

A stylized sunburst graphic on the left side of the slide, consisting of several curved lines radiating from a central point, with some lines ending in dark grey triangular shapes.

# Avionic Software

(embedded, real-time, safety critical)


for aerospace & defense applications

**Francesco Rogo – Product Policy**  
**April 16<sup>th</sup> , 2010**  
**University “La Sapienza”, in Rome**  
**Facoltà d’Ingegneria**  
*Percorso d’Eccellenza*



## **Finmeccanica Profile**

## **Avionic Software**

-  **Embedded Real-time**
-  **Architectures Algorithms**
-  **Software Engineering**
-  **Safety Certification**

## **Current methodologies and tools**

-  **Requirements**
-  **Design**
-  **Coding**
-  **Testing**

## **Avionic Software Products**

-  **Examples from Finmeccanica**

- Name: Francesco Rogo
- Age: 38
- Nationality: Italian
- Degree: Computer Science Engineering
- University: "La Sapienza" in Rome



- Profile:
  - Before Joining Finmeccanica, I have worked for 7 years in Marconi Mobile (a UK communications Company) now owned by Finmeccanica on the brand Selex-Communications.
  - Specialist in real-time embedded software for satellite communications and tactical data-link systems, during my professional life I have had many collaboration with US military Companies
  - Leadership and passion for the technology are the main features of my personality.
  - My mission, in life, is to succeed both professionally and privately: I'm married and I've got 2 wonderful children (... a third one is coming...).
  - In 2002, I got a Master in Business Engineering at Tor Vergata University.
  - Since last October, I've been studying for the Doctorate (PhD) in Knowledge Management at Tor Vergata University.
  
  - Current Position: FINMECCANICA CORPORATE - PRODUCT POLICY

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# Finmeccanica today: the “divisions”



## FINMECCANICA S.p.A.

(30% Government,  
70% Public)

Finmeccanica is Italy's largest high technology company and holds a leading position in Europe's aerospace, defence, security, energy and transport sectors.

■ Revenues	15.037 B€
■ Backlog	42.937 B€
■ New Orders	17.575 B€
■ R & D	1.809 B€
■ Employees	73,398 Ps

## Helicopters



20 % > 3 € bn

- AGUSTAWESTLAND

## Aeronautics



17 % > 2,5 € bn

- ALENIA AERONAUTICA
- ALENIA AERONAVALI
- ALENIA AERMACCHI
- ATR

## Defence Electronics

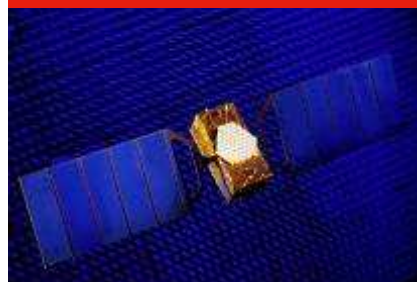


29 % > 6 € bn

- SELEX GALILEO
- SELEX COMMUNICATIONS
- SELEX SISTEMI INTEGRATI
- SELEX SERVICE MANAGEMENT
- SEICOS
- ELSAG DATAMAT
- DRS

■ 100% FNM ■ JVs

## Space



7 % > 1 € bn

- THALES ALENIA SPACE
- TELESPAZIO

## Defence Systems



7 % > 1 € bn

- OTO MELARA
- WASS
- MBDA

## Transportation



12 % > 1,5 € bn

- ANSALDO STS
- ANSALDO BREDA

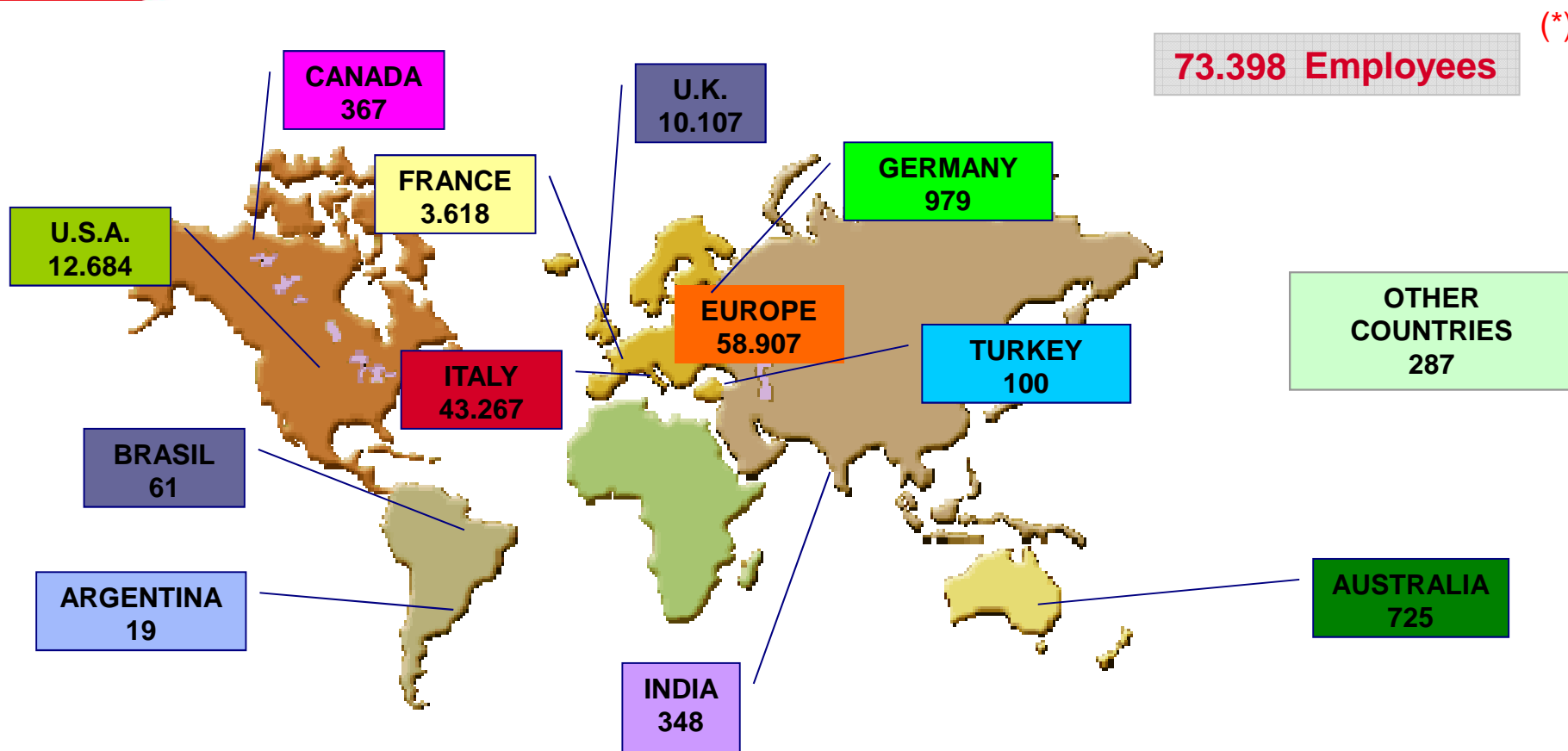
## Energy



9 % > 1 € bn

- ANSALDO ENERGIA

# Finmeccanica Employees



**FINMECCANICA - Consolidated**

**31.12.2008**

(\*) Employees within Joint Ventures are consolidated proportionally to the participation of Finmeccanica in the JV (MBDA, THALES ALENIA SPACE, TELESPAZIO, ATR, Superjet)

# Helicopters - Main Programmes



## Grand/AW109



A new intermediate size helicopter with light twin economics developed to meet a variety of market requirements

## AW139



A new generation medium twin-turbine helicopter setting new standards against which all new medium twin will be measured.

## AW149



The new standard in military utility helicopter. The AW149, provides the flexibility requested to a modern battlefield support helicopter

## NH90



The biggest helicopter programme ever launched in Europe. The NH90 has been developed in two versions to meet the requirements of both naval operations and tactical transport.

## Future Lynx



Future Lynx is a fully marinised military helicopter optimised for land, maritime and littoral operating environments.

## AW129



The **AgustaWestland** multi-role combat helicopter designed for day/night and adverse weather operations.

## AW/US101



The benchmark helicopter in the medium-heavy lift market and the only new generation helicopter in its category being in service in maritime, utility and commercial roles

## BA609



The BA609 Tiltrotor, is one of the most significant technological innovations, offering an extraordinary combination of helicopter flexibility together with airplane performance. Its revolutionary characteristics make it the best multi-mission aircraft for the task.

## RAT 31DL/M (DADR)



RAT 31DL/M (DADR - Deployable Air Defence Radar) is the mobile version of RAT 31DL. It is an advanced L-band (NATO D-band) solid state phased array, 3D air defence radar, effective to a range of about 450 km.

## C4I Systems



C4I systems for Joint operation command support the Chief of Staff for in or out of area combined multi-national missions

## VTMS Control Centre



The general system architecture is based on local, area and central control levels which interact with the traffic, analyse and synthesize data coming from different sensors sites.

## ATMS- Air Traffic Management Systems



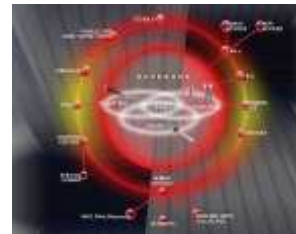
**SELEX Sistemi Integrati** designs, implements and supports a complete range of ATM Systems, including Control Centres, used in over 150 countries worldwide

## WIMAX



**SELEX Communications** is deploying Base Station and CPE, for both Backhaul and last mile networks in different licensed and unlicensed frequency bands. As a principal member of WiMAX Forum, is leading the technological experimental phase issued by the Italian Telecommunication Ministry.

## Secure Communications



**SELEX Communications** is a world leader in the development and supply of secure networks and security infrastructures for the military, government and enterprise markets, as well as private mobile networks for military, police and civil applications.

## TETRA



Whit its rich set of features and new functions PUMA T3-Plus offers a complete set of TETRA services to satisfy the highest demands of professional users.

## LOAM



A state-of-the-art “navigational aid system” for rotary wing platforms. Selected for the Italian Navy AW101 helicopter variant, for the Danish AW101 helicopters and for the NH90 TTH helicopter variant.

## Soldato Futuro



A lightweight, fully integrated Electro-Optics suite of products. The SOLDATO FUTURO programme fulfils the operative needs of the unarmored soldier by increasing the survival, communication and mobility capacities

## HIDAS



The Helicopter Integrated Defensive Aids System (HIDAS) is a suite of products which can be scaled to meet the requirements of every helicopter platform to provide optimum self-protection.

## Eurofighter simulator



**SELEX Galileo** is providing all Eurofighter partner countries with: the radar simulation system, the Debriefing Station and Theatre, the Lesson Planning, the Scenario Generator and the Instruction Stations.

## Defence Logistics Information Systems



**Elsag Datamat** has an outstanding track record delivering Logistic Management Information systems and services to Italian Forces. Its capabilities span from methodological consultancy on logistics issues to end-to-end process automation.

## Autodetector



The licence plate reading system designed and built by Elsag Datamat. 3,000 Carabinieri patrol cars in Italy and more than 250 US police departments use the system

## Stadium security



**SELEX Service Management** provides innovative solutions to prevent and to face threats to stadiums security

## Network Operation Centre



**Seicos** develops and manages secure communication networks for Police Corps and other State Agencies. The company from the Sardinian Network Operation Center, located in Sassari, manages the TETRA network day and night.



# Aeronautics - Main Programmes



## Eurofighter Typhoon



The Eurofighter is the world's most advanced new generation swing-role fighter with 707 aircraft under contract

## C-27J Spartan



Already ordered for a total of 117 units, the C-27J is the only tactical airlifter in its category

## Unmanned Aerial Systems



**Alenia Aeronautica** is leader in the UAS, conceived to perform a wide range of civil and security missions

## M-346



The **Aermacchi** M-346 is the only new generation advanced/lead-in fighter trainer, currently available in Europe

## ATR Family



With more than 900 aircraft ordered **ATR** is the world's most successful turboprop regional aircraft family

## ATR42MP



The ATR42MP is a maritime patrol aircraft derived from the ATR42. The aircraft has been already ordered for a total of ten aircraft.

## Boeing 787 Dreamliner



Alenia Aeronautica manufactures the fuselage's central and aft sections and the horizontal stabiliser of the 787

## Sukhoi Superjet 100



A new-generation 75-95 seats - regional jet family designed and produced by SCAC in co-operation with Alenia

# Space - Main programmes

## LEOP Control room



**Telespazio** is one of the major global operators in LEOP (Launch and Early Orbit Phase) services and the management of satellites' operational life

## Galileo Control Centre



One of the control centres that will manage the Galileo constellation is being built at Telespazio's Fucino Space Centre.

## Earth Observation\_



Image captured by QuickBird, the most advanced satellite in remote sensing. Telespazio exclusively distributes QuickBird data in Europe and South America.

## Emergency satellite communication



Telespazio developed, for the Italian Civil Protection Department, a broadband interactive satellite network for emergency communications

## COSMO-SkyMed



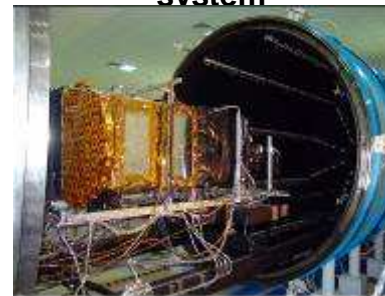
The Earth observation system based on a constellation of four satellites manufactured by **Thales Alenia Space** and capable of observing our planet by day and by night

## International Space Station



The multi-purpose pressurized laboratory Columbus of Thales Alenia Space is Europe's main contribution to the International Space Station

## Galileo navigation system



GIOVE-B, the second satellite of Galileo Constellation in the Thales Alenia Space Satellite Integration Centre..

## Sicral



SICRAL 1B satellite, dedicated to the Italian Armed Forces, will ensure strategic and tactical communications on the Italian and foreign territories

# Defence Systems - Main programmes



## Naval Guns\_



The **Oto Melara** 127/64 Lightweight naval Gun Mount is a rapid fire gun mount suitable for installation on large and medium size ships

## Centauro



Highly mobile and protected vehicle that combines the firepower of a main battle tank, with the speed and agility of a wheeled vehicle.

## HITFIST Turret



HITFIST® (Highly Integrated Technology, Fire In Small Turret) can include weapons like 25 mm and 30 mm with or without anti-tank missiles launchers. All the turrets of the HITFIST® family are multirole turrets.

## Unmanned Ground Vehicle



Robotic technology, for a fully and multi role integration in army forces: ISR, counter-IED, data relay, CBRN

## Heavy Torpedoes



The **BLACK SHARK** Heavy Weight Torpedo is a multipurpose weapon designed to be launched by surface vessels or submarines.

## Aspide



Aspide 2000 (semi-active guided missile) is the ammunition of the Surface to Air SPADA2000 Plus Missile System

## ASTER



The ASTER family of vertically launched missiles is being developed by **MBDA** within the Franco-Italian FSAF programme.

## Light Weight Torpedoes



The MU90/IMPACT Advanced Light Weight Torpedo is the leader of the 3rd generation of LWTs. The weapon is of fire-and-forget type, conceived to cope with any-task any-environment capability requirements

## Combined cycle power plant



**Ansaldo Energia** specialises in supplying plants and components for the production of energy of all the configurations required by the market

## Gas turbines



Ansaldo Energia brings to the market the most advanced consolidated technology gas turbines, combining the robustness of its standard design with its recognised ability in fulfilling customer needs with tailored solutions.

## Services (Power Generation)



Ansaldo Energia supplies operation and maintenance services on all its products and products using other technologies

## ETR 500-High Speed Train



The **AnsaldoBreda** ETR 500 Multi-Voltage train is the Italian High Speed Train. The transport capacity is of 590 passengers on 1st and 2nd class coaches. Maximum speed: over 300 km/h.

## Driverless metro



Driverless vehicles for Copenhagen are conceived as an integral part of the state-of-the-art Metro Car System with automatic drive within the public transport network of the city.

## SIRIO Tram



SIRIO demonstrates its state-of-the-art production through its high level of comfort: low internal noise levels, low floor on the entire inner surface, wide doors, devices for the handicapped and an air conditioning system for passengers. The SIRIO platform is widespread both in Italy and abroad.

## OTP (Optimizing Traffic Planner)



**Ansaldo STS** is helping Union Pacific, the biggest railway network in North America, to optimize its traffic movements with the OTP (Optimizing Traffic Planner) of Ansaldo STS.





## Signalling Systems



Ansaldo STS designs, manufactures, manages and maintains both railway/subway signalling and monitoring systems and turn key metropolitan and rail systems.

## Finmeccanica Profile

## **Avionic Software**

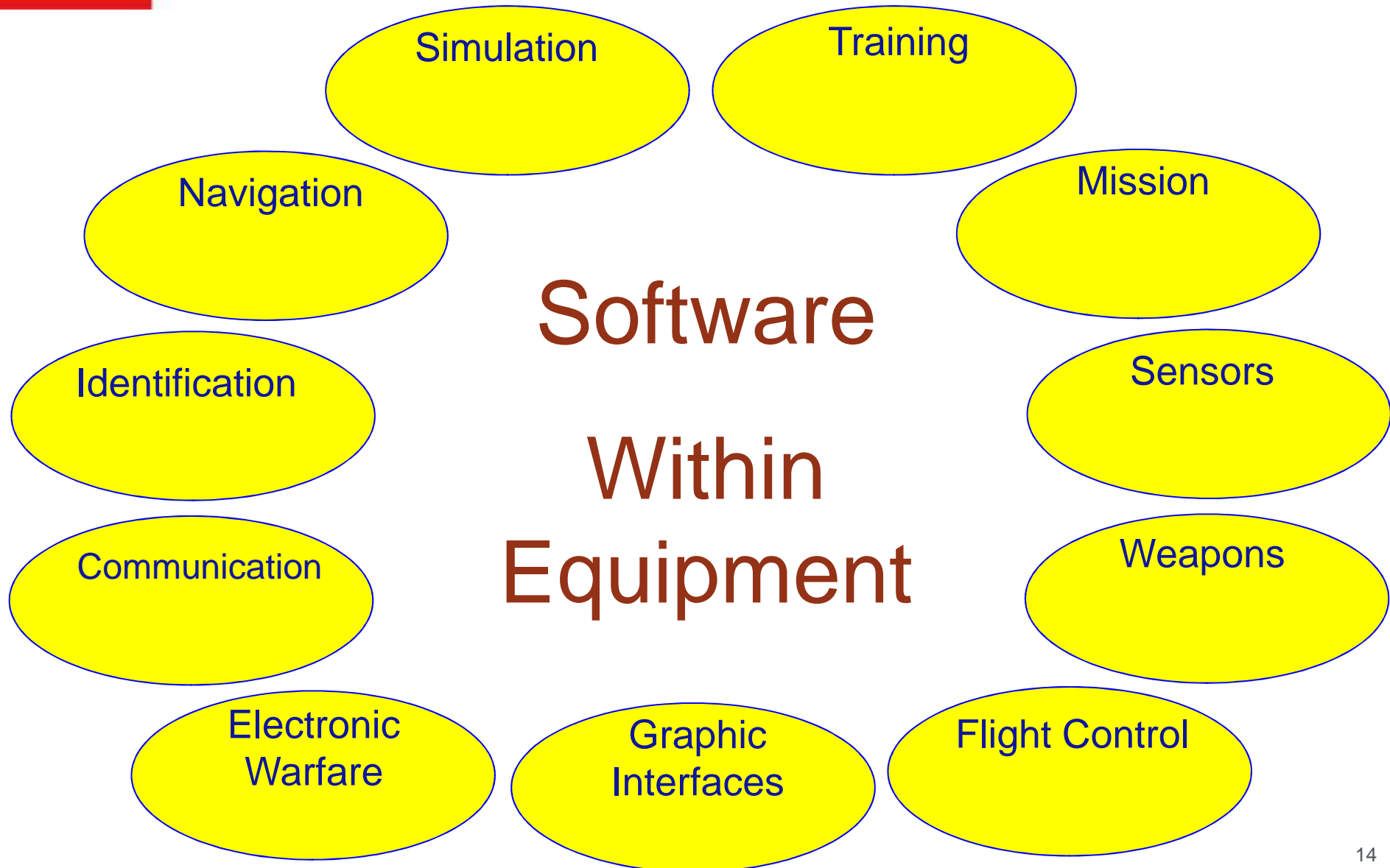
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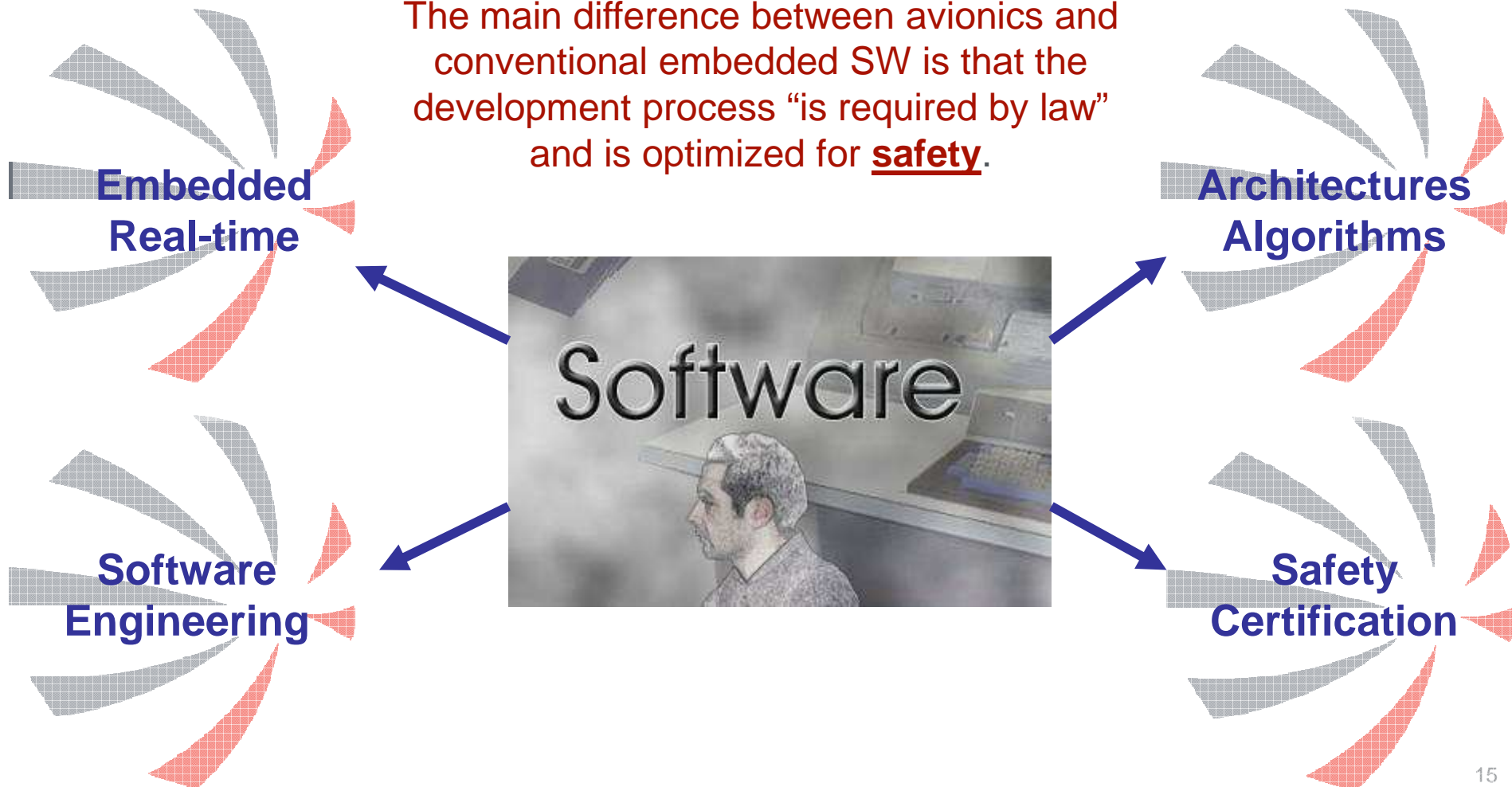
## **Avionic Software Products**

-  **Examples from Finmeccanica**



Avionic SW is embedded SW with legally mandated safety and reliability concerns used in Avionics.

The main difference between avionics and conventional embedded SW is that the development process “is required by law” and is optimized for **safety**.



# ..... in airborne platforms





# ..... in helicopter platforms



Cockpit Interfaces  
MMI & Control  
Panels



Flight Control  
Computers  
(x3 or x4)



Plant  
Management  
Computer

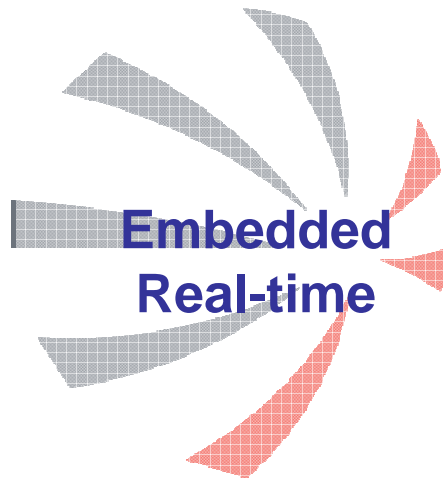


Mission Tactical  
Computer



Data Management  
Control Unit





A **real time system** may be one where its application can be considered (within context) to be **mission critical**. Real-time computations can be said to have *failed* if they are not completed before their **deadline**, where their deadline is relative to an event. A real-time deadline must be met, regardless of **system load**.

An **embedded system** is a special-purpose computer system designed to perform one or a few dedicated functions, often with **real-time computing** constraints. It is usually *embedded* as part of a complete device including hardware and mechanical parts.

An embedded system is usually more complex than a traditional solution, most of the complexity is contained within the microcontroller itself. Very few additional components (**space, temperature, memory size and power consumption constraints...**) may be needed and most of the **design effort is in the software**.

The intangible nature of software makes it much easier to prototype and test new revisions compared with the design and construction of a new circuit not using an embedded processor.

A Real-Time Operating System (RTOS) is a **multitasking operating system** intended for real-time applications. Such applications include embedded systems (programmable sensors, appliance controllers), industrial robots, spacecraft, industrial control (see SCADA), and scientific research equipment.

- An RTOS typically uses specialized scheduling algorithms in order to provide the real-time developer with the tools necessary to produce **deterministic behavior** in the final system, but does not guarantee the final result will be real-time; this requires correct development of the software (semaphores, queues, watchdogs, ...).

- An RTOS is valued more for how quickly and/or predictably it can respond to a particular event than for the amount of work it can perform over a given period of time. Key factors in an RTOS are therefore a minimal **interrupt latency** and a **minimal thread switching latency**.



Software in **embedded systems** runs with limited computer resources: small memory, no screen, no keyboard, but with special facilities: timers, PLL, buffers, in-circuit debugger, in-circuit emulator, watchdog...

Many systems have “maintenance” or test facilities (JTAG, ISP, BDM port...) and typically have many peripherals, such as: Serials, SSC, USB, Ethernet, Discrete IO, ADC/DAC, 1553, ARINC...

An increasing number of embedded systems today use more than one single processor core. A common problem with **multi-core development** is the proper synchronization of software execution. In such a case, the embedded system design may wish to check the data traffic on the busses between the processor cores, which requires very low-level debugging, at signal/bus level, with a **logic analyzer**, for instance.

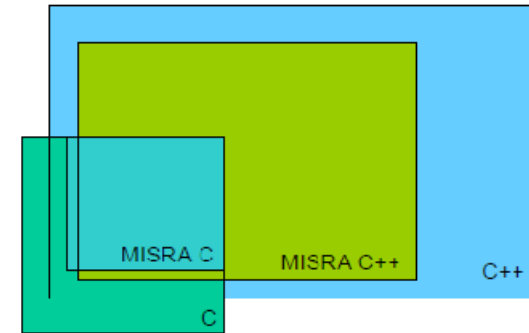
**Preemption** in computing is the act of temporarily interrupting a task being carried out by a computer system, without requiring its cooperation, and with the intention of resuming the task at a later time. Such a change is known as a context switch. It is normally carried out by a privileged task or part of the system (kernel) known as a preemptive scheduler, which has the power to **preempt**, or interrupt, and later resume, other tasks in the system.



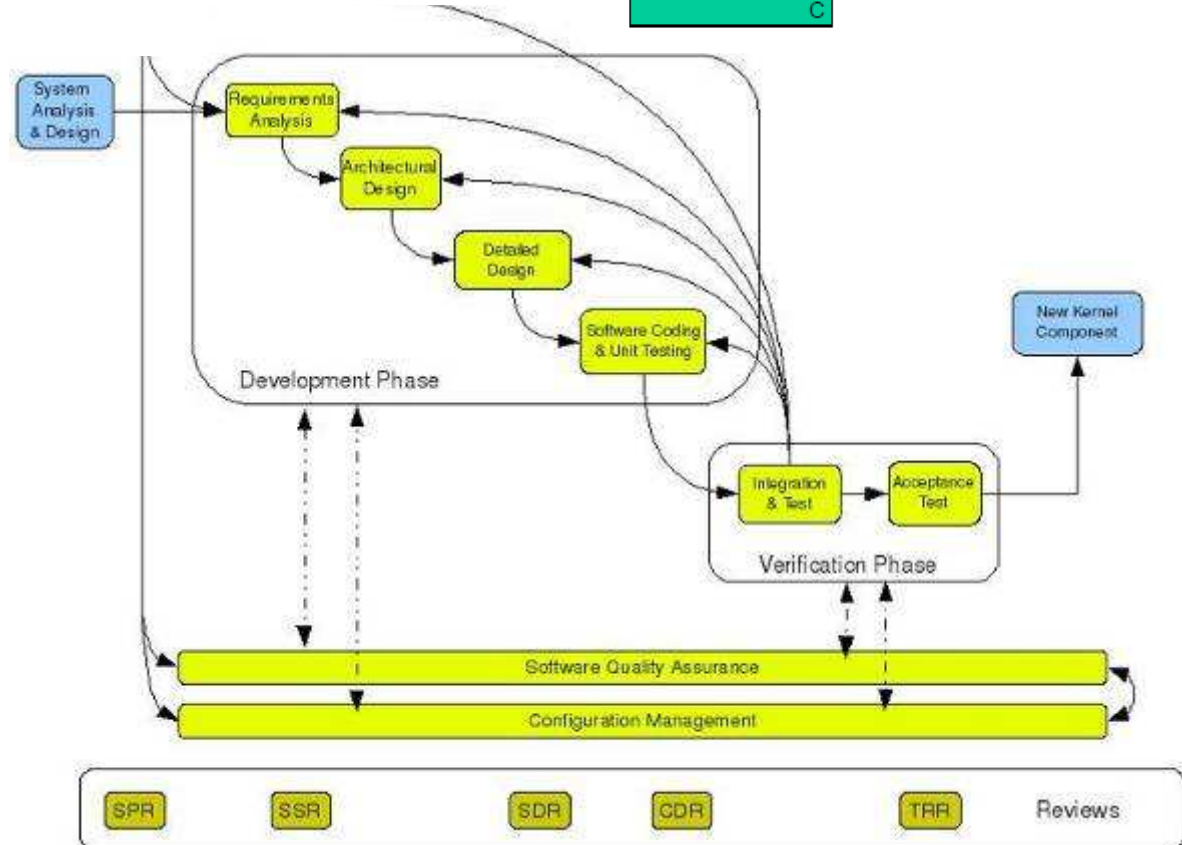
# Software Engineering

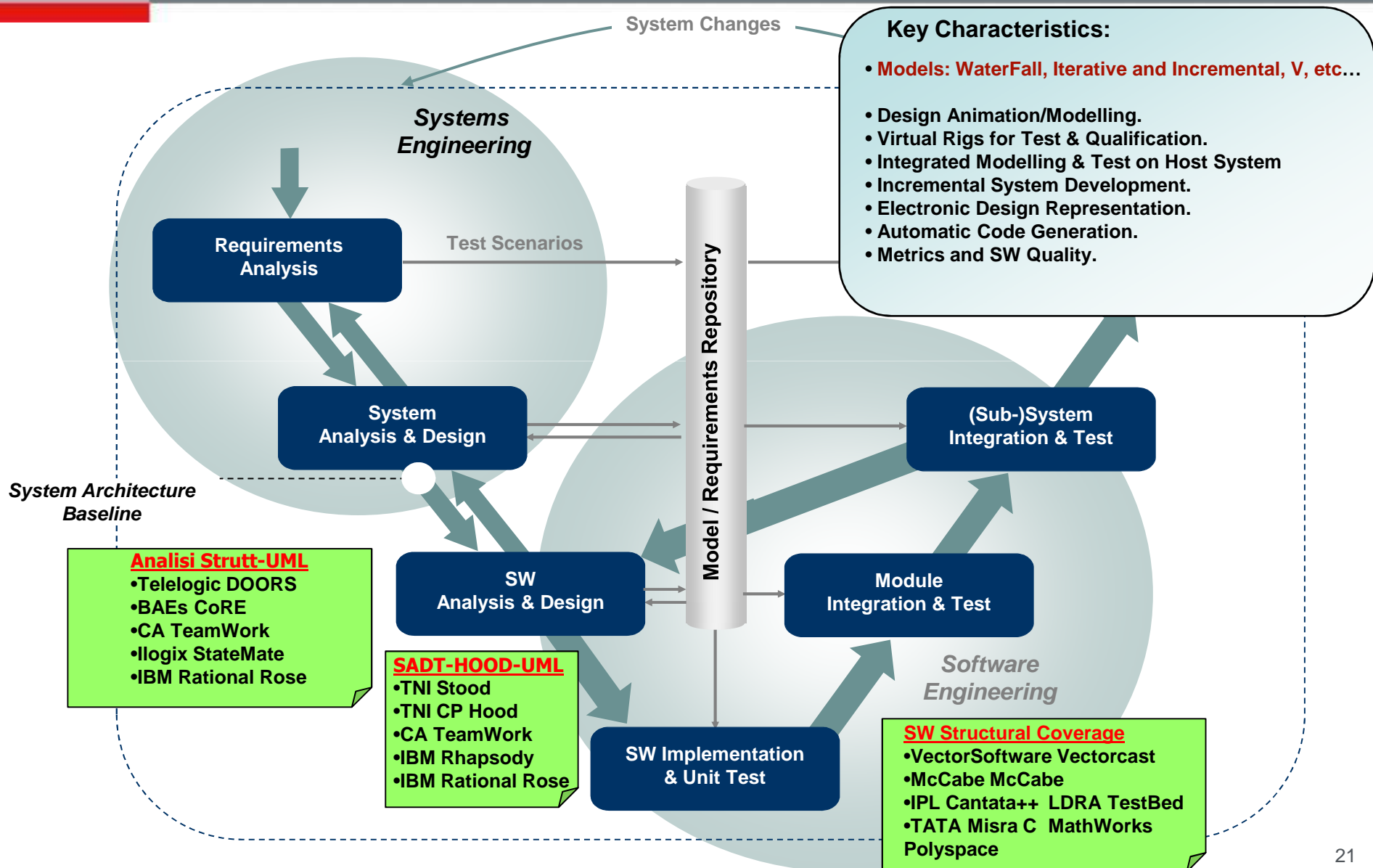
- To avoid undefined behaviour
- To avoid implementation defined behaviour
- To improve clarity for review and maintenance.
- To provide a consistent style across a program or set of programs
- To avoid common programmer errors
- To incorporate good practice, particularly with regard to 'future proofing'.

- Dividing by zero
- Size of integer
- Not allowing confused names
- Hungarian notation
- If x=y
- Only throw objects of class type

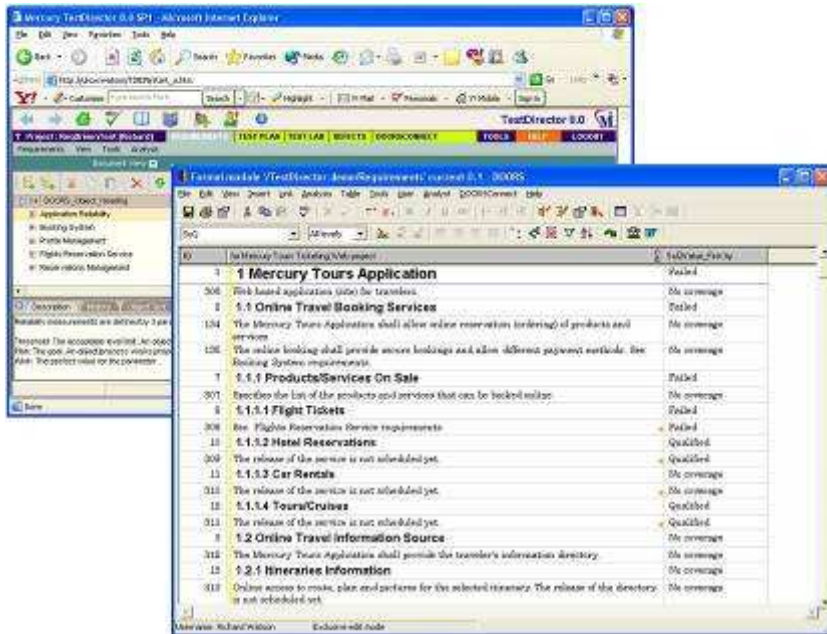


Use of non common languages (i.e. ADA) or subsets in coding.





# Requirements Management and Configuration Control



- SW Baselines
- SW Version Control
- SW Change Management
- Roles and Process Control

- **SYS to SW Requirement Traceability**
- **SW to Code Requirement Traceability**
- **SW Artifacts ever updated (autom.gener.)**

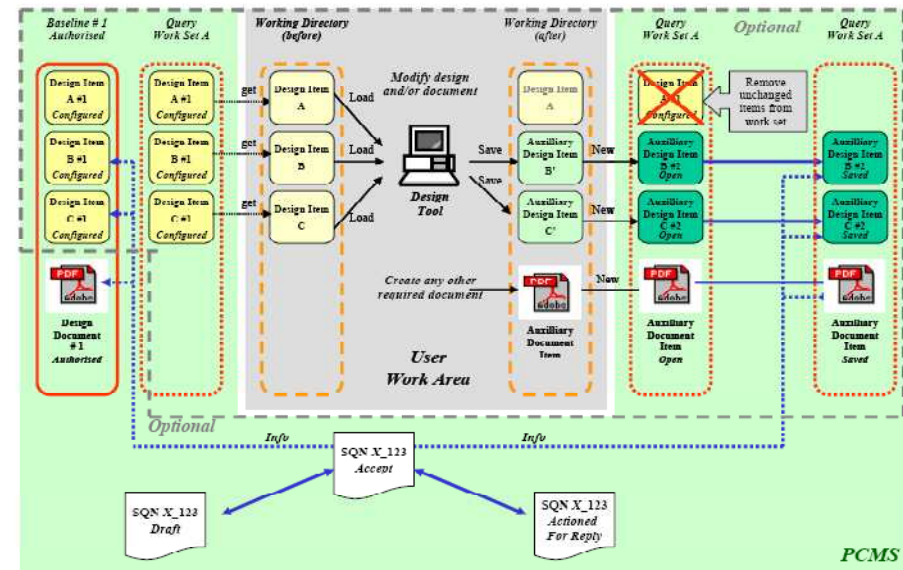


Figure 4-4: Activity 1A Tasks

## Mission

- Mission Management
- Planning constrains,
- Reaction to unexpected mission needs,
- Reporting and briefing
- Payload management

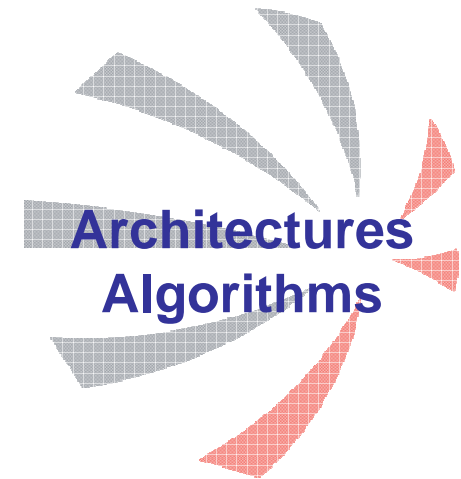
## Sensor management, sensor mission employment strategy, weapon employment

- Data Fusion management and correlation
- Flight Path mission generation
- Flight path taking into account specific constrains
- System health management
- On board failure situation assessment, isolation actions and mission impact
- collision avoidance

## Target Identification and Recognition Management

- Mission Digital Map management
- Target geo-location by comparison of digital map and sensor images
- Multi-source imagery management
- Threat Avoidance

Typical on-board sensors:  
**GPS** (satellite long-range)  
**IN** (independent long-range) / **IMU**  
**Doppler** (independent long-range)  
**DME+VOR/TACAN** (radioassistance)  
**DLS+ILS** (approach and landing)  
**Radar Altimeter / Laser Altimeter**  
**Baro-Altimeter**  
**E/O – I/R cameras**  
**Inertial**



## Navigation

- data acquisition (position, attitudes, speed)
- route computation
- Navigation fixing over a target an

## Steering (path monitoring)

- 4D computation
- Path Deviation
- Replanning

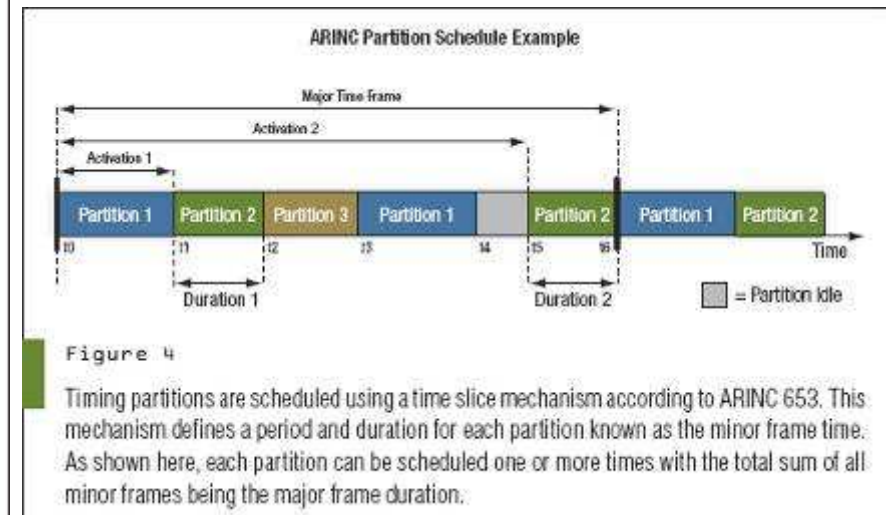
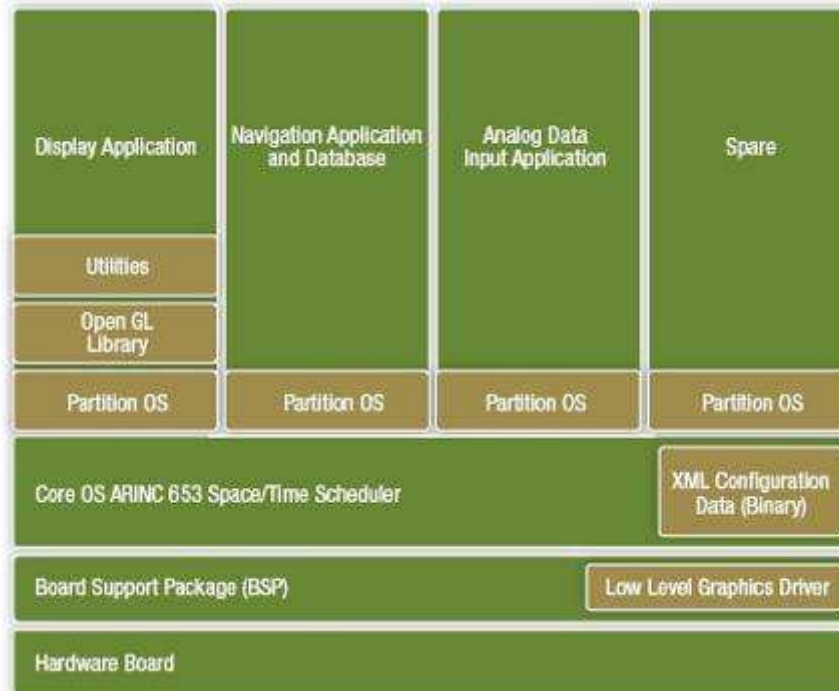
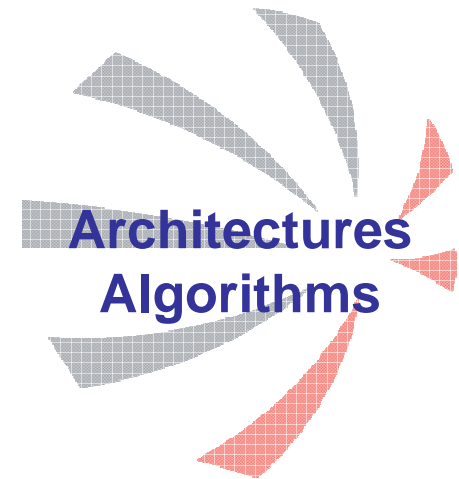
## Approach and landing

- Guidance
- Autopilot correction
- Missed approach

**Power  
Computing  
1K – 10 K  
MIPS**

# Architectures & Algorithms

**ARINC-653** is an *Avionics Application Software Standard Interface*. It defines a general-purpose Application/Executive (APEX) software interface between the Operating System of an avionics computer and the application software. The interface requirements between the application software and operating system services are defined in a manner that enables the application software to control the scheduling, communication and status of internal processing elements.





## ■ Strategies in place:

- \* SW Layering "Platform Abstraction" provided by 'highly standardized Equipment Software
- \* Considerable emphasis in the search for common functions during **requirements analysis**
- \* Object-Oriented Design with aspects of abstraction and HMI interface (Virtual Equipment) for products with project-Model-Based
- \* Test from the context abstraction of detail, supported by the automatic generation of the Test Code and instrumentation add-on

## ■ Strategies under experimentation:

- \* Emulators "HMI terminals for retrieving the results of tests regardless of the technology implementation of HMI (alphanumeric terminal, ARINC661, etc.).
- \* Electronic ICD (DOORS plugin) for the integration of data interface requirements, with meta-structured XML representation for equipment.

### **Maximizing of component reuse and effectiveness of Avionics SW products**



- Reuse in airborne applications
- Porting of applications in a non-airborne avionics
- Architectures and methodologies for certification
- Reuse of architecture (Design Patterns)
- Code generation from reuse of Requirements
- Limits and Opportunities from the use of COTS components

## DO-178B SOFTWARE CERTIFICATION LEVELS

### LEVEL A

Software that could cause or contribute to the failure of the system resulting in a catastrophic failure condition.

		Catastrophic	Hazardous	Major	Minor	No safety effect
<b>Frequent</b>	$> 10^{-3} /h$	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Acceptable
<b>Probable</b>	$< 10^{-3} /h$	Unacceptable	Unacceptable	Unacceptable	Acceptable	Acceptable
<b>Remote</b>	$< 10^{-4} /h$	Unacceptable	Acceptable	Acceptable	Acceptable	Acceptable
<b>Extremely Remote</b>	$< 10^{-5} /h$	Unacceptable	Acceptable	Acceptable	Acceptable	Acceptable
<b>Extremely Improbable</b>	$< 10^{-6} /h$	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable

	Unacceptable
	Acceptable

### LEVEL E

Software that could cause or contribute to the failure of the system resulting in no effect on the system.

### CATASTROPHIC

which could potentially result in a fatality to crew or ground staff.

### HAZARDOUS

which could potentially result in serious injury to UAV crew ground staff.

### MAJOR

which could potentially result in injury crew or ground staff.

### MINOR

These conditions may include a slight reduction in safety margins or functional capabilities and a slight increase in UAV crew workload.

### NO SAFETY EFFECT

DO-178B provides the aviation community with guidelines for developing software for airborne systems and equipment that complies with accepted airworthiness requirements. The effort required to show compliance with the certification requirements for DO-178B is based on the associated failure condition category

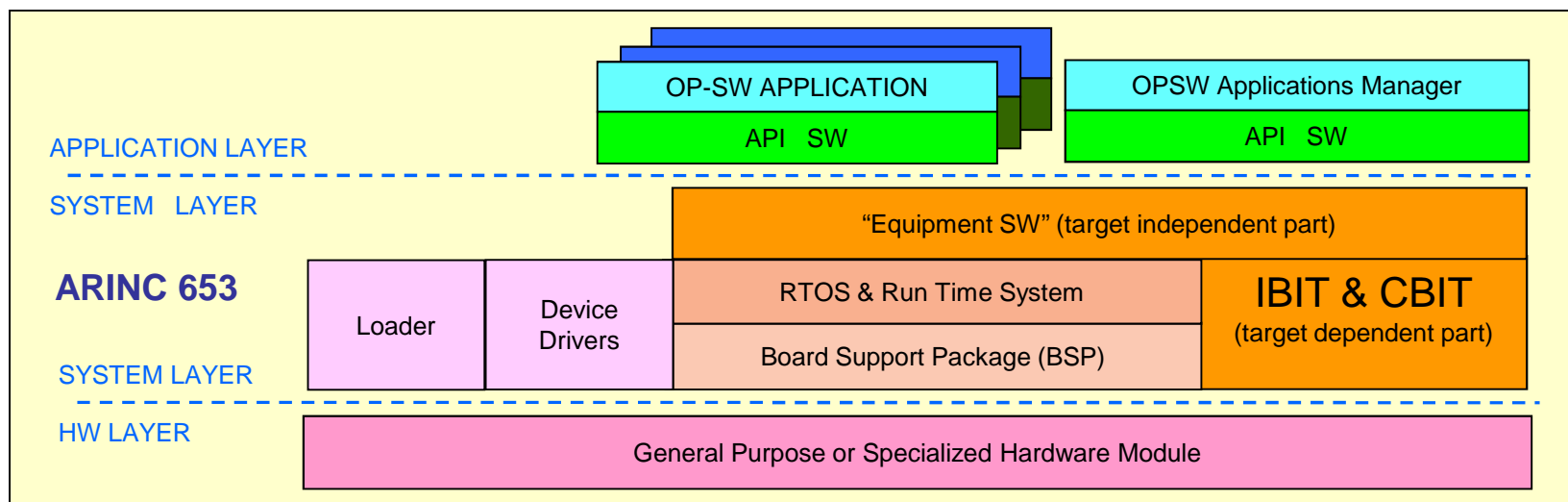
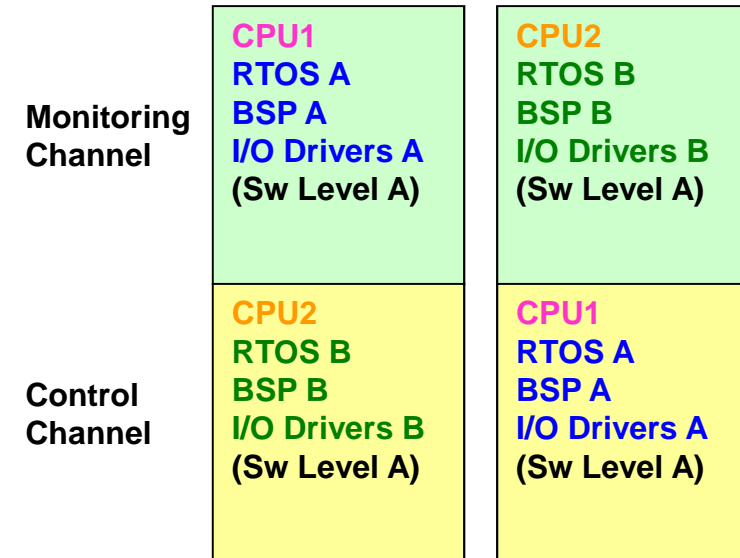
The cost to test and verify safety-critical software is directly proportional to the software level. The higher the software level, the more complex and expensive the development and verification process.



# IMA SW Dissimilarity

The software dissimilarity between the monitoring and control channels is achieved using different software development and test environment, executing each object code generated by different compilers, on a separate and dissimilar processor.

I.e. The run-time system must guarantee protection in both the **space and time domains**. lower software level CAN NOT, under any circumstance, disrupt the operation of the higher software-level functions



## ✦ Finmeccanica Profile

## ✦ Avionic Software

- ✦ Embedded Real-time
- ✦ Architectures Algorithms
- ✦ Software Engineering
- ✦ Safety Certification

## ✦ **Current methodologies and tools**

- ✦ **Requirements**
- ✦ **Design**
- ✦ **Coding**
- ✦ **Testing**

## ✦ **Avionic Software Products**

- ✦ **Examples from Finmeccanica**

# Typical Performance Requirements



- **Processing**
  - High Power Computing for Mission and Navigation application
  - **8.000 ÷ 10.000 MIPS**
  
- **Power Consumption**
  - Balancing between Performance and Power Consumption
  - **Less than 100 W**
  
- **Environmental conditions**
  - Adverse environment without ECS and cold plate available
  - **- 54 °C ÷ +71 °C (operating)**
  - Special conditions could potentially be applied on start-up at low temperature to lead start-up up to – 40 °C
  
- **Interfaces**
  - Massive interfaces capability required like Ethernet, ARINC 429, Discretes, Mil-bus 1553, analogue, video digital, serial RS 232/422/485, CCDL, AFDX, LVDS, fiber bus

## Typical code dimensions:

- Safety critical: 10 - 100 KLOC
- Ground systems: 100KLOC - 1.8 MLOC
- Mission systems: 200 - 300 KLOC
- Analysis/simulation: 100 - 200 KLOC
- Radar: 15KLOC - 1.2 MLOC
- Electrooptics: 5-100 KLOC
- Graphic systems: 10 KLOC – 1 MLOC

**Note: figures from different tools.**

## Methodology

Structured Analysis

UML, Structure Analysis

Structured Analysis

SysML, UML, Str. An.

Structured Analysis

Structured Analysis

Structured Analysis

## Tools

MS Word

Ilogix StateMate

CA Teamwork

Telelogic Doors

Presagis VAPS

BAE CoRE

IBM Requisite PRO

## Methodology

UML, Obj.

UML, Obj.

UML, Obj.

UML, Obj., Str. Des.

UML, Obj.

Hood

*“DSP, FPGA”*

## Tools

IBM Rhapsody

TNI Hood

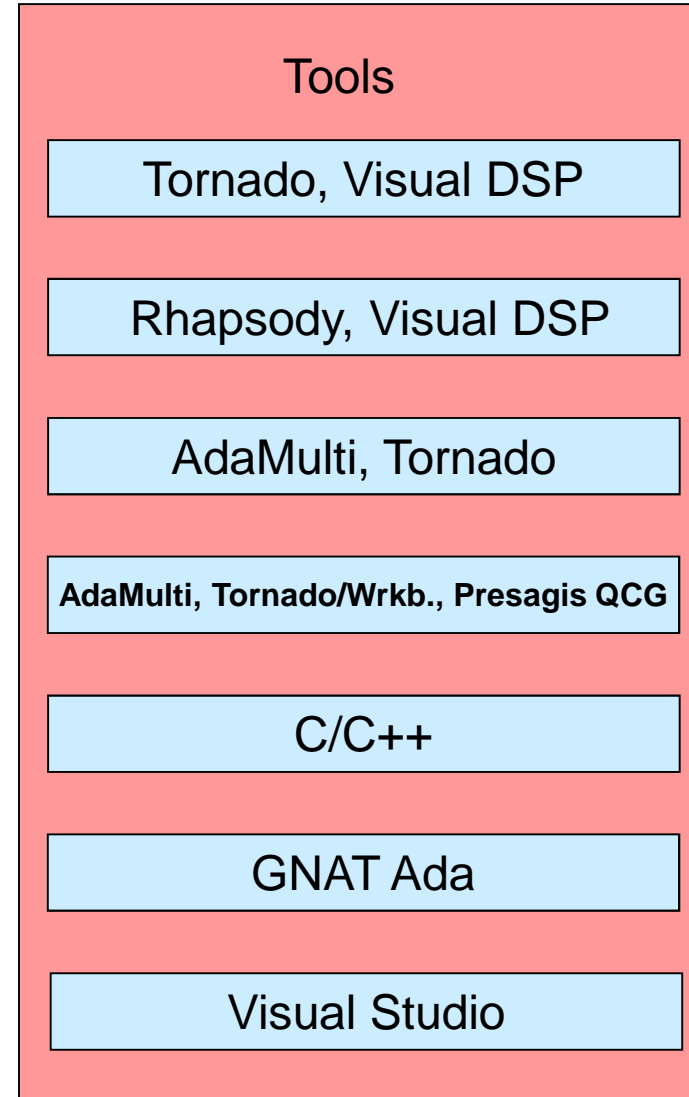
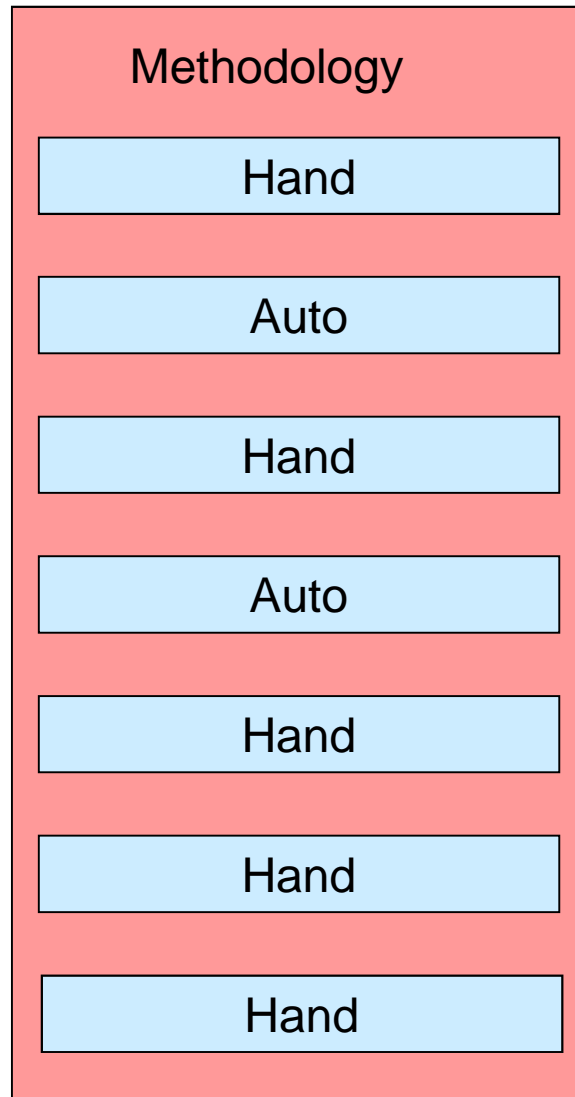
TNI Stood

VAPS, Rhaps., TNI Stood, Hood, Teamwork

Rational Rose

TNI Hood

Matlab, Simulink, MatrixX





## Methodology

Functional, W/B box

Functional

W/B box, Coverage

Coverage/Functional, W/B box

Code Coverage

RBT Functional

Functional

## Tools

Understand C++, Code Test

AdaTest

LDRA TestBed,

**VectorCast, AdaTest**

McCABE IQ

Rational TestMate

RationalTest Suite

## ✦ Finmeccanica Profile

## ✦ Avionic Software

- ✦ Embedded Real-time
- ✦ Architectures Algorithms
- ✦ Software Engineering
- ✦ Safety Certification

## ✦ Current methodologies and tools

- ✦ Requirements
- ✦ Design
- ✦ Coding
- ✦ Testing

## ✦ **Avionic Software Products**

- ✦ **Examples from Finmeccanica**



- **Eurofighter:**
  - Navigation Computer (NC, RC 2\*)
  - Non Safety Critical Armament Controller (NSCAC, RC 2)
  - Safety Critical Armament Controller (ESCAC, RC 1)
  - SPS Computer
- **Tornado:**
  - Pilot Navigator Head Down Display (PHDD/NHDD).
  - Enhanced Main Computer (EnMC).
  - Weapon Integration Package (WIP)
- **AM-X:**
  - Mission Systems
- **C27-J/JCA:**
  - Mission Computer (DO 178B Lev. A)
- **Sky-X, Sky-Y:**
  - UAV OBMC (DO 178B Lev. B)





- **Flight Control Systems civili (A109):** estensivo livello di riuso, Varianti del velivolo presentano dinamiche non lineari diverse che limitano ulteriormente il riuso del Design e di tutto ciò che ne deriva, in particolare nei loop di controllo primari.





- **EH101 di nuova generazione (US101, AW101, MCSP), Main Computer:** La gestione dei Requisiti in DOORS, una rivisitazione profonda del Design, oggi fortemente Object-Oriented (Artisan), e una architettura più modulare consente un buon riuso di Requisiti, Design e Codice.

Il riuso del Test è limitato dalle differenze di HMI tra le Varianti.

Requisiti, Design, Codice e parte del Test vengono riutilizzati, in larga misura, su AW149 e T129

- **Future Lynx Tactical Processor:** architettura basata su Stack ASAAC, che standardizza servizi, messaggistica e Macchine e Link Virtuali, consentendo la generazione automatica completa del Codice dal Design (Artisan). Il riuso è potenzialmente molto forte, tranne per il Test.

<p><b>SW Sviluppato</b></p>	<ul style="list-style-type: none"> <li>• Control Law SW</li> <li>• Air data</li> <li>• Autopilot/Flight Director</li> </ul>	
<p><b>Tools impiegati</b></p>	<p>SVILUPPO</p> <ul style="list-style-type: none"> <li>• AdaMulti di GHS</li> <li>• ARTISAN Realtime Studio (SyML/UML)</li> <li>• Matlab</li> <li>• Simulink</li> </ul> <p>VERIFICA</p> <ul style="list-style-type: none"> <li>• McCABE</li> <li>• Spark Examiner</li> <li>• Polyspace</li> </ul> <p>SUPPORTO</p> <ul style="list-style-type: none"> <li>• Requirements Management: Doors</li> <li>• Configuration Management: Serena Dimensions CM</li> </ul>	
<p><b>Linguaggi di sviluppo</b></p>	<p>ADA95 – Misra C</p>	
<p><b>Sistema operativo</b></p>	<p>OS Proprietario</p>	
<p><b>Protocollo di comunicazione</b></p>	<p>CCDL Proprietario e MIL-BUS 1553</p>	
<p><b>Certificazione del SW</b></p>	<p>Airborne Software Level A i.a.w. RTCA DO-178B</p>	

## Radar

### Airborne:

- Fighter (Grifo, G7)
- Meteo (RAN)



### Helicopter:

- Surveillance (HEW 784, NH90, Gabbiano)

### Shipborne:

- PAR for carriers (SPN 720)
- Navigation (SPS 702, SPN 730)

### Ground:

- Airport surveillance (SMR)
- PAR (P20xx)
- Air surveillance (P2091)

### Missile:

- Seeker (MARTE)

## Graphic Systems for Cockpits

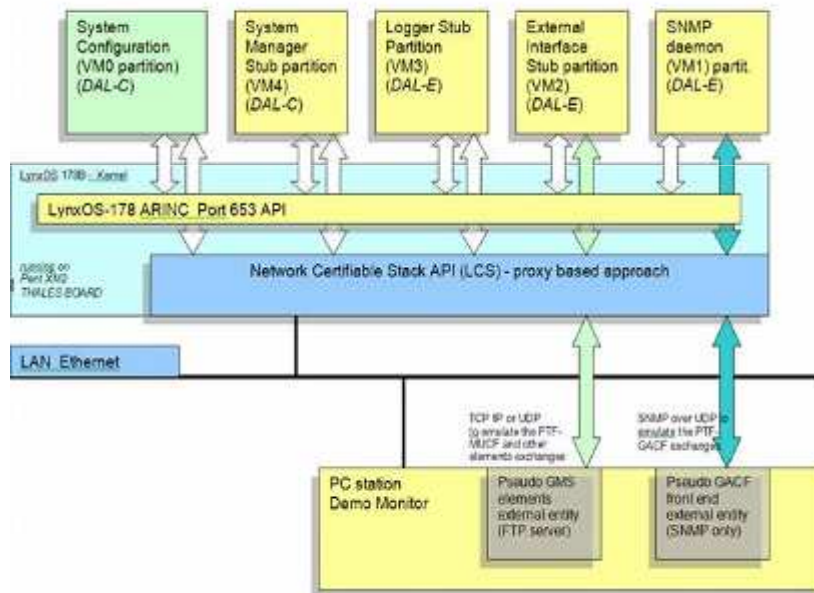
Systems and subsystems for graphic and imaging presentation. Target platforms are aircrafts and helicopters.

The most important programs are:

- EFA T2 – Symbol generators, aircraft bus protocols, display monitoring
- EFA – Helmet interface and processor unit
- M346 – Raster and stroke symbology, display and HUD controller
- Tornado – TV tabular Display
- AMX – Controller, HUD symbol generator
- NH90 – Mission symbol generator



## Galileo GMS Precise Time Facility

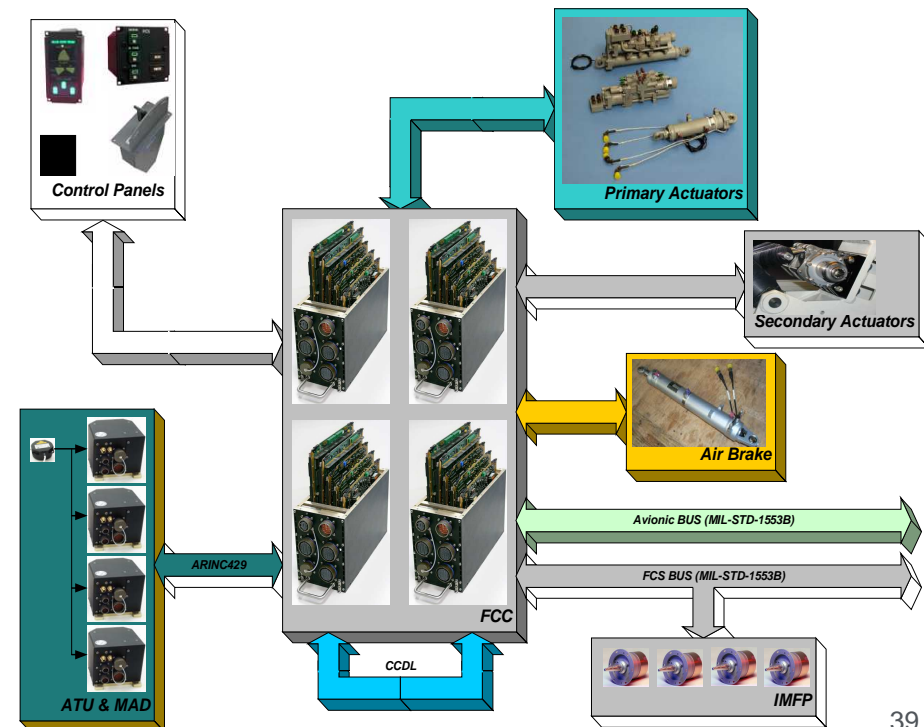


## Flight Control Computer M346

*Digital full-time, full authority fly-by-wire*

*Quadruplex fault tolerant redundant system providing two-fail-operate/ fail-safe capability*

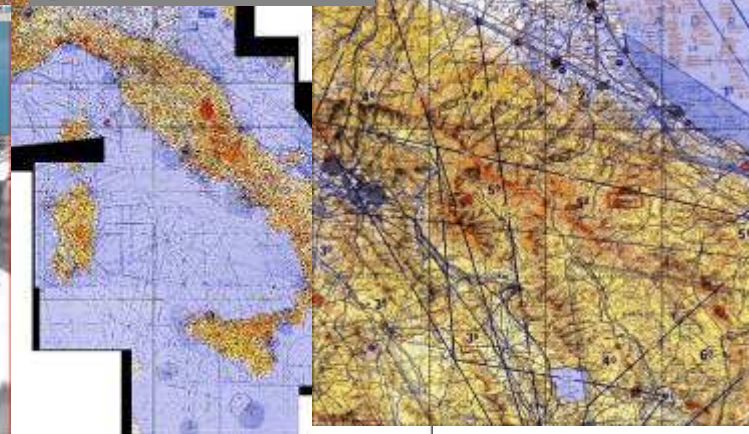
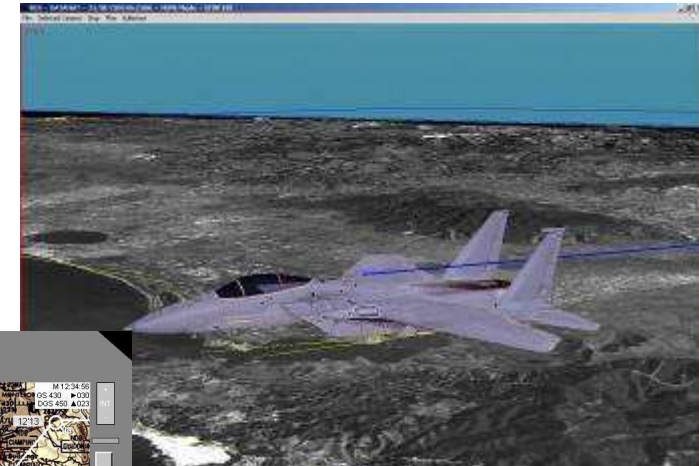
*Probability of loss of control due to flight control system failure is less than one in 10 million flight hours*



# ElsagDatamat – Software Developments



**Integrazione del RES™ (una tecnologia per la visualizzazione di scenari 2D e 3D, completamente sviluppata da Elsag Datamat) negli apparati Digital Map Display, prodotti dalla Selex Galileo e per la pianificazione della traiettoria balistica dei missili MBDA.**





# MBDA – Software Developments

- MBDA IT main lines for SW are:
  - Ground C2
  - Embedded SW for missiles
  - Mission Planning
  - Training



## EMBEDDED SOFTWARE IN MISSILES

- SW application:
  - Algorithm
  - OS
- No certification even id looking at Safety
- SW Life cycle
  - To ask
- Environment
  - Mainly in house product
- Language
  - VHDL, System C



# Selex-Communications – Software Developments



## Platform

## Network Centric Communications

### Display & Control Panels



### Data Links



### Self Protection



### Identification



### Navigation



### Communications



# FINMECCANICA LINUX



DO-178B



Create a common reference Linux distribution that Satisfy all FNM companies' needs in a single product:

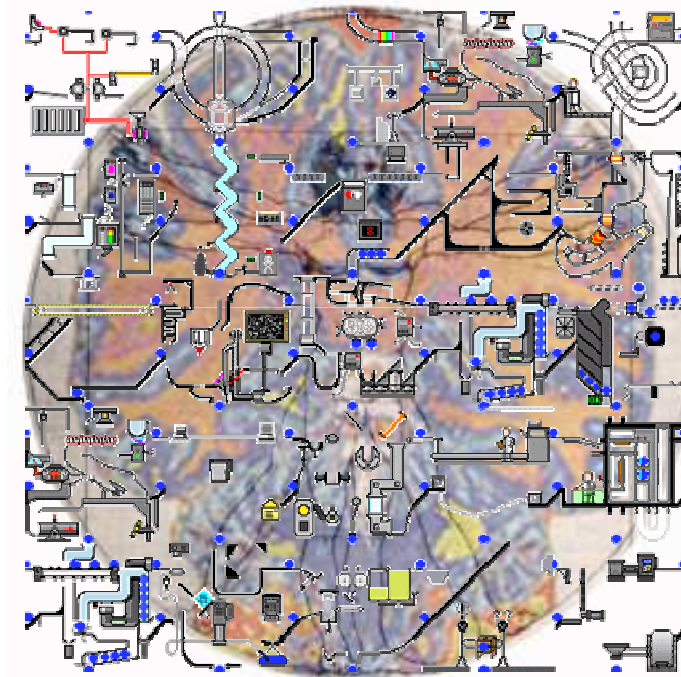
- Hard Real Time on multi-core CPU
- Scalability (from embedded –avionics- to workshop –networking-)
- Architecture heterogeneity (x86, PPC, ARM, Cell,...)
- Safety (DO178B, ARINC 653, IEC 61508,...)

Reduce dependence on a product,  
less risk for "locking in" effects  
overall Lower costs  
Increase quality and stability  
In house Know-how development



**Embedded  
Real-time**

**Software  
Engineering**



**Architectures  
Algorithms**

**Safety  
Certification**

*Thanks for your attention*