OVERVIEW OF TMO INTEGRATED AVIONICS PROGRAM

BRIEFER:

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IAP is an "umbrella" program to redesign the Target’s Control System components to reduce cost, weight, and complexity of the aircraft avionics.

The MQM-107 IAP consists of three main units:

- Common Avionics Package
- Forward Node
- Aft Node
Common Digital Architecture Program is an initiative to replace bulky & costly point-to-point wiring with single bus network

Why CAN?

- CAN = Controller Area Network
  - Automotive standard developed by BOSCHE Automotive.
  - Now proliferated throughout the world.

- Proven in Automobiles & Heavy Machinery

- Inexpensive & Reliable
  - Many other communications systems either too expensive or not reliable enough.
  - 1 undetected error in 800 yrs@ 125 Kbit/s

- Availability
- Reconfigurable
**Model 99 -- Universal Signal Processor Vehicle Interface**

Each Target Requires Target Specific Interface Cable & Target Specific Software.

Flight tested in September 2001

PM-ITTS

02 OCTOBER 2002
Model 99 -- *Universal* Signal Processor Vehicle Interface

- Interface virtually any aerial or ground target with a target-specific interface cable & software.
- Can be reprogrammed with a laptop.
- Allow CDA compliant devices to be controlled by the Target Tracking Control System (UHF).
- The USPVI replaces the current Army Aerial Target Group Set (SPVI, Antenna Switch, Transponder)
- Current SPVIs contain up to 7 boards. The USPVI contains a single board, GPS receiver, and transponder.

*Cost of the USPVI is 30% of the TGS!*
CDA Integration Test Flight

- Laboratory Simulation and analysis of CDA.
- Develop CDA flight nodes for Autopilot control and actuator functions.
- Use USPVI CDA interface.
- Proof of Principal for CDA flight control.
Integrated Avionics Program

What's the next step?

- Develop new avionics packages based on CDA network technology.

Combine functions, update circuits, reduce size, weight, and cost.
Common Avionics Package (CAP):

- The CAP makes use of the hardware and software developed for the USPVI.
- The CAP will communicate to the target via the CDA bus interface.
- Also houses the 12 Channel GPS unit.

CAP Development
Funded by TMI Program

FWD, AFT Node
Development & Test
Funded by TMO Engineering
Integrated Avionics Program

Common Avionics Package

- SPVI
- Autopilot
- Transponder
- Antenna Switch
- Gyros
- Pendulum
- Baroaltimeter
Integrated Avionics Program

Common Avionics Package

- Single board DAP and SPVI functions
- Inertial Measuring Unit (IMU)
- UHF RF transponder
- Antenna Switch
- 12 Channel Differential GPS unit
- External Test ports
**Forward Node (FN):**

- Perform the functions of the Power Distribution Unit and the Payload PDU.
- Interface to other electronic modules in the forward areas of the MQM-107 as well as future CDA compliant devices.
- KING node on the CDA bus.
- Same physical size as the PDU.
**Integrated Avionics Program**

**Aft Node**

**Aft Node (AN):**
- Replaces the current Electro-Explosive Device unit.
- PDU functions for the Wings and Aft of the Aircraft.
- Interface to the control surface actuators.
- Same form factor as current EED.
Software-in-the-loop Testing
Hardware-in-the-loop Testing
Flight tests.

IAP Testing

Hardware-in-the-Loop Simulator

MASTER CONTROLLER
Graphics

Shared Memory Uplink/Downlink Control Structures

DLL

Special I/O Interface

GUI/Datalink Simulator

Baselined Mission Input File

Autopilot Interface Module

6-DOF Simulator

I/O Data Sharing Structure

Transceiver

Autopilot

CANbus

RS-232

GPS RS-232

1 PPS

IMU SDLC

IMU SDLC
**Cost Savings**

MQM-107 Estimated with IAP

<table>
<thead>
<tr>
<th>Item</th>
<th>Current Cost</th>
<th>Est. Future Cost</th>
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<tbody>
<tr>
<td>Common Avionics Pkg (qty 25)</td>
<td></td>
<td>$22,000.00</td>
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<tr>
<td>Tgt Group Set—(SPVI, Ant Sw., Transponder)</td>
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<tr>
<td>Vertical Gyroscope</td>
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<td>Pendulum Assembly</td>
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<td>Yaw Rate Gyroscope</td>
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<td>Power Distribution Unit/Fwd Node</td>
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<tr>
<td>Electro Explosive Device/Aft Node</td>
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<tr>
<td>Autopilot</td>
<td>$10,000.00</td>
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<tr>
<td>Baroaltimeter</td>
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<tr>
<td>Wiring &amp; Connectors (Matl &amp; Labor)</td>
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<td>TOTAL COST</td>
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**ESTIMATED COST SAVINGS** (per Target) **$49,400.00**

CAP Replaces Target Group set, Gyroscopes, Pendulum, and Baroaltimeter

Updated 26 August 2002
Space Savings
Estimated with IAP

Current Control Electronics
Area
- Current: 262 in²
- Estimate with IAP: 78 in²
- Savings: 184 in² (70%)

Volume
- Current: 964 in³
- Estimate with IAP: 343 in³
- Savings: 621 in³ (64%)

Based on Existing Avionics v. IAP Avionics estimates
IAP Chronology

2001
- Specification Development
- Basic DAP software porting.
- Brassboard hardware development.
- Kalman Filter development.

2002
- Integration of IAP-DAP software & IMU.
- Develop IMU & IAP-DAP Simulations.
- Flight hardware development.

2003
- Complete Software integration
- Laboratory Software-in-the-loop tests.
- Laboratory Hardware-in-the-loop tests.
- Flight tests.
Integrated Avionics Program

Universal Drone System

- UDS was developed to be capable of droning any helicopter.
- Result was complicated and expensive.
- CAP will be basis for redeveloping the UDS
- Expect to reduce unit count by 60% and cost by greater than 80%.
- Could recover development cost in as little as 4 droned helicopters.
IAP SUMMARY

• Contractor format TDPs for CAP, FWD and AFT Nodes.
• Tested, proven design.
• CAP will be basis for next generation Universal Drone System for Helicopters.
  – Estimated 80% cost savings over current UDS.
• At conclusion of program, CAP will be ready for production.
• Puts CDA to practical use.