

***Reception Survey for assessment of
coverage area for satisfactory
reception of DVB-T2 transmitter
located at Bhopal***

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

Located

At

Bhopal (MP)

(11-1-17 to 20-1-17)

Field Strength Measurement/Reception Survey Team

R&D Report No. 930

PROPAGATION LAB

Research Department

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Introduction

DVB-T2 is the second generation standard for digital terrestrial TV, offering significant benefits as compared to the older version of DVB-T.

The emergence of DVB-T2 is motivated by the higher spectral efficiency. It means that with the same amount of spectrum a larger number of programmes can be broadcast or the same number of programmes broadcast with a higher audio / video quality or coverage quality.

Like its predecessor, DVB-T2 uses OFDM (orthogonal frequency division multiplex) modulation with a large number of subcarriers, 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 optimised for any target transmission channel. Additional new technologies used in DVB-T2 are as follows:

- 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.
- Alamouti coding is a transmitter diversity method that improves coverage in small-scale single-frequency networks.
- Constellation Rotation provides additional robustness for low order constellations.
- Extended interleaving, including bit, cell, time and frequency interleaving.
- Future Extension Frames (FEF) allow 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.

Objectives of Survey

Main objectives of this survey are given below:

- Determination of service range of Bhopal DVB-T2 TV transmitter, operating on 490 MHz (Channel # 23) in fixed reception mode as per ITU defined field strength value..
- Identifying areas of poor reception of the transmission, in the coverage areas of Bhopal DVB-T2 transmitter.
- Determination of service area on Smartphone using DVB-T2 dongle.

Equipment Used

1. Field strength cum Spectrum Analyzer, Anritsu MS 2035B & MS 2013E.
2. UHF Log periodic antenna, Make-Rhode & Shwarz.
3. GPS Navigator, Garmin Montana 650.
4. DVB-T2 STB.
5. Sony LCD TV receiver.
6. IRD, Ericsson RX-8200
7. Tata Safari Survey van equipped with 10 meter pneumatic mast and 3 KVA Honda generators.
8. Other accessories as per requirements.

Planning Criteria

Antenna diagram for fixed reception

The antenna diagram characterizes the relative output level of an antenna when the signal is received under different angles. Recommendation ITU-R BT.419 defines the directivity of a standard antenna used for fixed broadcast reception as in Fig. 1. To reproduce the actual receiving conditions of a customer installation, measurements for fixed coverage have been made with a measurement antenna having the same directivity.

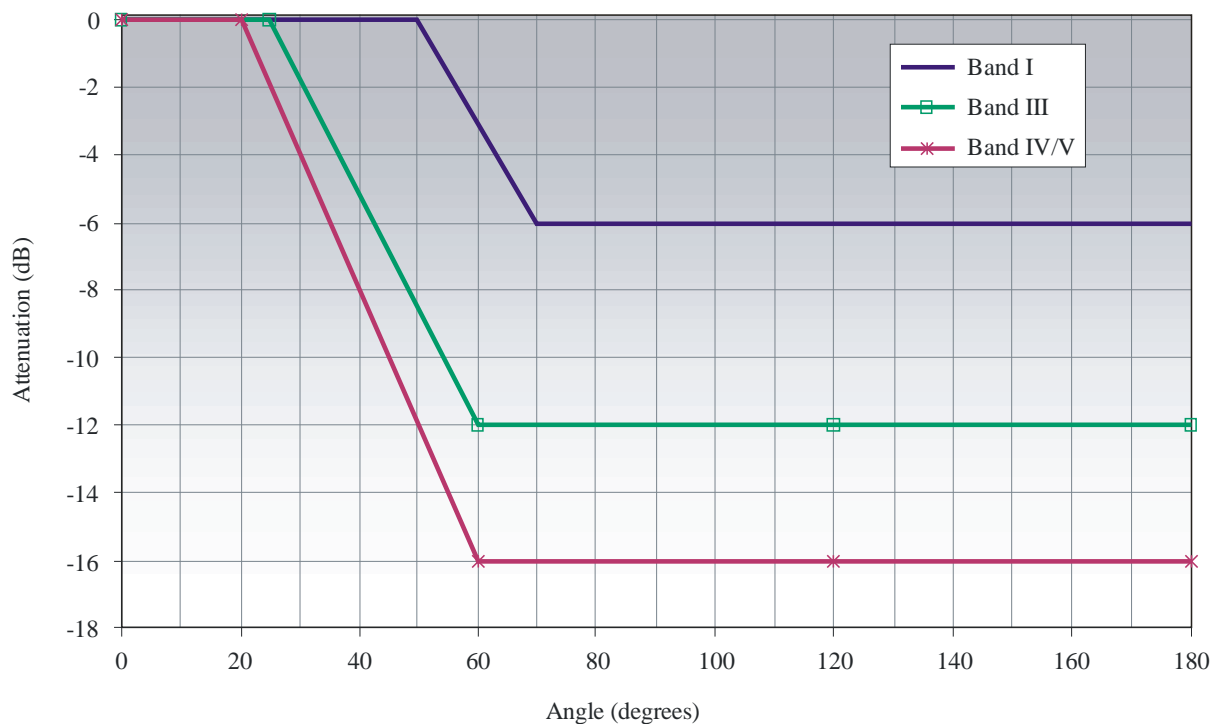


Figure-1

The term “covered”

A certain area is regarded as being “covered” by DVB-T2, when the median field strength for the particular receiving situation in a specified height above ground (often 10 m) and the protection ratio reach or exceed the values given in the relevant planning documents (e.g. ITU doc).

The fact of a certain area to be covered or not is a result of the calculation process done with a coverage survey that assumes defined conditions and/or values for:

- The receiving condition (e.g. fixed or portable reception);
- The field strength loss with distance due to topography and morphology;
- The receiver model (e.g. sensitivity and selectivity);
- The receiving antenna (height, gain and directivity);
- The reception channel (Gaussian, Rice or Rayleigh).

Attached to the attribute “covered” is also a certain probability in time and location. Using planning tools, the coverage area was calculated for this probability (e.g. 50% of the time and 50% of the locations).

It can therefore not be assumed that DVB-T2 reception with a standard receiver is possible at every single location inside the area defined as being covered.

Verification of coverage cannot be done with a standard DVB-T2 receiver by simply checking whether it works at a certain location. Instead, the technical parameters such as field strength have been measured, under the same receiving conditions as assumed in the planning tool.

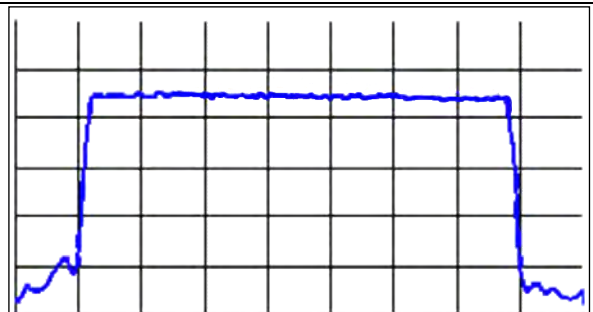
Reception Channel

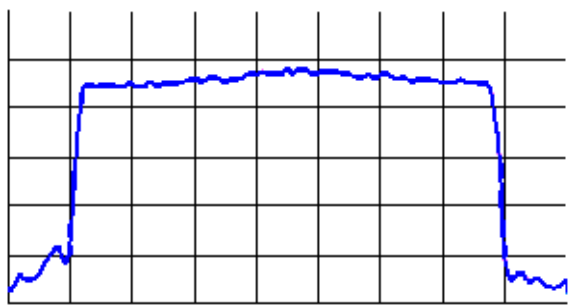
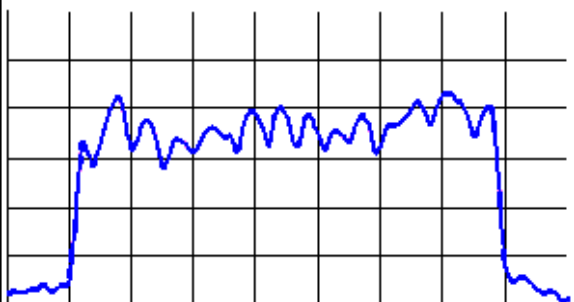
Due to reflections, shading and reception of signals from multiple transmitters of an SFN, the received spectrum can be degraded. The order of this degradation determines the reception channel

The standard deviation of the spectral amplitudes σ_{sp} has an influence on the minimum receiver input level necessary to decode the DVB-T2 signal.

Gauss channel:

Only the direct signal from a transmitter within line-of-sight is received. No reflections and co-channel emissions are received. As a result, the OFDM spectrum is rectangular. The standard deviation of the spectral amplitudes over the channel bandwidth σ_{sp} is between 0 and 1 dB.



<p>Rice channel: In addition to the direct signal, several smaller co-channel signals and reflections are received. The OFDM spectrum shows slight variations in amplitude over frequency. The standard deviation of the spectral amplitudes over the channel bandwidth σ_{sp} is between 1 and 3 dB.</p>	
<p>Rayleigh channel: The received signal is composed only of reflections and components from various co-channel transmitters. No dominant direct signal is received. The OFDM spectrum shows heavy distortion. The standard deviation of the spectral amplitudes over the channel bandwidth σ_{sp} is higher than 3 dB.</p>	

Measurement Set-Up

The field trial was 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 band standard log periodic antenna with known correction factor already loaded in the analyzer for different channels. To record digital parameters, Ericsson made IRD was used. In addition to this Garmin make GPS was used for the determination of the co-ordinates and LOS distance.

ITU Parameters for reception of DVB-T2 transmission

DVB-T2 in Band IV/V			Fixed	Portable outdoor/urban	Handheld Mobile, Class H-D/Int antenna
Frequency	Freq	MHz	650	650	650
Minimum C/N required by system	C/N	dB	20.0	17.9	10.0
System variant (example)			256-QAM FEC 2/3, 32k, PP7 Extended	64-QAM FEC 2/3, 32k, PP4 Extended	64-QAM FEC 1/2, 8k, PP2 Extended
Bit rate (indicative values)		Mbit/s	35-40	26-29	11-14
Receiver noise figure	F	dB	6	6	6
Equivalent noise bandwidth	B	MHz	7.77	7.77	7.71
Receiver noise input power	P_n	dBW	-128.0	-128.3	-129.1

DVB-T2 in Band IV/V			Fixed	Portable outdoor/urban	Handheld Mobile, Class H-D/Int antenna
Min. receiver signal input power	$P_{s\ min}$	dBW	-109.1	-111.2	-1119.1
Min. equivalent receiver input voltage, 75Ω	U_{min}	dBμV	29.7	27.6	19.6
Feeder loss	L_f	dB	4	0	0
Antenna gain relative to half dipole	G_d	dB	11	0	-9.5
Effective antenna aperture	A_a	dBm ²	-4.6	-15.6	-25.1
Min power flux-density at receiving location	Φ_{min}	dB(W)/m ²	-100.5	-95.6	-94.0
Min equivalent field strength at receiving location	E_{min}	dBμV/m	45.3	50.2	51.8
Allowance for man-made noise	P_{mmn}	dB	0	1	0
Penetration loss (building or vehicle)	L_b, L_h	dB	0	0	8
Standard deviation of the penetration loss		dB	0	0	2
Diversity gain	Div	dB	0	0	0
Location probability		%	70	70	90
Distribution factor			0.5244	0.5244	1.28
Standard deviation			5.5	5.5	5.9
Location correction factor	C_l	dB	2.8842	2.8842	7.552
Minimum median power flux-density at reception height ⁽¹⁾ ; 50% time and 50% locations	Φ_{med}	dB(W)/m ²	-97.6	-91.7	-78.5
Minimum median equivalent field strength at reception height ⁽¹⁾ ; 50% time and 50% locations	E_{med}	dBμV/m	48.2	54.1	67.3
Location probability		%	95	95	99
Distribution factor			1.6449	1.6449	2.3263
Standard deviation			5.5	5.5	5.9
Location correction factor	C_l	dB	9.04695	9.04695	13.72517
Minimum median power flux-density at reception height ⁽¹⁾ ; 50% time and 50% locations	Φ_{med}	dB(W)/m ²	-91.5	-85.6	-72.3
Minimum median equivalent field strength at reception height⁽¹⁾; 50% time and 50% locations	E_{med}	dBμV/m	54.3	60.2	73.5

⁽¹⁾ 10 m for fixed reception and 1.5 m for the other reception modes.

Basic Data and Transmitter details

Transmitter Details:

1. Name of the Station	: DDK Bhopal
2. GPS data of TV transmitter tower	: N 23.23960° & E 77.38811°
3. Terrain around Transmitter	: Urban, Populated Residential
4. Rated power of the transmitter	: 6.0 KW
5. Forward radiated power	: 5.5 KW
6. Reflected Power	: 7 Watt
7. Transmission mode	: SDTV
8. Make	: HARRIS
9. Model	: ULX-6500T2
10. Frequency of operation	: 490 MHz (CH#23)
11. Date of commissioning	: 25/2/2016

Transmitting Antenna Details

1. Make	: SIRA SISTEMI RADIO
2. Type/Model	: UTV-01/24(6×4) UHF PANEL
3. Antenna Gain	: 12.9 db (Nominal)
4. Effective height of antenna (Midbay)	: 183 meters.
5. Polarization	: Horizontal

Transmission Parameters of DTT transmission at DDK, Bhopal

1. Constellation:	QPSK
2. PLP:	ROTATED
3. PILOT PATTERN:	PP-3
4. CODE RATE:	$\frac{1}{2}$
5. FFT:	8K
6. OFDM SYMBOL RATE:	992 SYM/SEC
7. BW:	8 MHz
8. GUARD INTERVAL:	1/8
9. SISO/MISO:	SISO
10. PLP BIT RATE:	5.6108 Mbps
11. FREQUENCY:	490 MHz
12. CONTENT:	TV: FIVE SERVICES

Measurement Method

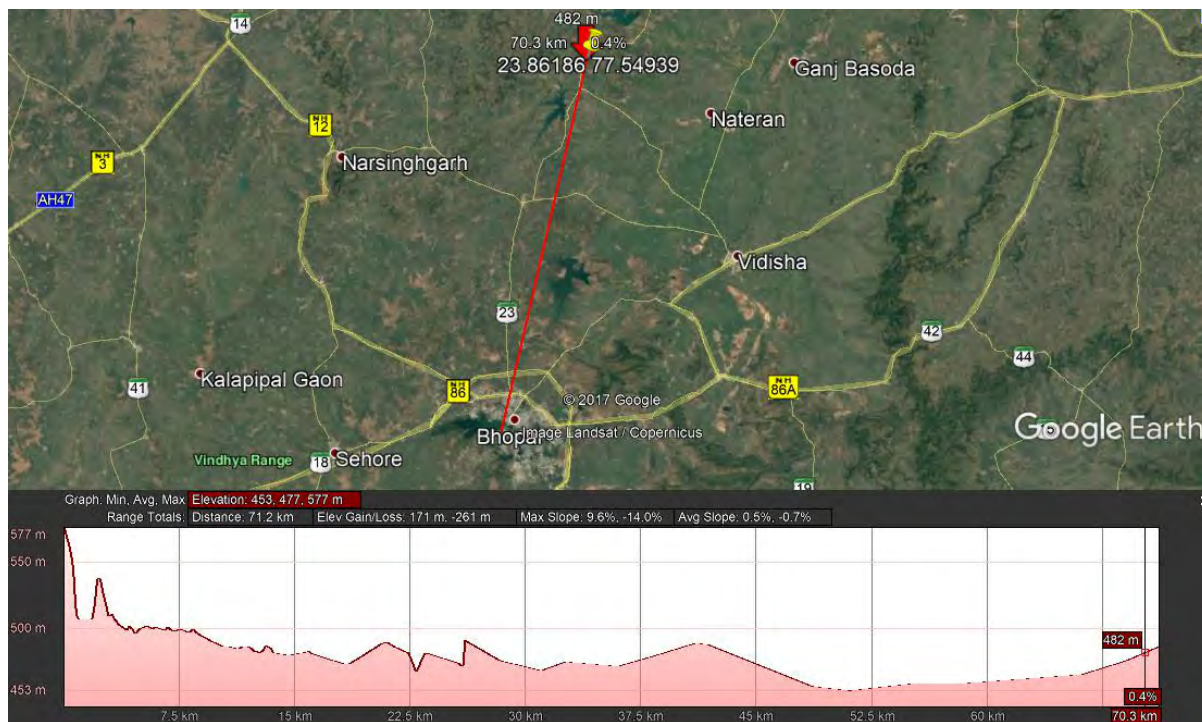
Google and Garmin maps were used throughout the survey for making different routes. Location of the transmitter tower was marked using GPS for reference purpose. Using this reference all the routes and survey points were decided keeping in consideration the type of terrain encountered. Since the purpose of the survey was to determine the fixed primary coverage area for satisfactory reception, the measurement was carried out in static condition along the motor able roads along particular route. ITU recommendation BT.2254-2 was used for determining coverage area on the basis of field strength at a height of 10 meters above ground using standard antenna. As per ITU recommendation the receiving antenna for subjective assessment of picture and sound quality must be checked using directional Yagi antenna having gain of 11 db (Nominal) under fixed rooftop mode. Accordingly necessary corrections were made where ever required. Digital television service coverage is characterized by a very rapid transition from near perfect reception to no reception at all and it thus becomes critical to be able to define which areas are going to be covered and which not. Accordingly coverage definition of "Excellent "has been selected as the case where 95 % of the locations within a small area are covered.

After data collection was over the field strength data and subjective assessment were tabulated and analyzed for final conclusion.

Route Analysis (Location map 9_A)

1. North: Table-1 & Map-1

The elevation profile in this route was not with much irregularity as clear from map-1. The survey started from transmitter with stop at regular interval for obtaining field strength value and other parameters.

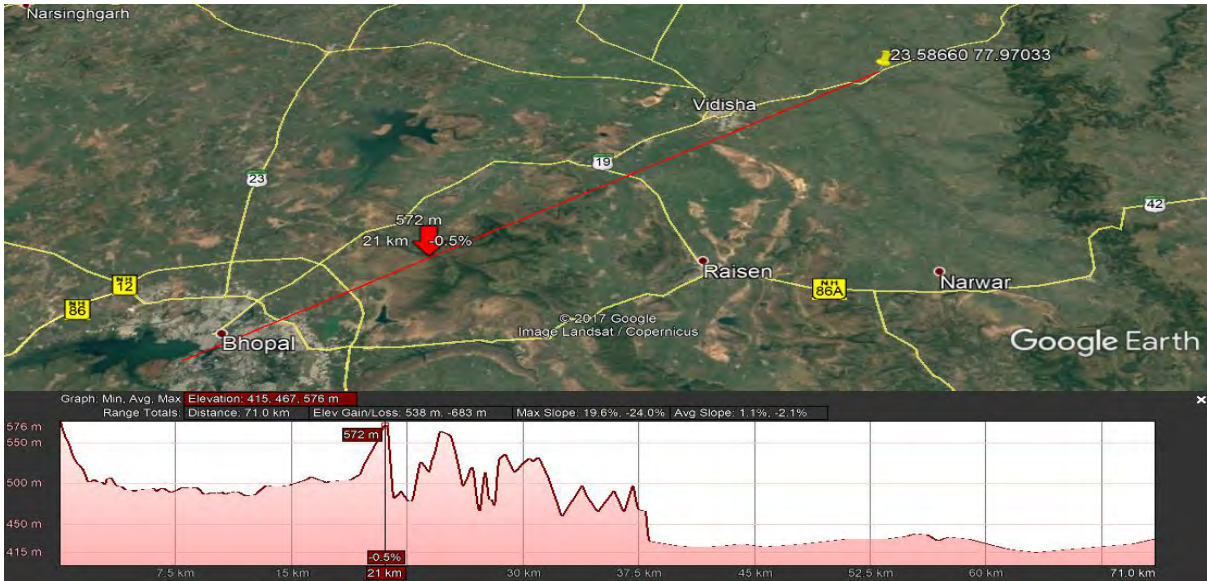


Map-1

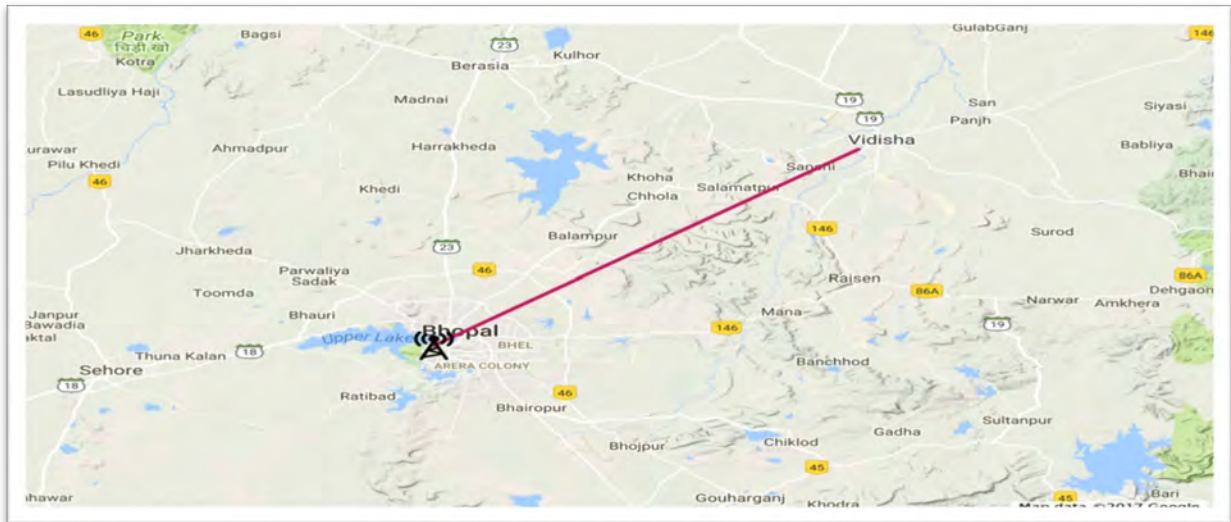
This area is covered with light vegetation along the road with open fields all around the road. The maximum height above MSL was 578 meters near TV tower itself. The Subjective assessment was excellent up to LOS distance of 70 Km. The field strength was 52 dB μ V/m at LOS distance of 50 Km. It is clear from the elevation profile that the reception of the DTT signal up to LOS distance of 70 Km does not render any troubles .

2. North-East: Table-2 & Map-2 (A&B)

The road in this route goes up to Vidisha town of Madhya Pradesh. The survey team travelled up to the LOS distance of 70 Km. However the required field strength of 54 dB μ V/ m was recorded only up to 20 to 25 Km LOS distance. Afterwards from LOS distance of 33 Km and more field strength was less than 44 dB μ V/ m, much below than the minimum required field strength as per ITU recommendations. Study of terrain map (Map-2B) gives explanation of this effect.



Map-2 (A)



Map-2 (B)

Exactly at LOS distance of 21 Km, lies a hillock of height 570 meters above msl, whereas the land height near TV tower was 578 meters above msl. Additional height of 100 meters or more of antenna tower is not enough to overcome shadow zone from 30 Km to 70 Km LOS distance towards Vidisha.

3. East: Table-3 & Map-3

In this route towards direction East from transmitter tower lies the fort town of Raisen. Similar to North-East route this also suffers in terms of propagation of DTT signals mainly due to the presence of hillock of height 535 meters above mean sea level.



Map-3

The shadow zone is created by hillock after the LOS distance of 27.7 Km. The effective coverage was just up to the LOS distance of 25 Km only. At Raisen one measurement were taken at the height of 494 meters above msl near Raisen fort entrance gate. Even at this height, the DTT signal was not available.

4. South-East: Table 4 & Map-4

This route goes to Hoshangabad town of Madhya Pradesh. The terrain profile map again clearly



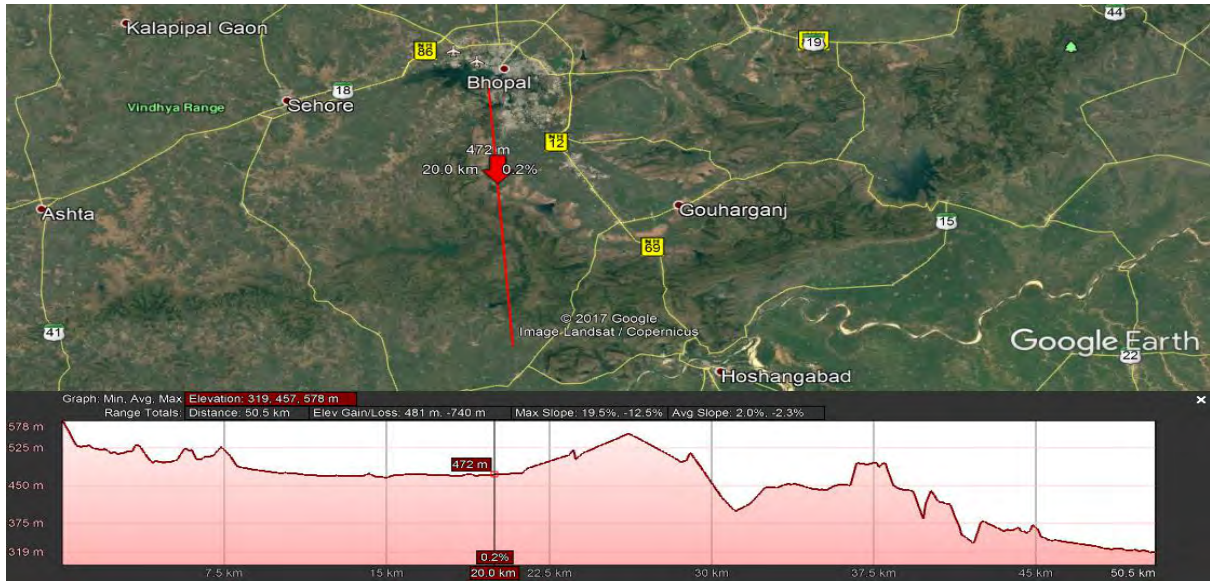
Map-4

showing the hillock at the LOS distance of 40 Km, which is 570 meters above msl. Similar hillock

again comes in this route at the LOS distance of 53 Km. The irregular terrain from 40 Km to 60 Km was creating shadow zone including severe multipath environment. As such the effective coverage in this route was just 39.8 or 40 Km.

5. South :(Table-5 & Map-5)

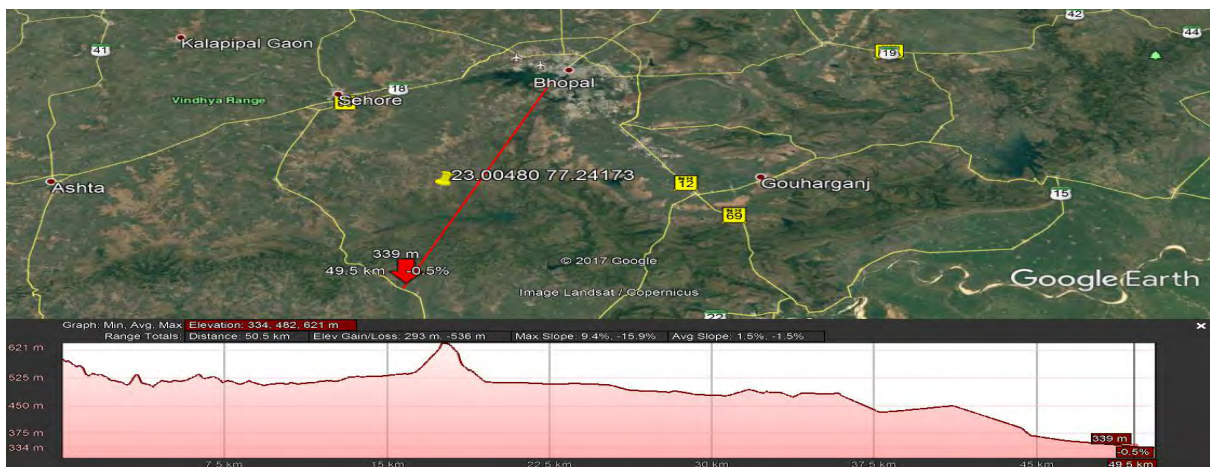
Perusal of the elevation profile towards south direction from DTT transmitter antenna clearly showing near flat elevation up to the LOS distance of 23 Km. Afterwards elevation drops more than



Map-5

150 meters up to the LOS distance of 50 KM. Due to the shadow zone created and severe multipath the field strength also drops to 38 dBμV/ m from 50 dBμV/ m within a range of 10 KM only. The minimum required signal was available only up to 20 Km.

6. South-West: Table 6 & Map-6

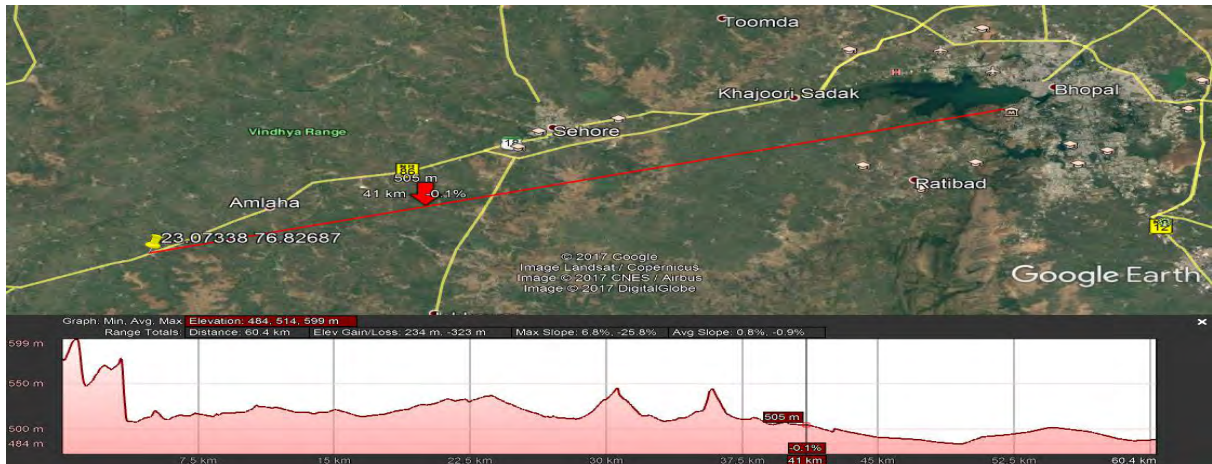


Map-6

The coverage was more in this direction compared with previous route. However again due to the terrain irregularity, and severe multipath environment, the effective coverage was only up to the LOS distance of 30 KM.

7. West: Table-7 & Map-7

The coverage in this route was found up to the LOS distance of 40 Km only.



Map-7

Nearby hillock is creating a shadow zone at LOS distance of 38 Km. In Sehore town the field strength was just 31 dBμV/ m. It was below the required signal strength mainly due to the 3-4 story houses near survey location.

8. North-West: Table-8 & Map-8



Map-8

At an aerial distance of just 5.6 Km lies a hillock of 590 meter height from msl. Further towards the North-West direction the terrain irregularity varies by 100 meters. The required minimum field strength was recorded up to the LOS distance of 50 Km.

9. City Areas: Table-9 & Map-9 (B)

Randomly selected locations within city areas were also tested for excellent reception of DTT of Bhopal DDK. Nearly at all places the quality of reception was excellent. However field strength values were not up to the mark when considering LOS distance from transmitter antenna. Otherwise in all cases it was above the minimum required field strength. Shadow effect was prominent near Van vihar where field strength was 67db μ V/m where as LOS distance from transmitting antenna was just 3 Km. Similarly the effect of large building was also observed near DB city mall where difference of 6-8 db was observed. In all selected areas the reception on Smartphone using **TV on Go** dongle was excellent and field strength was more than 70 dB μ V/ m except near Van vihar.

Conclusion:

At 10 meter height of reception antenna

Based upon field strength value on different routes and quality of decoded DTT signal, coverage map of DTT Bhopal was created and annexed as map-10. The coverage based on reception at 10 meter height is as follows:

Direction From Tx Antenna	Coverage in Km
North	50
North-East	20
East	25
South-East	40
South	20
South-West	30
West	40
North-west	50

At 3.0 / 1.5 meter height of reception antenna for Smart Phones

Field strength was also recorded at a measuring antenna height of 3 meters which is considered good for 1.5 meter reception height as per ITU recommendations, for prediction of coverage on Smart phones using inbuilt DVB-T2 system or using commercially available dongles connected to the mobile phone through micro USB port. As per ITU recommendation BT.2254-2 the minimum

required field strength should be 73.5 dB μ V/ m for excellent reception on mobile phones. Keeping in view the ITU recommendations, the coverage map has been prepared for reception on smart phones and same is annexed as Map-11. The coverage in this mode is as follows:

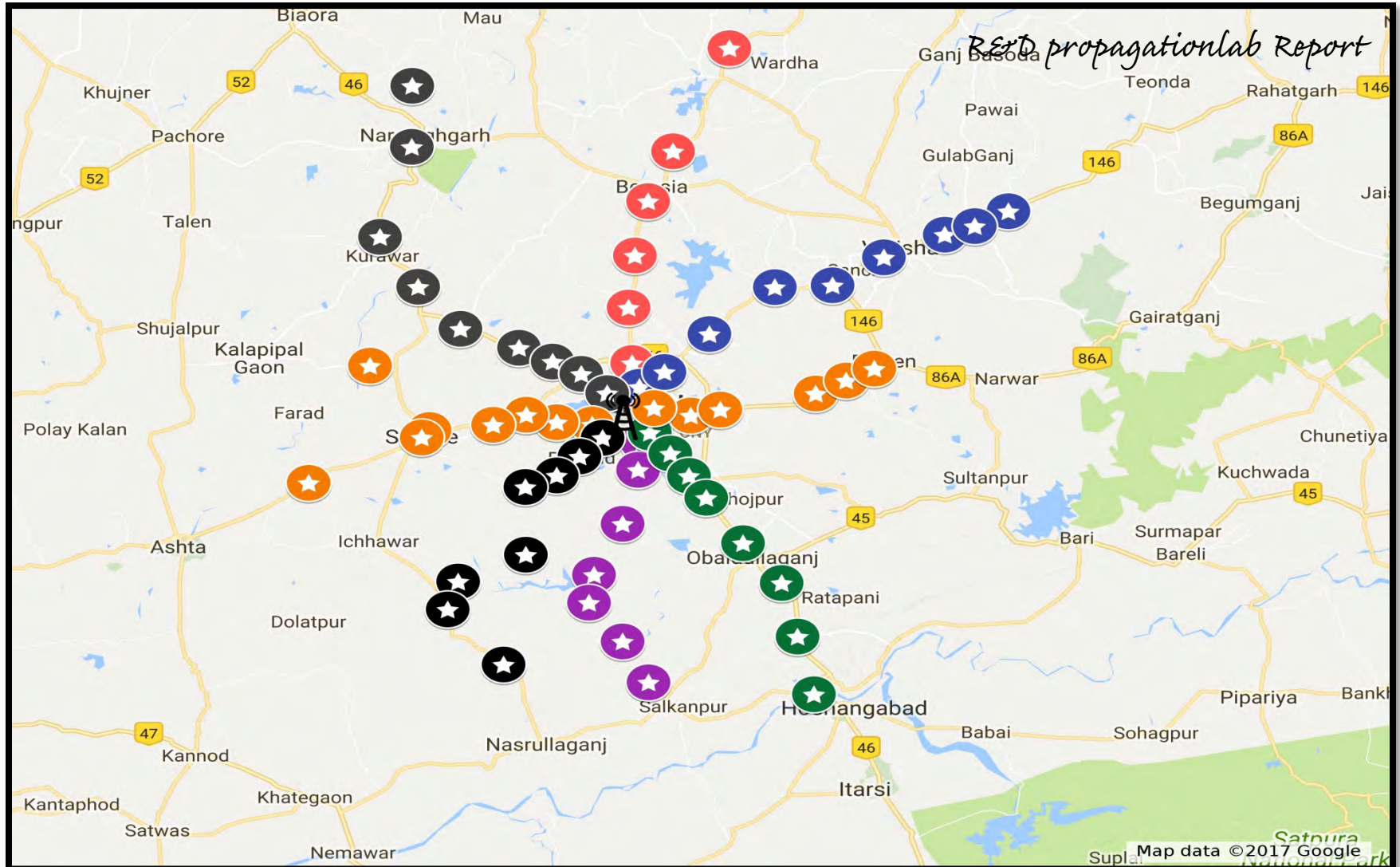
Direction From Tx Antenna	Coverage in Km
North	10
North-East	10.5
East	10
South-East	7
South	4
South-West	12
West	20
North-west	13

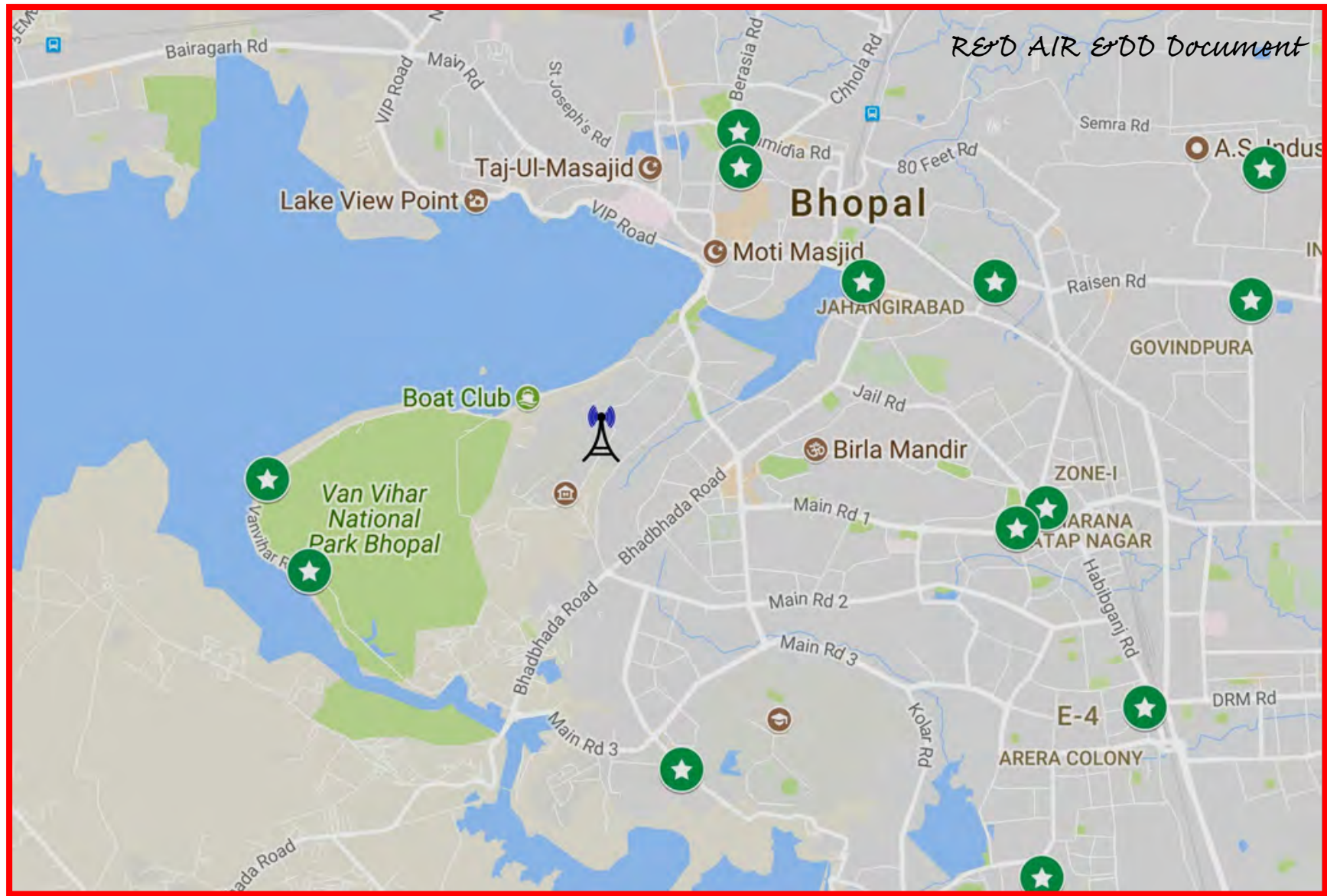
Acknowledgement:

The DTT coverage survey of DDK, Bhopal was carried out by the Propagation labs of The Research department of AIR & DD, New Delhi. The field trial was successfully done with the sincere support of the Engineers of DDK, Bhopal. The survey team also extends their gratitude to Ms. Navneet Kaur, Director (E) for providing all logistic support.

DTT Survey locations in Bhopal

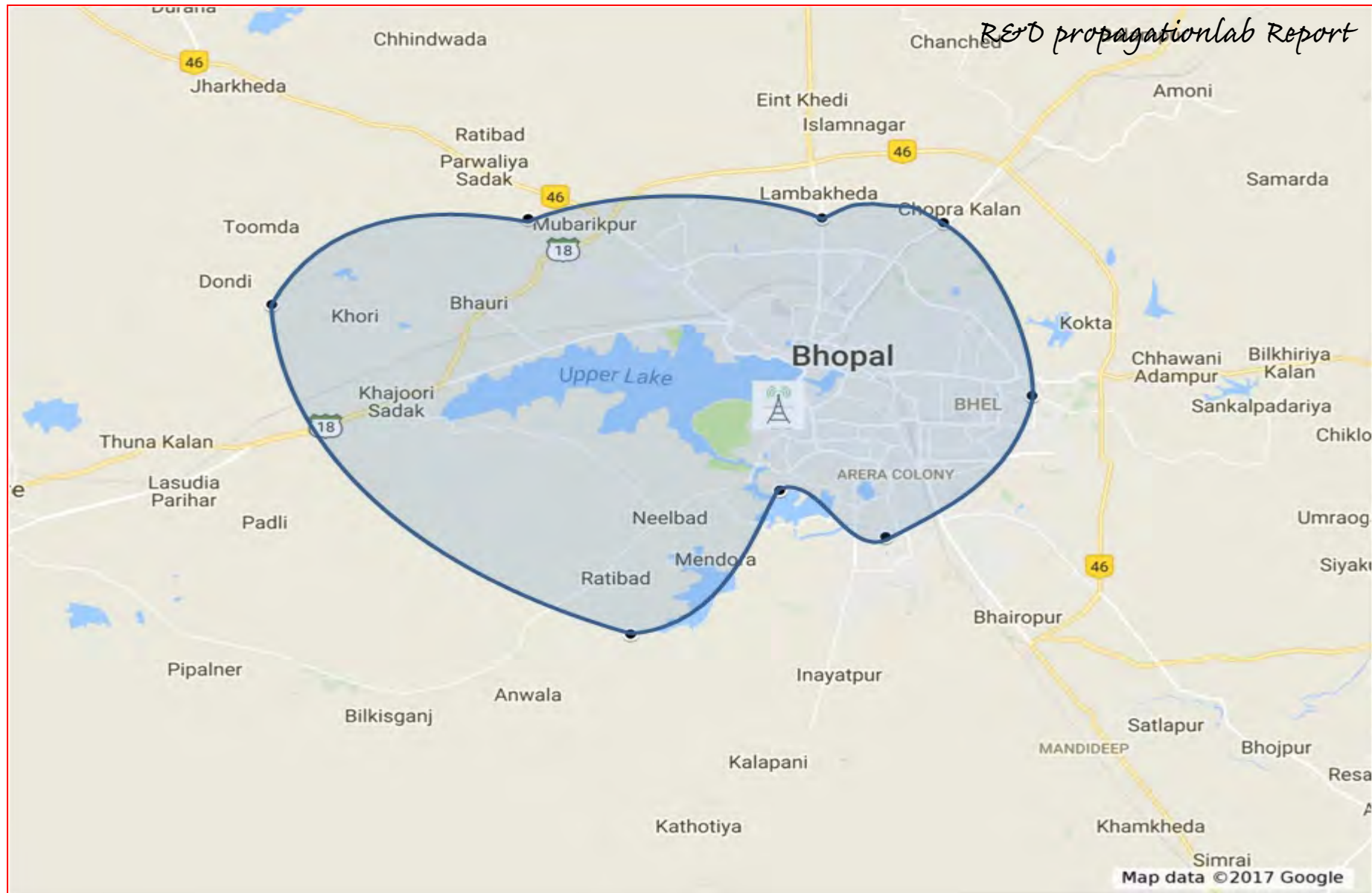
MAP-9_A

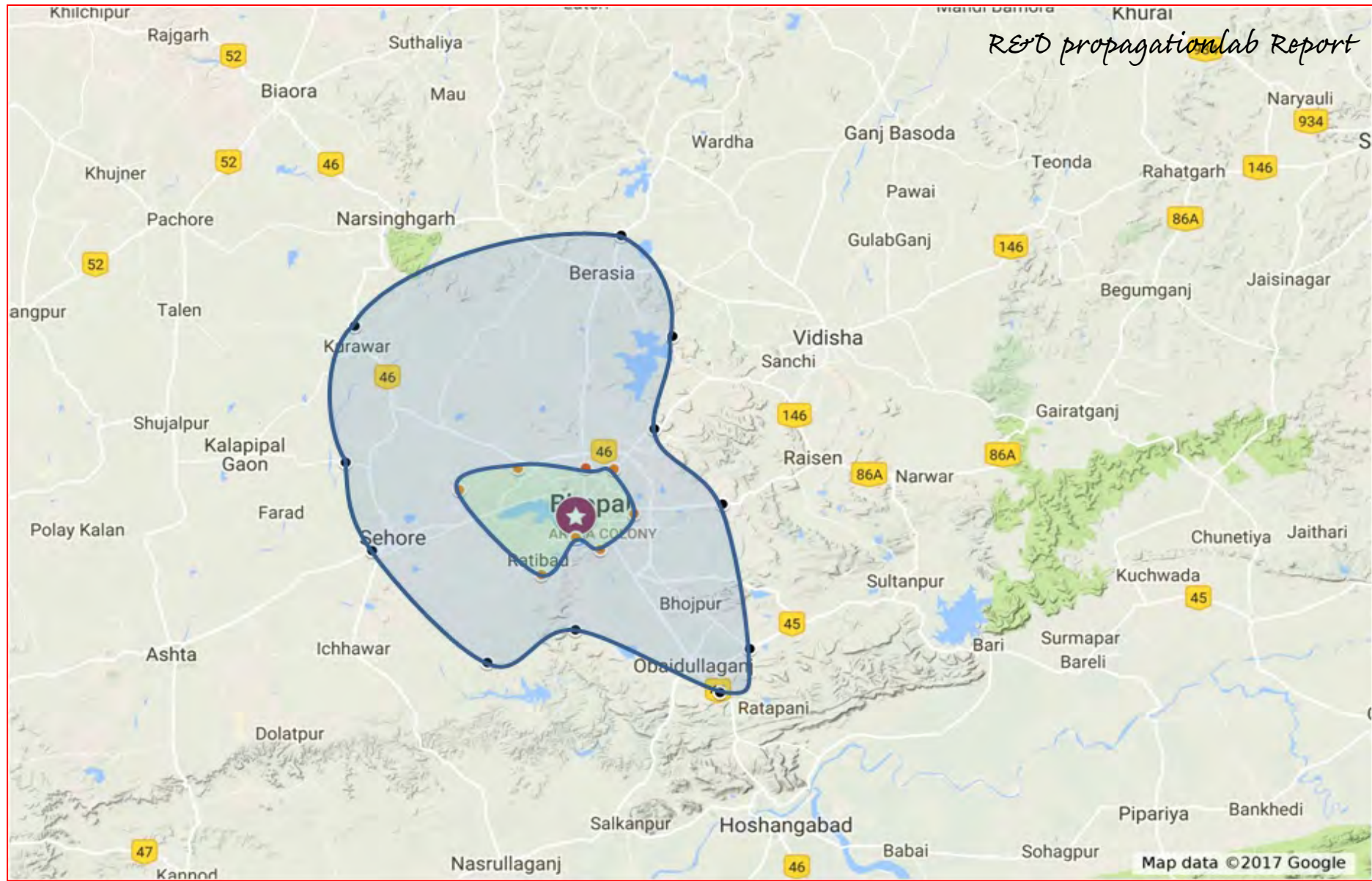




Coverage Map of DTT Bhopal (Receiving antenna at 10 meters) Map-10







Reception Survey for satisfactory coverage of DVB - T2 Transmitter (490 MHz, Ch # 23) Bhopal

Direction : North
Route: Bhopal-Berasia

Table no : 1
Date: 12/01/2017

Time (Hrs)	Spot /Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (KM)	Field Strength (dB μ V/m)		COFDM (IRD) Parameter @10Mtrs			Subjective Assessment on TV PROMAX	Subjective Assessment on Mobile	Terrain	Remarks
					10Mtrs	3Mtrs	MER (dB)	BER (Pre)					
								LDPC	BCH				
1335	Regiment Road Berasia Rd	N 23.28468 E 077.40332	512	5.2	99	93	28.9	1.0 E-6	1.0 E-8	OK	OK	OA/LRB/LT	
1515	Berasia Rd	N 23.32957 E 077.40245	494	10	62	65	28.1	1.0 E-6	1.0 E	OK	OK	OA/LT	
1640	Berasia Rd	N 23.42356 E 077.39681	477	20	59	60	26.6	1.6 E-6	1.0 E	OK	NT	OA/VLT	
1720	Berasia Rd Harrakheda	N 23.51191 E 077.40633	474	30	48	48	15.6	2.9 E-3	1.5 E	OK	NT	LRB/LT	
1750	Berasia Rd	N 23.60338 E 077.42605	489	40	42	42	23.5	1.0 E-3	1.0 E	OK	NT	OA/VLT	
1900	Berasia Sironj Road	N 23.68791 E 077.46418	474	50	52	--	26	2.5 E-6	1.0 E	OK	--	OA/VLT	
1950	--do--	N 23.86186 E 077.54939	475	70	45	--	26	1.4 E-2	1.0 E	OK	--	OA	

LEGENDS: - LT = Low Traffic, HT = High Traffic, MT = Moderate Traffic, HW = High Ways, HRB = High Rise Buildings, LRB = Low Rise Buildings, MRB = Medium Rise Building, Veg = Vegetation, OA = Open Area, IA = Industrial Area, HDP = High Density Population.

Reception Survey for satisfactory coverage of DVB - T2 Transmitter (490 MHz, Ch # 23) Bhopal

Direction : North-East
Route: Bhopal-Vidisha-Sagar

Table no: 2
Date: 13/01/2017

Time (Hrs)	Spot /Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (KM)	Field Strength (dB μ V/m)		COFDM (IRD) Parameter @10Mtrs			Subjective Assessment on TV PROMAX	Subjective Assessment on Mobile	Terrain	Remarks
					10Mtrs	3Mtrs	MER (dB)	BER (Pre)					
								LDPC	BCH				
1100	New Bhanpur Bridge Road	N 23.28946 E 77.41319	499	5.2	90	82	18.1	2.6 E-3	6.0 E-8	All OK	All OK	OA/MT/LRB	
1130	Sanchi Road MALIKHEDI	N 23.31441 E 77.45068	499	10.5	71	67	29.2	1.4 E-4	1.0 E-8	All OK	All OK	OA/LT/ORB	
1205	Vidisha Road	N 23.37888 E 77.51880	498	20.5	66	65	28.4	1.3 E-3	1.0 E-8	All OK	NT	Veg/MT/OA	
1750	Sanchi Bhopal Road	N 23.45821 E 77.61748	440	33.7	44	49.5	20.9	2.5 E-3	1.5 E-8	All OK	NT	AL/LT	
1250	Vidisha Road Before Sanchi	N 23.46163 E 077.70492	437	40.6	39	48	11.4	9.2 E-4	4.5 E-8	All OK	NT	OA/MT/NH	
1410	Before Vidisha	N 23.50846 E 77.78253	418	50.1	41	47	6.3	1.9 E-2	1.0 E-8	All OK	NT	Veg/LT/OA	
1535	Sagar road	N 23.54669 E 77.87459	424	60.2	39	--	8.0	1.8 E-2	3.0 E-8	All OK	--	OA/MT/LRB	
1840	Sagar road	N 23.56151 E 77.91965	419	65	39	--	1.3	1.1 E-1	2.9 E-5	MP OK	--	OA/MT	
1600	Sagar road	N 23.5866 E 077.97033	427	70	39	--	NT	NT	NT	NT	--	OA/MT	

LEGENDS: - LT = Low Traffic, HT = High Traffic, MT = Moderate Traffic, HW = High Ways, HRB = High Rise Buildings, LRB = Low Rise Buildings, MRB = Medium Rise Building, Veg = Vegetation, OA = Open Area, IA = Industrial Area, HDP = High Density Population.

Reception Survey for satisfactory coverage of DVB - T2 Transmitter (490 MHz, Ch # 23) Bhopal

Direction : East
Route: Bhopal-Raisen

Table no : 3
Date: 16/01/2017

Time (Hrs)	Spot /Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (KM)	Field Strength (dB μ V/m)		COFDM (IRD) Parameter @10Mtrs			Subjective Assessment on TV PROMAX	Subjective Assessment on Mobile	Terrain	Remarks
					10Mtrs	3Mtrs	MER (dB)	BER (Pre)					
								LDPC	BCH				
2010	Raisen Road near Shanshah Garden	N 23.25322 E 77.43504	496	5	94	87	26.2	5.8 E-4	1.5 E-8	All OK	All OK	MRB/HD/HT/UA/Market	
1550	Tagore Nagar Khajuri Kalan Rd	N 23.24100 E 77.49080	483	10	74	67	26.3	1.2 E-3	1.5 E-8	All OK	All OK	OA/UA/LT	
1615	Chhawani Adampur NH146	N 23.25060 E 77.53506	461	15	66	53	28.3	8.1 E-4	1.0 E-8	All OK	NT	Veg/RA/LT/LRB	
1900	NH 146 near Pipalkhiriya Ind Area	N 23.258084 E 77.632175	490	25	55		14.0	9.0 E-4	3.7 E-8	All OK		MRB/OA	
1655	Betwa River Bridge NH 146	N 23.27808 E 77.67982	437	30	39.5		4.0	6.1 E-2	7.5 E-8	MP – OK Others-NT		River/Hillocks/Veg/LT	
1725	Sendora NH 146	N 23.30028 E 77.72550	427	35	39		NT	NT	NT	NT		Hillocks/LT/OA	
1800	Raisen Fort Gate	N 23.32048 E 77.76804	494	40	50-51		NT	NT	NT	NT			@3 Mtrs

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Reception Survey for satisfactory coverage of DVB - T2 Transmitter (490 MHz, Ch # 23) Bhopal

Direction : South East
Route: Bhopal-Hoshangabad

Table no : 4
Date: 14-16/1/17

Time (Hrs)	Spot /Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (KM)	Field Strength (dBμV/m)		COFDM (IRD) Parameter @10Mtrs			Subjective Assessment on TV PROMAX	Subjective Assessment on Mobile	Terrain	Remarks
					10Mtrs	3Mtrs	MER (dB)	BER (Pre)					
								LDPG	BCH				
1145/16	Apex Bank Colony Main Road	N 23.21180 E 77.42887	511	5	80	77	28.5	6.8 E-4	1.0 E-8	ALL OK	ALL OK	LRB/Veg/AO/LT	
1210/16	Hoshangabad Snah Nagar Road	N 23.17611 E 77.45947	478	10	59	64	22.0	1.4 E-3	1.0 E-8	ALL OK	ALL OK	OA/LRB/HT/OA	
1225/16	Hoshangabad Rd	N 23.13818 E 77.48714	466	15	58	56	28.9	1.9 E-3	1.5 E-8	ALL OK	NT	LRB/NHW/MT/UA	
1305/16	Mandideep Hoshangabad Rd	N 23.10113 E 77.51432	471	20	54	--	23.8	2.1 E-3	1.5 E-8	ALL OK	--	LRB/NHW/HT/UA Ind. Area	
1330/16	Hoshangabad Rd	N 23.02403 E 77.56945	452	30	43	49	17	1.9 E-3	1.0 E-8	ALL OK	NT	Veg/NHW/HT/RA	
1740/14	Hoshangabad-Bhopal NHW	N 22.95627 E 77.62826	454	39.8	53	--	2.3	7.2 E-3	1.5 E-8	ALL OK	--	NHW/NT	
1711/14	Hoshangabad-Bhopal NHW	N 22.86553 E 77.65199	455	49.47	38	--	--	--	--	--	--	NHW/NT	
1634/14	Near Hoshangabad NHW	N 22.76721 E 77.67689	299	50.1	38	--	--	--	--	--	--	NHW/NT	

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Reception Survey for satisfactory coverage of DVB - T2 Transmitter (490 MHz, Ch # 23) Bhopal

Direction : South
Route:- Bhopal -Kolar Road dam

Table - 5
Date:- 14/01/2017

Time (Hrs)	Spot /Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (KM)	Field Strength (dB μ V/m)		COFDM (IRD) Parameter @10Mtrs			Subjective Assessment on TV PROMAX	Subjective Assessment on Mobile	Terrain	Remarks
					10Mtrs	3Mtrs	MER (dB)	BER (Pre)					
								LDPC	BCH				
1105	KOLAR ROAD	N 23.19987 E 77.41698	493	5.3	61	56	22.1	1.0 E-6	1.0 E-8	ALL OK	NT	MRB/MT/OA	
1119	KOLAR ROAD	N 23.19521 E 77.41711	489	5.76	72	--	--	--	--	ALL OK		MRB/MT/OA	
1203	KOLAR ROAD	N 23.14884 E 77.41103	479	10.37	63	60	28.7	2.1 E-3	1.0 E-8	ALL OK	NT	LRB/LT/OA	
1237	KOLAR DAM ROAD	N 23.05682 E 77.38760	480	20.2	50	48	27.2	1.9 E-3	1.0 E-5	ALL OK	NT	Veg/OA/Jungle	
1333	KOLAR DAM ROAD Vill. Birpur	N 22.97053 E 77.34463	437	30.1	38.8	--	2.5	8.2 E-2	2.6 E-5	MP channel OK Rest Freezing	--	Veg/OA/Jungle	
1420	KOLAR DAM TO SOUTH ROAD	N 22.92318 E 77.33657	511	35.4	39	--	NT	NT	NT	NT	--	Veg/OA/Jungle	
1447	Jholipur Reservoir	N 22.85748 E 77.38789	338	42.3	38.8	--	NT	NT	NT	NT	--	OA/LRB/RA	
1510	Bordha Khera Village	N 22.78740 E 77.42675	322	50.2	38.9	--	NT	NT	NT	NT	--	OA/Fields	

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Reception Survey for satisfactory coverage of DVB - T2 Transmitter (490 MHz, Ch # 23) Bhopal

Direction : South-West
Route:- Bhopal-Ratibad

Table no : 6
Date: 18/01/2017

Time (Hrs)	Spot /Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (KM)	Field Strength (dB μ V/m)		COFDM (IRD) Parameter @10Mtrs			Subjective Assessment on TV PROMAX	Subjective Assessment on Mobile	Terrain	Remarks
					10Mtrs	3Mtrs	MER (dB)	BER (Pre)					
								LDPC	BCH				
1157	Bhadbhada Marg	N 23.20284 E 77.35725	530	5.17	88	86	28.8	7.0 E-4	1.0 E-8	All OK	All OK	OA/LT/IRB	
1227	Ratibad	N 23.17120 E 77.32231	554	10.1	77	68	28.7	1.4 E-3	3.0 E-8	All OK	NT	UA/LT/LRB	
1253	NEAR Anwala-Sehore –Bhopal Rd	N 23.13889 E 77.28816	560	15.1	69	66	28.0	1.8 E-3	3.0 E-8	All OK	NT	RA/OA/VLD	
1319	Bilkisganj Sehore Rd	N 23.11969 E 77.24081	551	20	56	50	24.1	2.0 E-3	1.0 E-8	All OK	NT	RA/VLT/LRB	
1418	Near Balondiya Village	N 23.00480 E 77.24173	517	30	53	--	26.2	1.5 E-3	1.5 E-8	All OK	--	RA/OA/ Low Veg	
1450	Vill. Brijis Nagar near SH#22A	N 22.95914 E 77.13918	504	40.2	43	--	16.8	2.0 E-3	3.0 E-8	All OK	--	OA/No settlements fields only	
	Near Vill Guradi SH#22A	N 22.91188 E 77.12331	494	45	41	--	14.3	1.7 E-4	1.0 E-8	All OK	--	Veg(Small)/LT/SHW	
1546	Vill Ladvui SH#22A	N 22.81767 E 77.20760	341	50	39	--	No Tx lock			--	--	OA/LT/Fields	

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Reception Survey for satisfactory coverage of DVB - T2 Transmitter (490 MHz, Ch # 23) Bhopal

Direction : West
Route:- Bhopal-Sehore -Aasta

Table no : 7
Date: 17/01/2017

Time (Hrs)	Spot /Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (KM)	Field Strength (dBμV/m)		COFDM (IRD) Parameter @10Mtrs			Subjective Assessment on TV PROMAX	Subjective Assessment on Mobile	Terrain	Remarks
					10Mtrs	3Mtrs	MER (dB)	BER (Pre)					
								LDPC	BCH				
1140	BESANKHEDI Ahead SAI complex	N 23.22535 E 77.34184	518	5	81	87	29.9	6.5 E-4	1.5 E-8	All OK	All OK	OA/VLT/Vill	
1225	Near Mungaliya Chaap CVill	N 23.22943 E 77.28807	521	10	86	84	29.2	1.0 E-6	1.5 E-8	All OK	All OK	OA & Veg/ VLT//Vill	
1308	Khajoor Sadak Sh #18	N 23.24173 E 77.24236	531	15	71	68	30.1	1.8 E-3	1.0 E-8	All OK	NT	SH/LRB/RA/HT	
1350	Before Sehore Toll SH #18	N 23.22479 E 77.19228	532	20	76	72	28.9	8.3 E-4	1.0 E-8	All OK	NT	OA/SHW/MT	
1517	Outskirts Sehore	N 23.21615 E 77.09583	507	30	60	--	28.0	1.9 E-3	1.5 E-8	DD MP OK Rest Freezing	--	OA/Fields/VLT	
1540	Sehore City	N 23.20317 E 77.08421	500	31.3	41	--	3.9	5.4 E-2	1.8 E-8	DD MP OK	--	OA/City/MRB	
1550	Aasta Road	N 23.18391 E 76.82687	505	36	56	--	22.0	1.8 E-3	1.8 E-8	--	--		
1629	Off Sehore – Shyampur Rd	N 23.32553 E 77.00611	479	40	58	56	26.7	1.6 E-3	1.0 E-8	Rest Freezing	NT	OA/Fields/VLT	
1745	Bhopal Indore Highway	N 23.12667 E 76.91338	491	50	48	--	22.1	2.1 E-3	1.0 E-8	DD MP OK	--	NHW/HT/OA	
1815	INDORE Highway	N 23.07338 E 76.82687	484	60	39	--	NO	TS	LOCK	--	--	NHW/MT/OA	

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Reception Survey for satisfactory coverage of DVB - T2 Transmitter (490 MHz, Ch # 23) Bhopal

Direction :North-West

Route: Bhopal – Narsinghgar

Table no : 8

Date: 15-16/1/17

Time (Hrs)	Spot /Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (KM)	Field Strength (dB μ V/m)		COFDM (IRD) Parameter @10Mtrs			Subjective Assessment on TV PROMAX	Subjective Assessment on Mobile	Terrain	Remarks
					10Mtrs	3Mtrs	MER (dB)	BER (Pre)					
								LDPC	BCH				
0035/16	VIP Road	N 23.27826 E 77.36401	528	5	92	90	26.0	1.0 E-6	7.3 E-7	All OK	All OK	Veg/LRB/LT	
0005/16	Gandhi Nagar Main Road	N 23.31167 E 77.32549	510	10	74	82	28.1	1.4 E-3	1.0 E-8	All OK	All OK	NHW/City RD/LRB/Veg/LT	
2340/15	NH46	N 23.33216 E 77.28223	510	15	52	55	19.3	2.8 E-3	1.0 E-7	All OK	NT	NHW/LT/Veg	
2305/15	NH46	N 23.35574 E 77.23092	522	20.6	68	68	29.8	1.2 E-3	1.0 E-8	All OK	NT	NHW/LT/OA	
2225/15	NH46	N 23.38790 E 77.14263	485	30	58	58	29.0	1.2 E-3	1.0 E-8	All OK	NT	NHW/LT/OA	
2200/15	NH46	N 23.45889 E 77.07853	468	40	54	--	26.8	2.3 E-3	1.0 E-8	All OK	--	NHW/LT/OA	
2130/15	NH 46 near Kurawar	N 23.54307 E 77.02132	509	50	59	--	27.9	1.9 E-3	1.0 E-8	All OK	--	NHW/LT/OA	
2050/15	Near NarshingHG HAR Bypass	N 23.69559 E 77.06908	468	60	34	--	8.6	2.6 E-2	9.9 E-6	All OK	--	NHW/LT/Veg	
1855/15	Vill: AAGAR Distt:Rajgarh	N 23.79885 E 77.07007	457	70	33	--	4.1	7.2 E-2	3.4 E-6	MP OK Rest Freezing	--	RA/LRB/LT/Veg	

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Reception Survey for satisfactory coverage of DVB - T2 Transmitter (490 MHz, Ch # 23) Bhopal

Direction : City Areas
Route:- Mobile testing City on road

Table no : 9
Date: 19/01/2017

Time (Hrs)	Spot /Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (KM)	Field Strength (dBμV/m)	Subjective Assessment on Mobile	Terrain	Remarks
294	Van Vihar	N 23.23568 E 77.35629	491	3.28	82	All OK		
295	Van Vihar	N 23.22762 E 77.36028	519	3.14	67	NT		
296	Nehru Nagar	N 23.21021 E 77.39582	531	3.3	87	All OK		
297	Shahpura	N 23.20067 E 77.43018	513	6.1	78	All OK		
298	Arera colony	N 23.21563 E 77.43999	503	5.94	73	All OK		
299	Near BHEL Sports Club	N 23.22750 E 77.45995	501	7.47	69	OK/FREEZING		
300	Industrial Area Govindpura	N 23.26294 E 77.45144	506	6.98	77	All OK		
301	Old Bogda Bridge Rd	N 23.25301 E 77.42573	510	4.13	92	All OK		
302	Lower Lake Sultania Rd	N 23.25301 E 77.41316	515	2.97	108	All OK		
303	Bhopal Talkies Square	N 23.26621 E 77.40124	511	3.25	87	All OK		
304	Bhopal Talkies	N 23.26308 E 77.40144	518	2.95	81	All OK		
305	Peoples Mall	N 23.30412 E 77.42118	504	7.94	87	All OK		
306	ITI Tiraha	N 23.25140 E 77.45012	504	6.48	71	All OK		
307	DB City Mall	N 23.23315 E 77.43063	511	4.41	70	All OK		
308	DB City Mall back side	N 23.23136 E 77.42782	506	4.17	83	All OK		

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