

European Data Store Overview

A state-of-the-art solution to manage Natural Person Data securely and help ensure seamless compliance with regulatory obligations

MarketAxess European Data Store (EDS)

Designed for the needs of our European clients

Today's discussion:

► Understand the advantages of the MarketAxess EDS and how it works

Seamless

Transition data with minimum effort and maximum security

Secure

Immobilization into a single, fully compliant data store with advanced encryption

State-of-the-art

Leading technology platform owned and controlled by MarketAxess

► Familiarize client teams with EDS usage instructions

► FAQs and Next Steps

Definitions in this document:

- **MKTX** or **MarketAxess** means the MarketAxess group, of which the parent entity is MarketAxess Holdings Inc., (NASDAQ: MKTX) and where necessary in this presentation we identify the specific legal entity within the group
- **NPD** or **Natural Person Data** means the data required to identify natural persons pursuant to and in accordance with the requirements of RTS 22 of MiFIR, including specifically certain fields from Table 2 of the Annex to that RTS (as detailed in the MarketAxess Service Description)
- **AWS** means Amazon Web Services Inc.
- **EDS** is the IaaS virtual private cloud based *European Data Store* hosted by AWS in Germany & Ireland for storage of Natural Person Data provided by clients
- **IaaS** means Infrastructure as a Service
- **Personal Data** means personal data as defined in the GDPR and includes Tokens
- **Token** means a token or short code created by either Client or MKTX per NPD on a per individual basis

MarketAxess European Data Store (EDS)*

Six important benefits

Seamless, Secure, State-of-the-art

1

We developed the EDS to enable clients to segregate the submission of **transaction reports and associated Natural Person Data** that needs to be reported to NCAs.

2

Immobilisation of NPD elements has significant operational benefits and **reduces the number of times NPD needs to transfer externally** – it can be supplied once by clients and used on many transactions.

3

The EDS is a highly secure application that **utilises industry leading encryption technology and ensures NPD is always stored and processed within the EU**, providing enhanced comfort for our clients in meeting GDPR cross border transfer requirements in respect of such data.

4

Data management within the EDS is flexible, clients manage and enter their NPD **using either a GUI or via an automated SFTP file transfer.**

5

NPD in the EDS is mapped to transaction reports using Tokens, these Tokens are assigned by clients and should be **anonymous so that individuals cannot be identified** without knowledge of the mapping.

6

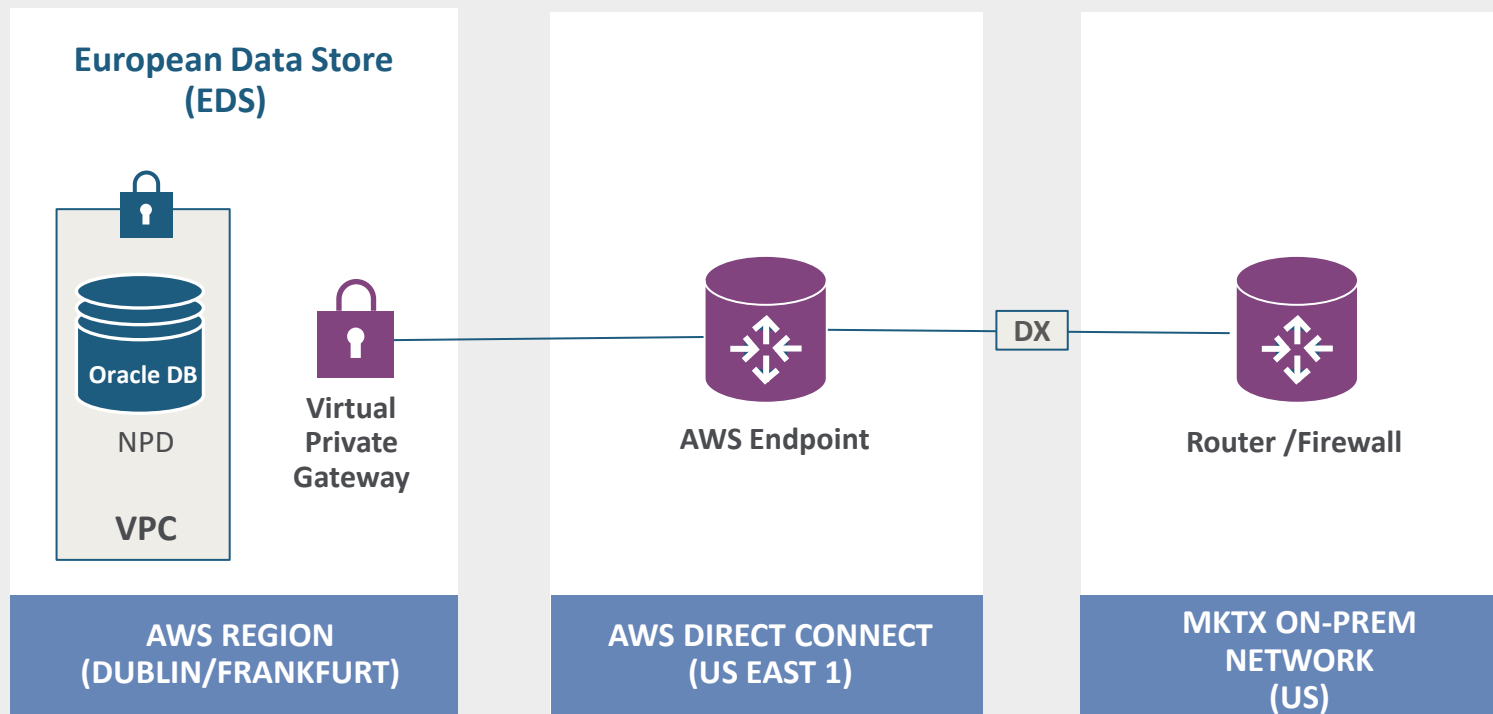
We act upon client instructions when processing NPD in the EDS. This means **MarketAxess is acting as a Data Processor** for any NPD required to deliver Report Services.

* The EDS is managed by MarketAxess Post-Trade Limited ("MAPT"), pursuant to an outsourcing arrangement with MarketAxess Post-Trade B.V. ("MAPT BV") which are, respectively, UK and NL domiciled wholly owned subsidiaries of MarketAxess Holdings Inc.

The European Data Store is based in the EU

and is privately owned and controlled by MarketAxess*

We use AWS Virtual Private Cloud – NOT as a Public Cloud



▶ Based in EU Private Cloud

We leverage the AWS Data Centres in Dublin and Frankfurt, as an **IaaS Virtual Private Cloud** NOT as a Public Cloud.

▶ MKTX Replicated in AWS


All MKTX security infrastructure (e.g., F5 Load Balancers) and vendor software (e.g., Oracle) is replicated in AWS as an extension of the MKTX corporate network.

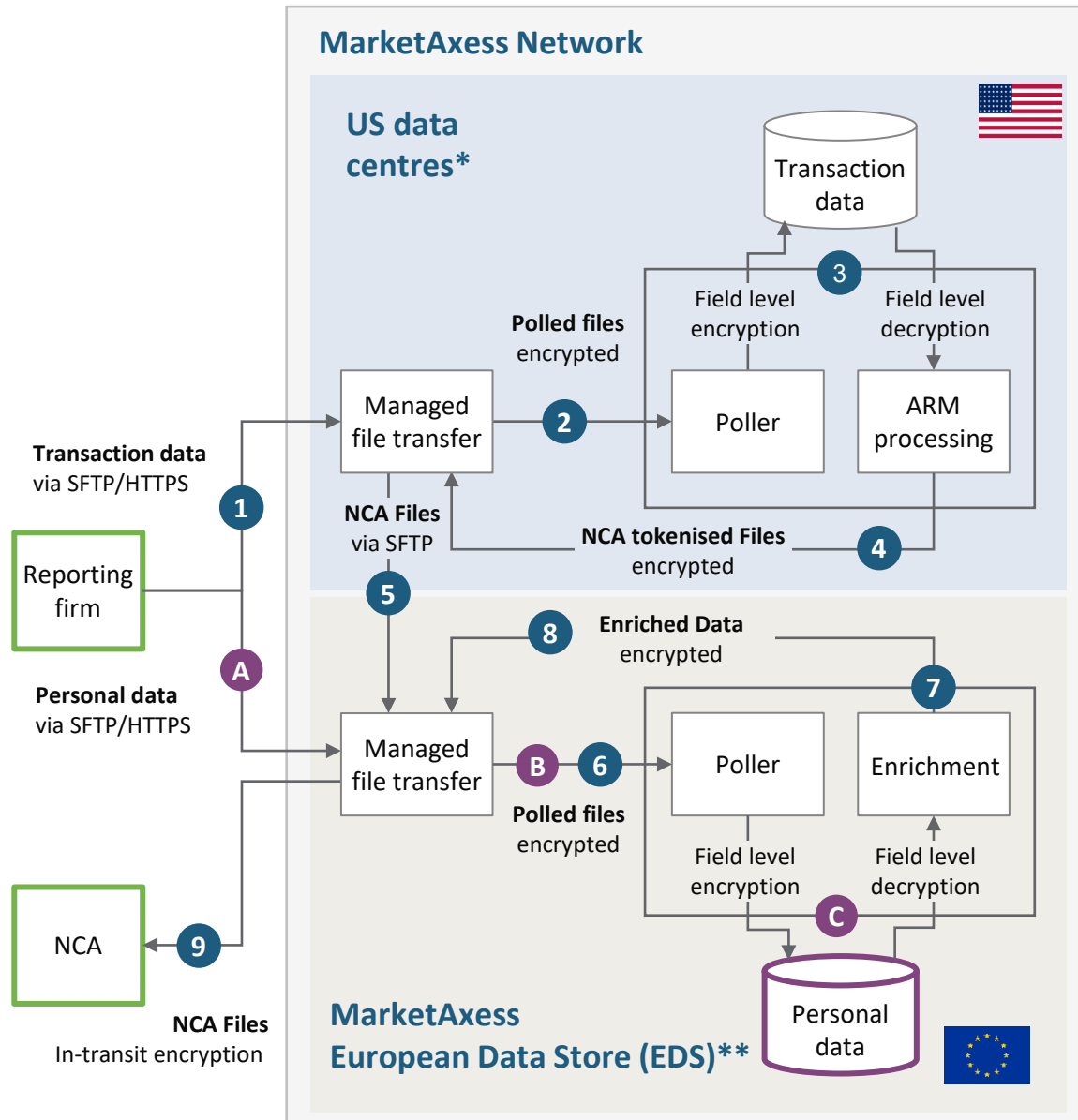
▶ No data access by AWS

There is no unencrypted data sharing with AWS native services.

*The contract is between AWS and MAPT

How it works: Data flows and data transfer process

 Data is encrypted end-to-end from client submission until delivery to NCA



Transaction Report Process

- Client submits the transaction report(s) to the MKTX physical data centre in the US via SFTP/HTTPS. For clients using the EDS, this does not include the NPD sent to the EDS pursuant to A below, but does include the Token
- MKTX polls for the transaction report(s), and these are transferred at file level and encrypted
- The poller decrypts and reads the files and writes the transaction report data at a transaction level and then encrypts it – which, for clients not using the EDS, this is inclusive of any NPD that is sent on the transaction report
- When the transaction report data needs to be processed, for example for validation purposes, all the data is decrypted.
- When the transaction report data is scheduled to be sent to the NCA, MKTX batches transactions and encrypts
- Transaction report data is sent to the EDS via SFTP channel
- MKTX** polls for the transaction report(s) in the EDS, and these are transferred at file level and encrypted
- The enrichment process then searches the relevant NPD data from the EDS database and adds it to the transaction report
- The enriched transaction report is then transferred via encryption ready to be sent to the NCA
- The enriched transaction report is then sent from the EDS to the NCA using in-transit encryption

Personal Data Process (end-to-end encrypted)

- The client submits files of NPD to the EDS over SFTP/HTTPS
- MKTX** polls for the NPD internally, and this NPD is transferred at file level and encrypted
- At the application process level, the poller decrypts and re-encrypts the NPD in the EDS database

*MKTX physical data centers in the US are hosted by Equinix, pursuant to a contract between MarketAxess Corporation (a US group entity) and Equinix

** management of the EDS processes and enrichment of data stored in the EDS is outsourced by MAPT BV to MAPT, a UK subsidiary of MarketAxess, subject to oversight and governance of MAPT BV

Using the European Data Store

Instructions for client interactions using EDS directly (not via the European Gateway)

Client setup Pre-requisites



Before submitting any report, clients set-up their NPD (client ID) mapping data via a Web GUI or bulk update via a CSV file

- For example, user: first name 'John', last name 'Smith', passport number '12345678' gets mapped to token "AE85Q79\$VF%" – token is stored in the U.S. and EU databases
- The NPD associated to the token is only stored in the EDS. All file and database processing of NPD is carried out by the ARM and EDS applications using credentials that are unique to the applications in a restricted environment
- Clients are responsible for creating tokens that cannot be retraced to the natural person. MarketAxess recommends that firms use randomly generated tokens that make it difficult to identify the individual
- Token length can be 35 Characters made up of Alpha / Numeric / Special Characters

Transaction reporting & lifecycle



Clients substitute their NPD with the pre-registered token in their submission payloads – for every instance where NPD exists

- Clients submit payloads directly to the U.S. based servers
- Where a Token is found, a look-up is performed to conduct Token verification; the lookup compares the hash value only

NCA reporting



The generation of the regulator file is kicked off in the US and uses stored tokenised values

- Once the file is generated in the U.S. data centre, it will be transmitted to the EDS
- The EDS application will enrich the NCA files with the actual NPD
- The enriched file will be sent to the NCA
- The NCA response status code will be sent back to the U.S. data centre (via EDS)
No NPD is included in the NCA response status code

MKTX insight



Transaction Search will need to be updated into a multiple step process to segregate the retrieval of trade economics and the retrieval of NPD

- NPD values will only be visible to those who are permissioned by the submitting entities administration

Benefit from EDS without segregating your data flow, using the European Gateway

While some MarketAxess clients prefer to separate the management and submission of NPD from their transaction reporting data, as is the case for clients with direct EDS access, others want to submit NPD on the transaction report itself. European Gateway is a time-saving and secure solution which removes the burden of separation of NPD from the transaction report from the client.

- The European Gateway service was designed as an optional service to allow clients to submit NPD on their transaction reports, while at the same time ensuring the NPD does not leave the EU.
- As part of this solution, MarketAxess* is able to remove NPD from a client's transaction report and store that data securely in the EU within the European Data Store. MarketAxess* creates randomised Tokens which are sent for onward processing in the US (see next slide).
- When the transaction report is due to be submitted to the NCA, the NPD is enriched back to the transaction through an entirely automated process and onward reported.
- The client is able to use their preferred submission method of reporting NPD and transactional data together whilst ensuring the NPD remains within the EU.
- Any subsequent management of the NPD within the EDS will be automatically handled by the EDS application as and when clients submit updated NPD on their transaction reports.
- In this way, Clients do not need to interact directly with the EDS themselves in order to manage NPD.

** performed within the EDS application*

Advanced Encryption and Key Management

Delivering security and confidence



MKTX leverages **Thales CipherTrust Manager** (formerly Gemalto Safenet Keysecure Key Management) infrastructure products in order to provide full key lifecycle management and encryption to NPD and Transaction Report data.

Keys are managed within the Safenet KeySecure appliances as per **ISO27001 and NIST SP 800-57** key lifecycle requirements and file and application layer encryption are provided via ProtectFile and ProtectApp products, respectively.

The encryption infrastructure is **completely separate** between the EDS and MKTX US data centres and keys are never shared between them.

Since AWS is only used as an extension to the on-prem network as an IaaS VPC, native cloud services around access control and encryption do not apply. For that reason, all data access and encryption is solely managed and processed by MKTX. **AWS does not have access to process data in clear (unencrypted).**

Management of Safenet key lifecycle and infrastructure is **restricted** to the Global Information Security team. Only deletion, rotation, creation, disabling of key actions are possible by the Information Security team.

Due to the nature of the Key Management devices, which are FIPS 140-2 certified, encryption keys cannot be directly accessed or transferred out of those devices.

Technical Whitepaper on Encryption Infrastructure
<https://cpl.thalesgroup.com/encryption/ciphertrust-manager>
<https://cpl.thalesgroup.com/encryption/transparent-encryption>
<https://cpl.thalesgroup.com/encryption/application-data-protection>

Important Data Security FAQs



- 1 Who can access the keys?** No one The entire encryption and decryption process is done between a Thales Agent and a Thales KMS appliance. See slide 9 on technology used.

- 2 Is MKTX required to expose the encrypted/tokenised NPD in order to provide the services, and if so how is this achieved?** The ARM and EDS applications process NPD in-memory only in order to provide the service. There is no “backdoor” or manual method to unencrypt data or bypass access controls. The ARM and EDS processes (shown in the diagrams) are entirely automated and run by restricted service accounts.

- 3 Can AWS see/process NPD unencrypted?** No. Files are ALWAYS written to AWS storage in encrypted format. The same applies to NPD stored in MKTX US data centres. This is achieved with file and application layer encryption.

- 4 Can NPD (exc tokens) be transferred out of EDS other than to be sent to the NCAs?** No. Technical controls prevent any employee from exfiltrating data out of EDS. For view only access, see the response to question 6.

- 5 Can keys be transferred outside of EDS?** No. KMS appliances do not offer an option to export keys. See question 1 and the previous slide.

- 6 Who has viewing access to the raw unencrypted NPD as part of their role?**

MKTX Global Production Support Team: This is a global team who may need to see submission files to troubleshoot NCA data transfers, or answer questions from regulators. MKTX leverages a ‘follow the sun’ support model to maximise the support it provides to clients and assist clients with their regulatory deadlines. Please refer to question 106 in the FAQs.

MKTX Global Control Team: This is a team located in the UK who are required to perform periodic reconciliations of transaction reporting data between the clients' submission to us and data from the NCA as per the requirements in RTS13. This access does not apply to any data submitted by EU clients.



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