

ENHANCEMENT TO THE VoLTE PROVISIONING FRAMEWORK TO
ENABLE VoLTE IN 4G SMARTPHONES

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DEDICATION

To God Almighty, for giving me the strengths in embracing life with a positive mind;

To my dearest parents, Mr. Azhar and Mrs. Wan Lathipah, who sacrificed a lot and uplifted me throughout this journey with tons of motivation and love;

To my wife, Zuraimah, and my children, Aira Maisarah and Ahmad Azhfar, who endlessly sacrifices for my success and showers me with moral supports;

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ABSTRACT

In preparing Malaysia for a steady transition to 5G technology, the Government of Malaysia has launched Jalanan Digital Negara (JENDELA). One of the initiative under JENDELA is the 3G Network Sunset project, where the 3G network will be switched off by the end of 2021. For a successful 3G Network Sunset, the voice calls need to be migrated from Circuit Switch (CS) to Packet Switch (PS) using Voice Over LTE (VoLTE) services because the 2G network will not be able to support the voice calls traffic over CS after the 3G switch-off due to the limited bandwidth. However, the low penetration of VoLTE provisioned devices in the market and the tedious and costly VoLTE provisioning process may impend the success of the 3G Network Sunset initiative. MCMC as the regulator of communications and multimedia is responsible for ensuring the initiative is successful and protecting the public interest. This research is intended to enhance the VoLTE provisioning framework to enable VoLTE in 4G smartphones to support the 3G Network Sunset initiative. The study will utilise Business Process Improvement (BPI), Lean, and Six Sigma principles to remove the waste process and subsequently improve the business process under the VoLTE provisioning framework in order to increase the penetration of VoLTE enable devices. For this research, the As-Is and To-Be model framework is chosen due to its benefits, as well as defining the differences between the original and the later improvised VoLTE provisioning process. Based on the As-Is Model, the waste process is identified, and it will be removed or modified to improve the overall business process. This research has significant influence locally and internationally, especially on Government policy in the communications and multimedia industry. The switching off of legacy networks is inevitable because of the fast pace of technology development. In addition, this research shows an excellent example of Government intervention in order to improve a business process involving multiple organisations through a collaborative platform.

Keywords: VoLTE, VoLTE PROVISIONING, BUSINESS PROCESS IMPROVEMENT (BPI), AS-IS AND TO-BE MODEL

ABSTRAK

Dalam mempersiapkan Malaysia untuk peralihan ke teknologi 5G, Kerajaan Malaysia telah melancarkan Jalinan Digital Negara (JENDELA). Salah satu inisiatif di bawah JENDELA ialah projek *3G Network Sunset*, di mana rangkaian 3G di seluruh Malaysia akan dimatikan pada akhir tahun 2021. Untuk memastikan projek ini berjaya, panggilan suara menggunakan komunikasi mudah alih perlu dipindahkan dari *Circuit Switch (CS)* ke *Packet Switch (PS)* menggunakan perkhidmatan *Voice over LTE (VoLTE)* kerana rangkaian 2G tidak akan dapat menyokong panggilan suara melalui CS setelah 3G dimatikan kerana jalur lebar yang terhad. Namun, penembusan yang rendah terhadap peranti yang disediakan VoLTE di pasaran, dan proses penyediaan VoLTE yang menyusahkan dan mahal dapat menghalang kejayaan inisiatif *3G Network Sunset*. MCMC sebagai pengatur komunikasi dan multimedia, bertanggung jawab untuk memastikan inisiatif tersebut berjaya dan melindungi kepentingan umum. Penyelidikan ini bertujuan untuk meningkatkan kerangka penyediaan VoLTE untuk membolehkan VoLTE digunakan di dalam telefon pintar 4G bagi menyokong inisiatif *3G Network Sunset*. Kajian ini akan menggunakan prinsip *Business Process Improvement (BPI)*, *Lean* dan *Six Sigma* untuk membuang proses yang tidak perlu dan seterusnya meningkatkan kecekapan proses VoLTE bagi meningkatkan penembusan peranti bersama VoLTE. Untuk penyelidikan ini, analisis model *As-Is* dan *To-Be* dipilih kerana faedahnya, serta menentukan perbezaan antara proses penyediaan VoLTE yang asal dan diubahsuai. Berdasarkan Model *As-Is*, proses yang tidak perlu dikenal pasti, dan ia akan dikeluarkan atau diubah untuk memperbaiki keseluruhan proses VoLTE. Penyelidikan ini mempunyai pengaruh yang signifikan di dalam dan luar negara, terutamanya terhadap dasar Kerajaan dalam industri komunikasi dan multimedia. Penutupan rangkaian warisan tidak dapat dielakkan kerana perkembangan teknologi yang pesat. Sebagai tambahan, penyelidikan ini menunjukkan contoh intervensi Kerajaan yang sangat baik untuk meningkatkan proses perniagaan yang melibatkan pelbagai organisasi melalui platform kolaboratif.

Kata Kunci: VoLTE, VoLTE PROVISIONING, BUSINESS PROCESS IMPROVEMENT (BPI), AS-IS AND TO-BE MODEL

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LIST OF ABBREVIATIONS

NDIL	:	National Digital Infrastructure Lab
JENDELA	:	Jalanan Digital Negara
MCMC	:	Malaysia Communications and Multimedia Commission
MNOs	:	Mobile Network Operators
MNFs	:	Manufacturer
CFM	:	Consumer Forum of Malaysia
GSMA	:	Global Systems for Mobile Communications
UMTS	:	Universal Mobile Telecommunications System
LTE	:	Long Term Evolution
VoLTE	:	Voice over Long Term Evolution
BPI	:	Business Process Improvement
GSMA	:	GSM Association
TSR 2000	:	Communications and Multimedia (Technical Standards) Regulations 2000
EMC	:	Electromagnetic Compatibility
MTSFB	:	Malaysian Technical Standards Forum Berhad
SIRIM	:	SIRIM QAS International Sdn Bhd
RF	:	Radio Frequency
CS	:	Circuit Switch
PS	:	Packet Switch
DL	:	Downlink
UL	:	Uplink
VOIP	:	Voice over IP
IMS	:	IP Multimedia Subsystem
SIP	:	Session Initiation Protocol
CFSB	:	Circuit Switched Fallback
MS	:	Mobile Station
BSS	:	Base Station Subsystem
CN	:	Core Network
BTS	:	Base Transceiver Station

BSC	:	Base Station Controller
UE	:	User Equipment
RNS	:	Radio Network Subsystem
RNC	:	Radio Network Controller
UTRAN	:	UMTS Terrestrial Radio Access Network
MSC	:	Mobile Switching Centre
VLR	:	Visited Location Register
HLR	:	Home Location Register
PSTN	:	Public Switched Telephone Network
ISDN	:	Integrated Services Digital Network
PCU	:	Packet Control Unit
SGSN	:	Serving GPRS Support Node
GGSN	:	Gateway GPRS Support Node
GMSC	:	Gateway Mobile Switching Centre
E-UTRAN	:	Evolved UMTS Terrestrial Radio Access Network
EPC	:	Evolved Packet Core Network
EPS	:	Evolved Packet System
E Node B	:	evolved Node B
TE	:	Terminal Equipment
MME	:	Mobility Management Entity
S-GW	:	Serving Gateway
P-GW	:	Packet Data Network Gateway
PCRF	:	Policy and Charging Resource Function
HSS	:	Home Subscription Server
UP	:	User Plane
PCC	:	Policy and Charging Control
QoS	:	Quality of Service
SAE-GW	:	System Architecture Evolution Gateway
HR	:	Half Rate
FR	:	Full Rate
EFR	:	Enhanced Full Rate
AMR	:	Adaptive Multi-rate Codec
AMR-NB	:	AMR Narrowband

AMR-WB	:	AMR Wideband
DTX	:	Discontinuous Transmission
VAD	:	Voice Activity Detector
SRVCC	:	Single Radio Voice Call Continuity
RB	:	Resource Blocks
BPR	:	Business Process Reengineering
BP-R	:	Business Process Redesign
DMAIC	:	Define, Measure, Analyse, Improve, and Control
DMADV	:	Define, Measure, Analyse, Design, Validate, and Verify
USP	:	Universal Service Funds
VoNR	:	Voice over New Radio
QoS	:	Quality of Services
QoE	:	Quality of Experience

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In achieving the National Aspirations, particularly to deliver high-speed mobile broadband service nationwide, MCMC has worked with the key communications service providers to develop a comprehensive digital infrastructure plan to meet the people's new needs. The action plan formulated through the National Digital Infrastructure Lab ("NDIL") sessions that were held from 13 July to 14 August 2020 will pave the way for the delivery of comprehensive and high-quality broadband service coverage, as well as prepare Malaysia for a steady transition to 5G technology. This action plan, known as the Jalinan Digital Negara or JENDELA, will be the platform for improving the country's digital communications under the 12th Malaysia Plan from 2021 to 2025.

With the increasing demand for digital services, the smartphone revolution, and the rapid growth in wireless data services, Mobile Network Operators ("MNOs") worldwide are exploring opportunities to reduce costs or re-use the 2G/3G spectrum for a more cost-efficient 4G and 5G technologies through shutting down the legacy technologies. Therefore, one of the initiatives under JENDELA is phasing out the 3G network or 3G Network Sunset project by the end of 2021. The 3G Network Sunset project was one of the recommendations made by key MNOs through the NDIL to optimise and enhance 4G speed by sunsetting the 3G network based on post-COVID19 trends. Spectrum re-farming from 3G sunset to 4G would deliver an additional 5Mbps average user speed and reach a practical speed of 35Mbps (NDIL, 2020).

To facilitate the implementation plan for 3G Network Sunset, MCMC has established the 3G Sunset Task Force that is spearheaded by MCMC, and the members consist of key MNOs, SIRIM, MTSFB, Consumer Forum of Malaysia ("CFM"), and selected smartphones Manufacturers ("MNFs"). The terms of reference for the 3G Sunset Task Force include, among others, planning for the MNOs Voice over LTE ("VoLTE") adoption for voice service, stopping the certification and type approval of all 4G smartphones which do not have VoLTE capability, and ensuring all 4G smartphones are provisioned with VoLTE services. This chapter will cover the sub-chapter that includes the company's background, problematic situations that occur in the organisation, research questions and objectives, the researcher's role, ethics, the theoretical and practical importance of the proposed research, and term definitions.

As it is crucial to ensure all 4G smartphones are provision with VoLTE services to support the JENDELA plan, this study will enhance the VoLTE provisioning framework to facilitate the provisioning process for VoLTE between MNOs and MNFs. The thesis mainly presents the current process and issues experienced by MNOs and MNFs to enable the VoLTE services on 4G smartphones and develop an improvised VoLTE provisioning framework based on Business Process Improvement ("BPI") principles. This research will also verify the improvised VoLTE provisioning framework's effectiveness to enable VoLTE services on 4G smartphones.

Globally, the anticipated rapid growth of data services has triggered many mobile operators to sunset 2G or 3G or both networks as they rationalise the costs of maintaining and deploying 2G, 3G, 4G, and 5G networks. The 2G and 3G network are technologically obsolete, however, the rationalisation to shut down the networks are based on a wide range of considerations. The current studies on shutting down legacy mobile networks acknowledge that "the main barrier for migrating 2G and 3G voice services to 4G is likely to be the low penetration of VoLTE enabled smartphones" (GSMA, 2020). The provisioning process to enable VoLTE services on 4G smartphones is different depending on the MNOs and MNFs business process and consumes a lot of workforces and monetary resources.

1.2 Case Company Introduction

The Malaysian Communications and Multimedia Commissions ("MCMC") was established on 1 November 1998 pursuant to the provisions of the Malaysian Communications and Multimedia Commission Act 1998. MCMC is entrusted with promoting and regulating the communications and multimedia industry and enforcing the communications and multimedia laws in Malaysia. One of the many roles of MCMC is the certification of communications equipment such as smartphones, tablets, smart wearables, walkie-talkies, and many others in accordance with the Communications and Multimedia (Technical Standards) Regulations 2000 ("TSR 2000").

Under these regulations, the certification required is in the areas of electrical safety, electromagnetic compatibility ("EMC"), interoperability, and the use of radio frequency as specified in the relevant technical codes developed by the Malaysian Technical Standards Forum Berhad ("MTSFB") and registered by MCMC. MCMC has appointed SIRIM QAS International Sdn Bhd ("SIRIM") as the certifying agency for the communications equipment. MCMC regulates the communications and multimedia industry that involve the certification of 4G smartphones and the issuance of MNOs licences. In this regard, MCMC was requested by the stakeholders to manage and oversee a collaborative platform between the MNOs and MNFs to enhance the VoLTE provisioning framework to support the 3G Network Sunset Project.

1.2.1 PEST Analysis

When it comes to assessing strategic risk, one of the most successful and often used methods is PEST analysis, which involves identifying and defining the changes and implications of the external macro-environment on the organisation's competitive position (Sammut-Bonnici et al., 2015). Therefore, PEST analysis will be used for this research to understand better the changes in political, economic, social, and technological factors that affect the VoLTE provisioning framework under the 3G Network Sunset Project.

The first analysis is on the political factor. The 3G Network Sunset Project was announced by the Prime Minister, Tan Sri Muhyiddin Yassin, on 30 August 2020 as part of the JENDELA initiative by the Government. Therefore, the Government fully supported the 3G Network Sunset Project, and MCMC has been tasked to oversee the project and ensure its success. As the project is part of the Government initiative, it is highly influenced by political factors. Political instability has a massive impact on the project, and the project has risked being scrapped if there are any changes in the ruling government. However, there are many benefits in sunseting the 3G Network, and all of the stakeholders are providing their full support to the initiative. The enhancement to the VoTLE provisioning framework is vital to ensure the success of the project, and MCMC, MNOs, and MNFs are working together under a collaborative platform to ensure its success.

Under the economic factors, running multiple generations of mobile networks at the same time is economically inefficient, MNOs tend to decommission the redundant legacy networks to reduce operational costs. The cost reductions are generated as a result of simplifying network management operations and Radio Frequency ("RF"), avoiding expensive maintenance of aging network equipment, eliminating ongoing costs of licences, and lowering the cost of leasing tower space for multiple antennas. Therefore, the MNOs fully supported the decision to sunset 3G Network.

In social factors, the demand for high-speed internet from cellular networks is increasing due to the Covid-19 pandemic, especially in rural areas with no fibre-optic broadband services. The lifestyle of office workers and students has drastically changed where there have to work or study from home and require high-speed internet connectivity for online meetings or classes. The 3G Network Sunset project will increase the overall speed of users by spectrum re-farming from 3G sunset to 4G would deliver an additional 5Mbps average user speed and reach a practical speed of 35Mbps. However, without a proper VoLTE provisioning process, there will be an interruption of making voice calls as currently, the MNOs are dependent on Circuit Switch ("CS") voice calls. With the enhancement of the VoLTE provisioning framework, the public will enjoy high-quality voice calls using VoLTe services.

In terms of technological factors, rapid technological advancement plays a crucial role in the decision to switch off 3G Networks. Wireless communications enable economies to keep going, keeping people entertained and accelerating the adoption of new technologies. As the nation is preparing for the 5G Network service rollout, MNOs require significant capital to prepare the 5G network by installing new hardware and software. Therefore, the money that is saved by switching off the legacy network can be used to prepare for the 5G launch.

In conclusion, the political, economic, social, and technological factors play a significant role in the 3G Network Sunset Project. Using the PEST analysis described above, MCMC can comprehend and identify the influence of various elements in the environment, preparing the company to take advantage of the opportunities and protect against threats.

1.3 Problem Statement

The voice calls made through a smartphone are predominantly using CS technology, which is available only on 2G and 3G networks. The current traffic for voice calls made through CS is 83% is carried over 3G, and the balance 17% is carried over 2G (NDIL, 2020). Aggressive spectrum re-farming to 4G has been implemented in Malaysia as 2G and 3G traffic have been declining over four (4) years. Only 13.9% of spectrum are occupied by 2G (3.8%; 2x10 MHz) and 3G (10.1%; 2x25 MHz) following aggressive re-farming to 4G (86.1%; 2x200 MHz) (NDIL, 2020). In this regard, the 2G network that occupied only 3.8% of the bandwidth will not be able to support the voice calls traffic over CS after the 3G switch-off, and the voice calls traffic needs to be carried over to the 4G network using VoLTE technology. Some challenges are identified to use VoLTE services for voice calls on 4G networks. One of the challenges is the low penetration of VoLTE enabled devices in the market. If the devices are not enabled with VoLTE services, the consumers will not be able to make a call using VoLTE even though the 4G smartphones are VoLTE capable.

However, there are difficulties in provisioning the 4G smartphones to enable VoLTE services for the consumers to enjoy. The issue lies in the tedious and costly VoLTE provisioning process that has inhibited the numbers of 4G smartphones with VoLTE enabled. In order to allow for VoLTE services on the 4G smartphones, a smartphone MNF first needs to provision the 4G smartphone by upgrading the software to include the network parameters of a specific MNO. Usually, the software upgrade is conducted at the MNF headquarter in their origin country. After the software upgrade, the 4G smartphone needs to be tested using a live network based on the VoLTE test cases to ensure that the 4G smartphones are compatible and interoperable. Every MNFs have their own test cases depending on the MNFs requirements. To conduct the VoLTE testing on a live network, the smartphone MNF needs to have technical personnel in Malaysia, which will add resource requirements for the MNFs.

After completing the testing, the MNF will notify the MNO and provide the 4G smartphone as a testing unit for the MNO to conduct independent testing based on its test cases, which is usually less rigid than the test undertaken by smartphone MNFs. The testing by MNO is to ensure the VoLTE services on the 4G smartphone work correctly as intended, and there are no system bugs before the MNO provision the 4G smartphone on their 4G network. The whole process needs to be repeated for other or new models of 4G smartphones with different firmware and/ or hardware. The VoLTE provisioning is initiated either by the MNOs or MNFs, which usually require business arrangements or agreements between the companies. Therefore, the VoLTE provisioning framework is not conducted simultaneously for all MNOs. The MNFs will only upgrade their software with the network parameters of MNOs they have business arrangement or agreement, resulting in a large disparity between 4G smartphones with VoLTE enable between the MNOs. The VoLTE provisioning framework consists of the whole process starting from the MNFs to the MNOs and takes approximately two (2) to three (3) months to complete per model and for each MNO. Half of the key MNOs (3 out of 6) just started to offer the VoLTE services in Q3 2020 and have just begun to enable some of the 4G smartphones with selected major brands. Based on the current provisioning framework, these MNOs will not be able to complete the provisioning process for the present and future 4G smartphones before the dateline, which is by the end of 2021.

In addition, all MNOs currently only have a business arrangement or agreement to provision VoLTE with major smartphone brands, such as Apple, Huawei, Oppo, and Xiaomi. The MNOs are not able to provision VoLTE service to the smaller smartphone brands, such as Realme, Asus, One Plus, and others, because these brands do not have a presence in Malaysia. The smaller brands appoint an agent in Malaysia, and these agents cannot decide on the VoLTE provisioning arrangement between the MNOs and the smaller brands owner. The smaller brands may have some reservations to enable VoLTE in their 4G smartphones because the current process is tedious and costly to the MNFs. These issues need to be resolved to ensure all 4G smartphones are VoLTE capable and enabled in order to achieve a successful 3G Network Sunset project by the end of 2021 to support the national JENDELA initiatives. This study will identify the bottleneck in the current business process to provision VoLTE services and look for ways to improve the business process to ensure it is more effective and reduce the resource needed to provision VoLTE. Most of the research that has been done for VoLTE provisioning is technical in nature and do not touch on the business process. Therefore, this research will add a different perspective to increase the penetration of VoLTE enabled smartphones to achieve successful sunsetting of the legacy network.

1.3.1 Problem Diagnosis

This study will use the Ishikawa (fishbone) diagram to highlight the root cause of the VoLTE provisioning framework between the MNOs and MNFs, as shown in the following Figure 1.1.

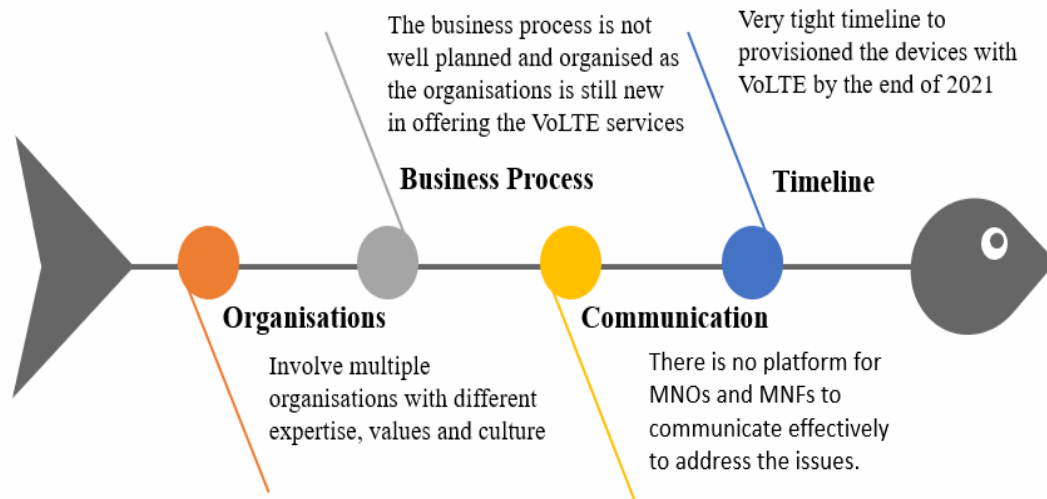


Figure 1.1: Ishikawa (Fishbone) Diagram

Figure 1.2 shows the root cause of the challenges faced in the VoLTE provisioning framework. Four (4) factors contribute to the issue: the organisations, business process, communication, and timeline. The first factor is the organisations. The VoLTE provisioning process involves multiple organisations with different expertise, values, and culture. Therefore, the MNOs may have difficulty formalising business arrangements or agreements to provisioned VoLTE in a particular brand of 4G smartphones. Some of the MNOs was not able to formalise business agreement due to high requirement from the MNFs. Besides, some MNOs or MNFs is harder to work with because of multiple layers of approval and lengthy VoLTE provisioning process.

Under the business process factor, most MNOs just started offering VoLTE services in the second half of 2020. Therefore, the business process to provisioned VoLTE in 4G smartphones is not well planned and organised. The MNOs is learning while doing the VoLTE provisioning process, which makes it not efficient and effective. In addition, there is no standardised VoLTE provisioning business process across the organisations which worsen the process. For example, MNOs or MNFs may have a different process when dealing with other organisations, which may confuse them and contribute to the delay in the VoLTE provisioning framework.

The MNOs and MNFs had known the challenges of the VoLTE provisioning framework for some time. One of the fastest ways to resolve the issues is by all of the MNOs and MNFs work together to address the challenges faced by them. However, there is no platform for the MNOs and MNFs to effectively communicate to address the issues as there are competitors. Therefore, MCMC must intervene and lead a collaborative platform whereby all the MNOs and selected major MNFs can work together to resolve the problems.

The government had decided that all 3G Network will be switch off by the end of 2021. In this regard, the penetration of VoLTE enabled device must be at an acceptable level in order to protect the public interest. Failure to do so will fail the 3G Network Sunset project, and the MNOs still need to maintain 3G networks. With a very limited timeline of about one (1) year, there must be an enhancement to the current lengthy VoLTE provisioning framework to ensure the success of the 3G Network Sunset project.

1.3.2 Theoretical Gaps

Research should contribute to the advancement of knowledge in a specific field or industry. The findings or outcome of the study should have a positive impact on the industry and is applicable outside of the research setting. The study involved VoLTE provisioning in terms of improving the process using the Business Process Improvement (“BPI”) theory. Using Web of Science, there is no record of research or study involving both VoLTE provisioning and BPI, as shown in the following Figure 1.2:

Select a database: Web of Science Core Collection

Basic Search | Author Search^{BETA} | Cited Reference Search | Advanced Search

Your search found no records.
 Check the spelling of your search query.
 Compare your query to the search examples on the search page.
 Use a wildcard (*, \$, ?) to find plurals and word variants. (e.g. graph*nanofib* for graphite nanofiber).
 Use multiple terms to find similar concept. (e.g., cell* phone* OR mobile phone*).
 Consider clearing the search form. Previous queries may remain in other fields.
 See search rules and training videos

VoLTE [X] Topic [v]

And [v] Business Process Improvement [X] Topic [v] Search Search tips

+ Add row | Reset

Timespan: All years (1970 - 2021) [v]

More settings [v]

Figure 1.2: Analysis from Web of science

Based on the researcher literature review, most of the research involving VoLTE is technical and discuss how to improve VoLTE in technological aspects. There is no study involving VoLTE in terms of enhancing the VoLTE provisioning process and BPI, maybe because Malaysia is the first country that chooses to switch off 3G first before 2G within a short time. The other countries issue of low penetration of VoLTE enable devices has yet to be faced by the other countries.

1.3.3 Practical Gaps

Most of the MNOs worldwide are offering VoLTE services at their own pace. They have no urgent needs to enhance the VoLTE provisioning framework, and the process is tailored according to their arrangement with the MNFs. However, as the world is preparing for 5G technology, more and more country is looking to switch-off the legacy network. One of the issues in switching off the legacy network is the low penetration of VoLTE enabled devices as the public cannot make a call because of the migration of voice calls traffic from CS to PS using VoLTE. Besides, there is no standardise VoLTE provisioning process, and it is different based on the MNOs and MNFs culture and expertise. This will result in an uneffecticve business process that will delay slow down the penetration of VoLTE enabled devices.

1.4 Research Questions

Based on the challenges and gaps mentioned above, this action research proposed to enhance the current VoLTE provisioning framework to enable VoLTE in 4G smartphones to support the 3G Sunset initiatives under the JENDELA plan. The action research questions are as stated below:

- a) **RQ1:** What are the current market scenario and the challenges for the VoLTE provisioning framework to enable VoLTE on 4G smartphones?
- b) **RQ2:** How to formulate the improvised VoLTE provisioning framework to ensure 4G smartphones are VoLTE enabled?
- c) **RQ3:** How to monitor the impact and effectiveness of the To-Be model in order to enhance the VoLTE provisioning framework.

1.5 Research Objective

The research objectives are interrelated to the study's research questions and should be achievable and clear. Therefore, the research objectives are as follows:

- a) **RO1:** To identify and understand the current market scenario and the challenges for the VoLTE provisioning framework to enable VoLTE on 4G smartphones.
- b) **RO2:** To formulate an improvised VoLTE provisioning framework to ensure 4G smartphones are VoLTE enabled.
- c) **RO3:** To monitor the impact and effectiveness of the To-Be model in order to enhance the VoLTE provisioning framework

1.6 Researcher's Role

In many cases, the shutdown of the legacy network is driven by the desire of MNOs to refarming the spectrum for a faster and more efficient 4G network. For the Malaysia case, the 3G Network Sunset project was proposed by the MNOs through NDIL and was included in the national initiative under the JENDELA plan. During the implementation of the 3G Network Sunset project, the issue of low penetration for VoLTE enabled devices was highlighted by the MNOs, which may hinder the project's success. Because it involved multiple organisations from MNOs and MNFs, MCMC is requested to become the mediator. MCMC has established a collaborative platform consist of all the relevant stakeholders to address the issues related to VoLTE devices. There are many issues identified under the device category, and one of the issues is the tedious and costly VoLTE provisioning process.

The researcher plays an enormous role in ensuring the impact and effectiveness of the research under study, including the intervention. The researcher is responsible for sharing knowledge in research methodology, identify the methodology of data collection, execution and analysis of data gathering, and ensuring the report is well written. The researcher will also utilise the collaborative platform established by MCMC to enhance the VoLTE provisioning framework and address the issue.

1.8 Significance of the Research

The action research is essential to find a solution to real industry challenge by utilizing BPI principles and the As-Is and To-Be model. Conducting research and making changes for the benefit of the community and the organisation will allow for a more in-depth exploration of the problem and a complete understanding of the situation.

1.8.1 Significance to Theory

Voice calls over cellular network played a significant role during the Covid-19 pandemic, especially on lockdown. Recently, ordinary users have had to depend on voice calls to stay in touch with their friends, family members, and coworkers. Businesses also turn to voice services as a supplement to their video conference services. 5G services are expected to be introduced in 2021, and MNOs worldwide are looking into switching off the legacy network to have more capital to invest in 5G. By switching off the legacy network, voice calls will also be migrating from CS to VoLTE. Most of the discussion for VoLTE is on the technical parameters, and therefore there is a lack of discussion on the actual process to enable VoLTE services on 4G smartphones. Because of the tedious and costly VoLTE provisioning process, the penetration of VoLTE devices is low as most MNOs are not ready to provide the services. This research will focus on improving the VoLTE provisioning framework by using BPI principles. The topics on VoLTE should be studied further in the future, and there should be a standard process that can enable the devices for the global market. In addition, this research uses BPI theory to improve the business process involving multiple organisations. This is a unique approach in BPI theory, and this type of research may be conducted because MCMC is the regulatory agency.

1.8.2 Significance to Practice

The primary purpose of this study is to identify the challenges faced by MNOs and MNF in enabling VoLTE services on 4G smartphones as well as enhancing the current VoLTE provisioning framework to increase the adoption rate of 4G smartphones with VoLTE enable in the market. Market with early 4G VoLTE deployment and high penetration of 4G smartphones with VoLTE enables are likely to have successful 3G switch off (GSMA, 2020). The research is vital because the numbers of 4G smartphones with VoLTE enabled are very low for most of the key MNOs, which may hinder the success of the 3G Network Sunset project by the end of 2021.

The study intends to increase the adoption rate of 4G smartphones with VoLTE enabled and eliminate the dependency on the legacy mobile network, 2G and 3G. The study will be able to help the success of the 3G Network Sunset project as the 3G network will be able to be fully switch-off when the voice call traffic is carried over a 4G network using VoLTE. The findings of this study will apply to other countries' regulatory bodies for communications and multimedia, MNOs, and MNFs of 4G smartphones for achieving a smooth and successful sunset or switch-off the legacy network.

1.9 Definition of Terms

The definition of the terms used in this study is described below:

MCMC: The regulators for the communications and multimedia industry in Malaysia. For this research, MCMC has been tasked to oversee the 3G Network Sunset project and act as the mediator for MNOs and MNFs to address the issues on communication devices, including VoLTE.

MNOs: Provider of mobile cellular communication services licensed by MCMC under Communications and Multimedia Act 1998 that owns or controls all the elements necessary to sell and deliver services to an end-user, including spectrum, infrastructure, billing, and customer services.

MNFs: The company that makes or owns the 4G smartphones and is responsible for the devices. MNFs can be either the Local Representatives, the entity located in Malaysia representing the Brand Owner or HQ, the main office situated overseas and own the brand and devices.

VoLTE: Stands for “Voice over Long Term Evolution”. Utilising IMS technology, it is a digital packet voice service delivered over IP via an LTE access network (GSMA, 2020).

VoLTE Capable Device: 4G smartphones that have the hardware capability to use VoLTE services. However, it has yet to be installed with the MNOs network parameters, and therefore VoLTE services are not available locally.

VoLTE Enabled Device: 4G smartphones that have gone through the VoLTE provisioning process with MNOs and MNFs. The devices have been installed with the MNOs network parameters and tested. VoLTE services can be used with the device.

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