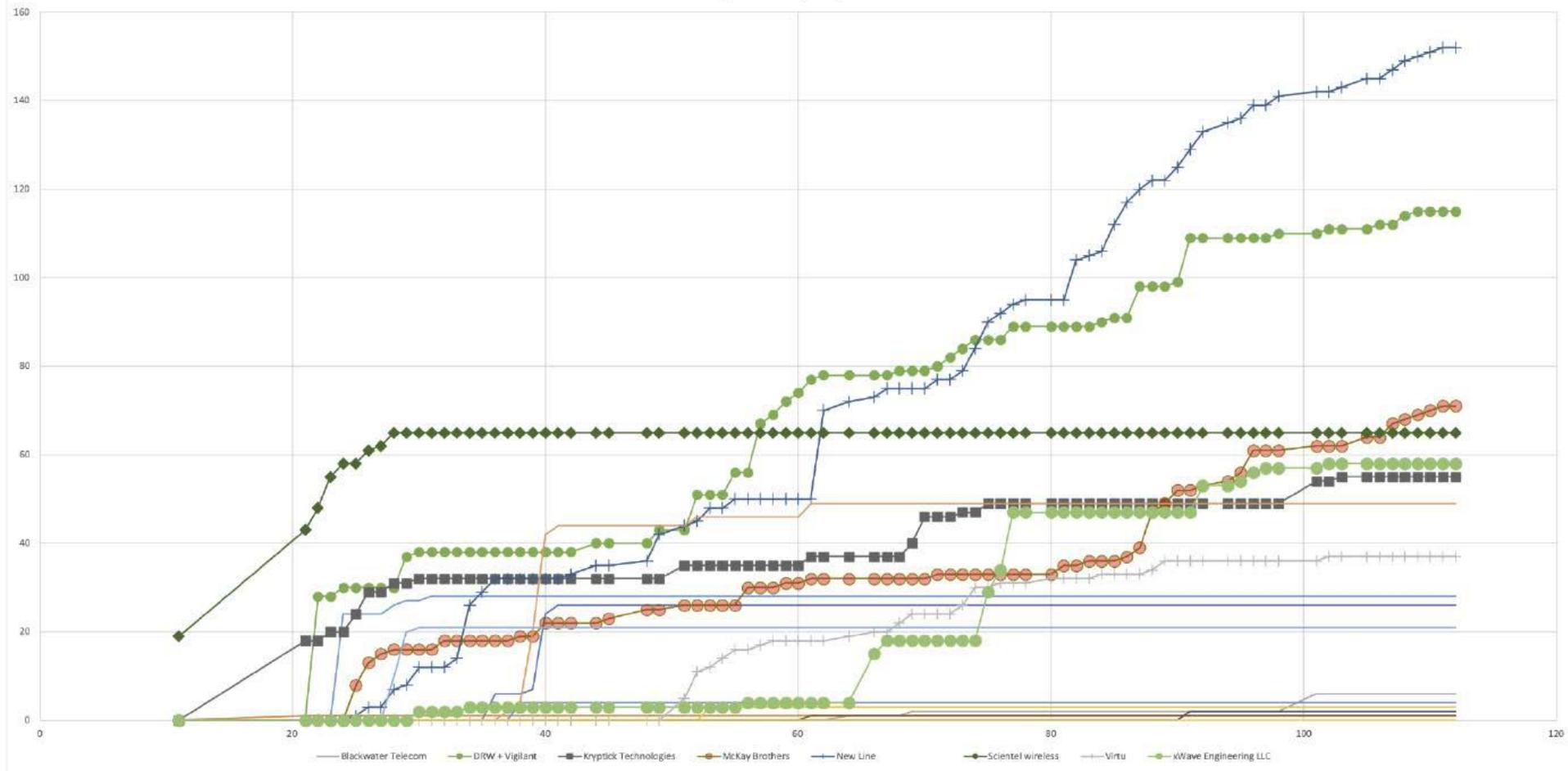
Active licence count per company vs months since 2011



CHICAGO to NJ

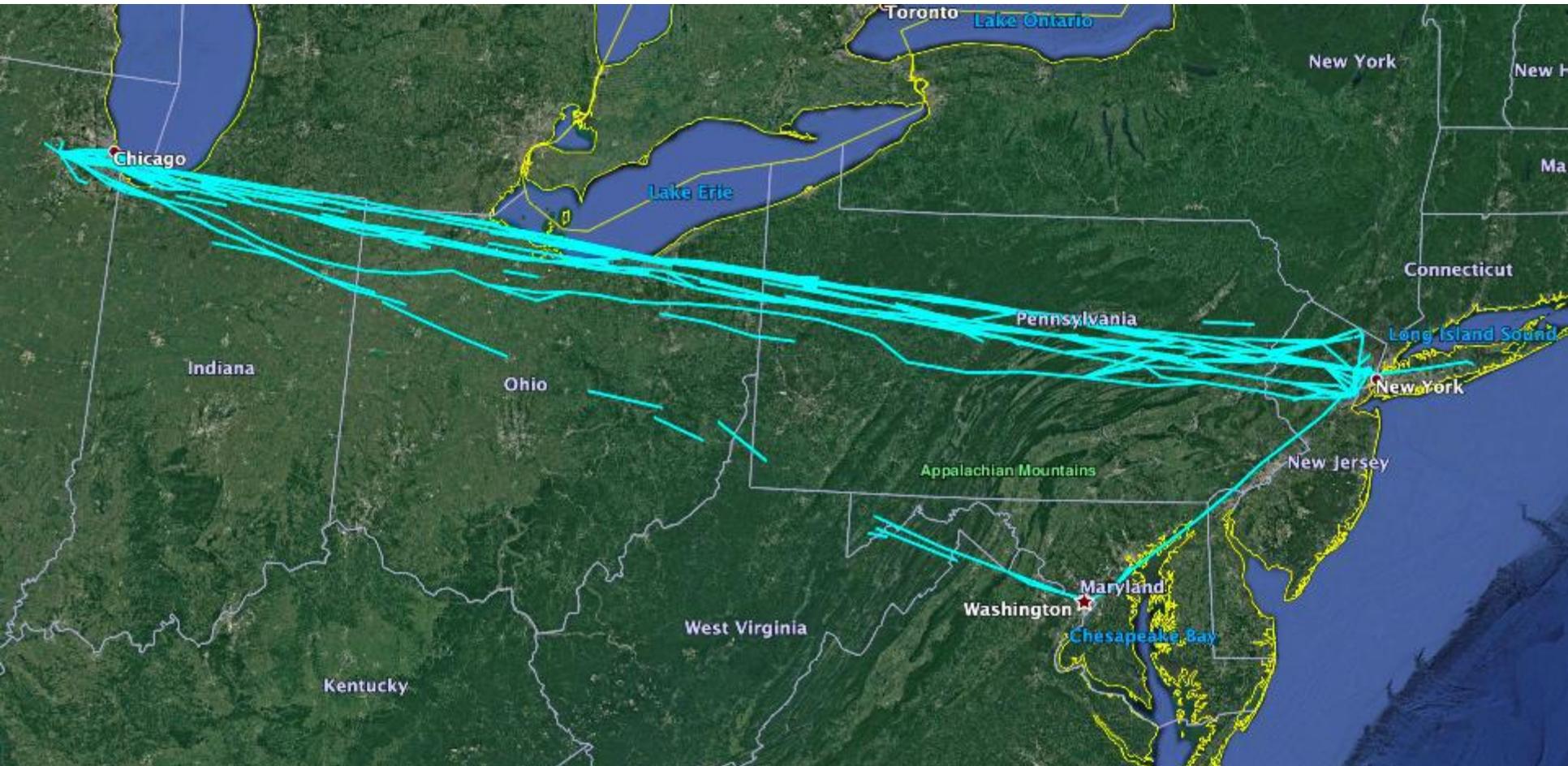
5

Active licence count per company vs months since 2011



All Active Licenses filled since 2018

6

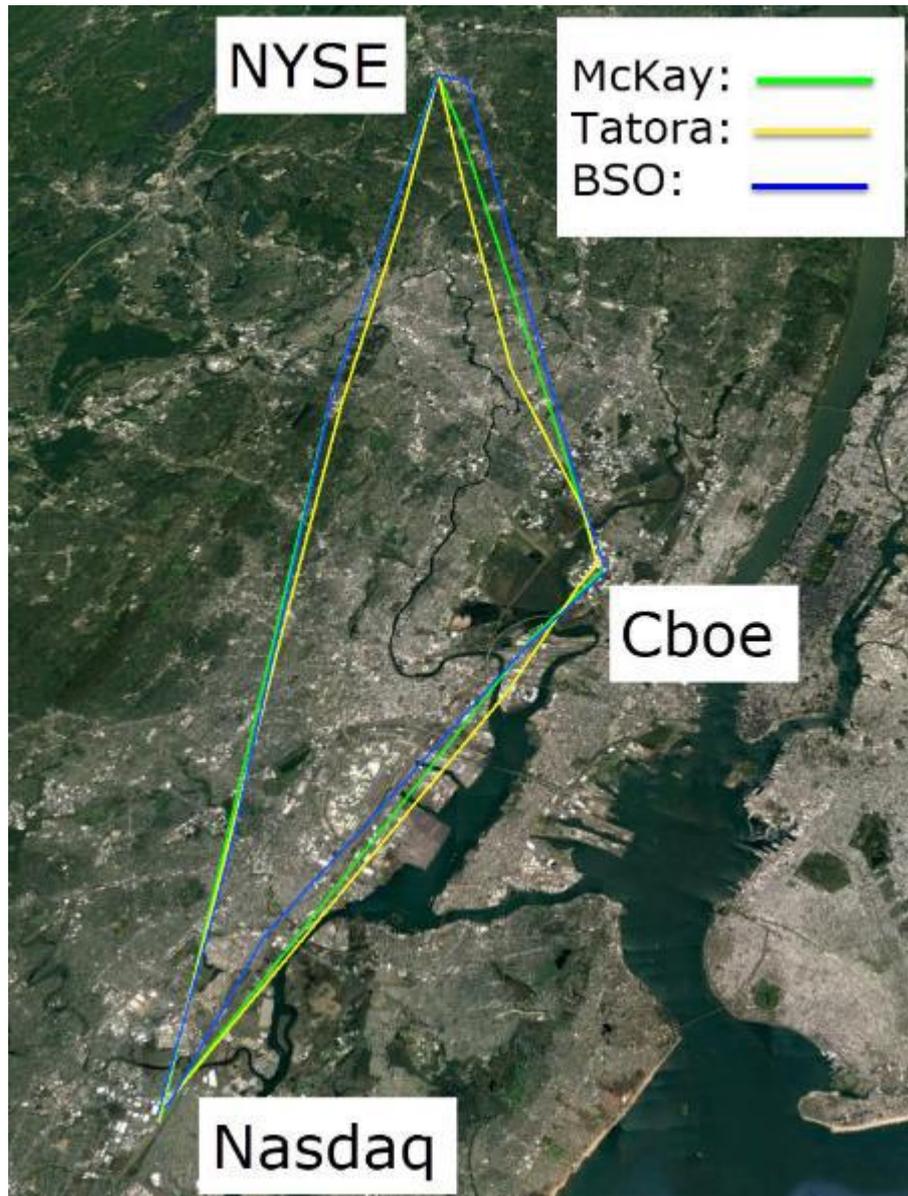


By the end of 2019 the three best networks will be within $1\mu\text{s}$ of each other



Wireless Networks Connecting Exchanges

7



Top three wireless networks for each leg of the triangle
McKay has exclusive use of the LMDS band at 28 GHz.

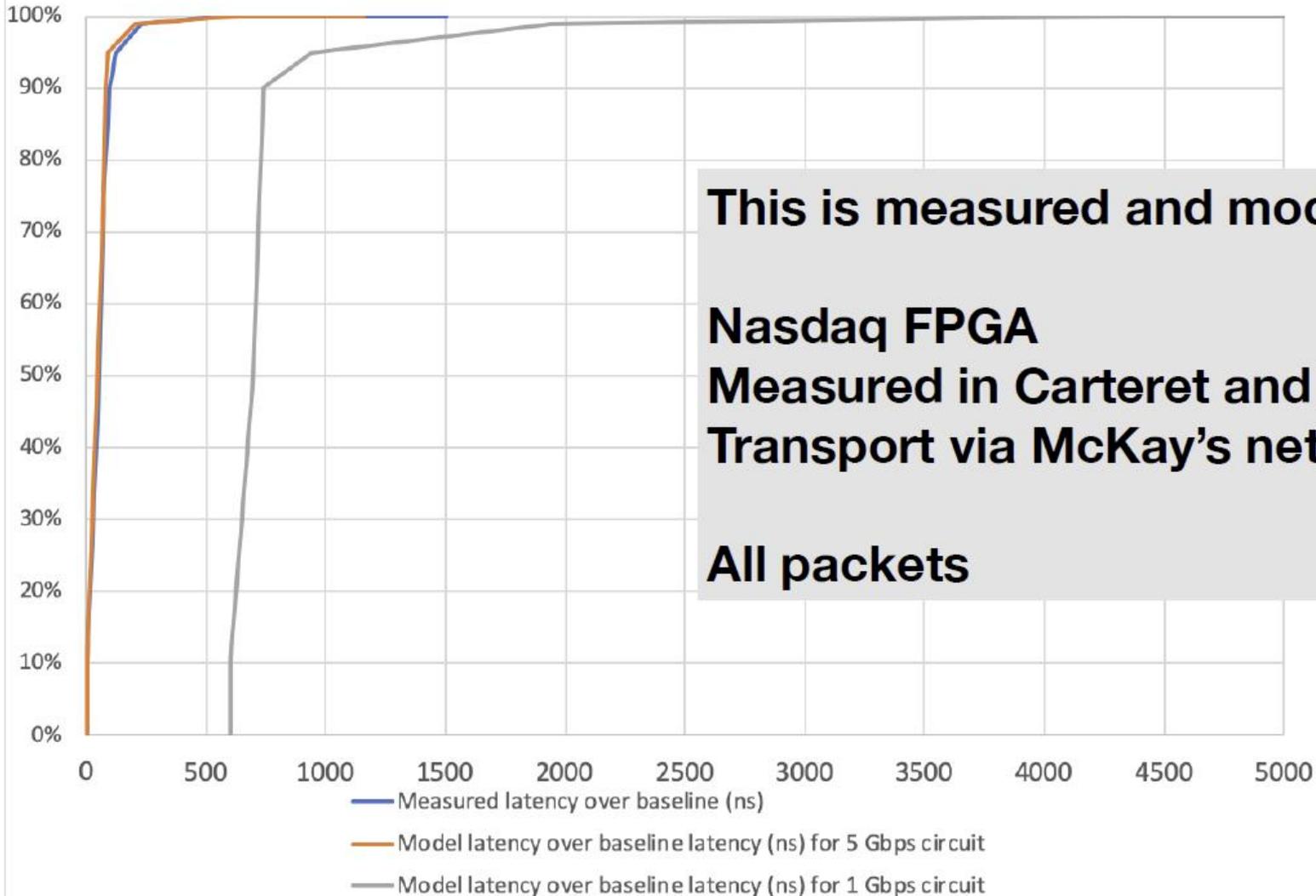
- 1. Straighter**
- 2. More reliable**
- 3. More bandwidth**

All other networks use E-Band which is congested.

Adding bandwidth will add path length. Reducing path length with existing bandwidth is hard.



Model vs Measured Latency
For All Packets on NASDAQ on Mar 22, 2019
Cumulative Distribution in Nanoseconds



This is measured and modelled data

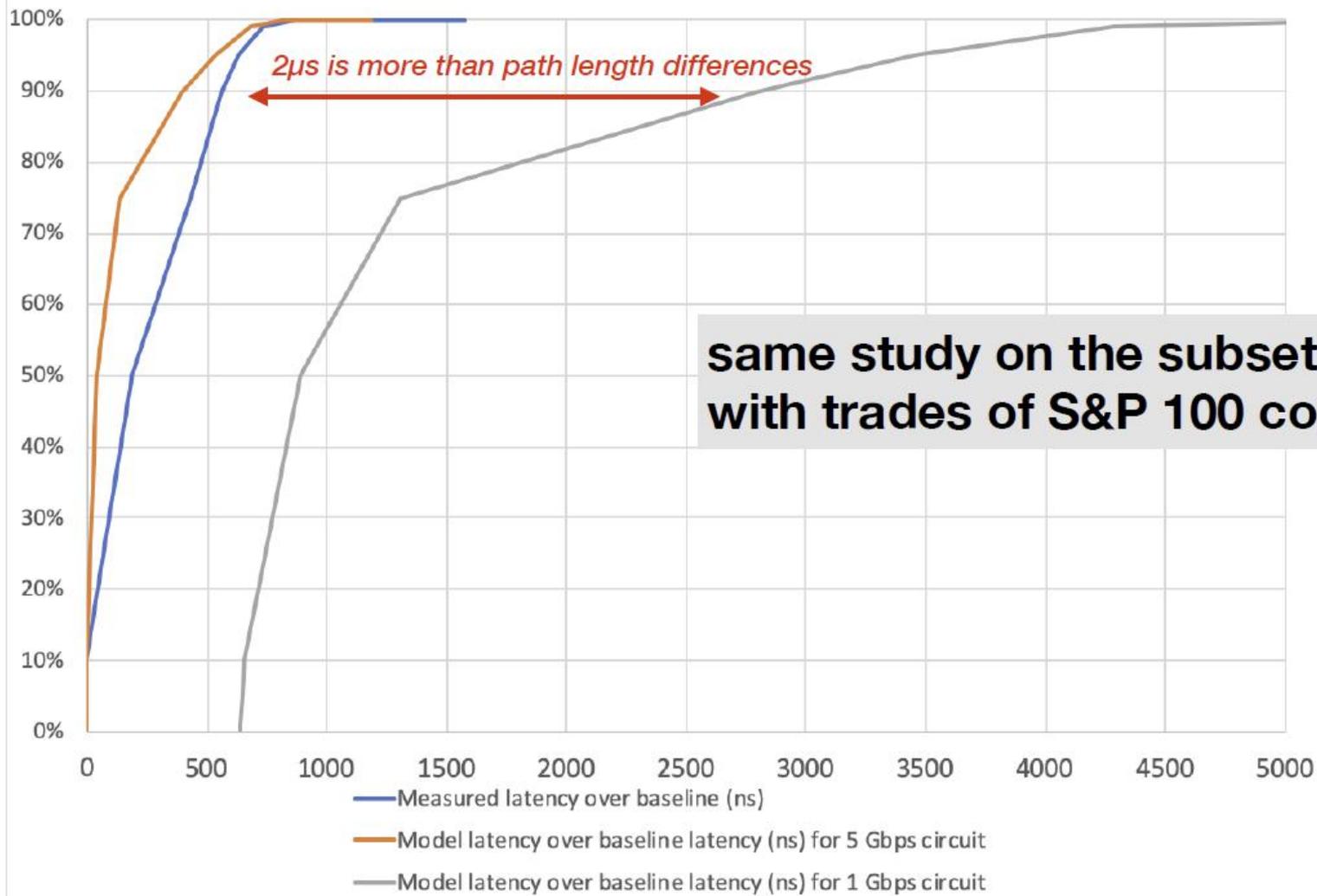
Nasdaq FPGA

**Measured in Carteret and Mahwah
Transport via McKay's network**

All packets



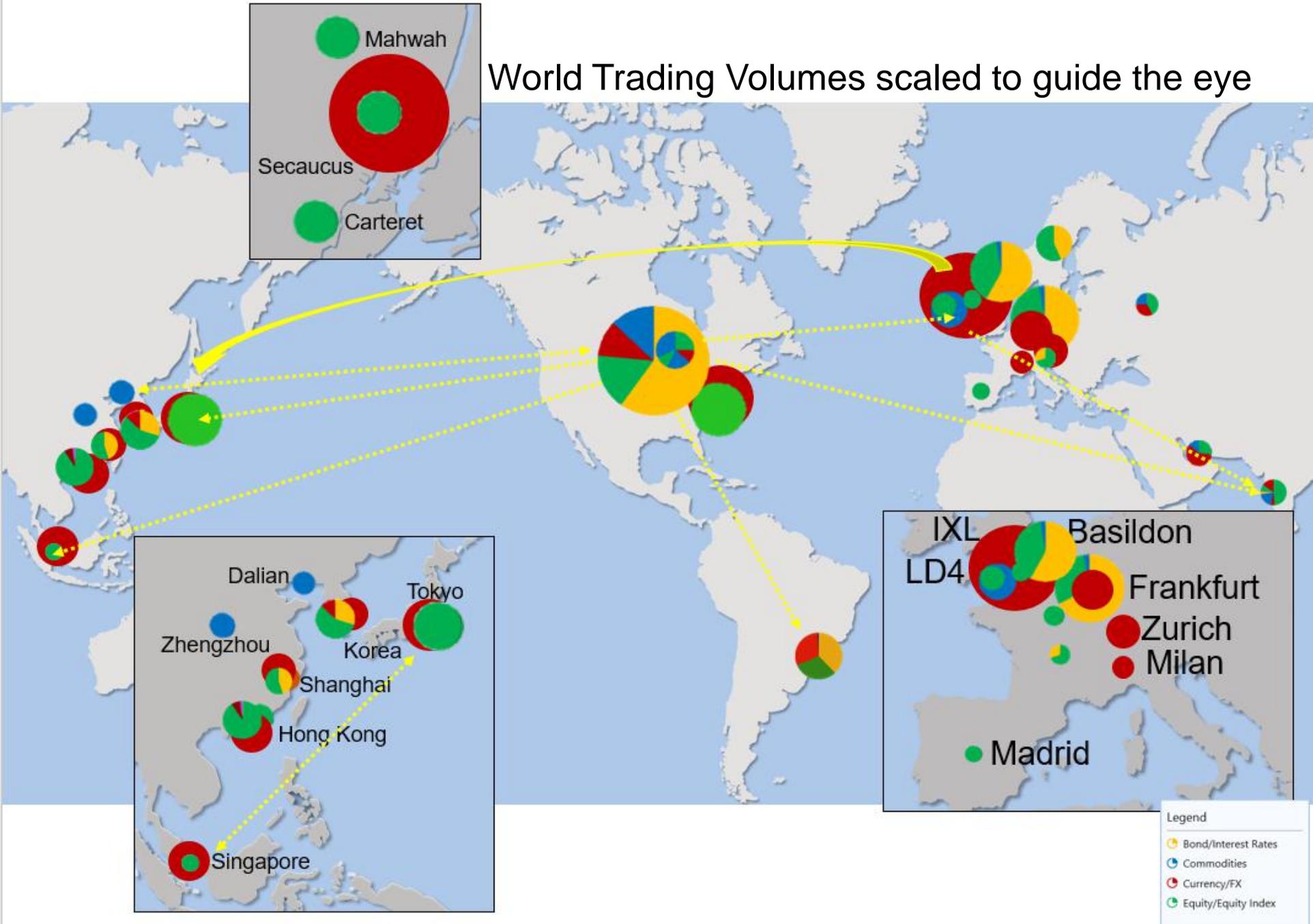
Model vs Measured Latency
For S&P 100 Trades on NASDAQ on Mar 22, 2019
Cumulative Distribution in Nanoseconds



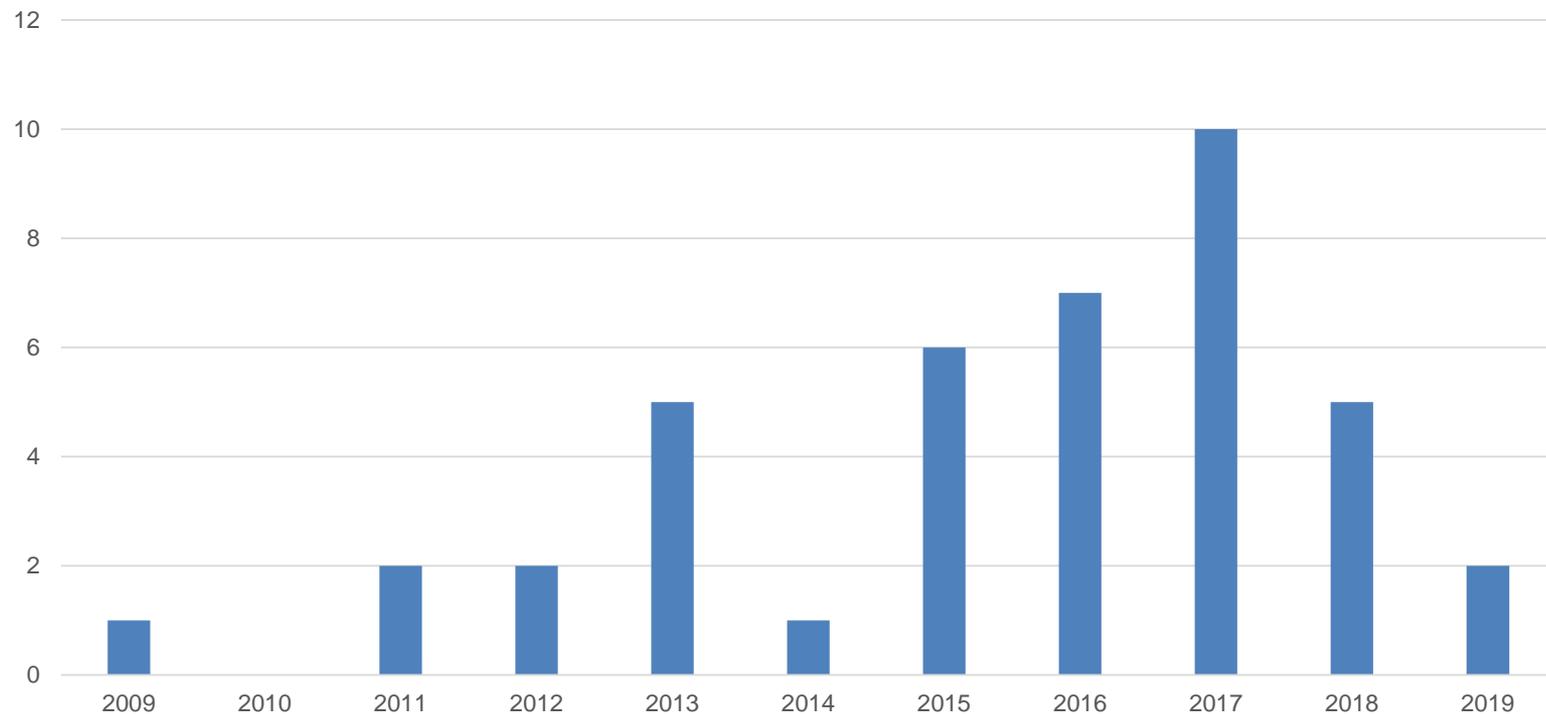
As announced we enabled level playing field competition



World Trading Volumes scaled to guide the eye



Nb of experimental licenses granted per year
200 km radius around Aurora

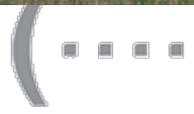
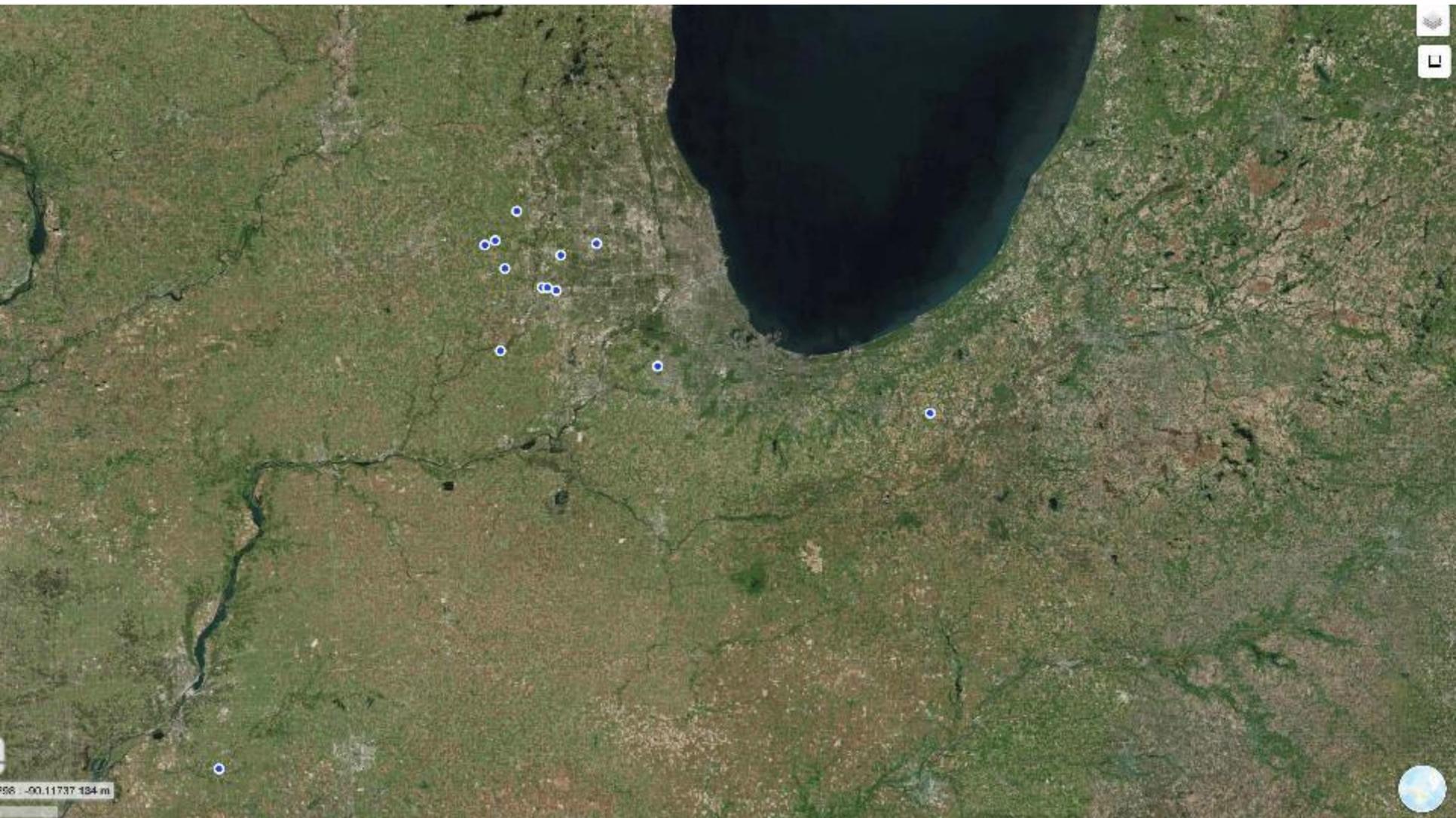


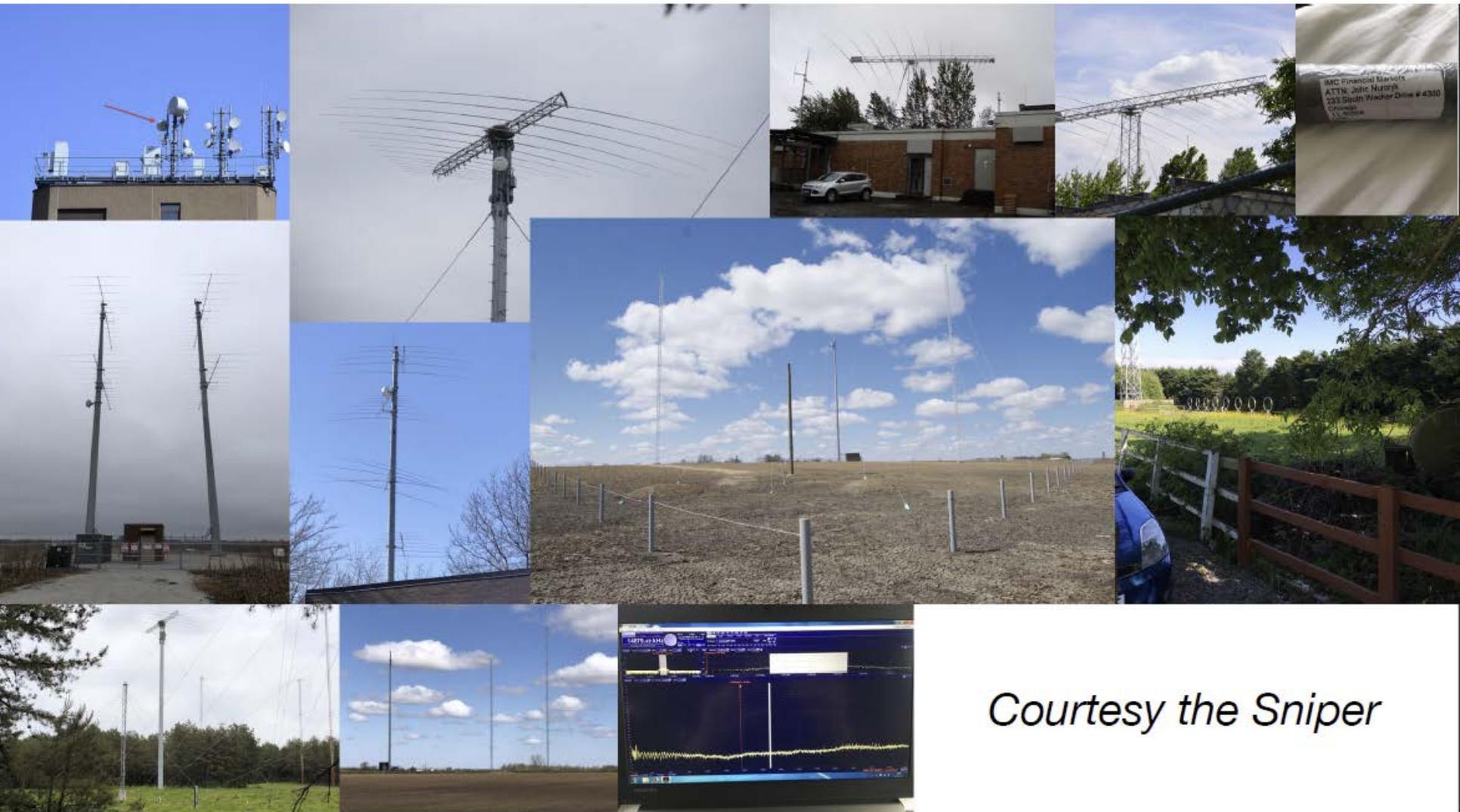
HF has been worked at for a long time



Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of grants	1	0	2	2	5	1	6	7	10	5	2
10Band LLC								1			
3DB Communication Inc.									2	1	1
Blueline Comm LLC									1		
CATERPILLAR, INC.				1			1	1	1		
Cognitive Data Dispatch, LLC			1								
COUNTY INFORMATION SERVICES, LLC							1				
Delmarva Broadband Services, LLC											1
DuPage Public Safety Communications	1		1		1		1				
Intel Corp.					1						
Jo-Carroll					1						
M-WAVE NETWORKS LLC										1	
Midwest Mobile					1						
POLRCOM LLC									2		
Rockwell Collins, Inc.				1	1						
Services Development Company LLC						1	2	3	2		
Toggle Communications LLC							1		1	2	
Transeastern Holding Corporate DBA Observant Network								1		1	
Ubiquiti Networks, Inc.								1			
Virtu Financial Operating LLC									1		

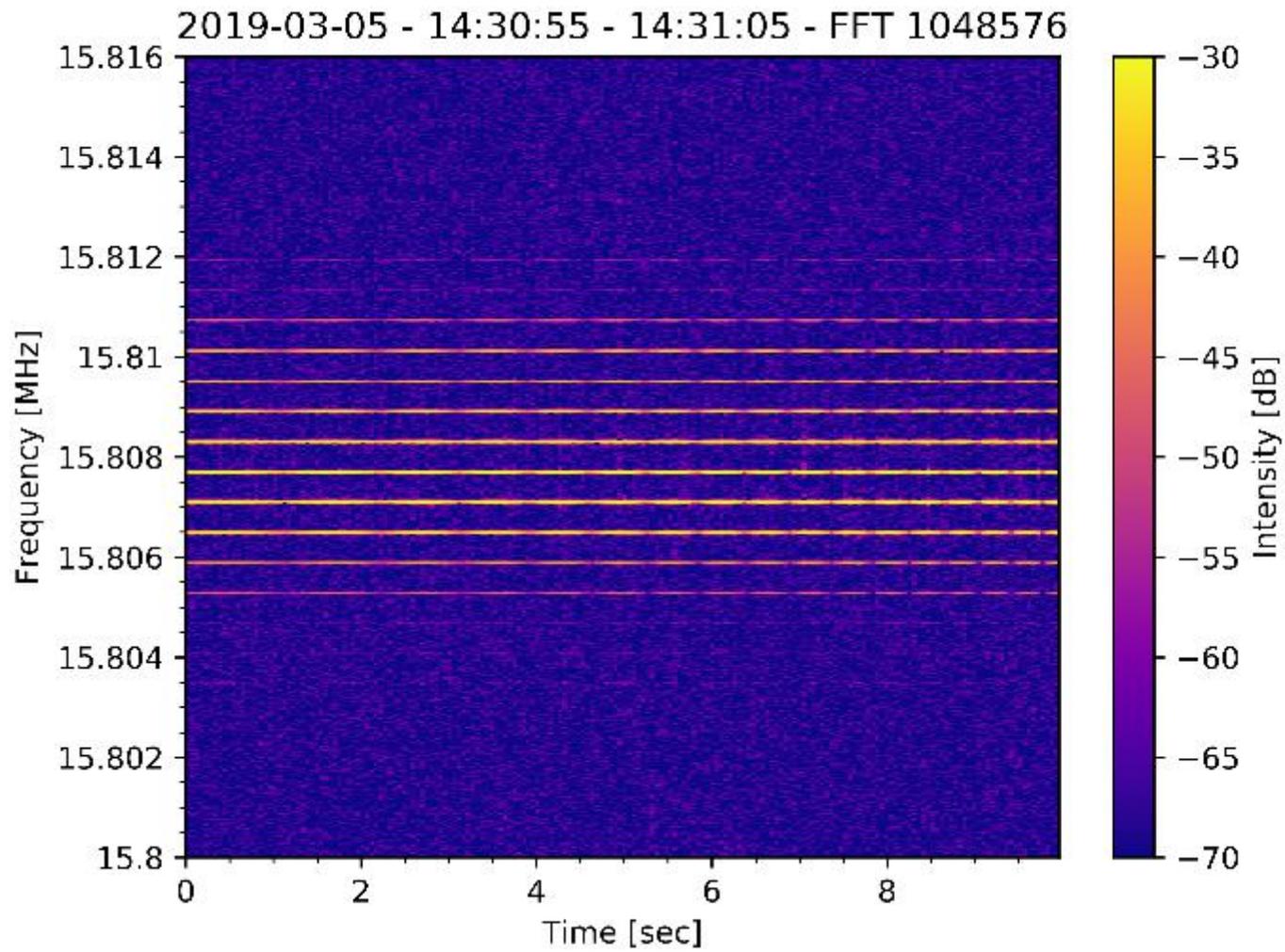


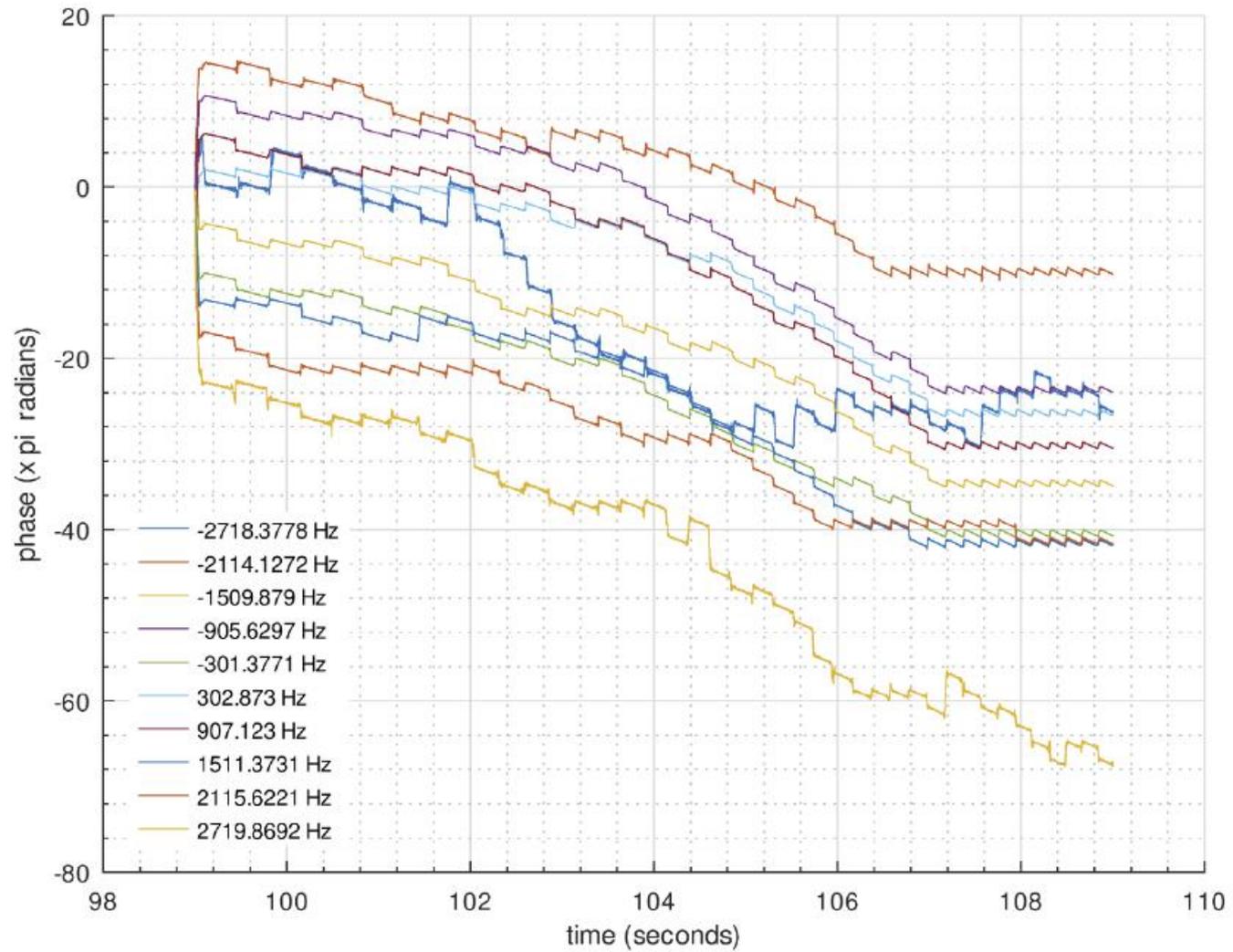


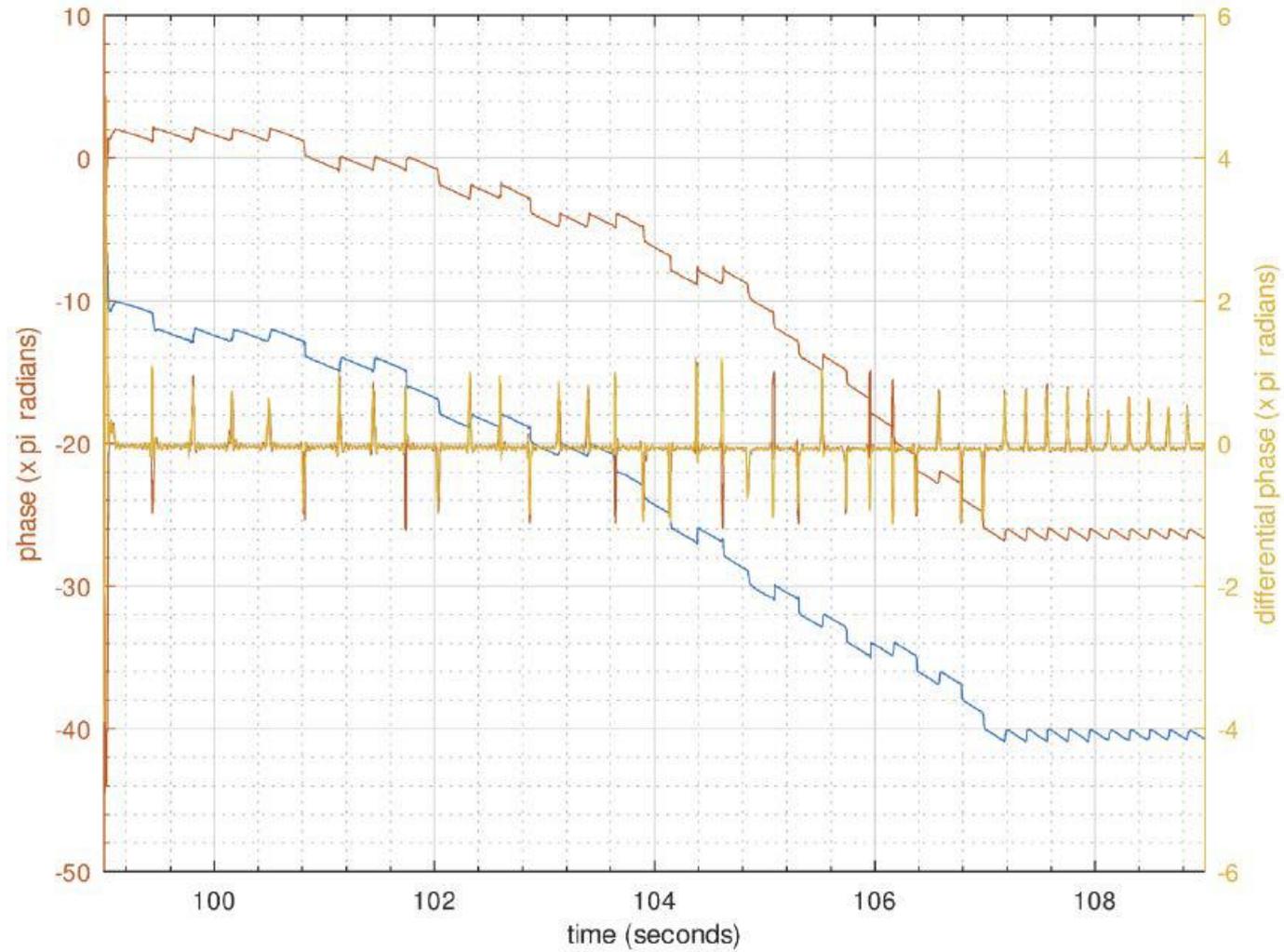


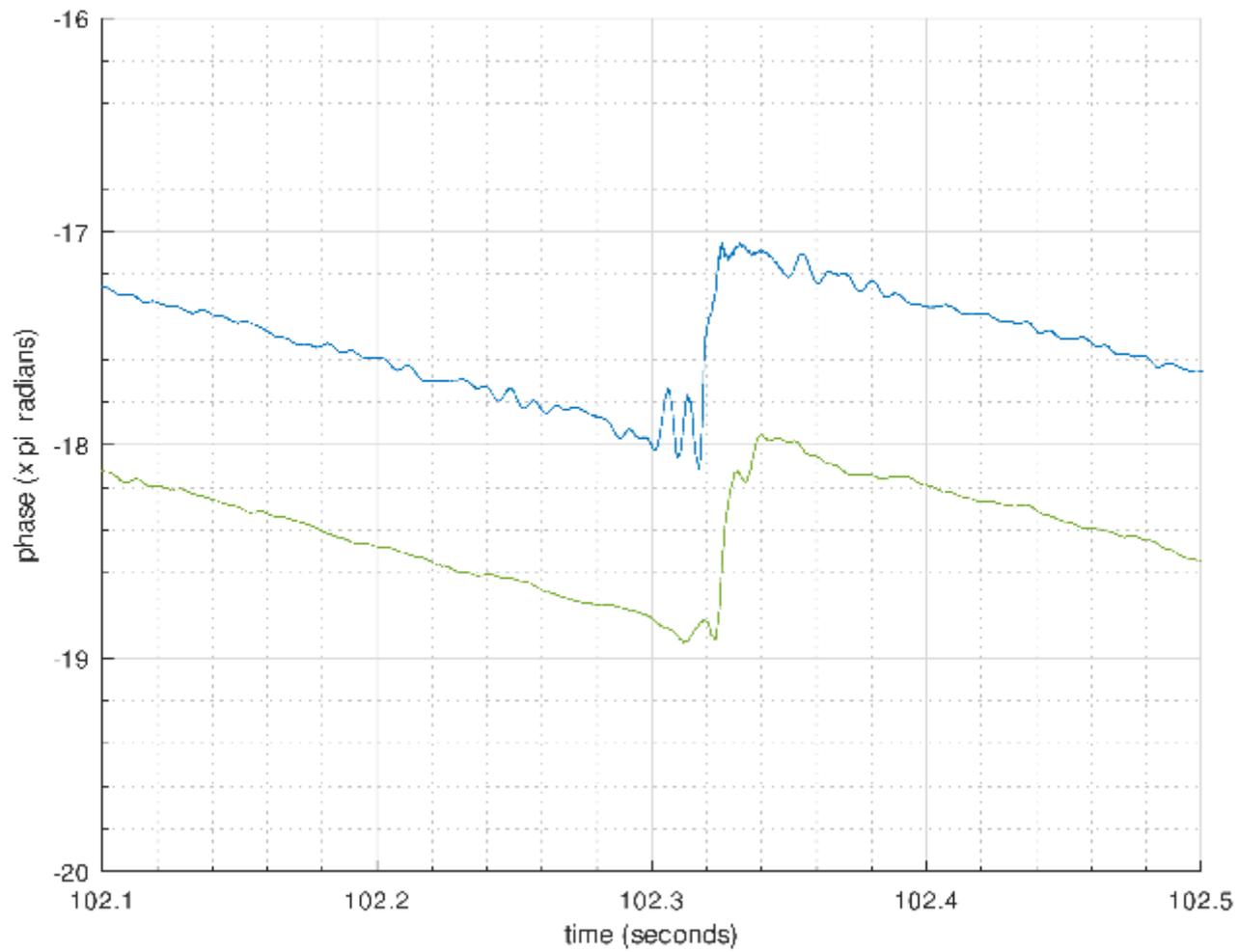
Courtesy the Sniper







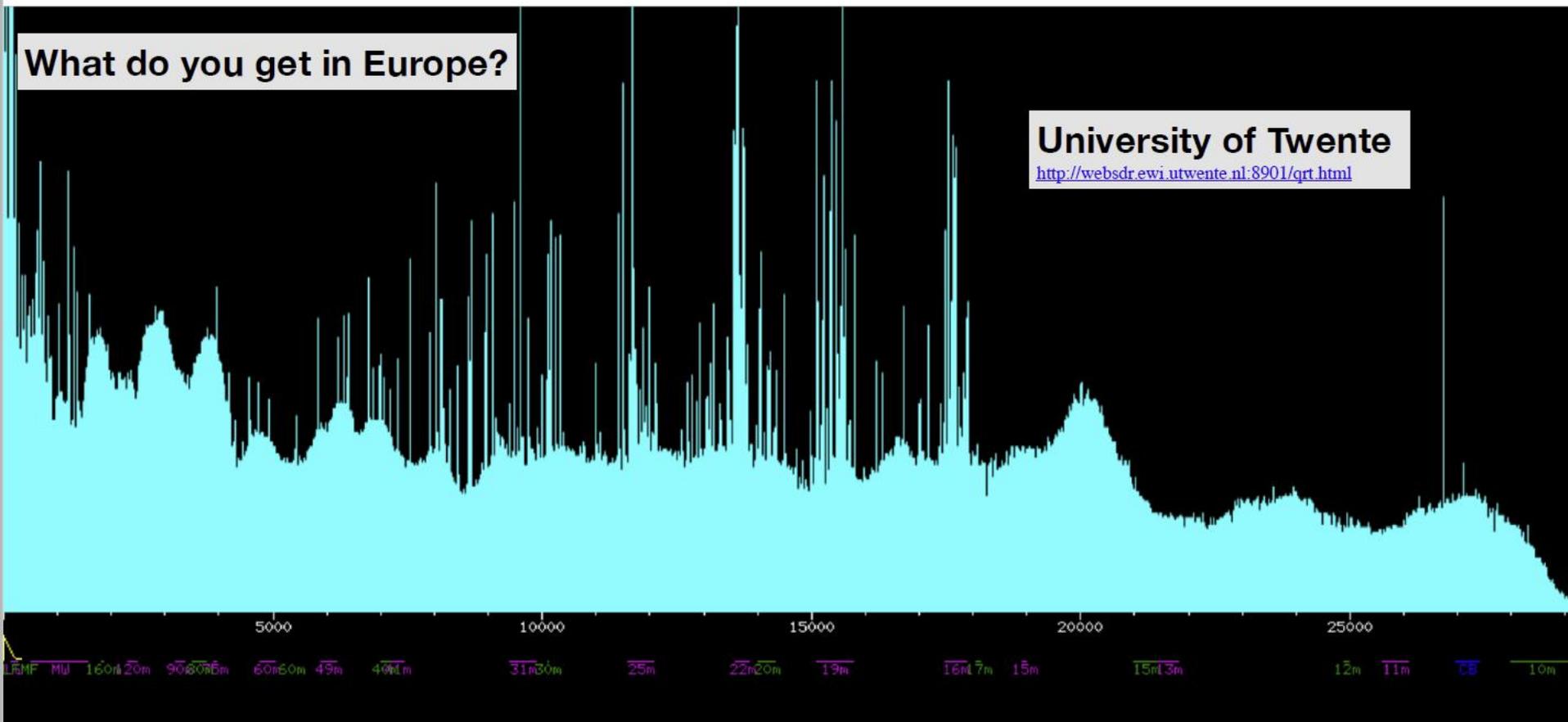


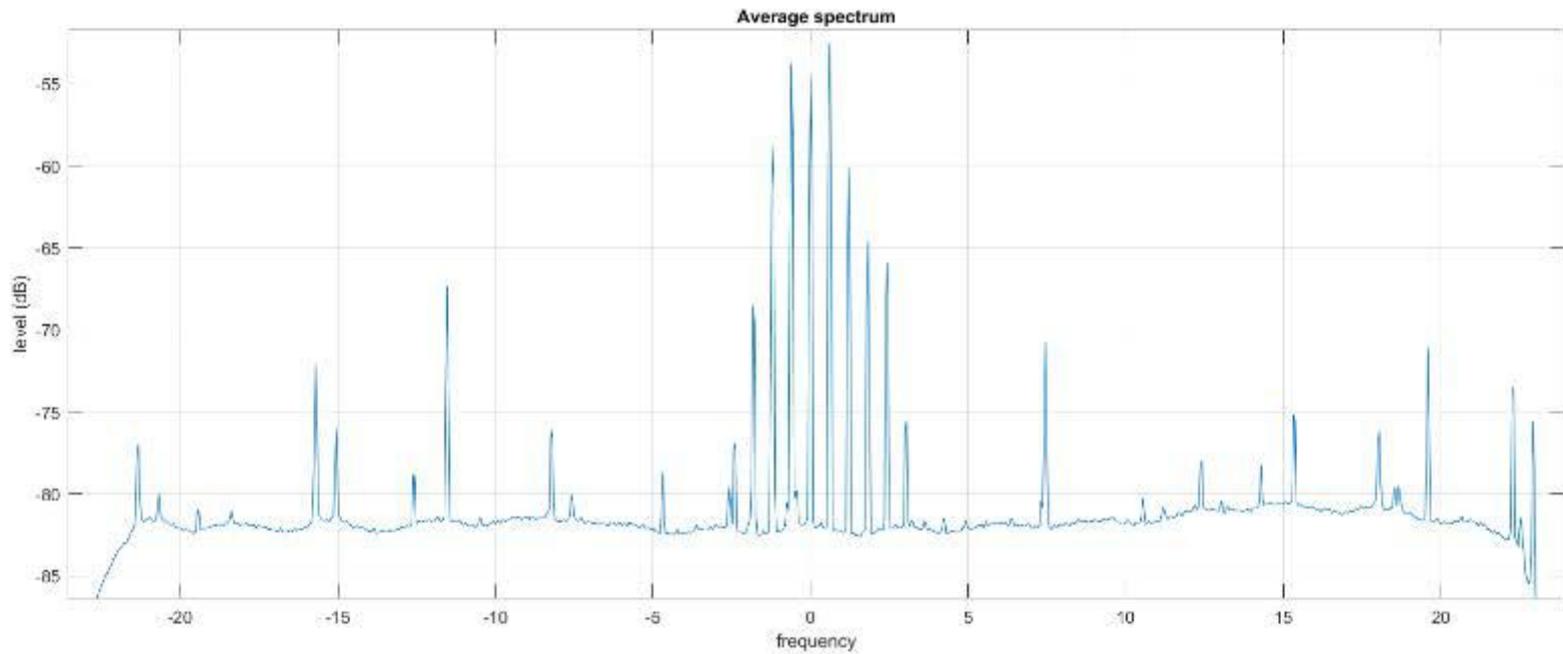


What do you get in Europe?

University of Twente

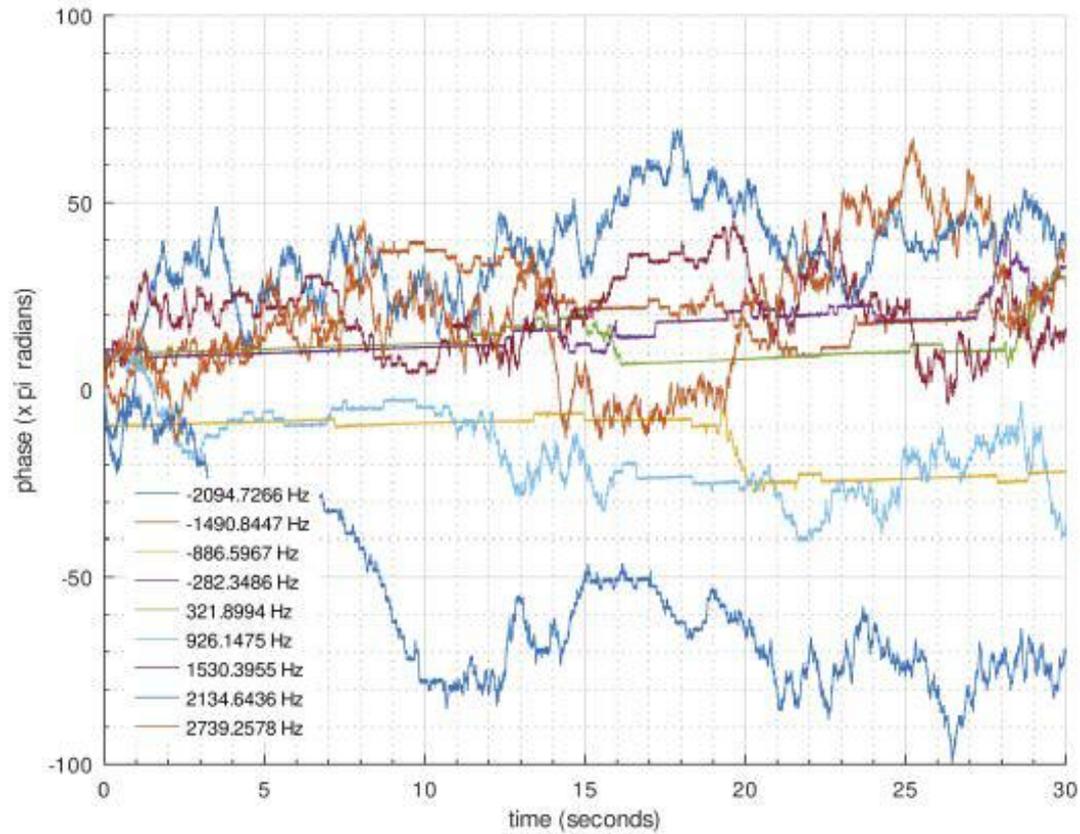
<http://websdr.ewi.utwente.nl:8901/qrt.html>





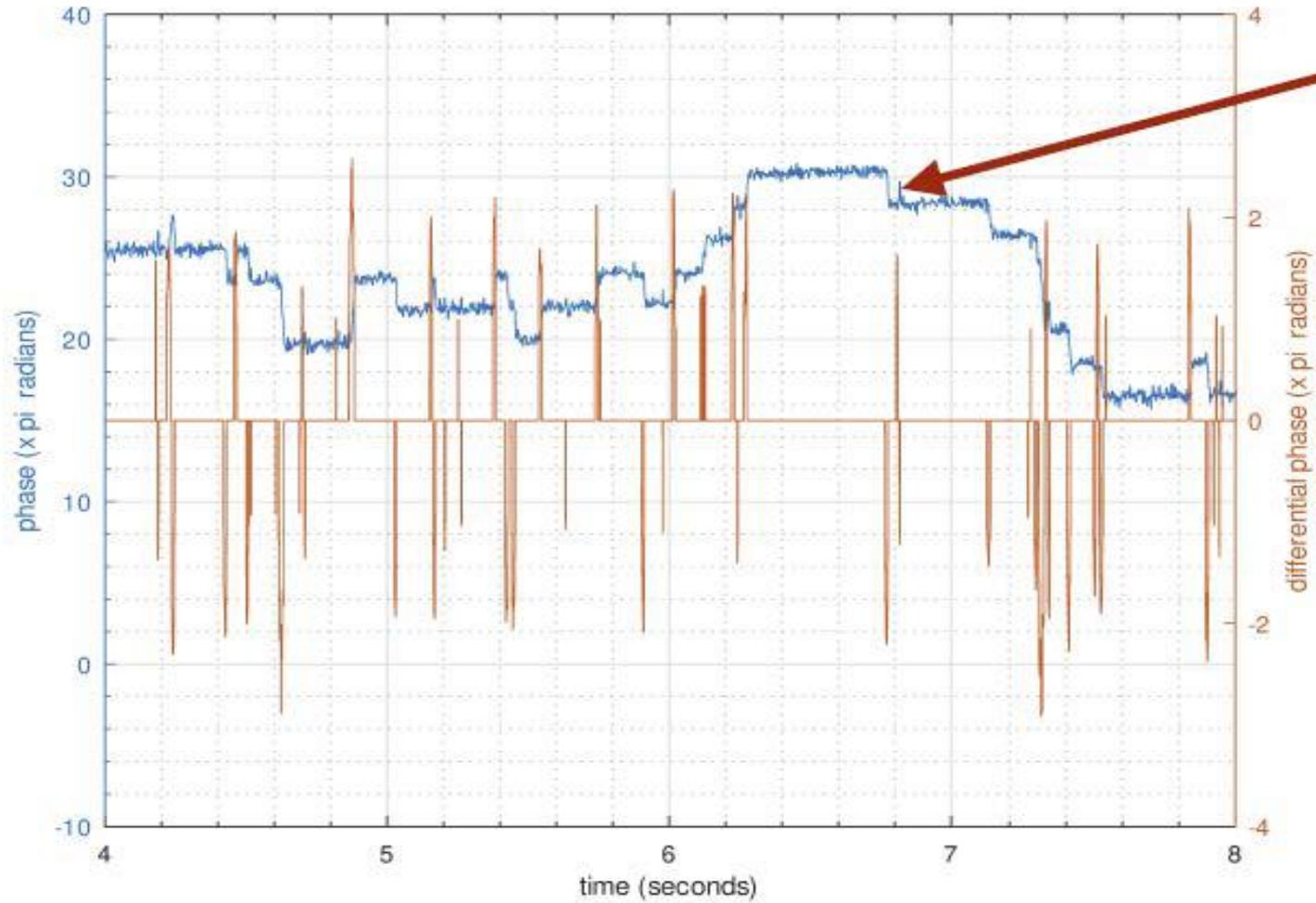
Somewhere in Europe





Same signal, more noise





You can trade with this but you have to control risk



	16/04/2019		22/03/2019	
CLK9				
	2	382	2	544
	3	33	3	39
	4	11	4	3
	5	2	5	0
	10	1		
CLM9				
	2	582		
	3	23		
	4	2		
	5	2		
	6	1		
ESM9				
	2	175	2	1341
	3	11	3	99
	4	1	4	14
			5	2
			6	1
6EM9				
	2	267	2	800
	3	22	3	82
	5	2	4	31
			5	8
			6	3
			7	1
			8	1
			10	1
			12	1
			13	1
			20	1
ZNM9				
	2	8	2	14

What to send?

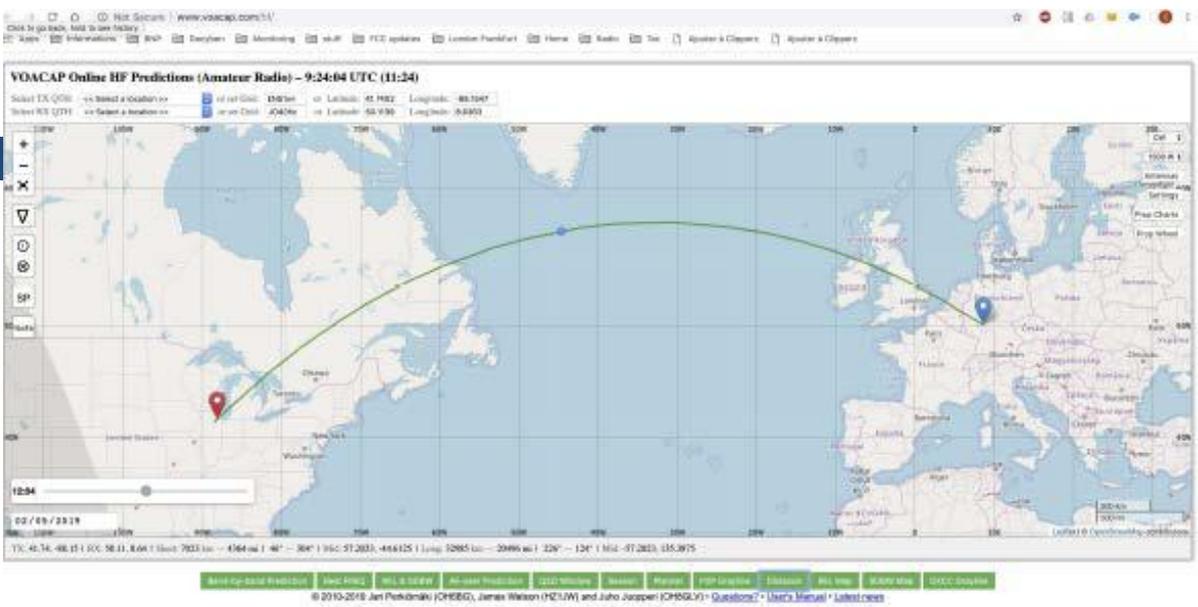
“Trade throughs”: an aggressor order removes completely the first limit and takes some of the second or third.

This is a sample count for two days and for relevant futures contracts on the CME

The order of magnitude of these trades is 10 000 per day.

Approximately 10% of the events occur in a 30 ms window.

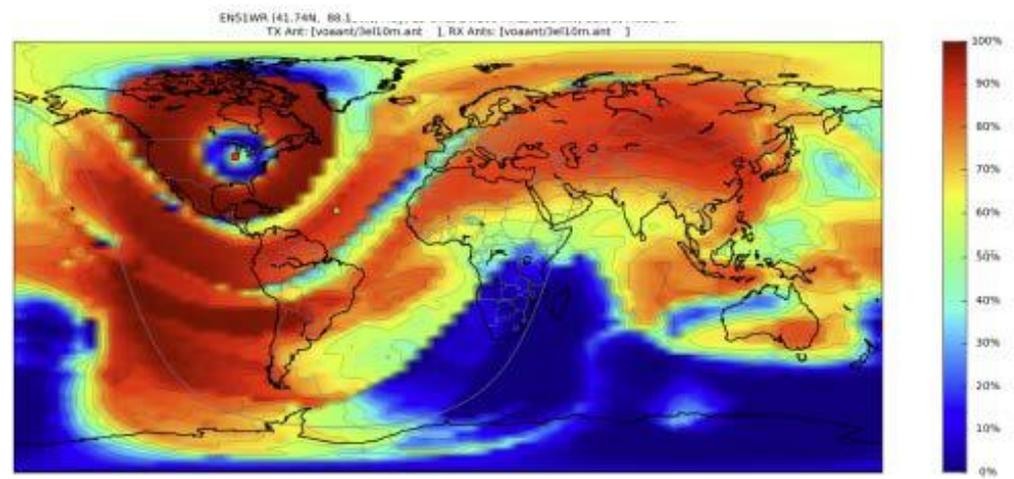
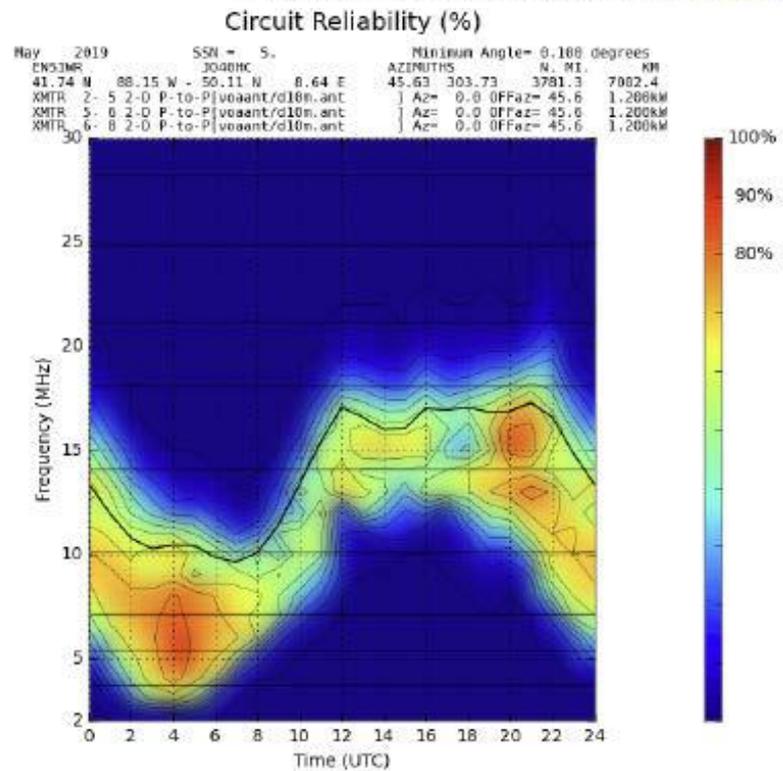




Then



Now



McKay & Quincy Data Map

