Agilent Technologies CellOpt AFP 2.5

User's Guide

Agilent Technologies

Notices

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In This Manual

This preface describes the *CellOpt AFP User Guide*, not the software itself, which has an overview in the "Introduction".

Who needs this guide

The *CellOpt AFP User Guide* has been written to help everybody involved in the planning of frequencies for a mobile telecommunications network. It tells you exactly what CellOpt AFP is and what it does and then goes on to tell you how to use it to produce the best possible set of frequencies and color code for any given network.

- If you are a cell planner or an optimization engineer you will find all you need to produce an implementation-ready set of frequencies and color codes, including detailed instructions on using CellOpt AFP as well as help in making engineering choices.
- If you are more concerned with management, you should at least read the "Introduction" of the guide, as it will give you an insight into the way CellOpt AFP works and help you make decisions about the larger-scale planning of your network.
- If you are a systems administrator concerned with the installation and maintenance of the software, full instructions are given for all the platforms available (the chapter on "System administration") and the appendix on "Input and Output Formats" will enable you to help the cell planners and optimization engineers.

Before you start

Agilent Technologies has produced CellOpt AFP for trained cellular network planners, and the *CellOpt AFP User Guide* expects you to be familiar with cellular communications and the associated terminology, as well as with planning and optimizing cellular networks.

You do not need any special computer knowledge to be able to use CellOpt AFP – this guide tells you all you need to use it to its best advantage. You should however, be comfortable with the user interface of your particular operating system (Windows or Unix) so that you can start the program from your desktop or command prompt. See the "Conventions used in this guide" on page v, for further information.

About this guide

After the Table of Contents, which follows this Preface, the guide contains the following chapters and appendices:

Introduction

This chapter provides an overview of what CellOpt AFP is, why it is such an enormous improvement on all earlier methods, describes how it fits in to the broader cell planning task and introduces you to Agilent Technologies, the company which produces it.

System administration

This chapter explains how to set up and maintain the hardware and software necessary to run CellOpt AFP, making its input data available for processing and its output data accessible to and readable to the software needed to carry on the implementation of the plan.

Using CellOpt AFP

This chapter lists the standard sequence of events during a CellOpt AFP session, from starting the application, loading and processing data to saving data and closing down the application. For some tasks, this chapter has all the information you need, but for more complicated ones there are references to parts of the *Guide* where you can find the instructions and explanations you need.

Modelling

This chapter gives you an overview of the way in which CellOpt AFP visualizes and displays the network, enabling you to build and alter the network itself, grouping carriers and setting and altering the rules which the *optimizer* will later use to assign the best possible frequency and color code plan. This chapter also introduces the more detailed instructions in the following four Modeling chapters.

Modelling the spectrum

This chapter tells you how to see and change the frequencies and the color codes available to the whole network. You can also see and alter lists of these which are available but would incur penalties if assigned to carriers – these are called illegal in CellOpt AFP. Then there are forbidden frequencies and color codes.

Modelling the network

This chapter shows you how to see details about the sites, sectors and carriers modeled in the physical network and gives you instructions on changing the physical model.

Modelling categories and layers

This chapter describes the CellOpt AFP method of grouping carriers by their different attributes (categories) and the values

of those attributes (layers). It enables you to see, create and modify carrier categories and layers within each of them.

Modeling penalties

This chapter tells you how to see and change the way in which CellOpt AFP applies penalty values to planning rules. Penalties govern the way in which the optimizer will prioritize your planning criteria by calculating the CellOpt Quality Index (CQI) for a given plan and thus be able to discriminate between the quality and efficiency of different plans.

Optimizing

This chapter explains how to run the CellOpt AFP optimizer, which continuously generates new plans for the network, working out the quality of each and retaining the best for implementation while still trying to find an even better one.

Analyzing and reporting

This chapter tells you how to generate, see and save reports offered by CellOpt AFP to analyze the results produced by the optimizer.

Glossary

This appendix contains an alphabetical list of all the technical terms used in the *CellOpt AFP User Guide* and gives a brief definition of each.

Input and output formats

CellOpt AFP can read input data and write output data in several formats. This appendix gives examples of all these formats as a quick reference to help you with interpreting and reusing the data.

Conventions used in this guide

Messages from the computer (error messages, for example) appear in `Courier font`.

Words and phrases which have definitions in the Glossary appear in *italics* on their first appearance in each chapter.

“Press **Enter**” means “Press the Enter, Carriage Return or ↵ key.”

“Press **X**” means “Press the **X** key on your keyboard.” You do not have to press **Enter** as well.

“Enter **XYZ**” means “Press **X**, then **Y**, then **Z** and then press **Enter**.”

“Press **Alt + X**” means “Hold down **Alt** and press **X**.”

“Click on something” means “Move the mouse cursor to the place given in the instruction and click the left mouse button once.” Note that some user interfaces allow you to transpose the mouse buttons, but these instructions assume you have not done so.

“Right-click on something” means “Move the mouse cursor to the place given in the instruction and click the right mouse button once.”

“Double-click on something” means “Move the mouse cursor to the place given in the instruction and click the left mouse button twice, quickly.” Some user interfaces allow you to define the time between the two clicks.

Contents

1 Introduction

This chapter introduces you to the CellOpt AFP software and its features.

CellOpt AFP

Frequency planning, already a complex issue, is becoming more complex as demands on spectrum increase. This increase stems from:

- A greater number of operators in the market
- A greater number of innovative uses to which operators have to devote scarce frequency allocation.
- Good frequency planning is therefore a vital competitive tool, improving quality of service and providing the technical justification for deferring major infrastructure investments. Conversely, poor frequency planning leads to high dropped-call rates, poor handover performance and a less than optimal use of radio features. The business implications of these failings need no underlining.

Managing information or automating decisions?

As any network operator knows, frequency planning has always been a time-consuming and frustrating task. The RF design software tool market is a crowded place, with each solution offering the planner something of real value.

Most RF design software tools focus primarily on managing and displaying information that results from decisions made by the planner. CellOpt AFP is different. It makes the decisions automatically, rather than relying on the planner to make them.

Although earlier tools support some sort of automated decision-making, they tend to be weak, because their proposed decisions contain many obvious errors to be identified, analyzed and adjusted by frequency planning staff. Costly personnel waste time on the very tasks that computers are excellent at doing – calculations and comparisons.

Accurate modelling and robust optimization

CellOpt AFP, bringing forward fast and reliable results with extensive modelling capabilities, offers a step improvement to the planning community. It uses advanced software not simply to produce a faster version of traditionally flawed planning processes, but to offer planners something altogether more accurate – CellOpt AFP generates implementation-ready frequency plans automatically.

More than this, plans generated by these new CellOpt AFP tools have been shown to have a significantly higher quality than plans derived by current methods. The strength of CellOpt AFP has two main sources:

- Its ability to model the problem flexibly with extreme accuracy.
- Its robust optimizer, converging rapidly and reliably to high quality solutions.

Modelling the trade-off problem

The frequency assignment problem inherently involves trade-offs which must be taken into account during modelling and optimization.

For instance, it may occasionally be acceptable for carriers from neighboring sectors to be assigned on adjacent frequencies, if that would reduce the interference situation significantly. The AFP tool must allow for accurate modelling and optimizing of such trade-off choices.

CellOpt AFP uses penalty weights to express numerically how undesirable it is that a particular planning rule is violated. The penalty weights allow the optimization algorithm to choose, just as the planner would, which planning rules to violate.

The robust optimization algorithms, working with penalty weights in tune with the cell planner's trade-off preferences, produce a solution that does not require manual changes afterwards.

Modelling new techniques and features

CellOpt AFP can also model many of the innovative techniques and features in the radio network now used to enhance network capacity and quality.

For instance, CellOpt AFP works out how the interference distribution would change through the application of Super Reuse carriers as well as the interference enhancing effects of Frequency Hopping, Discontinuous Transmission and Power Control.

CellOpt AFP models the frequency assignment problem on the carrier level. This is important as most new techniques and features take advantage of characteristic differences between carriers within the sector.

Modelling engineering principles

To generate implementation-ready frequency plans automatically, there is a need for the planning tool to adhere to engineering principles that the planner imposes on the frequency assignment.

These principles typically require the planner to split or group the available spectrum into sub-bands or frequency groups. CellOpt AFP's flexibility allows the engineering principles to be considered. It is important to understand that the principles impose additional rules on the planning problem and will inevitably call for trade-offs with other planning considerations.

The optimization algorithm

The ability to generate implementation-ready plans automatically is what distinguishes Next Generation Automatic Frequency Planning tools from the current generation of tools.

CellOpt AFP sets the standard of these new tools. It models the problem with extreme accuracy and then applies an extremely robust optimization algorithm, converging reliably and rapidly to high quality solutions. It is implemented as an iterative, heuristic, local search algorithm; something which tries and tries to improve the solution according to the trade-offs already agreed, using the computer to achieve much higher speeds than people ever could.

Reliable convergence is important to guarantee a high quality plan and to ensure that the optimized solution does not contain obvious
mistakes – which would require manual changes afterwards.

Rapid convergence allows for several optimization executions one after the other, so planners can do "what-if" analyses based on various sets of engineering principles.

Quantifying the quality

A particular frequency plan would typically violate some of the defined planning rules. The sum of the penalty weights for all violated planning rules defines a quality index for the frequency plan. The lower the quality index, the better the frequency plan. Minimizing this quality index is the main objective for CellOpt AFP.

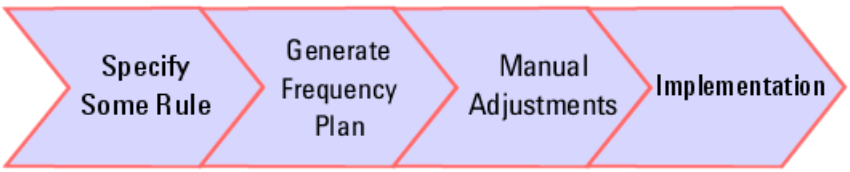
Planners can use the quality index to:

- Compare the quality of different frequency plans quantitatively, complementing the current visual comparisons of interference plots, which, all too often, are the products of either guesswork or history.
- Understand the quality impact of using various engineering principles such as frequency groups, separation requirements, spectrum allocation per layer and so on.

Reinventing the frequency planning process

Implementation-ready means that the planning tool proposes plans that can be trusted without the need for adjustments.

Automatic means that the computer does the frequency assignments based on rules and requirements clearly set out by the planner before the optimizer starts. The figure below shows the traditional route for the frequency planning process.

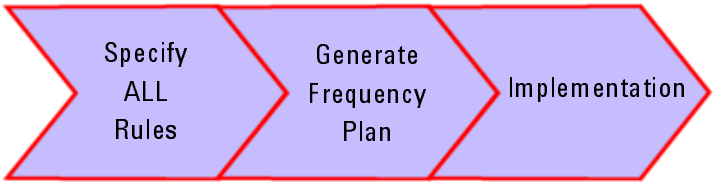


In the traditional process, the cell planner starts by setting *some* rules for the frequency plan; for instance the separation requirements of carriers within the same site or between neighboring cells. The planner then performs the actual frequency planning work manually or with the support of a tool with very limited capabilities. Typically, there is poor flexibility for modelling the trade-off preferences and engineering principles of the planner, and little consideration of the effects of the advanced radio features in the network.

Today's process of generating a frequency plan is a manual trial-and-error approach. It may or may not produce a workable solution in the end, but is always a very time consuming process that will produce a plan far short of the possible quality in the network.

Computers are excellent at calculations and comparisons. Cell planners should concentrate on specifying the rules and requirements for the frequency plan and on other more complex planning issues that are not accurately addressed with a quantitative number-crunching approach. This, ideally, is how the labor should be allocated to achieve an efficient frequency planning process that consistently produces high quality plans.

In the figure below, the cell planner sets all the rules for the frequency plan beforehand. The tool then automatically creates a high quality frequency plan, good enough for the planner to trust and implement. This re-engineered process will pay off very quickly for the cell planner and the network operator through significantly increased quality and saved time.



Key business benefits

Working with several major cell planning organizations, and with network operators themselves, Agilent Technologies has identified three key business benefits gained by using next generation AFP tools:

Increased cell planning productivity

Improvement potential in productivity is considerable, given the cost of skilled personnel's time. Any manual adjustment is wasted time, and there are many man-years lost to inefficient frequency planning in this way.

Time saved through automated planning will free scarce planning resources to work on higher value-added projects promising further positive effects on network quality.

Satisfied subscribers and less churn

A guaranteed, good frequency plan opens the way to better quality network performance. Fewer dropped calls and handover problems result in more satisfied subscribers and less churn. The precise value of this will be different for every network, and is not easy to quantify. For example, a reduction in the dropped call rate from 3% to 2% would be very beneficial, but *how* beneficial will vary from network to network.

Ability to defer major network infrastructure investment

There is a trade-off between quality and capacity. Any quality improvement offers the possibility of increasing the capacity of existing cell sites.

A next generation AFP tool can guarantee an improved plan, and planners can decide whether to use the improvement to increase network quality, or to keep the original quality and increase the capacity without having to invest in expensive network infrastructure. Increasing the network capacity, simply by adding more carriers on existing cell sites, is a highly attractive alternative as it promises enormous savings in capital investments.

Time, also, is critical to all mobile operators around the world. Competition is usually tough and roll-out time is one of the chief levers of competitive advantage. A much faster roll-out can be achieved by increasing capacity on existing cell sites instead of having to find and implement new cell sites.

A future at the leading edge

CellOpt AFP offers a judicious mix of advanced tools. They guarantee higher quality and eliminate most of the time-wasting and often counterproductive efforts of manual or limited-automated frequency planning. In addition, the application of these tools to new thinking in radio engineering can yield results to put operators at the Leading Edge.

Competitive demands on new and mature networks are high, but can probably be summed up as ensuring high quality and capacity at low cost. Fast, effective and accurate frequency planning leads directly to the achievement of quality, making good use of available spectrum and delivering superior call quality to the end user. In the process, planning time, infrastructure investment and the irritation – to operator and subscriber alike – are all minimized.

CellOpt AFP is a great advance on earlier planning technologies, but as with all technology, it is a point in the journey, not a destination. Even better algorithms, better modelling, and new ways of looking at network engineering will, in time, take frequency planning to an even higher level. Agilent Technologies is committed to deliver leading edge, automated, decision support applications.

About CellOpt AFP

CellOpt AFP is an advanced software application designed to automate the frequency planning process. At its release in early 1997, CellOpt AFP was a breakthrough innovation in the field of automatic frequency planning because of its ability to generate implementation-ready frequencies automatically. Today, CellOpt AFP is used to plan many of the major networks in the world efficiently, to achieve better network quality and higher capacity.

The new version, CellOpt AFP 2.0, released in early 1999, is a step improvement on the previous CellOpt AFP version. It incorporates many of the ideas for improvement gathered through the use of the first version. We are confident that the new version secures Agilent's product leadership position in the field of automatic frequency planning.

CellOpt AFP's comprehensive modelling capability has been further improved through its ability to handle any number of lists of planning considerations as well as its ability to handle

any number of layer attributes assigned to the carriers. This allows for even more flexible assignment of penalties, specifying the importance of various planning considerations.

The user interface has a new look and feel. It has been completely restructured for greater clarity and ease of use. There is also a significant reduction in the number of steps to go through to execute an optimization. The new user interface has been developed in the new programming language Java.

The proven CellOpt AFP optimizer is also used in the new version, but the implementation has been improved by allowing for a more diversified search that will improve the quality of the final solution even further. It also supports color code optimization using the same robust optimization engine.

CellOpt AFP 2.0 is available on both Unix and PC platforms as a modular client-server application. This allows CellOpt AFP to be used in the office planning environment on a powerful workstation for major re-tunes as well as in the field tuning process for smaller incremental changes on laptops.

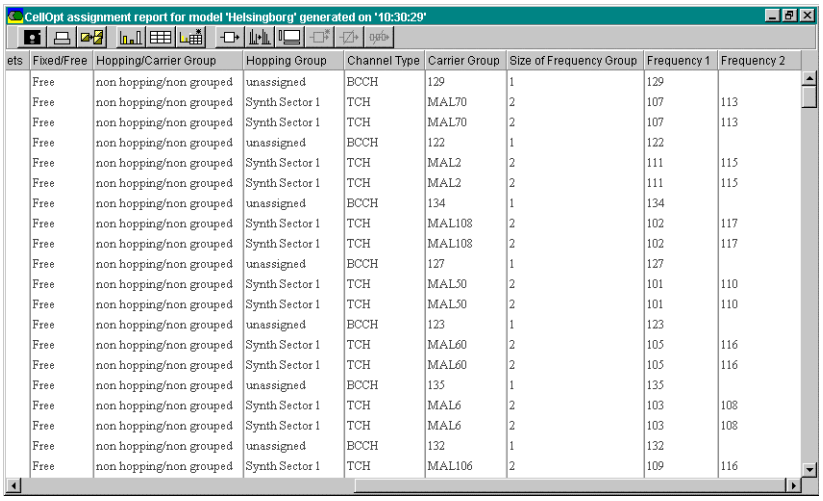
CellOpt AFP 2.1 has enhanced functionality to also support frequency planning in frequency hopping networks as well as planning with sets and subset. It also has much better data visualization capabilities than previous versions.

CellOpt AFP 2.2 generally speeded up the server. Also it had a lot of new features, for example enhanced list manipulation, MAL optimization, an installation program, and multi-lingual language support for the client.

CellOpt AFP 2.3, includes, among other things, advanced color codes, a model overview, and a forbidden spectrum (frequencies, color codes, sets, subsets and MALs).

CellOpt 2.4 Improvements, improves the planning of sets with forbidden frequencies, as well as better handling of the grouping of carriers for set and subset planning.

CellOpt assignment report Indicates the current frequency and color code assignment in the model. If you have enabled the frequency hopping or the frequency groups options you can find additional information specific to these planning options.

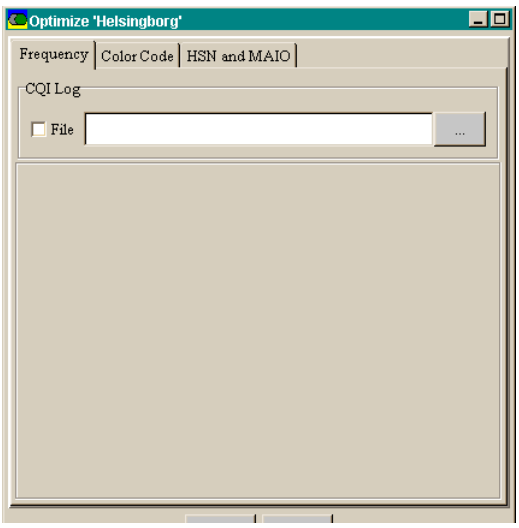


ets	Fixed/Free	Hopping/Carrier Group	Hopping Group	Channel Type	Carrier Group	Size of Frequency Group	Frequency 1	Frequency 2
	Free	non hopping/non grouped	unassigned	BCCH	129	1	129	
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL70	2	107	113
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL70	2	107	113
	Free	non hopping/non grouped	unassigned	BCCH	122	1	122	
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL2	2	111	115
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL2	2	111	115
	Free	non hopping/non grouped	unassigned	BCCH	134	1	134	
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL108	2	102	117
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL108	2	102	117
	Free	non hopping/non grouped	unassigned	BCCH	127	1	127	
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL50	2	101	110
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL50	2	101	110
	Free	non hopping/non grouped	unassigned	BCCH	123	1	123	
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL60	2	105	116
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL60	2	105	116
	Free	non hopping/non grouped	unassigned	BCCH	135	1	135	
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL6	2	103	108
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL6	2	103	108
	Free	non hopping/non grouped	unassigned	BCCH	132	1	132	
	Free	non hopping/non grouped	Synth Sector 1	TCH	MAL106	2	109	116

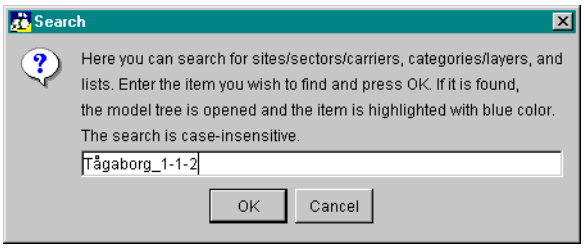
Optimizing sets and subsets Optimizing sets and subsets has been redesigned. Now you should only decide whether the carriers are grouped or not. This is accomplished in the carrier editor by defining carriers to either non-grouped or grouped in the carrier group category. The CellOpt AFP optimizer will then allocate sets and subsets to all grouped carriers in a sector according on the chosen set planning strategy.

You may choose to optimize with

- sets only
- one set and subsets
- one set and individual frequencies



Network search Search for a site/sector/carrier now has a dialogue in the model menu. This replaces a text field in the network tree.



CQI report Improved clarity and additional fields. For example, attributes in the fixed/free column are referred to as 'fixed' and 'free' instead of '1' and '0'.

CellOpt AFP 2.5 Improvements

The current version, improves the support for both set planning and frequency hopping planning by introducing a couple of new features as well as a new report to verify the input data.

Input Analysis Report new report is introduced in CellOpt AFP 2.5, which gives the user a quick overview of the input data that is loaded into the tool. For each sector that has any kind of data from the input files you will see what frequencies are used as well as how many relations this sector have in the different loaded lists.

Create Distance / Co-Channel List There is a possibility to create lists that consist of relations defined by the sectors physical locations and their original frequency plans. The new lists that you can create are a distance list, that creates relations between sites that are less than a certain distance apart, and a Co-Channel list that creates relations between sites that are 1) less than a certain distance apart and 2) have some original co-channel frequencies. Since these two lists have many components in common, they were developed concurrently.

IDEN specific handling of frequency set creation This feature allows the user to cater for the specific needs in iDEN frequency planning using sets. The iDEN technology states that only the first set's control frequency will be viewed as a control channel. The other sets can use their control frequency as traffic channels. This feature will allow iDEN customers to plan their networks according to the IDEN criteria.

Improve frequency hopping support The fractional load, min/max length and common length have in previous versions of CellOpt AFP only been possible to specify on a global level. In this new version you will be able to this on a layer level as well as on the global level.

Original and Unassigned frequency in the Network Editor In order to make CellOpt AFP easier to use the Network Editor has been updated with a new virtual category, the Original Frequency. With this feature the user will have the ability to view which the original frequency was as well as changing back to the original frequency. The user will now also have the possibility to set the carrier to unassigned before starting the optimiser.

Performance Enhancements A certain amount of time of each version of CellOpt AFP is spent on improving the overall performance of the tool. In version 2.5 the improvements have been in the area of overall memory usage. This will in particular benefit the users running frequency plans for big networks that require a lot of computer resources.

2
System administration

Client-server architecture

The CellOpt AFP application is based on a client-server architecture. The two primary components are the CellOpt AFP server, referred to as **CellServ,** and the CellOpt AFP client, known simply as **CellOpt**. During usage of the application, the user starts the CellOpt AFP client, which will run for the duration of the user's session. The server, however, may run continuously in the background, waiting for the client connection, or may be started only when necessary; the choice depends on the particular installation configuration. The client and server may run on the same machine or on different computers in the same network. This means that a number of configuration options need to be set up during the installation of the application.

Two options of particular interest are the **`hostname`** and TCP/IP **`port number`** on which the server runs.

The default port number for CellServ is **10088**, and the client will assume this number unless otherwise configured. It is not advisable to change this number unless your site has special requirements. If you do decide to change it, remember to configure both the client and server to the new settings.

The default hostname the client expects for a running server is **`localhost`**, which is the computer the client is on. If the server is running on another computer, you need to specify its hostname for the client during installation. If the installation values are not correct, it is still possible to change the values for

the client during a session, but the new settings will only affect that session, or that project if the session is saved in project form.

If the hostname and port number are not correctly configured, or the server is not running before the client, the client will produce the error message:

```
Error connecting to server 'hostname:port'-
Connection Refused
```

If this happens, check that the settings are correct and that the server is running on the specified computer.

Operating systems

CellOpt AFP supports multiple operating systems, currently covering **Windows** (NT and 2000) and **Unix** (Solaris 2.6 and 8, and Linux 2.2). The client can run on a different computer with a different operating system from the server. For example, a likely configuration might be to run the server on a powerful Solaris server, and run the client on desktop Windows computers. Both the running environment and the installation of the client and server components are slightly different on the different operating systems. However, once CellOpt AFP is running, the user will have access to the same features and experience similar application behavior in all environments.

Java

To ensure cross-platform compatibility of the CellOpt AFP client, it has been written in the Java programming language. This allows for a high level of interface compatibility between the different operating systems. However, it does have some implications with regard to the installation and the running of the client. Java applications need a **Java Virtual Machine** to exist on the computer being used. CellOpt AFP is provided complete with the JVM provided in the Java Runtime Environment developed by Sun Microsystems. Configuration of this environment is handled transparently by the installation scripts and should not concern the user or system administrator. There are, however, a few points of interest concerning the Java environment of the CellOpt AFP client:

Under both Windows and Unix the installation software InstallAnywhere is used, which installs a java application launcher called LaunchAnywnere as well as convenient shortcuts (soft links in Unix) or menu options to start the client. Under this environment the java console is suppressed and the

only text output visible is that which is displayed in the GUI itself. If you wish to run the client with console output, you need to use the custom CellOpt.bat (CellOpt.sh in Unix) script in the client scripts directory, which will run the client from a DOS text windows (terminal on Unix) which will display all the normal java console output.

Licensing

Only the server component of CellOpt AFP is protected by a software licensing system. CellOpt AFP uses the industry standard **FLEXlm** software licensing system. If you already have software running with FLEXlm licenses you may wish to incorporate the CellServ license into your current scheme, and therefore deviate partly from the recommended procedures. Under most circumstances, however, the licensing configuration recommended here will work best.

CellServ is licensed using a **floating** FLEXlm license key. This means that the server can run on any computer on the network, not necessarily the same computer that the FLEXlm license manager is running on, as long as the number of simultaneously running servers does not exceed the number of licenses purchased from Agilent Technologies. The license is only required for the server while it is actually connected to the client. So, for example, if you purchased 2 CellOpt AFP licenses and 3 access points, and you installed both client and server components on three machines, you would be able to start all three servers running in the background, but would only be able to connect two clients simultaneously, regardless of which server computer or computers you connected to. A simpler installation, however, would be to install the server on only one machine. The server will still be able to handle two simultaneous connections. In fact, the number of simultaneous connections to the server running on a single machine is limited only by the number of licenses purchased and the available memory and other resources on that machine.

Installation of the licensing system is described in the “Installation” on page 8.

Error reporting

Both the client and server programs produce error messages. The server will log the error messages to the general server logs, normally in **`/usr/local/CellOpt/log`**, **`C:\CellOpt\log`**, **`/tmp`** or **`C:\Temp`**.

The server logging system provides for various levels of logging, modelled on the standard Unix **syslog** facility. As a result, there may be a number of logging files in the log directory, all with the same primary filename (usually the name of the application with version number information), but with different extensions to mark the level of logging. However, the default installation will configure the server to log to only one file with the extension **.info**. This is the file that should be consulted for general information concerning the running on the server.

The server rotates the log files on a regular basis. The default installation will be configured to rotate the files once a day at midnight. For this reason the file extension will include the current date. The server does not automatically delete old files. It is up to the system administrator to delete old server log files when it is clear they are no longer of any interest. When reporting issues to customer support please be sure to include the file that is relevant to the problem, from the day the problem occurred.

The client logs error messages to the general log window and the Java console (which often contains more detailed information). If you are running under **LaunchAnywhere** and there is no java console visible, it might be useful to repeat the run using the **CellOpt.bat** or **CellOpt.sh** script which will show the Java console, allowing you to more easily extract the relevant error messages to sending to customer support.

Command-line parameters

Both the client and the server support a number of command-line parameters for modifying their behavior. In most cases you will not need to use these options after the installation has been completed, but subsequent castigations to the configuration of the system require some understanding of the possibilities available.

Server command-line parameters

To view the latest list of server command line parameters, run the server script **`cellopt-core-1.x/scripts/CellServ.sh`** (or **`CellServ.bat`** under Windows) with the **`-h`** option. The following options are available:

```
<+/-ol1esnrbith> <-p port> <-R tryport> <-P Logpath> <-L
Logfile> <-V EventLevel> <-S Unique name> <-ORBInitRef
NameService=corbaname::<host>:<port>> <-X ServiceName> <-B
Block> <-E Cycle>
```

Arguments are preceded by the - (minus) or + (plus) character. In some cases they take an extra argument representing the new value of the property being modified. Otherwise they are boolean operators, setting or unsetting internal flags. Normally the - character implies setting a value to true. + sets the value to false. For example, **-b** means that the server should convert itself into a background service, while **+b** means that the server should remain as a foreground process. Although this may seem counter-intuitive, it does conform to the standard Unix - option specifier, and the use of the **+** character has recently been used in a variety of applications to denote the opposite of -. Where a second argument is required, the + specifier has no effect. For example, **-p** port is identical to **+p** port.

-/+o	enable/disable output to stdout/stderr
-/+l	enable/disable output to logfiles
-/+1	enable/disable output to a single logfile
-/+e	enable/disable output to NT event log (NT only)
-/+s	enable/disable output to syslog (Unix only)
-/+S	This is the unique name the server registers in the CORBA NameService. So that it can easily be found by the clients.
-ORBInitRef NameService=corbaname ::<host>:<port>	This parameter is used in conjunction with the one above, to let the server know where the CORBA NameService is running. The <host> and <port> is the host and socket port of the CORBA NameService.
-/+n	enable/disable standalone mode
-/+r	enable/disable reconnect mode
-/+b	enable/disable daemon mode
-/+i	enable/disable single IP bind mode
-/+t	enable/disable low priority optimizer
-/+h	output this help information
Port	port number to bind server on
Tryport	number of ports to try for reconnect
Logpath	path to the logfile directory
Logfile	base name of logfiles used by logger
EventLevel	minimum log level to log to NT event log (NT only)
ServiceName	NT service and eventlog registered name (NT only)
Block	maximum block size for response blocks

Cycle	type of logfile cycling to perform (n,y,m,d,h,i)

An example usage of these command line options would be those used in the Unix service startup script `CellServ.init`:

```
-lb +nos –E d –P /usr/local/CellOpt/log –p 10088
```

Of note here is the enabling of logfiles and disabling of console output, as is appropriate for a service. Also the logfiles are rotated daily, and both the Logfile directory and the server port number are defined explicitly. The server is also configured to accept multiple connections with the **+n** option. Without any command line arguments the server default settings are appropriate for running in a console in the foreground as a standalone application accepting only a single client connection, and therefore the service requires a number of additional parameters to run appropriately.

Client command-line parameters

To view the latest list of client command line parameters, run the client script **`cellopt-coii-1.x/scripts/CellOpt.sh`** (or **`CellOpt.bat`** under Windows) with the **`-h`** option. The following options are available:

```
<+/-laocHfiht> <-s host> <-p port> <-n size> <-N size> <-q
size> <-C path> <-P path>
<-A BSICPartialDecouplingofNCCandBCC> <-A IDEN>
<-R path> <-A ServerLocator>
<-ORBInitRef.NameService=corbaloc::<host>:<port>/NameServi
ce> <-A feature> <filename/dirname>.
```

Arguments are of two types:

- Preceded by the - (minus) or + (plus) character. These arguments represent special options that change system settings from the compiled-in default values. In some cases they take an extra argument representing the new value of the property being modified. Otherwise they are boolean operators setting or unsetting internal flags. Normally the - character implies setting a value to *true*. + sets the value to *false*, as in the server settings.
- Arguments not preceded by - or + and not preceded by such arguments as take an additional parameter are taken to be filenames of CellOpt AFP format files to be loaded on startup.

The following table lists the client command-line parameters. Default values, where relevant, are in parentheses and *italic* or **bold**.

-/+l	Enable/disable log to file (*false*)

-/+a	Enable/disable log to registered listener (log panel) (*true*)
-/+o	Enable/disable log to stdout (*true*)
-/+c	Enable/disable Co/Adj coupling (limit Co>=Adj) (*true*)
-/+H	Enable/disable file header for CQI Reports (*true*)
-/+f	Enable/disable Simple Frequency Groups (*false*)
-/+I	Enable/disable ToolTips (*true*)
-/+h	Output help
-/+t	Output title (*true*)
-/+s hostname	the internet name of the server to connect to (*localhost*)
-/+p port	the internet port to connect to (10088)
-/+n size	the size of the initial network table data (30)
-/+N size	the size of the total network table data (2000)
-/+b block	the block size for bulk messages(*500*)
-/+q queue	The maximum queue size for outgoing messages(***50***)
-/+C path	the path to the CellOpt core installation directory (**/usr/local/ComOpt/cellopt-core-1.x**)
-/+P path	the path to the CellOpt client installation directory (**/usr/local/ComOpt/cellopt-coii-1.y**)
-/+R path	This is the full path to the Acrobat Reader executable, e.g. on Windows "C:/Program Files/Adobe/Acrobat 5.0/AcroRd32.exe", or on Solaris "/opt/Acrobat4/bin/acroread".
-/+A FrequencyHopping	Enable/disable full frequency hopping (*false*)
-/+A FrequencyGroup	Enable/disable full frequency groups (*false*)
Filename/dirname	Initial startup command file. Typically this would be used for loading a model or Project. More than one file can be specified and they will be loaded in order. The number of models loaded may, however, be limited in the application.
-/+A BSICPartialDecouplingofNCCandBCC	Enable/Disable the ability to optimize the Co BCCH - Co BCC relation as well as the Co BCCH - Co BSIC relation.
-/+A IDEN	Enable/Disable IDEN specific set handling.

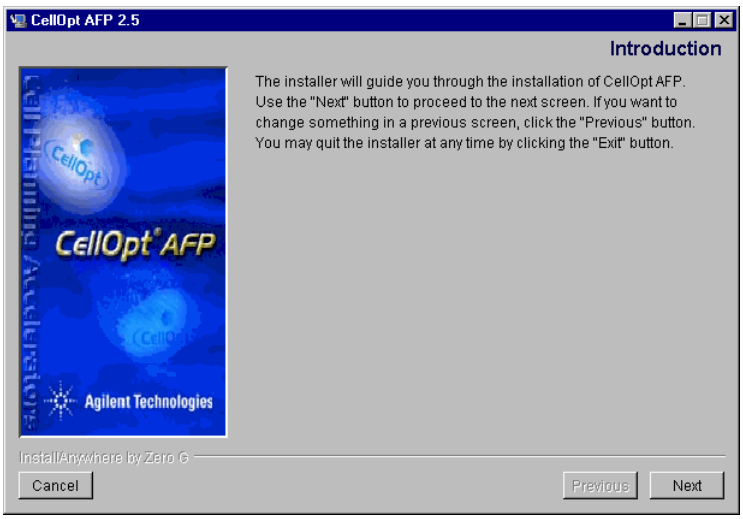
-/+A ServerLocator	Enable/disable the Server Locator functionality, this makes it possible through the CORBA NameService to easily locate available servers on the network.
-ORBInitRef.NameService=corbaloc ::<host>:<port>/NameService	This should be used in conjunction with the parameter above. It will through the <host> and <port> give a unique location of a CORBA NameService at which the CellOpt Servers register.

The most commonly used options are the **–s**, **-p** and **–A** options for specifying the server to connect to and the frequency planning features to enable. Normally these options should be correctly configured during the installation process.

Installation

The installation procedure is similar for all three supported operating systems Windows, Solaris and Linux. InstallAnywhere installation scripts are called either InstallAFP25_Windows.exe on Windows, InstallAFP25_Solaris.bin on Solaris or InstallAFP25_Linux.bin on Linux. These scripts provide an intuitive GUI based installation. The Windows and Unix installation procedures are very similar but differ in respect to that the software is installed as a certain user and that certain access is needed to be able to install it. Depending on your installation type follow the required procedure.

- “InstallAnywhere for Windows” on page 9
- “InstallAnywhere for Unix” on page 14

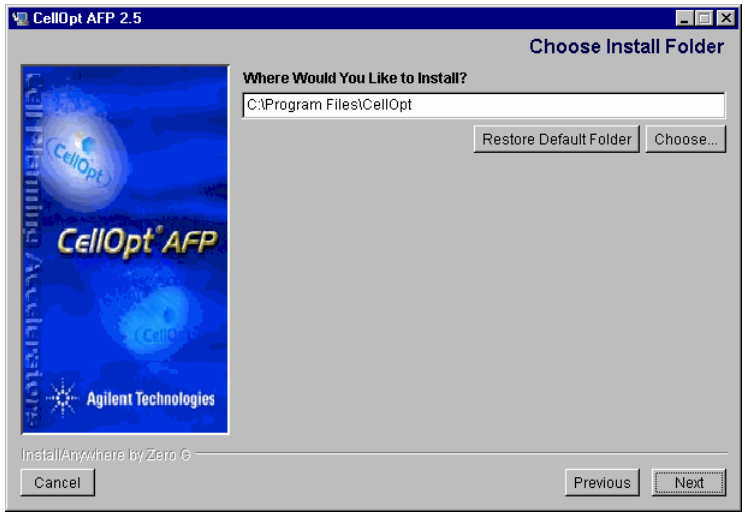


During installation you will be given the choice of whether to install the client, the server or both on the designated computer. The default choice will be to install both the client and server. For access points that do not involve the server, you should install the client only. The FLEXlm license server need not be installed on the same computer as one designated to run a **CellOpt AFP** server, but must be on the same network. The installer will also give you the opportunity to indicate which license file you are using to use the product.

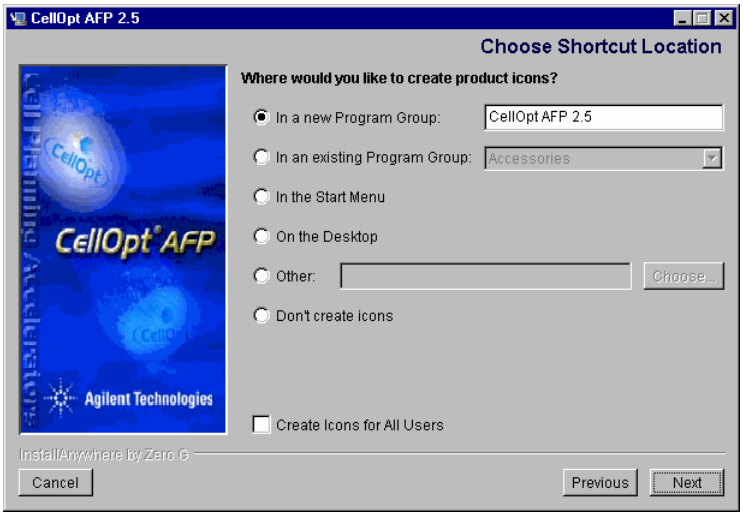
InstallAnywhere for Windows

InstallAnywhere will lead the user through the installation of the CellOpt AFP using the intuitive graphical user interface and will look and feel familiar to most Windows users. The installation procedure has a number of steps.

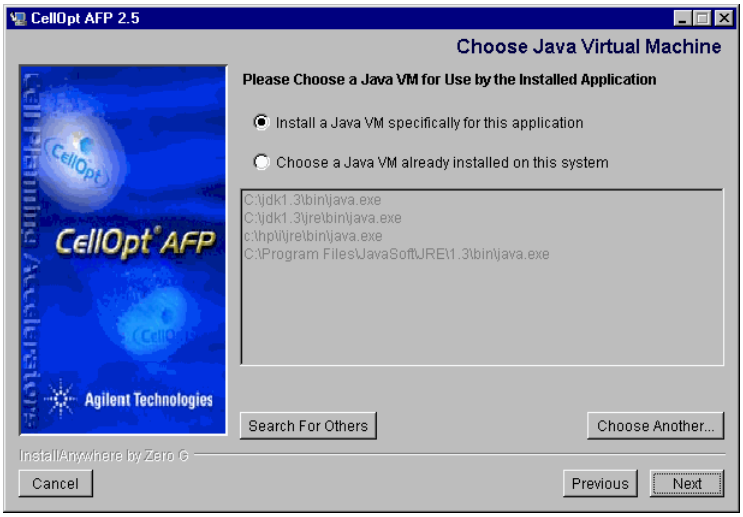
1 Choose Install Folder.



2 Create shortcut

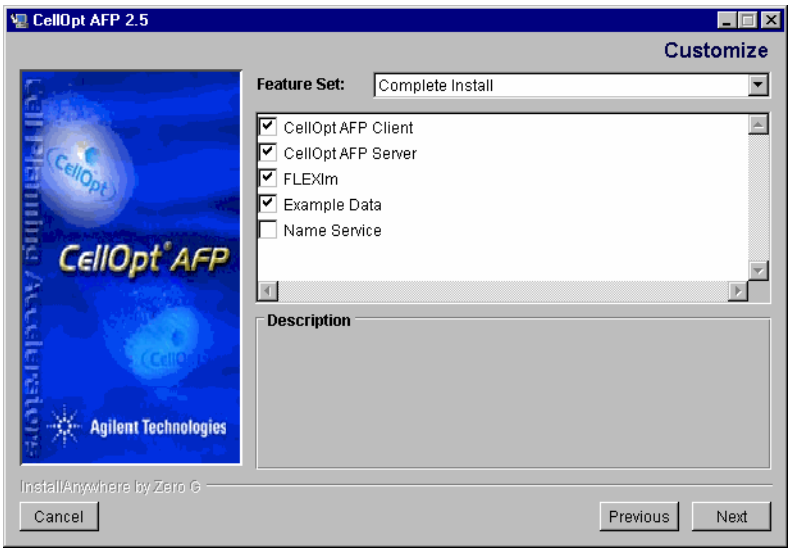


3 Choose Java Virtual Machine (JVM).
It is recommended that you choose the one supplied with the installer package.



4 Choose install set.

Either the client, the server or both can be installed on the local computer. The **Complete Install** will install everything. The **Server Only** install will install the server and the FLEXlm license manager subsystem. The **Client Only** install will install the client and the example data. The **Minimal Install** will install the client with no example data. By selecting **Customize** the screen below will be displayed allowing you to choose exactly which components are to be installed.

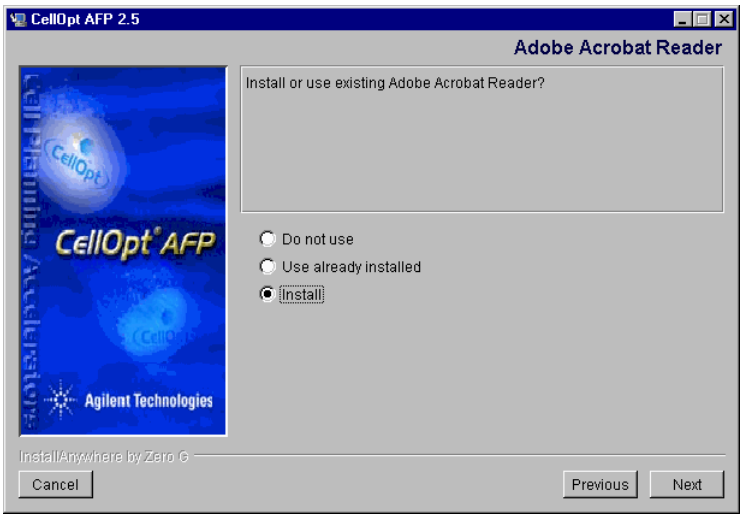


If the FLEXlm license management system is to be installed on a computer other than the CellOpt AFP server component, then the user needs to customize the installation. On the computer that will run the CellOpt AFP server choose **Server Only**, and then click customize and deselect the FLEXlm

component. On the license server computer again choose **Server Only** and customize, but this time deselect the CellOpt AFP server component. Note that the FLEXlm system must be installed on the computer for which the license has been made. The license file is normally located in the flexlm/license subdirectory of the CellOpt AFP installation.

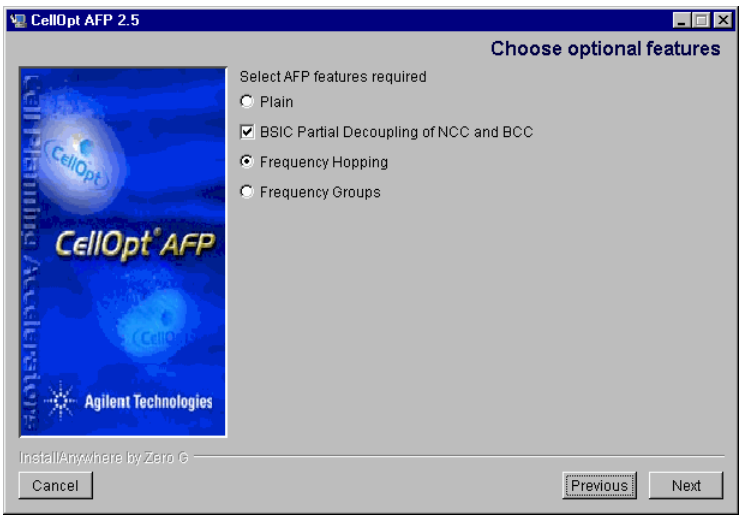
5 Installing the CORBA NameService, refer to the "CORBA NameService" on page 24.

6 Adobe Acrobat Reader.

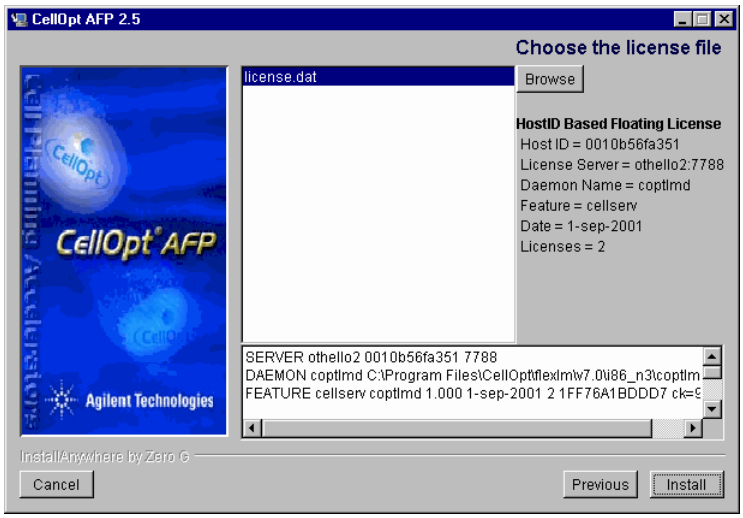


This window will only be shown if the installer is not able to find an installed copy of the 'Acrobat Reader'. Either a file browser can be used to locate the executable, or a new installation can be made, unless the user chooses not to use it at all. It is advised to use 'Acrobat Reader' otherwise you will not be able to view the 'Users Guide'.

7 Choose the features to install.



8 Choose license file.



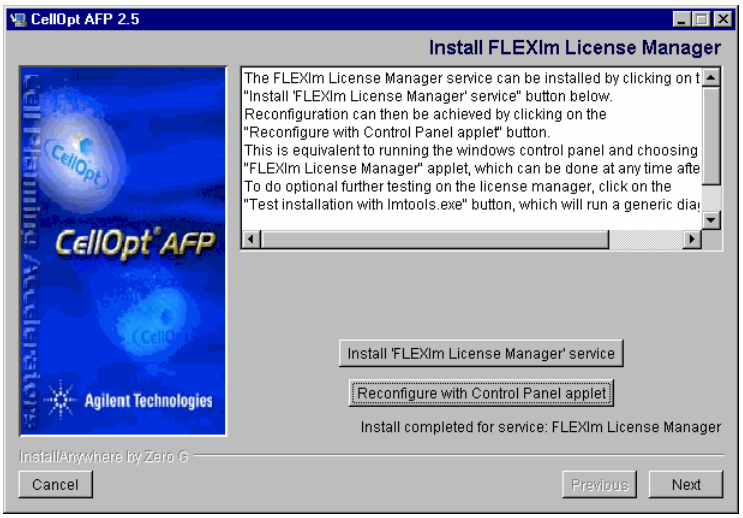
The license file is normally located in the flexlm/license subdirectory of the CellOpt AFP installation. Simply open it with any text viewer or editor and check that the server name and hostid corresponds to the correct computer. The CellOpt AFP server will use the license file to determine which computer to query for the license, while the FLEXlm license server will use the file to determine the validity of the license and manage the number of available licenses. If you install FLEXlm then the installer displays the available license files as shown above.

9 Installing.

10 Installing ‘Acrobat Reader’.
If the user was prompted for installing 'Acrobat Reader', step

6, then during the install phase the user will be prompted with a window for the actual install of 'Adobe Acrobat Reader'.

11 Install FLEXlm License Manager.
It is recommended to check that FLEXlm is not already installed on the machine as a new installation on top of the previous one, can erase the license information from other applications. For information read through "Installing FLEXlm licenses under Windows" on page 21.



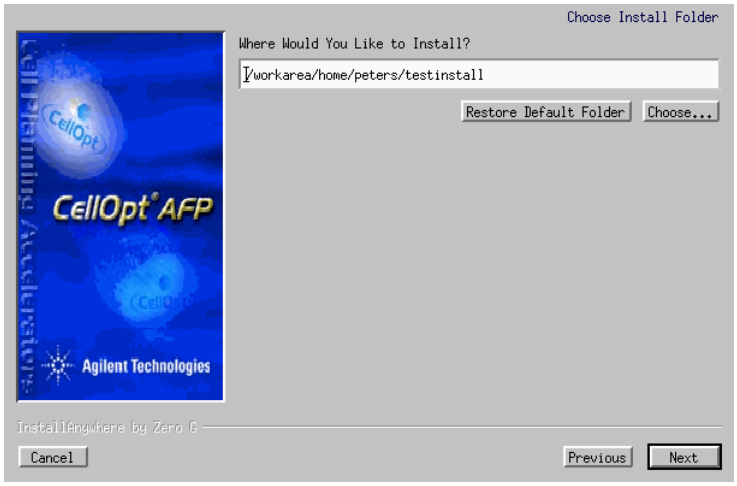
12 The installation is now completed.

InstallAnywhere for Unix

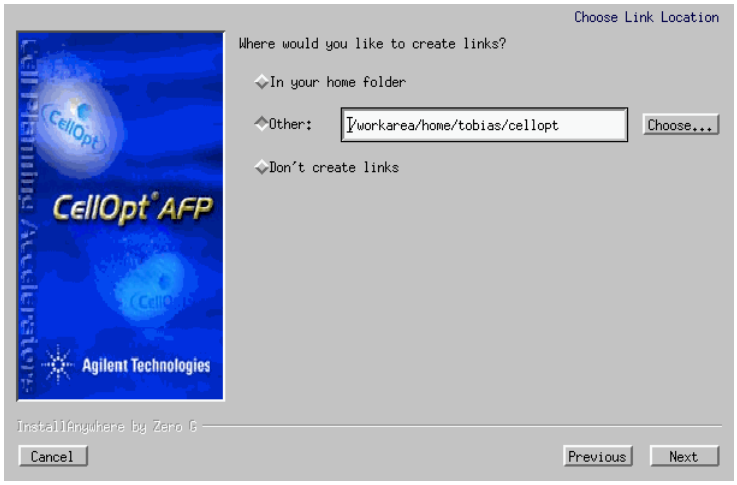
InstallAnywhere will lead the user through the installation of the CellOpt AFP using the intuitive graphical user interface and will look and feel familiar to most Windows users. The installation procedure has a number of steps.

The installation must be run as the 'root' user during the install, so that it is possible to configure the server as a service (under /etc/init.d), to install FLEXlm license manager and being able to create new Unix users.

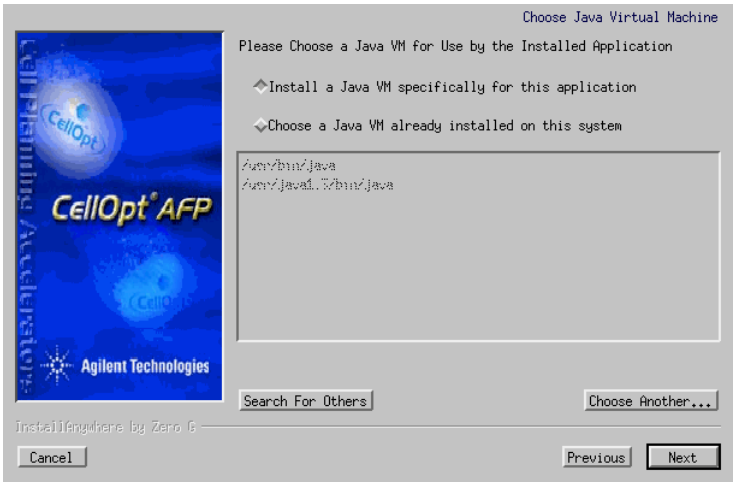
1 Choose Install Folder.



2 Create a link location

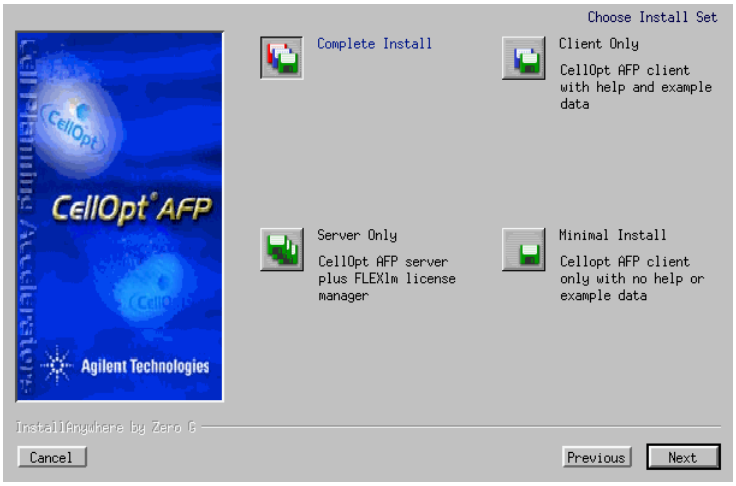


3 Choose Java Virtual Machine (JVM)



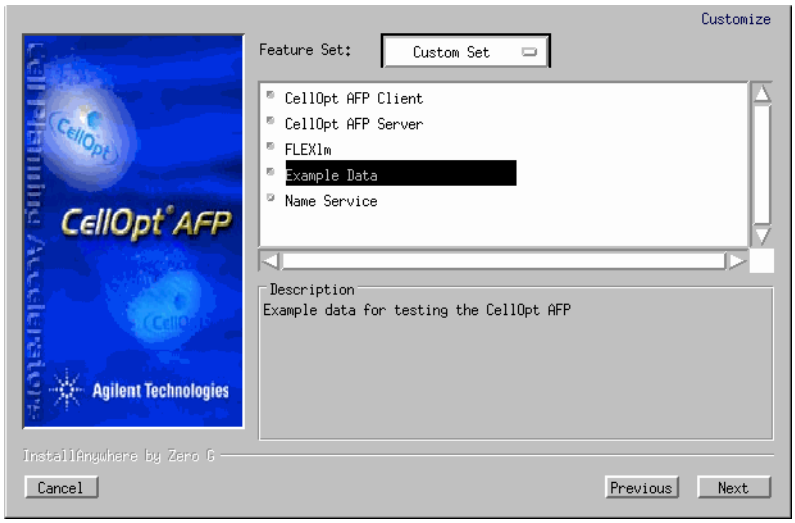
It is recommend to use the JVM supplied with the installation.

4 Choose the install set



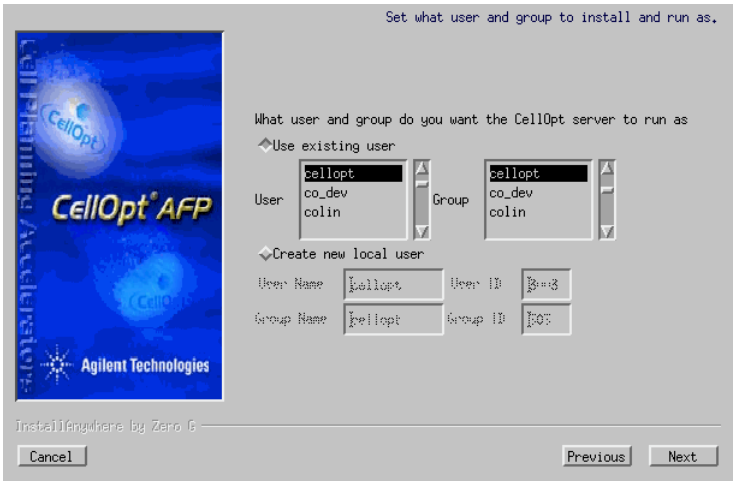
Either the client, the server or both can be installed on the local computer. The **Complete Install** will install everything. The **Server Only** install will install the server and the FLEXlm license manager subsystem. The **Client Only** install will install the client and the example data. The **Minimal Install** will install the client with no example data. By selecting **Customize** the screen below will be displayed

allowing you to choose exactly which components are to be installed.



If the FLEXlm license management system is to be installed on a computer other than the CellOpt AFP server component, then the user needs to customize the installation. On the computer that will run the CellOpt AFP server choose **Server Only**, and then click customize and deselect the FLEXlm component. On the license server computer again choose **Server Only** and customize, but this time deselect the CellOpt AFP server component. Note that the FLEXlm system must be installed on the computer for which the license has been made. The license file is normally located in the flexlm/license subdirectory of the CellOpt AFP installation.

5 Set user and group

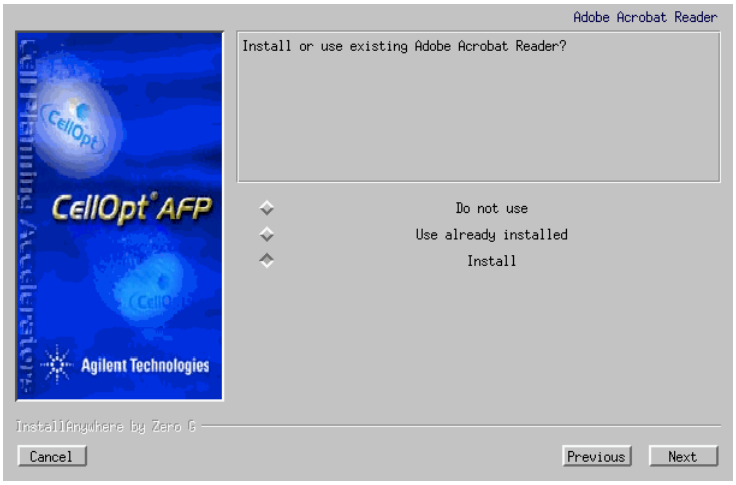


The user/group combination selected is the user/group

ownership set on the files during the install, and the owner of the client and server processes when they are running.

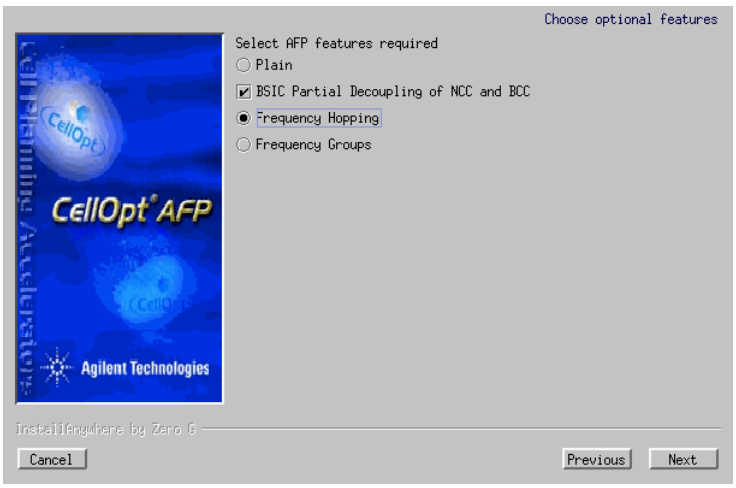
6 Installing the CORBA NameService, refer to "CORBA NameService" on page 24.

7 Adobe Acrobat Reader

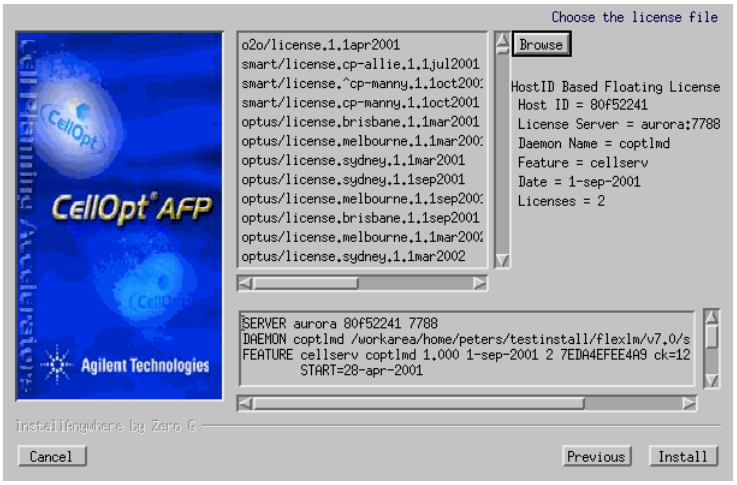


This window will only be shown if the installer is not able to find an installed copy of the 'Acrobat Reader'. Either a browser can be used to locate the executable, or a new installation can be made, unless the user chooses not to use it at all. It is advised to use 'Acrobat Reader' since otherwise the client will not be able to view the 'Users Guide'.

8 Choose the features to install.



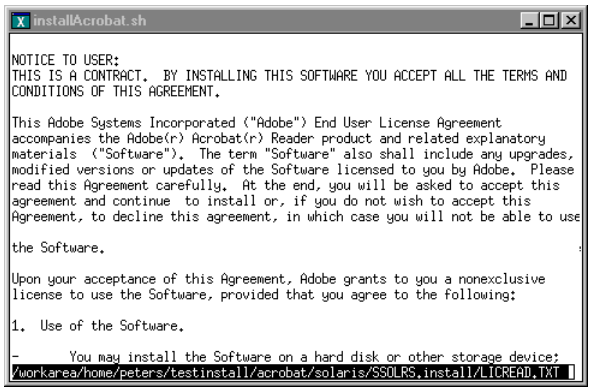
9 Choose license file.



The license file is normally located in the flexlm/license subdirectory of the CellOpt AFP installation. Simply open it with any text viewer or editor and check that the server name and hostid corresponds to the correct computer. The CellOpt AFP server will use the license file to determine which computer to query for the license, while the FLEXlm license server will use the file to determine the validity of the license and manage the number of available licenses. If you install FLEXlm then the installer displays the available license files as shown above.

10 Installing

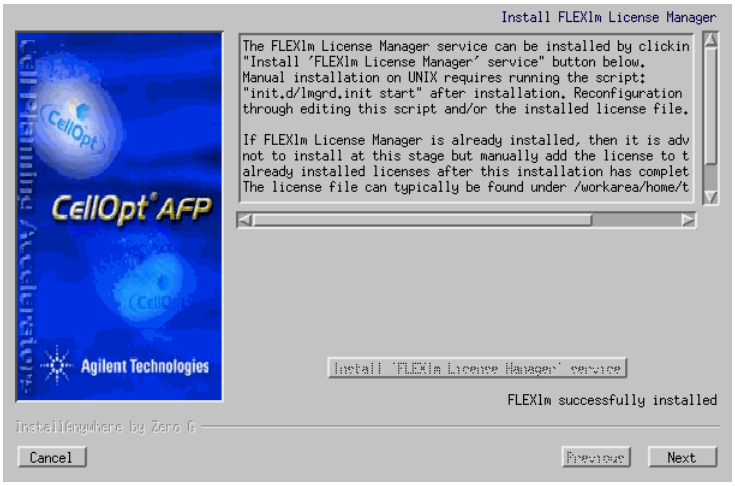
11 Installing ‘Acrobat Reader’.



If you were prompted for installing 'Acrobat Reader' then during the install phase you will be prompted with a text window above. Note, the 'Acrobat Reader' installer needs to be extracted first and therefore it might take some time before the text in the window shows up. When the agreement has been read through, press 'Q' and you will be prompted to either 'accept' or 'decline' the agreement. The script will then

ask for a path to install 'Acrobat Reader' into and then install it.

12 Install FLEXlm LIcense Manager.



Through the installation of FLEXlm changes are made to the /etc/init.d and /etc/rc3.d/ directories. The installer will prompt the user with error messages if it is unable to install it properly, this is usually an access permission error. Note that it is recommended to make sure that FLEXlm is not already installed on the machine as a new installation on top of the previous one can erase the license information from other applications. For more information read through "Installing FLEXlm licenses under Unix" on page 20.

13 The installation is now completed.

Installing FLEXlm licenses under Unix

Under Unix the installation of FLEXlm is taken care of by the 'InstallAnywhere script (InstallAFP25_Solaris.bin or InstallAFP25_Linux.bin)' script. However, because many other popular applications use FLEXlm for their license management requirements, and local FLEXlm configurations can vary considerably, it is useful to know how to install and/or reconfigure FLEXlm manually.

Installation of the FLEXlm license management system must be done by root, and comprises three parts:

Installation of the general **FLEXlm license server**. This requires ensuring that the license server **`lmgrd`** is running on the predefined **license host**. Typically, under Unix, this would be achieved by installing the binary in an appropriate place, like

`/usr/local/sbin/lmgrd`, and setting the system up to run it as a server, for example, by adding the following line to your server host startup scripts:

```
/usr/local/sbin/lmgrd > /var/log/lmgrd.log 2>&1
```

For Solaris and Linux a simple example script is provided in the cellopt-core-1.x/scripts directory of the installation. Please refer to your operating system documentation for details on configuring the SysV init system.

Installation of the **CellOpt AFP server license**. This should be installed in an appropriate place, like

```
/usr/local/CellOpt/flexlm/v7.0/sun4_u5/agilent
```

Please ensure that this path matches that defined in the **CellOpt AFP** license file.

Installation of the **CellOpt AFP license file**. The **CellOpt AFP** license file is called **`license.dat`**, and is typically installed as:

```
/usr/local/CellOpt/flexlm/licenses/license.dat
```

If your installation already uses FLEXlm it might be necessary to integrate this file with the current system files. Normally this would simply involve placing the FEATURE line from the **CellOpt AFP** license file into the system **license.dat**.

The **CellOpt AFP** license file will be provided together with the installation CD, and will match your license requirements. The license files will be created with a period of 6 months and at the end of a 6-month period you will be receiving a new license file by e-mail. Generation of the file is based on important information provided to Agilent Technologies.

Specifically we need to know the hostname and hostid of the server the license manager will run on. Under Solaris this information can be obtained by typing the commands **`hostname`** and **`hostid`** respectively. Additionally the license will depend on the number of concurrent connections being licensed and whether the license was purchased in full or on a lease basis.

Installing FLEXlm licenses under Windows

Under Windows the installation of FLEXlm is taken care of by the **InstallAFP25_Windows.exe InstallAnywhere** application. However, because many other popular applications use FLEXlm for their license management requirements, and local FLEXlm configurations can vary considerably, it is useful to know how to install and/or reconfigure FLEXlm manually.

Installation of the FLEXlm license management system under Windows must be done with administrator rights, and comprises four parts:

Installation of general **FLEXlm license server**. This requires ensuring that the license server **lmgrd** is running on the predefined **license host**. This would be done, using the control panel extension for FLEXlm. The control panel extension, **flexlm.cpl**, is provided on the CellOpt AFP distribution CD. This file needs to be copied to the system directory of the PC (for WindowNT c:\winnt\system32). Load the control panel and launch the FLEXlm configuration applet. Specify the lmgrd.exe, license file and debug log file. Choose whether or not to start the license manager at power-up. It is recommended to install FLEXlm as a service and have it started automatically on system boot.

Installation of the **CellOpt AFP server license**. This should be installed in an appropriate place, like

```
C:\CellOpt\flexlm\v7.0\i86_n3\agilent
```

Please ensure that this path matches that defined in the **CellOpt AFP** license file.

Installation of the **CellOpt AFP license file**. The **CellOpt AFP** license file is called **`license.dat`**, and is typically installed as **`C:\CellOpt\flexlm\licenses\license.dat`**. If your installation already uses FLEXlm it might be necessary to integrate this file with the current system files. Normally this would simply involve placing the FEATURE line from the **CellOpt AFP** license file into the system **`license.dat`**.

The **CellOpt AFP** license file will be provided together with the installation CD, and will match your license requirements. The license files will be created with a period of 6 months and at the end of a 6-month period you will be receiving a new license file by e-mail. Generation of the file is based on important information provided to Agilent Technologies. Specifically we need to know the hostname and ethernet physical address of the server the license manager will run on. Under Windows NT this information can be obtained by typing the command **ipconfig /all** in a command prompt window. Additionally the license will depend on the number of concurrent connections being licensed and whether the license was purchased in full or on a lease basis.

Configuration

After installation, you can carry out further configuration on both the client and server. Most configurations are controlled through the modification of the command-line options provided to the client and server components. Please refer to “Command-line parameters” on page 4 for details concerning all the configuration parameters available.

Configuring the server under Unix

The server can be configured through its command line parameters in the /etc/init.d/CellServ.init script. Information about the possible arguments can be found in “Command-line parameters” on page 4. Besides the command line parameters it may be necessary to modify the home directory of CellOpt (stored in the CELLOPT_HOME variable) and the license file location (stored in the LM_LICENSE_FILE variable). Note that the LM_LICENSE_FILE can either be a path to a file containing the license or a 'port@host' combination referring to the host and port carrying the license daemon, the default port for FLEXlm is 7788.

Configuring the server under Windows

Under Windows NT where the server has been installed as an NT service the NT registry is the primary means by which the server is configured because it is more inconvenient to modify command line options for NT services. The location of the configuration data in the registry is;
`"HKEY_LOCAL_MACHINE\SOFTWARE\CellOpt\AFP\2.x\Config".`

Refer to the “Command-line parameters” on page 4 for more information about the command line parameters.

Configuring the client

The client is configured in the same way for Windows as for Unix. The command line options can be changed in the LaunchAnywhere configuration file, CellOptAFP25.lax in the CellOpt home directory. Refer to “Client command-line parameters” on page 6 for more information about the command line parameters. Do note, that due to a bug in InstallAnywhere the command line arguments are listed twice in the file, therefore it is necessary to update them in both places.

CORBA NameService

The CORBA NameService enables the user to easily locate servers on the network. The main principle is that any server that is set up on a host is asked to register with the CORBA NameService. The clients (user interfaces) then simply bring up a window with available servers. Each entry in the list of available servers will have information about their current status; ip address, host name, socket port to connect to and perhaps, most importantly, the current load on that server. This window helps you to easily find an available server, and also choose one which is not to heavily loaded.

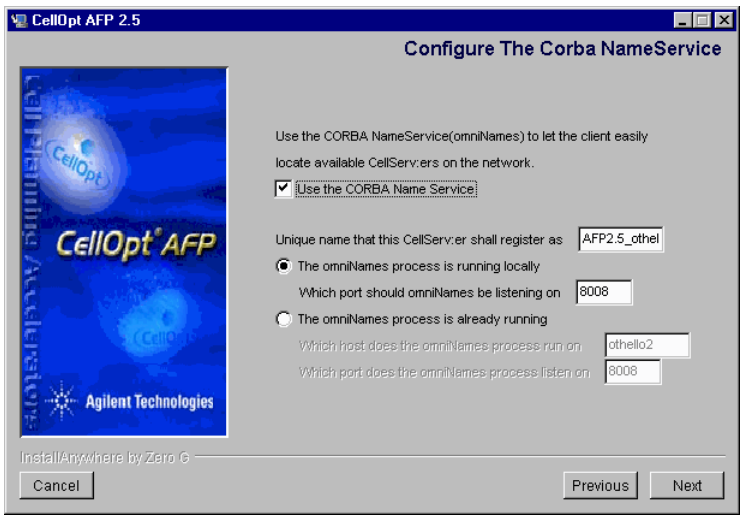
The CORBA NameService is a separate process which handles servers request to register their unique name and address, and clients requests for registered servers. The CORBA NameService can be set up in two ways, either locally or remotely. Since the CORBA NameService is only used to ease the locating of available servers it does not need to be installed. More than one CORBA NameService can be installed but it is not advisable, it is better to have all servers register in one, unless there is a reason for separation.

In the TaskManager the CORBA NameService is called omniNames.exe, and is the CORBA NameService from omniORB.

Local CORBA NmameService

The local CORBA NameService is configured with a specific socket port, and a unique name.

Unique name	The unique name, is the name assigned to the server being installed. The server being installed registers this name in the CORBA NameService for clients to use when trying to locate available servers. This name should be unique, if a name is set that is already used, then the newest server to register will override the previous registration. It is only useful to fill in a unique name if a server is installed.
Port to listen on	The socket port that the CORBA NameService should listen on. This port together with this hosts hostname is used when installing servers or clients that wants to use this CORBA NameService. This can be useful if for example several hosts are installed with only the client (user interface) and wants to easily locate the server. Or if there are several servers and clients installed on different machines which then all would like to use the common place to find an available server.

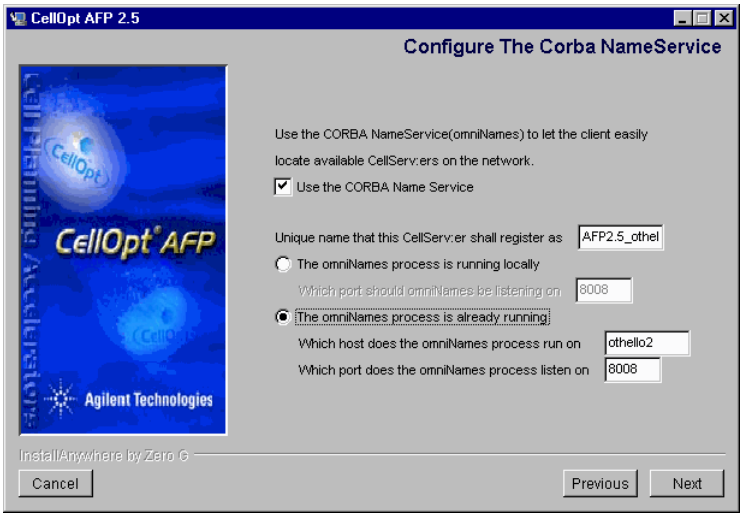


CORBA NameService Already Running

The CORBA NameService is preferably installed on one host only, which all servers register in and clients acquire information (available servers) from. If the CORBA NameService has been installed already on a host then any consecutive installs can use that CORBA NameService. If there is another CORBA NameService up and running that can be

used to. The only parameters the server and the client needs to have are the location (the host) on which the CORBA NameService is running, which socket port it is listening, and the unique name.

Unique name	The unique name, is the name assigned to the server being installed. The server being installed registers this name in the CORBA NameService for clients to use when trying to locate available servers. This name should be unique, if a name is set that is already used, then the newest server to register will override the previous registration. It is only useful to fill in a unique name if a server is installed.
Host name	The host on which the CORBA NameService is running.
Port to listen on	The socket port the CORBA NameService is listening on



3
Using CellOpt AFP

Overview

This chapter lists the standard sequence of events during a CellOpt AFP session. In some cases, it gives detailed instructions but in others there are references to parts of the *Guide* where you can find the instructions and explanations you need. The sequence is as follows:

- Start CellOpt AFP from the command line or desktop.
- Create a new model or open an existing one.
- Load data for the model.
- Carry out work in the main window, which:
  - Gives you an overview of the model and a route to seeing and changing its details using the CellOpt AFP modeling tool.
  - Allows you to start the optimization tool to produce the frequency/color code plan.
  - Generates and displays results and reports.
  - Displays the log and other messages from CellOpt AFP.
- Export the planned data.
- Save model details.
- Use CellOpt AFP's help screens.
- Close models and close down CellOpt AFP at the end of a session.

Starting CellOpt AFP

This section of the Guide deals primarily with the CellOpt AFP client. The CellOpt AFP server should be running before you start the client.

You can start CellOpt AFP in two ways – from the desktop or from the command line.

From the desktop

Simply double-click on the CellOpt AFP icon on your desktop to start the program with no models or other data files loaded. This runs a batch file (**cellopt.bat**, unless you have changed it). The main window opens and you can continue from "The Main Window – Look and Feel" below. This method of starting CellOpt AFP is only available under MS Windows® and assumes that you have set up a standard Windows shortcut from your desktop to the batch file. The mechanism for starting CellOpt AFP Client under Unix is up to your system administrator.

From the command line

You can start CellOpt AFP from the command line (or the **Run** option on Microsoft Windows' **Start** button), just by entering the name of the start-up batch file (usually **CellOpt.bat** under MS Windows®, or **CellOpt.sh** under Unix). This has the same effect as starting from the desktop. If you want to load data files automatically as soon as the program starts, or use system parameters other than the defaults, you follow the batch/script file name with one or more arguments, which are listed (with their defaults) below.

If you load data files, you will see information in the model's tree view when CellOpt opens. This is described in the chapter on "Modeling", but the rest of the main window is described in "The Main Window – Look and Feel" on page 3.

Command line options

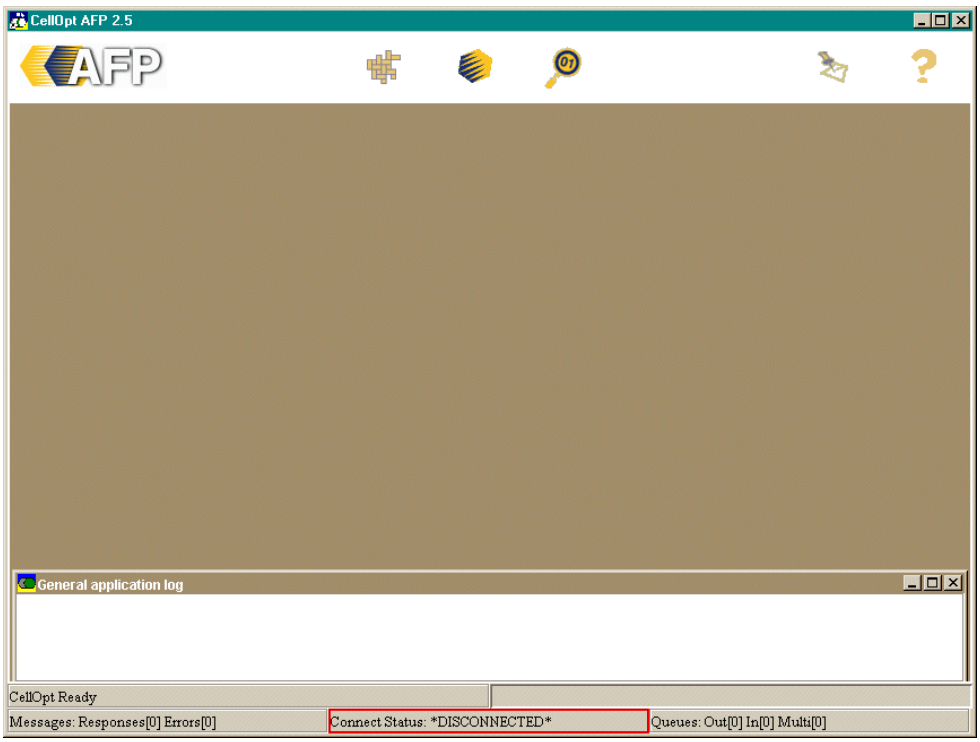
You can start CellOpt AFP with command line arguments. These affect the way CellOpt starts and runs. Multiple arguments are accepted, where the last repeated argument is taken.

The most common argument for CellOpt AFP would be a file name indicating what file to load on start-up. Most of the user arguments are found in the Settings from within CellOpt AFP and are not explained here – if you need advice at this stage you

should call CellOpt support. Other arguments can be seen by running CellOpt from the command line with the **-h** option (the help option).

The Main Window – Look and Feel

Once you have started CellOpt AFP, you will see the main window, like the one shown below. This is the way that it would appear before you load any files – the chapter on "Modeling" describes how information is presented after loading files.



This is the main window in CellOpt AFP and represents your current session. As long as the session is running, you are connected to the CellOpt AFP Server (thus occupying one concurrent licence – refer to your licence agreement for details). When you close the main window (the session), you are disconnected from the server and the licence is freed. CellOpt AFP will ask you for confirmation before closing a session.

The look-and-feel of CellOpt AFP will be metal under Unix and MS Windows under MS Windows. All screen shots in this user guide are in the MS Windows look-and-feel.

The components of the main window are described below:

The title bar

The title at the top of the window will show in the taskbar when you minimize the main window and indicates the current model.

The desktop

The largest area of the main window is the CellOpt AFP desktop. In the example, it contains only one panel (the general application log), though it will contain more once you start work on a model. There are several different panel types, as listed below.

You can have panels belonging to several different models on the desktop simultaneously. The relevant model name appears in each panel's title bar (but note that as the general log panel is for the whole session, there is only one regardless of the number of models in use).

Each panel behaves as an independent window within the desktop; when in focus, each is brought to the top and responds to the same mouse and keyboard controls as a standard window. Since this is in a Java environment, you will need to click on the panel to activate it and bring it into focus before you can use the panel.

The panels are automatically moved into the desktop (and possibly resized down) when they do not fit on the desktop. You will briefly see a red line indicating which side of the panel is not on the desktop. Note that the general application log will, in addition to moving back onto the desktop, expand to the width of the desktop.

Right clicking on the desktop accesses a menu of available panels. This allows for easy window navigation when one or more panels is hidden or minimized. See the section below on the "The menu bar" for details about minimizing the tree view, optimizer and analyzer panels.

The following sections give more details about each of the panel types which appear on the desktop.

Modeler (tree view) panel In the chapter on "Modeling". The modeling tool allows you to see and change the details about the current network model. CellOpt AFP uses the concept of current model and optimizing model. The current model is the model new data files would be loaded into, saved, exported, optimized, analyses and in general worked on. Each time the current model changes, the title in a non-optimizing optimizer

panel and the analyses panel changes to reflect the current model. If there is an optimization in progress, then the optimizer title will reflect the optimizing model.

Optimizer control panel See “Starting CellOpt AFP” on page 2. This tool takes the modelling data and uses it to generate the frequency, HSN & MAIO and color code plan. There is only one optimizer panel per session. This means that you can only have a single optimizer running even though you might have multiple models.

Analyzer control panel In the chapter on “Analyzing and reporting”. The analyzer tool lets you generate several different sorts of report, displaying and saving them as you wish. There is only one analyzer panel per session.

The CQI Improvement Log In the chapter on “Optimizing”. This panel shows the improvement log as the optimizer finds better plans. There is only one CQI improvement log per session. This means that all optimizer runs will be logged in the same panel.

Analyzer Reports In the chapter on “Analyzing and reporting”. The different types of reports generated by the Analyzer are each displayed in their own panel. The title of each panel will have the report name and a time stamp. When you close these panels, the data displayed in them is lost. You can however generate new reports if you still have the original data set (have not found a new plan yet).

The general application log This keeps you up to date on actions which CellOpt AFP is taking in the background, like loading data files and project information.

Records important user actions, such as deletions from a model, so that you can trace what you have done during this session if you need to.

Displays messages when errors occur, for example when CellOpt AFP cannot find the information it needs.

The menu bar

You can see and choose from the CellOpt AFP menu options by clicking on:

Modeler Optimizer Analyzer Settings Help

The options are as follows:

(Modeler) While there is no model loaded, this option enables you to load a model or data file, or create a new model.

Once one or more models are loaded, the following options are available for the current model (the one in focus on the desktop):

New Create and name a new, empty model and make it the current model.

Load Choose files (individually or as a set) to load into your model. Further details about this are given later on in this chapter.

Load As. Interactive version of the load command. Allows the user to change some properties when loading lists. For example, to determine what lists should be created from the file.

Save Use this option frequently to save the work you are doing, and always before quitting CellOpt AFP. It saves the current model structure as well as the details you have changed. There are further notes about “Saving” on page 15.

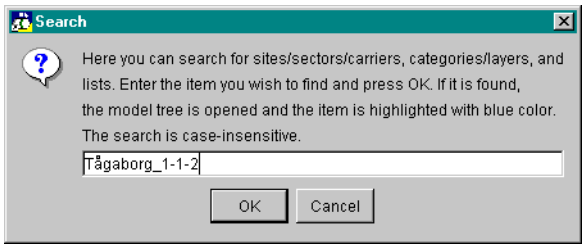
Save As Save the current model in a new directory/folder or with a new name or both.

Export Export CellOpt AFP data or merge it to another file, using a chosen frequency plan and format for the data. Exporting is described in the section on “Exporting” on page 13.

Close Closes the current model. You will be offered the chance to save or abandon any data added during the session. Read more details about “Closing” on page 21.

Edit Open the network editor described in the chapter on “Modeling the network”. This editor is also available by right-clicking on **Network** in the tree view.

Search Searches for sites, sectors, carriers, categories, layers and lists in your current model. When an item is found the model tree is opened and the item is highlighted with blue. The search is case insensitive.



Overview. Opens a document that contains an overview of the current model. This shows the most relevant properties of it, for example number of carriers and penalties.

Select Choose an existing model (already created or loaded in this session) and make it current.

(Optimizer) Bring up the optimizer control panel for the current model, ready for use.

(Analyzer) Bring up the report and analyzer control panel for the current model, ready for use on optimizer results.

(Settings) This facility allows you to modify some general CellOpt AFP settings.

(Help) This will give you access to the CellOpt AFP contact and help details. It also contains an online version of this user guide.

The general status line

The general status bar has two sections. It displays a text status message and sometimes will display a progress bar on the right. The text status messages are also displayed (as a history) in the general log panel.

The server status line

The server status line gives status information about the connection and communication between the client and server. On the left of the status bar is an indication of how many messages and errors the client has received from the server. In the center of the bar is the connection status, either disconnected (at start and with a red border) or connected when using CellOpt AFP. On the right of the bar is the status of client messages. The client sends messages *out* to the server, process messages *in* from the server and deals with certain *multiple* messages as a single communication.

Models

CellOpt AFP is conceptually divided into three sections: "Modeling", "Optimizing" and "Analyzing and reporting". All data loading and user configuration to change (or model) the loaded data to better represent the actual network is done in the modeler. The modeled data can then be optimized and the resulting plan analyzed.

More than one model can be used at the same time. The current model is the model that you are working with at the moment. You can change the current model by clicking on another model or by using the Select option in the model menu (click modeler icon or right click in the model tree view). The current model is indicated in the main title.

You can load data files into the model as well as input user-defined data directly into the model. See the section on "Loading Data Files" on page 10 and the section on Modelling respectively.

Each action that you do to the model is recorded. You can then save a "Model" file which will contain all the necessary commands to load the model to the same state that you last saved it in.

You can:

- Create a new model:

1 Click the modeler icon, choose **New** and enter the model name.

2 If you have no other model in the current session, then a new model will also be created as soon as you try and load any file.

- Load an existing model from disk:

1 Click on the modeler icon or right click in an existing model tree view form, choose **Load** and select the model name in the browser.

When you load a model, all the user defined data and data files associated with it are automatically loaded. If the newly loaded model shares files of the same name with one already loaded, you will be asked if you want to load again. Choose **Yes** to use the file from the newly loaded model, **No** to retain the one already loaded.

- Select a model already on the desktop (making it current, so you can model it, optimize it or obtain reports and analyses for it) by either:

1 Clicking on the model form, or

2 Right clicking on the main desktop and selecting the model form from the list of available forms, or

3 Clicking on the modeler icon or right-clicking in an existing model tree view form, choosing **Select** and then selecting the model you want from the list which appears. This method is useful when the desktop is crowded and the model you want is buried under others.

No matter how many models you have, CellOpt AFP only allows you to have one optimizer and one analyzer panel. The model name in the title bar will change to that of the current model as soon as you select it if there is no optimizer running. (When the optimizer is running, the optimizer title will indicate the model being optimized, which might not be the current model.)

- Minimize the model. All property forms associated with the model are also minimized and will be restored when the model is again selected as the current model.

- Save the current model by clicking on the modeler icon or right click in the model tree view form and choosing Save to update the model file, and associated data files.

- Close the current model by clicking on the modeler icon or right click in the model tree view form and choosing **Close**, or by using the window closer. Note that, when you close a model, you will lose any changes you have made since the last save if you do not save the model. You will be asked if you would like to save a model that has any unsaved data before the model is closed.

Data Files

The model typically consists of automatically generated data (for example, the Carrier Database, Interference Lists, Neighbor Lists) and user-defined data (such as List penalties, separation requirements). The user data is stored in five files, the **Custom**, **Data**, **Penalties**, **Layers** and **Plan** files. The model file itself consists of commands to load these and other generated data files into CellOpt AFP. The Custom, Data, Penalties, Layers and Plan files for the model's information are automatically updated every time you save the model. CellOpt AFP, however, never modifies the generated data files. Once they are loaded, their names are held in the model file, so they will be loaded again whenever the model is loaded.

You can load data list files into the current model in two ways:

By using the forms described in the chapters on "Modeling". You can use this method to apply the data to the whole model or to selected parts of it.

From the menu. You use this method only when the data is to apply to the whole model:

Click on the modeler icon, choose **Load** and select the data list file name in the browser. Note that you can load any file regardless of its directory. CellOpt AFP recognizes the sort of file it is by looking at its internal format, not its name, and ensures that its contents are used in the correct place within the model. Note that you can use the same data list file for more than one model, but if you alter it in one model, then the changes will apply to all the other models from the moment you save the current model. You should consider making copies of list files with different names or directories if you want to prevent this.

Loading Data Files

To load a file into CellOpt AFP simply **Load** it.

CellOpt AFP is capable of loading data from several different data formats. The format of files loaded will be automatically deduced from the structure of the data within the files. The first ten data lines of the file are used to determine the file format. When there is an uncertainty in the file format, you will be asked to help determine the file format by selecting it from a list of possible formats.

There is also a variant of the Load command called **Load As**. It is an interactive version, which lets the user change certain properties when loading files that create lists. For example, when loading a PlaNET interference matrix, the user may choose which lists that should be created as well as what they should be called.

All data loaded into CellOpt AFP is loaded into a model. It may originate directly from external tools (prediction or measurement, for example) or from CellOpt AFP user files from previous sessions or other models. You can also load a previously saved model file.

Each model file holds the model's name and instructions to load further files. Together, all these files make up the model, a description of a physical network, with its sites, sectors and carriers as well as the rules for frequency planning. The model's files include:

User data files called **Custom**, **Data**, **Penalties**, **Layers** and **Plan**, which are unique to the model.

- **Custom** holds:
  - Penalty values and list properties.
  - Illegal and forbidden frequencies.
  - Carrier and sector data.
- **Data** holds:
  - Available frequencies and colour codes which can be allocated (under given conditions) to carriers by the optimizer.
  - Categories and layer definitions
  - Other data that you define through the CellOpt AFP Modeler.
- **Penalties** holds data detailing the penalties, scaling, distribution data and so on (see the "Modeling" section).
- **Layers** holds the user-defined carrier layer assignment.
- **Plans** holds the current plan which the optimizer assigned.

A series of "Data" file(s), which hold:

- The sites, sectors and carriers belonging to the network.
- Separation Rules for calculating each carrier's attribute assignments. The separation rules are made up of Lists of illegal attributes, exception, neighbor and interference lists and the penalties for choosing or changing particular attributes.

The Model files may contain any number of these files, which CellOpt AFP will load when you load the model file. You can have more than one file of the same data type, for example, you might want to load two neighbor lists with one containing switch neighbors of a high handover count, and the other neighbors from a prediction tool.

You can have as many different models for the same physical network as you like, each with differences in the detail of their attributes, categories or rule lists. CellOpt AFP handles each model individually, enabling you to make very quick and comprehensive comparisons between them, testing new ideas and rules. Note that one data file can be shared by more than one model, though you may want to use a different copy of each list for each model. This will ensure that you only affect one model at a time if you alter the data in that file.

Before you start to use CellOpt AFP, you will have already developed the theoretical structure of the network, as well as sets of available and illegal attributes and statistics generated by other software. You will also possess predicted (or actual, if the network is already running) statistical lists of its performance to review.

CellOpt AFP allows to you to load all these directly into a model (no matter which application created them) so that the optimizer will be able to consider every single available factor when it starts. Once a model exists in CellOpt AFP, you can add new lists and remove unwanted ones between optimizer runs, and you can edit the attributes, categories, layers and lists directly in CellOpt AFP.

Model and data files saved by CellOpt AFP are simple text files with user-defined names, which reside in user-named directories or folders. CellOpt AFP imposes no conventions of any sort on file names and extensions or directory/folder names or hierarchies, though you may well want to impose your own conventions for ease of navigation. You should not try editing these files with a text processor; the position and number of space characters, tabs, empty columns and so on governs the way in which CellOpt AFP interprets the data and decides what

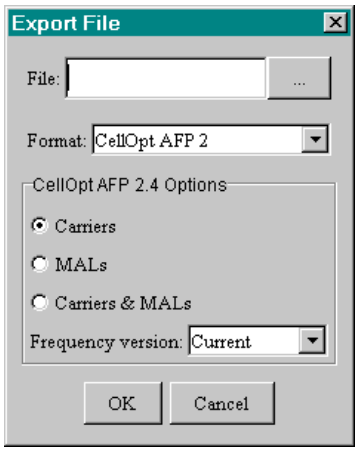
sort of information is held in each file. You should make all your modifications through CellOpt AFP's forms, described in the chapters on "Modeling".

Exporting

Once you have modeled the network, optimized a plan and analyzed it to your satisfaction, you will need to export the plan from CellOpt AFP so you can use to further the planning and implementation process. CellOpt AFP will save your current latest plan in the model file **Plan** for you, but it is recommended that you export your plan yourself. You can export your plan in a number of different formats.

To export the latest plans:

1 Click on the modeler icon or right-click on the model tree view form, and choose **Export** to see the dialog box.

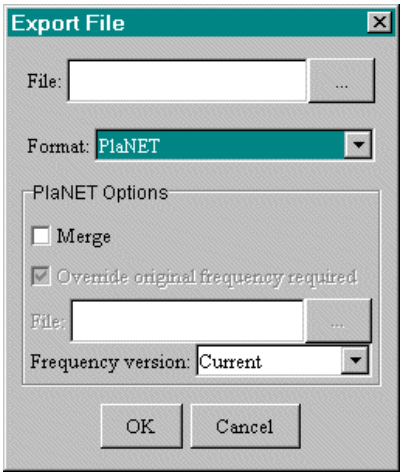


2 Use the browser (click on**...**) to locate the directory or folder where you want to store the plan and give the file a name (you can choose to overwrite an existing file if you want to). You can use any filename and any extension you like.

3 Choose the format of the file to be exported in from the **Format** drop-down list. You will have different options depending on the format type:

- If you chose CellOpt II file format (as illustrated just after step 1 above), select:
  - Carriers if you are just exporting a frequency, HSN & Maio or colour code plan.
  - MAL if you want to export the MAL definitions.

- Carriers & MAL if you prefer the data exported in a single file.



- If you chose PlaNET as the format, the dialog box changes:

  a Choose whether you would like to *merge* with an existing carrier database file. This is a very useful technique when the carrier database is for a larger region than the area you have just planned. If someone else has changed a frequency in a different region from the one you are dealing with in this model (the region marked by free carriers) then you will need to merge your changes into the changed carrier database.

  b If you select **Merge** (☑), you need to supply (in the lower File box) the name of the file to merge with. The merge file and the carriers in memory will be merged to form the output file. The output file is the merge file with only carriers marked as free updated. You can use the lower browser (...) to find the right directory or folder.

  c Choose whether (☑) or not (☐) to overwrite the original frequencies required. This can be used when you want the frequencies required to be equal to the original frequencies required, and not to the number of assigned frequencies. These would only be different if a carrier has remained unassigned (was unassigned and fixed) when the plan was found.

4 In all format types, choose one of the following:

- **Current** to export the current frequency version. This is your latest or current plan.
- **Original** to export the original frequency version (the one which existed when the carrier was first created or loaded in CellOpt AFP).

5 Click on **OK** to carry out the export. Progress is recorded in the log.

Saving

Save your work frequently. To make sure that your models contain only the information you really want to keep, CellOpt AFP does not save any of them automatically – the procedures for user-controlled saving are given below. CellOpt AFP will, however, always ask if you want to save before allowing you to close the application while a modified but unsaved model exists (see "Closing" on page 21).

You can send the logs and reports of the optimizer and analyzer respectively directly to named files. Instructions for doing so are given in the chapters on "Optimizing" and "Analyzing and reporting".

You can save the latest plan by exporting the data. See the section on "Exporting" on page 13.

Saving a model

When you save a model, you save the current model file, updating the information within it, including the data, penalties and layers files. The files themselves are also saved, but only those which have changed since the last save.

You can overwrite the current model file, or save the model under a new name, which will create a new model with the details of the current one, while leaving the current model unchanged and unsaved.

Under the current name

To overwrite the file holding the current model and update its data files:

1 Make sure the model you want is selected on the desktop (current).

2 Click on the modeler icon or right click on the model tree view form and choose **Save**. The log records the saving of each file and you can continue working.

Under a different name

This facility is useful when you want to create a model that is the same as an existing one; you can make a few changes to the newly created model and then compare optimizer results

between new and old. Whenever you save under a new name, a new model file and **Data**, **Custom**, **Penalties**, **Layers** and **Plan** files are created in the directory of your choice.

To save under a new name:

1 Make sure the model you want is selected on the desktop (current).

2 Click on the modeler icon or right click on the model form and choose **Save As**.

3 A browser appears for you to choose the directory and name the file before saving it.

4 The log records the saving of each file and you can continue working.

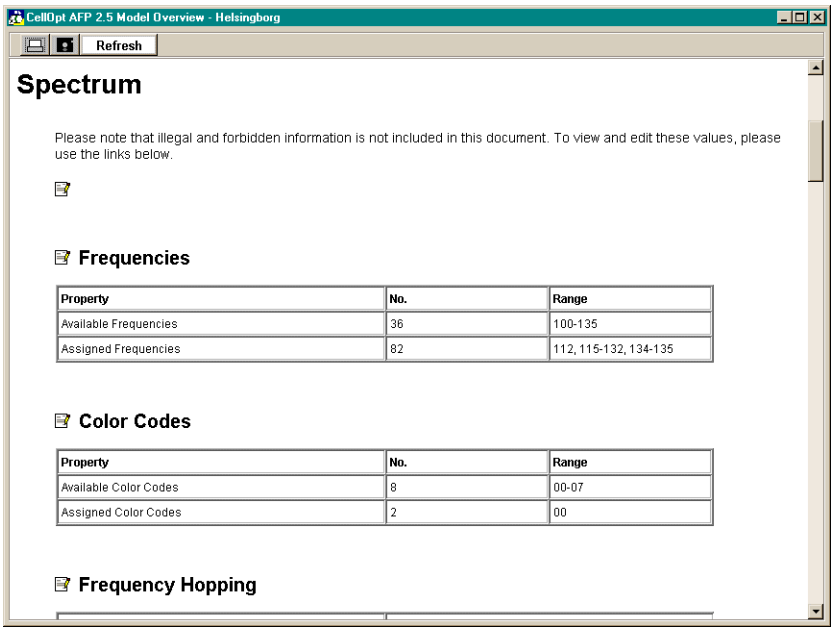
Model Overview

CellOpt AFP includes a feature for getting a document that gives you an overview of the current model. This document includes things like available and used frequencies and color codes, the number of sites, sectors and carriers, as well as all penalty values.

For descriptions about the properties included in the model overview document, see the relevant parts of this user guide.

Route from CellOpt AFP main window

Click on the modeler icon, then choose **Overview** in the menu.



What you can see

- A toolbar with buttons. It contains the following buttons:
  - Print.
  - Save.
  - Reload the document.
- A document that summarizes the most important properties of the model. It has four main sections:
  - **Spectrum.** The frequencies and color codes that the model uses. Also possibly sets, subsets, and MALs.
  - **Network.** The number of sites, sectors, carriers and free carriers.
  - **Categories & Layers.** The categories and layers that have been defined for the model. Also the number of carriers that belong to each layer.
  - **Penalties.** All penalty values. Both global and for each layer. Note that empty penalty values, i.e., those that are zero, are not included.

What you can do

- Print the report. To do this press the button with a printer on it.

- Save the report to disk. The document is written in HTML, and it may be saved to disk in this format. Press the button with a floppy disk on it to save the document.
- Reload the document.
- Open dialog boxes directly from the document. Hyperlinks are marked with red color. Click on one of them to open the related dialog box.
- Add comments to the document. To add a comment:

1 Click on one of the icons in the document.

2 Enter the text you wish to add in the text field in the dialog.

3 Press **OK.**

4 The document now reloads to include you comments.

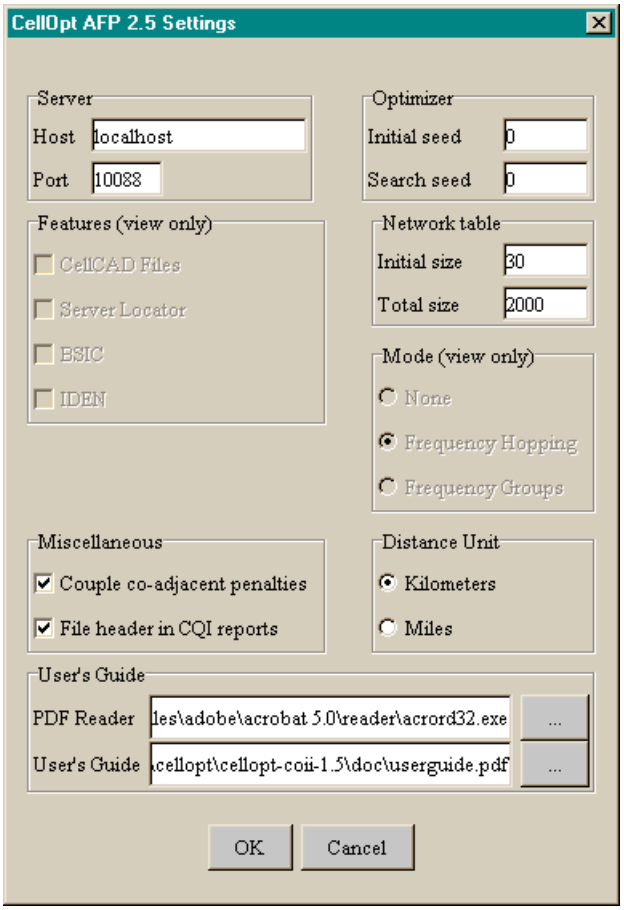
NOTE

These comments are saved with the model. So the next time you start CellOpt AFP with the current model and open the model overview, they are displayed again.

Changing the Settings

This facility enables you to set various parameters, most of which are also available as command-line parameters (these are defined earlier in this chapter).

To obtain the dialog box, click on the settings icon. The parameters are described below.



Server:

- **Host** The internet name or IP of the server on which the CellOpt AFP server is running and to which this machine should connected to as a client.
- **Port** The internet port number on the server that the CellOpt AFP server is listening on and waiting for a connection.

Optimizer:

- **Initial seed** The seed used to seed the pseudo random generator that will be used to assign an initial plan if no plan (or partial plan) exists.
- **Search seed** The seed used to seed the pseudo random generator that will be used by the optimizer as an initial search direction in the solution space.

A seed of 0 (zero) means the current time will be used to seed the pseudo random generator, giving a more truly random seed. Any other number will be used directly as the seed (giving a repeatable pseudo random sequence).

General:

- **Couple co-adjacent penalties** Check this box to ensure that adjacent penalties are never higher than the co-penalties in the same rule set. This concept is described in the chapter on "Modeling penalties". The default is checked (enabled).
- **File Header in CQI reports** Check this box if you would like file headers in the analyses report files. You might not want headers in the files if you plan to load them into some other tool
(MS Excel®, for example) to do further analysis on them.

Network table:

- **Initial size** The size of the first carrier display table. The full table is calculated in the background while you view the data in the first table.
- **Total size** The size of the final carrier display table. This should preferably be at least the number of carriers in your network, but is sometimes set smaller if you have a very large network (many carriers) and/or you are on a slow system. In such a case, it might be better to have faster response and sacrifice the visibility of the whole network.

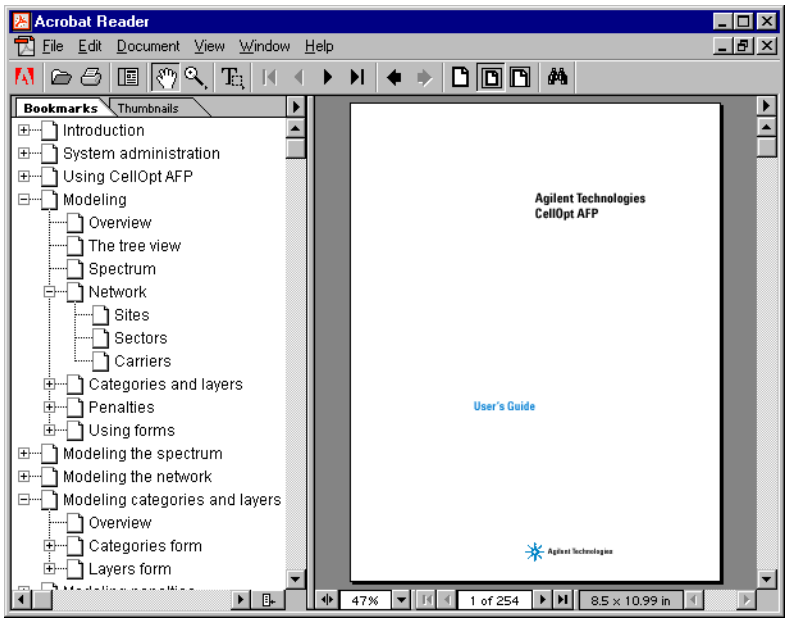
When you click on **Apply**, your new settings take effect immediately but will not be retained when you close and re-open CellOpt AFP. See the section on "Command line options" on page 2 for changing these settings in a batch or script file.

If you are already connected to a server (have had at least one model open in this session), then the server settings will not affect your connection.

Using Help

Choose:

User Guide to see an online version of this user guide.



About to see version and contact details.

Closing

You can remove a current model from the session or shut down CellOpt AFP altogether.

Closing a Model

If there is more than one model open, you can close each one individually and continue work on the others. As long as you save the model, you can reopen it in this or another session.

To close a model, click on **Model** and choose **Close** or use the normal window closer (usually a small X in the top of the window).

Closing CellOpt AFP

To close down at the end of a session:

Click on the window closer of the main window.

You are asked if you want to exit CellOpt AFP. Click on **Yes** to close, **No** to return to the main window.

If you clicked **Yes** and there is unsaved data, you will be warned. Click **Yes** to save the data before closing, **No** to leave all current unsaved models as they were when you last saved them.

4 Modeling

Overview

Modelling in CellOpt AFP is the creation and editing of a representation of the network and its requirements so that the optimizer has all the information it needs to allocate the best possible assignments to the individual carriers of the network.

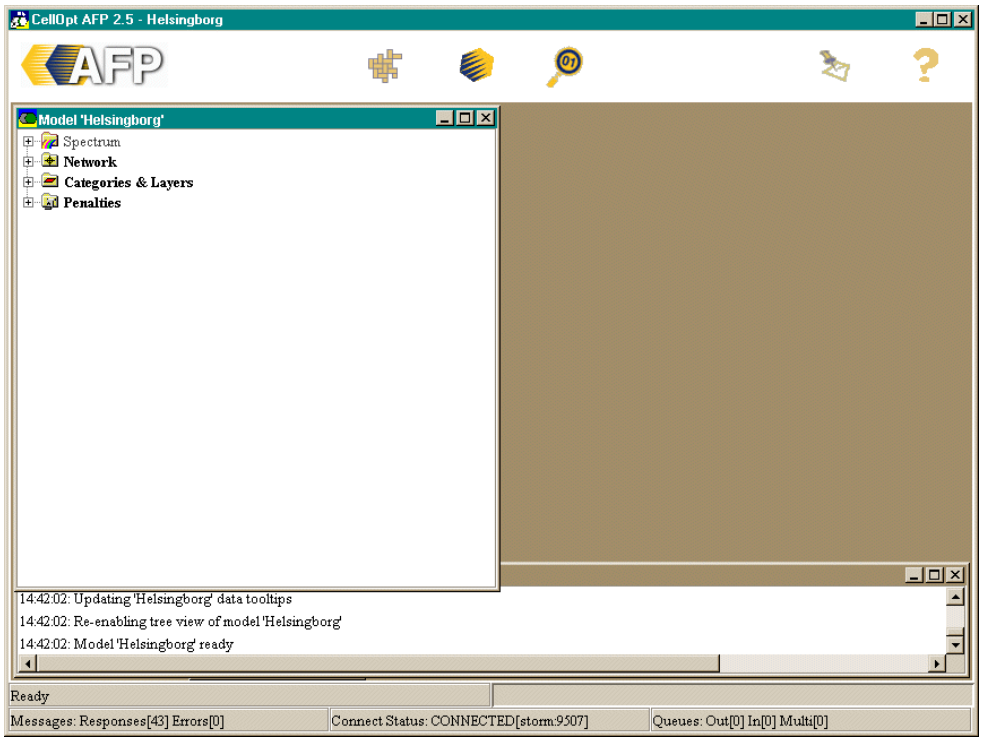
Most of the model network is created when you load data as described in the chapter on "Starting CellOpt AFP". This chapter explains how to see the model network as it appears after loading data.

You will also need to see and change details like frequencies, color codes, layer, separation requirement and "Penalties". Instructions for doing this are given in this and the four following Modeling chapters.

The model is logically laid out for viewing in "The tree view", which is described in the next section. When you need to change the details of the model, you do so by navigating to forms separate windows. Individual form(s) (and the routes by which you reach them) are described in the four following chapters, but they all (with some exceptions explained below) share the same generic characteristics, which are described in the section on "Using forms" on page 11 at the end of this chapter.

The tree view

Once you have started CellOpt AFP you will see the main window. All the parts of this are described in the chapter on "Starting CellOpt AFP" on page 2, except for the tree view at upper left, which is described here.



The tree view shows you an overview of the current model and provides ways for you to see and alter fine detail. The examples below show parts of the expanded tree view.

There are three elements to each line:

- The expand/collapse button (the plus or minus symbol on the left of the branch name). You can click on this button to open a closed branch or close an open one. Closing any branch will close all its subordinate open branches (if there are any) as well.
- The lowest branches of the tree can be opened no further, and therefore have no buttons.
- The icon, which provides a quick visual identification of the sort of branch you are looking at. Icons are listed in the branch descriptions below. Note that some are representations of folders which are closed when their subordinate branches are collapsed, open when expanded.

The name of the entity or, in subordinate branches, its value. This concept will become obvious as you read the lists below. It is the text of the name or value (not the button or the icon) which you right-click on when opening forms.

There are four main branches in the tree:

Spectrum This branch expands to let you see and change the frequencies and the color codes available to the whole network. You can also see and alter lists of those frequencies and color codes which are available but would incur penalties if assigned to carriers. These are called illegal or forbidden in CellOpt AFP. Further information is given in the "Spectrum" section below.

Network This branch shows you details about the sites, sectors and carriers modelled in the physical network, allowing you to change the model as described in the "Network" section.

Categories & Layers You can define any attribute of the network's carriers as a category (for instance, you could categories them by the sort of signal they carry). Within each category, each carrier has a layer (for instance, control carriers might be one layer, traffic carriers another). This branch enables you to see, create and modify carrier categories and layers within each of them, as described in the section on "Categories and layers".

Penalties This branch enables you to see and change the way in which CellOpt AFP applies penalty values to planning rules. For each rule, the value of each penalty is directly proportional to the desirability of obeying the rule. Further details are given in the section on "Penalties".

Spectrum

When you open the **Spectrum** branch, you gain access to two further branches:

Frequencies You can open a form from Frequencies to alter the list of available frequencies or define lists of illegal- and forbidden frequencies. If you have the frequency hopping option enabled, you are also able to edit MALs here, as well as define lists of forbidden MALs. If you have the frequency groups option enabled, you are also able to edit frequency sets and subsets here, as well as define lists of forbidden sets and subsets.

Color Codes You can open a form from Color Codes to alter the list of available color codes. You can also define lists of forbidden color codes.

Further details about spectrum modelling and the forms used are given in the chapter on "Modeling the spectrum".

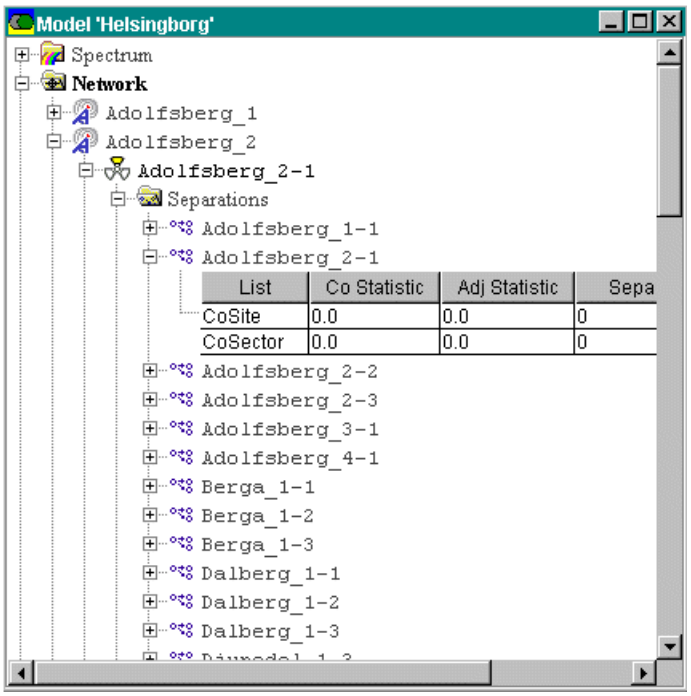
Network

The network branch enables you to view and model the sites, sectors, and carriers (and the relationships between them) belonging to the physical network. This section gives a brief description of the network tree, and you can see full details and instructions in the chapter on "Modeling the network".

From the **Network** branch, you can:

- Open two "network editor" forms – the carrier and "Sectors" editors – from **Network**. These enable you to view and model the attributes of the carriers and sectors in the network or in specific parts of it. Full instructions are given in the chapter on "Modeling the network".

- Open the branch to see a list of sites, each of which has the icon ***xxx*** where ***xxx*** is a unique identifier of the site (there is no practical limit to the length of ***xxx***, which can contain any characters except **Tab**).
- Each site is itself a branch, leading to sectors and thence to individual carriers, as described immediately below.



Sites

From each site branch under **Network**, you can open the branch to see a list of the sectors attached to the site. Each of these is in turn a branch which leads to details about the sector's separations, as well as to the carriers assigned to it, and eventually to details about each carrier's relations. Sectors have the icon ***xxx-yyy*** where ***xxx*** is the identifier of the site whose branch you opened (see above) and ***yyy*** is a unique identifier for this sector within the site. The remarks about ***xxx*** (see above) also apply to ***yyy***.

Sectors

From each sector branch (under site, under **Network**), you can:

- Open a form which enables you to add and remove illegal and forbidden frequencies or separations to lists for the sector. If you have the option frequency hopping enabled, you can also add and remove forbidden MALs. And if you have the option frequency groups enabled, you can add and remove forbidden sets and subsets.

- Open the branch to see:

Separations The separation requirements between this and other sectors, the lists they are defined in and the original statistics of these lists.

Carrier Each carrier belonging to the sector is listed, with the identifier ***xxx-yyy-zzz*** where ***xxx-yyy*** identifies the site and sector (see above) and ***zzz*** is a set of digits identifying the position of the carrier within the sector. Each carrier is itself a branch – further details are given below.

Carriers

From each carrier (under sector, under site, under **Network**), you can:

- Open a form which enables you to add illegal frequencies or separations into lists for the carrier.
- Open the branch to see:

Separations Lists the separation requirements with other carriers, what lists they are defined in and the penalties derived from statistics of these lists.

Categories and layers

You use category and layer to group carriers which share the same attribute. The name of the attribute is the category and its value is the layer. Both are user-defined.

This branch enables you to see and define categories and the layers within each category. Below is only a brief description, and you can see full details in the chapter on “Modeling categories and layers”.

Categories

From **Categories & Layers**, you can:

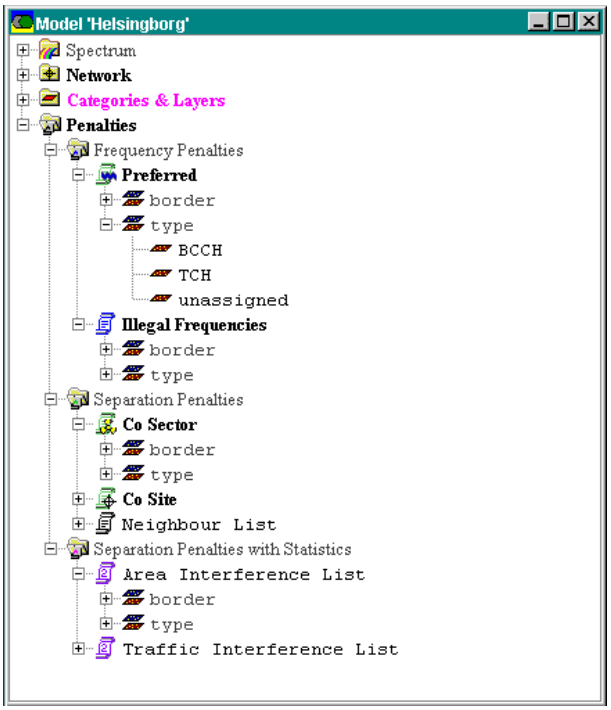
- Open a form to create, edit and delete categories.
- Open the branch to see a list of categories, each of which has the icon ***xxxx*** where ***xxxx*** is the name of the category (there is actually no practical limit on the number of characters and spaces you can use, but you cannot use the **Tab** as a character). Each category is itself a branch, leading to individual layers as described immediately below. From each category name, you can open another form to define its layers.

Layers

When you open a category branch, you see a list of layers, each of which has the icon ***xxxx*** where ***xxxx*** is the name of the layer (there is actually no practical limit on the number of characters and spaces you can use, though you cannot use the **Tab** as a character).

Penalties

You use the **Penalties** branch to see, set and edit the penalties to be applied if planning rules are violated.



From **Penalties**, you can:

- Open a form to see the names and descriptions of all the penalty-oriented lists of data (exception tables, interference tables and so on) which are already loaded into the model. You can disable selected lists in this form so that the optimizer will ignore them on its next run. Also you can create and delete lists, as well as rename existing ones.
- Gain access to three further branches:

Frequency Penalties	This branch lets you specify the penalties for assigning a certain frequency or color code to a particular carrier.
Separation Penalties	This branch lets you specify the penalties for assigning the frequency of a carrier where the separation from the frequency of another carrier is less than required.
Separation Penalties with Statistics	This branch lets you modify the separation penalties for particular carrier lists and layers so as to take into consideration the relative importance of different carriers according to their usage.

Each of these is described further below.

Frequency penalties

From **Frequency Penalties**, you can:

- Open the **Preferred** penalties branch (with the icon ). The form from this branch lets you see and set the penalty to apply if the optimizer decides to change the current frequency of a carrier.
- Open the **Illegal Frequencies** branch (with the icon ). The form from this branch lets you see and set the penalty to apply if the optimizer decides to assign a frequency which is defined as illegal.
- Open either of these branches to see a list of category names ( ***xxxx***). From here you can open any category name branch to see a list of the layers ( ***xxxx***) within it. You can open a form from any layer name which lets you set (depending on which branch you open):
  - The preferred penalty for that layer at an additional value than the penalty defined in the **Preferred** form.
  - The illegal frequency penalty for that layer at an additional value than the penalty defined in the **Illegal Frequency** form.

Separation penalties

From **Separation Penalties**, you can:

- Gain access to the following branches:

	**CoSector**	This branch enables you to impose penalties for assigning carriers within the same sector at certain separations.
	**CoSite**	This branch enables you to impose penalties for assigning carriers within the same site at certain separations.
	**Separation Lists**	There is one branch per defined separation list. You can impose penalties for violating the rules defined within each list.

From each of these branches, you can either open a form or open further branches for category names ( ***xxxx***) and thence to layer names ( ***xxxx***). The forms you reach from these have the following functions:

- **Right-click** These forms allow you to see and set the co- and adjacent penalties and the separation requirement between carriers within the same sites and sectors in the network or between carriers defined in the loaded separation lists.
- **Click on layer name** You can open a form from any layer name. It lets you set the co- and adjacent penalties and the separation requirement for that layer at an additional value than the penalty defined in the relevant **Co Site**, **Co Sector** or **Separation List** form.

Separation penalties with statistics

From **Separation Penalties with Statistics** you can:

- Open the branch to see the separation lists holding statistics (with the icon ). From each of these you can:
  - Open a form enabling you to:
  - Include or exclude the list at optimization time.
  - Apply a multiplier (scaling) to the penalties in the list to set their relative importance above or below the penalties in other lists. You can apply the multiplier to co- and adjacent penalties separately.
  - Distribute the original statistics based on the number of carriers in either the interfered or interfering sector.
  - Apply a sector dependant multiplier equal to either the interfered or interfering sector's served traffic or area.
  - Set co- and adjacent penalties that would be incurred if the penalties derived from statistics were higher than the defined absolute co- and adjacent threshold values.
  - Set co- and adjacent penalties that would be incurred if the penalties derived from statistics are higher than the defined relative co- and adjacent threshold values. The threshold values are relative either to the serving sector's served traffic or to its served area.

Open the branch to see a list of category names ( ***xxxx***). From here you can open any category name branch to see a list of the layers ( ***xxxx***) within it. You can open a form from any layer name which allows you to:

- Set the co-and adjacent scaling for that layer at any value. You can do this separately for carriers at interfered and interfering layers.
- Set layer distribution to bias the distribution of statistics so that penalties are proportionally higher for some carriers than for others.

- Set the layer protection/pollution for the layer to change the protection of carriers in this layer.
- Turn the sector dependent scaling with area or traffic on or off.
- Set an absolute threshold value and penalty for co- and adjacent penalties within the layer. All values must be the same as or higher than the corresponding values for the list.
- Set co- and adjacent penalties that would be incurred if the penalties derived from statistics are higher than the defined relative co- and adjacent threshold values. The threshold values are relative either to the serving sector's served traffic or to its served area. All values must be the same as or higher than the corresponding values for the list.

Using forms

To see and change detailed information about a model's spectrum, network, categories, layers and penalties, you use forms. Each form is related to a particular branch in the tree view, and you can see it by right-clicking on the name of the relevant branch.

Although each form shows different information, the general layout and method of making changes is consistent throughout CellOpt AFP. These generic forms and methods are described here and you should be familiar with them before starting detailed modelling work with the four following Modeling chapters.

There is one form, however, which is not typical. This is the network editor, and you will need slightly different techniques to use it. For this reason, the network editor has its own section in the chapter on "Modeling the network".

Information on forms

When you open a new form by right-clicking on a name in the tree view, it opens as a separate window. While a form is open, you can still navigate in the main window and use menu options. You can resize, move, minimize, maximize and close forms just like any other window.

If a window is too narrow to display all the information in a field, you will see a line of dots in that field. You can make the window bigger to see more, and sliders let you scroll up and down or sideways where information cannot be shown all at once.

You can have as many forms open as you wish. If a change in one affects the information in another, you will see the change in the other form (this is not true with the Network form where you need to ask it to refresh by clicking **View**).

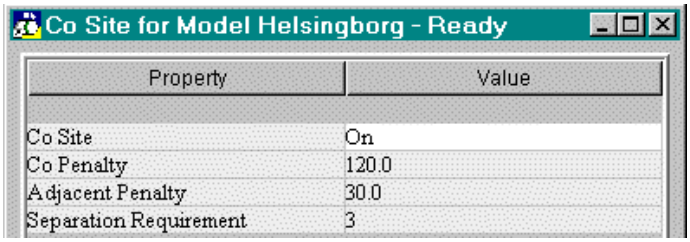
If you alter any of the information on a form, the changes will stand and will take effect throughout CellOpt AFP for the duration of the session. They will not survive the closure of CellOpt AFP unless you save them as described in the chapter on "Using CellOpt AFP".

The instructions below assume you will use the mouse for most of your navigation in forms. However, you can move around any form by using **Tab** (the active area is boxed) and then use the arrow keys.

There are five basic form types. Each of these can appear by itself or in the same window as another type.

The property form

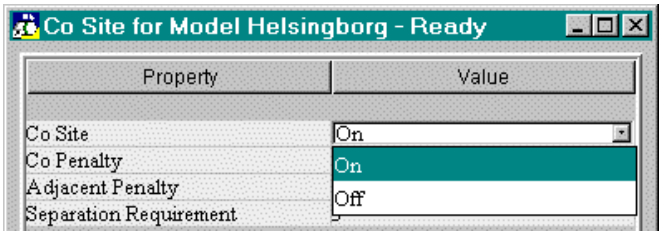
These forms show a table of properties of the entity on which you right-clicked in the tree view. The example shows part of the form reached by following **Penalties** → **Separation Penalties** → **CoSite**. It shows the attributes or properties of the chosen entity.



Like all tables of properties, the form has two columns. One is a list of the properties and the other their values.

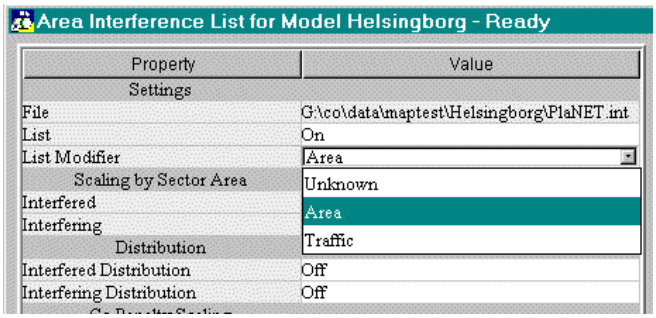
You cannot alter anything in the Property column, but you can alter some of the values in the right-hand column (others are generated and updated by CellOpt AFP). Editable fields are shown paler than non-editable ones. The two sorts of editable field are used for:

- **Switching conditions on or off** Some property forms have fields showing **On** or **Off** values. To toggle between on and off, click on the field to see the choices available:



  Move the mouse over the choices to highlight the one you want and click again.

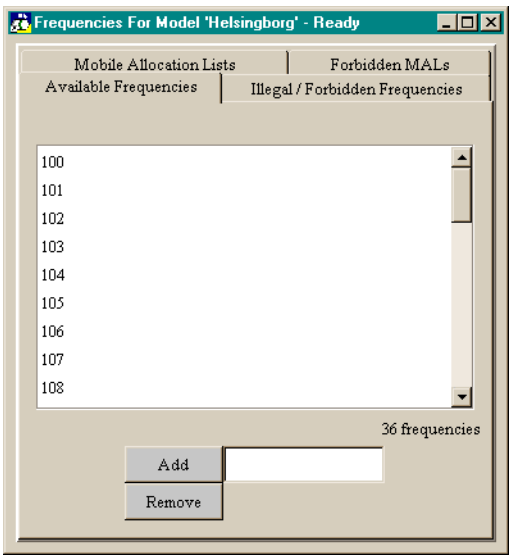
- **Drop-down menu** This is very similar to the switching described above, and is used in the same way, but several choices can appear:



The CellOpt AFP list form

These forms show (and allow you to change) model data which is held in CellOpt AFP itself rather than in data files, such as globally available frequencies and color codes. The form shows a simple list of data items (the isolated figure shows the number of items in the list) with sliders to scroll the list when necessary. You can add and remove items from the list as shown below.

Tabs Some forms, like the one in this illustration, have tabs, which allow you to change between forms with closely related functions. When you click on a tab, only the panel attached to it changes. Note that other form types also have tabs.



- **Adding data items** Whenever a list like the one in the example above is showing, you can add items to it:

1 Click in the box next to **Add** to see a flashing cursor.

2 Type in:

  - A single entry.
  - A list of entries separated by commas (but with no spaces), for example **3,29,32**.
  - A range of entries, for instance **29-32** if you wanted to add 29, 30, 31 and 32.
  - A combination of the above, for instance, **3,29-32,36** if you wanted to add 3, 29, 30, 31, 32 and 36.

3 Edit your typing if necessary and then press **Add** or the **Enter** key. The list is updated immediately and any relevant changes made in the left-hand panel as well.

- **Removing data items**. When a list of any sort is shown in the list area, you can remove single or multiple data items from it. The example above shows a form containing a list of frequencies.

1 Select and highlight:

  - Any single entry for removal by clicking on it (click again to cancel your choice).

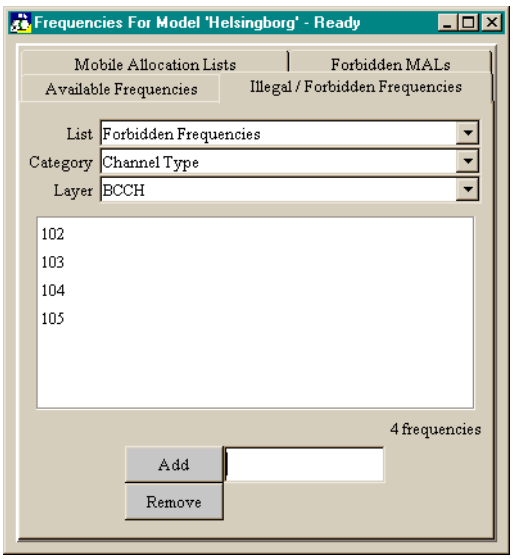
- Multiple entries by holding down CTRL as you click.
- A range of entries by holding down SHIFT as you click on the entries at each end of the range (the upper one first).

2 Click on **Remove** at the bottom of the panel.

3 A dialog box asks you to confirm the removal of each highlighted entry in turn. Press **Yes to All** (for all items) or **Yes** (for a single item) to remove, **No** to skip the current entry, or **Cancel** to abort the removal.

Data file list forms

These forms allow you to see and change the contents of lists held as separate data files. The instructions below tell you how to choose the list you want. Once you have done so, you can add and remove data items as described in "The CellOpt AFP list form" on page 13.



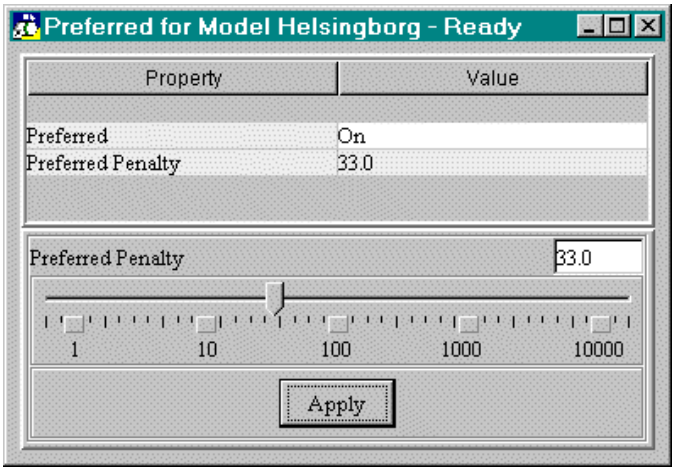
- **Select List** This field acts as both a browser and as a type-in field for creating a new list. You can type in a unique list name and add items to it manually with the Add facility, or you can click on the field to see a menu of existing lists from which to choose.
- **Drop-down selection** To make a selection from a field with a drop-down arrow, click on the arrow to see a list of the choices available, then move the cursor to highlight the choice you want and click again.

Simple slider forms

These forms are used for setting penalty values. In general:

Make your entries and settings as described below.

Click on **Apply** to accept all the changes you have made.

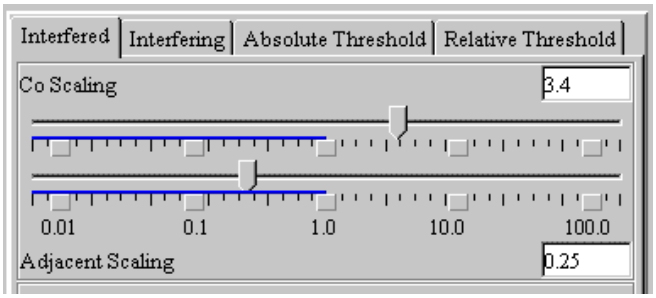


- **Using entry boxes** You can put figures directly into the entry box in the example above simply by clicking on the box to see a flashing cursor, typing in the numbers and pressing **Enter**. Illegal characters or out-of-range numbers are not accepted and the box reverts to its original value if you try to enter them. If the entry box has an associated slider, it will move to reflect the value you entered.
- **Using sliders** For properties like penalties, you are often not so much concerned with the value itself than you are with the need to increase or decrease it, so CellOpt AFP has sliders to help you make adjustments. Each slider has an associated entry box which updates as you move the slider. Not all slider scales are the same, but each is described fully in its place in following chapters.
- For coarse movements, you can move any slider simply by dragging it.
- For finer movements, click and hold anywhere on the slide or the scale underneath it. The slider moves slowly towards the mouse cursor, stopping when it reaches it. As long as the slider area is active (boxed), you can use the arrow keys for the same purpose.

Complex slider forms

These forms are used for setting separation requirements and penalties as well as scaling, threshold, distribution and protection values. They work on the same principles as the simple slider forms described above but have extra features as follows:

- CellOpt AFP sets certain rules, especially for penalties, which mean that you cannot set one value lower (or in some cases higher) than another.
- In the example below, the value set on the lower slider must always be the same as or lower than the one on the upper one. If you try to move it higher, it will spring back to the same value as the upper slider.
- Where a setting on one form affects the setting on another, the setting on the first form is indicated on the second with a blue line.



5
Modeling the spectrum

Overview

This chapter explains the form(s) that enable you to see and control the frequencies and color code for your network model.

The model needs the following information:

- All the frequencies which can possibly be used in the model (the available frequencies).
- Those frequencies which are available but which will have some restrictions placed on their use in the model (the illegal frequencies). Later, you will be able to define the restrictions importance numerically by awarding penalties for the use of the frequencies for each layer. You use the Penalties branch (described below) to do this.
- Frequencies that for certain groups of carriers are forbidden to use (the forbidden frequencies).
- If you have started CellOpt AFP with the frequency hopping option, then you may define and edit Mobile Allocation Lists under the Mobile Allocation List tab. Also, you may define forbidden MALs.
- If you have started CellOpt AFP with the frequency group option, then you may define and edit frequency set and subset under the Sets tab. Also, you may define forbidden sets and subsets.
- All the color codes globally available to the model.
- Color codes that for certain groups of carriers are forbidden to use (the forbidden color codes).

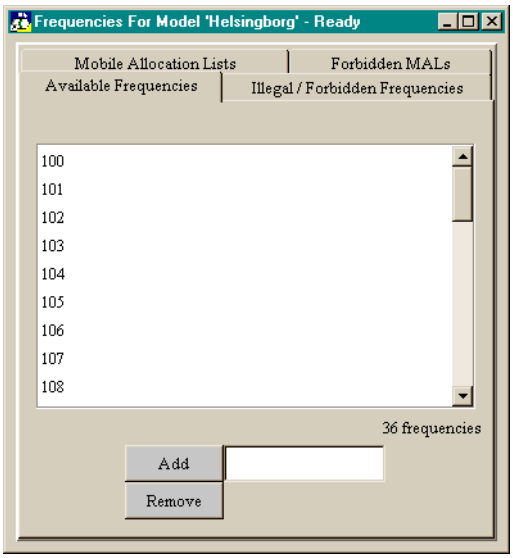
The forms in this chapter are all obtainable from the **Spectrum** branch in the tree view for the current model. Model loading and selection are described in the chapter on "Starting CellOpt AFP" on page 2, while the one on "Modeling" on page 1 explains the layout and navigation of the tree view as well as the ways of manipulating the information on forms.

Spectrum (Available frequencies) form

This form deals with the frequencies globally available to the model – the optimizer will consider only these frequencies. If you want to split your spectrum or use some frequencies only in given circumstances, you can declare them as illegal or forbidden. You do this by using the forms in the next two sections. However, the frequencies must appear here to be available for restraints.

Route from CellOpt AFP main window

Open the **Spectrum** branch, right-click on **Frequencies,** then click on the **Available** tab if necessary.



What you can see

- The number of frequencies currently globally available to the model.
- The globally available frequencies.

What you can do

Add and remove the frequencies globally available to the model. Instructions for using **Add** and **Remove** are given in the chapter on "Modeling".

Spectrum (Illegal / Forbidden frequencies) form

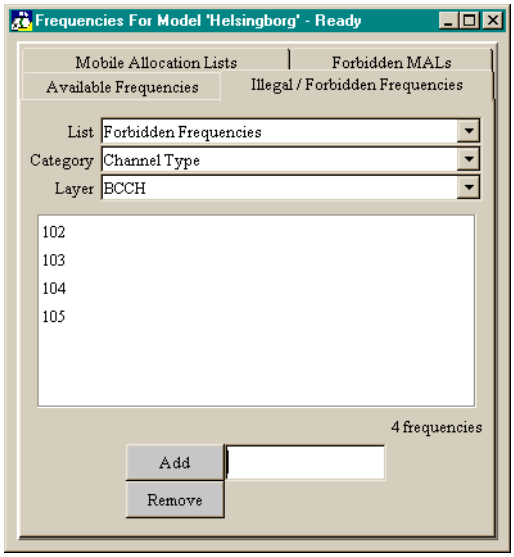
Amongst the data files loaded for the model some frequencies may be declared as illegal frequencies – those that, although included in the globally available list above, will have some restrictions imposed on their assignment to specific carriers.

Some frequencies may be declared as forbidden frequencies. These are frequencies with stronger restrictions on them than the illegal ones. They cannot even be considered by the optimizer. The difference between illegal and forbidden frequencies is that the former may be used – although it is not recommended to use them – while the latter cannot be used at all.

You use the Spectrum (Illegal/Forbidden frequencies) form to edit the illegal and forbidden frequencies for any given layer.

Route from CellOpt AFP main window

Open the **Spectrum** branch, right-click on **Frequencies**, then click on the **Illegal/Forbidden** tab if necessary.



What you can see

- A list of frequencies that have been declared either as illegal or forbidden, for any given layer of any given category.
- The number of illegal or forbidden frequencies.

What you can do

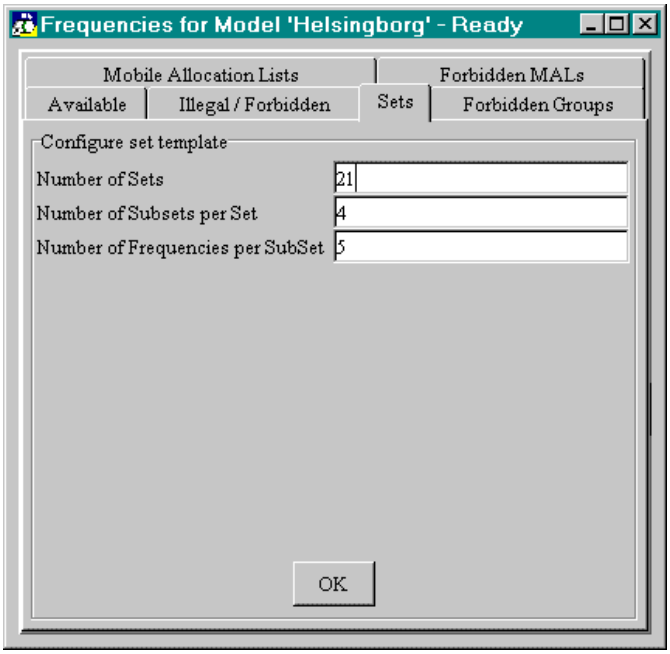
- To add or remove the illegal or forbidden frequencies:
  a. Choose the list, either illegal frequencies or forbidden frequencies, in the drop-down menu.
  b. Choose a category and layer.
  c. You can remove any of the frequencies you see, or add any valid frequency (one of the frequencies in the Available Frequencies
  list – use the **Frequencies** tab to toggle between the two lists). Instructions for using **Add** and **Remove** are given in the chapter on "Modeling".
- To create more illegal frequencies:
  a. Choose the list illegal frequencies in the Select List drop-down menu.
  b. Choose the category and layer to which the illegal frequencies will apply.
  c. Click in the **Add** field and enter the illegal frequencies singly, as a comma separated list, or as a range.
- To create more forbidden frequencies:
  a. Choose the list forbidden frequencies in the Select List drop-down menu.
  b. Choose the category and layer to which the forbidden frequencies will apply.
  c. Click in the **Add** field and enter the forbidden frequencies singly, as a comma separated list, or as a range.

Spectrum (Sets) form

The sets to be used in frequency group planning are defined using this tab. This tab only appears if CellOpt is started with the **-A frequencygroups** option described in the System Administration section.

Route from CellOpt AFP main window

Open the **Spectrum** branch, right-click on **Frequencies**, then click on the **Sets** tab.

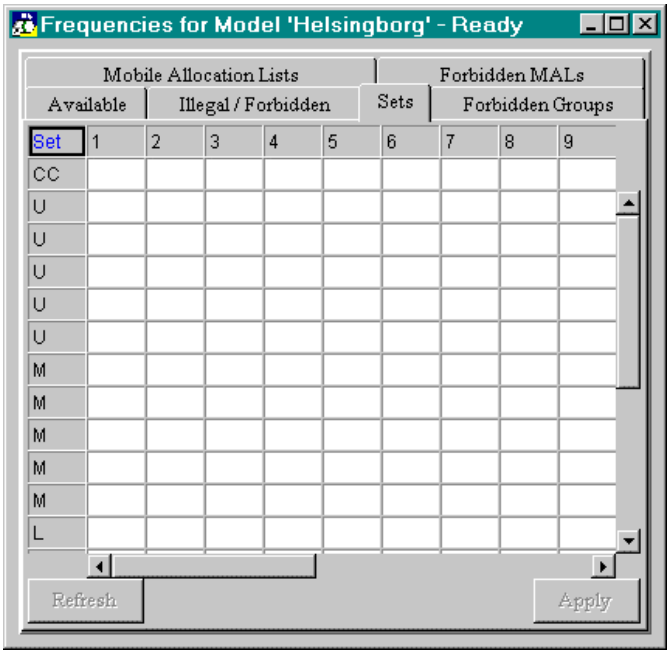


What you can see

If no sets have been defined previously, the set configuration panel will appear.

- Convenient defaults for the Sets template are predefined. These will be 21 sets, 4 sets per subset and 5 frequencies per subset.

  If sets have been defined previously, then the allocation of frequencies to sets will appear.



In the first fixed row you can see:

- The specified number of sets, numbered consecutively. Frequencies that belong to a set are specified in the column below the set number.

In the first fixed column you can see:

- CC - specifying the row where you should enter control frequencies if you want these to be assigned from the same set or subset.
- U, M, L, X, X1, X2, etc - specifying the rows where you should enter frequencies belonging to subsets. U denotes the frequencies in the Upper subset of a set, M denotes the frequencies in the Mid subset of a set, L is the frequencies in the Lower subset, and X, X1, X2 denote the frequencies in additional extra subsets of the set.

In the table you can see:

- The frequencies assigned to sets or subsets.

What you can do

- Select a region by placing the mouse over the first cell to select, depressing the left mouse button and releasing the mouse button over the last cell to select. Right clicking brings up a menu that allows you to:

- To fill a region with frequencies
  a Select the region to fill.
  b Depress the right mouse button and select Fill.
  c Choose the starting frequencies.
  d Choose the final frequency.
  e Mouse click on OK.
  f To clear a region of frequencies.
  g Select the region to clear.
  h Depress the right mouse button and select Clear.
  i To redefine the table defaults.
  j Right click on the Set Template Panel.
  k Choose Setup Table.
  l Choose the number of Sets, subsets and frequencies.

Defining control frequencies in the CC row

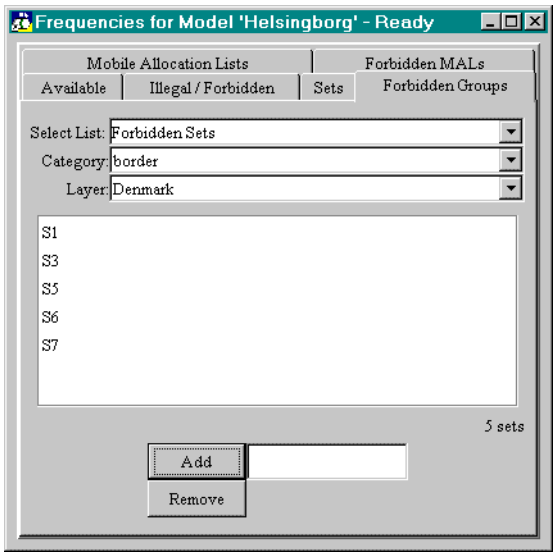
If any frequencies have been defined as control frequencies, in the first row marked CC in the table, then only these frequencies are assigned to carriers that are defined in a carrier group in the carrier group category and are marked as control carriers in the control id category
(Control id = 1). With control frequencies defined, the control carrier of a carrier group will always be assigned a control frequency from the same set or subset as the other carriers in the carrier group.

Spectrum (Forbidden Groups) form

In the same way as you define forbidden frequencies, you can also define forbidden groups, i.e., forbidden sets and subsets. A set or subset must exist if you want to use it here. This tab only appears if CellOpt is started with the **-A frequencygroups** option described in the System Administration section.

Route from CellOpt AFP main window

Open the **Spectrum** branch, right-click on **Frequencies**, then click on the **Forbidden Groups** tab.



What you can see

- A list of either sets or subsets that have been declared as forbidden, for any given layer of any given category.
- The number of forbidden sets or subsets.

What you can do

- To add or remove the forbidden sets and subsets:
  - a Choose the list, either Forbidden Sets or Forbidden Subsets, in the drop-down menu.
  - b Choose a category and layer.
  - c You can remove any of the sets or subsets you see, or add any valid set or subset. Instructions for using **Add** and **Remove** are given in the chapter on "Modeling".
- To create more forbidden sets:
  - a Choose the list Forbidden Sets in the Select List drop-down menu.
  - b Choose the category and layer to which the forbidden sets will apply.
  - c Click in the **Add** field and enter the forbidden sets singly, as a comma separated list, or as a range.

A set is named the letter S (for Set) plus a number, for example S1 or S15. When you enter forbidden sets, you can either type the full name (like S5) or just the number (like 5).

- To create more forbidden subsets:
  - **a** Choose the list Forbidden Subsets in the Select List drop-down menu.
  - **b** Choose the category and layer to which the forbidden subsets will apply.
  - **c** Click in the **Add** field and enter the forbidden subsets singly or as a comma separated list.

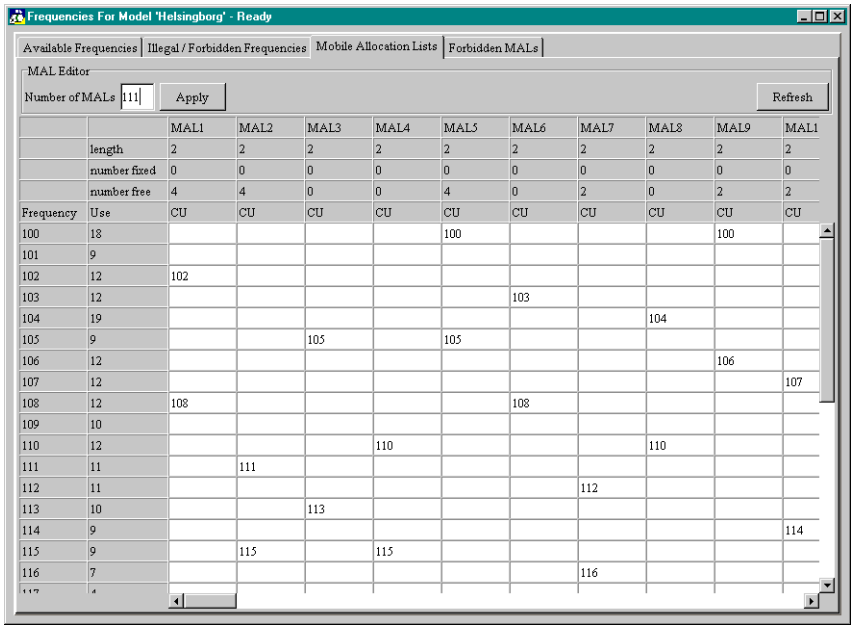
  A subset is named the letters SS (for SubSet) plus a number plus either of U, M, L, X or X1, X2, X3,... For example, SS5L. When you enter forbidden subsets, you have to type in the full name, not just the number, as is the case with sets.

Spectrum (Mobile Allocation Lists) form

The definition of Mobile Allocation Lists (MAL) is performed here. This panel only appears if CellOpt is started with frequency hopping enabled by the **-A frequencyhopping** option described in the System Administration section.

Route from CellOpt AFP main window

Open the **Spectrum** branch, right-click on **Frequencies**, then click on the **Mobile Allocation Lists** tab if necessary.



		MAL1	MAL2	MAL3	MAL4	MAL5	MAL6	MAL7	MAL8	MAL9	MAL1
	length	2	2	2	2	2	2	2	2	2	2
	number fixed	0	0	0	0	0	0	0	0	0	0
	number free	4	4	0	0	4	0	2	0	2	2
Frequency	Use	CU	CU	CU	CU	CU	CU	CU	CU	CU	CU
100	18					100				100	
101	9										
102	12	102									
103	12						103				
104	19								104		
105	9			105		105					
106	12									106	
107	12										107
108	12	108					108				
109	10										
110	12				110				110		
111	11		111								
112	11							112			
113	10			113							
114	9										114
115	9		115		115						
116	7							116			

What you can see

The Mobile allocation Lists Form allows you to specify the Mobile Allocation Lists used for the frequency Hopping. In the MAL editing Panel, you can see:

- The number of MALs used

In the first fixed rows you can see:

- The names of the MALs used.
- The Number of frequencies or length of each MAL
- The number of free carriers using a particular MAL
- The number of fixed carriers using a particular MAL
- The type of MAL. The type could be UD (User Defined), PG (PreGenerated) or CU (Customized). A User Defined MAL is specified in the input file or by the user by assigning frequencies to the MAL in this form. A pregenerated MAL is generated by the optimizer when the user is specifying the number of MAL to use in the optimizer window. When using the customized MAL in the optimizer window it will be defined as Customized.

In the first fixed columns you can see:

- The Available frequencies
- Excluded MAL frequencies are highlighted in orange or red. The frequency will be highlighted in orange if no MAL is using that frequency. Red indicates that a frequency is excluded to MALs and at least one MAL uses the frequency. The automatic MAL generating routine will never allocate a frequency belonging to the excluded MAL frequencies.
- The number of MALs using a particular frequency.

In the table you can see:

- The frequencies used by a particular MAL highlighted.

What you can do

Include individual frequencies in an MAL by double clicking in the relevant MAL column and Frequency row. The specific MAL will then be seen as a User Defined MAL and will not be changed during the optimization. A frequency can be excluded from automatic MAL planning by toggling the relevant frequency's Use column. Several operations can be performed on one or more selected ranges:

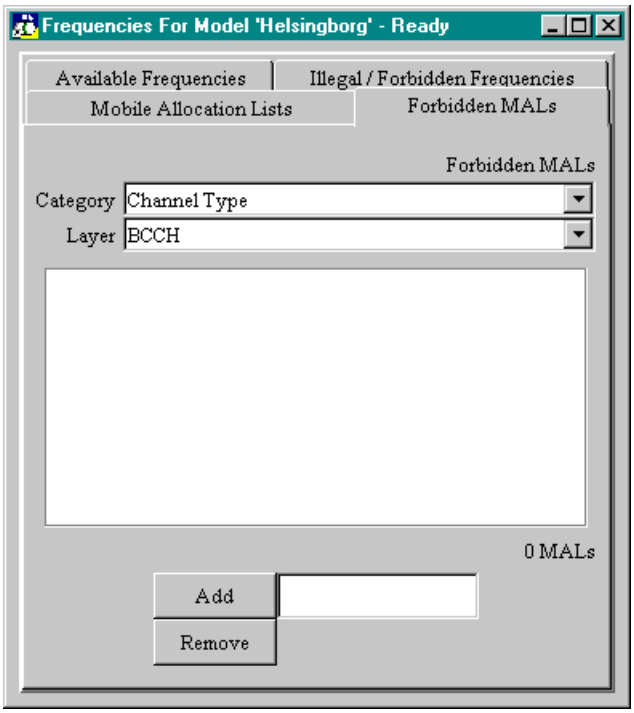
- The state of inclusion of a selected range of frequencies can be toggled by selecting a range of frequencies, right-clicking and selecting “toggle”.
- A range of frequencies can be removed from MALs by selecting the range of frequencies and MALs in the table, right-clicking and selecting “clear”.
- A range of frequencies can be added to MALs by selecting the range of frequencies and MALs in the table, right-clicking and selecting “set”.
- The state of exclusion of a range of frequencies can be toggled by selecting a range of frequencies in the Use column, right-clicking and selecting “Toggle exclude”.
- The type of MAL can be change from the current one to any of the other two types by selecting a MAL in the Use row, right clicking and selecting the new type.

Spectrum (Forbidden MALs) form

Use this form to define forbidden MALs. An MAL must exist if you want to use it here. This tab only appears if CellOpt is started with the
-A frequencyhopping option described in the System Administration section.

Route from CellOpt AFP main window

Open the **Spectrum** branch, right-click on **Frequencies**, then click on the **Forbidden MALs** tab.



What you can see

- A list of MALs that have been declared as forbidden, for any given layer of any given category.
- The number of forbidden MALs.

What you can do

- To add or remove the forbidden MALs:
  - a Choose a category and layer.
  - b You can remove any of the MALs you see, or add any valid MAL. Instructions for using **Add** and **Remove** are given in the chapter on "Modeling".
- To create more forbidden MALs:
  - a Choose the category and layer to which the forbidden MALs will apply.
  - b Click in the **Add** field and enter the forbidden MALs singly, as a comma separated list or as a range.

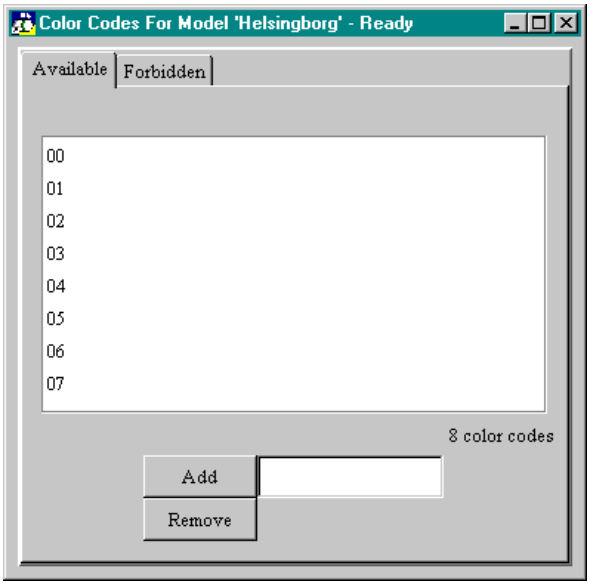
A MAL is named the letters MAL plus a number, for example MAL1 or MAL15. When you enter forbidden MALs, you can either type the full name (like MAL5) or just the number (like 5).

Spectrum (Available color codes) form

This form enables you to see and edit the list of color codes globally available to the current model.

Route from CellOpt AFP main window

Open the **Spectrum** branch, right-click on **Color Codes**, then select the **Available** tab.



What you can see

- The number of color codes currently globally available to the model.
- A list of the globally available color codes.

What you can do

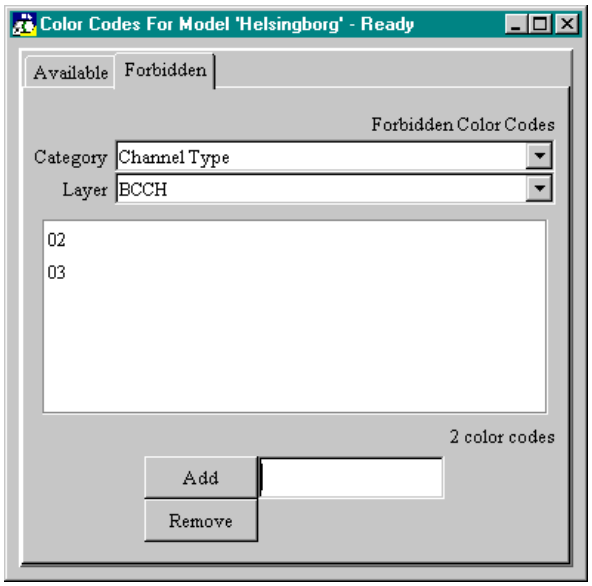
Add and remove the color codes globally available to the model. Instructions for using **Add** and **Remove** are given in the chapter on "Modeling". Note, however, that CellOpt reads color codes as text, so you must enter each code individually rather than as series or ranges.

Spectrum (Forbidden Color Codes) form

A forbidden color code is a color code that cannot be used for a certain group of carriers. This form enables you to see and edit the list of forbidden color codes.

Route from CellOpt AFP main window

Open the **Spectrum** branch, right-click on **Color Codes**, then select the **Forbidden** tab.



What you can see

- A list of color codes that have been declared as forbidden, for any given layer of any given category.
- The number of forbidden color codes.

What you can do

- To add or remove the forbidden color codes:
  - a Choose a category and layer.
  - b You can remove any of the color codes you see, or add any valid color code. Instructions for using **Add** and **Remove** are given in the chapter on "Modeling".
- To create more forbidden color codes:
  - a Choose the category and layer to which the forbidden color codes will apply.
  - b Click in the **Add** field and enter the forbidden color codes singly, as a comma separated list or as a range.

6
Modeling the network

This chapter enables you to see and change the model of the physical network which makes up your model – its sites, sectors and carriers and their assignments.

Most of this structure and detail will have been worked out at an earlier stage in the planning process, so you will load it with the data files when you start work on planning the frequencies for the model. CellOpt AFP allows you to see a logical tree structure for the network and to examine and change it radically or in fine detail.

The network editor

The network editor provides the four main forms for seeing and changing the fine detail (carriers, sectors, and filters) of the network. They are different from any other used in CellOpt AFP, so their use is described here rather than in "Using CellOpt AFP", which details the other ways of navigating and making changes in CellOpt AFP.

The network editor (carriers) form allows you to:

- Select sets of carriers according to different parameters and their values, as well as by category and layer.
- Change the frequency, color code and layers of any of the carriers in the network (all at once, in selected sets or individually) and to declare whether the optimizer is allowed to change a given carrier's frequency (free) or not (fixed).

- If the frequency hopping option is enabled you may also define in the hopping group category what carriers within the sector or site that should be using the same MAL. With this option enabled you can also edit MAL, HSN and MAIO assignments of each carrier.
- If the frequency group option is enabled you may also define it in the carrier group category what carriers within the sector that should be assigned frequencies from the same set or subset.
- Create new categories and layers without needing to open the categories and layers editor.

The network editor (sectors) form allows you to:

- Select sets of sectors according to different parameters and their values.

The network editor (filters) form allows you to:

- Define regular expression filters for selecting groups of carriers or sectors based on their names.

The network editor (set planning) form allows you to:

- Automatically arrange the carriers in the network to be planned using sets, subsets, or sets and subsets according to the frequency template used.

Network editor (carriers) form

The network editor for carriers allows you to:

- Select sets of carriers according to their name, frequency, color code, control id, layer, position in the sector, number of carriers in the sector or whether their frequencies are fixed or free.
- See and change the frequencies, color codes and layers of all the carriers in the network (all at once, in selected sets or individually).
- Change selected carriers' frequencies from fixed to free and back again.
- If the frequency hopping option is enabled you may also define in the hopping group category what carriers within the sector or site that should be using the same MAL. With this option enabled you can also edit MAL, HSN and MAIO assignments of each carrier.

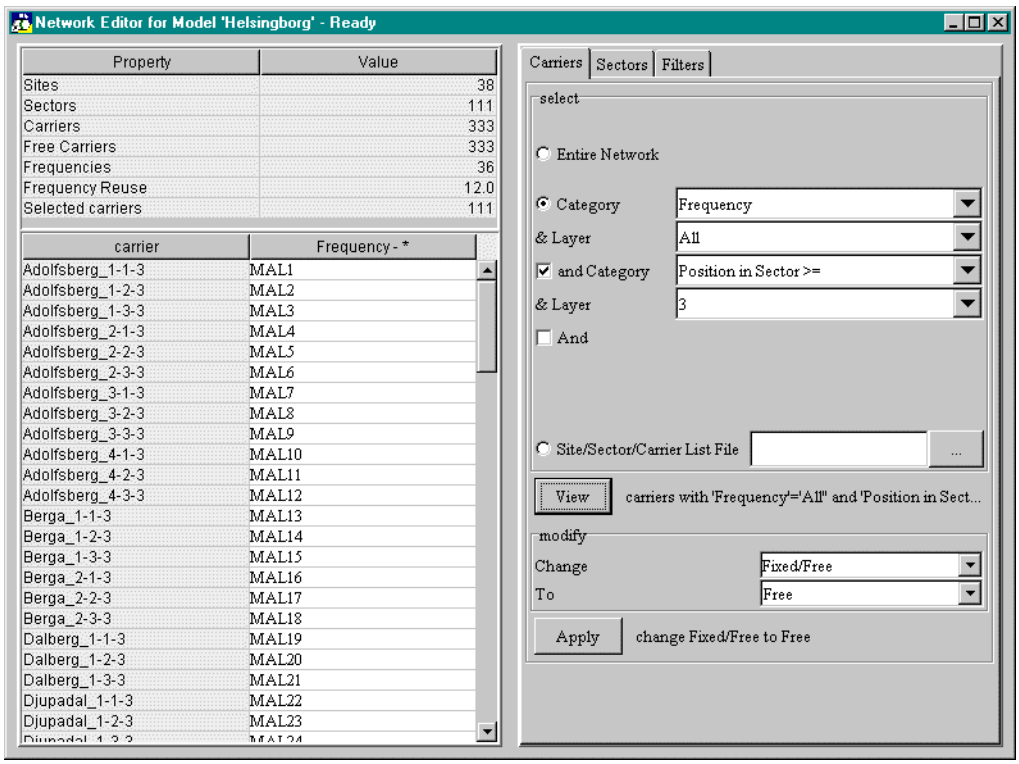
  In the hopping group category, each carrier is defined as either: non-hopping, synth sector 1, synth sector 2, synth site 1, synth site 2, baseband 1, or baseband 2. All carriers in the

same sector defined as synth sector 1 should be assigned the same MAL. It is possible to have some of the hopping carriers in the sector be assigned another MAL. This is accomplished by assigning these carriers to synth sector 2. Likewise, all carriers in the same site that are defined as synth site 1 should be assigned the same MAL. It is also possible to have some of the hopping carriers in the site to be assigned another MAL by assigning these carriers to synth site 2. Carriers may also be defined as either baseband 1 or baseband 2. This defines the carrier as a hopping carrier using baseband hopping. Any combination of these definitions is allowed.

- If the frequency group option is enabled you may also define in the carrier group category what carriers within the sector that should be assigned frequencies from the same set or subset.
- In the carrier group category, each carrier is defined as either grouped or non-grouped. Carriers that are defined as grouped will be assigned according to the chosen set planning strategy. The set planning strategy is set in the frequency optimization panel.
- Create new categories and layers without needing to open the categories and layers editor.

Route from CellOpt AFP main window

Right-click on **Network**. Alternatively, you can make sure that the correct model is in focus and then choose the modeler icon from the menu bar and **Edit** from the menu. Click on the **Carriers** tab if necessary.



Using the network editor

You use the upper part of the right pane to select carriers whose properties you want to see and possibly change. The results of your selection are shown in the list of carriers in the lower part of the left pane. Having made your selection, you can apply changes to it by using the lower part of the right-hand pane.

What you can see

The name of the current model appears in the window title bar.

For the current network model:

- The number of sites.
- The number of sectors.
- The number of carriers.
- The number of free carriers (those which the optimizer is allowed to change, with or without penalty).
- The number of frequencies.

- The current frequency reuse in the model. The reuse is derived by dividing the number of globally available frequencies by the average number of carriers required per sector.
- The number of carriers selected.
- A list of carrier names. The content of this list depends on the criteria you choose in the right-hand pane. You can choose to see all the network's carriers or just those which:
- Have a specific frequency.
- Have a specific color code.
- Are fixed (the optimizer is not allowed to change the frequency).
- Are free.
- Have a particular control id.
- Have a given position in its sector or a position no smaller than a given value.
- Belong to sectors with a given number of carriers or with no fewer than a given number of carriers.
- Belong to a given category or layer.
- Are included in a given data file (list).

The list of Carrier names can be narrowed by selecting multiple criteria by clicking the **AND** button. Only the first selection will be displayed.

To see the carriers in the model globally or selectively, follow the instructions for "Viewing carriers and their properties" on page 6.

What you can do

To change the carrier properties for a selected set of carriers, use the network editor (see below) to select the set you want. You can then change the following properties:

- Frequency – you assign the same frequency to all the carriers in the selected set.
- Color code – you assign the same color code to all the carriers in the selected set.
- Fixed/free – you make all the carriers in the selected set fixed, or all free.
- Category and Layer – you assign the same layer within a given category to all the carriers in the selected set.

NOTE

The property you use to select the set and the property you change can be different. For example, you could select all the carriers whose sector position is 1 and change their frequencies to 21.

Having chosen to view a list of carriers:

- With their fixed or free values, you can change any individual carrier to fixed or free.
- With the names of their layers in a given category, you can change the layer of any individual carrier.
- With their frequencies, you can change the frequency of any carrier in the list which is declared as free (you cannot select those that are fixed). The frequencies of free carriers have a paler background in the right-hand column.

To make a change:

a. "Using the network editor" on page 4 to select and view a set of carriers so that the list in the left pane includes both the carrier you need and the property you want to change.

b. Click on the **Value** field next to the carrier's name to see a drop-down list containing all the valid values available.

c. Click on the one you want and the value will change.

Viewing carriers and their properties

Decide exactly what it is you want to see, for example "All the carriers in the whole network", "All the carriers whose frequency is 6", "All the carriers in list listname".

If you want to see:

- All the carriers, together with the value of a particular property for each:

  a. Click on the topmost drop-down menu box and choose the property you want from the drop down list (these are also listed in the **Property** column of the table below).

  b. Click on the **Entire Network** radio button.

  c. Click on **View** to see the carriers in the left panel.

You achieve the same results as above by clicking on **Category & Layer**, selecting the property from the upper drop-down list and then choosing **All** in the box just below it.

- Only those carriers which share a given property value, click on the **Category & Layer** radio button, then choose the property you want from the topmost drop-down menu and its value from the one just beneath it. The table below give the properties available.

Topmost drop-down list (Property)	Second drop-down list (Value)
Fixed/Free	You can see either all the fixed-frequency carriers, or the free ones – all those whose frequency the optimizer is allowed to change. Choose Fixed or Free.
Frequency	Choose from the available frequencies.
Original Frequency	Choose from the original frequencies.
Color Code	Choose from the available color codes. You can also choose unassigned.
Control id	Choose from the available control ids.
Hopping/Carrier Group*	See all the carriers that have particular hopping or group characteristics.
Mobile Allocation List†	Choose from the used mobile allocation list. You can also choose unassigned.
Mobile Allocation Index Offset†	Choose from the used mobile allocation index offsets.
Hopping Sequence Number†	Choose from the used hopping sequence numbers. You can also choose unassigned.
Position in Sector	See all the carriers which share the same position in each different sector.
Absolute Carriers in Sector	See all the carriers which belong to sectors with a chosen number of carriers. Choose from a list of valid numbers of carriers.
Carriers in Sector >=	This is the same as Absolute Carriers in Sector, but includes the carriers in all those sectors whose carrier number exceeds the chosen number as well as equals it.
Carriers in Sector<=	This is the same as Absolute Carriers in Sector, but includes the carriers in all those sectors whose carrier number is less than the chosen number as well as equals to it.
Position in Sector >=	This is the same as Position in Sector, but includes the carriers in positions exceeding the chosen number as well as equalling it.

Topmost drop-down list (Property)	Second drop-down list (Value)
Filter	Using the tab Filters you can create regular expression filters for carrier (and sector) names. Here you can choose which filter to apply.
Categoryname	See all the carriers belonging to a given layer within the chosen category. If you need to see carriers which have yet to be assigned a layer within the category, choose Unassigned.

* Note that the name appearing here depend on whether frequency hopping, frequency groups or both have been activated as described in the section on system administration. If only frequency groups are active the selection will be called **Carrier group**. If only frequency groups are active, the selection will called **Hopping group**. If neither are active this selection will not appear.

† These options will only appear if the frequency hopping option is enabled.

After you have made your selection, click on **View** to create the list in the left panel.

- All the carriers in a given data file (list):
  - a Click on the **Site/Sector/Carrier List** File button.
  - b Enter the name of any data file currently associated with the model (you do not need to specify the path), or click on ... to choose the file with a browser.
  - c Click on **View** to see the results in the left column.

Making changes to carriers' properties

The instructions below enable you to make changes to the property values of selected sets of carriers or to all the carriers in the network.

1 Select the carriers whose properties are to be changed by following the instructions in "Viewing carriers and their properties" on page 6 above. Check to make sure that the list in the left-hand pane shows the correct selection, and note that the property in the left hand column does not have to be the same as the property you want to change.

2 Choose the property you want to change from the upper drop-down list in the **Modify** area and its new value from the lower one. The table below give the properties available:

Upper drop-down list (Property)	Lower drop-down list (Value)
Fixed/Free	You can make all the selected carriers fixed or all free.

Upper drop-down list (Property)	Lower drop-down list (Value)
Frequency	Choose from the available frequencies to make all the selected carriers the same frequency. You can also choose unassigned or original. The latter gives the frequencies in the selection with their original values.
Original Frequency	Choose from the available frequencies to make all the selected carriers the same original frequency. You can also choose unassigned.
Color Code	Choose from the available color codes to make all the selected carriers the same color code. You can also choose unassigned.
Hopping/Carrier Group*	See all the carriers that have particular hopping or group characteristics. You can also choose unassigned.
Mobile Allocation List**	Choose from the used mobile allocation list
Mobile Allocation Index Offset**	Choose from the used mobile allocation index offsets
Hopping Sequence Number**	Choose from the used hopping sequence numbers. You can also choose unassigned.
Categoryname	Choose from the available layers in the chosen category to assign all the selected carriers to the same layer.

3 Click on **Apply.** CellOpt AFP makes the changes and shows them in the **Value** column of the left-hand pane, replacing the information shown when you made the selection.

Creating and assigning new categories and layers

You can use the network editor to create new:

- Categories.
- Layers in existing categories, assigning each new layer to selected carriers at the same time.

To create a new category:

1 Type your new category name in the **Change** box.

2 Click on **Apply**. The list on the left changes to show that all the carriers have an **Unassigned** layer in the new category, which also appears in the drop-down lists in the network editor and in the tree view Categories and layers branch.

To create a new layer in an existing category and assign it to a selected set of carriers:

1 Use the instructions in "Viewing carriers and their properties" on page 6, to select the carriers which will be assigned the new layer.

2 In the **Change** box, select the category which will have the new layer.

3 In the **To** box, type your new layer name.

4 Click on **Apply** to create the new layer and assign it to your selected carriers. The new layer appears in drop-down lists and the tree view.

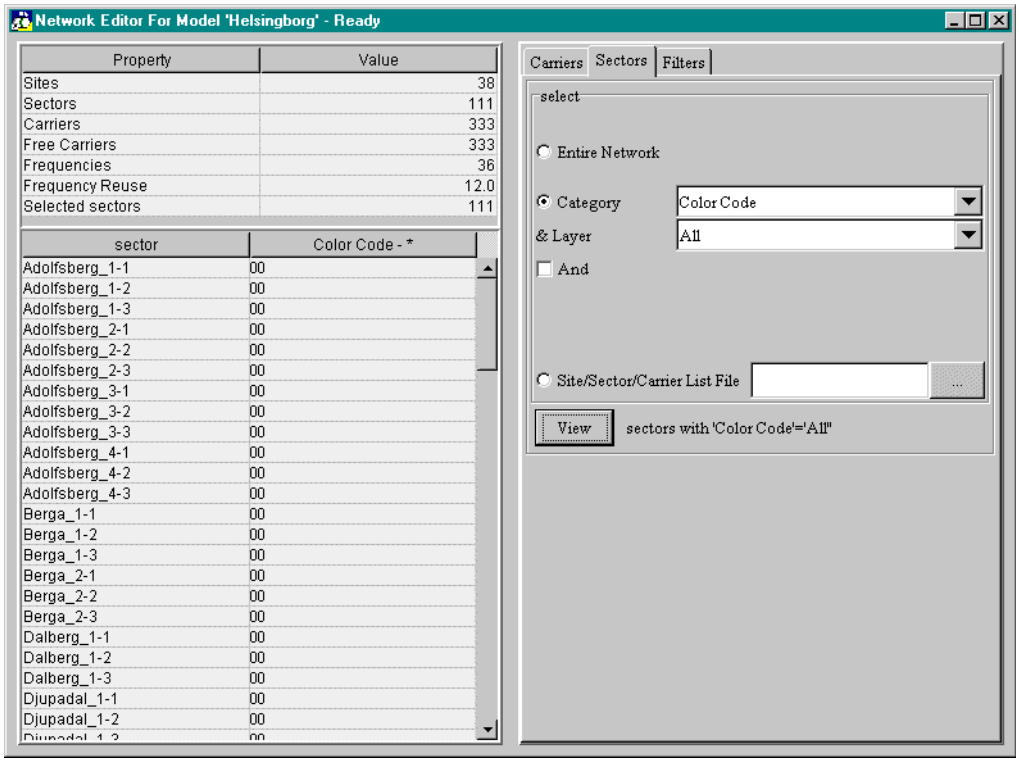
Network editor (sectors) form

The network editor for sectors allows you to:

Select sets of sectors according to their color code, absolute number of carriers or whether carriers' frequencies are fixed or free.

Route from CellOpt AFP main window

Right-click on **Network.** Alternatively, you can make sure that the correct model is in focus and then choose the modeler icon from the menu bar and **Edit** from the menu. Click on the **Sectors** tab if necessary. If you are changing from the carriers to the sectors form, note that the carriers information list in the left-hand panel remains unchanged until you click on **View** in the sectors form.



Using the network editor

You use the upper part of the right pane to select sectors whose properties you want to see. The results of your selection are shown in the list of carriers in the lower part of the left pane.

What you can see

The name of the current model appears in the window title bar.

For the current network model:

- The number of sites.
- The number of sectors.
- The number of carriers.
- The number of free carriers.
- The number of frequencies.
- The current frequency reuse in the model.
- The number of selected sectors.

- A list of sector names. The content of this list depends on the criteria you choose in the right-hand pane. You can choose to see all the network's sectors or just those which:
- Have a specific color code.
- Are fixed (the optimizer is not allowed to change the frequency).
- Are free.
- Have a given number of carriers or no fewer than a given number of carriers.
- Are included in a given data file (list).

To see the sectors in the model globally or selectively, follow the instructions for "Viewing carriers and their properties" on page 6.

What you can do

You cannot change any of the properties for the sectors. You can only view them. If you want to make any changes, you should use the carriers form.

Viewing sectors and their properties

Decide exactly what it is you want to see, for example "All the sectors in the whole network", "All the sectors with 6 or more carriers", "All the sectors in list listname".

If you want to see:

- All the sectors, together with the value of a particular property for each:
  a. Click on the topmost drop-down menu box and choose the property you want from the drop down list (these are also listed in the **Property** column of the table below).
  b. Click on the **Entire Network** radio button.
  c. Click on **View** to see the carriers in the left panel.
  - You achieve the same results as above by clicking on **Category & Layer**, selecting the property from the upper drop-down list and then choosing **All** in the box just below it.
- Only those carriers which share a given property value, click on the **Category & Layer** radio button, then choose the property you want from the topmost drop-down menu and its value from the one just beneath it. The table below give the properties available.

Topmost drop-down list (Property)	Second drop-down list (Value)
Color Code	See all color codes assigned to control carriers of the sectors.
Fixed/Free	See all the sectors which contain only carriers whose frequencies are fixed or alternatively sectors where at least one carrier's frequency is free. Choose **Fixed** or **Free**.
Traffic Served	The served traffic of the sector.
Area Served	The served area of the sector.
Carriers in Sector <=	See all the sectors whose carrier numbers are the same as or less than the number you choose. Choose from a list of valid numbers.
Carriers in Sector >=	See all the sectors whose carrier numbers are the same as or greater than the number you choose. Choose from a list of valid numbers.
Absolute Carriers in Sector	See all the sectors with a given number of carriers per sector. Choose from a list of valid numbers.
Filter	Using the tab *Filters* you can create regular expression filters for sector (and carrier) names. Here you can choose which filter to apply.

After you have made your selection, click on **View** to create the list in the left panel.

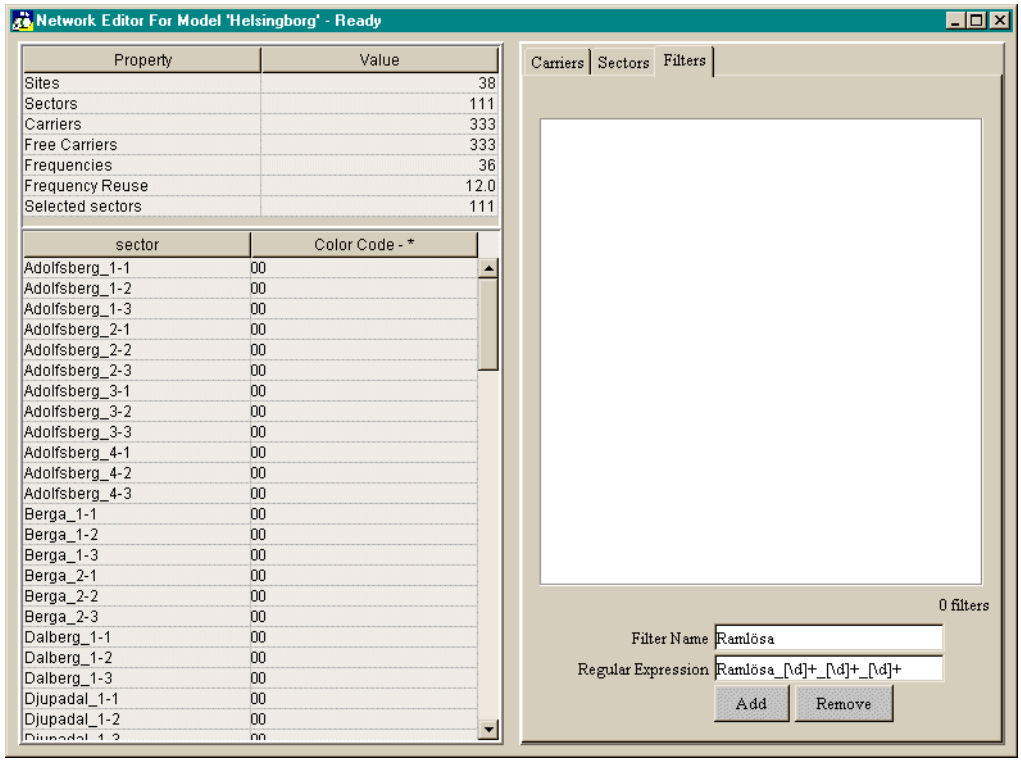
- All the carriers in a given data file (list):
  - a Click on the **Site/Sector/Carrier List** File button.
  - b Enter the name of any data file currently associated with the model (you do not need to specify the path), or click on ... to choose the file with a browser.
  - c Click on **View** to see the results in the left column.

Network editor (Filters) form

Using this form you can create filters based on regular expressions. You use these filters to select groups of carriers or sector

Route from CellOpt AFP main window

Make sure that CellOpt AFP is started with the **-A frequencygroups** option. Right-click on **Network**. Alternatively, you can make sure that the correct model is in focus and then choose the modeler icon from the menu bar and **Edit** from the menu. Click on the **Filters** tab if necessary. Note that the carriers information list in the left-hand panel remains unchanged when using this form.



What you can see

- A list of available filters.
- The number of available filters.
- A text field to enter the name of a new filter.
- A text field to enter a regular expression.

What you can do

Create regular expression filters for selecting groups of carriers and sectors.

- To create a filter:
  a. Enter the name of the filter in the Filter Name text field.
  b. Enter the regular expression in the Regular Expression text field.
  c. Press **Add** to add the filter.
- To remove existing filters:
  a. Select one or more filters in the list.
  b. Press **Remove.**

Sector editor (Illegal / Forbidden) form

You use this form to view and declare the illegal and forbidden frequencies, the forbidden sets and subsets and the forbidden MALs for a chosen sector.

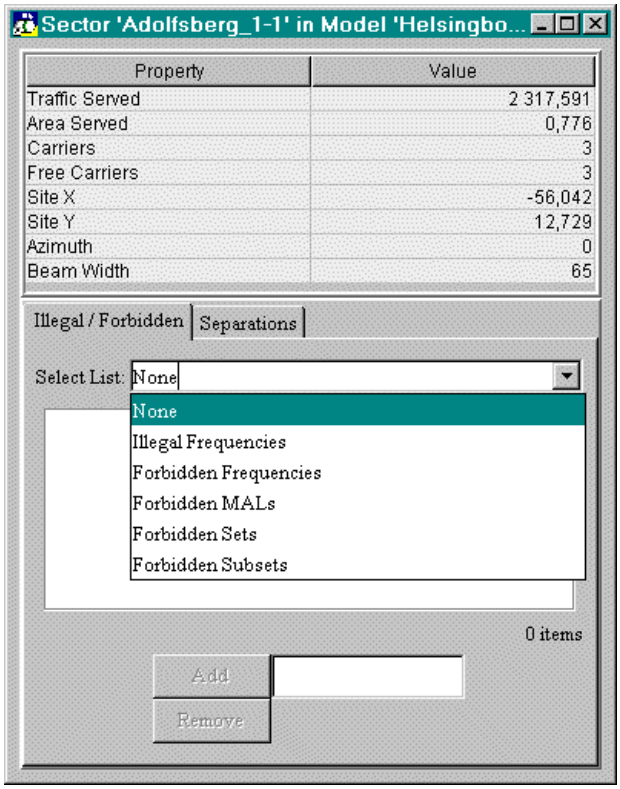
Note that you can also apply these properties to:

- All the carriers in a given layer by following the instructions in the chapter on "Modeling the spectrum".
- Individual carriers by following the instructions later in this chapter.

Route from CellOpt AFP main window

Open the **Network** branch, then the branch with the name of the site, then right-click on the name of the sector you want.

Click on the **Illegal/Forbidden** tab.



What you can see

- Information about the sector as described for the form above.
- The objects (frequencies, sets, subsets or MALs) that are defined as illegal or forbidden for this sector.

NOTE

The lists Forbidden Sets and Forbidden Subsets only appears if CellOpt AFP is started with the **-A frequencygroups** option.

NOTE

The list Forbidden MALs only appears if CellOpt AFP is started with the **-A frequencyhopping** option.

What you can do

Add or remove illegal and forbidden frequencies, forbidden sets and subsets, and forbidden MALs First select the list in the drop-down menu, then follow the instructions for using **Add** and **Remove** in the chapter on “Modeling”.

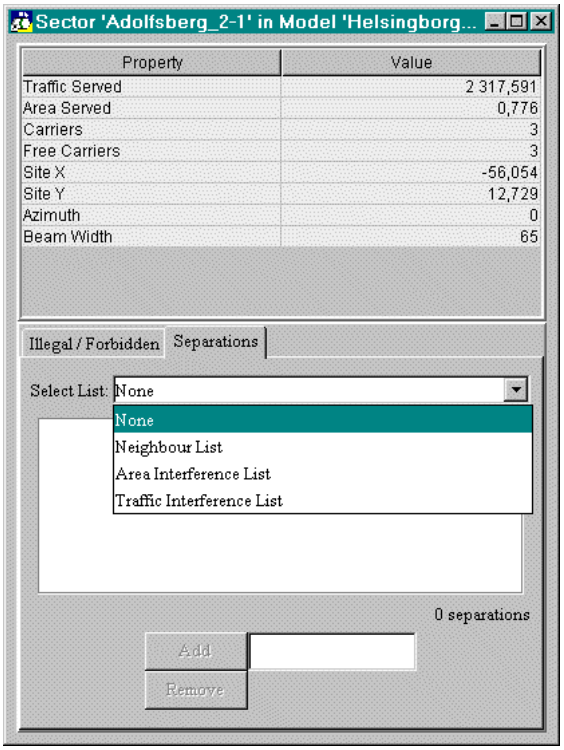
Sector editor (Separations) form

You use this form to view and declare separations for a chosen sector.

Route from CellOpt AFP main window

Open the **Network** branch, then the branch with the name of the site, then right-click on the name of the sector you want.

Click on the **Separations** tab.



What you can see

- Information about the sector as described above.
- The sectors whose frequency assignments require certain separations from the frequency assignments in the selected sector as defined in the selected list.

To select the list you want, choose the list name from the **Select List** drop-down menu.

What you can do

For the chosen sector you can add or remove separations in the selected list. Instructions for using **Add** and **Remove** are given in the chapter on “Modeling”.

Carrier editor (Illegal / Forbidden) form

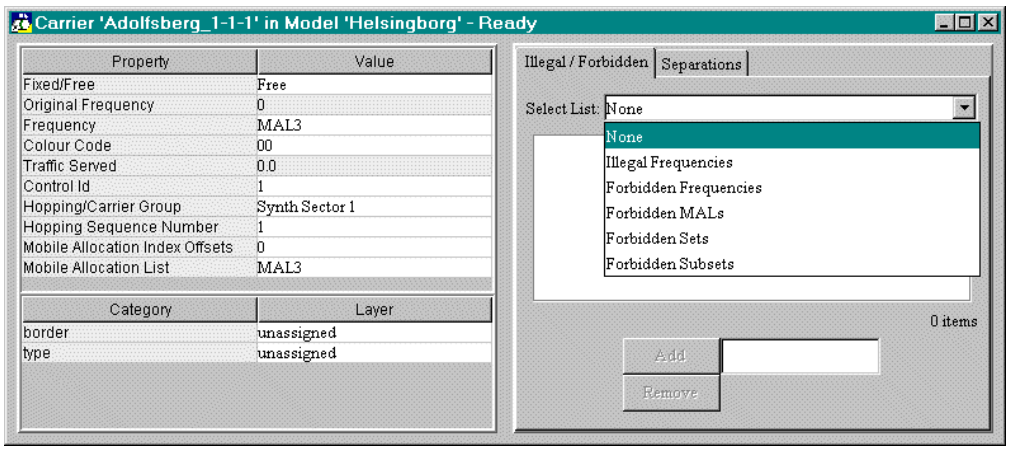
You use this form to declare the illegal and forbidden frequencies, the forbidden sets and subsets, and the forbidden MALs for a chosen carrier.

Note that you can also apply these to:

- All the carriers in a given layer by following the instructions in the chapter on "Modeling the spectrum".
- All the carriers in the network and individual carriers by following the instructions earlier in this chapter.

Route from CellOpt AFP main window

Open the **Network** branch, then the branch with the name of the site, then the branch with the name of the sector you want. Right-click on the carrier name you want. Click on the **Illegal/Forbidden** tab if necessary.



What you can see

For the chosen carrier (whose name appears in the title bar):

- The frequency assigned when this carrier was originally added to the model, either in CellOpt AFP or at an earlier stage in the planning procedure.
- The current frequency.
- The color code.
- Whether the carrier frequency is fixed or free for the optimizer to change.
- The Control Id.

- Hopping/ Carrier group*
- Hopping Sequence Number**
- Mobile Allocation Index Offset**
- Mobile Allocation lists**
- Any user-defined categories and the value of each one's layer.
- The contents of a selected list of objects, either frequencies, sets, subsets or MALs. These objects are illegal or forbidden for this carrier.

NOTE The lists Forbidden Sets and Forbidden Subsets only appears if CellOpt AFP is started with the **-A frequencygroups** option.

NOTE The list Forbidden MALs only appears if CellOpt AFP is started with the **-A frequencyhopping** option.

What you can do

- To change the current frequency, color code, Hopping/Carrier group, MAL, MAIO, HSN, or a layer of any of the categories shown, or to toggle between fixed and free:
  a Click on the current value to see a list of available values.
  b Click on the value you want. The field changes to show your choice.
- To add or remove the illegal or forbidden objects, follow the instructions for using **Add** and **Remove** in the chapter on "Modeling".

Implied objects, defined between the sector of the chosen carrier or a layer that the carrier is assigned to, cannot be removed in this form. Use the sector or the illegal or forbidden forms in the spectrum section to remove these. The implied objects are indicated with gray background. Editable objects defined for the chosen carrier are always indicated with white background.

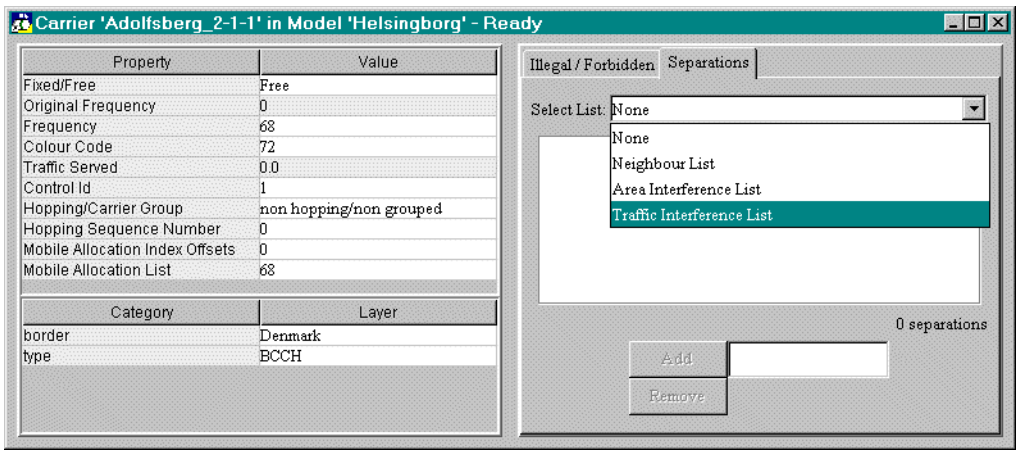
Carrier editor (Separations) form

You use this form to view and declare separations for a chosen carrier.

Route from CellOpt AFP main window

Open the **Network** branch, then the branch with the name of the site, then the branch with the name of the sector you want. Right-click on the carrier name you want.

Click on the **Separations** tab.



What you can see

- Information about the carrier as described above.
- The carriers whose frequency assignments require certain separations from the frequency assignments in the selected carrier as defined in the selected list.

To select the list you want, choose the list name from the **Select List** drop-down menu).

What you can do

For the chosen carrier you can add or remove separations in the selected list. Instructions for using **Add** and **Remove** are given in the chapter on “Modeling”.

Note that implied carrier separations, defined between the sector of the chosen carrier and other sectors, cannot be removed in this form. Use the sector form to remove these. The implied separations are indicated with grey background. Editable separations defined for the chosen carrier are always indicated with white background.

7
Modeling categories and layers

Overview

The categories and layers concept allows you to group your model's carriers according to user-defined criteria. The concept of categories and layers enables you to specify criteria only once for a layer and then apply those criteria to all carriers within that layer. For instance, you define illegal frequencies and set penalties, scaling factors and thresholds for layers.

A category is any property which can be assigned to a carrier, such as the type of signal it carries, its proximity to a national or network border, or the equipment vendor for the site it belongs to.

Carrier properties are called categories only if they are user-defined. CellOpt AFP has some predefined properties which are *not* treated as categories, although they can be used to group carriers. These are:

- Frequency.
- Color code.
- Site name.
- Sector name.
- Carrier name.
- Number of carriers in a sector.
- Carrier's position in a sector.
- Whether a carrier's frequency is fixed or free for the optimizer to change.
- If the frequency hopping option is enabled you may also have access to hopping group as a predefined property defining what carriers within the sector or site that should be using the same MAL. With the frequency hopping option enabled you can also have access to Mobile Allocation List, Hopping Sequence Number and Mobile Allocation Index as predefined properties.

- If the frequency group option is enabled you may have access to carrier group as a predefined property defining carriers within the sector that should be assigned frequencies from the same set or subset.

A layer is the value of the category for each carrier. For instance, you might have created a category called **type** to say what sort of signal is carried. In a **GSM** system you could then define two layers for that category, **BCCH** and **TCH**, and assign one or the other to every single carrier in your model.

CellOpt AFP always creates one layer (**Unassigned**) as soon as you create the category, and assigns it to each carrier as the default. When you assign your own layer to a carrier, you replace the **Unassigned** layer (it remains available, in case you want to remove a user-defined layer from a carrier at a later date).

For instance, if you create a category called **Border,** with layers like **Germany**, **Holland** and so on to identify countries with which you may have agreements on what frequencies may be used near the border, it may well be that several sites in the centre of the network are not subject to any special agreements. For these sites' carriers you do not need to define anything; they will retain their default **Unassigned** layers.

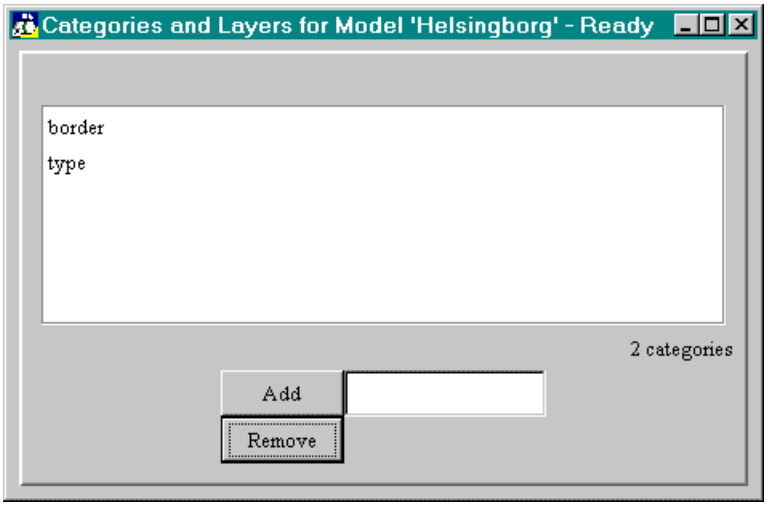
In practice, many categories and layers will have been created at an earlier stage in the planning process and will be imported with the data files. The instructions in this chapter tell you how to edit and remove all existing categories and layers as well as how to create new ones.

Categories form

You use this form to see a list of existing categories and their descriptions as well as to create new ones, edit existing ones and remove unwanted categories.

Route from CellOpt AFP main window

Right-click on **Categories and Layers**.



What you can see

- The number of categories currently defined for the model.
- A list of the current category names.

What you can do

Procedures for adding and removing are given in the chapter on "Modeling".

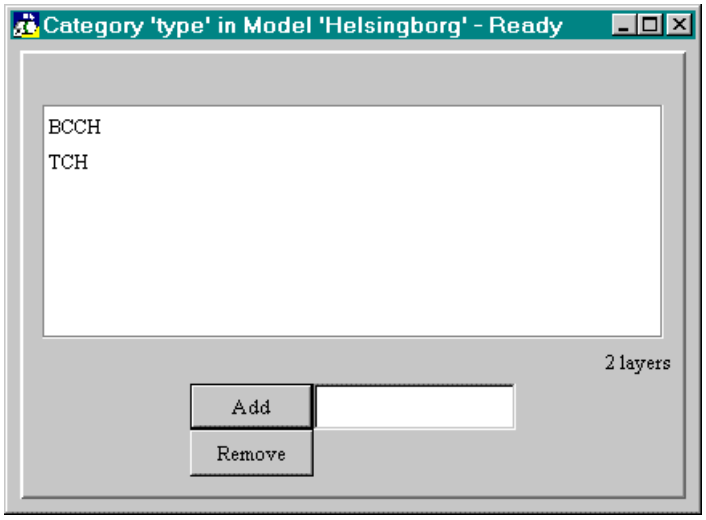
- Define new categories, using the **Add** field.
- Remove unwanted categories from the model, selecting them and using the **Remove** button.

Layers form

When you choose a category name, you see a list of the category's existing layers and their descriptions. You can create new layers and descriptions, edit existing ones and remove unwanted layers.

Route from CellOpt AFP main window

Open the **Categories and Layers** branch, then right-click on the name of the category whose layers you want to see or edit.



What you can see

- The name of the category you selected from the tree (in the title bar).
- The number of layers in the category.
- A list of the current layer names.

What you can do

Procedures for adding and removing are given in the chapter on "Modeling".

For the chosen category:

- Define new layers, using the **Add** field.
- Remove unwanted layers from the model, selecting them and using the **Remove** button.

8
Modeling penalties

Overview

This chapter explains the forms that allow you to set and change the way in which CellOpt AFP prioritizes assignment restrictions of carriers in your network. These priorities are specified by means of penalty values. The higher the penalty you give a restriction, the more important it is that the restriction is not violated by the assignment. Using these penalties, the optimizer can assign in such a way that the total penalty value for the whole network is a minimum.

CellOpt AFP recognizes two types of penalties:

- **Frequency penalties** Penalty awarded for assigning an illegal frequency to a carrier.
- **Separation penalties** Penalty awarded for assigning a frequency to one carrier which is too close to the frequency of another carrier (that is, the *separation* is too small).

These types of penalties are also used for colour code, MAL, HSN, frequency set and subset assignments. The principles of deriving colour code and HSN penalties are described in the optimizer section of this manual.

Penalties for assigning MAL are derived by aggregating all penalties for carriers being assigned a MAL. To consider the fractional load, all frequency and separation penalties are automatically scaled by the length of the MAL, that is 1 / (the number of frequencies in the MAL).

Likewise, penalties for assigning frequency sets and subsets are also derived by aggregating all penalties for the carriers being assigned a set or a subset. The optimizer considers all frequencies in the set and subset to have an equal likelihood of being assigned to any of the carriers in a carrier group by scaling automatically each penalty by
1 / (the number of frequencies in the set or subset). Note, however, that the actual assignment of frequencies from sets and subsets to carriers in the carrier group is done in ascending order - the lowest frequency is assigned to the first carrier and so on.

The assignment restrictions in CellOpt AFP are logically grouped into lists. For example, we could have an illegal frequency list, specifying that certain frequencies should not be assigned to certain carriers. We could also have a neighbor list that specifies frequency assignment separations between carriers in a serving sector and carriers in a neighboring sector. Interference and exception lists are common, as are frequency assignment separations of two carriers from the same sector or the same site. CellOpt AFP allows you to use as many lists as you want in to model your frequency assignment preferences.

The penalties in CellOpt AFP are modeled per list. For instance, you can specify the penalties, and thereby your preferences, for assigning illegal frequencies to carriers or for assigning co- or adjacent frequencies to carriers in a serving sector and to carriers in a neighboring sector.

CellOpt AFP uses the layer concept to group carriers with similar characteristics, and thus to refine the list penalty specifications even further. For instance, the illegal frequencies may only be applicable for control carriers in the sector, and the restrictions for assigning adjacent frequencies for neighboring carriers may be much stricter for control carriers than for traffic carriers.

Thus, assignment restrictions are specified in lists and penalty values may be specified for all the restrictions in the list and/or specifically for the carriers of a layer. All these penalties are added together to give the total applicable penalty to the restriction. Note the following examples below:

- **Adding penalties specified for a list and a layer**.

  You can specify penalties for all restrictions in the list as well as for carriers belonging to a particular layer. The applicable penalty for carriers in the particular layer is the sum of the penalty for the list and the penalty specified for the layer.

- **Adding penalties specified for multiple layers**.

For each category, a given carrier is assigned one (and only one) layer. You can specify penalties for each layer of each category, and the applicable penalty for a single carrier is the sum of the penalties for each of the layers to which it belongs.

- **Adding penalties specified for multiple lists**.

  A particular restriction can appear in multiple lists. For instance, the same restriction may occur in a neighbor list and an exception list. The applicable penalty for the restriction will be the sum of the penalty for the neighbor list and the exception list

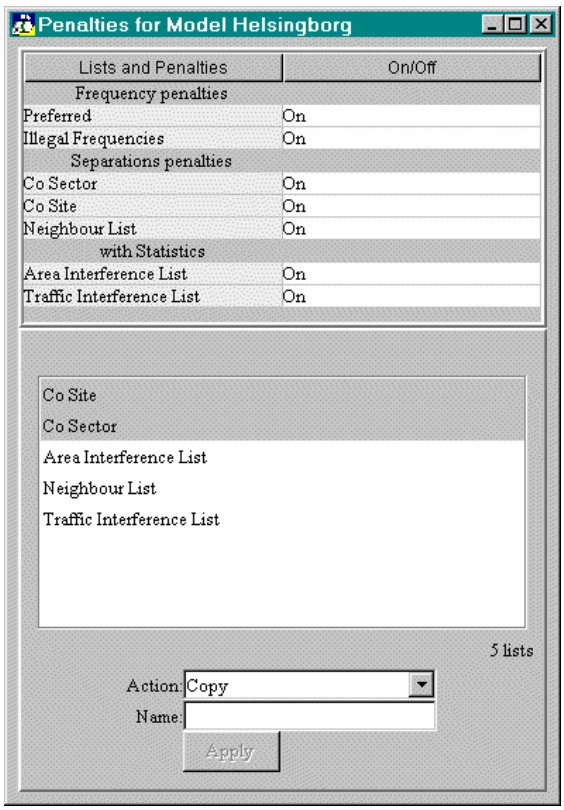
Penalty list form

This form identifies the lists of restrictions currently applied to your model. It also allows you to create or remove lists from the model permanently or temporarily. The create function will use the information from one or several existing lists to generate list for 2nd order, statistics or a copy of the marked list.

CellOpt AFP does not identify lists, which are simple text files, from their filenames, but by looking at the way the text is laid out inside the file. Having done this, it lays out the structure of the penalties branch of the tree view so that the right sorts of list appear in the right places. For this reason, it is very inadvisable to edit a list file directly in case you alter its nature as well as its content.

Route from CellOpt AFP main window

Right-click on the **Penalties** branch.



What you can see

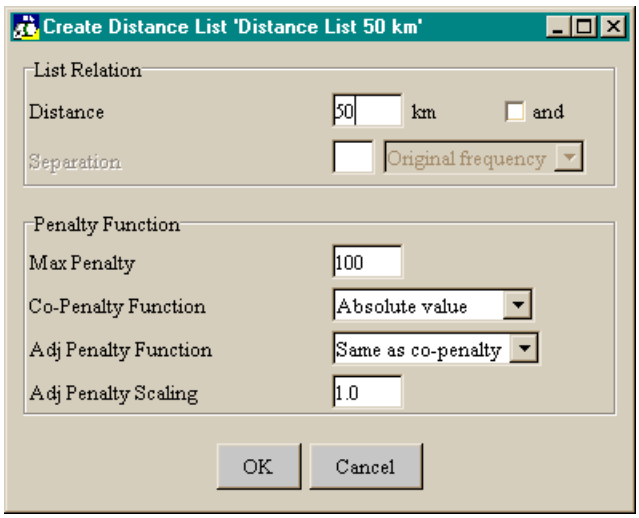
- The name of each list.
- Whether or not the optimizer will read the list (On) or ignore it (Off). It is On by default.
- The number of lists you have loaded and created. Note that this counter excludes Preferred frequencies and Illegal frequencies as they are always included by default. Co Site and Co Sector are included but grey marked as they are created by default and can't be removed.
- The action and name for creating a new list.

What you can do

- In the value fields, you can switch any list off to force the optimizer to ignore it, or back on again to take it into account.

- If you wish, you can remove a list with the delete action. You can load it again by following the instructions in "Using CellOpt AFP". Note that Preferred frequencies, illegal frequencies, Co Site and Co Sector cannot be removed. They can, however, be toggled off.
- You can rename a list by using the rename action. Specify the new name in the name box. Only one list at a time can be renamed with this action. Note that Preferred frequencies, illegal frequencies, Co Site and Co Sector cannot be renamed.
- You can create a copy of any existing list by using the copy action. Specify the name of the new list in the name box. Only one list at a time can be created with this action. Note that Preferred frequencies and illegal frequencies cannot be copied. You can create a second order list by using the generate second order action. Specify the name of the new list in the name box. The new list will contain information of about the relations of the relation in the original list. Only one list at a time can be created with this action. Note that Preferred frequencies and illegal frequencies cannot be used for creating a second order list.
- You join one or several lists together in a new list. The join could be done by not considering the statistics (both co and adjacent statistics will be equal to 0), taking the maximum statistic of the lists for co and adjacent separately and taking the sum of the statistic. Specify the name of the new list in the name box. Note that Preferred frequencies and illegal frequencies cannot be used for joining lists.
- The distance list function is used to create relations between sectors that are within a certain range from each other, with a penalty that is either inversely related to the distance between them or penalized with a fixed value. The requirement that sectors have to have a certain frequency overlap in order to be related can also be added.

  When the 'Create Distance List' function is chosen, a pop-up dialog window appears. The information entered in this window will control the creation of the distance list. When the list itself has been created, there is no way to see how it was created, so a good advice is to enter a descriptive name for the list.



The parameters that must be set by the user are:

Distance: All sectors that are within this distance from each other will be penalized. The penalty is dependant on the function chosen (see below). The unit of the distance is the same unit that is set with the command line paramters (-g distance_unit=km or -g distance_unit=miles).

Separation This option is not enabled by default, and is enabled by checking the 'and' checkbox to the right of the 'Distance' edit box. The checkbox will be enabled if you enter a value in the separation text field.

Defines the maximum separation to be considered for channel reuse filtering, with regards to the either the original frequency plan or the current frequency plan. A value of 1 implies all relations between sectors with co-channel reuse will be included. 2 means adjacent channel reuse should be included, etc. The drop-down box to the right of the separation edit box is used to choose the frequency plan used for channel reuse filtering. There are two choices, original frequency plan or current frequency plan.

Max Penalty: This edit box sets the maximum penalty. Depending on the distance function chosen, the penalty will range from this value to 0 (in the case of absolute value, only this value will be used).

Co-Penalty function / Adj penalty function: There are three different algorithms (functions) that can be used in penalty calculation. These functions will be applied to the distance between two sectors that make up a relation (i.e. they are within a certain distance from each other) to produce the penalty that will be assigned that relation. The co and adjacent penalties will be calculated in parallel, but the default is that the adjacent value will be calculated in the same way that the co penalty is calculated, so the default result of the adjacent and the co penalty calculation will be the same.
The three different algorithm choices are:

Absolute value: Sectors that are closer than the specified thresholds are all penalized at the maximum penalty value.

Linear drop-off: Sectors that are closer than the specified threshold are penalized at values dropping off linearly with distance according to the equation:

$$p = (maxpenalty) \times \frac{T - d}{T}$$

where *p* is the resulting penalty, *T* is the maximum distance and *d* is the actual distance between the sectors.

Quadratic drop-off: Sectors that are closer than the specified threshold are penalized at values dropping off quadraticly with distance according to the equation:

$$p = (maxpenalty) \times \frac{(T - d)^2}{T^2}$$

where *p* is the resulting penalty, *T* is the maximum distance and *d* is the actual distance between the sectors.

Adj penalty scaling: Value that the value calculated by the adjacent penalty function will be multiplied by.

Instructions for toggling and removal are given in the chapter on "Modeling". Remember to save your data to keep your entries beyond the end of this CellOpt AFP session.

Frequency penalties

Frequency penalties specify restrictions for assigning a frequency to a carrier. There are two sorts of frequency penalty:

- **Preferred penalty** A penalty to be applied if the optimizer changes the carrier's pre-assigned frequency, no matter what the value of the new frequency is.

- **Illegal penalty** — A penalty to be applied if the optimizer changes the carrier's current frequency to a new frequency which has been declared as illegal for the carrier.

Frequency penalties (preferred frequencies) form

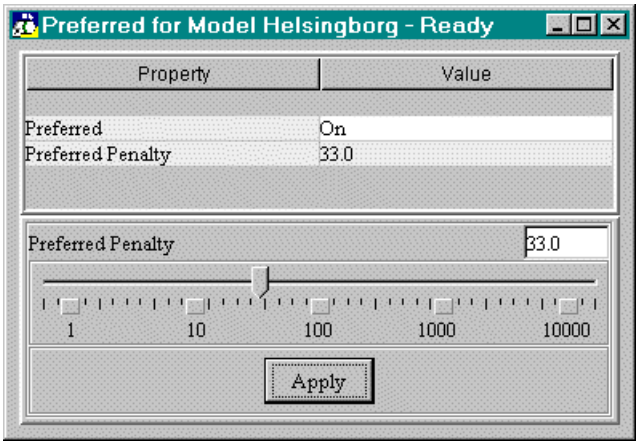
CellOpt AFP allows you to specify a preference that frequencies that are currently assigned to the carriers should not be changed. These pre-assigned frequencies are said to be *preferred*. This reluctance to change is quantified by penalty values, which will be applied if the optimizer changes any frequencies.

You can do either or both of the following:

- Apply penalties for all the carriers in the network (this form). They are called preferred global penalties.
- Define additional penalties (preferred layer penalties) against changing the frequencies of carriers belonging to particular layers. The form for doing this is described in the next section.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Frequency Penalties** branch, and right-click on **Preferred**.



What you can see

- Whether the preferred penalties are used (On) or not (Off). If On, the optimizer will calculate and apply preferred penalties when it makes frequency changes; if Off, it will ignore them.

- The current preferred global penalty value, which reads zero or the value applied last time. In the lower panel, the slider and the number in the box show the same value unless you have altered either since opening the form.

What you can do

Use the techniques described in the chapter on "Modeling" to:

- Toggle the preferred penalties On or Off. They are On by default.
- Set or change the value of the preferred global penalty. Once you have done this, click on Apply to save the value in memory – this is the value that the optimizer will use when next started.

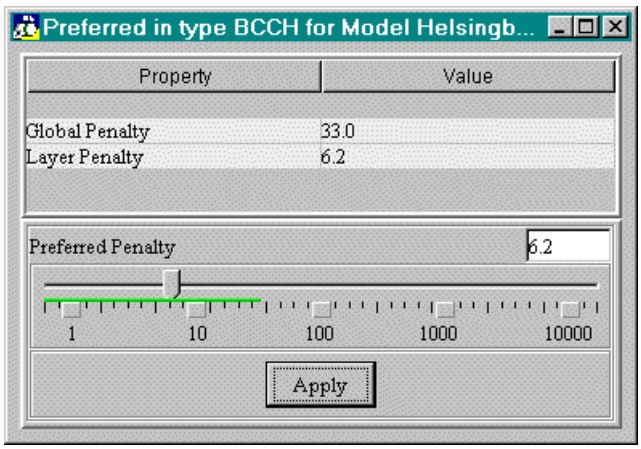
Remember to save your data to keep the new value beyond the end of this CellOpt AFP session.

Preferred frequencies (by layer) form

You can choose any layer and apply a specific penalty (preferred layer penalty) against changing the frequencies of its carriers from their current assignments. Note that the penalty you apply to a layer is added to the global penalty you have set for all carriers by using the form described immediately above.

Route from CellOpt AFP main window

Open the Penalties branch, then the Frequency Penalties, Preferred and category name branches, then right-click on the name of the layer you want.



What you can see

- The chosen layer (in the title bar).
- The current preferred global penalty – the value (if any) which you set in the form described above. This value is also shown as a green line on the slider bar.
- The current preferred layer penalty.

What you can do

You can use any of the methods described for slider forms in the "Modeling" chapter to set the preferred penalty for carriers in this layer. Remember to save your data to keep your entries beyond the end of this CellOpt AFP session.

Frequency penalties (illegal frequencies) forms

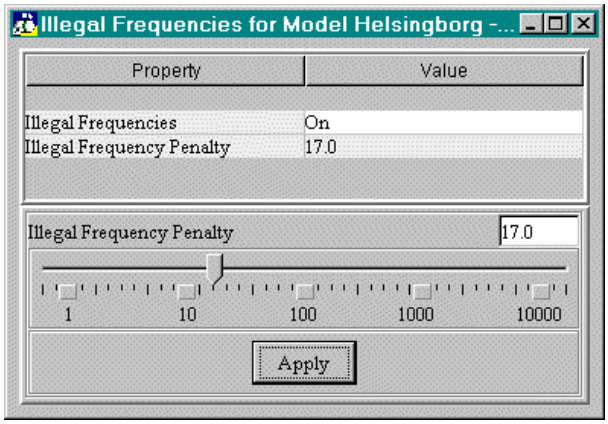
You use the form to see and change the penalty which the optimizer will apply if it assigns any of the carriers a frequency which has been declared illegal.

You can do either or both of the following:

- Apply penalties (illegal global penalties) for all the carriers (this form).
- Apply additional penalties (illegal layer penalties) for carriers belonging to a particular layer. The form for doing this is described in the next section.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Frequency Penalties** branch, and right-click on **Illegal Frequencies**.



What you can see

The current illegal global penalty value, which reads zero or the value applied last time.

What you can do

Use any of the techniques described in the chapter on "Modeling" to set or change the value of the illegal penalty. Once you have done this, click on **Apply** to save the value in memory – this is the value which the optimizer will use when next started. Remember to save your data to keep the new value beyond the end of this CellOpt AFP session.

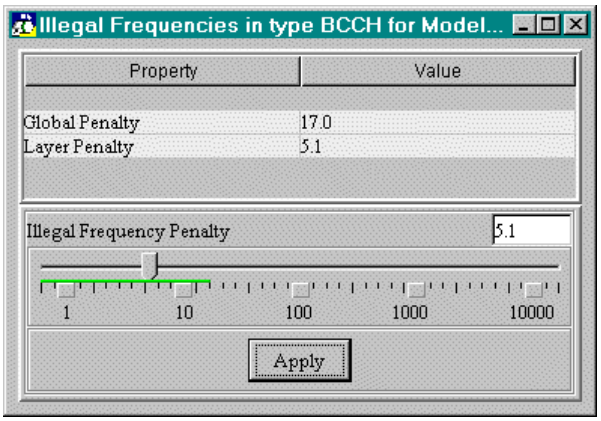
Illegal frequencies (by layer) form

You can choose any layer shown in the Frequency penalties branch and apply a specific additional penalty (the illegal layer penalty) for assigning an illegal frequency to carriers belonging to the given layer.

The penalty you apply to a layer is added to the global penalty you have set for carriers by using the form described immediately above.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Frequency Penalties** and **Illegal Frequency** branches; then open the appropriate category name branch and right-click on the name of the layer you want.



What you can see

- The chosen layer (in the title bar).

- The current illegal global penalty – the value (if any) which you set in the form described above. This value is also shown as a green line on the slider bar.
- The current illegal layer penalty.

What you can do

You can use any of the methods described for slider forms in the "Modeling" chapter to set the illegal penalty for carriers in this layer. Remember to save your data to keep your entries beyond the end of this CellOpt AFP session.

Separation penalties

The Frequency penalties branch described above manages preferences of assigning frequencies to carriers. This branch applies penalties for assigning frequencies of carriers at an insufficient separation to frequencies assigned to other carriers.

The way penalties are applied in this branch is very similar to the way they are applied in the Frequency penalties branch. However, the procedure is complicated a little by the fact that you can specify penalties for both co- and adjacent separations and for the layers of any pair of carriers whose frequencies should be separated.

Co site and co sector separations

You use the same penalty structure as described under frequency penalties above to declare the importance of avoiding, for two carriers:

- Identical frequencies:
  - In the same site, by applying:

    A co site global co penalty applicable to all carriers in the network and/or:

    A co site layer co penalty applicable whenever a carrier from the chosen layer has exactly the same frequency as another carrier in the same site
  - In the same sector, by applying:

    A co sector global co-penalty applicable to all carriers in the network and/or:

A co sector layer co-penalty applicable whenever a carrier from the chosen layer has exactly the same frequency as another carrier in the same sector.

- Frequencies which are too close together (you decide how close they should be by defining the separation requirement):
  - In the same site, by applying:

  A co site global adjacent penalty applicable to all carriers in the network and/or:

  A co site layer adjacent penalty applicable whenever a carrier from the chosen layer has a frequency assigned closer than the separation requirement of another carrier of the same site.

  - In the same sector, by applying:

  A co sector global adjacent penalty to all carriers in the network and/or:

  A co sector layer adjacent penalty applicable whenever a carrier from the chosen layer has a frequency assigned closer than the separation requirement of another carrier of the same sector.

Note that:

- Whatever the structure of any particular network, it is typically more detrimental for two carriers to have the same frequency than it is for them to have adjacent ones. For this reason, CellOpt AFP will not allow you to set any co-penalty lower than the adjacent penalty on the same form. If you try to do so, the slider you are using will reset to the same value as the other. This feature may be switched off in the settings menu.
- Adjacent penalties are applied when the separation of frequencies is less than – *not* equal to – the separation requirement. This means that you should set the smallest separation which you are willing to accept. The resultant separation requirement is the maximum of the global and the layer separation requirement.
- If the frequencies are the same and the co-penalty applied, the adjacent penalty is not applied, even though the separation requirement has of course been breached.
- If a particular separation requirement is zero, neither the adjacent nor the co-penalties will be applied even if the frequencies are the same. If the separation requirement is one, the adjacency rule can never be breached, though the co-frequency rule will work.

- The optimizer considers only two different penalty values for each separation relation. There is one penalty value for assigning frequencies on the same frequency and one penalty value for assigning adjacent frequencies. Thus, if a penalty is 100 for a separation requirement of 3 and another penalty value is 1,000 for a separation requirement of 4, then 1100 will be applied both for an assignment of only 2 frequencies or 3 frequencies apart. This slight modelling limitation is due to:
  - A decision to save memory as in most cases the separation penalties only involve co and adjacent penalties.
  - The fact that the separation penalties are often identical at higher order separations.

List separations

In the same way, you can apply list and layer co-penalties, adjacent penalties and separation requirements to sets of carriers belonging to individual lists. The names of these lists appear on the tree view underneath the Co Site and Co Sector branches. CellOpt AFP only displays lists here which can be used for this purpose, and the penalties and separation requirements you define apply only to those carriers in the list.

For any list, you can:

- Set a list co-penalty, a list adjacent penalty and a separation requirement.
- Set layer penalties and separation requirements for carriers of the layer. You can set them differently according to whether the carriers are interfering, or being interfered with.
- Disable a list, so that the penalties of this list are ignored. You can reactivate it at any time.

Separation penalties (Co Site) form

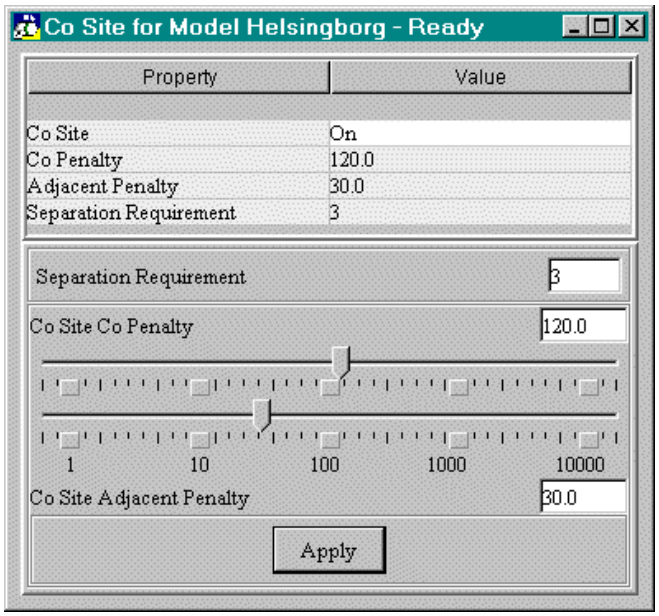
This form lets you:

- Disable or enable the penalties which apply to frequencies within each site.
- See and set, for all the sites in the current model:
  - The co site global co-penalty.
  - The co site global adjacent penalty.
  - The separation requirement to which the adjacent penalty will apply.

All these terms are explained in the introduction to this section.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties** branch, and right-click on **Co Site**.



What you can see

For all the sites in the network:

- Whether or not the co site penalties are enabled. If On, the optimizer will apply any co site penalties calculated from the rules in this form. If Off, it will ignore them.
- The current co site global co-penalty – the penalty applied if any two carriers in the same site use the same frequency. The value in the property form reads zero or the value applied last time. The upper slider and the number in the box just above it show the same value unless you have changed it since you opened the form.
- The current co site global adjacent penalty – the penalty applied if any two carriers in the same site use frequencies which are different but are closer than the separation requirement (see below). The adjacent penalty value in the property form reads zero or the value applied last time. The lower slider and the number in the box below it show the same value unless you have changed it since you opened the form.

- The current separation requirement. The property form shows the value current when you opened the form, as does the Separation Requirement box, unless you have altered it since opening the form.

What you can do

You can use the methods described in the chapter on "Modeling" to enable or disable co site penalties and to set or change:

- The co site global co-penalty.
- The co site global adjacent penalty.
- The global separation requirement.

If you have changed any numerical values, click on **Apply** to save them in memory – this is the value which the optimizer will use when next started. Remember to save your data to keep the new values beyond the end of this CellOpt AFP session.

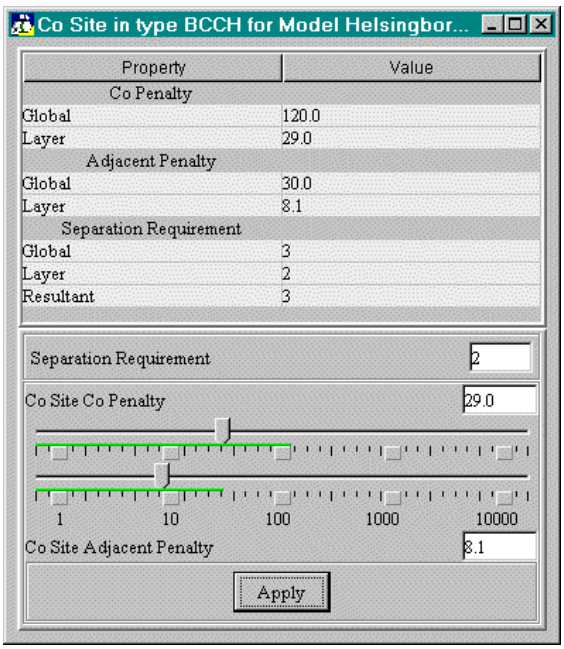
Separation penalties (Co Site by layer) form

You can choose any layer shown as a sub-branch of the Separation penalties Co Site branch and apply specific additional penalties (co site layer penalties) for carriers in the given layer, if other carriers in the same site are assigned identical or adjacent frequencies.

The penalty (co- or adjacent) you apply to a layer is added to the appropriate global penalty you have set for all carriers in the network by using the Separation penalties (Co Site) form described above.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties**, **Co Site** and category name branches and right-click on the layer you want.



What you can see

- The chosen layer (in the title bar).
- The current co site global and layer co- and adjacent penalties.
- The current co site global, layer and resultant separation requirements. The property form shows the value current when you opened the form, as does the Separation Requirement box, unless you have altered it since opening the form. The resultant separation requirement is the maximum of the global and layer separation requirement.

What you can do

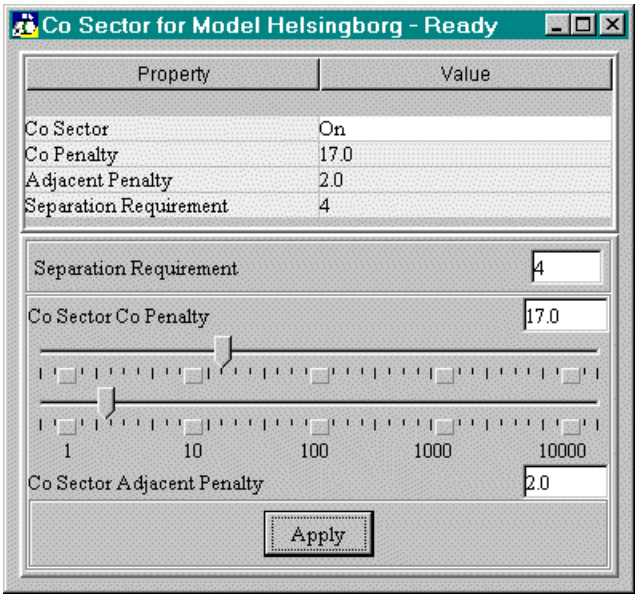
You can use any of the methods described for slider forms in the "Modeling" chapter to set the co site co- and adjacent penalties (and the separation requirement) for carrier sets in this layer. Remember to save your data to keep your entries beyond the end of this CellOpt AFP session.

Separation penalties (Co Sector) form

This form is exactly the same as the Separation (Co Site) form described earlier in this chapter, except that the penalties affect carriers that are all in the same sector rather than all in the same site. Refer to the earlier section for full information, substituting the word sector for the word site and co sector for co site throughout.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties** branch, and right-click on **Co Sector**.



What you can see

Refer to "Separation penalties (Co Site) form" on page 14, substituting the word sector for the word site and co sector for co site throughout.

What you can do

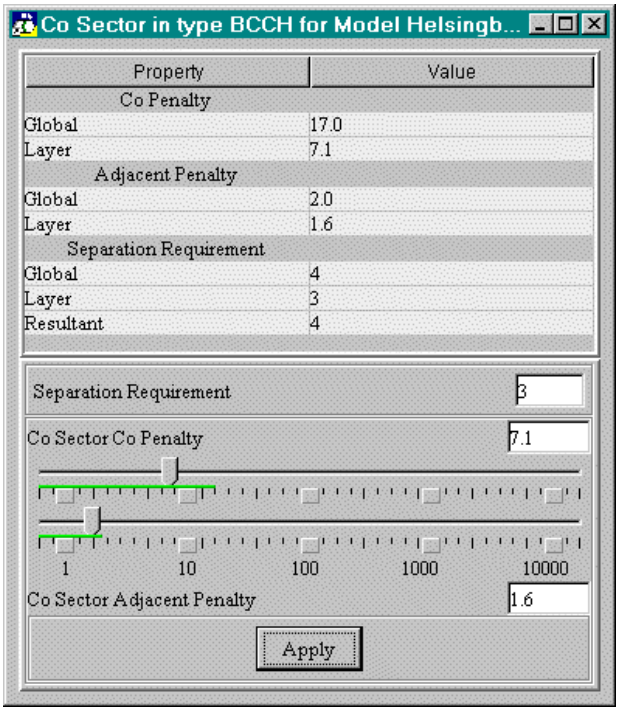
Refer to "Separation penalties (Co Site) form" on page 14, substituting the word sector for the word site and co sector for co site throughout.

Separation penalties (Co Sector by layer) form

This form is exactly the same as the Separation penalties (Co Site by layer) form described earlier in this chapter, except that the penalties affect carriers that are all in the same sector rather than all in the same site. Refer to the earlier section for full information, substituting the word sector for the word site and co sector for co site throughout.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties, Co Sector** and category name branches and right-click on the layer you want.



What you can see

Refer to “Separation penalties (Co Site) form” on page 14, substituting the word sector for the word site and co sector for co site throughout.

What you can do

Refer to “Separation penalties (Co Site by layer) form” on page 16, substituting the word sector for the word site and co sector for co site throughout.

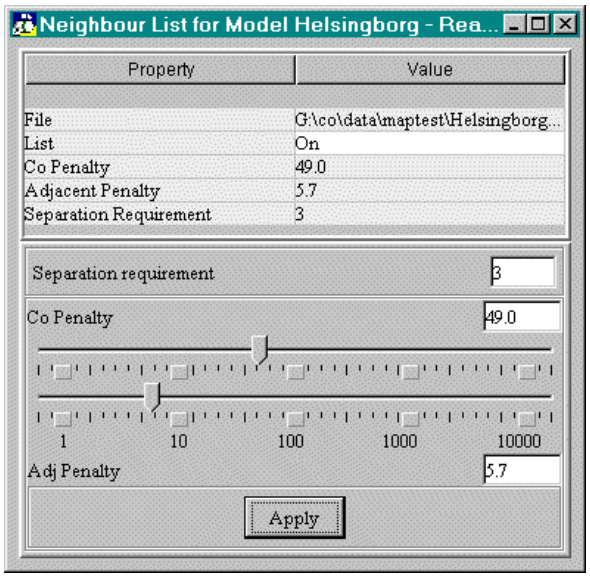
Separation penalties (list) form

In just the same way as the Separation penalties (Co Site) and (Co Sector) forms, this form allows you to assign list co-and adjacent penalties and a separation requirement. However, instead of relating to carriers of the same site or carriers of the same sector, the list form applies your penalties to restrictions specified in a list. Under Co Site and Co Sector in the Separations penalties branch, CellOpt AFP names (as extra branches) the lists. If you want to load more lists, you can do so by following the instructions in the chapter on "Using CellOpt AFP".

In addition to setting penalties, you can toggle lists on and off. Only the penalties from lists that are on are applied. If you want to bring a list in again, you need only toggle it back on – you do not need to reload the list or (unless you want to) reset the penalties and separation requirements.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties** branch and right-click on the name of the list you want.



What you can see

- The name (and full path) of the file that the list is loaded from. If it is generated from another list, the word *None* is shown instead.

- Whether the list is on (activated) or off (the penalties are ignored). You can make alterations on this form whether the list is on or off.
- For all the carrier relations in the chosen list:
  - The current list co-penalty – the penalty applied if any two carriers defined in a relation in the list use the same frequency. The value in the property form reads zero or the value applied last time. The upper slider and the number in the box just above it show the same value unless you have changed it since you opened the form.
  - The current list adjacent penalty – the penalty applied if any two carriers defined in a relation in the list use frequencies which are different but are closer than the separation requirement (see below). The adjacent penalty value in the property form reads zero or the value applied last time. The lower slider and the number in the box below it show the same value unless you have changed it since you opened the form.
- The current separation requirement. The property form shows the value current when you opened the form, as does the **Separation Requirement** box, unless you have altered it since opening the form.

What you can do

You can use the methods described in the chapter on "Modeling" to:

- Switch the selected list off without deleting the list or the co- and adjacent penalties and separation requirements associated with it. The penalties associated with this list will be ignored as long as it is off.
- Reactivate the list if it has been switched off.
- Set the co- and adjacent penalties and separation requirements associated with the list.

Remember to save your data to keep your entries beyond the end of this CellOpt AFP session.

Separation penalties (list by layer – interfered) form

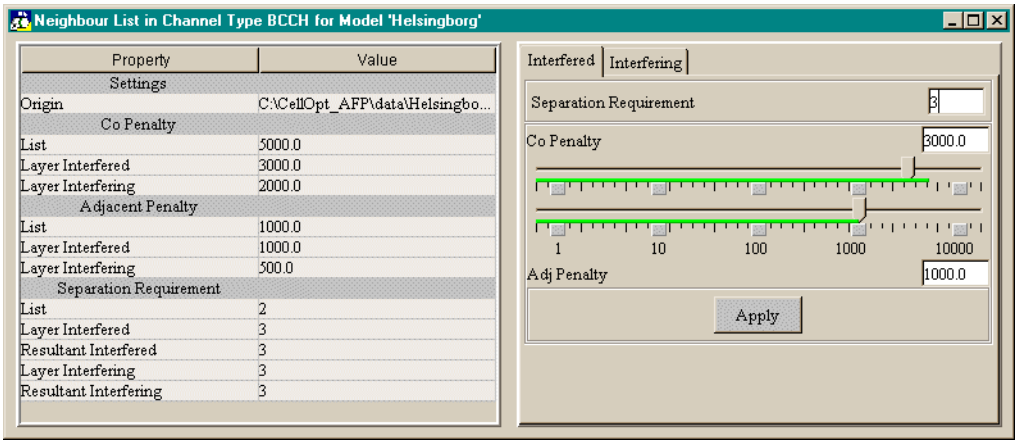
For any list shown as a sub-branch of the Separation penalties branch, you can choose a layer and apply specific additional penalties (interfered layer penalties) for assigning identical or adjacent frequencies to carrier relations defined in the list where a carrier from the chosen layer is being interfered.

You can also set a specific layer interfered separation requirement for carrier relations where a carrier from the chosen layer is being interfered. The resultant interfered separation requirement is the maximum of the separation requirement defined for the list and the layer interfered separation requirement.

The penalty (co- or adjacent) you apply to a layer is added to the appropriate list penalty you have set for all carrier relations in the list by using the Separation penalties (list) form described above.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties**, list and category branches and right-click on the layer you want. Click on the **Interfered** tab if necessary.



What you can see

- The chosen layer (in the title bar).
- The name (and full path) of the file that the list is loaded from. If it is generated from another list, the word *None* is shown instead.
- The current list and layer co-penalties, for both interfered (set on this form) and interfering carriers (set on the next form). The penalty of the list co-penalties (green line) is reflected in the upper slider bar.
- The current list and layer adjacent penalties for both interfered and interfering carriers. The penalty of the list adjacent penalties (green line) is reflected in the lower slider bar.

- The current list, layer interfered, layer interfering, resultant interfered and resultant interfering separation requirements. The Separation Requirements show the value current when you opened the form box, unless you have altered it since opening the form. The resultant separation requirement is the maximum of the list and layer separation requirement.

What you can do

You can use the methods described in the chapter on "Modeling" to set the co- and adjacent penalties and separation requirements for interfered carriers on the list and in the layer. Fix the new values in memory with the **Apply** button.

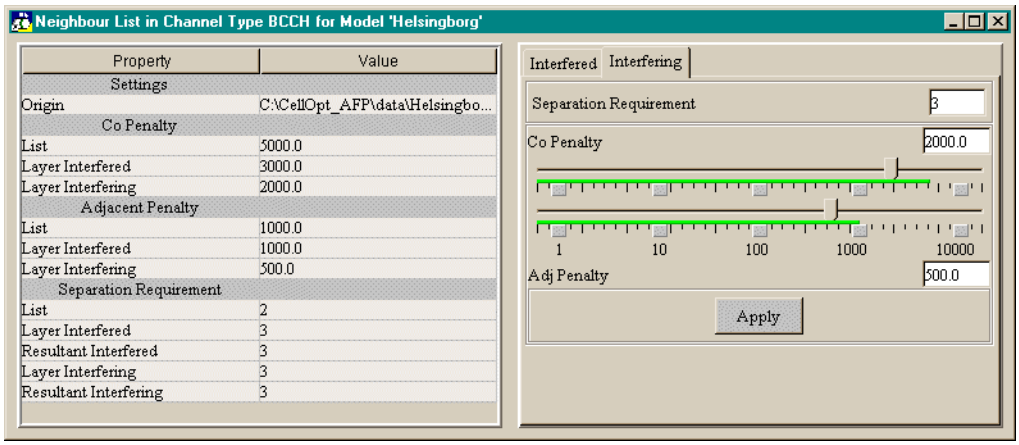
Remember to save your data to keep your entries beyond the end of this CellOpt AFP session.

Separation penalties (list by layer – interfering) form

This form is exactly the same as the one above except that it applies to carrier relations defined in the list where a carrier from the chosen layer is interfering.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties**, list and category branches and right-click on the layer you want. Click on the **Interfering** tab if necessary.



What you can see

The property form is exactly the same as the one immediately above. The slider form is also the same except that the sliders and boxes refer to the interfering layer penalties and separation requirement rather than the interfered ones.

What you can do

Your options in this form are the same as the ones in the form above except that you are setting layer penalties and separation requirements for the interfering carriers of the list rather than the interfered ones.

Separation penalties from statistics

This section applies specifically to lists of carrier relations which are specified with statistics. The statistics may for instance represent the amount that would be interfered if the carriers reused either co or adjacent frequencies. The separation penalties are derived by modifying these statistics by means of scaling, distribution and threshold penalties.

Scaling

Scaling lets you set a multiplier which is applied to statistics specified in the list. Make the multiplier more than one if it is relatively more important that these relations obey your co- and adjacent rules, less than one if it is less important.

At list level, you choose one of the following ways to apply scaling:

- **Co- and adjacent scaling**. This is a constant multiplier applied to co- and adjacent statistics.
- **By sector area or by sector traffic**. This is a sector-dependent, variable multiplier. Its scaling value depends on the area or the traffic of a sector. This allows you to reflect the importance of sectors covering larger areas by converting statistics representing the percentage area/traffic of the interfered sector to a measure of absolute area/traffic of the sector interfered. You can base this scaling on either the area/traffic of the interfered sector, interfering sector or both of a restriction.

The list modifier determines whether to use sector area or sector traffic as the variable multiplier. Note that you use the same modifier as the basis for relative thresholds (see below).

At layer level, the layer scaling is multiplied by the list scaling to give a resultant scaling, which is applied to the statistics in the list. You set further co-and adjacent scaling for each layer as follows:

- If you are using the constant scaling, you can set two different layer scalings – one relating to layers of carriers that are interfered and another relating to layers of carriers that are interfering.
- If you are using variable sector area or sector traffic scalings, you can choose whether or not to apply this scaling for a particular layer. Again, you can make different selections for layers of carriers that are interfered or interfering.

Distribution

The statistics of a list typically relate to the total interference of a sector, so there is a need to reflect the interference per carrier accurately. Distribution is used to spread the interference to the individual carriers of the sector.

- At list level, you choose whether or not to distribute the statistics in the list. You can choose to base distribution on the carriers in the interfered sectors, the interfering sectors or both.
- You use distribution based on the interfered sectors (interfered distribution) to represent the interference per carrier in the interfered sector.
- Use distribution based on the interfering sector (interfering distribution) only when you want to model that the interference load is decreasing in proportion to the number of carriers in the interfering sector.
- At layer level, if interfered or interfering distribution is applied for a list, you can choose to distribute the statistics non-uniformly. By default, the statistics are distributed evenly to all carriers in the sector. layer distribution is used to distribute the statistics non-uniformly. Please note that layer distribution re-distributes the penalties within the sector. The sum of the penalties for the sector is always unchanged. That means that if the carriers of one layer are getting smaller penalties after the distribution, carriers of other layers will get larger ones, and vice versa.

- At the layer level, you may also want to reduce the effect of the distribution for carriers in a particular layer. For example, you may want to distribute statistics to traffic carriers in the sector, but apply penalties equal to the original sector-related statistic of the list to the control carrier of the sector. In this way, you model that interference on the control carrier is as important as interference of the sector, but interference on traffic carriers is only as important as the traffic it is serving. Note that layer protection only affects the penalties of carriers in the layer it is applied to. You can use layer protection if interfered distribution is on for the list. layer pollution is the equivalent mechanism of layer protection, but applicable for interfering carriers and only accessible if interfering distribution is on for the list.

Thresholds

You may want to disallow carriers from having co- or adjacent penalties above or equal to a given threshold limit. This facility lets you spread the interference more evenly in the network as extra penalties are applied if the calculated penalty is above the threshold limit.

There are two sorts of threshold, each with its own threshold values and co- and adjacent penalties, that can be applied for all carrier relations in the list and for carriers in layers that are interfered:

- **Absolute threshold.** This applies an extra penalty to the carrier relation if the calculated penalty (after scaling and distribution) exceeds or is equal to an absolute threshold limit.
- **Relative threshold**. Use relative threshold to apply extra penalties if the calculated penalty (after scaling and distribution) exceeds or is equal to a relative threshold limit. The relative threshold limit is specified as a percentage of either the serving sector's area or the serving sector's traffic. To use relative thresholds, you must have chosen to use either area or traffic as the list modifier.

NOTE

The threshold principle makes it possible to apply penalties to a list with statistics in a similar way that penalties are applied to separation lists without statistics. By setting the threshold limit to zero, you make sure that the threshold penalty will be applied to all restrictions specified in the list with statistics. If you also scale the co- and adjacent statistics in the list with zero, the only penalties used for the restrictions in this list will be the threshold penalties.

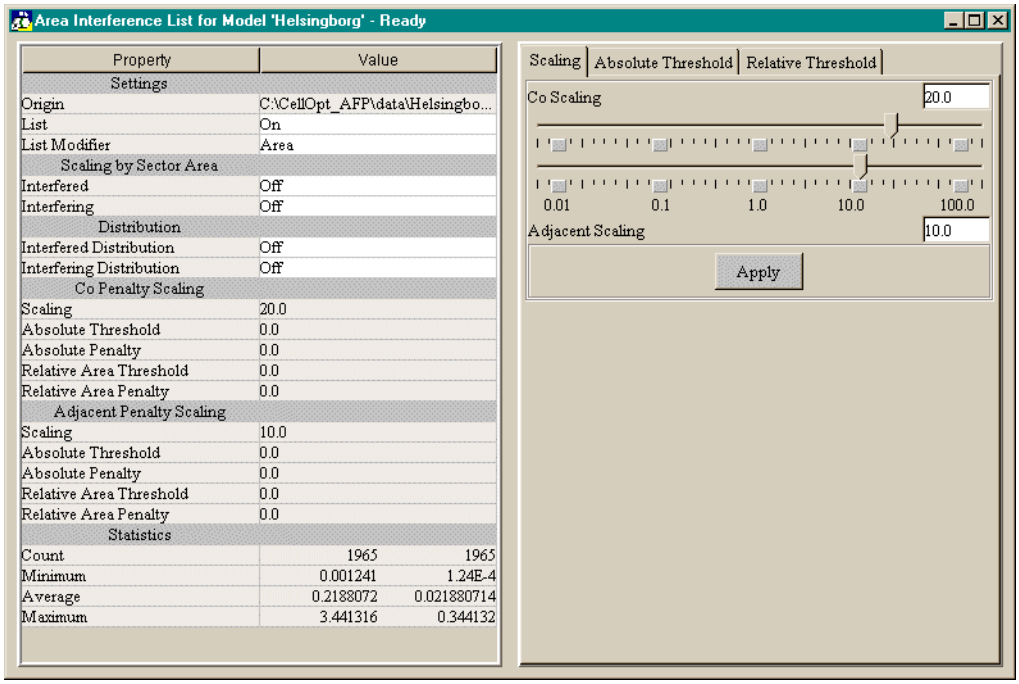
Separation penalties from statistics (list – scaling) form

This form allows you to modify the statistics of all carrier relations in the list. You may:

- Apply constant co- and adjacent scaling factors to the statistics of the list.
- Apply variable scaling factors dependant on either served area or served traffic of either the interfered sector or the interfering sector.
- Choose to distribute the statistics to the carriers within the sector based on either the interfered sector or the interfering sector.
- Apply extra penalties if absolute or relative threshold limits have been reached.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties from Statistics** branch and right-click on the name of the list you want. Click on the **Scaling** tab if necessary.



What you can see

- The name (and full path) of the file that the list is loaded from. If it is generated from another list, the word *None* is shown instead.
- Whether the list is On – the penalties derived from statistics of this list are taken into account, or Off – the penalties of this list are ignored.
- Whether the list modifier used for this list is Area, Traffic or Unknown. The choice of list modifier dictates whether the sector-dependent, variable scaling and relative threshold will be available, and, if so, based on served area or served traffic. An Unknown list modifier disables both variable scaling and relative threshold.
- If the variable scaling will be applied as sector traffic or sector area and whether it will be based on the interfered or interfering sector of the relation in the list (or both or neither). If the list modifier is Unknown, both these fields are blank.

- Whether the interfered distribution and interfering distribution are On or Off for the statistics in this list. If either or both of them is On, the statistics will be distributed to the individual carriers within the appropriate interfered or interfering sectors. If either or both are off, the statistics will not be distributed to the carrier for the relevant sector or sectors. Naturally, it is then not possible to distribute the statistics non-uniformly by layer distribution or reverse the distribution by layer protection/pollution. These are disabled and greyed out on the layer level.
- The constant co-penalty scaling factor for the list.
- The co-penalty absolute threshold limit and threshold penalty for this list. Both values are set in the next form.
- The current co-penalty relative threshold and threshold penalty for this list. You set both these values with the list relative threshold form described two sections below this one. These will remain blank if the list modifier is set to Unknown.
- The constant adjacent penalty scaling factor for the list.
- The adjacent penalty absolute threshold limit and threshold penalty for this list. Both values are set in the next form.
- The current co-penalty relative threshold and threshold penalty for this list – refer to the remarks about the co-penalty relative threshold above.
- Information about the statistics loaded in from input data. The count indicates the number of restrictions in the list. The maximum, minimum and average relates to the maximum, minimum and average of all the co and adjacent statistics in the list. This information helps you to decide how great an effect the listed problems are having on your network, and therefore how large your penalties, scaling factors and thresholds should be.

What you can do

You can use the methods described in the chapter on "Modeling" as follows:

- In the List value field, toggle the list Off – the penalties will be ignored in the list – or On (the default) to take them all into account.
- Enable the optimizer to use relative threshold penalties and to use variable, sector dependent scaling factors by selecting Area or Traffic in the List Modifier value field.

- In the Scaling by Sector value fields, toggle scaling On to enable variable scaling based on served traffic or served area of either the interfered or interfering sector. Default setting is Off. These fields are available only if you have chosen Traffic or Area as your list modifier.
- In the Distribution value fields, toggle list distribution On to enable the statistics to be distributed to carriers in either the interfered or interfering sector. Default setting is Off.
- With the upper slider and number box, set the scaling multiplier for co-penalties affecting statistics in this list. The default is a scaling multiplier of 1, which obviously has no effect on the statistics. Scaling multipliers below 1 diminish the importance of the original rule for co-penalties, above 1 increase it.
- Similarly, use the lower slider and number box to set the scaling multiplier for adjacent penalties. Note that the scaling for adjacent penalties must be equal to or smaller than the scaling for co-penalties if not this feature is disabled in Settings.

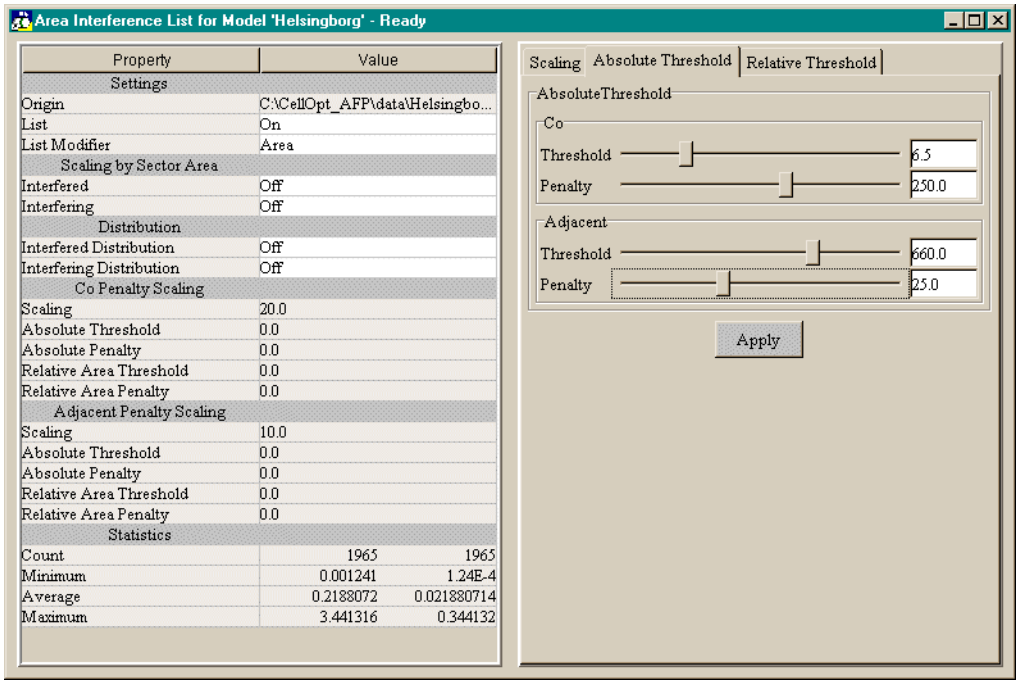
Use the **Apply** button to fix slider values in memory. Remember to save your data to keep your entries beyond the end of this CellOpt AFP session.

Separation penalties from statistics (list – absolute threshold) form

The information on the left-hand side of this form is the same as that in the form above, but the right-hand side enables you to set the co- and adjacent penalty absolute thresholds and threshold penalties for this list. These are explained above, in the introduction to the “Separation penalties” on page 12.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties from Statistics** branch and right-click on the name of the list you want. Click on the **Absolute Threshold** tab if necessary.



What you can see

- In the properties sheet, all the information described in the section above on the “Separation penalties from statistics (list – scaling) form” on page 27.
- On the right-hand side – unless you have changed them since opening the form – the current co- and adjacent penalty absolute thresholds and threshold penalties for this list.

What you can do

You can use the methods described in the chapter on “Modeling” for the following purposes:

- Toggling the List, Sector Scaling and Distribution on and off and choosing the List Modifier. These are explained more fully in the section above on the “Separation penalties from statistics (list – scaling) form” on page 27.

- With the upper two sliders and number boxes, set the co-penalty absolute threshold and threshold penalty affecting statistics in this list. Thresholds and their penalties are described above, in the introduction to the Separation penalties from statistics section.
- Similarly, use the lower slider and number box to set the adjacent penalty absolute threshold and threshold penalty. Note that the adjacent penalty must be equal to or smaller than the co-penalty. This feature can be disabled in settings. No such restriction applies to thresholds.

Use the **Apply** button to fix slider values in memory. Remember to save your data to keep your entries beyond the end of this CellOpt AFP session.

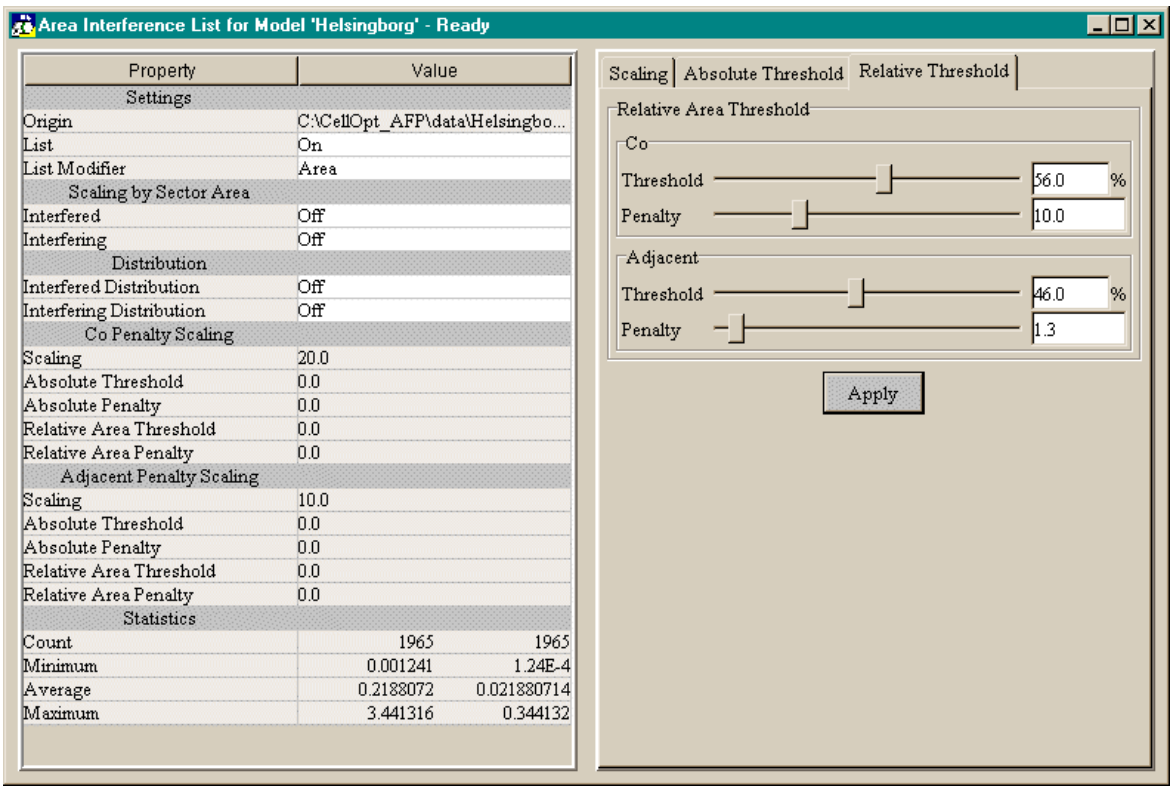
Separation penalties from statistics (list – relative threshold) form

The information and facilities on the left-hand side of this form are the same as that described in the section above on the "Separation penalties from statistics (list – scaling) form" on page 27.

The right-hand side enables you to set the co- and adjacent penalty relative thresholds and threshold penalties for this list. These are explained above, in the introduction to the "Separation penalties from statistics" on page 24.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties from Statistics** branch and right-click on the name of the list you want. Click on the **Relative Threshold** tab if necessary. Note that this tab is only available if you have selected **Area** or **Traffic** in the **List Modifier** value field.



What you can see

- In the properties sheet, all the information described in the section above on the "Separation penalties from statistics (list – scaling) form" on page 27.
- On the right-hand side – unless you have changed them since opening the form – the current co- and adjacent penalty relative thresholds and threshold penalties for this list.

What you can do

You can use the methods described in the chapter on "Modeling" for the following purposes:

- Toggling the List, Sector Scaling and Distribution on and off and choosing the List Modifier. These are explained more fully in the section above on the "Separation penalties from statistics (list – scaling) form" on page 27.

- With the upper two sliders and number boxes, set the co-penalty relative threshold and threshold penalty affecting statistics in this list. Thresholds and their penalties are described above, in the introduction to the "Separation penalties from statistics" on page 24.
- Similarly, use the lower slider and number box to set the adjacent penalty relative threshold and threshold penalty. Note that the adjacent penalty must be equal to or smaller than the co-penalty, though no such restriction applies to thresholds.

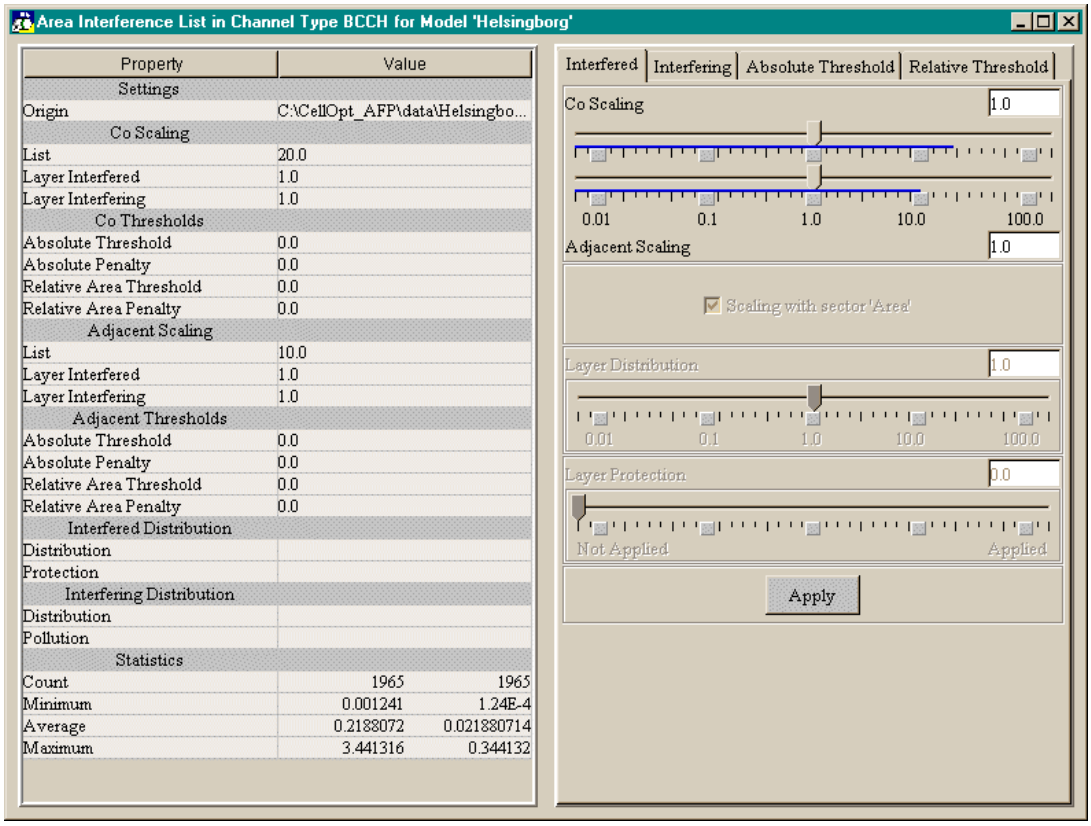
Use the **Apply** button to fix slider values in memory. Remember to save your data to keep your entries beyond the end of this CellOpt AFP session.

Separation penalties from statistics (list by layer – interfered) form

This form allows you to modify further the statistics for carriers being interfered. You can apply different rules for carriers in layers that are being interfered (this form), and for carriers in layers that are interfering (the next form).

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties from Statistics**, list and category branches and right-click on the layer you want. Click on the **Interfered** tab if necessary.



What you can see

- The name (and full path) of the file that the list is loaded from. If it is generated from another list, the word *None* is shown instead.
- The current scaling weight for co-penalties for all statistics in the list and further refined for carriers in layers:
  - Being interfered (the upper slider on this form). The blue line in the upper slider bar shows the list co-penalty scaling, and this will not move when you reset the scaling for the layer.
  - That are interfering. The interfering layer scaling is set in the next form.
- The current co-penalty absolute and relative thresholds and threshold penalties for this layer within the list. These values are set in the two forms after the next one.

- The current scaling weight for adjacent penalties for all statistics in the list and further refined for carriers in layers:
  - Being interfered (the second slider on this form). The blue line in the second slider bar shows the list adjacent penalty scaling, and this will not move when you reset the scaling for the layer.
  - That are interfering. The interfering layer scaling is set in the next form.
- The current adjacent penalty absolute and relative thresholds and threshold penalties for this layer within the list. These values are set in the next two forms but one.
- The settings for layer distribution and layer protection which are set by the lower two sliders in the right panel. These are disabled if the interfered distribution is Off.
- The settings for layer distribution and layer pollution which are set in the next form. These are disabled if the interfering distribution is Off.
- Information about the statistics loaded in from input data. The count expresses the number of restrictions in the list. The maximum, minimum and average relates to the maximum, minimum and average of all the co and adjacent statistics in the list. This information helps you to decide how great an effect the listed problems are having on your network, and therefore how large your penalties, scaling factors and thresholds should be.
- In the right hand panel, the check box shows whether the variable scaling is applied to this layer (checked), or not (clear). This check box is disabled and grayed, if the variable scaling based on interfered sectors is off.

What you can do

You can use the methods described in the chapter on "Modeling" to make the following changes for carrier sets in this list and layer:

- The scaling weight for co-penalties. The list scaling is indicated by the blue line, but you can set the layer scaling wherever you like. Note that carriers are assigned to one (and only one) layer per specified category. The compound scaling factor is the product of all co-scaling factors specified in layers the carrier belongs to and the list co-scaling factor.
- Similarly, the scaling weight for adjacent-frequency penalties. Note that the scaling for adjacent penalties must be equal to or smaller than the scaling for co-penalties. This feature may be disabled in Settings.

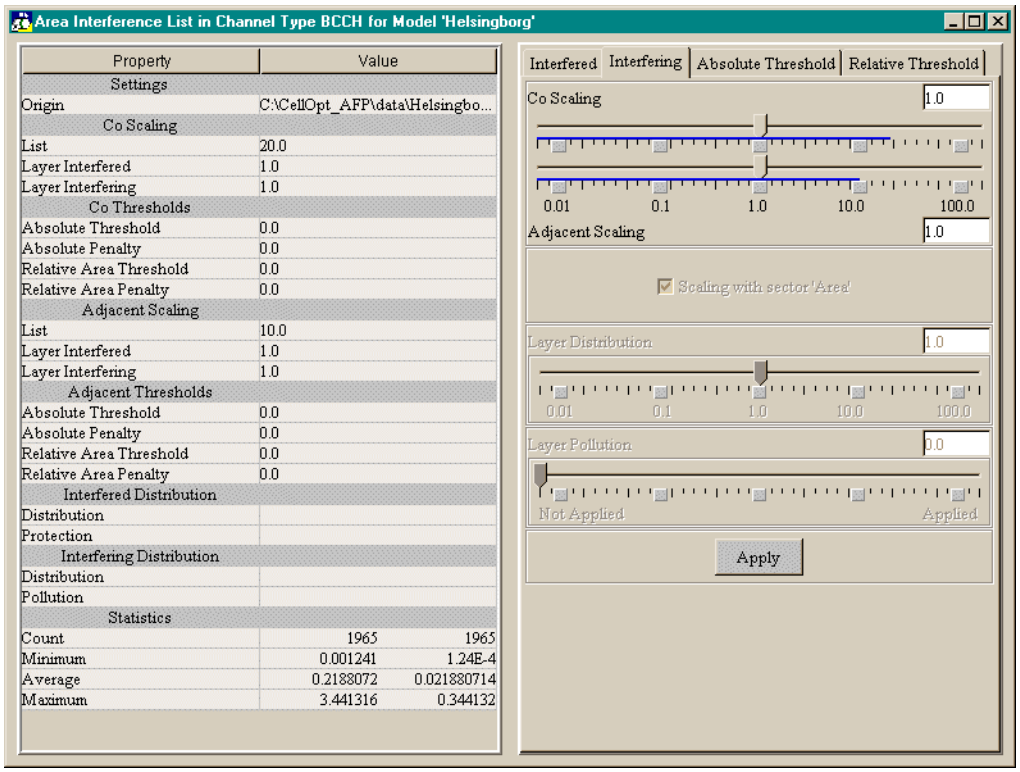
- Disable (clear the check) or enable (check) the sector scaling by area/traffic for interfered sectors for this layer. If the scaling is disabled for any of the layers a carrier belongs to, then the scaling is disabled for all restrictions on that carrier.
- Set the layer distribution to distribute the statistics non-uniformly to the carriers within the sector. The amount of penalties distributed to a carrier will be directly proportional to the layer distribution value of the (layer of the) carrier and the layer distribution values of other carriers in the sector. For instance, carriers in a layer with a layer distribution value of 2 will get twice as much penalty as a carrier in the same sector assigned to another layer with layer distribution value of 1. The default setting for layer distribution is 1, which implies a uniform distribution. The compound layer distribution value, considering all layers a carrier belongs to, is the product of all layer distribution values of the layers the carrier belongs to. Note that a change in layer distribution for a layer will affect the penalties of the carriers of other layers in the same sector.
- Set the layer protection to reverse the distribution for this particular layer. If the layer protection is set to 1, then the distribution is completely reversed for carriers in this layer. If the layer protection is set to 0, then no protection is applied. 0 (the default) and 1 are the two extreme values for layer protection. Layer protection values between 0 and 1 imply a protection proportional to the difference between the extremes. The compound layer protection value, considering all layers the carrier belongs to, is the maximum of the layer protection value of all the layers the carrier belongs to. Note that layer protection will not affect the penalties of other carriers in the same sector as was the case with layer distribution.
- Note that layer distribution and layer protection are only available if the list interfered distribution is switched On in the previous form. They are greyed when they are not available, though their sliders and value number boxes will show the values they had when the distribution was switched off and will have again if distribution is re-enabled.

Separation penalties from statistics (list by layer – interfering) form

This form is exactly the same as the one described under “Separation penalties (list by layer – interfered) form” on page 21 – except that the control settings on the right refer to the carriers of the list and layer when they are interfering with other carriers.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties from Statistics**, list and category branches and right-click on the layer you want. Click on the **Interfering** tab if necessary.



What you can see

Refer to the remarks in the section above on Separation penalties from statistics (list by layer – interfered) form. Note that the distribution modifier is called layer pollution on this form.

What you can do

Refer to the remarks in the section above on Separation penalties from statistics (list by layer – interfered) form.

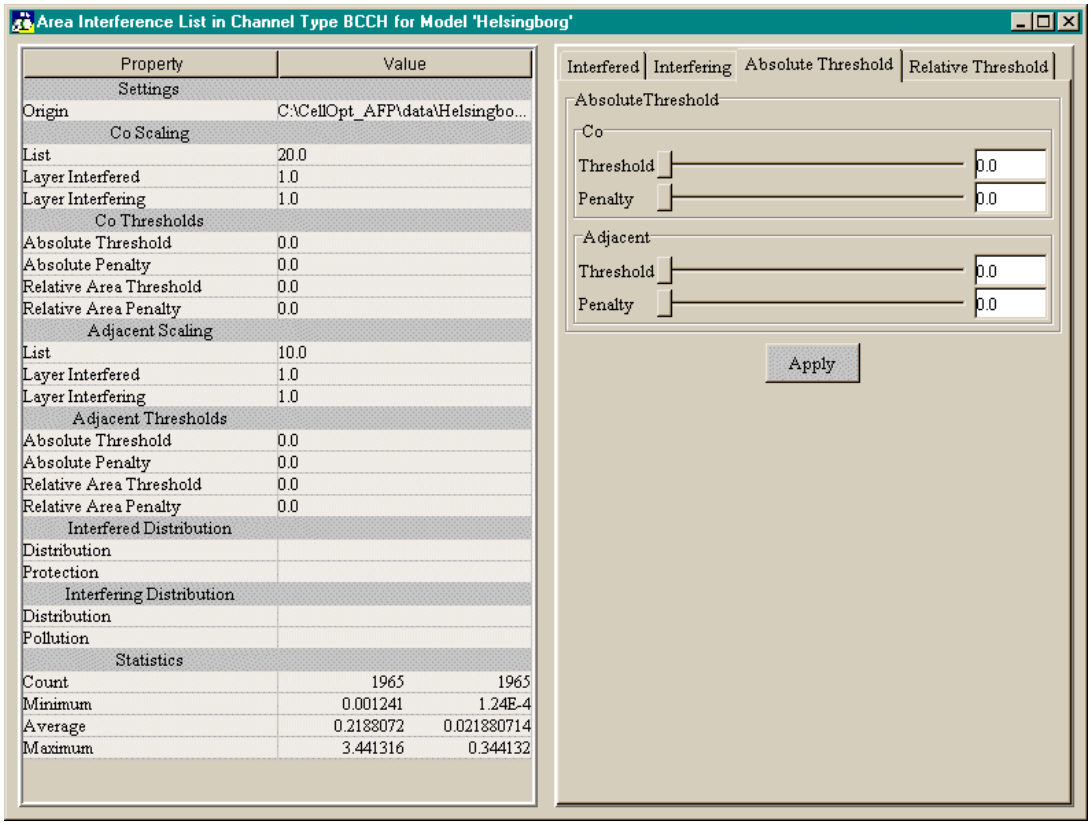
Separation penalties from statistics (list by layer – absolute threshold) form

Use this form to set co- and adjacent penalty absolute thresholds and apply threshold penalties applicable if restrictions involving carriers of the given layer have a penalty

that exceeds or is equal to the specified threshold limit. These are explained above, in the introduction to the “Separation penalties from statistics” on page 24.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties from Statistics**, list and category branches and right-click on the layer you want. Click on the **Absolute Threshold** tab if necessary.



What you can see

The left-hand pane is fully described in the section above on “Separation penalties (list by layer – interfered) form” on page 21. In the right-hand pane:

The upper slider set and number boxes show, for co-frequencies, the current value of the absolute layer threshold at which the layer penalty in the next slider will be applied. The green line shows the current list value.

Similarly, the second slider set and number boxes show the current value of the list and layer absolute thresholds and threshold penalties for adjacent frequencies.

What you can do

You can use the methods described in the chapter on "Modeling" to make the following changes on this form:

- For co-frequencies, use the upper slider set or number boxes to:
- Set the threshold limit at which the extra penalty on the slider below will be awarded.
- Set the penalty to be applied if the threshold is breached.
- Use the same procedures as above to set the adjacent frequency penalty threshold and threshold penalty on the second set of sliders or number boxes. If the setting for co and adjacent penalty coupling is checked, then the adjacent penalties cannot be set greater than the co-penalties.

Use the **Apply** button to fix slider values in memory. Remember to save your data to keep your entries beyond the end of this CellOpt session.

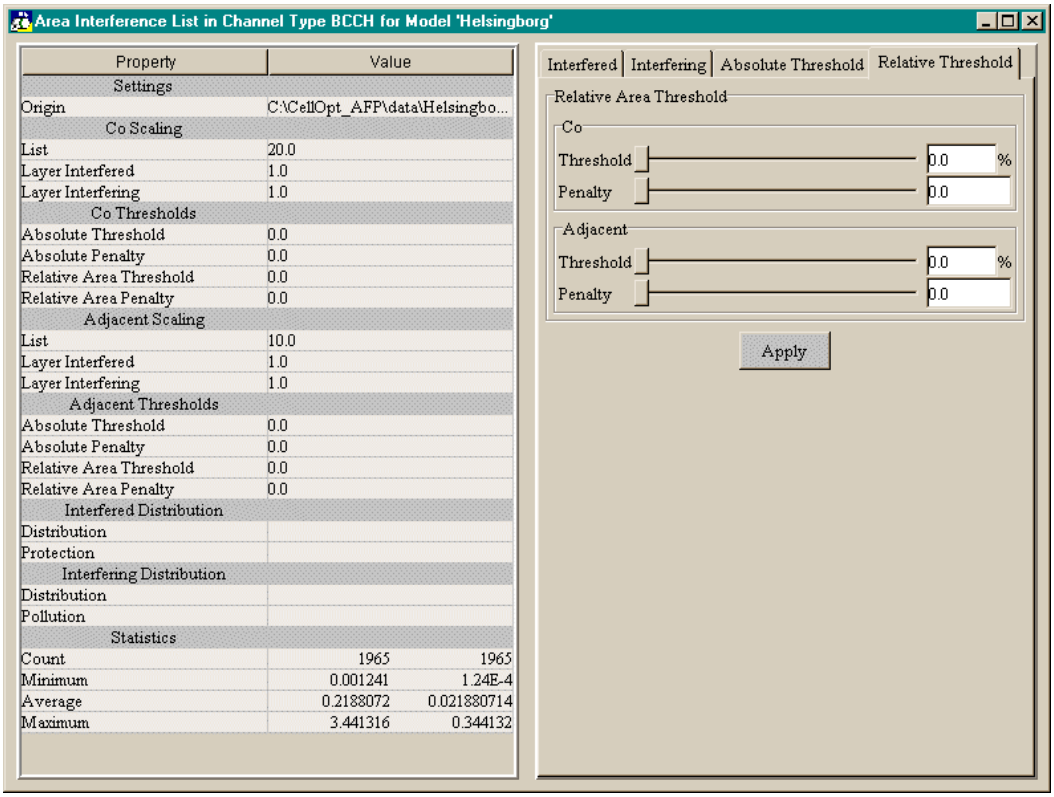
Separation penalties from statistics (list by layer – relative threshold) form

Use this form to set co- and adjacent penalty relative thresholds and apply threshold penalties applicable if restrictions involving carriers of the given layer have a penalty that exceeds or is equal to the specified relative threshold limit. These are explained above, in the introduction to the "Separation penalties from statistics" on page 24.

This form is available only if the **List Modifier** field in the Separation penalties from statistics (list) form shows **Area** or **Traffic**.

Route from CellOpt AFP main window

Open the **Penalties** branch, then the **Separation Penalties from Statistics**, list and category branches and right-click on the layer you want. Click on the **Relative Threshold** tab if necessary.



What you can see

The left-hand pane is fully described in the section on "Separation penalties from statistics (list by layer – interfered) form" on page 34. In the right-hand pane:

- The upper slider set and number boxes show, for co-frequencies, the current value of the relative layer threshold at which the layer penalty in the next slider will be applied. The green line shows the current list value.
- Similarly, the second slider set and number boxes show, for adjacent frequencies, the current value of the list and layer relative thresholds and threshold penalties.

What you can do

- With the upper two sliders and number boxes, set the co-penalty relative threshold and threshold penalty affecting carriers in this layer.
- Similarly, use the lower sliders and number boxes to set the adjacent penalty relative threshold and threshold penalty.

Use the **Apply** button to fix slider values in memory. Remember to save your data to keep your entries beyond the end of this CellOpt AFP session.

9 Optimizing

Overview

Once you have built your model of the network, you can start the optimizer. The optimizer assigns frequencies and color codes taking into account the restrictions you have modeled. You should let the optimizer assign the frequencies first, and then deal with the color codes as a separate operation afterwards. The instructions in this chapter tell you how to choose and carry out these two optimizing operations.

If you are running with the frequency hopping option enabled you may also optimize hopping parameters such as MAL, HSN and MAIO. You should let the optimizer assign the MAL first, and then assign the HSN and MAIO parameters as a separate operation afterwards. A carrier need to be defined in the hopping group category as synth sector/site to be assigned MAL or MAIO parameters.

If you are running with the frequency group option enabled you may optimize your frequencies in sets and subsets. You define the available sets and subsets under the spectrum menu.

The optimization process is an iterative local neighborhood search algorithm – the optimizer repeatedly tries to find better and better solutions by making small changes to the current solution. The algorithm works as follows:

1 Create an initial assignment by randomly assigning available frequencies, color codes, MAL, HSN and MAIO to carriers that do not already have been assigned.

2 Evaluate the assignment by calculating the CellOpt Quality Index or CQI – the sum of penalties for all violated restrictions in your model.

3 If a stopping criterion has been fulfilled, terminate the execution.

4 Suggest changing some assignments.

5 Evaluate the effect on the CellOpt Quality Index.

6 If the new assignment has a better CQI or fulfils some other criterion, accept the suggested changes; otherwise revert to the old assignment.

7 Repeat steps 2 to 6 over and over again until you stop the optimizer.

Algorithms like this are easy to state, but harder to implement efficiently. The key is to make them robust so they rapidly and reliably converge to high quality solutions. Note that the algorithm does not guarantee an absolutely perfect solution – it produces the best possible solution in the time allowed for it to do so. This is because it is solving a real life problem, and such problems very rarely have perfect solutions.

These features of the robust, rapid and reliable CellOpt AFP optimizer:

- There will always be a solution available as a solution is found already in step 1.
- The CQI will improve greatly with each iteration at the beginning of a run, but less and less significantly as time passes – the optimizer is fine-tuning the system, but probably no one solution is significantly better than any other.

The longer you allow the optimizer to run, the better the solution will be. You can see an example of this in the section on the Optimizer log below.

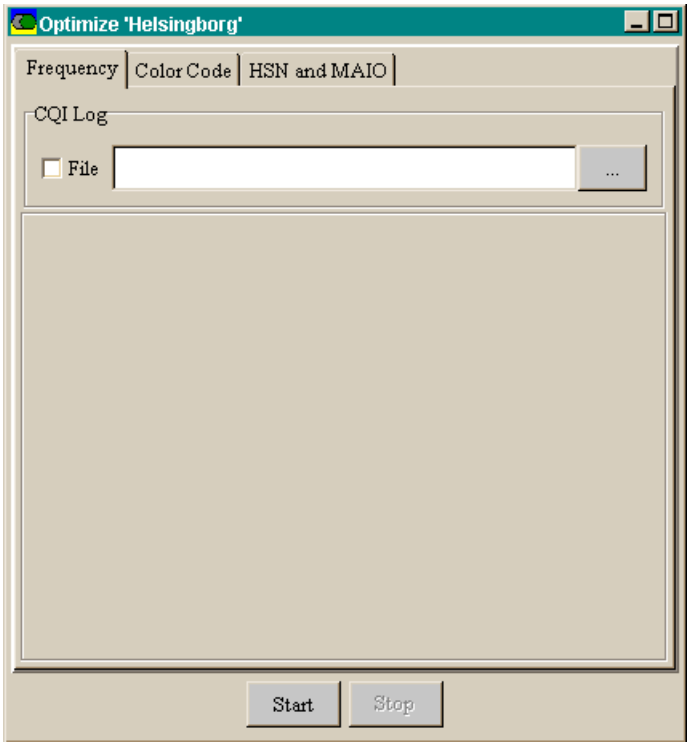
- Any plan can be evaluated quantitatively by the CQI.
- The CQI enables quantitative comparisons of planning strategies.
- You can analyze the current solution by viewing it or by generating reports, again without stopping the optimizer.

Starting and stopping the optimizer

To start the optimizer:

1 Make sure that the correct model is on the desktop and in focus (click in its panel if necessary).

2 Click on the optimizer icon to see the optimizer panel shown below.



3 Click the appropriate tab for Frequencies, Color codes or HSN and MAIO. MAL, frequency sets and subsets are optimized using the frequency tab. There are separate subsections on optimizing MAL or frequency sets and subsets at the end of this numbered list.

4 If you want to optimize frequencies, MAL or sets and subsets, continue from step 5. If you want to optimize color codes or HSN and MAIO, refer to the subsections at the end of this numbered list.

5 If you want to save the CQI calculations, check the File box. Results are saved in a log file which you name here. Checking the box (or clicking on ...) opens the browser for you to name a new file or choose an existing one.

- You can save the file in any directory (the project directory is the default) and give it any name. You do not have to use an extension, but the file will be a standard text file, so you may want to type your text editor's default extension here.

- If you open an existing file, the new iterations will be appended to the old, but the line numbering (see the log description in the next section) will start again at zero. The optimizer will start the operation all over again without using the results of the previous calculations.

6 Click **Start**. The optimizer will run in the background until you stop it with the **Stop** button. The log appears in a separate panel, updating in real time.

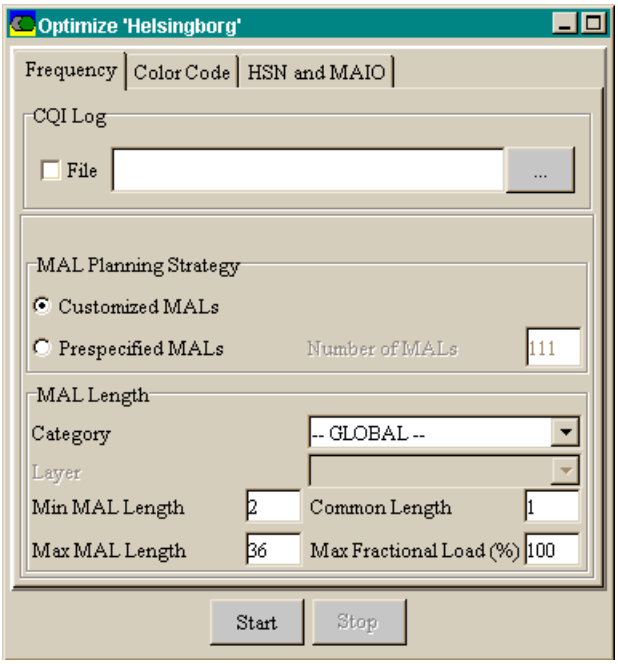
Optimizing Mobile Allocation Lists

Mobile Allocation Lists are optimized using the frequency form. Before you can optimize MAL, you should have:

- Enabled frequency hopping by specifying the **-A frequencyhopping** option when starting CellOpt AFP.
- Defined at least one carrier as a synthesizer hopping carrier. This is accomplished in the carrier editor by defining the synthesizer hopping carriers in the hopping group as either synth sector 1, synth sector 2, synth site 1 or synth site 2.

  All carriers in a sector defined as synth sector 1 will be assigned the same MAL. It is possible to have some of the hopping carriers in the sector be assigned another MAL. This is accomplished by assigning these carriers to synth sector 2. Likewise, all carriers in a site that are defined as synth site 1 will be assigned the same MAL. It is also possible to have some of the hopping carriers in the site to be assigned another MAL by assigning these carriers to synth site 2. Any combination of these definitions is allowed.

The appearance of the frequency tab will change if you are planning with the frequency hopping option enabled and have at least one synthesizer hopping carrier. An additional panel will appear that allows you to control the Mobile Allocation List assignment.



- You can choose that CellOpt AFP will Customize the MAL during the optimization, i.e. optimizing the frequencies in the MAL and assigning the MAL to the hopping groups during the optimization run.
- You can choose that CellOpt AFP will generate the MALs before starting the optimizer the most optimum way possible. During the optimization the MALs are fixed and they will be assigned to the different hopping groups.
- The number of MAL to use in frequency hopping can be set. This number correlates with the number of MAL used in the Spectrum form. You can increase the number of MAL to use here, but cannot decrease these, as that can result in accidental deletion of an MAL used. MALs can be deleted in the Spectrum form.

  You can specify how the length of the MAL's should be. This may be done per category - layer. You can also set global values. Do this by choosing **GLOBAL** in the category drop down box.
- You can specify the minimum and maximum MAL length to generate automatically. If you specify zero here, the best default values will be used.

- You can specify that the length of MAL should always have the common length as a common denominator. For instance if you specify 4 as the common length, then only MAL of length 4, 8, 12 etc. will be generated. The advantage of using some common length is that it makes it more likely that all hopping in the site can be synchronized, i.e. use the same HSN without violating the co-site and co-sector separation requirements.
- You can specify a maximum fractional load. You specify a maximum fraction load to ensure that the optimizer will use longer MAL. For instance, if maximum fractional load is set to 50%, then the MAL assigned to a group of carriers must have at least twice as many frequencies as the number of carriers.

There are some special considerations in MAL optimization you should be aware of:

- A hopping group defined to have the same MAL by being assigned to same synth sector/site in the hopping group category, a synthesizer hopping group, is considered fixed if any of the carriers in the hopping group is fixed.
- A synthesizer hopping group may only be assigned an MAL having at least as many frequencies as the number of carriers in the synthesizer hopping group.
- The following assignments to a synthesizer hopping group would be seen as forbidden assignments:
  - All individual frequencies or sets and subsets are forbidden assignments.
  - It is also forbidden to use a MAL with less frequencies than the number of carriers in the synthesizer hopping group.
  - If the common length option is set in the form above, then a MAL with less frequencies than the smallest multiple of the common length that is still greater or equal to the number of carriers in the synthesizer hopping group.
  - If the maximum fractional load is specified, then a MAL with less frequencies than the number of carriers in the synthesizer hopping group / maximum fractional load is forbidden.
  - If a MAL contains a frequency not defined as an available frequency, then that MAL is forbidden to be assigned to any synthesizer hopping group.
- The following assignments to a synthesizer hopping group would be seen as an invalid assignment:

- An MAL with less frequencies than the number of carriers in the synthesizer hopping group times the minimum of the largest separation requirement of the carriers in the synthesizer hopping group and the longest consecutive set of frequencies that violate this largest separation requirement. Invalid assignments are penalized with the sum of the illegal frequency penalties of the carriers in the synthesizer hopping group.

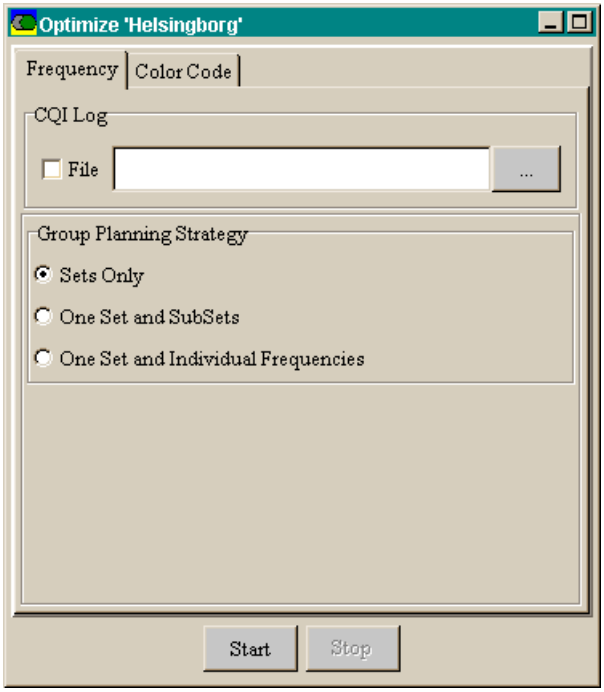
- If individual carriers in the synthesizer hopping group are assigned to different MAL it indicates a conflict as all carriers in the synthesizer hopping group should be assigned the same MAL. This conflict is resolved in the following different ways depending on if the carriers is fixed or free.
  - If any fixed carrier is assigned to a forbidden assignment or any if any two carriers in the synthesizer hopping group are fixed and assigned to different valid MAL, then the assignment of whole synthesizer hopping group cannot be resolved. Its assignment is set to 0 and reported as an invalid assignment. Such a synthesizer hopping group is ignored by the optimizer.
  - If all fixed carriers in the synthesizer hopping group are set to the same valid MAL, then all free carriers of this synthesizer hopping are also assigned to this MAL. This reassignment is made before the optimizer starts and before generating a report.
  - If all carriers are free in the synthesizer hopping group, then all carriers are reassigned to the valid MAL most carriers are assigned to. A tie is broken by taking the MAL of the first carrier of a large set of MAL. Also this reassignment is made before the optimizer starts and before generating a report.

Optimizing Sets and Subsets

Frequencies assigned using sets and subsets are optimized using the frequency form. Before you can optimize sets and subsets, you should have:

- Decide whether carriers are grouped or not. This is accomplished in the carrier editor by defining carriers to be either non-grouped or grouped in the carrier group category. Carriers that are defined as grouped will be assigned according on the chosen set planning strategy.
- Choose a set planning strategy in the frequency optimization panel. As the screenshot below indicates you may choose to optimize with:

- sets only
- one set and subsets
- one set and individual frequencies



There are some special considerations in assigning sets and subsets that you should be aware of:

- Fixed carriers are treated as if they were non-grouped.
- A set/subset may be assigned to grouped carriers even if some of its frequencies are forbidden to use.
- To find an initial solution, CellOpt AFP considers the chosen set planning strategy. Considering the assigned individual frequencies to the grouped carriers in a sector, CellOpt AFP determines what sets/subsets these frequencies belongs to and assigns sets/subsets which have the highest proportion of the assigned individual frequencies.
- If the total number of frequencies assigned, due to a certain set planning strategy, is greater than the number of grouped carriers in the sector, CellOpt AFP will still calculate its CQI value as if all the frequencies were assigned. There will be a random selection of what frequencies to use from the last assigned set/subset to the grouped carriers in the sector. As the optimizer has already penalized for the assignment where all non-forbidden frequencies in the set/subset are assigned, the spare frequencies can be added later to the sector when needed.

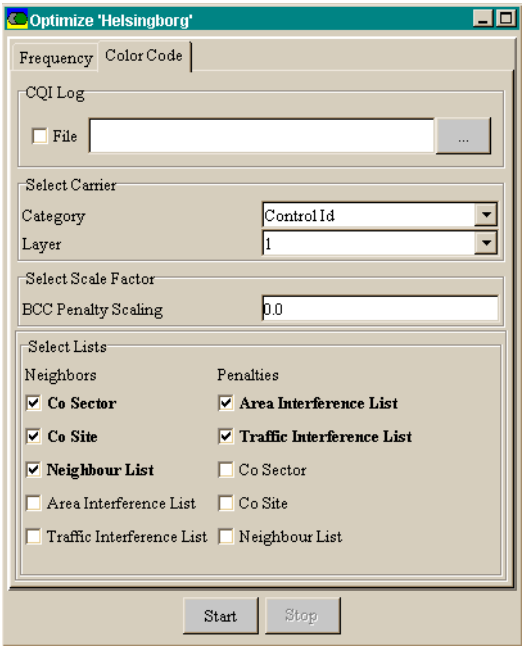
- If you like to calculate the CQI value without considering frequencies in sets that are not needed yet, for the purpose of generating a CQI-report, please set all carriers to non-grouped in the carrier editor as the assigned frequencies then will be taken into account as individual frequencies. Setting the carriers to non-grouped is also useful for the purpose of generating a CQI sensitivity report as this report is only generated for non-grouped free carriers.
- In optimizing with sets/subsets, using preferred penalties, these are considered by penalizing for the grouped carriers. The use of a set/subset, with a penalty equal to the preferred penalty times. The number of frequencies in the set/subset that are not used by the grouped carriers in the sector.
- If the **-A IDEN** flag is set when the client is started, IDEN specific set handling will be used when the individual frequencies are assigned to the carriers. This means that the control frequency (the very first frequency of every set, blank if the set isn't a control set) will be reused for all sets. Otherwise, control frequencies will only be assigned to carriers that has the control carrier property set to '1' (one).

Optimizing color codes

Before you optimize color codes for a model, you should have:

- Completed the frequency optimization by following the whole of the numbered list above.

- Completed steps 1 to 3 of the list above, choosing the **Color Code** tab to see the following form:



Complete the form as follows:

1. Fill in the **CQI Log** section (if you want to) as described in step 5 of the list above.
2. Select the carriers that require color codes by indicating a layer within a category. For instance, if your input format identified the carriers that required color codes you might want to base the carrier selection on layer **1** in category **Control Id**. Alternatively, you could have used the network editor to define a layer in a new category indicating all carriers requiring color codes.
3. Select the BCC Penalty Scaling. It should be between 0 and 1, and the default value is 0.
4. BSIC Color Code Planning
   Color Code planning attempts to reduce the reuse of Color Codes between Sectors and Carriers. A Color Code can be any value. In GSM, the Color Code is the BSIC, which in tern is made from the NCC and BCC. The Color Code optimizer will see BSICs that have the same BCC but different NCCs as being different Color Codes. In GSM, the training sequence is related to the BCC. To get CellOpt AFP to reduce reuse of the same BCC in the network, we have introduced the BSIC Color Code Optimizer functionality.

When the CellOpt AFP GUI is started with the BSIC option (see the section on Installation), then the Color Codes will be treated in a special way. The user will be prompted for a BCC Scaling value before starting the Color Code Optimizer. This value will be used to scale the penalty calculated for the normal Color Code reuse to penalize the reuse of the BCC.

Note: The Color Codes (BSICs) need to be specified as NCCBCC octal pairs (00,01...07, 10...77).

5 Select the lists from which the optimizer will derive the penalties for the calculation of the color code assignments. The goal of color code planning is to avoid the switch ordering a mobile user to hand over to a neighbor without sufficient signal coverage at the location of the mobile user. These situations can be avoided with CellOpt color code optimization, given that the neighbors and interferers of serving sectors are known to the optimizer.

The penalties for color code assignment are derived by identifying neighbors and interferers of a serving sector where the carriers that require a color code have identical frequencies. If they do, it is important to avoid having identical color codes as well; otherwise the signal from the interfering sector could be misinterpreted as the signal from a neighboring sector – and that could result in a handover to the neighboring sector even if it might not provide coverage at the location of the mobile user.

The neighbors are identified by selecting a subset of the lists given on the left side of the form. The set of lists you can choose is made up of all the lists with assignment restrictions between carriers. These are the same lists that are defined in the tree view under Separation Penalties and Separation Penalties from Statistics. These lists contain references to serving carriers and their related carriers. The reason for this relation might be that the related carriers interfere with the serving carriers, the related carriers are cosited, or the related carriers are defined to be neighbors. In lists that have been selected, it is the related carriers of serving carriers that define the neighbor relations to the optimizer. As neighbor relations are typically defined in lists with separation penalties, these lists are given first (in **bold**), before the lists with separation penalties from statistics.

After you have selected the lists that define neighbors, you must select the lists that define the penalties the optimizer will use in the color code optimization. The penalties for color code assignments are derived by identifying neighbors and interferers of a serving sector, where the carriers that

require color codes have identical frequencies. If they do, it is important to avoid assigning identical color codes as well; otherwise the signal from the interfering sector could be misinterpreted as the signal from a neighboring sector – and that could result in a handover to the neighboring sector even if it might not provide coverage at the location of the mobile user.

The penalties are defined by selecting a subset of the lists given on the right side of the form. This set of lists is made up of all the lists with assignment restrictions between carriers. The set of lists you can choose is made up of all the lists with assignment restrictions between carriers. These are the same lists that are defined in the tree view under separation penalties and separation penalties from statistics. As interference is typically defined in lists with separation penalties from statistics, these lists are given first (in **bold**), before the other lists with separation penalties.

It is the co-penalty from the selected lists that is used to define the penalty. Note that in frequency optimization the co-penalty of these lists defines a penalty between the interfering carrier and the serving carrier - whereas in color code optimization this co-penalty is used to discourage assignment of the same color code in a neighboring carrier and an interfering carrier to the serving carrier, in cases when the neighboring carrier and interfering carrier are assigned to the same frequency. If the same interfering sector appears in many lists, then the co-penalties from all these lists are added together to define the penalty used in color code optimization.

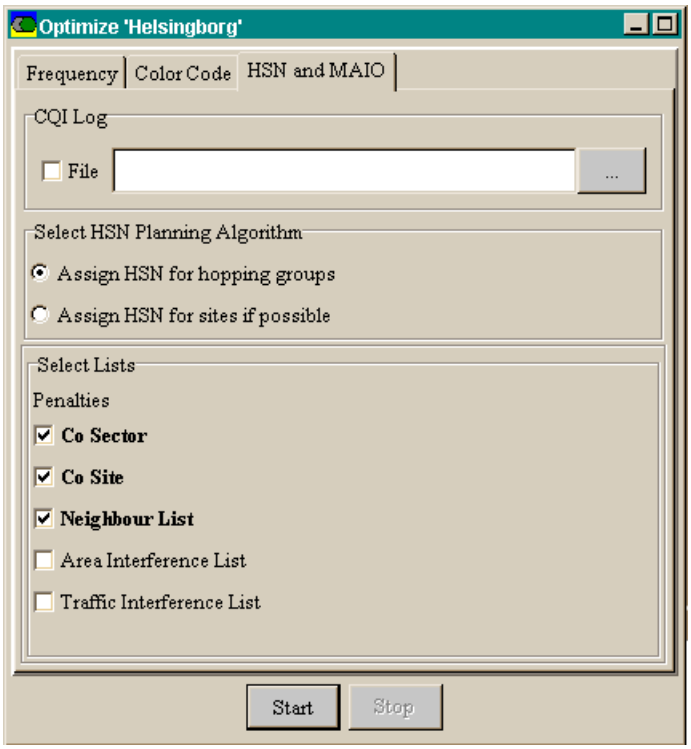
6 Click **Start**. The optimizer will run in the background until you stop it with the **Stop** button. The log appears in a separate panel, updating in real time.

Optimizing HSN and MAIO

Before you optimize HSN and MAIO for a model, you should have:

- Completed the frequency or MAL optimization by following the whole of the numbered list above.

- Completed steps 1 to 3 of the list above, choosing the HSN and MAIO tab to see the following form.



Complete the form as follows:

1 Fill in the **CQI Log** section (if you want to) as described in step 5 of the list above.

2 Select the HSN planning algorithm by indicating if you want HSN to be assigned for each hopping group or if you want the HSN planning algorithm to determine if it is possible to assign the same HSN to all hopping groups in a site. This will depend on whether it is possible do the MAIO assignment without violating any co-site and co-sector separation requirements.

3 Select the lists from which the optimizer will derive the penalties for the calculation of the HSN assignments. The set of lists you can choose is made up of all the lists with assignment restrictions between carriers. These are the same lists that are defined in the tree view under Separation Penalties and Separation Penalties from Statistics. The penalties used in HSN assignment are derived by considering all penalties for violated frequency assignment restrictions between carriers. The spectrum of HSN parameters assigned

is 1-63. HSN parameters are assigned to all hopping carriers in hopping groups where at least one carrier is defined as free.

4 Click **Start**. The optimizer will run in the background until you stop it with the **Stop** button. The log appears in a separate panel, updating in real time.

5 The MAIO optimization is done immediately after the HSN optimization. Based on the outcome of the previous HSN planning algorithm, the MAIO parameters are either assigned per hopping group or for all hopping groups in a site. MAIO parameters are assigned to all synthesizer hopping carriers in hopping groups where at least one carrier is defined as free.

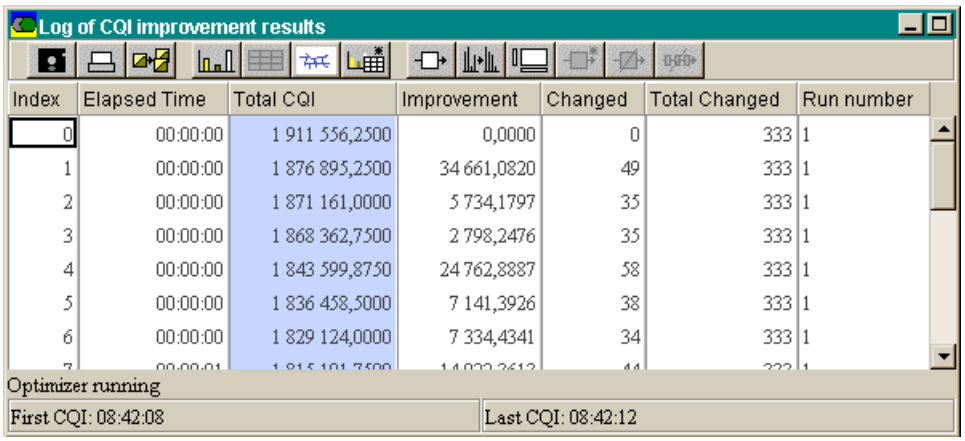
   If the MAIO assignment cannot assign MAIO to all carriers, then as many MAIO as can be assigned will be assigned. The remainder of the carriers will be assigned a MAIO = -1.

The optimizer log

As the optimizer runs, its results are sent to the log display as well as to a log file if you have chosen this option (instructions are given in the previous section). This section describes the two forms.

The display panel

The picture below shows the display log at the start of an optimizer run. You can alter the column widths by dragging in the headers or make it easier to read by maximizing it:

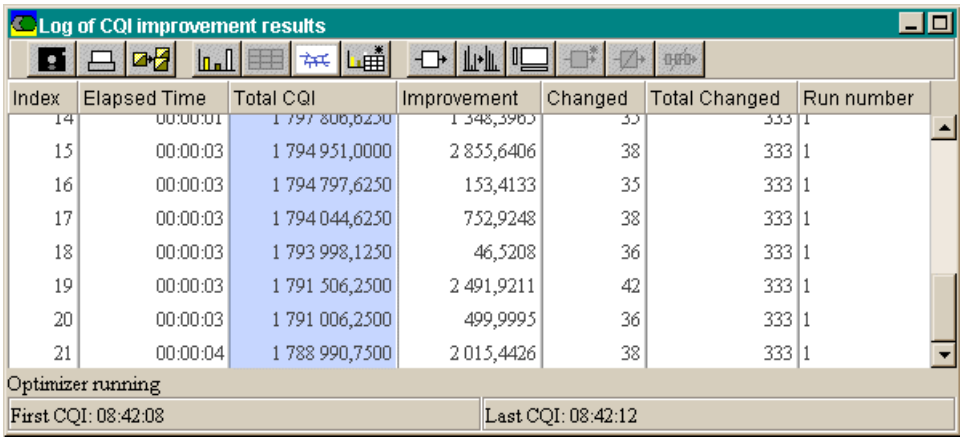


The **First CQI** gives the time that the optimizer was started on this run, and the **Last CQI** is the time of last improvement if the optimizer is still running, or the date and time that it was stopped. This is to help you judge how good the current result is likely to be – the longer the time, the better the result.

The columns hold the following information:

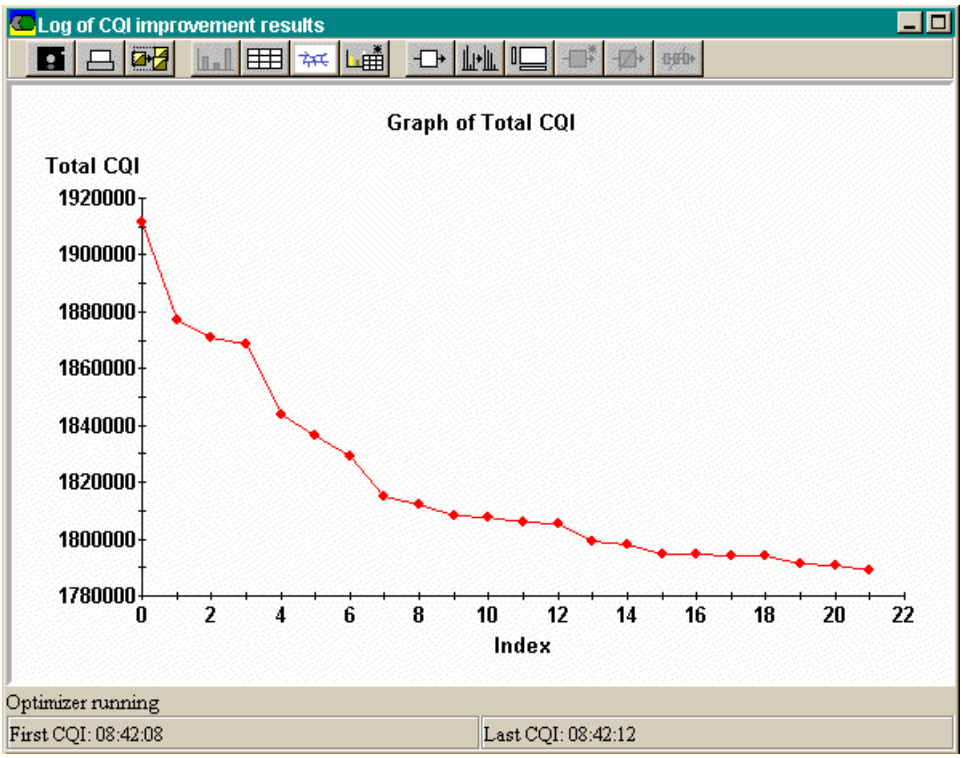
Index	The sequential number of the iteration. Each new line is added at the bottom of the log.
Elapsed Time	The time of completion of this iteration in seconds from the time when you clicked on Start. Because the log only records improvements, a long time between iterations indicates that the optimizer had some difficulty in finding one and therefore that the solution is approaching a point where it will be difficult to do much better.
Total CQI	The sum of the penalties of all violated restrictions.
Improvement	The difference between this line's Total CQI and the one on the earlier line above.
Changed	The number of carriers whose frequencies or color codes the optimizer has changed from the last iteration.
Total Changed	The number of carriers whose frequencies or color codes the optimizer has changed from the beginning of this execution run.
Run number	The execution number in this work session.

In contrast to the very coarse adjustments made at the beginning of the run, the display log below shows the much finer tuning after several iterations (the model in the example is very small and fairly simple – yours may take much longer).



The total CQI has become a smaller number at iteration 21, and further iterations may well reduce it to zero. Zero indicates that the optimizer has produced a perfect solution; in many real-world cases, zero will never be reached, but you can assume that the solution will not get much better once the CQI Improvement becomes steady and small.

The graph below gives a further illustration of the way the optimizer produces a good frequency plan very quickly and then continues to make it even better. Instructions on producing this graph (and the use of all twelve buttons at the top of the log window) are given in the chapter on "Analyzing and reporting".



The log file

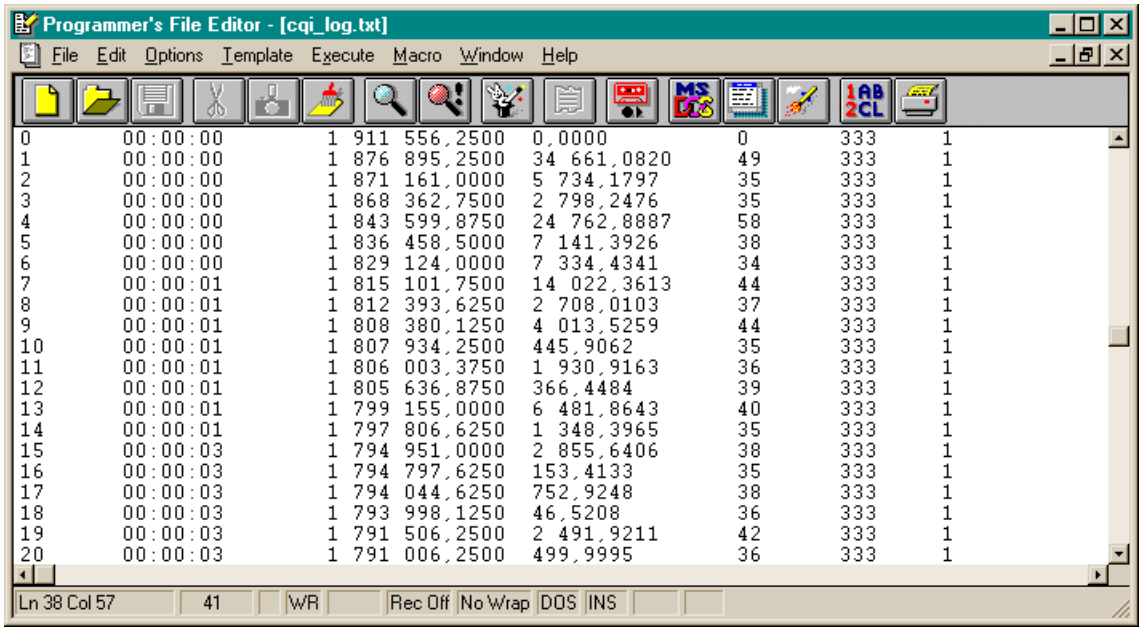
The log file is updated after every iteration, but is not saved until you stop the optimizer.

The picture shows an example of the log file (opened with Microsoft Notepad®). The columns are the same as the ones in the display log, except that the **CQILogRunNo** column is omitted.

"9.0350397E-4" = 9.0350397 x 10^{-4} = 0.00090350397

NOTE

Very small numbers (less than one-thousandth) are given as exponentials. For instance, the total CQI in the last row is shown as 9.0350397E-4.



Using the optimizer result

As well as inspecting the log output, which you can read with any text editor, you can:

- Filter and sort the data in the Log CQI improvement results to produce, save and print customized tables and graphs as described in the chapter on “Analyzing and reporting”.
- See the frequencies, color codes, MAL, HSN and MAIO assigned by using the sector and carrier editors described in the chapter on “Modeling the network” the network. Assignments made with sets and subsets are seen in the carrier editor as the individual frequencies in the set and subsets.
- Perform further analysis on the data produced and show the results in customizes tables and graphs, as described in the chapter on “Analyzing and reporting”.
- Export the model, with its new assignments, in a format which can be used by the software you intend to use for continuing the planning process. Instructions for exporting CellOpt data are given in the chapter on “Using CellOpt AFP”.

10
Analyzing and reporting

Overview

CellOpt enables you to analyze the data which describes a model, producing reports in tabular and graphical formats. There are four main report types:

- The *CQI improvements results* logs (for frequencies and color codes) are produced during optimization, and are therefore described in the chapter on "Optimizing".
- The *CellOpt assignment report* indicates the current frequency and color code assignment in the model. If you have enabled the frequency hopping or the frequency groups options you will also find additional information specific to these planning options.
- The *CQI report and Color code CQI repor*t list, for every carrier's appearance in every list, details about the carrier itself and also details of every carrier which interferes with it and the penalties applied for each sort of interference. These reports are described more fully later in this chapter.

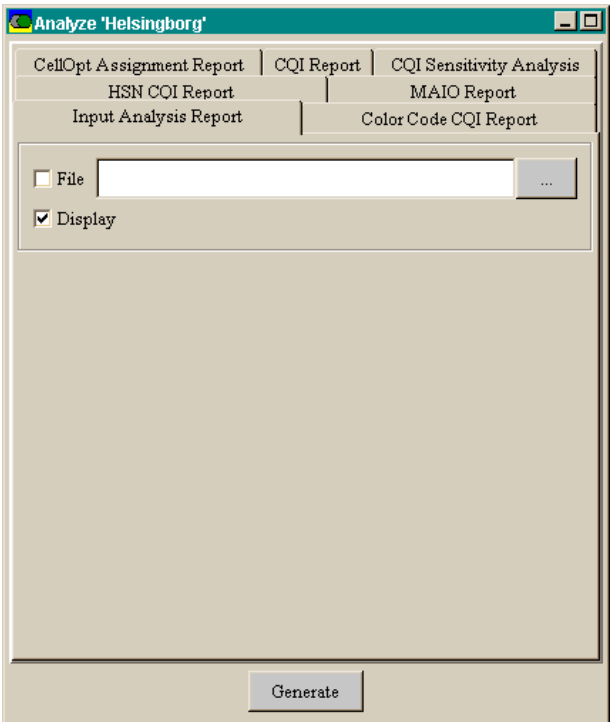
  If you have enabled the frequency hopping option you also have access to the HSN CQI report and the MAIO report. These reports are also described below.
- The *CQI sensitivity analysis,* also described fully later in this chapter, lists every free carrier with its currently assigned frequency. For every other globally available frequency, the report tells you what the penalty would be if you assigned it that frequency.

Once you have generated a report, you can:

- Save it.
- Print it.
- Show it as a table or a graph or both.
- Customize it by:
  - Choosing the axes of the graph.
  - Choosing the rows and columns of a table.
  - Sorting the data by chosen criteria.
  - Filtering the data to include only what you need to see.

These facilities are described at the end of this chapter.

Generating a report



To generate a report:

1 Make sure the model you want is in focus on the desktop and then click on the analyzer icon to see the analysis panel, as shown in the illustration.

2 Click on the tab for the type of report you want. Each type is described in its own section later in this chapter.

3 If you want to save the report which you are about to generate, check the **File** box. Checking the box (or clicking on ...) opens the browser for you to name a new file or choose an existing one.

- You can save the file in any directory (the project directory is the default) and give it any name. You do not have to use an extension, but the file will be a standard text file, so you may want to type your text editor's default extension here.
- If you open an existing file, the new information will overwrite the old. You are warned that this will happen and can cancel if you wish.

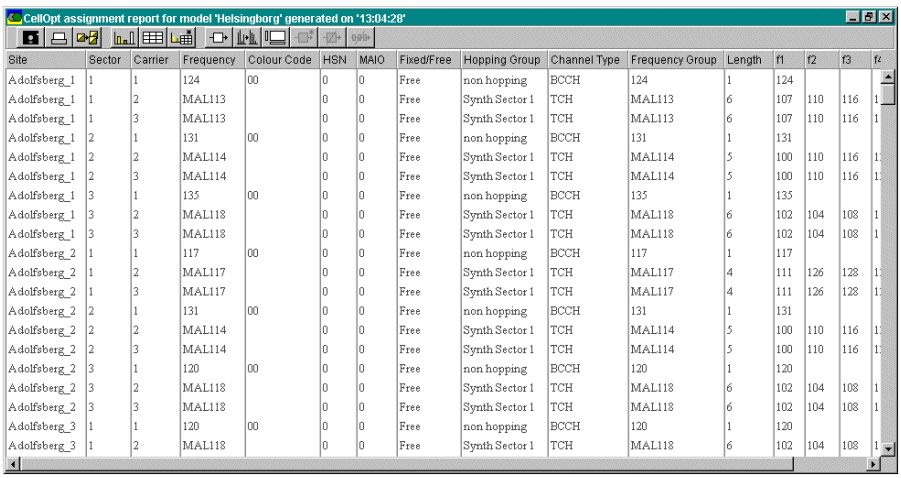
4 If you want to see the report on screen, check **Display.**

5 If you are generating a color code CQI report, refer to the section about it below, Otherwise, click on **Generate** to produce the report and display or file it (or both) according to your choices above.

CellOpt Assignment Report

The CellOpt assignment report describes for each carrier its current assignment in the model. It will always indicate the frequency and color code assignment of the carrier. If you are planning using the frequency hopping option it will also indicate the HSN and MAIO assignment, the MAL hopping length and its individual frequencies, and what hopping group the carrier belongs to. If the frequency groups mode is enabled it will instead also show the length of the frequency group and its individual frequencies, and whether the carrier is grouped or non-grouped.

The screenshot below is a CellOpt assignment report from a plan when the frequency hopping option is enabled. The meaning of each column is described in the table below the screenshot. Columns only appearing in frequency hopping mode is marked with a *, columns appearing in either frequency hopping or frequency group mode is marked with **.


CellOpt assignment report for model 'Helsingborg' generated on '13:04:28'

Site	Sector	Carrier	Frequency	Colour Code	HSN	MAIO	Fixed/Free	Hopping Group	Channel Type	Frequency Group	Length	f1	f2	f3	f4
Adolfsberg_1	1	1	124	00	0	0	Free	non hopping	BCCH	124	1	124			
Adolfsberg_1	1	2	MAL113		0	0	Free	Synth Sector 1	TCH	MAL113	6	107	110	116	1
Adolfsberg_1	1	3	MAL113		0	0	Free	Synth Sector 1	TCH	MAL113	6	107	110	116	1
Adolfsberg_1	2	1	131	00	0	0	Free	non hopping	BCCH	131	1	131			
Adolfsberg_1	2	2	MAL114		0	0	Free	Synth Sector 1	TCH	MAL114	5	100	110	116	1
Adolfsberg_1	2	3	MAL114		0	0	Free	Synth Sector 1	TCH	MAL114	5	100	110	116	1
Adolfsberg_1	3	1	135	00	0	0	Free	non hopping	BCCH	135	1	135			
Adolfsberg_1	3	2	MAL118		0	0	Free	Synth Sector 1	TCH	MAL118	6	102	104	108	1
Adolfsberg_1	3	3	MAL118		0	0	Free	Synth Sector 1	TCH	MAL118	6	102	104	108	1
Adolfsberg_2	1	1	117	00	0	0	Free	non hopping	BCCH	117	1	117			
Adolfsberg_2	1	2	MAL117		0	0	Free	Synth Sector 1	TCH	MAL117	4	111	126	128	1
Adolfsberg_2	1	3	MAL117		0	0	Free	Synth Sector 1	TCH	MAL117	4	111	126	128	1
Adolfsberg_2	2	1	131	00	0	0	Free	non hopping	BCCH	131	1	131			
Adolfsberg_2	2	2	MAL114		0	0	Free	Synth Sector 1	TCH	MAL114	5	100	110	116	1
Adolfsberg_2	2	3	MAL114		0	0	Free	Synth Sector 1	TCH	MAL114	5	100	110	116	1
Adolfsberg_2	3	1	120	00	0	0	Free	non hopping	BCCH	120	1	120			
Adolfsberg_2	3	2	MAL118		0	0	Free	Synth Sector 1	TCH	MAL118	6	102	104	108	1
Adolfsberg_2	3	3	MAL118		0	0	Free	Synth Sector 1	TCH	MAL118	6	102	104	108	1
Adolfsberg_3	1	1	120	00	0	0	Free	non hopping	BCCH	120	1	120			
Adolfsberg_3	1	2	MAL118		0	0	Free	Synth Sector 1	TCH	MAL118	6	102	104	108	1

Site	The serving site
Sector	The serving sector
Carrier	The serving carrier
Frequency	The frequency assigned to the serving carrier
Color code	The color code assigned to the serving carrier
HSN *	The hopping sequence number assigned to the serving carrier.
MAIO *	The mobile allocation index offset assigned to the serving carrier.
Fixed/Free	Whether the assignment of the carrier is fixed or free. If it is free the optimizer is allowed to change its assignment.
Hopping/Carrier group **	Which hopping or carrier group the serving carrier belongs to.
Channel type	**Channel type** is an example of a category that is used in this particular model. The column indicates the layer assigned to the serving carrier in this category. Each category in your model will have its own column here.
Frequency group **	Indicates the frequency group assigned to the serving carrier. In frequency hopping mode the contents of this column is always identical to the contents of frequency column above. In frequency group mode it indicates the set or subset the frequency of the serving carrier is assigned from.

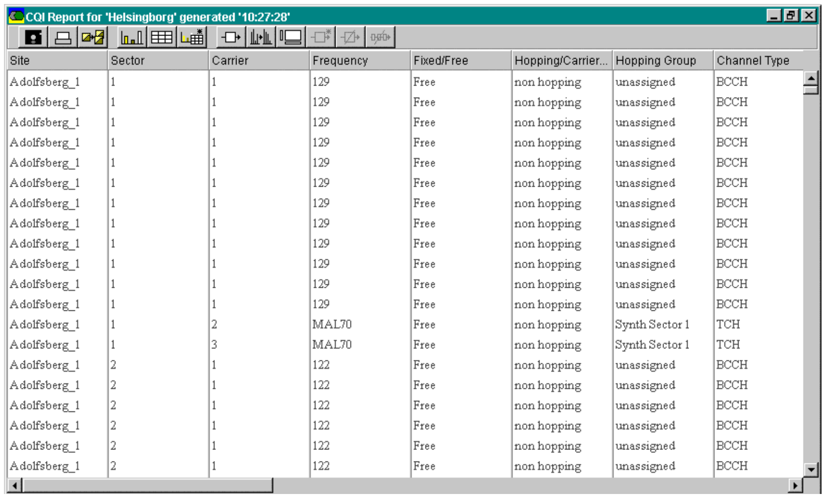
Length **	The number of individual frequencies in the MAL (frequency hopping mode) or in the set/subset (frequency group mode). If it is forbidden to assign some of the frequencies to the serving carrier in the set/subset then the column will indicate the number of frequencies available to use from the set/subset for the serving carrier and then, in brackets, the total number of frequencies in the set/subset.
f1, f2, f3, … **	The individual frequencies in the MAL (frequency hopping mode) or in the set/subset (frequency group mode). All frequencies of the set/subset are displayed here. If it is forbidden for the carrier to use some of the individual frequencies in the set/subset then that is indicated by means of a bracket around the individual frequency.

The CQI report

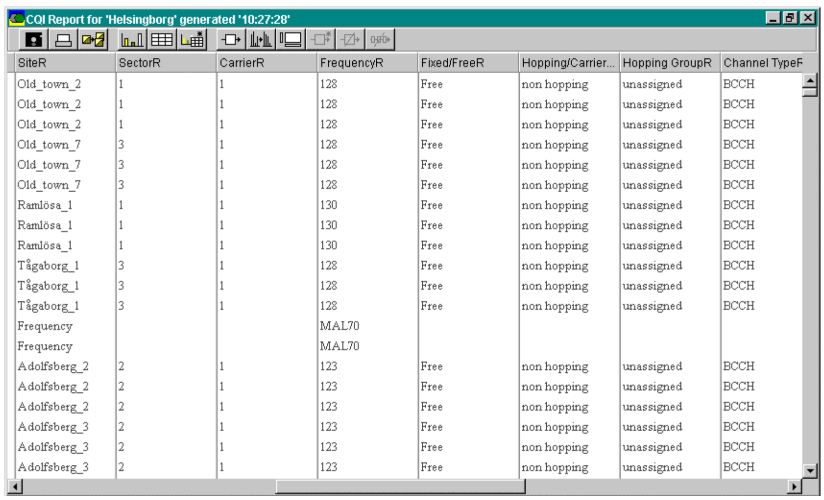
The CQI (CellOpt Quality Index) report is a detailed description of the violated assignment restrictions and the penalties awarded for the frequency plan. Each violated assignment restriction has one row for each list it appears in – for example, if a particular assignment restriction appears in three lists, there will be three rows in the report for that assignment restriction. Each of these rows indicates the list defining the assignment restriction.

The three screenshots below show the screen display of a CQI report generated using the instructions above. The horizontal scroll bar was used to show the whole width of the report in three sections. Note that you can click on any cell to highlight it and make its row's information easier to read as you scroll across.

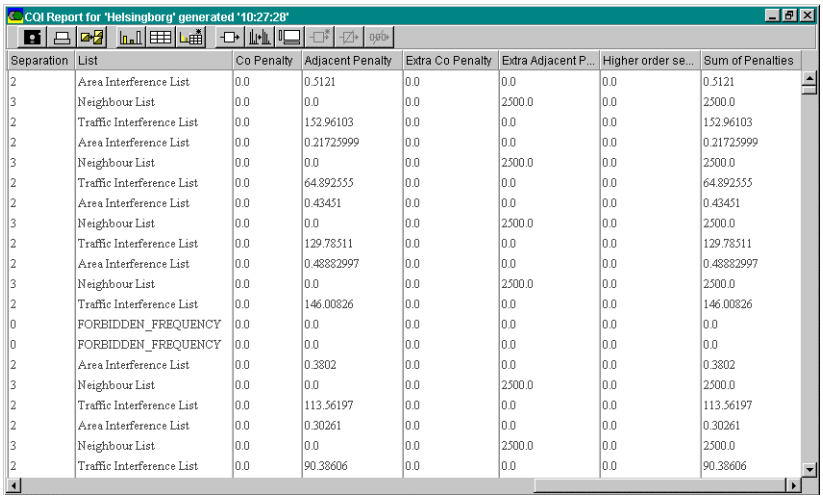
The meaning of each column is explained in the table following the screenshots:



Site	Sector	Carrier	Frequency	Fixed/Free	Hopping/Carrier...	Hopping Group	Channel Type
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	1	129	Free	non hopping	unassigned	BCCH
Adolfsberg_1	1	2	MAL70	Free	non hopping	Synth Sector 1	TCH
Adolfsberg_1	1	3	MAL70	Free	non hopping	Synth Sector 1	TCH
Adolfsberg_1	2	1	122	Free	non hopping	unassigned	BCCH
Adolfsberg_1	2	1	122	Free	non hopping	unassigned	BCCH
Adolfsberg_1	2	1	122	Free	non hopping	unassigned	BCCH
Adolfsberg_1	2	1	122	Free	non hopping	unassigned	BCCH
Adolfsberg_1	2	1	122	Free	non hopping	unassigned	BCCH
Adolfsberg_1	2	1	122	Free	non hopping	unassigned	BCCH



SiteR	SectorR	CarrierR	FrequencyR	Fixed/FreeR	Hopping/Carrier...	Hopping GroupR	Channel TypeF
Old_town_2	1	1	128	Free	non hopping	unassigned	BCCH
Old_town_2	1	1	128	Free	non hopping	unassigned	BCCH
Old_town_2	1	1	128	Free	non hopping	unassigned	BCCH
Old_town_7	3	1	128	Free	non hopping	unassigned	BCCH
Old_town_7	3	1	128	Free	non hopping	unassigned	BCCH
Old_town_7	3	1	128	Free	non hopping	unassigned	BCCH
Ramlösa_1	1	1	130	Free	non hopping	unassigned	BCCH
Ramlösa_1	1	1	130	Free	non hopping	unassigned	BCCH
Ramlösa_1	1	1	130	Free	non hopping	unassigned	BCCH
Tågaborg_1	3	1	128	Free	non hopping	unassigned	BCCH
Tågaborg_1	3	1	128	Free	non hopping	unassigned	BCCH
Tågaborg_1	3	1	128	Free	non hopping	unassigned	BCCH
Frequency			MAL70				
Frequency			MAL70				
Adolfsberg_2	2	1	123	Free	non hopping	unassigned	BCCH
Adolfsberg_2	2	1	123	Free	non hopping	unassigned	BCCH
Adolfsberg_2	2	1	123	Free	non hopping	unassigned	BCCH
Adolfsberg_3	2	1	123	Free	non hopping	unassigned	BCCH
Adolfsberg_3	2	1	123	Free	non hopping	unassigned	BCCH
Adolfsberg_3	2	1	123	Free	non hopping	unassigned	BCCH



Separation	List	Co Penalty	Adjacent Penalty	Extra Co Penalty	Extra Adjacent P...	Higher order se...	Sum of Penalties
2	Area Interference List	0.0	0.5121	0.0	0.0	0.0	0.5121
3	Neighbour List	0.0	0.0	0.0	2500.0	0.0	2500.0
2	Traffic Interference List	0.0	152.96103	0.0	0.0	0.0	152.96103
2	Area Interference List	0.0	0.21725999	0.0	0.0	0.0	0.21725999
3	Neighbour List	0.0	0.0	0.0	2500.0	0.0	2500.0
2	Traffic Interference List	0.0	64.892555	0.0	0.0	0.0	64.892555
2	Area Interference List	0.0	0.43451	0.0	0.0	0.0	0.43451
3	Neighbour List	0.0	0.0	0.0	2500.0	0.0	2500.0
2	Traffic Interference List	0.0	129.78511	0.0	0.0	0.0	129.78511
2	Area Interference List	0.0	0.48882997	0.0	0.0	0.0	0.48882997
3	Neighbour List	0.0	0.0	0.0	2500.0	0.0	2500.0
2	Traffic Interference List	0.0	146.00826	0.0	0.0	0.0	146.00826
0	FORBIDDEN_FREQUENCY	0.0	0.0	0.0	0.0	0.0	0.0
0	FORBIDDEN_FREQUENCY	0.0	0.0	0.0	0.0	0.0	0.0
2	Area Interference List	0.0	0.3802	0.0	0.0	0.0	0.3802
3	Neighbour List	0.0	0.0	0.0	2500.0	0.0	2500.0
2	Traffic Interference List	0.0	113.56197	0.0	0.0	0.0	113.56197
2	Area Interference List	0.0	0.30261	0.0	0.0	0.0	0.30261
3	Neighbour List	0.0	0.0	0.0	2500.0	0.0	2500.0
2	Traffic Interference List	0.0	90.38606	0.0	0.0	0.0	90.38606

Site	The serving site.
Sector	The serving sector.
Carrier	The serving carrier.
Frequency	The frequency assigned to the serving carrier.
Fixed/Free	Whether the frequency was fixed before optimizing, or was free for the optimizer to change if it chose to do so.
Hopping/Carrier Group*	Which hopping or carrier group the serving carrier belongs to.
border, type	The layer to which the carrier belongs in the border and in the type categories respectively. These two are just examples of categories and layers. Each category in your model will have its own column here.
SiteR	The interfering site.
SectorR	The interfering sector.
CarrierR	The interfering carrier.
FrequencyR	The frequency assigned to the interfering carrier.
Fixed/FreeR	Whether the frequency of the interfering carrier was fixed before optimizing, or was free for the optimizer to change if it chose to do so.
Hopping/Carrier GroupR*	Which hopping or carrier group the interfering carrier belongs to.

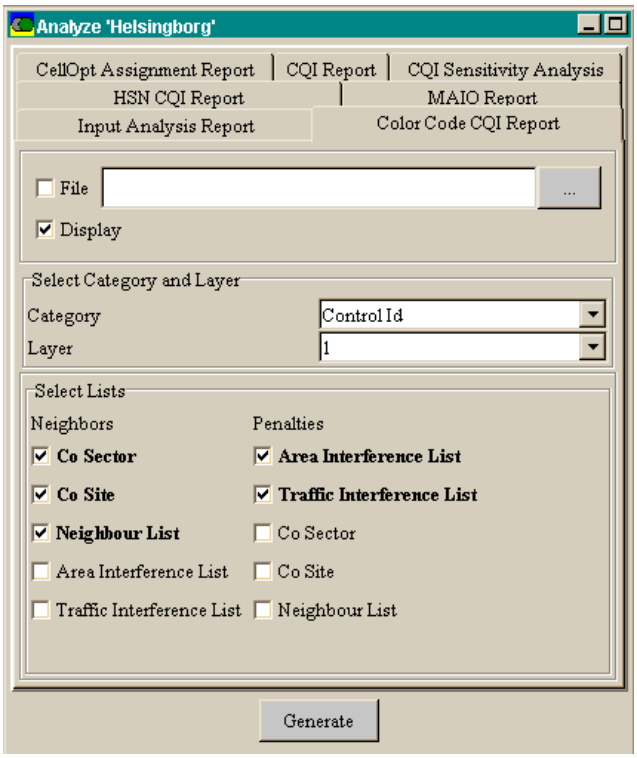
border', type'	The layer to which the interfering carrier belongs in the border and in the type categories respectively. These two are just examples of categories and layers. Each category in your model will have its own column here.
Separation	The frequency separation between the serving carrier and the interfering carrier.
List	The list defining the violated assignment restriction.
Co Penalty	The co-penalty awarded from lists with statistics if the separation is 0.
Adjacent Penalty	The adjacent penalty awarded from lists with statistics if the separation is 1.
Extra Co Penalty	The co-penalty awarded from lists other than those with statistics if the separation is 0.
Extra Adjacent Penalty	The adjacent penalty awarded from lists other than those with statistics if the separation is 1.
Higher Order Separation Penalty	The adjacent penalty awarded from lists other than those with statistics if the separation is higher than 1.
Sum of Penalties	The total of all the penalties awarded for this row. The sum of all the penalties in this column is the CQI.

* Note that the names appearing here depend on whether frequency hopping, frequency groups or both have been activated as described in the section on system administration. If only frequency groups are active the column header will be called **Carrier group**. If only frequency groups are active, the column header will called **Hopping group**. The name displayed is for both simultaneously active. If neither are active this selection will not appear.

The color code CQI report

The color code CQI report is a detailed description of the violated assignment restrictions and the penalties awarded for the color code plan. Each violated assignment restriction has one row for each interfering list in which it appears. Once you have carried out the instructions at the beginning of this chapter, you will see a form like the one below. You need to make two additional selections before you can generate this sort of report. Note that these two selections are identical to those in the color code optimization form (see the chapter on

"Optimizing"). In fact, the selections made in the color code optimization form are pre-selected when you open the color code CQI report, and vice versa.



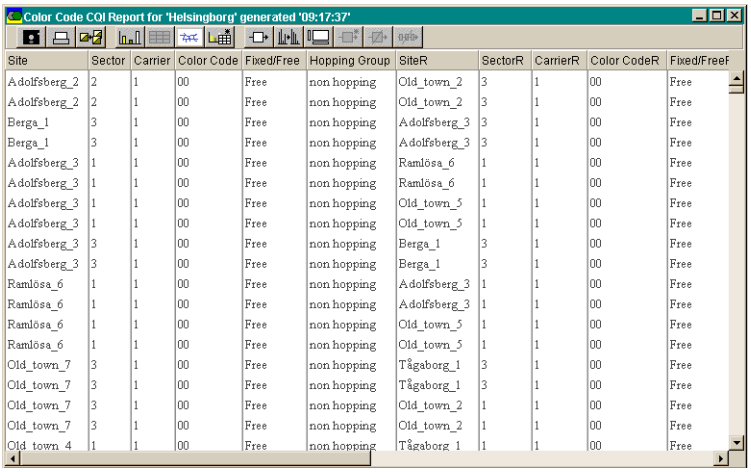
1 Select the carriers that require color codes by indicating a layer within a category. For instance, if your input format identified the carriers that required color codes you might want to base the carrier selection on layer **1** in category **Control Id**. Alternatively, you could have used the network editor to define a layer in a new category indicating all carriers requiring color codes.

2 Select the lists from which the analyzer will derive the penalties for the calculation of the color code CQI report. The goal of color code planning is to avoid the switch ordering a mobile user to hand over to a neighbor without sufficient signal coverage at the location of the mobile user. These situations can be avoided with CellOpt color code optimization, given that the neighbors and interferers of serving sectors are known to the optimizer.

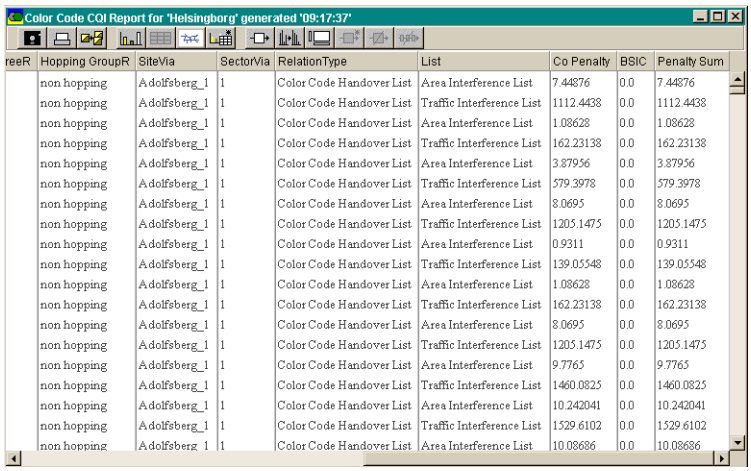
   The penalties for color code assignment are derived by identifying neighbors and interferers of a serving sector where the carriers that require a color code have identical frequencies. If they do, it is important to avoid having identical color codes as well; otherwise the signal from the interfering sector could be misinterpreted as the signal from

a neighboring sector – and that could result in a handover to the neighboring sector even if it might not provide coverage at the location of the mobile user.

3 Click on **Generate** to carry out the analysis and display or file (or both) the results. The resulting report is shown in the following picture. Note that you can click on any cell to highlight it and make its row's information easier to read as you scroll across. The meaning of each column is explained in the table below the picture.



Site	Sector	Carrier	Color Code	Fixed/Free	Hopping Group	SiteR	SectorR	CarrierR	Color CodeR	Fixed/FreeF
Adolfsberg_2	2	1	00	Free	non hopping	Old_town_2	3	1	00	Free
Adolfsberg_2	2	1	00	Free	non hopping	Old_town_2	3	1	00	Free
Berga_1	3	1	00	Free	non hopping	Adolfsberg_3	3	1	00	Free
Berga_1	3	1	00	Free	non hopping	Adolfsberg_3	3	1	00	Free
Adolfsberg_3	1	1	00	Free	non hopping	Ramlösa_6	1	1	00	Free
Adolfsberg_3	1	1	00	Free	non hopping	Ramlösa_6	1	1	00	Free
Adolfsberg_3	1	1	00	Free	non hopping	Old_town_5	1	1	00	Free
Adolfsberg_3	1	1	00	Free	non hopping	Old_town_5	1	1	00	Free
Adolfsberg_3	3	1	00	Free	non hopping	Berga_1	3	1	00	Free
Adolfsberg_3	3	1	00	Free	non hopping	Berga_1	3	1	00	Free
Ramlösa_6	1	1	00	Free	non hopping	Adolfsberg_3	1	1	00	Free
Ramlösa_6	1	1	00	Free	non hopping	Adolfsberg_3	1	1	00	Free
Ramlösa_6	1	1	00	Free	non hopping	Old_town_5	1	1	00	Free
Ramlösa_6	1	1	00	Free	non hopping	Old_town_5	1	1	00	Free
Old_town_7	3	1	00	Free	non hopping	Tågaborg_1	3	1	00	Free
Old_town_7	3	1	00	Free	non hopping	Tågaborg_1	3	1	00	Free
Old_town_7	3	1	00	Free	non hopping	Old_town_2	1	1	00	Free
Old_town_7	3	1	00	Free	non hopping	Old_town_2	1	1	00	Free
Old_town_4	1	1	00	Free	non hopping	Tågaborg_1	1	1	00	Free



reeR	Hopping GroupR	SiteVia	SectorVia	RelationType	List	Co Penalty	BSIC	Penalty Sum
	non hopping	Adolfsberg_1	1	Color Code Handover List	Area Interference List	7.44876	0.0	7.44876
	non hopping	Adolfsberg_1	1	Color Code Handover List	Traffic Interference List	1112.4438	0.0	1112.4438
	non hopping	Adolfsberg_1	1	Color Code Handover List	Area Interference List	1.08628	0.0	1.08628
	non hopping	Adolfsberg_1	1	Color Code Handover List	Traffic Interference List	162.23138	0.0	162.23138
	non hopping	Adolfsberg_1	1	Color Code Handover List	Area Interference List	3.87956	0.0	3.87956
	non hopping	Adolfsberg_1	1	Color Code Handover List	Traffic Interference List	579.3978	0.0	579.3978
	non hopping	Adolfsberg_1	1	Color Code Handover List	Area Interference List	8.0695	0.0	8.0695
	non hopping	Adolfsberg_1	1	Color Code Handover List	Traffic Interference List	1205.1475	0.0	1205.1475
	non hopping	Adolfsberg_1	1	Color Code Handover List	Area Interference List	0.9311	0.0	0.9311
	non hopping	Adolfsberg_1	1	Color Code Handover List	Traffic Interference List	139.05548	0.0	139.05548
	non hopping	Adolfsberg_1	1	Color Code Handover List	Area Interference List	1.08628	0.0	1.08628
	non hopping	Adolfsberg_1	1	Color Code Handover List	Traffic Interference List	162.23138	0.0	162.23138
	non hopping	Adolfsberg_1	1	Color Code Handover List	Area Interference List	8.0695	0.0	8.0695
	non hopping	Adolfsberg_1	1	Color Code Handover List	Traffic Interference List	1205.1475	0.0	1205.1475
	non hopping	Adolfsberg_1	1	Color Code Handover List	Area Interference List	9.7765	0.0	9.7765
	non hopping	Adolfsberg_1	1	Color Code Handover List	Traffic Interference List	1460.0825	0.0	1460.0825
	non hopping	Adolfsberg_1	1	Color Code Handover List	Area Interference List	10.242041	0.0	10.242041
	non hopping	Adolfsberg_1	1	Color Code Handover List	Traffic Interference List	1529.6102	0.0	1529.6102
	non hopping	Adolfsberg_1	1	Color Code Handover List	Area Interference List	10.08686	0.0	10.08686

Site The neighboring site.

Sector The neighboring sector.

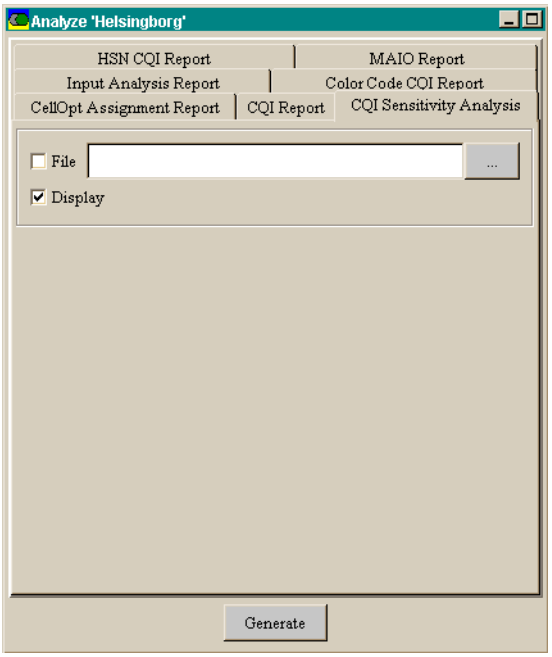
Carrier The neighboring carrier.

Color Code The color code assigned to the neighboring carrier.

Fixed/Free	Whether the color code of the neighboring carrier was fixed before optimizing, or was free for the optimizer to change if it chose to do so.
Hopping/Carrier Group*	Which hopping or carrier group the neighboring carrier belongs to.
border, type	The *layer* to which the carrier belongs in the **border** and in the **type** categories respectively. These two are just examples of categories and layers. Each category in your model will have its own column here.
SiteR	The interfering site.
SectorR	The interfering sector.
CarrierR	The interfering carrier.
Color CodeR	The color code assigned to the interfering carrier.
Fixed/FreeR	Whether the color code of the interfering carrier was fixed before optimizing, or was free for the optimizer to change if it chose to do so.
Hopping/Carrier GroupR*	Which hopping or carrier group the interfering carrier belongs to.
borderR, typeR	The layer to which the interfering carrier belongs in the **Border** and in the **type** categories respectively. These two are just examples of categories and layers. Each category in your model will have its own column here.
SiteVia	
SectorVia	
RelationType	
List	The list defining the violated assignment restriction.
Co Penalty	The penalty awarded for assigning identical color codes to the neighboring carrier and the interfering carrier of a sector.
BSIC	
Penalty Sum	

* Note that the names appearing here depend on whether frequency hopping, frequency groups or both have been activated as described in the section on system administration. If only frequency groups are active the column header will be called **Carrier group**. If only frequency groups are active, the column header will called **Hopping group**. The name displayed is for both simultaneously active. If neither are active this selection will not appear.

The CQI sensitivity analysis report

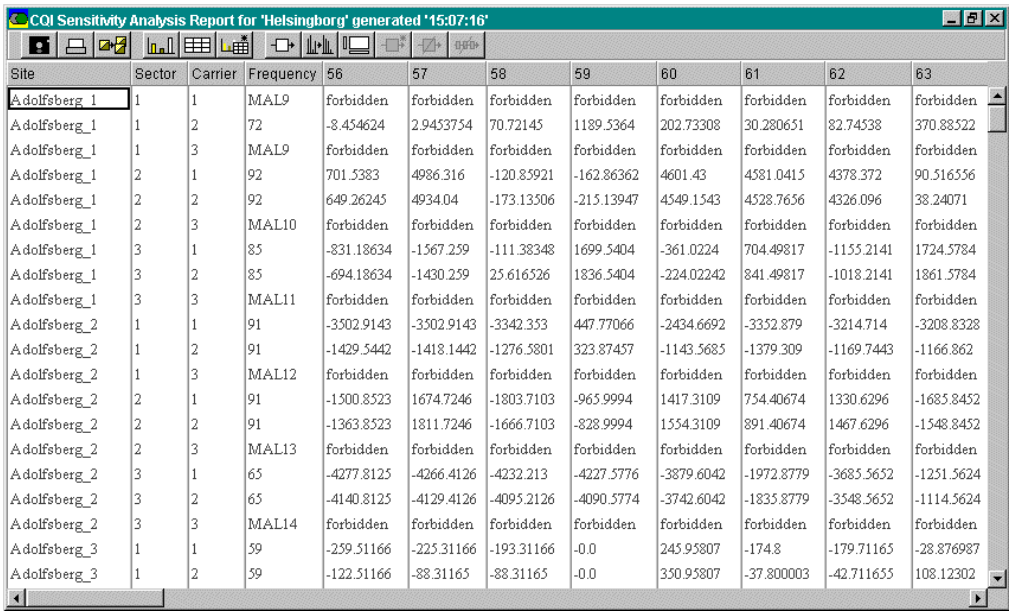


To generate this report, follow the instructions at the beginning of this chapter, choosing the **CQI Sensitivity Analysis** tab at the appropriate point.

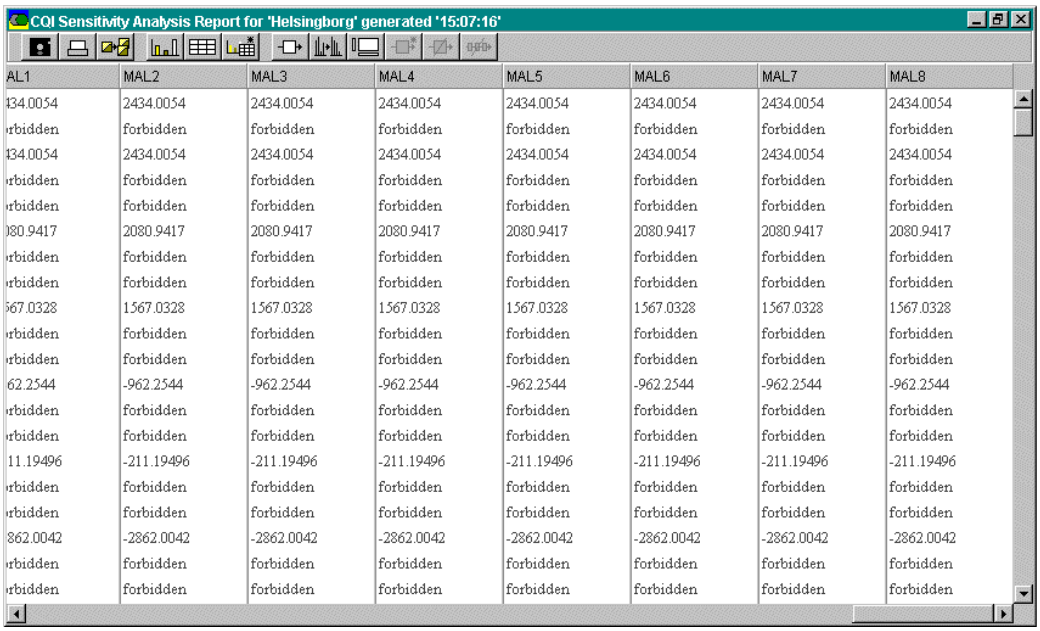
The CQI sensitivity report indicates the impact on the CQI of changing a frequency of any carrier to any other frequency. The report has one row per free carrier, describing its site-, sector- and carrier name as well as the frequency assigned to it. The impact of changing the frequencies of carriers to alternative frequencies is described in the following columns representing the available frequencies.

If you are planning with the frequency groups option enabled, please be aware of that only non-grouped carriers are included in the report.

The two screenshots below show the screen display of a CQI sensitivity analysis report generated using the instructions at the beginning of this chapter. The horizontal scroll bar was used to show the whole width of the report in two sections. Note that you can click on any row to highlight it and make its information easier to read as you scroll across.


CQI Sensitivity Analysis Report for 'Helsingborg' generated '15:07:16'

Site	Sector	Carrier	Frequency	56	57	58	59	60	61	62	63
Adolfsberg_1	1	1	MAL9	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
Adolfsberg_1	1	2	72	-8.454624	2.9453754	70.72145	1189.5364	202.73308	30.280651	82.74538	370.88522
Adolfsberg_1	1	3	MAL9	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
Adolfsberg_1	2	1	92	701.5383	4986.316	-120.85921	-162.86362	4601.43	4581.0415	4378.372	90.516556
Adolfsberg_1	2	2	92	649.26245	4934.04	-173.13506	-215.13947	4549.1543	4528.7656	4326.096	38.24071
Adolfsberg_1	2	3	MAL10	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
Adolfsberg_1	3	1	85	-831.18634	-1567.259	-111.38348	1699.5404	-361.0224	704.49817	-1155.2141	1724.5784
Adolfsberg_1	3	2	85	-694.18634	-1430.259	25.616526	1836.5404	-224.02242	841.49817	-1018.2141	1861.5784
Adolfsberg_1	3	3	MAL11	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
Adolfsberg_2	1	1	91	-3502.9143	-3502.9143	-3342.353	447.77066	-2434.6692	-3352.879	-3214.714	-3208.8328
Adolfsberg_2	1	2	91	-1429.5442	-1418.1442	-1276.5801	323.87457	-1143.5685	-1379.309	-1169.7443	-1166.862
Adolfsberg_2	1	3	MAL12	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
Adolfsberg_2	2	1	91	-1500.8523	1674.7246	-1803.7103	-965.9994	1417.3109	754.40674	1330.6296	-1685.8452
Adolfsberg_2	2	2	91	-1363.8523	1811.7246	-1666.7103	-828.9994	1554.3109	891.40674	1467.6296	-1548.8452
Adolfsberg_2	2	3	MAL13	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
Adolfsberg_2	3	1	65	-4277.8125	-4266.4126	-4232.213	-4227.5776	-3879.6042	-1972.8779	-3685.5652	-1251.5624
Adolfsberg_2	3	2	65	-4140.8125	-4129.4126	-4095.2126	-4090.5774	-3742.6042	-1835.8779	-3548.5652	-1114.5624
Adolfsberg_2	3	3	MAL14	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
Adolfsberg_3	1	1	59	-259.51166	-225.31166	-193.31166	-0.0	245.95807	-174.8	-179.71165	-28.876987
Adolfsberg_3	1	2	59	-122.51166	-88.31165	-88.31165	-0.0	350.95807	-37.800003	-42.711655	108.12302


CQI Sensitivity Analysis Report for 'Helsingborg' generated '15:07:16'

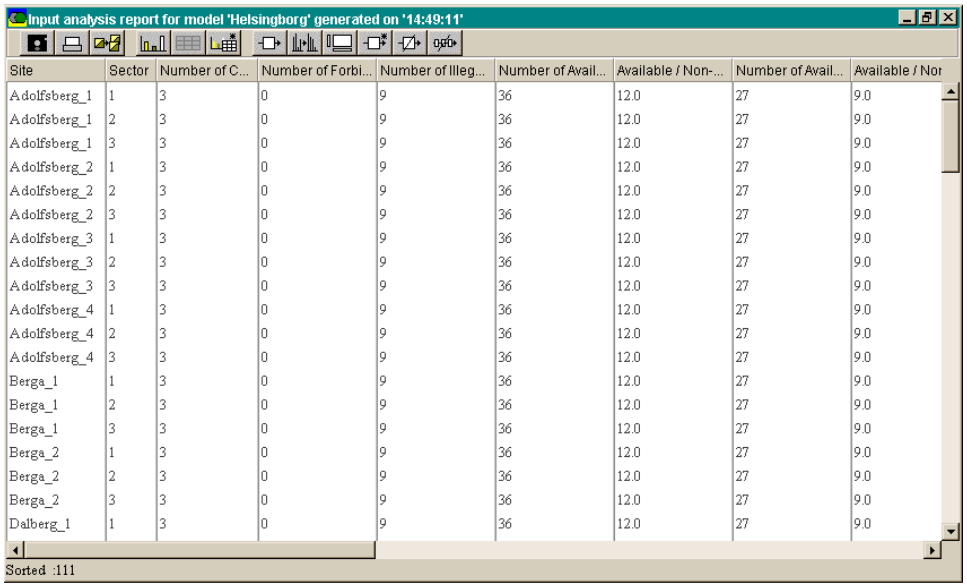
AL1	MAL2	MAL3	MAL4	MAL5	MAL6	MAL7	MAL8
434.0054	2434.0054	2434.0054	2434.0054	2434.0054	2434.0054	2434.0054	2434.0054
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
434.0054	2434.0054	2434.0054	2434.0054	2434.0054	2434.0054	2434.0054	2434.0054
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
080.9417	2080.9417	2080.9417	2080.9417	2080.9417	2080.9417	2080.9417	2080.9417
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
567.0328	1567.0328	1567.0328	1567.0328	1567.0328	1567.0328	1567.0328	1567.0328
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
62.2544	-962.2544	-962.2544	-962.2544	-962.2544	-962.2544	-962.2544	-962.2544
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
11.19496	-211.19496	-211.19496	-211.19496	-211.19496	-211.19496	-211.19496	-211.19496
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
862.0042	-2862.0042	-2862.0042	-2862.0042	-2862.0042	-2862.0042	-2862.0042	-2862.0042
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden
rbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden	forbidden

The meaning of each column is explained in the table below:

Site	The serving site.
Sector	The serving sector.
Carrier	The serving carrier.
Frequency	The frequency assigned to the serving carrier.
Frequency x, y, z (multiple columns)	The impact on the CQI if the frequency of the serving carrier is reassigned any of the other available frequencies.

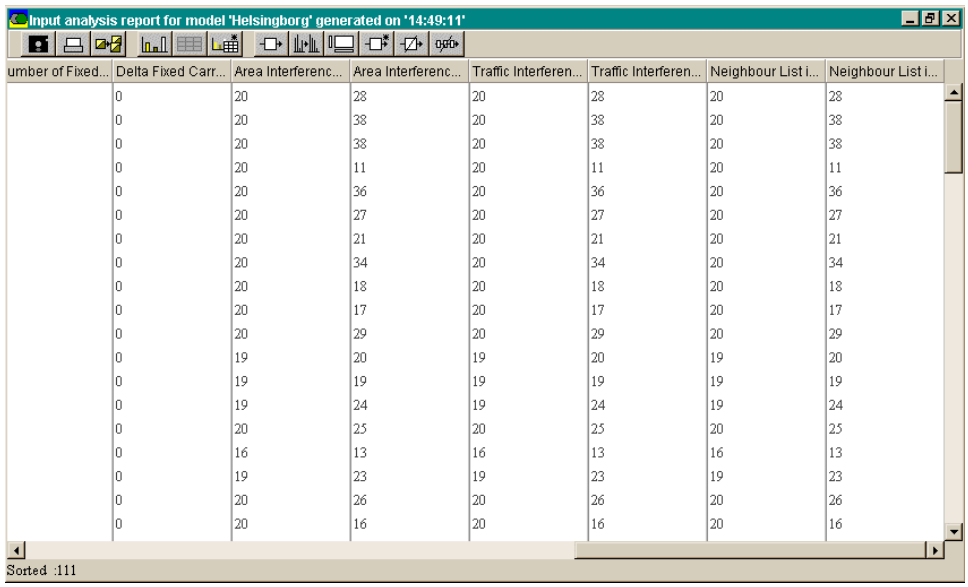
Input Analysis report

The vast amount of data in a medium sized network makes it impossible for the user to verify the input data using the Network Editor. In order to allow the user to get an overview of the input data, CellOpt AFP provide the Input Analysis report. The Input analysis report is a report that accumulates a number of carrier properties on a sector level. By using mechanisms such as filtering, pivoting and sorting, one can easily spot data input errors.


Input analysis report for model 'Helsingborg' generated on '14:49:11'

Site	Sector	Number of C...	Number of Forbi...	Number of Illeg...	Number of Avail...	Available / Non-...	Number of Avail...	Available / Nor
Adolfsberg_1	1	3	0	9	36	12.0	27	9.0
Adolfsberg_1	2	3	0	9	36	12.0	27	9.0
Adolfsberg_1	3	3	0	9	36	12.0	27	9.0
Adolfsberg_2	1	3	0	9	36	12.0	27	9.0
Adolfsberg_2	2	3	0	9	36	12.0	27	9.0
Adolfsberg_2	3	3	0	9	36	12.0	27	9.0
Adolfsberg_3	1	3	0	9	36	12.0	27	9.0
Adolfsberg_3	2	3	0	9	36	12.0	27	9.0
Adolfsberg_3	3	3	0	9	36	12.0	27	9.0
Adolfsberg_4	1	3	0	9	36	12.0	27	9.0
Adolfsberg_4	2	3	0	9	36	12.0	27	9.0
Adolfsberg_4	3	3	0	9	36	12.0	27	9.0
Berga_1	1	3	0	9	36	12.0	27	9.0
Berga_1	2	3	0	9	36	12.0	27	9.0
Berga_1	3	3	0	9	36	12.0	27	9.0
Berga_2	1	3	0	9	36	12.0	27	9.0
Berga_2	2	3	0	9	36	12.0	27	9.0
Berga_2	3	3	0	9	36	12.0	27	9.0
Dalberg_1	1	3	0	9	36	12.0	27	9.0

Sorted :111


Input analysis report for model 'Helsingborg' generated on '14:49:11'

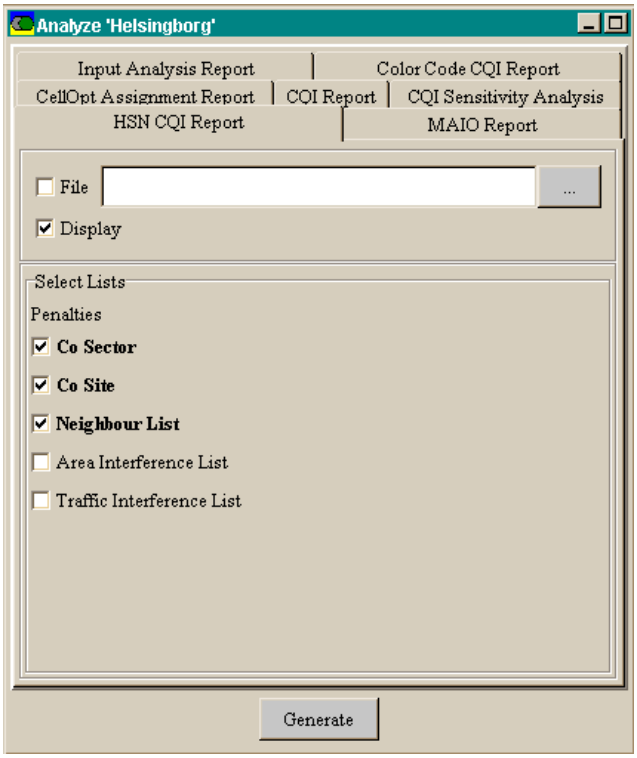
umber of Fixed...	Delta Fixed Carr...	Area Interferenc...	Area Interferenc...	Traffic Interferen...	Traffic Interferen...	Neighbour List i...	Neighbour List i...
	0	20	28	20	28	20	28
	0	20	38	20	38	20	38
	0	20	38	20	38	20	38
	0	20	11	20	11	20	11
	0	20	36	20	36	20	36
	0	20	27	20	27	20	27
	0	20	21	20	21	20	21
	0	20	34	20	34	20	34
	0	20	18	20	18	20	18
	0	20	17	20	17	20	17
	0	20	29	20	29	20	29
	0	19	20	19	20	19	20
	0	19	19	19	19	19	19
	0	19	24	19	24	19	24
	0	20	25	20	25	20	25
	0	16	13	16	13	16	13
	0	19	23	19	23	19	23
	0	20	26	20	26	20	26
	0	20	16	20	16	20	16

Sorted :111

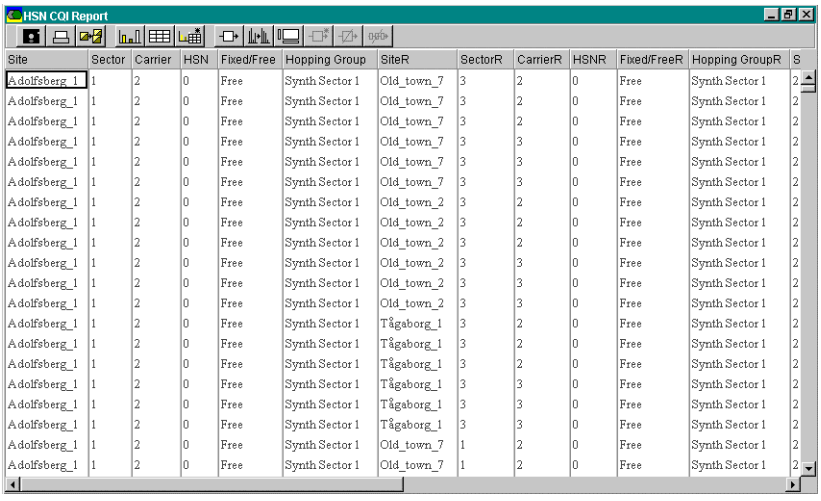
The columns that make up the report are:

Site	Name of the site
Sector	Name of the sector.
Number of Carriers	The number of radios.
Number of Forbidden Frequencies	The amount of different forbidden frequencies (every frequency only counted once).
Number of Illegal Frequencies	The amount of different illegal frequencies (every frequency counted only once).
Non-Forbidden/Carrier	The amount of available(non-forbidden) frequencies per radio.
Available / Non-Forbidden Ratio	The amount of available frequencies per radio.
Non-Illegal/Carrier	The amount of available(non-illegal) frequencies per radio.
Available / Non-Illegal Ratio	The amount of available frequencies per radio.
Number of Free Carriers Required	The number of radios marked as free
Number of Free Carriers Assigned	The number of radios marked as free and that have a valid frequency, valid means non-forbidden and in the available spectrum
Delta Free Carriers: Free radios allocated	Free radios assigned
Number of Fixed Carriers Required	The number of radios marked as fixed
Number of Fixed Carriers Assigned	The number of radios marked as fixed and that have a valid frequency
Delta Fixed Carriers: Fixed radios allocated	Fixed radios assigned
[per list represented in the network] interfered	Number of other sectors this sector is interfered by.
[per list represented in the network] interfering	Number of other sectors this sector is interfering.

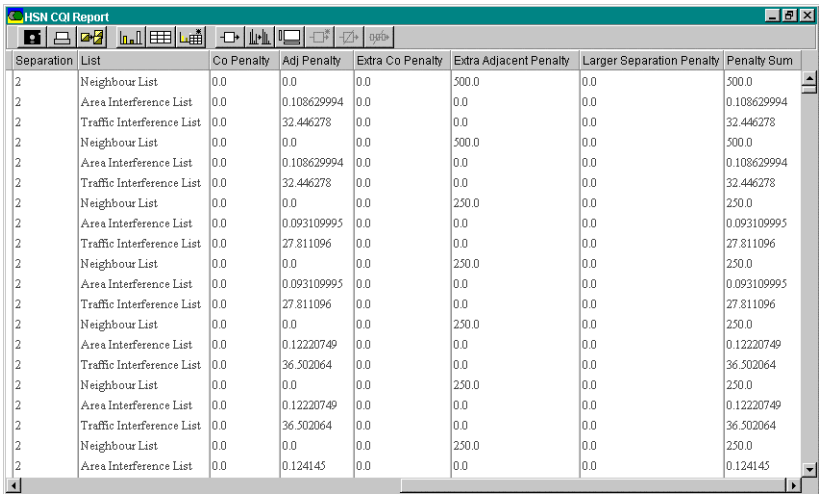
The HSN CQI report



The HSN report details the penalties that are violated when planning the Hopping Sequence number. To generate an HSN report choose the analyzer panel and select the HSN CQI Report. Select the Penalties and click on Generate. The meaning of each column is explained in the table below the screenshots:



Site	Sector	Carrier	HSN	Fixed/Free	Hopping Group	SiteR	SectorR	CarrierR	HSNR	Fixed/FreeR	Hopping GroupR	S
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_7	3	2	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_7	3	2	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_7	3	2	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_7	3	3	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_7	3	3	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_7	3	3	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_2	3	2	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_2	3	2	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_2	3	2	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_2	3	3	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_2	3	3	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_2	3	3	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Tågaborg_1	3	2	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Tågaborg_1	3	2	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Tågaborg_1	3	2	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Tågaborg_1	3	3	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Tågaborg_1	3	3	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Tågaborg_1	3	3	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_7	1	2	0	Free	Synth Sector 1	2
Adolfsberg_1	1	2	0	Free	Synth Sector 1	Old_town_7	1	2	0	Free	Synth Sector 1	2



Separation	List	Co Penalty	Adj Penalty	Extra Co Penalty	Extra Adjacent Penalty	Larger Separation Penalty	Penalty Sum
2	Neighbour List	0.0	0.0	0.0	500.0	0.0	500.0
2	Area Interference List	0.0	0.108629994	0.0	0.0	0.0	0.108629994
2	Traffic Interference List	0.0	32.446278	0.0	0.0	0.0	32.446278
2	Neighbour List	0.0	0.0	0.0	500.0	0.0	500.0
2	Area Interference List	0.0	0.108629994	0.0	0.0	0.0	0.108629994
2	Traffic Interference List	0.0	32.446278	0.0	0.0	0.0	32.446278
2	Neighbour List	0.0	0.0	0.0	250.0	0.0	250.0
2	Area Interference List	0.0	0.093109995	0.0	0.0	0.0	0.093109995
2	Traffic Interference List	0.0	27.811096	0.0	0.0	0.0	27.811096
2	Neighbour List	0.0	0.0	0.0	250.0	0.0	250.0
2	Area Interference List	0.0	0.093109995	0.0	0.0	0.0	0.093109995
2	Traffic Interference List	0.0	27.811096	0.0	0.0	0.0	27.811096
2	Neighbour List	0.0	0.0	0.0	250.0	0.0	250.0
2	Area Interference List	0.0	0.12220749	0.0	0.0	0.0	0.12220749
2	Traffic Interference List	0.0	36.502064	0.0	0.0	0.0	36.502064
2	Neighbour List	0.0	0.0	0.0	250.0	0.0	250.0
2	Area Interference List	0.0	0.12220749	0.0	0.0	0.0	0.12220749
2	Traffic Interference List	0.0	36.502064	0.0	0.0	0.0	36.502064
2	Neighbour List	0.0	0.0	0.0	250.0	0.0	250.0
2	Area Interference List	0.0	0.124145	0.0	0.0	0.0	0.124145

Site The serving site.

Sector The serving sector.

Carrier The serving carrier.

HSN The hopping sequence number assigned to the serving carrier.

Fixed/Free Whether the HSN was fixed before optimizing, or was free for the optimizer to change if it chose to do so.

Several Categories The following columns beginning with the Hopping Group list all the Categories that the Carrier is in.

SiteR The interfering site.

SectorR The interfering sector.

CarrierR The interfering carrier.

Fixed/FreeR Whether the HSN of the interfering carrier was fixed before optimizing, or was free for the optimizer to change if it chose to do so.

Several Categories The following columns beginning with the Hopping Group list all the Categories that the interfering Carrier is in.

Co Penalty The co-penalty awarded from lists with statistics if the separation is 0.

Adj Penalty The adjacent penalty awarded from lists with statistics if the separation is 1.

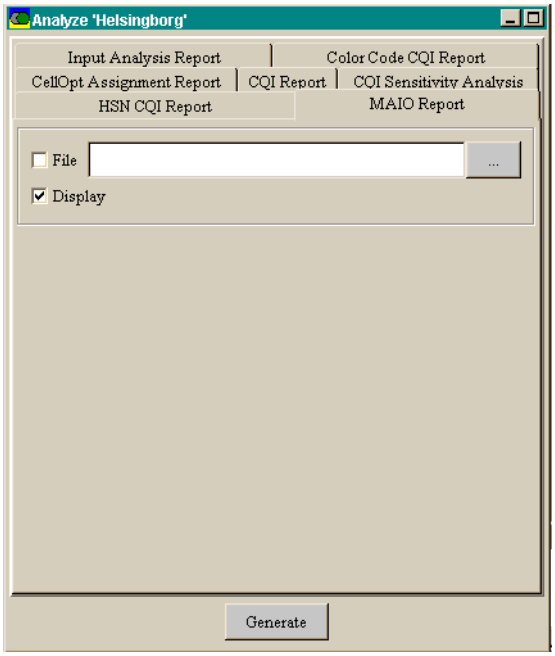
Extra Co Penalty The co-penalty awarded from lists other than those with statistics if the separation is 0.

Extra Adjacent Penalty The adjacent penalty awarded from lists other than those with statistics if the separation is 1.

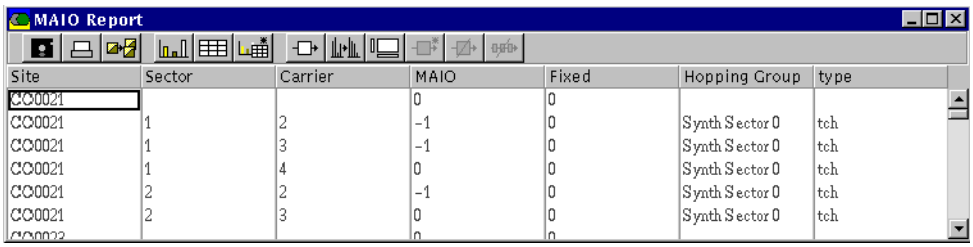
Larger Separation Penalty The adjacent penalty awarded from lists other than those with statistics if the separation is higher than 1.

Penalty Sum The total of all the penalties awarded for this row. The sum of all the penalties in this column is the CQI.

The MAIO report



The MAIO Report details whether any Mobile allocation index offsets could not be assigned. In order to generate the MAIO report choose the Analyze Panel and then select the MAIO report tab. Pressing Generate generates the report. The meaning of the individual columns is explained below the screengrabs:



Site	Sector	Carrier	MAIO	Fixed	Hopping Group	type
CC0021			0	0		
CC0021	1	2	-1	0	Synth Sector 0	tch
CC0021	1	3	-1	0	Synth Sector 0	tch
CC0021	1	4	0	0	Synth Sector 0	tch
CC0021	2	2	-1	0	Synth Sector 0	tch
CC0021	2	3	0	0	Synth Sector 0	tch

Site The site at which an assignment was attempted. If only the site appears in a row, then the MAIO could not be planned across the site.

Sector The sector of a failed MAIO assignment

Carrier	The carrier of a failed assignment.
MAIO	A -1 indicates no MAIO could be assigned.
Fixed/Free	Indicates whether or not the Carrier is fixed or free.

Saving, printing and customizing your report

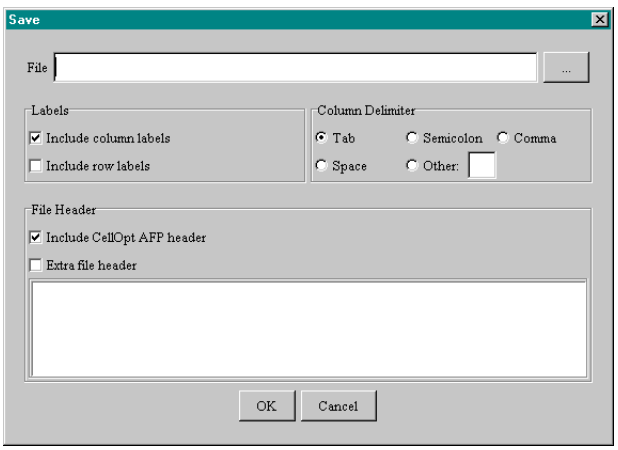
As soon as a report or log view window opens, a toolbar becomes available just under the title. This section describes the facilities available from each of these buttons.

You can detach the toolbar, making it a separate window, by dragging in one of the gaps between button sets. If you close it while a report window is open, it will return to its original place. A detached toolbar will disappear if you close its related report view.

Saving the report

Use this to save the contents of a particular view to disk. Pressing the save button brings up a popup menu that allows you to:

- Add a description at the top of the file
- Save the column labels as a separate row
- Save the row labels as a separate column
- Choose the character to use to separate columns

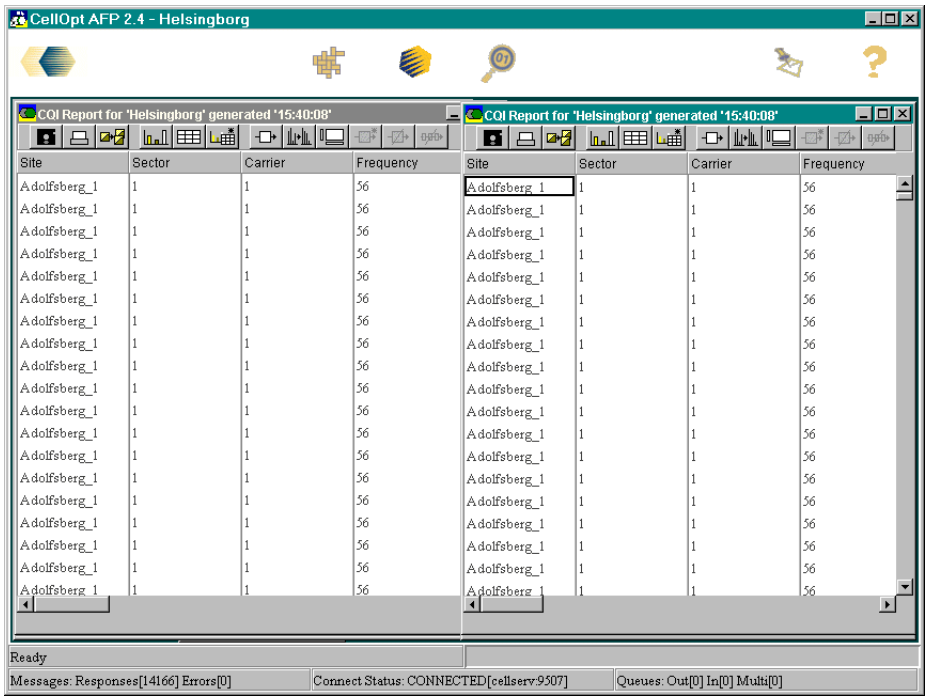


Printing the report

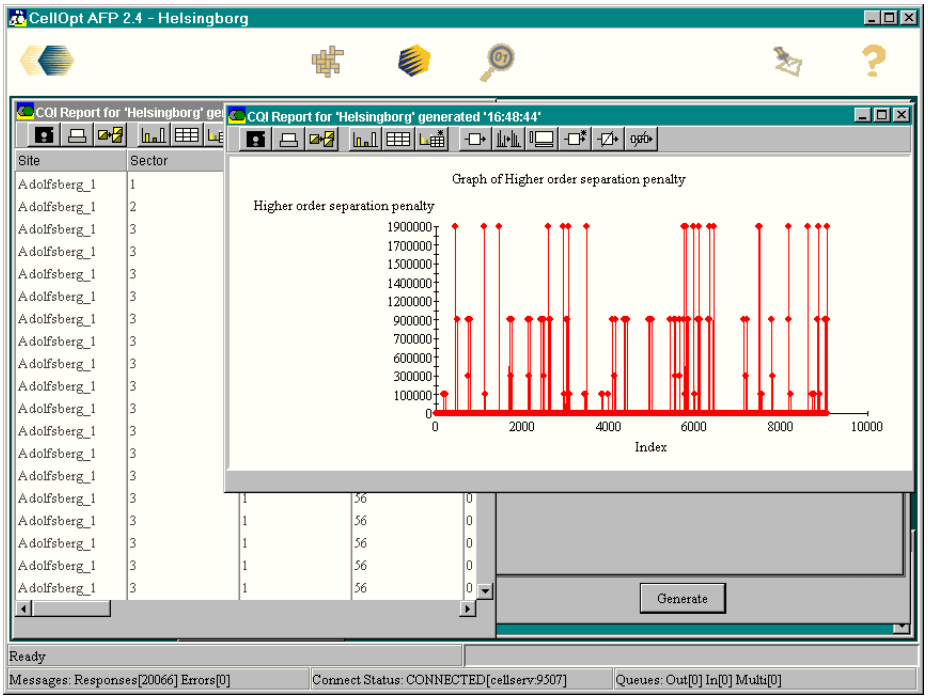
Use this button to obtain a preview of the table as it will be printed.

Duplicating the view

Use this button to create an exact duplicate view of the current report or optimizer results log in a new CellOpt window. You can produce as many of these as you wish.



Once created, duplicates are independent of each other. Each view has its own toolbar, which you can use to manipulate the data. This enables you to show two or more different treatments of the same data simultaneously, as the example below shows.



Each view's toolbar is detachable, but will still only work on the view from which it was detached.

Showing the report as a graph

When you do one of the following:

- generate a report;
- start the optimizer and it produces a results log; or
- edit an existing report by filtering, sorting or by producing a pivot table,

CellOpt displays the results as a table by default. If you click the Graph button for a chosen table, the view changes to graphical format. By default, this will be a standard X-Y line graph and CellOpt chooses the axes.

Once the graph is on the screen, you can:

- Use any two of the column headings in the chosen table as the X and Y axes.
- Change the format from line graph to bar or area graph format.

Instructions for making these changes are given in the section on “Configuring a graphical view” on page 22.

The Graph button is inoperative in a view which is already graphical.

Showing the report as a table

Whenever you generate a view of a report (or CellOpt displays an optimizer results log), the default format is always tabular. If you have changed any table to graphical format, you can change its view back to its source table by clicking this button. The button is inoperative in a view which is already tabular.

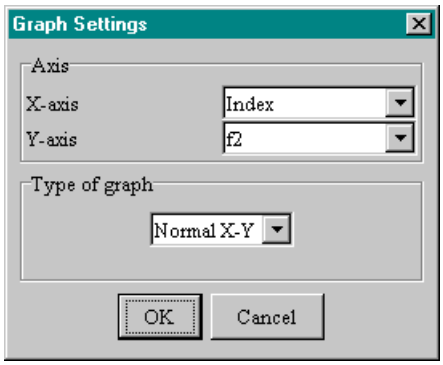
Configuring a graphical view

Once you have used the Graph button (described earlier) to show a graphical view of a report, you can use this button to:

- Choose new X and Y axes from the column headings of the table from which this view was created.
- Choose the display format, which can be a line, bar or area graph.

To configure a graphical view:

1 To see the dialog box below, click the graph configuration button in the graphical view you want to edit. Note that the button is inoperative in tabular views.



2 Open the **X Axis** drop-down menu to see a complete list of the column headings of the graph’s original table. Choose one of them.

3 Repeat step 2 for the **Y axis**.

4 Open the **Type of Graph** drop-down menu and choose the format from:

- Normal X-Y.
- Bar Graph.
- Area Graph.

5 Click **OK** to see the newly configured graph.

Note the following:

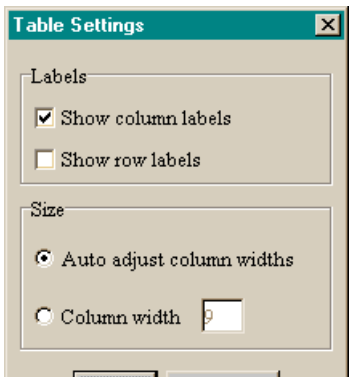
- If the information on the graph is hard to read, try swapping the X and Y axes. The scale adjustment often makes a difference.
- The graph takes its title from the name of the Y (vertical) axis.

Configuring a Table View

If the report is in table mode, you can configure the table view. Click on the icon above to bring up the settings dialog. In it, you can choose the following:

- Whether the column labels should be visible or not.
- Whether the row labels should be visible or not.
- How wide the columns should be.

Click **OK** to see the newly configured table.



Run the data through a filter

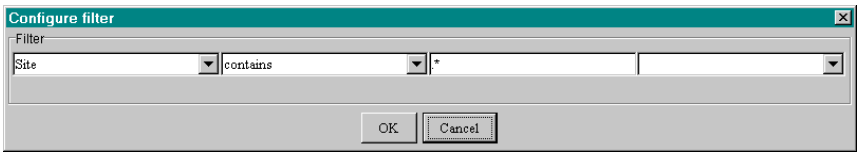
When you filter the data in a chosen report, you create one or more rules by choosing a column heading, a verb and a value - for instance **Sector equals 3**. CellOpt then removes all the rows from the table which do not obey the rules. Note that the filter removes rows; the number of columns remains the same as it was in the original report.

You can set up filters either for original reports, pivot tables (see later in this chapter) or reports which have already been filtered. If a report has been filtered or pivoted more than once, you can remove the filters all at once or one at a time in reverse order - these facilities are also described later in this chapter.

If you set up a filter from a report or pivot table, you will be offered the column headings which appear in that report or table. If you are starting from a graphical view, however, you are offered all the column headings in the underlying table from which the graph is taking its data. For instance, a graph of carrier **type** against interfering carriers' types (**typeR**) looks at the **types** and **typeR**s of all the carriers in the network - but if you apply a filter of **Sector equals 3**, the graph will take its data only from carriers belonging to 3-carrier sectors.

To set up a filter:

1 In the chosen tabular or graphical view, click the filter configuration button to see the dialog box below.



2 From the leftmost dropdown list, choose the name of a column whose values you want to filter.

3 From the second dropdown list, choose one of the following verbs:

CellOpt will retain a row in the report if the value in the named column:

contains Contains the character or characters you are about to enter in the box to the right. For instance, **Sector contains 3** would retain any row with a sector count of 3, 13, 23, 33 and so on

	CellOpt will retain a row in the report if the value in the named column:
equals	Equals the character or characters you are about to enter in the box to the right. For instance, **Sector equals 3** would retain any row with a sector count of 3, but reject any with a count of 13, 23, 33 and so on
begins with	Starts with the character or characters you are about to enter in the box to the right. For instance, **Sector begins with 3** would retain any row with a sector count of 3 or 35 but reject any with a count of 13, 23, 33 and so on
ends with	Ends with the character or characters you are about to enter in the box to the right. For instance, **Sector ends with 3** would retain any row with a sector count of 3 or 53 but reject any with a count of 31, 32, 34 and so on
regular expression	You can enter a UNIX regular expression here. For example ^..21.A matches all strings that have two arbitrary characters followed by 21, another arbitrary character and an A.

4 Enter a character or characters in the third box as described in step 3. Note that the default is *., denoting “all values”.

5 If this rule is the last (or only) one for the results you want, continue from step 8. If you want to add a further rule, continue from step 6.

6 From the rightmost dropdown menu, choose:

- **and** if the resultant rows must obey the rule in this line and the one in the next one as well.
- **or** if you want CellOpt to accept any row which obeys the rule in this line, or in the next one, or in both.

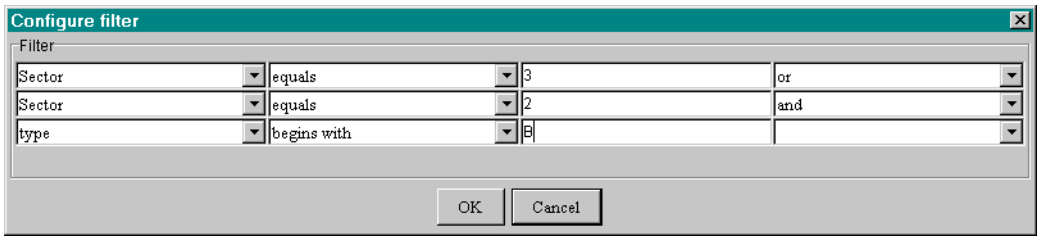
7 A new line appears (see the example below). Repeat steps 2 to 5. Note that:

- You can set up as many rules as you like.
- You can include the same column heading in two or more rules. For example, you can legally set **Sector equals 2 or Sector equals 3** on two separate lines.
- The order of the rules is important:

The example below, **Sector equals 3** or **Sector equals 2** and **type begins with B**, should be read as (**Sector equals 2** or **Sector equals 3**) and type begins with B. The result would show all rows with 2 or 3 carriers in their sectors as long as their **type** layer values also began with **B**.

If you change the order to **Sector equals 3** and **type begins with B** or **Sector equals 2**, you read it as (**Sector equals 3** and **type begins with B**) or **Sector equals 2**. This accepts rows with 2 carriers in their sectors irrespective of their types, but will only take 3-carrier rows if their types begin with **B.**

Because of the potential for confusion, it is advisable to set up filters with no more than three rules, and then to apply your next set of rules to the resultant report. As CellOpt allows you to remove one filter at a time, you can identify and correct mistakes quickly without having to start from scratch every time.



8 The filter is now ready. Click **OK** to remove the filtered-out rows from the report or pivot table or to redraw the graph from the altered source data. **Cancel** closes the dialog box and leaves the report, table or graph unchanged.

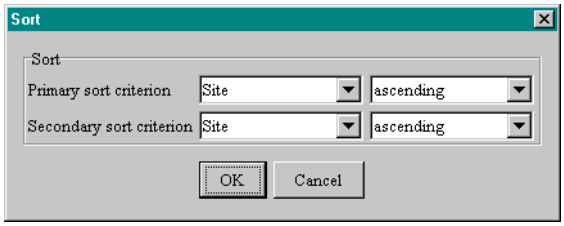
Sort the data

You can change the order of the rows in any report or pivot table by defining the order in which a given column displays its data.

You can use this facility only for reports and pivot tables. If you use it in a graphical view, it will affect the underlying report or pivot table but will not alter the graph itself.

To sort the data in a chosen table:

1 In the chosen tabular report or pivot table view, click the sort button to see the dialog box below.



2 Use the **Primary sort criterion** left dropdown menu to choose the column whose values you want to be the basis for the sort.

3 Use the **Primary sort criterion** right dropdown menu to choose whether the order is to be **ascending** (lowest value at the top of the table) or **descending**.

4 If you want to, you can order rows with the same primary value by choosing another column and sort order as a **Secondary sort criterion**. Otherwise skip this step and go on to the next one.

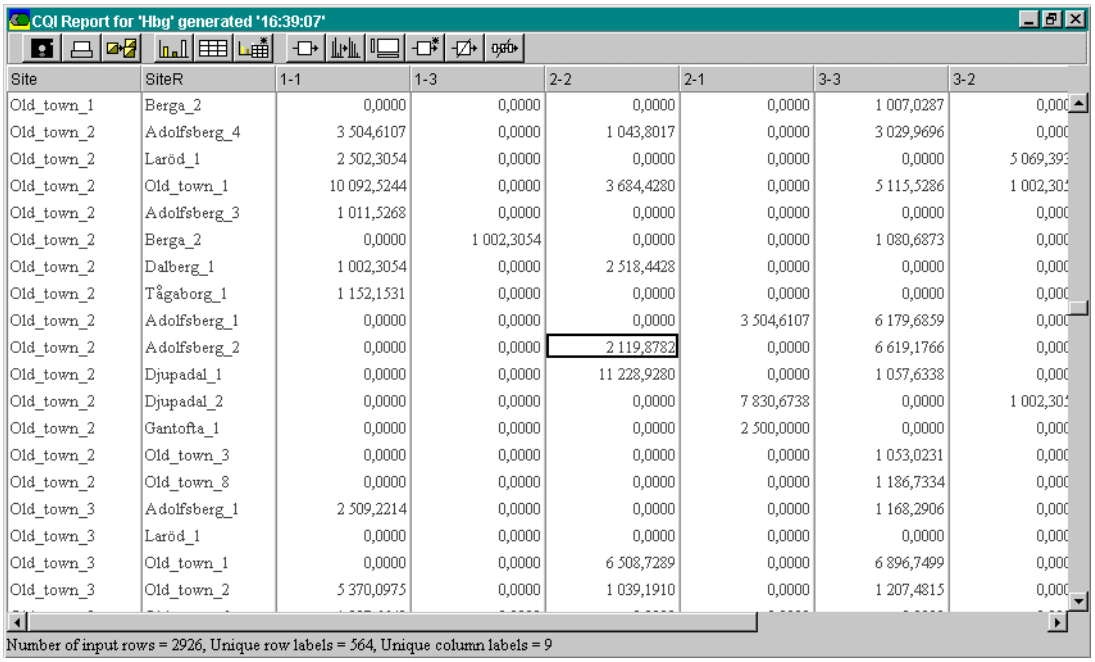
5 The sort is now ready. Click **OK** to redraw the report table. Cancel closes the dialog box and leaves the table unchanged.

Run the data through a pivot table

CellOpt provides a pivot table facility so you can customize the presentation of a report's data. You can:

- Choose one or more columns of the original report to act as rows in the pivot table.
- Choose one or more columns of the original report to act as columns in the pivot table.
- Choose the sort of data which will go into the cells of the table.

The example below was created by choosing **Site** and **SiteR** as the rows, **Sector** and **SectorR** as the columns, **Sum of penalties** as the data field and **Sum** as the pivot function.


CQI Report for 'Hbg' generated '16:39:07'

Site	SiteR	1-1	1-3	2-2	2-1	3-3	3-2
Old_town_1	Berga_2	0,0000	0,0000	0,0000	0,0000	1 007,0287	0,000
Old_town_2	Adolfsberg_4	3 504,6107	0,0000	1 043,8017	0,0000	3 029,9696	0,000
Old_town_2	Laröd_1	2 502,3054	0,0000	0,0000	0,0000	0,0000	5 069,39
Old_town_2	Old_town_1	10 092,5244	0,0000	3 684,4280	0,0000	5 115,5286	1 002,30
Old_town_2	Adolfsberg_3	1 011,5268	0,0000	0,0000	0,0000	0,0000	0,000
Old_town_2	Berga_2	0,0000	1 002,3054	0,0000	0,0000	1 080,6873	0,000
Old_town_2	Dalberg_1	1 002,3054	0,0000	2 518,4428	0,0000	0,0000	0,000
Old_town_2	Tågaborg_1	1 152,1531	0,0000	0,0000	0,0000	0,0000	0,000
Old_town_2	Adolfsberg_1	0,0000	0,0000	0,0000	3 504,6107	6 179,6859	0,000
Old_town_2	Adolfsberg_2	0,0000	0,0000	2 119,8782	0,0000	6 619,1766	0,000
Old_town_2	Djupadal_1	0,0000	0,0000	11 228,9280	0,0000	1 057,6338	0,000
Old_town_2	Djupadal_2	0,0000	0,0000	0,0000	7 830,6738	0,0000	1 002,30
Old_town_2	Gantofta_1	0,0000	0,0000	0,0000	2 500,0000	0,0000	0,000
Old_town_2	Old_town_3	0,0000	0,0000	0,0000	0,0000	1 053,0231	0,000
Old_town_2	Old_town_8	0,0000	0,0000	0,0000	0,0000	1 186,7334	0,000
Old_town_3	Adolfsberg_1	2 509,2214	0,0000	0,0000	0,0000	1 168,2906	0,000
Old_town_3	Laröd_1	0,0000	0,0000	0,0000	0,0000	0,0000	0,000
Old_town_3	Old_town_1	0,0000	0,0000	6 508,7289	0,0000	6 896,7499	0,000
Old_town_3	Old_town_2	5 370,0975	0,0000	1 039,1910	0,0000	1 207,4815	0,000

Number of input rows = 2926, Unique row labels = 564, Unique column labels = 9

The information in the first row tells us that the interference between:

- The carrier in the #2 sector of site Old_town_2 and
- The carrier in the #2 sector of site Adolfberg_2

Gives rise to a total penalty of 2119.8782. In addition, there is penalized interference between the third sector of Old_town_2 and the third sector (6619.1766) of Adolfsberg_2. There may well be further interactions between the two sites, which you can see by scrolling sideways.

The rows of this example lists every possible pairing of two interfering sites. Where the first two columns contain the same site number, the penalties shown are for interference between different sectors of the same site.

The columns of the example show every possible pairing of interfering sector numbers.

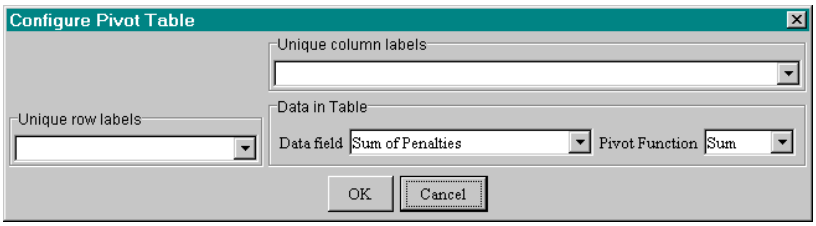
The instructions below amplify the choices you can make for the data field and pivot function.

You can create a pivot table from any report. If it is a filtered report or previously configured pivot table, the table will use only the information in the selected report or table. If you

create a pivot table from a graph view, you will be offered the columns and data belonging to the original report from which the graph was derived.

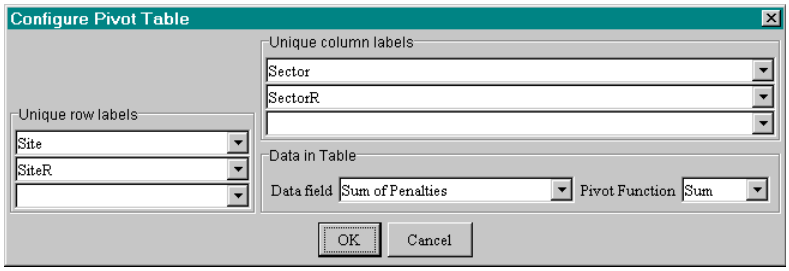
To produce a pivot table:

1 In the chosen source report, click the pivot table button to see a dialog box like the one below:



2 Give labels to the columns and rows of the pivot table:

- The **Unique column labels** dropdown menu enables you to choose a column heading from the source report or pivot table. Each value in the original report column will have its own column in the new pivot table. In the example above, the first column label chosen was **Sector**, and the sector number is the first digit in each column (except for the first two columns).
- Once you have chosen the first column label, a new line opens for you to add another - see the example below, which was used to generate the table above. In the example, the second column chosen was **SectorR**, so the columns of the pivot table show every possible combination of **Sector** and **SectorR** values.
- You can add as many column labels as you like - note, however, that if there are a large number of possible combinations, the table may be too large for easy understanding.



- The **Unique row labels** dropdown menu enables you to choose a column heading from the source report or pivot table. Each value in the original report column will have its own row in the new pivot table. In the example above, the first row label chosen was Site, so the first column of the pivot table is labeled **Site** and each row holds a site name. Once you have chosen the first row label, a new line opens for you to add another. In the example, the second row chosen was **SiteR**, so the rows of the pivot table show every possible combination of **Site** and **SiteR** values. You can add as many row labels as you like - but note the warning above.

3 Choose the information whose value is to be shown in the table cells. The Data field dropdown menu allows you to select any of the column headings. In the example above, **Sum of penalties** was chosen: each cell in the table shows the sum of the penalties for interference between the carrier pairs identified by the row (site pairings) and column (sector pairings within the sites) headings.

4 Choose the way the **Data field** values are to be presented. From the Pivot Function dropdown, choose from:

Sum	This will add all nonzero entries of the Data field column, and display the result in the relevant pivot.
Count	This will count the number of nonzero entries of the Data field column.
Max	This will display the largest entry of the Data field column.
Min	This will display the smallest entry of the Data field column.
Average	This will display the average of the nonzero entries in the Data field column.

5 The table is now ready. Click **OK** to redraw the table or graph. **Cancel** closes the dialog box and leaves the table or graph unchanged.

Configuring the current filter

If you run the data through a filter or a pivot table, you can do so progressively - you can filter previously filtered data, create a pivot table from filtered data, or filter the data in a pivot table. Your most recent action is called the current filter.

If the current filter has not produced the data presentation you wanted, you can change the filter or pivot table by clicking this button to see the appropriate filter or pivot table dialog box exactly as it was when you clicked OK, and you can change it as you wish.

This button is greyed if there is no current filter.

Removing the current filter

You can delete the current filter (defined immediately above), to return the data presentation to the way it was (an original report, filtered report or pivot table) before you applied the filter. You can therefore use it to work backwards through a series of filters, removing them in the reverse order in which you created them.

This button is greyed if there is no current filter.

Removing all filters

This button removes all filters and deletes all pivot tables, returning you the original report in standard format.

This button is greyed if there is no current filter.

11
Input and Output Formats

This chapter lists (with some examples) the file formats that CellOpt AFP supports.

The basic supported formats are as follows:

- CellOpt I File Format.
- CellOpt AFP II File Format.
- MSI's PlaNET File Format.

The Output formats (used in Exporting – see the section on "Using CellOpt AFP") are in general the same as the input formats for the carriers. There are comments about this in each format type.

CellOpt AFP automatically tries to detect the format of each file loaded. The detection is based on certain formats of the data or specific keywords in the file. There is no file naming convention. The auto-detection of file formats is explained in more detail at the end of this chapter.

All file formats are ASCII based. The CellOpt AFP file loader will ignore all empty lines and all comment lines that beginning with a # (hash).

CellOpt 1 File Format

The CellOpt I File Format is a simple format that has been used in the CellOpt AFP revision 1.x series. It is supported by CellOpt AFP revision 2.x for its simplicity and for backward compatibility.

The different file types are:

- Carrier Database

- Interference Statistic List
- Neighbor List
- Exception List
- Illegal Frequency List
- Site List

These are described below.

Carrier database

The Carrier database contains data that describes the sites, sectors and number of carriers allocated and required. Each line describes a sector and has the following format:

```
site sector carriers_required carriers_allocated carrier1 …
```

Where

`site`	is the site name – string
`sector`	is the sector/cell name – integer
`carriers_required`	is the number of required carriers/frequencies – integer
`carriers_allocated`	is the number of allocated carriers/frequencies – integer
`carrier1 ...`	is the frequency/channel number – integer

The numbers of carriers is `carriers_allocated` and `carrier1` is the *control* carrier.

Example

```
CO01 1 2 2 56 78
CO02 1 3 2 53 85
CO02 2 2 3 62 69 93
CO03 3 2 0
```

This file format is used to export the frequency plan.

Interference Statistics List

The Interference Statistics List contains separation rules with statistical values, which indicate the consequence of not meeting the separation requirement. Each line shows the separation rule between two sectors and has the following format:

```
site_interfered sector_interfered site_interfering
sector_interfering co_statistic adj_statistic
```

Where

`site_interfered`	is the site name of the sector/sector being interfered – string

`sector_interfered`	is the sector name of the sector/sector being interfered – integer
`site_interfering`	is the site name of the sector/sector interfering – string
`sector_interfering`	is the sector name of the sector/sector interfering – integer
`co_statistic`	is a value of how much interference would be seen by the interfered sector if it were co-frequency/channelled to the interfering sector. – real
`adj_statistic`	is a value of how much interference would be seen by the interfered sector if it were adjacent frequency/channelled to the interfering sector. – real

The co and adjacent statistics could include the area, percent area, traffic (preferred and recommended), percent traffic and so on which would be interfered.

Example

```
CO01 1 CO02 1 53.2 34.1
CO02 1 CO02 2 123.8 76.4
```

Neighbor List

The Neighbor List describes separation rules needed between two sectors because they are neighbors (these rules do not necessarily have to be from neighbors alone). Each line shows the separation rule between two sectors and has the following format:

```
site sector site_neighbour sector_neighbour
```

Where

`site`	is the site name – string
`sector`	is the sector name – integer
`site_neighbour`	is the site name of the neighboring site – string
`sector_neighbour`	is the sector name of the neighboring sector – integer

Multiple Neighbor Lists can be loaded.

Example

```
CO01 1 CO02 1
CO02 1 CO02 2
```

Exception List

The Exception List is similar to the Neighbor List, but also contains the separation requirement. Each line shows the separation rule between two sectors and has the following format:

```
site sector site_exception sector_exception separation
```

Where

`site`	is the site name – string
`sector`	is the sector name – integer
`site_exception`	is the site name of the exception site – string
`sector_exception`	is the sector name of the exception sector – integer
`separation`	is the required separation between the interfered and interfering sectors (1 = no co, 2 = neither co nor adjacent allowed) – integer

Multiple Exception Lists can be loaded.

Example

```
CO01 1 CO02 1 2
CO02 1 CO02 2 1
```

Illegal Frequency List

The Illegal Frequency List specifies rules for not using certain frequencies. Each line shows the frequency not to be used (illegal frequencies) in the sector and has the following format:

```
site sector frequency
```

Where

`site`	is the site name – string
`sector`	is the sector name – integer
`frequency`	is the frequency/channel number – integer

Multiple Illegal Frequency Lists can be loaded. More illegal frequencies would be specified on additional lines.

Example

```
CO02 1 112
CO02 1 113
CO02 1 114
```

Site List

The Site List contains a list of sites to be used within CellOpt AFP. Each line has the following format:

```
site
```

Where

`site` is the site name – string

NOTE The first two lines of the file are ignored. They must neither be empty nor comment lines.

Example

```
CellOpt Site List
Created on 17 November 1997
CO01
CO02
```

CellOpt AFP II File Format

This section briefly describes the messages that form the CellOpt Automatic Frequency Planner Revision 2 (CellOpt AFP 2) File Interface. It is assumed that you are familiar with the basic concepts underlying the modelling capabilities and optimizing functions of CellOpt AFP 2.

CellOpt AFP 2.x extends CellOpt 1.x. in concept and functionality.

NOTE CellOpt AFP 2.1 File Format is not backward compatible to CellOpt AFP 2.0 File Format.

Input File

An input file to CellOpt AFP typically contains several messages of the same or different type. CellOpt uses the following file forms:

Carrier Database - This contains information on all the cells in the network to be considered. It contains cell names, numbers of carriers required and existing frequencies allocated.

Interference Lists - This tells us how much/how many percent traffic/area will be interfered if two carriers in two particular cells are allocated to the same or adjacent frequency.

Neighbor Lists - A list of the neighbor relations in the network.

Exception Lists - A list of the exceptions in the network e.g. separation requirements for different cell relations and illegal frequencies for certain sectors.

Illegal frequency lists - A list of cells and their illegal frequencies.

Blank lines and lines starting with # will be seen as comment lines and will be ignored by CellOpt AFP.

Message

A message is a single line of information beginning with a mnemonic, a model name and optionally fields separated by a TAB (ASCII character 9). These messages give the user a powerful way of defining the input data to CellOpt.

There are two different basic types of messages, input messages and application messages. The input messages have the letter i as the first character in the mnemonic and is used for sending data into CellOpt AFP 2. The application messages have the letter a as the first character in the mnemonic and is used for sending commands and some data into CellOpt AFP 2.

Mnemonics

Different mnemonics are used to define the different types of messages. The important ones for the file interface are:

iSITE	Used to define sites in the network.
iSECT	Used to define sectors in the network.
iCARF	Used to define carriers in the network.
iFRQG	Used to define which frequencies belongs to a Sub set/Set/Group/MAL.
iCONC	Used to define a relation between two carriers or sectors, e.g. neighbor relation, interference, exception
iCONF	sed to define illegal frequencies for a carrier.
iCOFL	Used to define illegal frequencies for all carriers in a layer.
aLOAD	Used for loading a file.
aLIST	sed for creating a list.

Mask

The mask defines which bits are valid for the message. The first bit in the message is the least significant bit. A 1 means that the data field is valid and a 0 means that it will not be taken into account. Here is an example of a mask for a message of the form

```
MnemonicModel MaskData1 Data2 Data3 Data4 Data5 Data6
```

in which we require the model and mask bits, and data bits 1,3 and 6.

Mnemonic	Model	Mask	Data1	Data2	Data3	Data4	Data5	Data6	Sum
Binary	1	1	1	0	1	0	0	1	10010111
Decimal	1	2	4	0	16	0	0	128	151

In this case the mask should be set to 151 and the data Data1, Data3 and Data6 will be read into CellOpt. Note that the model and mask data fields must be included in the mask itself but the mnemonic field must not.

If the model and mask fields of the mask i.e. the two least significant bits, are set to 0 the message will be a delete message and those data fields that are set will be deleted.

To help with the mask the table below can be used or a calculator that can convert binary to decimal may be used.

	d0	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12	d13
Value	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192
Sum	1	3	7	15	31	63	127	255	511	1023	2047	4095	8191	16383

Model

A model is the representation of the network structure and behavior, containing the penalties, settings and the files to be loaded. The model part of the message could be seen as a default name of a model. This name will be changed inside CellOpt to the model name in which the file is loaded. Therefore use e.g. model as the model name in the input file.

List

A list is a set of assignment restrictions, e.g. a set of several messages having the same behavior. CellOpt AFP uses three different types of lists, frequency penalty lists, separation penalty lists and separations penalty with statistics lists.

Data

A data field can be of any of the following types: char, int or float. The asterisk (*) character is used as a wild character and an empty data field should be represented with the dash (-) character.

Content

This section explains the content of the different data fields in the messages.

aLIST

Name: Create a List

Description: Creates a new list in CellOpt

Message: `aLIST list_desc type_of_penalty`

Usage: Used to create a new list. Must be used before using the messages iCONC, iCOFL and iCONF into a new list.

Data Description:

Data	Description	Data Type	Range
List_desc	Name of the list that will be created.	Char	
Type_of_penalty	Which type of penalty the list contains	Int	0 frequency penalty 1 separation penalty with statistics 2 separation penalty

aLOAD

Name: Load a File

Description: Loads a file into CellOpt

Message: `aLOAD FileType FileName ListName`

aLOAD

Usage: Used to load files into CellOpt

Data Description:

Data	Description	Data Type	Range
FileType	The file type of the file	Int	1 CellOpt AFP 2 Generic Format 0 All other formats
FileName	Name of the file	char	
ListName	Name of the lists that will be created. Optional numbers of these.	Char	

iSITE

Name: Site Record

Description: The record defining the site

Message: `iSITE model mask site_desc latitude longitude`

Usage: Used to create sites in the network. This is the highest level you can define in the network and gives the positions of the sites. This message could be used in the **Carrier Database** if the features in CellOpt AFP that is using site positions are used.

Data Description:

Data	Description	Data Type	Range
Site_desc	The site name or number.	Char	The wild character (*) are not allowed
latitude	The latitude represented as a decimal, e.g. -56.0424	Float	
longitude	The longitude represented as a decimal, e.g. 12.7292	Float	

iSECT

Name: Sector Record

Description: The record defining the sector

Message:
```
iSECT model mask site_desc sector_desc
served_traffic served_area
```

Usage: Used to create sectors in the network. There is no message for creating sites, that means that this is the highest level you can define in the network. This message is one of two parts in creating the Carrier Database.

Data Description:

Data	Description	Data Type	Range
Site_desc	The site name or number.	Char	The wild character (*) are not allowed
Sector_desc	The sector name or number. A site can have many sectors and are then separated by this description	Char	The wild character (*) are not allowed
Served_traffic	The amount of traffic that is served in this sector	Float	>=0
Served_area	The area that is served in this sector.	Float	>=0

iCARF

Name: Carrier Record

Description: The record defining the carrier data

Message:
```
iCARF model mask site_desc sector_desc
car_desc freq frq_id served_traffic
code_desc fix_id position control_id HSN
MAIO
```

Usage: Used to create carriers in the network and the specific characteristics for carriers. This is the second part in creating the Carrier Database.

Data Description:

Data	Description	Data Type	Range
Site_desc	The site name or number.	Char	The wild character (*) is not allowed
Sector_desc	The sector name or number. A site can have many sectors and are then separated by this description	Char	The wild character (*) is not allowed
Car_desc	The carrier name or number	Char	The wild character (*) is not allowed
Freq	The frequency assigned to the carrier.	Int	
Frq_id		Int	= 0
Served_traffic	The amount of traffic that is served by this carrier	Float	>=0
Code_desc	The color code for this carrier.	Char	
Fix_id	Whether this carrier is fixed to the freq value or if it is free to change. This can be changed inside CellOpt	Int	0 = free 1 = absolutely fixed
Position	The position in the sector for this carrier	Int	>0 and unique for this carrier on this site and sector.
Control_id	If this is a control carrier or not.	Int	0 = not control carrier 1 = control carrier
HSN	The Hopping Sequence Number for this carrier	Int	0-63
MAIO	The MAIO for this carrier	Int	

iFRQG

Name: Frequency Group Record

Description: The record defining a globally available frequency groups

Message:
```
iFRQG model group_id no_freqs frequency1
frequency2 ...
```

iFRQG

Usage: Used to define the frequencies in each of the sub set/set/group/MAL. Used in the Carrier Database when using frequency groups (sub set/set/group) and SFH (MAL) planning.

Data Description:

Data	Description	Data Type	Range
Group_id	Specify what type of group and the number of that group. The types and their offset are: Sub set = 1 Set = 2 Group = 3 MAL, user defined = 4 MAL, pre-generated = 8 MAL, customizable = 9 The group_id is created by using the formula sub set / set / group / MAL id + type_offset * 100 000	Int	
no_freqs	The number frequencies included in the sub set/set/group/MAL	Int	
Frequency1	The number of the first frequency in the sub set/set/group/MAL	Int	
Frequency2	The number of the second frequency in the sub set/set/group/MAL	Int	
. .	. .		

iCONC

Name: Carrier Constraint Relation

Description: The record defining the statistic values between two carriers or between two sectors

Message:

```
iCONC model mask site_desc sector_desc
car_desc site_R_desc sector_R_desc
car_R_desc list_desc coStatistic
adjStatistic sep_req
```

iCONC

Usage: Used to create carriers in the network and the specific characteristics for carriers. This message is used to create Interference Lists, Neighbour Lists and Exception Lists. For the last two types of lists the statistics fields are typically set to 0.

For separations penalty lists the separation can be set either in the input messages or in the program. The optimizer will take the highest set separation as the valid one. To have the ability to change the separation the separation in the input file should be set to 0. For separations penalty with statistics lists the separation can only be set in the input file.

The most usual separation value for those is 2. Separation with higher values than 2 will use the adjStatistic as statistic.

Data Description:

Data	Description	Data Type	Range
Site_desc	The serving site name or number.	Char	The wild character (*) is not allowed
Sector_desc	The serving sector name or number. A site can have many sectors and are then separated by this description	Char	The wild character (*) is not allowed
Car_desc	The serving carrier name or number. If the wild character (*) is used this relation will be valid for the whole sector.	Char	
Site_R_desc	The interfering/neighbour site name or number.	Char	The wild character (*) is not allowed
Sector_R_desc	The serving sector name or number. A site can have many sectors and are then separated by this description	Char	The wild character (*) is not allowed. Not allowed to equal sector_desc if site_desc equal site_R_desc
Car_R_desc	The serving carrier name or number. If the wild character (*) is use this relation will be valid for the whole sector.	Char	

list_desc	The list where the relation is kept. The list must have been created with the aLIST message.	Char	
CoStatistic	The co-channel statistic for the relation above.	Float	>=0
AdjStatistic	The adj-channel statistic the relation above.	Float	>=0
Sep_req	The separation for the relation above.	Int	0,1,2,..

iCONF

Name: Frequency Constraint Relation

Description: The record defining the extra penalty values between a carrier, or a sector, or a network and an illegal frequency.

Message:
```
iCONF model mask site_desc sector_desc
car_desc freq list_desc coPenalty
adjPenalty sep_req
```

Usage: Used to create carriers in the network and the specific characteristics for carriers. This message is used to create illegal frequency lists.

Data Description:

Data	Description	Data Type	Range
Site_desc	The site name or number.	Char	The wild character (*) is not allowed
Sector_desc	The sector name or number. A site can have many sectors and are then separated by this description	Char	The wild character (*) is not allowed
Car_desc	The carrier name or number. If the wild character (*) is used this relation will be valid for the whole sector.	Char	
Freq	The frequency assigned to the carrier.	Int	
list_desc	The list where the illegal frequencies is stored.	Char	= Illegal Frequencies

CoPenalty	The co-channel penalty for assigning the above frequency to the above carrier/sector.	Float	>=0
AdjPenalty	The adj-channel penalty for assigning the above frequency to the above carrier/sector.	Float	>=0
Sep_req	The separation for the relation above.	Int	0,1,2,..

iCOFL

Name: Frequency Constraint List

Description: The record defining the extra penalty values for an illegal frequency for the Category and Layer in a list.

Message: `iCOFL model mask cat_desc layer_desc freq list_desc coPenalty adjPenalty sep_req`

Usage: Used to create carriers in the network and the specific characteristics for carriers. This message is used to create illegal frequency lists.

Data Description:

Data	Description	Data Type	Range
Cat_desc	The Category name.	Char	The wild character (*) are not allowed
Layer_desc	The layer name.	Char	The wild character (*) are not allowed
Freq	The frequency assigned to the carrier.	Int	
list_desc	The list where the illegal frequencies is stored.	Char	= Illegal Frequencies
CoPenalty	The co-channel penalty for assigning the above frequency to the above carrier/sector.	Float	>=0
AdjPenalty	The adj-channel penalty for assigning the above frequency to the above carrier/sector.	Float	>=0
Sep_req	The separation for the relation above.	Int	0,1,2,..

Creating files for CellOpt AFP

Carrier Database

The carrier database is created by a set of iSECT and iCARF messages. One iSECT message for each sector in the network and one iCARF message for each carrier in the network.

```
#Carrier Database for a network with 3 sector and 2
carriers for each sector
iSECT model 63 CO021 1 6573.000 1.250
iSECT model 63 CO021 2 6210.000 1.120
iSECT model 63 CO022 1 5349.000 1.580
iCARF model 4095 CO021 1 1 102 0 0.000 43 1 1 1 0 0
iCARF model 4095 CO021 1 2 86 0 0.000 - 1 2 0 0 0
iCARF model 4095 CO021 2 1 108 0 0.000 44 1 1 1 0 0
iCARF model 4095 CO021 2 2 99 0 0.000 - 1 2 0 0 0
iCARF model 4095 CO022 1 1 80 0 0.000 45 1 1 1 0 0
iCARF model 4095 CO022 1 2 89 0 0.000 - 1 2 0 0 0
```

Carrier Database including site position

The carrier database including site position is created by a set of iSITE, iSECT and iCARF messages. One iSITE message for every site in the network, one iSECT message for each sector in the network and one iCARF message for each carrier in the network.

```
#Carrier Database for a network with 3 sector and 2
carriers for each sector
iSITE model 31 CO021 –56.0424 12.7292
iSITE model 31 CO022 –56.0535 12.7287
iSECT model 63 CO021 1 6573.000 1.250
iSECT model 63 CO021 2 6210.000 1.120
iSECT model 63 CO022 1 5349.000 1.580
iCARF model 16383 CO021 1 1 102 0 0.000 43 1 1 1 0 0
iCARF model 16383 CO021 1 2 86 0 0.000 - 1 2 0 0 0
iCARF model 16383 CO021 2 1 108 0 0.000 44 1 1 1 0 0
iCARF model 16383 CO021 2 2 99 0 0.000 - 1 2 0 0 0
iCARF model 16383 CO022 1 1 80 0 0.000 45 1 1 1 0 0
iCARF model 16383 CO022 1 2 89 0 0.000 - 1 2 0 0 0
```

Carrier Database including MAL's

The carrier database including MAL's is created by a set of iSECT, iCARF and i FRQG messages. One iSECT message for each sector in the network, one iCARF message for each carrier in the network.

```
#Carrier Database for a network with 3 sector and 2
carriers for each sector
```

```
iSECT model 63 CO021 1 6573.000 1.250
iSECT model 63 CO021 2 6210.000 1.120
iSECT model 63 CO022 1 5349.000 1.580
iCARF model 16383 CO021 1 1 102 0 0.000 43 1 1 1 0 0
iCARF model 16383 CO021 1 2 40002 0 0.000 - 1 2 0 3 0
iCARF model 16383 CO021 1 3 40002 0 0.000 - 1 3 0 3 2
iCARF model 16383 CO021 1 4 40002 0 0.000 - 1 4 0 3 4
iCARF model 16383 CO021 2 1 108 0 0.000 44 1 1 1
iCARF model 16383 CO021 2 2 40005 0 0.000 - 1 2 0 6 0
iCARF model 16383 CO021 2 3 40005 0 0.000 - 1 3 0 6 1
iCARF model 16383 CO021 2 4 40005 0 0.000 - 1 4 0 6 2
iCARF model 16383 CO022 1 1 80 0 0.000 45 1 1 1
iCARF model 16383 CO022 1 2 40010 0 0.000 - 1 2 0 8 0
iCARF model 16383 CO022 1 3 40010 0 0.000 - 1 3 0 8 2
iCARF model 16383 CO022 1 4 40010 0 0.000 - 1 4 0 8 4
iFRQG model 400002 8 95 98 102 104 105 108 112 117
iFRQG model 400005 6 90 93 96 99 101 103
iFRQG model 400010 9 88 92 97 100 106 108 109 114 116
```

Interference List

The interference list is created by a aLIST message follow by a set of iCONC messages. One iCONC message for each interference relation between two sectors/carriers in the network. Since the interference list usually is based from statistics the list should be created for separation penalties with statistic (option 1 for aLIST). The statistics data field will then be considered.

```
#Interference list for the above network. All relations are
set on a sector to sector #basis.
aLIST area 1
iCONC model 4095 CO021 1 * CO021 2 * area 0.136 0.019 2
iCONC model 4095 CO021 1 * CO021 2 * area 0.170 0.067 2
iCONC model 4095 CO021 1 * CO022 1 * area 0.096 0.011 2
iCONC model 4095 CO021 1 * CO022 1 * area 0.994 0.580 2
iCONC model 4095 CO021 2 * CO022 1 * area 0.634 0.280 2
```

Neighbor List

The neighbour list is created by a aLIST message follow by a set of iCONC messages. One iCONC message for each neighbour relation between two sectors in the network. Since the neighbour list is usually is based on separations between to sectors the list should be created for separation penalties (option 2 for aLIST). The statistics data field will not be considered.

```
aLIST neighbour 2
iCONC model 4095 CO021 1 * CO021 2 * neighbour 0 0 0
iCONC model 4095 CO021 1 * CO021 2 * neighbour 0 0 0
iCONC model 4095 CO021 2 * CO021 1 * neighbour 0 0 0
iCONC model 4095 CO021 2 * CO021 1 * neighbour 0 0 0
```

```
iCONC model 4095 CO021 2 * CO022 1 * neighbour 0 0 0
iCONC model 4095 CO021 2 * CO022 1 * neighbour 0 0 0
```

Exception List

The exception list is created by a aLIST message follow by a set of iCONC messages. One iCONC message for each exception relation between two sectors in the network. Since the exception list is usually is based on separations between to sectors the list should be created for separation penalties (option 2 for aLIST). The statistics data field will not be considered.

```
aLIST exception 2
iCONC model 4095 CO021 1 * CO021 2 * exception 0 0 0
iCONC model 4095 CO021 1 * CO021 2 * exception 0 0 0
iCONC model 4095 CO021 2 * CO021 1 * exception 0 0 0
iCONC model 4095 CO021 2 * CO021 1 * exception 0 0 0
iCONC model 4095 CO021 2 * CO022 1 * exception 0 0 0
iCONC model 4095 CO021 2 * CO022 1 * exception 0 0 0
```

Illegal frequency List

The illegal frequency list is created by a set of iCONF messages. One iCONF message for each illegal frequency on a carrier in the network. Those illegal frequencies will be stored in the illegal frequency list that is an automatically created list in CellOpt.

```
iCONF model 1023 CO021 1 * 90 Illegal Frequencies 0 0 1
iCONF model 1023 CO021 2 * 91 Illegal Frequencies 0 0 1
iCONF model 1023 CO022 1 * 92 Illegal Frequencies 0 0 1
```

Output from CellOpt

Two different types of output files can be created in CellOpt, Carrier & Sectors and Carriers. The first one gives a iSECT message for each sector in the network and a iCARF message for each carrier in the network. The second has a iCARF message for each carrier in the network.

Carriers

When choosing CellOpt AFP 2 format, Carriers in the export from CellOpt AFP the output file will have the following look:

```
#
#19 rows with comments
#
iCARF model 16383 CO021 1 1 98 0 0.000 49 1 1 1 0 0
iCARF model 16383 CO021 1 2 103 0 0.000 - 1 2 0 0 0
iCARF model 16383 CO021 2 1 95 0 0.000 48 1 1 1 0 0
```

```
iCARF model 16383 CO021 2 2 100 0 0.000 - 1 2 0 0 0
iCARF model 16383 CO022 1 1 108 0 0.000 47 1 1 1 0 0
iCARF model 16383 CO022 1 2 89 0 0.000 - 1 2 0 0 0
```

Carriers

When choosing CellOpt AFP 2 format, MAL's in the export from CellOpt AFP the output file will have the following look:

```
#
#19 rows with comments
#
iFRQG model 400001 8 95 98 102 104 105 108 112 117
iFRQG model 400005 6 90 93 96 99 101 103
iFRQG model 400010 9 88 92 97 100 106 108 109 114 116
```

Carriers & MAL's

When choosing CellOpt AFP 2 format, Carriers & MAL's in the export from CellOpt AFP the output file will have the following look:

```
#
#19 rows with comments
#
iFRQG model 400001 8 95 98 102 104 105 108 112 117
iFRQG model 400005 6 90 93 96 99 101 103
iFRQG model 400010 9 88 92 97 100 106 108 109 114 116
iCARF model 16383 CO021 1 1 98 0 0.000 49 1 1 1 0 0
iCARF model 16383 CO021 1 2 40001 0 0.000 - 1 2 0 5 0
iCARF model 16383 CO021 1 3 40001 0 0.000 - 1 3 0 5 2
iCARF model 16383 CO021 1 4 40001 0 0.000 - 1 4 0 5 4
iCARF model 16383 CO021 2 1 95 0 0.000 48 1 1 1 0 0
iCARF model 16383 CO021 2 2 40005 0 0.000 - 1 2 0 1 0
iCARF model 16383 CO021 2 3 40005 0 0.000 - 1 3 0 1 1
iCARF model 16383 CO021 2 4 40005 0 0.000 - 1 4 0 1 2
iCARF model 16383 CO022 1 1 108 0 0.000 47 1 1 1 0 0
iCARF model 16383 CO022 1 2 40010 0 0.000 - 1 2 0 7 0
iCARF model 16383 CO022 1 3 40010 0 0.000 - 1 3 0 7 2
iCARF model 16383 CO022 1 4 40010 0 0.000 - 1 4 0 7 4
```

MSI's PlaNET Format

MSI's PlaNET Format is supported for historical and popular reasons. It was used in the CellOpt AFP revision 1.x series and is supported by CellOpt AFP revision 2.x for its continued popularity and for backward compatibility.

Carrier database

The carrier database expresses the sectors and carriers that CellOpt AFP should consider. It also contains information about pre-assigned carriers and defines which carrier is the control carrier.

Each sector has a record in the carrier database. Below is a description of the fields in the sector record:

Field name	Comment
site_id	Site_id must be unique per site and may not contain any spaces.
sector_id	Sector_id must be an integer.
#pre-assigned_carriers	Integer
frequency_id (1,..,#pre-assigned_carriers)	Frequency_id should be one of the globally available frequencies
#carriers_required	Integer
-	A field not used by CellOpt AFP
sector_id_for_repeater_site.	Sector_id for repeater site. CellOpt AFP requires that this sector_id is the same as the site_id of the donor sector and that the repeater is repeating of sector 1 of that site.
frequency_id_of_control_carrier	Frequency_id of control carrier. If no control frequency is indicated and pre-assigned carriers, CellOpt AFP assumes that the first pre-assigned carrier is control carrier.
- - - - - -	Fields not used by CellOpt AFP

Sample carrier database

```
CO01 1 2 45 65 1 - - 45 - - - - - -
CO01 2 0 2 - - - - - - - - -
CO01 3 1 56 3 - - 56 - - - - - -
```

This file format is used to export the frequency plan.

Interference table

The interference table describes the predicted interference which would occur if carriers in a sector were assigned to the same frequency as (or adjacent frequencies to) the carriers of another sector. The interference is measured as either

interfered area in square kilometres or as interfered traffic in milli Erlang. The two sets of data will be loaded as two separate **Lists**. You can then turn a List **Off** in the user interface if that list contains no meaningful data (see the section on "Modeling").

There are two types of records in an interference table. The record that begins with the character string `CELL`, indicating the interfered sector and the following records beginning with the character string `INT`, indicating its interfering sectors.

Field	Comment
CELL	"CELL" indicates that this record is the serving sector.
site_id	Site_id must be unique and may not contain any spaces.
Sector_id	Sector_id must be an integer.
Total_area	Total coverage area of sector in square km/miles.
Total_traffic	Total traffic on sector in milliErlang.
#interferes	The number of interfering sectors to follow.
INT	"INT" indicates that this sector is an interferer to the last "CELL" sector
site_id	Site_id must be unique and may not contain any spaces.
Sector_id	Sector_id must be an integer.
Co-channel_affected_area	Area of serving sector potentially affected by co-channel interference from this sector (km2)
Co-channel_affected_traffic	Traffic of serving sector potentially affected by co-channel interference from this sector (mE)
Adjacent-channel_affected_area	Area of serving sector potentially affected by adjacent channel interference from this sector (km2)
Co-channel_affected_traffic	Area of serving sector potentially affected by adjacent channel interference from this sector (mE)

Sample interference table

```
CELL  CO01 1  23.46   45.99 4
INT   CO01 2  12.23   32.87 2.21 4.76
INT   CO01 3  10.42   26.77 1.11 2.98
INT   CO02 1  2.56    3.75 0 0
INT   CO21 3  8.35    15.36 1.10 2.78
CELL  CO01 2  34.73   65.33 15
```

```
INT …
```

If the interference is measured in traffic, you are recommended to scale the interference parameters. Please refer to the section on Penalty Scaling in the chapter on Modelling for further information.

CellOpt AFP allows more than one interference table to be loaded.

Handover table

The Handover table defines the neighboring sectors of each sector. The file is made up of four distinct sections.

- The first section starts with the character string THRESHOLDS. It has only one record with four integer parameters. CellOpt AFP uses none of these.
- The second section starts at the second line and indicates the serving sectors and their neighbors. The serving sector is indicated on the record beginning with CELL and its neighbors on the following NBR records.
- The third section starts after a line with the character string ADDED. It contains more records of serving sectors and neighbors that have been manually added to the Handover table.
- The fourth section starts after a line with the character string DELETED. It contains records of serving sectors and neighbors that have been manually deleted from the Handover table.

Field	Comment
THRESHOLD 0 0 0 0	Not used by CellOpt AFP.
CELL	"CELL" indicates the serving sector for which the following lines beginning with "NBR" define its neighbors.
site_id	Site_id must be unique and may not contain any spaces.
Sector_id	Sector_id must be an integer.
0 0 0	Three integers not used by CellOpt AFP
#neighbors	Number of neighbors of the serving sector to follow.
NBR	"NBR" indicates that this sector is a neighbour to the last "CELL" sector.
site_id	Site_id must be unique and may not contain any spaces.
Sector_id	Sector_id must be an integer.

Field	Comment
0 0 0 0	Four integers not used by CellOpt AFP.
ADDED	Lists sectors and neighbors manually added to Handover table. Records of "CELL" and "NBR" follow in the same format as above.
DELETED	Lists sectors and neighbors manually deleted from Handover table. Records of "CELL" and "NBR" follow in the same format as above.

Sample Handover table

```
THRESHOLD 0 0 0 0
CELL CO01 1 0 0 0 1
NBR CO01 2 0 0 0 0
CELL CO01 2 0 0 0 2
NBR CO01 1 0 0 0 0
NBR CO01 3 0 0 0 0
ADDED
CELL CO01 2 0 0 0 1
NBR CO23 1 0 0 0 0
DELETED
CELL CO01 2 0 0 0 0
```

It is optional to load a Handover table and possible to load multiple Handover tables.

Exceptions table

The exception table defines additional separation constraints that CellOpt AFP should consider. It lists, on a per sector basis, required frequency separations with other sectors as well as illegal frequencies. The exception table begins, however, with two sections that are not used by CellOpt AFP.

It is optional to load exceptions tables and possible to load multiple exception tables.

Field	Comment
GLOBAL THRESHOLDS	Start of the first section. CellOpt AFP does not use information in this section.
Abs_Affected_Area 0; ... ;	Seven lines of information that is not used by CellOpt AFP.
GLOBAL ILLEGAL CHANNELS	Start of the second section. CellOpt AFP does not use information in this section.

Field	Comment
Frequency_id:s	Space separated list of frequency_id:s on a single line. Information not used by CellOpt AFP. If globally illegal frequencies, then update the globally available frequencies.
CELL	"CELL" indicates the serving sector for which the following lines define either other sectors with a minimum frequency separations or illegal frequencies. The character string "SEPARATIONS" or "ILLEGAL CHANNELS" determines what the following lines mean respectively. This character string follows immediately after the Site_id and the Sector_id on the same line.
Site_id	Site_id must be unique and may not contain any spaces.
Sector_id	Sector_id must be an integer.
SEPARATIONS / ILLEGAL CHANNELS	Indicates if the following lines has other sectors with minimum frequency separations or illegal frequency_id:s.
if SEPARATIONS Site_id Sector_id : Min_freq_sep	Indicate a sector that requires a minimum frequency separation with the serving sector at the previous CELL line.
If ILLEGAL CHANNELS Frequency_id	Indicate a line of space separated illegal frequency_id:s of the serving sector at the previous CELL line.

Sample exceptions table:

```
GLOBAL                                  THRESHOLDS
Abs_Affected_Area                            24.87
Percent_Affected_Area                        11.34
Abs_Affected_Traffic                        224.87
Percent_Affected_Traffic                      2.34
Min_Chan_Spacing_Site                            3
Min_Chan_Spacing_Cell                            4
Min_Chan_Spacing_Neighbour                       2
GLOBAL  ILLEGAL                         CHANNELS
38      48                                     66
CELL CO01 1 SEPARATIONS
CO11 2 : 2
CO12 3 : 1
CO12 1 : 2
CELL CO01 1 ILLEGAL CHANNELS
23 24 25 26 46
```

Auto File Format Detection

CellOpt AFP can detect recognized file formats automatically. The sequence is as follows:

1. The first ten non-comment lines are loaded and compared using a regular expression matching technique - each line is matched against a regular expression from each supported format.
2. If a given line matches the format, then that format is awarded a match point.
3. After all ten lines have been compared, the file formats are sorted by their match points.
4. If there is a probable good match (> 60% match) and there are no other probable matches (other file types < 30%), then that file format type is used. If no clear match is found, then you will be asked to choose between the most likely file formats (sorted by match points).

12 Glossary

This alphabetical list:

- Decodes acronyms, for instance AFP.
- Defines terms which have particular meanings in CellOpt AFP, like category and layer.
- Defines other telecommunications terms which occur in the guide, like sector and site.

A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z

A

absolute threshold

If the penalties of a given restriction is higher than or equal to a certain value– the absolute threshold – then an extra absolute threshold penalty is applied. This decreases the chance of violating severe interference constraints. Compare with relative threshold and see also threshold penalties.

adjacent frequencies

The adjacent frequencies of a frequency are the previous lower and the next higher frequencies in the frequency spectrum. The immediate lower and higher frequencies are adjacent frequencies at a frequency separation of one frequency.

adjacent frequency penalty

A penalty applied for assigning a frequency to a carrier closer than the separation requirement allows of a frequency assigned to another carrier in the same site, sector or separation list.

adjacent penalty

See adjacent frequency penalty.

AFP

Automatic Frequency Planning.

application log

See general application log.

area served

The physical area, in square units, of the ground covered by a sector. The units are not defined, but must be the same throughout the model. A synonym is Sector area.

assignment restrictions

CellOpt AFP allows you to specify assignment restrictions to indicate that certain assignments are not wanted. A synonym is planning criteria.

available color codes

Color codes which can be assigned to the carrier of the network. Only available color codes will be considered for assignment by the optimizer.

available frequencies

Frequencies which can be assigned to carrier of the network. Only available frequencies will be considered for assignment by the optimizer. If a carrier has been pre-assigned a frequency not on the available list, it is considered to have an unavailable frequency.

B

baseband hopping carrier

A carrier marked in the hopping group category with either baseband 1 or baseband 2 is baseband hopping. In addition to frequencies, hopping sequence numbers may also be assigned to baseband hopping carriers by CellOpt AFP.

BCCH

Broadcast Control CHannel. See control carrier.

C

carrier

A carrier is a network element that requires a frequency.

carrier editor

The network editor (carriers) form which allows you to select sets of carriers and change their attributes.

carrier group

A carrier group is a category in CellOpt AFP used to specify the carriers that should be assigned frequencies from the same set or subset. The default setting is that a carrier is non-grouped. Any carrier within the same sector assigned to the same carrier group is to be assigned frequencies from the same set or subset.

category

A user-defined attribute of carrier in the network, such that the attribute's name is the category and its value is a layer. In this way, you can group particular carriers by their layers. Note that a network can have any number of categories and each category can have any number of layers – but within a category, each carrier has only one layer. For example, you could create a category called **type** to define the kind of signal transmitted on carriers. Within the **type** category, you could define as many layers as you like.

CellOpt Quality Index

CellOpt Quality Index is the parameter that the CellOpt AFP optimizer seeks to minimize. It is defined as the sum of the penalties of all violated planning criteria. The CellOpt Quality Index Report gives a detailed breakdown of the CellOpt Quality Index, showing the penalty values which make up the total.

co-adjacent coupling

In most circumstances, it is more detrimental for two carrier to have the same frequency than it is for them to have adjacent frequencies. For this reason, CellOpt AFP will not allow you to set any co-penalty lower than the adjacent penalty on the same form. If for some reason you do not want this coupling, you can switch it off (and on again) from the settings menu.

co-frequency

Two carriers with the same frequency.

co-frequency penalty

A separation penalty applied if the same frequency is assigned to two carrier in the same site, sector or separation list.

co-penalty

See co-frequency penalty.

color code

A color code is an attribute of a carrier that CellOpt AFP can assign automatically in a similar process to the one it uses to assign frequency.

color code CQI report

The Color code CQI report (CellOpt Quality Index report) gives a detailed breakdown of the CellOpt Quality Index, showing the penalty values which make up the total given the current color code assignment.

command line parameter

When you launch CellOpt AFP by typing at a prompt or in the **Run** box, you can add certain codes to influence the way in which CellOpt AFP will run. You can also add the names of files which CellOpt AFP will load before allowing you to start work. Both codes and filenames are called command line parameter. Some parameters are also available once CellOpt AFP is running, by using the settings menu available at the top of the main window.

common Length

This is a term used for synthesizer hopping carriers to ensure that the number of frequencies used in the assigned Mobile Allocation List have a certain common denominator. The common length may be specified in the frequency optimization form in CellOpt AFP. A common length of 4, ensures that only Mobile Allocation Lists with lengths 4, 8, 12, 16 etc are used.

control carrier

The carrier responsible for switching and frequency control within the network.

control id

Some input formats define the control carrier of the network. These carrier are assigned a control id of one in CellOpt AFP and all the other carriers are assigned a control id of zero. The carriers assigned the same control id may be edited as a group in the carrier editor.

co-sector

Carriers within the same sector are said to be co-sector.

co-sector penalties

Separation penalties applied when two carrier in the same sector are assigned either the same frequency or frequencies which are too close to each other.

co-site

Carriers within the same site are said to be co-site.

co-site penalties

Separation penalties applied when two carrier(s) in the same site are assigned either the same frequency or frequencies which are too close to each other.

CQI

CellOpt Quality Index.

CQI log

A chronological list showing the CQI of each iteration of the optimizer, the time elapsed and the improvement in CQI from the previous iteration. You can see it in real time during optimization and also save it as a text file.

CQI report

The CellOpt Quality Index Report gives a detailed breakdown of the CellOpt Quality Index, showing the penalty values which make up the total given the current frequency assignment. See also color code CQI report.

CQI sensitivity analysis report

A “what-if” report that shows how the CellOpt Quality Index would change if you changed the frequency of a particular carrier to any other frequency.

D

“Data” file

For each model, CellOpt AFP creates a file called **data** which holds information defined inside CellOpt rather than read from an externally generated data list files. Other model information is held in CellOpt files called **layers**, **penalties** and **plan**. These internal files are used to load the model again at the next session, including all defined user settings.

data list files

Text files containing information about carrier and the assignment restrictions between them, generated (in most cases) by tools other than CellOpt AFP itself. interference list, handover list and exception list are all examples of data list files.

discontinuous transmission

An advanced interference reducing feature available in some cellular standards that switches off the transmission in one direction when the other party is transmitting. The positive effect of discontinuous transmission (DTX) may be modelled in CellOpt AFP by scaling down the interference from carriers that use DTX. frequency hopping with its interference averaging effect is required to realize the full interference reducing potential of DTX.

distribution

The statistics of a list typically relate to the total interference of a sector; there is a need to reflect the interference per carrier accurately. Distribution is used to spread the interference to the individual carriers of the sector.

Dropped call

A conversation that is interrupted by any means other than one of the participants hanging up.

DTX

discontinuous transmission.

E

exception

An exception is an assignment restriction between two carrier that complements the interference prediction between them. An exception, for instance, may define that a certain frequency separation is required between the carriers of two sector, no matter what the automatically generated interference prediction may indicate. Exceptions are typically found necessary after analysis of field measurements.

exception list

A data list file containing a set of exception.

exporting data

Saving CellOpt AFP-generated files in formats that can be read by other applications.

F

fixed carriers

If you fix the frequency of a carrier in CellOpt AFP, you forbid the optimizer to change the carrier's currently assigned frequency. Note that the optimizer still takes that frequency into account when awarding penalties.

forbidden frequencies

This is a term within CellOpt AFP used to denote frequencies that for certain groups of carriers are forbidden to use. Compare with illegal frequencies. The difference between illegal frequencies and forbidden frequencies is that the former may be used by the optimizer – although it is not recommended to use them – while the latter cannot even be considered. There are also forbidden color codes, forbidden sets, forbidden subsets and forbidden MALs.

form

A separate window opened from the CellOpt AFP main window, on which you can see and enter information about the network, network model.

fractional load

Fractional load is a term used for synthesizer hopping carriers to describe the ratio between number of synthesizer hopping carriers that are hopping together in a sector or site using the same Mobile Allocation List and Hopping Sequence Number and the number of frequencies in the Mobile Allocation List. To ensure that more frequencies are assigned to the Mobile Allocation Lists than the number of synthesizer hopping carriers it is possible to specify the maximum fractional load in the frequency optimizer form in CellOpt AFP.

free carriers

carrier which are not fixed carriers are free, and the optimizer can change their frequencies. It follows that no optimization can take place unless at least one carrier is free.

frequency

The channel number that defines the radio frequency of a carrier.

frequency hopping

An advanced quality enhancing feature available in some cellular standards by spreading the bursts of a conversation over multiple frequency. The positive effects of hopping may be modelled by scaling down the interference of hopping carrier to consider the frequency and interference diversity gains of hopping. Further, the interference from hopping carriers may

be scaled down even more as the interference averaging effect of hopping allows you to consider the average case interference load of a carrier instead of the worst case interference load.

frequency penalties

Preferences against assigning a frequency to a carrier. There are two kinds of frequency penalties in CellOpt AFP:

The illegal frequencies penalty used to specify how undesirable it is that CellOpt AFP assigns an illegal frequency to a carrier.

The preferred frequency penalty used to specify how undesirable it is that CellOpt AFP changes the pre-assigned frequency of a carrier.

frequency reuse

The frequency reuse is derived by dividing the number of globally available frequencies by the average number of carrier required per sector. A tight frequency reuse creates more interference problems in the network.

G

general application log

One of the panels in the CellOpt AFP main window. It shows details of what the program is doing in real time, as well as reporting successes and error messages. The time is shown for each event.

global penalty

A penalty applied to all the assignment restrictions of co-sector and co-site carriers as well as those of illegal and preferred frequencies.

H

handover list

A data list file containing assignment restrictions between sector caused by the possibility of handover occurring between a serving sector and a neighboring sector. neighbor list is a synonym for handover list.

hopping group

A hopping group is a category in CellOpt AFP used to specify what kind of hopping a carrier is using. The default setting is that a carrier is non-hopping, but it can also indicate baseband (baseband 1 or baseband 2) or synthesizer hopping (synth sector 1, synth sector 2, synth site 1, or synth site 2). All carriers in the same site marked by synth site x, where x is either 1 or 2, are hopping using the same Mobile Allocation List and Hopping Sequence Number. Likewise, all carriers in the same sector marked by synth sector x, where x is either 1 or 2, are hopping using the same Mobile Allocation List and Hopping Sequence Number.

hopping Sequence Number

A Hopping Sequence Number indicates one out of 64 possible pseudo-random number sequences. It determines how to sequence frequencies in a Mobile Allocation List assigned to a synthesizer hopping carrier. HSN are assigned to carriers marked in the hopping group category as baseband, synth sector or synth site by CellOpt AFP automatically.

HSN

See Hopping Sequence Number.

I

illegal frequencies

CellOpt AFP allows you to say that the assignment of a particular frequency to a particular carrier is undesirable. You can say how undesirable it is by a specifying an illegal penalties for that carrier. Note that the word “illegal” in CellOpt AFP means “undesirable”, not “forbidden”. See also forbidden frequencies.

illegal frequency list

A data list file containing assignment restrictions between sectors and frequencies. Note that illegal frequencies may often be more efficiently defined within CellOpt AFP per layer instead of loading them in as a data list file.

illegal frequency penalties

Illegal frequency penalties are applied when an illegal frequencies is assigned to a carrier.

illegal penalties

Sometimes used instead of illegal frequency penalties.

initial seed

For each carrier that is not already assigned an available frequency, the optimizer assigns available frequencies to each carrier pseudo-randomly, to provide a starting frequency plan on which it can start to improve. The initial seed influences the pseudo-random generation and you can change it from the settings menu if you wish. If the initial seed is set to zero, it will be automatically generated from a number provided by the computer's internal clock.

interfered

A carrier may potentially be interfered by other carriers which are assigned to the same or adjacent frequencies. You can apply separation penalties to specify that you prefer the interfering carriers to be assigned at a certain separation requirement. See also interfering.

interference list

A data list file containing assignment restrictions between carrier generated by signal propagation predictions or measurements. The interference list also typically contains statistics that indicate how much area or traffic would be affected if the carriers of two sector were to reuse the same or adjacent frequencies.

interfering

A carrier may potentially be interfering with other carriers which are assigned to the same or adjacent frequencies. You can apply separation penalties to specify that you prefer the interfered carriers to be assigned at a certain separation requirement. See also interfered.

L

layer

A generic grouping concept that allows carrier sharing similar characteristics to be grouped together. The concept of layers enables you to specify criteria only once for a layer and then apply those criteria to all carriers within that layer. For instance, you define illegal frequencies and set penalties, scaling factors and thresholds for layers.

layer distribution

Layer distribution is used to distribute the separation list statistics non-uniformly to the carrier within the sector. Note that a change in layer distribution for a layer will affect the penalties of the carriers of other layers in the same sector.

layer pollution

Layer pollution is used to reverse, for the selected layer only, the distribution of separation list statistics to carrier in the interfering sector. Note that layer pollution will not affect the penalties of carriers of other layers in the same sector.

layer protection

Layer protection is used to reverse, for the selected layer only, the distribution of separation list statistics to carriers in the interfered sector. Note that layer protection will not affect the penalties of carriers of other layers in the same sector.

layer penalties

layer penalties refine the global penalties or list penalties by defining penalties only applicable to carriers belonging to the particular layer.

“Layers” file

For each model, CellOpt AFP creates a file called **layers** which holds information defined inside CellOpt about each category and layer rather than read from an externally generated data list files. Other model information is held in CellOpt files called **data**, **penalties** and **plan**. These internal files are used to load the model again at the next session, including all defined user settings.

legal frequency

A frequency that is available for a carrier without the need to award any penalty.

list

A list is a set of assignment restrictions. Examples of lists are illegal frequency list, interference list and handover list.

list modifier

The choice of list modifier determines whether the sector dependent, variable scaling will be based on area served or traffic served as the trigger for the relative threshold. A list modifier set to **Unknown** disables the variable sector scaling and relative threshold.

list penalty

A penalty applied to all the assignment restrictions in a given list.

M

MAIO

See Mobile Allocation Index Offset.

MAL

See Mobile Allocation List.

maximum fractional load

See fractional load.

merging data

Updating an existing carrier database with the assignments made in CellOpt AFP.

Mobile Allocation Index Offset

The Mobile Allocation Index Offset determines exactly, for a given hopping sequence, the frequency in a Mobile Allocation List a synthesizer hopping carrier should be using at a

particular moment. MAIO are assigned to carriers marked in the hopping group category as synth sector or synth site by CellOpt AFP automatically, immediately after the HSN optimization.

Mobile Allocation List

A list of frequencies that a synthesizer hopping carrier is hopping over. MAL are assigned to carriers marked in the hopping group category as synth sector or synth site by CellOpt AFP.

model

A model in CellOpt AFP is the representation of the network, its assignment restrictions and the penalties associated with them.

“Model” file

A saved model consists of a model file, referencing one or many of the internal files **data**, **layers**, **penalties**, **plan** and an unlimited number of data list files (which could be shared with other models of the same network).

modelling

The activity of describing a network and its assignment restrictions so that CellOpt AFP has all the information it needs to make assignments automatically.

N

neighbor list

A synonym for neighbor list.

network, network model

The set of site and sector whose carrier are to be assigned frequencies and color codes.

network editor

Two forms in the Network branch of the tree view which enable you to see and alter the structure of carrier and sectors making up the network. See carrier editor and sector editor.

O

optimized frequency

A frequency that has been assigned to a carrier by CellOpt AFP.

optimizer

A module in CellOpt AFP software which uses the network model and penalty values to work out the best possible frequency or color code assignment to each carrier, and then continuously tries to improve upon its previous best.

P

penalties

A penalty is a weighting factor describing the undesirability of not meeting any particular assignment restrictions. CellOpt AFP seeks the frequency assignment solution that minimizes the sum of penalties for all violated assignment restrictions. The sum of penalties for all violated assignment restrictions builds up the CellOpt Quality Index.

“Penalties” file

For each model, CellOpt AFP creates a file called **penalties**, which holds penalty settings defined inside CellOpt. Other model information is held in CellOpt files called **data**, **layers** and **plan**. These internal files are used to load the model again at the next session, including all defined user settings.

“Plan” file

For each model, CellOpt AFP creates a file called **plan**, which holds the current frequency plan defined inside CellOpt. Other model information is held in CellOpt files called **data**, **layers** and **penalties**. These internal files are used to load the model again at the next session, including all defined user settings.

planning criteria

A synonym for assignment restrictions.

pollution

Carriers pollute the network when they are interfering with other carriers. See also layer pollution.

power control

Power control is an advanced interference reducing feature, available in some cellular standards, that reduces the power levels and therefore the pollution from a mobile terminal or a base station. The positive effect of power control may be modelled in CellOpt AFP by scaling down the interference from carrier that use power control.

preferred frequency

CellOpt AFP allows you to say that it is undesirable to change the frequency of a carrier that already has a frequency assigned to it. The frequency assigned is said to be the preferred frequency of the carrier. You quantify that undesirability by specifying a preferred penalty for that carrier either globally or specifically for carriers in a layer.

preferred penalty

You quantify the undesirability of changing a preferred frequency of a carrier by specifying a preferred penalty. This may be specified globally for all carriers and specifically for carriers in a layer.

project directory or folder

The directory or folder which contains the **project** file and may also contain model files with their associated **layers, data**, **penalties** and data list files.

“Project” file

A text file holding instructions to load the model which make up the project.

protection

See layer protection.

R

relative threshold

Like the absolute threshold, the relative threshold sets the point at which an extra penalty is awarded for an excess of separation penalties in a given carrier. However, with the relative

threshold, the threshold is relative to either the traffic or the area served by the carrier. Compare with absolute threshold and see also threshold penalties.

reuse

A carrier is reusing with another carrier if they are assigned the same frequency.

S

scaling

For separation penalties from statistics, scaling applies a constant multiplier to the statistics in these list. By default any multiplier is equal to 1, which disables the effect of the multiplier. Scaling could be imposed at the list level, affecting the statistics of all restrictions in the list and at the layer level, affecting only the statistics of such restrictions where a carrier from that layer is either being interfered or interfering. The effects of having multipliers applied at both list and layers are compounded by multiplication. It is possible to set different scalings for co-penalty and for adjacent penalty. See also scaling by sector area/traffic.

scaling by sector area / traffic

For separation penalties from statistics, scaling by sector applies a variable multiplier to the statistics in these lists. The multiplier will be derived from either the sector area or sector traffic of either the interfered sector or interfering sector of a restriction. By default the scaling by sector is **off** for the list level, which disables the effect of the multiplier. If the sector scaling is on for the list it can be disabled for any layer by turning it off. The user definable list modifier defines whether sector scaling with sector area or scaling with sector traffic will be used. See also scaling.

search seed

The choices the optimizer makes internally whilst searching for better and better solutions are influenced by a random variable. The search seed influences the pseudo-random generation and you can change it from the settings menu if you wish. If the search seed is set to zero, it will be automatically generated from a number provided by computer's internal clock.

Optimization executions with identical initial assignments and search seeds will give the same search path and solution, whereas different search seeds with identical initial solutions are likely to give different search paths and solutions.

sector

A site may be omni-directional, transmitting to all points of the compass, or sectored such that different sectors cover different azimuths. An omni-directional site is said to have one sector. A sector has one or many carrier that require frequency and color code to be assigned.

sector area

A synonym for area served.

sector editor

The network editor (sectors) form which allows you to select sets of sectors and change their attributes.

sector traffic

The amount of traffic served by a sector. The unit is typically Erlang.

sensitivity report

See CQI sensitivity report.

separation list

A separation list is a set of assignment restrictions relating to assigning frequencies of carriers at an insufficient separation from frequencies assigned to other carriers. The Separation branch of the tree view may contain any number of separation lists. You can apply different list and layer, co-penalty and adjacent penalty for each list. At layer level, you can define different separation penalties for the same layer, depending on whether the carriers are interfered or interfering. All separation lists are data list files, with the exception of co-site and co-sector lists.

separation penalties

Separation penalties are applied to the assignment restrictions in separation lists to decrease the risk of assigning the same or adjacent frequencies to carrier which are on the same site, in

the same sector, or in the same separation list. They are applied when the optimizer elects to assign the same frequency to two of these carriers, or frequencies which are different but closer together than their separation requirement allows (see co-frequency and adjacent frequencies). Separation penalties can be applied at both list and layer levels to both co- and adjacent frequencies, and the sum of the respective list and layer penalties gives the total separation penalty for the assignment restriction. At layer level for separation lists, you can define different separation penalties depending on whether the carrier is interfered or interfering.

separation penalties from statistics

Separation penalties from statistics are assignment restrictions that are supplemented with statistics describing the importance of the assignment restriction. These statistics might for instance describe the amount of traffic that would be interfered if the assignment restriction were violated. Separation penalties are derived from these statistics by modifying the statistics with scaling, distribution or thresholds. These operations can be applied at both list and layer levels to both co-frequency and adjacent frequencies, and the sum of the respective list and layer penalties gives the total separation penalty for assignment restriction. At layer level for separation lists, you can modify the statistics differently depending on whether the carrier is interfered or interfering.

separation requirement

The required frequency separation to avoid quality problems in the network. You define separation requirements in the co-site, co-sector and all separation list branches in the tree view, and you can define them at both list and layer level. At layer level for separation lists, you can define different separation requirements for the same layer, depending on whether the carriers are interfered or interfering.

Serving sector, serving carrier

The sector or carrier serving a mobile terminal.

set

A set is a pre-defined set of frequencies to be assigned to a group of carriers that have been grouped together in the carrier group category. Sets are pre-defined in the sets form under Spectrum/Frequencies.

settings

A subset of the command line parameter which can be accessed from the settings menu available from the top of the CellOpt AFP main window.

site

The physical location of one or more sectors.

spectrum

A branch of the tree viewwhich allows you to see and set globally available frequencies and color code as well as illegal frequencies.

subset

A subset is a pre-defined set of frequencies to be assigned to a group of carriers that have been grouped together in the carrier group category. Subsets are pre-defined in the sets form under Spectrum/Frequencies.

synthesizer hopping carrier

A carrier marked in the hopping group category with either synth sector x or synth site x, where x is either 1 or 2, is synthesizer hopping. Mobile Allocation Lists, Hopping Sequence Numbers and Mobile Allocation Index Offset are assigned to synthesizer hopping carriers by CellOpt AFP.

synth sector

A layer within the hopping group category specifying that a carriers is synthesizer hopping. All carriers within the same sector marked as synth sector x, where x is either 1 or 2, are hopping with the same Mobile Allocation List and the same Hopping Sequence Number.

synth site

A layer within the hopping group category specifying that a carriers is synthesizer hopping. All carriers within the same site marked as synth site x, where x is either 1 or 2, are hopping with the same Mobile Allocation List and the same Hopping Sequence Number.

T

TCH

Traffic CHannel. See traffic carrier.

threshold penalties

A threshold penalties are awarded to an assignment restrictions if their existing separation penalties exceed a user-defined value (see absolute threshold and relative threshold). The use of thresholds makes it less likely to have interference peaks as interference is more evenly distributed in the network. You can discriminate between co-penalty and adjacent penalty when applying the penalties.

traffic carrier

A carrier for transmissions of the customer's speech or data, rather than for switching and frequency control within the network, which is transmitted on control carrier. A TCH is an example of a traffic carrier.

traffic served

A measure of the volume of traffic in Erlangs served by a sector or other part of a network.

tree view

An expandable (and collapsible) hierarchical view of the model network which acts as an overview of the network and as a set of routes to forms, so you can see and adjust the fine detail of the model.

U

unassigned layer

When you create a category, every carrier in the network is given **Unassigned** as its default layer within that category. You may assign penalties or modify statistics even for the carriers in the **Unassigned** layer.

13
Revision Sheet

This is the CellOpt AFP User Guide for version 2.5 of the software.

If replacement manual pages are issued in future, they will be listed on a new revision sheet, which will carry the version numbers of both the software and the Guide. The new sheet will also tell you which out-of-date pages to remove.

Once you have made the changes, you should replace this revision sheet with the new one. Any subsequent revision sheets will summarize all the changes which should have been made since the original issue of the Guide.

13 Revision Sheet