Get the advantages of grid computing the easy way with Infrastructure-as-a-Service.

Why financial services firms are turning to high performance computing
It is a widely held belief across the financial services industry that long-term success and growth are largely dependent on making decisions faster than the competition. Decision makers demand the latest technological resources, since the required calculations are more complex than ever, the amount of data is vastly greater, and the competition much more intense.

In the hedge fund industry, when a request for leverage is made from a prime broker, the broker needs to know not just how that loan would increase its exposure, but — in the age of multi-primes — also needs the answer quickly — or another company will get the business. As a prerequisite, the firm has to determine the current value of its portfolios and the value of its collateral to comply with the risk-weighted capital ratios specified in Basel II and III or the Dodd-Frank Act. But calculating real-time value of portfolios is complex, particularly when portfolios include complex derivatives and debt plus the need to quantify intraday credit risk.

Traditional computing systems are not sophisticated enough to provide this information fast enough, which is why financial services firms have turned to grid computing, also known as high-performance computing (HPC). Firms both large and small know that HPC has become the industry standard. However, there are two fundamentally different ways for financial services firms to take advantage of HPC, which may significantly impact their market success.

What is HPC?
High Performance Computing, or grid computing, is seamless and scalable access to wide-area distributed computing resources. These computational grids enable the sharing, selection, and aggregation of geographically distributed computational resources (such as supercomputers, compute clusters, storage systems, data sources, instruments, and even people), presenting them as a single, unified resource for data-intensive computing applications.

Unlike conventional computing systems, such as cluster computing, grid computing is loosely coupled, heterogeneous and geographically dispersed. In fact, the same grid may be used for different tasks by different companies. HPC systems are typically made up of complete computers with onboard CPUs (cores), storage, power supplies, and network interfaces connected to a network (private, public or the Internet) and by a conventional network interface, such as Ethernet.

Users can access computing power irrespective of its source, just like an electrical grid, where someone can turn the lights on without needing to know where the generators are located. However, while HPC may seem like a commodity service to users, organizations maintain complete control over where data is being stored and processed.

Similar to each consumer’s individual need for electricity, the level of computing resources is not consistent for most organizations; it spikes when companies run compute-intensive analysis or process a large number of transactions. Simply put, it is impractical for a company to invest in infrastructure powerful enough to handle those peaks — only to have it 90 percent idle for 90 percent of the time. Grid computing is a cost effective solution.
What do the Analysts Say?

Grid computing has become universally adopted among financial services firms. The global HPC market has recovered from the great recession and is now poised to grow at a compound annual growth rate (CAGR) of 6.8 to 7.8 percent through 2016, according to IDC. Market Research Media Ltd. is even more bullish, estimating the worldwide HPC market to grow at an 8.3% CAGR reaching $44 billion in 2020.

Big Data and associated analytics are key drivers of growing HPC adoption. According to IDC, firms are turning to high performance data analysis (HPDA), the fast-growing worldwide market for big data workloads that exploits HPC resources. IDC forecasts that the server market for HPDA will grow rapidly at 23.5% compound annual growth rate (CAGR) to reach $2.7 billion in 2018 and the related storage market will expand to about $1.6 billion in the same year.

Though they see enormous potential for growth, IDC and other analyst firms also see two major challenges for grid computing:

- Difficulty in getting enough data center space, power, cooling and real estate — the familiar challenges of large data center implementations.
- Bandwidth limitations in moving large data sets around these geographically dispersed networks with high-reliability, high-bandwidth interconnectivity.

The Business Case for HPC in Financial Services

In this industry, timing is essential. Success often depends on the timely response to market shifts and minimizing the time to assess current positions and make decisions. HPC delivers both computing power and speed, helping financial institutions accelerate innovation and improve business success by delivering analyses and processing transactions quickly, even when it requires processing a large amount of data.

Grid computing is considered the fastest and most cost-effective way to value portfolios — especially those firms with complex derivatives and debt — for risk-weighted capital ratios in accordance with Basel II and III or the Dodd-Frank Act. It also helps companies to quickly assess global risk by analyzing multiple risk profiles, which requires gathering and storing massive amounts of information and then analyzing it rapidly to make timely decisions.

HPC also facilitates pre-trade analysis of large volumes of both structured and unstructured data to evaluate new derivatives or bonds and assess the risk of a proposed trade. In addition, with complex products and securities proliferating, HPC is the fastest way for financial services organizations to analyze multiple positions in order to determine what constitutes a good price for the asset they may add to their portfolio.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Need for Speed</th>
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<tr>
<td>Market data</td>
<td>• Keep pace with market data.</td>
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<td></td>
<td>• Adopt direct feeds and high-speed middleware to reduce latency.</td>
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<tr>
<td>Black box modeling /</td>
<td>• Scan real-time data in search of trading opportunities, slashing execution</td>
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<td>algorithmic trading</td>
<td>speed to milliseconds.</td>
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<td>• Divide up a large trade into smaller trades to avoid market impact costs and</td>
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<td>reduce transaction costs.</td>
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<td>Financial models for risk management</td>
<td>• Gain real-time insight into the potential risks and rewards for any given</td>
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<td>transaction.</td>
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<td>Interactive query response</td>
<td>• Model risk factors against statistical dependencies to derive probabilities</td>
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<td></td>
<td>of occurrence.</td>
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<tr>
<td>Equities trading system</td>
<td>• Respond to customer queries on transaction details in real-time.</td>
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<td></td>
<td>• Analyze market data and promptly publish every detail on the transaction.</td>
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<tr>
<td>Transaction evaluation and strategies</td>
<td>• Process trades on stocks, bonds, and options while immediately applying</td>
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<td>ordering and compliance rules.</td>
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<td></td>
<td>• Run financial models by applying policies and rules to large volumes of</td>
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<td>complex data at a very high rate to evaluate transactions.</td>
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<td></td>
<td>• Compute value for each transaction immediately.</td>
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<td>• Evaluate strategies for customers’ portfolios.</td>
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Table 1: Use cases for HPC in the financial services industry

Getting on the Grid, Two Ways

Once the firm has decided to utilize HPC, they should think through how to implement and maintain a grid.
The Traditional Approach

Grid computing places heavy demands on an IT system — including networks, storage, databases and input/output ports — and building it in-house requires substantial investment in hardware, software, networking, data center infrastructure and cooling, floor space, and staff. As a result, firms have to make capital expenditure decisions early on in the process to build the necessary capacity. Often, the ultimate decision is to determine an acceptable level of underutilization during normal loads and an acceptable degree of slowdown under peak processing loads. These decisions are often driven by the ever-changing regulations for fault-tolerant computing, which may prove costly in the back-up and data retrieval process.

The Buy-Don’t-Build Approach

Unlike the traditional approach, which involves making tough resource decisions around high and low volume processing periods, firms that outsource this capability are only paying for the resources they need while leveraging the breadth and depth of a world class infrastructure-as-a-Service (IaaS) provider.

Eliminates Need to Sink Capital into Building Data Centers

With IaaS, firms are using a shared resource for a dedicated period of time; they benefit from economies of scale, and don’t have to worry about underused infrastructure tying up their capital investment. In addition, as their need for HPC grows they can simply scale up to match the demands of the moment. By tapping into an outsourced, on-demand grid to deliver massive computational power for less sensitive use cases, firms can dedicate all their valuable data center space to those applications that dictate an in-house solution.

<table>
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<tr>
<th>Build HPC Infrastructure</th>
<th>Buy HPC IaaS</th>
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| Significant capex, ongoing maintenance, and depreciation on often underutilized infrastructure | • Opex model: pay for what you use
• Reduced TCO through avoiding maintenance
• Economies of scale |
| Fixed amount of resource may not align with changing business objectives | • Dynamic Infrastructure-as-a-Service model scales as business needs dictate
• More rapid time to market for strategic initiatives |
| Rising and fluctuating costs of data center real estate, power, cooling, bandwidth | • Predictable pay-per-unit used |
| Regulatory requirements (Basel II, Basel III, Dodd-Frank Act, Sarbanes-Oxley, MiFID, etc.) drive up storage and retrieval costs for compliance | • Utility storage, backup and retrieval services available as needed |

Table 2: Comparing Build and Buy benefits for HPC infrastructure

Enables Firms to Buy into a Service that’s Already Running

It’s no secret that IT systems — no matter how sophisticated or how expensive — often falls victim to rapid changes in the market. However, with an agile IaaS provider, firms reduce their risk of capital with a more predictable pricing model, additionally achieving more rapid time to market.
Grid as a Secure Service for Financial Services Firms from CenturyLink Business

CenturyLink Business provides HPC solutions for a number of top-tier financial services firms, with more than 150,000 cores under management in its facilities. Their financial services clients include all of Fortune’s top 14 securities firms and 28 of the top 30 commercial banks.

CenturyLink Business provides unmatched IaaS capabilities to deliver high-performance processing worldwide, including high-throughput networking to move huge volumes of data. The CenturyLinkTier-1 OC-192 Internet backbone encompasses more than 401,000 miles of fiber.

Markets Infrastructure

Across the globe, leading financial services organizations — encompassing buy-side, sell-side, liquidity venues and solutions providers — rely on Markets Infrastructure as the foundation for their trading and IT solutions including HPC. To offer purpose-built, cost-effective, and technologically advanced IT solutions for financial services organizations, Markets Infrastructure brings together:

- CenturyLink’s core IT IaaS capabilities.
- Compelling trading ecosystems resident in its global data centers.
- Unmatched depth of experience supporting the financial markets.
- CenturyLink’s global footprint of data centers.
- Fully managed, ultra-low latency and extremely resilient network connectivity.

Partnerships with Innovators Open Up New Opportunities

To get the greatest leverage and competitive advantage from HPC, financial services firms have to be able to identify and apply cutting-edge technology and approaches to implement fit-for-purpose infrastructure. CenturyLink Business partners with innovators that complement its services, to offer financial-services firms leading-edge functionality.

HP — Computing at the Speed of Innovation

HP has reinvented high performance computing (HPC) to positively impact the performance to space and power equation. HP offers a series of density-optimized servers for hyperscale and HPC with a range of capabilities to meet the needs of different workloads and customers — from Proliant SL series to the new Apollo 6000 & 8000 Systems.

The HP Apollo Family delivers breakthroughs in rack-scale performance, power and cooling in less space to find answers faster, in a more sustainable way than ever before. The Apollo 6000 System came to life as a result of a challenge from one of HP’s largest clients to build a server that would allow them to increase performance per core, while staying in the same space and power envelope of their existing environment (over 600,000 servers).

As a result, the HP Apollo 6000 System, with the HP ProLiant XL220a Server, is a great fit for single-threaded applications like financial services Monte Carlo simulations — critical for modeling and measuring risk. This System delivers 4x better performance per dollar per watt than a competing blade using 60% less floor space.
HP designed this platform for scalability and efficiency at rack-scale — delivering a TCO savings of $3M/1000 servers over 3 years.4 Below are some of the key advantages of the Apollo 6000 System.

- **Per-Thread Performance** Intel Xeon E3-1200 V3 processor based on the Haswell architecture offers the highest frequency per core/thread (up to 4GHz Max Turbo Frequency) of any Xeon-class solution. This newer architecture offers both power savings improvements and better compute efficiency. In addition to the benefits of Xeon E3 performance, one-socket servers can provide lower latency than two-socket, since there is no 2P cache coherency required.

- **Network Throughput** The HP Apollo 6000 System includes an I/O Innovation Zone which provides flexible configuration options for networking (1G, 10G, InfiniBand) depending on an application's needs. For workloads that need both the per-thread performance of Xeon-E3 and significant network bandwidth per rack, a system configuration with 10GbE could provide up to 1600 GbE Uplink bandwidth per rack.

- **Density Optimization** the HP Apollo 6000 System delivers a total rack density of 140 nodes in a standard 42U rack, or 160 nodes in a 47U rack. HP achieves this level of density by using shared infrastructure (enclosures, PCBs, fans, I/O, management module) and pooled power resources (Apollo 6000 Power Shelf).

“We believe this is going to be the new game changing technology for us. The Apollo 6000 will continue to increase the density of our computing, and reduce our data center footprint. This will help our designers to design their chips much faster, enabling us to respond to market demand and ultimately serve our customer better.”

James Chen  VP of Product Development and Engineering,  HP IT

**NetApp – High Performance Storage for HPC**

As financial firms develop new and more competitive services, the demand on storage is ever-increasing. HPC platforms need to perform more processing iterations, on more data, in a shorter period of time.

NetApp High Performance Computing solutions offer multi-GB/s performance for petabyte-scale, data-intensive applications. NetApp’s Fabric Attached Storage (FAS) platform addresses enterprise requirements for high performance and low latency as well as reliability and superior data management. Powered by NetApp® Data ONTAP®, all-flash FAS is a key part of IT when advanced storage control is needed for high-speed workloads and allows scaling of clusters by adding additional FAS nodes without service disruption. This allows seamless scalability with up to tens of petabytes of storage and over 2.6 million IOPS per cluster, while built-in data replication software provides a secure and efficient way of moving or backing up data and keeping environments in synch.

All-flash FAS delivers sub-millisecond response time for critical applications that demand low latency. The systems optimize I/O and maximize application throughput while running leading data management functions, featuring:

- Leading multiprocessor Intel® chip-sets with a higher number of cores
- High-performance DDR3 memory modules
- Increased NVRAM for persistent write cache
- I/O-tuned PCIe gen3 architecture

NetApp has a successful track record in the financial services industries, with over 9,000 customers worldwide.
Out in the Real World: Case Studies

CenturyLink’s values the confidentiality and privacy of its clients’ solutions. Consequently, the following examples are intentionally non-specific. Though they describe real CenturyLink capabilities, as proven in real-world financial services applications, they are not an exact representation of any specific client’s solution.

Acute, short-term need
An internationally recognized trading firm faced an unexpected regulatory challenge, and wanted immediate access to 50,000 cores for a stress test. CenturyLink’s HPC IaaS can deliver this kind of massive computational power in short, sharp bursts to companies facing a regulatory or market crunch — and can do it within days.

Faster processing
A major bank wanted to speed its processing, pricing, and risk calculations of credit derivatives so that it could deliver faster answers than its competitors and close more business. With an HPC solution from CenturyLink featuring FPGAs and Intel CPUs, the bank increased speed by 30 times compared to an 8-core Intel processor.

Worldwide scale-up
A major bank wanted to scale up its computing capacity and supplement its existing data centers worldwide. CenturyLink took on the challenge of scaling resources from 5,000 cores in two locations to 50,000 cores in four locations within two years, both through leveraging CenturyLink-owned cores and through managing the bank’s existing cores as a leased asset. Plus, CenturyLink offered ongoing technology refresh, continually upgrading cores with the most recent chips to ensure maximum possible performance. The bank achieved significant reduction in provisioning lead times for commodity items — and significantly lowered its TCO.

Conclusion

To get more for your HPC money, find out more from CenturyLink Business

CenturyLink customizes its offerings to help ensure it meets the individual needs of its clients. In creating a solution, CenturyLink experts both listen carefully to client requirements and contribute their unique perspective, gleaned from years of solving similar challenges for hundreds of different clients. The result: a comprehensive, state-of-the-art solution that performs as promised, when promised, for a predictable price.

Security: Data security is especially critical for financial services firms. CenturyLink data centers offer world-class security and flexible solutions that enable financial services firms to specify exactly where and how their servers are procured, provisioned, and maintained, and how their data is managed.
About CenturyLink Business

CenturyLink Business delivers innovative managed services for global businesses on virtual, dedicated and colocation platforms. It is a global leader in cloud infrastructure and hosted IT solutions for enterprise customers. Parent company CenturyLink, Inc. is the third largest telecommunications company in the United States, and empowers CenturyLink Business with its high-quality advanced fiber optic network. Headquartered in Monroe, LA, CenturyLink is an S&P 500 company and is included among the Fortune 500 list of America’s largest corporations.

For more information visit www.centurylink.com/technology.

4 Synopsys VCS data March 2013, measured HP data vs. Dell published power calculator and Dell/HP ILP, March 2014.
   HP internal estimate compared to Dell PowerEdge Blade M620 in an 80-node compare, standard rack.
   HP internal estimate based on 1000-server deployment, TCO savings over three years vs. Dell PowerEdge Blade M620.