Modelling the Future NAS using Multiple Modelling Agents (SWIM, FOMS, ATSCC, TMU, ATC, AOC…)

Genesis

1998: Interoperable model using Open Communication Interface

- RAMS Plus – Gate to Gate ATC Simulation Tool
- Decision Tool – AOC Operational Strategy Model
- Opgen – AOC dispatch / flight re-planning model
- ATMOS – NAS-Wide Weather model

Implemented as point to point interoperable modelling components using TCP/IP

Studied the impact on the ATNSP of allowing AOC to dynamically re-plan flight operations in response to NAS-induced delays (ATC/ATFM intervention, weather avoidance, airport induce delay, Military activity…)

Genesis (cont)

1999:

Experimental Conflict Resolution / Controller Cognitive Modelling Experiments

- RAMS Plus – Gate to Gate ATC Simulation Tool
- MIDAS (SJSU) – ATC Cognitive Model

Also implemented as point to point interoperable modelling components using OCI and TCP/IP

Supporting cognitive assessment of Controller actions during the Conflict Identification and Resolution process using a human behavioral model

Genesis (cont)

2000/2001:

Augmented Flight-Deck Model

- RAMS Plus – Gate to Gate ATC Simulation Tool
- AFDM – Augmented Flight Deck Model (*1..n instances*)

Still implemented as point to point interoperable modelling components using OCI and TCP/IP

Analysis of autonomous flight operations (e.g. DAG-TM, CoSpace, Free-Flight) in Controlled Airspace and the impact on the ATNSP, including ADS-B, Intent Broadcast, Conflict Identification, Flight-Flight Negotiation, Resolution and Controller Workload Analysis)

Realization!

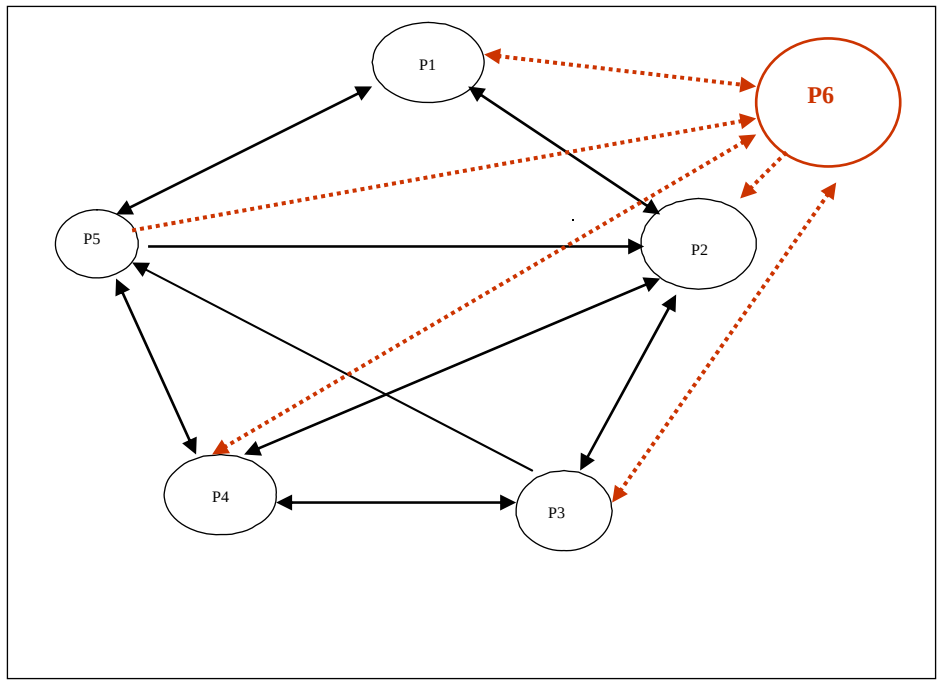
As each successful validation experiment increased interest in the technique, and additional concept began to be introduced to the Operational Concept Validation framework:

- *New ways of managing the collaboration between models were required on each occasion*
- *Num. of point to point connections increase to become difficult to manage*
- *Each new model requires n-1 connectors*
- *Data (and knowledge) remained embedded as "islands of functionality"*
- *…*

SO

… a new collaborative framework was needed to manage the "explosive behaviour"

Example:



Meanwhile – in the “real” world

FAA (and friends) had been continuing the development of their CONOPS foreseeing:

- **NAS-Wide Information Systems (NAS-WIS)**
- **Improved levels of Automation**
- **Enhanced Flow Management Techniques**
- **Improved Collaboration with Airspace Users**
- **Semi or Full Delegation of Separation Assurance (->Free Flight)**
- **More Management by Planning (Strategic ATM)**
- **Controller “Intervention by Exception”**
- **…etc**

CONOPS Future vision

New collaborative role in managing the NAS expected to:

- Improve NAS Operational Performance
  - Increase the NAS capacity
  - Improve aviation safety and schedule
  - Reduce controller's workload
- Enhance Common Situational Awareness
  - Users arrange resources to help resolve flow problems
  - Providers plan NAS in anticipation of changes to capacity

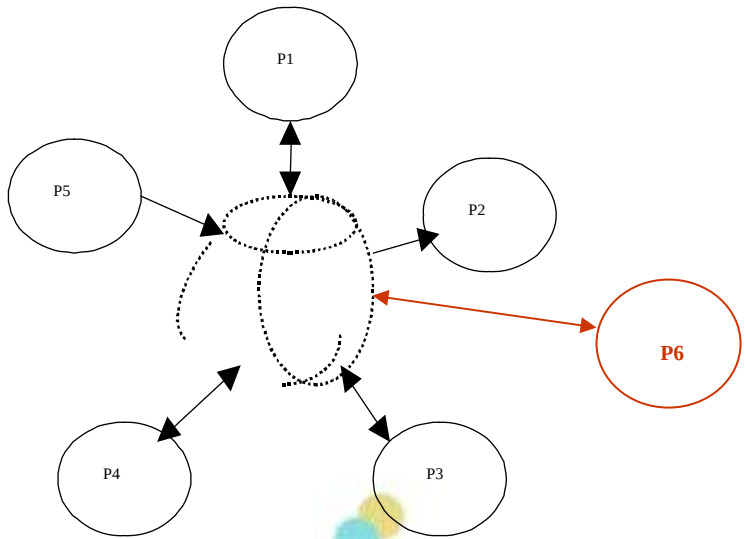
CONOPS Future vision (Cont)

Technically, the vision requires:

- Network centric operations
  - Connect all NAS users (organizations, automation systems and people)
  - Share information
  - Access to real-time information for decision-making
  - Exchange information to improve the common situational awareness

ATM Pool of information

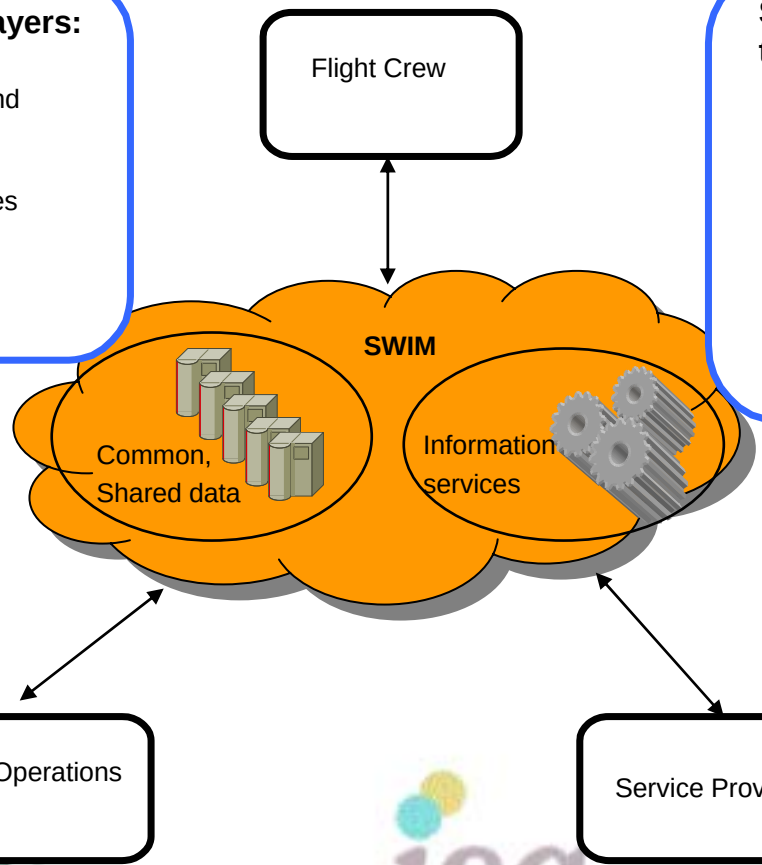
- Single connection point instead of many
- Support of the “many-to-many” exchange of information
- Support for the growth of decision points
- Unanticipated application can easily access the framework, use shared data and collaborate with existing applications



System Wide Information Management (SWIM)

SWIM provides three layers:

- Up-to-date pool of common and shared data to SWIM users (SUA, CNS, flights)
- Distributed information services to SWIM users (TIS/FIS)
- Robust communication infrastructure



SWIM resolves shortcomings of today systems :

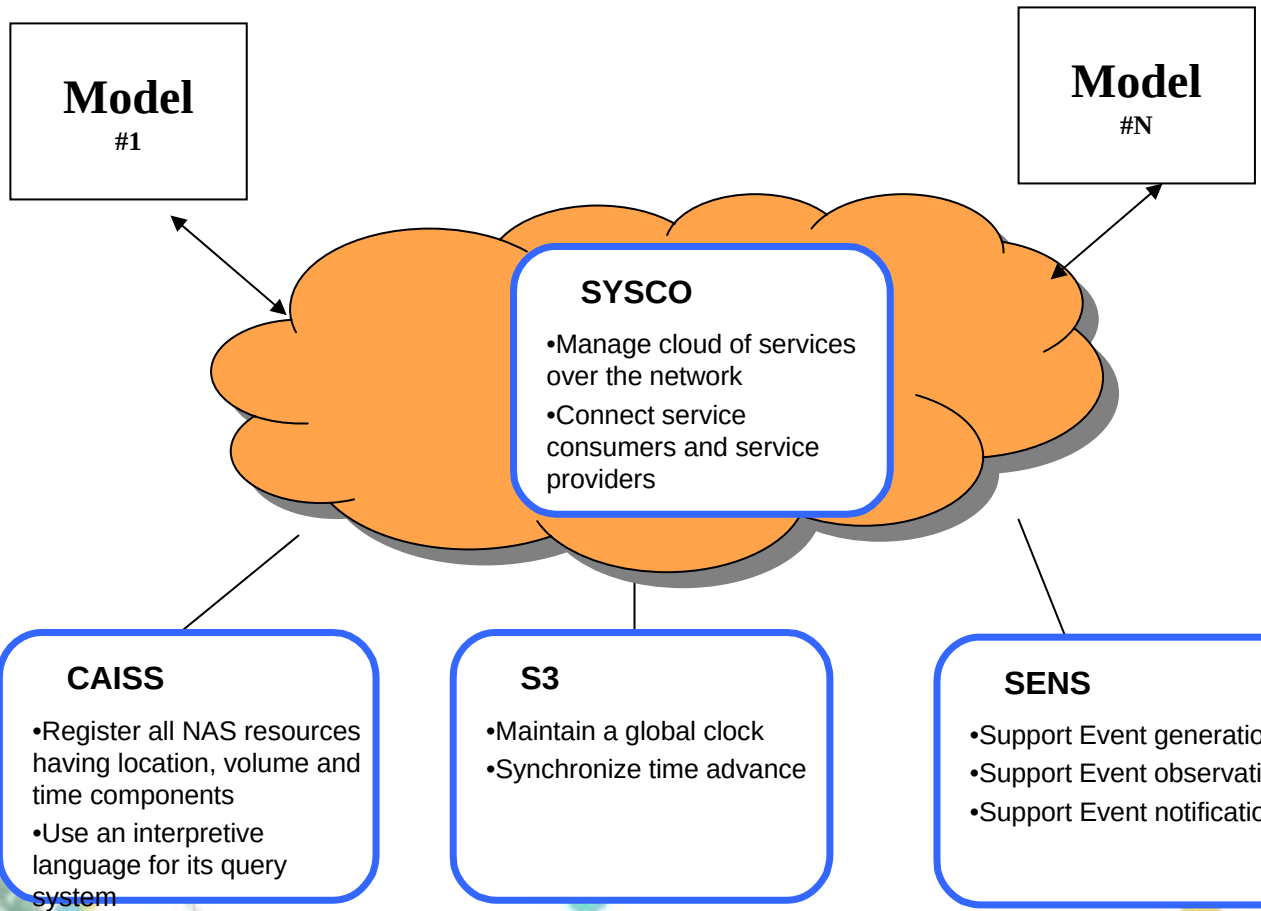
- Make data visible at the NAS level
- Make data securely accessible
- Promote data standardization, definitions and structures
- Information exchange is based on well defined transfer syntax
- Timely data delivery

The “New” modelling framework was born

Strategy for Information Management and Collaboration (SIM-C)

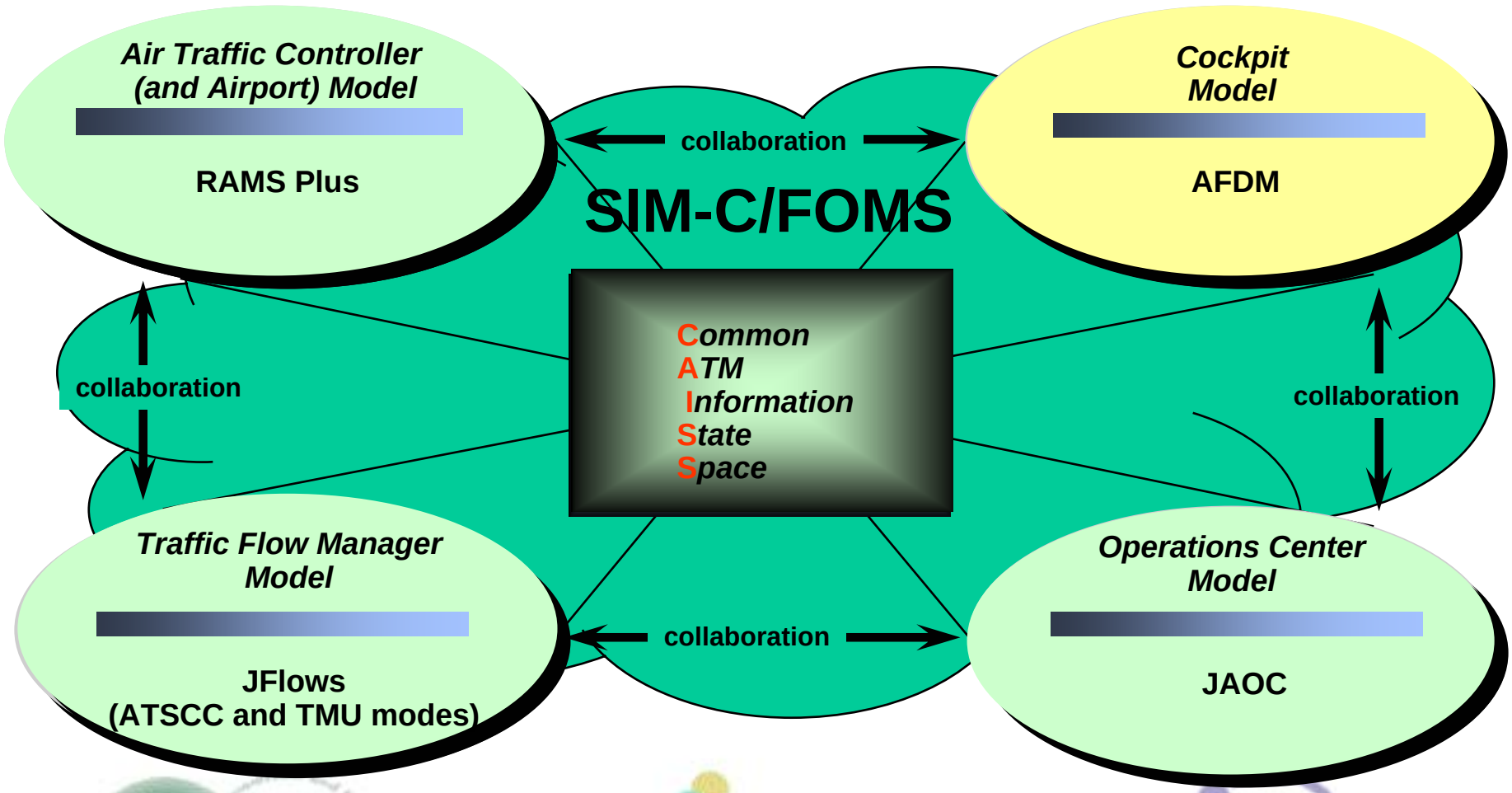
- Proof of concept for a SWIM infrastructure
- Incorporation of Flight Object Concepts
- Including target fast-time simulators and analytical tools
- Supported as a networked modeling infrastructure
- Providing access to common and shared information
- Disseminating information to all models that are impacted by information update or event occurrence
- Supports collaborative decision-making processes
- …to evaluate cooperative ATM concepts

SIMC Reference Model



SIMC Key Concepts - Summary

- Connectivity management through SYSCO
- CAISS in support of common data sharing
- CQL to interrogate dynamically CAISS
- Global clock to synchronize time advance (S3)
- Event notification service in support of event generation, observation and notification (SENS)
- Support of Community of Interest (Federations)
- Support of growth of decision points
- Architectural framework allowing for advanced intelligent agents to be easily built upon more primitives services


Air Traffic Controller (and Airport) Model
RAMS Plus
collaboration
Cockpit Model
AFDM
SIM-C/FOMS
Common ATM Information State Space
collaboration
collaboration
Traffic Flow Manager Model
JFlows (ATSCC and TMU modes)
collaboration
Operations Center Model
JAOC

Questions?