UMTS — THE DATA STORY

PROFIT OPPORTUNITIES FOR OPERATORS

A Shosteck Group White Paper

Published January, 2004

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The Shosteck Group
11160 Veirs Mill Road, Suite 709
Wheaton, Maryland 20902–2538 USA

Telephone: 1+(301) 589 2259 Fax: 1+(301) 588 3311
Email: jzweig@shosteck.com
Web: http://www.shosteck.com

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CHAPTER ONE

Our first study concluded that UMTS/W-CDMA will provide increased capacity and, as a consequence, lower operator costs, particularly in terms of voice.

However, to gain the full revenue potential of UMTS/W-CDMA, operators must support data.

This study examines the extent to which UMTS/W-CDMA will lower operator costs, how far operators might reduce tariffs, and the extent to which such reductions will increase traffic, revenues, and profits. In addition, it explores the strategies that operators might pursue to expand data revenues.

CHAPTER TWO

UMTS offers operators two key advantages. **First**, through its W-CDMA air-interface and new spectrum allocation, it delivers greater capacity than does GSM-GPRS or EDGE. **Second**, because of its more efficient air interface, it provides a lower cost per bit transmitted than does GSM-GPRS or EDGE. The greater capacity and lower cost are now available through Release 99.

This lower cost will enable operators to reduce tariffs and, thereby, generate greater traffic. Greater traffic will lead to greater revenues and profits.

Subsequent releases of UMTS will specify greater functionality and eventual migration to an all IP network. This will stimulate more applications and, in turn, revenues.

CHAPTER THREE

Node B base stations will reduce per bit costs to 10.0 to 15.0 percent those of GSM. However, to derive "true" costs, one must account for other network elements, customer acquisition and care, and future declines in network hardware costs. Doing so indicates that over the next five years, the full costs of UMTS will fall to 19.1 to 28.7 percent those of GSM-GPRS today – or 3.5 to 5.2x less. Such savings assume a fully loaded network. This will occur as UMTS matures – at about the end of 2006.

These savings will enable operators to reduce tariffs by 50 percent and more. Indeed, Hutchison "3" in the UK has already done so.

The consequences will be dramatic. Network traffic – voice and data – will increase by four-fold or more. Average Revenue per User (ARPU) will increase by 50 percent or more. Non-SMS data revenue, as a percent of ARPU, will increase substantially.

We examine how this will occur in our next two chapters – as well as why UMTS operators will produce profitable operating margins, notwithstanding what we foresee as major tariff reductions.

Chapter Four

Since 1994, U.S. tariffs have fallen from $0.42-$0.90 per minute to $0.08-$0.12 per minute. As a consequence, between 1998 and 2002, use increased from 123 Minutes of Use (MoU) per month to 450 MoU. In contrast, during 2002, use in Canada averaged 265 MoU. That in Europe averaged 120 MoU.

The rates of these countries explain 95 percent of the differences in MoU. Despite rates that are less than one-half those of Europe, U.S. operators earned 46 percent more Average Revenue per User (ARPU).

Driven by lower rates, ARPU in the U.S. increased from $39.66 in 1998 to $49.95 in 2003. A beginning increase has emerged in Europe over the past 18 to 30 months. There, Vodafone's largest networks have seen gains in ARPU of 4.7 to 6.8 percent.

Despite intense competition, U.S. operators are experiencing increasing Average Margin per User (AMPU). European operators are beginning to do so. This indicates that the falling tariffs, which already are accompanying UMTS, will increase use sufficiently to expand profit margins rather than reduce them.

Chapter Five

This chapter examines emerging data use in Korea, Europe, and Japan. In Korea, we show that non-SMS data already contributes as much as ten percent of ARPU. This has been supported by a robust packet network and camera handsets. In Europe, we reveal that ARPU from Vodafone's non-SMS data has doubled from 0.5 to 1.0 percent over the past year. We interpret this as a harbinger of increased data growth to come. In Japan, we document that with an improved network and handsets, data subscribers and data traffic escalate. Total ARPU and data ARPU escalate with it.

This suggests that legacy European operators will be rewarded for their decision to defer the launch of UMTS until 2004, when the technology will have reached tolerable maturity. Because of that, subscriber take-up may be more rapid than some operators expect.

Chapter Six

In this chapter, we suggest how operators can position UMTS offerings to assure profitability. The commercial issue is not which services are possible under UMTS, but which deliver profit.

Operators can provide complex and expensive video-telephony. They can provide less complex and less expensive multimedia services, in particular video-streaming. They can provide a "smart pipe," which offers encryption, virus protection, position location, multi-user conferencing, and QoS.

To succeed commercially, such services must (1) provide high value to end-users, (2) perform well, (3) be inexpensive to deliver, and (4) be deliverable in large quantities.

At present, video-telephony fails in terms of performance and, potentially, in terms of costs. Video-telephony requires real-time delivery on a network that is not yet mature enough to provide it. That failure illustrates the importance of technology maturity. In contrast, multimedia services, in particular video-streaming of high-resolution images and videos, can succeed. They do not require real-time delivery. The network, even in its early stage, is mature enough to support them.

Over the near term, operators who focus on simpler and less expensive UMTS services are most likely to profit. With time, handsets will become more sophisticated. Networks will mature. These will enable operators to deliver more complex services than are feasible at present, and to profit from them.

Chapter Seven

In summary, the greater capacity and decreased cost of UMTS will have three essential effects.

First, UMTS operators will be able to offer services which are not commercially feasible on 2.5G networks. This will enable them to serve specialized segments that they cannot serve at present or, more likely, to expand services to such segments.

Second, UMTS will allow operators to deliver more sophisticated services with higher value. Downloadable sound will gain audio quality, downloadable applications can be bigger (and hence more capable), and multimedia content can provide increased resolution. This will enable operators to increase, or at least maintain, profit margins.

Third, UMTS will allow operators to deliver services with much less concern for capacity. The ability of UMTS to deliver services quickly to large numbers of customers at low cost will stimulate use and increase revenues.

CHAPTER 1: AN OVERVIEW

INTRODUCTION

We published our first study of UMTS/W-CDMA in September 2003. It forecast subscriber growth and handset sales from 2003 through 2007.[1] It concluded that for both voice and "data" (non-voice), the primary advantage of UMTS/W-CDMA stems from its greater capacity and **lower operator costs – in particular, costs for voice**.

In this study, we focus on **how UMTS/W-CDMA operators can accelerate revenue – and profit – from data services**.[2]

Our previous study discussed three drivers of UMTS/W-CDMA – (1) mandates by European regulators, (2) more capacity than GSM-GPRS-EDGE and (3) lower investment and operating costs as network traffic increases.

UMTS/W-CDMA enables high-bandwidth data. However, over the **near to mid-terms**, its **commercial** merit centers on delivering low-cost voice, and to a lesser extent, efficiently delivering mixed voice and data traffic.

UMTS/W-CDMA requires construction of a new radio access network (RAN). Operators will realize its cost advantages only after they have attracted enough subscribers – or more correctly revenue – to depreciate that investment. This will occur for the first networks between years-end 2006 and 2008.

Our previous study examined the constraints to UMTS/W-CDMA adoption. We concluded that technology immaturity was (and remains) primary.

We pointed to NTT DoCoMo, which, due to limited coverage and poorly performing handsets, saw a slow initial take-up of subscribers.[3] However, subscriber gains accelerated (and continue to accelerate) as DoCoMo expanded (and continues to expand) its coverage and introduced (and continues to introduce) improved handsets. We observed that the deployment challenges of UMTS are inherent to any new technology and will be substantially mastered by years-end 2004-2005.

We anticipated two to three million UMTS subscribers worldwide by year-end 2003,[4] increasing to 125 to 150 million by year-end 2007. We estimated sales of as many as 85 million UMTS handsets during that year.

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[1] *UMTS - When and Why It Will Happen: Timetables and Forecasts*, The Shosteck Group, Wheaton, Maryland, September 2003. Hereafter cited as *UMTS - When and Why it Will Happen*. For further information, see www.shosteck.com.

[2] UMTS Release 5 specifies an all IP network. This will enable mobile devices to run IP applications written for landline. That will expand the applications available to mobile users and, thereby, encourage greater mobile use.

[3] Technically, DoCoMo deploys a Japanese variant of UMTS, although it is shifting to the globally accepted standard.

[4] As of January 2004, we continued to hold this expectation.

Organization of the Study

We have divided this study into seven chapters.

Chapter 1 states our goal – to analyze how operators can position UMTS/W-CDMA to increase data traffic, revenues, and profits.

Chapter 2 outlines the UMTS releases and their advantages. The W-CDMA air interface provides lower-cost transmission than does GSM-GPRS-EDGE. In the future, full IP functionality will enable developers to write a single application for both landline and mobile users.

Chapter 3 quantifies the cost savings that UMTS/W-CDMA provides. Costs will fall as much as 3 to 5x below current levels. That will enable operators to lower tariffs by approximately the same, stimulating exponential growth in traffic.[5]

Chapter 4 analyzes the impact of lower tariffs. It documents that lower tariffs increase MoU and, with that, ARPU. Increasing AMPU follows.

Chapter 5 studies the data market. It documents robust growth of non-SMS data in Korea and emerging growth in Europe. Using DoCoMo's FOMA network, it traces the accelerated gains in subscribers, ARPU, and packet traffic as the technology matures. It concludes that data revenues may exceed industry expectations.

Chapter 6 examines how UMTS/W-CDMA operators can market classes of data services to increase traffic, revenues, and profits.

Chapter 7 discusses market segmentation.

Summary and Conclusions

Our first study concluded that UMTS/W-CDMA will provide increased capacity and, as a consequence, lower operator costs, particularly in terms of voice.

However, to gain the full revenue potential of UMTS/W-CDMA, operators must support data.

This study examines the extent to which UMTS/W-CDMA will lower operator costs, how far operators might reduce tariffs, and the extent to which such reductions will increase traffic, revenues, and profits. In addition, it explores the strategies that operators might pursue to expand data revenues.

[5] This would also enable operators to provide video-telephony at rates equal to or less than those currently charged for voice.

CHAPTER 2: WHAT UMTS DELIVERS

INTRODUCTION

This chapter describes UMTS technologies and how they will contribute to operator profits.

UMTS is standardized by the Third Generation Partnership Project (3GPP). It specifies a core network and three radio access networks (RANs) – GSM-GPRS, EDGE and W-CDMA.[6] W-CDMA delivers greater capacity, due both to its more efficient air interface and new spectrum allocation. The new spectrum enables deployment without interference, in contrast to GSM-GPRS or EDGE. The air-interface lowers cost compared to GSM-GPRS and EDGE. **This is W-CDMA's primary advantage**.

W-CDMA increases voice as well as data capacity. It provides greater flexibility in managing voice and data, particularly in later releases.

In common with all radio interfaces, the real-world performance of W-CDMA will be less than the theoretical maximum. Industry estimates range around 200 kbps.[7] This exceeds the 20-40 kbps of GSM-GPRS[8] and the 60-120 kbps of EDGE.[9] Because of its greater speed, W-CDMA facilitates new applications, such as video-telephony.[10] As importantly, with maturation, W-CDMA will provide a better user experience for already available applications.

THE UMTS RELEASES[11]

The 3GPP is standardizing UMTS over stages. As the 3GPP completes each stage, it publishes a "release." Each release specifies expanded functionality for the standard. At this time, the three most important releases are 99, 4, and 5.[12]

Networks deployed so far are based on "Release 99."[13] This defines the GSM-GPRS-EDGE core network, as well as the W-CDMA radio interface. It specifies transmission of "packetized" voice and data. Voice packets, including video-telephony, are transmitted over legacy circuit-switches or Asynchronous Transfer Mode (ATM). Data packets may be circuit-switched or packet-routed.

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[6] www.3gpp.org/specs/releases-contents.htm#3gRelease1999. In addition to W-CDMA for paired bands, the network may also use TD-CDMA for unpaired bands.

[7] Hutchison's U.K initially delivered data rates of 64-128 kbps, (Richard Handford, "TIM takes the Lead with Move to EDGE for High-Speed Services," *Mobile Communications*, March 2003). Vodafone reported that its UMTS network in Ireland "will offer average throughput speeds up to 144 kbps, ("Handsets Limit Irish Launch," *3G* Mobile, May 14, 2003). More recently, *Unstrung* estimated data rates of 100-300 kbps "in urban environments - depending on the prevailing radio conditions and network load..." ("UMTS Release 5 to the *3G* Rescue," *Unstrung*, September 11, 2003). In theory, W-CDMA can deliver up to 2 mbps to a fixed device and 384 kbps to a mobile device.

[8] Handford, implicitly addressing Europe, places GPRS data rates at 20-30 kbps.

[9] Based on independent tests of the AT&TWS network in San Francisco (Brian T. Modoff and Michael W. Thelander, *Signals to Noise*, Deutsche Bank Securities, Inc., San Francisco, California, November 24, 2003, pp. 2-10). Handford places EDGE data rates at 80-120 kbps. AT&TWS, in the U.S., states 100-130 kbps. (Press release, "AT&T Mobile Takes Its Customers to the EDGE," AT&T Mobile Services, Las Vegas, Nevada, November 18, 2003.) This, however, is inconsistent with the concerns expressed by AT&TWS |in Europe over performance variations ("Questions Remain Regarding EDGE," *3G Mobile*, September 17, 2003, p. 9.)

[10] The UMTS Forum uses the term "rich video." Hutchison 3 in the U.K. is promoting this as "videocall."

[11] www.3gppp.org/specs/releases-contents.htm#3.

[12] The word "completes" is a misnomer, in that each release undergoes a process of refinement, enhancement, and correction following its initial publication.

[13] The first Japanese network, commercially deployed by NTT DoCoMo in October 2001, uses a unique variant of UMTS/W-CDMA. DoCoMo is now migrating to the global standard.

Release 99 precisely defines the **W-CDMA air interface**. In addition to greater flexibility,[14] **W-CDMA provides greater capacity, and therefore greater cost savings compared to GSM-GPRS and EDGE**. Subsequent releases define an all-IP network. IP will enable more versatile streaming content (audio or video) and more sophisticated services. It will provide little, if any, additional cost savings.[15] When we subsequently use the term "UMTS," we are referring to W-CDMA unless otherwise stated.

"Release 4" defines features such as Virtual Home Environment (VHE), Open Services Architecture (OSA), and location support. VHE allows users to develop personalization profiles, which are automatically carried from device to device and network to network. OSA will allow Application Program Interfaces (APIs) to support future non-voice applications. APIs enable any software to interface with any network.

"Release 5" specifies a converged packet network. This will allow UMTS to support end-to-end IP services, including voice and multimedia. It will enable Internet applications, developed primarily for the landline environment, to be more available and managed more efficiently for mobile networks. More applications will mean more revenues (traffic and content) for operators.

Release 5 also defines the option of High Speed Downlink Packet Access (HSDPA). HSDPA provides additional capacity and will likely improve the radio downlink to the range of perhaps 384 kbps to1.5 mbps.[16] With this, it promises users a yet richer experience than does W-CDMA. It will require handsets with significantly increased processing power.

As of late 2003, DoCoMo appeared to be the only operator publicly committed to HSDPA, with plans to launch in 2005.[17] Other operators are showing interest. Siemens considers HSDPA as "very real" and reports "a lot of customers who are very demanding" for it. At present, such demand centers less on a current need for capacity and more on contingency planning for competition from 802.xx and similar technologies.[18]

Three questions are raised over HSDPA's commercial success. **First**, what services require the speed that HSDPA enables (*demand*)? **Second**, would such services be economically justifiable even with the further cost savings that HSDPA promises? **Third**, when will vendors produce capable handsets (*supply*)? These questions are not answered. However, the limited evidence available is positive.

In terms of supply, DoCoMo appears determined to push HSDPA forward. In April 2003, it revealed a two-year, 42-billion yen ($350 million) R&D investment to help handset vendors develop UMTS.[19] In December 2003, it announced a 37-billion yen ($308 million) addition to that investment, extending it through March 2006.[20] We surmise that part will be spent to develop HSDPA.

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[14] The flexibility of the air-interface enables multiple users to transmit mixed voice-data at the same time.

[15] High Speed Downlink Packet Access (HSDPA), which is an option of Release 5, does provide added capacity. See our following discussion.

[16] "The HSDPA Advantage," Nortel Networks *Dialogue*, July 1, 2003. The theoretical speeds of HSDPA are 900 kbps, and 1.8, 3.6, 7.2 and 14.4 mbps.

[17] Justin Sgrinpham, "HSDPA to the Rescue?" *Unstrung*, November 20, 2003 and Kiyoshi Takenaka, "DoCoMo Banks on New Handsets to Boost 3G in 2004," *Reuters*, December 1, 2003.

[18] Personal communication, Dietrich Zeh, Director, Investor and Analyst Relations, Information and Communications Mobile Division, Siemens, Munich, Germany, December 10, 2003.

[19] "Sharp 3G FOMA Handset Investment," *3g.co.uk*, April 23, 2003; and *UMTS - When and Why It Will Happen*, pp. 21-22. Yen converted to dollars at ¥120 = $1.00

[20] "DoCoMo in ¥37 Bn Funding for Handset Developers," *Reuters*, December 19, 2003. Yen converted to dollars at ¥120 = $1.00

In terms of demand, Verizon has just launched what will be a nationwide cdma2000 1x EV-DO network, which increases data rates five times or more those of cdma2000 1x.[21] This announcement followed by three months Verizon's launch of commercial 1x EV-DO trials in Washington D.C. and San Diego.[22] The trials, directed toward enterprise users, revealed wide acceptance of unlimited use at $79.99 per month, and increasing traffic as users became familiar with the service. Verizon has concluded that faster speeds stimulate use.[23] This conclusion would hold regardless of technology.

The extent to which HSDPA proves commercially successful, or when, is not critical to the success of UMTS/W-CDMA. W-CDMA will deliver higher data rates and greater capacity as it matures, and as operators increase cell density to serve increasing traffic.

"Release 6" will provide full packet transport. Its cornerstone rests on the IP Multimedia Subsystem (IMS), which enables real-time multimedia services. Many of these services, such as streaming video clips and interactive games, are facilitated by Release 99. However, with IMS, the applications become interoperable with Internet-based services and IP-capable devices on landline networks. Voice over IP (VoIP), and by implication video-telephony over IP, also become feasible.[24]

Summary and Conclusions

UMTS offers operators two key advantages. **First**, through its W-CDMA air-interface and new spectrum allocation, it delivers greater capacity than does GSM-GPRS or EDGE. **Second**, because of its more efficient air interface, it provides a lower cost per bit transmitted than does GSM-GPRS or EDGE. The greater capacity and lower cost are now available through Release 99.

This lower cost will enable operators to reduce tariffs and, thereby, generate greater traffic. Greater traffic will lead to greater revenues and profits.

Subsequent releases of UMTS will specify greater functionality and eventual migration to an all IP network. This will stimulate more applications and, in turn, revenues.

[21] Press release, "Verizon Wireless Announces Roll Out of National 3G Network," Verizon Wireless, Bedminster, New Jersey, January 8, 2004. This reports data rates of 300-500 kbps for 1x EV-DO compared to 40-60 kbps for 1x.

[22] *ibid.*

[23] Personal communications, Jeffrey Nelson, Exec. Director, Corporate Comm.; Richard Lynch, Exec. VP and CTO; and Jim Strait, Vice President, Multimedia Services; Verizon Wireless, "Verizon Wireless Major Announcement - Analyst Pre-Brief," Verizon Wireless, Bedminster, New Jersey, January 7, 2003.

[24] "Feasibility Study of VoIP in 3GPP UMTS; Release 5 Mobile Networks Interworking with Fixed Networks," Andersen & Thoresen, Agder University College, Grimstad, May 2003.

CHAPTER 3: QUANTIFYING THE LOWER COSTS OF W-CDMA

INTRODUCTION

In this chapter, we quantify by how much UMTS will lower the per bit costs to transmit data, or more precisely, mixed voice and data.

There are many estimates of the **revenues** that UMTS may provide. There are few estimates of the **costs** to generate those revenues.[25] Quantifying the costs is challenging due to the **uncertain assumptions** that underlie estimates. These uncertainties stem from two sources.

First are dissimilarities in the market circumstances of different operators. The deployment costs of UMTS for an incumbent (such as Vodafone) differ from those of a "Greenfield" (such as Hutchison "3"). The former can reuse parts of its legacy infrastructure. The latter must build new infrastructure. In addition to network hardware and civil construction, this includes marketing, customer care, and billing operations, among others.[26]

Second are differences in accounting conventions. These encompass amortization and depreciation and, for incumbents, allocation of administrative, marketing, customer care, billing, and other shared costs between their UMTS and GSM-GPRS operations.

CONTRIBUTORS TO UNCERTAINTY

Putting aside accounting differences, any of the following – or other factors – may affect the relative capital and operating expenses of UMTS and GSM-GPRS.

– **Network loading**. High loading is crucial for recovering investment. The more loading, the more quickly UMTS becomes cost-competitive with GSM-GPRS.

– **Frequency assignment**. Networks at 900 MHz require fewer cells than do those at 1800 MHz.[27] This means that GSM 1800 operators can often deploy UMTS 1900/2100 using current cell sites. GSM 900 operators require additional sites, particularly in low-traffic areas.[28]

– **Older base stations**. To deploy UMTS, operators must replace all but their newest GSM base stations. Nokia emphasizes that, regardless of vendor, "under no circumstances has it been possible to simply upgrade a GSM BTS," prior to the relatively recent introduction of "triple mode" GSM-GPRS/EDGE/UMTS equipment.[29] As an example, only in mid-2002 did Alcatel begin to ship all of its Evolium base stations as "UMTS ready."[30]

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[25] In personal discussions, a senior manager of one vendor acknowledged that his company had "no specific numbers" that estimated the cost of bandwidth.

[26] Shared infrastructure adds a further complexity to estimating costs.

[27] Under terrestrial conditions, radio waves at higher frequencies attenuate more rapidly, requiring a denser cell structure.

[28] The importance of this will change with the introduction of UMTS 900.

[29] Personal communication, Virve Virtanen, Manager, Media Relations, Nokia, Irving, Texas; December 1, 2003.

[30] Philippe Germond, President and COO, "Leveraging Success in the Mobile Environment" (Slide: Evolium Infrastructure - For an Optimum Cost of Ownership), *Industry Analyst Conference 2003*, Alcatel, Mobile Communications Group, Boston, Massachusetts, June 18-20, 2003.

– **Whether an operator has upgraded to GPRS**. GPRS provides "basic" IP functionality[31] that can be reused for UMTS.

– **The mix of latency sensitive and insensitive traffic**. Latency-sensitive[32] traffic, such as voice conversations and real-time video-telephony is more expensive to deliver. Latency-insensitive traffic, such as video downloads and email, is less expensive.[33]

– **Handset subsidies**. Over the next five years, UMTS handsets will cost more than GSM-GPRS equivalents.[34] Subsidies, if any, will be correspondingly greater.

Such factors introduce extraordinary uncertainty in comparing UMTS and GSM-GPRS costs. To compensate for that, we focus on the **relative rather than absolute savings** that UMTS may provide.

Cost Savings and Their Contexts

The UMTS Forum states that a W-CDMA base station (Node B)[35] provides "up to 10 times the traffic capacity compared with GSM," at the same or 50 percent greater cost.[36] This translates into W-CDMA providing "incremental network capacity" at 10.0 to 15.0 percent the cost of GSM.[37] Alcatel puts the capacity of a Node B at up to eight times that of a GSM base station, while costing the same.[38] This translates into W-CDMA providing equivalent network capacity at 12.5 percent (or 8x less) the cost of GSM.[39]

In practice, the savings will be less. The above refer only to the air-interface. To estimate the "true" savings, other network elements must be included. These comprise radio network controllers (RNCs), ATM links, switches, routers, and location registers, among others.

The costs of these appear little different from the comparable elements of a GSM network. We surmise that they approximate the historical ratio of 30 percent of network costs, while the Node Bs comprise the historical 70 percent.[40] (We allocate the operating expenses between the Node Bs and the other network elements by the same ratio.) Under these conditions, the savings of a full UMTS/W-CDMA network would be 70 percent the savings of the Node Bs. This translates into a **full UMTS/W-CDMA network** providing the equivalent capacity of GSM at 14.3 to 21.4 percent the cost.[41]

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[31] GPRS does not support the four classes of UMTS service.

[32] "Latency" is the delay in a transmission as it passes through a network.

[33] Technically, 3GPP defines four classes of UMTS service - "conversational," "streamed," " interactive," and "best effort." Each class has a different cost associated with it, depending on its complexity and allowable latency. Conversational is the most expensive to deliver. Best effort is the least.

[34] *UMTS - When and Why It Will Happen*, pp. 28-29. UMTS handsets will include GSM-GPRS and, in the future, EDGE.

[35] "Node B" is the term for a UMTS (W-CDMA) base station.

[36] The UMTS Forum states that this reflects industry consensus. *Mobile Evolution Shaping the Future*, UMTS Forum, London, UK, August 2003, p. 1.

[37] (1/10 x 1.0) = 0.10; (1/10 x 1.5) = 0.15.

[38] Personal communication, Jean-Louis Hurel, Marketing Director, Mobile Networks, Alcatel, Paris, France; July 17, 2003.

[39] (1/8 x 1.0) = 0.125.

[40] Personal communications, Geoff Varrall, Principal, RTT Programmes, Ltd.; Richmond, UK; November 15-December 5, 2003. Mr. Varrall points out that the prices of separate network elements are "never quoted by the vendors" but are packaged with the Node Bs. Hereafter cited as "Varrall."

[41] (0.10/0.70) = 0.143; (0.15/0.70) = 0.214.

However, expenses also encompass marketing, customer acquisition, customer care, billing, etc., as well as Information Technology (IT), storage, and related overheads. The ratio of non-network to network expenses varies by operator. We assume that the capital and operating expenses associated with the non-network elements comprise one-half of an operator's total.[42] Taking this into account, a fully deployed UMTS network will reduce total costs to 28.6 to 42.8 percent those of GSM.[43] **Stated differently, it will cost 2.3 to 3.5x less than a GSM-GPRS equivalent**.[44] As we discuss below, eventual savings will prove greater.

Realizing the Cost Savings

In common with all new technologies, **W-CDMA will take five years to mature**.[45] Counting from DoCoMo's launch of the Japanese variant in October 2001, this points to full maturation by late 2006. By that time, UMTS will deliver a consistently better experience than GSM and, as is already happening, cost users less.

The fully loaded UMTS network – and with that, full return on investment – is the most important factor affecting per-user costs.[46] Operators, however, will realize savings from, at least, three other factors.

– Semi-conductors, in particular Digital Signal Processors, will continue to improve in processing power and to fall in price. With this, **the costs of UMTS infrastructure and handsets will decline by 20 to 25 percent per annum,** as did the costs of GSM and analog.[47] In three years, a 20 percent annual decline would reduce Node B prices to 51 percent those of today and in five years, to 33 percent.[48]

– The 5 MHz channels of W-CDMA are less subject to fade than are the 200 KHz channels of GSM. Due to this, W-CDMA channels have a lower and more consistent bit error rate than do GSM channels. Fewer errors requires less error-correction. This, and better channel coding, facilitate higher compression ratios. Transmissions can carry more relevant information per bit, thereby lowering cost.[49]

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[42] Varrall. Estimating the relative costs of network versus customer acquisition and support is especially complex, due to the capital-intensive nature of the former compared to the labor-intensive nature of the latter. Change in this assumption will alter the ensuing estimates of cost savings.

[43] (0.143/0.50) = 0.286; (0.214/0.50) = 0.428.

[44] (1/0.429) = 2.33; (1/0.286) = 3.5.

[45] "Evolution to 2.5G and 3G," (The Four Stages of Technology and Commercial Progress), *2003 Tuscany [Seminar] Program - Realistic Visions of the Wireless Future: Market and Business Profit Opportunities through 2007*, The Shosteck Group; Green Park Resort, Tirrenia, Italy; June 22-27, 2003.

[46] *UMTS - When and Why It Will Happen*, pp. 11-14, and *AMPU - Not ARPU: A Better Metric for the Wireless Industry*, The Shosteck Group, Wheaton, Maryland, May 2003, pp. 44-54. Hereafter cited as *AMPU - Not ARPU*.

[47] For example, from 1985 through 1997, the wholesale prices of low-end analogue handsets fell by an average of 22.1% per year. See: " Wholesale Prices of Analog Portable Terminals, U.S. Market, 1983-2000 (j_7)," *Shosteck E-STATS*, The Shosteck Group, Wheaton, Maryland, continuous.

[48] $(0.80)^3 = 0.512$; $(0.80)^5 = 0.328$.

[49] In addition, a higher quality and more consistent channel provides a better user experience. This will lead to greater use, adding revenues, and, in concept, fewer calls to customer service. The latter would provide further savings. The greater use will come from both **more** and **longer** user sessions. U.S. data document that voice calls are lengthening, as digital networks have matured and tariffs fallen. Between 1994 and 1997, call length averaged 2.27 minutes. In 1998, it increased to 2.36 minutes. Over the next three years it continued to increase, reaching an average of 2.67 minutes in 2001 and 2002. This is a 17.6 percent increase in call length compared to 1994-1997. Source: "Average Local Call Length," *Semi-Annual Wireless Industry Survey*, CTIA, Washington DC, continuous, and derivations by The Shosteck Group.

– Radio frequency (RF) channel planning for UMTS is simpler than for GSM. Assuming a 20 MHz assignment, an operator need plan for only four (5 MHz) UMTS channels compared to 100 (200 KHz) GSM channels. This lowers cost.

While the cost of Node Bs (and related network elements) will decline over five years to 33 percent or less the cost of today, operators will deploy Node Bs continuously. Because of this, the average cost will approximate the mid-point between the cost of today and that in five years – or about 67 percent that of today.

This means that in five years, a fully deployed UMTS network will reduce an operator's **total costs per bit** – including the customer-related elements – to 19.1 to 28.7 percent those of GSM-GPRS today.[50] **Stated differently, by 2009, a UMTS network – including the customer-related elements – will cost operators 3.5 to 5.2x less to build and operate than a GSM-GPRS equivalent.**

This estimate is consistent with the assertion of Bob Fuller, CEO of Hutchison U.K., that the cost of running a UMTS network at capacity will be one-quarter (4x less) that of a GSM-GPRS equivalent.[51]

Summary and Conclusions

Node B base stations will reduce per bit costs to 10.0 to 15.0 percent those of GSM. However, to derive "true" costs, one must account for other network elements, customer acquisition and care, and future declines in network hardware costs. Doing so indicates that over the next five years, the full costs of UMTS will fall to 19.1 to 28.7 percent those of GSM-GPRS today – or 3.5 to 5.2x less. Such savings assume a fully loaded network. This will occur as UMTS matures – at about the end of 2006.

These savings will enable operators to reduce tariffs by 50 percent and more. Indeed, Hutchison "3" in the UK has already done so.[52]

The consequences will be dramatic. Network traffic – voice and data – will increase by four-fold or more. Average Revenue per User (ARPU) will increase by 50 percent or more. Non-SMS data revenue, as a percent of ARPU, will increase substantially.

We examine how this will occur in our next two chapters – as well as why UMTS operators will produce profitable operating margins, notwithstanding what we foresee as major tariff reductions.

[50] (0.286) x (0.67) = 0.191; (0.429) x (0.67) = 0.287. This reduction assumes a continuing 50:50 ratio of network to customer-related costs. For commentary, see the preceding footnote.

[51] David Pringle and Evan Ramstad, "European Telecom Firms Face Price War From 3G Cellphones," *The Wall Street Journal*, August 12, 2003.

[52] *UMTS - When and Why It Will Happen*, pp. 15-16.

CHAPTER 4: QUANTIFYING THE IMPACT OF LOWER TARIFFS

INTRODUCTION

Our previous chapter described how UMTS will reduce cost. It placed the long-term reduction – including the customer-related elements – at 3.5 to 5.2x less than that of GSM-GPRS today. This will take place as UMTS matures. We posited that with lower cost, operators would reduce tariffs. This would lead to a massive increase in traffic per user. As an outcome, operators would increase gross revenue and ARPU, as well.

In this chapter, we quantify the effect of lower tariffs on use, revenue, and margins. We document that the shift to increased ARPU is already taking place with voice (and short messaging) and that margins are holding stable and often increasing. This sets the stage for our next chapter. There we show that **increasing ARPU is beginning for Internet-based data services as well**.[53]

DECLINING TARIFFS AND INCREASING MINUTES OF USE (MOU)

Among developed countries, the U.S. has seen the most dramatic declines in tariffs. In 1994, two operators charged an average of $0.42-$0.96 per minute.[54] Today, six or more operators have lowered tariffs by as much as 90 percent. T-Mobile, the lowest-priced operator, charges from $0.04 to $0.12 per minute.[55] Verizon, the highest-priced operator, charges from $0.08 to $0.14 per minute.[56]

As a consequence, minutes of use (MoU) have increased exponentially. In 1998, MoU averaged 123 per month. In 2003, they averaged 478,[57] by far the highest in the developed world. As we document below, this stems from U.S. tariffs that are one-half to one-third those of Europe.

Figure 4.1 relates tariffs to MoU for the seven largest European economies, Canada, and the U.S. The effect is striking. During 2002, the European economies averaged $0.17 to $0.25 per minute. All clustered between 90 and 155 MoU. Canada, with rates of $0.12 per minute, consumed 265 MoU. The U.S., with rates of $0.08, consumed 450.[58]

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[53] And, by inference, stable to increasing margins.

[54] From 1988 through 1994, the lowest charges for 50 local prime-time minutes per month ranged from $45 to $48 or $0.90 to $0.96 per minute. The lowest charges for 250 prime-time minutes ranged from $105 to $123 or $0.42 to $0.49 per minute. ("The Lowest Available Rates for Prime-time Analog Minutes, Ten Major U.S. Markets, 1988-1997." *Shosteck E-STATS*, The Shosteck Group, Wheaton, Maryland, continuous.)

[55] T-Mobile, in Washington D.C., charges $29.99 for 250 local prime-time minutes, including long-distance, or the equivalent of $0.12 per minute. It charges $39.99 for 1,000 local prime-time minutes. This is equivalent to $0.08 per minute for 500 minutes or $0.04 for 1,000 minutes. ("Get More America Plans," www.t-mobile.com/plan, December 22, 2003.)

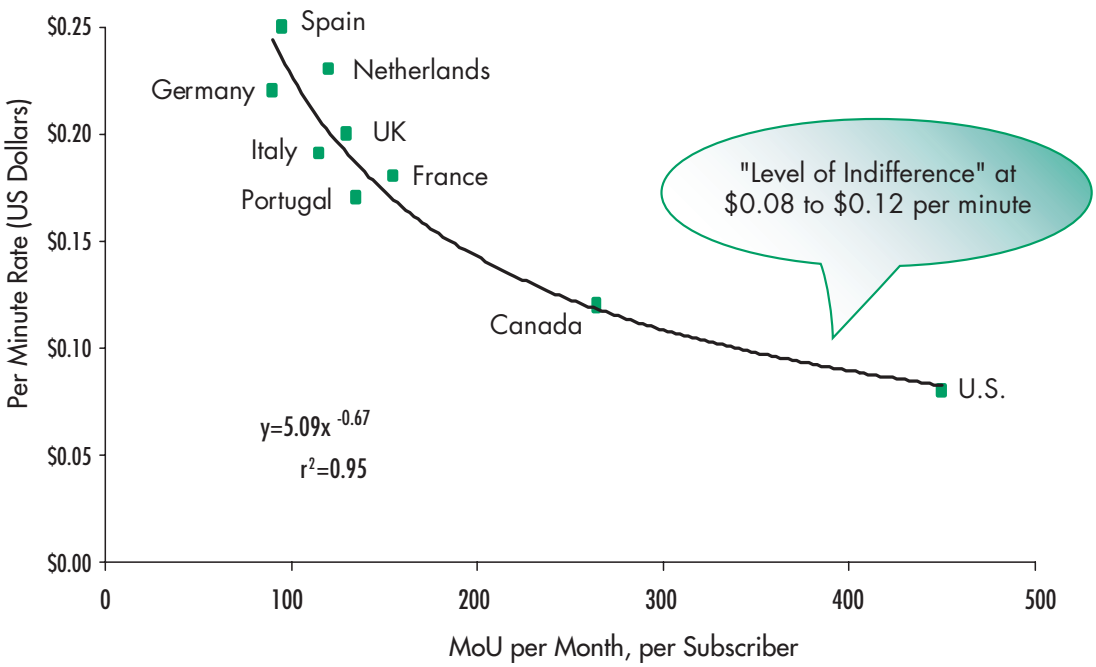
[56] Verizon, in the same market, charges $34.99 for 250 minutes, or the equivalent of $0.14 per minute. It charges $49.99 for 500 minutes, or the equivalent of $0.10 per minute. It charges $79.99 for 1,000 minutes, or the equivalent of $0.08 per minute. ("America's Choice," www.verizonwireless.com/ics/plsq1/ plan, December 16, 2003.)

[57] *Semi-Annual Wireless Industry Survey*, CTIA, Washington, D.C., continuous, and derivations by The Shosteck Group. Value for 2003 estimated by The Shosteck Group.

[58] Merrill Lynch, as reported by Lucent Technologies, *3G World Congress*, Cannes, France, February 18, 2003, and estimates by the Shosteck Group. Values as of November 2002. Currencies converted to U.S. dollars at then prevailing rates of exchange. The differences in estimates of U.S. rates and MoU in this and the previous two paragraphs are due to different measurement conventions.

FIGURE 4.1

THE EFFECT OF RATES ON MoU, SELECTED COUNTRIES, 2002



Sources: Merrill Lynch as reported by Lucent Technologies, *3G World Congress*, Cannes, France, February 18, 2003, and estimates by The Shosteck Group. Foreign currencies converted to U.S. dollars at then prevailing rates of exchange, November 2002.

The "correlational coefficient" (r2) equaled 0.95.[59] This means that for these nine economies, rates explained 95 percent of mobile use.[60] The relationship is curvilinear. As rates decline to $0.08 to $0.12 per minute, they reach "the level of indifference." **Below that, users consume mobile service relatively indifferent to price.** This explains the exponentially greater MoU in the U.S. compared to Europe.

Europe is shifting toward the U.S. model. During the last half of 2003, Danish operators cut tariffs by close to 50 percent – reducing the cost per minute from €0.17 to €0.09. They cut the cost of SMS from €0.07 to €0.03. The trend is spreading to the Netherlands, the U.K. and Germany. Others are expected to follow. Observers anticipate increasing use to follow.[61]

However, for operators, the critical issue is not minutes of use, but Average Revenue per User (ARPU), and, in turn, Average Margin per User (AMPU). Does greater MoU lead to greater ARPU and, more importantly, greater AMPU? The remainder of this chapter reveals that it does. **Lower rates lead to higher ARPU and either stable or increasing AMPU.**

[59] This is the r^2 of the power function, $y = 5.09x^{-0.67}$

[60] This does not discount the importance of network and handset maturation. Increasing MoU is a product of both technologies and tariffs. Technology has enabled operators to reduce cost and with that, tariffs. Likewise, it has provided an ever-improving end-user experience, encouraging greater use, independent of tariffs.

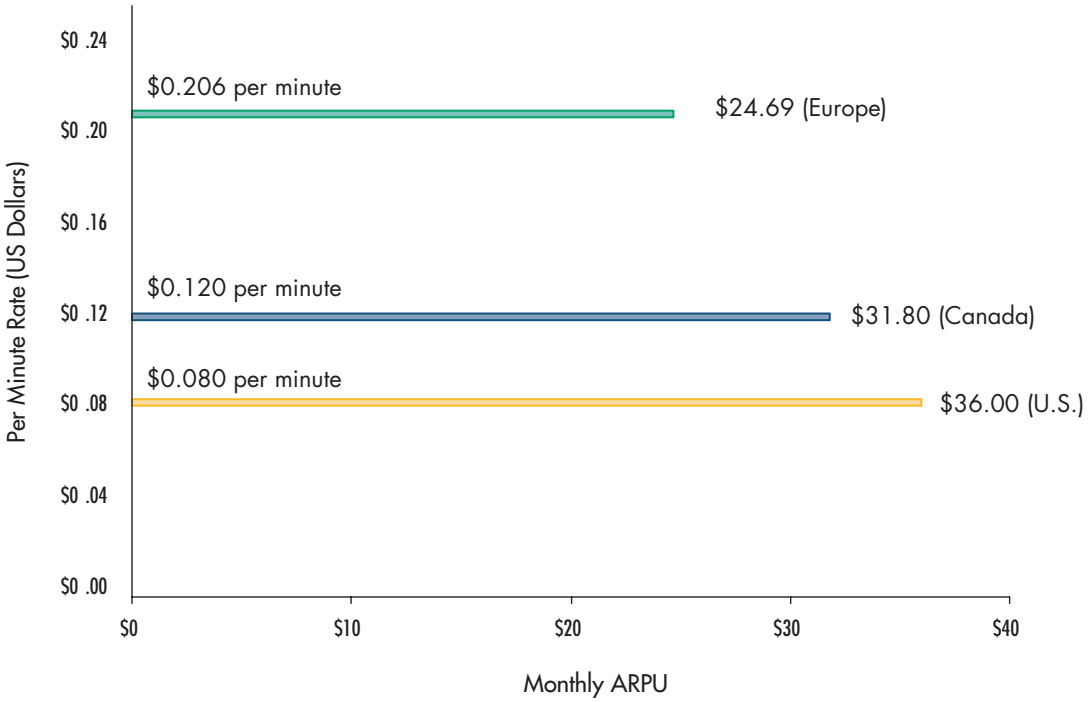
[61] Lucas van Grinsven, "Denmark Sets Scene for European Cellphone Price War," *Reuters*, December 18, 2003.

The Increase in ARPU

Figure 4.2 documents the tie between rates and ARPU. As we showed in our previous figure, European rates ranged from $0.17 per minute (Portugal) to $0.25 per minute (Spain). They averaged $0.206 per minute. Monthly use ranged from 90 MoU (Germany) to 155 MoU (France). It averaged 120 MoU. The $0.206 rate multiplied by 120 MoU indicated a European ARPU of $24.69. Rates for Canada averaged $0.12 per minute; MoU averaged 265. This indicated a Canadian ARPU of $31.80. Rates for the U.S. averaged $0.08; MoU averaged 450. This indicated a U.S. ARPU of $36.00.[62] Stated differently, **U.S. rates averaged 61 percent less than those of Europe.**[63] **Despite this, U.S. ARPU was almost 1.5 times (46%) greater**.[64]

FIGURE 4.2

THE EFFECT OF RATES ON ARPU, SELECTED COUNTRIES, 2002



Source: Merrill Lynch as reported by Lucent Technologies, *3G World Congress*, Cannes, France, February 18, 2003 and derivations by The Shosteck Group. Currencies converted to U.S. dollars at then prevailing rates of exchange.

The above, however, measured a point in time. The question remains, what is the impact of lower rates on ARPU over time?

[62] Merrill Lynch as reported by Lucent Technologies, *3G World Congress*, Cannes, France, February 18, 2003, and derivations by The Shosteck Group. Currencies converted to U.S. dollars at then prevailing rates of exchange. Values vary from others reported in this analysis due to differences in measurement conventions.

[63] [(0.206) - (0.080)]/(0.206) = 0.612.

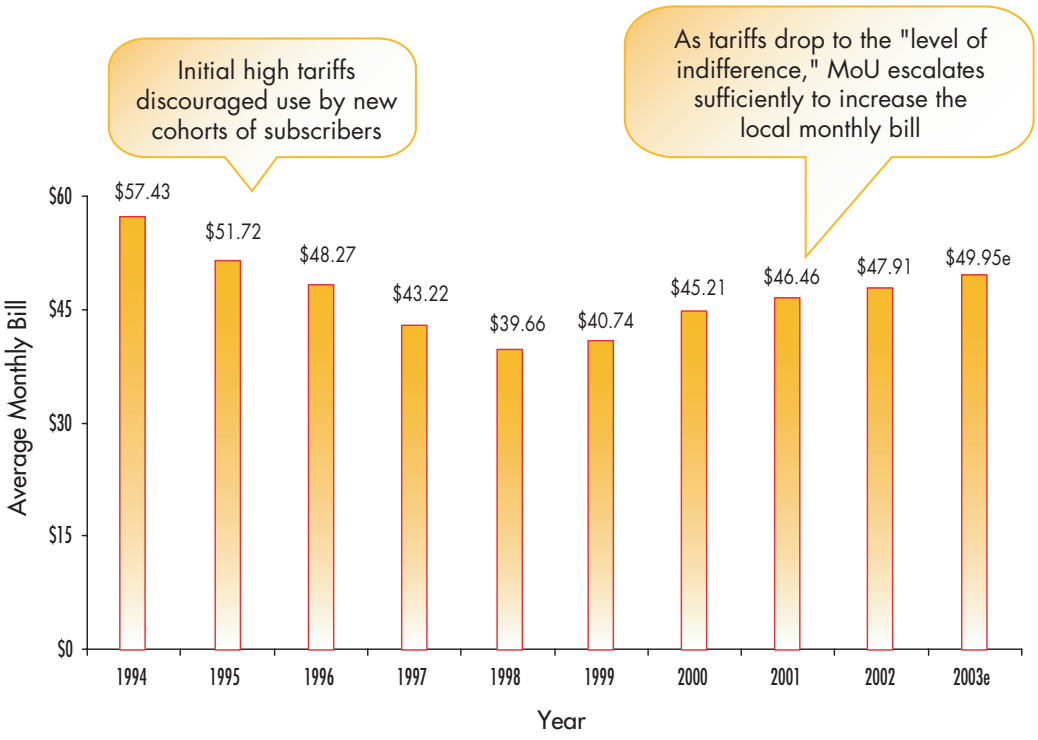
[64] ($0.08/$0.206) = 0.39; [($36.00) - ($24.69)]/($24.69) = 0.46.

We begin with the best-known example, that of the U.S., where ARPU has been increasing since 1999. We then turn to Europe, where – contrary to popular opinion – we find the same emerging pattern.

Figure 4.3 traces the decline in U.S. ARPU from $57.43 in 1994 to a low of $39.66 in 1998.[65] In that year, AT&T Mobile – still in the midst of the digital transition[66] – introduced its then revolutionary "DigitalOne" tariffs. These cut rates for heavy users by more than half – to $0.18 per minute for those using 500 minutes per month and $0.12 for those using 1,000 minutes.[67] Other operators followed. As a result, MoU escalated and ARPU began to climb. The latter increased to $40.74 during 1999 and has climbed each year since, reaching $49.95 in 2003.[68] This represents a 25.9 percent gain over the five-year period.[69]

FIGURE 4.3

AVERAGE REVENUE PER USER (ARPU), ALL OPERATORS, U.S., 1994 TO PRESENT



Source: "Average Local Monthly Bill," *Semi-Annual Wireless Industry Survey*, CTIA, Washington DC, continuous and estimates by The Shosteck Group.

[65] "Average Local Monthly Bill," *Semi-Annual Wireless Industry Survey*, CTIA, Washington DC, continuous, and derivations by The Shosteck Group.

[66] In common with all other 800 MHz operators.

[67] Press release, "AT&T Launches First National One-Rate Wireless Service Plan," AT&T, New York, May 7, 1998. These rates included nationwide roaming and long distance, both firsts for a major U.S. operator.

[68] "Average Local Monthly Bill," *Semi-Annual Wireless Industry Survey*, CTIA, Washington D.C., continuous. Value for 2003 estimated by The Shosteck Group.

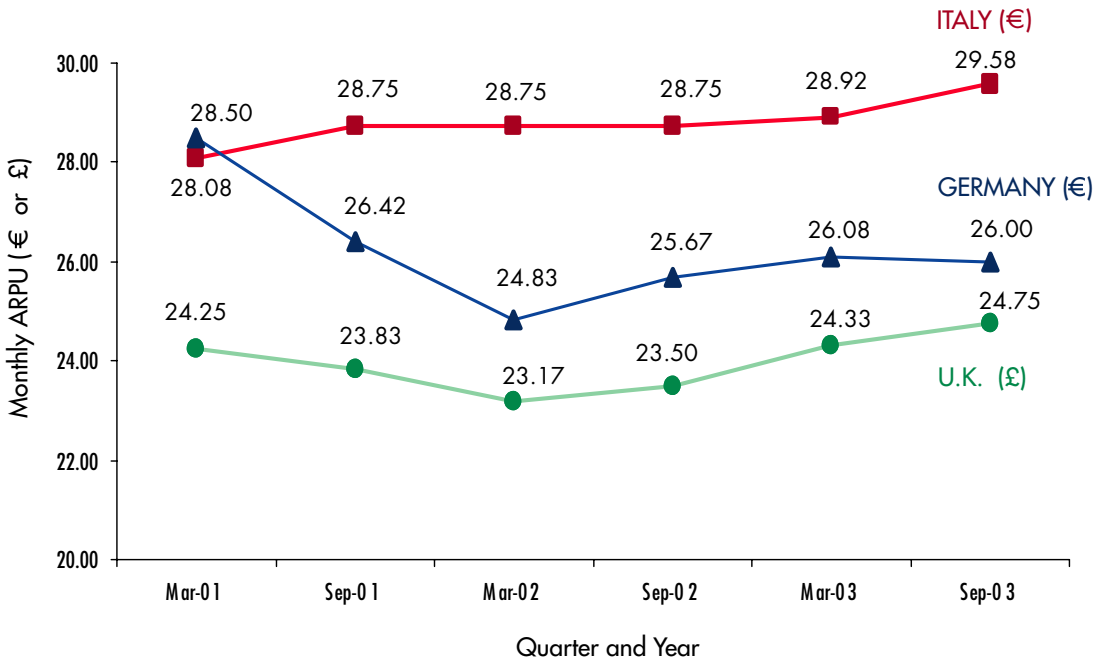
[69] ($49.95 - $39.66)/($39.66) = 0.259

European operators might acknowledge the phenomenon in the U.S., but question its relevance for Europe. Yet, our analysis reveals a parallel trend. **Europe, at least in part, is beginning a transition to higher ARPU.**

Figure 4.4 tracks the ARPU generated by Vodafone's largest European networks – Germany, U.K., and Italy from March 2001 to present.[70] We have converted them from an annual to a monthly basis, but have kept them in their original currencies.

FIGURE 4.4

AVERAGE REVENUE PER USER (ARPU), VODAFONE, EUROPE, 2001 TO PRESENT



Sources: "Vodafone Group PLC – Mobile Telecommunications Businesses, ARPU – History," *Interim Results for the Six Months…*, Vodafone, PLC, Newbury, Berkshire, U.K., continuous (www.vodafone.com) and derivations by The Shosteck Group. Values represent 12 month running averages.

These patterns show that for each of Vodafone's three major European networks, ARPU has increased since March 2002 – or, in the case of Italy, since at least March 2001.

At that time, Vodafone Italy reported an average monthly ARPU of €28.08 for the previous 12 months. This edged up to €28.75 from September 2001 through September 2002. It increased to €28.92 for March 2003 and €29.58 for September 2003. This represented a 5.3 percent gain over the 30 months.

[70] "Vodafone Group PLC - Mobile Telecommunications Businesses, ARPU - History," *Interim Results for the Six Months …*, Vodafone, PLC, Newbury, Berkshire, U.K., continuous. These are running averages, which reflect the previous 12 months. Consistent measurements prior to March 2001 are not available.

In March 2001, Vodafone Germany reported an average ARPU of €28.50. Unlike Italy, this declined to €26.42 in September 2001 and to €24.83 in March 2002. Then it reversed. In September 2002, it increased to €25.67. For March 2003 and September 2003, it increased to €26.08 and €26.00, respectively. The latter represented a 4.7 percent gain from 18 months before.

The ARPU of Vodafone U.K. paralleled that of Germany. In March 2001, it stood at £24.25. It declined to £23.83 in September 2001 and to £23.17 in March 2002. Subsequently, it increased, reaching £24.75 in September 2003. This represented a 6.8 percent gain from 18 months before.

Other operators are seeing greater ARPU as well. In 2001, Orange's U.K. ARPU dropped to an all-time low of £246 per year (£20.50/month) before recovering. In September 2003, it reached £270 per year (£22.50/month), a gain of 9.8 percent. During 2002, Orange's German ARPU fell to a low of €377 per year (€31.42/month). Since then, it has remained unchanged, potentially indicating the bottom of its decline.[71] T-Mobile's position is less clear. Its U.K. ARPU has increased, but is not comparable to that of earlier years due to a change in reporting convention. Similar to Orange, T-Mobile's German ARPU has remained stable at €24 per month, albeit since 2001.[72]

In sum, contrary to a common perception of decline,[73] over the last 18 to 30 months, ARPU for major European networks has remained stable or increased. This suggests that Europe is entering a new era of expanding voice (and SMS) ARPU. That entry is being encouraged by a growing recognition that "the high-price [per minute] strategy of the operators" is reducing, rather than increasing, profits.[74]

The question is whether this emerging voice experience will carry over to Internet data. Given the greater capacity, lower cost, and – over the long-term – greater functionality of UMTS, we believe that the answer is yes. As we show in our next chapter, data ARPU is already increasing around the world.

The Status of AMPU

We introduced the concept of Average Margin per User (AMPU) in May 2003, in our study, *AMPU – Not ARPU: A Better Metric for the Wireless Industry*. We posited that, by focusing on the revenues (ARPU) of data services, operators run the risk of ignoring the costs to deliver them. Without considering margins (AMPU), they face the danger of losing money, either by providing unprofitable services or forgoing more profitable alternatives.

The focus on high-priced data services, such as video-telephony, came from the fear that excessive competition was forcing voice tariffs to commodity prices – thereby shrinking profit margins. If this was happening (or would happen) with voice, the greater capacity and lower costs of UMTS would force data to commodity prices as well. Promoting high-priced data could lessen this danger.

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[71] "Operating Data," *Financial Results* (six and 12 month), Orange S.A., Investor Relations, Bristol, U.K., continuous (www.orange.com).

[72] "Germany: T-Mobil" and "UK: One 2 One," *Analyst Meeting*, Deutsche Telekom, April 19, 2000; and "T-Mobile Germany, T-Mobile UK - Key Financial Data," *Analyst Meeting*, Deutsche Telekom, August 23, 2002; and *Investors Presentation*, Deutsche Telekom, August 13, 2003 (www.telekom3.de).

[73] We base this statement on anecdotal evidence.

[74] "High Rates Don't Translate into Higher Profits," *Tiscali Europe News*, November 21, 2003.

Yet, we have not seen an analysis of how, if at all, lower tariffs may reduce margins.[75] We have argued the opposite, that lower tariffs increase margins. In this section, we reveal that, in general, **AMPU is increasing** in both the U.S. and Europe.

Operators do not publish AMPU. Nonetheless, we can derive a relative estimate, by dividing their cash flows, as reported in annual financial statements, by mid-year subscribers.[76] We begin with the U.S. We then turn to Europe.

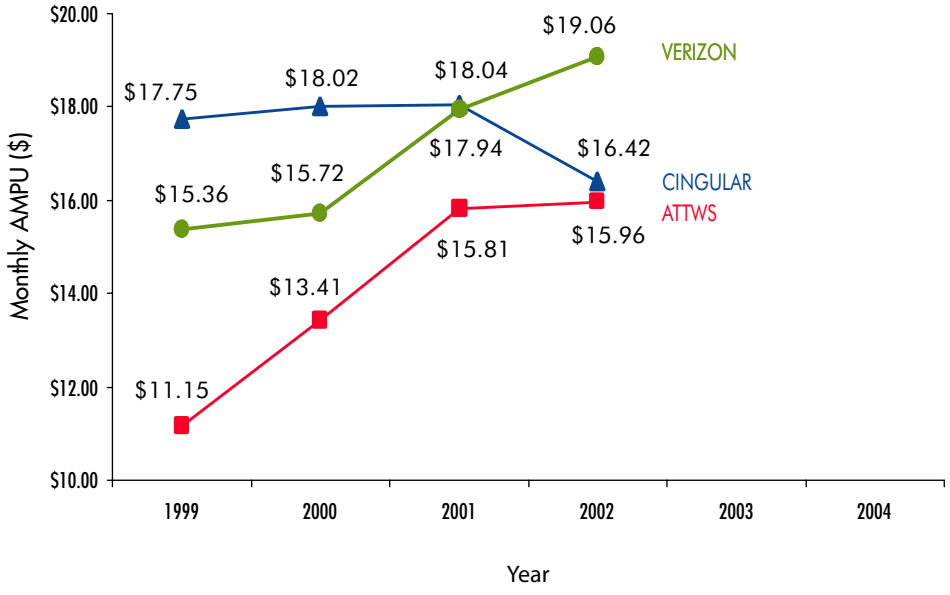
The U.S. experience is key. With six national operators, the U.S. is the world's most competitive and lowest priced major market. Thus, we should expect it to show the most severe effects of commodity pricing, if indeed they occur.

We analyze Verizon, AT&T Wireless Services (ATTWS), and Cingular – the three largest U.S. operators. We do not examine Sprint PCS and T-Mobile. They may suffer from competition. Because they are smaller, that could happen in a less competitive market as well.

Figure 4.5 traces the AMPU of Verizon, ATTWS, and Cingular from 1999 through 2002. With one exception, we find a continuous increase. Over the three years, ATTWS increased from $11.15 to $15.96 per month. Verizon increased from $15.36 to $19.06. Cingular, the single exception, increased from $17.75 in 1999 to $18.04 in 2001, but declined to $16.42 during 2002.[77] Contrary to popular assumption, intense competition in the U.S. has **not** led to declining margins. But does that hold for Europe?

FIGURE 4.5

AVERAGE MARGIN PER USER (AMPU), MAJOR U.S. OPERATORS, 1999 – 2002

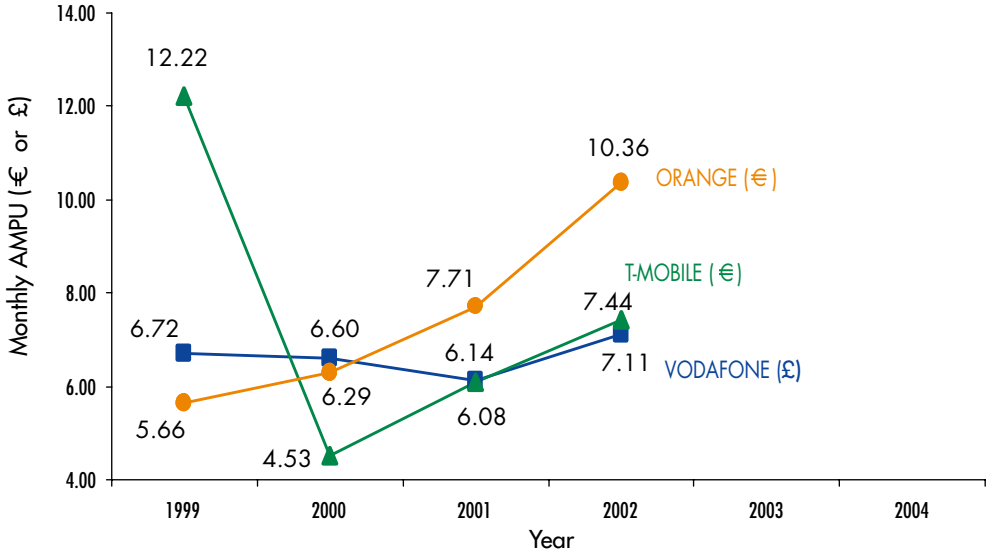


Sources: Annual and semi-annual financial reports of the operators and their predecessor companies, (www.verizonwireless.com, www.attws.com, www.cingular.com, www.sbc.com, and www.bellsouth.com), and derivations by The Shosteck Group. Monthly AMPU is calculated based on "Earnings before Interest, Taxes, Depreciation, and Amortization" (EBITDA) for the indicated year, divided by average subscribers during that year (using subscribers as of June 30 as a proxy), divided by 12. AMPU = [(EBITDA)/(subscribers)]/12.

Figure 4.6 charts the AMPU of Vodafone, Orange, and T-Mobile, the largest operators of Europe.[78], [79] Orange shows the most consistent upward pattern. Its AMPU almost doubled from €5.66 in 1999 to €10.36 in 2002. Vodafone has remained relatively flat, albeit now increasing. Between 1999 and 2001, it declined from £6.72 to £6.14. During 2002, it climbed to £7.11, a gain of 15.8 percent over the year. T-Mobile has displayed the most erratic shift. In 1999, it earned an AMPU of €12.22. In 2000, AMPU fell to €4.53. This followed the tens of billions of euros that Deutsche Telekom, T-Mobile's parent, paid for UMTS licenses.[80] By 2002, T-Mobile's AMPU had recovered to €7.44. If one discounts T-Mobile's difficulties of 1999-2000, we see an almost unbroken upward trend in European AMPU.

FIGURE 4.6

AVERAGE MARGIN PER USER (AMPU), MAJOR EUROPEAN OPERATORS, 1999 – 2002



Sources: Annual and semi-annual financial reports of the operators and their predecessor companies, (www.vodafone.com, www.orange.com, www.t-mobile.net, and www.telekom3.de) and derivations by The Shosteck Group. Monthly AMPU is calculated based on "Operating Cash Flow." This may be reported as "Operating Profit" (Vodafone), "Earnings before Interest, Taxes, Depreciation, and Amortization"/EBITDA (Orange and T-Mobile), or "Operating Income before Depreciation and Amortization"/OIBDA (T-Mobile). "Average subscribers" are based on proportionate subscribers as of the mid-point of the fiscal year. AMPU is calculated as [(Operating Cash Flow)/(Average Subscribers)]/12.

[75] Financial analysts constantly focus on margins. However, to our knowledge, they have not analyzed the effect of low tariffs.

[76] Mid-year subscribers provide an approximation of average subscribers over the course of the reporting year.

[77] Because of different accounting conventions, the AMPU measurements of the three operators are not comparable.

[78] With the exception of Egypt, virtually all of Orange's more than 50 million subscribers are in Europe, primarily in France and the U.K. With the exception of more than 11 million in the U.S., the same holds for T-Mobile's more than 50 million subscribers. Vodafone, the world's largest mobile operator, has most of its subscribers in Europe, but also holds Vodafone Japan and 40% of Verizon in the U.S.

[79] Annual and semi-annual financial reports of the operators and their predecessor companies (www.vodafone.com, www.orange.com, www.t-mobile.net, and www.telekom3.de), and derivations by The Shosteck Group. Monthly AMPU is calculated based on "Operating Cash Flow." This may be reported as "Operating Profit" (Vodafone), "EBITDA" (Orange and T-Mobile), or "OIBDA" (T-Mobile). "Average Subscribers" are based on proportionate subscribers (if any) as of the mid-point of the fiscal year. AMPU is calculated as [(Operating Cash Flow)/(Average Subscribers)]/12.

[80] "Chapter 6: The Issues of 3G Costs," *Third Generation Wireless (3G): The Continuing Saga*, The Shosteck Group, Wheaton, Maryland, February 2001, pp. 122-131.

Overall, extreme competition among U.S. operators has driven per minute rates to 60 percent less than those of Europe. Nonetheless, the AMPU of U.S. operators has risen. The AMPU of European operators appears to be following the same path. Such patterns reveal that the lower tariffs that UMTS enables can lead to increased traffic and from that, increased profit margins.

Summary and Conclusions

Since 1994, U.S. tariffs have fallen from $0.42-$0.90 per minute to $0.08-$0.12 per minute. As a consequence, between 1998 and 2002, use increased from 123 Minutes of Use (MoU) per month to 450 MoU. In contrast, during 2002, use in Canada averaged 265 MoU. That in Europe averaged 120 MoU.

The rates of these countries explain 95 percent of the differences in MoU. Despite rates that are less than one-half those of Europe, U.S. operators earned 46 percent more Average Revenue per User (ARPU).

Driven by lower rates, ARPU in the U.S. increased from $39.66 in 1998 to $49.95 in 2003. A beginning increase has emerged in Europe over the past 18 to 30 months. There, Vodafone's largest networks have seen gains in ARPU of 4.7 to 6.8 percent.

Despite intense competition, U.S. operators are experiencing increasing Average Margin per User (AMPU). European operators are beginning to do so. This indicates that the falling tariffs, which already are accompanying UMTS, will increase use sufficiently to expand profit margins rather than reduce them.

CHAPTER 5: THE GROWING DATA MARKET

INTRODUCTION

As we showed in our previous chapter, ARPU is increasing for some, if not all, major European operators. Data offerings, such as enabled by Orange's SPV E200 handset and "Vodafone Live," have been widely publicized.[81] Despite this, virtually all European ARPU still comes from voice and SMS.

This raises two questions: **First**, will the use of non-SMS data expand beyond the present early-adopters? **Second**, will the trend of increasing voice (and SMS) ARPU carry over to non-SMS data? As we show in this chapter, the answers are yes.

In Western Europe, data accounts for seven to 18 percent or more of revenues.[82] The vast majority is SMS. The industry foresees non-SMS data contributing more.

In the U.K., Peter Erskine, CEO of mmO2, "remains resolute" that SMS/non-SMS data will generate 25 percent of revenues by year-end 2004, up from 17.3 percent, as of March 2003.[83] Orange anticipates that data will generate 25 percent of revenue, about ten euros per subscriber, by 2005.[84] Alcatel foresees data representing 20 to 30 percent of revenues between 2005 and year-end 2007.[85] Nokia expects data to produce 30 percent of revenues by 2007.[86] Most of these gains will come from non-SMS data. Some will come from the Internet. Some will come from picture/video messaging and other content that subscribers originate.

In this chapter, we review experiences from Korea, Europe, and Japan. Each provides a different insight into how the market for non-SMS data may evolve.[87]

THE KOREAN EXPERIENCE

Korea's SK Telecom (SKT) and KTF have deployed cdma2000 1x and cdma2000 1x EV-DO. These provide packet functionality similar to that of UMTS. Unlike in Europe, about 70 percent of the data passing over the Korean networks represents **non-SMS** content.[88] Thus, the Korean trend provides an example of what will likely happen in Europe as operators deploy UMTS and data use expands beyond SMS.

During the past two years, the Korean market has made a full transition from monochromatic to color handsets. Since July 2003, more than 50 percent of handsets sold have built-in cameras, as well.[89] Camera phones enable user-generated traffic in the form of picture messaging. With greater memory, they also enable users to download larger applications.

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[81] Press release, "Orange Unveils Latest Signature Phone - SPV E200 - and Reveals New Smartphone Usage Research," Microsoft and Orange, Geneva, Switzerland, October 10, 2003; "Vodafone to Focus on Own Phones - Paper," *Reuters*, December 4, 2003; and "Vodafone Live: A Stepping-Stone to 3G," www.3G.co.uk, December 4, 2003. We discuss Vodafone Live in our last chapter.

[82] "Data Revenues for Selected Operators," *3G Mobile*, September 17, 2003, pp. 6-7. Values for Q2, 2003.

[83] "O_2 Trumpets Strong Data Performance," *3G Mobile*, July 9, 2003, p. 1.

[84] "Orange Unveils Latest Signature Phone..."

[85] Personal communication, Isabelle Warnier, Industry Analyst Relations Manager, Alcatel, Paris, France, December 5, 2003.

[86] "Nokia's Mobile-Network Sales Expected to Drop 15 Percent in 2003," *The Wall Street Journal*, June 11, 2003.

[87] Subsequently, when we use the term "data," we shall refer to "non-SMS," unless otherwise specified.

[88] Personal communication, informed industry source, December 3, 2003.

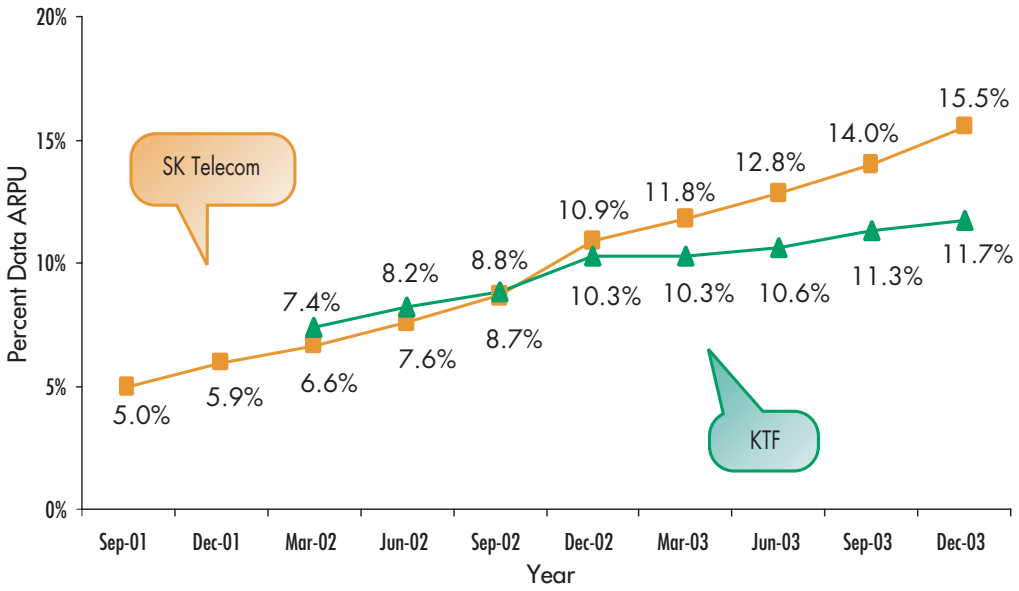
[89] "Camera Phones Account for More than Half of All Handsets Sold in South Korea," *DigiTimes.com*, August 6, 2003.

With the greater functionality of the network and handsets, SKT has introduced five sub-brands, each for a different market segment. "June," SKT's premium brand, emphasizes media services. "TTL" fits "the life style of young people." "Ting" is designed for teenagers. "UTO" serves professionals 25 to 35. "Cara" fits "the life style of married women."[90] SKT's major competitor, KTF, has adopted sub-branding.

Figure 5.1 traces the increase in data ARPU for the two operators over recent quarters. From September 2001 through September 2003, SKT expanded data ARPU from 5.0 to 14.0 percent. In October, it increased to 15.5 percent. From March 2002 through September 2003, KTF expanded data ARPU from 7.4 to 11.3 percent. In October, it increased to 11.7 percent.[91] Accepting that 70 percent is non-SMS, about 10.8 and 8.2 percent of the latest ARPU, respectively, stems from Internet-enabled applications and services.[92]

FIGURE 5.1

THE RELATIVE INCREASE IN DATA ARPU, SK TELECOM AND KTF, KOREA, 2001 TO PRESENT



Source: "Monthly Factsheet," Investor Relations Office, SK Telecom, Seoul, Korea, continuous, (www.sktelecom.com/english/investor/info/investor_packets/monthly/fact_sheet/index.html); "Monthly Factsheet," Investor Relations, KTF, Seoul, Korea, continuous, (www.ktf.com/eng/ir/invest/fact_sheet.jsp); and derivations by The Shosteck Group. Values for the December 2003 quarter are for October only.

The Korean experience suggests that European operators can experience similar data success, as they enter the market with relatively mature UMTS networks and handsets.[93]

[90] "Brand," SK Telecom. (www.sktelecom.com/en/services/brand.html).

[91] "Monthly Factsheet," Investor Relations Office, SK Telecom, Seoul, Korea, continuous (www.sktelecom.com/english/investor/info/investor_packets/monthly/fact_sheet/oindex.html); and "Monthly Factsheet," Investor Relations, KTF, Seoul, Korea, continuous (www.ktf.com/eng/ir/invest/fact_sheet.jsp); and derivations by The Shosteck Group. SKT first reported data ARPU in September 2001. KTF first reported in March 2002. We surmise that SKT's faster growth is due to more astute marketing, in particular, it's sub-branding.

[92] (0.155) x (0.70) = (0.108); (0.117) x (0.70) = (0.082)

[93] We have heard the argument that the success of Korean operators in promoting data services should be attributed to "cultural differences." However, we have seen no data to support this view.

The European Experience

At first glance, Europe's current data story seems limited to SMS. GSM-GPRS networks carry little non-SMS data traffic. Telecom Italia Mobile (TIM), Europe's most enthusiastic proponent of EDGE, will not launch until mid-2004, subject to handset availability.[94] Hutchison's UMTS networks are still teething.

We surmise that the scarcity of non-SMS traffic may be due, in part, to the **capacity limitations of GPRS**. To transmit data, GPRS must take one or more time-slots from voice service. For this reason, conventional GSM-GPRS operators may be reluctant to promote data as vigorously as they otherwise might, until the greater capacity of UMTS becomes available. Despite this surmised reluctance, a careful reexamination of available information reveals a positive data story.

We focus on Vodafone. It is one of the few, and perhaps only, European operators to publish separate ARPU for SMS and non-SMS (Internet-based) services. It labels them "messaging" and "data" ARPU, respectively and has reported them since September 2001. These reports enable us to plot the growth of Vodafone's Internet-based traffic.[95]

Figure 5.2 tracks such traffic for the U.K., Germany, and Italy, Vodafone's three major European markets.[96] We see a relatively consistent upward trend.

In September 2001, Vodafone Italy generated 0.2 percent of ARPU from non-SMS data. This increased to 0.3 percent in September 2002 and to 0.7 percent in September 2003. This was a more than three-fold increase over the two-year period.

In September 2001, Vodafone Germany reported 0.3 percent ARPU from non-SMS data. This reached 0.8 percent in March 2003 and spurted to 1.2 percent in September 2003. This was a four-fold increase over the two years.

The U.K. situation is less clear. In September 2001, non-SMS data made up 0.9 percent of ARPU. In March 2002, it increased to 1.2 percent. In September 2002 and March 2003, it slipped to 1.0 percent. In September 2003, it increased to 1.2 percent. Over the two years, it increased by one-third.

In sum, from September 2001 through September 2003, the ARPU for non-SMS data over Vodafone's three major European networks increased from 0.2-0.9 percent to 0.7-1.2 percent. The average ARPU doubled from 0.5 to 1.0 percent. Given the prominence of "Vodafone Live"[97] and the high data revenues of SKT and KTF, we view these emerging data gains as a harbinger of larger increases to come.

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[94] Julian Bright, "Italy's TIM Plans EDGE Launch by mid-2004," *Total Telecom*, September 26, 2003.

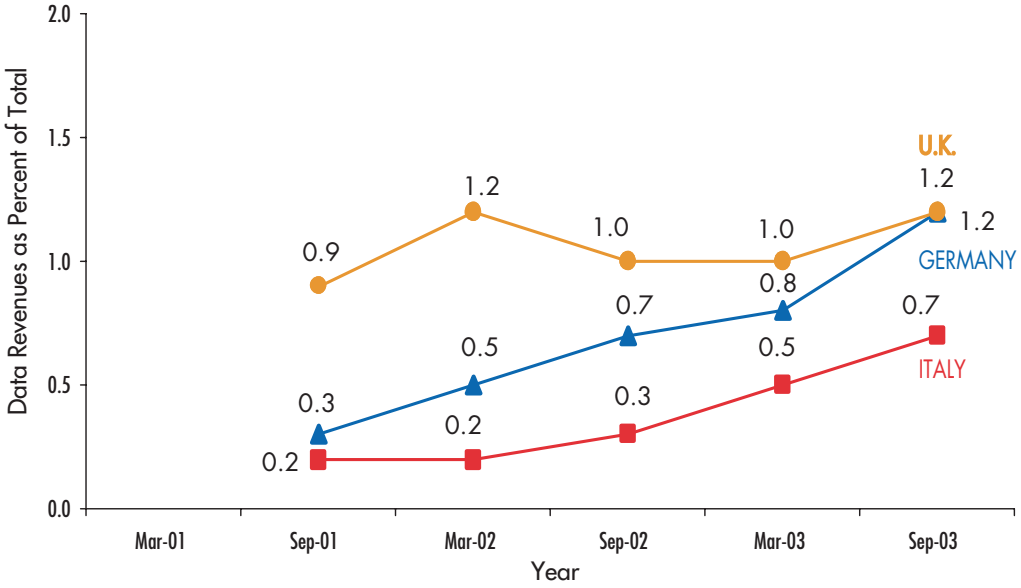
[95] As we noted in our previous chapter, Vodafone reports in terms of 12-month running averages. This masks shorter-term trends and means that upward tendencies may be more robust than they now appear.

[96] "Vodafone Group PLC - Mobile Telecommunications Businesses, Non-Voice Services as a Percentage of Services Revenues," *Interim Results for the Six Months ...*, Vodafone PLC, Newbury, Berkshire, U.K., continuous.

[97] We discuss this in our next chapter.

FIGURE 5.2

THE RELATIVE INCREASE IN DATA ARPU, VODAFONE, EUROPE, 2001 TO PRESENT



Sources: "Vodafone Group PLC – Mobile Telecommunications Businesses, Non-Voice Services as a Percentage of Services Revenues," *Interim Results for the Six Months…*, Vodafone, PLC, Newbury, Berkshire, U.K., continuous, (www.vodafone.com). Values are 12 month running averages.

Vodafone is assuring this. In December 2003, it announced it was providing PC cards for UMTS to choice customers in Italy and Germany. These will enable those customers to access the Internet with laptop computers. By using the cards, Vodafone can promote data without relying on still unreliable UMTS handsets.[98]

The Japanese Experience

NTT DoCoMo provides "FOMA" service over the world's longest established W-CDMA network. DoCoMo's experience reveals the importance of network coverage and density and, in particular, handset maturity for subscriber growth, use, and revenue.

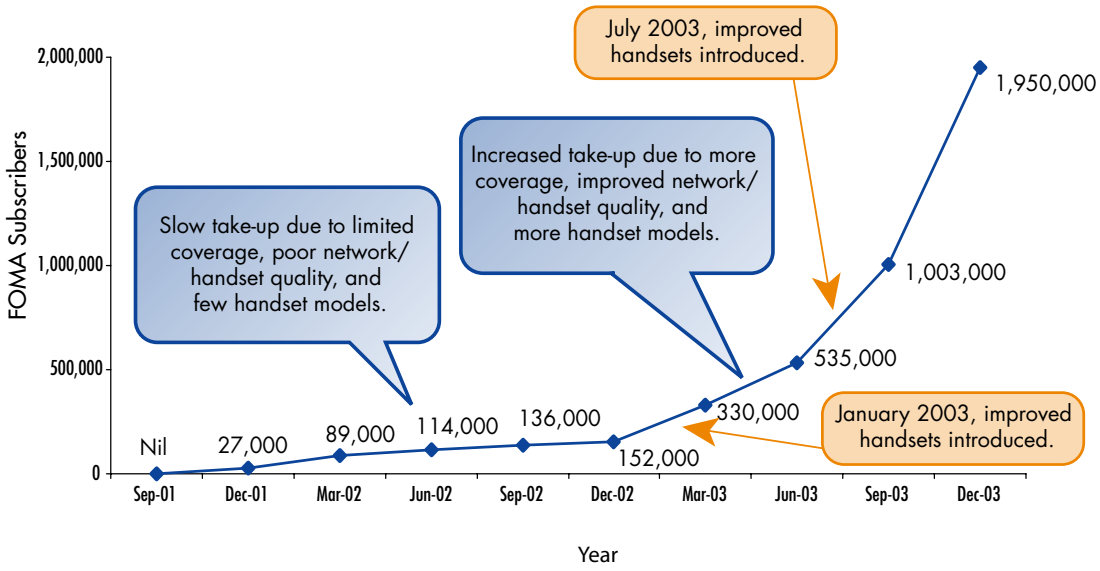
Figure 5.3 tracks the increase in FOMA subscribers for each quarter, from launch of service in October 2001 through December 2003. Because of incomplete network coverage and poorly performing handsets, DoCoMo struggled. In the 15 months from launch through December 2002, it attracted only 152,000 subscribers. In January 2003, it introduced improved handsets. Subscriber growth increased, reaching 330,000 at the end of March and 535,000 at the end of June. In June-July, DoCoMo introduced yet more improved handsets.[99] Growth accelerated. By November 2003, FOMA had attracted 1,626,000 subscribers and will likely reach 1,950,000 by year-end.[100]

As improved handsets enter the European market, UMTS subscribers, likewise, will increase. As importantly, their use of services will increase as well.

[98] Boris Groendahl, "Vodafone Launches 'Data Only' 3G," *Reuters*, December 11, 2003.
[99] *UMTS - When and Why It Will Happen*, pp. 20-21.
[100] "Subscriber Growth" (www.nttdocomo.co.jp/english...), and estimate by The Shosteck Group.

FIGURE 5.3

W-CDMA (FOMA) SUBSCRIBERS, NTT DOCOMO, OCTOBER 2001 TO PRESENT



Sources: NTT DoCoMo, trade press reports, and interpolations by The Shosteck Group. DoCoMo officially launched W-CDMA on October 1, 2001, (www.nttdocomo.co.jp/english…).

Figure 5.4 tracks average FOMA ARPU for voice and data combined. It reveals how improved technology contributes to ARPU gains. In December 2001, FOMA's first adopters generated ARPU of $86.67.[101] By September 2002, this had declined to $60.42. The exuberance of the early adopters faded as FOMA failed to perform. However, as the network and handsets improved, the decline reversed. By March 2003, ARPU rose to $66.92. By September, it had reached $86.92.

These ARPU gains took place as subscribers increased. Thus, they cannot be due to "early adopters." Rather, they reflect greater use due to the improved network and handsets.

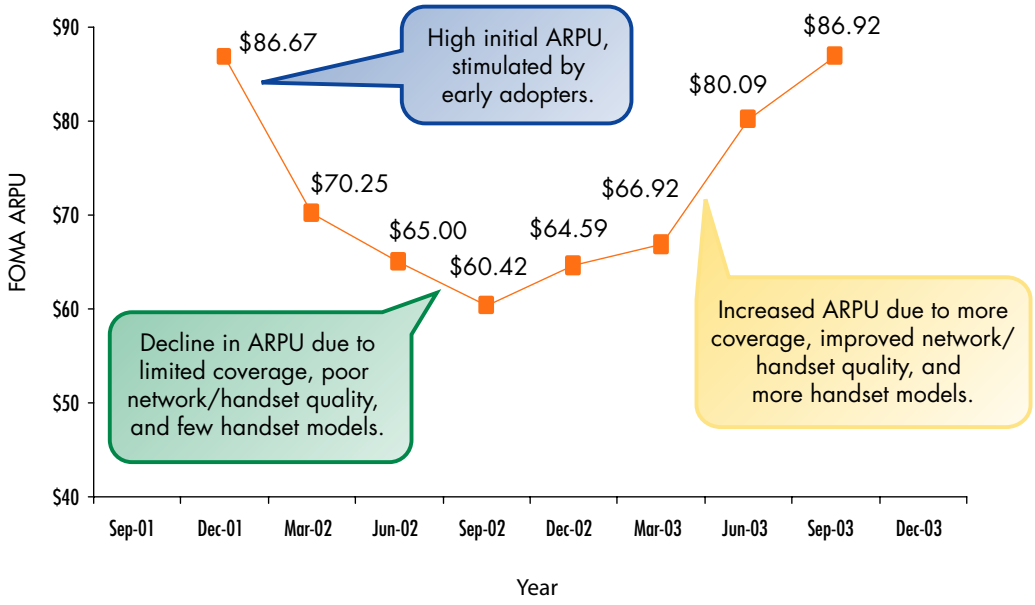
The data portion of ARPU is substantial. In the June 2003 quarter, when DoCoMo first reported voice and data ARPU separately, data contributed $27.09 or 33.8 percent to ARPU. In the September quarter, data contributed $30.00 or 34.5 percent.

One can posit that the higher ARPU comes from heavy data users who have migrated from DoCoMo's legacy PDC network, rather than the enhanced data experience that FOMA provides. That is unlikely. As we document in our next figure, as data traffic on the FOMA network has increased, so has that on the PDC network.

[101] "Operation Data" *Earnings Releases*, NTT DoCoMo, Tokyo, continuous and estimates by The Shosteck Group. Reported by DoCoMo as "Aggregate ARPU" (www.nttdocomo.co.jp/english...). Values in U.S. dollars, converted at ¥120 = $1.00.

FIGURE 5.4

W-CDMA (FOMA) ARPU, NTT DOCOMO, OCTOBER 2001 TO PRESENT



Sources: "Operation Data," *Earnings Releases*, NTT DoCoMo, Tokyo, continuous and estimates by The Shosteck Group. Reported as "Aggregate ARPU," (www.nttdocomo.co.jp/english…). Values in U.S. dollars, converted at ¥120 = $1.00.

Figure 5.5 tracks the packets transmitted per user per day on the FOMA and PDC networks, over time.[102] During the June 2002 quarter, data users transmitted 813 packets on FOMA. During the September quarter, this declined to 740 packets. In March 2003, it increased to 1,027 packets. By September, it had jumped to 1,840.

This decline and increase in packets parallels the decline and increase in ARPU. Both reflect the poorly performing and then improving UMTS network and handsets. Over the same time, packet traffic on the PDC network also increased, rising from 213 packets per user per day to 253.[103] This increase means that cannibalization is **not** occurring. Rather, the improved applications, content, and experience of FOMA (and to a lesser extent, PDC) are driving greater data use.

We see these improvements reflected in subscriber numbers. As FOMA subscribers are increasing, PDC subscribers are declining. PDC subscribers peaked at 44.1 million in August 2003. By November, they had declined to 43.6 million – a drop of 500,000.[104]

DoCoMo's experience underscores the effect of technology maturation on data traffic. European operators, including Vodafone and TIM, will not launch UMTS until handsets are ready. Because handsets will be reasonably mature, users may adopt data more rapidly than operators assume.

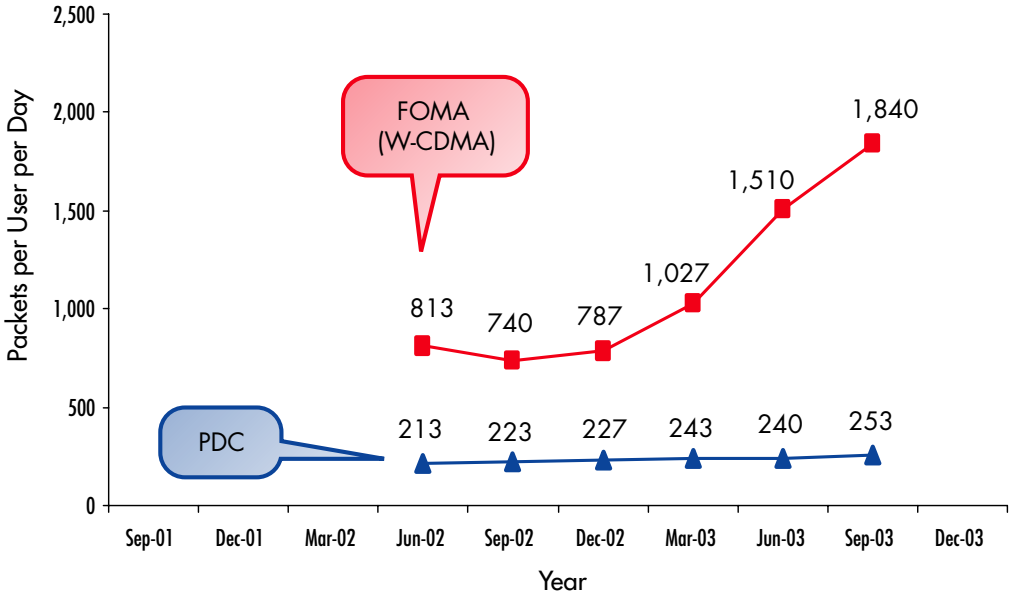
[102] This figure refers to i-mode users only. i-mode is a platform that provides a suite of data services. Both the PDC and FOMA networks support it. FOMA, however, enables an expanded set of services. It also provides a better end-user experience. For this reason, the comparison of packet traffic over the two networks indicates the greater functionality - and commercial potential - of the FOMA network and handsets.

[103] (www.nttdocomo.co.jp/english...)

[104] *ibid.*

FIGURE 5.5

DAILY PACKETS PER USER, FOMA (W-CDMA) AND PDC NETWORKS, NTT DOCOMO, APRIL 2002 TO PRESENT



Sources: Keija Tachikawa, President and CEO; "FOMA Usage Analysis (1) i-mode Packet Usage Trends," *Highlights of Fiscal 2003 First Half Results and Planned Activities in the Second Half, NTT DoCoMo*, Tokyo, October 30, 2003, (www.nttdocomo.co.jp/english/corporate/investor_relations/referenc/presentations/pdf/20031030/) and estimates by The Shosteck Group. Use by i-mode subscribers.

Our next chapter explores applications and services that UMTS enables and how operators can profit from them. We look at the "expanded market" of 2.5G applications, made faster and less expensive by UMTS. We study the greater functionality of new handsets and how they may enable operators to differentiate. We analyze video-telephony, promoted as a key selling point of UMTS, but which may carry high risks. Finally, we examine the "enterprise story." With that, we probe non-conventional laptop uses that may evolve with the greater capacity and lower cost that UMTS provides.

Summary and Conclusions

This chapter examines emerging data use in Korea, Europe, and Japan. In Korea, we show that non-SMS data already contributes as much as ten percent of ARPU. This has been supported by a robust packet network and camera handsets. In Europe, we reveal that ARPU from Vodafone's non-SMS data has doubled from 0.5 to 1.0 percent over the past year. We interpret this as a harbinger of increased data growth to come. In Japan, we document that with an improved network and handsets, data subscribers and data traffic escalate. Total ARPU and data ARPU escalate with it.

This suggests that legacy European operators will be rewarded for their decision to defer the launch of UMTS until 2004, when the technology will have reached tolerable maturity. Because of that, subscriber take-up may be more rapid than some operators expect.

CHAPTER 6: THE SERVICE OPTIONS OF UMTS OPERATORS

INTRODUCTION

We have presented the thesis, that by increasing capacity and reducing costs, UMTS will enable operators to offer more services at far lower charges than are possible today. As an outcome, use of data will expand exponentially. Revenues and profits will follow.

In this chapter and the one following, we suggest how operators can position their UMTS offerings to assure that profitability.

Operators may be tempted to rush to high profile services such as video-telephony. But, they must be cautious. The commercial issue is not which services become **possible** under UMTS, or which deliver the greatest ARPU, but which deliver the greatest **profit** – AMPU. As we point out below, video-telephony does not.

Operators can provide three categories of data services that leverage the capabilities of UMTS.

First is "video-telephony." This refers to two-way, real-time conversational video that allows people to talk and view moving images simultaneously. Technically, it is a multimedia service. Nonetheless, we treat it separately because it places the highest demand on the network of any application. This is due to its need for low latency, low "jitter" (the consistency of latency), instantaneous bandwidth, and high reliability (a minimum of lost or late packets). As a consequence, it is the most difficult and expensive service to deliver, in terms of allocated network resources and Node B density.

Second are "multimedia" services. These may include video-streaming, multimedia messaging, multiplayer gaming, application downloads, and information content. In the case of video-streaming, the content may be anything – movie promotions, sports highlights, or news clips. Typically, video-streaming is thought of as a one-way download from the network to the handset. However, a personal video can be sent from one handset to another or uploaded from a handset through the network to a PC.[105] Video-streaming need **not** be delivered in real time. The content is buffered in the memory of the device and then delivered to the display. Compared to video-telephony, which must be delivered in real time, this places less demand on the network. As such, it is easier to deliver and costs less. With its greater data rate and capacity, UMTS enables operators to deliver higher-resolution videos (and images) than otherwise would be the case.

Third is a "smart pipe."[106] The smart pipe provides operator-provisioned services in addition to transport. These might include encryption, virus protection, position location, multi-user conferencing, and higher Quality of Service (QoS). Higher QoS entails guaranteed delivery in terms of latency, jitter, bandwidth, and reliability. Each of these services increases the value of the network and, thereby, potential revenues.

[105] Unlike the case with a video-phone, this may require special software on the PC.

[106] The concept of "smart pipe" was introduced to the wireless industry during 1997-1999 by Mr. Ken Blakeslee, then VP of Business Development for Wireless Internet, Nortel Networks.

Some might expect that the smart pipe would be most relevant for corporations, governments, and professionals. This is too narrow a view. It can also enable services to consumers. These might include secure servers to facilitate commercial transactions as well as storage for personal photographs and videos, among others.

Users, in particular those from the enterprise world, may not adopt all aspects of the smart pipe. There are at least three reasons for this. **First**, the Information Technology (IT) departments of enterprises – whether in-house or out-sourced – may provide encryption, virus protection, and related services. **Second**, the costs of measuring and billing for aspects of QoS may exceed the potential revenues. **Third**, as networks mature, they will deliver improved QoS, diminishing the value of "premier" QoS. Notwithstanding the above, smart pipes still offer operators a revenue potential, in particular for enterprises without full-fledged IT departments.

UMTS operators may favor different data services. But in all cases, they will be positioned to deliver mixed voice and data with increasing efficiency over time. Unlike the case with GSM-GPRS, they will have little concern about crowding out their core voice business.

The "Sweet Spot" of Profitability

The key to profitability is understanding which applications and services provide the greatest margins. The most profitable services **maximize AMPU, not ARPU**. We refer to such services as occupying the "sweet spot" of profitability. Compared to GSM-GPRS, UMTS increases the sweet spot in two ways.

First, UMTS lowers the cost of delivery, enabling operators to **charge less**. **Second**, UMTS enables an **improved user experience** – higher image resolution, faster delivery, larger and more functional applications, and better QoS. QoS is critical to the success of data offerings. If services are conceptually worthy but under-perform, users will not adopt them. Improved services at lower charges mean that more people will use them and do so more often.

In the center of the sweet spot are services which (1) have high value to end-users, (2) perform well, (3) are inexpensive to provide, and (4) can be delivered in large quantities. These will deliver the most profit.

Video-telephony

Video-telephony is the flagship service of Hutchison 3G. It is also offered by NTT DoCoMo. But will it prove profitable for operators? That's unlikely over the near term. Until now, three factors devalue it – technology immaturity, limited network coverage, and, potentially, pricing.

Hutchison's initial offering underscores the challenge of immaturity. Its U.K. network has delivered "disjointed" sound and video images that are "subject to breaking up."[107] The battery life of hand-sets has been unsatisfactory, with early models delivering no more than an hour of use.[108] On its

[107] "Television Advertising Complaints Reports," Independent Television Commission (UK), Bulletin #18, July 21, 2003. See http://www.ITC.org.uk

[108] "mmO2 Sees Battery-Hungry 3G Phones until October 2005," *Total Telecom* (*Reuters*), November 24, 2003.

Australian network, users trying to receive video could see the persons transmitting, but could not hear them.[109] Its customers can only make video calls with other Hutchison customers, limiting the utility of the service. The network coverage is minimal compared to that of competitors.

Pricing is also an issue. As of December, Hutchison U.K. was running a promotion which allowed users to include video calls within their voice allowance. These buckets of combined voice and video-telephony started at £15 for 100 minutes,[110] or 15p per minute. However, after an initial three months, Hutchison plans to charge 50p per minute. One can ask, how many users will pay that much?

Given the above, video-telephony, at present, fails the sweet spot test on one, and likely two, criteria – poor performance and high cost.

The Hutchison experience is a warning to other operators. Take care in adopting advanced services. Ensure that they work. Remember that technology maturity takes time. Being first to market with failed offerings provides no advantage.

With time and continued network build-out, maturity issues will be resolved. We expect reasonable maturity of UMTS by late 2004 and full maturity by late 2006. By then, video-telephony will be more common. With declining component costs, it may be built into a majority of phones, much like camera phones in Korea today.

Multimedia Services

With the exception of video-telephony – multimedia services, in particular video-streaming, can tolerate latency and jitter. Because of this, they use fewer network resources and cost less to deliver. This provides the potential for greater margins.

Operators have established ties with content providers. These enable them to charge for **content** as well as **delivery** of it. Within two months of its launch, DoCoMo had partnered with more than 30 providers, including Sony Music Entertainment and Fuji Television, to provide news reports, music videos and sports highlights as part of its FOMA "i-motion" service.[111] More recently, DoCoMo has partnered with Walt Disney Company and Sony Computer Entertainment.[112] Hutchison has partnered with MTV to deliver video clips of MTV programming, including live performances and news.[113]

As we observed, users can generate their own content through personal video messages. Operators can stimulate such messages by reminding users of holidays, birthdays, and anniversaries. They can offer "clip art" that users can incorporate into messages. They can collect additional fees by providing links to vendors such as flower and candy shops, who may sell goods appropriate to the occasions.

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[109] Simon Hayes and Michael Sainsbury, "Angry 3 Mobile Users Are Dropping Out," *Australian IT*, December 2, 2003.
[110] Hutchison "3" website, www.three.co.uk; price plans, November 24, 2003. However, this may change. After an initial three-month period, Hutchison may raise charges.
[111] "Video Arrives for 3G Phones," *Reuters*, November 14, 2001.
[112] "Animation, Music Standard Fare on Upgraded Third-Generation Phones in Japan," *The Mercury News*, December 18, 2003.
[113] "3 Signs up MTV and Jackass," *ZDNet* UK, September 23, 2003.

Most multimedia services can be delivered over GSM-GPRS and, especially, EDGE. However, UMTS provides a richer and more consistent user experience – and, thereby, greater value. More importantly, UMTS costs operators less. This means that they can charge less, increasing user value yet more.

The Increasing Sophistication of Handsets and Services

Our discussion has focused on the importance of simpler and lower-cost services. It has argued that offering more complex and higher-cost services, such as video-telephony, will place operators outside the sweet spot of profitability, at least for early UMTS networks.

However, what today is complex will become simple. What today is impossible will become possible. What today is expensive will become less so. These changes will stem from the increasing sophistication of components and the increasing processing power of DSPs. Given Moore's Law, the power of DSPs will continue to double every 18 months and their prices will continue to decline. Handsets will continue to become more sophisticated and with that, the services they enable.

As components and software improve, handsets are providing higher quality images, sound, and graphics. More memory is enabling larger applications with more functionality.

As examples, in April 2003, DoCoMo introduced its first camera phones with 1.0 megapixel resolution.[114] In October, Vodafone K.K. (Japan) announced that Sharp would provide a 2.0 megapixel camera phone that would record video as well.[115] In January 2004, Toshiba announced a sub-one-inch (2.54 cm) disk drive, with an initial capacity of 2 to 4 GB.[116]

During 2001, Java and similar applications ranged from 12 to 45 kilobytes. This made for a reasonably quick download on 2.5G networks at a reasonable cost. By 2003, downloadable applications had increased in functionality and size, reaching hundreds of kilobytes.[117]

All of the above will stimulate greater demand. However, many GSM-GPRS operators limit picture messages to 30 kilobytes.[118] With UMTS, operators can transmit higher-resolution pictures and videos at charges acceptable to end-users, something not possible over GSM-GPRS.

Summary and Conclusions

In this chapter, we suggest how operators can position UMTS offerings to assure profitability. The commercial issue is not which services are possible under UMTS, but which deliver profit.

Operators can provide complex and expensive video-telephony. They can provide less complex and less expensive multimedia services, in particular video-streaming. They can provide a "smart pipe," which offers encryption, virus protection, position location, multi-user conferencing, and QoS.

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[114] "DoCoMo to Launch First Megapixel Camera Phones," *Mobile Monday*, April 11, 2003.

[115] "Vodafone Wireless Phone - 2 Megapixel Camera," *3g.co.uk*, October 20, 2003.

[116] "Cell Phones with 4GB Memories?", www.cellular-news.com/story/10402.shtml, January 9, 2004.

[117] Personal communication, informed industry sources, December 2, 2003.

[118] "Internet Access," Vodafone, www.vodafone.com, January 2, 2004; and *Strategic Implications of Multimedia Messaging*, The Shosteck Group, Wheaton, Maryland, February 2003.

To succeed commercially, such services must (1) provide high value to end-users, (2) perform well, (3) be inexpensive to deliver, and (4) be deliverable in large quantities.

At present, video-telephony fails in terms of performance and, potentially, in terms of costs. Video-telephony requires real-time delivery on a network that is not yet mature enough to provide it. That failure illustrates the importance of technology maturity. In contrast, multimedia services, in particular video-streaming of high-resolution images and videos, can succeed. They do not require real-time delivery. The network, even in its early stage, is mature enough to support them.

Over the near term, operators who focus on simpler and less expensive UMTS services are most likely to profit. With time, handsets will become more sophisticated. Networks will mature. These will enable operators to deliver more complex services than are feasible at present, and to profit from them.

CHAPTER 7: MARKET SEGMENTATION

INTRODUCTION

The greater functionality and lower cost of UMTS, together with more capable handsets, will enable operators to serve market segments more effectively than before. This will be especially the case for commercial and government applications.

With increasing sophistication, the value of services will increase. This will enable operators to support segments with focused offerings. We surmise that most UMTS operators will recognize this and leverage their expanded sweet spot to increase usage among such segments. These may comprise:

– **Consumer multimedia services.** These include DoCoMo's i-mode and Vodafone's "Vodafone Live!" Such services are being delivered over GSM-GPRS networks. However, UMTS will enhance their quality and functionality. This will occur as networks mature, coverage expands, handsets improve, and their prices fall. Importantly, such services can be delivered in greater quantities and with higher margins than possible over GSM-GPRS or EDGE.

– **High-value markets.** These include corporations and vertical markets, which have specific mobile requirements. In many cases, these requirements aren't practical or economically justifiable over GSM-GPRS or EDGE

– **New devices.** These will support new applications. Examples are camera phones, which can take very high-resolution pictures, and PDAs, which can support a wide range of interactive services originating from the Internet.

– **Small-to-Medium Businesses (SMBs).** These include businesses with fewer than 50 employees. They will use off-the-shelf software to connect office applications to mobile devices and they will demand low tariffs.[119]

– **Mobile laptop users.** Relatively few laptop owners are using them with Wi-Fi and/or GSM-GPRS. With UMTS providing a wide-area and/or faster alternative at lower cost, this market expands.

– **Supplements to Public Safety Networks**. Police, fire, and ambulance are increasingly concerned with domestic security, constrained budgets and especially, network interoperability. UMTS can offer an effective and low-cost alternative to purpose-built networks. However, this segment requires high reliability, priority access, and ubiquitous coverage.

These segments aren't new. But with increased capacity, lower costs, and all-IP networks (with Release 5 and beyond), UMTS operators will be better positioned to serve them. In the discussion that follows, we look at these segments in greater detail.

CONSUMER MULTIMEDIA SERVICES

Major operators have launched branded packages of multimedia services on their 2.5G networks. The most successful have been NTT DoCoMo, with i-mode, and more recently Vodafone, with "Vodafone Live!" We focus on these as examples.

[119] "The Maturing of the Mobile Corporate Enterprise Market," *The Shosteck Group Pulse*, October 2003.

NTT DOCOMO

NTT DoCoMo (DoCoMo) has the longest experience with W-CDMA and multimedia services. Looking at it, we see the issues that are likely to face all operators going forward.

DoCoMo's success with i-mode over its PDC network is legendary.[120] By October 2001, i-mode was a mature "cash cow" with 27.5 million subscribers.[121] In that month, DoCoMo launched its W-CDMA network, called FOMA, which supports its next generation of multimedia services.

FOMA went far beyond the PDC version of i-mode. It was significantly faster and able to handle greater volumes of data. By late 2003, this included email messages of up to 10,000 characters, attachment files of melodies, video-telephony, downloadable video clips, video messaging, and picture messaging.[122]

Initially, FOMA struggled. Through February 2003, only 192,000 subscribers had signed on.[123] Millions more had signed on to PDC-based i-mode. Much of the reason was FOMA's poor initial coverage and poorly performing handsets.

As we pointed out in Chapter 5, with extensive coverage and improved handsets, FOMA experienced a dramatic upswing in subscribers. These reached 1.6 million by the end of November 2003, and what we estimate as 1.9 million by the end of December.

As we observed in Chapter 6, DoCoMo launched FOMA content with partners such as Sony Music Entertainment and Fuji Television. However, in FOMA's first 17 months of operation, limited coverage and poor handset performance overshadowed content. This is a key lesson for new UMTS operators. "Bugs" will likely limit early network performance. For this reason, it may be better to devote initial resources to network tuning rather than to promoting services before the network is ready to deliver them.

VODAFONE

Vodafone will be one of the first European operators to follow in DoCoMo's footsteps. In October 2002, it launched a package of multimedia services branded "Vodafone Live!" over GSM-GPRS. Vodafone sees "Vodafone Live!" as a "seamless environment for customers to move on to 3G devices."[124] As Vodafone launches UMTS, it will expand its services, as did DoCoMo.

"Vodafone Live!" has proven popular. As of October 2003, it had three million subscribers in 15 countries.[125] They were signing up at the rate of 300,000 per month. In the first nine months, customers downloaded over three million games and ten million polyphonic ringtones.[126] The service has been popular in Germany and the U.K. and accounts for much of the increase in non-SMS data ARPU that we documented in Chapter 5.

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[120] PDC (Personal Digital Communications) is the unique Japanese 2G standard, which is similar to TDMA/IS-136.

[121] "Trying to Attract Cell Users to Next Mobile Generation," *The New York Times*, October 9, 2001.

[122] "FOMA Services," NTT DoCoMo, November 2003, www.nttdocomo.com.

[123] "Planned and Actual UMTS Subscribers, NTT DoCoMo, October 2001 through Present," *Shosteck E-STATS*, Figure CC.4.1, The Shosteck Group, Wheaton, Maryland, continuous.

[124] www.vodafone.co.uk

[125] *ibid.*

[126] "Vodafone Services - Vodafone Live!", Vodafone UK website (www.vodafone.co.uk), November 2003.

We surmise that launching "Vodafone Live!" on GSM-GPRS has been useful to Vodafone, for at least three reasons.

First, it has educated a segment of Vodafone's customers on the potential of mobile multimedia. Like DoCoMo, Vodafone launched with high-profile content partners, picture messaging, and other services, which hint at the capabilities of upcoming UMTS.

Second, "Vodafone Live!" utilizes a common platform across all Vodafone networks. Because of this, Vodafone has benefited from economies of scale from its suppliers and the offer of seamless services to its roaming users. This is fundamental to its core strategy. The advantages are apparent from other operators, such as Orange, who have launched/are launching their own branded platforms.

Third, "Vodafone Live!" has given Vodafone a better understanding of the multimedia market. Vodafone can apply this to its launch of UMTS in 2004.[127] With this, Vodafone should be able to convert a large base of existing customers to UMTS while avoiding the early problems of Hutchison 3 and DoCoMo.

Vodafone will not launch until major maturity issues are worked out. It wants network stability at least close to current 2.5G levels, average data rates of 200-250 kbps, and smaller handsets whose performance justifies any premium cost over current 2.5G handsets.[128]

Running A "Smart Pipe"

Internet access is typically sold in flat-rate "buckets," with monthly usage caps. However, selling flat-rate access – as opposed to discrete services – has long been regarded as a "pipe" proposition. The concerns common to this model are the loss of differentiation, low margins due to commodity competition, and network overloading.[129] But for UMTS operators, these concerns are minimal, for two reasons.

First, the capacity of UMTS removes the constraints of 2.5G networks.

For example, Vodafone's "Mobile Connect Complete" rate over its GSM-GPRS network offers up to 150 mb of data per month for £45 ($76.50),[130] an effective rate of £0.30 ($0.51) per megabyte if all the allowance is used. Additional megabytes are a moderately punitive £1 ($1.70) each.[131] This – and the relatively slow throughput of GSM-GPRS – discourages extensive use.

In contrast, as we described in Chapter 2, Verizon Wireless is offering **unlimited** data usage on commercial cdma2000 1x EV-DO networks for $79.99 per month. cdma2000 1x EV-DO provides high data capacity and announced throughput of 300-500 kbps, roughly comparable to UMTS.[132]

Verizon's offer encourages greater use. Freed from capacity constraints, UMTS operators have the same potential. Lower rates will attract more users. This will increase revenue and profit for all UMTS operators.

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[127] "Vodafone 3G Launch Delayed Further," *Financial Times*, September 26, 2003.

[128] "UMTS Deployment Congress - No Honeymoon in Amsterdam," Sines of the Times, *S2N*, Deutsche Bank, June 16, 2003. However, as we observed in Chapter 2, experienced data rates may be closer to 200 kbps.

[129] However, as we documented in Chapter 4, the concern about low margins due to commodity competition is likely misplaced.

[130] Converted at £1.00 = $1.70

[131] Vodafone price plans (www.vodafone.co.uk), November 26, 2003.

[132] UMTS, with its new spectrum allocation, provides more capacity. cdma2000 1x EV-DO provides higher data rates.

Second, the complexity of connecting mobile devices to the Internet offers opportunities for operators to add value beyond transport. As we described in Chapter 6, we call this model "the smart pipe."

These services may not be unique to any one operator. They will not differentiate operators by themselves. The profitability will come from the quality of execution.

There is great potential. Through business technology partners such as IBM, HP, Microsoft, and Oracle, operators can offer mobile/Information Technology (IT) integration. As part of this, operators can co-develop specialized devices and services for vertical markets or large enterprises. DoCoMo's investment of over $600 million in handset R&D illustrates this.

Operators are also in a unique position to provide value-added services such as user location, management reporting, network storage, and centralized digital rights management. Each of these services can be charged for, in addition to basic data transport.

For operators deploying UMTS, the challenges will be (1) working with mobile enterprise and business customers to determine their needs, (2) partnering with the appropriate integration firms, and (3) installing customer care and billing systems which can support these complex modes of use.

Corporate Enterprises and Small-to-Medium Businesses (SMBs)

UMTS will draw business users for three broad reasons.

First, UMTS will reduce the risk to enterprises in developing and deploying mobile applications. IT managers face numerous barriers to adopting mobile services – including security, system integration, and cost. Under UMTS, **the cost of mobile service is significantly reduced**.

Second, the greater capacity and lower cost mean that **more of the applications and services** that users expect from Wi-Fi and landline networks can be provided in mobile environments, as well. In other words, UMTS will allow mobile users to take their applications more places with less compromise than with 2.5G networks.

Business users equipped with UMTS phones or PC Cards will be able to access more of their office software, without worrying about the limitations of the mobile network. In support of this, Vodafone has announced an all-in-one "Mobile Connect" PC card that will seek out Wi-Fi, GPRS, and UMTS connections.[133] However, good coverage is critical to this.

Third, the all-IP networks specified in Release 5 will encourage use of **off-the-shelf software**. Right now, SMBs face high barriers to using all but the most basic PC applications via mobile networks. Typically, mobile applications have been heavily customized, expensive, and hampered by security issues. This has limited them to the largest corporations.

However, leading providers of software, such as Microsoft, are developing "mobilized" versions designed to work with their conventional office versions. For example, Swisscom and Microsoft have been cooperating to develop software that ensures a seamless handover between UMTS and Wi-Fi when a Wi-Fi hotspot is detected.[134] Microsoft has also announced a partnership with

[133] "Vodafone's Sarin Touts All-in-One Mobile Card and 'Decade of Change'," *ITU 03*, October 14, 2003.
[134] "3G: Time for an Upgrade," *Financial Times*, November 14 2003.

Vodafone to extend services such as messaging, location, authentication, and billing, to developers of web applications. This will allow subscribers to use web-based services on both wired and mobile networks.[135]

With this trend, the need for expensive custom applications will be minimized and business customers – particularly SMBs and mobile professionals – will be able to rely on easily connected mobile applications purchased off-the-shelf.

As a result, complex Return-On-Investment justifications for the mobile workforce will be reduced. This will increase the number of business users on UMTS networks. In the mobile industry, volume is key – and bringing mobile services to smaller businesses and practices will be an important way to exploit the volume opportunity.

The Mobile Laptop Market

Laptop PCs represent an unusual category because laptops aren't mobile devices. They are better called "portable" devices, which are used in a variety of locations. Because of their size, weight, fragility, and value, most people do not carry them unless they have a specific business purpose. For this reason, although there are tens of millions of laptops in the world, few persons use them for mobile access.

This has challenged public Wi-Fi "hotspot" networks such as Boingo, Wayport, The Cloud, and T-Mobile Hotspot. Public hotspots (such as coffee shops, airports, train stations, and convention centers) are typically a few hundred feet in diameter. A relatively small number of people enter hotspots carrying a laptop and are prepared to spend money to access the Internet. There are often alternatives, including landline (modem) access, broadband Ethernet services (typically in hotels), and public Internet terminals. These factors have limited the market for public Wi-Fi.

When it was launched, GSM-GPRS was expected to serve mobile laptop users (among others). Unlike Wi-Fi, GSM-GPRS enjoys the advantage of wide area coverage. However, it has disadvantages, including high cost[136] and slow (20-30 kbps) transmission rates. Mobile laptop users often transfer megabytes of data when using common applications like email, the web, and file transfer. This can be prohibitively slow and economically justifiable only by a small portion of the laptop-using market.

UMTS resolves these issues by delivering wide-area coverage (unlike Wi-Fi) at lower cost and with higher performance than GSM-GPRS or GSM-GPRS-EDGE. Even conservatively delivering 100 kbps on a loaded network (as we observed in Chapter 2, the lower end of a likely 100-300 kbps range), UMTS begins to match user expectations for Internet connectivity. While not "broadband" from a landline perspective, 100 kbps is still about double what modem users experience and roughly equivalent to landline ISDN. Most Internet-based services are designed to function well with this performance. With long-term costs of 3.5 to 5.2x less than those of GSM-GPRS networks, the price of using Internet applications on a laptop becomes affordable to a broader audience.

[135] "Microsoft, Vodafone team on mobile Web services," *CNET News*, October 13, 2003.

[136] As we observed earlier, Vodafone's highest GSM-GPRS "Mobile Connect Complete" rate offers up to 150 mb of data per month for £45 ($76.50), an effective rate of £0.30 ($0.51) per megabyte if all the allowance is used. Additional megabytes are £1 ($1.70) each.

Summary and Conclusions

In summary, the greater capacity and decreased cost of UMTS will have three essential effects.

First, UMTS operators will be able to offer services which are not commercially feasible on 2.5G networks. This will enable them to serve specialized segments that they cannot serve at present or, more likely, to expand services to such segments.

Second, UMTS will allow operators to deliver more sophisticated services with higher value. Downloadable sound will gain audio quality, downloadable applications can be bigger (and hence more capable), and multimedia content can provide increased resolution. This will enable operators to increase, or at least maintain, profit margins.

Third, UMTS will allow operators to deliver services with much less concern for capacity. The ability of UMTS to deliver services quickly to large numbers of customers at low cost will stimulate use and increase revenues.