STACS
Blockchain for Finance

Project Nathan: Smart Structured Products

A collaboration between STACS and EFG Bank

NATHAN

Foreword by STACS

STACS (Hashstacs Pte Ltd) is pleased to present the report "Project Nathan: Structured Products on Distributed Ledger". This report will serve as a summary of the 12 months of close collaboration work with our partners, EFG Bank AG, in the field of structured products.

Project Nathan demonstrates the commitment of STACS, an innovative fintech development company in the capital markets, and EFG Bank, a very forward-thinking private bank group towards the embracement of digitalization and new opportunities. Throughout the collaboration, we have identified several challenges associated with the current structured products industry, and how Distributed Ledger Technology (DLT) could be used to digitalize, automate and manage the trade lifecycle of complex financial instruments.

Tapping on the success of Phase I of Project Nathan, the project participants are looking towards further rollout of the digital initiatives towards the wider industry. In the interest of inspiring other financial institutions to explore the usage of DLT in the structured products industry, we hope that this report will be helpful as a starting point towards sparking further conversations.

We would also like to take this opportunity to thank the Monetary Authority of Singapore for funding the development of the project through the Financial Services Technology Innovation (FSTI) POC grant. The grant provides funding support for experimentation, development, and dissemination of nascent innovation technologies in the financial services sector, as we continue to achieve breakthroughs in digitalization of capital markets infrastructure.

Benjamin Soh
Managing Director
STACS

STACS
Blockchain for Finance

Foreword by EFG Bank

Participating in this MAS funded initiative was an exciting experience for EFG and our team members, in line with our efforts to change the speed and scope of digitalization in our business. Working with STACS has been very smooth and seamless, and we certainly managed to learn from each other.

The project is innovative, demonstrates significant efficiency gains and can be extended to other asset classes in the future.

Ivan Ferraroni
Managing Director, Global Markets
EFG Bank AG

EFG

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01 | Executive Summary

Structured products currently account for more than $7 trillion of the total derivatives market. The size of the industry is expected to gain even more traction with both institutional and retail investors, due to the flexibility and customizability of catering to individual's risk appetite and investment strategies. Notwithstanding the benefits, structured products can be complex to service from an operational standpoint. As compared to other plain vanilla asset classes, the structured product industry has not seen as much technological advancements, and market players still face a host of challenges due to their current legacy system setup.

Project Nathan is a project aimed at using new DLT technology to automate and manage the entire lifecycle of a structured product, from trade inception, trade valuation to trade servicing. Partnering with EFG Bank AG, a global Swiss private banking group offering private banking and asset management services, STACS (Hashstacs Pte Ltd) has collaboratively designed and built the Nathan Platform. Project planning took place between Sep 2019 – Feb 2020, with the development and testing of the Nathan Platform between Mar 2020 – Sep 2020.

The Nathan platform comprises the underlying STACS Blockchain and smart contracts, and a business application with an intuitive user interface. The platform allows for the creation of Smart Structured Products, which are tokenised versions of structured products that are distributed to private clients. As these Smart Structured Products are created on STACS Blockchain, they will be able to enjoy the benefits of the STACS Blockchain within the entire lifecycle management of such investment products.

For the purposes of the project, we have initially focused on FX Accumulators, as a moderately complex instrument. Nonetheless the overarching principle is how DLT and smart contracts could automate the various manual workflow processes today, and how different payoff options can be automatically serviced indisputably between different participants, based on different market occurrences.

This report provides an overview of the challenges associated with maintaining and servicing an FX Accumulator, and our methodology and approach towards overcoming some of these challenges. The report also depicts how we have built up a blockchain based platform to test our hypothesis, as well as the initial quantitative findings. Finally, we have also included several insights garnered throughout the project, and where future innovative value could lie. We hope you enjoy the report as much as we did writing it.

02 | Problem Statement

2.1 Introduction to Structured Products

Structured Products are a class of Financial Instruments whose performance and value are linked to 1 or more underlying asset, product, or index. The exact underlying components and percentage of holdings that comprises a Structured Product is determined based on the investor's individual circumstances and financial needs. This allows Private Banks and Wealth Management Units to offer custom exposure of specific asset classes to investors and provide easier access for highly customized investment products.

2.2 Accumulator Structured Products

A subset of the Structured Product asset class is the Accumulator, which is the focus of this project. An Accumulator allows for investors to "accumulate" holdings at a pre-determined strike price in an underlying security over a period specified in the contract, which is then settled periodically (i.e. weekly or monthly). A Knockout price is also pre-determined, which is the top limit price that an underlying security can reach before the contract is "knocked out" and outstanding securities accumulated are settled.

Various types of Accumulator Structured Products exist, such as basic accumulators, target, pivot and string accumulators, with varying characteristics in gearing, early termination and knock in effects, etc. For the purpose of this project, we will use a basic FX Accumulator. Future phases of the project will see the exploration of different types of structured products.

2.3 Structured Product Lifecycle Participants

Relationship Manager (RM): Relationship manager acts as account manager for the Private Bank's clients.

Operations Team: Operations team oversees the lifecycle of the trade. This includes keeping track of the knock out conditions and NAV valuation levels. Back Office/Ops is also in charge of booking/executing the appropriate trades once confirmed by the Trading team.

Risk Team: Risk team is in charge of monitoring the NAV portfolio of the investor and ensuring no breach of risk limits.

Trading Team: Trading team is in charge of liaising with Counterparty to purchase the FX accumulator and FX.

Counterparty: Counterparty provides the option for the Structured Product Contract and the underlying FX. The Counterparty is normally an Investment Bank that trades with the Private Bank.

Investor: High Net Worth Investor that is a client of the Private Bank.

2.4 Structured Product Lifecycle

The following diagrams denote the current lifecycle of a FX Accumulator.

Figure 1: Current Trade Inception Process

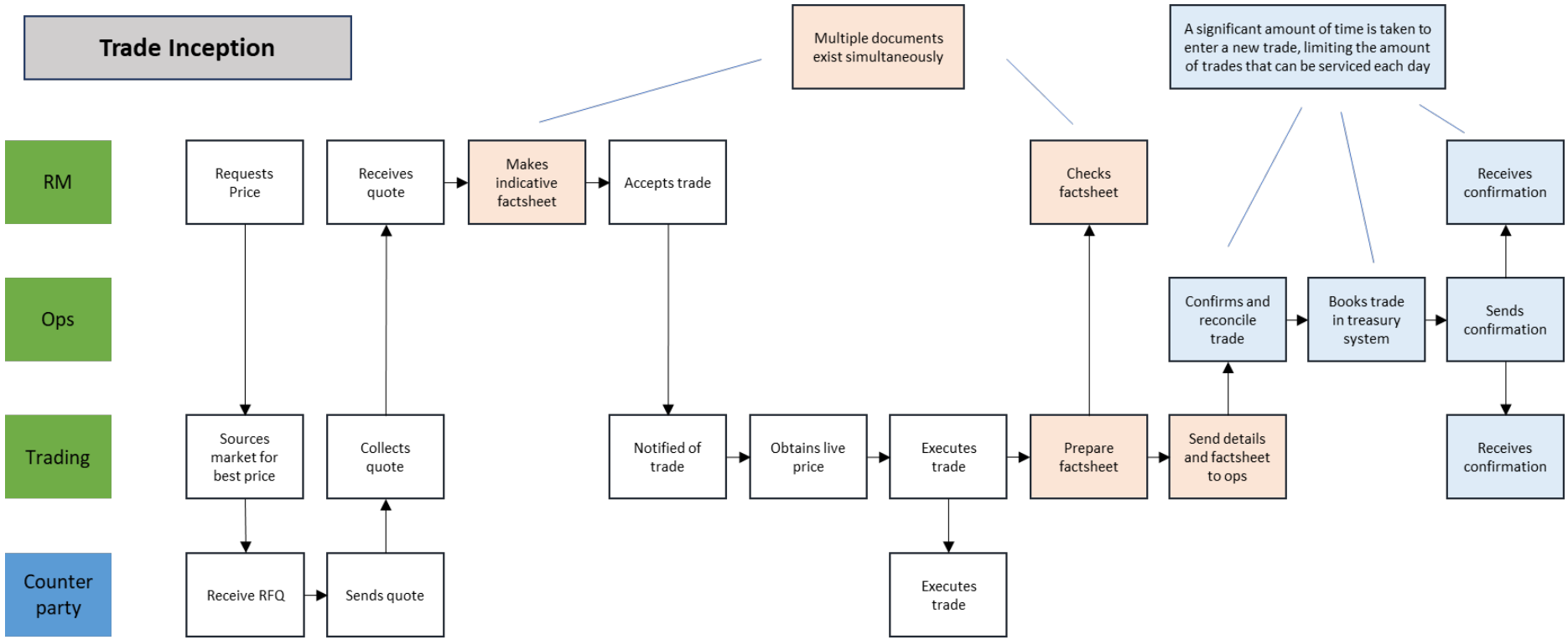
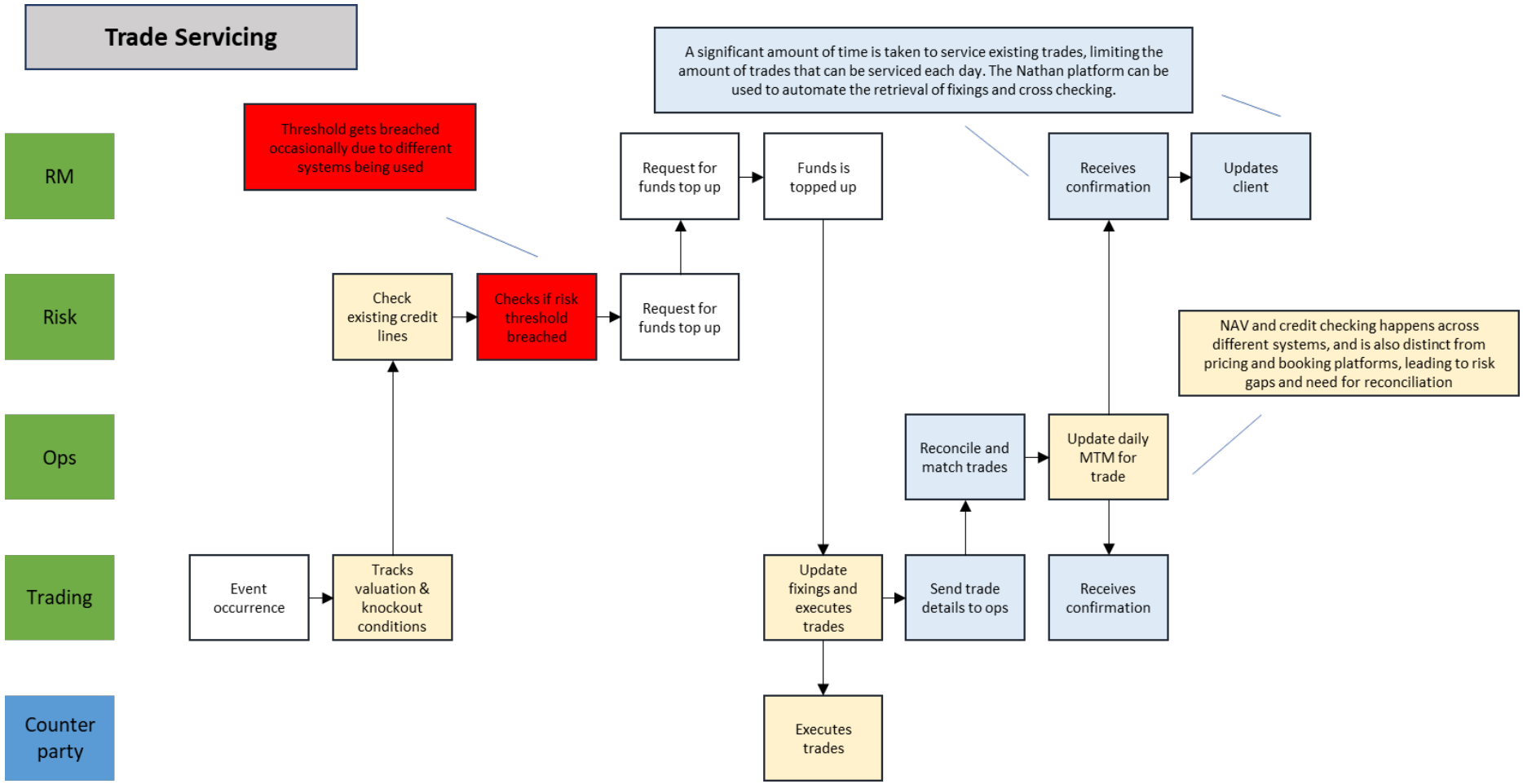


Fig 2: Current Trade Servicing Process



03 | Summary of Current Challenges

Based on the current processes as shown in the two diagrams above, we note several challenges as per the below.

Complex Servicing Process

While FX Accumulator Structured Products provide a customized approach for an investor to complement their portfolio of diversified traditional assets, the limitless customization possibilities complicate risk and payoffs during asset servicing. This results in expensive cost and intensive labour requirements. Thus, the added flexibility for investors results in increased complexity of servicing these products for Private Banks, further adding to the squeeze on profit margins.

Interdependency Between Internal Departments Limits Scaling

The current sequential steps required for servicing and valuation of each Structured Product limits the total number of Structured Products that can be serviced by a Private Bank at any one time. This is because all departments are dependent on other departments before they can perform their task. While increasing the total number of man hours will increase number of Structured Products linearly, this solution does not scale and the bank is at risk of having unproductive man hours at any point of time should there be less than ideal numbers of active Structured Products.

Risk of Undetected Trade Discrepancies

With the current processes in place, clearing and settlement of all trades for Structured Products can only be scheduled to start at the end of the trading day and must be completed by end of day. Thus, trade discrepancies can only be detected at the end of the trading day. A significant amount of manhours daily is required on average to resolve them as part of the Data Reconciliation work done at the Ops office.

Breach of Risk Threshold

Additionally, sequential steps lead to a state of Asymmetric Information that heavily impacts the Credit Risk team. The Credit Risk team is only informed of Trades executed by the Ops team after some time and there are cases where such execution should not be performed when the investor exceeds a risk threshold. Such cases are not uncommon, requiring additional manhours and operational losses to resolve.

04 | Objective and Methodology

4.1 Objectives

The objective of Project Nathan is to create a blockchain-enabled enterprise platform to allow for automated FX Accumulator asset servicing while reducing trade reconciliation requirements and information duplication. This would improve internal efficiencies to enable the management of complex structured products, while increasing servicing capacity in a modular manner, and which can be scaled up or down rapidly based on demand.

As such, the emphasis of Project Nathan focused on delivering the following core capabilities:

i. Having a distributed information flow and single source of truth across departments through a common application platform powered by underlying distributed infrastructure.
ii. Providing the ability to program (tokenize) Structured Product Contracts and the underlying FX Tokens, thereby increasing efficiency of operations through automated asset servicing based on market occurrences.

4.2 Methodology

Solution Designing

Given the complex nature of structured products in general, a large part of Project Nathan focused first on understanding the current workflow processes from the various stakeholders involved. Particularly, more time was dedicated to the operational users from different departments as they would be the final users of the Nathan Platform.

Once each department had provided sufficient feedback on their current workflow processes and current pain points, a target architecture for the solution was conceived and designed. The architecture took into consideration the current baseline processes and the improvements that could be made with this new solution, and includes the design of the frontend UI, backend processes, and the integration touch points with the STACS blockchain.

The application frontend UI was designed with the end user in mind to facilitate intuitive usage of the platform. Role-based access control was also planned to enforce data security to ensure that each user would only be authorized to view information based on their role and department.

The application backend processes and integration touch points with the STACS blockchain was designed to adhere to the core workflow processes in place currently, while improving on other key aspects to achieve greater operational efficiency.

The target architecture and solution were subsequently presented to the stakeholders involved. Once approval was granted the development and implementation of the finalized solution begun.

Development

The development of the Nathan Platform incorporated a modular design approach towards the building of UI components, application modules and smart contracts. Given that Project Nathan was focusing on testing technical and business feasibility, we deliberately left any

integration work with external systems out of scope. Hence, the Nathan Platform can essentially be used as a standalone end-to-end platform for the trade lifecycle management of structured products.

As such, this meant that certain information had to be manually ported over from different existing systems, and keyed into the Nathan Platform for the purpose of testing transactional trades. To support these measures, there was hence the need to build several ancillary modules to provide entry points for keying in information. For example, in the absence of any integration to real-time, live currency data feed, a FX Spot Price module was built, so as to provide an entry point for triggering different market conditions. Similarly, other modules such as a Client Management module was built for the purpose of 'onboarding' a user onto the platforms. We note that some of these ancillary modules might in future be discarded, due to integration with existing customer management and treasury systems. The solution designing and development of the Nathan platform took place from March to August 2020.

User Acceptance Test

Upon development of the Nathan Platform by the STACS team, several rounds of product walk through and demostration was conducted to EFG stakeholders and end users. After each round of the product demo, feedback was taken down in detail and provided to the development team to implement as improvements.

This iterative process of development and end user feedback was conducted over a rapid period with each phase lasting about 2 weeks from feedback to delivery of fixes. This rapid response allowed us to cater to the end user needs and deliver a product that would be to their satisfaction.

Once all feedback from the end users and stakeholders were implemented in the form of software fixes, various supplementary user manual guides were also created and provided for each user role in each department.

The User Acceptance Test was concluded once the final product demo yielded no further functional changes.

KPI Measurements

A set of quantitative measurements were created to assess the viability of the Nathan platform. These measurements range from cost savings for trade reconciliation across the lifecycle of the structure product between various internal bank departments, the amount of automation of asset servicing, risk related measurements, and the potential increase in servicing capacity and revenue gains using the same amount of headcount.

Once the final product was delivered to the EFG stakeholders, various stakeholders and end users from EFG simulated differing scenarios of market events and payoffs over a period of two weeks. These scenarios were conducted multiple times and the results were averaged across the many test runs conducted. The KPI measurements were then taken independently and solely by the EFG stakeholders to ensure an accurate assessment of the Nathan Platform.

05 | Platform Overview

The Nathan Platform encompasses the Application Layer, which comprises of a Frontend GUI component and an Application Backend component which is linked to the underlying STACS Blockchain.

Business logic is designed at the Application Layer to facilitate fluidity in business requirements, while a unified data state is maintained at the STACS Blockchain layer.

5.1 Terminologies

Fiat Money: These are traditional, non-blockchain funds.

Wallets: Representation of an Investors' account on the blockchain. The Wallet will store an Investor's digital funds and smart structured product tokens.

Structured Product Tokens (SP): Digital representations of the Structured Product Contract. SP Tokens are created on the Nathan Platform by inputting the terms of trade details into the Smart Contract Parameters Template.

Digital Cash Token: A digital representation of fiat currency to represent the quoted cash leg on the blockchain. For example, for an Accumulator Contract for USDJPY, when an investor "accumulates" USDJPY, he would use Digital Cash Tokens which represents the underlying JPY. This Digital Cash Tokens will be created based on the existing JPY amount in the Investor's fiat account with EFG.

FX Token: Digital representations of the underlying asset of the Structured Product. For example, for an Accumulator Contract for USDJPY, when an investor "accumulates" USDJPY, he is credited FX Tokens which represents the underlying USD asset accumulation. FX Tokens are uniquely tagged to each Structured Product Contract.

5.2 Application Modules

The Application Modules are separated into core modules and auxiliary modules. The core modules are used for programming of business logic into the smart structured product and FX tokens, tracking of transactions and actions, and monitoring NAV. The auxiliary modules are used to support the testing of the entire platform, such as to create a digital profile of an investor, to enter in static price data feed in the absence of live data feed integration, and to manage a client's account balance. It is likely that the auxiliary modules will be negated post integration with the bank's existing systems.

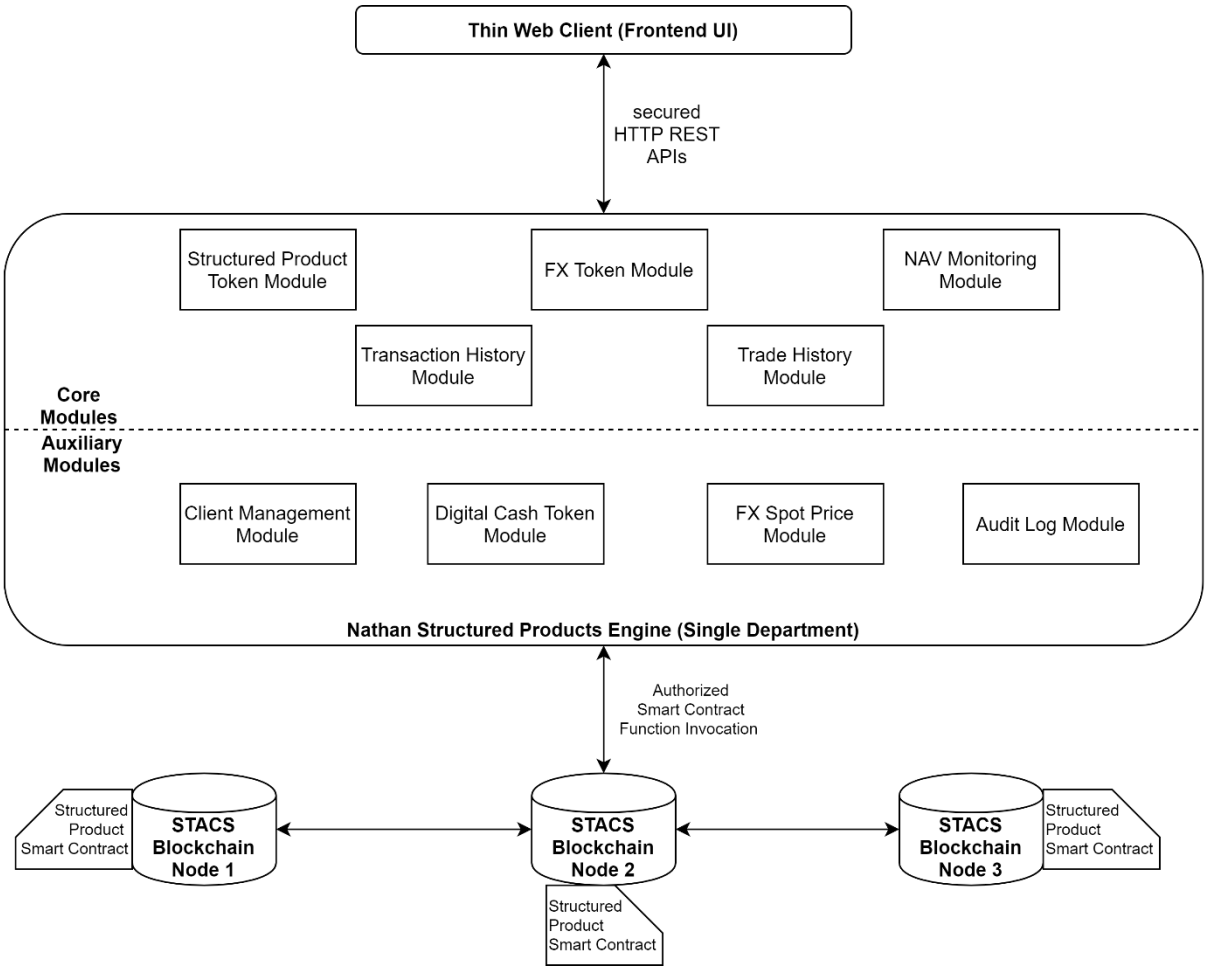
A description of the modules is depicted in Table 1.

Modules	Description	Team
	Core Modules	
Structured Product Token Module	❑ Enables issuance of SP Tokens ❑ Provides dashboard to view SP Tokens and their corresponding status (Active/Matured/Knocked-Out)	Operations
FX Token Module	❑ Enables issuance of FX Tokens ❑ Provides dashboard to view FX Tokens and their corresponding status (Open/Closed)	Operations Counterparty
NAV Monitoring Module	❑ Dashboard enables monitoring of NAV balance of Open Structured Product Contracts	Operations Risk
Transaction History Module	❑ Enables querying and viewing of Tokens Transfer, and Contract Status Updates	RM Operations Risk
Trade History Module	❑ Enables querying and viewing of Client's (Investor) transactions of FX Tokens	RM Operations Trading Risk
	Auxiliary Modules	
Client Management Module	❑ Enables creation of Client and assignation of wallet address ❑ Provides dashboard to view all clients in the system ❑ Enables transfer of Client's Asset	RM
Digital Cash Token Module	❑ Enables issuance of Digital Cash Tokens ❑ Provides dashboard to view Digital Cash Tokens	Operations
FX Spot Price Module	❑ Entry of FX Spot Price for selected currencies pairs ❑ Provides dashboard which displays past entries of Price Feed	Operations Trading
Audit Log Module	❑ Dashboard which provides activities logs of users on Application	Operations Risk

Table 1: Description of Modules

5.3 Technical Architecture

The high-level technical architecture is presented in the diagram below.



Application Layer

The frontend is a thin web client that is stateless to ensure that users do not need to pre-install any software and can simply use an Internet browser with secured access to complete their tasks.

The engine that comprises of all modules is deployed for each department and connected to a deployed node.

All business processes are isolated at the application engine level for each department while smart contract access by the applications are agreed upon by all departments at the blockchain level. Each department has their individual requirements customized at the frontend and application engine layer since the applicable business logic for individual departments differ greatly. These applications will be hosted separately for each department, and the segregation of data and business requirements between departments is thus enforced at this layer.

Every department will also host a node and thus run the same exact smart contract code that is mapped to their customised workflows. Essentially, each department will execute their business workflows on their own application, which in turn has pre-agreed authorization to only execute specific smart contract functions required by their workflows. At the same time, the design also ensures that all nodes in the network execute each transaction with the same smart contract code since this layer is not exposed to the department. This allows every

department to execute the same business logic for a particular transaction, and the various nodes will independently arrive at the same execution state to maintain the single source of truth of data that is sent to the blockchain layer.

STACS Blockchain

The STACS blockchain architecture is an Enterprise permissioned blockchain solution with a highly modular infrastructure design, enabling for the business logic and smart contract code to be separately designed. This allows for changing business requirements to be mapped at the business logic layer, which is designed at the application layer. This facilitates changing business needs to be fulfilled rapidly, while preserving the inherent immutability characteristics of a blockchain as the smart contract functions are invoked independently by all nodes through the business logic applications. Essentially, this ensures that data state is unified across the network.

Access and Control

The STACS blockchain has access control built into the blockchain to authorize which smart contract functions are accessible by specific applications. This access control layer can be pre-agreed upon by the participating departments (which is recorded to the blockchain) and permissions can also be later modified by the participating departments (also recorded to the blockchain) should there be a future change in business requirements.

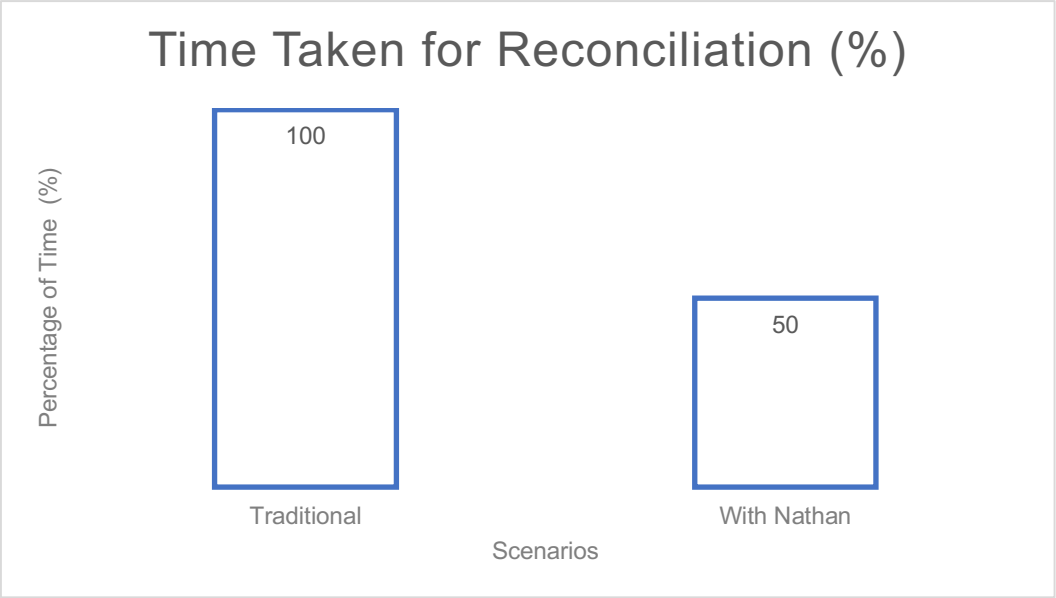
The access control layer therefore acts as a modular form of consortium governance of the network. For example, information entered by one department through a node can require explicit approval from a group of pre-determined departments which is decided prior to the controls being designed on the blockchain.

Finally, for each of the department's applications catering to their own business needs, additional role-based access control following the principle of least privileges will be provided and built into the APIs that are used by the web client. This ensures that business users in the department are only provided the minimal amount of permission to perform their specific tasks on their application. Ultimately, this results in a layered approach to data segregation and operational workflow segregation, while preserving the core benefits of the proposed solution.

06 | Project Outcomes and Quantifiable Findings

6.1 Transparent Real-Time Single Source of Data with Reduced Need for Data Reconciliation

Within the Nathan platform, each node can be operated by a stakeholder (RM, Trading Desk, Risk and Ops team) and all Structured Product related operations are conducted directly on the blockchain. Since all stakeholders see the same data state in the blockchain, there is little need for data reconciliation across departments. Data accuracy gains across the trade lifecycle (trade inception and trade servicing) saw a reduction of time consumed for reconciliation by approximately 50%.



6.2 Programmable Assets and Automation of Fixing Processes

The FX Accumulator structured product was programmed upon inception to react in a certain manner based on predefined conditions. For example, upon a spot price trigger above the knockout price, the structured product was automatically knocked out and settled. Since all information is distributed, there was no need for reconciliation between different books, while allowing for manual operations to be automated, and in a concurrent manner as compared to the previous sequential steps.

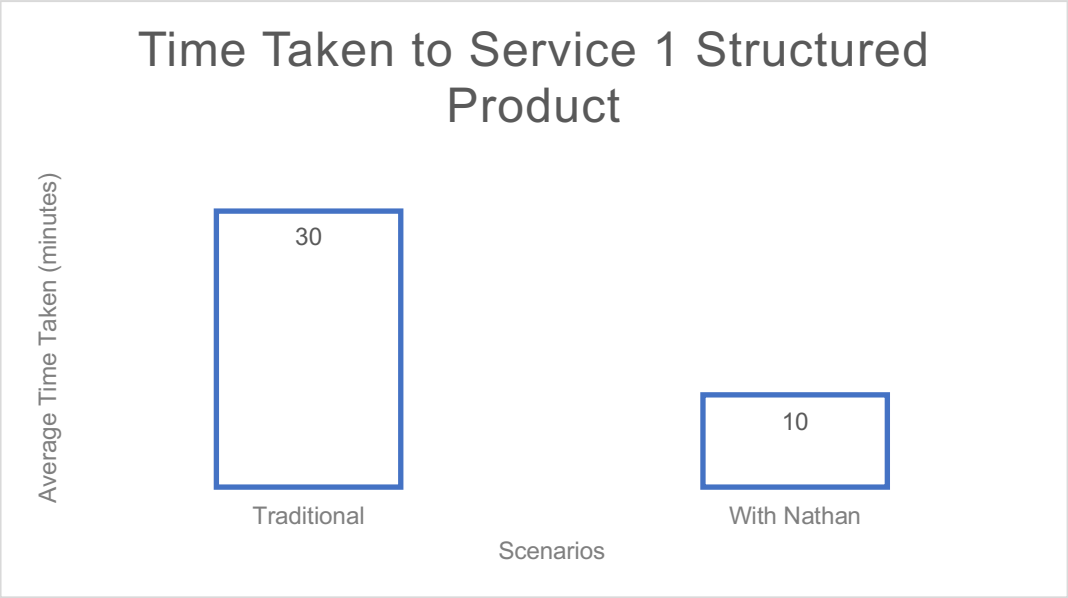
The combination of simultaneous information distribution alongside automation reduced the fixing time by around 30% and resulted in huge productivity gains of approximately 50%.

6.3 Real time NAV and Credit Checks

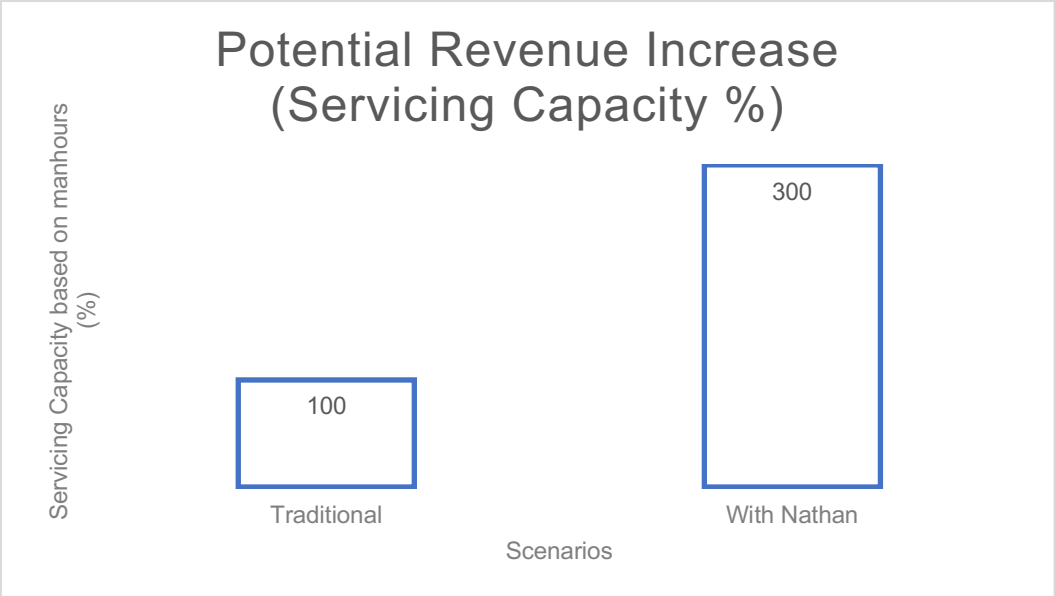
Compliance and risk monitoring ability is amplified due to the ability of the smart contracts to enforce pre-agreed rules and parameters. By checking real time NAV, the platform allows a much cleaner way to keep track of the credit limits as compared to some of the existing legacy systems. For example, if the client's risk is above a certain thresh point, the smart contract will prevent any new trades from being initiated as the smart contract is linked to the ledger and the single source of truth. Furthermore, by rolling the credit limit checking in the same platform as the pricing and booking platform, this reduces the inefficiency of multiple systems that legacy platforms currently use.

6.4 Increase in Servicing Capacity

Overall, the platform was able to reduce manhours and increase efficiency between 50 – 70% for manual reconciliation.



This translated to an increase of bandwidth by approximately 300% in a scalable and modular manner and thus potential revenue increase with existing manpower.



07 | Challenges and Limitations

Given the desire to test commercial and technical feasibility using a reasonable amount of time and resources, we have deliberately excluded certain variables as per below.

7.1 Absence of integration with Legacy System

To fully realize the potential of a Blockchain-power enterprise solution, the Nathan Platform needs to be fully integrated with EFG's systems.

In the current phase of the project, integration with legacy systems is absent, hence preventing full automation of the following operational processes:

i. **NAV Monitoring** – Operations Team have to enter the NAV of open Structured Product positions manually. With full integration, NAV can be updated in real-time with price feeds from counterparties, negating the need for manual intervention.

ii. **Manual entry of FX Spot Prices** – On every Fixing Date, Operations Team will have to enter the latest FX Spot Prices in FX Token Data Entry Module to trigger further actions on the smart contract layer. With full integration with an oracle data feed, the smart contract can fully automate the trade process, negating the requirement of the FX Token Data Entry Module.

7.2 Performance of Smart Contracts

In the current phase of the project, we have focused on Non-Boosted FX Accumulators. The current smart contract structure is non-complex in nature. To fully scale to facilitate enterprise adoption and encompass a wider range of Structured Products, greater functionalities will have to be embedded in the smart contract (i.e. Escrow Functions, Automated DvP, Leverage Functions, etc.)

In future phases, to enhance automation, we expect more functions to be embedded in the smart contract, coupled with integration of legacy system and external oracle data sources to fetch Spot Prices of currencies pairs. The added complexities may result in an impediment to overall performance due to the following factors:

i. Decreased execution speed due to additional time for transaction validation.
ii. Usage of compiler for oracles will further increase the smart contract execution runtime.

7.3 Irreversibility of Transactions on Application Layer

As STACS Blockchain is a Permissioned Network Blockchain, this would enable reversibility of transactions if all authorized node-holders affirm on the action. However, such functionality is not available in the current phase of the Nathan Application Layer.

In the current design of Nathan, transactions posted onto the STACS Blockchain ledger cannot be cancelled, and a record of the transaction will be uploaded onto the Blockchain in an immutable fashion. This poses a challenge for the stakeholder as an erroneous trade cannot be reversed once the Structured Product Contract is incepted on Nathan.

08 | Future Phases

In addition to addressing the above technical constrains, we have also intended to broaden the breadth and depth of the platform in future phases.

8.1 Additional Types of Structured Products

The current phase of Project Nathan focuses on a basic non-boosted FX Accumulator. However, the core concept of the Nathan platform revolves around how programmable assets can exhibit different behaviours and payoff structures based on different market events,

introduced via oracle data feeds. As such, the same concept can be applied to other types of structured products, i.e. FX Accumulator/Decumulator, FX TARF/Pivot TARF, ELNs, FCNs, etc.

8.2 NAV of Portfolio versus NAV of Structured Products

From a risk perspective, we have limited the tokenized structured product to one per client, so as to limit having to net exposure across different positions and portfolio. Future phases would expand on this, and additional work will have to be done to integration client risk/valuation from existing systems into the blockchain system, either through integration work or manual sighting and input of data.

8.3 Involvement of Additional Counterparties

For the purpose of the current phase, we have limited the number of counterparties to prevent complexity of the project. As such, we operated under the assumption of only one counterparty Investment Bank (simulated). Given that different counterparties would provide different structured products for the Private Banks, there is a need to onboard multiple counterparties to build a more holistic ecosystem in future.

A separate feasibility study can be also be conducted to evaluate the cost savings as the complexity grows with the involvement of addition counterparties. For example, would there be a linear or exponential relationship between cost savings for a single structured product and a single counterparty, versus that of a single structured product with multiple counterparties.

8.4 Data Standardization and Secondary Trading

An untested hypothesis was that the adoption of a new technology can be used as a catalyst towards data standardization. Structured products as an asset class does not by itself have the level of data standardization as compared to other product classes such as bonds, equities, or even derivatives, where industry led association such as ISO and ISDA are championing international standards. While the standardization of data is initially expected to be a driver of efficiency, it is hypothesized that with more standardized products, structured products can in future be traded on a common marketplace.

09 | Summary

An overarching theme observed in the problem statement relates to the shrinking profits faced by the Capital Markets Industry in general. This can be attributed to rising costs in a more stringent regulatory and operational environment, as well as the increase in competition. The irony is that Structured Products provides flexibility for financial institutions to craft new and differentiated products based on investor requirements, but are now constrained by complexity that is hard to service on an on-going basis given the current processes in place.

Project Nathan has presented a novel process that seeks to transform current sequential operational processes into concurrent processes, utilizing Blockchain technology to drive digital transformation. By providing an overview of the approach, methodology and quantifiable measurements of benefits, we hope that this can provide a steppingstone to the wider financial industry as part of a larger digital transformation journey. Ultimately, the belief is that a more streamlined operational workflow can enable financial institutions to provide a more compelling structured product for the end client.

In addition, while this project's objectives are focused on cost savings and operational efficiencies, preliminary discussions with various participants have advanced beyond the simple application of passing on cost savings to the end customers (investors). These include a new category of Structured Products that supports more complicated flows and underlying derivatives because of the cost savings in man hours required to service existing Structured Products. The creation of a secondary market for structured products has also been mooted, albeit on a preliminary scale.

Given the concurrent nature of Blockchain, we do anticipate that closer collaboration of financial institutions acting as Counterparties or Distribution Networks can be achieved, which will further increase operational efficiencies and productivity gains for the financial services industry. This can also potentially lead to greater financial product innovation, similar to the case presented above where cost savings are not simply passed to the end customer. Instead, there is now the creation of new product classes or market segments as the entry price points for the end customer can be reduced significantly.

10 | Project Participants

About STACS

STACS (Hashstacs Pte Ltd) is a Singapore fintech development company building enterprise blockchains and associated capital market platforms for financial institutions. We are leading the way forward by digitalizing assets, processes and documents using next generation blockchain based technology. Our clients and partners include investment banks, stock exchanges, central securities depositories, custodian banks, asset managers and private banks. We are recipients of the MAS FSTI POC grant, and also one of the chosen technology participants of the MAS Project Ubin.

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About EFG Bank

EFG Bank is one of the largest Swiss private banks with strong roots in the home market and a global presence. EFG represents security and solidity, an entrepreneurial way of thinking and acting, and a powerful blend of agility and reliability. EFG's motto is: "Entrepreneurial thinking. Private banking".

Company website: https://www.efgbank.com/


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