#### THE MOST INCREDIBLE THING WE'VE ENGINEERED IS OUR TEAM



# **Wireless Infrastructure**



#### The History, What We Know Today, The Future

ISO 9001:2015 Certified | Employee-owned Since 1988

### **Wireless Infrastructure**



- "Wireless Support Structures" Towers monopoles, lattice, guyed, roof tops, water tanks, small cells
- Antennas Broadcasts the wireless signal
- Coaxial Cables Provides connectivity from equipment to the antennas
- **Remote Radio Heads** Boosts antenna strength
- Equipment Cabinets, Enclosures, or Shelters
  - Radios, network demarcations, batteries and emergency generators.
- **Connectivity** Copper, microwave, fiber

# **Macro Self Support Tower**





# Macro Monopole





### **Macro Roof Top Installation**





# **Macro Water Tank Installation**





# Why Are Wireless Support Structures Needed?



- Propagate wireless signal from antenna
- Objectives:
  - Coverage Provide wireless services to areas with marginal, or no existing wireless signal.
  - **Capacity** Provide additional wireless services to areas where customer demand exceeds the capacity of the network.
  - Important Capacity of a wireless antenna location is limited by the equipment. Sometimes capacity issues can be overcome by adding equipment and frequencies, but when those paths are exhausted, a new location is needed.

# **History of Infrastructure**



- Macro networks were built on traditional towers; 100' to 400'.
- Height was needed to get the biggest footprint for the signal.
- At the beginning, only a few towers were needed. The power levels of the signal were high and the footprint was large.
- As customer demand grew, the equipment at the tower locations could not support the demand, thus new towers were needed.
- As more towers were added, lower power levels were required for the signal to prevent interference to other tower locations, thus a smaller footprint. This trend created 'holes' in the network.
- This pattern has been repeated for the last 30 years.

# **History of Technology**



### <u>Signal:</u>

- Analog (AMPS) Advanced Mobile Phone System (Launched 1983, phased out 2008)
- Digital
  - 1X (Phase out 2024?)
  - 3G (Phase out 2024?)
  - 4G/LTE
  - Voice over LTE

#### **Devices:**

- Bricks
- Bag phones
- Motorola StarTac
- Smart phones

# "History" Summary



- Technology constantly evolved
- Infrastructure stayed the same, but required more locations
- Constants:
  - The need for connectivity. Copper, microwave, fiber
  - Wireless support structures for antenna 'locations'

# What We Know Today



- Demand for wireless services continues to increase exponentially.
- Traditional macro towers will continue to be built to fill in 'holes' and as needed for capacity.
- Small cell technology will be added to macro network.
  - Smaller structures; 35' to 60'
  - Antennas 6 cubic feet (12" diameter x 4' in height)
  - Equipment 28 cubic feet. (Small refrigerator)
  - Footprint 500' 1,000'
- LTE/4G small cells being built today.
- 5G small cells will be the future.





- Macro network is the 'umbrella' for wireless services. It is robust and hardened.
- Small Cell network is the 'underlayment' of the network.
  - It is closer to the customer, thus providing the capacity that is needed for the network.
  - Provides 'precision' solutions to capacity problems.

# Macro Tower vs Small Wireless Facility



# **Pole Mounted Small Cell**





### **Pole Mounted Small Cell**





# **Roof Top Small Cell**





# **Stealth Small Cell**





# **Micro-Wireless Facility**







- Technology is evolving at an exponential rate.
- More antenna locations are needed for the networks. Small cells have been introduced to the mix.
- What has not changed?
  - The need for **fiber** connectivity
  - The need for wireless support structures for antenna 'locations'



- **5G** Protocol for the operation of a radio.
  - Lightning fast speeds for data and devices.
- IoT Internet of things Network of physical devices estimated to be 30 billion by 2020:
  - AV Autonomous Vehicles
  - CAV Connected autonomous vehicles
  - **ITS** Intelligent transportation systems
  - Smart Cities

# **Future Applications**



- Education: Access to information
- Economic Development:
  - Manufacturing Robotics and process efficiencies
  - Agriculture Monitoring and process efficiencies
  - Transportation Autonomous vehicles and ITS
- Health Care: Monitoring devices and reporting
- Municipal Infrastructure: Water/sewer service monitoring systems, parking, traffic control, and public safety
- **Tourism:** Attractions, adventures, events and lodging
- Entertainment: Movies, sports, music, games, etc.

# "Future" Summary



- Future technologies will not exist without:
  - Robust fiber networks
  - Antenna 'locations'

 Wireless infrastructure will provide connectivity for the community of IoT.





"The safest prediction is that reality will outstrip our imaginations. So let us **prepare** for not just for what we expect but for what will surely surprise us".\*

#### What will it take to prepare?

- Extensive **fiber** networks
- Multitudes of antenna 'locations'

(\*Liberties taken with a quote by Sendhil Mullainathan- Economics Professor at Harvard, Author of Scarcity: Why Having Too Little Means So Much.)





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