Improve Verizon Service with Open Source Technologies

“Safe Harbor” Statement

In this presentation we have made forward-looking statements. These statements are based on our estimates and assumptions and are subject to risks and uncertainties. Forward-looking statements include the information concerning our possible or assumed future results of operations. Forward-looking statements also include those preceded or followed by the words "anticipates," "assumes," "believes," "estimates," "expects," "forecasts," "hopes," "intends," "plans," "targets" or similar expressions. For those statements, we claim the protection of the safe harbor for forward-looking statements contained in the Private Securities Litigation Reform Act of 1995. We undertake no obligation to revise or publicly release the results of any revision to these forward-looking statements, except as required by law. Given these risks and uncertainties, readers are cautioned not to place undue reliance on such forward-looking statements. The following important factors, along with those discussed in our filings with the Securities and Exchange Commission (the "SEC"), could affect future results and could cause those results to differ materially from those expressed in the forward-looking statements: the effects of competition in the markets in which we operate, including the inability to successfully respond to competitive factors such as prices, promotional incentives and evolving consumer preferences; failure to take advantage of, or respond to competitors' use of, developments in technology, including artificial intelligence, and address changes in consumer demand; performance issues or delays in the deployment of our 5G network resulting in significant costs or a reduction in the anticipated benefits of the enhancement to our networks; the inability to implement our business strategy; adverse conditions in the U.S. and international economies, including inflation and changing interest rates in the markets in which we operate; cyberattacks impacting our networks or systems and any resulting financial or reputational impact; damage to our infrastructure or disruption of our operations from natural disasters, extreme weather conditions, acts of war, terrorist attacks or other hostile acts and any resulting financial or reputational impact; disruption of our key suppliers' or vendors' provisioning of products or services, including as a result of geopolitical factors or the potential impacts of global climate change; material adverse changes in labor matters and any resulting financial or operational impact; damage to our reputation or brands; the impact of public health crises on our business, operations, employees and customers; changes in the regulatory environment in which we operate, including any increase in restrictions on our ability to operate our networks or businesses; allegations regarding the release of hazardous materials or pollutants into the environment from our, or our predecessors', network assets and any related government investigations, regulatory developments, litigation, penalties and other liability, remediation and compliance costs, operational impacts or reputational damage; our high level of indebtedness; significant litigation and any resulting material expenses incurred in defending against lawsuits or paying awards or settlements; an adverse change in the ratings afforded our debt securities by nationally accredited ratings organizations or adverse conditions in the credit markets affecting the cost, including interest rates, and/or availability of further financing; significant increases in benefit plan costs or lower investment returns on plan assets; changes in tax laws or regulations, or in their interpretation, or challenges to our tax positions, resulting in additional tax expense or liabilities; changes in accounting assumptions that regulatory agencies, including the SEC, may require or that result from changes in the accounting rules or their application, which could result in an impact on earnings; and risks associated with mergers, acquisitions, divestitures and other strategic transactions, including our ability to consummate the proposed acquisition of Frontier Communications Parent, Inc. and obtain cost savings, synergies and other anticipated benefits within the expected time period or at all.

As required by SEC rules, we have provided a reconciliation of the non-GAAP financial measures included in this presentation to the most directly comparable GAAP measures in materials on our website at www.verizon.com/about/investors.

How

Overview

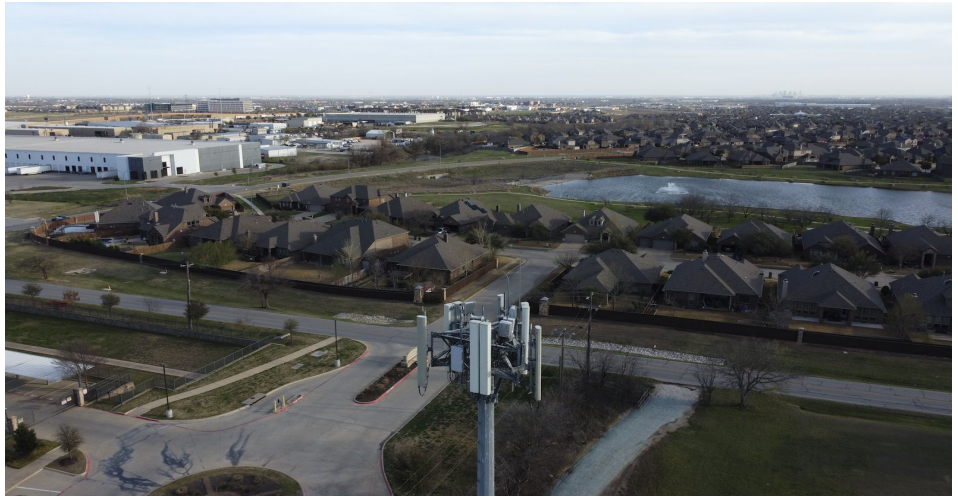
Challenge

Verizon is committed to delivering reliable, high-performance wireless service. Maintaining and expanding our network requires efficient and safe cell tower inspections and site surveys. Traditional methods are time-consuming, expensive, and potentially hazardous.

We challenge you to reimagine our cell tower inspection and deployment using drone technology, computer vision, AI, and data analysis. Develop a tool that automates the analysis of drone-captured imagery to assess tower health, identify construction anomalies, and optimize antenna placement for maximum coverage and performance. Integrate a user-friendly interface with natural language processing to provide actionable insights and recommendations based on the collected data

Material that can be shared with Team:

- Pre Trained Model
- Sample Videos / Pictures
- Technologies / Stack



General Direction:

- Identify the objects and label them
- Height of the tower
- Identify type of structure.
- Classification and number of objects on tower?
- What is the “interesting stuff” you identified in the tower or tower area that could help us improve coverage?
- Any bird nest or unplanned obstruction availability?

What

Industry Terms

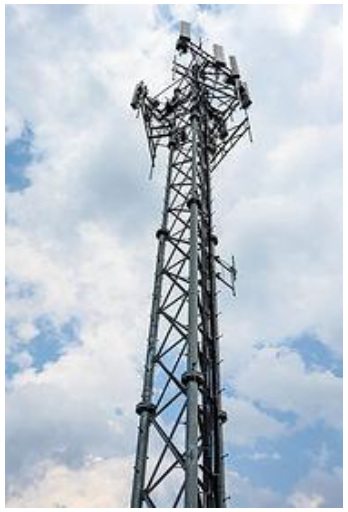
Azimuth:	In the context of cell towers, "azimuth" refers to the compass direction or angle (measured clockwise from north) that a cell tower antenna is pointing.
Tilt	In the context of cell towers, "tilt" refers to the angle at which an antenna is physically inclined to optimize signal coverage and network performance, directing the signal towards the desired area.
Antenna	A component used to transmit and receive radio waves
Height	Cell towers typically range in height from 50 to 400 feet, but this can vary based on location, terrain, and the area they need to cover.

What

Type(s) of Towers?

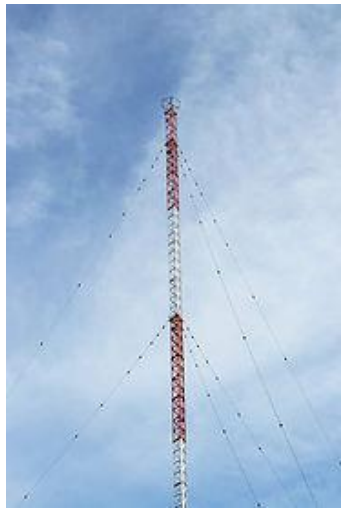
Monopole

Simple single pole.
Its elementary design reduces visual impact and is relatively simple to build, which is why this tower is favored by tower developers.



Lattice

Freestanding vertical tower.
It's designed with rectangular or triangular bases.



Guyed

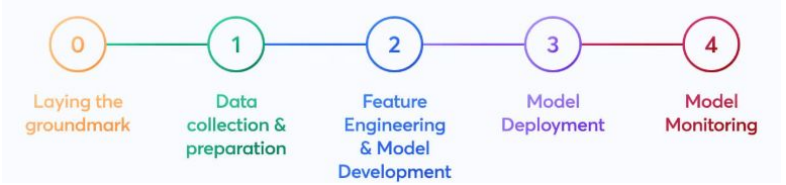
Slender steel structure.
It's anchored by steel cables in the ground.

Water

Essentially a water tower.
Cell tower entities are on the top of them. This structure is conducive financially to communication companies because the company does not have to spend thousands of dollars to build a new tower structure.

Reference: https://www.foresitegroup.net/post/types-of-cell-towers#:~:text=Cell%20towers%2C%20sometimes%20referred%20to,like%20cell%20phones%20and%20radios.

Steps of a Computer Vision Project



Define the Problem - Objective → Data Collection & Annotation - Labeling → Data Augmentation Splitting ,Test, Validate, Train → Model Training → Model Evaluation & Fine tuning → Model Testing → Model Deployment

Tools & Technologies

- **Roboflow:** Roboflow is a comprehensive platform designed to empower software with the ability to recognize and analyze objects within images and video. This tool is used to streamline the process of creating datasets, training models, and deploying to production in the field of computer vision. | **https://roboflow.com**
- **YOLO v8:** YOLO v8 is the newest state-of-the-art YOLO model that can be used for object detection, image classification, and instance segmentation tasks YOLO v8 is the newest state-of-the-art YOLO model that can be used for object detection, image classification, and instance segmentation tasks
- **Ultralytics**
  - Detect - Ultralytics YOLO Docs
  - Ultralytics Python Library: YOLOv8 - Ultralytics YOLO Docs
- **OpenCV Python Library: OpenCV-Python Tutorials**
- **Visual Studio Code or Jupyter Notebook**

Trained Model, Images and Sample Videos

- **Download the zip file for Trained model and Sample Cell Tower Drone Videos and Unzip the file.**
  - https://drive.google.com/file/d/1URMKn9xVGDKmK150dzfBzGtMAythnggd/view?usp=sharing
  - **Models Directory Path:** \UTD-Models-Videos\runs\detect
  - **Images those were trained:** \UTD-Models-Videos\TowerData.yolov12\train\images
  - **Sample Drone Videos of Cell Towers:** \UTD-Models-Videos\videos

Thank you and good luck!

Runtime Environment Setup for Computer Vision projects

- **Install Visual Studio Code :**
  - Search for "***Visual Studio Code***" version >= Visual Studio Code 1.95.1
- **Install Python:**
  - Search for "***Python***" version >=Python 3.12.1
- **Install packages for libraries :**
  - **Open CV:** *pip install opencv-python*
  - **Ultralytics:** *pip install ultralytics*
  - **Matplot library:** *pip install matplotlib*
  - **Numpy***:pip install numpy*
- **Download the zip file for Trained model and Sample Cell Tower Drone Videos and Unzip the file.**
  - https://drive.google.com/file/d/1URMKn9xVGDKmK150dzfBzGtMAythnggd/view?usp=sharing
  - **Models Directory Path:** \UTD-Models-Videos\runs\detect
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  - **Sample Drone Videos of Cell Towers:** \UTD-Models-Videos\videos

- ***Resources:***
  - *Some good tutorials I have gone through:*
    - https://www.youtube.com/watch?v=m9fH9OWn8YM
    - https://www.youtube.com/watch?v=OS5qI9YBkfk
    - *https://www.geeksforgeeks.org/object-detection-using-yolov8/*