THE CLIPPER GROUP
Navigator™
Navigating Information Technology Horizons℠
Published Since 1993 Report #TCG2016008 August 12, 2016

IBM's Blockchain Initiatives — More Secure with Mainframe Systems

Analyst: Stephen D. Bartlett

Management Summary

The information technology industry, a huge universe of innovation, is remarkable for its tempo. *Remember the "web-year"?* Patents are flowing like water over the Niagara Falls and revolutions are being claimed on a regular basis; the level of hype is hard to ignore. *Are you ready for another revolution?* This one may be real – there are claims that it will have a greater impact on humankind than the Internet. It is hard to accept this premise, but time will tell. Caution is in the air because its origins have been shrouded in controversy and have been associated with a number of non-traditional and even some nefarious endeavors.

I am referring here to the crypto-currency model embodied in *Bitcoin*, the mechanism designed for the exchange of digital currency that uses value tokens in lieu of actual money and is independent of any of the world's real currencies. Putting aside the controversies that continue to surround Bitcoin and its rivals such as *Ethereum*, what is most interesting and compelling about these undertakings are the underlying process models, models that have far broader implications and impact than simply the exchange of a substitute for currency. The technology model is known as *Blockchain* and when the likes of NASDAQ, Pfizer, Visa, Citibank, Fidelity, and others of that ilk gather to discuss its implications, it is a not-too-subtle suggestion that the world should take note, particularly those who own and operate the underlying infrastructures needed to support such a model. The claim is that Blockchain technology has the potential to replace or, at the very least, augment existing business process models far beyond the financial realm in which it was born.

What is Blockchain and why is it important? Blockchain is a peer-to-peer distributed ledger technology that enables a new generation of transactional applications that embody trust, accountability, transparency, and security that virtually guarantee end-to-end data integrity, all without requiring a central point of control – because no one entity owns the data repository and, in fact, there is no single repository. Any entity of value can be traded and tracked with the potential to vastly reduce the cost and complexity of the underlying business processes. Currently, most value exchange models involve a third party, a trusted financial intermediary, to warrant the veracity and track the exchange. This takes time (hours to days for complete reconciliation), adds cost to the transaction (the intermediary is not a charity), and the resolution of errors and other problems is cumbersome and very time consuming (days to weeks, or more), thereby adding more expense. These issues are eliminated or substantially mitigated by the Blockchain model.

The focus of this paper is to describe IBM's interests and its several significant investments

IN THIS ISSUE

to foster the Blockchain technology and how these efforts will benefit enterprise clients. These will accrue to not only data center managers and technology developers but, more importantly, also to general managers, business process owners, and system architects. It is not just another piece of software or a set of services to sell. It just might be as fundamental as the invention of the wheel, as it is likely to change the way many things are done.

This paper also will describe how the use of Blockchain technologies will affect those enterprises that operate and are dependent on mainframe systems as their core IT infrastructure. Our premise is that Blockchain distributed ledger technologies can benefit greatly through integration within the realm of IBM's mainframe systems. Please read on to learn how this latest revolution might affect you and your enterprise.

The "Promise" of Blockchain

The contribution of "record keeping" to the rise and development of civilization as embodied in all its institutions is underappreciated, even might properly be considered an afterthought. The keeping of records, whether they document commercial transactions, the principles under which we live, or the beauty of mankind's most creative efforts have been essential to the world's progress. Stone Age cave dwellers recorded the triumphs of the hunt; for bragging rights, they also may have been recording the score: *Fred 3, Barney 1*; thus it's Fred's turn to be chief of the tribe.[1] A dilemma ensues when Barney claims his score was 4, because it is "carved-in-stone" in his cave.

Skipping ahead 50,000 years or so, if Ms. J. Doe goes to the grocery store to buy a dozen eggs, then goes to the clerk, and hands her $1.75 in cash, there is not much chance of confusion in this transaction as long as both parties can count currency accurately (no sure bet). For both parties, the consumer and the grocery store, their ledgers are immediately reconciled. However, if Ms. Doe choses to use a credit or debit card, then three or four other barely visible parties are included in this heretofore simple transaction: the store's card servicer, a couple of banks, and a bank intermediary. Ninety-nine point nine nine percent of the time, all ledgers are reconciled with no apparent errors, although it may take two or three business days to do so. *But at what cost in terms of time, handling (manual and automated), fund's "float", error remediation, and risk of fraud?*

What if a transaction involves a large block of high-value stock, maybe a single seller and multiple buyers or maybe multiple sellers combined for a single buyer, perhaps several intermediaries; there is no paper trail, only a series of digital records – strings of bits – recorded on digital media on who knows how many information systems (and don't forget the backups)? This "deal" may take only fractions of a second to complete but the reconciliation across all parties may take considerably longer, and much longer if an error is introduced into the process. Moreover, when high-value exchanges are involved, the risk of fraud rises exponentially because of the large magnitude of the target. Likewise, the more diverse and disjointed the network, the more difficult it is to monitor assets ownership and transfer. Consequently, the costs of risk remediation are greatly increased, sometimes so high that additional efforts or a change of approach and further investments are required.

The Legacy of Bitcoin

As introduced above, Blockchain technology was invented[2] to address the unique needs of recording the exchange of a digital currency that has a floating value and has no physical representation – there are "bits" but no "coins" in *Bitcoins*. Bitcoin is both a digital token and the proper name of the network on which these tokens are traded and stored. One key attribute is that all parties participating in a particular Blockchain network share the same digital record. Simply speaking, they all have an identical copy of the record, which is a chain of blocks of transactions (think about these as a linked group of related transactions). Clearly, this eventually will become a very large record. Since it has no central authority or repository, it can never be altered. Every block of transactions is duplicated in each party's copy, thereby making the record "unhackable", as it would require the invading party to locate every copy of the record in order to alter it[3]. If that wasn't enough, every transaction is encrypted end-to-end with keys unique to each party.

Another attribute of Bitcoin's implementation is that the network's participants could chose to be anonymous in order to protect their privacy, which many perceive as a good thing. The downside is

[1] With apologies to Hanna-Barbera Productions.

[2] Its invention has been attributed to Satoshi Nakamoto, likely a pseudonym; other names have appeared in the media.

[3] The United States National Security Agency (NSA) and others have so far failed to penetrate a Blockchain.

Exhibit 1 — Blockchain Benefits

Source: IBM

that anonymity enables and protects criminal activity, e.g., money laundering, illicit drug trading, tax evasion, and dominance by major players. These types of activities have tarnished the reputation of the Bitcoin network and often have led to wild speculations in Bitcoin values.

However, this history has not discouraged those who recognized the true value and potential of the underlying Blockchain process model to significantly enhance the speed, simplicity, accuracy, security, auditability, and cost savings of a broad range of transactions well beyond those obvious to financial institutions. One example is, as a result of Blockchain's simplicity and the elimination of layers of intermediaries, the enabling of very-low-value transactions (think "cents" not "dollars"), or even those with no intrinsic value. This "micro" characteristic is extremely attractive for those operating outside traditional financial or governmental institutions. This is the realm of the *Internet of Things (IoT)*. (See Exhibit 1, above.)

A Little Bit about How Blockchain Works

There are four essential elements of a "Blockchain for business" solution. These are the basics of a fair and secure system, a "trusted" system in which transactions are settled in seconds compared to days, and for which there is no central authority that dominates or controls the flow of activity.

(1) A Shared Ledger

This is an append-only distributed (but not necessarily geographically separated) system of record shared between all participants. It is *permissioned* so that participants see only appropriate transactions that appear in their own copy of the replicated system of record.

(2) A Smart Contract

Business rules are implied in the contract, are embedded in the Blockchain logic are executed with each *transaction*, and are verifiable and signed. The contract can have tangible or intangible value, e.g., currency and other financial instruments, such as intellectual property, letters of credit, deeds, leases, options, or a quantity of goods (machinery, clothing, a bushel of corn, guns, or butter).

(3) Privacy

The ledger is shared but participants require *privacy* for their transactions. Their identity is not linked to a transaction even though transactions need to be authenticated by all parties. Fast and the most secure cryptographic facilities are essential to these processes.

(4) Consensus

Consensus is the process by which transactions are verified and committed. When participants are anonymous, commitment is expensive in terms of compute costs. When participants are known and trusted, commitment is possible at a low cost. There are several alternatives available to achieve this. If all the network's servers signal their approval by agreeing through a consensus vote to the legitimacy of a transaction, it is permanently recorded in each member's database and thus consensus has been achieved and

maintained.

Will Blockchain Transform Business and Society?

This is a bold question and could be considered as a future "grand challenge". But that future may be closer than one might expect. Even a superficial understanding of the Blockchain model and its current level of maturity and interest suggests that many entities, public and private, serving today as intermediaries for countless everyday functions are at risk of obsolescence if they do not adapt. *Who cannot appreciate a process that is quick, cheap, direct, transparent, and secure?* Imagine a loving and dutiful son living in the USA wants to send some money to his dear old mom who lives overseas, maybe in a third-world country, to assist her with her monthly bills. He can do this today but at considerable inconvenience and there is likely a significant commission and delay incurred with the intermediary. Soon those providing such services today will have two choices: (1) adopt the Blockchain model, or (2) be replaced by another organization that has done so. Mom surely will appreciate the change, whatever the outcome.

Quick, Cheap, Direct, Transparent and Secure – Potential Blockchain Applications

Previously suggested Blockchain applications in this paper were low-value payments (micropayments) and remittance forwarding, but also all types of financial assets where the integrity of the record ownership and subsequent trading of the asset – stocks, bonds, futures – are absolutely essential. Financial institutions, registrars, and trading markets beware – change is on your doorsteps.

The enablement of micropayments presents an interesting opportunity for the distribution of media. Consider the example of an emerging and talented musician distributes a video on one of the popular services. If you love his stuff, *why not compensate the artist (with a small micropayment) for the pleasure or inspiration you have received?*

Or consider a newsletter that is being published through an annual subscription. Some of its content, however, may not have broad appeal to many of the readers. *Why not make individual articles available with a small, quick, direct payment to the publisher?* This results in broader content distributed to a broader audience, a win-win. If discretion and privacy are paramount, payments can be made anonymously. It could be for something naughty (fill in your preference) or it could be nice, such as an anonymous donation to a charity or an individual.

There are some interesting examples in the area of land ownership. The registration of land ownership has been identified as a major obstacle to economic development, particularly in emerging economies. If legal property ownership cannot be assured and traded expeditiously, economic activity is stifled severely and, perhaps, subject to graft and corruption. This principle also could be easily applied to the ownership (and maintenance history) of motor vehicles, precious gems, branded designer goods, or a set of tickets for the next big game or match. When the "friction" on these transactions is reduced, new markets likely will be created, new organizations likely will emerge, and new wealth likely will be created.

How IBM Mainframes Support the Blockchain Process Model

The assurance of a secure environment and very fast and efficient cryptographic processing are essential elements of the Blockchain model. It can be strongly argued that IBM mainframe security technologies, particularly those embodied in the latest generation of *z Systems*, the *z13*[4], *z13s*[5], and *LinuxONE* family[6], are the "gold standard" for the IT industry with respect to these important requirements.

Two Cases for Blockchain Demonstrate the Mainframe's Security Differentiation

A Blockchain solution running on IBM z Systems or the LinuxONE family encompasses applications deployed on those systems are enabled with an additional level of security, scalability, availability, and high performance through the mainframe's hardware acceleration and features for handling sensitive and regulated data. Key differentiation of the mainframe approach – when compared to other platforms running Blockchain solutions – includes the ability of Blockchain peers to run in protected environments, such

[4] For more detail on the z13, see **The Clipper Group Navigator** entitled *The IBM z Systems and the New IBM z13 - Ready to Transform Your Enterprise*, dated January 26, 2015, and available at http://www.clipper.com/research/TCG2015001.pdf.

[5] See also **The Clipper Group Navigator** entitled *IBM z Systems Opens Up Secure Clouds and Introduces the z13s* dated February 16, 2016, and available at http://www.clipper.com/research/TCG2016003.pdf.

[6] See **The Clipper Group Navigator** entitled *Open for the Digital Business - IBM Announces LinuxOne Systems* dated February 16, 2016, and available at http://www.clipper.com/research/TCG2016002.pdf.

as secure service containers (more about this later) to prevent leaks through shared memory or hardware. Thus, there is complete protection around the cryptographic module that can detect and respond to unauthorized attempts at physical access, as well as the tamper-resistant storage of crypto keys. In addition, a Blockchain – in concert with z Systems – facilitates Blockchain applications that can access clients' existing transactional systems, such as *CICS*, *IMS*, or *DB2*, on z Systems through APIs to support new payment, settlement, supply chain, and business processes. This co-location and adjacency leverages decades of investment in z applications and transactional systems through secure APIs and micro-services.

As stated earlier, privacy is an essential element of a Blockchain enabled for business. IBM z Systems and the LinuxONE family provide exclusive features that deliver the following.

- **Secure key management** – hashing, signing, and authentication.
- **High evaluation assurance level protection between environments** – Blockchain peers run in protected environments isolated from other peers and parties.
- **Highly auditable operating environment** to support forensics and compliance.
- **Crypto optimization**, such as *Elliptical Curve Cryptography (ECC)*, provided by special purpose accelerators.[7]
- **Protection from host administrators** – secure service containers.

Cryptographic operations are provided by the *Central Processor Assist for Cryptographic Function (CPACF)* and are available on general purpose (CP) and IFL core types, as in prior generations. However, in the latest generation its speed has been greatly improved for a number of functions, especially for enterprises increasing their use of *Secure Socket Layer (SSL)* and *Internet Protocol Security (IPSEC)*; these uses will benefit directly. *Java V8* includes native support for CPACF, so Java applications also will benefit directly.

For I/O functions, z Systems and the LinuxONE family optionally include a PCIe-based crypto coprocessor, the *IBM Crypto Express5S (CEX5S)* that complements the CPACF and is tamper-resistant. It implements a number of accelerated secure key functions as a coprocessor.

[7] ECC uses keys that are shorter than RSA keys for equivalent strength-per-key-bit; therefore, the strength-per-key-bit is substantially greater in algorithms that use elliptical curve cryptology and potentially higher performance.

Secure Service Containers

Exclusive to the latest z Systems and the LinuxONE family are the protections provided by *Secure Service Containers (SSC)*. Provided as an optimized appliance (hardware, software, and firmware), this facility provides clients a highly secure logical partition (LPAR) and corresponding framework. This enables new Blockchain solutions to be easily packaged as a full runtime environment, including all necessary components such as the operating system, software, libraries, APIs, etc. Solutions built with this framework are signed and encrypted so that they can only be executed within the protected, tamper-proof LPAR environment. These solutions are configured, updated, and serviced via remote interfaces so that no root access to the underlying operating system is needed or permitted, even to rogue insiders. The cryptographic solutions that have been implemented in z Systems and the LinuxONE family have received the highest standardized security certification (*FIPS 140-2 Level 4* and *EAL 5+*)[8].

In addition, the latest z Systems and LinuxONE system family brings high performance (up to 5.0 GHz processors), highly granular scalability (up to 141 configurable cores and 10 TB of main memory), up to 85 LPARs, high-scale I/O operations capabilities, and world-class reliability and resiliency. In addition, *HiperSockets* provide secure memory-to-memory communication across LPARs without the need for any I/O adapters (and thus no external I/O traffic), and have virtual LAN (VLAN) capabilities. The *Single Instruction Multiple Data (SIMD)* instruction set is standard for all core types on the z13, z13s, and LinuxONE systems. These provide string, vector integer, and vector floating-point operations on thirty-two (32) 128-bit registers. SIMD will provide significantly improved performance for vector computations and complex mathematical modeling, such as that embodied in the Blockchain process model. Exploitation is through math and linear algebra libraries[9], and compiler enhancements for Java and C/C++.

On the software side, *z/VM* and z*KVM* hypervisors, and support for *Linux* distributions from *SUSE*, *Red Hat*, and *Canonical Ubuntu* bring a

[8] Federal Information Processing Standard (FIPS) 140-2 Security Requirements for Cryptographic Modules. See https://web.archive.org/web/20070825103724/http://csrc.nist.gov/cryptval/140-2.htm. This certification is currently exclusive to IBM's mainframes.

[9] *MASS – Mathematical Acceleration Subsystem*; *ATLAS – Automatically Tuned Linear Algebra Software.*

plethora of virtualization solutions into the equation. All of these capabilities are important when considering the implementation of large, robust Blockchain applications.

Choose Public, Private, or Hybrid Clouds

There is nothing inherent in the Blockchain process model that would preclude your favorite flavor of cloud implementation. But first let's dismiss the notion that IBM's mainframes are precluded from consideration for cloud implementations. We at The Clipper Group have argued the case that the IBM's mainframe has been – from its earliest days – at the center of cloud technology[10]. The mainframe's superior virtualization technologies and native Linux implementation since Generation 5 back in 1999 are at the heart of it. There are numerous examples of mainframes at the core or participating in public, private, and hybrid clouds. It was not until more recently that the cloud implementation model was explicitly named and defined; unfortunately, it now has fallen into the "market-ware" abyss.

An example of a Blockchain hybrid-cloud implementation arises out of the question: *Will the Blockchain technology replace the tried and true mainframe transaction and database systems –, CICS, IMS, and DB2?* This is highly unlikely as these well-established systems are focused on driving efficiency *within* an organization. Blockchain, in contrast, is focused on driving efficiency between organizations by allowing all members a view of a transaction that their membership "key" allows them to access. The most likely evolution will be a hybrid cloud model in which Blockchain will securely feed into or out of the enterprise's CICS, IMS, or DB2 databases. An example of a strictly private cloud implementation within an organization could be an internal audit, human resources, or any other application in which protecting proprietary information is paramount.

The potential uses of Blockchain exists across a wide range of industries, including medical records, land titles, manufacturing supply chain, trade goods finance, auto and property insurance, international payments, and the list will grow very quickly, a testimony to the qualities of service of this model. Think "quick, cheap, direct, transparent, and secure". With all these potential applications, it is easy to conceive that many will include an IBM z System or LinuxONE system within their implementation, most likely as a private or hybrid cloud.

IBM's Contribution to the Development of Blockchain Solutions

It's essential for Blockchain technology to be developed following the open source model so a critical mass of organizations will coalesce around it and reap its full benefits. Because of the open source generally accepted rules, participants can trust that the technology will fulfill their needs and conform to industry standards thus assuring interoperability among Blockchain applications. Also, by sharing the foundational layer, the participants can focus their individual efforts on industry-specific applications, platforms, and hardware systems to support transactions.

In keeping with those principles, in December 2105 IBM announced its commitment of a substantial amount of resources to the *Linux Foundation's Open Hyperledger Project*. For starters, IBM has contributed approximately 44,000 lines of code to the project that had been developed through the collaboration of more than 35 global IBM Research Division and other IBM business unit's software developers dedicated to the Linux Foundation project along with more than 100 technical architects focused on making Blockchain ready for business. Other Open Hyperledger participants include many familiar organizations: Intel, SWIFT, J.P. Morgan, Cisco, London Stock Exchange Group, and VMware, for example.

Getting Started with Blockchain - IBM Cloud is Open for Business

A new framework for securely operating Blockchain network and associated services now are available on the *IBM Cloud*. Designed to meet existing regulatory and security requirements, these cloud services have the highest Federal Information Processing Standards (FIPS 140-2, level 4) and Evaluation Assurance Levels (EAL 5+) in the industry to support the use of Blockchain in government, financial services and healthcare. Optimized for cloud-based Blockchain networks, the framework provides an auditable operating environment with comprehensive log data that supports forensics and compliance. Tamper-resistant storage of crypto keys and complete protection around the cryptographic

[10] See **The Clipper Group Navigator** entitled *IBM zEnterprise is Enterprise Cloud Infrastructure* dated April 8, 2014, and available at http://www.clipper.com/research/TCG2014008.pdf and also see **The Clipper Group Navigator** dated April 23, 2009, entitled *System z as a Cloud for Business Services - Available Today to Meet the Needs of Tomorrow*, available at http://www.clipper.com/research/TCG2009022.pdf.

module detects and responds to unauthorized attempts at physical access. Additionally, the IBM Cloud's service enables Blockchain peers to run in protected environments to prevent leaks through shared memory or hardware. The IBM Cloud is built to help businesses quickly host secure, tamper-resistant networks and scale to thousands of users. It allows production Blockchain networks to be deployed in minutes, running signed, certified, and tested *Docker Hub* images with dashboards and analytics as well as support.

In addition, to help enterprise application developers quickly build applications, IBM is making its code based on the Linux Foundation Hyperledger Project available for *any* computing environment, and is offering services through *IBM Bluemix*.[11] Developers and organizations can now run Blockchain on different cloud servers or devices, using a signed, certified distribution of IBM's code submission to the Hyperledger project, available on Docker Hub. Ongoing updates will provide new features including dashboards, analytics, chat support, and exclusive network services.

Developers who want to get a Blockchain environment running almost instantly and start building applications now can use the *IBM Blockchain* on Bluemix, which provides access to the very latest Linux Hyperledger code, updated as the code continues to emerge. Whether on Docker Hub or IBM Cloud, IBM Blockchain supports multiple industries and diverse use cases. Developers can create digital assets and accompanying business logic using fully integrated DevOps tools for creation, deployment, running, and monitoring Blockchain applications on *IBM Cloud* as well as the IBM z System and the LinuxONE family. For example, using its *Watson IoT Platform*, IBM will make it possible for information from devices such as RFID-based locations, barcode-scan event, or devices-recorded data to be used with IBM-hosted Blockchain applications.

Blockchain Service on the Industry's Most Secure Server

On July 14, IBM announced the beta availability of the *IBM Blockchain High Security Business Network*, which enables clients to quickly and easily access a secure, partitioned Blockchain network on the cloud to deploy, test, and run first projects. This is a cloud platform built on an IBM LinuxONE system. Developers can now test *four-node networks* – for transactions and validations with up to four parties. The network provides the next level of isolation and security for developers ready to go beyond the multi-tenant *Starter Developer plan* currently available on IBM Bluemix for testing and simulating transactions between two parties. LinuxONE is the industry's most secure Linux-only server, leveraging IBM z Systems mainframe Common Criteria Evaluation Assurance Level 5+ (EAL5+) security rating.

In association with this announcement, *Everledger*[12] is building a digital business network using IBM Blockchain, underpinned by IBM LinuxONE, to power its global certification system to track valuable items through the supply chain, thus helping to protect suppliers, buyers, and shippers against theft, counterfeiting, and other forms of corruption. The Blockchain is used to demonstrate the origin of high-value goods such as diamonds, fine art, and luxury goods.

Other Current Blockchain Development Efforts

There are several other Blockchain development efforts underway in association with IBM.

- *BNY Mellon* is utilizing IBM Bluemix to build a number of client use cases and is collaborating with IBM to accelerate the design and development of a unique application for securities lending using a Blockchain network to trade and transfer assets.
- The Mizuho Financial Group and IBM have kicked off a project using the open source code that IBM contributed to the Hyperledger Project to test the potential of Blockchain for use in settlements with virtual currency.
- On the other side of the globe, Credit Mutuel Arkea, and IBM have initiated a Blockchain project that focuses on improving the bank's ability to verify customer identity. The goal is to improve both customers and advisor experiences when dealing with the multiple services provided by the bank.

To facilitate these projects, IBM is initiating a secure, standardized, and scalable environment for banking using a concept that is known as an *IBM Garage*. The goal is to accelerate time-to-market using continuous integration and continuous delivery. It combines industry best practices for design thinking, lean startup, agile development, DevOps, and cloud to build and deliver innovative solutions. In addition to New York, IBM is opening them in London, Tokyo, San

[11] IBM's *Open Cloud Architecture* based on *Cloud Foundry*, an open source *Platform as a Service (PaaS)*.

[12] For more on Everledger's Blockchain efforts see http://www.everledger.io/.

Francisco, Toronto, Nice, and Singapore. Others are likely to follow.

IBM is Happy to Eat its Own Food

IBM is demonstrating its singular corporate commitment to Blockchain by initiating the *IBM Global Finance Project*. The *IBM Global Finance Division* provides a channel financing operation that spans a worldwide network of more than 4,000 suppliers and partners. In 2014, IBM financed $44B in more than 2.9 million transactions. The IBM Blockchain solution under development combines data provided by the participants in the network, thus creating a consolidated and detailed view of transactions that is visible to all parties. The result is a significant reduction in number of disputes, dispute cycle time, and improvement in productive use of working capital. Key features of IBM Blockchain solutions, such as immutability, non-repudiability, and privacy guarantees, provide a safe, trusted, and decentralized ledger for sharing information, while retaining role-based control of its visibility to other participants in the network.

Conclusion

The hype about the potential for Blockchain seems to be approaching an over-revved state. This is a signal to those who have witnessed any number of predicted revolutions in the IT industry to exhibit extreme caution. Nonetheless, it should not stifle a thorough investigation, as the presently observable inertia – as judged by the commitment of many industry leaders – should not be ignored. In addition, there are those haven't yet bought into it but are trying to learn more plus those that view this as an opportunity to reduce costs in their existing solutions; the latter are focused on today. Lastly, there are the risk takers who see this as a technology that can fundamentally reinvent their business or create new ones. If this latter group is successful, they will reap huge rewards.

The initial forays may begin within public clouds. IBM recognizes this and is positioning its many and diverse resources to assist its clients to quickly build proof-of-concept pilot projects and to begin rollouts and experience rapid payback of their clients' investments. Expect to see this across a number of industries and many ramp-ups through this year and next.

Who will be the key players for Blockchain adoption?

- **Regulators** – the organizations that create and enforce the rules of play, for a start. Their concern is systemic risk exposed by new technology, distributed data, and security.
- **Industry groups** that encourage best practices and provide technical advice.
- **Market makers** likely will be the most visible, as they are the ones who innovate early and swiftly to create new business processes that enable new goods and services and, as a consequence, new value and new wealth.

So, what about your organization? Keep your eye on Blockchain developments, particularly the Linux Foundation's Hyperledger Project; many use cases across several industries should become visible soon. Gather your key developers, architects, business process owners, and even some of your key partners to brainstorm how this technology can create leverage for your enterprise. The Bronze and Silver Medals will go to those who can use Blockchain to cut costs or lower service costs, but Gold Medals will be awarded to those leaders who can use this technology to create fundamentally new opportunities for their enterprises.

Be aware that the developments from the Hyperledger Project are server-platform agnostic. So for those who value the security and flexibility of their mainframes and the advantages of being able to directly connect to their DB2 or IMS databases or CICS transaction systems, maybe it's time to fire up a new LPAR (or IFL) to host a gaggle of virtualized Linux servers to begin your own efforts. Any of the last few IBM mainframe generations could accommodate this work, but obviously the latest generation z Systems, the z13s and the z13 and related LinuxONE products will have the most advanced technology, for instance in the cryptographic area, the new secure service container, and the highest performance. Or consider the very low risk and low-cost option of leasing a LinuxONE *Rockhopper*[13] for a year.

Clearly, another IT revolution is beginning. *Will you be ready to take advantage of it?*

[13] For more about the LinuxONE Rockhopper and the leasing option, see **The Clipper Group Navigator** entitled *Open for the Digital Business - IBM Announces LinuxOne Systems* dated February 16, 2016, and available at http://www.clipper.com/research/TCG2016002.pdf.

About The Clipper Group, Inc.

The Clipper Group, Inc., now in its twenty-fourth year, is an independent publishing and consulting firm specializing in acquisition decisions and strategic advice regarding complex, enterprise-class information technologies. Our team of industry professionals averages more than 25 years of real-world experience. A team of staff consultants augments our capabilities, with significant experience across a broad spectrum of applications and environments.

- ***The Clipper Group can be reached at 781-235-0085 and found on the web at www.clipper.com.***

About the Author

***Stephen D. (Steve) Bartlett* is a Senior Contributing Analyst for The Clipper Group.** Mr. Bartlett's interests include enterprise solutions including servers, system software, middleware, their underlying technologies, and their optimal deployment for responsiveness to emerging business requirements. In 2010, he joined the Clipper team after over 42 years with the IBM Corporation as an account and program manager in large system sales, product development, strategy, marketing, market research, and finance. During that time, he received several awards for his contributions in innovative market research and contributions to the business. He has a B.S. from Rensselaer Polytechnic Institute, and an M.S. from Union College.

- ***Reach Steve Bartlett via e-mail at steve.bartlett@clipper.com or at 845-452-4111.***

Regarding Trademarks and Service Marks

The Clipper Group Navigator, The Clipper Group Explorer, The Clipper Group Observer, The Clipper Group Captain's Log, The Clipper Group Voyager, Clipper Notes, The Clipper Group Calculator, and *"clipper.com"* are trademarks of The Clipper Group, Inc., and the clipper ship drawings, *"Navigating Information Technology Horizons"*, and *"teraproductivity"* are service marks of The Clipper Group, Inc. The Clipper Group, Inc., reserves all rights regarding its trademarks and service marks. All other trademarks, etc., belong to their respective owners.

Disclosures

Officers and/or employees of The Clipper Group may own as individuals, directly or indirectly, shares in one or more companies discussed in this bulletin. Company policy prohibits any officer or employee from holding more than one percent of the outstanding shares of any company covered by The Clipper Group. The Clipper Group, Inc., has no such equity holdings.

After publication of a bulletin on *clipper.com*, The Clipper Group offers all vendors and users the opportunity to license its publications for a fee, since linking to Clipper's web pages, posting of Clipper documents on other's websites, and printing of hard-copy reprints is not allowed without payment of related fee(s). Less than half of our publications are licensed in this way. In addition, analysts regularly receive briefings from many vendors. Occasionally, Clipper analysts' travel and/or lodging expenses and/or conference fees have been subsidized by a vendor, in order to participate in briefings. The Clipper Group does not charge any professional fees to participate in these information-gathering events. In addition, some vendors sometime provide binders, USB drives containing presentations, and other conference-related paraphernalia to Clipper's analysts.

Regarding the Information in this Issue

The Clipper Group believes the information included in this report to be accurate. Data has been received from a variety of sources, which we believe to be reliable, including manufacturers, distributors, or users of the products discussed herein. The Clipper Group, Inc., cannot be held responsible for any consequential damages resulting from the application of information or opinions contained in this report.