ATDI

■ **Human Exposure
And FCC-OET-B65
MPE compliance
calculations**

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Abstract

This white paper follows the article written by ATDI – Sami Nedhif in May 2008 introducing ICS Telecom's capabilities for calculating Health safety and Field Strength Exposure. This paper has generated a number of enquiries and requests for clarification in the context of compliance calculations according to the FCC Guidelines described in the OET Bulletin 65. This article describes the methodology used in ATDI software tools to quickly prepare a rooftop CAD project, and an MPE analysis.

Background

Wireless operators are required to submit an MPE analysis for the radio systems they setup on rooftops. The exposure levels vary according to frequency and their controlled / uncontrolled nature. They follow the two tables thereafter:

Table 1. LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm²)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f²)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

| Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm²)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f²)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz   *Plane-wave equivalent power density

The proper analysis should consider the following: a highly detailed description of the environment (typically with centimeter level accuracy), the setup of a radio characteristics summing up all the powers from all the channels present, signal strength based calculation utilizing multiple propagation models to consider the near/transitional/far field with or without obstacle reflections, and presentation of results compliant with the marking objectives. ATDI's ICS telecom / ICS map server suite meets all these requirements.

Mapping the Environment

The usual input information is a CAD drawing of the rooftop being studied. This drawing is used for various purposes and often contains many layers of information irrelevant to the MPE analysis. In our case, we have used a DWG file that we loaded and displayed with the free AutoCAD DWG TrueView software. We used the package purely as a viewer and produced on screen a clean picture of the rooftop area of interest, removed unnecessary layers, changed display colors, measured the distance between two easily recognizable points and saved the area as a *.PNG raster file.
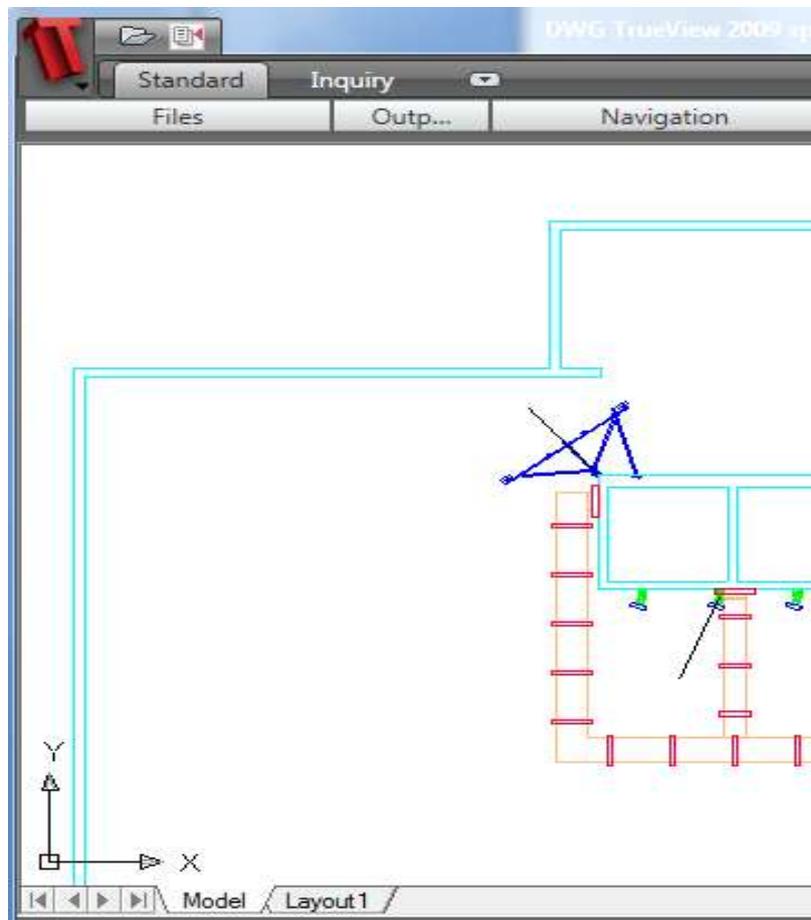
The area is now ready for processing with ATDI-ICS Map Server. The first step is to import the PNG into a special 8-bit raster workspace known as an *.IC1 layer that will allow us to classify the various layers according to their displayed color.

The IC1 layer is opened and 2 reference points are placed where the measure was previously taken. A special icon, *measure / Make CAD project* generates all the layers properly formatted for use in ICS Telecom or HTZ Warfare. A simple double-click on the *.PRO project file should get the user directly into their RF Interface.

Measure / Make CAD project button
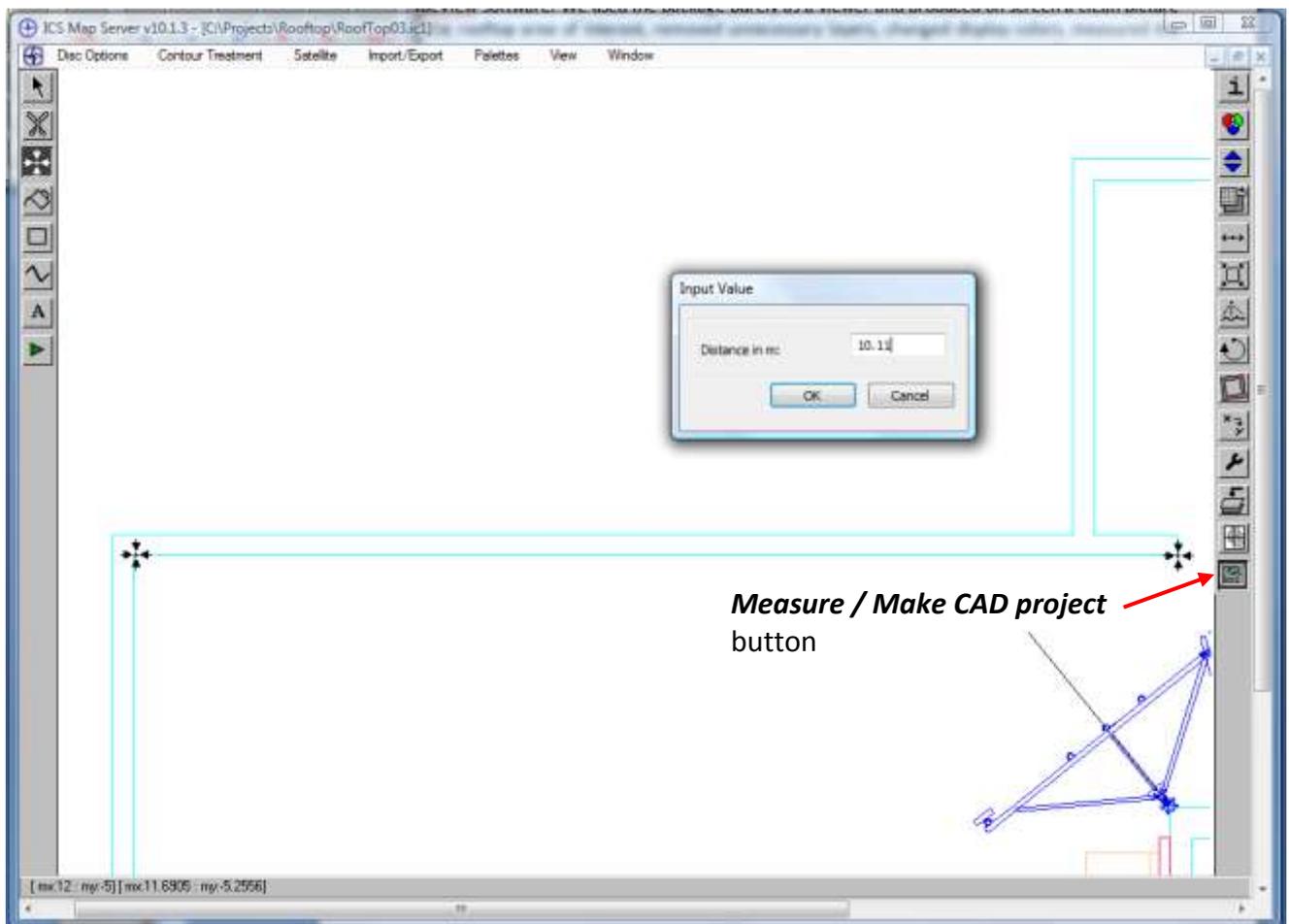
Radio Parameters Setup

The radiated power used for MPE calculation should aggregate all the individual channels and even other sources known to the operator. A power calculator is available in ICS Telecom for this purpose. The antenna pattern can be represented in many ways, in our case, a simple Horizontal and Vertical diagram are entered. The distance cuts between near, transitional and far field are derived from the diameter or size of the antenna. The tool will adopt OET-65 guidelines and formulas for the propagation analysis within the crossover distance calculated. After the crossover distance is exceeded, the tool will implement the directive pattern defined in the radio object's parameters box as pictured below:
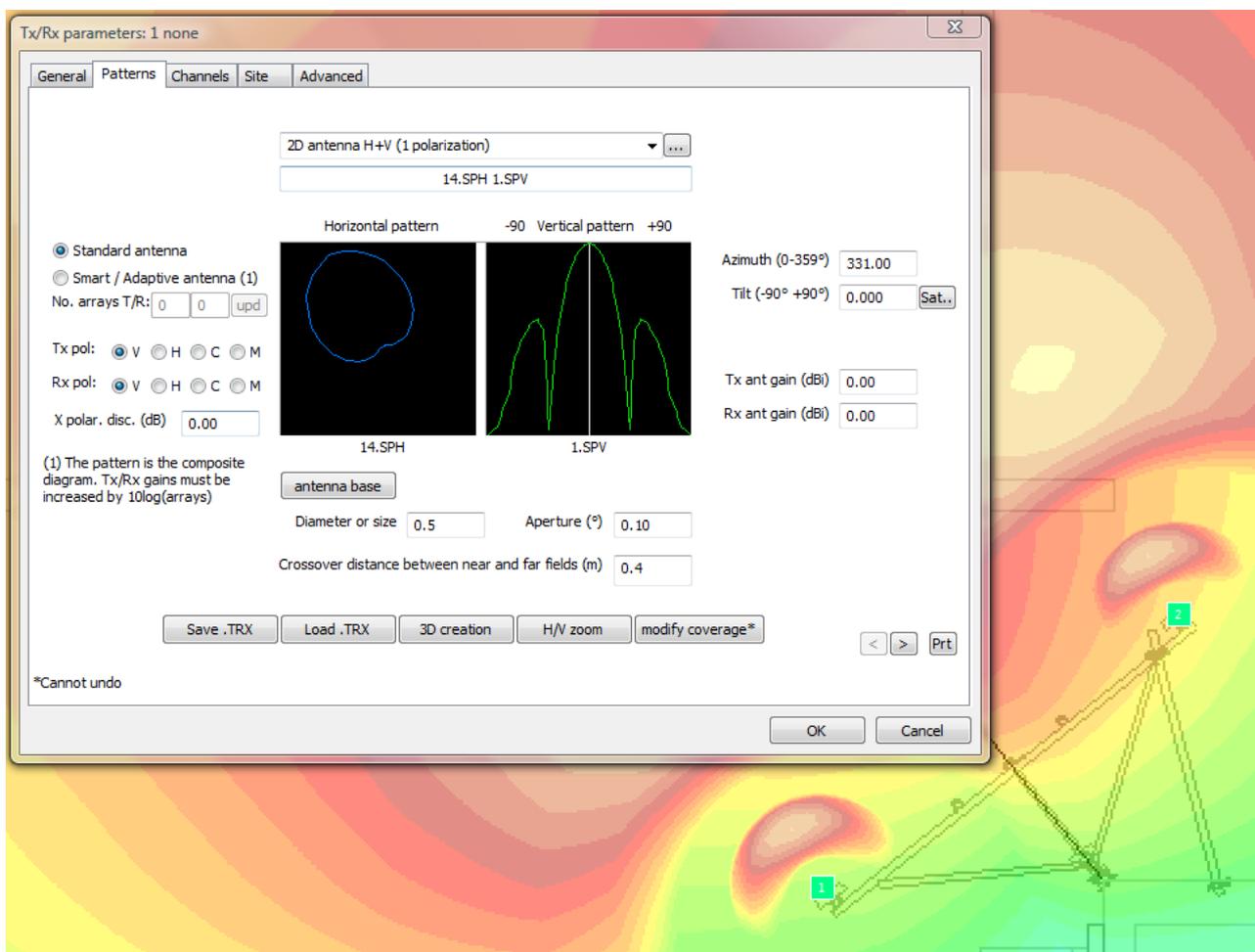
Propagation Analysis

Standard deterministic ITU-525/526 models apply well to this type of analysis. A reflection component can be added to the model to take into consideration obstacles like air conditioning cabinets, large metallic pipes, or any other material. The reflection characteristics of each obstructive component can be distinguished from each other. The OET-65 guideline offers a worst

case reflection scenario by applying a 2x power factor, or an EPA 1.6x power factor. Complete diffraction and subpath attenuations are part of the model. The Near-Field switch is located in the Option box before running the coverage analysis.

Presentation of the results

ICS telecom includes a conversion calculator to convert the power density thresholds defined in the OET-65 to RF signal strength thresholds in dBμV/m. The user can then reinterpret the coverage results to reflect controlled and uncontrolled exposure levels by defining the respective thresholds in the tool. Typically, three typical colors are used for markings, and they have been adopted in our custom palettes.

The following picture shows the marking areas for MPE limits at 1900 MHz. The effect of the antenna pattern is particularly visible in this particular example.
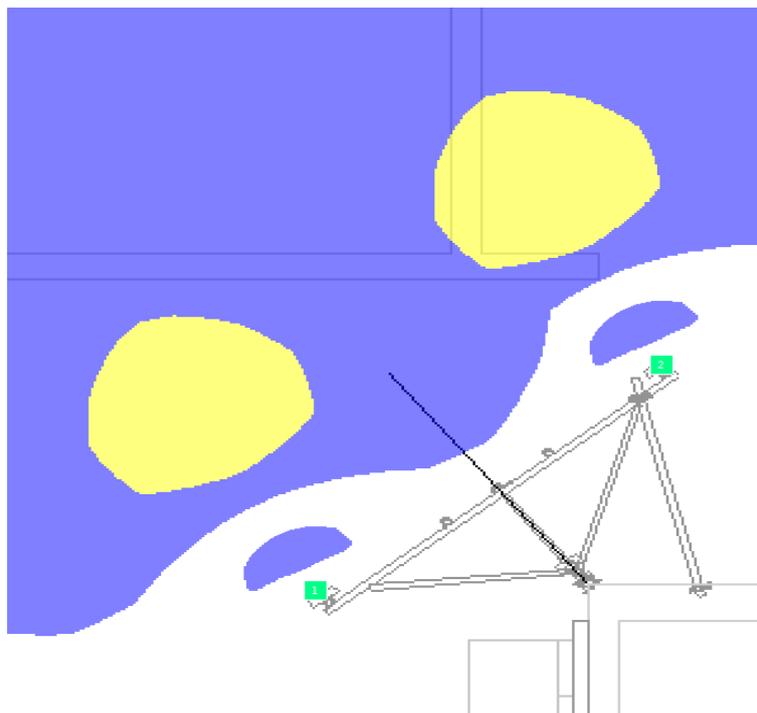
Conclusion

A proper MPE analysis requires all the standard components of a fully featured RF Planning tool like ICS Telecom plus dedicated functionalities and user customizing capabilities. The ATDI suite of tools has been streamlined to process and import the information provided from a CAD drawing in a user-friendly manner easy to replicate repeatedly. No training is required.

MPE studies are becoming a must have for operators looking to protect their investments, their right to transmit, and ensure their systems keep the general public and workers safe. Consequently, it is becoming critical for an operator to have a simple yet accurate solution for modeling close range antenna environments and articulate operational safety to not only industry experts but also the general public. ICS telecom's capability to manage the display of RF emissions and ICS map server's flexible platform for importing engineer friendly CAD drawings provide a ready-to-go solution that requires very little training to new customers, and additional value to existing customers.