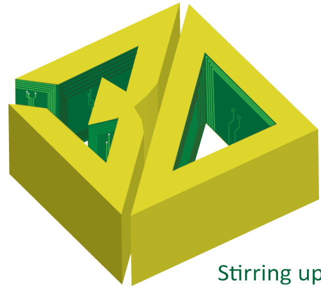


InCites

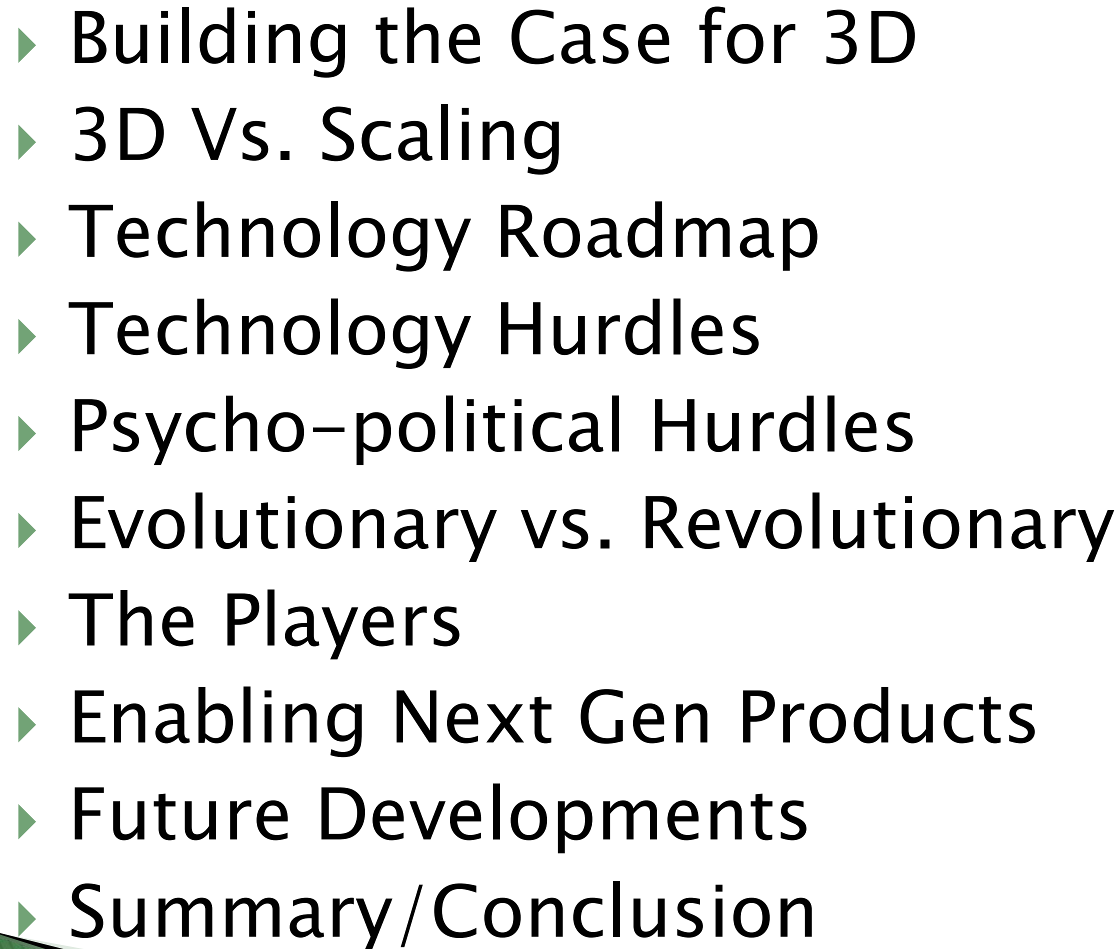
Stirring up interest in 3D integration

State-of-the-3D Industry

Future Opportunities and Challenges

Rev 2.0

Outline

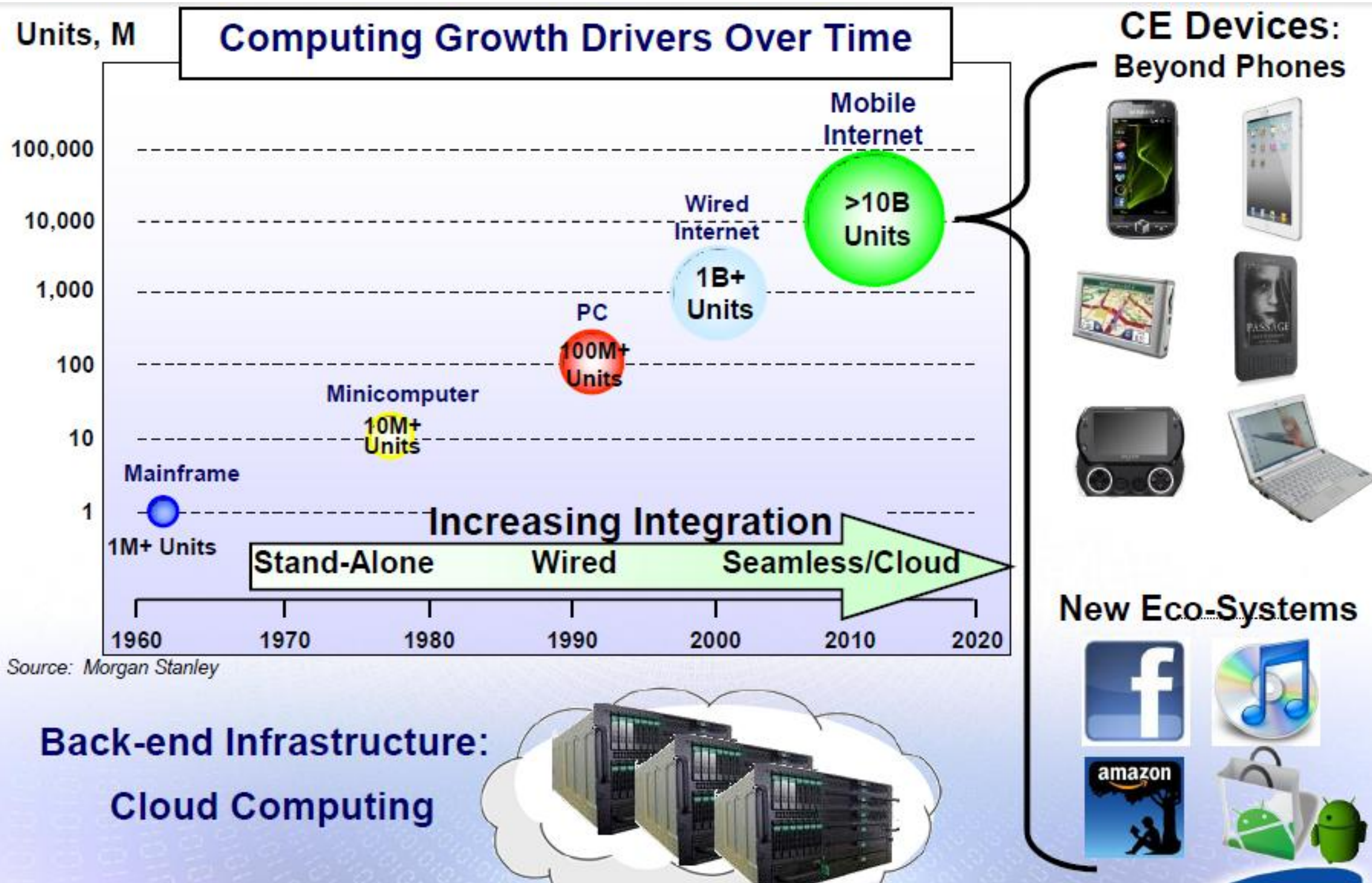


- Building the Case for 3D
- 3D Vs. Scaling
- Technology Roadmap
- Technology Hurdles
- Psycho-political Hurdles
- Evolutionary vs. Revolutionary
- The Players
- Enabling Next Gen Products
- Future Developments
- Summary/Conclusion

Performance Needs Are Increasing

Courtesy of Jim Elliott, Samsung,
GSA Memory Conference

Beyond the mobile device



Courtesy of Jim Elliott, Samsung, GSA Memory Conference

Mobile Computing Platform

Courtesy of Jim Elliott, Samsung, GSA Memory Conference

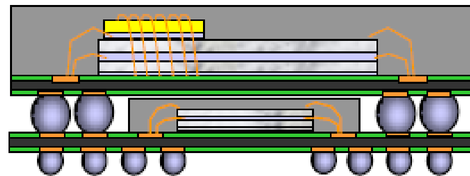
So Why 3D?

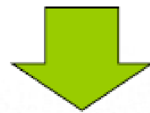
3D Architecture's Power Alley…

Memory + Logic TSV To Reduce Size, Decrease Power & Improve Speed

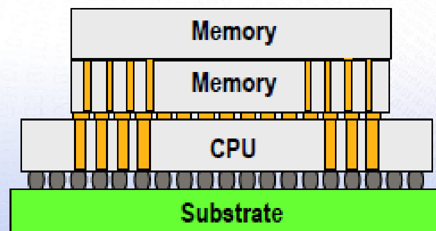
DRAM + Logic Stack

POP

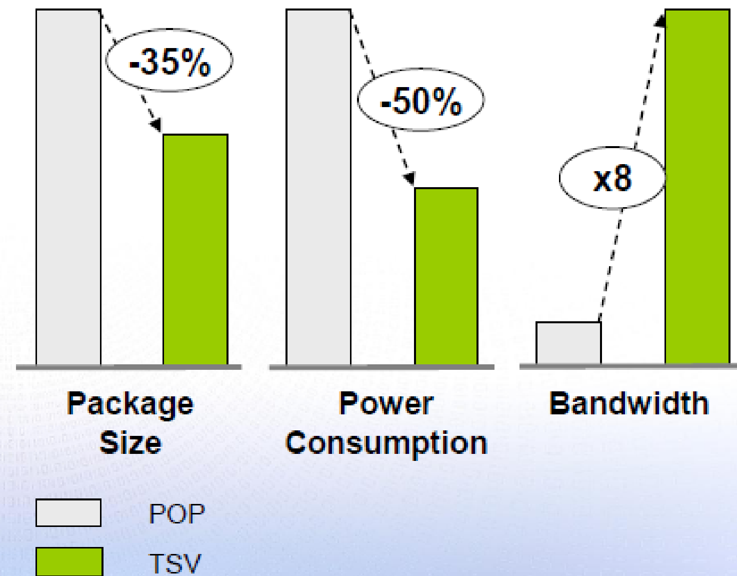




TSV

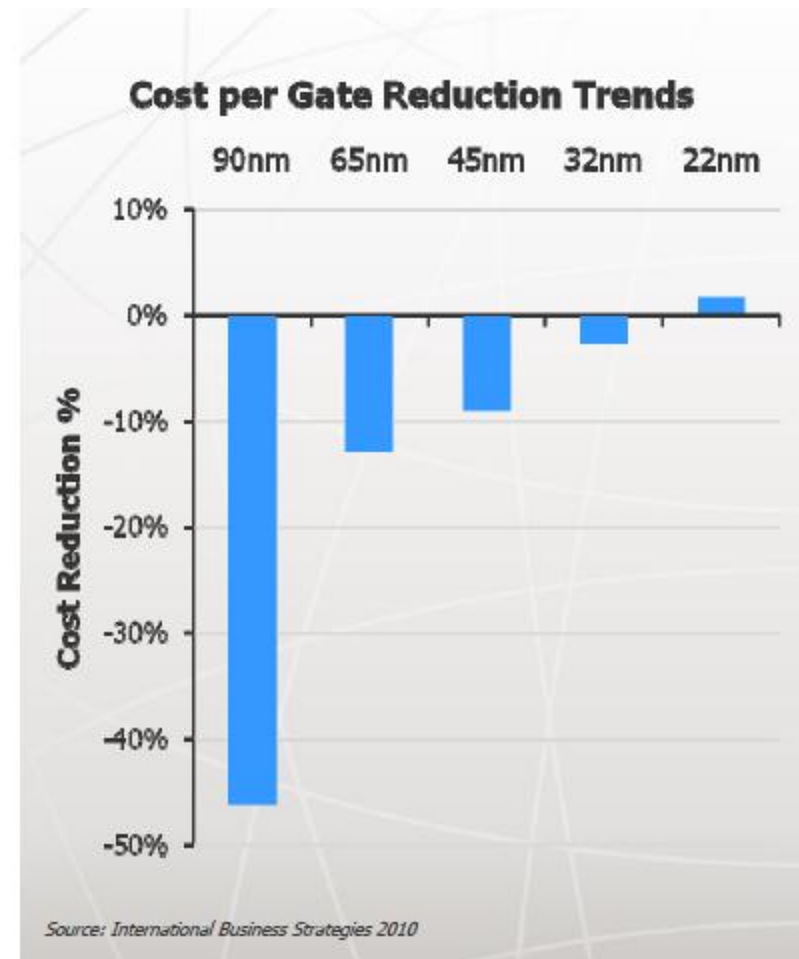


Size, Power & Speed

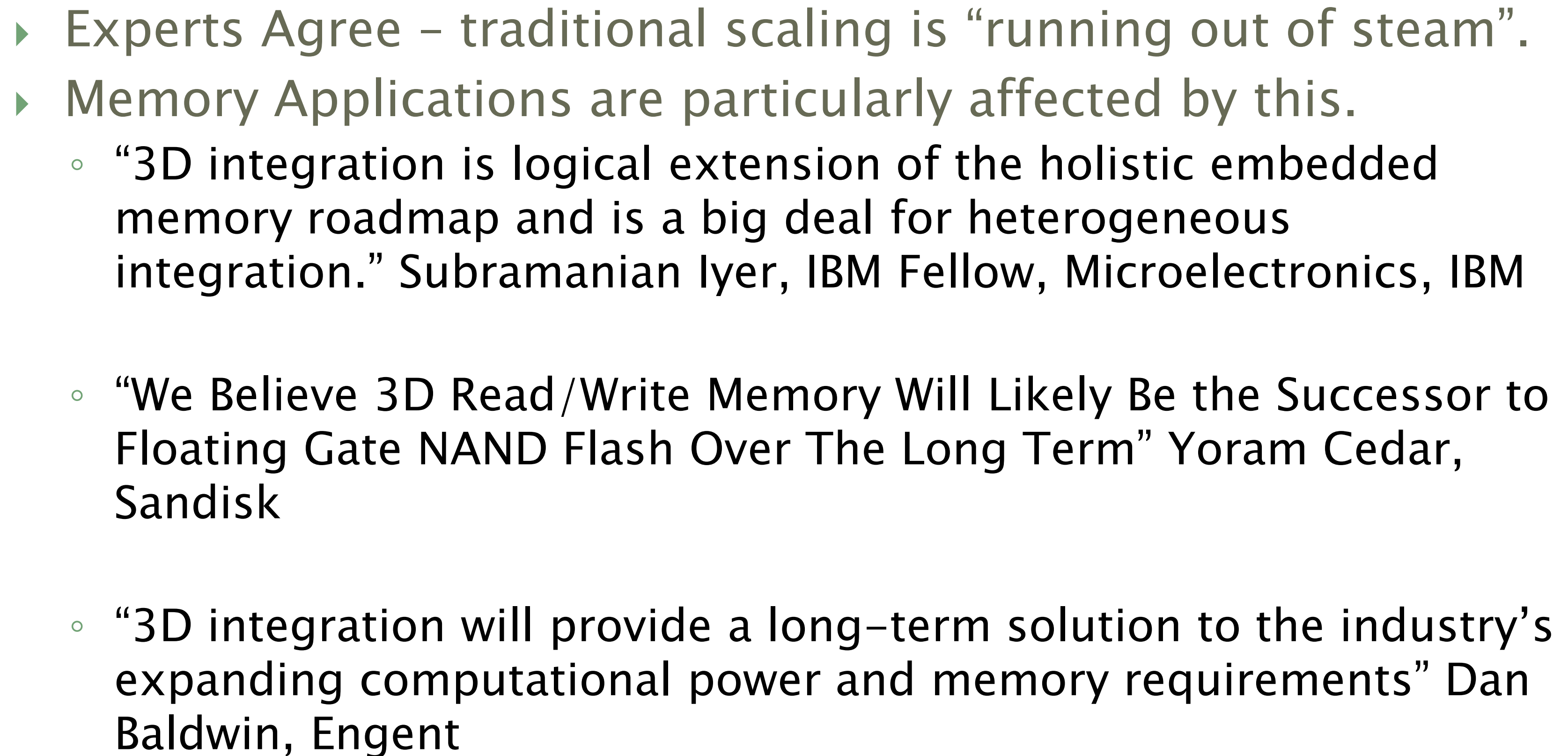


Why Not just keep Scaling?

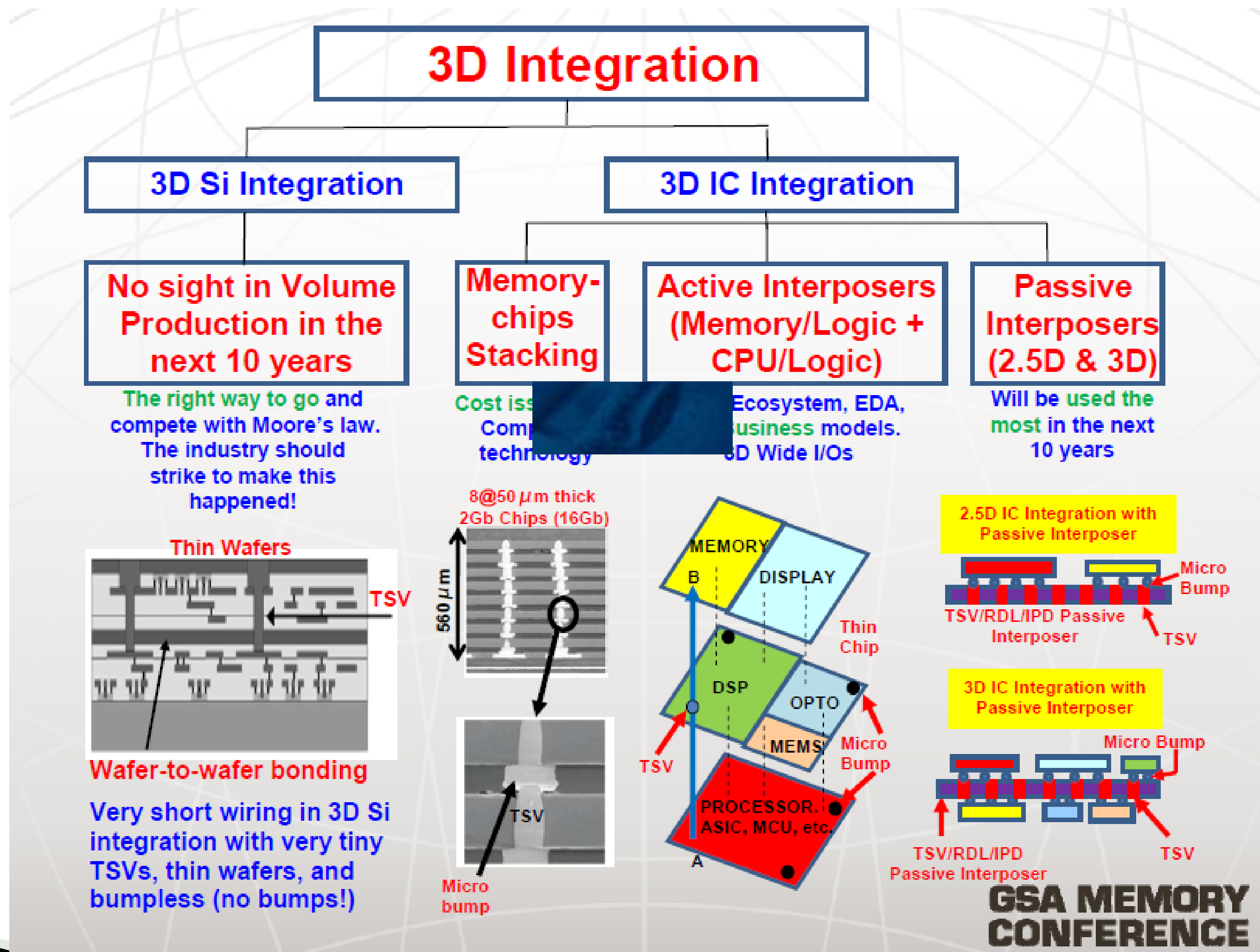
- Cost increases in scaling
  - At 22nm, per wafer cost increase is 15%, and is expected to be more at 20nm and 15 due to double patterning.
  - Next generation lithography will not solve the problem.
- Fewer players with capabilities for nodes past 22nm.
- Leakage current



IS 3D The “New Scaling”?



What's Now, Next, and Beyond

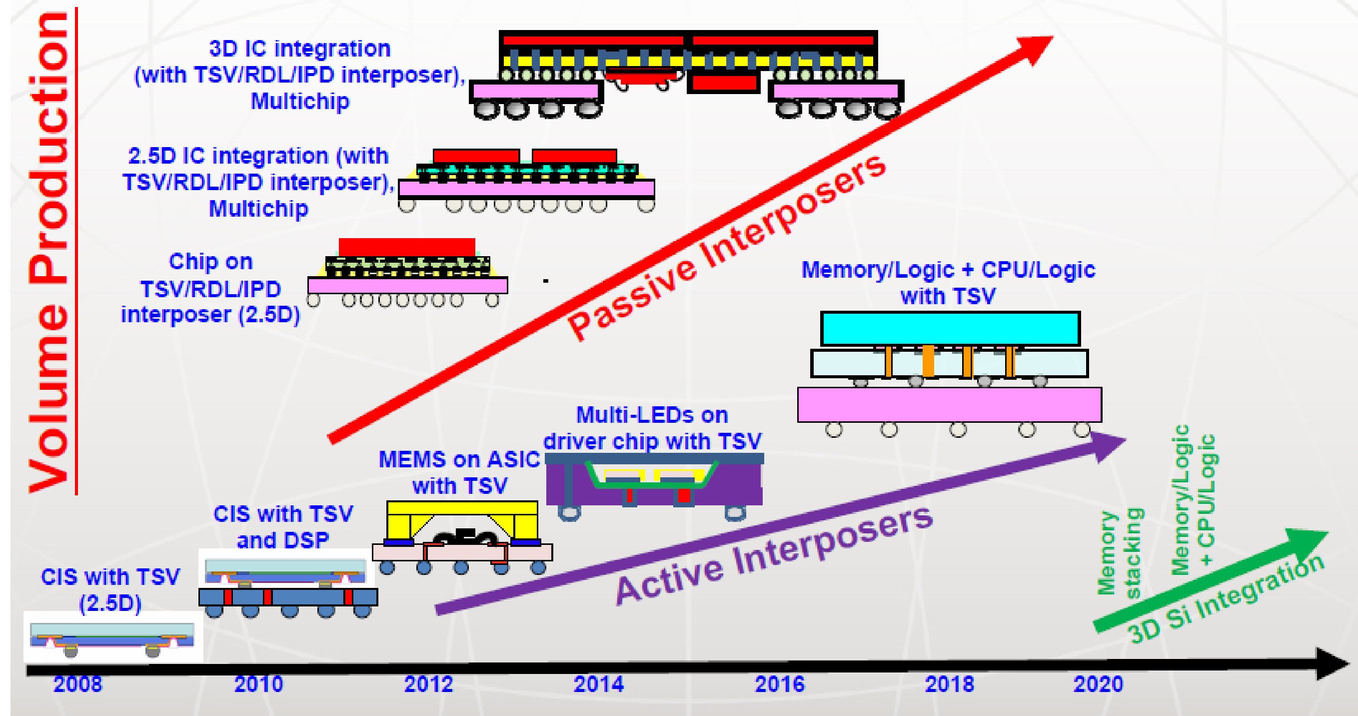


Courtesy of John Lau, ITRI, GSA Memory Conference

3D Technology Roadmap

- Now
  - Sensors on logic
  - Limited-volume stacked memory (wire bond)
  - Package-on-package and flip chip memories on processors
- Next 2-3 years: 2.5D+
  - Increased use of passive interposer technology with TSVs
  - Integration of logic and memory with flip chips and interposers
  - Mixed analog, RF, logic and memory in multi-die stacks
- **Future 5+ years: 3D**
  - TSVs in Active chip area
  - Embed TSVs in leading-edge logic chips
  - Mixed analog, RF, logic and memory in multi-die stacks

3D Technology Roadmap

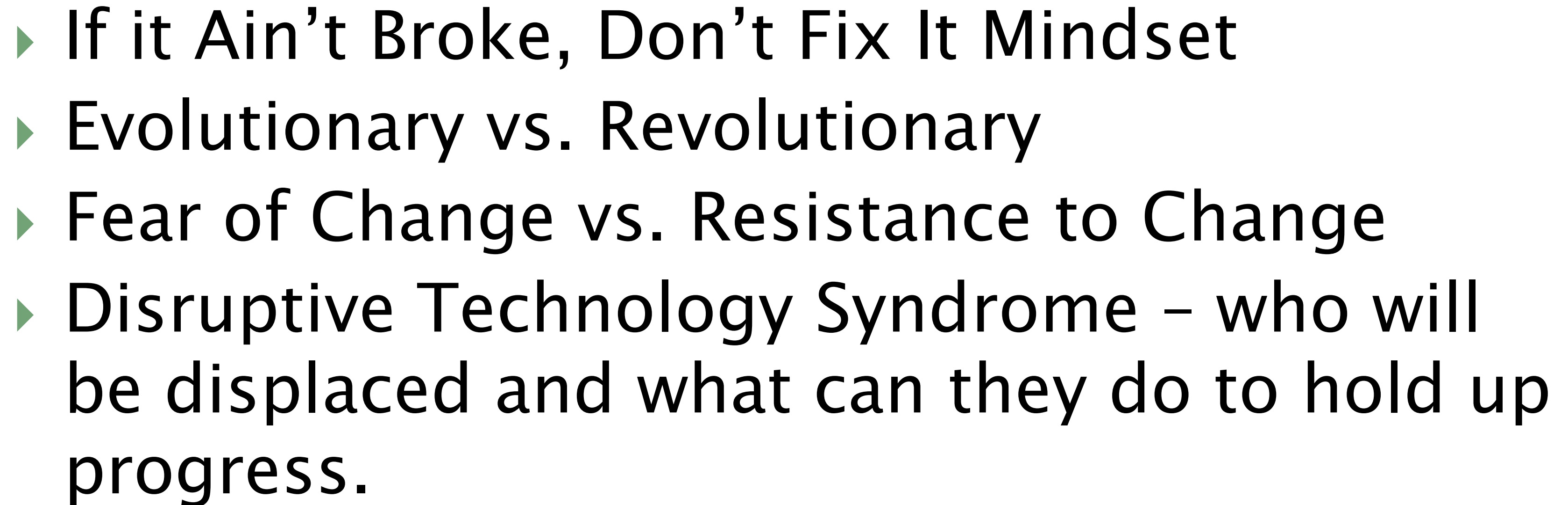


Courtesy of John Lau, ITRI, GSA Memory Conference

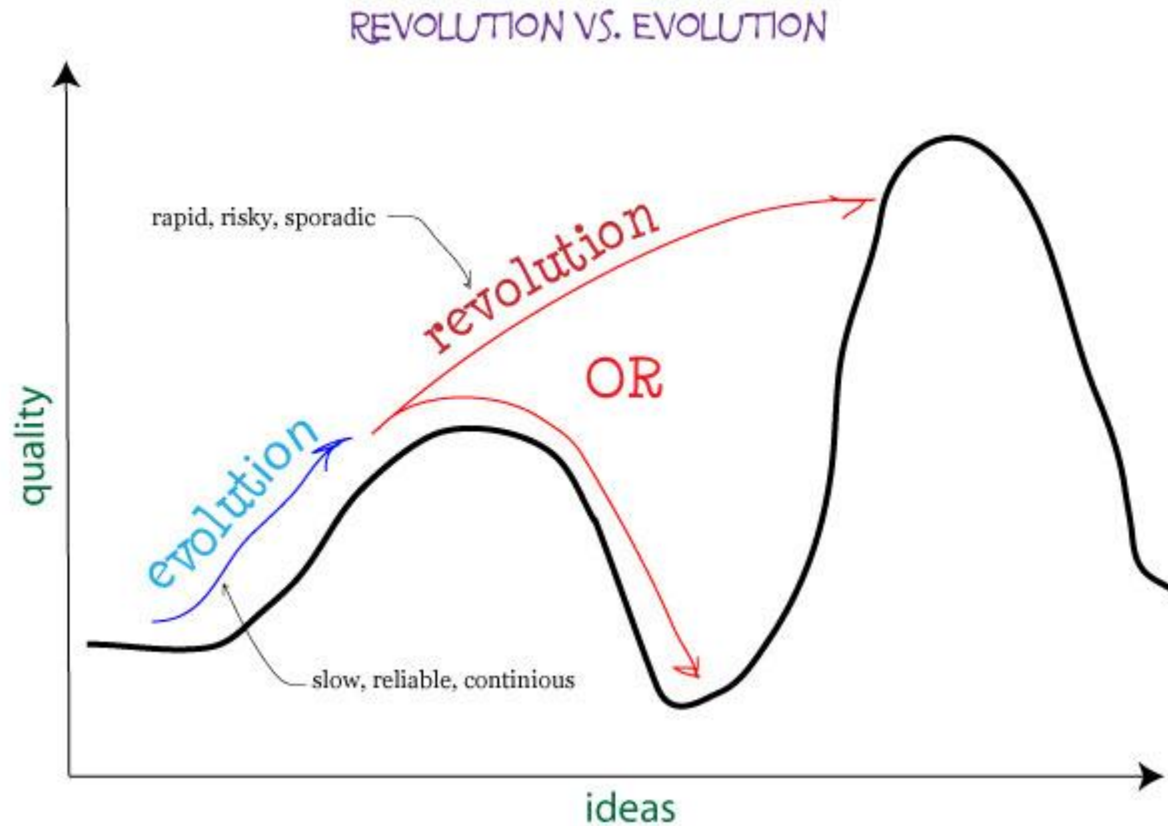
Technology Hurdles

- What's been the hold-up?
  - Waiting for the "Killer APP" – Breaking down the Memory Wall
    - Wide I/O DRAM on Logic.
  - Standards
  - Thermal management
  - Design tools
  - Test methodologies – cost could stop the show
- What will drive it forward?
  - The realization that there is no other way to do it.

Psycho-Political Hurdles

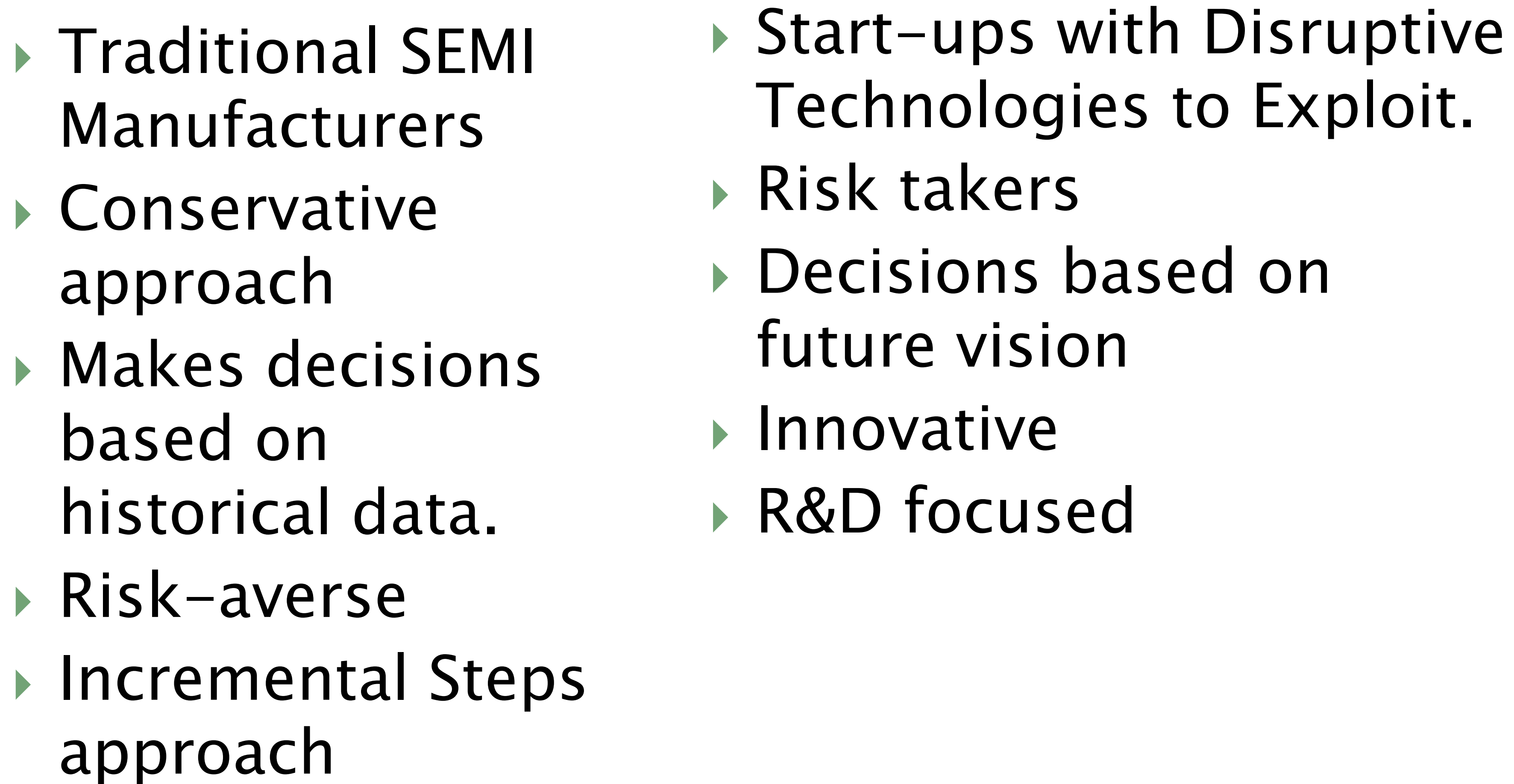


Evolution vs. Revolution



Evolution vs. Revolution

Evolutionary vs. Revolutionary



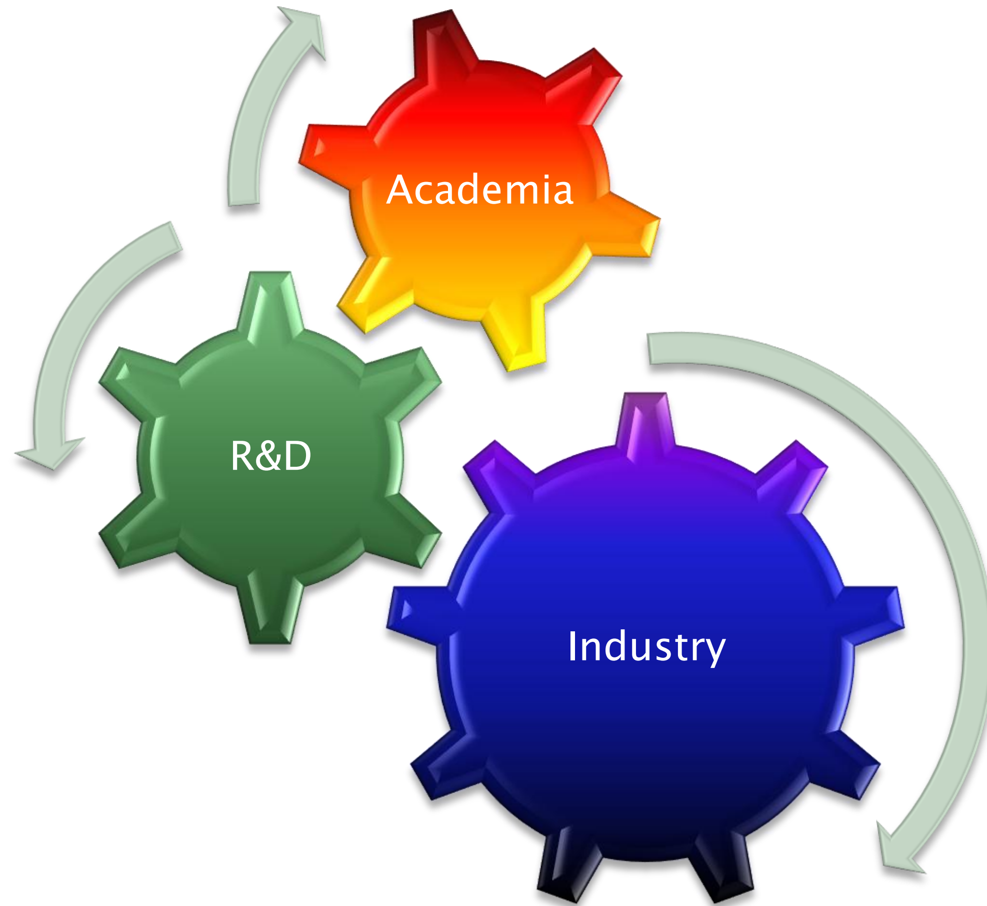
What Just Happened?

"The Rapid Ramp of Mobile Internet Usage Will be a Boon to Consumers and Some Companies Will Likely Win Big (Potentially Very Big) While Many Will Wonder What Just Happened"… Mary Meeker, Kleiner Perkins

Concept to Market Traditional Roles

Academia	R&D	Industry
• Proof of Concept • Government funding • Continued research • Far term techology	• Emerging/near term Technology • Marketability • Technology Transfer • Low Volume Production	• Market adoption • Value Proposition • Cost of Ownership • Market Adoption • High Volume Production

Adapting for 3D Ecosytem



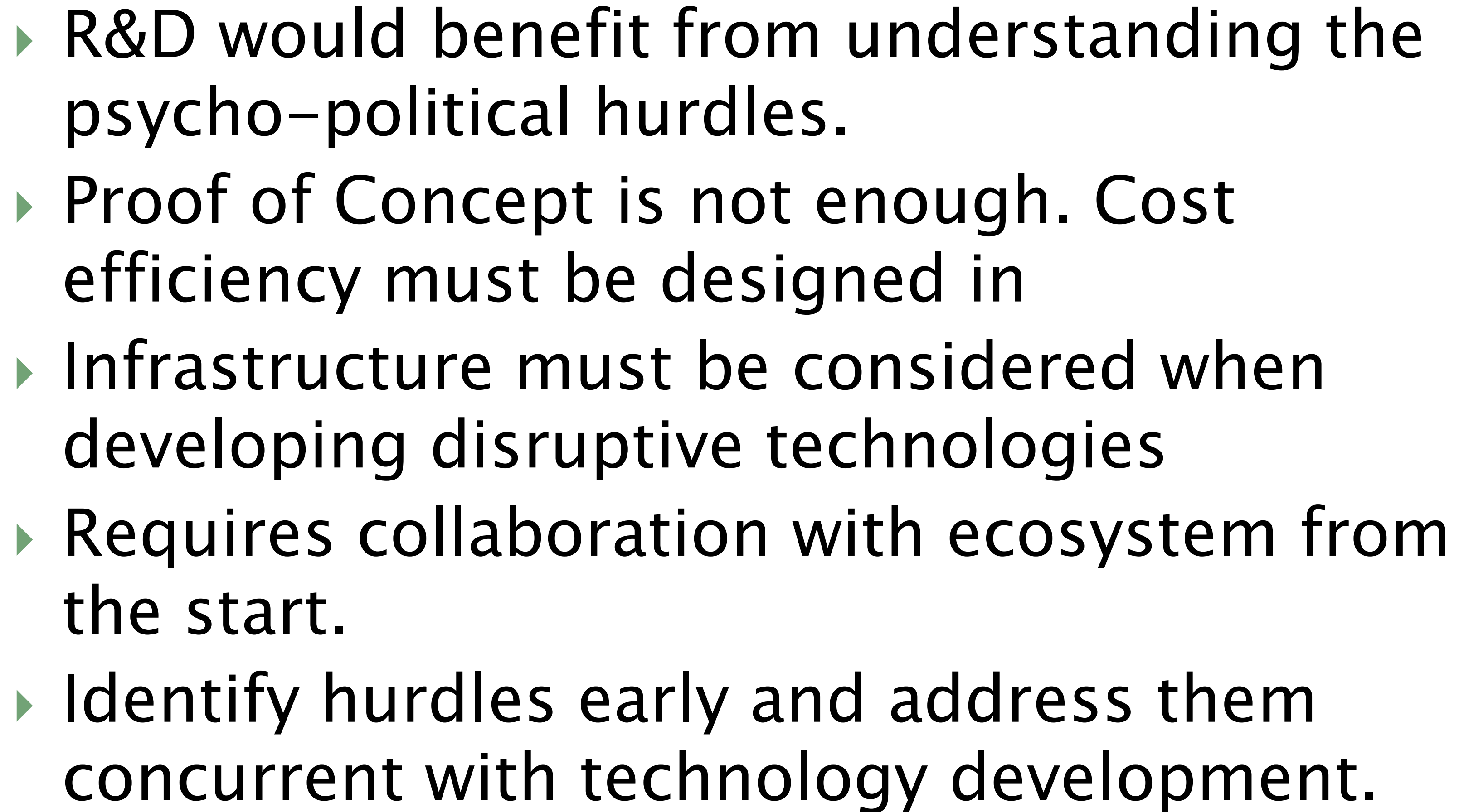
Enabling Next-Gen Products

- 3D Memory stacking can provide fast access and high bandwidth
- Memory Bandwidth Challenges in Many-core processors
- Enables Exascale computing
- Technology benefits will outweigh cost (Wide I/O DRAM)
  - HPC and Graphics Purposes
  - Future Quad High-Definition TV (HDTV) application

Future Developments

- 3D Systems: Where 2.5D and 3D IC Coexist
  - 3D Systems integrating heterogeneous devices will likely incorporate both passive interposer an 3D TSV stacks in the same package.
- 3D Silicon Integration
  - How it differs from 3D IC integration
  - What does it solve?

Summary/Conclusions



- R&D would benefit from understanding the psycho-political hurdles.
- Proof of Concept is not enough. Cost efficiency must be designed in
- Infrastructure must be considered when developing disruptive technologies
- Requires collaboration with ecosystem from the start.
- Identify hurdles early and address them concurrent with technology development.

A Final Word….

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