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**Reception survey for  
assessment of coverage area  
for satisfactory reception of  
DVB-T2 Transmitter  
*Located at Pitampura  
New Delhi***

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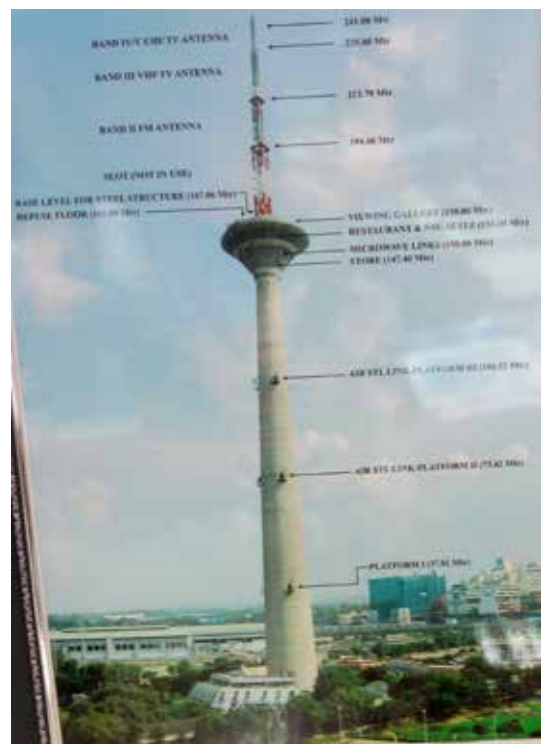
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Location Map (3D View) of TV Tower Pitampura, Delhi



6.0kW DVB-T2 Transmitter



HPT (TV) Antenna Tower

## **Introduction:**

Currently Doordarshan India is transmitting TV broadcast signal on analogue mode through its terrestrial transmitter installed in different part of the country. Today the world broadcast scenario is to establish digital broadcast terrestrial transmission system to reduce spectrum occupancy & to introduce value added services with enhance multimedia content. In the process of modernization of its existing infrastructural set up Doordarshan has stepped forward in the direction of establishing new second generation digital video broadcasting system (DVB-T2).Consequently Doordarshan is now in the process of establishing new DVB-T2 Transmitters in its network. Some of the transmitters have been installed in the country. One of such transmitter is installed at HPT(TV) tower premises Pitampura ,New Delhi & commissioned for regular DVB-T2 transmission on UHF Band(Ch#34,578MHz).Research Department is leading a pioneer role in establishing transmission parameters under existing environment condition for mobile/portable & fixed reception of DVB-T2 transmission. Earlier R&D has conducted field trial of the said transmitter for mobile reception & ascertaining the shadow zones/poor pockets within its coverage area. Under this context again a field trial for prediction of coverage area for satisfactory reception is to be carried out under existing transmission profile & environment condition. For this work a four member survey team carried out field strength survey during the period 07/04/2016 to 16/04/2016 in & around NCT region. 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 envisaged minimum field strength value for satisfactory reception.

## **Equipment Used:**

1. Spectrum Analyzer(Make: Anritsu, Model: MS 2035B & MS 2013E)
2. UHF Dipole antenna(Make: Anritsu, Model: MP663A)
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, Pitampura  
New Delhi
2. Location of the Transmitters : LAT- N 28° 41'51.0"  
(In 6 figure coordinates) LON- E 77° 09'01.8"  
MSL-218 Meter
3. Description of terrain around the : Urban, dense population, high  
Site of Transmitters rise buildings, heavy Traffic
4. Classification(Large city/urban/rural) : Large City
5. Rated power of the Transmitter : 6.0kW
6. Forward radiated Power : 5.80kW
7. Reflected Power : 10.0W
8. VSWR : 1.12
9. Transmission Mode : SDTV
10. Make : Harris
11. Model No. : MAXIVA ULX-6500 T2
12. Frequency of operation : 578MHz(Ch#34)
13. Date of Commissioning : 25/02/ 2016

:

### Transmitting Antenna Details:

1. Make : SIERA
2. Type /Model of Antenna : UTV-01/16(4X4)
3. Antenna Gain : 13dB
4. Height of Tower : 241 Meter
5. Effective height of antenna(Midbay) : 235 Meter
6. 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:

- ∅ 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) 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.

<b>Transmission Parameter</b>	<b>DVB-T</b>	<b>DVB-T2</b> (New improved option in Red)
FEC	Convolutional Coding + Reed Solomon(1/2,2/3,3/4,5/6,7/8)	LDPC + BCH(1/2, <b>3/5</b> ,2/3,3/4, <b>4/5</b> ,5/6)
Modes	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM, <b>256QAM</b>
Guard Interval	1/2, 1/8, 1/16, 1/32	1/4, <b>19/128</b> ,1/8, <b>19/256</b> ,1/16,1/32, <b>1/128</b>
FFT Size	2k, 8k	<b>1k, 2k, 4k,8k,16k,32k</b>
Scattered Pilot	8% of Total	<b>1%,2%,4%,8%</b> of total
Continual Pilot	2.6% of total	<b>0.35%</b> of total
Bandwidth	6,7,8 MHz	<b>1.7,5,6,7,8,10</b> MHz
Typical data rate(UK)	29 Mbit/second	<b>40 Mbit/second</b>
Max data rate @20dB C/N	29 Mbit/Second	<b>47.8 Mbit/second</b>
Required C/N Ratio @ 22	16.7 dB	<b>8.9dB</b>



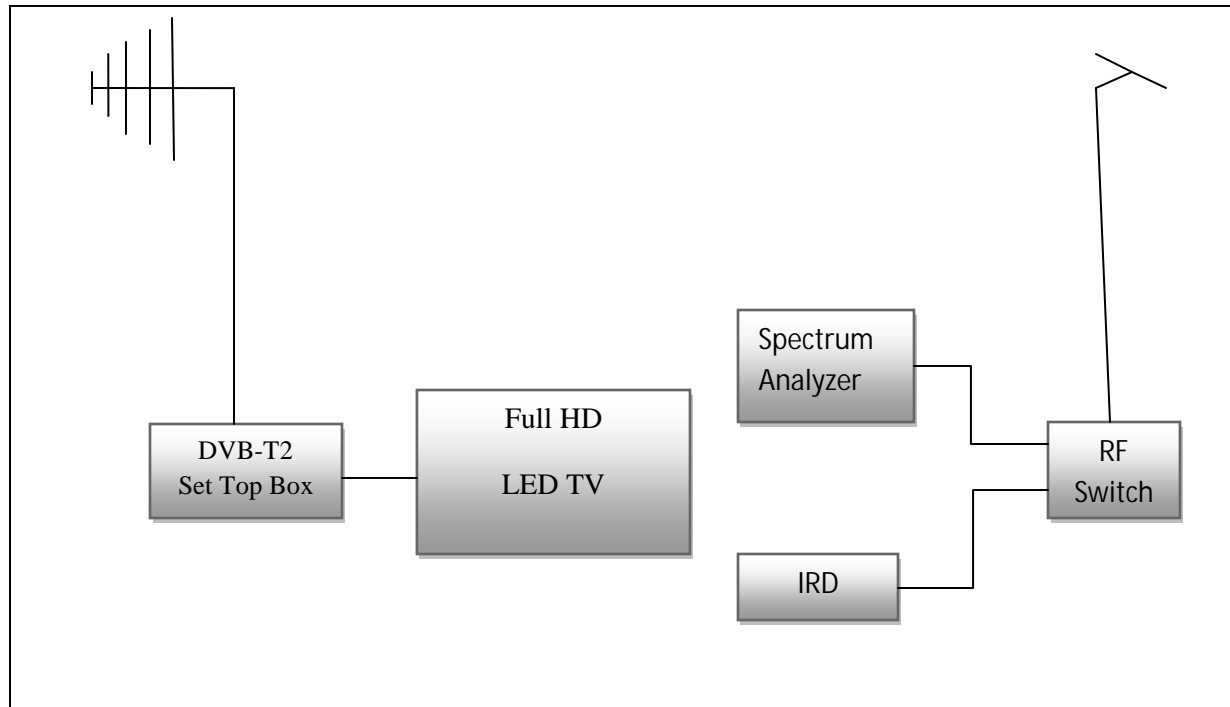
## Modulation Parameters:

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, Pitampura operating with following set of Modulation parameters targeted for fixed antenna & handheld portable (smart phone) reception mode.

Operating Frequency	578 MHz
Channel No.	#34(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 Electro-mechanical 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 spot 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 motor able 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/Metro track was avoided while collecting field strength data along a radial route.

## **Measurement Methodology:**

A map of the largest available scale may be used to mark the location of the transmitters. From the transmitter location eight radials are drawn passing through the transmitter location along North, East, South, West, North-East, North-West, South East & South West directions. For prediction of the coverage area, field strength measurement along a radial is 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 value. While taking static reception measurement LAT/LON, MSL & radial distance of each & every location was also recorded. Once all measurements have been undertaken, mast is fully retracted & then drive 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 motor able roads. The same procedures for field strength measurement/reception survey are adopted along all other eight radials. After data collection is 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 criteria are:

<b>Rural</b>	Areas with scarce isolated buildings, open fields.
<b>Suburban</b>	Small towns; residential areas with low building density and buildings not higher than two stories; wide roads or streets between buildings.
<b>Urban</b>	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

## **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. 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 upto 10 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 a 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, FF-Frequent Freezing, 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 & 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.

<b>Signal</b>	OK	No impairment in received audio/video quality.
	FF	Received frame simultaneously appearing-disappearing leading to irritable reception.
	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. Studied has been carried out worldwide to determine the minimum required field strength & MER value for satisfactory reception of DTT signal. Rec. ITU-R BT.2254 give minimum equivalent field strength at receiving location for satisfactory reception of DVB-T2 transmission are as illustrated in following table.

<b>Mode of reception</b>	<b>Minimum Field Strength</b>
Fixed Scenario	45.3 dB $\mu$ V/m
Portable/Outdoor/Urban	50.2dB $\mu$ V/m
Mobile/Rural	42.5 dB $\mu$ V/m

For large cities like Delhi it is a matter of further study to determine the minimum required field strength & MER value for satisfactory reception under existing environment conditions. In this survey it is also a scope of the survey to determine the minimum field strength & MER value for satisfactory reception of the DVB T2 Transmission & also to correlate them under existing terrain condition. Field strength measurements provide an efficient but definitive method of assessing station coverage.

## 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 Kundli, Gannaur, Samalkha, Kheri Nangal & Panipat up to a radial distance of 79 km. Satisfactory reception of DVB-T2 Transmission was observed to be up to a radial distance of 73km (Kheri Nangal, Panipat)
2. **Radial-2(North- East):** Along this radial field strength measurement done at location like Mandola, Balani(Merrut Highway), Upper Ganga Canal, Khattauli (Muzzafernagar Highway) & Muzzafernagar up to a radial distance of 110 km. Satisfactory reception of DVB-T2 Transmission was observed to be up to a radial distance of 95km (Jarauda Naraa Railway Station)
3. **Radial-3(East):** Along this radial field strength measurement done at location like Antriksha Apt, NH24, Lalkuwa, NH24, Dasana Pilkhuwa, Nijampur(Hapur Road) & Pannapuri Hapur up to a radial distance of 65 km. Satisfactory reception of DVB-T2 Transmission was observed to be up to a radial distance of 55km (Nijampur, Hapur Road).
4. **Radial-4(South- East):** Along this radial field strength measurement done at location like Sector 15( Noida), Festival City, Noida, Exp. Way, Sec-26, Exp.Way, Greater Noida ,Jhajhar(UP) & Jahangirpur up to a radial distance of 80 km. Satisfactory reception of DVB-T2 Transmission was observed to be up to a radial distance of 70km (Jhajhar UP).
5. **Radial-5(South):** Along this radial field strength measurement done at location like CariappaVihar(Ring Road Cantonment), Vasant Kunj, Mandi road , Bhondcee & Sohna up to a radial distance of 50 km. Satisfactory reception of DVB-T2 Transmission was observed to be up to a radial distance of 40km (Bhondcee).
6. **Radial-6(South-West):** Along this radial field strength measurement done at location like Janakpuri, Nazafgarh-Dhansa Road, Jhajjar, Farukhnagar, Pataudi (Rewari Road),Mundhalia & Rewari up to a radial distance of 75 km. Satisfactory reception of DVB-T2 Transmission was observed to be up to a radial distance of 70km (Mundhalia, Rewari).
7. **Radial-7(West):** Along this radial field strength measurement done at location like Vikas Vihar(Kirari Road),Bahadurgarh Bypass, Dujana, Sewana, Pilana, Sanjharwas (Rohtak Road) & Dadri up to a radial distance of 84 km. Satisfactory reception of DVB-T2 Transmission was observed to be up to a radial distance of 70km (Sewana).
8. **Radial-8(North-West):** Along this radial field strength measurement done at location like Rohini Phase V, Auchandi, Silana, Katwaal, Budana Kundu(Gohana) & Lalitkhera-Jind Road up to a radial distance of 90 km. Satisfactory reception of DVB-T2 Transmission was observed to be up to a radial distance of 73km (Butana Kundu, Gohana).

## **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, South-East, South-West, West & North-West direction is up to a radial distance of 70 km. In South & East direction coverage is up to 40 km. & 55km respectively whereas along North-East direction it is up to a radial distance of 95 km.
2. The coverage along North-East direction is found to be maximum(Upto 95 km.)
3. The coverage along South & East direction is the least .This shrinkage in coverage is mainly due to the existence of huge densely populated urban area having cluster of high raise buildings & skyscrapers causing shadowing effect & additional attenuation (Building Penetration Losses).
4. 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 50 dB $\mu$ V/m & MER over 12.0dB under existing environment condition. The predicted coverage contour itself reveals that DVB-T2 reception is satisfactory within the predicted coverage area (up to 40-95 km) with fixed roof top antenna mounted at a height of 10Mtrs from the ground.
5. No interference of unwanted signal in reception of DTT transmission has been observed within its coverage area.

## **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 condition. A comprehensive field strength survey of the said transmitter for reception in portable devices like smart mobile phone in densely populated areas, narrow lanes & inside different types of building falling within the coverage contour 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) Tower, Pitampura. Survey team also extends their gratitude to Sh. P.K.Singh (DDG) who has provided necessary equipment & actively cooperated to the survey team of research department. The survey team expresses their deepest sense of gratitude to Mrs. Anuradha Agarwal (ADG) & Sh. Deepak Kumar (DDG) whose motivation, suggestion & cooperation at every step helped in the successful completion of the survey.

# Reception survey for satisfactory coverage of DVB-T2 Transmitter (578MHz), Pitampura

Direction: North (Radial-1)

Table-1

Route: Pitampura-Kundli-Gannaur-Samalkha-Panipat

Date: 08/04/16

Time (Hrs).	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dB $\mu$ V/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
1145	Alipur	N 28° 47'32.8" E 77° 08' 35.8"	208	10.5	93.2	24.4	1.0E-6	1.0E-8	OK	Urban .Open. Moderate Traffic. Vegetation	
1245	Kundli	N 28° 53'20.5" E 77° 07' 00.2"	213	21.5	90.5	24.4	1.0E-6	1.0E-8	OK	Urban, Open, Low traffic	
1330	Khevda Village	N 28° 57'41.8" E 77° 07' 45.2"	210	29.4	80.8	26.9	1.0E-6	1.0E-6	OK	Rural, Low traffic Open, Vegetation	
1400	Chena tikkola Village	N 29° 02'04.4" E 77° 09' 21.8"	212	37.4	86.1	25.5	1.0E-6	1.0E-8	OK	Rural, No traffic, Vegetation	
1445	Gannaur	N 29° 08'52.0" E 77° 02' 16.4"	217	51.1	69.9	24.9	1.0E-6	1.0E-8	OK	Urban ,Low traffic, Vegetation	
1500	Karkoli Rakshera	N 29° 11'01.7" E 77° 07' 40.4"	218	55.0	69.2	21.1	1.0E-6	1.0 E-8	OK	Urban, low traffic, vegetation	
1515	Near Samalkha	N 29°13'38.2" E 77° 00' 55.5"	217	60	43.7	0.3	7.7E-2	1.0 E-7	NT	Suburban, Moderate traffic, Vegetation	
1600	Karse Village , near DPS, Panipat	N 29° 16'15.3" E77° 00'10.7"	223	65	52.3	3.8	3.6 E-2	6.0 E-8	FF	Rural, No traffic, Vegetation	
1630	Panipat Police line	N 29° 18'46.2" E77° 00'01.1"	223	70	53.1	21.0	7.0E-5	1.0E-8	OK	Rural, No traffic, Vegetation	
1700	Kheri Nangal, Panipat	N 29° 20'29.7" E76° 58'07.4"	221	73	52.7	12.8	6.9E-7	1.3E-8	OK	Suburban, Moderate traffic, Vegetation	
1720	Vikas Nagar, Panipat	N 29° 21'27.9" E76° 58'29.6"	223	75	48.0	6.3	8.5 E-5	1.2E-8	FF	Urban, Moderate traffic	
	Mahavir Colony Panipat	N 29° 23'17.8" E76° 58'00.0"	218	79	45.4	2.1	7.2E-6	1.0E-8	NT	Urban, Moderate traffic	



# Reception survey for satisfactory coverage of DVB-T2 Transmitter (578MHz), Pitampura

Direction: North-East (Radial-2)

Table-2

Route: Pitampura-Mandola (Khekhra Road)-Tikoli-Merrut Road-Balani (Merrut Highway)-Merrut-Muzzfernagar Highway

Date: 16/04/16

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			
1150	Jagatpur village (on Yamuna bank)	N 28° 45' 00.2" E 77° 13' 26.3"	200	10	85	26.3	1.0E-6	1.0E-8	OK	Rural, Open , No traffic, Vegetation	
1310	Mandola village (Khekhra Road)	N 28° 51' 22.0" E 77° 51' 29.4"	203	20	71	26.6	1.0E-6	1.0E-8	OK	Rural, Open , No traffic, Vegetation	
1415	Sainik Bhawan (Tikoli-Merrut Road)	N 28° 53' 53.0" E 77° 21' 48.9"	215	30	67	23.7	5.0E-4	1.0E-8	OK	Rural, Open , No traffic, Vegetation	
1440	Balani (Merrut Highway)	N 28° 57' 33.7" E 77° 26' 07.6"	217	40	68	26.6	1.4E-7	1.0E-8	OK	Rural, Open , No traffic, Vegetation	
1510	Jaanikurd (Merrut Highway)	N 28° 57' 50.7" E 77° 33' 56.9"	219	50	61	19.3	4.4E-4	3.0E-8	OK	Rural, Open , No traffic, Vegetation	
1610	Upper Ganga canal Road	N 29° 04' 45.4" E 77° 35' 58.7"	222	61	54	19.4	2.2E-4	1.5E-8	OK	Rural, Open , No traffic, Vegetation	
1640	Upper Ganga canal Road)	N 29° 09' 32.6" E 77° 38' 29.9"	222	70	61	20.2	1.6E-4	1.5E-8	OK	Rural, Open , No traffic, Vegetation	
1700	Upper Ganga canal Road)	N 29° 12' 11.4" E 77° 40' 01.4"	220	75	63	21.5	1.0E-4	3.0E-8	OK	Rural, Open , No traffic, Vegetation	
1715	Upper Ganga canal Road)	N 29° 14' 33.0" E 77° 41' 23.3"	223	80	52	21.5	1.6E-4	3.0E-8	OK	Rural, Open ,Moderate traffic, Vegetation	
1745	Khattauli(Muzzafnrg H/way)	N 29° 17' 08.4" E 77° 42' 46.2"	223	85	58	13.5	4.4E-4	1.0E-8	OK	Rural, Open ,Moderate traffic, Vegetation	
1755	Khattauli(Muzzafnrg H/way)	N 29° 18' 44.7" E 77° 43' 22.9"	224	88	55	21.9	1.6E-4	1.0E-8	OK	Rural, Open ,Moderate traffic, Vegetation	
1800	Khattauli(Muzzafnrg H/way)	N 29° 20' 24.7" E 77° 43' 02.7"	224	90	63	21.5	1.1E-4	1.0E-8	OK	Rural, Open ,Moderate traffic, Vegetation	
1820	Jarauda Naraa Railway Station	N 29° 24' 38.8" E 77° 41' 51.7"	224	95	52	20.5	1.7E-4	1.0E-8	OK	Rural, Open ,Moderate traffic, Vegetation	
1845	Muzzaferpur	N 29° 27' 56.2" E 77° 41' 42.0"	224	100	50	9.7	1.4E-4	1.0E-8	FF	Urban, Moderate Traffic, Vegetation	
1900	Muzzaferpur	N 29° 30' 40.9" E 77° 42' 32.0"	223	105	46	4.4	1.3E-4	1.8E-7	F	Urban, Moderate Traffic, Vegetation	
1920	Muzzaferpur-Manglaur Road	N 29° 32' 18.3" E 77° 44' 39.8"	224	110	43	--	--	--	NT	Urban, Moderate Traffic, Vegetation	

# Reception survey for satisfactory coverage of DVB-T2 Transmitter (578MHz), Pitampura

Direction: East (Radial- 3)

Table-3

Route: Pitampura-Antriksha Apartment (NH-24)-Dasana-Pilkhuwa-(Hapur Road)-Hapur

Date: 09/04/16

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dB $\mu$ V/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
1345	Antriksha Apt, NH24 Ghaziabad	N 28° 38' 14.7" E 77° 23' 47.3"	192	25	60.8	12.2	6.1E-4	4.5 E-8	OK	Urban High Rise Building, Moderate traffic	
1415	Lalkuwa, NH24	N 28° 38' 04.2" E 77° 27' 26.8"	206	30.7	64.4	17.7	1.5 E-4	1.5 E-8	OK	Urban High Rise Building, Moderate traffic	
1530	Dasana	N 28° 40'59.8" E 77°30' 34.3"	214	35	66.2	11.8	4.1E-3	4.5 E-8	OK	Urban, Heavy traffic	
1600	Masuri, Hapur Road,	N 28°41'29.9" E 77°33'44.6"	206	40	63.5	12.5	2.5E-4	1.0E-8	OK	Urban, No vegetation, Moderate traffic	
1620	Mother dairy, Hapur road, Pilkhuwa	N 28° 42' 02.0" E 77° 36' 49.7"	203	45	57.7	13.3	5.7E-2	3.0E-8	OK	Urban, Moderate traffic	
1645	Pilkhuwa	N 28° 42' 39.3" E 77° 40' 02.8"	201	50	47.6	9.2	2.5E-2	1.5 E-8	FF	Urban , Moderate traffic	
1650	Nijampur, Hapur road	N 28° 43' 08.4" E 77° 42' 52.2"	202	55	58.2	12.8	1.2E-5	1.0 E-8	OK	Urban , Moderate traffic	
1700	Sabli mode, Delhi road, Hapur	N 28°43'43.0" E 77° 45' 55.2"	201	60	53.4	0.5	3.8E-2	1.5E-8	FF	Urban, Low traffic	
1730	Pannapuri,Hapur	N 28° 43' 44.7" E 77° 47' 24.2"	202	65	53.2	1.09	4.1E-8	6 E-8	FF	Urban, Market, Moderate traffic	

# Reception survey for satisfactory coverage of DVB-T2 Transmitter (578MHz), Pitampura

Direction: South-East (Radial- 4)

Table-4

Route: Pitampura-Sector-15(Noida)-Festival City (Express Highway)-Jajjar Road-Jahangirpur

Date: 12/04/2016

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			
1210	Sector 15, Noida	N 28° 34' 47.4" E 77° 18' 19.0"	193	20	52.2	12.4	7E-2	3.5E-4	OK	Urban, Low traffic, Vegetation,	
1230	Noida Exp. way, Amity university	N 28° 32' 38.4" E 77° 20' 24.4"	190	25	50.6	17.7	3E-2	3.8E-8	OK	Urban ,Open, , Moderate traffic	
1245	JP Hospital, Noida Exp. way	N 28° 30' 57.6" E 77° 22' 54.6"	190	30	42.1	14.8	2.2E-2	1.6 E-7	OK	Urban ,Open, , Moderate traffic	
1300	Festival City, Noida, Exp. way	N 28° 29' 30.2" E 77° 25' 28.1"	192	35	53.6	12.4	4.7E-2	1.0 E-8	OK	Rural ,Open, , Moderate traffic	
1330	Noida Exp way	N 28° 27' 45.1" E 77° 27' 40.8"	188	40	61.4	17.8	1.8E-2	4.5 E-7	OK	Rural ,Open, , Moderate traffic	
1345	INOX Cinema, Kasana Road,	N 28° 27' 22.1" E 77° 31' 24.6"	190	45.3	57.5	12.5	1.4E-2	6.0 E-8	OK	Urban ,Open, , Moderate traffic	
1500	Sec-26, Exp.Way, Greater Noida	N 28° 23' 36.7" E 77° 31' 45.5"	189	50	57.2	13.1	4E-3	6.0E-8	OK	Urban, No traffic	
1530	Manua ka Rajpur	N 28° 21' 52.2" E 77° 34' 01.4"	195	55	56.8	25.3	2.8E-5	1.0E-8	OK	Rural, No traffic, Vegetation	
1615	Jajjar road , 1km ahead of Usmanpur	N 28° 19' 28.1" E 77° 35' 43.9"	184	60	55.3	17.5	3.7E-3	5.1E-8	OK	Rural, No traffic, Vegetation	
1640	Jhajhar road	N 28° 17' 36.1" E 77° 37' 57.5"	188	65	50.7	14.9	4.5E-4	6.0E-8	OK	Rural, No traffic, Vegetation	
1700	Jhajhar(UP)	N 28° 15' 54.7" E 77° 39' 35.5"	188	70	55.2	12.0	1.1E-1	3.6 E-7	OK	Rural, No traffic, Vegetation	
1730	Jahangir pur, Jhajhar road	N 28° 14' 13.8" E 77° 41' 02.6"	183	73	53.5	3.3	3.2 E-2	4.5 E-8	FF	Rural, No traffic, Vegetation	
1800	Jahangirpur power house	N 28° 12' 00.5" E 77° 41' 55.3"	184	77	45.5	3.5	3.5 E-6	6.0 E-8	FF	Rural, No traffic, Vegetation	
1810	Bhunna road, Arya nagar, Jahangir pur	N 28° 09' 58.3" E 77° 42' 22.3"	185	80	52.1	4.5	5.7 E-4	1.3 E-8	FF	Rural, No traffic, Vegetation	

# Reception survey for satisfactory coverage of DVB-T2 Transmitter (578MHz), Pitampura

Direction: South (Radial-5)

Table-5

Route: Pitampura-Vasant Kunj-Mandi Border-Badshahpur Sohna Road

Date: 07/04/16

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dB $\mu$ V/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
1440	CariappaVihar, Ring Road, Cantonment	N 28° 36' 25.1" E 77° 08' 25.3"	223	10	72.4	19.5	4.7E-5	1.0E-8	OK	Urban, Vegetation	
1530	Vasant Vihar Holy child school	N 28° 33' 36.8" E 77° 09' 49.1"	239	15	69.8	19.4	1.0E-8	1.0E-8	OK	Urban, Vegetation Moderate traffic	
1645	Vasant Kunj	N 28° 30' 57.1" E 77° 09' 46.3"	265	20	66.2	21.2	1.0E-6	1.0E-8	OK	Urban, Vegetation, Heavy traffic	
1715	Junapur Village Mandi road	N 28° 28' 17.5" E 77° 09' 22.2"	253	25	70.1	12.9	3.7E-4	1.0E-8	OK	Rural , Vegetation, Low traffic	
1800	Ghaatta	N 28° 25' 30.4" E 77° 06' 46.3"	253	30	74.0	23.3	1.0E-6	1.0E-8	OK	Urban, Vegetation Moderate traffic	
1830	Badshahpur, Sohana road	N 28° 41' 51.6" E 77° 09' 01.8"	218	35	55.6	15.5	7.4E-3	1.0E-8	OK	Rural , Vegetation ,No traffic	
1900	Bhondcee	N 28° 20' 35.3" E 77° 04' 04.9"	212	40	58.4	13.1	5.96E-3	1.0E-8	OK	Rural, Vegetation, moderate traffic	
1915	5 kM. ahead Sohana Road	N 28° 17' 42.2" E 77° 03' 59.5"	210	45	53.3	2.9	5.4E-2	1.0E-8	FF	Rural, Vegetation, Moderate traffic	
1930	Sohana	N 28° 14' 57.3" E 77° 04' 49.1"	208	50	48.4	1.2	--	--	--	Urban, Vegetation, Moderate Traffic	

# Reception survey for satisfactory coverage of DVB-T2 Transmitter (578MHz), Pitampura

Direction: South-West (Radial- 6)

Table-6

Route: Pitampura-Janakpuri-Nazafgarh Road-Dhansa-Farrukh Nagar-Pataudi Road-Riwari Road-Jind (Riwari)

Date: 10/04/2016

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dB $\mu$ V/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
1130	Janakpuri, D-1 Block	N 28° 36' 36.9" E 77° 06' 14.3"	209	10.7	64.2	12.9	4.5E-4	6 E-8	OK	Urban, Market, Moderate traffic	
1310	Nazafgarh-Dhansa Road	N 28° 36' 35.9" E 76° 58' 12.9"	210	20	69.9	22.8	6.9E-5	1.0 E-8	OK	Urban, Moderate traffic	
1340	Hajipur Rd. Dhansa	N 28° 34' 33.8" E 76° 52' 38.1"	205	30	78.6	21.6	1.0E-6	1.0E-8	OK	Rural, Open. Vegetation	
1415	Laadpur, Jhajjar	N 28° 32' 54.6" E 76° 46' 37.1"	212	40	76.7	28.0	1.0 E-6	1.0E-8	OK	Rural, Vegetation, No traffic	
1445	Shiojipur, Jhajjar,(Dadri)	N 28° 31' 45.8" E 76° 43' 38.3"	213	45	64.6	20.4	12.4 E-5	1.0 E-8	OK	Rural, Vegetation, No traffic	
1545	Farrukh Nagar	N 28° 27' 48.1" E 76°49' 32.5"	221	40	82.1	25.5	1.0E-6	1.0 E-8	OK	Rural ,Highway, Low traffic,	
1715	Jharodi kalan (Pataudi Road),	N 28° 21' 39.6" E 76° 48' 27.5"	224	50	51.2	11.9	4.2 E-4	5.3E-8	OK	Highway, Rural, Low traffic. Vegetation	
1740	Pataudi , (Rewari Road),	N 28° 19' 18.4" E 76° 46' 06.6"	224	55	62.7	7.05	4.1 E-3	1.0 E-8	OK	Rural, Vegetation, low traffic	
1800	Rewari Road	N 28° 17' 57.5" E 76° 43' 48.6"	223	60	51.5	4.2	3.8 E-2	1.5E-8	FF	Rural, Vegetation, low traffic	
1830	Zaid, Rewari	N 28° 17' 03.3" E 76° 40' 38.3"	219	65	56.3	14.8	4.6 E-4	1.0E-8	OK	Rural, Vegetation, low traffic	
1845	Mundhalia, ( near Rewari)	N 28° 15' 01.5" E 76° 38' 39.7"	223	70	52.5	13.1	4.2 E-4	1.0E-8	OK	Rural, Vegetation, No traffic	
1915	Rewari	N 28° 15' 01.5" E 76° 38' 39.7"	220	75	50.1	3.1	3.7E-4	1.0E-8	F	Urban, Moderate Traffic,	

# Reception survey for satisfactory coverage of DVB-T2 Transmitter (578MHz), Pitampura

Direction: West (Radial- 7)

Table-7

Route: Pitampura—Bahadurgarh Bypass-Matanchara Road- Dubaldhan road-Sewana-Pilana (Rohtak)-Dadrikalannaur road

Date: 14/04/2016

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dB $\mu$ V/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
1145	Vikas Vihar, Kirari road	N 28° 42' 55.0" E 77° 03' 00.4"	205	11	67.9	26.9	1.0 E-6	1.0 E-8	OK	Urban, Moderate traffic	
1230	Bahadurgarh bypass	N 28° 41' 02.4" E 76° 56' 46.9"	208	20	76.2	25.1	1.0E-6	1.0 E-8	OK	Urban,, Low traffic, Highway HighwayVEGETATION	
1300	Matanchara Bahadurgarh- Matan road	N 28° 41' 42.8" E 76° 50' 28.2"	209	30	86.3	23.6	4.5E-5	1.0E-8	OK	Rural, No traffic, Highway	
1320	Matanchara road,	N 28° 41' 37.4" E 76°44' 24.0"	208	40	66.4	25.3	1.0 E-6	1.0 E-8	OK	Rural, No traffic, Highway	
1345	Dujana( DRP School) Beri Road	N 28°41' 15.2" E 76°38' 14.0"	213	50	75.6	24.7	9.0 E-5	2.5 E-8	OK	Rural, No traffic, Highway	
1430	Dubaldhan Canal Dubaldhan Road	N 28° 41' 30.8" E 76° 31' 56.2"	221	60	64.5	24.3	1.5 E-6	1.0 E-8	OK	Rural, No traffic, Highway	
1450	Sewana	N 28° 42' 13.5" E 76° 26' 01.2"	215	70	54.6	13.9	5.5 E-2	4.5 E-7	OK	Rural, No traffic, Highway	
1515	Pilana,( Newton public school) Rohtak,	N 28° 42' 44.5" E 76° 22' 53.7"	216	75	47.5	2.0	5.5 E-2	8.3 E-5	FF	Rural, No traffic, Highway	
1530	Ranila, Rohtak road	N 28° 42' 42.6" E 76° 21' 06.1"	214	78	54.2	NT	NT	NT	NT	Rural, No traffic, Highway	
1600	Sanjharwas, Rohtak road	N 28° 43' 46.6" E 76° 19' 14.9"	197	81	43.7	NT	NT	NT	FF	Rural, No traffic, Highway	
1620	Dadri, Charkhi Dadri-Rohtak Road.	N 28° 42' 19.0" E 76°17' 33.8"	199	84	46.3	NT	NT	NT	NT	Rural, No traffic, Highway	

# Reception survey for satisfactory coverage of DVB-T2 Transmitter (578MHz), Pitampura

Direction: North-West (Radial- 8)

Table-8

Route: Pitampura-Rohini Phase-V (Bawana Road)-Auchandi-Silana-Gohana-Lalit Kheda (Jind Road)

Date: 13/04/2016

Time (Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dB $\mu$ V/m)	COFDM (IRD) Parameter			Subjective Assessment	Terrain	Remarks
						MER (dB)	BER				
							LDPC	BCH			
1315	Rohini Phase-V,Sec-34-35 Bawana Road,	N 28° 45' 19.5" E 77° 04' 13.8"	210	10	78.8	22.2	1.0 E-8	1.0 E-8	OK	Urban, Moderate traffic, Vegetation	
1400	Auchandi ( Govt Sarvodya School)	N 28° 49'11.6" E 76° 59' 55.2"	215	20	83.1	26.6	1.0 E-8	1.0 E-8	OK	Rural, No traffic, Vegetation	
1420	Kharkhanda, Delhi road	N 28° 52'26.3" E 76° 55' 00.1"	219	30	73.5	26.5	1.0 E-8	1.0 E-8	OK	Urban, No traffic,	
1545	Silana (Sonipat)	N 28° 56' 22.3" E 76° 50' 42.9"	212	40	74.6	27.2	1.0 E-8	1.0 E-8	OK	Rural, No traffic, Vegetation	
1600	Farmana ( Sonipat Road)	N 28° 58' 38.2" E 76°48' 55.5"	211	45	78.4	24.2	1.0 E-6	1.0 E-8	OK	Rural, No traffic, Vegetation	
1620	Katwaal ( Gohana)	N 29° 03' 22.2" E 76° 45' 25.1"	214	55	57.9	20.3	6.9 E-4	1.0 E-8	OK	Rural, No traffic, Vegetation	
1640	Sikanderpur Mazra, (Gohana)	N 29° 05'54.8" E 76° 44' 13.3"	215	60	64.2	21.5	8.0 E-5	1.0E-8	OK	Rural, No traffic, Vegetation	
1700	Gohana, Town	N 29°08' 06.5" E 76°42' 23.0"	215	65	51.7	20.9	2.4E-4	1.5 E-8	OK	Urban, Moderate traffic	
1745	Khadrai Village, Gohana - Jind road	N 29° 09'48.1" E 76° 39' 46.0"	218	70	56.3	16.8	3.3 E-4	4.3 E-8	OK	Rural, State Highway, No traffic	
1800	Butana Kundu Gohana	N 29° 10'47.2" E 76° 38' 13.3"	216	73	52.4	16.8	4.0 E-4	1.3 E-8	OK	Rural, State Highway, No traffic	
1815	Gohana - Jind Road	N 29° 11' 37.8" E 76° 36'31.9"	213	76	53.3	10.4	1.2 E-2	3.0E-8	FF	Rural, State Highway, No traffic	
1820	Nooran Kheda Jind Road	N 29° 12' 42.1" E 76°34' 16.0"	215	80	42.6	10.5	5.5 E-2	5.7 E-8	NT	Rural, State Highway, No traffic	
1845	Bhambheva, Jind Road	N 29°13'46.6" E 76° 33' 18.1"	214	83	53.2	11.5	4 E-2	1.25 E-8	FF	Rural, State Highway, No traffic	
1855	Lalit Kheda, Jind road	N 29°14'18.4" E 76° 31' 42.9"	212	85	54.5	10.2	3.8E-4	1.0 E-8	FF	Rural, Vegetation, No traffic	
1910	Jind Road, Lalit Kheda	N 29° 15' 17.8" E 76°28' 38.3"	211	90	44.7	3.0	3.0E-2	4.5 E-8	NT	Rural, Vegetation, No traffic	

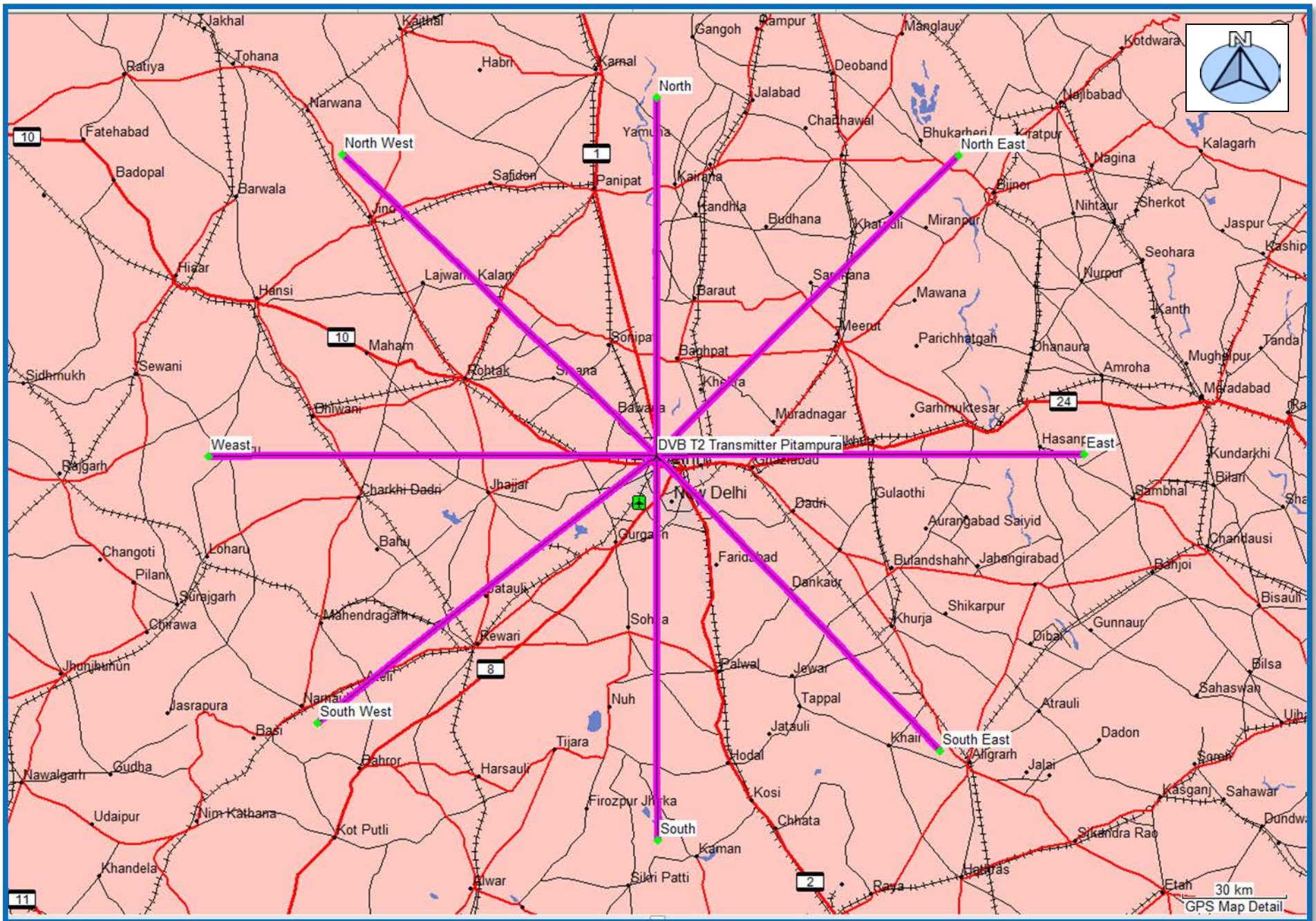
# Reception survey for satisfactory coverage of DVB-T2 Transmitter (578MHz), Pitampura

Table for satisfactory coverage of DVB-T2 Transmission in QPSK Mode

Table-9

Direction	Spot/Location	Location Co-ordinates	MSL (Meters)	Radial Distance (kM)	Field Strength (dBµV/m)	COFDM (IRD) Parameter			Subjective Assessment
						MER (dB)	BER(Pre)		
							LDPC	BCH	
North	Kheri Nangal, Panipat	N 29° 20'29.7" E76° 58'07.4"	221	73	52.7	12.8	6.9E-7	1.3E-8	OK
North-East	Jarauda Naraa Railway Station (UP)	N 29° 24' 38.8" E 77° 41' 51.7"	224	95	52.0	20.5	1.7E-4	1.0E-8	OK
East	Nijampur, Hapur road (UP)	N 28° 43' 08.4" E 77° 42' 52.2"	202	55	58.2	12.8	1.2E-5	1.0 E-8	OK
South-East	Jhajhar (UP)	N 28° 15' 54.7" E 77° 39' 35.5"	188	70	55.2	12.0	1.1E-1	3.6 E-7	OK
South	Bhondcee (Ashram),Haryana	N 28° 20' 35.3" E 77° 04' 04.9"	212	40	58.4	13.1	5.96E-3	1.0E-8	OK
South-West	Mundhalia (Near Rewari),Haryana	N 28° 15' 01.5" E 76° 38' 39.7"	223	70	52.5	13.1	4.2 E-4	1.0E-8	OK
West	Sewana (Haryana)	N 28° 42' 13.5" E 76° 26' 01.2"	215	70	54.6	13.9	5.5 E-2	4.5 E-7	OK
North-West	Butana Kundu, Gohana(Haryana)	N 29° 10'47.2" E 76° 38' 13.3"	216	73	52.4	16.8	4.0 E-4	1.25 E-8	OK

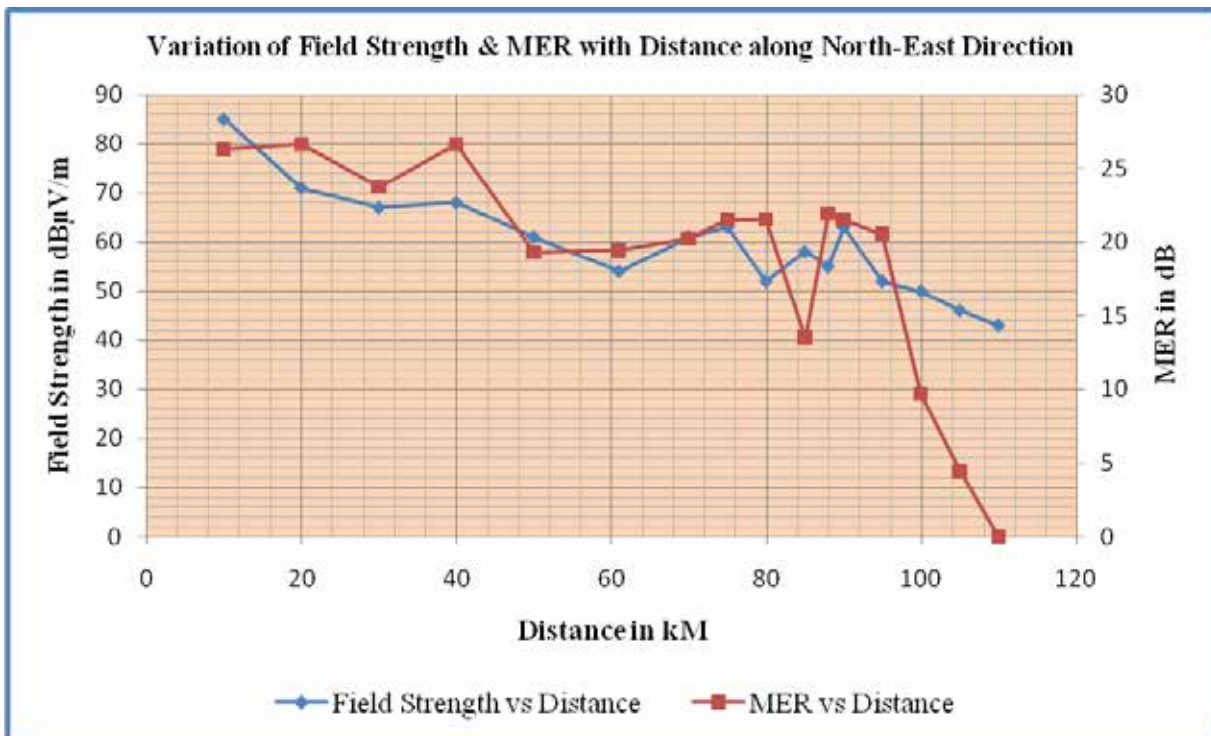
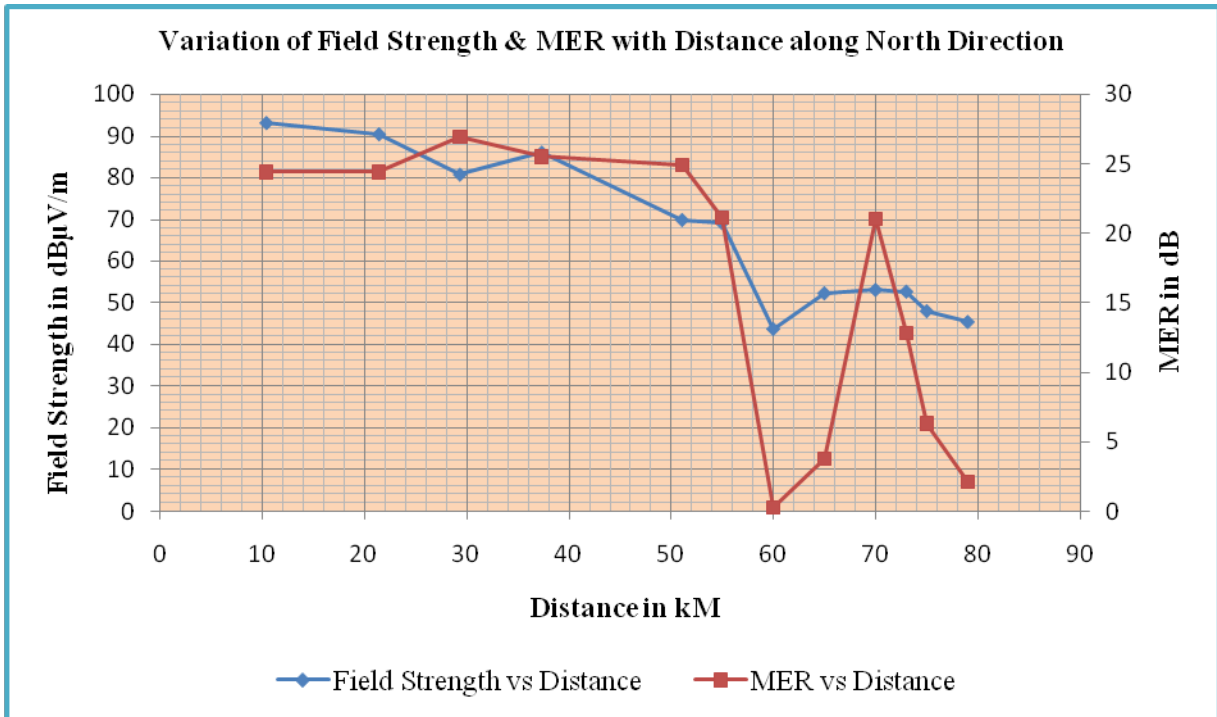




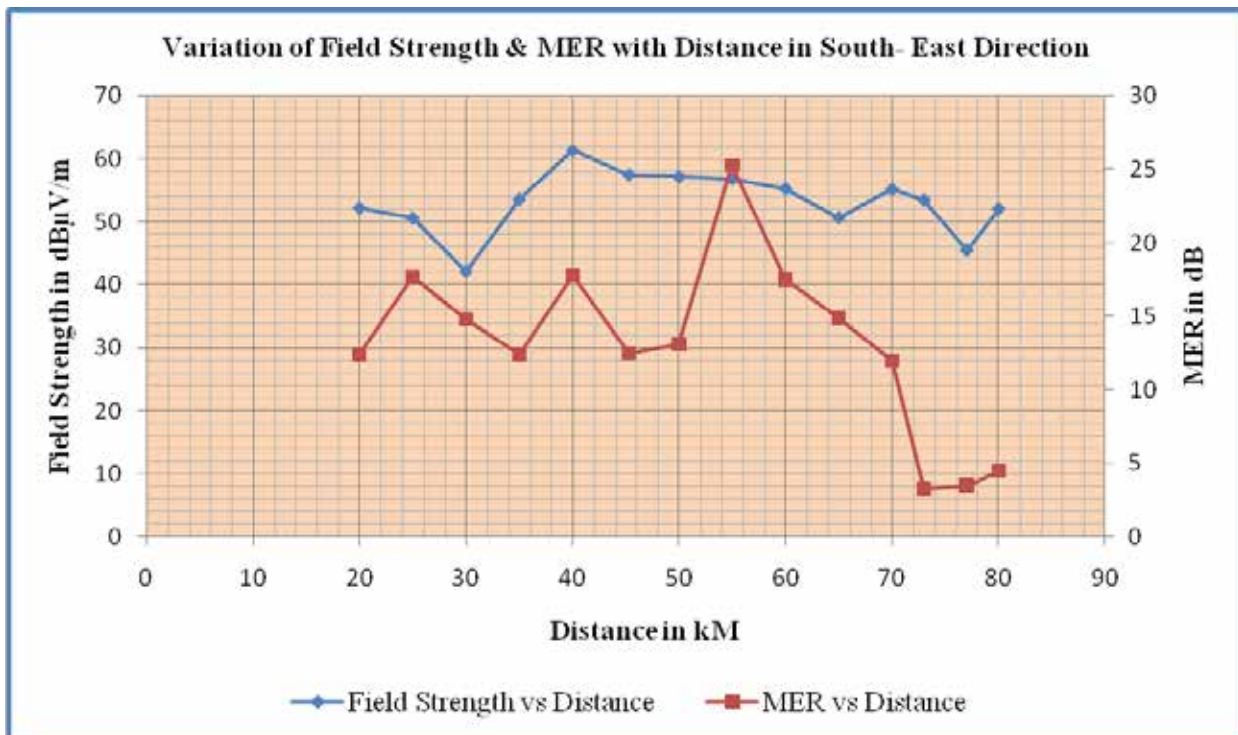
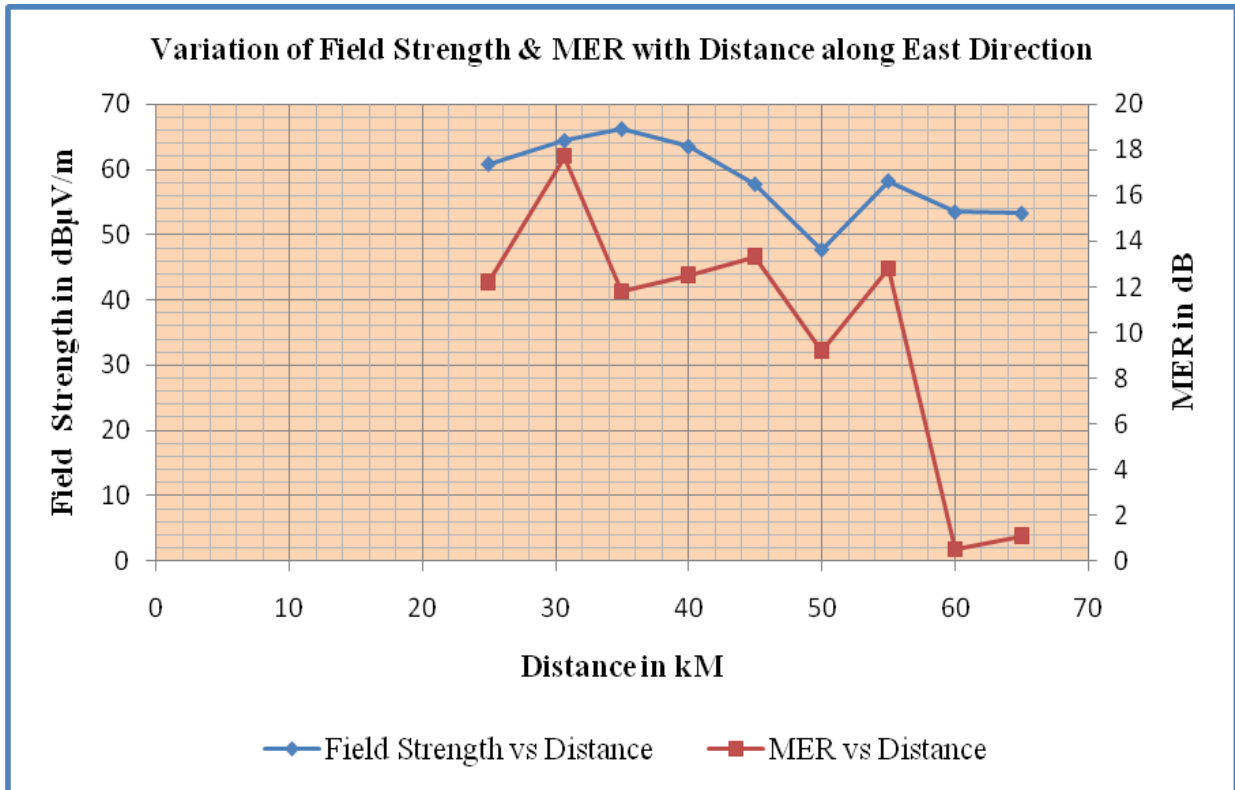
Route Map for reception survey of DVB-T2 Transmitter located at HPT (TV) Tower, Pitampura (New Delhi)

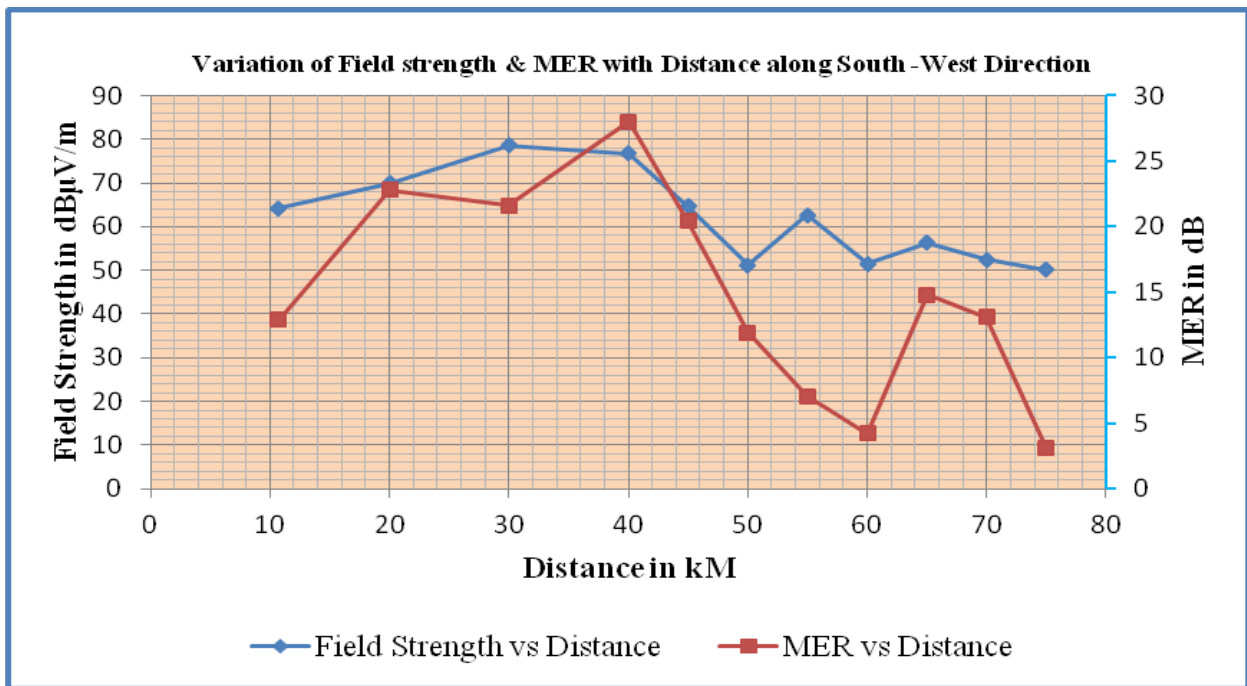
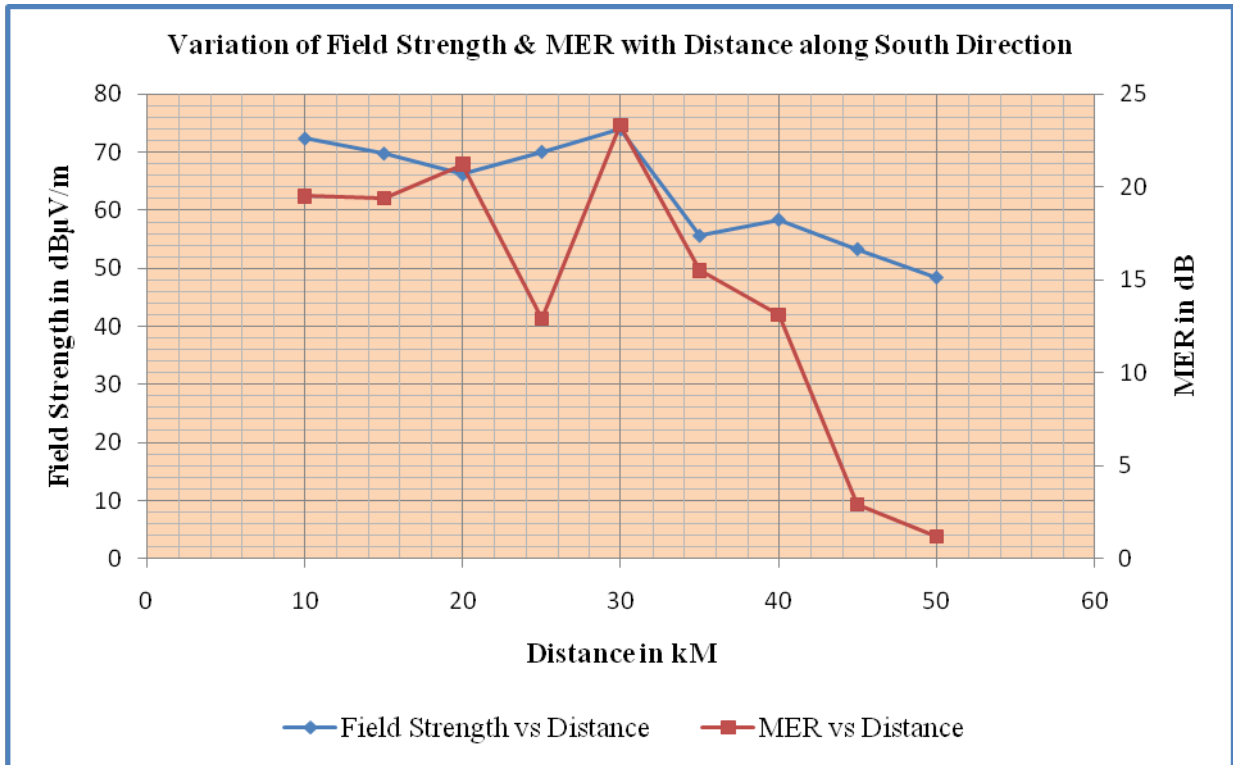


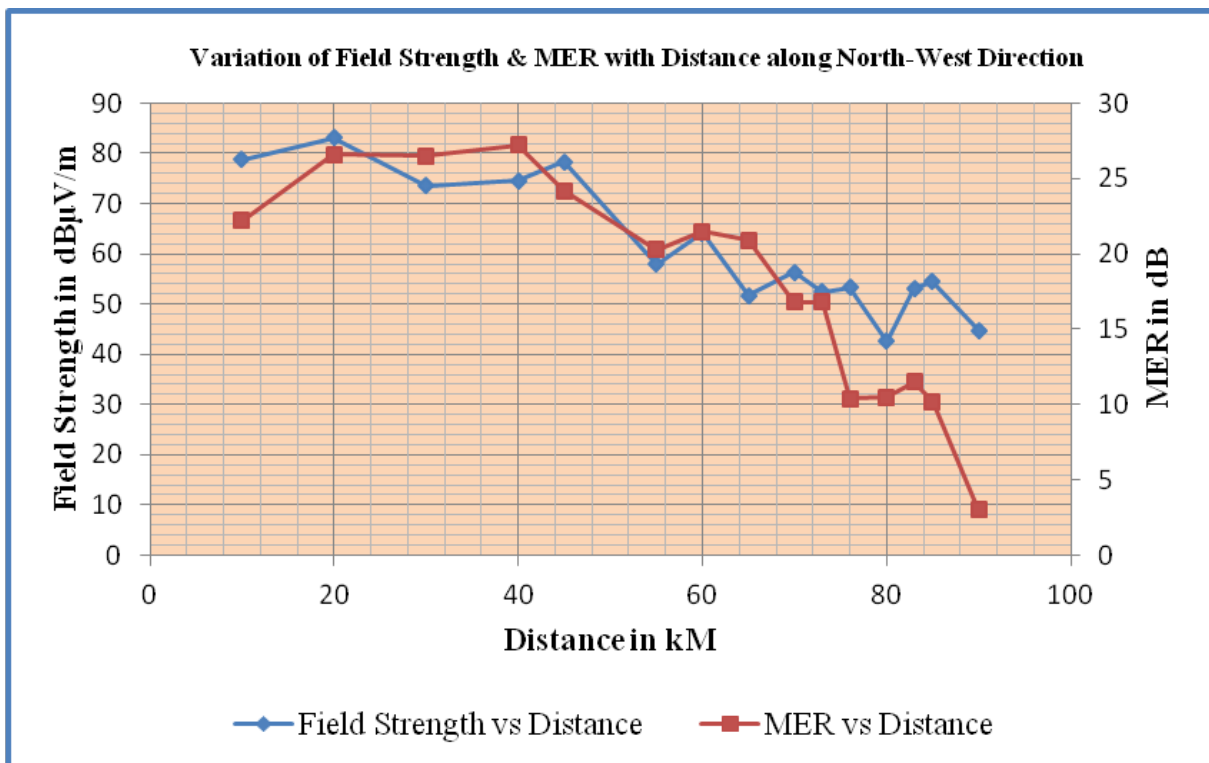
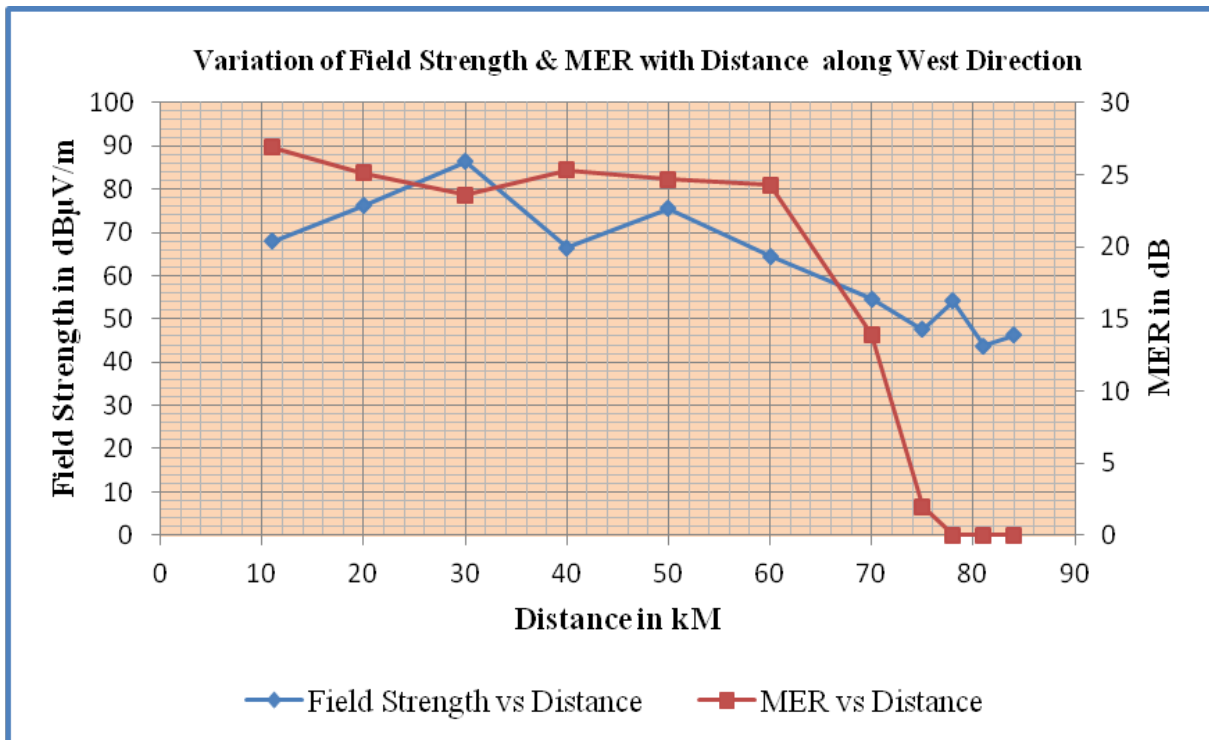




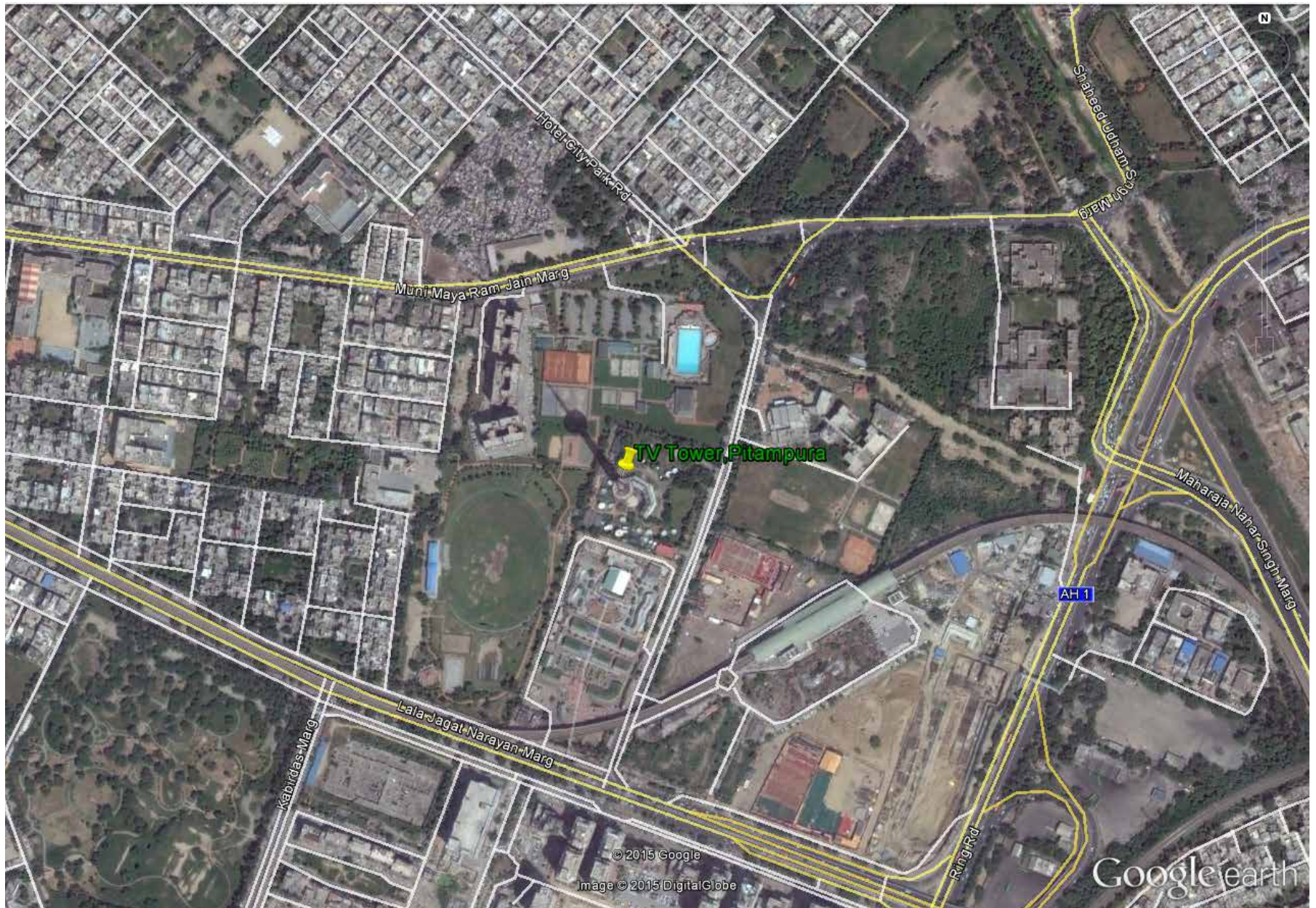












Location Map (3D View) of TV Tower Pitampura, Delhi