experts in radio network planning & optimisation tools

Forsk is an independent company providing RF planning and optimisation software solutions to the wireless industry since 1987. Forsk is completely independent from equipment suppliers and telecom operators. In 1997, Forsk released the first version of Atoll, its flagship RF planning software. Since then, Atoll has remained the most advanced RF planning and optimisation platform available and has reached a leading position in the market with more than 3500 installed licenses.

**Forsk’s success with Atoll has come from our commitment to 5 key factors:**

**Independence**
Forsk’s commercial success and strong financial position has ensured its independence of operators, equipment suppliers and financial institutions. Being independent, Forsk can maintain a long-term strategy for the development of Atoll and its relationships with customers and partners.

**R&D**
Forsk is totally focused on developing wireless network design and optimisation software. Forsk has a strong and committed R&D team which both keeps Atoll in line with the latest developments in the industry and maintains joint R&D projects for Atoll with a number of operators, equipment suppliers and partners. This R&D effort allowed Forsk to be the 1st on the market with 3G RF planning tools and to remain the leader in 3G simulation today. In 2008, Forsk was the 1st on the market with a LTE planning tool.

**Software Development Expertise**
Forsk uniquely combines in-depth knowledge of network design and software development expertise. Forsk’s team has an unmatched experience in developing wireless network design and optimisation software, which enables Forsk to provide its customers with powerful, scalable and user-friendly radio planning products.

**Open Platform Concept**
Forsk designed Atoll from the start as an open and flexible platform. Since the first version of Atoll, Forsk has been delivering development tools and partnering with 3rd party developers able to supply specialised complementary solutions. More additional solutions are available for Atoll, from the most renowned suppliers, than for any other RF planning tool. These solutions cover areas such as propagation modelling, automatic optimisation, dynamic simulation, QoS analysis and automatic frequency planning.

**Customer Support**
Forsk aims at building and maintaining long-term relationships with its customers in their use of Atoll. The quality and reactivity of our technical support are key elements of these relationships.

This unique combination of strengths and a long and consistent record make the Forsk difference. Today, Forsk is a global supplier with 200+ customers in 70 countries and strategic partnerships with major players in the industry including AT&T, Vodafone, Alcatel-Lucent, Huawei and Nortel.

Forsk distributes and supports Atoll directly from offices and technical support centres in France, USA and China and also through a world-wide network of distributors and partners.
Atoll is a scalable and flexible multi-technology network design and optimisation platform that supports wireless operators throughout the network lifecycle, from initial design to densification and optimisation.

Atoll is also an open technical information system that easily integrates with other IT applications and increases productivity.

It features advanced development tools and open interfaces that enable the integration of customised or commercially available complementary modules. Atoll is designed to work in a wide range of implementation scenarios, from standalone to enterprise-wide server-based configurations using distributed and parallel computing.

**Highlights**

**Advanced Network Design Features**
Atoll incorporates a high-performance propagation calculation engine, supports hierarchical networks, multi-service traffic modelling, automatic frequency/code planning and optimisation. Atoll supports GSM/GPRS/EDGE, UMTS/HSPA, LTE, CDMA2000 1xRTT/EV-DO, TD-SCDMA, WiMAX and Microwave links. It also includes support for multi-technology network planning (e.g., GSM/UMTS/LTE) including inter-technology handover modelling.

**Integrated Optimisation Tools**
Atoll includes a set of fully integrated AFP (Automatic Frequency Planning) and ACP (Automatic Cell Planning) tools, allowing operators to perform design and optimisation tasks from a single application using a single database and IT infrastructure. Optimisation tools are available for GSM, UMTS, LTE and WiMAX.

**Open and Flexible Architecture**
Atoll is an open platform for network design and optimisation. Atoll supports multi-user environments through an innovative database architecture that provides data sharing, data integrity management and easy integration with other IT systems. Atoll’s scripting capabilities allow easy automation using a standard macro language. Atoll also includes an advanced Software Development Kit (SDK) that facilitates customisation and IT integration. Atoll also has the largest range of compatible 3rd party products on the market.

**State-of-the-art GIS Features**
Atoll supports multi-format/multi-resolution geographical databases. Large, dense urban and country-wide databases are supported and displayed interactively as multiple layers including engineering and prediction plots. Atoll also features an integrated vector/raster cartography editor.

**Distributed and Parallel Computing**
Atoll allows distributing calculations over several workstations and supports parallel computing on multi-processor servers, thus dramatically reducing calculation times and getting the most out of hardware.
Atoll Core is the central module that supports the user interface, the GIS features, the propagation modelling engine, all data management services, interfaces and software development tools. All technology modules run on top of Atoll Core.

Atoll 2.8 also features Automatic Frequency Planning tools and Automatic Cell Planning tools that deliver, on top of the technology modules, a comprehensive set of automatic network design and optimisation functionalities.

In addition to the modules offered by Forsk, specialised products are available from 3rd party partners for specific applications such as urban propagation models (WaveSight from Wavecall and Volcano from Siradel), in-building engineering design software (RF-vu from iBwave) optimisation and post-processing tools.

Atoll Microwave is a comprehensive Microwave Link planning tool. It is based on the Atoll Core platform and has full database compatibility with Atoll radio-planning configurations. See the Atoll Microwave brochure for more information about this product.

The technology matrix below shows modules suitable for each technology. Several technology modules can be combined in the same Atoll configuration for planning integrated multi-technology projects.
Atoll

powerful RF design & optimisation platform

Used together with one or several technology modules, Atoll Core delivers the general features shared by all technology modules, customised developments and 3rd party products.

Based on an object-oriented architecture and designed for radio planning & optimisation, Atoll Core is a robust and scalable platform that supports very large projects while remaining user-friendly and easy to administrate.

The Atoll platform also enables the integration of live network data into the planning & optimisation process, allowing users to combine predicted and real network data. Supported data include CW measurements, drive test data, interference matrices and OSS KPIs.

GIS Features
- Optimised cartographic database supporting Digital Elevation Models, clutter data (type and height), 3D building data (vector/raster), traffic Data, scanned maps, vector data, population and climate data.
- Integrated cartography editor (vector/raster)
- Interface with GIS tools: MapInfo, ArcView, Google Earth
- Support for Web Map Services (WMS)

Propagation Modelling
- Support for dual-resolution pathloss matrices: high resolution results near transmitter and lower resolution results far from transmitter for interference calculation
- Full support for multi-resolution prediction plots
- Comprehensive integrated propagation model library
- 3rd party urban/microcell propagation models (optional)
- Automatic propagation model tuning using CW or test mobile data
- Pathloss matrix adjustment using prediction/drive test interpolation
- Integration of external propagation models through an API and a C++ development kit

Task Automation and Scripting
- Scripting language allowing integration of user-defined macros
- User-defined calculation batch based on macros and scripts

Distributed Computing
- Distributed computing on networked workstations and servers
- Parallel computing on quad- and dual-processor systems

Printing and Reports
- Flexible report generator including traffic, population and clutter-based statistics
- User-defined reports based on macros
- Export of reports and prediction plots into other software
- Any printing devices supported up to A0

User and Database Management
- Advanced administration module supporting data access and user privilege management
- Flexible database structure allowing integration of user-defined parameters and custom fields
- Multi-user support including database consistency management, data synchronisation and user disconnection/reconnection from/to the database
- Support for standalone/centralised/distributed configurations
- Advanced import/export features allowing quick data migration from other RF planning tools

Measurements Module
- CW measurements
  - Import, display and analysis of CW data
  - Prediction/measurements comparison and statistical analysis
  - Automatic propagation model tuning using CW measurements
- Test mobile data
  - Import, display and analysis of test mobile data
  - Call events display and analysis
  - Automatic propagation model tuning using test mobile data
  - Pathloss matrix adjustment using prediction/drive test interpolation
Atoll includes state-of-the-art GSM/GPRS/EDGE features that provide comprehensive and accurate modelling of voice and data services, including full support of HCS and frequency hopping. Multi-resolution predictions and optimised interference calculations facilitate planning as well as optimising mature networks that have a large number of sites and country-wide coverage.

Atoll also includes GSM/UMTS co-planning features that have been developed in partnership with leading wireless operators. Atoll 2.8 includes new GSM/UMTS interference analysis features that allow operators to analyse GSM and UMTS deployments in the same frequency bands.

### Network Modelling
- Support of dual-band networks
- Support of HCS (Hierarchical Cell Structure)
- Support for frequency hopping (baseband & synthesised), DTX and AMR
- Modelling of GPRS and E-GPRS
- Advanced service modelling

### Service Planning and Analysis
- Cell and network coverage analysis
- GPRS/EGPRS/EGPRS2 prediction plots (throughput, coding scheme selection)
- Interference analysis
- QoS analysis: FER/BER/BLER/MOS prediction plots
- Neighbour planning and handover analysis

### Traffic Analysis
- Multi-service traffic map generation from multiple sources: vector, raster and live traffic data
- Traffic spreading between cell layers with traffic overflow modelling
- Cell dimensioning for mixed voice/data traffic and timeslot configurations
- Traffic analysis including calculation of KPIs such as packet delay, blocking rate, etc.

### Interference Matrix Generation
- Prediction and drive test-based interference matrices
- Support of subcell-based (e.g., BCCH, TCH) quality thresholds
- Open format allowing editing and modifying interference matrices using 3rd party applications

### GSM/UMTS Co-planning
- Site sharing
- Simultaneous display and analysis of GSM and UMTS networks
- Inter-technology handover modelling based on proven intra/inter-technology neighbour allocation algorithms
- Inter-technology interference analysis (e.g. GSM 900 and UMTS 900)

#### Automatic Frequency Planning - AFP
- Advanced algorithm based on a soft penalty approach
- User-definable constraints and editable cost function
- Allocation of frequency hopping parameters (HSN, MAIO, MAL)
- Integration with 3rd party AFP tools through an open API

#### Automatic Cell Planning - ACP
- Automatic optimisation of network parameters to increase coverage & capacity
- Site selection and activation for greenfield and densification scenarios
- Antenna selection & parameter optimisation (azimuth & tilt)
Atoll was the first UMTS network planning solution available on the market. Since then it has stayed ahead of the competition with continuous improvements made through close cooperation with GSM and UMTS operators.

Atoll version 2.8 includes support for HSPA+ and MIMO.

Atoll 2.8 includes a new GSM/UMTS interference analysis feature that helps operator to analyse and plan GSM and UMTS deployments in the same frequency bands.

**Network Modelling**
- Support for multiple carriers
- UMTS equipment modelling including RRM and inter-carrier power sharing
- Advanced bearer and service modelling
- HSPA and HSPA+ modelling
- MBMS modelling
- MIMO modelling
- VoIP modelling

**Traffic Modelling**
- Modelling of multiple circuit and packet switched services
- Modelling of user equipment, user profiles and environment types
- Multi-service traffic map generation from multiple sources: vector, raster and live traffic data

**Simulation and Analysis**
- State-of-the-art Monte Carlo UMTS/HSPA/MBMS simulator including DL and UL power control, RRM, HSDPA/HSUPA to R99 downgrading and carrier allocation algorithms
- Real-time point analysis tool
- Generation of prediction plots, based on simulations or on user-defined cell load figures, including:
  - Ec/Io prediction plots
  - Downlink and Uplink Eb/Nt prediction plots
  - Service areas
  - Number of servers
  - Handover areas
  - Interference and pilot pollution
  - BER/FER/BLER
  - HSPA prediction plots
  - MBMS service area

**Neighbour and Scrambling Code Planning**
- Manual and automatic multi-carrier neighbour planning
- Automatic scrambling code allocation supporting various allocation strategies
- Scrambling code allocation analysis tool including SC interference plots

**GSM/UMTS Co-planning**
- Site sharing
- Simultaneous display and analysis of 2G and 3G networks
- Inter-technology handover modelling based on proven intra/inter-technology neighbour allocation algorithms
- Inter-technology interference analysis (e.g. GSM 900 and UMTS 900)

**Automatic Cell Planning - ACP**
- Automatic optimisation of network parameters to increase coverage & capacity
- Site selection and activation for greenfield and densification scenarios
- Antenna selection & parameter optimisation (azimuth & tilt)
Network and Radio Parameter Modelling
- Support of various frequency bands, channel bandwidths, and sampling frequencies
- Support of TDD and FDD duplexing methods
- Support of LTE OFDMA (DL) and SC-FDMA (UL) parameters:
  - Frame structure, subframes, slots and cyclic prefixes
  - Resource blocks, subcarrier widths, reference signals
  - Control channel overheads: reference signals, PDCCH, PUCCH, P-SCH, S-SCH etc.
- Support for multiple modulation types and coding schemes
- MIMO modelling: transmit diversity, spatial multiplexing (SU-MIMO), uplink collaborative MIMO (MU-MIMO), AMS

Traffic Modelling
- Modelling of voice and data services
- Multi-service traffic demand maps generated from multiple sources: vector, raster, and live traffic data
- Subscriber traffic modelling

Simulation and Analysis
- LTE Monte-Carlo simulator including power control, advanced RRM and scheduling algorithms, support for MIMO
- Generation of prediction plots, based on simulation results or on user-defined cell load figures including:
  - Cell and network coverage analysis
  - Uplink and downlink interference analysis
  - Uplink and downlink bearer coverage predictions
  - Uplink and downlink throughput coverage predictions
  - Uplink and downlink quality indicator prediction plot
- Aggregate throughput prediction plot
- Capacity Planning

Neighbour and Physical Cell ID Planning
- Manual and automatic neighbour planning
- Automatic CellID/Cell Group ID planning

GSM/UMTS/LTE and CDMA2000/LTE co-planning
- Site sharing
- Simultaneous display and analysis of 2G/3G and LTE networks
- Inter-technology handover modelling
- Inter-technology interference analysis (e.g. UMTS/LTE, CDMA2000/LTE)

Automatic Frequency Planning - AFP
- Generation of interference matrices
- User-definable constraints and editable cost function
- Allocation of channels and fractional frequency planning (FFP)

Automatic Cell Planning - ACP
- Automatic optimisation of network parameters to increase coverage & capacity
- Site selection and activation for greenfield and densification scenarios
- Antenna selection & parameter optimisation (azimuth & tilt)
Forsk has been working with market leaders in North America and Asia to deliver state-of-the-art CDMA2000 planning features, including a combined 1xRTT/1xEV-DO traffic model. Atoll fully supports EV-DO Rev. A.

**Network and Radio Parameter Modelling**
- Network database
- Support for repeaters
- Radio configuration and channel modelling
- Radio Resource Management (RRM)
- Support for multiple carriers and frequency bands
- Carrier type modelling (1xEV-DO, 1xRTT)
- FCH and SCH modelling (1xRTT)
- Hybrid-ARQ modelling

**Data Services Modelling**
- 1xRTT FCH activity factor/SCH variable rate modelling
- 1xRTT SCH and FCH forward/reverse link Eb/Nt thresholds
- 1xEV-DO Rev.0 and Rev.A quality tables (C/I vs. forward link data rate)
- Reverse link 1xEV-DO Rev.0 and Rev.A physical channels modelling
- Forward/reverse Rev.A radio bearer modelling

**Traffic Modelling**
- Modelling of voice and data services
- Support for multiple sources of traffic data
  - user distribution maps
  - live traffic data per service per cell
  - service demand maps (raster/vector)

**Simulation**
- State-of-the-art Monte Carlo based CDMA simulator including RRM and carrier allocation algorithms
- Modelling of mixed 1xRTT/1xEV-DO traffic
- Forward and reverse link power control
- Carrier selection modelling
- Extended multi-service Monte Carlo simulations
- 1xRTT SCH and FCH power control modelling
- 1xRTT reverse and forward link SCH data rate downgrading
- 1xEV-DO reverse link power control simulation including data rate downgrading
- 1xEV-DO forward link cell capacity calculation

**CDMA Prediction Plots**
- Based on Monte-Carlo simulation results or on user-defined cell load figures
- Ec/Io pilot prediction plots
- Forward and reverse link Eb/Nt prediction plots
- Forward and reverse link coverage per 1xRTT SCH rate
- Forward and reverse link prediction plots per data rate 1xEV-DO (Rev.0 and Rev.A)
- Service areas (pilot + forward & reverse link traffic)
- Handoff status prediction plots
- Number of servers
- Pilot pollution prediction plots
- Total forward link noise and noise rise prediction plots
- Real-time point analysis tool
- Reports

**Neighbour and PN-offset Planning**
- Manual and automatic neighbour planning
- Multi-carrier neighbour planning
- Automatic PN-offset allocation
- PN-offset allocation analysis
WiMAX/BWA

Atoll WiMAX is a state-of-the-art WiMAX and Broadband Wireless Access (BWA) network planning tool developed in cooperation with WiMAX equipment manufacturers. Atoll WiMAX supports the IEEE 802.16d and the evolving IEEE 802.16e standards. It also supports advanced antenna diversity systems, such as Adaptive Antenna Systems (AAS) and Multiple-Input-Multiple-Output (MIMO).

**Simulation and Analysis**
- SUI/Erceg propagation model for WiMAX
- WiMAX Monte-Carlo simulator including power control, advanced RRM and scheduling algorithms, support for adaptive antenna systems and MIMO
- Generation of prediction plots, based on simulation results or on user-defined cell load figures including:
  - Cell and network coverage analysis
  - Uplink and downlink interference analysis
  - Uplink and downlink bearer coverage predictions
  - Uplink and downlink throughput coverage predictions
  - Uplink and downlink quality prediction plot
  - Aggregate throughput prediction plot

**Neighbour and Preamble Index Planning**
- Manual and automatic multi-carrier neighbour planning
- Automatic preamble index and segment assignment (Fractional Frequency Plan, FFP)

**Subscriber Modelling**
- Fixed subscribers database
- Subscriber display on map
- Automatic & manual connection of subscribers to serving cells
- Analysis of received signal level, interference, bearer (adaptive MCS) and throughput for each subscriber

**Network and Radio Parameter Modelling**
- Support for TDD and FDD PMP networks
- Support for multiple frequency bands
- Subcarrier configuration and frame structure modelling
- Support for different permutation zones
- Segmentation and permutation zone modelling
- WiMAX reception equipment modelling
- Site database can be shared with Atoll Microwave for backhaul planning

**Traffic Modelling**
- Modelling of voice and data services
- Support for all WiMAX QoS classes (UGS, rtPS, Expedited rtPS, nrtPS, and BE)
- Modelling of customer premises equipment and user profiles
- Multi-service traffic demand maps generated from multiple sources: vector, raster, and live traffic data
- Subscriber traffic modelling

**Automatic Frequency Planning - AFP**
- Generation of interference matrices
- User-definable constraints and editable cost function
- Allocation of carrier channels and preamble index

**Automatic Cell Planning - ACP**
- Automatic optimisation of network parameters to increase coverage & capacity
- Site selection and activation for greenfield and densification scenarios
- Antenna selection & parameter optimisation (azimuth & tilt)
Atoll TD-SCDMA has been developed in partnership with major players in the TD-SCDMA scene in China, and is the most advanced and widely used TD-SCDMA planning software on the market.

Network Modelling
- Support for multiple carriers
- TD-SCDMA equipment modelling including RRM and capacity parameters
- Timeslot configuration modelling including switching point definition for each carrier
- Advanced service modelling
- HSDPA modelling
- UpPCH shifting modelling
- MBMS modelling

Traffic Modelling
- Modelling of multiple circuit and packet switched services
- Modelling of user equipment, user profiles and environment types
- Multi-service traffic map generation from multiple sources: vector, raster and live traffic data

Simulation and Analysis
- TD-SCDMA Monte-Carlo simulator including timeslot modelling, smart antenna modelling, and Dynamic Channel Allocation (DCA) modelling
- Generation of prediction plots, based on simulations or on user-defined per-timeslot cell load figures including:
  - P-CCPCH RSCP coverage
  - DL and UL Eb/Nt coverage
  - Required power
  - Effective service areas
  - Cell-to-cell interference
  - UpPCH interference
  - P-CCPCH pollution
  - Offered/required capacity per cell
  - DwPCH, UpPCH coverage
  - Baton handover
  - HSDPA prediction plots: CQI, RLC, MAC and application throughput per pixel
  - MBMS service area
- Real-time point analysis tool

Smart Antenna Modelling
- Switched beam, adaptive beam, and beamforming smart antennas modelling
- Modelling of C/I gains based on smart antenna parameters and angular spread
- Support for user-defined smart antenna parameters and algorithms
- Smart antennas considered in Monte Carlo simulations and prediction plots

Neighbour and Scrambling Code Planning
- Manual and automatic multi-carrier neighbour planning
- Automatic scrambling code allocation supporting various allocation strategies
- Scrambling code allocation analysis tool

2G/3G Co-planning
- Site sharing
- Simultaneous display and analysis of 2G and 3G networks
- Inter-technology handover modelling based on advanced inter-technology neighbour allocation algorithms
Forsk offers a complete range of services to operators for a quick implementation of Atoll and in-depth knowledge transfer to users. These services enable operators to benefit from the productivity increase delivered by Atoll in the shortest period of time. Once the implementation phase is complete, users get assistance through our helpdesk and Forsk can also provide on-site assistance when needed.

Implementation
Forsk can provide a turn-key implementation of Atoll on operator premises, including software installation and system configuration. Forsk can migrate data from a previous planning tool into Atoll, therefore delivering a solution that is ‘ready to use’ right after the installation.

Training
Forsk has a comprehensive training course portfolio that covers all activities related to Atoll: user training, administrator training, technology module and specialised module training (e.g. propagation model calibration). Training courses can be delivered at our training centres in Europe, North-America and Asia as well as on customer premises. Forsk can also deliver customised training courses upon request.

Mentoring
Forsk provides on-site post-training support in order to help operators within their first few weeks of operational use of Atoll. During this phase, operators get a comprehensive knowledge transfer from Atoll experts with long experience of similar situations.

Custom Software Development
Forsk can develop additional modules for Atoll, in order to meet specific integration or functional requirements. Such modules are developed using the standard Atoll Software Development Kit (SDK) in order to achieve full integration and make future evolutions and maintenance easy.

Helpdesk & Support Portal
Once the Atoll implementation project has been completed, operators get a continuous access to Forsk support through the Atoll Helpdesk and the Support Portal. The Atoll support portal provides access to a set of online resources and allows users to log technical questions to the Forsk helpdesk/support team.
Software Development Kit

3rd Party Products

Atoll Developer’s Toolkit

Atoll is an open platform and includes development tools that allow operators or 3rd party developers to customise their working environment and easily integrate Atoll with other IT applications. This key feature provides flexibility and a capacity to quickly add customised modules that no other RF planning solution delivers.

The Atoll developer’s toolkit includes a general programming interface and some dedicated interfaces:

- The general interface provides access to all Atoll project data allowing developers to add their own functions to the Atoll user interface. This extremely powerful feature enables the integration of a wide range of applications with Atoll, including simulation, optimisation and configuration tools. It also allows the automation of tasks in Atoll, such as calculations and simulations, using VBScript.
- Dedicated interfaces allow the integration of specialised modules such as propagation models, smart antenna models and frequency planning applications.

Customisation can be performed using external scripting tools or Atoll’s Visual Studio .NET Software Development Kit.

Forsk also offers training courses and support services for developers.

Technology Partners

Forsk’s “3rd party developer program” aims at helping developers to integrate their solutions with Atoll through the Atoll SDK. Forsk has been providing its partners with developer licenses and support for several years. As a result, a wide range of “best of breed” applications are available to Atoll users. Such 3rd party applications include urban propagation models, automatic optimisation tools, frequency planning applications and simulation tools.

Check out the “Partners” section at www.forsk.com for more information about our technology partners.
Hardware and software requirements

- Minimum recommended configuration for workstations or laptops
  - Intel Xeon (or equivalent) with 2 GB of RAM
  - Microsoft Windows 2000, XP Professional and Vista

- Relational Database Management System (not required for stand alone configurations)
  - Oracle 9i and 10g
  - Sybase Adaptive Server V12.5
  - Microsoft SQL Server 2005
  - Microsoft Access