The Potential Of Blockchain Technology To Change International Mobile Roaming Business Model

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Abstract. The key objectives of this paper is to propose a design implementation of blockchain based on smart contract which have potential to change international mobile roaming business model by eliminating third-party data clearing house (DCH). The analysis method used comparative analysis between current situation and target architecture of international mobile roaming business that commonly used by TOGAF Architecture Development Method. The purposed design of implementation has validated the business value by using Total Cost of Ownership (TCO) calculation. This paper applies the TOGAF approach in order to address architecture gap to evaluate by the enhancement capability that required from these three fundamental aspect which are Business, Technology and Information. With the blockchain smart contract solution able to eliminate the intermediaries Data Clearing House system, which impacted to the business model of international mobile roaming with no more intermediaries fee for call data record (CDR) processing and open up for online billing and settlement among parties. In conclusion the business value of blockchain implementation in the international mobile roaming has been measured using TCO comparison between current situation and target architecture that impacted cost reduction of operational platform is 19%. With this information and understanding the blockchain technology has significant benefit in the international mobile roaming business.

Keywords: Data Clearing House; International Mobile Roaming; Blockchain, TOGAF

2. Introduction

Nowadays, Mobile Network Operators (MNOs) are facing trends that are rapidly transforming their networks and even their business models. As well as international mobile roaming (IMR) services that MNOs need to reshaping strategy with the pricing and bill shock swiftly to ensure subscribers utilize roaming services in increasing usage of traffic. In the context of mobile telecommunication network, the word of international mobile roaming (IMR) is used when a mobile phone is used outside of the range of its home network and connects to another available cell visited network (GSMA, 2012a). For example: a subscriber used the mobile telecommunications services in one country is able to use his or her mobile device in other countries. As the following describes in Figure 1. When a customer starting call during roaming, the retail price will have consumed for some cost elements: the wholesale charge for using the visited network, costs of interconnection link network, data clearing house platform for CDR processing fees, signalling fees between the networks, home operator's retail costs and taxes. Data clearing house is a intermediary system that acts as central authority to exchanges and processing of call data records (CDRs) and settlement between home operators and visited operator (GSMA, 2012b). The research problem on this paper is that the existing architecture of international mobile roaming has been used intermediary Data clearing house (DCH) as central authority for call data record processing between Mobile Network Operators. In term of business model each of operator will be charged platform fee and data processing fee with an expensive cost component
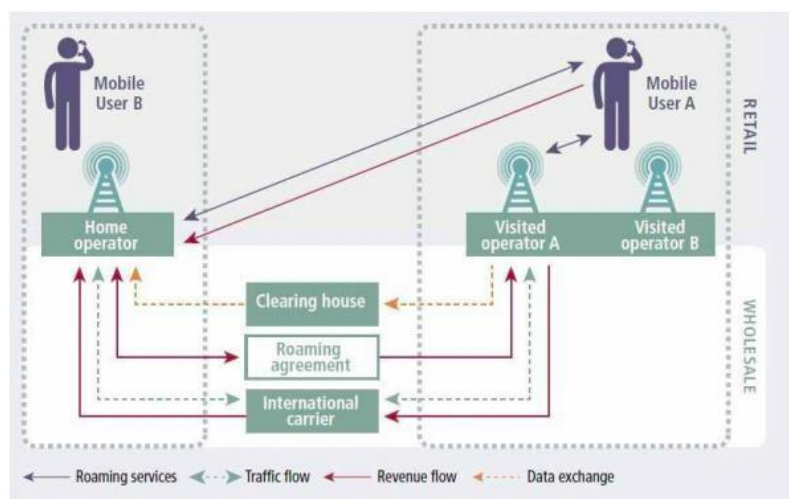
Figure 1.Commercial required for international roaming (GSMA, 2012b)

By developing a smart blockchain contract it has the potential to be implemented to cellular network operators that have roaming agreements. The real-time settlement using blockchain based smart contract as games changer to replace the method of offline billing information exchange between roaming partners used DCH. Automatic triggering of roaming contract based on call/event data which enables online charging and avoid in roaming fraud cases. Applications of blockchain technology have capabilities beyond the cryptocurrency. Blockchain could be eliminates the intermediaries player who have not any impact in the business architecture. Each transaction in the private chain ledger is verified by consensus of a majority of the participants in the system in simply means, blockchain is "a distributed database comprising records of transactions that are shared among participating parties"(Leon Zhao et al., 2017). Blockchain technology substitutes for the trust which under the central authority exchange data transaction. As a database which offers "data security, transparency and integrity, anti-tampering and anti-forgery, high efficiency, low cost"(Zhu and Zhou, 2016). The objectives of this paper is to propose a design implementation of blockchain based on smart contract which have potential to change international mobile roaming business model by eliminates third-party data clearing house.

2. Literature review

2.1 International Mobile Roaming

The review of the literature with international mobile roaming should be start with defining the concept of international mobile roaming. As this definition the possibility of roaming by telecommunications subscribers travelling between two countries requires a roaming 'route', which depends on the existence of commercial arrangements between mobile network operators ('MNOs') . (Kotlowitz and Tania, 2016). The terms and conditions of international roaming agreements are largely generic, with net settlement payments managed through a third-party clearing house between the MNOs. The roaming agreements and the required rating and billing facts are managed through the relevant billing system's roaming observe- up functions. The exchange of roaming events is managed by an outside broker, which is a data clearing house (DCH) .

2.2 Blockchain Based Smart Contracts

The literature of blockchain concerning in the capabilities of blockchain technology to enhanced business value of international mobile roaming services. The Blockchain implements a method to reach an understanding between two entities that exist in the blockchain. Called a "smart contract", is that of blockchain application make it viable to exchange an asset without third parties being aware of the transfer. This opens up the possibility of disintermediating the entire legal system and creating a new form of virtual agreements (Deloitte, 2017). One of the ideas behind smart contracts is to remove the middleman player in value chain of business to function as an intermediary, ensuring that the contract is executed (Alvseike et al., 2017). Moreover, smart contracts are not written in legal languages but are

written as computer programs and these computer programs have the ability to define strict rules (Tuesta et al., 2015). In addition, smart contracts can be programming in order to support a business logic driven by data. The conclusion of this literature is that the application of blockchain technology goes far beyond cryptocurrency. The ability of Blockchain can eliminate the presence of traditional business agreements with intermediaries involved through smart contract solutions.

2.3 TOGAF (The Open Group Architecture Framework)

The Open Group Architecture Framework (TOGAF) is a framework for enterprise architecture, which provides an approach for designing, planning, implementing, and governing an enterprise information technology architecture. According to the previous paper from (Sökmen, 2016) that TOGAF can helps organizations to design and implement a technology management architecture that meets the needs of the business. It is a comprehensive framework for developing a broad range of different IT architectures. This paper applies the TOGAF approach in order to addressing architecture gap to evaluate by the enhancement capability that required from these three fundamental aspect which are Business, Technology, Information. Most importantly, it enables to design, evaluate, and build the right architecture to enterprise. Figure 4 shows the diagram of TOGAF ADM lifecycle

3. Method (Material and Methods)

The analysis method of this paper using comparative analysis with the current situation of international mobile roaming business that commonly used framework from TOGAF Architecture Development Method (ADM) and will be validate using business value analysis by calculation of Total Cost Ownership comparison. This paper applies the TOGAF approach in order to addressing architecture gap to evaluate by the enhancement capability that required from these three fundamental aspect which are Business, Technology, Information. The TOGAF is used as a framework to develop and maintain enterprise architecture which have the requirement management process at the center of Architecture Development Method (ADM) in order to maintain traceability between requirements and the architectural structures (Sökmen, 2016). Based on the architecture gap evolution used TOGAF ADM there will be propose new design architecture of international mobile roaming business by involving of blockchain capability using smart contract solution and then there will be validate the business value. The validation of business value is used Total Cost of Ownership calculation. In general, the IT industry uses Total Cost of Ownership (TCO) to define acquisition cost, usage cost, O&M, of a feature to determine the feasibility of a purchase. (Barreneche, 2015). Figure 5 shows the method of analysis framework for this research.
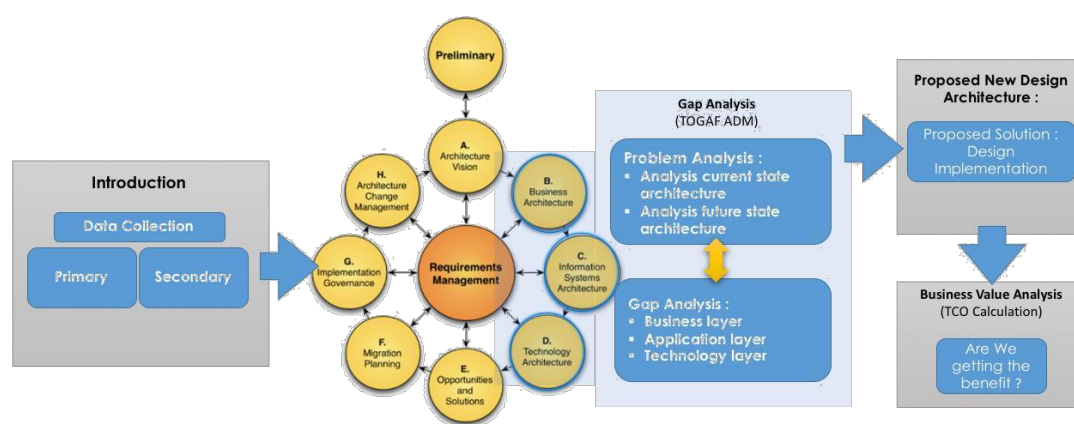

Figure 5. Method of analysis framework using TOGAF (adapted from The Open group, 2011)

The primary data are collecting from 3 main areas which are: (1) existing architecture and component cost for DCH system from company which running on International mobile roaming business, (2) contract roaming agreement from Mobile network operator company, (3) The data of high level architecture and business proposal for smart contract deployment from blockchain solution provider

company. While for the secondary data there are used desk research of previously papers, company white paper concerning blockchain technology and international mobile roaming service.

4. Result and Discussion

4.1 Gap Analysis with TOGAF framework

As describes in the Table 2. The architecture gap analysis based on TOGAF for phase B, C and D which are (B) Develop Business Architecture: Develop baseline and target architectures and analyze the gaps, (C) Develop Information Systems Architectures: Develop baseline and target architectures and analyze the gaps, (D) Develop Technology Architecture: Develop baseline and target architectures and analyze the gaps.

Table 1. Comparison of current and target architecture of International Mobile Roaming Business

Gap Analysis	Current Architecture	Target Architecture
Business Layer	There is high chances of disputes being raised between Operators since the exchange of billing records are offline	Lower operational overheads and cost leading to financial product
Application Layer	The offline billing information exchange between roaming partner through DCH system	Automatic triggering of roaming contract based on event data which enable online charging
	Dispute resolution process is also offline executed by DCH by validating the CDRs and contracts of all partners	Repository of verifiable transactions between operators allowing for quick dispute resolution
Technology Layer	The roaming agreement and the required rating and billing information are managed through the central billing system by using DCH system	Blockchain based smart contract is a software program on the the distributed ledger, allowing an immutable, verifiable and secure record of all contract

4.2 Target Architecture

The current and target solution using blockchain technology to provide as describe in the figure 6.
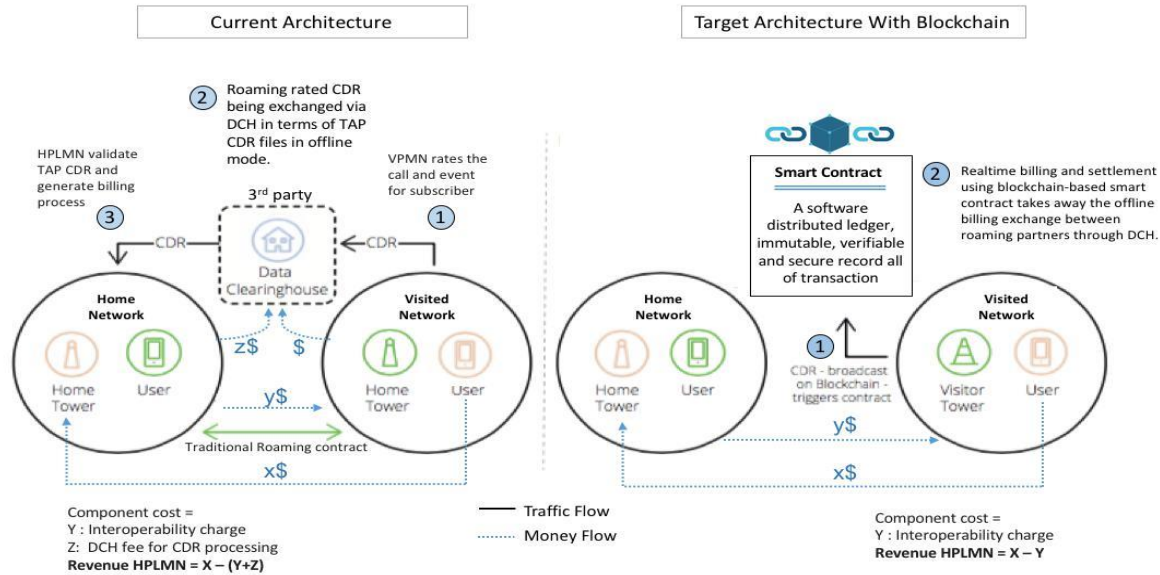

Figure 6. High level architecture IMR with blockchain smart contract

A capability of blockchain can be applied between mobile network operators that have a roaming agreement. The roaming agreement is carried out among the home network and the visited network as a smart contract this is prompted whilst a transaction containing the CDR information is broadcasted on the blockchain network. Every time a subscriber triggers an event in a visiting network, the visited network broadcasts the CDR information as a transaction to the Home network. This information triggers the smart contract and the terms of the agreement are done. The home network can thus automatically calculate the billing amount based on the services rendered and send this information back to the visited network. This helps instantaneous and varied authorization as well as settlement to occur in line with blockchain based smart contract terms. MNOs can also do eliminates with the DCH as intermediary, resulting in reducing operational cost.

4.3 Business Value Analysis

Based on the primary data from internal company that running for international mobile roaming business with existing DCH system have the two main component cost, which are platform fee and CDR processing fee. In this case we get the data from MNO that has 29 roaming partner for platform fee per month is around IDR 151,000,000 and IDR 4,700,000 per month for CDR processing fee. as describes in Table3 The TCO calculation using 5 years business case with the NPV result is IDR 6,817,559,123

Table 2. TCO calculation for existing DCH solution

TCO Current System	Year-1	Year-2	Year-3	Year-4	Year-5
Platform fee	1,812,000,000	1,812,000,000	1,812,000,000	1,812,000,000	1,812,000,000
TAP-CDR Processing fee	56,400,000	62,040,000	74,448,000	96,782,400	125,817,120
TOTAL	1,868,400,000	1,874,040,000	1,886,448,000	1,908,782,400	1,937,817,120
NPV	6,817,559,123				

Comparing the TCO calculation where used blockchain smart contract solution there are have 3 component cost which are initial setup fee, manage service and cloud infrastructure. Based on the primary data from Blockchain solution provider that initial setup fee is IDR 1,800,050 for one-time charge, which are cover whole project activities including resources for project manager, blockchain developer, UI/UX developer and system engineer for project time delivery is 3 months. While for the manage service cost is IDR 270,000,000 yearly based. Could infrastructure is required for this deployment, referring cloud subscription fee from Amazon web services that dimensioning based on requirement for 20 nodes is IDR 630,000,000 yearly based. The TCO calculation using 5 years business case with the NPV result is IDR 4,610,441,689

Table 3. TCO calculation for Blockchain solution

TCO of Blockchain	Year-1	Year-2	Year-3	Year-4	Year-5
Platform fee	1,800,050,000				
Manage Service	270,007,500	270,007,500	270,007,500	270,007,500	270,007,500
Cloud Infra (20 nodes)	360,000,000	360,000,000	360,000,000	360,000,000	360,000,000
TOTAL	1,868,400,000	1,874,040,000	1,886,448,000	1,908,782,400	1,937,817,120
NPV	4,610,441,689				

The comparison of Total cost ownership between existing DCH solution and using blockchain solution in the first year the blockchain solution cost higher than DCH solution, however in the second year until five years cost of blockchain solution lower than existing DCH solution. In summary that used blockchain smart contract solution generate the cost reduction around 19% as describes in figure 7.
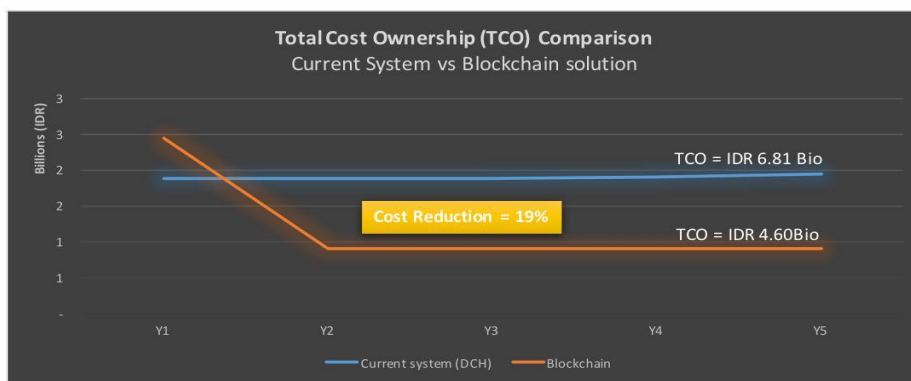

Figure 7. TCO Comparison

4.4 Validation Approach

In order to validate the reference architecture expert interviews have been conducted. The qualitative method is used to validate the propose target architecture and objectives of this research. There are several direct interviews were conducted with five experts from the telecommunication industry background and blockchain solution provider. The main section interview consisted of the background of the current international mobile roaming business, overview of capability blockchain smart contract based, the propose design architecture and business model canvas. In the last session of interview, we ask the interviewees to provide the explanation about alignment of this research objectives. All interviewee agreed with this architecture can be running well the blockchain as solution to roaming business, however some additional architecture integration needs to be improved to make smart contract deployment more suitable solution for data clearing house implementation. Basically blockchain smart contract architecture have the static data base method which the roaming contract agreement should be well converted into smart contract logic in the beginning of logic deployment. Due to blockchain have ability is immutable data, once changes of the contract agreement there are more complicated things to do which required effort to upgrade and migration to the latest version. To accommodate this condition, the deployment smart contract in International Mobile Roaming case is strongly recommended that to separate data base into two type which are static database and dynamic database. Where the static data which containing permanent information in the contract agreement (e.g: money flow) will be store to internal blockchain network protocol. While the dynamic data which containing periodically change information (e.g: rate, charging) there will be store to the dynamic database which excluded in the blockchain network. So that once any change of contract that impacted to code deployment is not disturbing to the central blockchain network. The following below in figure 8 the enhanced target architecture with blockchain.
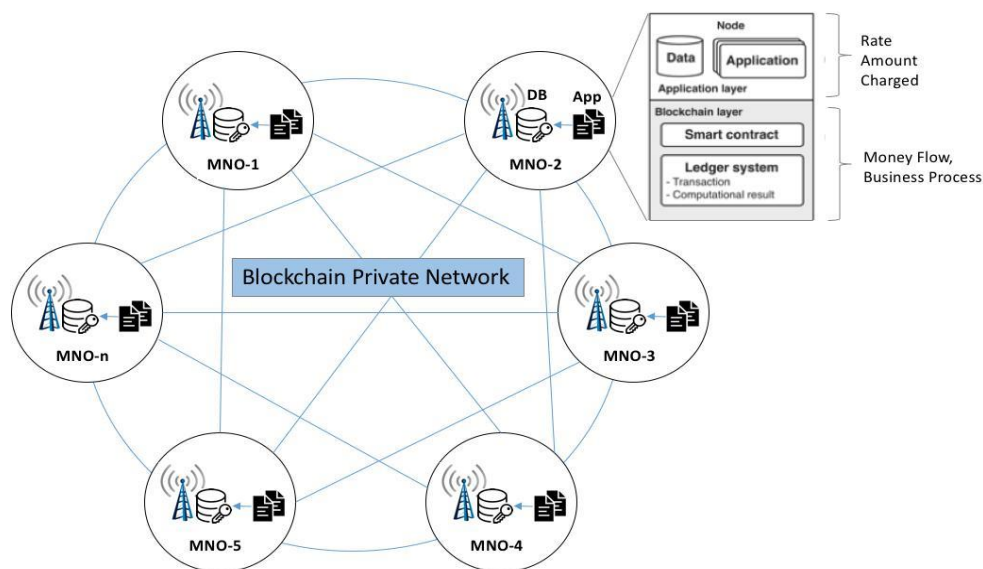

Figure 8. Enhanced Target Architecture with Blockchain

4.5 Conclusions

From the data above we can analyse that architecture blockchain smart contract solution able to eliminate the intermediaries DCH system in the international mobile roaming business. With the

blockchain the business model of international mobile roaming could be change with no more intermediaries fee for CDR processing. The online billing and settlement for Peer to peer connectivity among the mobile network operator become a value proposition to avoid dispute because of the offline CDR processing in the legacy DCH solution. In conclusion The business value of blockchain solution has been measured that cost reduction of 19% can be generated. With this valuable information and understanding the blockchain technology has significant benefit in the international mobile roaming business.

4.6 Recommendations

There challenging for the blockchain deployment in the international mobile roaming that should be consider which is the international mobile roaming services is a standardized by GSMA. Therefore, to make blockchain acceptable by MNOs globally, it should be standardized business process which is facilitated by GSMA as a worldwide community of MNO. The other thing is the paper is limited by the analysis for business value of blockchain technology in the international mobile roaming business, to make more comprehensive analysis the future research is needed on the risk analysis of deployment the blockchain smart contract in international mobile roaming service.

References

Alvseike, R., Arne, G., Iversen, G., 2017. Blockchain and The Future of Money and Finance.

Barreneche, J.G., 2015. Analysis of Total Cost of Ownership (TCO) Applied to Processes of Biomedical Technology Acquisition Competitive Intelligence.

BBVA Research, 2015. Smart contracts : the ultimate automation of trust ? Digital Ec.

Deloitte, 2017. The Blockchain (R)evolution – The Swiss Perspective White Paper.

GSMA, 2012a. International Roaming Explained. https://www.gsma.com/latinamerica/wp-content/uploads/2012/08/GSMA-Mobile-roaming-web-English.pdf 1–2.

GSMA, 2012b. Mobile SMS and Data Roaming Explained Mobile SMS and data roaming explained 2–3.

Kotlowitz, D., Tania, V., 2016. Trans-Pasific Partnership: Will The Mobile Roaming Provisions Benefit Tourists and Traders ? Vol17, 5–6.

Leon Zhao, J., Fan, S., Yan, J., 2017. Overview of business innovations and research opportunities in blockchain and introduction to the special issue. Financ. Innov. 3, 9. https://doi.org/10.1186/s40854-017-0059-8

MarketResearchFuture, 2018. Communications Technology Smart Contracts Market Smart Contracts Market Research Report – Global Forecast to 2023 1, 1–11.

Opengroup.org, 2011. The Business Executive ' s Guide to IT Architecture.

Rautopuro, L., 2009. Mobile Content Revenue Assurance 44.

Sökmen, N., 2016. The TOGAF Based Governance Framework Proposition for Technology Management Systems 15, 379–387. https://doi.org/10.17265/1537-1506/2016.08.002

Zhu, H., Zhou, Z.Z., 2016. Analysis and outlook of applications of blockchain technology to equity crowdfunding in China. https://doi.org/10.1186/s40854-016-0044-7