MOBILE PAYMENTS
CALL FOR COLLABORATION PROJECTS

REVIEW REPORT

11 March 2003

The findings contained in this document have been written and compiled by the Infocomm Development Authority of Singapore (IDA) in consultation with the respective Mobile Payment CFC participants.

An online version of this document may be found at http://www.ida.gov.sg.

For more information on this document, please contact IDA's Wireless Mobility Development Division at wireless@ida.gov.sg.

The Infocomm Development Authority of Singapore

The Infocomm Development Authority of Singapore (IDA) is a dynamic organisation with an integrated perspective to developing, promoting and regulating info-communications in Singapore. In the fast-changing and converging spheres of telecommunications, information and media technologies, IDA will be the catalyst for change and growth in Singapore's evolution into a vibrant global info-communications technology centre.

The Wired With Wireless Programme

The Wired With Wireless Programme was launched in October 2000 by IDA and it aims to develop Singapore into a Living Lab for wireless developments in Asia.

Under the programme, IDA will collaborate with the communications industry to identify, develop and launch key projects with industry-wide impact. This will include enabling the proliferation of pilot and trial projects across various sectors.

To facilitate collaborations amongst wireless players and related industries, a series of Call for Collaboration (CFC) projects have been launched under the Wired With Wireless Programme, in the areas of Mobile Payments, Mobile Workforce, Wireless Java, Pervasive Wireless Access and Wireless Tourism Applications.

For more information on the IDA and the Wired With Wireless Programme, please visit www.ida.gov.sg.

Foreword

In May 2001, the Infocomm Development Authority of Singapore (IDA) invited proposals for the Mobile Payments Call for Collaboration (M-Payments CFC). The first in a series of CFCs conducted by IDA, the M-Payments CFC sought to develop the mobile payments infrastructure in Singapore through the collaboration of mobile operators, banks, payment providers, wireless equipment manufacturers, and other players in the wireless industry.

Five months later, IDA announced the award of the CFC to four consortia to trial five different mobile payment solutions. The CFC effectively facilitated industry collaboration between the country's three mobile operators with NETS – a payment provider owned by the three local banks. The CFC also resulted in Asia Pacific's first Wireless Public Key Infrastructure m-payments trial.

Within one and a half years, the consortia successfully deployed the underlying m-payments infrastructure as well as a breadth of mobile payments applications and services. The trials have allowed the consortia to obtain consumer and merchant feedback which has been important not only in helping the consortia improve on their solutions but also in shaping their commercialisation decisions and plans.

The key results of the CFC are as follows:

- **Growth and commercialisation of 3 mobile payments services providers** Four of the five trials will be commercialised. NETS will commercialise YW8 and Go Virtual while Systems@Work and Mobile Solutions and Payment Services will commercialise TeleMoney and Blink respectively. The presence of these m-payment service providers beyond the trial will bring greater competition to the market and more choices for businesses and consumers wanting to adopt mobile payments.

- **Development of an open, non telco-centric m-payments infrastructure** The three mobile operators in Singapore – MobileOne, SingTel Mobile and StarHub – have collaborated closely in the area of mobile payments for the benefit of the market. With the commercialisation of Blink, YW8 and Telemoney, all mobile phone users are now able to conduct mobile payment transactions offered by these platforms regardless of which mobile operator they subscribe to. This greatly reduces consumer and merchant fragmentation in the mobile payments market.

- **Pilot of 11 types of new m-payment services has encouraged initial consumer usage of these services** Altogether, 11 types of payment services were mobile-enabled[1]. More than 7,000 consumers (about 0.15% of population) conducted at least one m-payment transaction each during the trials, and more than 40,000 transactions were conducted in total.

- **Contribution to capability development and employment in the area of wireless and m-commerce** More than 260 infocomm professionals were involved in the CFC, of which close to 5% were hired by the companies during the CFC period. Of the 260, more than half were technical staff, while the rest consisted of management and marketing personnel. A new company – Mobile Solutions and Payment Services Pte Ltd – was also set up during the trial with a paid-up capital of S$5 million.

[1] Fine payments, bill payments, exam results, movie/event ticketing, retail POS, food and beverage purchases, mobile content and applications, payment for autopay station car parking, Person to Person payments, travel insurance purchases and pre-paid phone top-ups

- **Facilitation of local companies' access to overseas markets** The trials also provided reference points for local companies in their expansion overseas. Systems@Work, for example, is now providing mobile payment services in Malaysia. The CFC award also helped Systems@Work and Mobile Solutions and Payment Services open doors to companies in Geneva, Japan, South Korea, India and China.

The efforts of the consortia have also placed Singapore's wireless developments on the map. Companies such as IDC Asia Pacific, Computer Chronicles (United States), Strand Consult (UK), InterData (Australia) and PMN (UK) have reported on the trials. The Feature (Finland) also named Singapore "one of the top wireless cities to watch for in 2002" in highlighting the m-payment trials as well as other wireless developments in Singapore.

Notwithstanding these results, IDA recognises that the heavy lifting has only just begun. To further realise the potential of m-commerce, merchants and service providers outside the CFC also need to be aware of what worked and what did not. It was with this objective in mind that IDA had worked with the various consortia in compiling this report. The report begins by providing some background to the CFC process. It then proceeds to document the experiences and findings of the five mobile payments trials before ending with a chapter on the key findings from the trials.

IDA hopes that this document will provide a useful reference for both service providers and users (businesses and government organisations) of mobile commerce in Singapore and overseas. A successful mobile payments deployment is as much an Art as it is a Science – a certain degree of experimentation is needed notwithstanding an understanding of the underlying human factors, technologies and business models. It is through such experimentation, validation and sharing among players locally and with companies overseas, that Singapore hopes to realise the full potential of m-commerce.

We would also like to take this opportunity to express our appreciation to the consortia that have forged the path in making the m-payment trials happen. In an area that straddles both the financial and wireless space, the trials are testimony of the win-win mindset among the players that has made Singapore an ideal living lab for collaborative pilots. IDA looks forward to working with the consortia and others in the industry as we continue down this road of m-payments discovery.

Khoong Hock Yun
Assistant Chief Executive, Infocomm Development Group
Infocomm Development Authority of Singapore

March 2003

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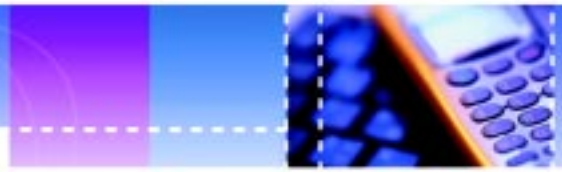


Executive Summary

In May 2001, IDA announced a Call for Collaboration (CFC) in the area of Mobile Payments to develop the mobile payments infrastructure in Singapore.

The CFC effectively led to the formation of several consortia in this area, four of which were later awarded under the CFC to trial five different mobile payment solutions. Between March 2002 and March 2003, the Blink, Gemini, Go Virtual, TeleMoney and YW8 consortia successfully piloted a range of payment methods, wireless technologies and services, attracting more than 7,000 consumers to make transactions via mobile payments.

In the process, a few findings related to mobile payments have emerged including:

- Mobile payments appear to be most relevant to the sale of perishables (goods with a limited shelf-life), bill and fine payments, unmanned vending purchases, sale of Internet and mobile contents and applications, top-up of pre-paid accounts and Person-to-Person (P2P) payments;
- Mobile payments appear least relevant to face-to-face retail transactions;
- Credit card payment is the preferred payment method for mobile payments;
- Consumers aged 20-40 appear to be the most receptive to the services deployed in the trial;
- Consumers prefer to use existing handsets for mobile payments and are unlikely to purchase new handsets in order to conduct mobile payments;
- Registration processes and user interface need to be simplified in order to encourage greater consumer adoption;
- SMS may not be well-suited for m-payment transactions that are complex; and
- Wireless PKI may be too costly to implement for small value transactions.

With the completion of the trials in March 2003, four out of five of the trials have commercialised or have made plans for commercialisation. IDA looks forward to working with these consortia and others in the industry to further leverage mobile payments for the benefit of businesses and consumers in Singapore.

1. Mobile Payments Call for Collaboration

1.1 Introduction

On May 2001, the Infocomm Development Authority of Singapore (IDA) launched the Mobile Payments Call for Collaboration (CFC). Similar to a Request for Proposal (RFP) process, the CFC was an open call to the industry to collaborate, propose and deploy solutions for trial in the area of mobile payments. Besides specifying the scope of the CFC, IDA also facilitated the collaboration by organising a networking event for interested parties.

1.2 Background

The CFC announcement was made against a backdrop of several industry developments in the wireless and payments space in Singapore in mid-2001, including:

- **Growth in mobile subscription rates**
  For one year leading to May 2001, mobile subscription rates grew each month at a rate of 2.5%, resulting in a mobile penetration of 72% at May 2001 (*Figure 1 below*).

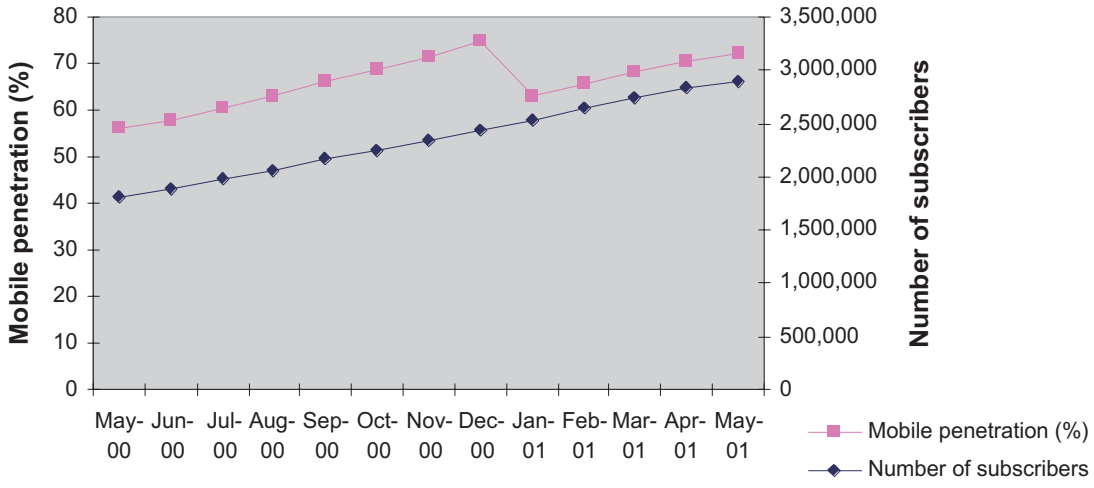
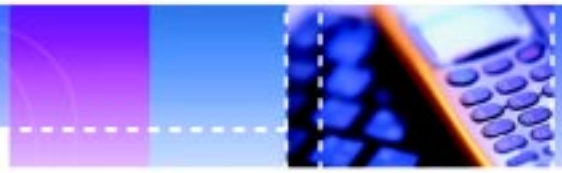


Figure 1. Mobile penetration in Singapore (May 2000 – May 2001) *(source, IDA)*

What caused the dip in mobile penetration?

From Jan 2001, IDA had started to use total population (including non-residential population) instead of total residential population as a population base for the calculation of penetration rates for telecom services. This accounts for the dip in mobile penetration in Jan 2001 despite the increase in mobile subscribers.



- **Launch of advanced wireless data infrastructure**

In Feb 2001, SingTel became the first mobile operator in Singapore to commercially launch General Packet Radio Services (GPRS). This was followed by similar announcements from MobileOne and StarHub Mobile later in the year. The first GPRS handsets also entered the market by the first half of 2001.

- **Increased consumer sophistication in wireless data usage**

Even before the introduction of GPRS, consumers were already heavy users of wireless data especially Short Message Service (SMS). SMS was used not only for communication and gaming, but also for the distribution of mobile coupons and for the ordering of drinks at pubs. Although no statistics of SMS use was publicly available during the conceptualisation of the CFC, a later report by A.T. Kearney and Cambridge University confirmed the heavy usage of SMS in Singapore (*see inset*).

SMS usage in Singapore

In a survey of 5,666 mobile phone users across Asia, Europe and America, Singapore topped the list of countries whose mobile phone users use short messaging service (SMS) frequently.

The survey, conducted by global management consultancy AT Kearney and Cambridge University's business school, found that 52 per cent of mobile phone users in Singapore use SMS more than once a day, compared to a global average of 23 per cent.

Source: Singapore Straits Times, March 2002

- **Introduction of new payment and billing methods**

Mobile operators had at this time, been offering billing-on-behalf services for several micro-payment services ranging from ring tone downloads, SMS games to vending machine purchases. It was also around this time that NETS launched the island's first multi-purpose server-based stored value payment instrument - the NETS Virtual Card (later renamed eNETS VCARD). The NETS Virtual Card supplemented the existing credit card and direct debit payment methods that were in the market.

- **Emergence of player-centric mobile payment services**

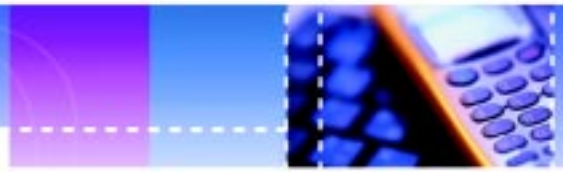
A few banks including the Development Bank of Singapore and Citibank had been piloting bank-centric banking services based on Sim Tool Kit (STK). At the same time, mobile operators were also offering telco-centric billing-on-behalf services albeit for micro-payment transactions.

1.3 Objectives

In the light of these developments, a CFC for the deployment of mobile payment trials was initiated by IDA with the following objectives:

- **To jumpstart the development of a mobile payments infrastructure in Singapore**

Mobile payments was identified as a key enabling infrastructure for mobile commerce. With the increased consumer receptiveness to mobile services and the launch of more advanced wireless data networks, more merchants and service providers would naturally start thinking about using the phone as another marketing and sales channel. If commercialised, the m-payment systems piloted in the CFC would enable merchants including those in F & B, retail and ticketing to innovate with new business models, for example, the sale of perishables through last-minute discounts advertised through the phone. It would also allow wireless application providers to monetise their applications on a pay-per-use basis, instead of just relying on subscription-based payments.



- **To facilitate the collaboration of industry players in developing the mobile payments infrastructure**
  The CFC sought to minimise duplication of efforts and to maximise the benefits of collaboration among relevant industry players. Mobile operators, banks, payment providers and equipment manufacturers each had their own value proposition that other parties would find costly to duplicate. As a result, IDA designed the CFC process with a deliberate emphasis on promoting collaboration. IDA, however, left the market to decide on the composition of each consortium.

  Not only would there be collaboration within the consortium to deploy and market its system, there would also be potential synergy between the consortia, such as in creating consumer awareness of the potential of mobile payments during the period of the trials.

1.4 Call for Collaboration Process

The CFC process, from announcement of the CFC to the award of funding, lasted a period of six months from May 2001 to October 2001.

Briefly, the following activities were undertaken during the CFC process:

Date	Event	Activity
22 May 2001	CFC Announcement	Press release and public document on scope of CFC made available
5 June 2001	Public Briefing	Public Briefing on the process and scope of the CFC; registration for Networking Event opens
22 June 2001	Networking Event	Presentations by interested companies on their company offerings and partners sought
10 Aug 2001	Submission of Proposals	Submission of proposals by consortia, followed by evaluation of proposals
15 Oct 2001	Award of Funding	Four consortia awarded to test five m-payment solutions
March 2003	Completion of Trials	Completion of trials

Table 1. Call for collaboration timeline and activities (May 2001 – March 2003)

Public Briefing In June 2001, soon after the CFC was announced in the press, a public briefing was conducted to explain the objectives, timeline, scope of the CFC and the expected support from IDA. The briefing also touched on the pre-requisites and the broad criteria that would be used to evaluate the proposals (*see inset*). Lastly, the public briefing covered the purpose of the upcoming networking event.

Pre-requisites and evaluation criteria

Each CFC proposal had to be an *end-to-end mobile payment solution*. That is, regardless of whether a dual-chip, server wallet or any other solution was proposed, the consortium needed to have the participation of the relevant handset manufacturers, telcos, banks, payment providers, merchants and service providers that were necessary to conduct the trial.

The broad evaluation criteria included the value proposition to the consumers, proposition to the merchants, proven expertise of the consortium members and the commercial viability of the service.

Networking Event Prior to the networking event, interested companies had to pre-register for a speaking slot. Each company was allocated no more than 10 minutes to present 2 to 3 slides on the company's core expertise, their interest in m-payments and the partners sought for the purpose of the CFC. In all, 43 presentations were made during the networking event. It was during this networking event that the mobile operators in the YW8 consortium first announced the collaboration of the three national mobile operators in developing mobile payments in Singapore.

Submission of Proposals Two months later, on Aug 2001, each consortium submitted their proposal to IDA, describing the role of each member in the consortium, the solutions to be piloted and the scope of the trial. Altogether, 21 proposals were submitted to IDA. Out of these submissions, 12 were short-listed based on the pre-requisites. The 12 consortia were then requested to present their solutions to an Evaluation Committee comprising members from the Economic Development Board, Monetary Authority of Singapore, selected venture capitalists, research institutes and IDA.

Award of Projects Four out of twelve of the consortia were then awarded funding to test their mobile payment solutions. This was followed by the development, marketing and trial of the respective systems, which ended in March 2003.

1.5 Awarded Proposals

On 15 October 2001, four consortia led by the National Computer Systems, Nokia (comprising of both the dual-chip and RFID systems), Singapore Technologies and Systems@Work were awarded funding to test a range of mobile payment solutions in Singapore.

The composition of each consortium, together with the branding of the trials and the initial set of merchants, is depicted in *Table 2* below:

Consortium	Trial Name	Category/Role	Companies
Singapore Technologies	"Blink"	Product Company	1. Mobile Solutions and Payment Services
		Bank	2. ABN-AMRO Bank N.V. 3. Citibank, N.A. 4. Maybank
		Technology	5. BCS Information Systems 6. CET Technologies 7. mPayment 8. WizVision
		Merchant	9. C.K. Tang 10. Cathay Cineplexes 11. Metro 12. National Service Resort and Country Club 13. TicketCharge
		Mobile Operator	14. Starhub Mobile
		Marketing	15. Mastercard 16. Singapore Technologies Electronics
Nokia	"Gemini"	Equipment Manufacturer	1. Nokia
		Financial Institution	2. The Development Bank of Singapore
		Payment Provider	3. Network for Electronic Transfers (S)
		Certification Authority	4. ID.Safe and Commercial & Industrial Security Corporation (CISCO Security)
		Security Vendor	5. Baltimore Technologies
		Smart Card Manufacturer	6. Oberthur Card Systems
Nokia	"Go Virtual"	Equipment Manufacturer Payment Provider and Service Operator Merchant	1. Nokia 2. Network for Electronic Transfers (S) 3. The Coffee Bean and Tea Leaf 4. Bossini 5. Ritz Apple Strudel & Pastry
Systems@Work	"TelePay & TeleParking"	Technology Provider and Payments Enabler	1. Systems@Work
		Facilities Service Provider and	2. Suntec City Management
		Marketing Partner Technology Provider and	3. Hewlett-Packard E-Services Bazaar
		Marketing Partner Security Solutions Provider	4. Gemplus
		Marketing Partner	5. VISA
National Computer Systems	"YW8" ("Why Wait?")	Systems Integrator	1. National Computer Systems*
		Payment Provider & Service Operator	2. Network for Electronic Transfers (S)
		Payment Provider	3. The Development Bank of Singapore 4. VISA International
		Telecommunications Operator	5. MobileOne (Asia) 6. SingTel Mobile 7. StarHub
		Merchants/Service Provider	8. Diethelm Singapore 9. Eng Wah Organization 10. National Library Board 11. National University of Singapore

Table 2. Awarded consortia of the mobile payments CFC

The consortia deployed their solutions for Business-to-Consumer (B2C) and Person-to-Person transactions (P2P). The solutions spanned a comprehensive range of payment methods and wireless technologies including credit card, direct debit and stored value payments made over Short Messaging Service (SMS), Wireless Access Protocol (WAP), Radio Frequency Identification (RFID), Interactive Voice Response (IVR), Bluetooth and Infrared technologies.

The range of piloted solutions is depicted in *Figure 2* below.

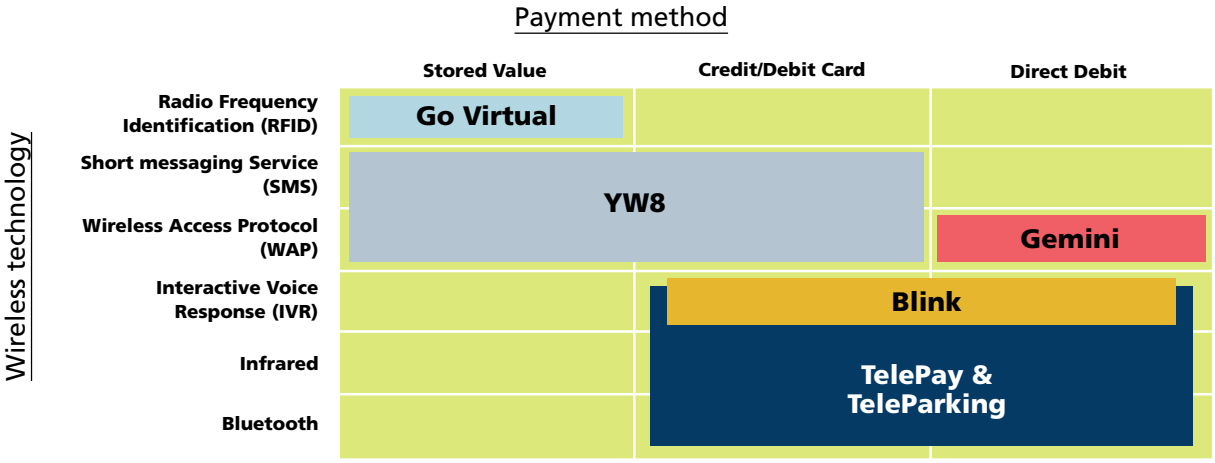


Figure 2. Coverage of mobile payment trials

1.6 Organisation of the Report

The remainder of the report is devoted to the proceedings of each trial and the key learnings and observations made by IDA and the consortia.

Chapters 2 to 6 provide an overview of the proceedings and learnings from the Blink, Gemini, Go Virtual, Teleparking and Telepay, and YW8 trials respectively. The quantitative results of the trials have been supplemented by descriptions of the implementation issues, the consumer and merchant experience and improvements to the systems in the course of the trial. Commercialisation decisions for the trial systems are also included in these chapters. For each trial, these chapters attempt to answer the following questions:

a) How was the consortium formed?
b) What roles did the mobile operators, payment providers, banks, handset manufacturers, security vendors, SIM card manufacturers, systems integrators and merchants undertake in deploying the mobile payment service?
c) How did the consortium decide on the wireless technology and payment method to use?
d) What were the technical and marketing preparations before the launch of the pilot?
e) What was some of the work done during the trial period?
f) How did consumers and merchants react to the mobile payment services?
g) What plans does each consortium have after the trials?

Chapter 7 highlights the key learnings from the trials. The trials have validated some of IDA's initial hypothesis on consumer preferences and habits. They have also shown which services are likely to be more relevant to mobile payments. Just as importantly, it has surfaced new issues that service providers and merchants should take note of when deploying their m-payment services. We conclude the report in **Chapter 8**.

BLINK - Collaboration of major multi-national banks for mobile payments

We would like to thank the following for their contribution to this chapter on the Blink trial:

Sandeep Dhar	ABN-AMRO Bank, N.V. (Singapore)
Guai Eng Chun	BCS Information Systems Pte Ltd
Quek Hong Ping	Cathay Cineplexes Pte Ltd
Veronica Yong	Cathay Cineplexes Pte Ltd
Yong Gek Chin	CET Technologies Pte Ltd
Wong Long San	Citibank, N.A
Ajay Gupta	C.K. Tang Limited
Robin Ng	Maybank
Vincent Yap	Maybank
Lau Kong Cheen	Metro (Private) Limited
Sharon Tan	Mobile Solutions and Payment Services Pte Ltd
Adeline Tan	National Service Resort & Country Club
Charles Pang	TicketCharge Pte Ltd

2. Blink – Collaboration of major multi-national banks for mobile payments

2.1 Highlights

- No registration process for the end consumer
- No new hardware requirements for any merchants or consumers
- Direct debit payment for Citibank, ABN AMRO and Maybank customers – straight from the consumer's bank account
- Credit card payments involving Citibank and Maybank customers
- Formation of Mobile Solutions and Payment Services Pte Ltd (MSPS), a new company, to lead m-payment initiatives ("Blink" is the MSPS brand)
- Interoperability with the iQB payment network

2.2 Background

The Blink trial had its beginnings as an m-payments initiative in the Singapore Technologies group (ST). ST recognised early on that in order to launch a successful m-payments service, there would be a need to collaborate with industry partners including banks, merchants, mobile service providers and technology solutions providers with both mobile and payment expertise.

Through its subsidiary iQB, a Singapore payment switch, ST had already established close ties with financial institutions in Singapore. ST also had subsidiaries such as CET Technologies (CET) that could provide the technical expertise for the setup of the m-payment infrastructure.

2.3 Formation of the Blink consortium

With the launch of the CFC, ST brought together like-minded players who had the expertise to deliver a complete end-to-end m-payment solution.

Technology providers Through Citibank, ST enlisted the participation of mVent (later renamed Mobile Solutions and Payment Services) in the consortium. mVent would work with technology providers mPayment, WizVision and CET to provide the technology and integration expertise to the banks.

Financial Institutions Citibank provided the initial investment in mVent in 2000. Its global expertise across multiple functions and processes as well as its broad resource base provided the essential platform to launch the business. In addition, Citibank helped design the consumer experience for the mobile payments process, fundamentally helping to shape the product into what it is today. The consumer experience was designed for ease of use and mass consumer adoption. For example, no upfront registration was required, other than the banking PIN. Citibank was the first bank to launch Blink Mobile Payments.

In July 2002, ABN-AMRO and Maybank confirmed their participation in Blink. Prior to this confirmation, from early 2001, ABN-AMRO had already worked with Blink to enhance the payment flow design and to explore remote payment solutions for its consumers, focusing on security and consumer convenience.

Maybank's participation in Blink was borne out of a desire to increase value for its customers through innovative products and services. As one of the leaders in mobile banking and Internet payment initiatives through iQB, Maybank found that mobile payments would complement its product suite.

Merchants Metro and C.K. Tangs had been in discussions with the consortium since 2001 to explore alternate channels of payment for consumers that would not require new hardware or significant changes in their current operational systems. Cathay and TicketCharge saw SMS as a natural extension of their existing offerings. NSRCC also wanted to facilitate other channels of bill payment for those customers who chose not to pay by traditional means.

No.	Company	Category	Role
1.	ABN AMRO Bank N.V (ABN-AMRO)	Bank	Offering consumers direct debit payments
2.	BCS Information Systems Pte Ltd (BCSIS)	Technology	Payment solution provider and integrator offering payment switching services through iQB. Supporting the payment and settlement process for the inter-bank mobile payments for ABN AMRO Bank, Citibank and Maybank
3.	Cathay Cineplexes Pte Ltd (Cathay)	Merchant	Piloting remote ticketing purchases
4.	CET Technologies Pte Ltd (CET)	Technology	Overall systems integrator and technology partner
5.	Citibank, N.A. (Citibank)	Bank	Offering consumers mobile credit card and mobile direct debit payments. Designing and developing the consumer interaction booking/payment as well as the bank-merchant settlement flows with MSPS
6.	C K Tang Limited (C.K. Tangs)	Merchant	Piloting brick-and-mortar retail payment purchases
7.	Maybank	Bank	Offering consumers mobile direct debit payments and mobile credit card payments
8.	MasterCard	Marketing	Marketing and promoting mobile payment services
9.	Metro Pte Ltd (Metro)	Merchant	Piloting retail payment purchases
10.	Mobile Solutions and Payment Services (MSPS)	Product company	Leading overall consortium initiatives, including launching and marketing/promotion activities; providing design for payment processes (Consortium Lead)
11.	National Service Resort & Country Club (NSRCC)	Merchant	Piloting membership bill payments
12.	Singapore Technologies Electronics (STE)	Marketing	Marketing and promoting mobile payment services
13.	StarHub Mobile	Merchant and Telco	Providing telco connectivity as well as preparations to pilot remote pre-paid top-up payments (end March 2003)
14.	TicketCharge Pte Ltd (Ticketcharge)	Merchant	Piloting push advertising and remote ticketing payment purchases

Table 1. Roles of Blink consortium members

2.4 The mobile payment solution

2.4.1 Overview of payment method and wireless technology

As shown in *Figure 1* below, the Blink trial covered direct debit and credit card payment methods via IVR. All three banks enabled direct debit payments, while only Citibank and Maybank enabled credit card payments for the trial.

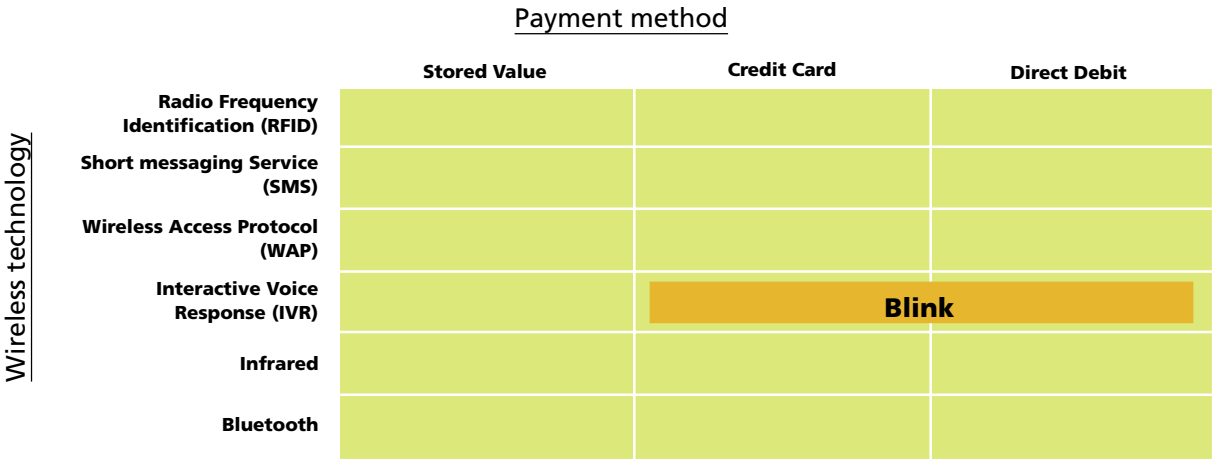


Figure 1. Payment method and wireless technology in the Blink trial

IVR was the authentication and payment method of choice for the trial as it leveraged the existing phone banking channel between banks and consumers. As such, it was a channel that consumers were familiar with.

Even though payment authentication was always via IVR, SMS was also used during the trials to shop and define purchases (such as movie tickets).

The consortium did initially consider including WAP as a channel for consumers. In order to gauge the readiness of WAP then, MSPS conducted a product demo lab in March 2002 to test the process flows using WAP. The WAP technology for mobile payments was proven feasible during the demo lab. However, feedback from consumers indicated that WAP was not a widely accepted consumer technology. These concerns significantly contributed to the decision not to deploy WAP in the trial. MSPS and the banks, however, intend to continue to evaluate WAP as a product enhancement for the future, depending on consumer acceptance of WAP.

2.4.2 Wireless protocols and standards

From a consumer payment flow perspective, the overall system made use of SMS and IVR. However, as banks and MSPS modified their systems to build the overall infrastructure, they also increased their expertise in other wireless protocols such as WAP, WTLS and WML.

2.4.3 Payment protocols and standards

The system relied on International Financial Exchange (iFX) XML-based message, a marketplace-accepted message format for financial institutions and the ISO 8583 standard. This helped to accelerate systems integration as all participating banks were familiar with these standards.

2.4.4 Other technologies

Other than the above wireless and payment standards, the consortia also gained experience in working with message handling using XML, including XSLT. In addition, they were able to use many of the advanced features of Java/J2EE, such as Message Beans and Transactions, JAXB, JMS and EJB.

The consortium also worked with the National University of Singapore (NUS) to facilitate the initial consumer merchant interaction. The Natural Language Processing (NLP) technology sought to ease the consumer experience by providing a more intuitive SMS interaction to the consumer. In that way, users did not need to rely on keywords in their initial SMS interactions with Blink. (*see inset*)

About the Natural Language Processing (NLP) engine used in Blink

Developed by a group of researchers from NUS, SmartTalk™ enabled users to type in their SMS request in free-form. Essentially, the free-form SMS is sent to the NLP engine for processing. The engine recognises if the input is a date or time or a movie field. Through the use of NLP, the consortium thus avoided the need for formatted text messages.

The technology used was developed in NUS under the research project named Programme for Research into Intelligent Systems (PRIS). PRIS focused on the development of intelligent techniques in text and video, and was a 5 year project supported by A*STAR and Ministry of Education.

2.5 Preparations for the trial

2.5.1 Formation of the project team

In 2002, the consortium finalised the roles and responsibilities of each consortium member. *Figure 2* illustrates the project structure of Blink during the period of the trial.

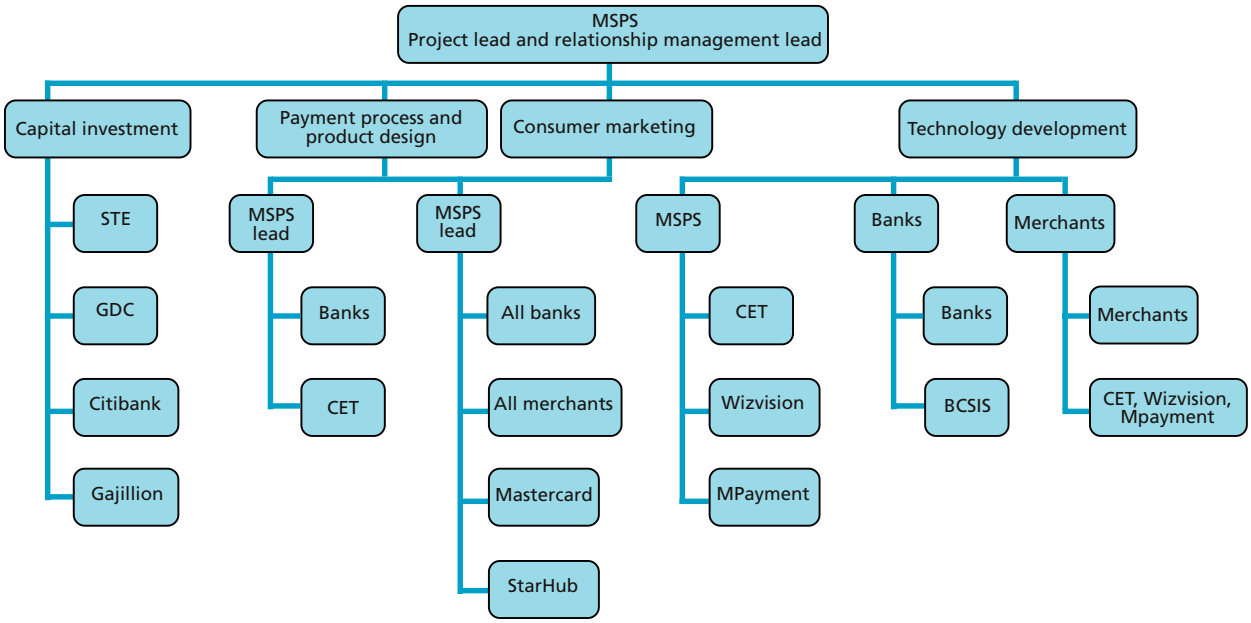


Figure 2. Project structure of Blink

2.5.2 Timeline for trial preparations

The pre-trial preparations included both technical and marketing efforts.

Technical preparations included setting up a secure network between the merchants, banks and the payment switches. Development of the m-payment products was phased as follows: The direct debit infrastructure enabling retail payments was first put in place followed by the infrastructure for remote payments. Finally, credit card payments were put in place together with bill payments.

Marketing preparations included a demo lab to garner initial consumer feedback on the system. Merchant training and customer hotline briefings were also conducted. Using a two-phase approach, MSPS launched Blink amongst the employee base of consortium partners before launching it to the general public on 8 December 2002.

Figure 3 below shows the timeline of the technical and marketing preparations.

Activity	Oct 01-Dec 01	Jan 02-Feb 02	Mar 02 - Apr 02	May 02-June 02	July 02-Aug 02	Sep 02-Oct 02	Nov 02-Dec 02
Formation of MSPS							
Product/Process flow design completion							
Product development and testing							
Retail payments – direct debit							
Remote payments – direct debit							
Credit card payments							
Bill payments							
Marketing activities							
Demo lab							
Brand name development							
Trial for internal employees							
Public launch							

Figure 3. Timeline for trial preparations

2.5.3 Coordination of payment functions

MSPS worked with Citibank, iQB/BCSIS and the iQB banks – Maybank and ABN AMRO Bank - to integrate the MSPS design, and user interface to adhere to the iQB systems design. As the only merchant bank in this trial, Citibank also provided the credit card authorisation and merchant settlement facilities, as well as the connections needed to facilitate interoperability between the banks.

In order to effect capital transfer between banks, Blink leveraged on the existing inter-bank settlement model established by iQB banks. By doing so, no major changes were required at a bank's settlement engine if the bank was already on the iQB inter-bank switch. Finally, MSPS enabled the routing of payment messages between all parties, connecting all aspects of the mobile payments value chain.

2.5.4 Marketing preparation – demo lab

In March 2002, MSPS conducted a product demonstration lab at StarHub Centre to garner feedback from end users before bringing the product to market. For three weeks, MSPS presented in-depth demos and interviewed a random sample of consumers, comprising walk-ins as well as the employee and customer bases of consortium partners. This market research gauged both the consumer's readiness to use mobile payment, as well as consumer opinion of the user interface and the overall process flow.

Key feedback from Blink demo lab

- Remote transactions were preferred over retail products, given existing payment methods already available in the retail world, such as by credit card.
- Consumers indicated greater usage of remote payments for product in high demand. (for example, blockbuster show tickets)
- Customers wanted to use credit products via mobile payments because they could do more with the features offered by credit cards (such as disputing and earning loyalty points)
- For remote transactions, availability of merchant services and products were important. Customers would be unlikely to use this mode of payment if they consistently received messages on the unavailability of products.
- Desirability, ease of use, speed, and security all have some correlation with usage.
- Accessible customer support was essential, given the newness of the concept of mobile payments.

2.5.5 Consumer education – roadshows

Also as part of marketing preparations to soft-launch the product and to gain further consumer feedback, roadshows were conducted at consortium partners' offices across Singapore. During these roadshows, MSPS staff would be present to educate users on how they could conduct an m-payment transaction. Citibank, as well as StarHub Mobile, also offered attractive packages to the consumers at the roadshows. For example, StarHub offered a special subscription package, while Citibank waived fees for opening accounts.

2.5.6 Merchant training

MSPS recognised that training for merchants was not just a requirement but a means to educate more individuals about m-payment. MSPS trained the customer service, cashier, finance, technical and frontline staff of each merchant, not only on how to handle the new processes and exceptions, but also on the consumer experience. As such, the staff received training on questions related to:

a) What was mobile payments in general?

b) How did their company process mobile payments and what were the operating procedures (if they differed from current practice)?

c) How could they handle customer queries and problems relating to payments and booking requests?

d) What was the consumer's experience in conducting mobile payments?

MSPS had to tailor training specifically to each merchant's requirements as each had its own unique businesses processes. This in turn provided MSPS with greater insights into the merchants' business.

Finally, in the case of remote merchants, staff had to be trained to ensure that real-time information was consistent across all channels offered by the merchant. For example, movie listings on the Internet needed to be consistent with those found on SMS. Again, merchants were trained on operational procedures to minimise information disconnects.

2.5.7 Customer support briefing

There were two types of customer service support – one run by the banks for the consumers and another run by MSPS for banks and merchants. The banks formed the first line of support for consumers, thus reinforcing the bank-consumer relationship. To service their customers, bank staff were trained on all aspects of the system, including the back-end processes.

The MSPS hotline supported the banks and merchants. In the event that a bank could not resolve an issue, the MSPS customer service could then walk the bank's customer service personnel through the process of resolving the problem. In exceptional situations, MSPS would rectify the problem directly with the consumers.

2.6 Conduct of the trial

After the launch, the consortium focused on the following:

- Raising consumer awareness on mobile payments
- Increasing usage of Blink services
- Addressing business operational issues, including customer service

2.6.1 Timeline for conduct of trial

The actual pilot occurred over an eight-month period, from August 2002 to March 2003. *Figure 4* below illustrates the dates of the various product launches for the trial.

	Maybank		Citibank		ABN-AMRO	
	Direct Debit launch date	Credit Card launch date	Direct Debit launch date	Credit Card launch date	Direct Debit launch date	Credit Card launch date
RETAIL						
- Metro	N.A.	N.A.	Aug 2002	N.A.	N.A.	N.A.
- Tangs	N.A.	N.A.	Dec 2002	N.A.	N.A.	N.A.
- Subway	N.A.	N.A.	Nov 2002	N.A.	N.A.	N.A.
REMOTE						
- Cathay	Dec 2002	Nov 2002	Sep 2002	Nov 2002	Dec 2002	N.A.
- Ticketcharge	Dec 2002	Nov 2002	Sep 2002	Nov 2002	Dec 2002	N.A.
BILL PAYMENT						
- NSRCC	Dec 2002	N.A.	Dec 2002	N.A.	Dec 2002	N.A.
- StarHub (top up)	To be launched by end March 2003					

N.A. denotes not launched for the trial

Figure 4. Dates of product launches during the Blink trial

2.6.2 Marketing activities

The overall marketing plan addressed tactical implementation in four phases: internal advertising, merchant discounts, public advertising and "man-on-the-street" activities.

Phase 1: Internal advertising Initial marketing activities were targeted at the employee base of consortium members. Employees received information about the services through roadshows, posters, e-mails and their intranet sites. ABN AMRO Bank, Citibank and Maybank worked with their internal staff clubs to increase awareness and drive transactions.

Phase 2: Merchant discounts MSPS also introduced numerous promotions at different merchants to encourage first time users to overcome their initial resistance to using a new payment system. For example, one could obtain Subway sandwiches at 99 cents (retail price of more than $3), obtain discounts of $10 with purchases above $30 at C.K. Tangs, and also obtain $4 off movie tickets at Cathay cineplexes (retail price of more than $8 per ticket).

Phase 3: Public advertising Having started with consortium members' staff, MSPS began an above-the-line communications strategy to reach the public quickly and effectively. From December 2002 to March 2003, MSPS launched a series of public advertising campaigns through press releases and advertisements placed in the local newspapers. These publications served to promote the service and to teach users how to make a mobile payment.

Phase 4: "Man-on-the-street" activities With public awareness growing, MSPS placed people on the streets to interact directly with customers, to answer questions and encourage transactions. First, MSPS provided queue helpers for retail payment at C.K. Tangs, Metro and Subway during weekends. The queue helpers' role was to assist customers in conducting mobile payment transactions. They also answered questions and educated non-users on the benefits of the system. The queue helpers served as an important feedback loop to the marketing team in getting users' comments on the system, their likes and dislikes and the problems they encountered.

About BlinkMan

In January 2003, MSPS launched its mascot "BlinkMan", to create visibility and awareness, and to provide consumer education on how to use the system. Blinkman went to all the merchants as well as ABN AMRO Bank, Citibank and Maybank branches to educate their customers on mobile payment. He also provided one-on-one assistance to shoppers who needed help with getting started on m-payments.

Blink ads to raise consumer awareness

"BlinkMan" to create visibility awareness

Figure 5. Marketing activities

2.6.3 User profile

Before the trial began, MSPS conducted preliminary market research to understand market demand for product functionality and general attitudes regarding technology, payments and brand. Preliminary research identified three primary target groups:

a) Heavy users of mobile devices – Middle-aged and very familiar with mobile and electronic commerce
b) Heavy shoppers – Mainly women with multiple credit cards
c) Young innovators - Heavy mobile application users

TARGET AUDIENCE	PROFILE	MOTIVATORS/DRIVERS	CONCERNS/ISSUES	NEEDS/INSIGHTS
Heavy users of mobile devices	Middle-Aged	- Practicality - Service makes life easier - Service is absolutely essential, an "indispensable tool" - Service is part of daily routine - External pressure due to life/work demands	- User-experience needs to be consistent with other channels - M-Payments service needs to provide productivity and efficiency - Consumers need to know more about m-payment systems	- Hassle-free. "I need my life to be easier, simpler, less complicated" - Usefulness - Positive reactions to technology - Seeing it as speeding up tasks and increasing productivity
Heavy shoppers	Mainly women with multiple credit cards	- Is it part of my handbag or part of my lifestyle? - Do I get rewarded for using it? - Does it look and feel good? - Ease of use	- Open to trying new things - User-friendliness and security were cited as important - Concerned about lower quality of interaction	- Needs to suit current lifestyle, must be easy to use, simplify life and be great to carry around
Young innovators	Heavy mobile application users	- Is it fun to use? - Is it part of my take-out kit? - How expensive is it and how much value can I get from it?	- How much is this going to cost? - Value for money - Ease of use	- Needs to provide entertainment and connectivity - Needs to provide great value and suit current lifestyle
All respondents	All groups agreed that they preferred the myriad functions available to be centred on their mobile phone. They did not see PDAs, for example, as their central tool. All groups could foresee the day that the mobile phone would be the central tool in their lives. The mobile phone plays a huge central role in their lives, and all groups were emotionally bonded to their phones. They saw it as an absolute necessity – an essential part of their work/take-out kit/ handbag. And most felt completely distraught without their phones. Brands generally admired were Nokia, Palm and NETS – the former two because of their ability to blend function with design/form; the latter for its sheer usability and usefulness.			

Table 1. Three likely groups of m-payments users (based on preliminary research)

2.6.4 User experience

To conduct a transaction, users would either have to call the bank (in the case of retail face-to-face transactions) or compose an SMS to send to BLINK (in the case of remote and bill payment transactions).

A user conducts a mobile payments transaction with Cathay, Tangs, Metro, Subway, TicketCharge and NSRCC using the following steps shown below:

Paying at Cathay

1. **Booking done via SMS**
   Consumer sends an SMS with the following information to BLINK ("25465"): movie name, merchant, location, date, time, number of tickets, bank name (abn, citi, maybank)

2. **Paying tickets by calling bank and following the IVR prompts**
   - ABN AMRO
   - Citibank:
   - Maybank: 1800-PAYMENT (1800-729-6368)

3. **Collecting tickets**
   The customer receives an SMS receipt that confirms the purchase. This receipt SMS is shown to the cashier at the special MOBILE PAYMENT Box Office

For example, Harry Potter showing at Cathay Orchard on December 1, starting at 5pm. Booking two tickets and paying with a Citibank account.

- Users do not need to key in fields in any specific order.
- Users only need type in key words like Harry for "Harry Potter"
- System can also recognise dates and time in almost any format. For example, 20-Nov or 20112002 and 2.00 pm or 1400

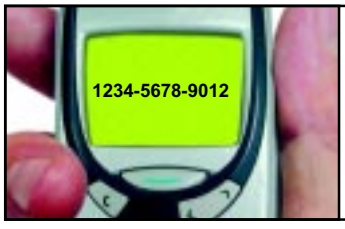
Paying at Metro, Subway and C.K. Tangs

1. **Call bank's Automated Voice Response system (for example 6883-1118 for Citibank)**
   Press "2" for mobile payments

2. **Enter NRIC or ATM card number**

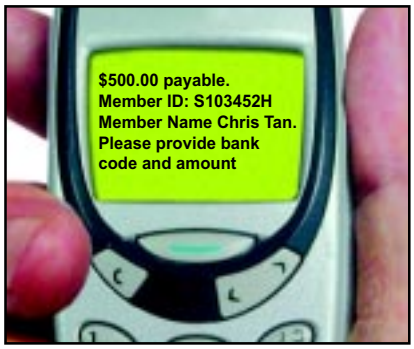
3. **Enter Telephone Banking PIN (TPIN)**
   Press "1" for a payment code

4. **Show cashier payment code**
   A 12-digit code is sent to the customer by SMS. This code is shown to the cashier.



The code expires after 15 minutes to protect the consumer in the event that he loses his phone.

Paying bills at NSRCC



1. SMS enquiry and send it to BLINK ("25465")
(a) Merchant Code = NSRCC
(b) S1243567J = Members ID as registered with NSRCC
(c) 19770410 = Date of birth of the Member

Customer will receive an SMS message on bill information and payment instruction.

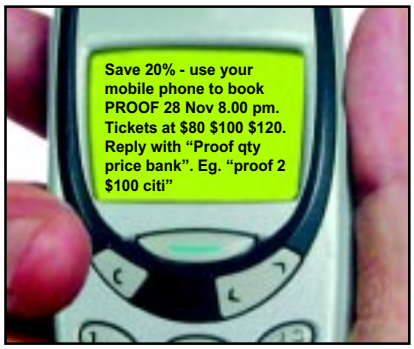
2. SMS amount to pay and bank name
"For example,. $500 Citi". User will then receive SMS to call bank to make payment.

3. Call bank and follow the IVR prompts
ABN AMRO Bank: 1800- ABN AMRO (1800-226-2676)
Citibank: 6883-1118
Maybank: 1800-PAYMENT (1800-729-6368)

4. Receive SMS Receipt
Customer receives a final SMS message confirming payment details, for example, "Payment to NSRCC Successful. $500.00 paid. Transaction ID 23456332".

Purchasing tickets after receiving promotional SMS from TicketCharge

1. Receive SMS message with promotional offer



2. Reply to promotion with the following details
- Show name ("proof")
- Number of tickets ("2")
- Price category ("$100")
- Bank ("citi")

3. Receive an SMS that confirms the booking

4. Call bank and follow the IVR prompts
ABN AMRO Bank: 1800- ABN AMRO (1800-226-2676)
Citibank: 6883-1118
Maybank: 1800-PAYMENT (1800-729-6368)

5. Show SMS receipt to collect tickets
User receives an SMS receipt that confirms the purchase. The SMS is then presented at the venue for the collection of tickets. Alternatively, the user may request for tickets to be mailed.

2.6.5 Transaction flow

As stated above, Blink transactions can be classified into three of the following:

Retail payment flow The retail flow allows a consumer to walk into a brick and mortar shop with only a mobile phone to make payment. Once the consumer has selected the goods and is queuing to pay, he calls his bank's Automated Voice Response (AVR) line (e.g. 68831118 for Citibank). After authenticating his identity with the bank – entering a user ID and PIN, the consumer requests a dynamic payment code/session ID. The consumer receives this code via an SMS message sent by the bank. This code is valid for only 15 minutes and can be used for only one transaction. After the cashier has scanned in the goods, the consumer presents the payment code/session ID to the cashier, who enters it into the electronic cash register (ECR) machine. The message is then sent back to the consumer's bank via the ECR machine to verify the validity of the payment code/session ID and to debit the consumer's account. Quickly, the ECR receives bank approval for the transaction, and a receipt is printed for the consumer. The transaction is now complete and the consumer can leave the store with goods.

Remote booking and payment flow The remote payment application allows consumers to conduct transactions, such as booking and/or paying for tickets, goods, services and bills – anywhere, anytime, with a virtual merchant. When buying cinema tickets, the consumer first interacts with the merchant to book a ticket by sending an SMS with the key information needed to secure the booking – merchant name, location, movie title, number of tickets, time, date, bank and the method through which the consumer wants to make payment. The merchant will verify that seats are available, and will instruct the consumer via SMS to call the bank to pay for the ticket. As with the retail process, the consumer will then call the bank to authenticate the mobile payment. However, in the case of remote purchasing, the consumer will have an invoice generated in his account. The consumer can then select the invoice to pay, select the account from which to pay, and confirm the transaction. After payment is completed, the merchant will send the consumer a final SMS with a confirmation number. The number is used to pick up the tickets at the box office.

Bill payment flow The bill payment flow allows the consumer to verify his identity and find out his total bill. Once this interaction has been completed, the consumer follows the same steps as in the remote process to pay for the bill via his bank AVR system. Again, the consumer receives a final confirmation SMS from the merchant to indicate successful payment.

Figure 6 below shows the high level overview of the various transaction flows.

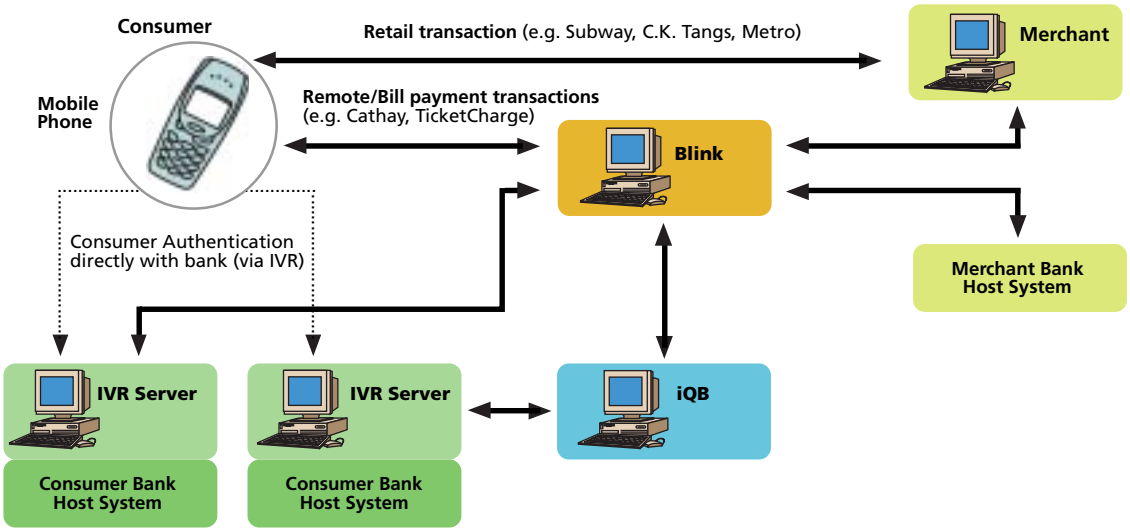


Figure 6. Transaction flows for remote, retail and bill payment purchases

2.6.6 Consumer usage

As of 15 January 2003, more than 1,800 consumers have conducted at least one m-payment transaction each with the various Blink merchants. Of the 1,800, more than 1,200 users have used the m-payments system more than once to make purchases.

In terms of transactions, more than 9,200 transactions have been conducted. The breakdown of transactions by merchant is shown in *Figure 7* below.

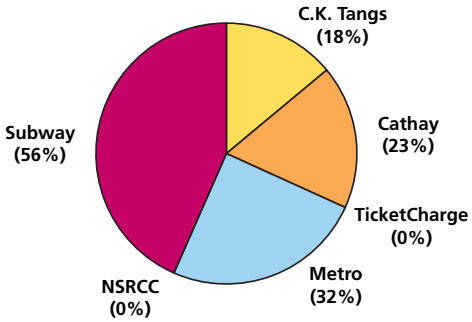


Figure 7. Breakdown of merchant transactions (as of 15 January 2003)

2.6.7 Consumer feedback

Preliminary feedback from consumers has been encouraging. Despite the recent start-date of the various services, more than 1,800 consumers have used the system, with a relatively high repeat usage rate. An initial list of consumer likes and dislikes from the consumer has been compiled:

	Top Likes	Top Dislikes
Remote and bill payment (Cathay, TicketCharge and NSRCC)	• No need to queue • Convenient, and enables booking or paying of bills without having to go to merchant site • Able to receive SMS information such as promotion SMS for special events (push marketing) • Discounts enjoyed during pilot period • Able to choose which account to pay through mobile phone • No need to carry wallet	• For movie and events booking, customers are unable to choose the seats as system automatically allots the seat to customer • Some customers are still unused to not having a physical receipt although they get an SMS confirmation number after payment • Having to pay for telco charges for SMS and phone calls to bank to authenticate payment
Retail payment (Metro, Subway, Tangs)	• No need to hand over personal information like credit card or bank card to third party, for example, to cashier during payment at point of sale • No need to carry wallet • Discount enjoyed during pilot period	• Customers still have to queue when they make mobile payment although processing time in front of cashier is usually quite fast • Having to remember to call for payment code before approaching cashier • The 15 minutes expiry time for payment code is sometimes insufficient if queue is too long • Having to pay for phone call to bank

Table 2. Initial findings about consumer likes and dislikes

2.6.8 Merchant feedback

Feedback from merchants so far indicates that collaboration in the planning and implementation phases has contributed to stable and reliable products that are easy for the consumer to use. Most merchants have been able to maintain most of their current standard operating procedures (SOPs). However, some SOP changes had to be worked through during the pilot phase. In particular, reconciliation processes continue to be enhanced to aid the merchant in handling transactions from the new mode of payment.

Merchants felt that a longer pilot would allow them to further understand the service's potential. As such, most have agreed to extend their pilot beyond the CFC trial. The merchants are still evaluating whether or not to commercialise the product. They have identified the key areas of evaluation as:

- The effect of mobile payments on overall sales: new revenues vs. cannibalisation of other channel sales
- Feedback from their own customer base (to determine ease of use, convenience, etc.)
- On-going maintenance and upgrade costs
- Transactional costs
- Overall take up rate

2.7 Conclusion

MSPS's anchor CFC partners – ABN AMRO Bank, Citibank, Cathay, C.K. Tangs, Maybank, Metro, NSRCC, StarHub, Subway and TicketCharge - are already reaping the initial benefits of participating in the MSPS m-commerce network through:

1) Increased revenue while focusing on their key businesses and competencies
2) New business relationships gained by participating in the network

MSPS secured these market-leading partners early to build a solid foundation for mobile commerce. These trials provide prove that the concept can succeed and provided a mechanism for feedback to enhance the user's experience with the system.

Moving forward, MSPS intends to commercialise its existing network of merchants and banks and bring more merchants and banks into its current network.

Gemini – Asia Pacific's first Wireless PKI m-payments trial

We would like to thank the following for their contribution to this chapter on the Gemini trial:

Sherman Tan	The Development Bank of Singapore Ltd
Nicholas Cheong	The Development Bank of Singapore Ltd
Wong Wai Yin	The Development Bank of Singapore Ltd
Jocelyn Ang	Network for Electronic Transfers (S) Pte Ltd
David Chen	Network for Electronic Transfers (S) Pte Ltd
Teo Ban Sim	Network for Electronic Transfers (S) Pte Ltd
Jessie Saw	Network for Electronic Transfers (S) Pte Ltd

3. Gemini – Asia Pacific's first Wireless PKI m-payments trial

3.1 Highlights

- Direct Debit Person to Person (P2P) Trial involving Wireless Public Key Infrastructure (WPKI) and Wireless Access Protocol (WAP) General Packet Radio Service (GPRS) dual-chip handsets
- Trial conducted over 3 months (26 April 2002 – 31 July 2002)
- First WPKI-based m-payments trial in Asia-Pacific
- First dual-chip m-payments trial in Asia-Pacific
- 211 users registered for the service, with 201 users making at least one transaction and 183 users making more than one transaction
- More than 2,600 transactions were made, with total value of over $130,000
- Highest usage was for account-to-account transfer of money to friends and family, with occasional transfer of funds to third-parties, such as landlords for rent
- If digital certificates are to be used, trial users prefer digital certificates to be embedded into WIM chips compared with other alternatives.
- Trial-users welcome the use of dual-chip phones for added security

3.2 Background

DBS Bank (www.dbs.com) is the largest bank in Singapore in terms of assets, and has a dominant position in consumer banking, treasury and markets, securities brokerage, Singapore dollar loans, deposits, and equity and debt fund raising. Through its Dao Heng Bank and DBS Kwong On Bank operations, DBS Bank is the fourth largest banking group in Hong Kong. Besides its anchor markets in Singapore and Hong Kong, DBS Bank serves corporate, institutional and retail customers in Thailand, the Philippines, and Indonesia. The bank's credit ratings are among the highest in Asia Pacific.

Why "Gemini"?

In Greek mythology, Gemini is the sign of the "twins", much like the two identical SIM cards used in the trial – one, a conventional GSM SIM, and the other, a Wireless Identity Module (WIM).

DBS is no newcomer to Internet and wireless innovations in the e-banking space. It launched the first Internet banking service in Singapore in 1997 and extended its online offerings to include wireless banking services using SIM Tool Kit in February 2000, and Wireless Application Protocol (WAP) banking in December 2000. DBS was also judged to have the top-ranked Internet banking website in Asia-Pacific, outside Australia, by the Lafferty Group of London in June 2000.

DBS, like Nokia, has been an active member of the Mobey Forum (www.mobeyforum.org), an organisation founded in May 2000 by a number of the world's leading financial institutions and mobile terminal manufacturers. Formed to encourage the use of mobile technology in financial services, Mobey produced a set of documents in June 2001 describing the "Preferred Payment Architecture (PPA)".

The PPA is Mobey Forum's recommended payer- and payee-architecture for facilitating the development and growth of mobile financial services. PPA is described largely in the context of local and remote payments and recommends the use of a dual-chip handset solution, with the bank issuing the WAP Identity Module (WIM) chip. Specifically for customer authentication in remote payments, PPA states a preference for dual-chip phones with a WIM-based digital signature capability.

3.3 Formation of the Gemini consortium

Although dual-chip WIM-based solutions have been piloted in Europe (*see inset*), none had been launched in Asia Pacific.

Other dual-chip m-payment trials

Nordea, Helsinki (www.nordea.com) In September 2001, Nordea, together with VISA and Nokia, launched the Electronic Mobile Payment Services (EMPS) project. The pilot consisted of 150 dual-chip handsets through which customers in Helsinki could make purchases at two selected retail chains. A plug-in-size chip card issued by Nordea was inserted into a special chip-card reader in the phone. A WIM application allowed Visa transactions to be made over the system.

In May 2002, Nordea launched a similar dual-chip WIM based trial with Nokia to test mobile banking and stock trading services, including account transfers, account inquiries and stock purchases.

UBS AG, Switzerland (www.ubs.com) In April 2002, UBS launched a pilot that let selected customers access banking services using Nokia 6310 dual-chip handsets, with WIM functionality for authentication.

The Gemini project was initiated by DBS and Nokia in response to the CFC. The objective of the trial was to test the technical feasibility, commercial viability and consumer receptiveness of a secure WAP mobile banking channel that would rely on digital signatures for authentication. Two hundred Nokia 6310 dual-chip handsets were supplied by Nokia for the trial.

The Gemini trial architecture would conform to the Mobey Forum's PPA in the use of a dual-chip WIM-enabled handset for authentication.

To ensure that the architecture was scalable for multiple banks, DBS also enlisted the participation of Network for Electronic Transfers(S) Pte Ltd (NETS) – operator of one of the largest payment switches in Singapore. Leveraging on its experience in existing EFTPOS network with the banks (*see inset*), NETS's main role was to act as the switch for the trial and would help define the message formats between the consumers and NETS, and between NETS and participating banks. NETS would handle the authentication of the consumer to verify that the consumer was who he claimed to be. Once the consumer was authenticated, the banks would then authorise the transaction.

Figure 1 shows the role of NETS in the authentication and authorisation of each transaction.

About Network for Electronic Transfers(S) Pte Ltd (NETS)

Formed in 1985, NETS is owned by Singapore's three local banks, The Development Bank of Singapore (DBS), United Overseas Bank (UOB) and the Overseas Chinese Banking Corporation. NETS manages an inter-bank online direct debit POS service and provides a range of electronic payment services to retailers and consumers. It is through these payment services that NETS has over the years established a strong relationship with many retail merchants in Singapore.

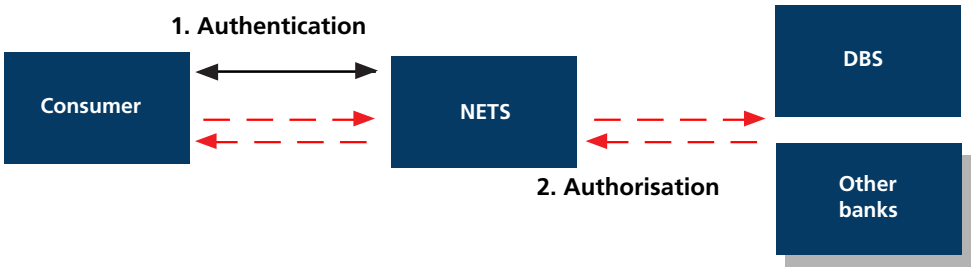


Figure 1. Role of NETS and the banks in the Gemini trial

The authorisation process consisted of three steps: verification that the user was allowed to conduct the transaction requested, validation of the balance in the user's bank account and verification of the existence of the payee account.

Subsequent to the award of the CFC in October 2001, ID.Safe, a commercial Certification Authority (CA) in Singapore, was enlisted to act as CA in the trial. Together with Baltimore Technologies, which had some prior experience in WPKI products, ID.Safe assisted DBS and NETS in defining the required specifications for the WPKI aspects of the trial. The requirements would include the roles and responsibilities of each party and the procedures and policies to be implemented for the PKI. Oberthur Card Systems was selected to provide the WIM chips for the trial.

The role of each member, including vendors, in the consortium is summarised in *Table 1* below:

No.	Company	Category	Role
1	The Development Bank of Singapore Ltd (DBS)	Financial institution	Consortium member Primary project sponsor and financial institution to allow for real-time direct debit transactions. Also provided the customer base for the trial and led marketing and customer support functions for the trial
2	Nokia Pte Ltd (Nokia)	Equipment manufacturer	Consortium member Provided technical support to NETS and DBS and GPRS-enabled dual-chip handsets equipped with software that could perform the necessary digital signing functions. Nokia was also consortium lead.
3	Network for Electronic Transfers (S) Pte Ltd (NETS)	Payment provider	Consortium member Performed the "switch" function as an intermediate gateway between the consumer and the bank(s) (in this case, it was only for DBS)
4	ID.Safe and Commercial & Industrial Security Corporation (CISCO)	Certification authority	Vendor Provided functions of a Certification Authority for the trial. CISCO is a shareholder of ID.Safe and took over the functions of the CA when ID.Safe ceased operations.
5	Baltimore Technologies (Baltimore)	Security vendor	Vendor Provided the technical design and implementation of the Wireless Public Key Infrastructure set-up.
6	Oberthur Card Systems (Oberthur)	Smart card manufacturer	Vendor Provided the Wireless Identity Module (WIM) for the handsets

Table 1. Roles of Gemini Consortium Members

3.4 About the trial mobile payment solution

3.4.1 Overview of payment method and wireless technology

The Gemini trial provided banking customers access to their direct debit accounts. For the trial, DBS wanted to enable its customers to perform account-to-account transfers without the need for an Internet-enabled PC or an Automated Teller Machine (ATM). To ensure a high level of security, DBS chose Wireless Public Key Infrastructure (WPKI) to be delivered over WAP for the authentication of the user and the authorisation of the transaction. In doing so, DBS became the first bank in Asia Pacific to pilot a WPKI based solution for banking services.

More information about PKI and WPKI is provided in *Appendix B-1*.

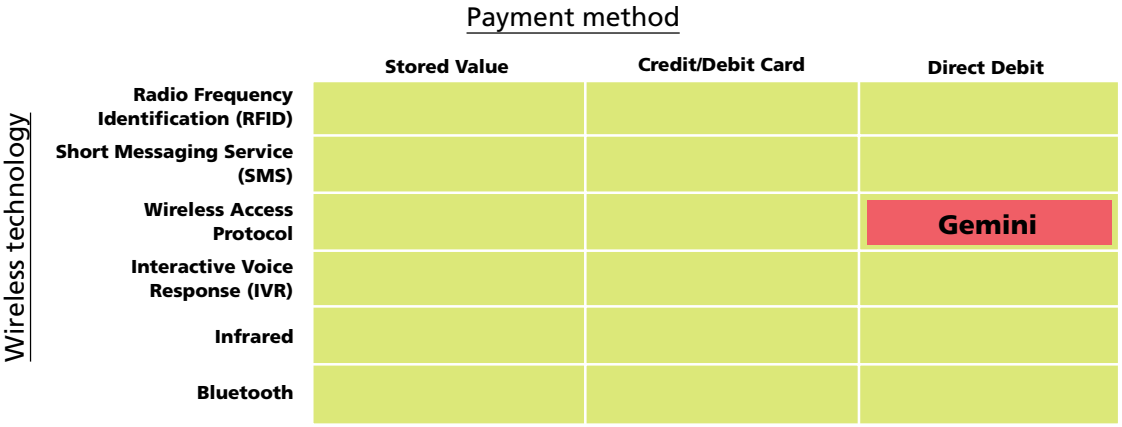


Figure 2. Payment method and wireless technology in the Gemini trial

3.5 Preparations for the trial

3.5.1 Formation of the project team

In November 2001, directly after the award of the CFC trial, the consortium's first task was to finalise the roles and responsibilities of each consortium member. *Figure 3* illustrates the structure of Project Gemini.

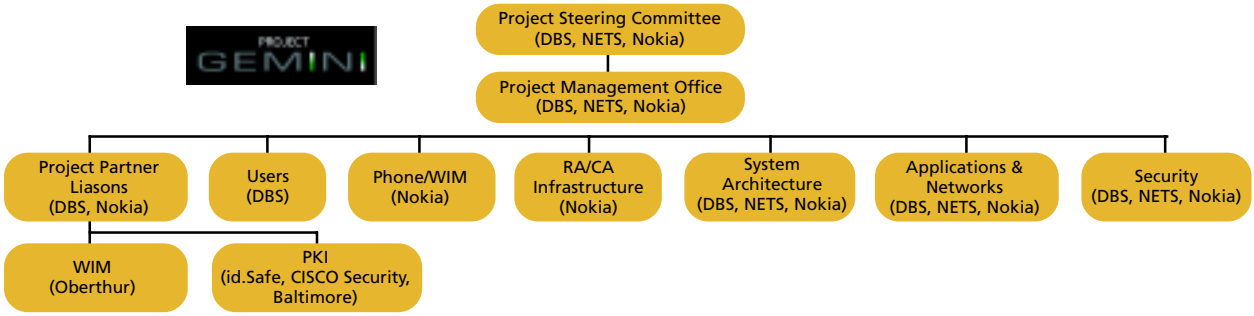


Figure 3. Project structure of Gemini

- The Steering Committee consisted of senior management from DBS and NETS and a project manager from Nokia;
- DBS was responsible for security, user recruitment, development of the debit account application and the installation of the Registration Authority (RA) and Certification Authority (CA) infrastructure;
- NETS led the development work for the switching network and applications (including the message formats) together with DBS and Nokia; and
- Nokia handled the phone and WIM-related issues.

With the project structure in place, the consortium proceeded to hold a series of discussions to define the timeline and functional specifications for the project.

3.5.2 Timeline for trial preparations

As shown in *Figure 4*, the pre-trial preparations included both technical and trial user preparations.

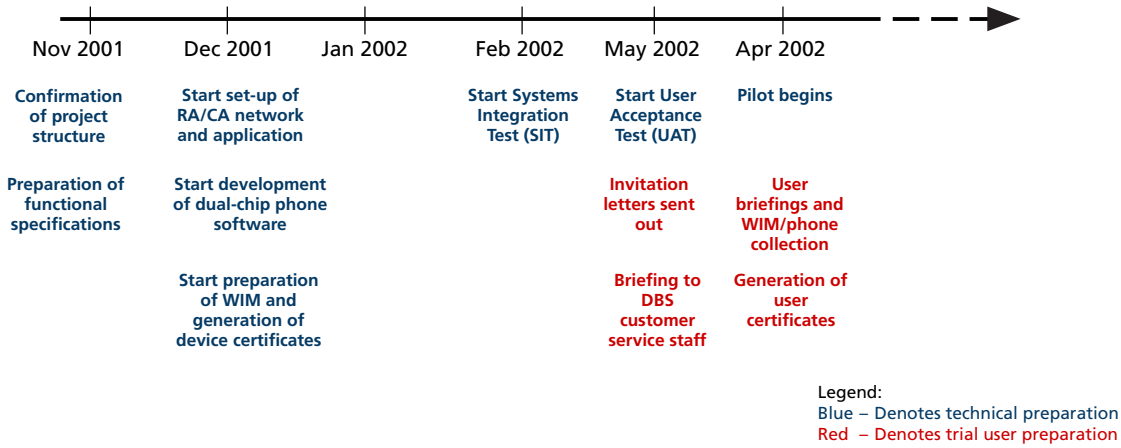


Figure 4. Timeline for trial preparations

3.5.3 Establishment of network and applications

As seen in *Figure 4*, the technical preparations began with the establishment of the network between the RA and CA entities at DBS, NETS and ID.Safe. The RA and CA applications also had to be developed. These applications would be used to generate the device and user certificates in the user registration as well as to handle the certification, revocation and verification of the certificates in the trial.

3.5.4 Development of phone software application

Work to modify the phone software in the Nokia 6310 dual-chip phones began in December 2001. Nokia had to ensure that the software conformed to the Wireless PKI WAP specifications outlined in the previous section. These included the security features provided for in the Wireless Identity Module (WIM), Wireless Transport Layer Security (WTLS) and WML Script Crypto Library (WMLScrypt). Using these standards, the phone software application would define the communications between the phone and the WIM. The phone software would also determine the interactions between the phone and the PKI Portal.

Figure 5 shows the Nokia 6310 dual-chip phones that were used in the trial.

Figure 5. Nokia 6310 dual-chip phones used in the trial

3.5.5 Preparation of WIMs and device certificates

The consortium concurrently prepared the WIMs to be used with the Nokia 6310 dual-chip phones. The WIM would reside in a specially manufactured battery pack for the Nokia 6310 phone. Like the phone software and other entities in the WPKI infrastructure, the WIM conformed to the Wireless PKI WAP specifications. At this stage of WIM preparation, device certificates were generated. Each device certificate would bind the relevant public keys to the corresponding WIM. These device certificates would be used during the subsequent user-registration process to bind the user with his or her corresponding WIM and public keys. The preparation of the WIM and the generation of the device certificates were conducted as follows:

- Oberthur first printed a unique identifier on each WIM.
- Two sets of public-private key pairs were then generated and loaded into the WIM. One key pair would be used for authentication and the other for authorisation.
- A certificate URL consisting of a base URL and a unique identifier of the WIM was generated and loaded into the WIM. This certificate URL pointed to the location of the user certificates which would be generated during the user-registration process.
- A device certificate binding the corresponding public key to the WIM card was then generated. The certificates were stored in the CA server.

Figure 6. Contents of WIM chip

3.5.6 Trial user recruitment

While the technical teams were preparing the CA/RA network infrastructure, as well as the WIMs and software for the dual-chip phones, the user-recruitment team in DBS began their trial recruitment efforts. As only 200 phones were available for the trial, inclusive of testing phones, DBS had to select a limited number of users from its customer base.

In March 2002, invitation letters were sent first to selected Internet banking and Wireless banking DBS users to invite them for the trial. Users were required to have WAP GPRS subscriptions with any of the mobile operators in Singapore. Interested users were required to return an application form with their details filled in, so as to enable DBS to prepare the phones and the WIMs prior to the phone collection exercise.

3.5.7 Preparation of user certificates

Prior to the user registration and collection of WIMs and phones, DBS being an RA in this trial, had to make the necessary preparations in generating the user certificates. This would expedite the collection process when the users came to collect the phones. The process was as follows:

• DBS processed users' applications and registered their user certificates with the CA. The user certificate was a record that bound a user to a WIM and the corresponding set of private-public key pairs. Earlier, the device certificate bound a WIM chip to a public/private key-pair. Thus, with the device certificate and the user certificate, each user was bound to a public/private key pair.

• At the same time, the registration officer used a registration application to record the user details and the WIM identifier. Based on the WIM identifier, the registration application
  o retrieved the corresponding device certificate from the CA's server,
  o extracted the public key from the device certificates and
  o created a new certificate with the user's information and the same public key as the device certificate.

The user certificates were then signed by the CA and published to the CA server at the location specified by the certificate URLs in the WIMs. The user certificates, like the device certificates, were stored by the CA.

3.5.8 Registration and WIM/phone collection

In April 2002, users who had returned the application forms were invited to come personally to collect the dual-chip mobile phone and personalised WIM chip. To prepare the users, DBS briefed them on the scope of the trial and provided assistance to the trialists by helping them to conduct their first transaction. Multiple sessions were planned to reduce the size of each session for more personalised coaching, and to stagger the times to cater for the different schedules of the trialists.

Users were required to show up in person to collect the phone and WIM chips. They were first briefed on the scope and duration of the trial before they proceeded to collect their phones and WIM card.

After the phone and WIM collection, the users inserted their own SIM cards into the newly-issued dual-chip phone, and put the WIM card into the phone cover pack. The consortium members then assisted the users in transferring the users' respective mobile operator's GPRS settings into the trial phone. Finally, users were guided to set passwords for both the authentication and authorisation certificates, before being taken through the steps to make their first transaction.

Figure 7 shows pictures taken at one of the user briefing and registration sessions at DBS.

Briefing sessions for users

Project Gemini Trial Pack

Users performing their first fund transfer using the dual-chip WPKI phone

Figure 7. User briefing and registration session at DBS.

3.6 Conduct of the trial

3.6.1 Timeline for conduct of trial

The actual pilot testing occurred over a period of just over five months, from April 2002 to August 2002. *Figure 8* below depicts the actual pilot timeline.

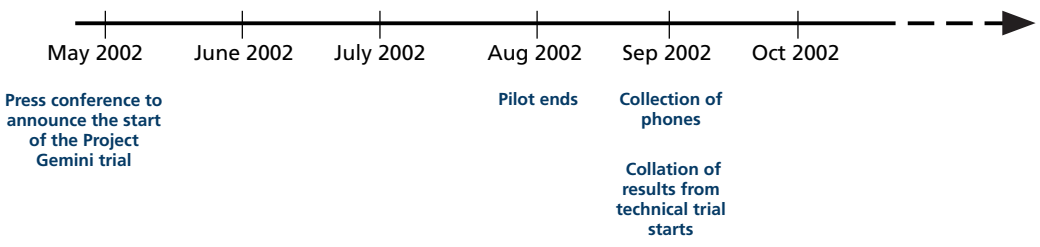


Figure 8. Timeline of trial

3.6.2 User profile

By the end of the trial in August 2002, 211 users had signed up, with 201 users using the service at least once. Most users were in the 20 to 40 year age range, with the majority having some experience with Internet banking at DBS. In addition, almost three out of four of the trialists were male. *Figures 9 and 10* provide the age distribution and gender breakdown of the Gemini trialists respectively.

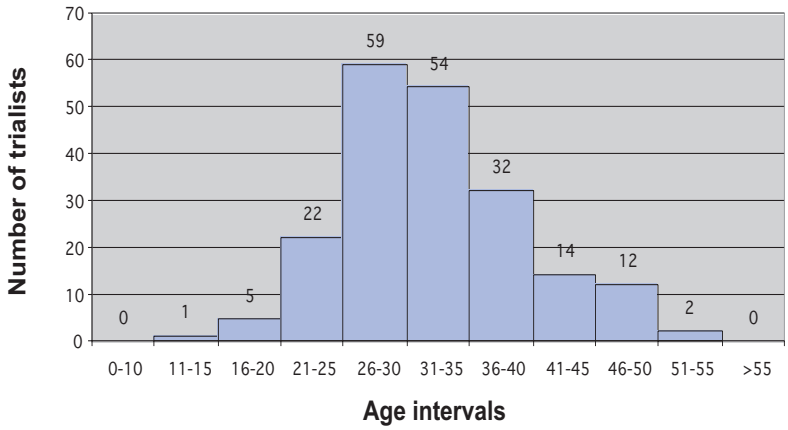


Figure 9. Distribution of Gemini trialists (by age)

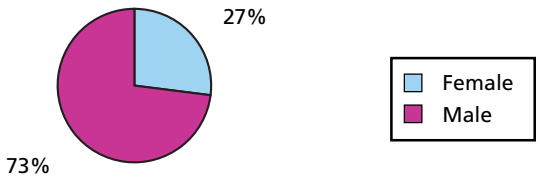


Figure 10. Gender of trialists

3.6.3 User interface

To conduct a transaction, users would first log-in to the Project Gemini WAP site, before using the relevant digital certificates to authenticate themselves and then to authorise the transaction.

Screen-shots in *Figure 11* demonstrate the user interactions during a transaction.

Figure 11. User interface

A user goes through the following steps to conduct a P2P transaction:

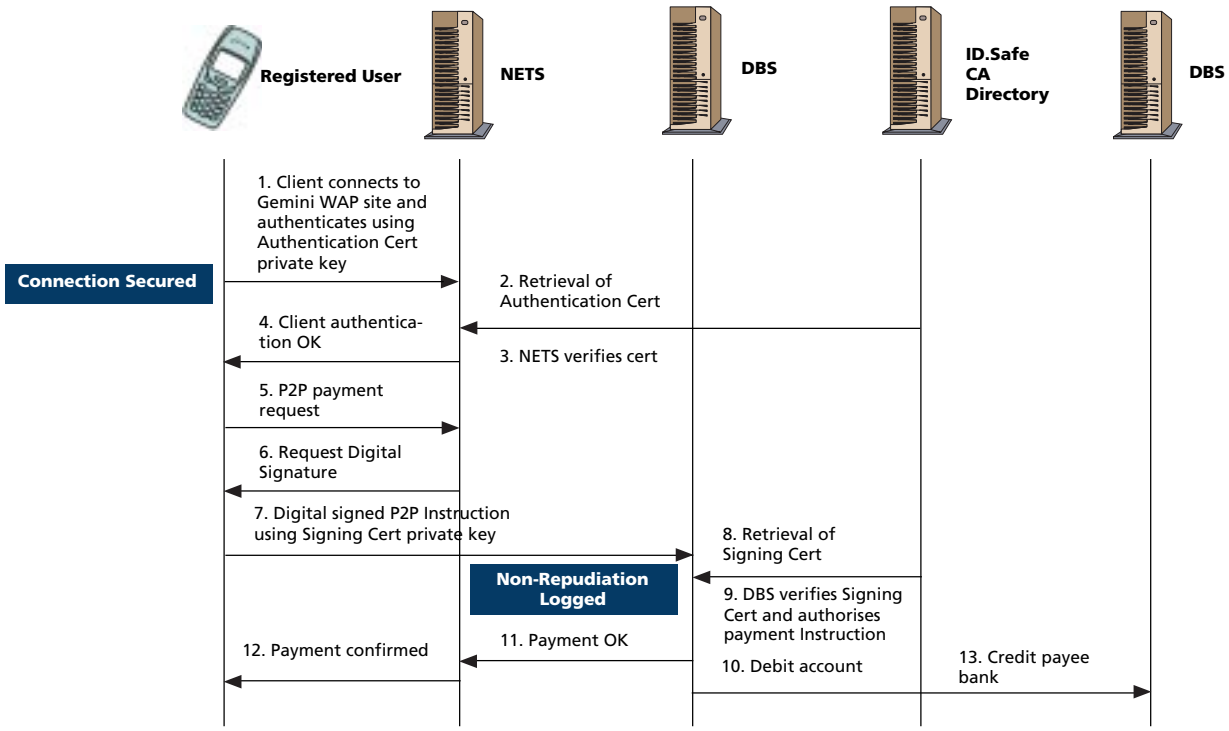
- The user accesses the Project Gemini WAP site using GPRS over WAP with his dual-chip phone.
- The user is then prompted to select the certificate for log-in or for signing. Use of log-in certificate and signing certificate
- For a new session, the user would opt to use his log-in certificate before keying in his log-in PIN.
- Once the log-in PIN is accepted, the user sees the generic financial services menu. The user can then select Person-to-Person Transfer (P2P Transfer) and enter the necessary payment details, such as the payee account information and the amount of money to transfer.
- The user is presented with a confirmation page
- The user then selects the signing certificate and keys in his signing PIN, this time to authorise the transaction with the bank.
- Finally, the user receives an acknowledgement page to indicate that the transaction has been successfully completed.

Use of log-in certificate and signing certificate

The log-in certificate is used to authenticate the user to NETS, while the signing certificate is used to authorise the transaction with the bank. A user needs to use the log-in certificate to be authenticated in the session before he can access the financial services menu. At the financial services menu, the user can then select and authorise a transaction using his signing certificate.

3.6.4 Transaction flow

Figure 12 illustrates the interactions between the various entities and the client.



NB: The architecture was designed to be scalable for multiple banks. If other banks participated in the trial, each bank would have the same set of server applications as DBS.

Figure 12. Transaction flow

The consortium felt that an open system, which allowed any bank to participate, would gain wider acceptance amongst consumers and banks. Some of the key design features that facilitated the open participation of more banks included the following:

- ***The Project Gemini WAP site was hosted by NETS instead of DBS***
  This leveraged on NETS' existing role as a neutral switch among the local banks. Any bank could participate by signing up with NETS. While DBS was the only bank in this trial, this model made it easy to add other banks without having to redesign the business logic.

- ***Routing of instruction to banks was done by NETS, transparent to the user***
  One of the recognised potential hurdles to consumers was the hassle of navigating or even changing their phone settings if they needed to access different bank sites. This implementation removed that fuss by making it easy for the consumers to access their banks. They only needed to log-in to the Project Gemini WAP site for NETS to automatically route their instructions to the relevant bank. User feedback conducted after the trial overwhelmingly confirmed that this was the preferred model.

- ***Use of separate authentication and authorisation certificates***
  By using separate digital certificates for authentication and authorisation, banks (and NETS) could collectively issue authentication certificates to enable consumers to perform transactions such as account enquiry or online trading at any of the banks. For transactions requiring authorisation, such as for funds transfer, the banks could issue individual authorisation certificates.

3.6.5 Consumer usage

Of the 201 users who conducted at least one transaction each, 97 users conducted between 0 to 10 transactions while 90 users conducted between 11 to 20 transactions, as shown in *Figure 13*. A small number of users conducted more than 20 transactions during the trial period.

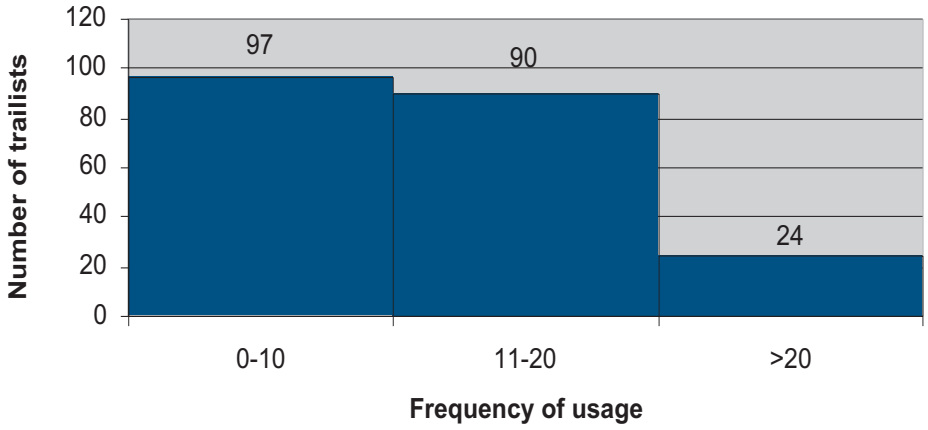


Figure 13. Frequency of consumer usage

3.6.6 Consumer feedback

Besides the quantitative usage, consumer feedback on the trial was also recorded through the 24-hour customer service hotline maintained by DBS, an e-mail survey, and interviews with a small focus group conducted after the trial.

- **Trial users provided positive feedback about the trial and looked forward to being involved in more trials of such a nature** From the survey responses, the trial left a positive impression and almost all trialists would volunteer themselves again for a trial of similar nature. This showed consumer receptiveness towards experimenting with m-payments and wireless technologies in general.

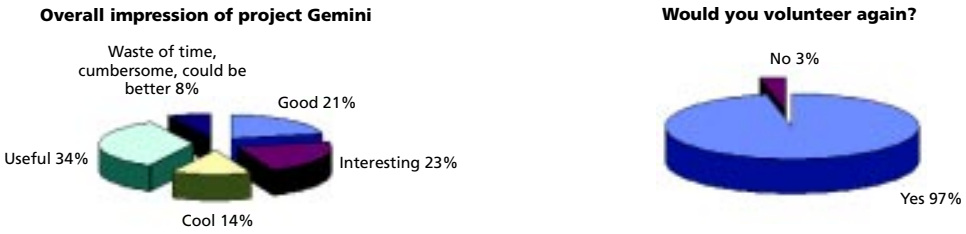


Figure 14. Consumer impression of Gemini trial

- **Trial users felt that the solution was easy to use** Most consumers felt that it was generally easy to conduct transactions using the dual-chip phone. Most of the users had no difficulty accessing the WAP site and conducting the funds transfer on their own after being guided through the process during the user briefing session. Many felt that the Wireless PKI technology was transparent to them and they keyed in their PINs without having to understand the underlying technicalities of WPKI.
- **Trial users felt that the solution provided convenience** Most consumers felt that it was convenient to be able to make funds transfers through the phone, without having to go online or to the ATM. According to one of the users,

  "I found it to be convenient as it can be accessed anytime, anywhere….My friends were impressed with this technology and wondered how I got into the trial while they did not! During a meeting, I managed to transfer funds to a friend on the spot and it amazed those around me."
  – Comments from Gemini user

- **Trial users provided suggestions for improvements to the user interface** Many users felt that they could have conducted more transactions if they did not have to remember or constantly look up the payee's bank account number before it could be keyed into the phone. Most users felt that they would usually make funds transfers to a select group of friends or family. As such, it would be useful if they could select the payee from a pre-configured drop-down list, just as they currently do on the DBS Internet banking site. It was noteworthy that in interviews, some users said they circumvented this issue after they discovered and used the "Wallet" function in the Nokia 6310 dual-chip phone. Specifically, these users used the "Wallet" function to store the payee's bank account numbers which they then used when conducting the funds transfer.
- **Trial users valued security for mobile financial transactions** One of the questions posed to users was whether it was important that the mobile transactions conducted were of a sufficiently high level of security (for example, such as that provided by the use of digital certificates). Seventy-five per cent of the responses indicated that they would need the security, 22% were indifferent, while only 3% did not mind not having that level of security.

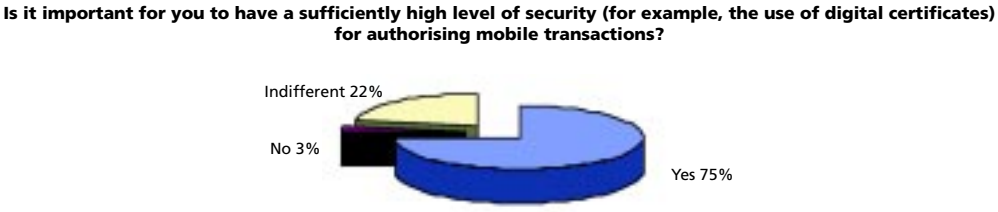


Figure 15. Importance of security for mobile transactions

- **WIM is preferred for storing digital certificates** The users were asked to rank their top three choices of where they would want their digital certificates to be embedded. WIM was the clear top choice - either as first preference, or as one of the top three. NRIC/Driver's license and ATM card were the next choices.

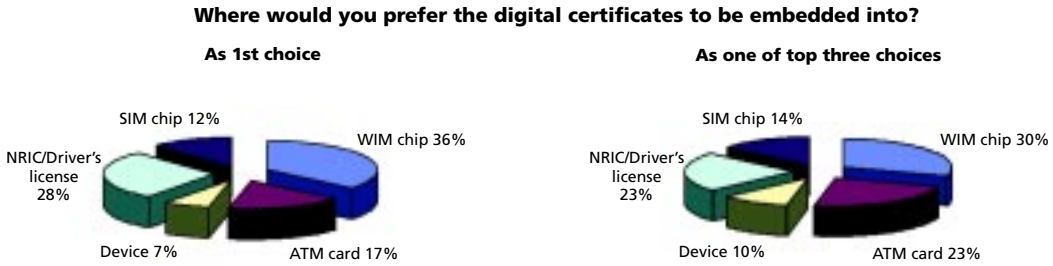


Figure 16. Preferred location of digital certificates

- **Trial users preferred to log-in to a bank-neutral portal** Users' feedback confirms DBS' belief that consumers preferred having a bank-neutral gateway which could be a "front" for all the banks. Eighty-eight per cent said that they preferred to log-in to NETS and let NETS redirect their instructions to the correct bank. The rest indicated that they did not mind manually selecting the bank site each time they logged in.

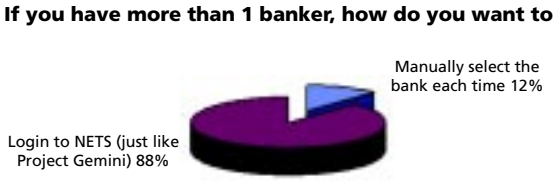


Figure 17. Preferred log-in means for banks

- **Dual-chip mobile phones are acceptable** Although most of the users had never seen a dual-chip mobile phone prior to the trial, 92% of the survey respondents felt that such phones should be made widely available. However, more services must be enabled using this infrastructure before such phones can take off.

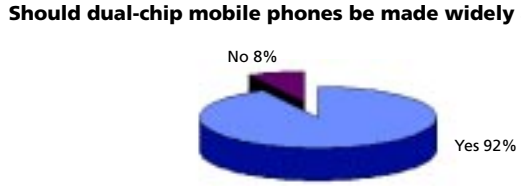


Figure 18. Consumer impressions on the usability of dual-chip phones

Interview with Gemini user

Adam (not his real name) is a 24 year-old male Singaporean who works as a helpdesk engineer with a multinational IT company. He considers himself relatively IT-savvy, having been involved in software testing prior to his current job. For the past two years, Adam has been using DBS Internet Banking to pay his bills, to pay his friends after meals, and more recently, to transfer money to his joint account with his fiancee after payday.

Adam conducted more than 20 transactions over the five-month trial period. He used the dual-chip phone to conduct most of the transactions that he used to do through Internet banking. He felt that the Internet channel was complementary to the mobile banking channel as he still relied on Internet banking to verify the correctness of the Gemini transactions. Adam had no problems accessing the Gemini WAP site after it was set up during the user-registration session. Moreover, he did not wish to change the settings once they were set. Adam also felt that the mobile banking channel was more convenient than the Internet banking channel as no Internet connection was required – during the trial, he often made mobile banking transactions in the MRT, or while relaxing at home in front of the TV. Adam thought that mobile banking would be useful in transactions such as auctions or sales on the classified, since such transactions currently insist on cash-on-demand.

He wished, though, that the trial had included other online banking functions, such as bill payment. He also felt it would be useful to have a function that would allow users to select the payee's bank account so that the user would not have to remember the account number. In his case, he remembers the joint account number he has with his fiancee, but had to refer to his PDA in order to retrieve the account numbers of his friends and family.

3.6.7 Results from the trial

The trial results showed the following:

- A dual-chip Wireless PKI solution is feasible from the technical, system performance, customer acceptability and security viewpoints. There were some doubts initially whether GPRS could provide an acceptable speed for the data transfers involved in the Gemini trial. This trial proved that the speeds were acceptable to consumers.
- The trial also reaffirmed the importance of implementing new technology where technicalities were kept transparent to the users. They do not need to know how the technology works in order to use it. The responses from the users showed that this trial managed to achieve this objective.
- Consumers are receptive to a secure WAP mobile banking channel and welcome initiatives that can offer a higher level of security.
- Although new to dual-chip phones, the users overwhelmingly felt that such phones should be made commercially available. This addresses one of the questions that the trial had set out to answer: "What is the acceptance level of dual-chip phones among the consumers?" The consortium recognises that one of the greatest drawbacks to commercial viability is the current lack of dual-chip mobile handsets in the market. Few users want to be locked in to a single phone model or to a particular telco.
- As with any new service, the overall User Interface using WAP was the key to its success. Given the practical constraints of the trial, many useful features which are technically possible could not be included. Feedback from the users and the experience gained from this trial have, however, provided the consortium with many valuable design tips that will be useful to improve the user experience.

3.7 Conclusion

The Gemini trial was carried out primarily to research, develop and test the technical viability and feasibility of using WPKI and dual-chip phones for secure mobile payments by retail consumers in the form of Person-to-Person funds transfer. This combined technology of WPKI and dual-chip phone is relatively new but it is attractive because it offers great potential for mobile commerce, especially in countries with high levels of mobile phone penetration.

These objectives were achieved as shown in the results of the trial. However, due to the lack of commercially available dual-chip handsets and the costs of implementing WPKI for the trial transactions, DBS has no plans to commercialize this trial currently.

By leveraging on the newly-established open mobile payment architecture proposed by the Mobey Forum, the trial offers possibilities of regional collaboration if these standards are adopted in other countries. In designing the applications on a bank-neutral basis, the infrastructure is also positioned for future adoption by any banks or service providers who are interested to pursue further investigations into other mobile payments services offerings.

Go Virtual – The mobile smart chip payment trial

We would like to thank the following persons for their contribution to this chapter on the Go Virtual trial:

Jocelyn Ang	Network for Electronic Transfers (S) Pte Ltd
Teo Ban Sim	Network for Electronic Transfers (S) Pte Ltd
Theresa Lee	Network for Electronic Transfers (S) Pte Ltd
Alan Fong	Network for Electronic Transfers (S) Pte Ltd
Jessie Saw	Network for Electronic Transfers (S) Pte Ltd
Sirpa H. Ikola	Nokia Pte Ltd
Vincent Chang	Coffee Bean & Tea Leaf
Sharon Lee	Coffee Bean & Tea Leaf

4. Go Virtual – The mobile smart chip payment trial

4.1 Highlights

- Virtual stored value payments activated by ISO 14443 Type A contactless chip embedded in mobile phone
- Trial conducted over six months (April 2002 to September 2002)
- Merchants recorded almost $6,000 in transaction value (over 1,000 transactions) with the system
- Over 400 unique users, of which 170 were repeat users

4.2 Background

Since 2000, NETS has been studying the viability of introducing contactless proximity payments to complement its existing suite of payment products. NETS had by then established an island-wide retail merchant base in Singapore and it made sense to offer merchants and consumers a form of payment that was "quicker" than the existing contact-based CashCard option.

However, the cost of contactless chips, security concerns and the lack of standards in the area had made it prohibitive to launch contactless-based payments using Radio Frequency (RF) technology at that time.

The launch of the CFC in May 2001 was therefore timely for NETS in a few ways. By then, the use of contactless-chip payment technology was more widespread and more affordable. The technology was also more stable, with standards in place. NETS, in addition, had plans to launch its eNETS VCard (formerly known as NETS Virtual Card) that would meet the need of the remote micro payments segment.

4.3 Formation of the Go Virtual Consortium

At the launch of the CFC, a few contactless chip/RF based mobile payment trials and services were already being deployed worldwide. These included services in the area of vending machines, retail Point-of-Sale, fast-food check-out and petrol stations (*see inset*).

Other contactless chip/RFID-based payment services

Fast-food outlets (United States) – In the first quarter of 2001, Nokia and 2Scoot collaborated in the trial of an RFID-based credit card payment system with KFC and Taco Bell in Raleigh, North Carolina. In the trial, a Radio Frequency Identification (RFID) chip was integrated into Nokia 5100 Series SmartCovers™. Customers who entered a store or restaurant with a 2Scoot reader panel at the door would hold their phone or tag to the reader as they walked in. Before the customer reached the cash register, the reader would transmit an instruction to 2Scoot's central server to perform a credit authorisation. 2Scoot would immediately send that authorisation information back to the store. By the time the shopper reached the check-out counter, the 2Scoot system would be ready to complete the transaction, and apply any necessary discounts. (source: The Feature.com)

Retail fuelling – Deployed by ExxonMobil, Speedpass™ was perhaps the industry's first RFID-based automated payment system. Now in use at more than 3,800 Mobil service stations across North America alone, the Speedpass programme claims close to four million users. The RFID system consists of a transponder with a secure and unique ID code. The code is programmed into the tag and registered to an individual customer, who can link the code to a credit card account of the customer's choice. However, the credit card number is not stored on the transponder and is never transmitted. When the customer waves the transponder near a reader unit housed within the petrol dispenser, the tag is activated by radio frequency interrogation signals emanating from the reader. This prompts the tag to transmit its ID code to the reader, which then interfaces with a central host computer for authorisation via a local point-of-sale terminal. (source: Texas Instruments)

Retail and transport (Hong Kong) Originally used for transit payments alone, the Octopus card is one of the most popular methods of electronic payment in Hong Kong today. As of February 2002, more than 8.3 million Octopus cards were in circulation, with approximately 7 million transactions every day. In March 2002, Nokia and Octopus unveiled a new Xpress-on cover for the Nokia 3310 and 3330 mobile phones that contained a mini Octopus chip. This chip was essentially a contactless smartcard with an electronic purse for users to conduct payments electronically.

In line with its objectives to expand the role of the mobile phone as a personal trusted device, Nokia was already participating in a few proximity payment trials internationally. With the launch of the CFC, Nokia was thus keen to explore a trial using a contactless smart chip in Singapore with a suitable local payments infrastructure provider. It valued NETS as a strong player in the space and was also aware that NETS had earlier tested contactless solutions. NETS in turn, saw value in the convenience of enabling payment on a device that combined two personal effects that most Singaporeans carry - a wallet and a mobile phone. Besides relying on a contactless chip, the Nokia phone cover would add a "lifestyle" appeal to teenagers – the initial target segment for the VCard market.

The roles of NETS and Nokia in the Go Virtual trial are summarised in *Table 1*.

No.	Company	Category	Role
1.	Network for Electronic Transfers (S) Pte Ltd (NETS)	Payment provider and service operator	Operator of the eNETS VCard and Go Virtual mobile payments service during the trial.
2.	Nokia Pte Ltd (Nokia)	Equipment manufacturer	Provider of handset covers equipped with Type A Mifare contactless chip
3.	The Coffee Bean & Tea Leaf (Coffee Bean)	Merchant	Merchant to test Go Virtual at all its 38 outlets in Singapore
4.	Bossini	Merchant	Merchant to test Go Virtual at 8 of its outlets in Singapore
5.	Ritz Apple Strudel & Pastry	Merchant	Merchant to test Go Virtual at 4 of its outlets in Singapore

Table 1. Roles of Go Virtual consortium members

4.4 The trial mobile payments solution

4.4.1 Overview of payment method and wireless technology

In the Go Virtual trial, consumers were provided with Nokia 3330/3310 phone covers, each carrying a contactless chip. The transponder in the contactless chip contained a unique identification (ID) number which was linked to the consumer's eNETS VCard account. At the retail point-of-sale, the customer could wave the contactless chip at the reader/antenna, which would in turn pick up each transponder's unique identifier signal. The reader/antenna would then pass that information on to NETS' network to verify the customer's profile and VCard information. Upon authentication, the terminal would process the transaction and print a receipt for the consumer. The appropriate sum would then be credited into the merchant's account as part of the end-of-day settlement processing.

More information on RF technologies can be found in *Appendix B-2*.

Unlike some other contactless chip payment trials that leveraged on credit card payments, the Go Virtual trial would rely on VCard – a server-based stored value account for payments. The intent was to allow all users, not just consumers above 21, to use the system. This was especially important to maximise usage of the system at merchant outlets such as Coffee Bean and Tea Leaf, Bossini and Ritz Apple Strudel.

Figure 1 shows the payment method and wireless technology deployed in the Go Virtual trial.

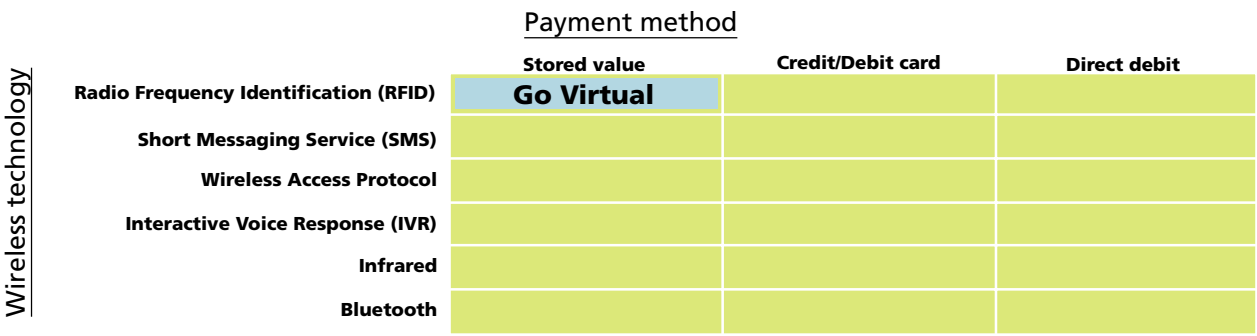


Figure 1. Payment method and wireless technology in the Go Virtual trial

4.5 Preparations for the trial

4.5.1 Formation of the project team

In November 2001, the consortium set out to finalise the roles and responsibilities of each consortium member. *Figure 2* illustrates the structure of the Go Virtual project during the period of the trial.

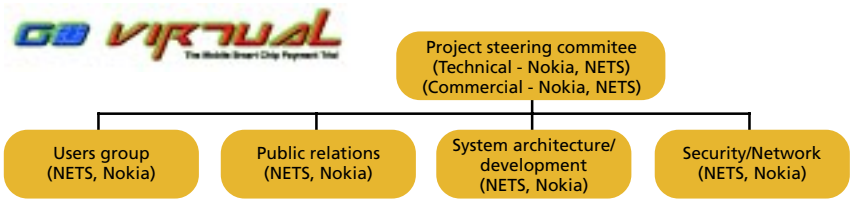


Figure 2. Project structure of Go Virtual

4.5.2 Timeline for trial preparations

As shown in *Figure 3*, the pre-trial preparations consisted of technical and marketing efforts.

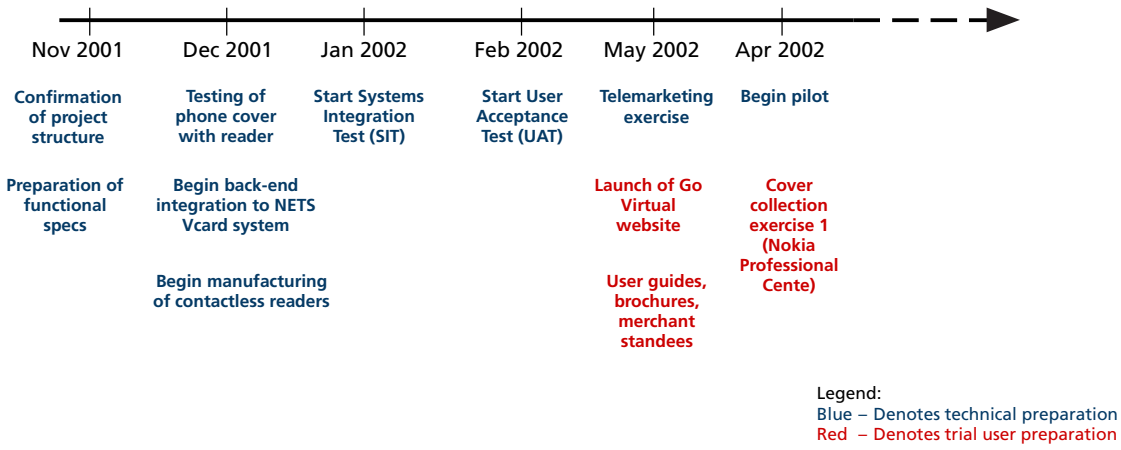


Figure 3. Timeline for trial preparations

4.5.3 Testing of phone covers with contactless reader

Soon after finalising the functional specifications, Nokia and other vendors and suppliers brought in trial-sets of the following:

- Nokia 3330/3310 covers and phones from Nokia
- Point-Of-Sale terminals from Ingenico
- Mifare Contactless Readers from Asis Technologies
- ISO 14443 Type A Compliant Mifare contactless chip from Gemplus

The consortium first had to decide on the best position to place the contactless chip on the cover. It was found that the chip had to be located as far as possible from the phone battery. This was because the Nokia 3310/3330 battery material actually blocked the RF signal from the reader to the Gemplus chip.

Figure 4 shows one position where the contactless chip was not affected by the battery power. However, the chip would be too close to the cover "release catch", making it challenging and costly to embed the chip there. Moreover, it could cause problems for the user if he or she later wanted to switch phone covers.

Figure 4. Trial placement of chip (white arrow denotes location of chip)

A more suitable location was found for the contactless chip where it neither affected the battery power nor any component of the phone. The reader also successfully detected the contactless chip approximately five cm from the transponder. *Figure 5* shows the optimal location for the contactless chip.

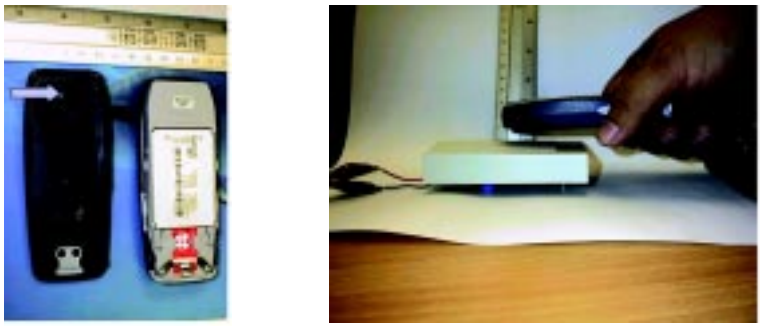


Figure 5. Final placement of chip (left) and testing of chip within interrogation zone (right)

4.5.4 Preparation of contactless chip readers

The readers were prepared and tested at ASIS Technologies. A secure SAM chip was also loaded with the appropriate keys to interact with the contactless chip to ensure the authenticity of the RF signals.

4.5.5 Personalisation of contactless chips at NETS

The personalisation process had to be done manually using a personalisation software developed by Gemplus. The software allowed the necessary data to be written into each chip including:

- A unique contactless chip serial number and
- A contactless chip encrypted ID.

At the end of this process, each chip would have a unique ID printed on the chip (visible to the user), as well as store a unique ID and an encrypted ID.

4.5.6 Integration of personalisation system with VCard back-end

At this point, while each contactless chip could be uniquely identified, the consortium still needed to enable each chip to be linked to a user's VCard account. This user-personalisation would be done by the user when he collected the phone cover. The consortium thus prepared a personalisation system that would allow a user to personalise his or her chip over the Internet.

Figure 6 shows how data from the personalisation system would be updated into the VCard backend database.

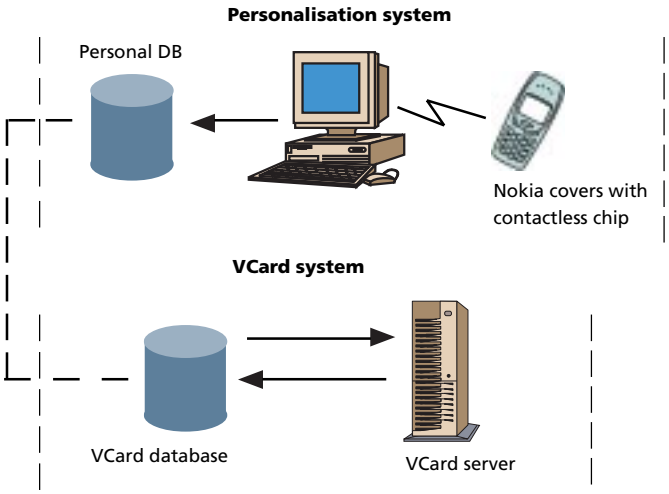


Figure 6. Personalisation process

4.5.7 Set-up of payment terminals at merchant outlets

The payment terminals were set up via NETS' current operational infrastructure. The terminal consisted of the contactless RF reader attached to the NETS POS terminal. The terminal was in turn connected by a dial-up line to NETS.

4.5.8 Marketing preparation

In December 2001, the consortium engaged marketing company "The Event Company" to manage the marketing aspects of the trial and to recruit users. At that time "Go Virtual - The Mobile Smart Chip Payment Technology Trial" was selected as the branding for the trial.

Over the next two months, the consortium and The Event Company mapped out marketing activities. Brochures, user guides, standees and the Go Virtual website were also made ready for the launch of the trial.

Figure 7. Go Virtual brochures and website

4.5.9 Customer support briefing

NETS provided the first point of contact for all consumer queries, routing all technical issues involving the mobile phone covers and chips to Nokia. Payment-specific queries were handled by NETS. Customer service representatives were given detailed briefings so that all problems were tracked, and feedback from both merchants and consumers was documented.

4.5.10 Merchant preparation and training

NETS installed the contactless readers at merchant outlets and trained the cashiers. Merchants were also briefed as to the objectives of the trial and the profile of consumers participating in the trial.

4.6 Conduct of the trial

4.6.1 Timeline for the trial

The trial covered a period of just over six months, from April 2002 to September 2002. The timeline of the press launch, cover collection exercises, and the e-mail and SMS direct mailer campaigns is shown in *Figure 8*.

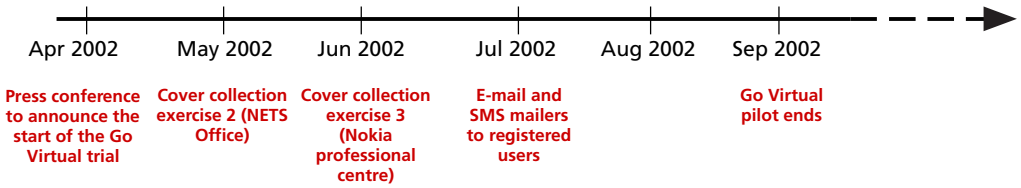


Figure 8. Timeline for the trial

4.6.2 Marketing activities

Marketing activities were centred on user recruitment and the actual usage of the Go Virtual system. The user registration process was as follows:

- Consumers registered for a VCard account at www.nets.com.sg.
- Consumers were then given a Nokia "smart phone cover" with an embedded Mifare Type A ISO 14443 contactless chip. The phone covers could be collected during any of the three designated collection periods.
- Consumers activated their "smart phone covers" at the NETS website to make payments.
- Consumers activated the covers by keying in the unique chip ID found on the inside of the phone cover. It was at this stage that the user linked up his VCard account with his contactless chip on the phone cover.

The consortium targeted its recruitment exercises at the youth segment which was the VCard target audience as well as the client base of Coffee Bean & Tea Leaf, Bossini and Ritz Apple Strudel. Specifically, recruitment drives were conducted at Temasek Polytechnic, National University of Singapore and Ngee Ann Polytechnic between February 2002 and April 2002.

An SMS/e-mail campaign was also conducted by the consortium between July 2002 and August 2002. This was to remind registered users where they could use the Go Virtual system.

4.6.3 User profile

The Go Virtual base consisted primarily of students. Of the registered users, at least 45% were students registered during roadshows at tertiary institutions. The remaining 55% were students enlisted during other roadshows, such as those conducted at Suntec City.

4.6.4 Transaction flow

When a user wishes to make a Go Virtual payment, he would have to indicate the payment preference to the cashier. The following steps are then required to complete a Go Virtual transaction:

Step 1 Cashier selects Go Virtual payment option on merchant POS terminal and keys in purchase amount.

Step 2 Cashier asks the consumer to place his phone (equipped with smart cover) on the reader.

Step 3 The contactless chip ID, along with other information, is sent to the contactless reader. The information is then passed to the merchant POS terminal and subsequently through the NETS EFTPOS network for back-end processing. The NETS VCard system deducts the purchase amount from the appropriate VCard account.

Step 4 The NETS application returns a successful response through the network to the POS terminal and the terminal prints a receipt of the transaction.

Figure 9 depicts the components and interactions in a Go Virtual transaction flow.

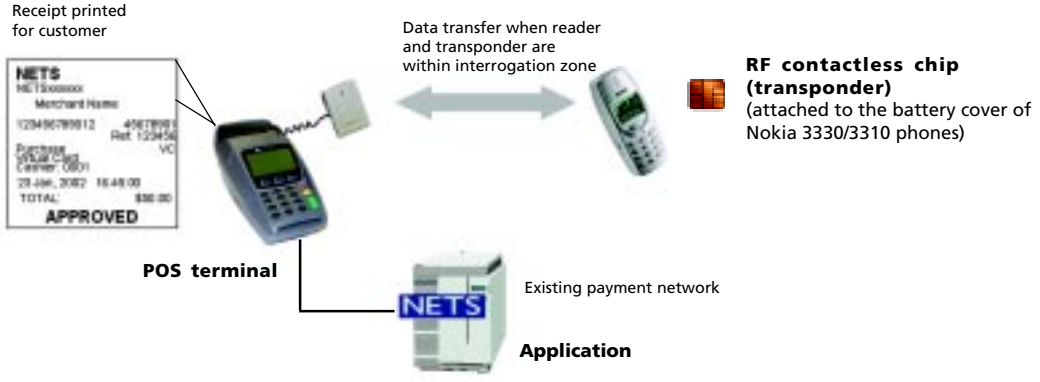


Figure 9. Transaction flow

4.6.5 Consumer usage

More than 1,000 transactions were made, most being conducted at Coffee Bean. By the end of the trial in September 2002, slightly more than 400 users had used the Go Virtual system to make purchases at the various merchant outlets. Of these, approximately 43% (or 175 trialists) used the system more than once. This showed a relatively high repeat usage rate over the short period of trial. *Figure 10* shows the growth in unique and repeat users over the period of the trial.

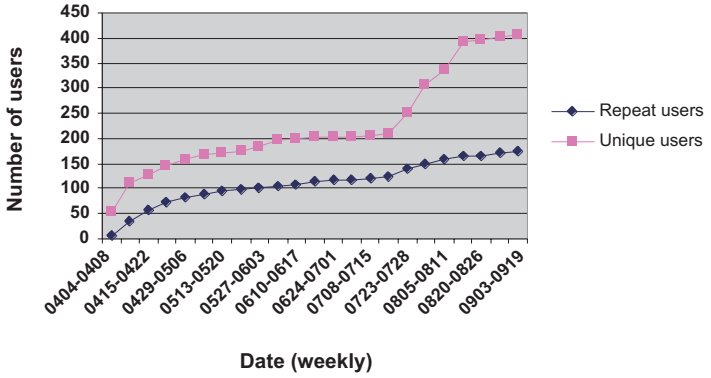


Figure 10. Cumulative number of Go Virtual users (April to September 2002)

As expected, the Coffee Bean outlets clocked the highest number of transactions. This was due to several reasons: Firstly, the number of Coffee Bean outlets involved in the trial (38) , was significantly larger than the 4 and 8 outlets selected by Ritz Apple Strudel and Bossini respectively.

Secondly, it was easier for Coffee Bean to market the trial, as all their outlets, and not just selected ones, were involved in the trial.

Moreover, the volume of transactions at an average Coffee Bean outlet was generally larger than that of any Ritz Apple Strudel and Bossini outlets. As such, one would expect the Go Virtual transactions to also be proportionately higher. In addition, Coffee Bean had regular customers who would frequent the outlets, as often as once a day, to purchase their beverage.

The breakdown of transactions by retail chains is shown in *Figure 11* below:

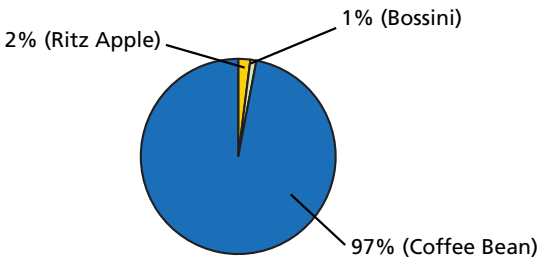


Figure 11. Breakdown of transactions (by merchant)

Figures 12 and 13 show the number of transactions recorded by all three merchants on a weekly as well as a cumulative basis.

As seen from the charts, most transactions were made at the beginning of the trial, and also around the July 2002 to August 2002 period. This was probably due to the recruitment briefings conducted at the beginning of the trial, and the SMS/e-mail campaign conducted by the consortium between July 2002 and August 2002. The consortium had found that some users who had signed up for the trial had not used the system prior to the reminders and felt it was useful to remind them of the outlets where they could use the Go Virtual system. Some users had also changed their mobile phone models during the trial period.

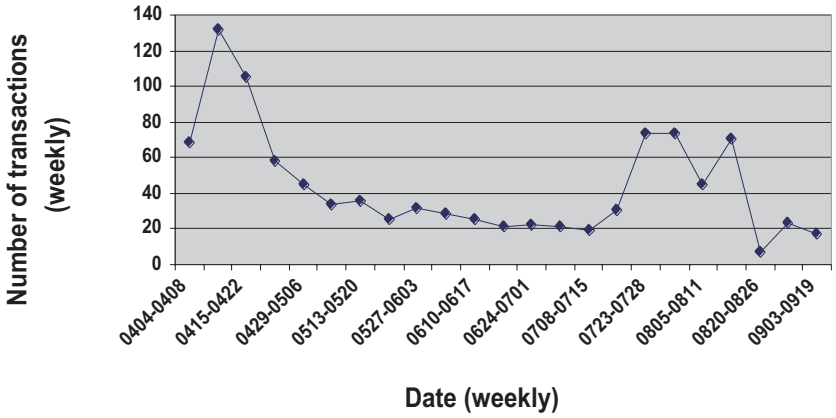


Figure 12. Number of Go Virtual transactions (weekly)

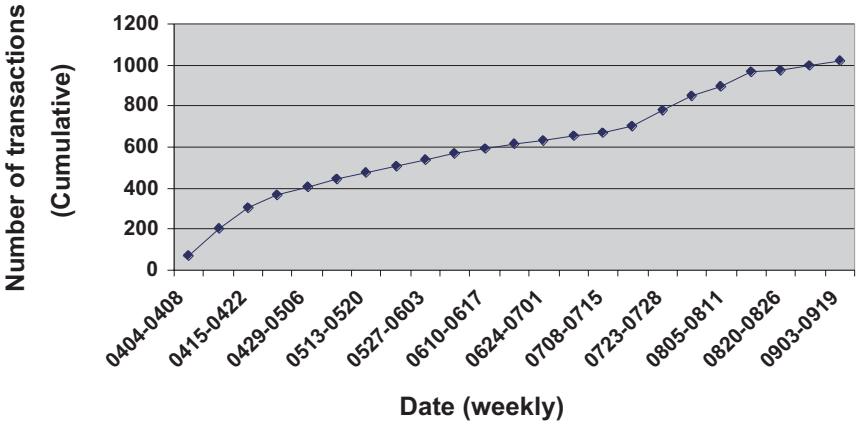


Figure 13. Number of Go Virtual transactions (cumulative)

4.6.6 Consumer feedback

Besides the quantitative usage, consumer feedback regarding the trial was also recorded through the customer service hotline maintained by NETS.

Most users felt that the trial should not be limited to the Nokia 3330/Nokia 3310 phones. Although it was 'cool' to flash the phone for payments, most felt that they would not invest in a new phone just to use this payment method. It would have been better to have the contactless chip placed on all types of mobile phone, or in devices other than mobile phones (for example, as part of a key ring or card).

4.6.7 Merchant feedback

Merchants generally liked the following aspects of the system:

- ***Convenient installation*** The merchants generally reported little downtime while installing the system, which included the new Ingenico POS terminals and the contactless reader.
- ***Fast payment process*** Payment transactions were processed relatively quickly, compared with other payment methods.
- ***Ease of use*** *Consumers* found the service convenient and easy to use.

However, merchants reported that the trial contactless readers sometimes malfunctioned. They generally felt that the readers were not robust enough.

4.7 Conclusion

Island-wide roll out of commercial Go Virtual is targeted for the second half of 2003. NETS plans to use Type B contactless chips during commercialisation instead of the ISO 14443 Type A used during the trial.

In the commercialised version of Go Virtual, contactless chips will be de-coupled from phone covers, allowing consumers the option of attaching the chips to any surface.

NETS will also invest in new readers to replace the existing Type A readers used during the trial.

TelePay and TeleParking: Mobile payments at the Suntec City shopping mall

We would like to thank the following persons for their contribution to this chapter on the TelePay and TeleParking trial:

Edwin Ng	Systems@Work Pte Ltd
Joan Teo	Suntec City
Kelvin Tan	Hewlett-Packard E-Services Bazaar

5. TelePay and TeleParking: Mobile payments at the Suntec City shopping mall

5.1 Highlights

- Direct debit via GIRO and credit card payments using Interactive Voice Response (IVR)
- Trial conducted over nine months from April 2002 to December 2002
- Introduction of new m-payments services for retail shopping (TelePay) and for car park payments (TeleParking)
- 500 users
- More than 800 transactions with a total value of S$5,000
- Highest usage was for car park payments
- Mobile payments most useful to consumers for remote payment rather than retail payment
- Credit card usage was highest compared with other payment methods

5.2 Background

Incorporated in 1999, Systems@Work Pte Ltd is considered a pioneer in the field of mobile payments in Singapore.

The company launched its first mobile payments service under the TeleMoney brand as early as February 2001. For the launch, Systems@Work Pte Ltd partnered Fuji Film to showcase an application that allowed customers to upload and order photo prints on the Fuji Film website (www.fuijifilm.com.sg). Customers used their mobile phones to authenticate payments via the customers' pre-registered credit cards. Two years after that initial showcase, Fuji Film continues to use TeleMoney as the preferred mode of payment on its website.

About TeleMoney

TeleMoney is a mobile payments service that enables the use of a standard mobile phone as an identification and authentication device for making convenient and secure payments. To date, Systems@Work has deployed several services under the TeleMoney branding, including TeleMoney Shopper Assure, TeleCab, TelePay and TeleParking. Each of these services leverage on the mobile phone for payments over the Internet, in a cab, over the counter and even for car-parking.

The unique value proposition of TeleMoney lies in its patent-pending technology that recognises a standard mobile phone for the purpose of authenticating the user and authorising payments.

5.3 Formation of the Systems@Work consortium

With the launch of the CFC in May 2001, Systems@Work took the lead in bringing together partners to test m-payments services that would bring value to merchants and consumers alike. The trial had begun with the intent to deploy a retail m-payments service for face-to-face transactions in a retail mall. This trial would later be known as TelePay.

The Systems@Work consortium was formed after careful deliberation of the capabilities and technologies needed to implement TelePay. Various partners were needed to deliver an end-to-end solution.

M-Payments service provider Systems@Work led the consortium and operated the m-payments service as part of its TeleMoney suite of services. TeleMoney was the only "live" mobile payments infrastructure service in Singapore at the start of the CFC.

Technology provider Systems@Work was also a member of the Hewlett-Packard Bazaar (HP Bazaar), an initiative by Hewlett-Packard to encourage closer collaboration of key companies in the mobile eco-system. HP Bazaar provided strong marketing support to the consortium and also supplied infrastructure for the TeleMoney platform. In addition, Gemplus, a leading innovator of SIM-based applications and operating systems, was invited to provide the security expertise necessary for the trial.

Facilities provider Suntec City (*see inset*) participated in the consortium to assist with the recruitment of merchants for retail payments.

Payment provider The consortium also roped in Visa – a global leader in payments and the operator of a proven global settlement infrastructure. With the lion's share of Singapore's total card billings of over S$10 billion last year, Visa's expertise in consumer and merchant relations, marketing and banking relationships was identified as a key capability for the success of the trial.

The role of each member in the trial is summarised in *Table 1* below.

Suntec City

Suntec City is the single largest integrated commercial development in Singapore consisting of 7 million square feet of convention, exhibition, offices, retail and car park space. There are more than 290 retailers in the complex, the target audience for TelePay.

In addition, the 3,000 car park lots in Suntec City record thousands of transactions daily. The deployment of TeleParking at a later stage of the trial eased queues for payment of Autopay station tickets in the car park.

No.	Company	Category	Role
1.	Systems@Work Pte Ltd (Systems@Work)	Technology provider and payment enabler	Managed the overall project and operated the mobile payments service (Consortium Lead)
2.	Suntec City Management (Suntec City)	Facilities service provider and partner marketing	Provided the retail mall setting as a trial site and helped significantly in the marketing and recruitment of merchants within the mall. Its carpark also adopted m-payments using TelePay.
3.	Hewlett-Packard E-Services Bazaar (HP)	Technology provider and marketing partner	Provided core technology platforms including enterprise servers and mobile devices such as the Jornada PDA
4.	Gemplus	Security solutions provider	Provided key technologies for security requirements, especially in SIM-based security areas
5.	VISA	Global payment standards and marketing partner	Provided global standards on Infrared for Financial Messaging (IrFm) and 3D-Secure for the roll-out of the new mobile payments infrastructure service

Table 1. Roles of Systems@Work consortium members

In mid-2002, the consortium leveraged on the close collaboration among its partners to plan a remote mobile payments service for parking payment at Suntec City. This was beneficial to consumers who signed up for mobile retail shopping by allowing them to use the mobile payments system for car parking. This trial was later named TeleParking and was launched in December 2002.

Table 2 provides a brief comparison of the TelePay and TeleParking trials, both of which were implemented by the Systems@Work consortium during the CFC.

	TelePay	TeleParking
Launch Date	April 2002	December 2002
Type of m-payment transaction	Retail (face-to-face using Bluetooth and IR)	Remote (using Interactive Voice Response)
Usage scenario	Pay for retail purchases at physical Point-of-Sale using Bluetooth and IR	Pay for car parking fees using a voice-call instead of having to queue at the Autopay Station

Table 2. TelePay and TeleParking

5.4 About the trial mobile payment solution

5.4.1 Overview of payment method and wireless technology

The payment method and wireless technology used in the trial were selected on the basis that they would require minimal or no changes to existing consumer equipment or habits. Likewise, businesses would not be required to install new software and hardware in order to offer m-payments services.

Wireless technologies For retail payments, Bluetooth and Infrared (IR) were selected as proximity wireless technologies to be piloted for the CFC. A consumer would "beam" his TeleMoney ID, using either of these technologies, to a Merchant Accepting Device (MAD), which would then process the transaction. The consumer would then receive an IVR call confirming the details of the transaction. Infrared was used as it was available on most GSM phones, and no telecom access charges were levied for Infrared usage. While Bluetooth phones were still new to the market then, it was touted as an emerging proximity wireless technology. The consortium thus felt that it was worth testing should the technology later gain wider consumer acceptance.

For remote payments, a consumer would use IVR to call a designated merchant number (for example, (65) 64640080 for TeleParking). The consumer would then follow a series of prompts on the voice-line.

Like all other services under TeleMoney, IVR was chosen as the mode of wireless communication for payment authentication in both TelePay and TeleParking. This was because the consortium felt that voice-based calls provided immediate interactivity and security similar to phone banking. It was also intuitive to users familiar with the mobile phone.

Payment methods Credit card and direct debit via GIRO were available to consumers for the trial.

Figure 1 shows the payment method and wireless technology deployed in the TelePay and TeleParking trials.

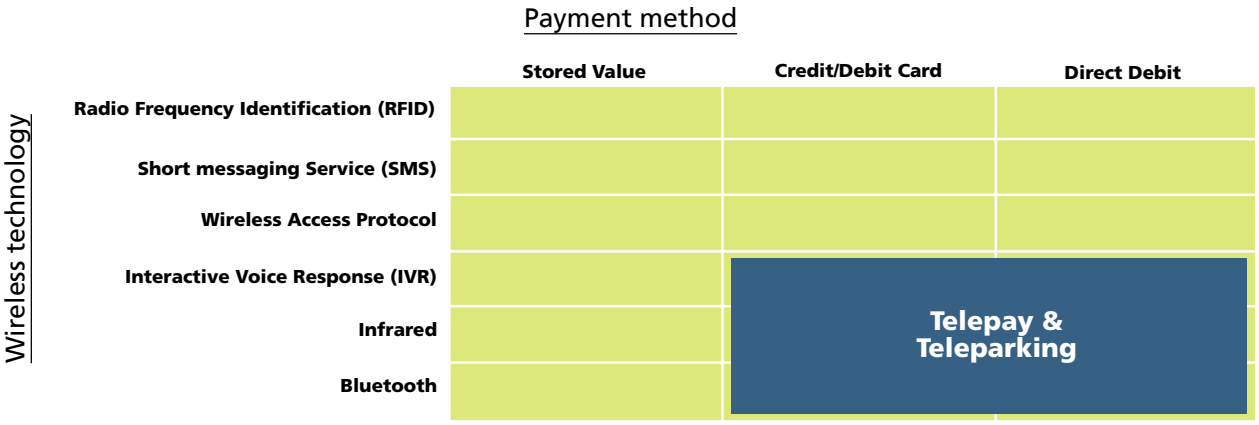


Figure 1. Payment method and wireless technology in the Systems@Work trial

5.5. Preparations for the trial

Preparations in marketing, technology and business operations were conducted before the official launch.

5.5.1 Formation of the project team

A project structure was first put in place to manage three key areas: marketing, technology and operations. *Figure 2* illustrates the project structure during the period of the trial.

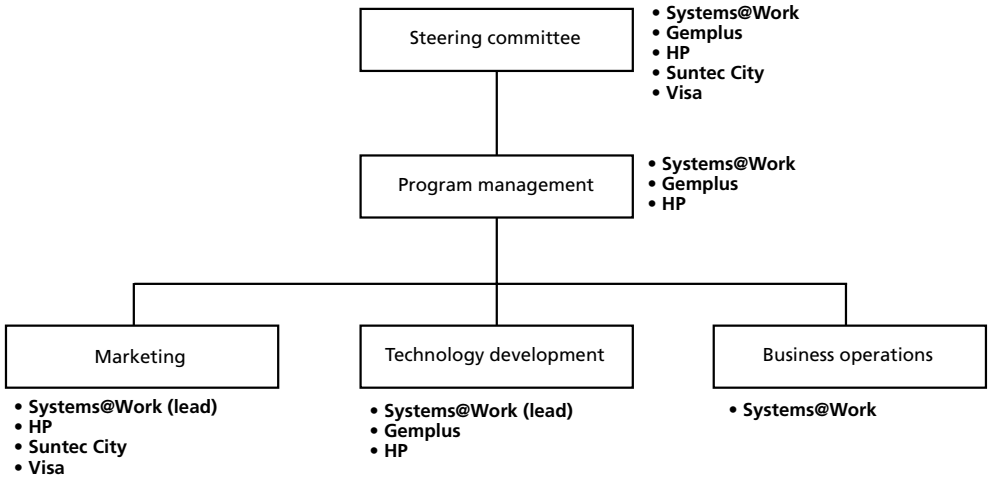


Figure 2. Project structure

- The steering committee consisted of key representatives from Gemplus, HP, Suntec City, Systems@Work and Visa. Representatives from IDA were also invited to attend the monthly meetings.
- The technical team consisted of technical personnel from Gemplus, HP and Systems@Work. Working sessions were often held to discuss the requirements and implementation of the payment processes.
- The marketing team included consortium members from HP, Suntec City, Systems@Work and Visa.

5.5.2 Timeline for trial preparations

As shown in *Figure 3*, the trial preparations included both technical and marketing efforts. Marketing for the pilot began as early as November 2001, about five months before the official launch.

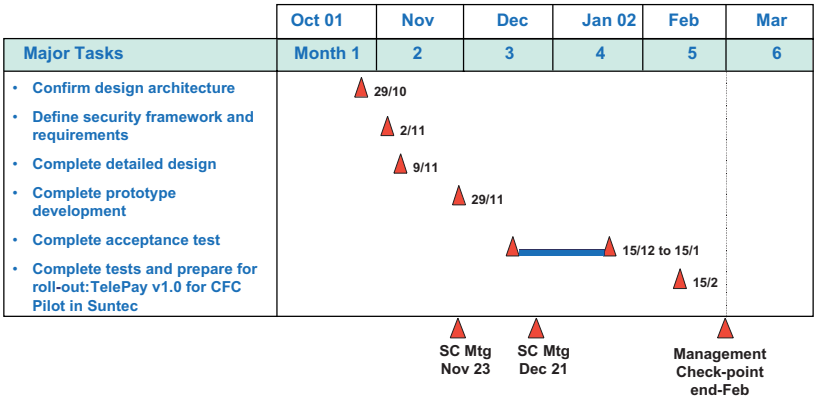


Figure 3. Timeline for trial preparations

5.5.3 Setting up the network and applications

A common TeleMoney infrastructure was set up to enable voice-authenticated mobile payments for both TelePay and TeleParking.

For TelePay, a physical connection was established between the merchant (via dial-up) and the TeleMoney payment infrastructure hosted by Systems@Work.

For TeleParking, a new server was set up to interface with the existing car park system and to control the entry/exit barriers.

5.5.4 Setting up Bluetooth and IR-enabled terminals for TelePay

Merchant Accepting Devices (MAD) applications were developed on HP's Jornada PDAs to enable the following functions:

- Processing customer TeleMoney ID through IrDA and Bluetooth
- Allowing input of merchant transaction details including transaction reference numbers and purchase amounts
- Protecting accessibility to TelePay MAD application through User ID and passwords for merchant staff
- Connecting to standard payment messages such as ISO 8583 with Triple-DES encryption
- Protecting against "shadow" MAD devices which might try to access the payments processing infrastructure
- Linking MAD with back-end payment processing to use multiple payment methods including debit/credit cards and bank account debit
- Generating local statement reports for settlement reconciliation.

For IrDA communications, Visa's IrFM messaging model was followed as closely as possible. IrFM is a global standard developed by Visa in conjunction with the IrDA association. At the time of implementation, IrFM was still a draft version.

5.5.5 Finalising user flows

In designing the user interface for TelePay, the consortium had in the early stages of discussions, narrowed its focus down to two options. The first option was to have the customer "beam" his TeleMoney ID (via IR or Bluetooth) to the MAD with TeleMoney calling back to obtain authorisation via a PIN. The second option was to have the customer send both the TeleMoney ID and PIN to the merchant via IR/Bluetooth. Both options are detailed in *Figure 4* below.

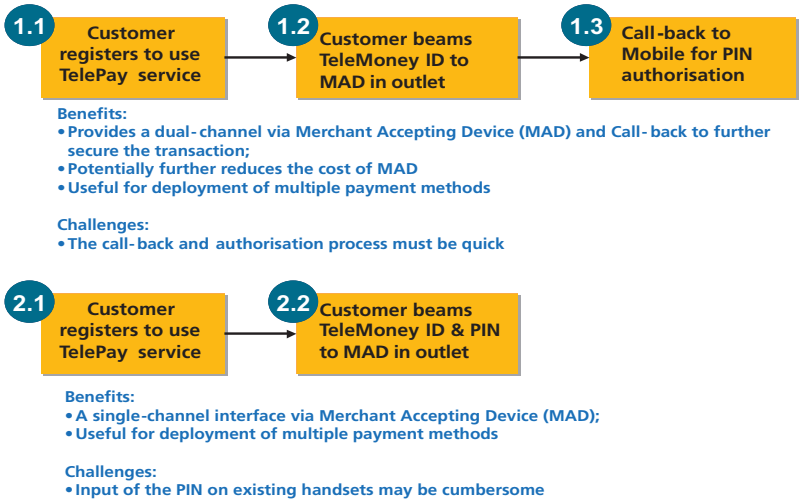


Figure 4. TelePay user interface options

Both user flows required the input of a TeleMoney PIN to authorise a payment transaction. Eventually, user flow (1) was implemented for TelePay as it managed the PIN input more securely and intuitively. Moreover, the consortium wanted to ensure a consistent payment authentication experience for consumers. Since other services running on TeleMoney would use payment authentication by IVR, it would be less confusing for the user if TelePay also used the same IVR-authentication.

In designing the TeleParking interface, Systems@Work and Suntec City had to ensure that users who wanted to pay by cash could still do so. As far as possible, users should not need to change their habit of pulling out the ticket at the entry gantry and then inserting the ticket at the exit gantry. To pay for the ticket, however, the user should not need to queue at the Autopay Station or be faced with the situation of not having the change to pay for parking.

Taking into account these considerations, the consortium designed the following User Interface for TeleParking shown in *Figure 5*.

1. Motorist drives into Suntec carpark, Takes ticket from the gantry as per normal

2. When he wishes to exit, motorists pays for parking in 3 steps:
   - Calls a TeleParking Hotline
   - States the ticket number#
   - Authorises the payment with PIN (if already registered) or keys in credit card number and expiration date for payment processing
3. Payment is immediately updated to Suntec's parking system
4. Motorist drives to any Suntec car park exit gantry and inserts ticket into the system as per normal. Parking system recognises that the ticket has been paid for and the barrier lifts. Motorist drives out of car park.

#Note that both the Teleparking Hotline and ticket number are printed on the carpark ticket for easy reference.

Figure 5. TeleParking user interface

Essentially, the TeleParking service enabled Suntec City car park users to pay their fees using a standard mobile phone. With IVR, TeleParking only required a user to input the ticket number and payment method from wherever they were. The parking fee would then be calculated by the TeleParking system, which would read out the amount to the user. Upon getting this information, the user would key in his PIN (if already pre-registered) to complete the payment. Upon exit, the paid ticket would be inserted into the exit gantry as per normal.

5.5.6 Incorporating value-added services

Consumers of TeleMoney services, including TelePay and TeleParking, were also provided with value-added services such as viewing their transaction history, changing their PINs and managing their payment methods. A TeleMoney Members Lobby at www.TeleMoneyworld.com was built to provide users with such services during the trial.

5.5.7 Marketing preparations

As part of the launch preparations for TelePay in April 2002, the TelePay service was first piloted at SITEX, a consumer IT show in November 2001. This allowed the consortium to solicit feedback on the system five months before the official launch of the mobile retail payment service.

Telemoney Pavilion at SITEX (Nov 2001) showcasing proximity commerce, later launched at Suntec City

The first Telepay consumer flyers distributed at SITEX 2001

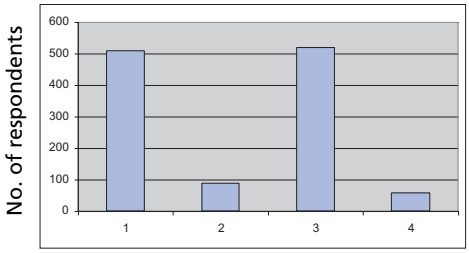
Figure 6. TelePay soft launch at SITEX 2001 in November 2001

The pre-trial at SITEX was immensely useful to evaluate critical features of the TelePay service, including the user interface.

As part of the soft launch, about 600 people were surveyed during SITEX, to assess the attractiveness of mobile payments for retail shopping and taxi payments.

From the survey, the consortium learnt the following:

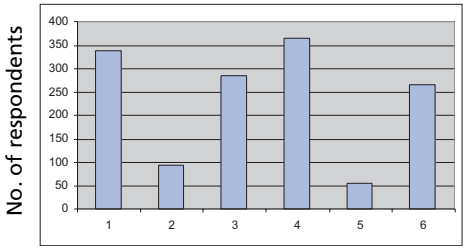
- 85% to 90% of the 600 respondents liked the idea of cashless payments.



State your choice of payment methods:

- Taxi: Cashless or cash?
- Retail: Cashless or cash?
- **85% responded that they would prefer cashless payment for taxi rides**
- **90% said the same for retail shopping**

- A number of those surveyed also thought that mobile payments was a useful way to pay their shopping and taxi bills, with credit card payment as the preferred mode of payment.



Do you think it would be useful to pay using your mobile phone for the following ?

- For taxi: Credit card, Cabcharge and NETS;
- For Retail: Credit card, Cabcharge and NETS;
- **Taxi: 47% credit card; 13% Cabcharge; 40% for NETS**
- **Retail: 53% credit card; 8% Cabcharge; 39% for NETS**

Figure 7. Sample responses to face-to-face consumer survey at SITEX 2001

5.5.8 Customer support briefing

Customer support was a key element in TeleMoney service. Customers could call a help desk hotline to obtain help or have their queries answered.

In addition, a customer booth was set up initially at Suntec City to assist users with the TeleParking trial. Customers who wanted to use their mobile phones for car park payment could obtain information on the TeleParking service from car park tickets and signages placed at Autopay stations.

5.5.9 Merchant preparation and training

Multiple series of merchant briefings were organised to encourage merchant participation. With the strong support of Suntec City and HP, merchants were given incentives to participate in the TelePay pilot. These included MADs that were installed free-of-charge during the period of the trial.

5.6 Conduct of the trial

5.6.1 Timeline for conduct of trial

The actual pilot testing occurred over a nine-month period from April 2002 - Dec 2002. The key milestones for the pilot were as follows:

Month	Highlights
Nov 2001	Pre-trial test at SITEX 2001
2002: Apr-Jun	Launch of TelePay proximity mobile payments at Suntec City. Fifteen merchants were recruited for the launch Won the HP/Intel/MCVF Innovative Mobile e-Services Award – Retail Category
Jul – Sep	Showcase of trials to overseas visitors including American Express, JCB Japan, ITU Bangkok Technical Meeting, and Korea Telecom Freetel
Oct – Dec	25 merchants recruited Launch of TeleParking service for Suntec City's 3,000-lot car park Completion of trials

Table 3. Timeline for conduct of trial

5.6.2 Marketing activities

There were two primary objectives for marketing activities: to (a) create awareness, and (b) encourage usage. Highlights of the marketing activities included roadshows and marketing campaigns at Suntec City. Lucky draws and discounts were also held to draw customers to try the services.

Month	Objective	Marketing Activities	Incentives
Nov 2001	Feedback	Pre-trial test at SITEX 2001	Free gifts
2002: Apr-Jun	Awareness and usage	Suntec City launch of mobile payments 4-day Roadshow at Suntec Publicity at business partner websites and channels: Fujifilm, JCB	Lucky draw, free gifts
Jul – Sep	Awareness and usage	Joint communications with Suntec City - posters, plasma screen, video communications. Periodic electronic newsletters Joint incentive programme with CityCab	Lucky draw, free gifts, discounts on taxi rides
Oct – Dec	Awareness and usage	Joint communications with Suntec City - posters, plasma screen, video communications. Periodic electronic newsletters Joint incentive programme with CityCab Joint incentive programme with Suntec City	Lucky draw, free gifts, discounts on taxi rides, car park fees

Table 4. Marketing activities

Figure 8 shows some of the marketing communications for the TelePay service.

Telepay signs at the Autopay Stations

Telepay instructions on the back of each car park ticket

Figure 8. Marketing communications for TeleParking service

5.6.3 User profile

Through consumer feedback and merchant interviews, the consortium derived a set of user characteristics for a typical m-payments consumer. The consortium found that a typical user would be between 18 to 40 years old and likely to be an early adopter of Internet e-commerce or other technologies.

The profile of the target consumer was as follows:

Profile	Characteristics
Regular Internet user	• Communicates using e-mail regularly • Surfs the Net at least for research • Conducts e-commerce (at least one of the following) - Shops from established sites for products that could not be obtained or are cheaper than retail outlets; - Pays bills via Internet; - Submits income tax via Internet; - Performs e-banking
Mobile phone user	Always has phone within reach, uses the phone book easily and can send SMS
Age group from 18 to 40	Undergraduates and professionals
Users with IT Lifestyles	Early adopters of services and/or seeks instant gratification or convenience

Table 5. Target user profile

5.6.4 User interface

The user experience for TelePay is as follows:

- User walks into retail shop in Suntec City and picks out his purchases
- User brings purchases to the check-out counter and indicates that he wishes to pay by TelePay
- Cashier logs-in and inputs the purchase detail into the PDA Merchant Accepting Device (MAD). Cashier also prepares the MAD to receive the TeleMoney ID (*see Figure 9*).

(a) Log-in by merchant staff

(b) Enter purchase details

(c) Accept TeleMoney ID via IrDA/Bluetooth

Figure 9. Merchant MAD User Interface

- User then sends his TeleMoney ID – in this case, his mobile number – to the cashier via IR/Bluetooth. To illustrate, for Infrared, the user should first have made an entry of his TeleMoney ID into his phone. He then points his Infrared port to the one on the MAD and selects "Send business card via IR" (in the case of Nokia phones). This TeleMoney ID, together with the payment details and merchant information, is sent by the MAD application via the dial-up line to Systems@Work
- User receives an IVR call and is asked to confirm the payment details. User is asked to key in his PIN to authorise the transaction
- The payment is processed through the TeleMoney payment service and a completion of transaction is sent back to the merchant's MAD

The user experience for TeleParking is as described in *Section 5.5.5* above.

5.6.5 Consumer usage and feedback

About 500 consumers signed up and used the Telepay and TeleMoney services at least once throughout the trial. About 40% of these users conducted more than one transaction.

A total of 800 transactions were generated by 500 users of the TelePay and TeleParking services.

As shown in *Table 6* below, more than 90% of the transactions came from the TeleParking service, despite its later launch. Of all the transactions, most payments were made by credit card.

Key Features	Planned	Actual	Remarks
Number of merchants using Telepay	50	25	- Weak value proposition to merchant; - Does not save costs;
Number of consumers	1,000 users	500 users	- Insufficient "reason" to use - Lack of essential services
Duration of pilot	6 months	9 months	
Transaction volume over pilot	1,200	800	- 90% of transactions generated by car park payment
Average transaction value	$28	S$53	- The mix of merchants carried higher purchase values. There seemed to be little fear of fraud

Table 6. Planned versus actual consumer usage

The TeleParking service was popular for a variety of reasons. First, it allowed a person to pay for parking without having to queue at the Autopay station – this was especially attractive during weekends, as Suntec City was usually quite crowded then.

Secondly, a user did not need to first register on-line in order to use the service. A non-registered user could simply key in his credit card number and expiration date if he decided to use the TeleParking service on the fly. First-time users would also not have any difficulty accessing the TeleParking number as it was printed on the ticket. Those who liked their initial experience with the system and who anticipated repeat visits to Suntec City could register their credit card on-line at the TeleMoney website. Registered users would be recognised the next time (based on their mobile number) they called in to TeleParking and would only be requested to key in their PINs.

Thirdly, a user did not need to have sufficient change to pay for the parking. Nor would he end up with a lot of coins. As in most Autopay stations, the ones in Suntec City returned change in the form of coins, which are heavy and inconvenient to carry around.

Finally, by using TeleParking, a user would be able to charge his parking to his credit card. It was noticed in this and other trials, that credit card loyalty points provided an incentive for consumers to use their credit cards for purchases, regardless of whether the purchase was made in a retail outlet, on-line, or on a mobile phone.

In contrast, consumers generally found it difficult and slow to use Infrared or Bluetooth for the TelePay transactions. Most preferred to use existing payment methods such as NETS, credit cards or cash. Consumers also provided feedback that merchants were sometimes unsure of the procedure to complete the transactions.

5.7 Conclusion

The trial clearly validated the following

- Mobile payments are most useful for remote rather than retail payments
- Merchants found that retail proximity payments did not significantly reduce their costs, nor increase revenue for them
- A related point is that the potential for TelePay is limited in Singapore, where POS infrastructure is mature
- The potential for TeleParking is good. Response from car park users to date has been very encouraging

Besides these findings, Systems@Work and its partners have benefited from the trial in several ways. Specifically, the trials

- Generated press coverage both locally and internationally for Systems@Work and its partners.
- Provided a reference for Systems@Work's internationalisation efforts
- Demonstrated the collaboration value and synergy between diverse partners such as HP E-Bazaar, Suntec City, VISA and Systems@Work

Based on the findings and infrastructure set-up during the trial, Systems@Work now looks forward to working with its partners to commercialise more mobile payments services in Singapore and abroad.

YW8 (“Why Wait?”) – Collaboration of Singapore’s three national mobile operators with a national payment provider

We would like to thank the following persons for their contribution to this chapter on the YW8 trial:

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Jessie Saw	Network for Electronic Transfers (S) Pte Ltd

6. YW8 ("Why Wait?") – Collaboration of Singapore's three national mobile operators with a national payment provider

6.1 Highlights

- Pilot from March 2002 to Dec 2002 for a period of nine months, leading to commercialisation on Jan 2003
- Transactions conducted using credit card and stored value, leveraging on SMS and WAP
- 11 m-payment services were piloted including bill payment, Person-to-Person payments, fine payments, ticketing and account top-up
- More than 10,000 registered users with more than 40% of users using the service at least once
- Close to 30,000 transactions conducted

6.2 Background

On 22 June 2001, representatives from the country's three mobile operators - SingTel Mobile Ltd, StarHub Pte Ltd and MobileOne (Asia) Pte Ltd made a joint presentation during IDA's Networking Event for the Mobile Payments CFC. In their brief 5-minute, 2-slide presentation, the three mobile operators publicly announced for the first time their commitment to "collaborate as a consortium to adopt a national mobile payment solution that will work for all mobile consumers."

The announcement paved the way for the formation of YW8 – Asia's and perhaps the world's first collaboration of three national mobile operators with a national payment provider – Network for Electronic Transfer(S) Pte Ltd (NETS). On October 2001, just four months after the announcement, the three mobile operators, together with NETS, National Computer Systems Pte Ltd (NCS) and several key merchants were named as one of the consortium to test m-payments solutions in Singapore.

In the ensuing months, the consortium became the first to launch their mobile payments solution through movie ticketing merchant, Eng Wah Organisation Ltd (Eng Wah). It also kept a constant look-out for new services that could be deployed on the mobile payments platform. By the end of the trial in Dec 2002, the consortium had introduced 11 new mobile payment services to the market[1] – more than double the five services that had been originally planned in Oct 2001.

About the Network for Electronic Transfer(S) Pte Ltd (NETS)

Formed in 1985, NETS is owned by the country's three local banks - Development Bank of Singapore, United Overseas Bank and the Overseas Chinese Banking Corporation. NETS manages an inter-bank online direct debit service and provides a range of electronic payment services to retailers and consumers. Over the years, NETS has established and maintained strong relationships with many retail merchants in Singapore.

[1] These services allow users to purchase movie tickets at Eng Wah Cinemas, purchase NTUC Income travel insurance, make i2U payments (Person-to-Person funds transfer), pay M1 mobile phone bills, pay SingTel bills, pay car park charges at Changi Airport Terminal 2, pay library fines at NUS, check exam results at NUS, top up NLB's eLibraryHub's prepaid account, play Yigra games with Genii and top up eNETS VCard (multi-purpose pre-paid account).

6.3 Formation of the YW8 consortium

NCS, NETS and other payment operators like Visa and DBS had been evaluating various options for deploying mobile payment as the natural extension of existing payment solutions offered.

NETS and NCS had begun preliminary discussions with selected merchants such as the National University of Singapore (NUS), Eng Wah and the National Library Board (NLB), before meeting the mobile telecommunication operators. NCS had worked with NUS and NLB in earlier projects while NCS and Eng Wah had become acquainted through mutual contacts. Diethelm later participated in the trial at the invitation of NETS.

The mobile telecommunication operators (M1, SingTel, StarHub), on their part, had also started looking for partners in the area of mobile payments. Expectedly, the decision of the mobile operators to collaborate in deploying mobile payments was well-received by the industry, including NETS and NCS. Not long after, mobile operators, NETS, NCS, Visa, DBS and the merchants started discussions to form a consortium towards IDA's Call for Collaboration.

The finalised role of each of the consortium member is summarised in *Table 1* below.

No.	Company	Category	Role
1.	Network for Electronic Transfers(S) Pte Ltd (NETS)	Payment Provider and Service operator	Provided payment infrastructure and was the operator of the YW8 mobile payments service during the trial and post-trial periods.
2.	National Computer Systems Systems Pte Ltd (NCS)	System Integrators	Provided the technological expertise for this mobile payments solution. Also scoped out requirements where integration work was involved, as well as managed and implemented the project. NCS, the consortium lead of the project, also provided consultancy services when required.
3.	SingTel Mobile Ltd (SingTel Mobile)	Telecommunications Operator	Provided technical development and support for the telecommunication networks and inter-operability with other telcos. Also assisted in consumer recruitment.
4.	StarHub Pte Ltd (Starhub)	Telecommunications Operator	Provided technical development and support for the telecommunication networks and inter-operability with other telcos. Also assisted in consumer recruitment.
5.	MobileOne (Asia) Pte Ltd (M1)	Telecommunications Operator	Provided technical development and support for the telecommunication networks and inter-operability with other telcos. Also assisted in consumer recruitment.
6.	VISA International (VISA)	Payment Provider	Provided marketing support for the use of credit card payments in YW8.
7.	Development Bank of Singapore (DBS)	Payment Provider	Facilitated the top-up of VCard accounts and provided technical advice on relevant financial standards and security.
8.	Diethelm Singapore Pte Ltd (Diethelm)	Merchant/ Service Provider	Enabled payment of car park fees using mobile payments.
9.	Eng Wah Organisation Ltd (Eng Wah)	Merchant/ Service Provider	Allowed patrons to request for movie information, confirmation of bookings and payment for tickets via mobile payments.
10.	National Library Board (NLB)	Merchant/ Service Provider	Allowed NLB patrons to top up NLB Virtual Account to pay library fines and access multimedia services. This Virtual Account can also be used at NLB's eLibraryHub online portal to view premium content like news, journal articles and databases.
11.	National University of Singapore (NUS)	Merchant/ Service Provider	Allowed students to pay their NUS library fines and obtain exam results services using mobile payments.

Table 1. Roles of YW8 consortium members

6.4 About the trial mobile payment solution

6.4.1 Overview of payment method and wireless technology

The YW8 consortium chose to deploy credit card and stored value payments over WAP and SMS for the trial.

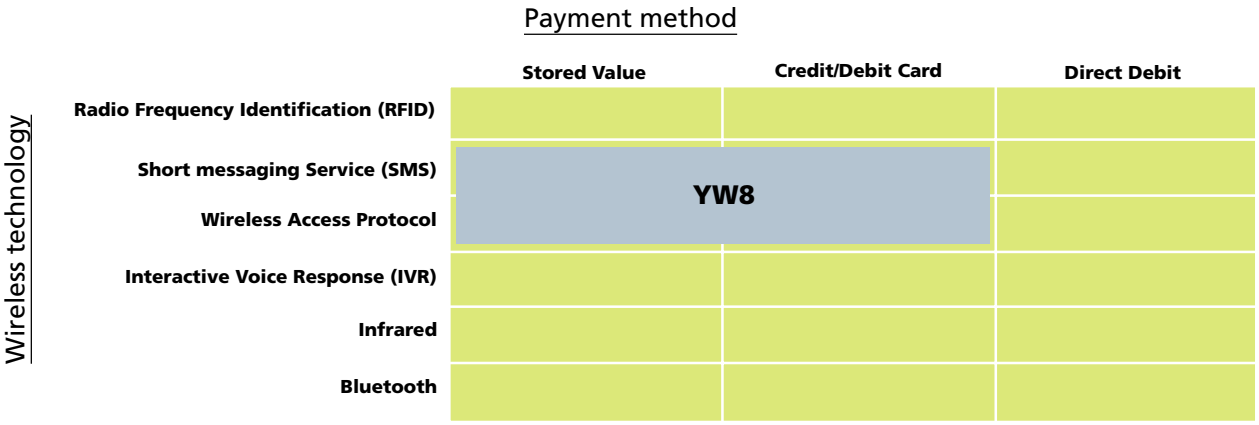


Figure 1. Payment method and wireless technology in the YW8 trial

The choice of payment methods was seen as complementary to the billing-on-behalf services already provided by the mobile operators.

Credit Cards Due to its widespread use in Singapore (*see inset*), credit cards were expected to be popular for larger value transactions such as buying movie tickets and paying bills. The majority of credit card holders also belong to the Professionals, Managers, Executives and Business Persons (PMEB) market segment in Singapore – a sector with considerably higher incomes and thus higher spending power.

Stored Value Payments By comparison, payment using a virtual stored value account (eNETS VCard) was a relatively new concept to the Singapore market with adoption lower than that of the credit card base in Singapore. However, there were no income requirements to open a VCard account, thus making it ideal for teenagers and students. The comparatively lower cost structures would also make it attractive for micro-payments like Person-to-Person transactions (eNETS i2U Payment Service) and car park payments.

WAP and SMS were chosen as the preferred wireless technologies to be used by the consortium because these remote wireless technologies are suitable for the trial scenarios. Apart from the Diethelm car parking payment service, the other services did not assume that the user would be close to a point-of-sale terminal or a cashier. Therefore, proximity wireless technologies such as Bluetooth or Infrared would be less relevant to these services, and were not selected for deployment in the trial.

Cards 'n Such

Credit Cards At end-October 2002, there were 3.1 million credit cards - both main and supplementary - in circulation, up 4 per cent from just a month before. Total card billings also climbed above the $1 billion mark to $1.05 billion, up 9.6 per cent from a month earlier.

In Singapore, credit cards can only be issued to people with annual incomes above $30,000 and the limit per card or credit line is two times the consumer's monthly income. There are however, no restrictions on how many cards or credit lines a consumer can have.

eNETS VCard Launched in August 2001, the NETS Virtual Card (later named the eNETS VCard) was the first multi-purpose virtual stored value account introduced into the Singapore market. The same VCard account can be used for payments over the Internet and on most mobile phones. The stored value account can be topped up using a credit card, bank account or another VCard account. Despite the recent introduction to the market, there were already more than 10,000 registered users for VCard with an average of more than 2,000 transactions conducted monthly.

Moreover, Singapore boasts one of the highest SMS usages in the world[2]. While WAP has been slower to take off, it was expected that the introduction of General Packet Radio Services and other WAP-based services such as Multi-Media Services (MMS) would facilitate the adoption of WAP in the near future.

[2] Mobinet 4 – A.T Kearney and Cambridge University, www.atkearney.com

6.4.2 Standards and technologies used in the trial

The consortium worked closely to define a message exchange based on XML that was used by NETS, the telcos and the merchants to transmit and receive SMS messages to and from the consumer's handset. The XML standard was successfully integrated into the various disparate platforms used by the merchants, such as the Eng Wah Mobile Ticketing system based on Microsoft .NET, and the NUS library fines and exam results system based on Fenestrae Mobile Data Server.

About .NET

Microsoft .NET is a set of Microsoft software technologies for connecting the world of information, people, systems and devices. It enables an unprecedented level of software integration through the use of XML Web Services. With .NET technology, the YW8 consortium was able to connect movie-goers with Eng Wah cinemas through mobile services on their handphones.

To facilitate easy integration by the merchants into the SMS infrastructure, NCS developed an SMS-On-Behalf system that routed SMS messages between the merchants and the telcos using the XML protocol that was defined by the consortium. The SMS-On-Behalf system was developed with the Microsoft .NET Framework, which was chosen for its strength in XML processing.

6.5 Preparations for the trial

6.5.1 Formation of the project team

The consortium set out to finalise the roles and responsibilities of each consortium member directly after the CFC award. *Figure 2* illustrates the project structure of the YW8 project during the period of the trial.

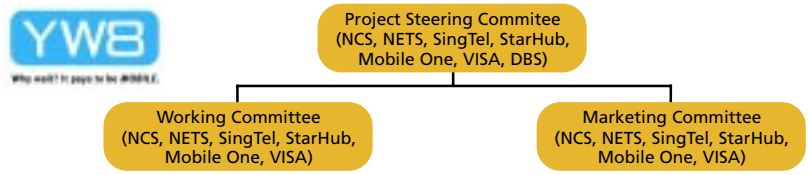


***Figure 2*. Project structure of YW8**

- The Steering Committee consisted of senior management from each consortium member. Meetings were held on a monthly basis to decide on and resolve major issues pertaining to strategy, scope priority and budget.
- The Working Committee consisted of technology and product managers from each consortium member. Meetings were held regularly to plan, define, execute and monitor progress of infrastructure development and interfacing matters.
- The Marketing Committee consisted of marketing and business development representatives from each member of the consortium. The committee was tasked with the branding and positioning, recruitment and education of consumers, plan, execute and track intermediate marketing objectives.

6.5.2 Timeline for trial preparations

As shown in *Figure 3*, the pre-trial preparations included both technical and marketing efforts.

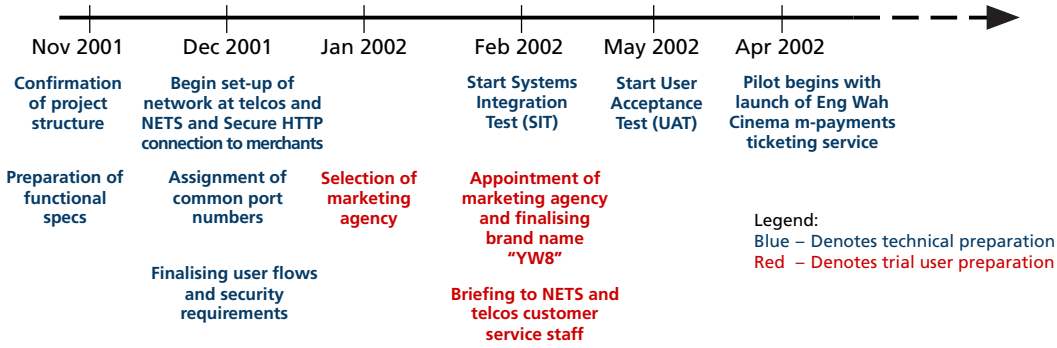


Figure 3. Timeline for trial preparations

6.5.3 Setting up network at telcos

As the three telcos had different technical configurations and used different network equipment at their networks, considerable time was spent in drawing up a common specification to allow the three networks to communicate seamlessly with each other.

In addition, the consortium had to handle the communications between NETS and the merchants. For the trial, the merchants were connected to NETS via a secure connection over the Internet.

Figure 4 provides a high level diagram of the network communications between the consumer, his mobile operator, NETS and the merchant.

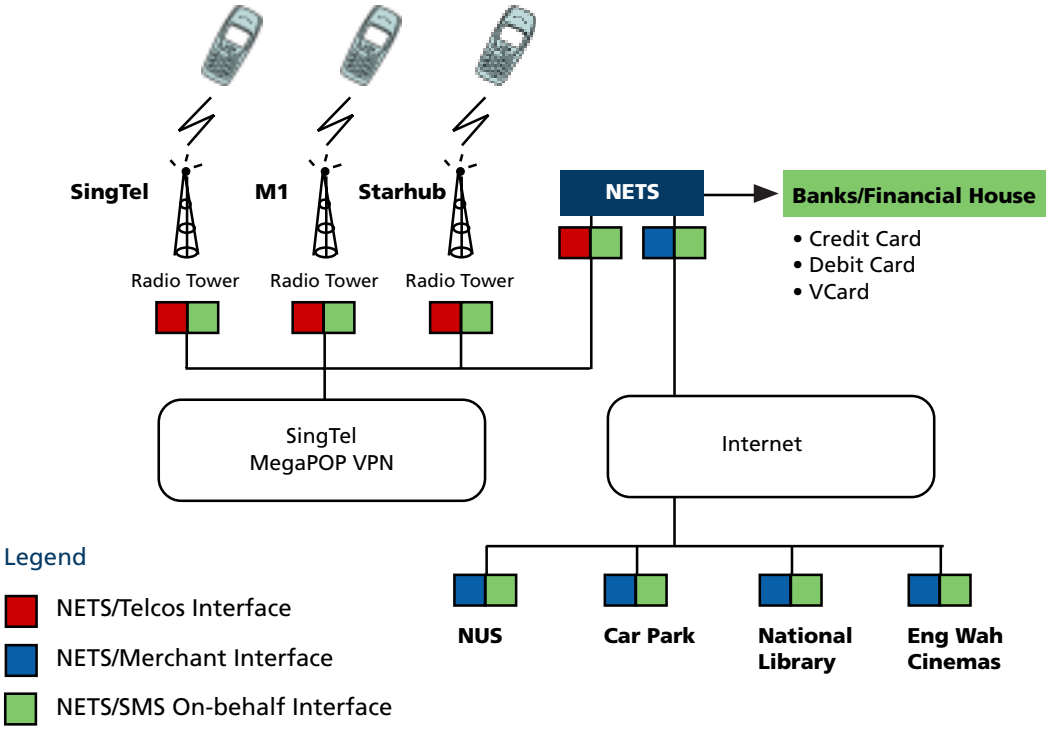


Figure 4. Infrastructure connecting the consumer, telcos, NETS and merchants

When an SMS is sent from a consumer to the merchant through his mobile operator, the mobile operator immediately recognises from the destination number that it is a message meant for one of the mobile payment merchants (e.g. "66881" for Eng Wah). Upon identification of the merchant, the message is routed by the mobile operator to the SMS-On-Behalf server via the Virtual Private Network (VPN) established for the YW8 service.

When the SMS-On-Behalf server receives the message from the telco, it communicates with the appropriate merchant, requesting for a response to the consumer's message. The response could be, for example, to display the movies currently being shown at Eng Wah. The SMS-On-Behalf server then sends an SMS back to the consumer, containing the merchant's response.

With the three telcos supporting a common implementation specification and using a shared VPN, the transaction process between consumers and merchants (S*MS On-behalf Interface)* as well as debiting request between merchant and NETS mobile payment gateway (T*elcos/NETS Interface and NETS/Merchant Interface)* becomes highly efficient.

6.5.4 Assignment of common port numbers

In addition to setting up the network between the mobile operators, the consortium further leveraged on the operator collaboration to allocate a common range of port numbers to the merchants supporting YW8 services. For example, all three operators assigned port number "66881" to Eng Wah. As such, regardless of which operator the consumer used, he or she could just SMS to "66881" in order to obtain Eng Wah services.

Prior to this, consumers would sometimes be required to send SMS messages to different numbers depending on the mobile operator they used; merchants would also need to approach the operators individually in order to obtain the port numbers – such a practice was both costly to the merchants and confusing to the consumers. The list of port numbers assigned to the merchants included:

No.	Merchant	Port Number
1.	Eng Wah Cinemas	66881
2.	NUS	66882
3.	NLB	66883
4.	NTUC Income Travel Insurance	66885
5.	NETS (includes all consumer-initiated transactions like M1 and SingTel bill payment, Person-to-Person service, topup of VCard account)	66888

Table 2. List of port numbers assigned to each merchant

6.5.5 Balancing security with usability

Security was an important consideration in deploying the YW8 service. As the user was not physically present to confirm the transaction, it was important to address fraud issues, which might stem from the consumer or merchant.

Any security implementations, however, had to be balanced with the usability and cost to the consumers and merchants in adopting the system. In weighing these factors, the consortium decided to implement a two-factor authentication for the system without requiring any additional modifications or downloads to the phone. The consumer would be required to register a unique User ID, PIN and mobile number online or through SMS registration. In other words, the security of a transaction relied on what the consumer *knew* and what he *had*. "What he knew" would be in the form of a secret ID that he specified at the point of registration while "what he had" would be his mobile phone, tied to that unique ID.

6.5.6 Finalising consumer interactions

Another important process in developing the YW8 service was the designing of the user-interactions in the system. The user-interactions covered everything that the consumer experienced, from user registration to the actual amount of SMS text or levels of WAP linking that the consumer had to input or scroll through. The consortium understood that these processes affected the usability of the service as well as the merchants' operating cost.

In designing the user-registration process, the consortium had to take into account security requirements, ease of registration and usability. As the YW8 mobile payment service was one of the first in the region to rely extensively on SMS and WAP for shopping and payment, it had few existing service models to refer to. Discussion were held with the merchants to draw up an acceptable transaction flow for consumers.

For example, considerable effort was spent designing the purchase flow of an Eng Wah ticket. A movie ticket transaction needs four important pieces of information, namely the movie location, title, time and the number of tickets. From Eng Wah's experience with their other sales channels, it was found that movie-goers typically frequented the same movie theatres and would use the cinema location and not movie title as a pre-requisite to conduct their search. This consumer information was important as it helped in designing the message flow for the SMS screens in the YW8 service – by allowing the selection of a movie location before the selection of the movie. As it turned out, the sequencing also helped Eng Wah save some costs. Eng Wah only had five cinemas and each of these cinemas typically screened several movies a day. Keeping in mind that each SMS could accommodate only 160 characters, it would cost Eng Wah more to initially send SMSs detailing all the movies than to first send an SMS listing all its cinema locations.

6.5.7 Customer support briefing

The customer hotline at NETS would form the customer touch-point in the trial and was thus crucial in engendering trust in the new system. NETS Call Centre staff were thoroughly briefed on the details of the system to provide first level support to the customers. In the event that the NETS customer service staff were unable to answer the queries, NETS routed the queries to the respective parties.

6.5.8 Branding of trial

YW8 or "Why Wait" was chosen as the branding of this trial to convey the concept of convenience and speed as consumers would not need to stand in line at queues any longer.

6.6 Conduct of the trial

6.6.1 Timeline for conduct of trial

The actual pilot testing occurred over a period of a little more than 9 months, from March 2002 to December 2002. As illustrated in *Table 3* below, the timeline of marketing activities and launches for each service was staggered across the period of the trial.

No	Merchant	Service	Launch	Marketing Events
1.	Eng Wah Cinemas	SMS-a-movie with Menu Mode and Command Mode	9 March 2002	Roadshows for 6 weekends from 9 March till 14 April.
		Advance SMS booking	1 April 2002	Advertisements in the local English and Chinese newspapers (The Straits Times/Zhaobao/Wanbao and Shin Min) Cyberguide on www.ewcinemas.com.sg and www.yw8.com.sg
		WAP-A-Movie	End-April	Mobile Payments video played continously at all cinema receptions from September to December 2002.
2.	National University of Singapore	Library Fines	21 March 2002	Roadshow on 21 to 26 March at Central Library Level 4. Cyber guide on www.yw8.com.sg
3.	National Library Board	Topup Prepaid Account	6 April 2002	Roadshow on 6 to 7 April at Woodlands and 13 to 14 April at Woodlands. Three advertisement insertions in The New Paper on 3, 5 and 12 April , two on The Straits Times on 4 and 10 April. More than 26,000 brochures and flyers provided at 21 library locations on YW8 Cyber guide on www.elibraryhub.com and www.yw8.com.sg
4.	NETS	VCard P2P (Person to Person Funds Transfer)	End April 2002	Launched via e-mail communication to the VCard base. Cyber guide on www.yw8.com.sg
5.	Diethelm	Pay Parking Fee at Changi Airport Terminal II	July 2002	Cyber guide on www.yw8.com.sg
6.	NUS	Exam Results	End May	Roadshow in July during NUS Matriculation Exercise Cyber guide on www.yw8.com.sg
7.	M1	Pay M1 Bills	July 2002	SMS broadcast, e-mail and cyber guide on YW8 website.
8.	SingTel	Pay SingTel Bills	October 2002	SMS broadcast, e-mail and cyber guide on YW8 website.
9.	NETS	SMS registration (VCard and Credit Card)	18th September 2002	• Roadshow at SingTel Hello Shops (21 to 22 September 2002 and5 to 6 October 2002) • Roadshow at NTU (in conjunction with Strategise 2002 by SIFT - The Students' Initiative For Technopreneurship) • Eng Wah Suntec city (12 to 13 October 2002) • New Paper advertisements during September and October 2002.
10.	Genni	Top up Credit to Play Yigra Games	September 2002	Cyber guide on YW8 website.
11.	NTUC Income	Buy Travel Insurance	December 2002	Cyber guide on YW8 website.

Table 3. Launch dates and marketing activities (YW8)

6.6.2 Marketing activities

Directly after the launch of the service, the various merchants, together with VISA, the mobile operators and NETS, worked closely together on the marketing of YW8.

As depicted in *Figure 5*, the consortium ensured that the look and feel of each item of marketing material was made consistent among the various services.

YW8 newspaper ad on Oct 2002

YW8 poster

YW8 brochure (for Person to Person payments)

Figure 5. Ensuring consistent YW8 branding

The YW8 Marketing Committee also coordinated the timing of the marketing events in order to minimise duplication of efforts among consortium members. As shown in *Table 3* above, several roadshows were held at merchant sites and at the premises of mobile operators.

6.6.3 User profile

The marketing committee profiled the "early adopters" of this service as:

- Teenagers and PMEBs
- Aged from 16 – 45
- Possess either a credit card or a VCard or both
- SMS savvy, open to new technology

A pre-selection of trial users was done on the combined subscriber base of M1, SingTel and StarHub using this profile.

The consortium recruited more than 10,000 consumers from the combined subscriber population. During the roadshows, it was observed that consumers in their twenties and thirties were more receptive to mobile payment services.

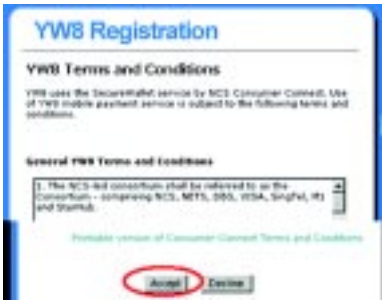
6.6.4 User registration – opening a YW8 account

To use the YW8 mobile payment service during the trial, a user first had to register for a YW8 account. This was essentially a secure server-wallet account where a user could store his or her payment information (credit card or VCard information) and personal details.

The following screen shots depict the steps involved in creating a YW8 account:

(1) At the YW8 home page (www.yw8.com.sg), click on "Register".

(2) At the "Welcome to YW8" page, click "Sign me up now".



(3) At the "YW8 Terms and Conditions" page, click on "Accept" after reading and accepting the terms of usage.

(4) At the "YW8 Registration" page, fill in your particulars and click on "Next".

(5) At the "Payment Options" choose to register for an eNETS VCard and/or link an existing Visa credit card. Assuming the user wishes to create a new eNETS VCard registration, he clicks on "Register a New NETS Virtual Card".

(6) At the "eNETS VCard Terms and Conditions" page, click "Accept".

(7) At the "eNETS VCard Registration" page, the YW8 user ID is automatically selected as the VCard user ID. The VCard PIN must be entered twice. The same PIN used in the YW8 registration may be used again. A hint to the PIN is entered, as well as a Virtual Name. This is used by others to make Person-To-Person (P2P) payment to the user. Click on "Next".

(8) At the "Payment Options" page, click on "Finish Registration" or "Register Credit Card" to link the credit card.

In the initial stages of the trial, the consortium received feedback that the online user-registration process could be further improved to allow "impulse" users to register for the YW8 account. Moreover, consumers who wanted to use their VCard needed either an Internet banking account, or had to sign a GIRO form in order to top-up their VCard account.

In response to this feedback, NETS developed another channel of user-registration, this time relying simply on the phone. The user simply had to key in the following SMS message: "Reg <NRIC> <Email> <Preferred UserID> <Name>" and send the information via SMS to NETS. In addition, in October 2002, NETS introduced the top-up of the VCard account using credit card.

6.6.5 Deployment scenarios and user interface

While the payment back-end was standard, each merchant had to work closely with NCS and NETS in designing the User Interface for the respective services. The following paragraphs depict the deployment scenarios and the User Interface for selected merchants involved in the YW8 trial.

6.6.5.1 Eng Wah Cinemas movie ticketing

Eng Wah Cinemas had deployed both SMS and WAP for the payment of movie tickets via YW8. To allow users to place bookings on behalf of their friends or family, users were also required to key in the national identification number of the person who would be collecting the tickets. This was not necessarily the same person as the one paying for the tickets.

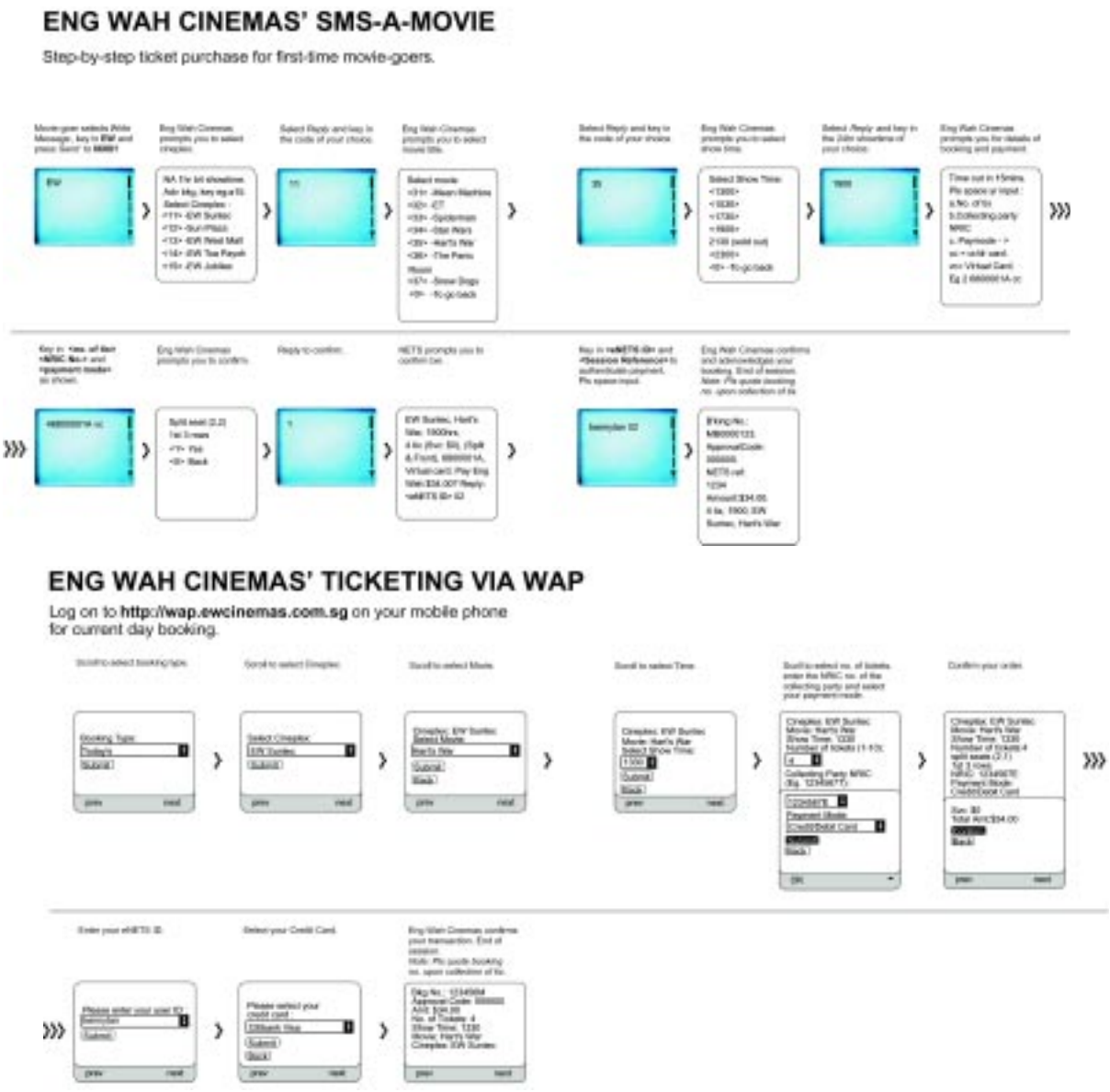


Figure 6. User interface for Eng Wah Cinemas (SMS and WAP)

6.6.5.2 National Library Board account pre-paid top-up

National Library Board chose to implement only credit card payments for the top-up of the eLibraryHub account. This was because their existing patrons were already familiar with the use of credit cards for top-up through NLB’s existing Internet portal.

Since September 2001, eLibraryhub members of NLB could already receive top-up alerts via SMS when their pre-paid accounts fell below S$1. Using YW8, however, the members could immediately top-up their pre-paid accounts when they received these alerts. eLibraryHub members could also top-up five other pre-paid accounts for their family members and friends.

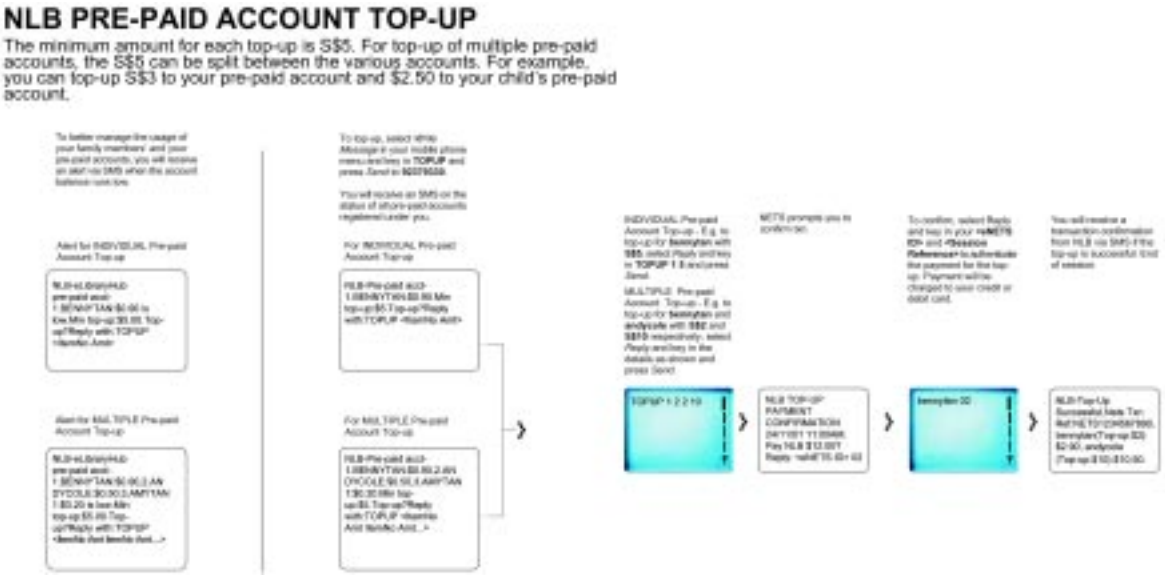


Figure 7. User interface for NLB pre-paid account top-up (SMS)

6.6.5.3 National University of Singapore fine payments

Since December 2000, NUS had developed a portal - mobileNUS (or mNUS) – to enable NUS students to receive alerts pertaining to library fine payments and the release of exam results. Using YW8, registered mNUS users were able to respond to these alerts by paying for library fines or requesting for an exam result.

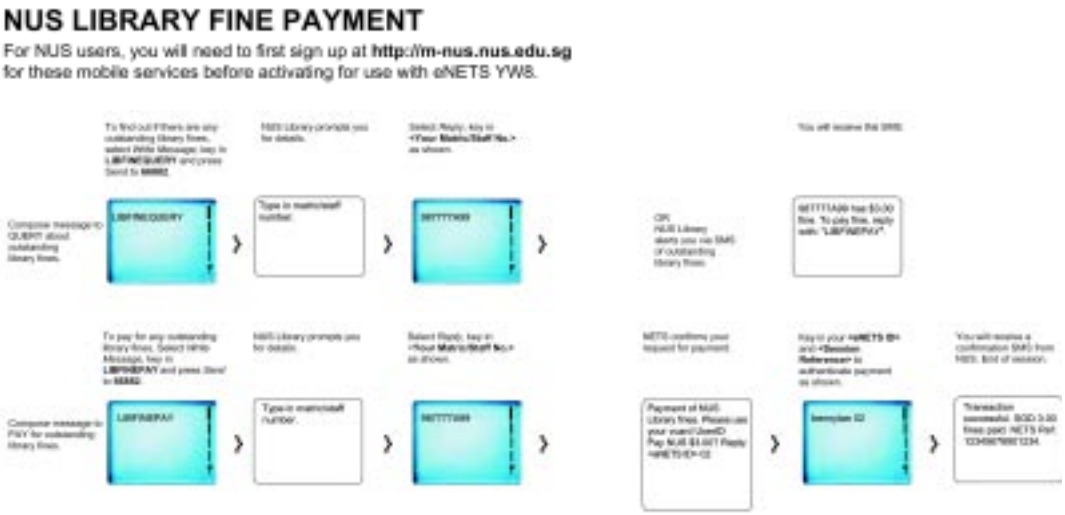


Figure 8. User interface for NUS Library Fine Payments (SMS)

6.6.5.4 Diethelm Car Park Payments

In the Diethelm trial, users were still required to go to the Autopay stations at the carpart to insert their tickets. At the booth, however, they could choose to pay for the parking using their VCard. The trial would ascertain the demand for using the VCard in the event that users did not have adequate cash for the transaction or were not prepared to receive a substantial amount of change.

Figure 9. User interface for Diethelm Car Park Payments (SMS)

6.6.5.5 Person-to-Person (P2P) payments

Figure 10. User interface for eNETS Vcard P2P payments (SMS)

6.6.6 Consumer usage and feedback

More than 4,300 users were involved in the trial, and they conducted more than 27,000 transactions during the trial period.

As can be seen in *Figure 11*, the bulk of the transactions came from Person-to-Person (P2P) payments. The most popular merchant was Eng Wah Cinemas, generating more than 2,000 transactions. Despite the later introduction of the telco bill payment services, M1 and SingTel noted that consumers were enthusiastic about the services. The National Library Board's top up service was utilised more than 200 times.

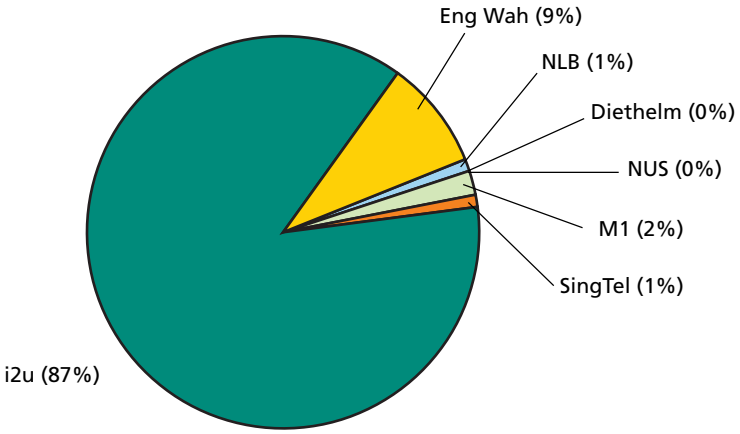


Figure 11. Breakdown of transactions (by merchant)

Besides the quantitative usage of the trial, consumer feedback on the trial was recorded through the customer service hotline maintained by NETS. In general, consumers reflected the following points:

- ***Convenience*** The service helped save travelling and waiting time, especially when booking cinema tickets. Patrons would otherwise need to go to the cinema early to secure good seats.
- ***Speed*** *Due* to the efficient network and standardisation among operators, there were minimal complaints about SMS delays in the network from the public. In fact, consumers would normally receive their SMS responses from merchants and NETS within a few seconds.
- ***Difficulty in user registration*** Users initially faced difficulty registering for Vcard and YW8 as they had to go online ito register. NETS later introduced a new channel to allow registration via SMS (for both VCard & credit card) to help consumers who wanted to perform transactions on the fly but who had yet to register.
- ***Difficulty in remembering User IDs*** As the YW8 service was launched with a selected set of merchants, many users had difficulty remembering their user IDs after using the service for the first time. To address this issue, the consortium sent an e-mail to the subscribers midway during the trial to remind users of their User ID. Such e-mails could in future contain information such as their account summary for the month and the launch of new services, if any.
- ***Problems remembering merchant port numbers*** With the increased number of participating merchants, consumers find it difficult to remember a list of port numbers. The infrastructure providers are working towards a common port number concept where consumers only need to remember a single port number regardless of the merchant. Help functions via SMS would also be introduced in the first quarter of 2003 for those consumers who have difficulty remembering the message format for the desired service.

Feedback was also recorded by the respective merchants in the period of the trial.

Merchant and customer feedback for individual services

Eng Wah Cinemas
By the end of the trial, Eng Wah Cinemas found that more than 90 per cent of customers who paid for tickets, did so by credit card instead of VCard payments. This was probably because the VCard was still relatively new in the market.

WAP transactions were significantly lower than SMS transactions. This was probably because of the smaller WAP base, which was highlighted earlier and the later launch date of the WAP service. However, it was felt that the running cost of the WAP channel service could be lower compared with the SMS service, as the latter involved the sending of SMS messages for each movie enquiry.

Eng Wah also found that seasoned purchasers were able to reduce the number of steps taken to buy their tickets. Most repeat users saved their messages as "templates" for future use. It also found that bookings increased significantly for more popular films. This was similar to the consumer behaviour exhibited on Eng Wah Cinema's Internet sales channel.

National Library Board (NLB)

Most NLB patrons felt the service was useful but most did not need to top-up their accounts regularly. Moreover, NLB also offered other channels of top-up, such as via the Internet, which were sufficient for most users. Even in the libraries, users who needed to top-up their accounts (for example, when intending to use the multimedia services) would use the Cash card machines or Internet-enabled PCs that were readily available, instead of the mobile channel. For the settling of fines via elibraryHub, most users would pay their fines on their next visit to the library, so there was less demand for an alternative top-up channel that was mobile enabled.

National University of Singapore (NUS)
For the NUS exam results and fine payment services, only payments by VCard was offered, as most of the student population would not posses a credit card and the value of payments warranted the use of a micro-payment tool. Repeat users found it useful to obtain alerts of their exam results before they checked their results. This was especially the case when they were on holidays, as exam results were typically released during the vacation periods when the students were without Internet access.

Initially, some users reported difficulty with the user registration of VCard and the topping-up of VCard. Originally, VCard could only be topped up via Internet banking which meant that users needed either to be existing Internet banking customers, or would have to sign-up, in order to use the VCard. This was later improved on by NETS, which added credit card as a top-up channel for the VCard. In addition, like NLB, there were also many other channels through which students could check their exam results and pay fines. They could for example, check their exam results via Interactive Voice Response (IVR) and through WLAN access that was readily available on the campus.

Diethelm Car Parks

In the Diethelm trial, response was poor as only a few Auto-pay machines could be YW8 enabled. Lack of marketing meant that consumers were not educated on the option of paying car park charges through their mobile phone.

6.7 Conclusion

The commercialisation of the YW8 service has been announced in February 2003. Under commercial arrangements, YW8 will be marketed under NETS' e-payment brand eNETS YW8. NETS' International Division also intends to market eNETS YW8 overseas. The consortium's partnership with merchants has allowed it to expand the service offerings and to recruit more merchants for the new services and products.

7. Key Findings

"There are some significant technology developments on the horizon that promise to allow m-commerce to finally live up to its initial hype...But can they (industry players) avoid the same mistakes they made last time? Can they master the complex mixture of technology, business and human elements necessary for success?"

– extracted from "The M-Commerce Roadmap", Accenture, 2002

As shown in the earlier chapters, the five trials were distinct. Each covered a particular range of payment methods and wireless technologies; each had different sets of partners that reflected the core competencies neede to implement the application and each concentrated on a particular merchant and consumer segments.

Yet, amidst these differences, a few findings have remained consistent. These findings have emerged and have been validated in most if not all trials. What types of applications seem most suited for mobile payments? What types aren't? What should service providers and end-user organisations avoid in furthering their mobile payment initiatives? What should they pay more attention to?

(1) Mobile payments appear to be relevant to at least six categories of services and applications

The six categories of services shown in *Figure 1* have been identified as potential services and applications that relevant end-user organisations may wish to consider for deployment onto an m-payments platform.

Categories	Possibilities
• **Perishables** • Ticketing - Cinemas Performing Arts, Travel • Auctions • Travel Insurance	• Cinemas, events, theatres, budget airlines, hotels • C2C auction sites • Insurance companies/consolidators
• **Bill and fine payments** • Bill Payments • Fine Payments	• Telcos, utility provider, bill consolidators • Selected government agencies, fines consolidators
• **Unmanned vending payments** • Carpark Autopay Sations • Vending Machines/Dispensers	• Selected car parks* • Drinks dispensers, newspaper/magazine dispensers
• **Internet, mobile content and applications**	• Existing E-Commerce sites • Access (e.g. WLAN) providers
• **Top-up of pre-paid accounts** • Cash Card, Transport Farecard • Mobile operator and other pre-paid accounts	• Transport pre-paid, cashcard pre-paid • Library account, game credits, operator pre-paid
• **P2P**	• Payments to family/friends (including remittance)

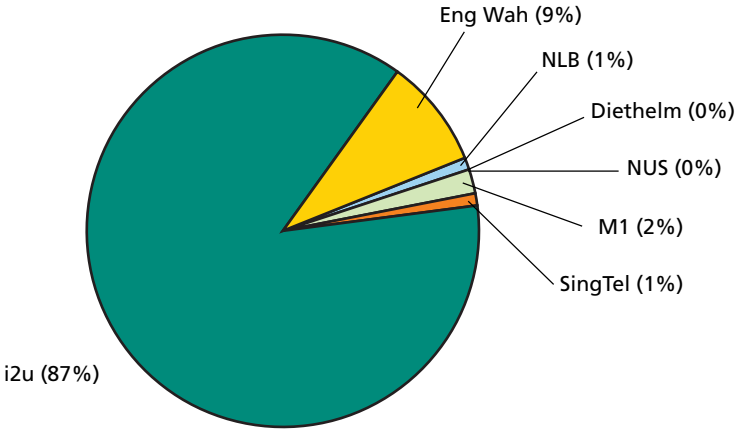
** Taking into account trade-offs with other technologies e.g. Electronic Parking System for car parks*

Figure 1. Six categories of services for m-payments consideration

Using mobile payments, a consumer who previously needed to visit a distributor outlet or ATM to top-up his pre-paid phone card may be able to key in his credit card over the phone to conduct the top-up. A merchant who was previously unable to sell his perishables could consider using m-payments to reach his customers at the last-minute.

These categories of services were identified from the CFC trial results as follows:

a) In the YW8 trial, P2P payments and ticketing transactions from Eng Wah formed 87% and 9% of the total transactions respectively. Bill payment was also relatively popular despite the later start date of the services and the monthly-occurring nature of bill payments. *[P2P, Perishables, Bill and fine payments]*



Merchant	Launch Date
Eng Wah	March 2002
NUS	March 2002
NUS	April 2002
I2u	April 2002
M1	July 2002
SingTel	October 2002

Figure 2. Breakdown of YW8 transactions and launch date of various services

b) Also in the YW8 trial, m-payments was used for pre-paid top-up for National Library Board's eLibraryHub account. Although transaction volume was lower compared to ticketing and P2P, this was mainly due to the availability of other channels for top-up and the fact that most users settled their fines on their next visit to the library. *[Pre-paid top-up]*

c) In the Gemini trial, there was a significant amount of repeat usage for P2P payments throughout the three months of the trial. *[P2P]*

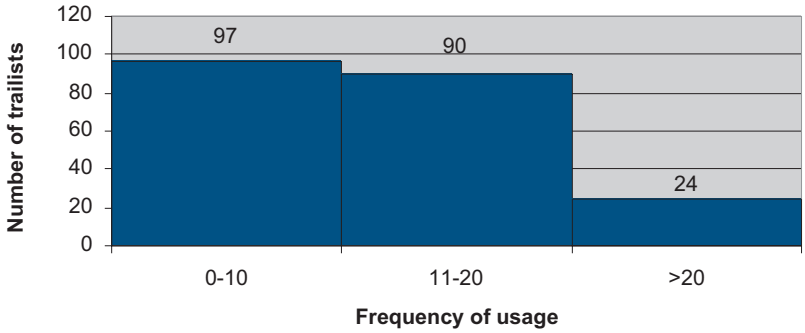


Figure 3. Frequency of usage in Gemini trial (201 users)

d) The results of the TeleParking trial (more than 700 transactions in 2 months) suggests that payments for unmanned vending machine applications including auto-pay stations may also have potential for m-payments. In the case of auto-pay stations, m-payments may be especially attractive in countries where the In-Vehicle Unit (IVU) payment infrastructure is not available. In Singapore, car park operators need to weigh the m-payment option along with other car parking technology options including Electronic Parking Systems. *[Unmanned vending payments]*

e) Systems@Work had, outside the trial, also deployed mobile payments for Internet services provided by FujiFilm. The service helped generate increase in sales of photo printing for the FujiFilm outlets and the outlets are still adopting the service after close to two years of adoption. *[Internet and mobile applications and services]*

A few of these six categories are also validated by results of m-payment services that have been deployed overseas including:

a) *(Finland)* On September 2001, the Helsinki Traffic Authority launched an SMS-ticketing service that allowed a customer to purchase single trip tram or subway tickets by sending an SMS message to a certain phone number and then receiving the "ticket message" on his phone. The customer was required to show the ticket to a traffic authority inspector if one boarded the tram. The price of the ticket was added into the customer's phone bill. After a slow start the SMS ticket sales had gained popularity and as of August 2002, over half a million tickets were purchased via SMS. It was found in the trials that the SMS ticket arrived into the phone so quickly that some riders ordered the tickets only when the inspectors came aboard. To deal with this issue, the Traffic Authority planned to build a delay into the SMS ticket.[1] *[Perishables-Ticketing]*

b) *(China)* After years of losses, China's three biggest Internet portals - NetEase.Com Inc, Sina.Com Inc and Sohu.Com Inc, are making a sharp turnaround and posting their first profits. A recent Jan 2003 Singapore Business Times report attributed this turnaround to their collaboration with mobile operator China Mobile to collect revenues using m-payments. The portals found an easy way to charge users who visited their Web sites via SMS. The portals obtained about 1.5 yuan (34.6 Singapore cents) each time a mobile user downloaded information or games.[2] *[Internet and mobile applications and services]*

c) *(Netherlands)* On Oct 2001, O2 (formerly BT) and ING Postbank (ING) collaborated in deploying a pre-paid top-up solution for O2 customers. ING distributed over half a million phones to customers who were willing to deposit at least 500 Euros into a new account. In each phone, there was an application that would allow consumers to top-up their O2 pre-paid accounts from the phone. O2 reported that it gained 376,000 new mobile customers from this trial, and ING gained close to 500,000 new bank accounts.[3] *[Pre-paid top-up]*

[1] Helsinki SMS tram tickets gain in popularity", Mobile CommerceNet, Aug 2002
[2] From bust to better: China's Internet firms roar back to life", (Singapore) Business Times, 18 Jan 2003.
[3] www.macalla.com

(2) Mobile payments is more suitable for remote payments than face-to-face retail payments

The TeleParking, TelePay trial and focus group feedback from the Blink trial showed that mobile payments was more suitable for remote payments than for retail face-to-face payments. This was likely because of consumers' deeply entrenched habits of just using their cash or swiping their credit or debit cards when making a face-to-face retail transaction. For m-payments to be relevant in a face-to-face transaction, service providers need to match the speed, convenience and reach of these established payment methods. An illustration of this would be the use of RFID-based transit cards for retail purchases in Hong Kong. Launched in September 1997 as a transit fare card, the Octopus card is now offered by over 130 service providers, including car parks and retailing services. Today, more than 8.6 million Octopus cards are in circulation, with over 7.2 million transactions daily.

(3) Credit card payments is the preferred payment method for larger value mobile payment transactions

For micro-payment transactions, bill-on-behalf via the operators is likely to be the preferred method of payment. For larger value mobile payments where billing-on-behalf is not offered, credit card payments seem to be the preferred method of payment.

Blink's focus groups revealed that customers would like to use credit products via m-payments to obtain benefits such as disputing and loyalty points. In the Eng Wah trial that lasted 9 months and garnered 2,400 transactions, 83% of transactions were credit card transactions, while the remaining were Virtual Card transactions. Both payment methods were offered by Eng Wah at the same time.

The preference for credit card usage for m-payments is likely due to the already popular usage of credit cards for traditional payments and e-commerce payments. As of end 2002, there were 3.2 million credit cards circulating in Singapore with total billings amounting to over a billion dollars a year.[4] This usage is in turned likely spurred by consumer incentives and the ability to delay and dispute payments when using credit cards.

(4) Consumers aged 20-40 appear to be most receptive to the mobile payment services deployed in the trial

The YW8 consortium concluded, after 9 months of trials, that persons aged 20-40, and not teens, were the most receptive to m-payment services piloted in YW8. This is likely related to the above point on the popularity of credit card usage; in Singapore, credit cards can only be issued to consumers 21 years and above.

The Gemini consortium, a direct debit trial also recorded that more than 80% of their registered and actual users were aged 20-40.

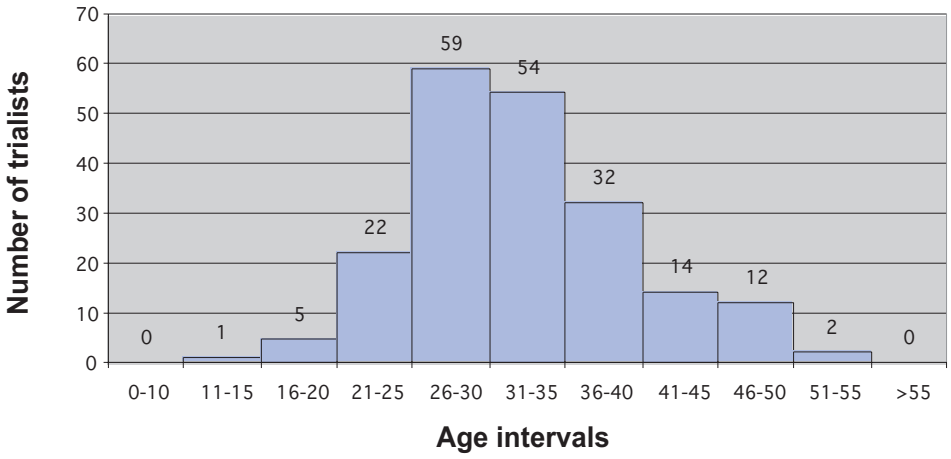


Figure 4. Age distribution for Gemini users (201 users)

[4] Source: Monetary Authority of Singapore

Another likely cause of this is the higher income bracket of this age group and the fact that they are more likely to be the persons paying for bills, making fine payments and driving cars (and hence have use for car park applications).

Higher incomes also meant higher opportunity costs of "lost time". The trial applications could have thus appealed more to this age group, compared to teens since the applications aimed to help "save-time" by bringing greater convenience to the consumers. The teen market may still be the market segment for m-payment services that help to "kill-time" including payment for the download of games, ring-tones and usage of chat-lines services.

(5) Consumers prefer to use existing handsets for mobile payments

The Gemini and Go Virtual trials validated the hypothesis that consumers will not purchase new handsets in order to conduct m-payments. In the Go Virtual trial, consumers who did not already have the Nokia 3330/ 3310 phones were not willing to purchase the phones in order to participate in the service. Even consumers with the appropriate Nokia 3330/3310 handsets were sometimes unwilling to go to the collection centres in order to collect the free RFID covers. To the furthest extent possible, providers should consider leveraging on capabilities of existing handsets available in the market for m-payment services.

(6) Registration processes and user interface need to be simplified in order to encourage greater consumer adoption

While most consortia had invested significant resources on simplifying the payment flows and user interface for the consumer, the trials showed that it was just as crucial to simplify the registration process. For example, the trials showed that consumers found difficulty in having to register physically. Most even found it tedious to fill online forms to sign-up for m-payment services. These registration processes caused m-payments to lose its immediacy and mobility. An unregistered user who wanted to make an impulse purchase would not be able to do so with such processes in place. It also reduced the effectiveness of word-of-mouth since a person who was already a registered user could not show his or her friends how they could also use the m-payments system unless they were near an Internet-enabled PC. To ease registration, service providers may consider allowing customers to sign up for the m-payment service when they sign up for other services. To illustrate, a mobile operator offering a mobile payment service could allow customers to sign up for the mobile payment service when the customers signed up for a mobile subscription plan.

(7) SMS may not be well-suited for lengthy transactions

While there is high usage of SMS in Singapore and widespread use of SMS for m-payments overseas, the trials revealed that SMS may not be well-suited for all types of transactions.

Cost Specifically, in using SMS for lengthy transactions such as those involving non-commodities, a merchant may end up sending several messages to the consumer in order to define the product. These messages may become quite costly to the merchants since these are recurring costs (*see inset*). The use of IVR or WAP may be more appropriate under such circumstances.

Scalability SMS may also present scalability issues to service providers. To illustrate, a service provider that uses one single port number for multiple merchants will encounter scalability issues when more merchants sign-up for the service. Due to the 160-character per message limitation of SMS, a user who requests for the menu of merchants may end up receiving several messages in order to view the full list of merchants.

Use of SMS in lengthy transactions

A ticketing transaction, for example, is defined by at least four attributes - movie name, location, time and number of tickets. Assuming an SMS costs 5 cents to the cinema operator, an average transaction will cost at least 20 cents. Even after the product is defined, consumers may abandon the transaction, resulting in pure loss per transaction for the cinema operator. In comparison, an outgoing IVR fixed-line call costs less than 2 cents a minute to the merchant. In a WAP implementation, the merchant does not incur recurring costs per transaction.

The alternative implementation would be for each merchant to obtain a unique port number and for the consumer to SMS directly to the merchant. The trade-off lies in additional cost for the merchant in securing the port number and in marketing the number. This option is thus suitable for merchants that have a convenient marketing channel for the number.

(8) Wireless PKI may be too costly to implement for small value transactions
In the Gemini trial, consumer feedback showed that most consumers actually liked using the system and to many, they were just keying in six-digit PINs and the wireless PKI technology was transparent to them. The drawback of this was that many consumers did not understand the notion of PKI and thus would not be willing to pay additional for a PKI-enabled transaction versus a PIN-based transaction. This could also be due to the fact that in the trial, consumers were not subject to differentiated liability levels depending of whether they used a PIN-based or WPKI-based system.

Another potential issue that surfaced during the trial was the need for consumers to personally register for the digital certificate, at least for the level of security that was implemented in the trial. While few problems were encountered in registering slightly over 200 persons during the trial, it may be much more costly and time-consuming to implement a similar system for a commercial service.

8. Conclusion

M-commerce revenues in Singapore alone will reach US$279 million by 2004 and double to US$528 million by 2006.

- estimates from "Asia Pacific M-Commerce Forecast and Analysis", Oct 2002, IDC

Although mobile payments is in its infancy, the development of an open, non telco-centric mobile payments infrastructure is an important step towards realizing the fuller benefits of mobile commerce. The CFC has helped to spur initial take-up and consumer and merchant awareness of the potential of m-commerce. Just as importantly, it has provided insights into consumer behaviour and business issues in a local context – insights that IDA hopes will be useful to the consortia and other m-payment providers and businesses as they embark on their m-commerce initiatives.

Appendix A – Company Information of Consortia

Appendix A-1 – Company information of Blink consortium

ABN AMRO Bank

ABN AMRO is one of the largest financial institutions in the world and serves its wholesale, consumer and commercial, and private and asset management clients through an extensive global network. Headquartered in Amsterdam, ABN AMRO has total assets of over US$620 billion and employs more than 100,000 professional staff worldwide. ABN AMRO was founded in 1824 and has been active in Asia since 1826.

Established in 1858 in Singapore, ABN AMRO Bank is the oldest bank here. It was awarded the Qualifying Full Bank (QFB) Licenced by the Monetary Authority of Singapore in October 1999, and since then, has opened five branches and has two off-site ATMs (Automated Teller Machines).

Website: www.abnamro.com.sg

BCS Information Systems

BCS Information Systems (BCSIS) is a leading payment and clearing solutions provider, with 15 years of experience in supporting central banks, clearing houses and commercial banks to offer a higher level of service to their customers.

Headquartered in Singapore, projects undertaken include the nationwide eGIRO System and Cheque Truncation System in Singapore, Real Time Gross Settlement System in Malaysia, Indonesia, Shenzhen and Hong Kong, Deferred Net Settlement System in Brazil, Scripless Securities Settlement System and Electronic Cheque Clearing System in Malaysia and Indonesia, Business Process Outsourcing services to 3 largest banks in Singapore and Payment and Clearing Consultancy Services in Asia-Pacific.

Website: www.bcsis.com

C.K.Tangs

From humble beginnings, C K Tang Limited has established itself as a prominent leader in Singapore's vibrant retail scene. It has been at the forefront of local retail and a leader in fashion and contemporary lifestyle retailing since the opening of its first store in 1932. Tangs continues to set the pace for the local fashion scene and the development of the retail industry through design innovation, creative retailing, service excellence and a continuing effort to offer quality merchandise at affordable prices. Today, in addition to its successful flagship department store, Tangs in Orchard Road, C K Tang Limited has a number of niche and speciality businesses in Singapore and Malaysia, each with its own identity and customer base.

Website: www.tangs.com

CalendarONE TicketCharge

As the first comprehensive computerised ticketing system set up in Singapore in 1991, TicketCharge has accumulated vast experience in handling the ticketing needs of event organisers and show promoters. TicketCharge provides a full suite of ticketing services for both large-scale and small-scale events at venues around Singapore. Its services to event organisers and show promoters encompass the sale of event tickets via its network of distribution outlets on-line and call-centre channels, ticket inventory management, sales reporting and in the near future, mobile ticketing services.

Website: www.ticketcharge.com.sg

Cathay Cineplexes

Cathay Organisation is a leading company engaged in the businesses of entertainment, leisure, lifestyle and property management services. Established in 1935, it is today listed on the Stock Exchange of Singapore (SESDAQ) as Cathay Organisation Holdings Ltd. Cathay Cineplexes Pte Ltd, one of the five subsidiaries of Cathay Organisation Holdings Ltd, was incorporated in 1998 in an effort to deliver a high quality cinematic experience to patrons in Singapore and Malaysia. To date, it owns and operates 13 screens in Singapore and manages another 18 screens in Malaysia.

For its commitment and drive to achieve world-class standards in cinematic experience for cinema-goers, Cathay Cineplexes has won numerous accolades and awards from the media and the public. Cathay Cineplexes has earned the distinction of having the "Overall Best Screens in Singapore" by The Straits Times. Cathay Cineplex, Orchard was also voted the runaway favourite in the "Nominate Your Favourite Cinema Contest" held by Adpost. Cathay Cineplexes continues to explore means to enhance the movie-going experience. In an effort to uphold the professional standard of cineplex operations, the company became the first Cineplex operator in Singapore to achieve ISO 9002 certification awarded by the Singapore Productivity and Standards Board (PSB) in December 2000.

Website: www.cathay.com.sg

CET Technologies

CET Technologies Pte Ltd

Singapore Technologies Electronics

CET Technologies Pte Ltd (CET) is a subsidiary of Singapore Technologies Electronics (ST Elect), the electronics arm of Singapore public-listed Singapore Technologies Engineering (ST Engg), one of the largest electronics system houses in the region. CET has, over the past two decades, built up extensive experience and skills as a leading system house in the region for communication and electronics businesses. It has vertically integrated the processes of design, development, production, system integration, maintenance and system upgrade to be a one-strop solution house for its customers. Its core business expertise includes mobile solutions and infocomm appliances, intelligent traffic and fleet management systems, integrated communications solutions, radio frequency tagging systems, and infosecurity products and solutions.

Website: www.cet.st.com.sg

CitiBank

Citibank is part of Citigroup (NYSE: C), the pre-eminent global financial services company with some 200 million customer accounts in more than 100 countries. Citigroup provides consumers, corporations, governments and institutions with a broad range of financial products and services, including consumer banking and credit, corporate and investment banking, insurance, securities brokerage, and asset management. Major brand names under Citigroup's trademark red umbrella include Citibank, CitiFinancial, Primerica, Smith Barney, Banamex, and Travelers.

Website: www.citibank.com

MasterCard International

MasterCard International has a comprehensive portfolio of well-known, widely- accepted payment brands including MasterCard®, Cirrus® and Maestro®. More than 1.7 billion MasterCard, Cirrus and Maestro logos are found on credit, charge and debit cards in circulation today. With approximately 25,000 MasterCard, Cirrus and Maestro members worldwide, MasterCard serves consumers and businesses, both large and small, in 210 countries and territories. MasterCard is a leader in quality and innovation, offering a wide range of payment solutions in the virtual and traditional worlds. MasterCard's award-winning Priceless® advertising campaign is now seen in 90 countries and in 45 languages, giving the MasterCard brand a truly global reach and scope. With more than 29 million acceptance locations, no payment card is more widely accepted globally than MasterCard. For the nine months ended September 30, 2002, gross dollar volume exceeded US$831.7 billion.

Website: www.mastercard.com

Maybank

Maybank is among the top five banks in ASEAN and is a Qualifying Full Bank in Singapore. Maybank has 22 Branches and 26 ATMs, including three off-site ATMs located at Jurong Point Shopping Centre, Terminal 2 of Changi International Airport and the Tanjong Pagar Railway Station.

Maybank is customer-focused and continually pursues initiatives on how to better anticipate customers' evolving needs. Maybank is committed to bringing convenience and a wider range of financial services to their customers via both traditional and electronic channels, enabling them to conduct their banking needs anytime, anywhere in the world.

Maybank will continue to move towards relationship banking and focus on providing value-added financial services to their customers by harnessing the latest technological advancements.

Website: http://www.maybank2u.com.sg

Metro

The Metro Group's core businesses – property and retail – are located in some of the key cities of Singapore, Malaysia, China, Indonesia and Australia. The Group employs and trains more than 1,065 staff to provide the best products and services.

Metro is a familiar and respected icon in Singapore's retail industry. Beyond the chain of five Metro department stores in Singapore, the retail division continues to build a strong brand presence in Indonesia with four retail stores. Its retail space is 870,000 square feet.

The Metro Group's property ventures have an interest in a total of 1.5 million square feet of prime retail and office space in Singapore, and Shanghai and Guangzhou in China. The Group also has a 24.5% interest in 700,000 square feet of retail space in Penang, Malaysia. In the hospitality arena, the Group owns The Oasis Resorts, Cairns, a 314-room resort hotel in North Queensland, Australia.

Website: www.metro.com.sg

Mobile Solutions and Payment Services

Mobile Solutions and Payment Services aims to become a leading mobile payment and mobile commerce service provider in Singapore and the region. MSPS will provide more than mobile payment solutions as it aims to be an innovator in mobile applications and solutions. Besides payments, it will provide new and value-added mobile applications, and end-to-end solutions and services in collaboration with financial institutions, telecommunication companies and content or information providers.

Website: www.blinkmobile.com

mPayment

mPayment is a specialist mobile payment solutions provider, m-commerce enabler and m-marketing solutions company. Started by a team of four young payment and banking security professionals, it holds four new patent-pending technologies - mPurse™, mDebit™, mCredit™ and mP2P™. mPayment's mPurse™ is a world's first end-to-end mobile stored-value micro-payment solution, fully deployed on an extensive, secure and reliable multi-bank multi-merchant payment infrastructure. mPurse™ enables any mobile phone user to send a simple SMS to the mPayment mPurse™ Gateway ("MMG") to authorize and instruct micro-payment from the user's virtual e-purse account to a designated merchant. mDebit™ and mCredit™ will enable a consumer to use any mobile phone to authorise and authenticate his instructions for micro-payments and enable Visa-type transactions or direct debit from his account in a participating bank and deliver payment record to a participating merchant. mP2P™ will enable mobile peer-to-peer micro-payments including cross-border transactions.

Website: www.2mpayment.com

National Service Resort and Country Club

The National Service Resort & Country Club is a premium but affordable country club for national servicemen (NSmen), in recognition of their contribution to Singapore's total defence. The resort currently has a membership base of 10,000. The Resort is the first country club in Singapore to have golf courses, holiday bungalows, a fully equipped sea sports centre and complete resort and country club facilities under one roof. The Resort also strives to extend quality service to its members. In line with this objective, the resort attained the ISO 9002 status in July 1997, which makes it the first country club in Singapore to do so.

Website: http://www.esrcc.com.sg

StarHub Mobile

StarHub is a Singapore-based media and info-communications company providing a full range of information, communications and entertainment services over fixed, mobile and internet platforms. It operates its own nationwide broadband network that delivers multi-channel cable TV services, data services, voice services, and internet access services. StarHub also operates its own GSM network that is fully upgraded for GPRS services. Driven by a passion for listening and providing what customers want, StarHub endeavours to bring affordable and premium quality services with innovative and useful features to all its customers. StarHub raises the level of competition in Singapore, challenging others as well as challenging itself, to constantly introduce new world-class services at competitive prices. This unwavering commitment will further strengthen Singapore's position as a leading media and info-communications hub in the region.

Website: www.starhub.com

Singapore Technologies Electronics

ST Electronics (ST Elect), the electronics arm of Singapore Technologies Engineering (ST Engg), is one of the largest electronics system houses in the region. ST Elect prides itself in delivering innovative system solutions to defence, commercial and industrial customers worldwide. It specialises in the design, development and integration of advanced electronics systems, such as broadband radio frequency and microwave communication systems, rail and traffic management systems, real-time command and control systems, training and simulation systems, intelligent building management systems, and information security and m-commerce solutions. ST Elect applies leading edge technologies and design methodologies to meet the stringent requirements of customised electronics systems and solutions. It undertakes continuing research and development to help create cost-effective proprietary products at system and component levels, delivering innovative and quality solutions to customers.

Website: www.stee.st.com.sg

WizVision

WizVision is a technology company providing end-to-end solutions for payments, bill presentment and on-line banking. With clients that include leading international banks, payment processors, large enterprises and government agencies, the company has consistently delivered significant and quantifiable benefits to its clients through the innovative use of technology. The company, which started in April 2000, is rapidly expanding the regional distribution network for its products, while maintaining a strong focus on research and development. The company has been profitable since incorporation.

Website: www.wizvision.com

Appendix A-2 – Company information of GEMINI consortium

DBS Bank

DBS Bank is the largest bank in Singapore as measured by assets, with dominant positions in consumer banking, treasury and markets, securities brokerage, Singapore dollar loans, deposits, and equity and debt fund raising. Through its Dao Heng Bank and DBS Kwong On Bank operations, DBS Bank is the fourth largest banking group in Hong Kong. Beyond the anchor markets of Singapore and Hong Kong, DBS Bank serves corporate, institutional and retail customers through its operations in Thailand, The Philippines, and Indonesia. The bank's credit ratings are amongst the highest in the Asia-Pacific region.

Website: www.dbs.com

NETS

NETS was founded in 1985 to operate and manage an on-line debit payment service. It has since grown from a single to a multi–service organisation, providing a comprehensive range of electronic payment services.

Based in Singapore, NETS is expanding internationally with a vision to becoming the preferred world-class solution provider for payment and processing services, accepting multimedia and multi-channel transactions on behalf of companies, institutions and individuals around the world. NETS products and services are currently marketed in the Philippines and South Korea.

NETS provides merchants, banks and consumers with fast and convenient electronic payment services for carrying out everyday transactions. With a willingness to push new technology frontiers, NETS is continuously developing new payment solutions to create an integrated multimedia platform that allows payments to be made seamlessly across the mobile, wireless and physical arenas. With a growing range of payment services, NETS is poised to become the integrated payment gateway for Asia.

Website: www.nets.com.sg and www.govirtual.com.sg

Nokia

A leader in the cellular industry in many markets across Asia Pacific, Nokia provides innovative, industry-leading and market relevant technology and products to about 20 different markets in the region. Nokia is the world leader in mobile communications. Backed by experience, innovation, user-friendliness and secure solutions, the company has become the leading supplier of mobile phones as well as a top supplier of mobile, fixed broadband and IP networks. By adding mobility to the Internet, Nokia creates new opportunities for companies and enhances the daily lives of people. Nokia is a broadly held company, listed in six major exchanges.

Website: www.nokia.com

Appendix A-3 – Company information of Go Virtual consortium

NETS

NETS was founded in 1985 to operate and manage an on-line debit payment service. It has since grown from a single to a multi–service organisation, providing a comprehensive range of electronic payment services.

Based in Singapore, NETS is expanding internationally with a vision to becoming the preferred world-class solution provider for payment and processing services, accepting multimedia and multi-channel transactions on behalf of companies, institutions and individuals around the world. NETS products and services are currently marketed in the Philippines and South Korea.

NETS provides merchants, banks and consumers with fast and convenient electronic payment services for carrying out everyday transactions. With a willingness to push new technology frontiers, NETS is continuously developing new payment solutions to create an integrated multimedia platform that allows payments to be made seamlessly across the mobile, wireless and physical arenas. With a growing range of payment services, NETS is poised to become the integrated payment gateway for Asia.

Website: www.nets.com.sg and www.govirtual.com.sg

Nokia

A leader in the cellular industry in many markets across Asia Pacific, Nokia provides innovative, industry-leading and market relevant technology and products to about 20 different markets in the region. Nokia is the world leader in mobile communications. Backed by experience, innovation, user-friendliness and secure solutions, the company has become the leading supplier of mobile phones as well as a top supplier of mobile, fixed broadband and IP networks. By adding mobility to the Internet, Nokia creates new opportunities for companies and enhances the daily lives of people. Nokia is a broadly held company, listed in six major exchanges.

Website: www.nokia.com

Appendix A-4 – Company information of TelePay/ TeleParking consortium

Systems@Work

Systems@Work is a secure, end-to-end mobile electronic payment technology company with its headquarters in Singapore. Its patented TeleMoney technology enables a mobile phone to be used as the device to make convenient and secure payments. TeleMoney's users can transact via multiple Internet and wireless access channels such as the Interactive Voice Response, the Wireless Application Protocol and the Short Message Service, and select to pay from multiple payment methods such as credit cards, debit cards, prepaid cards, charges to phone bills and direct debit.

Systems@Work builds and operates secure payment and billing gateways for financial institutions and corporate clients as an ASP. The services are called TeleMoney ShopperAssure and TeleMoney BusinessAssure for B2C and B2B marketplaces respectively. Systems@Work also provides consultancy, builds, operates or licenses the TeleMoney technology to companies with large customer bases that would like to have their own private secure mobile payment services.

Website: www.TeleMoneyworld.com

Gemplus

Gemplus, the world's leading provider of smart card solutions, helps its clients offer an exceptional range of portable, personalised solutions that bring security and convenience to people's lives. These include mobile Internet access, interoperable banking facilities, e-commerce and a wealth of other applications.

Gemplus is the only completely dedicated, truly global player in the Smart Card industry, with the largest research and development team, unrivalled experience, and an outstanding track record of technological innovation. In 2001, Gemplus was the worldwide smart card leader in both revenues and total smart card shipments (source Gartner-Dataquest and Frost & Sullivan). Gemplus was also awarded Frost & Sullivan's 2002 Market Value Award for its exceptional performance.

Gemplus trades its shares on Euronext Paris S.A. First Market and on the NASDAQ Stock Market as GEMP in the form of ADSs. Its revenue in 2001 was 1 billion Euros.

Website: www.gemplus.com

Hewlett-Packard Bazaar

Based in the world's technology epicentres, HP's Mobile E-Services Bazaar is a centre for collaboration, where the key players in the mobile ecosystem can work together. The Bazaar is the hub of a rapidly growing global community of mobile applications developers. HP's Mobile E-Services Bazaar is part of the HP Solution Partner Division.

Website: http://www.hpbazaar.com

Suntec City

Suntec City is the single largest integrated commercial development in Singapore consisting of 7 million square feet of convention, exhibition, offices, retail and car park space. A popular "city within a city", Suntec City offers a complete lifestyle to the working community.

To remain relevant in the IT age, Suntec City leverages on technology to enhance its core competency, thus adding intangible value to the tenants. By transforming its traditional role of landlord to a revolutionary role of a Facilities Service Provider, FSP (patent pending), Suntec City offers the tenants more than just physical space. Suntec City actively sources for innovative products and services that will enhance the lifestyle for its tenants and visitors, providing them with much benefits from cost savings and value added services, which results from the aggregation of such useful facilities and services.

Through its revolutionary business model, Suntec City is able to create the catalysts that attract the desired crowds and suitable occupants to Suntec City. More importantly, Suntec City is able to interact with them actively, to enhance the value for all parties involved. This is a truly win-win-win situation for the entire Suntec Ecosystem. By do this, Suntec City has undergone a powerful transformation to become an exciting and vibrant environment which has earned itself the enviable reputation of being "Asia's Vertical Silicon Valley". This transformation has augmented Suntec City's market value exponentially over the past couple of years.

As a FSP, Suntec City is committed to provide quality services to its tenants, shoppers and the general public, as well as foster the Suntec City Community spirit, and create an intangible sense of pride and belonging.

Website: http://www.sunteccity.com.sg

VISA International

VISA International is the world's leading payment brand and the largest payment system worldwide. Visa branded cards generate almost US$2 trillion in annual volume worldwide and are accepted at 22 million merchant locations and 700,000 Automated Teller Machines around the world. Visa is also a leader in electronic commerce, with more than 50 percent of electronic transactions being made with Visa.

In the Asia Pacific, Visa has a market share of more than 56 percent in terms of retail sales volume, more than all other payment brands combined. During 2001, a total of US$480 billion was spent in Asia Pacific using Visa cards, growth of 70 per cent over the previous year. By the end of 2001, the number of Visa cards on issue in Asia Pacific had risen to 330 million, including all Visa, Visa Electron, Interlink, and PLUS-branded cards.

Website: www.visa-asia.com

Appendix A-5 – Company information of YW8 consortium

National Computer Systems

National Computer Systems Pte Ltd (NCS) is a wholly owned subsidiary of the Singapore Telecommunications Group Ltd (SingTel Group). As the region's leading IT service provider, NCS's mission is to help customers create business value and gain competitive edge through the strategic implementation of IT and engineering solutions. With a regional workforce of 2,800, the core competencies of NCS are business consulting, systems integration and development, infrastructure integration and outsourcing. NCS has provided the technology expertise for this mobile payment solution. It provided integration, implementation and consultancy services for the project.

Website: www.ncs.com.sg

NETS

NETS was founded in 1985 to operate and manage an on-line debit payment service. It has since grown from a single to a multi–service organisation, providing a comprehensive range of electronic payment services.

Based in Singapore, NETS is expanding internationally with a vision to be the preferred world-class solution provider for payment and processing services, accepting multimedia and multi-channel transactions on behalf of companies, institutions and individuals around the world. NETS products and services are currently marketed in the Philippines and South Korea.

NETS provides merchants, banks and consumers with fast and convenient electronic payment services for carrying out everyday transactions. With a willingness to push new technology frontiers, NETS is continuously developing new payment solutions to create an integrated multimedia platform that allows payments to be made seamlessly across mobile, wireless and physical arenas. With a growing range of payment services, NETS is poised to become the integrated payment gateway for Asia.

Website: www.nets.com.sg & www.nets.com.sg/yw8

MobileOne

M1, Singapore's most exciting and innovative mobile, IDD and paging service provider, was launched in April 1997. Since then, it has made significant inroads into the local mobile communications market, gaining considerable brand presence and market share. M1 aims to be the leader in personal voice and data communications, focusing on value, quality and customer service. M1 has been a pioneer in providing mobile financial services including Asia's first SMS-based mobile banking service and one of the world's first CashCard top-up services via the mobile phone.

Website: www.m1.com.sg

SingTel

SingTel is Asia's leading communications company with a comprehensive portfolio of services that include voice and data services over fixed, wireless and Internet platforms. Serving both the corporate and residential markets, SingTel is committed to bringing the best of global communications to its customers in the Asia Pacific and beyond. SingTel Mobile, its wholly-owned subsidiary, leads the Singapore market with more than 1.5 million mobile subscribers, who enjoy an automatic dualband GSM900 and GSM1800 service as well as excellent indoor and outdoor coverage. As the leading mobile operator in Singapore, SingTel has pioneered many innovative and exciting services to benefit its customers. It was the first to introduce SMS, WAP and location-based services (LBS) using the *SEND service into the local mobile market.

Website: www.singtel.com

StarHub

StarHub is a Singapore-based info-communications company providing a full range of information, communications and entertainment services over fixed, mobile and Internet platforms. It operates its own nationwide broadband network that delivers multi-channel CableTV services, data services, voice services, and Internet access services. StarHub also operates its own GSM network that is fully upgraded for GPRS services.

Driven by a passion for listening and providing what customers want, StarHub endeavours to bring affordable and premium quality services with innovative and useful features to all its customers.

Website: www.starhub.com.sg

DBS Bank

DBS Bank is the largest bank in Singapore as measured by assets, with dominant positions in consumer banking, treasury and markets, securities brokerage, Singapore dollar loans, deposits, and equity and debt fund raising. Through its Dao Heng Bank and DBS Kwong On Bank operations, DBS Bank is the fourth largest banking group in Hong Kong. Beyond the anchor markets of Singapore and Hong Kong, DBS Bank serves corporate, institutional and retail customers through its operations in Thailand, The Philippines, and Indonesia. The bank's credit ratings are amongst the highest in the Asia-Pacific region.

Website: www.dbs.com

Diethelm Singapore

Diethelm Singapore Pte Ltd originated from Switzerland in the nineteenth century. It is now a multi-division organisation today, specialising in consumer goods, pharmaceuticals, furniture, architectural, industrial and engineering products and more. The Diethelm Group, with companies and affiliates in North America and Europe, was established in the Far East in 1871. Since its merger with Edward Keller in 2000, the Diethelm Keller Group was able to further nurture its values and strengths across Asia. To implement the SMS payment in the trial, the company had to develop firmware for the communication between the existing equipment and system providers via the NETS network, and modify current equipment on-site.

Eng Wah Cinemas

Eng Wah is one of the leading service providers of entertainment in Singapore. It is involved in film distribution, film exhibition, and the developing and leasing of multifaceted entertainment centres. The Group currently operates six cineplexes (total of 29 screen halls) that are strategically located in Suntec City Mall and most of the other densely populated town centres of HDB estates, such as Ang Mo Kio and Toa Payoh. Eng Wah wants to be the preferred provider of entertainment in the markets that it serves. Its emphasis is on delivering customer-focused services at affordable prices. With the mobile payment solutions, its customers can now enjoy the convenience of buying movie tickets via SMS while on the move, literally anytime and anywhere. This service will provide consumers SMS alerts of movie schedules and payment of the tickets via SMS. Alternatively, consumers may choose to request for movie information and pay for tickets via SMS. Consumers can also choose to request for movie information and pay for tickets via a WAP phone.

Website: www.ewcinemas.com.sg

National Library Board

The National Library Board (NLB) was established on 1 September 1995 with the mission to continuously expand the learning capacity of the nation. NLB oversees the management of the National Library, two regional libraries, 20 community libraries, 45 community children's libraries, as well as libraries belonging to government agencies, schools and private institutions. Its digital library, eLibraryHub, provides patrons access to information resources and services anytime, anywhere. Through its innovative use of technology and its collaboration with strategic partners, the NLB ensures that library users have access to a rich array of information services and resources that are convenient, accessible, affordable and useful.

Website: www.nlb.gov.sg

National University of Singapore

The National University of Singapore (NUS) has its roots in Singapore's first centre of higher education - The Straits Settlements and Federated Malay States Government Medical School, which was founded in 1905. It was given its present name in 1980 through a merger between the University of Singapore and Nanyang University. As a confluence of talents, it is well placed to be the intellectual and entrepreneurial pulse of Singapore. Being a knowledge enterprise, NUS seeks to create, impart and apply knowledge. With this mobile payments service, NUS students can have services such as SMS alerts of library fines, payment of fines, and checking of exam results.

Website: www.nus.edu.sg

Visa Asia Pacific

Visa is the world's leading payment brand and the largest payment system worldwide. Visa's branded cards generate almost US$2 trillion in annual volume worldwide and are accepted at 22 million locations around the world. In Asia Pacific, Visa has a dominant market share of more than 56 percent in terms of card sales volume, more than all other payment brands combined. During the 12 months ended September 30, 2001, Visa Asia Pacific reported card sales volume of US$450 billion, including US$298 billion in card sales volume plus a further US$154 billion of commercial activity using Visa cards in China. In the same period, the total number of Visa, Visa Electron, Interlink and PLUS-branded cards on issue in Asia Pacific rose to 315 million. Visa is a leader in Internet-based payments and is pioneering the creation of u-commerce, or universal commerce, which is the ability to conduct commerce anytime, anywhere, over any type of device.

Website: http://www.visa-asia.com

Appendix B – Technology Overview of WPKI and RFID (for Gemini and Go Virtual trial)

Appendix B-1 – Technology Overview of PKI and WPKI (for Gemini trial)

1. About Public Key Infrastructure (PKI)

A PKI is a set of hardware, software, people, policies and procedures needed to create, manage, store, distribute, and revoke digital certificates based on public-key cryptography.[1] The PKI environment can generate trust in a transaction by ensuring the following four attributes:

a) Authentication - The user is who he claims to be
b) Confidentiality - The transaction is made known only to the intended recipient
c) Integrity –The transaction was not tampered with en-route to the recipient
d) Non-repudiation – Parties involved in the transaction cannot disprove the validity and existence of the transaction

The following paragraphs describe the various components of a PKI in greater detail:

Public key cryptography is a key component of any PKI and involves the use of a mathematical function known as an asymmetric encryption algorithm. Based on the characteristics of the algorithm chosen, one can decide on a pair of numeric strings - one of which made known to the user (private key) while the other can be revealed to any third-party (public). Examples of asymmetric algorithms include Rivest-Shamir-Adleman (RSA) and the Elliptic Curve Cryptography (ECC). These algorithms are "asymmetric" because the private key is different from the public key. It has been shown that it is computationally hard to derive the private key from the public key, even if the cryptography function is known. In addition, a message that is encrypted by a public key can only be decrypted by the corresponding unique private key. To illustrate, if Alice (the sender) wishes to send Bob (the intended recipient) a confidential message, she would encrypt the message using Bob's public key before sending it to Bob. Bob then uses his private key to decrypt the message. Anyone else who intercepts the encrypted message from Alice will not be able to decipher the message, since only Bob's private key can decrypt the message.

Certificate Authority (CA) In the above example, it is important that Alice encrypts the message using only Bob's public key. Otherwise, any adversary impersonating Bob may simply send Alice the adversary's own public key and Alice may use that public key to encrypt and send the message, thinking that she was using Bob's public key. The adversary then intercepts the encrypted message from Alice to Bob, decrypts it with its own private key, re-encrypts it with Bob's public key and sends it on to Bob.

The "man-in-the-middle" attack described above can be averted if a trusted third party is used by Alice to obtain Bob's public key. Certificate authorities (CAs) play the role of this trusted third party. CAs are responsible for issuing and revoking digital certificates. Digital certificates include information such as the name of the issuing CA, the validity period, the user's name, address and public key. When issuing a certificate to a user, the CA signs the certificate with its private key in order to validate it. As such, for Alice to obtain Bob's public key securely, she simply obtains this signed certificate from the CA, and verifies it using the CA's public key.

[1] Internet Engineering Task Force (IETF), http://www.ietf.org/internet-drafts/draft-ietf-pkix-roadmap-09.txt

Registration Authority (RA) A user however, does not always need to transact with a CA in order to obtain or verify a certificate. In certain PKI set-ups, a RA may be included to perform this interface between the user and the CA by accepting user requests for certificates. The RA then is responsible for authenticating the user's identity and for binding the user with a public key. Once the user is authenticated (for example, through face-to-face verification), the request is then forwarded to the CA.

Besides using Bob's public key to encrypt a message and ensure confidentiality, Alice can also use her private key to sign the message before sending it to Bob. In doing so, Bob then ensures the authenticity and integrity of the message - that the message was really from Alice and not from someone else, and it was not tampered with in transit.

To sign the message, Alice can go through the following steps:

Step 1: She applies a hashing function on the message to produce a considerably shorter "footprint" of the message. This "footprint" is known as the message digest. It is computationally unfeasible to produce the same message digest with two different messages.

Step 2: She encrypts the message digest with her private key to obtain a digital signature. The message is now signed.

Step 3: Alice appends the digital signature to the message and sends these to Bob.

Step 4: Bob requests Alice's public key from the CA.

Step 5: Bob receives Alice's public key and uses it to decrypt the digital signature to verify the message digest. Bob also applies the same hashing function that Alice used on the message to produce a message digest. If this message digest was the same as the message digest created when the message was decrypted, Bob knows that the message has not been tampered with.

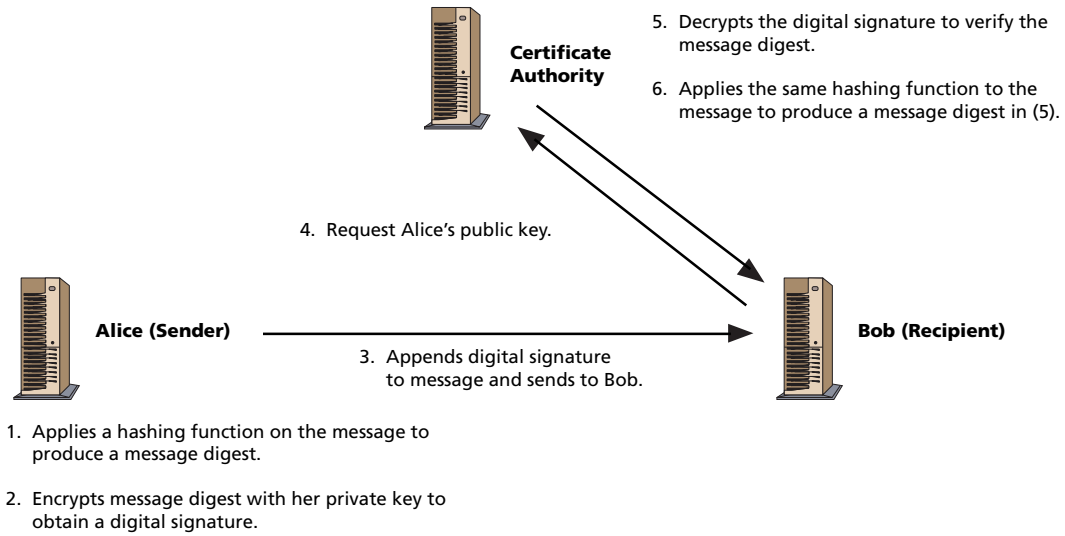


Figure 1. Ensuring authenticity and integrity in PKI

This signing capability in the PKI is heavily utilised in WPKI specifications, which is described in the next section.

2. About Wireless Public Key Infrastructure (WPKI)

On a basic level, a WPKI implementation is similar to that of any Public Key Infrastructure (PKI) system. Like PKI, a WPKI system comprises CAs, RAs and end-user entities, all of which perform similar functions as illustrated above in the PKI system. However, a wireless PKI system does vary from a Web-based PKI system in several ways, owing to the differences in their environments.

In the wireless environment, there is often limited bandwidth between the wireless client (a handset or any other wireless enabled device) and server. The wireless client also has limited computational and storage capabilities.

To address these differences in the wireless and Web environment, the WAP Forum (*see inset*) has defined a set of standards and protocols known as the WAP. WAP was designed to allow wireless devices access to the Internet, taking into account the limitations of the wireless environment.

About the WAP Forum

The Wireless Application Protocol (WAP) Forum was initiated by four founding members – Motorola, Ericsson, Nokia and Unwired Planet (now Openwave) in June 1997. The WAP Forum aimed to develop WAP as "an open global de facto standard that allows mobile users of wireless hand-held devices to securely access and interact with Internet-based content, applications and services."

In June 2002, the WAP Forum, together with other standards initiatives, formed a new consolidated standards organisation known as the Open Mobile Alliance (OMA). The OMA has more than 200 members.

More information about the WAP Forum and WAP specifications can be found at www.wapforum.org

Recognising that security would form a pre-requisite for certain classes of transactions, the WAP Forum also incorporated a set of security-related standards at the Application and Security layers of the WAP protocol. These security-related standards, like the other specifications in WAP, try to reuse or optimise existing standards and components already defined for Web-based PKI as described earlier.

The key WPKI related standards are:

- **Wireless Transport Layer Security (WTLS)**[2] - WTLS is the Security layer protocol as defined for WAP 1.x and is based on the Transport Layer Security (TLS) protocol in the Web environment. With WTLS, security is only ensured from the client to the gateway and not from the client to origin server, so the specifications of WAP 2.0 will use TLS instead protocol of WTLS. WTLS supports WPKI and caters for three classes of implementation. In WTLS Class 1, certificate-based authentication is optional. In WTLS Class 2, certificate-based server authentication is mandatory, while in WTLS Class 3, certificate-based server and client authentication are both mandatory. Thus, by using WTLS Class 3, a client can prove his identity to the server and vice versa using encryption.

- **Wireless Identity Module (WIM)**[3] - The WIM specification describes the use of a tamper-resistant hardware known as a WIM, and its interactions with the wireless client device. The WIM is used to store confidential information such as private keys of a digital certificate. It is also used for securely processing the application layer and WTLS security functions such as cryptographic operations on the keys in a WPKI environment. The most typical WIM implementation is the smart-card, in the form of a SIM chip or an external smart card.

[2] Wireless Transport Layer Security, Wireless Application Protocol Forum, Apr 2001.
[3] Wireless Identity Module, Wireless Application Protocol Forum, July 2001.

- **WML Script Crypto Library (WMLScrypt)**[4] - WMLScrypt defines the programming interface to cryptographic functions in WAP for Application layer security. While WTLS can provide for transient client authentication for the duration of a WTLS connection, it is unable to provide persistent, end-to-end authentication for data sent during the period of the connection. Using the signText() function in WMLScrypt, the WAP browser can provide such a level of authentication by signing the data generated during the session and sending the digital signature together with the message. It is recommended that the browser uses signature keys that are different from the authentication keys used for WTLS.

- **WAP WPKI (WPKI)**[5] - The WPKI specifications provide a framework for a PKI implementation in WAP and documents the roles of the certification authority, registration authority and the wireless client viz-a-viz the various security services such as WTLS, WMLScrypt and WIM provided for in WAP. The WPKI specifications follow the standards used by PKI in the Web environment closely.

There are, however, several differences between the WPKI and the Web-based PKI system. For example, there is a new entity known as a "PKI Portal" that is not present in the Web-PKI architecture. The PKI portal is a server that resides on the wired network. It is both WAP and PKI-aware and is defined as the entity with which the WAP client communicates during the WPKI operations. The PKI portal is responsible for translating requests made by the WAP client in the wireless network, and can function as the RA in the wired network.

Due to storage constraints in the wireless client and bandwidth limitations over-the-air, WPKI also provides an option to store certificate URLs instead of the actual certificates in the WIM. The URLs serve as pointers to the actual certificates and are transmitted together with the signed message. A recipient thus has to first retrieve the certificate from the URL before using it to verify the message.

In summary, many of the Web-based protocols and standards that were described earlier have been optimised or reused (such as in the case of TLS in WAP 2.0) for WAP. There has also been a constant emphasis on usage of cryptographic algorithms and encoding schemes that are computationally less intensive, as well as digital certificate that requires less storage space in WAP.

More information on WPKI, WIM, WMLScrypt and WTLS can be found at the WAP Forum (now known as the Open Mobile Alliance) specifications at www.wapforum.org.

[4] WML Script Crypto Library, Wireless Application Protocol Forum, June 2001.
[5] WAP Public Key Infrastructure Definition, Wireless Application Protocol Forum, Apr 2001.

Appendix B-2 – Technology Overview of Radio Frequency Identification (for Go Virtual trial)

As highlighted in Chapter 4, Radio Frequency Identification (RFID) has been used in proximity payment trials in Singapore and elsewhere in the world. RFID has also been widely used in other sectors. Like barcode systems and optical character recognition technology, RFID has primarily been used for automatic data capture (ADC) and automatic identification (AID) in industries such as logistics, manufacturing, retail and transport.

The primary advantage of RFID over other ADC/AID technologies is its ability to store larger amounts of information as well as its greater processing capabilities (such as encryption). Unlike bar codes and OCR, RFID tags are also re-programmable and do not require line-of-sight.

A basic RFID system consists of two components:
- the *transponder*, which is located on the object to be identified
- the *reader* (also known as an *interrogator*), which may be a read or write/read device.

These two components work via radio signals that carry data either uni-directionally or bi-directionally. Figure 1 shows that when the transponder enters the interrogation zone of a reader, data (such as a unique ID) from the transponder is captured by the reader. The power required to activate the transponder and to conduct the data transfer may be derived from a battery in the transponder (active transponders) or drawn from the magnetic/electrical field of the reader (passive transponders). When the reader receives the data from the transponder, the reader sends the data to an application that may be hosted on a physically connected PC or Point-of-Sale (POS) terminal.

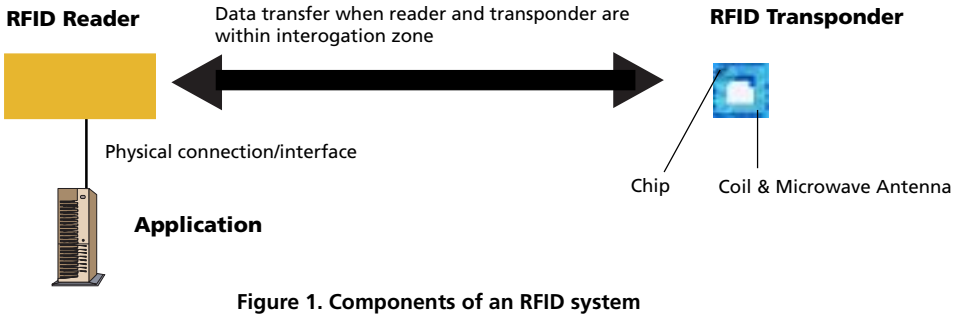


Figure 1. Components of an RFID system

Depending on the application, RFID systems can be set at different frequencies to obtain different ranges of interrogation zones. For example, in electronic door locking systems, a close-coupled system with a small range of 0 to 1 centimeters (cm) could be adequate. For applications that require a slightly larger range, a proximity-coupled RFID system, such as that based on the ISO 14443 standard may be deployed to allow a read range of about 10 cm. Long range systems are available for ranges between 1 m and 10 m; such systems typically require an auxiliary battery to provide power for data transfer between the transponder and reader.

In the Go Virtual trial, Type A ISO 14443 was chosen by Nokia as the standard to be deployed for the contactless smart chips that were issued. This was because the Type A standard was relatively established and was one of the available standards for electronic cash applications. The availability and trend towards RFID readers at POS which support Type A chips also influenced Nokia's decision.

About IS0 14443 Contactless Smart Card Standard

The ISO/IEC 14443 is a contactless technology standard with a read range of up to about 10 centimetres (4 inches). The technology was originally designed for electronic ticketing and electronic cash applications. This standard was finalized in 2001 and comes in two versions - Type A and Type B. Differences include the modulation of the magnetic field used for coupling, the coding format, and the anti-collision method (i.e. how the cards and readers respond when more than one card responds at the same time to a reader's request for data).

More about the standard can be found on Smart Card Alliance (www.smartcardalliance.org).

More information about RFID systems and contactless smart card standards can be obtained from the Association for Automatic Identification and Data Capture Technologies (www.aimglobal.org/technologies/rfid/).

This section was compiled from information in "RFID Handbook" by Klaus FinkenZeller, Wiley Publishers and www.smartcardalliance.org.