

Intelligent Distributed Control / Prognostic Health Management (IDC/PHM)

The Direction Engine Control Integration With HM Technologies Should Lead

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Honeywell

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- **Synergy Programs**
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- **Architecture**
- **Benefits**

Provide IDC/PHM Solutions for Aircraft Systems

I Performance Enhancement for Unmanned and Manned Vehicles

- ◆ Improve pilot's capability to manage vehicle and mission assets
- ◆ Develop the capability to make decisions autonomously

II Energy Management

- ◆ Develop the capability to control the energy available to meet the demands of Directed Energy Loads

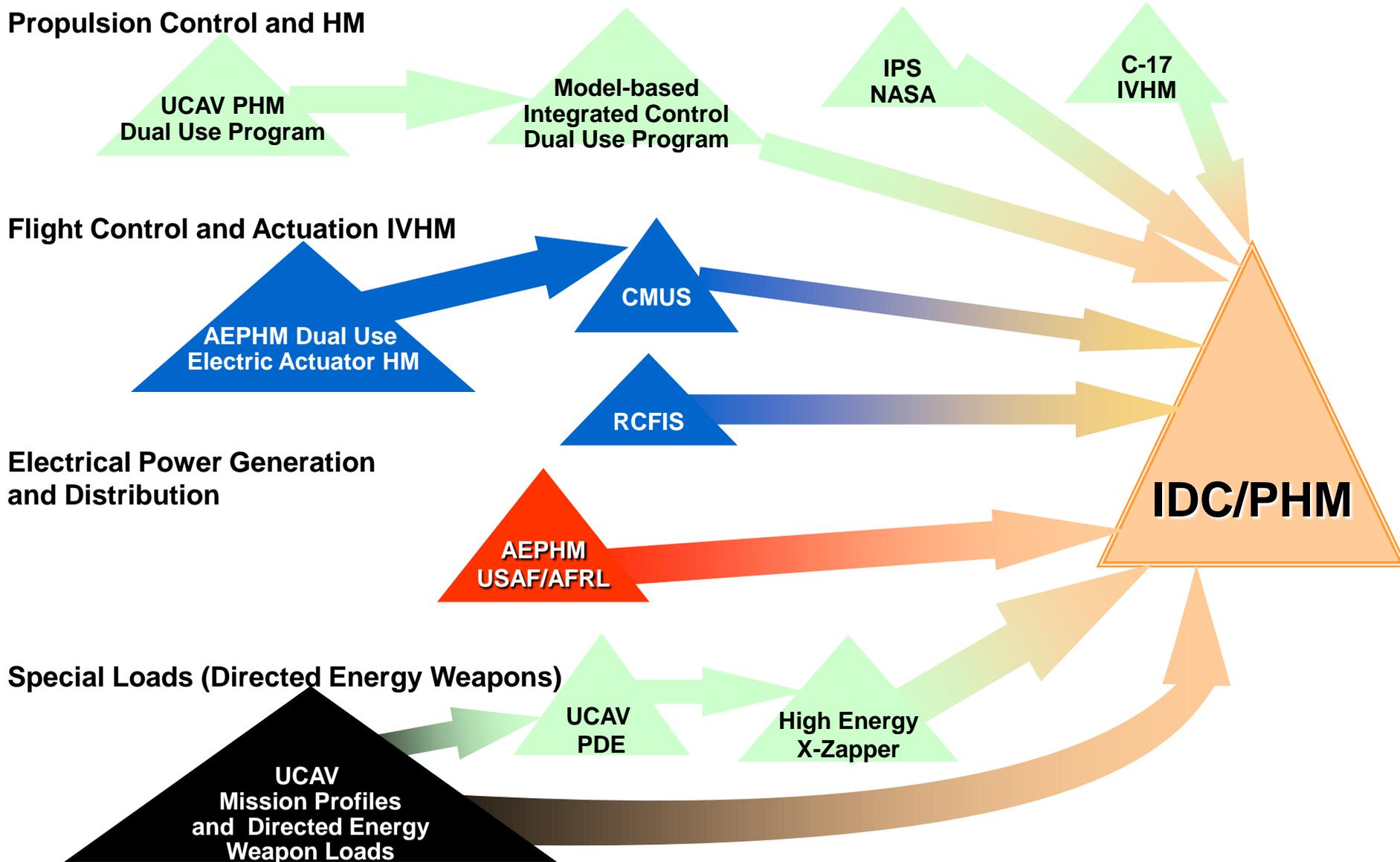
III Onboard/Off-board Life Extending Control (Vehicle Life Management)

- ◆ Develop the capability to control aircraft and engine to maximize component life

Synergy Programs

Customer	Programs
1. NASA	Intelligent Propulsion System (Intelligent Vehicle System) <ul style="list-style-type: none"> • Integrated Health Management • Integrated Health Management & Controls • Integrated Health Management, Controls & Operations
2. NAVAIR	Integrated Airplane Health Management (IAHM) <ul style="list-style-type: none"> • Commercial • F/A-18 E/F Flight Controls
3. USAF	C-17 Integrated Vehicle Health Management <ul style="list-style-type: none"> • AWODS/GBR
4. AFRL	UCAV X45A Propulsion Prognostics Health Monitoring <ul style="list-style-type: none"> • PHM Algorithms for F124 engine on X45A platform
5. NASA AMES	Integrated Propulsion Engine & Vehicle Control <ul style="list-style-type: none"> • F-16
6. NAVAIR	Reconfigurable Control and Fault Identification <ul style="list-style-type: none"> • Integration of hydraulic actuator health management, capabilities estimation and adaptive control to get optimal use from actuator.
7. USAF/AFRL	Aircraft Electrical Power System Prognostics and Health Management (AEPHM) <ul style="list-style-type: none"> • Health Management for Electro-mechanical Actuators, Fuel Pumps and Valves, Wiring and Generators
8. USAF/AFRL	Control of Multiple Unmanned Systems (CMUS) <ul style="list-style-type: none"> • System Level Reconfigurable Flight Control • Adapt subsystem level actuator control of electro-mechanical actuator diagnostics/prognostics.
9. AFRL	Electrical Power for Pulsed Directed Energy for Unmanned Air Vehicles <ul style="list-style-type: none"> • Power Generation System 300KW Capability; 40KW for ISR Mission
10. AFRL	Auxiliary Power System for the Raytheon High Energy X-Zapper

Synergy Programs



Objectives / Synergy

I. Performance Enhancement for Unmanned and Manned Vehicles

- ◆ Improve pilot's capability to manage vehicle and mission assets
- ◆ Develop the capability to make decisions autonomously

1: Aircraft Power Management

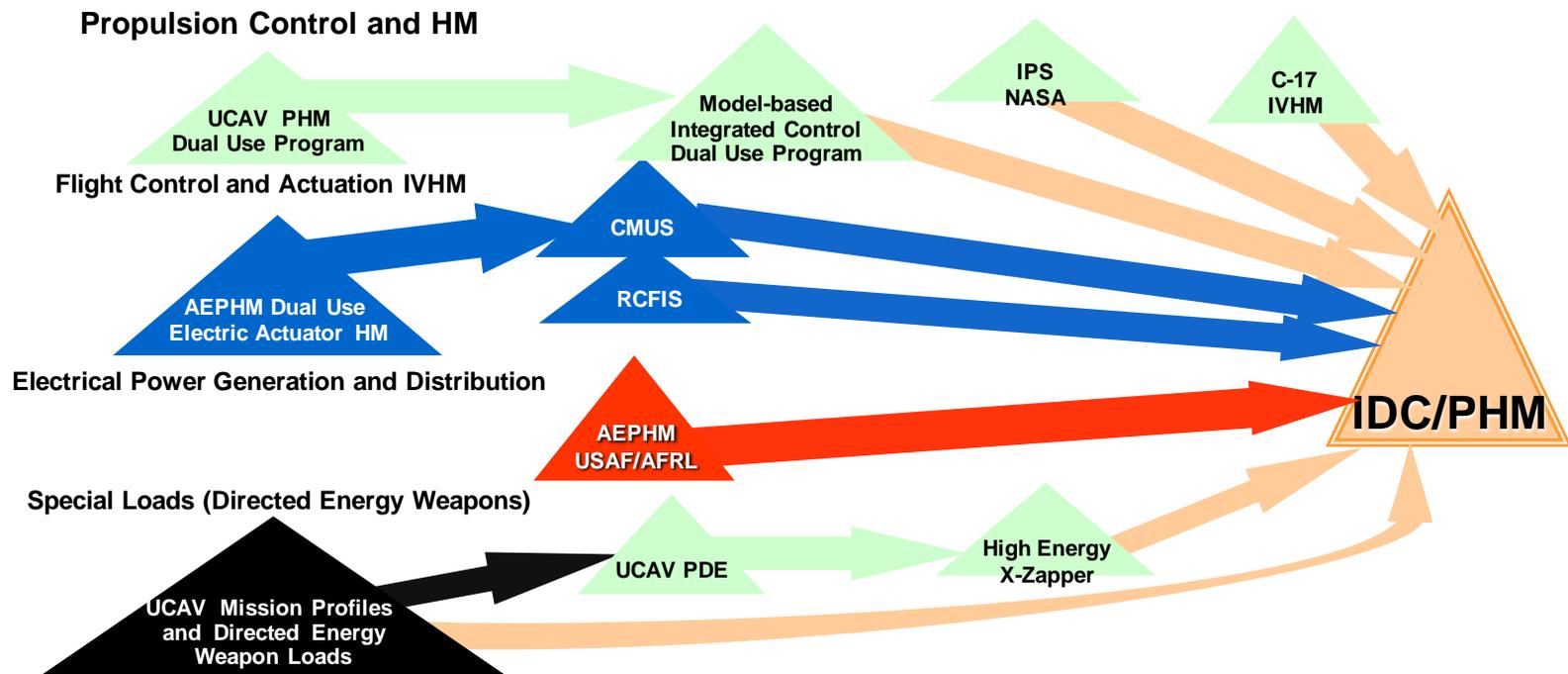
- A) Identify aircraft mounted generator power management controls for appropriate power demand loads. Airframe has two generators driven by a shaft on the propulsion engine.
- B) Optimize generator availability with DE loads needs.
- C) Identify and limit DE loads with high power demands to short duration.
- D) Manage flight control energy requirements.

2: Propulsion Health Management /Control

- A) Degradation due to combat damage and associated accommodations.
- B) Accommodation and optimization of power extraction at level of maximum power availability
- C) Accommodation for engine surge, flame-out, and stall
- D) Optimization of engine life traded with current capability
- E) Performance loss for engine components
- F) Flight control and electrical power health management

3: Internal Nozzle Actuator / Flight Control Surfaces used to control A/C

Failure of flight surface actuators or combat damage to flight surfaces

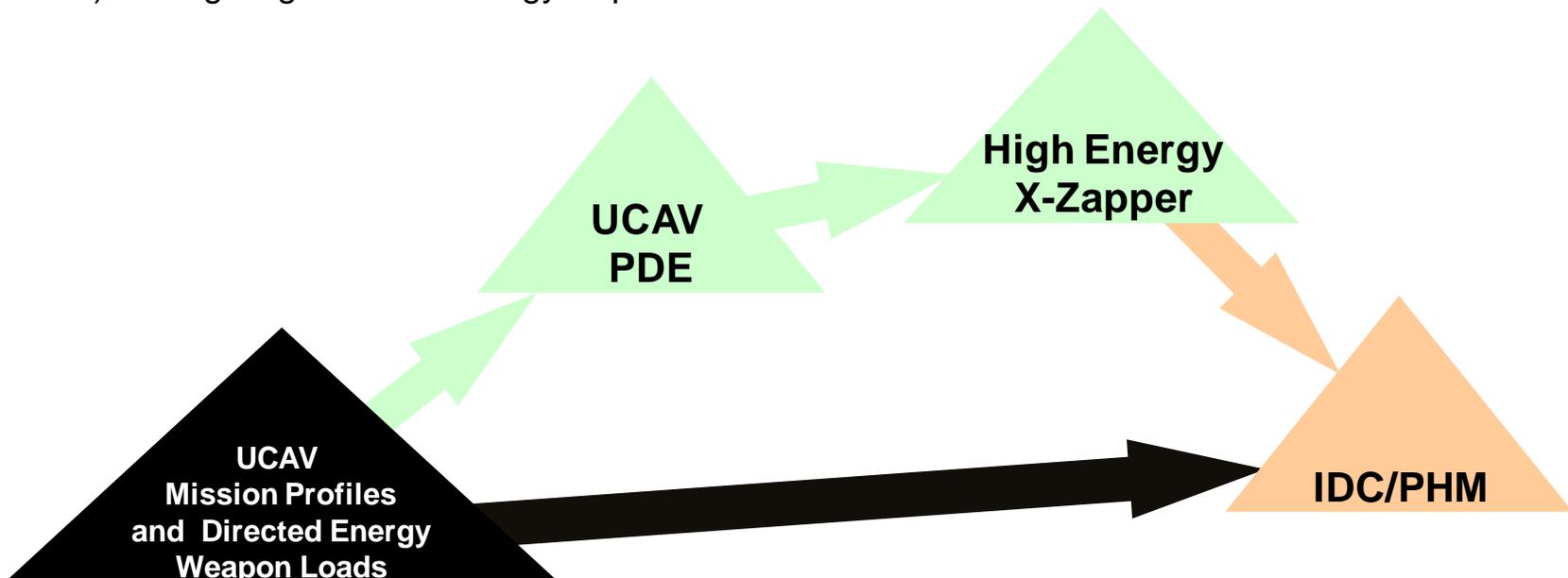


II. Energy Management

- ◆ Develop the capability to control the energy available to meet the demands of Directed Energy Loads

1: Aircraft Power Management

- Identify aircraft mounted generator power management controls for appropriate power demand loads. Airframe has two generators driven by a shaft on the propulsion engine.
- Optimize DE loads needs with generator availability.
- Identify and limit DE loads with high power demands to short duration.
- Manage flight control energy requirements

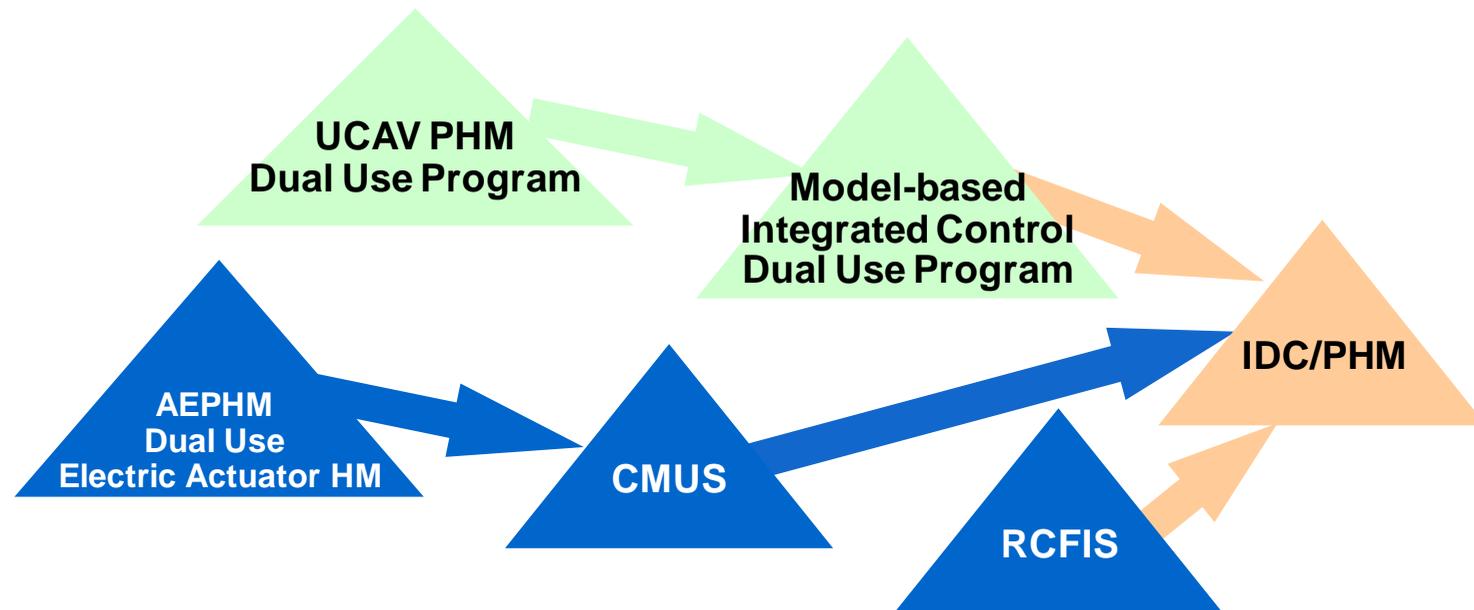


III. Onboard/Offboard Life Extending Control (Vehicle Life Management)

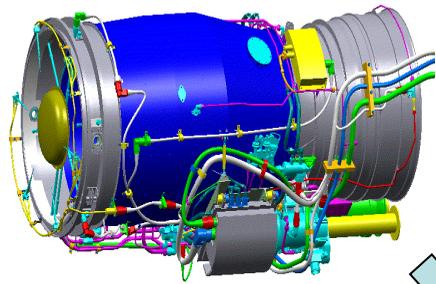
- ◆ Develop the capability to control aircraft and engine to maximize component life

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Adaptive Power Management

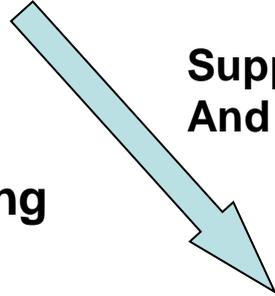


Propulsion
Shaft Power
Thrust Vectoring

Supplies Shaft Power



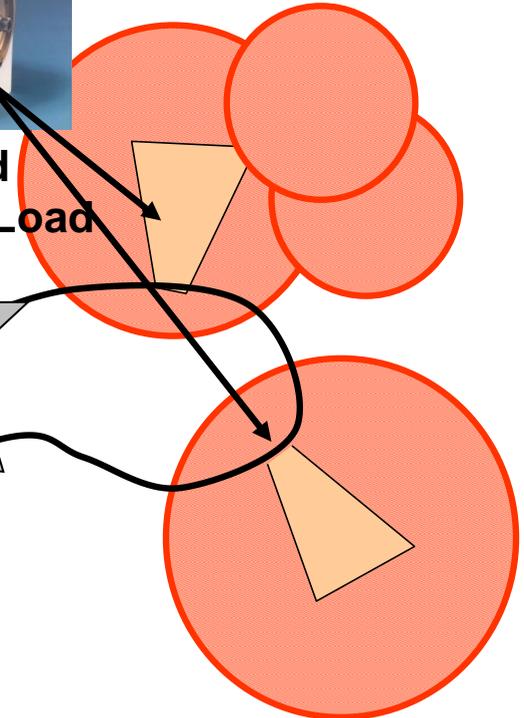
Supplies Thrust
And Vectoring



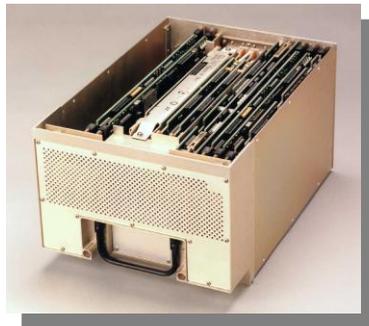
Major
Electrical
Load



Directed
Energy Load

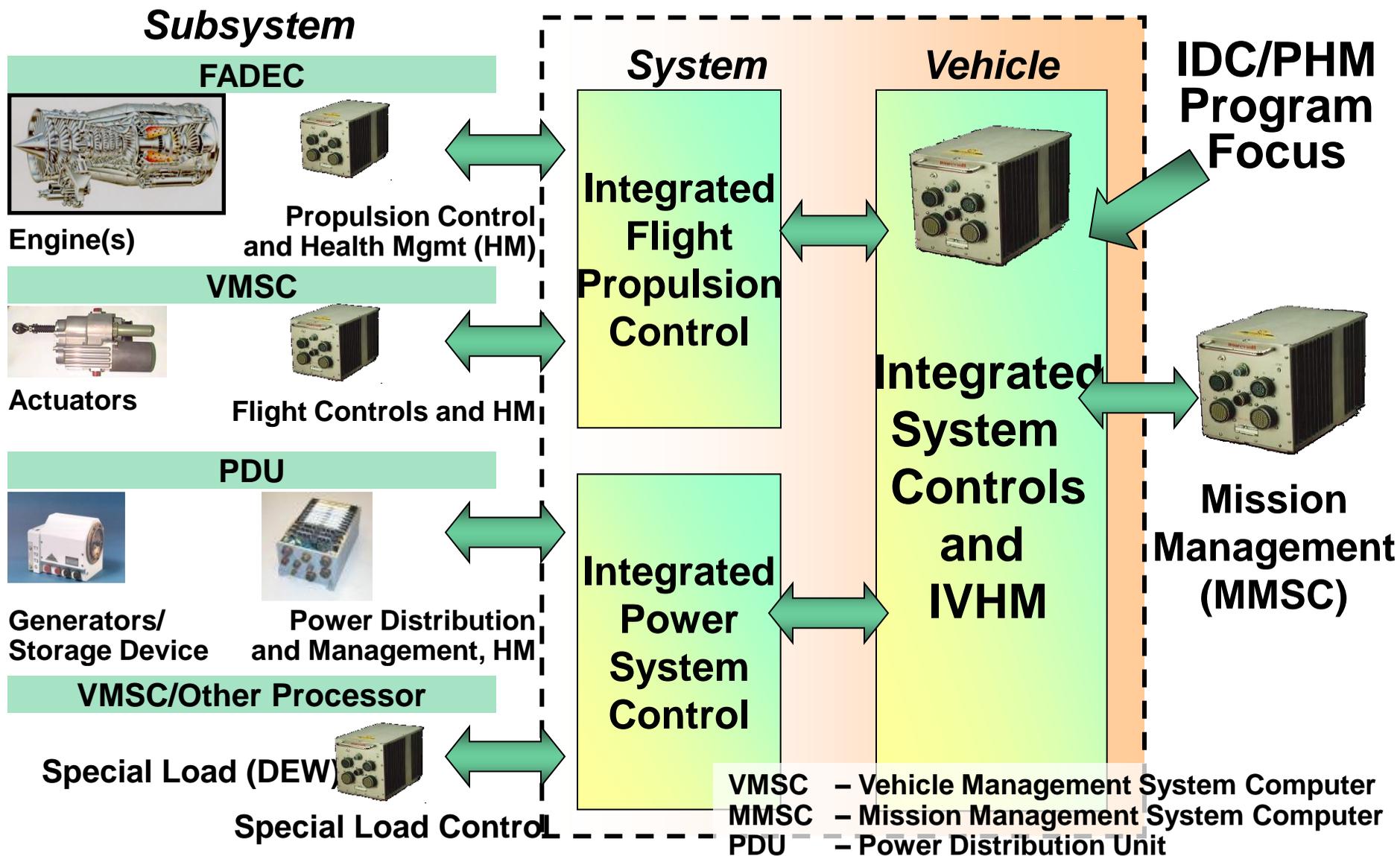


• **Flight Control:**
Maneuvering/
Trajectory



The combined knowledge from previous programs enables the study of adaptive power management

Architecture



Benefits

- **Performance**
 - Manned And Unmanned Enhancements
 - Energy Management
 - Vehicle Life Management
- **Platform Commonality**
 - Common Architecture and Algorithms
 - Universal FADEC
 - Universal Modeling Framework
- **Costs**
 - Reduced Development
 - Reduced NRE
 - Reduced Cost of Ownership