



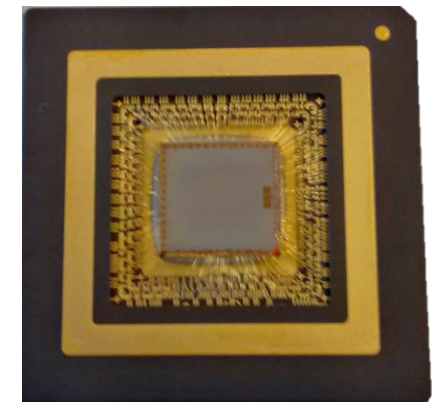
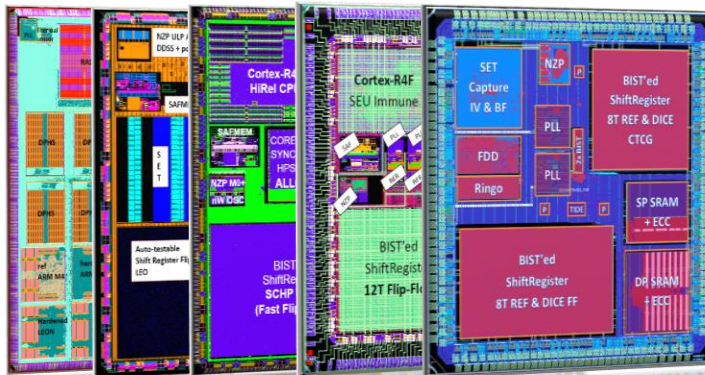
# High Density EEE for Future Space ST Perspective

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# High Density for Space : Context 1 / 2

- Space industry has entered a race to smallest technology
  - Integration - Performance - Speed - RF - Power - Flexibility...
- ST has all bricks to support Space
  - Technologies : 65 nm, 28 nm FD SOI, access to smaller FDSOI
  - Tools and know how : Design, Hardening, Libraries, Qualification
  - Test results & flight history : 65 nm, 28 nm FDSOI...
  - Supply Chain : ESCC & DLA certification, renewed facility
    - Ceramic & Organic – Wire bonding & Flip Chip
  - Ecosystem for ASIC and ASSP (MPU, FPGA...)



- High Density for Space : a business model issue
  - Traditional semiconductor business model :
    - Cost, performance & quality driven by integration & volume
    - Challenged by Moore's law end : raising costs & resources / transistor

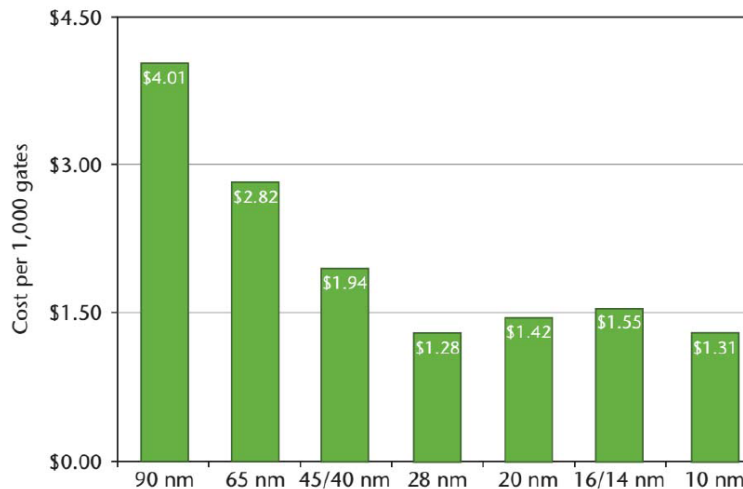


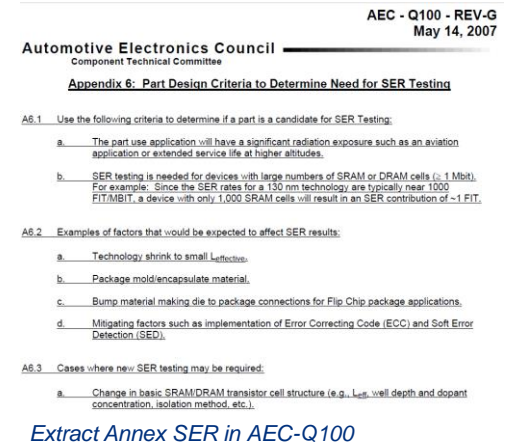
Figure 6. Cost per logic gate, with projection for 10nm technology node  
Source: Jones (2015)

- Space : Model sustainable for all actors is still to be defined
  - Space market primarily limited to Mission Critical (GEO...) + Constellations
  - Other Space : Mass Market or selective case by case

# AEC-100 does NOT offer any space guarantees

- **YES**, Space can benefit from Automotive
  - High volume over long time securing quality & longevity
  - AECQ100 quality framework
  - Tools and architectures to mitigate effects of particles
- **YES**, AECQ100 covers radiation
  - Needed for devices with RAM > 1Mbits
  - Characterization, not mitigation
  - Only atmospheric particles, alphas and neutrons
  - Only SEU sea-level
- **NO**, AEC-Q100 has no space guarantee
  - Space particles have higher ionizing power
  - No TID
  - No space-SEL

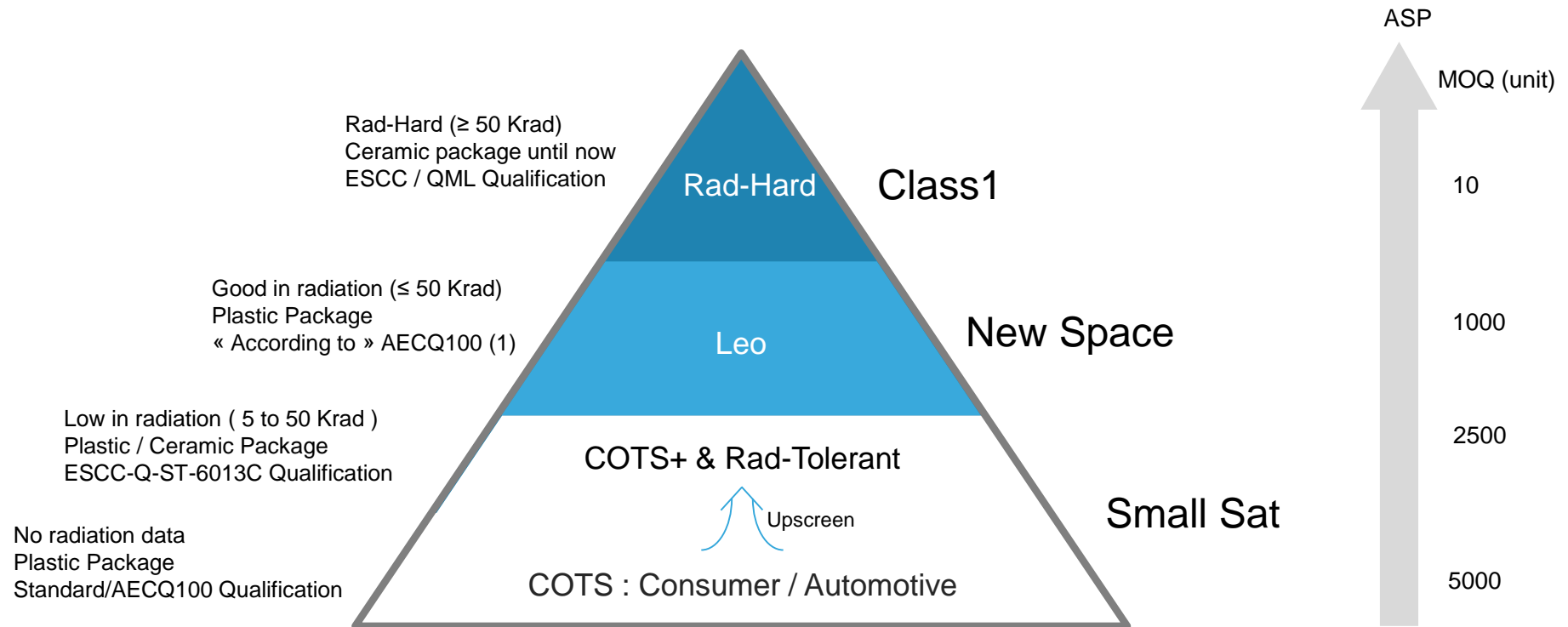
 No space-SEU in AEC-Q100



*Out-of-control spacecraft*

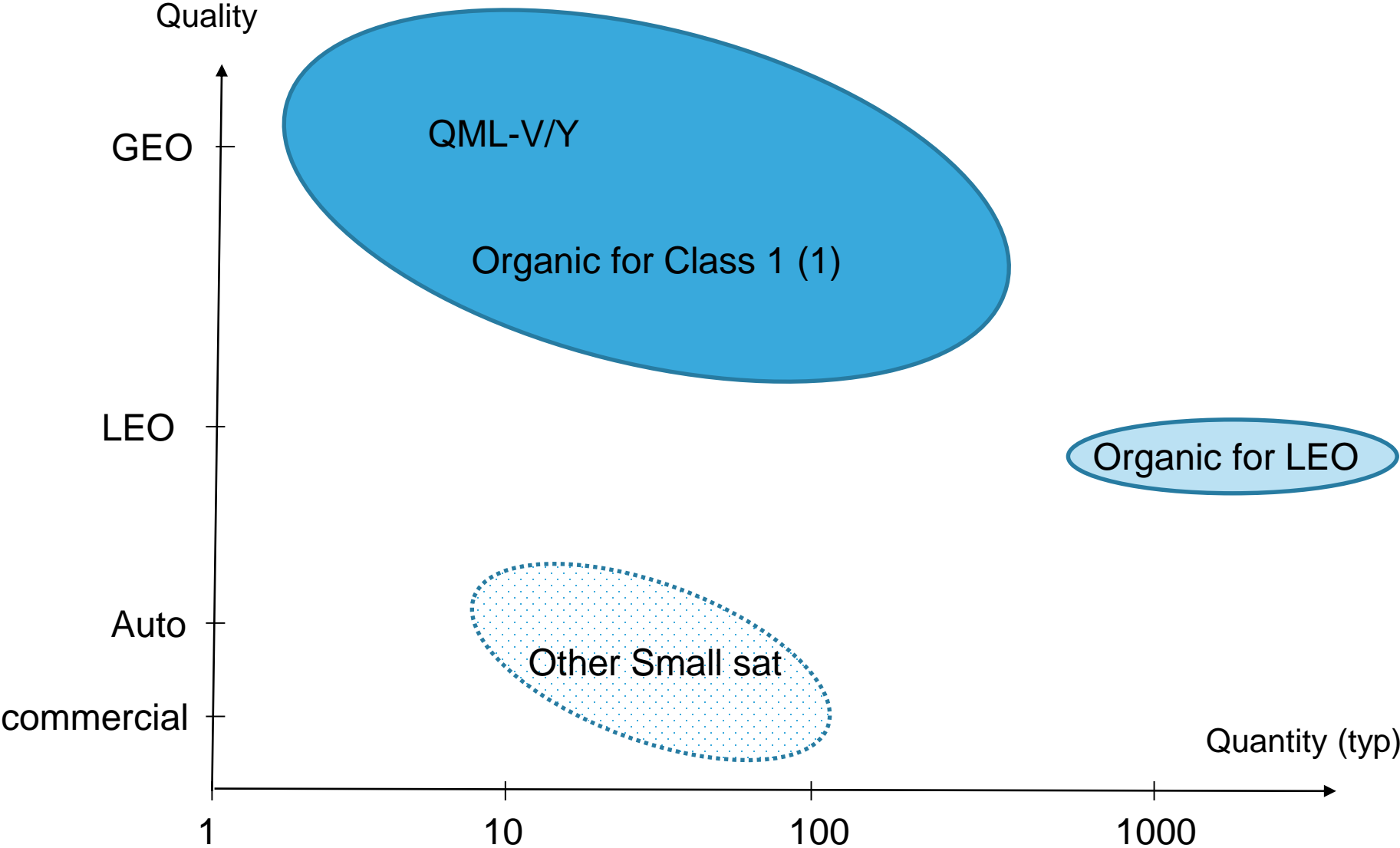
- Use of automotive products in Space is probably limited
  - Standard automotive products are Heavy Ion SEE sensitive
  - Automotive demands cost optimized products
    - Heavy Ions cannot be taken into account
  - Some missions might be able use generic product with redundancy
    - Fault tolerant MCU and MPU...
- ST limited support of existing automotive portfolio
  - Standard products & support through distribution
    - Documentation and traceability « As Is »
  - Specific business cases to be analyzed

# Space Segmentation Proposal



(1) : AECQ100 framework adapted to space. Key variation include : additional radiation characterization, qualification on one assembly lot only, no PPAP...

# ST High Density for Space



Bubble area : Cost of ownership – Bubble density : Radiation Hardness

(1) If justified by delta performance vs QML

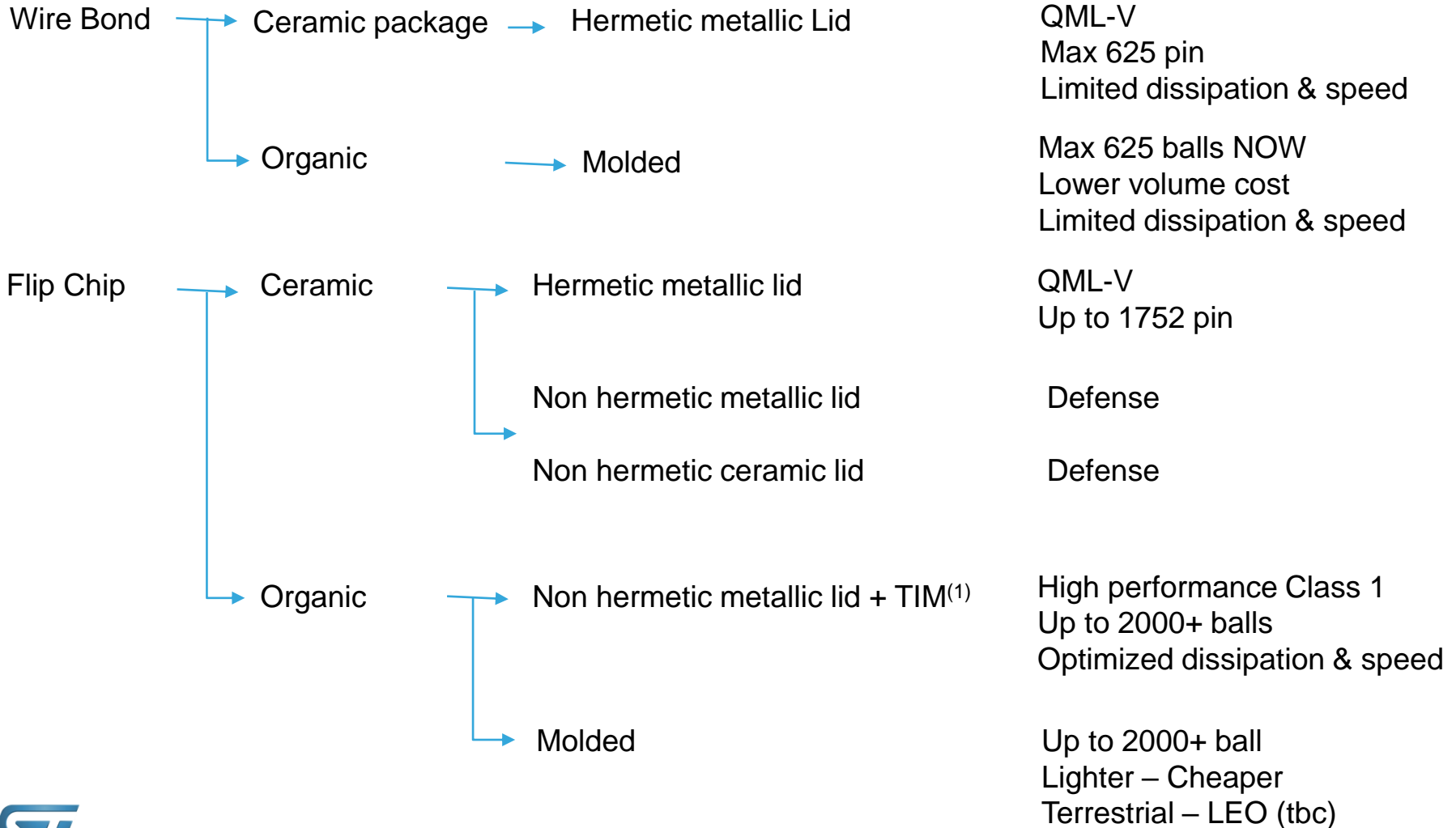
# High Density Tentative Packaging Mapping

## Die Connect

## Substrate

## Sealing

## Usage & features



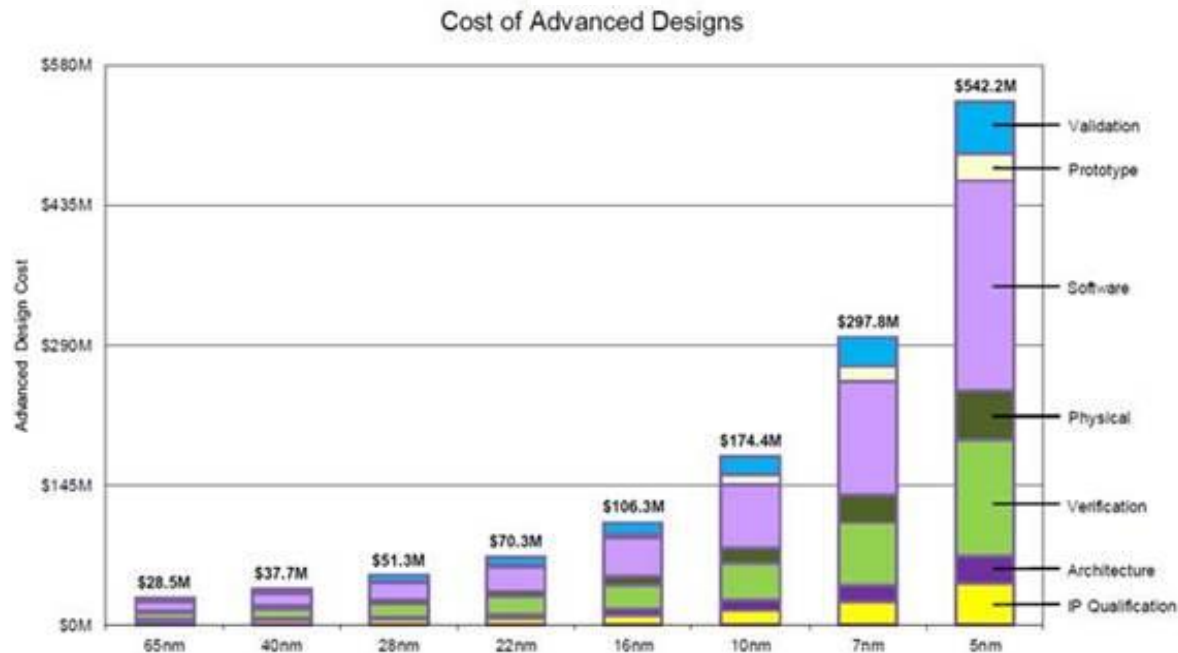


# High Density for Space : Tentative Business Model

- ST Supply Chain

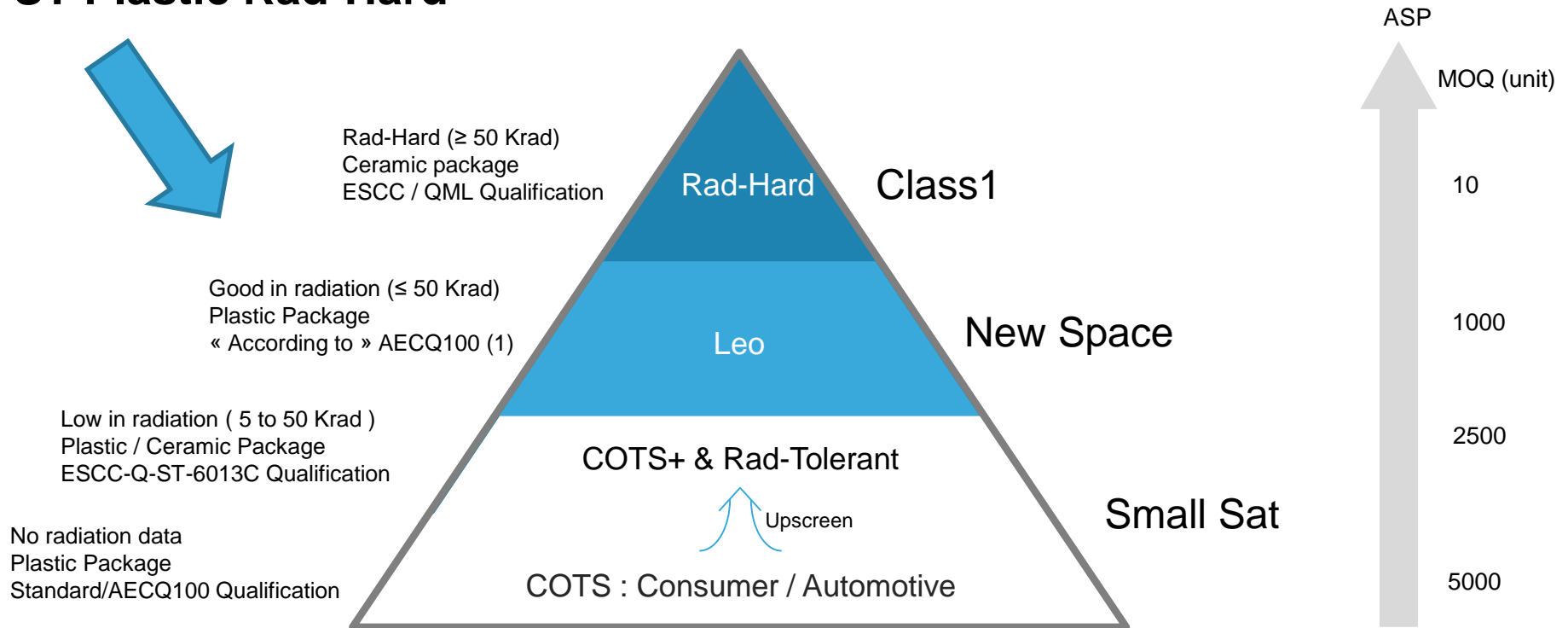
- Rad-hard capable technologies : 65 nm, 28 nmFDSOI, BiCMOS...
- Design platform for rad-hard designs : libraries, IPs, ecosystem
- Packaging : ST Rennes
  - Wire / Flip Chip + Ceramic / Organic substrate, Qualification, screening...
  - Subcontracted : Bumping, Column...

- Product : High value flexible ASIC & ASSP - few quality levels



# ST Space Companion Chip Roadmap

## ST Plastic Rad-Hard



(1) : AECQ100 framework adapted to space. Key variation include : additional radiation characterization, qualification on one assembly lot only, no PPAP...