

RAMS Plus Simulation Solutions

1	WHAT IS RAMS PLUS™?	1
1.1	RAMS PLUS™ - DYNAMIC SIMULATION SOLUTIONS	1
1.2	RAMS PLUS™ - GATE TO GATE ATM FAST-TIME SIMULATION	1
1.3	RAMS PLUS™ - A VALIDATED COMPONENT FOR YOUR SIMULATION TOOLKIT	2
1.4	RAMS PLUS EXCHANGE (RPX)	3
1.5	WHO IS ISA SOFTWARE?	3
2	RAMS PLUS AIRSIDE & GROUND SIDE FUNCTIONALITY	3
2.1	AIRSIDE FUNCTIONALITY	3
2.2	GROUND SIDE FUNCTIONALITY	4
2.3	APPLYING AIRSIDE & GROUND SIDE TOGETHER	4
2.4	EXAMPLE ATM SCENARIO USING RAMS PLUS	5
2.5	GATE-TO-GATE IN 2 PROGRESSIVE LAYERS	8
3	RAMS PLUS LICENSING POLICY	9
3.1	RAMS PLUS™ USAGE POLICY	9
3.2	RAMS PLUS™ LICENSE & PRICING POLICY FOR COTS CLIENTS	9
3.3	GET A FREE EVALUATION VERSION OF RAMS PLUS™	10
3.4	RAMS PLUS™ UNIVERSITY POLICY: RAMS PLUS™ IS FREE	11

1 What is RAMS Plus™?

1.1 RAMS Plus™ - Dynamic Simulation Solutions

RAMS Plus™ is a complete turn-key, high-fidelity, cost-effective easy-to-use gate-to-gate ATM fast-time simulation tool available on the familiar and powerful Windows NT/2000/XP platforms.

RAMS Plus™ from ISA Software promotes a progressive era for the ATC simulation and modelling community. Much more than an ATC simulator, ISA Software's experienced ATM analysis team applying RAMS Plus™ to your study requirements is a complete commercial solution that can satisfy the evolving requirements of the ATC/ATM simulation community for many years to come.

The RAMS Plus™ ATM simulator offers a reliable and proven simulation engine, with a full graphical user interface available on the familiar Windows platform. Complemented by the flexible ATM Analyser report package, you can concentrate more time & budget on analysis and less time on data development and software /hardware support.

RAMS Plus™ is developed, supported, and distributed exclusively by ISA Software.

1.2 RAMS Plus™ - Gate to Gate ATM Fast-Time Simulation

RAMS Plus™ provides a comprehensive range of ATM fast-time simulation capabilities, from enroute airways and speed/altitude restrictions, to TMA, SIDS/STARS, runway operations, shortest-path taxipaths, ground taxi capacity, and gate allocation. In addition, facilities to allow the modelling of future operational

concepts such as free routes airspace or RVSM are fully supported in the *RAMS Plus™* model.

RAMS Plus™ features include an integrated editor and display environment, rapid data development facilities, 4D flight profile calculation, 4D sectorisation, 4D spatial conflict detection, AI rule based conflict resolution, 4D resolution manoeuvring, workload assignment, TMA runway and hold-stack operations, airspace routing, free-flight and RVSM zones, ground taxiing, airport gates, stochastic traffic generation, and graphical animation.

RAMS Plus™ can even load external 4D flight profiles generated from other ATM tools, where these external 4D profiles can be fully simulated, including sectorisation and conflict separation violations, within the *RAMS Plus™* environment.

To allow you to analyse the results of your simulation in exactly the way that you want, *RAMS Plus™* produces a comprehensive and cohesive array of simulation history events in an easily accessible text-based format. Using these events, you have unlimited possibilities to perform the analysis that is relevant to your problem needs, either from your own reporting packages or with the ATM Analyser.

ATM-Analyser™ is a general-purpose reporting and analysis toolkit that integrates with standard Windows office tools to provide data and graphic reporting facilities. As it is independent on any particular data format, *ATM-Analyser™* provides a common analysis facility that can be used to produce reports from multiple tool sources. The ATM Analyser comes with a slew of standard reports, which are easily extendable and can be customised by you for your specific analysis requirements.

1.3 *RAMS Plus™* - A Validated Component For Your Simulation Toolkit

The *RAMS Plus™* simulation engine has been developed and enhanced since 1991, and is currently used around the world to analyse and answer ATM problems and concepts, including these principle players in the ATM domain:

USA FAA Washington DC
USA FAA Tech Center, New Jersey
USA NASA Langley
USA Mitre Corp., Virginia
EUROCONTROL Experimental Centre, France
EUROCONTROL HQ, Brussels
EUROCONTROL CRDS, Budapest
Africa ASECNA
Australia AirServices
Bulgaria Air Traffic Services
Italy SICTA
Italy ENAV
Portugal NavPortugual
Korea KARI (Korean Airspace Research Institute)
Korea Hankuk Aviation University
Spain AENA

Spain INECO
Sweden ATS Sweden
UK NATS
UK Imperial College London

1.4 RAMS Plus Exchange (RPX)

The RAMS Plus™ Exchange (RPX) user group meets once a year to discuss simulation and analysis techniques, as well as priorities for future enhancements.

The 2002 RPX was hosted by INECO in Madrid, Spain.

The 2003 RPX was hosted by EUROCONTROL CRDS in Budapest, Hungary.

The 2004 RPX was hosted by NAV Portugal in Lisbon, Portugal.

The 2005 RPX was hosted by NATS UK in Bournemouth, England.

1.5 Who Is ISA Software?

ISA Software is a privately held, independent company, which provides un-biased ATM analysis solutions to international clients, including the FAA and EUROCONTROL, since 1997. Solutions include turn-key ATM component software design and development, as well as ATM analysis to study future ATM concepts and ATM decision support tools, applying our ATM knowledge and in-house tools.

ISA Software is part of the ISA Research Group, which also includes ENV-ISA and ISA Telecoms. ENV-ISA provide environmental engineering solutions in ATM, especially in aircraft emissions and noise modelling. ISA Telecoms provide simulation and real-time tools for telecommunications.

ISA Software are the sole providers, developers, supporters, and trainers in the RAMS Plus gate-to-gate ATM fast-time simulation package.

More information about ISA Software can be found at <http://www.ISA-Software.com>

More information about the RAMS Plus can be found at <http://www.RAMSPPlus.com>

For other information and questions, please contact ramssupport@isa-software.com

2 RAMS Plus *Airside* & *Groundside* Functionality

The complete RAMS Plus gate-to-gate system conceptually consists of two domains, the *Airside* and the *Groundside*, which function together in the same environment to provide a global macro/micro gate-to-gate view of the air traffic system.

2.1 *Airside* Functionality

The RAMS Plus *Airside* domain is a runway-to-runway simulator, where the primary functionality includes:

- Traffic schedule
- Traffic profiles (routes, nav aids)

- Airport delay model
- Runway occupancy and scheduling
- TMA
 - SIDS/STARS
 - Holdstacks
 - Path stretching/Tromboning
 - Continuous Descent STARS
- 4D Sectorisation
- Controller separations and rulebased resolution
- 4D Conflict Detection
- 4D Conflict Resolution

Some primary objectives using the RAMS Plus *Airside* features includes:

- Propose alternative sectorisation,
- Measure controller workload,
- Measure airspace complexity,
- Measure airspace safety in relation to separation violations,
- Impacts of concepts such as free flight or RVSM.
- Study an unlimited view of ATM concepts.

2.2 **Groundside Functionality**

The *Groundside* domain is from a runway-to-gate simulator, where the primary functionality includes:

- Runway occupancy, including touchdown variance, deceleration/acceleration rates, hi-speed exits, and runway backtracking.
- Airport ground taxi movements from the gate to the runway.
- Taxipath shortest-path routings, considering constraints such as arr/dep status, aircraft type, ground separation, direction, etc.
- Gate allocation based on airline, aircraft model, etc.
- SID/STAR layout feeding the airport configuration.

Some primary objectives using the RAMS Plus *Groundside* features include:

- Measuring delay, for example delay by:
 - Taxi times and distances,
 - Average flight ground delays, by arrival, departure, airline, etc.
- Measuring runway demands and operations,
- Proposing alternate runway configuration, including new or closed runways,
- Proposing taxiway configurations.

2.3 **Applying Airside & Groundside Together**

Of course you can use both *Airside* and *Groundside* features within the same data scenario.

The RAMS Plus model can be configured to concentrate on the scope of the problem being studied, where this configuration can be as high-fidelity or low-fidelity as necessary to study the problem at hand.

The primary objective of using both the *Airside* & *Groundside* features together is to measure the impacts of ground operation/delay into the entire ATM system, providing a gate-to-gate view of the scenario being studied. This gate-to-gate view reflects the interaction and knock-on effects of aircraft from departure gate passenger loading and gate push-back to arrival gate passenger unloading and departure preparation turnaround.

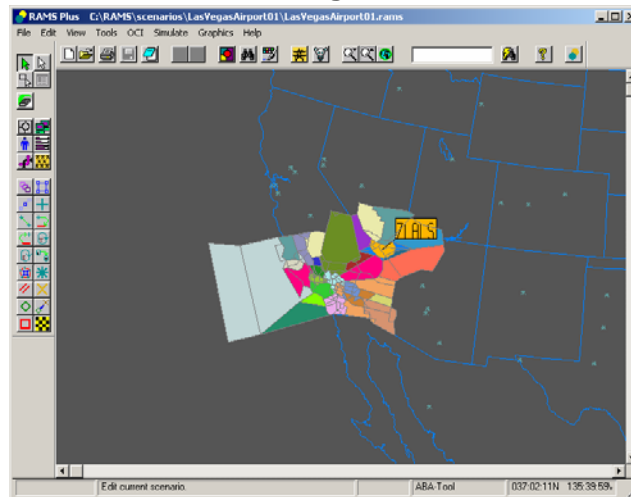
2.4 Example ATM Scenario Using RAMS Plus

Below is an example simulation that uses the RAMS Plus *Airside* to model the airspace sectorisation & *Groundside* to model gates, taxiways, runways and runway departure queues.

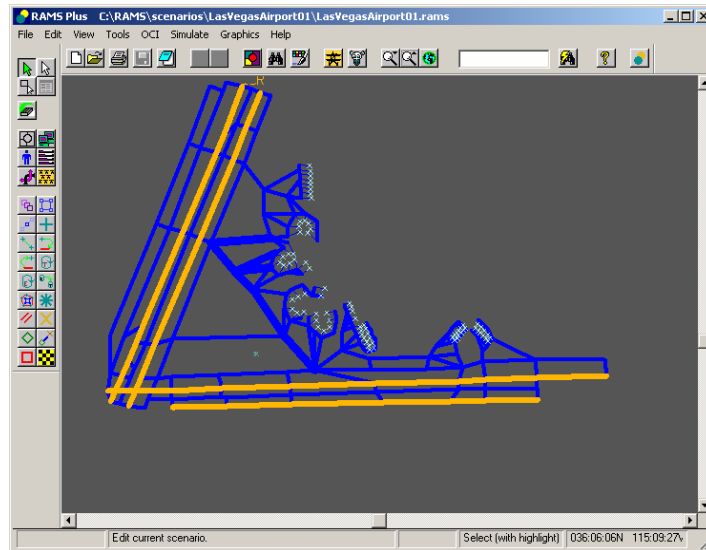
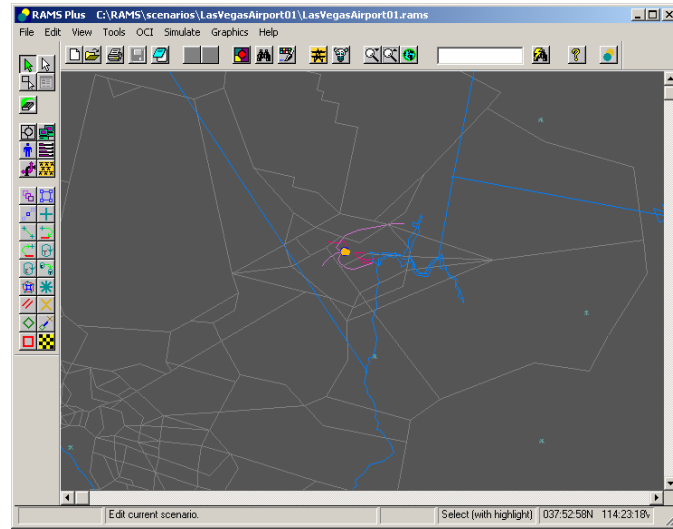
This RAMS Plus scenario of Las Vegas McCarran International Airport was created and drawn entirely within the RAMS Plus environment, based on airport diagrams available at the *Aircraft Owners and Pilots Association* website link <http://www.aopa.com/asf/taxi>. (The AOPA Air Safety Foundation, in conjunction with the FAA Runway Safety Program Office, provides airport taxi diagrams for more than 451 of the busiest U.S. towered airports to help reduce runway incursions and improve surface navigation airport taxi diagrams for more than 451 of the busiest U.S. towered airports.)

The traffic data is generated within RAMS Plus based the airline schedule located at the official McCarran International website <http://www.mccarran.com>

West Coast USA with the Los Angeles Center



Southern Tip of Nevada with Las Vegas McCarran Airport



Las Vegas McCarran International Airport as represented in RAMS Plus data formats. The flight labels indicate the flight's current ground operation, such as departure gate boarding, gate pushback, taxi-out or taxi-in, taxi ground delay, runway departure queue hold, etc.

2.5 Gate-to-Gate In 2 Progressive Layers

To model gate-to-gate in RAMS Plus, each airport within your data scenario can be optionally defined as either an *airport delay model* or with hi-fidelity *airport ground operations*, which is represented by a full gate and taxiway airport layout, and is fully integrated and interactive with the airspace and TMA operations.

1. Airport Delay Model

The airport delay model measures gate occupancy, gate pushback, taxi-out, taxi-in, and gate arrival/unloading, and gate turnaround times and delay. These times and delay times are simulated using mathematical distributions.

For example, a gate pushback may be represented by a distribution with an optimal operation time of 7 minutes, with a possibility of between 0 and 4 minutes delay. (as easily defined by the RAMS Plus random number & probability distributions).

An airport can define each of these six operation time/delay distributions by time & by airline.

The basic airport delay model also incorporates equipment holds, where a flight can not take off until its equipment airframe (as optionally defined) has arrived.

The airport delay model does not move individual aircraft through an airport ground configuration.

2. Full Airport Ground Operations

Alternately, an airport can be defined with gates and taxiways. This airport layout is represented in a familiar 2D manner, where aircraft move from the gate to the taxi to the runway, where they are possibly delayed by other aircraft moving on the ground.

Gates allocation is defined by airlines and by aircraft groups, and gate selection can be defined, by airport, as the first available gate, or the first available gate closest to the runway.

Arrival and departure gate occupancy and delay is defined by the airport distributions, as described above in the *Airport Delay Model*.

Taxiway segments are defined by the direction (one-way, two-ways), a maximum capacity, and by usage by arrival, departure, or both, and by aircraft type.

Taxiway routing is determined by a shortest-cost algorithm, where for this introduction of airport ground movements in RAMS Plus, the cost considered is the shortest-path distance from the gate to the runway. Of course, the shortest-path calculation considers the taxiway segment's direction and usage type when calculating the path.

The traditional RAMS Plus behaviour of runway occupation and runway blocking is fully integrated with the gate/taxi movements, with enhanced runway acceleration and deceleration movements, hi-speed exits, and runway backtracking.

To model aircraft separation, as aircraft move from the gate/apron area taxiways, if a taxiway segment is congested and above capacity, the aircraft will wait until the taxiway segment can be traversed.

The following wait times are recorded and are available for reports in the ATM Analyser:

- Equipment delay (wait for the airframe to arrive),
- Departure gate time and gate delay,
- Pushback time and pushback delay,
- Taxi-in and taxi-out times, distance, and delay,
- Runway departure queue delay,

3 RAMS Plus *Licensing Policy*

3.1 RAMS Plus™ Usage Policy

RAMS Plus is licensed as COTS (commercial off-the-shelf software) to European Civil Aviation Authorities, and other sites on a case-by-case basis. A license is by single-machine (Windows NT/2000/XP), where multi-site licenses are available in certain circumstances, and can represent fair cost-savings over a single-license.

For other world-wide commercial or governmental agencies, the RAMS Plus simulator can be applied to your ATM simulation requirements in collaboration with ISA Software. Collaboration with ISA Software ensures you get the highest level of fidelity and results for your analysis, whilst meeting your time-lines and budget requirements. The level of collaboration depends on your requirements, where ISA Software provides a full spectrum of analysis services from abstracting modeling requirements to data development, running the simulations, and producing reports.

In either case above, contact ramssupport@isa-software.com to discuss your simulation and license requirements.

3.2 RAMS Plus™ License & Pricing Policy for COTS Clients

ISA Software maintains RAMS Plus™ as a community-supported tool. RAMS Plus™ is a high-calibre, cost-effective easy-to-use simulation platform, which encourages fast-time simulation and a large user community. We try to keep the support costs as low as possible, to cover costs for support and continued development, where RAMS Plus™ is constantly evolving to satisfy current and future simulation requirements.

A RAMS Plus license includes:

- Comprehensive RAMS Plus simulator tool & graphical scenario development environment.
- Comprehensive User Manual and Data Manual (in PDF format)
- Complementary ATM Analyser report package, including a configurable set of standard reports that recognise RAMS Plus simulation outputs.

- One year of support (see details below).
- Unrestricted usage rights (private, internal, commercial, etc.), where you can apply the RAMS Plus tool as part of any internal, private, or commercial endeavor you wish, without asking "permission" from ISA Software or anybody else

All RAMS Plus license options include 1 year of support, representing:

- All RAMS Plus releases, upgrades, and patches.
- All ATM Analyser releases, patches, and upgrades.
- Product support via email at ramssupport@isa-software.com, normally an immediate or same day response.
- Full access to all areas of RAMSPlus.com
- Transfer of license(s) to newer machines, and temporary lap-top license for client visits.

A RAMS Plus License Includes Free Training:

- Two and half day training session for a maximum of three persons
- Available at ISA Software Ltd. located in the center of Paris.
- Available at your site providing (1) you pay transportation & hotel costs (2) provide a suitable room/projector/machines.

A RAMS Plus license is competitively priced so you can't afford not to use RAMS Plus for your ATM business applications.

RAMS Plus multi-license packages are available, where, depending on your agency or company's objectives, can represent fair cost-savings over a single-license.

After the first licensing year of support, you can choose to continue receiving RAMS Plus support and new releases by paying the continuing support fee.

Of course, you are not obliged to continue paying for RAMS Plus, and can continue to use your RAMS Plus license as long as you like.

Additional licensing information can be found at <http://www.RAMSPlus.com>, and you can contact ramssupport@isa-software.com for a price quote.

3.3 Get A Free Evaluation Version of *RAMS Plus*[™]

In many cases, ISA Software provides an evaluation version of *RAMS Plus*[™], with full functionality but limited by number of flights, and available on the PC Windows NT, 2000, and XP platforms.

Please contact ISA Software at ramssupport@isa-software.com for more information.

ISA Software will provide an easy-to-use InstallShield *RAMS Plus*[™] installation package via ftp download, containing all the software, full documentation (in PDF format), several demonstration scenarios, and the ATM Analyser report package.

3.4 RAMS Plus™ University Policy: RAMS Plus™ Is Free

As part of ISA Software's efforts to promote fast-time simulation in the ATM community, in some cases we provide the RAMS Plus simulation tool for free to universities.

If you are a professor or student at a university, and would like to use RAMS Plus™ for research or educational purposes, RAMS Plus™ is available to you at no cost. Of course there are strings attached to the amazing offer:

- We ask your permission to use your University name when publicising the RAMS Plus™ users.
- We ask for the availability, as individually approved by your University, of any research papers to be posted at www.RAMSPPlus.com
- There will be limited help from ramssupport@isa-software.com
- The RAMS Plus™ license can not be used for any commercial or profit purposes, part of the university curriculum, or CBT laboratory situations. If you would like to use RAMS Plus™ at your University for these commercial purposes, please contact ISA Software for special University license pricing.