



VERSALIFT WHITEPAPER

**5G: FIFTH GENERATION INTERNET
A GUIDE TO AERIAL LIFT MARKETPLACE IN SUPPORT OF GROWTH**

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What is 5G, and how is it different?

American telecommunications providers such as Verizon, AT&T and the newly merged Sprint-T-Mobile, are preparing to roll out a new 5G mobile network across several major urban and suburban areas within the United States. The initial rollout will take several years. Following that, many more urban areas will receive 5G, as the network is delivered across the country. The construction and maintenance of these new 5G networks will require hundreds of billions of dollars in investment, and that will come from major carriers, municipalities, and other global corporations who will own the networks they build. As telecommunications providers focused on this implementation, they will require thousands of technicians, using highly specially-equipped bucket trucks, over decades of time, in order to be completed.

The 5G Opportunity for Versalift

Telecommunications fleets are going to have to expand significantly in order to address the enormous project of implementing a 5G nationwide mobile network. Aerial lifts that are built for current telecommunications networks are likely going to be able to handle a significant amount of the work in deploying and maintaining 5G infrastructure. While it is possible that some adjustments and customizations to existing units may be all that is required, research and development are ongoing. Versalift has developed a 5G Aerial Lift Pilot Program to build equipment specifically purposed for safely and efficiently installing 5G antennas. Based upon a survey of manufacturers, 5G antennas can weigh between 50 and 350 lbs, and require specialized mounts to be safely installed on utility poles.

Experts involved in planning initial implementations expect that 5G antennas will be mounted in a variety of ways and places, including on the exterior facades and roofs of buildings. In cities, 5G antennas will need to be mounted upon street furniture, which includes bus shelters, public restrooms, utility cabinets and other objects and equipment installed along roads for a public purpose. In very dense areas, 5G antennas will also be installed within buildings, as they are needed, in order to account for the accelerating number of connected devices in cities.

5G Technology

5G towers will provide a significant improvement in performance over the current 4G and 4G-LTE networks. In order to get a better understanding of the tremendous impact 5G will have on our everyday lives, below, we include a brief summary of older networks.

3G

3G has its name because it was the network that was born of the third generation of wireless technologies. 3G came with significant enhancements over previous wireless technologies, including high-speed transmission, advanced multimedia access and global roaming. With the development of 3G came the creation of the 3rd Generation Partnership Group (3GPP), which

was formed to promote 3G standards. 3GPP has since evolved to develop standards around 4G/LTE and 5G.

3GPP - A Global Mobile Communications Policy Working Group

The organizations that make up the 3GPP are each national industry working groups that include many of the largest carriers and manufacturers in each market. The global membership base of the 3GPP illustrates the global nature of the 5G evolution. Every developed nation, and several developing nations, is invested in the quality of its mobile communications infrastructure.

Members of the 3GPP include:

- **ARIB** (Japan) - Association of Radio Industries and Businesses
- **CCSA** (China) - China Communications Standards Association
- **ETSI** (Europe) - European Telecommunications Standards Institute
- **TSDSI** (India) - Telecommunications Standards Development Society - India
- **ATIS** (USA) - Alliance for Telecommunications Industry Solutions
- **TTC** (Japan) - Telecommunications Technology Committee
- **TTA** (Korea) - Telecommunications Technology Association

4G

4G earned its name by being the network that supports the fourth generation of mobile phone technology. 4G follows on from the existing 3G mobile technology, and is based upon global standards that were developed by the 3GPP working group. In terms of performance, 4G supports much higher data rates than 3G, and tends to work between five and seven times faster than 3G. 4G also has some functionality for MIMO (multiple input - multiple output) antenna systems, traffic prioritization and machine to machine functionality. 4G is often interchangeably used with the term LTE, which stands for “Long-Term Evolution.”

5G

5G is the fifth generation of mobile technology. GMSA, a leading global industry group for mobile providers, product manufacturers, software makers and internet companies, proposes that the definition of 5G falls broadly into two schools of thought:

1. A service-led view which sees 5G as a consolidation of 2G, 3G, 4G, Wi-fi and other innovations providing far greater coverage and always-on reliability
2. A view driven by a steep change in data speed and order of magnitude reduction in end-to-end latency.

Note that these definitions are often discussed together, which can result in contradictory ideas. This example helps to illustrate the challenge of defining 5G.

5G & The Internet of Things

5G will deliver a platform for the Internet of Things, which may be the most important evolution in mobile communications for fifty years. Major wireless providers will move to hire and employ thousands of new technicians to meet the demand for 5G across the United States and abroad. It has been estimated that a nationwide 5G rollout could create as many as 3 million jobs and

add \$500 billion to the United States GDP. According to management and tech consultancy Accenture, the US wireless industry currently generates \$475 billion in GDP, supports 4.7 million jobs, and creates \$1 trillion in economic output. By designing, manufacturing, and distributing a newly developed 5G unit, Versalift will enable these technicians to safely install, maintain, and tune 5G devices for years to come. It is not just towers that will need to go up high, but also security devices such as cameras, and relays for autonomous vehicles. Versalift is preparing with innovative equipment that safely meets the applications of the future.

Who Uses the Internet of Things?

While an in depth discussion of IoT, or the Internet of Things, is beyond the scope of this paper, it is important to know that ordinary devices such as diesel engines, factory floors, electricity grids, automobiles, and wearable communication devices. Currently, IoT, is being used with great success by companies around the world. Logistics organizations are able to provide advanced services to their customers. Manufacturers see enormous improvements in product quality and production time through the implementation of IoT. Sports teams use IoT to inform coaches of probabilities and possibilities. Similarly, gyms and other subscription-based service providers use IoT to offer their customers feedback.

Some estimates suggest that there may be more than 25 billion internet-connected devices by 2024. While not all IoT devices will require 5G, the digital spectrum and MIMO technology discussed below provide a runway for advancement, research, and development.

Industries - General Overview

It's not yet possible to fully understand how 5G will impact the lives of average people in the United States. The economic opportunity that exists in the 5G marketplace is huge, and there is a great deal of buzz about how it will be created. Already, there are many major American business sectors and industries that are feeling the impact of 5G.

- **Mobile Communications Providers**, who are already marketing 5G, are offering new services for mobile phones and computers, made available as a result of increased internet speeds and bandwidths.
- **Public and Private Electric Utility Providers**, which generate energy and deliver it to people and businesses, will gain efficiency and reliability through 5G-enabled smart grid management.
- **Banks, Insurers and Other Financial Services Providers** will create more opportunities for enhanced client security and identity protection through 5G-enhanced monitoring systems and smart cameras.
- **Hospitals, Doctors and Other Healthcare Providers** will get precise, real-time information from 5G-enabled medical devices pacemakers, heart monitors and other life-sustaining medical technologies.
- **Manufacturers of Equipment, Products and Goods** will enhance their operations with 5G technology to improve their inventory management, optimize production lines and improve efficiency.

- **Retail Environments** that are 5G-enabled will be able to offer true omni-channel engagement with customers. Shopper convenience and customizations will add value. 5G will make retail stores more efficient with self-updating price tags, improved inventory management and more complete security.
- 5G-enabled vehicles and connected traffic infrastructure in the **Transportation Industry**, including the self-driving car, will offer new vehicle-to-vehicle (V2V) communication. This technology is not limited to just cars: boats, trains and other modes of transportation will benefit from this set of advancements.

A look at 5G and the Electric Utility Industry

Smart Grids

Smart grid technology is a leading source in the demand increase for aerial units. Running on an electrical grid based system, the grid transmits signals out to transmission lines, substations, transformers, to and from your home or business. Smart grid technology has higher frequencies and lower latency that make it have to be installed every five hundred feet from each station. It will start being installed on traffic lights, street lights and light poles. Smart grid is also an energy efficient system that only operates when connected to unlike our current 4G. It has a renewable energy system allowing for lower cost.

A look at 5G and the Transportation Industry

Autonomous Vehicles

Autonomous transportation that doesn't require humans to operate will constantly communicate with both enhanced high speed satellite networks as well as line of site internet systems. These systems are called V2C "Vehicle to Cloud": The technology exchanges information about and for applications of the vehicle with a cloud system. This allows the vehicle to use information from other, though the cloud connected industries like energy, transportation and smart homes and make use of IoT. While self driving vehicles today (Like those by Tesla) do not require the Internet to drive, they do require the internet to update systems using this cloud technology.

Connected Traffic Infrastructure

As we begin to share the roads with Autonomous vehicles there are several 5G driven developments that will influence safety and efficiency. Road markings, protection/safety equipment, sign sheeting, and other products are currently in development and being deployed that allow networks to better read traffic and understand and communicate risk. Through mobile technology, 5G is expected to provide end-to-end connectivity across our cities and beyond. It will support many types of communications for transportation companies. Two of the most important include:

- **Vehicle-to-vehicle (V2V):** Vehicles relay signals directly to each other

- **Vehicle-to-infrastructure (V2I):** Vehicles communicate with sensors on bridges, roads and traffic lights

To date, municipal area networks have typically been a hodgepodge of wireless networking protocols. Wi-Fi, RF-Mesh, ZigBee, Z-Wave, Wi-SUN and LoRa operate without heeding each other, creating application silos that make it difficult to serve city-wide applications. By using integration gateways to unify these short-range communication technologies, a city can create a single network governed by a common set of rules or policies. Unifying network protocols in this way makes it possible to seamlessly hand off communications with a connected vehicle as it travels between different access points. As 5G networks roll out across our cities and bind together existing wireless networks, they can provide real-time, end-to-end visibility into our transportation systems.

Mobile Telecommunications Infrastructure

5G Cell Towers and Antenna Requirements

5G cell towers are telecommunications sites that are predicted to boost wireless signals by at least ten times the current speed of 4G/LTE. 5G operates in a high-frequency band of the wireless spectrum. Because high frequency waves have a much harder time traveling over long distances and through objects, the 5G network will need to be built using small cell, also known as microcell, technology, with antennas that are located as close as 500ft to one another. In cities, 5G microcell site density will be higher, due to line-of-sight issues as 5G requires line-of-sight or single-bounce line of site to communicate with receivers. It is important to note that in addition to micro-sites, increased throughput is also going to require thousands of large cell towers to be built for a satisfactory 5G rollout.

5G Cell Types

Macrocell - Traditional technology seen on familiar cell towers. The radius for a typical site is 1.75-2 miles, with ranges up to 4-5 miles if the antennas are located on a very tall guyed tower. Advancements in macrocell technology are changing how they are deployed. Macrocells use a high-power cellular base station. Macrocells can be located on towers, rooftops, and other existing structures. Macrocells have been traditionally preferred by carriers in rural areas where population density is low, and they have an important role in the nationwide rollout of 5G.

Microcell - Microcells almost always use less power than macrocells, and their range of coverage is significantly smaller. In the case of 5G, microcell sites are going to be heavily placed in densely populated, urban areas. These sites are there to enhance network capacity in

cities and other areas with very dense phone usage, such as college campuses, sporting events, hotels, airports, and within buildings where there is no other way to get coverage.

Picocell - Picocells are similar to microcells in purpose: to provide coverage to a smaller area not able to be serviced by traditional coverage. Picocells are usually used to extend coverage to indoor areas where outdoor signals do not adequately reach, or to add network capacity to densely used areas. Picocells have a smaller radius of coverage, so their main use is inside buildings – or more recently, in airplanes. As with microcells, there need to be multiple cells connected through a base station. With the ever-increasing need for data on smartphones, Microcells and Picocells have seen a significant increase in use in the past several years.

Femtocell - Even smaller than a picocell is a femtocell. These are used mainly for the home or small business. It connects to the internet through DSL or cable, and can typically support up to 16 active phones in a small area.

MacroCell Tower Types

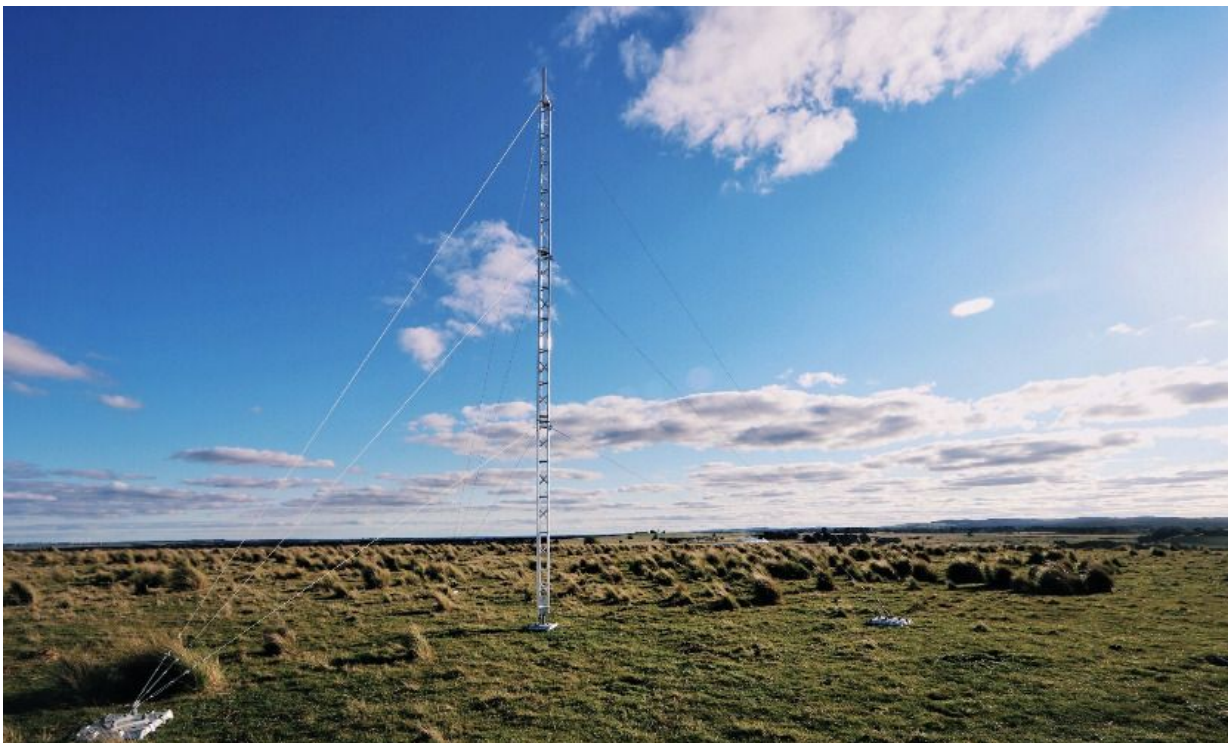
Monopole Tower - a single tube tower, with a primary use of telephony. Monopole towers typically stand at 100-200 feet in height, with antennas mounted upon the exterior of the tower.



Lattice Tower - also known as a "self-supported tower" or SST. This is because lattice towers are free-standing. Typical lattice towers stand between 200-400 feet tall, and feature a pyramid-shaped base with either three or four sides. Like monopole towers, lattice towers are primarily used for telephony.



Guyed Tower - a straight rod that is supported by guy wires attached to the ground for support. Guyed towers tend to be the least expensive towers to build, especially at heights above 300 feet. The tallest guyed towers reach as high as 2,000 feet. Typical uses include telephony, radio, and television.



Concealed Tower - towers that are deployed to be hidden in order to satisfy zoning regulations. Concealed towers can range in size to accommodate their surroundings. They are more expensive than other types of towers because they require additional material to create a "concealed appearance," yet at the same time, they provide less capacity to tenants than other towers do. Below is an interesting concealed tower at a California church.

- Smart Grid Network
- New Placements
- Cities & Street Furniture
- Suburban Areas
- Rural America
- Urban









Aerial Lifts and 5G

Existing Demand for Aerial Lifts, Diggers and Cable Placer Units

The American telecommunications market for aerial lifts is mature and well-established. Global telecommunications giants, national providers and regional players own fleets of van and truck-mounted aerial lifts, and update their fleets regularly. There is continual existing demand for the telecommunications aerial lift that currently maintain existing data lines.

Global mobile carriers such as Verizon, Sprint-T-Mobile and AT&T are investing several hundred billion dollars in initial infrastructure to get 5G up and running in selected US markets.

USA 5G Rollout

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- **Verizon** - Fixed & Mobile 5G - Live in Selected major US Cities
- **AT&T** - Mobile 5G Live for Some Customers in 20 cities, with expanding coverage throughout 2019
- **T-Mobile** - Fixed 5G - Live for Commercial Customers in Selected Cities, with expanded coverage expected in 2020
- **Sprint** - Mobile 5G - Live in Selected major US Cities (ATL, DAL, HOU and KC)
- **U.S. Cellular** - 5G planned for Q4 2019
- **C Spire** - Fixed 5G services - Live in parts of Mississippi
- **Charter** - 5G testing currently
- **Starry**: Fixed 5G in Selected major US cities (BOS, DEN, LA, NYC and DC)

The 5G rollout will occur on a next-level, previously unknown scale of expense and complexity. There are many known impediments to success, such as tower congestion, device inefficiency and heat up, indoor signal strength, and limitations of signal in urban environments.

Versalift is Starting the Conversation Around 5G in the Marketplace

Versalift is leading the conversation around 5G in our industry right now. As of ICUEE 2019, Versalift's website ranks #1 and/or #2 on Google for the following search terms:

- **5G aerial lift(s)**
- **aerial lift(s) 5G**
- **5G bucket truck(s)**
- **bucket truck 5G**
- **aerial work platform(s) 5G**

Currently, Versalift is the only manufacturer in the aerial lift/aerial work platform industry that is actively discussing 5G on the internet and in the press. A survey of major competitors reveal no content or new equipment that is purposed for building and maintaining the upcoming 5G network rollout.

Survey of Industry Competitors

While we know that competitors are currently working with Verizon, and AT&T to develop 5G units which may have lower costs than similar sized units previously used in the telecommunication space, none of these competitors are actively speaking about 5G through internet and press channels.

A survey was conducted on Altec, Terex, ETI/Palfinger and Elliot to determine their levels of commitment to the nationwide 5G rollout. Altec's website revealed zero mentions of 5G, and no references to the national rollout of the 5G network on it's telecommunications and blog landing pages. Terex doesn't traditionally support the telecommunications industry with aerial lifts so, as an organization, they appear to not be competing in this space. ETI & Palfinger compete in the telecommunications space, but they are not openly discussing 5G or offering modified equipment to address the specific needs that technicians will have when they install and maintain the new network. Elliot builds equipment for telecommunications servicers, but do not specifically mention 5G or equipment that has been modified for the construction and maintenance of the new 5G network.

Telecommunications - Complete Fleet Services

Versalift offers a complete solution to fleet customers who build, manage and maintain overhead telecommunications infrastructure. Versalift equipment creates a lower true cost of ownership for telecommunications fleets.

Versalift's complete fleet solution includes the following services:

- Equipment Design & Manufacture
- Assembly & Upfitting
- Sales & Distribution
- Financing

- Post-sales service
- Operator and maintenance training
- Warranty
- Parts & Maintenance
- Fleet Rental Services
- Disposition/Resale

Versalift - Summary

Versalift is a leading global manufacturer of bucket trucks, digger derricks, aerial lifts and other specialty equipment for the construction and maintenance of telecommunications networks and electric power transmission and distribution networks, sign, light & traffic maintenance, forestry and more. In addition to manufacturing the safest and most efficient equipment, Versalift provides a complete fleet solution, including equipment financing, parts & maintenance, operator training, warranty and fleet rental services.

Versalift offers a lower true cost of ownership to fleets that build and maintain electric utility infrastructure. Through smarter and more reliable design, Versalift equipment has the lowest warranty rate and the fewest product recalls of any aerial lift manufacturer. Founded in 1965 and based in Waco, Texas, the company has an established track record of innovation leadership in aerial lift design. Currently, Versalift has corporate-owned upfit and assembly distribution centers around the United States and Europe, and has a robust local distribution network with decades of local, tribal knowledge. Additionally, there are more than 250 service locations in North America.

Versalift is building a major manufacturing and distribution organization for the East Asian market in China, in partnership with the China Grid Corporation. Working with government agencies and corporations through its global network of facilities and family of dealers, the company now employs more than 1,100 associates worldwide.

FOR ADDITION INFORMATION - Please Contact your local Versalift Distributor
<https://versalift.com/distribution>

Additional Areas of Recommended Research

Technology

Geography
 New Entrants to 5G Marketplace

Substitute Products

Drones/Ladders
 Trained Giraffes

Future with 5G

Applications
 Problems/Issues

Industry Associations

Cttaa.org
Via.org

Contractors Market

Electricity
 Telecom
 Street/Municipal

Chip Providers

Huawei
 Qualcomm
 Erickssen