



TEA™ Family of Business Case Analysis Tool

TEA|WiMAX™

Release 2.2.3.1

User Guide

Revision 1.5

27 June 2011



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1.4	22 July 2010	Release for TEA WiMAX 2.2.3 - Increase of the number of antenna elements at BS and UT side (up to 4 antenna elements in TX and RX) - Introduction of the "Multi carrier configuration" feature
1.3	12 January 2010	Release for TEA WiMAX 2.2.2 New Input: Other Revenues
1.2	04 June 2009	More detailed description of manual setting in Technical Analysis/Network Dimensioning
1.1	10 April 2009	Release for TEA WiMAX 2.2.1 - New Installer - New software license registration procedure - Description of icons in the <i>Start Program</i> menu - Introduction of Miles as an alternative unit of length in the <i>Project Setup</i> - Brief description of the default <i>Sample Project</i> - Introduction of <i>VoIP Coding Algorithm</i> and <i>Voice Activity Detection (VAD)</i> in the <i>Market Analysis</i> - Clarification about the calculation of acquired and lost users in the <i>Market Analysis</i> - Introduction of the <i>Over Booking Factor (OF)</i> for data and <i>Peak Busy Hour (PBH) Activity Level</i> for VoIP in the <i>Technical Analysis</i> - Clarification about coverage radius calculation in the <i>Technical Analysis</i> - Clarification about the radio link roll-out in the <i>Technical</i>

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1.0	21 November 2008	Release for TEA WiMAX 2.2.0



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1 Introduction

In the project lifecycle to build a WiMAX network, the initial business planning stage is critical for setting a solid foundation for the success of the initiative. Indeed, here is where the business case is defined and the budget is allocated. This requires a properly-run set of market analysis and revenue forecast, well calibrated technical cost modeling, and a profit & loss calculation over the initiative period with close evaluation of the key performance indicators. Misjudgments and mistakes made at this stage will influence heavily the next phases; in particular, the subsequent detailed project phase.

Fundamental ingredients of every business case exercise are revenues and costs which, quite naturally, have to be maximized and minimized respectively.

On one hand, costs are thereby a consequence of the underlying market, rollout plan, and technology strategies, which can be directly mapped on a certain infrastructure required to serve the service demand associated with the revenue predicted.

On the other hand, costs also impact on the chosen technology (or chosen technology profile), the rollout plan, and market strategy. For instance, the introduction of flat fees has to be based on a sound knowledge of the service production costs and the network capabilities.

A holistic, iterative approach, that takes into account all business and technology aspects since the outset is thus key. This will ensure that an iterative alignment of the business and technology strategies will be achieved, allowing to clearly identify the main cost drivers.

In other words, it is important not to focus on the single facets of the revenue forecast, technical decisions, and cost calculation, but consider all these different aspects in a comprehensive, integrated view, building the business case through successive approximations.

Thus, on the Market side, it will be required to evaluate the potential market for WiMAX services, identifying target segments, defining service profiles, choosing types of User Terminals, and, finally, forecasting Revenues.

Subsequently, on the Technical side, this will mean to properly dimension the WiMAX Access & Backhauling network infrastructures, defining the required bill of quantities.

On the Economic & Financial side, it will mean calculating CAPEX & OPEX and evaluating all WiMAX Business Plan's Key Performance Indicators.

Finally, a Scenario & Sensitivity Analysis should allow to iteratively fine-tune the WiMAX Business Plan, analyzing the influence of parameter & boundary condition changes.

This business planning activity can be better done when equipped with an appropriate decision support tool, which has to have some key characteristics:

First, the tool has to be based on real best practices; that is, it should incorporate the real experience coming from having done real projects.

Second, the tool should be equipped with well calibrated, WiMAX technology-related, market, technical, and economic models. Well calibrated means that these models should allow to reliably close the link between revenues and costs, and this should happen through a modeling cycle that allows to iteratively calculate investment costs until an optimized result, typically minimized costs, is achieved that is able to sustain the service demand associated with the revenue predicted.

Third point, the tools should be able of presenting manageable Input and Output with meaningful correlations; that is, each model should understand and manage the correlations between model input and output and its validity range.

Last but not least, the tool should support an iterative way of working by design; in particular, the scenario & sensitivity analysis activity should be supported natively.

TEA|WiMAX by WiTech supports and provides exactly all of the above

TEA|WiMAX is a unique application capable of performing thorough techno-economic analyses in an integrated manner to deliver a reliable Business Case for a WiMAX initiative in a fast, accurate, and dependable manner.

TEA|WiMAX is the latest member in the TEA a family of tools that WiTech has built over four years of extensive industry experience in supporting major operators and equipment suppliers in several strategic initiatives and projects.

At the heart of **TEA|WiMAX** there is a set of powerful and comprehensive market, engineering, and economic models, tailored to the WiMAX technology.

TEA|WiMAX is very easy to use through a completely new, carefully designed interactive dashboard-style Graphic User Interface, built with BusinessObjects Xcelsius™. This interface allows a fast and simplified configuration of more than five hundred different input variables and assumptions, for a fine-tuned setting of the tool and to enable a full set of powerful scenario and sensitivity analyses in real time.

At the end of the analyses, a comprehensive final report is automatically compiled and published in editable and PDF formats. The report contains a complete summary (with tables, diagrams and charts) of input parameters and assumptions, the results of the market analysis, the outcome of the technical modeling, and the economic and financial statements for up to ten years.



TEA|WiMAX is conformant to the IEEE 802.16e/d standard and the WiMAX Forum's Fixed and Mobile technical profiles. Additional custom profiles can be added independently by the user.

In addition to the Candidate Bands for WiMAX, the TEA|WiMAX supports all Custom Bands in the 450 MHz to 60 GHz range.

2 Main Modules and Sub-modules of the Tool

As shown in **Errore. L'origine riferimento non è stata trovata.**, TEA|WiMAX is made up of four main modules, according to the main analyses that the tool can perform, and each module is constituted by different sub-modules.

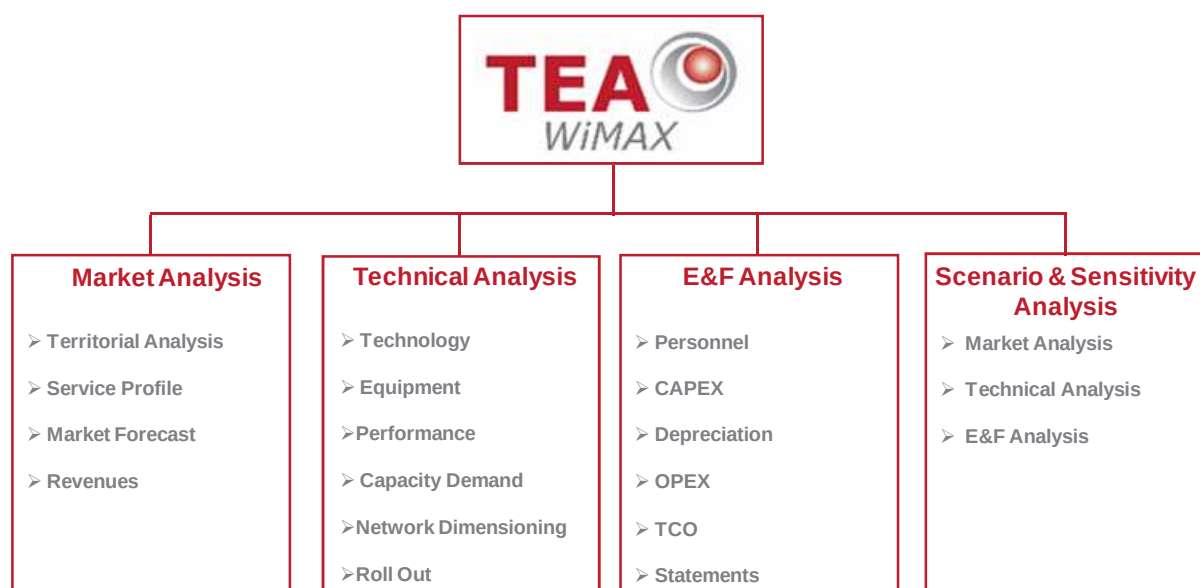


Figure 1 – TEA|WiMAX Main Modules

A summary of the main functions of each module and sub-module is provided in Table 1.

Table 1 – Summary of the functions

Module / Sub-module	Function
Market Analysis	The Market Analysis aims at properly evaluating the potential market for WiMAX services and at making reliable revenue forecasts for the WiMAX services to be offered. This analysis is performed taking into account various elements, including territorial, socio-demographic and business parameters, and identifying target segment, defining service profiles, choosing types of User Terminals and, finally, forecasting Revenues.
Territorial Analysis	The geographical area of interest is characterized considering

	key territorial parameters such as the total extension of each area and the percentage of Dense Urban, Urban, Suburban and Rural types of areas. As for main demographic data, these are the number of inhabitants, households and micro/small/medium/large local units located in the considered area, and the related percentage to be served. Up to five geographical areas can be analyzed at the same time and independently.
Service Profile	The portfolio of service profiles to be offered is defined considering both technical features and pricing policies. As for technical features, the Internet access service is characterized in terms of Peak Information Rate (PIR) and Committed Information Rate (CIR) in Down Link and Up Link; whereas the VoIP service is taken into account in terms of average number of VoIP lines per user, coding algorithms, Voice Activity Detection (VAD) and Peak Busy Hour (PBH). Concerning pricing policies, Activation Fees, Monthly Fees, and Lease Fees are taken into consideration as revenue sources. Up to six different user profiles can be defined.
Market Forecast	In order to evaluate the market size properly, the broadband penetration rate and the churn impact are set up per each year of the analysis period and for each considered area.
Revenues	Visualization of the revenues forecast charts related to every user profile for each market segment .
Technical Analysis	The Technical Analysis has the purpose of dimensioning the WiMAX Access and Backhauling network infrastructures, defining the required bill of quantities in terms of number of Base Stations, logical sectors, radio links and ASN needed to meet both capacity and coverage requirements.
Technology	This can be selected among the standard Fixed and Mobile certification profiles defined by the WiMAX Forum. Moreover custom profiles can be defined to completely customize the use of the WiMAX technology.

Equipment	It is possible to configure up to three types of Base Stations and six types of User Terminals, specifying for each of them if Multiple Antenna System technologies are supported.
Performance	A complete link budget analysis is conducted taking into consideration an extended set of parameters. The proper Path Loss Model, which better reproduces the radio propagation scenario, can be chosen among six supported models (Cost-231, Okumura Hata, SUI, ECC-33, Log-normal with/without Shadowing, Free Space).
Capacity Demand	To evaluate the feasibility of the offered services in the defined application scenario and to dimension the network infrastructure correctly, the capacity required in Down Link and Up Link by the users located in each area to be served is estimated, depending on the relevant parameters defined in the Market Analysis, such as PIR, CIR, and number of VoIP lines and Overbooking Factor and PBH Activity Ratio, defined in this section.
Network Dimensioning	As for network sizing, this takes into account some relevant parameters, such as Base Station overlapping factor, existing backbone infrastructures, and type of wireless backhauling technology to be adopted (SDH, PDH, Native Ethernet or Other).
Roll - out	As for network roll-out, this is defined in terms of the percentage of year-on-year deployed infrastructure.
Economic & Financial Analysis	The economic and financial feasibility of the WiMAX initiative can be assessed after having calculated CAPEX and OPEX expenses and having estimated some key indicators, such as EBITDA, Net Income, NPV, PBP and IRR.
Personnel	The personnel costs are analyzed considering all the typical roles in a WiMAX company (executive staff, technical ops,

	sales, marketing, general & administrative people) and defining their salary and benefits.
CAPEX and OPEX	To forecast expenditures, all main CAPEX and OPEX figures for the WiMAX initiatives are defined and calculated, such as spectrum license cost, broadband connectivity cost, network and system equipments costs (Base Station, ASN Gateway, CSN, etc.), costs of labor for network management, charging/billing and customer care costs, marketing and sales costs, etc..
Depreciation	Evaluation of the Depreciation breakdown.
TCO	A Total Cost of Ownership is calculated in order to fully evaluate all direct and indirect costs related to the WiMAX initiative.
Statements	Profit & Loss, Cash Flow and Balance sheet statements are produced to understand whether the WiMAX initiative makes or not a positive Net Income during the analysis period.
Scenario & Sensitivity Analysis	The Scenario & Sensitivity Analysis allows to iteratively fine-tune the WiMAX business plan, in real-time and total privacy, analyzing the influence of parameter & boundary condition changes for the Market, Technical, and Economic & Financial analyses, and to view the results instantly in an animated graphical format.

3 Installing the Software

3.1 System Requirements

TEA|WiMAX software runs on a standard PC environment. Basic system requirements are:

- **Processor:** Intel® Core™2 Duo (or compatible) processors at 2.00 GHz.
- **Memory:** 2 GB of RAM for Microsoft® Windows® XP™; 3 GB of RAM (recommended) for Microsoft® Windows® Vista™ and Microsoft® Windows® 7™.
- **Disk Space:** 300 MB available hard drive space.
- **Display:** Super VGA (800 x 600) or higher-resolution monitor.
- **Operating System:** Microsoft® Windows® XP with Service Pack 2 or Microsoft® Windows® Vista™ Home Premium, Business, Ultimate, or Enterprise, or Microsoft® Windows® 7™ Home Premium, Professional and Ultimate (certified support for 32-bit editions). In Windows® XP, Windows® Vista™ and Windows® 7™, TEA|WiMAX requires Microsoft .NET Framework version 2.0 or higher to run. If this component is not already installed, update your computer at <http://www.microsoft.com/downloads/en/default.aspx> :
 1. searching for the *Microsoft .NET Framework Redistributable Package* and
 2. installing the package following the instruction provided in the download page.
- **Internet Connectivity:** A connection to Internet is only required to complete the *License Registration* procedure and to perform a *Software Update*. No connectivity is required whilst running the tool to perform the analyses.

Note that some of the system's RAM physical memory may be unavailable due to being used by the graphics card and/or not being handled by the system's chipset.

3.2 TEA|WiMAX Installer

To install TEA|WiMAX on your PC, make sure you have Administrator rights then download and unpack the software in a temporary directory.

Double click on the TEA|WiMAX installer. The following figures show the operative steps.

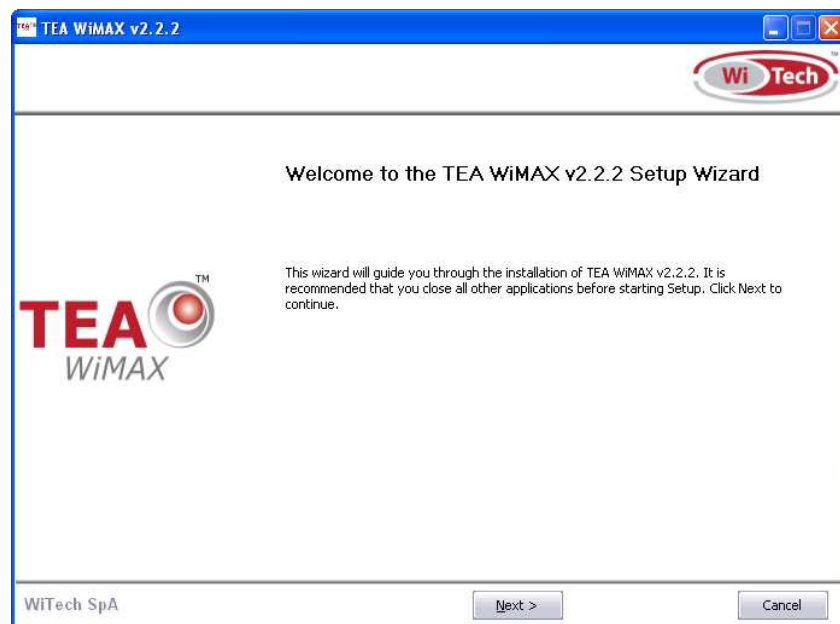


Figure 2 – TEA|WiMAX installer: Step 1



Figure 3 – TEA|WiMAX installer: Step 2

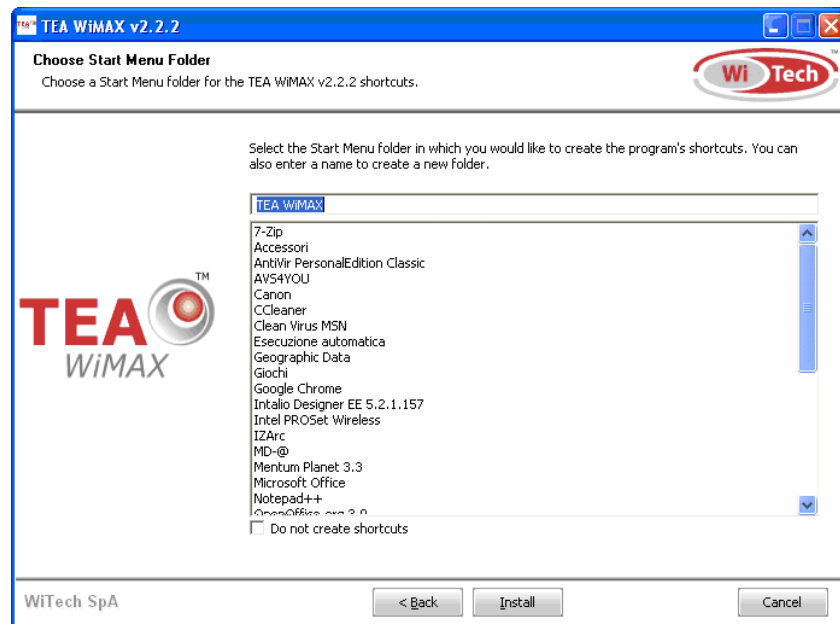


Figure 4 – TEA|WiMAX installer: Step 3

TEA|WiMAX software requires Microsoft .NET Framework version 2.0 or higher to run. If this component is not already installed on your computer, you will be notified by a pop-up message as in the figure below. Follow the instructions in the message to update your computer.

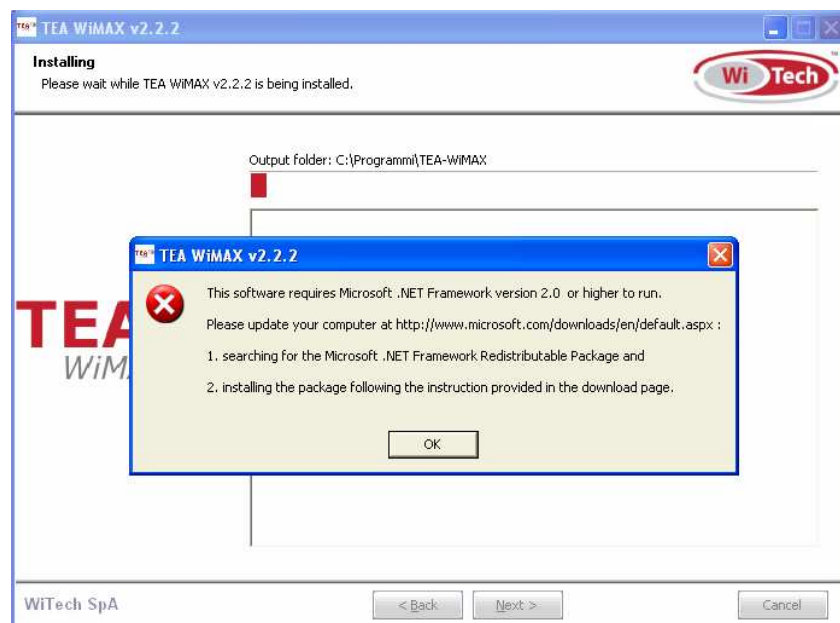


Figure 5 – TEA|WiMAX installer: Step 4

It is possible to install (or re-install) all **TEA|WiMAX** software components from scratch or update an existing installation (Figure 6).

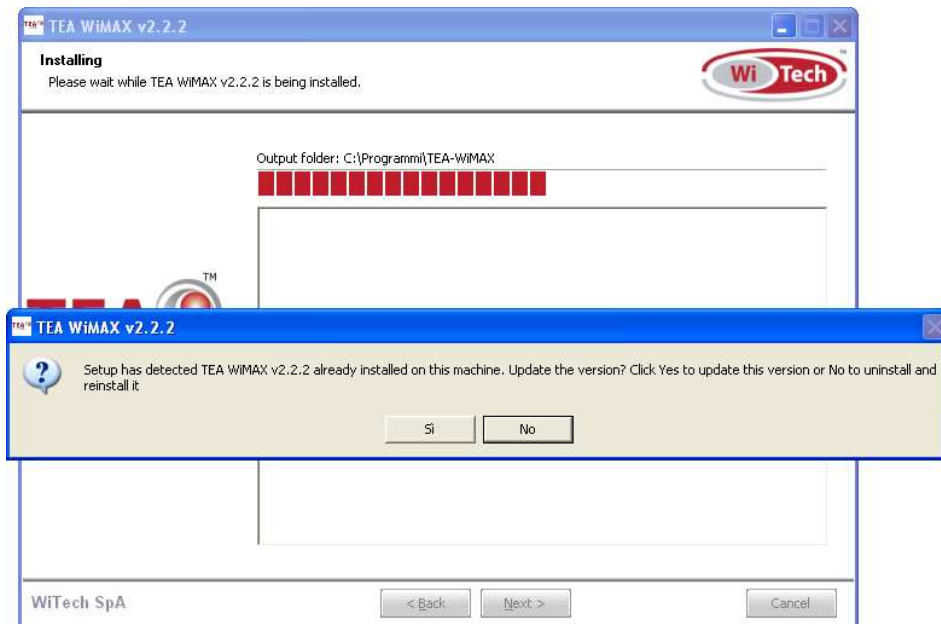


Figure 6 – TEA|WiMAX installer: Step 5

To update the existing installation, click **Yes** on the message shown in Figure 6.

To re-install the software, click **No** on the message shown in Figure 6, then

- click **Yes** on the message shown in Figure 7 to preserve all existing project and license files;
- click **No** to delete all existing project and license files.

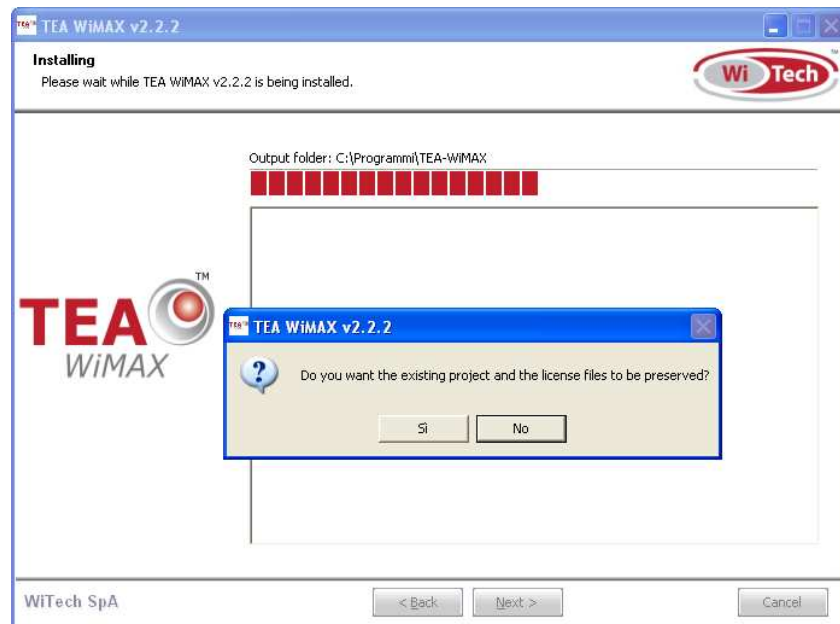


Figure 7 – TEA|WiMAX installer: Step 6

To publish in PDF format the final report containing all the main results of the TEA analyses, a PDF publisher is required. We recommend to install PDFCreator version 0.9.6 or higher, freely available at <http://www.pdfforge.org/products/pdfcreator>. Figure 8 shows the pop-up message advising to install PDFCreator and the instruction about where to find the software. For your convenience, Section 3.3 describes the operative steps to install and properly configure PDFCreator.

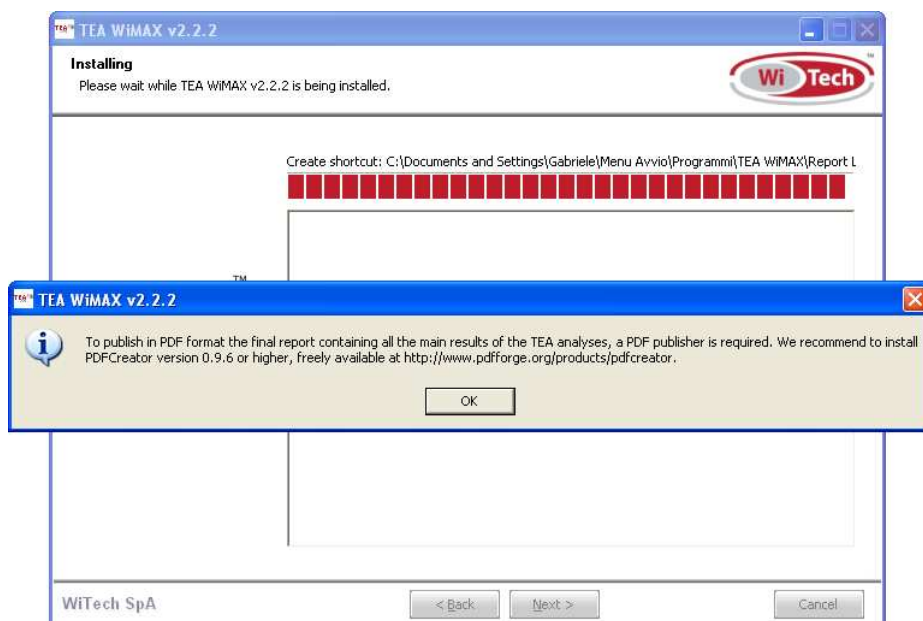


Figure 8 – TEA|WiMAX installer: Step 7

At the end of the installation process, you will be asked to reboot the computer (Figure 9).

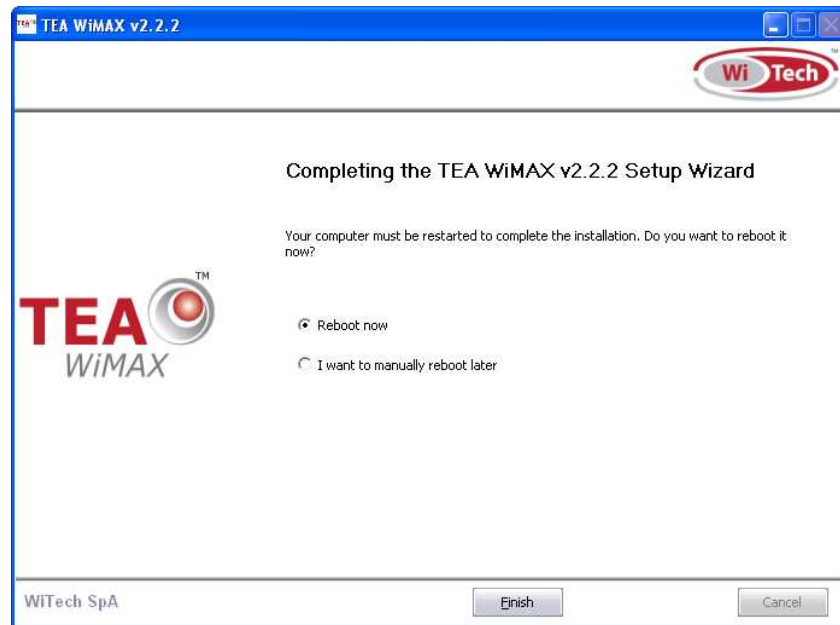


Figure 9 – TEA|WiMAX installer: End of the installation

3.3 PDFCreator installation

The following figures show the operative steps needed to install and properly configure PDFCreator.



Figure 10 – PDFCreator installation: Step 2

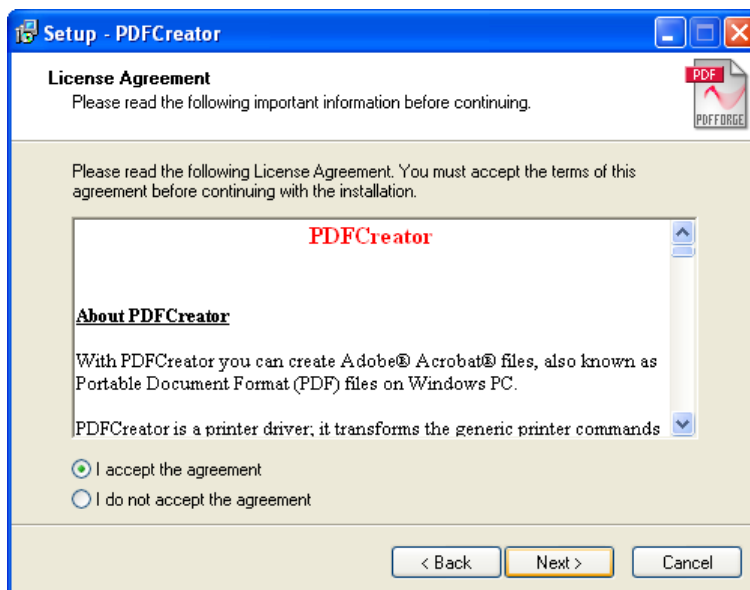


Figure 11 – PDFCreator installation: Step 3

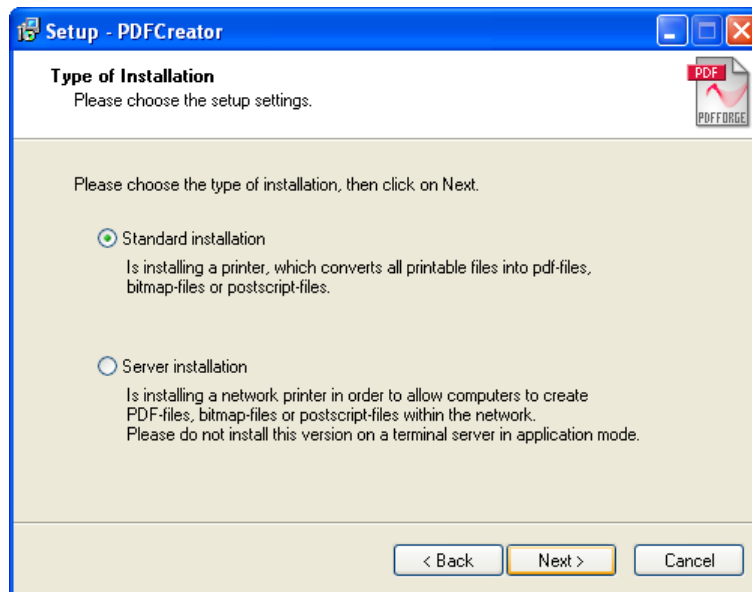


Figure 12 – PDFCreator installation: Step 4

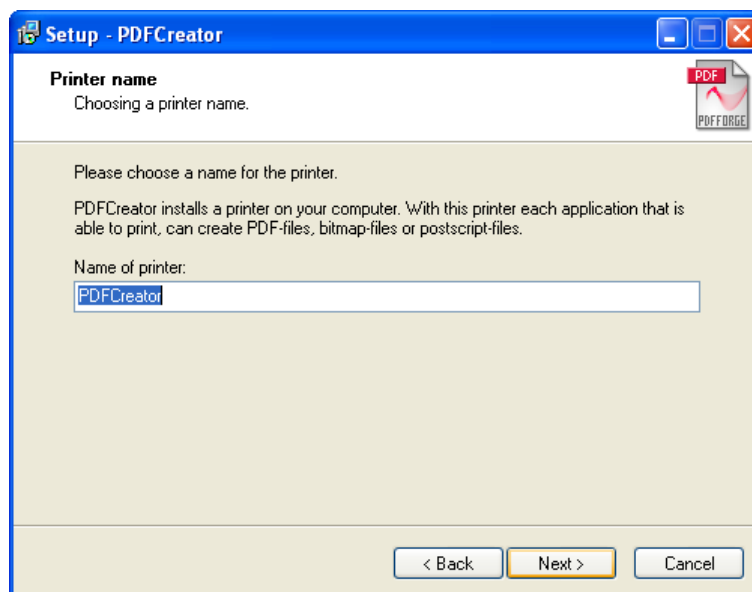


Figure 13 – PDFCreator installation: Step 5

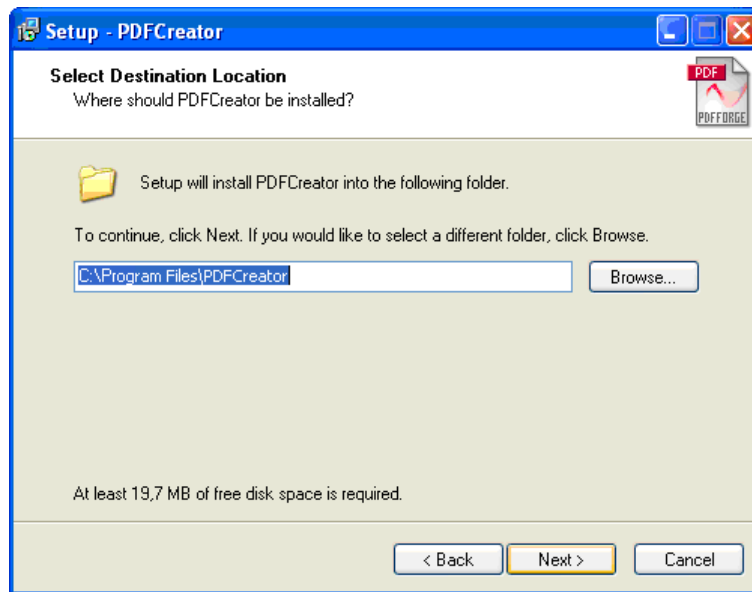


Figure 14 – PDFCreator installation: Step 6

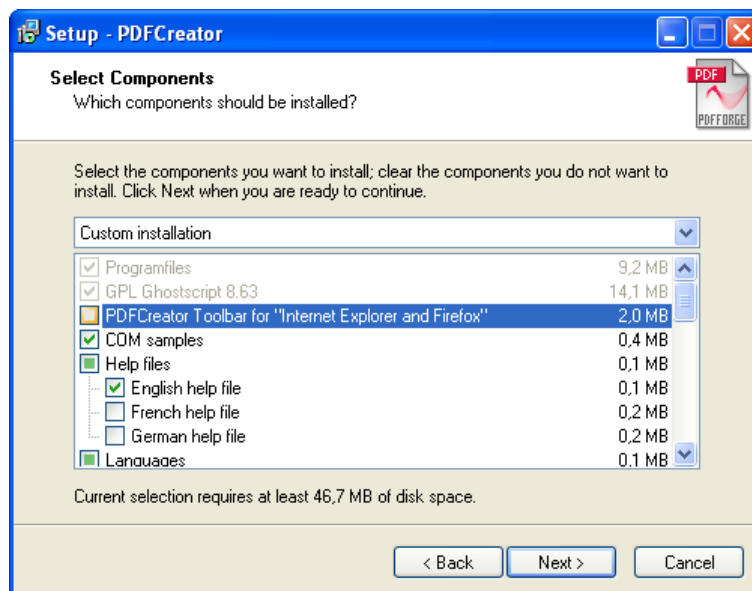


Figure 15 – PDFCreator installation: Step 7

The PDFCreator Toolbar is not necessary for TEA|WiMAX, so you do not need to select it from the list of components to be installed.

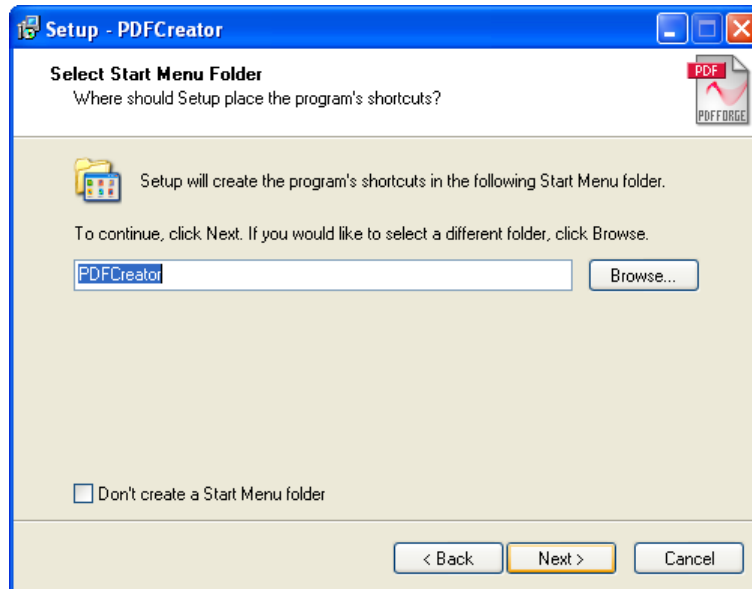


Figure 16 – PDFCreator installation: Step 8

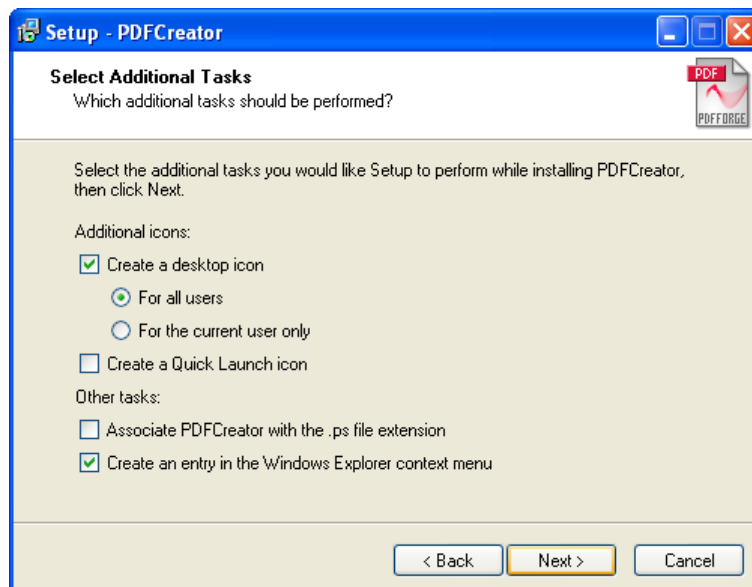


Figure 17 – PDFCreator installation: Step 9

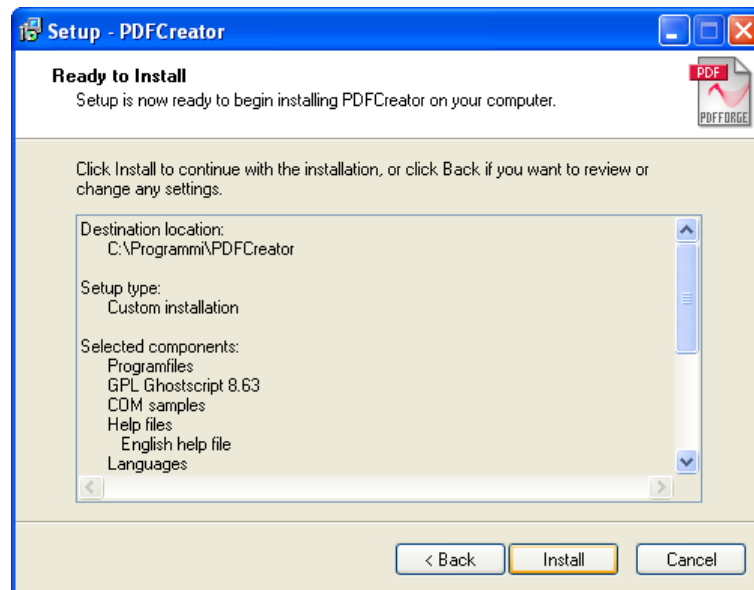


Figure 18 – PDFCreator installation: Step 10



Figure 19 – PDFCreator installation: Step 11

3.4 For Windows Vista™ Users Only - Disabling UAC

To run **TEA|WiMAX** on Microsoft® Windows® Vista™, you will have to disable UAC (User Account Control) as described below.

1. Open the **Control Panel**.
2. Under **User Account and Family Safety** settings (Figure 20) click on **Add or remove user accounts**.

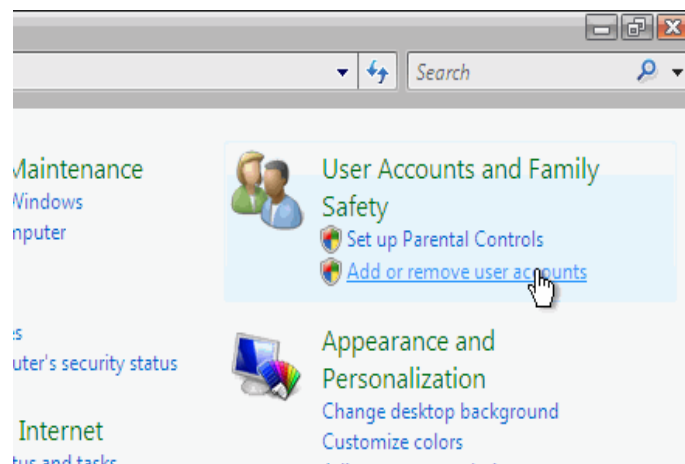


Figure 20 – Disabling UAC on Windows Vista: Step 2

3. Under your user account click on the **Go to the main User Account page** link.
4. Under **Make changes to your user account** (Figure 21) click on the **Change security settings** link.

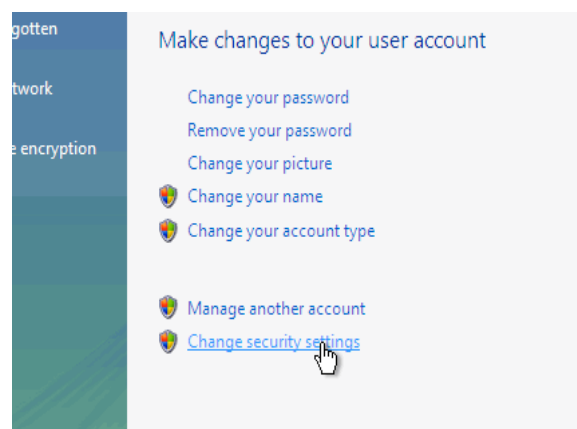


Figure 21 – Disabling UAC on Windows Vista: Step 4

5. In the **Turn on User Account Control (UAC) to make your computer more secure**, click to unselect the **Use User Account Control (UAC) to help protect your computer** (Figure 22) and then click on the **OK** button.

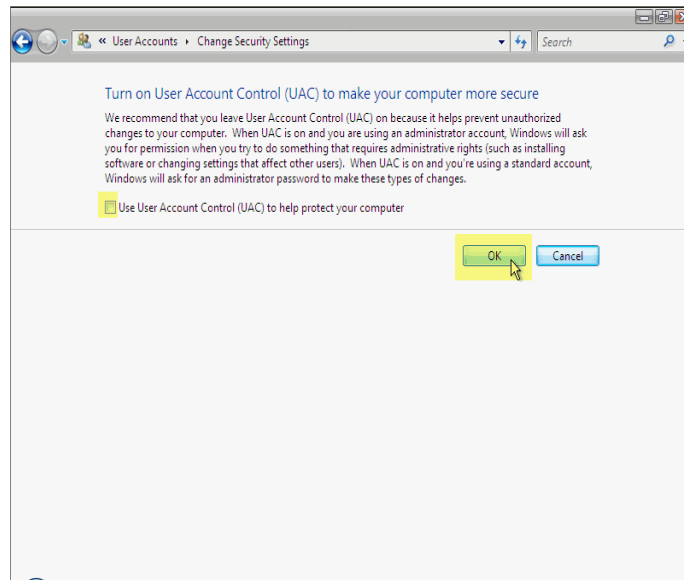


Figure 22 – Disabling UAC on Windows Vista: Step 5

6. You will be then prompted to reboot your computer (Figure 23). Do so when ready.

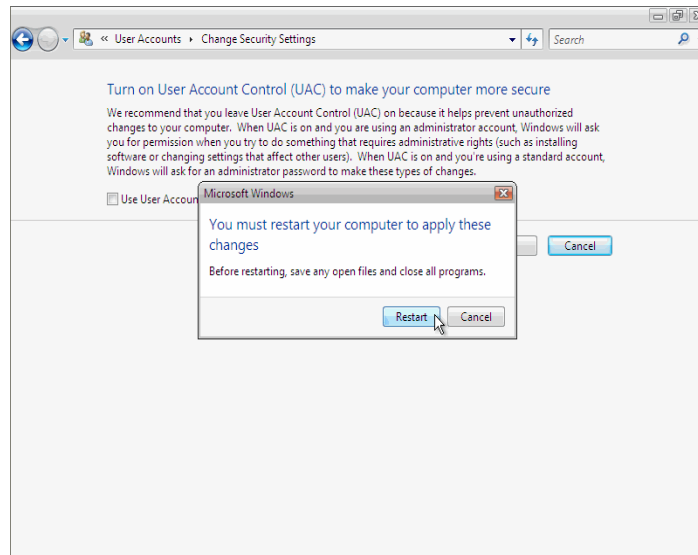


Figure 23 – Disabling UAC on Windows Vista: Step 6

7. Once Windows Vista™ has been restarted, launch **TEA|WiMAX** software as indicated in the next Chapter 4.

3.5 For Windows 7™ Users Only - Disabling UAC

To run **TEA|WiMAX** on Microsoft® Windows® 7™, you will have to disable UAC (User Account Control) as described below.

1. Click the **Start Button** and type “uac” into the text field above, and then click **Change User Account Control settings** (Figure 24 – Disabling UAC on Windows 7: Step 1).



Figure 24 – Disabling UAC on Windows 7: Step 1

2. Drag down the slider to the lowest level (Figure 25 – Disabling UAC on Windows 7: Step 2).

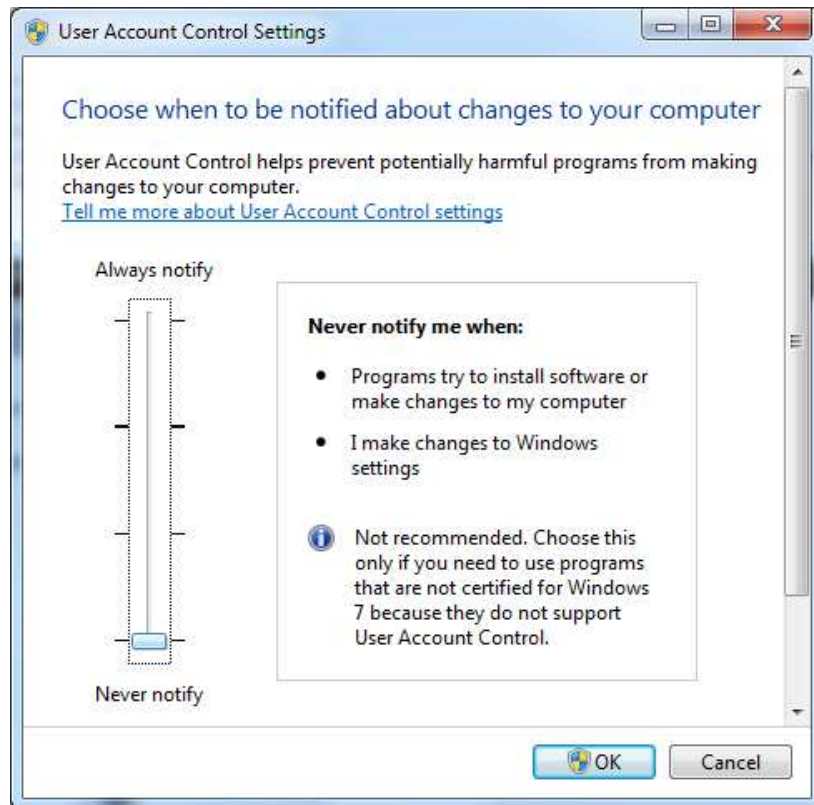


Figure 25 – Disabling UAC on Windows 7: Step 2

3. Restart your system.
4. Once Windows 7™ has been restarted, launch **TEA|WiMAX** software as indicated in the next Chapter 4.

4 Running the Tool

4.1 Starting the Software

Double click on the **TEA WiMAX** icon on *Start menu* → *All programs* → *TEA WiMAX* to launch the **TEA|WiMAX** software (Figure 26).

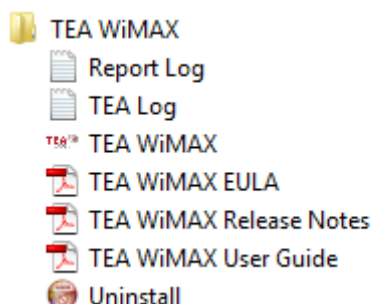


Figure 26 – Launching TEA|WiMAX

Clicking the other icons in the menu performs the following actions:

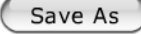
- **Report Log:** Displays the log of the errors that could happen during the generation of the final **Report** (you might be asked to send this log to the TEA|WiMAX Support Team to help troubleshooting).
- **TEA Log:** Displays the log of the errors that could happen whilst running the tool (you might be asked to send this log to the TEA|WiMAX Support Team to help troubleshooting).
- **TEA WiMAX EULA:** Displays the End User License Agreement (EULA) in PDF format
- **TEA WiMAX Release Notes:** Displays the Release Notes in PDF format containing information about known/late-breaking issues and possible workarounds for those issues.
- **TEA WiMAX User Guide:** Displays this document in PDF format
- **Uninstall:** Uninstalls all the application components from the PC. However, the existing project files will be saved in the *C:\Program Files\TEA-WiMAX\OLDPROJECTS* directory if you answer yes when asked with the “Do you want to preserve the existing project files” popup message. To recover these files after the application is installed again, move them manually from this directory to the *C:\Program Files\TEA-WiMAX\Apache\cgi-bin\TEA\data* directory.

4.2 Main Elements of the Graphic User Interface

The following table presents all main elements of the **TEA|WiMAX** Graphic User Interface and explains how to use them.

Table 2 – Main elements of the Graphic User Interface

Element	Function	Notes
	Input data box	To enter a value, you can write data directly in the box or you can enter data through the upward/downward buttons aside the box. A value can be entered in a data box also pasting the content of the clipboard (e.g., you can copy the content of a .xls cell and then paste it into the input data box).

	Output data box	To display an output. You cannot edit this box.
	Input text box	To enter a text, point your mouse inside the box and right click, delete the current text and edit the new text.
	Scroll-down Menu list	To view the option, click on the scroll-down menu list. To select one of the elements displayed in the scroll-down menu list, click on it. The currently selected choice is displayed on the menu list element and the scroll-down menu list is automatically closed. To hide the options click again on the scroll-down menu list.
	Check box	To select an option, check the box
	Radio button	To enable an option, select the button. In a list of radio buttons, the options are mutually exclusive: only one radio button at time can be enabled
	Play	To explore automatically the values of a range (you can change the lower and upper limits of the range)
	Table / Chart	When present, this buttons allow to display the real-time results of each section of the tool in tabular format or in graphical format, respectively
	Limits	To set the lower and upper limits of the range of values that can be automatically explored in the Scenario & Sensitivity Analysis.
	Print	To print the current screen.
	Save	To save the last modifications in the same project file, before moving on to another analysis step.
	Save As	To save the project file including the last modifications in a new file, before moving on to another analysis step. Do not use a project name which has been already used, unless you want

		to overwrite the existing project file.
Set-up	Set-up	To access the tool <i>Setup</i> pages where it is possible to manage the tool environment and perform the preliminary steps of a project configuration.
Report	Report	To generate a report, in the form of a web page, containing all the main results of the analyses.
Help	Help	To access to the on-line help pages that provide detailed explanations about all dialog boxes and a comprehensive definition of each parameter.
Exit	Exit	To exit and close the tool.

4.3 Sample Project

Please note that the screenshots in the next chapters refer to a sample project for a greenfield operator, fictitiously named “GreenMAX”, operating in an emerging Country.

When the TEA|WiMAX tool is installed, the “GreenMAX” sample project file is provided by default within the package and can be loaded in the tool selecting it from the list of existing projects in the scroll-down menu list. Please note that the “GreenMAX” sample project file is overwritten every time the TEA|WiMAX tool is updated or reinstalled after having uninstalled it.

If you wish, you can use the “GreenMAX” sample project as a starting project that you can modify with the specific data of your project. To preserve the original sample project file, you need to save your modified project file with a new name using the **Save As** button (note that there is no warning message displayed when you overwrite an existing project file).

The following table summarizes the main characteristics of the GreenMAX sample project.

Table 3 – GreenMAX sample project configuration

Parameter	Set to	Name
-----------	--------	------

Currency	€	
Unit of Length	Km	
Analysis Period (number of years)	8	
Areas	5	MAXCity1 MAXCity2 MAXCity3 MAXCity4 MAXCity5
Service Profiles	3	Personal Residential Business
Base Station Types	2	MIMO_BS DIV_BS
User Terminal Types	4	Out SU Ind SU Ind SU + wa USB Dongle

The three Service Profiles in the GreenMAX sample project were defined having in mind the following associations with the identified target market segments:

- “Personal” for Individuals
- “Residential” for Households
- “Business” for Micro Local Units

The access network of the GreenMAX sample project was dimensioned assuming the use of a Mobile WiMAX System Profile operating in the 3.5 GHz Band with a channel bandwidth of 10 MHz and supporting TDD as duplexing format

The two types of Base Stations defined in the GreenMAX sample project, fictitiously named “MIMO_BS” and “DIV_BS”, were both configured with three sectors.

The “MIMO_BS” Base Station was configured with an EIRP equal to 53 dBm with multiple antenna both at the transmitter and receiver side (MIMO 2x2) supporting both matrix A and Matrix B configuration (space time coding and spatial multiplexing respectively). A Base Station like “MIMO_BS” would be suitable for urban and suburban scenarios.

The "DIV_BS" Base Station was characterized by receive diversity and an EIRP also equal to 53 dBm. A Base Station like "DIV_BS" would be suitable for a rural scenario.

As far as Subscriber Units (SU), the "Out SU" was imagined to be equipped with a planar 15 dBi antenna with receive diversity; an SU like this would be well-suited for business users (Micro Local Units in this sample project).

The "Ind SU" was equipped with a 6 dBi antenna and would be well-suited, above all, for residential users, but also for business users.

The "Ind SU + wa" was imagined to be equipped with a 12 dBi window antenna and would be suitable for all the three market segments taken into account.

The "USB Dongle" solution was thought of only for the "Personal" service profile.

4.4 First Page

When launching the **TEA|WiMAX** software, the following *First* page will be shown (Figure 27), with three buttons in the lower part of the screen:

Enter: To enter the tool accessing by default the *Setup* pages where it is possible to manage the tool environment and perform the preliminary steps of a project configuration.

Help: To access to the on-line help pages that provide detailed explanations about all dialog boxes and a comprehensive definition of each parameter.

Exit: To exit and close the tool.

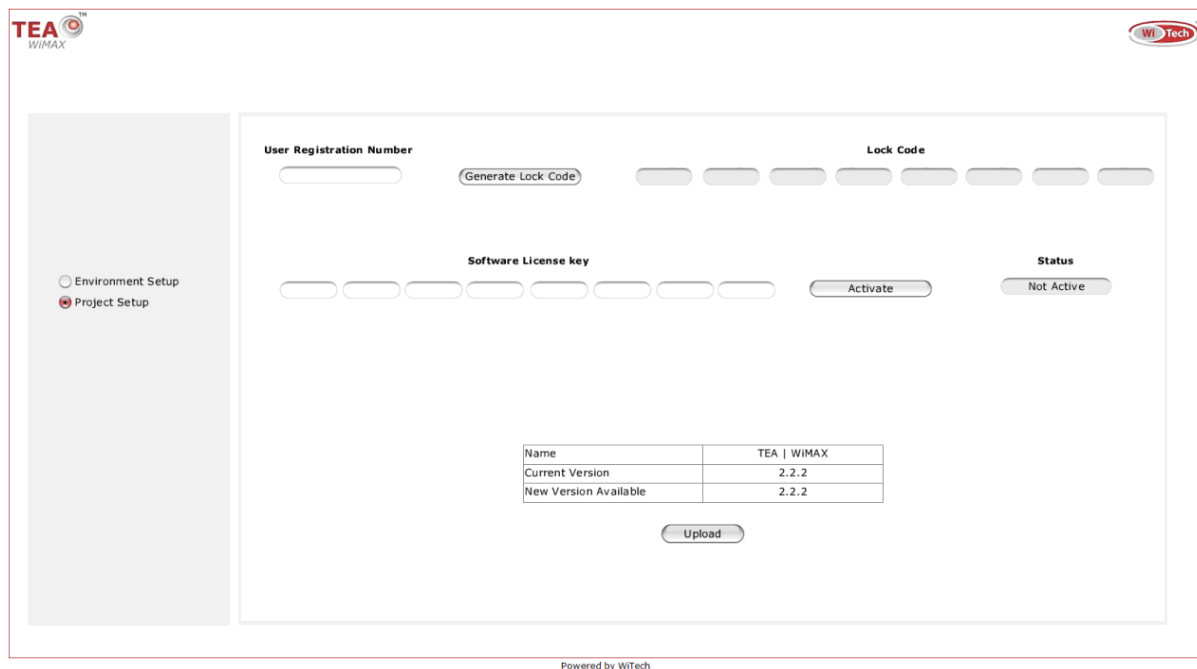


Figure 27 – First Page

4.5 Setup Pages

The *Setup* pages of the tool can be reached by default from the *First* page (clicking on the **Enter** button) as well as from all the analysis pages (clicking on the **Setup** button). There are two *Setup* pages, **Environment Setup** and **Project Setup**, that can be accessed enabling the corresponding radio buttons on the left side menu.

4.5.1 Environment Setup



Name	TEA WiMAX
Current Version	2.2.2
New Version Available	2.2.2

Figure 28 – Environment Setup

Software License Registration

After having installed the software on your PC (see Chapter 3), you must register your *Free Trial Software License* or *Permanent Software License* (being this your either first received license or a subsequent upgrade to it) in order to obtain the **Software License Key** that will allow the activation of the tool's choice of functional modules and that will enable the limit on the maximum number of Base Stations (*BS < 500* or *BS < 1500* or *BS Unlimited*) the license is granting you.

To perform a software license registration, make sure your PC is connected to Internet, access the *Environment Setup* page (Figure 28) and enter the **User Registration Number** in the corresponding input data box. The **User Registration Number** is a unique identifier assigned by WiTech to the Licensee of the **TEA|WiMAX** software for the purpose of administering the software license and the related *End User License Agreement (EULA)*. You should have received this identifier in the email with the instructions to download the software from a server or in a communication accompanying the recording media (CD-ROM, DVD, USB key, etc.) containing the software.

After having entered the **User Registration Number**, click the **Generate Lock Code** button. This will cause the tool to automatically display a **Lock Code** in the corresponding output data box. The **Lock Code** is a signature build of hardware parts or unique serial numbers of the system where the **TEA|WiMAX** software is being installed and will run.

In addition to the above, also the *TEA Software License Registration Webpage* at the URL <http://www.witech.it/teatool/activation/teaActivation.php> will be automatically opened on your PC (Figure 29) showing both the **User Registration Number** and the **Lock Code**.

You should then double enter your **email address** and click the **Generate License Key** button. This will cause your unique **Software License Key** to be displayed in the corresponding output data box of the *TEA Software License Registration Webpage*, as well as to have it sent to you by email at the provided address. For your record, you can also print the *Webpage* with all the relevant license data clicking on the **Print** button in the lower part of the page. Please, pay attention to *capital* and *small letters* when entering the **User Registration Number** and the **Software License Key**, because the tool is key sensitive; as well as be careful when cutting and pasting the **User Registration Number** and the **Software License Key** from the email.



TEA Software License Registration Webpage

Dear Customer, please use this Webpage to register your *Software License* and obtain the *Software License Key* for the activation of the TEA tool you have installed on your PC. Once the form below will be completed with your *email address*, *User Registration Number* and *Lock Code*, click the **Generate License key** button and your *Software License key* will be displayed on the Webpage as well as be sent to you by email at the provided address. For your record, you can also print the Webpage with all the relevant license data clicking on the **Print** button. Click on the **Help** button for more information.

email address

Confirm email address

User Registration Number

Lock Code

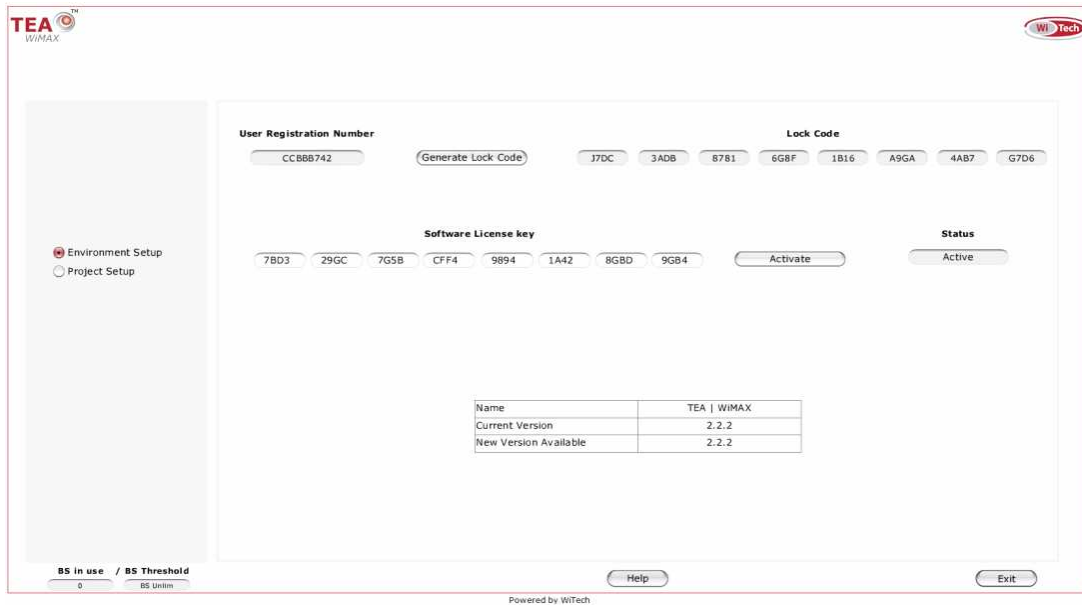
Software License Key

Figure 29 – TEA Software License Registration Webpage

If, for whichever reason, the *TEA Software License Registration Webpage* will not open automatically, enter the <http://www.witech.it/teatool/activation/teaActivation.php> address in your preferred web browser and open the page manually. In this case, in addition to your **email address**, you will need to enter the **User Registration Number** and the **Lock Code** manually and then click the **Generate License Key** button.

After having obtained your unique **Software License Key**, enter it in the corresponding input data box in the *Environment Setup page* of the tool and click the **Activate** button. After a few seconds, the **TEA|WiMAX** software should be activated and the message “Active” (Figure 30) should appear in the **Status** output data box.

If you reinstall the **TEA|WiMAX** software on your PC after having uninstalled it, you have only to enter the **User Registration Number** and the **Software License Key** into the *Environment Setup* page and, then, click the **Activate** button, without the need of following all the steps of the previous procedure.



Name	TEA WiMAX
Current Version	2.2.2
New Version Available	2.2.2

Figure 30 – Environment Setup after registration

After having installed the **TEA|WiMAX** software and registered its software license for the first time, successive reinstallations of the software using the same **Software License Key** are only possible on the same system that generated the original **Lock Code**.

License-Limited Maximum Number of Base Stations

After the successful registration of your software license and the activation of the software on your PC, in the lower left corner of each page of the tool, starting from the *Environment Setup* page, the two output data boxes labelled **BS in use** and **BS Threshold** (Figure 30) will show, respectively, the current total number of Base Stations the tool has automatically calculated with the loaded project (or that would have been manually set by you in the *Technical Analysis/Network Dimensioning* sub-module) and the maximum number of Base Stations (**BS < 500** or **BS < 1500** or **BS Unlimited**) your software license is granting you.

If you have a software license with a limited maximum number of Base Station (**BS < 500** or **BS < 1500**), the tool will not allow you to complete the business case analysis if the threshold is exceeded. In this case, the **Roll-out** button in the *Technical Analysis*, the **E&F Analysis** button to enter the *Economic & Financial Analysis*, the **S&S Analysis** button to enter the *Scenario & Sensitivity Analysis*, and the **Report** button to generate the final report will all be disabled (i.e., these buttons will not be displayed). To resume the tool's full set of functionalities, you will need to either reduce the

scope of your project, changing the setting of those parameters that have an impact on the resulting total number of Base Stations (for example, reducing the target extension of the geographical area to be analyzed, the target Population, the target number of Local Units, etc.) or purchase an upgrade of your software license that will raise the limit.

Software Update

A box in the lower part of the *Environment Setup* page (Figure 28) shows if the installed software is the latest available version. In case a new version is available, make sure your PC is connected to Internet, click on the **Update** button and an automatic update procedure will start.

The most common causes for a unsuccessful *Software Update* could be:

- o The internet connection is not active.
- o There are special or particularly stringent security settings (including firewalls and antivirus) preventing the software to access the network; in this case, seek the support of your IT department to change temporarily the security settings until the procedure completes successfully.

4.5.2 Project Setup

To start performing your analyses with the TEA|WiMAX tool, you need first to enable the **Project Setup** radio button and then enable either the **Create New Project** or **Load Existing Project** radio buttons to create a new project or open an existing project, respectively.

Create New Project

Enabling the **Create New Project** radio button (Figure 31) allows to define the name of the new project and configure the following parameters to set the environment for your analyses:

- **Currency:** To select the currency to be adopted during the analyses.
- **Unit of Length:** To select the unit of length (Kilometer or Mile) to be adopted during the analyses
- **Analysis Period (Years):** To define the analysis period (from 1 up to 10 years)
Note that to obtain a correct performance evaluation of all economic and financial outputs when creating a new project, it is necessary to set all input parameters (penetration rate, roll-out rate, churn rate etc.) for each year of the chosen analysis period.
- **Area:** To establish the number of geographical areas to be analyzed (from 1 up to 5 areas). During the analyses, the different areas will handled in parallel and independently

one from the others. The name of each geographical area can be edited (maximum length: 8 characters)

- **Service Profile:** To establish the number of service profiles to be used during the analyses (from 1 to 6 profiles). The name of each service profile can be edited (maximum length: 12 characters).
- **Base Station Types:** To establish the number of types of Base Station to be used during the analyses (from 1 to 3 types). The name of each type of Base Station can be edited (maximum length: 12 characters).
- **User Terminal Types:** To establish the number of types of User Terminal to be used during the analyses (from 1 to 6 types). The name of each type of user terminal can be edited (maximum length: 11 characters).
- **Show Save Reminder:** If the check box is selected, the following "save alert" message
"Remember to save if you want to apply your last modifications."

(To save, click Cancel and then Save.)"

will pop-up reminding you to perform a save whenever this action would be required (that is, before you will be moving on to another analysis step). When the pop-up is shown, if you have already saved your modifications (or if you do not want to save them) simply click on the **OK**, button and proceed; on the contrary, click on **Cancel** and then save the modifications in the same project, clicking on the **Save** button, or save them into a new project, clicking on the **Save As** button.

- **Save:** To save the project configuration
- **Start:** To start performing your analyses entering into the *Analysis* pages.

When you create a new project, you need to assign a name to it (Note that the default name of a new project is "NewProject"). Do not use a project name which has been already used, unless you want to overwrite the existing project file (note that there is no warning message displayed when you overwrite an existing project file).

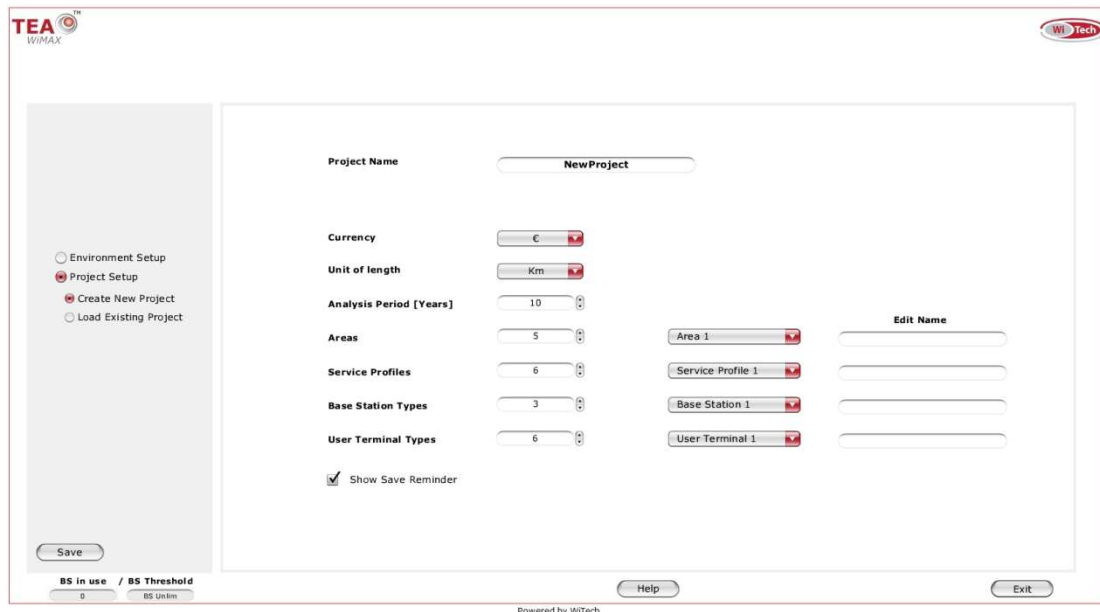


Figure 31 – Project Setup, Create New Project

Load an Existing Project

Enabling the **Load Existing Project** radio button allows to select an existing project through the scroll-down menu list. Once the project is selected, click on the **Load** button and the related existing set of configuration parameters will be shown in the main configuration area (Figure 32). You can modify existing values (see the *Create New Project* section above for a complete description of all parameters) and save them in the same project, clicking on the **Save** button, or save them into a new project, clicking on the **Save As** button (Note that no warning message is displayed when you overwrite an existing project file with the same file name). After this, click on **Start** to start performing your analyses entering into the *Analysis* pages.

Figure 32 – Project Setup, Load Existing Project

4.6 Analysis Pages

The *Analysis* pages can be reached clicking on the **Start** button in the *Project Setup* page.

The next four chapters provide a detailed description of all input and output parameters in the different *Analysis* pages:

- **Market Analysis**
- **Technical Analysis**
- **Economic & Financial Analysis**
- **Scenario & Sensitivity Analysis**

5 Market Analysis

To start performing the *Market Analysis*, select the corresponding **Market Analysis** button in the upper part of the *Analysis* page

5.1 Territorial Analysis

After having clicked on the **Territorial Analysis** button in the upper part of the page, the **Area** scroll-down menu list on the left side allows selecting a geographic area to be analyzed. The number of areas and the name of each area to be analyzed should have been set in the *Project Setup* page. For each area, it is possible to configure its characteristics enabling first the **Territory** and then the **Demography** radio buttons. The **Apply To All Areas** check box allows to apply the configuration of the selected area to all the other areas.

5.1.1 Territory



	Area [sq Km]	Total Area [sq Km]	Target Distribution [%]
Total	7,150.00	1,010.00	
Dense Urban	0.00	0.00	0.00%
Urban	1,250.00	125.00	12.38%
Suburban	2,600.00	390.00	38.61%
Rural	3,300.00	495.00	49.01%

Figure 33 – Territorial Analysis, Territory

After having selected a geographical area in the scroll-down menu list, enabling the **Territory** radio button (Figure 33) allows configuring the following parameters for that area:

- **Total Area [sq Km/mi]:** This input data box denotes the extension of the geographical area to be analyzed, measured in square Kilometers/miles. The area could be a region, a country or a town rather than a village. Its size should typically depend on the desired degree of precision of the results and on the accuracy of input data you have available to characterize the area.
 - **Distribution [%]:** This column of input data boxes denotes the distribution percentages of total area among *Dense Urban*, *Urban*, *Suburban* and *Rural* scenarios.
 - o **Dense Urban:** The inner area of larger cities with the highest population density, a lot of multiple tenant offices and residential buildings with great height.
 - o **Urban:** The inner area of cities with high population density and many multiple tenant offices and residential buildings.
 - o **Suburban:** The areas on the outskirts of cities with moderate population density, higher percentage of single family residences, business park and strip malls.
 - o **Rural:** Small cities and towns located far from the major metro areas with low population density, few offices and small businesses.
 - **Check [%]:** This output data box helps to properly set scenario distributions: the sum of scenario distribution percentages set in the same column above must be made equal to 100%. If the sum of scenario distributions is different from 100%, the check box will turn red alerting the user that the entered configuration is not correct. This parameter is calculated by the tool.
 - **Area [sq Km/mi]:** This column of output data boxes provides the extension of *Dense Urban*, *Urban*, *Suburban* and *Rural* areas. These parameters are calculated by the tool.
 - **Target Percentage [%]:** This column of input data boxes denotes the percentages of scenario extension to be served.
 - **Target Area [sq Km/mi]:** This column of output data boxes provides the scenario extension to be served. These parameters are calculated by the tool.
 - **Total Target Area [sq Km/mi]:** This output data box provides the total area to be served. This parameter is calculated by the tool.
 - **Target distribution [%]:** This column of output data boxes provides the weight (in percentage terms) of each scenario on the total area to be served. These parameters are calculated by the tool.
- Chart:** Shows total extension of the *Dense Urban*, *Urban*, *Suburban* and *Rural* areas and the related target to be covered at the end of the analysis period.

Table: Provides global results for total area analyzed: total area extension, total extension of *Dense Urban*, *Urban*, *Suburban* and *Rural* scenarios and the weight (in percentage terms) of each scenario on the total area to be covered.

5.1.2 Demography



	Number	Target Number
Total		
Population	1,647,000	1,222,600
Households	299,670	226,866
Local Units	49,738	37,653
Micro	49,738	37,653
Small	0	0
Medium	0	0
Large	0	0

Figure 34 – Territorial Analysis, Demography

After having selected a geographical **Area** in the scroll-down menu list, enabling the **Demography** radio button (Figure 34) allows configuring the following parameters for the market segments in that area:

- **Population:** Inhabitants that live in the analyzed area. These are considered as *Individuals* in the *Market Analysis* and usually are the target of “*Personal Broadband*” type of services.
- **Households:** Nuclear families that live in the analyzed area.
- **Local Units:** Headquarters or branches of enterprises and/or public and private institutions located in a geographically identified place in the analyzed area. *Local Units* are classified as *Micro*, *Small*, *Medium* and *Large*, depending on their number of employees:

- **Micro LU:** from 1 to 9 employees
 - **Small LU:** from 10 to 49 employees
 - **Medium LU:** from 50 to 249 employees
 - **Large LU:** more than 250 employees
- **Number:** This column of input data boxes denotes the size of the *Population* and the number of *Households*, *Micro*, *Small*, *Medium* and *Large Local Units* located in the considered area. Total *Number of Local Units* is an output data box and the parameter is calculated by the tool.
 - **Dense Urban Distribution [%]:** This column of input data boxes denotes the percentages of *Population*, *Households*, *Micro*, *Small*, *Medium* and *Large Local Units* located in *Dense Urban* scenario.
 - **Urban Distribution [%]:** This column of input data boxes denotes the percentages of *Population*, *Households*, *Micro*, *Small*, *Medium* and *Large Local Units* located in *Urban* scenario.
 - **Suburban Distribution [%]:** This column of input data boxes denotes the percentages of *Population*, *Households*, *Micro*, *Small*, *Medium* and *Large Local Units* located in *Suburban* scenario.
 - **Rural Distribution [%]:** This column of input data boxes denotes the percentages of *Population*, *Households*, *Micro*, *Small*, *Medium* and *Large Local Units* located in *Rural* scenario.
 - **Check [%]:** This column of output data boxes helps to properly set scenario distributions: the sum of scenario distribution percentages in the same row must be made equal to 100%. If the sum of scenario distribution is different from 100%, the check box will turn red alerting the user that the entered configuration is not correct. These parameters are calculated by the tool.
 - **Target Percentage [%]:** This column of input data boxes denotes the percentages of *Population*, *Households*, *Micro*, *Small*, *Medium* and *Large Local Units* to be served.
 - **Target Number:** This column of output data boxes provides the size of the *Population* and the number of *Households*, *Micro*, *Small*, *Medium* and *Large Local Units* to be served. These parameters are calculated by the tool

Chart: Shows the number of *Population*, *Households*, *Micro*, *Small*, *Medium* and *Large Local Units* and the related target to be served at the end of the analysis period.

Table: Provides global results for all area analyzed: total size of the *Population*, and total number of *Households*, *Micro*, *Small*, *Medium* and *Large Local Units* and total target to be served.

5.2 Service Profile

After having clicked on the **Service Profile** button on the upper part of the page, the **Service Profile** scroll-down menu list on the left side allows selecting the service profile to be defined. The number of service profiles and the name of each service profile to be defined should have been set in the *Project Setup* page. For each service profile it is possible to define its key characteristics, enabling the **Characterization** radio button, and the assigned distribution on the different market segments (*Individuals*, *Households* and *Local Units*), enabling the **Distribution Rates** radio button.

5.2.1 Characterization

The screenshot displays the 'Service Profile' configuration window for 'Personal'. The 'Characterization' radio button is selected. The interface is divided into several sections:

- Navigation Tabs:** Market Analysis, Technical Analysis, E&F Analysis, S&S Analysis, Territorial Analysis, **Service Profile**, Market Forecast, Revenues.
- Service Profile:** Personal (selected from a dropdown).
- Characterization Options:**
 - ☒ Characterization
 - ☐ Distribution Rates
- Internet Access:**
 - PIR [Mbps]: 1.024 (Down Link), 0.064 (Up Link)
 - CIR [Mbps]: 0.256 (Down Link), 0.016 (Up Link)
 - Lines per User: 0
 - Coding Algorithm: G.729a - 8 kbps (20 ms)
 - VAD: ☒
 - Bandwidth per Line [Kbps]: 19.60
- Monthly Service Fee:**
 - Internet Access - Y1 [€]: 18.00
 - VoIP - Y1 [€]: 0.00
 - Total - Y1 [€]: 18.00
 - Annual Variation [%]: -5.00
- One Time Activation Fee - Y1 [€]:**
 - Out SU: 300.00
 - Ind SU: 80.00
 - Ind SU + wa: 100.00
 - USB Dongle: 90.00
- Monthly Lease Fee - Y1 [€]:**
 - Out SU: 4.00
 - Ind SU: 4.00
 - Ind SU + wa: 4.00
 - USB Dongle: 0.00
- Annual Variation [%] for Fees:**
 - Out SU: -5.00
 - Ind SU: -5.00
 - Ind SU + wa: -5.00
 - USB Dongle: 0.00
- Buttons:** Print, Save, Save As, Setup, Report, Help, Exit.
- Status:** BS in use / BS Threshold 110 / BS Utilization.
- Footer:** Powered by WiTech

Figure 35 – Service Profile, Characterization

After having selected a service profile in the scroll-down menu list, enabling the **Characterization** radio button (Figure 35) allows configuring the service characteristics of both the *Internet Access* and *VoIP* services for that profile:

- **PIR [Mbps] – Internet Access:** This input data box denotes the *Peak Information Rate (PIR)*, that is, the maximum allowable data rate that a user may experiment in Down Link / Up Link during non-busy hours.
- **CIR [Mbps] – Internet Access:** This input data box denotes the *Committed Information Rate (CIR)*, that is the minimum bandwidth that is guaranteed to work under normal conditions; at any time the bandwidth should not fall below this limit.

- **Lines per Users – VoIP:** This input data box denotes the average number of VoIP lines needed by each user.
- **Coding Algorithm:** This scroll-down menu list allows selecting the Coding Algorithm (combination of VoIP codec/packet sample period/etc.) to be supported. If your preferred coding algorithm is not present in the list, select “Custom” and enter the your choice of Bandwidth (in kbps) in the *Bandwidth per Line* data box
- **VAD:** When this check box is selected, the *Voice Activity Detection (VAD)* technique is implemented that allows a data network carrying VoIP traffic to detect the absence of audio to prevent the encoding of "silent packets" over the network. Most conversations, in fact, include about 50% silence; VAD (also called "silence suppression") allows saving on network bandwidth. When this option is selected, only half the throughput normally required by the chosen *Coding Algorithm* is taken into account for network dimensioning.

Table 4 summarizes the technical features of the *Coding Algorithms* supported by the tool.

Table 4 – Supported Coding Algorithms

Coding Algorithm	Bandwidth per line [kbps]
G.711 - 64 kbps (20 ms)	95.2
G.722 - 32 kbps (20 ms)	82.4
G.722.1 - 16 kbps (20 ms)	48.8
G.723.1A 5.3 kbps (30 ms)	25.8
G.723.1A - 6.4 kbps (30 ms)	27.2
G.726 - 32 kbps (20 ms)	63.2
G.728 - 16 kbps (10 ms)	78.4
G.729a - 8 kbps (20 ms)	39.2
AMR - 4.75 kbps (20 ms)	35.6
AMR - 7.4 kbps (20 ms)	38.4
AMR - 12.2 kbps (20 ms)	43.2
AMR - 6.6 kbps (20 ms)	37.6
Custom	To be defined by the user

- **Bandwidth per Line [kbps]:** This output data box provides the bandwidth at the interface between Ethernet and IP layers needed for each VoIP line depending on the selected *Coding Algorithm*. When the *Custom* coding algorithm is selected, this will become an input data box where to enter your choice of bandwidth (in kbps) needed for each VoIP line.

- **Monthly Service Fee (Y1 – Annual Variation[%]):** This row of input parameters allow setting the monthly fee for the selected service profile. The fee is characterized by the monthly cost at the first year of the analysis period related to both Internet Access and VoIP services and by an annual variation as a percentage on the total monthly cost (which is provided in the output data box). The annual variation can be either positive (increase) or negative (decrease).
- **One Time – Activation Fee (Y1 – Annual Variation[%]):** This two columns of input data boxes denotes the one-time fees to activate the selected service profile with each type of User Terminal. Each fee is characterized by the cost at first year of the analysis period and an annual variation as percentage on it. The annual variation can be either positive (increase) or negative (decrease).
- **Monthly – Lease Fee (Y1 – Annual Variation[%]):** These two columns of input data boxes denotes the monthly fees to lease each type of User Terminal for the selected service profile. Each fee is characterized by the cost at first year of the analysis period and the annual variation as percentage on it. The annual variation can be either positive (increase) or negative (decrease).

5.2.2 Distribution Rates

The screenshot displays the TEA WiMAX software interface. On the left, a sidebar shows 'Service Profile' set to 'Personal' and 'Distribution Rates' selected. The main area is divided into tabs: 'Market Analysis', 'Technical Analysis', 'E&F Analysis', and 'S&S Analysis'. Under 'Technical Analysis', there are sub-tabs for 'Territorial Analysis', 'Service Profile', 'Market Forecast', and 'Revenues'. The 'Service Profile' sub-tab is active, showing a table of distribution rates for 'Individuals', 'Households', and 'Local Units' (Micro, Small, Medium, Large). Each row has input fields for 'Distribution [%]' and 'Check [%]'. Below the table, two bar charts are shown: 'Service Profile Distribution' and 'User Terminal Distribution'. The 'Service Profile Distribution' chart shows the distribution of 'Personal' and 'Business' profiles across 'Individuals', 'Households', and 'Local Units'. The 'User Terminal Distribution' chart shows the distribution of 'Out SU', 'Ind SU', 'Ind SU + wa', and 'USB Dongle' across 'Individuals', 'Households', and 'Local Units'. At the bottom, there are buttons for 'Print', 'Save', 'Save As', 'Setup', 'Report', 'Help', and 'Exit'.

Figure 36 – Service Profile, Distribution Rates

After having selected a service profile in the scroll-down menu list, enabling the **Distribution Rate** radio button (Figure 36) allows configuring the assigned distribution rates of that profile on each

market segment, defined as **Individuals, Households, Local Units - Micro, Local Units - Small, Local Units - Medium, Local Units - Large**:

- **Distribution [%]:** This column of input data boxes denotes the percentage of *Individuals, Households, Micro Local Units, Small Local Units, Medium Local Units* and *Large Local Units* associated to each Service Profile.
- **Check [%]:** This column of output data boxes (second from the left) helps to properly set service profile distribution: the sum of service profile distribution percentages related to each market segment must be made equal to 100%. If the sum of service profile distribution is different from 100%, the check box will turn become red alerting the user that the entered configuration is not correct. These parameters are calculated by the tool.
- **User Terminals Distributions [%]:** This row of input data boxes denotes the User Terminal distribution related to the selected service profile per each market segment.
- **Check [%]:** This column of output data boxes (last on the right) helps to properly set User Terminal distribution: the sum of User Terminal distributions related to a market segment on the same row must be equal to 100% per each service profile. If the sum of User Terminal distribution is different from 100%, the check box will turn red alerting the user that the entered configuration is incorrect. These parameters are calculated by the tool.

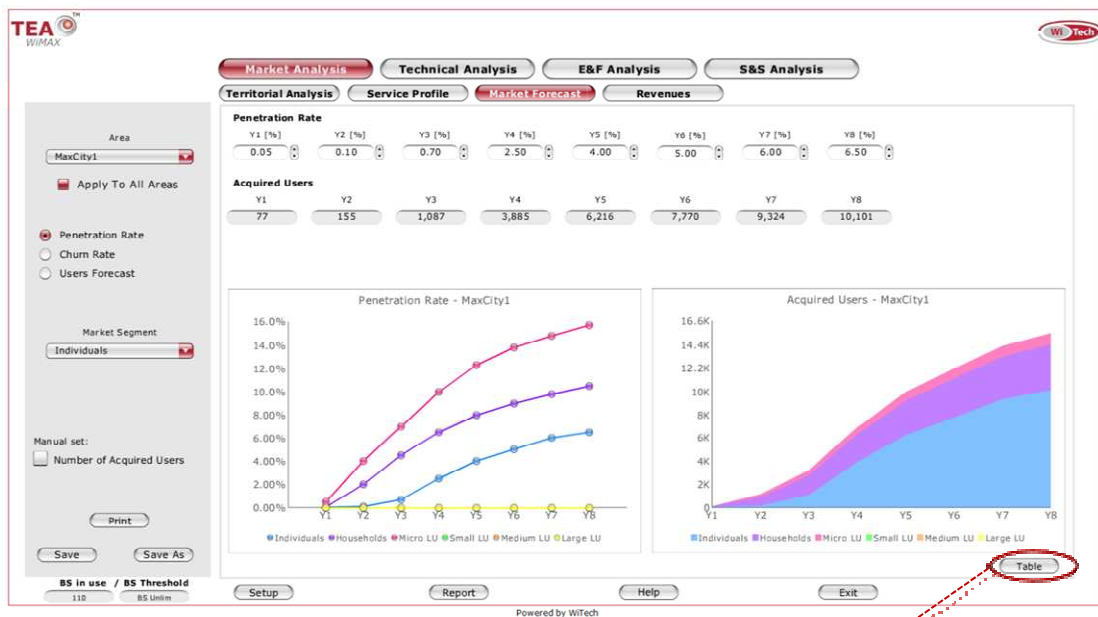
Chart-“Service Profile Distribution”: Shows the distribution of Service Profiles on each market segment.

Chart-“User Terminal Distribution”: Shows the distribution of User Terminals on each market segment.

5.3 Market Forecast

After having clicked on the **Market Forecast** button on the upper part of the page, selecting a geographical **Area** and then a **Market Segment** in the corresponding scroll-down menu lists (Figure 21) allows to perform a market forecast for that combination enabling first the **Penetration Rate** and then the **Churn Rate** radio buttons. Finally enabling the **Users Forecast** radio button will open an output page which provides the results on users forecast.

5.3.1 Penetration Rate



	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
MaxCity1								
Individuals								
Acquired Users	77	155	1,087	3,885	6,216	7,770	9,324	10,101
Lost Users	8	23	129	505	1,076	1,745	2,503	3,263
Net Users	69	132	958	3,380	5,140	6,025	6,821	6,838
Households								
Acquired Users	18	742	1,671	2,414	2,971	3,343	3,640	3,900
Lost Users	2	76	236	454	706	970	1,237	1,503
Net Users	16	666	1,435	1,960	2,265	2,373	2,403	2,397
Local Units								
Acquired Users	30	246	431	616	758	850	912	968
Lost Users	2	22	55	100	153	209	265	321
Net Users	28	224	376	516	605	641	647	647
Acquired Users	125	1,143	3,189	6,915	9,945	11,963	13,876	14,969
Lost Users	12	121	420	1,059	1,935	2,924	4,005	5,087
Net Users	113	1,022	2,769	5,856	8,010	9,039	9,871	9,882

Figure 37 – Market Forecast, Penetration Rate

After having selected a geographical **Area** and a **Market Segment** (*Individuals, Households and Local Units*) in the respective scroll-down menu lists, enabling the **Penetration Rate** radio button (Figure 37) allows configuring the following parameters for that combination:

- **Penetration Rate [%]:** This row of input data boxes denotes the target percentage of forecasted users (irrespective of churn, which effect will be determined setting the specific parameter – see section 5.3.2) on the target market segment, per each year of the analysis period.
- **Acquired Users:** This row of output data boxes provides the number of forecasted users on the target market segment (irrespective of churn, which effect will be determined setting the specific parameter – see section 5.3.2) per each year of the analysis period. These parameters are automatically calculated by the tool.

Manual Set - Number of Acquired Users



MaxCity1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Individuals								
Acquired Users	77	155	1,087	3,885	6,216	7,770	9,324	10,101
Lost Users	8	23	129	505	1,076	1,745	2,503	3,263
Net Users	69	132	958	3,380	5,140	6,025	6,821	6,838
Households								
Acquired Users	18	742	1,671	2,414	2,971	3,343	3,640	3,900
Lost Users	2	76	236	454	706	970	1,237	1,503
Net Users	16	666	1,435	1,960	2,265	2,373	2,403	2,397
Local Units								
Acquired Users	30	246	431	616	758	850	912	968
Lost Users	2	22	55	100	153	209	265	321
Net Users	28	224	376	516	605	641	647	647
Acquired Users	125	1,143	3,189	6,915	9,945	11,963	13,876	14,969
Lost Users	12	121	420	1,059	1,915	2,924	4,005	5,087
Net Users	113	1,022	2,769	5,856	8,030	9,039	9,871	9,882

Figure 38 – Market Forecast, Penetration Rate, Manual Set

Checking the **Manual Set - Number of Acquired Users** option (Figure 38) allows manually setting the number of forecasted acquired users on the selected geographical **Area / Market Segment** combination:

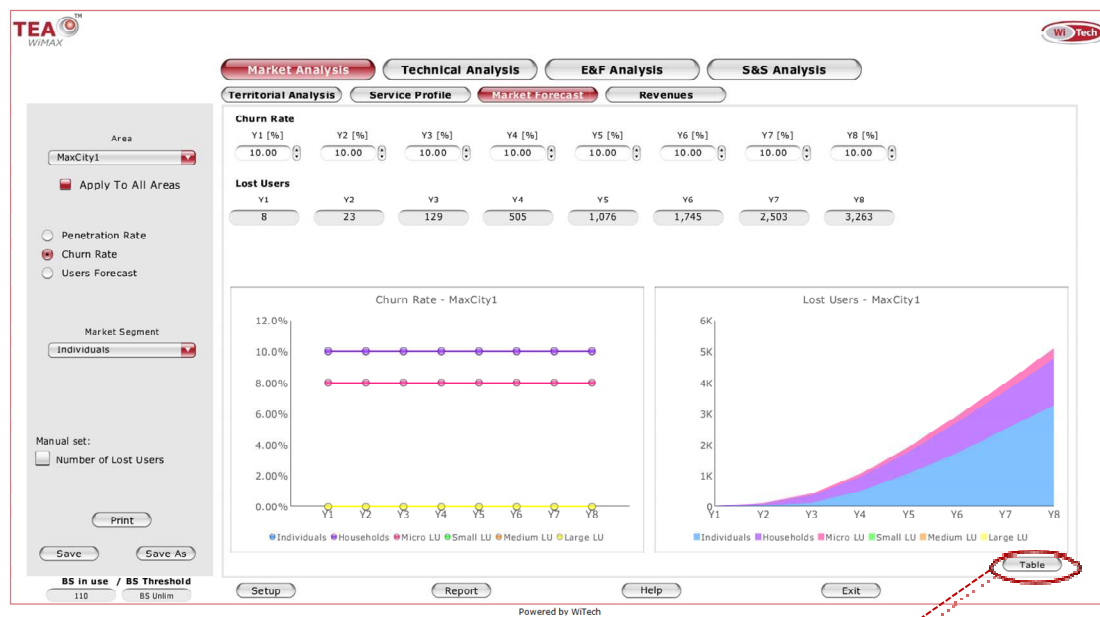
- Acquired Users – Suggested Values:** This row of output data boxes provides the number of forecasted acquired users per each year of the analysis period calculated automatically by the tool considering the input penetration rate (see above). These results can be used as a guideline to manually set forecasted acquired users.
- Acquired Users:** This row of input data boxes denotes the number of forecasted acquired users per each year of the analysis period (this should be irrespective of churn, which effect will be determined setting the specific parameter – see section 5.3.2). This row of input data boxes is pre-set with the values calculated automatically by the tool the first time this page is opened.

Chart – “Penetration Rate”: Shows penetration curves for all areas.

Chart – “Acquired Users”: Shows temporal evolution of acquired users number for all areas.

Table: Provides the number of *Acquired*, *Lost* and *Net Users* for *Individuals*, *Households* and *Local Units* per each year of the analysis period.

5.3.2 Churn Rate



	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
MaxCity1								
Individuals								
Acquired Users	77	155	1,007	3,893	6,216	7,770	9,324	10,101
Lost Users	8	23	129	505	1,076	1,745	2,503	3,263
Net Users	69	132	958	3,389	5,140	6,025	6,821	6,838
Households								
Acquired Users	18	742	1,671	2,414	2,971	3,343	3,640	3,900
Lost Users	2	76	236	454	706	970	1,237	1,503
Net Users	16	666	1,435	1,960	2,265	2,373	2,403	2,397
Local Units								
Acquired Users	30	246	431	616	758	850	912	968
Lost Users	2	22	55	100	153	209	265	321
Net Users	28	224	376	516	605	641	647	647
Acquired Users	125	1,143	3,189	6,915	9,945	11,963	13,876	14,969
Lost Users	12	171	420	1,059	1,811	2,924	4,006	5,087
Net Users	113	1,022	2,769	5,856	8,010	9,039	9,871	9,882

Figure 39 – Market Forecast, Churn Rate

After having selected a geographical **Area** and a **Market Segment** (*Individuals*, *Households* and *Local Units*) in the respective scroll-down menu lists, enabling the **Churn Rate** radio button (Figure 39) allows configuring the following parameters for that combination:

- **Churn Rate [%]:** This row of input data boxes denotes the percentage of acquired users that are forecasted to discontinue their use of service per each year of the analysis period.

- **Lost Users:** This row of output data boxes provides the number of forecasted users that are forecasted to discontinue their use of service per each year of the analysis period. These parameters are automatically calculated by the tool using the Churn Rate.

Manual Set - Number of Lost Users



	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
MaxCity1								
Individuals								
Acquired Users	77	135	1,087	3,883	6,216	7,770	9,324	10,101
Lost Users	8	23	129	505	1,076	1,745	2,503	3,263
Net Users	69	112	958	3,380	5,140	6,025	6,821	6,838
Households								
Acquired Users	18	742	1,671	2,414	2,971	3,343	3,640	3,900
Lost Users	2	76	236	454	706	970	1,237	1,503
Net Users	16	666	1,435	1,960	2,265	2,373	2,403	2,397
Local Units								
Acquired Users	30	246	431	616	758	850	912	968
Lost Users	2	22	55	100	153	209	265	321
Net Users	28	224	376	516	605	641	647	647
Acquired Users	125	1,143	3,189	6,915	9,945	11,963	13,876	14,969
Lost Users	17	151	470	1,076	1,935	2,924	4,005	5,087
Net Users	113	1,022	2,769	5,856	8,010	9,039	9,871	9,882

Figure 40 – Market Forecast, Churn Rate, Manual Set

Checking the **Manual Set - Number of Lost Users** option (Figure 40) allows manually setting the number of forecasted lost users on the selected area/market segment combination:

- **Lost Users – Suggested Values:** This row of output data boxes provides the number of forecasted lost users per each year of the analysis period calculated automatically by the tool considering the input churn rate. These results can be used as a guideline to manually set forecasted lost users.
- **Lost Users:** This row of input data boxes denotes the number of forecasted lost users per each year of the analysis period. This row of input data boxes is pre-set with the values calculated automatically by the tool the first time this page is opened.

Chart – “Churn”: Shows churn curves for all market segments.

Chart – “Lost Users”: Shows temporal evolution of lost users for all market segments.

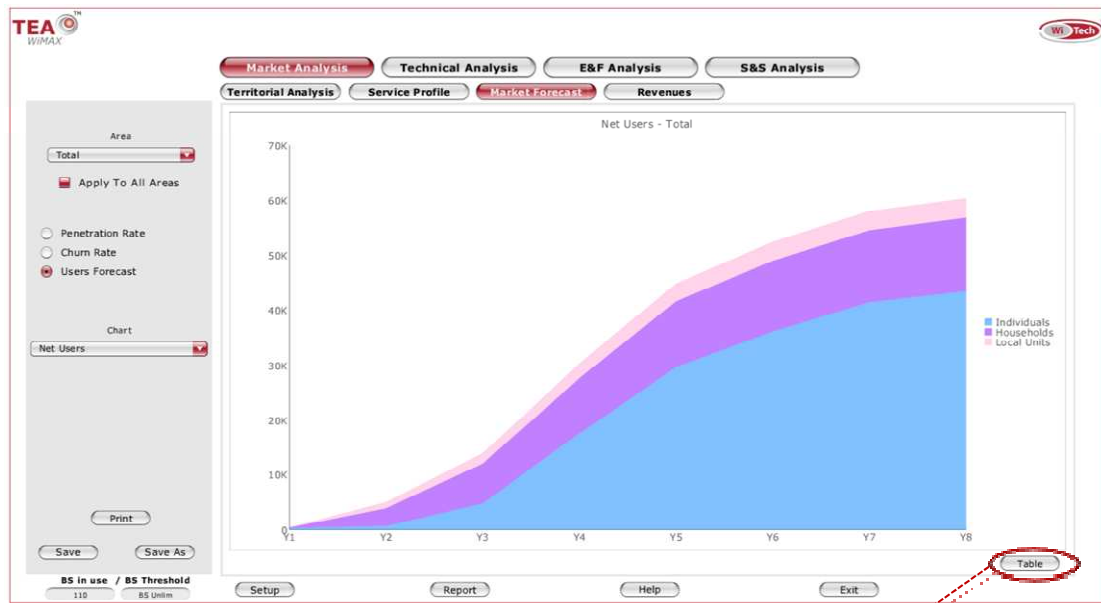
Table: Provides the number of *Acquired*, *Lost* and *Net Users* for *Individuals*, *Households* and *Local Units* per each year of the analysis period.

5.3.3 Users Forecast

After having selected a geographical **Area** in the scroll-down menu list, enabling the **Users Forecast** radio button opens an output page which presents the results on users forecast.

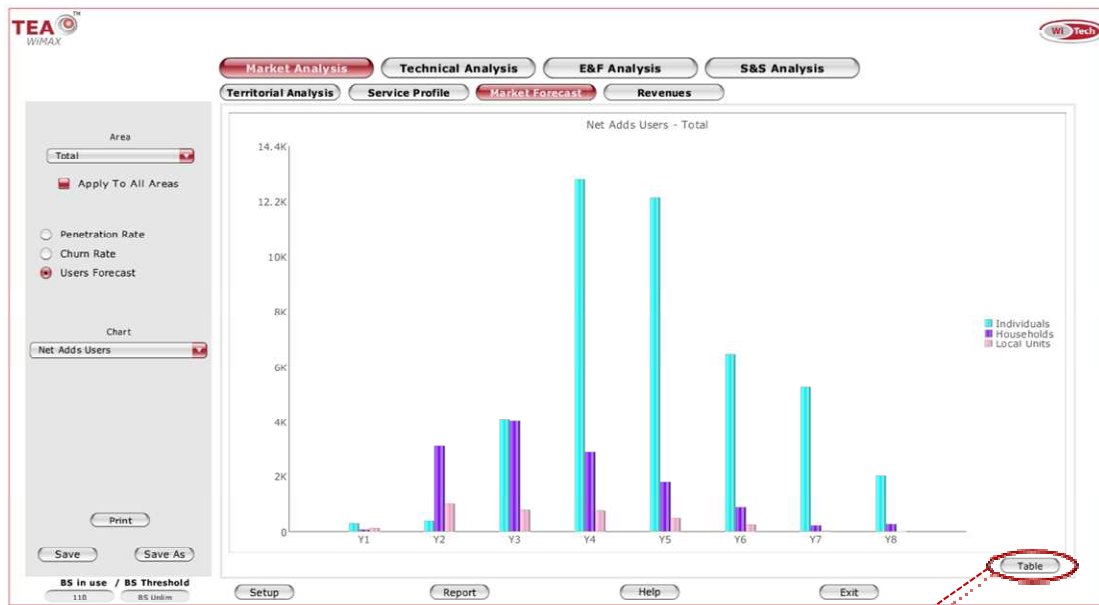
The **Chart** scroll-down menu list allows selecting the chart to visualize:

- **Net Users:** Shows temporal evolution of effective number of *Individuals*, *Households* and *Local Units* in the network (Figure 41).
- **Net Adds Users:** Shows number of adds for *Individuals*, *Households* and *Local Units* per each year (Figure 42)
- **Net Users per Service Profile:** Shows distribution of users on a specific market segment among the service profile offered. A **Market Segment** scroll-down menu list allows selecting the chart related to the market segment to display (Figure 43).



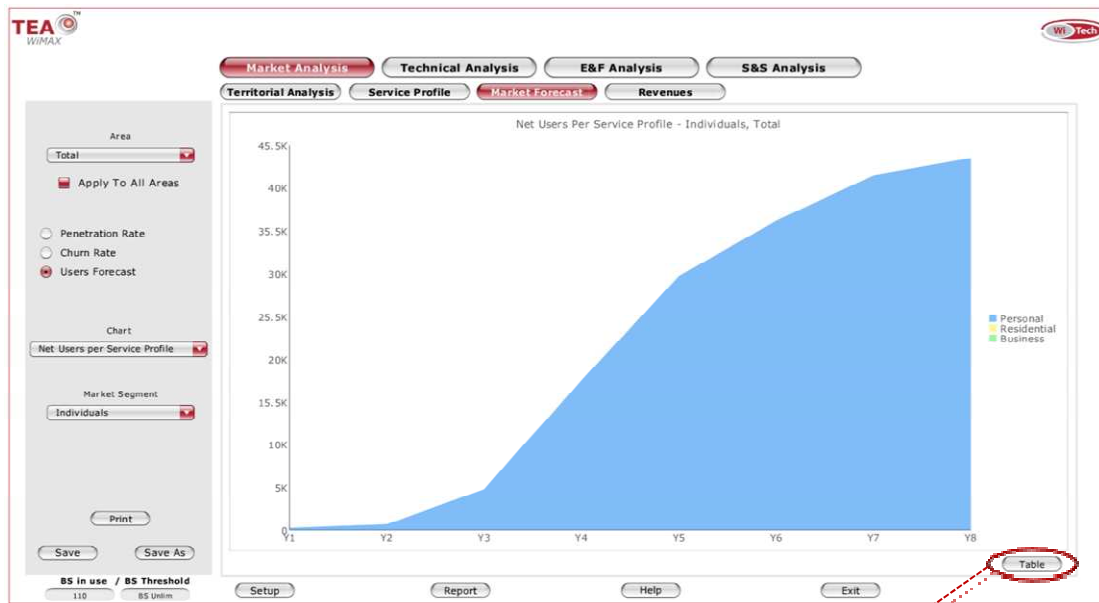
Total	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Individuals								
Personal	290	707	4,809	17,619	26,755	36,214	41,514	43,532
Residential	0	0	0	0	0	0	0	0
Business	0	0	0	0	0	0	0	0
Net Users	290	707	4,809	17,619	26,755	36,214	41,514	43,532
Net Adds Users	290	417	4,102	12,810	12,136	6,459	5,300	2,018
Households								
Personal	0	0	0	0	0	0	0	0
Residential	92	3,190	7,219	10,114	11,918	12,813	13,049	13,328
Business	0	0	0	0	0	0	0	0
Net Users	92	3,190	7,219	10,114	11,918	12,813	13,049	13,328
Net Adds Users	92	3,098	4,039	7,895	1,904	895	336	385
Local Units								
Personal	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0
Business	134	1,143	1,928	2,715	3,024	3,479	3,507	3,521

Figure 41 – Market Forecast, Users Forecast, Net Users



Total	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Individuals								
Personal	290	707	4,899	17,619	29,755	36,214	41,514	43,532
Residential	0	0	0	0	0	0	0	0
Business	0	0	0	0	0	0	0	0
Net Users	290	707	4,899	17,619	29,755	36,214	41,514	43,532
Net Adds Users	290	417	4,102	12,810	12,136	6,459	5,300	2,018
Households								
Personal	0	0	0	0	0	0	0	0
Residential	92	3,190	7,219	10,114	11,918	12,813	13,049	13,328
Business	0	0	0	0	0	0	0	0
Net Users	92	3,190	7,219	10,114	11,918	12,813	13,049	13,328
Net Adds Users	92	3,098	4,039	7,895	1,804	895	736	795
Local Units								
Personal	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0
Business	124	1,543	1,928	2,713	2,024	2,479	2,507	2,521

Figure 42 – Market Forecast, Users Forecast, Net Adds Users



Total	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Individuals								
Personal	290	707	4,899	17,619	29,755	36,214	41,514	43,532
Residential	0	0	0	0	0	0	0	0
Business	0	0	0	0	0	0	0	0
Net Users	290	707	4,899	17,619	29,755	36,214	41,514	43,532
Net Add'l Users	290	417	4,102	12,810	12,136	6,459	5,300	2,818
Households								
Personal	0	0	0	0	0	0	0	0
Residential	92	3,190	7,219	10,114	11,918	12,813	13,049	13,328
Business	0	0	0	0	0	0	0	0
Net Users	92	3,190	7,219	10,114	11,918	12,813	13,049	13,328
Net Add'l Users	92	3,098	4,000	7,895	1,804	865	736	785
Local Units								
Personal	0	0	0	0	0	0	0	0
Residential	0	0	0	0	0	0	0	0
Business	134	1,543	1,928	2,713	2,224	2,479	2,507	2,321

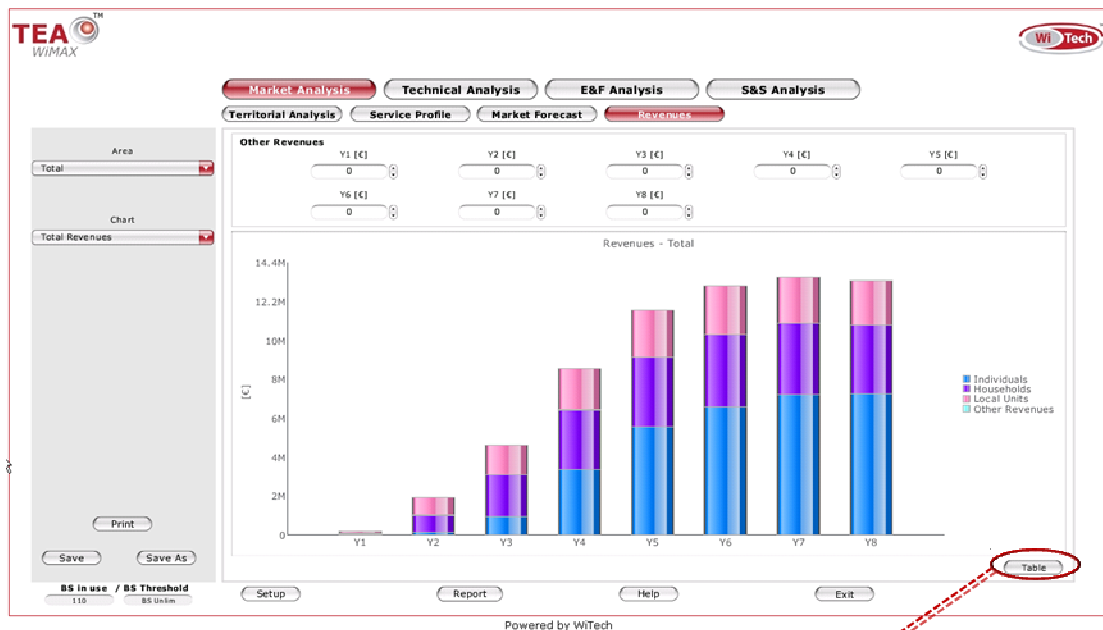
Figure 43 – Market Forecast, Users Forecast, Net Users Per Service Profile

Table: Provides a complete view of *Individuals*, *Households* and *Local Units* users distribution per service profile per each year of the analysis period.

5.4 Revenues

Having selected *Total* in the **Scenario** scroll-down menu list (Figure 44) will enable you to configure the following parameter:

- **Other Revenues:** This row of input data boxes denotes other possible incomes.



Total	Y1	Y2	Y3	Y4	Y5	Y6
Revenues per Individuals						
Service Fee [€]	31,329	190,292	337,645	2,676,734	4,167,233	5,512,939
Activation Fee [€]	29,716	43,359	385,313	1,184,957	1,117,265	766,333
Lease Fee [€]	5,792	4,738	25,950	184,457	218,435	301,832
Total Revenues per Individuals [€]	62,428	158,389	748,908	3,246,148	5,542,833	6,581,105
Revenues per Households						
Service Fee [€]	15,014	508,841	1,533,123	2,425,294	2,638,657	3,133,057
Activation Fee [€]	8,772	281,947	375,036	294,412	219,249	154,318
Lease Fee [€]	2,199	74,839	221,459	39,681	439,885	459,273
Total Revenues per Households [€]	25,994	865,628	2,133,618	3,078,389	3,578,591	3,746,648
Revenues per Local Units						
Service Fee [€]	52,260	473,870	1,085,139	1,355,853	1,886,568	2,022,795
Activation Fee [€]	51,649	375,184	395,648	361,719	225,498	151,983
Lease Fee [€]	8,040	72,803	146,944	279,382	290,241	311,199
Total Revenues per Local Units [€]	111,249	921,957	1,527,731	1,796,954	2,402,307	2,485,977
Service Fee [€]	58,394	1,285,053	3,155,904	6,857,803	8,162,518	10,689,771
Activation Fee [€]	89,328	696,481	1,068,454	1,787,088	1,652,811	1,012,635
Lease Fee [€]	11,640	152,470	418,353	700,480	939,261	1,071,604
Total Revenues [€]	199,762	1,933,954	4,639,913	8,325,470	11,524,730	12,783,618

Figure 44 – Revenues, Total Revenues

The **Chart** menu list allows selecting one of the available charts:

- **Total Revenues:** Shows temporal evolution of forecasted revenues for *Individuals*, *Households* and *local units* (Figure 44).
- **Revenues per Market Segment:** Shows temporal evolution of forecasted revenues for each market segment with details on revenues source. A **Market Segment** menu list allows selecting the chart related to market segment to display (Figure 45).

Table: Provides a summary of all Revenues for *Individuals*, *Households* and *Local Units* detailing revenues sources.



	Y1	Y2	Y3	Y4	Y5	Y6
Total						
Revenues per Individuals						
Service Fee (\$)	31,320	183,280	837,848	2,076,784	4,187,323	8,512,930
Activation Fee (\$)	29,768	43,150	385,910	1,184,957	1,187,365	746,323
Lease Fee (\$)	1,392	4,738	23,950	104,457	218,435	301,832
Total Revenues per Individuals (\$)	62,480	150,289	948,698	3,246,188	5,542,833	9,560,285
Revenues per Households						
Service Fee (\$)	15,014	506,841	1,531,320	2,435,284	2,628,157	3,121,267
Activation Fee (\$)	8,772	281,947	378,036	298,412	219,249	154,318
Lease Fee (\$)	3,289	74,833	225,439	398,461	439,685	439,273
Total Revenues per Households (\$)	25,994	863,618	2,134,815	3,078,269	3,578,391	3,714,648
Revenues per Local Units						
Service Fee (\$)	32,360	473,870	1,085,139	1,555,853	1,886,368	2,622,795
Activation Fee (\$)	91,040	371,184	359,688	395,719	226,498	151,883
Lease Fee (\$)	3,040	32,953	146,944	239,363	299,241	311,199
Total Revenues per Local Units (\$)	111,240	917,997	1,691,692	2,190,924	2,412,107	2,485,977
Service Fee (\$)	88,104	1,081,803	3,115,304	6,837,923	8,198,108	10,689,971
Activation Fee (\$)	89,328	696,481	1,261,604	1,787,588	1,602,811	1,282,635
Lease Fee (\$)	31,640	132,470	418,353	709,480	939,361	1,071,604
Total Revenues (\$)	199,762	1,910,754	4,809,913	8,535,470	11,524,739	12,783,010

Figure 45 – Revenues, Revenues per Market Segment

6 Technical Analysis

To start performing the *Technical Analysis*, select the corresponding **Technical Analysis** button in the upper part of the *Analysis* page. As a help to perform the *Technical Analysis*, a number of relevant parameters in this module are, by default, pre-set to typical/recommended values when you create a new project. You can change these values at any time during the analysis. A summary of the pre-set parameters and their default values is provided in Chapter 9.

6.1 Technology

After having clicked on the **Technology** button in the upper part of the page, it is possible to configure the technological characteristics of the WiMAX network enabling first the **Characterization Step 1** radio button and then the **Characterization Step 2** radio button on the left side.

6.1.1 Characterization Step 1



Figure 46 – Technology, Characterization Step 1, Mobile WiMAX System Profile

Enabling the **Characterization Step 1** radio button (Figure 46) allows configuring the following parameters:

- **System Profile:** This scroll-down menu list allows selecting a system profile choosing between the WiMAX Forum's *Fixed WiMAX* and *Mobile WiMAX* system profiles. For both system profiles, a default combination of *Certification Profile*, *Frequency Band*, *Channel Bandwidth*, *Duplexing* is shown the first time this page is opened for a newly created project. You can set your project combination for the currently selected system profile at any time during the analysis session. Moving from one system profile to the other in the scroll-down menu list will restore the default combination.

Default system profile combinations

- **Fixed WiMAX**
Frequency Band: 3.5 GHz
Channel Bandwidth: 3.5 MHz
Duplexing: TDD
- **Mobile WiMAX**
Frequency Band: 3.5 GHz
Channel Bandwidth: 10 MHz
Duplexing: TDD
- **Certification Profile:** This scroll-down menu list allows selecting a certification profile related to the selected WiMAX Forum's system profile. All certification profiles approved by the WiMAX Forum are available; moreover, it is possible to define a *Custom* certification profile for both WiMAX Forum's *Fixed WiMAX* and *Mobile WiMAX* system profiles. Selecting the *Custom* certification profile in the scroll-down menu list allows to customize the WiMAX technology settings.
- **Frequency Band [GHz]:** This data box provides the carrier frequency supported in the selected certification profile. This parameter is automatically set by the tool for the WiMAX Forum's *Fixed WiMAX* and *Mobile WiMAX* certification profiles. For the *Custom* certification profile, it is possible to manually set it.
- **Channel Bandwidth [MHz]:** This data box provides the nominal channel bandwidth supported in the selected certification profile. This parameter is automatically calculated by the tool for the WiMAX Forum's certification profiles; for the *Custom* certification profile it is possible to choose the channel bandwidth in the list defined by the IEEE 802.16d Rev2004 and 802.16e standards.

- **Duplexing:** This data box provides the format of the duplexing technique supported in the selected certification profile. This is the way Down Link and Up Link data is arranged in a two-way wireless transmission. Two duplexing techniques are allowed: *FDD (Frequency Division Duplexing)* and *TDD (Time Division Duplexing)*. This parameter is automatically set by the tool for the WiMAX Forum's certification profiles; for the *Custom* certification profile it is possible to manually set it.

Table 5 summarizes WiMAX Forum's system and certification profile characteristics.

Table 5 – WiMAX Forum's System and Certification Profiles

System Profile	Certification Profile	Frequency Band	Channel Bandwidth	Duplexing
Fixed WiMAX	3.5 GHz, 3.5 MHz, TDD	3.5 GHz	3.5 MHz	TDD
	3.5 GHz, 3.5 MHz, FDD	3.5 GHz	3.5 MHz	FDD
	3.5 GHz, 7 M Hz, TDD	3.5 GHz	7 MHz	TDD
	3.5 GHz, 7 MHz, FDD	3.5 GHz	7 MHz	FDD
	5.8 GHz, 10 MHz, TDD	5.8 GHz	10 MHz	TDD
Mobile WiMAX	1 A	2.3 GHz	8.75 MHz	TDD
	1B, 5 MHz	2.3 GHz	5 MHz	TDD
	1B, 10 MHz	2.3 GHz	10 MHz	TDD
	3A, 5 MHz	2.5 GHz	5 MHz	TDD
	3A, 10 MHz	2.5 GHz	10 MHz	TDD
	5 AL	3.5 GHz	5 MHz	TDD
	5 BL	3.5 GHz	7 MHz	TDD
	5 CL	3.5 GHz	10 MHz	TDD

If the *Mobile WiMAX* system profile is selected from the corresponding scroll-down menu list (Figure 46), the following parameters are available:

- **Symbols per frame:** This output data box provides the total number of *OFDM* symbols per frame excluding gap times of *TTG* and *RTG*. This parameter depends on the channel bandwidth supported by the selected system profile. This parameter is automatically calculated by the tool .
- **Total Symbols (Down Link/Up Link):** In Down Link, the input data box denotes the number of *OFDM* symbols in Down Link. It is possible to manually set it when *TDD* duplexing is selected. The Up Link output box provides the number of *OFDM* symbols in Up Link and is automatically calculated by the tool. If the set configuration is not admitted, the input box will turn red to alert the user.

- **Overhead Symbols (Down Link/Up Link):** These two input data boxes denote the Number of overhead *OFDM* symbols per frame in Down Link/Up Link. If the set configuration is not admit, the input boxes will turn red to alert the user.
- **Modulation (Down Link/Up Link):** These two columns of check boxes allow selecting the supported modulation in Down Link/Up Link among those provided by the standard. The *Mobile WiMAX* profile supports *QPSK 1/2x6*, *QPSK 1/2x4*, *QPSK 1/2x2*, *QPSK 1/2*, *QPSK 3/4*, *16 QAM 1/2*, *16 QAM 3/4*, *64 QAM 1/2*, *64 QAM 2/3*, *64 QAM 3/4*. To select a modulation it is necessary to check the related box for the Down Link and Up Link.

Data Rate Chart: Shows the Down Link and Up Link data rate for the supported modulation.

Table: Provides supported modulations and related data rate in Down Link and Up Link.

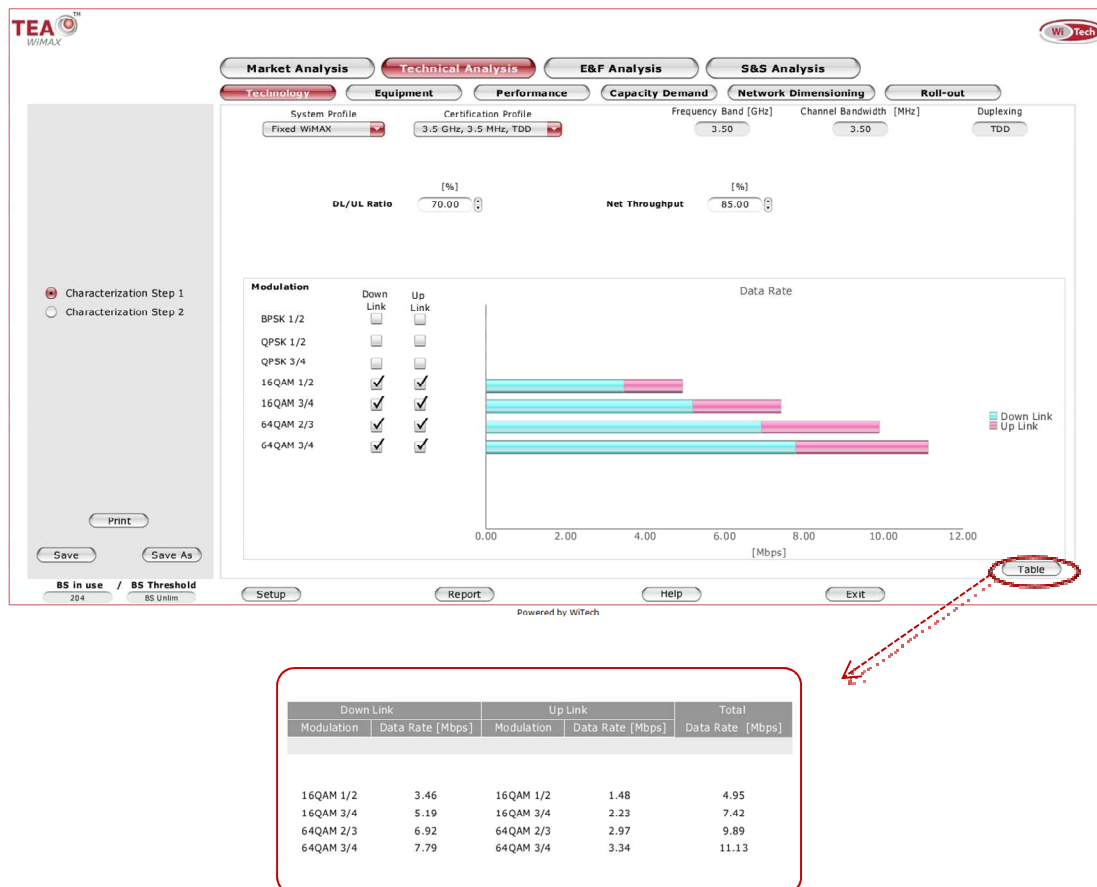


Figure 47 – Technology, Characterization Step 1, Fixed WiMAX System Profile

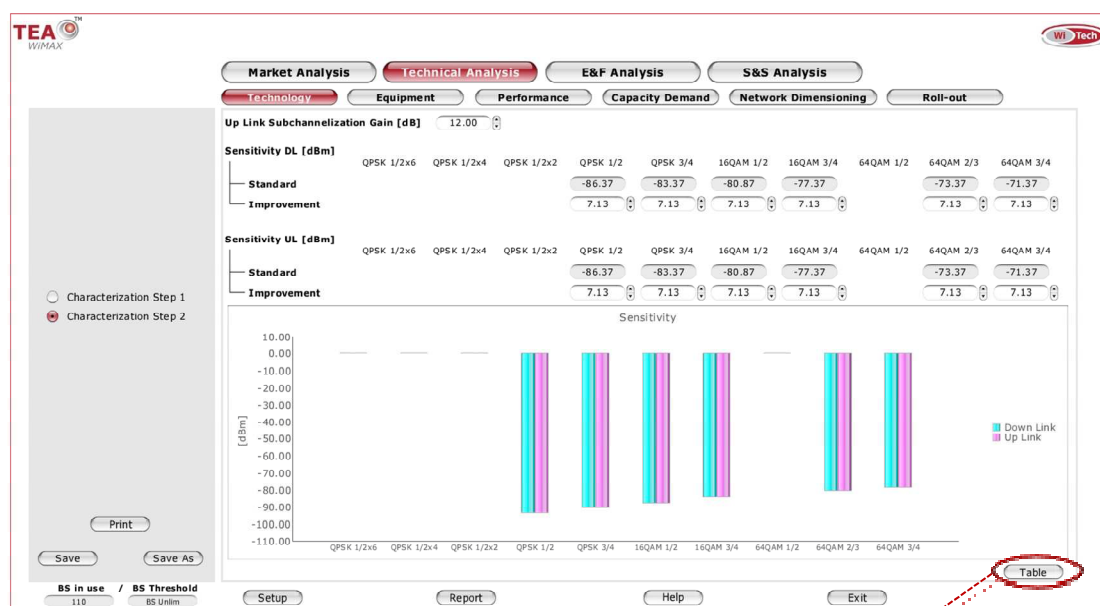
If the *Fixed WiMAX* system profile is selected from the corresponding scroll-down menu list (Figure 47), the following parameters are available:

- **DL / UL Ratio [%]:** Ratio between Down Link and Up Link sub-frame. If the selected certification profile supports the *TDD* duplexing technique, this parameter cannot be equal

to 0% (no data rate would be allocated in Down Link) and 100% (no data rate would be allocated in Up Link). If the selected certification profile supports the *FDD* duplexing technique, this parameter is automatically set by the tool and it is equal to 100%.

- **Net Throughput [%]:** Net throughput calculated as percentage on throughput on air excluding overhead (e.g., preamble, gap time, PHY and MAC headers, ACK and overhead by encryption).
- **Modulation (Down Link/Up Link):** These two columns of check boxes allows selecting the supported modulation in Down Link/Up Link among those provided by the standard certification profiles. The *Fixed WiMAX* system profile supports *BPSK 1/2*, *QPSK 1/2*, *QPSK 3/4*, *16 QAM 1/2*, *16 QAM 3/4*, *64 QAM 2/3*, *64 QAM 3/4*. To select a modulation it is necessary to check the related box for the Down Link and Up Link.

6.1.2 Characterization Step 2



Down Link				Up Link			
Modulation	Standard Sensitivity [dBm]	Improvement [dBm]	Total Sensitivity [dBm]	Modulation	Standard Sensitivity [dBm]	Improvement [dBm]	Total Sensitivity [dBm]
QPSK 1/2	-86.37	7.13	-93.50	QPSK 1/2	-86.37	7.13	-93.50
QPSK 3/4	-83.37	7.13	-90.50	QPSK 3/4	-83.37	7.13	-90.50
16QAM 1/2	-80.87	7.13	-88.00	16QAM 1/2	-80.87	7.13	-88.00
16QAM 3/4	-77.37	7.13	-84.50	16QAM 3/4	-77.37	7.13	-84.50
64QAM 2/3	-73.37	7.13	-80.50	64QAM 2/3	-73.37	7.13	-80.50
64QAM 3/4	-71.37	7.13	-78.50	64QAM 3/4	-71.37	7.13	-78.50

Figure 48 – Technology, Characterization Step 2

Enabling the **Characterization Step 2** radio button (Figure 48) allows configuring the following parameters:

- **Up Link Subchannelization gain [dB]:** This input data box denotes the gain due to subchannelization to improve Up Link coverage.
- **Standard Sensitivity [dBm]:** These rows of output data boxes denote the sensitivity estimated according to WiMAX Forum's specifications, per each selected modulation in Down Link/Up Link.
- **Sensitivity Improvement [dBm] (Down Link/Up Link):** These rows of input data boxes denote the improvement in sensitivity over the standard values, per each selected modulation in Down Link/Up Link.

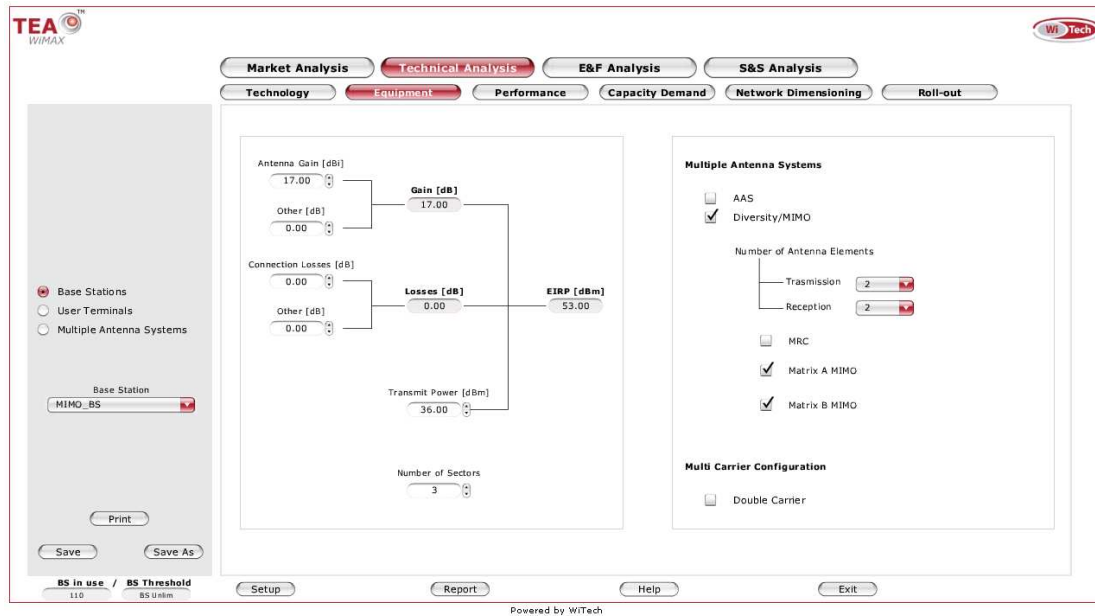
Chart: Shows the sensitivity in Down Link and Up Link per each modulation, taking into consideration sensitivity provided by the standard and improvement.

Table: Provides results about sensitivity.

6.2 Equipment

After having clicked on the **Equipment** button in the upper part of the page, it is possible to configure the technical characteristics of the equipment to be used enabling, in turn, the **Base Stations**, **User Terminals**, and **Multiple Antenna Systems** radio buttons.

6.2.1 Base Stations



The screenshot shows the 'Equipment' tab in the TEA WiMAX software. The interface includes a sidebar on the left with radio buttons for 'Base Stations' (selected), 'User Terminals', and 'Multiple Antenna Systems'. Below these is a scroll-down menu for 'Base Station' with 'MIMO_BS' selected. The main area contains a flow diagram for calculating EIRP (dBm) from Antenna Gain (dBi), Connection Losses (dB), and Transmit Power (dBm). The 'Multiple Antenna Systems' section on the right has checkboxes for AAS, Diversity/MIMO, MRC, Matrix A MIMO, and Matrix B MIMO. The 'Multi Carrier Configuration' section has a checkbox for Double Carrier. The bottom of the window shows status information and navigation buttons.

Figure 49 – Equipment, Base Stations

Enabling the **Base Station** radio button (Figure 49) allows configuring the different types of Base Stations selecting them from the corresponding scroll-down menu list on the left side. The number of types of Base Stations and the name of each type of Base Station to be configured should have been set in the *Project Setup* page. For each type of Base Station it is possible to define its key characteristics in terms of:

- **Antenna Gain [dBi]:** This input data box denotes the gain of the Base Station antenna.
- **Other [dB]:** This input data box denotes other gains at Base Station side.
- **Gain [dB]:** This output data box provides the total gain at Base Station side. This parameter is automatically calculated by the tool.
- **Connection Losses [dB]:** This input data box denotes the losses introduced by the components between the output of the transmitter and the input of the antenna at Base Station side.
- **Other [dB]:** This input data box denotes any other loss at Base Station side.
- **Losses [dB]:** This output data box provides the total losses at Base Station side. This parameter is automatically calculated by the tool.
- **Transmit Power [dBm]:** This input data box denotes the power at each antenna connector.

- **EIRP [dBm]:** This output data box provides the value of the *Equivalent Isotropic Radiated Power (EIRP)*, defined as the power of the transmitter plus antenna gain minus transmission losses at Base Station side. This parameter is automatically calculated by the tool.
- **Number of Sectors:** This input data box denotes the number of logic sectors with which the Base Station is equipped.

Multiple Antenna Systems: This section allows defining the multiple antenna technology supported by the Base Station. Two options are available checking the corresponding check box:

- **AAS** (a technique to increase coverage and capacity performance).
- **Diversity/MIMO**

Having selected the *Diversity/MIMO (multiple-input multiple-output)* option, the following parameters need to be configured:

- **Number of Antenna Elements (Transmission/ Reception):** These two input data boxes denote the number (maximum 4) of transmission/receiver antennas with which the Base Station is equipped.
- **MRC, MIMO A and MIMO B** options are available:
 - o **MRC** is the “*Maximum Ratio Combining*” technique to combine multiple signals for a more robust reception. It is feasible with at least two receiver antennas.
 - o **MIMO matrix A** technique adopts the “*Space Time Block Codes*” algorithm to encode the data streams to enhance system coverage. It is feasible with at least two transmitter antennas and one receiver antenna.
 - o **MIMO matrix B** technique also known as “*Spatial Multiplexing MIMO*” is used to enhance the system capacity. It is feasible with at least two transmitter and receiver antennas.

Whilst MIMO A can be used at the same time with MRC or MIMO B, MRC and MIMO B techniques are mutually exclusive.

Multi carrier configuration: This section allows defining if double carrier configuration is supported. This technique is used to enhance the capacity per each sector by using two different carriers per each sector. The transmit power per carrier in the double carrier configuration is half of the transmit power per carrier in the single carrier configuration.

6.2.2 User Terminals

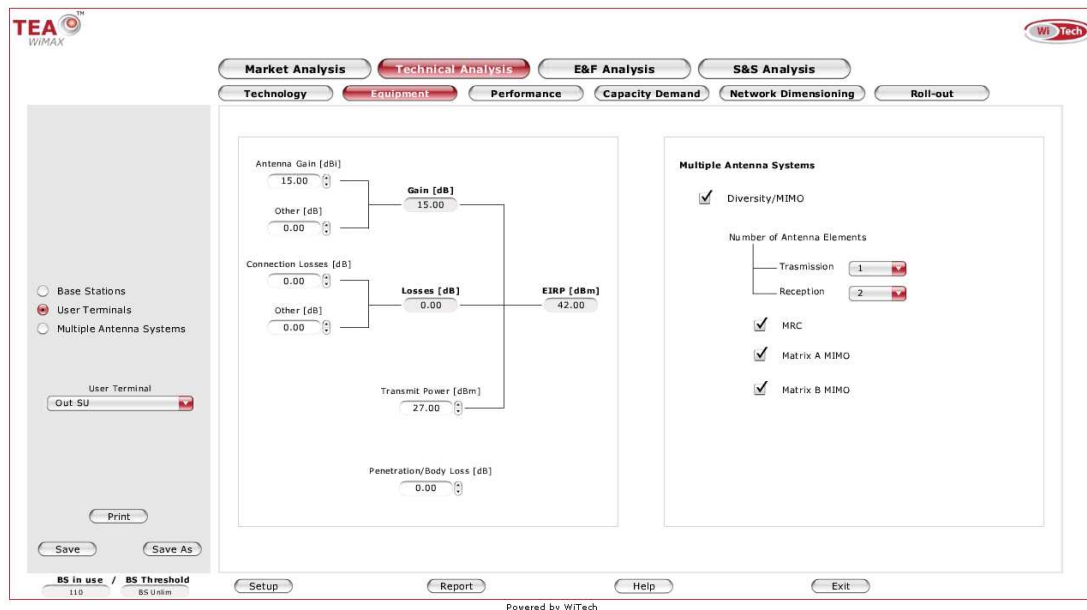


Figure 50 – Equipment, User Terminals

Enabling the **User Terminal** radio button (Figure 50) allows configuring the different types of User Terminals selecting them from the corresponding scroll-down menu list on the left side. The number of types of User Terminals and the name of each type of User Terminal to be configured should have been set in the *Project Setup* page. For each type of User Terminal it is possible to define its key characteristics in terms of:

- **Antenna Gain [dBi]:** This input data box denotes the gain of the User Terminal antenna
- **Other [dB]:** This input data box denotes other gains at User Terminal side.
- **Gain [dB]:** Total gain at User Terminal side. This parameter is automatically calculated by the tool.
- **Connection Losses [dB]:** This input data box denotes the losses introduced by components between the output of the receiver antenna and the input of the receiver at User Terminal side
- **Other [dB]:** This input data box denotes other loss at User Terminal side.
- **Losses [dB]:** This output data box provides the total losses at User Terminal side. This parameter is automatically calculated by the tool.
- **Transmit Power [dBm]:** This input data box denotes the power that the User Terminal transmitter produces at its output.

- **EIRP [dBm]:** This output data box provides the value of the *Equivalent Isotropic Radiated Power (EIRP)* defined as the power of the transmitter plus antenna gain minus transmission losses at User Terminal side. This parameter is automatically calculated by the tool.
- **Penetration / Body Loss [dB]:** This input data box denotes the margin, depending on User Terminal type, for absorption losses due to, for example, buildings, body, cars, etc.

Multiple Antenna Systems; this section allows defining if multiple antenna technology is supported by a User Terminal, checking the corresponding check box **Diversity/MIMO**

Having selected *Diversity/MIMO (multiple-input multiple-output)* option, the following parameters need to be configured:

- **Number of Antenna Elements (Transmission/ Reception):** These two input data boxes denote the number (maximum 4) of transmission/receiver antennas with which the Base Station is equipped.
- Depending on the number of antennas, **MRC**, **MIMO A** and **MIMO B** options are available:
 - o **MRC** is the “*Maximum Ratio Combining*” technique feasible with at least two receiver antennas.
 - o **MIMO matrix A** technique adopts the “*Space Time Block Codes*” algorithm to encode the data streams to enhance system coverage. It is feasible with at least two transmitter antennas and one receiver antenna.
 - o **MIMO matrix B** technique also known as “*Spatial Multiplexing MIMO*” is used to enhance system capacity. It is feasible with at least two transmitter and receiver antennas.

6.2.3 Multiple Antenna Systems

Figure 51 – Equipment, Multiple Antenna Systems

Enabling the **Multiple Antenna Systems** radio button (Figure 51) allows configuring the following parameters:

- **AAS gain [dB]:** These rows of two input data boxes denote the gain in Down Link and Up Link due to *Adaptive Antenna System* (AAS) technique.
- **MRC Gain [dB]:** These input data boxes denote the Down Link and Up Link gain due to *Maximum Ratio Combining* technique. This parameter depends on the number of receiver antennas.
- **Matrix A MIMO Gain [dB]:** These input data boxes denote the Down Link and Up Link gain due to *MIMO matrix A* technique. This parameter depends on the number of transmitter and receiver antennas.
- **Matrix B MIMO Gain:** These input data boxes denote the Down Link and Up Link gain due to *MIMO matrix B* technique. This parameter depends on the number of transmitter antennas.

6.3 Performance

After having clicked on the **Performance** button in the upper part of the page, the **Scenario** scroll-down menu list on the left side allows selecting the type of geographical area scenario (*Dense*

Urban, Urban, Suburban, Rural) to be characterized. Enabling the corresponding radio buttons, it is possible to configure the characteristics of the **Maximum Path Loss**, **Path Loss Model**, and **Coverage & Capacity** for each scenario.

6.3.1 Maximum Path Loss



	Out SU	Ind SU	Ind SU + wa	USB Dongle
Down Link				
Transmit Power [dBm]	36.00	36.00	36.00	36.00
Gain [dB]	17.00	17.00	17.00	17.00
Losses [dB]	0.00	0.00	0.00	0.00
EIRP [dBm]	53.00	53.00	53.00	53.00
Multiple Antenna System Gain [dB]	6.00	6.00	6.00	6.00
Log Normal Fade Margin [dB]	5.40	5.40	5.40	5.40
Fast Fading Margin [dB]	2.00	2.00	2.00	2.00
Interference Margin [dB]	1.00	1.00	1.00	1.00
Penetration/Body Loss Margin	0.00	12.00	4.00	12.00
Other [dB]	3.00	3.00	3.00	3.00
Total Margin [dB]	8.40	20.40	12.40	20.40
Gain [dB]	15.00	6.00	12.00	2.00

Figure 52 – Performance, Maximum Path Loss

For each selected geographical area scenario (*Dense Urban, Urban, Suburban, Rural*) from the scroll-down menu list on the left side, enabling the **Maximum Path Loss** radio button (Figure 52) allows configuring the following parameters:

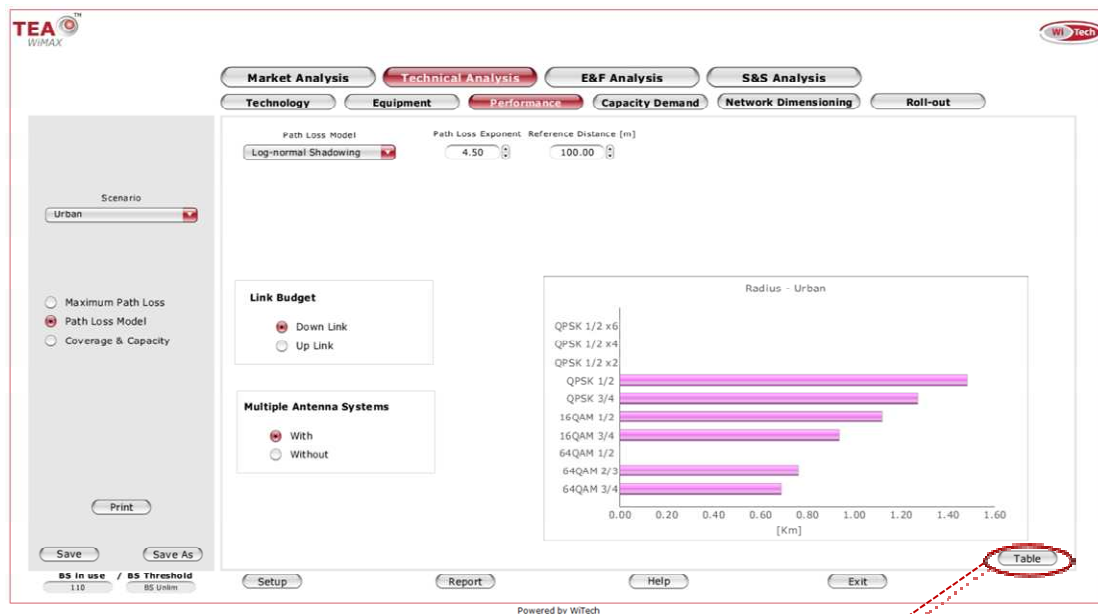
- **Base Station Choice:** This list of radio buttons show all the types of Base Stations that were previously defined in the *Project Setup* page and allows choosing the Base Station type to be adopted in the selected scenario. Only one Base Station type is selectable at any time for each scenario: to do it, enable the corresponding radio button from the list.

- **Cell Edge Coverage Probability [%]:** This input data box denotes the probability that a receiver would experience a signal above a certain threshold at the cell edge.
- **Lognormal Shadowing SD [dB]:** This input data box denotes the standard deviation of Log Normal distribution.
- **Lognormal Fade Margin [dB]:** This output data box provides the margin which takes into account that two locations at the same distance from the Base Station can experiment different propagation scenarios, due to the presence of obstacles. This parameter is automatically calculated by the tool.
- **Fast Fading Margin:** This input data box denotes the margin which takes into account that the radio propagation channel can change quickly during the communication above all in a mobile access scenario.
- **Interference Margin [dB]:** This input data box denotes the margin which takes into account possible interferences if multiple users transmit contemporaneously on the same radio propagation channel.
- **Penetration/ Body Loss [dB]:** This output data box provides the average margin for absorption losses due to, for example, buildings, bodies, cars, etc.. This parameter is automatically calculated by the tool.
- **Other[dB]:** This input data box takes into account other gains (for example if, in the network dimensioning, the direction towards the half power gain is used instead of the max gain).
- **Total Margin [dB]:** This output data box provides the total of margins. This parameter is automatically calculated by the tool.
- **Multiple Antenna Systems:** Allows including/excluding the multiple antenna system effect in the performance analysis:
 - **With:** Enabling this radio button, multiple antenna system effect is considered in the performance analysis.
 - **Without:** Enabling this radio button, multiple antenna system effect is not considered in the performance analysis.

Chart: Shows the maximum path loss available in Down Link and Up Link for each type of User Terminal considered in the analysis, at least modulation.

Table: Provide details of link budget calculation, considering the selected Base Station for current scenario and all types of User Terminal considered in the analysis, at least modulation.

6.3.2 Path Loss Model



Modulation	Radius [Km]			
	Dense Urban	Urban	Suburban	Rural
QPSK 1/2		1.48	2.22	2.97
QPSK 3/4		1.27	1.87	2.44
16QAM 1/2		1.12	1.62	2.07
16QAM 3/4		0.94	1.32	1.64
64QAM 2/3		0.76	1.05	1.26
64QAM 3/4		0.69	0.94	1.11

Figure 53 – Performance, Path Loss Model

For each selected geographical area scenario (*Dense Urban, Urban, Suburban, Rural*) from the scroll-down menu list on the left side, enabling the **Path Loss Model** radio button (Figure 53) allows configuring the following parameters:

- **Path Loss Model:** The scroll-down menu list allows selecting the path loss model to be adopted to model the environment, choosing among *Log-normal Shadowing, Log-distance, Free Space, Cost 231 Hata, SUI, ECC-33, Okumura Hata*..
- **Path Loss Exponent:** This input data box denotes the rate at which the path loss increases with distance. You must set this parameter for all selected path loss models since it is needed to calculate the cell coverage area probability. As commonly recommended by literature, this parameter has been set equal to 2 for the *Free Space* path loss model.

- **Reference distance:** This input data box is shown only after having selected one of the following path loss models: *Log-normal Shadowing*, *Log-distance* and *SUI*. It denotes the minimum distance from which the model is applicable.
- **BS height:** This row of input data boxes is shown only after having selected one of the following path loss models: *Cost 231 Hata*, *SUI* and *ECC-33* and *Okumura Hata*. They denote the height at which is located the electric centre of each Base Station defined for the project.
- **UT height:** This row of input data boxes is shown only after having selected one of the following path loss models: *Cost 231 Hata*, *SUI* and *ECC-33* and *Okumura Hata*. They denote the height at which is located the electric centre of each User Terminal defined for the project.
- **Link Budget:** Allows selecting Down Link or Up Link to be taken into consideration in the performance analysis:
 - **Down Link:** Enabling this radio button, Down Link is taken into consideration in the performance analysis.
 - **Up Link:** Enabling this radio button, Up Link is taken into consideration in the performance analysis.
- **Multiple Antenna Systems:** Allows including/excluding the multiple antenna system effect in the performance analysis:
 - **With:** Enabling this radio button, multiple antenna system effect is considered in the performance analysis.
 - **Without:** Enabling this radio button, multiple antenna system effect is not considered in the performance analysis.

Chart: Shows the maximum radius, expressed in Km/mi, for each modulation supported by the systems.

Table: Provides the coverage radius calculated for each modulation in each scenario.

Please note that for each selected modulation, the maximum radius values shown in both the *Chart* and the *Table* are calculated assuming centred-fed hexagonal cells.

6.3.3 Coverage and Capacity

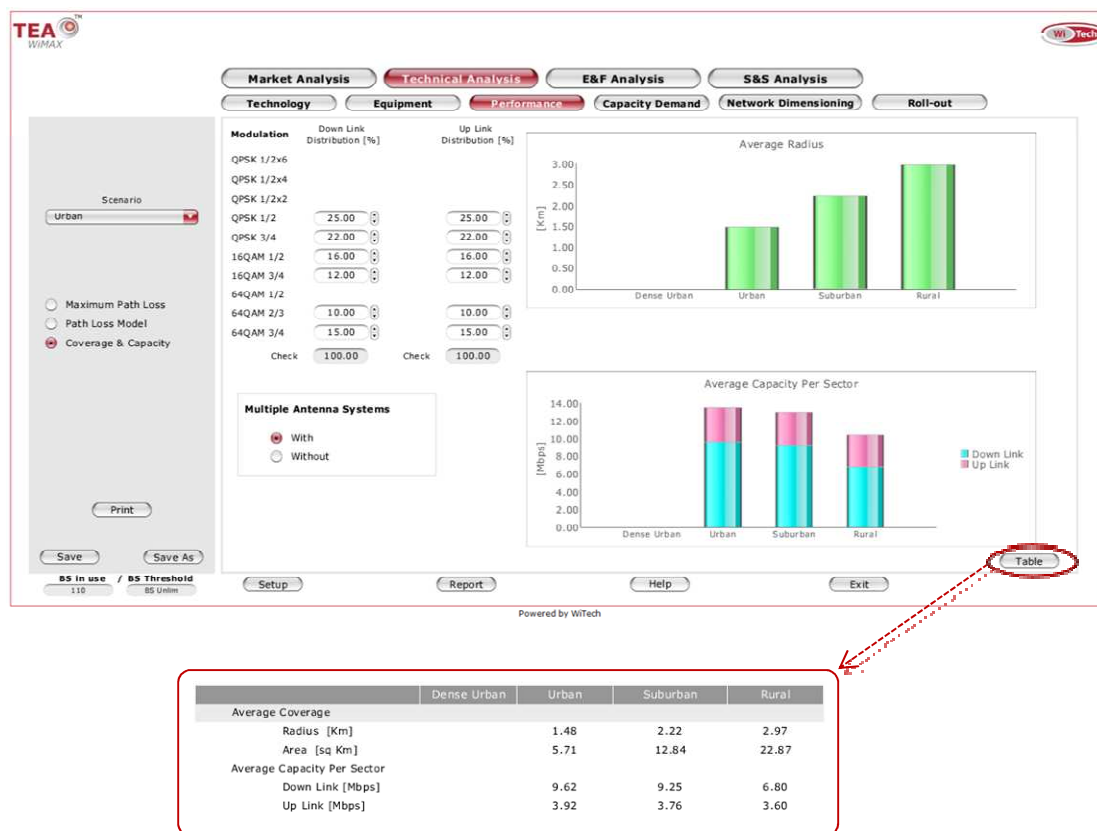


Figure 54 – Performance, Coverage and Capacity

For each selected geographical area scenario (*Dense Urban, Urban, Suburban, Rural*) from the scroll-down menu list on the left side, enabling the **Coverage & Capacity** radio button (Figure 54) allows configuring the following parameters:

- **Down Link/ Up Link distribution:** These two columns of input data boxes denote the percentages of influence of supported modulations in Down Link and Up Link.
- **Check:** These two output data boxes help to properly set modulation distribution: the sum of distributions must be equal to 100% for each market segment. If the sum of user distribution is different from 100%, the check box will turn red alerting the user that the entered configuration is not correct. These parameters are calculated by the tool.
- **Multiple Antenna Systems:** Allows including/excluding the multiple antenna system effect in the performance analysis:
 - **With:** Enabling this radio button, multiple antenna system effect is considered in the performance analysis.

- **Without:** Enabling this radio button, multiple antenna system effect is not considered in the performance analysis.

Chart - Average Radius: Shows the average coverage radius, expressed in Km/mi, for each scenario.

Chart - Average Capacity per Sector: Shows the average capacity per sector, expressed in Mbps, in Down Link and Up Link for each scenario.

Table: Provides the average coverage and capacity results for each scenario.

Please note that the average coverage radius values shown in both the *Chart* and the *Table* are calculated taking into account the lowest order modulation (the most protected and the least performing in terms of throughput).

6.4 Capacity Demand



Figure 55 – Capacity Demand

After having clicked on the **Capacity & Demand** button in the upper part of the page (Figure 55), it is possible configuring the following parameters:

- **Internet Access – Overbooking Factor [1:N]:** This factor takes into account that not all users will consume all their available bandwidth at the same time, thus less bandwidth can be reserved when dimensioning the total access capacity. Overbooking is, in general, a method to maximize the usage of physical resources without losing in quality of service. This parameter should be set with reference to PBH¹ in order to guarantee CIR throughput.
- **VoIP – Peak Busy Hour Activity Level [%]:** This input data box denotes the maximum percentage of users calling at the same time in the PBH¹.
- **Chart:** Shows temporal evolution of aggregate capacity required by users in Down Link and Up Link for all geographical areas considered in the analysis.

Table: Provides the temporal evolution of aggregate capacity required by users in Down Link and Up Link for all geographical areas considered in the analysis.

6.5 Network Dimensioning

After having clicked on the **Network Dimensioning** button in the upper part of the page, the **Scenario** scroll-down menu list on the left side allows selecting the geographic area scenario (*Dense Urban, Urban, Suburban, Rural*) to be characterized. Enabling the corresponding radio buttons, for each scenario it is possible to configure the characteristics of the **Access Network** and of the **Backhaul Network**.

Please read the “**License-Limited Maximum Number of Base Stations**” section in Chapter 4.5.1 if you have a software license with a limited maximum number of Base Stations.

¹ PBH (Peak Busy Hour) is the sliding 60-minute period during which occurs the maximum total traffic load in a given 24-hour period. The busy hour is determined by fitting a horizontal line segment equivalent to one hour under the traffic load curve about the peak load point. If the service time interval is less than 60 minutes, the busy hour is the 60-minute interval that contains the service timer interval. In cases where more than one busy hour occurs in a 24-hour period, i.e., when saturation occurs, the busy hour or hours most applicable to the particular situation are used.

6.5.1 Access Network



	MaxCity1	MaxCity2	MaxCity3	MaxCity4	MaxCity5
Urban					
Number of Base Stations					
Coverage Requirement				41	
Capacity Requirement				30	
Required				41	
Number of Logical Sectors				123	
Number of Users per Sector				194	
Offered Capacity					
Down Link [Mbps/sq Km]				6.31	
Up Link [Mbps/sq Km]				2.57	

Figure 56 – Network Dimensioning, Access Network

For each selected geographical area scenario (*Dense Urban, Urban, Suburban, Rural*), enabling the **Access Network** radio button (Figure 56) allows configuring the following parameters:

- **BS Overlapping Factor [%]:** This input data box denotes the percentage of overlapping area between two contiguous Base Stations.
- **Number of BS – Coverage Requirement:** This row of output data boxes provides, for each geographical area covered by the analysis, the number of Base Stations needed to meet coverage requirement. These parameters are calculated by the tool taking into consideration each area to be covered and Base Station coverage performance.
- **Number of BS – Capacity Requirement:** This row of output data boxes provides, for each geographical area covered by the analysis, the number of Base Stations needed to meet capacity requirement. These parameters are calculated by the tool taking into consideration each area to be covered, capacity demand and Base Station capacity performance.

- **Number of BS – Required:** This row of output data boxes provides, for each geographical area covered by the analysis, the number of Base Stations needed to satisfy both coverage and capacity requirements. These parameters are calculated automatically by the tool.
- **Number of Logical Sector:** This row of output data boxes provides, for each geographical area covered by the analysis, the number of logical sectors needed to equip the required number of Base Stations. These parameters are calculated automatically by the tool.



Total	MaxCity1	MaxCity2	MaxCity3	MaxCity4	MaxCity5
Number of Base Stations					
Coverage Requirement	19	14	20	41	13
Capacity Requirement	14	15	14	30	15
Required	19	15	20	41	15
Number of Logical Sectors	57	45	60	123	45
Number of Users per Sector	173	178	173	194	183
Offered Capacity					
Down Link [Mbps/sq Km]	2.81	1.20	2.74	6.31	1.27
Up Link [Mbps/sq Km]	1.14	0.64	1.11	2.57	0.68

Figure 57 – Network Dimensioning, Access Network, Total

Having enabled the **Access Network** radio button and having selected **Total** in the **Scenario** scroll-down menu list (Figure 57) will enable you to configure the following:

- **BS per ASN:** This input data box denotes the number of Base Stations supported by one ASN Gateway. This parameter is common for all scenarios and to all areas to be covered.

- **Number of BS – Coverage Requirement:** This row of output data boxes provides, for each geographical area covered by the analysis, the total number of Base Stations needed to meet coverage requirement. These parameters are calculated by the tool taking into consideration each area to be covered and Base Station coverage performance.
- **Number of BS – Capacity Requirement:** This row of output data boxes provides, for each geographical area covered by the analysis, the total number of Base Stations needed to meet capacity requirement. These parameters are calculated by the tool taking into consideration each area to be covered, capacity demand and Base Station capacity performance.
- **Number of BS – Required:** This row of output data boxes provides, for each geographical area covered by the analysis, the total number of Base Stations needed to satisfy both coverage and capacity requirements. These parameters are calculated automatically by the tool.
- **Number of Logical Sector:** This row of output data boxes provides, for each geographical area covered by the analysis, the number of logical sectors needed to equip the required number of Base Stations. These parameters are calculated automatically by the tool.

It is possible to manually set the **Number of Required Base Stations** and/or the **Number of Logical Sectors** checking the corresponding check box

Manual Set - Number of Required BS



Figure 58 – Network Dimensioning, Access Network, Manual Set

Checking the **Manual Set - Number of Required BS** option (Figure 58) allows manually setting the number of required Base Stations for the selected geographical area scenario (*Dense Urban, Urban, Suburban, Rural*).

- **Number of BS – Coverage Requirement:** This row of output data boxes provides, for each geographical area covered by the analysis, the number of required Base Stations needed to meet coverage requirement and calculated automatically by the tool. These results can be used as a guideline to manually set the number of required BS..
- **Number of BS – Capacity Requirement:** This row of output data boxes provides, for each geographical area covered by the analysis, the number of required Base Stations needed to meet capacity requirement and calculated automatically by the tool. These results can be used as a guideline to manually set the number of required BS.
- **Number of Required BS:** This row of input data boxes allows to set manually, for each geographical area covered by the analysis, the number of required Base Stations. This

row of input data boxes is pre-set with the values calculated automatically by the tool the first time this page is opened.



Total	MaxCity1	MaxCity2	MaxCity3	MaxCity4	MaxCity5
Number of Base Stations					
Required	19	15	20	41	15
Number of Logical Sectors	57	45	60	123	45
Number of Users per Sector	173	178	173	194	183
Offered Capacity					
Down Link [Mbps/sq Km]	2.81	1.20	2.74	6.31	1.27
Up Link [Mbps/sq Km]	1.14	0.64	1.11	2.57	0.68

Figure 59 – Network Dimensioning, Access Network, Manual Set, Total

Checking the **Manual Set - Number of Required BS** option and selecting **Total** in the **Scenario** scroll-down menu list (Figure 59) allows manually setting the required total number of Base Stations. Please note that this will overwrite any setting previously done for each specific scenarios (*Dense Urban, Urban, Suburban, Rural*).

- **Number of BS – Coverage Requirement:** This row of output data boxes provides, for each geographical area covered by the analysis, the total number of required Base Stations needed to meet coverage requirement and calculated automatically by the tool. These results can be used as a guideline to manually set the number of required BS..
- **Number of BS – Capacity Requirement:** This row of output data boxes provides, for each geographical area covered by the analysis, the total number of required Base

Stations needed to meet capacity requirement and calculated automatically by the tool. These results can be used as a guideline to manually set the number of required BS.

- **Number of Required BS:** This row of input data boxes allows to set manually, for each geographical area covered by the analysis, the total number of required Base Stations. This row of input data boxes is pre-set with the values calculated automatically by the tool the first time this page is opened.

Chart: Shows the number of Base Stations and Logical Sectors needed to deploy the network for each geographical area covered by the analysis. Also number of Users per sector and Offered Capacity per sq Km/mi are given as results. These results refer to all scenarios characterizing an area .

Table: Provides the access network dimensioning for each geographical area covered by the analysis.

Manual Set - Number of Logical Sectors



	MaxCity1	MaxCity2	MaxCity3	MaxCity4	MaxCity5
Urban					
Number of Base Stations					
Required				41	
Number of Logical Sectors				123	
Number of Users per Sector				194	
Offered Capacity					
Down Link [Mbps/sq Km]				6.31	
Up Link [Mbps/sq Km]				2.57	

Figure 60 – Network Dimensioning, Access Network, Manual Set

Checking the **Manual Set - Number of Logical Sectors** option (Figure 60) allows manually setting the number of required Logical Sectors for the selected area scenario (*Dense Urban, Urban, Suburban, Rural*).

- **Number of Logical Sectors - Suggested Values:** This row of output data boxes provides, for each geographical area covered by the analysis, the number of Logical Sectors calculated automatically by the tool. These results can be used as a guideline to manually set Logical Sectors.
- **Number of Logical Sectors:** This row of input data boxes allows to manually set , for each geographical area covered by the analysis, the number of Logical Sectors This row of input data boxes is pre-set with the values calculated automatically by the tool the first time this page is opened.



Total	MaxCity1	MaxCity2	MaxCity3	MaxCity4	MaxCity5
Number of Base Stations					
Coverage Requirement	19	14	20	41	13
Capacity Requirement	14	15	14	30	15
Required	19	15	20	41	15
Number of Logical Sectors	57	45	60	123	45
Number of Users per Sector	173	178	173	194	183
Offered Capacity					
Down Link [Mbps/sq Km]	2.81	1.20	2.74	6.31	1.27
Up Link [Mbps/sq Km]	1.14	0.64	1.11	2.57	0.68

Figure 61 – Network Dimensioning, Access Network, Manual Set, Total

Checking the **Manual Set - Number of Logical Sectors** option and selecting *Total* in the **Scenario** scroll-down menu list (Figure 61) allows manually setting the required total number of

Logical Sectors. Please note that this will overwrite any setting previously done for each specific scenarios (*Dense Urban, Urban, Suburban, Rural*).

- **Number of Logical Sectors - Suggested Values:** This row of output data boxes provides, for each geographical area covered by the analysis, the total number of Logical Sectors calculated automatically by the tool. These results can be used as a guideline to manually set Logical Sectors.
- **Number of Logical Sectors:** This row of input data boxes allows to manually set , for each geographical area covered by the analysis, the total number of Logical Sectors This row of input data boxes is pre-set with the values calculated automatically by the tool the first time this page is opened.

Chart: Shows number of Base Stations and Logical Sectors needed to deploy the network for each geographical area covered by the analysis. Also number of Users per sector and Offered Capacity per sq Kilometer/mile are given as results. These results refer to all scenarios characterizing an area.

Table: Provides the access network dimensioning for each geographical area covered by the analysis.

6.5.2 Backhaul Network



Figure 62 – Network Dimensioning, Backhaul network

For each selected area scenario (*Dense Urban, Urban, Suburban, Rural*), enabling the **Backhaul Network** radio button (Figure 62) allows configuring:

- **BS With Wireless Backhaul [%]:** This input data box denotes, for each geographical area covered by the analysis, the percentage of required Base Stations that need to be linked through a wireless connection to the backhaul network in the selected scenario.
- **Multi Hop Factor [%]:** This input data box denotes the factor that takes into account the possibility that a Base Station needs to relay signal through one or more intermediary Base Stations to reach another Base Station.
- **Number of Radio Link:** This row of output data boxes provides, for each geographical area covered by the analysis, the number of radio links needed to deploy the network in the selected scenario. These parameters are calculated by the tool.

- **Radio Link Distribution [%]:** This column of input data boxes denotes the percentage of radio links implemented with SDH/PDH/Native Ethernet or Other typology in the considered scenario per each geographical area covered by the analysis.
- **Check:** This output data box helps to properly set radio link distribution per each scenario covered by the analysis: the sum of distributions must be equal to 100%. If the sum of radio link distribution is different from 100%, the check box will become red alerting the user that the entered configuration is not correct. This parameter is calculated by the tool.



Figure 63 – Network Dimensioning, conditioned Backhaul network

Please note that if in the **Access Network** dimensioning you had checked the **Manual Set Number of Required BS** and selected **Total** from the **Scenario** scroll down menu list (Figure 59), then the **Backhaul Network** radio button will enable you to configure the following parameters when selecting one of the specific scenarios (*Dense Urban, Urban, Suburban, Rural*) (Figure 63) in the **Scenario** scroll-down menu list:

- **BS With Wireless Backhaul [%]:** This input data box denotes, for each geographical area covered by the analysis, the percentage of required Base Stations that need to be linked through a wireless connection to the backhaul network in the selected scenario.

- **Multi Hop Factor [%]:** This input data box denotes the factor that takes into account the possibility that a Base Station needs to relay signal through one or more intermediary Base Stations to reach another Base Station.
- **Radio Link Distribution [%]:** This column of input data boxes denotes the percentage of radio links implemented with SDH/PDH/Native Ethernet or Other typology in the considered scenario per each geographical area covered by the analysis.
- **Check:** This output data box helps to properly set radio link distribution per each scenario covered by the analysis: the sum of distributions must be equal to 100%. If the sum of radio link distribution is different from 100%, the check box will become red alerting the user that the entered configuration is not correct. This parameter is calculated by the tool.



Figure 64 – Network Dimensioning, Backhaul network, Total

Having enabled the **Access Network** radio button and having selected *Total* in the **Scenario** scroll-down menu list (Figure 64) cause the tool to show the following data output summary::

- **Number of Radio Link:** This row of output data boxes provides, for each geographical area covered by the analysis, the total number of radio links needed to deploy the network. These parameters are calculated by the tool.

- **Radio Link Distribution [%]:** This column of output data boxes provides the total number of radio links needed to deploy the network implemented with SDH/PDH/Native Ethernet or Other typology per each geographical area covered by the analysis.

Manual Set Number of Radio Links



	MaxCity1	MaxCity2	MaxCity3	MaxCity4	MaxCity5
Urban					
SDH				0	
PDH				1	
Native Ethernet				16	
Other				0	
Number of Radio Link				17	

Figure 65 – Network Dimensioning, Backhaul network, Manual Set

This option allows manually setting the number of radio link on the specific scenario per each geographical area covered by the analysis:

- **Number of Radio Links - Suggested Values:** This row of output data boxes provides, for each geographical area covered by the analysis, the number of radio links calculated automatically by the tool. These results can be used as a guideline to manually set radio links.
- **Number of Logical Sectors:** This rows of input data boxes denote, for each geographical area covered by the analysis, the number of radio links on the specific scenario. This row of input data boxes is pre-set with the values calculated automatically by the tool the first time this page is opened.



	MaxCity1	MaxCity2	MaxCity3	MaxCity4	MaxCity5
Total					
SDH	0	0	0	0	0
PDH	1	1	1	1	1
Native Ethernet	11	11	11	16	11
Other	0	0	0	0	0
Number of Radio Link	12	12	12	17	12

Figure 66 : Network Dimensioning, Backhaul network, Manual Set, Total

Checking the **Manual Set - Number of Radio Links** option and selecting **Total** in the **Scenario** scroll-down menu list (Figure 66) allows manually setting the required total number of radio links. Please note that this will overwrite any setting previously done for each specific scenarios (*Dense Urban, Urban, Suburban, Rural*).

- **Number of Radio Links – Suggested Values:** This row of output data boxes provides, for each geographical area covered by the analysis, the suggested total numbers of radio links needed to deploy the network. These parameters are calculated by the tool.
- **Number of Radio Links – Required:** This row of input data boxes allows setting, for each geographical area covered by the analysis, the total number of radio links needed to deploy the network. These parameters are further split into four rows of input data boxes for the distribution of the different technologies:

1. SDH
2. PDH
3. Native Ethernet

4. Other

- **Check:** If the sum of the technology distributions is different from 100%, the check box will turn red alerting the user that the entered configuration is not correct. This parameter is calculated by the tool.

Please note that if in the **Access Network** dimensioning, you had checked the **Manual Set Number of Required BS** and selected *Total* from the **Scenario** scroll down menu list (Figure 59), then this second manual set option () would be the only one shown by the tool.

Chart: Shows number of radio links needed to deploy the network for each geographical area covered by the analysis. These results refer to all scenarios characterizing an area.

Table: Provides the backhaul network dimensioning for each geographical area covered by the analysis.

6.6 Roll-out

After having clicked on the **Roll-out** button in the upper part of the page, the **Area** scroll-down menu list on the left side allows selecting a geographical area for which to define the *Roll-out Rate*, enabling the **Roll-out Rate** radio button, in order to obtain the *Roll-out Plan*, visible by enabling the **Roll-out Plan** radio button. Please read the “*License-Limited Maximum Number of Base Stations*” section in Chapter 4.5.1 if you have a software license with a limited maximum number of Base Stations and this button will not be visible.

6.6.1 Roll-out Rate

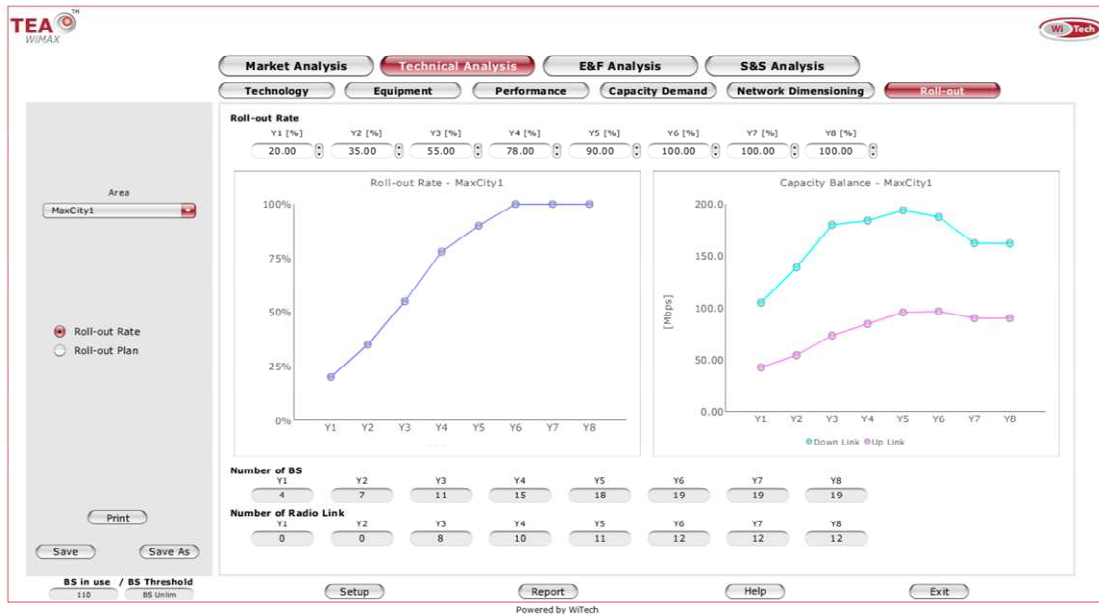


Figure 67 – Roll-out, Roll-out Rate

For each selected geographical area, enabling the **Roll-out Rate** radio button (Figure 67) allows configuring:

- **Roll-out Rate [%]:** This row of input data boxes denotes the percentage of year-on-year deployed infrastructure characterized as annual percentage of implementation on total network dimensioning.
- **Number of BS:** This row of output data boxes provides the number of deployed Base Stations per each year of the analysis period. These parameters are calculated automatically by the tool.
- **Number of Radio Links:** This row of output data boxes provides the number of deployed radio links per each year of the analysis period. This output is calculated taking into account the percentage of “BS without wired backhaul ” set in “Network dimensioning”. These parameters are calculated automatically by the tool.

Chart - “Roll-out Rate”: Shows the roll-out function.

Chart - “Capacity Balance”: Shows the difference between offered and required capacity in Down Link and Up Link. It allows defining correctly the Roll-out Rate in order to meet the request of capacity every year. If the represented curve is negative, it means that the network is under-dimensioned and, therefore, it would be necessary to reassess the rollout function.

6.6.2 Roll-out Plan

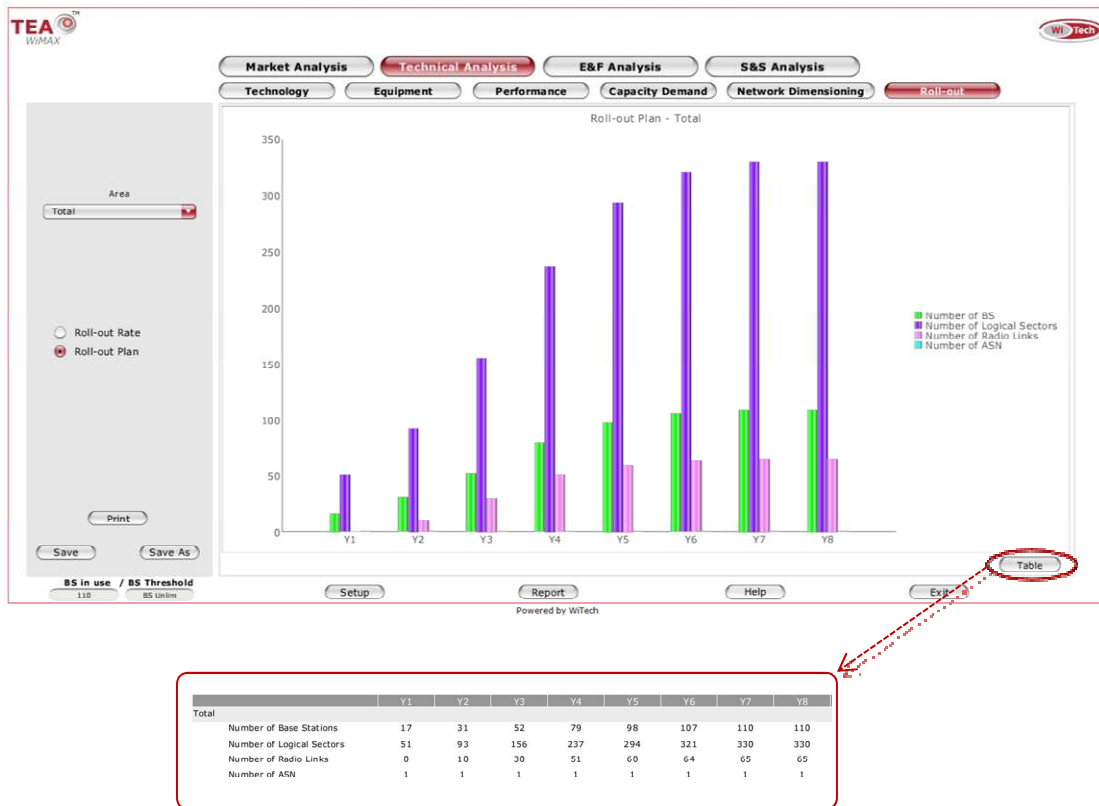


Figure 68 – Roll-out, Roll-out Plan

For each selected geographical area, enabling the **Roll-out Plan** radio button (Figure 68) shows an output page which provides the results on network deployment.

Chart: Shows temporal evolution of Base Stations, radio links and logical sectors deployment for each geographical area covered by the analysis and the total area to be covered.

7 Economic and Financial Analysis

To start performing the *Economic and Financial Analysis*, select the corresponding **F&A Analysis** button in the upper part of the *Analysis* page. Please read the “*License-Limited Maximum Number of Base Stations*” section in Chapter 4.5.1 if you have a software license with a limited maximum number of Base Stations and this button will not be visible.

7.1 Personnel

After having clicked on the **Personnel** button in the upper part of the page, enabling the **Head Count** radio button or the **Salaries & Benefits** radio button on the left side allows to define, respectively, the number and the cost of the personnel, divided in four main groups: *Executive Staff*, *Technical Ops*, *Sales* and *Other*.

The composition of each group is shown in the following table:

Table 6 – Personnel Composition

Executive Staff	Technical Ops	Sales	Other
President	Operations Manager	General/ Market Manager	Marketing
CEO	Voice Engineer	Direct Sales Manager	General & Administrative
CFO	IP Engineer	Indirect Sales Manager	Other
COO	IT Engineer	Indirect Dealer Manager	
CTO	RF Engineer	Direct Sales Rep	
Vice President	Site Tech	Sales Support	

7.1.1 Head Count



Figure 69 – Personnel, Head Count

Having enabled the **Head Count** radio button (Figure 69), the **Group** scroll-down menu list on the left side allows selecting the head count group to configure their corresponding numbers.

For each role, a row of input data boxes denotes the number of persons required per each year of the analysis period.

Number of **Site Techs** and **Sales Support** are automatically calculated by the tool requiring as input, respectively, the number of sites assigned to each technician (**Sites per Tech**) and the number of contract stipulated every day (**Contracts per Day**).

Chart: Shows the breakdown of Head Count per each year of the analysis period.

Table: Provides the breakdown of Head Count per each year of the analysis period.

7.1.2 Salaries and Benefits

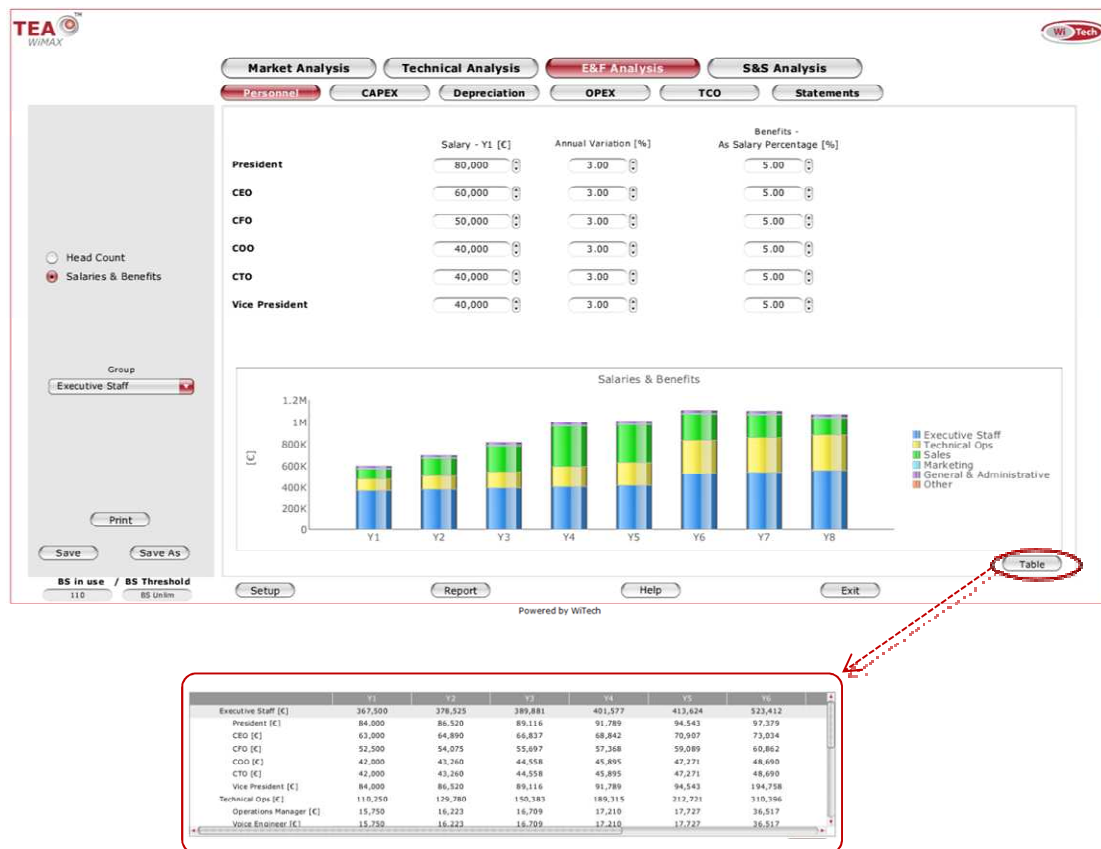


Figure 70 – Personnel, Salaries and Benefits

Having enabled the **Salaries & Benefits** radio button (Figure 70), the **Group** scroll-down menu list allows selecting the head count group to configure their corresponding costs.

- **Salary (Y1 – Annual Variation [%]):** These columns of input data boxes denote the annual remuneration at first year of the analysis period and the annual variation as percentage on it for each role. The annual variation can be either positive (increase) or negative (decrease).
- **Benefit As Salary Percentage [%]:** This column of input data boxes denotes the annual benefit evaluated as percentage of annual remuneration for each role.

Chart: Shows the breakdown of Salaries and Benefits per each year of the analysis period.

Table: Provides the breakdown of Salaries and Benefits per each year of the analysis period.

7.2 CAPEX

After having clicked on the **CAPEX** button in the upper part of the page, enabling the **Base Station, User Terminal, ASN Gateway & CSN**, or **Other** radio button on the left side allows to define its corresponding CAPEX costs.

7.2.1 Base Station



Figure 71 – CAPEX, Base Station

Having enabled the **Base Station** radio button (Figure 71) allows to configure the following parameters for each type of Base Station. The number of types of Base Stations and the name of each type of Base Station should have been set in the *Project Setup* page. For each type of Base Station it is possible to define its key CAPEX costs in terms of:

- **Site Acquisition:** This column of input data boxes denotes the one-time costs related to the acquisition of the site where each type of Base Station is located.

- **Logical Sector (Y1 - Annual Variation [%]):** These two columns of input data boxes denote, respectively, the logical sector unit costs defined at first year of the analysis period and the annual variation as percentage on it. The annual variation can be either positive (increase) or negative (decrease).
- **Networking Elements:** This column of input data boxes denotes the total costs of the hardware per Networking elements.
- **Services - Cost:** This column of **Services** scroll-down menu lists allows selecting the type of service related to Base Station implementation (*Site equipping, Civil Works, Project, Installation and Commissioning and Test Activities*). For each type of service, it is required to enter the related cost in the corresponding cost input data box.
- **Other:** This column of input data boxes denotes the other costs per each type of Base Station.

7.2.2 User Terminal

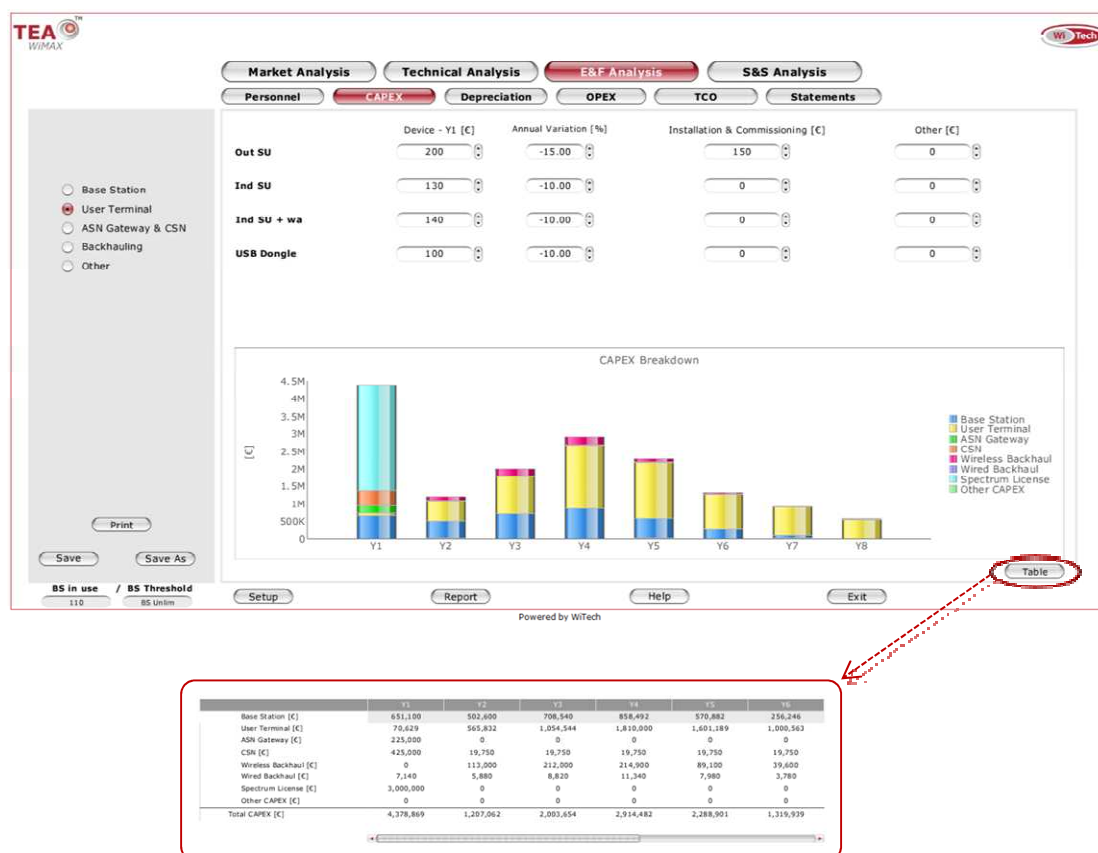


Figure 72 – CAPEX, User Terminal

Having enabled the **User Terminal** radio button (Figure 72) allows to configure the following parameters for each type of User Terminal. The number of types of User Terminals and the name of each type of User Terminal should have been set in the *Project Setup* page. For each type of User Terminal, it is possible to define its key CAPEX costs in terms of:

- **Device (Y1 – Annual Variation [%]):** These columns of input data boxes denote the device unit costs defined at first year of the analysis period and annual variation as percentage on it. The annual variation can be either positive (increase) or negative (decrease).
- **Installation & Commissioning:** This column of input data boxes denotes the installation and commissioning costs for one single device.
- **Other:** This column of input data boxes denotes the other costs per each type of User Terminal considered in the analysis.

7.2.3 ASN Gateway & CSN



	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Base Station [€]	651,100	502,600	708,540	858,492	570,882	256,246		
User Terminal [€]	70,629	565,832	1,054,544	1,810,000	1,401,189	1,000,563		
ASN Gateway [€]	225,000	0	0	0	0	0		
CSN [€]	423,080	19,750	19,750	19,750	19,750	19,750		
Wireless Backhaul [€]	0	113,000	212,000	214,900	89,180	39,600		
Wired Backhaul [€]	7,140	5,880	8,820	11,340	7,980	3,780		
Spectrum License [€]	3,000,000	0	0	0	0	0		
Other CAPEX [€]	0	0	0	0	0	0		
Total CAPEX [€]	4,378,869	1,207,062	2,003,684	2,914,482	2,288,901	1,319,939		

Figure 73 – CAPEX, ASN Gateway & CSN

Having enabled the **ASN Gateway & CSN** radio button (Figure 73) allows configuring the following parameters:

For ASN Gateway, the following types of CAPEX costs are available:

- **HW & SW (Y1 – Annual Variation [%]):** This input data box denotes the Hardware and Software costs per ASN Gateway defined at first year of the analysis period. An annual variation, that can be either positive (increase) or negative (decrease), is considered as percentage on it.
- **Installation and Commissioning:** This input data box denotes the installation and commissioning costs per ASN Gateway.
- **Other:** This input data box denotes the other costs related to the ASN Gateway.

For CSN, the following types of CAPEX costs are available:

- **HW & SW Item – Cost:** The **HW & SW Item** scroll-down menu list allows selecting the hardware and software items related to the CSN component (*HA,,DNS/DHCP, AAA – Backup and Proxy, PF, NMS, Billing, Rating, Router Core, IP-Centrex, Wholesale Platform, CRM, ERP, BPM, Other*) and assign to each of them the related costs defined at first year of the analysis period.
- **HW & SW Total (Y1 – Annual Update [%]):** The total costs for CSN hardware and software defined at first year of the analysis period is automatically calculated by the tool. The user can define an annual update percentage to consider possible system upgrade.
- **Installation and Commissioning:** This input data box denotes the installation and commissioning costs per CSN.
- **Other:** This input data box denotes the other CAPEX costs related to the CSN.

7.2.4 Backhauling

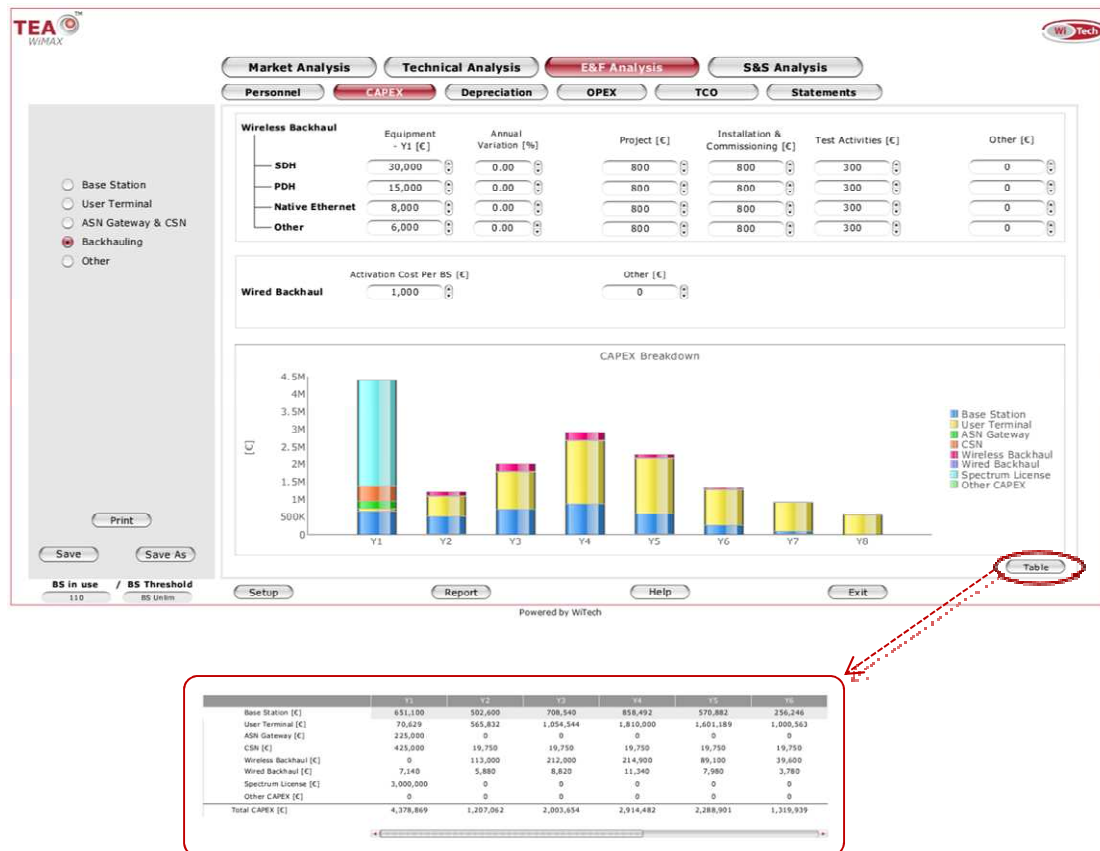


Figure 74 – CAPEX, Backhauling

Having enabled the **Backhauling** radio button (Figure 74) allows configuring the following parameters:

Wireless Backhaul

- **Equipment (Y1 – Annual Variation [%]):** These columns of input data boxes denote the hardware costs to implement a single radio link at first year of the analysis period and annual variation as percentage on it, per each type of radio link. The annual variation can be either positive (increase) or negative (decrease).
- **Project:** This column of input data boxes denotes the project costs related to a single radio link, per each type of radio link.
- **Installation and commissioning:** This column of input data boxes denotes the installation and commissioning costs related to a single radio link, per each type of radio link.

- **Test Activities:** This column of input data boxes denotes the test activities cost related to a single radio link, per each type of radio link.
- **Other:** This column of input data boxes denotes the other costs, per each type of radio link.

Wired Backhaul

- **Activation Cost per BS:** This input data box denotes the one-time costs related to the activation of the connectivity per a single Base Station.
- **Other:** This input data box denotes the other costs related to broadband connectivity.

7.2.5 Other CAPEX



	Y1	Y2	Y3	Y4	Y5	Y6
Base Station [€]	631,100	502,600	708,540	858,492	579,882	256,246
User Terminal [€]	70,629	565,832	1,054,544	1,810,000	1,601,189	1,000,543
ASN Gateway [€]	225,000	0	0	0	0	0
CSN [€]	425,000	19,750	19,750	19,750	19,750	19,750
Wireless Backhaul [€]	0	113,000	212,000	214,900	89,100	39,600
Wired Backhaul [€]	7,140	5,880	8,820	11,340	7,980	3,780
Spectrum License [€]	3,000,000	0	0	0	0	0
Other CAPEX [€]	0	0	0	0	0	0
Total CAPEX [€]	4,378,869	1,207,062	2,003,654	2,914,482	2,288,901	1,319,939

Figure 75 – CAPEX, Other CAPEX

Having enabled the **Other** radio button (Figure 75) allows configuring the following parameters:

- **Spectrum License Acquisition:** This input data box denotes the one-time costs related to the WiMAX spectrum license.
- **Other:** These rows of input data boxes denote the other annual CAPEX costs per each year of the analysis period.

Chart: Shows temporal evolution of CAPEX breakdown.

Table: Provides the temporal evolution of CAPEX breakdown.

7.3 Depreciation

Depreciation is used in accounting to try to match the expense of an asset to the income that the asset helps the company earn.



Figure 76 – Depreciation

Having clicked on the **Depreciation** button in the upper part of the page (Figure 76) allows configuring the following parameters:

- **Years to Depreciate:** These columns of input data boxes denote the years to depreciate costs for each CAPEX item (**Base Station, User Terminal, ASN Gateway, CSN, Wireless Backhaul, Spectrum License, Other CAPEX**).

Chart: Shows depreciation breakdown per each year of the analysis period.

Table: Provides the depreciation breakdown per each year of the analysis period.

7.4 OPEX

After having clicked on the **OPEX** button in the upper part of the page, enabling the **Cost of Service** or the **Sales, General & Administrative** radio button on the left side menu allows to define its OPEX costs for each OPEX item selected from the corresponding **OPEX Item** scroll-down menu list.

7.4.1 Cost of Service

Base Station



	Y1	Y2	Y3	Y4	Y5	Y6
Base Station [€]	41,905	118,320	204,595	322,915	436,305	505,325
User Terminal [€]	599	6,449	22,057	51,537	87,429	113,025
ASN Gateway [€]	17,500	25,000	35,000	35,000	35,000	35,000
CSN [€]	20,000	40,000	40,000	40,000	40,000	40,000
Wireless Backhaul [€]	0	5,000	20,000	40,500	55,500	62,000
Wired Backhaul [€]	23,423	211,951	539,514	928,305	1,240,653	1,321,629
Spectrum License [€]	0	0	0	0	0	0
VoIP [€]	4,637	51,624	148,412	284,484	422,421	501,248
Tech Ops (Salaries & Benefits) [€]	110,250	129,780	150,383	189,315	212,721	310,396
Other COS [€]	0	0	0	0	0	0

Figure 77 – OPEX, Base Station

Having selected the **Cost of Service** radio button and the **Base Station** OPEX item from the scroll-down menu list (Figure 77), it is possible to define the corresponding annual costs associated to each type of Base Station. The number of types of Base Stations and the name of each type of Base Station should have been set in the *Project Setup* page. For each type of Base Station it is possible to define its key OPEX costs in terms of:

- **Site Lease & Utilities:** This column of input data boxes denotes the annual costs for Base Station lease and utilities.
- **Maintenance & spare:** This column of input data boxes denotes the annual costs for Base Station maintenance and spare parts.
- **Technical Support:** This column of input data boxes denotes the annual costs for Base Station technical support.
- **Quality & Assurance:** This column of input data boxes denotes the annual costs for Base Station quality and assurance.
- **Operation:** This column of input data boxes denotes the annual operational costs.
- **Other:** This column of input data boxes denotes the other annual operational costs.

User Terminal



	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Base Station [€]	41,305	118,320	204,595	322,915	436,305	505,325	565,325	565,325
User Terminal [€]	599	6,449	22,057	51,537	87,429	113,025	113,025	113,025
ASN Gateway [€]	17,500	35,000	35,000	35,000	35,000	35,000	35,000	35,000
CSN [€]	20,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
Wireless Backhaul [€]	0	5,000	20,000	40,500	55,500	62,000	62,000	62,000
Wired Backhaul [€]	23,423	211,951	339,514	628,395	1,240,653	1,327,629	1,327,629	1,327,629
Spectrum License [€]	0	0	0	0	0	0	0	0
VoIP [€]	4,637	51,024	148,412	284,884	422,421	501,248	501,248	501,248
Tech Ops (Salaries & Benefits) [€]	110,250	129,780	150,383	189,315	212,721	310,396	310,396	310,396
Other COS [€]	0	0	0	0	0	0	0	0

Figure 78 – OPEX, User Terminal

Having selected the **Cost of Service** radio button and the **User Terminal** OPEX item from the scroll-down menu list (Figure 78), it is possible defining the corresponding annual costs associated to each type of User Terminal. The number of types of User Terminals and the name of each type of User Terminal should have been set in the *Project Setup* page. For each type of User Terminal it is possible to define its key OPEX costs in terms of:

- **Maintenance & spare:** This column of input data boxes denotes the annual costs for User Terminal maintenance and spare parts.
- **Other:** This column of input data boxes denotes the other annual operational costs for User Terminals.

ASN Gateway & CSN



Figure 79 – OPEX, ASN Gateway & CSN

Having selected the **Cost of Service** radio button and the **ASN Gateway & CSN** OPEX item from the scroll-down menu list (Figure 79), it is possible defining the corresponding annual costs in terms of:

- **Maintenance & spare:** This input data box denotes the annual costs for ASN Gateway/CSN maintenance and spare parts.
- **Technical Support:** This input data box denotes the annual costs for ASN Gateway/CSN technical support.
- **Quality & Assurance:** This input data box denotes the annual costs for ASN Gateway/CSN quality and assurance.
- **Operation:** This input data box denotes the annual costs for ASN Gateway/CSN operation.
- **Other:** This input data box denotes the other annual operational costs for ASN Gateway/CSN.

Backhauling

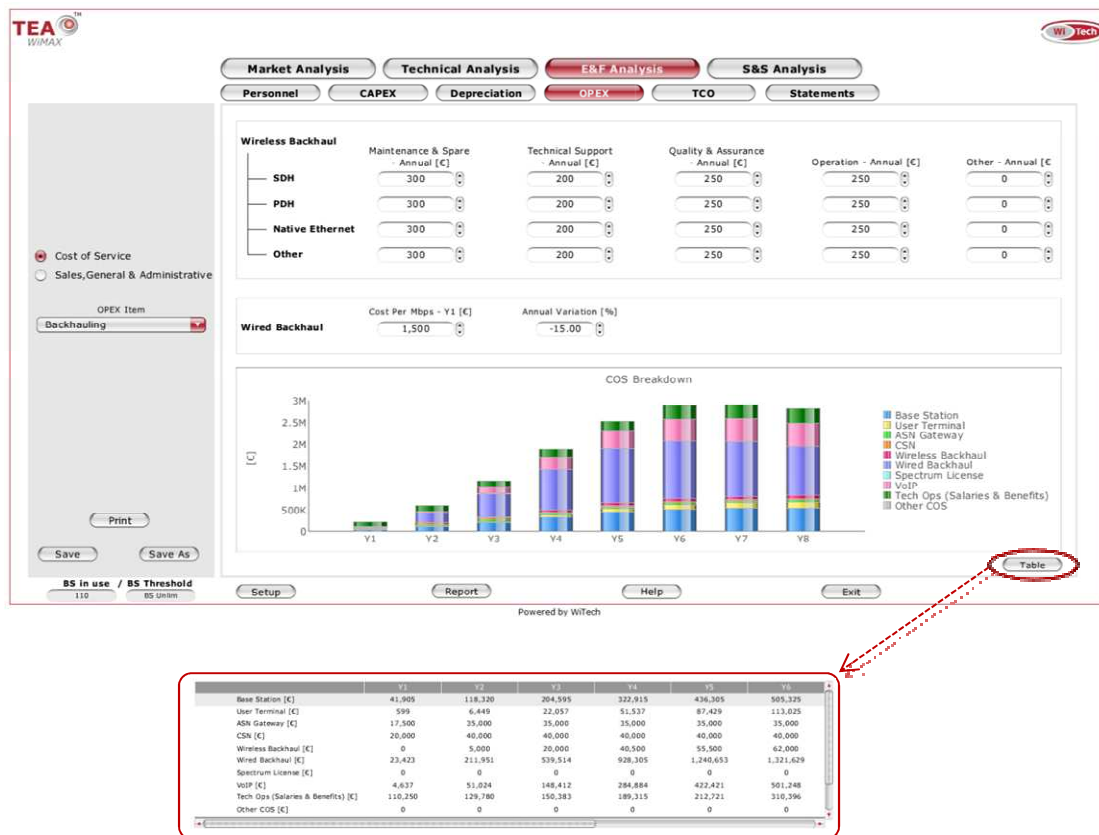


Figure 80 – OPEX, Backhauling

Having selected the **Cost of Service** radio button and the **Backhauling** OPEX item from the scroll-down menu list (Figure 80), it is possible to define the corresponding annual costs in terms of:

Wireless Backhaul

- **Maintenance & spare:** This column of input data boxes denotes the annual costs for wireless backhaul maintenance and spare parts, per each type of wireless backhauling considered in the analysis.
- **Technical Support:** This column of input data boxes denotes the annual costs for wireless backhaul technical support, per each type of wireless backhauling considered in the analysis.
- **Quality & Assurance:** This column of input data boxes denotes the annual costs for wireless backhaul quality and assurance, per each type of wireless backhauling considered in the analysis.
- **Operation:** This column of input data boxes denotes the annual costs for wireless backhaul operation, per each type of wireless backhauling considered in the analysis.

- **Other:** This column of input data boxes denotes the other operational annual costs, per each type of wireless backhauling considered in the analysis.

Wired Backhaul

- **Cost per Mbps (Y1 – Annual Variation [%]):** These two input data boxes denote the annual connectivity costs per Mbps evaluated at first year of the analysis period. An annual variation, that can be either positive (increase) or negative (decrease), is considered as percentage on it.

Other COS



Figure 81 – OPEX, Other COS

Having selected the **Cost of Service** radio button and the **Other COS** OPEX item from the scroll-down menu list (Figure 81), it is possible defining the corresponding annual costs in terms of:

- **Spectrum License - WiMAX Annual:** This input data box denotes the annual cost related to the WiMAX spectrum license.

- **Spectrum License - Other Annual:** This input data box denotes the annual cost related to other possible spectrum license.
- **VoIP as Service Fee Percentage [%]:** This row of input data box denotes the annual VoIP connection cost evaluated as percentage of service fee related to the VoIP service, per each year of the analysis period.
- **Other COS:** This rows of input data boxes denote the other annual cost of service per each year of the analysis period.

Chart: Shows cost of service breakdown per each year of the analysis period.

Table: Provides the cost of service breakdown per each year of the analysis period.

7.4.2 Sales, General & Administrative

G&A, MKT, Sales



	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
General and Administrative [K]	392,495	438,834	504,958	595,034	667,755	803,417		
Marketing and Sales [K]	107,740	244,901	430,234	725,396	821,433	760,854		
Customer Acquisition [K]	20,640	181,040	356,960	659,280	577,960	304,360		
Customer Care [K]	1,998	19,340	46,399	85,255	115,247	127,830		
Billing [K]	516	5,558	19,008	44,414	75,345	97,403		
Bad Debts and Churn [K]	1,998	19,340	46,399	85,255	115,247	127,830		
Other SG&A [K]	0	0	0	0	0	0		
Total Sales, General & Administrative	525,387	909,102	1,409,958	2,194,623	2,372,988	2,221,695		
TOTAL OPEX [K]	743,700	1,506,627	2,569,918	4,087,079	4,903,616	5,110,317		

Figure 82 – OPEX, G&A, MKT, Sales

Having selected the **Sales, General & Administrative** radio button and the **G&A, MKT, Sales**

OPEX item from the scroll-down menu list (Figure 82), it is possible defining the corresponding annual costs in terms of:

- **General & Administrative as Revenues Percentage [%]:** This row of input data boxes denotes the General and Administrative costs evaluated as percentage of revenues, per each year of the analysis period.
- **Marketing as Revenues Percentage [%]:** This row of input data boxes denotes the Marketing costs evaluated as percentage of revenues, per each year of the analysis period.
- **Sales as Revenues Percentage [%]:** This row of input data boxes denotes the Sales costs evaluated as percentage of revenues, per each year of the analysis period.

Customer Acquisition & Care



Figure 83 – OPEX, Customer Acquisition & Care

Having selected the **Sales, General & Administrative** radio button and the **Customer Acquisition & Care** OPEX item from the scroll-down menu list (Figure 83), it is possible defining the corresponding annual costs in terms of:

- **Customer acquisition: Cost per user (Y1 – Annual Variation [%]):** This two input data boxes denotes the one-time customer acquisition costs evaluated at first year of the analysis period and annual variation as percentage on it. The annual variation can be either positive (increase) or negative (decrease).
- **Customer Care as Revenues Percentage [%]:** This row of input data boxes denotes the Customer Care costs evaluated as percentage of revenues, per each year of the analysis period.

Other SG&A

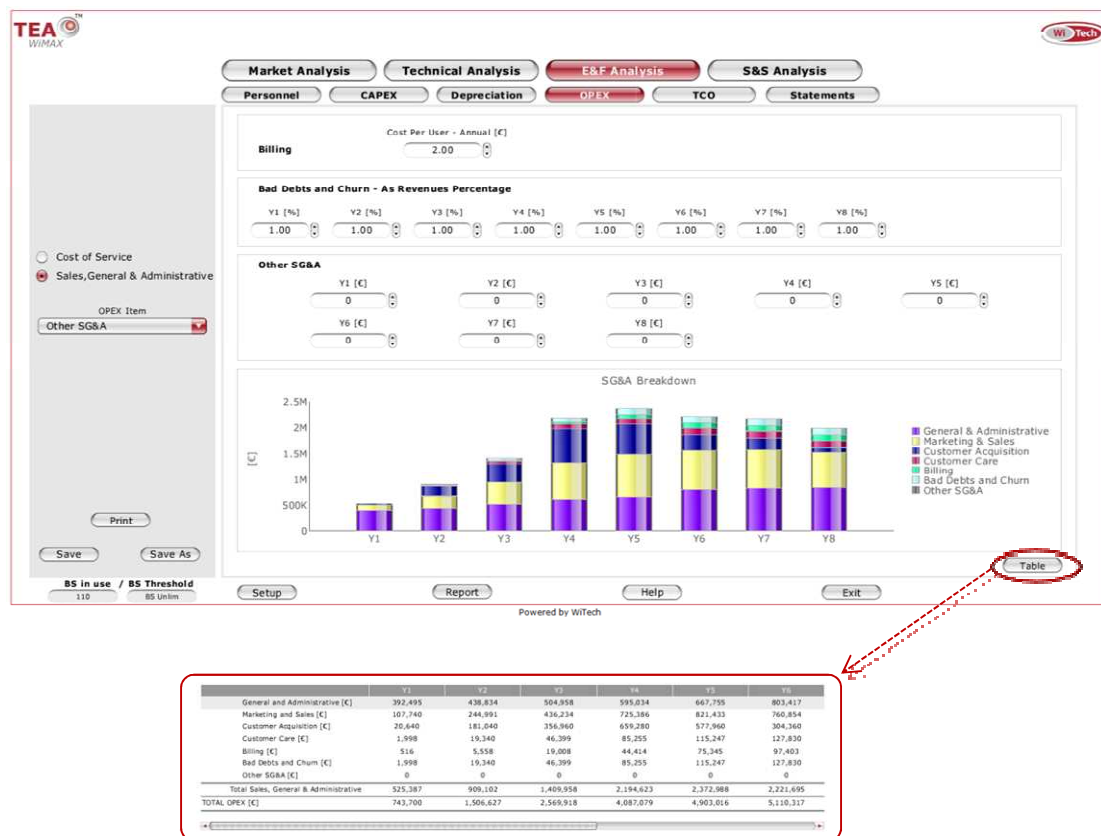


Figure 84 – OPEX, Other SG&A

Having selected the **Sales, General & Administrative** radio button and the **Other SG&A** OPEX item from the scroll-down menu list (Figure 84), it is possible to define the corresponding annual costs in terms of:

- **Billing: Cost per user - Annual:** This input data box denotes the annual billing cost per user.

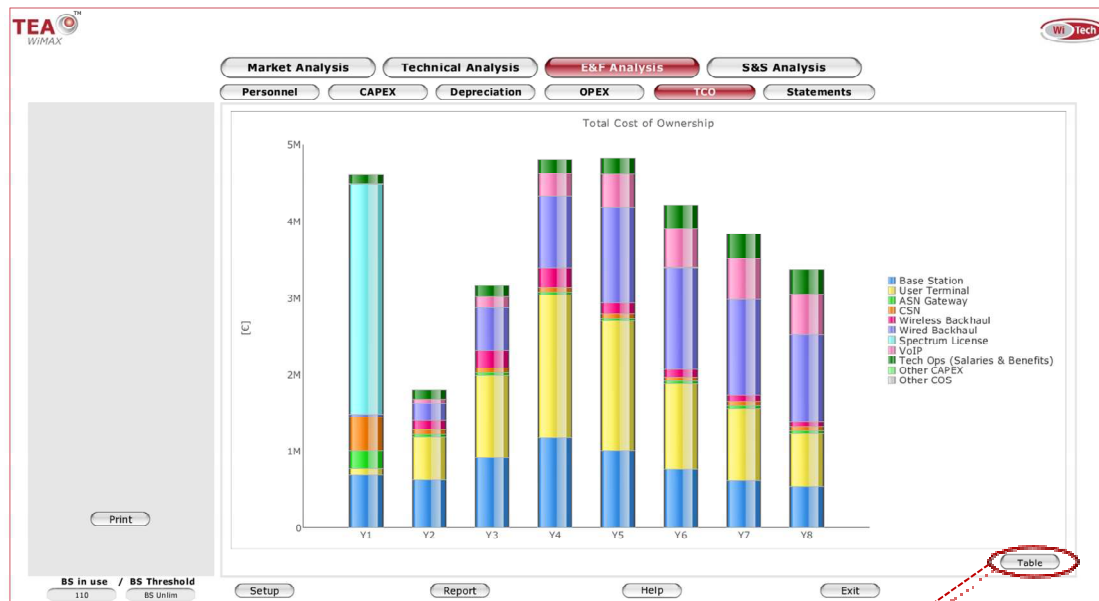
- **Bad Debts and Churn as Revenues Percentage [%]:** This row of input data boxes denotes the Bad Debts and Churn impact costs evaluated as percentage of revenues, per each year of the analysis period.
- **Other SG&A:** This rows of input data boxes denote the other annual Sales, General and Administrative costs, per each year of the analysis period.

Chart: Shows marketing, sales, general and administrative costs breakdown per each year of the analysis period. The marketing, sales, general and administrative items costs includes salaries and benefits.

Table: Provides marketing, sales, general and administrative costs breakdown per each year of the analysis period.

7.5 TCO

After having clicked on the **TCO** button in the upper part of the page (Figure 85), an output page will open which will present **TCO (Total Cost of Ownership)** results, in order to fully evaluate all direct and indirect costs related to the WiMAX initiative under analysis. It is important to underline that the **TCO** (for *Base Station, User terminal, ASN Gateway, CSN, Wireless Backhaul, Wired Backhaul*) shown in the *chart* are referred to the sum of Capex and Cost Of Service (COS). The breakdown of these costs is provided in the *Table*.



	Y1	Y2	Y3	Y4	Y5	Y6
CAPEX						
Base Station (K)	851,100	502,600	708,540	858,492	570,882	256,246
User Terminal (K)	76,629	565,832	1,054,544	1,816,000	1,601,189	1,000,563
ASN Gateway (K)	225,000	0	0	0	0	0
CSN (K)	425,000	19,750	19,750	19,750	19,750	19,750
Wireless Backhaul (K)	0	113,000	212,000	214,900	89,100	39,600
Wired Backhaul (K)	7,140	5,880	8,820	11,340	7,980	3,780
Spectrum License (K)	3,000,000	0	0	0	0	0
Other CAPEX (K)	0	0	0	0	0	0
Total CAPEX (K)	4,376,869	1,207,062	2,003,654	2,914,482	2,288,901	1,319,939
Cost Of Service						
Base Station (K)	41,905	118,320	204,595	322,915	436,305	505,325
User Terminal (K)	599	6,449	22,057	51,537	87,429	113,025
ASN gateway (K)	17,300	35,000	35,000	35,000	35,000	35,000
CSN (K)	20,000	40,000	40,000	40,000	40,000	40,000
Wireless Backhaul (K)	0	5,000	20,000	40,500	55,500	62,000
Wired Backhaul (K)	23,423	211,951	539,514	926,295	1,240,653	1,321,629
Spectrum License (K)	0	0	0	0	0	0
VoIP (K)	4,637	51,024	148,412	284,884	422,421	501,248
Tech Ops (Salary & Benefits) (K)	110,350	129,780	150,383	189,315	212,721	310,396
Other COS (K)	0	0	0	0	0	0
Total Cost Of Service (K)	218,313	597,525	1,159,960	1,892,456	2,530,029	2,888,622
TOTAL COST OF OWNERSHIP (K)	4,595,182	1,804,587	3,163,614	4,806,938	4,818,930	4,208,561

Figure 85 – TCO

Chart: Shows Total Cost of Ownership breakdown per each year of the analysis period.

Table: Provides the Total Cost of Ownership breakdown per each year of the analysis period.

7.6 Statements

After having clicked on the **Statements** button in the upper part of the page, enabling the **Profit & Loss**, **Cash Flow** or **Balance Sheet** radio button on the left side allows to manage the corresponding statement for the WiMAX initiative under analysis.

7.6.1 Profit & Loss

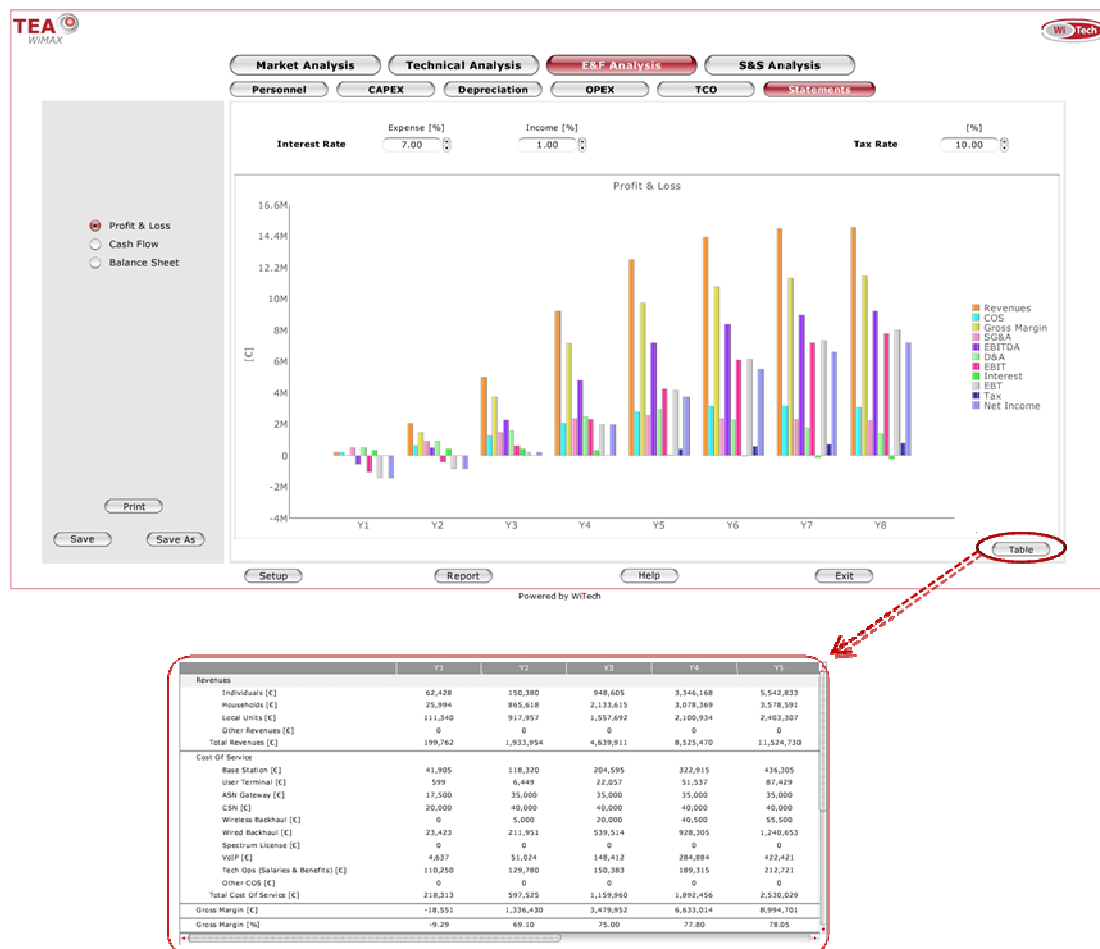


Figure 86 – Profit & Loss

Having enabled the **Profit & Loss** radio button (Figure 86) allows managing the initiative's Profit and Loss statement that indicates how revenue is transformed into net income. The purpose of the income statement is to show whether the WiMAX initiative made or lost money during the analysis period.

The following parameters are required to be entered:

- **Interest Rate: Expense [%]:** This input data box denotes the interest that a company pays to bondholders, banks or private lenders.
- **Interest Rate: Income [%]:** This input data box denotes the interest that a company earns for business and short-term deposit investments
- **Tax Rate [%]:** This input data box denotes the percentage of income paid as tax.

Chart: Shows main all main items of the *Profit and Loss* statement: *Revenues*, *COS*, *SG&A*, *EBITDA*, *D&A*, *EBIT*, *Interest*, *EBT*, *Tax* and *Net Income*.

Table: Summarizes the *Profit and Loss* statement.

7.6.2 Cash Flow



	Y1	Y2	Y3	Y4	Y5
EBITDA [€]	-543,938	427,328	2,069,993	4,438,391	6,621,714
Working Capital Needs [€]	335,720	-519,713	-345,932	-518,241	-527,690
CAPEX					
Base Station [€]	651,100	592,600	706,540	856,492	570,882
User Terminal [€]	70,629	565,832	1,854,344	1,810,000	1,601,389
ASN Gateway [€]	225,000	0	0	0	0
CSN [€]	425,000	19,750	19,750	19,750	19,750
Wireless Backhaul [€]	0	113,000	212,000	214,900	89,100
Wired Backhaul [€]	7,140	9,800	8,800	11,340	7,900
Spectrum License [€]	3,000,000	0	0	0	0
Other CAPEX [€]	0	0	0	0	0

Figure 87 – Cash Flow

Having enabled the **Cash Flow** radio button (Figure 87) allows managing the initiative's Cash Flow statement that shows the flow of cash generated by the WiMAX initiative under analysis. The following parameters are required to be entered:

- **Discount Rate:** This input data box denotes the interest rate used to determine the present value of future cash flows.
- **Perpetual Growth:** This input data box denotes the rate of growth of the cash flows.
- **Financing:** This scroll-down menu list allows selecting the **Financing** item to characterize, per each year of the analysis period, the following parameters:
 - o **Debt Value:** This input data box denotes the amount of loan money in the referring year.

- o **Annual Interest rate [%]:** This input data box denotes the annual interest rate applied to debt value got in the referring year.
- o **Years to Pay off:** This input data box denotes the years in which the loan got in the referring year will be paid off.
- **Equity:** This rows of input data boxes denote the equity capital of the company

Chart: Shows the cash flow statement.

Table: Summarizes the cash flow statement.

7.6.3 Balance Sheet



	Y1	Y2	Y3	Y4	Y5
Current Assets					
Cash [€]	-4,493,003	-6,289,327	-7,085,368	-6,525,752	-3,202,115
Accounts receivable [€]	113,773	414,634	977,085	1,780,422	2,374,085
Total Current Assets [€]	-4,379,230	-5,874,693	-6,108,283	-4,745,330	-837,130
Long Term Assets					
Property, Plant & Equipment (PP&E) [€]	1,371,729	2,572,911	4,567,745	7,470,887	9,751,808
Accumulated Depreciation [€]	292,135	991,455	2,366,591	4,577,040	7,192,957
Net Fixed Assets [€]	1,079,595	1,581,456	2,201,154	2,893,847	2,558,851
Intangible assets [€]	3,007,149	3,013,809	3,021,840	3,032,180	3,041,169
Accumulated Depreciation [€]	202,380	406,720	614,000	822,680	1,032,060
Net Intangible assets [€]	2,804,769	2,606,300	2,407,840	2,210,500	2,009,109
Total Long Term Assets [€]	3,884,355	4,187,756	4,608,994	5,104,348	4,567,951
Total Assets [€]	-494,875	-1,686,937	-1,499,289	359,517	3,740,821
Short-Term Liabilities					
Accounts payable [€]	449,493	230,641	447,161	732,256	799,129
Total Short-Term Liabilities [€]	449,493	230,641	447,161	732,256	799,129
Long-Term Liabilities					
Senior debt [€]	500,000	0	0	0	0
Accumulated Repayment [€]	-46,501	-50,360	-54,540	-59,567	-63,969
Net senior debt [€]	453,499	403,139	348,599	289,533	225,563

Figure 88 – Balance Sheet

Having enabled the **Balance Sheet** radio button (Figure 88) allows managing the initiative's Balance Sheet statement which is a summary of the initiative balances: assets, liabilities and

ownership equity are listed as of a specific date, such as the end of its financial year. The following parameters are required to be entered:

- **Accounts Receivable:** This input data box denotes the amounts of money billed to customers and owed to company on the balance sheet's date.
- **Accounts Payable:** This input data box denotes the amounts of money that company owes to suppliers, but has not been paid yet on the balance sheet's date.
- **VAT Receivable From Government [Days]:** This input data box denotes the days to carry forward the VAT excess credit from the Government.
- **VAT Payable To Government [Days]:** This input data box denotes the days to charge the VAT payment to the Government.
- **Year:** playing on this play button, the balance sheet chart will update per each year of the analysis period.

Chart: Shows the balance sheet statement per each year of the analysis period.

Table: Provides details of balance sheet statements.

8 Scenario & Sensitivity Analysis

To start performing the *Scenario & Sensitivity Analysis*, select the corresponding **Scenario & Sensitivity Analysis** button in the upper part of the *Analysis* page. Please read the “*License-Limited Maximum Number of Base Stations*” section in Chapter if you have a software license with a limited maximum number of Base Stations and this button will not be visible.

In the *Scenario & Sensitivity Analysis* pages, all data can be entered by means of both a standard input data box and a play button, which allows exploring automatically the values in a range. You can modify the lower and upper limits of a range.

The influence of parameter and boundary condition changes can be visualized in real time on the following charts, depending on the section you are in:

- **Net Users:** Shows temporal evolution of actual number of *Individuals*, *Households* and *Local Units* in the network.
- **Revenues:** Shows temporal evolution of forecasted revenues for *Individuals*, *Households* and *Local Units*.
- **Roll-out Plan:** Shows temporal evolution of Base Stations, radio links and logical sectors deployment for each area involved in the analysis and the total area to be covered.
- **CAPEX:** Shows temporal evolution of CAPEX breakdown.
- **OPEX:** Shows temporal evolution of OPEX breakdown.
- **TCO:** Shows Total Cost of Ownership breakdown per each year of the analysis period.
- **P&L:** Shows main items of the Profit and Loss statement: *Revenues*, *COS*, *SG&A*, *EBITDA*, *D&A*, *EBIT*, *Interest*, *EBT*, *Tax* and *Net Income*.
- **Cash Flow:** Shows the cash flow statement.

8.1 Market Analysis

After having clicked on the **Market Analysis** button in the upper part of the page, enabling the **User Target Percentage**, **Pricing Policies**, **Distribution Rates**, or **Penetration Rate** radio button on the left side allows to perform the corresponding, specific *Scenario & Sensitivity Analysis*.

8.1.1 Users Target Percentage



Figure 89 – Market Analysis, Users Target Percentage

Having enabled the **User Target Percentage** radio button (Figure 89) allows performing the corresponding *Scenario & Sensitivity* analysis.

The **Area** scroll-down menu list on the left side allows selecting the geographical area to be analyzed. For each area it is possible to play with the following parameter:

- **Target Percentage [%]:** This column of input data boxes denotes the percentages of *Population, Households, Micro, Small, Medium* and *Large Local Units* to be served.

8.1.2 Pricing Policies



Figure 90 – Market Analysis, Pricing Policies

Having enabled the **Pricing Policies** radio button (Figure 90) allows performing the corresponding *Scenario & Sensitivity* analysis.

The **Service Profile** scroll-down menu list on the left side allows selecting the service profile to be analyzed. For each service profile it is possible to play with the following parameters:

- **Monthly Service Fee (Y1):** This row of input data boxes denotes the fees for the service offered. The fee is characterized by the monthly cost at the first year of the analysis period related to both Internet Access and VoIP service.
- **One Time – Activation Fee (Y1):** These columns of input data boxes denote the one-time fees to activate the service per each type of User Terminal. Each fee is characterized by the cost at first year of the analysis period.
- **Monthly – Lease Fee (Y1):** These columns of input data boxes denote the monthly fees to lease each type of User Terminal. Each fee is characterized by the cost at first year of the analysis period.

Limits: Enables to set the lower and upper limits of the range that will be explored automatically by means of the play button, per each parameter aforementioned. Be careful to set the *Upper Limit* first and then set the *Lower Limit* (to avoid the *Lower Limit* being overwritten to zero). Until the limits are not set, the various input data boxes will have a red background.

8.1.3 Distribution Rates



Figure 91 – Market Analysis, Distribution Rates

Having enabled the ***Distribution Rates*** radio button (Figure 91) allows performing the corresponding *Scenario & Sensitivity* analysis.

The **Service Profile** scroll-down menu list allows selecting the service profile whilst the **Market Segment** scroll-down menu list allows selecting the market segment to be analyzed. For each combination of *Service Profile / Market Segment* it is possible to play with the following parameters:

- **Distribution [%]:** This input data box denotes the distribution of service profiles per each market segment.

- [illegible]

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Having enabled the **Penetration Rate** radio button (Figure 92) allows performing the corresponding *Scenario & Sensitivity* analysis.

The **Area** scroll-down menu list allows selecting the geographical area whilst the **Market Segment** scroll-down menu list allows selecting the market segment to be analyzed. For each combination of geographical area / market segment it is possible to play with the following parameter:

- **Penetration Rate [%]:** These columns of input data boxes denote the percentage of forecasted users on the specific market segment per each year of the analysis period.

8.2 Technical Analysis

After having clicked on the **Technical Analysis** button in the upper part of the page, enabling the **Profile**, **Base Station Choice**, **Multiple Antenna Systems**, or **Network Dimensioning** radio button on the left side allows to perform the corresponding, specific *Scenario & Sensitivity* Analysis.

8.2.1 Profile

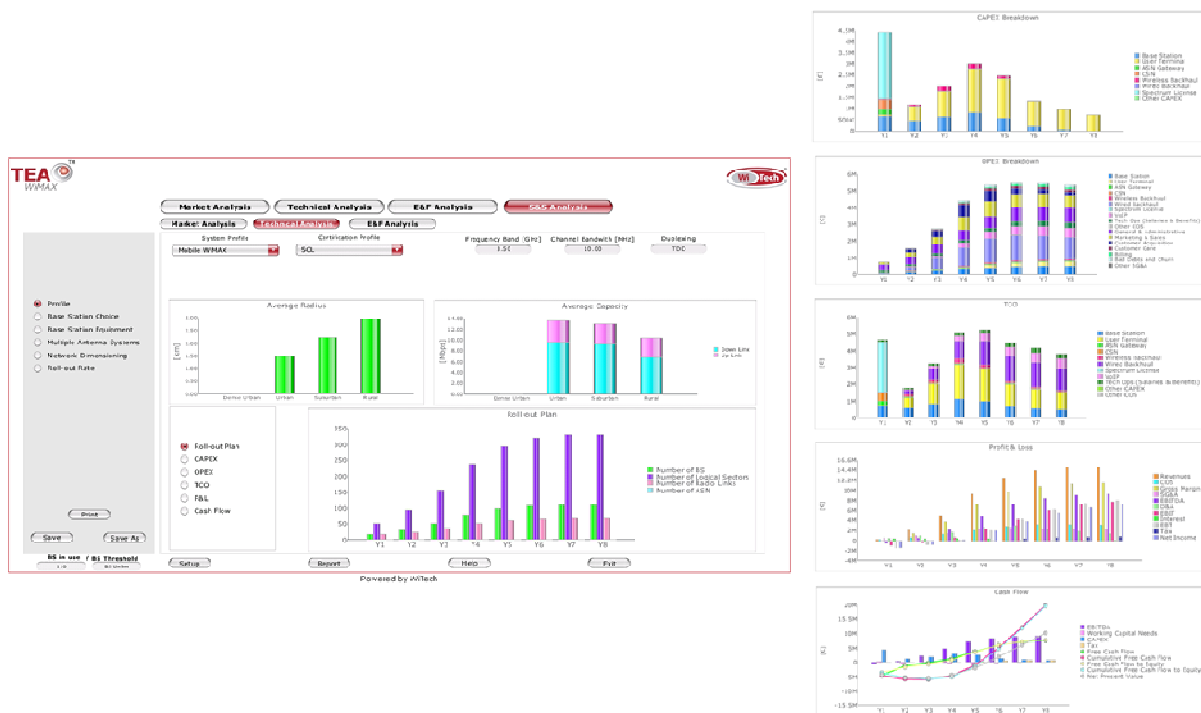


Figure 93 – Technical Analysis, Profile

Having enabled the **Profile** radio button (Figure 93) allows performing the corresponding *Scenario & Sensitivity* analysis playing with the following parameters:

- **Certification Profile:** This scroll-down menu list allows selecting a *Certification Profile* related to the selected WiMAX Forum's *System Profile*. All *Certification Profiles* approved by the WiMAX Forum are available; moreover, it is possible to define a *Custom Profile* for both WiMAX Forum's *System Profiles*. *Custom Profile* allows to customize the WiMAX technology settings.
- **Frequency Band [GHz]:** This scroll-down menu list allows selecting a Carrier frequency supported in the selected *Certification Profile*. This parameter is automatically calculated by the tool for the WiMAX Forum's *Certification Profile*; for the *Custom Profile*, it is possible to manually set it.
- **Channel Bandwidth [MHz]:** This scroll-down menu list allows selecting the nominal channel bandwidth supported in the selected *Certification Profile*. This parameter is automatically calculated by the tool for the WiMAX Forum's *Certification Profiles*, for the *Custom Profile* it is possible to chose it among a list, defined according to the IEEE 802.16d Rev2004 and 802.16e standards.
- **Duplexing:** This scroll-down menu list allows selecting the format of the duplexing technique supported in the selected certification profile. This is the way Down Link and Up Link data is arranged in a two-way wireless transmission. Two duplexing techniques are allowed: *FDD (Frequency Division Duplexing)* and *TDD (Time Division Duplexing)*. This parameter is automatically set by the tool for the WiMAX Forum's certification profiles; for the *Custom* certification profile it is possible to manually set it.

8.2.2 Base Station Choice



Figure 94 – Technical Analysis, Base Station Choice

Having enabled the **Base Station Choice** radio button (Figure 94) allows performing the corresponding *Scenario & Sensitivity* analysis playing with the following parameters:

1. **Dense Urban:** This column of input data boxes allows choosing the Base Station type to be adopted in the Dense Urban scenario. Only one Base Station type is selectable: to do it, select the related check.
2. **Urban:** This column of input data boxes allows choosing the Base Station type to be adopted in the Urban scenario. Only one Base Station type is selectable: to do it, select the related check.
3. **Suburban:** This column of input data boxes allows choosing the Base Station type to be adopted in the Suburban scenario. Only one Base Station type is selectable: to do it, select the related check.
4. **Rural:** This column of input data boxes allows choosing the Base Station type to be adopted in the Rural scenario. Only one Base Station type is selectable: to do it, select the related check.

8.2.3 Base Station Equipment

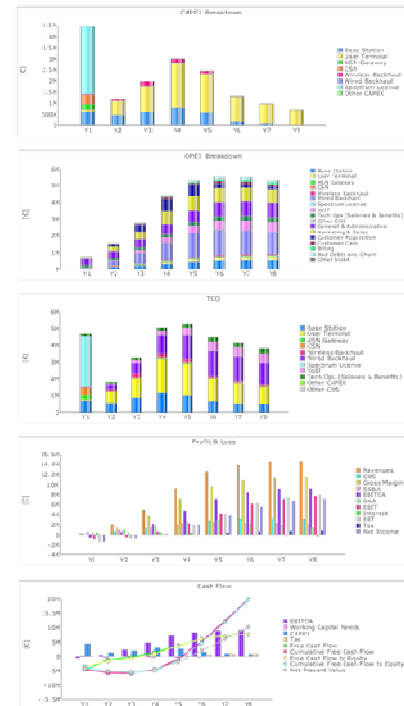


Figure 95 – Technical Analysis, Base Station Equipment

Having enabled the **Base Station Equipment** radio button (Figure 95) allows performing the corresponding *Scenario & Sensitivity* analysis playing with the following parameters:

- Multi carrier configuration:** This column of input check boxes allows defining if double carrier configuration is supported. This technique is used to enhance the capacity per each sector by using two different carriers per each sector.
- Transmit Power [dBm]:** This column of input data box denotes the power at each antenna connector. . The transmit power per carrier in the double carrier configuration is half of the transmit power per carrier in the single carrier configuration.

8.2.4 Multiple Antenna Systems



Figure 96 – Technical Analysis, Multiple Antenna Systems

Having enabled the **Multiple Antenna System** radio button (Figure 96) allows performing the corresponding *Scenario & Sensitivity* analysis playing with the following parameters:

- **Dense Urban:** This column of input data boxes allows including multiple antenna system effect in the performance analysis for the Dense Urban scenario.
- **Urban:** This column of input data boxes allows including multiple antenna system effect in the performance analysis for the Urban scenario.
- **Suburban:** This column of input data boxes allows including multiple antenna system effect in the performance analysis for the Suburban scenario.
- **Rural:** This column of input data boxes allows including multiple antenna system effect in the performance analysis for the Rural scenario.

8.2.5 Network Dimensioning



Figure 97 – Technical Analysis, Network Dimensioning

Having enabled the **Network Dimensioning** radio button (Figure 97) allows performing the corresponding **Scenario & Sensitivity** analysis playing with the following parameters:

- **BS Overlapping Factor [%]:** This row of input data boxes denotes the percentage of overlapping area between two contiguous Base Stations in the considered scenario.
- **BS With Wireless Backhaul [%]:** This row of input data boxes denotes the percentage of required Base Stations that are not linked to wired backhaul in the considered scenario.

8.2.6 Roll-out Rate

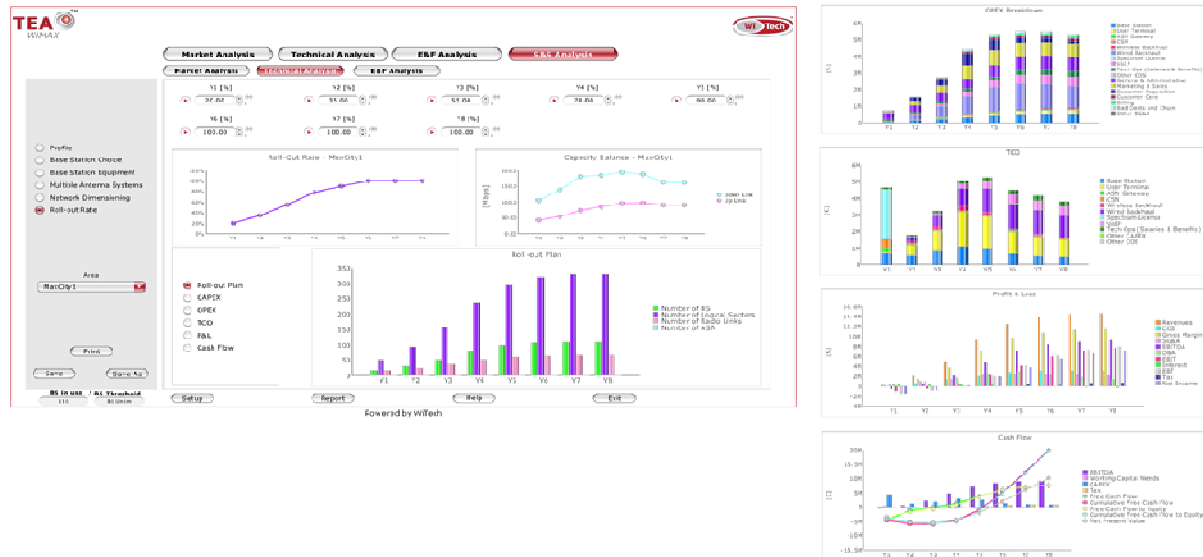


Figure 98 – Technical Analysis, Roll-out Rate

Having enabled the **Roll-out** radio button (Figure 98) allows performing the corresponding *Scenario & Sensitivity* analysis.

The **Area** scroll-down menu list allows selecting the geographical area to be analyzed. For each geographical area, it is possible to play with the following parameter:

- **Roll – out Rate [%]:** This row of input data boxes denotes the percentage of year-on-year deployed infrastructure characterized as annual percentage of implementation on total network dimensioning.

8.3 Economic & Financial Analysis

After having clicked on the **E&F Analysis** button in the upper part of the page, enabling the **CAPEX** or **OPEX** radio button on the left side allows to perform the corresponding, specific *Scenario & Sensitivity Analysis*.

8.3.1 CAPEX

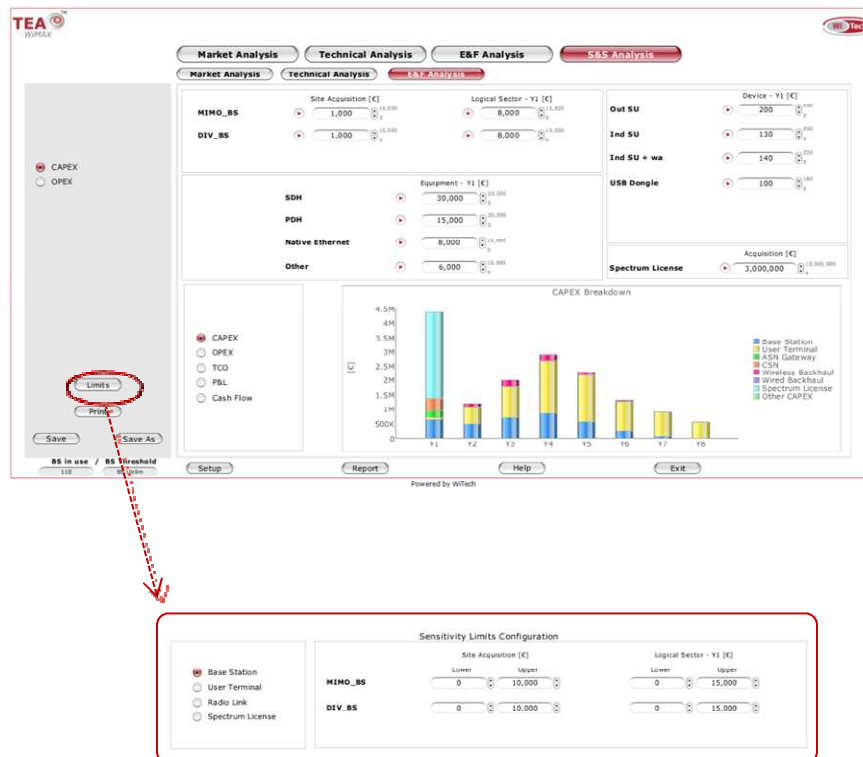


Figure 99 – E&F Analysis, CAPEX

Having enabled the **CAPEX** radio button (Figure 99) allows performing the corresponding *Scenario & Sensitivity* analysis playing with the following parameters:

- **Site Acquisition:** This column of input data boxes denotes the one-time cost related to the acquisition of the site where the Base Station is located per each type of Base Station considered in the analysis.
- **Logical Sector - Y1:** This column of input data boxes denotes the logical sector unit cost defined at first year of the analysis period.
- **Device - Y1:** This column of input data boxes denotes the User Terminal unit cost defined at first year of the analysis period.
- **Equipment - Y1:** This columns of input data boxes denotes the hardware cost to implement a single radio link at first year of the analysis period.
- **Spectrum License Acquisition:** This input data box denotes the one-time cost related to the WiMAX spectrum license.

Limits: Enables to set the lower and upper limits of the range that can be explored automatically by means of the play button, per each parameter aforementioned. Be careful to set the *Upper Limit* first and then set the *Lower Limit* (to avoid the *Lower Limit*

being overwritten to zero). Until the limits are not set, the various input data boxes will have a red background.

8.3.2 OPEX



Figure 100 – E&F Analysis, OPEX

Having enabled the **OPEX** radio button (Figure 100) allows performing the corresponding *Scenario & Sensitivity* analysis playing with the following parameters:

- **Site Lease & Utilities:** This column of input data boxes denotes the annual cost for Base Station lease and utilities, per each type of Base Station considered in the analysis.
- **Wired Backhaul Cost per Mbps – Y1:** This input data box denotes the annual connectivity cost per Mbps evaluated at first year of the analysis period.
- **Customer acquisition – Y1:** This input data box denotes the one-time customer acquisition cost evaluated at first year of the analysis period.

Limits: Enables to set the lower and upper limits of the range that can be explored automatically, by means of the play button, per each parameter aforementioned. Be careful to set the *Upper Limit* first and then set the *Lower Limit* (to avoid the *Lower Limit* being overwritten to zero). Until the limits are not set, the various input data boxes will have a red background.

9 Parameters pre-set to typical/recommended values

9.1 Technical Analysis module

In addition to the setting defined by the WiMAX Form for the Fixed WiMAX and Mobile WiMAX System Profiles, to help run the Technical Analysis, a number of relevant parameters in this module are, by default, pre-set to typical/recommended values when you create a new project. You can change these values at any time during the analysis. A summary of the pre-set parameters is provided below:

Table 7 – Pre-set parameters, Technology Sub-module

Parameter	Value
DL/UL Ratio	70%
Throughput Percentage	85%
Down Link Overhead Symbols	6
Up Link Overhead Symbols	3

Table 8 – Pre-set parameters, Equipment Sub-module, Base Station

Parameter	Value
Transmit Power	36 dBm
Antenna Gain	17 dBi
Other Gain	0 dB
Connection Losses	0 dB
Other Losses	0 dB
Sector Number	3
Number of Antenna Elements in Transmission	1
Number of Antenna Elements in Reception	2

Table 9 – Pre-set parameters, Equipment Sub-module, User Terminal

Parameter	Outdoor SU	Indoor SU	USB Dongle
Transmit Power	27 dBm	27 dBm	23 dBm
Antenna Gain	15 dBi	6 dBi	2 dBi
Other Gain	0 dB	0 dB	0 dB
Connection Losses	0 dB	0 dB	0 dB
Other Losses	0 dB	0 dB	0 dB
Number of Antenna Elements in Transmission	1	1	1
Number of Antenna Elements in Reception	2	2	2
Penetration/Body Loss	0 dB	12 dB	12 dB

Table 10 – Pre-set parameters, Equipment Sub-module, Multiple Antenna Systems

Parameter	Value
Down Link MRC Gain	3 dB
Up Link MRC Gain	3 dB

Table 11 – Pre-set parameters, Performance

Parameter	Dense Urban	Urban	Suburban	Rural
Cell Edge Coverage Probability	75%	75%	75%	75%
Lognormal Shadowing Standard Deviation	8 dB	8 dB	7 dB	6 dB
Fast Fading Margin	2 dB	2 dB	2 dB	2 dB
Interference Margin	1 dB	1 dB	1 dB	1 dB
Reference Distance	100 m	100 m	100 m	100 m
Path Loss Exponent	4.80	4.50	4.00	3.50
Base Station Height	30.00 m	30.00 m	35.00 m	40.00 m
Outdoor SU Height	9.00 m	9.00 m	6.00 m	6.00 m
Indoor SU Height	6.00 m	6.00 m	4.00 m	4.00 m
USB Dongle Height	1.50 m	1.50 m	1.50 m	1.50 m

Table 12 – Pre-set parameters, Network Dimensioning

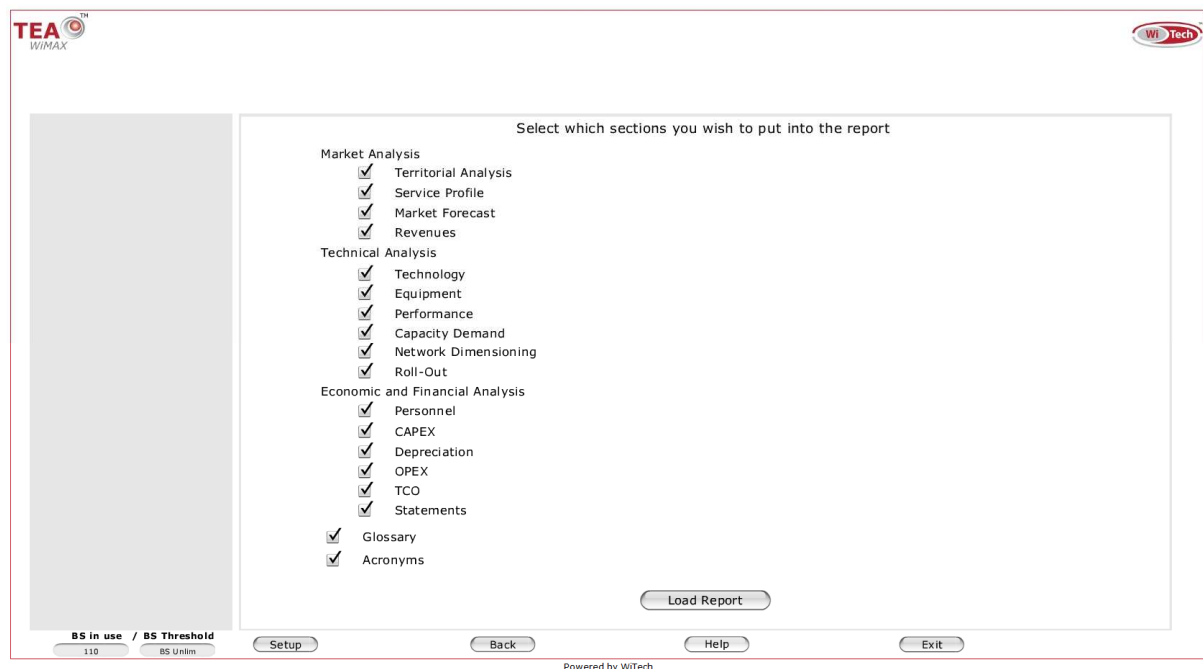
Parameter	Value
BS per ASN	200

10 Report

The tool can generate automatically a report containing all the main results of the analyses.

Please note that to avoid the risk of producing a too big document (considering the possible combinations of the maximum number of years in the period, geographical areas, market segments, types of equipment, service profiles, etc.) only the main assumptions (input data) and results (output data) are consolidated in the report. In all cases, the full set of variables can be collected directly from the tool pages.

To generate the report, click on the **Report** button. This will open a configuration page where you can select which sections of the report you want to compile; then click on the **Load Report** button to publish it (Figure 101).



TEA WiMAX

WiTech

Select which sections you wish to put into the report

Market Analysis

- ☒ Territorial Analysis
- ☒ Service Profile
- ☒ Market Forecast
- ☒ Revenues

Technical Analysis

- ☒ Technology
- ☒ Equipment
- ☒ Performance
- ☒ Capacity Demand
- ☒ Network Dimensioning
- ☒ Roll-Out

Economic and Financial Analysis

- ☒ Personnel
- ☒ CAPEX
- ☒ Depreciation
- ☒ OPEX
- ☒ TCO
- ☒ Statements

☒ Glossary

☒ Acronyms

Load Report

BS in use / BS Threshold

110 / BS Unlim

Setup

Back

Help

Exit

Powered by WiTech

Figure 101 – Report, configuration page

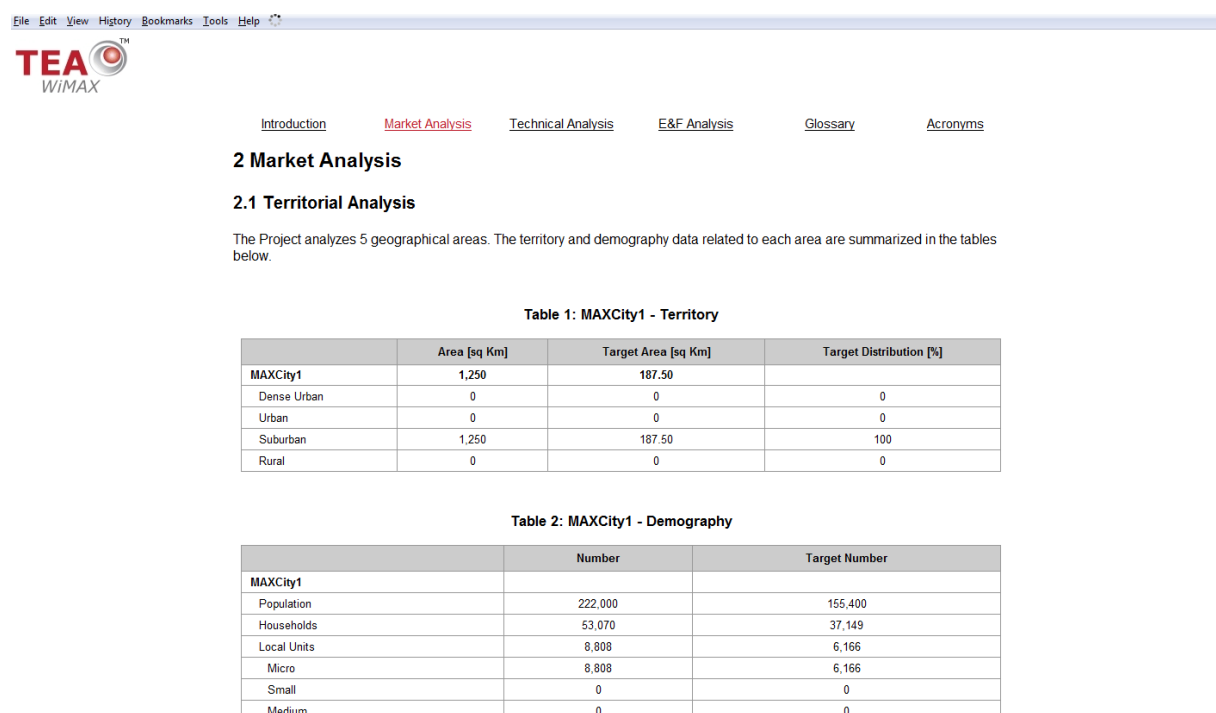
The report will contain all relevant input/output data that would have been entered/configured by you and/or calculated by the tool until that moment. The data will be arranged in a convenient mix of text, tables and charts.

The report will be published in the form of web pages, a page for each one of the main sections selected (Figure 102, Figure 103, Figure 104, Figure 105, Figure 106 and Figure 107). To move from a page to another one, select it from the page list on the top of the page.



The screenshot shows the TEA|WiMAX Report web interface. At the top, there is a menu bar with options: File, Edit, View, History, Bookmarks, Tools, Help. Below the menu bar is the TEA|WiMAX logo. A navigation bar contains links: Introduction (highlighted), Market Analysis, Technical Analysis, E&F Analysis, Glossary, and Acronyms. The main content area displays the title "TEA|WiMAX Report" in red. Below the title, it shows "Project Name: GreenMAX" and "Data Created: 2009-03-27 19:17". The section "1 Introduction" is displayed, followed by a paragraph stating: "This report contains all relevant data for the Market, Technical and, Economic & Financial analyses of the GreenMAX Project. The analyses have been carried on with the support of the TEA|WiMAX tool from WiTech and cover a period of 8 years."

Figure 102 – Report, Introduction



The screenshot shows the TEA|WiMAX Report web interface. At the top, there is a menu bar with options: File, Edit, View, History, Bookmarks, Tools, Help. Below the menu bar is the TEA|WiMAX logo. A navigation bar contains links: Introduction, Market Analysis (highlighted), Technical Analysis, E&F Analysis, Glossary, and Acronyms. The section "2 Market Analysis" is displayed, followed by the sub-section "2.1 Territorial Analysis". A paragraph states: "The Project analyzes 5 geographical areas. The territory and demography data related to each area are summarized in the tables below."

Table 1: MAXCity1 - Territory

	Area [sq Km]	Target Area [sq Km]	Target Distribution [%]
MAXCity1	1,250	187.50	
Dense Urban	0	0	0
Urban	0	0	0
Suburban	1,250	187.50	100
Rural	0	0	0

Table 2: MAXCity1 - Demography

	Number	Target Number
MAXCity1		
Population	222,000	155,400
Households	53,070	37,149
Local Units	8,808	6,166
Micro	8,808	6,166
Small	0	0
Medium	0	0

Figure 103 – Report, Market Analysis

File

Edit

View

History

Bookmarks

Tools

Help

TEA

WIMAX

Introduction

Market Analysis

Technical Analysis

E&F Analysis

Glossary

Acronyms

3 Technical Analysis

3.1 Technology

The considered WiMAX Forum Profile is 5CL Mobile WiMAX, which operates in the 3.5 GHz with a channel bandwidth of 10 MHz and supports the TDD as duplexing format.

The supported Data Rates and related Sensitivity are summarized below.

Table 24: Data Rate

Down Link Modulation	Down Link Data Rate [Mbps]	Up Link Modulation	Up Link Data Rate [Mbps]	Total Data Rate [Mbps]
QPSK 1/2	3.17	QPSK 1/2	1.68	4.85
QPSK 3/4	4.75	QPSK 3/4	2.52	7.27
16QAM 1/2	6.34	16QAM 1/2	3.36	9.70
16QAM 3/4	9.50	16QAM 3/4	5.04	14.54
64QAM 2/3	12.67	64QAM 2/3	6.72	19.39
64QAM 3/4	14.26	64QAM 3/4	7.56	21.82

Table 25: Sensitivity

Down Link Modulation	Down Link Standard Sensitivity [dBm]	Down Link Improvement [dBm]	Down Link Total Sensitivity [dBm]	Up Link Modulation	Up Link Standard Sensitivity [dBm]	Up Link Improvement [dBm]	Up Link Total Sensitivity [dBm]
QPSK 1/2	-86.37	7.13	-93.50	QPSK 1/2	-86.37	7.13	-93.50
QPSK 3/4	-83.37	7.13	-90.50	QPSK 3/4	-83.37	7.13	-90.50
16QAM 1/2	-80.87	7.13	-88.00	16QAM 1/2	-80.87	7.13	-88.00
16QAM 3/4	-77.37	7.13	-84.50	16QAM 3/4	-77.37	7.13	-84.50
64QAM 2/3	-73.37	7.13	-80.50	64QAM 2/3	-73.37	7.13	-80.50
64QAM 3/4	-71.37	7.13	-78.50	64QAM 3/4	-71.37	7.13	-78.50

Figure 104 – Report, Technical Analysis

4 E&F Analysis

4.1 Personnel

The personnel structure has been defined considering all typical roles in a WiMAX company, as summarized below. The Head Count projections are as follows.

Table 50: Head Count

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Executive Staff	7	7	7	7	7	9	9	9
President	1	1	1	1	1	1	1	1
CEO	1	1	1	1	1	1	1	1
CFO	1	1	1	1	1	1	1	1
COO	1	1	1	1	1	1	1	1
CTO	1	1	1	1	1	1	1	1
Vice Presidents	2	2	2	2	2	4	4	4
Technical Ops	7	7	9	10	12	16	16	16
Operations Manager	1	1	1	1	1	2	2	2
Voice Engineer	1	1	1	1	1	2	2	2
IP Engineer	1	1	1	1	1	2	2	2
IT Engineer	1	1	1	1	1	2	2	2
RF Engineers	1	1	1	1	1	1	1	1
Site Techs	2	2	4	5	7	7	7	7
Sales	6	13	20	33	30	18	15	12
General/Market Manager	1	1	1	1	1	1	1	1
Direct Sales Manager	1	1	1	1	1	1	1	1
Indirect Sales Manager	1	1	1	1	1	1	1	1
Indirect Dealer Manager	1	1	1	1	1	1	1	1
Direct Sales Reps	1	1	1	1	1	1	1	1
Sales Support	1	8	15	28	25	13	10	7
Marketing	1	1	1	1	1	1	1	1

Figure 105 – Report, E&F Analysis

Glossary

Market Analysis

Territorial Analysis

Area [sq Km]: Extension of the *Total/Dense Urban/ Urban/Suburban/Rural* areas to be analyzed measured in square kilometers. The Area could be a region, a country or a town rather than a village. Its size should typically depend on the desired degree of precision of the results and on the accuracy of input data you have available to characterize the area.

Market Segment

- **Population:** Inhabitants that live in the analyzed area. These are considered as *Individuals* in the Market Analysis and are the target of Personal Broadband services.
- **Households:** Nuclear families that live in the analyzed area.
- **Local Units:** Headquarters or branches of enterprises and/or public and private institutions located in a geographically identified place in the analyzed area. Local Units are classified as *Micro, Small, Medium and Large*, depending on their number of employees.

Number: Size of the *Population* and the number of *Households, Micro, Small, Medium and Large Local Units* located in the considered area.

Scenario

- **Dense Urban:** The inner area of larger cities with the highest population density a lot of multiple tenant offices and residential buildings with great height.
- **Urban:** The inner area of cities with high population density and many multiple tenant offices and residential buildings.
- **Suburban:** The areas on the outskirts of cities with moderate population density, higher percentage of single family residences, business park and strip malls.
- **Rural:** Small cities and towns located far from the major metro areas with low population density, few offices and small business.

Figure 106 – Report, Glossary

Acronyms

AAA	Authentication, Authorization, and Accounting
AAS	Adaptive Antenna System
ASN	Access Service Network
BPM	Business Process Management
BPSK	Binary Phase Shift Keying
BS	Base Station
BWA	Broadband Wireless Access
CAPEX	CApital EXPenditures
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CIR	Committed Information Rate
COO	Chief Operation Officer
COS	Cost Of Service
CRM	Customer Relationship Management
CSN	Connectivity Service Network
CTO	Chief Technical/Technology Officer
dB	Decibel
D&A	Depreciation & Amortization
DNS	Domain Name System
DHCP	Dynamic Host Configuration Protocol
EBIT	Earnings Before Interest and Taxes
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EBT	Earnings Before Taxes
ERP	Enterprise Resource Planning

Figure 107 – Report, Acronyms

If you have a PDF publisher, each main section of the report can be saved as a separate PDF file by first clicking on **File** in the menu bar in the upper left corner of the page and then clicking on **Page Setup**.

If you have installed the recommended PDFCreator publisher, use the following configuration settings for **Margins & Header/Footer** (Figure 108) to produce an optimal PDF page layout

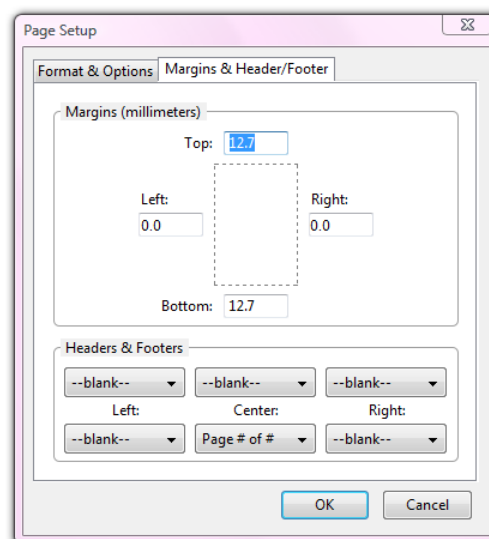


Figure 108 – Page Setup

Then, again from the **File** menu, click on **Print** selecting PDFCreator as the printer in the popup menu:

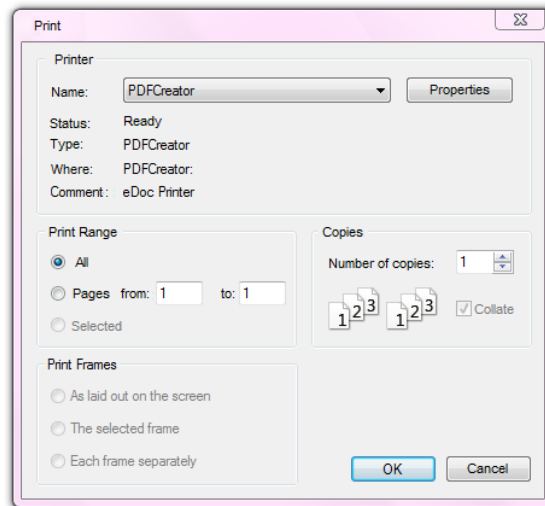


Figure 109 – Print

When the creation of the PDF file has terminated, save it in the destination folder of your choice specifying a different PDF file name for each section of the report.

You can also save the web pages with the report (one page for each main section) on your PC as *.html files. The *.html files can be opened with Microsoft Word (or similar) to perform a final editing and/or reformatting of the content to produce your own personalized set of reports and presentations.

All tables generated by the tool can be imported into MS Excel for further editing, following the steps below:

1. Generate the Report section where the table you are interested in is
2. Save the Report section page as a .html file
3. Open the .html file with Word
4. Select and Copy the whole table and then Paste it into the .xls file

11 Acronyms

AAA	Authentication, Authorization, and Accounting
AAS	Adaptive Antenna System
ASN	Access Service Network
BPM	Business Process Management
BPSK	Binary Phase Shift Keying
BS	Base Station
BWA	Broadband Wireless Access
CAPEX	Capital EXPenditures
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CIR	Committed Information Rate
COO	Chief Operation Officer
COS	Cost Of Service
CRM	Customer Relationship Management
CSN	Connectivity Service Network
CTO	Chief Technical/Technology Officer
dB	Decibel
dB _i	Decibel isotropic
dB _m	Decibel referenced to one milliwatt
D&A	Depreciation & Amortization
DNS	Domain Name System
DHCP	Dynamic Host Configuration Protocol
EBIT	Earnings Before Interest and Taxes
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EBT	Earnings Before Taxes
ECC	Electronic Communications Committee
E&F	Economic & Financial
EIRP	Equivalent Isotropic Radiated Power
ERP	Enterprise Resource Planning
FDD	Frequency Division Duplexing
GUI	Graphical User Interface

HA	Home Agent
HH	Household
HW	Hardware
IP	Internet Protocol
IRR	Internal Rate of Return
LU	Local Units
Mbps	Mega bits per second
MIMO	Multiple Input Multiple Output
MRC	Maximum Ratio Combining
NMS	Network Management System
NPV	Net Present Value
OFDM	Orthogonal Frequency Division Multiplexing
OPEX	Operational Expenditures
PBH	Peak Busy Hour
PBP	Payback Period
PDH	Plesiochronous Digital Hierarchy
PF	Policy Function
PIR	Peak Information Rate
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RTG	Receive /Transmit Transition Gap
SD	Standard Deviation
SDH	Synchronous Digital Hierarchy
SG&A	Sales, General & Administrative
sq Km/mi	Square Kilometer/mile
STC	Space Time Code
SUI	Stanford University Interim (a channel model)
SW	Software
S&S	Scenario & Sensitivity
TCO	Total Cost of Ownership
TDD	Time Division Duplexing
TEA	Technical and Economic Analysis
TTG	Transmit/Receive Transition Gap
UT	User Terminal
VAD	Voice Activity Detection
VAT	Value Added Tax



VoIP

Voice Over IP

WiMAX

Wireless Interoperability Microwave Access