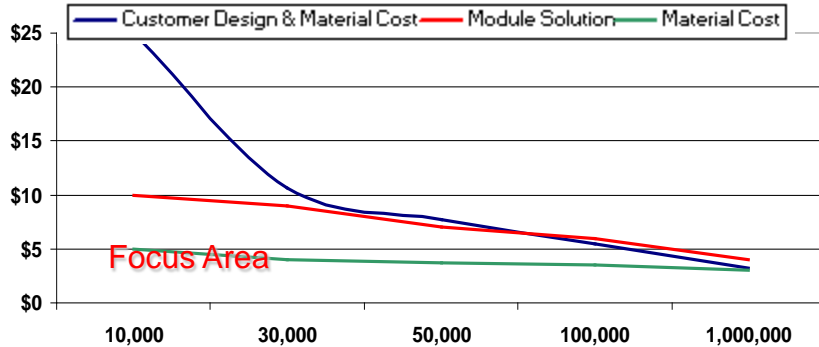




|                    | <b>Module</b>  | <b>Discrete/On-board</b>   | <b>Module Benefit</b>                               |
|--------------------|--|--|---|
| <b>RF Design</b>   | Core competency of module vendor<br>Heavy 1-time investment of module vendor | Expertise required for layout, signal routing, layer stack-up, interference, shielding | Lower RF team needs<br>Less board design iterations |
| <b>Size</b>        | Size optimized   | Non module will require larger area on target PCB                                      | Saves board area                                    |
| <b>Procurement</b> | 1 component  | Non module will increase procured BOM elements management                              | Reduce operational costs                            |
| <b>Assembly</b>    | 1 component  | Full BOM   | Reduced production cost                             |
| <b>Test</b>        | Module fully tested  | Individually tested end-product  | Reduced production cost                             |
| <b>Quality</b>     | Modules are fully tested and provided as known good                          | RF expertise and test flows to cover connectivity subsystem                            | Increased quality                                   |
| <b>Yield Loss</b>  | Pre-yielded modules  | Yield losses in production<br>Failure analysis & rework costs                          | Reduced production cost                             |

# RF Module -

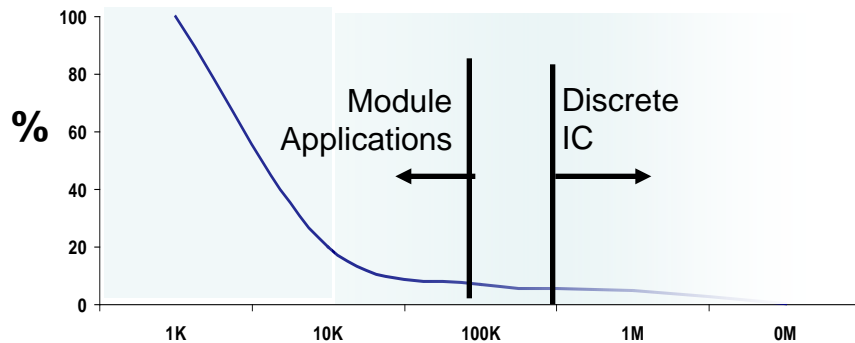
## Module vs. Chip Cost



## Customer Decision: Module vs Chip

- Initial Development / RF Certification & Testing --\$181,970
  - Respin
  - Hardware Engineering
  - Firmware
  - Layout
  - Testing & Verification
  - Certification
- TOC = BOM + Mfg & Packaging

## Module Adaption Rate



## Module Adaption Considerations

- Time to market – Modules reduce time to market.
- Product Life – Modules are the best choice for products with a long life cycle, as a module life can be extended beyond IC life cycle by using a single footprint over several generations.