


## A Product Line Architecture for Army Aviation Diagnostics and Maintenance: Views and Evolution

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Advanced Multiplex Test System

Product Line Concepts


- Definition
- Application to AMTS

Architecture Views

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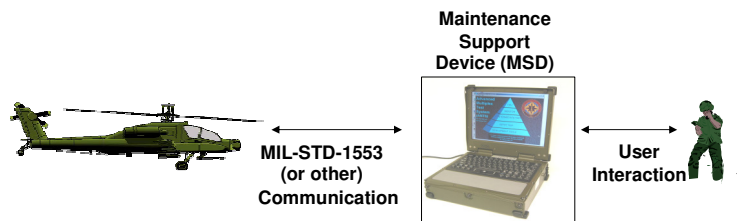
- Product line growth
- Tele-maintenance
- Condition-Based Maintenance

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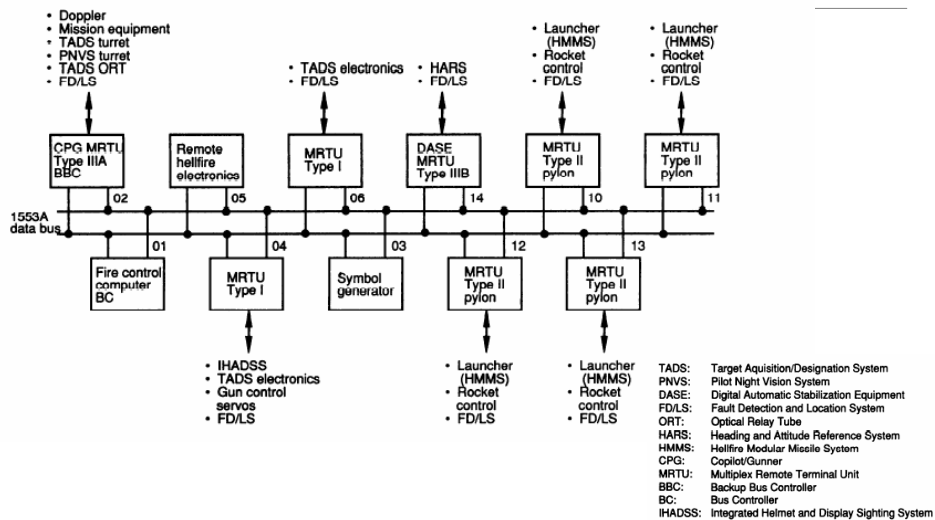
## AMTS Product Description

A line of off-board (non-embedded) diagnostic products to:

- support Army and Joint Aviation weapon platform maintenance
- assist maintainers
- support all maintenance levels (flight-line, intermediate, and depot)
- diagnose and repair avionics data bus networks faults



## 1553B System for AH-64A



## AMTS Business Goals

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Improve productivity of maintenance activities and eliminate false diagnoses

- ✓ Increases aircraft readiness
- ✓ Reduces aircraft operation and sustainment (O&S) costs

Meet anticipated product demand with current resources

Reduce product development time and cost

Minimize customer's cost of entry

Provide products for various applications /maintenance levels

- Operational: Aviation or Vehicle Platforms
- Intermediate: Line Replaceable Unit (LRU)
- Depot: from LRU to card level

Support collaborative (i.e., tele-) maintenance



## What's a Product Line?

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A software product line is defined as

- "A set of software-intensive systems that share a common, managed set of features satisfying the specific needs of a particular market segment or mission and that are developed from a common set of core assets in a prescribed way."



## Product Line Features and Variations

<b>Platforms supported</b> Helo Apache A Apache D UH-60 Aircraft F-18 C-17 (under discussion) Ground vehicles M1A1 Abrams Variations within each by tail # or other vehicle feature	<b>Bus</b> Type 1553 (1553A, 1553B) Ethernet 1773 ARINC (commercial aircraft) CAN? (automotive) Architecture Single bus Multiple bus Single type Mixed type Nested (i.e., bus within bus; e.g., JTRS)	<b>Message handling</b> Message analysis From text From XML Message DB XML translator Read Write (for sim/stim tool) Test level Operational Intermediate Depot Development
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## Variation Example – Maintainer Interface

The screenshot displays the AMTS Maintainer Interface. On the left, there are panels for 'Bus Loadings' (74.4%) and 'Messages'. The main window shows a diagnostic error for 'RHE' (RHE 05). The error message states: 'AMTS has detected a 1553 mux problem with the RHE or its associated DTU and/or stub wiring. To further fault isolate, connect AMTS Bus Cable Adapter AAS328004 (RHE cable) between the RHE and the 1553 mux bus as follows: 1. Locate the RHE (Point B on picture)'. Below the error message is a diagram of the aircraft's wiring harness with a red box labeled 'B' indicating the location of the RHE. A 'REPLACE DASEC' dialog box is open in the foreground, providing instructions for replacing the DASEC: 'AMTS has detected a problem with the DASEC 1553 circuitry. This fault will require replacement of the DASEC. It is intended that AMTS remain on during DASEC replacement and subsequent test. If the same reason AMTS is closed, or otherwise set out of the fault diagnostic sequence, you will need to restart the Bus Cable Diagnostics from the beginning, with AMTS reconnected back at the aircraft forward max 1553 test ports following the DASEC replacement. Replace the DASEC as follows: 1. Do not shut down AMTS. 2. Power down aircraft. 3. Refer to IM 1-1520-238-23-7-2, Section 11-018, for...'. The dialog box includes 'Page Up', 'Page Down', and 'OK' buttons.



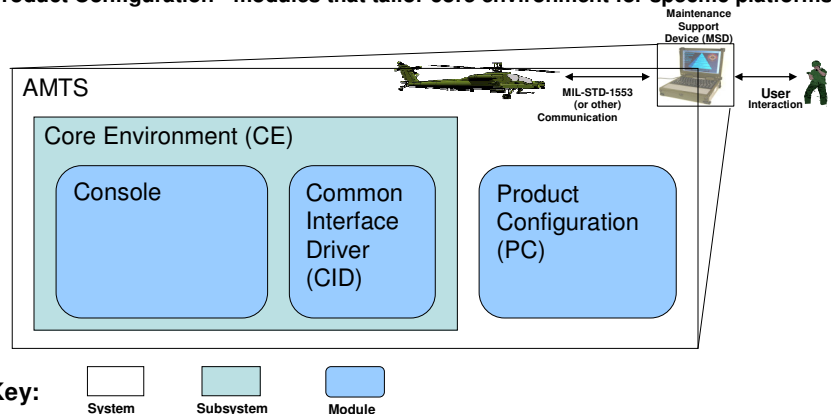
## How AMTS Was Created

- Leveraged years of experience supporting avionics maintenance and developing software/hardware tools
- Exploited MIL-STD-1553 commonality
- Established management support to develop prototype
- Mined existing assets
- Incorporated iterative/reactive Product Line engineering approach



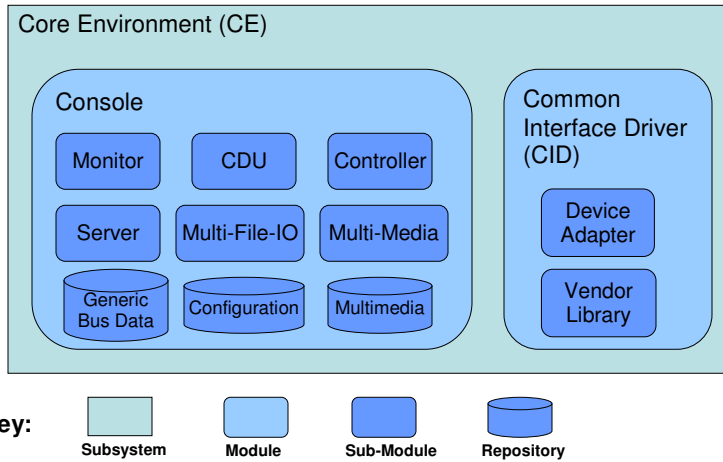
## AMTS Decomposition View

- Core Environment - common modules across the product line
- Product Configuration - modules that tailor core environment for specific platforms



## Core Environment Decomposition View

Common assets for building testing systems for specific aviation platforms, systems, and subsystems



## Core Environment (CE)

Consists of Console and Common Interface Driver (CID) modules

- Console: data driven software utilizes
  - Non-specific data and graphics to provide a universal data bus analyzer
  - Specific data, graphics, and software modules to provide platform data bus specific diagnostics
- CID: software adaptor utilizes
  - Vendor libraries to provide device communication independent of manufacturer

Common assets include a 1553 data bus generic monitoring system without platform specific data (Bus Tester Tool Kit) .

- Every possible LRU on data bus, up to 32
- Specific LRU's unknown. Where located on bus unknown
- Configuration capability to be added in future with tools to build plug-ins



## Product Configuration (PC)

### Product core assets and product specifics

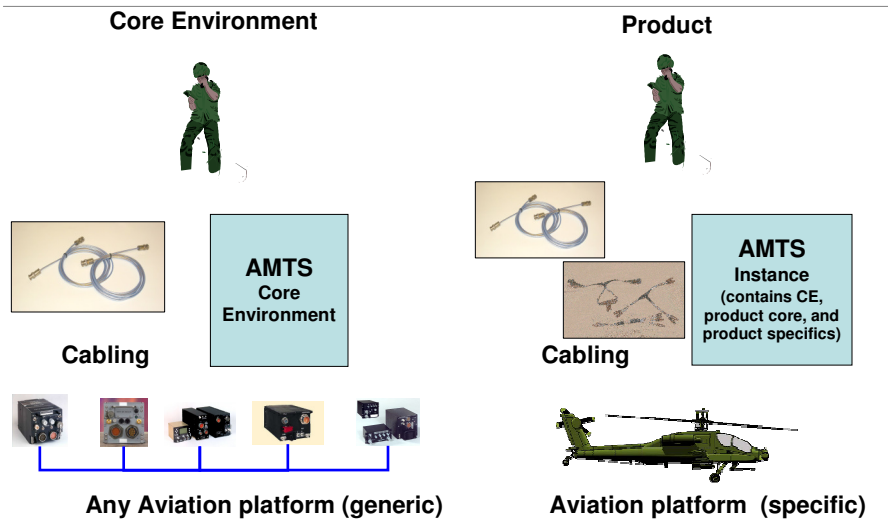
- employ reverse engineering of platform system to understand behavior for data base system information and message repository
- Use Multiplex ICD to identify product-specific messages
- Use Bus controller SRS to understand behavior

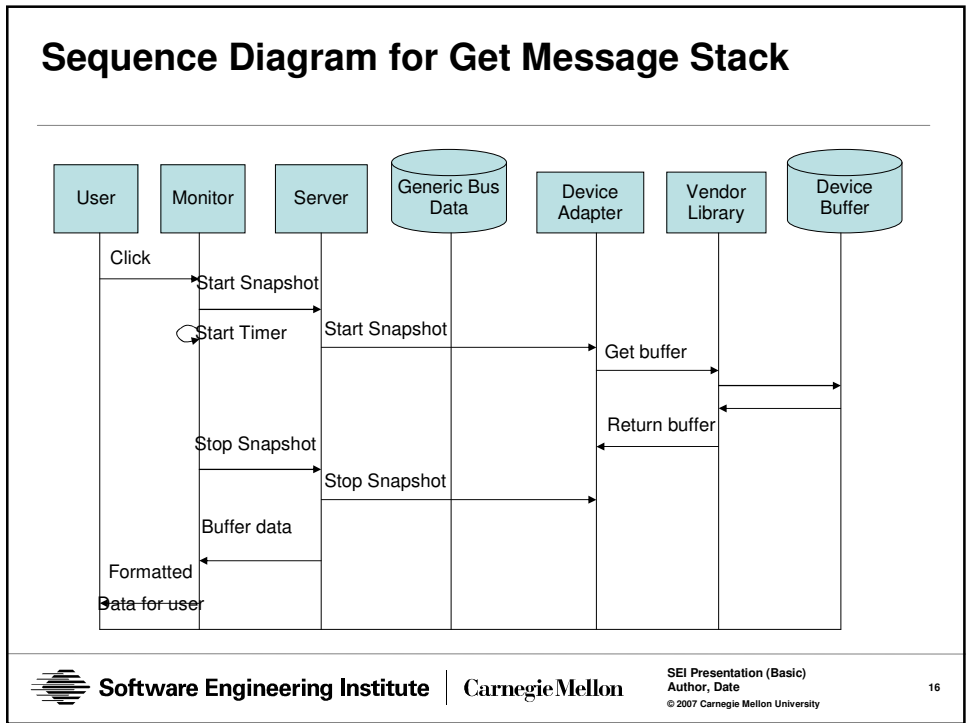
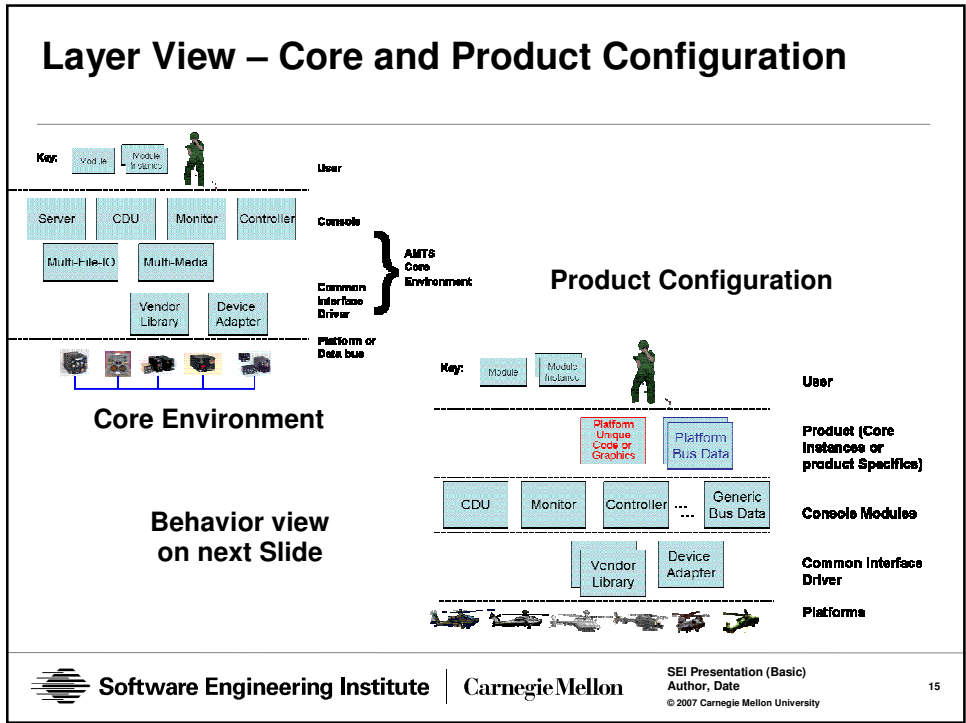
### Product modules

- Core environment asset instances (console and CID)
- Product core (PCore) & PCore instances
- Product specifics (e.g., Read Codes for AH-64A)



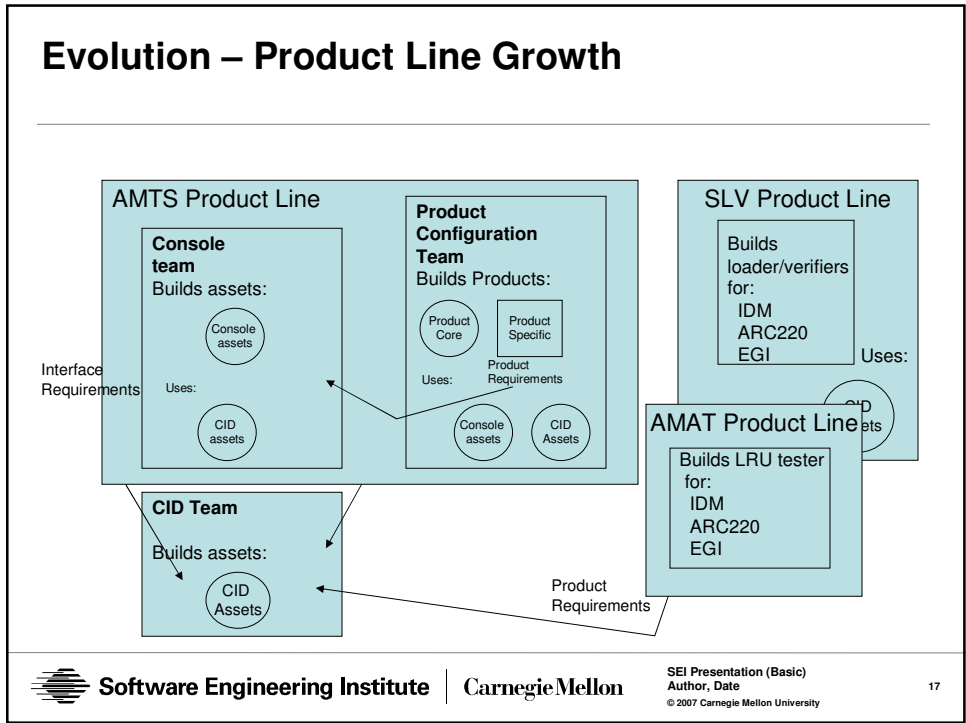
## AMTS Layered Context



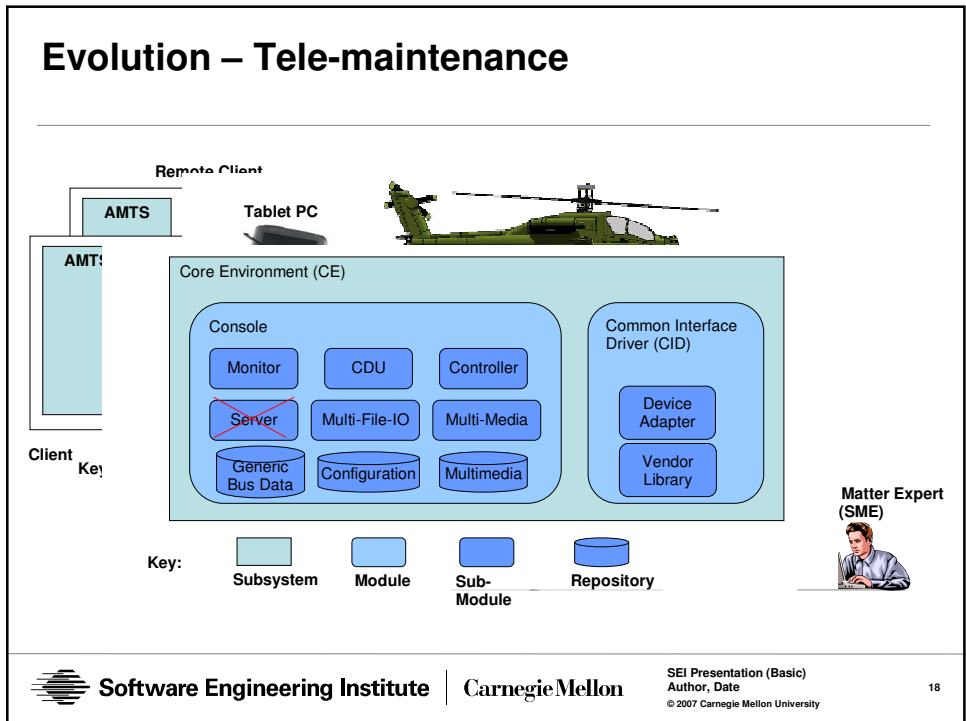


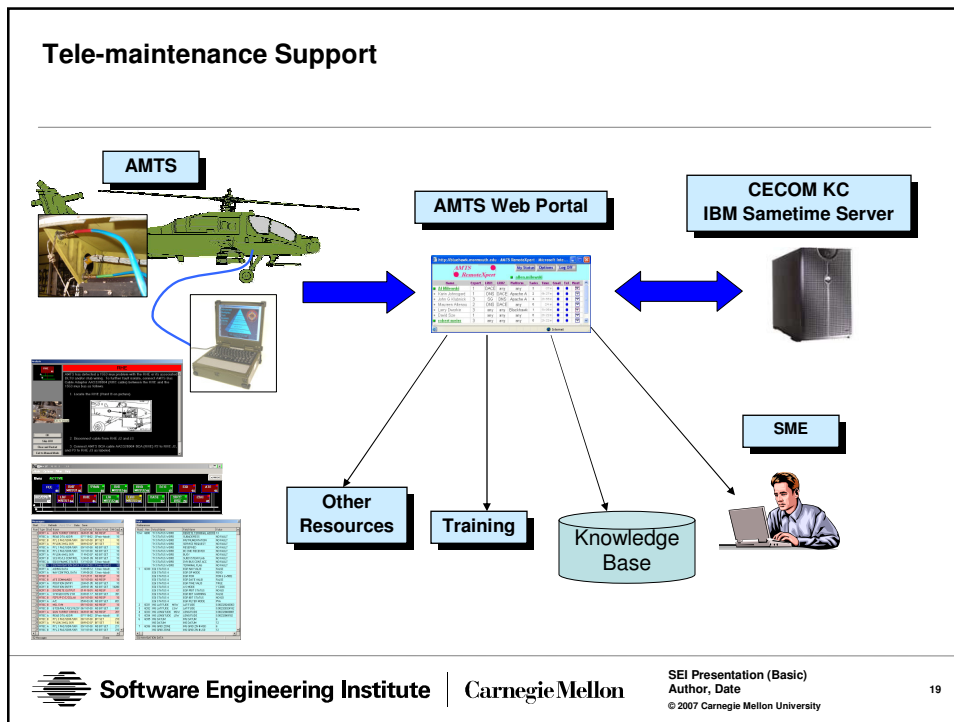


## Evolution – Product Line Growth



## Evolution – Tele-maintenance





## Evolution – Condition Based Maintenance

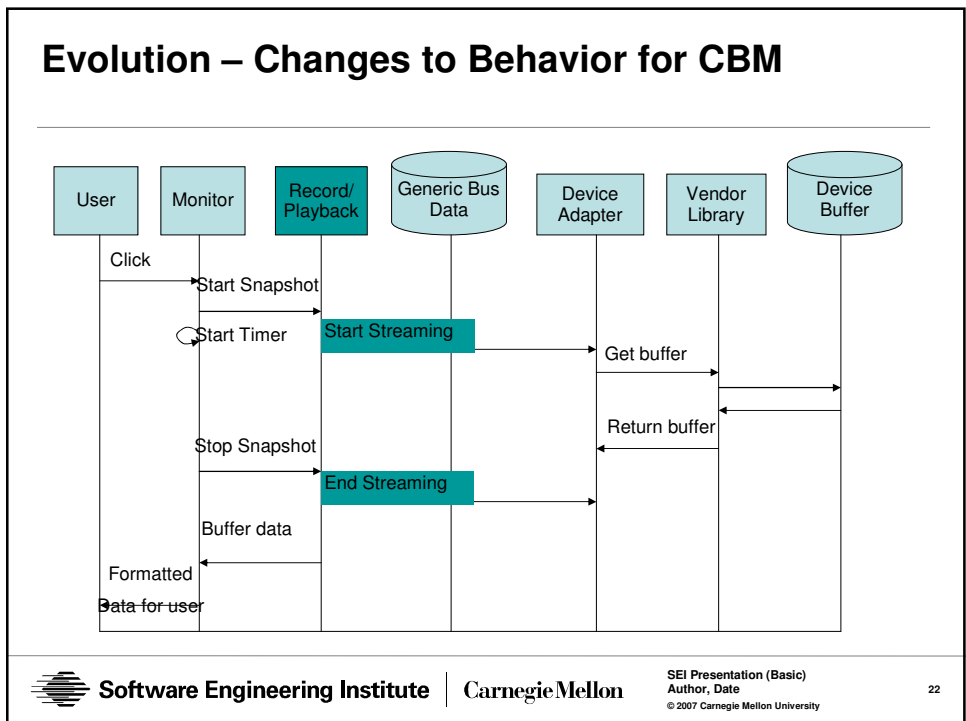
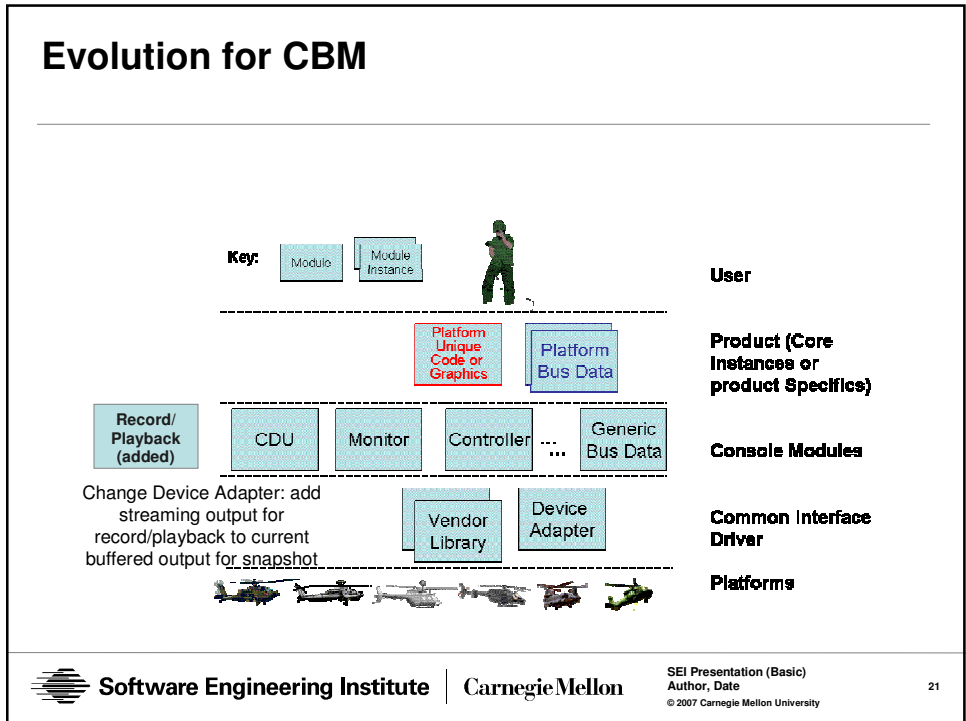
Need expressed by maintainers in field

Aviation Responsive Maintenance System (ARMS) to consolidate and provide situational awareness picture

- of aircraft readiness for use in CBM
- of current data state across the fleet
- for playback on AMTS (collect data (one-hour's worth) and the SME who is providing assistance has it for analysis).

Use existing built-in analysis capabilities as model to determine how to retrofit this in off-board for all aircraft

Product line approach is an enabler



## Summary

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AMTS architecture supports multiple and growing list of diagnostic/maintenance products

Changes managed through architecture evolution

- Identification of new goals (e.g., adding CBM capability)
- Technology changes (e.g., secure collaboration support)

Variation mechanisms not covered in this presentation – possible topic for working group discussions

