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# DIGITAL AVIONICS

# A CORNERSTONE OF AVIATION

by

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Presented to the NASA Formal Methods Workshop

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N91-12560

# DIGITAL AVIONICS - A CORNERSTONE OF AVIATION

## INTRODUCTION: Avionics Roles

- Communication
  - HF and VHF
  - Satellite
  - Data Links
- Navigation
  - Ground-based systems
  - Inertial and satellite-based systems
    - Goal: Autonomous operation!!!

# DIGITAL AVIONICS - A CORNERSTONE OF AVIATION

INTRODUCTION

CURRENT EXAMPLES

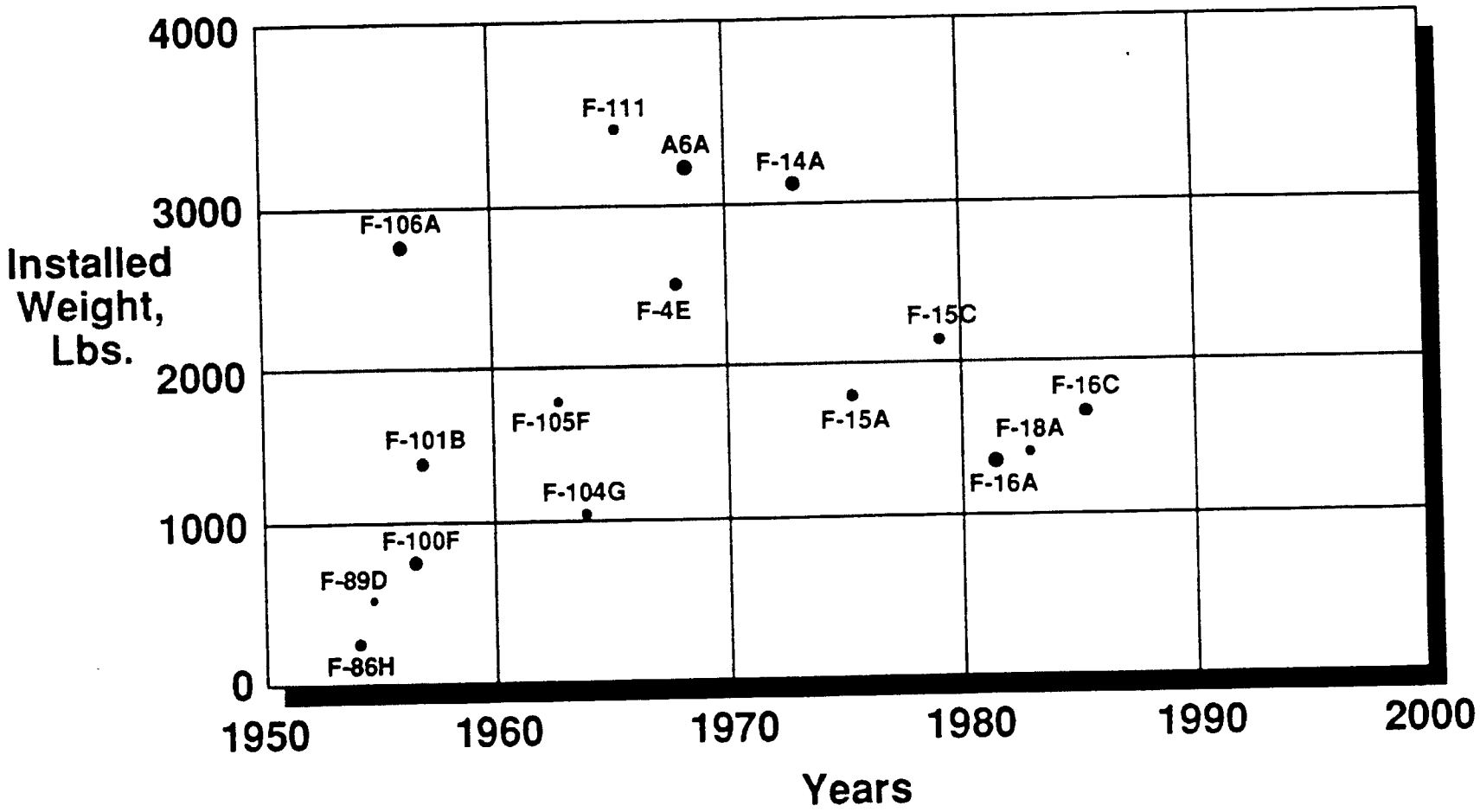
CURRENT ISSUES

FUTURE TRENDS

INTERNATIONAL SCENE

SUMMARY

# FIGHTER INSTALLED AVIONICS WEIGHT

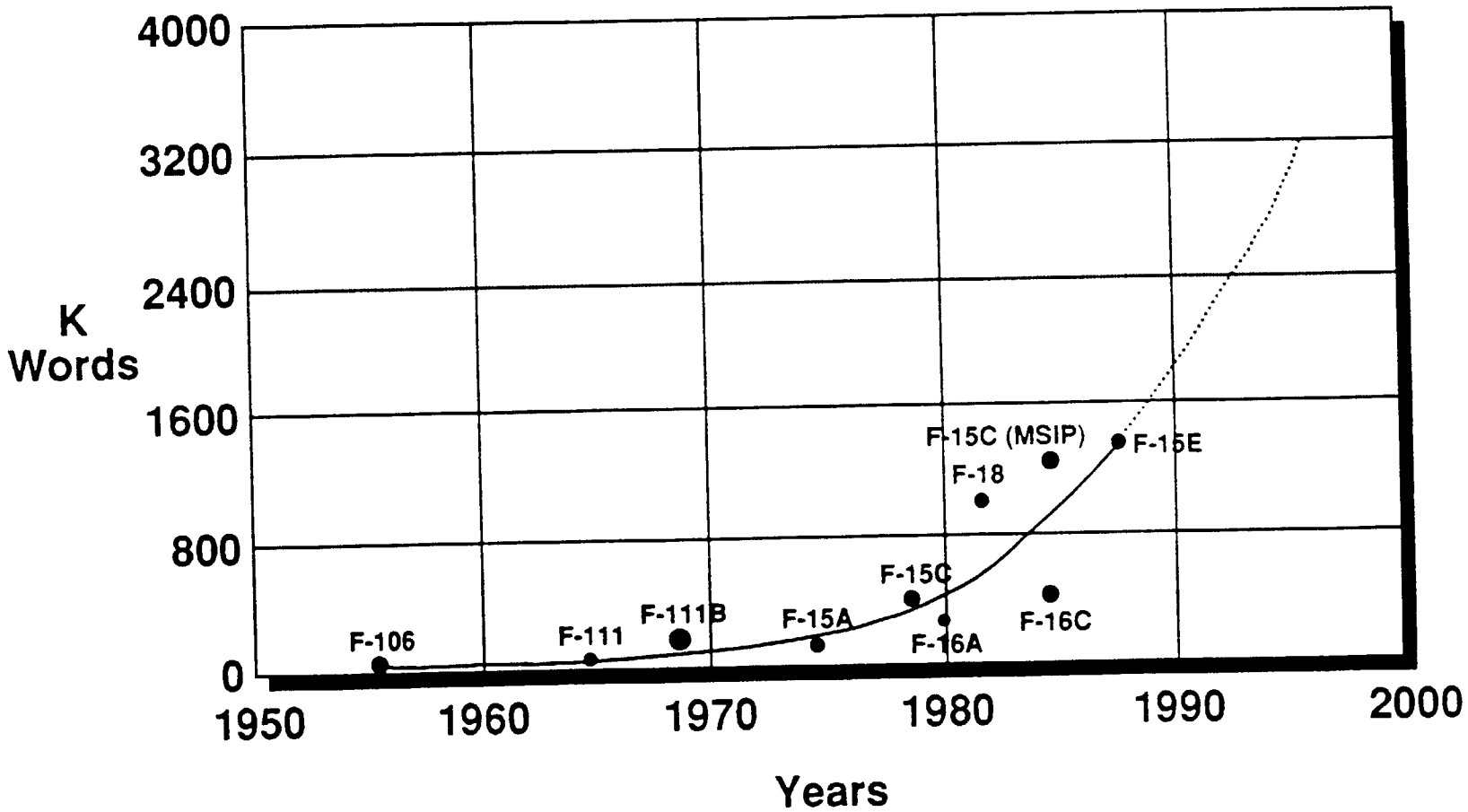


# DIGITAL AVIONICS - A CORNERSTONE OF AVIATION

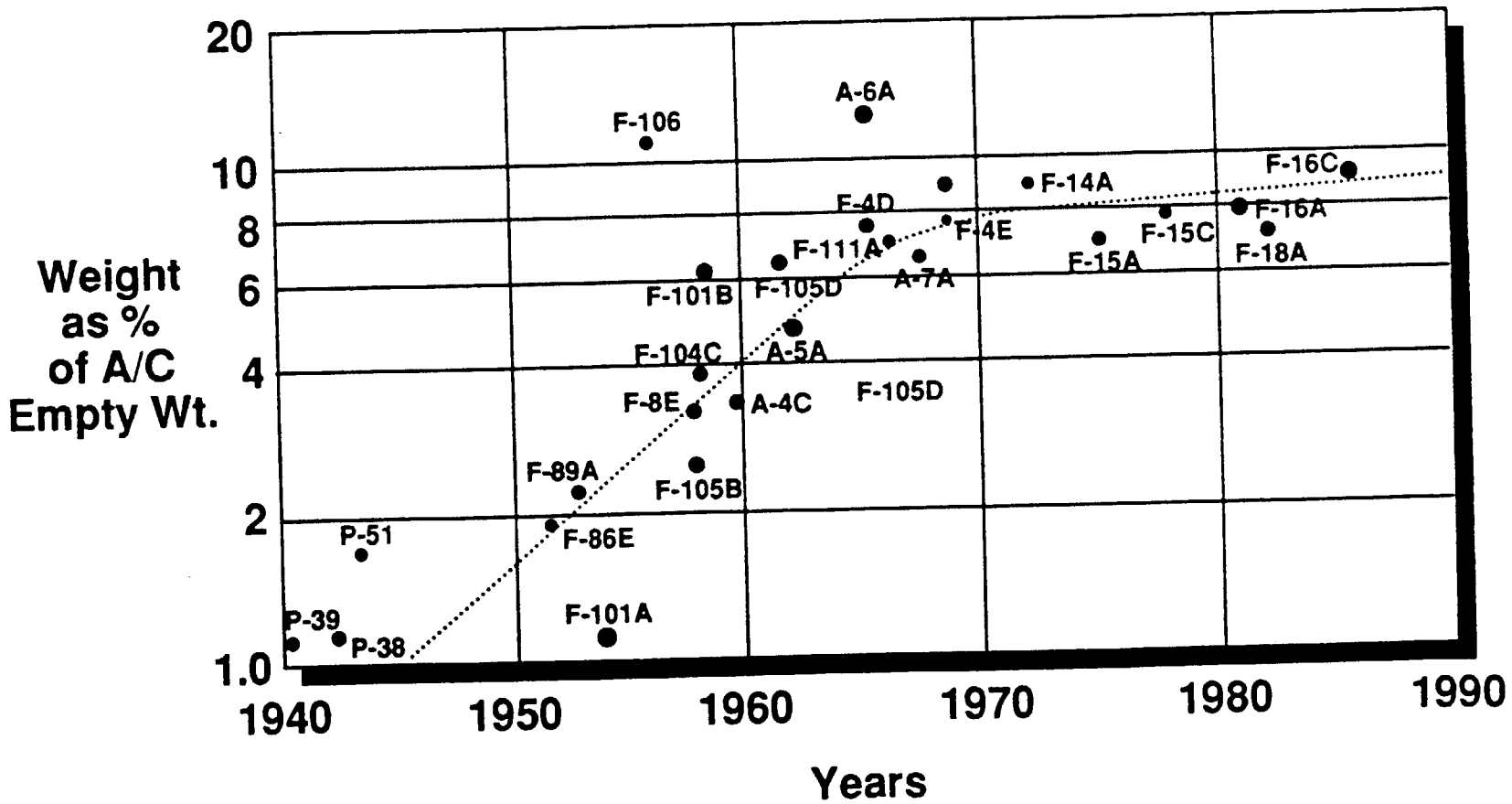
## INTRODUCTION: Avionics Roles

- Fly-by-wire flight controls
  - Historically used for stability & control augmentation
    - Not flight critical
  - Emerging as a flight critical system
    - Driven by performance and economic demands
    - F-16, A-320, B-777

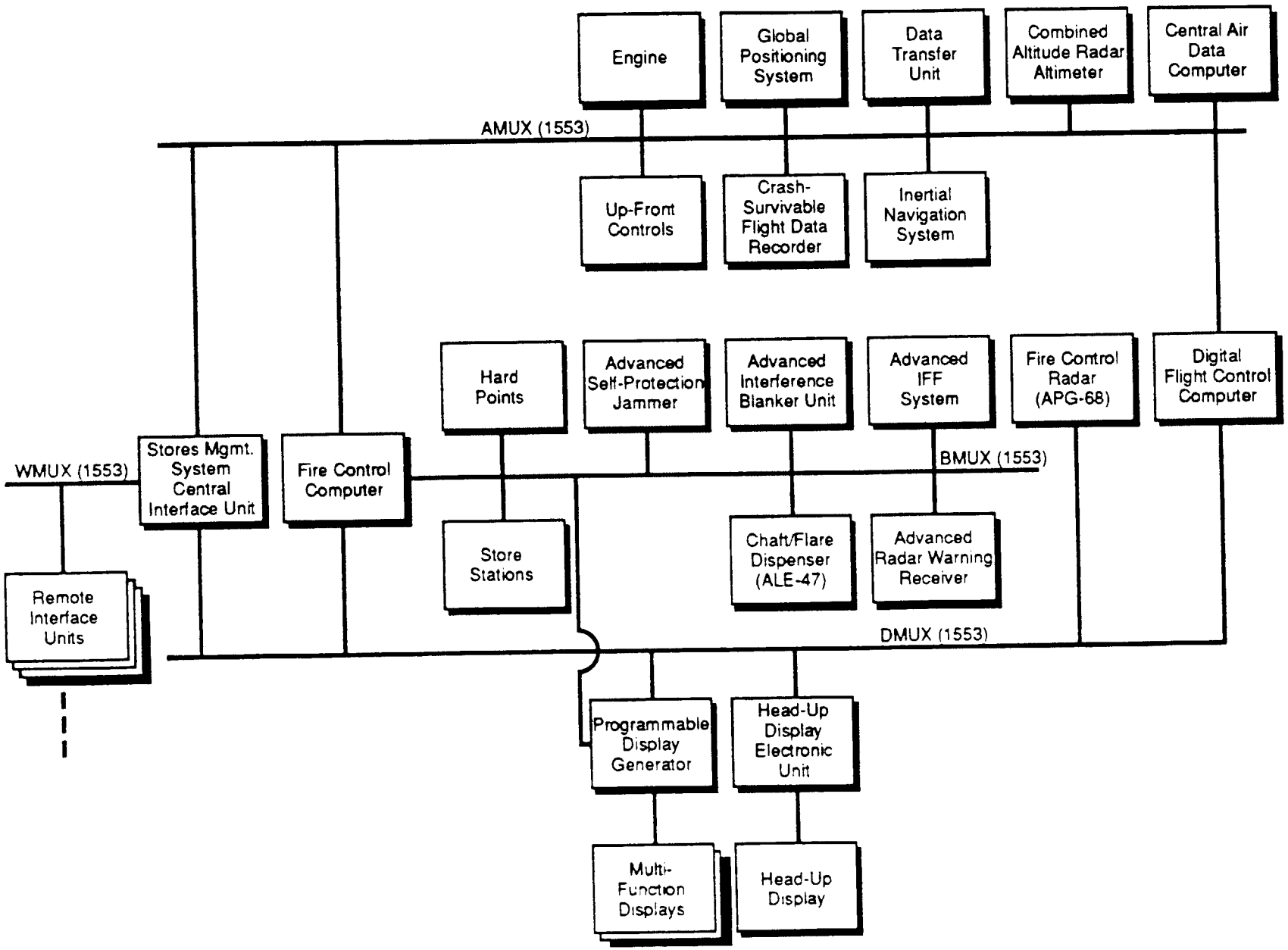
# TOTAL ON BOARD COMPUTER CAPACITY (OFP)



# TRENDS IN AVIONICS ABOARD FIGHTER/ATTACK AIRCRAFT



# F-16 AVIONICS SYSTEM ARCHITECTURE



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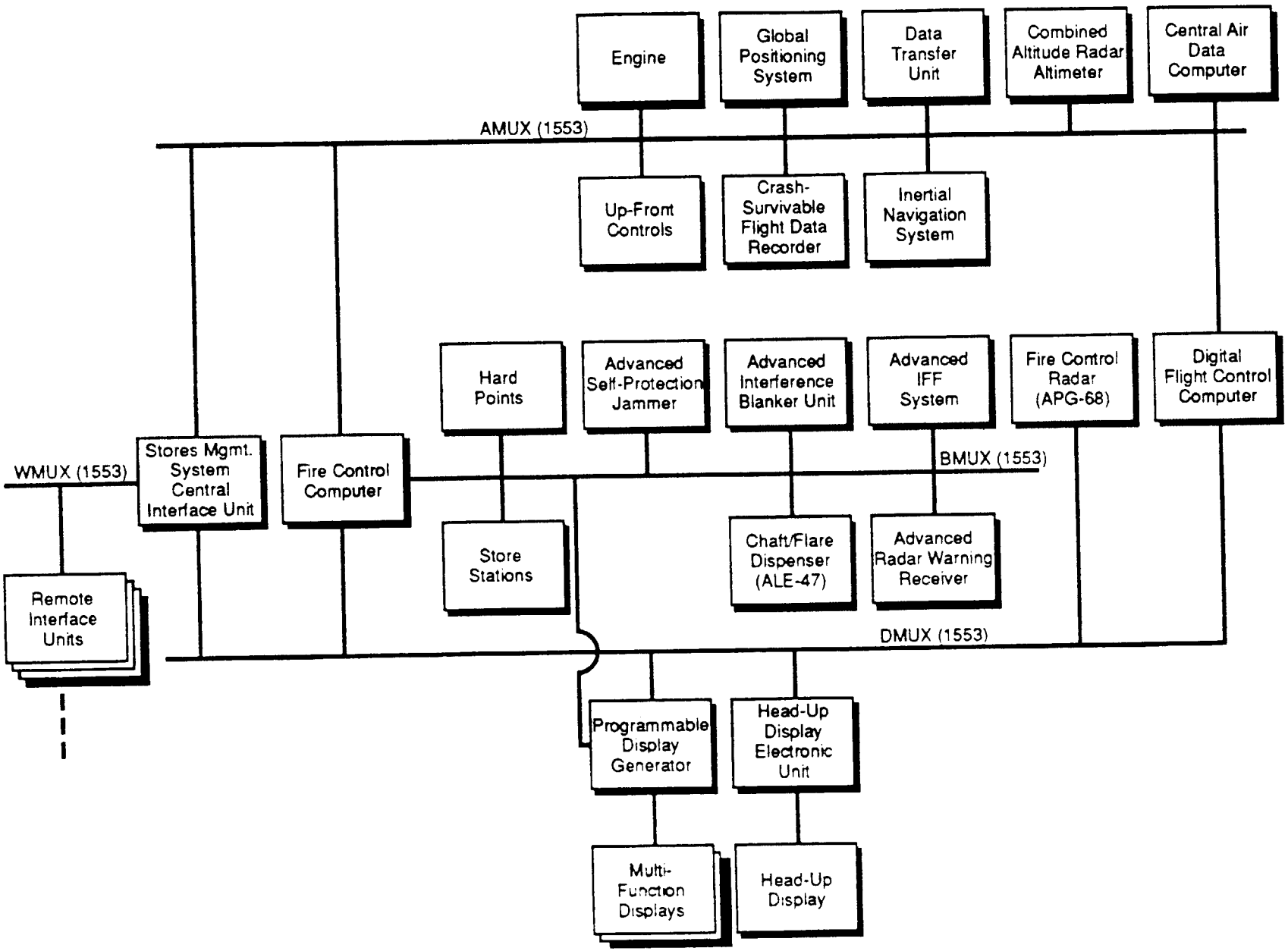

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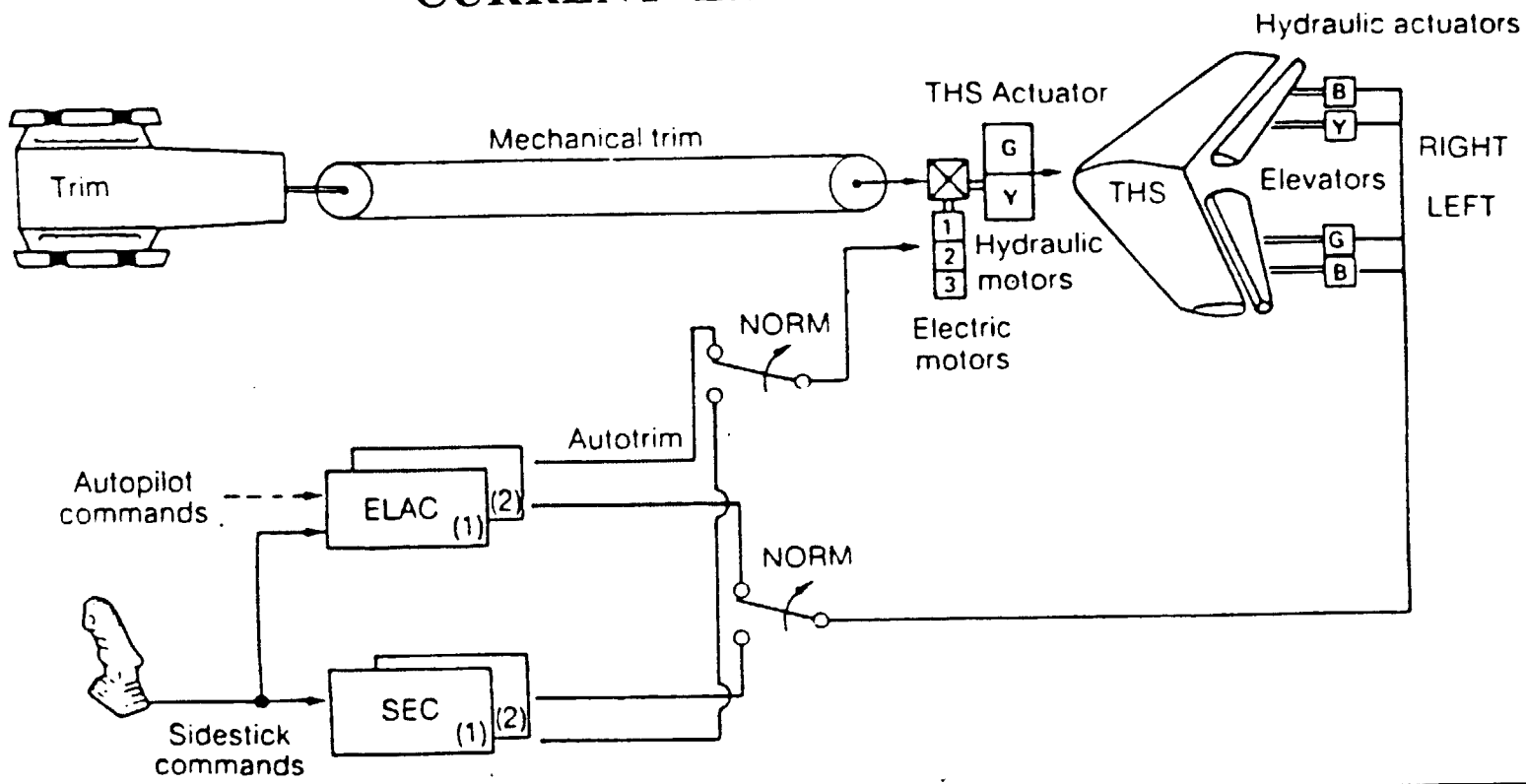
## CURRENT EXAMPLES: A-320




| | | | |
|---|---|---|---|
| THS | Trimmable horizontal stabilizer | | Hydraulic |
| ELAC | Elevator and aileron computer | B | Blue system |
| SEC | Spoiler and elevator computer | G | Green system |
| | | Y | Yellow system |

Pitch Control

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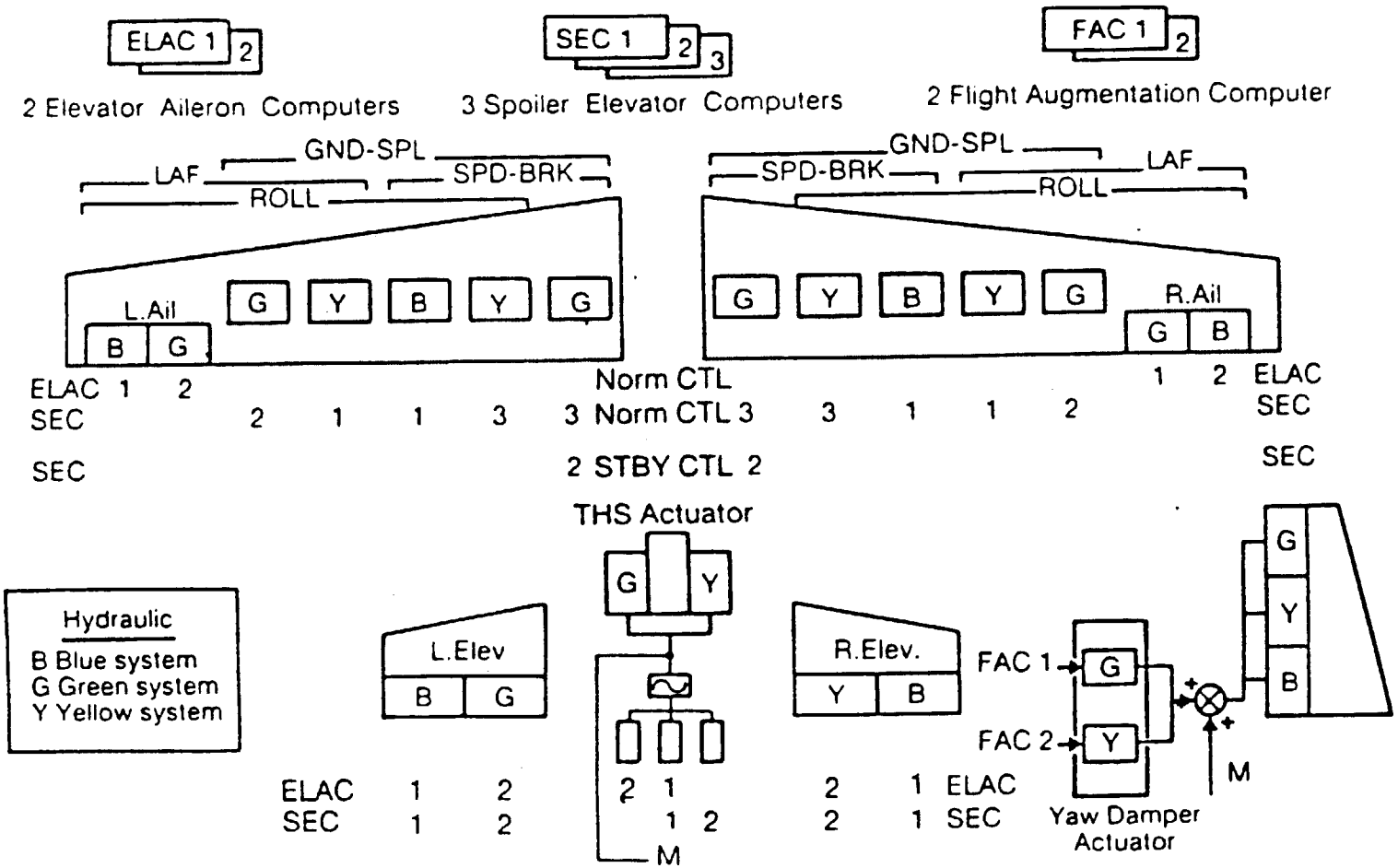
## CURRENT EXAMPLES: A-320




Electronic Flight Control System Architecture

# DIGITAL AVIONICS - A CORNERSTONE OF AVIATION

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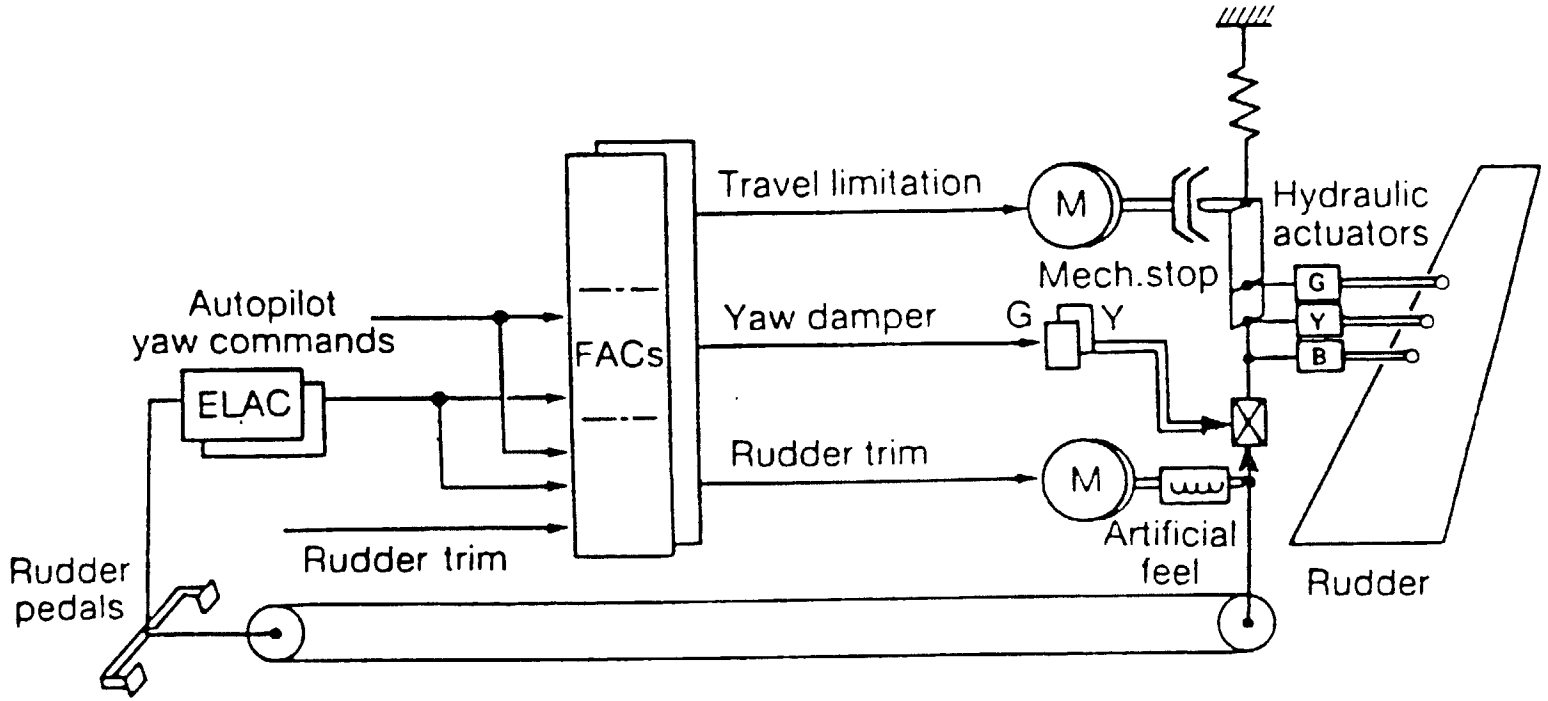


| | | | |
|---|---|---|---|
| M | Motor actuator | Hydraulic | |
| FAC | Flight augmentation computer | B | Blue system |
| | | G | Green system |
| | | Y | Yellow system |

Yaw Control

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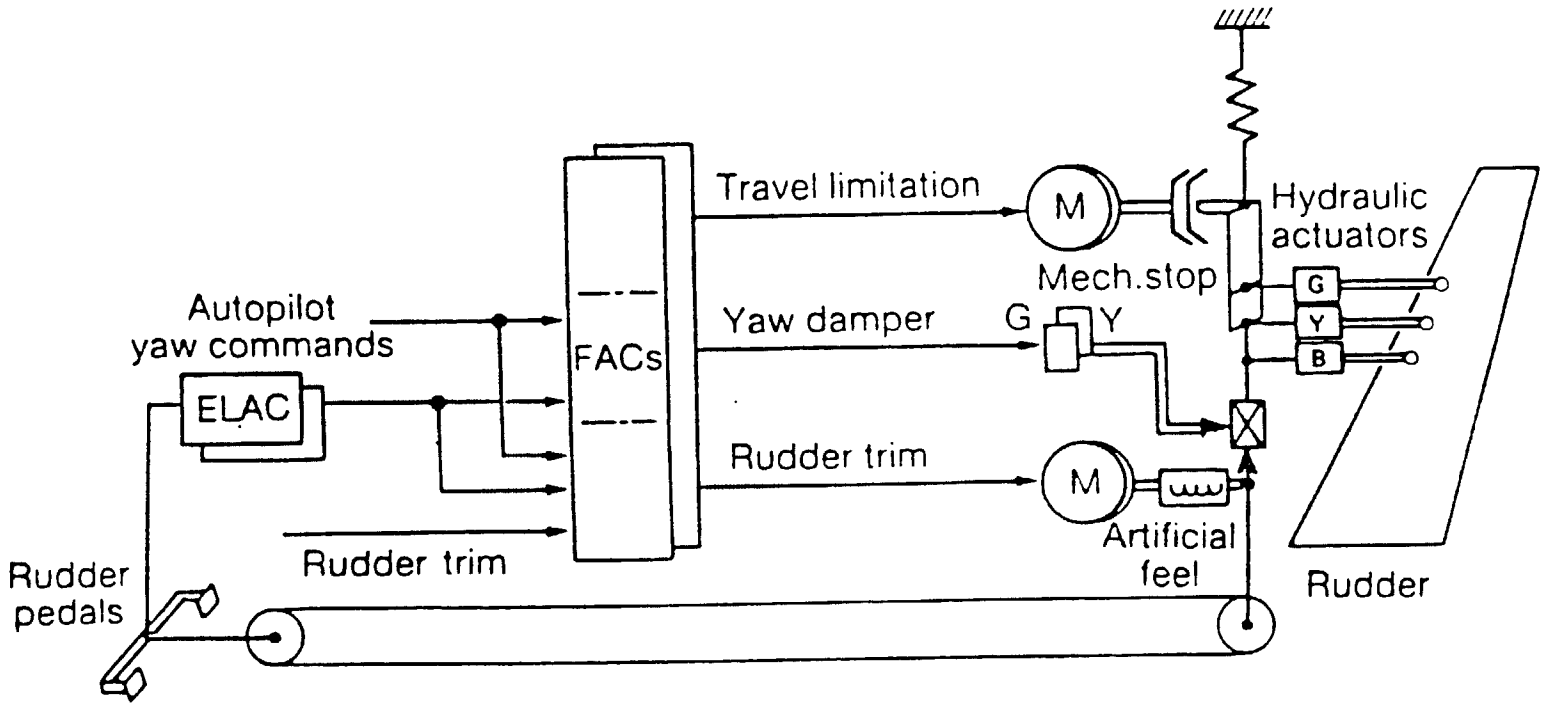


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# DIGITAL AVIONICS - A CORNERSTONE OF AVIATION

## CURRENT ISSUES: Hardware

- Modeling of complex systems
    - Proof of fault tolerance, high reliability
- Electromagnetic interference
    - Growing concern due to composite aircraft, increased emission of RF, and smaller electronic element sizes

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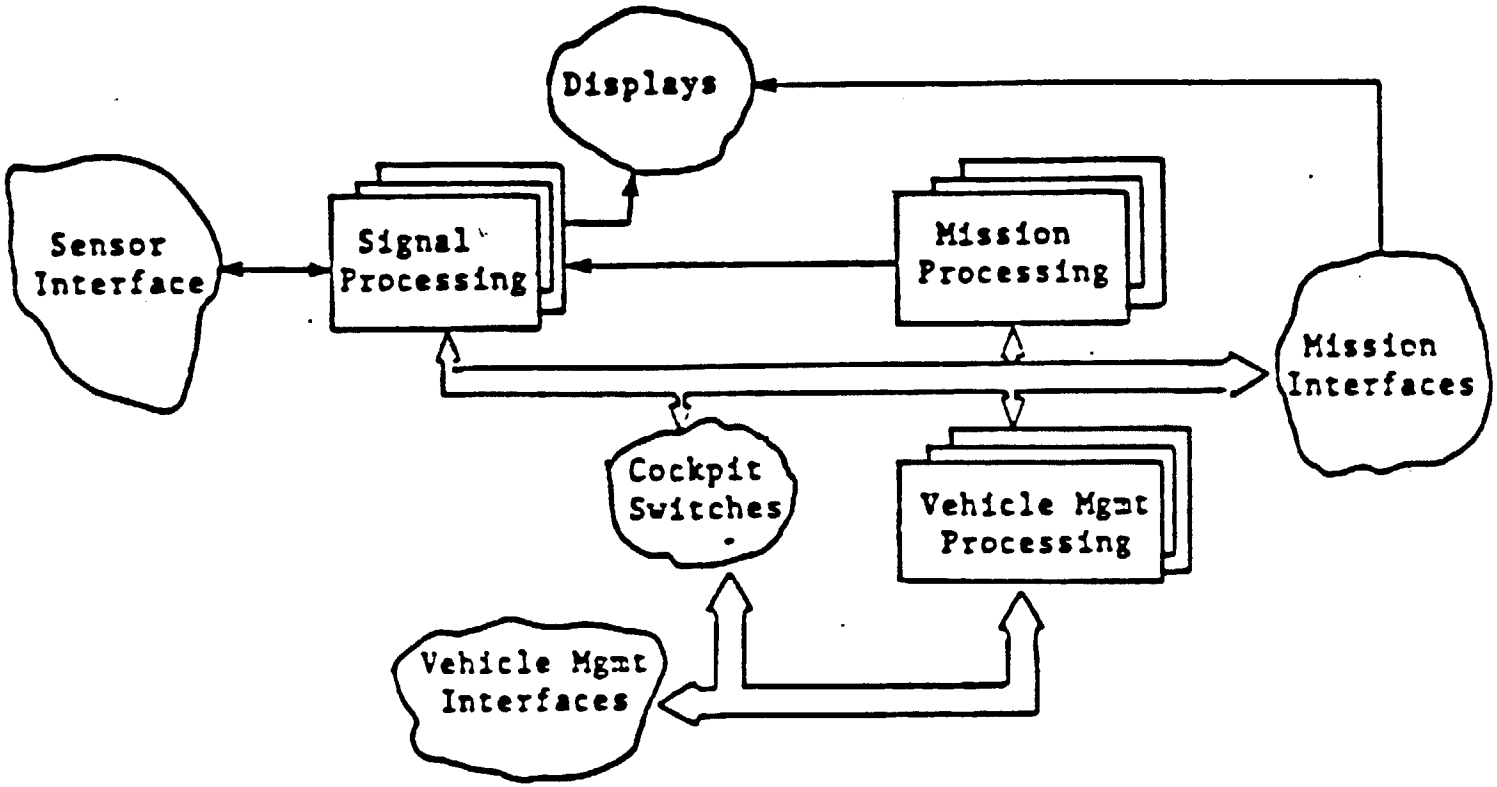
## FUTURE TRENDS: PAVE PILLAR



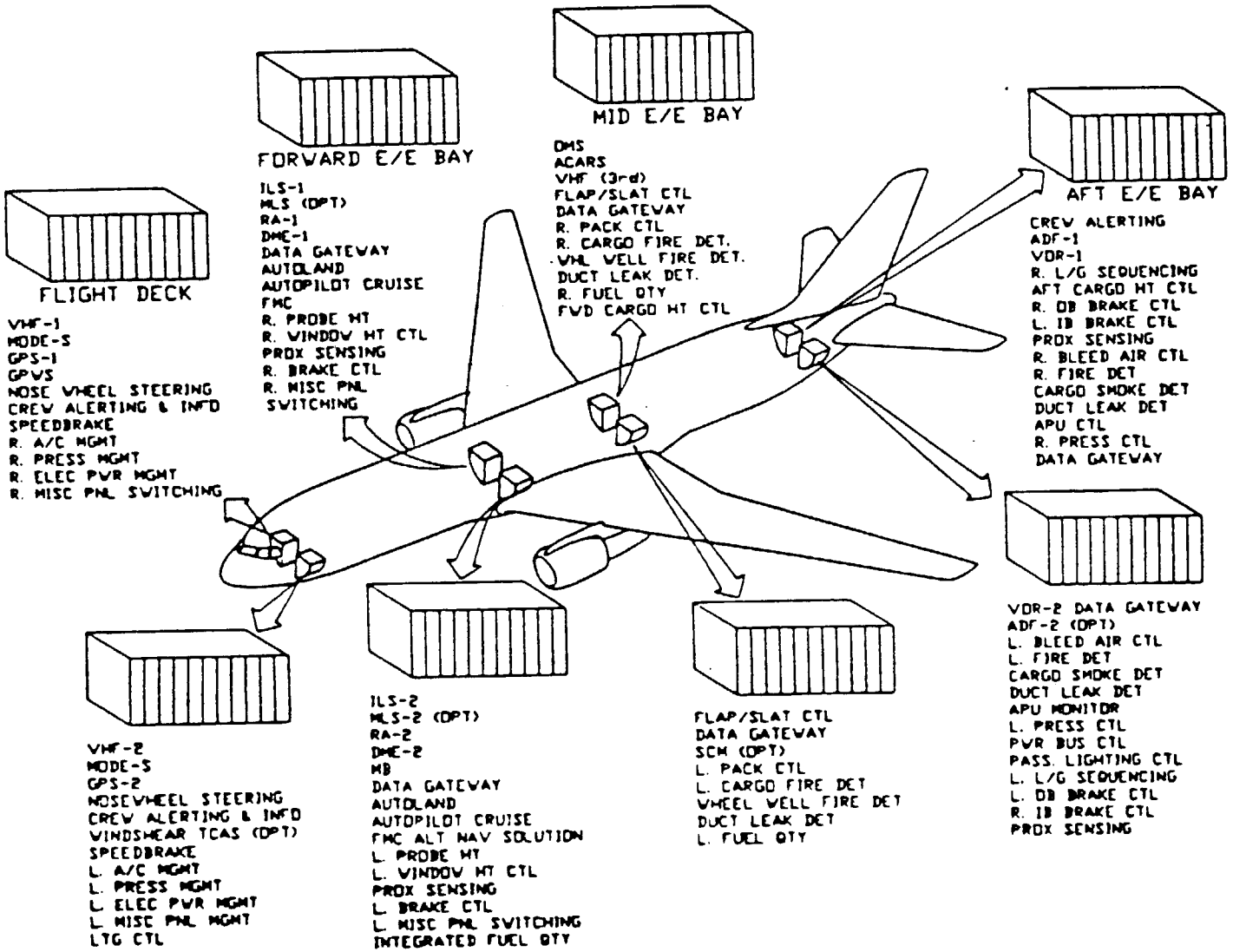
# DIGITAL AVIONICS - A CORNERSTONE OF AVIATION

## CURRENT ISSUES: Software

- Developing competency in Ada
  - Mandated for DoD, Space Station Freedom, civil transports
- Computer-Aided Software Engineering (CASE) Tools
  - Capabilities for real-time software analysis & design
  - Tool validation

# DIGITAL AVIONICS - A CORNERSTONE OF AVIATION

## FUTURE TRENDS: INTEGRATED MODULAR AVIONICS

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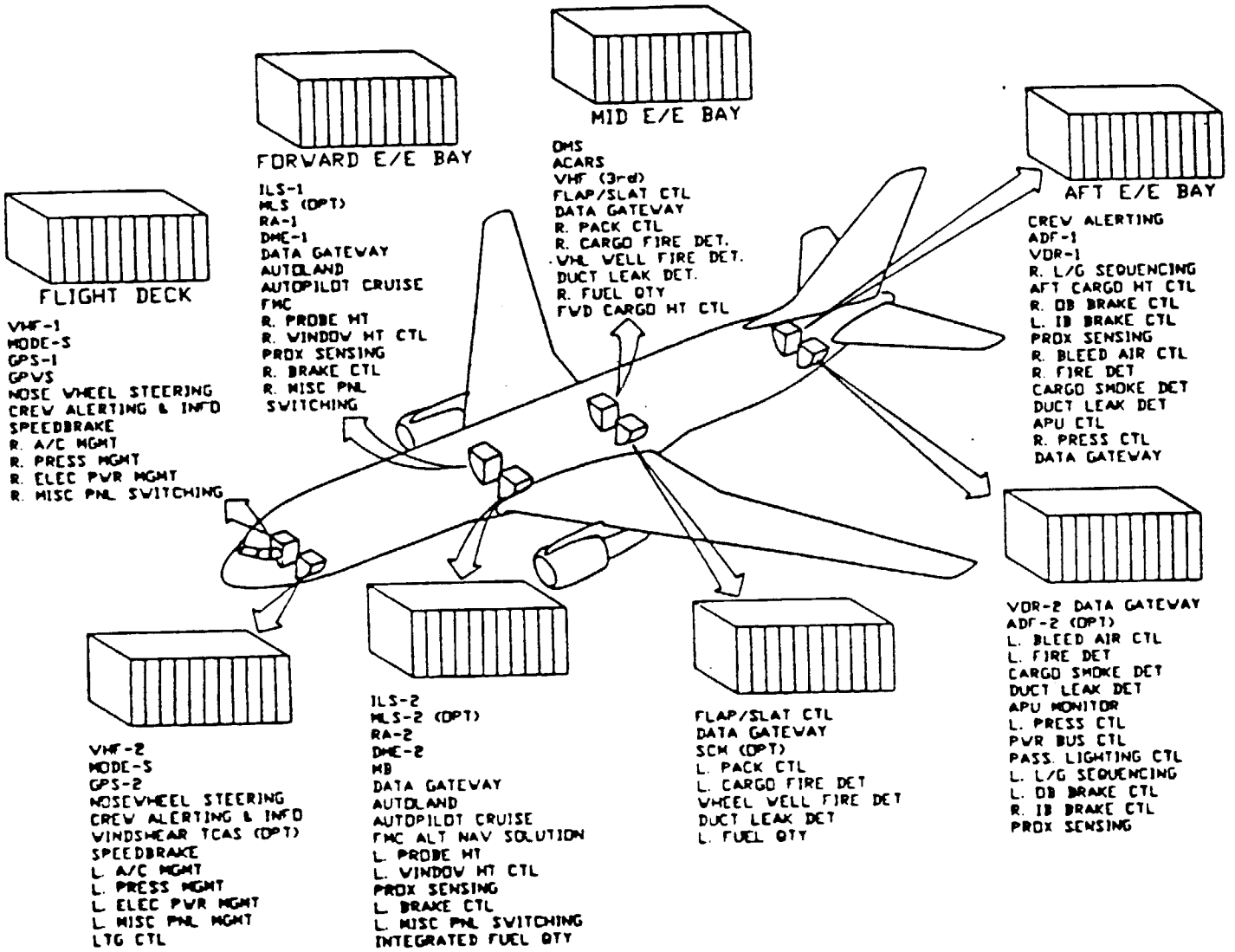


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# DIGITAL AVIONICS - A CORNERSTONE OF AVIATION

## FUTURE TRENDS: Supporting Technologies

- Flat panel, full color, liquid crystal displays
  - Replacing CRTs
  - Advanced formats; not electronic steam gauges
- Higher speed data buses
- Artificial intelligence pioneer programs
  - Faultfinder
  - Diverter
  - Pilot's Associate

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## INTERNATIONAL SCENE: Japan

- An emerging competitor in the world market
- Historically has been component oriented: displays, microprocessors, etc.
- Lack system design and analysis, & software capabilities
    - FS-X program will help to build a foundation for military & civil avionics
- MITI has established a committee to define an avionics technology development plan

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## SUMMARY

- Continually expanding role for avionics
- Flight critical avionics are here
- Strong emphasis on Ada
- Module-based architectures emerging
- Artificial intelligence applications being developed
- Significant competitive threat to U.S. firms from Europe & Japan