Keeping Abreast of Emerging Test Technologies

DoD Maintenance Symposium – October 2005

Bill Ross

NAVAIR PMA260

Test Technology - Scope

- Electronics/avionics on-system and off-system automatic maintenance test

- I will use the Navy CASS Automatic Test Equipment and Test Programs as the examples, but most of the test technology discussed are:
  - Leveraged Joint Services initiatives
  - Cooperative initiatives with Industry
    - 90% commercial solutions

- Terms:
  - Automatic Test Equipment (ATE) = The Test System
  - Test Program (TP) = the diagnostics S/W and the H/W to interface weapon system components to the ATE

Pursuing Test Technology

Two Reasons:

1. To add capability to our test systems to meet emerging weapon system test requirements
   – Four times as accurate as the weapon system component being tested

2. To replace existing test capability to:
   – Address obsolescence
   – Improve quality of test
   – Improve through-put
   – Satisfy new operational need – scalable/mobile/smaller
   – etc

The CASS Story
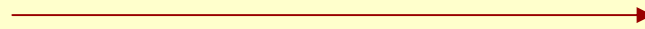
30 Legacy Testers ⟶ **One tester Family**

$3.8B Reduced Total Ownership Costs

1970	1980	1990	2000

Test Technology Roadmap

CASS

RTCASS

+ Multi Analog Capability (80% solution)
+ Programmable Serial Bus Capability
+ Measurement Synthetic Instruments
+ ATML

**ARGCS
ACTD**

+ Common Tester Interface
+ Stimulus & Measurement SI
+ Next Gen Digital Instrument (Parallel)
+ Power Supply Packaging
+ Smart Diagnostics

Test Technology Demonstrations

+ Advanced Synthetic Instruments
+ Multi Analog Capability (100% solution)
+ Next Gen Serial Bus

eCASS

Current Test Technology Investments

- Advanced E-O test system

- Inertial Test Reference System

- Fast Serial Digital Test

- Link 16 Test Technology

- **Advanced Synthetic Instruments**

- **Programmable Serial Bus**

- **Improved ATE and TP Software**

- **Common Tester Interface (CTI)**

- **Multiple Analog Stimulus and Measurement**

- **High Density Analog Instrument**

- **Next Generation Test System-level Demonstration**
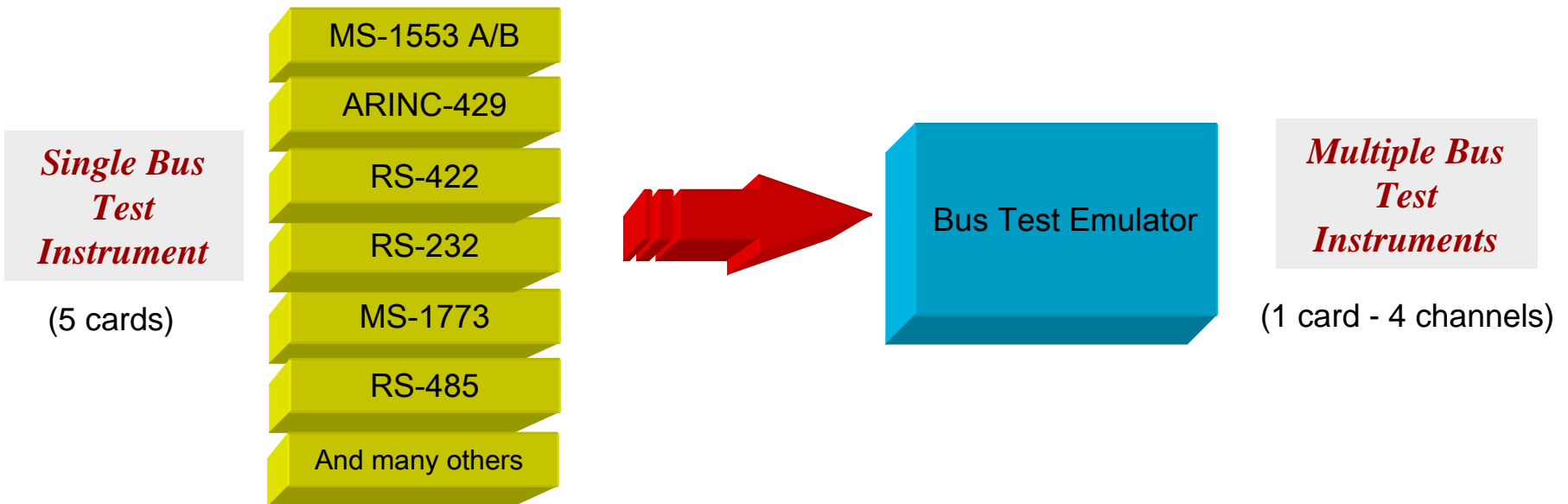 - **Agile Rapid Global Combat Support (ARGCS) ACTD**

Advanced Synthetic Instruments

- Think of Synthetic Instruments as "software instruments"
  - Eliminates redundant ATE overhead hardware
  - Eliminates redundant ATE functionality
  - Creates needed instrument/function via software

- Modernized Mainframe CASS could replace at least <u>12 existing separate stimulus & measurement instruments</u> with a small SI package
  - Demonstration programs underway

- Benefit: at least 65% decrease in hardware (and, therefore, support costs) and footprint

Programmable Serial Bus Instrument

- Bus Test Emulator provides
  - Bus communication – standard serial bus and custom bus protocols (MS 1553, ARINC 429, RS 422, RS 232, MS 1773, RS 485, etc)
  - 4 channels per card
  - Parametric variation for bus performance verifications

- Benefit:
  - Footprint reduction (5 cards replaced by 1 card)
  - Higher quality tests with Increased capability

Single Bus Test Instrument

(5 cards)

MS-1553 A/B

ARINC-429

RS-422

RS-232

MS-1773

RS-485

And many others

Bus Test Emulator

Multiple Bus Test Instruments

(1 card - 4 channels)

Reusing Diagnostics Data

- ATML (XML for Automatic Test and diagnostics)
  - Industry/Gov't Working Group & IEEE SCC20 standard
  - Integrated Diagnostics Interfaces
  - Knowledge Based Systems
  - Test Requirements Modeling

- "Smart" concepts for improved test program diagnostics (a CASS plug-in)
  - Use platform BIT data to "direct" a start point in a test program – 25% runtime savings
  - Historical maintenance data reuse to improve diagnostics decisions
  - Demonstrating on F/A-18 APG73 Radar Receiver and Super Hornet Flight Control Computer

Multiple Analog Stimulus and Measurement

- Multiple Analog Instrument
  - Each test pin has 6 instruments, all useable at same time
  - 1 VXI card has 32 pins, all useable at same time
  - CASS currently has 64 different instruments – the 3 Ai7 cards that CASS will use add 576 instruments – all useable at the same time

- Benefit:
  - Significant reduction in some TP runtimes
  - Real-time functional test - higher quality diagnostics

Teradyne Ai710

Mode 1: Legacy TP
Mode 2: Legacy TP with Ai7
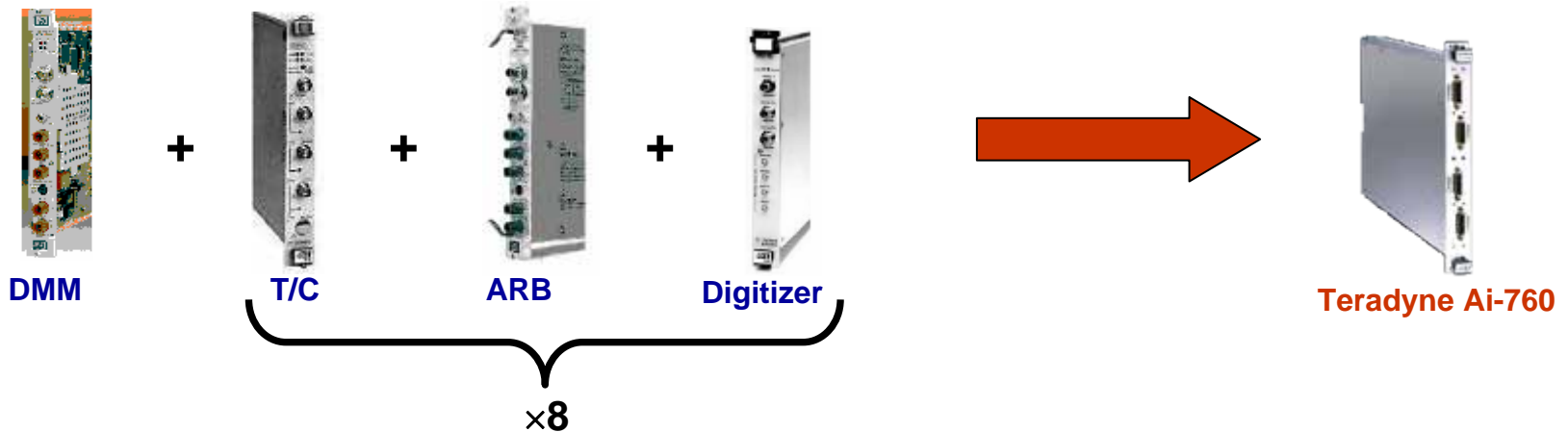Mode 3: New TP with Ai7

Run Time
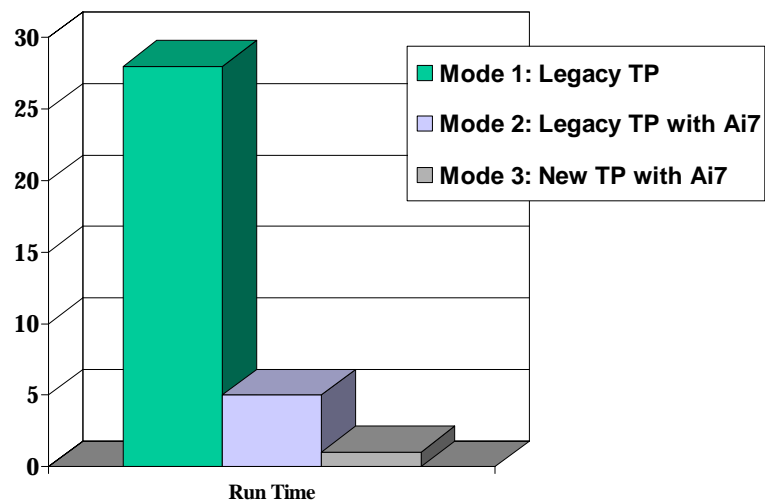
High Density Analog Instrument

- High Density Analog Instrument
  - Eight single-ended system-per-pin channels, including up to sixteen 200 MHz universal timers, 50 MSa/s 12-bit digitizers and 50 MHz 12-bit arbitrary waveform generators.
  - Includes a 6.5-digit digital multimeter and a 2-channel 1 Gsps digital sampling oscilloscope.
- Parallel source and measure capability for high-speed functional and operational analog testing
- More accurately emulates complete system-level operation
- Benefit: significantly reduce test times and increase fault coverage while reducing footprint


Teradyne Ai760

DMM + **T/C** + **ARB** + **Digitizer**

×8

Teradyne Ai-760

Common Tester Interface

- Industry/Gov't Working Group developing a common standard pin map for the physical mating of the interface device to the automatic tester
  - IEEE standard in process

- Specification requirements include scalability, frequency coverage from DC to light, cost, reliability, etc

- Benefit:
  - Enable <u>interoperability</u> across DoD testers
  - Reduce costs associated with test program rehost
  - Ease insertion of new instrument technology
  - Facilitate modification and upgrade to existing testers

CTI Pin Map

Agile Rapid Global Combat Support System (ARGCS)

FY04 Advanced Concept Technology Demonstration
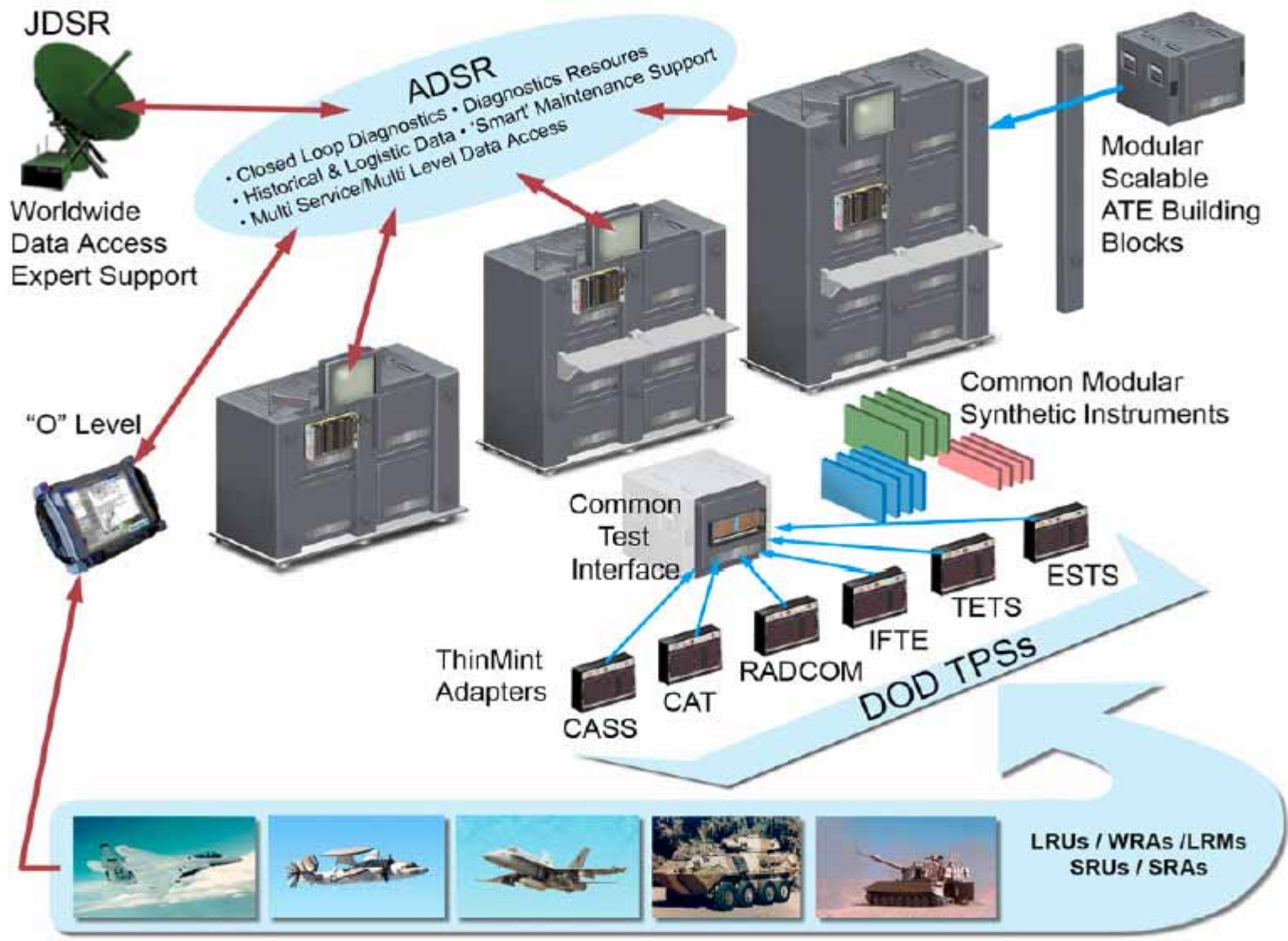
Our eCASS Vision

- Much smaller footprint with more test capability

- Faster run times

- Multi-lingual test environments
  - Facilitate factory-to-field

- Interoperable with other Services' ATE

- More scalable to needs

- Reduced acquisition and support costs

- "Smarter" diagnostics concepts
  - Faster and better diagnostics
  - Reduced A-799 rate