Workshop on Software Defined Multi-function Multi-mode Avionics

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Software Defined Avionics Issues

- Market-driven
- Equipage
- Implementation
- Cost
- Certification
Market-driven Issues

- What are the most desirable/marketable combinations of legacy and/or emerging CNS functions and/or modes?
  - For those combinations, what are the application(s), flight domains and aircraft categories?
    - Multi-mode avionics more marketable than multi-function avionics (easier certification; esp for integration of communication modes and integration of navigation modes; market: international air traffic, international business jet operators)
      - Desirability of software reconfiguration as opposed to multiple hardware implementations
      - Easier international standardization
    - How do we capture the best of open architectures vs proprietary innovations?
      - The market size just isn’t that large; hard to obtain enough market share when market isn’t large to begin with.
- Other
  - Potential for reduction of legacy ground infrastructure once a certain percentage of the (military) fleet is equipped (UHF, TACAN)
  - Potential for implementation of SDA in ground infrastructure for future-proofing (next generation air-ground com) and cost reduction
Market-driven Issues - Cont’d

- What are the most desirable/marketable combinations of legacy and/or emerging CNS functions and/or modes?
  - For those combinations, what are the application(s), flight domains and aircraft categories?
    - Synergistic integration and fusion of existing and emerging functions may enable higher total system performance reliability and therefore operation in more desirable airspace and airports, preferential routing, etc.
      - May require policy & procedure changes
      - Self-separation at high altitudes
      - Reduced spacing for oceanic routes
      - Human machine interface (managing/reducing workload, novel or more intuitive ways of presenting information)
    - Other benefits:
      - Reduced training needs
      - Reduced costs of equipage, maintenance, spare parts
      - Added capabilities for greater reach into other markets (increase revenues)
      - Reduced downtime for re-equipage via software download (raises significant certification issues)
Market-driven Issues - Cont’d

- What are the most desirable/marketable combinations of legacy and/or emerging CNS functions and/or modes?
  - For those combinations, what are the application(s), flight domains and aircraft categories?
    - Drawbacks
      - Complexity issues
      - Human machine interface (too complex??)
Equipage Issues

- What equipage/sparing strategies are enabled by software defined avionics to reduce cost?
  - For broad suite of integrated functions (e.g. VHF/UHF/L-Band)
  - For narrow suite of functions (e.g. VHF/UHF and L-band)
    - Box level reconfiguration of functionality as opposed to board level replacements
    - Issues of open (built to a standard performance and interface specification) vs proprietary architecture
    - The level of functional integration may be offset by single point of failure
- Graceful degradation to minimal functionality
- Certification of the suite of components at the functional level is responsibility of avionics integrator
- Reduced box count, reduced physical size of box, reduced spare parts (helps with cost, reliability, maintainability)
- Need to address safety and robustness aspects of reduced equipage (A failsafe capability? A safe restart mode? Graceful degradation to minimum capabilities for safe flight?)
Implementation Issues

- What implementation considerations are most critical for success?
  - E.g. open SDA architecture; integration level of hardware and software; performance degradation from integration; security concerns
    - Consider a tailored subset of the SCA as a viable alternative for civil aviation (as opposed to JTRS subset of SCA)
    - Partitioning DO178b software certification specifications
      - Aspects of certifying multiple modes in the same function may be different from certifying multiple functions in an SDA
    - Antennae issues (location, interference) caused by multi-function avionics
    - Need to consider the human-machine interface
      - Should be intuitive
      - Opportunity to take advantage of background/experience of rising generation of users
    - Minimize downtime for MRO (maintenance, repair, operations)/Upgrades
    - Sparing philosophy and equipage issues may force novel implementation backups
Implementation Issues - Cont’d

- What implementation considerations are most critical for success?
  - E.g. open SDA architecture; integration level of hardware and software; performance degradation from integration; security concerns
    - Security & Safety: multiple channels for varying security levels (e.g. red/black portions of JTRS architecture)
    - Must still maintain safety and security standards of today
    - Authentication, verification and validation aspects of SDA
Cost Issues

- How will initial cost, annual operating costs and life cycle cost of SDA have to compare with that of conventional avionics to be attractive in the next 5 years?
  - What are the best ways to improve those cost perceptions?
    - Pricing strategies of initial investment
    - Who should pay for initial equipage costs?
      - Benefit to FAA and NAS?
      - Benefit to user of NAS?
    - Leveraged development of ground and airborne components that perform the same function (hardware and software components)
    - International operability to increase market size
    - International harmonization of standards to increase market size
      - RTCA & EUROCAE
Certification Issues

- What are specific concerns facing certification of SDA?
  - What recommendations will reduce cost and time of certification and life-cycle recertification of SDA?
    - The nature of the software architecture for the SDA greatly affects its certifiability
    - Certify at the performance level as opposed to the internal implementation level
    - Aircraft location at time of upgrade (reconfigurations on ground or in flight would have different security, safety and certification issues to consider)
    - Is the FAA certification methodology equipped to address certification of SDA? Does it impress another policy decision by the FAA concerning how certification is accomplished?
    - Can software development tools aid the certification process with certifiable process steps/tools?
  - Lessons learned from prior experience from SDA:
    - Avidyne avionics radio for NEXCOM
    - Honeywell EPIC radio
    - Scalability, flexibility, adaptability
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