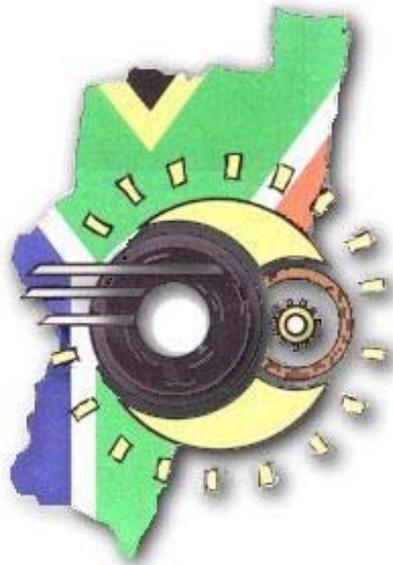




Satellite Monitoring of Public Transport





1	VISION	4
2	TRANSPORT SPECIFIC TRENDS	4
2.1	LIBERALISATION AND DEREGULATION	4
2.2	GLOBALISATION OF CUSTOMERS AND CARRIERS	5
2.3	THE RISE OF INFORMATION TECHNOLOGY	5
2.4	INCREASING AWARENESS OF SAFETY AND ENVIRONMENTAL CONSEQUENCES....	5
2.5	GLOBAL MANUFACTURING SOURCING	5
3	BACKGROUND	6
3.1	WHY SUBSIDIZE PUBLIC TRANSPORT	6
3.2	WHY THE NEED TO CHANGE	7
3.3	BENEFITS AND IMPLICATIONS OF NEW SUBSIDY SYSTEM	7
4	MANUAL MONITORING	8
4.1	COST IMPLICATIONS OF MONITORING vs. VALUE FOR MONEY	9
4.2	PROBLEMS / CHALLENGES WITH MANUAL MONITORING	10
5	SATELLITE MONITORING	11
5.1	BENEFITS OF SATELLITE MONITORING.....	11
5.1.1	<i>Reducing manpower.....</i>	<i>11</i>
5.1.2	<i>Comparison between manual and satellite reports</i>	<i>13</i>
5.1.3	<i>Payment Certificate for December</i>	<i>15</i>
5.1.4	<i>Operator using the system as a management tool.</i>	<i>17</i>
5.1.5	<i>Better planning.....</i>	<i>17</i>
5.1.6	<i>Better base for performance evaluation</i>	<i>18</i>
5.1.7	<i>Bus recovery from theft.....</i>	<i>19</i>
6	SOLUTION VIA TECHNOLOGY	20
6.1	SOLUTION METHODOLOGY	20
6.1.1	<i>Onboard hardware:</i>	<i>20</i>
6.1.2	<i>Communication platforms:</i>	<i>20</i>
6.2	FLOW DIAGRAM	26
7	ADDED VALUE & FUTURE EXPANSION	27
7.1	CONNECTING TO TICKET MACHINES FOR PASSENGER DATA.....	27
7.1.1	<i>Essentially an electronic system comprising of different configuration of the following.....</i>	<i>27</i>
7.1.2	<i>Cash Fare Machine.....</i>	<i>27</i>
7.1.3	<i>Cash Fare Machine (ticket details).....</i>	<i>27</i>
7.1.4	<i>Software</i>	<i>28</i>
7.1.5	<i>Revenue Control System</i>	<i>28</i>
7.1.6	<i>Statistics Package (ASP).....</i>	<i>29</i>
7.1.7	<i>Management Information Systems.....</i>	<i>29</i>
7.2	ELECTRONIC ROUTE SIGNS	29
7.3	TRAFFIC MANAGEMENT SYSTEM	30



7.4	INTERNET SCHEDULE INFORMATION.....	30
8	CONCLUSION	31

Table of Figures

<i>FIGURE 1: RURAL ROAD</i>	<i>FIGURE 2: RURAL ROAD</i>	<i>6</i>
<i>FIGURE 3: MANUAL MONITORED DAYS.....</i>		<i>9</i>
<i>FIGURE 4: MIDLANDS SERVICE.....</i>		<i>10</i>
<i>FIGURE 5: PERCENTAGE STOPS MONITORED</i>		<i>11</i>
<i>FIGURE 6: NONDWENI AND NKANDE SERVICES</i>		<i>12</i>
<i>FIGURE 7: MANUAL MONITORING REPORT</i>		<i>14</i>
<i>FIGURE 8: SATELLITE MONITORING REPORT.....</i>		<i>14</i>
<i>FIGURE 9: PAYMENT CERTIFICATE (MANUAL MONITORING)</i>		<i>15</i>
<i>FIGURE 10: PAYMENT CERTIFICATE (SATELLITE MONITORING).....</i>		<i>17</i>
<i>FIGURE 11: MIDLANDS EA DATA</i>		<i>17</i>
<i>FIGURE 12: FRISGEWAAGD EA DATA</i>		<i>18</i>
<i>FIGURE 13: SAMPLE OF GPS PLOTTING</i>		<i>19</i>
<i>FIGURE 14: GSM COVERAGE (SOUTH AFRICA).....</i>		<i>21</i>
<i>FIGURE 15: LEO SYSTEM DESCRIPTION</i>		<i>21</i>
<i>FIGURE 16: LEO AFRICA LICENSE</i>		<i>22</i>
<i>FIGURE 17: LEO COVERAGE</i>		<i>22</i>
<i>FIGURE 18: GEO DATAFLOW</i>		<i>24</i>
<i>FIGURE 19: GEO COVERAGE.....</i>		<i>24</i>
<i>FIGURE 20: INTERNET REPORTING TOOL.....</i>		<i>25</i>
<i>FIGURE 21: PENALTY MANAGEMENT SYSTEM.....</i>		<i>26</i>
<i>FIGURE 22: TICKET MACHINE</i>		<i>28</i>
<i>FIGURE 23: INTERNET SCHEDULE INFORMATION.....</i>		<i>30</i>



"The world that we have made as a result of the level of thinking we have done thus far creates problems that we cannot solve at the same level as they were created"

Albert Einstein

1 VISION

The Vision of National Department of Transport as set out in the White Paper:

" Provide safe, reliable, effective, efficient and fully integrated transport operations and infrastructure which will best meet the needs of freight and passenger customers at improving levels of service and cost in a fashion which supports government strategies for economic and social development whilst being environmentally and economically sustainable."

The *Vision 2020* project became 'Moving South Africa', which commenced in June 1997 with a mandate to

"Develop a strategy to ensure that the transportation system of South Africa meets the needs of South Africa in the 21st Century and therefore contributes to the country's growth and economic development."

2 TRANSPORT SPECIFIC TRENDS

In addition to changes in the economy at-large and in the social environment, current and future trends in the global transport industry itself will have a significant impact on South Africa's transport system, as the ability to affect them falls generally outside of the ambit of South African government or operators. The major trends include:

2.1 Liberalisation and Deregulation

Especially in aviation, increasing numbers of countries are permitting open skies agreements with unrestricted entry (beyond safety regulations) with little or no protection for national flag carriers. In some cases, the liberalisation is also being



applied to rail and road operators. Related to this trend, in some countries, is a reduced reliance on government operating subsidies.

2.2 Globalisation of Customers and Carriers

International customers of transport are demanding high service levels, while operators are consolidating globally to meet the needs of global customers, through alliances, joint ventures, or outright acquisitions.

2.3 The Rise of Information Technology

With increasingly sophisticated IT, global high-value-added manufacturers have increasingly been able to move towards just-in-time manufacturing processes, reducing inventory costs but increasing the demand for high-precision transport and logistics. Similarly, within transport, IT allows operators to offer more precise information to shippers and customers, raising the service levels.

2.4 Increasing Awareness of Safety and Environmental Consequences

Developed countries, in particular, are revising their transport strategies specifically to improve outcomes on these dimensions. Multilateral organisations like the UN have regularly convened conferences to address the environmental issues, which eventually could result in further global treaty restrictions on emissions. Rapidly rising dependence on automobiles is the single biggest contributor to this trend, and controls and efforts to improve outcomes, in many cases, are raising the overall transport costs to users.

2.5 Global Manufacturing Sourcing

Enabled by the advent of sophisticated IT and accompanying transport logistics, global manufacturers are increasingly sourcing their production from multiple sources around the world. This, along with the other global trends above, creates a cycle of further increased demand for high-precision, flexible, integrated transport services that deliver not only to domestic factories but to multiple foreign locations.

All of these trends, taken together with the new constitutional dispensation, the new economic strategy and goals, and new social direction, combine to make imperative the need for a new transport strategy for South Africa.



3 BACKGROUND

3.1 WHY SUBSIDIZE PUBLIC TRANSPORT

In terms of the apartheid policy of previous governments, many people of color were forced to live in the rural areas of the country. These people then had to find transport from their place of residence to their place of work, which more often than not was in the city. The government at that time elected rather to provide transport than have the workforce living in and around the cities.

This created its own set of problems, as South Africa is a vast area, and the places of residence of the workforce were normally some distance from the city, and access was predominately via very poor gravel roads which constituted over 80 % of the subsidized transport routes, this lead to very high transport costs due to the distance and the poor quality of the roads, for example, one would expect to get about 20 to 25 thousand kilometers on a tyre, but in many of these areas bus operators are not getting more than 12 thousand kilometers per tyre.

The majority of this workforce was very poorly paid and had they been required to pay an economic fare for public transport, it may have cost them more than they were earning, therefore to sustain this apartheid policy, the government had to subsidize the operators who were providing this transport.



Figure 1: Rural Road



Figure 2: Rural Road

Added to these peculiarities, in KwaZulu-Natal most of the areas are very hilly, with many of the roads becoming untraversable when there has been rain. This all affects the running costs of as service, maintenance as well as shortens the life of a vehicle.



The policy of government was to subsidize the commuter who was employed, and the thinking was that a person who was employed would purchase a monthly ticket of Multi Journey Ticket (MJT), thus the government subsidized these monthly tickets.

3.2 WHY THE NEED TO CHANGE

This method of subsidization was not the ideal, as many workers still preferred to pay cash, as if they were sick, they would have still paid for the month's journeys with the MJT. Another reason they might have preferred to pay cash is, on certain routes the busses are unable to operate when there has been rain and the commuter would have to find and pay for alternative transport.

There was also room for unscrupulous bus operators to manipulate the system to receive more subsidies. This was very difficult to prove, as it is very difficult to audit ticket sales.

The new method of subsidy is based on revenue kilometers; i.e. the operator is paid according to the number of passenger kilometers he has delivered. This excludes dead kilometers, such as positioning trips and contra flow trips. When a tender is advertised, the number of trips to be operated, and the kilometers which will be subsidized are stipulated, and the operator tenders an amount per kilometer.

3.3 BENEFITS AND IMPLICATIONS OF NEW SUBSIDY SYSTEM

The main benefit of the new tender system, is that government can now ensure a certain level of service is sustained and enforced through monitoring.

Some differences between the two methods of subsidization, was that with the original method, the service area was determined by the operator as well as the level of service to be provided. There was little or no control on levels of service, whereas, with the new subsidy method, the service area as well as the level of service is determined by the government. There are also several specifications regarding the standard of the busses, i.e. no bus may be older than 10 years etc.



The new system also provides for non compliance penalties to ensure a high level of service is provided, i.e. if the bus runs more than 15 minutes late a 20 % penalty is levied, if the bus runs more than 30 minutes late, it has been deemed not to have run, and there are also penalties for torn seats, dirty busses etc etc

This new method has also allowed for improved budgeting and controls as government knew up front exactly how much the service would cost, and at long last there was an easier manner of ascertaining that value for money was achieved.

The problem then arose as to how government was going to monitor compliance in a cost-effective manner.

4 MANUAL MONITORING

Originally the manner in which we monitored the services, was to appoint consultants, who would do random checks alongside the road. It must be mentioned that the onus to report the non-performance of trips rests upon the operator, the monitoring is to ensure that the operator is reporting what he should. In terms of the contract the operator must report more penalties than the monitor, the reasoning is as follows, the monitoring firm, only checks on a sample of the service, i.e. between 20 and 50 % of the service, therefore the operator should be reporting many more penalties, than which are picked up by the monitoring firm.



Manual Monitored Days

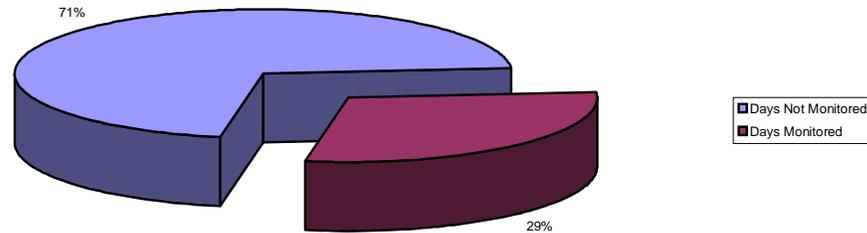


Figure 3: Manual Monitored Days

4.1 COST IMPLICATIONS OF MONITORING vs. VALUE FOR MONEY

Manual monitoring was proving to be very costly, with between R350.00 and R550.00 being charged per bus per month, and this for a 40 % monitoring of a service for about 20 % of the time.

With satellite monitoring, the initial costs are about R 6 000.00 per bus, with a monitoring cost of R600.00 per bus per month. Whilst these costs may be close to the manual monitoring, the satellite monitoring covers 100 % of the service 100 % of the time.

The reason why the manual monitoring is such a small percentage, is that due to the topography of the area, many busses sleep out some distance from the main operational areas, and it would require monitoring teams ten times bigger and at ten times the cost to try to monitor these services.

Whilst one may think that these monitoring costs are high, when you take that the



budget for subsidies in KwaZulu-Natal is just under 300 million Rand p.a., and the costs of monitoring are 5,5 million Rand p.a., which is about 1.8 % of the total subsidy bill. Penalties and savings directly resulting from monitoring total approximately 11 million Rand p.a.

The satellite monitoring also removes the human element, which eliminates the potential of intimidation, bribery and lack of performance.

4.2 Problems / Challenges with manual monitoring

Some difficulty arises when trying to ensure that all trips depart on time, as many starting points are very remote and the monitors would have to leave at about 2:30 in the morning and travel up to 80km of very bad dirt roads to be at some of the starting points, and as can be seen from the figure below, the starting points are so spread out one would have to employ hundreds of monitors to monitor each and very starting point.

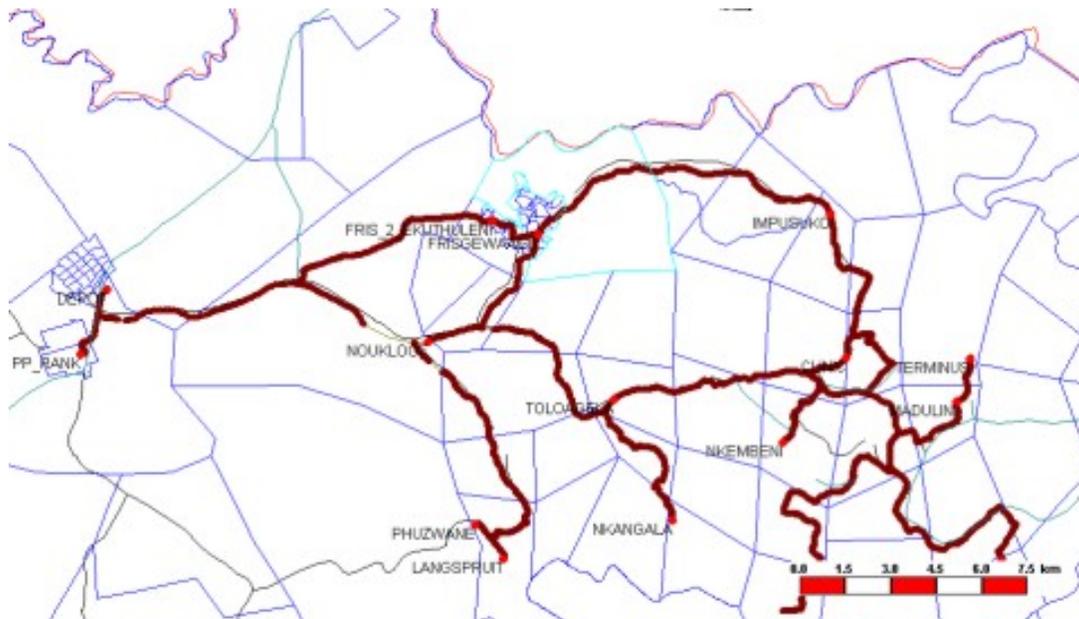


Figure 4: Midlands Service

There is also quite a laborious process of manually inputting the information from the monitors onto the computer and then transferring this data onto the payment



certificate and the penalty certificates, as well as the manpower required to do 40 % of the monitoring about 20% of the time.

Percentage Stops Monitored

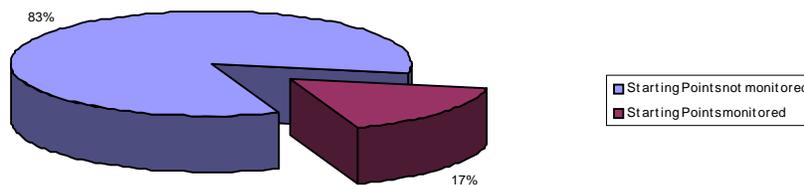


Figure 5: Percentage Stops Monitored

5 SATELLITE MONITORING

5.1 BENEFITS OF SATELLITE MONITORING

5.1.1 Reducing manpower

With the development of satellite monitoring, we immediately saw a substantial saving. Not only was there this huge saving, but also instead of 40 % of the service been monitored 20 % of the time, now 100% of the service was been monitored 100% of the time.



Thredbo 7 Conference 2001



TRANSPORT PLANNING & CONTROL (PTY) LTD

CENSUS FORM

DATE: 16/08/00 LOCATION: Bank TEAM: 16/001 (14)

TIME	DUTY NO	BUS NO	LIGHTS		DIRECTION		PASSENGERS	
			ON	OFF	FROM	TO	IN	OUT
12:00	2	1						
12:10	3	6						
12:30	103	30						
12:40	8	17						
12:53	103	34						53
13:00	8	11						60
13:05	4	1						60
13:10	7	13						
13:40	10							
14:00	7	13						58
14:14	12							40
14:47	1	18						
15:00	1	18						52
15:23	8	17						
15:23	8	17						9
15:33	4	1						21
15:44	103	34						20
15:45	103	34						11
16:08	5	6						
16:12	101	35						
16:13	9	2						
16:28	5	6						60
16:29	101	35						60
16:34	4	1						
17:00	4	3						63
17:00	4	1						61
17:01	103	34						
17:14	102	38						
17:25	104	36						

REMARKS: 101
NO 117745 HOLDING FOR NY 24628 (10) DEPT. HALL

5.1.2 Comparison between manual and satellite reports



Figure 7: Manual Monitoring Report

Penalty Report								
NONDWENI BUS SERVICES VRYHEID								
From:		14/12/2000						20/02/2001
To:		14/12/2000						
DAY	BUS NUMBER	DUTY NUMBER	OPDAY	TRIP NUMBER	BUS STOP NAME	BUS STOP TIME	ACTUAL BUS STOP TIME	TIME DISCREPANCY
12/14/2000	1	204	M-F	01.201.01	Vryheid Rank	13:00:00	13:03:00	00:03:00
12/14/2000	1	204	M-F	01.201.01	Duval Flats	13:22:00	13:20:00	00:02:00
12/14/2000	1	204	M-F	01.201.01	Mkhungwane	14:08:00	13:53:00	00:15:00
12/14/2000	1	204	M-F	01.201.01	Barkley Side	14:15:00	13:56:00	00:19:00
12/14/2000	1	204	M-F	01.201.01	Barkley Side	14:15:00	14:38:00	00:23:00
12/14/2000	1	204	M-F	01.201.01	Nhlulamithini	14:40:00	14:24:00	00:16:00
12/14/2000	1	204	M-F	01.201.01	Vryheid Rank	17:00:00	17:04:00	00:04:00
12/14/2000	1	204	M-F	01.201.01	Duval Flats	17:22:00	17:19:00	00:03:00
12/14/2000	1	204	M-F	01.201.01	Mkhungwane	18:08:00	17:50:00	00:18:00
12/14/2000	1	204	M-F	01.201.01	Barkley Side	18:15:00	17:54:00	00:21:00
12/14/2000	1	204	M-F	01.201.01	Nhlulamithini	18:40:00	18:24:00	00:16:00
12/14/2000	1	205	M-F	02.201.17	Nhlulamithini	08:00:00	08:00:00	00:00:00
12/14/2000	1	205	M-F	02.201.17	Barkley Side	08:24:00	08:33:00	00:09:00
12/14/2000	1	205	M-F	02.201.17	Mkhungwane	08:30:00	08:39:00	00:09:00
12/14/2000	1	205	M-F	02.201.17	Duval Flats	09:17:00	09:19:00	00:02:00
12/14/2000	1	205	M-F	02.201.17	Vryheid Rank	09:40:00	09:37:00	00:03:00
12/14/2000	5	203	M-F	04.201.17	Nondweni Section 5	05:19:00	05:30:00	00:11:00
12/14/2000	5	203	M-F	04.201.17	Barkley Side	05:26:00	05:35:00	00:09:00
12/14/2000	5	203	M-F	04.201.17	Mkhungwane	05:33:00	05:39:00	00:06:00
12/14/2000	5	203	M-F	04.201.17	Duval Flats	06:19:00	06:10:00	00:09:00
12/14/2000	5	203	M-F	04.201.17	Vryheid Rank	06:44:00	06:47:00	00:03:00
12/14/2000	5	212	M-F	01.201.01	Vryheid Rank	14:15:00	13:44:00	00:31:00
12/14/2000	5	212	M-F	01.201.01	Duval Flats	14:37:00	14:32:00	00:05:00
12/14/2000	5	212	M-F	01.201.01	Mkhungwane	15:23:00	15:05:00	00:18:00
12/14/2000	5	212	M-F	01.201.01	Barkley Side	15:30:00	15:11:00	00:19:00
12/14/2000	5	212	M-F	01.201.01	Nhlulamithini	15:55:00	15:36:00	00:19:00

Figure 8: Satellite Monitoring Report

The yellow areas show a comparison between the manual monitoring and satellite monitoring for a specific day at the Vryheid stop. The manual monitoring for this day was from 12:00pm until 18:00. Even with this small sample, the difference between the manual and satellite monitoring can clearly be distinguished. On the satellite report with a sample of only two busses, one extra penalty and two extra trips were reported. This would have a financial implication for the operator.



FORM A	
PUBLIC TRANSPORT:	
CONTRACT NO:	OPERATOR:
PAYMENT CERTIFICATE NO: 26	FOR MONTH: December-00
ACCUMULATED CONTRACT AMOUNT (FORM C, COL.7)	R 8,641,760.90
LESS: ACCUMULATED AMOUNT PAID (FORM C, COL.9)	R 8,218,171.14
SUB-TOTAL	R 423,589.76
ADD/DEDUCT THE FOLLOWING REFUNDABLE PENALTIES RELEASED/IMPOSED FOR NON-COMPLIANCE WITH SERVICE SPECIFICATIONS:	
5% FOR APPROVED VEHICLES NOT OPERATED SCC-CL 5.5.8 (a)	R
3% FOR APPROVED EE NOT USED SCC-CL 5.5.9 (b)	R
5% FOR MONTHLY STATISTICS NOT SUPPLIED SCC-CL 5.5.9 (c)	R
TOTAL AMOUNT ADDED/DEDUCTED	R
PAYMENT DUE	R 423,589.76
APPROVED BY THE REPRESENTATIVE	DATE
CERTIFIED: DEPARTMENT OF TRANSPORT	DATE
PAYMENT OF R _____ APPROVED BY	DATE
DEPARTMENT OF TRANSPORT	DATE

5.1.3 Payment Certificate for December

Figure 9: Payment Certificate (Manual Monitoring)



Thredbo 7 Conference 2001



FORM A

PUBLIC TRANSPORT:

CONTRACT NO: _____ OPERATOR: _____

PAYMENT CERTIFICATE NO: 26 FOR MONTH: December-00

ACCUMULATED CONTRACT AMOUNT (FORM C, COL.7)	R	8,605,386.63
LESS: ACCUMULATED AMOUNT PAID (FORM C, COL.9)	R	8,218,171.14
SUB-TOTAL	R	387,215.49

ADD/Deduct THE FOLLOWING REFUNDABLE PENALTIES RELEASED/IMPOSED FOR NON-COMPLIANCE WITH SERVICE SPECIFICATIONS:

5% FOR APPROVED VEHICLES NOT OPERATED SCC-CL 5.5.8 (a)	R	
3% FOR APPROVED EE NOT USED SCC-CL 5.5.9 (b)	R	
5% FOR MONTHLY STATISTICS NOT SUPPLIED SCC-CL 5.5.9 (c)	R	
TOTAL AMOUNT ADDED/DEDUCTED	R	

PAYMENT DUE R 387,215.49

_____ APPROVED BY THE REPRESENTATIVE	_____ DATE
_____ CERTIFIED: DEPARTMENT OF TRANSPORT	_____ DATE
PAYMENT OF R _____ APPROVED BY _____	
_____ DEPARTMENT OF TRANSPORT	_____ DATE



Figure 10: Payment Certificate (Satellite Monitoring)

5.1.4 Operator using the system as a management tool.

With the satellite monitoring reports been made available via the internet on a daily basis, an operator can immediately see where problems arise and instead of waiting to see how many penalties he is going to incur, the operator can now be proactive and address the problems as they arise.

The operator also has the option of real time monitoring should he wish to pay the communication costs.

5.1.5 Better planning

With the census data linked to the routes, planners can now ensure that the routes, starting points and fare collection is correct. When the electronic ticket equipment is linked, planners will be able to determine exactly how many people get on and off the busses at each and every stop, this will allow for maximum rationalisation of the service.

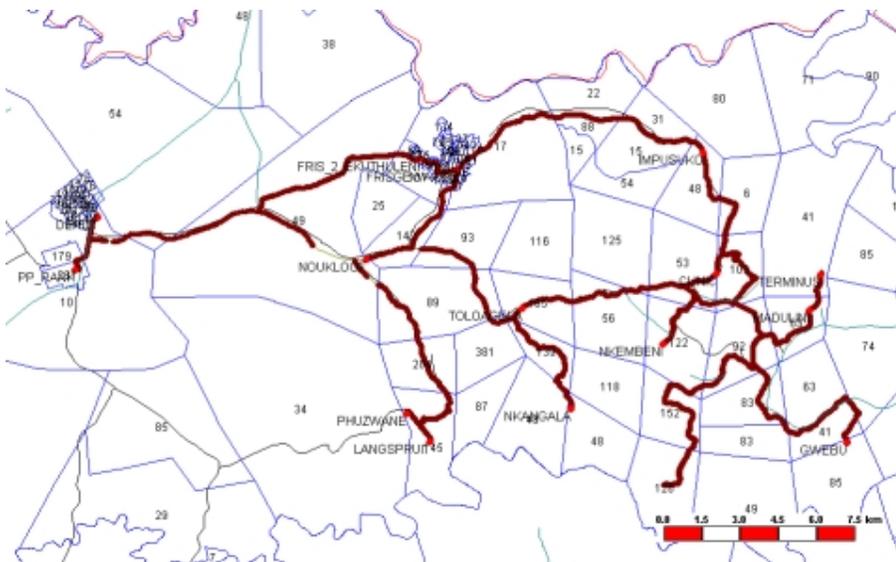


Figure 11: Midlands EA Data



5.1.7 Bus recovery from theft

All the information received from the satellite unit has got a gps position in the message string.

This data will then be plotted on a GIS map to show the current position of the unit.



Figure 13: Sample of GPS Plotting



6 SOLUTION VIA TECHNOLOGY

6.1 Solution methodology

The solution comprises of the following:

6.1.1 Onboard hardware:

This hardware is programmed to send back data on a Management By Exception basis (MBE) when the bus is not on time or on route. This will ensure that the minimum communication is used.

6.1.2 Communication platforms:

GENERAL

The satellite constellations provide GPS and offer global two-way data transfer from any remote area. The satellites supply interactive data communication as follows:

Two-way (Dual) communication ability through one- and/or two-way communication links. Self-positioning of the Satellite Modem by utilizing the formal Global Positioning system (GPS). The satellite constellation coverage clearly indicates the global connectivity provided by the geo-stationary satellites – all remote areas are globally covered which make this essential for fleet monitoring solutions.

The solution is based on a (GUCP) Generic Universal Communication Platform that can communicate via LEO - Low earth satellites namely Orbcomm, as well as the GEO - Inmarsat D+ satellite constellations including GSM networks as well as existing Radio trunk, landline infrastructure.



1. GSM/SMS



Figure 14: GSM Coverage (South Africa)

2. LEO Satellites

LEO SATELLITE CONSTELLATION - ORBCOMM SYSTEM OVERVIEW

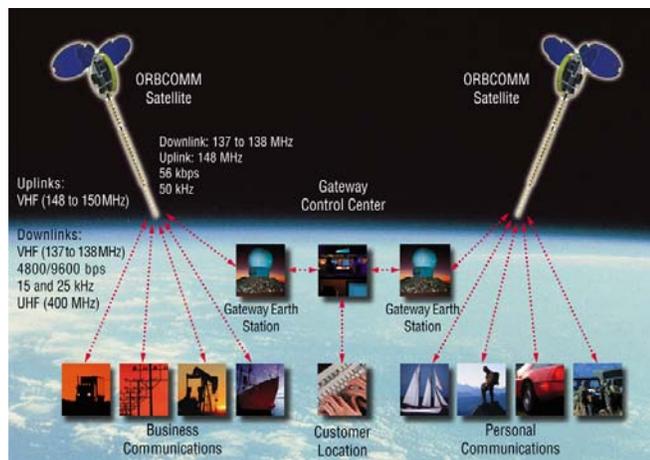


Figure 15: LEO System Description



Figure 16: LEO Africa License

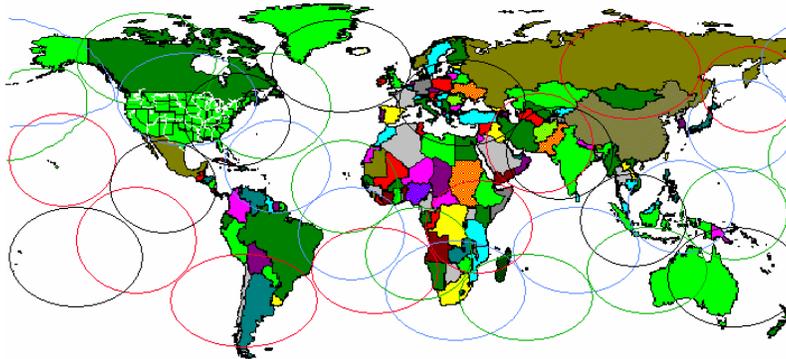


Figure 17: LEO Coverage

The satellites can supply interactive data communication as follows:

- Dual communication ability through one- and/or two way communication links
- Self positioning of the Satellite Communicator (SC) by utilising the ORBCOMM down link Doppler effect
- Using the formal Global Positioning System (**GPS**).



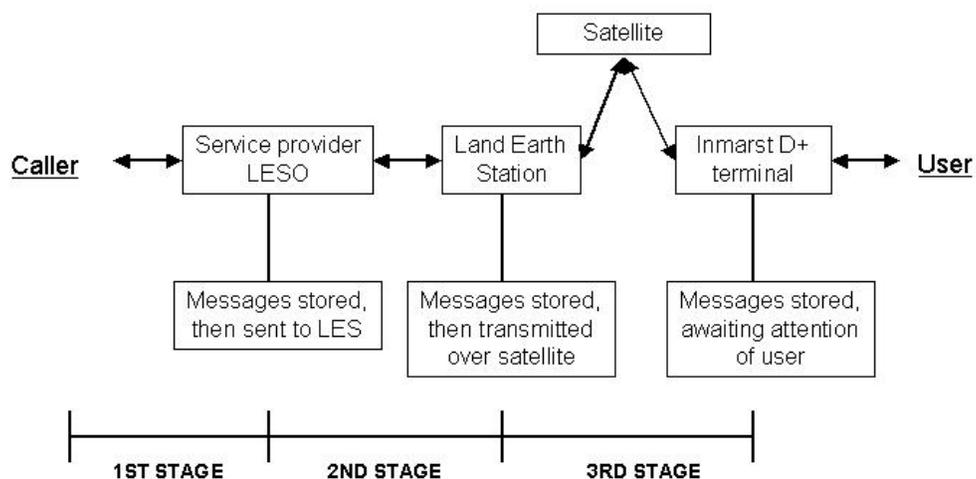
There is no hand-over of communications from one satellite to another. The small data packages are transmitted to a selected satellite and if only a partial message is transmitted where a satellite moves out of range, the ORBCOMM gateway will buffer the portion, until the remainder of the message is transmitted and received. The total message is then re-assembled and communicated to the customer.

The data communication services are based on low-bandwidth and low bit rate architecture, due to the limitation of the spectrum allocation system. Based on the above, the satellites can provide services mainly focused on data collection and reporting, near real time process control, two way messaging, and positioning which translate into tracking, remote monitoring and personal messaging applications. The system uses up-links in the 148 to 150Mhz range. The downlinks are located in the 137 to 138MHz and 400 to 400.15 bands. The GMPCS licenses and gateways are still under negotiation for sub-Saharan Africa.

3. GEO Satellites

SATELLITE CONSTELLATION - INMARSAT D+ OVERVIEW

Inmarsat D+ Dataflow



Inmarsat D+

9



Figure 18: GEO DataFlow

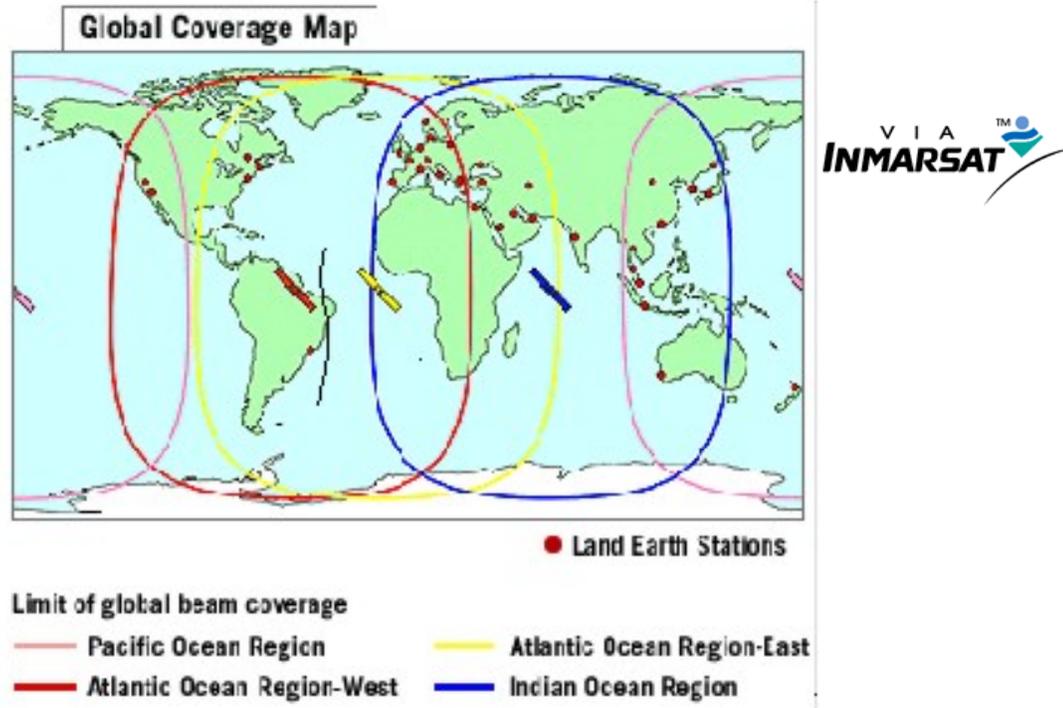


Figure 19: GEO Coverage

The Inmarsat system consists of nine satellites in geostationary orbit at a altitude of 36000km Inmarsat coverage is global except for the extreme polar regions. The Inmarsat constellation is reliable and exists for more than 15 years. The Inmarsat D+ is based on two way communication via very small packets of data and are frame based. The Inmarsat frequencies are 1525-1559MhzDownlink , 1626.5-1660.5MHz Uplink with GPS frequency at 1575.442MHz



Reporting application:

The operational and penalty reports will be available via the web or a specified intranet.

Penalty Report
NONWINE BUS SERVICES VRIHEID

From: 01/12/2000 To: 30/12/2000 1900/2000

Bus	Bus Camera	City	Operator	Trip Number	Stop Name	Stop Time	Actual Bus Stop Time	Time Shortage/Excess
1500 03000	1	304	WLP	87 390 04	Victoria Park	11:00:00	10:21:00	0:39:00
1500 03000	1	304	WLP	89 390 04	Highland	11:14:00	11:14:00	0:00:00
1500 03000	1	304	WLP	92 390 04	Ormeau	11:21:00	11:21:00	0:00:00
1500 03000	1	304	WLP	89 390 04	Adelphi	11:08:00	10:56:00	0:12:00
1500 03000	1	304	WLP	89 390 04	Garfield	10:11:00	10:31:00	0:40:00
1500 03000	1	304	WLP	92 390 04	Highland	11:40:00		
1500 03000	1	305	WLP	87 390 11	Highland	8:00:00	8:04:00	0:04:00
1500 03000	1	305	WLP	89 390 11	Garfield	8:34:00	8:31:00	0:13:00
1500 03000	1	305	WLP	92 390 11	Adelphi	8:30:00	8:44:00	0:14:00
1500 03000	1	305	WLP	92 390 11	Ormeau	9:11:00	9:24:00	0:23:00
1500 03000	1	305	WLP	87 390 11	Victoria Park	9:34:00		
1500 03000	1	305	WLP	89 390 11	Victoria Park	9:40:00		
1500 03000	2	306	WLP	18 300 11	Ormeau	4:30:00		
1500 03000	2	306	WLP	18 300 11	Highland	4:34:00		
1500 03000	2	306	WLP	18 300 11	Victoria Park	4:00:00		
1500 03000	2	306	WLP	18 300 11	Ormeau	2:44:00		
1500 03000	2	306	WLP	18 300 11	Highland	1:44:00		
1500 03000	2	306	WLP	18 300 11	Victoria Park	0:30:00		
1500 03000	2	306	WLP	11 300 04	Victoria Park	11:20:00		
1500 03000	2	306	WLP	11 300 04	Highland	11:41:00		
1500 03000	2	306	WLP	11 300 04	Ormeau	11:24:00		
1500 03000	2	306	WLP	11 300 04	Highland	10:20:00		
1500 03000	2	306	WLP	11 300 04	Highland	10:04:00		
1500 03000	4	308	WLP	04 300 15	Ormeau	1:00:00		
1500 03000	4	308	WLP	04 300 15	Highland	1:20:00		
1500 03000	4	308	WLP	04 300 15	Ormeau	0:11:00		

Figure 20: Internet Reporting Tool



6.2 Flow diagram

This diagram shows the typical information flow for the penalty management system.

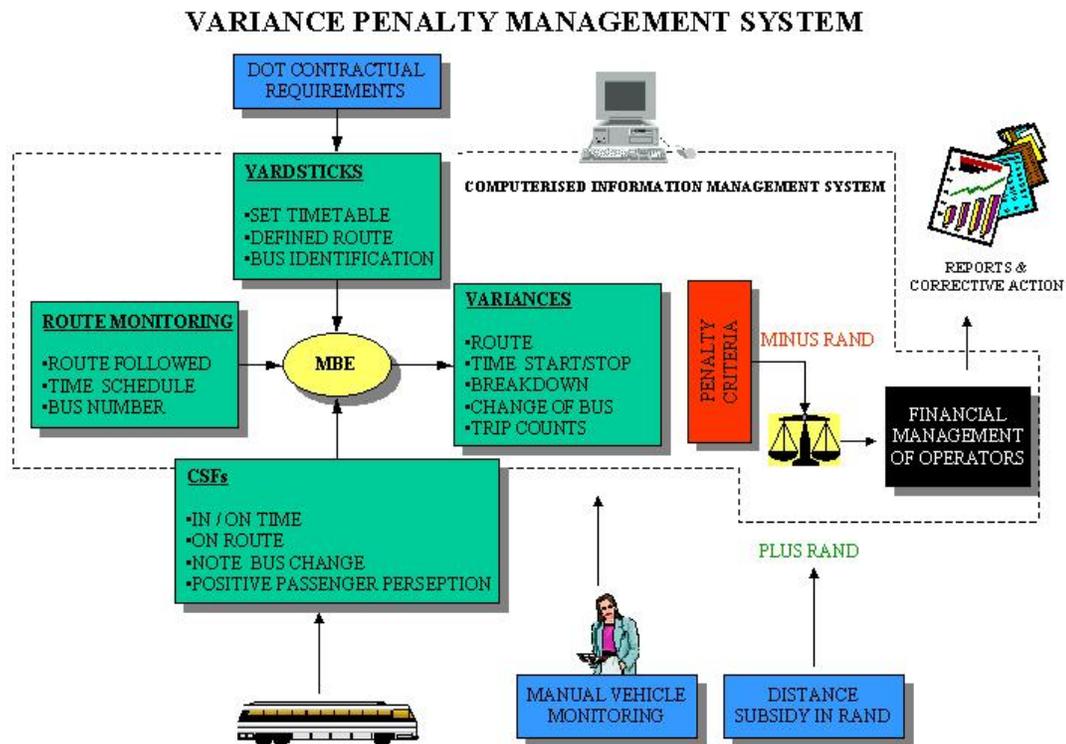


Figure 21: Penalty Management System



7 ADDED VALUE & FUTURE EXPANSION

7.1 Connecting to ticket machines for passenger data

The satellite system can connect to the following ticket machines to send back relevant information regarding the passengers per trip.

This passenger information can then be linked to a Geographical map for planning purposes.

7.1.1 Essentially an electronic system comprising of different configuration of the following

- Bus Machine (cash fares) - On board Cash Ticket Terminal
- Depot Machine (Cashier / Dispatcher)
- Magnetic Card Cancellor (Multi Journey Tickets) - Magnetic Cards
- Smart fare (Multi Journey Tickets) - Smart Cards
- ACE (Memory Module) - Driver Module

7.1.2 Cash Fare Machine

- Stored fares by zone or stage
- Reverse - stored fares
- Peak and off peak fares
- Configurations for adult, Scholar, Pensioner, Pets etc
- End of Shift Driver waybill

7.1.3 Cash Fare Machine (ticket details)

- Class of passenger and fare paid
- Boarding and destination stage name
- Date and time of ticket issue





-
- Date and time of ticket validity
 - Route, Journey, Stage and driver number
 - Four line advertising message
 - Machine number and Bus identification number

Figure 22: Ticket machine

7.1.4 Software

Management System

This software resides in the management computer and provides the following

- Stored routes and journey
- Zone based Systems
- Fare triangle
- Distance triangle
- Fare Scales
- Class description
- Driver table
- Advertising messages
- Preset fare values

7.1.5 Revenue Control System

- Accounts finish report
- Revenue by route
- Revenue by driver
- ACE History report
- Present ACE driver report
- Missing ACE report



-
- Late ACE report
 - Incomplete ticket reports

7.1.6 Statistics Package (ASP)

Data from the RCS package is updated into management computers for operation decisions.

- Where passengers are boarding / alighting
- Best / worst Revenue earning route
- Best / worst Revenue earning fare
- Efficiency of Scheduling
- Accurate costing
- Revenue by driver on duty
- Mileage analysis
- Time analysis per route
- Inspector reports
- Ticket details
- Journey scheduling
- Driver reports.

7.1.7 Management Information Systems

Originally developed for the south African Market by SA Cash Register and was found later to be suitable as a cost effective management tool that offers Managers immediate specialty Management Reports.

7.2 Electronic route signs

In the years to come, the satellite technology could be utilised to notify passengers of arrival time, delays and other transport information.



7.3 Traffic management system

In the city centres traffic signals could be linked to the public transport system, which would allow public transport vehicles to be quicker and attract more passengers.

7.4 Internet Schedule Information

Schedule information for a specific area can be viewed via the internet.

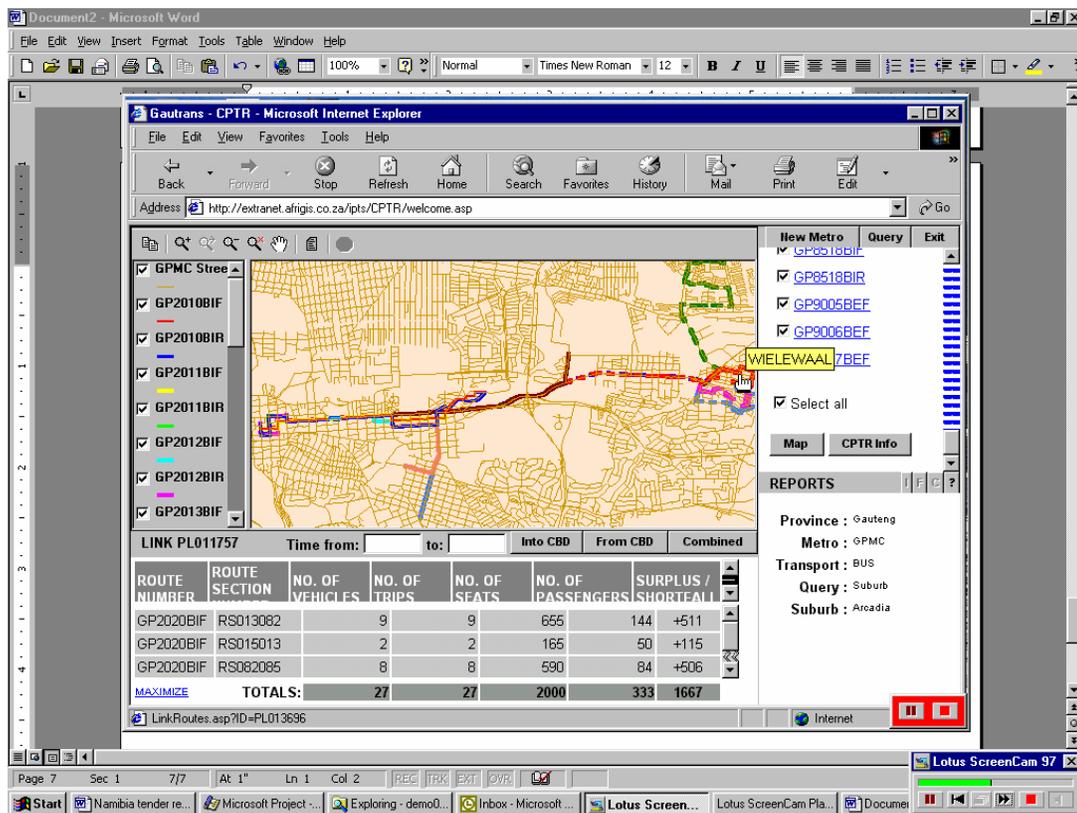


Figure 23: internet Schedule Information



8 CONCLUSION

In South Africa we have a long way to go with regard to incorporating technology into public transport. Some ideas such as electronic route signs may never become a reality, but there are many initiatives which we can implement that might make some distant dreams a more attainable reality.