Network Manager
nominated by
the European Commission

EUROCONTROL

Capacity Planning and Assessment
Additional considerations

Air Traffic Services System Capacity Seminar/Workshop
Nairobi, Kenya, 8 – 10 June 2016

Raffaele Russo
EUROCONTROL Operations Planning

Network Manager
nominated by
the European Commission

EUROCONTROL

Summary

Capacity Planning

Winter

Annual Performance Analysis - Network Operations Report –(the NOR)

Consolidation of Plans - Network Operations Plan (the NOP)

Spring

Traffic Forecast
Network Delay Forecast

Update NOP

Tool
NEST
(SAAM + NEVAC)

Demand Data Repository DDR2

Summer

Evaluation of Summer performance

ACC Capacity Baselines

Autumn

Traffic Forecast update

Traffic Demand and Distribution

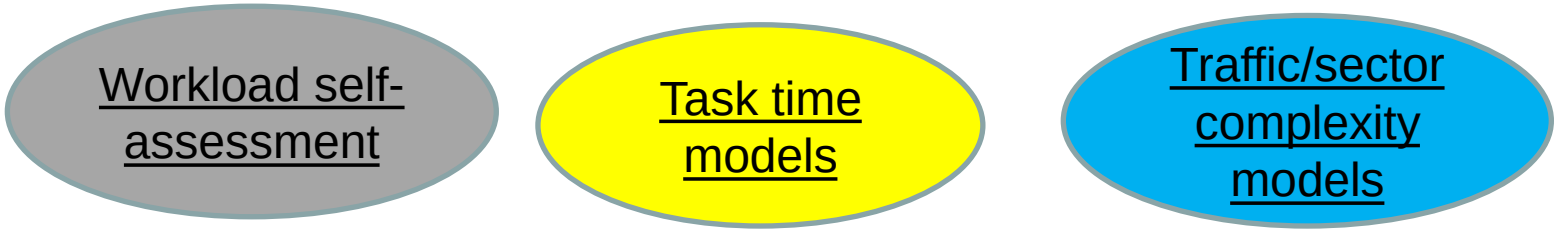
Capacity Requirements and Delay

Interactive Capacity Planning meetings with ANSPs

ANSP Plans

Assessing sector capacity through controller workload

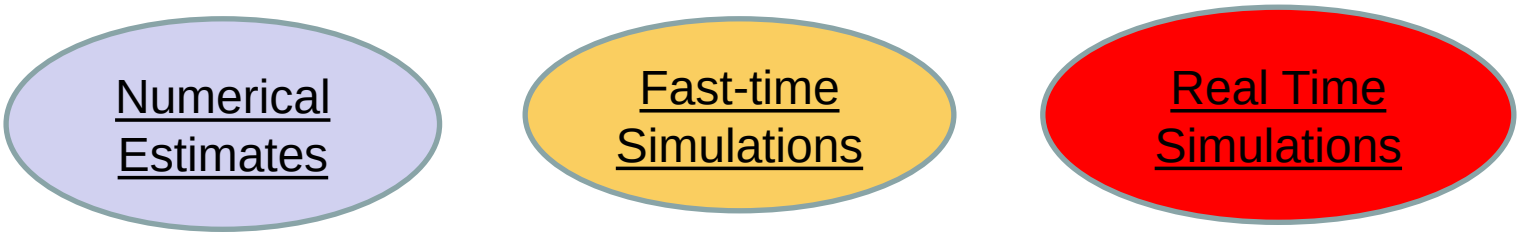
- Several approaches to workload modelling

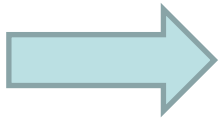


- Different workload vs.capacity relationships

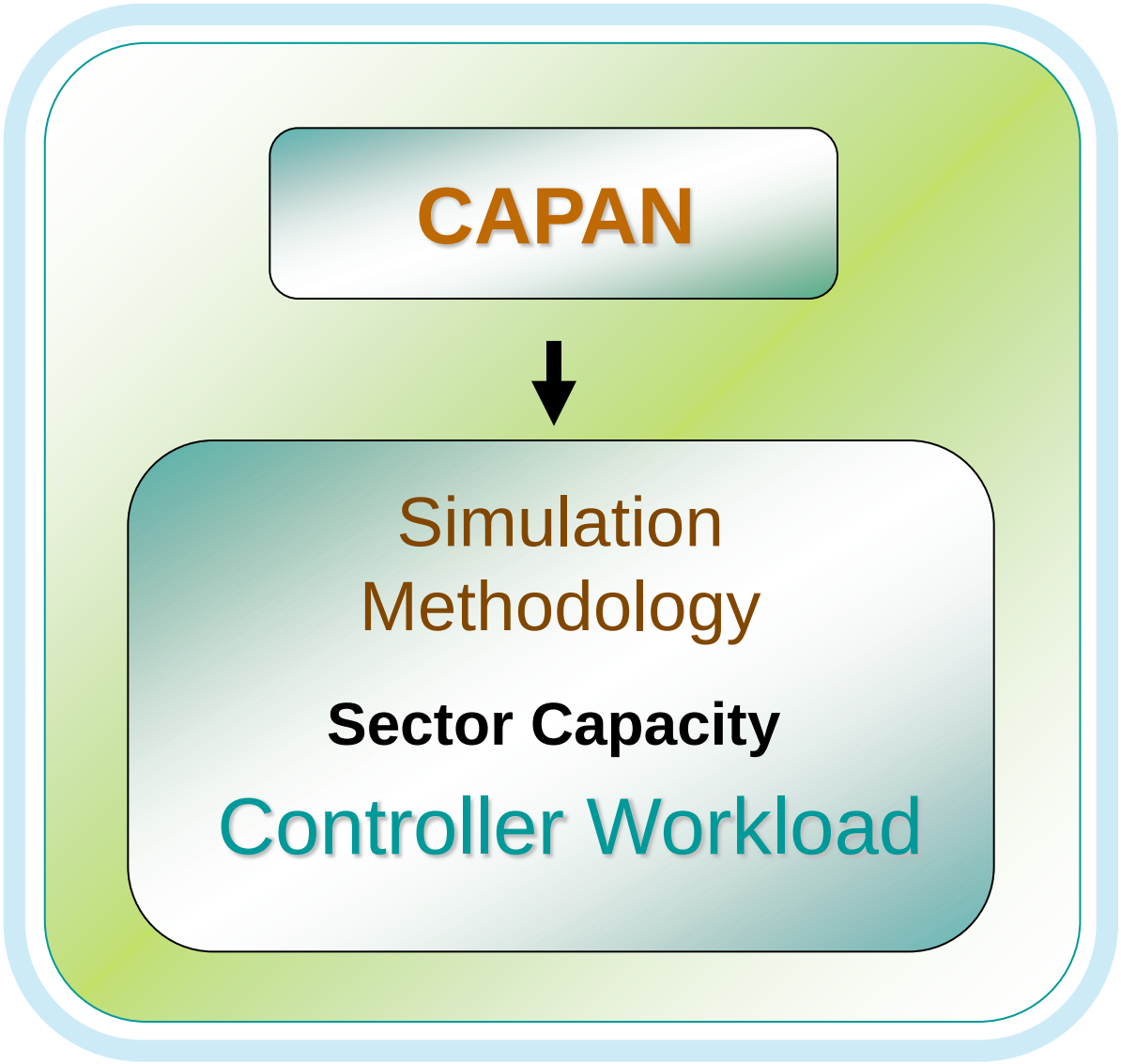
  → Workload thresholds

- Different assessment process



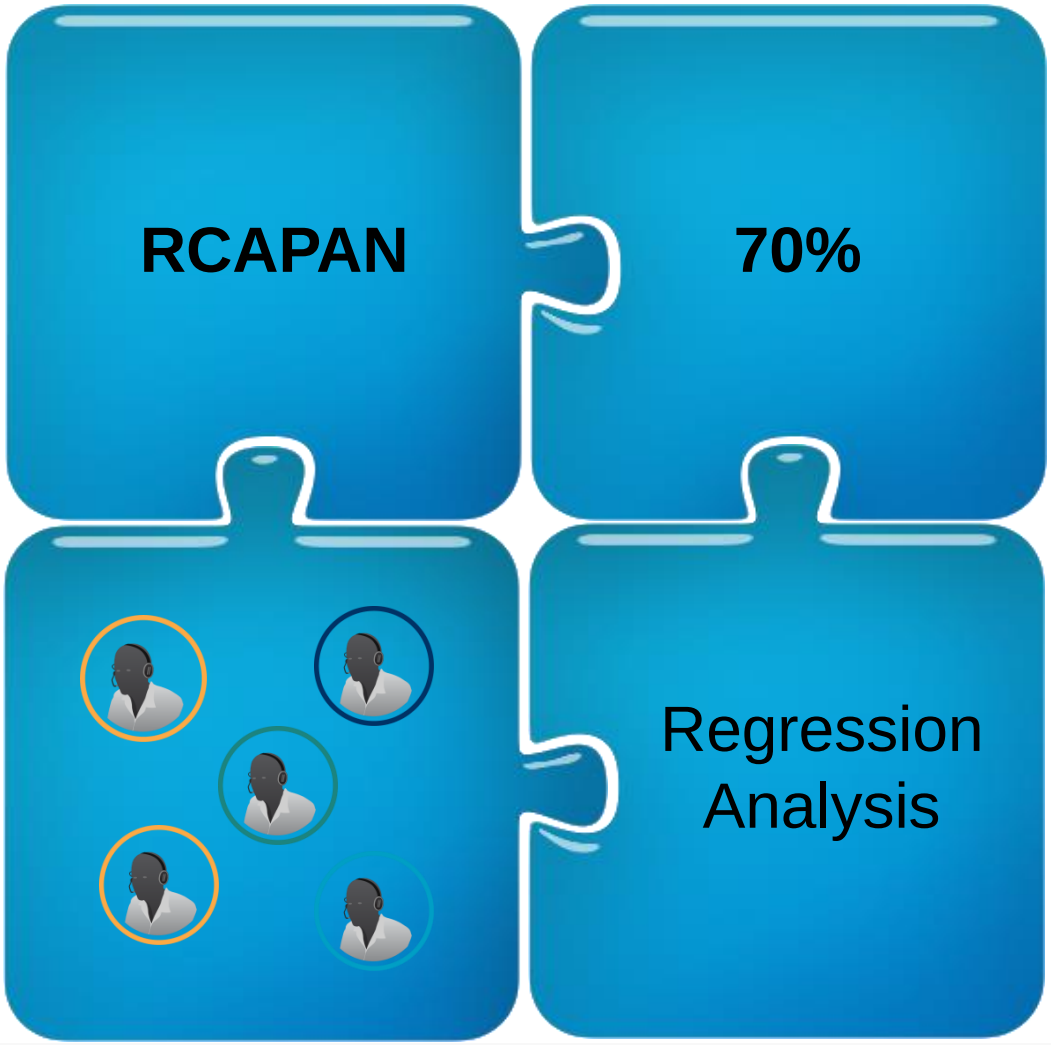


Several valid methodologies available


CAPAN
Simulation
Methodology
Sector Capacity
Controller Workload

Fast Time Simulation in ATM

CAPAN

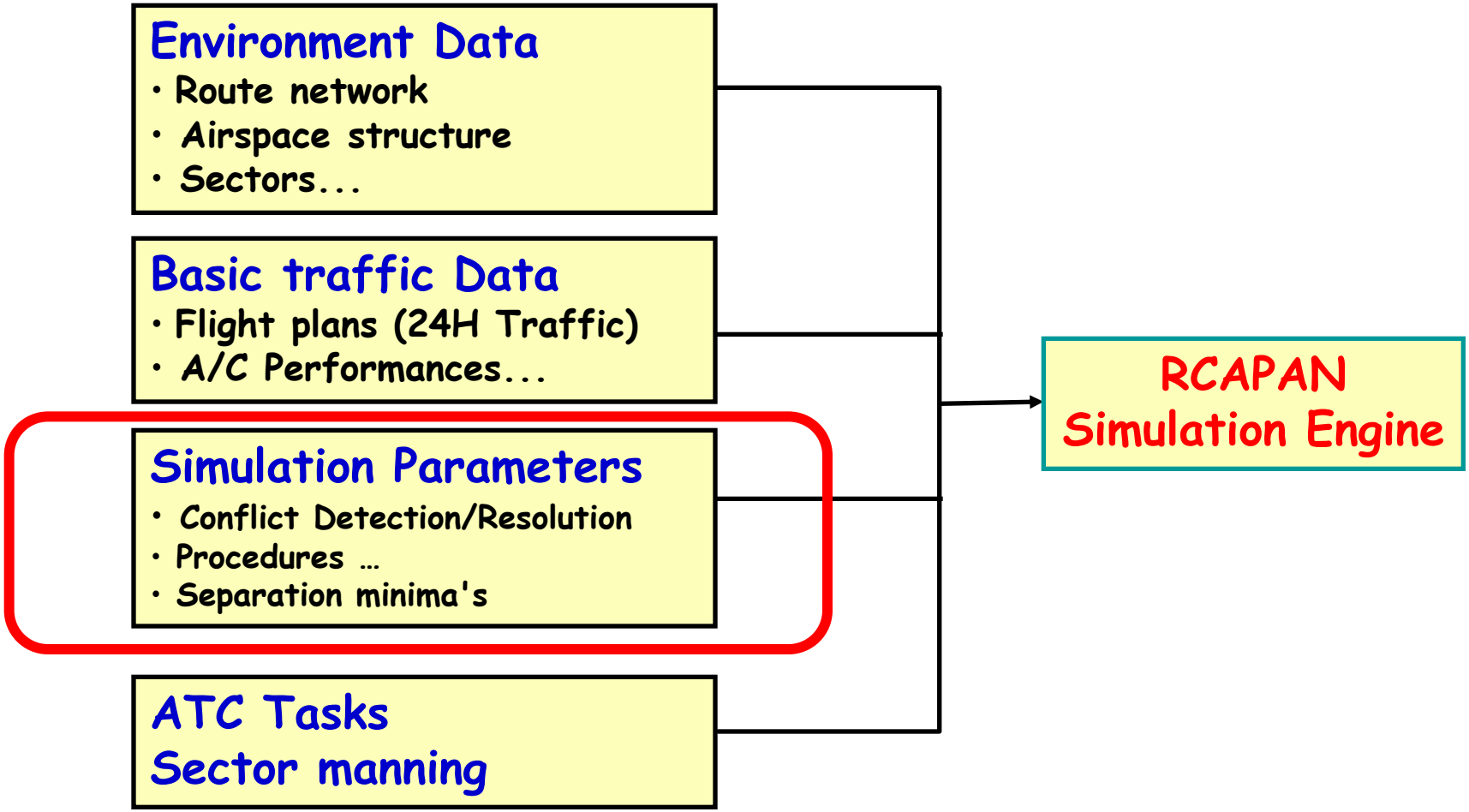


Network Manager
nominated by
the European Commission

EUROCONTROL

Conflict Detection & Resolution

Input Data


Environment Data
• Route network
• Airspace structure
• Sectors...
Basic traffic Data
• Flight plans (24H Traffic)
• A/C Performances...
Simulation Parameters
• Conflict Detection/Resolution
• Procedures ...
• Separation minima's
ATC Tasks
Sector manning
RCAPAN
Simulation Engine

Conflict Detection & Resolution

A conflict is detected if time and/or distance separation between two flights is infringed at any time while crossing the portion of airspace under control

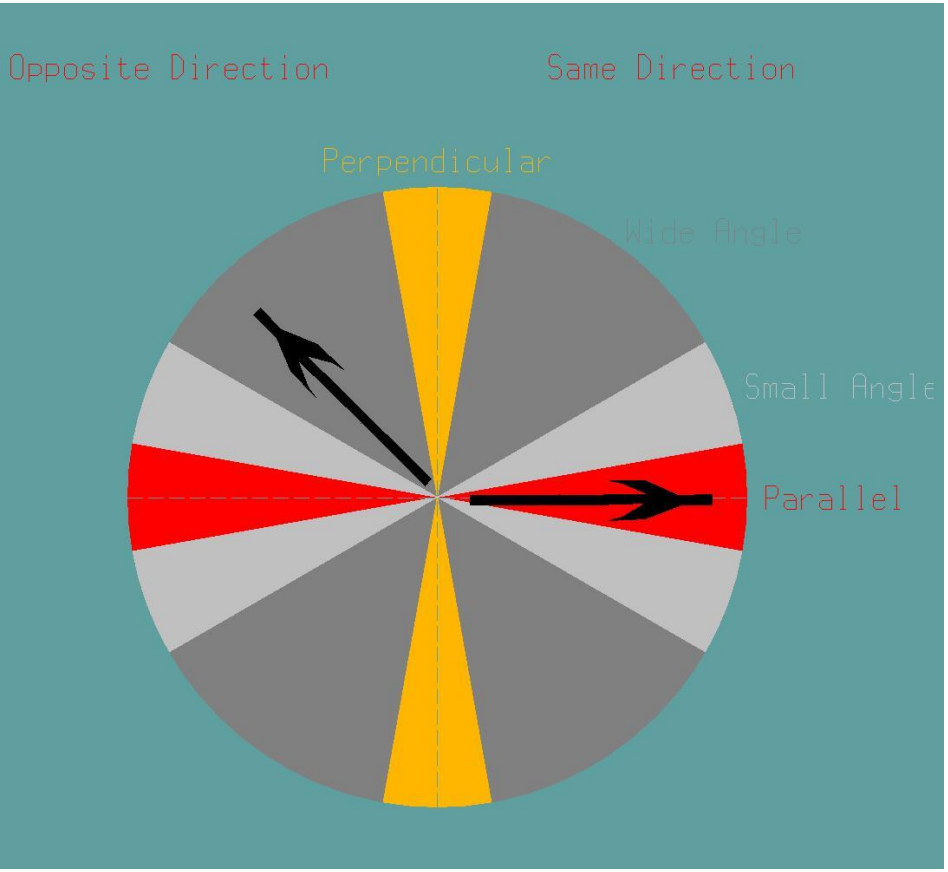
An action is taken to solve the conflict depending on:

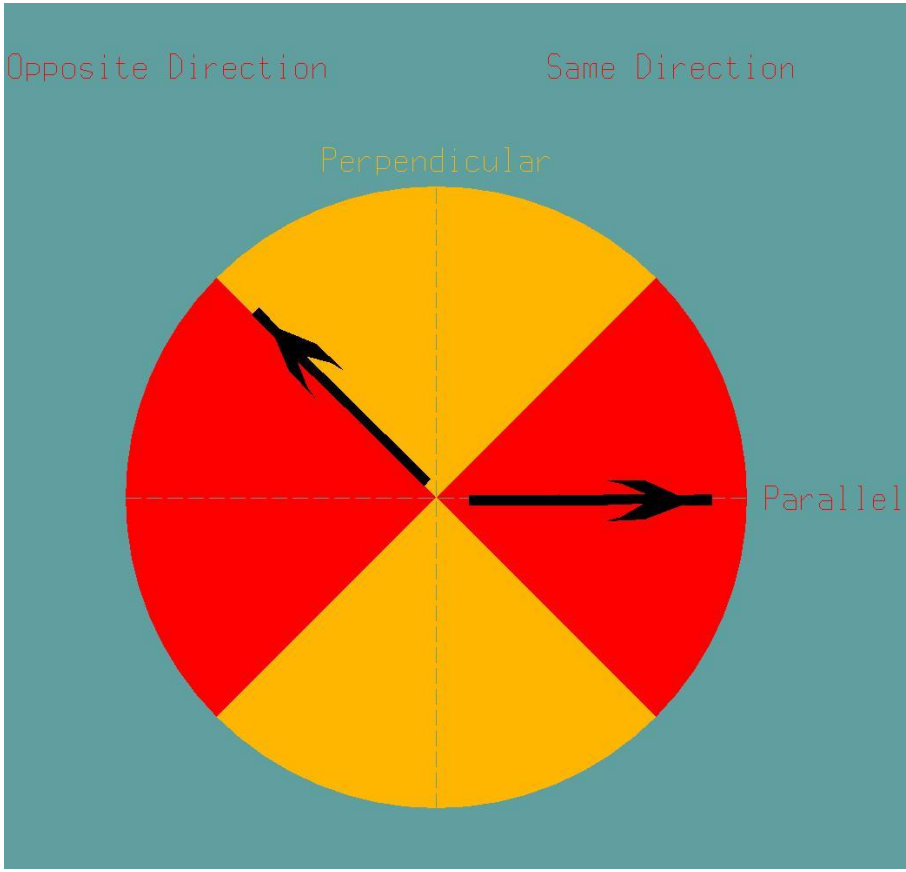
- Type of conflicts
- Conflict evolution
- System capabilities

Define time and/or distance thresholds for separation infringement

Define controller conflict resolution logic

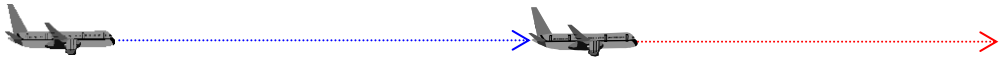
Conflict Geometry
Horizontal Plane



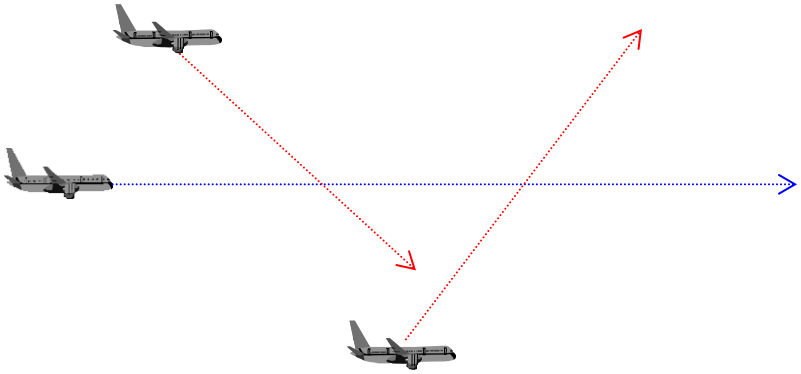


Conflict Attitude
Vertical Plane

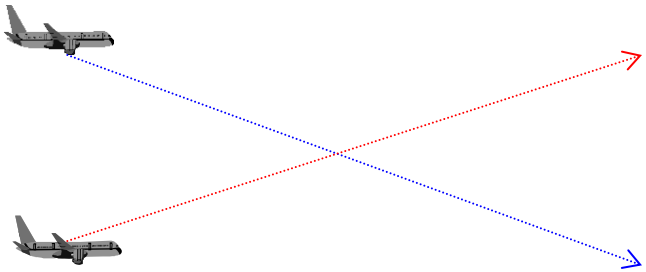
1. Both aircraft at the same level in cruise



2. One aircraft in cruise, one aircraft in climb or descent



3. Both aircraft either in climb or descent

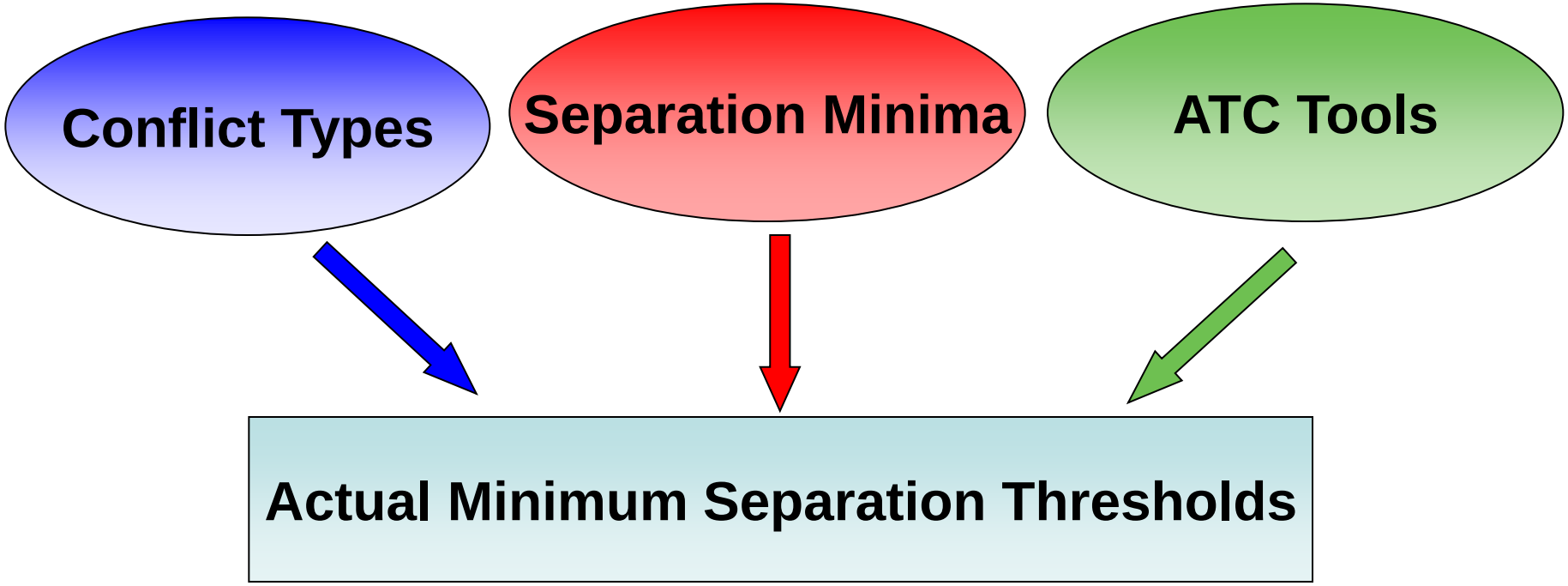


Conflict Types

A minimum of 9 types of conflicts

RADAR Conflict Number	Description
Type 1	Two aircraft on the same track at the same flight level in cruise.
Type 2	Two aircraft on the same track, one of which is in climb or descent
Type 3	Two aircraft on the same track, both of which are in climb or descent
Type 4	Two aircraft on crossing tracks, both in cruise at the same flight level
Type 5	Two aircraft on crossing tracks, one of which is in climb or descent
Type 6	Two aircraft on crossing tracks, both of which are in climb or descent
Type 7	Two aircraft on opposite tracks, both of which are in cruise at the same flight level.
Type 8	Two aircraft on opposite tracks, one of which is in climb or descent.
Type 9	Two aircraft on opposite tracks both of which are in climb or descent.

Conflict Detection



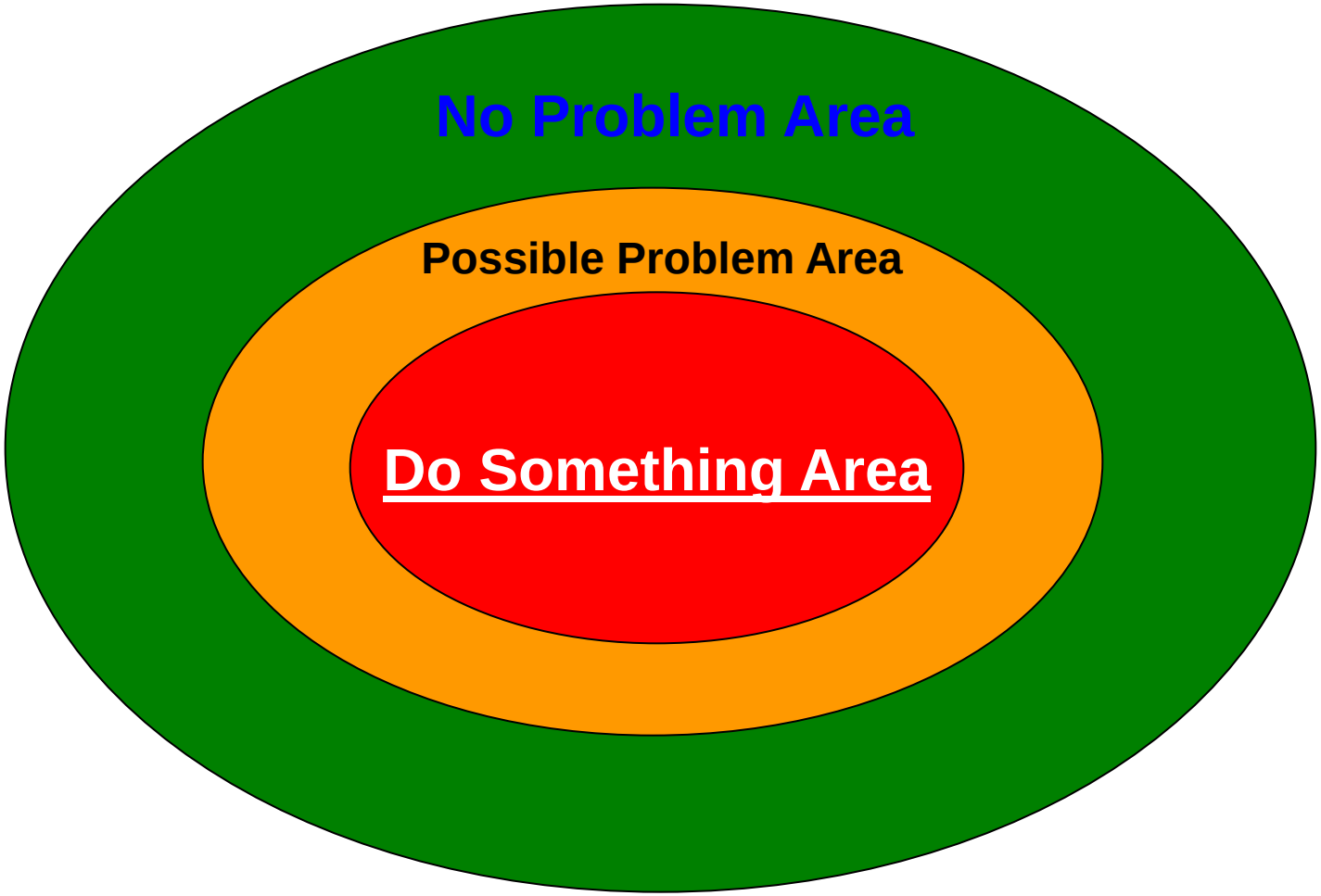
Separation Minimum distances need to be defined for all types of conflicts

These figures are used to detect and discriminate conflicts for all simulated flight profiles

Controller Separation Thresholds

- Monitoring Threshold:
  - Controller will monitor closely the situation
  - Controller will not modify the flight trajectory
- Intervention Threshold:
  - Controller will modify the flight trajectory to ensure safe (and comfortable) distance between the involved flights

Controller Separation Thresholds



Conflict Detection Thresholds: An Example

- Applicable Separation Minima: 5nm
- Conflict Type 1: Parallel Same Direction, Same Level
- ATC Tools: CPA calculation between two flights based on present heading and speed
- Detection starting as soon as flights are within controller window

Faster aircraft behind

Slower aircraft in front

Case 1

a. Controller assesses CPA to be 6 nm
b. Even though CPA>Sep.Min. controller takes an action

Case 2

a. Controller assesses CPA to be 10 nm
b. Controller does not intervene
c. Controller might monitor the evolution of the conflict

A possible threshold for conflicts Type 1 could be 10 nm

Conflict Resolution

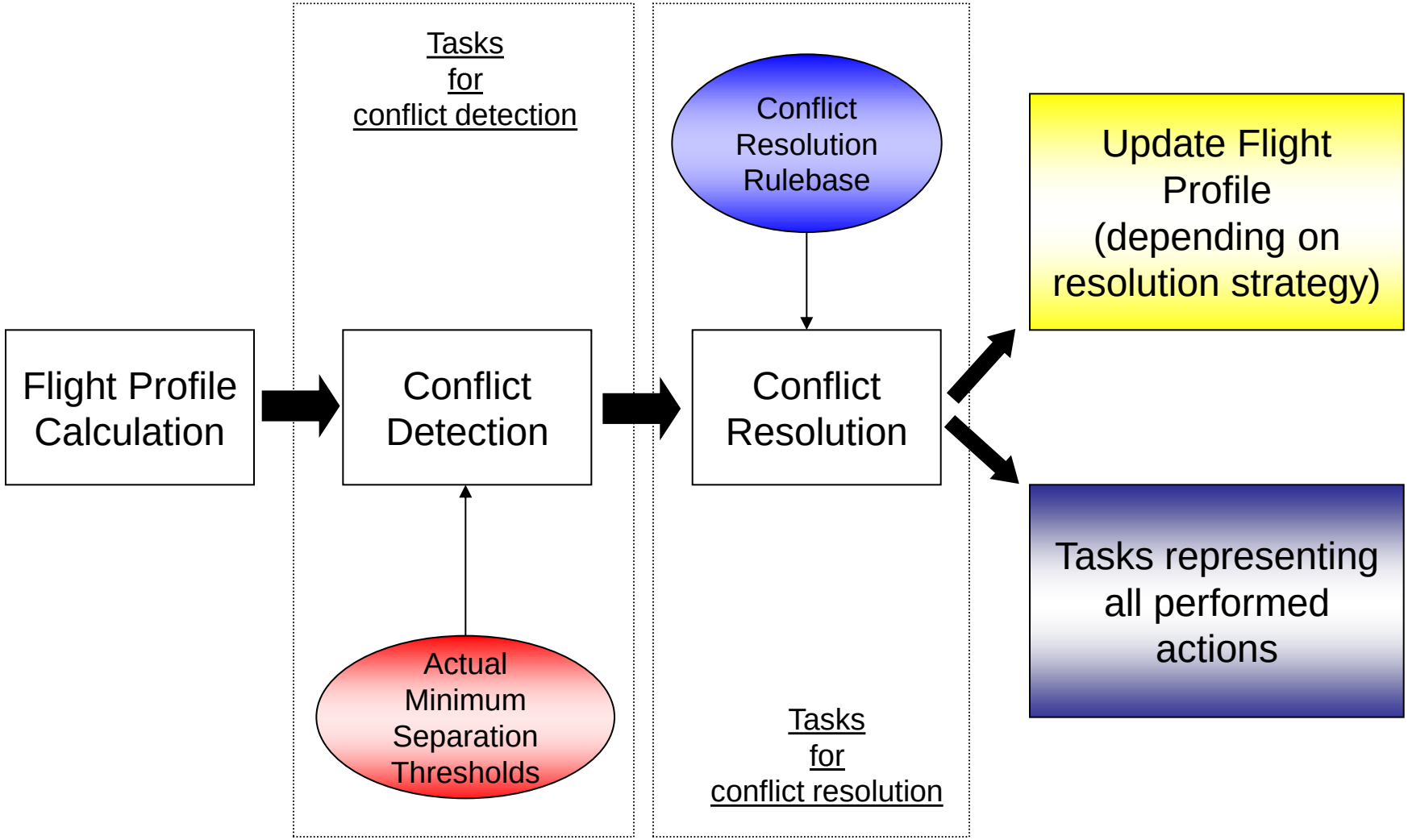
A conflict can be solved in many different ways, for example:

- Level Change
- Speed control
- Vectoring
- Direct-To

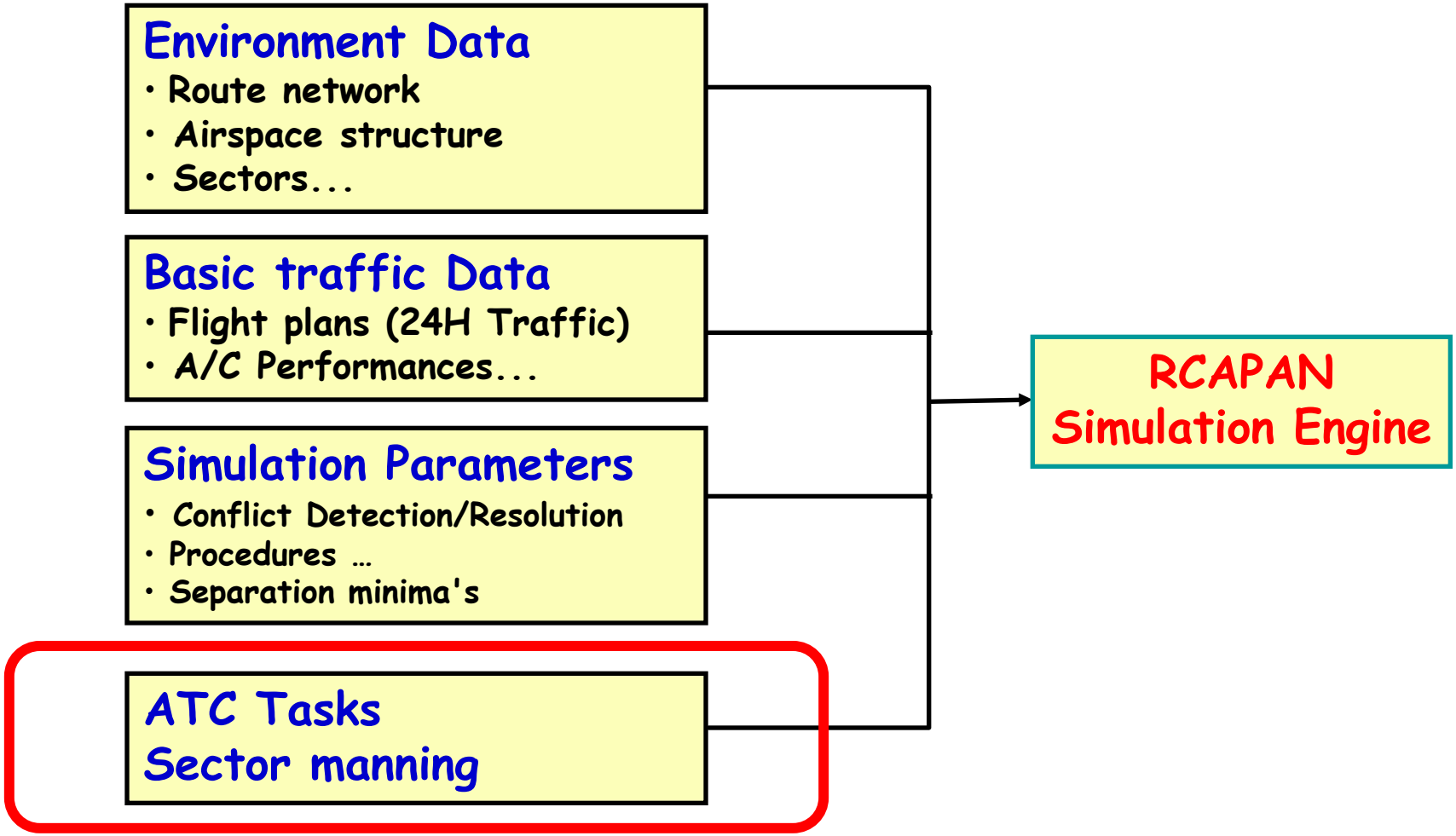
Workload assessment needs to be able to take this into account either by simulating it realistically or by reproducing the proper load for the controller → *resolution strategy*

A **set of rules** has to be defined to choose the right resolution according to actual conflict evolution, local procedures and modus operandi

Conflicts and Tasks



Input Data

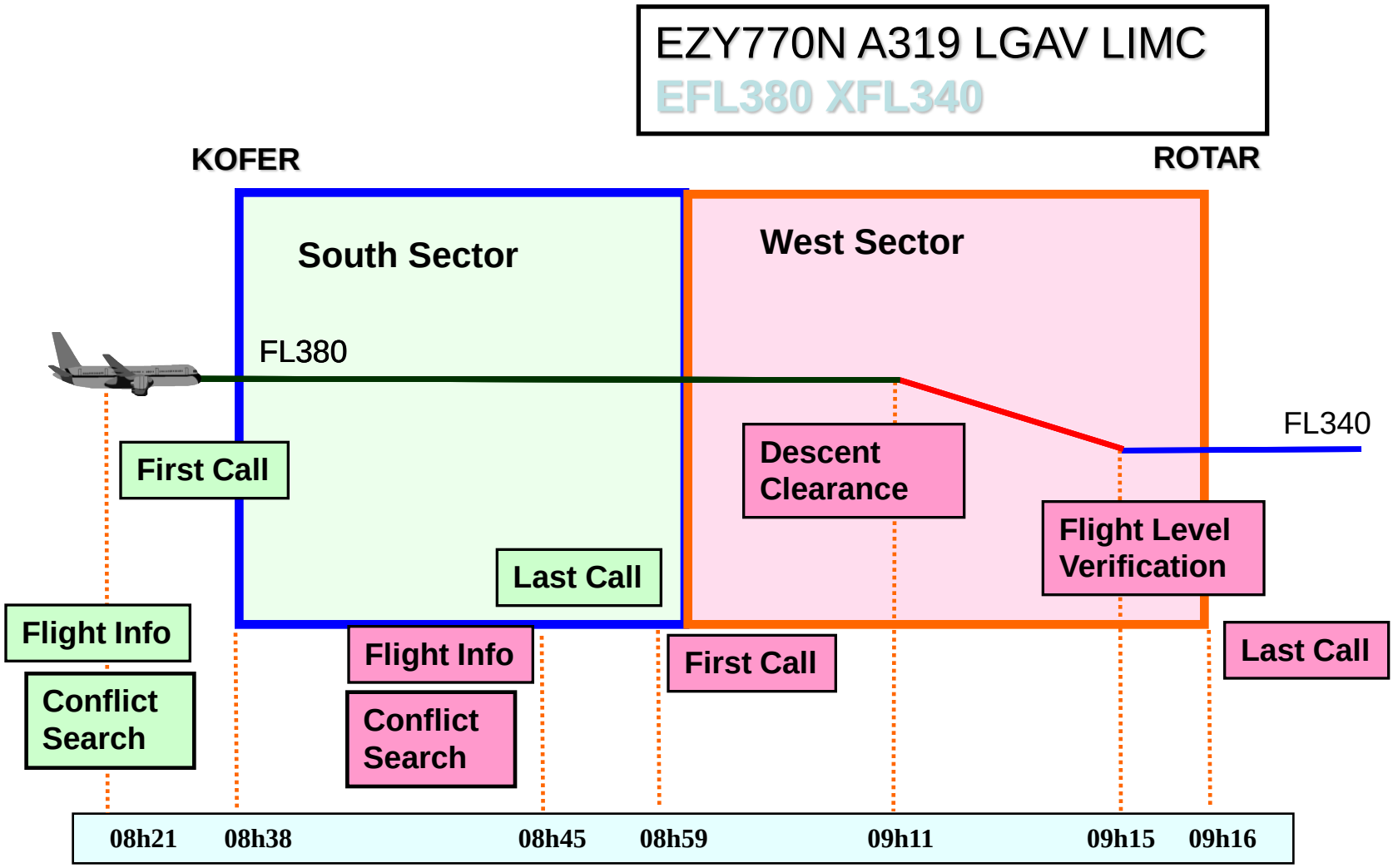

Environment Data
• Route network
• Airspace structure
• Sectors...
Basic traffic Data
• Flight plans (24H Traffic)
• A/C Performances...
Simulation Parameters
• Conflict Detection/Resolution
• Procedures ...
• Separation minima's
ATC Tasks
Sector manning
RCAPAN
Simulation Engine

Network Manager
nominated by
the European Commission

EUROCONTROL

Tasks and Task Categories

Events and Tasks



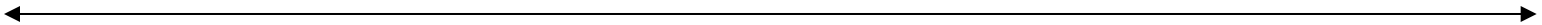
Task Definition

- Tasks reproduce controller actions
- Tasks are triggered by discrete ATC events

  e.g. entry into a sector, entry into controller window, start of descent, etc.
- Tasks can be associated to specific conditions

  e.g. airport, route, flight level, fight attitude
- Tasks can be grouped/chained to represent a set of connected actions

→ One Task = Many Actions vs. Many Tasks = One Action



Low Granularity **High Granularity**

Task Categories

Tasks categories are chosen:

- To cover all discrete actions a controller can perform
- To reflect work organisation
- To address analysis interest

Categories and Sub-Categories can be defined as appropriate

Example:

Main Category - Radar

It covers all actions to detect and solve conflicts

<u>Sub-category for each action</u>

e.g. Vector ~ Sub-cat.: TX Vector

Monitor vector ~ Sub-cat.: Radar Monitoring

Passing traffic information ~ Sub-cat.: TX traffic info

<u>Sub-Category for groups of actions</u>

e.g. Vectors + Monitor + Passing Traffic Info ~ Radar Conflict Resolution

Controller Tasks & Categories Eurocontrol CAPAN

- Standard model for controller tasks for both ACC and TMA environment
- Totally Customisable depending on system capabilities, specific procedures, separation minima, etc
- Divided into 5 main task categories:
  1. Flight Data Management
  2. Conflict Search
  3. Coordination
  4. Standard Radio Telephony
  5. Radar
- Applicable to single/double man operations, multi-sector planner, etc.

Network Manager
nominated by
the European Commission

EUROCONTROL

Sector Capacity Assessment
General conclusions

Sector Capacity Assessment

Sector Capacity is driven by controller workload

A capacity assessment methodology should define:

- task categories and tasks
- conflict detection and resolution mechanisms
- a set of rules to mimic controller reasoning
- a threshold for average theoretical working time corresponding to sector capacity
- a technique to establish the relation between workload and capacity indicator

Sector Capacity Assessment

Assessment as a standardized process

A capacity assessment methodology should:

- Use a simulation engine which allows reproducing the ATC environment
- Follow a reiterative process of validation for every assessment case
- **INVOLVE active ATC staff** throughout the full process
- Encourage transparency and teamwork at all stages
- Use expert staff to guarantee that input data and simulation are properly carried out

→ **WRONG INPUT ~ WRONG OUTPUT**

Sector Capacity Assessment

Usability of results

A capacity assessment methodology should:

- Establish a comprehensive and possibly standardized set of results
- Define capacity related KPIs

Useful Links

- EUROCONTROL: www.eurocontrol.int
- Network Manager: http://www.eurocontrol.int/network-manager
- Operations Planning: http://www.eurocontrol.int/operations-planning
- ATFCM: http://www.eurocontrol.int/articles/air-traffic-flow-and-capacity-management
- Fatigue Risk Management: http://www.eurocontrol.int/news/too-tired-be-safe-fatigue-risk-management-systems