THE 5G MOBILE UBIQUITY PRICE TAG

COSTS FOR FULL U.S. DEPLOYMENT OF 5G - WITH AND WITHOUT SUPPORT FOR AUTONOMOUS DRIVING

INTRODUCTION

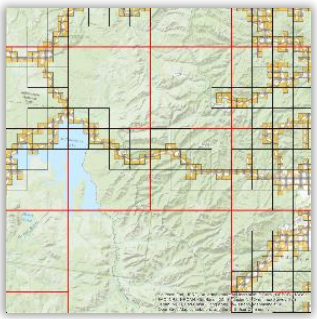
There has been much discussion about 5G mobile deployment. While the standards for 5G technology are still being worked on, questions abound. When is 5G coming? How will it mesh with the existing 4G macro network? What might it mean to consumers in terms of bandwidth, speed and practical use? With the explosion of mobile bandwidth use, the development of IOT solutions and the potential of autonomous vehicles looming large on the horizon, there are additional, pressing questions to be answered in regards to 5G deployment. How much new infrastructure will be needed to support a fully ubiquitous 5G meshed deployment? What will this network cost? With these latter questions in mind, CQA developed a 5G mesh network model to estimate costs of a full, ubiquitous road coverage network, to serve every roadway in the U.S. The following represents a high-level summary of CQA's study and findings.

APPROACH FOR THE ESTIMATION OF COSTS

CQA (CostQuest Associates) developed a model to estimate the upfront investment needed to deploy a mesh 5G to the entire U.S., to cover all roads, buildings and homes.

The Network

The mesh network will need to utilize frequency spectrum bands well above 2.5Ghz, in concert with spectrum bands in use today, to provide 5G coverage in specific smaller cells (i.e., 200 meter radius microcells), which would provide service in high density areas and along major roadways, that would mesh with a full macro network. In order to estimate the total number of cells/sites needed to support such a mesh network, grids were used to estimate serving areas based on anticipated demand. Any location needed to be served by the 5G mesh network across the U.S. would be served by one of five grid sizes based on estimated serving radius.



Grid Level1: 8 mile grids
Grid Level1.5: 4 mile grids
Grid Level2: 2 mile grids
Grid Level3: 800m grids
Grid Level4: 200M MicroGrids

Given the current serving constraints of 5G service, 5G was the assumed technology in the Level4, Microgrids, along with the use of extremely high frequency spectrum bands. For Levels 1 through 3, lower spectrum bands were assumed along with the use of a 4G like technololgy.

Backhaul

It was assumed that fiber backhaul would be needed serve all site locations. This fiber network was modeled and the full cost of fiber and electronics were developed.

Roads

CQA has modeled coverage for all road types across the U.S (this includes Highways, ramps, primary roads, secondary roads, 4WD roads, local, rural and city roads, alleys, private roads for service vehicles, and parking lot roads). Demand along roads is the targeted coverage for the estimation of costs in this study. While the model includes estimating costs to deploy mobile service that reaches static demand such as structures (homes and buildings), there is no assumption that this modeled network will provide indoor coverage.

Geographic Area

This study looks at the entire U.S., including Alaska, Hawaii and all territories.

RESULTS

CQA intends to publish a more detailed description of the study and breakout of costs and results at more granular geographic levels in the coming months. Until that time, CQA is providing (below) a high-level overview of the total estimated investment for the entire U.S. based on four network deployment scenarios:

1. The deployment of a 5G mesh network using near term bandwidth demand assumptions (2Gbps/month per user),
2. The deployment of a 5G mesh network assuming demand increases markedly in the next 10 years (50Gbps/mo. per user),
3. The deployment of a 5G mesh network using near term bandwidth demand assumptions (2Gbps), and also could support autonomous vehicles on primary and secondary roads, and
4. The deployment of a 5G mesh network that assumes future demand (50Gbps) and also could support autonomous vehicles on primary and secondary roads.

The scenarios calling for support of autonomous vehicles require more cell (i.e., grid) density, thus more investment, due to the increased deployment in largely rural areas to support roads that could have easily been served with macro sized cells (e.g., 4 or 8 mile radius cells).

Overall Estimated Investment – All U.S.

These values capture a full network deployment, inclusive of the fiber network needed for backhaul. As such, it does not represent the incremental investment to an existing carrier.

Study Description		User Demand	Total Investment
Scenario 1	Ubiquitous Coverage	2Gb/Mo.	$61B
Scenario 2	Ubiquitous Coverage, Future Demand	50Gb/Mo.	$145B
Scenario 3	Ubiquitous Coverage, Autonomous Vehicle support	2Gb/Mo.	$185B
Scenario 4	Ubiquitous Coverage, Autonomous Vehicle support, Future Demand	50Gb/Mo.	$250B

Results (Cont'd)

Investment by Type – All U.S.

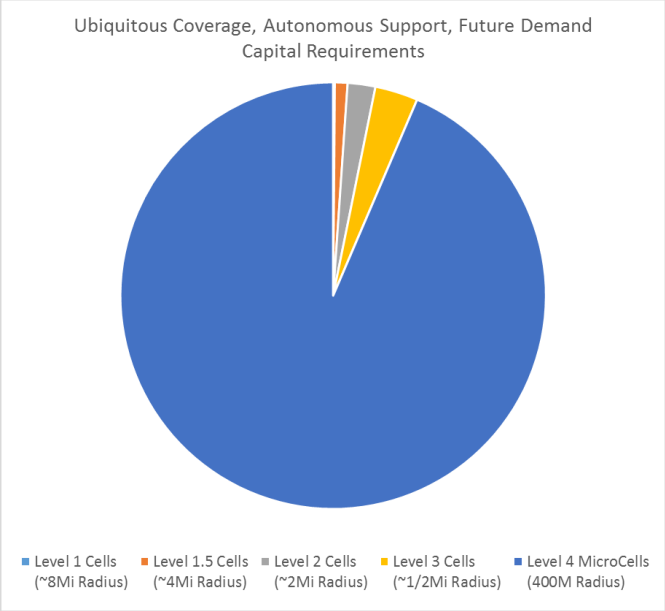
Study Description		User Demand	Capital Type: Fiber Backhaul	Capital Type: RAN Equipment
Scenario 1	Ubiquitous Coverage	2Gb/Mo.	$14B	$47B
Scenario 2	Ubiquitous Coverage, Future Demand	50Gb/Mo.	$15B	$130B
Scenario 3	Ubiquitous Coverage, Autonomous support	2Gb/Mo.	$56B	$129B
Scenario 4	Ubiquitous Coverage, Autonomous support, Future Demand	50Gb/Mo.	$57B	$193B

Cell/Site Counts

In terms of total site locations needed to support a ubiquitous 5G mesh network, CQA has estimated the number of grids (each containing a site/tower) to serve all roads and demand across the U.S. Below is a breakdown of cells/grids needed for each of the four scenarios. The 400 meter MicroGrids (200m serving radius) are shown separately to show that investment is largely driven by higher demand areas with greater site density.

Study Description		User Demand	Cell Counts: Total	Cell Counts: MicroGrids
Scenario 1	Ubiquitous Coverage	2Gb/Mo.	454,019	386,149
Scenario 2	Ubiquitous Coverage, Future Demand	50Gb/Mo.	755,509	540,879
Scenario 3	Ubiquitous Coverage, Autonomous support	2Gb/Mo.	2,587,003	2,523,422
Scenario 4	Ubiquitous Coverage, Autonomous support, Future Demand	50Gb/Mo.	2,800,944	2,620,138

For Scenario 4, where the highest demand is estimated in terms of bandwidth needs, the total cells/sites exceeds 2.8 million, with nearly 94% of the sites have just a 200 meter coverage radius.



Quick Takeaways

CQA has undertaken this initial effort to "size the problem" with this cursory look at total investment needed for 5G ubiquity. At a minimum, to cover high density areas and highways with 5G coverage, almost 400,000 microcells would need to be deployed to meet near term demand. And with the inclusion of potential support for autonomous vehicle along major roads and secondary roads, the investment increases between 3.5 and 5.5 times, while the count of microcells increases by more than 600%, depending on future demand assumptions. This significant jump in cells and investment is the direct result of facility density requirements along key roads.

About the Author

CostQuest Associates (CQA) serves as the frontrunner in designing, developing and implementing economic models for the telecommunications industry. CQA has provided proprietary profitability, cost, telecom engineering, and metrics systems along with demographic data, data analysis, and GIS support to enhance decision making in some of the world's leading companies. CQA is also known for its work for federal government agencies such as the FCC and NTIA, and with state and local governments.

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