

2003 FAA National Software Conference

FAA Software and CEH Activities – 5 Year Plan

Aircraft Certification Software and Complex Electronic Hardware Program Management Plan FY04 – FY08

Overview



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AIR-120
September 16, 2003

Acronyms



- AACE Airworthiness Assurance Center of Excellence
- AC Advisory Circular
- ACO Aircraft Certification Office
- AFS Flight Standards
- AVSI Aerospace Vehicle Systems Institute
- CAST Certification Authorities Software Team
- CEH Complex Electronic Hardware
- CNS Communication, Navigation, and Surveillance
- COTS Commercial-off-the-shelf
- CSTA Chief Scientific and Technical Advisor
- DASC Digital Avionics Systems Conference
- DC Decision Coverage
- DER Designated Engineering Representative

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Acronyms



- FAA Federal Aviation Administration
- FAATC FAA Technical Center
- FY Fiscal Year
- HUMS Health Usage Monitoring System
- IMA Integrated Modular Avionics
- IVT Interactive Video Teletraining
- MC/DC Modified Condition/Decision Coverage
- NASA National Aeronautics & Space Administration
- NSA National Security Agency
- OASIS Overarching Aviation Safety Inspectors Software
- OO Object-oriented
- OOT Object-oriented Technology
- OOTiA Object-oriented Technology in Aviation



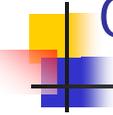
Acronyms



- OS Operating System
- POC Point of Contact
- RED Research, Engineering, and Development
- RTOS Real-Time Operating System
- SDSS Software and Digital Systems Safety
- SMT Standards Management Team
- TIA Type Inspection Authorization
- TCRG Technical Community Research Group
- UAV Unmanned Aerial Vehicle

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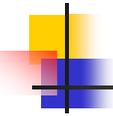
FAA Software and CEH Activities – 5 Year Plan



Outline



- Plan Summary
- Snapshot of FY03 Tasks
- FY04 - FY08 Tasks
- Conclusion



Plan Summary



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Plan Summary



- Plan outlines Software and Complex Electronic Hardware (CEH) activities for FY04 - FY08
- Purpose of Software and CEH Program:
 - Standardization across Aircraft Certification Service
 - Meet needs of field and industry in timely manner
- Plan is living and is updated as needed
- CEH has been added to the software program:
 - Common process-driven approach
 - Overlap in field personnel

Plan Summary



- Plan provides project description, activities, owners, participants, milestones, and is used as input to the annual Business Plans
- Plan implementation:
 - Led by AIR-106N (Chief Scientific and Technical Advisor (CSTA) for Aircraft Computer Software)
 - Role includes oversight of software, CEH technology, digital computing technology, and integrated modular avionics (IMA) implementation
 - Managed by AIR-120
 - Supported by AIR-130, AIR-140, AIR-200, and AIR-500 as well as field personnel in Directorates and Aircraft Certification Offices (ACOs)

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Snapshot of FY03 Tasks



Snapshot of FY03 Tasks

- Policy and Guidance
 - AC 20-145 Guidance for Integrated Modular Avionics (IMA) that Implement TSO-C153 Authorized Hardware Elements (Published Feb 03)
 - 8110.49 Software Approval Guidelines (Published June 03)
 - AC 20.RSC Reusable Software Components (Public comments obtained July 03)
 - AC 20.CEH Complex Electronic Hardware (FAA comments obtained Aug 03)

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Snapshot of FY03 Tasks



- Certification Authorities Software Team
 - Hosted CAST #37 (July 03)
 - Completed Papers
 - CAST-15 - Merging High Level and Low Level Requirements
 - CAST-16 - Databus Evaluation Criteria
 - CAST-17 - Structural Coverage of Object Code
 - CAST-18 - Reverse Engineering in Certification Projects
 - CAST-20 - Dealing With Cache in Certification Projects
- Workshops
 - Annual Software and CEH (Sept 03)
 - OOTiA Workshop #2 (Mar 03)



Snapshot of FY03 Tasks



- Training
 - IMA TSO and AC IVT (Oct 02)
 - Software Job Functions (Feb 03)
 - Real-Time Software Development (May 03)
 - Software for Managers (Sept 03)
- CNS
 - Vision for CNS Software Assurance
- Military
 - Vision for Addressing common Civil/Military Software Needs

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Snapshot of FY03 Tasks



- Research and Development
 - Completed Reports
 - Issues Concerning the Structural Coverage of Object-Oriented Software (Nov 02)
 - Study of Commercial Off-The-Self (COTS) Real-Time Operating Systems (RTOS) in Aviation Applications (Dec 02)
 - Submitted annual SDSS Research Plan
- Other
 - Provided support to industry committees – RTCA/SC-200, SAE S-18
 - Submitted papers to CNS, DASC conferences
 - Supported software reviews and audits



FY04 - FY08 Tasks



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Integrated Modular Avionics



Description

- Phase I
 - In FY02 and FY03, FAA developed new guidance to address IMA hardware elements and their implementation via the TSO process resulting in TSO-C153 and AC 20-145
- Phase II
 - RTCA SC-200 was established in May 2002 to expand upon this material to include the IMA platform approach (i.e. operating systems) and to address needs of all aircraft categories
 - Joint Committee was formed by merging RTCA SC-200 and EUROCAE WG-60 to co-develop Industry standard for IMA (first joint meeting November 2002)

Integrated Modular Avionics (IMA)



Activities and Milestones

- Draft IMA platform AC (Aug 04)
- Coordinate IMA platform AC with SC-200/WG-60 (Nov 04)
- FAA coordination of IMA Platform AC (Jun 05)
- Public comments of IMA Platform AC (Sept 05)
- Publish final IMA Platform AC (Jun 06)
- POC
 - Leanna Rierson, John Lewis (Secretary for SC-200)

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Object-Oriented Technology



■ Description

- As the prevalent software development paradigm, object oriented technology (OOT) has created safety and certification concerns in the aviation community
- OOTiA Workshop #2 was held to update the handbook. Products will be:
 - Multi-volume handbook (to be posted on FAA web-site)
 - Interactive video teletraining (IVT) course on OOT basics
 - Training course for FAA engineers and software DERs on OOT

Object-Oriented Technology



■ Activities and Milestones

- Meet with pilot OOT project team (Nov 03)
- Publish Handbook (Jun 04)
- Deliver OOT Basics IVT (Nov 04)
- Deliver Prototype training course (Oct 05)
- Gather feedback on use of Handbook (beyond Jun 04)
- POC
 - Leanna Rierson, Barbara Lingberg

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Certification Authorities Software Team



■ Description

- International team of certification/regulatory authority representatives
- Meet semi-annually in January and July
- Charter
 - Harmonize software, complex electronic hardware, and ground-based software issues among authorities and regulators
 - Support industry software and CEH committees
- Papers may become basis for policy, guidance, or training material

Certification Authorities Software Team



■ Activities and Milestones

- Develop and review position papers
- Post suitable materials on Website
- Make presentations to industry groups as requested
- Serve as CAST Chairperson and participate in semi-annual meetings
- Host U.S. meetings

■ POC

- Barbara Lingberg, Leanna Rierson, John Lewis, Software Specialists from ACOs and Directorates

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Certification Authorities Software Team



- Status of CAST Papers
 - Currently on website
 - CAST 1 - CAST 16
 - To be posted on website by Oct 03
 - Structural Coverage of Object Code (CAST 17)
 - Reverse Engineering in Certification Projects (CAST 18)
 - Dealing with Cache in Certification Projects (CAST 20)
 - On agenda for final approval at next CAST meeting
 - Data and Control Coupling Clarification (CAST 19)
 - Other papers are in various stages of development

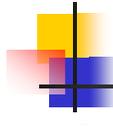
Certification Authorities Software Team



- Topics for future discussion
 - Dead versus deactivated code
 - Cyclic redundancy checks (CRC)
 - Tracing of structural coverage to the requirements that give the coverage
 - Compiler and math libraries
 - Security Assurance
 - Probabilities and software testing
 - Hardware versus software versus firmware determination criteria for using DO-254
 - Advanced verification methods such as elemental analysis and formal methods in DO-254
 - Tool qualification in DO-254

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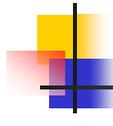
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Creating DO-178C



- Description
 - Activities in last few years supplement DO-178B
 - Notices, Orders, DO-248B, Object-oriented Handbook, CAST papers, etc.
 - Research to address emerging software technologies
 - Effort needed to capture this information in a single guidance document, i.e., DO-178C



Creating DO-178C



- Activities and Milestones
 - With industry input, document what should be included in DO-178C (Dec 04)
 - Meet with RTCA PMC to initiate new committee (Mar 05)
 - Launch new committee (Sep 05)
- POC
 - Leanna Rierson

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Standardization Conference



■ Description

- Sponsor annual Software and Complex Electronic Hardware Conference
- Provide support to primary audience of software DERs
- Inform industry and international certification authorities of new software and CEH policies, regulations, and activities in the FAA
- Provide forum for sharing ideas and new technology on an international level

Standardization Conference



■ Activities and Milestones

- Submit "call for training" form (March)
- Determine date, facility, and agenda (March)
- Prepare presentations (July)
- Conduct conference (Sept 03)
 - Plan to conduct 2004 conference in June/July
 - Plan to conduct future conferences in April/May
- POC
 - Leanna Rierson, John Lewis, Barbara Lingberg, Ken Filippelli, Steve Sandmann

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Software & Digital Systems Safety Research



■ Description

- AIR-120 is project sponsor for Software & Digital Systems Safety (SDSS) Research, Engineering, and Development (RED) program
- Addresses safety, performance, and technology issues in the areas of:
 - Software
 - Complex electronic hardware
 - Digital systems
- Identifies / prioritizes research requirements using AVR research definitions and prioritization criteria
- Details included in annual *SDSS Research Plan*

Software & Digital Systems Safety Research



■ Activities and Milestones

- Update annual SDSS Research Plan (June)
- Prioritize proposed tasks (July)
- Provide input to RE&D Program Manager (August)
- Brief Regional Program Managers and Standards Management Team (SMT) (August/Sept)
- Brief SDSS Program (ongoing)
- POC
 - Leanna Rierson (lead), Barbara Lingberg (sponsor), and SDSS Technical Community Research Group (TCRG)

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Software & Digital Systems Safety Research



- Current Tasks (prioritized Aug 03)
 - ✓ - Component Integration
 - Local Area Networks (LANs) in Aircraft
 - ✓ - Object Oriented Technology Verification
 - ✓ - Effects of Accelerated Semiconductor Device Wearout
 - ✓ - Ethernet as an Aviation Databus
 - ✓ - Software Development Tools Assessment
 - ✓ - Software Verification Tools Assessment
 - Databus Evaluation Criteria
 - ✓ - Case Study of Complex Electronic Hardware using DO-254
 - ✓ Active Task

Software & Digital Systems Safety Research



Current Tasks (prioritized Aug 03)

- Requirements Engineering Management
- Advanced Guidance & Control System Functional Design
- Augmented Manual Control (Fly-By-Wire/Fly-By-Light) Systems
- Flight Critical Systems Architecture Design Assurance
- Microprocessor Evaluations
- ✓ - COTS Ground Systems Verification
- ✓ - Real-time Scheduling Analysis
 - Tool Qualification of Complex Hardware
 - Guidance and Control Displays

- ✓ Active Task

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Software & Digital Systems Safety Research



Current Tasks (prioritized Aug 03)

- Certification / Operation of Unmanned Aerial Vehicles (UAVs)
- Transfer of Aviation Data on Internet
- Environmental Qualification of Industrial and Commercial Electronic Components
- Burn-In Testing Criteria of Critical Electronic Equipment
- Safety Engineering Approaches for Software
- Accelerated Life Qual Methods for Critical Electronic Equipment
- Other Complex Hardware Device Assurance
- Component Reliability Models
- Service History (Reliability Models)

✓ Active Task

Software & Digital Systems Safety Research



- Cooperative efforts with:
 - Individual companies
 - NASA's Aviation Safety Program
 - Universities
 - Aerospace Vehicle Systems Institute (AVSI)
 - Airworthiness Assurance Center of Excellence (AACE)
 - Volpe National Transportation Systems Center
 - National Security Agency (NSA)

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Communication – Navigation – Surveillance Vision



■ Description

- Needs of CNS software community differ from that of aviation software community
 - Roles and responsibilities of engineers are not clear and understanding of DO-178B is inconsistent among sponsors
 - Current training is directed toward aviation's organizational composition, e.g. ACOs and DERs
- Goal
 - Assess safety and assurance needs for CNS software
 - Create vision for addressing these needs through policy, guidance, and training
 - Prepare and implement detailed implementation plan

Communication – Navigation – Surveillance Vision



■ Activities and Milestones

- Prepare a detailed implementation plan to address CNS software needs through policy, guidance, and training (Jun 04)
- Implement the plan (beyond Jun 04)
- POC
 - Leanna Rierson, Barbara Lingberg, AIR-130 managers and team leads

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Overarching Aviation Safety Inspector Software



- Description
 - Phase 1
 - OASIS (Overarching Aviation Safety Inspectors Software) virtual team created in Jan 2002
 - Completed its goal to develop a vision for aviation safety inspectors (ASIs) in manufacturing / production software
 - Phase 2
 - OASIS will identify policy, guidance, and training needs related to manufacturing and production software

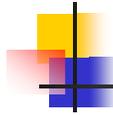
Overarching Aviation Safety Inspector Software



- Activities and Milestones
 - Publish AC-21-XX "Guidance on software used in manufacturing and production" and send to field offices for comments (2004)
 - Review "Digital Data Storage" document and other industry materials (ongoing)
- POC
 - Leanna Rierson, Steve Sandmann, ACO and MIDO representatives

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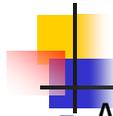
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Software Training



- Description
 - Training needs are identified and initiated, as needed
 - Results of activities in other sections of Plan and input from FAA and industry are used to identify needs



Software Training



- Activities and Milestones
 - Reuse IVT (Oct 03)
 - 1-week Software Fundamentals course for ASEs who do not have the prerequisites for SW Job Functions (Jan 04)
 - 1-week prototype software course for AIR-130 CNS engineers whose responsibilities require a knowledge of software but who do not perform DO-178B audits (May 04)
 - 2-week prototype software course for AIR-130 CNS engineers whose responsibilities include performing DO-178B audits (May 04)

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Software Training



- Activities and Milestones (cont)
 - Software Job Functions (Aug 04)
 - OOT Basics IVT (Nov 04)
 - 1-week Software Job Functions course for DERs (Nov 04)
 - 1-week course on CEH (Nov 04)
 - Real-Time Software Development (July 05)
 - 1-week prototype course on Object-Oriented Technology (Nov 05)
 - 1-week course for ASIs on Software in Manufacturing Document (Sept 07)



Software Training



- POC
 - Leanna Rierson, John Lewis, Barbara Lingberg, AIR-200, AIR-500

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Military Software Vision



- Description
 - Military services want to meet civil aviation standards to ensure access to worldwide controlled airspace
 - Legacy military systems often do not comply with software standards, e.g., DO-178B
 - Commercial Derivative/Military aviation software needs often differ from that of civil aviation software
 - Military services typically do not have a clear understanding of DO-178B resulting in increased ACO/DER workload



Military Software Vision



- Activities and Milestones
 - Create white paper for addressing common civil and military software needs through policy, guidance, and training (Sept 03)
 - If applicable, then prepare a detailed implementation plan to address Commercial Derivative / Military software needs (Jun 04)
- POC
 - Leanna Rierson, John Lewis, and AIR 110

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Complex Electronic Hardware



■ Description

- Currently, no national guidance or policy has been implemented by the FAA to address complex electronic hardware design
- An Advisory Circular, an Order, supporting designee materials, and training are needed to address this technical area
- Effort will be closely coordinated with the Designee Standardization Team, FAA, international certification authorities, and Industry

Complex Electronic Hardware



■ Activities and Milestones

- FAA coordination on draft AC.CEH (August 03)
- Public comments on draft AC.CEH (Sept 03)
- Designee Qualifications for CEH (Feb 04)
- Publish final AC.CEH (March 04)
- FAA coordination of draft order 8110.CEH (Apr 04)
- Public comments of draft order 8110.CEH (Sept 04)
- Training for CEH (Nov 04)
- Publish 8110.CEH (Mar 05)

■ POC

- Leanna Rierson, John Lewis

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Flight Standards Software



- Description
 - A white paper will be developed to document the needs in Flight Standards (AFS) regarding software and make recommendations on how to meeting these needs
 - Goal is to make this Plan an AVR-wide plan



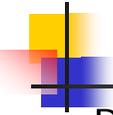
Flight Standards Software



- Activities and Milestones
 - Develop a white paper (Dec 03)
 - Make recommendations regarding AFS software needs (Mar 04)
 - Create an AFS software team to develop an AFS vision for software (Oct 04)
 - Create an AVR-wide Plan (FY05)
- Participants
 - Leanna Rierson, AFS

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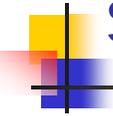
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Software Tools



- Description
 - FAA is currently funding research in both the verification and development tools areas
 - Tools are being proposed for use in the verification, development, configuration management, maintenance, and return-to-service areas
 - Guidance in DO-178B and Order 8110.49 does not address many of these needs and need for a special tool committee is foreseen
 - Effort may be combined with DO-178C development



Software Tools



- Activities and Milestones
 - Provide support to industry pilot tools project (FY04)
 - Conduct Tools Workshop (3rd qtr FY04)
 - Evaluate need for tools policy/guidance (Aug 04)
 - Document needs and develop plan to meet those needs (Oct 04)
- POC
 - Leanna Rierson, Barbara Lingberg

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Real-Time Operating System Needs



- Description
 - Real-time operating systems (RTOS) are a unique and complex component of most avionics systems
 - Several efforts have been initiated to address FAA and industry needs regarding RTOS, including research efforts, the IMA RTCA/EUROCAE committee (SC-200/WG-60), the reusable software component AC, etc.
 - Goal is to identify a potential need for specific guidance on RTOS

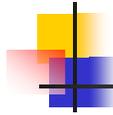
Real-Time Operating System Needs



- Activities and Milestones
 - Review documents on RTOS (Sept 05)
 - Determine need for RTOS guidance (Dec 05)
 - Develop plan for RTOS guidance (Dec 05)
- POC
 - Leanna Rierson

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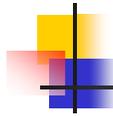
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Databus Needs



- Description
 - Although a number of databuses are being proposed by applicants, FAA has no criteria for evaluating such buses
 - CAST developed a position paper which is being used by ACOs but this needs to become formal guidance
 - Small airplane directorate expressed need for a databus AC in near term



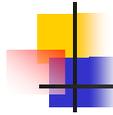
Databus Needs



- Activities and Milestones
 - Create draft AC.databus (Sept 03)
 - FAA coordination of AC.databus (May 04)
 - Public comments on AC.databus (Oct 04)
 - Publish final AC.databus (Jan 05)
- POC
 - Leanna Rierson, John Lewis

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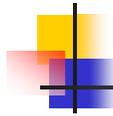
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Security Assurance



- Description
 - New aircraft types will have a single network that services both flight controls, in flight entertainment, and operations software
 - Need to determine how security assurance for airborne software is handled



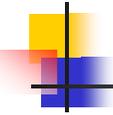
Security Assurance



- Activities and Milestones
 - Prepare CAST paper (Jan 04)
 - Determine plan for guidance (TBD)
- POC
 - Leanna Rierson

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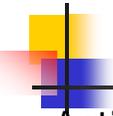
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Other



- Description
 - Software program will support other tasks as time permits and management directs



Other



- Activities and Milestones
 - Participate in RTCA, ARINC, SAE, and other industry committees
 - Provide input on notices, orders, ACs, TSOs as appropriate
 - Develop and present papers on topics of relevance at international conferences
 - Add new criteria to 8110.49 on maturity of software prior to type inspection authorization (TIA)
- POC
 - Leanna Rierson, John Lewis, Barbara Lingberg, AIR-200

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Conclusion



Conclusion

- Website: <http://av-info.faa.gov/software/>
- Contact us at:
 - Leanna.Rierson@faa.gov
 - John.Lewis@faa.gov
 - Barbara.Lingberg@faa.gov

Thank you for listening! 😊

Any questions or comments ?