



Technology choices for wireless callers

T-Mobile

Wireless technology builds vibrant communities

Nearly all Americans own a mobile phone and a vast majority of them are smartphones. In fact, over 50% of all U.S. households are cell phone only¹. Wireless is essential to our lives but the nation's wireless infrastructure is under pressure to keep pace with demands for faster data speeds, more coverage and new services.

Wireless networks need infrastructure

To meet demand, T-Mobile must address the challenges of coverage and capacity with denser networks and infrastructure that incorporates different technologies to solve the challenges of transporting vast amounts of data. Traditional macro cell sites, small cells and distributed antenna systems are a few examples of the infrastructure needed to create the coverage and capacity essential for a wireless network.

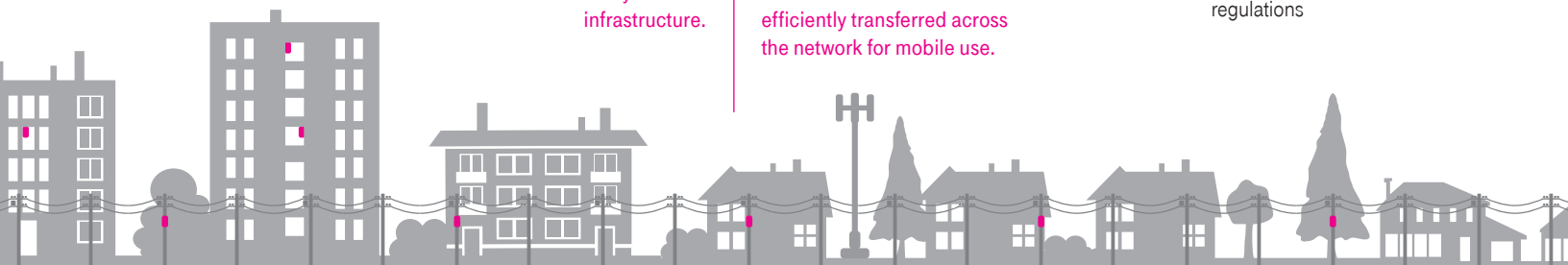
Specific factors determine where infrastructure needs to be located

T-Mobile engineers make decisions to locate wireless infrastructure based on a number of technical factors including:

- Service reliability
- Coverage objectives
- Capacity needs
- Future network expansion
- Enhanced 911 requirements
- Worker safety for operations
- Federal, state and local regulations

Coverage is the geographic area that is served by wireless infrastructure.

Capacity is the amount of data and voice traffic that can be efficiently transferred across the network for mobile use.



Quick facts:

Macro Cells

Macro cells, sometimes called towers, range from 50' - 200' high with a coverage area from a half mile to several miles.

Small Cells

Small cells are low powered and encompass a smaller geographic area compared to macro cells but add capacity to a network.

Pico Cells

A small cellular base station typically covers an area of less than 150 yards. Used to extend coverage to indoor areas.

Femto Cells

A small, low-powered cellular base station designed for use in a home or a small business.

Building blocks of wireless networks

MACRO SITES

Traditional macro sites are installed on rooftops, building facades, monopoles and other steel structures. These traditional antenna support structures handle many users across a general geographic footprint.

SMALL CELLS

Small cells are miniature versions of traditional cell sites. These self-contained cell sites are small, lightweight and low power. They can be used indoors so large crowds of people can simultaneously access a wireless network, or they can be placed outdoors in the public right-of-way, like on street lights and utility poles.

DAS TECHNOLOGIES

A Distributed Antenna System (DAS) network is made up of a base station connected by fiber optic cable to a group of antennas placed remotely in outdoor and indoor locations. DAS networks share and receive signals with remote nodes simultaneously, creating a single large cell. DAS systems can be shared by multiple carriers and are multi-frequency.



Small cells relieve congestion

This small cell provides additional voice and data capacity and is a complement to existing infrastructure.

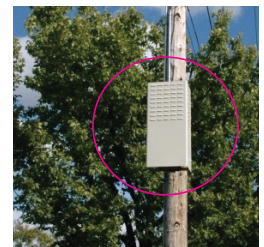
Small cell considerations

COVERAGE

Coverage in hard-to-reach locations: Man-made and naturally occurring obstacles to radio waves — and in some instances, aesthetics — are considerations for using small cell and DAS technologies.

CAPACITY AND REACH

Small cell deployments offer greater capacity with lower power antennas. While the reach of the radio waves is a fraction of macro cell sites, the smaller footprint means more antennas are closer to where mobile devices are used — which improves service quality.



DAS technology

A distributed antenna system (DAS) provides a wireless network in a building or geographic area.

Wireless networks require constant investment

As T-Mobile's network constantly grows and evolves, our engineers continually analyze our network data and consider several important factors when determining how to improve or optimize the network including coverage, congestion, spectral efficiency and customer experience. Depending on the scenario, engineers may recommend adding new antennas, sectors or small cells to an existing macro site. We strive to use a current infrastructure before recommending new sites.



Macro sites

Macro sites cover a large geographic area, can be located on a tower, rooftop, water tower or other structure. Multiple carriers can locate their equipment on a macro site.

1. <https://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201512.pdf>