Comparative Study on RFID based Tracking and Blockchain based Tracking of Material Transactions

Bhuvana R.[1], Madhushree L. M.[1] & P. S. Aithal[2]

[1]Research Scholar, College of Management & Commerce, Srinivas University, Mangalore, India

E-mail: bhuvanareddy08@gmail.com

[2]Professor, College of Management & Commerce, Srinivas University, Mangalore – India

E-Mail: psaithal@gmail.com

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Bhuvana R.[1], Madhushree L. M.[1] & P. S. Aithal[2]

[1]Research Scholar, College of Management & Commerce, Srinivas University, Mangalore, India

E-mail: bhuvanareddy08@gmail.com

[2]Professor, College of Management & Commerce, Srinivas University, Mangalore – India

E-Mail: psaithal@gmail.com

ABSTRACT

Radio Frequency Identification & Detection (RFID) technology is used frequently in material and device identification and tracking in business firms and retail shops. In RFID technology tags are used to transmit data in the form of radio waves. The device transmits information from a reader to an RFID computer program. The RFID tags are often used for goods as well as for the follow-up of pets, Alzheimer's disease patients & vehicles. RFID tag is called an RFID chip as well. This technology supports the tracking of tangible components and materials. Similarly, one of the ICCT underlying technologies called blockchain technology is recently developed and it consists of a growing list of cryptography associated records in the form of chain that has the property of transparency, decentralization, and immune to modifications. Blockchain technology is used for record creation across many computers or digital devices of a process or an activity which cannot be altered retroactively, without altering its subsequent processes or activities. Blockchain technology allows a system to own digital goods, assets, and data and capable to trace the history of everything which is created as a footprint in the past transactions. In this paper, we have analyzed and compared how RFID and Blockchain technologies can be complementary to each other and add new features in material-based tracking in society. The data were gathered from various websites & scholarly journals. Initially, RFID, ICCT & BCT are analyzed in terms of their material tracking properties, then a comparison is made between RFID & BCT in material tracking to give an insight into different complementary technologies in transactions and material tracking.

Keywords: RFID, ICCT underlying technologies, Blockchain technology (BCT), Tracking of transactions, Complementary technologies.

1. INTRODUCTION :

It has been argued recently that the generation, communication, processing, storage and retrieval of information are the parts of a single framework called information Communication and Computation Technology (ICCT) and is known as an integrated variant of Information Communication Technology (ICT) and Computer Technology (CT) [1]. RFID technology is commonly used by companies and retailers to interpret and record information on radio waves stored on a tag attached to an item and to include a unique id for an item. RFID offers various advantages such as the acquisition of real-time data, better decision-making, reliability and error reduction. An active tag is an RFID device with a battery, which can interact with a reader several meters away. A passive RFID tag is used, with a material tracking device capable of identifying thousands of objects in manufacturing and storage areas and locating them in real-time. The remote Sensing Antennas are positioned at each remote location to be tracked, interrogators are connected to Sensing Antennas to the multiplex Signals Antenna Signal, and a host device interacts with interrogators to identify item positions for a challenging measurement. Sensing Antennas are also accessible at various sites [2]. Technologies have played a prominent role in the tracking of products and material transactions for decades. ICCT is a platform for general use with other technologies [23]. Under its umbrella, one such technology is blockchain, which has immense benefits for companies in the tracking of materials. Conversely to this technology, there is RFID technology, which mainly works with tags

attached to transponder-containing materials that emit Messages open by specialized Radio frequency identification readers tracking the product origins through diverse supply chains requires a straightforward, flexible metadata system which can be trusted not just by all of the stakeholders, but adapted to changes in environments and laws [3]. A combination of lower rates and expanded efficiency helped companies to consider carefully what Radio frequency identification would do for them. One big move forward was the retail giant Walmart's announcement that their hundred leading suppliers were to provide RFID-permitted deliveries [4]. The revealed modalities involve computer-controlled procedures and tools creating protected ledger systems that allow monitored asset based on monitoring events. With one case, the system affiliated with the central authority of a protected blockchain ledger that can predict the probability of an event occurring and will use the confidential master cryptographic key to access or decode a set of rules in the blockchain secure ledger [5]. Centralized activities include a number of technology-appropriate challenges such as Value-added network, Electronic information exchange, Assimilation of Big Data [6-8]. Aspects such as low performance, poor synchronization, and low teamwork reduces corporate members' productivity& business intelligence. Development of a distributed network allows peer-to-peer documentation of shared ledger transactions, not just for the transaction but also for transparency and open cooperation. Aspects such as low performance, poor synchronization and low teamwork reduces corporate contributors' productivity. Not just for the transaction but also for transparency and open cooperation [9]. At present there still remains a need for openness across proceedings and trust connections between players while business processes function within a centralized structure for overseeing internal operations in individual locations [10]. For example, the inadequate wait for confirmation of information was long which reduced by real-time monitoring in supply chains. When using a distributed network, better efficiency can be achieved. Also, the divergence between supply chain systems increases overall effectiveness in managing hand-offs, including the transfer of ownership or changes in the status among two parties [11]. A powerful mechanism for collection, storages and data sharing with all supply chain partners is a combination of IoT and blockchain – securely and in real time [12].

2. RELATED RESEARCH WORK :

For several years now, the technologies of radio frequency identification were available. New technology progresses, and requirements demonstrate the cost and security interplay [13]. Transparency & reliability of BCT are intended to make the information & material flow across the distribution chain more efficient; with automated management requirements. Such shifts may lead to an expanding shift from a commodity, product economy to customised economy & information. The output relies more on know-how, information & communication and doesn't rely on material characteristics. For example, consumers may track accurate product details to increase confidence in the products [14].

Table 1: Related publications on RFID and Blockchain based material tracking by different researchers

Technology	Contribution	References
RFID (Radio Frequency Identification & Detection)	RFID reader lets customers to get the basic product details when shopping.	Tian, F. (2016) [15]
	A portable RFID reader (or reader / writer), uses a full search history of application file. A subsystem for role determination enabling reading (or reading / writing) location determination. A satellite GPS (Global Positioning System) localisation technology can be used for the position subsystem, in which structures unimpeded these signals.	Chand, S., et al. (2008) [16]
	Wireless communication technology is a radio frequency identification that enables computers to read the identity of cheap electronic tags from far without a battery being needed for the tags.	Nath, B., et al. (2006) [17]
	RFID systems consist of three elements in two combinations: a receiver and antenna are usually paired with an RFID reader. The transceiver / receiver. A transponder and antenna are combined for the	Kaur, M., et al. (2011) [18]

	development of the RFID tag.	
Blockchain Technology	Blockchain can be viewed as a distributed database or ledger: a chronological blockchain and each block stores all network operation information as the block is added to the chain	Bogart, S., et al. (2015) [19]
	Unlike other current decentralized blockchain structures in which all transactions are explicitly revealed on the block chain, "hawk" does not specifically store financial transactions on the block chain, thereby maintaining transactional privacy from the perspective of the public.	Bruce, J. D. (2013) [20]
	Blockchain will improve supply chain productivity and accountability and have a positive effect on all logistic processes, from storage to distribution and payment. Aside from enhanced transparency and protection obtained by blockchain, the physical movement of products can be accelerated.	Lindman, J., et al. (2017) [21]

3. OBJECTIVES OF THE STUDY :

The study is focused on RFID technology, ICCT and blockchain technology and its importance in material tracking.

1. To study the RFID, ICCT& Blockchain technology.
2. To know the properties of Blockchain & RFID technology.
3. To analyse Blockchain based tracking & RFID based tracking.
4. To determine complementary technologies for RFID & Blockchain technology.
5. To find out what are the possible challenges faced by IBM implementing.

4. ABOUT RFID, AND BLOCKCHAIN TECHNOLOGY :

Internet of Things (IoT) & ICCT are universal technologies under which multiple technologies are used for multiple technological inventions like RFID technology under IoT & Blockchain come under ICCT [22,23]. Radio Frequency Identification is a great chance in IT that can change the world in a broad &profound way. After Radio Frequency Identification readers are connected to an Internet terminal in accordance with appropriate communication protocols, readers around the globe Objects connected to tags can be identified, tracked and monitored globally, instantaneously and also in real time, if required. BCT is quite frequently listed & used in crypto currencies but the scope of usage is considerably broad “Blockchain is a public blockchain where a peer to peer network passes and embraces. It consists of an associated block sequence which holds time-stamped transactions that are checked by the network community through public-clean cryptography. When a blockchain element is attached, it cannot be changed and turned into a record of past activity” [24, 25]. The Radio frequency identification being an automated technology that supports machinery or computer in object identification, capturing power over radio signals. It is composed of tags & reading devices. A tag is a microchip based on antenna that can be connected to an object as an identifier for the object. A Radio frequency identification reader uses radio waves to interact with the radio tag[26]. Blockchain is a distributed ledger book that includes various potentials. This is ideal for just about any transferring of information, financial transactions, shipment monitoring & including contracts. The data are distributed over various computers and any movement is captured by the block [27].

5. PROPERTIES OF BLOCKCHAIN & RFID TECHNOLOGY :

Some of the properties of blockchain technology and radio frequency identification device technology are listed in table 2.

Table 2: Properties of blockchain technology & RFID technology

Technology	Properties

Blockchain [28]	♦ Blockchain technology is that the efficiency of the entire network is enhanced. Since there are many computers working together that deliver great power overall, unlike few centralized devices. ♦ Blockchain has greater security, as there has not been a single risk of the network shutdown. ♦ The Blockchain is a permanent transaction record. If a block has been inserted it can't be changed. That creates trust in the record of the transaction. ♦ Decentralized – A blockchain is recorded and stored that any node on the network can view and copy to. This accounts for decentralization. ♦ Consensus – The Consensus model, which incorporates block validation rules and uses a scarce resource (e.g. computational power) to show sufficient effort, independently validates each block. This is known as the mining method in Bitcoin. The system does not work with a central authority or a certain trustee. ♦ Transparent — As BCT is a free ledger, it is accessible and audited by every party. This provides a way of following the lifetimes of assets.
RFID [29, 18]	♦ Special product recognition, the capacity for simultaneously read numerous tags& non-line readability. ♦ RFID advantages for including the collection and sharing of data in real time between organisations. ♦ The RFID tag can contain a maximum of several kilobytes of information. All the required data for each process (process history, inspection history, etc.) can be stored easily, without the need for direct communication. This allows for the growth of paperless locations, where production stop triggers are reduced. ♦ Unhuman tag identification decreases the cost of work & Removes human data collection errors. ♦ No sightline is necessary. Because the positioning of the tags is less restricted. ♦ One can combine the RFID tags with sensors ♦ Automatic multi-place reading eliminates time lags and inaccuracies in inventories

6. COMPARISION BETWEEN RFID BASED TRACKING AND BLOCKCHAIN BASED TRACKING :

The RFID based tracking & Blockchain based tracking are compared in Table 3 as depicted below:

Table 3: Comparison between RFID based tracking & Blockchain based tracking

RFID Based Tracking	Blockchain Based Tracking
1. RFID tags are used for the object for purposes of type & instance identification only, a database is usually kept background in order to supply as well as retrieve extra information. 2. RFID is all about the world of the supply chain, but the system often takes on as an easy payment method. Among the most prevalent use of RFID today it is used to continued payment of toll roads without stopping. 3. RFID tags were used for product tracking purposes for object type or instant identification, and data is normally	1. Combined with sensors and the Internet of Things (IoT) tools, the business blockchain platform provides a cost-effective framework for accountability in the supply chain. 2. Using BCT the gap in the supply chain process is minimized with access to a reliable digital ledger established using IOT sensors based on blockchain. 3. BCT is decentralized, distributed ledger used to record transactions that occur within a network, secured using cryptographic technology.

maintained throughout the background to get or gather extra information. 4. Inventory monitoring is growing RFID use. Companies may attach, RFID tags for goods which are frequently stolen or lost underused or difficult to locate when needed. 5. RFID has been used in production facilities for over a decade. It is used to monitor components and work phases and faulty production. 6. In closed loop supply chains and for automating supply chain components controlled by a company, RFID technology has been utilized for years. 7. At the forefront of RFID adoption are retailers such as Wal-Mart, Best Buy, Target, Metro & Tesco. Several dealers focus mainly on improving the quality of the supply chain and on ensuring that the product is on the shelf if consumers want to buy it.	4. Blockchain-based supply chain technologies will automate the entire cycle, from the manufacturer to the supplier using smart contracts to track inventory. 5. Blockchain has the ability to revolutionize the way companies design, engineer, manufacture and scale their products. 6. Blockchain has the potential to drive efficiencies that save costs and improve customer experience through traceability, accountability, and transparency. 7. The blockchain platform has the ability to revolutionize retail supply chains by handling supply records, automated transactions, and information on the chain of custody. The blockchain powered framework will help to create trust among the stakeholders in the retail supply chain.

7. COMPLEMENTARY TECHNOLOGIES :

By using technology like B2B messaging, computer interfaces, QR code, electronic data interchange, global positioning system, bar codes, near field communication & radio frequency identification tools, several organizations have track-and-trace solutions. These solutions also employ an inventory management system & RFID tags to make sure that goods are traceable.

1. DATA INTERFACES :

An OEDQ User Interface is a specification for a collection of attributes representing a specific entity, that is used to construct processes that read, write to, or read from interfaces instead of directly from or to the user sources or targets.

2. ELECTRONIC DATA INTERCHANGE(EDI) :

To address paper-based processing of transactions & other modes of electronic communication, EDI has been planned. In addressing these issues, EDI is a tool to reengineer business processes as well as information flows. Problems with the paper transaction system from EDI encourage long-term trading partners commitments, enhance data transmission efficiency, and enable businesses to meet their customers' requirements via short order cycles [30].

3.B2B MESSAGING AND REPORTS :

Providers of Messaging Program map business processes compiled into code. The code is implemented on a computer network run by business users for transactions. These transaction processes are developed by the provider of messaging systems and cannot be configured by the user. In order to complete transactions electronically using current messaging systems, there are two types of issues. The first is integration, which is called point-to-point integration, and the second kind of issue is communications between companies at various locations, known as business-to-business (B2B) messages [31].

4. BARCODES :

The barcode is a binary code consisting of a parallel arrangement of gaps & bars with in a sector. The data elements are grouped by a fixed pattern and are referred to as a linked sign. The series, consisting of breaks, wide &narrow, is alphanumerically &numerically interpretable. This is read using optical laser scanner, i.e., by interpreting the beam of laser differently from white gaps& black bars. although the coded form of the approximately 10 barcode forms currently in use is substantially different in its physical nature [32].

5. QR CODE :

QR means a quick response that a mobile phone can read easily. They use to collect a bit of info and bring

it into your computer from transitional media. This is because you can store (and digitally present) a lot more data, which include connections to Geo co-ordinates, URLs and text, than a regular barcode. [33].

6. RADIO-FREQUENCY IDENTIFICATION (RFID) :

RFID is a system designed to simplify the detection of radio waves. It consists of three main components: an RFID tag, (sometimes called a reply machine), an RFID reader, and a data processing device. RFID tags including an antenna and a data chip for the storage of information are normally mounted on targets which need to be marked [34].

7. NEARFIELD COMMUNICATION (NFC) :

Near Field Technology (NFC) operates by using a system of magnetic induction. It runs at 13.56 MHz radio surface frequency. NFC communicates with small chips with built-in radios via RFID tags. Today, wireless data transfers like cable keys, electronic cash, mobile trading, electronic tickets, and web documents are included in the applications [35].

8. GLOBAL POSITIONING SYSTEM (GPS) DEVICES :

It is widely used in studies of vehicle navigation and traffic engineering, such as traffic time. Most mobile phones have navigation capabilities and are thus classified in the same group as the GPS. A navigation system based on satellite is GPS. The satellite circles the earth in very specific orbit twice a day, & relay signals to the earth. GPS recipients gather data & use triangulation to identify the precise consumer position [36].

8. FINDINGS AND SUGGESTIONS :

1.RFID reader will scan all tags within its range in large warehouses, which won't work if we want to scan products from a particular shipment at some location.
2. RFID tags cannot be used on materials such as metal, a special form of RFID block is required to avoid antenna interference.
3. Present test cases & proof of concept in Blockchain technology envisage that BCT will underpin complex & diverse global supply chains.
4. The cost of RFID tags will vary from USD 10 to USD 30. Furthermore, RFID readers are 10 times more costly than barcode scanners, so the prices are very high.
5.For growing users in the supply chain, there is an increase in graded access to data which is constantly difficult and cannot be accommodated.
6. Due to the lack of technological expertise in RFID & Blockchain technology, their incorporation of small suppliers may be a major problem.

9. CONCLUSION :

This paper has shown that when it comes to material monitoring, RFID technology has a potentially wide array of applications. The broad functionality illustrated is hoped to allow implementers to use tags for various applications, thereby increasing the benefits and enhancing investment. That, along with continued technical developments, would cause it to become more accessible to a broader user base. The potential to integrate BCT to different processes of business for boosting supply chains' functioning & efficiency in various sectors is increasing day by day.

REFERENCES :

[1] Aithal, P. S. (2019). Information Communication & Computation Technology (ICCT) as a Strategic Tool for Industry Sectors. *International Journal of Applied Engineering and Management Letters (IJAEML)*, *3*(2), 65-80.

[2] Moore, S. E. (2004). *U.S. Patent No. 6,714,121*. Washington, DC: U.S. Patent and Trademark Office.

[3] Lu, Q., & Xu, X. (2017). Adaptable blockchain-based systems: A case study for product traceability. *IEEE Software*, 34(6), 21-27.

[4] Weinstein, R. (2005). RFID: a technical overview and its application to the enterprise. IT professional, 7(3), 27-33.

[5] Haldenby, P., Mahadevan, R., Lee, J. J. S., Chan, P. M. W., & Del Vecchio, O. (2017). U.S. Patent Application No. 14/936,833.

[6] Schneider, G.P. (2017). Electronic Commerce, 12th ed. Cengage Learning, Boston, MA.

[7] Acharya, A., Singh, S.K., Pereira, V., Singh, P., 2018. Big data, knowledge co-creation and decision making in fashion industry. *International Journal of Information Management*, 42, 90-101.

[8] El-Kassar, A. N., & Singh, S. K. (2019). Green innovation and organizational performance: the influence of big data and the moderating role of management commitment and HR practices. *Technological Forecasting and Social Change*, *144*, 483-498.

[9] Goertzel, B., Goertzel, T. & Goertzel, Z. (2017). The global brain and the emerging economy of abundance: Mutualism, open collaboration, exchange networks and the automated commons. *Technological Forecasting & Social Change*, 114, 65-73.

[10] Vigna, P. & Casey, M. J. (2016). The Age of Cryptocurrency: How Bitcoin and the Blockchain Are Challenging the Global Economic Order. Macmillan Publishers, New York.

[11] Cecere, L. (2017). Moving blockchain forward: Seven use cases for hyperledger in supply chain. Retrieved from: http://www.supplychainquarterly.com/columns/20170426-time-for-change-in-direction-sevenuse-cases-for-hyperledger-in-the-supply-chain/ (Last Accessed: 1 March 2020)

[12] https://www.infosys.com/Oracle/insights/Documents/product-tracking-tracing.pdfretrieved on 10/05/2020.

[13] Karygiannis, T., & Kuhn, R. (2005). Security standards for the RFID market. *IEEE Security & Privacy*, *3*(6), 85-89.

[14] Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain technology and its relationships to sustainable supply chain management. *International Journal of Production Research*, *57*(7), 2117-2135.

[15] Tian, F. (2016). An agri-food supply chain traceability system for China based on RFID & blockchain technology. In *2016 13th international conference on service systems and service management (ICSSSM)* (pp. 1-6).

[16] Chand, S., Bapat, V. R., Hall, K. H., Morse, R. A., Owen, J. P., Pietrzyk, A. P., ... & Tinnell, K. A. (2008). *U.S. Patent No. 7,388,491*. Washington, DC: U.S. Patent and Trademark Office.

[17] Nath, B., Reynolds, F., & Want, R. (2006). RFID technology and applications. *IEEE Pervasive computing*, *5*(1), 22-24.

[18] Kaur, M., Sandhu, M., Mohan, N., & Sandhu, P. S. (2011). RFID technology principles, advantages, limitations & its applications. *International Journal of Computer and Electrical Engineering*, *3*(1), 151-157.

[19] Bogart, S., & Rice, K. (2015). The blockchain report: welcome to the internet of value. *Needham Insights*.

[20] Bruce, J. D. (2013). Purely P2P crypto-currency with finite mini-blockchain. *Bitfreak. Info,(May)*.http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1046.128&rep=rep1&type=pdf. Retrieved on 10/06/2020.

[21] Lindman, J.; Rossi, M.; Tuunainen, V.K. (2017). Opportunities and Risks of Blockchain Technologies in Payment—A research agenda. *In Proceedings of the 50th Hawaii International Conference on System Sciences, HICSS/IEEE Computer Society, Waikoloa, HI, USA*, 4–7, 1533–1542.

[22] Aithal, P. S. (2018). Emerging Trends in ICCT as Universal Technology for Survival, Sustainability, Differentiation, Monopoly and Development. In *Proceedings of National Conference on Advances in Information Technology, Management, Social Sciences and Education,* (2018) (pp. 130-141).

[23] Madhushree, L. M., Revathi Radhakrishnan & Aithal, P. S. (2019). A Review on Impact of Information Communication & Computation Technology (ICCT) on Selected Primary, Secondary, and Tertiary Industrial Sectors. *Saudi Journal of Business and Management Studies*, 4(1), 106-127.

[24] Francisco, K., & Swanson, D. (2018). The supply chain has no clothes: Technology adoption of

blockchain for supply chain transparency. *Logistics*, *2*(2), 1-13.

[25] Seebacher, S.; Schüritz, R. (2017). Blockchain Technology as an Enabler of Service Systems: A Structured Literature Review. *Springer Nature*, 279, 12–23.

[26] Jia, X., Feng, Q., Fan, T., & Lei, Q. (2012). RFID technology and its applications in Internet of Things (IoT). In *2012 2nd international conference on consumer electronics, communications and networks (CECNet)* (pp. 1282-1285). IEEE.

[27] Tijan, E., Aksentijević, S., Ivanić, K., & Jardas, M. (2019). Blockchain technology implementation in logistics. *Sustainability*, *11*, 1185, 1-13.

[28] Sultan, K., Ruhi, U., & Lakhani, R. (2018). Conceptualizing blockchains: characteristics & applications. *arXiv preprint arXiv:1806.03693*.

[29] Kim, S., & Garrison, G. (2010). Understanding users' behaviors regarding supply chain technology: Determinants impacting the adoption and implementation of RFID technology in South Korea. *International Journal of Information Management*, *30*(5), 388-398.

[30] Choudhary, K., Pandey, U., Nayak, M. K., & Mishra, D. K. (2011, July). Electronic data interchange: A review. In *2011 Third International Conference on Computational Intelligence, Communication Systems and Networks* (pp. 323-327).

[31] Fletcher, S., & DelaTorre, J. (2002). *U.S. Patent Application No. 09/991,156*.

[32] Finkenzeller, K. (2010). *RFID handbook: fundamentals and applications in contactless smart cards, radio frequency identification and near-field communication*. John wiley & sons.

[33] https://searchengineland.com/what-is-a-qr-code-and-why-do-you-need-one-27588. Retrieved on 10/05/2020.

[34] Lahtela, A. (2009). A short overview of the RFID technology in healthcare. In *2009 Fourth International Conference on Systems and Networks Communications* (pp. 165-169).

[35] Want, R. (2011). Near field communication. *IEEE Pervasive Computing*, *10*(3), 4-7.

[36]https://www.sciencedirect.com/topics/engineering/global-positioning-system. retrieved on 10/05/2020.

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