

# **Combining Fixed Site and Mobile Direction Finders to Enhance Radio Direction Finding Capability**

## ***A Technical Application Note from Doppler Systems Inc.***

Doppler Systems provides both fixed site and mobile direction finders and PC based software to process and display the data from the direction finders. In some cases our customers use a network of fixed sites and a mobile direction finder to track down the source of RF emission. This document discusses various networking architectures and the use of the new virtual site feature in the AutoTrack software to aid the mobile operator in the location of the RF source.

## **Required Equipment**

### ***Remote Fixed Sites***

The fixed site systems are designed to be setup in a remote location and to send the bearing information to a central site. At each remote site the following equipment is required:

- Doppler Systems DDF6001 Display/Processor
- One or more of the following DF antennas
  - o Doppler Systems DDF6092 125 – 250 MHz Antenna
  - o Doppler Systems DDF6095 250 – 500 MHz Antenna
  - o Doppler Systems DDF6097 500 – 1000 MHz Antenna
- If multiple antennas are used
  - o Doppler Systems DDF6040 Three antenna stacking hardware
  - o Doppler Systems DDF6079 Three antenna remote switch
- ICOM R8500 receiver (or equivalent)
- Personal Computer

In addition each remote site will need a way to communicate with the central site and the central site will require equipment to receive the communications from the remote site. There are a variety of ways to set up the communications between the remote and central sites. Three common ways are telephone modems, radio modems, and Ethernet connections. These networking options will be discussed below.

### ***Mobile Site***

The mobile site consists of a mobile DF antennal roof pod system, a display processor, a receiver, and a laptop. The following equipment is required:

- Doppler Systems DDF6002 Display/Processor
- Doppler Systems DDF5948 Mobile Antenna, Roof Pod
- Doppler Systems DDF6074 GPS Receiver/Antenna
- Doppler Systems DDF6075 Compass

- Doppler System DDF6072 Power Distribution Unit
- ICOM R8500 receiver (or equivalent)
- Laptop Computer

## **Networking Options**

### ***Telephone or Radio Modems***

Figure 1 illustrates connecting remote sites via telephone lines and Figure 2 shows the use of radio modems. A modem is required at the end of each telephone line and a Doppler Systems DDF6077 serial data expander is needed at the central location. The follow additional equipment is required to connect multiple fixed sites to the central site:

#### Telephone (Figure 1)

- Doppler Systems DDF6077 Serial Data Expander
- Four Multitech 5600DSVD Modems or equivalent
- Serial cables to connect the modems to the direction finders and the central computer

#### Radio Link (Figure 2)

- Doppler Systems DDF6077 Serial Data Expander
- Four Radio Modems
- Serial cables to connect the modems to the direction finders and the central computer

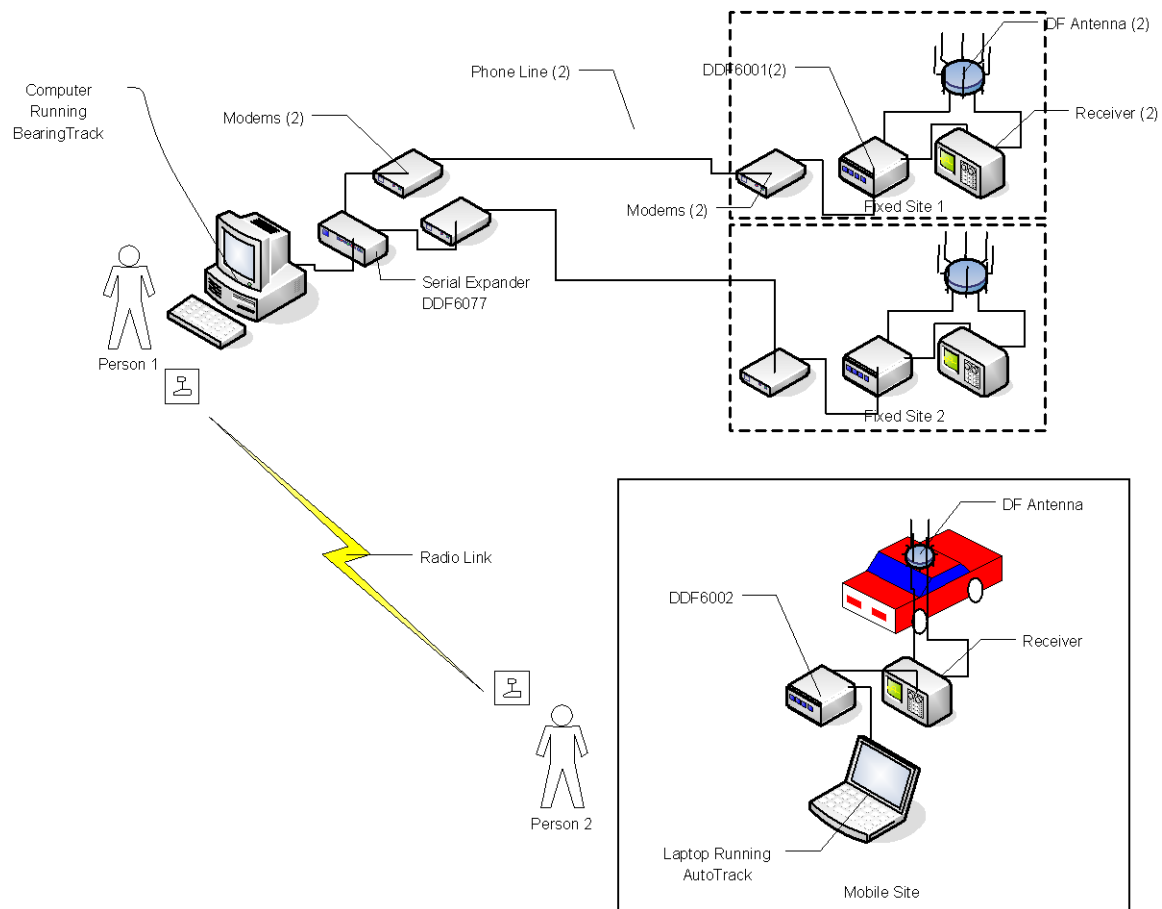


Figure 1: Remote Sites can be connected to the Central Location via Telephone Modems. Mobile Operator and Central Station Operator Communicate via Two-Way Radio

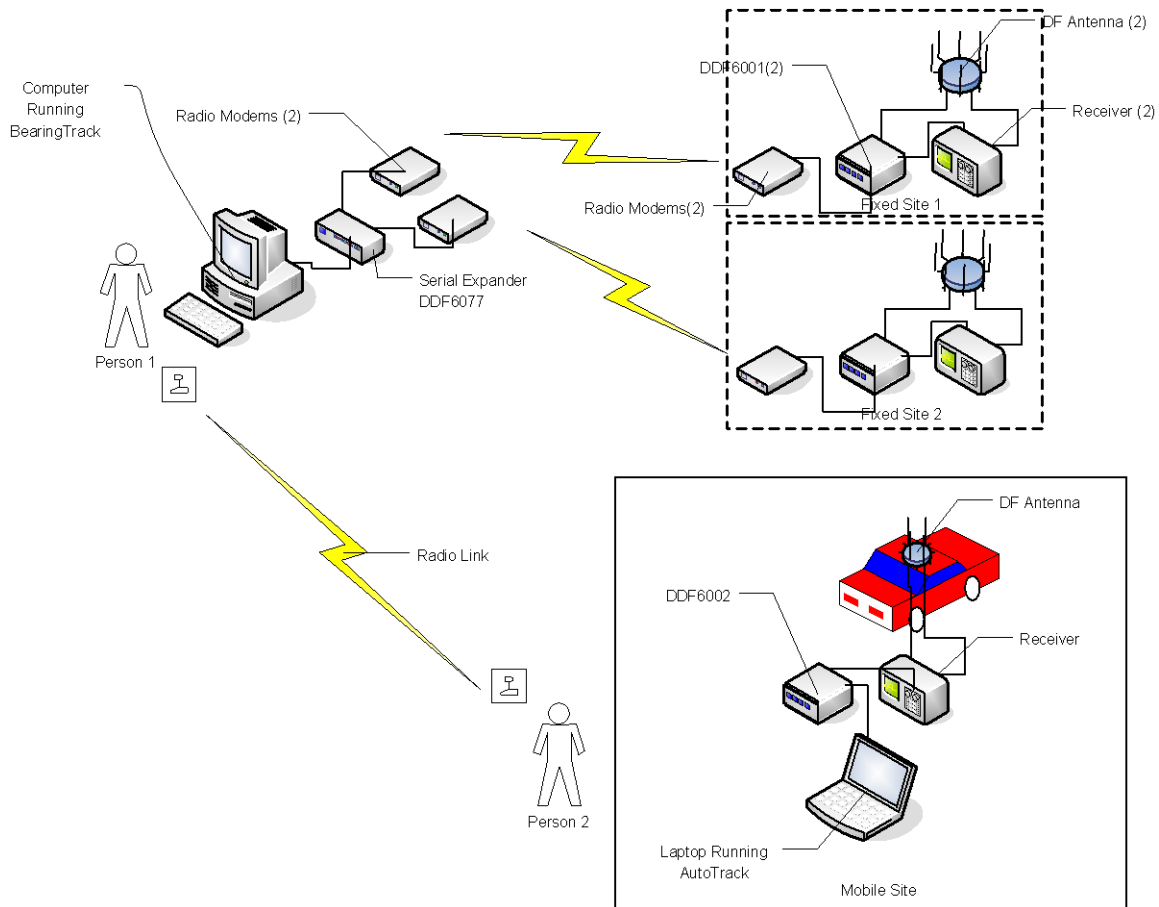


Figure 2: Remote Sites can be connected to the Central Location via Radio Modems. Mobile Operator and Central Station Operator Communicate via Two-Way Radio

### ***Ethernet Connection***

Figure 3 demonstrates the equipment required for an Ethernet connection. The actual Ethernet connection can be obtained using an intranet or by using the internet. In either case, each remote site must have a dedicated IP address. The only additional equipment required is a serial to Ethernet adapter (Digi One SP recommended) at each remote location.

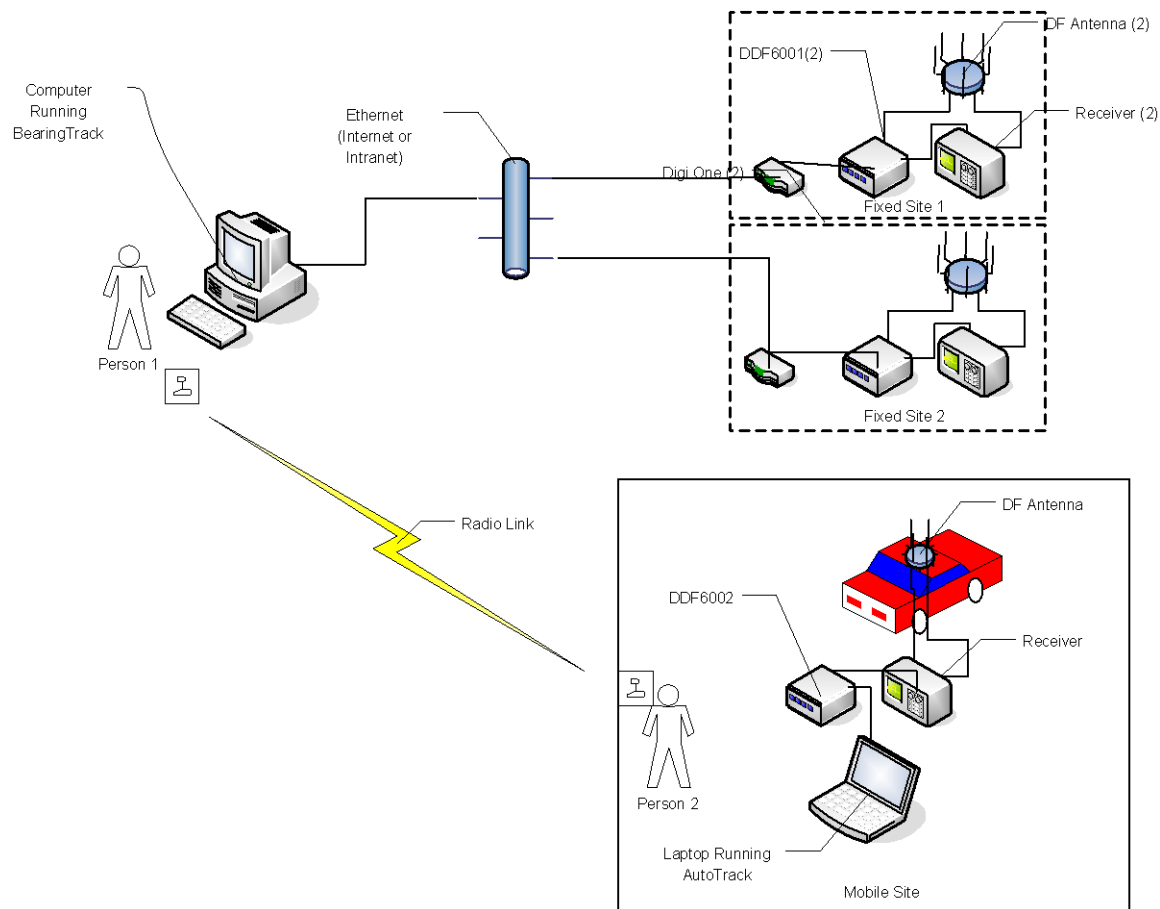


Figure 3: Using Serial-to-Ethernet Converters the Remote Sites, the Ethernet can connect the Remote Sites to the Central Site

## Operation

The system requires two human operators: one located at the central location and one located with the mobile unit. The mobile site computer will be running AutoTrack and the fixed site computer will run BearingTrack. When a bearing is received the central site operator tells the mobile site operator the received bearing from both sites. The mobile site operator then uses the virtual site feature in AutoTrack to plot the location of the fixed sites and the bearings. AutoTrack will then use its received bearing and the bearings from the central location to calculate a predicted location of the RF source.

The virtual site feature is a recent addition to AutoTrack and is contained in all version 2.0.0.0 and later. It allows the mobile operator to add sites on the screen without receiving data from the direction finder.

To add a virtual site right click on the map at the location of a fixed site and select **Add Virtual Site** from the popup menu as shown in Figure 4.

Add Virtual Site	
Add Beacon	
Zoom In	Ctrl+Z
Zoom Out	Ctrl+Alt+Z

Figure 4: Select Add Virtual Site from the Popup Menu

Next enter the bearing that the central site operator has sent for that site in the dialog box next to the virtual site (see Figure 5).

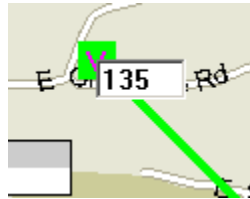


Figure 5: Enter the Bearing in the Dialog Box and Press the Enter Key

Repeat this process for all the fixed sites. After all the virtual sites are entered AutoTrack will provide an estimate of the source location. Figure 6 demonstrates the combination of two fixed site bearing measurement and one mobile site bearing.

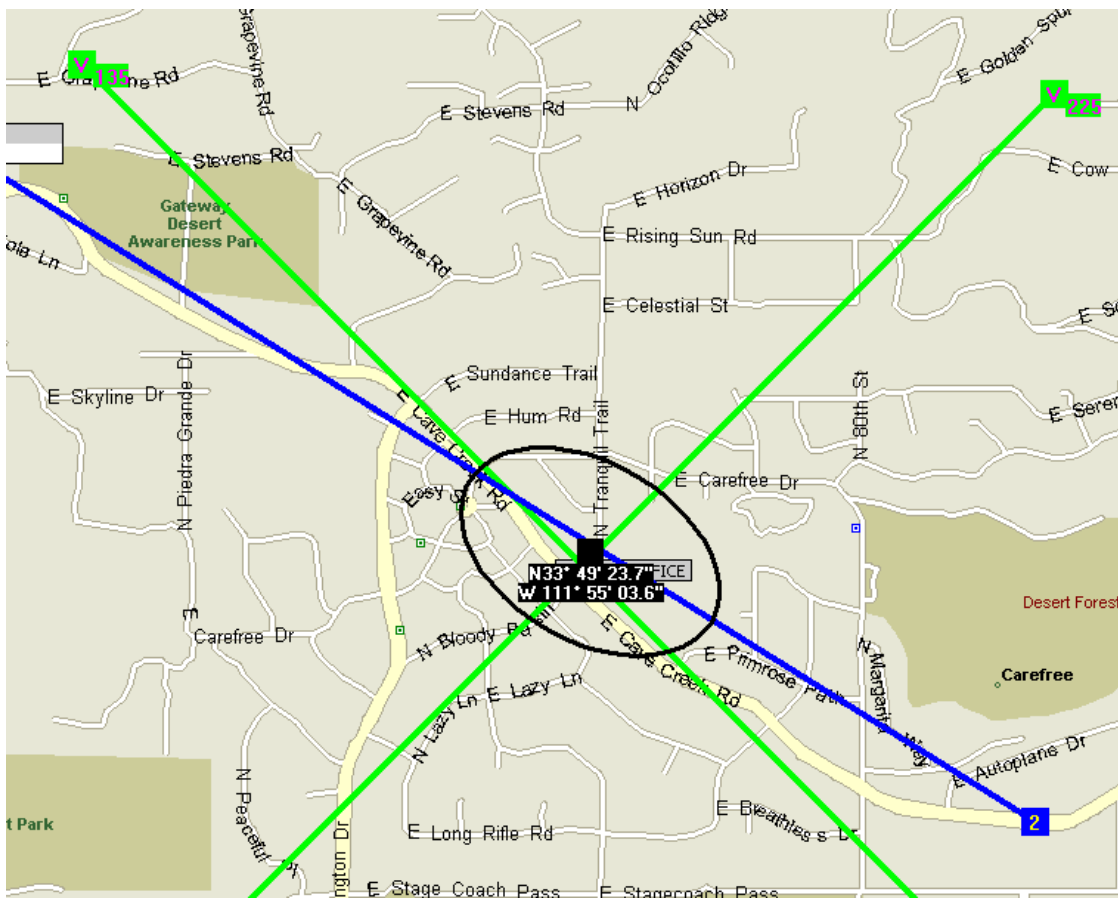


Figure 6: Two Virtual Sites Representing Fixed Site Locations (green) are combined with a Mobile Site Bearing Reading (blue) to Predict the Location of the Source

Once the virtual site locations are added to the map, they can be moved by left clicking on them and dragging them to the required location. Also, the bearing measurements can be changed by right clicking on them and selecting **Set Bearing** from the popup menu.

## **Conclusion**

The virtual site feature of AutoTrack 2 allows the mobile operator to use data from other sites to aid in finding the RF emission source. This feature can greatly enhance the mobile operator's ability to accurately identify the location of the source particularly when fixed site direction finders are used.