
*Combined Reception Survey Report of
200kW MW AM-DRM Transmitter
(Chennai-A) in Simulcast mode & 20kW
MW AM-DRM Transmitter (Chennai-C)
in Full DRM mode*

Combined Reception Survey
Report of 200kW MW AM-DRM
Transmitter (Chennai-A) in
Simulcast mode & 20kW MW AM-
DRM Transmitter (Chennai-C) in
Full DRM mode

(Survey Period: 6/9/17 to 15/9/17)

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Basic Data and Transmitter details

Chennai-A,

Transmitters Details:

1. Name of the Station : HPT-AIR, Avadi- Chennai
2. Location of the Tx Active Antenna : N 13.14786 E 80.12814
3. Terrain around Tx Antenna : Open Areas
4. Traffic : Low
5. Classification of Area : Urban
6. Rated Power of the Transmitter : 200 kW
7. Make & Model : Nautel NX-200
8. Frequency of Operation : 720 KHz (AM) 729 KHz (DRM)
9. Date of Commissioning : 25/7/2015

Transmitting Antenna Details

1. Type of Antenna : Vertical Self Radiating Mast, DA type
2. Height of Antenna : 148 meters (Active), 121.6 meters
3. DA System : Passive element at a distance of 42 Meters (121.6 meters) in South-West direction from Active mast

Basic Data and Transmitter details

Chennai-C,

Transmitters Details:

1. Name of the Station : HPT-AIR, Avadi- Chennai
2. Location of the Tx Active Antenna : N 13.14140 E 80.12697
3. Terrain around Tx Antenna : Open Areas
4. Traffic : Low
5. Classification of Area : Urban
6. Rated Power of the Transmitter : 20 kW
7. Make & Model : Harris, 3DX25
8. Frequency of Operation : 783 KHz (DRM)
9. Date of Commissioning : 12/4/2013

Transmitting Antenna Details

1. Type of Antenna : Vertical Self Radiating Mast
2. Height of Antenna : 91.5 meters, ECIL Make

This mast is being used with one additional transmitter (Chennai-B) of 20 kW power with rejecter system in place. The frequency of the additional transmitter is 1017 KHz.

1. INTRODUCTION

Digital Radio Mondiale (DRM) is one of the worldwide digital radio standards accepted by the ITU. The DRM standard has configurations (modes) suitable for frequencies up to 30 MHz and additional modes (DRM+) for frequencies up to band III. In order to migrate from analog AM transmission to digital (DRM), simulcast technology will be used for suitable migration for a few years. Later, full DRM or DRM only transmission will be on air from the vast network of AIR radio transmitters spread across India.

2. OBJECTIVES

Directorate General, AIR has directed the Research Department to monitor the reception of the AM-DRM signal originating from the medium-wave transmitter (200kW & 20 kW) of HPT-AIR, Chennai for the purpose of obtaining coverage with the following configurations:

1. In simulcast mode during the normal transmission periods in case of Chennai 'A' transmitter.
2. In pure DRM in case of 20 kW Chennai 'C' transmitter.
3. In pure DRM at provided timings in the case of Chennai 'A' transmitter.

3. EQUIPMENTS USED

- Field strength meter and tripod make: Anritsu model MS2713E with Antenna (Loop) make: Schwarzbeck model FMZB 1513.
- Professional DRM receiver
Make: Fraunhofer
Model: DT700
- Garmin make Montana 650, GPS
- Avion commercial receiver
- Dell Studio laptop computer
- Su-Kam sine wave inverter (1400 VA)
- Philips commercial receiver
- DRM-PC radio, Make: WIN RADIO, Model:G313e
- Active Antenna, Schwarzbeck
- Passive 1 meter length antenna
- Tools- assorted
- Mobile set

4. METHODOLOGY & PARAMETERS

AIR's medium wave transmitter is situated in Chennai. The antenna is a self-supported radiating mast with DA system. The passive element of DA system is ungrounded and lies in South-West direction from active mast in case of Chennai-A 200 kW transmitter. The transmitter is new with R.F. analog power of 200 kW. It is capable of radiating Simulcast as well as pure DRM signals. In Simulcast mode, DRM power can be set @12dB, 14dB and 16dB down of full analog power.

The Chennai-C transmitter is also installed in the same campus. This transmitter is working in full DRM mode carrying two nos. of audio channels. The self radiating mast of this transmitter is radiating RF power of one more transmitter of 20 kW power with suitable diplexer and rejecter circuits in ATU.

The geographical location of Chennai is not central in the state of Tamil Nadu, and suitable radials only in five different directions were clearly identified for the purpose of survey. Rest three directions lies inside the Bay of Bengal Sea.

For full DRM reception, route towards West on Chennai to Bengaluru road has been selected. For Simulcast & full DRM transmission, AIR-Directorate has set the parameters for Chennai which is as follows:

- DRM back off ratio in Simulcast : -16 dB
- Frequency of operation in Simulcast Service : Fc+9 kHz
- Robustness Mode : A
- MSC QAM : 16
- SDC QAM : 4

One commercial vehicle (Innova) has been equipped with all relevant equipments with one passive antenna of one meter length installed on rooftop of the vehicle. The route map is annexed as Map-VII.

In each selected route, spots were identified for field strength measurement as well as digital parameters like MER & SNR on a professional receiver. In order to avoid results influenced by time variations, median field strength was observed at each location. At many spots, 4 to 5 measurements were carried out within a small defined area to calculate mean field strength keeping in consideration the location probability factors. While taking measurements along different radial directions from the transmitter on suitable motorable roads, field strength in dB μ v/m has been observed at suitable intervals. Simultaneously the quality of the AM reception was also monitored on an ordinary cheap

Radio receiver and as well as on good quality Sony receiver and the subjective quality was noted. Similarly subjective reception of digital signal was also observed on professional and cheap digital receivers. Our main objective was to obtain day time primary coverage areas in each route as per latest ITU recommendations.

Similarly many DRM parameters like Doppler/ Delay, Channel estimation, MER & SNR values also checked to assess the quality of received DRM signal. As DRM technology is very new in our network, understandings of key received parameters (As received on Win Radio and DT 700) are very useful. Few such parameters are described below:

- Doppler / Delay: The Doppler frequency of the channel is estimated using Wiener filter design of channel estimation in time direction. If linear interpolation is set for channel estimation in time direction, this estimation is not updated. The Doppler frequency is an indication of how fast the channel varies with time. The higher the frequency, the faster the channel changes are.
- Protection level (B/A): The different protection levels are defined in the DRM standard. Protection level 0 has the highest protection where level 4 has the lowest protection. The letters A & B are the names of the higher and lower protected parts of a DRM block when Unequal Error Protection is used. If Equal Error Protection is used, only the protection level of part B is valid.
- DRM Mode / Bandwidth: In a DRM system, four possible robustness modes are defined to adapt the system to different propagation channel conditions. As per DRM standard:
 - ❖ Mode A: Gaussian channels, with minor fading.
 - ❖ Mode B: Time and frequency selective channels, with longer delay spread.
 - ❖ Mode C: As Robustness mode B, but with higher Doppler spread.
 - ❖ Mode D: As Robustness mode B, but with severe delay and Doppler spread.

Audio services are transmitted in the main service channel (MSC) of the DRM multiplex. For all robustness modes two different modulation schemes (16- or 64-QAM) are defined for the MSC, which can be used in combination with one or two (16 QAM) or four (64 QAM) protection levels, respectively.

Each protection level is characterized by a specific parameter set for the two (16-QAM) or three (64-QAM) convolutional encoders, resulting in a certain average code rate for the overall multilevel encoding process in the modulator. For 16-QAM protection level, No. 0 corresponds to an average code rate of 0.5; No. 1 to 0.62.

For DRM robustness mode A (QAM-16) minimum S/N should be 12 dB to achieve BER of 1×10^{-4} . This will give uninterrupted high quality digital audio. The required minimum field strength value for DRM reception depends upon man made noise and some other factors also.

The ITU recommended minimum field strength value for day time primary coverage for AM is 63 dB μ V/ m.

As a standard practice before the start of detailed survey, it is essential to ascertain the actual radiated power. The field strength readings thus obtained, at a distance of 1 KM in clear line of sight from the antenna, was recorded and tabulated (Table-9).

5. DATA ANALYSIS OF SIMULCAST & PURE DRM TRANSMISSION OF CHENNAI 'A' & 'C'

A. North-(Table-1)(Map-I)



Map-I

The survey started with the GPS marking of the radiating tower of HPT Chennai 'A' and Chennai 'C'. Initially we took measurements at an interval of 10 kilometers (L.O.S.) and increased it up to 20 or more kilometers as per requirements. The land soil in this direction is fertile and possesses good water content. As such, we expected a good range in this direction. In case of AM signal, commercial cheap Philips receiver as well as good quality Sony receiver was used for subjective reception. For obtaining MER/ SNR value of the digital signal, a professional receiver, DT 700, was used. The same receiver was also used for checking the audio quality and other related parameters of digital signal.. One commercial DRM radio manufactured by AVION was also used for checking the audio quality of the digital signals.

As per the ITU guidelines, magnetic loop antenna is preferred over active Rod antenna for the purpose of obtaining field strength. Accordingly, Shwarzbeck's magnetic loop antenna was used to measure the correct field strength of the analogue signal. At each survey location, the corresponding GPS data was also saved for obtaining the LOS distance from the Antenna of the concerned transmitter alongwith the terrain profile.

In simulcast (Chennai-A) digital transmission, MER of 12 dB was available up to the aerial distance of 180 Kms (Bitragunta, AP) in North direction. However bad spots were observed at 140 LOS Kms in Nellore. It may be due to the high level of manmade noise in

city environment. Analogue transmission of Chennai-A was available up to the LOS distance of 270 Km

In case of Chennai-C full DRM transmission, the coverage was available up to the LOS distance of 230 Kms. In the city of Nellore, breaks were observed regularly.

B. South Direction (Table-2)(Map-II)



Map-II

This route lies in South direction from transmitter and covers some parts of Chennai city areas. It further moves towards Puducherry and Chidambaram. The terrain profile is normal with one spot rising to a height of 160 meters above mean sea level at the LOS distance of 50 Km. The width of this small hillock was low and as such propagation condition was not much effected.

The analogue Chennai-A transmission was available up to the LOS distance of 200 Km where field strength was $72 \text{ dB}\mu\text{v}/\text{m}$. As timings of the survey were after the Sunset the f/s was the vector sum of ground & sky wave components. This location was again re-checked in day timings for necessary correction. Due to the increased level of manmade noise, the audio quality on both the receivers was not up to the mark. In simulcast the coverage was up to the LOS distance of 120 Km.

The digital transmission of Chennai-C was available up to the LOS distance of 80 Km only compared to the 200 Km of analogue transmission. It may be due to the very high manmade noise and other factors.

C. South-West (Table-3 & Map III)

This route goes to the Attur via Sriperumbudur, Kanchipuram and Tiruvannamalai. Rising Hillocks of more than 1 km height before Attur was creating adverse propagation conditions in this route. Otherwise up to the LOS distance of 200 Km, the

terrain was very good for ground wave propagation.



Map-III

The Chennai-A analogue coverage was recorded up to the LOS distance of 238 Km, whereas digital signal in Simulcast was well decoded up to the LOS distance of 200 Km with poor/ bad pockets in town areas of Avalurpettai and Tiruvannamalai.

Similarly digital transmission of Chennai-C was available up to LOS distance of 200 Km.

D. West (Table-4 & Map IV)



Map-IV

The West route goes towards Bengaluru via Chittoor and Kolar. The terrain profile clearly shows the rising elevation from Chennai to Kolar in a very uniform way and reaches the height of more than 750 meters above mean sea level just before the Kolar town.

The Chennai-A, analogue transmission was available up to the LOS distance of 200 Km with minimum ITU defined signal level. The Digital transmission in Simulcast mode was available up to the LOS distance of 160 Km.

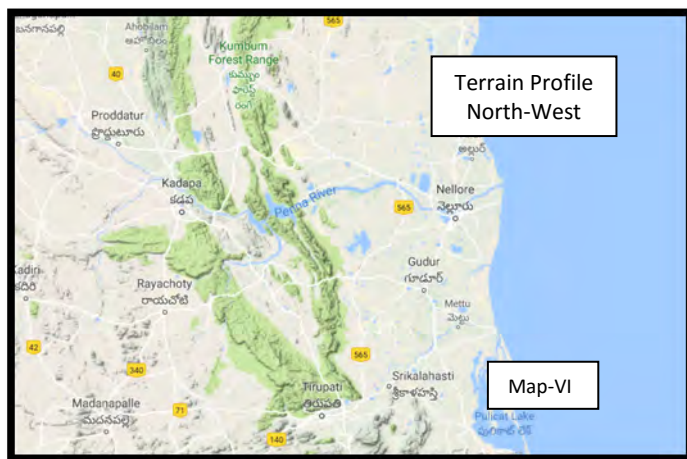
The Chennai-C, Digital transmission was well decoded up to the LOS distance of 160 Km. At this location the field strength was 52 to 57 dBµv/ m. The wide fluctuation is due to the location movement.

E. North-West (Table-5)(Map-V)



Map-V

The North-West route goes up to Kadapa in Andhra Pradesh via Nandalur, Rajampet and Trupati.



This route was very difficult in terms of ground wave propagation as terrain profile (Map-VI) and elevation profile (Map-V) clearly shows multiple hillocks along with the dense forest over it. Such environment is very difficult to decode Digital signals. The DRM signal was found ok only up to the LOS distance of 100 Km.

The Analogue signal of Chennai-A was available up to the

LOS distance of 170 Km, but due to the difficult terrain condition the subjective reception at this location was not up to the mark in Philips radio.

The Chennai-C digital transmission was fully decoded up to the LOS distance of 140 Km.

6. Data analysis in Full DRM mode , Chennai-A (DRM power-80 Kw)

As timings of operation in Full DRM was very limited, our team could not made full comprehensive coverage measurement of Full DRM transmission on 720 KHz. However we had tested the performance of Full DRM in one particular direction (West) and very good quality reception of digital audio signal was available up to the LOS distance of 220 Km. The professional receiver DT 700 was used for this purpose. Whereas in AM transmission in the same route, the minimum field strength of 63dB μ V/ m was available up to the LOS distance of 200 Km.

The transmitter power during Full DRM transmission was 80 KW compared to 200 KW in Simulcast mode. In big towns like Chennai and Vellore the presence of large echo signal in DRM creates problem in reception in certain areas. Also audio is not properly decoded below flyovers etc. In those areas, after a limit, the COFDM decoder is not able to correct bit errors as per requirement.

7. R.F. POWER AT 1 KILOMETRE (Table-6)

Seven locations, having a LOS distance of 1 Km from the radiating mast, were selected to ascertain the radiation pattern and the power of the transmitter. The field strength was nearly same in all the directions. Not much difference was observed even in the presence of Directional Antenna system in case of Chennai-A transmitter.

8. Performance of commercial DRM Radio

Performance of Avion Make DRM commercial Radio was also tested. In comparison to Professional receiver, the MER values go down below 12 db much earlier in terms of coverage. Details of subjective assessment on commercial receiver, is available in tables.

8. Conclusion

Coverage by Analogue & DRM Signal in Simulcast mode Chennai-A (200 Kw) (16 dB ↓)(Map-VIII)

Direction from AIR Transmitter Antenna Chennai-A	LOS Distance from Tx (KM)	
	Analogue 63dB μ V/ m	DRM Excellent Audio on DT 700 Professional Receiver
NORTH	270	180
SOUTH	200	120

SOUTH-WEST	238	200
WEST	200	160
NORTH-WEST	170	100

The purpose of DA system in Chennai-A transmitter may be re-considered again as there is not much difference in field strength when compared with other directions.

**Coverage by DRM Signal in Pure DRM mode
Chennai-C (8 Kw)
Map-IX**

Direction from AIR Transmitter Antenna Chennai-C	LOS Distance from Transmitter Antenna (KM)
North	230
South	80
South-West	200
West	160
North-west	140

The ATU of Chennai-C transmitter is also being used for Chennai-B Analogue transmitter with diplexer unit and common antenna system. Chennai-C transmitter is mandated to work in pure DRM with two content channels with occupation of 18 KHz bandwidth. However due to the some matching problem in ATU and diplexer unit the bandwidth is restricted to 9 KHz only. This gives a very limited bit rate and the content quality suffers. In order to provide good quality digital signal with two content channels, 18 KHz bandwidth is required.

Coverage in Pure DRM mode from Chennai-A transmitter

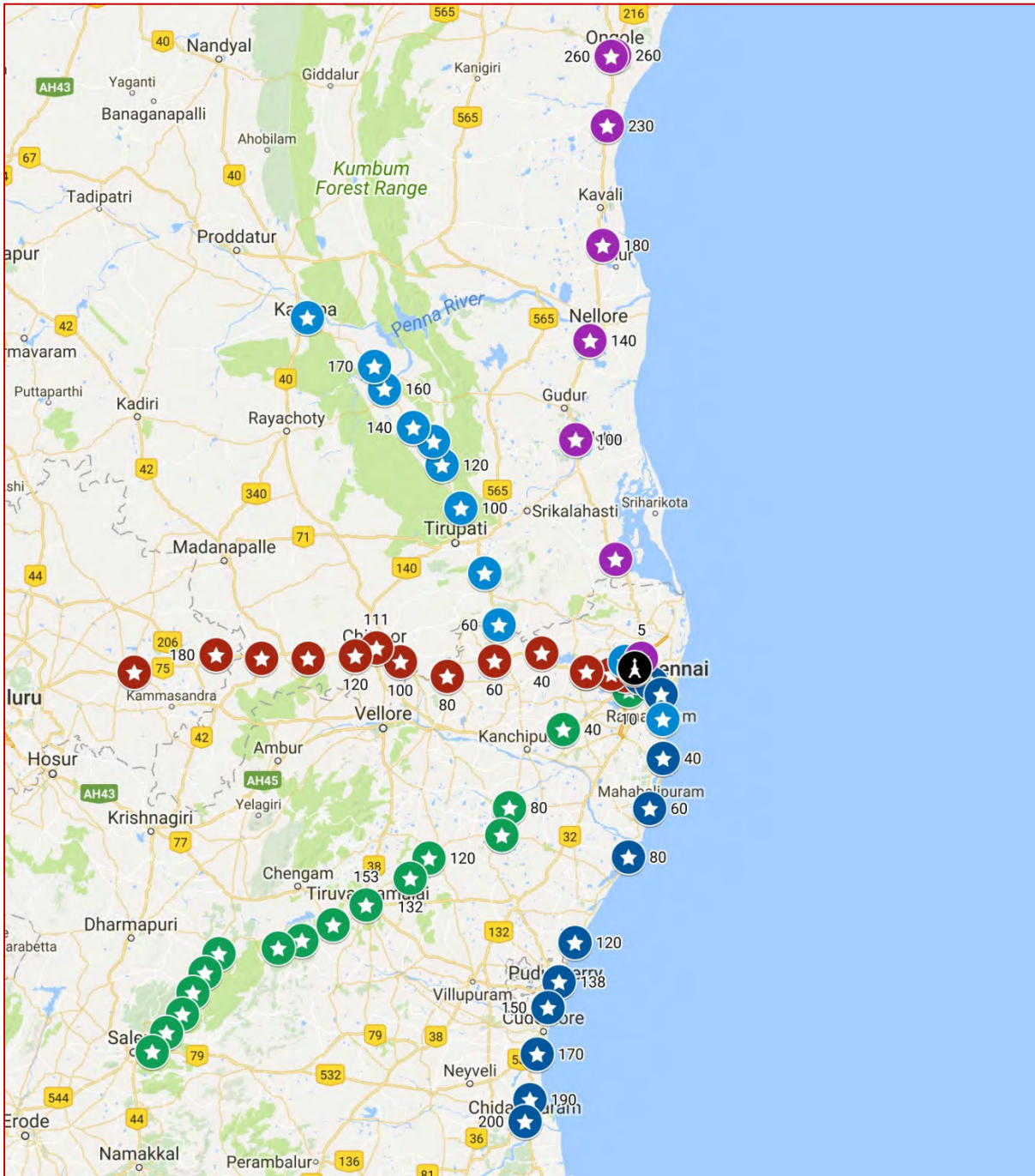
The 200 KW AM-DRM transmitter of AIR Chennai-A, was operated in pure DRM mode with a power of 80 KW to assess the coverage in any one direction. Chennai to Kolar route was selected for this purpose. The DRM reception was very good up to the LOS distance of 220 Km.

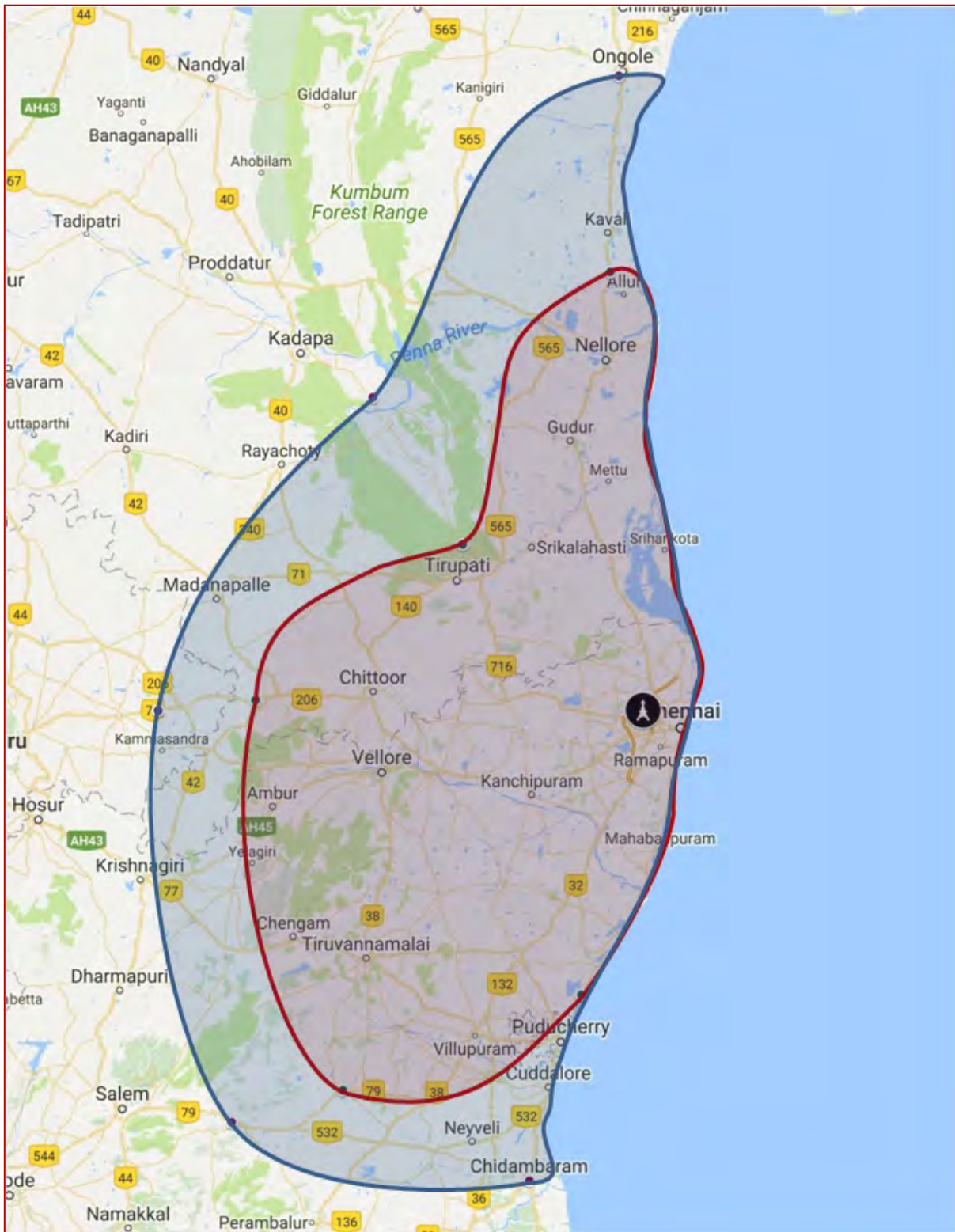
Acknowledgement

Completing this rigorous report would not have been possible without the support and the help extended by our colleagues of R&D and AIR HPT-Chennai. We would also like to thank the officials of the Transmitter design section of AIR Directorate in Delhi. We are also grateful to the Office of the ADG (E), South Zone, at Chennai for providing logistical support to our team. We would also like to thank the Engineering Head of AIR HPT-Chennai Mr. T S K Pillai, DDG (E) and Mr. S Pandi, DE for extending necessary help during the survey period.

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Radial Routes for Chennai-A & Chennai-C Transmission

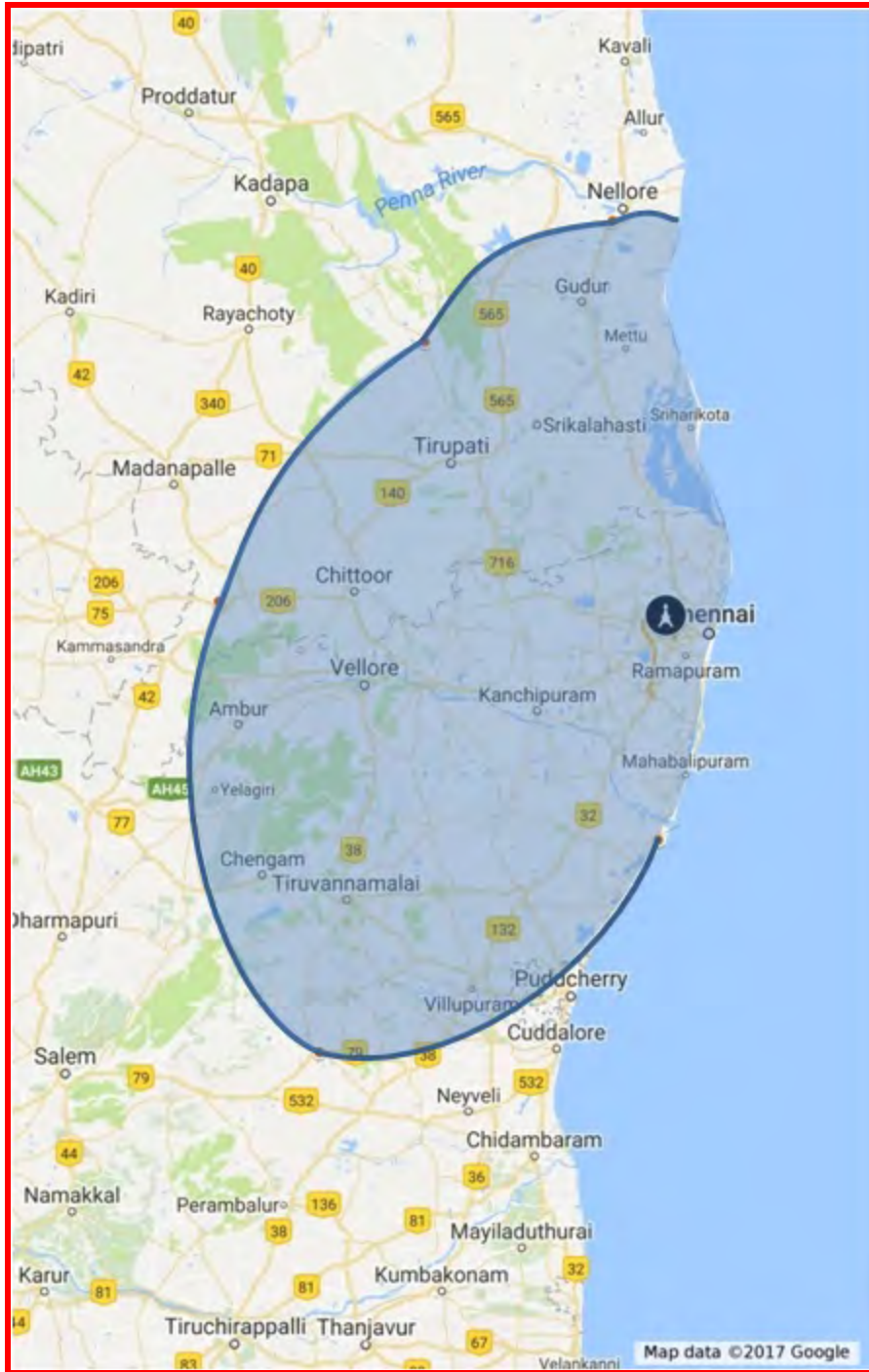




1. Areas inside the Red line, shows the coverage of DRM transmission in Simulcast mode from Chennai-A transmitter.
2. Areas inside the Blue line which also includes areas inside Red lines, shows the coverage of AM transmission from Chennai-A transmitter in Simulcast mode.
3. The Coverage Map also includes many bad spots in case of DRM transmission in Simulcast mode.

Coverage Map of Chennai-C Full DRM Mode (8Kw)

Map-IX



Areas inside the Blue lines are the coverage of Chennai-C (783 KHz) in Full DRM mode

Table No: 1

Reception Survey of 200 kW AIR (MW), 20 kW AIR (MW) DRM Transmitter at Chennai
Analogue 720 KHz & Digital 729 in Simulcast (16db↓) & DRM 783 KHz in Multi-Channel transmission mode

DIRECTION: North **ROUTE:** Nellore-Ongole

Date: 15/9/17

Sr. No	Time	GPS Coordinates	Spot/ Location	Radial Distance (km)	Filed Strength (dBμ V/m)		MER (dB)		Subjective Quality				Filed Strength (dBμ V/m)	MER (dB)		Subjective Quality		Terrain	Remarks
					Chennai A		DT-700 Professional	Avion Commercial	DT-700 Professional	Avion Commercial	Sony Analogue	Phillips Analogue	Chennai C (20kW)	DT-700 Professional	Avion Commercial	DT-700 Digital	Avion Digital		
					Analogue 720 kHz	Digital (Simulcast) 729 kHz													
1	1015	13.18520 80.15523	AVADI ROAD Off: SH#14	5	117	107	36	30	OK	OK	VG	VG	103	37	38	OK	OK	OA/LAKE/LT	
	2240	14.02405 79.89493	BEFORE GUDUR	100	82	74	18	0-4	OK	NT	VG	VG	67	24	14	OK	OK	NHW/MT/OA	
	1345	14.40445 79.95164	G.T ROAD OLD NELLORE	140	80	71	10	---	Breaks	NT	VG	VG	61	10-11	6-7	Breaks	NT	LRB/CITY/HDP/MT	
	1629	14.76817 80.00264	NH#16 BITRAGUNTA	180	73	67	14	----	OK	NT	VG	VG	56	20	9	OK	Breaks	MT/OA/NHW	
	1730	15.22471 80.01965	BEFORE SINGARAYAKONDA	230	72	64	9	---	Breaks	NT	VG	VG	54	9-11	-	OK	NT	MT/OA/NHW	
	1800	15.49336 80.04865	NEAR RATNA MAHAL, ONGOLE	260	70	64	---	---	---	NT	P	P	70	-	-	NT	NT	HDP/MT/HRB	
	1824	15.48904 80.03540	BYPASS ONGOLE	260	67	58	7-9	---	NT	NT	G	G	52	8-11	-	Breaks	NT	HW/MT/OA	

LEGENDS: **LT** Low Traffic **HT** High Traffic **MT** Moderate Traffic **HDP** High Density Population **HW** High ways **HRB** High Rise Buildings **LRB** Low Rise Building **MRB** Medium Rise Building
VEG Vegetation **OA** Open Area **IA** Industrial Area

Table No: 2

**Reception Survey of 200 kW AIR (MW), 20 kW AIR (MW) DRM Transmitter at Chennai
Analogue 720 KHz & Digital 729 in Simulcast (16db↓) & DRM 783 KHz in Multi-Channel transmission mode**

DIRECTION: South **ROUTE:** Puducherry-Chidambaram

Date: 11/9/17

Sr. No	Time	GPS Coordinates	Spot/ Location	Radial Distance (Km)	Filed Strength (dBμ V/m)		MER (dB)		Subjective Quality				Filed Strength (dBμ V/m)	MER (dB)		Subjective Quality		Terrain	Remarks
					Chennai A		DT-700 PROFESSIONAL	Avion Commercial	DT-700 Digital	Avion Digital	Sony Analogue	Phillips Analogue	Chennai C (20kW)	DT-700 Professional	Avion Commercial	DT-700 Digital	Avion Digital		
					Analogue 720 kHz	Analogue 720 kHz							Pure DRM (8 kW) 783 KHz						
1.	1050	13.11004 80.15227	AYAPAKKAM	5	119	110	34	25	OK	OK	VG	VG	102	35	34	OK	VG	HT/MRB/POP/City	
2.	1136	13.08734 80.19622	ANNANAGAR WEST	10	114	104	26	18	OK	OK	VG	VG	99	33	20	OK	OK	HT/MRBA/HRB/POP/CITY	
3.	1222	13.0460 80.23288	T. NAGAR	16	111	101	27	2-3	OK	NT	VG	VG	97	32	34	OK	OK	HT/MRB/HRB/VEG/POP/LRB/City	
4.	1336	12.79911 80.24154	EAST COAST ROAD SH 49	40	101	91	29	3	OK	NT	VG	VG	84	34	25	OK	OK	NH/LT/OA	
5.	1455	12.60748 80.18844	MAHABALIPURAM	60	94	85	25	-	OK	NT	VG	VG	77	29	-	OK	NT	OA/VEG/Sea Shore /LT/LRB	
6.	1557	12.41928 80.1364	SH 49 KOOVATHUR	80	90	80	22	8-9	OK	NT	VG	VG	73	29	20	OK	OK	VEG/NH/MT	
7.	1648	12.08947 79.89320	SH 49 WHITE BEACH	120	74	66	10	0	OK	NT	VG	VG	63	8	0	NT	NT	VEG/NH/MT	
8.	1744	11.93693 79.82938	PUDUCHERRY	138	80	73	-	-	NT	NT	P	P	66	0	0	NT	NT	HDP/HT/MRB/	
9.	1856	11.83749 79.78574	NH 32 VIVEKANANDA NGR	150	76	64	-	-	NT	NT	G	G	58	-	-	NT	NT	HT/NH/LRB/MKT	
10.	1950	11.65774 79.74268	HIGH WAY CUDDLOR	170	70	62	-	-	NT	NT	G	F	61	-	-	NT	NT	HT/NH/LRB/City	
11.	2027	11.48184 79.71362	CHIDAMBARAM	190	68	58	-	-	NT	NT	F	F	57	-	-	NT	NT	MT/VEG	
12.	2101	11.39709 79.69523	CHIDAMBARAM NH 32 CITY	200	72/64	44	-	-	NT	NT	F	F	46	-	-	NT	NT	HT/LRB/City	FS AFTER SKY WAVE ADJ

LEGENDS: **LT** Low Traffic **HT** High Traffic **MT** Moderate Traffic **HDP** High Density Population **HW** High ways **HRB** High Rise Buildings **LRB** Low Rise Building **MRB** Medium Rise Building
VEG Vegetation **OA** Open Area **IA** Industrial Area

Table No: 3

Reception Survey of 200 kW AIR (MW), 20 kW AIR (MW) DRM Transmitter at Chennai
Analogue 720 KHz & Digital 729 in Simulcast (16db↓) & DRM 783 KHz in Multi-Channel transmission mode

DIRECTION: South-West

ROUTE: Tiruvannamalai-Harur-Attur

Date: 12/9/17

Sr. No	Time	GPS Coordinates	Spot/ Location	Radial Distance (Km)	Filed Strength (dBμ V/m)		MER (dB)		Subjective Quality				Filed Strength (dBμ V/m)	MER (dB)		Subjective Quality		Terrain	Remarks
					Chennai A		DT-700 Professional	Avion Commercial	DT-700 Digital	Avion Digital	Sony Analogue	Philips Analogue	Chennai C (20kW)	DT-700 Professional	Avion Commercial	DT-700 Digital	Avion Digital		
					Analogue 720 kHz	Analogue 720 kHz													
1.	11:28	13.11429 80.09621	Nehru Nagar	5	96	87	30	30	OK	OK	VG	VG	82	322	34	OK	OK	LRB/HT/HDP	
2.	1200	13.06072 80.10500	Near SA Engg College	10	110	101	31	27	OK	Breaks	VG	VG	95	35	30	OK	OK	LRB/SLUM	
3.	1328	12.91092 79.84578	NH-48	40	103	91	30	0-3	OK	NT	VG	VG	86	35	18	OK	OK	MHW/HT/VEG	
4.	1535	12.60960 79.63364	SH-116 near Nedungal	80	96	87	30	0	OK	NT	VG	VG	78	33	22	OK	OK	OA/VEG/LT	
5.	1604	12.50297 79.60278	Govt Girls School Vandavasi	91	96	86	10		OK	NT	VG	VG	78	15	14	OK	OK	HDP/City/MT/LRB	
6.	1710	12.41517 79.31485	SHW	120	88	78	21	9	OK	NT	VG	VG	70	26	75	OK	OK	VEG/LT/OA	
7.	1755	12.33792 79.24035	Avalurpetty	132	-	-	3-4	-	NT	NT	VG	VG	-	13	13	OK	-	Small Town	
8.	1836	12.23401 79.06644	Tiruvallamalai Town	153	81	73	8-9	3	NT	NT	VG	VG	64	11	12	OK	OK	HDP/MT/MTB	
9.	1916	12.15759 78.93559	NEAR THANDRAMBATTU	170	80	69	10	0	Breaks	NT	G	G	61	10	10	OK	FEW BREAKS		
10.	1335	11.69074 79.29619	Vlumberpet Town	185	78	68	18		OK	NT	VG	VG	58	22	67	OK	NT	VEG/LT/TOWN	
11.	1435	11.73490 78.98428	Before Vlenderpet	200	73	64	12		OK	NT	VG	VG	55	17	3	OK	NT	OA/LT/VEG	
12.	1531	11.61508 78.56252	MGR Near Attur	240	60-62	51			NT	NT	G	G	42	8		NT	NT	OA/HWY/LRB	ECHO

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VEG Vegetation **OA** Open Area **IA** Industrial Area

Table No: 4

Reception Survey of 200 kW AIR (MW), 20 kW AIR (MW) DRM Transmitter at Chennai
Analogue 720 KHz & Digital 729 in Simulcast (16db↓) & DRM 783 KHz in Multi-Channel transmission mode

DIRECTION: West

ROUTE: Chittoor-Kolar

Date: 9-10-14/9/17

Sr. No	Time	GPS Coordinates	Spot/ Location	Radial Distance (Km)	Filed Strength (dBμ V/m)		MER (dB)		Subjective Quality				Filed Strength (dBμ V/m)	MER (dB)		Subjective Quality		Terrain	Remarks
					Chennai A		DT-700 Professional	Avion Commercial	DT-700 Digital	Avion Digital	Sony Analogue	Phillips Analogue	Chennai C (20kW)	DT-700 Professional	Avion Commercial	DT-700 Digital	Avion Digital		
					Analogue 720 kHz	Analogue 720 kHz							Pure DRM (8 kW) 783 KHz						
1.	1620	13.11870 80.09076	BAKKAM LAKE	5	116	106	26	34	OK	OK	OK	OK	99.5	26	25	OK	OK	NHW/HT	
2.	1652	13.12545 80.03625	AMRUTHA NAGAR	10	111	102	38	25	OK	OK	OK	OK	98	36	33	OK	OK	NHW/HT	
3.	1730	13.13364 79.93752	NH 716	20	107	97	37	22	OK	OK	OK	OK	PAUSE PERIOD				NHW/HT		
4.	1930	13.13364 79.93752	NH 716	20	---	---	---	---	---	---	---	---	92	35	35	OK	OK	SHW\HT	NEXT DAY READING
5.	1815	13.20521 79.76133	NH 716	40	103	93	28	20	OK	31	OK	OK	86	37	31	OK	OK	NHW/HT	
6.	1230	13.17410 79.57440	SH 54 CHITTOOR ROAD	60	96	86	29	12	OK	OK	OK	OK	78	32	24	OK	OK	HW/VEG/MT	
7.	1325	13.11580 79.38702	--DO--	80	94	84	28	9	OK	NT	OK	OK	77	33	27	OK	OK	VEG/LT/LRB	
8.	1404	13.17196 79.20128	AP CHECK POST	100	79	70	11	0	OK	NT	G	G	64	08	4		NT	VEG/MT/LRB	
9.	1440	13.22575 79.10687	CHITTOOR CITY NEAR KATTAMANCHI	111	81	69	13	3	OK	NT	OK	OK	61	15	8	OK	DROP	MRB/MT/Tower	
10.	1740	13.19436 79.02352	NH	120	79	69	13	5	OK	NT	OK	G	60	16	9	OK	Breaks	VEG/HT	
11.	1820	13.18538 78.83984	NH	140	80	67	15	-	OK	NT	G	G	56	20	-	OK	NT	VEG/HT	
12.	1316	13.18516 78.83607	NH-KOLAR RD	140	79	71	8	-	NT	NT	G/ Noisy	G	69	9	-	NT	NT	VEG/SH/CT	
13.	1924	13.18579 78.65219	KOLAR RD	160	75	62	12	-	OK	NT	G	G	57	22	-	OK	NT	VEG/HT	
14.	1355	13.18711 78.65401	--DO--	160	72	62	9- 11	-	Breaks	-	VG	G	52	9- 14	-	Breaks	NT	VEG/MT/SHW	
15.	1444	13.19903 78.47227	--DO--	180	71	62	-	-	NT	NT	VG	G	51	-	-	NT	NT	OA/LT/SHW	
16.	1730	13.14620 78.28143	BENGALURU RD	200	64	55	2	-	NT	NT	G	G	--	--	--	--	--	NHW/MT	

LEGENDS: **LT** Low Traffic **HT** High Traffic **MT** Moderate Traffic **HDP** High Density Population **HW** High ways **HRB** High Rise Buildings **LRB** Low Rise Building **MRB** Medium Rise Building
VEG Vegetation **OA** Open Area **IA** Industrial Area

Table No: 5

**Reception Survey of 200 kW AIR (MW), 20 kW AIR (MW) DRM Transmitter at Chennai
Analogue 720 KHz & Digital 729 in Simulcast (16db↓) & DRM 783 KHz in Multi-Channel transmission mode**

DIRECTION: North-West ROUTE: Tirupati-Kadapa

Date: 13/9/17

Sr. No	Time	GPS Coordinates	Spot/ Location	Radial Distance (Km)	Filed Strength (dBμ V/m)		MER (dB)		Subjective Quality				Filed Strength (dBμ V/m)	MER (dB)		Subjective Quality		Terrain	Remarks
					Chennai A		DT-700 Professional	Avion Commercial	DT-700 Digital	Avion Digital	Sony Analogue	Philips Analogue	Chennai C (20kW)	DT-700 Professional	Avion Commercial	DT-700 Digital	Avion Digital		
					Analogue 720 kHz	Analogue 720 kHz							Pure DRM (8 kW) 783 KHz						
1.	2240	13.17353 80.08998	MORAI	5	118	109	32	31	OK	OK	VG	VG	104	37	36	OK	OK	OA/VEG/LT/RES	
2.	2040	13.31316 79.59214	NAGARI BY PASS	60	92	62	25	17	OK	B/OK	VG	VG	74	29	15	OK	OK	OA/HW/LT	
3.	1900	13.76243 79.44012	SH-31 AFTER RENIGUNTA	100	74	65	-10	-	OK/B	NT	VG	VG	59	15	7-8	OK	OK/B	Hillocks both side/VEG//HW	
4.	1435	13.92753 79.36604	KADAPA RENIGUNTA BY PASS	120	82	78	-	-	-	-	P	P	75	-	-	-	-	VEG/HT/HW	
5.	1510	14.01828 79.33256	SH 31 TIRUPATI KADAPA ROAD	130	69	60	6-7	-	NT	-	F	F	54	10-11	-	With Breaks	-	VEG/HT/HW	
6.	1525	14.07129 79.25269	SH 31 BEFORE RAJAMPET	140	66	57	5-7	-	NT	-	G	G	54	13	4	OK	NT	VEG/HT/HWH	
7.	1631	14.21879 79.13863	BOYANAPALLI HIGH WAY	160	64	55	-	-	NT	NT	G	G	51	8	-	NT	NT	VEG/HWH/MT	
8.	1655	14.30513 79.09835	MOULATAT DARGAH, BEFORE KADAPA	170	63	55	-	-	NT	NT	G	F	50	7	-	NT	NT	VEG/HW/MT	

LEGENDS: **LT** Low Traffic **HT** High Traffic **MT** Moderate Traffic **HDP** High Density Population **HW** High ways **HRB** High Rise Buildings **LRB** Low Rise Building **MRB** Medium Rise Building
VEG Vegetation **OA** Open Area **IA** Industrial Area

Reception Survey of 200kW AM-DRM Transmitter (Chennai-A) in Simulcast transmission mode.

Table: 6

Transmitter Power: 200 kW (Analogue power-190 KW approximate)

Frequency: 720 KHz

Date: 09-09-2017

Field strength measurement at, 1km distance from the radiating mast.

Sr.No.	Direction/Radial	Spot/Location	LAT/LONG	Field Strength (dB μ V/m)	Terrain	Remark
1	NORTH	New Vellanur	N 13.15683 E 80.12965	131.6	OA	
2	SOUTH	Internal Road AIR campus	N 13.13962 E 80.12427	131.5	OA/LT/VEG	
3	NORTH-EAST	Upparapalayam	N 13.15579 E 80.13416	127.3	HDP/LRB	
4	SOUTH-WEST	Ashok Nagar	N 13.14451 E 80.11925	132.3	LRB/OA	
5	WEST	Krishna Canal Road	N 13.15128 E 80.11948	133.2	OA	
6	NORTH-WEST	New Vellanur	N 13.15660 E 80.12125	131.5	OA/VEG	
7	SOUTH-EAST	Moorthy Nagar	N 13.14144 E 80.13464	131.6	LRB/HDP	

Terrain Legends: 1. OA-Open areas 2. VEG-Thick vegetation of average heights 3. Low heights- Vegetation with low height 4. LT-Low Traffic 5.NHW-National highway