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Mercury 16E Mobility – Nomadic Mode

Introduction

Mobility setting allows for the Mercury subscriber station to more optimally handle moving between different base stations. Mercury 16E supports two forms of mobility operation. The subscriber unit supports WiMAX seamless mobility, and a non-seamless nomadic handover.

- Seamless handover is subscriber-initiated based on the received signal levels. The seamless handover requires an ASN-GW server on the backend network to coordinate the handover. The Mercury base station is not currently interoperable with the ASN-GW, and a third party base station must be used with this configuration.

- The nomadic mode uses the subscriber's GPS or received signal information to determine if it should break its current connection and look for another base station.

Scope

This bulletin is intended for application engineers and end users who wish to understand the nomadic mobility option in the Mercury 16E platform. Configuration is discussed as well as comparing it to the WiMAX seamless mobility mode.

Terms

- ASN: (Access Service Network)
- ASN-GW: (Access Service Network Gateway) The server on the backend system that acts as a gateway for all wireless devices, routing all their traffic.
- BS: (Base Station) End of the wireless link used to connect to the backend network.
- GPS: (Global Positioning System)
- MS: (Mobile Station) The mobile radio.
- SS: (Subscriber Station) The mobile radio, alternate term for MS.
- CPE: (Customer-premises Equipment) The mobile radio, alternate term for MS.
- WiMAX: (Worldwide Interoperability for Microwave Access)

Overview

Nomadic mode on the Mercury 16E platform works similar to that of the Mercury D platform. The subscribers are loaded with a file called the "base station location file" that lists all the base

stations the subscriber will connect to. The file lists each base station's frequency, bandwidth, latitude, longitude, and optionally the MAC address. All frequencies and bandwidths are put into a list that the subscriber scans for whenever it is not already connected to a base station.

The radio provides five connection modes in nomadic mode. The connection mode is a way to configure the radio to break the connection with the current base station, and allow the radio to look for a base station with a stronger signal. It makes this determination based on either the current base station's signal strength or the subscriber's GPS location.

Radios configured to operate in regions governed by the FCC, have restricted maximum transmit power unless they are operated at a fixed registered location. To assist in this compliance, the base station location file also allows for specifying operating sectors where the radios are registered to operate at full power. More information on this feature is contained in the Operating Sectors section of this bulletin.

Connection Modes

There are five different base station selection modes supported. All but Strict Connection and Strict Signal require the subscriber to be equipped with a GPS module.
- **Strict Distance** – This mode uses the GPS coordinates of the subscriber and compares it to the coordinates of those listed in the base station location file. If there is another base station closer to the subscriber than the one it is currently associated to, it breaks the current association and tries to associate to the best base station.
- **Strict Signal** – This mode uses the RSSI and SNR thresholds listed in the menu. If either the current RSSI or SNR is below their thresholds, the subscriber disassociates from the current base station and tries to associate to the best base station.
- **Signal and Distance** – The mode uses the RSSI and SNR thresholds just like strict signal, except it will *not* break the current association unless there is another base station within the distance threshold.
- **Signal, Distance, and Bearing** – This mode uses the RSSI, SNR, and distance thresholds like Signal and Distance. This mode also saves the radios previous position and uses it to determine if the radio is moving away from the current base station. The radio will only break the current connection if it is moving away from the current base station.
- **Strict Connection** – This mode will not purposely break the current connection for any reason. Upon boot up, or if the current connection drops, the radio looks for all the base stations listed in the base station location file. This mode is provided as a way to program the radio with a large list of potential base stations.

It is important to note that even if the radio breaks connection with the current base station, it may reassociate to the same base station. When the radio is trying to connect, it scans all radios listed in the base station location file and attempts to connect to the one with the strongest signal. As such, if the connection mode is set to strict distance, and the subscriber is associated to a base station that is slightly farther away from another base station, the radio will break connection. However, if the radio path is obstructed, or some other factor causes the closer base station to have a weaker signal, the radio may associate to the original base station. This will cause the

radio to continually disassociate. This can be mitigated by increasing the **Max Connection Time** parameter in the radio configuration menu. The Max Connection Time is the time that the radio will wait after it first associates a base station *before* it evaluates the connection mode condition. So, if the Max Connection Time is set to sixty minutes in the above case, the radio will break connection every hour and reassociate to the same base station. A better solution is to choose a connection mode and thresholds that can maintain a stable connection for the expected system usage.

Operating Sectors

Operating sectors are used in the United States where the FCC restricts the transmit power to 40mW per MHz bandwidth when not at a registered location. The transmit power on the subscriber is controlled by the **Max Transmit Power** parameter in the Radio Configuration menu. This is the transmit power that the radio will not exceed when connecting to a base station. In nomadic mode with GPS, the Mercury subscriber will restrict its maximum transmit power to the FCC minimum if it is not in an operating sector. If the radio enters an operating sector, the power will be raised up to the value set in the menu. The Mercury subscriber will not raise the transmit power to more than it is set in the radio's menus.

The FCC limit is based on radiated power, so the radio has to store the antenna gain in order to set the correct transmit power out of the RF port. The gain is set in the **Radio Configuration – Advanced Settings** menu by setting the **Antenna System Gain** parameter. This parameter is in effect even when operating in an operation sector. So, if the Antenna System Gain is 10 dB and the Max Transmit Power is set to 20 dBm, the power coming out of the RF port will not exceed 10 dBm.

Base Location File Format

The base station location file is a text file that lists all the possible base stations and the operating sectors. The beginning of each base station's description is marked by a <BS> tag and the end is marked by a </BS> tag. Between those tags, each line can be used to define one parameter of the base station. An example of a defining one base station with all the possible parameters is:

```
<BS>
NAME=MY_BASE_STATION
LAT=43.11790
LONG=-77.61270
FREQ=3652.00
BW=3.5
MAC=00:06:3D:00:12:34
</BS>
```

The possible parameters are as follows:

- NAME — (optional) The name of the base station. This is just for labeling purposes and has no impact on the radio's operation.
- LAT — GPS Latitude of the base in decimal degrees
- LONG — GPS Longitude of the base in decimal degrees
- FREQ — Center frequency configured on the base station.
- BW — Bandwidth configured on the base station.
- MAC — (optional) The "Ethernet Address" configured on the Base Station.

The parameters are used by the subscriber to build a list of frequencies and bandwidths to scan when not associated. The latitude and longitude are used when the connection mode requires the subscriber's current location be compared to the base station's location. The MAC address is used to confirm the correct base station is being connected to. If it is not supplied, when a subscriber associates, it will assume that the first base station listed in the file with the current bandwidth and frequency is the base station that it is connected to. The MAC address is only useful in networks where channel reuse is used.

Operating sectors are defined in a similar way. The use the <OS> and </OS> tags to specify one operating sector. The operating sector can only define the latitude and longitude and optionally, a name. An example of a definition of an operating sector is as follows:

```
<OS>
NAME=Operating Sector 1
LAT=43.11500
LONG=-77.61175
</OS>
```

The file also supports comments as a way to enter notes into the file, which are not used by the radio. Any line that begins with the # character will be ignored.

Comparison to Seamless Handover

Both mobility options allow subscribers to move between base stations in a more intelligent manner than waiting for the current signal to degrade to the point that it drops. The primary benefit of nomadic mode over WiMAX seamless handover is Nomadic does not require the significant backend networking equipment to function. Nomadic does not require an ASN-GW be connected to all base stations to coordinate moving the subscriber's connection to a new base station. An ASN-GW is carrier grade equipment that is typically provisioned by a network engineer. The only action required to enable nomadic mobility in an already functional radio network is to load each subscriber with the base station location file.

The drawback to nomadic mobility is that when a subscriber changes base stations, there is a greater time that the network connection is broken. Also, because the subscriber breaks connection before evaluating the signal of any other base stations, there is the potential for the radio to break connection when there are no better base stations available. Because in seamless

handover the subscriber scans for other base stations before breaking the current connection, the radio will not attempt to handover unless there is another base station to move to.

End of application bulletin.