

Extraction of Knowledge Complexity in 3G Killer Application Construction for Telecommunications National Strategy

Muhammad Suryanegara, Dendi Wijayatullah, and Dadang Gunawan (*Member IEEE*)

Abstract—We review a knowledge extractor model in constructing 3G Killer Applications. The success of 3G is essential for Government as it became part of Telecommunications National Strategy. The 3G wireless technologies may reach larger area and increase country's ICT penetration. In order to understand future customers needs, the operators require proper information (knowledge) lying inside. Our work approached future customers as complex system where the complex knowledge may expose regular behavior. The hidden information from 3G future customers is revealed by using fractal-based questionnaires. Afterward, further statistical analysis is used to match the results with operator's strategic plan. The developments of 3G applications also consider its saturation time and further improvement of the application.

Keywords—3G Killer Applications, Knowledge, Telecommunications Strategy.

I. INTRODUCTION

THE 3G wireless technologies can carry multimedia mobile applications running on high speed and high mobility access [1] [2]. 3G technology comes with higher bandwidth (5MHz for WCDMA) supporting any popular applications that can generate more revenue for operators. Operators have spent huge investment for 3G license spectrum and for building physical infrastructures. In order to return their investment and to produce revenue, operators should deploy killer applications applied to their future customers.

As the evolution of wireless cellular, 3G has abilities to reach larger areas where its future customers can be urban and rural people. For the reason of its advantages, 3G has been stated as main part of Telecommunications National Strategy by most countries. As a consequence, the 3G deployment is not only done by operators but also Government and/or National Regulator. Any strategic scheme or decision will be impact to the success of 3G implementation. For operators, the success is merely defined as how much the 3G generates

money. On the other side, operator's success can be reflected as the success of 3G deployment as government's willingness. Therefore, operators, supported by Government, have to create 3G applications that will generate high profit.

Killer applications are applications which successfully accepted and used by customers [2]. An application can be said as killer application once it attracts customers buying the device, utilizing the system and using it continuously. The construction of 3G killer applications depends on what the future customers actually need. Operators can not launch something that people don't want. It also correlates to how much tariff they can afford and how long the applications will last. Operators require to understand and to reveal that knowledge which is lying inside the future customers. However, customers are complex system which exposes non-linear willing and demand. Hence, it is important to extract the knowledge inside future customer by revealing their pattern and regular behavior.

This paper reviews the model of knowledge extractor to construct 3G Killer Applications. Our work approached future customers as complex system where the knowledge is hidden inside. The model consists of logical paces to get the knowledge information by using fractal-based questionnaires, statistical analysis and content development. The 3G Killer applications will be constructed by operators and matched with their strategic plan, while Government will act as National Strategic Planner creating supporting atmosphere for the operator's plan.

II. 3G IN TELECOMMUNICATIONS NATIONAL STRATEGY

The Telecommunications National Strategy is designed to meet primary benefit of Telecommunications, that is bring prosperity and increase the quality of life. Most developed countries have set Telecommunications as the key factor underlying concept of Knowledge Based Economy. The Economic activities are running on Telecommunications broadband infrastructure which is fast and reliable, supported by secure and friendly applications.

Factors in technology and economy, are considered in the development of strategy roadmap. They are driven to construct Knowledge Based Society as the main actors of new economy paradigm. Reflected by the success of wireless cellular, the 3G technology has come as one of promising

This work was supported in part by Policy Studies Grant *Program Hibah Kompetisi B* (PHK-B) in collaboration with *Center for Information and Communications Engineering Research* (CICER) Department of Electrical Engineering University of Indonesia, Jakarta.

Muhammad Suryanegara, Dendi Wijayatullah, Dadang Gunawan are with Department of Electrical Engineering University of Indonesia. (phone: 62-21-7270078; fax: 62-21-7270077; e-mail: msurya@ee.ui.ac.id).

technology options. Comparing to WLAN, 3G are least mature and costly solution, but it can touch all future market segments: home, student and enterprise [4]. Therefore, most countries have placed 3G as one of main players in their National Strategy.

Government (as National strategy designer) requires wireless technology to increase ICT penetration. Along with another wireless technology –such as WiMAX or DVB-R - , 3G may reduce digital divide because it can touch larger area including rural and urban. Government has importance to the success of 3G implementation. The success of 3G is part of the success of overall National Strategy.

Fig. 1 illustrates knowledge extractor model of 3G Killer Applications construction, involving operators and government. In 3G auction era, the main issue of Government’s actions was spectrum management. Fig. 1 also pictures the relation between Operators and Regulator/Government where they are affecting each other. On first case, Regulator sold the spectrum on the high price then made operators can not return the investment. It might initiate the 3G failure, and might bankrupt the operators. On second case, operators might afford the spectrum fee or simply awarded by Government. It directly opened possibility to reduce 3G tariff, then bring maximum profit from user’s utilization. On both cases, Government/Regulator played important role determining the success of 3G even though they never expected operators would be bankrupt or would fail. The failure of 3G would behave as negative sign of National Telecommunications Strategy.

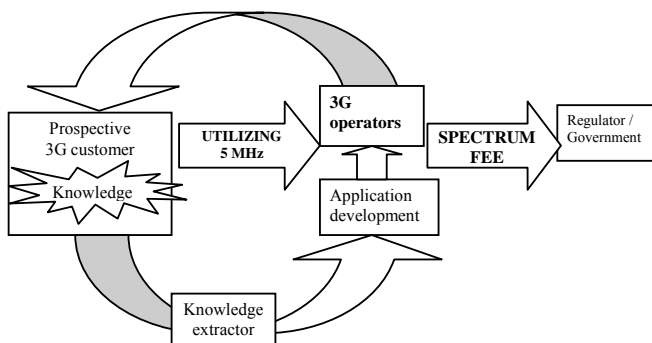


Fig. 1 Knowledge Extractor Model; consists of Relation between 3G Operators and Government, and cycle of 3G Killer Applications construction

For operators, the center problem was the spectrum fee, and the center solution is to utilize spectrum they already have. The utilization is only can be done once future customers access the future 3G applications. In order to quick-return the investment, operators should enroll killer applications which shall capture 3G market intensively. On the other side, for avoiding the possibility of failure, Government will have to push the creation of 3G killer applications.

Government and Operators will also frame certain policy to create conducive 3G atmosphere. They are structured based on specific 3G user categories, such as Home, Student, Enterprise [4] ; Residential and Office; Rural and Urban; Personal and Corporate; etc. Table I shows the classifications of 3G applications based on future customers (developed from [4]). The table mentions killer applications that are located on each of category.

TABLE I
CLASSIFICATION OF 3G FUTURE CUSTOMERS (DEVELOPED FROM [4])

USER CATEGORIES		
Home	Student	Enterprise
<ul style="list-style-type: none"> • Web access • Email • Online shopping • Video applications 	<ul style="list-style-type: none"> • Web access • Email • File transfer • Gaming, navigation system • Video applications 	<ul style="list-style-type: none"> • B2B applications • e-commerce • fleet management • MMS
<ul style="list-style-type: none"> • Killer Application 	<ul style="list-style-type: none"> • Killer Application 	<ul style="list-style-type: none"> • Killer Application

III. 3G KILLER APPLICATIONS

A. 3G Technologies

Several 3G wireless protocols were released to support migration from 2G platforms. Countries might chose on which technology their 3G technology will be. GSM which has successfully deployed in Europe and Asia, are migrating to UMTS underlying WCDMA. On the other hand, CDMA in Japan and most countries in North America move to CDMA2000. Both offer high reliability performance and place on near spectrum allocation.

The 3G technologies can have variable bit rate based on user’s mobility. The high mobility (500 km/h) support 144 kbps, full mobility (120 km/h) support 384 kbps, while the limited mobility scheme (10 km/h) can reach 2 Mbps [1]. The 3G system are placed in spectrum which can carry larger traffic band (15 – 20 MHz). The defined allocations for 3G are 1885 – 2025 MHz, and 2110 – 2200 MHz. Unlike the 2nd cellular generation which was built mainly to provide speech services, the 3G offer bit rates up to 2Mbps supporting multimedia services [1]. Because 3G technologies run on IP-based content, the multimedia services are formed in IMS (IP-Multimedia sub-system). The IMS can differentiate QoS characteristic and control end-to-end applications performance.

B. 3G Killer Applications

It is argued that future 3G killer applications are simply unknown [5]. However, operators need to search killer

application to cover 3G large investment for its hardware and spectrum license fee. Several countries' Telecommunications Regulator was setting high 3G spectrum fee. During 3G hype in Europe, owning the spectrum was considered prestigious hence they paid overpriced amounts of money [4]. In some countries, the fee were determined based on number of bandwidth shall be used (for WCDMA 1 band = 5Mz). Several operators in Asia already paid millions dollars per band without guarantee future customers will utilize 3G applications. On the other hand, the success story of Japan's 3G was delivered by Japanese government's policy; awarded license to major operators without referring to auctions [4].

Technically, one GSM spectrum can support 8 voice channels while one 3G band can carry up to 256 voice channels, or up to 100 slots of 115 kbps data. If operators can not utilize the channel with proper multimedia applications, they will waste the available bandwidth. It is significant for operators to release killer applications in order to pay back their investment and to generate the profit.

The searching to capture various market segment and types of future customers lead to the creation of applications which would attract customers and offer friendly pricing scheme [4]. Even though voice is still the major source of revenue, any applications running on 3G must utilize the bandwidth, mainly on the basis of data services. The application is simply to be killer applications, which can make customers to use and to utilize, then bring profit for operators. Since people might show different needs and behaviors, the 3G killer applications have to be constructed properly. Therefore operators should know what the knowledge inside future customer is. The knowledge should be extracted to clearly define the customer's need.

Fig. 1 illustrates the role of knowledge extractor in 3G Business Model. In order to construct proper 3G applications operators require knowledge that is hidden inside customers. Once the killer applications are developed and implemented, it is expected that future customers will use and utilize the available band. In this case, we said one band equal to 5 MHz UMTS system. The generated income will return spectrum fee, and deliver the profit. Cellular operators played 3G not only because of natural evolution from 2G but also due to promising future profit. Hence, the further step afterward is to gain another 3G band that hasn't released by Regulator/Government.

C. The Construction of 3G Killer Applications

The killer applications in telecommunications technology are basically designed to be used personally and to meet any conditions. Killer applications should lie on proper device and make users can access their data anytime and anywhere [2]. The applications are built on service architecture which is implemented by service modules [2]. Service modules make applications can be developed specifically. Modules can be constructed in the part of software, hardware, and also

transport network integration. Fig. 2 shows modular service architecture [2].

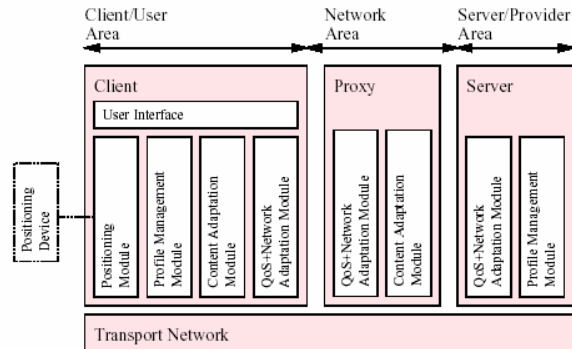


Fig. 2 Modular Service Architecture [2]

In 3G application, service data are generally classified based on content and mobility, including wireless advertising, mobile information, business solution, and person-to-person communications. For its multimedia ability, most 3G applications were designed to meet entertainment needs, such as music download and video browsing. However, when it faces tariff issue customers might prefer not to utilize the applications.

The facts that not every multimedia service offered is accepted by customers, has driven 3G application basic purpose. The operators should release applications offering solution of specific customer's problem that part of customer's actual needs. The actual customer's needs are lying in complexity. Therefore operators should understand clearly by revealing the knowledge inside.

In 3G markets, besides measured by generated revenue, the success of applications also can be seen from which it make people buying the handset and registering to other 3G services. Therefore, the constructed applications should also consider others factors leading to its tertiary effects.

IV. KNOWLEDGE EXTRACTOR MODEL

A. The Knowledge inside Future Customer

In constructing 3G applications, operators should get the knowledge hidden inside their future customers. The extracted knowledge is to answer following basic questions:

- What is customer's actually need?
- Is that proper enough with available 3G band and the 3G advantageous offered?
- After we offer that, will they pay for that?
- After they pay, will they continuously use that?
- When will be the saturation time of that application?

The basic information needed is not merely what customer's need, because not every killer application is suitable enough with 3G band's facilities. For example, some

might predict *sms* pooling still being major applications in 3G market. However, it's not suitable with 3G features, since the *sms* doesn't require large bandwidth and higher bit rate. Operators have to create applications that can utilize the available band. Besides for returning license fee, it is essential since telecommunications regulator (or government) might insist operators to utilize the band before operators can buy new ones.

Another significant issue is tariff. Operators should determine the tariff that future customers can afford then will continuously use the applications. The last knowledge to be revealed is when the saturation time of its application. It is important that operators should think the next improvement of current constructed applications.

B. The Complex Knowledge System

Since knowledge inside customers is complex system, we propose an approach using a simplification method. The method is based on study of dynamic complexity to reveal pattern inside the knowledge. Study of complexity brings a new perspective in understanding a dynamic complex system [6] [7] [8]. Inside the chaotic state lays a regular pattern [6]. Hence, it is believed that future customers are deterministic system which may exhibit regular behavior. The regular behaviors are so much essential to understand what customer's demand. It shows pattern that could be dissimilar for each society group. Urban customers may expose pattern which so much different to rural people.

We won't attach the system by using mathematical approach, instead of its statistical analysis. The study of complexity is used to help constructing operator's perspective in developing survey to reveal the knowledge. We develop a model to understand regular behavior of future customers. Future customers are a complex system standing in irregular state or unstable condition. Each customer behaves as actor who has similarity and differences among others. The similarity exhibits a regular behavior, while the difference performs unique manners. Both assemble irregular state which uniquely constructs complexity.

Operators should consider the position of 3G killer application that is giving solution of customer's problem. The problem could exhibit based on customer's group. Operators may group or classify customers matched with its strategic scheme (Table I show the example of 3G future customer classification). The solutions offered are running on high speed access and in the structure of multimedia content. Hence, the 3G killer application will be a tool that reform regular behavior in unstable to be regular behavior in stable condition. Fig. 3 illustrate on which 3G Killer Applications has function to transform instable condition to be stable one. Once operator understands customer's regular behavior, they can determine the 3G application.

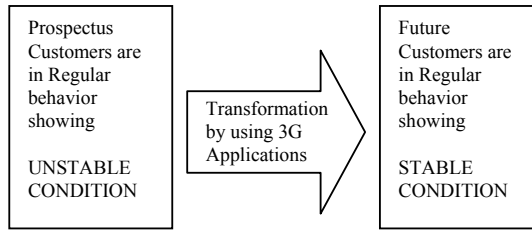


Fig. 3 Transformation by 3G Killer Applications

C. The Significance of Survey and Statistical Analysis

We suggest using survey as a tool to get knowledge inside future customers. The pattern and regular behavior will be disclosed. The survey questions have to be constructed based on fractal method. Fractal in study of complexity is used to simplify its irregular system [8]. Fractals are the smallest units shaping the pattern. In the deployment of 3G technology, operators may deem fractal as components, include: price affordability, community habits, customer social condition, politics, psychological aspect, and other significant factors shaping the customer's behavior.

In order to get mature information, operators should consider many issues in real customer's life. However, it is impossible to perform entire aspect, since each customer still has their unique manner. It should be emphasized that the purpose of survey is to reveal customer's regular behavior. Figure 4 shows the construction of fractals questionnaire.

Questionnaires are designed to search customer's behavior and the advanced questions are required. Further statistical analysis will be done upon its result. As part of strategic development, operator diversifies regular behavior in urban and rural area. It is predicted that most urban people shall welcome 3G since the technology support their daily activities [3]. However, it applies differently to any cities, then operators should know what kind of specific activities people will go for.

One of the outputs of statistical analysis is customer's regular behavior. As mentioned in section B, the behavior is translated as similar activities among users. Operators should get that information then search its correlation to other factors. For example, if survey tells that urban customer have similar problem in facing traffic jam operators should think a 3G application which can help customer to overcome the problem. Before developing the application, operators should analyze its correlation to customer's price affordability, customer's habit, and other relevant factors.

Correlations are more significant in matching customer's price affordability and 3G tariff. Through correlation analysis, operators can search information in how much price people shall pay the 3G applications.

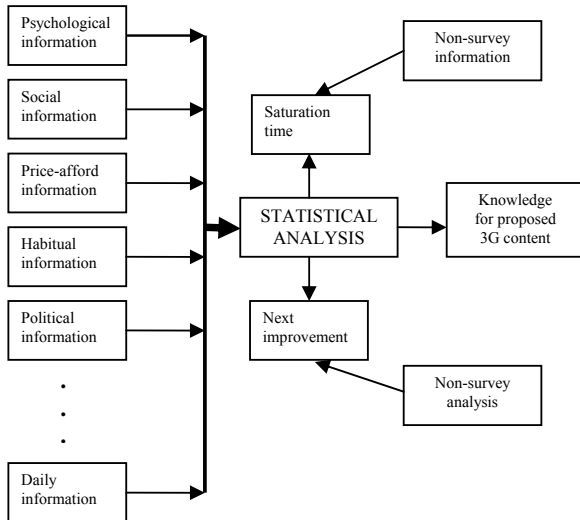


Fig. 4 The fractal-based questionnaire

D. The Proposed 3G Applications / Content

The primary knowledge of proposed 3G content is constructed after statistical analysis. It results future customer's regular behavior and their elements including saturation time and next improvement feature. The clear format of 3G applications shall be matched with operator's strategic plan apart from the survey. Knowledge from the survey is only to answer questions mentioned in section IV A, while interpretation of its answer are applied differently based on operator's vision. Fig. 5 illustrates a model to match between knowledge revealed from the survey and operator's strategic plan.

Operator's strategic plan approaches the format of 3G killer applications. For instance, real-time traffic information will be set differently in city A and city B. If the 3G operator in city A intends to promote video streaming, operator will design information through online video. On the other hand, city B's operator will send traffic information just by text, because operator think it's better to utilize video channel for another worth-money applications.

The basic idea of using study of complexity is to charge 3G Killer Applications as transformation tool, changing a complex unstable condition to be stable one. The transformer is constructed by considering regular behavior or pattern lying on that complexity. Nevertheless, the features of this transformer are determined by operator itself, to match with its strategic plan.

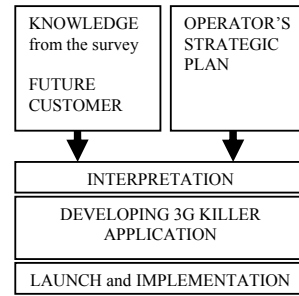


Fig. 5 Matching between knowledge

In addition, the development of 3G killer applications may follow service module showed in Fig. 2. By using service module concept, operators can easily adapt the application with its network and type of customers. Service modules also help operators to improve 3G applications to the next step.

E. The Next Improvement of 3G Proposed Content

Besides primary knowledge of proposed 3G content, statistical analysis produces saturation time and its next improvement. The saturation time of '3G proposed content will be essential since it should be matched with application's next improvement. Operators are expecting that current applications are continuously used and generate constant revenues. However, this also follows general rule in *s-curve* that at some point will reach maturity level and stagnant performance.

The proposed 3G content should be developed by considering its saturation time. Operators can understand the time by extracting more knowledge from survey and information from non-survey analysis. Both knowledge from future customer's and non-survey information are combined to get further saturation time. For example, real-time traffic jam information would be 3G killer applications for urban people, only when traffic is still customer's problem. Thus, operators should think its sequence applications after customer faces no traffic jam problem.

Consequently, the design of current proposed 3G applications should also consider its next improvement. The transition between proposed and next one should be smooth and present no enforcement. The license-paid band in 3G technologies are required to be fully utilized. Any applications running are driven to be continuously increase channel utilization.

V. CONCLUSION

We review the model of knowledge extractor in designing 3G killer applications used by operators to understand future customer's needs. In National Telecommunications Strategy, most Government apply 3G as part of main ICT players, therefore knowledge extractor model can also help them for making 3G success. The model revealed knowledge inside future customer complexity through survey and its statistical analysis. The information shall be used by operators for

setting proper 3G applications to be applied. Our future work will apply the model in real field-practice. Further works also involve development of particular statistical tools and formation of more precise algorithm.

REFERENCES

- [1] Harry Holma, Antti Toskala (editor), "WCDMA for UMTS (book style with paper title and editor)", John Wiley&Sons, 3rd edition, 2004.
- [2] Gunther Pospichil, Ernst Bonekm, Alexander Schneider "UMTS Applications Development – Designing A Killer Application", Institut für Nachrichtentechnik und Hochfrequenztechnik der Technischen Universität Wien.
- [3] Jan Damsgraad, Ping Gao, "Mobile Telecommunications Market Innovation: The Transformation From 2G to 3G" Department of Informatics Copenhagen Business School.
- [4] Venkata Praveen Tanguturi, Fotios C. Harmantzis, "Migration to 3G Wireless Broadband Internet and Real Options: The Case of an Operator in India", Stevens Institute of Technology, School of Technology Management, USA.
- [5] Heikki Karjaluo, An Investigation Of Third Generation (3g) Mobile Technologies And Services, Faculty of Economics and Business Administration, University of Oulu
- [6] Brian Davis, "Exploring Chaos", Westview Press, 2004.
- [7] Muhammad Suryanegara, Djamhari Sirat "On Developing National ICT Strategy by using Chaos Theory", IRFD-WFIS 2005 Proceeding, Tunisia, 2005.
- [8] M. Nakagawa, "Chaos and Fractals in Engineering (book style with paper title and editor)"World Scientific.

Muhammad Suryanegara, earned M.Sc in Telecommunications from University College London (UCL) in 2004, and Bachelor of Engineering (distinction) from Universitas Indonesia - Jakarta in 2003. His research interests are in Wireless topics and Telecommunications Management. Several works in ICT Policy studies and Telecommunications Management has been published in international conferences.

Dendi Wijayatullah, is junior researcher with Electrical Engineering University of Indonesia, at present actively doing research in 3G Killer Applications. At present, he joins research works assigned to implement concept of Knowledge Extractor in real field.

Dadang Gunawan, (B.Eng 1982, M.Eng University of Keio 1990, PhD University of Tazmania 1995). Currently serve as Professor in Digital Signal Processing in University of Indonesia and also program head of master in Telecommunications Management. He is chairman of IEEE Indonesia section and works in frontier research related with Telecommunications Management.