Photo by Zedong Li at Signal Hill Park, Long Beach, CA (2021)

The Analysis of Coverage of Cell Towers in Los Angeles County

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Introduction

Los Angeles is a metropolitan area in Southern California that needs comprehensive network coverage for the demand of a large population. Currently, there are many cell towers around the county, but there are not enough for building an uninterrupted network in the county; the phone carriers need to find an optimal and cost-effective way to improve the coverage of the cell towers. Therefore, it is essential to analyze how to improve the coverage of cell towers in Los Angeles county.

Understand the Influence Factors, then Analyze

Before starting the analysis, it is important to know the distribution of the current cell towers and the factors that influence the distribution of cell towers. According to Map 1, most cell towers are concentrated in the center area of Los Angeles, which tends to be close to the densely inhabited area. Also, making the hill shade map before the analysis is helpful to understand why the cell towers are distributed and how we can optimize the locations of the incoming new cell towers. When comparing Map 1 and Map 2, it is obvious that most cell towers are distributed in the low-elevation area. The elevation is one of the important factors that influence the distribution of cell towers. Now we have three options to optimize the coverage of cell towers. The first one is to add three cell towers in those no-coverage areas close to inhabited areas. The second option is to increase all the tower heights by 10 meters, and the third method is to increase each towers' range by 5km because of the elevation factor. For this analysis, we have to focus on the visibility analysis, and it is significant to collect all the coverage results using the viewshed method. Therefore, making the coverage map of the original coverage and the three optimized options by the viewshed method is necessary. Furthermore, it is significant to analyze from the results of the zonal histogram of these viewshed layers and receive the zonal statistics then have a further analysis to know the percentages of coverage by each optimize option and to compare the options to pick the best one for optimizing the coverage of cell towers in Los Angeles County.

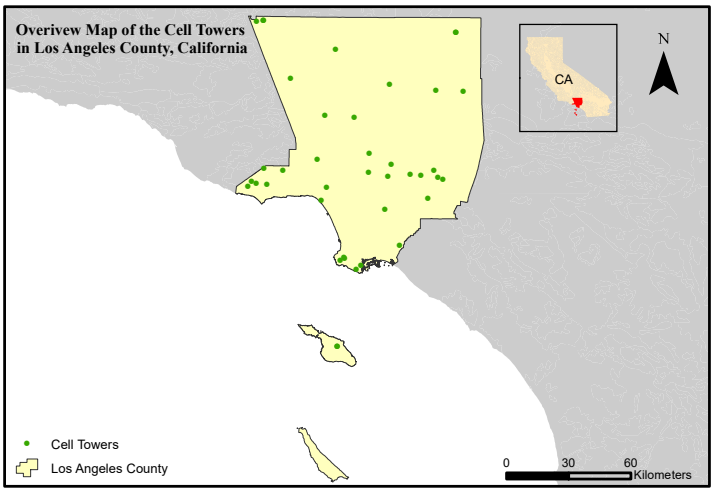
Increasing the Heights is the Best Choice

Map 3 shows the original coverage of the cell towers, and it is obvious that the non-coverage areas are mainly the high-elevation areas when we compare map 3 with Map 2. For option 1 of adding three cell towers, I pick three locations: one tower is in a low-elevation area, two towers are in high-elevation areas, and they are all close to an inhabited area. Map 4 shows that the one in the low-elevation area has obvious widen coverage to its neighbor area. Still, the other two towers in high-elevation and mountains areas are not providing obvious coverage improved. Map 5 and Map 6 show better coverage than Map 4, and Map 5 and Map 6 indicate the improved towers by option 2 and 3 now have more widen coverage, mainly in low-elevation areas. Table 1 provides the details and shows that option 2 is the best method to widen the coverage by increasing all the tower heights by 10 meters, and this option provides 49.7% available coverage of the total area in Los Angeles County, which is the highest one among these options; it increases 4.2% of coverage when comparing it to the original coverage.

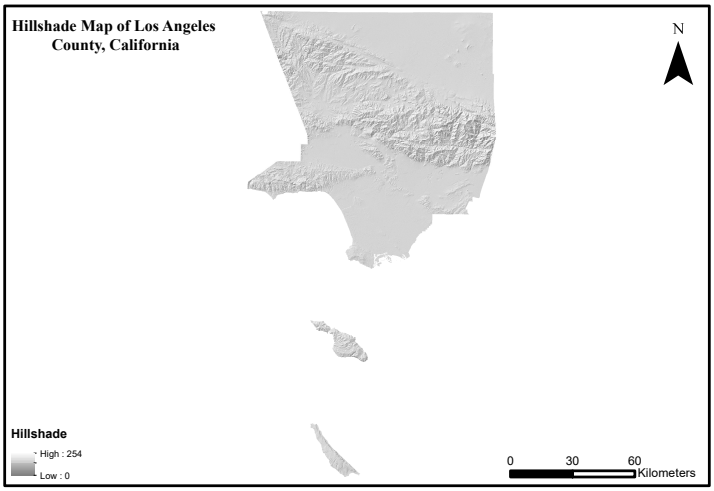
Conclusion

From this analysis, it is obvious that the cell towers have better performance in low-elevation areas. The high-elevation areas are also the mountains areas and have more obstacles that impact the signal coverage. Adding three new towers in high-elevation areas is not helpful enough. The option of increasing the towers' range by 5km is also not as beneficial as the option of increasing all the heights by 10 meters. The analysis finally shows that increasing all the tower heights by 10 meters is the recommended choice to improve the coverage of the cell towers in Los Angeles County because increasing the heights of cell towers can maximize avoiding the disturb from high obstacles.

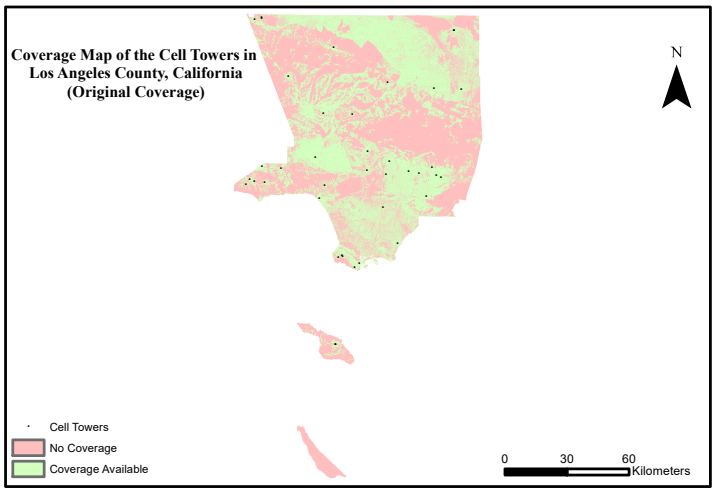
Appendix



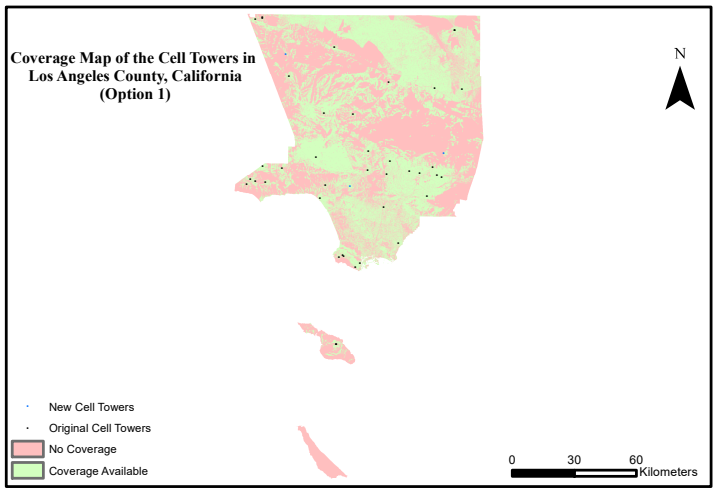
Map 1: Overivew Map of the Cell Towers in Los Angeles County, California



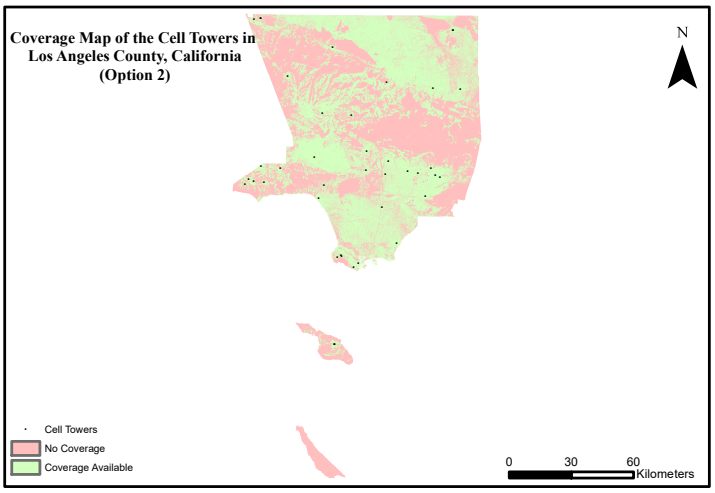
Map 2: Hillshade Map of Los Angeles County, California



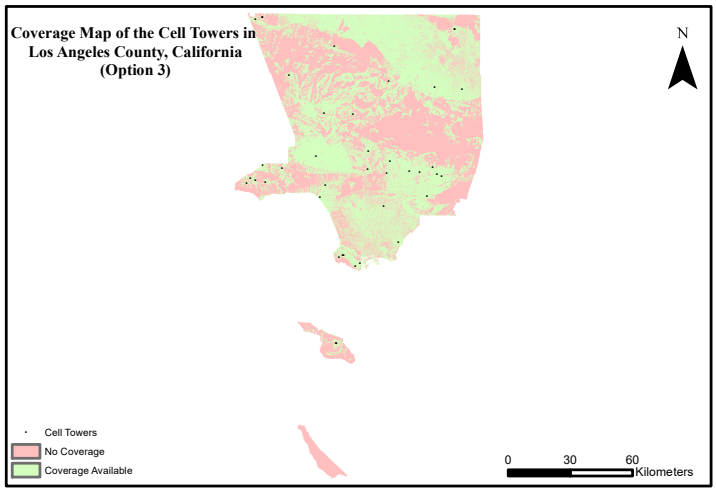
Map 3: Coverage Map of the Cell Towers in Los Angeles County, California (Original Coverage)



Map 4: Coverage Map of the Cell Towers in Los Angeles County, California (Option 1)



Map 5: Coverage Map of the Cell Towers in Los Angeles County, California (Option 2)



Map 6: Coverage Map of the Cell Towers in Los Angeles County, California (Option 3)

Table 1: Statistics

(Numbers are rounded to have 1 decimal place)

	Signal Coverage	Percentage (Total in L.A. County)	Change of Percentage (Compare to the Original Coverage)
Original Coverage	Coverage Available	45.5%	0
	No Coverage	54.5%	0
Option 1	Coverage Available	46.4%	+0.9%
(Add three additional towers at optimal locations)	No Coverage	53.6%	-0.9%
Option 2	Coverage Available	49.7%	+4.2%
(Increase all the tower heights by 10 meters)	No Coverage	50.3%	-4.2%
Option 3	Coverage Available	49.6%	+4.1%
(Increase each towers' range by 5km)	No Coverage	50.4%	-4.1%