GLOBAL FUND SERVICES

# Blockchain & DLT Solutions: Benefits for Transfer Agency

**Global Fund Services Technology Working Group**

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# 1. Introduction

The objective of this paper is to provide a summary of how Blockchain can potentially be used to enhance Transfer Agency (TA) operational processes in the UK.

# 2. Understanding Blockchain

## 2.1 What Is a Blockchain?

A blockchain is a distributed database or ledger that is shared among the nodes of a computer network. As a database, a blockchain stores information electronically in digital format. Blockchains are best known for their crucial role in cryptocurrency systems, such as Bitcoin, for maintaining a secure and decentralised record of transactions.

Historically, TA's use a multitude of different databases to maintain the shareholder register and provide administration services, the key difference between a typical database and a blockchain is how the data is structured. A blockchain collects information together in groups, known as blocks, which hold sets of information. Blocks have certain storage capacities and, when filled, are closed and linked to the previously filled block, forming a chain of data known as the blockchain. All new information that follows that freshly added block is compiled into a newly formed block that will then also be added to the chain once filled.

A database usually structures its data into tables, whereas a blockchain, as its name implies, structures its data into blocks that are strung together. This data structure inherently makes an irreversible timeline of data when implemented in a decentralised nature. Data added to the chain is attributable to either a known entity, or is linked to the holder of a private key, allowing the source of data in the block to be known. When a block is filled, it is set in stone and becomes a part of this timeline. Each block in the chain is given an exact timestamp when it is added to the chain.

## 2.2 How Does a Blockchain Work?

The goal of blockchain is to allow digital information to be recorded and distributed, but not edited. In this way, a blockchain is the foundation for immutable ledgers, or records of transactions that cannot be altered, deleted, or destroyed. This is why blockchains are also known as a distributed ledger technology (DLT).

A blockchain allows data held in a database to be spread out among several network nodes at various locations. This not only creates redundancy but also maintains the truth of the data stored therein—if somebody tries to alter a record at one instance of the database, the other nodes would not be altered and thus would prevent a bad actor from doing so. If one user tampers with Bitcoin's record of transactions, all other nodes would cross-reference each other and easily pinpoint the node with the incorrect information. This system helps to establish an exact and transparent order of events. This way, no single node within the network can alter information held within it.

Because of this, the information and history are irreversible.

To validate new entries or records to a block, a majority of the decentralized network's computing power would need to agree to it. To prevent bad actors from validating bad transactions or double spends, blockchains are secured by a consensus mechanism such as proof of work (PoW) or proof of stake (PoS). These mechanisms allow for agreement even when no single node is in charge. This is described as decentralised governance, where the network is governed by the blockchain network's code instead of a central body. Users of the solution agree to these rules by running the network's code.

Although a digital ledger might be used to record any form of data, the principal use to date has been to record transfers of so-called digital assets, also referred to as digital coins or tokens. In some cases, the digital asset is the record itself ("native" digital assets, such as bitcoin) and in other cases the digital asset corresponds to a legal entitlement to an asset or service, such as a "backed stable coin" that can be exchanged for an underlying currency. Digital assets are stored in "wallets": applications that interact with the distributed ledger to track a person's holdings of the digital asset and to authorise transfers. In order to access and transfer assets in to and out of wallets, users require a "public key" and "private key." A public key serves as the public address for a wallet akin to a routing number and a private key is the private password to access the wallet similar to a PIN.

## 2.3 Is Blockchain Secure?

Blockchain technology improves decentralised security and trust in several ways. To begin with, new blocks are always stored linearly and chronologically. That is, they are always added to the "end" of the blockchain. After a block has been added to the end of the blockchain, it is extremely difficult to go back and alter the contents of the block unless a majority of the network has reached a consensus to do so. That's because each block contains its own hash, along with the hash of the block before it, as well as the previously mentioned timestamp. Hash codes are created by a mathematical function that turns digital information into a string of numbers and letters. If that information is edited in any way, then the hash code changes as well.

Cybersecurity is a key concern for our industry. High-profile hacks to blockchain solutions mostly come in two forms: the stealing or unauthorised use of user's private keys, allowing the attacker to move digital assets to accounts they control, or the exploitation of errors in the smart contracts that run on the blockchain networks. Decentralisation also comes with another trade-off: speed. This impacts scalability, and has led to solutions to net transactions, manage complex transactions off-chain while only adding asset ownership changes on-chain, or the development of public networks with larger data throughputs.

In the funds world, security and scalability are must-haves. If they aren't compatible with decentralisation, then some form of central governance i.e., bank-run private blockchain, may be a necessary trade-off.

## 2.4 Private & Public Blockchain

The sole distinction between public and private blockchain is related to who is allowed to participate in the network, execute the consensus protocol and maintain the shared ledger. A public blockchain network is completely open and anyone can join and participate in the network.

A private blockchain network requires an invitation and must be validated by either the network starter or by a set of rules put in place by the network starter. Businesses who set up a private blockchain, will generally set up a permissioned network. This places restrictions on who is allowed to participate in the network, and only in certain transactions. Participants need to obtain an invitation or permission to join. The access control mechanism could vary: existing participants could decide future entrants; a regulatory authority could issue licenses for participation; or a consortium could make the decisions instead. Once an entity has joined the network, it will play a role in maintaining the blockchain in a decentralised manner.

## 2.5 Banking and Finance

It is widely recognised that no industry stands to benefit from integrating blockchain into its business operations more so than banking, where consumers can see their transactions processed in as little as minutes—basically the time it takes to add a block to the blockchain and is operational 24/7 365 days a year. This is particularly useful for cross-border trades, which usually take much longer because of time zone issues and the fact that all parties must confirm payment processing.

With blockchain, banks also have the opportunity to exchange funds between institutions more quickly and securely. In fund trading, the settlement process can take four days meaning that the money is unavailable for that period of time, which given the size of the sums involved, even the few days that the money is in transit can carry significant costs and risks for banks and asset management firms.

## 2.6 Smart Contracts

A smart contract is a computer code that can be built into the blockchain to facilitate, verify, or negotiate a contract agreement. Smart contracts operate under a set of conditions to which users agree. When those conditions are met, the terms of the agreement are automatically carried out. A distributed ledger with embedded smart contracts could disrupt the role of a transfer agent by automating the transaction processing activities, and decentralising oversight and control of the fund distribution model to the fund managers, distributors and supervisory entities. Yet the legal status of crypto assets and enforceability of smart contracts under private law in jurisdictions around the world remains a difficult subject, in addition questions around data protection, and the sharing and storage of data, especially in jurisdictions with data privacy regimes such as GDPR.

Smart contracts are also visible to all users that have access to the chain. This can lead to the business logic used by companies to be leaked to competitors, and in public blockchains has led to high-profile hacks that have stolen assets of significant value. These risks need to be managed

with smart solution design, thorough security testing, and by processing some data off-chain to prevent sharing of secret or personal data on-chain.

## 2.7 Pros and Cons of Blockchain

From greater user privacy and heightened security to lower processing fees and fewer errors, blockchain technology may very well see applications beyond those outlined above, however there are also some disadvantages.

### Pros

- Disintermediation of inefficient processes
- High-Quality Data
- Durable storage and distribution of data
- Transactions are secure, private, and efficient
- Transparent technology
- Public solutions provide a banking alternative and a way to secure personal information for citizens of countries with unstable or underdeveloped governments

### Cons

- Implementation can lead to significant technology cost
- Public solutions consumes vast amounts of computational power (when using PoW consensus)
- Complex signature verification process
- Integration concerns
- Regulation varies by jurisdiction and remains uncertain

## 2.8 Tokenisation

Tokenisation is the process of transforming ownerships and rights of particular assets into a digital form. By tokenisation, you can transform indivisible assets into token forms. Tokens are typically bearer instruments, which allows any bearer that controls the asset to be certain they own the asset. Tokens are similar to physical cash, and represent a claim on the token issuer.

A tokenised fund, which may also be known as a digital fund or a BTF (blockchain-traded fund) is one where shares or units in the fund, or a feeder fund for it, are digitally represented and can be traded and recorded on a distributed ledger. It uses code to mimic the functionalities of a traditional fund and replaces shares or units with tokens. With tokens issued and traded on a blockchain, subscriptions and redemptions settle by delivery of fund tokens against payment tokens directly into the investor wallets, therefore ownership changes occur instantaneously, eliminating the need for a separate register (as the blockchain ledger would be the register). Settlement of tokenised assets using tokenised payment (e.g., fiat currency) also allows for atomic settlement. Atomic settlement means that the asset transfer and payment transfer either occur simultaneously, or both legs fail (i.e., it is not possible to transfer the asset without payment, or vice versa). This can dramatically reduce the risks associated with settlement of fund transactions.

## 3. Blockchain DLT & TA

TA's understand the need to innovate with the use of DLT potentially at the forefront, however TA's must ensure that any technological solution implemented must be fit for purpose with proven capabilities and have the architectural flexibility to support future methodologies.

The planning and testing required to a DLT solution is significant with majority of our members reporting that they estimate being approximately 5-7 years away before DLT will be part of BAU in their fund operating model.

For blockchain-based funds using electronic fund transfers, the distributed ledger will need to interface with an external system that matches trade orders to cash transfers. Therefore, an essential element of the core function of a transfer agent would still need to be handled outside the distributed ledger.

The most likely near-term scenario is the prospect of a dual on- and off-chain environment existing in parallel, which transfer agents will need to support. Adoption of a DLT solution to manage fund orders is likely to form part of a more general 'digitalisation' update of the fund industry where legacy systems and operations are updated to take advantage of new networks and reduce operational costs. The rate of adoption of DLT solutions in the TA industry will be influenced by perceived operational benefits and the need for replacement of legacy solutions.

## 4. Strawman for Blockchain Fund DLT

The TA Forum Blockchain Working Group (now known as GFS Technology Group) discussed how Blockchain DLT could potentially provide a means of maintaining a register for a Fund. This Strawman focuses on direct investors as institutional investors who invest via nominee wallets have a layer of complexity which limit some of the benefits of tokenisation due to the necessary continuance of reconciliation, KYC, AML, CFT and other sanction screen checks required.

A Blockchain Fund could develop a decentralised application (dApp) that permits users to submit trades directly to a distributed ledger network using a smart phone, tablet or personal computer. The distributed ledger would serve as a virtual transfer book for the shares, recording each trade and the current share balance held by each shareholder.

Investors could download the dApp and use it to open an account with the Fund. The investor would link a bank account to the dApp account and purchase or redeem shares by electronic fund transfers from and into the bank account. The dApp would have to provide some means for the user to transmit sufficient information to comply with anti-money laundering, know your customer and tax reporting laws and regulations and this information would have to be

reviewed and overseen by the appropriate compliance personnel. The dApp could nevertheless automate many other steps of the account creation process.

When an investor opens an account through the dApp, a blockchain wallet and a corresponding public and private key pair would be created for the investor. The investor could submit trade orders through the dApp at any time, using the private key to authorise the order. A node would incorporate the transfer of shares to or from the shareholder's wallet, as the case may be, into the next block added to the distributed ledger, thereby increasing or reducing the number of shares recorded to the wallet's public address. A Blockchain Fund would need to use the dApp as the exclusive means of entering trade orders. A shareholder must authenticate any order transmitted to the distributed ledger network using their private key.

Processing phone or mail trade sell orders would require the shareholder to provide the private key to the employee at the TA taking the order, which would defeat the purpose of a private key by introducing the risk of unauthorised transactions by these employees. A dApp, in contrast, could allow the shareholder to use a private key without sharing it with anyone or exposing it to misappropriation. Buy orders could be placed on the user's behalf by a TA, and purchased assets would be added directly to their wallet (after transaction settlement). Users could then sell these assets using their dApp.

This direct integration approach highlights a key challenge of decentralised finance (and not using a TA). The solution presented would leave users vulnerable to losing their private keys, and in turn permanently losing access to their assets. A solution cater for lost keys would be required, and if poorly designed this could leave users open to hacking through social engineering (through attackers impersonating them in order to have their keys revoked and replaced by the attacker generated keys). A robust customer management solution would need to be stood up by the fund provider to avoid this (something that a TA would normally provide).

Another consideration for a Blockchain Fund and its shareholders is the payment of fees. Some protocols would require investors to add a small amount of a native digital asset to each transfer. As the transfers are included in blocks, the protocol distributes these additional assets among the operators of the network validating the block as compensation. The need for shareholders to pay these transaction costs could make explicit the currently implicit cost of transfer agent services.

Transfer agents charge fees to mutual funds based, in part, on the number of transactions processed. These fees are included in the "Fund Operating Expenses" disclosed in the prospectus and are not separately broken out. If a distributed ledger is used as a mutual fund's transfer books, the network's transaction fees would be the equivalent of transfer agent fees, except they could be externalised and paid by shareholders directly. A distributed ledger may also have the advantage of requiring shareholders who engage in the largest number of transactions to bear a proportionate share of the cost of recording their transactions.

**Hurdles to Providing Core Transfer Agency Functions through a Distributed Ledger Solution**

Shareholders could use the dApp to send trade orders to the network, which would then validate the trade and record a transfer of shares to or from the shareholder's wallet from or to the Blockchain Fund's wallet. The smart contract for these transfers could include a step to prevent the Blockchain Fund from issuing more than its authorised shares, effectively performing the function of a registrar. This represents only one side of a TA's core function, who is also responsible for the transfer of money to (in the case of a purchase) or from (in the case of a redemption) the Blockchain Fund.

The exchange of fund assets for purchases and redemptions should not be recorded on the distributed ledger until the corresponding cash transfer is confirmed. So long as the Blockchain Fund relies on electronic fund transfers, the distributed ledger will need to interface with an external system that matches trade orders to cash transfers. **Thus, an essential element of the core function of a TA would still need to be handled outside the distributed ledger**. Significantly, the protocol would not need to match cash transfers to transfers made by one shareholder directly to another. If both parties have Blockchain Fund wallets, the transferor could use the dApp to transfer shares to the transferee. Because a distributed ledger operates continuously, such transfers could be made on any day at any time, rather than only during the TA's business hours. This secondary trading of funds may require a change of legislation.

Eventually, a distributed ledger could handle the payment side of trade orders if the Blockchain Fund began accepting digital currency as well as clearing house funds. Banks and other financial institutions have begun to introduce "backed stable coins" that are recorded on distributed ledgers and exchangeable for UK Sterling or any currency. If a Blockchain Fund agreed to issue and redeem its shares for a specified stable coin, entering a purchase order through the dApp could also authorise the transfer of such stable coins in the amount of the purchase price from the purchaser's wallet.

The stable coins would be directed to a smart contract, which would issue shares to the purchaser's wallet while transferring the stable coins to the Blockchain Fund's wallet. The Blockchain Fund would exchange the stable coins for UK Sterling, or any other fund denominated currency and invest the proceeds. Redemptions would move shares and stable coins in the opposite directions. The use of digital currencies would allow for atomic settlement of fund units for digital currencies, and this provide instantaneous settlement of fund trades.

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## 5. Identifying which TA Processes could benefit from Blockchain DLT

**The table below shows the key processes typically performed by TA's and have been colour coded to indicate which processes we believe can be the first to potentially benefit from Blockchain/DLT solutions. Key: Green – Highly possible, Amber – Some challenges would need to be overcome and Red – Difficult due to significant challenges/external factors.**

| TA Process | Challenges of moving to DLT | Benefits if moved to DLT | Architectural Principles |
|---|---|---|---|
| Transaction processing (the placing of subscriptions, redemptions, switches, conversions and transfers) | **Order Routing via Distributor**<br>• Order router charges for the service - Calastone, EMX (Euroclear). 1000s daily messages in each organisation – significant volume of transactions.<br>• Message - has a request. ISO 20022. XML. ISO message - limited fields.<br>  • Current flexible Business Model - Calastone/ EMX - give me anything and I'll process and route<br>• PLATFORM - putting trades in, put excel dump in, and then covert for TA<br>• Need participants to connect to the network. Calastone - has all the end points | • Cost reduction to Asset manager of Order Routing Fees<br>• Improved Order Routing direct from customer – potential of reduced fees.<br>• Reduced admin & reconciliation<br>• Distributor - one stop shop to see all funds. (Hargreaves's Lansdown/ FIL).<br><br>**Implementation can be minimal to address this.** | **Design Approach:**<br>• Investor submits instruction directly on-chain (either via an industry standard interface, or through a private application)<br>• TA adds order on-chain<br><br>**Architectural Principles:**<br>• Trades should have a publicly accessible Data Format<br>• Core trade data should align with ISO standards<br>• Data format should be extensible (and used by agreement)<br>• Network should be able to accept historical holding data |

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| | • Calastone is free for a Distributor - Challenge on ability to change the market.<br>• Reconciliation of data can be a challenge, for a distributor - what they hold vs. what TA holds.<br>• Link with Banks<br>• Regulatory Constraints | | |
| Investor and account data validation | • Storing personally identifiable information<br>• Data would need to come from the Customer<br>• Regulatory Constraints | • Improved client record<br>• Improved demographics and look through<br><br>**Data on-chain, value to the asset managers** | **Design Approach:**<br>• Investor creates/amends their account directly on-chain, or<br>• TA creates investor accounts and processes updates on-chain<br><br>**Architectural Principles:**<br>• On-chain records should avoid using PII data<br>• Individual Investor identifiers should only be exchanged between parties to an exchange<br>• All participants must be identifiable, with identities verified by TA entity or agreed/accredited identity verifier.<br>• Identity verification needs to happen prior to interaction with fund market. |

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| Anti-money laundering (AML) and know your client (KYC) processing | • Labour intensive, onboard and verify.<br>• Use of credit reference agencies with pass rate currently averaging at c.50-75%. Varies with age. Younger have less identity, which require further manual process, proof of identity and address.<br>• Corporate is more complex where range of docs required, which need to be periodically reviewed and updated.<br>• How to detect anomalies?<br>• Credit reference - have proprietary access to data.<br>• Additional data required for institutional clients being the ultimate beneficial owner for AML5 legislation.<br>• Interested parties linked to both individual investor accounts and institutional investors.<br>• Need for going PEP & Sanctions checks. | • Reduced risk management - common, holding siloed. - industry wide. Illegal, fraudulent, regulatory overhead. Terrorise financing, AML. Regulatory overhead.<br>• Expedite - onboarding process.<br>• Anomaly detection<br>• Improved MI - more accurate, timely, issue detection. ISA - subscription detection. Cap across any asset manager. Relying on HMRC reporting.<br>• Universals are driven by the regulator- regulatory logic - drives the systems. If the regulation is common,<br>• CASS, AML, KYC - large regulatory change budgets. Questions around whether this can this be done by a smart contract. No USP, nothing proprietary. Common service.<br>• Corporate – potential of shared pooled data sets, where Corporates update info only once | **Architectural Principles:**<br>• AML and KYC Processing for investors should meet current standards.<br>• AML and KYC checks should where possible to be integrated into each transaction (where on-chain AML/KYC check status can be maintained)<br>• Network should allow independent identity verification services (e.g., Decentralised Identity Services)<br>• Regulatory reporting and PII data management should be off-chain |

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| Box management | • Link with Depositary<br>• Regulatory Constraints | • Box management could be automated via DLT solution smart contracts, but would often be managed prior to interaction with the order routing solution | **Design Approach:**<br>• Order aggregation is immediately visible to the fund manager on chain<br>**Architectural Principles:**<br>• Solution must meet regulatory constraints (e.g., 'Regional Specific Box Management approach')<br>• Needs the ability to send box management metadata where required (Investor identity information)<br>• Additional data must be private (not on-chain or accessible to non-parties to a trade) |
| Settlement and associated reconciliation | • Current settlement period of T+4 too long. Need to monitor ongoing discussions in UK and EU regarding T+1 and T+2 settlement.<br>• Headline flow: Investor settling their trades. Money from Asset Manager to distributor to the investor.<br>• CASS obligation<br>• Data quality & GL postings<br>• Banks data is poor<br>• General ledger owned by the TA Ops – separate record keeping | • Fiat currency can be represented on-chain<br>• Atomic settlement can ensure risk free transfer of assets | **Design Approach:**<br>• Settlement with tokens on-chain, or<br>• Cash settlement off-chain as is today<br>**Architectural Principles:**<br>• Settlement on-chain should be optional (segregation of settlement from order management must be possible)<br>• Settlement approach must be agreed by parties to a trade |

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| | • Balance sheet - Asset Manager front-loading.<br>• Inclusion of currencies, currencies cut off time which could delay settlement, FX trades.<br>• Commissions, Rebates AMC's, end of day holdings, deals and prices for Investment house to download into their systems. | | • Existing payment schedules should be accommodated. |
| Banking activities, including control of client money | • Complex CASS model rules with recognition of digital assets in the context of our settlement requiring regulator support<br>• Link with Depositary & Banks<br>• Regulatory Constraints | • Automate CASS rules<br>• Real time reconciliation | **Design Approach:**<br>• Segregated tokenised cash holdings on-chain, or<br>• Segregated cash holding in traditional customer accounts.<br>**Architectural Principles:**<br>• Digital Assets should be integrated into CASS reporting by Regulators<br>• Interaction with on-chain payment methods (e.g., stablecoins) should be opt-in only (not mandatory, and by agreement only)<br>• Payment lifecycles should allow for the asset manager or seller to confirm settlement. |

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| | | | • Off-chain settlement processes should allow for settlement failure to reverse on-chain change of asset ownership. |
| Document management (workflow and record keeping) | • Documentation and detailed records normally are managed completely off-chain | • Enhanced coordination of document sharing and management.<br>• Registration of documentation on-chain can be useful | **Architectural Principles:**<br>• Documentation should be maintained off-chain<br>• On-chain references to documentation should have no transaction or PII details (e.g., could include a hash of the document). Any sharing of transaction or PII details must be limited to the parties of the transaction (normally this information is shared off-chain). |
| Registration updates and maintenance | • Regulatory Constraints<br>• Bereavement process still heavily manual<br>• Legacy books with dormant client records | • Improved coordination of investor management | **Design Approach:**<br>• ON Investor creates/amends their account directly on-chain, or<br>• TA creates investor accounts and processes updates on-chain<br>**Architectural Principles:**<br>• Network maintenance windows must not unduly disadvantage any participant groups<br>• Bereavement changes in holdings must be able to be processed (this could include a network body that can |

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| | | | recover ownership of funds with specific)<br>• Legacy holdings should be able to be consolidated on-chain (with reference to Hash of off-chain ledger) |
| Call centre and investor servicing | • Ability to respond to shareholder enquiries and provide service to clients who are not digitally enabled.<br>• Inclusion of end of day holdings, deals and prices for Investment house to download into their systems. | • Solution could provide investor lifecycle management or migration support capabilities | **Design Approach:**<br>• Some investor servicing responsibilities are removed from TA and placed on-chain<br>**Architectural Principles:**<br>• Solution should be flexible enough to provide direct integration into the fund market, or enable investors to be represented by a TA |
| Distribution processing and corporate actions | • Regulatory Constraints<br>• Automation of corporate actions<br>• Group1 & 2 calculations<br>• Paper distributed<br>• Inclusion of notification to the holders, how the tokens, Income is paid away, Income reinvestments notification process. | • Efficient distribution of corporate action data | **Architectural Principles:**<br>• Solution should allow for Corporate Action data distributions<br>• Data distributions should support private distributions (based upon holdings or corporate attributes)<br>• Tokenised holdings could be used for corporate actions |
| Management and financial accounting | • Regulatory Constraints<br>• Paper distributed<br>• Link to Fund Accounting | • DLT solution could provide efficient method completing data reconciliation and | **Architectural Principles:** |

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| | • Inclusion how fund manager is notified of monies in and out of the fund, notification to fund accountant, depository / trustees. | improving regulatory reporting. | • Regulators should allow investors to opt in for electronic distribution and management of their fund ownership<br>• Decentralised Identity credentials could be used for investor reporting / access to reports |
| Agent maintenance and commission processing | • Complying with Data protection & GDPR rules and linking to client data<br>• Various layers of agent types (Networks, IFA etc)<br>• Inclusion of Adviser maintenance, commission, Annual Management Charges calculations and redemptions. | • DLT solution could provide method of managing agent relationships and commission process.<br>• Direct ownership of assets is possible via a DLT solution for raising orders and managing asset ownership. These two models could co-exist in DLT solution. | **Architectural Principles:**<br>• Investor information should only be processed by parties to a transaction or business relationship. No PII data should be distributed via the blockchain network.<br>• Solution should provide flexibility for transaction or annual processing fees. Direct relationship fees should be managed off-chain where possible. |
| Annual management charge rebates | • Annual Management Charges calculations and redemptions. | • DLT solution could provide method of managing investor orders and calculating rebates. | **Architectural Principles:**<br>• Solution should allow for varying investor representation models<br>• Solution should provide the ability to securely share private data between participants |
| Output management, contract notes, distribution vouchers, | • Generally outsourced & physical documentation<br>• Regulatory Constraints | • Management of data off-chain is required, but DLT solution could provide method of | **Architectural Principles:**<br>• Regulators should allow investors to opt in for electronic distribution |

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| periodic statements, prospectuses etc. | • TA - different unedited managers. Fund accounts - common data sent out in multiple formats. need to have several different versions.<br>• Distribution of NAV to distributors e.g., fund price, MiFid template - charges within the fund. Static data. Needs to be changed. Cascaded EMT data.<br>• Data out initiated by the TA - various trigger points. Reporting tool, to draw data together. Info can be sent on email and fax<br>• IMPACT: Operational overhead, Maintain - different reports rather than one report, Approval processes. Report structure. Pricing issues.<br>• DATA TA send out - creation, liquidation data. Asset Manager sends - e.g. market data, not for TA. Often used by third party.<br>• Pricing generated by the fund accountant but consumed by the TA. TA is a channel for the data.<br>• Consequence of pricing errors – which are normally fixed by TA | organising market data and distributing updates in static and fund data. | • Solution requires an approach to managing Static Data either in central body, or on blockchain<br>• Need for the integration of reporting services into market (e.g., industry body, or private organisations that people subscribe to for reporting), especially to send information direct to participants (via email, fax or physical mail if required) |

## 6. Fund Market Architectural Principles

This section is to provide an overview of our key architectural principles for the fund network. Our initial approach is to cover core architectural principles and then apply these principles to an analysis of how the network can be supported by permissioned or public networks.

One key aspect of this analysis is the choice between **permissioned and permissionless blockchains**. Permissioned blockchains offer enhanced control and security by restricting participation to authorised entities, making them well-suited for regulated financial markets where compliance with KYC/AML regulations is paramount. On the other hand, permissionless blockchains, like those used for cryptocurrencies, are open to anyone, offering greater decentralization and potential for innovation. While permissioned tokens are often associated with private blockchains, they can also be implemented on public blockchains with appropriate access controls and smart contract logic. This approach can be particularly advantageous when tokenising a single share class of an existing fund, as it allows for broader investor access while maintaining regulatory compliance. In addition to these principles, it's crucial to consider the importance of maintaining parallel records on both the blockchain and traditional systems.

**Overall Architecture Principles:**

- Market Operators should with sufficient governance have the power to make changes to holdings.
- Tokenised settlement methods should be opt-in.
- Individual investor interaction with the network will require third party identity verification
- Network requires mature private capability to limit blockchain linked information to being shared only with transaction participants.

To meet these architectural principles we see the following design criteria being key to the evaluation of public or private blockchain networks:

- Network Fees approach
- Governance (Code Only or Operational Body/Code)
- Operational Requirements
- Reversibility of trades and Tokenisation
- Access to tokenised payments (and different approaches)
- Access for unaffiliated investors (and decentralised identity services)
- Reporting and management of regulatory rules (what can and cannot be supported)

The advantages and disadvantages of using public or private blockchain networks are summarised in the table on the next page.

| Public Network | Private Network |
|---|---|
| Solution placed on any public network that meets the design goals, which could include layer two solutions integrating with public layer one blockchain networks.<br><br>**Advantages**<br><br>• Permanent management of digital asset ownership (supported by all other use cases on the public network).<br>• Trading network less susceptible to dominant player intervention (as the network will implement rules based upon code, and the only way to reject those rules is for participants to trade using different code)<br>• Solution is more open to anonymous investing, and technically capable users can interact directly with the trading infrastructure (likely they would need to be accredited or identified by a trusted third party to trade)<br><br>**Disadvantages**<br><br>• Depending upon the network select, transaction costs may float depending upon the additional traffic or load on the public blockchain network. This may be especially significant for transactions of lower value, reducing the ability to innovate using transaction heavy processes.<br>• Solution less suited to sharing personal information required for regulatory reporting<br>• More difficult to integrate governance of network, especially including the ability to reverse ownership of assets when required (due to settlement failure or trade errors). Likely these features would undermine the code governance, and may be unavailable. | Solution that is either completely private or a hybrid solution that involves a mix of private order management and public fund ownership registration. Solution will involve a single entity or collective governing access to this infrastructure.<br><br>**Advantages**<br><br>• Ability to integrate controls over counterparties joining network<br>• Solution can control who has access to trade information, allowing additional details to be shared using the blockchain network (and not off-chain by participants using separate infrastructure)<br>• More control over data reporting, including the ability to generate reports using off-chain data.<br>• Predictability over transaction costs can be managed by the network providers.<br>• Permissioned network provides a natural forum to agree on market interaction changes, operational processes and network's strategic direction.<br><br>**Disadvantages**<br><br>• Digital Asset Ownership data not as permanent compared to use of a public network (ownership ledger is maintained as long as participants maintain the network, but will be relied upon less when the market is in decline)<br>• More difficult for independent participants to integrate with and trade on the market. (This approach would normally require a third party TA.)<br>• Requires a trusted network operator which can be relied upon to act in good faith. This is especially true with the market operator has the ability to invalidate any digital asset holdings (not all solutions will allow this). |

# 7. Tokenised Real World Assets

Real world assets are increasingly being tokenised as asset managers seek to reduce management costs, to access to larger investor populations, and gain access to features that are difficult to implement using traditional message based ecosystems. While tokenisation can add additional management costs (to cover the operation of the network and tokenisation process), it can also reduce asset investment minimums (particularly through asset fractionalisation), automate business processes through smart contracts, and allow for efficient integration into blockchain-based settlement networks.

Tokens representing real world assets are effectively bearer instruments that can provide instant settlement and precise control of ownership. This can support instantaneous and atomic settlement, and provide functionality that is not possible with existing markets. For example, the JP Morgan Onyx Digital Assets platform provides intraday repurchase transaction that allow short term borrowing using collateralised cash[1]. This solution provides minute by minute interest on borrowed cash, and similar solutions with precise asset control will drive innovation in asset management and utilisation.

The market for real world tokenisation is expected to grow to trillions of dollars by 2030[2,3], and assets that have large minimum investments, or those that are traded across borders, will especially benefit from tokenisation. Fund markets will see the tokenisation of the fund's underlying assets (that are bought and sold by the fund manager) and tokenisation of the fund units (to improve access to the funds and to reduce the costs of purchasing units). This section will consider the opportunities and risks associated with each of these approaches.

## 7.1 Tokenisation of Fund Assets

The first tokenisation model is the tokenisation of real world assets that are held by funds. Tokenisation of real world assets will accelerate the market's ability to efficiently manage the ownership of assets and build them into investment products. The use of blockchain technology to manage assets also introduces the ability to automate the trading and operational management of these assets through smart contracts. The smart contracts could automate the distribution of funds to a range of asset exchanges, automating asset trades, or be used to automate the reporting or corporate actions associated with the holding of the assets.

Opportunities associated with the tokenisation of fund assets:

- The automatic execution of asset transfers has potential to drive down administrative costs associated with buying and selling assets. Integrating this process into tokenised settlement solutions (e.g., atomic settlement using fiat backed stablecoins) could greatly reduce settlement risk, accelerate settlement timeframes (allowing traceable fund units to be

[1] *https://www.jpmorgan.com/insights/payments/wallets/blockchain-onyx-asset-tokenization*
[2] Banerjee, A., Sevillano, J., & Higginson, M. From ripples to waves: The transformational power of tokenizing assets | McKinsey; June 2024 (link)
[3] S. Kumar, R. Suresh, D. Liu, B. Kronfellner & A. Kaul, 2022. Relevance of on-chain asset tokenization in 'crypto winter'. BCG, ADDX report (link)

created instantly), and improve the ability to settle across borders (further reducing costs, risk and settlement timeframes).

- Tokenised asset markets could allow funds to more easily hold new asset classes (e.g., fractions of bonds, units of private companies, etc.). This can be achieved by linking to previously unavailable markets (e.g., cryptocurrencies or private company equity), or through the use of a fractionalised asset markets (which could drive more efficient purchase of assets allowing for smaller minimum investment levels). This could further diversify fund assets and provide investors with greater control of risks from a specific market.
- Atomic settlement of assets could reduce the counterparty risks associated with asset transfer and settlement. Reducing the risks associated with managing fund unit creation could reduce the capital reserves required to cover the realisation of fund asset settlement risks.
- The improved efficiency with which blockchain based markets can operate (especially when considering fractional asset trading) could provide new opportunities to automate the processing of underlying assets purchasing and rebalancing. The automation of fund unit price calculations could also greatly improve fund administration and reduce reporting costs.
- Having the asset registry, trades and settlement infrastructure on the same ecosystem should improve trust in the solution and reduce trading errors.
- A reduction in the overall cost for managing funds could also unlock a new class of investors that were previously locked out of the fund investment ecosystem due to cost.
- This market efficiency could also provide the ability to more cheaply provide segregated portfolios and targeted funds tailored to individual retail investor goals and exposure requirements. Integration of ESG or other market data could be used to further personalise funds and automate investment decisions.
- Pre and post-trade compliance checks could be automated using smart contracts. Identity verification checks could be more easily implemented per trade, instead of per trading relationships, and this could further reduce operational risks and reduce compliance reporting costs.
- Tokenised assets are bearer instruments, and they therefore are easily traded in a secondary market (if permitted by the asset custodian). This use of public blockchain networks to trade assets has the potential to greatly expand the secondary markets for asset trades.

**Risks associated with the tokenisation of fund assets:**

- Trading assets on a public network has the potential to inadvertently leak confidential business information around asset ownership, fund asset makeup, or trading activity. This could allow competitors (or the general public) to mimic investment strategies without paying for the fund administrator's investment expertise. This risk could be addressed

through adequate privacy controls, or through the use of private blockchain or DLT solutions.

- Access to a broad range of tokenised assets could increase the potential for access to non-traditional assets to be included in funds. These could include assets traded using units of privacy companies, inclusion of debt or foreign assets, decentralised finance (De-fi) protocols or include cryptocurrencies. The risks associated with using these assets would need to be well understood, and funds using a range of blended assets could potentially confuse fund purchases. Retail ownership of these types of funds could introduce risks as investors are unable to understand the complete risk profile of the assets they're purchasing in a fund.
- Tokenised assets traded on a public network are often traded as bearer instruments that are impossible to recover once transferred. This puts fund managers are significant risk of asset loss compared with traditional markets that have more robust governance structures.

## 7.2 Tokenisation of Fund Units

The second tokenisation model is the tokenisation of fund units to allow for more efficient distribution and ownership management. This model involves meeting existing KYC and AML regulatory requirements through potentially independent identity service providers, and through the use of either traditional or new settlement mechanisms (e.g., using stablecoins for settlement). In this tokenised fund model, the role a TA organisation plays could be simplified, but there are opportunities to expand their services.

Issuance of fund tokens onto a blockchain register could be managed solely by the fund manufacturer or a third party. Identity or settlement services could also be independently provided, and integrating these services into trading of fund units could dramatically simplify issuance, trading and settlement of fund units. Interaction with blockchain based markets requires specialised skills and solutions, and TA organisations could provide these services along with traditional financial services. This section looks at some of the opportunities and risks associated with this tokenisation model.

Opportunities associated with the tokenisation of fund units:

- New settlement approaches (e.g., stablecoin settlement) could greatly reduce settlement costs and counterparty risks (especially for cross border settlement).
- Improve the ability to purchase and sell fund units immediately, decoupling the trading times from traditional fund market trading cutoffs or trading rules.
- Dramatic reduction in the cost and time involved in onboarding investors (KYC checks, management of subscription details, etc.). Market participants that have investor relationships could also provide identity verification and banking services to investors in different markets (e.g., for participating in decentralised finance (DeFi) services on public blockchain networks).
- Trading networks that leverage existing public networks would be opening fund manufacturers up to a greatly expanded addressable market of new investors that previously may not have been able to access TA services.

- The integration of the register into the trading infrastructure could ensure much higher integrity of asset ownership records. Asset servicing could also be made more efficient through the use of smart contracts. These services could be simplified implementation of current requirements, or could adapt to emerging asset servicing requirements.

Risks associated with the tokenisation of fund units:

- A key risk with the tokenisation of funds is to distribution. Funds that are able to be purchased only via a blockchain solution, potentially only when engaging a specific identity service provider, could limit fund distribution to users capable of interacting with this type of network.
- Immediate settlement of funds could increase the potential for trading errors or financial fraud. Atomic settlement of fund units could allow positions to be created in error that cannot be unwound. Rules associated with the governance of trades, and the ability to reverse transactions will need to be considered as immediate settlement or secondary trading of funds is considered in new legislation.
- The use of a shadow register on a blockchain could add costs without significantly improving efficiency of the fund management. This is likely to be the case if traditional identity services and settlement infrastructure is used.
- Regulatory requirements vary for the use of a new register for funds. Many traditional funds will not be able to be migrated to a blockchain register without the explicit consent of an investor. The difficultly of convincing all market participants to opt in to this new management approach may restrict fund unit tokenisation to new funds that are launched natively on a blockchain.

## 7.3 Asset Tokenisation Summary

Tokenised assets provide lots of opportunities for driving innovation and reducing the costs associated with fund management. As the tokenisation of real world assets increase, fund managers will be increasingly drawn to using these systems. The opportunities of both models will be amplified when both models are used in conjunction with each other. End to end automation from the purchase of fund units to the pricing and purchase of fund assets, and the management of assets will have profound impact on the TA market.

Risks associated with this emerging market are to both the TA organisations and investors. Regulation will need to adapt to a global market model, and consider the technical and governance controls required to ensure investor safety and market stability. TA organisations will also need to adapt to ensure that they can still provide core features that the market relies upon, including:

- Management of customer relationships, tax wrappers and reporting
- identity and banking services
- classification of asset value and independent brokerages advice

- administration and processing of market data, and
- integration between blockchains and providing trusted transactions

## 8. Important Information

As the responsible party, the fund manager firm being the regulated entity will ensure that the services provided by the administrator in conjunction with the services provided directly by the firm itself meet their regulatory obligations and it is therefore their decision as to whether Blockchain or alternative technology is adopted and to ensure adequate due diligence and testing has been conducted.

GLOBAL FUND SERVICES

## Appendix A - TA Blockchain Case Study

For the purpose of this paper the TA Forum Blockchain Working Group (now known as GFS Technology Group), based their analysis on the following product characteristics:

- Funds that are universal
- Fund that can be marketed to all, both institutional and retail
- UK Equities Fund - FTSE Fund
- UCITS Fund - not a specialist category
- Daily traded fund

The TA provides the primary contact between investors and the companies or trusts managing their investments. Investors generally fall into three broad categories:

1. **Retail investors**, including trusts. These will show on the register as a person or a company with a name and address.
2. **Aggregators** who hold investor level records themselves but will typically have an aggregated account with the AFM to hold assets belonging to the underlying investors. These will usually show on the register as a holding in the name of a nominee company that is owned/controlled either by the regulated aggregator or that of a platform service provider.
3. **Institutional investors** such as charities, local government entities and pension/insurance companies where the account will typically show on the register in the name of the legal entity.

For the purpose of Blockchain, the above categories are known as Blockchain Actors which are entities that can participate in an action or in a blockchain network.

**In addition, the following can also be defined as Blockchain Actors: -**

- Investment Manager/ Fund Manager
- Distribution Sales
- Transfer Agency Operations
- Intermediary
- Order Router - Calastone, EMX
- Fund Accountant
- Trustee
- Custodian
- Front Office
- Middle Office

For the purpose of this paper the TA Forum Blockchain Working Group (now known as GFS Technology Group), based their analysis on the following process flow for establishing a new product/fund:

1. ESTABLISH FUND
   a. Actor:

i. Product Manager
ii. Investment Manager/ Portfolio Manager

2. ESTABLISH DISTRIBUTION
   a. Actor:
      i. Distribution Sales

3. ESTABLISH BUSINESS RELATIONSHIP
   a. Actor:
      i. Transfer Agency Operations
   b. Events:
      i. Channels:
         1. Direct Investor
         2. Investors through IFA
         3. IFA through platform
         4. Asset Manager with platform
      ii. Risk profile complete
      iii. Allocation model
      iv. Client details (name, address, docs, etc)
      v. AML/ KYC check
      vi. Cash paid by investor pre-trade (FIL use case as this is done up-front)
      vii. Set up account

4. TRADE REQUEST
   a. Actors:
      i. Investor
      ii. Order Router
      iii. Intermediary
   b. Event:
      i. Aggregate platform requests
      ii. De-aggregate
      iii. Redemption?

5. TRADE ACK/ NACK (Accept request/ trade)
   a. Actors:
      i. Transfer Agency Operations
   b. Events:
      i. Cost of order router: Pay per message (EMX/ Calastone)
      ii. Bank Reconciliation
      iii. General Ledger posting

6. AGGREGATION (collect trade orders)
   a. Actors:
      i. Front Office
      ii. Middle Office

b. Events:
   i. Confirm the trade (with customer)

7. TRADE PRICING
   a. Actors:
      i. Fund Accountant

8. UIC - (Units in Constitution) Change
   a. Actors:
      i. Transfer Agency Operations
   b. Events:
      i. Custodian Instructions - send reports

9. REPORT BETWEEN PARTIES & RECONCILIATION
   a. Actors:
      i. Portfolio Manager
      ii. Fund Accountant
   b. Events:
      i. Custodian & Fund Accountant - create common view and match

10. CASH RECIEPT
   a. Actors:
      i. Transfer Agency Operations
   b. Events:
      i. Match the money and the client
      ii. Payment to the investor (redemption)

11. TRADE SETTLEMENT
   a. Actor
      i. Transfer Agency Operations
      b. Events
      i. General Ledger posting/ Cash Receipt - equals Settlement

12. CREATION PAYMENT
   a. Actors:
      i. Transfer Agency Operations
   b. Events:
      i. Liquidation

13. END