

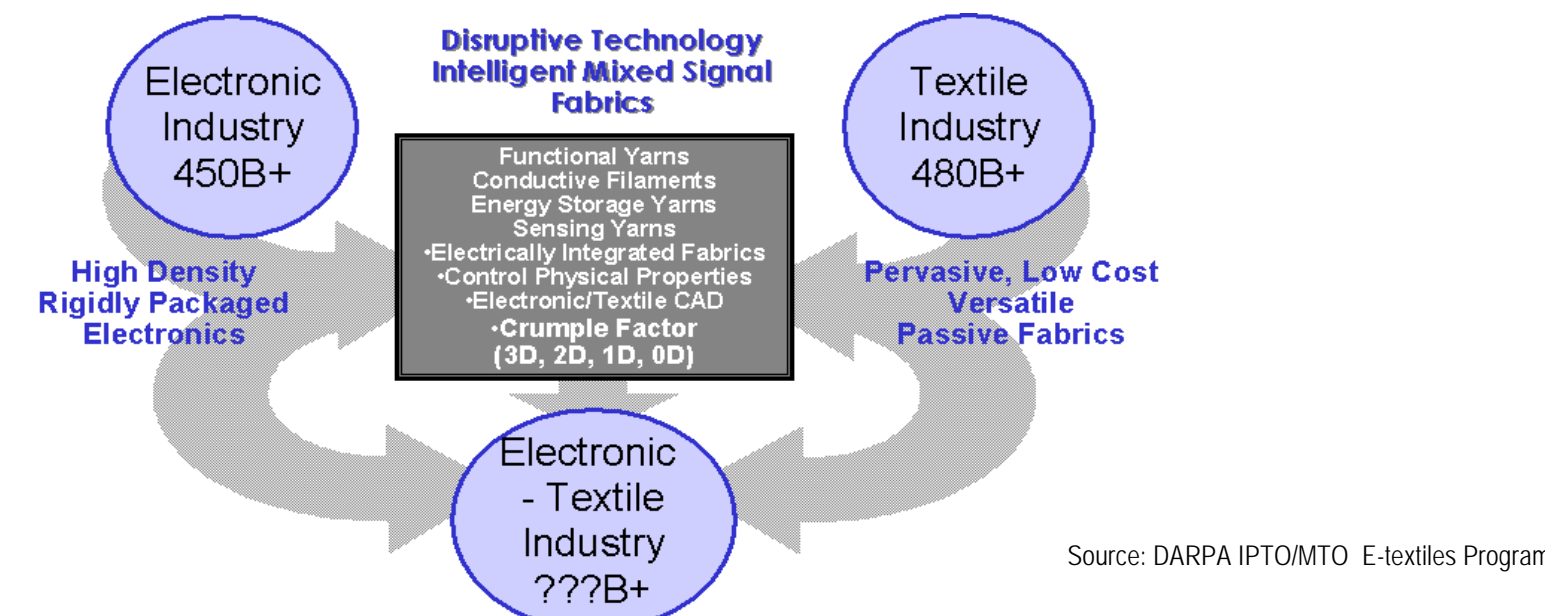
Challenges and Opportunities in Electronic Textiles Modeling, Analysis and Optimization

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Abstract and motivation

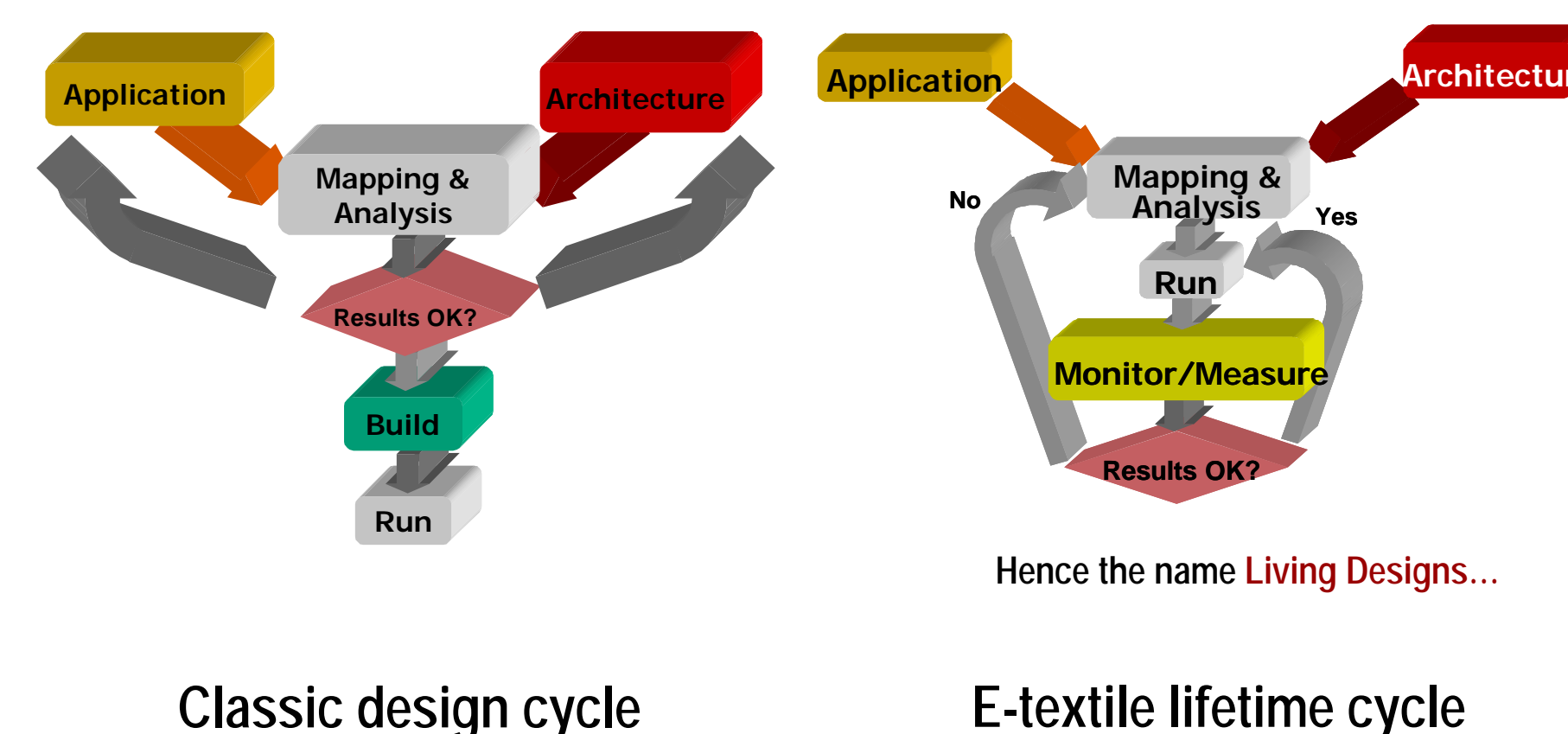
- We address the modeling and analysis of e-textiles, an emerging technology that combines the strengths and capabilities of electronics and textiles in one. In e-textiles, sensors and simple processing elements are embedded into yarns, with the goal of gathering sensitive information, doing local computation and sending them remotely (possibly over a wireless channel) for further processing. We illustrate the challenges imposed by the dual textile/electronics technology on their modeling methodology. As a case study, we show how *redundancy and application remapping via migration* can be successfully employed for *extending operational longevity* of acoustic beamforming application by more than three times when run on an electronic textile system.



Source: DARPA IPTOMTO E-textiles Program

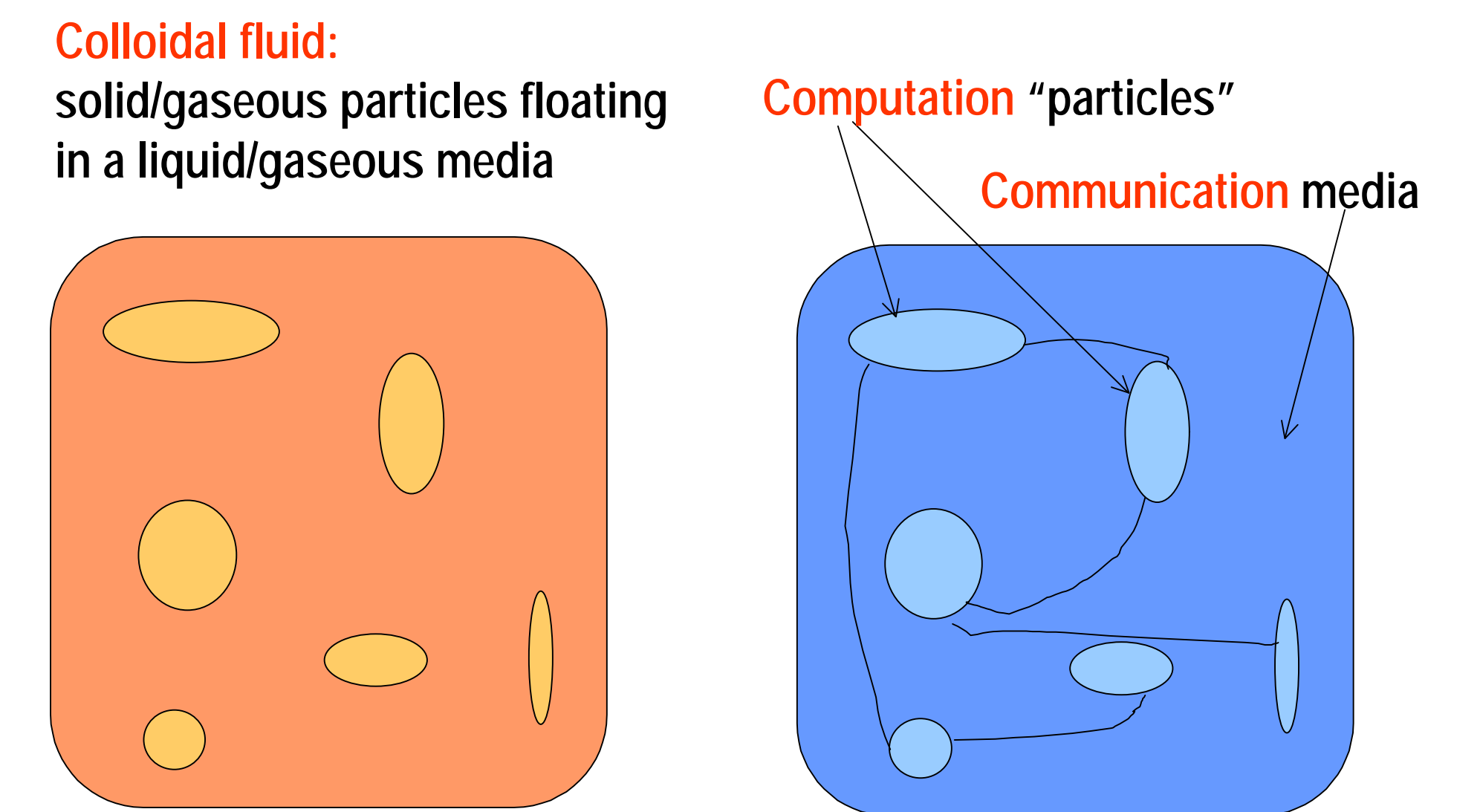
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Classic design cycle vs. E-textiles lifetime cycle



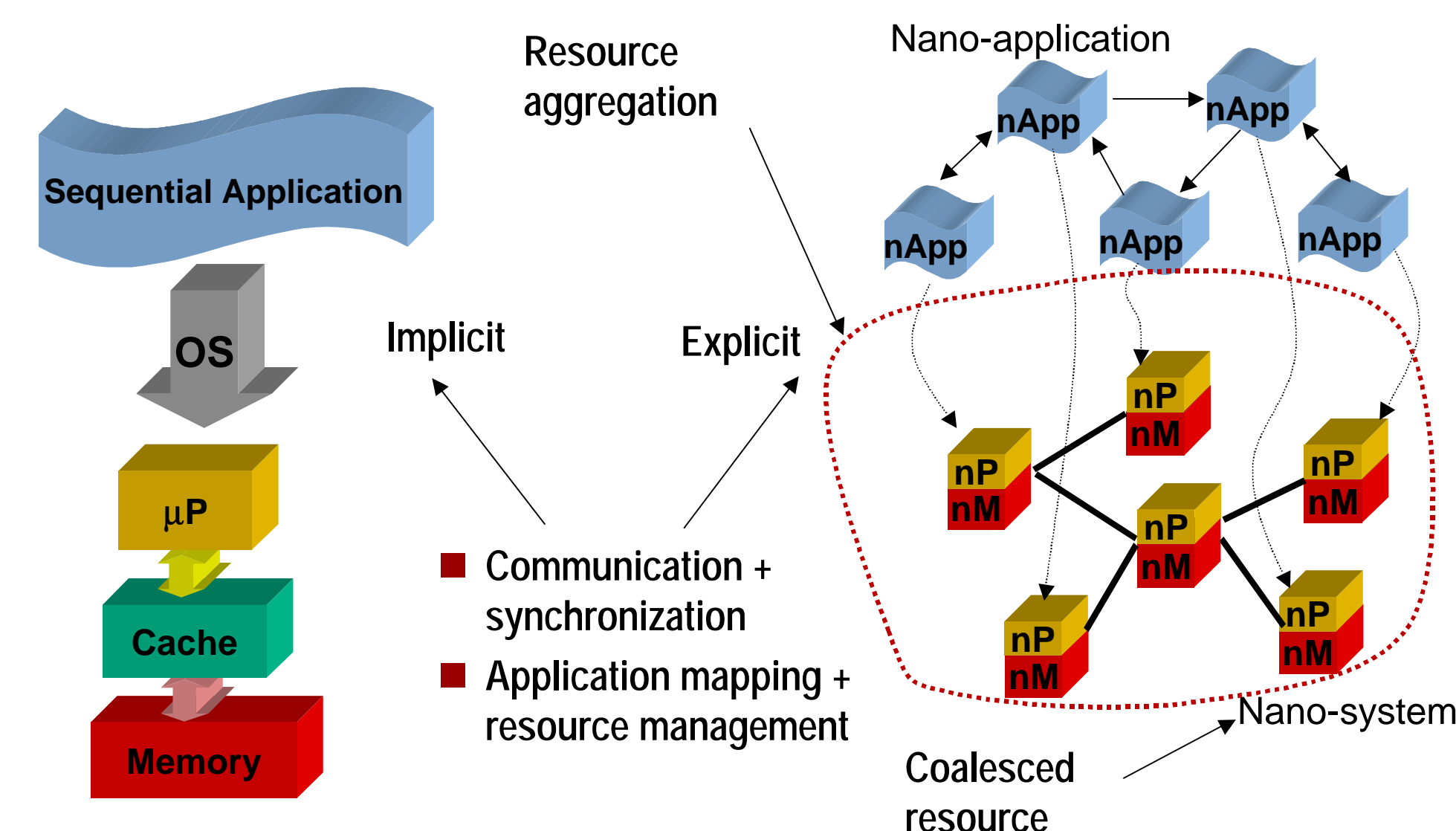
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Model of computation: MC² (colloidal computing model)



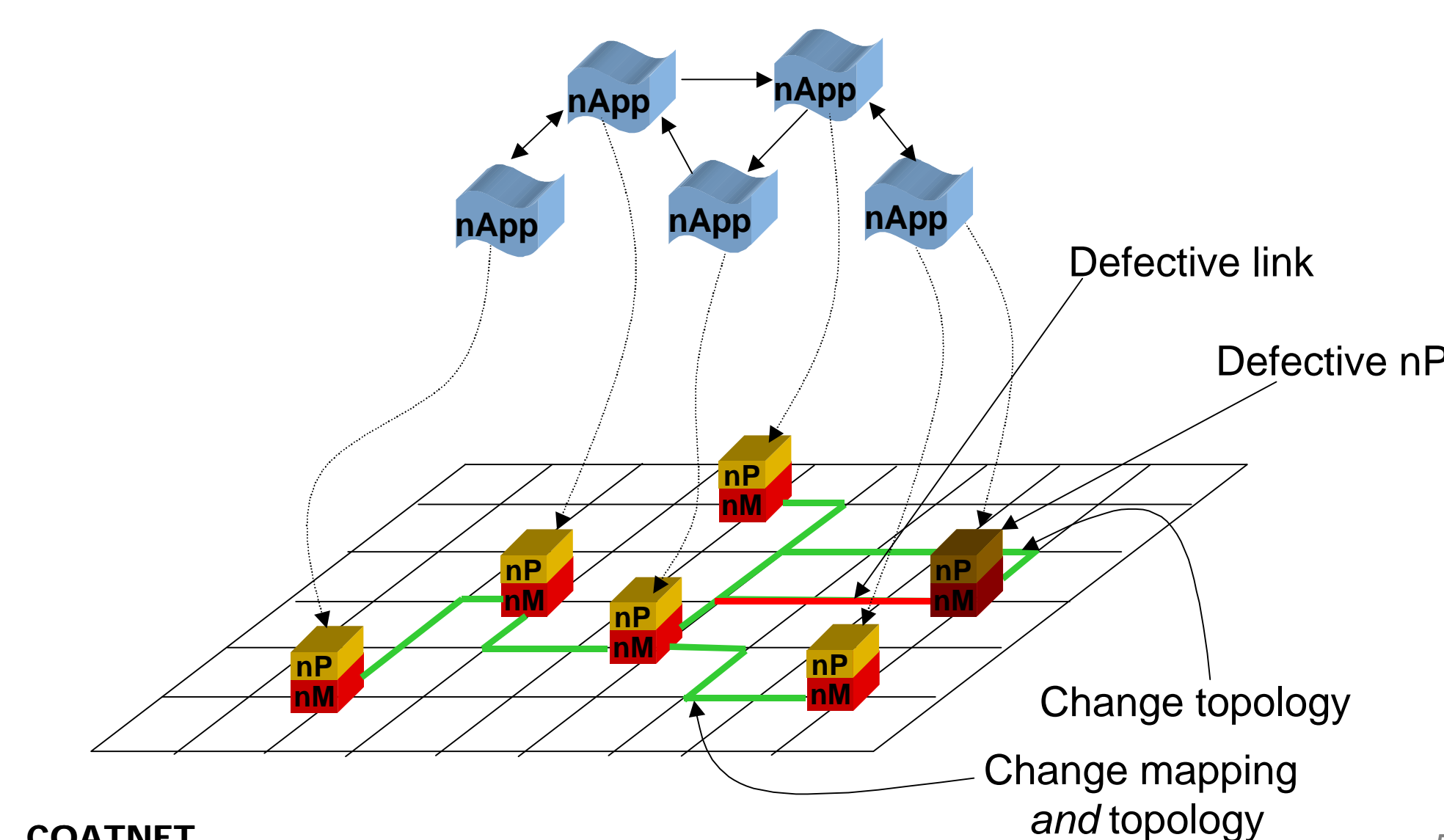
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Classical vs. MC² model



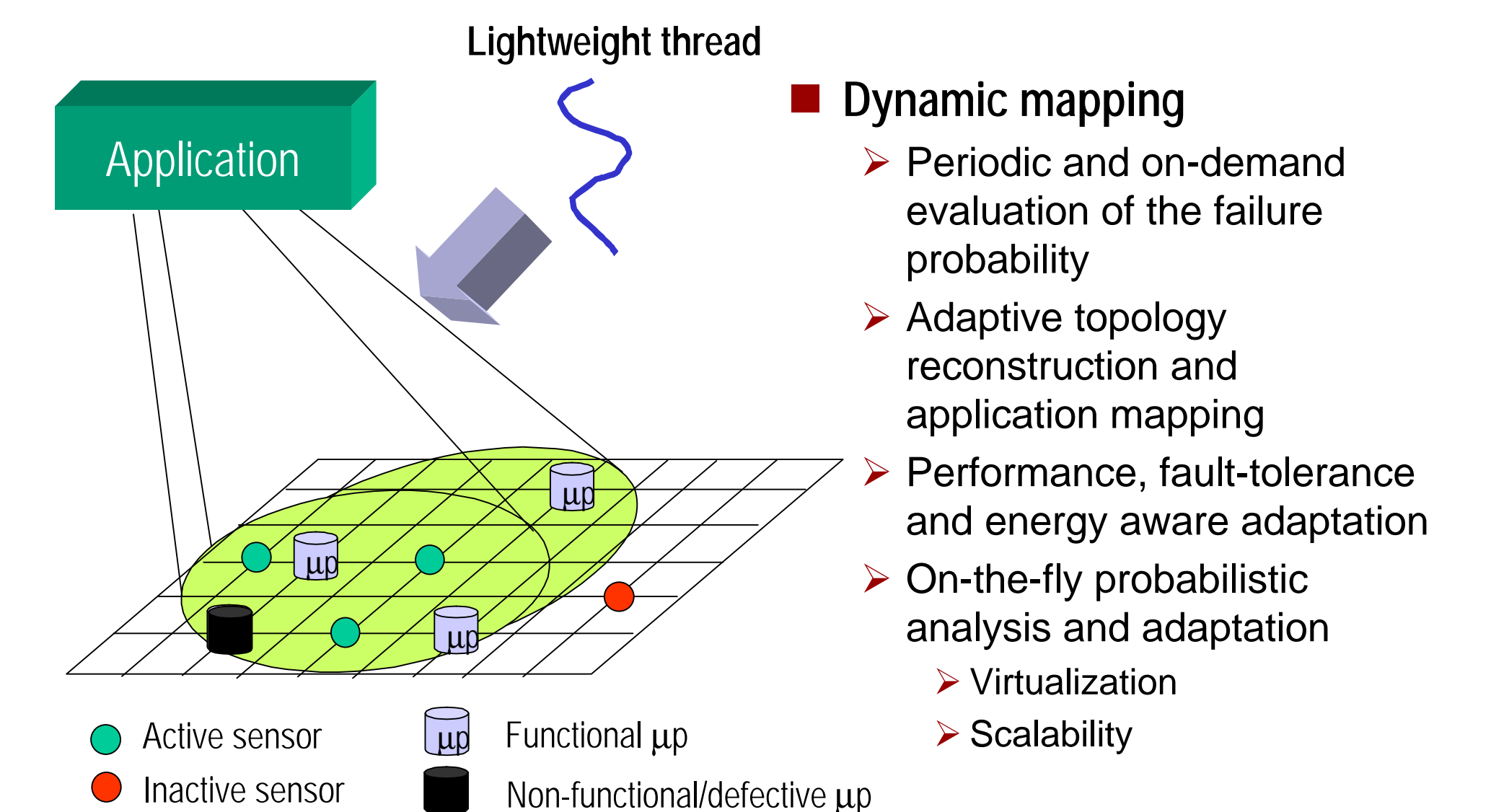
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MC² in action: Adaptive routing and mapping



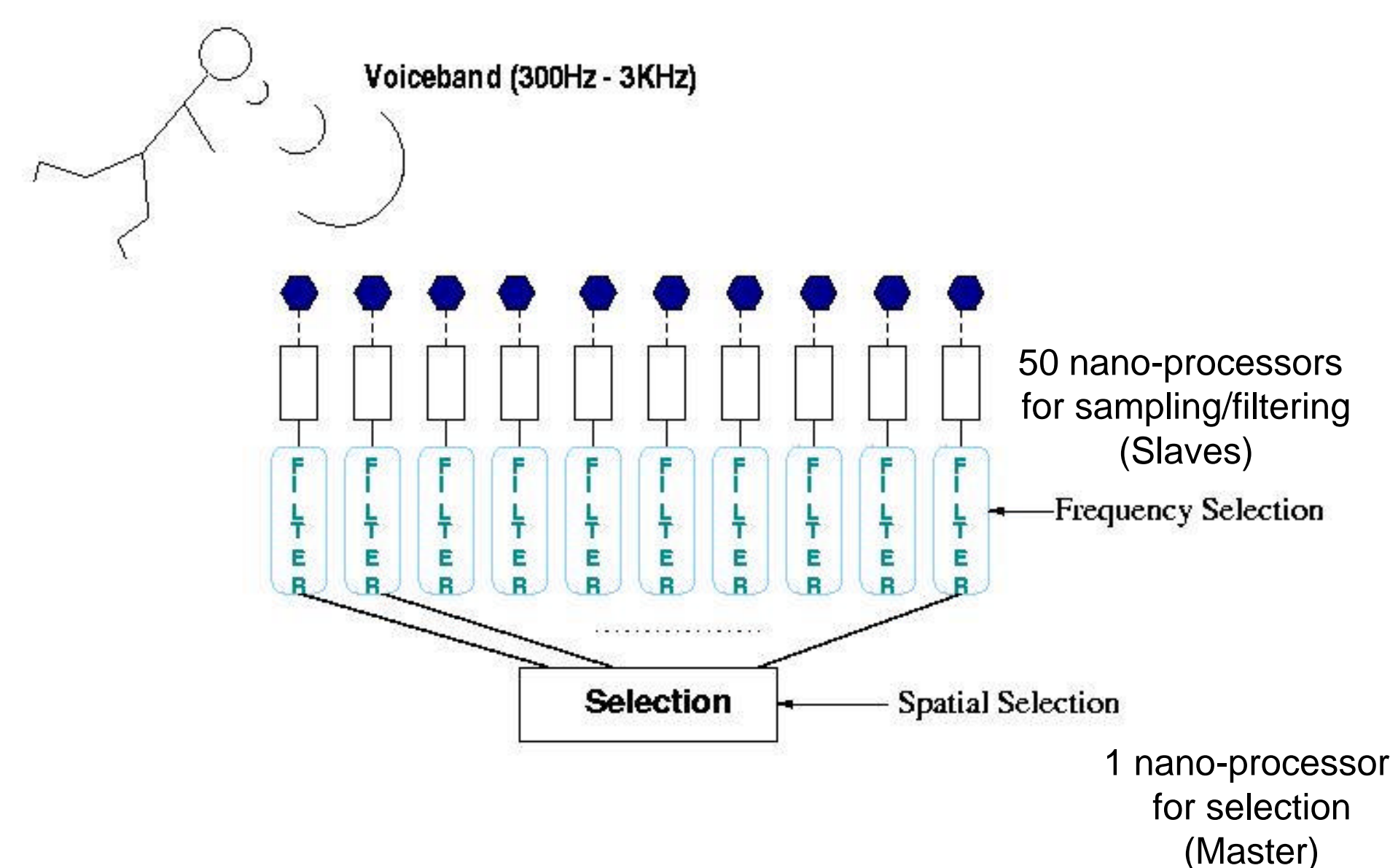
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Application mapping and resource management



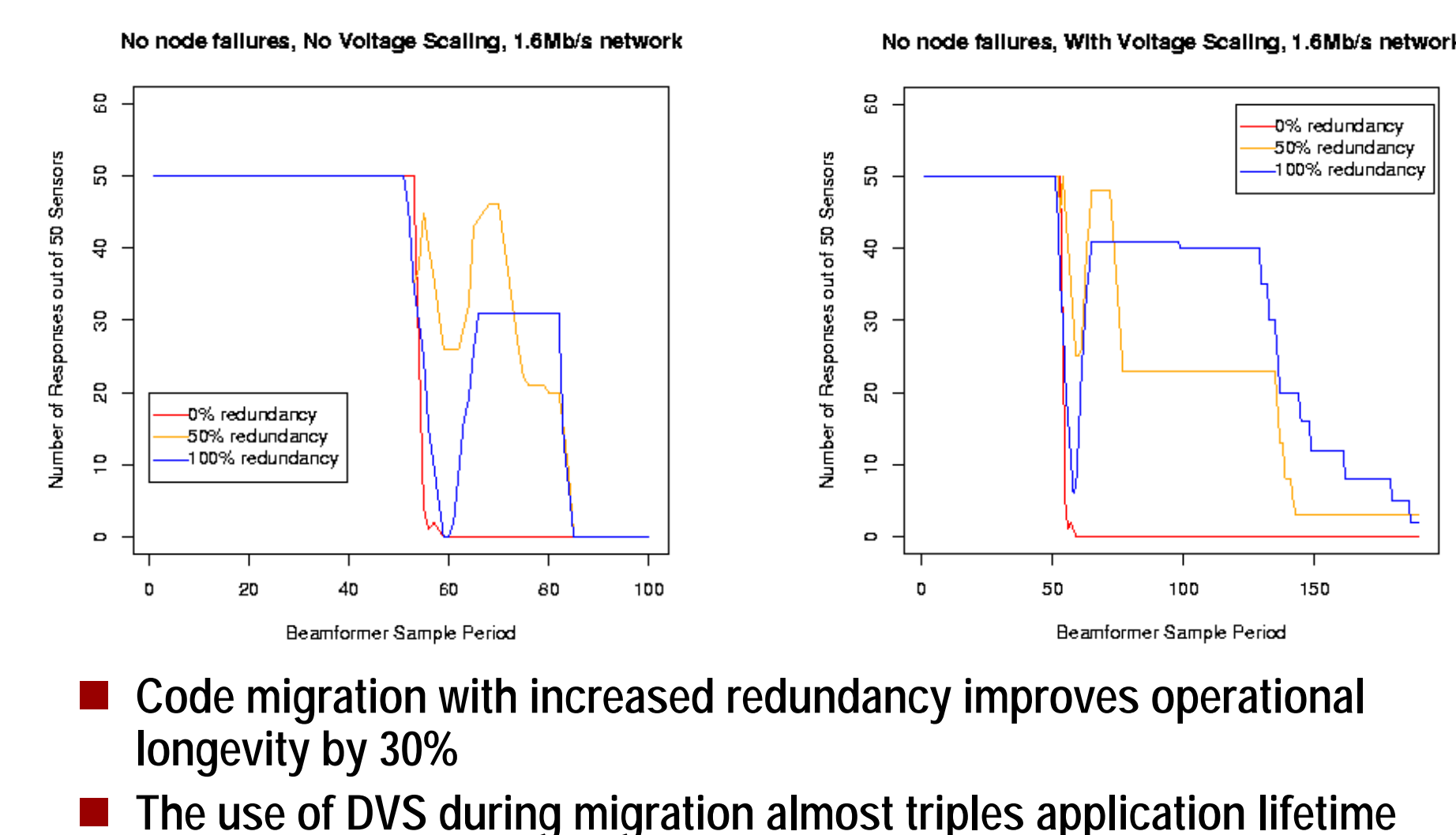
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Case study : Acoustic array prototype evaluation



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Operational longevity analysis



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Conclusion

- E-textiles open a challenging area of research for "Living Designs"
 - Characterized by micro-level unreliable behavior...
 - ...But stringent macro-level requirements
- Presented an integrated methodology for e-textiles modeling, analysis and on-the-fly self management and reconfiguration
- Still open: the case of yarn-embedded computation
 - Up to 10K transistors/cm² available in the next few 3-5 years (\$100-\$500 per m²)
 - What type of logic should be exported onto the yarns? How can it be modeled?
 - Additional challenges for mixed mechanical/electrical faults
- More information: <http://www.ece.cmu.edu/~etex>

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