MORPHEUS.NETWORK

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WHITEPAPER

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MORPHEUS.NETWORK

According to the World Economic Forum's report, Enabling Trade: Valuing Growth Opportunities, reducing supply chain inefficiency could increase worldwide GDP by almost 5 percent and total trade volume by 15 percent. This equates to a global economic boost of over $2 trillion USD.

At Morpheus.Network, we are intensely focused on helping companies and government organizations remove barriers to digitize, optimize and automate their global supply chain operations. We help clients maximize revenue through digitization and process automation, protecting sensitive data, and untangling complex issues with the legacy supply chain system while delivering effective, equitable, and efficient global trade solutions.

We launched our first platform, called Blue, in March 2019. With the evolution of our platform and the addition of over 100 new features, we reached a new milestone in the company's development.

We then launched the next version of our enterprise platform in 2021 which we called Black. In 2024, we started building a suite of products based on our current enterprise platform which has now been rebranded as Middleware.Supply. The first of 10 slated products will be called Speed.Supply and serve as the core platform for which many additional products and modules can be added to to increase functionality and overall efficiency. Additional product releases include:

• Trust.Supply – Masternode Validation Ecosystem
  (Currently Live)
• Ships.Supply – Maritime Optimization
• Automate.Supply – Voice Powered Workflows
• Vision.Supply – AI Powered Dashboard
• Assessment.Supply – Know Your Supply Chain
• Validate.Supply – Blockchain Verified Data
• Protect.Supply – Brand Protection
• Deliver.Supply – Transportation Management System
• Structure.Supply – Construction Solution
• FSMA.Supply – Food Safety Modernization
• Risk.Supply – Shipment Risk Scores
• Weather.Supply – Weather Intelligence
• NetZero.Supply – Tokenized Carbon Credits
• Future.Supply – ML Powered Predictability Models

Introducing Middleware.Supply

"This technology couldn't have come at a better time as tedious compliance documentation and the absence of real time tracking were hindering our operational efficiency. We're definitely impressed on how easily the platform eased those pain points."

— **Kevin Brock, President of Brock Air Products**

"Morpheus.Network has allowed us to move past the traditional hurdles that many US companies face when importing and exporting goods. By enabling greater transparency in the supply chain, we're able to process shipments faster and more efficiently than ever before."

— **Blake Childers, Marketing Manager of Hoosier Feeder**

"Working with Morpheus.Network has resulted in an efficient throughput of our supplier document management and validation processes. Next up we are looking at the overall visibility of our supply chain from suppliers to FCL warehouses. The transparency provided by Morpheus.Network's technical solutions fits well with our own co-operative ethos of driving integrity from start to finish."

— **Raymond Gareau, Supply Chain Manager of Federated Co-operatives Limited**

"We attached the QR codes to a variety of welding equipment to give visibility to our clients as to the handling points of the equipment we manufactured. The QR code is also being used to store the shipping documents for the client, which I've been explained, in an unchangeable fashion. This technology is very exciting and revolutionary but also extremely easy to implement."

— **Lisa Li, Export Manager at Ji'nan North**

"I have enjoyed working with the Morpheus.Network team these past few years. They have such a great product, their track and trace and export documentation fits perfectly delivering downstream supply chain capability complementing our Dimitra Technology platform which delivers the upstream Agriculture components."

— **Jon Trask CEO & Founder of Dimitra Ag Tech**

"As simple to use as an Amazon tracking number, Morpheus.Network has provided our team of supply chain managers with a trusted Digital Footprint to track and trace each step of the process."

— **Alejandro Marcos, CIO of Vitalcan**

"We look forward to using the Morpheus.Network Platform to simplify compliance with its automated document generation features. Dan and the team have been very helpful in assisting us with integrating this into our process."

— **Peter Terranova, President of Century–Tech**

"Our focus is to grow volume and achieve market leadership. We chose Morpheus.Network because they are committed to innovation and have helped us develop supply chain strategy and drive execution."

— **Eric Gomez, CEO of Maxianet**

"With an end goal to improve the coordination of our products and merchandise traveling through China, we have picked Morpheus.Network to furnish us with the transparency we need to trace our global shipments and establish a great relationship with our customers."

— **Lulu Liu, Head of Exportation at Jiangsu APEC Machinery**

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Introduction
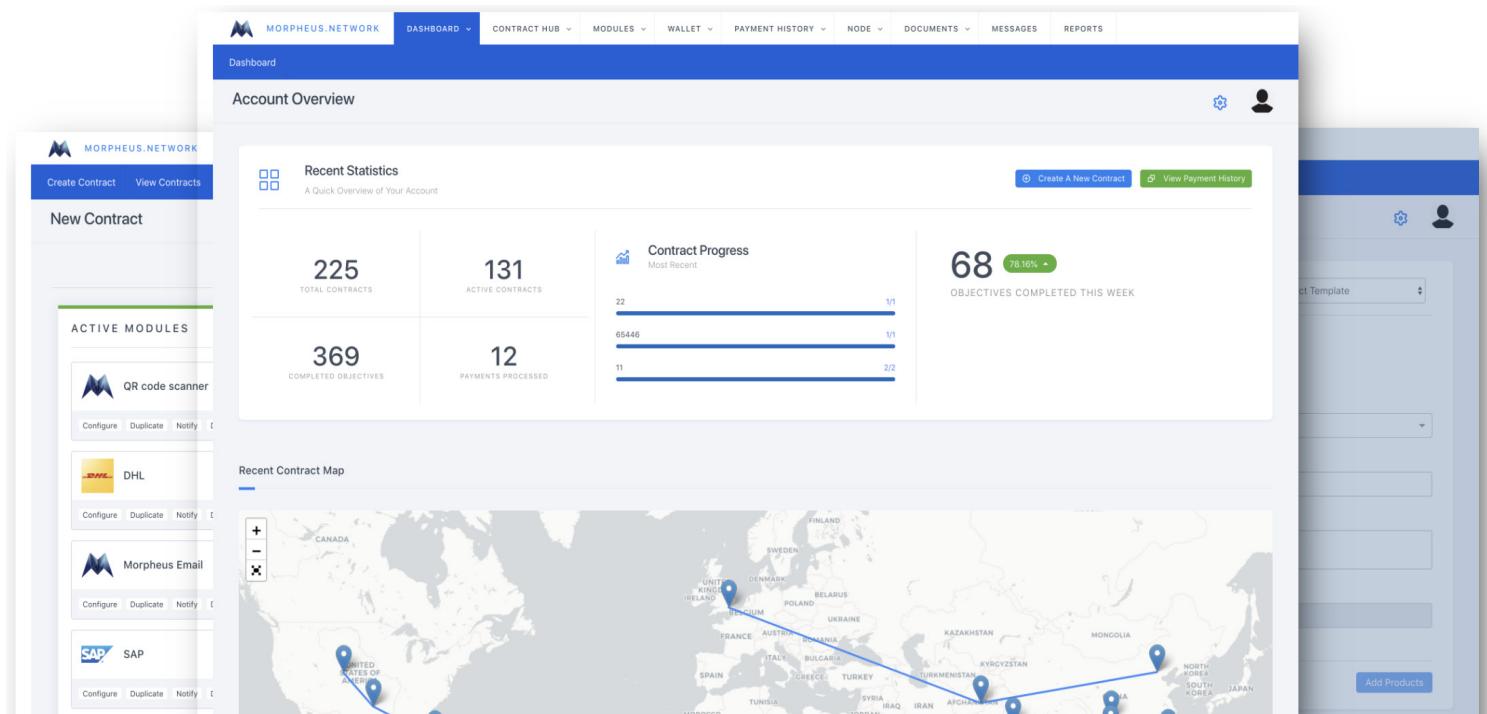
With the dawn of globalization, supply chains have become incredibly complex. A typical supply chain involves a tangle of stakeholders in different parts of the world, each subject to different regulations, languages, currencies, and more. Not only are there co-dependencies across the entire chain, but there are also a multitude of intermediaries involved in the physical movement of goods.

Today, the backbone of supply chain networks involves many different IT systems and platforms which need to communicate with each other. This includes different enterprise resource planning (ERP) platforms, warehouse management systems (WMS), legacy databases, order processing tools, logistics tools, documentation management and payment layers, just to name a few. Information is mostly stored in inefficient data silos with inhibited data sharing and collaboration.

Efficient supply chain management is one of the key pillars to a profitable business and has evolved from a business support role to a value generator that became a business model of its own. The COVID-19 pandemic has further highlighted the need for robust and resilient supply chains. Efficient supply chain management not only allows companies to mitigate unforeseen challenges, but more importantly can create competitive advantages and new revenue streams.

Automation of Documentation

Morpheus.Network is a software solution catered to the needs of supply chain managers. It brings all data into the same platform, makes information exchangeable and allows managers to automate and digitize previously manual processes end-to-end, resulting in higher efficiency and cost-savings. The platform allows customers to easily integrate new technologies like blockchain, IoT, artificial intelligence, optical character recognition, machine learning, data analytics, and much more into their existing infrastructure.

This is where digitalization and new technologies can work together to create optimization and automation. It has been estimated that the supply chain management software market size grew by $9.56 billion USD from 2020-2024.

Imagine a world where supply chains can be automated end-to-end, including the handovers between multiple parties and back office processes. Not only would this increase speed and reduce costs, but ultimately would allow for a better customer experience. Technological advancements in IoT, blockchain, machine learning and big data now support the realization of this vision.

The World Economic Forum has declared removing supply chain inefficiencies as the single most important way to stimulate global economic growth, increasing global GDP by over $2 trillion USD.

Morpheus.Network is intensely focused on helping companies and government organizations remove supply chain inefficiencies to optimize the global supply chain.

A New Dawn

In March 2019, Morpheus.Network launched the first version of their platform which was called Morpheus.Network Blue. This release brought innovative features such as automated workflows, IoT, IPFS document storage, QR code triggers, and more.

Since then, our team has implemented 100+ new features, capabilities and improvements in close collaboration with our clients and partners. The updates were so significant and numerous that we decided to release a whole new version which we called Morpheus.Network Black.
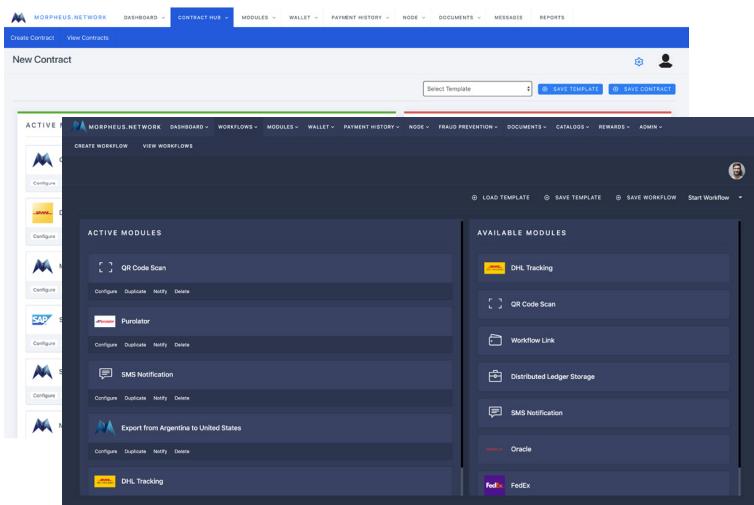
ABOUT
MIDDLEWARE.SUPPLY

In 2024, we transitioned development to the React framework (also known as React.js or ReactJS) to leverage a larger coding library. This shift enabled numerous new capabilities and UI changes, leading to a new release that we are calling Middleware. Supply. All future product releases, such as Speed.Supply, Vision.Supply, and many others, will be built on this foundation.

Morpheus.Network has received numerous awards for its groundbreaking platform, including:

- Winner of the Gulftainer 'Future of Ports' competition from over 2,000 entries across 6 continents and over 200 cities
- Winner of the FOOD LOGISTICS 2022 Top Software & Technology Providers award
- Winner of the ISCEA PTAK Award for Supply Chain Excellence at the SCTECH2021 conference
- Finalist for the Entrepreneurship World Cup 2022
- Finalist for the 2021 Blockchain Revolution Global Enterprise Blockchain Awards
- Shortlisted for the Desjardins Open Innovation Challenge

Middleware.Supply includes a beautiful new Dark Mode

Morpheus.Network has been deeply involved with the SAP ecosystem, joining their SAP PartnerEdge Open Ecosystem and being accepted into their Co-Innovated with SAP Program where we are working to expand parts of our platform to run on SAP software. Our Brand Protection Solution earned SAP Certification as integrated with SAP S/4HANA and is available to purchase on SAP's customer marketplace.

Morpheus.Network has a technology partnership with IBM and was one of 22 companies (out of 500) accepted into the Supply Chain Innovation Program at the legendary Plug and Play Tech Centre in Silicon Valley. We were also accepted into the Supply Chain Innovation Platform at Plug and Play Toronto and invited to join Plug and Play Alberta.

We are members of organizations such as the blockchain in Transport Alliance, Trusted IoT Alliance, European Blockchain Sandbox, Florida Blockchain Foundation, Canadian Produce Marketing Association (CPMA) and the International Association for Trusted Blockchain Applications helping to define and promote new industry standards and best practices.to define and promote new industry standards and best practices.
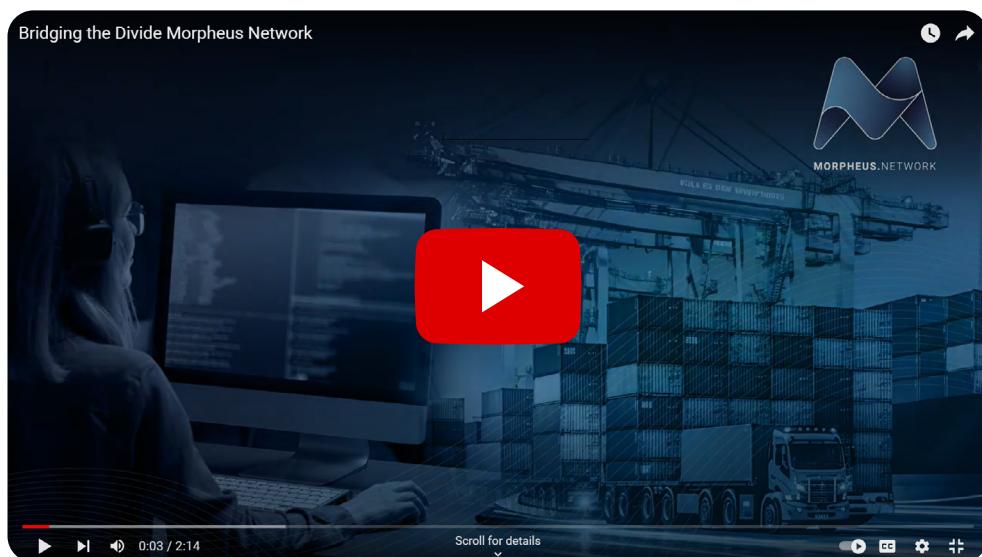
How It Works

In a typical supply chain, there are over 40 points of contact between different entities. Something as simple as sending a bulk shipment of flowers internationally can generate over 200 physical documents from dozens of sources. Each handling point is susceptible to human error: misfiling, late documentation, lost packages, slow payments, etc., all with the potential of delaying or halting the entire shipment.

Within sensitive supply chains involving the transport of food, medication or disaster relief— successful mitigation of these errors could be the difference between life or death.

Morpheus.Network's Middleware.Supply Platform is uniquely positioned as a middleware solution, acting as a binding glue between various IT systems and solutions. The platform can connect to multiple separated systems and trigger actions in an event-based workflow that resembles an automated digital clone of the existing manual processes.

Learn how Morpheus.Network's blockchain-powered supply chain platform is revolutionizing the industry: https://youtu.be/1OKmGxUgCTo

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Middleware.Supply replaces manual, error-prone processes with an automated and streamlined digital workflow. It creates a digital twin of supply chain processes, allowing all systems and data to be connected and integrated. The result is enhanced control, higher efficiency and the ability to easily monitor process performance and implement preemptive measures before errors occur.

With a simple drag-and-drop interface, automating the most complex global supply chains requires no technical expertise. The platform transforms the most advanced technologies into basic modules that can be deployed in minutes.

Morpheus.Network's Middleware.Supply offers 150+ preset modules that represent the most used technologies in global trade today, as well as emerging technologies like blockchain and machine learning that the industry has embraced as the future.

These modules include SAP robotics automation, IPFS document generation and storage, government compliance systems for imports and exports, shipment alerts (temperature/shock/humidity), email notifications, continuous QR code scans and global fiat/cryptocurrency payments. The new platform also gives clients the option to create new modules from scratch with the support of our developer team.

Once all workflows are set up and operational, the platform supports the optimization of the supply chain network by analyzing all data that is created in the process execution. It gives users the possibility to monitor performance in real-time with integrated dashboards and uses data analytics to suggest improvements of the process by altering the process flow or integrating new technologies (e.g., automated digital document transfer instead of a manual process). In terms of new technologies, the platform enables users to easily tap into new technologies such as IoT devices or telematics without having to repurpose the existing IT infrastructure or exchange legacy systems.

Picture a supply chain on autopilot, each completed process triggering the next, until the package lands safely where it was intended. Morpheus.Network applies this logic to the platform as well as conditions for when things do not go as intended. Process steps are automated by creating customizable, predefined workflows, driving the supply chain with predetermined events, such as handovers, document creation or payments. Catching mistakes as they happen with automated corrections is a key feature of the platform. Interacting with the network by revising or adding workflow objectives in your supply chain is designed to be intuitive and easy to navigate.

With its blockchain-agnostic architecture, Middleware.Supply can ensure that confidential information remains in permissioned networks, while other data can be openly shared between partners and suppliers. Furthermore, a fully digitized data-driven workflow establishes a strong foundation for leveraging other technologies like machine learning and data analytics.

Various technology stacks can be layered in as part of the workflow such as SAP, Microsoft Dynamics ERP systems, UPS Package Tracking or SWIFT international wire payments to over 1600 banks worldwide. The backend layer of the platform is built on a distributed ledger (blockchain) architecture which also enables cryptocurrency payments (Bitcoin, Litecoin, etc.) if preferred by the user.

Morpheus.Network's Middleware.Supply removes existing barriers between stakeholders by creating a mutual trust layer without imposing all parties to use the same backend stacks or legacy systems. Thus, it creates a trustless system for information and data exchange. Value and competitive advantage stay in the customer-facing service layer and the established ecosystem of each party. By bringing the previously segregated layers of payments, physical goods and auxiliary services into one architecture, the platform allows companies to save money and develop new data-driven services.

As an example, the digital identity assigned to products (e.g., via barcode or QR scans) allows companies and consumers to determine the origin of a product. In return, digital certificates for fair trade standards or loyalty schemes for purchases can be implemented at the point of purchase. These services can give sellers an edge over the competition without having to pay middlemen to handle the data streams or hand out supply chain data to an external entity.

MIDDLEWARE.SUPPLY

Middleware.Supply currently integrates with 150+ industry-leading technologies and service providers such as DHL, UPS, FedEx, SAP, and Salesforce, as well as various IoT devices from leading companies such as Geotab, Hanhaa and Digital Matter.

As a middleware solution, it is agnostic of a specific protocol or legacy system and is able to integrate different data sources to create value for the user. Data is stored in a trustless architecture based on distributed ledger technologies.

For international payments, our platform integrates with the international SWIFT banking payment protocol which connects our platform to 1600 banks worldwide.

Middleware.Supply enables suppliers, manufacturers and exporters from around the world to receive their local currency in over 200 countries globally. Additionally, purchasing importers can send their own country's currency to finance purchases in other countries. Our platform also enables fast and secure payments through an AML-compliant, Know-Your-Customer (KYC) verification process.

As a middleware platform, we do not seek to replace existing systems and services, but rather augment and enhance them.

This means that our clients do not need to throw out their established technology infrastructure but can utilize our platform to optimize and automate their current workflows in conjunction with existing IT infrastructure. This approach minimizes adoption costs for companies and allows parties to maintain their own customer experience through established ecosystems and networks.

This is also the reason why we decided to move the blockchain layer into the backend and focus on providing an intuitive user interface. Instead of requiring companies to overhaul their entire software stack and set up networks themselves from scratch, Middleware.Supply does the heavy lifting in the background. Our platform is web-based, which means there is no costly software and hardware to install or maintain and companies can adopt and benefit from the platform within days instead of months.

By connecting to all internal and external data streams for supply chain operations and bringing them into the same place, previously separated layers of physical distribution, documentation and services, as well as payment streams, are connected.

> This creates the base for holistic analytics, automation and process improvements by receiving in-depth insights into all datasets created along operations.

Introducing Middleware.Supply

"Fix the Supply Chain, Fix the World"

https://youtu.be/rzRVXwa45v4

OUR ADVANTAGES

1   Web-based software. No hardware or software to install and the platform is accessible anywhere.

2   As middleware we connect to your existing systems. No need to rip out and replace current IT infrastructure.

3   Highly customizable features and user interface with custom-tailored modules and APIs.

4   Data is highly portable and exportable. No vendor lock-in.

5   Predictable, pay-as-you-go pricing.

6   Connect fragmented systems into a common machine-readable platform to allow for effective exchange and automation.

7   Automating your previously manual and error-prone processes to save time and money.

8   Flexible user premissions so different users only have access to the information and capabillities they need.

9   Blockchain-agnostic, Cloud-agnostic and IoT-agnostic, providing you with tremendous freedom to work with your preferred vendors.

10   Our Morpheus.Network Training and Support Team is available to assist with your supply chain digitization and automation journey.

FEATURE HIGHLIGHTS

Our middleware platform seamlessly integrates legacy as well as emerging technologies. This enables organizations to take advantage of technological advancements in IoT, blockchain, artificial intelligence, machine learning and big data without lengthy and cumbersome implementation projects. To give our users a better understanding of what this means, we have compiled a breakdown of some highlights that have been developed and integrated into the new release.

IPFS DOCUMENT STORAGE

IPFS, a revolutionary new way to store and access documents, has been built into our platform. For shipping of goods across borders, it is critical — both functionally and legally — to have verifiable and accessible documentation regarding every shipment.

Middleware.Supply uses a private network of IPFS document storage nodes, combined with event logging on an EVM compatible layer2 such as Polygon, Base, Arbitrum or Optimism via our proprietary Trust.Supply masternode network to ensure that shippers, authorities, and recipients can retrieve shipment data, and be assured that documents used in shipping transactions are verified, tamper–free originals. Since all goods shipped using Morpheus. Network's platform can be easily associated with the proper documentation, users can move shipments across borders with less friction and greater speed.

And because all documentation is stored using IPFS, there is no central data clearinghouse holding sensitive shipping details, including financial information or other personally identifiable information.

This provides two layers of assurance: apart from the access control afforded by encryption, IPFS's use of "content addressing" offers inherent tamper protection, solving a too–real problem in the global shipping industry.

Every party involved with a shipment can now be completely assured the documents they work with are unmodified

originals. Paired with our document generation features, the complete process of creating, transmitting, validating and signing documents is digitized and automated, removing a previously manual and error-prone chain of processes.

"It's about trust. One of the reasons why the international supply chain industry is so inefficient is because you have organizations who need to work together, but don't necessarily want to share their data because there's not a lot of trust amongst all these organizations. There have been a lot of solutions attempted over the years, but all of those solutions required a central entity in the middle. Our supply chain platform, which takes a more decentralized approach through technologies such as IPFS, enables more organizations to collaborate."

— Noam Eppel
(Co-founder & COO, Morpheus.Network)

Read the Morpheus.Network Case study on the official IPFS site:
https://docs.ipfs.io/concepts/case-study-morpheus/

Document Generation

Morpheus.Network's Middleware.Supply has developed a Document Handling System to enable immutable documentation of production, processing, and all subsequent handling stages in digital format. Through a partnership with Customs Direct, a U.S. Customs Broker, our platform can generate, digitize and store custom documentation to facilitate cross-border shipments. All documentation can be generated and attached directly to the workflow and easily exchanged between all parties.

For a fully digitized document flow, the platform offers integrated OCR scanning tools and intelligent data extraction to translate documents into machine-readable format. This can reduce manual intervention and allow the automation of processes, resulting in higher efficiency and reduced risk of errors. Leveraging the modular workflow design, the platform can be adapted to any supply chain and feature specific documents like BoL (Bill of Lading), customs declaration, or official certificates needed in the food industry like FDA approvals.

Best-in-Class IoT

We work with IoT devices from best-in-class companies such as Geotab, Hanhaa and Digital Matter. Through our IoT partnerships, we are able to enhance our platform by automating the collection of data such as temperature, humidity, shock, tampering, theft, and irregular movement and make them actionable. All collected data is stored on an immutable blockchain.
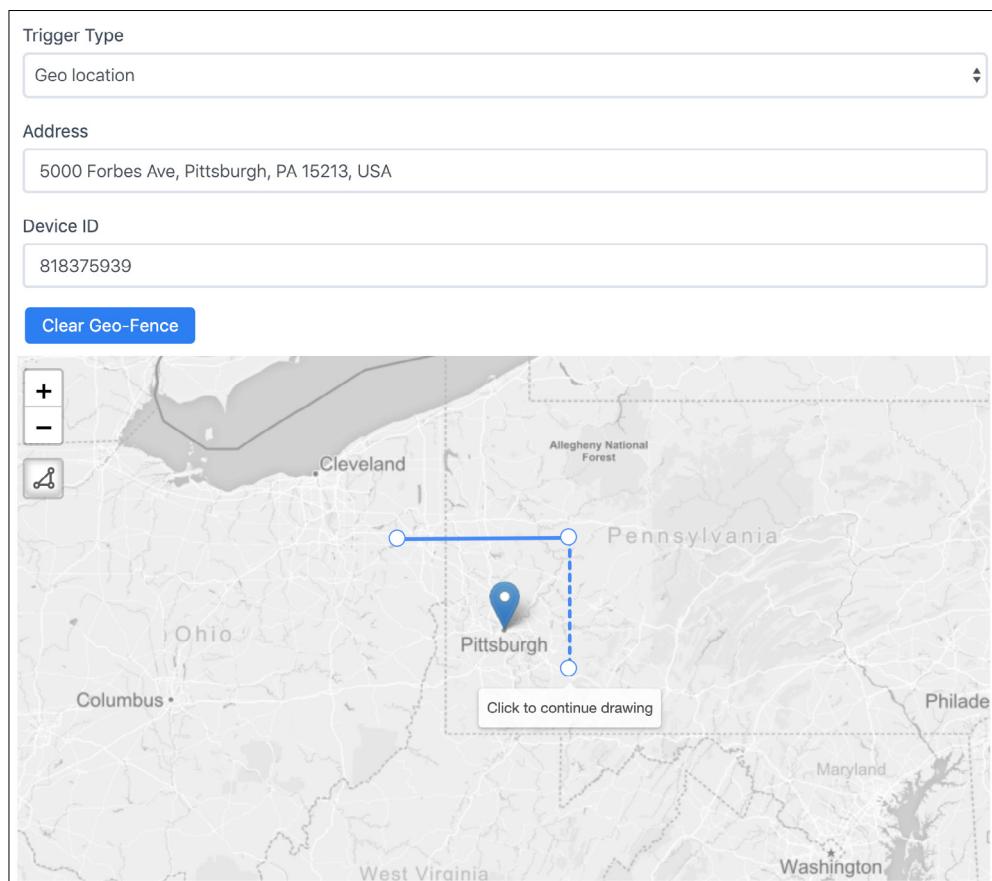
> "By partnering with Morpheus.Network and its blockchain platform we can provide a solution that is not only transparent but which is trusted and actionable as part of a workflow — which is fundamental when it comes to agri food, cold chain pharma, perishable and high value goods." *Azhar Hussain, CEO, Hanhaa*

> "Integrating Geotab with Morpheus.Network's middleware unlocks great potential for their end users. By tapping into our telematics capabilities, Morpheus.Network's supply chain automation platform produces endless possibilities of automation and emerging technology integrations." *Michael Branch, Vice President Data & Analytics at Geotab*

Geotab is one of the largest telematics outfits in the world. Geotab focuses on fleet management, aiming to improve safety, fleet optimization, compliance, scalability, and more. Geotab hardware trackers integrate directly with the Middleware.Supply Platform providing exceptional fleet-tracking capability to our customers. Our IoT partnerships have allowed us to expand our product offerings, including a Brexit ready solution to target the European Agri-Food sector and a USMCA cross-border solution for shipments traveling from Mexico to the USA.

Request a copy of our Hanhaa and Vitalcan IoT case study here:
https://connect.morpheus.network/vitalcan.html

Our user-friendly, highly-intuitive platform allows our customers to adopt and benefit from IoT devices with minimal training.

Big Data and Machine Learning

Bringing all supply chain related datasets into one architecture and format gives our platform the chance to create a holistic monitoring interface for supply chain performance and deploy efficient algorithms for optimization.

Middleware.Supply features a built-in dashboard to track the flow of single SKUs from production to end-users across all handovers and touchpoints. It also integrates proactive email, SMS and browser notifications in case of unexpected deviations or delays in shipments to immediately inform supply chain managers of potential problems with their shipments.

However, our ultimate goal is to not only provide reactive alerts but to design proactive measures that allow action-taking before a disturbance becomes a problem. We achieve this by feeding all datasets into analytics tools and building algorithms with our customers that constantly optimize the performance of workflows. This is where the strength of our platform to bring all relevant datasets into a uniform machine-readable format is leveraged, as it guarantees that AI, ML or RPA algorithms are built on trusted and uniform datasets, ultimately improving the result of deployment.

To illustrate this with an example, the Middleware.Supply platform generates data on precise timestamps of handovers, optimal shipping routes, busy traffic intersections and port delays. These datasets can be used to plan and route container shipping ports in advance based on global traffic, port delays, weather, as well as many other factors and data sources. Also, if there is a statistical accumulation of delays at a certain handover point within the supply chain, our platform can provide recommendations to the supply chain manager on how to improve the associated worksteps.

Digital ID and Fraud Prevention

According to the Global Brand Counterfeiting Report 2018-2020, "The amount of total counterfeiting globally … is bound to reach 1.82 Trillion USD by the year 2020."

Morpheus.Network's Middleware.Supply helps vendors to establish full transparency within their supply chain. Products are equipped with unique digital identifiers at production level using a QR code - or any other preferred scanning technology like RFID, Barcodes or NFC - as the identifier. By combining this identifier with unique product data from other data sources like the ERP system, our platform creates digital identities of products. In outbound logistics, distributors and retailers can scan the product upon receipt and at the point of sale, while connecting information to the unique identity of the product.

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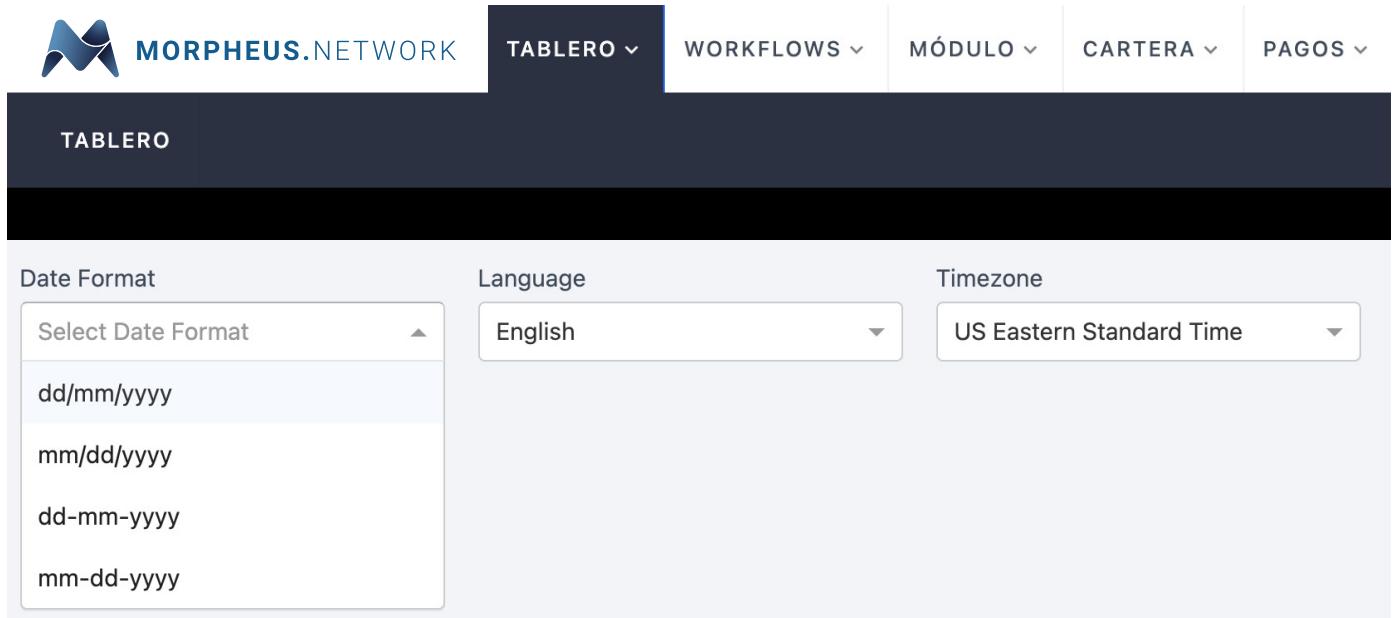
By storing all information immutably on the blockchain, an effective protection mechanism is created against plagiarism.

A beneficial side effect of this, is the platform can use the created data to optimize stock levels and automate reordering or payment processes by providing timestamped information along every action within the Supply Chain. It gives the chance to identify buying patterns, optimize shelf times to find the right balance between waste and availability and can be used to streamline production and warehousing. By using QR codes, which can be scanned using any modern smartphone, transparency is extended to the end consumer, thereby increasing brand confidence and loyalty.

MULTILINGUAL (MEHRSPRACHIG)

Supply chains are international and so is our platform. You can transact with partners and suppliers across the world as easily as across the street. The Middleware.Supply platform includes support for Internationalization (i18n) and Localization (l10n), and can use multiple languages, local timezones, currencies and date formats to better support our global audience.
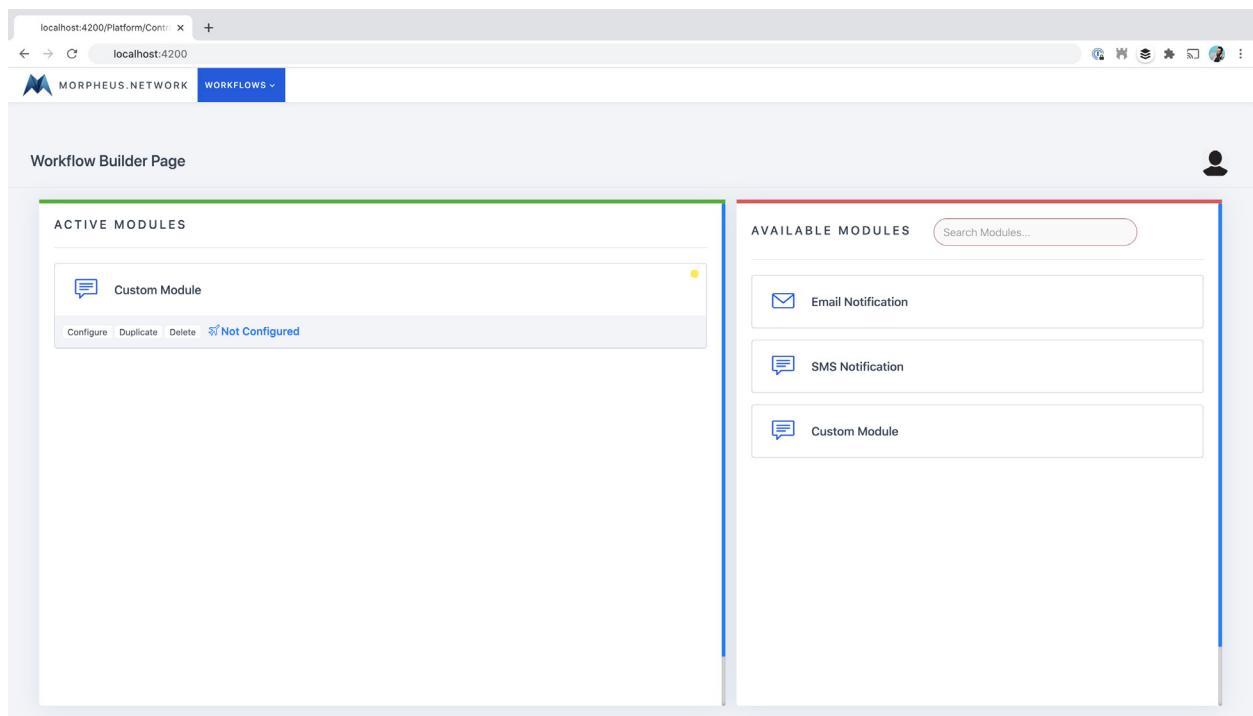
Highly Extensible (SDK)

Together with our new platform release, we will also offer a new Software Development Kit (SDK). This allows third-party developers to build modules on our platform (of course falling under the same quality standards as native solutions). Our goal is to make the platform highly extendable to ensure that features and functions can be easily adapted to all use cases. Our SDK is already in use by developers in Argentina as part of our collaboration for SENASA.

This opens up new opportunities and collaboration potential and takes our platform to a whole new level of compatibility, customization and extensibility. It also gives our clients the chance to earn revenue through our platform by offering their own custom-build modules to third parties. Imagine it as a supply chain-catered ecosystem similar to the Google Play store or the Apple App Store, where companies that use Middleware.Supply have the chance to monetize their own development efforts by offering the module to other platform users.

In addition to the standard modules developed by Morpheus.Network, partners, developers and community members may create their own solutions to solve new use cases faster and with a better user experience. In the first phase of the partner program, we intend to distribute a percentage of the global net revenue collected by custom modules directly to the developers of those modules. In the future, we plan to launch a third party marketplace to incentivize solution providers.

Our new Software Development Kit which allows third-party developers to build custom modules for our platform!

Security & Data Portability

We take security very seriously. Aside from utilizing defence-in-depth principals across our technology and organization, we have partnered with industry leading security companies as additional layers of security on top of our own rigorous security standards.

We utilize external code audits from industry-leading firms such as Veracode, Certik and Inviti to ensure that our code meets the highest standards of security. We use external vulnerability testing services which helps to identify threats ahead of time.

By company policy and practice, we use m-of-n multi-signature hardware wallets for all roles with elevated privileges. This is in accordance with best security practices and helps to eliminate the risk of a single rogue actor conducting unauthorized transactions. Our platform uses secure authentication methods including support for Single Sign-On (SSO) and Two Factor Authentication (2FA).

> "WE WERE THRILLED TO WORK WITH NOAM EPPEL AND MORPHEUS.NETWORK TO PROVIDE RIGOROUS AND THOROUGH CODE AUDITS OF THEIR SMART CONTRACTS. THIS INCLUDED AUTOMATIC STATIC ANALYSIS AND MANUAL CODE REVIEW. WE ARE VERY PLEASED WITH MORPHEUS.NETWORK'S STRONG COMMITMENT TO SECURITY!" – JASON JIANG, HEAD OF BUSINESS DEVELOPMENT AT CERTIK

It is your data, so it should not be locked into a proprietary system. All data can be exported to CSV or systems such as Microsoft Power BI. We are also assessing the recently-ratified GS1 EPCIS 2.0 Supply Chain Comprehensive Business Vocabulary (CBV) standard. This would help with data exchange and migration, as well as create a JSON version of the Digital Footprint which can be pulled and parsed by any EPCIS 2.0 interpreter.

SAP-Certified Brand Protection

The Morpheus.Network Blockchain-Powered Brand Protection feature is now SAP certified! Find us in the SAP Marketplace!

https://store.sap.com/dcp/en/product/display-0000061372_live_v1/morpheus.network-brand-protection

The black and gray market for luxury goods is well known. Any luxury items, such as watches, purses and scarves, are a target for counterfeiting and impersonation. This issue also impacts the spirits industry. Wine and spirits across the globe are duplicated using low quality ingredients and dubious processes, then sold as the genuine product. Physical media — still a large industry globally — has always been plagued with knock-offs. These counterfeits of legitimate items like DVDs or vinyl records flood the market in the US and Canada greatly impacting artist royalties.

We help you protect your revenue and your customers by connecting to your purchase orders on SAP S/4HANA Cloud and using a digital twin with a verifiable identity and blockchain to protect your brand value.

https://www.youtube.com/watch?v=_lU37V5L5BU

Digital Footprint

For every shipment, the platform generates a Digital Footprint. This transparent audit trail provides supply chain managers with exceptionally detailed, real-time visibility into their global supply chain operations.

Multiple stakeholders, such as brokers, 3rd party logistics companies and freight forwarders, can add compliance and shipping documentation at key handling points across the entire supply chain. IoT triggers enrich the Digital Footprint with real-time telematics (e.g., geolocation, temperature, humidity, shock, light, etc).

The digital identity assigned to products (e.g., via barcode or QR scans) allows companies and consumers to ascertain the origin of a product. In return, use cases like certificates for organic food or fair trade standards or loyalty schemes for purchases can be implemented. These services can give sellers an edge over competition without having to pay middlemen to handle the data streams or handing out supply chain data to an external entity.

All the data collected is stored on an immutable blockchain providing a highly trusted record of events. Each Digital Footprint includes a map to help quickly identify any issues with a particular shipment which requires attention.

Digital Footprints can remain private to your organization or shared with select third party suppliers and partners, allowing compliance with data privacy and company specific requirements.

Digitize all data related to a shipment and bring them together into a Digital Footprint providing you with detailed shipment visibility.

WHY BLOCKCHAIN?

A blockchain is a distributed, decentralized ledger—a digital system for recording events and transactions among multiple parties in a verifiable, tamperproof way. We recognize blockchain as a technology to be leveraged across supply chains to see breakthroughs in automation, optimization, security, visibility, and forecasting. Using a blockchain backend layer provides several key advantages for the platform:

- Data is stored in a trustless environment to facilitate secure exchange between multiple parties.
- Datasets are notarized, normalized and fed into one pipeline, which creates an efficient backbone to deploy machine learning or artificial intelligence algorithms for process automation and predictions, as these technologies require trusted datasets to work with.
- Smart contracts are used for event triggers, i.e., automated process steps. By using a smart contract architecture, conditional actions can be triggered (e.g., if a temperature sensor measures a breach in the cooling chain, an alert is automatically sent to the forwarder and the event is reported to the insurance company).
- Once data has been written to a blockchain, no one can change it. This creates a secure, immutable audit trail of all documents and transactions to ensure compliance with local regulations.

With a fully digitized data-driven workflow, the required basis for leveraging other data-based technologies like artificial intelligence, machine learning or data analytics is established. Our blockchain layer normalizes all data streams into a "common machine-readable language," with Morpheus. Network acting as the translating agent. Normalized and validated datasets are a key success-factor to deploy efficient algorithms. Given the nature of distributed ledger architecture, the need for middlemen for data storage or data clearance is removed, allowing for a more cost efficient data exchange between actors.

For illustration, an important part of supply chains can be utilized: Document creation and exchange (e.g., customs, shipping or certification documents). Documents are digitized within Middleware.Supply, recorded on the blockchain and can

be accessed only by authorized participants; this can be all participants or only those who need a particular portion of the data. Document ownership and access can be anonymous yet securely identified between partners who require verification. In short, it can be widely shared and protected at the same time.

MORPHEUS.NETWORK ADDRESSES SHORTCOMINGS OF BLOCKCHAIN TECHNOLOGY

While many existing supply chain solutions rely on proprietary blockchains, thereby ensuring vendor lock-in and scalability limitations, our platform was fully designed to be blockchain-agnostic. We are currently integrated with Ethereum, EOS, Hyperledger and Polygon to help streamline supply chain operations. We are also cloud-agnostic and currently run on Amazon AWS, Microsoft Azure and Google Cloud. This allows the user to choose the right blockchain solution and platform based on their requirements, giving them full flexibility regarding IT infrastructure and setup.

Trying to force all actors within a supply chain network to utilize the same legacy system and/or IT infrastructure has proven to be a large hurdle to blockchain adoption, as it presents massive switching costs for implementation. With our platform, partners within the network are not forced to use the same blockchain.

Morpheus.Network is a proud member of the Enterprise Ethereum Alliance

Our blockchain-agnostic approach was also chosen to tackle the most prevalent shortcomings associated with distributed ledger networks:

In public, permissionless blockchains, all information is publicly available at any time. While this endorses transparency and trust, it poses a great challenge for mission-critical and sensitive datasets. Middleware.Supply solves this problem by allowing users to switch between permissioned (private), permissionless (public) and hybrid networks for data transmission. The platform features permission settings that establish which data, documents or workflow objectives are kept private, and which ones are visible and shareable with your shipping agents, customs brokers and freight forwarders. This ensures that confidential information remains in permissioned networks, while other data can be openly shared between partners and suppliers, allowing compliance with data privacy and company-specific requirements.

Another common criticism associated with blockchain is scalability for high-throughput applications. Using blockchain for data notarization in high-frequency applications can become expensive with high volume datasets such as IoT geolocation, tracking data or document handovers. For a single company executing on an average of 20-25 workflows in a day, the calculated number of intermediate transactions easily ends up at around 7500 transactions per day.

Every time a transaction is notarized on a public blockchain, a transaction fee is incurred. This results in uneconomical costs at scale and a backlog of transactions that cannot be processed due to network congestion. One possible solution would be to use a highly scalable blockchain network. However, this contradicts with our approach of interoperability and not forcing all users into one blockchain network. Also, when validating all transactions on the public blockchain, dependency is increased and controlling the privacy of sensitive data becomes more difficult.

Morpheus.Network's Middleware.Supply tackles this issue with a side-chain architecture. We have developed a layered platform that allows the abstraction of different blockchain protocols. It enables users to benefit from the inherent strengths of different protocols and systems for leveraging the required transaction data in one, single place – without compromising on flexibility, security or scalability.

To drive the evolution of distributed ledger technologies for corporate use, we are actively engaged in the Ethereum for Enterprise network. We are a sponsor and Governing Board Member of the Ethereum OASIS Open Project and Governing Board Member of The Baseline Protocol. The Baseline Protocol defines a series of steps to privately and securely synchronize data and business logic between multiple independent systems of record, using the Ethereum Mainnet as an auditable common frame of reference. This protocol implements best practices around data consistency and compartmentalization, and leverages public Ethereum for verifying execution of private transactions, contracts and tokens on the Mainnet using zero-knowledge proofs.

MNW TOKEN

In our pursuit to provide a unified communication layer between different systems and blockchain protocols, Morpheus.Network grants an abstraction layer that leverages multiple distinct and disparate platforms in one place. MNW tokens are the currency used to cover the costs associated with operating the platform for data storage, notarization and exchange.
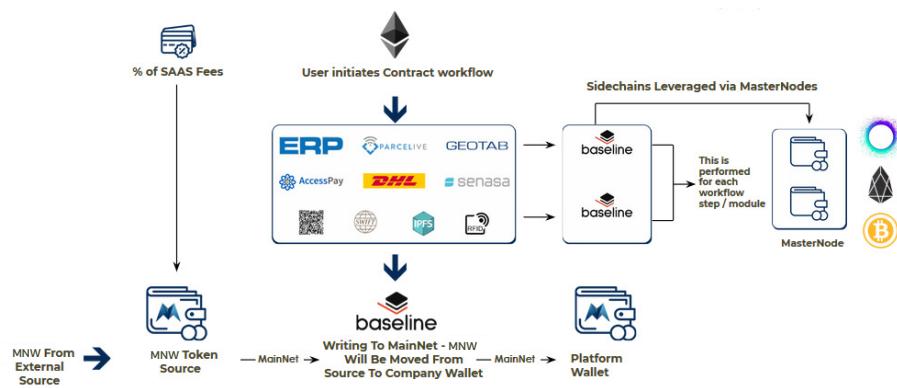
From a user standpoint, MNW tokens are used to "pay" for two key functions of the platform: firstly, automating processes that had to be done manually before, thereby saving time and money; secondly, notarizing all transactions/datasets in an immutable ledger for all parties to create a single source of truth and converting information into a common machine-readable data format.

The primary use case for MNW tokens is Morpheus.Network's Trust. Supply DLT-as-a-Service Network. Trust.Supply provides decentralized validation of enterprise supply chain data in exchange for transaction fees. These transaction fees are payable to validation node operators in MNW. When clients choose to pay for the Trust.Supply service in fiat currency, Morpheus.Network will purchase MNW tokens on the open market to cover the necessary transaction fees for those clients.

In addition to being utilized as part of the Trust.Supply Network, MNW tokens are used to compensate other participants in the Morpheus.Network ecosystem, including Morpheus.Network Solution Providers and Module Developers.

Ethereum was chosen based on its native ability to process smart contracts and the fact that it is one of the most secure and widely recognized decentralized networks. However, there exists a need to address specific Ethereum-based issues. Some of the significant problems include a limited volume of transactions processed per second and thus the critical need for interoperability.
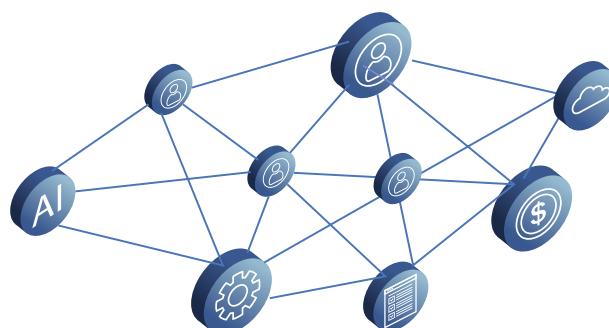
Currently, the Ethereum mainnet can only handle approximately 15 transactions per second. To resolve this issue, the Morpheus.Network Platform will be able to leverage Trust.Supply masternodes, which can seamlessly utilize Layer 2 blockchains to increase transaction throughput. By leveraging Layer 2 solutions, the Trust.Supply masternodes can process a high volume of transactions off-chain, aggregating them before settling on the Ethereum network. This approach not only enhances scalability but also lowers transaction costs, making the Morpheus.Network Platform more efficient for supply chain operations.

As we will be integrating a side-chain architecture for private networks and scalability, clients can become a functional part of the network by operating validator nodes if they wish to do so. Lastly, we are currently working on offering our customers a marketplace for custom-built modules. In other words, our clients will be able to monetize the development efforts they put into creating new modules. Within our module store, MNW tokens will become an integral part for managing the ecosystem (similar to an App-Store).

MNW tokens give users full access to all functions of the platform. We are convinced that distributed ledger technologies offer great opportunities for digitizing supply chains. However, we also understand that the process of acquiring, storing and using tokens represents a hurdle for most enterprises – at least as of now. That is why Morpheus.Network does the heavy-lifting associated with using blockchain and tokens in the background to give our clients a frictionless and easy user experience:

• We offer our clients to pay for our services in their established and preferred payment methods (most commonly fiat currencies) and automatically convert into MNW tokens on-the-fly at the time required.

• Network setup and "plugging into" blockchain protocols is done in the backend, making it easier for companies to interact with distributed ledger technologies.

ARCHITECTURAL OVERVIEW

Architectural Overview

Our platform integrates **Polygon Layer 2** for high transaction throughput and **AWS** for scalable cloud infrastructure. We employ two types of smart contracts: the **Master Smart Contract**, which manages validator registration, rewards, and wallet operations, and **Validator Smart Contracts**, responsible for staking and transaction validation.

The infrastructure is fully managed with **Terraform**, enabling automated, scalable deployment and maintenance, ensuring consistent and reliable operations.

Security is prioritized through **Certik audits** and comprehensive unit test coverage, ensuring a robust and resilient system. The architecture guarantees scalability, security, and future-proofing, with seamless adaptability for future needs.

Technology Stack

1. **Polygon (Layer 2 Solution):** We leverage **Polygon** as a Layer 2 scaling solution to improve transaction throughput and reduce costs on the Ethereum network. Polygon enables faster, cheaper transactions by processing them on its secondary chain while maintaining the security and decentralization of Ethereum. This approach ensures scalability without sacrificing security or decentralization, making it ideal for handling high volumes of transactions efficiently.

2. **Alchemy (Blockchain Development Platform):** We integrate **Alchemy**, a leading blockchain development platform, to provide reliable infrastructure for building decentralized applications (dApps). Alchemy optimizes the performance of our blockchain interactions by offering enhanced monitoring, debugging tools, and scalable infrastructure. It ensures that our system remains responsive and resilient even during periods of high network activity.

3. **Ethers.js (Ethereum Library)**: For interacting with the Ethereum blockchain, we use **Ethers.js**, a lightweight and user-friendly JavaScript library. Ethers.js allows seamless integration of our smart contracts with the front-end and simplifies the process of handling private keys and deploying contracts. Its modularity and flexibility make it ideal for developing secure and scalable blockchain applications.

Core Functionality of Smart Contracts
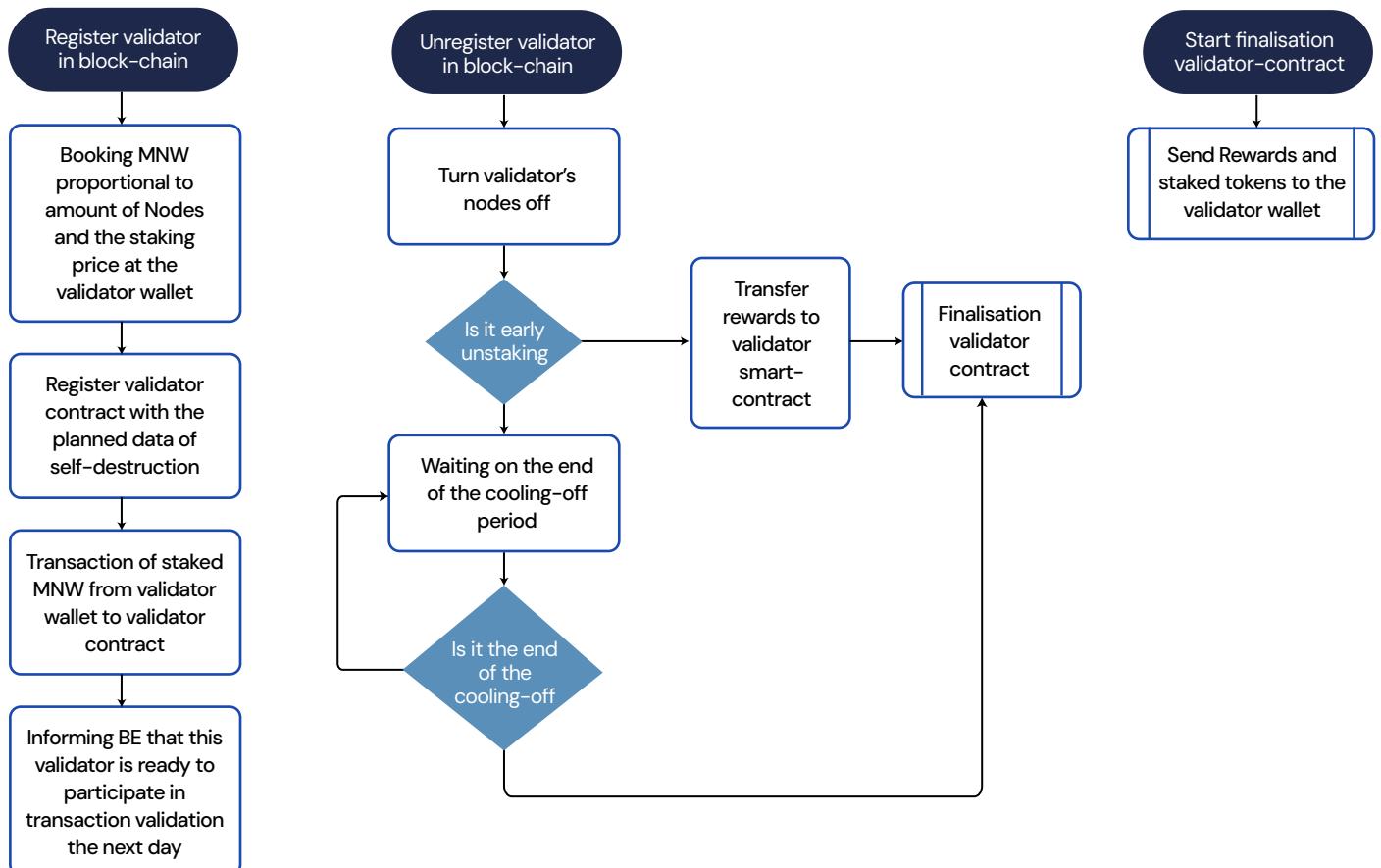
Master Smart Contract (ERC721/a/ERC1155):

- **Validator Registration/Unregistration:** Allows validators to join or leave the network by registering or unregistering their smart contracts.

- **Reward Management:** Approves and distributes rewards to validators for successfully validating transactions.

- **Validator Management:** Oversees the activities of all validators, ensuring they meet the required standards to participate in the network.

- **Wallet Operations:** Manages wallets responsible for holding and distributing rewards generated within the system, ensuring transparency and security.
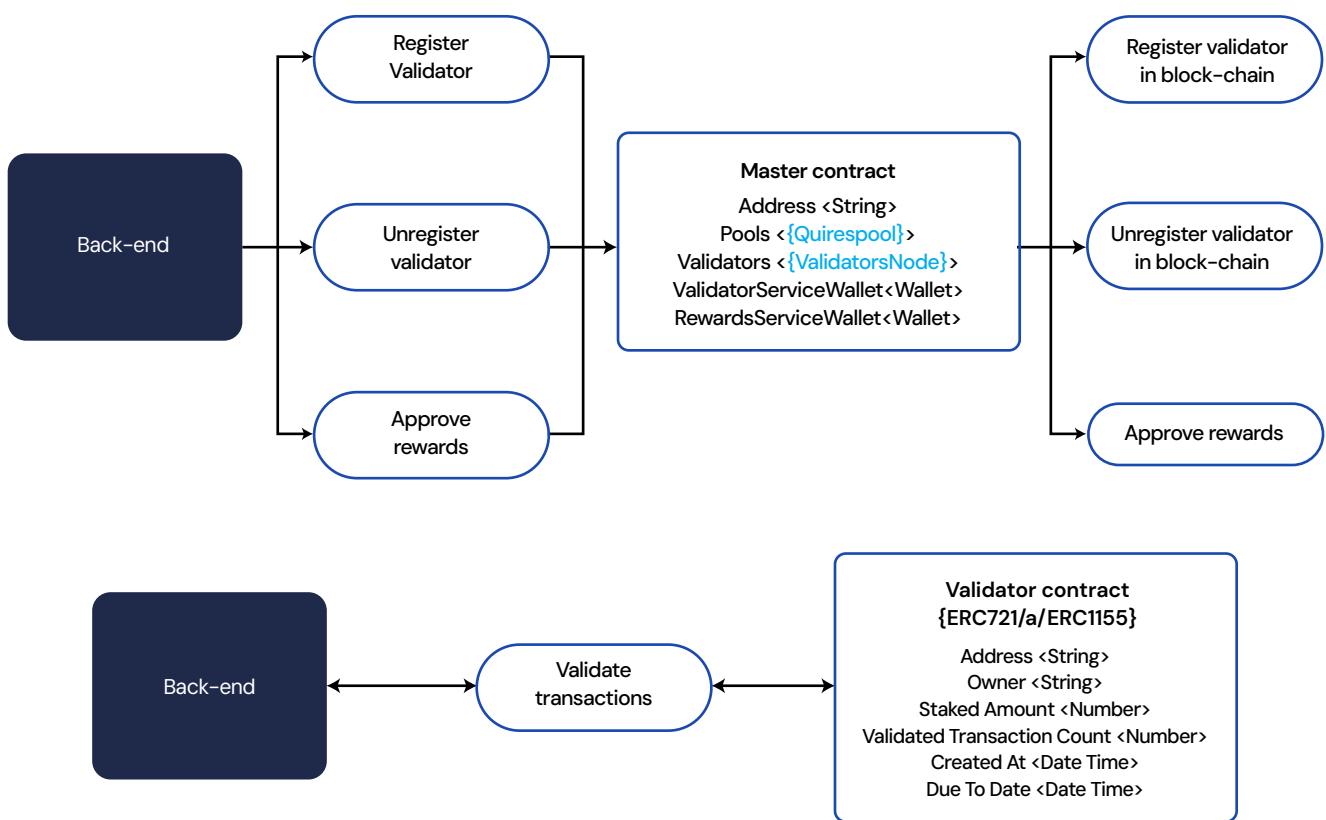
Validator Smart Contract (ERC721/a/ERC1155):

- **Staked Tokens Management:** Operates with the validator's staked tokens, ensuring financial commitment to the integrity of the network.

- **Transaction Validation:** Validates transactions within the network, confirming legitimacy before recording them on the blockchain

Register/unregistered validators in blockchain

Register validator in block-chain	Unregister validator in block-chain	Start finalisation validator-contract
Booking MNW proportional to amount of Nodes and the staking price at the validator wallet	Turn validator's nodes off	Send Rewards and staked tokens to the validator wallet
Register validator contract with the planned data of self-destruction	Is it early unstaking → Transfer rewards to validator smart-contract → Finalisation validator contract	
Transaction of staked MNW from validator wallet to validator contract	Waiting on the end of the cooling-off period	
Informing BE that this validator is ready to participate in transaction validation the next day	Is it the end of the cooling-off	

Interactions between Back-end and Smartcontracts

Scalability Solutions

Our system is designed for high scalability, limited only by the transaction throughput of the **Polygon Layer 2 network**, which significantly increases the capacity for handling transactions compared to Ethereum's mainnet. By leveraging **Polygon's Layer 2 solution**, we can process thousands of transactions per second (TPS), providing robust infrastructure for high-volume applications with lower transaction fees and faster finality.

- **Polygon Layer 2:** The scalability of our platform is underpinned by Polygon's infrastructure, which utilizes sidechains and scaling solutions like Plasma and Rollups to increase transaction capacity while maintaining the security of Ethereum. This ensures we can support high transaction volumes without the congestion and cost constraints of Layer 1 networks

- **Backend Infrastructure:** Our backend is hosted on **AWS (Amazon Web Services)**, providing a flexible, scalable, and secure cloud environment. AWS allows us to dynamically adjust computing resources based on demand, ensuring smooth performance during traffic spikes and large-scale operations. With AWS, we can scale globally, reducing latency and improving user experience for users across different regions.

By combining Polygon's Layer 2 capabilities with AWS's scalable cloud infrastructure, we ensure our system is highly efficient and capable of handling growing user demand, making it suitable for both current and future needs.

Security Measures

Security is a top priority, and we have implemented rigorous measures to ensure the integrity and safety of all transactions and data. As part of our commitment to high security standards, our smart contracts and platform architecture underwent a comprehensive audit by **Certik**, a leading blockchain security auditor.

- **Certik Audit:** Our smart contracts successfully passed Certik's detailed audit, which included a thorough examination of potential vulnerabilities, such as reentrancy attacks, integer overflows, and access control weaknesses. Certik also performed advanced verification techniques to ensure all our contracts are secure and functioning as intended.

By passing the Certik audit, we have demonstrated that our platform adheres to the highest security protocols, mitigating risks and ensuring the system is resilient against attacks or exploitation.

Development Tools and API

The API is implemented using the **Nest.js framework**, enabling the creation of efficient and scalable server-side applications. Further efficiency is achieved through the integration of **GraphQL**, allowing for optimized querying and data management. Additionally, **BullMQ**, in conjunction with Redis, handles background tasks, ensuring smooth execution of asynchronous operations.

List of Development Tools:

- **Language:** Node.js/TypeScript
- **Architectural Request:** GraphQL
- **Framework:** Nest.js
- **ORM:** TypeORM
- **Message Queue Library:** BullMQ
- **Database:** PostgreSQL, Redis
- **Testing Framework:** Jest.js

Future-Proofing

Our platform is designed to remain adaptable and future-ready, ensuring scalability while maintaining operational integrity and security.

- **Back-end development and integration:** We maintain comprehensive unit test coverage for all back-end functionalities, ensuring every component is rigorously tested before deployment. This supports continuous integration and deployment (CI/CD), providing a stable and reliable platform while facilitating ongoing improvements.

- **Infrastructure-as-Code (IaC) with Terraform:** Our infrastructure is provisioned and managed using **Terraform**, enabling automated, scalable deployment across environments. Terraform ensures reproducibility and scalability, while allowing rapid deployment of updates and enhancements, contributing to disaster recovery and compliance capabilities.

- **Scalability with AWS and Polygon:** With our back-end hosted on AWS and blockchain operations running on Polygon's Layer 2, we efficiently scale as demand grows. This setup allows easy integration of new technologies, ensuring the system evolves with the rapidly changing blockchain landscape.

By combining Terraform-based infrastructure automation, and a scalable backend on AWS and Polygon, our platform is well-positioned to remain secure, adaptable, and future-proof.

TRUST.SUPPLY – THE PLATFORM

Overview

In the Trust.Supply system, validators are critical participants within a decentralized network that validates queries issued by various providers via the Trust.Supply API. Validators participate by staking MNW tokens, representing their commitment and capacity to perform validation tasks. The system ensures that demand for validation, indicated by the transaction count (TTT), is met by a robust supply of validator capacity, thereby aligning the incentives of validators with the needs of the network.

Approval Mechanism and Member Access to Portal

For masternodes, KYC is required to be passed before you can stake MNW tokens, you must also agree to the terms: https://trust.supply/terms

There are certain regions referred to as "Prohibited Jurisdictions" in the terms above that are not able to participate in masternodes.

KYC is performed on trust.supply via Sumsub, utilizing artificial intelligence to quickly and effectively validate credentials.

You will need to provide government issued identification, ensuring the image quality is clear.

You will then be notified via email if your KYC has passed successfully and can move onto staking to run masternodes via the dashboard.

Staking Mechanism

Validators stake MNW tokens to participate in the MasterNodes program, with each node requiring a specific amount of MNW tokens (for instance 1800 per node as an example). This stake represents the validator's weight within the Equitable Validator Leader Selector (EVLS) algorithm, affecting their chances of being selected to validate queries.

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Staking Terms and Rewards

Validators can choose to stake their MNW tokens for fixed terms of 3, 6, or 12 months (Calculated as N+1 days where N is the stake duration). The reward per validated transaction varies based on the term of the stake:

1. 3 months/90+1 days: 0.06 MNW per transaction
2. 6 months/180+1 days: 0.08 MNW per transaction
3. 12 months/365+1 days: 0.1 MNW per transaction

These rewards are gross amounts, and net earnings are calculated after deducting gas fees necessary for recording validations on the public blockchain.

Validation Demand and Work Allocation

The Trust.Supply API determines the required number of validations per query, which varies depending on the provider and the type of information being validated. Daily, the total amount of required validations (queries x validations) is scheduled, ensuring a predictable workload for validators.

Work Allocation Process

Each day, the EVLS algorithm selects validators based on their staked nodes to distribute the validation tasks evenly. The more nodes a validator has staked, the higher their probability of receiving work, promoting fairness and efficiency in task distribution.

Penalties for Early Unstaking

To maintain network stability and commitment, penalties for early unstaking are structured to discourage premature withdrawals while also adjusting rewards based on the completed duration of the stake relative to the committed term. All penalty fees will be added to the liquidity pool.

Penalty Structure

1. Early Unstaking Penalty:

   Regardless of the term length or when the unstaking occurs, there is a flat 10% penalty on the net rewards amount for unstaking before the end of the commitment period.

2. Reward Adjustments:

Rewards are adjusted based on the last completed term prior to unstaking. Any partial term does not count towards reward calculations.

3. Cooling-Off Period:

In the case of unstaking early, rewards will be held for 30 days before being returned to the wallet of origin.

Specific Scenarios and Calculations

1. **Example #1:** Unstaking Before 3 Months (+1 day):

    1.1. Rewards: No rewards are paid.
    1.2. Scenario: A validator who stakes for any term but unstakes within 3 months and 1 day forfeits all rewards.

2. **Example #2: Unstaking After 5 Months (6-Month Commitment):**

    2.1. Rewards for Completed Term: Calculated at the rate applicable to a 3-month term (0.06 MNW per transaction).
    2.2. Penalty: 10% of the net rewards amount.
    2.3. Scenario: If a validator commits to a 6 month term and unstakes at month 5, they receive rewards at the 3 month rate of 0.06 and a 10% penalty on the net rewards amount.

3. **Example #3: Unstaking After 10 Months (12-Month Commitment):**

    3.1. Rewards for Completed Term: Calculated at the rate applicable to a 6-month term (0.08 MNW per transaction).
    3.2. Penalty: 10% of the net rewards amount.
    3.3. Scenario: If a validator commits to a 12-month term and unstakes at month 10, they receive rewards at the 6 month rate of 0.08 and incur a 10% penalty on the net rewards amount.

Term Definitions and Reward Rates

1. 3 months/90+1 days: 0.06 MNW per transaction
2. 6 months/180+1 days: 0.08 MNW per transaction
3. 12 months/365+1 days: 0.1 MNW per transaction

Each term is effectively extended by one day to accommodate time zone differences and ensure clarity in term completion.

Work Allocation Process

Maintaining high availability is critical for the functionality of the network. Validators are required to ensure an uptime of 99% or higher for their validating software, which is typically run on Virtual Private Servers (VPS). This high standard ensures that the network remains operational and capable of handling validation requests at all times, thereby maintaining its reliability and efficiency.

Daily Uptime Requirement

1. Immediate Consequences: Validators must meet the 99% uptime threshold daily to qualify for selection in the next validation day. Failure to meet this requirement results in the validator being ineligible for selection the following day, missing potential rewards. This slashing measure encourages validators to quickly address any issues that may affect their uptime.

Long–Term Uptime Requirement

1. End of Stake Term: If a validator's average uptime falls below 99% by the end of their staking term, they will forfeit any rewards accrued during that period. Instead of applying a penalty equal to the size of their stake, the forfeited rewards will be added to the rewards pool. These funds will then be redistributed in future validation cycles to other validators who meet the uptime requirements.

2. Opportunity for Recovery: Validators have the entire term to monitor and improve their infrastructure to ensure consistent uptime. Meeting the daily requirement consistently after any downtime is crucial to avoiding reward forfeiture at the end of the staking term.

Equitable Validator Leader Selector (EVLS) Algorithm

In distributed ledger technologies (DLT), maintaining decentralization and fairness in the validator selection process is crucial for system integrity and trust. The Equitable Validator Leader Selector (EVLS) algorithm addresses these challenges through a dynamically weighted random selection mechanism, where the selection probability is tied to the node count of each validator within the Validators Network. The algorithm includes measures to prevent monopolization by any single validator and ensures a balanced distribution of transaction validation opportunities.

Equitable Validator Leader Selector (EVLS) Algorithm

The Validators Network consists of a set of validators, each with an associated node count representing their weight in the selection process. Prior to initiating a validation cycle, we normalize the node counts to prevent any single validator from disproportionately influencing the network. This normalization process adheres to an anti–monopolistic guideline, ensuring that the node count of the largest validator does not exceed the sum of the node counts of all other validators in the network, multiplied by two, minus one.

Normalization Formula

Given a validators network $W = [w1, w2,....., wn]$ where wi represents the node count for the $i - th$ validator:

1. Calculate the sum of node counts for all validators except the largest:

$$Sum_{rest} = \sum_{j=1, j=i}^{n} w_j$$

Here i_{max} the index of the largest validator with the maximum node count.

2. Adjust the node count of the largest validator (wi_{max}) if necessary:

$$wi_{max} = min(wi_{max}, 2xSum_{max} - 1)$$

Transaction Validation Cycles

The validation process is structured into cycles, each designed to handle a predefined number of transactions proportional to the total node count (SSS) of the normalized Validators Network.

Cycle Definition

Total Node Count (SSS):

$$N = \sum_{i=1}^{n} w_i$$

1. Number of Full Cycles *(N)* for a total of *T* transactions

$$N = [\tfrac{T}{S}]$$

2. Transactions in Last Partial Cycles (R):

$$R = T \bmod S$$

Each cycle involves a random selection of a validator based on the weighted probabilities derived from their node counts, followed by a decrement in the node count of the selected validator to ensure equitable participation across cycles.

Implementation and Governance

The EVLS algorithm is meticulously designed to prioritize transparency, fairness, and adaptability. This ensures that every aspect of its implementation aligns with these core principles. The governance protocols established are comprehensive, allowing for regular reviews and adjustments to the normalization criteria and selection mechanisms. These reviews are conducted periodically and take into account various factors such as network performance, feedback from validators, and evolving system requirements.

By incorporating this structured approach, the algorithm guarantees that no single validator can dominate the validation process. This is crucial for maintaining the principles of decentralization and fairness in transaction validation. The periodic review and adjustment process ensures that the algorithm remains responsive to changes and challenges within the network, thereby sustaining a balanced and equitable environment for all participants. This commitment to a fair and transparent validation process upholds the integrity of the system and reinforces the trust of all stakeholders involved.

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Selection Process in the Equitable Validator Leader Selector (EVLS) Algorithm

Weighted Random Selection Mechanism

The EVLS algorithm employs a sophisticated method to ensure fair and unbiased selection of validators for transaction validation within the Validators Network. The selection process uses a weighted random selection mechanism, where the probability of a validator being chosen correlates directly with their node count after normalization.

Detailed Steps

1. Weight Assessment

    1.1. Each validator in the network is assigned a weight (wi) that quantifies their stake or contribution to the system. These weights are indicative of the validator's capacity or reliability.

2. Total Weight Calculation

    2.1. The total weight (S) of all validators in the system is calculated as the sum of individual weights:

$$S = \sum_{i=1}^{n} w_i$$

    2.2. This total weight represents the entire 'weight' of the system and is used to scale the random selection process.

3. Total Weight Calculation

    3.1. Cumulative weights are computed to facilitate the selection process. For each validator i, the cumulative weight (C (i)) is the sum of all weights from the first validator to the i –th validator.

$$C(i) = \sum_{j=1}^{i} w_j$$

    3.2. These cumulative weights create thresholds that partition the weight into segments corresponding to each validator's contribution.

4. Random Selection Process

    4.1. A random number (r) is generated and scaled by the total weight (S), yielding a value in the range of 0 to S:

$$r = random\ (0,\ 1)\ x\ S$$

    4.2. The selected validator is determined by finding the smallest index k such that:\

$$r \leq c\ (k)$$

    4.3. This process ensures that the probability of selecting a particular validator is proportional to their weight.

Dynamic Adjustment of Node Count

Post–selection, the node count of the selected validator is decremented by 1:
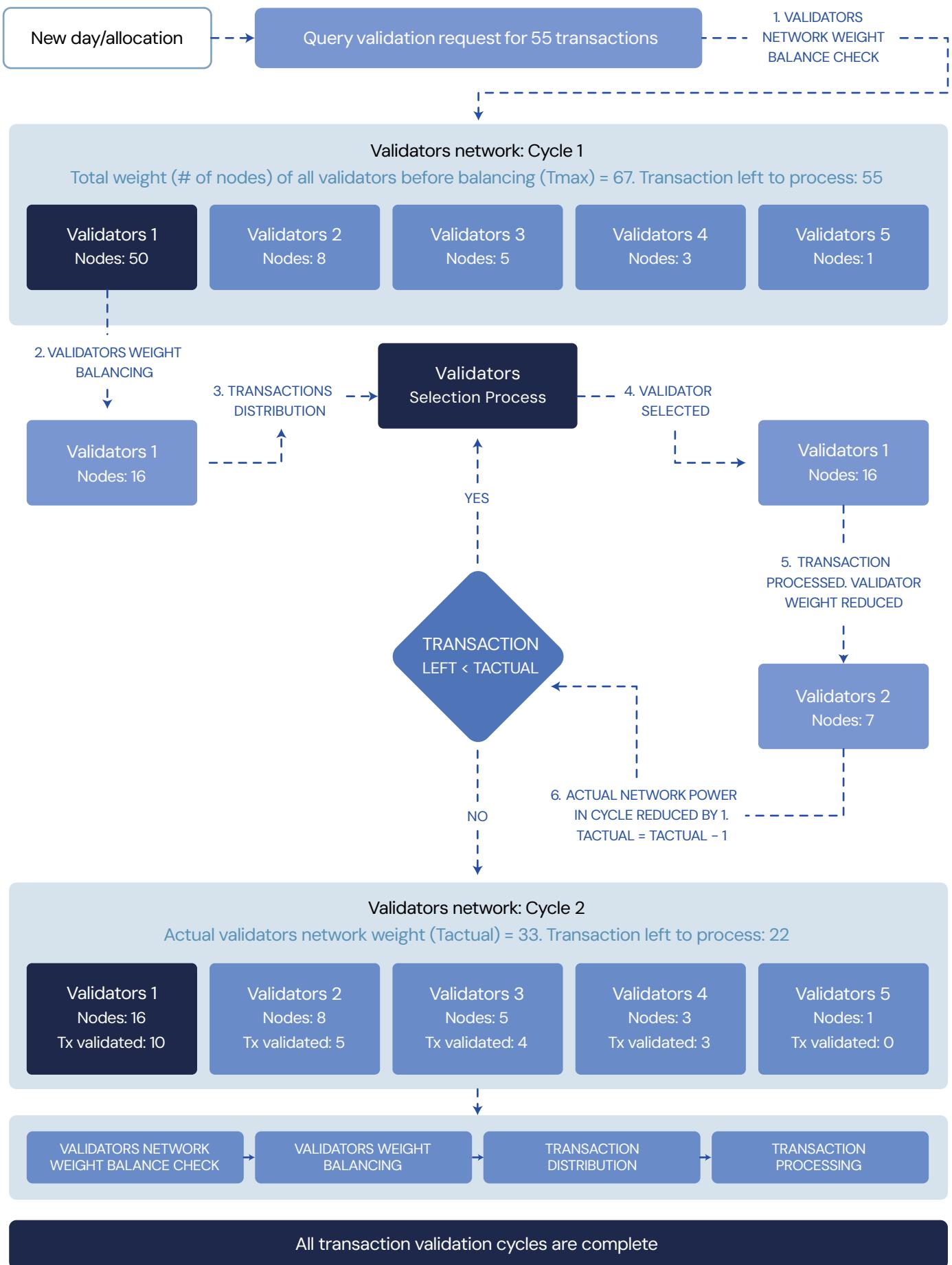
$$w_k = w_k - 1$$

This decrement is crucial as it dynamically adjusts the probability of subsequent selections, ensuring equitable participation across all validators. It prevents any single validator from repeatedly dominating the validation process due to a higher initial node count.

Monitoring and Adjustment

To maintain the integrity and efficiency of the selection process, continuous monitoring is conducted. Adjustments are made as necessary to ensure the algorithm remains adaptive to changes within the Validators Network, such as variations in node counts and the entry of new validators. This proactive approach ensures that the EVLS algorithm continues to perform optimally under varying network conditions.

EVLS Algorithm Example

New day/allocation - - -> Query validation request for 55 transactions

1. VALIDATORS NETWORK WEIGHT BALANCE CHECK

Validators network: Cycle 1

Total weight (# of nodes) of all validators before balancing (Tmax) = 67. Transaction left to process: 55

| Validators 1 Nodes: 50 | Validators 2 Nodes: 8 | Validators 3 Nodes: 5 | Validators 4 Nodes: 3 | Validators 5 Nodes: 1 |

2. VALIDATORS WEIGHT BALANCING

Validators 1
Nodes: 16

3. TRANSACTIONS DISTRIBUTION

Validators
Selection Process

4. VALIDATOR SELECTED

Validators 1
Nodes: 16

5. TRANSACTION PROCESSED. VALIDATOR WEIGHT REDUCED

YES

TRANSACTION
LEFT < TACTUAL

Validators 2
Nodes: 7

6. ACTUAL NETWORK POWER IN CYCLE REDUCED BY 1.
TACTUAL = TACTUAL – 1

NO

Validators network: Cycle 2

Actual validators network weight (Tactual) = 33. Transaction left to process: 22

| Validators 1 Nodes: 16 Tx validated: 10 | Validators 2 Nodes: 8 Tx validated: 5 | Validators 3 Nodes: 5 Tx validated: 4 | Validators 4 Nodes: 3 Tx validated: 3 | Validators 5 Nodes: 1 Tx validated: 0 |

VALIDATORS NETWORK WEIGHT BALANCE CHECK -> VALIDATORS WEIGHT BALANCING -> TRANSACTION DISTRIBUTION -> TRANSACTION PROCESSING

All transaction validation cycles are complete

QUERY VALIDATION PROCESS

Overview

The Query Validation Process is a core component of the Trust.Supply system, facilitating the validation of data queries issued by various providers such as IoT platforms, UPS, and FedEx. This process ensures the integrity and accuracy of data through a decentralized network of validators, leveraging a robust response protocol to manage and verify the flow of information.

Validation Workflow

Query Distribution

Queries from different providers are received by the Trust.Supply API and entered into the Target Data Query Queue. For instance, the IoT Pool, UPS Validation Pool, and FedEx Validation Pool, have a specific demand and minimum confirmation requirement per query.

The total demand (as an example 56,000 queries for a given period) is managed by the validators network balancer, which distributes these queries based on the available capacity and stakes of validators.

Query Pickup and Validation

Queries are picked up from the queue by the balancer and distributed to the appropriate validation pool. For example, a FedEx tracking query code might be distributed into the FedEx pool.

Validators within the network (Node_1 to Node_N) pick up these queries for validation. The selection of validators for each query is determined by the Equitable Validator Leader Selector (EVLS) algorithm, which ensures that validators with higher stakes have a proportionately higher chance of receiving queries.

Validation Execution

Each validator executes the validation of the query using their resources. This involves verifying the data against predefined criteria or external data sources.

The raw responses from these validations are collected in the Raw Response Pool, where they are encrypted (e.g., SHA256 encryption) to ensure data integrity and security.

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Response Handling and Blockchain Logging

The encrypted responses are evaluated, and a consensus mechanism determines if the responses meet the validation criteria.
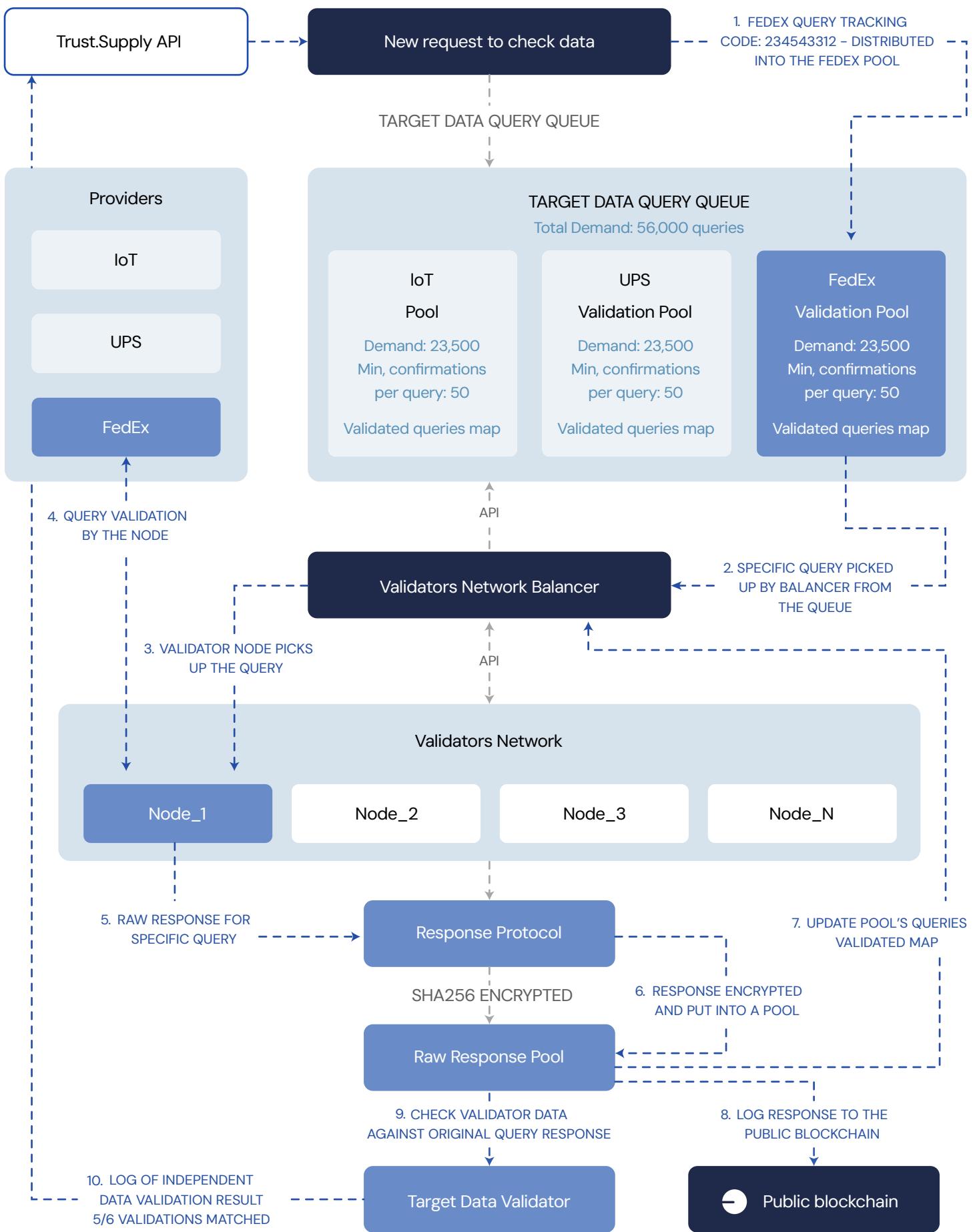
Successful validations are logged onto the public blockchain, providing a transparent and immutable record of the validation process. This includes logging the response and the independent validation results, such as "5/6 validations matched."

The validated queries map is updated with the results of the validations,

The validated queries map is updated with the results of the validations, and the Validators Network Balancer uses this information to adjust future query distributions.

This continuous feedback loop enhances the efficiency and accuracy of the validation process, ensuring that validators are effectively utilized based on their performance and reliability.

Query Validation Process

Trust.Supply API

New request to check data

1. FEDEX QUERY TRACKING CODE: 234543312 – DISTRIBUTED INTO THE FEDEX POOL

TARGET DATA QUERY QUEUE

Providers

IoT

UPS

FedEx

TARGET DATA QUERY QUEUE

Total Demand: 56,000 queries

IoT Pool

Demand: 23,500
Min, confirmations per query: 50

Validated queries map

UPS Validation Pool

Demand: 23,500
Min, confirmations per query: 50

Validated queries map

FedEx Validation Pool

Demand: 23,500
Min, confirmations per query: 50

Validated queries map

API

4. QUERY VALIDATION BY THE NODE

Validators Network Balancer

2. SPECIFIC QUERY PICKED UP BY BALANCER FROM THE QUEUE

3. VALIDATOR NODE PICKS UP THE QUERY

API

Validators Network

| Node_1 | Node_2 | Node_3 | Node_N |

5. RAW RESPONSE FOR SPECIFIC QUERY

Response Protocol

7. UPDATE POOL'S QUERIES VALIDATED MAP

SHA256 ENCRYPTED

6. RESPONSE ENCRYPTED AND PUT INTO A POOL

Raw Response Pool

9. CHECK VALIDATOR DATA AGAINST ORIGINAL QUERY RESPONSE

8. LOG RESPONSE TO THE PUBLIC BLOCKCHAIN

10. LOG OF INDEPENDENT DATA VALIDATION RESULT 5/6 VALIDATIONS MATCHED

Target Data Validator

Public blockchain

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