The Mobile Commerce Value Chain: Analysis and Future Developments

Article *in* International Journal of Information Management · April 2002

DOI: 10.1016/S0268-4012(01)00047-0

Stuart J. Barnes
King's College London

Capital One
Exhibit 1014

PERGAMON International Journal of Information Management 22 (2002) 91–108

International Journal of
Information
Management

www.elsevier.com/locate/ijinfomgt

The mobile commerce value chain: analysis and future developments

Stuart J. Barnes*

School of Information Management, Victoria University of Wellington, PO Box 600, Wellington, New Zealand

Abstract

Barely before Internet-facilitated e-commerce has begun to take hold, a new wave of technology-driven commerce has started—mobile (m-) commerce. Fuelled by the increasing saturation of mobile technology, such as phones and personal digital assistants (PDAs), m-commerce promises to inject considerable change into the way certain activities are conducted. Equipped with micro-browsers and other mobile applications, the new range of mobile technologies offer the Internet 'in your pocket' for which the consumer possibilities are endless, including banking, booking or buying tickets, shopping and real-time news. Focusing on business-to-consumer markets, this paper examines how value is added in the stream of activities involved in providing m-commerce to the consumer. As such, it analyses the key players and technologies that form part of the m-commerce value chain, providing a foundation for future strategic analysis of the industry. Drawing on some of the key factors that may influence the take-up of m-commerce—including technological and other issues—the paper also provides predictions regarding the future of m-commerce.

Keywords: Mobile commerce; Wireless Internet; Telecommunications; Value chain

1. Introduction

It is increasingly becoming an understatement to say that the Internet and related technologies are changing the ways we live. Clearly, these technologies will affect peoples' lives in ways that have yet to be imagined. Indeed, if the Internet pundits are correct, few areas of our lives will remain untouched (e.g. Negroponte, 1995; Tapscott, 1997). One of the most significant changes promises to be in the way business is conducted. From being primarily a resource for the rapid and secure communications of the scientific and military communities, the Internet and related

*Corresponding author. Tel.: +64-4-463-5819; fax: +64-4-463-5446.
E-mail address: mnssjb@aol.com (S.J. Barnes).

0268-4012/02/$ - see front matter © 2002 Published by Elsevier Science Ltd.
PII: S0268-4012(01)00047-0

technologies are developing into the communication systems of choice for a variety of business activities in a diverse range of industries (e.g. GVU, 1999; Nua, 2001).

Another trend has been the proliferation of wireless telephones. From a penetration of only 8% in 1995, more than two-thirds of the UK adult population now own a mobile phone (Wearden, 2001). Similar patterns of growth can also be seen in Japan, the US and many other countries. In some places, such as some parts of Scandinavia and Hong Kong, the saturation of mobile phone ownership is now in excess of 80% (Fernández, 2000). Furthermore, the diffusion of mobile technology is likely to continue well into this decade. By 2003, the global number of cellular phone users is forecast to exceed one billion (IDC Research, 2001).

Recently, the impact of the Internet and wireless telecommunications has taken a new turn. Until recently, these technologies have followed very separate paths. However, this decade will see the convergence of wireless communications and the Internet. Although the commercial impact of wireless communications has thus far been largely limited to cellular telephones, the business and technical communities anticipate rapid growth in wireless data services; the media frequently reports well-known companies announcing plans for mobile (m-) commerce enhancements to their businesses (Goodman, 2000).

These new trends could be more powerful than anything the Internet has offered before. Mobile telephony offers the potential platform for unprecedented penetration of the Internet and services such as m-commerce. Simply speaking, m-commerce is defined as any transaction with a monetary value—either direct or indirect—that is conducted over a wireless telecommunication network. Already this has injected significant growth in forecasts for future revenues in total global e-commerce, predicted to be $6.9 trillion by 2004 (Forrester Research, 2000), of which more than $200 billion will be derived from m-commerce (Strategy Analytics, 2000).

This paper explores the nature and potential of mobile commerce in business-to-consumer markets—the newest and fastest-growing sector of m-commerce (724 Solutions, 2001; Datamonitor, 2000). As a foundation, it analyses the key players and technologies in the m-commerce value chain. Further, the paper examines the future of m-commerce, outlining the motivators and inhibitors that will influence the diffusion of m-commerce.

2. The m-commerce value chain

Well before the introduction of m-commerce, the rapid adoption of personal computers (PCs) and greater accessibility of Internet infrastructure had already fuelled immense growth in the digitisation of products and services. In this new digital economy, consumer online services demand that diverse inputs must be combined to create and deliver value. No single industry alone has what it takes to establish the online digital economy; success requires inputs from diverse industries that have only been peripherally related in the past (Schleuter & Shaw, 1997; Tapscott, 1995). As a result, co-operation, collaboration and consolidation have been the key watchwords, as arrangements are struck between companies in complementary industries. Noticeably, companies in telecommunications, computer hardware and software, entertainment, creative content, news distribution and financial services have seized opportunities by aligning competencies and assets via mergers and acquisitions, resulting in a major consolidation of information-based industries (Symonds, 1999).

The challenge in this section is to move beyond an understanding of traditional Internet-based commercial activities to the relatively new and unexplored area of m-commerce. In particular, we aim to provide an understanding of how value is added in this new paradigm of mobile Internet.

2.1. The basic model

Like any product or service, m-commerce involves a number of players in a chain of value-adding activities that terminates with the customer. Whilst traditional value chain analysis (Porter & Millar, 1985) could be used to unravel this complexity, there are a number of more advanced value chain techniques specifically aimed at the new media that are preferable (Loebbecke, 2001). In particular, the European Commission (1996) developed a framework for new media publishing that has been productively employed in other areas of online activity (Loebbecke, 2001; Schleuter & Shaw, 1997). Within this paper the framework is adapted for m-commerce and used to analyse the players, technologies and activities involved in providing m-commerce—as summarised in Fig. 1.

The basic model consists of six core processes in two main areas: (a) content, and (b) infrastructure and services. In m-commerce these are interpreted as:

2.1.1. Infrastructure and services

1. *Mobile transport*. This is the basic network involved in communications, including transportation, transmission and switching for voice and data. This includes major telecommunications players such as AT&T, NTT DoCoMo and Vodaphone, and forthcoming

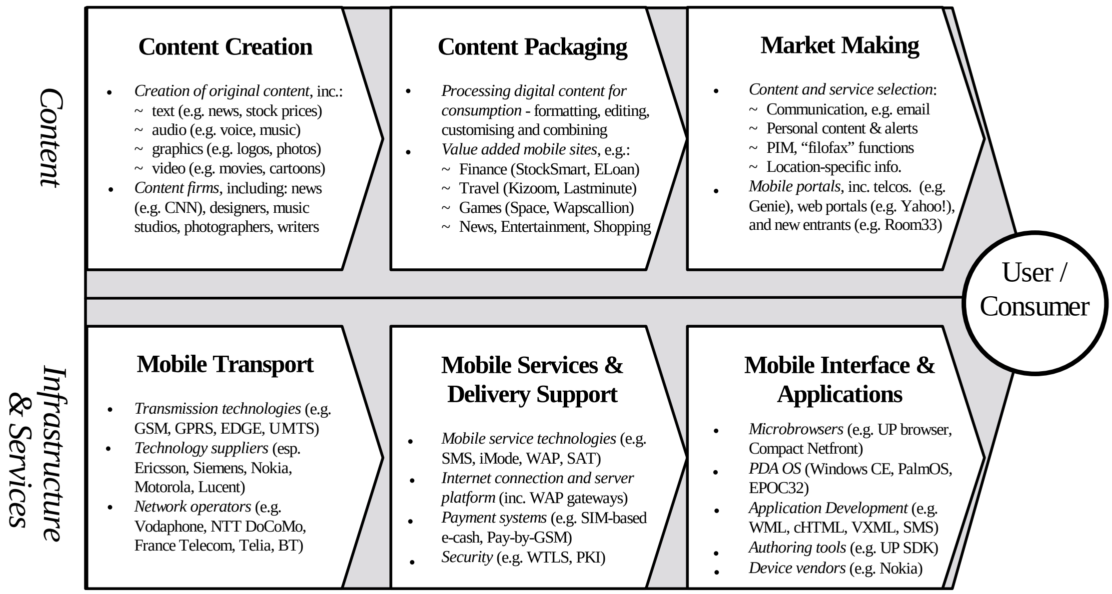

Fig. 1. The m-commerce value chain.

high-speed transmission technologies such as the Universal Mobile Telecommunications System (UMTS).
2. *Mobile services and delivery support*. This involves, for example, the infrastructure in connecting to the Internet, security, the server platform, and payment systems. Standards such as the wireless application protocol (WAP) and iMode are key building blocks towards enabling the delivery of Internet services via mobile handsets. Key standards for payment and security have yet to be developed.
3. *Mobile interface and applications*. This process centres on integrating the infrastructure and systems with users—hardware, software and communications. This includes the user interface, navigation and application/middleware development, as well as the authoring tools. For example, Phone.com dominates the micro-browser market for WAP phones, while Windows CE, Symbian's EPOC32 and PalmOS are key platforms for PDAs.

2.1.2. Content

1. *Content creation*. The focus in this value space is on creating digital material such as audio, video and textual information. For example, digital news feeds and real-time stock information are available from Reuters.
2. *Content packaging*. In this box, we are likely to see digitising, formatting, editing, customising, and the use of software to combine and package content. This could include, for example, packaging Reuters' stock information for FT.com, the online version of the business and financial newspaper. The information on this site is also customisable for individual users who may, perhaps, only be interested in certain financial markets.
3. *Market making*. Marketing and selling content is the primary role of mobile portals. This includes programme development, service delivery and customer care. For example, the Yahoo! Mobile Web portal provides a one-stop shop for a large number of services.

2.2. Components of the m-commerce value chain

The six primary components of the m-commerce value chain have been established above. This section explores them in more detail. In this way, the analysis uncovers some of the key companies and technologies involved.

2.2.1. Mobile transport

Infrastructure equipment vendors and network operators are the main players involved in adding value in the transport element of the framework. The leading suppliers for mobile network infrastructure equipment—including Ericsson, Siemens, Nokia, Motorola and Lucent—have developed and continue to develop solutions for mobile data, Internet and commerce. The innovative capabilities of these companies are driving the next wave of technological developments. Table 1 summarises some of the key present and future transport technologies.

Mobile network operators—such as Sonera, AT&T, NTT DoCoMo, Telia and Vodaphone—are also an important part of the transport process. However, these players are now leveraging their infrastructure advantages in transport to enable movement along the value chain towards

Table 1
Key mobile network technologies

Standard	Description	Speed[a]
GSM (Global System for Mobile Communication)	The prevailing mobile standard in Europe and most of the Asia-Pacific region—around half of the world's mobile phone users.	14.4 kbit/s
PCS (Personal Communications Services)	A standard based on Time Division Multiple Access (TDMA), which divides a frequency into time slots and gives users access to a time slot at regular intervals. TDMA is used in the US, central/south America and many other countries.	14.4 kbit/s
PDC (Personal Digital Cellular)	A standard used in Japan. Uses packet-data overlay on second-generation networks to achieve 'always-on' data communication and a higher speed.	28.8 kbit/s
HSCSD (High Speed Circuit Switched Data)	A circuit switched protocol based on GSM. It is able to transmit data at around four times the speed of GSM by using four radio channels simultaneously. Some services were launched in late 1999 and early 2000.	57.6 kbit/s
GPRS (General Packet Radio Service)	A packet switched wireless protocol as defined in the GSM standard offering instant, 'always on' access to data networks. The speed will initially be less than the maximum burst: at first 43.2 kbit/s upstream and 14.4 kbit/s downstream rising to 56 kbit/s shortly afterwards.	115 kbit/s (burst)
EDGE (Enhanced Data rates for Global Evolution)	This is a higher bandwidth version of GPRS and an evolution of GSM. The high speeds will enable bandwidth-hungry multimedia applications. EDGE conveniently provides a migration path to UMTS by implementing necessary modulation changes. Planned service availability is for 2002.	384 kbit/s
IMT2000 (International Mobile Telecommunications)	This is a third generation (3G) standard. Three rival protocols have been developed: Universal Mobile Telephone System (UMTS) in Europe, Code Division Multiple Access (CDMA) 2000 in the US, and Wideband-CDMA in Japan. The development of the standard requires significant investment in infrastructure. Commercial availability of most services is predicted for 2002–3.	384 kbit/s–2 Mbit/s

[a] Note: Speed is measured in kilobits (one kilobit = 1024 bits) and megabits (one megabit = 1,048,576 bits) per second (kbits/s and Mbits/s, respectively).

mobile services, delivery support and market making (Durlacher Research, 1999). Typically, these operators control the billing relationship and SIM (subscriber identification module) card on the phone and are ideally positioned to become Internet service providers (ISPs) or portals, thereby establishing a transport pipeline for content services.

2.2.2. Mobile services and delivery support

An important aspect of m-commerce provision is the availability of platforms for delivering services. The establishment of these platforms goes hand-in-hand with network standards and key interest groups ensure this, including the UMTS Forum, ITU, ETSI (European Telecommunications Standards Institute), GAA (GPRS Applications Alliance), WAP Forum and others. Some of the current wave of mobile service technologies is given in Table 2.

Middleware infrastructure is crucial to driving applications. In the WAP environment, gateways are required—either at the mobile operator's or corporate customer's site. Major players who have developed a WAP 'stack' include Nokia, Ericsson and Phone.com. Fig. 2 presents a simplified picture of the role of a WAP gateway. A WAP service using real-time and other data feeds can use both SMS and WML via a WAP gateway to send content via the wireless network. While standard Web content is received via the PC browser, WAP content is received via a WAP phone 'micro-browser'. Some mobile services allow customisation via a Web browser and storing of user profiles.

Other important aspects of mobile services and delivery support include payment systems and security—both of which are inextricably linked in m-commerce. The development of security standards is currently an issue that has not been fully resolved (Manchester, 2000). In WAP, security is currently dealt with using Wireless Transport Layer Security (WTLS), which encrypts data based on Netscape's Secure Sockets Layer (SSL) technology. This is reasonably secure but does not support security aspects such as digital signatures and non-repudiation. Future developments of WAP (see www.wapforum.org) will overcome some of these limitations; WAP 1.3 introduces a WML Script Cryptolibrary and wireless Public Key Infrastructure (PKI). PKI uses digital certificates, certificate authorities, strong asymmetric encryption and digital signatures to ensure integrity, privacy, authenticity and non-repudiation (Stein, 1998). If m-commerce is to move beyond low value transactions, these developments should be addressed as a priority by the mobile industry.

In terms of mobile cash and payment systems, the wireless Web again has some way to go towards maturity. Mobile electronic cash refers to cash stored (via SIM or credit-sized card) and transferred via the wireless network. In the UK, Visa piloted a debit smartcard system called Visa Cash in 1999, while France Telecom launched a similar service called Iti Achat. Such a system relies on a dual-slot phone such as Motorola's StarTac D model that can accept a credit-sized card. However, the extra size and weight of devices favour a more SIM-based approach. For example, in Finland, Sonera's Pay-by-GSM enables the user to dial a number to receive a charge to a prepaid phone or for a deduction from a mobile account. Similarly, KLELine (part of Paribas) allows a virtual wallet application that can be loaded from major credit cards. Visa, Nokia and Merita-Nordbanken have piloted the dual SIM concept for the Nokia 7110 phone, where a second SIM is a Visa credit, debit and bankcard.

Table 2
Key mobile service technologies

Service	Description
SMS (Short Message Service)	Allows text messages of up to 160 characters to be sent to and from mobile handsets via a store-and-forward system. Although a large proportion of this is based on person-to-person communication and voicemail, other services such as news, stock prices and SMS chat are growing in popularity. Around 500 billion messages were sent in 2001.
MMS (Multimedia Message Service)	This is a new messaging service supporting graphics and audio currently on trial in Europe. It plans to build on the success of SMS.
CB (Cell Broadcast)	Not to be confused with citizen's band (CB) radio; this is another text messaging service. However, unlike SMS, CB provides a one-to-many broadcast facility that is ideal for push-based information services such as news feeds.
SAT (SIM Application Toolkit)	This allows applications to be sent via CB or SMS in order to update SIM cards, e.g. for downloading ringing tones. Data security and integrity are standard features making it a popular choice for mobile banking. The WAP 2.0 standard will be compatible with SAT.
WAP (Wireless Application Protocol)	WAP is a universal standard for bringing Internet-based content and advanced value-added services to wireless devices such as phones and PDAs. In order to integrate as seamlessly as possible with the Web, WAP sites are hosted on Web servers and use the same transmission protocol as Web sites, that is hypertext transfer protocol (HTTP). The most important difference between Web and WAP sites is the application environment. Whereas a Web site is coded mainly using hypertext markup language (HTML), WAP sites use Wireless Markup Language (WML), based on eXtensible Markup Language (XML).
MExE (Mobile Station Application Execution Environment)	This standard is aimed at incorporating Java into the mobile phone and providing full application programming. MExE is compatible with WAP but incorporates many other sophisticated services including voice recognition and positioning technology.
J2ME (Java 2 Micro Edition)	A version of the Java language designed for small devices. This is somewhat similar to MExE.
iMode (information mode)	iMode uses a variant of HTML for the provision of Web pages. iMode enabled Web sites utilize pages that are written in compact HTML (cHTML)—a subset of HTML 4.0 designed with regard to the restrictions of the wireless infrastructure.
iAppli (information application)	From January 2001, an upgraded version of iMode was provided in Japan to premium customers. The new service, iAppli , is based on Java. Applications can be downloaded and stored, thereby eliminating the need to continually connect to a Web site. Further, constantly changing information is automatically updated at set times, e.g. stock prices or weather forecasts.
PDA Web Clipping	This technology allows popular PDA devices, such as Palm and Handspring, to access dynamic and updated HTML content via a modem. Web clipping is used in combination with applications stored on the device.
PDA Syncing	This allows PDAs to store or cache content without the use of a wireless modem. Content is updated when the user synchronises ('syncs') or connects their PDA to the Internet via computer connection.

2.2.3. Mobile interface and applications

Given the very different nature of communication over the current generation of mobile devices as compared to standard PC use, developing and integrating an application interface for the user is critical. Even in the future, the very nature of mobility will mean a new line of thought is needed for developing mobile solutions that get to the heart of the user's needs rather than technological constraints. Some of the important players in this value-adding space include technology platform vendors, application developers and mobile device vendors.

Technology platform vendors provide the operating systems (OS) and micro-browsers for mobile devices. Micro-browsers perform the same function as those of the Web, such as Netscape and Internet Explorer, but have been designed explicitly for the mobile environment. They have reduced functionality tailored to the present mobile devices. Phone.com's UP browser dominates the WAP market, and they have support from all but two major phone manufacturers (see www.phone.com); Ericsson and Nokia have developed their own micro-browsers. On the iMode platform, Compact NetFront is the most popular micro-browser, used in 75% of devices.

The OS market, typically for PDAs, is dominated by Microsoft, Symbian and 3Com. Microsoft's Windows Compact Edition (CE) is a cut-down version of the standard Windows OS created especially for palmtops and PDAs. It has gained support from some major PC manufacturers (such as HP and Compaq), but has also been criticised for its shortcomings in memory requirements, reliability, synchronisation and user-friendliness. Symbian (a consortium comprising Motorola, Ericsson, Nokia, Psion and Matsushita), which developed the popular EPOC32 OS for Psion PDAs, is now collaborating with 3Com, owner of the popular PalmOS and top-selling range of Palm Pilot PDAs. The result of this powerful collaboration could set the standard for mobile OS (Varshney, 2000).

In terms of mobile application development, the trends are following those of the mobile OS market. Typically, applications are being built largely for the offline palmtop/PDA environment using Windows CE, Symbian's EPOC32 and 3Com's PalmOS (Durlacher Research, 1999). Connectivity is being improved by the development of applications on these platforms, but this is somewhat overshadowed by developments in the more lucrative smartphone market via iMode, WAP and SMS. Whereas iMode uses a variant of HTML for service provision, and more recently Java has become used (e.g. in iAppli), WAP adopts WML as the format for displaying Web pages over the WAP phone (based on XML, a meta-language used to describe the content and format of data). In most cases, HTML content needs to be rewritten for WML. Another language for the mobile environment, this time aimed at voice recognition, Voice XML, is under development (see www.vxmlforum.org).

In the smartphone market, as in the PDA market, the brand and model are the most important part of the purchase decision; the service provider or network provider is less important (Peter D. Hart Research Associates, 2000). One of the reasons for this is the importance of 'image' and 'personality' to young customers—as associated with specific mobile phones. In the mobile interface and applications component of the value chain, this places a lot of power in the hands of smartphone producers, who also decide which technologies are incorporated into the end products. These producers must continue to innovate and support leading edge technologies and services in their new products if m-commerce is to prosper (Financial Times, 2000). Recent innovations emerging in the market have included 3G phones (e.g. Panasonic's P2101V and NEC's N2001 iAppli phones), devices combining the capability of a mobile phone and PDA (e.g.

Kyocera's QCP 6035 and Sprint PCS's TP 3000), and Bluetooth-compatible phones for short-range connectivity (e.g. Ericsson's R520 phone).

2.2.4. Content creation

The concept of digital content creation and delivery is the same in m-commerce as e-commerce (Choi, Stahl, & Whinston, 1997), although the specific format will differ due to the nature of mobile devices. Typically, on the wireless Internet, such content will include:

- *Text*, e.g. news, stock prices, film listings, advertisements, product descriptions and restaurant locations.
- *Audio*, e.g. voice, wireless Internet radio and music files (including MP3 format).
- *Graphics*, such as wireless bitmap or GIF formats.
- *Video*, e.g. animated graphics files, wireless TV and video files.

Such content can be easily modified, consumed repetitively by the same or different users, and is fast and cheap to reproduce; respectively, online delivered content (ODC) has the fundamental attributes of transmutability, indestructibility/non-subtractivity and reproducibility (Loebbecke, 2001).

The creation of digital content for delivery via the mobile Internet raises some important issues (see Choi et al., 1997; Loebbecke, 2001). These include: interactivity and customisation (dynamic vs. generalised content), time-dependence (e.g. real-time stock quotes vs. a dictionary), intensity of use (used once, several or many times), operational format (executable vs. fixed document), pricing (e.g. based on usage, subscription or commission), and externalities (who gains and loses from consumption, e.g. positive externalities from positive reviews and negative externalities from illegal copyright infringement). To a large extent, these are dependent on the user, their needs and

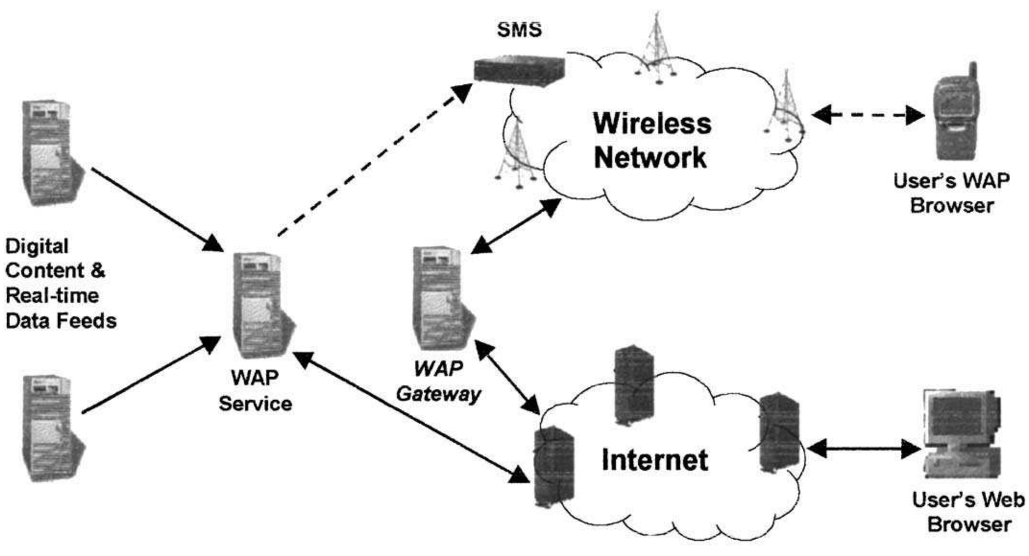

Fig. 2. The role of WAP gateways in connecting to the Internet.

the nature of services provided. Whilst these are not a key focus of the discussion in this paper, some of the issues are touched-upon in downstream components of the m-commerce value chain.

Although plentiful on the standard Web, digital content is still quite limited on the mobile Internet. A key problem is the effort needed to transmute content for mobile consumption; in many cases ODC must be tailored specifically for use on mobile devices and there are certain standards to enable this (such as WML, SMS, cHTML and others—see above). However, numerous organisations are positioning themselves to provide mobile content. Forward-thinking companies such as CNN (a news service), Reuters (a news and financial information provider) and Webraska (a traffic news company) are leading the way by positioning their products using a variety of distribution channels. For example, Reuters is providing selected content to key portals (Yahoo and Excite) and network providers (Nokia and Ericsson), as well as developing its own portals for a broad range of news markets. In this way, Reuters is moving into the market making value space in Fig. 1.

2.2.5. Content packaging

In most cases, digital content must be transmuted, edited, customised or combined to provide consumable content for the user. Firms in the content packaging stage of the value chain focus on aggregating and transforming information for distribution to wireless devices. Here, value is added by the reconfiguration of data into the most appropriate package for user consumption.

There are a plethora of mobile sites situated in this space, particularly on HTML and WAP platforms. In the WAP sector they include:

- *Sports* (such as sports results and information on sports clubs and facilities, e.g. igolftheworld, Manchester United Mobile, SkiWap and WAP a Result);
- *Online games* (particularly simple games that can be played online via the mobile device, e.g. Wapscallion and Wireless Games);
- *Finance* (including financial information, banking, brokerage and loans, e.g. American Express, CitiBank, E-Loan, HSBC, StockPoint and StockSmart);
- *Entertainment* (particularly entertaining information or information on entertainment facilities, e.g. AstroWap, Curryhouse, Somewhere Near and Wapped-out);
- *News* (e.g. BBC News, News Vendor and Newswatch UK);
- *Shopping* (e.g. Amazon and Indigo); and,
- *Travel* (including travel information and bookings, e.g. Campsite, Hotel Catalogue, Lastminute.com, MapQuest and Online Weather).

Kizoom, the online travel service, provides a good example of a content packaging firm. The service allows customised, time- and location-sensitive planning of travel. Fig. 3 gives an example of how a user of the site might find details of the next train from his or her workplace to home, based on a known personal profile. The user may also go on to buy a train ticket. Essentially, the site relies on content provided from national timetables, journey planners, location services, spatial database maps, real-time travel information feeders, personal alert services, advertisers, transport companies (involved in m-commerce ticket sales), operators and m-commerce portals (Kizoom, 2000). M-commerce portals are important for market making (see Section 2.2.6), along with ‘white label’ software licensing for corporate customers, revenues from advertising, commission from ticket sales, and subscriptions.

Fig. 3. Catching the next train home using the Kizoom mobile site.

2.2.6. *Market making*

The key business-to-consumer market makers on the mobile Internet are mobile portals (or m-portals)—revenues of which are predicted to be $42 billion by 2005 (Ovum, 2000). Literally, the word 'portal' means a doorway or gate; mobile portals are high-level information and service aggregators (Ticoll, Lowy, & Kalakota, 1998) or intermediaries (Chircu & Kauffman, 2001) that provide a powerful role in access to the mobile Internet. Their main aim is the provision of a range of content and services tailored to the needs of the customer, including:

- *Communication*, e.g. e-mail, voice mail and messaging;
- *Personalised content* and *alerts*, e.g. news, sports, weather, stock prices and betting;
- *Personal information management* (PIM), e.g. 'filofax' functions; and,
- *Location-specific information*, e.g. traffic reports, nearest automated teller machine (ATM), film listings, hotels and restaurant bookings.

As such, mobile portals are usually characterised by a much greater degree of customisation and personalisation than standard Web-based portals in order to suit the habits of the consumer (Durlacher Research, 2000). The current technology restraints dictate that this should be necessary: whilst a standard Web page may have an average of 25 links to other sites or pages, on a WAP phone the average is only 5 links. Therefore, whilst three-clicks on the Web might provide access to 25^3 (=15,625) core sites or pages, on the mobile Web this falls to just 5^3 (=125) pages (Durlacher Research, 2000). As a result, the mobile portal must be suitably tailored to the user's needs so as to present the right information at the right time (see Fig. 4).

The mobile portal market is currently undergoing significant expansion in anticipation of market growth. More than 200 WAP portals have been launched in Europe alone since Autumn 1999 (Bughin, Lind, Stenius, & Wilshire, 2001). Players have attempted to build on existing

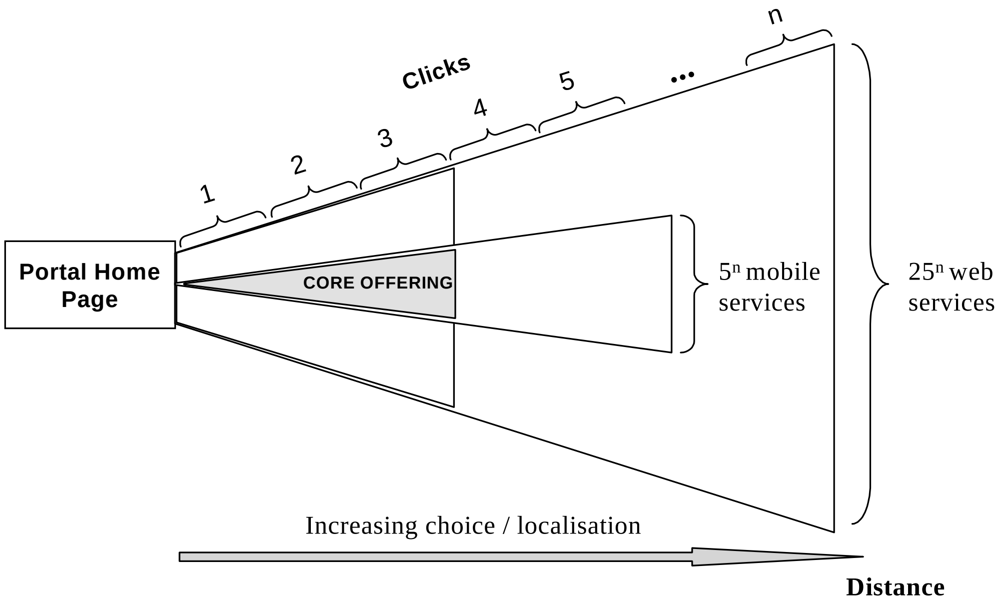

Fig. 4. The role of mobile portals (adapted from Wappup.com, 2000).

brands, competencies and customer-relationships to develop a subscriber base. Key players have been:

- *Mobile operators*. Portals include Genie (BT), Zed (Sonera) and MyDof (Telia).
- *Technology vendors*. For example, Nokia, Ericsson, Palm and Motorola have all developed portal services.
- *Traditional Web portals.* Including offerings from Yahoo!, AOL and Excite.
- *Retail Outlets.* For example, the Mviva portal is owned 85% Carphone Warehouse.
- *Random new entrants.* Including portal services from banks, e.g. Barclays, and mass-media companies, e.g. the Vizzavi portal is half owned by Vivendi.
- *New independents*, including Iobox, Room33 and Quios.

Given time, one might expect the portal market to consolidate, although the potential role of niche players appears much greater that the traditional Web portal market.

The Japanese network operator NTT DoCoMo controls the provision of content for iMode through a portal page. Each of the links, of which there are now more than 2000, has been approved by DoCoMo for uniqueness and usefulness. D.C.M. takes 9% of all subscriptions to these as a handling charge. Additionally, there are in excess of 40,000 ‘unofficial’ pages created by private individuals. In March 2001, NTT DoCoMo announced that it would open up iMode site selections to include many of those that are currently unofficial (Nakada, 2001).

Now that we have some appreciation of the m-commerce value chain, the next section takes a critical perspective on the future possibilities of this phenomenon. Here, the issue is whether the value chain can be further leveraged to create a profitable partnership with consumers.

3. The future potential of m-commerce

Modern wireless communications represent the convergence of two key technology trends of the 1990s: portability and networking. Combined with the diffusion of mobile telephones and the Internet, the potential of these technologies has been widely recognised since the early 1990s. However, wireless computing has not, as yet, become well established. Typically, the problems hindering the progress of mobile computing have been the high cost, slow transmission rates, high power consumption of devices, and inadequate mobile interfaces (Goodman, 2000). Notwithstanding, it is interesting to examine whether such barriers can be overcome, thereby unlocking the future potential of m-commerce.

3.1. The potential of new transmission technologies

Current mobile networks have limited speeds for data transmission and are largely based on second-generation (2G) technology, such as GSM and PCS. These circuit-switched networks require the user to dial-up for a data connection. The current wave of network investment will see faster, packet-switched networks in 2001—such as GPRS—that deliver data directly to handsets, which are, in essence, always connected. These are more suitable for *ad hoc* m-commerce, such as instant messaging or alerts, as well as reducing the cost of data transmission for the consumer. In the future, third generation (3G) networks promise yet higher transmission speeds and more sophisticated m-commerce interaction, although based on a much bigger investment in infrastructure.

However, although recent advances in network technologies such as 3G have helped to alleviate the problem of transmission speed, this is only part of the story. Problems of high power consumption and cost remain important barriers to adoption: where high transmission speeds can be achieved power consumption will be immense, and the high initial outlays in infrastructure and frequency licensing in countries such as the UK and Germany mean that initial charges for services are likely to be high. Moreover, 3G is not quite as powerful as claimed; the commercial roll-out of 3G network capability will be incremental, and further, the use of 'rate adaptation techniques' means that in most mobile conditions the rate of transmission will be less than optimal (since speeds are adapted to the prevailing environmental conditions).

3.2. The potential of WAP

At present, WAP adoption by consumers is both patchy and limited. As of July 2001, the use of WAP phones has been disappointingly low; just 6% of Finnish and US mobile phone users access the Internet using their phones, compared with only 10% in the UK and 16% in Germany (eMarketer, 2001). Predictions are much better for some parts of the Asia-Pacific. In Japan, the success of WAP services has been greatest, with 6 million subscribers to the EZWeb WAP service in July 2001 (Mobile Media Japan, 2001).

In most countries, the expectations of consumers have not been met and WAP has been considerably oversold. Part of the problem is the limitation of technology and the non-subtractive nature of services; WAP is not a replacement for the wired Internet and involves an important trade-off between richness and reach in providing data services (Wurster & Evans, 2000).

Furthermore, whilst proponents argue that WAP is scalable and extensible enough to endure (Leavitt, 2000), many see WAP as a stopgap until 3G phones. In particular, critics point to the primitive nature of WAP, which is too closely aligned to the current generation of mobile phones (Goodman, 2000). Other key problems include security, high cost (until networks become packet-switched and the pricing model changes) and limited infrastructure (from networks and devices) (Barnes, Liu, & Vidgen, 2001).

In the present environment, SMS has proved the preferred service for data communication on mobile phones in many developed countries (Frost & Sullivan, 2001). An analysis of SMS usage has shown unrivalled access to the age group from 15 to 24 years—a group that has proved extremely difficult to reach with other media (Puca, 2001). Key reasons for this include privacy, flexibility, absence of face-to-face contact, and easy availability of the SMS medium. Examples of m-commerce via SMS have included: share price alerts, news, bulletin services for nightclubs, dating services, and a Euro2000 football messaging service. Notwithstanding, SMS is very limited in its capability and does not allow the flexibility of browsing Web content.

Aside from SMS and WAP, considerable attention is now being drawn to the HTML-based iMode standard in Japan (Barnes, 2001). Launched in February 1999, iMode has a subscriber growth rate of nearly 1 million per month, standing at 24 million in June 2001 (Mobile Media Japan, 2001). This is nearly four times more than the competing WAP service, EZWeb. Analysts put this success down to a number of reasons including technological investment, market dominance, vertical integration in technology development, and the low penetration of expensive wired Internet connections (Funk, 2000; Kramer & Simpson, 1999; WireFree-Solutions, 2000).

NTT DoCoMo, the owners of the iMode brand and service, are now planning to 'export' this model to the US and Europe. Through a strategy of partnering, NTT DoCoMo hopes to emulate its earlier success (Associated Press, 2001; Business Week, 2001). Clearly, the development of iMode is very different to WAP. In some senses the Japanese iMode example is unique and perhaps unlikely to be emulated in the US and elsewhere. However, there appear to be some lessons that can be gleaned. IMode is very definitely a brand and stands for key concepts like simplicity, functionality and meeting consumer needs (WireFree-Solutions, 2000). In this respect, WAP has some way to go to catch up with iMode; WAP is a bundle of technologies and protocols, which on its own does not deliver value to the end-user.

Other possible alternatives to WAP are standards based on Java—a 'write once, run anywhere' programming language—to provide a full application execution environment. These standards—such as MExE, iAppli and J2ME—are primarily aimed at the next generation of powerful smartphones. MExE, for example, incorporates some advanced features to provide intelligent customer menus, voice recognition and softkeys, as well as to facilitate intelligent network services.

3.3. The potential of location-specific applications

Although platforms such as WAP provide some potential for moulding applications to mobile lifestyles, this is, at present, quite limited. Indicative research suggests that only a limited number of services are truly suited to WAP, with the suitability to task of news (61.54%) and booking a flight (42.14%) being far in excess of shares prices (26.88%) and e-mail (23.13%) (PC Magazine,

Table 3
Key location-specific mobile technologies

Technology	Description
Bluetooth	A low-power radio technology, with a throughput of about 1 Mbit/s, designed to replace cables and infrared links for distances up to 10 m. This allows local interaction between devices and the separation of wired components. Bluetooth-enabled mobile phones became available in 2001.
IEEE 802.11 (Institute of Electrical and Electronics Engineers)	A low-power radio technology standard similar to Bluetooth. Again, this is suitable for applications aimed at replacing cables and infrared links to enable device interactivity, particularly local area networks.
E-OTD (Enhanced Observational Time Difference)	Based on the GSM infrastructure, this works by sending positional information each time a user phones a service provider. The positional information is based on relative times of arrival of signals at the handset and fixed receivers as sent by base stations. Typically accurate from 50 to 125 m.
TOA (Time of Arrival)	This involves more exact information from the network than E-OTD based on significant—and somewhat expensive—modifications.
COO (Cell of Origin)	A location-fixing scheme for network customers. However, while accurate in urban areas where the cell size is quite small, in rural areas this technique is far less accurate than other methods. Typically it is only accurate to 1000 m or more.
GPS (Global Positioning System)	The GPS is based on satellite technology and was originally developed by the US military, but has been available for general use from the early 1990s. However, only recently has the US Army derestricted outdoor positioning to a sufficiently high resolution for advanced use—currently 10–20 m. GPS cannot be used in areas of poor signal reception such as inside buildings.
AGPS (Assisted Global Positioning System)	This combines GPS with a mobile telecommunications network to get positioning to within 50 m indoors and in other areas with poor satellite signal reception.

2000). As iMode has demonstrated, if m-commerce is going to succeed, clearly it needs to adapt to users rather than current technological constraints.

In search of true mobility, numerous technologies are under development to allow location-specific m-commerce, often referred to as positioning (p-) commerce. Table 3 summarises a number of these. The applications of these technologies are endless and many examples have been cited. Standards such as Bluetooth and IEEE 802.11 allow a new wave of short-range device interactivity and provide cheap, low-power, high-data-rate connectivity for portable devices in a limited area. The roaming phone user can be provided with information, alerts or even advertisements based on their location, and could also conduct transactions with their mobile phones at the point of sale—vending machines and ATMs being the best-known examples (Zeus Wireless, 2000). Conceivably, the customer looking for a specific product or price could scan or enter a code into a phone; when the customer walks past a store with the right product or price the phone could send an alert. Stores could even send adverting alerts in an effort to tempt customers inside.

In addition to technologies that allow localised communication and interaction by *being* at a certain location, there are others that work by *knowing* the location of a mobile device. Typically, these include those mentioned in Table 3. These have created the platform for a plethora of services in areas such as safety, navigation and tracking, information, and location-based transactions. Of these, safety is the key market driver, where US policy has mandated high-resolution emergency service caller location by October 2001. In Europe, such services are expected in 2002. The commercial potential of this is enormous. Roadside assistance, fleet management, geographic pricing and location-based products are some of the other possible location-based services (LBS) under development. Indeed, the Strategis Group (2000) estimates that LBS could be worth $3.9 billion by 2004. In terms of business-to-consumer m-commerce, one of the most basic LBS being offered by mobile operators is the mobile Yellow Pages. In this type of service, the roaming user asks the question: 'what's near me?' For example, items such as locations of restaurants, shops, public transport or nearby ATMs may be useful to the user as they move through an unfamiliar city. Weather or traffic information can also prove useful; Bell Mobility's Book4golf service allows the user to locate a North American golf course, book a tee time and get a location-specific weather forecast.

4. Conclusions

The convergence of wireless telecommunications and the Internet provides many exciting possibilities and predictions for the growth of mobile commerce. The penetration of both technologies in the developed world has already evoked changes in our daily lives—how we work, live, learn, and so on. This paper has attempted to examine how value is added in this new era of mobile Internet. It outlines some of the key players and technologies that underpin the delivery of m-commerce services. The result is a detailed value chain analysis that provides a solid foundation for understanding the concept of m-commerce.

Alongside, the paper also provides some predictions regarding the future potential of m-commerce. Without doubt, the emergence of standards such as WAP, iMode, GPRS and 3G will drive the wireless Internet forward. However, the paths of these technologies are so close to the current cellular infrastructure that is difficult to imagine them enduring. A fresh, creative look at the needs of the wireless consumer will shed new light on this issue and possibly break some of the technological constraints that are holding m-commerce back. Location-specific technologies could present some important pieces of this puzzle and enable p-commerce applications that get to the heart of adding value in a mobile environment. The next few years will be very important in the development of technologies and standards that provide truly mobile commerce.

References

724 Solutions. (2001). *Commerce goes mobile*. San Francisco: 724 Solutions Inc.

Associated Press. (2001). NTT DoCoMo to offer Mode in Europe later this year. http://www.anywhereyougo.com/ayg/ayg/wireless/Article.po?id = 1034, accessed 18 January 2001.

Barnes, S. J. (2001). "Big in Japan"—iMode and the mobile Internet. *Journal of Information Technology Theory and Application*, *3*(4), 27–32.

Barnes, S., Liu, K., & Vidgen, R. (2001). Evaluating WAP news sites: the WebQual/m approach. In *Proceedings of the European Conference on Information Systems*, Bled, Slovenia, June, pp. 344–355.
Bughin, J., Lind, F., Stenius, P., & Wilshire, M. (2001). Mobile portals: mobilize for scale. *The McKinsey Quarterly, 38*(2), 118–127.
Business Week. (2001). America next on DoCoMo's calling card. http://www.anywhereyougo.com/ayg/ayg/imode/Article.po?id=36786, accessed 15 January 2001.
Chircu, A. M., & Kauffman, R. J. (2001). Digital intermediation in electronic commerce—the eBay model. In S. Barnes, & B. Hunt (Eds.), *E-commerce and V-business*. Oxford: Butterworth-Heinemann.
Choi, S. -Y., Stahl, D., & Whinston, A. (1997). *The economics of electronic commerce*. New York: Macmillan.
Datamonitor. (2000). US mobile market worth USD1.2 billion by 2005. http://www.datamonitor.com/press/, accessed 28 August 2000.
Durlacher Research. (1999). *Mobile commerce report*. London: Durlacher Research.
Durlacher Research. (2000). *Internet portals*. London: Durlacher Research.
eMarketer. (2001). Wireless Web growing around the world. http://www.nua.ie/surveys/index.cgi?f=VS&art_id=905357175&rel=true, accessed 10 September 2001.
European Commission. (1996). *Strategic developments for the European publishing industry towards the year 2000—Europe's multimedia challenge*. DG XIII/E. Brussels: European Commission.
Fernández, A. (2000). The future of mobile telephony. Presentation to *Mobile Telephony and Communications*, Madrid, Spain, 22–23 May.
Financial Times. (2000). Global M-commerce standard in development. http://www.nua.ie/surveys/index.cgi?f=VS&art_id=905355728&rel=true, accessed 19 April 2000.
Forrester Research. (2000). USD7 trillion in e-commerce revenues by 2004. http://www.nua.ie/surveys/index.cgi?f=VS&art_id=905355736&rel=true, accessed 21 April 2000.
Frost & Sullivan. (2001). *World mobile commerce markets*. London: Frost & Sullivan Ltd.
Funk, J. (2000). *The Internet market: lessons from Japan's iMode system*. Unpublished White Paper, Kobe University, Japan.
Goodman, D. J. (2000). The wireless Internet: promises and challenges. *IEEE Computer*, *33*, 36–41.
GVU (Graphics, Visualization and Usability) Centre. (1999). *Tenth World Wide Web user survey*. Georgia Institute of Technology, http://www.cc.gatech/gvu/use_surveys/, accessed 1 June 2000.
IDC Research. (2001). A billion users will drive e-commerce. http://www.nua.ie/surveys/index.cgi?f=VS&art_id=905356808&rel=true, accessed 28 May 2001.
Kizoom. (2000). Building a WAP application: software engineering for the mobile Internet. *Presentation to WAP Wednesday*, London.
Kramer, R., & Simpson, B. (1999). *Wireless wave II: The data wave unplugged*. London: Goldman Sachs.
Leavitt, N. (2000). Will WAP deliver the wireless Internet? *IEEE Computer*, *33*, 16–20.
Loebbecke, C. (2001). Online delivered content: concept and potential. In S. Barnes, & B. Hunt (Eds.), *E-commerce and V-business*. Oxford: Butterworth-Heinemann.
Manchester, P. (2000). Security fears are clouding heady growth forecasts. *Financial Times*, July 5.
Mobile Media Japan. (2001). Japanese mobile Net users. http://www.mobilemediajapan.com/, accessed 15 July 2001.
Nakada, G. (2001). iMode romps. http://www2.marketwatch.com/news/, accessed 5 March 2001.
Negroponte, N. (1995). *Being digital*. New York: Alfred Knopf.
Nua. (2001). Internet surveys. http://www.nua.ie/surveys/, accessed 16 August 2001.
Ovum. (2000). Wireless portal revenues to top USD42 Bn by 2005. http://www.nua.ie/surveys/index.cgi?f=VS&art_id=905355888&rel=true, accessed 5 July 2000.
PC Magazine. (2000). Usability labs report—WAP services. September, pp. 134–147.
Peter D. Hart Research Associates. (2000). *The wireless marketplace in 2000*. Washington DC: Peter D. Hart.
Porter, M., & Millar, V. E. (1985). How information gives you competitive advantage. *Harvard Business Review*, *63*(4), 149–160.
Puca. (2001). Booty call: how marketers can cross into wireless space. http://www.puca.ie/puc_0305.html, accessed 28 May 2001.
Schleuter, C., & Shaw, M. J. (1997). A strategic framework for developing electronic commerce. *IEEE Internet Computing*, *1*(6), 20–28.

Stein, L. D. (1998). *Web security*. Reading, MA: Addison-Wesley.

Strategis Group. (2000). European wireless location services: strategies and outlook. http://www.strategisgroup.com/press/pub/wlocate.htm, accessed 1 December 2000.

Strategy Analytics. (2000). Strategy analytics forecasts $200 billion mobile commerce market by 2004. http://www.wow-com.com/newsline/press_release.cfm?press_id = 862, accessed 10 July 2000.

Symonds, M. (1999). Business and the Internet: Survey. *Economist*, *26*, 1–44.

Tapscott, D. (1995). *The digital economy*. New York: McGraw-Hill.

Tapscott, D. (1997). *Growing up digital*. New York: McGraw-Hill.

Ticoll, D., Lowy, A., & Kalakota, R. (1998). Joined at the bit—the emergence of the e-business community. In D. Tapscott, A. Lowy, & D. Ticoll (Eds.), *Blueprint to the digital economy*. New York: McGraw-Hill.

Varshney, U. (2000). Recent advances in wireless networking. *IEEE Computer*, *33*, 100–103.

Wappup.com. (2000). Fighting for mobile Internet freedom of choice. *Presentation to WAP Wednesday*, London, July.

Wearden, G. (2001). UK mobile phone users hits 40 million. http://www.zdnet.co.uk/news/2001/0/ns-20014.html, accessed 2 February 2001.

WireFree-Solutions. (2000). *WAP vs. iMode—let battle commence*. Madrid: WireFree-Solutions.

Wurster, T., & Evans, P. (2000). *Blown to bits*. Boston: Harvard University Press.

Zeus Wireless. (2000). *Wireless data telemetry*. Maryland: Zeus Wireless Inc.

Stuart Barnes is Associate Professor of Electronic Commerce at the School of Information Management, Victoria University of Wellington, New Zealand. After starting as an economist, Stuart later completed a PhD in Business Administration at Manchester Business School, specialising in Information and Communications Technologies (ICTs). He spent the last six years working at the University of Bath before moving to Wellington in 2002. His current research interests include evaluating Web site and e-commerce quality, e-commerce strategy, information systems implementation, knowledge management systems, and business applications of mobile technologies.