AIRCON 2100

System Highlights and IOP Capabilities

indra

Mexico City, 21 April 2014

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INDRA'S ATM MISSION

Indra's ATM mission is to enhance the safety of flights by providing ATCOs with information of air movements from Surveillance sensors such as MSSR, PSR, MLAT/WAM systems and ADS-B stations, together with weather data and planning information (FPLs, route availability and flow information), while communicating control through Voice and Data Link technologies.

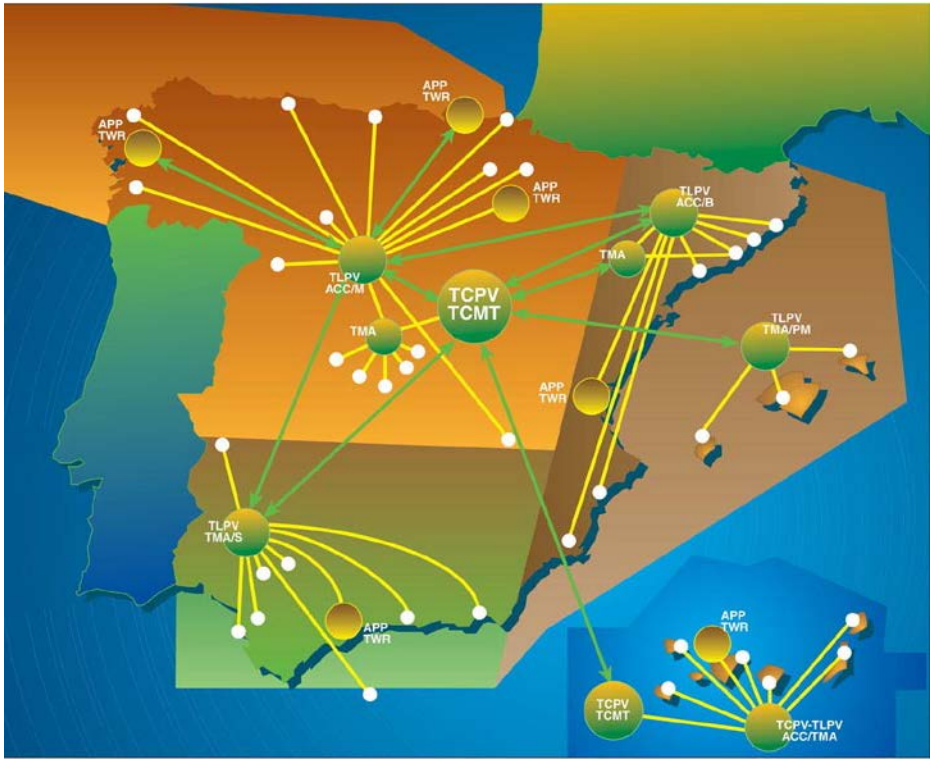
THE BEGINNING OF OR JOURNEY: SPAIN'S SACTA

- **Our journey begins with Spain's SACTA for AENA**

  Indra has been implementing SACTA on an ongoing basis since 1984. The system comprises 5 ACC, 12 APP and several dozen TWR centers.

- **SACTA implements the 'Spanish Single Sky'**

  SACTA manages around 1 million flight hours and 1.5 million unique flights a year.



SACTA I → **SACTA II** → **SACTA III** → **SACTA IV**

1984 to 1991 | 1992 to 1996 | 1997 to 2006 | 2007 to 2014

INDRA AS THE INDUSTRIAL LEADER OF THE ITEC CONSORTIUM

- **The iTEC consortium seeks a common system for Flight Data Processing – the iTEC-eFDP**

  Spain's AENA, Germany's DFS, UK's NATS and Dutch LVNL have selected Indra to provide them with the first SESAR-compliant FDP system.

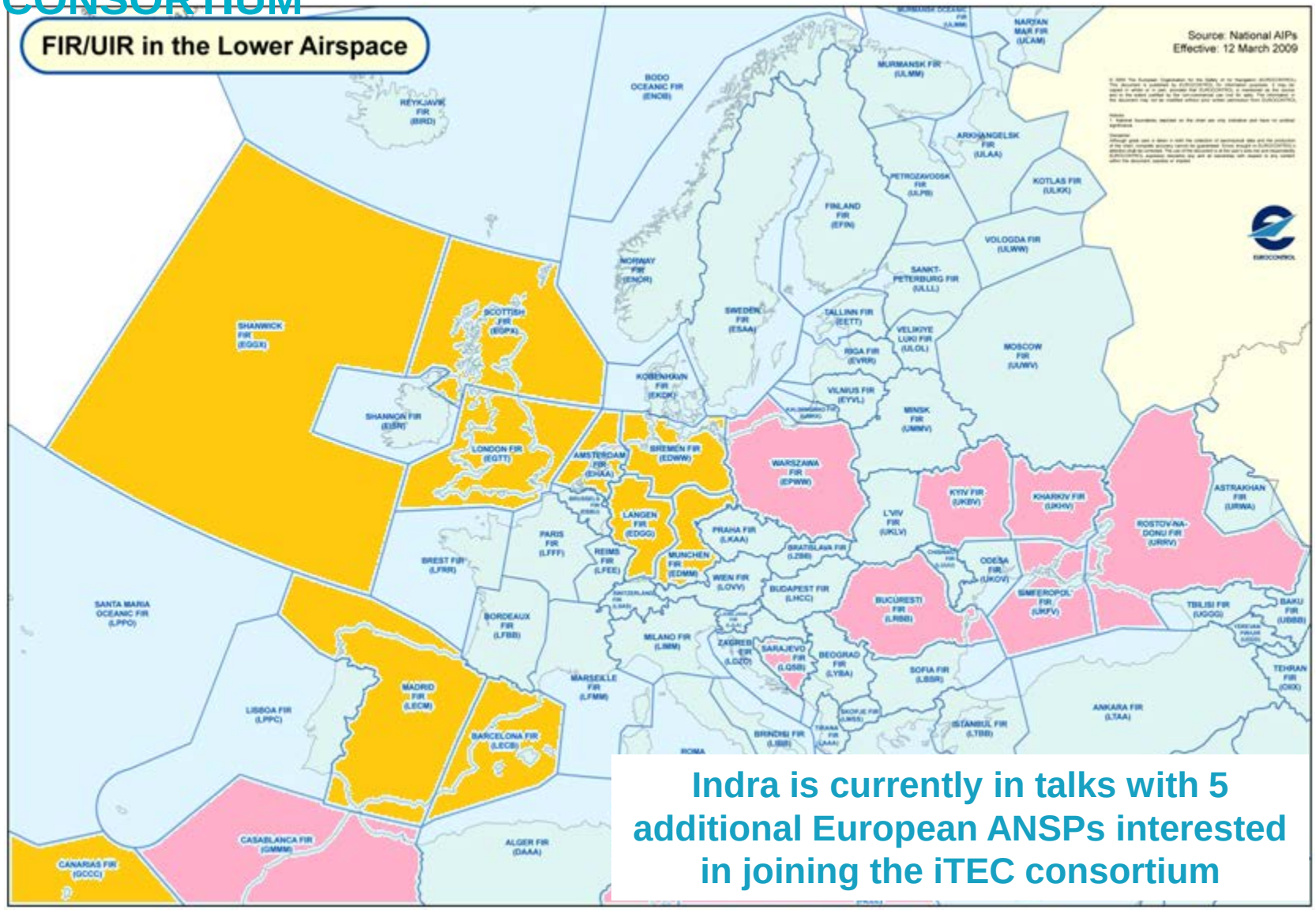
- **Eurocontrol's Maastricht UAC (MUAC) uses Indra's FDPS**

  Eurocontrol has entrusted Indra to provide the FDPS for Europe's busiest airspace, controlling around 1.5 million unique flights and 1.5 million flight hours a year.

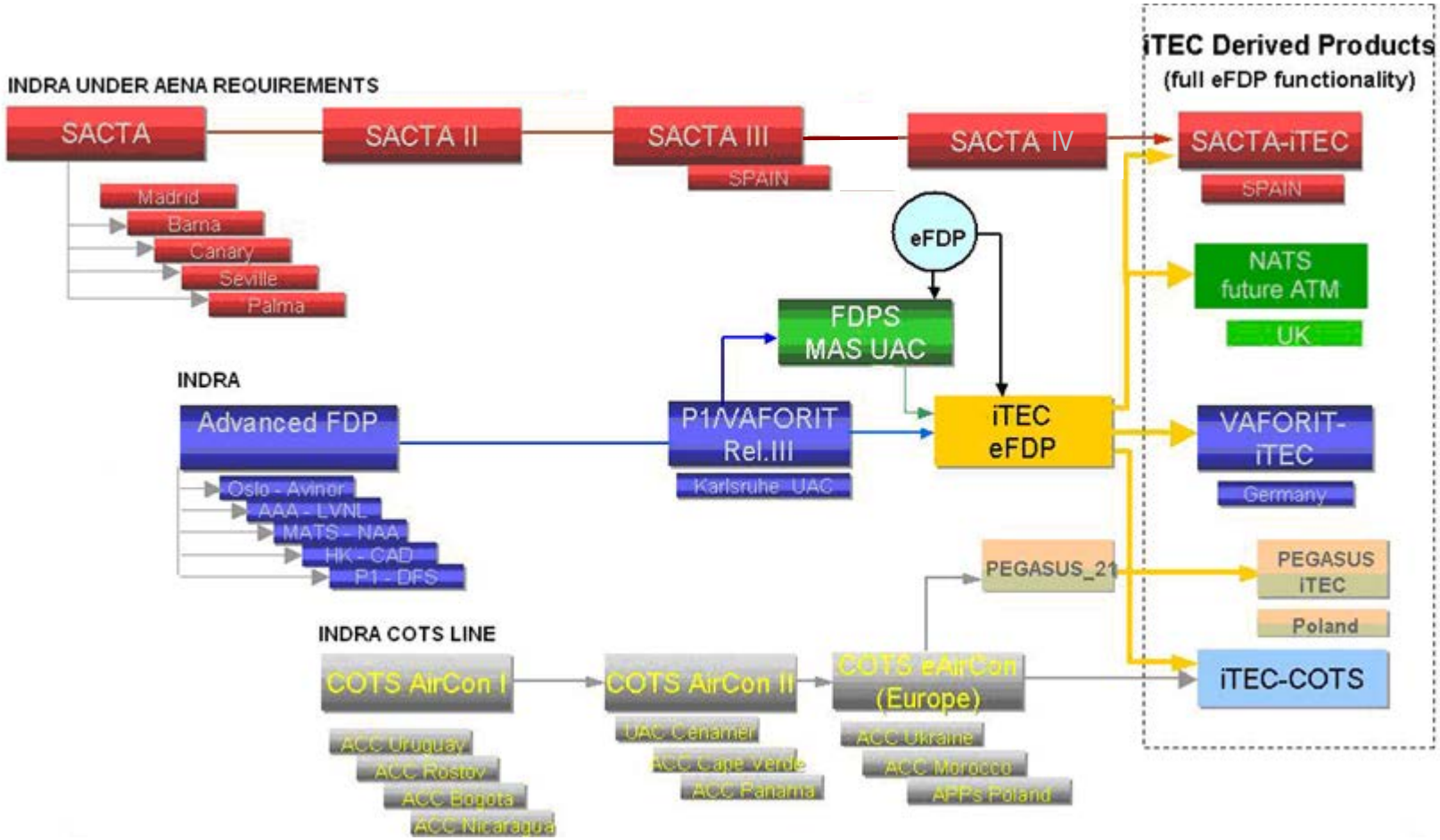
- **Karlsruhe UAC (KUAC) uses the first iTEC-eFDP system**

  With traffic figures similar to those of MUAC, DFS KUAC is one the most complex ATM automation systems in the world.

INDRA AS THE INDUSTRIAL LEADER OF THE ITEC CONSORTIUM



INDRA'S ATM SYSTEMS HISTORICAL EVOLUTION



1984 1990 1995 2005 2015 2018-20

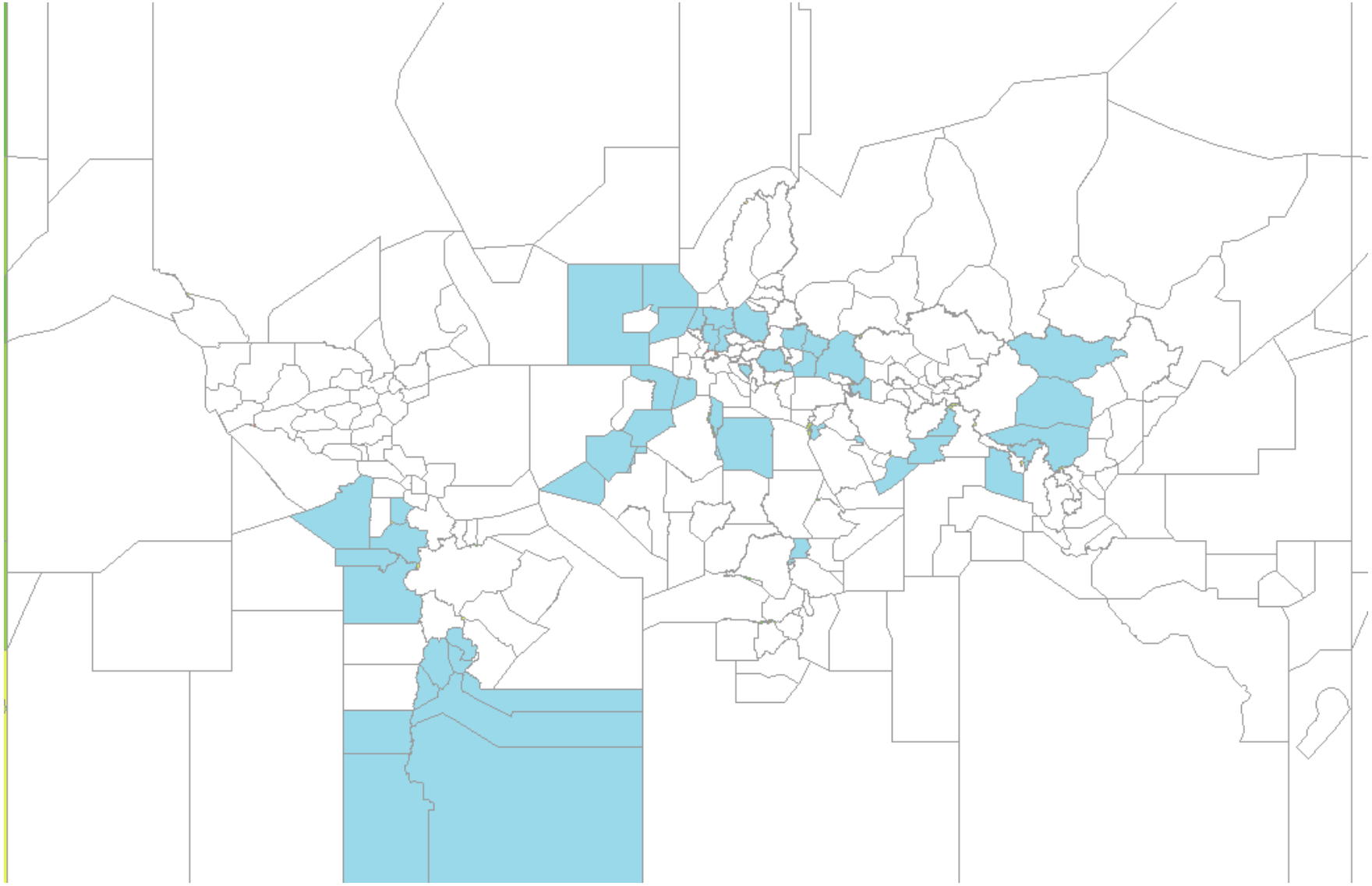
AIRCON 2100 AS A STANDARD ATM AUTOMATION SYSTEM

- **AIRCON 2100 is the result of having standardised most features of Indra's bespoke systems in Europe since the mid 90s**
  Indra's ATM automation COTS product line (AIRCON) was started in the mid 90s in response to ANSPs requiring a standard solution for airspaces with medium air traffic loads.

- **Since 2010, AIRCON 2100 has included SESAR proven solutions in its baseline**
  Once a SESAR-related development is tested and validated and in use for Indra's customers in Europe, it is included in AIRCON's product baseline – thus giving AIRCON users the benefits obtained from the development of bespoke systems.

INDRA'S ATM VISION

Indra's en-route systems worldwide



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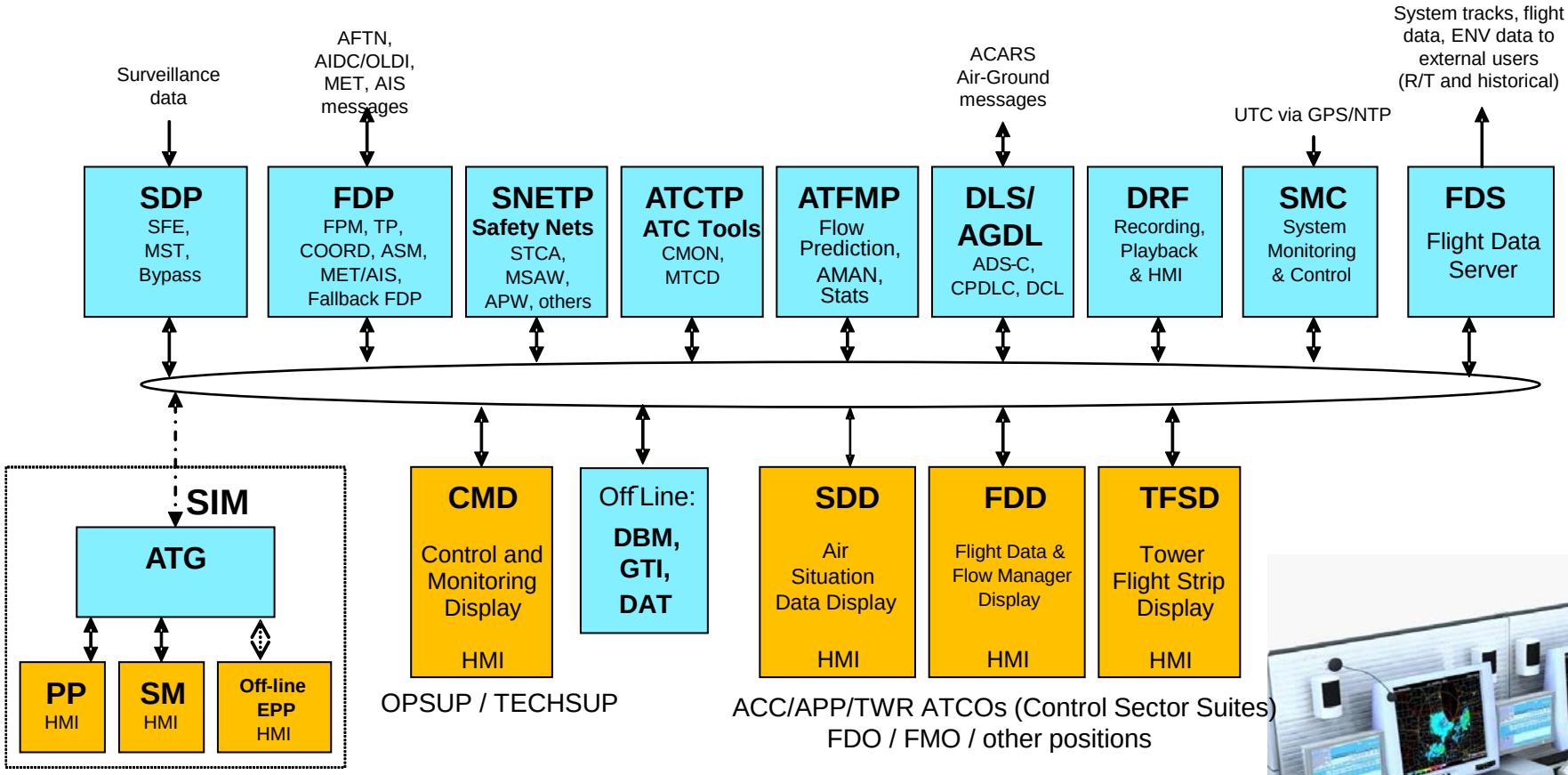
AIRCON 2100 INTERFACES

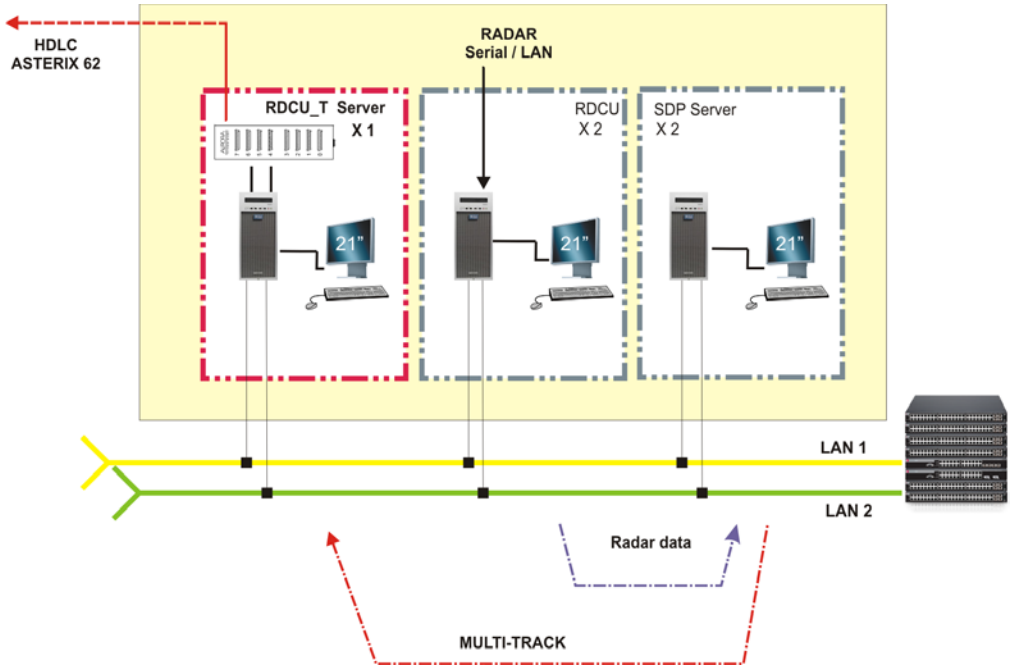
A TYPICAL ARCHITECTURE FOR AIRCON 20100



SURVEILLANCE DATA SHARING

- **Surveillance Data Sharing is performed from the RDCU_T unit of AIRCON 2100**

  Asterix CAT062 is used for track distribution to adjacent ATSUs. Internal users of system tracks are also receivers.



- **Indra strives to promote Surveillance Data sharing among neighboring ANSPs**

  In Europe and LATAM, Indra has been able to increase continent-wide situational awareness by sharing track information among neighboring countries. In Europe, this has paved the way for new developments.

COORDINATION AND DATALINK CAPABILITIES

- **AIRCON 2100 performs AIDC coordination in hundreds of ATSU interfaces worldwide**

  Indra has accrued a lot of experience in the establishment of AIDC interfaces (also of OLDI interfaces in Europe and the MID region).

Type:	Asynchronous serial or Ethernet IP port (Point-to-Point)
Protocol:	Async: Full Duplex, 7 bits, even parity and 1 stop bit, Ethernet: TCP/IP
Data Type:	AIDC messages (ABI, CPL, CDN, EST, PAC, MAC, CDN, ACP, REJ, TOC, AOC, LAM, FAN, FCN).
Message Format:	AIDC: ICAO format according to ICD of AIDC version 3.0 and lower versions.
Data Rate:	Async: 300bps~19.2Kbps, configurable Ethernet:10 Mbps minimum
Electrical Characteristics:	Async: RS-232c V24/V28 Ethernet : IEEE 802.3
Physical Connection:	Async: “D” Type 25 pin Ethernet: RJ-45

COORDINATION AND DATALINK CAPABILITIES

- **AIRCON 2100 is ADS-C/CPDLC-capable**
  AIRCON 2100's Data Link Server (DLS) allows to perform Air-Ground communication between the aircraft/pilot and the ATSU. It also uses ADS-C to optimise automation in mixed Continental-Oceanic airspaces.

Type	IP, Synchronous Serial
Protocol	TCP/IP, X.25
Data Type	AFN, CPDLC, ADS-C according to FANS 1/A RTCA DO-258A/EUROCAE ED-100A and DCL according to ED-85A.
Message Format	ARINC 622, ARINC 623-2, and Type B Application to Application Protocol (BATAP) specified in the MATIP Internet RFC 2351
Data Rate	LAN: 10/100Mbps
Electrical Characteristics	IEEE 802.3
Physical Connection	RJ45

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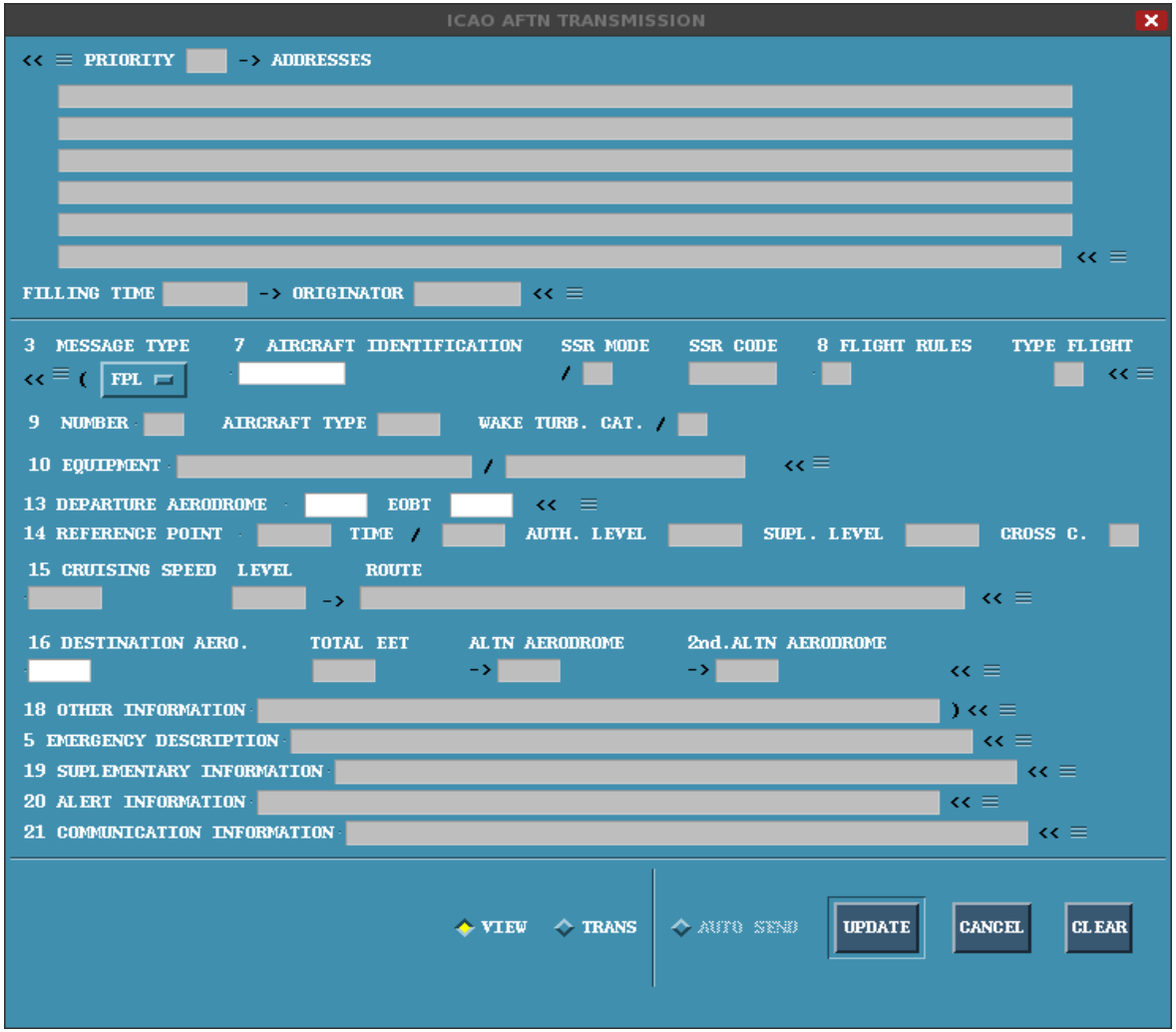
AFTN RECEPTION AND PROCESSING

- **AFTN Header Processing**
  - ✓ Low level processing of the AFTN protocol, ensuring the integrity of the received and transmitted information in the event of malfunctioning of the communication link (SVC messages).
- **AFTN/ADEXP Text Processing**
  - ✓ Automatic processing with fields extraction of messages FPL, CPL, CHG, DLA, CNL, ARR, EST, DEP, ACP, CDN, APR, RQP/RQS, SPL updating the Flight Plan Database
  - ✓ Erroneous messages queued to operator for correction
  - ✓ NOTAM messages (NOTAMN, NOTAMR, NOTAMC) queued to operator for confirmation
  - ✓ MET messages (METAR, SPECI, TAF, SIGMET, AIRMET, GAMET, SNOWTAM, ASHTAM) update the MET database
- **Other sources**
  - ✓ AIDC messages (also OLDI, TACT and other CFMU messages)

AFTN MESSAGE TRANSMISSION

- **Automatic**

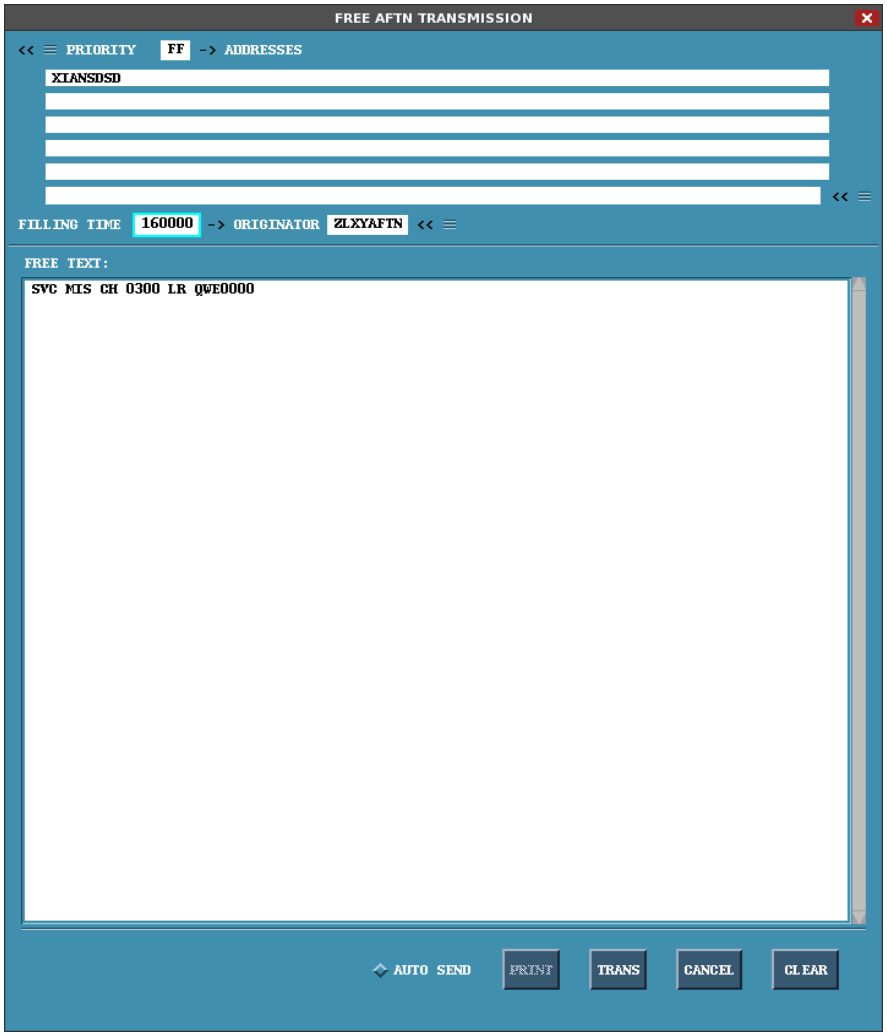
- ✓ DEP (for controlled departing flights)
- ✓ ARR (for controlled arriving flights)
- ✓ CNL, DLA, EST, CPL, etcetera



AFTN MESSAGE TRANSMISSION

- **Manual**

- ✓ Any type
- ✓ Also free text



COORDINATION

- **Four types of coordination**

  - ✓ **Manual** coordination by phone
  - ✓ ICAO **AFTN** EST messages
  - ✓ ICAO **AIDC** (ATS Interfacility Data Communications)
  - ✓ EUROCONTROL **OLDI** (On-Line Data Interchange)

COORDINATION

- **Benefits** of automating coordination

  - ✓ Avoid phone communications
  - ✓ Coordinate with more precise times and levels based of calculated trajectories
  - ✓ Dynamic interaction with collateral
  - ✓ Ability to set coordination rules through LoAs
  - ✓ Ability to customise different coordination arrangement with different neighbors

COORDINATION

- **Safety and efficiency** go up!

  - ✓ Coordination makes flying significantly safer for the aviation community by providing ATSUs with data in advance to manage incoming and outgoing flights and avoid conflict
  - ✓ Executive and Planning ATCOs do not need to lose time and attention to phone calls from/to collaterals
  - ✓ Strips (and strip printing) and FPLs are adjusted based on coordination data
  - ✓ Enhanced operations in high altitude airspace
  - ✓ Automatic correlation between FPLs and radar data and parameterised alerts based on received coordination messages

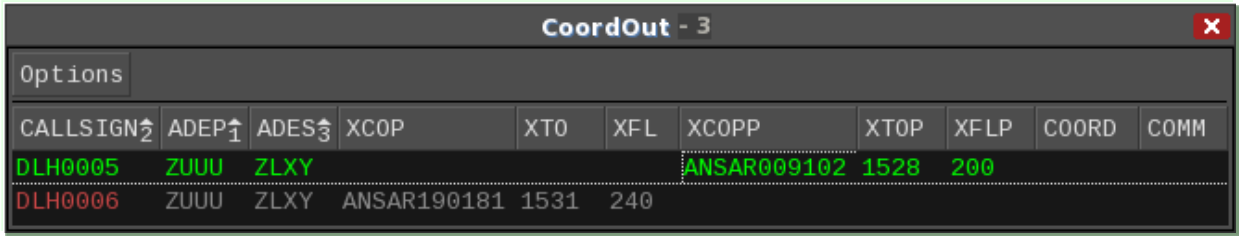
COORDINATION

- ✓ Automatic coordination processes are transparent to ATCOs.
- ✓ Both AFTN and AIDC/OLDI coordination with external centres are supported.
- ✓ **AIRCON 2100 fully supports AIDC 3.0** (and OLDI 4.2).

COORDINATION

- ✓ Automatic Windows for external entry/exit pending AIDC coordination dialogue

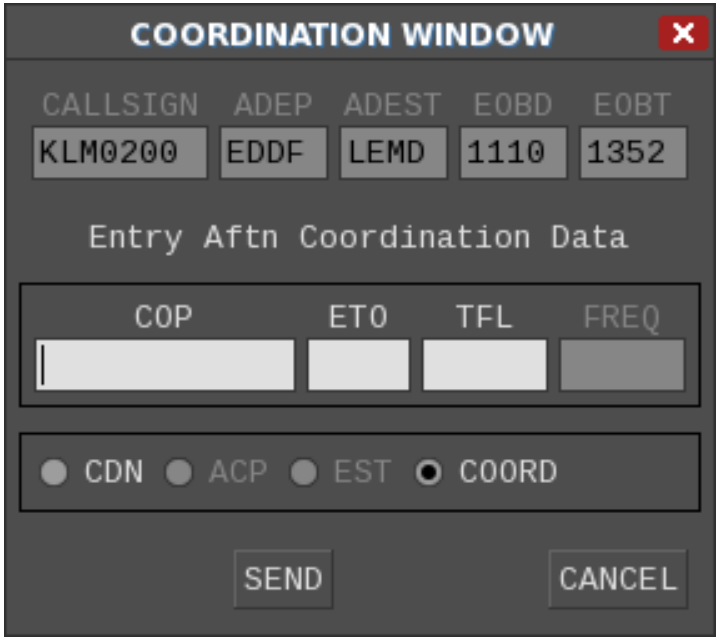
CoordIn window (example)

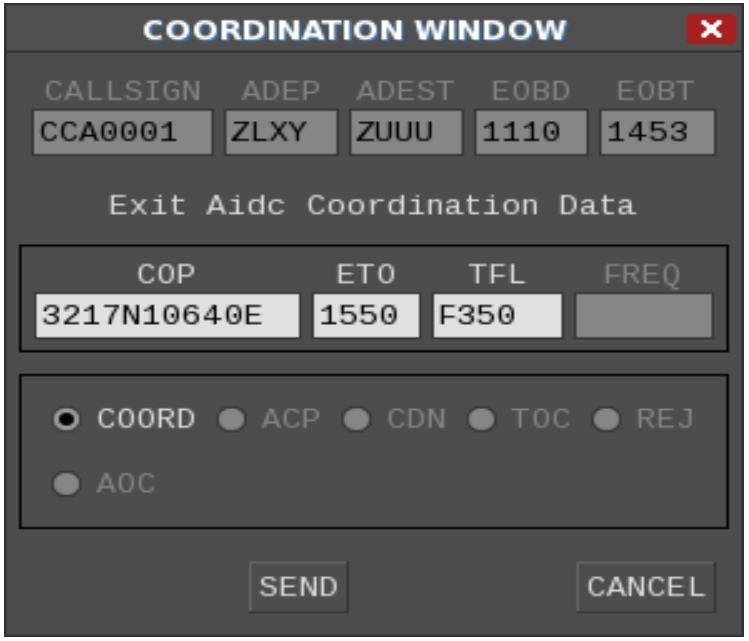


CoordOut window (example)

COORDINATION

- Windows for manual AIDC coordination processes accessible from flight plan lists





- AIDC interfaces are defined in the DBM (adaptation).

AIDC COORDINATION

✓AIRCON 2100 supports AIDC 3.0.

- **Notification Phase**
  - ✓ The control centre receives information about a future incoming flight to the FIR.
    - Advanced Boundary Information (ABI), revised ABI and Manual Abrogation of Coordination (MAC).

- **Coordination Phase**
  - ✓ Crossing conditions are agreed between upstream and downstream centres.
    - Coordination With Possible Dialogue: Current Flight Plan (CPL), Coordination (CDN) and Acceptance (ACP).
    - Brief Coordination: Estimation (EST) and Acceptance (ACP)
  - ✓ Coordination can be cancelled at any time with MAC message.

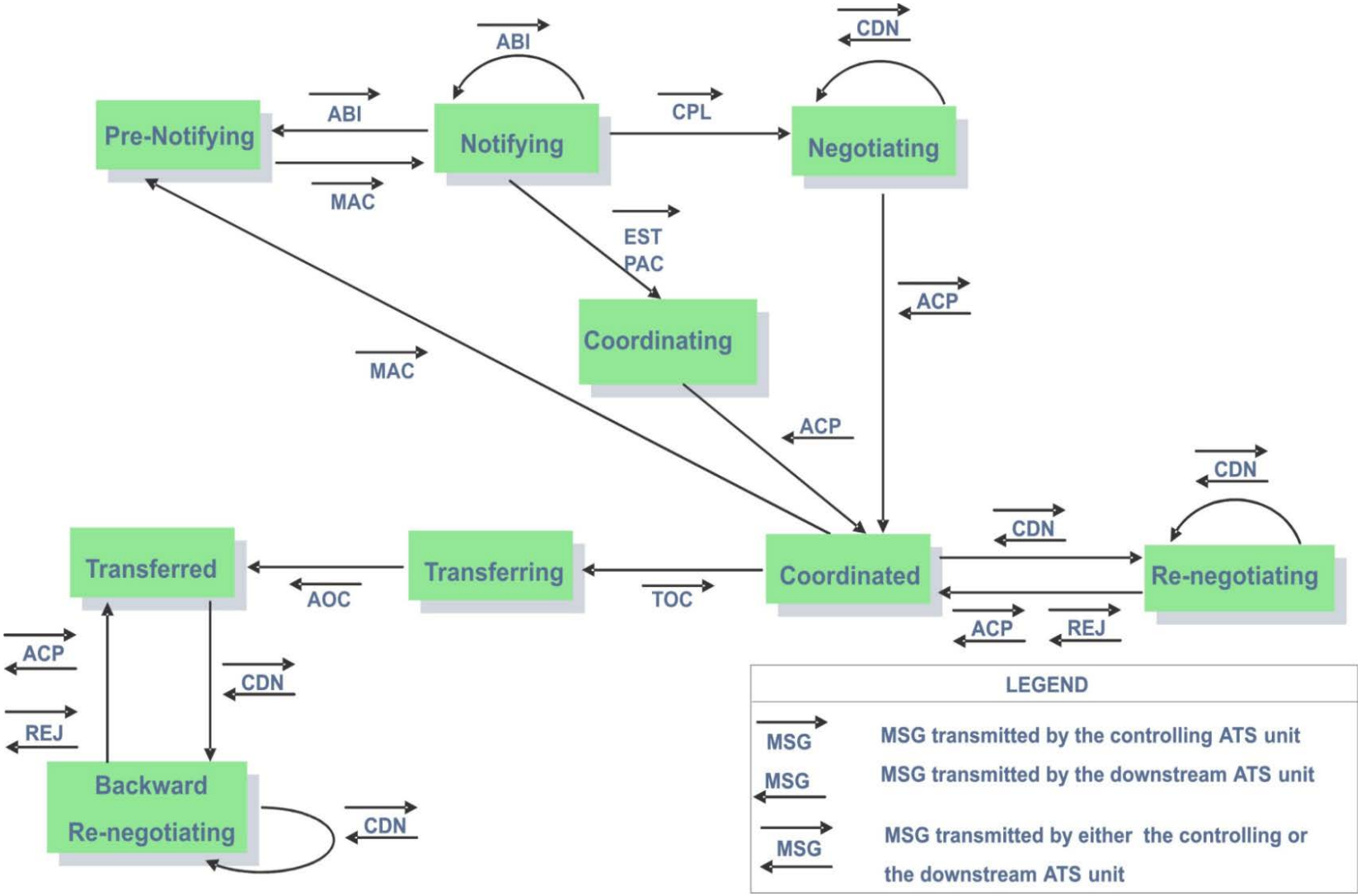
AIDC COORDINATION

✓ AIRCON 2100 supports AIDC 3.0.

- **Re-negotiation Phase**
  - ✓ After completing the initial coordination, there is still the option to re-open dialogue and propose new coordination conditions.
  - ✓ The dialogue can be initiated by either sector with a CDN message.
    - CDN, ACP or Rejection (REJ)

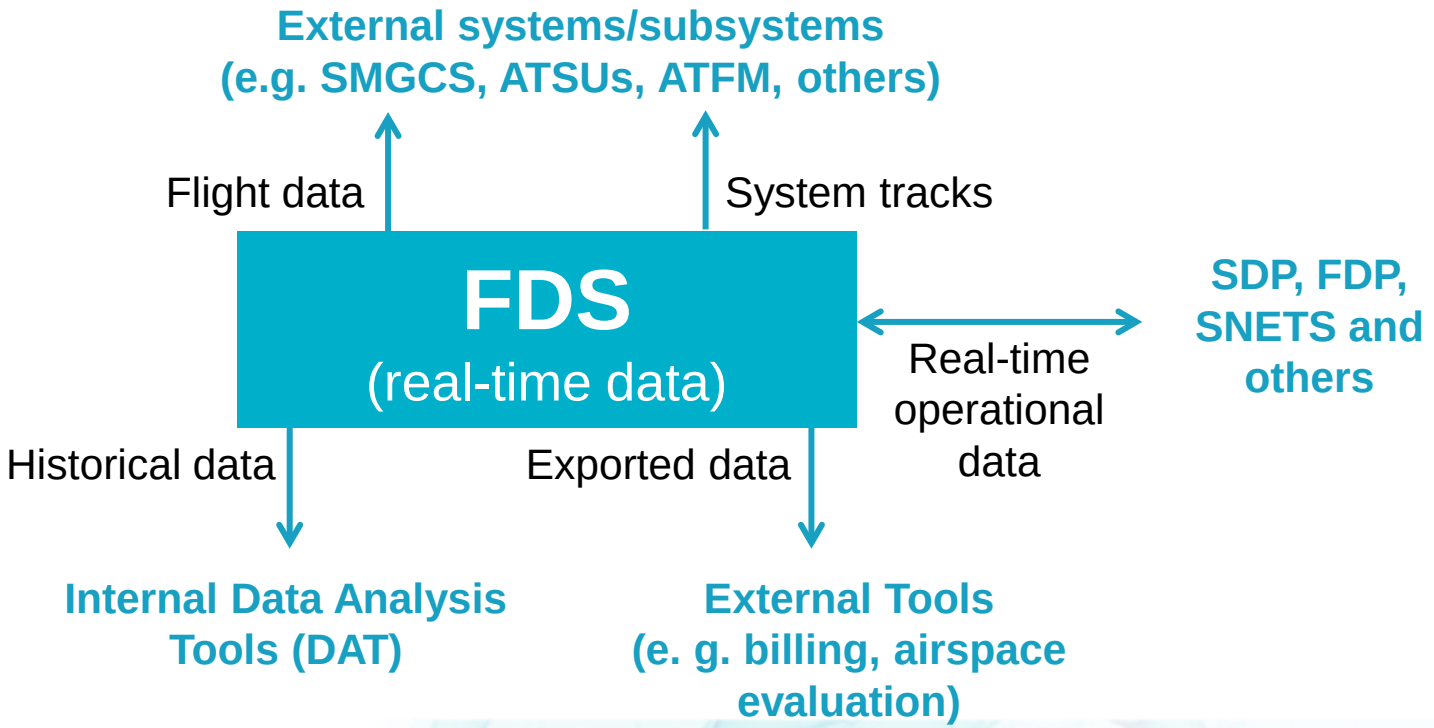
- **Transfer Phase**
  - ✓ Transfer is initiated by the upstream center by sending a Transfer of Control (TOC) message
  - ✓ Transfer is finished by the downstream center by sending back an Assumption Of Control (AOC) message.

AIDC COORDINATION



FLIGHT DATA SERVICE (FDS)

- The Flight Data Service stores, collects and sends system real-time data (flight data, system tracks, ENV data) to external subsystems (e.g. SMGCS, other ATSUs, etcetera) and external tools (e.g. billing systems, airport FIDS) as well as historical data to be used by internal data analysis tools (e.g. traffic statistics, data test and verifying tools, event logs).



EXPERIENCE IN THE DEPLOYMENT OF AIDC INTERFACES

- ✓ Regional agreement among ANSPs on a common understanding of AIDC (and coordination in general) procedures (set of AIDC messages to be used, standardisation of LoAs) is of the essence for a good establishment of these interfaces.
- ✓ Upgrade to AIDC 3.0 for those ATSUs not supporting this version is urgent in those areas expecting high traffic growth.
- ✓ Manual coordination (by telephone) and through AFTN EST messages is still prevalent in many places in the world and there is usually strong resistance to change (specially because one party can ‘blame’ the other) even though benefits are apparent.

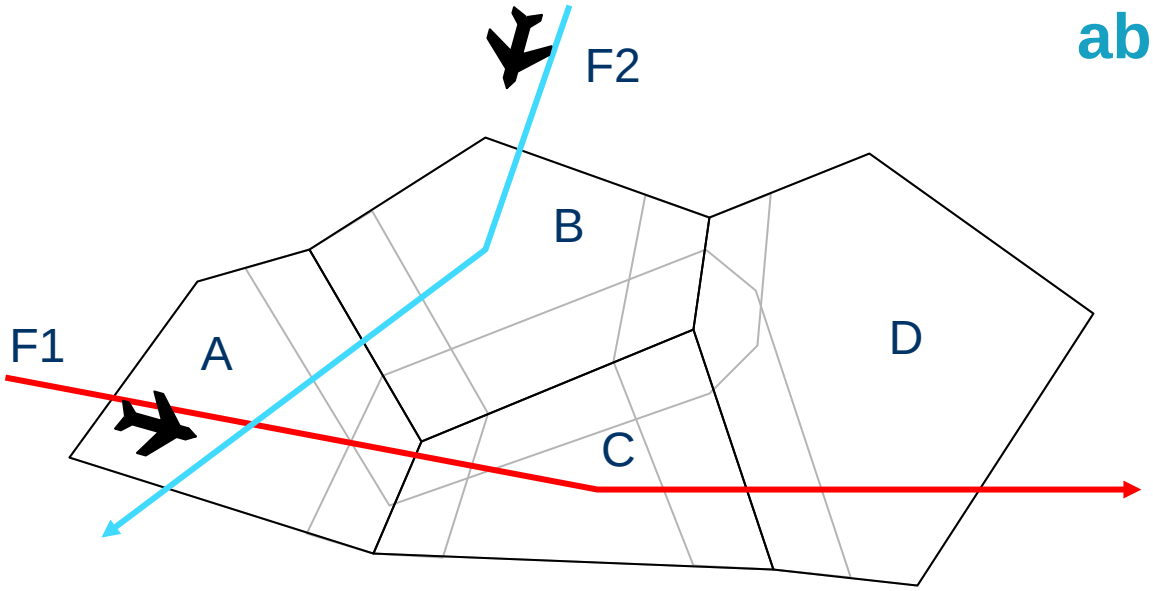
INDRA'S NEXT STEPS IN COORDINATION WITHIN SESAR

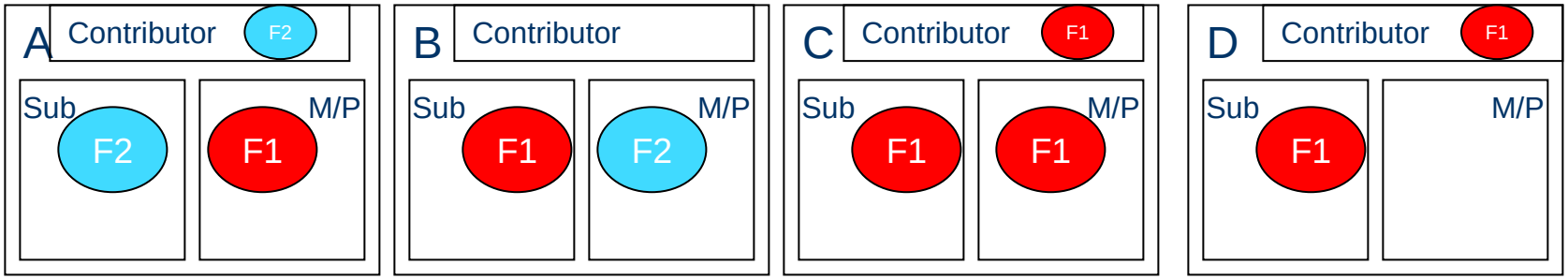
- **Coordination in the future will take place through the exchange of Flight Objects (FO)**
  Indra leads SESAR Project 10.2.5, in charge of Flight Object (FO) IOP System Requirement Validation.

- **Flight Objects (FO) aim to make heterogeneous ATSUs to work together to achieve a common and agreed view of a flight**
  By that we mean:
  - ✓ Data will be shared and the seamless calculation of trajectories shall be accomplished.
  - ✓ There will a collaborative approach to build FO data

INDRA'S NEXT STEPS IN COORDINATION WITHIN SESAR

More about this later!





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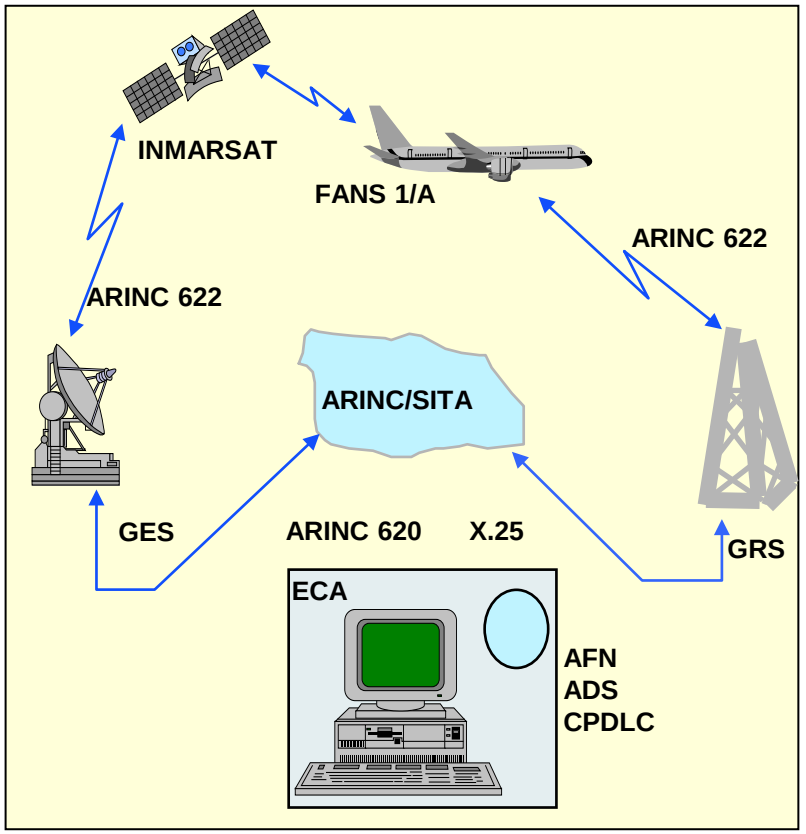
AIR-GROUND DATA LINK SERVER (DLS / AGDL)

- DLS / AGDL interfaces to the air segment for Air Ground Data Link (AGDL) services (CM/AFN, ACM, ACL, AMC and others) based on ADS-C, CPDLC and DCL applications for FANS 1/A equipped aircraft.
- DLS / AGDL organizes the data link message exchange between AIRCON subsystems and the network (SITA/ARINC).
- AGDLS determines the assignment of messages to the appropriate CWP, the SDP, and/or the FDP.



AIR-GROUND DATA LINK SERVER (DLS / AGDL)

- DLS / AGDL functions in AIRCON 2100:

✓ **Context Management (CM) / ATS Facilities Notification (AFN) Manager** provides addressing capability for DL applications between aircraft and ground, helping to establish a logon between ground-based ATS and aircraft systems and peer ground-based ATS systems. The status of aircraft logged-on or logged-off is conveniently displayed to the ATCO.

✓ **Automatic Dependant Surveillance – Contracts (ADS-C) Manager** obtains the position and other information from suitably equipped aircraft, in a timely manner, and in accordance with the established contract between the ATCO and the aircraft. The ADS-C Manager is responsible for initiating, maintaining, modifying and cancelling contracts of all types (periodic, on demand, events and emergency). The periodic position report is used by surveillance data processing for aircraft tracking in non-radar coverage areas.

AIR-GROUND DATA LINK SERVER (DLS / AGDL)

- DLS / AGDL functions in AIRCON 2100:

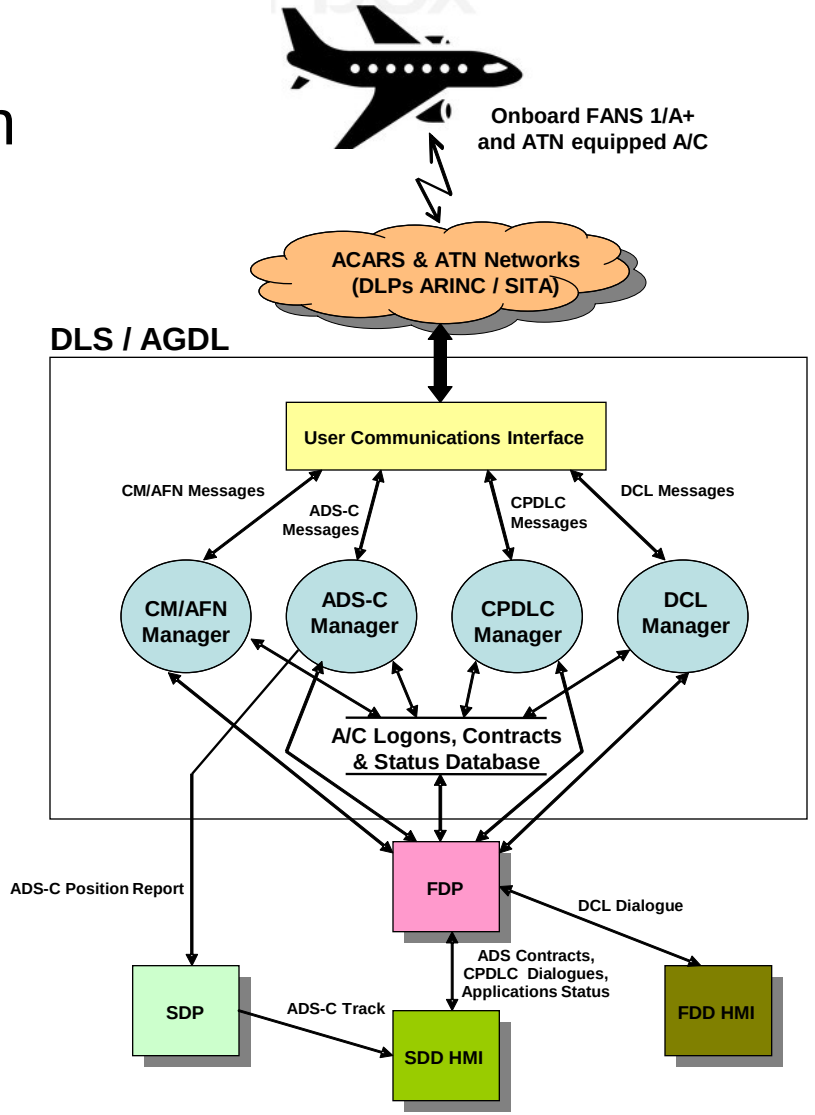
✓ **Controller-Pilot Data Link Communication (CPDLC) Manager** supports the exchange of data messages between ATCOs and pilots. The CPDLC application provides the capability to establish, manage and terminate dialogues initiated by the pilot or by the controller.

✓ **Departure Clearance (DCL) Manager** provides automated assistance for requesting and delivering departure clearances through the data message exchange for communication between TWR personnel and pilots.

✓ **FANS/ATN Communication Interface** contains the ground-end system communications interface for the ACARS network (used by FANS 1/A equipped aircraft) and, if necessary, for the ATN network (used by ATN equipped aircraft).

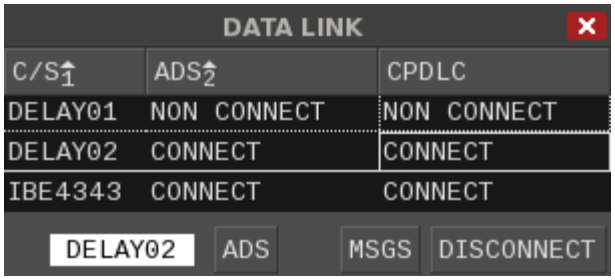
AIR-GROUND DATA LINK SERVER (DLS / AGDL)

- DLS / AGDL functions in AIRCON 2100:

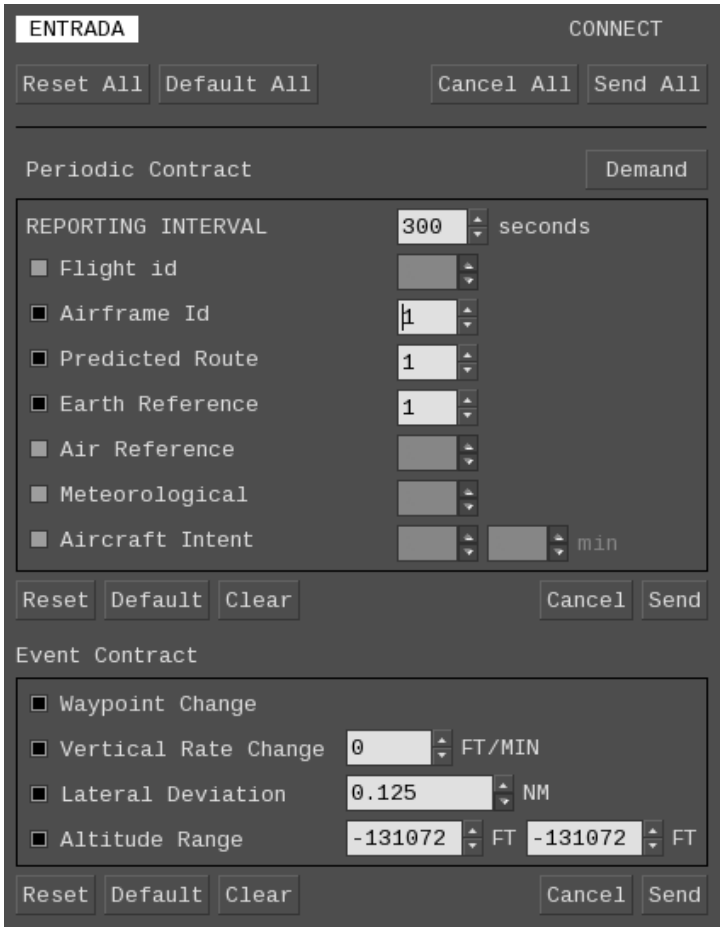


ADS (PERIODIC / DEMAND / EVENT) CONTRACTS

- The ADS Contract window is displayed when clicking on the indicator “ADS Capacity/ADS Connection Established” displayed on the label of the ADS track or on the FPL list.
- It is used for creation, modification or cancellation of ADS contracts (for all contracts or individually selected contract).



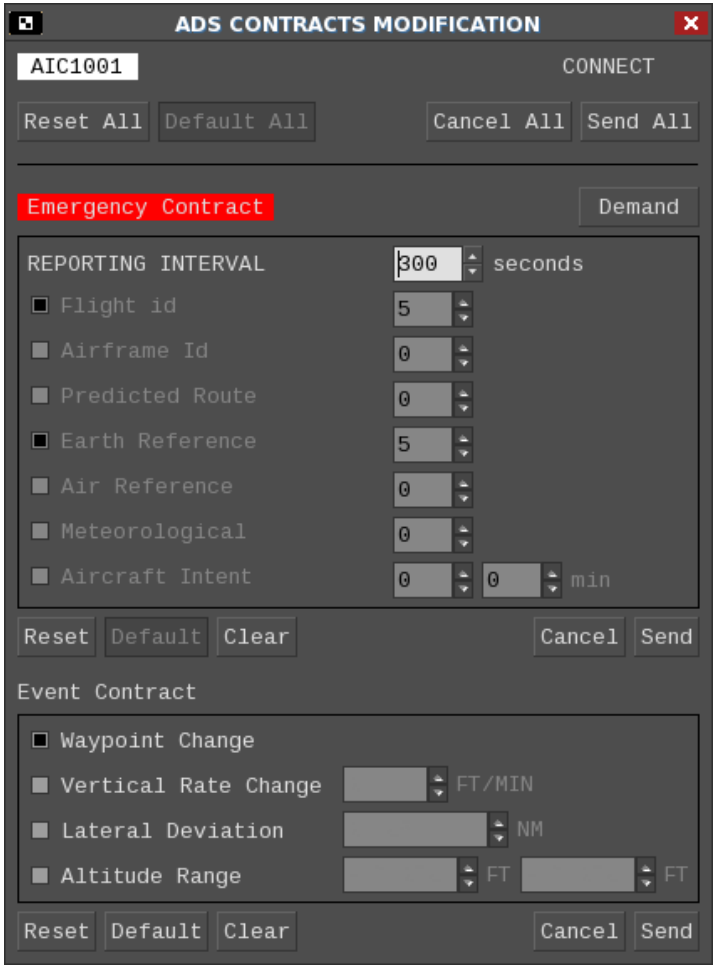
Data Link window



Periodic Contract window

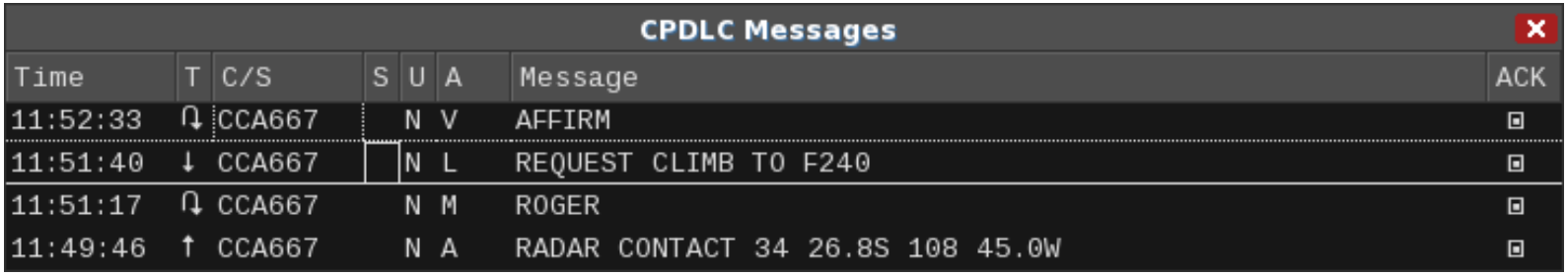
ADS (PERIODIC / DEMAND / EVENT) CONTRACTS

- “Establishment and Operation of Emergency Mode” will allow the avionics to initiate emergency mode, either on instruction from the pilot or automatically.
- Emergency mode will be entered when periodic or event contracts are established with the aircraft.
- The system presents emergency information to the controller as long as the emergency mode remains active.



Emergency Contract window

CPDLC MESSAGES WINDOW



CPDLC Messages window

- This window contains the last received and sent CPDLC messages from/to aircraft controlled by the CWP. It shows the following information:
  - Time of the Message.
  - Message Direction (Uplink / Downlink).
  - Callsing.
  - Attributes: message status, message urgency, alert status.
  - Message contents.
  - Message acknowledge field.
- Messages are displayed in the sequence of the dialogue, sorted by time.
- On clicking with the mouse on the received messages which require a reply, the Edition & Transmission Message Window is automatically opened.

EDITION AND TRANSMISSION OF CPDLC MESSAGES WINDOW

- **Preformatted Messages**

✓ This section is used to select and send the most common CPDLC Messages used.

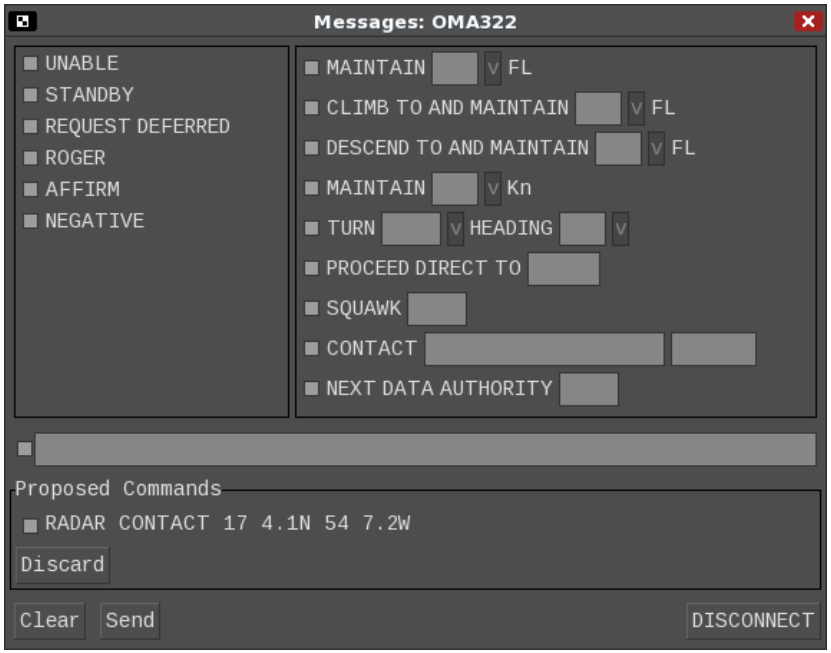
✓ The type of available messages are configured. The value of the variable fields of the messages are selected in the menus opened when the field is selected.

- **Free Text Messages**

✓ This section is used to edit and send free text messages to aircraft without FANS-1 (Aircraft without ADS and/or CPDLC properties) but with ACARS property.

- **Proposed Messages**

✓ This one includes CPDLC messages automatically proposed by the system on significant events



Edition & Transmission of CPDLC Messages window

ADS INFORMATION DISPLAY

- **ADS-C information on the track label**

✓ ADS-C capability/ ADS-C connection established indicators.

✓ CPDLC capability/ CPDLC connection established indicators.

✓ Navigation Integrity Control (NIC) Indicator.

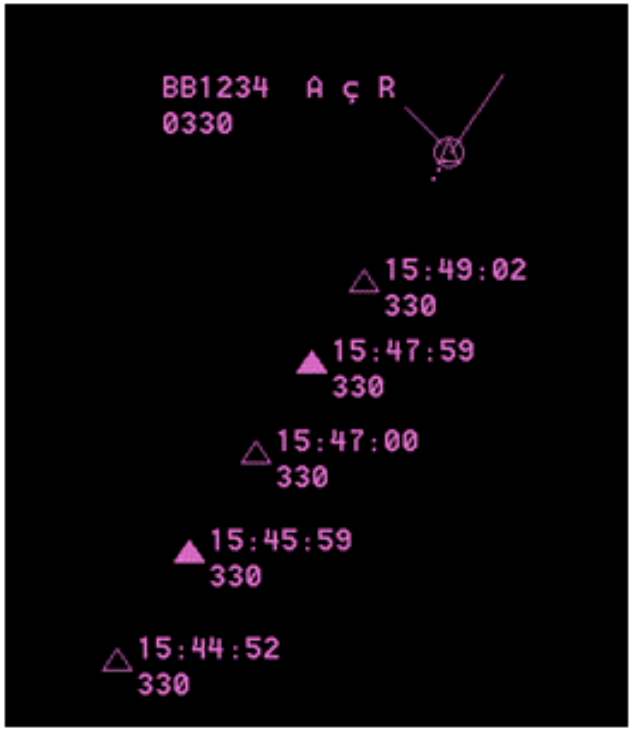
✓ ADS Emergency mode indicator.

✓ Predicted Route (next two waypoints) from ADS, available.

✓ Message used protocol (ACARS)

✓ ADS event indicator: whenever any of the requested events of the ADS contract are fulfilled, this is indicated until acknowledged by the operator:

- Altitude Range (AR);
- Vertical Rate (VR);
- Lateral Deviation (LD);
- Waypoint Change (WP).



Display of ADS-C information

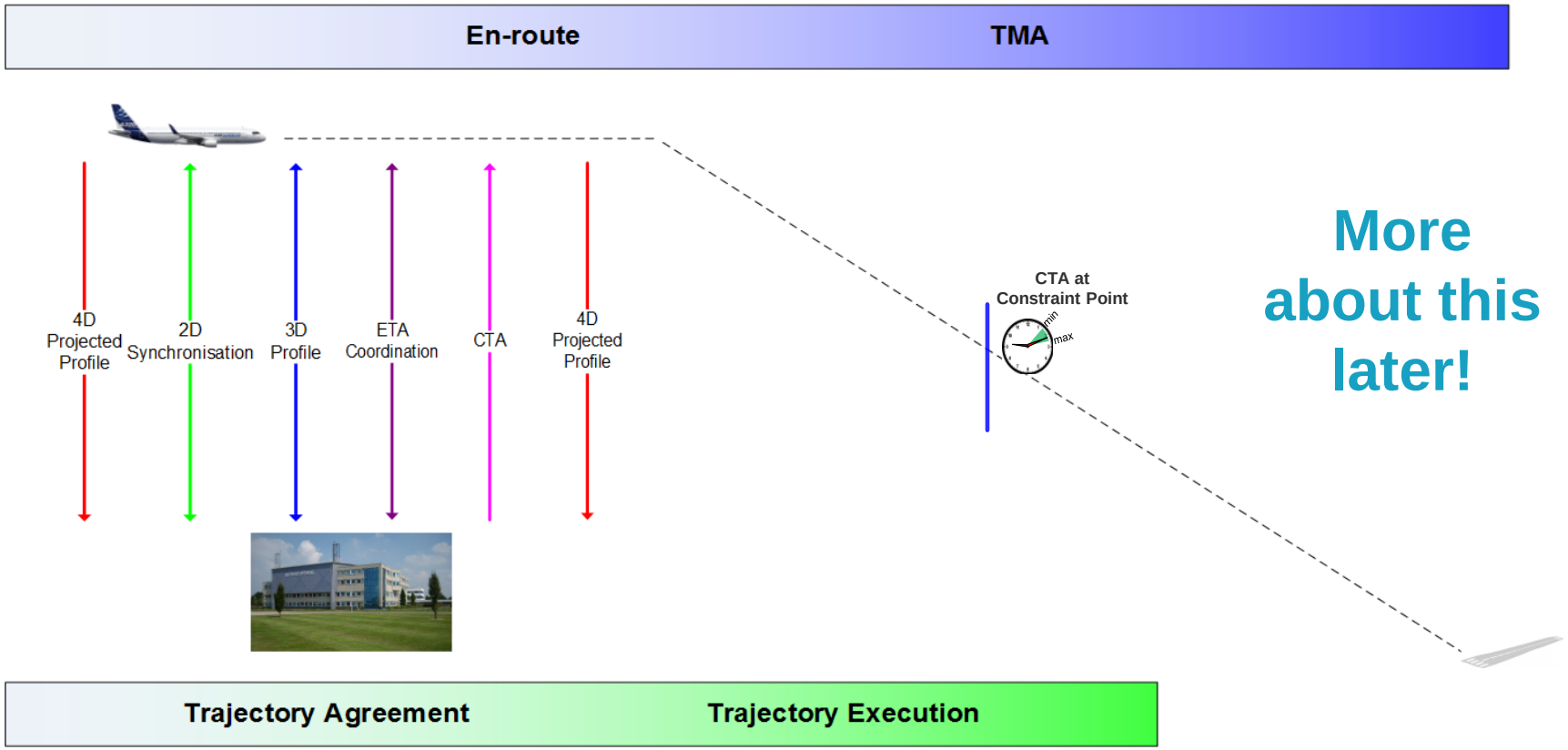
- ADS Basic (without speed information)
- ADS Extended (with speed information)
- CPDLC Basic (without speed information)
- CPDLC Extended (with speed information)

INDRA'S ACTIVITIES IN THE ADS/CPDLC-SUPPORTED I4D CONCEPT WITHIN SESAR

- **Indra has conducted flight trials through MUAC airspace to test new aspects of the i4D (4D-TRAD) concept**

  MUAC i4D validations from 2011 up to now (last flight trial took place in mid March) have led to very useful insights about the use of the Extended Projected Profile (EPP) data and the safety gains possible, the use of the Flight Object (FO) for Flow Management in the downstream and the calculation of discrepancies between the airborne trajectory according to the FMS and the ground-based FPL.

INDRA'S ACTIVITIES IN THE ADS/CPDLC-SUPPORTED I4D CONCEPT WITHIN SESAR



More about this later!

Thank you!

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