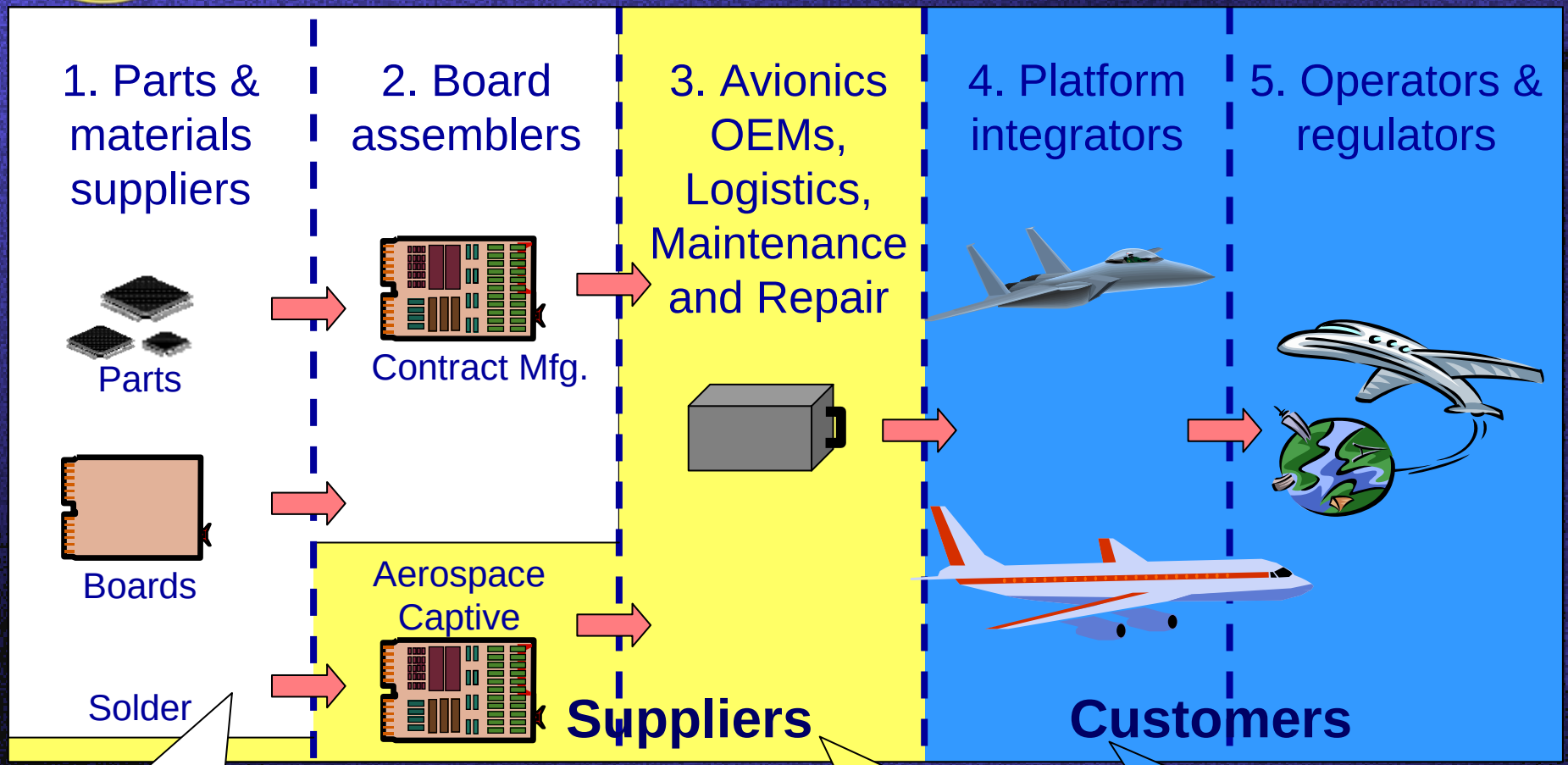
Agenda

1. Lead Free Transition and Impacts
2. Lead Free Failure Modes
3. **A Comprehensive Lead Free Strategy**
4. GEIA Lead Free Standards and Handbooks
   - GEIA-STD-0005-1 Performance Standard
   - GEIA-STD-0005-2 "Tin Whisker Document
   - GEIA-HB-0005-1 Program Management Guidelines
   - GEIA-HB-0005-2 Technical Guidelines
   - GEIA-STD-0005-3 Performance Testing
   - GEIA-HB-0005-3 Rework and Repair
   - GEIA-HB-0005-4 Reliability Assessment
5. Summary
   - Acknowledgements
   - Lead Free Links
   - Points of Contact

The Avionics Supply Chain



Beyond aerospace control

Majority of costs incurred here

Majority of costs determined here

Effects of the European Directives on the Military/Aerospace Industry

The move towards lead-free electronics is driven by RoHS and WEEE European directives

- **Disruptive** to the aerospace industry
- **Neither drive nor resist it**
- **Must work together** in response to it
- **Must ensure** that our systems are ***Reliable, Repairable, Supportable, Safe, Affordable, Airworthy, Certifiable***

Lead-Free technology can impact any program regardless of whether the program itself is exempt or bound by environmental regulations.

Military & Commercial Aerospace Industries

- **Reality**
  - **Component manufacturers have already switched** and are currently delivering components with lead-free component finishes.
  - **Aerospace suppliers sell** commercially in US and **worldwide**.
  - **Cost prohibitive for suppliers** to put in separate soldering lines.
- **Military and Aerospace will be "swept along" by a supply chain** that is beyond our control

Mil/Aero Lead-Free Efforts

- Military and Aerospace related lead-free efforts
  - DoD Executive Lead Free IPT
  - DoD Lead Free Working Group
  - Government, industry and academic lead-free research efforts
  - LEAP Working Group

The commercial industry has spent millions in development and conversion to lead free
They have not solved all the technical issues

ELF IPT

Executive Lead-Free Integrated Process Team (ELF IPT)

- Identify DoD specific issues
  - Lead-free roadmap
  - Business case/cost impacts
  - Contract language
  - Gap analysis
- Coordinate service efforts
- Access to Government Policymakers
  - Provide policy guidance to DoD Lead Free WG

Senior Membership from:

Air Force	Army	DLA	DMEA
FAA	NASA	Navy	Industry

DoD Lead Free WG

- Lead Free Working Group
  - Government only
- Created to address Policy and Funding issues for lead-free
- Draft LF Policy developed with input from ELFIPT and LFWG members
- Formal Charter and Policy in coordination
- Expect DoD lead-free policy issued at Undersecretary of Defense level

Mil / Aero Lead-free Efforts

- University of Maryland - CALCE
  - Computer Aided Life Cycle Engineering (CALCE) Electronic Products and Systems Center (EPSC)
  - Several “science projects” and tools related to lead-free and tin whisker
- NASA – Goddard Space Flight Center
  - Extensive research and documentation on tin whisker effects
  - Check out the pictures!
- JCAA/JG-PP and NASA Kennedy
  - Lead-Free Solder Testing for High-Reliability Applications
  - Four solders tested in MIL qualification tests
  - Test results published May 2006
- Navy – ONR
  - Office of Naval Research (ONR) - Best Manufacturing Practices Center of Excellence (BMPCOE)
  - Ongoing tin whisker research with Raytheon, CALCE, NASA, Boeing, Honeywell, Northrop Grumman

NASA-DoD Lead-Free Electronics Project

- Multi-year project to address reliability impacts
  - Rework of lead-free alloys
  - Mixing of lead-free and SnPb alloys
  - Several package types (TSOP, BGA, PDIP, etc)
  - Multiple solder alloys (SnPb, SAC305, SN100C)
- Environmental profile (proposed)
  - Thermal cycle -55°C to +125°C
  - Thermal cycle -20°C to +80°C
  - Vibration
  - Combined environments (thermal + vibration)
  - Mechanical shock
  - Drop testing
- Launched November 2006
  - Follow-on to JCAA/JGPP LFS Project

AIA-AMC-GEIA Lead-free Electronics in Aerospace Project Working Group (LEAP WG)

- Formed in 2004 as AIA Lead-free Aerospace Electronics Working Group
- Includes all stakeholders (market segments, supply chain, geographic regions)
- Addresses issues that are:
  - Unique to aerospace and military
  - Within control of aerospace and military

- Currently over 100 corporations plus numerous US and European government agencies and educational institutions actively participate.

AIA = Aerospace Industries Association
GEIA = Government Engineering and Information Technology Association
AMC = Avionics Maintenance Conference

Partial List of LEAP Member and Consulting Organizations (as of Feb 07)

- AAI Corp
- ADS Transicoil
- Aerospace Corp
- Airbus
- Air Canada
- AMETEK Rotron
- Avtech Corp
- Axsys
- BAE Systems
- Barfield
- Boeing Company
- Bombardier Aero
- Celestica
- Cie Barco
- Corfin Industries
- CSP Inc
- Curtiss-Wright
- Delta Airlines
- Diehl Avionik
- DfR Solutions
- DPACI
- EADS
- Eaton Aerospace
- Elbit Systems
- ELDEC
- FEDEX
- Fischer Technology
- Gables Engineering
- Garmin International
- General Dynamics
- Gixel
- Goodrich
- Hamilton-Sunstrand
- Harris Corp
- Hispano-Suiza
- Honeywell
- IBM
- Intel
- Internat Rectifier
- Intersil
- IMEC
- IPC
- ITB, Inc
- ITT
- Jabil Circuit
- Japan Airlines
- Kidde Aerospace
- L-3
- Lansdale Semicon
- LCIE
- Linear Tech Corp
- Lockheed-Martin
- Lufthansa Technik
- Mascorp
- Matsushita Avionic
- MBDA
- Medtronic
- Meehan Electonics
- Microsemi Corp
- MOOG
- National Semicon
- Northrop Grumman
- Orbital Sciences Corp
- ORS Labs
- Panasonic Avionic
- Parker
- Phillips Medical
- Purdue University
- QTEC
- Raytheon
- Rockwell Collins
- Rolls Royce
- Safe Flight Instr
- SBS Technologies
- Six Sigma
- Smiths Aerospace
- Space Dynamics
- Stilwell Baker
- Teldix
- Teledyne Controls
- Terma AS
- Texas Instruments
- Textron
- Thales
- Trimle
- TTI, Inc
- Tyco
- UIC
- United Tech Corp
- Univ of Alabama
- Univ of Maryland
- Univ of Missouri
- Vishay Semicon
- Vibro-Meter
- Wyle Labs
- AIA
- AMC
- American Competitive Institute (ACI)
- ARINC
- BMPCOE
- BSI
- CALCE
- Defense Acq Univ
- DMEA
- DOD (USAF, Navy, Army, Coast Guard)
- Euro Space Agency
- FAA
- GAMA
- GEIA
- IEQC
- NASA
- NIST

AIA-GEIA-AMC Lead-free Electronics in Aerospace Project Working Group

The purpose of LEAP is to develop and implement actionable deliverable items that enable the aerospace industry to accommodate the global use of lead-free electronics. The deliverable items address problems that are unique to, and are within the control of the aerospace industry.

- Goals & Objectives:
  - Enable the aerospace industry, on an ongoing basis, to accommodate the global electronics transition to lead-free electronics
  - Provide a common set of standards to be used by suppliers and customers to address issues related to lead-free electronics ("level playing field")
  - Provide avenues of communication between the aerospace industry and customers
  - Provide avenues of communication within the aerospace industry

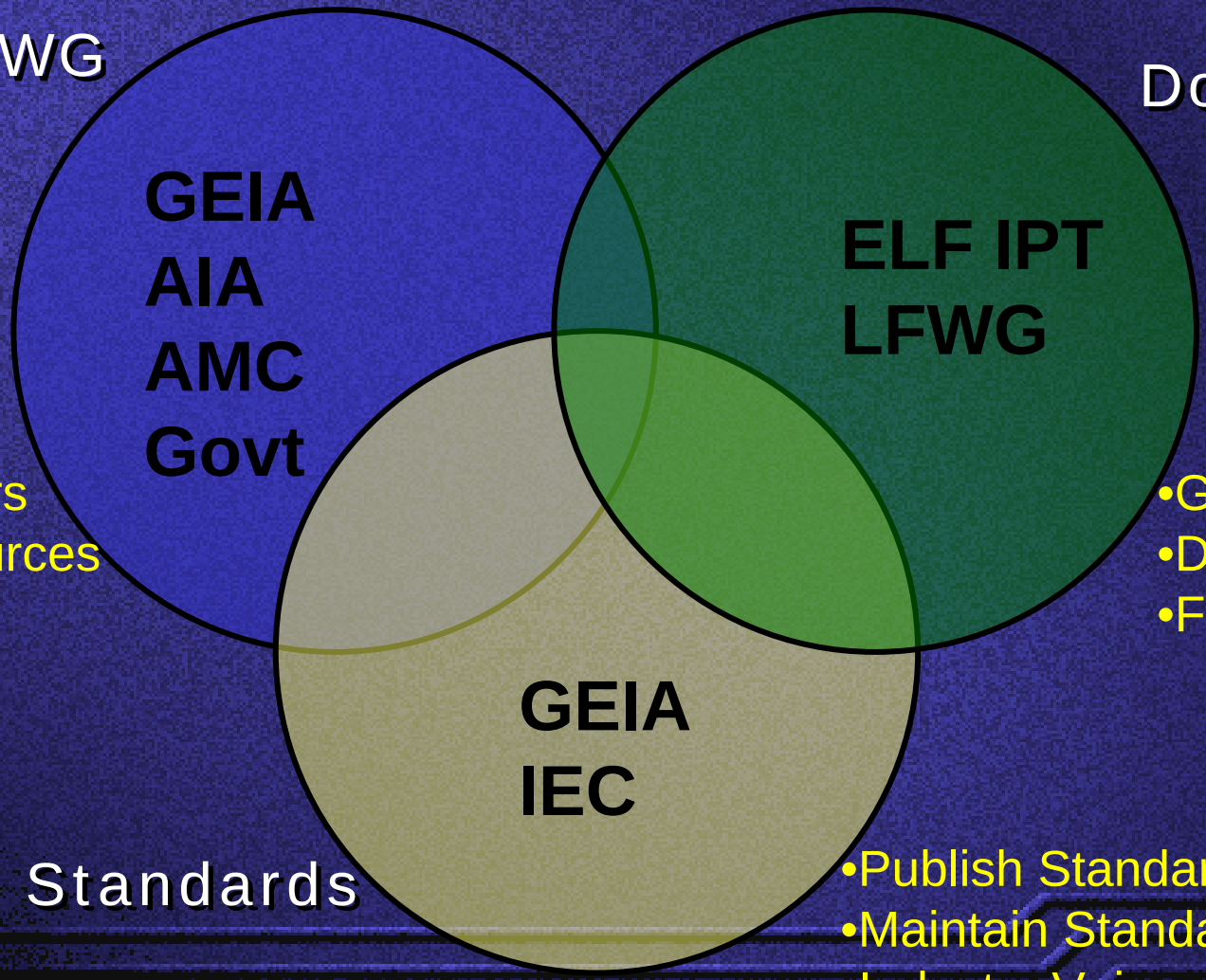
Actionable Deliverables

- **GEIA-STD-0005-1** Performance Standard for Aerospace and High Performance Electronic Systems Containing Lead-free Solder
- **GEIA-STD-0005-2** Standard for Mitigating the Effects of Tin in Aerospace and High Performance Electronic Systems
- **GEIA-HB-0005-1** Program Management / Systems Engineering Guidelines for Managing the Transition to Lead-free Electronics
- **GEIA-HB-0005-2** Technical Guidelines for Aerospace and High Performance Electronic Systems Containing Lead-free Solder
- **GEIA-STD-0005-3** Performance and Qualification Testing for Aerospace and High Performance Electronics Containing Lead-free Solder
- **GEIA-HB-0005-3** Rework, Repair and Maintainability for Aerospace and High Performance Electronics Containing Lead-free Solder
- **GEIA-HB-0005-4** Reliability Assessment for Aerospace and High Performance Electronics Containing Lead-free Solder
- **New Document** proposed concerning Configuration Control

Actionable Deliverables

GEIA-STD-0005-1	Performance Standard	Lloyd Condra, Boeing	Published GEIA 30 June 2006	Submit to IEC 31 March 2007
GEIA-STD-0005-2	Tin Whiskers	Anduin Touw, Boeing	Published GEIA 30 June 2006	Submit to IEC 31 March 2007
GEIA-HB-0005-1	Program Mgmt Guide	Pat Amick, Boeing	Published GEIA 30 June 2006	Submit to IEC 31 March 2007
GEIA-HB-0005-2	Technical Guidelines	Stephan Meschter, BAE	Submitted GEIA 31 Jan 2007	Proposed 30 June 2007
GEIA-STD-0005-3 (in work)	Performance & Qual Testing	Tony Rafanelli, Raytheon	Proposed 30 Jun 2007	Proposed 31 Dec 2007
GEIA-HB-0005-3 (in work)	Rework / Repair	Tim Kalt, USAF	Proposed 30 Sep 2007	Proposed 31 Mar 2008
GEIA-HB-0005-4 (in work)	Reliability Assessment	John Biel, Smiths Aerospace	Proposed 30 Sep 2007	Proposed 31 Mar 2008
New Document	Configuration Control	Dan Korte, Rockwell Collins	New Document	New Document

A Comprehensive Strategy



- Stakeholders
- Tech Resources
- "Experts"

- Gov Access
- DoD Policy
- Funding

- Publish Standards
- Maintain Standards
- Industry Voice