Assembled Replacement Integrated Circuits (ARICs)

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KEYPORT

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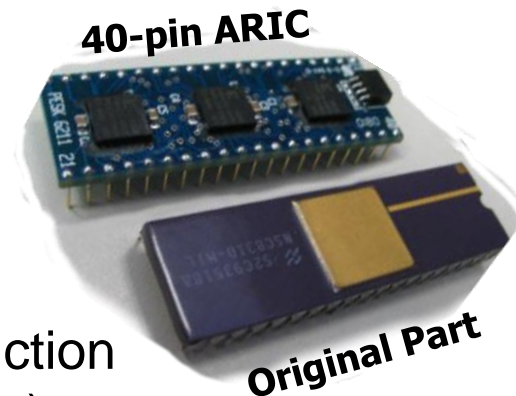
Problem

- Obsolescence driven by discontinued integrated circuits (ICs)
  - Average life-span of commercial ICs < 8.5 years, with certain microprocessors and memories obsolete in < 5 years.

- In a recent survey 88% of users confirmed the use of equipment beyond the manufacturer's obsolescence date.
  - Many users don't have a plan for when items become obsolete

- Recovery options can be expensive and time-consuming.

  - Costly design changes to assembly or system

    - Design, test & requalification, and associated time & costs

    - Documentation changes and other logistics costs

    - Can add up to millions of dollars for a single subassembly

    - System capability degradation while solutions are being worked

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Solution (Firmware)

- ARIC's use of VHDL (VHSIC Hardware Description Language)

  – In high density programmable electronic components, use of VHDL programming allows designs to be more cost-effectively transitioned to new technologies, significantly minimizing future obsolescence resolution costs.

  – Air Force Materiel Command (AFMC) reported significant cost avoidance achieved when replacing discontinued technology. For example, where VHDL was used to document F-22 ASIC designs, re-partitioning and redesign costs were approximately half the cost incurred by those who did not document ASIC designs in VHDL.
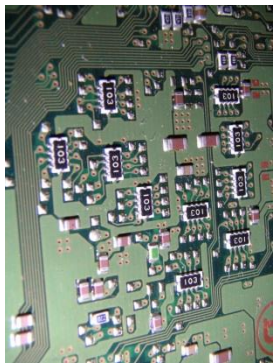
22-pin ARIC for DoD Platform
(Stock photo shown - actual image and platform details not publicly releasable)

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Solution (continued)

Another PCB in a DoD Platform; 20-pin ARIC with Resistors and Capacitors

*(Stock photo shown - actual image and platform details not publicly releasable)*

- If the specific function of any IC is known or can be determined, an ARIC can likely replace it.

  – Digital ICs, Analog ICs, Even Packaged Hybrid Circuits; DIP Packages or Surface Mount Technology (SMT)

  – Extends sustainment solutions (repair & replenishment) of existing systems

- Custom ARICs can be developed for the application, or standard components can be programmed onto ARIC blanks using a handheld programmer (current Keyport library includes all 14- and 16-pin 54/74 series 5V logic ICs)
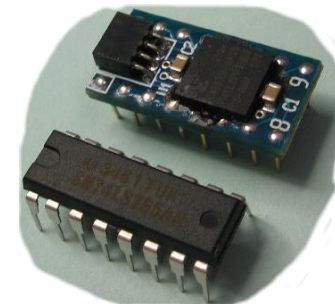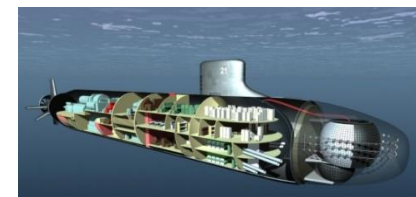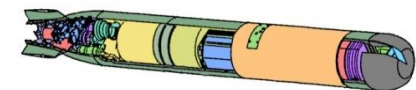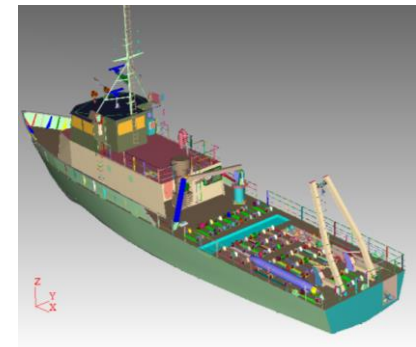

16-pin ARIC & Original Part

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Benefits

- Sustainment "*game changer*":
  - Mitigates component *obsolescence*
  - Preserves system *supportability* and avoids costly redesign of the subassembly or parent system
  - Enables *Service Life Extension* (SLEP) decisions
  - Avoids being held "hostage" by planned obsolescence

- Simply a *new source* for the function of an IC – everything else stays the same
  - "*Plugs and Plays*" into the same place as the original
  - *Transparent* to the higher level assembly
  - May improve component *reliability* over original part
  - *Reduced risk* of counterfeit parts (controlled resupply)

- Solutions may be *transportable* to other applications using the same ARIC (solutions may cross platforms and services) *

* Engineering analysis required to make this determination

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Example: F/A-18 RT-1379 (Radio Receiver-Transmitter)

Obsolete Chips

CPU CCA

Replacement Example

Data I/O Buffer CCA
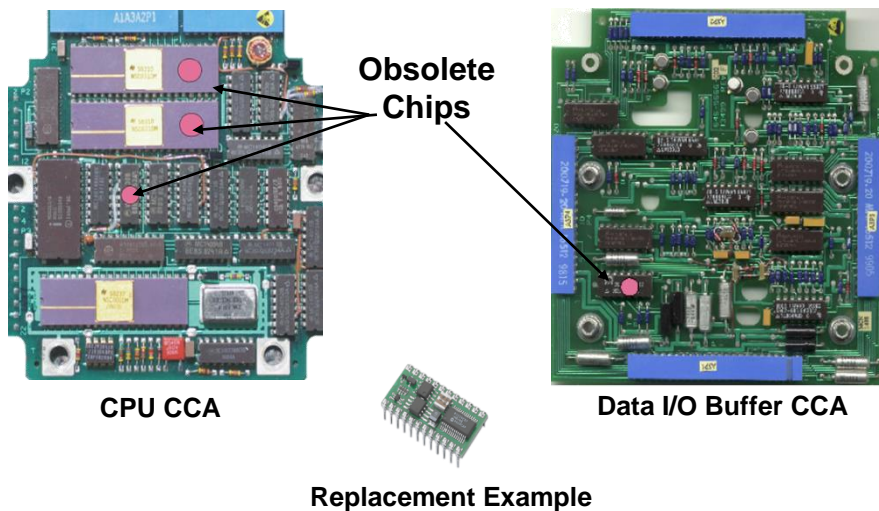
Problem:

- RT-1379 production & logistics support ends in 2007
  - 217 unique electr. components (59 no longer available)
  - Low Product Volume, Aging Test Equipment, and Diminishing Technical Expertise

NUWC Keyport Solution:

- Established Organic RT-1379 Repair Depot

- Applied ARICs to obsolete control processor & data I/O boards
  - Minimized design & documentation changes, and part requalification
  - Drop-in replacements that extend reparability
  - Feed solutions into Depot repair processes

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Challenges & Risks

- DoD Community Awareness/Exposure

- Identifying candidates for ARIC solutions in advance of emergency supply failures

  – Lead time associated with analysis of alternatives, selection, design, validation, and fielding

  – How to leverage existing solutions to other applications (where else is this part used, and will the same solution work in that application?)

- Acceptance of replacement ICs without requirement for system requalification (or with streamlined testing).

  – Cost/Risk/Schedule tradeoffs

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Innovation Status

- NUWC Keyport has been using the ARIC concept to mitigate chip obsolescence for NAVSEA, NAVAIR, and Air Force programs for ~10 years.

- ARICs have been fully qualified for military environments and are in use in the field.

- Spiral development has streamlined both the technology and the capabilities, including design of tools to simplify ARIC programming.

  – Library of solutions is continually growing

- Solutions are typically faster than more involved redesign efforts

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Vision / Final Thoughts

- "Game Changer" for DoD Maintenance processes.
  - Can replace multiple obsolete ICs with one newer technology ARIC, with minimally-invasive design changes
  - Minimizes impacts on documentation and part requalification
  - ARIC Redesign process faster than traditional redesigns
  - Drop-in replacement extends reparability by integrating newer technology
  - Feeds DoD-owned design into Depots for repair support
  - ARIC's VHDL code easily transferrable to newer technology programmable devices if required at a later date (further decreases obsolescence resolution costs down the road)

- Design and programming may be portable between applications and between services
  - Cross-service parts library is key to leveraging existing solutions

Questions?

What we do:
We fix it…
We build it…
We design it…
We manage & resolve
obsolescence…
We keep it running…

"Those who say 'It cannot be done' should not interrupt those who are doing It."
Anonymous Quote