Wavion Coverage Tool Kit
User Guide

January 2010

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Contents

Package Contents

Your WCT package includes the following:

- WCT Installation CD
- Magnetic base GPS-USB receiver
- Wavion WCPE-24HP-USB wireless adapter or ORiNOCO 11b/g Gold PC card wireless adapter
- USB Disk with all drivers, software and manuals
- 2.4 GHz 5 dBi Omni antenna with rubber magnetic stand, 1 m low loss cable and SMA male reverse polarity connector.

System Requirements

- **Mobile Mapping Client** – Laptop PC, Windows XP or Windows 2000, Pentium IV, 512 MB RAM, 1 GB of disk space, 2 USB ports.

  Traffic Server – Laptop or Desktop PC, Windows XP or Windows 2000, Pentium III, 256 MB RAM

WCT Kit Specification

Wavion WCPE-24HP-USB (Optional) Wireless Adapter

Interface

- USB 2.0

Radio Characteristics

Frequency:

- 2400-2462 MHz

Data Speeds:

- 802.11g modes: 54, 48, 36, 24, 18, 12 9, 6 Mbps
- 802.11b mode: 11, 5.5, 2, 1 Mbps

Maximum output power:

- 802.11g, 500 mW, EIRP
- 802.11b, 100 mW, EIRP

Please refer to the Wavion WCPE-24HP-USB User Manual included in the Wavion WCPE installation CD for additional specification, installation, configuration and operating details.

Proxim ORiNOCO® 11 a/b/g PC Card, Gold (Optional) Wireless Adapter

Interface

- CardBus Card (32-bit) Type-II PC CARD

Radio Characteristics

Frequency

- 2400-2484 MHz

Data Speeds

- 802.11g modes: 54, 48, 36, 24, 18, 12 9, 6 Mbps
- 802.11b mode: 11, 5.5, 2, 1 Mbps

Maximum output power

- 802.11g, 60 mW, EIRP
- 802.11b, 80 mW, EIRP

Please refer to the Proxim ORiNOCO 11b/g PC Card User Manual included in the ORiNOCO installation CD or Flash disk for additional specification, installation, configuration and operating details.

AmbiCom GPS-USB Rev1.0 GPS Receiver

Receiver

- SiRF Star III With Active 20 Parallel Satelite-Tracking Channels

Dimensions (D x W x H)

- 2.16 x 1.45 x 0.68 in (55 x 37 x 17.5 mm)

Cable Length

- 6.5 ft (2m)

Acquisition Times

Approximately 1 sec (Hot), 38 sec (Warm), 42 sec (Cold)

GPS Accuracy

- Approximately 16 ft(5m)

GPS Protocol

- NMEA 0183 Compliant

Operating Temperature

- -4°F - +140°F (-20°C - +60°C)

Acquisition Sensitivity

- -159 dBm in High Sensitivity Mode

Power Connector Type

- USB Powered

Operating System

Microsoft Windows XP, 2000

Please refer to: the AmbiCom GPS-USB Receiver documentation included in the Installation CD for additional installation, configuration and operating details.

2.4Ghz 802.11b/g WiFi 5dBi Wireleaa Antenna

2.4 GHz 5 dBi Omni antenna with rubber magnetic stand, 1m low loss cable and SMA male reverse polarity connector

- Frequency: 2400-2483 MHz
- Gain: 5 dBi
- Polarization: Vertical
- SWR: ≤2:1
- Impedance: 50 Ohm
- Color: Black
- Operation Temperature: -20~+60 °C
- Storage Temperature: -30~+75 °C
- Length: 198 mm (Including Connector)

Wavion Networks tested and verified all parts of the WCT Kit for mutual interoperability. The WCT Performance is optimized for the components provided in the WCT Kit. Any use of different component models and/or additional WiFi devices may degrade or misrepresent WCT measurements.

Wavion Networks highly recommends that only devices included in the WCT Kit be used.

Contacting Technical Support

Address:
Wavion Technical Support

Wavion LTD
6 Hayetzira Street,
PO BOX 580
Yoqneam Illit, 20692
Israel

Telephone:	+972-4-9097343
Fax:	+972-4-9097322
Email:	support@wavionnetworks.com
Web:	www.wavionnetworks.com

Overview

What is the Purpose of the Wavion Coverage Tool?

The Wavion Coverage Tool is designed to perform effective and reliable pre and post deployment site surveys of Wi-Fi networks. It maps and analyzes throughput and coverage of Wi-Fi networks based on Wavion Wi-Fi networking equipment.

A key factor in the design and performance analysis of any wireless communication system is the amount of transport-level data transfer (i.e. throughput) between a transmitter and a receiver per unit of time. Therefore, when setting up any Wi-Fi network it is important to analyze the maximal achievable downlink throughput coverage.

On the other hand, the maximal coverage radius of the transmitting base station observed during WCT downlink tests is still limited by uplink performance. This is because even in downlink tests the receiving client has to transmit 802.11 ACK packets to the transmitting base station. Thus, a single WCT mapping drive tests both the maximal downlink throughput and the coverage radius of a designated area.

What is a Mapping Drive Test?

WCT runs a simple downlink throughput test from the Wavion base station to a Wi-Fi client mounted on a moving vehicle. The link throughput is constantly measured and correlated with the mobile client geographic coordinates and presented graphically, in real-time, on Google Earth geo-software.

The real-time map presentation assists the user to visually determine what areas have not yet been tested. The mapping information can later be used to target areas with minimal throughput areas.

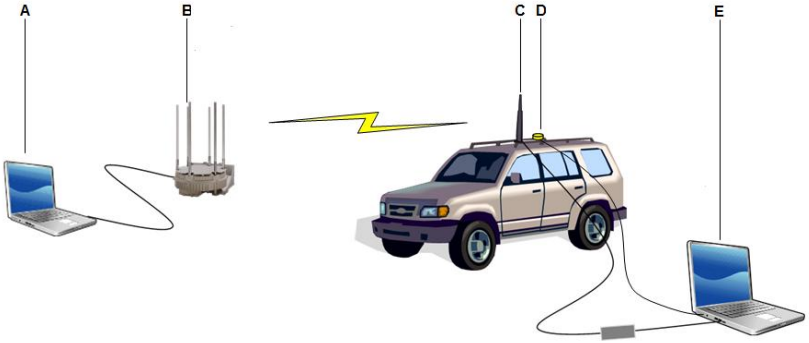
The WCT Deployment

The WCT deployment includes the following components:

- A **Wavion Base Station** which receives traffic from the Traffic Server via an Ethernet connection and then transmits it to a Wi-Fi Mobile Mapping Client.
- A PC which acts as a **Traffic Server** to run link overloading UDP traffic.

  As the theoretical maximal capacity of 802.11b/g link approximates 30 Mbps it is sufficient to generate UDP traffic bandwidth of 35 Mbps to overload the link. WCT uses the Iperf testing tool to measure actual downlink UDP throughput.
- A laptop that acts as a **Mobile Mapping Client** and on which the WCT application runs.

  WCT utilizes a GPS receiver to obtain a location update every second and match it with the measured average throughput. The WCT localized measurement is then represented as a colored line on a Google Earth map according to a predefined color scheme.
- **GPS Receiver and Wi-Fi Omni-Directional Antenna** which are mounted on the vehicle's roof using magnet covered base.



The WCT Deployment: A. The Traffic Server, B. The Wavion Base Station, C. The Wireless Adapter Antenna, D. The GPS Receiver, D. The Mobile Mapping Client

How Is This Guide Organized?

This document aims to guide you through the steps required to set up and run the Wavion Coverage Tool (WCT).

The topics in this guide are organized according to a chronological workflow. We recommend that you follow the sequence of the topics in setting up and operating the WCT. This guide includes the following chapters:

- **Install WCT** - This chapter provides a step by step guide on how to install and configure the WCT system hardware and software (refer to page 17: Install WCT).
- **Validate WCT Setup –** This chapter provides instructions on how to validate the WCT installation and configuration integrity (refer to page 41: Validate WCT Setup).
- **Perform a Mapping Drive Test –** This chapter provides provides a step by step guide on how to perform a mapping drive test (refer to page 49: Perform a Mapping Drive Test).

- **Display Mapping Drive Test Results –** This chapter provides instructions on how to display mapping drive test results in Google Earth after having completed the test (refer to page 69: Display Mapping Drive Test Results).

Install WCT

This chapter provides step by step instructions on how to install and configure the WCT system hardware and software.

The topics in this chapter are listed in a logical and operational system requirement sequence. We suggest you follow the step order sequence in order to ensure a smooth and successful setup:

- Install WCT on the Traffic Server, refer to page 18
- Install the WCT Application on the Mobile Mapping Client; refer to page 28
- Install Wireless Adapter on the Mobile Mapping Client; refer to page 29
- Set the Wireless Connection Between the Traffic Server and the Mobile Mapping Client; refer to page 33
- Install the GPS Receiver ; refer to page 36
- Select GPS COM Port; refer to page 37
- Install Google Earth on the Mobile Mapping Client; refer to page 39
- Verify WCT Installation; refer to page 39

Install WCT on the Traffic Server

Installing the WCT software and hardware on the Traffic Server is comprised of the following activities:

- Connect the Traffic Server to the Base Station; refer to page 18
- Run the WBS Configuration Management Tool; refer to page 18
- Select the WBS Transmission Channel; refer to page 19
- Create a Dedicated Connection Between the WBS and the Mobile Mapping Client; refer to page 23
- Install the Traffic Generating Application (IPERF) on the Traffic Server on page 27

Connect the Traffic Server to the Base Station

1. If the base station is powered by a PoE injector:
   - Connect the PoE injector to the Ethernet port of the Transmitting computer. Use a CAT5 cable (refer to the WBS-2400 User Manual for more details).
2. If the base station is powered by an AC power cable:
   - Connect the base station directly to the Ethernet port of the Transmitting Computer. Use a CAT5 cable (refer to the WBS - 2400 User Manual for more details).

Run the WBS Configuration Management Tool

To be able to manage the Wavion Base Station from the Traffic Server, perform the following:

1. Set the Traffic Server IP address to the same subnet as the Wavion Base Station management IP address, the default is 192.168.1.1). Refer to the Wavion Base Station User Manual for more details.

> **Note:** If the default Traffic Server IP address was modified and the current IP address is not available, contact Wavion support.

2. Browse with the Traffic Server browser to the abovementioned IP address.

The WBS Configuration Management Tool (CMT) is displayed in your browser.

Select the WBS Transmission Channel

After setting the connection between the Traffic Server and the WBS, the WBS's Automatic Channel Selection (ACS) utility can be run. ACS selects the channel that WBS will use to transmit traffic from the Traffic Server to the Mobile Mapping Client. The ACS may be accessed by running the CMT application.

1. Run the WBS Configuration Management Tool (CMT) (Refer to page 18: Run the WBS Configuration Management Tool).

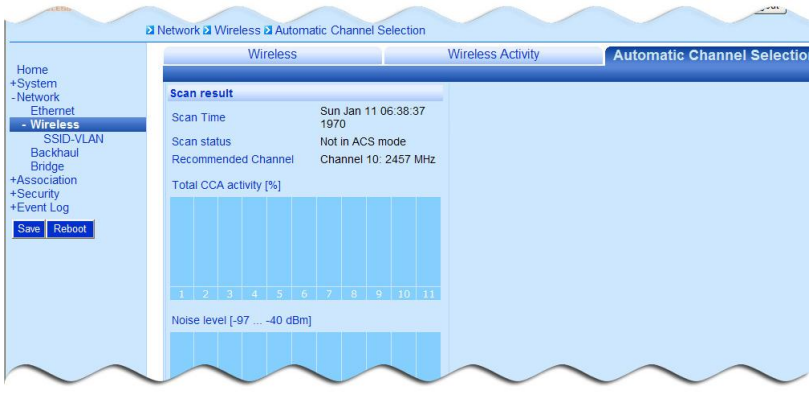
Either the *Wavion Startup Wizard* (see image below) or the CMT home page are displayed. If the CMT home page is displayed proceed to step **4**.


WAVION
WS 410
WBS Startup Wizard
System Name: Prima2
User Name: eng
Quick Installation Guide
Next>
Step 1:
Prepare the Pole Bracket
Slip the bands of the hose clamps through the slots of the pole bracket. Attach the pole bracket at the top of the pole.
Step 2:
Pole Installation
Insert the unit's lead pin into the pole bracket, obtain the correct position, and tighten 4 bolts using a 4mm Allen wrench.
Step 3: Omni Unit
Attach and Seal the Antennas
Hands tighten the antennas, holding only the antenna's metal collar, then seal them using attached sealing tape and according to Antenna sealing procedure document.
Step 4: Grounding
Step 5: Connect the Ethernet Port
Unscrew the plastic cap and the cap cover. Thread the Ethernet cable through the cap cover and the cap. Connect the Ethernet cable to the "ETH" port and screw the plastic cap, make sure it is well tighten. Furthermore screw the cap cover to ensure perfect sealing. It will ensure IP-67 compliance.

2. Follow the wizard instructions until you complete the setup routine which includes running the automatic channel selection utility.
3. To continue with the WCT installation, refer to page 22: Create a Dedicated Connection Between the WBS and the Mobile Mapping Client.
4. In the CMT home page side bar, expand the *Network* menu and the *Wireless* submenu.

The Wireless tab is displayed:

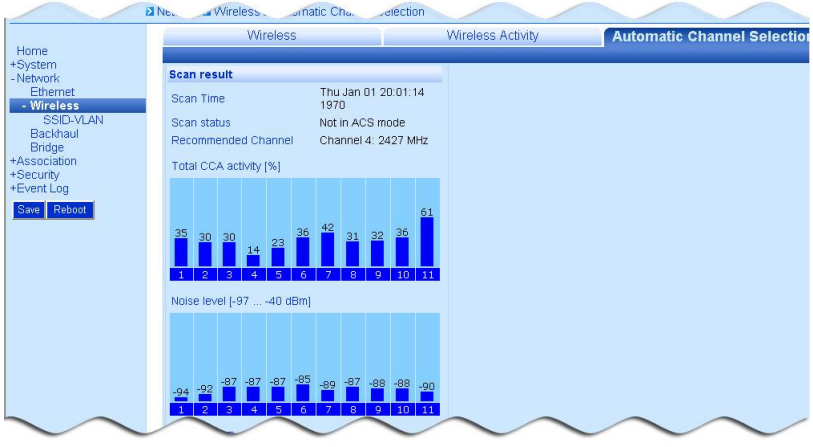
5. Open the *Automatic Channel Selection* tab



6. Click *Scan*

When the channel selection process is completed:

- The WBS is set to transmit over the selected channel**.**
- The scan results are displayed in the Automatic Channel Selection tab charts.



Create a Dedicated Connection Between the WBS and the Mobile Mapping Client

Before conducting the mapping drive test, create a dedicated connection between the WBS and the Mobile Mapping Client so that only the Mobile Mapping Client will receive traffic from the base station during mapping. A dedicated connection helps to achieve maximal throughput and coverage.

To set a dedicated connection, perform the following activities:

- In the WBS Configuration Management Tool (CMT), define a new encrypted WLAN using a new Service Set ID (SSID) and a new shared Key (refer to page 22: Define a Dedicated WLAN in the WBS).
- In the Mobile Mapping Client configure the wireless network adapter to connect with the new WLAN (refer to page 24: Configure the Mobile Mapping Client Wireless Connection to Connect to the Dedicated WLAN).

Define a Dedicated WLAN in the WBS

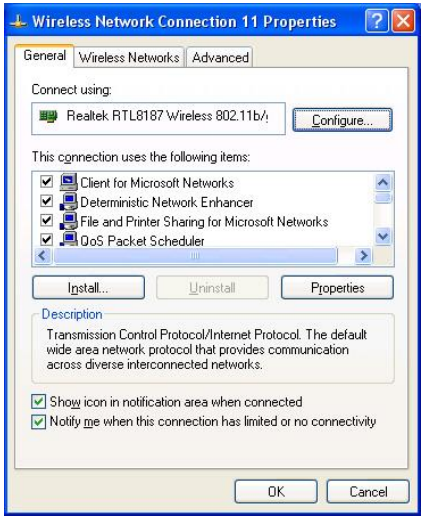
1. Run the WBS Configuration Management Tool (CMT) (refer to page 18: Run the WBS Configuration Management Tool).
2. In the CMT home page side bar, expand the *Network* menu and the *Wireless* submenu.
3. Click *SSID-VLAN* under the *Wireless submenu*.

The *SSID Editing* page is displayed:

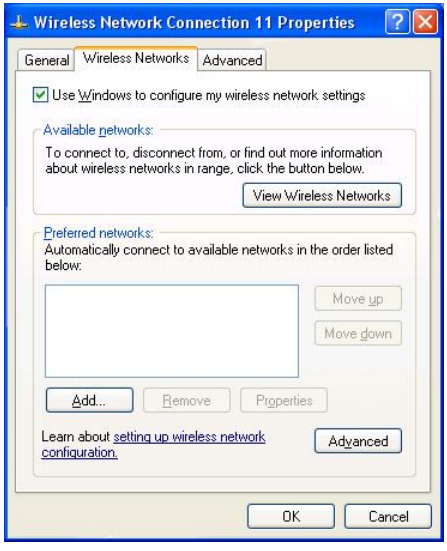
4. Fill in the following fields:
   - *Rename SSID*: Type the name of the dedicated connection.
   - *Authentication*: Select the *Open System + Shared Key* authentication method.
   - *Encryption*: Select the *WEP/40* security protocol.
   - *WEP Key #1*: Type the WEP KEY.
5. Click *Apply*.
6. Click *Save*.

Configure the Mobile Mapping Client Wireless Connection to Connect to the Dedicated WLAN

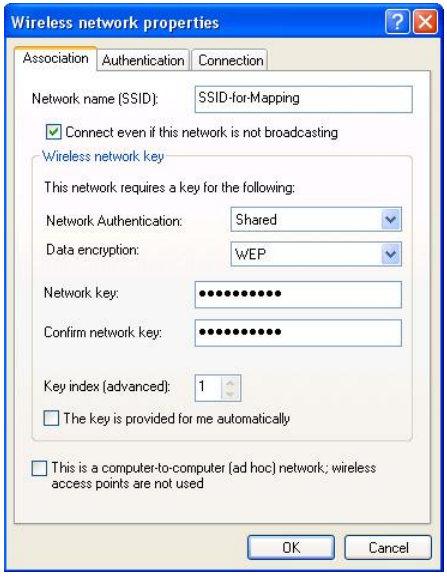
1. In Windows display the Wireless Network Connection Properties dialog box.



2. Display the *Wireless Networks* tab.



3. Click *Add* to display the *Wireless Network Properties* tab

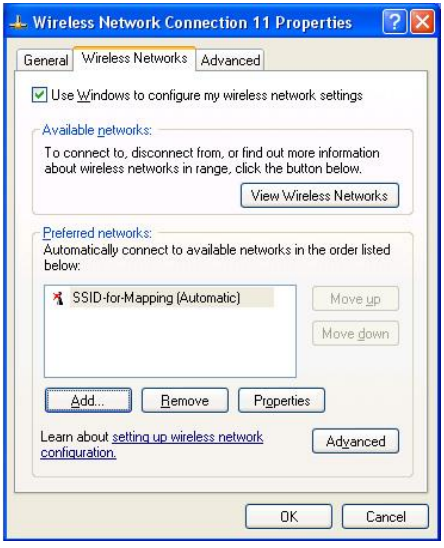


4. Complete the following fields:

   - *Network name (SSID)*: Type the same name that was typed in the *Rename SSID* field of the WBS Configuration Management Tool (CMT) (refer to page 22: Define a Dedicated WLAN in the WBS).
   - *Network Authentication*: Select the *Shared* authentication method.
   - *Data Encryption*: Select the *WEP* security protocol.
   - *Network Key*: Enter the same WEP KEY that was typed in the *WEP Key #1* field of the WBS CMT (refer to page 22: Define a Dedicated WLAN in the WBS).

5. Click *OK*.

   The new network name is displayed in the *Preferred networks* list of the *Wireless Networks* tab.



6. Click *OK*.

Install the Traffic Generating Application (IPERF) on the Traffic Server

1. Insert the WCT Installation USB drive supplied with the Wavion Coverage Tool Kit (WCT) into the Traffic Generation Server.
2. Locate the folder *Batch File* and copy it to the Traffic Generation Server (for example, C:\WCT\Batch File).

Note: The *Batch File* folder only includes 2 files – iperf.exe and run_iperf.bat**.** For more information on iperf, refer to: http://dast.nlanr.net/projects/Iperf/).

The WCT software is ready for use on the Traffic Generating Laptop.

Install the WCT Application on the Mobile Mapping Client

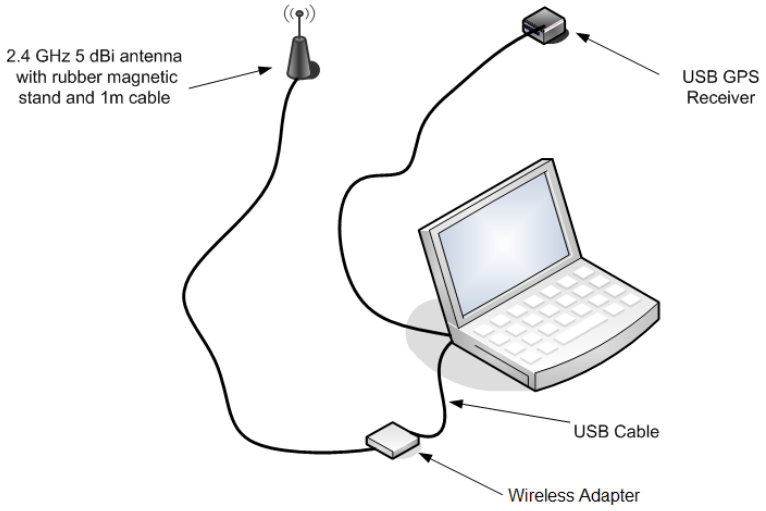
1. Insert the WCT Installation USB drive supplied with WCT into the Mapping Client.
2. Copy the WCT folder from the WCT Installation USB Drive to the Mapping Client (for example, C:\WCT).

Install Wireless Adapter on the Mobile Mapping Client

The WCT kit is supplied with one of two wireless adapters: the Wavion WCPE-24HP-USB which is a USB based adapter or the Proxim ORiNOCO 11 a/b/g which is a PCMCIA based adapter. Install the correct driver and then connect the adapter and the wireless antenna:

Perform the following installation activities:

- Install WCPE-24HP-USB Wireless Adapter Driver and Configuration Utility (Optional); refer to page 30
- Install ORiNOCO 11 a/b/g ComboCard Wireless Adapter Driver and Configuration Utility (Optional), refer to page 30
- Connect the Wireless Antenna to the Mobile Mapping Client, refer to page 32



Install WCPE-24HP-USB Wireless Adapter Driver and Configuration Utility (Optional)

In order to receive Wi-Fi communication, WCT can either use a USB based wireless adapter (WCPE-24HP-USB) or a PCMCIA based wireless adapter (ORiNOCO 11 a/b/g).

Important: WCT will only work with the wireless adapters supplied with the WCT kit.

Perform the following steps if you use WCPE-24HP-USB.

1. Insert the WCT Installation USB drive supplied with the Wavion Coverage Tool Kit (WCT) into the Mapping Client.
2. Browse to the *WCPE24HP-USB* folder and run SETUP.EXE.
3. Follow the InstallShield Wizard instructions until the installation is complete.
4. Connect the WCPE-24HP-USB Wireless adapter to your laptop's USB Port.
5. Connect to a wireless network and browse the Internet to ensure that the wireless adapter is working correctly.

Note: For additional WCPE Wireless Client installation and configuration information, refer to the *WCPE Wireless Client User Guide* located in the *WCPE-24HP-USB* folder.

Install ORiNOCO 11 a/b/g ComboCard Wireless Adapter Driver and Configuration Utility (Optional)

In order to receive Wi-Fi communication, WCT can either use a USB based wireless adapter (WCPE-24HP-USB) or a PCMCIA based wireless adapter (ORiNOCO 11 a/b/g).

Important: WCT will only work with the wireless adapter's supplied with the WCT kit.

Perform the following steps if you use ORiNOCO 11 a/b/g.

1. Insert the *ORiNOCO 11 a/b/g ComboCard* Installation CD into the Mapping Client's CD drive.
2. If the installation program does not launch automatically, run SETUP.EXE from the installation CD.
3. Follow the InstallShield wizard instructions until the installation is complete.
4. Insert the wireless adapter into the Mapping Client's PCMCIA Card slot.
5. Connect to a wireless network and browse the Internet to ensure that the wireless adapter is working correctly.

Note: For additional ORiNOCO PC Card installation and configuration information, refer to the *ORiNOCO PC Card User Guide* located in the *WCPE-24HP-USB* folder.

Connect the Wireless Antenna to the Mobile Mapping Client

1. Connect the Wi-Fi Antenna Base wire to the wireless adapter’s female SMA connector.
2. Screw the Wi-Fi antenna to the magnetic base.
3. Route the antenna wire and the magnetic base through the vehicle window or, alternatively, through the vehicle door rubber seals.
4. Attach the Antenna to the vehicle's external roof.

> **Note:** Mounting the Wi-Fi antenna on the vehicle roof enables Wi-Fi coverage mapping that is independent of both the Mobile Mapping Client orientation and the Wi-Fi signal reception conditions inside the vehicle.

Set the Wireless Connection Between the Traffic Server and the Mobile Mapping Client

To configure and validate the connection between the Traffic Server and the Mobile Mapping Client perform the following:

- Configure the Traffic Server's Ethernet Network Adaptor, refer to page 33
- Run the Traffic Generator from the Traffic Server, refer to page 34
- Configure the Mobile Mapping Client's Wireless Network Connection; refer to page 35
- Validate the Traffic Server – Mobile Mapping Client Connection; refer to page 35

Configure the Traffic Server's Ethernet Network Adaptor

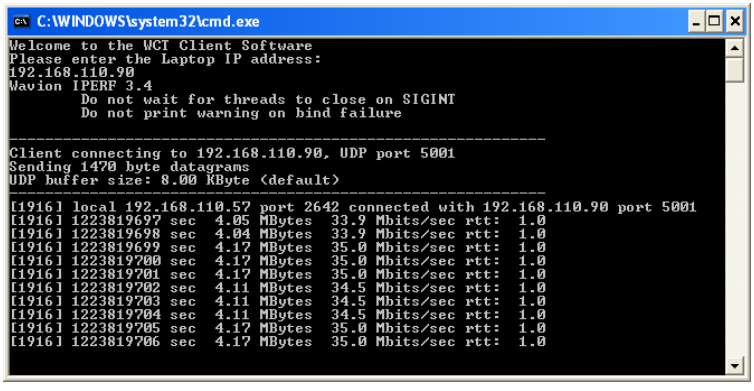
1. Deactivate the Traffic Server’s Ethernet Network Adaptor firewall.

> **Note:** For more information, refer to page 82: Appendix B: How to Turn Windows Firewall On/Off.

2. Set the MTU (Maximal Transmit Unit) size of the above Ethernet Network Adaptor to 1500 Bytes.
3. Configure the IP address of the above Ethernet Network Adaptor to be on the same subnet with the IP address of the Wireless Network Connection of the Mobile Mapping Client.

Run the Traffic Generator from the Traffic Server

1. Open the *Batch File* folder in the WCT installation dir.
2. Click *run_iperf.bat*.
3. Enter the Mobile Mapping Client IP address at the prompt and press Enter.



UDP traffic generation is started.

4. The following will take place:
   - A new row is displayed every 1 second.
   - Each row displays a rate of 35 Mb/sec.

Note: Iperf is an open source application for TCP and UDP bandwidth measurements that has proved to be an exceptionally useful tool in network performance evaluation and optimization. Initially written by NLANR (http://dast.nlanr.net/projects/Iperf/), Iperf has become a de facto standard for link capacity measurements in the wireless communication industry.

Configure the Mobile Mapping Client's Wireless Network Connection

1. At the Mobile Mapping Client, disable all Wireless Network Connections except for the Wireless Network Connection corresponding to the Wi-Fi PC card supplied with the WCT Kit.
2. Deactivate the abovementioned Wireless Network Windows Firewall.

   Note: For more information, refer to page 82: Appendix B: How to Turn Windows Firewall On/Off.

3. Change the MTU size of the above Wireless Network Connection to 1500 Bytes.

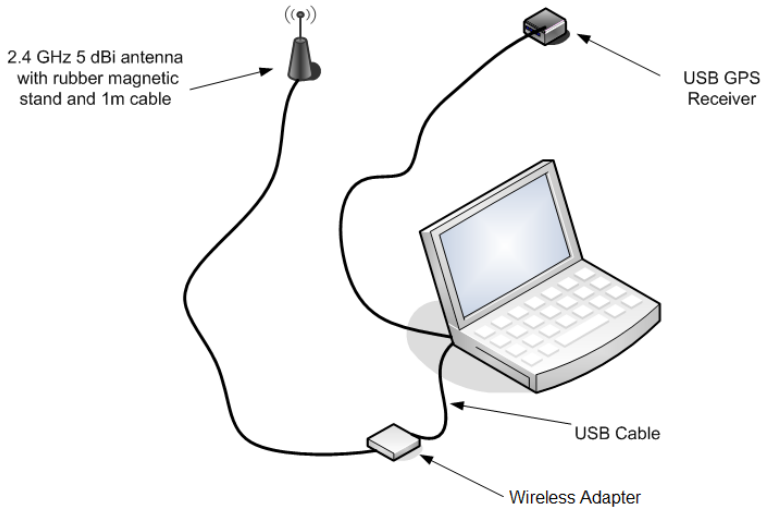
Validate the Traffic Server – Mobile Mapping Client Connection

1. Connect the Mobile Mapping Client to the Wavion base station wireless network.
2. Ping the Traffic Server.

Note: As the Traffic Server already generates high bandwidth UDP traffic some pings may be lost.

Install the GPS Receiver

This section will instruct you how to install the GPS receiver driver and connect the GPS receiver.



1. Insert the WCT Installation USB drive supplied with the Wavion Coverage Tool Kit (WCT) into the Mapping Client.
2. Browse to the *GPS USB* folder and click Setup .exe to run the installation.
3. Follow the InstallShield wizard instructions until the installation is complete.
4. Connect the AmbiCom GPS Navigation Receiver to one of the available USB ports on your computer device.
5. Ensure that the GPS Navigation Receiver is working correctly by running any available GPS based application.

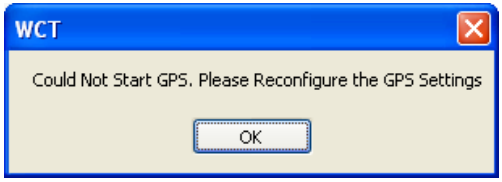
Note: For additional AmbiCom GPS Navigation Receiver installation and configuration information, refer to the *AmbiCom GPS USB Quick Installation Guide* located in the *GPS-USB* folder.

Select GPS COM Port

After installing the WCT application and the GPS receiver, direct the WCT application to the COM Port which is streaming the GPS data.

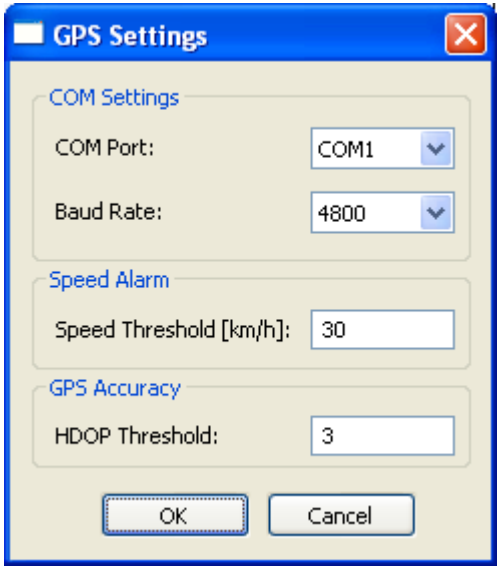
1. In the Mobile Mapping Client, double-click on WCT.exe file under the WCT installation directory (e.g. C:/WCT/WCT.exe).

The following message is displayed.



2. Click *OK*.

The WCT's *GPS Settings* dialog box is displayed.



3. Select the correct COM port for the GPS receiver in the *COM Port* drop-down box.

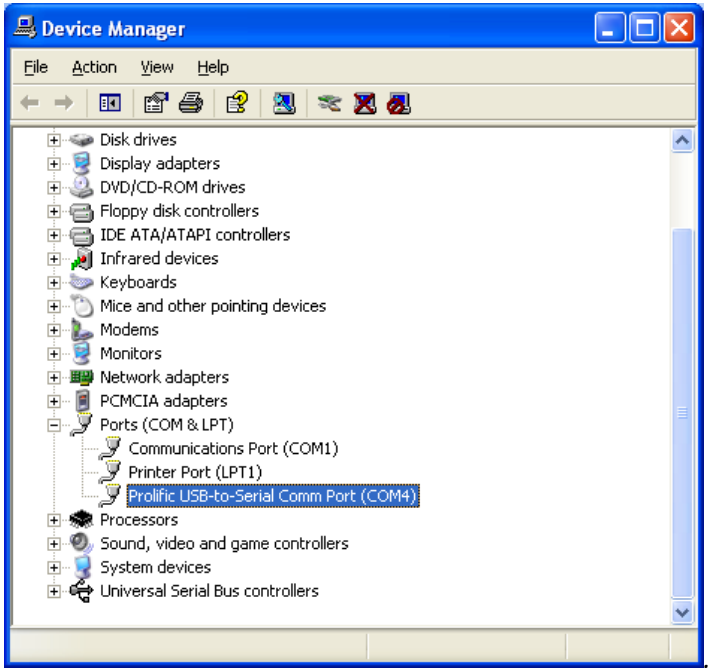
4. If the GPS receiver COM port identity is not known, perform the following:

   4.1 In *Windows* select Start -> Run

   4.2 Type *devmgmt.msc* in the *Run* dialog box and click OK. The *Device Manager* is displayed.

   4.3 Expand the *Ports (COM & LPT)* group to reveal the GPS COM port value**.**

   4.4 In the *GPS Settings* dialog box, select the above COM value in the *COM Port* drop-down box.



5. Click *OK*.

The main WCT window is displayed.

Install Google Earth on the Mobile Mapping Client

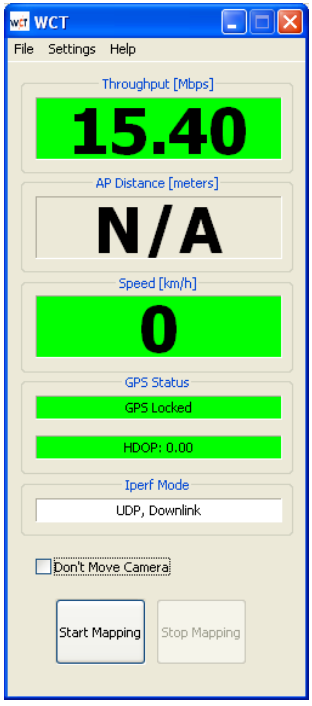
1. Install the latest version of Google Earth software from earth.google.com.

Verify WCT Installation

After completing the WCT installation and configuration, activate the WCT application on the Mobile Mapping Client and display the WCT main window to confirm that the WCT setup is working correctly.

1. In the Mobile Mapping Client, double-click on WCT.exe file in the WCT installation directory (e.g. C:/WCT/WCT.exe).

The WCT Main window is displayed.



2. Verify that**:**

- The *GPS Status* is *GPS Locked* (for more information on GPS Status, refer to page 73: WCT Main Window Quick Reference).
- The *HDOP* metric value is highlighted in Green which indicates that it is below the HDOP threshold (for more information on HDOP Threshold, refer to page 73: WCT Main Window Quick Reference).

  The *AP Distance* is *Not Available* (N/A) as the base station location is not yet defined (for more information on defining the AP Distance, refer to page 56: Start Mapping).

Validate WCT Setup

This chapter provides instructions on how to validate the WCT setup performed in the previous chapter. As the WCT setup consists of different hardware and software components, each with its own installation and configuration requirements, it is important to confirm that all components work well together before continuing to the actual WCT mapping drive test.

To validate the WCT setup, perform an indoors throughput measurement, in a lab-like environment, and review the Throughput, Noise Level and CCA Activity parameters.

The validation activities in this chapter are organized in a chronological order:

Position WCT Components

1. Position the Wavion Base Station and the connected Traffic Server on a table.
2. Position the Mobile Mapping Client at a distance of 2-3 meters from the Wavion Base Station.

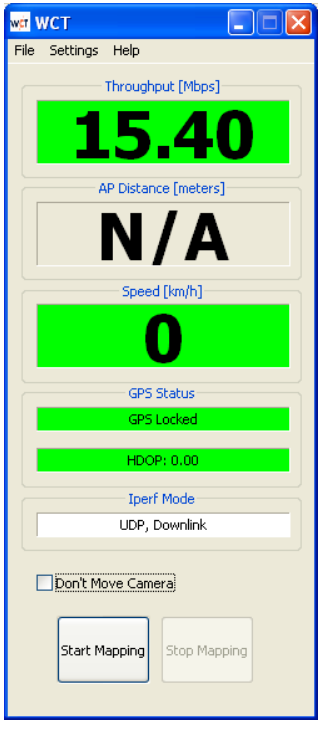
Review the Throughput Parameter

The Throughput parameters measure the amount of data per second received by the Mobile Mapping Client:

How to Display the Throughput Parameter:

1. In the Mobile Mapping Client, double-click on WCT.exe file in the WCT installation directory (e.g. C:/WCT/WCT.exe).

The WCT Main window is displayed showing the *Throughput* box.



What Is a Good Throughput Value?

The WCT setup is operating correctly if the throughput displayed in the WCT Main window is above 20 Mbps.

What To Do If There is No Good Throughput Value?

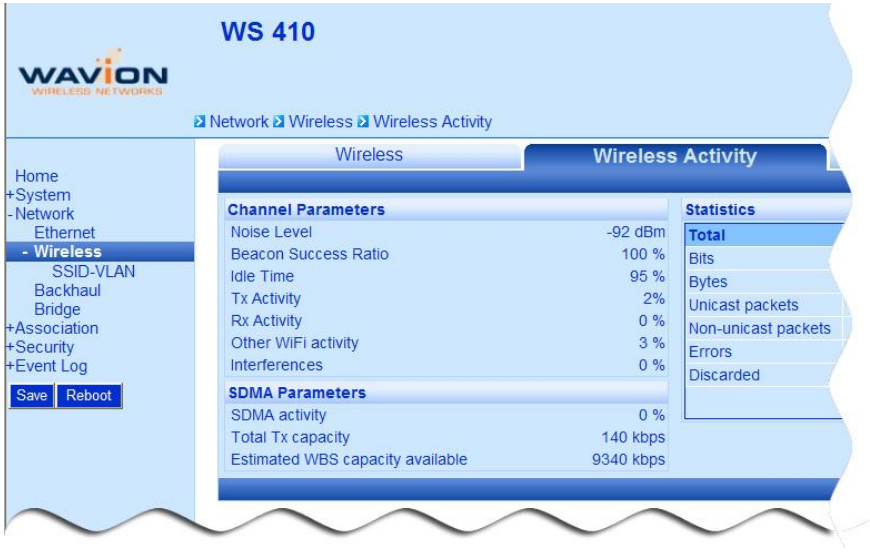
If the **Throughput** displayed in the WCT Main window is below 20 Mbps, review WCT setup and configuration:

- Tighten all cable connectors.
- Review the WCPE-24HP-USB wireless adapter configuration (refer to page 34: Configure the Mobile Mapping Client's Wireless Network Connection and also to page 24 Configure the Mobile Mapping Client Wireless Connection to Connect to the Dedicated WLAN).

Review the Noise Level Parameter

How to Display the Noise Level Parameter:

1. Run the WBS Configuration Management Tool (CMT) from the Traffic Server (refer to page 18: Run the WBS Configuration Management Tool).
2. In the CMT home page side bar, expand the *Network* menu and the *Wireless* submenu.
3. Display the *Wireless Activity* tab.



4. Review the *Noise Level Parameter* field value.

What Is a Good Noise Level Value?

The **Noise Level** value should be below -88 dBm.

What To Do When There is No Good Noise Level Parameter Value?

1. Display the *Automatic Channel Selection* tab.
2. Review the *Noise Level* chart, in the *Scan Results* area and search for a channel with a Noise Level value that is below -88 dBm.
3. If you were not able to locate a channel that is above the good noise level value, perform another automatic channel selection scan (For instructions on how to perform another channel selection scan refer to page 19: Select the WBS Transmission Channel).
4. If you were able to locate a channel with the above noise level value, display the *Wireless* tab.
5. Select the above channel in the *Operational Channel* drop down box.

Review the Interferer Handling Mode Parameter

How to Display the Interferer Handling Mode Parameter:

1. Run the WBS Configuration Management Tool (CMT) from the Traffic Server (refer to page 18: Run the WBS Configuration Management Tool).
2. In the CMT home page side bar, expand the *Network* menu and the *Wireless* submenu.
3. Display the *Wireless Activity* tab.

4. Review the *Interference Handling Mode* area.

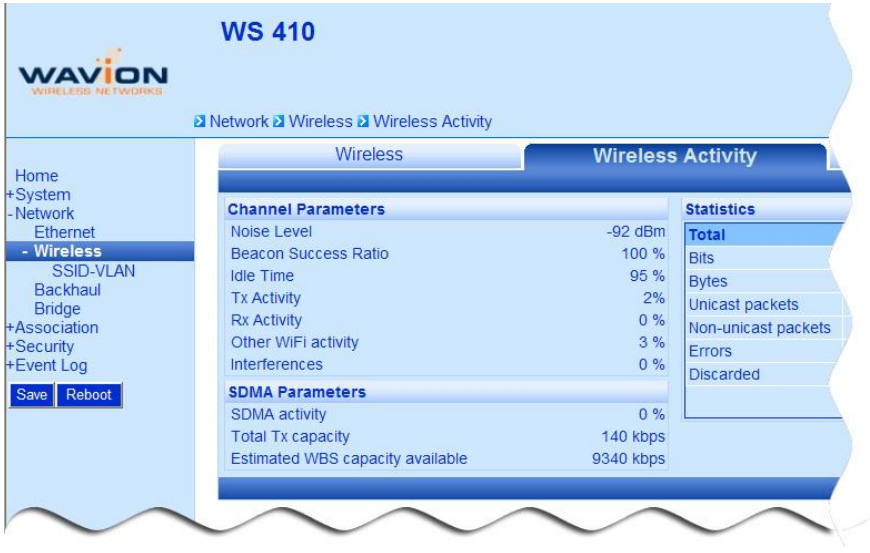
What Is a Good Interference Handling Mode Value?

The *Interference Handling Mode* should be set to *Interferences Mode*.

Review the Idle Time Parameter

How to Display the Idle Time Activity Parameter:

1. Run the WBS Configuration Management Tool (CMT) from the Traffic Server (refer to page 18: Run the WBS Configuration Management Tool).
2. In the CMT home page side bar, expand the *Network* menu and the *Wireless* submenu.
3. Open the *Wireless Activity* tab.
4. Review the *Idle Time Parameter* field value.



What Is a Good Idle Time Activity Value?

The *Idle Time Activity* value should be above 75%.

What To Do When There is No Good Idle Time Activity Parameter Value?

1. Display the *Automatic Channel Selection* tab.

   If the last ACS scan was performed when the WBS was in a different location perform the scan once again (refer to page 19: Select the WBS Transmission Channel). The last scan date is displayed in the *Scan Time* field.

2. Review the *CCA Activity* chart, in the *Scan Results* area and search for a channel with a CCA Activity value below 25%.
3. If you could not locate a channel with the abovementioned CCA Activity value, perform another automatic channel selection scan (for instructions on how to perform a new channel selection scan refer to page 19: Select the WBS Transmission Channel).
4. If you were able to locate a channel with the abovementioned CCA Activity value display the *Wireless* tab.
5. Select the above channel in the *Operational Channel* drop down box.

Perform a Mapping Drive Test

After installing the WCT system, this chapter will help you to perform a mapping drive test. The following topics are organized in a chronological sequence.

- Prepare the Mobile Mapping Client for the Drive Test; refer to page 49
- Begin the Mapping Drive Test; refer to page 54
- Read Google Earth; refer to page 61
- Pause Mapping; refer to page 62
- Solve Problems During the Drive Test; refer to page 63

Prepare the Mobile Mapping Client for the Drive Test

Before starting to drive the Mobile Mapping Client in the test subject area a few preparatory activities and last minute checkups must be performed:

- Prepare Google Earth For the Mapping Drive Test; refer to page 50
- Connect the Mobile Mapping Client to a Power Source; refer to page 51
- Position the Wireless Antenna on the Vehicle Roof, refer to page 52
- Position the GPS Receiver on the Vehicle Roof; refer to page 53

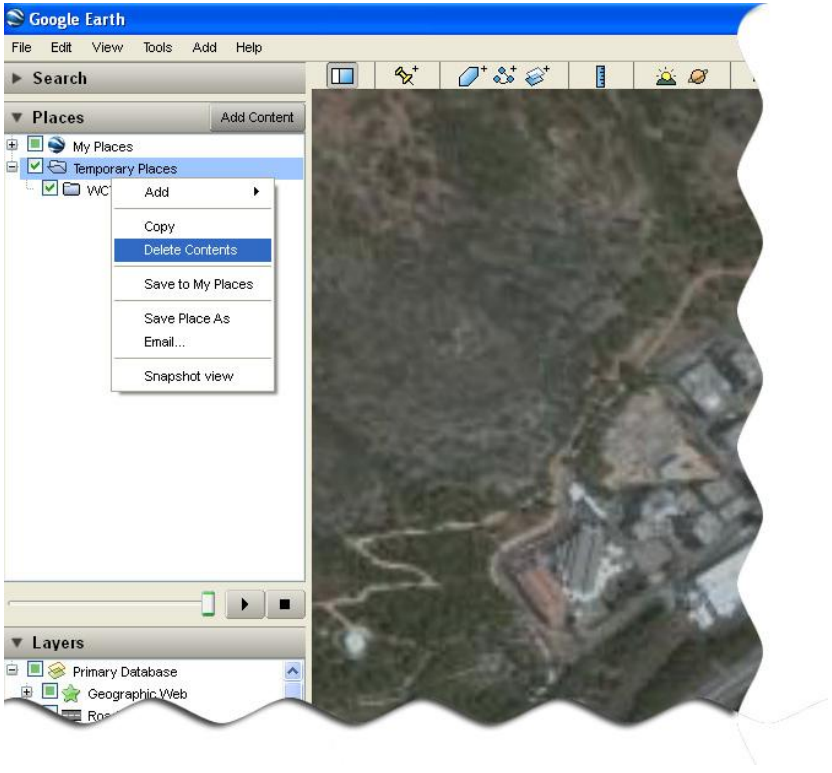
Prepare Google Earth For the Mapping Drive Test

After having installed Google Earth and while still connected to the Internet, perform the following activities to prepare and optimize Google Earth for the mapping drive test.

- Delete Temporary Places; refer to page 50
- Cache Google Earth Image Data; refer to page 51

Delete Temporary Places

1. Run *Google Earth*.
2. To improve the synchronization of *Google Earth* and the WCT, right click the *Temporary Places* checkbox under *Places* and select *Delete*.



Cache Google Earth Image Data

Google Earth requires Internet access to load area images. However, during WCT drive tests, the Mobile Mapping Client is not connected to the Internet. Therefore, Google Earth imagery caching should be completed beforehand while still connected to the Internet.

1. Connect the Mobile Mapping Client to the Internet.
2. Run *Google Earth.*
3. Zoom in on the planned drive-test area in Google Earth.

Google Earth automatically caches the area images and loads them from the cache during the drive-test.

4. Do not close Google Earth before the end of the drive-test.

Connect the Mobile Mapping Client to a Power Source

To power the Mobile Mapping Client laptop during a WCT mapping drive test, we recommend using the DC to AC inverter car lighter plug supplied in the WCT kit.

Position the Wireless Antenna on the Vehicle Roof

1. Connect the wireless antenna to the Mobile Mapping Client and to the magnetic base (for more information, refer to page 131: Connect the Wireless Antenna to the Mobile Mapping Client)
2. Route the antenna wire and the magnetic base through the vehicle window or, alternatively, through the vehicle door rubber seals.

3. Attach the Antenna to the vehicle's external roof using the magnetic base.

> **Note:** Mounting the Wi-Fi antenna on the vehicle roof enables Wi-Fi coverage mapping that is independent of both the Mobile Mapping Client orientation and the Wi-Fi signal reception conditions inside the vehicle.

Position the GPS Receiver on the Vehicle Roof

1. Connect the GPS Receiver to the Mobile Mapping Client (for more information, refer to page 35: Install the GPS Receiver).
2. Route the connected GPS receiver through the vehicle window or, alternatively, through the vehicle door rubber seals.

3. Attach the GPS receiver to the vehicle's external roof using the receiver's magnetic base.

> **Note:** Mounting the GPS receiver to the vehicle roof, guarantees better GPS signal reception comparing to an in-vehicle GPS receiver.

Begin the Mapping Drive Test

After completing the Mobile Mapping Client setup preparation for the drive, you can start the mapping drive test.

Last Minute Checks Before Starting to Drive

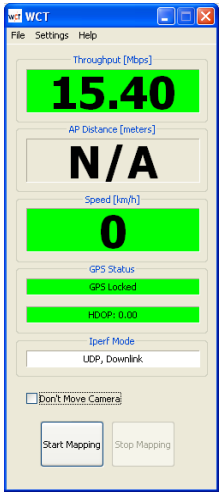
Confirm the following:

- A successful WCT setup validation was performed, (refer to page 41: Validate WCT Setup).
- Google Earth image areas are cached, (refer to page 51: Cache Google Earth Image Data).
- The GPS and Wireless antennas are attached correctly to the vehicle's external surfaces (refer to page 52: Position the Wireless Antenna on the Vehicle Roof, and to page 53 Position the GPS Receiver on the Vehicle Roof).

Start the WCT application

1. In the Mobile Mapping Client, double-click on WCT.exe file in the WCT installation directory (e.g. C:/WCT/WCT.exe).

The WCT Main window is displayed.



Review Drive Preconditions

On the WCT window, confirm that:

- **Throughput** box which displays the average measured throughput is updated periodically every 1 second and that its textbox is colored Green.
- **GPS Status** field is updated to **GPS Locked** and its textbox, in the main WCT window, is colored Green.
- **HDOP** metric values are below the HDOP threshold and its textbox, in the main WCT window, is colored Green.

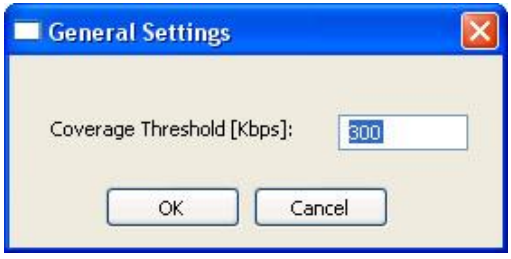
Set Coverage Threshold

WCT maps throughput measurements that are above a certain value known as Coverage Threshold. Locations with throughput readings which are higher than this value are marked in color while locations with throughput readings below this value are marked in black. The default Coverage Threshold value is 300[Kbps].

If wish to modify this value perform the following:

1. On the WCT window, select Settings-> General.

The *General Settings* dialog box is displayed



2. Type the throughput Kbps value in the Coverage Threshold box.

3. Click *OK*.

Locations with throughput readings lower than the typed value will be marked in black, while locations with throughput readings higher than the threshold will be marked in color.

Start Mapping

1. On the WCT window, click *Start Mapping*.

The *Coverage Settings* dialog box is displayed.

2. Click *Browse* if you want to change the location and filename of the WCT file. A WCT file stores mapping and throughput data.
3. If you know the base station coordinates, enter them in the *Longitude* and *Latitude* fields,
4. If you do not know the base station coordinates and you are located close to the base station, click *Current Location* to receive the coordinates directly from the GPS receiver.

AP Location Longitude and Latitude must be defined before the WCT mapping drive.

5. If you want to run the WCT mapping without displaying the results on Google Earth mark the *Work Without Google Earth* checkbox.

WCT collects the mapping information to a WCT file during the mapping. At the end of the mapping WCT saves the coverage data to a compatible Goggle Earth KMZ file.

6. Type any test description in the *Test Description* field**.**
7. Press *OK*.

WCT start to collect throughput and GPS data until *Stop Mapping* is clicked.

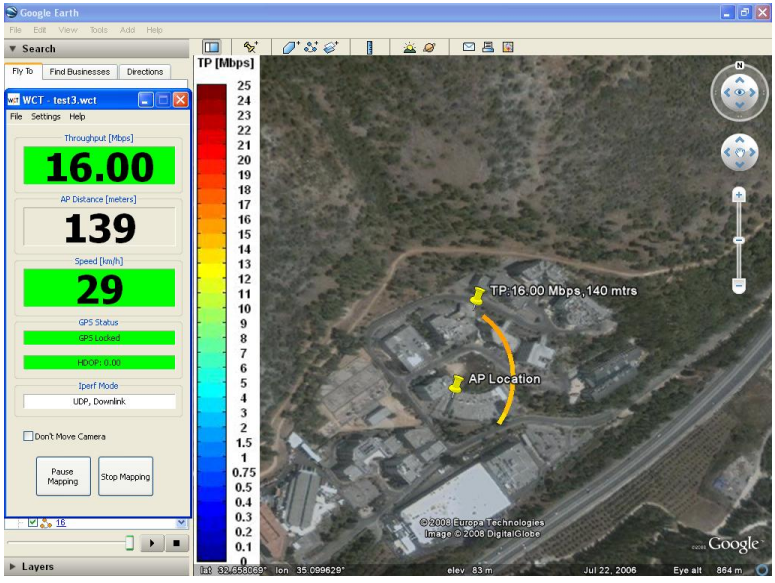
Display Google Earth

1**.** Display Google Earth window on the Mobile Mapping Client screen.

> **Note:** As the Mobile Mapping Client cannot be connected to the Internet during the mapping drive, Google Earth should already be running in your Mobile Mapping Client with the relevant area maps stored in the application's cache memory (for more information refer to page 51: Cache Google Earth Image Data).

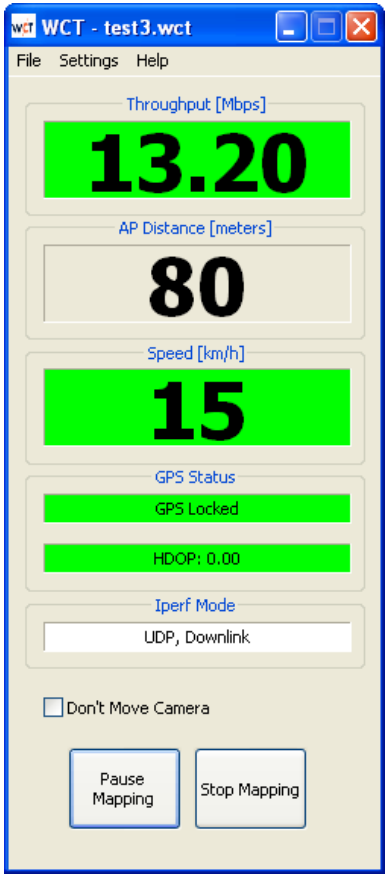
2. Ensure that the following place marks are pinned to the area image displayed in Google Earth:
   - *AP Location* place mark indicating the location of the Wavion Base Station at the coordinates you entered in the *Coverage Setting* dialog box (refer to page 56: Start Mapping).
   - *TP* indicating measured throughput in Mbps and the Mobile Mapping Client distance, in meters, from the current location to the marked location.

3. Position the WCT window and the Google Earth window, side by side, on the Mobile Mapping Client screen or in any other layout.



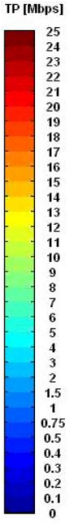
Read The WCT Main Window In Good Mapping Conditions (All Green)

Use the WCT Main window to monitor the drive test. During good mapping conditions the WCT displays the following:



- **Throughput [Mbps] –** average measured throughput. Updated every 1 second. Green background indicates that throughput data collection is currently in progress.
- **AP Distance [meters] –** Distance from the base station to the Mobile Mapping Client during WCT drive-test mapping. This field is updated every 1 second.
- **Speed [km/h] –** speed of the Mobile Mapping Client during WCT drive test. This field is updated every 1 second. Green background indicates that speed data collection is currently in progress.
- **GPS Status** – Locked during proper test conditions. Background is Green.
- **HDOP** – Horizontal Dilution of Precision –*0-2* indicates high GPS tracking precision. Background is Green.

Read Google Earth

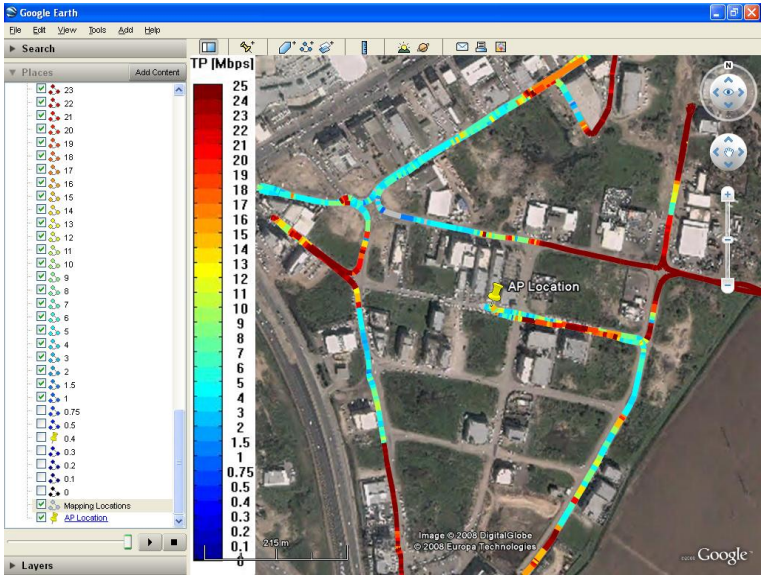


1. Drive through the area you want to test. Your driving route is displayed in Google Earth. The route is colored according to the following throughput levels:
   - Blue colors represent low throughput values,
   - Red and reddish-brown colors represent high throughput values.

If two measurements are taken at the same location at different times, the later measurement is displayed above the earlier one.

2. To only display throughput values belonging to a certain value range,
   - **2.1** Display the *Places* Panel
   - **2.2** Clear the checkboxes corresponding to value ranges that you want to hide.

Route segments that were colored by throughput values which fall in the cleared value ranges are grayed out.



3. Use the Google Earth *Ruler* tool to measure distance and the *Polygon* tool to mark areas.

Pause Mapping

1. In the WCT main window, click *Pause*.

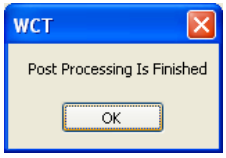
WCT stops collecting Throughput and GPS data, even though the place mark of the current position in the *Google Earth* window displays the current position of the Mobile Mapping Client.

2. Click *Resume Mapping* to continue mapping.

Stop Mapping

1. On the *WCT* window, click *Stop Mapping*.
2. In the *Save KMZ File* dialog box, select a destination folder, type the WCT mapping KMZ file name and click Save.

The KMZ file is saved and a message is displayed:



3. Press *OK*.
4. To continue the mapping drive, click *Start Mapping* to resume the mapping.

Tip: By stopping and re-starting the mapping you can divide the mapping drive session data between several KMZ files. This practice can prove useful when mapping large areas.

Solve Problems During the Drive Test

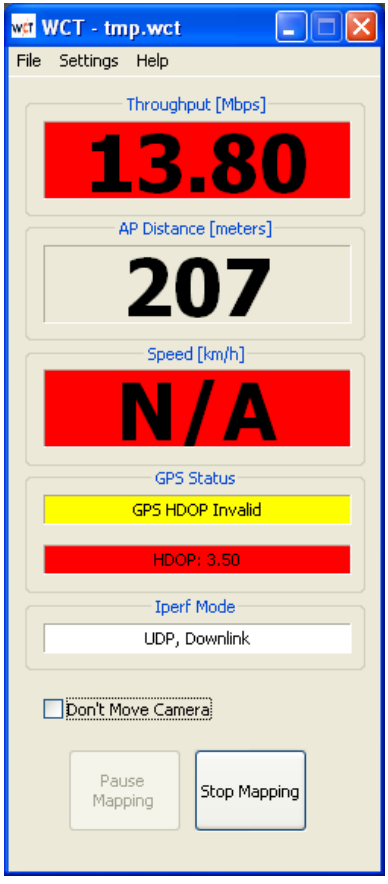
To ensure that the throughput mapping results are accurate and truly reflect Wavion throughput and coverage capability, monitor the mapping drive using the WCT Main window and troubleshoot any problems that arise during the drive test.

The WCT Main window can alert you to the following problems. For each problem type, apply the corresponding solution:

- Read The WCT Window When GPS Tracking is Imprecise; refer to page 66
- Read The WCT Main Window When the Car Speed Exceeds the Defined Limit; refer to page 66
- Read the WCT Main Window When GPS Status is Unlocked; refer to page 66

Read The WCT Window When GPS Tracking is Imprecise

WCT does not collect mapping data and does not present throughput measurements on the map when a low GPS tracking precision is detected.



- *GPS Status* field is *HDOP Invalid* and colored in Yellow.
- *HDOP* field, highlighted in Red, indicates that the measured tracking precision reported by the GPS receiver is not optimal. The *HDOP* box is highlighted in Red when the measured HDOP exceeds the threshold level defined in the *GPS Settings* window (refer to page 76: GPS Settings Quick Reference).
- *Throughput* and *Speed* are highlighted in Red to indicate that throughput and speed data is not collected.

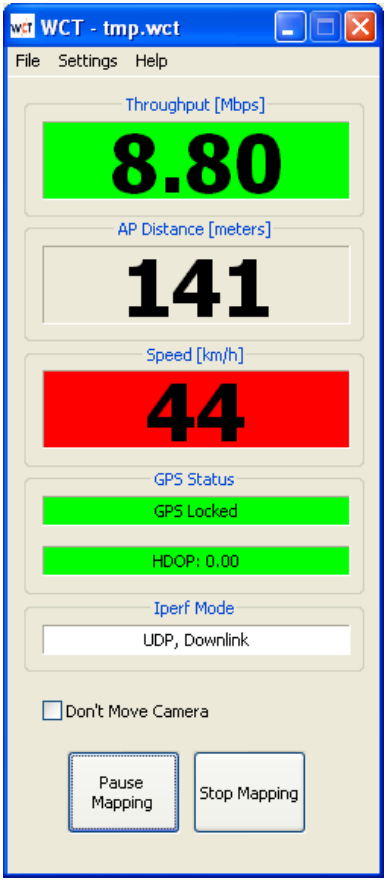
Solutions

1. In the event of a temporary GPS accuracy error the HDOP returns to normal levels in a few seconds and WCT automatically returns to operational mode.

2. If HDOP values are above normal levels for more than 20-30 seconds and the current position of the Mobile Mapping Client indicated in Google Earth is correct, consider increasing the HDOP threshold in the *GPS Settings* window (refer to page 76: GPS Settings Quick Reference).

Read The WCT Main Window When the Car Speed Exceeds the Defined Limit

WCT does not collect mapping data and does not present throughput measurements on the map when the car speed exceeds the defined limit.



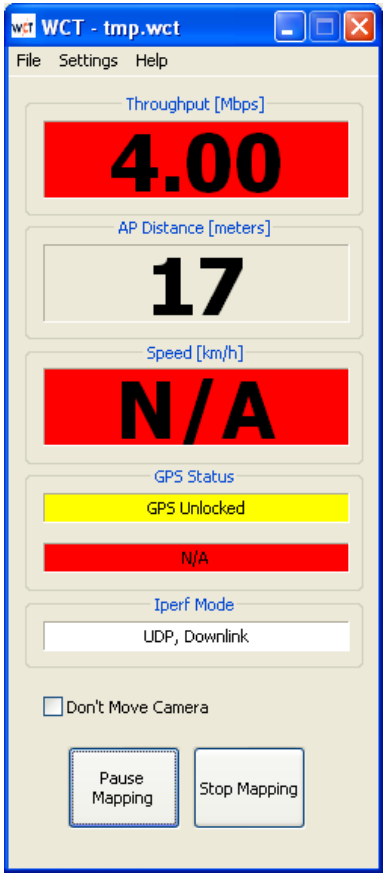
- *Speed* is highlighted in Red to indicate excessive car speed.

Solution

WCT returns to an operational mode when the car speed is reduced below the Speed Threshold. The speed threshold is defined in the *GPS Settings* dialog box (refer to page 76: GPS Settings Quick Reference).

Read the WCT Main Window When GPS Status is Unlocked

WCT does not collect mapping data and does not present throughput measurements on the map when *GPS Status* is *Unlocked*. GPS Unlocked status is triggered when WCT fails to receive data from the GPS receiver, either permanently or temporarily. Reception interferences can result from cloudiness or urban density.



- *GPS Status* field is highlighted in Yellow with status – *GPS Unlocked*.
- *Throughput*, *Speed* and *HDOP* fields are highlighted in Red.

Solutions

1. If this is a temporary GPS error, then WCT will return to the operational mode automatically in a few seconds.

2. If WCT does not return to the operational mode after more than 20-30 sec, ensure proper connection of your GPS receiver to the laptop (unplug and re-plug it into the laptop).

Display Mapping Drive Test Results

After the mapping drive test completion, the results can be displayed and analyzed. This chapter provides instructions on how to display and save the test results for analysis at a later stage.

Mapping drive test results are stored in a WCT file. WCT automatically converts the WCT file to a KMZ file – a Google Earth file format designed for storing geographical data. The KMZ file can be saved and opened with Google Earth at a later stage; it can also be saved as a JPEG file to view the results independent of Google Earth.

The chapter includes the following results:

Save a KMZ File

Under normal circumstances WCT prompts the saving of the KMZ file, via the WCT Main window, when you stop the mapping procedure (refer to page 63: Stop Mapping) If for any reason the KMZ file needs to be recreated, perform the following:

1. In the WCT Main window, open the *File* menu and select *Open*.
2. Browse to the WCT file and click *Open*.
3. In the *Save KMZ File* dialog box, save the KMZ file in a selected location.

Open a KMZ File

To display the mapping drive test results in *Google Earth* after completing the mapping drive, perform the following:

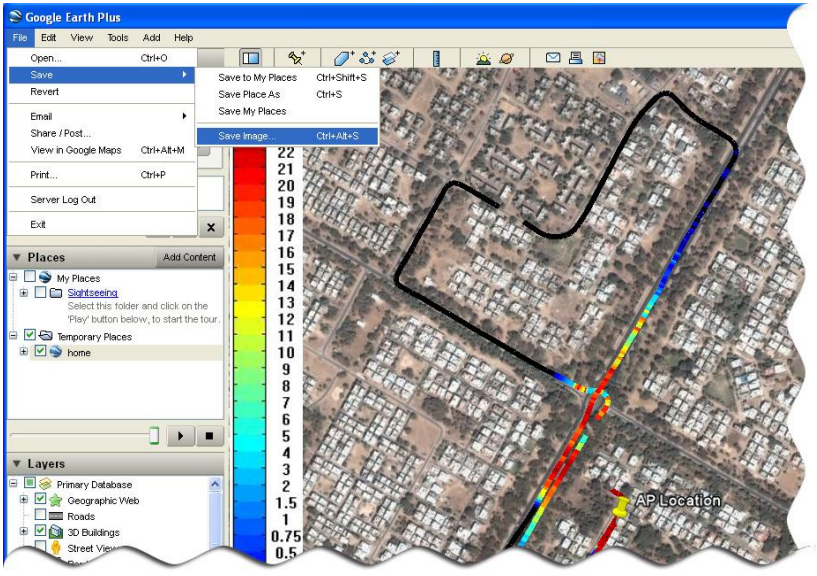
1. In *Google Earth*, open the *File* menu and select *Open.*
2. Browse to the KMZ file and click *Open.*

The mapping drive test results are displayed in *Google Earth*.

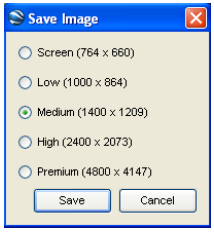
Save Mapping Drive Test Results in JPG Format

Save the mapping drive test results in JPG format when Google Earth is unavailable.

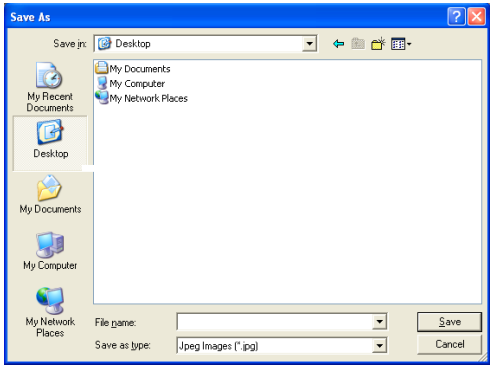
1. In *Google Earth*, open the *File* menu and select *Save Image* in the *Save* sub menu.



2. In the *Save Image* dialog box, select the required resolution level and click *Save*.

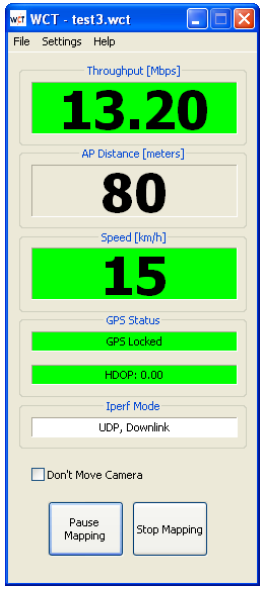


3. In the *Save As* dialog box, select a destination folder; type the WCT mapping JPG file name, and click *Save*.



WCT Quick Reference

WCT Main Window Quick Reference



Access the Window

1. In the Mobile Mapping Client, double-click on WCT.exe file in the WCT installation directory (e.g. C:/WCT/WCT.exe).

The WCT Main window is displayed.

Fields

The WCT Main window consists of the following fields:

- **Throughput [Mbps] –** Average measured throughput. The field is updated every 1 second in normal operation mode. The field is

highlighted in Green when throughput data is collected and Red when no throughput data is collected.

- **AP Distance [meters] –** Distance from the base station to the Mobile Mapping Client. The distance is calculated based on the Wavion Base Station coordinates entered in the Coverage Settings dialog box, (For more information refer to page 76: GPS Settings Quick Reference)
- **Speed [km/h] –** Speed of the Mobile Mapping Client during WCT mapping drive test. This field is updated every 1 second. The field is highlighted in Green when speed data is collected and Red when no speed data is collected.

GPS Status – consists of 2 fields:

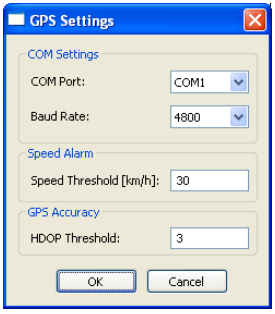
- **Status** – possible statuses:
  - **GPS Locked** – Highlighted in Green in normal mapping conditions.
  - **NO GPS found** – Highlighted in Red when there is no GPS signal. To troubleshoot, check the GPS Receiver connection (refer to page 35: Install the GPS Receiver), the GPS COM Port (refer to page 36: Select GPS COM Port), and the GPS Receiver positioning (refer to page 53: Position the GPS Receiver on the Vehicle Roof).
  - **GPS Unlocked** – Highlighted in Yellow (for troubleshooting refer to page 67: Read the WCT Main Window When GPS Status is Unlocked)
- **HDOP** – Horizontal Dilution of Precision – a commonly-used metric of GPS longitude-latitude estimation accuracy.
  - **0-2** – Indicates high GPS longitude-latitude estimation accuracy, highlighted in Green;
  - **2-4** – Indicates medium GPS longitude-latitude estimation accuracy, highlighted in Red.
  - **Higher than 4** – Indicates low GPS longitude-latitude estimation accuracy, highlighted in Red.

- **Iperf Mode** – Indicates the generated traffic direction (Downlink or Uplink) and type (TCP/UDP). This field is updated every 1 second.

  Note: WCT Ver. 1.0.0.5 supports UDP Downlink traffic only.

- **Don't Move Camera –** Toggle between 2 modes of movement illustration in Google Earth:
  - The map moves while the Mobile Mapping Client marker remains in the center.
  - The map is static while the Mobile Mapping Client marker moves along the route.

GPS Settings Quick Reference



Access the Window

1. In the WCT Main window, click *Settings*.

The *GPS Settings* window is displayed.

Fields

The *GPS Settings* window consists of the following fields:

- **COM port** – The GPS receiver COM. For more information on how to determine the GPS receiver COM Port refer to page 36: Select GPS COM Port.
- **Baud Rate** – The Baud Rate of the GPS receiver provided in WCT Kit is 4800. Do not change this value.
- **Speed Threshold** – Allows setting a speed threshold in km/h for the WCT speed alarm.

  If, during the mapping, the car speed measured by the Mobile Mapping Client exceeds this threshold, WCT stops collecting mapping data and does not present throughput measurements on the map (refer to page 66: Read The WCT Main Window When the Car Speed Exceeds the Defined Limit).

The default value is 30 km/h. In most cases this speed value does not affect WiFi performance transmitted from the Wavion Base Station. Therefore, it is recommended that this speed threshold not be exceeded so that the resulting values will yield good representation of fixed client throughput values.

- **HDOP Threshold** – HDOP (Horizontal Dilution of Precision) values measure GPS tracking accuracy. The GPS receiver reports a new value to WCT every 1 sec.

  If, during the mapping, HDOP values drop below this threshold, WCT stops collecting mapping data and does not present throughput measurements on the map (refer to page 65: Read The WCT Window When GPS Tracking is Imprecise).

  The recommended HDOP value is the default value of - 3. In specific environmental contexts that are prone to high HDOP values, such as cloudiness or in downtown urban areas, higher HDOP thresholds are recommended.

Coverage Settings Quick Reference

Access the Window

1. In the WCT Main window, click *Start*.

The *Coverage Settings* dialog box is displayed.

Fields

The *Coverage Settings* dialog box consists of the following fields:

- **WCT File Name** – *Browse* and select the WCT file location and name, if you want to change the default location. WCT stores throughput and GPS data in a *.WCT file.
- **AP Location** – If you know the base station coordinates, enter them in the *Longitude* and *Latitude* fields. This location is displayed in the *WCT Main* window in the *AP Distance* field
- **Current Location** – If you do not know the base station coordinates and you are located close to the base station, click *Current Location* to receive the coordinates directly from the GPS receiver.

Note: AP Location Longitude and Latitude must be defined before the WCT mapping drive.

- **Work Without Google Earth** – If you want to run the WCT mapping without displaying the results on Google Earth mark the checkbox.
- **Test Description** – Type any test description in this field**.**

Appendix A: How to Determine GPS Receiver COM Port Number

To determine the COM port number of the GPS receiver, follow the steps listed below:

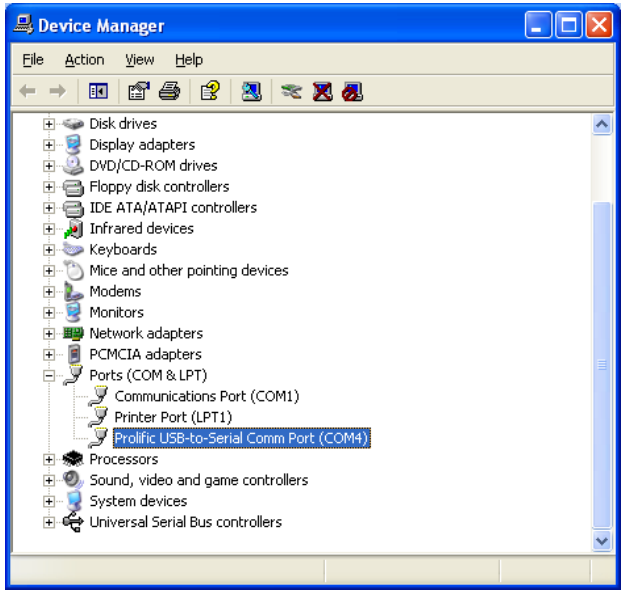
1. In Windows open Device Manager with the following steps:

   1.1 Click *Start-> Run*.

   1.2 In the *Run* dialog box, type *devmgmt.msc* and click *OK*

2. In the *Device Manager* window, click on the *+* sign adjacent to *Ports (COM & LPT)*

The COM Port number appears in brackets at the end of the USB port name.



Appendix B: How to Turn Windows Firewall On/Off

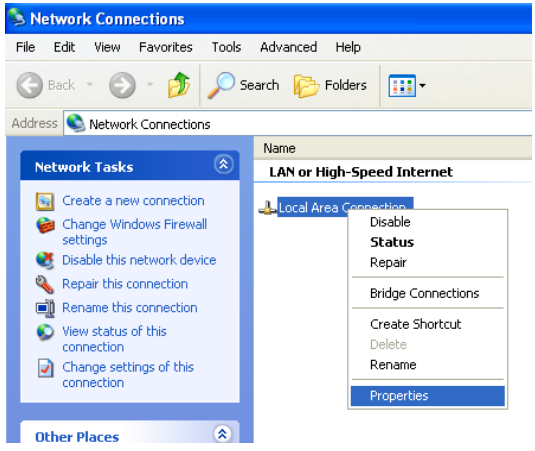
To activate/deactivate Windows firewall for a network adapter, follow the steps listed below:

1. In Windows, open Network Connections using the following steps:

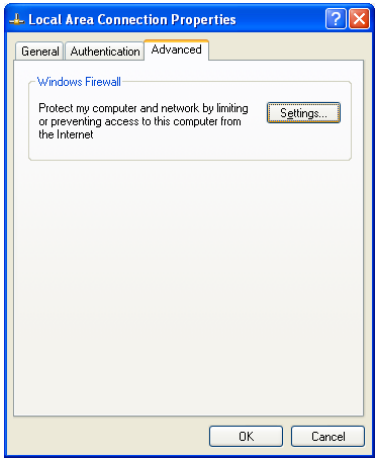
   1.1 Click *Start*-> *Run*.

   1.2 In the *Run* dialog box, type *ncpa.cpl* and click *OK*

2. In the *Network Connections* panel right-click on the network connection which corresponds to the network adapter and select the *Properties* option from the context menu.



3. In the Connection Properties sheet, display the *Advanced* tab



4. Click *Settings*.

5. In the *Windows Firewall* dialog box, check the *On* checkbox to activate the firewall or *Off* checkbox to deactivate the firewall and press *OK*.