



Quincy Data & McKay Brothers

Time & Latency

Wireless Innovation in Financial Markets

October 2023

Stephane Tyc, Co-founder

Some History: The Original Wireless Network

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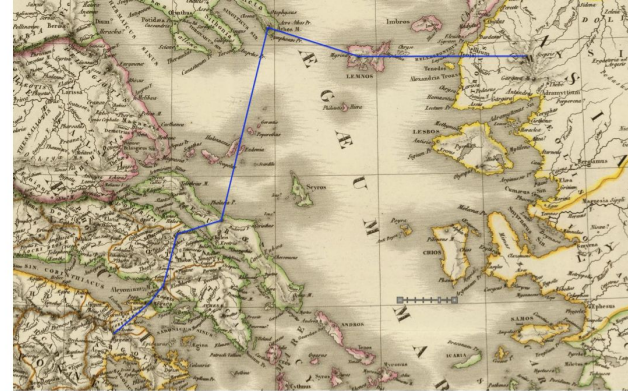
Medieval illumination of a fair



Leonardus Lessius

A moral theological approach to economic and financial questions.

The technology



	1200 BC	Today
Propagation speed	c	c or $2/3 \times c$
Indirectness	33%	<1%
Regeneration latency	1000 s	1 μ s
Bandwidth	1 bit/week	100 Mbits/s
Data rate	1 bit/10 years	10 Gbits/s
Data compression	Ideal	Must be ideal to compete

The fall of Troy was announced with pyres on mountain tops
As described by Aeschylus in Agamemnon

Communication is part of the overall market microstructure design

And it is highly dependent on the choice of Market data or Private fills first



Indian Fish Market Experience

Improved Communication Leads to More Efficient Markets

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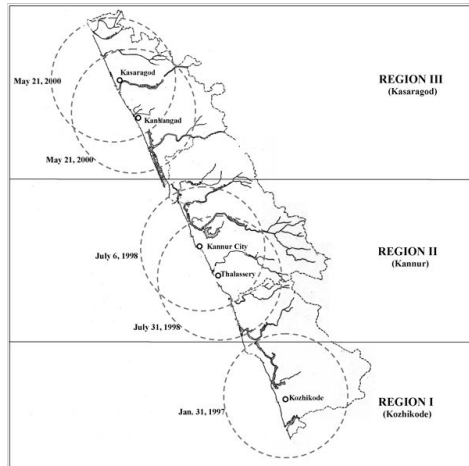


FIGURE II
Spread of Mobile Phone Coverage in Kasaragod, Kannur, and Kozhikode Districts

sea.¹⁸ In general, phones were bought by the largest boats first, since they faced the largest potential gains to arbitrage and were also more likely to be able to afford the phones, which were initially expensive (as much as \$100 US).

Our empirical analysis compares how changes in the outcomes of interest (price dispersion, waste, and welfare) correspond to the staggered introduction of mobile phones across the regions. We can break the sample into four time periods: period 0

18. Both fishermen and buyers report that it is extremely rare for a negotiated deal at sea to be broken later, largely due to the need to establish a credible reputation.

THE
QUARTERLY JOURNAL
OF ECONOMICS

Vol. CXXII August 2007 Issue 3

THE DIGITAL PROVIDE: INFORMATION (TECHNOLOGY),
MARKET PERFORMANCE, AND WELFARE IN THE
SOUTH INDIAN FISHERIES SECTOR*

ROBERT JENSEN

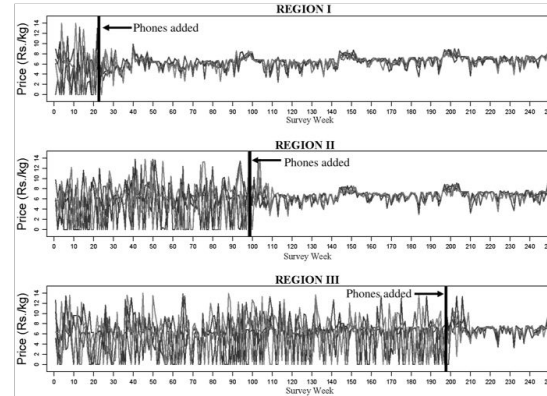


FIGURE IV
Prices and Mobile Phone Service in Kerala

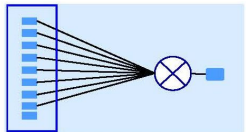
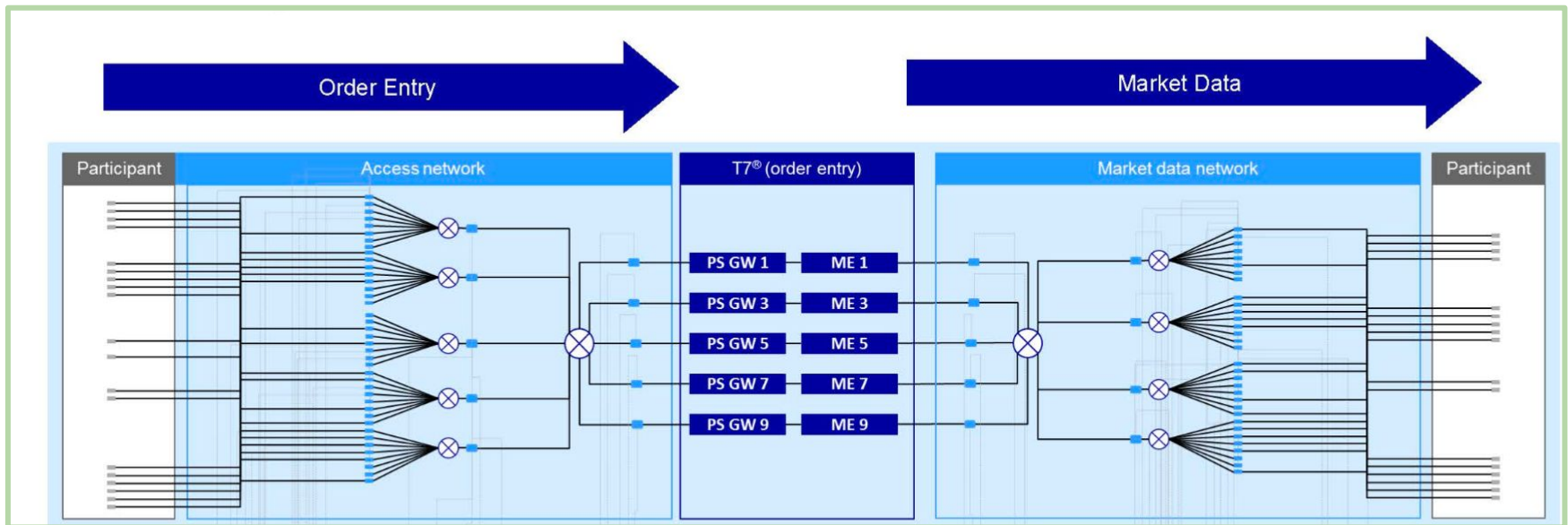
Data from the Kerala Fisherman Survey conducted by the author. The price series represent the average 7:30–8:00 A.M. beach price for average sardines. All prices in 2001 Rs.



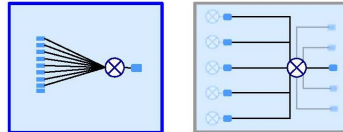
EUREX: Full transparency and market data first

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Exchange Architecture: Order Entry and Market Data Paths



Interarrival time
arbitrarily small



Overtaking probability
drops to zero above 5 ns
interarrival time

https://www.eurex.com/resource/blob/1567598/d42f3075b0ed50136f22b4dd5ba6283d/data/presentation_stac_summit_new_york.pdf



CME: A more nuanced approach

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Balancing private fills and market data

Critical Updates (*October 2022*)

CME Globex Performance Change for E-mini S&P 500 Futures

Effective this **Sunday, October 30** (trade date Monday, October 31), CME Globex will implement internal changes to the lead month future contracts in E-mini S&P markets that will result in additional processing on a small subset of match events. These changes will have no functional or messaging impacts to client gateways. In internal testing, these changes increased latency slightly and had no impact on market dynamics. There is no plan to apply these changes to other markets at this time.

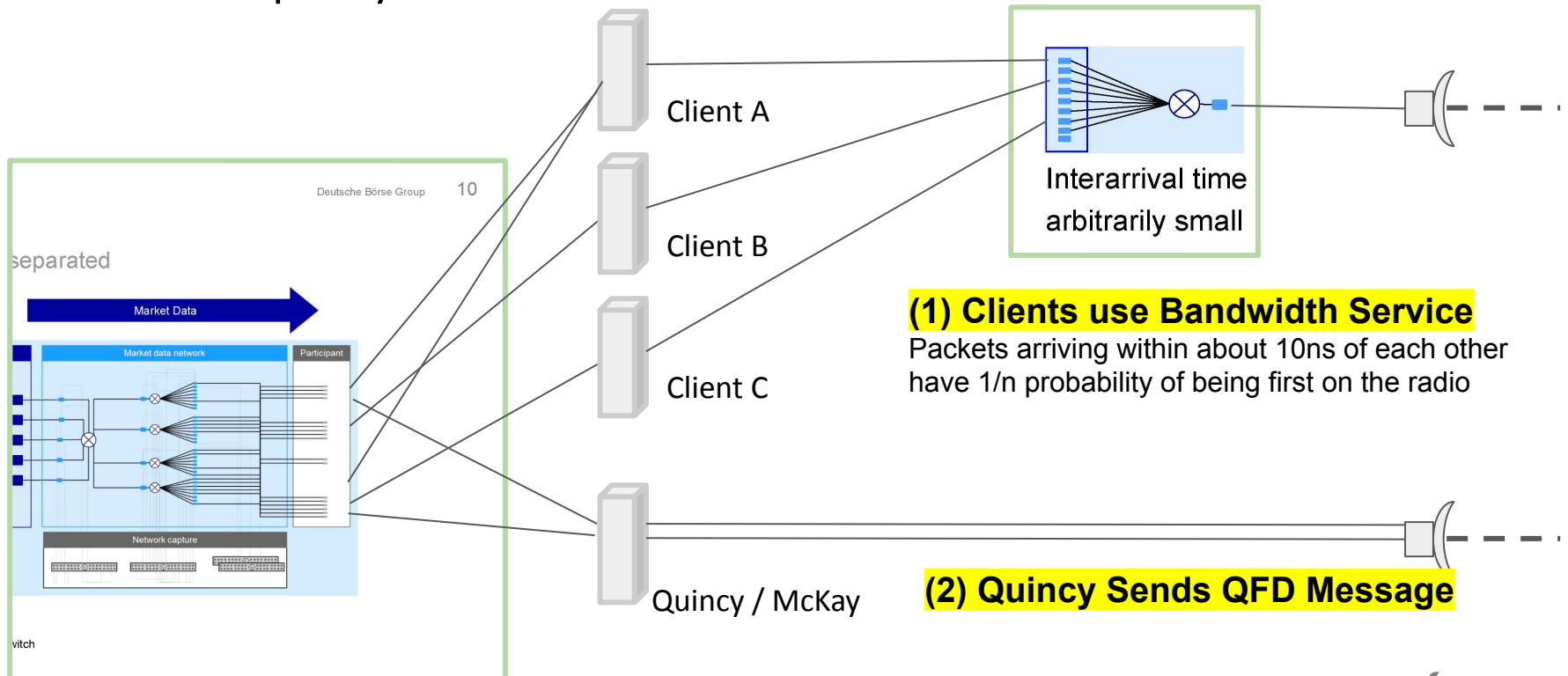


McKay/Quincy: a trend toward market data first

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Constrained by

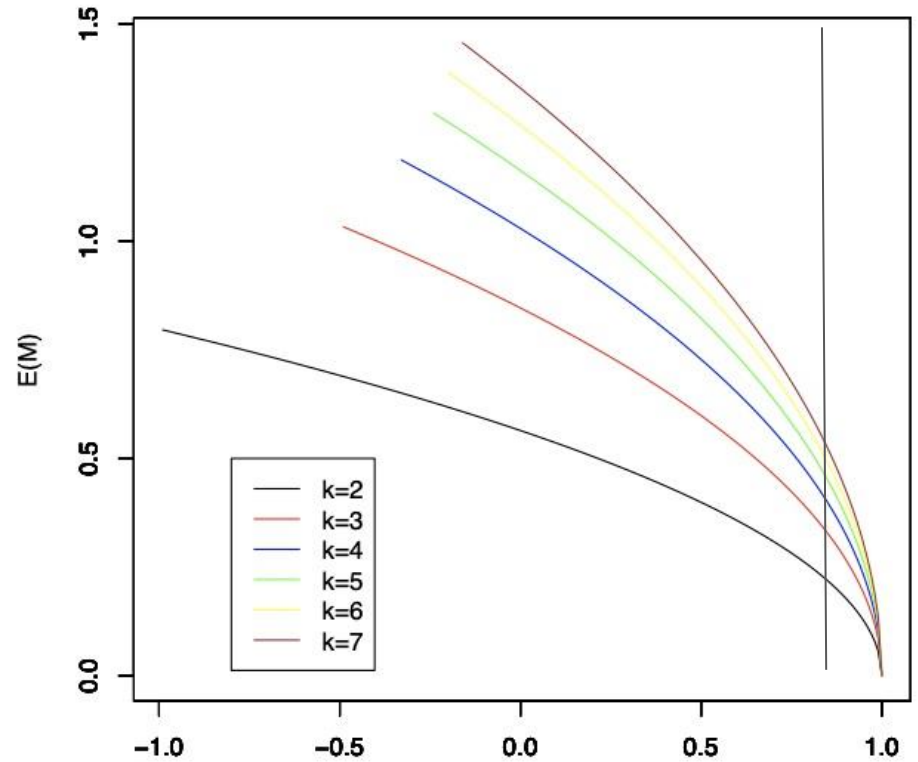
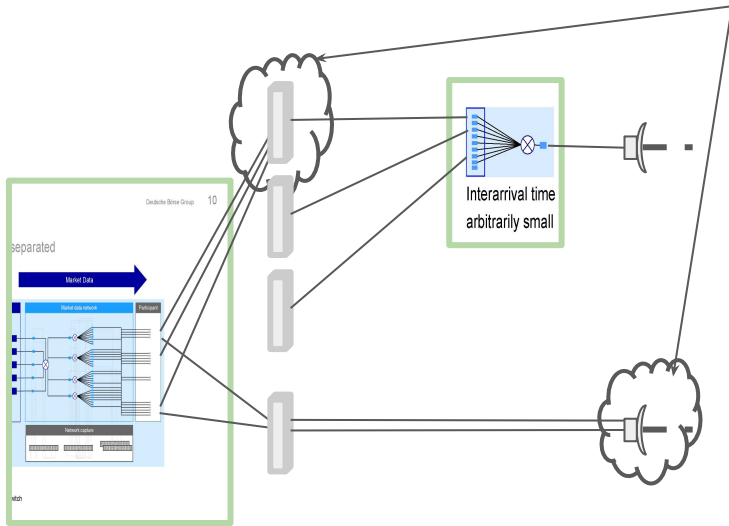
- Market designs
- The capacity of wireless networks



(...)

CME G-Link Arbitration

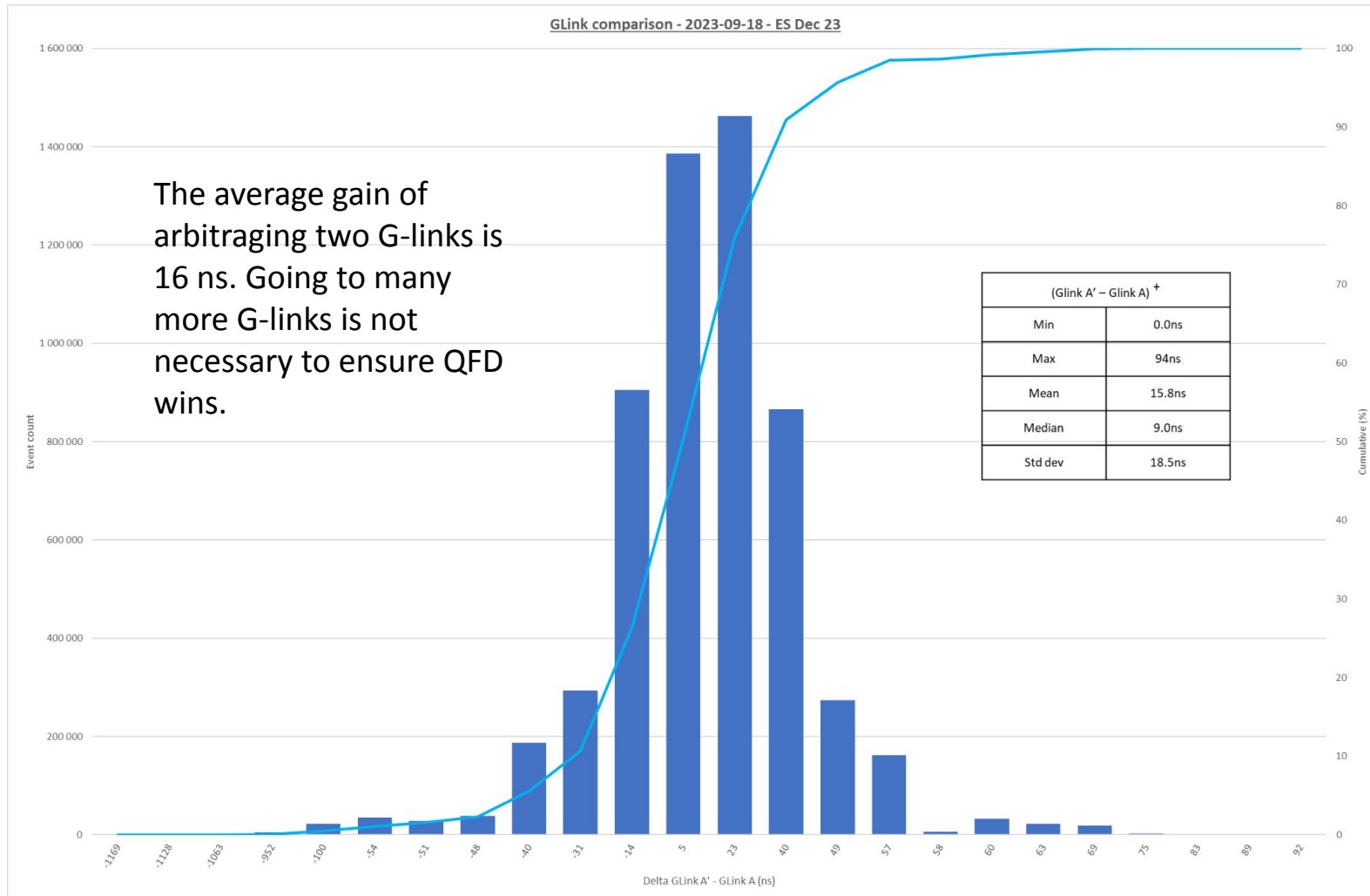
G-link arbitration



Citation for published version (APA):
Nadarajah, S., Afuecheta, E., & Chan, S. (2018). On the distribution of maximum of multivariate normal random vectors. *Communications in Statistics - Theory and Methods*. Advance online publication. <https://doi.org/10.1080/03610926.2018.1465088>



G-Link Comparison



The average gain of arbitraging two G-links is 16 ns. Going to many more G-links is not necessary to ensure QFD wins.

Distribution of packet time GLink A - packet time GLink A'

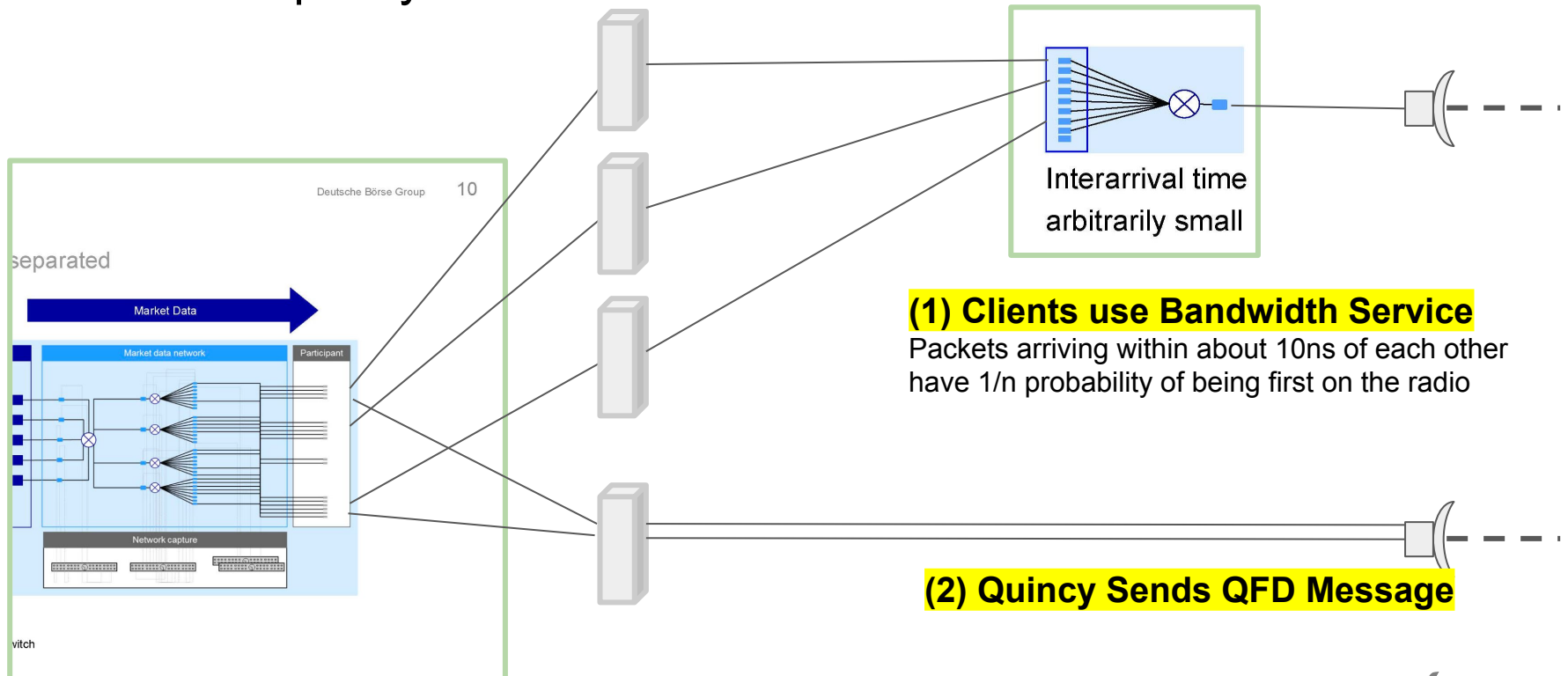


McKay/Quincy: a trend toward market data first

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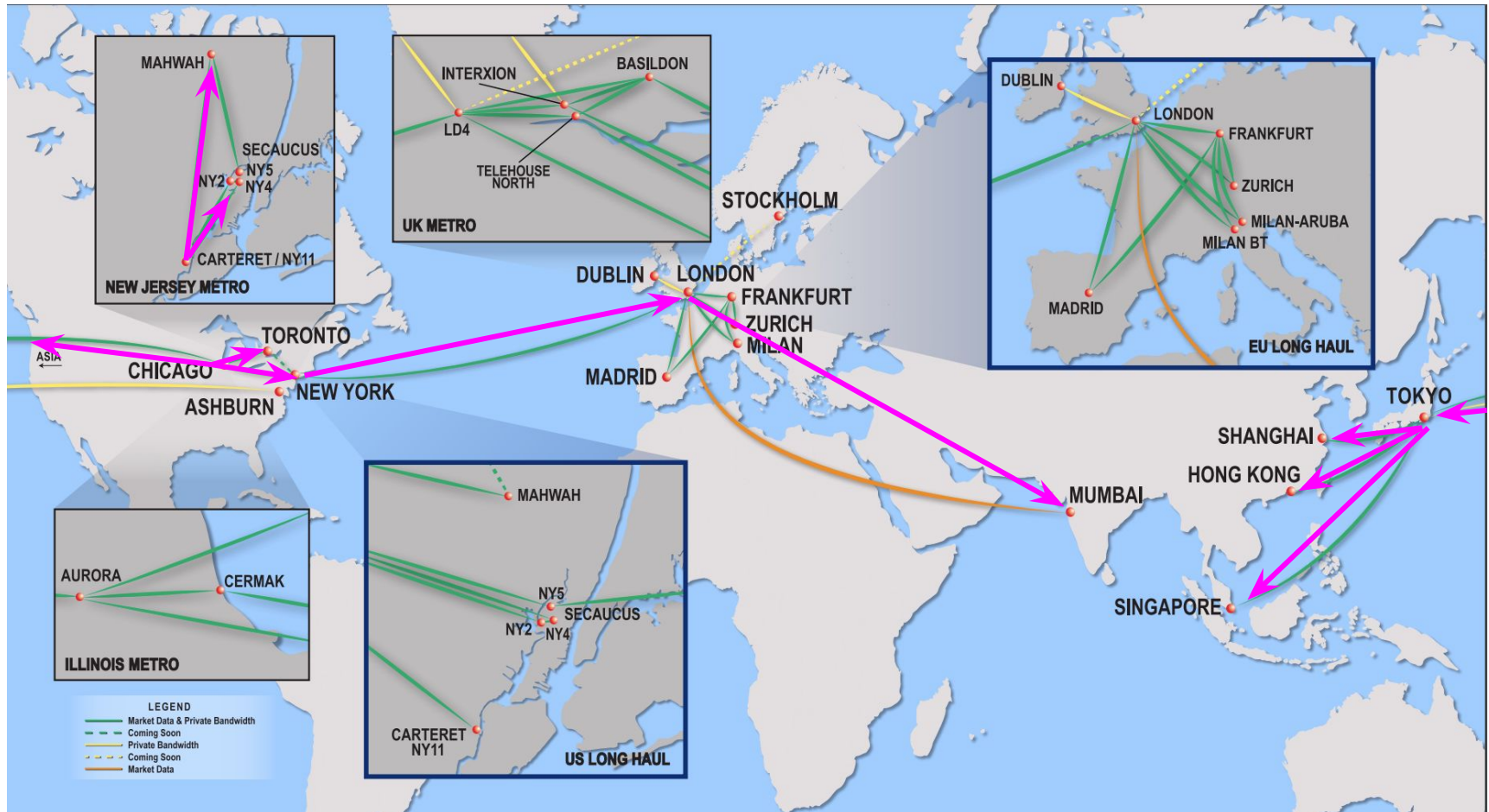
- Market designs
- The capacity of wireless networks



(...)

McKay/Quincy : a trend toward market data first

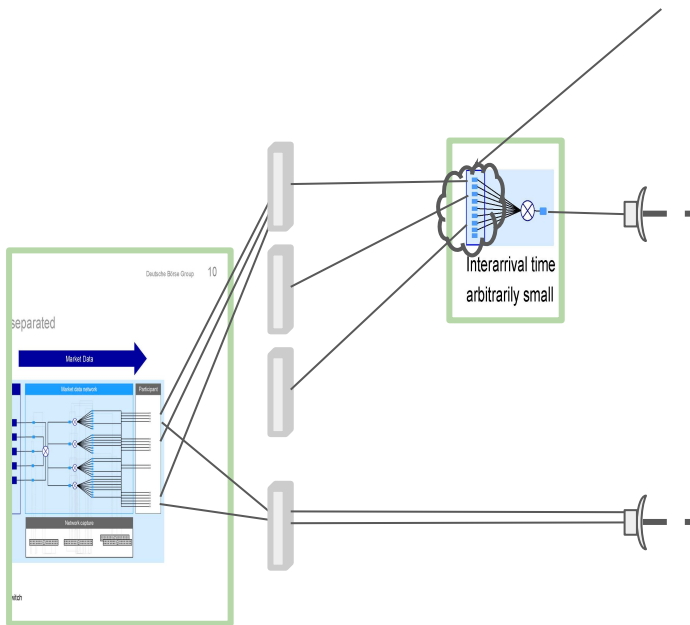
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Measuring the Impact of Collisions at the Policer

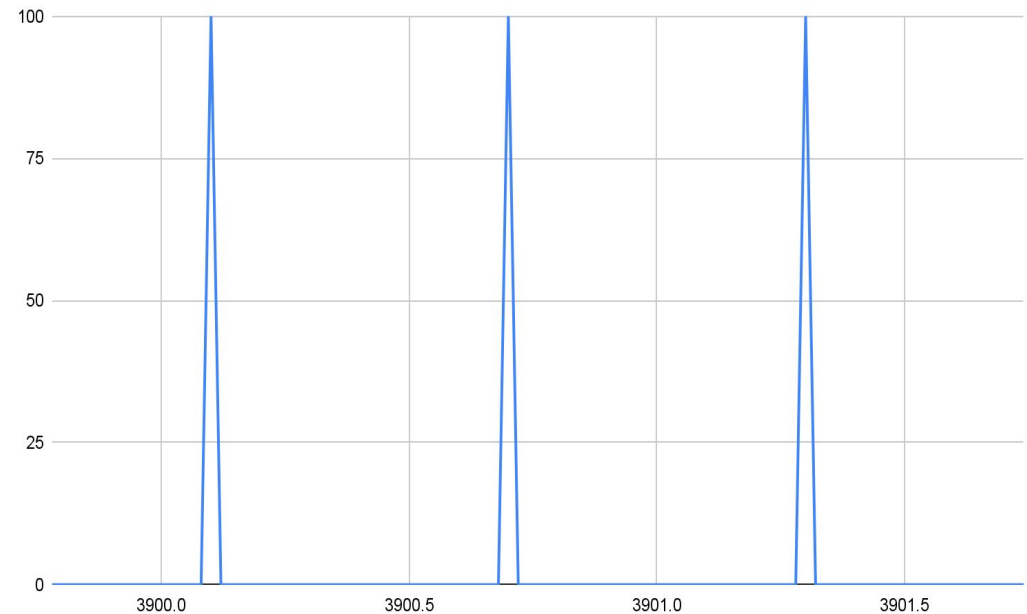
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Policer statistics



No Jitter

Three way collision of 3 packets of 8 bytes (300 observations)

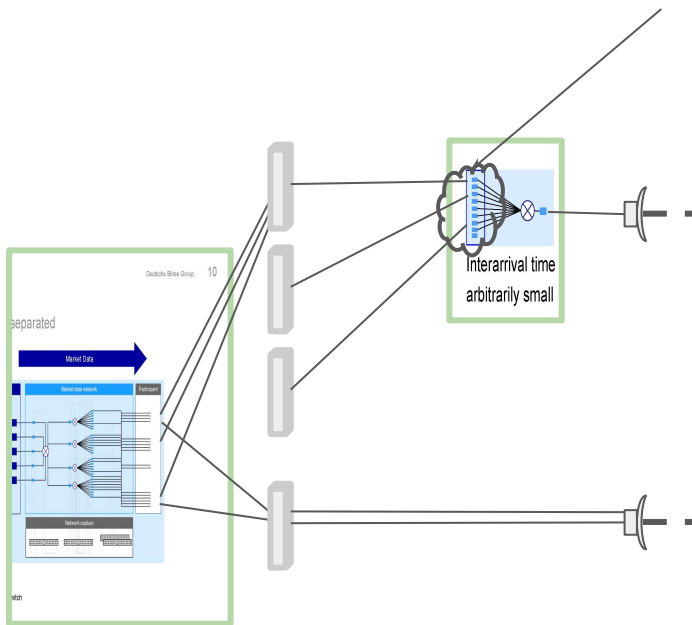


Theoretical latency distribution at reception of MBEL for 3 way collision without considering jitter



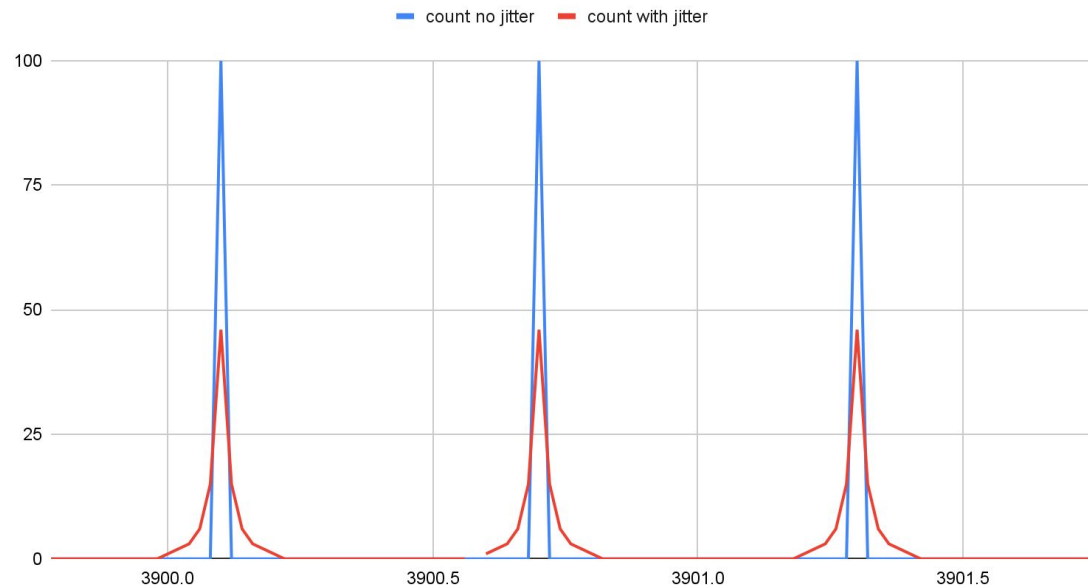
Measuring the Impact of Collisions at the Policer

Policer statistics



Including the jitter of the Microwave Circuit

Three way collision of 3 packets of 8 bytes (300 observations)



Theoretical latency distribution at reception of MBEL for 3 way collision with jitter:

1. Fast jitter: radio delimiter, Ethernet to modem, clock boundary crossing (we display the measured jitter in the graphs above) : of the order of 40 nanoseconds
2. Slow jitter: k factor changes, index of refraction changes, rain (how much is this?)



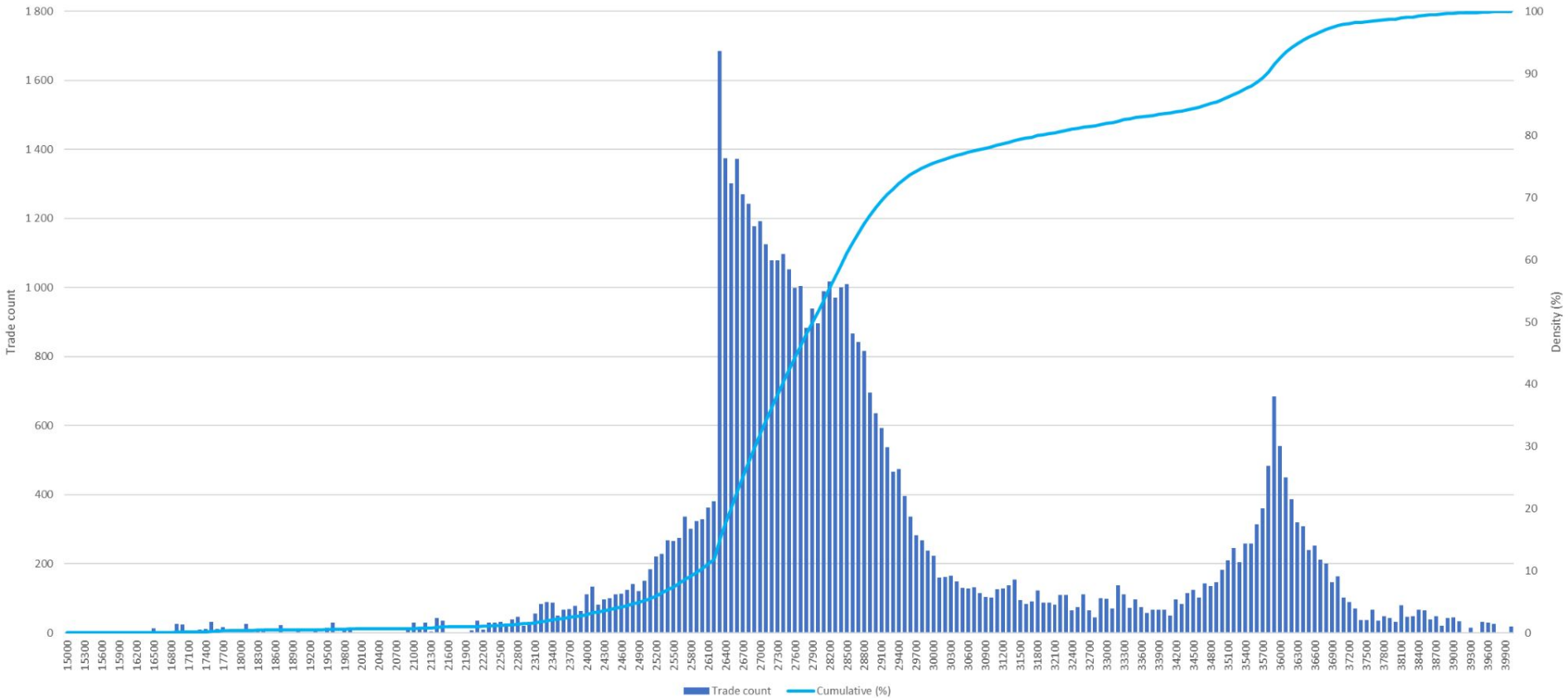
What is happening in HF land?

(.....)

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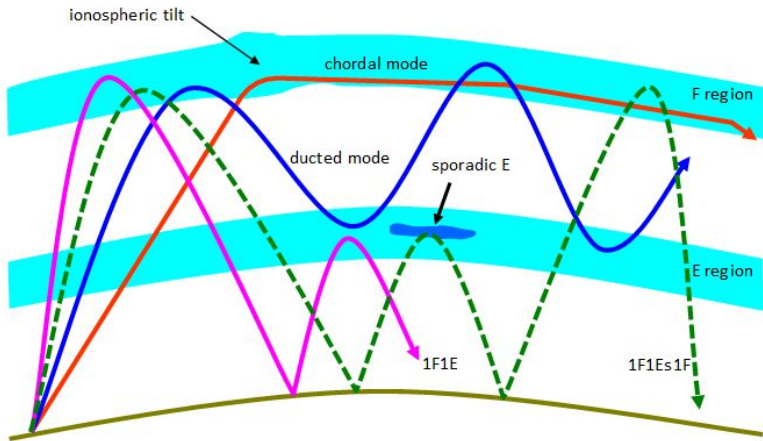
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Trade count on Eurex (DAX) following a trade through event on CME (ES) - 2023-08-21 to 2023-08-25

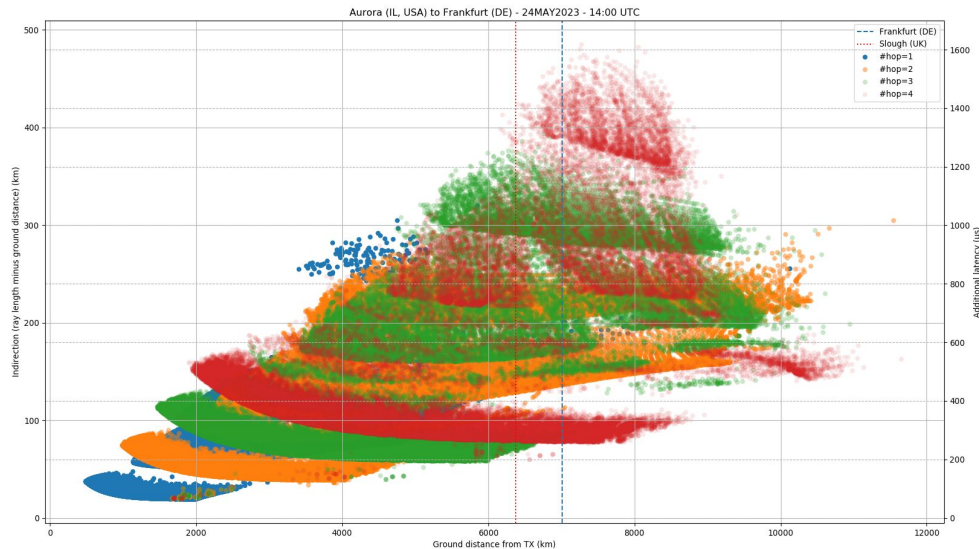


What is happening in HF land?

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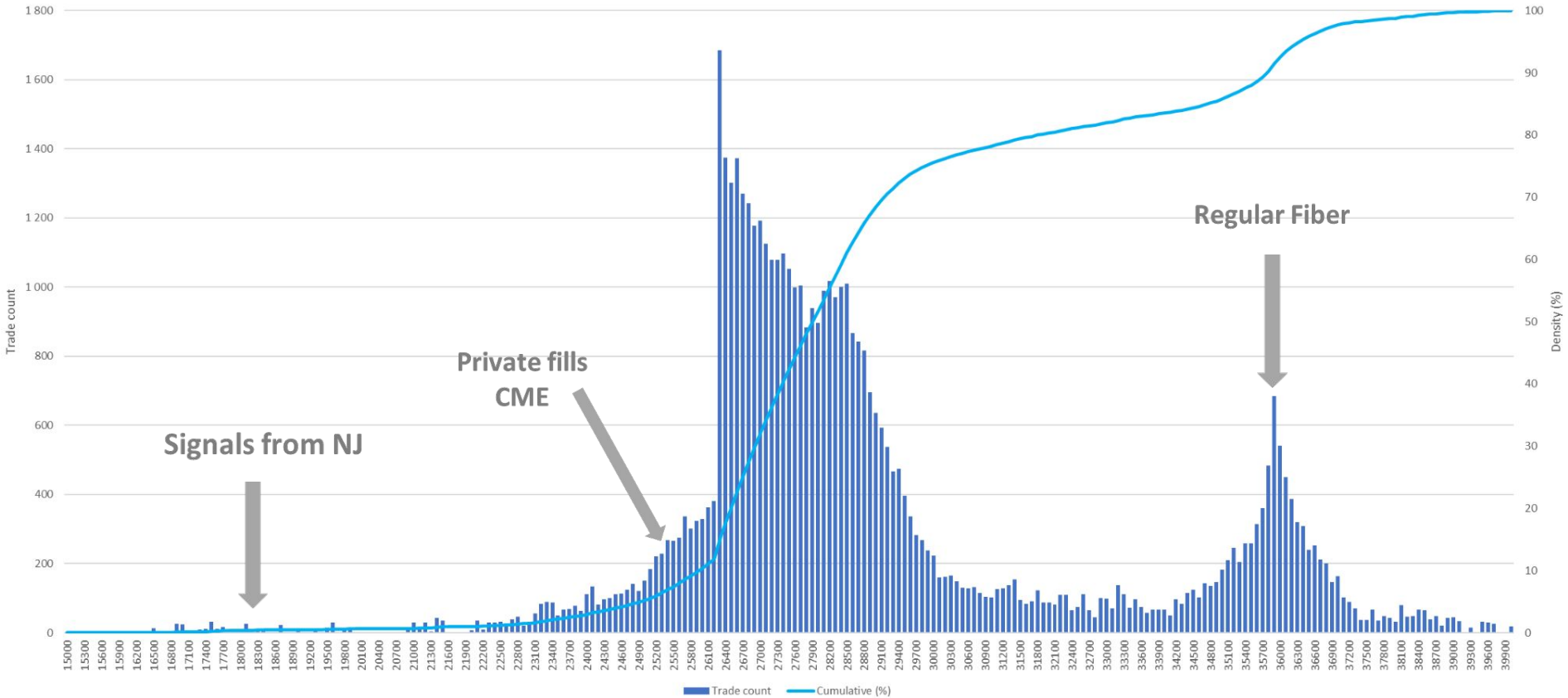


Indirection as a function of ground distance from TX



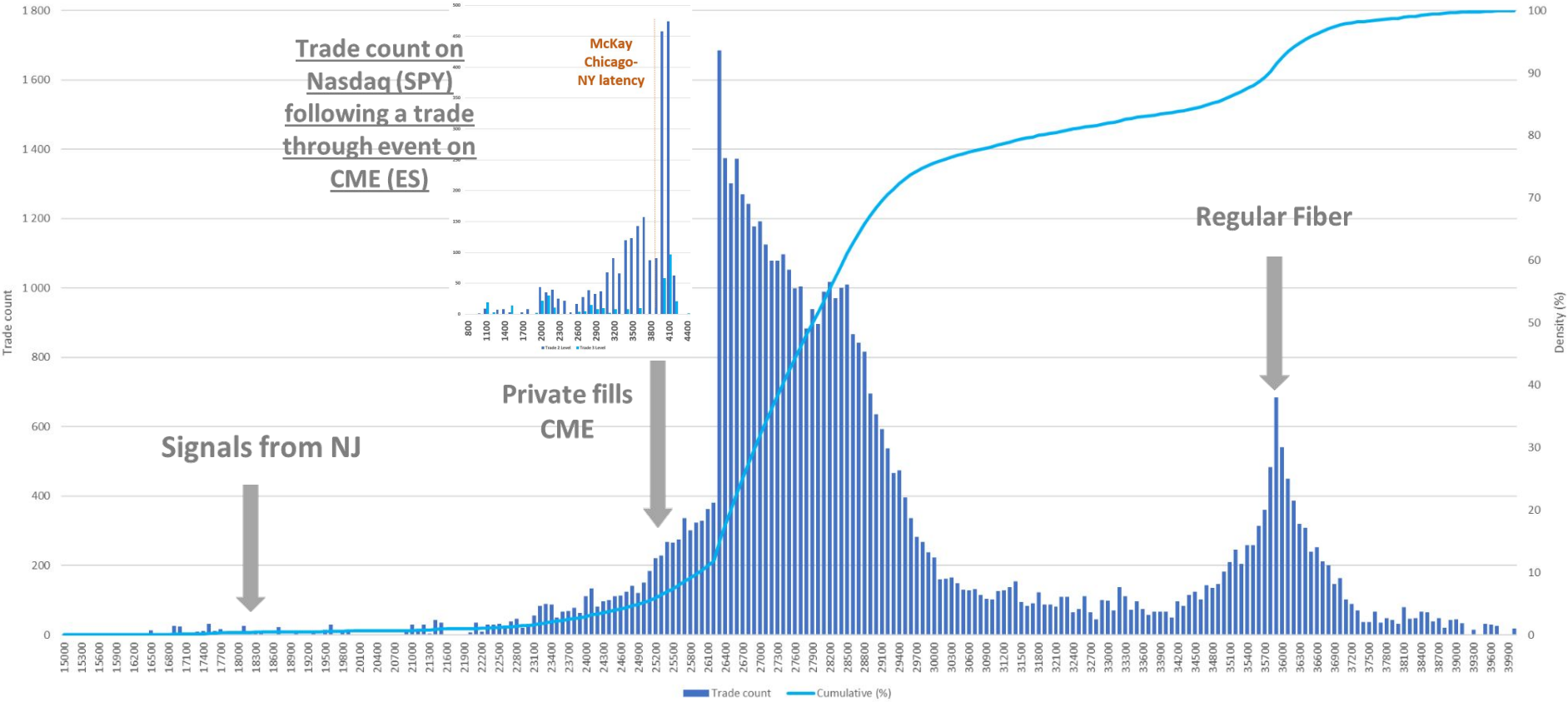
What is happening in HF land?

Trade count on Eurex (DAX) following a trade through event on CME (ES) - 2023-08-21 to 2023-08-25



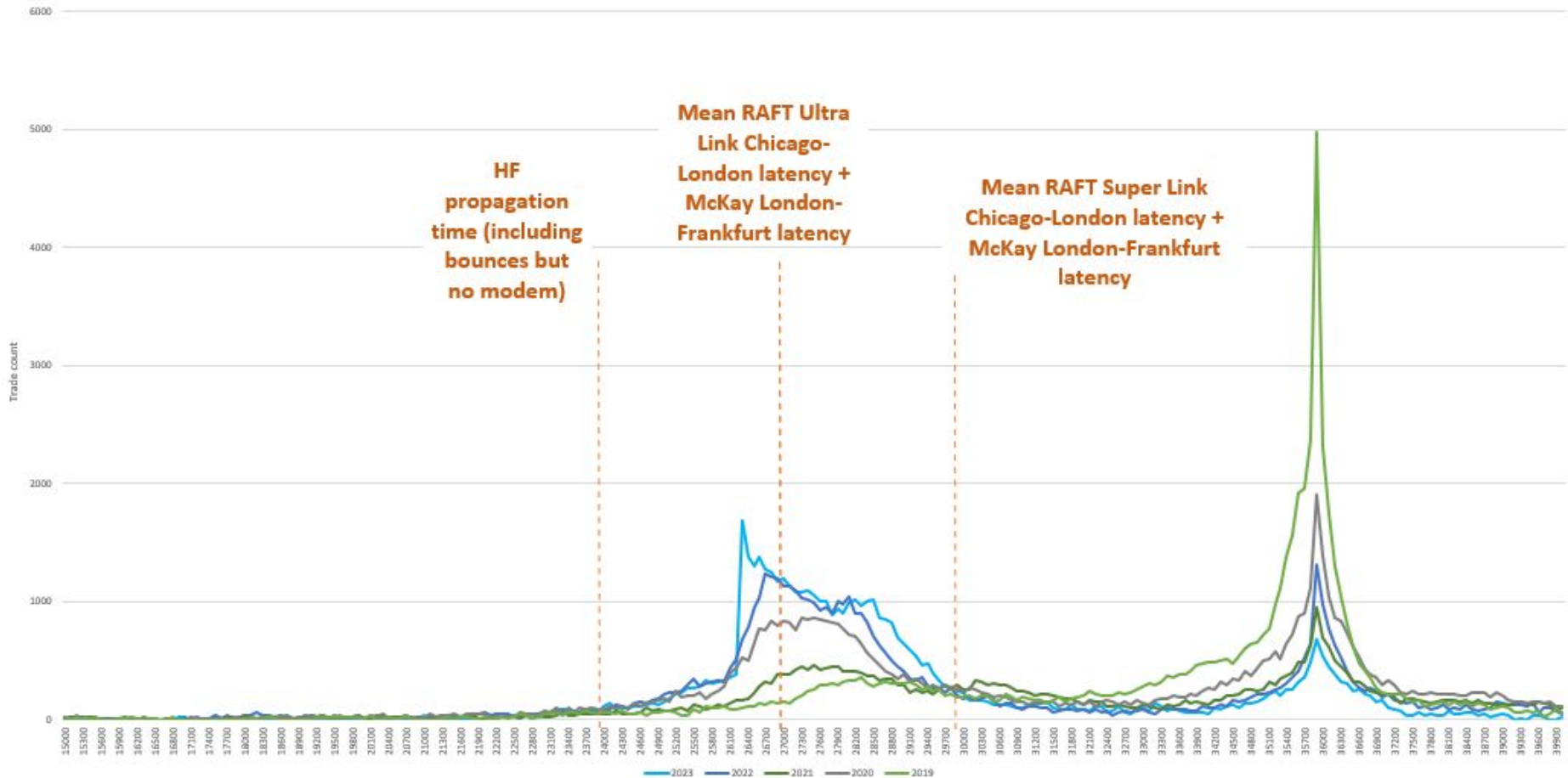
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Trade count on Eurex (DAX) following a trade through event on CME (ES) - 2023-08-21 to 2023-08-25



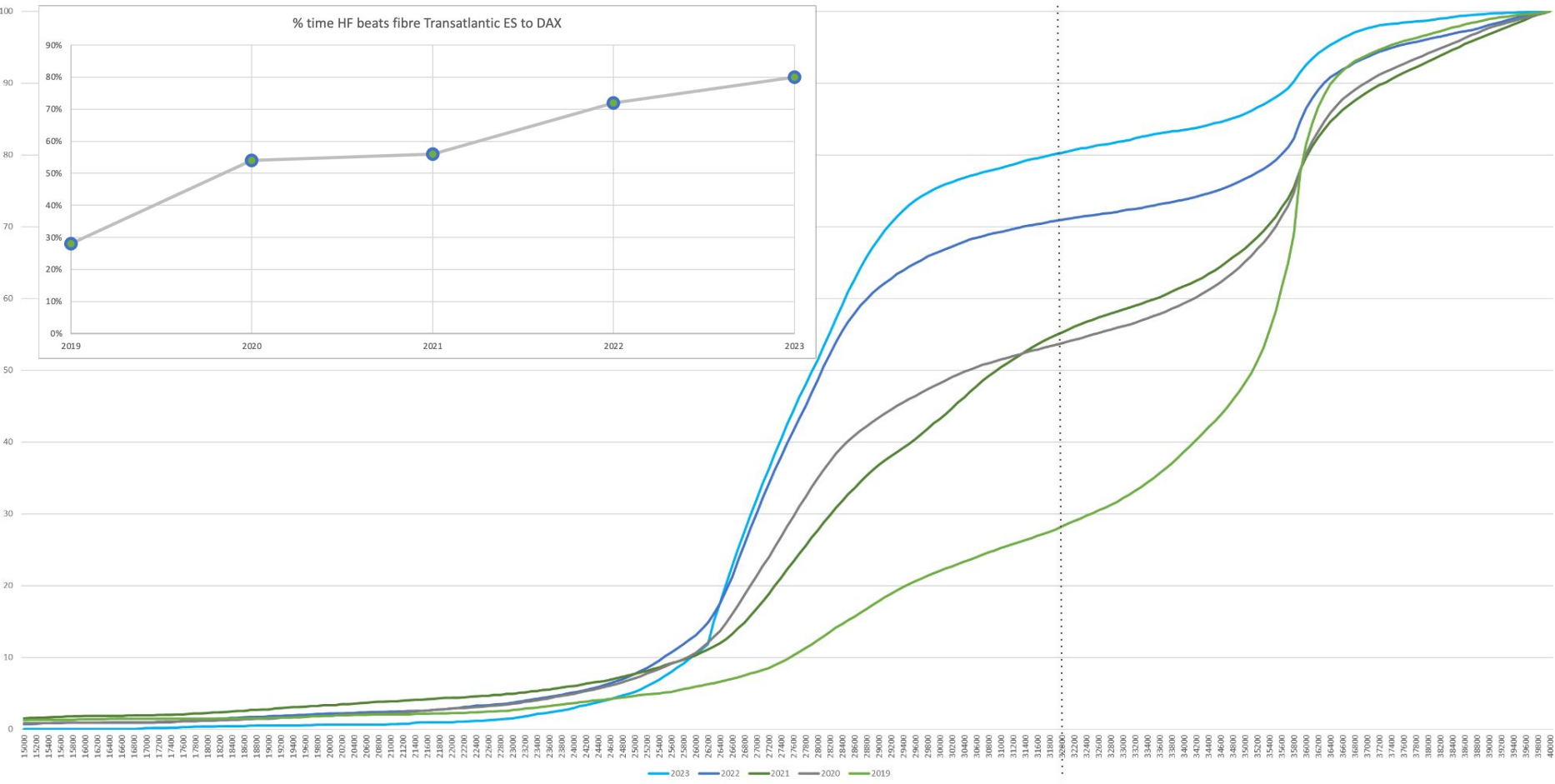
What is happening in HF land?

Trade count on Eurex (DAX) following a trade through event on CME (ES) - Evolution from 2019 to 2020



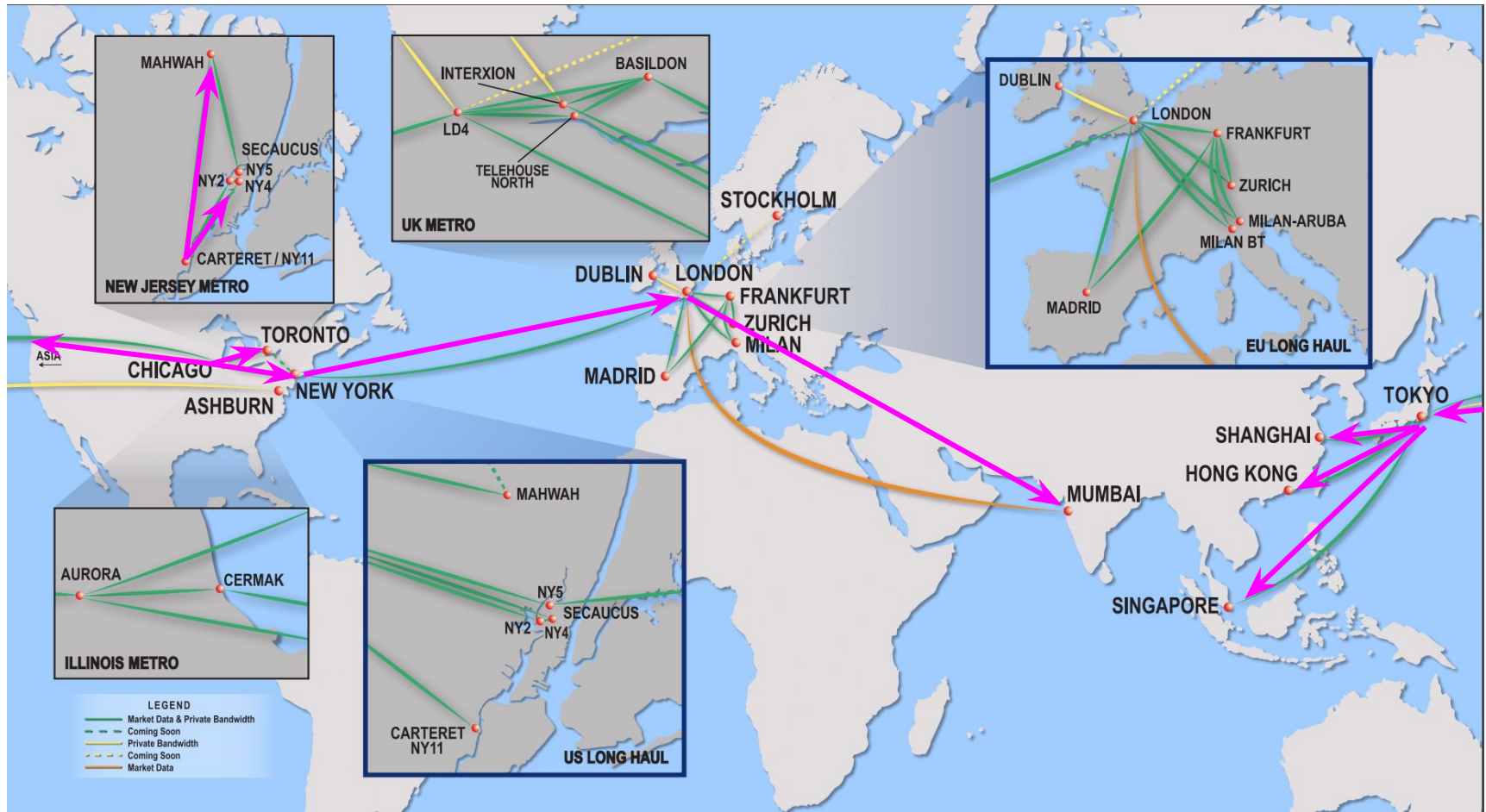
What is happening in HF land?

Cumulative percentage of trade count on Eurex (DAX) following a trade through event on CME (ES) - Evolution from 2019 to 2023



McKay/Quincy : a trend toward market data first

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Thank You!

