
Morningstar Cloud Technical Specification

Frequently Asked Questions

Morningstar Cloud
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As we continue to drive innovation and increase productivity across our global technology organization, we're moving our desktop products to a web-based architecture hosted in the cloud. As a company, we want to focus on what we do best—creating great products that help investors reach their financial goals. Making the transition to cloud-based software can create a number of questions around the technical and security features. We hope that this document will answer those questions for you, and assure you that Morningstar has put a tremendous amount of thought behind our latest platform.

Engineering

What are your product development philosophies?

Our developers work using an Agile methodology, and we ship updates every two weeks which are delivered automatically through the cloud. By following this model, we're able to avoid the downtime of major upgrade releases. With this system, we're able to maximize our talents, increase our capacity for innovation, and free up time to continue pursuing our mission of helping investors succeed, all while advancing our security profiles.

What is the technology infrastructure?

The technology stack consists of a service-layer of RESTful APIs implemented by either .NET or Java, fronted by a node.js backend-for-frontend tier and leveraging various JavaScript libraries in the browser. The service-layer is backed by our data platform, which is mostly comprised of Java processes, NoSQL and SQL-based databases, and a databus connecting the various processes.

What are the implementation options for Morningstar Cloud?

Morningstar Cloud is a customizable off-the-shelf, configurable product with broad capabilities. An account manager works closely with clients to determine the best solution for their team.

What integration options are available?

Morningstar Cloud integrates with a series of APIs, has the option to integrate pluggable/embeddable user interfaces, and features granular data directly through APIs, direct query, or batch.

Do you provide a method for testing functionality in the product?

Testing occurs as part of our Agile process. Each story that is created is tested individually in a QA environment. All scripts are added to the test repository and included in a risk based regression suite. Regression testing is run when code is integrated. Regression includes functional as well as non-

functional testing such as load, performance, security, etc. Critical, high, and medium risk scripts are automated. The automation suite includes unit, service layer, as well as functional UI test scripts.

Has your system been performance tested and endurance tested?

Yes. We have specific test scripts which validate the performance timing of jobs to be done. Each automated test script also has timing thresholds which would fail beyond a set limit. In addition, there is a suite of load tests which are run with every two-week sprint.

What transport protocols does your system use (HTTPS, TCP, SFTP, SMTP, etc.)?

HTTPS, SMTP (for batch reports), and SFTP (for data import).

What licensing does your product use?

We use the licensing that is required to use the particular open source software, such as Apache or MIT.

What licenses are used from components or libraries inside your product?

We use a number of OSS products on the server and browser. They're mostly licensed under Apache and MIT.

Does your system use any base application frameworks such as Enterprise Library or Spring?

Yes. We use Node.js/Express, .net mvc/webAPI, .net/WPF, Angular, Ember, and Vue.

Please describe your logging and tracing capabilities.

We log to file and then collect with Splunk.

Do you include performance information, troubleshooting information, and exceptions?

Yes, we include troubleshooting, auditing, and exceptions. We monitor performance with New Relic for Morningstar Cloud.

Is all web traffic in your system over https?

Yes, all traffic from the public internet to our load balancers is SSL.

What types of UI does your system use? Do you leverage AJAX?

Morningstar Cloud uses browser based UI using AJAX. The Excel add-in uses Excel/WPF, and Presentation Studio is fat client application WPF.

Is there business logic done at the UI layer?

It is the intent to be a thin client with all business logic done on the server side. There may be some exceptions, where logic must be implemented on encrypted data that is only decrypted within the context of the browser. This logic will be minimized, and will be handled by client-side libraries and still be held to the same standards around re-use across the platform.

Data and Security

Where is the Morningstar cloud infrastructure hosted?

Currently, the Morningstar cloud is hosted on our servers in Dallas. But beginning in 2018, we will move the Morningstar cloud to be hosted on Amazon Web Services. AWS is a secure cloud platform that offers high-speed computing power, database storage, and content delivery to help businesses scale and grow. Amazon is the industry's leading infrastructure-as-a-service provider, and many other big names in the finance industry, including FINRA, NASDAQ, and Trading Technologies use AWS.

Why is Morningstar moving to Amazon Web Services?

As a company, we understand that maintaining data centers is not a key differentiator for us, and it takes up time that could otherwise be spent creating products for our users. By using the cloud, we'll be able to maximize our talents, increase our capacity for innovation, and free up time to continue pursuing our mission, all while advancing our security profiles.

Who will be in charge of ensuring my data security is secure?

As we move to AWS, Amazon will be responsible for the underlying infrastructure and physical security of the data centers, while Morningstar is responsible for securing the confidential information, assets, and intellectual property that belong to Morningstar and its clients.

Is AWS a proven, secure host?

Amazon ensures its robust security model for infrastructure and physical security through multiple industry-standard security certifications, including SOC compliance.

How will Morningstar protect confidential information?

Morningstar is committed to protecting the confidential information, assets, and intellectual property that belongs to Morningstar and our clients. We protect this information through a combination of security techniques, such as access control policies, employee screenings, security groups, firewalls, encryption techniques, routine scans, maintenance procedures, and more.

How does the Morningstar cloud infrastructure handle authentication?

The Morningstar cloud uses basic authentication over a secure sockets layer (SSL) encrypted channel to create a session. It uses session cookies over an SSL encrypted channel for subsequent requests.

What integration methods can you handle for SSO and perimeter authentication?

SAML integration is supported for SSO using a customer-supplied authentication system.

Do you use session constructs such as cookies? What type of information is stored in them?

Yes, session IDs are stored in cookies. All other session data is stored in the server's memcache.

Does your system handle transaction integrity?

No, the Morningstar cloud does not handle transaction integrity.

What level of auditing is deployed in your system?

Entitlement systems are custom implementations. We can work through the specifications after discussing the specific requirements.

What methods of auditing are used?

The Morningstar cloud uses Splunk to log user activity, including login, password reset, time of login, etc.

Have you had security tests such as ethical hacks or secure code reviews on your system?

Morningstar's information security team performs a monthly automated static analysis scan on source code to identify common security vulnerabilities. Assessment findings are ranked by severity and entered into our bug-tracking system. The team also reviews vulnerabilities with application development teams and provides a clear set of remediation instructions. In addition, Morningstar utilizes a third party to conduct external application penetration tests on an annual basis.

Is the Morningstar cloud accessible to authorized security members of my firm to check and assist with security policies?

Morningstar allows its clients to do an annual onsite audit of Morningstar security policies and controls. During this audit, Morningstar will have appropriate security personnel on site to answer questions about security controls and walk through policies and procedures. Morningstar does not allow its clients access to its systems during these audits to perform their own security testing.

Can your system ensure that users or external interfaces cannot repudiate that something occurred?

Yes, through audit logs.

Does your system use encryption for confidential and internal information?

Yes, the information moving from the internal load balancer to the public internet is encrypted.

Does your system use mutual authentication leveraging digital certificates for communications with other systems? If no, what is used?

No. API keys are used for service to service authentication. Only authentication uses encryption for all data in motion.

Please list all types of data storage used by your system?

Morningstar Cloud uses MSSQL, Postgres, LDAP, DynamoDB, and S3.

Are your connection strings encrypted to external systems such as databases and Idaps?

Only the passwords and API keys.

Are usernames and password centrally stored and encrypted?

Yes. User passwords are encrypted and stored in LDAP.

Is sensitive data within a request/response specifically protected via encryption, obfuscation, tokenization, or other means (not just transport layer encryption)?

Tokenization is supported for sensitive data. For more information, view the security overview document [here](#).

Do you provide a process to promote to environments from within your product?

No, the promotion process is managed outside the application.

Support**What implementation resources are available?**

On purchasing our product, clients will have the following dedicated resources:

- ▶ A client service consultant to guide users through the onboarding process, train them on the application, answer any questions and escalate issues to our internal product team.
- ▶ A regional sales director who will oversee the purchase process.
- ▶ A dedicated back office services team member to help with conversion of historical data where applicable.
- ▶ A support hotline to answer any questions during or after onboarding.

What is the technical implementation timeframe?

As our solution is primarily cloud based, there really is no technical implementation timeframe. A computer with minimal specifications and a compatible web browser will be up and running quickly once the back office services team imports the client data. The rollout timeframe is mostly dependent on the data conversion from other portfolio accounting systems.

What is the average timeframe for end user rollout?

The average time for end user rollout after purchase is typically a month to month and a half. Most of the time is spent in performing data conversion from the current portfolio accounting system to Morningstar. This typically takes a few weeks but depending on data quality, access issues may take longer.

What does the Morningstar cloud onboarding model look like?

Morningstar has a global service organization, made up of client support representatives, who act as our end users' first line of support. Users also have access to a client service consultant who is available for more advanced workflow consultation and training. For larger engagements, client education consultants are also made available to hold firm-specific trainings. Dedicated sales representatives and relationship managers assist in providing any training materials necessary for getting teams up to speed.

How can I reach out to Morningstar for support?

Users can reach out for support via email or telephone. Our global contact centers, manned by dedicated client support representatives, can handle any support need, and escalate should there be a critical issue.

How are updates and releases for platforms built on the Morningstar cloud handled?

Updates for these products will show up automatically, and won't require any action from users. Our teams work in an Agile software development methodology, so users can anticipate small updates every two weeks. By updating our system continuously, it reduces the need for major product releases.

Morningstar Office Cloud

For independent financial advisors, Morningstar Office Cloud offers an integrated portfolio and practice management platform to simplify their daily work so they can focus on helping their clients pursue their financial goals. Morningstar Office Cloud integrates leading market data and research with up to date client account details to enable portfolio construction, planning, monitoring, reporting, rebalancing, trading, client engagement, and many other practice management functions in one platform on the cloud. Advisors can access their practice anytime, anywhere, and on any device. This version also includes a client web portal, data aggregation services, third party integrations, and a tax-aware rebalancer.

Client Web Portal

The client web portal is a secure client web site that advisors who use Morningstar Office Cloud can customize for clients to use. Clients can log into the portal using their email and a custom password. In addition to providing real-time visibility into clients' accounts and portfolios, the client web portal also acts as a two-way communication vehicle—advisors upload and receive reports and other documentation from clients, securely. The dynamic reports and straight forward presentation of information provide constant support for the advisor-client relationship.

Unlike other account based investment websites, the Morningstar client web portal uses the aggregated and reconciled data from Morningstar Office Cloud – making the data the most comprehensive and up to date resource for the client.

What level of customization is possible?

Morningstar Office Cloud settings provide the ability to enable/disable the investment overview page, account detail pages, client report generation, and document upload. Advisors can also control how their clients' performance is calculated—net of fees or gross of fees, time-weighted return or money weighted return, and with and without a benchmark comparison. Users can also customize their firm's contact information that is displayed to clients.

What is the encryption for client' data and uploads?

The connection to <https://fp.morningstar.com> uses 256-bit encryption. The connection uses a strong protocol (TLS 1.2), a strong key exchange (ECDHE_RSA with P-256). The identity of the website has been verified by Thawte SSL CA.

Who can post files to the portal?

Advisors and clients can post files to the portal for collaboration. Clients can also post their own files for personal use.

Can reports be posted to portals for all clients simultaneously to save time?

The batch reporting feature in Morningstar Office Cloud offers a quick and easy way to globally put information into clients' hands.

What kind of training and support is available for advisors?

The Morningstar support team is available during normal Eastern Time business hours and can help with questions or issues with all Morningstar products. Morningstar Office Cloud also has a built-in knowledge base where users can search for specific help topics.

What kind of training and support is available for clients?

After an advisor enables a client, Morningstar Office Cloud will automatically generate an email with login and password setting instructions. Advisors can also disable the auto-generate feature and manage email and password settings manually. Additionally, a quick start training guide designed to walk clients through the portal is (will be in January) available.

How long does it take to set up?

Each client who is authorized to access the portal needs to be set up in the Morningstar Office Cloud - global settings. A training manual is provided titled Morningstar Office: Setting up the Client Portal.

*Morningstar ByAllAccounts***What is Morningstar ByAllAccounts?**

Morningstar ByAllAccounts helps advisors and investors gain a holistic view of their portfolios by automating the aggregation process. Morningstar's intelligent data aggregation system implements a knowledge based process that uses artificial intelligence to gather and transform financial account data to meet sophisticated data requirements. The data is then delivered to virtually any financial application for various use cases including analysis, personal trade monitoring and performance reporting.

How does Morningstar ByAllAccounts collect and transform the data?

We use a four-step process to ensure consistency:

- ▶ Data gathering: Morningstar ByAllAccounts utilizes user submitted financial institution credentials to access and aggregate financial account data.

- ▶ Data normalization: This step involves taking the raw data that we have gathered and normalizing it into a single consistent data model.
- ▶ Enriching the data: Our smart engine has over a decade of experience at evaluating inconsistencies and combining data from other sources, such as Morningstar's asset classes and extensive security master, to fill in data gaps.
- ▶ Business logic: The final step in our process is applying business logic to deliver the cleanest, highest-quality data possible to Morningstar Office.

How do Advisors interact with Morningstar ByAllAccounts?

AccountView is the browser based application financial professionals use to link to managed accounts. Financial professionals may also invite their clients to this application in order to aggregate held-away account data. Both the professional and client facing application can be customized, white labeled, and launched through single sign-on.

How many sources of data do you aggregate account data from today?

We aggregate data from custodian banks, brokerages, credit unions, recordkeepers, bank trusts, reporting platforms, etc., covering more than 15,000 different data sources.

What types of data domains are supported?

Account, Position, Transactions, Price, Security, Open Tax Lot, Client, Advisor.

What investment types are supported?

We support a wide array of instruments including 401(k)s, 529 plans, IRAs, bonds, brokerage accounts, cash and equivalents, checking and savings accounts, equities, ETFs, mutual funds, offshore funds, proprietary investments, REITs, sweep accounts and variable annuities. Our aggregated data delivery solution includes positions, transactions, securities, prices and trade or settlement based transactions.

What are your data quality metrics? What types of validations are performed on the source data?

Our data quality standard is driven by the needs of our clients to produce performance returns. This means that the data not only needs to reconcile from the custodian to a user's investment management system, but the transaction detail needs to be sufficient for understanding and accurately capturing the cash flows within the account. Morningstar's intelligent data aggregation system implements a knowledge-based process that uses artificial intelligence to gather and transform financial account data to meet sophisticated data requirements.

What is your process for handling errors?

We work proactively with many financial institutions to utilize the most effective means of data extraction. We have a team strictly dedicated to enhancing our connections and establishing APIs or direct feeds where available. We also proactively monitor our connections in the case we need to update our code to compensate for website changes or security enhancements. If issues are discovered by our users, we have a dedicated support and engineering team that handle these fixes. Clients are notified of issues via alerts.

How often is your data updated?

Data is aggregated automatically every evening beginning at midnight, and continuing through the early morning. The availability of data will be largely driven by the timing in which the financial institution makes the data available.

What is the process for adding new sources?

We add 20+ new financial institutions per week by request. As part of Morningstar ByAllAccounts' commitment to providing our clients with access to the highest quality, and most reliable data, these financial institution support requests are provided as a complimentary service.

How do you maintain security of the data?

All sensitive data is encrypted before transmission or storage. "Strong" encryption (128-bit or stronger) is used exclusively where Morningstar data aggregation controls the sending of the sensitive data. Our primary data center maintains an annual SSAE16 SOC I Type II report.

How is data collected?

Our processing does not rely on any specific format, and we often use multiple different-format sources for gathering data to ensure completeness of data. We will always use whichever mechanism provides us access to the most complete and reliable data. Common formats are proprietary extracts (feeds), QIF, OFXC, CSV, Tab, and websites. Delivery mechanisms include dedicated connections, OFX servers, file servers, and websites. We receive the majority of data from structured data files.

How can the consolidated data be consumed by operational and analytical systems?

Morningstar ByAllAccounts offers a suite of integration tools designed to deliver account data to portfolio management, reconciliation, compliance, trust accounting and performance systems. Specifically, we provide DataConnect API with both read/write capabilities, AccountView, an account management tool, as well as Custodial Integrator, a data transformation tool.

Is your solution installed at a client site, or hosted?

Morningstar ByAllAccounts is a hosted solution that runs in a secure data center. There is an optional client-site component called Custodial Integrator. The technical stack is Java / Oracle. We heavily utilize open source packages as well.

What support services are available?

Users can reach out to the global client service team for support. The Morningstar back office services team is available as well to handle questions specific to data issues.

How many clients are using data aggregation services?

We have implemented over 60 enterprise level firms and 2,000+ independent advisory firms. As of November 2017, these firms aggregate over \$1.6 trillion in investment assets on a daily basis.

Morningstar Third Party Integration

Morningstar maintains an open ecosystem which allows firms to continue using third party software they deem critical through a variety of integration options. By offering choice, Morningstar gives advisors the freedom to build out the infrastructure that best supports their business model and goals for the future success of their firms.

What options are available for integration?

Integrations are delivered via API, data feeds or report services.

Can Morningstar reports like security HTML, investment detail, portfolio snapshot, x-ray, stock intersection be accessed within a third party's user interface?

Yes, third party solutions can use the Morningstar Report Web Service to accomplish this.

Can client account position data from Morningstar's portfolio management solution be delivered to other platforms such as financial planning and risk analysis software?

Yes, the Client Positions API contains the client account/position data.

What are some examples of integrations available?

- ▶ CRM integration –Use client and contact information from a CRM system.
- ▶ Positions API – See client and account level market values and positions from Morningstar platforms in third party software
- ▶ Single Sign on –Sign in and toggle between a Morningstar platform and integrated applications without inputting credentials more than once.
- ▶ Reports and Component Integration – Run Morningstar reports in an integrated application or conduct a workflow using a Morningstar component in a consuming application.

What third party integrations exist to/from Morningstar Office Cloud?

Vendor	Integration Point
MoneyGuidePro and Advicent (Naviplan)	Pull client account data using standard Client Positions API
eMoney Advisor	Reports integration
Redtail CRM	Reports integration, market tools, Contact synch and position API
FinanceLogix	Pull client account data using standard Client Positions API
HiddenLevers	Pull client account data using standard Client Positions API
Schwab OpenView Gateway	Reconciliation assist and cost basis view
RiskAlyze	Pull client account data using standard Client Positions API
TD Ameritrade VEO Dashboard	Reports integration, Management fee file upload
Rixtrema	Pull client account data using standard Client Positions API

Vendor	Integration Point
Modest Spark	Pull client account data using standard Client Positions API
Junxure CRM	Client account data from Office flows into Junxure
Schwab Advisor Center Training	Send Trade files from TRX to execution seamlessly
Fix Flyer Trade Order Management	Send trade files from TRX to execution seamlessly

Morningstar Total Rebalance Expert

Morningstar Total Rebalance Expert (TRX) is used by advisors to rebalance opportunistically as portfolios drift away from their target allocation, monitor clients cash needs to raise or invest excess cash as needed, and take advantage of market shifts with mass rebalancing and tax loss harvesting.

Where does TRX get its data?

TRX leverages the reconciled client account and transaction data maintained in Morningstar Office Cloud.

How are trades delivered to the custodians?

- ▶ TRX generates trade files specifically formatted for import to each custodian’s trading platform. We also provide a generic file format and numerous exports and reports to provide trading information for outside accounts.
- ▶ We will soon release our integration with Fix Flyer, a popular trade order management system allowing advisors to send trades directly from TRX to most major custodians.
- ▶ Advisors who custody at Schwab can benefit from direct integration with Schwab Openview Gateway for direct access to Advisor Center’s trade blotter.

What is the average implementation timeframe?

Most firms are fully operational with TRX in 3-4 weeks.

What kind of training and support is available?

Each firm is assigned an implementation specialist. Training generally consists of five or six hourly sessions over WebEx to ensure that each new user is familiar with all of the settings and functions of the program, as well as assist with configuring the data to run efficiently and align with the firms rebalancing strategy. ■■



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