A Prepayment Primer

Presented by Franco Pucci
Engineering Director: Conlog
Agenda

- Understand the benefits and disadvantages of prepayment
- What does Prepayment mean to the utility
- Water prepayment
- Tariff structures
- AMR and prepayment
- Vending systems
Understand benefits & disadvantages of prepayment
Introducing Prepayment

- Prepayment is more than just a meter, there are four parts
  - A prepayment meter for dispensing
  - A token for transfer of credit
  - A vending outlet for sales
  - A management system to provide overall control
Benefits of Prepayment

- Eliminates meter reading cost
- Only visit meter for periodic inspection
- Re-deploy resources to other activities
- No postal address required
Benefits of Prepayment

- No more disconnection or reconnection required
  - The meter automatically disconnects on credit exhaustion
  - No legal processes to collect fees
  - Poorest of the poor not drawn into debt trap scenario
- Serves the consumer & the utility
Benefits of Prepayment

- Payment in advance
  - The utility receives cash up front
  - Supports capital recovery model
  - Improved collection mechanism
- Improved cash flow
Benefits of Prepayment

- No need for billing
  - Reduces support costs
  - No meter reading mistakes
  - No more billing disputes
- Improved customer relationships
Benefits of Prepayment

- The consumer also benefits
  - Visual indication of consumption rate
  - User manages own budget
  - No disconnection or reconnection costs
  - Meter readers do not enter the home
  - Convenient purchase locations (24 hrs / 7 days a week service)
- Better management of users lifestyle
Steps required to implement conventional metering

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>DOWNLOADING OF READINGS</td>
</tr>
<tr>
<td>5</td>
<td>GENERATE EXCEPTION REPORTS</td>
</tr>
<tr>
<td>6</td>
<td>CHECK READINGS TAKEN</td>
</tr>
<tr>
<td>7</td>
<td>READING ADJUSTMENTS MADE</td>
</tr>
<tr>
<td>8</td>
<td>ACCOUNTS GENERATED</td>
</tr>
<tr>
<td>9</td>
<td>ACCOUNTS POSTED/ RECEIVED</td>
</tr>
<tr>
<td>10</td>
<td>PAYMENT OF ACCOUNTS BY PUBLIC</td>
</tr>
<tr>
<td>11</td>
<td>FIRST DEFAULTER LIST GENERATED</td>
</tr>
<tr>
<td>12</td>
<td>FIRST WARNING POSTED</td>
</tr>
<tr>
<td>13</td>
<td>POSSIBLE P. R. EXERCISE</td>
</tr>
<tr>
<td>14</td>
<td>FINAL NOTICE TO DEFAULTERS</td>
</tr>
<tr>
<td>15</td>
<td>RESTRICT WATER / TERMINATE ELECTRICITY</td>
</tr>
<tr>
<td>16</td>
<td>INSPECTION OF CONTINUED DEFAULTER</td>
</tr>
<tr>
<td>17</td>
<td>CONNECTION REMOVED</td>
</tr>
<tr>
<td>18</td>
<td>LEGAL ACTION INITIATED</td>
</tr>
<tr>
<td>19</td>
<td>ATTACHING OF ASSETS PENDING COURT CASE</td>
</tr>
<tr>
<td>20</td>
<td>RECOVERY OF OUTSTANDING DEBT?</td>
</tr>
</tbody>
</table>
Steps required to implement prepayment metering

<table>
<thead>
<tr>
<th>Steps</th>
<th>Actions in Service delivery and Revenue Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONNECTION TO SERVICE</td>
</tr>
<tr>
<td>2</td>
<td>ISSUING OF CREDIT BY CASHIERS</td>
</tr>
<tr>
<td>3</td>
<td>SERVICE DELIVERY</td>
</tr>
<tr>
<td>4</td>
<td>GENERATION OF EXCEPTION REPORTS</td>
</tr>
<tr>
<td>5</td>
<td>INSPECTION OF POSSIBLE DEFAULTERS</td>
</tr>
<tr>
<td>6</td>
<td>TERMINATION OF CONNECTION</td>
</tr>
</tbody>
</table>
Token Technologies
Method of securely moving the money

Available tokens by technology

- Keypad Tokens
- Smart Card Tokens
- Memory Card Tokens
- Smart Tokens (iButton, Electronic Key)
Keypad Tokens

- Keypad token features
  - Low cost token
  - Virtual applications – only a code entry
  - Print on multiple mediums
  - Simple to manage
  - Proven technology
- Common in other applications
  - Cell phone prepay
  - Distributed access control
  - Public key encryption
- Low cost hardware to read / program token
Smart / Memory Card

- Smart Card features
  - Secure solution
  - Self contained
  - Higher cost token
  - Implementation of complex algorithms
  - Robust under normal operating conditions

- Memory Card features
  - Lower cost token
  - Less functionality
  - Limited security
Smart / Memory Card

- Common in other applications
  - Security, prepayment and industrial
  - Remote coding devices
  - Many diverse data logging applications
- Security depends on device – can be highly secure
- Low cost hardware to read / program token
Smart Tokens

- Smart Token features
  - Secure solution
  - High cost token
  - Proprietary solutions
  - Variety of different options available
  - Robust & reliable technology
  - Host of application opportunities
- Common in other applications
  - Security, prepayment & industrial
  - Remote coding devices
  - Many diverse data logging applications
- Security depends on device – can be highly secure
- Low cost hardware to read / program token
Project Success

Key steps

- Have a good project plan
- Get buy in from all parties concerned
- A marketing campaign is critical
- Sell the benefits of the system
- Training is the key to success
- IT infrastructure must be adequate
- Manage the system rigorously
Disadvantages of prepayment

- Meter price higher
- New system to learn
- Requires vending infrastructure
- Could be a political challenge to implement

The advantages by far outweigh the disadvantages
Prepayment in the utility context
On the face of it, the lower capital cost of installing a conventional billing system seems attractive...
Conventional metering

Conventional metered sites work best in economically mature environments

The factors influencing choice to follow conventional metering methodology include:-

- Historical environment pervades
- Culture of payment & social acceptance of service costs
- Established postal & communications infrastructure
- Mature economies & infrastructures
- Stronger legal & social conditions to address non-payment
Conventional metering pitfalls

Conventional metered sites have their own set of constraints:

- Management intensive
  - Computing charges, Estimations, Account postage & admin.
- No auto disconnect
  - Disconnection & reconnection is required
Conventional metering pitfalls

- Meter reading
  - Meter reading is labour intensive
- Reading errors
  - Leads to customer dissatisfaction
- No feedback
  - Illegal connections are difficult to trace
- Established infrastructure
  - Postal & communications infrastructure are required to administer system
The early payment advantage

- By deploying prepayment you receive payment on average 3.5 months ahead of conventional billing.
- By deploying prepayment you eliminate the risk of non-payment compared to conventional billing where you remain at risk in excess of 58 days.

**Purchase prepayment voucher**

<table>
<thead>
<tr>
<th>Prepayment Method</th>
<th>Prepayment Voucher Read</th>
<th>Bill Prepared</th>
<th>Bill Received</th>
<th>Bill Not Paid (with penalty)</th>
<th>Utility Suspends Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREPAID</td>
<td>20 Days prior (20kWh)</td>
<td>30 Days</td>
<td>88 Days</td>
<td>118 Days</td>
<td>148 Days (Disconnected)</td>
</tr>
<tr>
<td></td>
<td>Consumption starts</td>
<td>44 Days</td>
<td>58 Days</td>
<td>118 Days</td>
<td>148 Days (Disconnected)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>58 Days</td>
<td>(120kWh used)</td>
<td>118 Days</td>
<td>148 Days (Disconnected)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>88 Days</td>
<td>(160kWh used)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>118 Days</td>
<td>(180kWh used)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>148 Days</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The new world utility

Throughout the world most utilities are facing ever-increasing challenges to remain competitive. Many of these challenges have forced utilities to look to new and innovative approaches to their changing world.

Drivers for the move towards prepayment solutions include some of the following:

- Improved method of cash flow management
- A solution to a culture of non-payment
- Penetration into poor infrastructure regions
- Preservation / conservation of resources
- No postal or communications infrastructure
An Example...

Sudan is the second largest prepayment site in the world.

- Reduced a $70 Million debt to a sustainable development project within a matter of a few years.
- Project capex paid off in under 1 year
- Largest on-line vending system for pp with each server handing 100000 customers and a transaction every 45 seconds
Water prepayment
Water prepayment

The principles of water prepayment are the same as electricity

The politics, however, are very different!

As opposed to electricity, water prepayment is very politically and emotionally charged. People believe they have a right to free water.
Prepayment and the Community

- Social & environmental factors
  - Clean potable water improves hygiene
  - Reduced wastage of valuable resource
  - Improved standard of living
  - Shift from debt collection to service delivery
- On the one hand...
  - People have a right to water
  - Basic necessity
  - Cannot switch off the supply
  - Why should they pay for it?
- On the other hand...
  - Water must be fetched, filtered, cleaned, pumped, delivered...
  - Who pays for this?
Basic facts

- Tariff is usually multi-step with up to 16 steps or more
- “Lifeline” must be catered for
- May not be able to switch off the valve
- Negative credit must be allowed
- Two way communication the norm
- No industry standard exists yet
- Essentially two types of meter...
End of line meter (example)

- Pressure range: 1-10 BAR
- Measurement: positive displacement
- Housing: Steel added security
- Battery life: 2-3 years
- Community use
- Specialized token required, must maintain credit in memory
- Feedback data transferred by the token
In-line meter (example)

- Pressure range: 1-10 BAR
- Measurement: positive displacement
- Housing: Plastic
- Battery life: 2-3 years
- Household use
- Usually all credit transferred at once
- Feedback data transferred by the token
Advantages

- Provide clean potable water
- Reduces consumption
- Sustainable development?
- Similar to electricity – well known system with years of use
Known problem areas

- Water hammer
- Water purity causes valve failure (In-line filters)
- Installation quality
- Maintenance & management
- Air pockets – measurement of airflow, can seize bearings
- Battery life & replacement
Revenue management of water
Smart Token

- 2 Way information transfer
  - Transfers credit and tariffs to meter
  - Returns usage information to point of sale
- Yard meter uniquely coded
  - Token is unique to individual yard meter
- Zoned standpipe coding
  - Allows multiple users per meter
  - Users can access more than one meter
  - Limits number of users per zone
Standards?

- SANS 1529-9
  - National standard for prepayment water
  - Specifies type and production requirements
  - Published in 2002
  - Includes compliance requirements for data integrity verification, pressure range, flow range, etc.
STS-Enhanced

- Currently in progress
- Introduction of bulk data transfer capability
- Open standard
- STS Association managed
- Multiple source of manufacturers
Prepayment water

Is prepayment water a thing of the future...

Or a thing of the past?
Tariff structures
What is a Tariff?

- The amount of money that is charged for the usage of a service
  - Water
  - Telephone
  - Electricity
  - Many others...
- A balance between the cost of generation, transmission, distribution, maintenance & supplying electricity at an affordable rate
Straight Line Tariffs

- Linear function
- Base / fixed charges depending on breaker size, VAT
- Fixed charge per kWh
- Ideally suited for prepayment meters that accept kWh tokens
- No cross-subsidisation of users
Step/block Tariffs

- Depends on the amount of energy used, not the time of use
- Different rate for each step
- Slope of the graph changes for each step
- Could have different fixed costs per step
- Used to reduce grid loading
- Used to cross-subsidize between different types of users
Time of Use (TOU) Tariff

- Rate depends on the time of day that the energy is used
- Used as a demand-side-management tool to flatten the demand curve
Predictive Tariffs

- Due to complexity, these are typically done in the vending system
- Predict usage by moving average and other purchase history
- Works well in the long term, granular in the short term
- Depends on usage, not time
- Allows the use of fixed tariff meters in a step tariff environment
- This is used in numerous prepayment sites with good effect
# Tariffs (example)

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS Token Tax Receipt No</td>
<td>12345</td>
</tr>
<tr>
<td>Date</td>
<td>Wednesday, 6th March, 1997 1:20:18 PM</td>
</tr>
<tr>
<td>Meter No</td>
<td>040000000002</td>
</tr>
<tr>
<td>Customer Id</td>
<td>AB1234</td>
</tr>
<tr>
<td>Amount Tendered</td>
<td>28,437.70 Tsh</td>
</tr>
<tr>
<td>Sales Tax</td>
<td>1,421.88 Tsh</td>
</tr>
<tr>
<td>Sales Tax Rate</td>
<td>5.0%</td>
</tr>
<tr>
<td>Service Charge</td>
<td>1,500.00 Tsh @ 1</td>
</tr>
<tr>
<td>Energy Received</td>
<td>600.0 kWh</td>
</tr>
<tr>
<td>Purchased as</td>
<td></td>
</tr>
<tr>
<td>66.6 at</td>
<td>17.20 Tsh per kWh</td>
</tr>
<tr>
<td>300.0 at</td>
<td>27.00 Tsh per kWh</td>
</tr>
<tr>
<td>233.4 at</td>
<td>70.00 Tsh per kWh</td>
</tr>
<tr>
<td>Average for Mar</td>
<td>666.7kWh / Month</td>
</tr>
<tr>
<td>Allocations into</td>
<td>May 1997</td>
</tr>
<tr>
<td>Operator</td>
<td>Mary</td>
</tr>
<tr>
<td>Point of Sale</td>
<td>VAL01</td>
</tr>
</tbody>
</table>

* * * * * * *
Other Costs

- VAT
- Fixed costs
- Arrears collection changes
  - By % of purchase
  - By fixed amount
- Other service changes and taxes
Which Tariffs apply where?

- No fixed rules
- Complex tariffs exist in 3rd world environments
- Straight line tariffs exist in 1st world environments
- Determined by the utility
- Has an affect on the meter selection
  - TOU requires Real Time Clock
  - Easier to change a tariff in the vending system than the meter
  - Clock synchronisation
Which Tariffs apply where?

- The attributes of a prepayment revenue management system need to be taken into consideration when deciding on a tariff.
- Simplicity must be the guiding factor for reasons of management and understanding of the system by the customer.
AMR and prepayment
AMR & prepayment

- “Automatic Meter Reading”
- Goes way beyond that
- Prepayment & AMR are ideally suited to each other
  - Vending
  - Meter reading
  - Profiles
  - Up market installations
AMR & prepayment

- Even prepayment meters must still periodically be audited
- AMR can reduce these labour costs
- Can highlight non-technical losses immediately when tampering occurs
AMR & energy measurement

- Load profiling of an area
- Reticulation management
AMR & vending

- Tokenless vending – vending system direct to meter (Top up)
- High end users do not want to stand in queues
- Low credit warnings
- Advertising to end user
- GSM phone connectivity from user to meter
And the cost?

- Cost per unit low if used with a concentrator
- It is a value added feature which could be charged for
- Should reduce the costs of audits
- Could convert a conventional site to prepayment seamlessly
What is revenue management?

- Revenue management systems are essential for a successful prepayment project, & are the heart of the operational system
- Manages financial & meter related information, providing an integrated & efficient management tool
- The system facilitates the monitoring of service usage, customer & meter management, revenue collection, financial management & reporting
- Capable of handling over a million customers & their associated transactions
Revenue management systems

The drivers affecting a decision to consider prepayment should be based on sound revenue management principles

- Prepayment is only a component of the total revenue management solution
- Complete financial control over the revenue stream
- An auditable link from electricity sale to bank statement
- A control mechanism to implement realistic energy balancing analysis
- An infrastructure to provide improved levels of customer service including account payment & arrears collection
- A service history for management of meter replacement & repairs
Generic System

**Management station**: housed in utility, manages financial and meter information - monitoring service usage; customer & meter management; revenue collection; financial management; tariff updates; & reporting

**Vending unit**: retail interface, undertakes the transaction process; tariff index; records information for audit trail & security; online system through LAN/WAN, radio, GSM, GPRS or TCP/IP supported mechanism

**Prepayment meter**: housed in consumers’ premises, provides the electricity service; reflects consumption and credit register; recharge token entered; no token, service suspended
The management system
Features & functionality

- Provides management control of entire system
- Data exporting to utility’s mainframe(s)
- Supports communication & dialup to remote vending sites
- Maintain customer, transaction & vending unit databases
- View numerous management control reports
- Manage hierarchy of vending stations
- Configure management station & vending units operation & access
- Download parameters & data to vending units
- Profiled operator logins & tasks (unlimited operators; variety of standard profiles)
Vending systems
Typical Features & functionality

- Vends credit tokens
- First level financial & management control
- Generate engineering & test tokens
- Secure access control (indiv. Passwords; Dallas Buttons)
- Programmable credit limit
- Key data (credit) stored in fused memory (security module)
Types of vending systems

- Offline
- Online
- GSM
- Supervendor
- Upfront vending
- POS, POP
- ATM
- Non-addressable systems
Generic systems – Offline

Security module

Dial up / GPRS / Radio

Transaction records

Tariff info / credit limits

Management System

Vending point

Token

Click to buy NOW!

P

D

F

­

X

C

H

A

N

G

E

w

w

w

.

do
c
u
c
­

r
a
c

ck
.
c
o
m

Click to buy NOW!

P

D

F

­

X

C

H

A

N

G

E

w

w

w

.

do
c
u
c
­

r
a
c

ck
.
c
o
m
Generic systems – On-line

Vending point (Thin Client) → WAN → Request → Token → Management System → Security module

Token
Vending Solutions

Utility Sub-Office

Management System Server and Vending Server

Utility Offices

Remote Office

Audit Printer
Vending Unit Client VU01
Audit Printer
Audit Printer
Vending Unit Client VU02
Audit Printer
Vending Unit Client VU03
GPRS Modem

Vending
PD - FX
CAN
GE
w
w
.
d
o
c
u
t
r
a
c
o
m

Click to buy NOW!

Click to buy NOW!

Click to buy NOW!
Vending Solutions

Differences

- Addressable systems
  - Although more secure and integrated, these solutions rely on the sales process to track sales per unique identified meter. This is the basis of operation for a revenue management systems approach.
  - One vending point will support 1000 people
  - There are 3rd party vending opportunities but these require an investment in compatible vending equipment
Vending Solutions

Differences

- Non-addressable systems
  - Conceptually no vending is required as a sale could be through any outlet operated by an independent 3rd party
  - The advantages are countered by the need to inspect more regularly to detect tampering as there is no sales history to facilitate monitoring of an individual’s consumption patterns
  - Tokens are usually on a secure card technology
  - Risk of tokens representing pre-made money, & can be valuable in large quantities & therefore subject to theft
Scratchcard systems?

- Scratchcards of various denominations ($10, $20, $50) are produced for the supply authority.
- These cards are purchased upfront (prepaid) directly from the authority, by vendors.
- Vendors can comprise large retailers, convenience stores or street hawkers.
- The vendor sells the scratchcards to consumers (end-users).
The consumer sends their meter number and scratchcard voucher number via SMS.

They receive a return SMS that contains an STS token which is entered into the meter.

When the electricity credit is depleted, the consumer simply returns to the vendor & purchases a new scratchcard.
Scratchcard overview

- **Scratchcard**
- **Voucher Verification**
- **kWh**
- **Prepaid Customer Database**

Money flow:
- Scratchcard offer
  - Voucher Verification
  - Prepaid Customer Database
  - kWh
  - Money flows in the opposite direction for each transaction.

Click to buy NOW!

Related image:

**Metering Middle East**

**Billing/CRM Middle East**

**napic 2006**

North African Power Industry Convention
Benefits of scratchcard systems

- Guaranteed payment
  - Purchase of electricity cards by vendor is upfront (prepaid), less commission
- Easy distribution network
  - No high infrastructure, personnel or equipment costs
- Single back office
  - Authority only requires small ‘back office’ to retail cards to vendors
- Secure
  - Prevents shrinkage or theft, electricity volume is capped & no security risks of handling cash especially in rural areas
Vending summary

INFORMATION
- Transactions
- Sales audits
- Banking audits
- Engineering data
- Customer updates

SALES
- Tariff updates
- Security settings
- Customer information
- Reporting

Vending
- User pays vendor
- Token received
- Token entered in meter
- Receive electricity
- Disconnect on completion of credit

Management station

Consumer’s meter
Meters are becoming a commodity. Utilities are more and more requiring a complete solution to their pre-payment system. Suppliers must be gearing towards turnkey projects which offer a revenue management solution rather than a prepayment one...
Thank You