Roush Fenway White Paper

Roush Fenway Racing, originally, Roush Racing, is an American professional stock car organization that currently competes in the NASCAR Cup Series. Founded in 1988, the NASCAR program is built around having multiple cars and providing engine, engineering, and race car build services to other NASCAR teams. The multi-team aspect of the company allows for information and resources to be shared across the enterprise, improving the performance of all the teams. One of the many NASCAR races, the Daytona 500, is a 500-mile-long (805 km) NASCAR Cup Series motor race held annually and is regarded as the most important and prestigious race on the NASCAR calendar. The Daytona 500 is an event that gathers more than 100,000 fans from all over the world to experience the thrill of the exotic race cars and the races.

As hundreds of thousands of fans gather, available cell towers are overloaded with tremendously slow data, if available at all, making the communications system clunky. NASCAR has 17 teams with a potential of up to 4 cars from each team. The communications system currently implemented with each team and vehicles containing radio frequencies (digital & analog) and significant Wi-Fi broadcasts contribute to an overwhelming amount of communications traffic. This congested and unreliable communications system, along with having cell tower and bandwidth capacity issues during race conditions, when data and communications are needed the most, is unacceptable. The AGILE team had the opportunity to observe and evaluate the communication needs of Roush Fenway. Here below are a few outlined:

- Data readings for each vehicle (17 teams with up to 4 cars each): speed, temperature, and other critical information from each vehicle to monitor them on real-time, including video.
- Managing data readings for vehicle testing through real-time for testing and on race day is critical.
- Signal strength was acceptable; however, the data throughput was very low (less than 500Kbps). Observations also found that there was a lot of activity at the low and high end of 5MHz.
- Wi-Fi using long range: when cellular connection is at maximum, to be able to tune out noise to access their own internal network and ecosystem.
- Transfer of information from pre-race and practice session's data readings to headquarters so that they can listen and do real-time engineering for races.
- Different radio systems are used to communicate and are not interoperable. This induces difficulty in rapid information transfer.
- Data for the fans to communicate.

The AGILE team attended the racing event and had been given access to the trailer, the garage, and the pits to see how a solution can be built to satisfy their needs outlined above. The AGILE team determined

that a solution with a multi-element communications solution to address the issues identified, provided a higher bandwidth of data and flexible voice communications. Through our tests, we created solutions outlined below:

- Create a separate ecosystem for communication designed for the Roush team, independent from the network that the fans are using. This results in creating the ability to send real-time video updates back to the Headquarters in any given time.
- A 4-channel gateway and a Wi-Fi transmitter in one device has been built as a prototype solution to provide a stronger cellular connection.
- Ability to access cell towers that are located further away, utilizing antennas, to expand the network capacity by 6~20 times the current throughput used.
- Established a stable PtMP (Point-to-multi point) link in a crowded 5GHz space utilizing a TDMA technology.
- Expand the Wi-Fi bubble for the Roush team and fans for seamless connection.
- With a higher throughput connection availability, the executive team can now virtually/directly run their software from our device to any other device or from the headquarters directly.
- Bridging various radio systems together to form interoperable communications, including analog and digital radios. Allows communication with various radio systems using cell phones and office phones.
- Bridging communication in the office room so that the personnel at the headquarters can monitor and observe data streams, listen to the radio communications on multiple channels, speak back to the radios (from a cell phone or a desk phone), and video conference to the hauler.
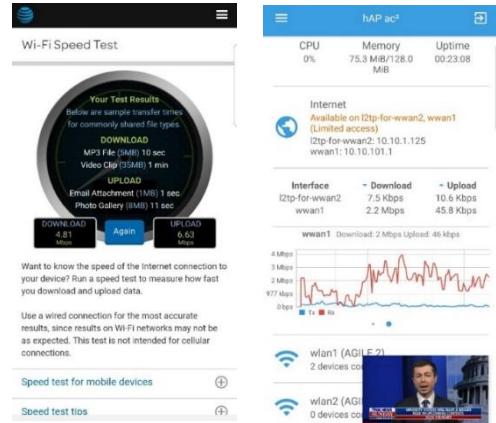
Mobile CORE

Navigating through a congested frequency spectrum, then creating a very direct and dedicated communications system solely for the Roush team and supporting fans was a crucial need and goal. To achieve this, a customized communications ecosystem solution that connects their various entities (garage, pit, HQ, and vehicles) was created. Innovating ways for a communications solution was needed, installed and working within 2-weeks due to the COVID-19 pandemic restrictions. The rigid, isolation restrictions created by the pandemic required an elevated need for robust and reliable remote communications for the team. The need was understood, tests and measurements were taken to validate the issue and the resulting data was provided to create an independent communications ecosystem solution.

Physically spending time with the Roush team at the racing event allowed us to better understand their current and possible future needs for a more seamless communication. Their communications obstacles were evaluated and tackled accordingly with state-of-the-art communications solution by the AGILE team. A quick response to the need and the timeliness of implementation to put together an entire ecosystem within 2-weeks now supplies hundreds of thousands of different needs simultaneously.