Multi Carrier (Mauritius) Ltd

TECHNICAL REPORT

on

Digital Terrestrial Television Broadcasting Experimental Tests

in Mauritius

26 January 2004

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Executive Summary

This report on experimenter's licence tests on Digital Terrestrial Television Broadcasting (DTTB) carried out during 2003 highlights various issues such as national policy on introduction of DTTB in Mauritius, frequency planning, infrastructure including transmission and receiving systems, coverage, interference, test results and reaction from the public. These 2003 tests follow earlier tests on DTTB in Mauritius in February 2002 with the collaboration of Telediffusion de France.

MPEG compression has expanded the existing UHF television broadcasting frequency spectrum capacity. The tests have confirmed that a single UHF television frequency can carry up to 6 TV channels or a lesser number of television channels plus data/internet based services.

The long awaited introduction of private terrestrial television channels will become possible. The potential of DTTB to also broadcast enhanced and interactive services including internet based services has been demonstrated. The system will also enable mobile television and mobile internet based services to become a reality in Mauritius. DTTB is thus expected to become a major force driving national economic and social development.

The tests were carried out from 3 transmission sites namely Malherbes, Mont Simonet and Signal Mountain, achieving a coverage of near 70% of the island with the digital transmitters having output power of 10 dB down on existing analogue transmitter power for the same coverage.

The viewer will continue to use his existing television set and antenna system plus a set top box to receive digital television and data. PCI cards are also available for receiving these services on PC and laptop computers.

The reaction of viewers and the public has been favourable and shows an expectancy among these persons on availability of more terrestrial television channels and broadband interactive services which DTTB can satisfy. Strategies to be adopted for implementation of DTTB in Mauritius have also been evoked.

1. Introduction

1.1 Digital television is available via satellite and cable. Digital Terrestrial Television is now already mature. It started in May 1990 in the USA. Within slightly more than a decade, the USA, UK, Italy, Spain, Finland, Sweden, Germany, Singapore had developed their digital terrestrial television networks and many other countries followed suit. As a matter of fact, the city of Berlin has switched off its analogue terrestrial television transmission since August 2003.

1.2 Analogue technology is giving way to digitalisation. Technological developments are forcing countries to position themselves as digital players of one kind or other. Policies are being formulated to manage the migration from analogue to digital broadcasting.

The International Telecommunication Union (ITU) Telecommunication Development Bureau has examined this matter in Study Group 2 (Question 11/2). In order to facilitate the early introduction of Digital Terrestrial Television Broadcasting (DTTB), 34 European countries have signed the "Chester 97 - Multilateral Coordination Agreement relating to technical criteria, coordination, principles and procedures for the introduction of DVB-T". This Agreement guarantees the compatibility of existing analogue transmission infrastructure with current and future digital transmission.

The Regional Radio Communication Conference – 2004 (RRC-04) which will be held in Geneva later this year will look into various aspects of DTTB including Digital Frequency Planning for DTT and will submit recommendations to WRC-05.

1.3 Digital technology has brought, amongst others, a wider choice of programmes, improved spectrum utilisation efficiency, a spectrum more immune to interference, the potential for quality video and audio, and numerous value-added services such as Internet / Walled Gardens, pay per

view, home shopping, home banking, Video on Demand, T-services, multimedia services etc.

1.4 To introduce Digital Terrestrial Television Broadcasting (DTTB) in Mauritius Telediffusion de France (TDF), MBC and MCML had carried out pilot tests on DTTB in February 2002.

A National Digital Broadcasting Committee (NDBC) was subsequently set up in May 2002, under the chairmanship of the Secretary for Home Affairs, Prime Minister's Office, to discuss strategies for the introduction of digital terrestrial broadcasting for both television and data casting purposes. MCML was entrusted the responsibility to set up the digital terrestrial broadcasting network. Head-End and Transmission Equipment as per the list and specifications at **Annex I** were installed and became operational on 12 March 2003.

The former Prime Minister Sir Anerood Jugnauth, in his opening address at the CIRTEF conference held in Mauritius in xx 2003 had referred to the impending introduction of digital terrestrial television broadcasting in Mauritius.

1.5 Further tests were conducted by MCML as from July 2003, after an Experimenter's Licence was issued by the Information and Communication Technology Authority (ICTA).

1.6 This Technical report gives an overview of the tests on DVB-T, the European Digital Terrestrial Television standard. It highlights the results and feedback from consumers. Strategic issues are being examined for Mauritius to fully harness the technical potentials and business opportunities offered by digital terrestrial broadcasting technology with its multi-channel TV, and enhanced and virtual services.

2. Objectives of DVB-T tests

The main objectives of the field tests were:

(i) to demonstrate that the DVB-T head-end, the transmitters and the DVB-T receivers used in the field trials operate in accordance with the European standards for the technology (ETSI specifications ETS 300 744, TR 101 190, EN 3O1 192 and TR 101 202).

(ii) to investigate possibilities and occurrences, if any, of interference between DVB-T and other services and identify appropriate remedial/mitigating measures.

(iii) to confirm that field strength measurements in different locations are consistent with values obtained during the first pilot tests.

(iv) to make recommendations on receiving apparatus, i.e., the types of reception antennas and receivers/set-top boxes required for DVB-T reception by the public.

The results of the field tests will enable MCML to take measures to implement the DVB-T network for Mauritius thus allowing potential promoters to operate in the additional bandwidth in a secure and interference-free environment.

3. Frequency planning for DTT in Mauritius

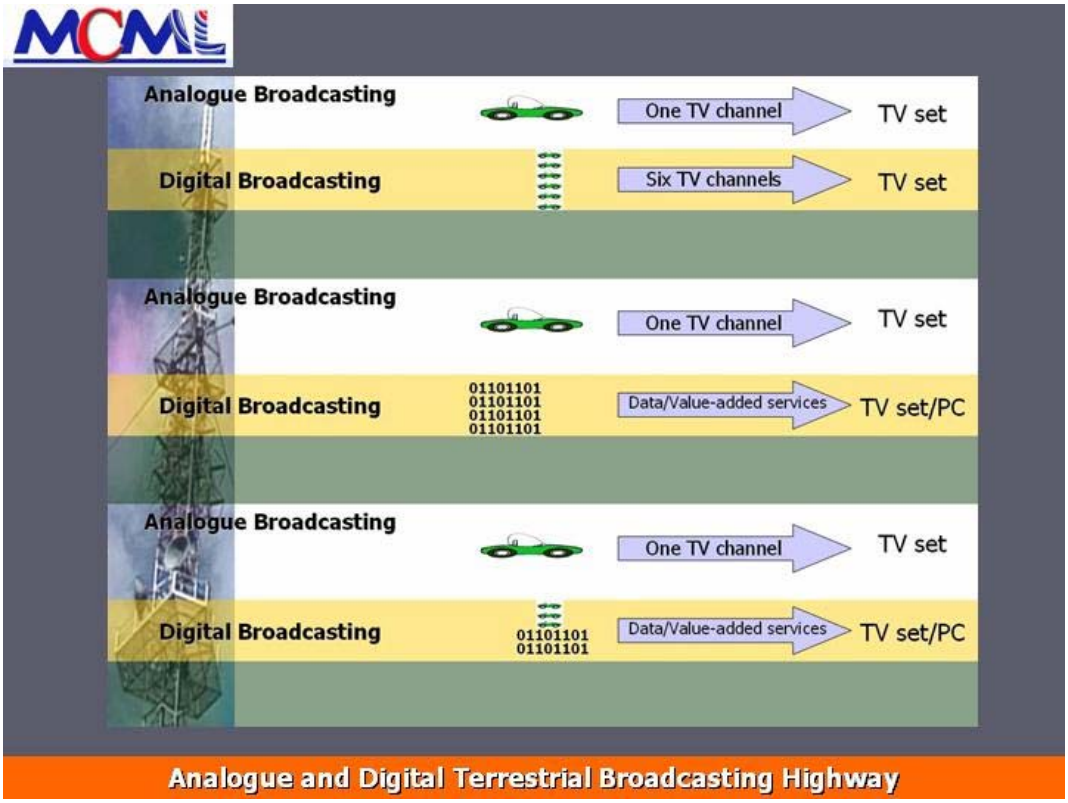
Terrestrial television is a necessary and respected part of the broadcasting ecology. Mauritius and Reunion have altogether built more than forty-five television transmitting stations to bring the population served to near 100%.

In the analogue world, there is a direct and exact relationship between the number of programmes services and the number of 8 MHz bandwidth UHF channels required to broadcast from a given station: *it is exactly one to one.*

Digital broadcasting technology smashes this relationship. Using Moving Picture Expert Group (MPEG) compression techniques adapted in video broadcasting by the Digital Video Broadcasting (DVB) consortium, a single 8 MHz UHF channel can hold five to six programme services including stereo audio. Furthermore, DTT

offers many advantages such as the ability to overcome many types of interference, ghost and noise free pictures using the existing TV antenna for reception.

The challenge for the spectrum planners is to interleave a digital network with five to six multiplexes within the existing frequency plan, while minimising the damaging effect to existing analogue television transmission and reception.



Algorithms are available to determine which UHF channel goes to which multiplex, particularly when it concerns the sharing of channels between neighbouring *Mauritius and Reunion islands* where analogue television services are already on the air.

A feasibility study including a computer simulated frequency plan as per copy at **Annex III**, was prepared by TDF in 1999 at the request of Government. The same digital frequency plan for one multiplex was therefore used for the Experimenter's Licence test.

4. The three pillars for DTT

The pillars for Digital Terrestrial Television are: ***Technology, Infrastructure and Content*.** All three pillars were available for the tests in Mauritius.

4.1 Technology

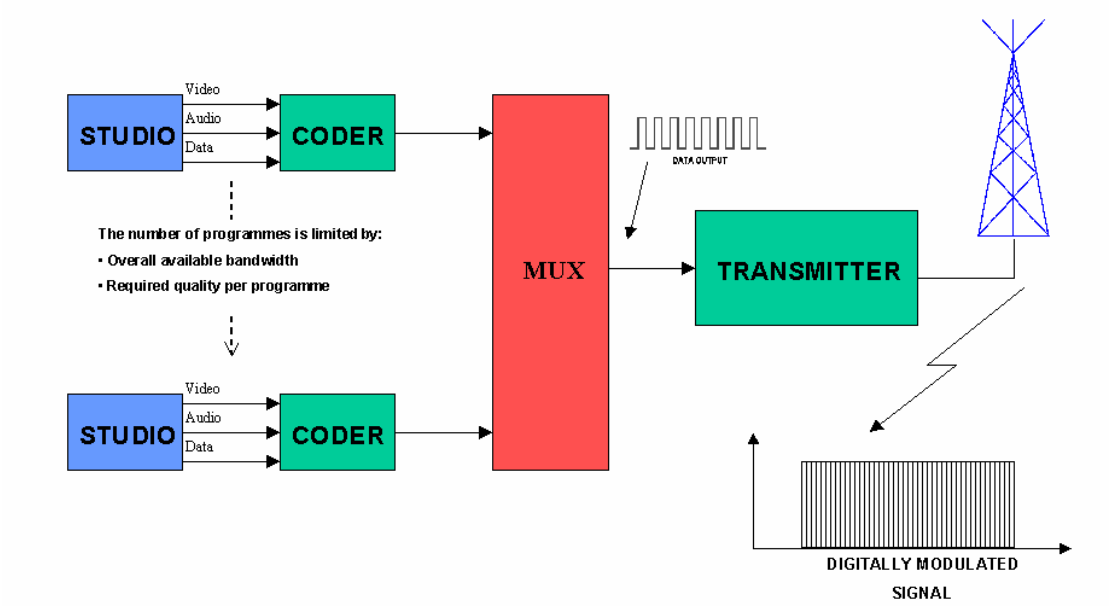
The techniques and systems developed through research in the electronic, broadcast and telecommunications fields such as digital signal processing, compression techniques together with the advancement in gallium arsenic semiconductor chip technology, modulation and multiplexing techniques, have given digital television the potential to provide viewers with new services for programming and multimedia.

DVB-T is the most sophisticated and flexible digital terrestrial transmission system available today. It allows digital television service providers to match existing television coverage with only a small fraction of the analogue transmission power on the digital transmitters. It also extends the scope of DTT for portable and mobile reception.

The key feature of the system is the use of COFDM (Coded Orthogonal Frequency Division Multiplexing). This is a very flexible wide-band multicarrier modulation system that uses different levels of forward error correction, time and frequency interleaving and two level hierarchical channel coding.

Basically, the information to be transmitted is split into a given number ("2k" 1705 or "8k" 6817) of modulated carriers with individual low bit rate, so that the corresponding symbol time becomes larger than the delay spread of the channel. A guard interval (1/4, 1/8, 1/16, 1/32 of the symbol time) is inserted between successive symbols to avoid intersymbol interference and to protect against echoes.

Depending on the channel characteristics, different parameters (sub carrier modulation - QPSK, I6 QAM, 64 QAM; number of carriers - 2k, 8k; code rate of inner protection; guard interval and modulation) can be selected. Thus different operation transmission modes are possible. Every mode offers a trade-off between net bit rate and protection of the signal (against fading, echoes, etc). Depending on the selected transmission mode, 60 different net bit rates may be obtained ranging from 5 to 32 Mbps.



A simple example of DVB-T Transmission System

The main drivers for the introduction of DVB-T are as follows:

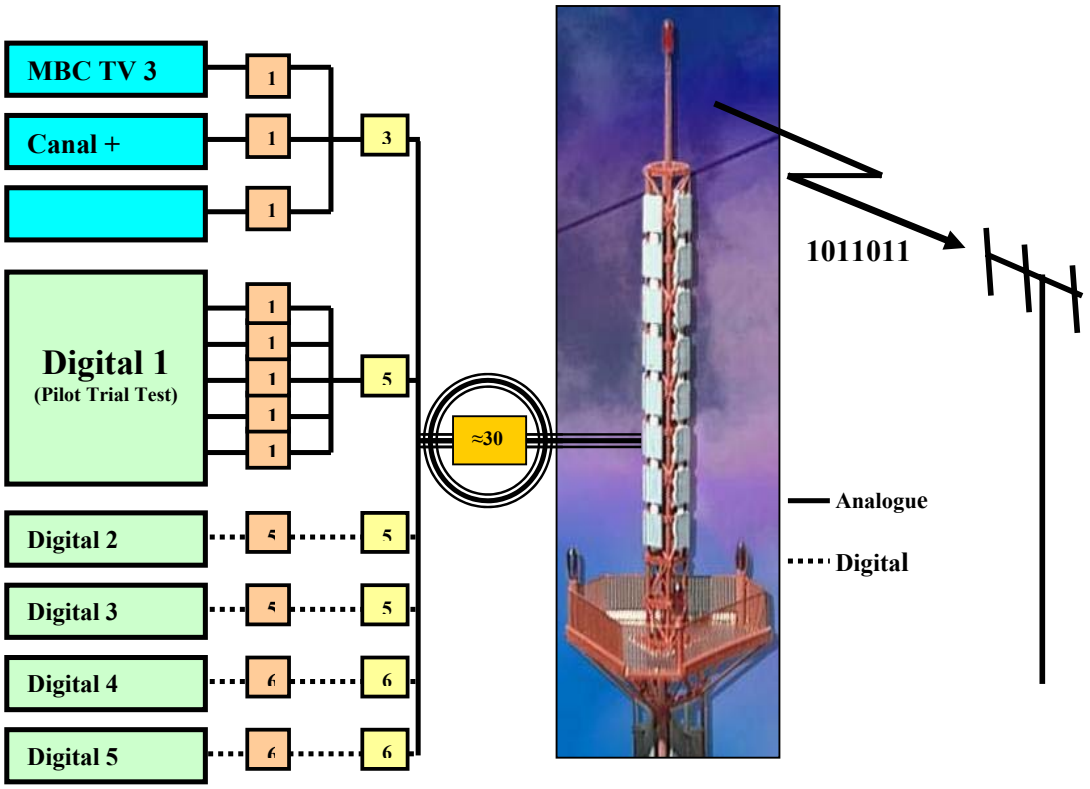
- **Portability with simple antenna and minimum installation**
- **Reduced implementation system cost**
- **Widescreen TV**
- **Spectrum Efficiency**
- **Quality Reception using current TV receiving antenna**
- **Interactivity**
- **High speed delivery of Internet**
- **Convergence of services**

The DVB-T variants used for the test are as follows:

- **MPEG-2 digital compression**
- **Coded Orthogonal Frequency Division Multiplexing (COFDM)**
- **64 QAM Modulation**
- **Error Coding rate 2/3**
- **Data rate ≈ 24 Mbits/s for 8 MHz bandwidth**
- **Carrier – 8k**
- **Multi Frequency Network (MFN) using frequency channels adjacent to existing analogue TV channels**

4.2 Infrastructure

The integration of the DTTB system using a common carrier approach within the existing UHF analogue transmission systems at Malherbes, Mont Simonet and Signal Mountain stations, was carried out by MCML in March 2003.



Analogue/Digital Set Up at Malherbes Transmitting Station

In the analogue world, one TV programme needs one complete channel bandwidth whereas up to six digitally compressed TV channels can be squeezed within an equivalent channel bandwidth for digital. **Digital 1,** a digital bouquet, was integrated using the same UHF antenna currently used for analogue transmission of MBC3, Canal + and RTL9 at Malherbes as shown in diagram above.

Digital video, audio as well as data services were fed to a single 200 W digital transmitter at Malherbes and to 25 W transposers at Mont Simonet and Signal Mountain. The following important features must be noted:

- *The radio frequency channel for the DTT multiplex was the upper adjacent channel to the MBC3 analogue channel **27** namely **channels 28** for Malherbes. For Signal Mountain, the channel for digital was **channel 30**, adjacent to MBC3 channel **29** and for Mont Simonet, channel 48 was used.*
- *A separate radio frequency combiner was used to combine the digital and analogue services (power ratio 1:10) to feed Malherbes UHF antenna system.*
- *The digital bouquet (Digital 1) can contain 5 to 6 TV programmes, compressed to an equivalent of 24Mbits/s within the 8 MHz channel bandwidth.*
- *A multi frequency network (MFN) was adopted using frequency channels adjacent to analogue ones. This simplifies the digital multiplex transmission.*

STATIONS	ANALOGUE					DIGITAL				
	MBC 1	MBC 2	MBC 3	CANAL +	RT L9	Multiplex 1	Multiplex 2	Multiplex 3	Multiplex 4	Multiplex 5
Malherbes	4	5	**27**	21	24	**28**	22	##	##	##
Signal Mt	7	32	**29**	35	38	**30**	34	##	##	##
Jurancon	9	32	29	35	38	30	34	##	##	##
Butte Aux Papayas	12	40	49	43	46	48	42	##	##	##
Pte Jerome	12 V	41 V	50V	44V	47 V	51V	45V	##	##	##
Le Morne	8	40 V	49V	43V	46 V	50V	44V	##	##	##
Motte a Therese	9	33	36	30	39	37	31	##	##	##
Bambous	45	48	57	51	54	58	50	##	##	##
Corps de Garde	31	34	53	37	49	52	36	##	##	##
GRSE	55	58	67	61	64	63	60	##	##	##
Baie du Cap	48	45	57	51	54	53	50	##	##	##
Terre Rouge	59	62	56	65	68	57	66	##	##	##
Citadelle	48	9	54	48	51	55	47	##	##	##
Coromandel	55	58	67	61	64	68	60	##	##	##
Pointe du Diable	31	34	37			38		##	##	##
Riche en Eau	45	48	51							
Chamarel	41	51	54							
Bel Air Riv Seche	61	64	67							

Frequency plan and usage for DTTB in Mauritius

4.3 Content

It is apparent that television and the PC are merging to give rise to a 'hyper TV' or a 'Teleputer'. A viewer can watch a video clip, jump to a group of the artist's other videos, read articles about the artist, watch interviews with the artist, listen to selection from the newest CD and then order what he desires from an on-line server, all without leaving the TV environment. This is what digital television and the convergence network is all about. The marvels of a multitude of channels, language choice and interactivity are within the reach of the consumers.

Technical groups have contributed towards the implementation of a common platform for all links between television programming and multimedia services. Multimedia Home Platform (DVB-MHP) is an important step towards a global approach to the rationalisation of a common interface and full interoperability of the Head-End and the Transmission system to bring in enhanced and virtual services. This innovation in terrestrial broadcasting and new business opportunities will attract both content providers and the consumers.

Without exciting content and a concerted marketing strategy of all stakeholders concerned, the best technology and infrastructure will remain idle because viewers want significant added value. The more attractive the services are, the more we can optimise on technology and infrastructure using a roadmap towards the magic formula **'DTT + CI + MHP + IP',** thus creating an impact on society by democratising information and bridging the digital gap.

Content with digital television is classified into two main streams: programme and data.

During the period of the tests, content as follows was transmitted on an ad-hoc basis -

- ***TV channels received via satellite namely DD India, DD Bharathi, MiTV, TV5***
- ***MBC channels - as a matter of fact, the Indian Ocean Games on MBC3 was simulcast in digital and received on wide screen for promotions***
- ***DVD content from the Head-End with specific packages on line and video clips***
- ***VOD and Internet access using IP over DVB and PCI cards***
- ***CD quality radio channels***

5. Transmission system

The main transmitter was installed at Malherbes and set on channel 28, to cover the centre of the island as well as some parts of the East and the South. A transposer was installed at Mont Simonet for the purpose of transposing and relaying the signal received from Malherbes on CH 28 towards Signal Mountain on CH 48. Signal Mountain, in turn, was set to transpose the signals from CH 48 to CH 30 to cover Port-Louis and parts of the northern region of the island. The frequencies for DVB-T implementation were determined in 1998 by TDF following a feasibility study commissioned by Government.

DVB encoding and multiplexing of up to five television channels, 2 radio channels and data followed by COFDM digital modulation was carried out at the main transmitter site at Malherbes. The table below summarises the encoding parameters for the head-end and COFDM modulator.

Parameters		
1	**No. of carriers**	**8 K**
2	**Bandwidth**	**8 MHz**
3	**Modulation**	**64-QAM**
4	**Guard Interval**	**1/32**
5	**Code Rate**	**2/3**
6	**Information Rate (Mbits/s)**	**24**

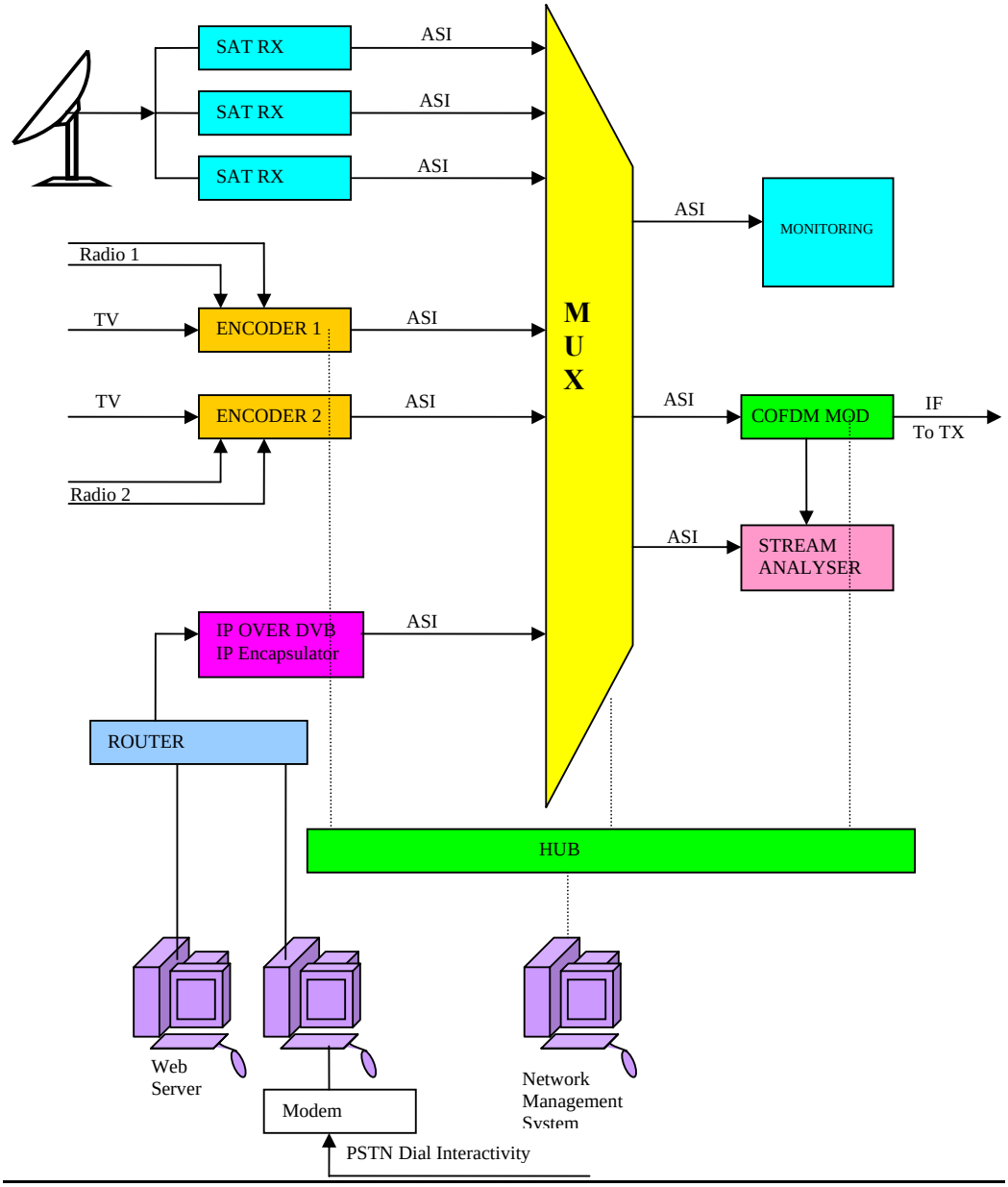
All the digital transmitters operate round the clock. The output of the digital transmitter on each site was connected to the same UHF transmitting antenna used for analogue television broadcasting on respective sites by means of an RF combiner.

The UHF transmitting antenna at Malherbes consists of 32 horizontally-polarized UHF panels with an omni directional radiation pattern. On the other hand, the antenna at Signal Mountain comprises of 3 horizontally-polarised UHF panels with unequal power split to give a desired radiation pattern for optimum coverage in targeted areas.

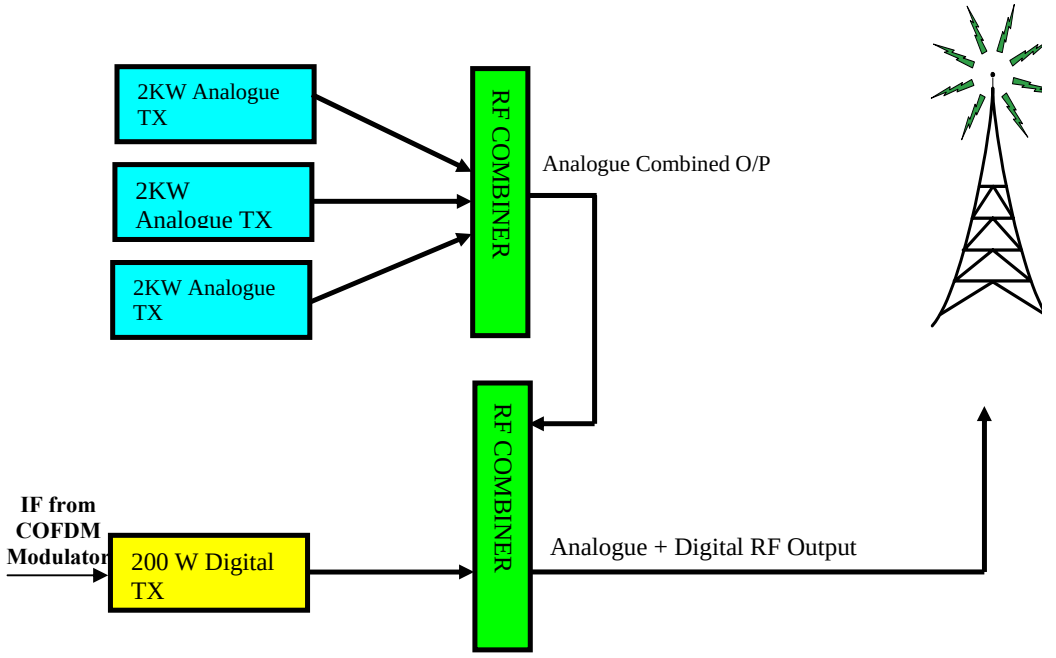
The following table summarises the transmission parameters for each site.

Parameter	Location		
	Malherbes	Signal Mountain	Mont Simonet
Antenna height above sea level (m)	650	290	606
Transmitter power (W)	200	25	25
Antenna gain (dB)	12	8	8
Polarisation	Horizontal	Horizontal	Horizontal
ERP (W)	3160	126	126
RF Channel (Transmit)	UHF Ch. 28	UHF Ch. 30	UHF Ch. 48

5.1 Malherbes Main Station



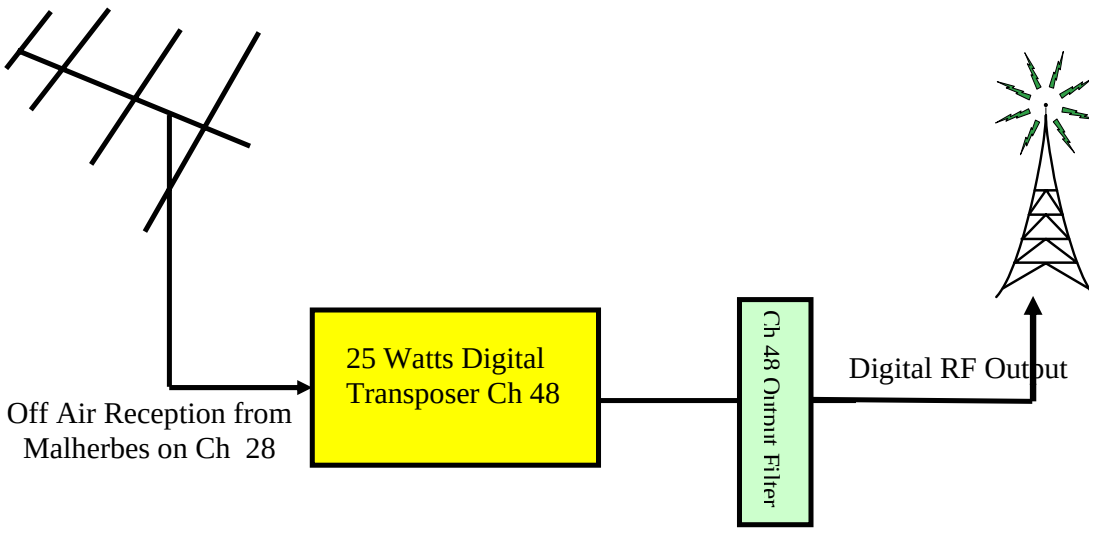
Head End (schematic) set up for TV and IP over DVB



Malherbes DVB-T Transmission Equipment (schematic) Setup

The above schematic shows the combination of analogue and digital RF powers to feed a common antenna system at Malherbes.

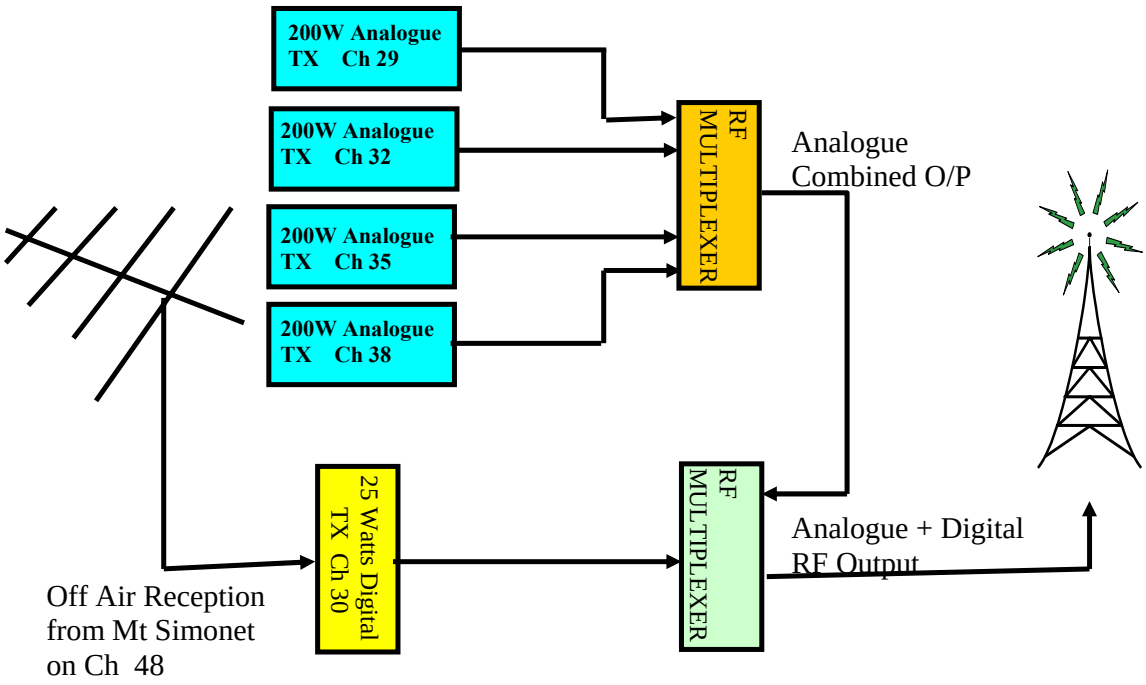
5.2 Mont Simonet Relay Station



Mont Simonet DVB-T Transmission Equipment set up

At Mont Simonet, a reception antenna receives the DVB-T signal transmitted from Malherbes on Ch 28. This frequency is then transposed to Ch 48 before it is transmitted in the direction of Signal Mountain. This station acts as a relay to feed DVB-T signals to Signal Mountain. The latter cannot receive the signal directly from Malherbes due to the abrupt topology of the island. Part of the western part of the island can also be covered with digital transmission from Mont Simonet by adding a power splitter and a second UHF antenna panel. The RF power will be splitted in the ratio 3:1.

5.3 Signal Mountain Relay Station

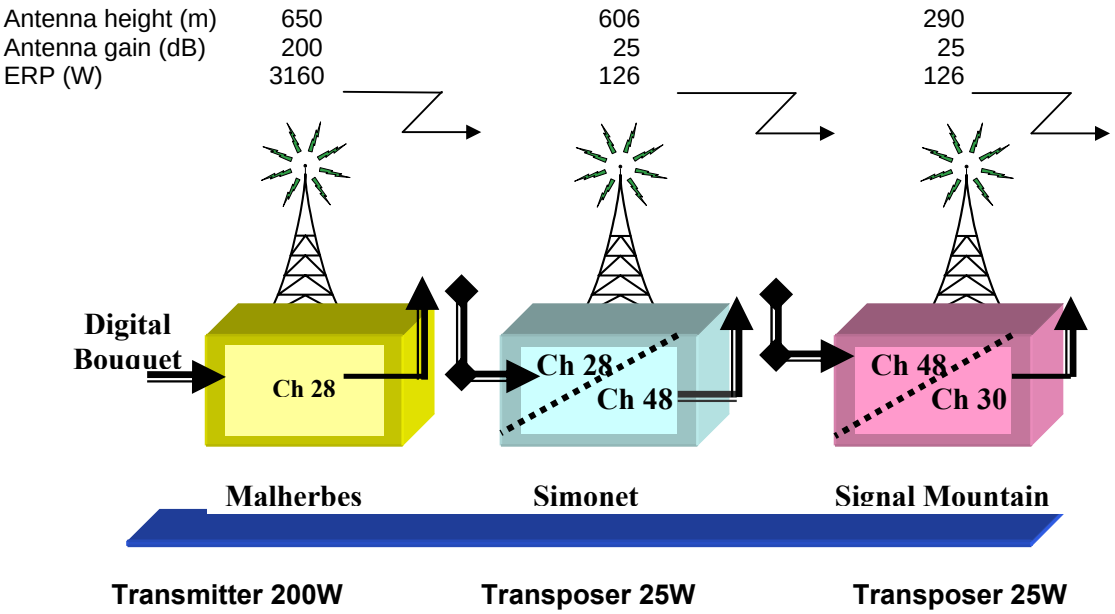


Signal Mountain (schematic) DVB-T Transmission Equipment set up

The above schematic shows the combination of analogue and digital RF powers to feed a common antenna system at Signal Mountain.

The digital DVB-T transposer receives signal off-air from Mont Simonet on Ch 48. The frequency is then transposed to Ch 30.

5.3 Malherbes - Mont Simonet - Signal Mountain stations



The above schematic diagram shows the three stations set up for the experimenter's tests to telecast the digital bouquet to cover near 70% of the island (see coverage map on page 17) while transmitting the three or four UHF analogue channels in the simulcast mode.

5.5 Power supply security

The DVB-T Transmitters at the 3 test sites and the Head End equipment at Malherbes are all connected to uninterruptible power supplies to avoid the power sensitive digital equipment from exposure to power outages or fluctuations.

6. Evaluation of reception

The experimental tests and the field survey were conducted in order to:

(a) assess the penetration of DTT from the three transmitting stations;
(b) bring about an awareness of the broad concepts of DTTB and advantages of implementing a digital terrestrial television network in Mauritius;
(c) clarify implementation pitfalls which could occur mainly due to interference;
(d) assess integration and compatibility with the existing analogue channels;
(e) pay special attention to frequency sharing with Reunion Island for the implementation of DTTB on a short, medium and long term basis.

6.1 Receiver and test vehicle

The receiving equipment consisted of:

(i) set-top boxes from Nokia, XSAT, HUMAX, Technisat (see **Annex IV)**

(ii) TV monitors
(iii) log periodic and yagi Band IV/V antennas
(iv) field strength meter make Prolink-4 (DVB compliant) (see **Annex IV (a)**)

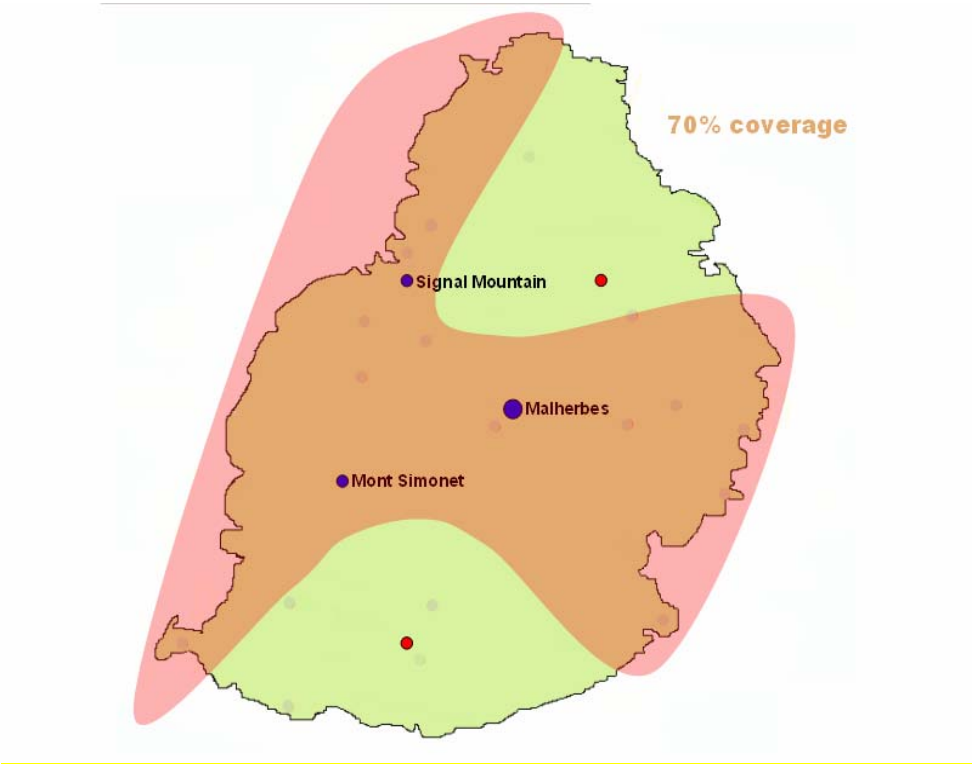
The receiving equipment was mounted on a Land Rover jeep referred to as "FSM test Van". The receiving antennas were mounted on a telescopic mast.

The FSM test van moved in various accessible locations and measurements of field strength were taken with the receiving antennas 10m above ground level. The set-top boxes were used to measure BER and quality of the received signal.

The exercise was carried out at various times of the day and night and in different environmental conditions.

6.2 Coverage

The coverage was evaluated throughout the targeted areas, and places where reception is inadequate was identified. Gaps in the coverage, relevant data on the environment, the received RF signal strength and the multipath conditions observed were noted. The results of the field strength measurement are shown in Table 1 at page 20.



Coverage map

6.3 Interference

MCML made public announcements of the tests on MCML's web site, in the newspapers, and on radio and television, 7 days in advance of and during the tests, thereby inviting the public to report any case of abnormal functioning of their radio equipment (copy of press notice, interference reporting form are given at **Annex V**).

MCML considered services which were at risk as listed below: -

(i) Hospital authorities for medical apparatus;

(ii) Existing users of radio frequencies being also suppliers of telecommunication services such as CEB, Department of Civil Aviation and Government Fire Services;

(iii) Digital domestic appliances such as DVD, digital cameras;

(iv) Analogue television reception.

A technical team was set up to monitor any such interference. Members of the team had instructions to respond immediately to any complaint of interference reception. Investigations have shown that these services have not suffered any interference from the DVB-T transmissions and that the above organisations do not have any equipment operating in the frequency band of interest for the tests.

MCML is continuing the monitoring exercise with above-mentioned and other organisations to have a clearer and complete picture of radio equipment operated by them and which may suffer from interference.

We have, however, noted two cases of interference received from other services namely:-

(i) Electrical noise caused by engines of old motorcycles and other vehicles causing temporary freezing of pictures. However, the phenomenon of electrical noise can also be detected on analogue radio and television sets.

This is an RF interference. When the Set Top Box is moved about 30 metres away no such interference is noted. Two types of Set Top Boxes

were used and both showed the same symptoms in the given circumstances. The technical team is further investigating the problem. A motor vehicle engineer has been contacted to advise the authorities concerned on required legislation to enable modifications to be brought to old engines.

(ii) When mobile phones of make Motorola and Siemens are operated too close to the Set Top box, mosaic pictures are seen on the TV screen. Nokia and Samsung mobile phones have no such effect on the Set Top Box. The technical team has further investigated this isolated problem and has found that the given mobile phones were causing a disturbance in the internal circuitry of the microprocessor in the Set Top Box decoder and is not an RF interference. The matter has already been reported to the manufacturer of the Set Top Box for necessary investigations and remedial action at their end.

6.4 Field Tests

Another technical team was assigned the duties to carry field tests. The receiving equipment used were as follows

- *A log periodic (LP 345) VHF/UHF antenna with low-loss cable.*
- *Set Top Boxes from different suppliers offering basic conversion to analogue and interactivity.*
- *A PCI card from Technisat offering television and added services including Internet downloading and interactivity*

The log periodic antenna ref LPV 345 from Fracarro (see **Annex VI**), which is commonly used by the local viewers, was specifically chosen for its good antenna gain. It is cheaper and simpler for the user to receive analogue and digital RF signals using this antenna. For digital reception 2 important measurements are required namely the C/N in dB and the $E_{average}$ in dBuV/m. The signal level on available STBs should be above 40% in the range 0 to 100%. The average field strength is around 56 dBuV/m for good fixed roof-level reception. The regions covered for the field tests and the corresponding results are shown in Table 1 below:

Table 1

Field Test Locations	Distance from TX (Kms)	Antenna Height (agl) /m	Signal Level Received (Indicator on STB) Range 0 – 100%	Field Strength measured on FSM (dBuV)	Reception with Fracarro LPV345HV Antenna
Channel 28 reception from Malherbes					
La Marie	7	10	75	65	Good
Phoenix	12	15	75	62	Good
Vacoas	8	Indoor	55	55	Good
Lalouise	12	10	65	63	Good
Quatre-Bornes	14	12	80	62	Good
Palma	25	10	72	62	Good
Rose Hill	14	10	71	58	Good
Beau Bassin	25	6	65	55	Good
Signal Mountain	30	15	-	-	No reception
Citadelle	30	10	-	-	No reception
Albion	30	10	-	-	No reception
Butte aux Papayes	40	15	40	57	Good
Roche Noire	45	8	70	59	Good + booster
Rivière du Rempart	50	10	55	53	Good
St Pierre	13	10	68	57	Good
Moka	15	10	72	61	Good
Nouvelle Decouverte	20	10	58	50	Good
Rose Belle	15	10	74	62	Good
Mahébourg	36	9	65	55	Good
Pointe D'Esny	40	10	70	59	Good + booster
Olivia	25	7	81	63	Good
Pont Lardier (Bel Air)	25	7	-	-	No reception

Bel Air Rivière Séche	30	12	48	50	Good
Trou D'eau Douce	40	6	-	-	No reception
Bramstan	35	8	-	-	No reception
Central Flacq	38	12	65	55	Good
Channel 30 reception from Signal Mountain					
Citadelle	4	10	80	72	Good
Coromandel	7	10	75	68	Good
Albion	12	10	70	61	Good
Beau Bassin	10	6	71	61	Good
Terre Rouge	10	12	70	65	Good
Triolet	17	10	60	57	Good
Grand Baie	40	12	56	52	Good
Pointe aux Cannoniers	45	12	50	45	Freezing

Viewers with a UHF analogue reception system categorised to be relatively poor were identified. Some areas are known to suffer from a combination of antenna reception system impairments at the viewer's end and the topography of the coverage area targeted. Many households have improved reception after practical advice was given to them on the use of the right type of antenna and coaxial cable as well as proper antenna system installation,. A very good receiving antenna system is essential for good DTT reception.

The minimum field strength values for reception of television specified in ITU recommendation ITU-R BT.1368-1 will be taken into account in the detailed design of islandwide coverage.

Protection ratios to allow for interference free reception will be in accordance with recommendations ITU-R BT.655 and ITU-R BT.1368.

7. Results

7.1 Technical results

The tests were an excellent occasion to check the theoretical aspect of digital transmission propagation which, accordingly, has also helped to highlight ground realities such as viewer's reception antenna system, user acceptance, attitude and perception.

Areas where the field strengths and BER measurements were not good are already areas of poor analogue reception. The use of narrow-band boosters to improve both analogue and digital reception have given the desired results. However there are still some field research work underway to demonstrate that DVB-T can be a very good terrestrial transmission medium to broadcast video, voice and data.
The overall tests have shown the following:

- The experiment, using DVB-T (the European standard for DTT), gave the expected results. The same standard has been implemented with success in other countries like U.K, Finland, Singapore, Australia, India, China, South Africa, Brazil, Mexico etc.
- The multichannel and multilingual capabilities are proven with the digital bouquet on one hand and the choice of languages on the other hand.
- The spectacular spectrum efficiency of the broadcast spectrum, a scarce resource, is a reality because adjacent channels, known as "taboo" channels in analogue broadcasting, have been tested with positive results. Examples are Channel 28 at Malherbes adjacent to Channel 27 (MBC 3) and Channel 30 at Signal Mountain adjacent to Channel 29 (MBC3). These channels are ***preferred channels*** for DTTB.
- The coexistence of analogue and digital services using the MCML transmission infrastructure has shown no negative impact on each other.
- The marked reduction in power for the digital transmitter (–10dB w.r.t analogue power) and yet a better coverage than analogue reception using MCML common UHF transmission antenna system.

- The off-air feed to relay stations for retransmission can replace microwave link feeds because of the crystal clear picture and sound of DTT. This is translated into an important reduction in the cost of implementation of DTTB when compared to analogue. Mont Simonet Relay Station is an excellent UHF relay station to distribute off-air DTTB signals to other stations.
- The use of current VHF/UHF receiving TV antenna for combined reception of analogue and digital is not a problem.
- There is no ghost and/or RF noise at reception.
- Picture and sound reception is crystal clear as in DTTB the received signal can only be either 1 or 0. Remote regions like Pointe D'Esny, Mahebourg, and Flic en Flac can therefore have good reception.
- The coverage from Malherbes, Mont Simonet and Signal Mountain stations as shown in the coverage map on page 17 nears 70% of the island with only a 200 W transmitter at Malherbes station and 25 W transposers at Mont Simonet and Signal Mountain relay stations.

7.2 Reactions from viewers

Public demonstrations were performed at chosen strategic commercial places in Goodlands, Curepipe, Port-Louis and Phoenix. The public was invited through press articles to visit these beta-testing places to get acquainted with the new TV broadcast technology. MCML technical staff had the opportunity to show and explain the advantages and benefits associated with the installation of a set top box using the normal antenna and TV set to receive the digital terrestrial broadcast.

The positive reaction of viewers from different socio-economic agglomerations was very encouraging. The general public has shown a keen interest to adopt this mode of reception. They were also particularly impressed by the CD quality sound, multichannel and multilingual capabilities and the interactivity aspect. All around the island, viewers expressed readiness to invest in a set-top box of reasonable price to enjoy quality reception, multi-channels and Internet facilities thus bridging the 'digital divide' with the niche group having digital TV via satellite.

7.3 InfoTech 2003 and feedback from visitors

The Info Tech Exhibition held last November 2003 at the Freeport was an excellent opportunity to present the digital terrestrial broadcast to the industry people and the public interested in IT. Apart from digital television images, access to remote data such as simulated Government on line information, access to the internet, video on demand and digital audio channels were also demonstrated live to the visitors. Many of the visitors were willing to purchase the PCI cards. The feedback we received from the visitors is given at **Annex VII** and is an encouraging invitation for the implementation of digital terrestrial broadcast in Mauritius.

8. Strategic Issues

(1) *DVB-T, the European standard*, is the most flexible and popular standard and has been adopted by all European countries, Australia, Malaysia, Singapore, India, South-Africa and even China among others. This means that set top boxes would be available at an affordable price; **prices actually range from 50 to 125 US$.** The PCI cards for PCs are available at 125 US$. It is recommended that we adopt an open-market policy as is the case for Berlin in Germany which has already switched off analogue terrestrial television, hence giving the chance to every stakeholder to play its role in this digital venture.

(2) *A common carrier approach* for simultaneous analogue and digital terrestrial transmission using the MCML infrastructure, as is the case now, during the transition period to complete switch-over to digital, will reduce costs in terms of economies of scale and risks. A common encryption is possible for different operators to control their subscribers by applying for example the zoning scenario software of Via Access.

(3) *Sharing of frequencies* with Reunion in the UHF bands, particularly Band IV, in agreement with ANFR (France), is important to allow equal and most efficient access as well as to achieve satisfactory digital coverage while ensuring protection ratios to existing analogue services and future digital services. TDF engineers from France and MCML technical team can collaborate and play an important role to achieve this. Such was the case in

1989 for the frequency planning of analogue TV channels in the UHF bands between TDF and MBC.

(4) *Spectrum management efficiency* – availability of channels adjacent to analogue for TV multi-channels thus enabling private television to operate within weeks of the liberalisation of airwaves.

(5) *Digital multiplexes are available* for programme and data providers to insert their content. Policies and regulations adopted by Government, IBA and other bodies concerned have to therefore cater for this new audio-visual agenda.

(6) *Broadcast and Broadband networks* are slowly but surely merging to a converged network with interactive multimedia content delivery via DTT. A multimedia platform strategy would be developed with a full range of value-added services, sharing existing infrastructure and technology on the DTT network to provide cost-effective multimedia services.

(7) *Multimedia Home Platform* (DVB-MHP), based on Java technology, is an open - standard middleware adopted by many countries – *this is the key to convergence for enhanced and virtual services* (EPG, T-Government, T-Education, T -Commerce, T-Business, T- Advert etc). Finland already has an MHP interactive service operational since two years.

(8) *Time and cost implication* to cover the whole island with DTTB services.

(9) *Cost effective way to* distribute Internet-based services and Walled Gardens for School Projects and Corporate Users and households using the PCI cards.

(10) *Local content creation* would be encouraged because the platform for proximity and interactivity would be a reality. Introduction of new and appropriate courses on visual design and animation and multimedia services have to be designed to produce qualified and skilled software professionals in collaboration with countries which already have experience in the field.

(11) *Emphasis on software applications* to attract our young talents in this digital world.

(12) *Same TV transmission and reception antennas* for analogue and digital terrestrial broadcasting.

(13) *Right technology* to support portable television reception and IP over DVB – It, inter alia, avoids ghosting and noise which are a nuisance for analogue television. Mobile television, mobile IP and DVB-H can also be envisaged. MCML will eventually use SFN on one multiplex to test mobile reception in cars and buses. Mobile IP over DVB can use diversity reception in vehicles. The opportunities are immense provided we understand the long term ROI and social benefits Mauritius can derive.

(14) *Strategic move towards ICT* – interactive multimedia and the convergence transform. Policy formulation would have to take into consideration such move by MCML in the short and medium term.

(15) *T-services,* increased opportunities to disseminate information and to bridge the digital gap between information-rich and information-poor.

8. Conclusion

The Experimenter's License test has been a repeated success following the first pilot test of 2002 – thus making Mauritius another country in the wagon of DTT. DTT is a smart, reliable and cost-effective technology to provide multi-channel TV and value-added services within a given channel bandwidth in the UHF bands.

The sharing of UHF channels with Reunion Island for the digital multiplexes right now is most important. Our country will therefore have to secure the digital channels within the UHF bands first and foremost to activate DTTB. The digital frequency plan, in agreement with ANFR (France), must be forward looking.

DTTB is a cheap and simple means to exchange information and data, hence multimedia broadcasting. A case in point is the use of digital terrestrial television in order to adopt new management techniques, such as Customer Relations Management (CRM) to gain competitive advantage. British Airways and Jaguar car

manufacturer were the first two companies in the UK to benefit from the interactive applications of DTTB. Virtual services will be at the tip of our fingers in two or three year's time using a remote keyboard and our TV set.

The opportunities will lead to new consumer behaviour. The audience will be even more fragmented than it is today and viewers will take on a more active role creating their own niche schedules, not just television but a package of multimedia services using a multimedia terminal combining television, internet and mobile telephone technologies.

Digital Terrestrial Television is expected to grow exponentially. Managing the migration is a great challenge. It will provide a plethora of opportunities for savvy broadcasters. Interactive digital TV (iDTV) is forecast to become Europe's main e-commerce platform and will provide services to Corporate end-users.

Mr Anwar Choudhury, Director of the Office of e-Envoy in UK and also the Adviser to UK Prime Minister Tony Blair, on a brief visit to Mauritius, announced that Digital TV is a very important feature to support the introduction of electronic business in Mauritius and confirmed that DTTB will provide reliable Internet access. This will enhance the opportunities to make of Mauritius a cyber island. DVB-MHP will bring along such facilities. MCML will perform DVB-MHP tests using the existing digital platform to provide interactive T - services. The captions at **Annex VIII** show an extract of a presentation by MCML at InfoTech 2003 and what MCML can deliver to make of Mauritius a cyber island.

GLOSSARY

- ANFR - Agence National de Fréquence (France)
- BER - Bit Error Rate
- CD - Compact Disc
- COFDM - Coded Orthogonal Frequency Division Multiplex
- DTT - Digital Terrestrial Television
- DTTB - Digital Terrestrial Television Broadcasting
- DVB-MHP - Digital Video Broadcasting – Multimedia Home Platform
- DVB-T - Digital Video Broadcasting – Terrestrial
- EBU - European Broadcast Union
- IBA - Independent Broadcasting Authority
- iDTV - Interactive Digital Television
- ICT - Information and Communication Technology
- ICTA - Information and Communication Technology Authority
- ISDB-T - Integrated System Digital Broadcasting- Terrestrial
- ITU - International Telecommunications Union
- MBC - Mauritius Broadcasting Corporation
- MCML - Multi Carrier (Mauritius) Limited
- MFN - Multi Frequency Network
- MPEG - Motion Picture Expert Group
- MTA - Mauritius Telecommunications Authority
- QAM - Quadrature Amplitude Modulation
- SFN - Single Frequency Network
- STB - Set top box
- TDF - Télédiffusion de France
- VHF(H) - Very High Frequency(High- Band III)
- 8-VSB - 8- Vestigial Side Band
- UHF - Ultra High Frequency (Band IV and V)