GRP Project – Documentation of Work Done

Data used for implementation

- Cell ID chart of IDEA, Madhya Pradesh
- CDR data of phone no. 9644346975 (IDEA operator)
- Railway network of MP
- Railway Stations of MP

Two python scripts and QGIS functions are run to achieve the required result. They are given below in sequence in which they should be run

1) mobnet_read2_idea.py

This takes in csv file of IDEA Cell ID chart for MP region as input. The file used is "Idea.csv". Below shown is screenshot of how this file looks before processing

	A	В	C	D	E	F	G	Н	1	J	ĸ	L	M	N
1	CellID	Site	IMID of Site	Zone	District	Town	Site Name	CGI1	LAT	LONG	TEHSIL	Network_	Address	AZIMUTH
2	AACHR1A	AACHR1	IMRPR_10811_15U	RAIPUR-2	DURG	ACHHOLI	ACHHOLI (ANDA)	404-78-40011-29121	21.08026	81.25021	DURG	2	SHRI VILL.	80
3	AACHR1B	AACHR1	IMRPR_10811_15U	RAIPUR-2	DURG	ACHHOLI	ACHHOLI (ANDA)	404-78-40011-29122	21.08026	81.25021	DURG	2	SHRI VILL.	150
4	AACHR1C	AACHR1	IMRPR_10811_15U	RAIPUR-2	DURG	ACHHOLI	ACHHOLI (ANDA)	404-78-40011-29123	21.08026	81.25021	DURG	2	SHRI VILL.	270
5	AARAR1A	AARAR1	IMBIL_03137	AMBIKAP	JASHPUR	AARRA	AARRA	404-78-30985-64801	22.82555	84.26666	JASHPUR	2	MR. MOTI	0
6	AARAR1B	AARAR1	IMBIL_03137	AMBIKAP	JASHPUR	AARRA	AARRA	404-78-30985-64802	22.82555	84.26666	JASHPUR	2	MR. MOTI	120
7	AARAR1C	AARAR1	IMBIL_03137	AMBIKAP	JASHPUR	AARRA	AARRA	404-78-30985-64803	22.82555	84.26666	JASHPUR	2	MR. MOTI	240
8	ABDAB1A	ABDAB1	IMBPL_30101	GUNA	RAJGARH	ABADA	ABADA	404-78-38005-62911	23.49295	76.77338	NARSING	2	MR. KAMA	0
9	ABDAB1B	ABDAB1	IMBPL_30101	GUNA	RAJGARH	ABADA	ABADA	404-78-38005-62912	23.49295	76.77338	NARSING	2	MR. KAMA	110
10	ABDAB1C	ABDAB1	IMBPL_30101	GUNA	RAJGARH	ABADA	ABADA	404-78-38005-62913	23.49295	76.77338	NARSING	2	MR. KAMA	260
11	ABDAR1A	ABDAR1	IMRPR_14819_15U	RAIPUR-1	KANKER	ALBEDA	ALBEDA	404-78-40027-54811	20.28	81.36	KANKER	2	SHRI RAM	50
12	ABDAR1B	ABDAR1	IMRPR_14819_15U	RAIPUR-1	KANKER	ALBEDA	ALBEDA	404-78-40027-54812	20.28	81.36	KANKER	2	SHRI RAM	215
13	ABDAR1C	ABDAR1	IMRPR_14819_15U	RAIPUR-1	KANKER	ALBEDA	ALBEDA	404-78-40027-54813	20.28	81.36	KANKER	2	SHRI RAM	300
14	ABDAR2A	ABDAR2	IMRPR_14819_15UR	RAIPUR-1	UTTAR BA	ALBEDA	ALBEDA	404-78-30982-54821	20.28002	81.36067	UTTAR BA	2	ATC TOWE	60
15	ABDAR2B	ABDAR2	IMRPR_14819_15UR	RAIPUR-1	UTTAR BA	ALBEDA	ALBEDA	404-78-30982-54822	20.28002	81.36067	UTTAR BA	2	ATC TOWE	260
16	ABDAR2C	ABDAR2	IMRPR_14819_15UR	RAIPUR-1	UTTAR BA	ALBEDA	ALBEDA	404-78-30982-54823	20.28002	81.36067	UTTAR BA	2	ATC TOWE	330
17	ABDIB1A	ABDIB1	IMBPL_33143	BHOPAL	SEHORE	ABIDABAD	ABIDABAD	404-78-36000-30371	23.05175	77.29361	ICHHAWA	2	RELIANCE	10
18	ABDIB1B	ABDIB1	IMBPL_33143	BHOPAL	SEHORE	ABIDABAD	ABIDABAD	404-78-36000-30372	23.05175	77.29361	ICHHAWA	2	RELIANCE	135
19	ABDIB1C	ABDIB1	IMBPL_33143	BHOPAL	SEHORE	ABIDABAD	ABIDABAD	404-78-36000-30373	23.05175	77.29361	ICHHAWA	2	RELIANCE	260
20	ABER1A	ABER1	IMREW_13051	REWA	SATNA	ABER	ABER	404-78-50031-10011	24.69724	81.02291	RAMPUR-	2	LAXMAN H	350
21	ABER1B	ABER1	IMREW_13051	REWA	SATNA	ABER	ABER	404-78-50031-10012	24.69724	81.02291	RAMPUR-	2	LAXMAN	100
22	ABER1C	ABER1	IMREW_13051	REWA	SATNA	ABER	ABER	404-78-50031-10013	24.69724	81.02291	RAMPUR-	2		220

This python script generates coverage polygons for each antenna on every mobile.

For each antenna on a mobile tower, we use two azimuth values on either side of its orientation (azimuth angle) to fix the beam-width (see figure for meaning of beam-width). The two azimuth values are calculated as orientation of angle bisector with adjacent antennas.



The radius of coverage has been fixed to a constant value here. However, it is not accurate and this value should be calculated based on nearest mobile tower distance.

Following new attributes are generated in processing are

- Sector_Radius Distance upto which antenna covers a region (taken fixed as mentioned above)
- wkt Two long-lat pairs on either side of antenna orientation marking end-points of coverage polygon
- SectorNum Antenna number on a mobile tower. For ex, if tower has 4 antennas then SectorNum for that tower (or site) varies from 1 to 4
- Angle Angle 1 value (in clockwise direction) for that antenna.
 Angle 2 value (in anticlockwise direction) is Angle 1 value of adjacent antenna
- nwkt Entries of format "POLYGON((starting point long-lat, end point_1 long-lat, end point_2 long-lat, starting point long-lat))" specifying coverage polygon for each antenna

The nwkt attribute has been created in above format so that the polygon can be visualized in QGIS platform. Thereafter, intersection of these polygons with railway network gives the required database i.e. which antenna covers which railway network.

At the end of this step we obtain a new excel file containing old and new attributes as mentioned above. The file name is "mobnet_processed_idea.csv"

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2) QGIS processing

The result file from previous step **"mobnet_processed_idea.csv"** is opened in QGIS making use of wkt functionality in QGIS and "Intersection" operation is performed between this imported layer and railway line layer.

Step by step procedure is as follows :

• Open the railway network and railway station shape file for Madhya Pradesh. The visualization is below



• Next, we open the mobnet_processed_idea.csv file through following steps



• Select the file (mobnet_processed_idea.csv) using 'Browse' and under 'Geometry definition' select 'Well Known Text (wkt)'. Click OK

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• After clicking OK following output is seen



These are triangular coverage regions at various mobile tower locations for IDEA TSP. A zoomed version looks like this



• The next step is perform "Intersection" operation in QGIS using above imported layer and railway network layer.

This final step gives the railway network segments covered by each antenna. The attribute table of the intersected layer (attribute table is a database containing info on various parameter for each record in that layer) is **exported as a csv file by name of "intersect_IDEA_MP.csv"** for next step.

The csv file is shown below

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761 KHND13	A KHND13	404-78-401	21.8195	76.359	40	INDORE-2	2 EAST NIM	1	76.45575	1	90	21.8194	76.4558	21.9079	76.3422	2 RAILWAY	BROAD GA	AL YES	BHOPAL	WEST CEN	BROAD G	69273.7	MATHELA	TALWADY	22	6	- 11
762 KHND13	A KHND13	404-78-401	21.8195	76.359	40	INDORE-2	2 EAST NIM	1	76.45575	1	90	21.8194	76,4558	21.9079	76.3422	2 RAILWAY	METRE G	A NO	RATLAM	NORTHER	METRE GA	62376.6	AJANTI	KHANDW	11	7	
763 KHND13	KHND13	404-78-331	21.8195	76.359	140	INDORE-2	2 EAST NIM	1	76.39206	2	160	21.735	76.3921	21.8194	76.4558	B RAILWAY	BROAD GA	AL YES	BHUSAVA	CENTRAL	F BROAD G	66548.1	DONGAR	KHANDW	22	3	
764 KHND13	KHND13	404-78-331	21.8195	76.359	140	INDORE-2	2 EAST NIM	1	76.39206	2	160	21.735	76.3921	21.8194	76.4558	B RAILWAY	_METRE_G	A NO	TIRUCHIR	SOUTH CE	METRE GA	60714.9	KHANDW	TAKAL	34	8	
765 KHND13	B KHND13	404-78-401	21.8195	76.359	180	INDORE-2	2 EAST NIM	1	76.31063	3	210	21.7417	76.3106	21.735	76.3921	1 RAILWAY	BROAD GA	AL YES	BHUSAVA	CENTRAL	BROAD G	66548.1	DONGAR	KHANDW	22	3	
766 KHND13	C KHND13	404-78-401	21.8195	76.359	300	INDORE-2	2 EAST NIM	1	76.34217	5	350	21.9079	76.3422	21.8194	76.2622	2 RAILWAY	_METRE_G	A NO	RATLAM	NORTHER	METRE GA	62376.6	AJANTI	KHANDW/	11	.7	
767 KHND11	A KHND11	404-78-401	21.8202	76.349	10	INDORE-2	2 EAST NIM	1	76.40448	1	35	21.8938	76.4045	21.9016	76.308	B RAILWAY	BROAD GA	AL YES	BHOPAL	WEST CEN	BROAD GA	69273.7	KHANDW	MATHELA	3	5	
768 KHND11	A KHND11	404-78-401	21.8202	76.349	10	INDORE-2	2 EAST NIM	1	76.40448	1	35	21.8938	76.4045	21.9016	76.308	B RAILWAY	BROAD GA	AL YES	BHUSAVA	CENTRAL	F BROAD GA	66548.1	DONGAR	KHANDW/	22	3	
769 KHND11	A KHND11	404-78-401	21.8202	76.349	10	INDORE-2	2 EAST NIM	1	76.40448	1	35	21.8938	76.4045	21.9016	76.308	B RAILWAY	_METRE_G	A NO	TIRUCHIR	SOUTH C	METRE GA	60714.9	KHANDW	TAKAL	34	3	
770 KHND11	A KHND11	404-78-401	21.8202	76.349	10	INDORE-2	2 EAST NIM	1	76.40448	1	35	21.8938	76.4045	21.9016	76.308	B RAILWAY	BROAD GA	AL YES	BHOPAL	WEST CEN	BROAD GA	69273.7	MATHELA	TALWADY	22/	.6	
771 KHND11	A KHND11	404-78-401	21.8202	76.349	10	INDORE-2	2 EAST NIM	1	76.40448	1	35	21.8938	76.4045	21.9016	76.308	B RAILWAY	(_METRE_G	A NO	RATLAM	NORTHER	METRE GA	62376.6	AJANTI	KHANDW/	11	.7	
772 KHND11	KHND11	404-78-331	21.8202	76.349	60	INDORE-2	2 EAST NIM	1	76.44571	2	90	21.8202	76.4457	21.8938	76.4045	5 RAILWAY	BROAD G	AL YES	BHUSAVA	I CENTRAL	F BROAD GA	66548.1	DONGAR	G KHANDW/	22	.3	
773 KHND11	KHND11	404-78-331	21.8202	76.349	60	INDORE-2	2 EAST NIM	1	76.44571	2	90	21.8202	76.4457	21.8938	76.4045	5 RAILWAY	(_METRE_G	A NO	TIRUCHIR	SOUTH C	METRE GA	60714.9	KHANDW	TAKAL	34	.3	
774 KHND11	B KHND11	404-78-401	21.8202	76.349	120	INDORE-2	2 EAST NIM	1	76.42304	3	130	21.7625	76.4231	21.8202	76.4457	7 RAILWAY	BROAD GA	AL YES	BHUSAVA	I CENTRAL	F BROAD G	66548.1	DONGAR	CKHANDW	22	.3	_
775 KHND11	B KHND11	404-78-401	21.8202	76.349	120	INDORE-2	2 EAST NIM	1	76.42304	3	130	21.7625	76.4231	21.8202	76.4457	7 RAILWAY	(_METRE_G	ANO	TIRUCHIE	SOUTH C	METRE GA	60714.9	KHANDW	TAKAL	34	3	- 10
776 KHND11	KHND11	404-78-331	21.8202	76.349	140	INDORE-2	2 EAST NIM	1	76.33215	4	190	21.7318	76.3322	21.7625	76.4231	1 RAILWAY	BROAD GA	AL YES	BHUSAVA	I CENTRAL	F BROAD G	66548.1	DONGAR	CKHANDW	22	3	_
777 KHND11	C KHND11	404-78-401	21.8202	76.349	300	INDORE-2	2 EAST NIM	1	76.30803	6	335	21.9016	76.308	21.8202	76.2522	2 RAILWAY	(_METRE_G	ANO	RATLAM	NORTHER	I METRE GA	62376.6	AJANTI	KHANDW	11	7	
1/8 DDWDI1	X DDWDI1	404-78-331	21.8208	76.28	90	INDORE-2	2 KHANDW	1	76.37347	1	105	21.7975	76.3735	21.8896	76.3423	B RAILWAY	BROAD G	AL YES	BHUSAVA	I CENTRAL	F BROAD G	66548.1	DONGAR	E KHANDW	22	3	-
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700 DDWDI1	B DOWDI1	404-78-100	21.8208	76.28	120	INDORE-2	Z EASTNIM	1	J /6.28002	2	180	21.731	/6.28	21.7975	/6.3735	5 KAILWAY	I BRUAD GA	N YES	BHUSAVA	U CENTRAL	I BRUAD G	66548.1	DONGAR	E KHANDW	22	3	-
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ID shown in the table is railway segment number

UP and DOWN represent railway stations at two ends of railway segment

3) cdr_idea.py

This code reads the CDR data of the given individual (excel file 9644346975 idea.xlsx). It matches the Initial and Final Cell ID for each record in CDR with those in 'intersect_IDEA_MP.csv'.

Below shown is CDR data in form of excel file

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1 13:544-11 NA MATEN 0-60-2016 1607-46 0 40483-2054-4613 NA MAT 9662702465150 407433117667 NA 9.1992-111 168-111-106 NA NA MAT 9662702465150 407433117667 NA 9.1992-111 168-111-106 NA NA MAT 9662702465150 407433117667 NA 9.1992-111 168-111-20 NA NA MAT 9662702465150 407433117667 NA 9.1992-111 168-111-20 NA NA NA MAT 9662702465150 407433117667 NA NA <td>11</td> <td>Calling (A) Part</td> <td>I RN</td> <td>Called (B) Parts</td> <td>Date</td> <td>Time</td> <td>Duration</td> <td>First Cell ID/LOCATIO</td> <td>N AREA CODE</td> <td>Last Cell ID / PDF</td> <td>Address</td> <td>Call Type</td> <td>IMEL</td> <td>IMSI</td> <td>Type of C</td> <td>o SMS Centre Ni</td> <td>First Roa</td> <td>26/36/40</td> <td>Bouting Ar</td> <td>ea Code/R4</td> <td>C)</td> <td></td> <td></td>	11	Calling (A) Part	I RN	Called (B) Parts	Date	Time	Duration	First Cell ID/LOCATIO	N AREA CODE	Last Cell ID / PDF	Address	Call Type	IMEL	IMSI	Type of C	o SMS Centre Ni	First Roa	26/36/40	Bouting Ar	ea Code/R4	C)		
1 19 19:5444511 NA MA MAT 19:5445515 0473311176671 MA 9:19:544515 19 19:5445611 NA 19:5445611 NA MAT 19:5642515 0473311176671 MA 9:19:541515 19:541511 19:545151 19:541515 19:541511 NA NA NA MAT 19:562701465150 0473311176671 MA 9:19:54151 19:541515 19:541511 NA NA </td <td>12</td> <td>9 19644F+11</td> <td>N/A</td> <td>VM-TEN</td> <td>05-08-2016</td> <td>16:07:46</td> <td>0</td> <td>40489-2054-46613</td> <td></td> <td>N/A</td> <td>1001035</td> <td>SMT</td> <td>868627024695150</td> <td>404783311176687</td> <td>NA</td> <td>9 1982F+11</td> <td>Idea Utta</td> <td>26</td> <td>N/A</td> <td>cu coucito</td> <td></td> <td></td> <td></td>	12	9 19644F+11	N/A	VM-TEN	05-08-2016	16:07:46	0	40489-2054-46613		N/A	1001035	SMT	868627024695150	404783311176687	NA	9 1982F+11	Idea Utta	26	N/A	cu coucito			
1 51544451 NA MAT MAT <td< td=""><td>13</td><td>9 19644F+11</td><td>N/A</td><td>VM-TEN</td><td>05-08-2016</td><td>16:07:41</td><td>0</td><td>40489-2054-46613</td><td></td><td>N/A</td><td></td><td>SMT</td><td>868627024695150</td><td>404783311176687</td><td>NA</td><td>9 1982E+11</td><td>Idea Utta</td><td>26</td><td>N/A</td><td></td><td></td><td></td><td></td></td<>	13	9 19644F+11	N/A	VM-TEN	05-08-2016	16:07:41	0	40489-2054-46613		N/A		SMT	868627024695150	404783311176687	NA	9 1982E+11	Idea Utta	26	N/A				
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10 2) 5264451 N/A 319545611 N/A N/A N/A N/A 2) 52644511 N/A 3120 512644511 N/A N/A N/A N/A 2) 52644511 3000 512644511 N/A N/A </td <td>18</td> <td>9 196445+11</td> <td>N/A</td> <td>IX-612345</td> <td>05-08-2016</td> <td>11:05:14</td> <td>0</td> <td>40478-38006-1241</td> <td></td> <td>N/A</td> <td></td> <td>SMT</td> <td>\$68627024695150</td> <td>404783311176687</td> <td>NΔ</td> <td>9 198265+11</td> <td>N/A</td> <td>26</td> <td>N/A</td> <td></td> <td></td> <td></td> <td></td>	18	9 196445+11	N/A	IX-612345	05-08-2016	11:05:14	0	40478-38006-1241		N/A		SMT	\$68627024695150	404783311176687	NΔ	9 198265+11	N/A	26	N/A				
20 21 <td< td=""><td>19</td><td>9 19644F+11</td><td>N/A</td><td>9 19454F+11</td><td>05-08-2016</td><td>07:57:53</td><td>75</td><td>40478-33082-22313</td><td></td><td>40478-33082-22</td><td>313</td><td>MOC</td><td>868627024695150</td><td>404783311176687</td><td>PP</td><td>N/A</td><td>N/A</td><td>36</td><td>N/A</td><td></td><td></td><td></td><td></td></td<>	19	9 19644F+11	N/A	9 19454F+11	05-08-2016	07:57:53	75	40478-33082-22313		40478-33082-22	313	MOC	868627024695150	404783311176687	PP	N/A	N/A	36	N/A				
21 21 <td< td=""><td>20</td><td>9 19644E+11</td><td>3120</td><td>9 198945+11</td><td>05-08-2016</td><td>06:31:08</td><td>48</td><td>40478-32000-36111</td><td></td><td>40478-32000-47</td><td>513</td><td>MTC</td><td>868627024695150</td><td>404783311176687</td><td>NA</td><td>N/A</td><td>N/A</td><td>26</td><td>N/A</td><td></td><td></td><td></td><td></td></td<>	20	9 19644E+11	3120	9 198945+11	05-08-2016	06:31:08	48	40478-32000-36111		40478-32000-47	513	MTC	868627024695150	404783311176687	NA	N/A	N/A	26	N/A				
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21 21 <td< td=""><td>23</td><td>9 19644F+11</td><td>3021</td><td>9 19451E+11</td><td>05-08-2016</td><td>05-53-52</td><td>7</td><td>40478-32000-37412</td><td></td><td>40478-32000-37</td><td>23</td><td>MOC</td><td>868627024695150</td><td>404783311176687</td><td>PP</td><td>N/A</td><td>N/A</td><td>26</td><td>N/A</td><td></td><td></td><td></td><td>_</td></td<>	23	9 19644F+11	3021	9 19451E+11	05-08-2016	05-53-52	7	40478-32000-37412		40478-32000-37	23	MOC	868627024695150	404783311176687	PP	N/A	N/A	26	N/A				_
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The final output is railway tracks and corresponding stations (for each matched Cell ID) at which the train running schedule is required on particular date and time (obtained from CDR data)

The final result is obtained in a csv file "result.csv". This can now be sent to Railway Authorities to get the railway operation data.

Below shown is the output file 'result.csv'

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