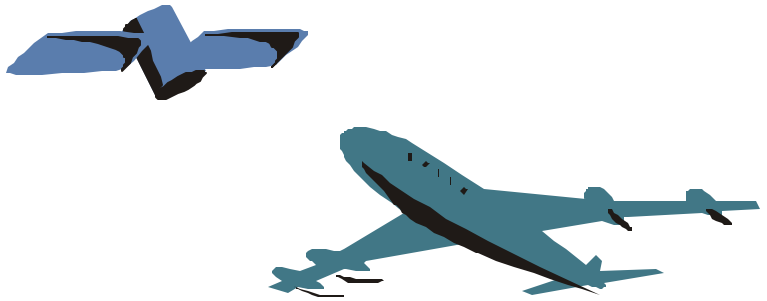
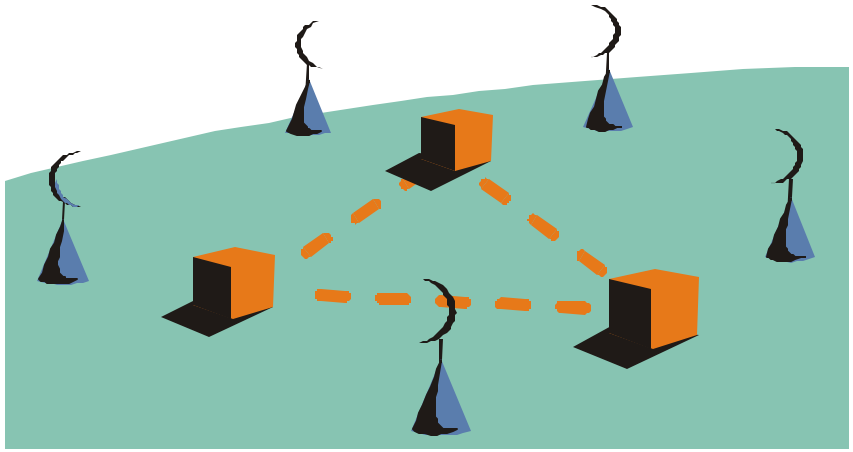
Eurocontrol Surveillance Activities

Presentation to Ad'hoc ADS-B MASPS Working Group

April 2001



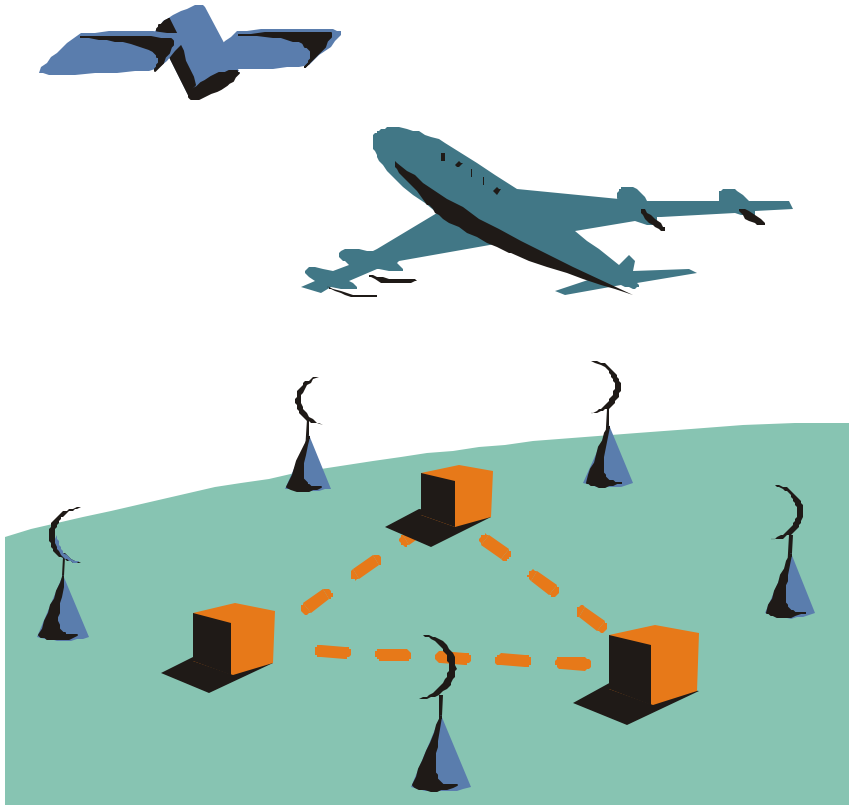
An Integrated Surveillance Programme



Jean Marc Duflot
Surveillance Domain Manager
ARTAS Project Manager

Agenda

- ➔ EATMP Surveillance context
- ➔ Overview of Surveillance Products
- ➔ ARTAS presentation
  - ☑ Concept
  - ☑ Functions
  - ☑ System/Software aspects
  - ☑ Future Developments
  - ☑ Implementations status
  - ☑ Relationship with industry



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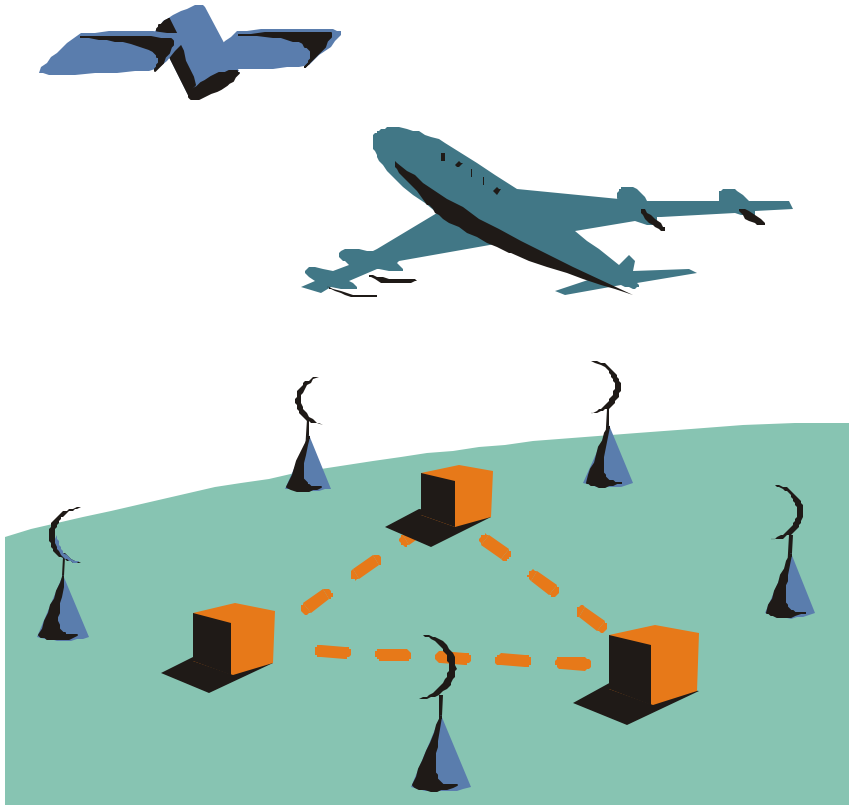
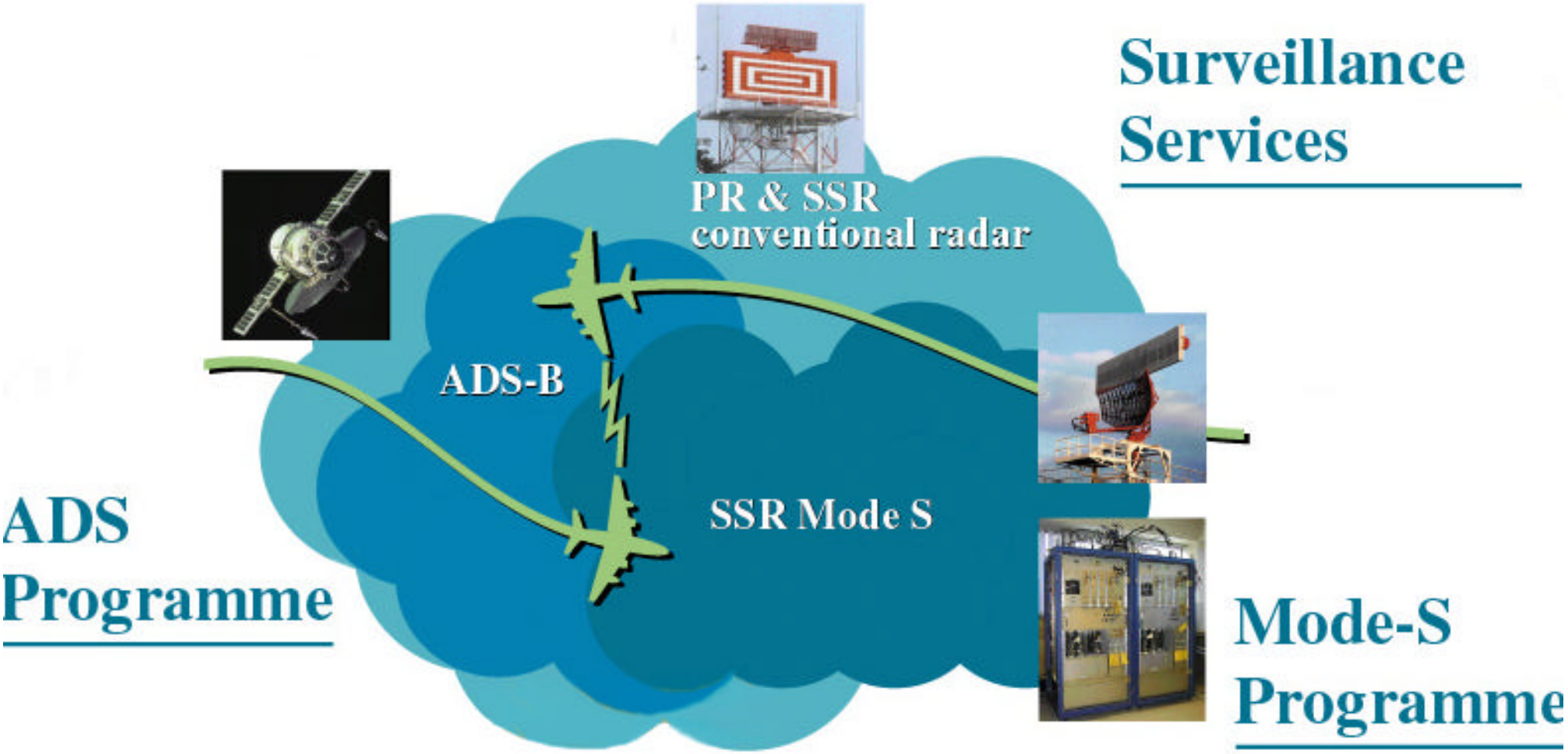
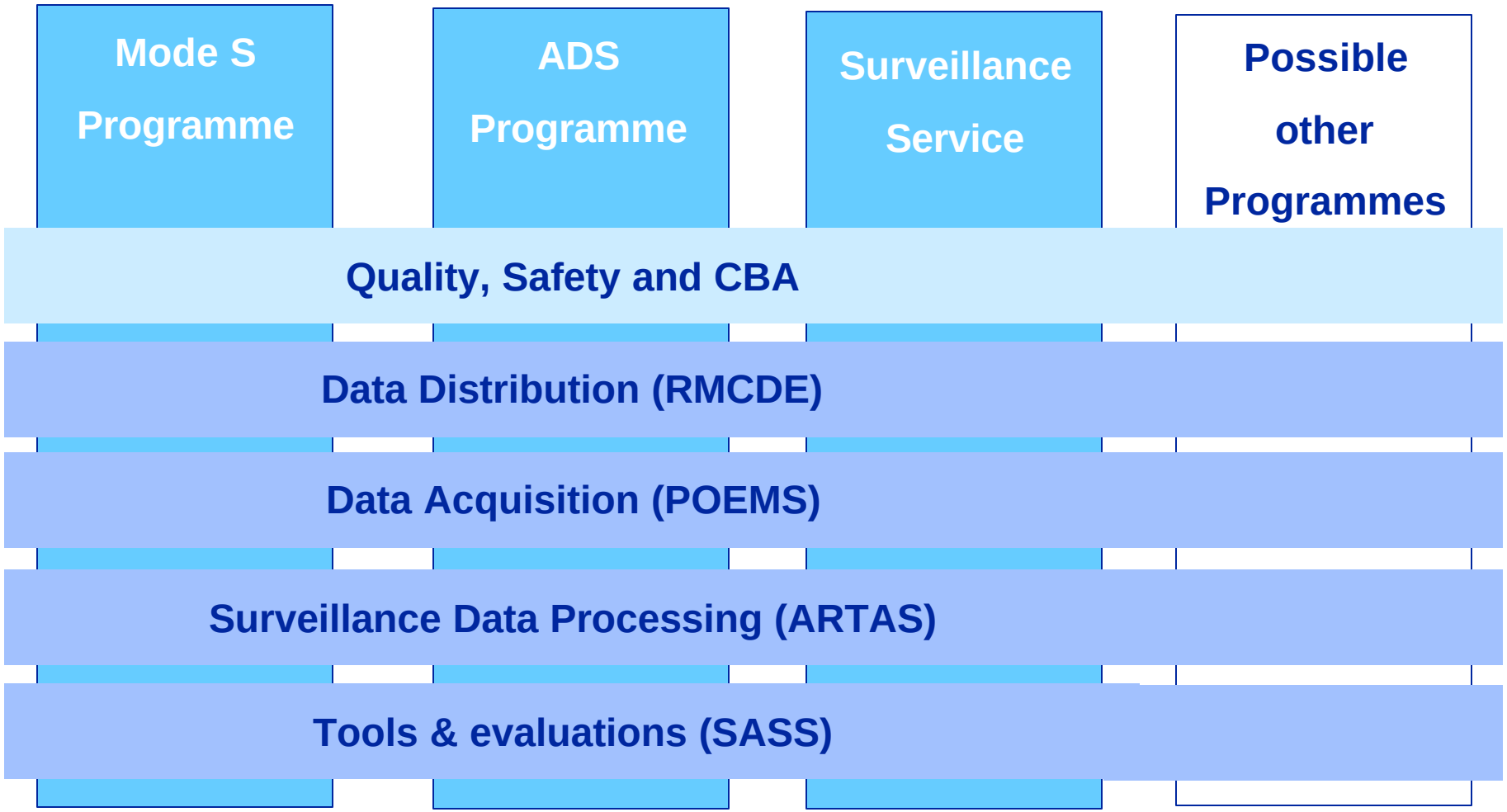


An Integrated set of Surveillance Activities within EATMP



Surveillance activities and EATMP



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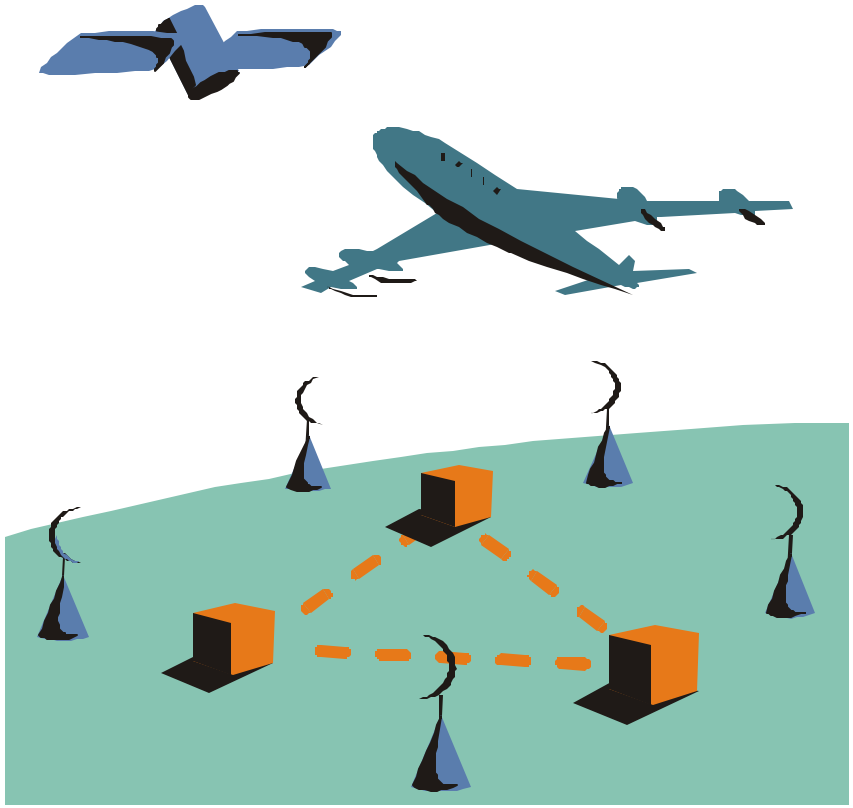
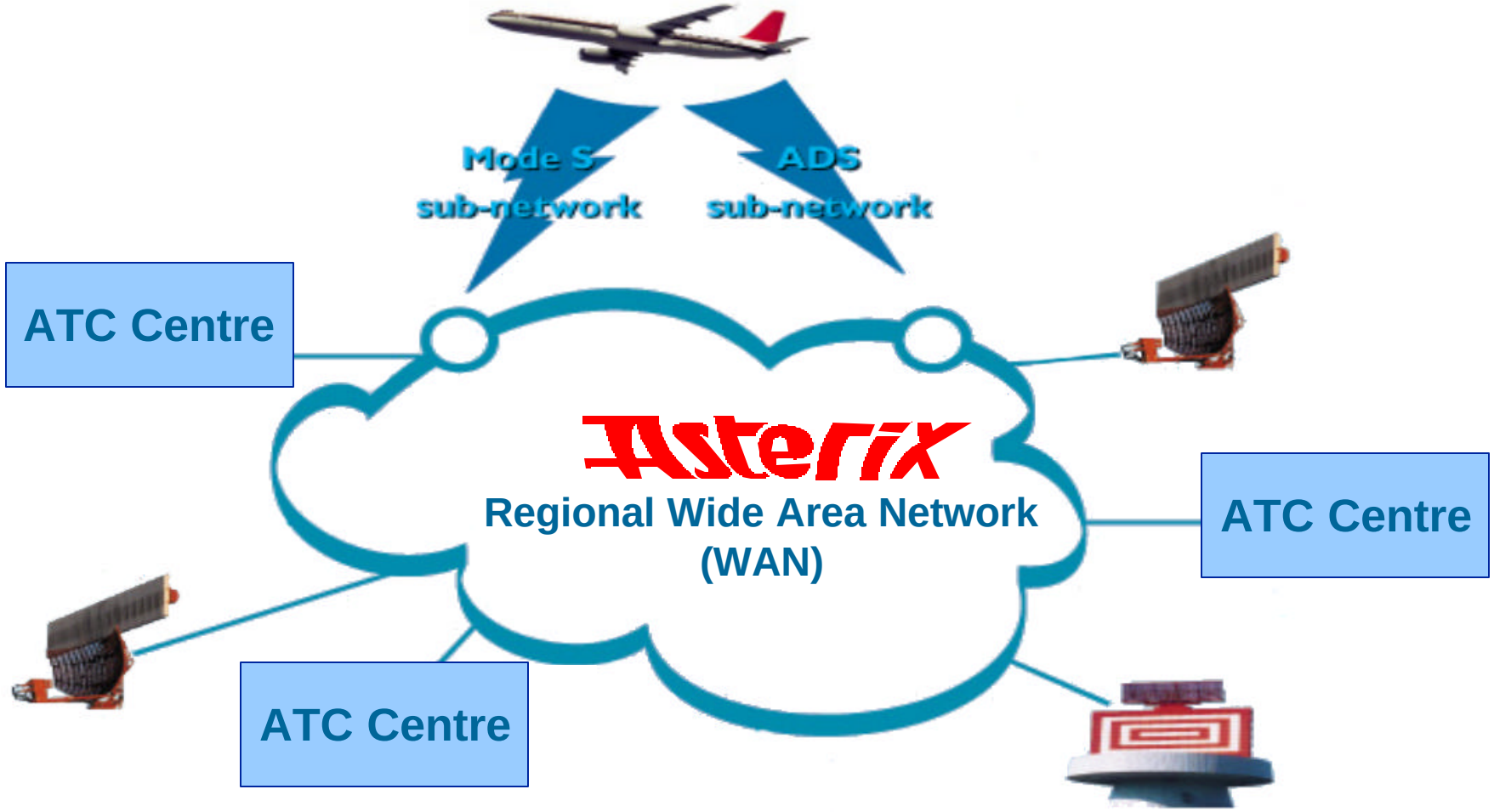
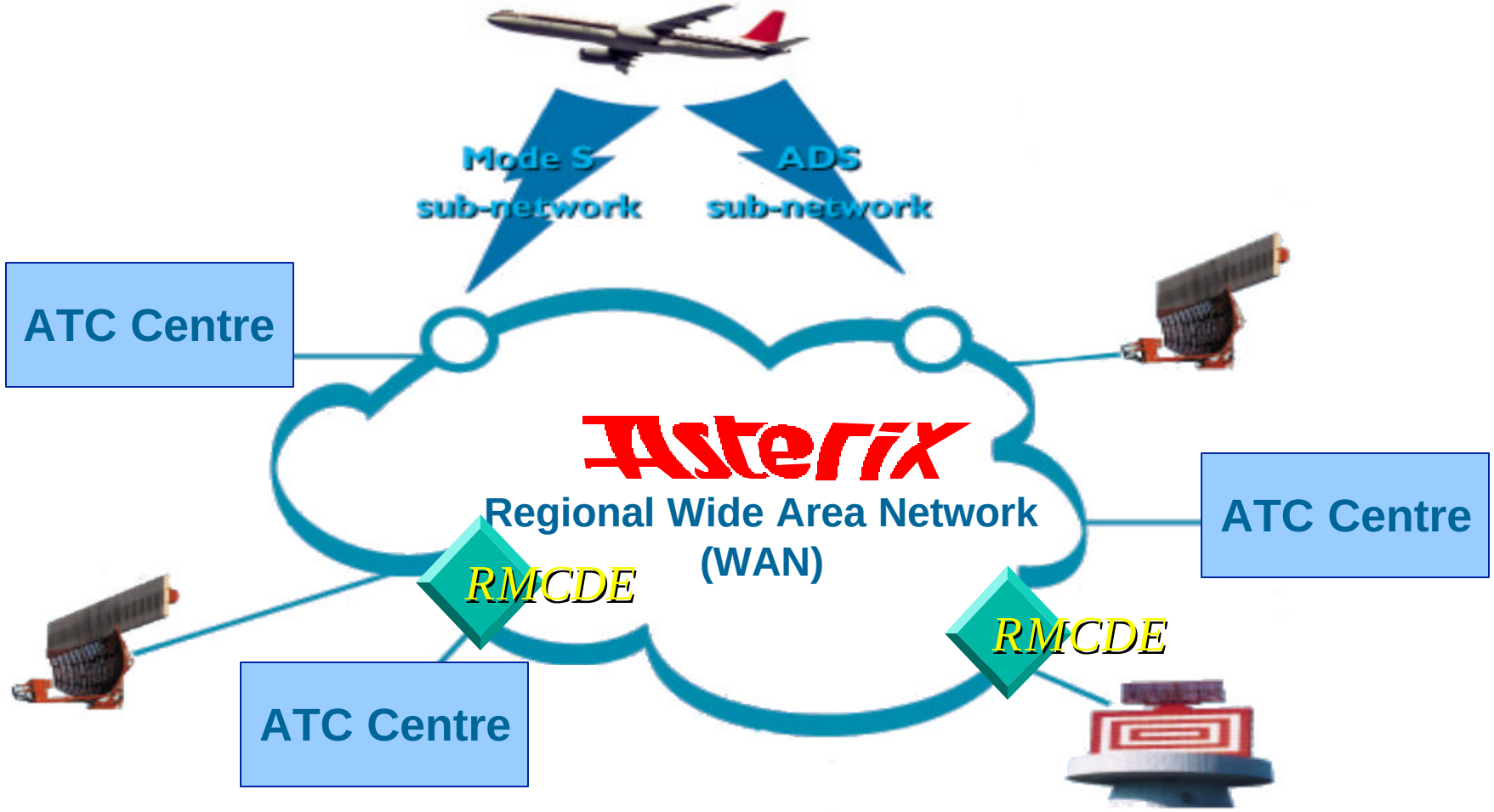



Mode S
sub-network
ADS
sub-network
ATC Centre
Asterix
Regional Wide Area Network
(WAN)
ATC Centre
ATC Centre

All-purpose Structured EUROCONTROL suRveillance Information Exchange

Standardised Eurocontrol data and message format used for the exchange of surveillance related information between sensors and surveillance data processing system and between surveillance data processing systems.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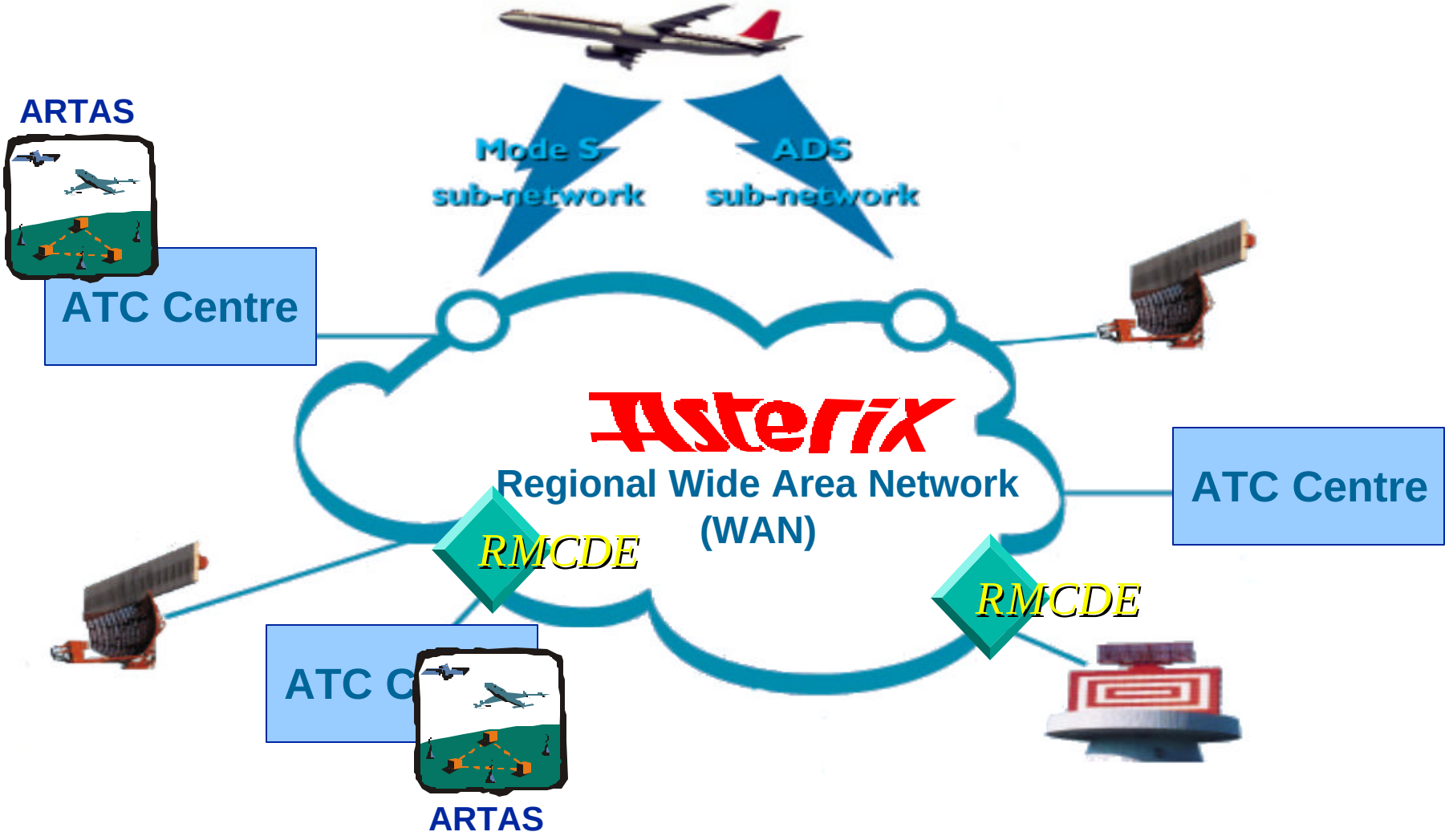
Radar Message Conversion & Distribution Equipment

System used as network node for surveillance data distribution networks or as a surveillance data front-end processor and distribution system in an ATS Unit environment.

RMCDE

Functionality

- Conversion from “alien” radar data formats to ASTERIX and vice versa
- Handling of various communication protocols on a high number of I/O ports (HDLC LAP-B/Frame level, X.25, LAN (Ethernet/FDDI), Euro, CD2, etc…
- Data Filtering: user specific selection acquisition of sensor/server/SMC data
- Coordinate conversion (polar ⇔ cartesian)
- Accurate time stamping (DCF77 or GPS)
- User defined flow control mechanism
- Radar line monitoring, Remote status and diagnostics, Data recording facility
- Data concentration and multiplexing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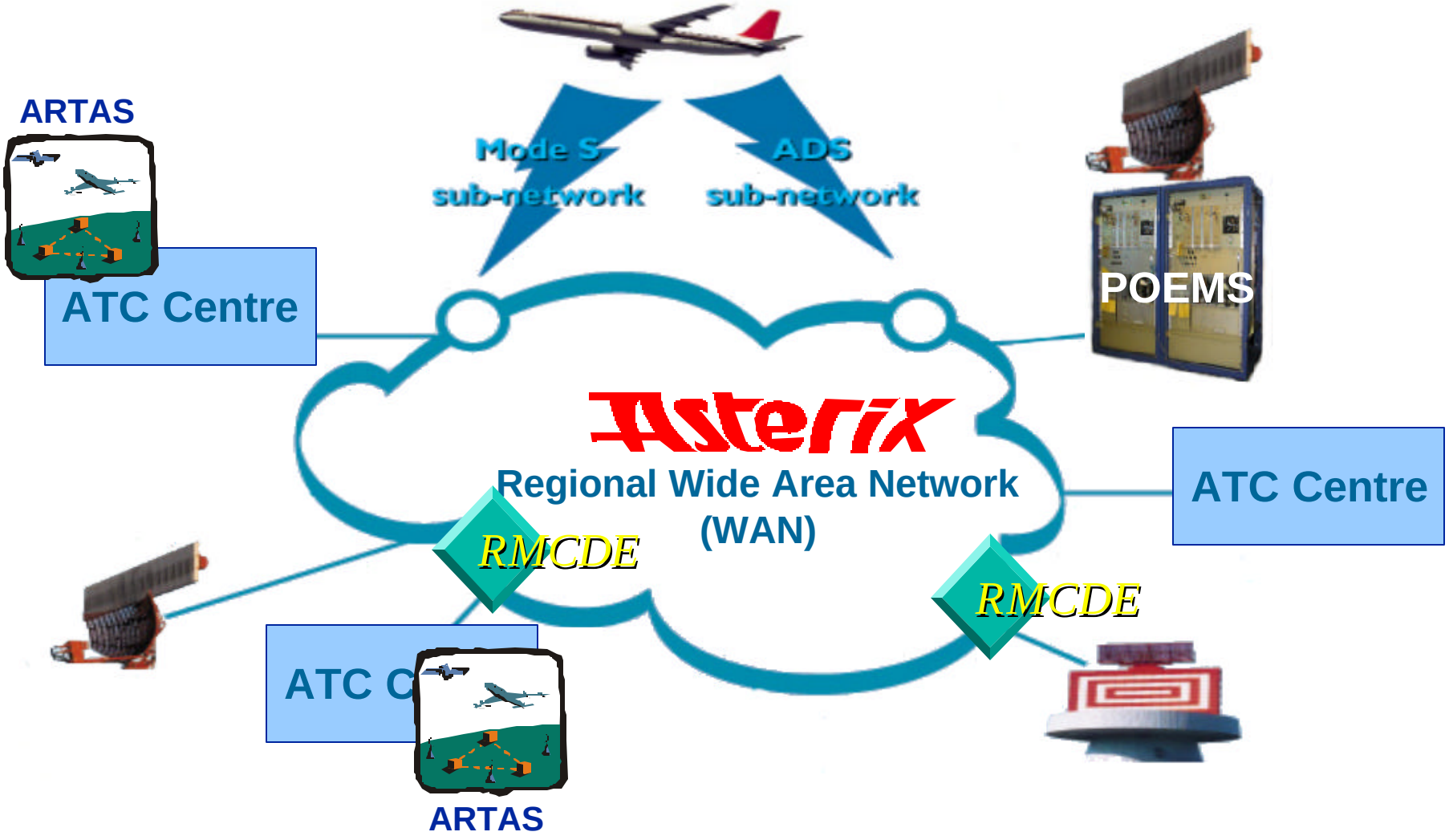
ARTAS

ATM suRveillance Tracker And Server

Europe-wide distributed Surveillance Data Processing system. The system concept relies on the implementation of interoperable SDP Units which all co-ordinate together to act as one region-wide integrated Surveillance system.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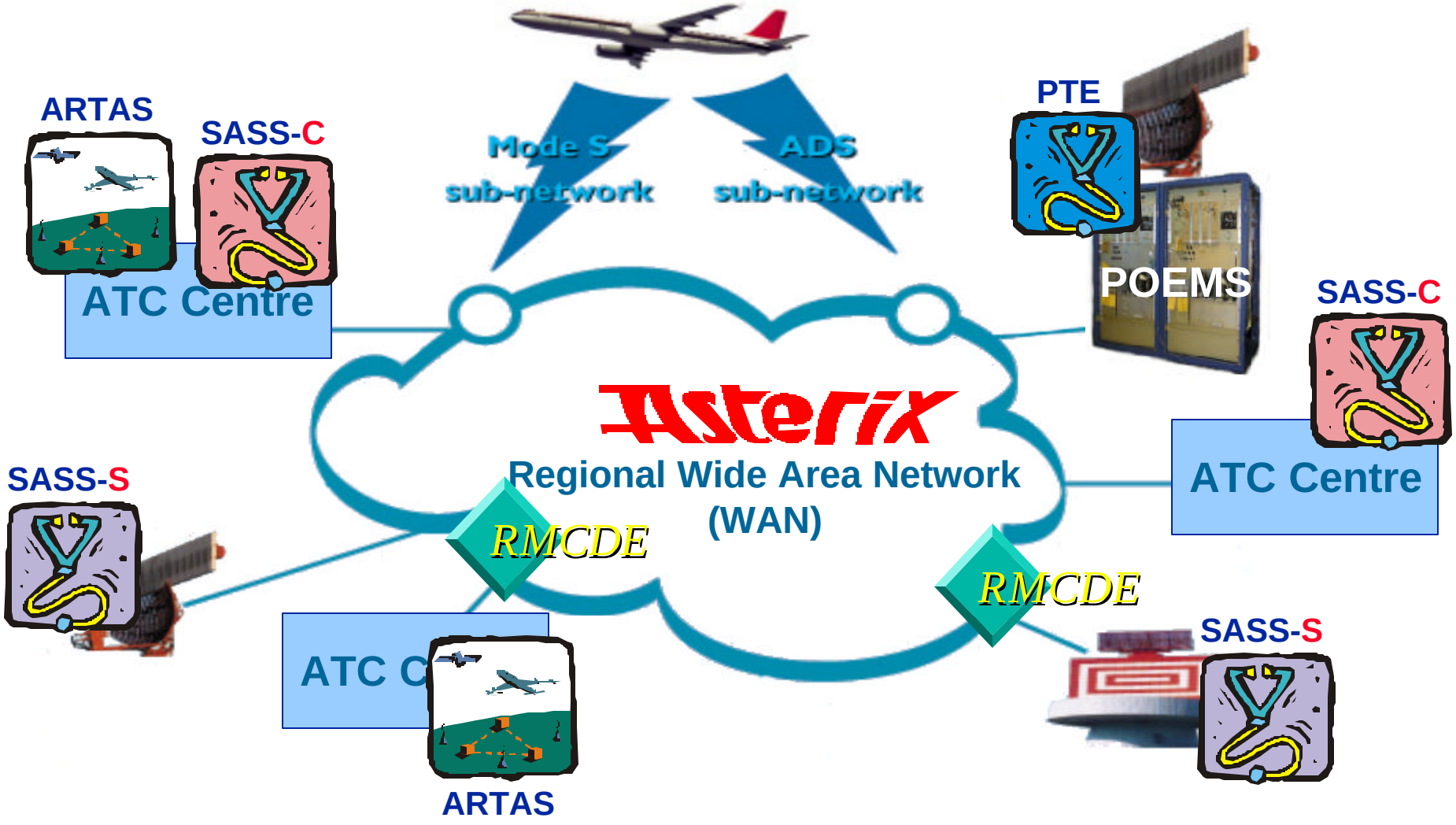
Pre-Operational European Mode-S Station

pilot development of Mode-S for Europe, the new generation Surveillance Sensors (Radar Stations) that enables to address Aircraft Transponders selectively and has the capability to down-link additional Aircraft derived data.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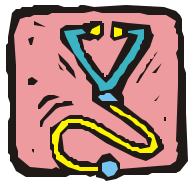
SASS-S

Surveillance Analysis Support System for Sensor

SASS-C



Surveillance Analysis Support System for Centre

PTE

POEMS Test Environment

Set of complementary tools to assist in the performance assessment of both the radar and multi-radar tracker infrastructure against defined performance criteria.

Surveillance tools

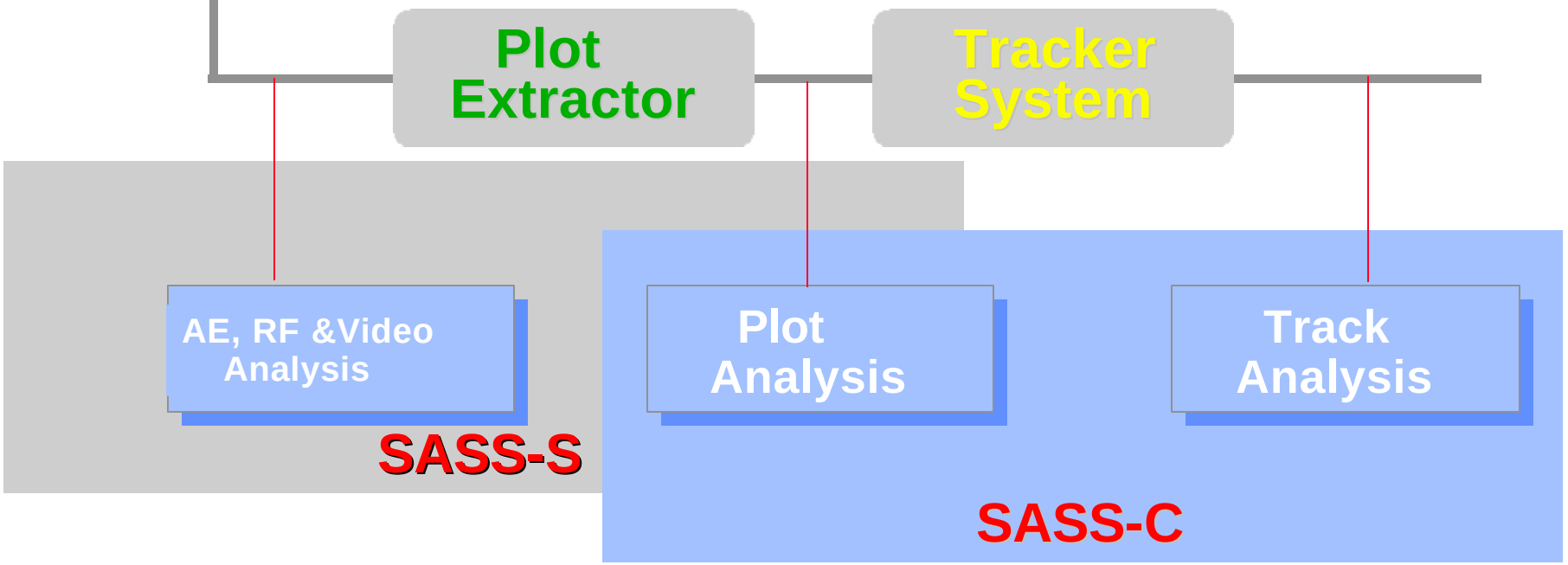
➔ Surveillance Analysis Support System

- ☑ **SASS for ATC centre - SASS-C**
  - ↖ performance measurement of sensor and tracker
- ☑ **SASS for Sensor - SASS-S**
  - ↖ investigation of sensor performance

➔ POEMS Test Environment - PTE

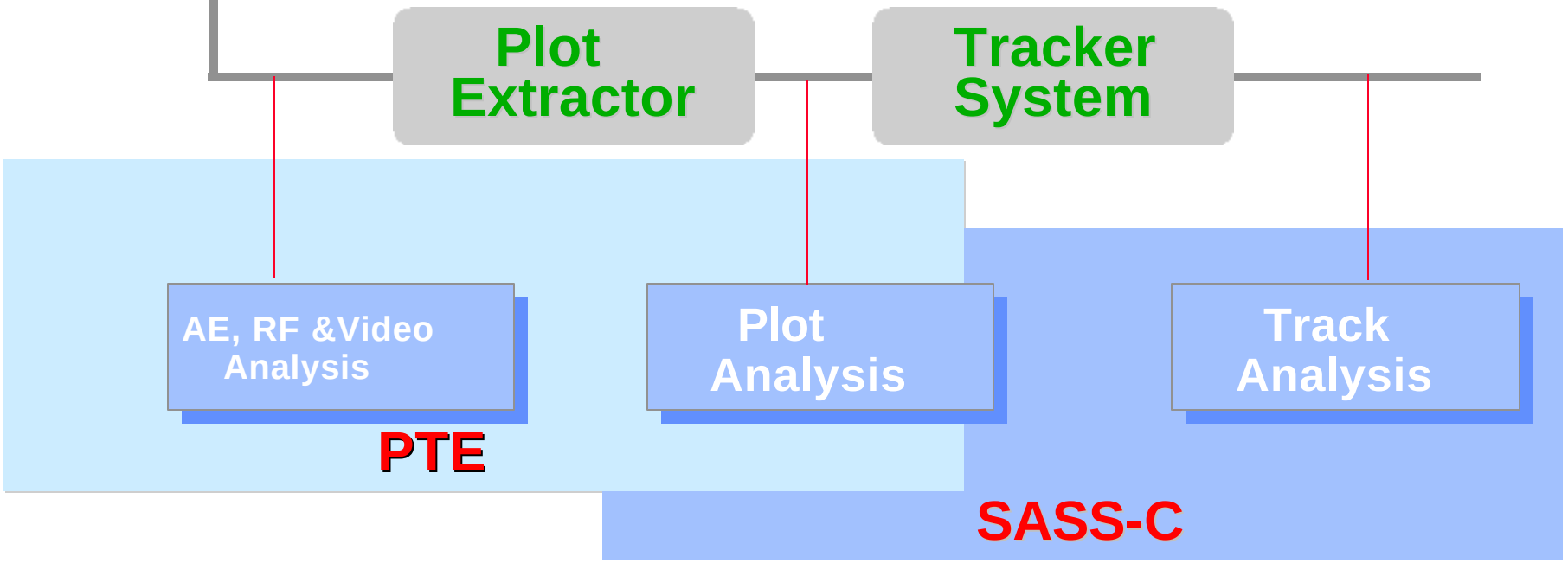
- ☑ for POEMS acceptance and common evaluation

Analysis of the Surveillance Infrastructure



Analysis of the Surveillance Infrastructure

- POEMS



Points of contact

DIS/SUR Head of Unit	Mel Rees	00 322 729 33 60	melvyn.rees@eurocontrol.be
ADS Programme	Pieter van der Kraan	00 322 729 33 59	pieter.van-der-kraan@eurocontrol.be
Mode S Programme	Pascal Dias	00 322 729 33 69	pascal.dias @eurocontrol.be
Surveillance Services	Hans Wilts	00 322 729 32 77	hans.wilts @eurocontrol.be
ASTERIX	Claude Leclerc	00 322 729 33 55	claude.leclerc@eurocontrol.be
RMCDE	Dimitri Doukas	00 322 729 34 60	dimitri.doukas@eurocontrol.be
POEMS	Jan Berends	00 322 729 34 11	jan.berends@eurocontrol.be
ARTAS	Jean Marc Duflot	00 322 729 31 26	jean-marc.duflot@eurocontrol.be
SASS-C	Bruno Lambin	00 322 729 33 72	bruno.lambin @eurocontrol.be
SASS-S & PTE	Andrew Desmond-Kennedy	00 322 729 32 90	andrew.desmond-kennedy@eurocontrol.be

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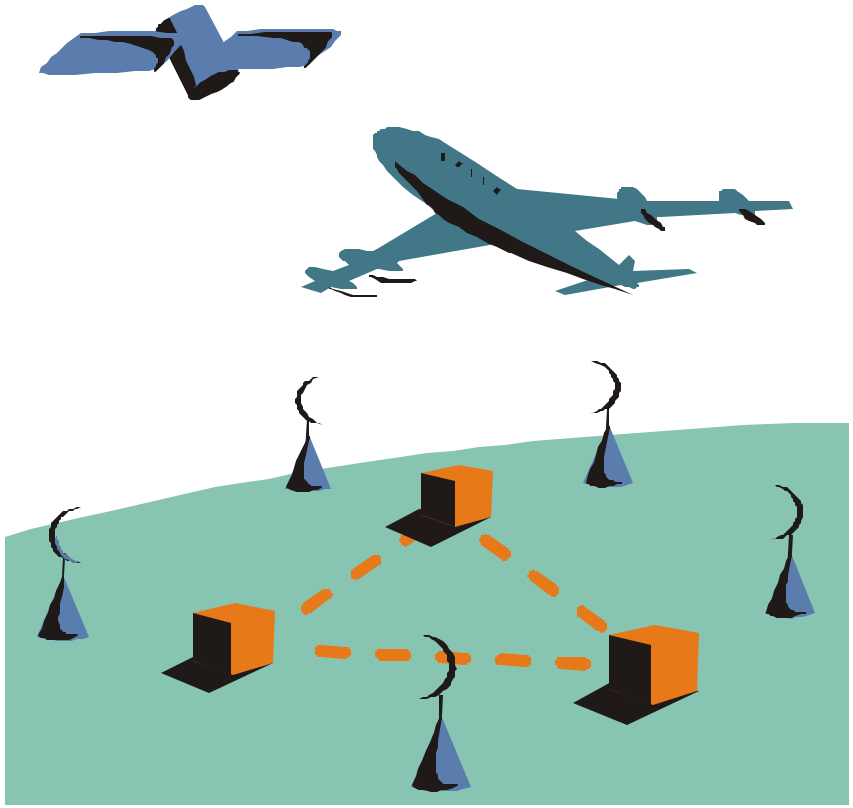

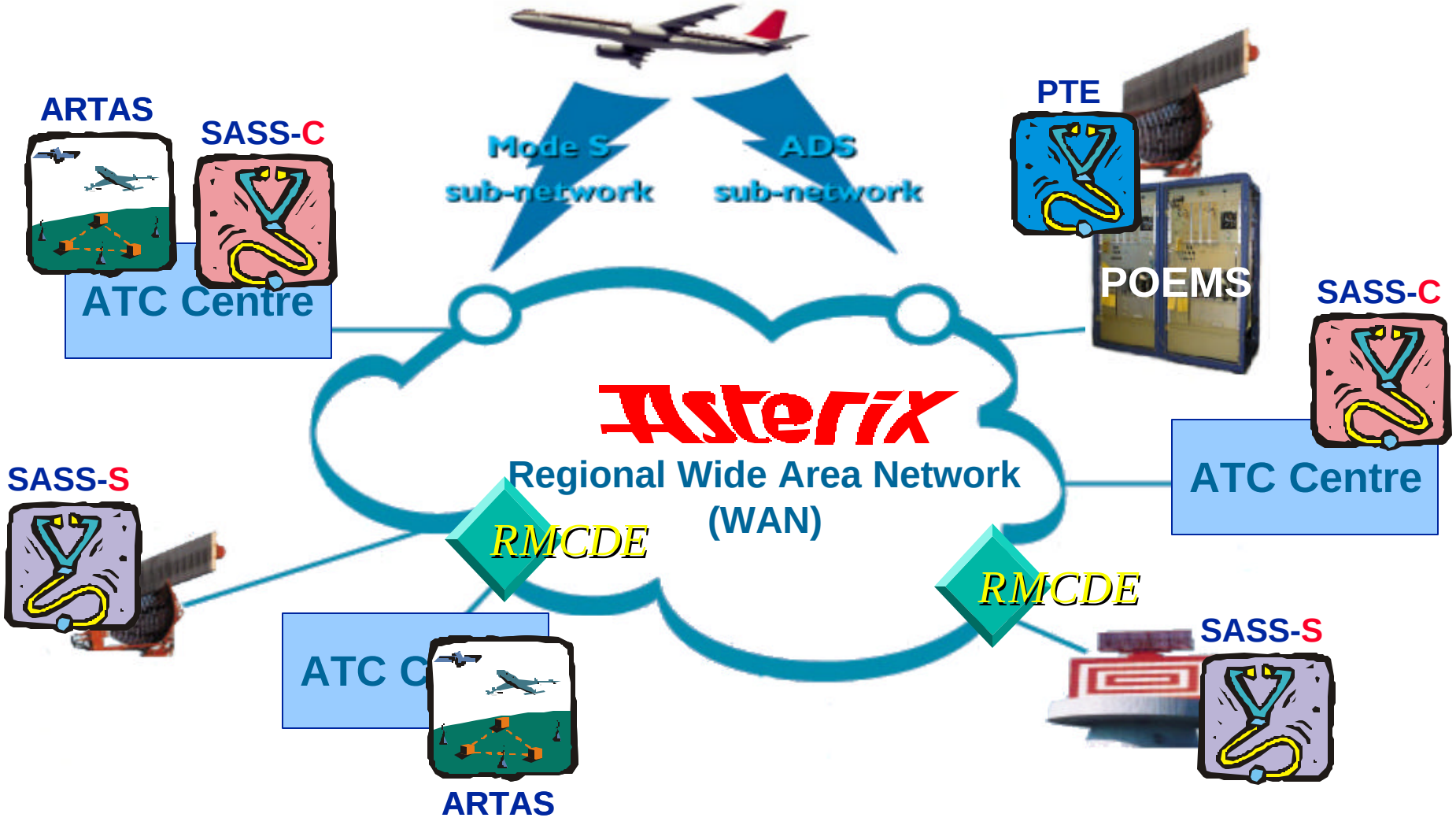
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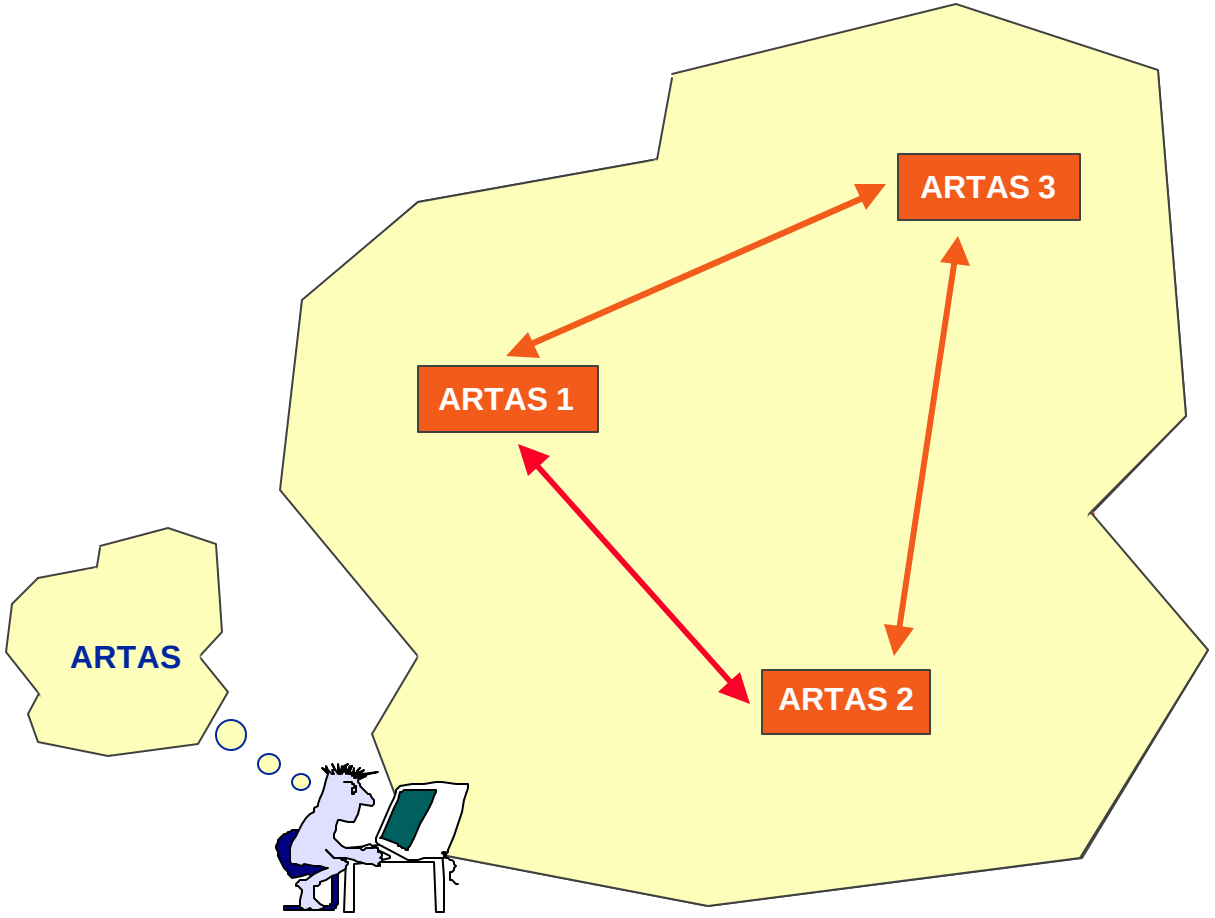
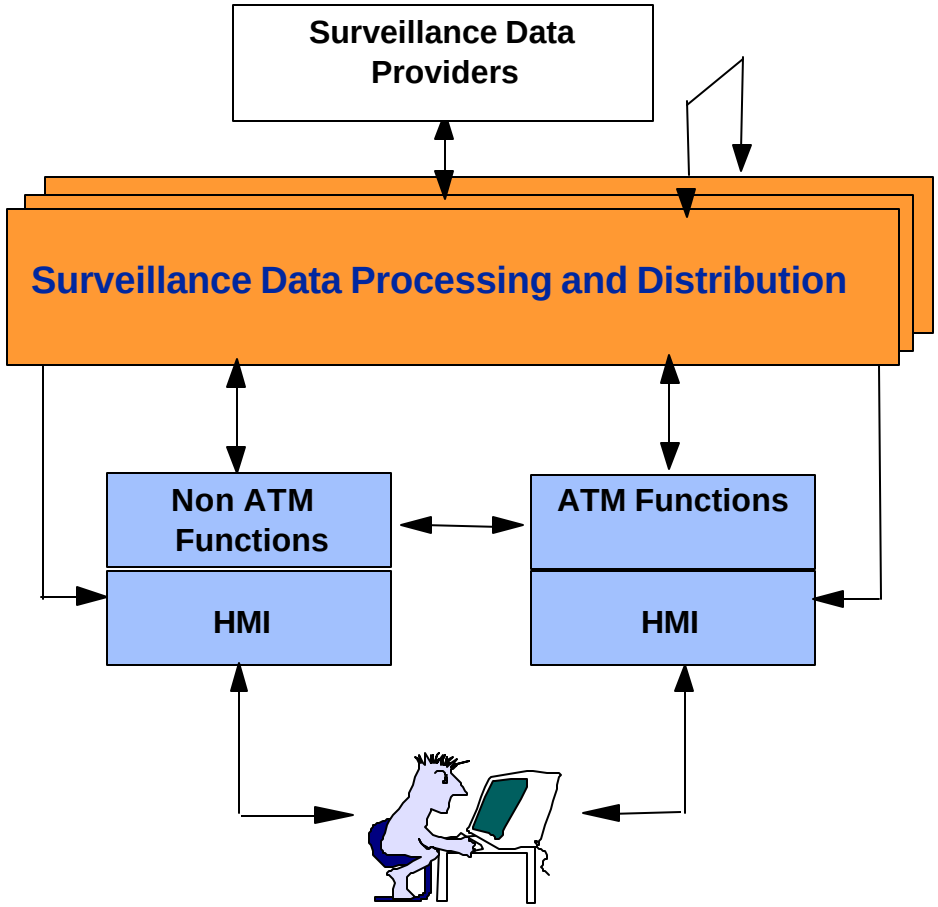
System concept : harmonisation & integration



.... Seamless

Role of the SDPD System



- ➔ Conventional sensors
  - ☑ (PSR, SSR, combined)
- ➔ Mode S Elementary Surveillance

- ➔ ATM Functions
  - ☑ Human Machine Interface
  - ☑ Safety Nets
  - ☑ Flight Plan Processing Systems
  - ☑ Air Traffic Flow Management, etc.
- ➔ Non-ATM Functions
  - ☑ Air Defence Systems
- ➔ Neighbouring ARTAS Units

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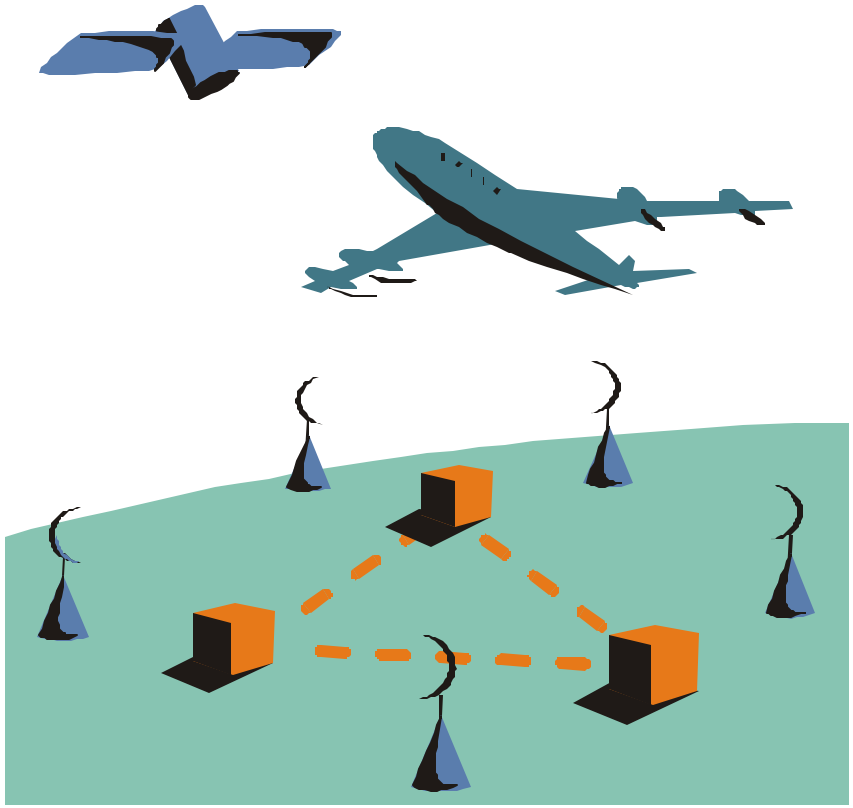
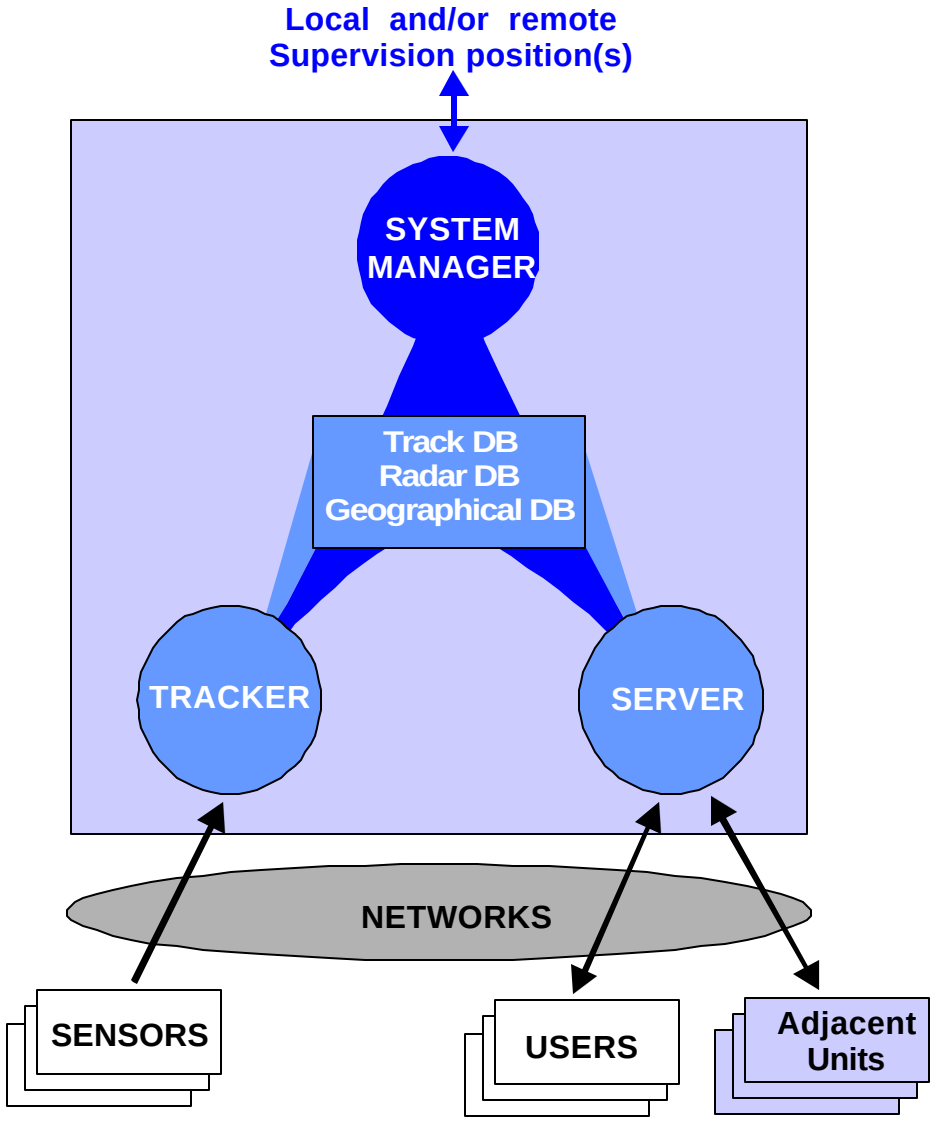
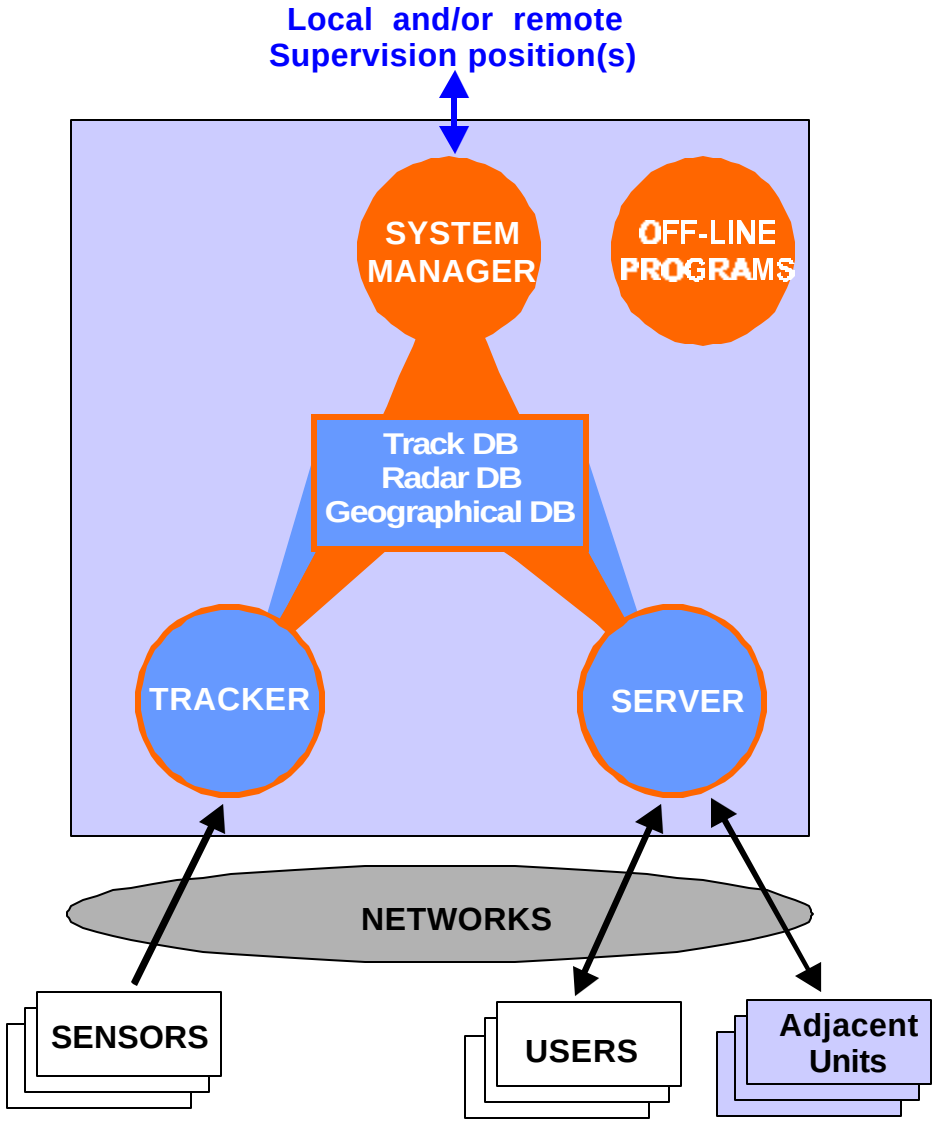


Functional Architecture of an ARTAS Unit



ARTAS System Manager

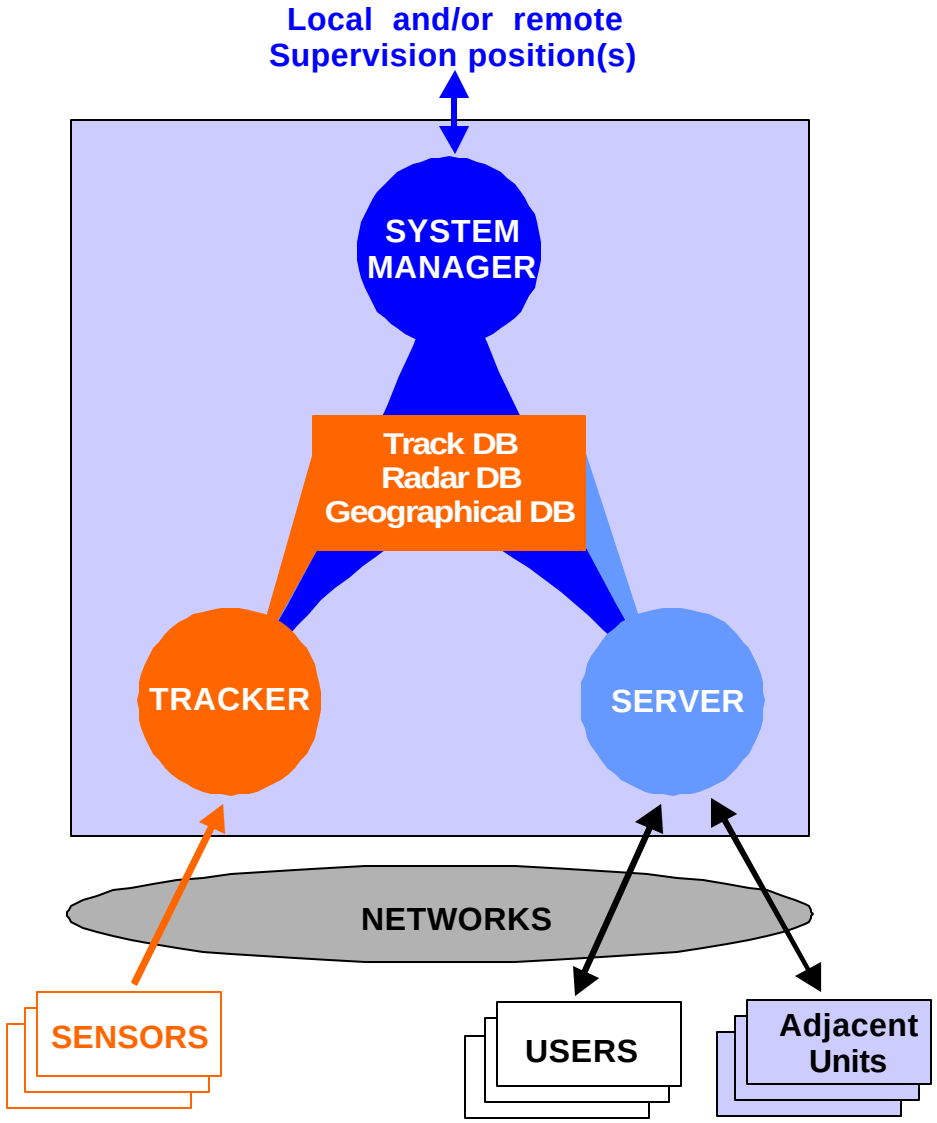
- **on-line : User-friendly supervision of all system elements and provisions for data recording.**
- **SNMP for remote control**
- **Off-line :**
  - ☑ Databases definition
  - ☑ Data Analysis : **DAF**
  - ☑ User simulation tool : **SIMARTAS**



ARTAS Tracker

Estimation of the complete track state vector (including position, speed, Mode-of-Flight) and related data items of all traffic.

- ➔ **Bare Tracker**
- ➔ **Dressed Tracker**
- ➔ **Multi radar environment assessment**



TRACKER Functions (1/2)

Bare Tracker : “pure tracking”

- **MRT-VU** (Multi Radar Tracking - Variable Update)
- Track initiation: **MHT** (Multi-Hypothesis Techniques)
- Plot-to-track association: **JPDA** (Joint Probabilistic Data Association)
- Track state vector estimation and extrapolation: **IMM** (Interacting Multiple Models)
- Estimation of the Mode-of-Flight
- Vertical tracking

TRACKER Functions (2/2)

➔ **Dressing functions** :

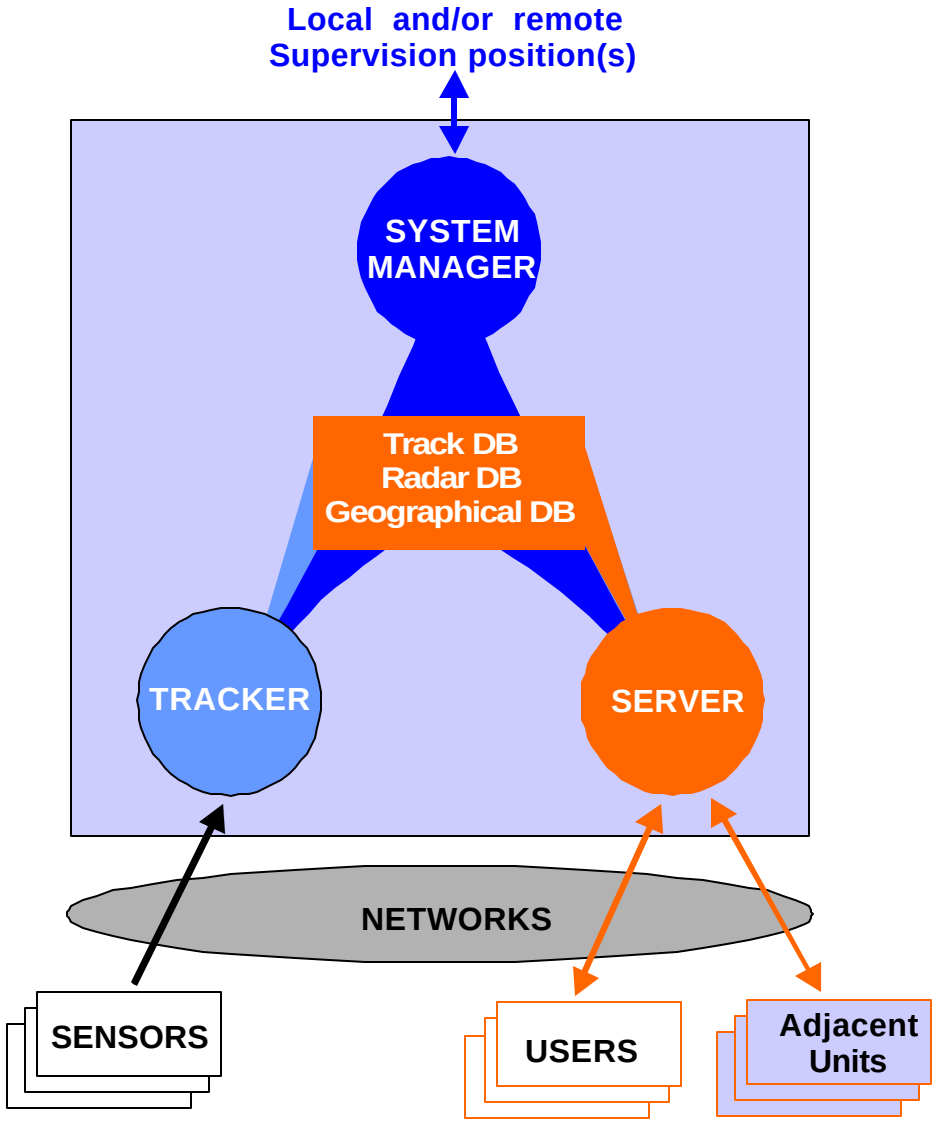
- ☑ False track processing
- ☑ Resolution problems
- ☑ Track classification (aircraft/non-aircraft)
- ☑ Coverage gaps, correlated errors, transponder delays, ...

➔ **Multi-Radar Environment Assessment** :

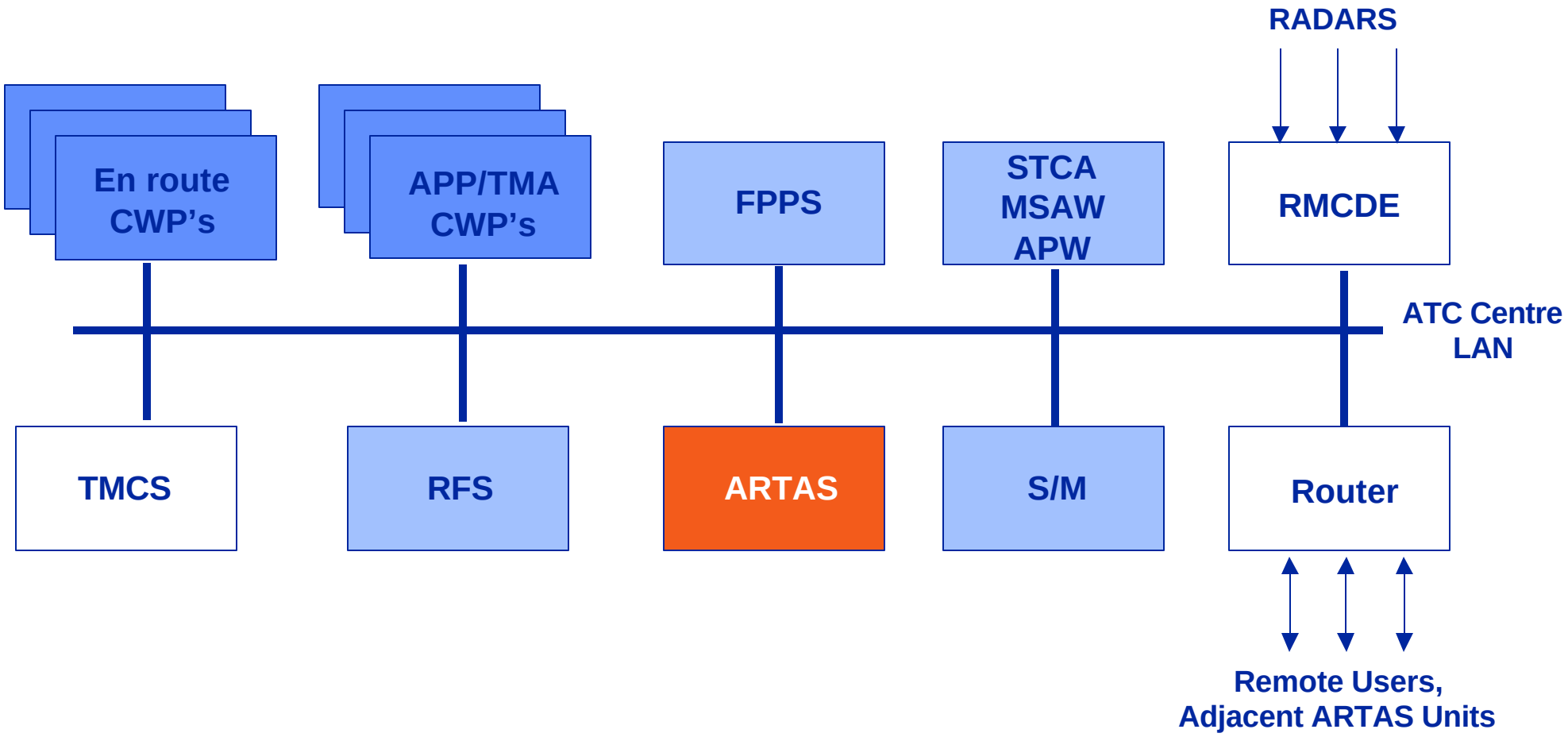
- ☑ Assessment of 3-D radar coverage characteristics
- ☑ Assessment and mapping of false plot data
- ☑ Assessment of systematic errors

ARTAS Server

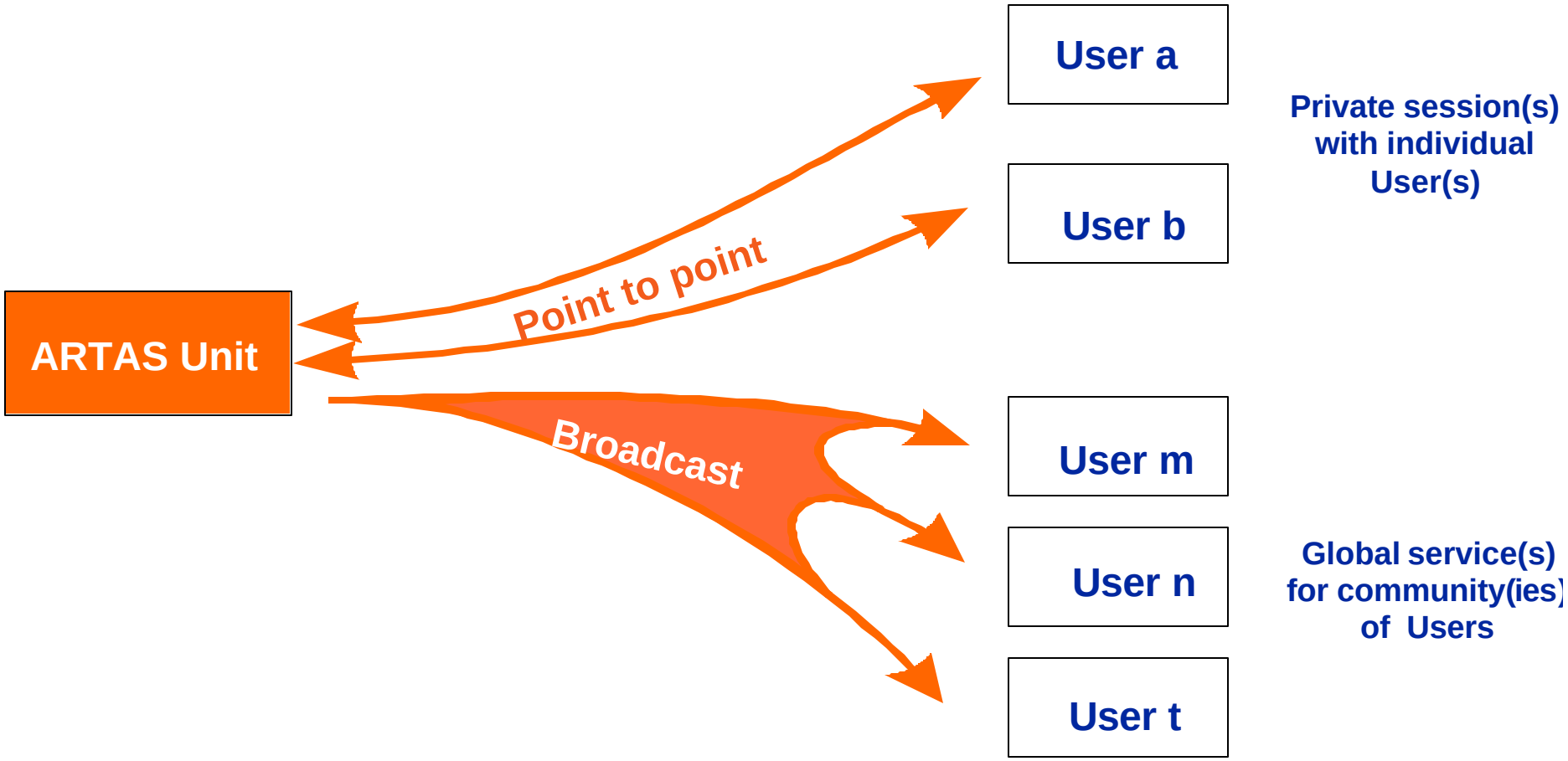
- Provision of flexible, continuous, and where required User-specific service to any User of processed Surveillance data,
- inter-ARTAS Tracking Continuity and Service Continuity functions, to ensure a fully seamless operation.
- Track labelling



ARTAS services :“Typical” configuration of Users



ARTAS services : modes of operation



ARTAS
Track information service

HMI
Safety nets
FPPS
ATFM
etc

Service definition :

what tracks ?

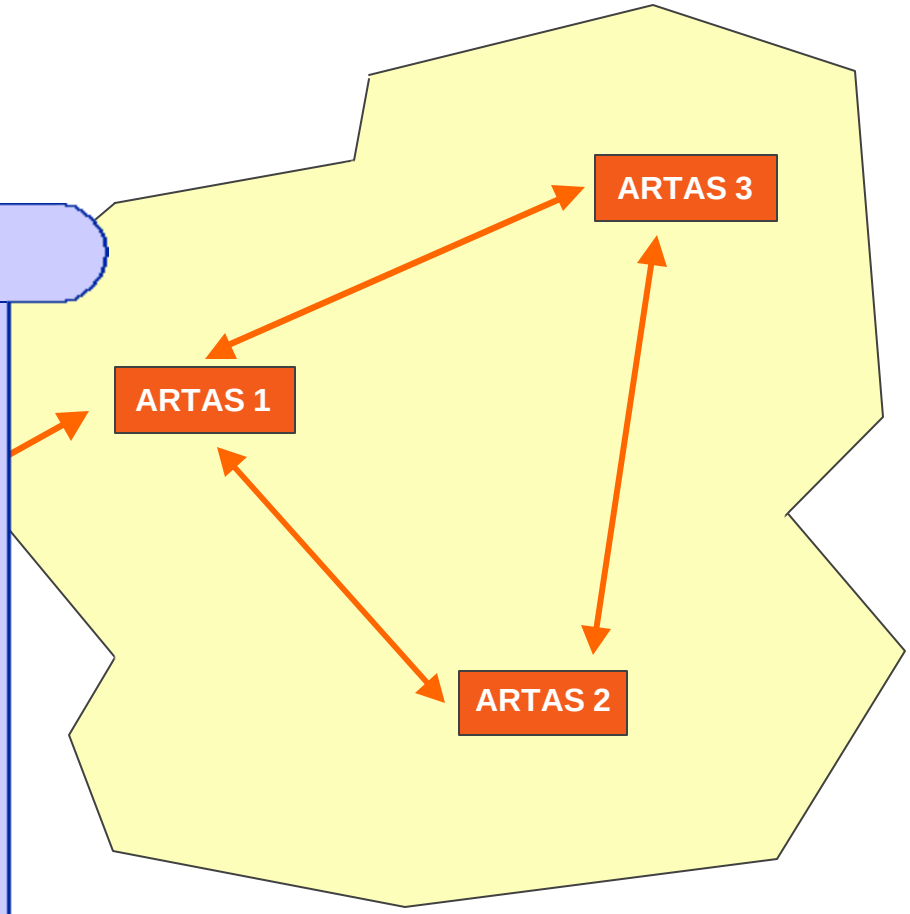
-> Track Selector

what information ?

-> Item Selector

at which update rate ?

->Transmission Characteristics



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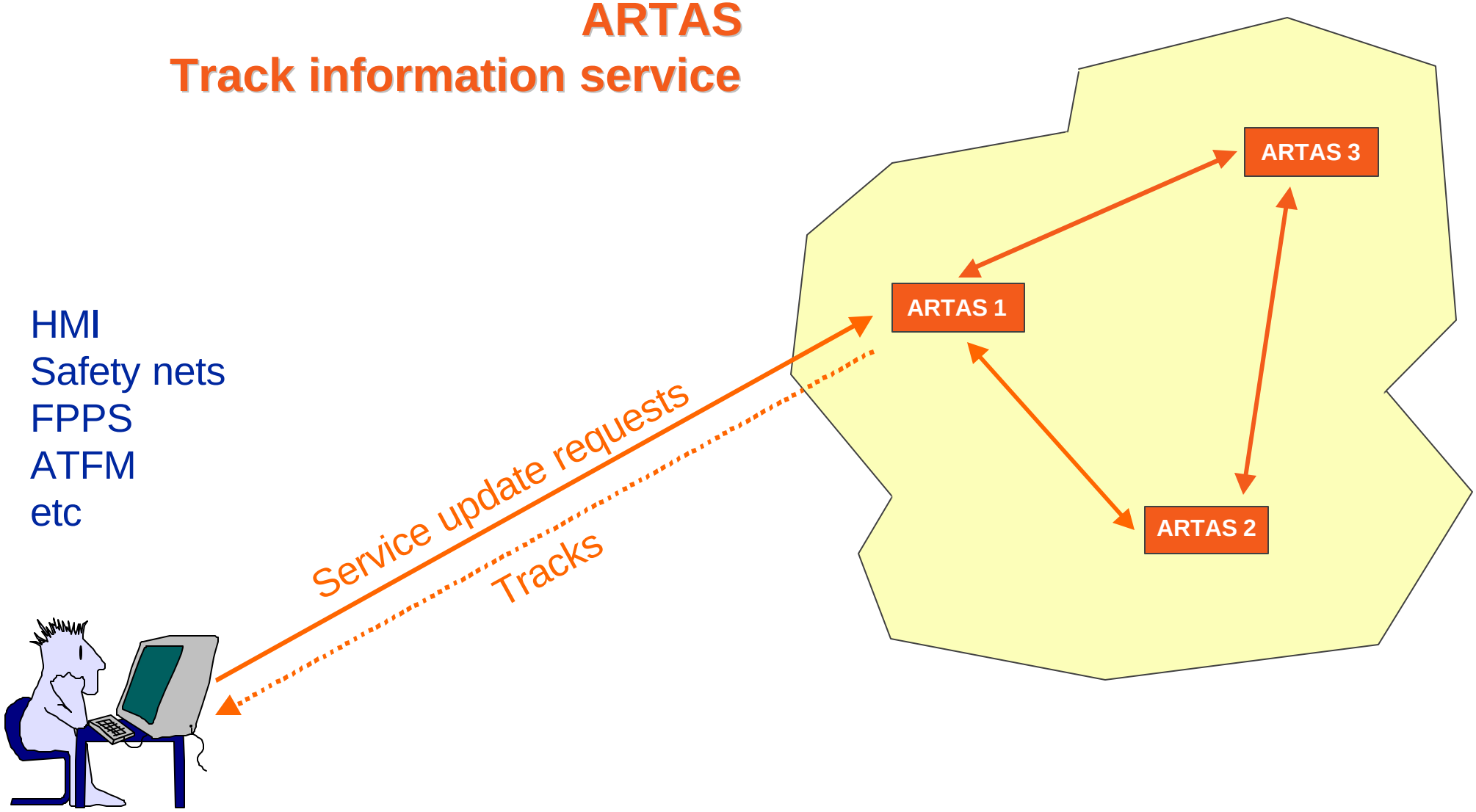
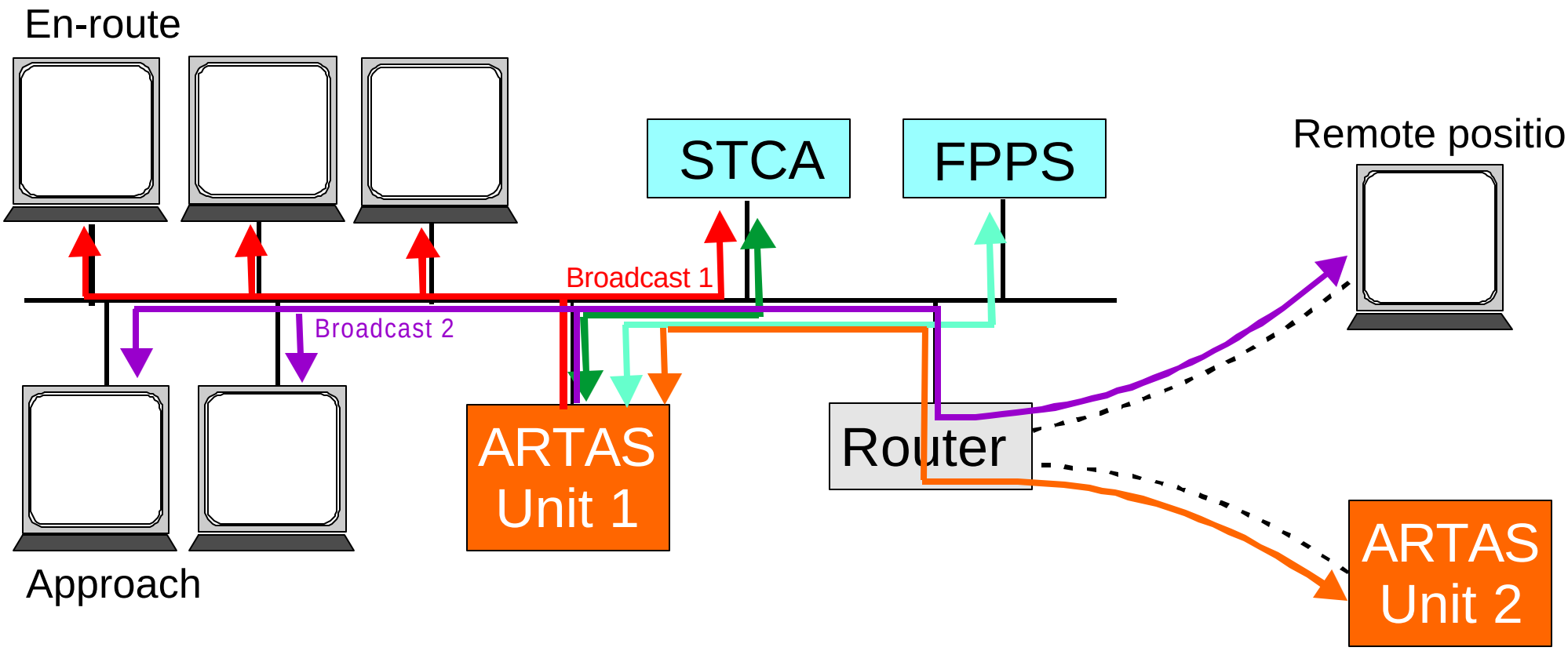
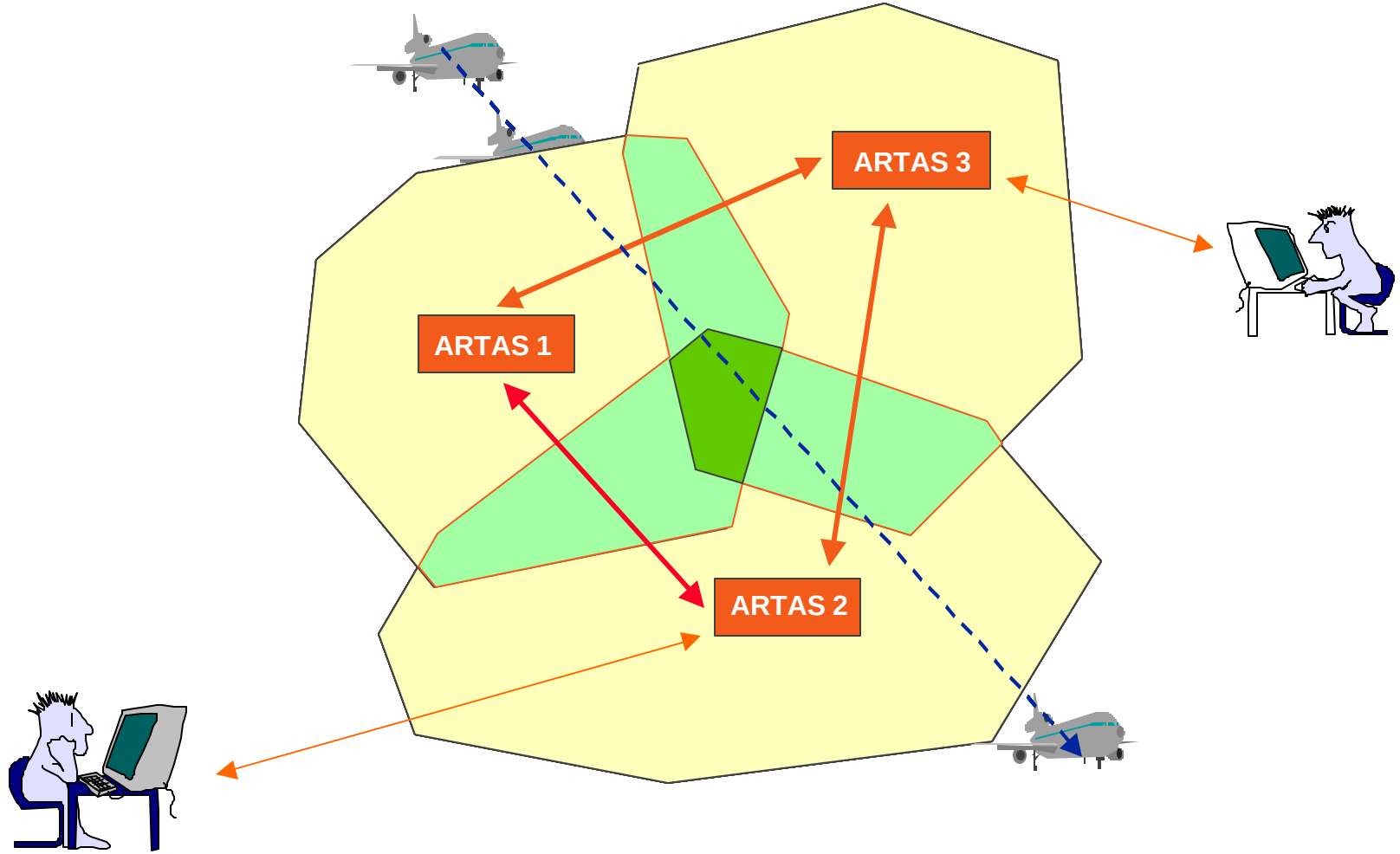


Example of User services configuration



Seamless integration : Tracking Continuity



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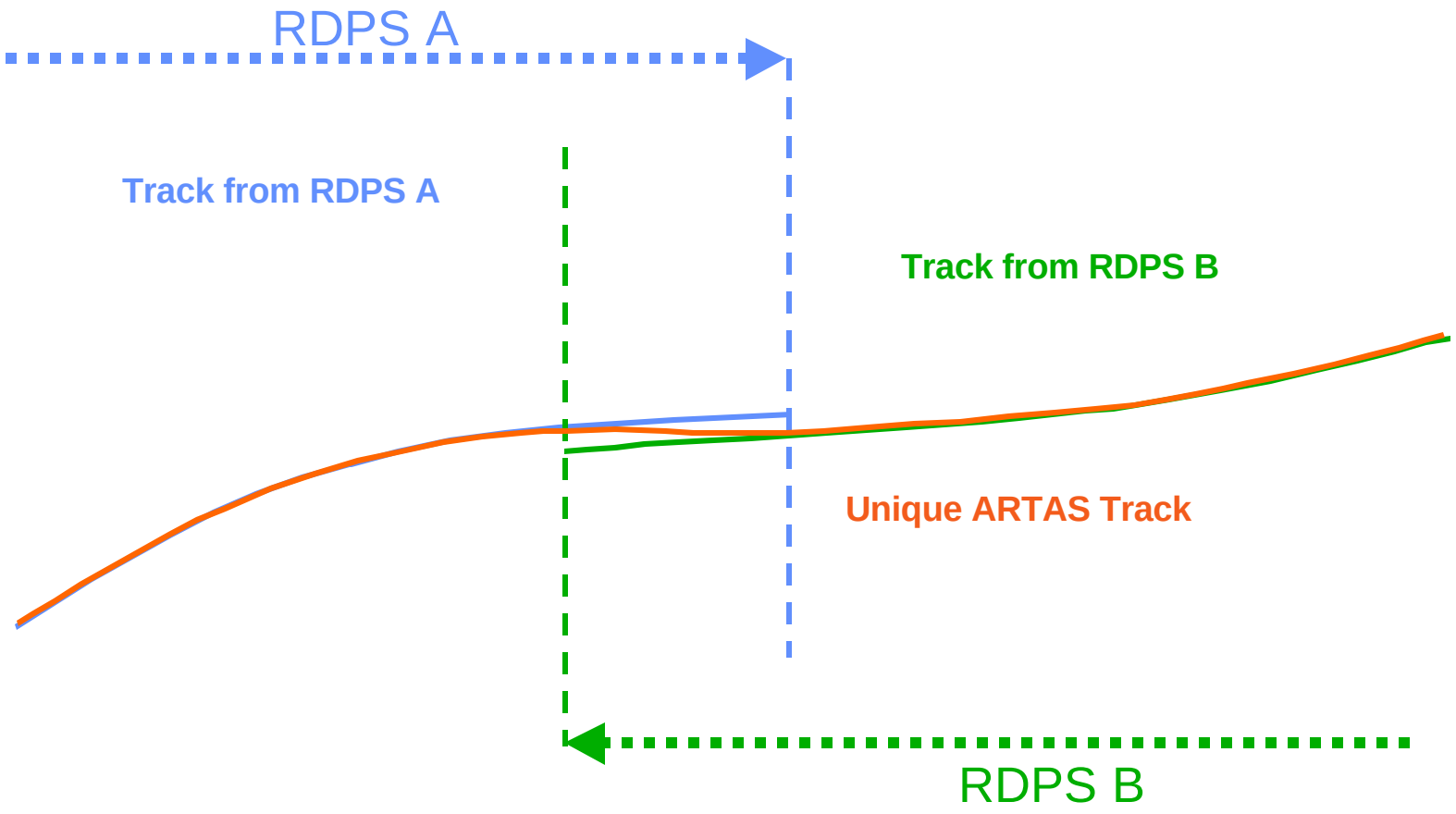
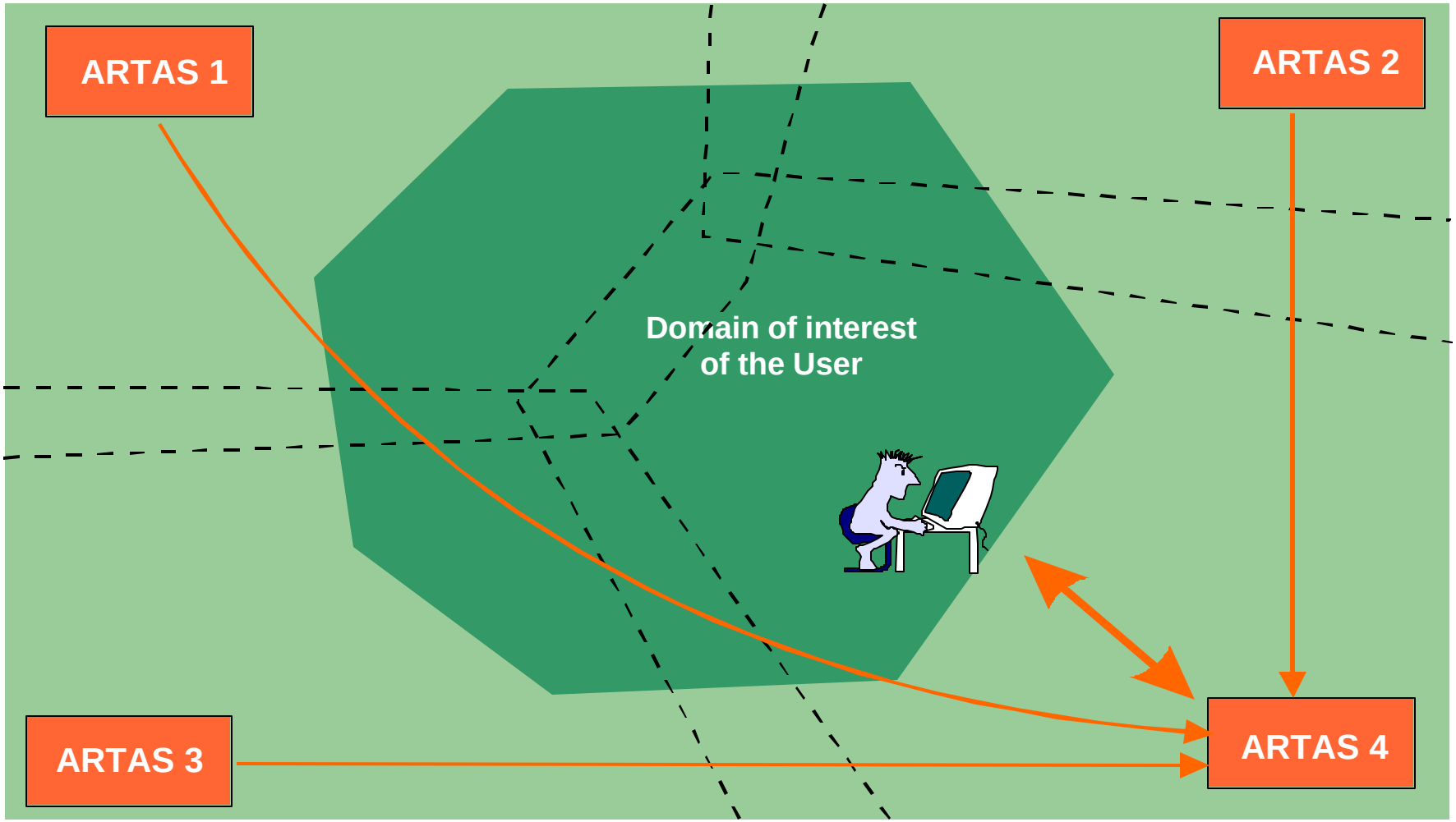
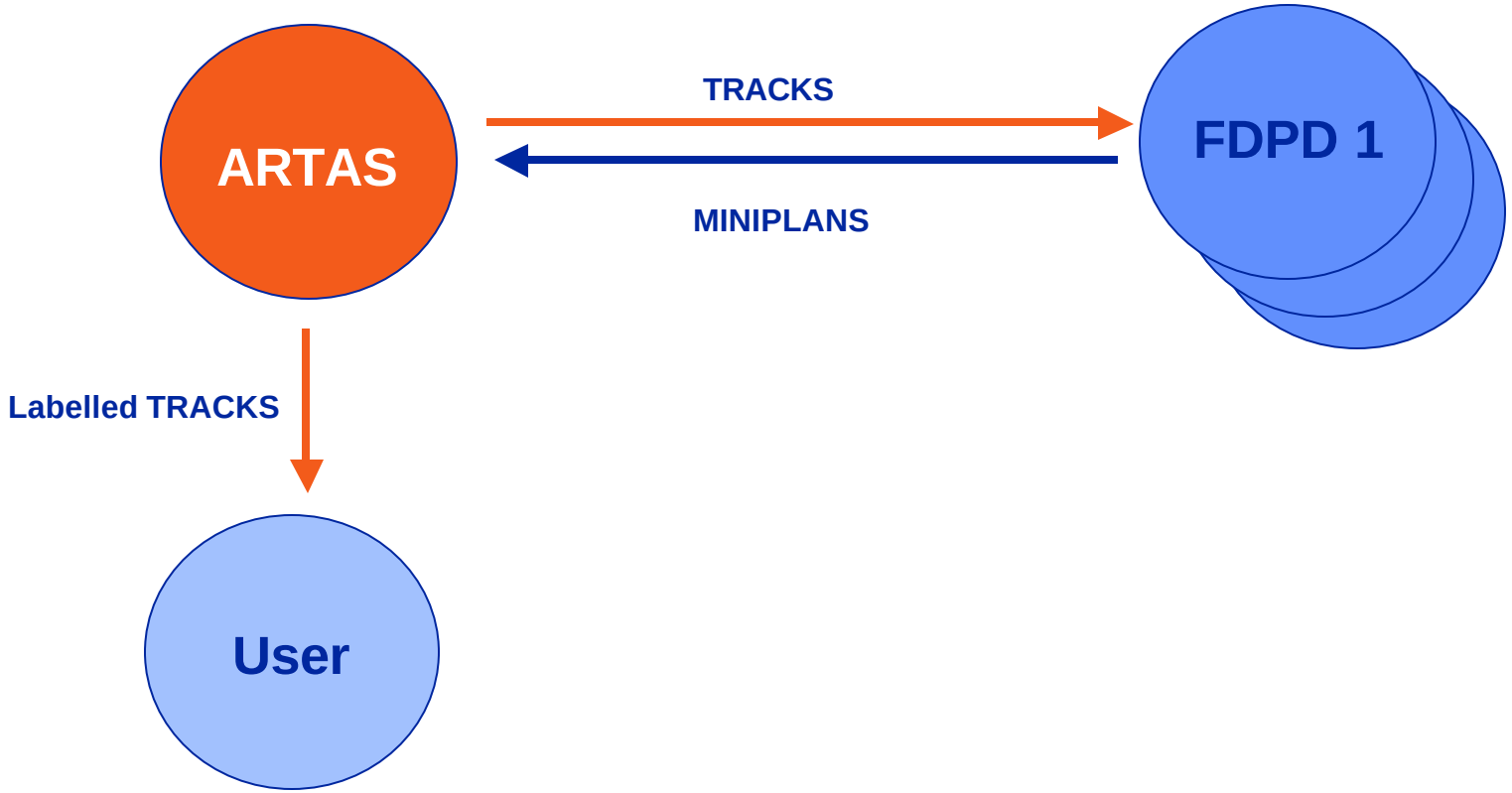


Seamless integration : Service Continuity



Track labelling : Miniplan Processing



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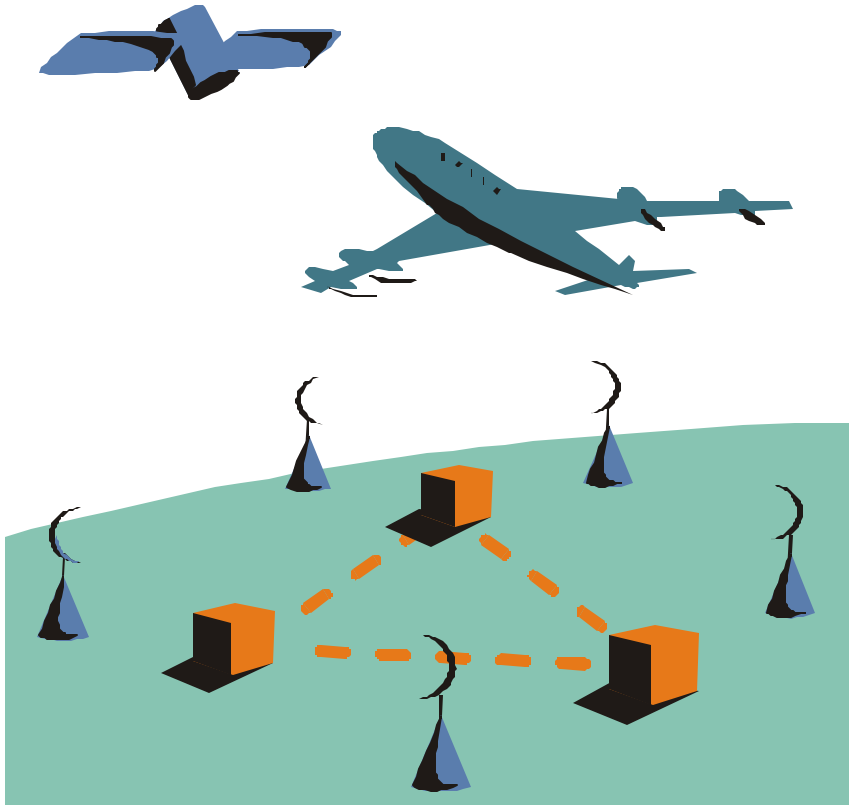


System Capacity

For each ARTAS Unit :

TRACKER :

Simultaneously :

- ➔ System Tracks : 1000 (nominal Unit)
  2000 (scaled up version)
- ➔ Up to 30 Sources (PSR, SSR)
- ➔ 1000 plots/second
  - ☑ 400 plots/local tracks per Radar Scan
  - ☑ 50 false SSR returns per Radar Scan
  - ☑ 350 false PR returns per Radar Scan

SERVER :

- ➔ Provision of up to 23 simultaneous “standard” Track Information Services
  (for each, 200 track updates/5seconds)
- ➔ Up to 1000 tracks per User

SYSTEM :

- ➔ System area: 1024NM x 1024NM
- ➔ Unavailability: 5mn/year

Communication : full ASTERIX interfaces

CAT001: Transmission of monoradar data

CAT002: Radar service messages

CAT034 : Transmission of mono-radar service messages

CAT048: Transmission of mono-radar target reports

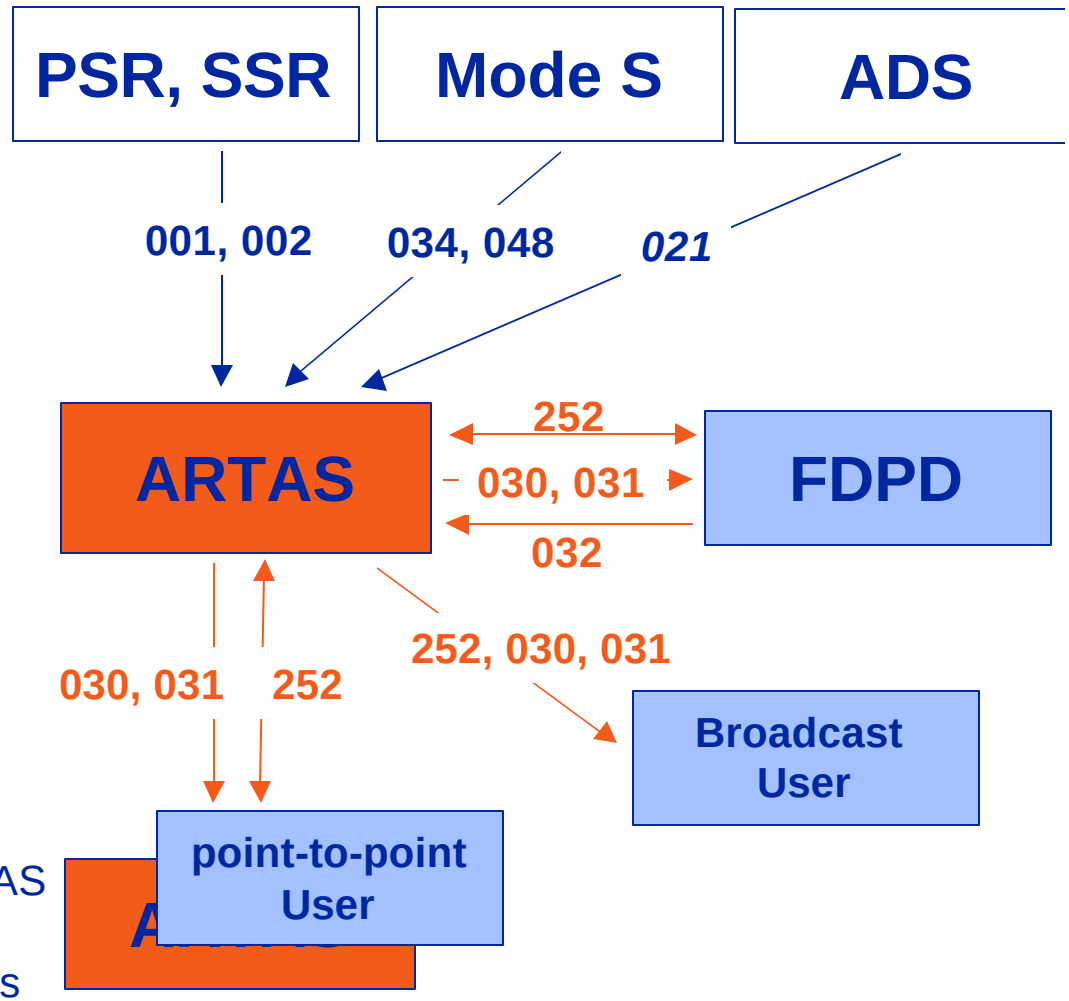
***CAT021** : ADS surveillance reports*

CAT030: Exchange of Air Situation Pictures
CAT062

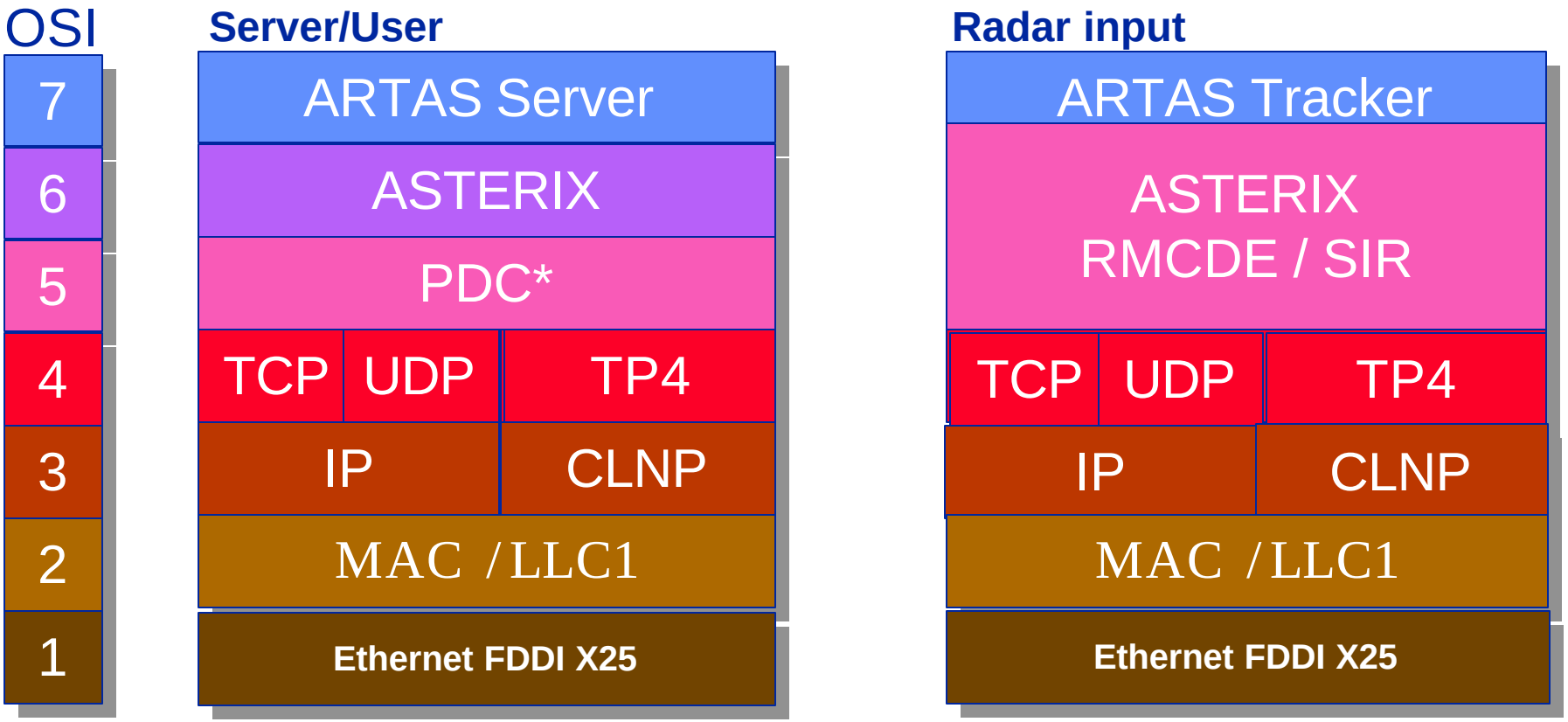
CAT031 : transmission of sensor information

CAT032: Information provided by Users to ARTAS

CAT252: Session and Service Control Messages



Communication : protocol stacks

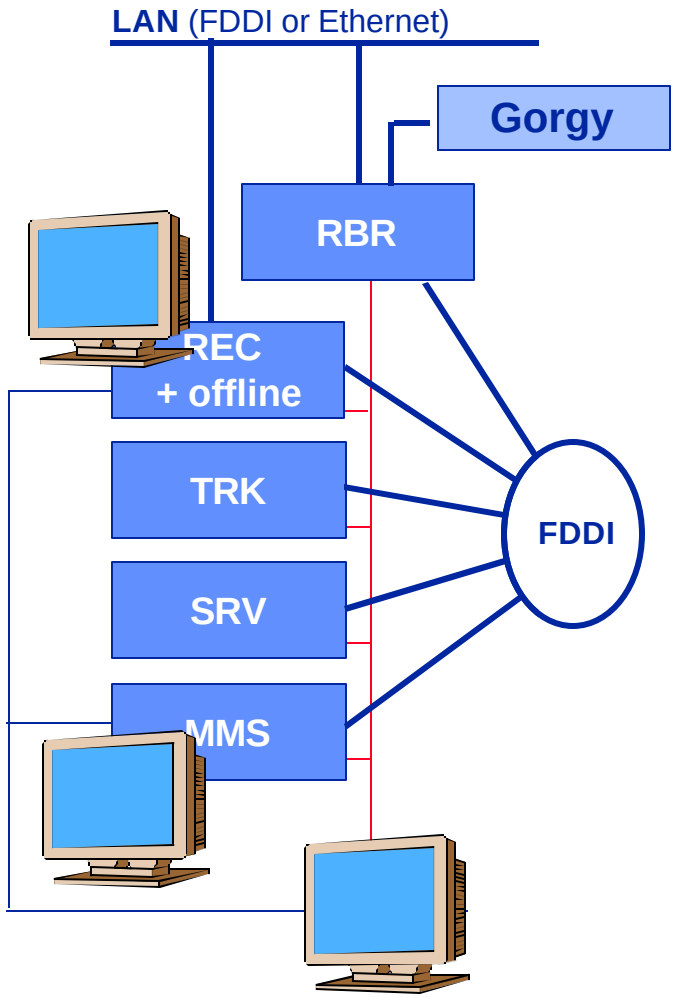


PDC: Private data channel **SIR : Serveur d'Information Réseau** **RMCDE : Radar Message Conversion and Distribution Equipment**

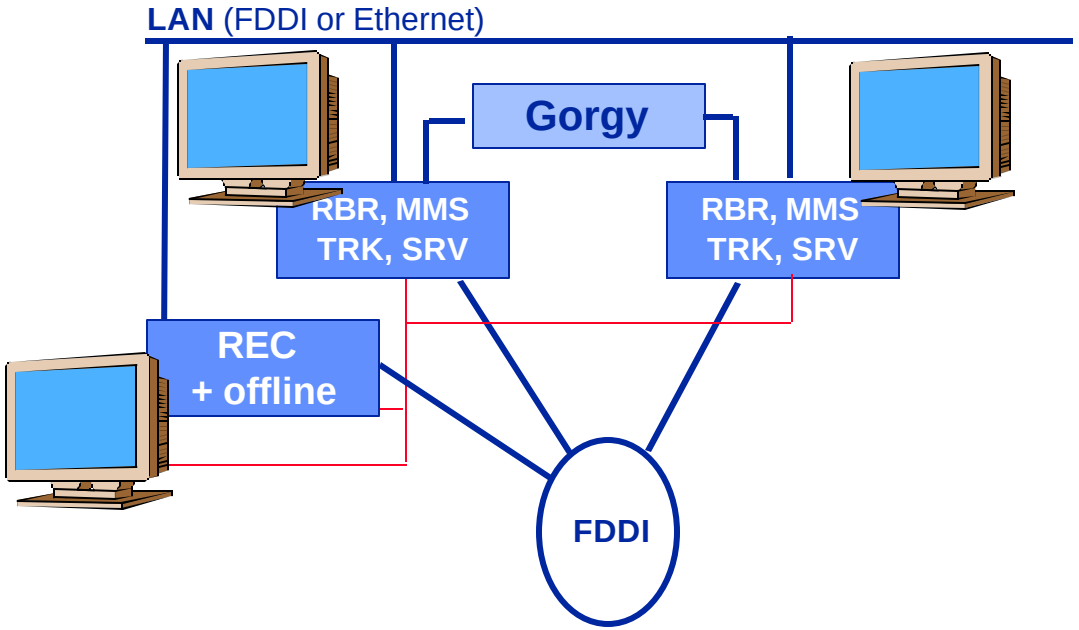
System Architecture

Nominal : 10 Compaq Alpha

Scaling down/up study



System Architecture



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Scaling down/up study

ARTAS standard configuration

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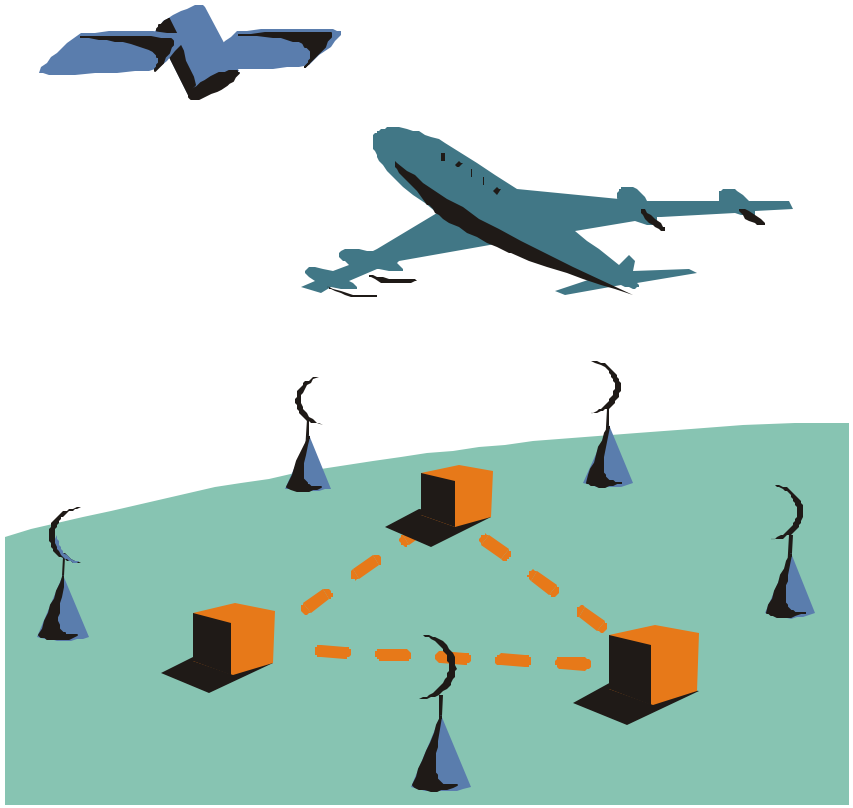
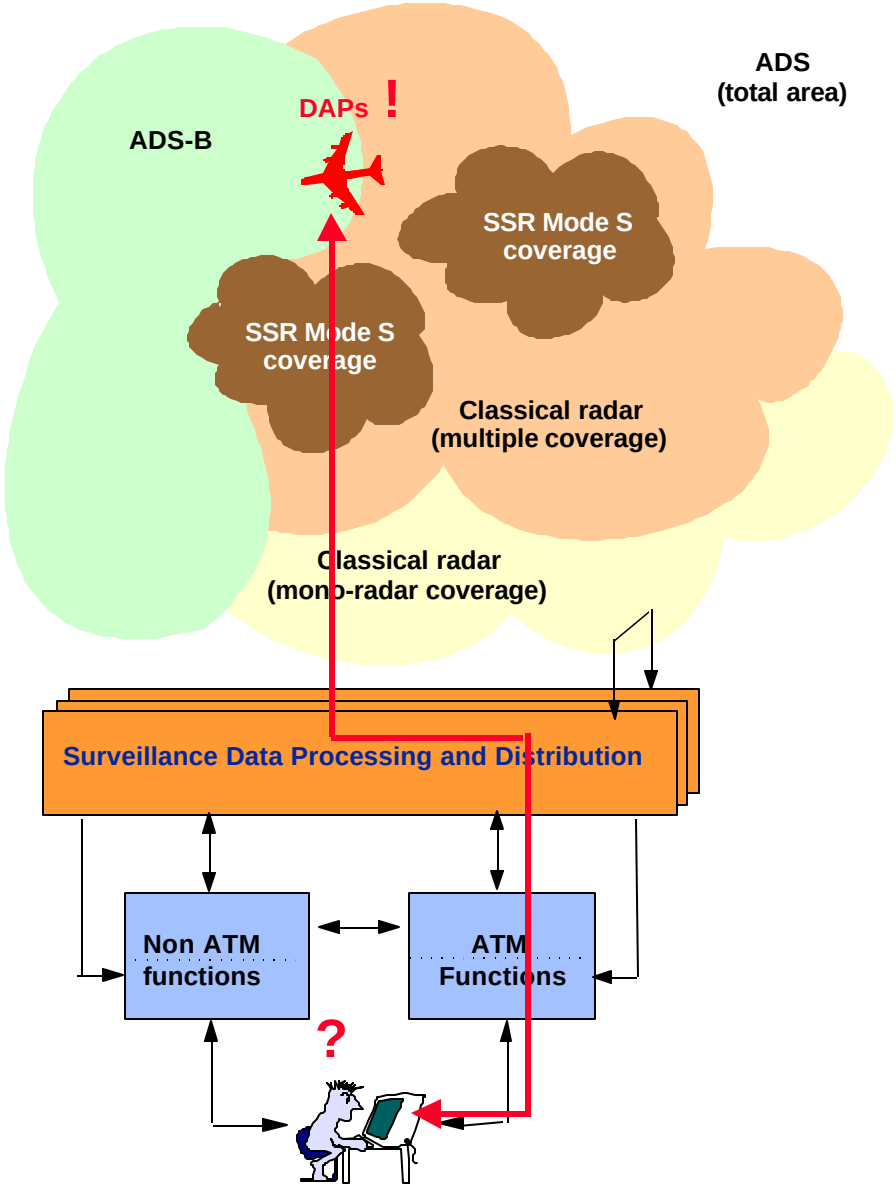


ARTAS future role

In addition to the present ARTAS principles, the system shall be capable to process the complete list of **SSR Mode S** and **ADS** data which will be available in the future Surveillance System



Potential evolutions

Surveillance Roadmap & Downlinked Aircraft Parameters :

- ➔ Enhanced Surveillance
  - ☑ **extraction from the aircraft avionics of a limited number of air derived data parameters.**
  - ☑ **CAP's** (Controller AP's) and **SAP's** (System AP's)
    - ↖ Mode S Enhanced Surveillance
    - ↖ ADS-B
- ➔ Intent based ATM
  - ☑ **extraction of intent information and possibly more air derived data**

Evolutions for Enhanced Surveillance

- Processing of Down-linked Aircraft Parameters :
  - ☑ Controller Access Parameters (Aircraft state vector and intention e.g magnetic heading, airspeed, selected FL)
  - ☑ System Access Parameters (Aircraft state vector and intention)

- DAP's tracking **(integrity checking, consistency checks, availability monitoring, filtering)**

- Tracker improvements **(Track Initiation Delay, Random Track Probabilities, Extra Track Rate, Accuracy, MOF Detection Delay, False MOF Indication)**

Next ARTAS version : when ?

➔ The Surveillance programmes comprise the further development of all Eurocontrol products

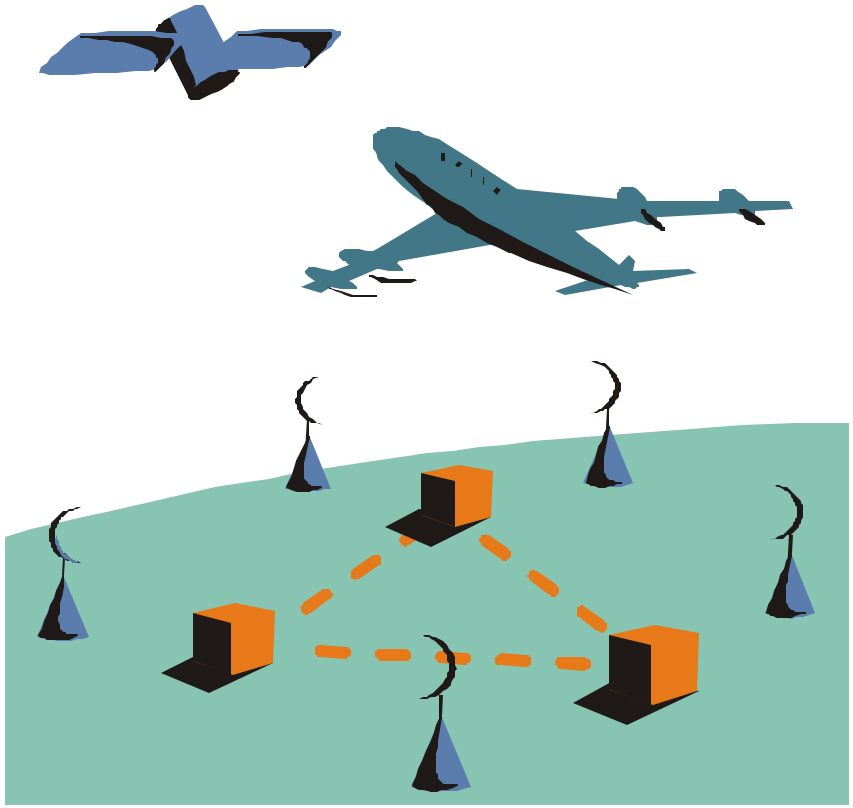
- ☑ **Mode S Programme** : decision on Mode S enhanced surveillance expected to be taken by mid 2001
- ☑ **ADS Programme** : programme stage 2 (implementation) expected to be approved by mid 2001

R&D activities

- Studies
  - ☑ specification of ECP for processing ADS-B
  - ☑ specification of ECP for Mode S enhanced
  - ☑ Potential use of ARTAS for TIS-B
    - ↖ experiments ?
  - ☑ “Airborne ARTAS”
  - ☑ SMGCS ARTAS
- development of a prototype based on ARTAS V6
- Prototype tests in ATM trials environments
  - ☑ **DUP** : DSI Upgrade Program
  - ☑ **PROVE** : Pre-Operational European Validation and Experiments

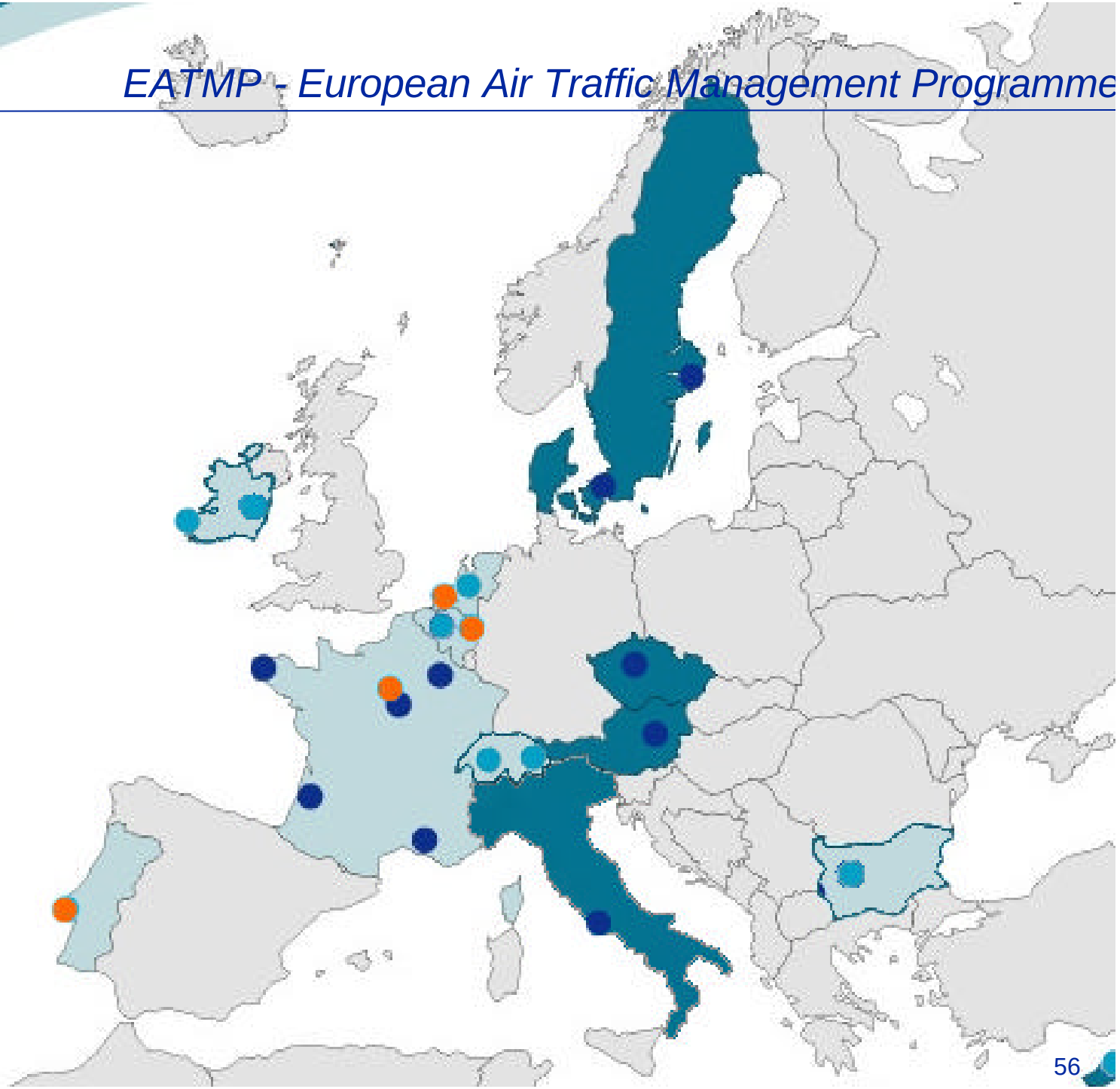
Agenda

- ➔ EATMP Surveillance context
- ➔ Overview of Surveillance Products
- ➔ **ARTAS presentation**
  - ☑ Concept
  - ☑ Functions
  - ☑ System/Software aspects
  - ☑ Future Developments
  - ☑ **Implementations status**
  - ☑ Relationship with industry



ARTAS Operational use

February 2001

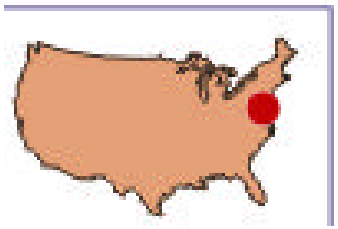


17 pilot units at 13 different sites

ARTAS Pilot Systems

September 2000

- Installed
- Planned



CAMOS
Centralised ARTAS Maintenance and Operational Support

support to all ARTAS users

- ➔ Software maintenance
- ➔ ARTAS release distribution
- ➔ Support for hardware maintenance
- ➔ Support for implementation of new releases
- ➔ Support ARTAS implementation team
- ➔ Updating and distribution of documentation
- ➔ Configuration management
- ➔ Validation of successive versions
- ➔ Provision and update of ARTAS training material and courses
- ➔ Support of the development facilities
- ➔ Training management

Agenda

- ➔ EATMP Surveillance context
- ➔ Overview of Surveillance Products
- ➔ **ARTAS presentation**
  - ☑ Concept
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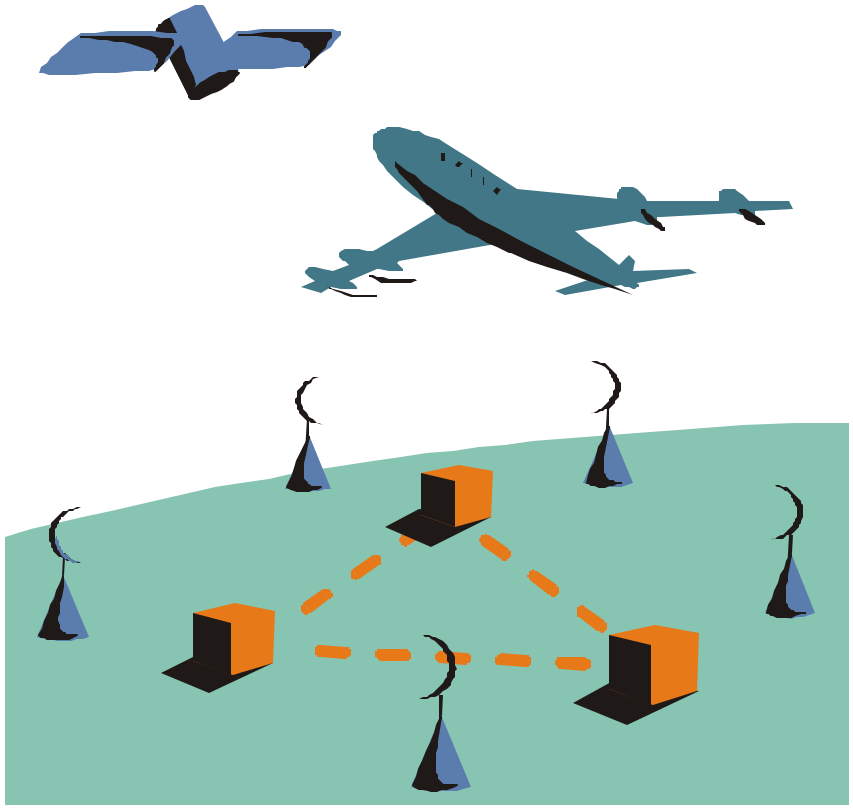
  - ☑ Future Developments
  - ☑ Implementations status
  - ☑ **Relationship with industry**



ARTAS system/software distribution

- IPR situation in conformity with the EUROCONTROL policy, i.e.:
  - ☑ a monopoly position of any industry shall be avoided,
  - ☑ any Administration desiring to implement ARTAS may select any industry of its choice.

- Free distribution of complete ARTAS software (executable) to ECAC civil & military Administrations.
  - ☑ Full user rights
  - ☑ CAMOS service

- Free distribution of ARTAS application software to industry for allowing the complete understanding of the system
  - ☑ integration of ARTAS within own product lines
  - ☑ future open tender actions on ARTAS
  - ☑ very limited CAMOS support

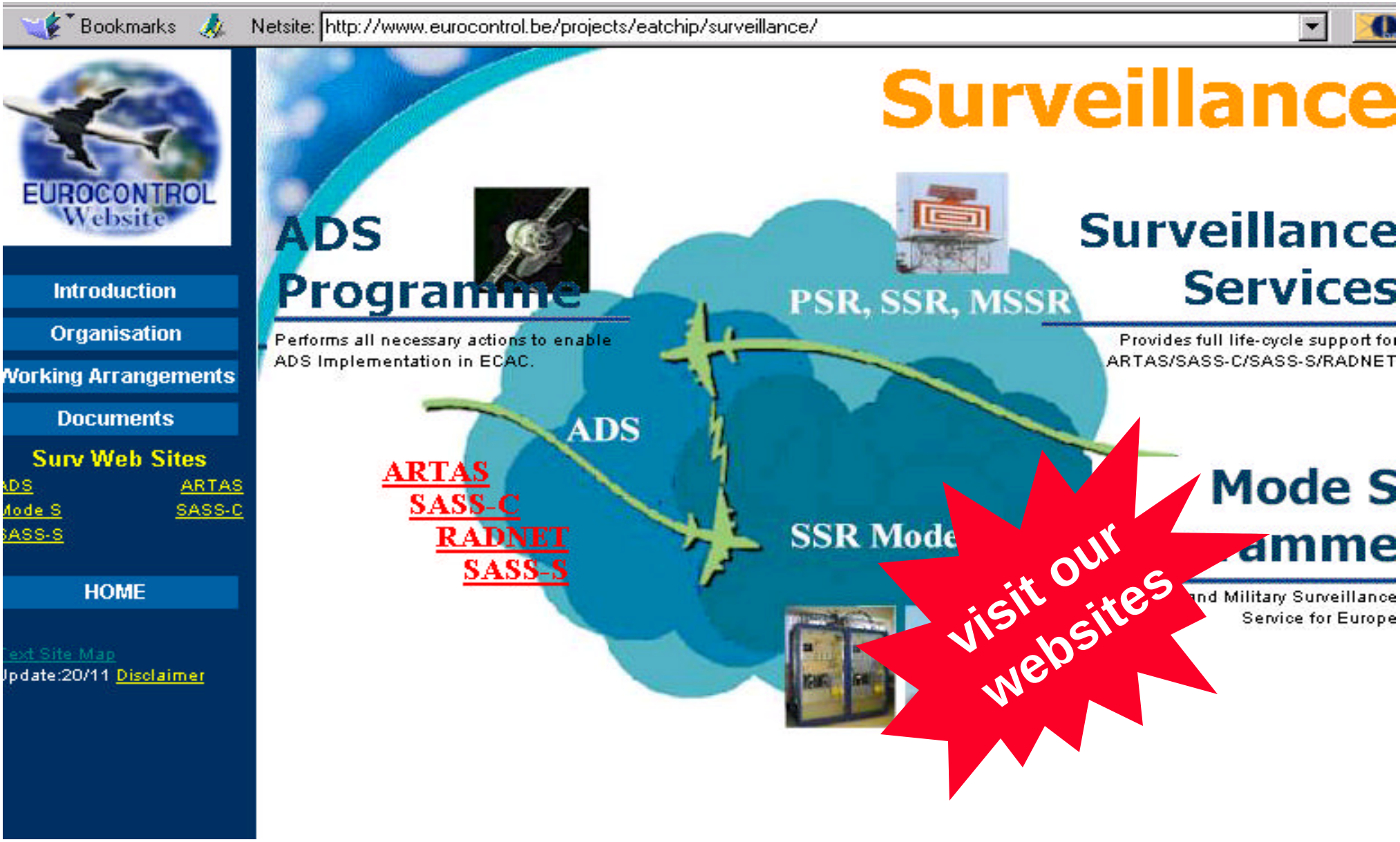
Relationship with industry

- Thales/Airsys : **integration of ARTAS in the *EUROCAT* systems family**
- Lockheed Martin : **integration of ARTAS in the *Skyline* systems family.**
- Raytheon : **on the way to integrate ARTAS in a "componentized" *P1*.**
- Alenia Marconi systems: **integration of ARTAS in the *SATCAS* systems family.**
- Compaq : **common procurement of rack-mounted ARTAS Units.**
- Hewlett Packard **: business case for re-hosting ARTAS**

Relationship with industry

Distribution of a License agreement with respect to the transfer of ARTAS source codes

- ☑ **Alenia Marconi Systems**
- ☑ THALES/AIRSYS ATM
- ☑ **Comsoft**
- ☑ H.a.n.d
- ☑ HITT
- ☑ Lockheed Martin
- ☑ NLR
- ☑ Raytheon
- ☑ **Syseca Belgium**
- ☑ **Vitrociset**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Netsite: http://www.eurocontrol.be/projects/eatchip/surveillance/
EUROCONTROL Website
Introduction
Organisation
Working Arrangements
Documents
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ADS
ARTAS
Mode S
SASS-C
SASS-S
HOME
Text Site Map
Update:20/11 Disclaimer
Surveillance
ADS Programme
Performs all necessary actions to enable ADS Implementation in ECAC.
PSR, SSR, MSSR
Surveillance Services
Provides full life-cycle support for ARTAS/SASS-C/SASS-S/RADNET
ADS
ARTAS
SASS-C
RADNET
SASS-S
SSR Mode
Mode S
Service for Europe
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