Supportability Lessons Learned with Line Replaceable Modules

NDIA
System Engineering Division

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DoD Directions for Life-Cycle Support

- Reduce operating and support (O&S) costs for deployed weapon systems
- Minimize the logistics footprint for deployed weapon systems
One Way to Get There

- Design into our weapon systems lower value Line Replaceable Units (LRUs)
- Line Replaceable Modules (LRM) is one solution
- I will discuss some considerations/issues of implementing LRMAs
LRM vs. LRU

Line Replaceable Module

LRM is more cost effective, light weight and easier to remove/replace
Environmental Design Considerations

- **Vibration**
  - Shock mounting approach

- **Temperature**
  - Operating temperature requirements
  - Not-in-use requirement (non-mission use)

- **ESD**
  - Prevent ESD damage due to any environmental factors
BIT Design Considerations

- Fault detection vs. fault isolation
  - Harder to isolate to LRM

Fault Isolation is easier at the LRU level.

Fault Isolation is harder at the LRM level

BIT Maturity: higher development costs → lower support costs
Maintainability Design Considerations

- Accessibility for maintenance
  - Installation trades
    - New platform
    - Major modification to existing platform
  - Access to module for testing and R/R
    - Access points for testing
    - Space to open covers/doors
    - Room to attach cabling and hoses

- Special Tooling/Support Equipment
Unique Identification (UID)

- Total Asset Visibility (TAV)
- Pedigree of the weapon system
- Real-time information
- History of the item (how many times it has come back, maintenance history, repair history, FRACAS)
- By tracking at the LRM level, faster trends, design implementation, and design changes are identified (as long as it is the same format/fit/function)
Storing

- Less storing space required for LRM due to smaller size
- Under 250 lbs can utilize overnight express shipping
  - Less docking space required
  - Less time to transport
  - May reduce the need of special storage containers (i.e.: ISOPODS)
- Reduce the footprints in supply
## Sparing

- **Spare the high failure LRM vs. LRU**
  - Quantity based on weighted failure rates

- **Spare testing**

<table>
<thead>
<tr>
<th>Component</th>
<th>MTBF</th>
</tr>
</thead>
<tbody>
<tr>
<td>REX Unit</td>
<td>16,300</td>
</tr>
<tr>
<td>Receiver</td>
<td>190,000</td>
</tr>
<tr>
<td>Preprocessor</td>
<td>79,000</td>
</tr>
<tr>
<td>Waveform Gen</td>
<td>75,000</td>
</tr>
<tr>
<td>Transmit Drive</td>
<td>88,000</td>
</tr>
<tr>
<td>Local Oscillator</td>
<td>93,000</td>
</tr>
<tr>
<td>Linear Regulator</td>
<td>202,000</td>
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<tr>
<td>Chassis</td>
<td>332,000</td>
</tr>
</tbody>
</table>

- Much higher quantity to spare at LRU level
- Higher quantity in spares for these 2 LRM
- LRM delivers much less redundant supply – Supply more representative of the actual failure items.
Summary

Therefore LRM can significantly reduce the logistics footprint due to fewer spares quantity and smaller physical dimensions of each spare.

Reduced O&S cost can be achieved due to:

- Decreased MTTR (Mean Time To Repair)
- Requires less manpower effort to accomplish remove/replace
- Minimized spare investment based on reliability at the lower level (LRM) of the weapon systems
- Less special support equipment
- Reduce shipping cost and faster shipping turnaround time