

Client-Managed Router Guidance

November 7, 2008

Customer Router Guidance

This document is intended to provide guidelines to assist customers with determining what router best fits their needs for Client DIRECTLink connections to the CME Globex Platform.

- **Current CME Globex Connection types impacted include:**
 - CME Group International Hubs
 - Client DIRECTLink connections
 - LNET
 - Jackson Direct
- **Upon request, CME Group can schedule the appropriate resources to discuss the details of the guidance. This request should be coordinated through your CME Globex Account Manager.**

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Start with the numbers

- The two most significant data points are:
 - Estimated bandwidth
 - The maximum peak number of packets per millisecond given the market data to which you are listening
- Electronic markets now operate in the millisecond range, 1/ 1000th of a second or below
- Typical network devices measure Packets Per Second (PPS) on a 1 second average basis
 - The peak number of packets and peak bandwidth measured per second will typically be lower than the peak level which occurs at a point in time within the one second interval.
 - For example: if the first 500 milliseconds of a 1 second period are very busy and the second 500 milliseconds of a 1 second period of measurement are not very busy, the measurement will average the two 500 milliseconds together into a single number that is low.
 - We recommend you start by measuring or calculating the required throughput for the market data that you subscribe to presently, plus any new market data that you may subscribe to in the future.
- See Slide 11 for CME Group 2009 Market Data Projections

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Plan for Growth

- Factor in a reasonable amount of growth.
- Over time the number of transactions per second for any specific product will grow as a normal function of improved system response and market activity
- At times individual products will become very busy. New products may be created.
- On average, overall market data transactions have grown in the range of 300% to 400% per year when measured over many years.
 - It is important to note that there are no guarantees that this will continue at this rate.
 - That said the 300% to 400% range is fairly consistent when averaged across all products.

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Actual Experience May Vary

- Routers are just another form of computer
- They have different levels of performance depending on the
 - Make
 - Model
 - Configuration
 - Processing load
- The exact same router can have vastly different throughput capabilities based on what it is asked to do.
- As an example, configuring a router to do Network Address Translation (NAT) will consume significant amounts of processing power and will lower the effective throughput of a router.
- Be aware that any additional functions (NAT, Static Joins, ACLs, ...) added to a router will limit its throughput.

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Balance Capacity and Cost

- Over time it may be possible given Moore's law to get better and faster routers for less money.
- Buying too much capacity is costly because you will be able to purchase more capability at a lower cost in the future.
- At the same time not having enough capacity will create other significant problems.
- CME Group generally targets a minimum 36 month lifespan for routing equipment. This is only a general guideline.
- Historically targeting a 36 month lifespan has balanced the risk, cost and capacity reasonably well.

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Partner With Your Vendor of Choice

- Most reputable router companies measure traffic flows, make specific model recommendations, and allow you to test their products in a lab before you purchase them.
- We recommend testing the router that you are considering using with your exact configuration installed prior to purchasing.
- We have consistently found that the performance statistics given by router manufacturers assume the most optimal configuration possible.
- Routers never seem to be as fast as the glossy brochure says they are either.
- Test the router in a lab with your expected present and future traffic loads applied.

Customer Network Guidance

Consider using a chassis

- Upgrading routers takes time and represents potential risk.
- Higher-end chassis-based routers can frequently be upgraded through a processor card swap.
- Most “stackable” routers do not have an option for a field upgrade other than complete replacement.
- Having the option to upgrade a router by swapping a processing card is convenient, fast, lower risk, and can lower overall Total Cost of Ownership (TCO).
- While a chassis-based router may be more expensive initially, it may end up with a lower overall cost in the long run.
- We have also noted that many of the chassis-based routers have excellent performance characteristics for only a moderate increase in price when compared with “stackable” routers

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CME Group Hardware Throughput Reference

- All 100 Mbps CME Group-managed connections use a Cisco platform capable of routing 15 million PPS
- CME Group is in process of upgrading the balance of its CME Group-managed customer connections to the same platform as above

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Conclusion

- Review the projected PPS metrics on the following slide
- Assess your current router capabilities
- If needed coordinate a call with CME Group to discuss your specific conditions and requirements

Please refer any questions to your CME Globex Account Manager:

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FIX/FAST 2009 Projections

Note: Snapshot channels should be joined during recovery only

FIX FAST 2009	Futures		Options		Futures & Options	
	Packet Rate (PPS)	Bit Rate (BPS)	Packet Rate (PPS)	Bit Rate (BPS)	Packet Rate (PPS)	Bit Rate (BPS)
Incremental	18,000 PPS	18 Mbps	14,000 PPS	14 Mbps	32,000 PPS	32 Mbps
Snapshot	14,000 PPS	14 Mbps	12,000 PPS	9 Mbps	26,000 PPS	23 Mbps
TOTAL	32,000 PPS	32 Mbps	26,000 PPS	23 Mbps	58,000 PPS	55 Mbps
Instrument Definition Replay	6,000 PPS	11 Mbps	16,000 PPS	27 Mbps	22,000 PPS	38 Mbps

Projections are based on the current measurements and extrapolated based on a 1 second average