The Formal Design Model of an Automatic Teller Machine (ATM)

Salem S. M. Khalifa and Kamarudin Saadan
University Sains Islam Malaysia, Faculty of Science & Technology,Bandar Baru Nilai, 71800 Nilai, Negeri Sembilan, Malaysia
Email:Salem_sayd@yahoo.com; kamarudin@usim.edu.my

***Abstract*—Automated teller machines (ATM) have become a part and parcel of supermarkets, convenience stores, travel centers and banking. ATM is a real-time system that is very complex in design and application. This paper presents the formal design, requirement, a distributed approach for the ATM networks, and type of the ATM system**.

***Index Terms*—ATM, real-time systems, formal design models, system behaviour specification, Distributed Database System (DDS).**

I. Introduction

An automatic teller machine (ATM) is a computerized telecommunications device and real-time system that provides the clients of a financial institution with access to their bank accounts in a public space without intervention administration of financial institution. These machines can now be found at most supermarkets, convenience stores and travel centers [1].

To use an automatic teller machine, clients must have a plastic ATM card with a plastic smartcard with a chip or a magnetic stripe, which contains a unique card number and some security information about the client [2].

The customer is identified by inserting plastic ATM card and entering a personal identification number (PIN) for the customer. ATM allow customers to access their bank accounts, and enable them to deposit and withdrawal processes as well as check their account balances and enable them to use their mobile phones to buy prepaid credit. Also an automatic teller machine allows a bank customer to conduct their banking transactions from almost every other ATM machine in the world. [3] [4].

Don Wetzel was the co-patentee and chief conceptualist of the automated teller machine, an idea he thought of while waiting in line at a Dallas bank. At the time (1968) Wetzel was the Vice President of Product Planning at Docutel, the company that developed automated baggage-handling equipment. The other two inventors listed on the patent were Tom Barnes, the chief mechanical engineer and George Chastain, the electrical engineer. It took five million dollars to develop the ATM. The concept of the ATM first began in 1968, a working prototype came about in 1969 and Docutel was issued a patent in 1973. The first working ATM was installed in a New York based Chemical Bank [3].

II. Location.

ATMs are placed not only near or inside the premises of banks, but also in locations such as shopping centers/malls, airports, grocery stores, petrol/gas stations, restaurants, or any place large numbers of people may gather. These represent two types of ATM installations: on and off premise. On premise ATMs are typically more advanced, multi-function machines that complement an actual bank branch's capabilities and thus more expensive. Off premise machines are deployed by financial institutions and also ISOs (or Independent Sales Organizations) where there is usually just a straight need for cash, so they typically are the cheaper mono-function devices [4].

III. Financial Networks

ATM networks are an integral part of new generation banking. ATM networks became more intelligent when it providing a banking procedures. All the ATM machines working around the world are based on the concept of centralized database system. ATM uses a host processor to connect, and communicate.

The host processor is analogous to an Internet service provider (ISP) in that it is the gateway through which all the various ATM networks become available to the cardholder (the person wanting the cash) [5].

Most ATMs are connected to interbank networks, enabling people to withdraw and deposit money from machines not belonging to the bank where they have their account or in the country where their accounts are held (enabling cash withdrawals in local currency). Some examples of interbank networks include PLUS, Cirrus, Interac and LINK. ATMs rely on authorization of a financial transaction by the card issuer or other authorizing institution via the communications network. Many banks charge ATM usage fees. In some cases, these fees are charged solely to users who are not customers of the bank where the ATM is installed; in other cases, they apply to all users. Many people oppose these fees because

Manuscript received December 21, 2012; revised February 15, 2013.

doi: 10.12720/lnit.1.1.56-59

ATMs are actually less costly for banks than withdrawals from human tellers [4] [6] [7].

In order to allow a more diverse range of devices to attach to their networks, some interbank networks have passed rules expanding the definition of an ATM to be a terminal that either has the vault within its footprint or utilizes the vault or cash drawer within the merchant establishment, which allows for the use of a scrip cash dispenser [4].

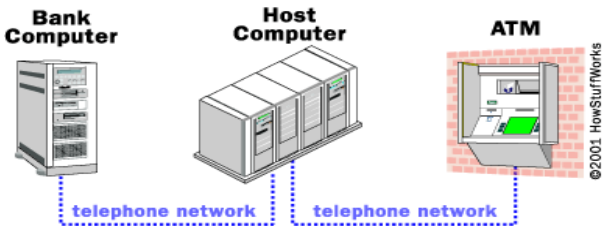

Figure 1. ATM Network

Recently, due to heavier computing demands and the falling price of computer-like architectures, ATMs have moved away from custom hardware architectures using microcontrollers and/or application-specific integrated circuits to adopting a hardware architecture that is very similar to a personal computer. Many ATMs are now able to use operating systems such as Microsoft Windows and Linux. Although it is undoubtedly cheaper to use commercial off-the-shelf hardware, it does make ATMs vulnerable to the same sort of problems exhibited by conventional computers [6].

IV. Parts of the Machine

There are probably millions who has used an ATM. As know, an ATM has two input devices:

- Card reader captures the account information stored on the magnetic stripe on the back of an ATM/debit or credit card. The host processor uses this information to route the transaction to the cardholder's bank.
- Keypad lets the cardholder tell the bank what kind of transaction is required (cash withdrawal, balance inquiry, etc.) and for what amount. Also, the bank requires the cardholder's personal identification number (PIN) for verification. Federal law requires that the PIN block be sent to the host processor in encrypted form.
- An ATM has four output devices:
- Speaker provides the cardholder with auditory feedback when a key is pressed.
- Display screen prompts the cardholder through each step of the transaction process. Leased-line machines commonly use a monochrome or color CRT (cathode ray tube) display. Dial-up machines commonly use a monochrome or color LCD.
- Receipt printer provides the cardholder with a paper receipt of the transaction.
- Cash dispenser is the heart of an ATM is the safe and cash-dispensing mechanism. The entire bottom portion of most small ATMs is a safe that contains the cash. [1]

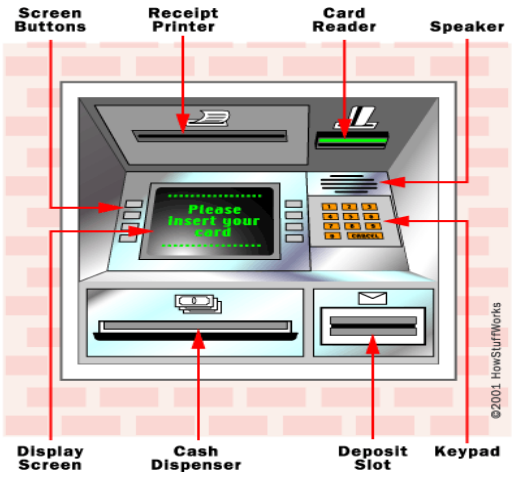

Figure 2. Parts of the ATM

V. Security

Security, as it relates to ATMs, has several dimensions. ATMs also provide a practical demonstration of a number of security systems and concepts operating together and how various security concerns are dealt with [8].

New technology (ATMs to operate without a card) has been unveiled to allow clients to withdraw money from cash machines using their cell phones .customers are given a six-digit code to allow them to enter into an ATM to release the cash. The services are the latest developments in a long-predicted move towards the smart phone becoming a digital wallet [9].

VI. Physical

Modern ATM physical security, per other modern money-handling security, concentrates on denying the use of the money inside the machine to a thief, by means of techniques such as dye markers and smoke canisters [10].

VII. Transactional Secrecy and Integrity

The security of ATM transactions relies mostly on the integrity of the secure crypto processor: the ATM often uses commodity components that are not considered to be "trusted systems". Encryption of personal information, required by law in many jurisdictions, is used to prevent fraud. Sensitive data in ATM transactions are usually encrypted with DES, but transaction processors now usually require the use of Triple DES.Remote Key Loading techniques may be used to ensure the secrecy of the initialization of the encryption keys in the ATM. Message Authentication Code (MAC) or Partial MAC may also be used to ensure messages have not been tampered with while in transit between the ATM and the financial network [4] [10].

VIII. Customer Security

In some areas, multiple security cameras and security guards are a common feature. Critics of ATM operators

assert that the issue of customer security appears to have been abandoned by the banking industry it has been suggested that efforts are now more concentrated on deterrent legislation than on solving the problem of forced withdrawals.

IX. Reliability

The client information is stored in multiple branches. If the host processor is unable to connect to the nearest neighbor then it tries to connect with the second nearest neighbor. This is impossible in the case of centralized database concept [5].

Before an ATM is placed in a public place, it typically has undergone extensive testing with both test money and the backend computer systems that allow it to perform transactions. Banking customers also have come to expect high reliability in their ATMs, which provides incentives to ATM providers to minimize machine and network failures. Financial consequences of incorrect machine operation also provide high degrees of incentive to minimize malfunctions. ATMs and the supporting electronic financial networks are generally very reliable, with industry benchmarks typically producing 98.25% customer availability for ATMs and up to 99.999% availability for host systems. If ATMs do go out of service, customers could be left without the ability to make transactions until the beginning of their bank's next time of opening hours. Of course, not all errors are to the detriment of customers; there have been cases of machines giving out money without debiting the account, or giving out higher value notes as a result of incorrect denomination of banknote being loaded in the money cassettes. Errors that can occur may be mechanical (such as card transport mechanisms; keypads; hard disk failures); software (such as operating system; device driver; To aid in reliability, some ATMs print each transaction to a roll paper journal that is stored inside the ATM, which allows both the users of the ATMs and the related financial institutions to settle things based on the records in the journal in case there is a dispute. In some cases, transactions are posted to an electronic journal to remove the cost of supplying journal paper to the ATM and for more convenient searching of data [4] [10].

Improper money checking can cause the possibility of a customer receiving counterfeit banknotes from an ATM. While Bank personnel are generally trained better at spotting and removing counterfeit cash, the resulting ATM money supplies used by banks provide no absolute guarantee for proper banknotes. Some ATMs may be stocked and wholly owned by outside companies, which can further complicate this problem when it happens. Bill validation technology can be used by ATM providers to help ensure the authenticity of the cash before it is stocked in an ATM; ATMs that have cash recycling capabilities include this capability [11].

X. The Way of Atms Work

An ATM is simply a data terminal with two input and four output devices. Like any other data terminal, the ATM has to connect to, and communicate through, a host processor. The host processor is analogous to an Internet service provider (ISP) in that it is the gateway through which all the various ATM networks become available to the cardholder (the person wanting the cash) [5].

Most host processors can support either leased-line or dial-up machines. Leased-line machines connect directly to the host processor through a four-wire, point-to-point, and dedicated telephone line. Dial-up ATMs connect to the host processor through a normal phone line using a modem and a toll-free number, or through an Internet service provider using a local access number dialed by modem.

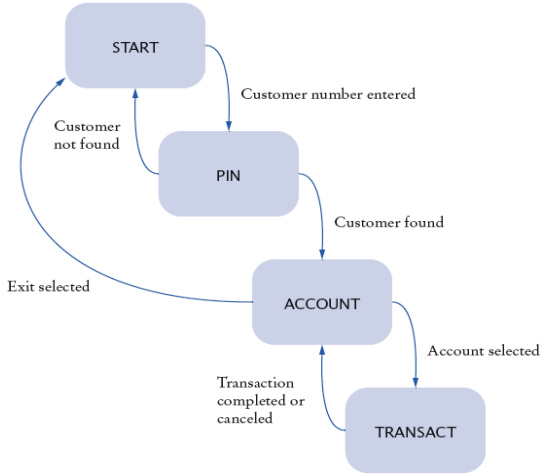

Figure 3. State machine diagram for object ATM

Leased-line ATMs are preferred for very high-volume locations because of their thru-put capability and dial-up ATMs are preferred for retail merchant locations where cost is a greater factor than thru-put. The initial cost for a dial-up machine is less than half that for a leased-line machine. The monthly operating costs for dial-up are only a fraction of the costs for leased-line.

The host processor may be owned by a bank or financial institution, or it may be owned by an independent service provider. Bank-owned processors normally support only bank-owned machines, whereas the independent processors support merchant-owned machines [1].

XI. Conclusions

An automatic teller machine (ATM) is a computerized telecommunications device that provides the customers of a financial institution with access to financial transactions in a public space without the need for a human clerk or bank teller. ATMs are placed near any place large numbers of people may gather. Most ATMs are connected to interbank networks.ATM contains from Card reader, Keypad, Speaker, display screen, Receipt printer and Cash dispenser.

References

[1] J. Bowen. (2010). How ATMs Work. [Online].Available: http://money.howstuffworks.com/atm3.htm,.

[2] M. Badmus. (2011). Nigerian Students and the ATM (Automated Teller Machines). [Online]. Available:

http://www.upiu.com/other/2011/06/15/Nigerian-students-and-the-ATMAutomated-Teller-Machines/UPIU-3801308194612/

[3] C. Robat. (2006). ATM Automatic Teller Machine. [Online]. Available: http://www.thocp.net/hardware/atm.htm

[4] Wikipedia the Free Encyclopedia. (2010). Automated Teller Machine. [Online]. Available: http//:en.wikipedia.org,.

[5] R Hossain, et al., Designing an Atm Network Based on Distributed Database Systems", no date.

[6] A. R. Rai, "Customer relationship management: Concepts and cases " New Delhi, 2008, pp. 97-98

[7] E. W. Croft and B. J. Spencer, "Fees and surcharging in automatic teller machine networks: non-bank atm providers versus large banks", 2003.

[8] R. Rajesh and T. Sivagnanasithi, "Banking theory: LAW & Practice," New Delhi, 2009, pp 313-314.

[9] Bbc News,"ATMs to operate without a card," 2012.

[10] S. K. Singh, "Bank Regulation". New Delhi, 2009, pp 169-170.

[11] Answers. (2012). Automated Teller Machine. Available from http://www.answers.com/topic/automatic-teller-machine

