R&D *TECHNICAL REPORT*

No.RD/2016/929

AIR & DDI

Reception survey for assessment of coverage area for satisfactory reception of DVB-T2 Transmitter

Located at Indore

Madhya Pradesh

PRASAR BHARATI

RESEARCH DEPARTMENT

ALL INDIA RADIO & DOORDARSHAN

Reception survey for assessment of coverage area for satisfactory reception of DVB-T2 Transmitter

Located at Indore

Madhya Pradesh

(Survey Period 02.01.17to 12.01.17)

Field Strength Measurement/Reception Survey Team

PROPAGATION LAB

Team Leader	**:**	**Sh. Bani Singh (AE)**
Team Members	**:**	**Smt. Rashmideep (SEA)**
		Sh. Hari Ram (Tech)
Assisted by	**:**	**Sh. G.P.Srivastava (AE)**
Coordinated by	**:**	**Sh.V.K.Verma (DDE)**
Guided by	**:**	**Sh. S.Hyder (DDG)**
Inspired by	**:**	**Mrs. Anuradha Agarwal (ADG)**

Introduction:

Modern broadcasting scenario is changing so rapidly that viewer of today wants something more in addition to what is being received through analogue mode of TV transmission. Innovative efforts in the field of broadcast technologies and new habits of audio-visual content have driven the need to define new broadcasting standards that allow for such a social evolution. Earlier digital transmission began with DVB (H) & DVB (T) transmission that made possible for reception of broadcast signal through hand held (Mobile Phone) or fixed/mobile TV receiving devices. Further due to its limitation (spectral efficiency, bandwidth & robustness), in 2009, DVB finalized the development of the second generation terrestrial transmission system DVB-T2 which is the new DVB standard for DTT. It allows the simultaneous transmission of multiple services, each one with a different configuration, and thus, with different robustness and quality. This permits new type of reception scenarios for these digital terrestrial signals, like mobile and handheld pedestrian reception scenarios. So DVB-T2 can be used for providing both fixed and mobile services within the same channel with number of configurations supported. Although, this new standard has been fundamentally designed for fixed reception (receiver devices with rooftop and set-top antennas) but now the DVB-T2 reception is also feasible in portable and mobile devices (Smart Mobile Phones, PCs, laptops or in-car receivers).In the process of modernization Doordarshan India has established DVB T2 Transmitters in its network with future plan to replace analogue transmitters with such DVB-T2 Transmitters. One of such transmitter is being established at HPT (TV) Tower Indore (Madhya Pradesh) & commissioned for DD National Transmission on UHF Band Ch#26 (514MHz) .In this context Research Department is involved in carrying out propagation studies on DVB-T2 transmission to assist fixing of planning parameters/transmission configuration under existing terrain condition. The scope of work for the survey team of Research Department is to carry out field trial for prediction of coverage area for satisfactory reception. For this work a three members survey team carried out field strength survey during the period 02/01/2017 to 11/01/2017 along eight radials around the location of DVB-T2 Transmitter. The survey was carried out for fixed antenna reception mode mounted at a height of 10 Meters.

Objective:

1. Ascertaining the coverage area for satisfactory reception of DVB-T2 Transmission.
2. To envisage minimum field strength value for satisfactory reception.

Equipment Used:

1. Spectrum Analyzer(Make: Anritsu, Model: MS 2035B & MS 2013E)
2. UHF Log Periodic Antenna(HE223-R&S Make)
3. GPS Navigator(Make: Garmin, Model: Montana 650)
4. DVB-T2 Set Top Box
5. LED TV Receiver(Make: Sony,)
6. IRD(Make: Ericsson)
7. Survey Van fitted with 10 Meters Mast & Portable Generator etc)

Basic Data and Transmitter details

Transmitters Details:

1.	Name of Station	:	HPT(TV) Tower, Indore Madhya Pradesh
2.	Location of the Transmitters	:	LAT- N 22° 42' 02.4" LONG- E 75° 52' 48.8" MSL-550 Meter
3.	Description of terrain around the Transmitters	:	Urban, dense population, heavy traffic
4.	Classification(Large city/urban/rural)	:	Urban
5.	Rated power of the Transmitter	:	6.0kW
6.	Forward radiated Power	:	6.0kW
7.	Reflected Power	:	10.0W
8.	VSWR	:	1.05
9.	Transmission Mode	:	T2MI
10.	Make	:	Harris
11.	Model No.	:	MAXIVA
12.	Frequency of operation	:	514MHz(Ch#26)
13.	Date of Commissioning	:	01/01/ 2016

:

Transmitting Antenna Details:

1.	Make	:	Jampro
2.	Type /Model of Antenna	:	(Stacked Dipole)Wide band,24 panels(6 panels/side)
3.	Antenna Gain	:	13dB
4.	Height of Tower	:	150 Meter
5.	Type of Polarization	:	Horizontal

DVB-T2 Broadcast System:

DVB-T2 is the world's most advanced digital terrestrial transmission (DTT) system, offering more robustness, flexibility and at least 50% more efficiency than any other DTT system. It supports SD, HD, mobile TV, or any combination thereof. Like its predecessor, DVB-T2 uses OFDM (orthogonal frequency division multiplex) modulation with a large number of sub-carriers delivering a robust signal, and offers a range of different modes, making it a very flexible standard. DVB-T2 uses the same error correction coding as used in DVB-S2 and DVB-C2: **LDPC (Low Density Parity Check)** coding combined with **BCH (Bose-Chaudhuri-Hocquengham)** coding, offering a very robust signal. The number of carriers, guard interval sizes and pilot signals can be adjusted, so that the overheads can be optimized for any target transmission channel. The key new technologies in DVB-T2 are:

- Ø Multiple Physical Layer Pipes allow separate adjustment of the robustness of each delivered service within a channel to meet the required reception conditions (for example in-door or roof-top antenna).It also allows receivers to save power by decoding only a single service rather than the whole multiplex of services.

- Ø Alamouti coding is a transmitter diversity method that improves coverage in small-scale single-frequency networks.

- Ø Constellation Rotation provides additional robustness for low order constellations.

- Ø Extended interleaving, including bit, cell, time and frequency interleaving.

- Ø Future Extension Frames (FEF) allows the standard to be compatibly enhanced in the future.

As a result, DVB-T2 can offer a much higher data rate than DVB-T or a much more robust signal. For comparison, the two bottom rows show the maximum data rate at a fixed C/N ratio and the required C/N ratio at a fixed (useful) data rate.

Transmission Parameter	**DVB-T**	**DVB-T2(New improved option in Red)**
FEC	Convolutional Coding + Reed Solomon(1/2,2/3,3/4,5/6,7/8)	LDPC + BCH(1/2,3/5,2/3,3/4,4/5,5/6)
Modes	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM, 256QAM
Guard Interval	1/2, 1/8, 1/16, 1/32	1/4,19/128,1/8,19/256,1/16,1/32,1/128
FFT Size	2k, 8k	1k, 2k, 4k,8k,16k,32k
Scattered Pilot	8% of Total	1%,2%,4%,8% of total
Continual Pilot	2.6% of total	0.35% of total
Bandwidth	6,7,8 MHZ	1.7,5,6,7,8,10MHz
Typical data rate(UK)	29 Mbit/second	40 Mbit/second
Max data rate @20dB	29 Mbit/Second	47.8 Mbit/second
Required C/N Ratio @	16.7 dB	8.9dB

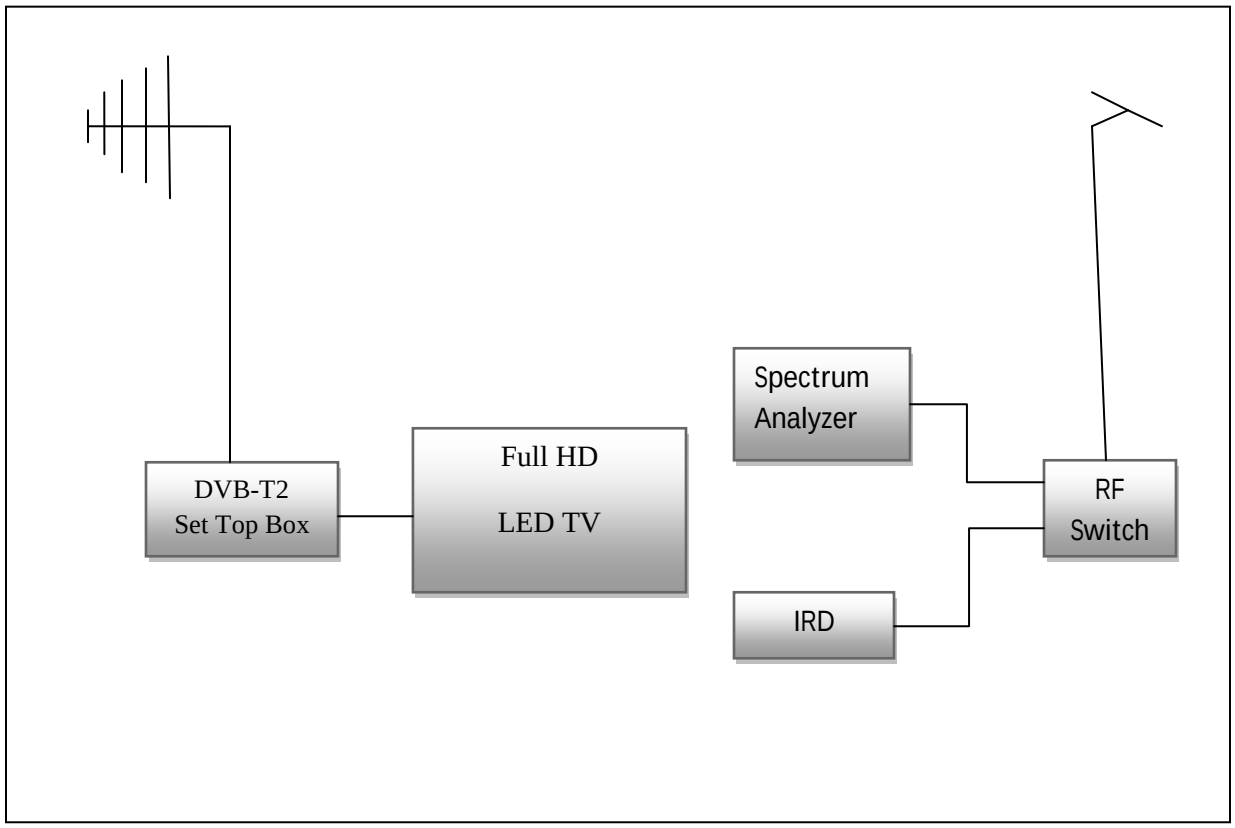
Modulation Parameters:

DVB-T2 standard offers a bigger choice of the OFDM parameters and modulation schemes depending upon application & reception mode. Combining various modulation schemes with FFT sizes and guard intervals allows construction of MFN and SFN networks designed for different applications: from low bit-rate but robust mobile reception to the high bit-rate fixed reception for domestic and professional use. Currently DVB-T2 transmitter, Indore operating with following set of Modulation parameters targeted for fixed antenna & handheld portable (smart phone) reception mode.

Operating Frequency	514 MHz
Channel No.	#26(UHF, Band-IV)
Bandwidth	8 MHz
Number of Programme Content	TV : Five Services Radio: Nil
PLP Bit Rate:	6.17 M Bit/s
FFT	1K
Guard Interval	1/8
PLP Constellation	QPSK
PLP Rotation	Rotated
PLP Code Rate	1/2
Pilot Pattern	PP3
SISO/MISO	SISO
FEC Frame Length	Normal

System configuration:

The field trials system mainly consists of field strength measuring equipment, standard calibrated UHF Dipole antenna & Yagi receiving antenna for receiving horizontally polarized TV Broadcast signal, Portable Generator, 10 Meters electromechanically operated telescopic mast housed in a customized Survey Van of Research Department. A pictorial diagram is given below.



Measurement Set Up:

The field trials were carried out by utilizing mobile survey van of Research Department having 10 meter pneumatic telescopic mast. Field strength measurement was carried out, using Anritsu make Spectrum Analyzer & UHF Dipole Antenna. The whole system was assembled in a mobile van with power generating system (portable generator set). The two main components of the reception set up are DVB-T2 receiving system and field strength measuring system (Spectrum Analyzer). A calibrated UHF dipole antenna is used to receive the signal whereas for subjective assessment of the received signal was performed by using DVB-T2 set top box & a Sony make LED TV. To record Pre LDPC/BCH & MER data an Ericsson make professional IRD was used. In addition to this Garmin make GPS navigator was used for determination of the spot/location co-ordinate in six figures & radial distance from the transmitter location.

Selection of sites for measurement:

As far as practicable an open & safe spot/ location (overhead power and telephone cables, trees and other hazards were avoided) was chosen for the measurement of received field strength. Instead of cluster measurement (measurement at four to five spots for a given location), single sample method in this survey is preferred, because of the additional time that may be taken in making cluster measurements (due to the frequent raising or lowering of the receiving antenna & insufficient space along the motorable road side), or because of the hazards in moving the measuring vehicle while the antenna is fully erected. High tension overhead wires, close to high raise buildings & elevated flyovers/underpasses were avoided while collecting field strength data along a radial route.

Measurement Methodology:

A map of the largest available scale was used to mark the location of the transmitters. From the transmitter location eight radials were drawn passing through the transmitter location along North, North-East, East, South East, South, South West ,West, North-West directions. For prediction of the coverage area, field strength measurement along a radial was carried out by employing mobile survey van having 10Mtrs telescopic mast with rotor & tilt facility. For field strength measurement the survey vehicle was mostly parked in open space, raising the telescopic mast up to the required height of 10 meters & then rotating the antenna to align it along the direction of transmission source for getting optimum value of field strength & MER values. While taking static reception measurement LAT/LONG, MSL & radial distance of each & every location was also recorded. Once all measurements were undertaken, mast was fully retracted & then driven away for the next location. Since the purpose of the survey was to determine the primary coverage area for 'Satisfactory Reception' so the measurement was carried out in static condition along motorable roads. The same procedures for field strength measurement/reception survey were adopted along all other eight radials. After data collection was over, the FSM data are tabulated & interpreted on the basis of the findings.The quality of received audio/video was also analyzed by using DVB-T2 Set Top Box & SONY make receiver, under given terrain conditions. The environment classification crieteria is:

Rural	Areas with scarce isolated buildings, open fields.
Suburban	Small towns; residential areas with low rise building density and buildings not higher than two stories; wide roads or streets between buildings.
Urban	Big to medium sized cities, residential areas with high density of buildings; areas where buildings are higher than two stories and close distances between them.
Large Cities	Densely populated cities having cluster of township with high rise building & skyscrapers.

TV Broadcast Signal Propagation:

TV broadcast signal propagates from the transmitter by space wave propagation mechanisms i.e. Line of sight Propagation & travel straight way in propagating medium & undergoes all optical phenomena like Reflection, Refraction, Scattering, Diffraction etc while travelling through the medium. DVB T2 reception is largely affected by multipath, which changes along time due to the receiver travelling around the buildings. It is also important to point out other factors typical of urban reception environment such as traffic, speed change due to traffic lights and pedestrian crossings, etc. The field strength level, at a given point, not only depends on its distance from the transmitter, the frequency of transmission and the antenna heights but also on the long-term and short-term interferences caused by reflections of the natural environment (terrain configuration, vegetation) and the man-made environment. Thus the received signal must be considered as the vector sum of the wanted signal and many reflected signals. Due to the effect of reflected signals, the Field Strength/MER along a route shows severe fluctuation. Since, the measurements are made on public roads the reflected signals coming from other vehicles cannot be foreseen. The field strength test results therefore very rarely match the results of measurements obtained at the same place, at a different time.

Collection of field strength data:

The field strength data were collected along eight radials routes drawn (Annexure-I) around the transmitting antenna. At each & every spot/location along the radial the telescopic mast was expanded upto10 Meters from the ground level keeping the dipole antenna horizontally as the polarization of the radiated beam is horizontally polarized. The antenna position is being continuously rotated for optimized value of field strength in the direction of line of sight with respect to the transmitting antenna. The optimum field strength values are thus recorded. In addition to this the terrain detail of each & every spot/location was also recorded along with the subjective assessment of the received audio/video quality on the basis of watching on DVB-T2 TV receiving system These collected data's are being tabulated in proper sequence to make it convenient for discussion & correlation with other parameters. The subjective assessment of received audio/video quality on TV receiver is graded as OK, F-Freeze & NT- Not Traceable. The field strength measurement values along with subjective assessment at each & every spot/location are recorded in a tabular form giving at an instance the trend for variation in received field strength/MER & signal reception quality with distance. In this report the received field strength & subjective assessment data collected along eight radials are tabulated accordingly in Table No.-1 to Table No.-8.In addition to this the radial distances, MER/BER & field strength value corresponding to satisfactory reception along all eight radials are compiled in tabular form (as in Table No: 9) to make it convenient to determine the primary coverage area of the said transmission. On the basis of Table -9, a coverage contour for DVB-T2 transmission has been drawn & annexed as in Annexure-II. Annexure III to Annexure VI represents variation of Field strength & MER along different radials. The code used for grading of the received signal is illustrated as follows.

Criteria for grading of received signal on the basis of subjective assessment:

Signal	OK	No impairment in received audio/video quality.
	F	Received frame freeze permanently.
	NT	Not Traceable or No Signal.

Broadcast Service Area:

The objective of broadcasting is to provide quality reception free from interferences & noise in a commercial domestic receiver, either fixed or mobile, to as much of population and area of the country as possible, In case of analogue transmission coverage area of broadcasting is decided by the minimum required received 'field strength' at the farthest end of the coverage area for satisfactory reception with commercially available domestic receivers but in digital terrestrial transmission one more transmission parameter(MER) is required along with the minimum field strength value for prediction of the coverage area. Studies have been carried out worldwide to determine the minimum required field strength & MER value for satisfactory reception of DTT signal. Rec. ITU-R BT.2254 gives minimum equivalent field strength at receiving location for satisfactory reception of DVB-T2 transmission is, as illustrated in following table.

Mode of reception	**Minimum Field Strength** Location probability 99%
Fixed Scenario	54 dBµV/m
Portable/Outdoor/Urban	60.1dBµV/m
Handheld Mobile class H-D at 1.5 m.	73.5 dBµV/m

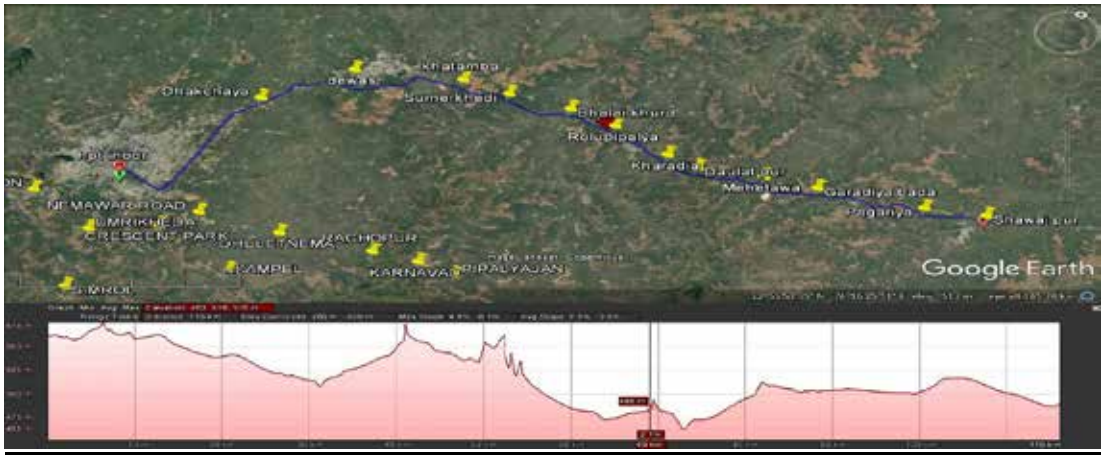
Interpretation of the collected data along radials:

In this report efforts are being made for the interpretation & analysis of the collected FSM data along a radial & then a coverage contour based on compiled Table-9 for satisfactory reception of DVB-T2 transmission was drawn on a map.

1. **Radial-1(North)**:

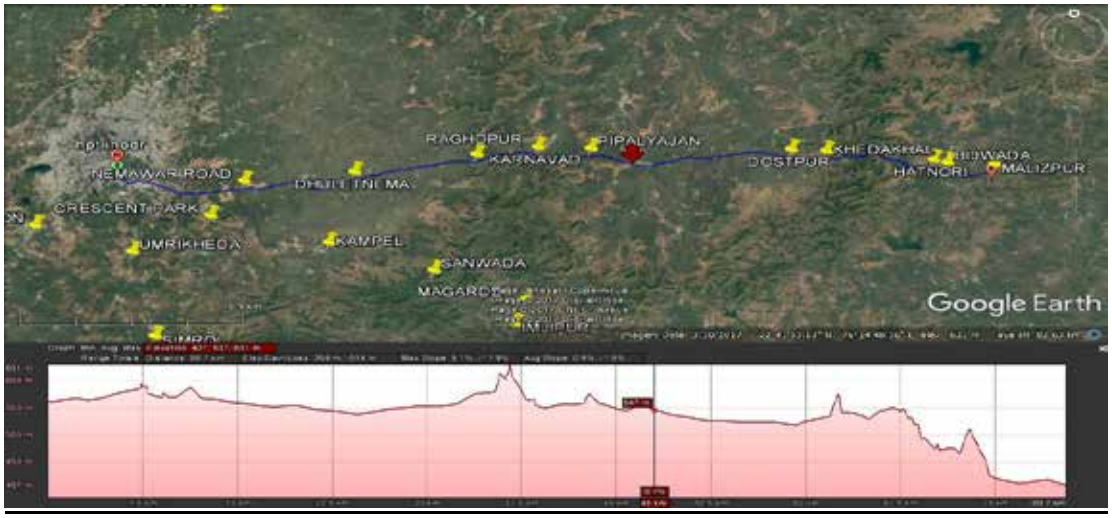
Along this radial field strength measurement done at location like Dharampuri-Sanwer-Nayakhedi-Pawapuri colony-**Sorasa**-Najarpur-Ghatiya-Palwa-Jhangra-Ghodubag & PartParsi, upto a radial distance of 95km .Satisfactory reception of DVB-T2 transmission was observed upto a radial distance of **60km (Sorasa)**.

2. **Radial-2 (North-East)**:



Along this radial field strength measurement done at location like Dhakhachya-Khatamba-Sumrakhedi-**Bhalaikhurd**-Rolupiplalya-Karadiyagada-Daulatpur-Mehatwara-Guradiyabada-Pudra-Bahadarpura & Shahwajpura, upto a radial distance of 95 km .Satisfactory reception of DVB-T2 transmission was observed upto a radial distance of **50km (Bhalaikhurd)** .

3. **Radial-3(East)**:

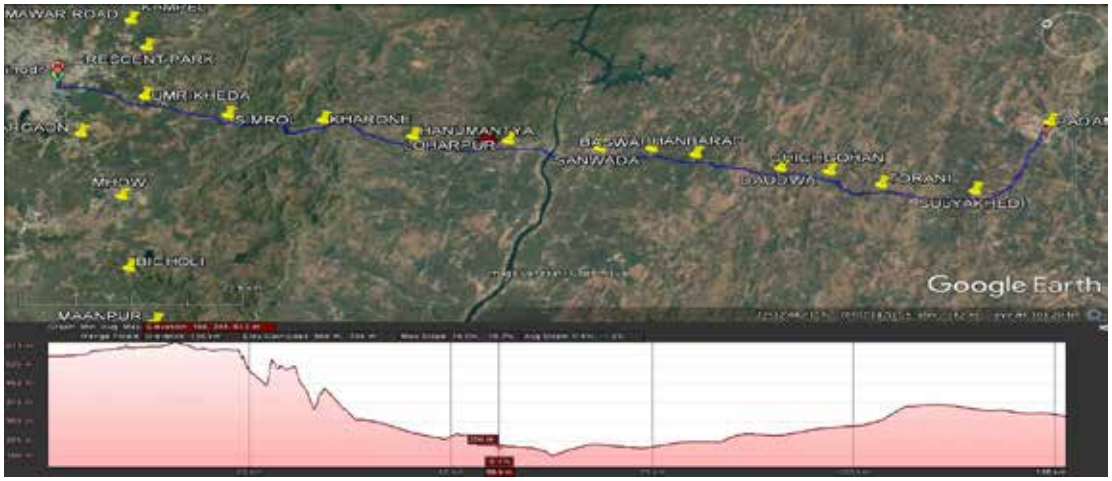


Along this radial field strength measurement done at location like Dhuletnema-Raghogarh-Karnawad-Bhamori-chapda-Pipalyajan-Deharitadama-**Dostpur**-Khedakhal-Hatnora-Bijwad & Maljipura ,upto a radial distance of 75 km .Satisfactory reception of DVB-T2 transmission was observed upto a radial distance of **57.5km (Dostpur)**.

4. Radial-4(South- East):

Along this radial field strength measurement done at location like Kampel-Sanawada-Magaradeh-Imlipura-**Kishangarh**-Polakhal-Neemanpura & Ratanpur , up to a radial distance of 61 km .Satisfactory reception of DVB-T2 transmission was observed upto a radial distance of **45km (Kishangarh) .**

5. **Radial-5(South)**:



Along this radial field strength measurement done at location like Simrol-Khargone-Hanumantya-**Loharpura**-Sanawad-Baswa-Bhanbarad-Delgaon-Daudwa-Torani-Sulyakhedi-Kondawad & Padawa upto a radial distance of 110 km . Satisfactory reception of DVB-T2 transmission was observed upto a radial distance of **50km (Loharpura)** .

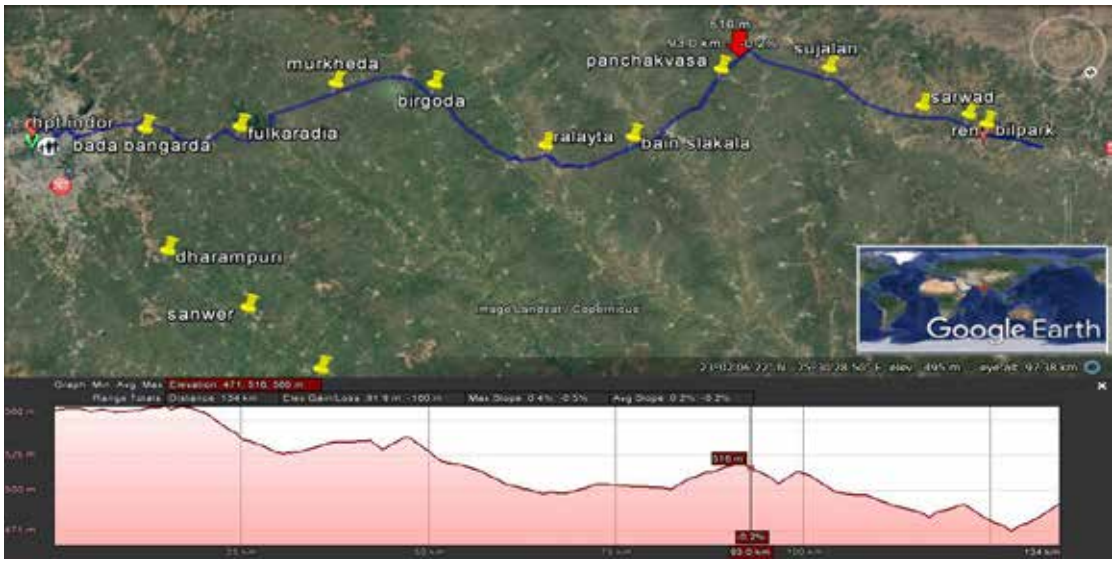
6. **Radial-6(South-West)**:

Along this radial field strength measurement done at location likeMhow-**BicholiGhati**-Manpur-Bakaner-Sirsodiya-Dhanmod-Aurangapura-Thikri-Segwal-Temla & Ghulania, up to a radial distance of 100 km .Satisfactory reception of DVB-T2 transmission was observed up to a radial distance of **80km (Bicholi Ghati).**

7. **Radial-7(West)**:

Along this radial field strength measurement done at location like Machal-Mathala-Bilodh-Utawad-Navgaon-Raipuriya-**Hatod**-Bodla-fulgaondi-Piparni& Amodiya, up to a radial distance of 98 km .Satisfactory reception of DVB-T2 transmission was observed upto a radial distance of **80km (Hatod)**.

8. **Radial-8(North-West)**:



Along this radial field strength measurement done at location like Fulkaradiya-Murkheda-Birgoda-Ralayata-Bainslakala-Panchakwasa-**Sujlana**-Sarwad-Ren & Bilpank ,up to a radial distance of 96.5km.Satisfactory reception of DVB-T2 transmission was observed up to a radial distance of **80km (Sujlana).**

Conclusion:

On the basis of received field strength & MER values at the spot/location along eight radials & coverage contour(Annexure-II) drawn on the basis of table prepared/compiled for satisfactory reception of DVB-T2 transmission following conclusions can be stipulated.

1. The coverage along North direction it is up to a radial distance of 60 km. In North-East & East directions coverage is up to 50 km & 57.5 km respectively. In South-East it is up to 45 km, in South it is up to 50km.In South-West direction the coverage area is up to 80Km, West & North-West direction it is up to a radial distance of 80 km.

2. The coverage along South & South-East as well as North-East was the least compared to the other directions. The terrain profile map (Map-1) of Indore clearly shows the hills of height varying between 400 to 700 meters. In all these routes, the decrease in height w.r.t msl is steep, which is the cause of low field strength.

3. From the field strength & MER data collected along all eight radials, it is being observed that the reception is quite satisfactory for minimum field strength value of 53.2 dBµV/m & MER over 20.0dB under existing terrain condition. No interference of unwanted signal in reception of DTT transmission has been observed within its coverage area.

On the basis of received signal field strength on different radials, conclusion is as follows:

Sr.No.	Direction from the Transmitter	Distance(LOS)as per I.T.U recommendations
1.	North	60 Km.
2.	North -East	50 Km.
3.	East	57 Km.
4.	South -East	45 Km.
5.	South	50 Km.
6.	South-West	80 Km.
7.	West	80 Km.
8.	North-West	80 Km.

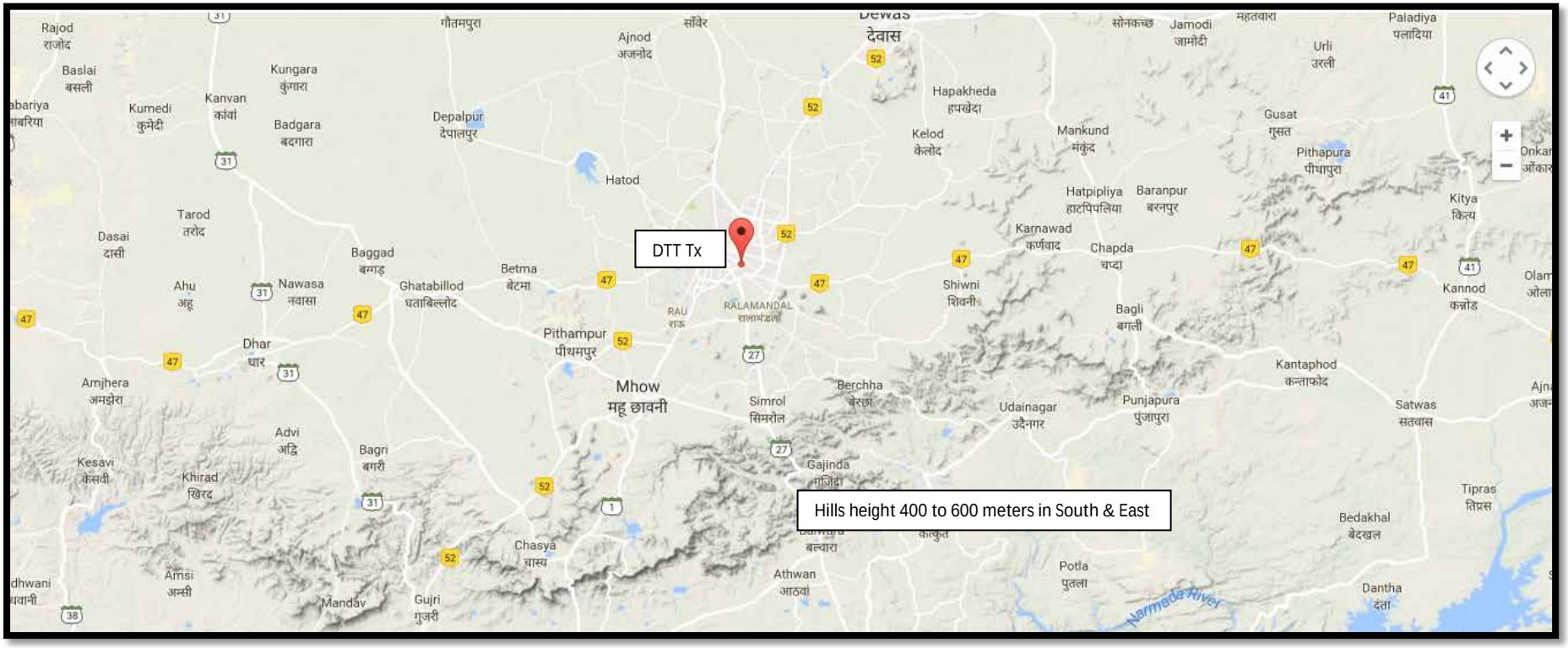
Scope of further study:

The purpose of this field trial is to determine the coverage contours for satisfactory reception of DVB-T2 Transmission under existing environmental conditions. A comprehensive field strength survey of the said transmitter for reception in portable devices like smart mobile phone in densely populated areas, narrow lanes etc. to assess poor pocket zone & inside different types of building falling within the coverage contour & also reception on go inside moving vehicles is suggested for further propagation study under different environment conditions.

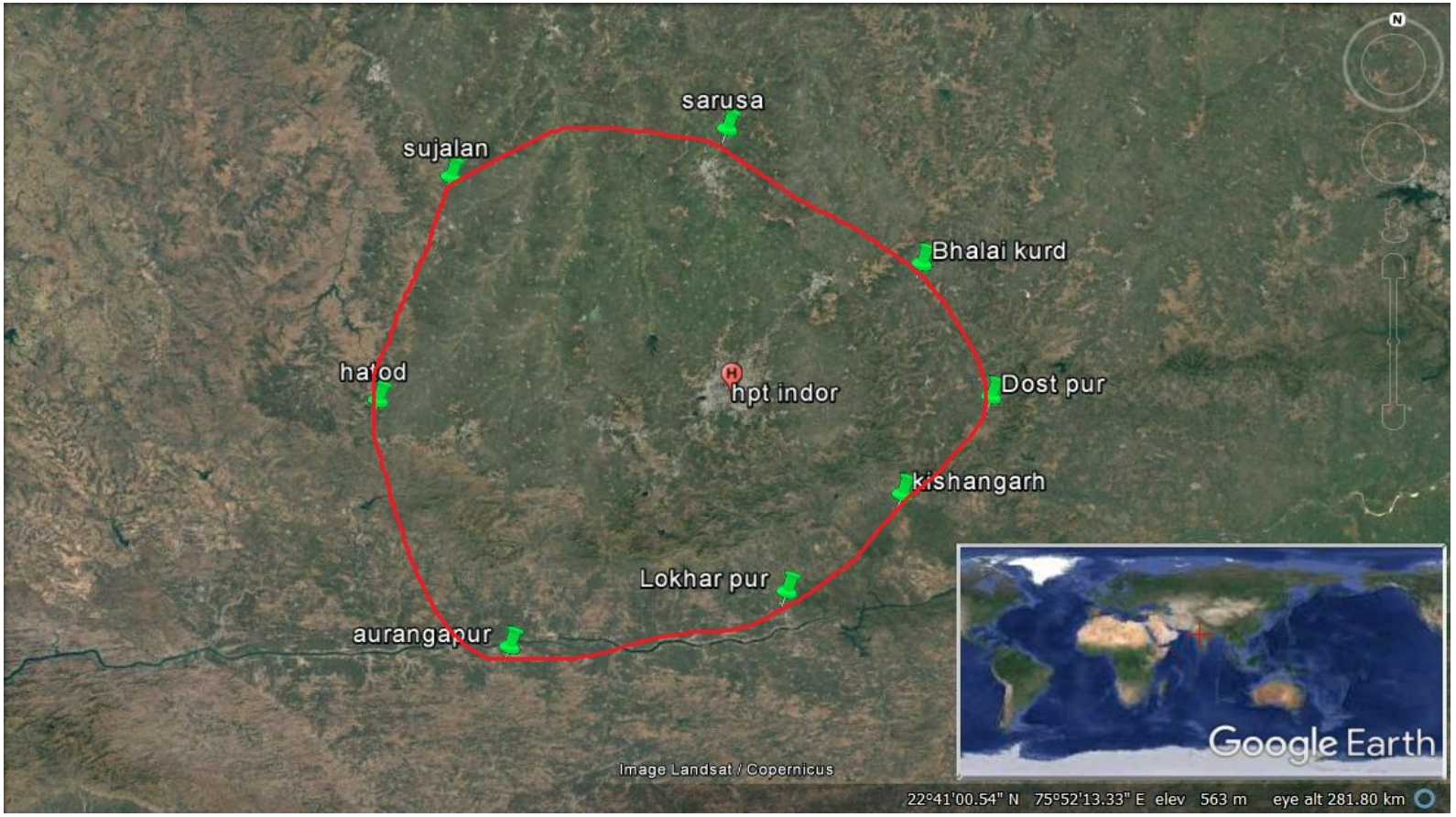
Acknowledgement:

The propagation studies presented in this document are carried out by the Propagation Lab of Research Department of All India Radio & Doordarshan, New Delhi. The field trial was successfully done with the sincere support & cooperation of the shift duty staff of HPT (TV) Transmitter, Indore Survey team also extends their gratitude to Sh.Virender Pandit (ADE) & Sh.S.K.Agarwal who has provided necessary equipment & actively cooperated to the survey team of Research department. The survey team expresses deepest sense of gratitude to Mrs. Anuradha Agarwal, ADG (E) & Sh. S.Hyder, DDG (E) whose motivation, suggestion & cooperation at every step helped in the successful completion of the survey.

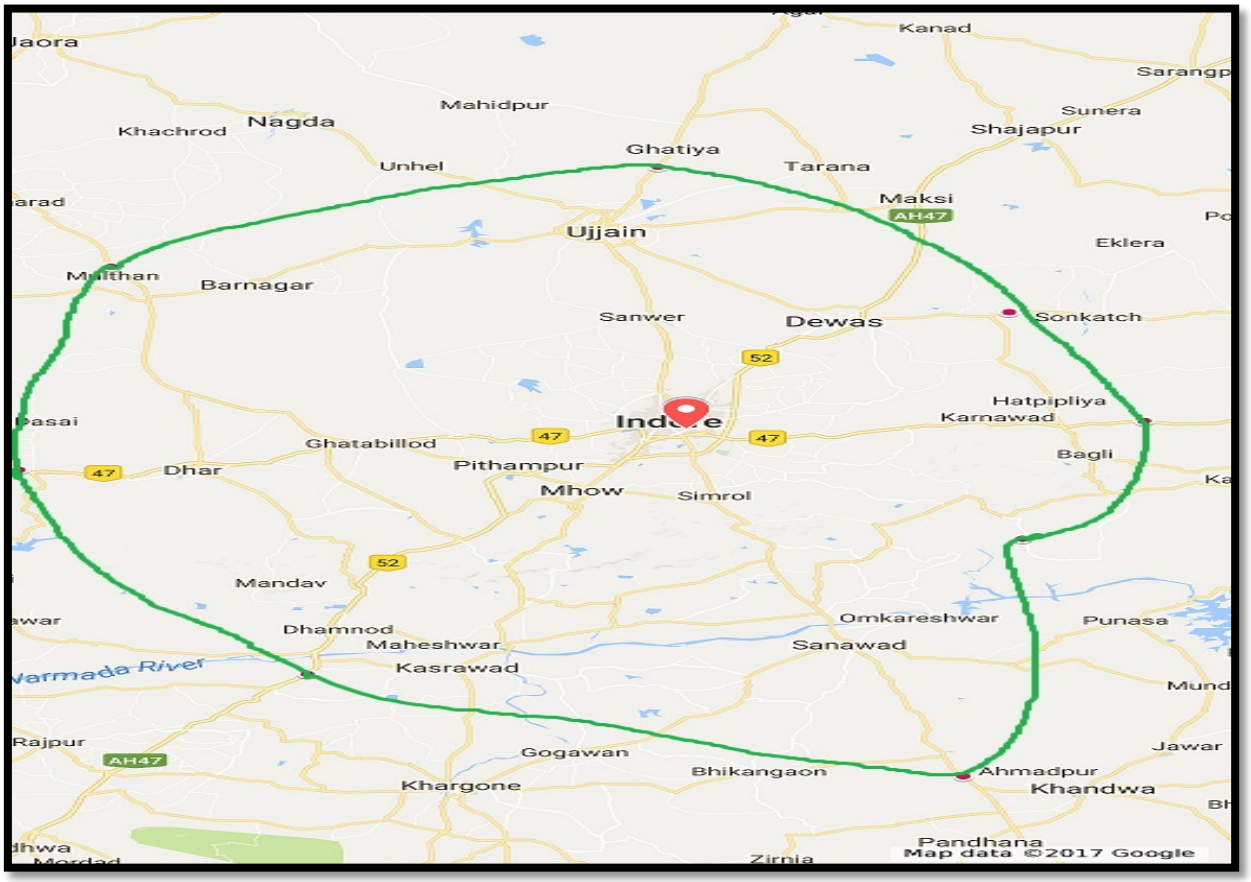
Terrain around the DTT of Indore Map-1



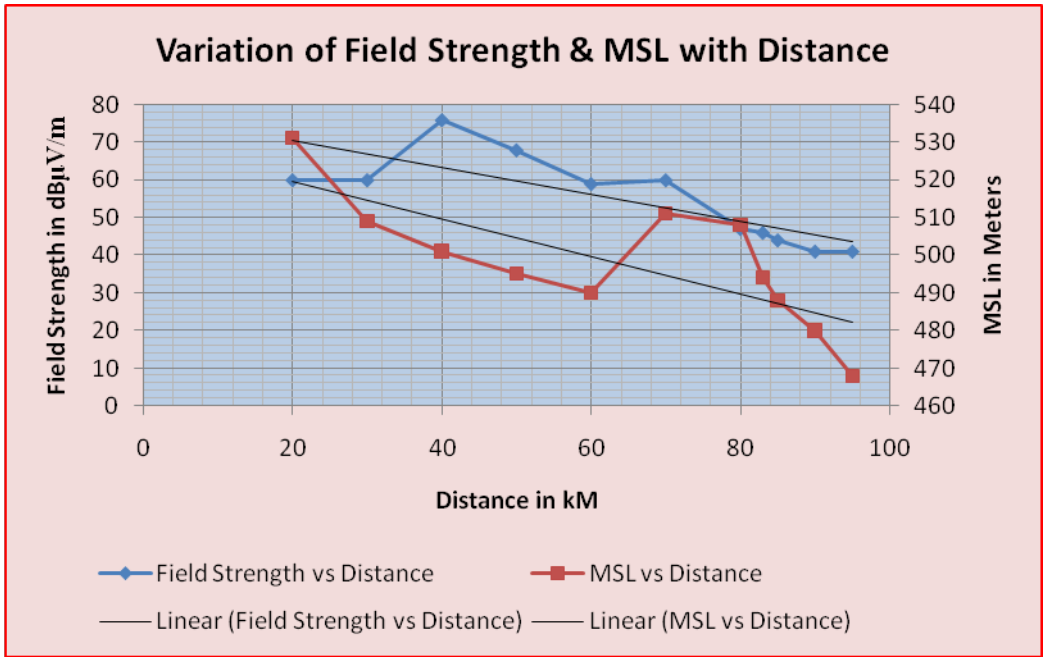
DTT COVERAGE MAP OF INDOR MAP-II

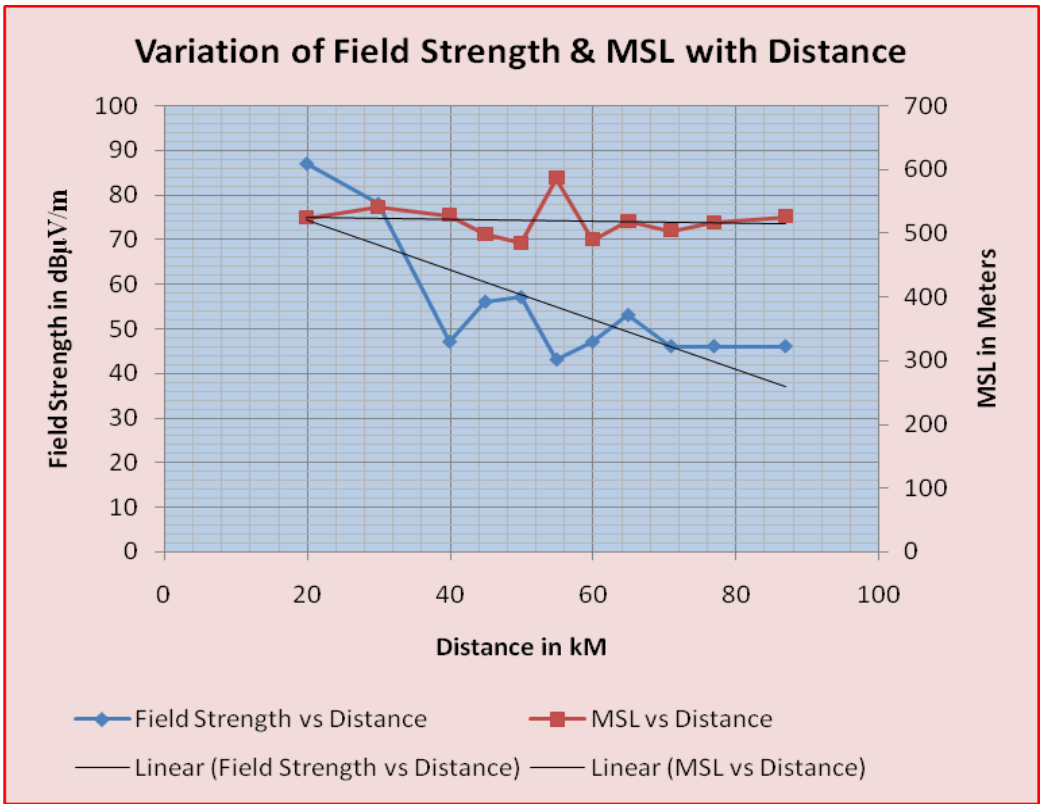


DTT COVERAGE MAP OF INDOR MAP-III

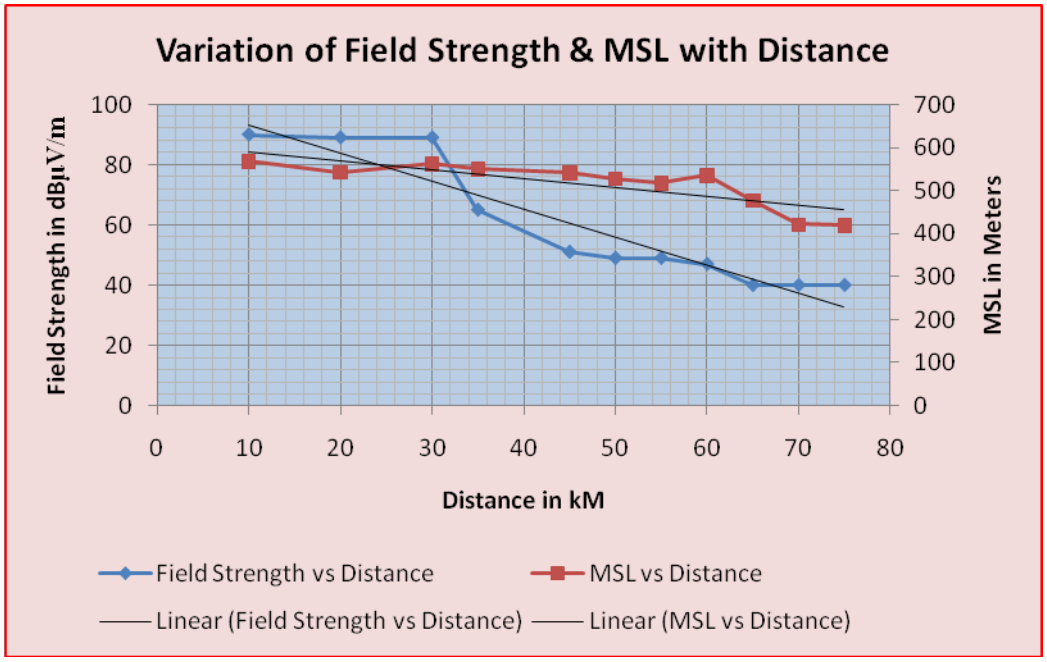


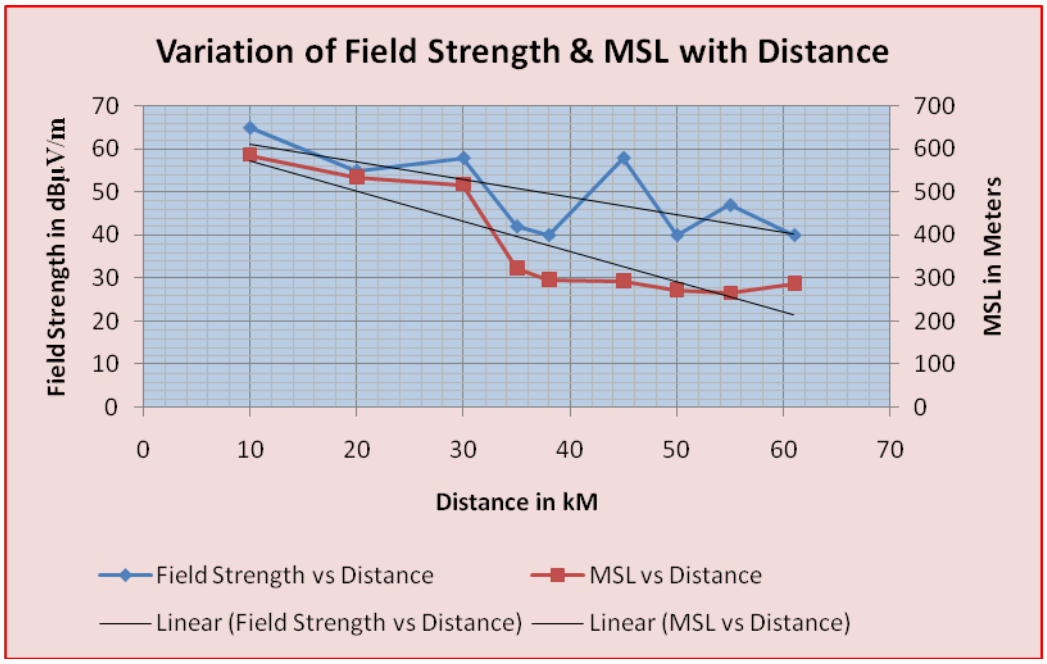
Annexure III (North & North East)



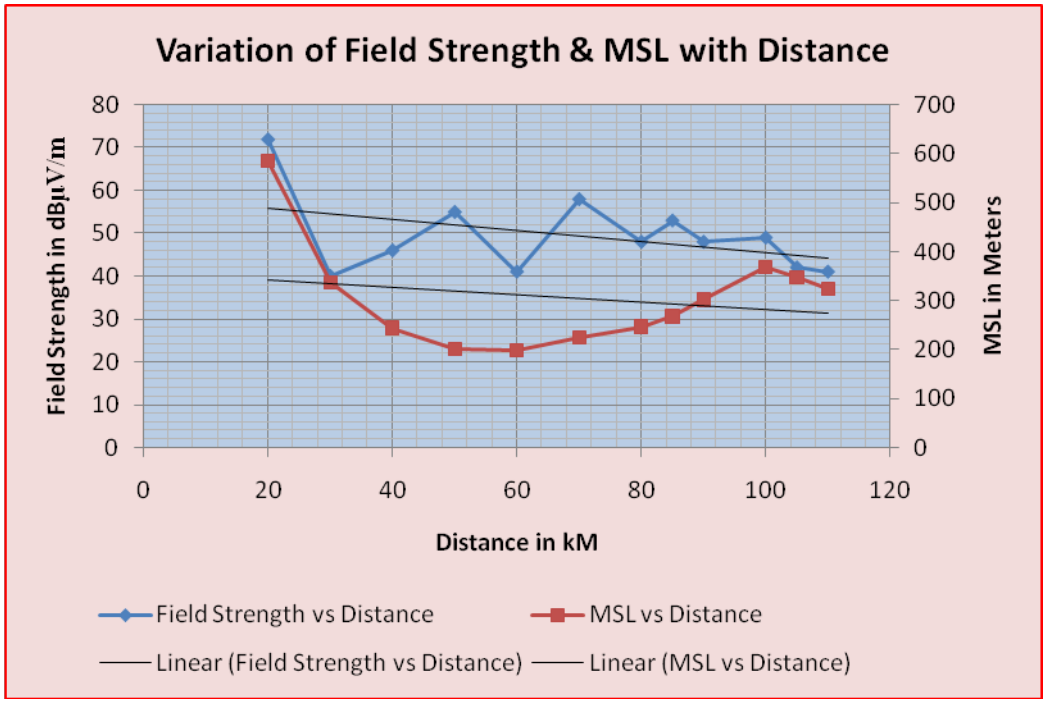


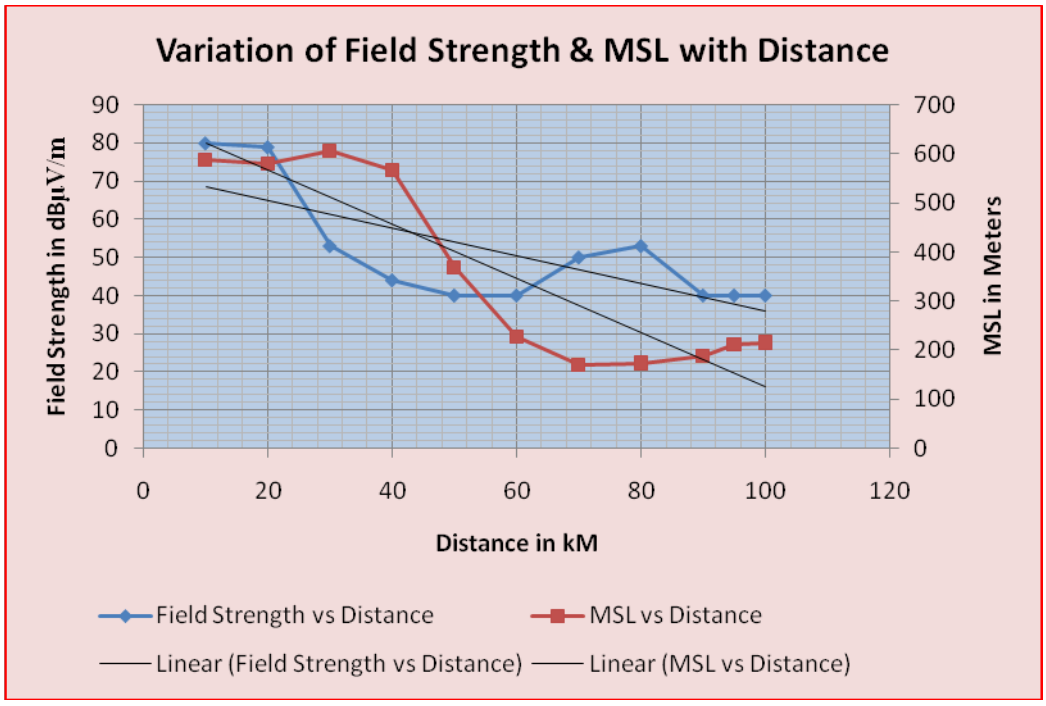
Annexure IV (East & South East)



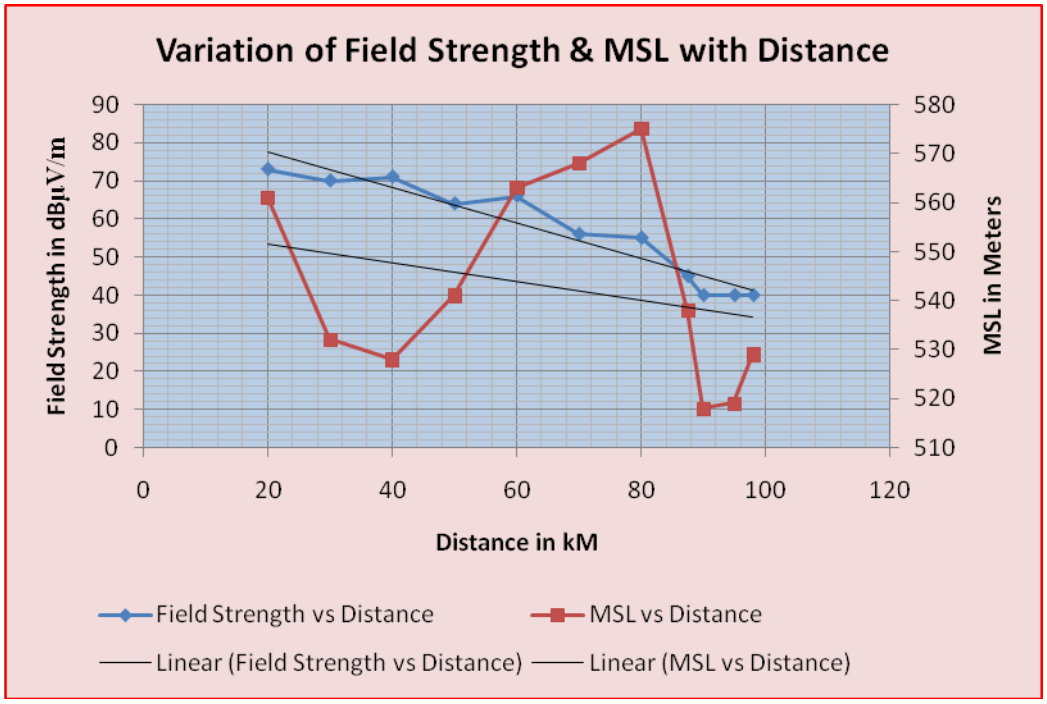


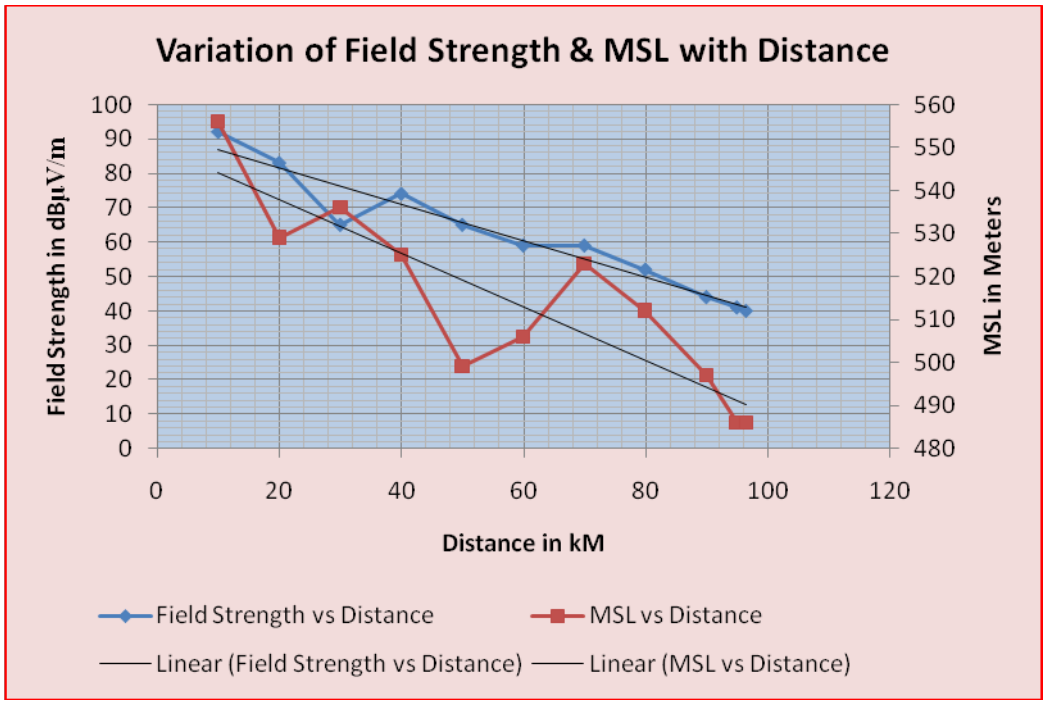
Annexure V (South & South West)





Annexure VI (West & North West)





Reception survey for satisfactory coverage of DVB-T2 Transmitter (514MHz), Indore

Direction North (Radial-1)

Table-1
Date:03/01/17

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBµV/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
1130	Dharampuri ,Jetpura	N 22° 52' 48.3" E 75° 51' 27.3"	*531*	*20*	60	27	2.1 E-4	1.0 E-8	OK	Open, heavy traffic,highway	
1200	Sanwer near Saaver,Ujjain Indore rd.	N 22° 58' 08.5" E 75° 50' 14.8"	*509*	30	60	27	2.0 E-6	1.0 E-8	OK	Open,light traffic Vegetation,highway	
1220	Nayakhedi	N 23° 03' 34.0" E 75° 49' 26.1"	*501*	*40*	76	27	1.0 E-6	1.0 E-8	OK	Open, Heavy traffic,highway Vegetation	
1240	Pawapuri colony	N 23° 08' 31.4" E 75° 47' 22.5"	*495*	*50*	68	27	1.0 E-2	1.5 E-8	OK	Open,light traffic,highway Vegetation	
1320	Sarosa ,Ujjain road	N 23° 14' 15.1" E 75° 50' 28.9"	*490*	*60*	59	23	2.9 E-4	1.0 E-8	OK	LRB,lightTraffic. Vegetation	
1355	Najarpur	N 23° 20' 02.2" E 75°50’ 36.3”	*511*	*70*	60	23	4.3 E-1	1.0 E-8	OK	H/Way, Open,,heavy traffic,vegetation	
1420	Palwa,Ujjain road (high way)	N 23° 25' 17.5" E 75° 52’ 29.8”	*508*	*80*	47	_	_	_	F	H/Way, Open,heavy traffic,vegetation	
1440	Jhangra, Ujjain road (high way)	N 23° 28' 06.4" E 75° 53’ 07.8"	*488*	*85*	44	_	_	_	NT	H/Way, Open,heavy traffic, vegetation	
1500	Ghodubag, Agar road highway	N 23° 30' 51.2" E 75° 53’ 46.2"	*480*	*90*	41	_	_	_	NT	H/Way, Open,,light traffic,vegetation	
1545	Padsi,	N 23° 33' 34.1" E 75° 54’ 18.0"	*468*	*95*	41	_	_	_	NT	H/Way, Open,,light traffic,vegetation	

Legends: 1**. H/Way**-Highway 2**. LRB**- Low rise buildings 3**. Open**- Open area 4**. F**- Freezing 5**. NT**- No picture/ Not traceable

Reception survey for satisfactory coverage of DVB-T2 Transmitter (514MHz), Indore

Direction North East (Radial-2)

Table-2
Date:04/01/17

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBµV/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
0900	Dhakachya,Dewas bypass rd.	N 22° 51' 52.4" E 75° 57' 36.8"	*524*	*20*	87	18	2.3 E-4	1.0 E-8	OK	Open,light traffic,highway	
9300	Dewas, bypass rd.	N 22° 55' 39.9" E 76° 02' 39.4"	*541*	30	78	27	1.0 E-6	1.0 E-8	OK	Open,heavy traffic highway	
1030	Khatamba,SH-18	N 22° 58' 19.2" E 76° 08' 23.9"	*528*	*40*	47	12	3.6 E36	1.0 E-8	F	Open, heavy traffic,highway	Surrounded with hills
1100	Sumerakhedi,SH- 18	N 22° 58' 34.9" E 76° 12' 22.5"	*499*	*45*	56	30	2.3 E-4	1.5 E-8	OK	Open,heavy traffic,highway	Surrounded with hills
1120	Bhalai Khurd, SH-18	N 22° 59' 10.7" E 76° 15' 28.9"	*485*	*50*	57	20	2.7 E-4	1.0 E-8	OK	Open,heavyTraffic. Vegetation,highway	Surrounded with hills
1140	Rolupipalya	N 22° 59' 01.3" E 76° 19' 06.3"	*586*	*55*	43	_	_	_	NT	H/Way, Open,,heavy traffic,vegetation	Surrounded with hills
1200	Karadiyagada	N 22° 58' 13.7" E 76° 23' 09.4"	*490*	*60*	47	10	2.3E-4	1.0E-8	NT/F	H/Way, urban,heavy traffic,vegetation	Surrounded with hills
1210	Daulatpur	N 22° 58' 23.0" E 76° 26' 47.5"	*519*	*65*	53	26	1.5E-4	1.0E-8	OK	H/Way, Open,heavy traffic, vegetation	
1230	Mehatwara,SH-18	N 22° 59' 04.1" E 76° 29' 55.6"	*504*	*71*	46	12	2.0E-3	1.0E-8	NT	H/Way, Open,,heavy traffic,	
1300	Guradiya bada,Sehore rd.SH-18	N 22° 59' 48.3" E 76° 33' 15.3"	*517*	*77*	46	11	1.8E-3	1.0E-8	NT	H/Way, Open,,light traffic,	
1325	Pagariyachor,Ashta rd.	N 23° 01' 16.8" E 76° 39' 13.8"	*526*	*87*	46	12	1.4E-3	1.0E-8	NT	Open,rocky,highway ,dry	Down the hills
1345	Shahwaj pura	N 23° 02' 18.1" E 76° 43' 42.3"	*496*	*95*	41	_	_	_	NT	Down the hills	

Legends: 1**. H/Way**-Highway 2**. LRB**- Low rise buildings 3**. Open**- Open area 4**. F**- Freezing 5**. NT**- No picture/ Not traceable

Reception survey for satisfactory coverage of DVB-T2 Transmitter (514MHz), Indore

Direction East (Radial-3)

Table-3
Date:05/01/17

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBµV/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
0850	Nemawar road	N 22° 40' 45.8" E 75° 58' 25.6"	*568*	*10*	90	29	1.0 E-6	1.0 E-8	OK	Open heavy,rural traffic,highway	
0915	Dhuletnema rd.	N 22° 41' 24.5" E 76° 04' 25.5"	*542*	20	89	29	1.0 E-6	1.0 E-8	OK	Open,heavy traffic highway,rural	
1000	Raghogarh,,zila Dewas	N 22° 42' 35.7" E 76° 10' 18.9"	*561*	*30*	89	28	1.2 E36	1.0 E-8	OK	Open, light traffic,highway Vegetation	
1020	Karnavad,,zila Dewas	N 22° 43' 08.5" E 76° 13' 12.0"	*550*	*35*	65	27	1.9 E-3	1.5 E-8	OK	Open,heavy traffic,highway Vegetation	
1110	Pipalyajan	N 22° 42' 51.3" E 76° 21' 59.6"	*527*	*50*	49	20	1.5E-3	1.0E-8	OK	H/Way, urban,heavy traffic,vegetation	
1130	Dostpur	N 22° 42' 58.6" E 76° 26' 13.8"	*531*	*57.5*	55	23	1.6E-4	1.0E-8	OK	H/Way, Open,heavy traffic	
1140	Khedakhal	N 22° 42' 48.9" E 76° 27' 45.7"	*535*	*60*	47	17	2.7E-4	1.0E-8	F	H/Way, Open,,light traffic	
1155	Hatnora	N 22° 43' 14.1" E 76° 30' 43.2"	*477*	*65*	40	_	_	_	NT	H/W, forest area,heavy veg.surrounded by	
1220	Bijwad,	N 22° 42' 17.7" E 76° 33' 44.3"	*421*	*70*	40	_	_	_	NT	H/W, forest area,heavy veg.surrounded by	
1230	Maljipura	N 22° 42' 04.2" E 76° 36' 32.1"	*419*	*75*	40	_	_	_	NT	H/W, forest area,heavy veg.surrounded by hills,,light traffic	

Legends: 1**. H/Way**-Highway 2**. LRB**- Low rise buildings 3**. Open**- Open area 4**. F**- Freezing 5**. NT**- No picture/ Not traceable

Reception survey for satisfactory coverage of DVB-T2 Transmitter (514MHz), Indore

Direction South East (Radial-4)

Table-4
Date:06/01/17

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBµV/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
0845	Near Crescent park	N 22° 38' 38.0" E 75° 57' 22.9"	*585*	*10*	65	29	1.5 E-4	1.0 E-8	OK	Light traffic,vegetation ,highway,surrounded by mountains	
0915	Kampel	N 22° 37' 06.3" E 76° 03' 18.8"	*534*	20	55	23	1.9 E-4	1.0 E-8	OK	Open,light traffic highway,veg.	
1000	Sanawada	N 22° 35' 21.0" E 76° 08' 33.2"	*518*	*30*	58	28	1.4E-4	1.0 E-8	OK	Narrow path between hills, light traffic ,highway (Ghaat)	
1010	Magaradeh	N 22° 34' 40.9" E 76° 11' 32.7"	*324*	*35*	42	_	_	_	NT	Narrow path between hills, light traffic ,highway (Ghaat)	
1030	Imlipura	N 22° 32' 24.2" E 76° 12' 11.2"	*298*	*38*	40	_	_	_	NT	No Traffic,rural,market ,LRB	
1115	Kishangarh	N 22° 29' 44.0" E 76° 15' 37.2"	*295*	*45*	58	25	4.9E-4	1.0E-8	OK	no traffic,veg.,open	
1230	Polakhal	N 22° 26' 20.2" E 76° 16' 37.2"	*273*	*50*	40	14	1.0E-3	1.0E-8	F	Forest area,open,no traffic	
1250	Neemanpura	N 22° 23' 11.6" E 76° 17' 36.9"	*267*	*55*	47	17	1.8E-4	1.0E-8	F	Forest area,open,no traffic	
1310	Ratanpur	N 22° 23' 04.1" E 76° 21' 48.9"	*288*	*61*	40	12	4.3E-4	1.0E-8	NT	Rural,mud huts,congested,no traffic	

Legends: 1**. H/Way**-Highway 2**. LRB**- Low rise buildings 3**. Open**- Open area 4**. F**- Freezing 5**. NT**- No picture/ Not traceable

Reception survey for satisfactory coverage of DVB-T2 Transmitter (514MHz), Indore

Direction South (Radial-5)

Table-5
Date:07/01/17

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBµV/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
0920	Umrikheda,Khandwa rd.	N 22° 36' 32.3" E 75° 53' 25.8"	*607*	*10*	77	29	1.0 E-3	1.0 E-8	OK	Heavy traffic,vegetation ,highway	
0940	Simrol,Khandwa rd.	N 22° 31' 02.5" E 75° 54' 59.0"	*585*	20	72	28	1.0 E-3	1.0 E-8	OK	Open,heavy traffic highway	
1010	Khargone,,Khandwa rd.	N 22° 26' 20.1" E 75° 57' 24.5"	*337*	*30*	40	_	_	_	_	Open, heavy traffic,highway (Ghaat)	
1035	Hanumantya,,Khandwa rd.	N 22° 21' 06.9" E 75° 58' 59.7"	*245*	*40*	46	18	1.6 E-4	1.0 E-8	OK	Open,heavy traffic,highway,rural	Direction reqd.
1105	Loharpura, Khandwa rd.	N 22° 16' 11.6" E 76° 01' 39.1"	*202*	*50*	55	23	1.2 E-4	1.0 E-8	OK	Open,heavyTraffic. ,highway,rural	
1150	Sanawad,Khandwa rd.	N 22° 11' 02.1" E 76° 04' 06.3"	*200*	*60*	41	10	2.6E-3	1.5E-7	_	H/Way,rural ,heavy traffic,veg.	
1210	Baswa,near Khedi,Khandwa rd.	N 22° 08' 47.2" E 76° 05' 26.5"	*201*	*65*	45	10	3.1E-4	1.5E-8	F	H/Way,heavy traffic,open	
1230	Bhanbarad ,Khandwa rd.	N 22° 06' 00.8" E 76° 06' 37.3"	*225*	*70*	58	27	1.4E-4	1.0E-8	OK	H/Way, Open,heavy traffic	
1305	Daudwa,Highway Khandwa	N 22° 00' 58.4" E 76° 08' 32.1"	*248*	*80*	48	19	3.3E-4	1.0E-8	OK	One side forest,other side open,H/way,heavy traffic	
1320	Chichgohan,Khandwa highway	N 21° 58' 36.6" E 76° 09'32.7"	*269*	*85*	53	24	1.7E-4	1.0E-8	OK	Bothsideforest,H/way,heavy traffic	
1335	Toranil.H/way Khandwa	N 21° 55' 31.2" E 76° 10' 11.8"	*303*	*90*	48	19	1.1E-1	1.0E-8	OK	H/Way,rural ,heavy traffic	
1350	,Sulyakhedi,Khandwa rd.	N 21° 50' 50.0" E 76° 12' 25.2"	*369*	*100*	49	21	2.2E-4	1.0E-8	OK	H/Way,rural ,heavy traffic,veg.	
1410	Kondawad near Mukhul,Khandwa highway	N 21° 48' 35.4" E 76° 13' 49.1"	*348*	*105*	42	11	1.1E-8	1.0E-8	F	H/Way,rural ,heavy traffic	
1430	Padawa,Padam ngr.Khandwa	N 21° 49' 28.6" E 76° 20'40.2"	*324*	*110*	41	_	_	_	NT	LRB,market area,congested	

Legends: 1**. H/Way**-Highway 2**. LRB**- Low rise buildings 3**. Open**- Open area 4**. F**- Freezing 5**. NT**- No picture/ Not traceable

Reception survey for satisfactory coverage of DVB-T2 Transmitter (514MHz), Indore

Direction South West (Radial-6)

Table-6
Date:08/01/17

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBµV/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
0845	Dongargaon	N 22° 33' 03.3" E 75° 43' 34.1"	*588*	*10*	80	28	1.0 E-6	1.0 E-8	OK	Heavy traffic, ,highway,LRB,City	
0930	Mhow	N 22° 33' 14.5" E 75° 45' 29.3"	*579*	20	79	28	1.0 E-6	1.0 E-8	OK	veg. ,LRB,Chawni	
0950	Bicholi ghati	N 22° 29' 55.9" E 75° 40' 45.8"	*605*	*30*	53	19	1.4E-4	1.0 E-8	OK	Forest area ,highway (Ghaati),light traffic	
1015	Maanpur	N 22° 25' 48.7" E 75° 36' 59.7"	*566*	*40*	44	15	1.0E-4	1.0E-8	NT	light traffic ,highway ,open	
1045	Bakaner /Dhar	N 22° 22' 34.0" E 75° 31' 46.3"	*369*	*50*	40	_	_	_	NT	Ghaat	
1115	Sirsodiya	N 22° 17' 22.4" E 75° 29’ 43.5”	*228*	*60*	40	_	_	_	NT	Low hills ,highway ,heavy traffic	
1145	Dhanmod	N 22° 11' 57.2" E 75° 27’ 44.3"	*171*	*70*	50	19	1.8E-4	1.0E-8	OK	Low hills ,highway ,heavy traffic	
1210	Aurangapura NH-52	N 22° 06' 16.7" E 75° 26’ 07.6"	*174*	*80*	53	20	2.4E-4	1.0E-8	OK	Low hills ,highway ,heavy traffic	
1230	Segwal,NH-52	N 22° 02' 17.5" E 75° 22’ 13.4"	*189*	*90*	40	_	_	_	NT	Low hills ,highway ,heavy traffic	
1240	Temla,NH-52	N 22° 00' 19.3" E 75° 19’ 52.4"	*212*	*95*	40	11	2.2E-3	1.5E-8	NT	Low hills ,highway ,heavy traffic	
1255	Ghulamia,NH-52	N 21° 58' 29.0" E 75° 17’ 49.4"	*216*	*100*	40	_	_	-	NT	Open,veg.,highway,heavy traffic	

Legends: 1**. H/Way**-Highway 2**. LRB**- Low rise buildings 3**. Open**- Open area 4**. F**- Freezing 5**. NT**- No picture/ Not traceable

Reception survey for satisfactory coverage of DVB-T2 Transmitter (514MHz), Indore

Direction West (Radial-7)

Table-7
Date:09/01/17

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBµV/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
0945	Maachal,NH-47	N 22° 40' 29.1" E 75° 40' 41.7"	*561*	*20*	73	28	1.0 E-6	1.0 E-8	OK	Rural,Light traffic, ,highway,open	
1010	Pirpipliya,Maathla,NH -47	N 22° 40' 52.1" E 75° 34' 53.8"	*532*	30	70	28	1.0 E-6	1.0 E-8	OK	Open,light traffic,highway	
1035	Ghat Bilodh nearPaankhedi,Lebad NH-47	N 22° 40' 15.9" E 75° 29' 13.9"	*528*	*40*	71	28	1.4E-4	1.0 E-8	OK	Open,light traffic,highway	
1145	Utawad nearNiyamat khedi,NH-47	N 22° 37' 17.3" E 75° 23' 37.8"	*541*	*50*	64	27	1.0E-5	1.0E-8	OK	Open,light traffic,highway	
1205	Navgaon,NH-47	N 22° 37' 06.9" E 75° 17' 55.3"	*563*	*60*	66	28	1.0E-6	1.0E-8	OK	Open,light traffic,highway	
1220	Raipuria,NH-47	N 22° 35' 32.9" E 75° 12’ 15.8”	*568*	*70*	56	23	1.2E-4	1.0E-8	OK	Open,light traffic,highway	
1245	Hatod,NH-47	N 22° 35' 59.3" E 75° 06’ 17.0"	*575*	*80*	55	23	1.7E-4	1.0E-8	OK	Open,light traffic,highway	
1305	Bodla,NH-47	N 22° 38' 25.1" E 75° 01’ 37.1"	*538*	*87.5*	45	12	1.7E-4	1.0E-8	NT	Open,light traffic,highway	
1325	Dhar/Fulgaondi,NH-47	N 22° 39' 08.6" E 75° 00’ 08.2"	*518*	*90*	40	_	_	_	NT	Open,light traffic,highway	
1430	Fulgaondi near Piparni,NH47	N 22° 39' 47.1" E 74° 57’ 07.0"	*519*	*95*	40	_	_	_	NT	Open,light traffic,highway	
1455	Amodiya	N 22° 40' 58.1" E 74° 55’ 03.6"	*529*	*98*	40	_	_	_	NT	Open,light traffic,highway	

Legends: 1**. H/Way**-Highway 2**. LRB**- Low rise buildings 3**. Open**- Open area 4**. F**- Freezing 5**. NT**- No picture/ Not traceable

Reception survey for satisfactory coverage of DVB-T2 Transmitter (514MHz), Indore

Direction North West (Radial-8)

Table-8
Date:10/01/17

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBµV/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
0900	.,Bada bangarda	N 22° 45' 24.1" E 75° 47' 52.7"	*556*	*10*	92	29	1.7 E-6	1.0 E-8	OK	Major dist.rd.,heavy traffic,open	
0930	Fulkaradiya,major dist.t rd.	N 22° 48' 33.5" E 75° 43' 05.8"	*529*	20	83	29	1.0 E-6	1.0 E-8	OK	Major dist.rd.,heavy traffic,open	
1000	Murkheda,Hatod Depalpur rd.	N 22° 49' 28.7" E 75° 36' 55.1"	*536*	*30*	65	26	1.0 E-6	1.0 E-8	OK	Major dist.rd.,heavy traffic,open	
1030	Birgoda,Hatod Depalpur rd.	N 22° 52' 42.6" E 75° 32' 14.7"	*525*	*40*	74	27	1.4E-6	1.0E-8	OK	Major dist.rd.,heavy traffic,open	
1100	Ralayta	N 22°59' 45.3" E 75° 29' 49.7"	*499*	*50*	65	27	1.4E-2	1.0E-8	OK	Major dist.rd.,heavy traffic,open	
1205	Bainslakala,Burnagar rd.	N 23° 02' 20.4" E 75° 25’ 07.3”	*506*	*60*	59	26	2.7E-5	1.0E-8	OK	Major dist.rd.,heavy traffic,open	
1245	Panchakvasa,SH-18	N 23° 01' 39.4" E 75° 17’ 19.6"	*523*	*70*	59	26	2.7E-3	1.0E-8	OK	Major dist.rd.,heavy traffic,open	
1405	Sujlana near Multhan ,	N 23° 05' 15.6" E 75° 12’ 51.8"	*512*	*80*	52	22	1.5E-4	1.0E-8	OK	Major dist.rd.,heavy traffic,open	
1420	Sarwad	N 23° 10' 44.9" E 75° 09’ 51.7"	*497*	*90*	44	14	1.8E-2	1.0E-8	F	Major dist.rd.,heavy traffic,open	
1440	Ren	N 23° 12' 48.7" E 75° 08’ 00.6"	*486*	*95*	41	9	1.1E-2	1.0E-8	NT	Major dist.rd.,heavy traffic,open	
1450	Bilpark	N 23° 13' 31.4" E 75° 07’54.6"	*486*	*96.5*	40	_	_	_	NT	Major dist.rd.,heavy traffic,open	

Legends: 1**. H/Way**-Highway 2**. LRB**- Low rise buildings 3**. Open**- Open area 4**. F**- Freezing 5**. NT**- No picture/ Not traceable