September 2022

# AUTOMATED FREQUENCY COORDINATION (AFC) FOR OPEN PIT MINING

Domenico Ficara

Pascal Thubert

Amine Choukir

Alessandro Erta

Stefano Ferrari

*See next page for additional authors*

Inventor(s)
Domenico Ficara, Pascal Thubert, Amine Choukir, Alessandro Erta, Stefano Ferrari, Loris Gazzarrini, Arun Khanna, Roberto Muccifora, Vincent Cuissard, Kasi Nalamalapu, and Sudhir Jain

# AUTOMATED FREQUENCY COORDINATION (AFC) FOR OPEN PIT MINING

AUTHORS:
Domenico Ficara
Pascal Thubert
Amine Choukir
Alessandro Erta
Stefano Ferrari
Loris Gazzarrini
Arun Khanna
Roberto Muccifora
Vincent Cuissard
Kasi Nalamalapu
Sudhir Jain

## ABSTRACT

The techniques are described herein to facilitate the use of 6GHz frequencies in deployments, such as strip mines, where Access Point (AP) locations change, while still complying with Automated Frequency Coordination (AFC) requirements.

## DETAILED DESCRIPTION

In the U.S., use of 6GHz frequencies will soon become a reality. Currently, the Federal Communications Commission (FCC) requires a device communicating in the 6GHz spectrum to search an Automated Frequency Coordination (AFC) database daily for the device's location, to determine which frequencies the device can use without causing interference.

However, in open pit mining deployments, Access Points (APs) are not in fixed locations. Rather, their locations change according to the progress of the mining and the requirements of the machines that they support. Thus, open pit mining involves an ever-changing deployment, where APs do not have to stay in the same position from one day to the next, because the landscape changes according to mining progress.

AFC provides yay/nay responses for 6GHz frequency usage according to the Global Positioning System (GPS) locations/positions that APs report. Such GPS positions can change over time.

Even on a given day, the exact location of the AP is irrelevant as long as the location allows the AP to provide a good enough connectivity to the associated mining machines.

Accordingly, techniques described herein may involve:

- identifying the machine location for the day;
- identifying an area (or a grid of points) where APs can be located to fulfill the bandwidth and latency requirements of the machines;
- laying out a grid of points on top of the area;
- performing an AFC request for each of these grid points;
- generating virtual Identifiers (IDs) for each location (AFC mandates each request to have an AP identifier, typically its serial number. In one example, a message may be sent to the AFC system, using a vendor extension field, with information regarding the mapping between the generated virtual IDs and the corresponding real AP serial number. In another example, the same AP identifier may be used for each location);
- choosing the grid points that provide best results from AFC (e.g., no incumbents in that location); and
- positioning the APs in the grid points and permitting them to assume the virtual ID of those locations in subsequent AFC communications.

Figure 1 below illustrates how the grid is defined and each virtual ID (vID1, etc.).

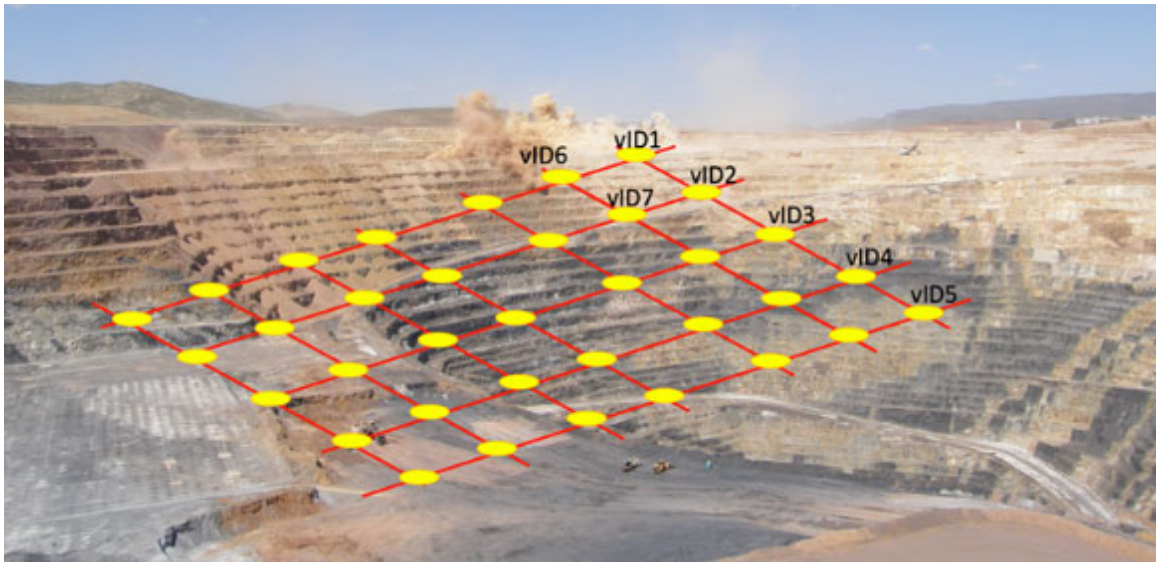


*Figure 1*

Alternatively, as illustrated in Figure 2 below, the whole area may be represented with a linear polygon, and the AFC request may be sent for that area. If full power is obtained from the AFC system, then the AP can use full power in that area, and there is no need to split the area into multiple grid points. If, instead, the AFC system returns a power less than maximum, the entire area may be split into sub-areas, and AFC queries may be sent for each of the sub-areas. This process may be repeated multiple times to optimize the power usage for each sub-area.

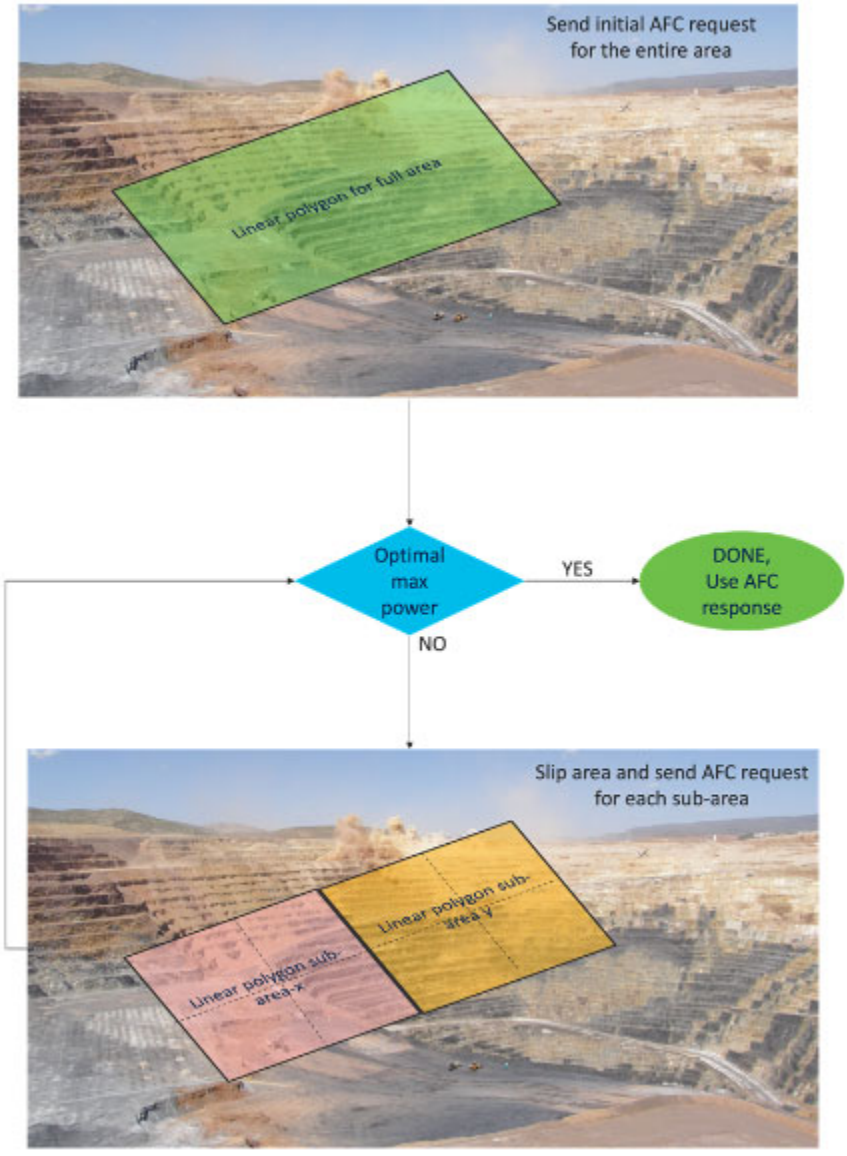


*Figure 2*

In summary, techniques are described herein to facilitate the use of 6GHz frequencies in deployments, such as strip mines, where AP locations change, while still complying with AFC requirements.