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Summary: In an attempt to define the extent and nature of cellular coverage in Vermont, the VT Telecommunications Authority (VTA) asked VCGI to calculate the percentage of cell coverage for every town. The VTA would like to know what percentage of a town's buildings, roads, and total land area have cell coverage. The information will be used to help target investments toward towns that have poor cell coverage.

Methodology: VCGI acquired cell coverage GIS layers from four carriers¹. These were combined into a single cell coverage layer. The combined coverage layer was intersected with three GIS layers²; 1) buildings², 2) roads³, 3) and towns. The intersected datasets were used to generate statistics for each town documenting the percentage of cell coverage for all buildings, roads, as well as the entire surface area of each town.

Conclusion: VCGI was able to generate statistics documenting the number and percentage of buildings, road miles, and surface area with cell coverage on a town-by-town basis. The maps included in Attachment C illustrate some of the differences between these indices. For example, according to the data, 75% of the buildings in the town of Benson have cell coverage. However, only around 60% of the road miles and surface area of the town have cell coverage. This highlights the fact that land use patterns are spatial variable throughout most towns in Vermont, with clusters of buildings in village centers. The degree of spatial variability varies from town to town, depending on topography and historical patterns of development.

Note: The results of this study should be used with a degree of caution. The methods used to generate the cell coverage layers are undocumented⁴. Therefore the quality and nature of the cell coverage data is unknown. As result, the statistical results may over or under-estimate the extent of cell coverage within any given town.

¹ RCC, USCC, Verizon, and Sprint. Refer to Appendix B for details.

² Extracted from E911 ESITE layer. Refer to Appendix B for details.

³ Extracted from E911 RDS layer. Refer to Appendix B for details.

⁴ RCC, USCC, Verizon, and Sprint did not include any metadata (documentation) with their data submissions.

Appendix A – Procedural Details

Overview: The following procedures and steps were used to generate cell coverage statistics for each town in Vermont.

Software: VCGI used ArcGIS Desktop 9.3 (SP1) to perform all of the geoprocessing steps outlined below.

Procedures:

1. Merged combined cell coverage layer with town boundary layer (Cell_Cov_Plus_TownBnds).
2. Intersected⁵ Cell_Cov_Plus_TownBnds with road centerline layer to create Roads_Cell_Coverage.
3. Intersected Cell_Cov_Plus_TownBnds with buildings layer to create Buildings_Cell_Coverage.
4. Generated summary statistics of buildings-by-town with and without cell coverage. Used the ArcGIS Desktop “frequency” tool.
5. Generated summary statistics of road-miles-by-town with and without cell coverage. Used the ArcGIS Desktop “frequency” tool.
6. Generated summary statistics of total-land-area-by-town with and without cell coverage. Used the ArcGIS Desktop “frequency” tool.
7. Combined results into a single table and exported to Microsoft Excel format (CELLCOV_STATS_BY_TOWN_FINAL.xls)

XLS Metadata: The Excel file includes the following attributes/columns

TOWN	Town name (255 Major Civil Divisions)
CNTYCODE	County FIPS code (DO NOT DELETE)
FIPS6CODE	Town FIPS code (DO NOT DELETE)
RFP TARGET TOWN (Y/N)	Flag indicating if this town is part of RFP
BUILDINGS_PERCENT	Percentage of buildings in town within cell coverage
ROADMILES_PERCENT	Percentage of road miles in town within cell coverage
AREA_PERCENT	Percentage of total area of town within cell coverage
BUILDINGS_CELLCOV	Number of buildings with cell coverage
ROADMILES_CELLCOV	Number of road miles with cell coverage
AREASQM_CELLCOV	Total square miles of town with cell coverage
TOTAL_BUILDINGS	Total number of buildings in town
TOTAL_ROADMILES	Total number of road miles in town
TOTAL_AREASQM	Total square miles of town

⁵ Used ArcGIS Desktop “intersect” tool.

Appendix B – Data Sources

Cell coverage layer: Cell coverage information was acquired from four carriers; RCC, USCC, Sprint, and Verizon. The RCC data was provided in hardcopy format (8.5x11 sheet). The RCC map was part of RCC’s 2008 ETC submission. The remaining carriers provided the data in GIS shapefile format. The data is thought to be based on 2007 sources, however, this cannot be confirmed.

- **RCC** = The Department of Public Service scanned RCC’s 2008 ETC map at 600 dpi, and submitted it to VCGI in JPEG format. VCGI georeferenced the image to VT State Plane Meters NAD83, then extracted the red and blue coverage areas. The resulting data was saved to shapefile format.
 - NOTE: It should be noted that there are certain limitations to this methodology, including spatial errors introduced by the scanning and georeferencing process. The data also contains artifacts, such as the lettering and boundaries contained in the original map.
- **Sprint:** VCGI used the following shapefiles provided by Sprint. No documentation was available, therefore the methods used to generate these shapefile are unknown.
 - [Sprint Spectrum LP VT Coverage - Voice.shp](#)
 - [Sprint Spectrum LP VT Coverage - Data.shp](#)
- **USCC:** VCGI used the following shapefile provided by USCC. No documentation was available, therefore the methods used to generate this shapefile are unknown.
 - [USCC VT Coverage_region.shp](#)
- **Verizon:** VCGI used the following shapefiles provided by Verizon. No documentation was available, therefore the methods used to generate these shapefiles are unknown.
 - [vt_cd_evdo.shp](#)
 - [vt_cd_1x.shp](#)

Buildings layer: The buildings layer was extracted from E911’s ESITE⁶ dataset. VCGI extracted points which could be characterized as “buildings”. For example, fire hydrants were excluded. Figure 1 below includes a complete list of what was extracted from ESITE into the buildings layer.

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http://www.vcgi.org/dataware/search_tools/moreinfo.cfm?catalog_id=1&layer_id=39&layer_name=EmergencyE911_ESITE

Methodology used to Calculate Cell Coverage Statistics for Vermont Towns VTA - Joint Backbone Project



TYPE	TYPEDESC	DES	TYPEGROUP
R1	Single Family	R1-SINGLE FAMILY	BUILDINGS
R2	Multi Family	R2-MULTI FAMILY	BUILDINGS
R3	Mobile Home	R3-MOBILE HOME	BUILDINGS
R4	Other Residential	R4-OTHER RESIDENTIAL	BUILDINGS
R5	Camp/Bungalow	R5-CAMP/BUNGALOW	BUILDINGS
C1	Commercial	C1-COMMERCIAL	BUILDINGS
CF	Commercial Farm	CF-COMMERCIAL FARM	BUILDINGS
CL	Lodging	CL-LODGING	BUILDINGS
C9	Other Commercial	C9-OTHER COMMERCIAL	BUILDINGS
P1	Government	P1-GOVERNMENT	BUILDINGS
P2	Health Care	P2-HEALTH CARE	BUILDINGS
P3	Church	P3-CHURCH	BUILDINGS
P4	Educational	P4-EDUCATIONAL	BUILDINGS
P5	Cultural	P5-CULTURAL	BUILDINGS
P8	Public Gathering	P8-PUBLIC GATHERING	BUILDINGS
P9	Ambulance House	P9-AMBULANCE HOUSE	BUILDINGS
I1	Industrial	I1-INDUSTRIAL	BUILDINGS
B4	Campground	B4-CAMPGROUND	BUILDINGS
H1	Hanger	H1-HANGER	BUILDINGS
A1	Accessory Building	A1-ACCESSORY BLDG	BUILDINGS
A2	Abandoned	A2-ABANDONED	BUILDINGS
R6	Seasonal Home	R6-SEASONAL HOME	BUILDINGS
C2	Commercial with Residence	C2-COMMERCIAL W/APT	BUILDINGS
PS	PSAP	PS-PSAP	BUILDINGS

Figure 1

Roads layer: The road centerline layer was extracted from E911’s RDS⁷ dataset. VCGI extracted roads which could be characterized as “active”. For example, legal trails or proposed roads were excluded.

Town Boundary layer: VCGI’s used the town boundaries represented in the BNDHASH⁸ layer to determine cell coverage by town.

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http://www.vcgi.org/dataware/search_tools/moreinfo.cfm?catalog_id=1&layer_id=43&layer_name=EmergencyE911_RDS

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http://www.vcgi.org/dataware/search_tools/moreinfo.cfm?catalog_id=1&layer_id=148&layer_name=BoundaryOther_BNDHASH



Appendix C – Maps





