SMART BUS TICKETING USING HANDHELD COMPUTERS
COST AND SAVINGS
WHITE PAPER

Date: December 02. 2011.
Prepared by: Zack Podrug

SMART BUS TICKETING – COST AND SAVINGS - WHITE PAPER

While benefits of the **AFC** (**A**utomatic **F**are **C**ollection) systems are many it stands true that initial investment in equipment is significant. In this white paper we will try to break down the costs and savings to clarify money benefits to potential buyers.

This document is compiled with help of data and materials published by companies that make ruggedized handheld computers, Psion, Intermec and Motorola. In-bus validators represent one of the 2 biggest expenses in implementation and manufacturer's own testing sheds more light onto hardware costs.

To start let's just repeat most important benefits of AFC systems implemented in mass transit situations:

- Smart cards replace paper tickets
- No paper waste and no extended waste resulting of paperless back office
- Smart card tickets are secure
- Smart tickets can be re-used thousands of times
- Smart card based AFC is cashless
- One passenger can pay for multiple persons in the same party
- System is easy to use
- Only authorized persons can perform transactions in the system
- AFC reduces or eliminates fraud
- AFC reduces or eliminates internal leakage
- AFC increases driver's safety
- AFC reduces actual transactions times, promotes easy flow of passengers
- System provides detailed reporting tools to the management
- With portable ticket validators there is no installation in the buses
- With portable ticket validators any unit goes to any route
- With portable ticket validators actual handheld computers can have multiple roles in the system
- With smart ticketing transportation company gets money way before services are rendered
- Many more …

HOW MUCH DOES IT COST?

Costs of implementation can be broken down in hardware costs, software costs and installation costs. We'll analyze small operator with 15 buses and 10000 cards

HARDWARE

Terminals, portable computers	$1700.00	15	$25500.00
Smart cards, control	$10.00	20	$200.00
Smart cards, passenger	$0.95	10000	$9500.00
Office smart card readers	$81.00	2	$162.00
Office contact smart card readers	$22.00	2	$44.00

SOFTWARE

Comprehensive software package, backoffice, terminals, cards	$8000.00

INSTALLATION COSTS

Software installation, office	$50.00	2	$100.00
Software installation, terminals			$0.00
In bus installation			$0.00
Grand total:			**$43506.00**
Total hardware and software cost per bus			$**2267.06**
Total per smart ticket cost			$**4.35**

OTHER COSTS THAT REPRESENT TCO – Total Costs of Ownership

Looking at above breakdown in equipment used it is pretty much clear that with contactless smart cards only part subjected to wear and tear is in-bus validator. In our case it is handheld, ruggedized computer.

Since everybody today has a small computer in the pocket called smart phone question could arise why not smart phone instead of ruggedized computer? It costs about 2-3 times less and is widely available. So we need to clear that dilemma first.

SMART PHONE VS RUGGEDIZED COMPUTER

Perhaps the biggest differences between traditional and emerging smart phone deployments are who is using the phones, and where.
Smart phones entered the enterprise in the pockets and purses of white collar workers who mostly moved from offices to conference rooms to cars. A device failure often only represented a temporary inconvenience, as the user could access e-mail from a nearby PC, make calls and retrieve voicemail messages from a landline or cell phone borrowed from a colleague. Today smart phones are tools for blue collar and “gray collar” (which is somewhere between white and blue) workers, who often work alone where there is no roof overhead or carpeted floor underfoot. These usage environments raise the requirement for reliability and durability.

For gray and blue collar workers, a device is a necessity, not a convenience. They cannot do their jobs without the ability to collect data, charge tickets, consult with colleagues, access enterprise information and complete transactions. When their phone fails, their productivity plummets. Depending on their jobs, handheld device users lose an average of 50 to 80 minutes of productivity each time the device fails, not counting the time IT or other support staff spend troubleshooting the device. Mobile workers
who experience 50 to 80 minutes of downtime will probably have to miss at least one of their sales or service calls that day.

Productivity loss – not device purchase price – is by far the largest component of the total cost of ownership for smart phones and other handheld devices. The value of lost productivity accounts for 41 percent of the total cost of ownership (TCO) for commercial grade handheld computers used in the enterprise. Because downtime is so expensive, there is clear value to keeping these devices functional. Ruggedness is a requirement, not an option, when working extensively outside office and home environments. In the real world, mobile phones will be dropped onto concrete, and they will be rained on. That doesn’t mean the phone will stop working. There are product features that protect phones – and preserve productivity – in very challenging environments. The following sections explain how specific features and product characteristics impact reliability in non-office environments.

Failure rate studies:

DEVICE	1st Year	2nd Year	3rd Year	4th Year
Rugged Mobile computers	3.3%	7.8%	18.2%	55.4%
Non-Rugged Mobile Computers	18.0%	38.5%	82.6%	96.8%

When reviewing professional devices in the round, the business case becomes even stronger. Most vendors of professional hand-held computers provide support packages that are vastly superior to those operated by mobile service providers. Motorola for instance recognizes that mobile computing is not a 'nice to have': it's business critical. The company offers a wide range of versatile support packages that recognize this imperative. For instance, if a product is dropped, smashed, fails of it's own accord or is in any way faulty, it's replaced the next day. No questions asked. No hassle. It's a service that's properly tailored to the needs of dynamic organizations.

General-purpose smart phones have notoriously short life cycles when used for these operations. Annual failure and replacement rates of 50 to 90 percent or higher are common.
Plus, device manufacturers frequently introduce new operating systems on current and new models, which creates an ongoing need to port, test and maintain applications. The frequent churn of devices and operating systems makes it difficult to maintain application consistency across the user population as phones are replaced and rollouts are scaled over time. Enterprises can avoid rapid replacement cycles by selecting the right devices for the work environments. Ruggedized handhelds that are designed for enterprise operations can reasonably be expected to last three to five years, even when frequent handling, data collection and outdoor use are normal business processes.
As Figure 1 shows, first-year replacement rates are 5.5 times higher for non-ruggedized handheld devices as ruggedized ones used in enterprise operations. After three years, 82.6 percent of non-ruggedized smart phones and PDAs used in enterprise operations needed to be replaced because of damage or failure, compared to just 18.2 percent of ruggedized models. Enterprise users need smart phones that are designed to prevent the leading causes of device failure, which include screen damage, antenna problems and lost peripheral functionality. They also need devices that provide a stable operating system and development environment so that software applications and development skills can be leveraged over the lifecycle of the device and subsequent deployments.

There are many other factors where ruggedized computers are clear winners:

- **IP ratings** – best measures of device ruggedness against water and dust penetration. Tested by running water directly onto unit under angle
- **Drop ratings** – it is usually tested by dropping device onto concrete floor from 4ft - 5ft height (1.2m – 1.6m). If that wasn't enough, drop is repeated to all six sides of the tested handheld
- **Temperatures** – extreme temperatures shall not make ruggedized computer inoperable
- **Components considerations** – leading causes of failures on smart phones are their screens and radios. Ruggedized computers have selected components for every little piece involved
- **Static electricity** – it is good to know that ruggedized computers are protected against static

shocks

- **Screen and keypad keys** – crack and scratch resistant screens are standard on ruggedized computers. Keypads will take hundreds of thousands of presses and buttons will not wear out

Conclusion to above is clear: don't try it at home with your smart phone! You will be buying new one on short order! Smart phone has nothing to offer in truly working environment.

GOING BACK TO EARNING MONEY – ROI (Return On Investment)

By looking into cost breakdown on page 3 it is clear that total investment is $43506.00 to equip 15 vehicles with smart ticketing and release first 10000 smart ticket cards into the sales chain.

In best case scenario transition between old paper tickets (cash purchases) to new smart tickets (cashless) system should be as short as possible. Bus operator's sales offices shall start issuing smart tickets and propose deadline when every passenger should have smart ticket instead of cash to pay for the ride.

Smart tickets should sell market up for part or complete cost of the smart card, pre-loaded with certain amount of money or number of rides. Smart tickets in that form are suitable to be sold anywhere, stores, variety stores, kiosks, paper stands … on the street, so deployment penetration should be quick.

In reality passengers are the ones to pay for the cost of the smart tickets. Bus operator pays for the initial investment but recovers that part of payment rather quickly. Let us assume the following:

- Typical cost of ride is $1.00
- Smart ticket is sold with $10.00 pre-loaded + $0.50 to cover for the cost of the smart card
- Operator sells 70% of the smart tickets in startup release > 7000 x $10.50 = $73500.00
- Assuming conservative 20% profit factor calculation shows that $14700.00
- From tickets sales is going against complete initial investment of $43506.00
- so from every smart ticket sold following amount goes against initial investment, $2.10
- that means after operator sold number of tickets complete investment is paid for, 20717

MORE FACTORS TO CONSIDER

Internal leakage - which is nice word for internal theft by the bus drivers. Practically it means that driver is pocketing cash collected by not issuing ticket to the passenger, or issuing wrong ticket by recycling used tickets. By introducing honest driver into regular route it is documented that internal leakage could be as high as 70%! That will ruin any business model quickly.

In our calculation we will take that number down to very conservative 15% so it is additional $11025.00
that goes against initial investment reducing number of tickets needing to be sold to 11838

Unused ticket factor – there is another amount floating in the system that helps our ROI considerations. Those are the tickets that are paid for but will never be rendered. Those amounts belong to passengers that lost their tickets altogether, broke the cards or there is a simply balance in the card unused. We will put that factor at 2%. That means 10000 smart tickets sold for $105000 will produce savings at no cost to operator, $2100.00

Smart tickets are re-usable - thousands of times before it is lost or destroyed. Passengers use buses or mass transportation every day to get to work and back or other places. Assuming using smart ticket twice a day it is obvious that it will last for one week. Passenger will re-charge smart ticket with more rides for next days or weeks to come. Important to spot here is that passenger is using same smart card so he doesn't have to purchase new smart ticket but rather re-load existing one.

Assuming that only 50% of initially purchased smart tickets shall be used for daily rides those tickets will probably be re-loaded on weekly bases so passenger now pays, 3500 x $10.00 = $35000.00
20% + 15% going against original investment produces $12250 per week
making final payout of $43506 in 3.55 weeks only, making it in 3 weeks and 4 days

Now we believe that this is pretty remarkable! Whole investment returned under 4 weeks of operation and achieved with 70% smart tickets sold and only 35% used on daily bases.

OTHER CONSIDERATIONS

In this white paper we are concentrated on pure money cost factors neglecting other benefits to passengers and operator. There are more benefits to operator using handheld, ruggedized computers:

- Cashless – system analyzed is truly cashless. Very few people see and handle money.
- Drivers safety – bus drivers and specially taxi drivers are target for criminals wanting quick money.
- Bus installations – actually lack off, change bus or terminal at any time, no modifications needed. That saves about 4 hours of mechanic and electrical work, 4 x $50 = $200.00 per bus resulting in total savings of $3000.00
- Portable – true portable solution means that implementation of the smart payments is instantaneous.
- Transferable – system like that is easily transferable to other means of transportation, taxi, bus, ferry, train, light train, water taxi.

- Single terminal – single terminal model can satisfy many or all means of smart ticketing application. Drivers, controllers, sales can all share same units. Unified model means less confusion and maintenance costs

CONCLUSION

AFC based on handheld, ruggedized computers can definitely get you up and running in short time. With average useful life of 5-6 years ruggedized computer will outlast any other similar device and perform hundreds of thousand transactions before being retired.

In this document we used very conservative numbers. Using calculator it is easy to see that initial investment will pay itself in even shorter time if:

- Actual ride costs more than $1.00
- Cost of smart ticket is smaller ($0.95 used), buying more smart cards gets a lower cost
- Cost of ticket built into price of the pre-loaded ticket is higher ($0.50 used)
- Internal leakage is higher than 15%
- More smart tickets are used by everyday passengers (35% used)

ROI could be even better with some extras involved. Smart ticketing system like that gives small bus operator new leverage that he would never be able to achieve using regular methods. New world of opportunities opens up.
Since operator has a working system and all that hardware available he could leverage that investment by:

- Selling advertising space on his smart tickets. Normally they come blank or printed on one side. Second side could be sold to businesses that want to put their advertising message into the pockets of the thousands or tens of thousands of consumers! Pizza, fast food, restaurants, cinemas, local transactions, museums, bars, sports facilities, gyms, health food places … are all potential buyers of that advertising real estate.
- Sell the system to other bus owners, get them on board and share same system.
- Extending services to other means of transportation. Street cars, light train, water taxi, intercity rail, subway, ferry. Working system in salesman's hands can do miracles with other transportation managers. They will likely to follow the lead and accept existing solutions.
- Since person is likely to use the same smart ticket for very long time think about loyalty points opportunity. Reward customers for loyalty and get them to spend more.
- After some time when penetration to the market achieved considerable saturation, good marketing and involvement with other businesses might create universal payment card on bigger scale. What bus operator brings to the table are thousands of consumers that already have smart cards in their pockets and know how to use them!

Almex Ltd.

Almex Ltd.