EZ-LINK AND NETS E-PAYMENT: CREATING A STANDARD AND BUILDING A PLATFORM INNOVATION

Christina Soh & Yvonne Chong

The e-payments landscape in Singapore was previously dominated by two major card issuers with non-interoperable cards. The Infocomm Development Authority launched an initiative to develop an innovative standard that would provide an interoperable platform in order to boost local micropayments and open up e-payment services for consumers. The result was a pioneering ISO standard - the Contactless e-Purse Application Standard (CEPAS). This open standard, with unique security and high-performance features, enabled multiple payment applications offered by different issuers to be on a single smart card, which consumers could use for bus, taxi and rail transport, car park and road usage charges, and retail micropayments.

The case examines the significant challenges and trade-offs in the development and deployment of this platform innovation – such as orchestrating the efforts of multiple stakeholders and balancing various stakeholders' legitimate interests; incentivising investment in supporting infrastructure and complementary innovations; as well as promoting the adoption and diffusion of the cards by consumers and merchants. The CEPAS platform was also being leveraged for the next generation of e-payment innovations, such as payments via Near Field Communication-enabled mobile phones.

INTRODUCTION

Prior to 2009, Singapore had a fragmented e-payments landscape driven by two major card issuers with non-interoperable cards. The Land Transport Authority (LTA) with its ez-link farecard monopolised the public transit market including rail/Mass Rapid Transit (MRT) ticketing, bus and taxi fare collection. The Network for Electronic Transfers Singapore (NETS) with its contact CashCard held exclusive rights to the Electronic Road Pricing (ERP) system, and it also dominated retail payments as well as Singapore's private car park payment schemes with 60% market share. Together, they accounted for 95% of the country's micropayments market.

The lack of interoperability between the two systems stymied the overall proliferation of contactless card payments in Singapore. The promise of greater convenience from e-payments for consumers had been only partially fulfilled as one could use either the CashCard at NETS-equipped retailers and car parks or the ez-link card on buses and MRT, but not one combined card with any transit or retail contact device.

The integration needed to make NETS' contact card system and LTA's contactless system work together faced significant barriers, including the differing commercial interests of the parties involved. Cost was a consideration because there was already an existing infrastructure in place and each player had established its network of cards and card readers. NETS could take advantage of its extensive network of top-up points deployed by the banking sector, while LTA's ticketing system had incurred high cost in installing and supporting its own top-up system.

The challenge was in finding common ground and an approach to address the commercial, operational and technical aspects of such a large-scale implementation nationwide.

Early E-Payments Landscape in Singapore

In 1998, it cost the Singapore economy S$656 million to support local currency in circulation and the cost of handling cash was projected to exceed S$1 billion by 2006. The Singapore government was therefore keen to promote a cashless society.[1]

NETS, set up in 1985 by a consortium of local banks as part of a government initiative to drive productivity, pioneered Singapore's first cashless payment platform through its nationwide Electronic Funds Transfer at Point-of-Sale (EFTPOS) network, a debit payment service using the banks' automatic teller machine (ATM) cards for consumer purchases and bill payment. In 1996, NETS launched the CashCard, a national e-purse scheme using smart cards. The CashCard was used primarily for payment of parking fees and ERP toll charges introduced in 1998.

By 2003, NETS' annual collection from ERP charges was about S$80 million while CashCard payments at car parks totaled more than S$85 million.[2] In the retail sector, NETS faced significant competition from credit and debit cards even though the CashCard was accepted by 12,500 merchants including self-service kiosks, libraries, public payphones and vending machines. Building on its first-mover advantage in merchant acquisition through the EFTPOS network and the largest terminal base installed island-wide, the CashCard demonstrated strong growth in retail transaction volumes. Total number of CashCard transactions rose from 102 million in 2001 to over 135 million in 2003.[3] The NETS Rewards loyalty programme was launched in 2004 to complement its core e-payments business.

The LTA was also promoting e-payments through the use of its single function magnetic farecard launched in 1987. In the late-1990s, LTA reviewed its fare collection technology and future development strategy to explore contactless smart card technology that could be used for fast-paced transit transactions, and possibly retail payment applications. (See **Exhibit 1** – The Rise of Contactless Smart Cards.)

In 2002, LTA replaced its magnetic farecard with a contactless multipurpose smart card based on Sony's FeliCa technology. Sony's FeliCa smart card had been successfully adopted by Octopus Cards for use

---

1   The National Library Board Singapore. (2007). *The national campaign to minimize cash transactions*. Retrieved April 8, 2012, from
     http://infopedia.nl.sg/articles/SIP_1075_2008-12-06.html

2   Tan, C. (2004, June 29). NETS keen to cash in on public transport. *The Straits Times*.

3   Letter from NETS to the Editor. (2004, September 30). *The Asian Banker.*

in Hong Kong. LTA's deployment of the contactless smart card was part of the Enhanced Integrated Fare System (EIFS). EIFS' extended fare structure allowed commuters to transfer between different transit networks, run by different operators, with the backend system apportioning the fares among operators at the end of each day. The contactless smart cards employed standards proprietary to Sony and were more reliable, with a failure rate of 1 in 25,000 transactions compared to 1 in 5,000 transactions for magnetic farecards.[4] The ez-link card (a 'tap-and-go' card payment scheme operated by EZ-Link Pte Ltd, a fully-owned subsidiary of LTA) was issued only by LTA and was transit-centric. With the launch of the ez-link farecard, NETS was no longer the sole provider of widely accepted stored value facilities approved by the Monetary Authority of Singapore (MAS).

By 2003, there were an estimated 5.5 million ez-link cards in active circulation compared to 4.5 million NETS CashCards.[5] However, the local market was approaching saturation with card growth at 5%. While 60% of transactions in Singapore were estimated to be cash-based, the two payment modes ez-link and CashCard collected S$974 million and S$271 million respectively.[6]

EZ-Link and NETS each competed through continuing innovation. NETS began looking into introducing a Combi card – a smart card with two interfaces and only one chip-set; a combined card for contact and contactless applications that could also be used for public transport. The existing one-megabyte contact CashCard was not compatible with the ez-link system as it required much more power from the reader to drive it and the card cost about three times that of a contactless card. On its part, EZ-Link appointed QB Pte Ltd (later renamed PaymentLink) to grow and manage its non-transit service offerings. McDonald's became Singapore's first fast food chain to offer ez-link card payments in early-2004. LTA also began developing a next-generation In-vehicle Unit (IU) that could use its contactless card for both ERP and car park payments, which had been the sole purview of NETS.

The CEPAS Initiative

Sensing that its market share was facing an imminent challenge from the ez-link card, NETS sought to gain a foothold in the lucrative S$1 billion transit market. In the early-2000s, NETS tried to lobby the Infocomm Development Authority of Singapore (IDA) for a unified national platform arguing that the Sony card was expensive, proprietary and unable to meet LTA's key concern – speed. While Sony had tried to get their FeliCa card admitted under the International Organisation for Standardisation (ISO), the option of opening up to an ISO standard card from various sources was raised by NETS.

LTA had also approached Raymond Lee, then Deputy Director for Technology Direction at IDA, through Lin Yih, Chairman of the Cards and Personal Identification Technical Committee (CPITC). CPITC was appointed by the Information Technology Standards Committee (ITSC). (See **Exhibit 2** for details on ITSC and CPITC.) CPITC comprised of both public and private sector companies that produced smart card hardware, such as chips and readers, and developed applications using smart cards. LTA's priority was to have access to a suitable card that was faster, more cost-effective and compatible with existing readers and new IUs.

By facilitating the development of a new standard for an interoperable platform that would bring the main operators together, IDA saw the potential to boost the local micropayments industry and to promote the opening up of services for consumers to use one card seamlessly. From a national perspective, it made sense to have a single form factor for two dominant competing players in a very small market. Raymond Lee noted that there was no point in creating small infrastructure whereby "you did not grow and were stuck with a technology that was closed".[7]

Abiding by international standards meant that smart cards issued in Singapore could be used in countries that adhered to ISO standards, and possibly lead to exporting the technology overseas. At that time, IDA was exploring the concept of using standards to enter

---

4 Prakasam, S. (2011, January 27). *Integrated through ticketing and automatic fare collection system* [Presentation].
5 Micropayments stagnate in Singapore. (2004, September 7). *The Asian Banker*.
6 ibid.
7 Raymond Lee to Authors, 23 April 2012.

overseas markets to strengthen the country's export of products and services:

> _Maybe it was more of a mindset people accepted in the early days, that standards were basically something you had to adopt from overseas. But what we were trying to do here was to put standards first – start with standards, then compliance, and then to create one market._[8]

Raymond Lee
Director
Resource Management and Standards, IDA

The intent therefore was to move away from proprietary systems towards an open environment such that one card would be used across all systems, and the resultant level playing field could lead to more micropayment participants and drive down costs. This shared vision and convergence of strategic interests of major stakeholders set the ground for the inception of the Contactless e-Purse Application (CEPAS) common standard.

In 2002, a Memorandum of Understanding was signed between EZ-Link and NETS, which was supported by IDA and LTA, for the commencement of a pilot EZ-Cash project to develop and test a standard that could meet LTA's stringent requirements. Lin Yih came on board as a consultant, and together with senior representatives from the organisations involved, began to draft technical specifications for the new standard. The new specifications were expected to be as inclusive as possible, allowing cards of different configurations and standards to be used within the scheme, such as ISO 14443 Type A and B cards, supporting a multi-supplier base in the future. According to Lin Yih:

> _It started as a proof of concept; nobody was sure that a 7816 APDU (application protocol data unit)-based contactless smart card could meet the transit time requirements of below 180 milliseconds. The subsequent success of CEPAS surprised many people, including myself._[9]

The standards development process required that the draft specifications and amendments be reviewed and approved by the ITSC, which was supported by SPRING Singapore (an enterprise development agency) and IDA. The draft also had to undergo a public review before publication as a Singapore Standard. To ensure that the development of Singapore Standards took into account the views of relevant interest groups, ITSC members were appointed from the industry, professional bodies, associations, government agencies, and research and educational institutions.

The CEPAS draft specification was submitted to the ITSC in early-2004 for further work and publication as a Singapore Standard. By then, the security and performance of cards and readers had improved significantly and the government set up a taskforce comprising CPITC, SPRING, IDA, NETS, LTA and EZ-Link, to review and develop a national e-purse standard. The objectives were to:[10]

- Bring together multiple payment applications onto a single smart card;
- Enable greater synergy between applications and minimise resource duplication;
- Permit multiple entities participating in a common e-payment scheme to create their own keys on a card, that would be used to protect their own liabilities without affecting the liabilities of other parties.

The collaboration process on CEPAS coincided with a change of management at both LTA and NETS. In 2003, Poh Mui Hoon took over as CEO of NETS and two years later, Yam Ah Mee became LTA's CEO. Emerging afresh from renewed discussions, the two CEOs reached an understanding and Yam assigned LTA's Chief Engineer, Leong Kwok Weng, to chair a LTA/NETS Steering Committee to resolve policy, technical and project management issues on joint CEPAS-related programmes. This was instrumental in moving the project forward.[11]

Work to develop a new card by LTA and NETS began in 2005 while the CEPAS specifications were still in draft stage. LTA worked closely with various card

---

8   Raymond Lee to Authors, 23 April 2012.
9   Lin, Y. (2009, August 6). _Smart Card, TPM, Lightweight Encryption, Standards_++ [CPITC Presentation].
10 Prakasam, (2009, November) S. Evolution of E-Payments in Public Transport – Singapore's Experience. _Journey_.
11 Lim Khee Ming to Authors, 4 June 2012.

vendors to ensure that the card operating system was implemented according to CEPAS specifications as well as the stringent requirements of both ERP and the transit environment. While the Sony FeliCa card was yet to be accepted by ISO, LTA's card readers were expected to accept the ISO-approved FeliCa cards, a standard recommended by CPITC.

The CEPAS draft was released for public comment in September 2004 and November 2005 to gather feedback and notify the industry of new developments.[12] The Singapore Standard Specification for Contactless e-Purse Application (SS 518:2006) was officially launched in June 2006, as a common standard for all e-Purse cards within the country, to be compatible across multiple issuers and acquirers. CEPAS incorporated a banking e-purse, transit and ERP requirements and provided standardised command sets for Debit, Credit, and ReadPurse.

> *This is a pioneering effort for e-Purse solutions, especially in the debit and credit areas because there currently are no international standards in this area. SS 518 CEPAS will benefit both industry and end users – by ensuring a level playing field for card issuers, higher security and more choices of service providers for consumers.*[13]

> Loh Khum Yean
> Former Chief Executive, SPRING

CEPAS was designed to be generic enough to be deployed over contact (ISO 7816) and contactless interfaces (ISO 14443) as well as GSM SIM applications in near field communication (NFC) enabled mobile phones. This allowed direct top-up to the e-Purse from a bank account, while the ISO 7816 command set and file structure allowed CEPAS to co-exist with Europay, MasterCard, and Visa (EMV) and contactless credit card applications on one card.

Like the CashCard, CEPAS was designed to meet the security and integrity requirements of an open e-Purse system. Most importantly, it had to meet the high-performance requirements of Singapore's transit

system. Some of its unique features were:

- Atomicity - Updates were completed either in total or not at all, to ensure information was always complete. No corrupted or partial updates to the card were allowed, to improve reliability of transactions across multiple interfaces.
- Signed Certificate - After each Debit, Credit and ReadPurse, the card would return a Signed Certificate, which was cryptographically signed (encrypted) using the Issuer Key (signing key). Issuer Key could be different from Credit or Debit keys. Successful verification of Signed Certificate at the Card Manager's host proved integrity and authenticity of transaction record.
- AutoLoad - Automatic add-value service with a handling fee for each transaction increased purse balance by a specified amount when the debit amount was insufficient, provided the card was linked to a bank account or credit card.
- Partial Refund – Limited to the most recent amount debited, this was useful for retail and bus fare transactions that required 'at start, deduct maximum, upon end, and refund unused amount'.
- Cumulative Debit (or Slicing) – To minimise transaction processing overheads, debit operations for one card were accumulated into a final amount for example payphones and photocopiers.

LTA's Deployment of CEPAS Smart Cards

Although LTA was already using contactless smart cards (based on Sony's proprietary standards), it was nonetheless in favour of the CEPAS initiative. LTA supported the national effort to have a single card that would have several applications and multiple issuers. For instance, the single card could be used not only for public transport (bus and rail), but also for ERP and car park charges, and other micropayments. (Prior to CEPAS, cards for IUs that were used for ERP and car parks were issued by NETS.) Banks were encouraged to issue credit and debit cards enabled with CEPAS for use in transit and other applications.

Previously, the lack of interoperability between ez-link cards and NETS CashCards had meant higher costs of infrastructure for LTA – for example, ez-link cards

---

12 Lin, Y. (2006, June 27). *CEPAS Launch* [Presentation].
13 IDA and SPRING Singapore. (2006, June 27). *Singaporeans to enjoy the convenience of one card for electronic payments* [Press release].

could not leverage on NETS card top-up infrastructure. In addition, LTA's involvement in the design of the new standard was with an eye to increase efficiency, security and speed in the next generation contactless card. Having an efficient revenue collection and settlement system was critical to keep fares low.[14] Many of the unique features of CEPAS, such as atomicity, reflected LTA's inputs on what would be useful for transit applications.

In addition to helping draft the CEPAS standard, LTA worked with three potential card vendors to create a CEPAS-compliant card that would meet its stringent operational requirements, and be suitable not only for transit but also for the IUs. To enable processing at ERP gantries, the card had to be capable of being read in less than 140 milliseconds. More than 2,000 test scenarios were conducted at both the vendor and LTA test laboratories to check among other things, that there was no blind spot within the detection field of the transit reader (greater than 8 cm), and that the card could withstand operating temperatures up to 85 degrees celsius.[15] One of the card vendors – Watchdata – pulled ahead of the others in the development effort and was involved in the first major launch of the new CEPAS ez-link card. The cost of the

first wave of CEPAS cards was about S$4 each. By 2012, the cost of the cards had fallen to about S$2.50, with the other two card vendors also involved in the production of CEPAS cards.[16]

The replacement of 8 million active ez-link cards with CEPAS ez-link cards within the relatively short timeframe of January to September 2009 was challenging. One issue was how to motivate commuters to exchange their cards. LTA set up multiple easy access options for commuters such as having roving centres in schools, extending ticket office hours, and enabling card replacement at post offices, community centres and bus interchanges. The replacement was on a free one-for-one basis, with automatic value transfer from the old to the new card. The previous Sony contactless ez-link cards would no longer be accepted on public transportation from 1 October 2009. By early-2010, there were over 10 million CEPAS cards issued. The cost of replacing the cards – about S$30 million – was borne by the government.[17]

The adoption of a common CEPAS standard by both EZ-Link and NETS opened up NETS banking top-up network for ez-link CEPAS cards as well. In June

---

CEPAS

SS 518 CEPAS describes the technical requirements that can be used in a multi-issuer deployment scenario. Each issuer is responsible for the personalisation of their own card. Interoperability is achieved by multiple sets of keys residing in the terminal readers and in the card. For interoperability, smart card readers contain debit keys of all the participating issuers, but not their credit keys. Credit operation is thus limited to selected terminals (readers) that contain the required credit keys. The e-Purse is designed to be generic enough to accommodate a variety of interfaces and architected on the ISO/IEC 7816 series of standards.

- Contains two versions:
  - Version 1.0 for certain legacy applications.
  - Version 2.0 to be used for all new deployments, transit and ERP.
- Consists of three commands – ReadPurse, Debit and Credit.
- Designed with next generation cryptographic algorithms (AES, ECC) in mind – standard can be amended later to include these cryptographic algorithms.
- Designed to co-exist with other standards on the same card – EMV, Cashcard, Visa and Mastercard Contactless Magstripe.
- Developed using ISO 7816-style commands which exist in a variety of configurations.

---

14 LTA. The lowest 10% of income earners spent no more than 8% of their income in public transport. Source: Prakasam, S. (2011, December 5). *Fare integration for seamless travel in Singapore* [Presentation].

15 Prakasam, S. (2010, November). *Status of CEPAS deployment* [LTA Presentation].

16 Silvester Prakasam to Authors, 5 June 2012.

17 ibid.

2009, EZ-Link launched ez-link top-ups at 950 DBS ATMs island-wide. EZ-Link was keen to promote self-serve and auto top-ups, given the higher cost of manned counters and cash collection. Top-up channels expanded to include self-service kiosks (ATMs, ez-link top-up kiosks, 560 AXS stations[18]), auto top-ups (to pre-specified limit via bank GIRO transfer when readers sensed that the card's stored value was low), online top-ups, and mobile phone authorisations. EZ-Link also sought to leverage non-transit infrastructure such as convenience stores (7-Eleven), fast food outlets (McDonald's) and schools for top-ups. By early-2010, there were 200,000 top-ups daily averaging S$100 million per month, with 60% of top-ups done via self-service machines.[19]

EZ-Link issued co-branded banking cards with Citibank and DBS. Both EZ-Link and the banks hoped that everyday use of the card for transit would drive the co-branded card to 'top of wallet' and increase its retail use. It was thought that the convenience of having an 'all-in-one' card that could be used for transit, ERP, retail micropayments as well as a credit/debit card, would shift consumer habits. EZ-Link also initiated the PAssion ez-link cards which let its members earn loyalty points at retailers such as Cold Storage and Shop N Save supermarkets.[20]

Another significant development effort that had to be made in order for the CEPAS cards to be successfully deployed, was the new backend system needed for processing e-payments and clearing settlements among the various parties. The system, named the National Transport Fare Clearinghouse System – or Symphony for e-Payments (SeP), was developed in-house, over a period of three years (including a year for testing). SeP was developed using open standards and critical to opening up the transit market to other card issuers by enabling consolidation and clearing of payments among the stakeholders comprising public transport operators (SMRT, SBS Transit), card

managers (NETS, EZ-Link, LTA for ERP), transit acquirer (TransitLink), and PaymentLink handling non-transit transactions. (See **Exhibit 3** – SeP and LTA Key Statistics.)

The system had to incorporate new business roles and operational procedures for handling cards from different issuers. It also had to provide revenue allocation and settlement reports by the following day at 9am. SeP's ability to support multiple card issuers reduced the technical entry barriers for new card issuers for transit ticketing. To reduce missing transactions, the system had to be able to handle the upload of previous as well as current transactions. The cost of developing and implementing SeP, about S$100 million, was paid by the government. The system was soft-launched in December 2008, in time for the mass replacement of cards which began in January 2009. In 2011, the Clearinghouse handled 20 million transactions daily and had an online enquiry response time of less than 0.3 seconds.[21]

LTA also developed the new generation IU, known as the dual mode IU (2GIU), which could use CEPAS cards. The 2GIU was launched in July 2009 and could accept both CEPAS contactless cards and existing contact cards.

In September 2010, EZ-Link partnered Singapore's second largest taxi operator, TransCab, to equip 4,400 taxis with EZ-Link's own new payment terminal that accepted nine different payment modes.[22] This extended the use of CEPAS cards to yet another mode of transit.

EZ-Link was the largest issuer of CEPAS cards. (See **Exhibit 4** – Business Structure of EZ-Link.) However, about 60% to 70% of ERP transactions still used the NETS contact cards.[23] This was partly due to the need for new 2GIUs, costing S$150 each, in order to use CEPAS cards.

---

18 An automated 24 hour-self-service kiosk which provides a wide range of services such as bill and fine payments, top-up of prepaid cards, and purchase and collection of movie tickets.

19 Luo, J. (2010, January 28). *EZ-Link Pte Ltd – A contactless smart card business beyond transport* [Presentation].

20 Membership card for the People's Association. There were over 740,000 PAssion card/ez-link card holders in January 2010.

21 Prakasam, S. (2010, November). *Status of CEPAS deployment* [LTA Presentation].

22 EZ-Link. (2010, September 30). *TransCab taxi goes EZ with new all-in-one payment terminal by EZ-Link* [Press Release].

23 Silvester Prakasam to Authors, 5 June 2012.

NETS' Deployment of CEPAS Smart Cards

NETS launched their new Combi CashCards with both contactless and contact interfaces in July 2006. The Combi CashCard used an earlier version of CEPAS (CEPAS 1), and was designed to work in either contact or contactless mode, and thus could be used with the already installed base of readers belonging to NETS. About a million Combi CashCards were sold over the next three years. However, the Combi CashCard could not be used in transit as LTA did not convert to CEPAS and deploy its SeP system until 2009, and when it did so, it used the CEPAS 2 standard.

In October 2009, the NETS FlashPay (NFP) contactless CEPAS 2-compliant card was introduced which could store up to a maximum of S$500. In conjunction with the launch, NETS initiated a nationwide marketing campaign. Anyone who bought a NFP card received a S$5 bonus value for transit or S$7 bonus for free rides (if purchased at iNETS kiosks) and promotional merchant offers such as 'S$1 Specials' at snack chains Old Chang Kee and Polar Puffs. Each card came with free one-year insurance of up to S$20 for lost cards and up to S$5,000 for permanent disability due to a public transport accident. One million cards were sold within a year, accounting for 10% market share.[24] NFP cards had a lifespan of seven years from the date of issue. Older CashCards continued to be usable at various NETS payment points. However, only the NFP card could also be used on buses and trains.

NFP cards could be purchased and topped up at TransitLink ticket offices, convenience stores 7-Eleven and Cheers, and iNETS kiosks initially available at six MRT stations. Existing EZ-Link machines at MRT stations could be used to reload only ez-link cards, not NFP cards. NFP top-ups were enabled at OCBC and UOB ATMs from November 2009 and DBS ATMs from March 2010. NETS worked with its shareholder banks DBS, UOB and OCBC to roll out ATM and debit cards integrated with NFP capability, which would give cardholders an option to top-up directly from their bank account while making a purchase.

NETS incurred significant costs for major upgrading to its backend system to accommodate and support the new payment solutions. Substantial costs were also incurred to conduct extensive tests of the NETS card with the new LTA SeP and ERP systems.[25] Under the CEPAS framework of multiple issuers and acquirers, NETS was required to be certified by LTA, the system provider, for the processing of transactions and settlement interactions, to ensure alignment of operational procedures for handling cards from different issuers.

By late-2009, NETS had 37,000 retail locations with 2,500 NFP-enabled while EZ-Link had established over 5,000 points, more than half of which were on board SMRT taxis.[26] (See **Exhibit 5** – Comparison of EZ-Link and NFP.) One of the major investments for NETS was the upgrades to its existing merchant network to CEPAS-compliant terminals. Businesses using the NETS technology paid monthly rental of about S$60 for the terminals and a fee for each transaction. Taking a strategic view that the NFP contactless card was most suited for fast, hassle-free payment transactions, NETS prioritised quick service retailers that handled cash for small ticket items to be converted to e-payment or upgraded to contactless payment first.[27] From its experience, NETS knew that the conversion from the habit of using cash to e-payment would take time. Within two months of the launch, 20% of NFP cards had been used in retail.[28]

To promote adoption of the NFP card, NETS introduced an auto-top up (ATU) feature in October 2010, allowing users to instantly top-up their cards through GIRO to a predetermined value (S$30, S$40 or S$50) in transit, upgraded electronic parking system car parks and ERP gantries. The ATU facility could be activated only at transit, and not retail, points which made it difficult to abuse. For the launch, NETS made an introductory offer of S$0.15 per top-up and the S$1.50 registration fee was waived until June 2011, which was subsequently extended to June 2012. NFP cardholders who signed up for the ATU insurance plan (by American Home Assurance Company) had complimentary one-

24 Siow, L.S. (2010, October 18). CEPAS to be offered on more bank cards. *The Business Times*.
25 Lim Khee Ming to Authors, 4 June 2012.
26 Tan, W. and Wong, T. (2009, October 14). Retailers giving smart cards a miss. *The Straits Times*.
27 Lim Khee Ming to Authors, 4 June 2012.
28 Tay, D. (2009, December 1). One step closer to cashless. *MyPaper*.

year insurance for up to S$30 if their ATU-enabled NFP card was lost, and up to S$300 if their wallet was lost. However, by end-2011, only a few thousand subscribers had signed up for the ATU service, which worked only with CEPAS cards and not with the older CashCards.[29]

The integrated iNETS platform was launched in 2010 to facilitate consumers' ease of use in making fast and secure e-payments through a multi-channel payment infrastructure, which allowed users to make online financial transactions using their mobile phones or via self-service kiosks. Registration for the ATU service was immediate at any iNETS kiosk. As part of the Flashpay platform, the first non-card payment accessory – the NFP Key Tag, was launched in September 2011 and priced at S$15.90 each. (See **Exhibit 6** – CEPAS cards.)

NETS partnered banks and merchants to offer integrated CEPAS capability on their credit, debit or member cards in broadening the use of NFP into new markets. These collaborations included the Maybank Platinum Debit MasterCard, UOB Direct Card with Visa PayWave, OCBC Frank credit card, and membership cards, such as the Singapore Maritime Officers' Union, and the 'Extra SHIOK!' card with exclusive deals at the country's largest suburban mall, Jurong Point. Consumers could also accumulate LinkPoints[30] when they made purchases at retail outlets, such as supermarket chain NTUC FairPrice, as an incentive to use the NFP card. It partnered fashion retailer Jay Gee Melwani to introduce a 2-in-1 privilege card which offered 10% off popular brands such as Levi's, Liz Claiborne and Dockers.

By 2011, NETS had issued 6.5 million CashCards and 1.5 million NFP cards, and had 4,000 top-up points including iNETS kiosks and local bank ATMs. NETS had a competitive edge in the retail sector as it processed over 90% of Singapore's debit transactions. By end-2011, NETS had established more than 15,000 NFP retail and F&B points including Starbucks and KouFu foodcourts.[31]

The NFP card was an extension of NETS' portfolio of e-payment products and services to provide consumers with more choices. In March 2012, NETS worked with car park payment solution providers to enable EFTPOS payment, which would allow motorists to top-up their NETS CashCards using their NETS ATM cards directly at the exit, to pay the parking fees.

> *What we're doing is giving them (motorists) greater convenience so that they have other options. Car park operators also benefit from implementing the NETS EFTPOS payment system as it allows them to reduce the resources needed to man car parks.[32]*
>
> Ang Sok Hong
> Vice-President, Sales and Partnership, NETS

To complement its core business of e-payment transaction processing, NETS had shown that it could be 'platform agnostic'.[33] Competition was at the card issuer-level and not among the acquirers – which referred to institutions that enabled merchants to accept card payments. For each transaction, the merchant typically paid a fee to the acquirer who paid a fee for processing to the issuer. For example, NETS provided an integrated service enabling AMEX, Global Refund and Visa/MasterCard transactions from various acquiring banks on its terminals. Since 2005, NETS also operated an ISO 9002 VISA and MasterCard-certified centre that provided card personalisation services (embossing names and card numbers, loading account data on to smart card chips and magnetic stripes) for more than four million cards a year including ATM, AMEX, Visa and MasterCard. This represented 60% of the total market.

CEPAS Impacts

In 2011, more than 10 million CEPAS-compliant cards were in circulation and total annual transit transaction value was worth S$1.5 billion.[34] The move away from a transit-centric system to CEPAS-based multipurpose

---

29 Tan, C.Y. (2012, January 11). New 'CashCard's' auto top-up feature fails to draw drivers. *The Straits Times.*
30 NTUC LinkPoints is a loyalty programme belonging to the only national trade union in Singapore.
31 NETS launches key tag as payment accessory. (2011, September 19). *AsiaOne.*
32 NETS. (2012, March 26). *NETS Introduces NETS EFTPOS payment in car parks* [Press release].
33 Tham, I. (2010, October 23). Cellphone as e-wallet could be a tap closer. *The Straits Times.*
34 Public Transport Council, Singapore. (2010/2011). *Annual Report.*

smart cards offered consumers the ability to use a single card for a wide range of transactions; from bus, rail and taxi payments, to ERP and parking fees, as well as for retail purchases. It gave consumers more control and access to a wider range of top-up infrastructure island-wide including bank ATMs. Top-ups could even be done at home with a credit or debit card using a CEPAS-compliant EZ-Online reader (costing S$39 and only for ez-link cards), which could also be used to check previous transaction records online.

The government-driven mass market deployment of CEPAS in transit played a significant role as it demonstrated that contactless payments could be a safe, reliable and convenient experience for commuters. This helped consumers and businesses overcome their initial resistance to new technologies and gradually make the transition from cash towards contactless e-payment solutions, in tandem with the global landscape which saw increasing levels of adoption from 2010. (See **Exhibit 7** – Contactless Payments Worldwide.) This could potentially pave the way for continuing innovation and adoption of emerging technologies in the e-payments arena. For instance, in early-2012, McDonald's Singapore installed NFP readers at over 100 restaurants although it had earlier stopped using an older payment system which accepted ez-link cards.

Contactless payments were already providing benefits to the industry, in terms of greater convenience for consumers and higher throughput for merchants. Payment transactions using contactless smart cards were found to be 63% faster than cash and 53% faster than swiping a conventional credit card.[35] This could reduce queuing time and potentially result in higher sales and transaction volumes.

For LTA, the very high market penetration rate of 230% (see **Exhibit 8** – Mass Transit Ticketing Market in Asia Pacific 2010) translated into tangible benefits such as easing of congestion in transit and on roads due to speedier response from CEPAS features tailored for ERP gantries. Another significant benefit was the minimisation of revenue leakage. The novel feature of being able to upload previous transactions enabled LTA to greatly reduce missing transactions, which

sometimes occurred when buses that collected the transaction information and downloaded them at the end of the day at the depot did not do so (for a variety of reasons such as the bus being re-routed). As a result, about three to four million transactions were not recorded each year.[36] With this new feature, enabled by CEPAS, missing transactions reduced significantly from over S$2 million to less than S$100,000 a year.[37] This was primarily due to capturing the previous and current transactions on the card and uploading them at every touchpoint.

The new smart cards with the SeP system also enabled LTA to move from zonal fares to distance-based fares in July 2010. Distance-based fares were more equitable compared to zonal fares, where long trips within the same zone cost less than shorter trips that crossed zone boundaries. The new distance-based system computed fares based on route distance, service grade (basic air-con bus, express bus, premium rail) and patron category (adult, child, student, senior citizen).

A single standard had, in general, offered CEPAS cardholders access to an expanded range of payment applications and service offerings. As standardisation lowered reader and card costs due to multi-vendor support, there were positive spill-over effects into the non-transit sector. With the emergence of more payment options, consumers benefited from a host of attractive marketing promotions, privileges and merchant discounts from card issuers competing to gain strategic mindshare, even as the market adopted a wait-and-see attitude to the new e-payment mechanisms. Merchants also had the option of offering exclusive deals through the loyalty programmes of NETS and EZ-Link.

While the CEPAS smart cards were well established in public transit, use was less widespread in the retail sector despite concerted efforts to promote their usage. Consumers were still using cash for smaller payments, with S$20 billion cash transactions a year.[38] This was in spite of initiatives such as EZ-Rewards, a loyalty programme to reward ez-link cardholders every time their registered concession or ez-link card was used to pay for purchases at 23,000 merchant acceptance points.

---

35 Smart Card Alliance Payments Council. (2006, November.). *The what, who and why of contactless payments* [White paper].
36 Singapore Land Transport Authority. (2009, September). *IBM* [Case study].
37 Silvester Prakasam to Authors, 5 June 2012.
38 Prakasam, S. (2009, November). Evolution of e-payments in public transport – Singapore's experience. *Journey*.

One of the barriers to retail adoption was that there was not yet a common terminal network across all card managers in the retail arena. Rather than manage the cost and hassle of working with diverse payment options and instruments, some merchants chose not to adopt the newer options until consumer preference for this mode of payment was stronger.

In December 2009, to encourage merchants to support CEPAS smart cards, IDA offered S$16 million in a Call-for-Collaboration (CFC), to jointly fund the cost of local merchants who switched their POS terminals to contactless CEPAS-compliant readers. In particular, the focus was on merchants in selected high cash-based segments running smaller scale businesses such as hawkers at food courts, coffee shops, fast food outlets, convenience stores, provision shops and vending machines. All merchants/businesses benefitted from a waiver of setup fees and monthly terminal rental fees for at least a year as well as a shorter two-working day settlement period. For every e-payment transaction, merchants paid acquirers a percentage fee based on the value of the transaction. Under the CFC, transaction fees were capped at 0.85% for two years compared to prevailing market rates of 1% to 1.8%. The five companies awarded the CFC were EZ-Link, NETS, Nera Telecommunications Ltd, PaymentLink and Way Systems Solutions.

The number of contactless POS terminals was expected to more than quadruple from 5,000 to almost 24,000 by 2011 beyond the transport sector. IDA's aim was to convert an expected 94 million payment transactions from cash to e-payment transactions each year.[39] IDA partnered the industry to provide more than 2,250 free top-up points such as Passenger Service Counters and ticketing machines at MRT stations and bus interchanges, and through various channels such as AXS stations, ATMs and iNETS kiosks in community centres, public housing estates and shopping malls island-wide.

Merchants could also benefit from marketing campaigns jointly run by IDA and acquirers. For example, IDA initiated a year-long 'Just Tap It!' campaign from November 2010, whereby consumers were encouraged to pay for their retail purchases with their ez-link or NFP cards and were entitled to participate in weekly lucky draws. Merchants were featured on advertisements in the newspapers, MRT trains and also Poster Walkers to draw traffic.

Consumers had also been slow to change their preference for cash in paying for taxi fares. A survey by MasterCard found that 80% of passengers still used cash to pay for their taxi rides.[40] ComfortDelGro, Singapore's largest cab operator with 15,600 taxis, launched in mid-2011, a new contactless payment system that could accept all major card payment modes. A surcharge of S$0.30 on top of the total fare was applicable for CEPAS cards while a 10% administrative charge applied for credit and charge card payments. Prior to the introduction of the new system, cashless payments on board its cabs had grown 20% in 2010 to 10.7 million transactions.[41]

The conversion of car parks had been gradual. Over one-third of more than 1,000 electronic parking system car parks in Singapore were able to accept the CEPAS card by March 2012. As car parks could be privately-owned, terminal upgrades were dependent on the owners' consent as an upgrade could cost S$20,000 to S$30,000 or more.[42] Another reason hindering the uptake was that a vehicle needed a new dual-mode IU, which was fitted in about 220,000 vehicles or less than a quarter of the vehicles in Singapore.

Continuing Innovations

The creation of the contactless card ecosystem and CEPAS-compliant payment mechanisms provided a platform for the next step in e-payments – using NFC-enabled mobile phones. Merchants with contactless credit card or CEPAS terminals were already able to accept payment via NFC phones. Industry players could leverage the existing platform instead of having to invest in their own infrastructure. IDA noted that a fully interoperable NFC ecosystem could generate a market eight times that of a non-interoperable environment.[43]

---

39 IDA. (2009, November 30). *IDA Collaborates with Industry to Accelerate e-Payment Adoption in Singapore* [News release].
40 Ho, V. (2012, April 16). Alternative options challenging the tap-to-pay dream. *The Business Times*.
41 *ComfortDelGro taxis introduces contactless card payments.* (2011, June 27) [Press release].
42 Tan, C.Y. (2012, January 11). New 'CashCard's' auto top-up feature fails to draw drivers. *The Straits Times*.
43 Industry Roundtable takes key step towards NFC interoperability. (2009, March 1). IDA. Retrieved June 26, 2012, from http://www.ida.gov.sg/insg/category/Infocomm-Snapshots.aspx

In 2009, IDA announced that after more than a year of discussions, 11 key industry players had agreed to collaborate and establish an interoperable infrastructure to commercially deploy mobile payments using NFC technology. Initiated by IDA, the NFC Industry Roundtable comprised members from telecommunication companies, banks, and payment service providers including MobileOne, SingTel, StarHub, DBS, OCBC, UOB, BCS, EZ-Link, NETS, MasterCard, Visa, Ministry of Finance, MAS and LTA.

The CFC was awarded in October 2011 to a consortium comprising three telcos (SingTel, StarHub, M1), two banks (DBS, Citibank) and two technology vendors EZ-Link and Gemalto. EZ-Link would enable users to store their ez-link cards on their NFC phones and was looking to convert all existing and new ez-link acceptance points to accept payments via NFC phones. The NFC system was set up to be standardised on the CEPAS platform and participants were required to comply with the CEPAS requirements and framework for implementation in a mobile device.[44]

French smart card maker Gemalto was chosen over local firms NETS and Cassis International, to develop and operate a neutral trusted third party (TTP) payment platform for NFC services, which was not exclusive to consortium members and other providers could connect with to enable contactless services. A TTP infrastructure eliminated the need for any service provider to establish separate technical connections with individual mobile operators. IDA and the seven-member consortium would jointly invest S$40 million to develop the TTP infrastructure.

The nationwide 'tap-and-pay' service using NFC technology was rolled out in August 2012. The new payment mode could be accepted at about 30,000 retail points equipped with contactless reader terminals, which worked with NFC-enabled mobile phones as well as contactless cards, including CEPAS-compliant cards.[45] Using a NFC mobile (with a NFC-enabled SIM card) certified by Gemalto, Visa and MasterCard, consumers would have a choice to access credit, pre-paid or stored-value payment options with participating companies including Cold Storage, Watson's, G2000 and ComfortDelGro taxis. IDA and consortium members were working with LTA to assess NFC mobile payment readiness for transit in early 2013 and trials were expected to be conducted at end-2012.[46]

---

44 Deployment of Interoperable Mobile Near Field Communication (NFC Infrastructure and Payment Services). (2010, November 18). Call for collaboration. IDA.

45 IDA. (2012, August 3). *Near Field Communication Services Go Live in Singapore*. [Press release].

46 Singapore NFC services finally go live. (2012, August 3). *ZDNet*.

EXHIBIT 1

THE RISE OF CONTACTLESS SMART CARDS

The handling of cash transactions was relatively less efficient and more costly than e-payments. It had been estimated that the average cost of handling an e-payment was about a third or half that of handling a cash transaction.[1] A study by VISA showed that every 10% increase in the share of e-payments in the economy could stimulate GDP growth by as much as 0.5%. Consumers typically spent more per transaction when they did not pay with cash. E-payments could be made by various means such as credit/debit, electronic funds transfer, card-based and mobile payments, which offered convenience and saved time. Technological advances and a need for security capabilities led to the rise of multipurpose smart cards with mechanisms to store and process information. With changing consumer lifestyle trends, there was a move towards credit for high-value payments, debit for larger daily purchases and contactless for micropayments.

The magnetic stripe card, predecessor of the smart card, had been used for credit and debit applications and payment for public transit since the 1970s. The publication of the Europay, MasterCard, and Visa (EMV) specifications for global chip-based card payments in the mid-1990s was a catalyst for the shift from traditional magnetic stripe to smart cards, with embedded microprocessor chips offering more secure 'chip and PIN' technology. Smart cards were widely used as stored value or secure data storage cards in a variety of government and commercial settings, such as banking and loyalty programmes, ID cards, prepaid cards in telecommunications, mass transit, healthcare, e-payments in retail and vending transactions, and physical access control. The subsequent availability of wireless technologies saw the emergence of 'swipe-and-go' proximity card systems. Such contactless smart cards were increasingly in demand since the late-1990s because of faster response time and greater durability relative to the magnetic stripe card. It could also support multiple applications enabling a card to be used across transit, payment and access.

Contactless smart cards were cards with an integrated chip that complied with ISO/IEC 14443[2], which set communication standards and transmission protocols between card and reader to create interoperability for contactless smart card products. End users often required full compatibility in both the readers and the cards. The two main communication protocols supported under the ISO 14443 standard series were the Type A (exemplified by MiFare) and Type B. ISO 14443A was the most widely used contactless smart card standard in the world, mainly for transport applications.

In Asia, transport operators were early adopters of contactless smart card ticketing solutions, such as South Korea's Upass (1996), Octopus in Hong Kong (1997), Japan's Suica (2001) and EasyCard in Taiwan (2002). Hong Kong's well-known Octopus card was the world's first multipurpose smart card payment system deployed in public transit ticketing and was recognised to have achieved considerable success as a retail payment mechanism.

Source: Author.

---

1   Humphrey et al. (2006). Benefits from a changing payment technology in European banking. *Journal of Banking and Finance*, 30 (6),1631-52.

2   ISO/IEC 14443 is an international standard for contactless technology with an operational range of up to 4 inches. This 13.56 MHz technology was originally designed for e-ticketing and e-cash. Initiated in 1994 to standardise contactless proximity cards, ISO/IEC 14443 was finalised in 2001. The standard includes two versions with different modulation approaches: Type A and Type B. Most of the contactless cards in circulation are based on ISO/IEC 14443 Type A. Source: Contactless Technology for Secure Physical Access. (2002). *Smart Card Alliance*.

EXHIBIT 2

INFORMATION TECHNOLOGY STANDARDS COMMITTEE (ITSC)

Formed in 1990, ITSC was under the purview of the Standards Council appointed by SPRING Singapore, which coordinated the national standardisation programme and appointed Standards Committees to lead standards development and implementation in various functional and technical areas. ITSC was a neutral and open platform for industry and government parties to come together to agree on technical standards. The objective of ITSC was to champion and support Singapore's infocomm standardisation programmes and participation in international infocomm standardisation activities. ITSC was an industry-led effort comprising volunteer members from the industry. In 2012, there were 350 technical experts and representatives from 180 organisations engaged in ITSC's standardisation activities.

To ensure that the development of Singapore Standards took into account the views of relevant interest groups, committee members of ITSC were appointed from the industry, professional bodies, associations, government agencies, and research and educational institutions. IDA served as the Secretariat.

ITSC appointed Technical Committees (TC) and Working Groups (WG), one of which was the Cards and Personal Identification Technical Committee (CPITC), formed to undertake standardisation works. The setup of the TCs/WGs reflected the structure of Joint Technical Committee 1 (JTC1) of the ISO whenever possible, to provide a platform for Singapore's participation in the international standardisation effort and facilitate faster evaluation and adoption of the international standards as Singapore Standards.

CPITC was an industry-led partnership made up of volunteer members comprising vendors, regulators and card issuers. Once the development of projects under the auspices of CPITC was completed, the specification was reviewed and subsequently approved by ITSC, before it became a Singapore Standard. The Contactless e-Purse Application Standard (SS 518:2006 CEPAS) was developed by a WG under the CPITC.

Table 1

Members of CEPAS Working Group (2002)

Raymond Lee, IDA	Lin Yih (CPITC Chairman)
Adrian Ong, IDA	Chan Huang Seng, IDA
Silvester Prakasam, LTA	Winstedt Rasiah, LTA
Johnny Chung, NETS	Lim Khee Ming, NETS
Kristy Chan, Citigroup	David Tharm, QB Pte Ltd
Bernard Cheong, Gemplus Technologies Asia Pte Ltd	Leow Chee Tiong, Gemplus Technologies Asia Pte Ltd
Teoh Wan Peow, Giesecke & Devrient Asia Pte Ltd	Philip Thong, Watchdata Technologies Pte Ltd
Chua Ting Kin, Euroasia Technology Pte Ltd	Tan Keng Boon, Advanced Card Systems Limited

Source: Lin Yih to Author, 28 March 2012.

EXHIBIT 3

SeP AND LTA KEY STATISTICS

a) Stakeholders in SeP
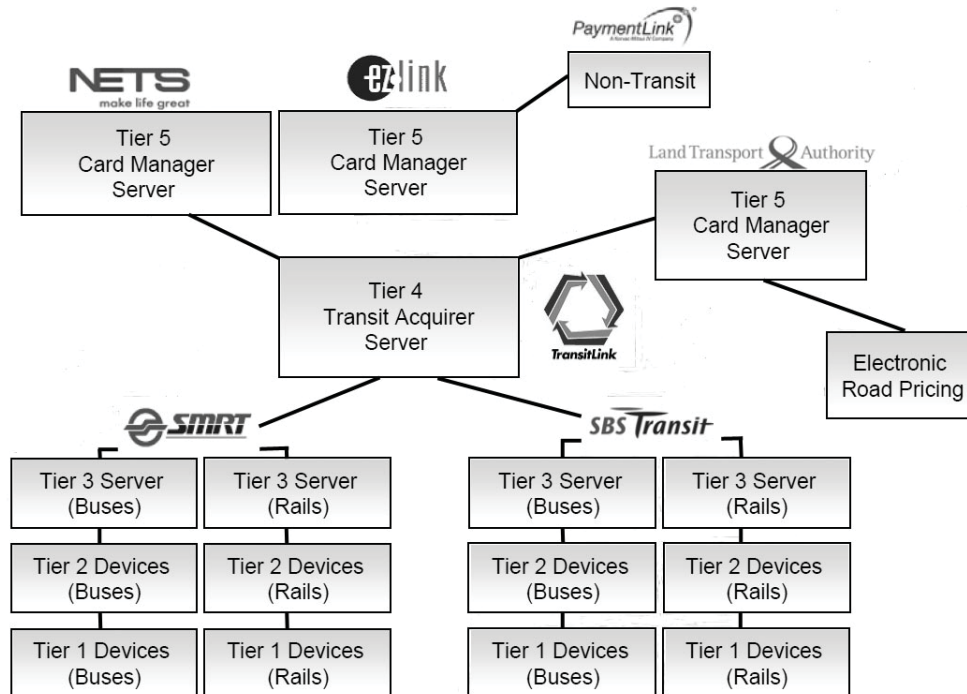
b) LTA – Key Statistics

Source: Fare Integration for Seamless Travel in Singapore. (2011, December). LTA.

EXHIBIT 4

BUSINESS STRUCTURE OF EZ–LINK

Source: Luo, J. (2010, January 28). EZ-Link Pte Ltd – A contactless smart card business beyond transport [Presentation at Transport Ticketing].

EXHIBIT 5

COMPARISON OF EZ–LINK AND NETS FLASHPAY

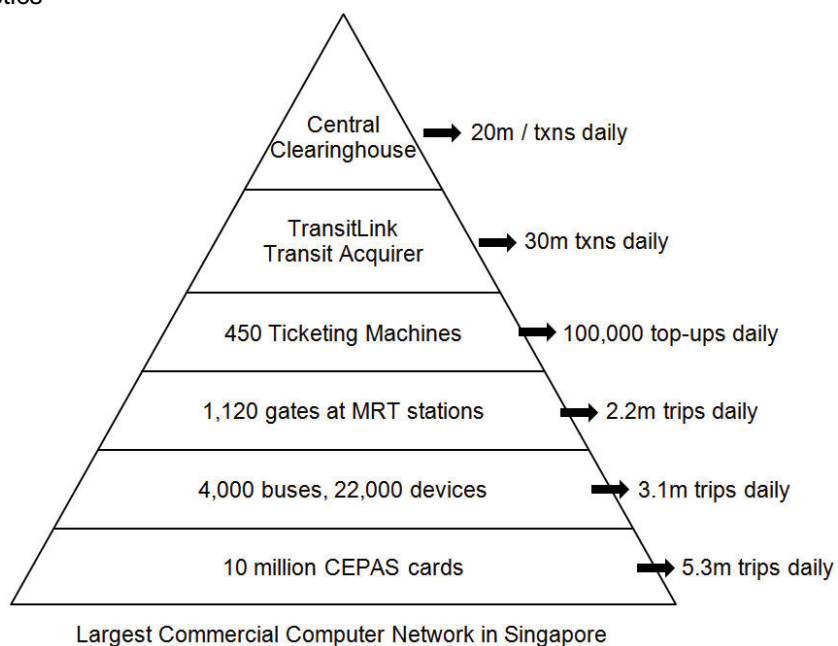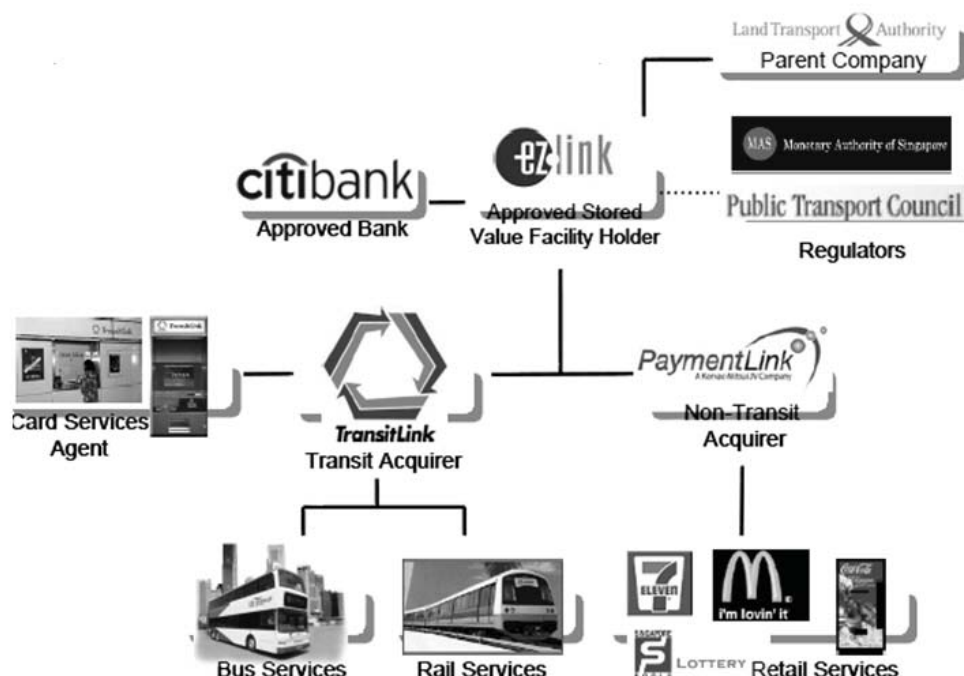|	EZ-Link	NETS FlashPay
Cost	**$15** ($5 in card cost + $10 stored value)	**$12** ($5 in card cost + $7 stored value)
Purchase and top-up mechanism	At TransitLink ticket offices, EZ-Link website, General Ticketing Machines, and Passenger Service Centres in all MRT stations.	At all TransitLink ticket offices, SPH Buzz, Cheers and 7-Eleven stores. Also at NETS kiosks located in 5 MRT stations.
Merchants where cards could be used	Over 5,000 merchants including all SMRT cabs, libraries, convenience stores, schools and hospitals.	2,500 merchants including cafes, food courts and stalls, convenience stores, bookshops and cinemas.
ERP/Car parks	Yes, only with new-generation IUs.	Yes, only with new-generation IUs.
Extra charges	Ez-Reload mechanism – an auto top-up function, with S$0.25 fee for each top-up.	Extra charges applied for bank-issued FlashPay cards when auto top-ups were done at selected merchants. Amount depended on the merchant.
Lifespan	5 years	7 years

Source: Tan, W. (2009, October 10). Nets multi-use card joins fray. *The Straits Times*.

EXHIBIT 6

CEPAS CARDS

1) The logo

2a) Old EZ-Link card – 2002

b) NETS CashCard – 1996

3) New EZ-Link card - 2009

4) NETS FlashPay card – 2009 and NETS Key Tag - 2011

Source: Compiled from media reports.

EXHIBIT 7

CONTACTLESS PAYMENTS WORLDWIDE

2010: Visa contactless cards in UK to reach 12 million by year end

2008: Barclaycard issued over a million MasterCard PayPass-branded Barclaycard credit cards in UK

2010: PayPal and Barclaycard have released statistics demonstrating the rise of mobile and contactless payment methods in the UK.

2009: MasterCard & RBS WorldPay introduce Contactless Payments in UK

2010: MBNA and Virgin Money roll out UK contactless card

2010: PKO Bank Polski S.A. started mass deployment of Visa PayWave

2010: The OTP Bank of Hungary announced rollout of MasterCard PayPass contactless cards

2006: Japan and South Korea are leading the word in contactless payment adoption

2009: NETS Introduces Singapore's Most Innovative Contactless Debit Card

2010: Commonwealth Bank contactless drive gathers momentum

2010: McDonald's and 7-Eleven go contactless in Australia

2010: Intesa Sanpaolo moves to contactless in Italy

2010: Over 1 million contactless Visa payment cards have been issued in Turkey since spring.

2009: Citibank launches contactless payment Citi Tap and Pay in India.

2010: Burger King Singapore goes contactless

2009: Interac introduces contactless capability in Canada.

2011: Starbucks introduces Mobile Payment

2010: RBC goes contactless for Vancouver Olympics

2005: 7-Eleven to Accept Visa Contactless Payments

2010: Discover begins roll out of contactless cards and stickers

2010: US Bank introduces contactless payments

2006: MasterCard's PayPass contactless cards for Banamex Financial Group in Mexico

2011: Telefonica and Mastercard set up JV in the 12 Latin American countries

Source: Growth potential in payment business with new payment trends and technologies. (2011, April 5). *Giesecke & Devrient. Euro ID 2011.*
Retrieved May 28, 2012, from http://www.euro-id-messe.de/pdf/userforum2011/Dinges.pdf

EXHIBIT 7
(CONTINUED)

CONTACTLESS PAYMENTS WORLDWIDE

Banks and credit card issuers were increasingly promoting contactless cards as part of an integrated payments strategy. Global applications such as MasterCard PayPass and Visa PayWave had provided their services since 2005 and 2007 respectively. Visa PayWave technology used an EMV chip to securely store and encrypt confidential information. An EMV chip was virtually impossible to copy and used RSA public key algorithms with up to 1984-bit keys that uniquely identified each transaction. No two cards shared the same key and the key was not transmitted. The MasterCard PayPass, similar to Visa PayWave, was a 'tap-and-go' system instead of card swiping. No signature or pin was required for transactions under S$100, and it worked as a normal credit card for transactions above S$100. Consumers could make purchases with a PayPass-enabled phone, card or mobile payment tag. In 2012, there were over 20,000 PayPass contactless terminals in Singapore.[3]

In the UK, the Barclaycard PayTag – a NFC sticker, one-third the size of a typical credit card, was launched in April 2012. The PayTag could be affixed to any mobile phone and was linked to a customer's traditional credit card account, allowing for 'wave-and-pay' purchases at any retailer which accepted contactless payments, including major retailers Waitrose, McDonald's, WH Smith, Boots and Tesco. Paytag was offered free for 12 million Barclaycard Visa cardholders and the payments did not require a pin number to pay for items up to £20. HSBC also planned to begin the conversion to contactless technology for its UK-issued debit cards, due to expire from May 2012, with the new chips.

Source: Compiled by Author.

EXHIBIT 8

MASS TRANSIT TICKETING MARKET IN ASIA PACIFIC 2010
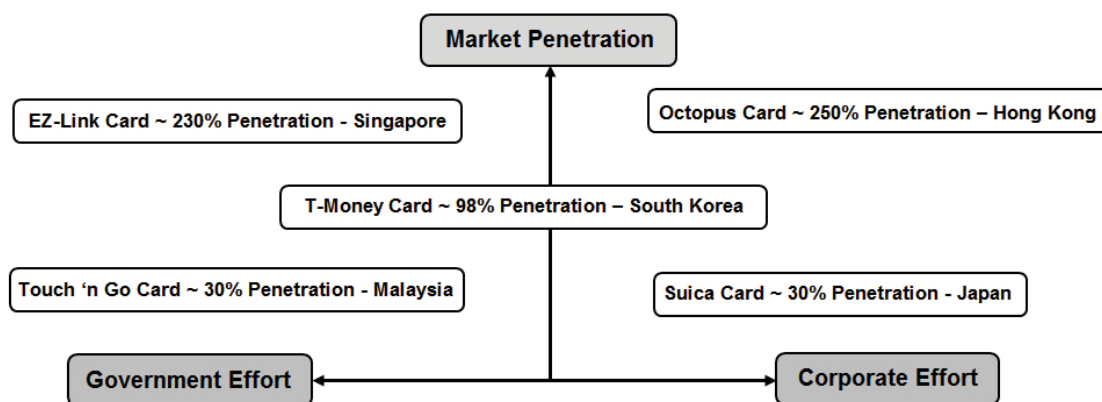
Source: The Hong Kong influence in smart cards. (2010, May). Frost and Sullivan.

---

3   Ho, V. (2012, April 16). Alternative options challenging the tap-to-pay dream. *The Business Times.*