

Reinventing Healthcare Service through M-care Business Model: The Strategy Analysis of WiMAX Adoption

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Abstract—To address the emerging issues of aging society, new technology creates many opportunities to solve the problem of care service and increases added-value in the digital family. Therefore, this paper analyzes the characteristics of WiMAX wireless technology and its applications in healthcare service. To investigate the local users' demand of wireless service, this research conducted a questionnaire survey in Hualien County, Taiwan. The findings from the analysis of the 230 returned sample data demonstrate that the new applications and service provided through WiMAX wireless technology is highly appreciated by the people. Based on these findings from surveys and in-depth interviews conducted in the local area, this paper proposes a strategy map for the development of the M-care (Mobile care) service through a five-force analysis of the industrial value chain and a SWOT analysis of wireless healthcare delivery in order to provide advice to WiMAX vendors on how to create new business for M-service provision.

Index Terms—WiMAX, M-Care, Wireless Service Business Model, Healthcare Service, Aging Society

I. INTRODUCTION

By the end of May 2006, the population of elder people in Taiwan (over 65 years old) reached 2,245,000, accounting for 9.85% of Taiwan's population. 39.54% of the elder need care and related service assistance, including social care and health care [1]. With the emergence of an aging society and the trend of longer average life expectancies, healthcare costs become a heavy burden for both the family and the government [2]. In addition, the population of elder people who either live alone or are alone during the daytime is growing dramatically, making the issue of healthcare a significant social concern that draw on ICT to provide service, as

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well as remote monitoring in the home environment. Furthermore, the appropriation of ICT could conceivably reduce the cost of healthcare, resulting in the promotion of healthcare and other ICT related service industries development. Therefore, as the underlying call for ICT in healthcare grows, advanced ICT applications should be developed and adopted in healthcare activities [3]

This paper is an empirical study, based on first-hand materials and in-depth interviews, and provides not only an investigation into how to create value through a wireless network that facilitates healthcare service, but also analyzes the business strategy for creating a new business model to merge healthcare-related industries that is focused on highly value-added IT healthcare appliances. Consequently, this paper conducts a field study and questionnaire survey to explore the users' demand in wireless appliances and service. In accordance with the findings, the researchers propose a strategy matrix for the development of the healthcare industry based on the five-force analysis of the industrial environment and the SWOT analysis of the new value-added IT healthcare appliances.

II. CASE BACKGROUND

The much-anticipated technology of WiMAX, the Worldwide Interoperability for Microwave Access, aims to provide business and consumer wireless broadband services on the scale of the Metropolitan Area Network (MAN) [12]. This paper aims to examine the experience of the WiMAX project in Hualien, which was deployed to execute strategies to implement a new wireless business model of healthcare. WiMAX is a standard-based wireless technology that provides high-throughput broadband connections over long distances. Based on these characteristics, WiMAX not only provides wireless access technology, but also acts as a supplement to landline networks (Cable, DSL), especially in remote areas. As such, the Taiwanese government has been actively promoting the E-Taiwan and M-Taiwan (Mobile Taiwan) Projects for many years in order to accelerate the

penetration of the ICT infrastructure. One of M-Taiwan's objective aims to connect all kinds of networks, integrating mobile networks and wireless networks, which would create the first dual-network application service in the world. Now, this project has already been deploying WiFi and 3G, and has begun to promote WiMAX in order to accelerate the progress of the M-Taiwan project [4].

This case is focused in the Hualien County, which is located beside the Pacific Ocean. Hualien County is 240 km long from north to south, with coastal mountains and beautiful natural sceneries. Its population density is low and the proportion of elderly people is high, as members of the county's younger demography usually leave to find jobs in other cities. In order to address the issues of the aging population proportion and digital division, the Taiwanese government cooperated with the private sector to deploy a pilot project, with the focus directed at developing the WiMAX network and operations in the eastern area of Taiwan, where ICT infrastructure penetration is low. The telecom operator tried to propose an innovative service provision in integrating healthcare, security services and other social and commercial activities, through the adoption of WiMAX applications. See Figure 1.



Figure 1. Tatung Co. M-care business plan in Hualien

III. BUSINESS MODEL, M-CARE SERVICE AND ITS VALUE CHAIN

A. Business model and M-care service

Business models is the way in which managers configure the value chain of the firm through strategy, so that they can build the distinctive competencies necessary to attain efficiency, quality, innovation and customer responsiveness required to support the firm's position, thereby achieving a competitive advantage and generating superior profitability[5]. Some research find that business models equal revenue models, while others reserve the term to denote the value creation logic of new business initiatives. None of these approaches provide a perspective on cross-company collaboration in complex value networks because they focus on business models of

a single company. We focus on service offerings that require cross-company collaboration, and on a business model as a blueprint for how a network of organizations co-operates to create and capture value from technological innovation [9].

For commercializing wireless service, the design and configuration of a business model is vital to sustaining open innovation. It contains important implications that the diffusion of technology, by the creation of new business models, will accelerate the provision of further service methods, through establishing co-development partnership [6].

Based on the analysis of some international cases and projects in countries such as the U.S., Finland, and Japan [7][8], we conclude that these ICT enabled healthcare services should include: (1) self-healthcare management in family; (2) physical/health information measurements instruments: blood pressure meter and blood sugar meter; (3) front physical/health information processing: integrating the format in various types of data transmission (e.g. transfer simulating data to digital data), digital level, and transmitting ports; (4) single-service portal based on websites: providing services such as query, application, data exchange, and purchase through the portals. The service needs to be connected by Internet technologies (e.g. outpatient registration system, patient transfer system, etc.); (5) integrated healthcare platform: after the physical information has been transmitted into the database, the healthcare information system should play the role of the center for all services, processes, and subsystems; (6) emergency aids: reporting (succor) accidents, consultations, and video monitoring.

One company proposes that the M-care service items provided in Hualien County offer the following: (1) online safety; (2) message notification; (3) health measurement: collection of the user's physical data continually through a non-invasive physical examination system. The data collected is transmitted to the remote server via a landline or wireless network. The data is subsequently transmitted to the host computer of the community health center via wireless network. The user can browse or download this data through the community health system him/herself; (4) E-business platform: this platform provides an integrated purchasing service based on the integrated well-being information of the elderly, such as well-being activities, therapy information for the elderly in all hospitals in Hualien County, and websites for the elder well-being. It is also augmented with supplemented service which can increase the hit rate and attractiveness of the website.

The aforementioned services demonstrate the feasibility of packaged M-Care. In addition, the application of ICT in healthcare can create many innovative ICT enabled services supported by WiMAX wireless networks, such as interactive services, real time reporting, message notification services, electronic physical information collection (i.e. it can provide long-term tracking of physical health and create a detailed patient history that is helpful in therapy), real time feedback, Healthcare platforms (e.g. an electronic

healthcare integration platform), monitoring and reporting on the safety of members within a family, remote medical information transmission, local based safety, care service, and mobile business.

B. Value Chain of M-care service

The value chain of the M-care sector, based on data collection and in-depth interviews with knowledgeable experts, is summarized in the following figure:

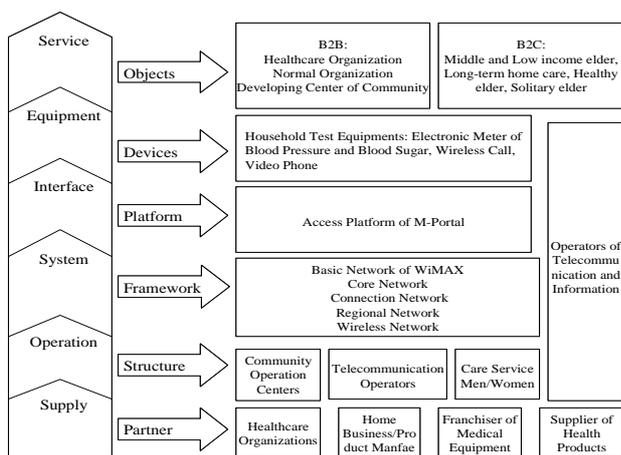


Figure 2. The value chain of M-care service in healthcare

Telecommunication operator could take a “package sales” strategy in offering innovative M-care service. By merchandising long-term WLAN service plans, combined with VOIP and mobile service/support or discounts, this package could become a primary strategy in WiMAX sales. At the same time, providers can also take a multi-faceted alliance approach through the collaboration of entities from different sectors, such as medical clinics, community and healthcare organizations, and other related telecommunication players. Such an alliance would help the foundation of a supply chain in medical care services, and encourage the creation of an M-care network and related added-value service, using WiMAX as the means for communication (WWW or VOIP). Through the digital divide and the coordination of resources, healthcare equipment will reach standards that will accommodate and satisfy home healthcare needs.

The creation of such a partnership relation between all players, utilizing packaged sales and a multi-faceted alliance, inherits the following advantages: (1) promote WiMAX application in Hualien County, through packaged sales strategy, and provide convenience and lower cost web access which would aid in decreasing digital divide while enhancing value-added applied services; (2) bolster the company’s foothold and prior strengths in the local community as it enters previously unknown territory, namely the healthcare sector, and create a grouping effect leading to a single window interface that provides a composition of services. This would build a win-win scenario for both the company and related suppliers.

IV. RESEARCH METHODS AND DATA ANALYSIS

A. Research Methods

The researchers developed a questionnaire to investigate the demands and acceptance of the promotion of WiMAX wireless service provision. Questionnaires were sent to visitors of the Hualian ICT exhibition in September 2006. 320 questionnaires were sent and 72.5% (230) of them were returned. 224 questionnaires are valid, 62.6% of them were answered by male respondents, and 37.1% of them were answered by female respondents.

The questionnaire was composed of three parts: the

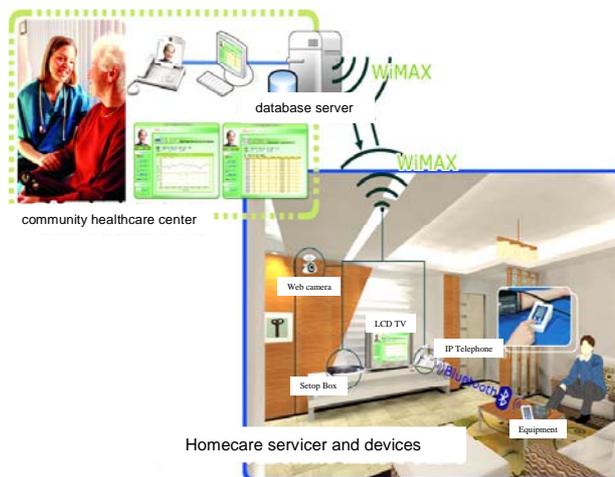


Figure 3. The scenario of new healthcare service provision

first part focused on the awareness of mobile/wireless applications and services; the second part focused on understanding people’s perceived concept and cognition of wireless application products (including both devices and services) such as their understanding of product functions and its devices and services, their knowledge on the importance of the products and equipments, and their purchasing inclination and the prices that they perceive as acceptable; the third part focused on the basic information of the respondent, such as gender, age, education, profession, fostering situation, habitation situation and income. The software SPSS 14.0 for Windows was used to analyze the collected data. We used statistic description and one way analysis of variance (ANOVA) to conduct the comparison of the characters of different respondents and determine the characters of different groups. Our objective was to provide some valid information to practitioners that will help them do more effective market location selection and segmentation.

B. Results

For the analysis results on the wireless application service of Tatung Co., most respondents answered that they were aware of the function and contents of telemedicine and related m-services provided by Tatung Co. 81.3% respondents know of VOIP, while the awareness rates stand at 73.7% for mobile health care (M-care), 78.1% for mobile tours guiding service (M-Portal), and 83.9% for wireless internet service (WIS).

In terms of the importance of products on the four domains of VOIP, M-care, M-portal and WIS, 87.3% of respondents think that the cost-saving of VOIP is

important, while 76.5%, 83.1% and 82.6% think that video display, call function and wireless communication are important, respectively. In the M-care, the proportion of respondents who think a function or service is important varies, with the figures standing at 77.8% for blood pressure measurement, 75.3% for blood sugar measurement, 86.2% for automatic saving and recording physical information, 84.8% for surveying long-term health information via internet, and 87.8% for health situation reminder services. Generally, most respondents think that the importance of products on VOIP, M-care, M-portal and W access service domains are very important.

Since respondents differ in various aspects, it is necessary to identify significant disparities in their understanding of importance and practicality on four levels (VOIP, M-Care, M-Portal, and WIS). In this case, we chose ANOVA to analyze whether there is a significant deviation. The results show that even with the inclusion of factors including age, education level, vacation, and gender, there is no significant deviation in understanding of importance (as p value > 0.05). Similarly, considering the aforementioned factors, we find no significant deviation in understanding of practicality on all four levels.

Concerning respondents who are willing to use

TABLE 2. THE ANOVA ANALYSIS IN SIGNIFICANT DEVIATION

		VOIP	M-Care	M-Portal	WIS
Age	F Test	0.524	0.159	0.306	0.768
	P Value	0.758	0.977	0.909	0.574
Education	F Test	1.003	0.898	0.575	1.321
	P Value	0.418	0.484	0.719	0.265
Vacation	F Test	0.265	0.406	0.562	0.871
	P Value	0.932	0.874	0.760	0.518
Gender	F Test	0.344	0.099	0.009	0.432
	P Value	0.558	0.754	0.925	0.512

WiMAX related products, cross-reference analysis indicates that in the category of low-price range consumers (<NT\$800), 47.2% of respondents would prefer to purchase VOIP functions, and 77.9% were willing to purchase VOIP and M-Care functions. In the category of mid-price range consumers (NT\$801-1200), 42.9% of respondents would prefer to purchase M-Care functions, while 81.0% were willing to purchase VOIP and M-Care functions. In the category of high-price range consumers (>NT\$1200), 54.8% of respondents would prefer to purchase VOIP functions, while 83.4% were willing to purchase VOIP and M-Care functions. However, despite pricing, less than 2.4% of respondents showed preference in purchasing M-Portal function. Also, respondents willing to purchase Wireless Access Service decreased from 21.3% in the category of low-price range consumers to 14.3% in the category of high-price range consumers.

Overall, from the above analysis concerning VOIP, M-Care, M-Portal and WIS, 91.7% of respondents believe that WiMAX products are important and a pivotal factor

in providing convenience to desirable internet access, whether in location or time. At the same time, our analysis shows no significant deviation in the understanding of importance and practicality from respondents, regardless of age, education, vacation, or gender, thus indicating a consensus from all respondents. Lastly, the survey reveals that 83.4% of high-price consumers would prioritize the purchase of both VOIP and M-Care functions, while less than 2.4% of respondents were willing to purchase M-Portal functions, regardless of pricing.

V. THE ANALYSIS OF COMPETITIVE STRATEGY FOR THE M-CARE SERVICE SECTOR

A. Five Force analysis of M-care sector

“Telemedicare service in the home” is one of the projects in the new service industries development plan of Taiwan in 2008. This plan estimates that this sector will have a market size of 7 billion NT dollars. The five-force analysis can help us understand the competitive environment and key factors for competitive advantage.

Rivalry among the existing players

The emerging m-care service provides new business opportunities in an aging society. Though the healthcare market has gradually matured in Taiwan, many firms have begun to appropriate advanced ICT enabled services for healthcare. Most large hospitals, telecommunication providers, and care service providers are currently on their way to promoting ICT deploying projects and integrating related players. Moreover, the Taiwanese government is promoting a project named ‘U-care pilot project for the aging society’. It can be expected that this sector will experience fierce competition in the future.

Suppliers

Suppliers in the Telemedicare industry include hardware and deployment of service providers for WiMAX, large hospitals and/or communities and associations which provide voluntary service in healthcare, and local hospitals and doctors who provide emergency care service.

Customers

Customers may include social well-being institutions belonging to the government or private sectors, communities or associations, local hospitals, local elderly, and family members of the elderly. The target customers of healthcare are wealthy and self-dependent senior citizens who highly care about their health. The company can provide differentiated services through related hospitals, communities, associations and well-being institutions.

Substitutes

The substitutes for healthcare services are provided through family members, neighbors, local and foreign labor, security service providers, well-being institutions, voluntary organizations, local hospitals, traditional healthcare centers, and healthcare villages. Furthermore, all healthcare services are currently still labor-intensive activities.

Potential competitors

In 2005, the Industrial Technology Research Institute (ITRI) organized an industrial alliance for Telemedicine service. At the same time, large hospitals and care institutions were also paying attention to the demands of Telemedicine service in the home environment. Other local ICT and telecommunication companies showed interest in entering healthcare industries, as were security service providers who wanted to integrate security monitoring and care services. Thus, all members in the value chain have their own interests in providing similar services.

As the population of senior citizens continues to grow at a rapid pace, so too will the demand for in-house Telemedicine service. Furthermore, the low technological barriers for M-Care, combined with the large numbers of related players, will lead to the emergence of fierce competition in the market. Therefore, this paper advises that success of healthcare providers should stress providing integrated healthcare services through the integration of virtual marketing channels, ICT applications, healthcare operation modes and its supplier chain.

The demand assessment indicates that M-service providers need to set up cross-sector alliances and cooperate with related players within the industry. This will allow for the sharing of the risks inherent in the endeavor as well as the acquisition of a larger market share through the provision of more integrated services [9]. In this case, it suggests that healthcare service providers should continuously integrate supplementary services and innovative applications to increase attractiveness and transfer cost of use as well as acceptance.

D. SWOT analysis of M-Care services

The M-Care services and related industry competition analysis results are listed in following:

Strengths

- 1) Records the user's physical data automatically and builds a database of physical/health information for tracking progress toward healthcare goals.
- 2) Reduces the cost of accessing physical/health data and creates a portable personal health record with the help of WiMAX wireless technology.
- 3) There is a special level in WiMAX for certifying, classifying, and encrypting during data transmission.
- 4) The farthest transmitting distance of WiMAX is longer than others, which requires fewer base stations than peer network options.

Weaknesses

- 1) The business sector does not have sufficient confidence in WiMAX as of yet.
- 2) Wi-Fi occupies a big market share and has already matured for many years.
- 3) The physical data collected through non-invasive examination is limited.
- 4) Because there exists a lack of face-to-face confirmed measures when the user is unconscious, the function of real time notification will fail.
- 5) The elderly are not familiar with the new ICT, and may have a difficult time adopting to the electronic devices and services.

6) Wireless applications have an image of high price and low visibility for the public.

Opportunities

- 1) With the trend of an aging society, the population of the elderly who need care will increase rapidly.
- 2) The long-term localized service and the need for a healthcare network are emerging as a result of the aging society.
- 3) More attention has been paid to social well-being, while discussion on care needs has also increased in Taiwan.
- 4) The Taiwanese government encourages the development of ICT enabled service and promotes all parties to build a strategic alliance to strengthen competitive advantage.
- 5) The government supports the application of WiMAX and has added it into the M-Taiwan project.

Threats

- 1) The leading fixed network telecomm company also promotes healthcare services based on the integration of wireless technologies such as Wi-Fi, 3G and WiMAX.
- 2) There will be furious competition in the healthcare industry, since there are many providers.
- 3) For promoting new mobile service, creating business model should balance strategic interests and technological requirements in capturing value and profitability from this new service through assessing supply and demand sides of m-care industries [10]. Based on the aforementioned analysis results, we propose a policy to propel M-Care. The analytical results will also

TABLE 2. THE SWOT ANALYSIS FOR STRATEGY FORMULATION

	Strength	Weakness
Opportunity	II.	I.
Threat	III.	IV.

reveal competitive advantages, strategies to prevent risk, and business models.

In the first quadrant, M-Care need has increased and the advantage of WiMAX has shown solid performance, while the consumers, especially the elderly, and industry may not have sufficient confidence in WiMAX as of yet. Moreover, limited non-invasive physical data collected with the image of high price and low visibility result in a barrier to consumer purchase of such wireless applications and its service. To remedy this problem, companies can utilize the Taiwanese government's social welfare program to directly assist families and elderly in need of M-Care services. Companies can also work with local medical/healthcare and social welfare institutions to encourage public usage of services while enhancing public awareness and acceptance of M-Care.

In the second quadrant, companies that have garnered the support of the Taiwanese government in the M-Care industry and the long-term localized service of the aging

society strengthen sales promotion and advertisement in the efficiency and effectiveness of using M-Care, thus attracting consumers to the products and increasing the market sharing of WiMAX applications.

In the third quadrant, where WiMAX players focus and compete primarily in healthcare, 3G, and fixed network, acceleration is a must in order to 'network dissimilar industries' through the ways of strategic alliance with other players. At the same time, there is the need to harmonize specifications through industry standards in order to accelerate WiMAX products into the market and provide more applications in M-care service and related services. One should note that through VOIP and M-Care packaged sales, and even by providing video phones to consumers, utilizing the imagery capacity of VOIP, to enhance the public's willingness to use WiMAX products, accept WiMAX M-Care service, and ultimately increase market share.

As for the fourth quadrant, the issue of risk avoidance should be considered. Under the worst case scenario, WiMAX's M-Care service providers should draft simulations, preventive measures, and contingency plans to lower the company's potential failure rate, whether in finance or production.

VII. CONCLUSIONS AND SUGGESTIONS

Because of the geographic disadvantage and the sparse population in Hualien County, adoption of wireless access technology is very helpful in reducing the digital divide. In addressing the shortage of health resources, electronic investments and networks of support facilitate not only connections of rural residents to high-quality care, but also generate better outcomes as the system leverage clinical expertise. Moreover, the telemedicine programs decrease time-to-diagnosis, save financial resources, and reduce hospitals stays [11].

WiMAX is characterized as possessing remote and fast transmission, high bandwidth, and mobile advantages, thereby enabling it to provide alternative solutions to effectively address healthcare challenges as well as alleviate the issues of unbalanced development inherent in eastern Taiwan. The adoption of an M-care platform, electronic healthcare records, and the establishment of partnerships between suppliers is seen as the catalyst for facilitating innovative healthcare services with the help of advanced wireless technologies. Moreover, M-service providers also design integrated and packaged services which bound M-care to in-house security monitoring and other location-based services that are more convenient as well as the personnel security and interactive service through the WiMAX network. Consequently, M-service providers could create niches and synergy in service provision and reinforce the competitive advantages created by differentiation. Suggestions on how the provider can accomplish this are as follows:

Short term strategy

WiMAX company should develop a business model in provision of M-care service before the emergence of competitors, as well as a need to establish collaborative relationships with its partners in the M-service value

chain. In fact, the firm may take large advantage of e-health system market shares and incubate a famous brand through its advantage in the original market channel. Thus, the first priority in business policy agenda setting should be to focus on the development of cooperation with health/care professional companies and institutions in the health/care industry to facilitate the provision of M-care service and acceptance of users.

Middle term strategy

Since the pricing of M-service is an issue critical to success, it is suggested that WiMAX Company adopts the flat-rate pricing policy as it operates these WiMAX networks and provides M-services. In order to realize the benefits from economies of scale, the firm should try to maximize the market sharing rate of WiMAX, which will in turn increase the level of users and allow for the provision of package services at lower prices firstly. Then, the other innovative M-care applications could be created by extending the scope of extant mobile service provision. The logistic areas of physical distribution, such as e-commerce, have the potential to stimulate the demand for in-house packaged services. In fact, in-house ICT applications are very beneficial for facilitating the success of the "aging in place" policy in an aging society. The other applications – such as VOIP, M-tourism, M-government, and M-learning – should be encouraged through adoption in the public sphere.

Long term strategy

By bundling all the services into one package, Tatung Co. has adopted the low pricing policy strategy to promote M-service. It is possible that users will adopt M-service for many purposes because of the increased attractiveness of the fixed price offered for multiple services. The target customers of M-care are not only the elderly, but also parents and the disability since the functions are compatible for many purposes. Moreover, M-care service envisions ICT application for the Digital Family, which will offer many devices or media to facilitate a better environment for the care of families everywhere, via the WiMAX network.

Based on the analysis of the niche, marketing channel and competitive strategy of WiMAX products, it is obvious that telecom company would establish the 'strategic alliance' with partners in the healthcare industries, which means that it can construct a healthcare service supply chain by integrating all healthcare service suppliers such as hospitals, community health centers, and related telecommunication and logistics suppliers.

In fact, following the trends in wireless broadband deployment is the emergence of a wireless commons, a variation of the community-based model, the successful M-care business model would offer the service through collaboration in complex value networks, especially with the involvement of community organizations, local government, and other vendors who wish to enhance connectivity, and thus quality of life in a given neighborhood [13]. Then, the companies of strategic alliance would try to design a set of service packages, providing highly value-added services through the appropriation of the WiMAX, under the expectations of

innovative technology providing more throughputs to enable data-intense applications and multimedia experience on wireless.

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