

APTA Fare Collection Study Mission: Hong Kong, Seoul, Tokyo June 2009

Hong Kong

June 16: MTR

The group visited MTR headquarters and was primarily hosted by Paul Chan, AFC Engineering Manager. Paul led off with a video highlighting MTR operations and the Octopus card.

MTR recently merged its operations with KCR (Kowloon Canton Railway) which operates both heavy rail (gated) and commuter rail (non-gated) operations on the Kowloon side of the harbor. Combined, the operation now includes 150 stations.

MTR was described as a multi-faceted organization not only active in constructing and operating the rail network, but in developing and managing a large real estate portfolio. MTR is known to be one of the few global transport companies generating a profit due to both the scale and efficiency of its operations and the manner in which it leverages its real estate holdings and foot traffic. It also generates revenue and profit due to Octopus card; Octopus Cards Limited (OCL) is largely owned by MTR without any bank ownership or involvement. It was stated that the fare revenue basically covers the operating costs while the non-fare revenue activities, including real estate activities and marketing (e.g. advertising on trains), generate the profits. For example, their latest venture is in the “Element” Shopping Center, which is built to get people to ride MTR and to come shopping. They are investing in integrating shopping, rail, business, and residential spaces.

MTR is now discussing rail system projects in mainland China as well (currency exchange will be an issue). They are offering consulting services internationally and have a joint venture with Transport for London surrounding the operation of rail service lines. MTR is also the backend system provider for Dubai Metro.

Launched without government funding, Octopus Cards Limited (previously Creative Star Limited) was established in 1997 as a joint venture (operated by MTR) of the five major operators participating in the Octopus network with the following shareholdings:

MTR	57.4%
KCR	22.1%
KMB	12.4%
Citybus	5%
First Bus	3.1%

No government funding was provided. Octopus was launched in 1997. Since then, OCL --the card issuer-- has split off from MTR-- the rail company. Given the MTR/KCR merger, MTR now owns almost 80% of OCL, which operates as a stand alone subsidiary.

MTR is expanding with new lines: West Island line, Tseung Kwan O line, then four to five more to be built through 2015. They operate three types of systems:

- 1) Completely open system for light rail
- 2) Partially open system on the Airport Express

3) Closed system with entry and exit barrier

MTR's "Touch & Go" smart card system works on both public transit – minibuses, buses, rail and ferry -- and with vendors in the Octopus Cards Limited (OCL) network, both inside and outside the station. There are now 400 participants in the Octopus network and about 25% of all payment transactions are non-transit. A total of 50,000 readers are installed in Hong Kong. OCL charges late joining Octopus merchants a 1% discount fee on all transactions on average. They negotiate reduced fees with high volume vendors such as McDonald's and 7-Eleven. They also pay convenience outlets a .4% commission for performing top up (reloading) services. The stored value purse is limited to a maximum of \$1000 HK for security purposes. Everything (both transit and non-transit) is kept in the same purse. Multiple purses can get complicated particularly with security. A program is being developed with Visa for Auto pay (auto load) but this is now less than 5% of top ups. 80% of loads are with cash at Add Value machines. Time in Hong Kong is precious so it is not uncommon for people to load in \$100 HK increments. Finally, the system allows for the option of an account linked payment. There are now 1.5M people on a form of account linked payment. This transaction is processed by the device as normal (based upon the usage data in the card file), but there is no value field and the card is not debited. The back office collects the fare charges from the devices and bills them to the credit card.

From a fare collection perspective, MTR has equipment from a variety of suppliers with original devices from Cubic being complemented over years of expansion by devices from Thorn Transit Systems (now Cubic), Ascom (now ACS), Thales, ERG and items developed locally in partnership with MTR. For Octopus, the equipment items were either retrofitted with or delivered including smart card processors from SONY. The original software design and systems integration for the card/device application and overall systems integration was performed by ERG. The back office was developed via collaboration between ERG (as the prime contractor), James Martin and Associates (as a sub-contractor), and Creative Star Ltd. MTR is currently developing the next generation reader, which will be a multi-vendor model. This will enable OCL to introduce additional card types beyond the base media.

Chan shared that the multi-vendor model has come with its share of complications and that MTR has basically taken on the role of systems integrator. There is a deep base of engineering talent within MTR performing a variety of systems integration and support tasks normally performed by an agency's AFC contractor.

Octopus Cards Ltd. operates the card program and leverages MTR engineering capabilities in developing new products and technologies. One of these is a next generation reader that will support Type A (Mifare), B (Motorola), and C (the SONY standard). The new multiscard reader with an open architecture will enable OCL to introduce additional card types beyond the SONY card, which currently is the sole basis for the system. The plan is to replace all readers in the system with the new model. Chan stressed the importance of ensuring a seamless transition where legacy media continue to be supported as new products are introduced. OCL may be willing to license their new universal reader design.

It was noticed that Octopus card printing and quality was different than the cards issued by Suica and Pasma in Japan. Octopus cards seem to be produced using a different card construction and card printing technique; i.e., one-up or single card printing (graphics printing on white cards and covering it with varnish for protection). On average, the SONY card transaction is completed in 300ms, however the latest generation of the card is closer to 200ms. Sony is developing the new FeliCa chips using FRAM technology, which is quite faster than EEPROM. It also provides for a virtually unlimited number of write cycles, which comes down to the reader API. Cards are performing on average 30K transactions between card failures. They are performing 12.5 million transactions per day (including parking, retail, etc) and have an outstanding base of 15 million cards (7.6 million of these are active). Their monthly reliability index has gone up significantly since launch because they don't rely on contractors for changes to their system.

While the card life is specified at 10 years, basic patron behavior sees a card life at about five years. Cards are issued with a three year expiration date and in some cases, cards that are in good condition are re-issued. If a

card has not been used in nine months it is suspended so that they can keep track of how many cards are active; a card can be reactivated at a Customer Service Centre point (Ticket Office).

OCL asked SONY to add “Edge Effect” protection to the card, and are currently paying around \$17 HK (\$2.50) per unit for the SONY card. They are able to re-label their cards multiple times for 20 cents each.

It was reported that 91% of MTR transactions are now on Octopus, and 9% still on the magnetic Single Journey Ticket (SJT). Not all gates are equipped with a mag reader so there is queuing for mag ticket users. Mag stripe costs about 70% extra in gate maintenance and requires additional compatibility testing on gates. MTR was asked whether it might move to limited use cards, but Chan indicated that studies showed an insufficient business case. It’s more likely they will introduce contact-less tokens as is being used on the Chinese mainland. Magnetic cards are recycled, although this is more expensive, it saves them some money.

Between developing the next generation, multi-vendor reader and re-constructing the back office system; OCL and MTR are marketing the package internationally. The Netherlands is their first customer. OCL has also been selling consulting services, recently assisting Delhi, Bangkok, and Beijing.

MTR determines fares by the number of stops, with an extra fee for crossing through the tunnel. Although, the further you go the more you pay, it is not a simple distance-based scheme. The six bus companies each have separate tariffs strategies of their own. Most are flat upon entry with an extra fee for the tunnel (smart card users just tap in) but they are considering moving to a more complex tariff system. They have phased out “peak/off peak” fares because they experienced high ridership at all times (peak used to be from 8:30 – 9:30am).

There is an intermodal scheme in place on some routes with a commercial basis (e.g. riding MTR gives you a bus discount). They have an intramodal scheme on MTR, where use of the Airport Express gives you a free or reduced subway ride.¹

Octopus has recently been introduced into taxis (although still in limited penetration). The less than universal success is due to the challenge of accounting with an owner-operated single taxi. Taxis are not perceived as competitors to MTR because taxis are more convenient. MTR competes more with buses.

MTR is preparing to replace much of their original AFC equipment and will procure gates and TVMs for the expansion lines as well. Because each new line requires a new tender, MTR has many gate types in use, including tripod, flap, wide gate, and scissor gates. There are interoperability and maintenance issues as a result.

MTR has outsourced some of the maintenance activities and are maintaining all the software in-house. Their core team builds the machines.

Questions were asked about Near Field Communications (NFC) phones. Concern was expressed surrounding Over the Air security. There is no current NFC activity in Hong Kong but a trial is planned for next year. There is not much of a demand for NFC in Hong Kong because of the penetration of the Octopus card, but OCL is having discussions with NFC telco providers. MTR would work through OCL to implement NFC.

OCL does not want to entertain the direct acceptance of a contact-less bankcard model as they see the banks/associations as competitors. In fact, OCL has secured its own banking charter in order to push their Octopus as an E-Money product into the retail environment. Octopus initially had to prove to the Hong Kong Monetary Authority (HKMA) that they would only be dealing with the high volume-low value applications and not be competing with credit cards in the low volume-high value applications. Octopus has indeed been positioned as the micro-payments card in Hong Kong, a market that only interested the banks after Octopus’

¹ Side note on user experience by Ging Ging: Although they had fantastic customer service at the airport assisting with Octopus card purchases and explaining all the options, this information was not obvious upon arriving at the airport.

success. People are now upset at not having the credit card option to reload, but there is no reason for OCL to take VISA/MC for loading for the following reasons:

- 1) Signatures are required for transactions > \$30 US
- 2) It does not make sense to pay MC/VISA if they already have a good system in place
- 3) Additional security would be required

They are, however, working with VISA to do auto pay/top-up. Top-up helps riders take care of any negative balance (Octopus allows users to go into negative balance because they are holding a \$50HK deposit on every card). But OCL is experiencing problems with cancelled accounts, cheating, and chargebacks. They have worked with VISA to send one consolidated bill at the end of the month, and have limited the number of auto pays to one per day in order not to step out of the high volume-low value arena. There are no plans for a co-branded card.

Compared to bank cards, they have found that smart cards have added convenience and a lower maintenance cost. More people can be processed with fewer problems.

OCL has multiple usage based “points” or rewards programs in place. The points balance can be checked at kiosks (e-instant bonus machines) which also act as a point of redemption. The points are kept on a remote server, not on the card, and require registration through an internet account. Separately, the MTR Club allows participants to earn free rides, breakfast, etc. Also, they have a “Fare saver” program which gives a 10% discount on fare at a station where the card holder did a lot of shopping.

An Octopus Rewards program offers registered card holders a 0.5% value bonus on each purchase in the retail environment. Retail payment does not have to be via Octopus: rewards can be earned with cash, credit, or Octopus payment methods. Over 1 million patrons are signed up and there are 10 participating merchants including McDonalds, Wellcome, UA Cinemas, and Fotomax. Registered cards must be personalized by OCL based upon the patron’s submittal of an application form and photograph. About 20% of active cards are registered/personalized, giving users extra protection.

There are approximately 10M Octopus payment transactions each day totaling more than \$74M. Fare payment results in 75% of these transactions with the remainder in retail and parking. Parking and retail is considered non-transit business. Group road parking meters also take Octopus.

Octopus data is very useful and the card technology is flexible. OCL is mining user data for marketing purposes and partnerships (e.g. selling data to insurance companies). Octopus is also being used for school attendance, so all students must have an Octopus card. Octopus is also used for residential building access.

OCL not only provides the operating services but also controls the technology. For an AFC equipment item to be used in the system, the supplier must procure a reader/processor from OCL carrying the Octopus application software. The unit carries with it an established set of Application Programmer Interfaces that are released to the vendor under controlled documents and is then tested and certified by OCL.

OCL pays MTR for services performed including engineering and customer support. Most MTR customer service center questions are related to the Octopus card. One such service is reloading through customer service centers in each station. OCL charges MTR for other services.

OCL performs outreach and education to students particularly when there are transitions to new systems.

Operational requirements: Accommodation for disabled passengers through use of Braille and special exists is done through a special Octopus bit for tactile guide path.

June 17: Kowloon Motor Bus (KMB)

Kowloon Motor Bus operates just over 4000 buses out of 6 depots. They are also a shareholder in OCL (12.4%). They participate in the Octopus system based upon ERG Driver Control Units and Smart Card Validators placed on each bus.

A wireless LAN solution places access points in the fueling bays to collect daily transaction data and transmit it to a depot level computer. The depot level computer then serves to distribute, table, configure, and provide software updates to the bus equipment. Finally, forwarding transaction data aggregated over the vehicles assigned to the garage to the central computer system.

The bus equipment is currently more than 10 years old and a tender is in process to replace it. The new equipment will incorporate the new multi-protocol reader provided by OCL.

KMB operates to a 90% bus availability target with a 10 to 15 minute response time to put a bus back in service given equipment failure.

Seoul

June 19: Seoul Metro

There are 12 million people in the Seoul Metropolitan area and Seoul Metro takes a lot of pride in its safety record. Seoul Metro operates lines 1 thru 4 of the metropolitan rail network and serves 4.5M trips per day. In 2007, they had 30M customers. This makes up a little less than half the subway network. Seoul Metropolitan Rapid Transit Corporation (SMRT) which was established in 1994 operates lines 5 thru 8. They cooperate with Korea Train Corporation on other lines. For transfers, they only need to integrate on fares.

There are 2,648 readers (smart card terminals) in the Seoul Metro system. The card utilized is the T-Money card issued by Korea Smart Card Corporation. KSCC is 35% owned by the city government with remaining shareholders consisting of banks, insurance companies, and investors.

LG CNS manufactures the cards and Clear Smart Card issues the cards. In using the system many members of the trade mission observed slow transactions and a high incidence of transaction failure requiring multiple presentments of the card. We later learned that a combination of card platform and security architecture has led to average transaction times in the range of 600 ms and is microprocessor based on Type B, using an Infineon chip. The chip needs to be about 5cm from the reader. Greater than 90% of the population uses the smart card.

June 19: Korea Smart Card Corporation

KSCC operates the smart card program on behalf of the various operators and employs just over 100 people (in addition to approximately 200 outsourced engineers). They are a card issuer and the clearinghouse. They are now doing approximately 25M card transactions per day across with 10M unique users. Transaction volume is split between 13.4M per day on bus and 12.6M on rail. Booz Allen Hamilton assisted them in developing the system specifications and operating practices.

The Seoul City government specifies the fares, routes, etc. Bus companies are reimbursed by passenger-kilometers - not by the number of passengers. The bus management is quasi-public. Although the bus companies are private, all the routes were redone at the same time to optimize the system.

The Seoul City Reform in Public Transport System program began with a very bus centric focus as ridership was falling. As part of the program, they moved depots out to the suburbs and improved bus driver services. Additions of axial bus-priority lanes have reduced traffic experienced by buses by up to 70%. They also introduced the smart card system and are moving to integrate a bus management system targeting better on-time performance and more convenient payment of fares. Ridership is now growing again.

The Unified Integrated Fare System was introduced in 2003. They ran the tender for the integrated ticketing system with LG CNS winning the bid and formed Korea Smart Card Company. Stakeholders included pre-existing card issuers. Shareholders in KSCC are as follows:

Seoul Metropolitan Government and LG CNS	35%
11 credit card companies, all 3 telecoms, 1 terminal manufacturer, 1 card manufacturer, the Korea Teachers Fund, the Korea Local Administrators Fund.	Remainder

Top-up can be done in three ways: 1) through vendors 2) through the internet 3) through the mobile phone. They have a USB T-money application for topping off the card. They have begun to introduce mobile payment with just over 300K phones now T-Money enabled in collaboration with 3 carriers. The phones are specially fitted with an antenna and a SIM loaded with the app. These units are not compliant with NFC standards but functionally perform the same way.

With the smart card system the operators implemented a unified fare structure across rail and bus. Up to 5 free transfers can be taken within a 10km trip. Additional charge is incurred beyond 10 km. They operate a tag-in-tag-out system on bus and fare by distance on rail. There is a max fare penalty for not tagging out. They use a wireless LAN to send data to the bus depot at about 1a.m. every morning. Transactions are settled by about 7a.m. the next day. There is a re-settling at the end of the month for any errors.

They provide an “omnipresent e-money service”. They claim 99% of passenger traffic is now on the card and 92% on Metro with the remainder on paper tickets, which makes it easy for them to extend to other markets (e.g. Korean convenience stores, parking, fast food museums, interior malls, payment of city fines, tax payments, and civil services). They would like to give benefits back to customers like mileage bonuses and income tax reporting. Their elderly system (currently all paper) will be changing in August to require a card and by 2009 they will be able to get tickets through the vending machine by using their national ID. They expect to go through 3M full feature cards each year. Metro will go all CSC by introducing a small recyclable single-use card (single-use throw-away is too expensive) based on either the Ultra-Lite or the ST Micro Limited Use card. The system is open to other cards, as some are using MiFare; there are 2 post-paid cards, and 3 telecoms using SIMS (T-Money application on a SIM).

The T-Money card is a stored value card that carries a 20 record history file. Card based transactions are processed at fare terminals. Sixty per cent of users carry a credit card carrying a light version of the T-Money application. The registered pre-paid cards carry the previous trip record and the accumulated distance with KSCC. All transactions are reported to the tax board. Device calculated transactions are billed to the credit card. Post-paid cards have no money on the chip, it just records histories.

The card platform is microprocessor based (8k EEPROM supplied by Infineon) and the security architecture utilizes multiple (6) hardware based security access modules (SAM’s) in the terminal. The bankcard issuers each have their own SAM but must procure it through a single supplier established by KSCC. This company initializes all the SAM’s prior to delivery to KSCC for reader deployment. KSCC implemented the protocol and integrated with the SAM. All readers support ISO 14443 Types A and B.

The processing overhead imposed by both the card OS and the SAM coupled with the lower baud rate inherent in SIM based SAM's appear to contribute to the longer transaction times and create the occurrence where the card can be lifted prior to completion of the transaction thus necessitating a re-touch.

The terminals support a 10M record hotlist. The depth of this list also appears to be having an effect on the transaction time of 600ms. The hotlist is obtained from card issuers.

For cards issued by credit card companies (60% of cards) the operators and merchants pay a 2.4% discount fee. Of this, KSCC gets 1.5%. On the KSCC issued stored value cards KSCC charges a 1.9% discount fee on each transaction. There is also an initial royalty fee. These fees are negotiated every year. KSCC pays a commission (unstated) to re-load agents. There are over 5000 re-load terminals across the network. They have customer service for merchants selling cards.

The readers and devices are developed by KSCC (in close association with shareholder LG CNS) the production of the terminals is outsourced. KSCC does not supply gates and TVM's but does provide the readers to the rail operators and the terminals to the bus operators. This is an expense item in their business case (the operators do not pay for the terminals). The bus terminals include GPS functionality procured from SUB 3. Maintenance is also outsourced.

Taxis communicate by CDMA. It requires online validation so the taxi terminals do not carry a hotlist. Their hardware is installed for free because the fees pay for all of it. It has not proven to be good business due to having to deal with each individual taxi. Taxis went live in 2006 with 30K of 72.5K taxis now accepting T-Money.

KSCC is pitching a program they call "Big Settler". The notion is that they would provide remote processing services on behalf of transit operators around the globe leveraging their Seoul based facilities. They would follow a similar model of providing the readers and bus terminals and charge transaction fees. They are taking advantage of economies of scale by using existing settlers rather than creating new ones.

KSCC is pursuing national interoperability. There are two other fare collector operators in other cities that will be interoperable. KSCC is now working in 6 other Korean cities and continuing to expand. They have entered into an agreement in Wellington NZ (via a local Value Added Re-seller) and have bid the procurement in Auckland. They are also aggressively pursuing business in China and are working with VISA in Macau. They are in discussions with Octopus in Hong Kong and EZRider in Singapore. They are hoping that interoperability may help to reduce their costs, such as costs of cards.

June 20: Seoul Metropolitan City Government

The Seoul Metropolitan City Government is one of the major shareholders in KSCC and the entity that initiated the program.

Seoul has 9 subway lines under 4 operators. The Seoul Metropolitan area has a population of 10.35 million. In 2004, a series of public transportation reforms were mandated in order to combat declining transit usage (mainly seen in reduced bus passenger volume) and increasing personal vehicle usage. They described a "vicious circle" of reductions in passenger volume resulting in reductions in service and, as a result, more people moving into their cars.

Among the reforms were revisions to bus routing, improvements to infrastructure, assistance systems (including ITS and the integrated ticketing system), and the procurement of a bus management system. The bus

management system feeds into a sophisticated transportation management complex known as TOPIS. The system was built by Samsung.

As for fare reform, they implemented a Unified Integrated Fare System in 2003 for both rail and bus (using the concept of “single mode” so users are charged only once). For subway and bus trunk routes the basic fare is 900 won for the first 10KM traveled. Beyond 10KM an additional 100 won is charged for each 10KM. Within 40 minutes, a rider can transfer 4 times. Both rail and bus are entry/exit (tag in-tag out on bus) controlled with the basic fare charged upon entry and the surcharges collected (if due) upon exit.

On bus feeder routes, the basic fare is 600 won. Linked journeys are determined by time and a multi-modal trip is referred to as a transaction unit. Transfers within the transaction unit are free. Break points between transaction units are determined by time of day.

When this structure was implemented the operators saw a significant reduction in the average fare value. As a result, the SCG has taken on the obligation of subsidizing the difference between the original fare and the new discounted fare, which currently is a subsidization of about 15%. The SMG is subsidizing the operating community the equivalent of \$150M US per year.

Bus operators are guaranteed a 4.5% operating profit with a schedule of deductions for below standard performance. Bonuses are available to operators exceeding standards. There are 8140 buses spread across 74 operators (running 422 routes) with the largest running a fleet of 200. The bus operators must invest their own money for capital, but the Seoul government reimburses them through operating costs (not by time but by km since some routes are easy and higher speed, whereas difficult areas operate at slower speeds). Seoul Metro is subsidized up to 100% by the city.

Currently about 30% of busses are still on diesel fuel with that objective to have 100% of vehicles on compressed natural gas and be low-floor by 2010. Bus operators buy oil together.

The effect of the various programs has been increased ridership.

SCG was asked if KSCC was generating any profit and, if so, were distributions taken as additional sources of operating revenue. KSCC was not yet profitable. However, KSCC was now at break even financial performance, but that they did not expect to be showing profits until 2012.

June 20: Seoul TOPIS

Seoul TOPIS is the traffic management center for Seoul. They gave us a demo of their system and showed us how they use CCTVs to find illegally parked vehicles and issue tickets.

They are working on a Bus Management System proposed by the Seoul City Government to be built by Motorola which will track buses real-time.

Tokyo

June 23:Tokyo Metro

We were hosted by Satoshi Kawamura, Director of International Affairs, and Lisa Shikame, also of the International Affairs department.

In this meeting we were introduced to the PASMO system. Contact-less smart cards in Japan were first introduced by JR East in partnership with SONY Corporation. JR built the system and launched the Suica card in early 2001.

The other rail and bus operators, however, do not appear to have wanted to fall under the Suica program as JR would have controlled all of the cash flow, float (and associated yield), and card breakage (abandoned card value). An agreement was negotiated whereby JR shared the technology and systems it had developed with the other operators in exchange for the opening of the operator systems to accept the Suica card.

The 3rd party operators (27 railways and 54 bus companies...to be extended to 78) now run their own instance of an interoperable back office and have developed their own terminals to common specs, called the Cybernetic Standard, with Suica. This was migration from a bus only mag card and the Passnet train and monorail card. The PASMO card was introduced in 2007. PASMO Card Company Ltd. was established with the major (non JR) rail and bus companies as shareholders and a separate branded smart card product launched, the PASMO card.

Both terminals deployed by PASMO and by Suica (JR) support both card brands. Suica also had to make some changes to their system and replaced all of their gates to achieve this interoperability. Settlement between the two card systems is performed by the private company, IC Card Integration Center Company (IC Card Mutual Usage Corporation?). PASMO currently supports cash top ups only but is looking to expand into bankcard reloads. The current card acquisition strategy is similar to Suica where the user pays 2000 Yen at issuance with 1,500 Yen of stored value and a 500 Yen deposit.

The basic software for the cards is obtained from JR, but each company builds their own readers. They feel that the Cybernetic Standard strikes a balance between competition and cooperation. Note that the Cybernetic Standard is a closed, proprietary standard. Taxis can obtain equipment from either Suica or PASMO.

The actual cash is held separately by JR and PASMO and payment is made within 30 days (100% settled). The business rules for the system are set by a Steering Committee consisting of PASMO and Suica members. The public portion of the group, Tokyo Metro, has plans to release their shares.

The service area of PASMO is extending at a rate of 5 additional buses being integrated into the system per day. They have observed an 8% increase in customer's chances of bus use with the introduction of smart cards due to convenience. This is low because magnetic cards still give you discounts and off-peak fares that IC cards can't yet.

Tokyo Metro hosted us at their training and test lab. This was a well laid out facility complete with a full station environment of gates, vending machines, ticket office terminals, and customer service terminals all assembled in a pseudo station environment.

Tokyo Metro operates a similar equipment suite to JR with very sophisticated gating systems built to a common spec by three suppliers (Nippon Signal, Omron, and Toshiba). The gates accept both magnetic cards and contact-less cards (Suica/Pasmo). The magnetic cards may be inserted in any direction and the ticket transport mechanism can orient the ticket, read, write, and verify it in very rapid time. The gate was opened for us and the transport was shown to be a very complex and rich mechanism.

The Tokyo Metro runs a fare by distance system (thus entry and exit control) and the smart card transactions were reported to operate in 100 ms. The smart card reader sits on the top surface of the gate at either end as the gates are reversible and control both entry and exit. Currently these readers are the standard SONY configuration but it was shared with us that a next generation Type A, B, C (C being the SONY standard) multi-

protocol reader was pending. It is unclear the relationship (if any) between the ABC Hong Kong Reader and the ABC Tokyo reader.

The vending machines are mounted in the wall and serviced from the rear via an access controlled room. The visible portion of the TVM simply houses the user interfaces and the media acceptance orifices. Behind the wall each ticket vending machine has a rolled steel cabinet with rear door that allows personnel in the controlled room to perform revenue service, any necessary re-stocking, and repair services when necessary. This type of design requires forethought and planning in station design and consumes a significant amount of space for the control room.

JR East

We were hosted by Mitsuo Higashi, General Manager International Department and Satoshi Komoda, Assistant Manager, International Department.

JR East is one of 7 members of the Japan Railways Group. Among these there are 6 passenger and 1 freight company. These 7 operators are among 207 total rail companies operating in Japan. JR Group was formed in the late 1980's via privatization of Japanese National Rail. JR has been running as a private enterprise for 20 years and is 30% owned by foreigners.

JR East operates over 1,700 stations handling over 16 million passengers per day. As a secondary business line it operates over 120 shopping centers with hundreds of retailers and about 40 hotels totaling over 5,600 rooms.

It was shared that Rail operations and Services (stations) are managed as separate business activities. They have a general target of collecting 100Yen for each of 16 million travelers each day. Tokyo and the South Region have a population of approximately 30 million people.

JR developed, launched, and operates the Suica smart card program. The program was launched in 2001 and was developed as part of an effort to decrease congestion by improving service and speeding ticket purchase and processing through the fare gates. It had a secondary financial benefit of reducing maintenance, lowering ticket stock costs, and generating new business opportunities. Today 70% of traffic is on the Suica card with the remaining 30% on the magnetic ticket.

Suica stands for Super Urban Intelligent Card. It supports both commuter passes and stored value. The stored value utility as provides an e-Money function as is honored throughout the JR retailer community. Up to 20,000 Yen can be stored on the card.

The Suica card is processed in 200 ms as compared to 700 ms for the magnetic card. Suica uses the SONY Felica smart card as is used in Hong Kong. Currently the system is closed to this proprietary (non-ISO compliant) card platform, however, a plan is underway to introduce a Type A, B, C (SONY) reader to allow a smooth introduction of new ISO compliant card products. They are *Common Criteria (ISO 15408) Certified - EAL 3*. They are also looking at ISO/IEC 18092 for NFC.

Similar to the Hong Kong system, the Suica card carries a transaction history 20 records deep which is accessed by the fare processing device to apply fare calculations. This card history is also used for both attended and unattended customer service purposes. SONY is now offering a variety of its VAIO computers within built Felica readers. This is proving popular in Tokyo with users able to perform balance checks and transaction history reviews on their own computers without the need to go on line to the Suica system.

About 10% of the traffic is using NFC phones (about 1 million handsets in use). The latest phones now support an Over the Air download of the Suica application. The original phones had to be delivered pre-configured.

The application is free to the patron and the carrier is not paid a fee to deliver it. It remains unclear what the business case is for the carriers to issue the more expensive phone and to service the ticketing application. This needs more research.

When including both JR Suica terminals and PASMO terminals (both fully inter-operable), there are over 140,000 terminals in the combined network (50,000 on rail, and 88,000 sales terminals of which 67,000 are Suica). Combined there are now more than 30 million cards in circulation (of these 25M are Suica and 1M are mobile phones).

Starting in 2004, Suica acceptance was pushed outside the station to a series of shopping malls (19,000), Family Marts (2,650), C-Stores (1,640), Airport merchants (220), and others (150). Today there are about 1,150,000 non-transit e-Money transactions on Suica per day. Suica transactions jumped dramatically (from 8M/day to 20M/day) when the PASMO operators came on line even though a competing card product was introduced. So many people already had Suica cards and just kept using it on new services.

The system deployment cost them JR 13 billion yen and they claim a revenue gain of 3.5 billion per year coupled with ticket stock reductions of .4 billion per year. Together this generated a payoff of the investment in 3 years.

JR is now looking at establishing Suica as the third pillar of operations alongside the railway ops and real estate management.

They are in the midst of a series of expansion programs including:

- Expanding the number of Suica View Credit Cards. These are bank issued credit cards carrying the Suica chip and application on a common card body with a mag stripe credit card.
- Establishing more “PASMO like” relationships with other national rail operators to extend the acceptance of Suica nationally.
- Expanding the working relationship with Credit card issuers to enable the over the air purchase of Suica product using credit/debit payment for products to be loaded to the NFC phone
- Expanding “EASY- mobile Suica” services where mobile phone users can utilize Suica without credit card functions
- Enhancing the system to enable settlement over the Internet...e.g. on-line goods and services could be paid for with Suica E-money.
- Enhancing the system to include Suica Pocket, a service that would allow the over the air gifting of Suica E-money from one person to another.
- Expanding compatibility with Softbank
- Establishing Mobile Suica Express Ticket as a national solution to train ticketing via mobile phone

SONY

We were hosted by:

- Jun Kondo, US Business Development lead,
- Toshikazu Tachibana, Senior Manager International Sales,
- Mitsushige Suzuki, Senior Manager Technical Solutions
- Jun (JJ) Shionozaki, Assistant Manager, Technical Solutions
- Katsuhiko Masaoka, Deputy general Manager

This group belongs to the Electronics Business Group under the B2B Solutions Group. SONY has a new anglo CEO who is promoting “SONY United”.

Sony shared some details on the Felica card platform enabled with 3G phones and the list of users including Transport Operators in Hong Kong, Singapore, Shenzhen, Delhi, China and Japan (Tokyo, Osaka, more). Nearly all 3G phones in Japan are now Felica enabled (I-mode Felica).

They shared that the other PC manufacturers (NEC, Fujitsu, and Toshiba) were now interested in adding the Felica module to their models to be marketed in Japan due to the demonstrated demand. Sony would provide the software in a chipset to allow Felica cards to be read. This would enable top-up of e-money cards such as Edy. Suica does not yet currently do this. The download of software has been perceived to be troublesome as seen in MobileSuica, so far, having Suica on a phone has not been seen as an advantage to the Suica card. But potential benefits include: 1) Being able to see the balance on the phone 2) ability to charge through the phone 3) not having to queue at the green card (seat reservation service).

DoCoMo allows charging through phone via a credit card. DoCoMo is allowing charging through a mobile phone account, but this is not being discussed for Suica.

There was quite a bit of discussion surrounding NFC with SONY outlining a secure protocol they have developed allowing a remote content server to securely exchange information with the Felica chip residing in the handset. Utilization of this interface will allow a content provider to securely deliver the application file and key set from the content server to the handset, thus enabling the ticketing application on the mobile phone.

It was discussed that US properties (including those present in the room BART, LA Metro, Houston Metro) had all (among many more) deployed reader infrastructure in conformance with ISO 14443. As such, these readers support only Types A and B and not the proprietary SONY Type C. It was noted with SONY that while their card appeared to be exceptional technology the RF protocol appeared to be an obstacle for its acceptance in the US. As such it was asked if SONY could or would be willing to deliver a version of the product in conformance with Type B (the ISO protocol closest to Type C).

They explained that their product would enable them to separate the RF interface from the core operating system and security and that a Type B compatible product could be delivered should there be sufficient demand to justify the expense of developing such an alternate configuration.

SONY also shared that they have developed their own Type A, C reader and are in the process of incorporating Type B. It is not clear if there is any relationship between the SONY development efforts and those taking place in Hong Kong or with Tokyo Metro.

While SONY claimed in the meeting that “Type B is not so popular” it does not appear that they are following what is happening with the banks in the US. Here the majority of contact-less payment cards on issue is using Type B cards from Texas Instruments and Inside Contact-less. As such, it would appear that transit agencies would want to follow the volume in order to command the best card pricing. Accordingly, Type B is likely to be very significant in years to come.

June 24: Nihon Bus Association

We were hosted by Shoji Fujii – President and Hiroshi Fnnato – Manager

This is a large association of bus operators established 3 years after WW II. The bus operation started over 100 years ago. There are 2,200 members mostly private but some public. They collect membership dues and have an annual budget of \$1B Yen. They act as a lobbying and policy organization. They served as a coordinator in establishing the PASMO fare system.

The largest bus operator member is Tokyo Bus Corp. Mr. Saito, the Managing Director for Tokyo Bus, attended the meeting and presented on the PASMO program. Mr. Saito led the initiative. Mr. Saito pointed to the elimination of coins on bus as a major priority and the basic thrust behind the smart card. He shared that the program required a great deal of preparation and consideration for patron transition and education.

He shared that there are many operators and some are not large and sophisticated. Essentially, getting a license to operate is not difficult if you can prove you meet safety requirements. He shared that the fares have been deregulated (subject to a cap) as of 2002 and this gives the operators a lot of flexibility. The combination of flexible wide ranging fare structures and the general nature of the operator community made the development and implementation of PASMO challenging.

He explained there are 4 basic types of fares:

1. Block/Distance: Fare by distance
2. Flat fare: used in large cities (in most cities as far as you can go for ~200 Yen)
3. Special Block/Distance: for areas near cities (typically 4km out, but as low as 1km)
4. Zone Fare System: 2 Ways
 - a. Center to the suburbs (concentric rings)
 - b. Overlapping cities

All of these are supported in the system.

For flat fare, payment is made upon boarding. Passengers can alight from the middle or rear, but still need to tag off.

Today, the IC card is only being used in the big cities but there is a plan to move it forward in outlying areas later. Today, about 30% of the fares on PASMO equipped operators are with the IC card

For fare by distance, it is a tag on tag off system. If cash is used, a ticket is purchased on boarding and the balance (if due) is paid on exit. In the outlying areas, a ticket can be picked up at the middle or back of the bus and the whole amount paid at exit at the front.

For fare by distance, the drivers have to manually enter the zone changes as there is no integrated GPS with the farebox (although GPS is used for signal prioritization) because not all bus companies have GPS. Passengers must get on in the front and make their payment immediately and then they exit through the middle or the back. Buses do have fareboxes which support coins, notes, magnetic tickets, and smart cards. The form factor is much different than US fare boxes and there is no integrated WLAN. A data card is carried back to the depot and the end of the shift and tour data uploaded manually. The farebox we saw is manufactured by a company called LECIP. It was explained that there are three other suppliers of a similar device.

Japan is a very rail driven market with 2000 data showing that only 10% of transit trips occur on busses.

Mr. Saito shared that PASMO Card Company, Ltd. was set up with the shareholders consisting of a few of the larger rail and bus operators. There was a technology transfer from JR to enable the operation and establish inter-operability.

Mr. Saito explained that they took the back office software and specs from JR then developed their own reader and terminals. Suica and PASMO settle only monthly.

The value on PASMO cards does not expire for 10 years.

Mr. Saito claimed that Tokyo Bus does not get operating subsidies. They run entirely on the farebox revenue. We scratched our heads as to how that could be but we then looked at the fare structure. There is very little in the way of fare discounting and the average fare is much higher in the US (170Yen or \$1.70) where passes and discount fares drop the figure much lower. When coupled with the large volume of transactions it becomes apparent how this could be possible.

Tokyu Bus Corporation Branch

We were hosted by:

Kazuo Takahashi – Director General Manager, Transport Division

The delegation traveled to the Tokyu Bus Corporation office in Chiyoda-ku and was given a presentation overview of the bus operations.

The summary for the financial year of 2007 are:

Number of buses – 937

Number of bus routes – 441

Ridership per day – 428,000

Operating Revenue – US\$250 million

A guided tour was given of the fare collection equipment onboard the bus (registering farebox), followed by the operational collection of data by the driver. The fare transaction data is stored using a contact smart card which is then submitted by the driver to the bus operations room together with the coin and note vaults which are emptied by an automated collector machine.

Useful web links:

Company	Website
MTRC, Mass Transit Railway Corporation (Hong Kong)	www.mtr.com.hk/eng/homepage/cust_index.html
Octopus Cards Limited (Hong Kong)	www.octopus.com.hk/company/en/index.jsp
KMB, Kowloon Motor Bus (Hong Kong)	www.kmb.hk/english.php
Seoul Metro	www.seoulmetro.co.kr
KSCC, Korea Smart Card Corporation	www.t-money.co.kr/
T-Money	www.t-money.co.kr/
Seoul City Government	http://english.seoul.go.kr/
Tokyo Metro	www.tokyometro.jp/global/en/index.html
JR East	www.jreast.co.jp/e/
Sony	www.sony.net/Products/felica/
Nihon Bus Association	www.bus.or.jp/e/
Tokyu Bus Corporation	www.tokyubus.co.jp/top/index.shtml