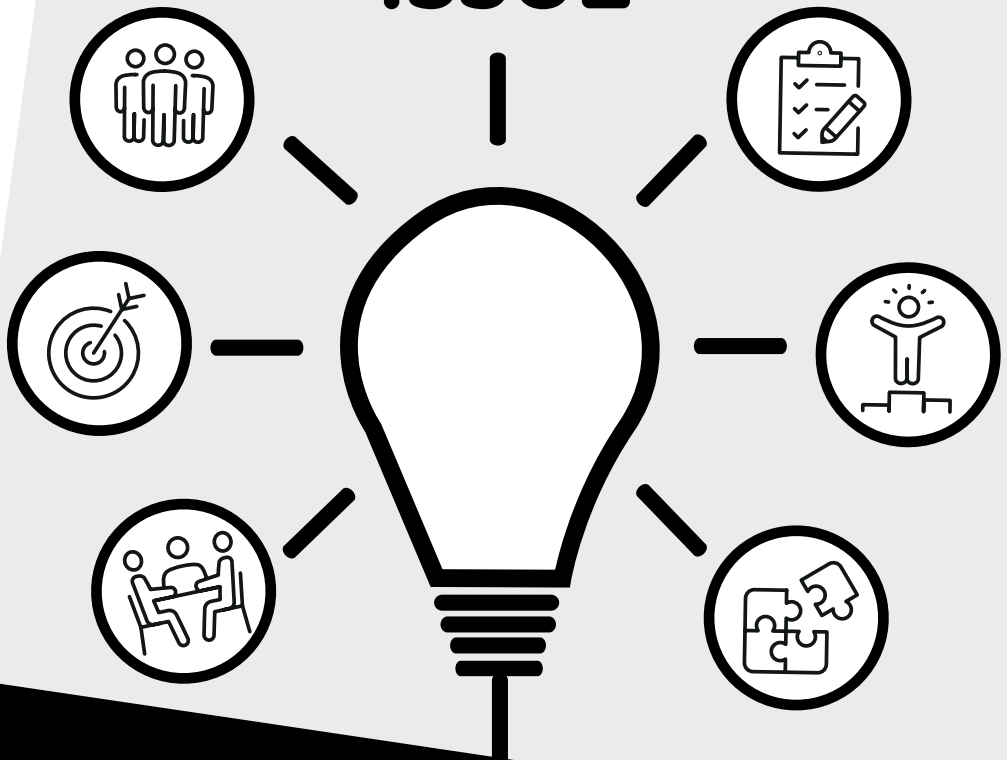


2022 Number 4

THE IDEAS ISSUE



THE IDEATION FACTOR

About Quartz – The Smart Ledgers™

Quartz comprises Smart Solutions, a set of 'designed for blockchain' business offerings for different industries; Ledgers, Off-the-shelf ledger structures, functions, and APIs for business processes across various domains; the DevKit, a smart contract development kit to enable programming of high-quality code on multiple blockchain platforms; the Gateway & Command Center for the integration of existing solutions with blockchain ecosystems and their administration and supervision. Built on the core principles of Coexistence, Integration and Interoperability, Quartz enables existing systems to coexist and integrate with blockchain platforms and other messaging networks.

With Quartz, you can facilitate the creation of a complete decentralized ecosystem for stakeholders in your value chain. Quartz caters to organizations across Industry segments including Financial Services, Banking, Supply Chain, Energy & Utilities and eGovernance.

To know more about Quartz, please visit: <https://www.tcs.com/quartz>

About Tata Consultancy Services (TCS)

Tata Consultancy Services is an IT services, consulting and business solutions organization that has been partnering with many of the world's largest businesses in their transformation journeys for over 50 years. TCS offers a consulting-led, cognitive powered, integrated portfolio of business, technology and engineering services and solutions. This is delivered through its unique Location Independent Agile™ delivery model, recognized as a benchmark of excellence in software development

A part of the Tata group, India's largest multinational business group, TCS has over 592,000 of the world's best-trained consultants in 46 countries. The company generated consolidated revenues of US \$25.7 billion in the fiscal year ended March 31, 2022, and is listed on the BSE (formerly Bombay Stock Exchange) and the NSE (National Stock Exchange) in India.

TCS' proactive stance on climate change and award-winning work with communities across the world have earned it a place in leading sustainability indices such as the MSCI Global Sustainability Index and the FTSE4Good Emerging Index. For more information, visit www.tcs.com.

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By R. Vivekanand,
Global Head,
BFSI Products and
Platforms,
Tata Consultancy
Services

Quartz is built on the belief that Distributed Ledger Technology will transform enterprises across industries over time. That belief, and the need to test ideas continuously, has driven our designs for toolkits and frameworks, which are built to ensure interoperability on any chain, integration with messaging networks, and co-existence with existing enterprise solutions.

Today, clients in multiple industries are using Quartz Smart Solutions and Quartz DevKit to build new services and business models that will stand the test of time. We are gratified to see our early vision becoming a reality, and we are tremendously excited to see what we will co-create with our customers next.

THE IDEATION FACTOR

Quartz supports the rapid creation of distributed shared ledgers for trusted, transparent, and decentralized access to immutable records of a single source of the truth. As these new shared ledgers become available within and across industries, entire value chains will be transformed, with profound implications for every organization.

Given these massive changes, a core competency for organizations will be **ideation**. It is the power of ideas that will drive reimagination of existing processes.

Some questions which I would urge all business leaders to consider:

How ready is your organization for developing and cultivating new ideas?

How quickly do ideas evolve within your organization, using rapid iteration based on real-time feedback?

How well do you understand the ways in which innovations in other industries and other countries will change your business?

How open and collaborative are your networks of suppliers, customers, and business partners?

How easily can the people at your organization participate in brainstorming and other ideation practices, including in-person and work-from-home resources, and including staff members and contractors?

Many organizations struggle with ideation within their own businesses, let alone with the cross-industry collaborations required for launching successful DLT initiatives.

The reality is that these collaborations are already happening.

Innovators in every industry are building cross-industry solutions for decentralized records of ownership, and decentralized identity tokens. These big ideas, and the emergence of CBDCs will continue to transform every kind of physical and digital commerce.

(You can read more about these ideas in this **Ideas Issue** of the Quartz Magazine.)

At TCS, we have been fully engaged with these ideas, thinking through the various possible outcomes, and ensuring that our customers and partners successfully manage the transition with flexible solutions that enable full participation in the Web 3.0 economy taking shape.



THE IDEATION FACTOR

For any organization, the starting point is the ability to generate insights about the future through collaborative and open ideation. With those insights, and the courage and capability to execute, you'll be ready for the new world.

Yet we fully understand the tension involved with collaboration on shared ledgers. For many entities, moving from proprietary data collection to a single source of trusted data carries the real risk of disintermediation, and perceived loss of control over data. On the other hand, as the new Web 3.0 infrastructure becomes a reality, which we believe will be the case, the most eager participants will quickly outpace the reluctant holdouts.

To resolve this tension, we work with customers to identify genuine reasons for deploying blockchain in ways that promote mutually beneficial ecosystem-level collaborations within and across industries. By finding meaningful use cases, we can build a business case to achieve widespread buy-in, enabling not just the creation of technology solutions, but the purpose-driven realization of business value.

Our approach enables quick wins with reasonable investment, whether building custom solutions using the rapid development tools of **Quartz DevKit**, or accelerating deployment with **Quartz Ledgers** or the more comprehensive **Quartz Smart Solutions**, for various industries.

Quartz has been built with interoperability, coexistence, and integration from the outset. We support traditional assets alongside crypto assets, ensuring connectivity with multiple chains and platforms. These capabilities make Quartz the ideal starting point for CEOs and business leaders seeking to discover the reality amid the hype.

We are at the beginning of a major transition to the next stage in commerce and connectivity. It is exciting and rewarding to be an active participant, and at Quartz, we look forward to helping you on your journey.

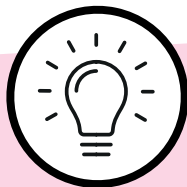
The Quartz logo features the word "QUARTZ" in a bold, sans-serif font. The letter "A" is stylized with a colorful, multi-segmented design in shades of orange, yellow, and red.

For more information about Quartz Smart Solutions:
<https://www.tcs.com/quartz/smart-solutions>

For more information about Quartz DevKit:
<https://www.tcs.com/quartz/devkit>

FROM THE EDITOR

Welcome to our Ideas issue.



In our **Quartz Live** webinars, we showcase major industry players putting world-changing ideas into practice.

Our most recent Quartz Live featured Amit Mahajan, CTO of CDSL, India's leading depository, who spoke about the recent launch of a decentralized ecosystem for bond market participants; and Blair Canavan from Thales, our valued partner for secure encryption and authentication services, who spoke about the foundation of digital trust on blockchain implementations. (For more on blockchain security, see our "How to Secure Enterprise Blockchain" article on page 35.)

On behalf of the entire Quartz community, we would like to express our sincere appreciation to our Quartz Live speakers for their participation. You can watch the replay of the latest Quartz Live at <https://on.tcs.com/3AaBgOu>.

We are excited to share that Quartz for Markets won an award from FTF News for Best New Post-Trade Solution. In addition, the Quartz Fraud Management solution was ranked at the top of the IBS Intelligence Sales League Tables for 2022. These industry recognitions validate Quartz's enterprise-focused approach to the marketplace for DLT solutions.

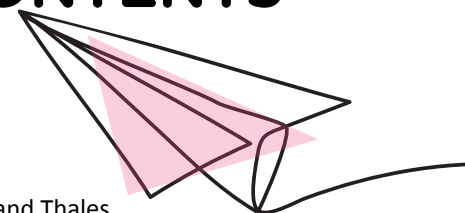
Our enterprise focus can be seen in this "Ideas Issue" of Quartz Magazine. From central bank digital currencies (CBDCs) being launched by countries the world over to NFTs that create a new way of storytelling for brands, we anticipate a breathtaking array of enterprise use cases for Quartz ledgers. Distributed ledgers also enable a new approach to decentralized identity that simplifies access while protecting individual privacy. Our recent health-pass pilot for facility access is just one example.

Throughout our ideation with Quartz, our passion goes beyond pushing crypto technology to its limits. We are motivated to discover meaningful, purpose-driven use cases that allow enterprises to improve people's lives. And if that philosophy resonates with you, we'd love to publish your contributions in future issues of Quartz Magazine. We are eager to hear your ideas for changing the world.



Happy Reading,
Anjana Chandrika
Editor, Quartz Magazine
anjana.srikanth@tcs.com

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QUARTZ | Live

Be sure to subscribe to our Quartz Live webinars,
where we talk with the major industry players
who are putting world-changing ideas into practice.

You can watch the latest Quartz Live here:

<https://on.tcs.com/3AaBgOu>

**SPECIAL
SECTION**

QUARTZ | Live

Just as **Quartz** smart ledgers enable sharing of real-time information by organizations across industries, our **Quartz Live** webinars bring together people from across industries and functional areas to explore the most important topics in enterprise blockchain.

Each Quartz Live webinar provides a showcase for clients to discuss recent go-lives, partners to explain critical technology components, and Quartz executives share expectations for the future of the blockchain-powered economy.

TCS hosted the most recent edition of Quartz Live on 23rd June, 2022, where industry stalwarts shared their experience and insights on how they are harnessing the power of blockchain to drive trust and transparency and create compelling value for their customers. We also shared a directional update on Quartz during the session.

SPEAKERS

- **Amit Mahajan**, Chief Technology Officer, Central Depository Services (India) Limited
- **Blair Canavan**, Senior Business Development Manager (Blockchain and Quantum), Thales

QUARTZ DIRECTIONAL UPDATES

- **R. Vivekanand**, Global Head, BFSI Products and Platforms, Tata Consultancy Services

ANCHOR

- **Malini Raman**, Product Head, Quartz, Tata Consultancy Services

EVENT SUMMARY

Amit Mahajan, Chief Technology Officer, Central Depository Services (India) Limited, explained the significance of CDSL's recent launch of a platform for sharing real-time, standardized information about corporate-issued securities in India. CDSL created a decentralized ecosystem for bond market participants that will help participants to meet the expectations of India's market regulator SEBI, which has proposed reforms to the bond issuance process to enhance liquidity and price discovery.

Mahajan provided an overview of the marketplace for secured corporate bonds, outlined the challenges with the existing system for bond issuance and fundraising, and explained the benefits of deploying a distributed ledger for delivering immutability, transparency, and real-time data to the full range of stakeholders.



Amit Mahajan



Blair Canavan



Blair Canavan, Senior Business Development Manager (Blockchain and Quantum), Thales, explained the integration between Thales and Quartz and described the full lifecycle management of physical hardware security modules (HSMs).

Thales has partnered with Quartz to safeguard crypto wallets for the trading and transfer of digital assets. Quartz has integrated its ledger management solutions with Thales to provide customers with best-in-class security for custody, trading, and settlement transactions across a diverse range of crypto and digital assets. To protect cryptographic keys against digital threats and the risk of theft, Quartz leverages Thales Luna HSMs to provide secure encryption and authentication services.

The financial services industry has relied on HSMs for decades, and participants in distributed ledgers are quickly realizing the value of the critical technology. In blockchain, HSMs are deployed to safeguard cryptographic wallets and digital assets across a wide range of use cases from deployment to audit.

R. Vivekanand, Global Head, BFSI Products and Platform, Tata Consultancy Services, provided a Quartz™ Directional Update on the current trends in blockchain and latest updates with Quartz solutions.

The event was moderated by **Malini Raman, Product Head, Quartz, Tata Consultancy Services**.



R. Vivekanand



Malini Raman



**Amit Mahajan,
Chief Technology Officer,
Central Depository Services (India) Limited:**

Central Depository Services (India) Limited, or CDSL, is India's leading depository, providing services to all market participants including exchanges, clearing corporations, depository participants, issuers, and investors. To address the lack of standardization for corporate-issued securities, CDSL proposed to reimagine the entire process by building a distributed ledger for corporate securities and covenant monitoring, using blockchain.

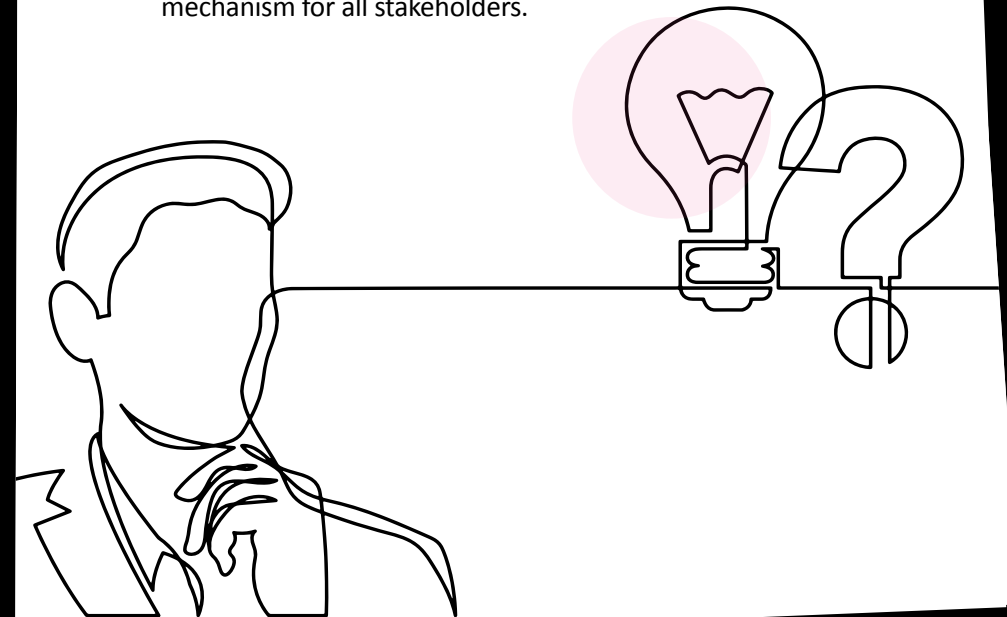
(Condensed and edited version of Quartz Live presentation.)

Why blockchain?

As a single source of truth, the blockchain provides the ability to publish a shared ledger for assets, giving the currently available value of the assets to all stakeholders. The trust and transparency give the ability to provide an audit trail of all actions, from issuance to listing, with information made available to all stakeholders.

The business logic for the solution was built using Quartz. The requirements are going to be evolving quickly, and so for us, time-to-market was very important. Quartz helps us with quicker development. Also, TCS has been a longstanding technology partner for CDSL, and the team has both the domain knowledge and the technology skill sets to manage a platform of this level.

This is the first implementation of a blockchain-based system in the Indian financial markets, laying the foundation for creating a robust and transparent lending mechanism for all stakeholders.





**Blair Canavan,
Senior Business Development Manager**

(Blockchain and Quantum), Thales, spoke about the progression of blockchain through the hype cycle, an analyst framework that tracks market expectations over time for new innovations.

"We're over the top of the hype curve, and into the everyday use of blockchain," says Canavan. "The community of blockchain is growing exponentially, and aspects of blockchain are being pulled into every single use case," says Canavan.

Use cases span financial services, retail, supply chain, health care, and manufacturing – with widespread appeal for any globally distributed industry with broad demand for greater visibility into resources, materials, assets, or contracts.

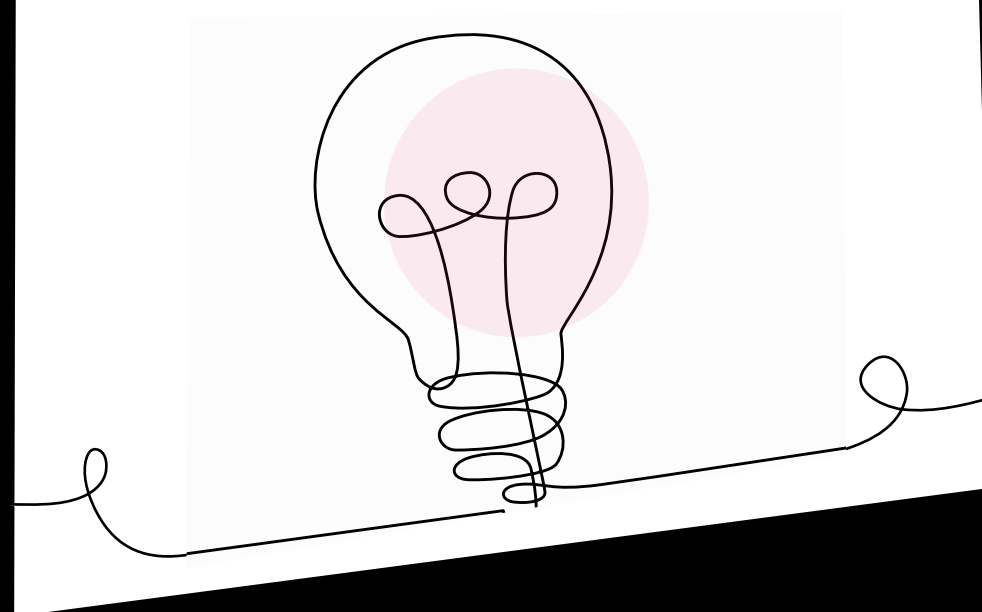
Thales' Digital Identity and Security division provides solutions in data protection, encryption, tokenization key management, and identity and access management.

Banks have been operating with HSM technology for the last 25 years, and proponents of blockchain solutions have quickly realized that they will need to do the same.

To support blockchain implementations, Thales provides a "foundation of digital trust" for assurance that all parties have been identified, authenticated, and verified for authenticity. "All the transactions, all the cryptographic operations for those transactions, any secure communications, and any identity or authentication brought into the equation, must be rooted in trust," says Canavan. "With a highly distributed system, you must have trust at the core."

To enable the highest levels of trust for ledger transactions and smart contracts, Thales' Luna HSM safeguards cryptographic wallets for digital assets. "We provide secure generation, storage, and protection of cryptographic keys used to sign blockchain transactions with non-repudiation," says Canavan. "This provides an audit trail, to make sure that the environment remains trusted for the entire lifecycle of the blockchain."

"We are the back-end cryptographic root of trust for large banking institutions around the world," says Canavan. "We provide institution-grade security for Quartz deployments."



Watch the replay: <https://bit.ly/QuartzLiveTY>

Roche

Swiss Pharma Firm Automates End-to-End Payments with Cross-Industry Blockchain

Roche demonstrated **cross-industry automation** of End-to-End (E2E) transactional ERP processes using blockchain, smart contracts, and digital payments, orchestrated by the **Quartz Smart Solution for Contract Performance Monitoring**.



“E2E is E2E: the big benefit is to have one integrated, automatically reconciled, secure information flow from order to payment.”

- Martin Schlageter, Head of Treasury Operations, Roche






“We now have a better understanding of the capabilities of blockchain for the P2P process, interface requirements (which worked!), how to structure collaboration with banks (DB) and suppliers and many more insights.”

- Stephan Wilckens,
Procurement Lead,
Portfolio & Performance,
Roche

“Long term, we envisage replacing our paper based SoWs and manually triggered fiat payments by milestone-enabled payments using smart contracts and digital currencies, significantly reducing administrative overheads.”

- Dirk König - ERP Head,
Finance & Procurement and
EMEA & APAC & LATAM,
Roche



The objective of the project was to automate E2E payment processes with the elimination of manual processes involving Procurement, Finance, and Treasury.

A typical vendor relationship may involve several hundred bookkeeping items per year, with significant manual processes required for tracking milestones, approvals, and payments.

These processes were automating using **Quartz Smart Contracts** for managing milestones, contractual terms, and enterprise middleware connectivity.

The initial Proof of Concept (PoC) achieved its aim of building a single source of truth for procurement, payments, and reconciliations. The private, permissioned blockchain ecosystem provided Roche and its vendors with secure, integrated, automatically reconciled information flow from order to payment.

Statement of Work (SoW) documents, including milestones and terms, were stored as Smart Contracts on a Quartz blockchain. As milestones were completed and approved, a series of API calls from Quartz automatically generated the appropriate vendor invoices in **SAP**, which were sent to **Roche** for verification. Upon approval, payment instructions were automatically sent to **Deutsche Bank** for payment, with acknowledgement recorded on the **Quartz** blockchain.

Roche is now prepared to pilot the technology for production. Real contracts and payments were added to the solution to validate the concept.

Roche is now prepared to pilot the technology for production.

Preparing for the Future

of NFTs

The evolution of NFTs
is leading to

a vibrant ecosystem with

huge opportunities for

well-known brands

Ganesh Jayapalan
Product Specialist,
Head, Quartz Enablement Center
Tata Consultancy Services



Non-fungible tokens (NFTs) are decentralized ownership records for assets that are unique, verifiable, and traceable through an immutable, public blockchain. NFTs offer a simple, user-friendly alternative for creating tokenized products/assets and declaring ownership to a global audience through a unique token, without the need for any central institution or intermediaries.

NFTs represent an estimated USD 15 billion market, with the potential to reach USD 120 billion within six years due to heavy interest by celebrities, artists, and well-known brands in retail, fashion, automobile, ticketing, media companies, gaming, and supply chain, among other industries. For showcasing brands that want to appeal to Gen Z customers, NFTs has been the go-to platform.

However, issuing NFTs is not simple. Several factors go into the decision making for issuers, including which blockchain to choose, security considerations, pricing strategy, launch timing, target audience, additional features and services, and more.

Building upon the trust associated with TCS and the Tata Group heritage, our award-winning Quartz for Markets solution suite builds upon our long-standing relationships with customers to enable them to introduce NFTs in their product portfolio. The solution supports a rich set of features including collections, drops, lazy minting, rules for apportioning fees, royalties, payment using either fiat money or cryptocurrency using users' own wallets or custodial wallets from the solution. These features are designed to encourage first-time users to enter the world of NFTs with relative ease.



Quartz DevKit, our low code smart contract development tool enables development of NFT smart contracts with quick time to market and allows them to be deployed on the target blockchain platform using the target token standard.

Quartz Gateway provides connectivity to NFT marketplaces with interoperability across multiple chains to support advanced implementations. For example, an issuer may choose to create NFTs for the same asset in different, linked blockchains such that when the buyer purchases an NFT on one blockchain, the second token gets burnt automatically to prevent duplicate sale of the same unique NFT. These features are carefully designed to improve the salability of tokens for different customer segments, thereby increasing liquidity in the marketplace.

Quartz for Markets solution suite also provides components for KYC and AML checks, directory services, rewards, custodial wallets, trading, surveillance, and asset servicing. The solution provides institutional grade security features, thus enabling strong governance and controls in how transactions are processed.

Components of **Quartz for Markets** have already been deployed by market infrastructure and financial institutions, with one of the leading depositories in India already using the Issuance module from the Quartz for Markets product suite in production. We're moving forward with deployments for several other clients and are seeing strong interest globally in issuing NFTs that represent a wide variety of underlying assets.

The underlying Quartz architecture is **microservices-ready** and **SaaS-based**. We also work with partners for niche solutions like hardware security modules, insurance, and forensics. We also work in close collaboration with blockchain platforms such as Ethereum, Tezos, and many others to give our customers the latest and the best of capabilities that the underlying technology could offer.

In addition to our Quartz solutions, we also provide consulting support and business advisory services to achieve regulatory compliance and marketplace readiness through our strong partner network.

**The future of
NFTs is upon us.
We are excited to help our
customers position themselves
for success with their creative
endeavors in the world of
digital collectibles
by leveraging Quartz.**

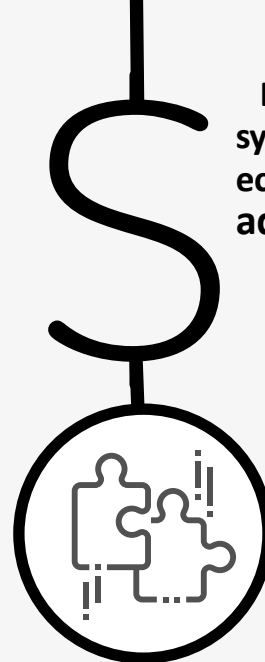
THE CBDC VISION

By **R. Vivekanand**,
Global Head,
BFSI Products and
Platforms,
Tata Consultancy
Services

**The global
banking system
is at the cusp of
transformation
from CBDCs.**

**Central bank
digital currencies, or
CBDCs, will be the digital
equivalent of government-
issued bank notes, made
available directly to retail
consumers and businesses.**

**Central banks around
the world are moving
forward with CBDCs. At
Quartz, we are already
actively participating with
research, experiments,
and pilot projects involving
CBDCs, and we expect the
first CBDCs to become a
widespread marketplace
reality by the end of the
decade.**



**By fundamentally rewiring the banking
system, CBDCs represent a transformation with
economy-sized risks. Yet the economy-sized
advantages are too compelling to ignore.**

Consumers would benefit from
widespread financial inclusion, instant
payments, and lowered transaction
costs, resulting from having marketplace
participants connected by a real-time
ledger.

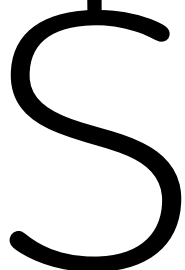
Policymakers would have extremely
powerful monetary tools at their disposal
given immediate visibility into money
supply and cash flow throughout the
economy.

Innovators, whether financial
institutions or non-bank technology
companies, would have a wider set of
capabilities for embedding financial
transactions into everyday commerce,
using programmable capabilities that can
be built into shared ledgers driven by
transactions involving CBDC holdings.

Banks will have the opportunity
to reinvent themselves for a digital
global economy. At first, this will likely
involve a different approach for each
country or currency union in which they
do business. In some countries, banks
may focus on account opening, and in
others, they may be active intermediaries
for all account holdings. Over time,
convergence across economies will favor
those banks with the flexibility to adapt.

**Most central banks are
taking it slowly by examining
the big “macro” questions,
including:**

- To what extent would CBDCs
displace physical currencies?
- How will CBDCs interact
with token-based
cryptocurrencies?
- How will commercial banks
adapt to market entry by a
large, government-backed,
risk-free deposit-taking
institution?
- By what mechanisms
would CBDC deposits be
transformed into loans?
- How will CBDCs will affect
local economies, cross-border
trade, and foreign exchange?



It's all in the details

Although bank notes and coins may look very different from one country to the next, cash is essentially the same concept wherever you go – a tradeable piece of paper or metal that signifies value.

To be sure, CBDCs can be designed to work just as cash, as a **token-based** currency, held anonymously, shareable with anyone, and usable anywhere in the world. But in most envisioned implementations, that's not the most likely scenario.

Shared ledger technology enables an **account-based** currency which assigns ownership of CBDCs to an identified accountholder. For many governments, the potential reduction in financial crime and tax evasion more justifies the loss of pure anonymity, which may be mitigated by financial privacy protections.

An account-based currency would enable **systemic** constraints on the stock, flow, or exchange of CBDCs. For example, a central bank may incentivize bank holdings by limiting CBDC holdings; or defend a domestic currency by restricting

currency outflow. Controls can also be placed on the digital wallets that provide access to CBDCs. For example, some digital wallets could be limited to residents only, with others for non-residents having limited capabilities. Digital wallets could even implement spending limits or category restrictions.

CBDCs and digital wallets give governments and policymakers choices practically unlimited options, with immense powerful options with thought-provoking implications.

Yet **global competition** places some external constraints to CBDC design. In a multipolar world, CBDCs will reflect the principles and beliefs of each issuing country and currency union. Over time, one might expect CBDCs built for free trade to outperform those with more restrictive implementations. There are also potential **first-mover advantages** for the first CBDCs that gain acceptance as a global reserve currency, and any such currency would require an open architecture with liberalized ownership and trading rules.

Our role

Central banks, or groups of central banks acting in concert, will soon be making significant choices that will define how CBDCs work and how their economies function in the global economy.

At Quartz, our responsibility as a solution provider is to understand the wide range of possibilities for the design, deployment, and implementation of CBDCs. Through this ongoing effort, we stand ready to help our customers in central banking, financial services, payments, and other industries to understand the changes underway and to adapt with strategic transformation.

Although bank notes and coins may look very different from one country to the next, cash is essentially the same concept wherever you go – a tradeable piece of paper or metal that signifies value.

Takeaways

from the ISSA Workshop and Conference

The biennial ISSA Symposium is one of the most important and prestigious global events within the securities services industry.

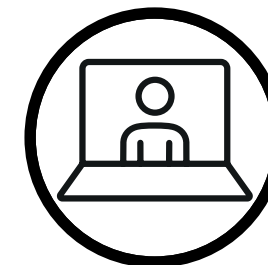
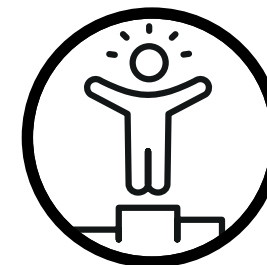
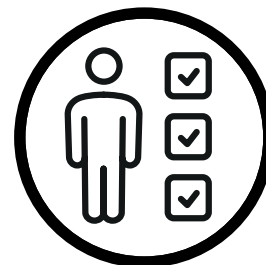
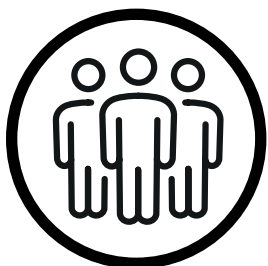
ISSA, a Zurich-based non-profit association of securities services providers, has more than 110 member institutions, such as custodian banks, clearing organizations, central depositories, stock exchanges, brokers and asset managers in about 50 countries.

TCS is a member of ISSA's working groups on corporate actions and distributed ledger technology.

At the May 2022 ISSA Symposium, held in Madrid, Spain, **R. Vivekanand**, Global Head, BFSI Products and Platforms, Tata Consultancy Services and **Giles Elliott**, Head of Business Development, Capital Markets, TCS Financial Solutions were involved in a wide range of high-level discussions on CBDCs, tokenization, retail investors, cloud, and industry standards, as summarized on the following pages.

R. Vivekanand

Giles Elliott



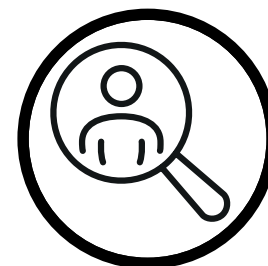
CBDCs enable efficient settlement in digital assets

The global introduction of CBDCs will be a net positive for incumbent providers responding to new entrants.

Since digital exchanges can trade digital securities and tokens in a millisecond, clearing and settlement will need a reliable source of digital cash. So far, digital exchanges have relied mainly on stablecoins created by the marketplace. Soon, we expect that CBDCs backed by central banks will have a central role in the clearing and settlement of digital assets. We're already seeing widespread interest in CBDCs with initiatives in over 80 countries including the world's leading economies.

Incumbent providers with strong regulatory compliance cultures will be well positioned to take advantage of the growth of CBDCs. Securities services providers should strive to understand the different varieties of CBDCs and stablecoins, build expanded settlement capabilities, and appropriately position themselves in the marketplace.

In response, incumbent providers in securities services would be smart to match the capabilities of the new entrants by building competitive offerings for issuing, trading, and settling cryptocurrencies and tokenized securities.



Tokenization builds community around ownership

The eye-opening concept of shareholder tokens is just one example of how NFTs and tokenization will go far beyond the first-generation concept of fractionalized ownership of artwork, real estate, or securities. Tokenization offers massive opportunities to rethink ownership by issuing new asset classes, restructuring existing asset classes, and embedding rewards and the benefits throughout the value chain.

The key idea is to consider not just the characteristics of the underlying asset, but also the nature of the community surrounding the asset. Whenever you're interested in owning an asset, whether it's a prestige property, a rare comic book, or company shares, you're implicitly part of a community. The technology now offers a way to enhance the ties within that community.

Market infrastructure providers will have the opportunity to build community offerings that incentivize ownership, trading, and increased participation, and companies that anticipate the trend will benefit by figuring out how to cultivate communities for their brands.

Retail investors demand new capabilities

Retail investors are not only contributing to higher transaction volumes, but they are also leading the way toward decentralized finance and tokenized assets. We're seeing new trading behaviors particularly in younger demographic brackets, including fractionalized ownership of shares purchased through smartphone apps, increased trading activity from gamification, and a massive thirst for cryptocurrencies and NFTs.

To support the new breed of retail investor, the securities services industry will require expanded capabilities and higher levels of connectivity across a broader array of assets. This will not be easy, as it represents a major shift away from the capabilities built to support institutional investors.



Cloud supports ecosystem growth

The unlimited scalability and widespread access to cloud computing has successfully delivered stronger operational resilience throughout the securities industry.

We believe the next frontier for cloud growth is represented by the creation of ecosystems involving multiple organizations. We see large opportunities for cloud-based collaboration in areas that will deliver the highest level of benefits only with widespread participation.

Stable markets require industry standards

At TCS, we know how to implement industry standards. We also understand the importance of timing.

For well-developed, mature areas in financial services, standardization delivers easier connectivity, greater efficiency, and higher levels of automation. For example, we actively support the adoption and use of ISO 20022, which enables financial institutions to lower costs, automate interactions, and deliver better end-to-end experiences to customers.

Yet market innovation often calls for solutions that exceed the scope or reach of the existing standards. Over the last several years, the DLT marketplace has seen spectacular growth in new and innovative business models having varying degrees of success. These efforts were achieved without the benefits – or design constraints – of standardization.

We are now at a stage in the market cycle where standardization would be a positive and stabilizing influence. For DLT to reach the next level of adoption and acceptance calls for standardization in technology, legal, and compliance frameworks.

Market participants across industries will benefit from having access to the innovative qualities of DLT technology, made available within the context of stable, sustainable, and resilient markets.



d-ID

Credentials for banking, medical, travel, and commerce converge on shared blockchain



By Malini Raman,
Product Head,
Quartz Blockchain Solutions

“We all carry credentials that give us access to travel, public spaces, health records, and customer services.

In the digital age, we have come a long way from paper-based documents.”

Today, the next transition is upon us: A decentralized identity ecosystem.

The **traditional identity model** requires customers to submit physical documentation upon opening an account or when requesting access to services. This is costly for organizations and cumbersome for customers, while also posing risks from the potential misuse of the documents being submitted to commit frauds or forgeries.

The **federated identity model** places responsibility for authentication on a single, centralized entity. The authentication burden is reduced for organizations, but at the cost of having to adapt to a one-size-fits-all approach managed by a single, centralized entity, which concentrates the risks of theft, fraud, and unauthorized sharing of customer data and frequently results in systemic information security failure.

The new approach of a **decentralized identity model** uses a self-service identity ecosystem to simplify the overall experience for organizations and customers while enabling greater flexibility and higher levels of information security and personal

data protection. The concept of decentralized identity puts control into the hands of the ID owner, thus providing autonomy in choosing how personal data is shared.

The **decentralized identity**, or **d-ID**, ecosystem establishes a shared, cross-industry **d-ID blockchain layer** to support three entity types:

Owners, who can be individuals as well as business entities, maintain their own digital wallets containing the private keys for any number of credentials stored on the d-ID blockchain.

Owners may approve how much data is shared, for what purposes, and for how long. To illustrate, if you need to prove you are 21 years old to enter an establishment, you shouldn't have to share your home address and birthdate, let alone give away your data indefinitely. The core principle of d-ID is that sharing personal data should be auditable, revocable, and on a need-to-know basis.



Issuers include passport authorities or licensing agencies, banks responsible for performing KYC and due diligence checks, vaccination facilities, universities and educational institutions, transit agencies, or any public or private entity issuing credentials.

Issuers maintain only the credentials under their area of responsibility, with personally identifiable information and other private data about customers stored on the d-ID blockchain. By relying on the d-ID ecosystem rather than their own internal systems, issuers can simplify their security architecture and reduce the risk of data loss or breach, while still being able to use customer data exactly as authorized.

Verifiers are checkpoints that require credentials for physical or digital access, such as airports examining travel documents, facilities requiring proof of vaccination for entry, or banks performing automated KYC checks during account opening.

Without the need to examine or validate the full documentation, verifiers confirm credentials through the single source of an authoritative, shared record on the d-ID blockchain. By doing so, the verifier trusts both that the credential was issued properly, and that the holder of the digital wallet is the rightful owner of the credential. This approach makes verification far faster and easier, enabling higher throughput and greater assurance at verification checkpoints while maintaining privacy for the credential owner.

Use-case examples

Medical records. Patient information must be shared with doctors, hospitals, pharmacies, and insurers, and yet this is highly private data subject to high levels of oversight and security management costs. Using d-ID blockchain, these records can be shared precisely according to the patient's wishes, enabling entities to access the information they need, when they need it, through a simple and secure shared system of record.

Health pass. Individuals can maintain their vaccination status on a shared blockchain containing credentials issued by government agencies, hospitals, and vaccine centers. Verifiers, whether at airports, malls, stadiums, or other facilities, would be able to grant entry with a single, trusted QR code, without front-line staff having to spend prolonged periods in close contact with the public.

KYC checks. Opening a new account at a financial institutions involves a significant compliance cost given the need for examiners to verify and research documents pertaining to tax status and the source of funds. A shared credential would enable financial institutions to trust the KYC process of other entities better equipped to conduct compliance checks, which would lower the overall compliance burden for the entire industry while driving improved results through task specialization. It would

also vastly improve the experience for end customers by enabling them to open accounts with more than one bank without the lengthy process of submitting KYC-related documents each time.

Legal identify identifiers. Firms doing international business often need to provide their LEI to organizations throughout the supply chain, including vendors, suppliers, shippers, logistics companies and financial services firms. Having LEI records on a shared blockchain will reduce the friction involved with commerce and lower compliance costs throughout the supply chain.

Mobile payments. Individuals can request or send money without having to share their bank account details. Payments could be made to a mobile number as a proxy which would help derive the linked bank account(s).

Student loans. Universities can provide trusted credentials that enable students to apply for student loans with minimal paperwork requirements, driving down borrowing costs by expanding the pool of potential lenders. In addition, an ecosystem connecting universities, banks, corporates, and students could maintain continuous updates on students' repayment status and employment status, bringing in transparency and reducing the risk of loan defaults.



How to begin

Migration to a d-ID blockchain ecosystem requires widespread buy-in, and the build-out of blockchain will happen differently for different use cases. For example, in financial services, a KYC utility provider may take on the role of launching a blockchain-based ecosystem based on their knowledge of the documentation required to provide banking services in a particular region. Other examples may be led by government agencies, industry consortia, or other collective efforts.

In each case, intermediaries will need to lay down the “rules of the game,” establishing discipline and governance in the operating rules to ensure that all credential owners, issuers, and verifiers can trust that the blockchain is being maintained according to the principles for which it was designed, and that automated data replication is functioning as expected. ■



How to Secure Enterprise Blockchain

Namitha Jeremiah
Head,
Product Development and
Technology, Quartz
Tata Consultancy Services

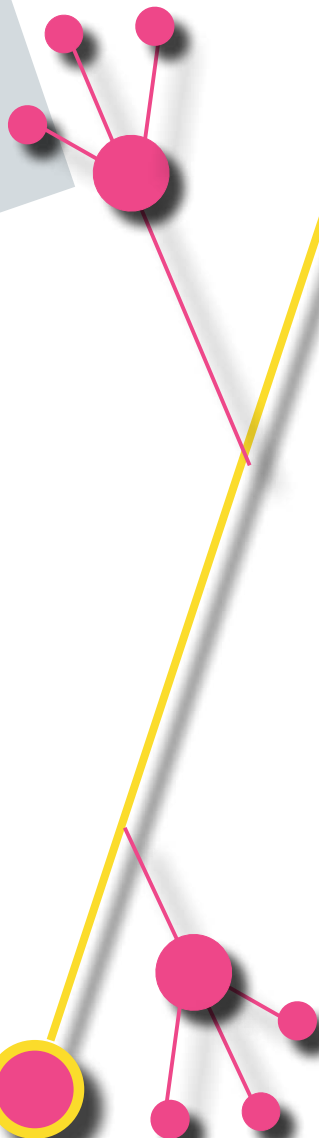


Annie Thomas
Solution Architect, Quartz
Tata Consultancy Services



Blockchain is fast emerging as a prominent and revolutionary technology for creating irreversible and tamper-resistant transactions that prevents double-spending of digital currencies.

With the cryptographic algorithms and hashing functions of blockchain technology, decentralized ecosystems managed by distributed peers have the potential to enable the creation of a trusted, stable, and transparent system, allowing business processes across industry segments to be efficiently managed. All participating peers of a blockchain ecosystem jointly manage the risks previously managed by a central intermediary in the traditional business model. The blockchain ecosystem offers many business and technical benefits to the participating entities – immutability, no single point of failure, high availability, disintermediation, and potentially lower fees for various stakeholders serviced in the value chain.



Although Blockchain is secure by design, digital assets can still be stolen, and wallets have become the prime targets for hackers. The strength of autonomously running transactions coded in smart contracts comes with the risk of potential exploit of unmitigated weakness against the numerous blockchain attack vectors. Any enterprise-grade solution deployment should only be approved after detailed threat analysis, assessment, and deployment of built-in defenses as part of the security architecture. This paper describes the attack vectors at various layers including at the Network, Node, Smart contract, Consensus, and Data layers.

Value
risks

Avoiding the Exploit Avalanche

Smart contracts, once deployed, are visible to anyone joining the peer-to-peer network, and security must be managed by the logic codified in the contract. However, no smart contract can ever be tested against the entire universe of possible test scenarios, which means that an actor with a malicious intent could exploit any known weakness in the publicly available source code. An attack, for example, might execute multiple transactions that siphon funds to the attacker's address. Public blockchains are subject to repeated attacks, with hacktivists and script kiddies keen to show-off their technical prowess without leaving a personal identity trail.



evolution of blockchain security standards

Over the last few years, blockchain security frameworks have significantly improved in maturity, mainly due to blockchain security professionals curating cyber threat intelligence. Such efforts have facilitated deeper understanding of smart contract weakness, vulnerabilities, secure coding guidelines, encryption features and security audit tools. This understanding has provided the backbone for business to shift their processing logic to a smart contract-based, enforceable trust model via tamper-proof, autonomous code execution. Service providers have a huge responsibility to guarantee data protection, risk mitigation, configuration of multi-signature policies and business governance of decentralized marketplaces which are data-centric, event-driven, distributed, borderless, and completely autonomous.

However, public blockchain is also more prone to adversarial threats due to open access to participating peers.

As an alternative to public blockchain, Permissioned Distributed Ledgers are membership-based and private to the participating peers in B2B scenarios. This meets the needs of enterprise businesses to have a common world state enforced through smart contracts, wherein the participating peers on a permissioned platform share a distributed ledger with private, protected views of their transactions in an enterprise application, while still preserving the transparency, auditability, provenance, and trust of a public blockchain in the consumer space.

Based on this enterprise need, a fresh hybrid model is evolving which incorporates the benefits of both public and private permissioned blockchains. A hybrid scenario for a B2B2C ecosystem would implement user identity, privacy sensitivity, and transaction confidentiality for participating enterprise peers through a private permissioned Blockchain, while simultaneously guaranteeing transaction transparency and pseudonymous identity for consumer peers on a public blockchain and the permissioned ledger operations triggering transactions on the public blockchain.

B2B

With the rising number of blockchain applications, industries have acknowledged the pivotal role standards will play in the growth and adoption of blockchain technologies. The knowledge resource updates include new security standards for building enterprise-grade blockchain applications, digital assets, and cryptocurrency management.

The International Standards Organisation - ISO/TC 307 Blockchain and distributed ledger technologies has a series technical reports which cover key aspects on smart contract security good practice and security management of digital asset custodians. Whilst this space is fast evolving, numerous tried-and-tested, structured processes like threat modelling, vulnerability assessment, and a well compiled weakness registry for early identification of the flaws will help build preventive controls against weakness exploitation.

Several alliances have emerged to bridge security gaps by consolidating learnings across the industry about how to release rigorously tested and audited smart contracts.

These alliances include:

- **Smart Contract Security Alliance:** Industry group with a core mission of standardization of security evaluations of smart contracts and adoption of blockchain applications. Smart contract vulnerabilities are categorized according to a potential severity or business impact.

- **Enterprise Ethereum Alliance (EEA)**
EthTrust Security Levels Working Group:

Aims to set standards for secure, smart contract transactions that are conducted within the Ethereum ecosystem. Under the envisioned standard, an EthTrust security rating would be required before new tokens are listed or before multi-member ecosystem can publish a smart contract.

- **Cloud Security Alliance:** Crowdsourced security expertise with curation of over 200 common, known blockchain attacks, vulnerabilities, and weakness in a public repository.

Threat Modelling, Attack Vectors & Mitigations

Any computing ecosystem needs a rigorous threat model evaluation. Figure 1 shows the list of common Blockchain attack vectors. Other sets of standards are being established for blockchain applications. Just like credit card transactions are governed by PCI compliance, the information security requirements for blockchain applications are increasingly being benchmarked against two major standards – one for Cryptocurrencies (CCSS) and other one for Enterprise grade (EBSS) applications.

assets

- **Cryptocurrency Security Standard, or CCSS,** was introduced in 2014 as a set of requirements for all information systems that make use of cryptocurrencies, including exchanges, web applications, and cryptocurrency storage solutions. These are designed to complement existing information security standards (i.e. ISO 27001:2013) with respect to cryptocurrencies.

- **Enterprise Blockchain Security Standard (EBSS)** is a specification for a minimum standard of security for enterprise applications that make use of, or interact with, a distributed ledger system which may include both public and permissioned Blockchain. Security efforts have also been focused on evidence-based threat intelligence. Enterprise partnerships with security alliances and joint working groups can help identify and mitigate root causes to address weaknesses and alleviate risk swiftly.





Threat intelligence sources include:

- **MITRE ATT&CK,**

a globally accessible knowledge base of adversary tactics and techniques based on real-world observations

- **Smart Contract Weakness Classification Registry**

(SWCRegistry), designed to provide smart contract developers with a common language for describing security issues in smart contract systems' architecture, design, or code along with remediation steps in the smart contract secure development lifecycle.

- **OSINT** (open source intelligence) from published or publicly available sources

By working with intelligence sources, standards bodies, and industry alliances throughout the ecosystem, enterprises can protect themselves in any blockchain deployment scenario, whether public, private, or hybrid.

Use cases for bridging the private permissioned blockchain and the public blockchain.

Consider the immense difficulties faced by a health-and-wellness conscious consumer trying to verify the provenance of "Verified Organic" branded products at a supermarket. Such consumers typically seek to read reviews from verified purchasers to make an informed decision about these products. The buyer might scan the QR codes on the product or search for online reviews, but there are challenges in finding authentic reviews among the celebrity endorsements and paid promotions through Instagram

influencer networks. While the largest sites such as Amazon have attracted a critical mass of reviewers, the broader, fragmented marketplace has been slower to provide verified, authentic reviews from people who have indeed purchased that brand.

In response, smaller marketplace participants could incentivize marketplace consumers to provide real reviews by offering real rewards for doing so. In return for product reviews, the consumer would receive reward points, redeemable for product discounts and seasonal promotions. This approach could be realized through a blockchain ecosystem consisting of a private blockchain managed by enterprise custodians for industry participants connected to a public blockchain for verified-purchaser reviews. The result would improve competitiveness and transparency in the market.



trust

For each stakeholder, the ability to contribute and share verified data throughout the value chain enables new levels of service and product differentiation. Farm owners can guarantee origin provenance, brand owners can ensure authenticity, and suppliers can track inventory, leading to a marketplace that consumers can trust.



Data Opacity & Transparency:

A Single Window with Double Panes

Enterprises are working towards offering safe and secure connectivity between private, permissioned blockchains and public blockchains within ecosystems that preserve transactional data, ownership, and access restrictions intact. Architecting a secure and privacy-conscious, end-to-end blockchain solution covering a wide spectrum of enterprise and consumer

stakeholders will be critical for adoption in B2B, B2C or hybrid B2B2C scenarios. Through “co-opetition,” business models that connect public and permissioned ledgers via trusted interfaces will propel blockchain adoption into the mainstream decentralized marketplace.

To stay ahead of digital transformation, many enterprise use cases will not only need a trusted

off-chain/on-chain interface between their legacy apps in the enterprise IT landscape, but also an integrated solution to bridge the different worlds of public and permissioned blockchains. While there are many enterprise use cases running on private, permissioned distributed ledgers, and others suited for public blockchain running on the open internet, it is of significant interest

to consider use cases requiring an integrated application view with a single login and seamless navigation between a permissioned and public distributed ledgers via trusted interface across disparate distributed ledger architectures.

To make that “double-paned window” approach possible, enterprises will need to conduct a systematic threat analysis with scrutiny of the risks, and to evaluate and apply robust security controls to mitigate those risks and threats using solid software engineering practices. Cyber resiliency of enterprises relies upon proactive monitoring and establishment of controls over hardware,

software, firmware, infrastructure, and networks, along with policies coupled with comprehensive administration and governance mechanisms.

With the promise of removing central intermediaries in the transaction blockchain and decentralized technology delivers trust within an internet of value. Adopting industry standard Security and Cyber-resiliency practices will be essential to building confidence and driving mainstream blockchain adoption across enterprises.

smart



TATA CONSULTANCY SERVICES' QUARTZ JOINS THE ENTERPRISE ETHEREUM ALLIANCE

A row of pink, 3D cubes of varying sizes, arranged in a slightly overlapping line.

TCS has joined the **Enterprise Ethereum Alliance (EEA)**, a member-led industry organization dedicated to driving the use of Enterprise Ethereum and Mainnet Ethereum blockchain technology as an open-standard to empower all enterprises.

As a member of the EEA, TCS will collaborate with industry leaders in pursuit of **Ethereum-based technology best practices and open source architectures**. It will assist in accelerating the pace of adoption of Ethereum leveraging the community's work around creating open standards, solving industry business challenges and in shaping the roadmap.

TCS' **Quartz™ suite of solutions** are architected for co-existence, integration, and interoperability, enabling customers to assimilate blockchain technology into their businesses seamlessly. Quartz can facilitate the creation of a complete decentralized ecosystem and caters to organizations across Industry segments including financial services, banking, supply chain, energy & utilities and egovernance.⁵⁰

A series of black, horizontal bars of varying lengths, arranged in a row.A large, stylized pink quotation mark.

At TCS, we are excited by the promise that Ethereum holds in creating decentralized ecosystems that can democratize the way assets and data are exchanged, and in driving the evolution of Web3.0. TCS offers a unique value proposition by bringing together its Quartz blockchain solutions, and services, through a consulting-led, integrated framework. This empowers customers with a 360-degree view of their blockchain adoption journey. Ever since we launched Quartz, we have been focusing on looking at ways to help enterprises speed up their blockchain adoption in a purpose-driven and meaningful manner. The EEA's focus on open standards, interoperability and roadmap planning resonate well with the Quartz design philosophy and strategy,”

said R Vivekanand, Global Head, Quartz,
Tata Consultancy Services.

“We look forward to being part of the innovation journey at EEA, and contributing our knowledge, capabilities and experiences towards promoting enterprise adoption using Quartz and Ethereum,”
he added.

About the EEA

A large, stylized pink bracket.

The EEA's membership base represents companies from every region of the world. The EEA's Interest Groups, Working Groups and events bring together the top Ethereum and global business leaders, technologists, and industry experts to learn about the latest business reference implementations, real-world use cases, and technical innovations.

BEST NEW POST-TRADE SOLUTION OF THE YEAR



Quartz for Markets was named the Best New Post-Trade Solution at the 2022 FTF News Technology Innovation Awards.



TCS was recognized for launching an exceptional offering, Quartz for Markets, a collection of business components that support the entire post-trade lifecycle of digital assets.

Quartz for Markets was chosen by one of the largest depositories in Asia for managing the end-to-end bond issuance lifecycle on blockchain technology. This decentralized ecosystem re-imagines the way bond issuance is performed, enabling seamless information exchange on a real-time basis among stakeholders.

Instituted by the Financial Technologies Forum, the FTF News Technology Awards recognize the professionals, financial technology vendors, service providers, industry bodies and regulators that have made significant strides in operational excellence and noteworthy achievements during the year. Winners for this year's 11th competition, in its 11th year, were determined by votes cast online by readers of FTF News and industry participants.

We are happy to announce that TCS' solution, Quartz for Markets, has won the Best New Post-Trade Solution for 2022," said **Maureen Lowe, Founder and President, FTF and FTF News**. "This distinction focuses attention on the benefits that the solution brings to middle or back-office systems and in helping the buy side meet crucial operational efficiency demands."

"We are delighted that the Quartz for Markets solution has won the FTF News Technology Awards this year," said **R Vivekanand, Global Head, Quartz, Tata Consultancy Services**.

"**Quartz for Markets** has been enabling market infrastructure organizations, custodians and issuers introduce new services around tokenized assets and builds on TCS' position as the largest independent software provider to MIs, with its proven **TCS BaNCS for Market Infrastructure and Custody** solutions powering the operations of over 50 market-critical institutions across 66 countries," added Vivekanand.

"We believe that digital assets will prove to be a significant growth driver in the years to come, and that enterprises that transform quickly will benefit from increased customer acquisition, improved liquidity, and expanded balance sheets."

Quartz™ Ranked #1

Best Performing Fraud Management Solution



- **Tata Consultancy Services' Quartz Won the Industry Special Leader Award in Fraud Management in the IBS Intelligence Sales League Tables 2022**
- **The Solution Helps Financial Institutions Strengthen Fraud Detection and Response Mechanisms**

Quartz™ was named an Industry Special Leader and ranked as the number one Fraud Management solution in the IBS Intelligence Sales League Tables (SLT) for 2022.

The IBS SLT is the result of an annual benchmarking exercise that ranks global banking technology

suppliers across 22 system categories based on the number of new customer contracts signed in a given calendar year. It has been running for over 21 years and has become a barometer for financial technology supplier sales performance across the banking and financial services industry.

Quartz's fraud management solution covers a comprehensive range of regulatory requirements in financial crime. The solution is continuously enhanced to keep up with evolving market needs in the anti-money laundering space and comes with well-defined APIs that allow for quick and easy integration with external sources and third-party systems. Compliant with global and regional regulations such as FATF, PSD2 and FIU, the solution comes with configurable business rules to determining fraud patterns across banking, spanning debit and credit cards, ATM, SWIFT and local transfers, and direct channels like internet banking, mobile, IVR and instant payments.

The Quartz solution has been designed on the principles of co-existence, interoperability, and integration, making it easy for both institutions and regulators to monitor and manage financial compliance using cutting-edge technology, such as robotic process automation, machine learning and advanced analytics. Sophisticated machine learning models enable behavioral analysis, network analytics, transaction fraud and anomaly detection to identify outliers and score risks. Quartz provides a holistic client risk profile to ensure a consistent experience for clients across channels and dynamic clustering to detect hidden customer segments.

R Vivekanand, Global Head, BFSI Products & Platforms, TCS, said, "We are delighted to see this independent recognition of the market success we have had with Quartz's fraud management solution. Our solution uses watch-list screening, blockchain enabled KYC and advanced machine learning for real-time detection of fraud to help clients gain a competitive edge in fraud and risk reduction."

Robin Amlot, Managing Editor, IBS Intelligence, commented, "We congratulate Tata Consultancy Services on the leadership ranking in the Fraud Management Special Category. With firms expecting continuous compliance with all fraud regulations, blockchain, machine learning and network intelligence and analytics are critical to a fraud management system."

SMART SOLUTIONS

Banking

Crypto Services
Interbank Ledgers
Digital Guarantees
KYC & Compliance

Energy & Utilities

Tokenization for Energy Assets
Renewable Energy Certificates

Travel, Tourism & Hospitality

Rewards
Wallets

Insurance

Insurance Repository
Reinsurance Contract Management

Payments

Crypto Services
Remittances
Proxy Resolution

Retail

Rewards
Wallets

Government

KYC
Transaction Register
Digital Asset Register

Supply Chain

Contract Performance Monitoring
Contract Authoring

Life Sciences

Transaction Register
Digital Certificates
Contract Performance Monitoring

Capital Markets

Settlements
Announcements
Tokenization
Surveillance



Events

WFC
2022

The World Forum of Central Securities Depositories held WFC 2022 from May 30 through June 1, 2022. The virtual event brought together industry leaders to discuss emerging technology and industry trends. TCS was a Silver sponsor.

The Banking Scene

Tata Consultancy Services was sponsor and exhibitor at The Banking Scene (TBS) 2022, Brussels, one of the largest conferences in Belgium.

The Banking Scene is an active community of bankers in Benelux and aims to transform the sector through innovative thinking and technology.

At the event, leading thinkers from the financial services community explored the latest evolutions in banking, payments and DLT.

Hiten Khambhadia, Head of Technology BFSI Europe, TCS, shared insights on the topic:

**Digital ID Interoperability:
Reimagining the Future of Banking.**



Money 20/20

"Fintech's biggest conversation" took place in June 2022 in Amsterdam.

TCS had a large presence at the event, sparking discussions on how to create differentiated services using an open collaboration approach.



ISSA Symposium

The 20th Symposium of the International Securities Services Association (ISSA) was held in Madrid in May 2022, and R Vivekanand hosted a breakout session and group discussion on **Digital Assets, Crypto Currencies & CBDC Impacts on Securities Services.**





QUARTZ

Building on belief

Sibos is back in person in 2022.
Promising to be insightful and enjoyable.

Quartz has been helping enterprises deploy blockchain technology in a purpose-driven, meaningful manner. Living our brand's promise of co-existence, integration and interoperability.

Quartz will be at SIBOS 2022, Amsterdam at D04 and we look forward to meeting you there.

