國立政治大學科技管理研究所碩士學位論文

電信業界之雙網整合趨勢研究

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誌　謝

2002 年，我幸運地進入政大 EMBA 科管所。大學畢業超過二十年後，我重拾學生生涯，暫拋紅塵的煩瑣，在翠綠滿盈的校園認識老師同學，分享知識、工作和生活，這是多麼難得的福份和機緣。

感謝吳思華，李仁芳，溫肇東，吳豐祥，尹啟銘，于卓民等師長的帶領，你們努力歸納、整理、介紹的各種管理理論、模型、方法論，幫助我跳脫日常工作模式與格局，去思考和吸收管理大師們的智慧，從不同角度看待企業與個人的挑戰，受益良多。

精彩課程與個案討論固然有助於學習，更深刻的學習卻是源自週遭同學們的真實際遇。就在上課的同時，過半數同學轉換跑道--換行業，換公司，有的創業，更有多位改變工作地點，從大陸到北美到歐洲，大家共同見證了現代社會與產業環境的**多變**本質。同學們在中年負擔最重之際，仍然勇敢面對人生的變局，戮力向前，真讓我感動與欽佩。在此對我的同窗獻上深摯的祝福和感謝，與你們共度的美好時光長在我心，縱使海角天涯，情誼永存。

2003 年年底，我參與共同創立的友笙資訊公司被宏達電子公司併購，我和其他三十位同仁因此加入宏達，開啟職涯的另一段奇航。宏達電子以生產製造智慧型手機與 PDA Phone 見長，其獨特而成功的「電信運營商品牌」經營模式(Carrier-brand)，讓我們得以窺見歐美先進電信產業的無窮商機。本研究論文也是受工作環境之啟發而得到靈感，並有機會和同仁切磋討論，方得完成。謝謝宏達電子周永明總經理的支持，及同仁陳學群、吳祖進、曾俊豪的知識與心得分享。

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摘　要

　　本研究旨在探討固網及行動電話業的**雙網整合**(Fixed-Mobile Convergence，簡稱 FMC)，造就此一趨勢的市場背景及促成技術，影響此趨勢未來發展走向的因素，電信業界的實施方式，與手機製造業的機會。

　　為何要討論固網及行動電話的整合? 因為它是近兩、三年來全世界電信業界最重要的發展趨勢，是電信業與網際網路的碰撞及交融，電信業界的典範轉移，也是固網業與行動電話業的大競合。它會影響電信業版圖勢力的重整，電訊網路的變革，手機功能的調整，服務提供的方式，是整個「未來世代網路」(NGN: Next Generation Network)的核心議題。

　　什麼是固網及行動電話的整合? 簡單說來，是指在同一支手機或 PDA 上，既可接打一般行動電話，又可打網路電話(Mobile Voice over IP)。換言之，雙網整合的行動電話同時具備 GSM 與 Wi-Fi 兩種網路之接取能力，在 Wi-Fi 範圍內時打網路電話，不在時就仍用 GSM 打電話，由於網路電話通常免費或價錢很低，如此既得到良好通話品質，又享受最低通話費用。要做出這種產品與服務，除了需要手機製造端的技術整合外，電信業者也需整合其通訊網路技術，並更新服務模式，牽涉層面十分廣泛。

　　本研究發現，促成雙網整合的市場因素包括:
　　(1)　有線電話逐漸被行動電話取代，固網業者為奪回市場佔有率，遂以雙網整合模式推出新的服務模式
　　(2)　行動電話電信業者希望降低客戶轉換率
　　(3)　電信業者增加收入的壓力
　　(4)　消費者簡化通訊方式的需求

　　而雙網整合的促成技術包括:
　　(1)　「網路電話」(VoIP)技術的發展
　　(2)　無線寬頻技術的發展，固接式寬頻連線的普及
　　(3)　整合式手持通訊裝置的製造技術日益成熟，市場接受度高

　　如何實施雙網整合，固網電信業與行動電話電信業各有不同打算。純粹的固網電信業多選擇成為「虛擬行動電話業者」(Mobile Virtual Network Operator)，或與行動電話電信業策略聯盟，以取得後者在行動電話網路的接取能力。同時，它們以具備 Wi-Fi 接取點功能的「家用閘道」(Residential Gateway)，與 Cellular/Wi-Fi 雙網手機，提供家庭用戶雙網整合的服務。在未來電信網路設備的選擇上，多傾向採用符合 IMS (IP Multimedia Subsystem)標準的產品。

行動電話電信業者則多選擇 UMA (Unlicensed Mobile Access) 技術，在其基地台建設中，加入 UMA 網路控制器，並提供 UMA 雙網整合手機與服務給用戶。目前有多家行動電話電信業者在測試此技術與服務模式。如果採用 UMA 技術，未來如何與 IMS 技術接軌，會是行動電話電信業者需要考量的議題。

　　未來會影響雙網整合發展的因素則為:
(1) 標準的採用: 雙網整合相關的標準包括 SIP (Session Initiation Protocol)，UMA 與 IMS 等。SIP 與 UMA 目前已有產品問市，IMS 則有待未來。
(2) 電信業者的經營模式是否成功，即推出的雙網整合服務的產品與價位，是否足以吸引消費者換機，與學習新的使用模式
(3) Wi-Fi/Cellular 雙網手機有耗電量，通話品質，使用方法友善程度等問題，這些是消費者能否接受的關鍵因素
(4) 企業界整合語音通訊與資料通訊的意願及速度，並將辦公室交換機昇級至 IP PBX 的決心。企業界將會是雙網整合技術最早的採用者，其使用經驗將對一般消費者有很大影響力。

　　雙網整合的真正主角，是具備雙網整合能力的智慧型手機。手機製造業者在此趨勢中的市場機會包括:UMA 雙網手機，SIP Wi-Fi 單網手機，SIP Wi-Fi/Cellular 雙網手機等。但要製造這些手機，需解決許多技術問題，包括:數位語音壓縮/解壓縮方法，回音消除處理，Wi-Fi 耗電問題，Wi-Fi 通訊之安全保護機制，使用者介面整合，互通性測試等等。再加上雙網整合的遊戲規則是由電信業者制定，如何使手機與電信業者的服務模式搭配完美，是一大挑戰。

　　雙網整合目前仍在發展階段，相關的標準、技術、產品、與服務皆未臻成熟，非常值得持續的研究與觀察。

Abstract

"Fixed-mobile convergence" (FMC) is the theme of study in this research. This research attempts to find out: 1) the "Pull" forces coming from the market demand for FMC solutions; 2) the "Push" forces of the enabling technologies that make FMC possible; 3) the factors that will impact FMC's future; 4) how the carriers are deploying FMC; and, 5) FMC-related opportunities for the mobile phone manufacturers.

FMC is about the convergence of telecommunication world and the Internet world. It is the former's endeavor to benefit from Internet's low cost, and richness in online services. It stems from the business battle for market share between the fixed network operators and the mobile operators, and it will affect the future power span of these operators. FMC trend includes the following aspects: terminal devices, services, business models, and network technologies. It is so crucial in forming the telecommunication industry's future, which makes it the core subject of Next Generation Network implementation.

FMC is the enablement of mobile phones to use fixed network technologies, such as Wi-Fi network, corporate LANs, IP PBXs, and so on. A Wi-Fi/Cellular dual-mode mobile phone has telephony capability on both Wi-Fi network via mobile VoIP (Voice over IP) technology, and on cellular (such as GSM) network. When the end user is within the Wi-Fi hot spot coverage, the voice communication will be on top of IP. When the user is out of Wi-Fi coverage, then the phone calls are running on cellular network. For the consumers, this technology promises "any time, any where" ubiquitous connectivity and mobility, while at the lowest possible price, since VoIP is normally free or has very low cost. To deploy such products & services, the operators have both technical & business issues to deal with.

Based on the findings of this research, the market demand which accelerates converging mobile & fixed network include:

- Fixed-mobile substitution (FMS), which means people are using mobile phones more often than fixed-line phones. In many Western European countries, about one third of the household do not install fixed phone lines any more. They only use mobile phones as communication vehicle. Under such circumstances, fixed-line operators are forced to fight back for their market share. FMC is one of such strategies for launching new products and services to win back the end customers.

- Mobile operators need to lower the subscriber churn rate, for which they are losing customers. In the United States and some areas in Europe, mobile phone coverage in residential area is unsatisfactory, due to the high cost of building up cellular infrastructure to cover vast space. This is the main reason for the subscribers to switch operators, for the mobile operators, FMC seems a logical solution. Since household penetration rate of high-speed broadband access is high in US, Europe, and many Asian countries, with a Wi-Fi access

point and Wi-Fi/cellular dual mode phone, even when the cellular signal strength is weak at home, the user is still able to make phone calls using Mobile VoIP technology on Wi-Fi. This is the origin of UMA (Unlicensed Mobile Access) technology and standard, which mobile operators are pursuing.

- All network operators are under constant pressure for growing their revenue, since voice service has quickly become a commodity when flat-rate tariff model is getting prevalent. With FMC solution, mobile operators could earn back the users who are attracted away by the low cost of Internet telephony. For fixed-line operators, FMC is a mechanism for providing packaged deal of broadband access and dual-mode mobile phones. More over, they could provide "quadruple play" services to support IP TV, Video on Demand, and other Internet services to increase their revenue.

- "Less is more" mentality of the consumers. Most consumers or working people nowadays have at least three telephone numbers: home phone, office phone, and mobile phone. Each one of them has its own phone bill, voice mail box, and phone book. Some people even have e-mail account, instant message account, and Internet telephony account (such as Skype screen name). The mobility or interchange between these mechanisms of communication, and to manage them is becoming complex. The consumers are asking the mobile operators to integrate their services and phone bills, which again, pulls the operator to FMC solutions.

The following are the enabling technologies that facilitate the development of FMC. Without these technologies, FMC can not take root in the telecommunication industry, and generate commercial products in the future.

- VoIP (Voice over IP). VoIP service, products, and PC-based software clients have flourished in the past several years along with the exponential growth of the Internet. With the success of Vonage (pure-play VoIP service provider) and Skype (peer-to-peer internet telephony network based on PC), internet telephony has entered the main stream. Network operators that seek to lower the operation cost are turning to this technology as well. Mobile VoIP over EVDO, HSDPA, Wi-Fi, & WiMAX are getting a lot of attention recently since it can help to reduce the tariff, thus attract more users. For Mobile VoIP technologies to secure its market foothold, many issues need to be tackled, such as AEC, voice codec (compression & decompression), jitter buffer handling, SIP (Session Initiation Protocol) stack and RTP (Real-time Protocal) stack handling, power consumption, telephony UI integration, and so on.

- High density of wireless broadband network such as Wi-Fi and WiMAX, and wide spread availability of wired broadband access such as xDSL and FTTH in school campus, office buildings, hot spots, transportation hubs, and homes, lay the foundation of FMC. Without such infrastructure, FMC can not thrive.

With the combination of both wireless and wired broadband accessibility, Wi-Fi/cellular dual mode phone becomes practical and useful to the general public.

- Converged handheld devices with multiple functionalities like push e-mail, PIM (Personal Information Management), Camera, SMS/MMS, internet browsing, phone book, Calendar, and so on, are getting very popular among business professionals in the last two, three years. With the advent of 3G network, data transmission need for email and SMS, more than voice, has increased peoples' appetite for more powerful devices. Smartphones or PDA Phones that use open operating system such as Windows Mobile, Linux, or Symbian, have become powerful productivity and connectivity tools that cater to consumers' needs, and have gained great success. The market demand helped to increase the sales volume, and drive down the unit price, which in turns stimulate more buyers.

  Bluetooth and Wi-Fi capabilities are newly added functions that further facilitates mobile VoIP in an economical way. Once the phone makers have taken care of issues like AEC (Acoustic Echo Cancellation), voice codec (compression/decompression), power consumption, integrated user interface for telephony, CPU loading, GSM/Wi-Fi handover, and so on, the Wi-Fi/Cellular dual-mode phone are taking the center stage of FMC.

The factors that will impact the future direction of FMC:

- Uncertainty of the FMC-related standards, especially for UMA (Unlicensed Mobile Access). UMA was adopted as FMC solution mostly by the mobile operators, however, it was considered as an intermediate solution toward IMS (IP Multimedia Subsystem), which so far was mainly adopted by fixed-line operators. UMA-compliant products are yet to be launched and proved by the market in the later half of year 2006, its fate uncertain at this moment. SIP (Session Initiation Protocol) is now de facto standard for VoIP, yet its implementation has many variations depending on the vendor. As for IMS (IP Multimedia Subsystem), its standardization process is still undergoing, VCC (Voice Call Continuity) specification is not final yet, the commercialization of IMS could take another two to four years. With all these standards evolving, both consumers and businesses could hesitate in their purchase decisions, and this may impose negative effect on FMC.

- Business model of the operators. How they are going to launch FMC service, at what price, with which handheld device, will affect the end customers' willingness to purchase. They need to provide good incentives for the end users to switch to the new dual-mode phone, and the UI needs to be intuitive enough to shorten the learning curve, and at attractive price.

- As described above, the quality of the handset itself plays a critical role on the

future of FMC, and its user friendliness and benefits will define the development of FMC.

- How fast the enterprises will upgrade their PBX and networking facilities to integrate outbound data and voice communication. VoIP, IP PBX/Centrex, office software, and phone vendors are working together now to provide the enterprises "premised-based" FMC solutions. These solutions promise the executives more efficient administration of the phone bills, better productivity of the employees, and better customer relationship, and so on. Enterprises are the early adopters and test beds for FMC. If they find it useful, it will be helpful for the sales and distribution to the home and personal market.

FMC deployment strategy varies from one operator to the other. Pure-play wired operators tend to become MVNO (Mobile Virtual Network Operator), or at least to have alliance with the mobile operators, so that they could get access to the mobile network infrastructure. Since wireline operators in most cases are also suppliers of broadband service to the home, they will take advantage of this infrastructure, and provide residential gateway (e.g. Wi-Fi access point) and Cellular/Wi-Fi dual-mode mobile phone as the FMC solution for the home market. In preparing for future, they tend to select IMS-compliant network equipments.

Mobile Operators prefer UMA technology as FMC solution. It is comparatively simple in deployment in the network. Quite a few mobile operators are now in trial run of UMA. In the future, how to migrate UMA to IMS will be a challenge for those who adopt the former.

For the mobile phone makers, FMC trend indicates the market opportunity of: UMA dual-mode phone, SIP Wi-Fi single-mode phone, and SIP Wi-Fi/Cellular dual-mode phone. Yet, unlike general purpose consumer market, these FMC phones need to be tied hand-in-hand with the operators for better integration of services and tariff plans. If these solutions are targeted at the enterprises, the phone makers need to work with IP PBX vendors as well. How to work with these parties, and come out good, integrated phones, is a great challenge.

Fixed-mobile convergence is still evolving in the telecommunication world, with many vendors and parties involved, and each has its unique way of FMC implementation and business model. How it will turn out takes continuous research and observation. Due to its scale and influence for the future, the effort will definitely be worthwhile.