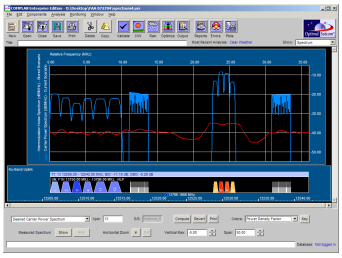
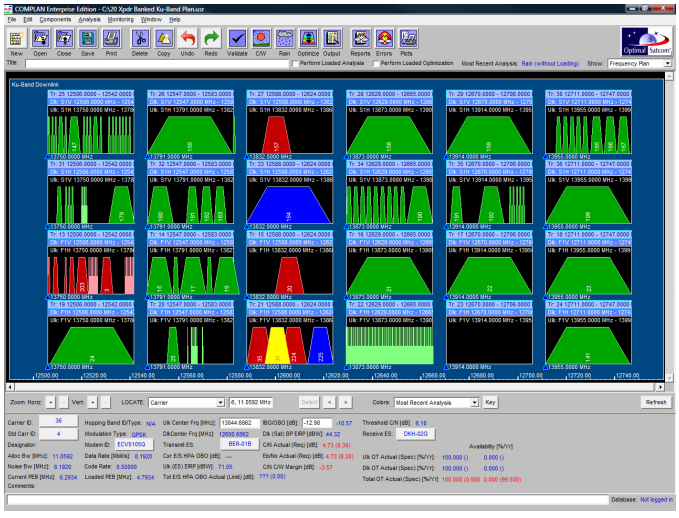
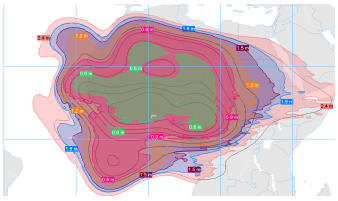
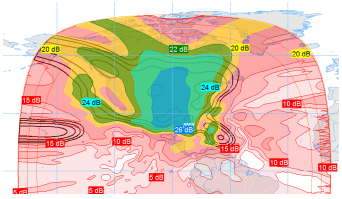
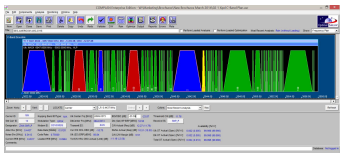
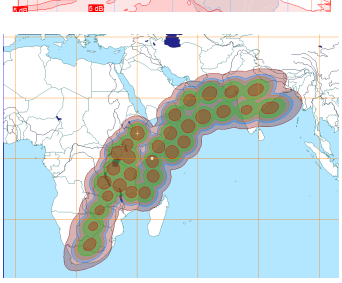
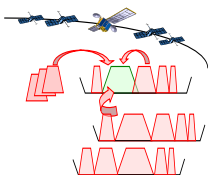
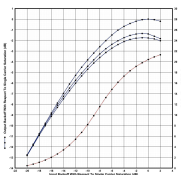
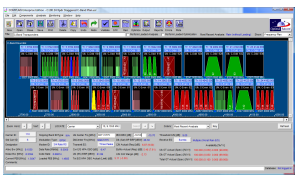
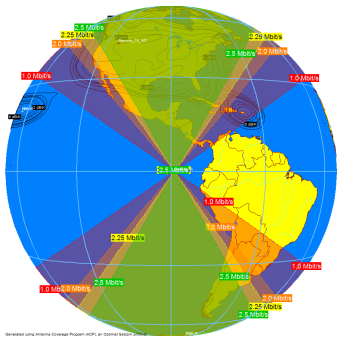
Complan®

Advanced Software for Satellite Transmission Engineering, SATCOM System Design, and Capacity Optimization

www.optimalsatcom.com

Complan®

Overview

Complan is an advanced satellite transmission engineering tool used for design, analysis, optimization, and troubleshooting of satellite communications networks.

Complan accurately models and analyzes commercial and military satellite systems operating in C, X, Ku, and Ka-band, including the new generation of multi-beam high-throughput satellite (HTS) systems.

Complan employs detailed impairment models and sophisticated non-linear optimization algorithms that have been proven through more than 20 years in production use by major satellite operators, some of the world's largest service providers, and the heaviest users of satellite capacity within the government.

Complan can simultaneously plan and optimize hundreds or thousands of links in an entire network, or even an entire satellite. No other commercially available tool comes close to matching its speed, accuracy, and level of detail.

Utilizing Complan, capacity engineers can manage higher volumes of capacity than are possible with traditional link budget tools or in-house developed systems. They are able to quickly analyze their networks, perform complex trade-off analyses not otherwise practically possible, and optimize system design to make efficient use of space and ground-segment resources.

Companies deploying Complan have experienced multi-fold gain in staff productivity; substantial savings in satellite lease and ground segment costs; and improvement in the quality and performance of their networks.

Who Uses Complan

Complan is used by satellite operators, satellite service providers, and end-user satellite network engineers operating on both commercial and military satellites. Anyone who manages a large amount of satellite capacity or who operates large or complex satellite networks will potentially benefit from the use of Complan.

Complan for Satellite Operators

Complan can accurately model almost every current and proposed transponded (bent-pipe) commercial/military geostationary satellite, including the new generation of high-throughput satellites.

Complan can simultaneously model all transponders on a satellite. It provides detailed modeling of amplifier non-linear gain and phase-shift transfer characteristics, IMUX and OMUX filter characteristics, SFD/gain settings, uplink and downlink copol, cross-pol antenna gain patterns, and G/T and EIRP contours.

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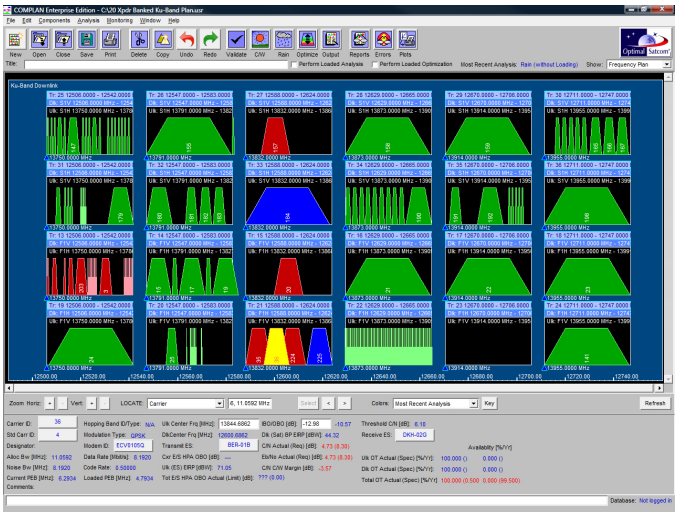
Satellite operators use Complan during the design phase to design satellite coverages, assess non-linear behavior of conventional vs. linearized TWTAs, develop power-sharing strategies for multi-beam high-throughput satellite systems, and perform adjacent satellite interference (ASI) analysis for inter-system coordination.

During the operational life of the satellite, satellite operators use Complan to routinely analyze their networks and ensure that inter-ference, intermodulation, carrier suppression, and other non-linear effects are held in check. They also use Complan to ensure that transmission plans comply with customer lease allocations, FCC/ITU limits and inter-system coordination agreements.

Complan provides a number of functions, including graphical drag-and-drop, to reassign carriers and groom frequency plans across multiple transponders. Complan is also used to optimize the configuration of the satellite, including gain settings, pointing of steerable antennas, and spacecraft platform bias.

When a satellite is to be relocated or nears end-of-life, Complan is used for planning the transition of traffic to the new satellite, aided by intuitive drag-and-drop functions that facilitate carrier reassignment. Some of the most challenging transition planning scenarios have been aided through use of Complan.



Complan's Frequency Planning Screen Showing a 24-Transponder Plan

Complan for Satellite Service Providers and End-Users

Satellite service providers who lease substantial amounts of satellite capacity from multiple satellite operators find Complan to be an extremely versatile tool. Rather than having to laboriously analyze their network one-link-at-a-time using conventional link-budget tools, the engineer can use Complan to quickly and accurately model and optimize the entire transponder network.

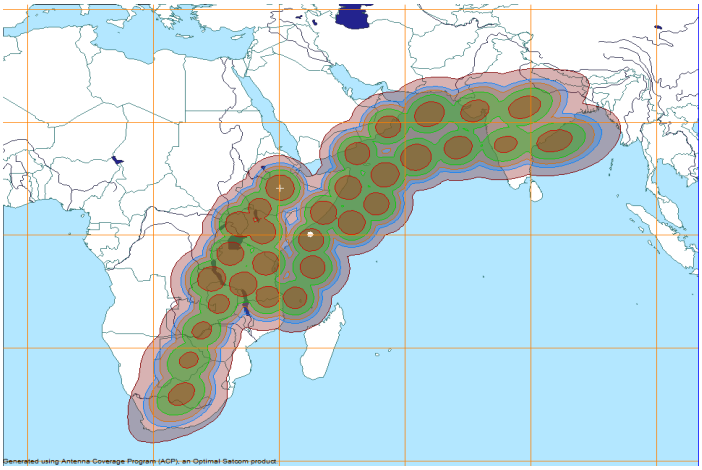
Complan's power optimization algorithms minimize use of space-segment capacity while achieving the required quality of service (Eb/No, BER, and availability). Parametric analysis features allow the planner to perform judicious trade-offs between key network parameters. Complan's broadcast/wide-area planning features allow service providers to analyze the performance of their network over the entire coverage of a satellite, and appropriately size their hub and remote antenna diameter and HPA size, outbound and return-carrier mod-cod settings, etc. to provide the requisite performance over the specified service area.

Using these powerful features, Complan users routinely achieve significant, often dramatic, cost savings through optimum ground-segment design and minimization of required satellite bandwidth, when compared to other commercially available or satellite operator provided link budget tools.

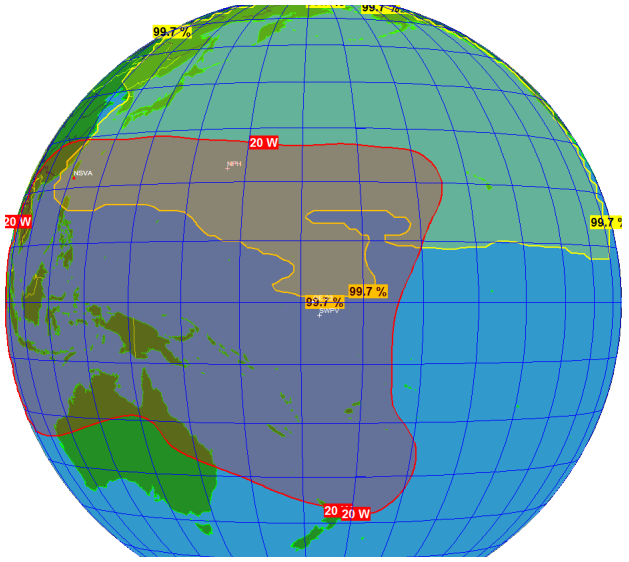
Complan for Next-Generation High-Throughput Satellites

Complan includes all the features necessary to model the new generation of high-throughput satellites:

- Complan includes the best available propagation models for Ka-band, the prevalent band for high throughput satellites. Rain fade and other propagation impairments are much more severe at Ka-band than at lower frequencies.
- Complan can model multi-spot-beam satellites with large numbers of beams. Cross-beam interference is often a limiting factor in these satellites – Complan's interference model computes interference from all potentially interfering beams regardless of whether they are spatially or cross-pol isolated (or a combination thereof).
- Complan models bandwidth-efficient modulation/coding techniques (e.g. 16-APSK and 32-APSK), low-roll-off modem technologies, and transmit carrier suppression techniques (e.g., DoubleTalk CnC, and PCMA) which are frequently used with HTS systems.
- Multi-beam satellites often use wide-band amplifiers with power-sharing across multiple beams. Complan models these types of split-beam transponders, and the complex non-linear effects and resource allocation considerations that arise from power-sharing.



Performance of a Multi-Beam Satellite – Map Shows Aggregate Performance As a Terminal Moves Across Multiple Beams



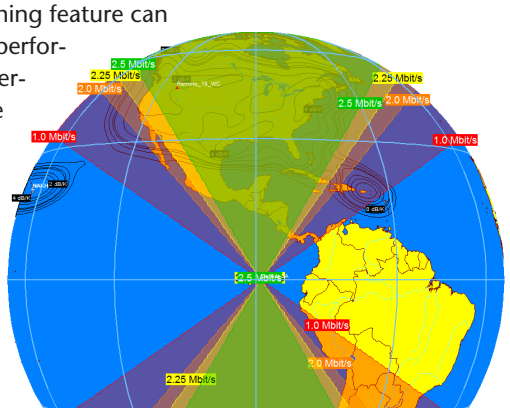
Outbound and Return Carrier Service Areas Generated Using Complan – Intersection Represents Network's Effective Service Area

> *"Complan includes all the features necessary to model the new generation of high-throughput satellites."*

Complan for Airborne Networks

Complan includes the modeling of specialized airborne antennas which often use a combination of mechanical steering and electromagnetic beam-forming (e.g., phased arrays) to steer and align the antenna due to the limitations imposed by the mobile platform.

Complan has the ability to load the co-pol and cross-pol gain performance of these antennas as a function of off-boresite and skew angle, or elevation angle, allowing precise modeling of the performance from all locations. Accurate geometric and propagation models take into account the effect of altitude. Complan's broadcast/wide-area planning feature can rapidly analyze the performance of airborne terminals and generate maps of link performance, impact of interference from adjacent satellites, and limits on uplink power and link throughput required to comply with ITU and FCC limits.



Computed Throughput Limit of an Airborne Terminal – Map Shows Dependence on Skew Angle

Benefits

- Reduce costs by maximizing space-segment capacity utilization
- Perform trade-off analyses to minimize ground-segment infrastructure costs
- Design complex satellite networks with ease
- Manage and efficiently plan large scenarios with hundreds or thousands of links in multiple transponders
- Achieve orders-of-magnitude increase in productivity of satellite planners
- Track power and bandwidth utilization, and discover "hidden" capacity
- Troubleshoot operational plans and easily identify complex problems
- Evaluate future satellite systems and assess long-term capacity requirements
- Plan with confidence using the most accurate, laboratory and field verified models

Major Features

- Ability to model entire satellite and plan a large number of links simultaneously
- Comprehensive and accurate modeling of complex nonlinear effects
- Accurately models thermal noise, intermodulation noise, propagation impairments, and all major sources of interference – adjacent-carrier (ACI), co-channel (CCI) and adjacent satellite (ASI)
- Includes the ITU, COMSAT® PAP, COMSAT DAH, and Crane Two Component propagation models; and includes comprehensive databases of rainfall, and other climate statistics
- Models extensively verified in the lab, through field testing, and by customer-site measurements
- Extremely fast computation utilizing sophisticated non-linear optimization algorithms
- Selected by US Government as benchmark for validating other systems
- Powerful features for broadcast/wide-area planning and performance prediction; generates results on a map
- **Uplink Maps Include:** Required uplink EIRP, transmit terminal antenna size or HPA/BUC size, carrier C/N or availability as a function of transmit location, and uplink PSD limit margin (FCC or ITU)
- **Downlink Maps Include:** Carrier downlink EIRP, clear-sky Eb/No or C/N, availability under rain, required receive terminal G/T or antenna size, and aggregate ASI C/I
- Parametric analysis feature can be used to perform sophisticated trade-off analyses and complex system studies
- Ability to model FDMA, TDMA, CDMA, Carrier-in-Carrier (CnC), PCMA, and spread-spectrum; precisely computes self-interference
- Provides drag-and-drop carrier frequency assignment and frequency grooming functions
- Interfaces with commercial Communication System Monitoring (CSM) systems
- Plans saved in XML standard file format and can be viewed/modified by publicly available tools

Complan Reports & Plots

- Extensive set of reports and plots in ASCII, Word, Excel, and PDF
- Graphical frequency plan report
- Detailed and summary link budget reports
- Noise, margin, and power summary reports
- Rain analysis, predicted link availability, and required rain margins
- Detailed interference and intermodulation reports
- Power spectral density reports and plots – carrier power, intermodulation, co-pol and cross-pol spectrum at receive earth stations
- Broadcast performance report provides transponder and link performance for a list of cities or lat-lon locations
- Sun outage reports

Interaction With Other Optimal Satcom Products

Antenna Coverage Program™ (ACP™)

All map-based results generated by Complan are rendered in ACP, a full-featured mapping and visualization software that comes bundled with Complan. ACP does not need to be procured separately.

Sun Outage Calculator™ (SunOut™)

Complan uses SunOut to generate sun-outage reports. SunOut is an accurate sun outage prediction software that comes bundled with Complan. SunOut does not need to be procured separately.

Enterprise Capacity Manage® (ECM™)

Complan is seamlessly integrated with Optimal Satcom's ECM product. When a customer has both ECM and Complan, ECM forms the broad-based capacity management system, while Complan is used as an advanced transmission engineering and capacity optimization tool.

ECM maintains all data and is used for routine capacity management. When Complan analysis is required, ECM can automatically synthesize and export the plan to Complan for further off-line analysis. Results of Complan can later be saved back to ECM as needed. When used together, Complan and ECM form a powerful capacity management system.

ECM is a separately licensed product.

Versions

Complan is available in two versions:

Complan Enterprise Edition can model multiple transponders within a plan and is suitable for satellite operators.

Complan Professional Edition is limited to modeling one (1) transponder per plan and is suitable for satellite service providers and end users.

In either case, there is no limit to the number of plans that may be created or used with Complan.

Licensing

Complan is licensed based on number of concurrent users. It can be procured either as a perpetual license (CAPEX), or an annual license (OPEX).

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Optimal Satcom is the leading global provider of enterprise systems and services for satellite capacity management.

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