1  **ATC TASKS**

The specification and definition of tasks in the RAMS simulator is inherent to the tool’s simulation event philosophy. The RAMS simulator is, in fact, an “ATC event” generator that reports its discreet events, or triggers, thereby enabling the modeller to program a unique set of activities, including user-defined sets of ATC tasks and ATC participants as required, to perform a simulation study. The ATC participants are those controller positions described for the sector manning arrangements.

These tasks are grouped into five main categories:

**Flight Data Management**: includes tasks of loading, preparing and discarding flight progress strips, etc., and also includes computer updates.

**Co-ordinations**: records co-ordinations between centres (external) and between sectors of the same centre (internal).

**Conflict Search**: Before issuing clearances, the controllers search their data to ensure that the action does not jeopardise separation.

**Routine R/T**: includes all the radio communication tasks (first call, last call, position report, transmission of a new clearance, etc...)

**Radar Tasks**: represents the tasks of maintaining separation of aircraft by radar actions and, when necessary, the required radar related co-ordinations with adjacent sectors.

All ATC tasks are activated by a pre-defined trigger. The trigger (e.g. ATC sector Pierce) is the event that initiates / ensures the recording of a specific ATC task.

Each ATC task is allocated a “weighting”. The weighting concerned is an arbitrary unit value assigned to the task’s actor when triggered by a simulation event. In the case of a controller workload study, the unit values would be time in seconds.

The time specified is the average time spent on the task by an experienced and fully trained controller, ignoring extreme situations which could favourably or unfavourably affect the standard execution time.

The weighting allocated is not intended to represent the actual duration of the task, but the amount of time the controller is considered to be totally committed to the task, to the exclusion of all other tasks.

In certain cases a task may involve more than one control position, and different weightings may be allocated to each.

Different weightings may be allocated to the same task occurring in different sectors.

A time offset can be applied to each task. The time offset, defined in seconds, affords the modeller the flexibility to record a task before or after a specified trigger.

Where one trigger instigates multiple activities, they can be specified to occur at different times. All tasks are related to an "object". An object is defined as the place or
position where the task is recorded. This may be defined either globally for all control centres, or more specifically in respect of a particular control centre, sector, airport, navigational aid etc…

The dynamic conditions of all tasks can be fine-tuned to afford the highest degree of flexibility to the ATC task specification.

The specification and definition of ATC tasks generally vary from one study to another. They are developed by the simulation working group members.

2 CONTROLLER PERCENTAGE LOADING

Each task is allocated to different control positions in accordance with the sector manning and distribution of duties specified for each simulated sector. In this way the RAMS model is able to calculate not only the actual workload on each position but also the percentage loading on each position over certain peak periods (generally one and three hours).

There are two values generally used in the interpretation of controller loadings: the peak 1-hour percentage loading and the average 3-hour percentage loading.

The **peak 1-hour percentage loading** represents the total time spent by a working position on the tasks recorded during the busiest 60-minute period for that position, and is expressed as a percentage of the 60 minutes. The actual time of the peak hour varies from one position to another. This loading is used to assess workload problems on individual working positions.

The **average 3-hour percentage loading** represents the total time spent by a working position on the tasks recorded by the RAMS model during the busiest 3-hour period and is expressed as a percentage of that time. Generally, the actual busiest 3-hour periods as well vary from one position to another. When these periods are coinciding, the average percentage loading can be used to assess the balance of workload between working positions, especially in those sectors belonging to the same area of the simulated airspace. These loadings are also used to compare the results of the different organisations tested.

To assist in the interpretation of these loadings, approximate criteria, established for en-route sectors, are used to describe each loading:

- **Severe 1-hour loading**: in excess of 70%
- **Heavy 1-hour loading**: in excess of 55%
- **Severe 3-hour loading**: in excess of 50%
- **Heavy 3-hour loading**: in excess of 40%

The general feeling is that these values should be to some extent increased when looking at TMA airspace or Terminal ACC sectors.
3 DETERMINATION OF CAPACITY

The following will shortly describe the method used to determine the capacity figure for each simulated sector.

3.1 Technique used

The capacity estimation technique used in RAMS is based upon the theory that ATC capacity can be defined as the maximum number of aircraft that can enter a particular control sector in a specified period (one hour), while still permitting an acceptable level of controller workload. This controller workload level is known as the heavy load threshold (HLT).

The following technique is applied in respect of each sector simulated:

- **Simulate a sufficiently large traffic sample** for the area of interest in order to permit the generation of a suitable number of distinct traffic / workload relationships.

The figure below illustrates how a sample Traffic / Workload relationship might be generated.

![Generate Workload (W) vs Traffic (T) Relationship based on a large traffic sample](image)

*Figure 1: Determination of capacity, workload / traffic relationship*

- **Make an average assessment** for the three main levels of controller workload (moderate, heavy and severe), with the provision that ultra high and ultra low are excluded so that there are no distortion effects and that the width of each loading band is sufficient to allow for variance due to conflict load effects.
Workload calculation and Determination of Capacity with RAMS

**Calculate Average Workload / Traffic Values for Heavy, Medium and Low Load Bands**

![Graph showing relationship between controller workload and traffic loading](image)

**Figure 2**: Determination of capacity, Average workload / traffic figures for various levels

- **Identify a formula** to suit the relationship between traffic loading and controller workload

**Identify Formula for the Relationship between Workload (W) and Traffic (T)**

![Graph showing formula: W = aT + bT^2 + c](image)

*Note: The formula is shown as W = aT + bT^2 + c, with specific values not provided.*

**Figure 3**: Relationship between workload and traffic loading
• **Apply this formula** to estimate the average traffic loading that would represent the defined heavy load threshold (HLT).

![Solve the deducted equation: No of Flights for HLT = Theoretical Capacity](image)

**Figure 4 : sector capacity estimate**

### 3.2 Important Notes about sector capacity

**Note 1**

The use of workload estimates from a model based simulation relies on the fact that the model is calibrated sufficiently well to give reasonable assessment of workload and that the defined HLT is suitable for that calibration.

In modelling, the determination of qualitative values (heavy load, severe load etc.) from quantitative values (numbers) is, of necessity, a function of the realism or fidelity of the particular model to that of the real world environment being simulated appropriately factored by experience gained from previous simulations or in the field. The thresholds used by the RAMS simulator tool are based upon those applied by the EUROCONTROL ATC CAPACITY Analyser (CAPAN) which in turn have been validated by several real-time studies.

**Note 2**

It is stressed that the ATS service providers are solely responsible for the issue of declared capacity values in respect of their sectors. It is obvious therefore that the values delivered by RAMS should, under no circumstances, be taken as being declared capacity figures.