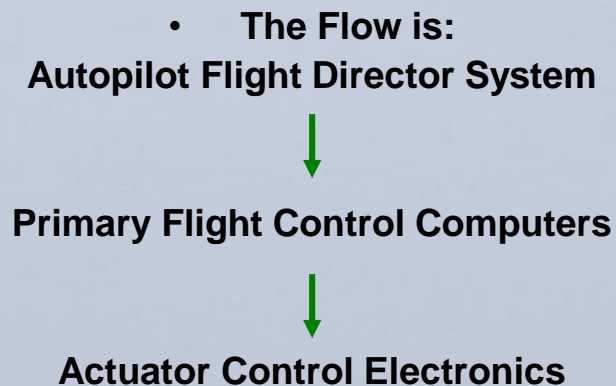


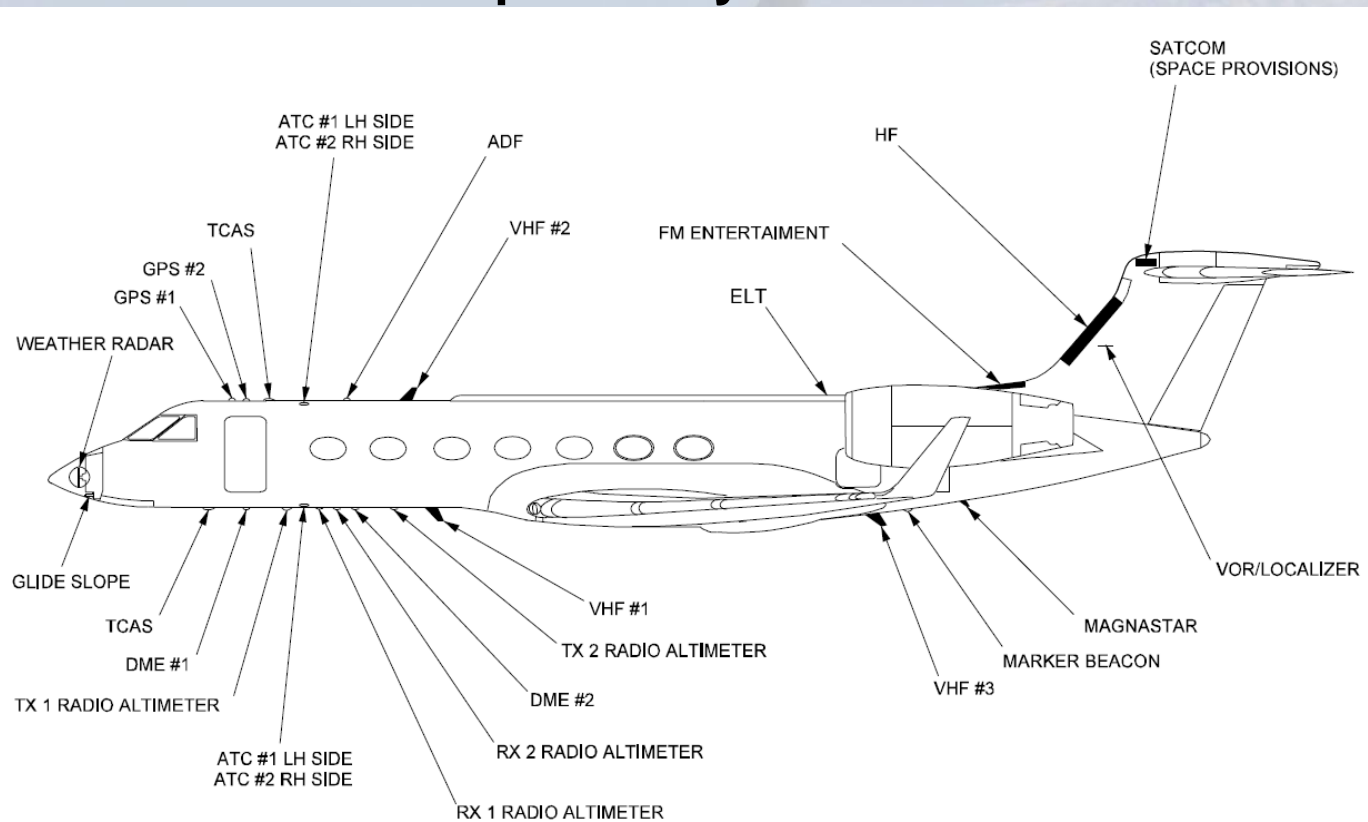
Automatic Flight Control System

- **Flight Director – Flight envelope protection**
- **Autopilot – Coupled with FMS**
- **Thrust Director**
- **Auto-Throttle**
 - Provides functions necessary for automatic control.
 - The system consists of:
 - Mode Control Panel (MCP)
 - THREE Autopilot Flight Director Computers (AFDCs)
 - Flight Director
 - Back drive Control Actuators (BACs) ... etc.
 - AFDS does not have direct control of Primary flight Control Surfaces.



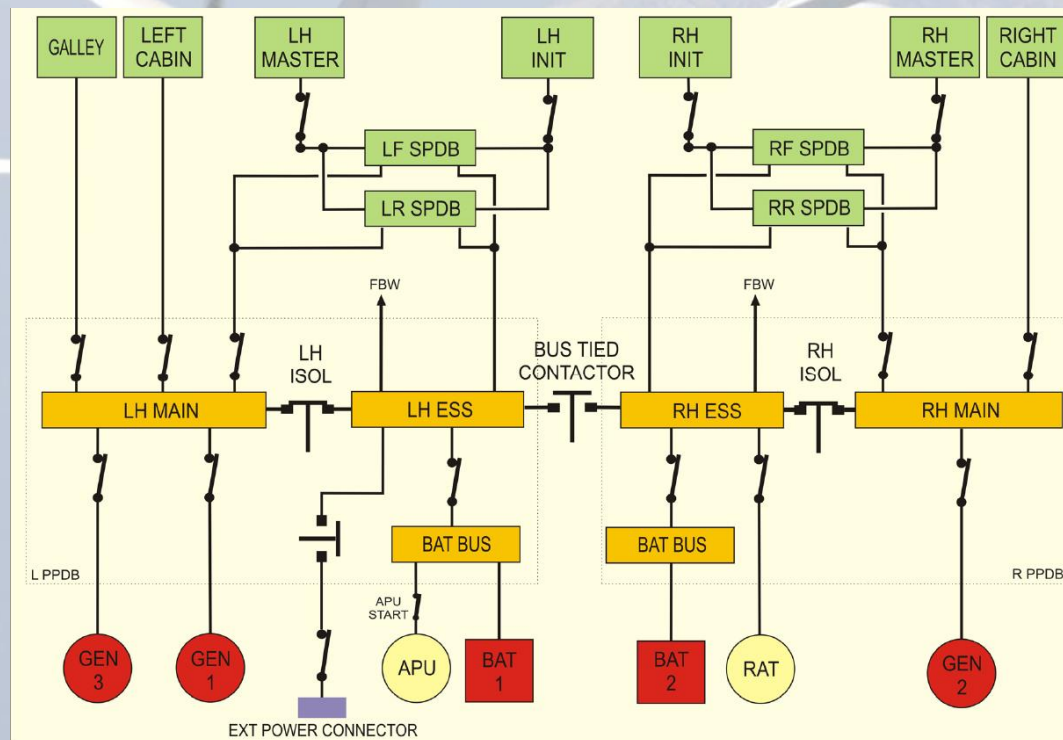
Communication System

- **The communication system includes:**
 - VHF and HF systems, as well as the public address system and SELCAL
 - CMF / AFIS optional system, including weather uplink,
 - SATCOM optional system.



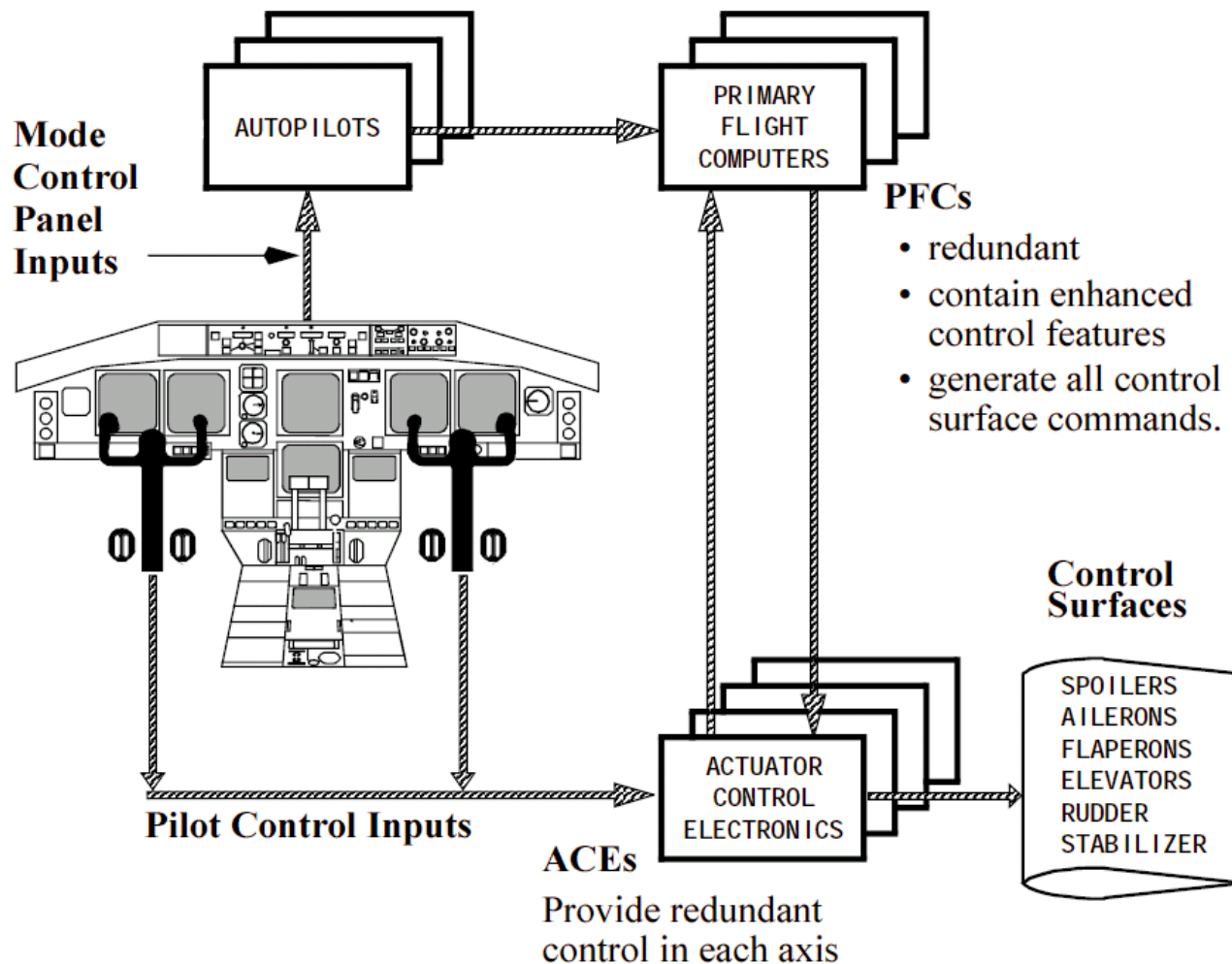
Electrical Power

- The Falcon 7X uses 28 Volts DC power for operation of the various systems installed in the airplane.
- The electrical system is supplied by:
 - Three engine-driven generators,
 - Two Batteries,
 - A RAT in some emergency cases.
- The Primary Flight Control System and Engine Electronic Controller are also powered by dedicated Permanent Magnet Alternators.



- **Electric signal command hydraulic actuation**

Pilot or autopilot control inputs command the PFCs to generate control surface commands.



PFCS (Falcon 7X)

The Primary Flight Control System (PFCS) architecture is based on six main functionalities:

- Data collection:

- From sensors (IRS, AHRS, RA, ADS,...),
- From pilots controls,
- From the Flight Director if the AutoPilot is engaged,

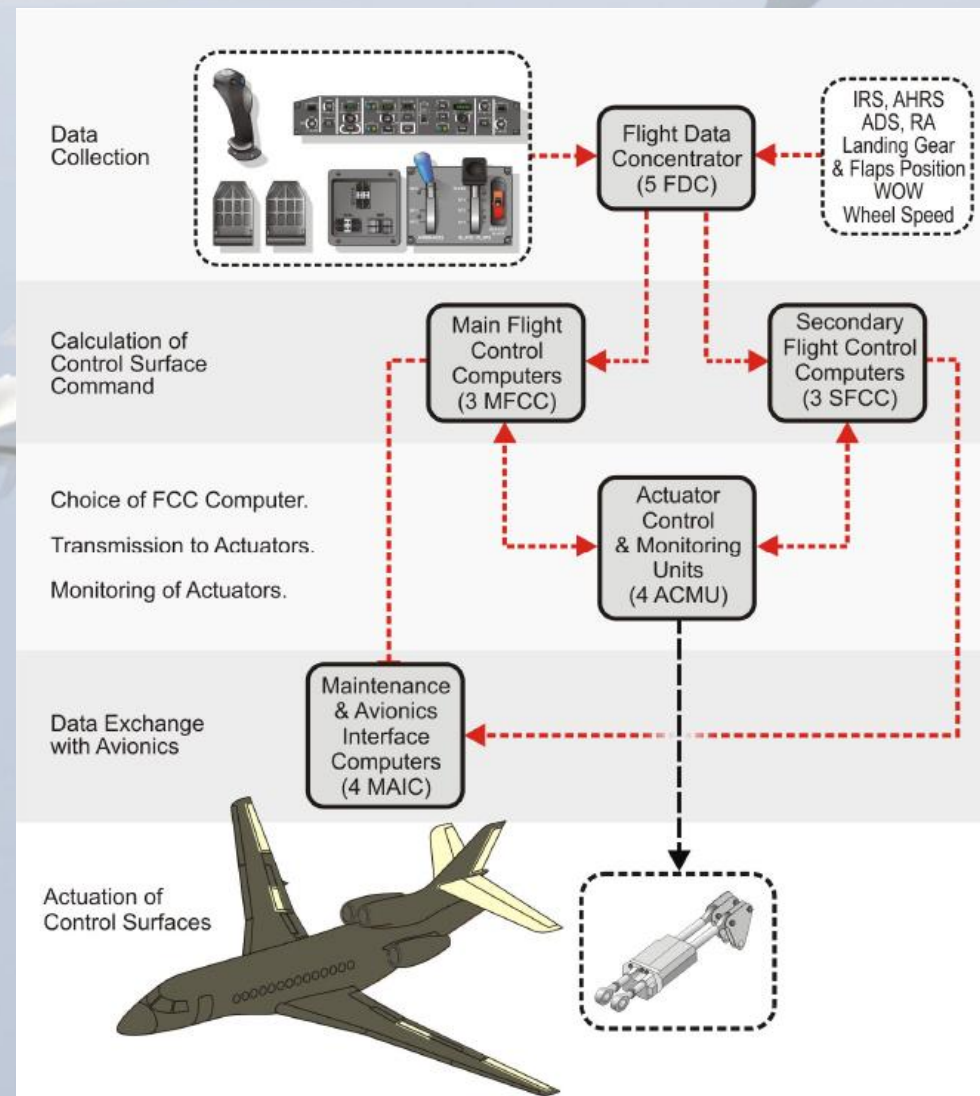
- Calculation of control surfaces commands by the main and secondary Flight Control Computers,

- Selection of Flight Control Computer for control surface commands and transmission of commands to actuators,

- Actuation of flight control surfaces by the actuators,

- Monitoring of actuators,

- Data exchanges with avionics.

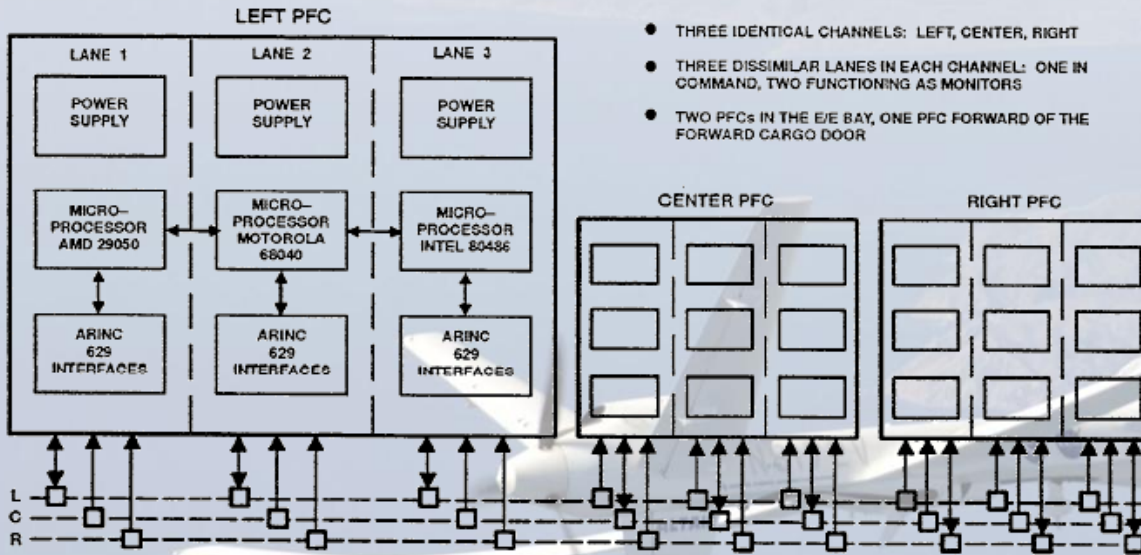


777 FBW PFC

Each PFC receives data from all 3 databuses, but transmit only on 1 databus.

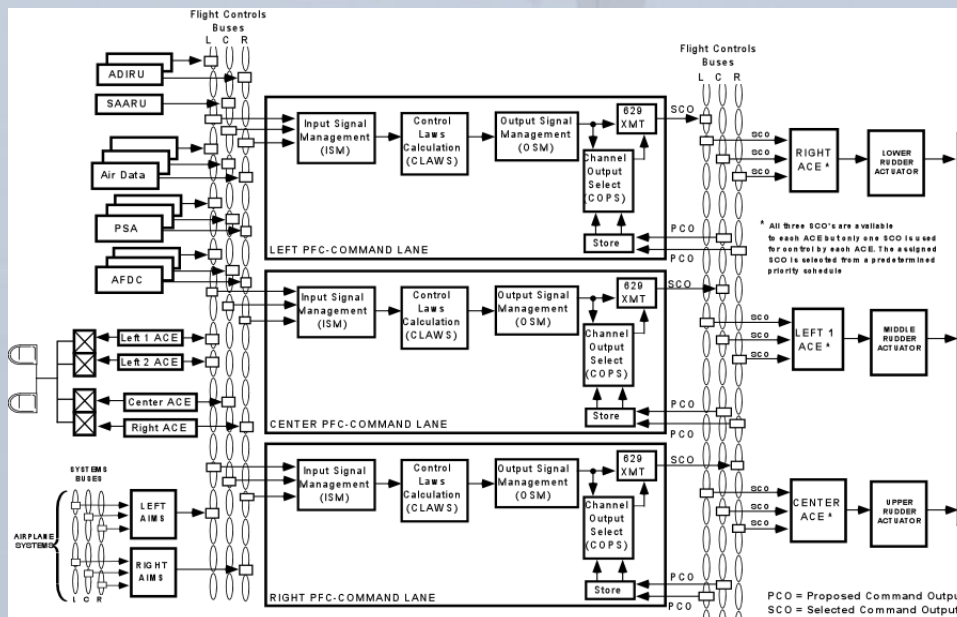
This is meant to prevent a failed lane from contaminating good lane with erroneous data, or worst, prevent masquerading error.

Each PFC is made up of 3 internal lanes



- THREE IDENTICAL CHANNELS: LEFT, CENTER, RIGHT
- THREE DISSIMILAR LANES IN EACH CHANNEL: ONE IN COMMAND, TWO FUNCTIONING AS MONITORS
- TWO PFCs IN THE E/E BAY, ONE PFC FORWARD OF THE FORWARD CARGO DOOR

Flight Controls ARINC 629 Data Buses



Software “Size”

Function (or “partition”)	Commercial FBW	Military FBW
Control Laws	25 – 30%	40%
Redundancy Management	60-70%	50%
Continuous BIT (not pre-flight)	10%	10%

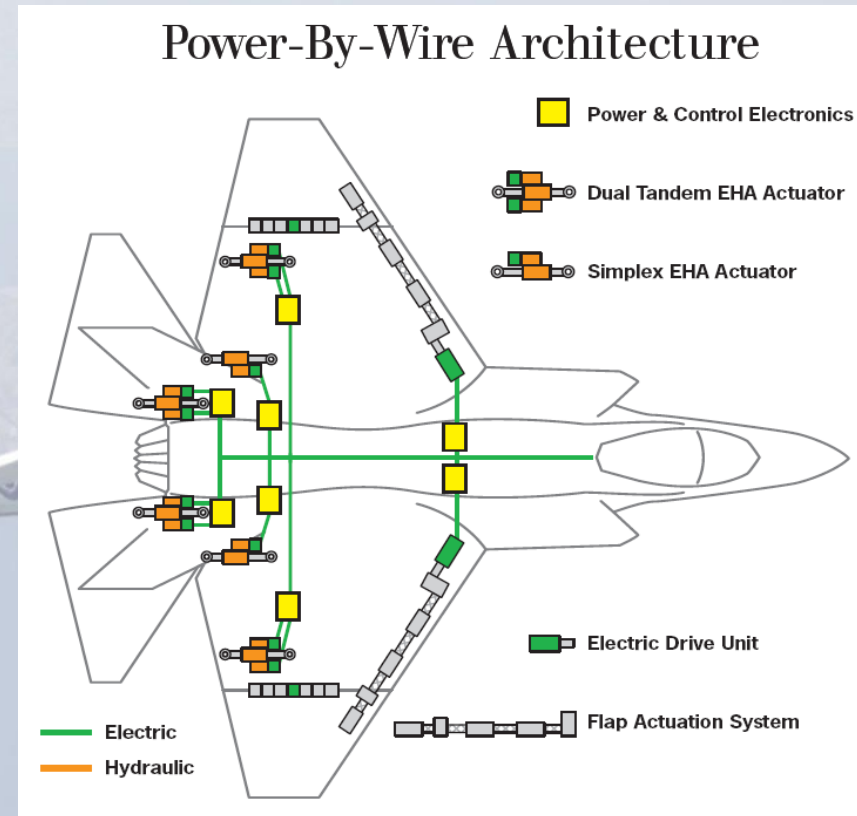
**Redundancy Management is more complex
(and challenging to design) than the control laws !**

Hydraulic System

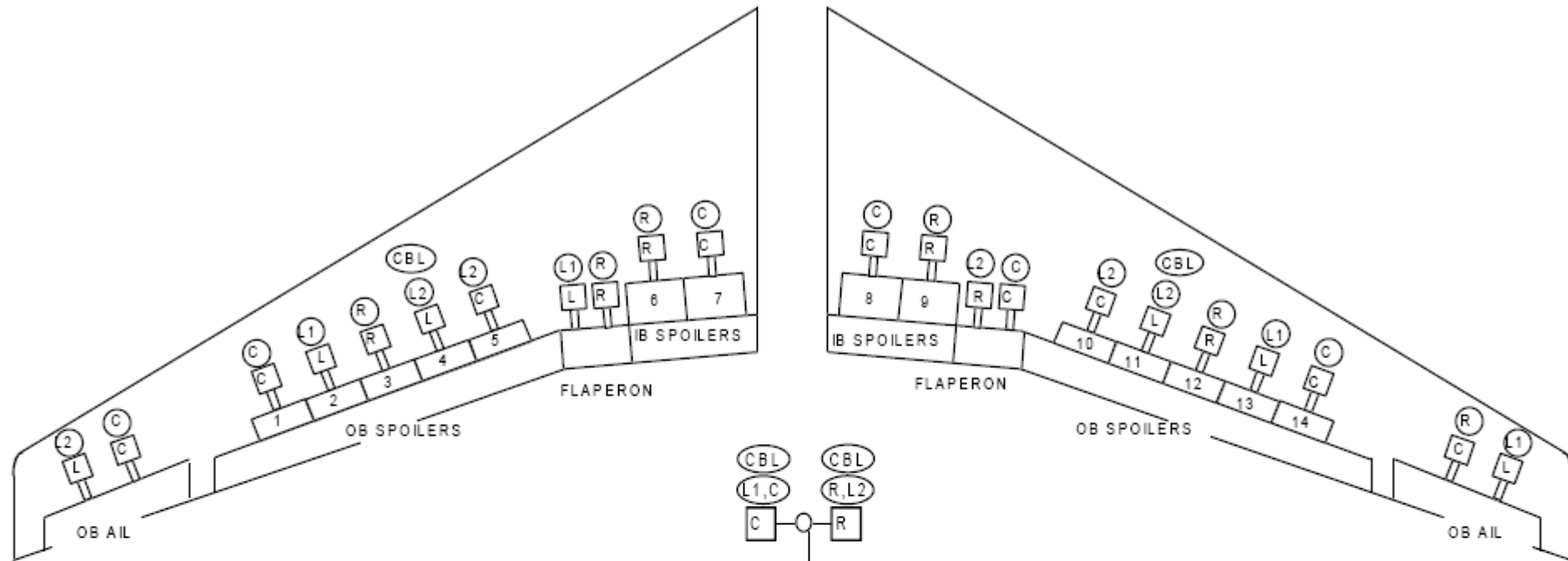
Hydraulic power system provides pressure for actuation:

- Primary Flight Controls System (PFCS: ailerons, elevators, rudder and spoilers),
- Secondary Flight Controls System (SFCS: slats, flaps and airbrakes),
- landing gear, brakes and nose wheel steering,
- Thrust reverser of engines.

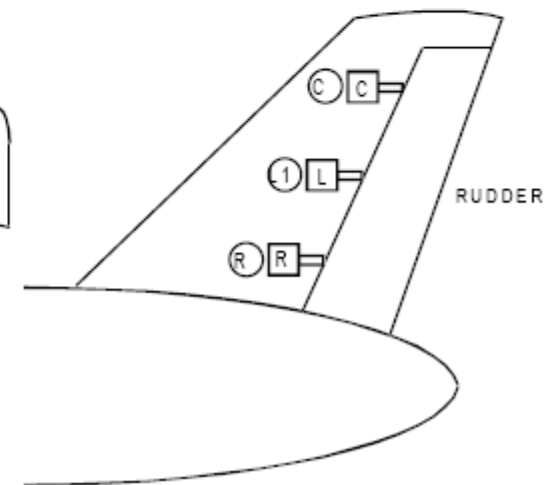
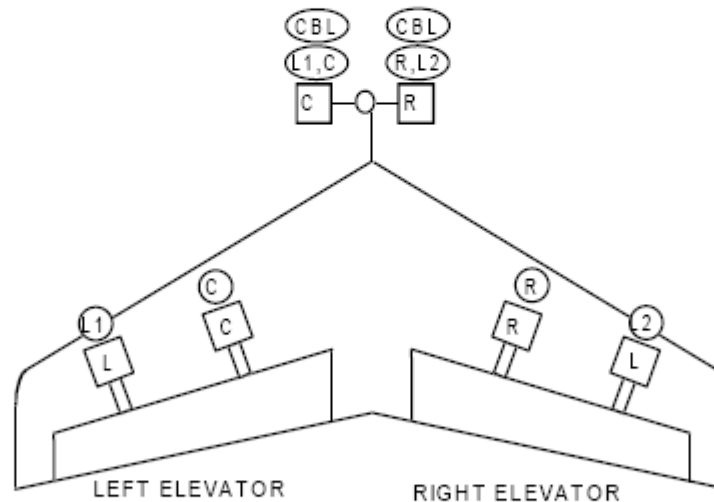
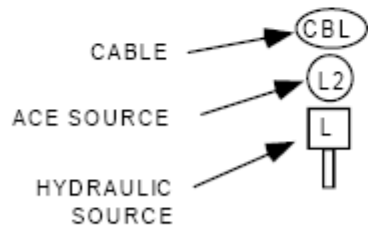
In More Electric Architectures central Hydraulics is getting replaced by Electro-Hydraulic actuators



Electric signal command hydraulic actuation

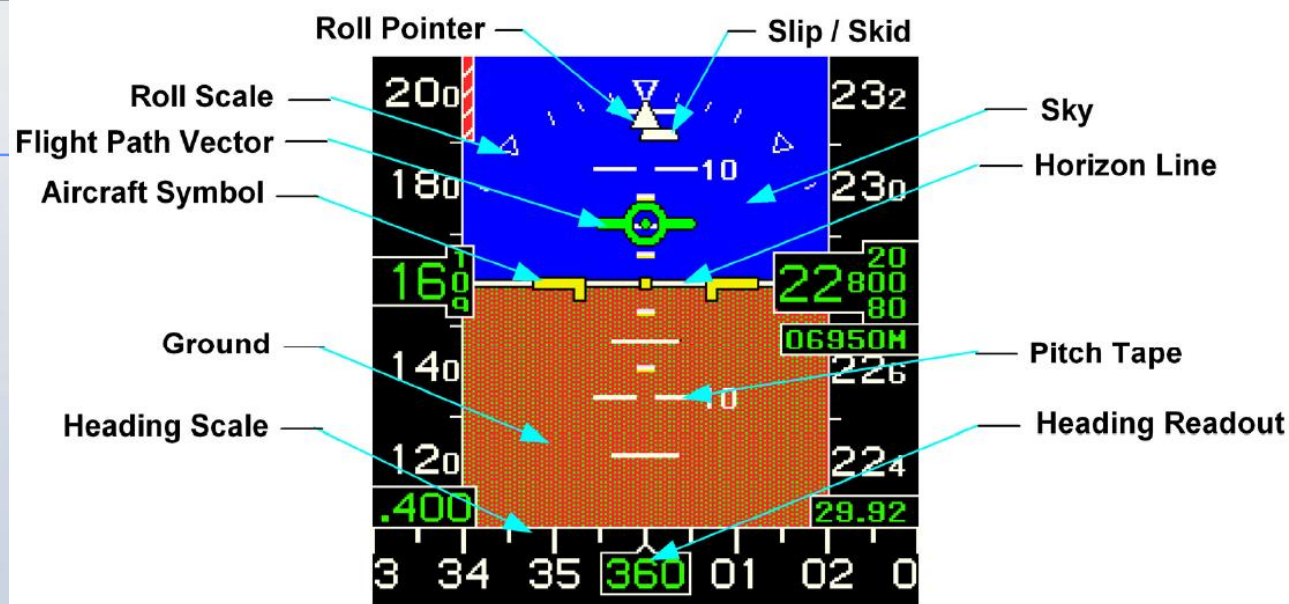


L1, L2, C, R DENOTES ACE SOURCE



NOTE: SPOILERS 4 AND 11 ARE COMMANDED VIA CABLES FROM THE CONTROL WHEEL AND VIA THE ACES FROM THE SPEED BRAKE LEVER. THE STABILIZER IS COMMANDED VIA THE CABLES THROUGH THE AISLE STAND LEVERS ONLY AND OTHERWISE IS COMMANDED THROUGH THE ACES.

Navigációs rendszer

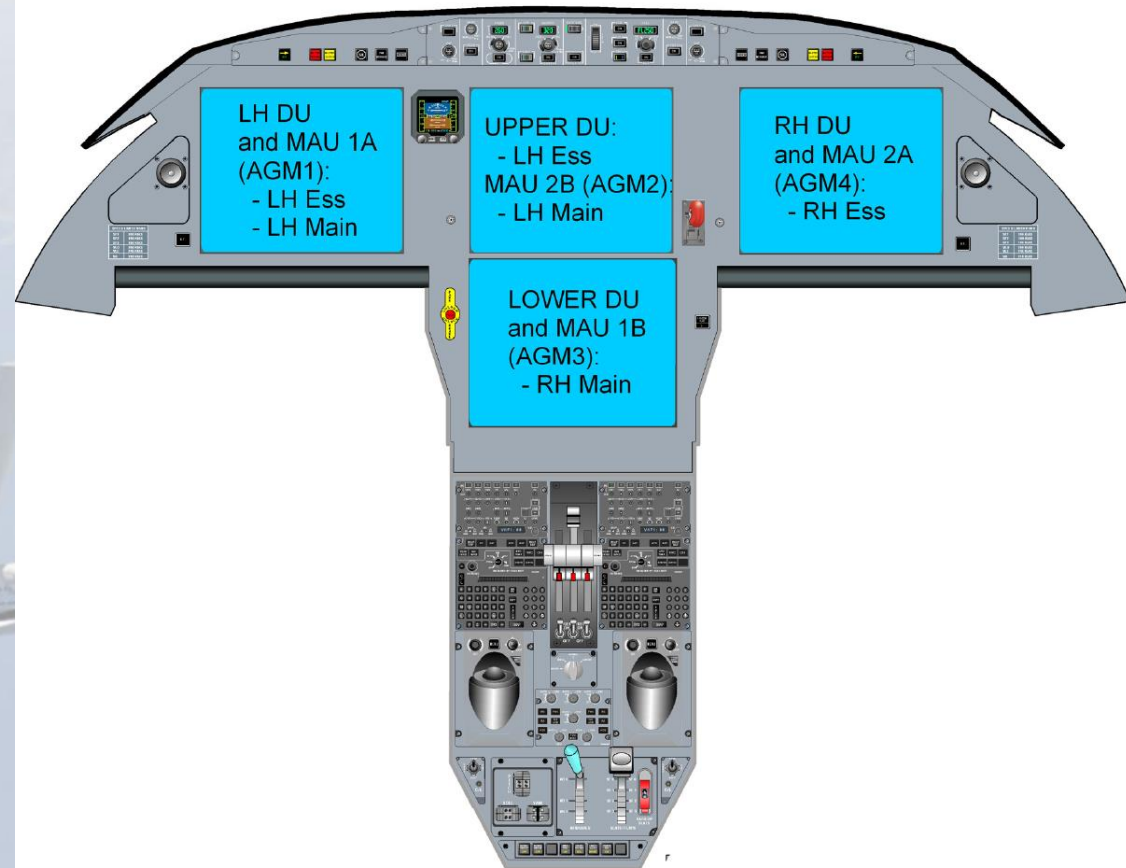


- **FMS: Flight Management System, (including JEPPESEN charts) – a navigáció központi számítógépe**
- **GPS: Global Positioning System – műholdas helyzet meghatározás**
- **HGS: Head up Guidance System, - pilóta látóterébe vetített kép**
- **SFD: Secondary Flight Display, - LCD kijelző repülési adatokkal**
- **WX - LSS: Weather Radar – Lightning Sensor System, - időjárási radar és villámlás érzékelő**
- **EGPWS: Enhanced Ground Proximity Warning System, - földközelség figyelmeztető**
- **ATC / TCAS: Air Traffic Control / Traffic Crew Alerting System, - légiforgalmi szituáció**
- **ADS: Air Data System, - légadat gyűjtő rendszer**
- **IRS, AHRS: Inertial Reference System and Attitude and Heading Reference System, - inerciális navigációs rendszer és repülőgép irányszög rendszer**
- **Radar Altimeter, - radaros magasságmérő**
- **NAVAIDS (VOR/DME, ADF, ILS.) – navigációs segédberendezések pld. leszálláshoz**

Indicating and Recording

EASy Modular Avionics:

- Displays,
- Crew Alerting System (CAS),
- Electronic CheckList (ECL),
- Combine recorder (Digital Flight Data Recorder and Cockpit Voice Recorder) and Emergency Locator Transmitter (ELT).



The EASy modular avionics provides the following avionics functions:

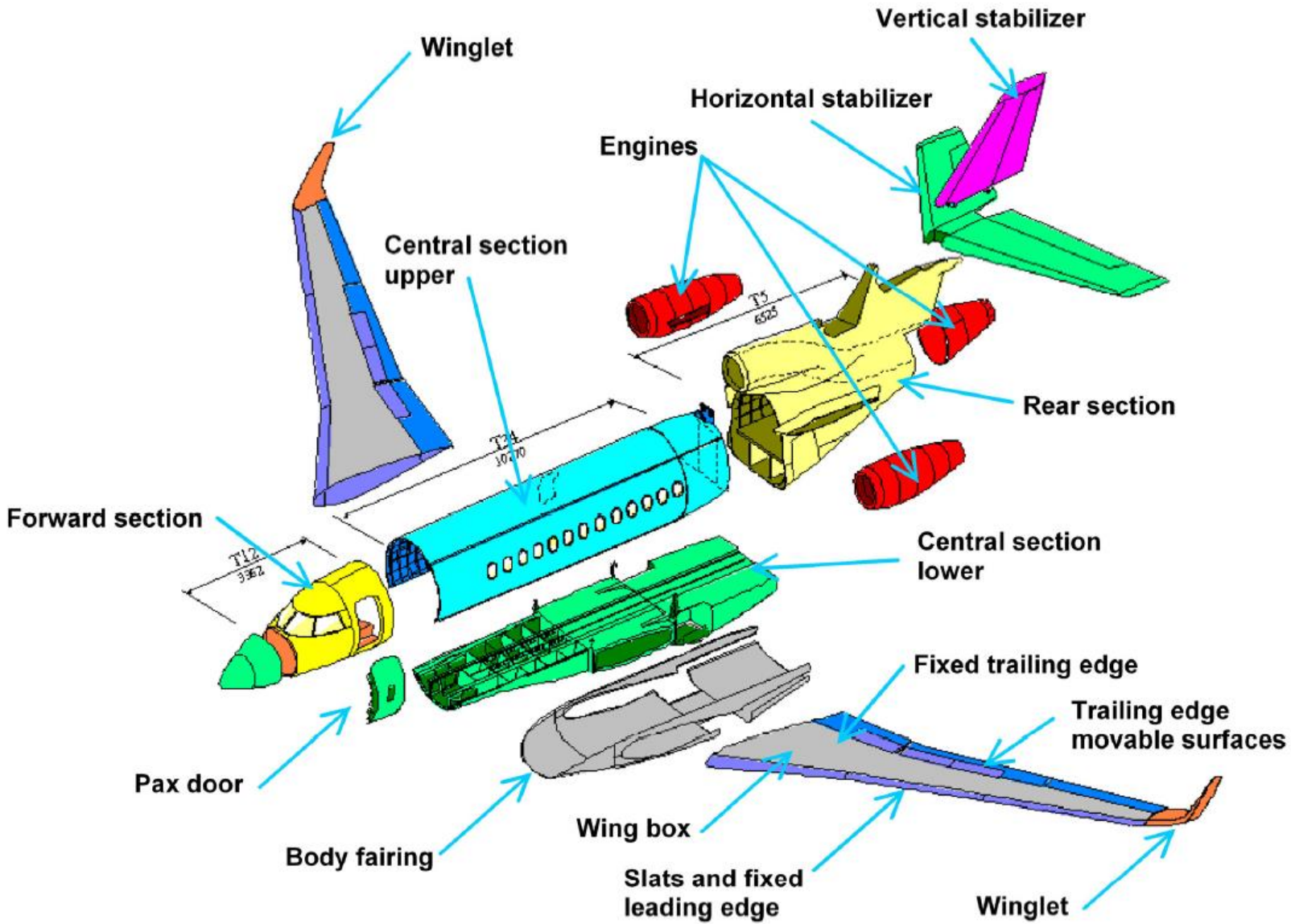
- **Processing of display for:**
 - Attitude information based on IRS data,
 - Radio Altitude information based on Radar Altimeters data,
 - Air Data information based on Air Data Systems data.
- **Elaboration of data and processing of display for:**
 - Navigation (GPS, VOR, DME, FMS, ILS...),
 - Flight Director / Thrust Director Guidance,
 - EGPWS.
- **Transmission of FD orders to Primary Flight Control System for AutoPilot function,**
- **Elaboration of Auto-Throttle commands for Throttle Quadrant,**
- **Communication means,**
- **Transmission of TCAS guidance received from the independent TCAS.**

MULTI-SYSTEM FUNCTIONS

- **In addition to avionics functions, the EASy modular avionics provides the following functions, based on data received from airplane systems:**
 - Display of CAS/Fault messages related to system failures,
 - Display of systems synoptic,
 - Transmission of data between systems,
 - Recording of maintenance data.

- **The purpose of the Centralized Fault Display System (CFDS) is to make the maintenance task easier by displaying fault messages in the cockpit and permitting the flight crew to make some specific tests.**
- **There are two levels of maintenance:**
 - at the line stop : removal and replacement of equipment
 - at the main base : troubleshooting
- **The CFDS includes :**
 - the BITE (Built-In Test Equipment) for each electronic system
 - a central computer, the Centralized Fault Display Interface Unit (CFDIU)
 - two MCDUs (Multipurpose Control and Display Units), used also for FMGS (Flight Management and Guidance System), AIDS (Aircraft Integrated Data System), and ACARS (Aircraft Communication And Reporting System, if installed), which work with the CFDIU to display information or initiate tests
 - one printer.
- **If a main channel of the CFDIU fails, the backup channel takes over**
 - **Class 1:** Failures indicated to the flight crew by means of the ECAM, or other flight R deck effect. They must be repaired or entered in the MEL (Minimum Equipment List) before the aircraft can depart.
 - **Class 2:** Faults indicated to maintenance personnel by the CFDS, and which trigger a MAINT status entry on the maintenance part of the ECAM status page. The aircraft can operate with these faults, but they must be repaired within 10 days.
 - **Class 3:** Faults indicated to maintenance personnel by the CFDS, but which do not trigger a MAINT status. The operator may have these faults corrected at his convenience.

Airframe



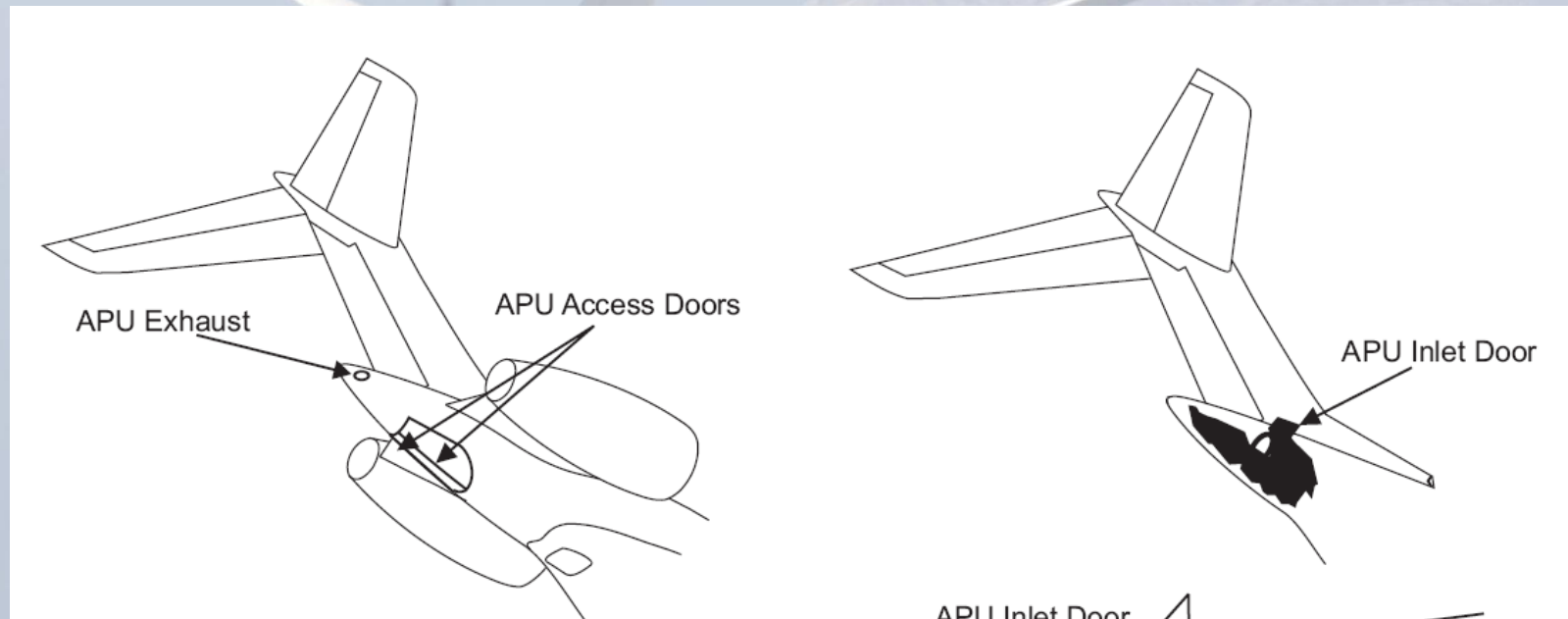
AIRPLANE STRUCTURE OVERVIEW

- **Airflow and Temperature Control**
- **Pressurization Control**

Hot pressurized air from the compressor sections of the engines or the auxiliary power unit is cooled through a series of processes by the Environmental Control System (ECS) Air Conditioning Packs (ACPs), remixed with some of high temperature bleed air to achieve the desired temperature, and then delivered throughout the airplane. Distribution ducts provide air to the cockpit, passenger cabin, and baggage compartment.

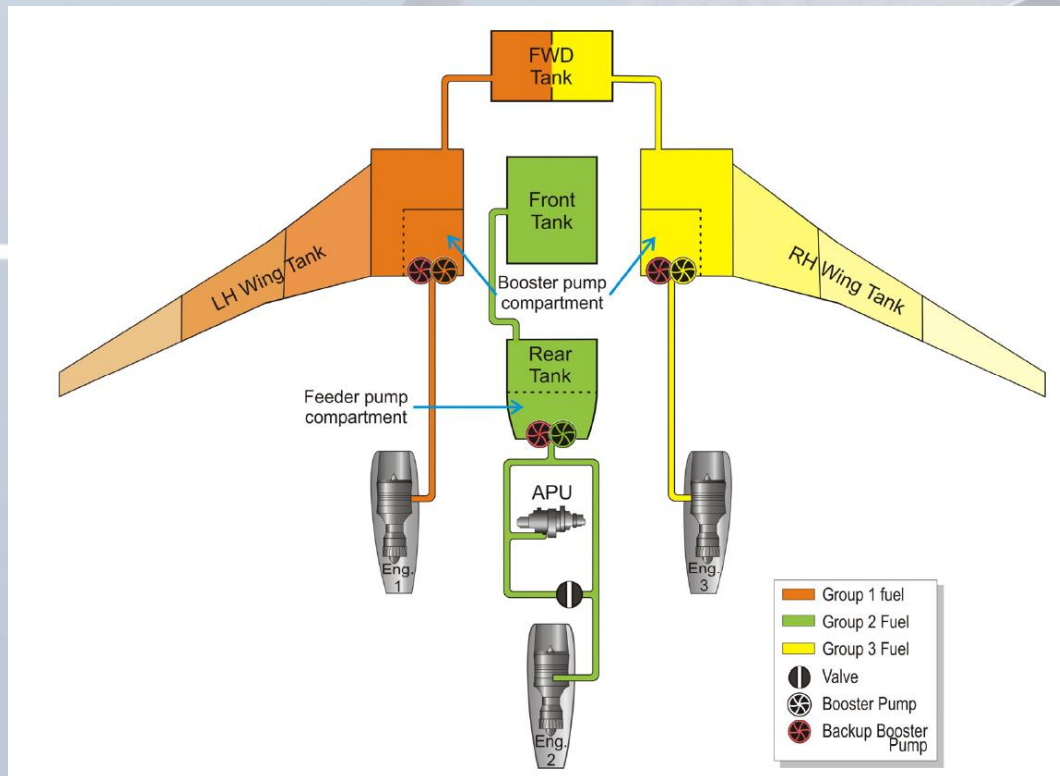
The higher pressure of this airflow allows regulation of the ambient pressure within the airplane to maintain an air density comfortable for breathing even though the airplane may be at the highest operating altitude limit of fifty-one thousand (51,000) feet. Air density within the airplane is controlled by regulating how much of the pressurized conditioned air remains within the aircraft. The airflow leaving the aircraft is regulated by a Thrust Recovery Outflow Valve (TROV) that opens and closes in response to automatic or manual commands to maintain the desired air density level.

- The APU provides bleed air for cabin cooling and heating through the Environmental Control System (ECS), main engine starting, and electrical power on the ground and in flight.
- Under high demand load conditions, the APU electrical load takes priority over pneumatic load.



Fuel System

- Fuel system provides engines and APU with pressurized fuel.
- It is composed of three independent groups of fuel tanks that feed, in normal operation, their
- respective engine and the APU:



- **The ice and rain protection system is intended to permit:**
 - Safe flight through intermittent or continuous maximum icing conditions,
 - Improved visibility through windshield during taxi, take off, approach and landing in rain condition and during ground operation in dew conditions.

The system uses three ice and rain protection sources:

- **Pneumatic source for:**
 - Wings,
 - Engines air intake anti ice,
 - Engine 2 S-duct anti ice,
 - Brakes anti ice.
- **Electrical source for:**
 - Windshields and lateral windows,
 - Air data probes,
 - Waste water drain mast.
- **Specific fluid for:**
 - Windshield rain protection (rain repellent).

Brakes/Landing gear

- Electrically controlled,
- Hydraulically actuated.
- 787 has electric brake-by-wire
- Extension retraction including panels
- Braking with ABS
- Heat and wear monitoring
- Nose wheel steering
- Weight on wheel for FMS calculations

Control of the landing gear system is performed by a dual channel computer named Landing Gear and Steering Control Unit (LGSCU).

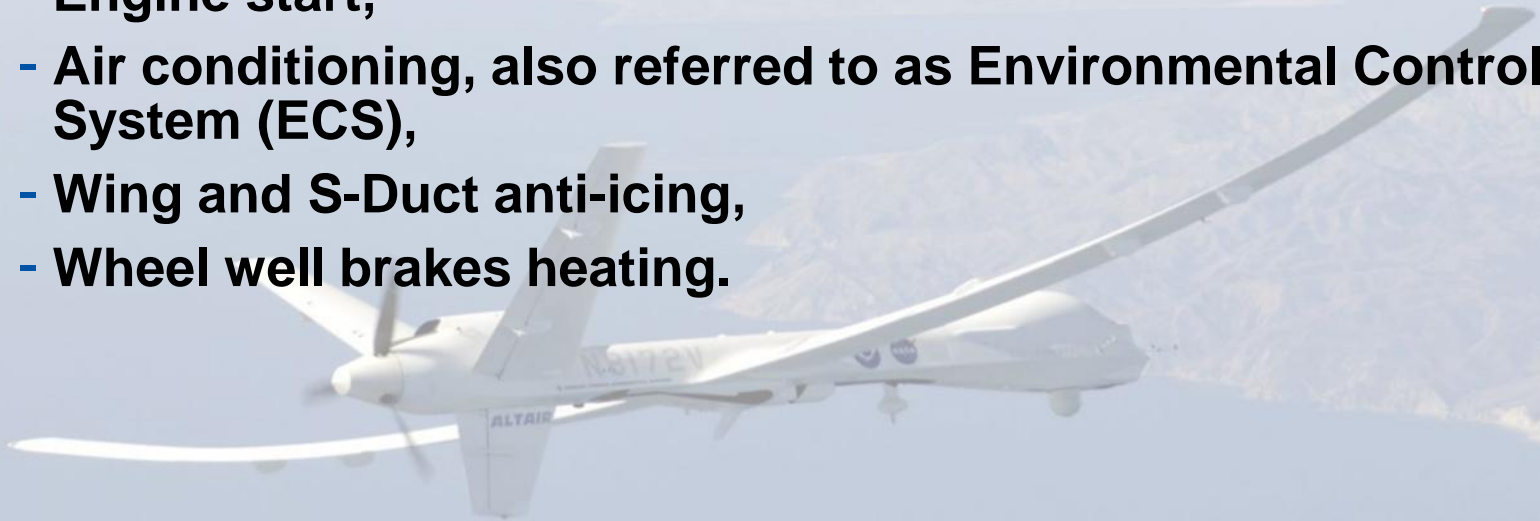


- **Engine control is performed by a dual channel Full Authority Digital Engine Control (FADEC),**
- **Engines are independent of Flight Control System**
- **The Engines provide:**
 - Thrust,
 - Bleed air (for ECS and Anti ice),
 - Mechanical energy to drive the hydraulic pumps,
 - Mechanical energy to drive the DC generators and PMA.
- **Engine operation requires the following systems:**
 - Control system,
 - Fuel system,
 - Oil system,
 - Ignition system,
 - Air-start system.

The fire protection system can be separated into three functions:

- **1: Detection,**
 - Engine, apu, cabin, cargo, avionics bays, wheels
- **2: Extinction of Fire,**
 - closure of the Shut Off Valves (SOV) and built-in extinguishers
- **3. Auxiliary functions in case of engine or APU fire.**
 - The corresponding Hydraulic and Fuel Shut Off Valves are closed,
 - The corresponding generator is disconnected, (used for emergency landing procedure as, in other conditions, the engine will have been shut off first)

- **The Bleed Air System refers to the air distributed to provide following functions:**
 - Engine start,
 - Air conditioning, also referred to as Environmental Control System (ECS),
 - Wing and S-Duct anti-icing,
 - Wheel well brakes heating.



The Airplane lighting system provides the following functions:

- **External Lighting:**

- Illumination of airplane environment (runway, taxiway, parking),
- Illumination of airplane structure (wings, refuel area, loading area),
- Signalisation of airplane visual position and track (anti collision lights, navigation lights),

- **For Interior Lighting:**

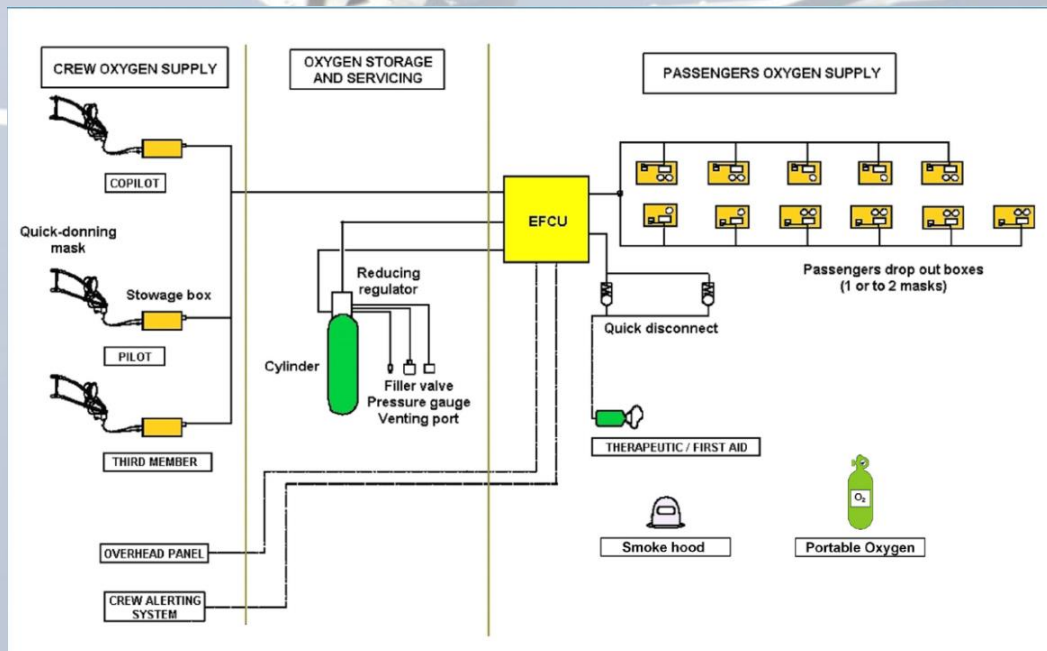
- Required level of cockpit illumination according to crew comfort, environmental condition and phase of flight,
- Required level of cabin illumination according to passenger comfort,
- Illumination of working area for servicing, maintenance and inspection operation, (compartments, refueling panel, water filling panel),

- **For emergency Lighting:**

- Signalisation of internal evacuation access and routing (interior emergency lighting),
- Signalisation of External evacuation routing (exterior emergency lighting).

Oxygen system

- The Falcon 7X is equipped with an oxygen system supplying oxygen to the passengers and the crew members in case of:
 - Cabin depressurization,
 - Smoke or noxious gas in the cabin,
 - Need for first aid.
- Controlled by the Electrical Flow Control Unit (EFCU)



- **The Water system provides potable cold and hot water to:**
 - The washbasin faucets in the aft lavatories,
 - The washbasin faucet and coffee maker in the galley.
- **The system is controlled:**
 - Automatically through the Water System Computer Unit (WSCU),
 - Manually by one of the crew members in case of WSCU failure.
- **The waste water and the whole water system are drained overboard through two heated drain masts.**
- **The aft toilets are chemical-type with a dedicated tank and recirculating system.**

Water and waste

