



Executive Summary

CelPlan International, Inc.

3G/4G Consulting, Services & Solutions

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About CelPlan

CelPlan International, Inc., headquartered in Reston Virginia, USA, is a leading provider of radio frequency (RF) planning & optimization tools and value added consulting, engineering & training services to the wireless industry.

Founded in 1992 by a corps of engineers and managers with extensive experience in International Telecommunications, CelPlan has rapidly established itself as an innovative leader in providing the most advanced engineering solutions for the wireless industry.

CelPlan has performed design, optimization and expansion of large and small networks throughout the world. The firm has participated in several 4G-related projects (LTE or WiMAX), including RF planning & optimization, RFP creation & response assessments, network modeling, network audits, migration planning, network deployments, project management, and technology transfer programs, to name a few.

CelPlan's broad, inclusive focus on all segments of the wireless industry combined with its powerful and sophisticated portfolio of RF engineering capabilities and RF tools enables it to successively and efficiently resolve the most intractable wireless problems.

CelPlan creates new opportunities for mobile operators, vendors and partners to boost performance, reduce costs, and retain customers by providing innovative, RF planning & optimization software solutions and high, value-added consultancy & engineering services.

CelPlan at a Glance

- Providing solutions to the wireless industry since 1992
- Employee owned and debt free
- Leader in 4G design and solutions with focus on customer experience
- Innovative software applications and value added consultancy
- Published technical experience and methodologies through books being published by Wiley (several books in preparation)
- Highly experienced staff
- Hundreds of implemented designs
- Headquarters in Reston, Virginia, USA
- Other global offices in North America, South America, Europe, Africa and Middle East.

CelPlan's Mission and Business Practice

CelPlan is a wireless technology house providing tools, technology, expertise, and manpower for technology transfer to our client's organization.

Our mission is to be the best in class, vendor-neutral, one-stop-shop for all RF planning & optimization needs, and value added consulting, engineering & training services to the wireless industry.

CelPlan's standard business practice is to establish a true partnership with our clients, whereby we are involved from the design stages right through the rollout and optimization phases of the client's project.

The benefits of this approach are two-fold, as it not only enables CelPlan to leverage its expertise to ensure the success of the project but is also enables the transfer of experience and skill sets, as the project progresses, to the client's organization. The ultimate goal is to enable our clients to stand on their own, with our guidance and support limited thereafter, to an "as-needed" basis.

To that regard, all of our training programs and project management services are directed at technology transfer, unless the client specifies otherwise.

CelPlan can also be contracted as an unbiased third party for annual or periodic reviews.

CelPlan's Offerings

CelPlan has a large portfolio of solutions for operators, equipment vendors and service companies. The main offerings are:

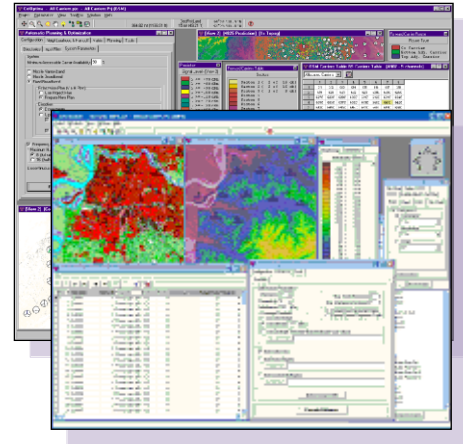
- Market studies and analysis of market potential, customer distribution and traffic demand.
- Preparation of Business Plans, CAPEX and OPEX
- Greenfield network design or expansion of existing networks
- Preparation of technology or vendor swap strategies and spectrum re-farming
- Expert consultancy and studies to be presented for regulators or environmental agencies
- Spectrum and interference consultancy to regulators
- Equipment RFP preparation for RAN, CORE and Backhaul
- Vendors selection and contract negotiation
- Network deployment support and acceptance
- Vendor interface support for operators
- Optimization of existing networks
- Development of software applications for operators
- Network parameter analysis and consolidation
- Specialized scanners for 4G RF spectrum analysis
- Planning, design and Optimization tools
- Field measurement devices and applications
- Technology and product training

4G Planning & Optimization Solutions that focus on Customer Experience

CellDesigner™

CellDesigner™ is a next generation RF planning and optimization tool that is based on customer experience parameters and provides reliable/long lasting network optimization. It has enhanced 3D-RF predictions, multiple service classes, statistical SNR availability, **customer experience** considerations. It is an ideal companion for SON-based solutions.

The tool supports all wireless technology standards, including but not limited to LTE –A (TDD and FDD), WiMAX, WI-FI, WCDMA (UMTS), HSPA, HSPA+, IS2000 (1xRTT, EVDO), GSM (including Frequency Hoping), GPRS, EDGE, EDGE-E, CDMA One, PMR/LMR (Tetra and P25), MMDS/LMDS, DVB-T/H, and Wireless Backhaul.



CellDesigner has fully implemented the Korowajczuk 3D model, capable of performing simultaneously outdoor and indoor multi-floor predictions.

Automatic Frequency Planning (AFP)

CellDesigner™ features an automatic resource-planning tool that utilizes sophisticated statistical algorithms to allow the user to dramatically increase the network capacity and performance. It automatically and efficiently optimizes handoff thresholds, neighbor lists, and frequency plans. It also offers optimization of several CDMA network parameters. It is the only tool in the industry that allows sequential layers of optimization and geographic performance analysis for the entire network. CelPlan has developed a new methodology (patent pending) based on cell interference regions, capable of increasing significantly cell capacity and ideal to be used in conjunction with SON and ICIC.

Automatic Cell Planning (ACP)

Additionally, CellDesigner™ is also capable of automatically shaping cell footprints to simultaneously minimize interference (considering diversity effects), while maintaining the same coverage, and balancing traffic.

It also allows optimization of radiated power, antenna type, tilt, azimuth, and height. Users can specify parameters changes for each sector, their relative priority, and the acceptable value range for each modification.

Google Earth Integration

CellDesigner™ integrates Google Earth into it, so it is capable of presenting the predictions and measurements live in the 3D environment.

Network Master Plan (NMP)

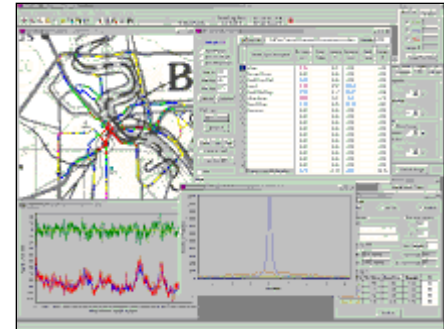
CelPlan has developed a methodology that simplifies SON and ICIC procedures (patent pending). We are talking to vendors and operators that are willing to benefit from this solution.

Integration of Field Measurement Data

CellDesigner™ can be configured to collect data from virtually all types of measurement equipment, from general spectrum analyzers to specialized vendors' equipment, and it also features CelPlan's exclusive Hyper Windows, allowing engineers to open multiple, synchronized windows for easy analysis of various types of information.

GIS Database Editor

CellDesigner™ also includes a powerful GIS database editor that allows users to edit and process geographical databases. A set of specialized applications is included in the tool, providing users with resources to handle and modify imagery, topographical, and morphological data.



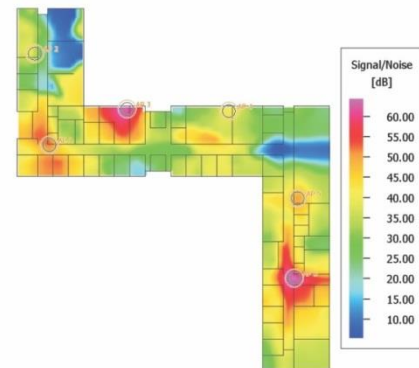
Backhaul Planning

CellDesigner™ also calculates network interconnections, interference analysis & reporting for point-to-point, microwave transmission links. It implements all of the 3GPP specifications and integrates fully with Google Earth, presenting the Fresnel zone in 3D.

CellTrace™

CellTrace™ is a suite of software tools that addresses Radio Frequency (RF) planning, design, modeling, analysis and optimization of wireless communication systems within buildings, tunnels, stadiums and in campus environments.

It supports a wide variety of Air Interfaces, including but not limited to LTE-A, WiMAX (802.16x), Wi-Fi (802.11x), CDMA, UMTS/HSPA+, GSM, and TETRA. It also supports MIMO technology, Distributed Antenna Systems (DAS), leaky feeder cables and a number of other transmissions modes.



CellTrace™ uses 3D vector databases with planar objects, each with their own individual properties, combined with extremely fast & accurate propagation models to compute path loss and wide-band properties, such as delay and angular spread, LOS/NLOS, directional channel, impulse response, angular profile, and propagation paths, of radio links within buildings.

CellTrace™ has the most advanced RF propagation algorithms, based on 3D ray-tracing and prevalent path, that predict accurately indoor environments, tunnels, stadiums and any other location.

CellSpectrum™

CellSpectrum™ is a unique, patent-pending, RF Spectrum Scanner and Channel Analyzer based on a universal software-defined receiver (SDR) that enables the capturing, digitizing, storage and analysis of detailed wideband RF spectrum.

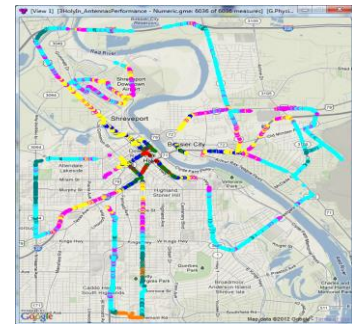
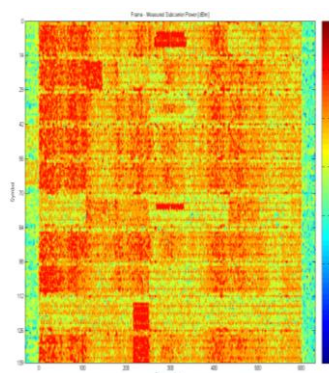
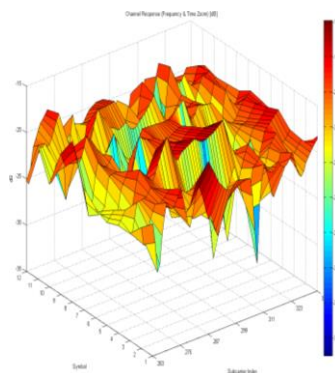
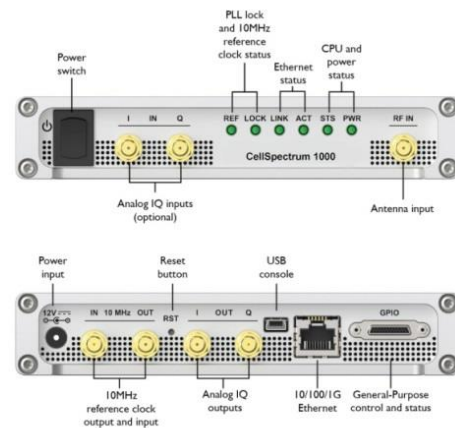
It allows the analysis of important RF channel characteristics needed for the proper design of 4G networks.

CellSpectrum™ digitizes up to 100 MHz of spectrum at a time, from 100 MHz to 18 GHz, extracting parameters as: LTE channel response per Resource Element, Multipath delay spread, Average frequency fading, Average time fading, Noise floor & interference, Signal to Noise Ratio along the RF frame, RF channel response along the frame and MIMO antenna correlation over a drive test route. It also supports time synchronized measurements, the decoding of multiple technologies and single or multiple deployments, which also makes it ideal for triangulation.

Additionally, allocation and traffic information can be derived, providing valuable information about the allocation used for Inter Cell Interference Coordination (ICIC). Framed OFDM transmitters, like WiMAX and LTE, provide ideal platforms to characterize the RF channel.

CellSpectrum™ product consists of a Software Defined Receiver (SDRx) combined with Capture, Processing and Analysis Software.

- CellSpectrum™ 1000 consisting of a Software Defined Receiver (SDR), a regular Spectrum Analyzer, a rugged outdoor multi-satellite GPS with WAAS, a Dead Reckoning unit, a universal antenna (698-960 MHz/1700-2700 MHz), a rugged Windows based PC with Solid-state drives (SSD), and cables. Band-pass filters are not included but should be added for the specific bands being measures to avoid receiver saturation.
- CellSpectrum™ 2000 consisting of software capable of capturing, storing and analyzing time and location stamped spectrum data using the CellSpectrum™ 1000 hardware.



CellServices™

With a team of over 500 full time RF engineers, CelPlan has the necessary expertise on staff to carry out the most complex, telecom-related projects.

CellServices™ is a portfolio of industry leading technology consulting and engineering services, available for operators & vendors, ranging from design, optimization, site surveys, drive tests, backhaul deployment, equipment installations, managed services and provision of specialized man-power, to name a few.

Typical projects include but are not limited to:

- RFP Creation & Response Analysis
- RF Planning (Pre And Post RFP)
- Spectrum Analysis
- Propagation Theory and Modeling
- Traffic Theory
- Demand/Traffic Analysis
- System Optimization
- System Design and Audit
- System Validation
- Site Audits
- Field/Indoor Measurement
- Networking
- Capital/Economic Model
- Microwave Relocation
- Turnkey Projects
- Project Management
- Quality Assessment
- Switching Equipment Design and Dimensioning
- Cell Site/Base Station Equipment Design
- Acceptance Test Procedures (ATP)
- Commissioning
- Certified Training & Technology Transfer
- Geographic Information Systems (GIS)
- Managed Services
- Technical Staffing

Training & Technology Transfer Programs

Wireless technologies have evolved at such a fast pace that it has become increasingly difficult for professionals to keep up-to-date with all the changes in standards, technologies, market trends and developments.

Realizing this void, CelPlan has developed a series of training & technology transfer programs to cover all major issues, technologies and the most recent developments & standards in the wireless telecommunications arena.

CellDesigner™ Training

CellDesigner Suite of tools training covers the introduction and usage of our advanced RF planning and design software. The courses are sub-divided into the specific functional areas of the software, Building a Project, AFP, ACP, Optimization, Backhaul Planning, Implementation Field Measurement Data, to name a few.

Technology-based Training

CelPlan also offers a comprehensive array of training courses that follows market trends and focuses on the newest telecommunication technologies. Our 4G Technologies and Network Design Boot Camp is a prime example of one of our technology-based training courses.

Please see our website or Training Catalog for a full description of our courses.

Technology Transfer Program

CelPlan Technology Transfer Program is designed to enable capacity building and knowledge transfer to the client organizations. This objective is realized over an extended period of time by placing a seasoned CelPlan engineer within the client's organization, where they not only function as an integral part of the customer's day-to-day operations & engineering teams, but they also provide on the job guidance & training to the members of the team.

Customized Training

CelPlan can also develop new training modules to meet specific customer needs.

LTE, WiMAX, WIFI Design Topics

The following issues are not unique to 4G but are worth noting based on our experience with recent projects.

1. **Importance of proper RF Planning and investment** – the investment in a thorough initial design is very small compared with the costs of having to redesign after the first deployment, CelPlan performs CAPEX and OPEX analysis, to assure that the networks will comply with the financial requirements..
2. **Timeline for RF Planning** – time must be provided for a complete design and not rushed for commercial or internal reasons. Many projects do not allocate the proper amount of time for the initial RF planning, as there are numerous other tasks in a network rollout. Typically, it will take one to two weeks to coordinate design resources, and another week for designing each urban area. For an initial design, CelPlan suggests allocating four to six weeks.
3. **Availability of Trained and Experienced Staff** – Because 4G networks differ from most other wireless technologies deployed worldwide, experienced RF engineers that have designed similar systems are a requirement. It takes at least one project for a cellular engineer to understand all the issues involved in a full scale WiMAX, LTE , and WiFi design. CelPlan provides training for all partners at the beginning of a project with ongoing consultation and project management throughout the design. In addition, most clients request a full CTO review and sign-off for these designs.
4. **Planning Resource Requirements** – several resources are required for proper network design, including drive testing for model calibration, GIS databases for coverage area, and BT site data (existing and new). Depending on the market, up to two weeks may be required to gather this information. Many operators are using outdated data about its networks. We strongly recommend site reviews and audits, to update the network data, so proper analysis and decisions can be taken. The benefits of this task are generally huge.
5. **Network Parameters** – Amongst the several network parameters considered during the design process, a thorough analysis of the network should include interference considerations, frequency planning, traffic demand and capacity studies, service classes' definition, and technology selection. Even though the client may provide most of these items, multiple meetings may be required to finalize all parameter definitions.
6. **Design Balance between Commercial and Technical Requirements** –the balance between these issues often requires multiple network designs and reviews, which directly impact the timeline and budget.
7. **Selecting the Proper RF Planning Partner** – the ideal partner will not only have experience with similar projects and a proven track record, but also be a provider of design & optimization tools that have been tested and fully exercised.

2012-2013 LTE, WiMAX & Wi-Fi Track Record

A brief summary and sample of projects that CelPlan International designed in the last year:

- Public Safety project – North America, Metropolitan area of 12M, 4.9GHz, strong design for mobile data and streaming video.
- Public Safety project – North America, metropolitan area of 900K, 4.9GHz, design for mobile data and streaming video.
- Network Operator – Middle East, Countrywide Design, 3.5GHz, capacity of 200K subscribers, rural to dense urban areas, all services classes.
- Network Operator – Africa, developing country with large urban city, Phased 4G design with 250 sites with expansion plans for additional urban areas.
- Network Operator – South America – Citywide design, metropolitan area of 2.2M, 160 sites, 802.16e /LTE design.
- Network Operator – South America, countrywide initial design for operator for HSPA+ upgrade.
- Network Operator – Asia Pacific, Countrywide initial design for operator, 3.5GHz, pre RFP design, and signal strength only.
- Network Operator – Asia Pacific, three urban cities in same country, 3.5GHz, 14MHz of spectrum, and 9K subscribers.
- Network Operator – Caribbean, regional design, multi-island 4G-LTE network.
- Network Operator – Caribbean, regional design, small-cells deployment.

Technical Team Leaders

Leonhard Korowajczuk

CEO/CTO

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Leonhard Korowajczuk sets the high standards for the wireless solutions developed by CelPlan. With over 40 years' experience in designing telecommunications equipment & wireless networks, he holds several patents, and is a published author. He previously worked for Standard Electrica, STC, BTM, Elebra, Alcatel, and Comsat in South America, Europe and U.S.

Paulo Leite

Director of Engineering

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Paulo Leite brings over twenty years of senior engineering experience to his role at CelPlan. Along with his extensive product knowledge, he also oversees all customer software licenses, engineering projects, and pre-deployment activities. Prior to his role with CelPlan, Paulo served in a senior engineering position with Alcatel. He has supervised the design and optimization of hundreds of wireless networks in all technologies.

Cristine Korowajczuk

Director of Training & Customer Support

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Cristine Korowajczuk has been affiliated with CelPlan since its inception in 1993. With a thorough knowledge of the CelPlan software portfolio, she has provided quality assurance control for CelPlan's software documentation and software version releases. Beyond product support, she has also been a key contributor in the development and delivery of CelPlan's software training. Cristine has been working in RF engineering throughout her career.

Contact CelPlan

For more information on CelPlan International and our LTE, WiMAX or Wi-Fi solutions, please contact a representative at one of our following regional offices:

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