



**1st EU/US Lead Free Solder Interface Meeting
27 March 2002**

JG-PP Lead-Free Solder Project

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Raytheon Company

Agenda

- ◆ Problem
- ◆ Raytheon's Interest
- ◆ JG-PP Process
- ◆ JG-PP Pb-Free Solder Project Status
- ◆ Summary

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Problem

- ◆ Use of conventional tin lead solders in circuit card manufacturing is being questioned today
 - Environmental concerns
 - Increasing regulations
- ◆ U.S. Environmental Protection Agency has lowered reporting thresholds for Pb and Pb compounds
 - Lowered reporting threshold on Toxics Release Inventory to 100 pounds
 - Increased regulatory burden to electronics industry of ~\$95 million



Drivers for Change

- ◆ **A Sense of Urgency**
 - **EC's Waste for Electrical & Electronic Equipment (WEEE) Directive**
 - Ban on Pb use by ~2006 or 2008 (TBA 2002)
 - **Japanese EPA suggests reduced usage**
 - **Nordic proposals potential:**
 - import, sale and production bans
 - complete ban by 2020
 - **U.S. actions uncertain**
- ◆ **Military sales impact**
 - **Exemptions?**
 - **Public/community perceptions?**



Lead-Free Solder Projects

- ◆ NCMS
 - Pb-Free Solder
 - High Temp Fatigue Resistance Pb-Free Solder
 - Pb-Free Solder for Harsh Environments
- ◆ NEMI
 - Pb-Free Solder Project
- ◆ CALCE
 - Durability of Pb-Free Solders
- ◆ ITRI
 - Pb-Free Laminate and surface finishes
- ◆ IPC
 - Pb-Free Roadmap
- ◆ Open University
 - The Solder Programme
- ◆ NPL
 - Pb-Free Soldering Technology
- ◆ IVF
 - Integrity of Pb-Free Solders
- ◆ IDEALS
 - Improved Design Life....by Pb-Free Soldering

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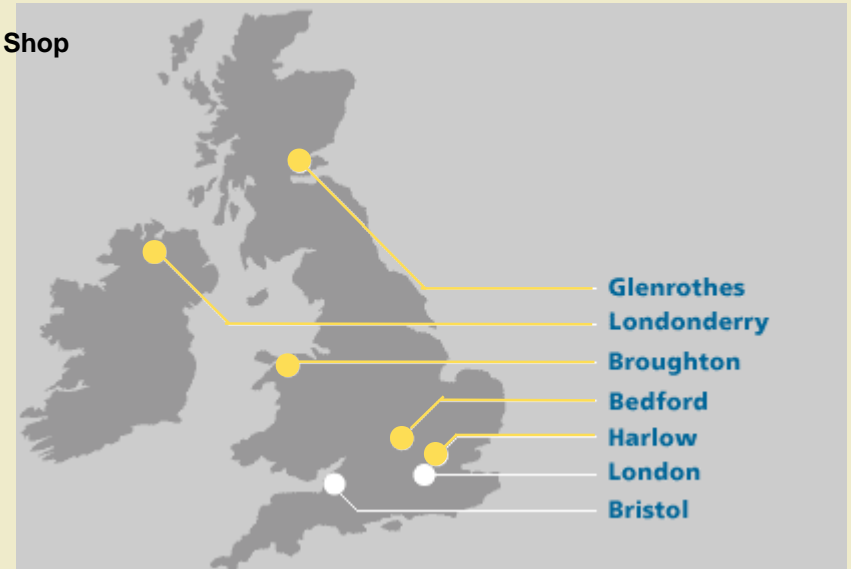
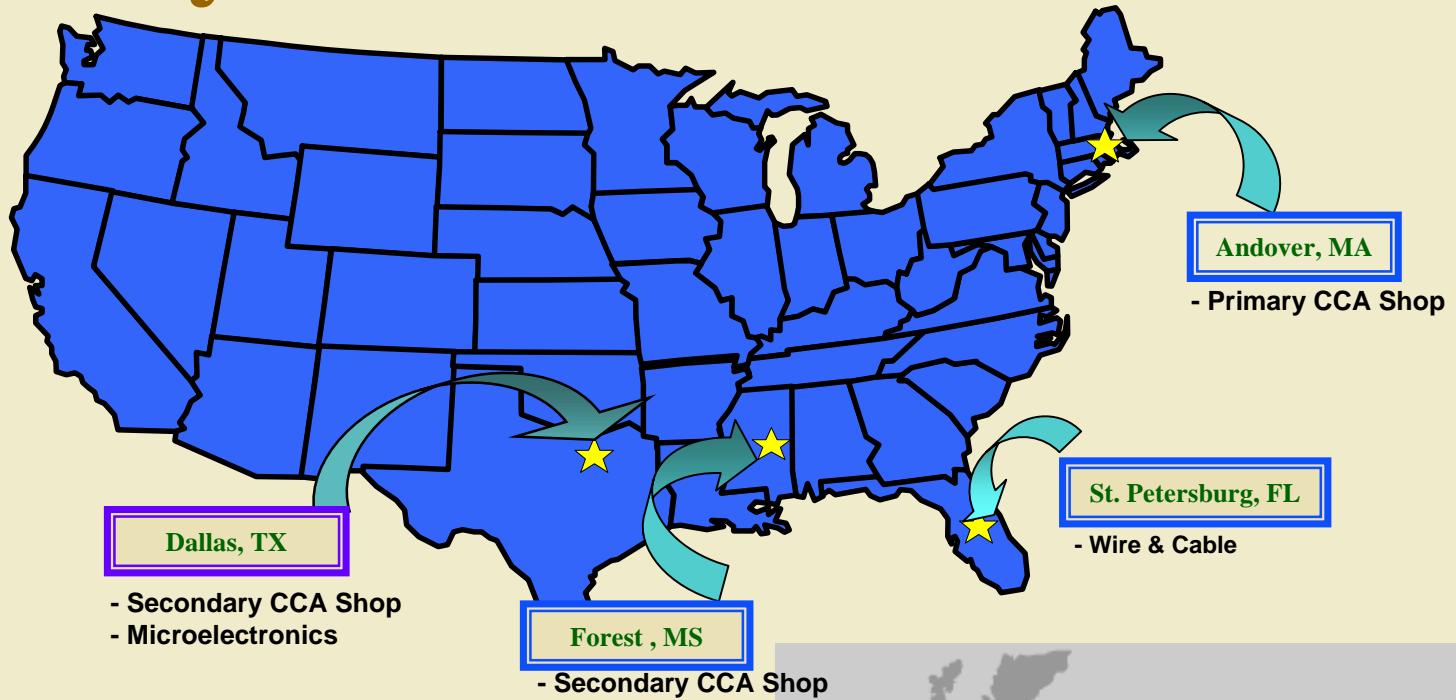
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Raytheon Company

- ◆ **Raytheon is the largest U.S. military manufacturer of electronics**

Major Impact to Change to Lead-Free Solder

Raytheon Electronics Facilities



4/16/02



Why is Raytheon involved?

- ◆ Training: \approx Approximately 3000 operators
- ◆ Need to touch soldering process on every CCA
- ◆ Risk assessment of higher application temperature on components
- ◆ Implementation in parallel with production
- ◆ Compatibility between existing and new designs
- ◆ Customer Return Material and sustaining

We Must Get an Early Proactive Start



History of Consortia Participation

- ◆ **EPA/DoD/Industry Ad Hoc Solvents Working Group**
 - Elimination of ozone depleting solvents in military electronics (1995)
- ◆ **LRSTF**
 - Low-Residue Soldering for Military & Commercial Applications (1995)
- ◆ **NCMS**
 - Lead-Free Solder Project (1997)
 - Environmental Stress Screening 2000 (1997)



Raytheon's Sponsorship

Raytheon has long history with JG-PP projects:

- ◆ **1996** - Alternative Low VOC Paint Coatings
(1st EHS SPI) 
- ◆ **1997** - Performance-based standards for Paint Top Coats
- ◆ **1997** - Circuit Card Assembly Task Force (CCAMTF):
 - Low VOC Conformal Coatings
 - Lead-Free PCB Surface Finishes 
- ◆ **1998** - Qualified new formulation for CARC Powder Paint
- ◆ **2000** - Primers & Topcoats SPI expanded for Raytheon use

The Challenge

- ◆ Quality - Reliable/environmentally conscious
- ◆ Cost - Feasible; not an economic burden
- ◆ Schedule - Acceptable transition

Joint Group on Pollution Prevention (JG-PP) as the bridge

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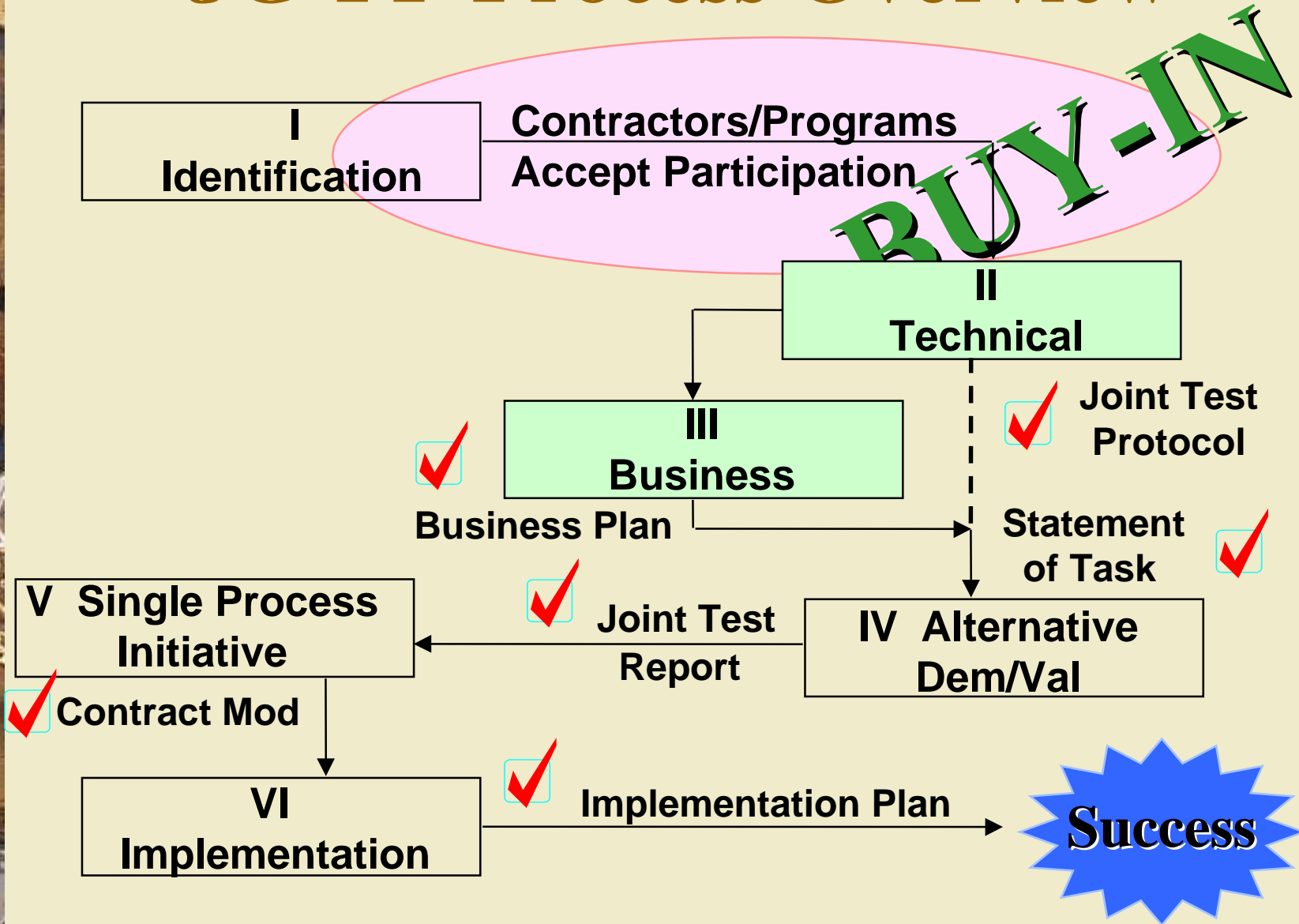
Pb-Free Solution

- ◆ Electronics manufacturers currently pursuing ways to reduce lead use
 - Component suppliers going Pb-free
- ◆ Solution requires a consortium of industry, military and government organizations
- ◆ Application dependent; may not be a single Pb-free alternative or may be one or more alternatives

JG-PP Benefits

- ◆ Unlike some consortia:
 - Results and data are not treated as intellectual property of participating organizations
 - Results and data immediately available as status reports
- ◆ Facilitation of Weapons Systems participation
- ◆ Funding shared with stakeholders
- ◆ Projects lead to implementation through block change and Single Process Initiative

JG-PP Process Overview



Without the JG-PP Approach

- ◆ Tremendous operational burden
- ◆ Tremendous logistical burden
- ◆ Increased technical risk
- ◆ Increased costs associated with system performance reliability

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This Project is Different

- ◆ **Project goal is Demonstration/Validation of alternatives leading to implementation**
- ◆ **Customer inputs/consensus on Joint Test Protocol (JTP)**
 - Include rework challenges (Pb contamination)
- ◆ **Combined environments testing simulates harsh operational conditions experienced by military electronic hardware**
- ◆ **Performance data gathered from application and end use environments**



Proposed Project Focus

- ◆ Pb-free solders vs Sn/Pb eutectic solder baseline
- ◆ Technologies
 - Plated-through-hole (PTH)
 - Surface mount technology (SMT)
 - Mixed technology circuit card assemblies
- ◆ Investigate impact of rework
 - Lead contamination of lead-free assemblies
 - Lead-free contamination of lead assemblies
- ◆ Minimize duplication of other industry projects currently in progress
- ◆ Incorporate customers' and stakeholders' key performance parameters



Current Participation

36 Organizations, 50+ Individuals

- ACI
- AIA
- Air Force Research Lab
- AMKOR
- BAE
- Boeing
- CTC
- Harris
- Honeywell
- IPC
- Lockheed-Martin
- Lucent Technologies
- Mitsui-Senju
- Motorola
- Motorola
- NASA
- Navy – NAVAIR
- Navy – NAVSEA
- NIST
- Northrup Grumman
- Raytheon
- Rockwell Collins
- Sandia National Labs
- Texas Instruments
- TRW
- Army - AMCOM
- Army – Ft. Monmouth
- Army – Picatinny
- Army – Redstone
- Army – TACOM
- USAF - Hanscom AFB
- USAF - Wright-Patterson AFB
- USAF – Hill AFB
- USAF – Robins AFB
- USAF – Tinker AFB
- USAF – Wright Paterson



JG-PP Pb-Free Project Status

- ◆ Technical Phase in progress
- ◆ Potential Alternatives Report **in progress**
- ◆ Cost Benefit Analysis **in progress**
- ◆ Draft Joint Test Protocol generated, **not finalized**
- ◆ List of alloys and applications identified
- ◆ Test Vehicle **in design**
- ◆ ROM Schedule **proposed**

Joint Test Protocol

- ◆ Environments identified
- ◆ Test parameters **not finalized**
- ◆ Critical Performance Requirements
 - Combined Environments Testing (modified HALT)
 - **Vibration**
 - **Thermal Cycling**
 - Mechanical Shock
 - Thermal Shock
 - Humidity

JG-PP Test Solder Alloys

- ◆ Baseline Solder:
 - Sn/Pb37
- ◆ Wave Solder:
 - Sn/0.7Cu
 - Sn/3.9Ag/0.6Cu
 - Sn/3.4Ag/0.1Cu/3.3Bi
- ◆ Reflow Solder:
 - Sn/3.9Ag/0.6Cu
 - Sn/3.4Ag/0.1Cu/3.3Bi

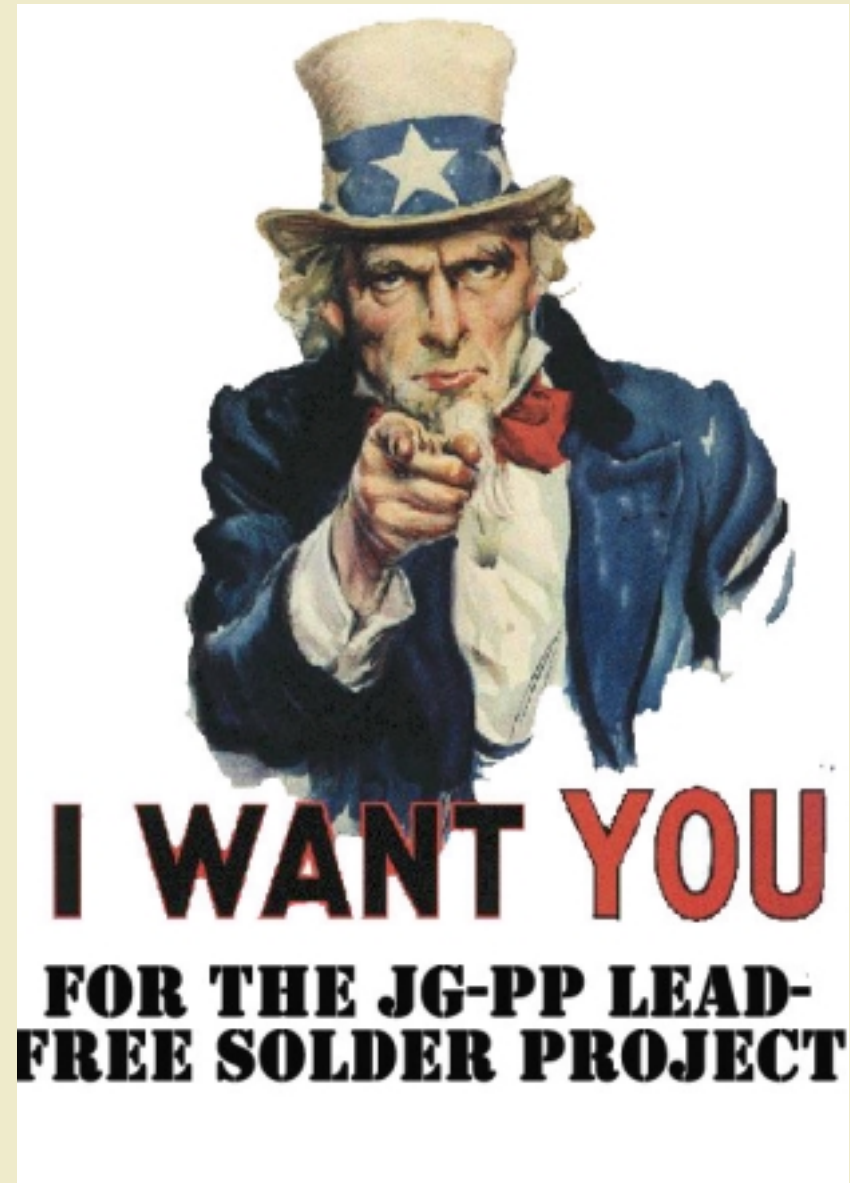
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Summary

- ◆ **Days of tin lead solder may be numbered**
- ◆ **Raytheon Company is interested in active participation to find a solution**
- ◆ **JG-PP Process benefits:**
 - Facilitates OEM and weapons systems participation
 - Provides a funding mechanism
 - Leads to implementation
- ◆ **JG-PP Lead-Free Solder Project is in the Technical Phase**
- ◆ **JTP performance requirements, test vehicle design and test solder alloy selection are not finalized.**
- ◆ **Still ample time to participate.**

In Closing



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