



Network Technology Energy Efficiency



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Cisco's Green Mission



Operations

Impacting how we operate as a business

Products

Creating efficiencies and innovations in our products

Architecture

Providing solutions to our customers to address global environmental issues

Employees & Advocacy

Inspiring our employees to get involved and take action

Cisco's Green Strategy

- Driving to aggressive goal: GHG down 25% by 2012
- Approach: Heavy emphasis on Networking & IT
 - Telepresence / Collaboration
 - IP enabled facilities
 - Labs / Data Centers
 - Improved product efficiencies ←
- Active participation in many standards and agencies



Green Engineering

VISION

CDO will deliver thought leadership and product solutions to climate change beyond normal product enhancements

5+ Years

STRATEGY

CDO will maximize efficiency while fundamentally driving game changing innovation

CDO will deliver solutions that leverage the network effect of energy management on a global basis

2 - 4 Years

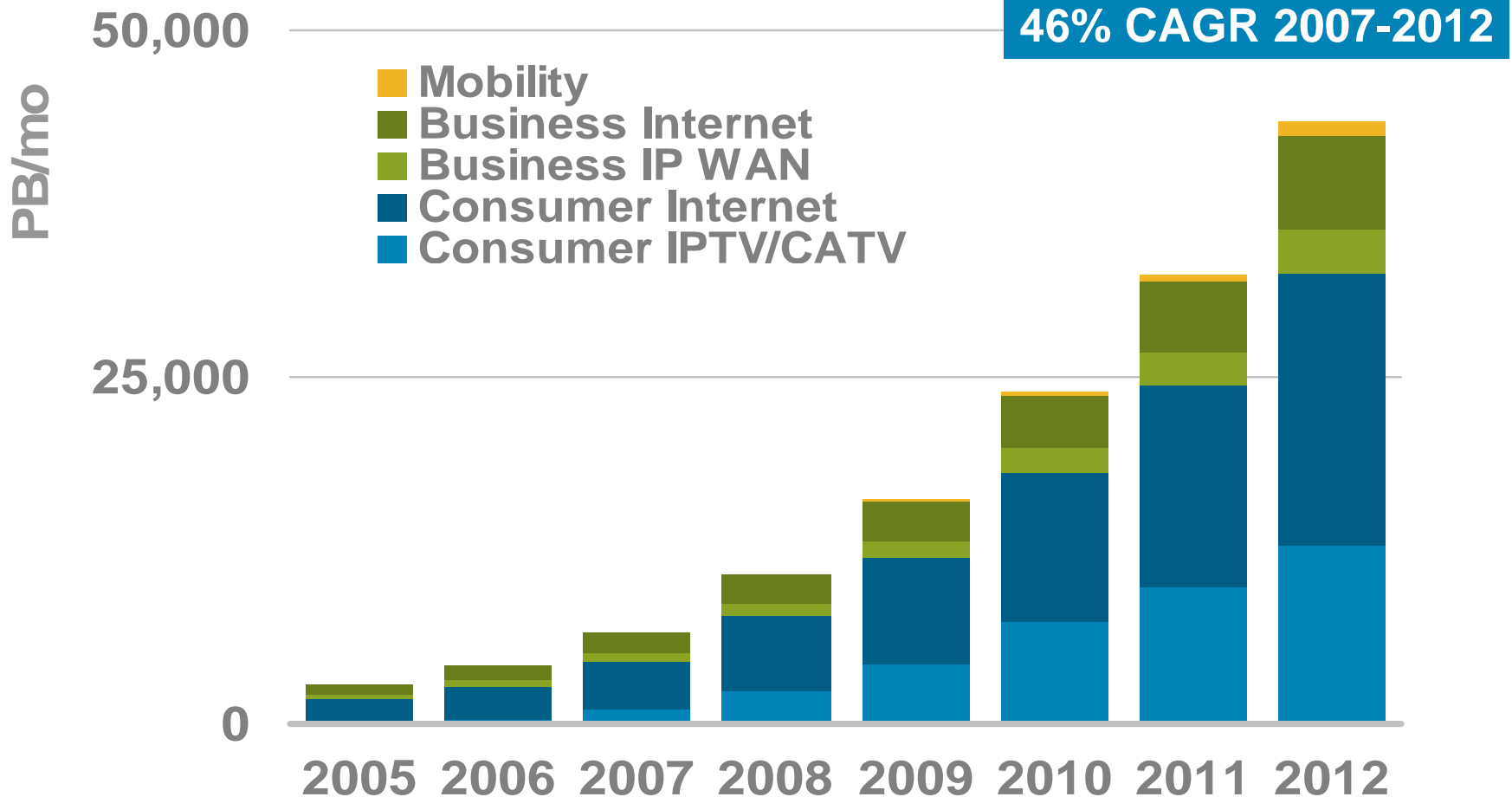
EXECUTION

1. CDO Green Education
2. Global Lab Power Mgmt
3. Power Supply Efficiency & Mgmt
4. ASIC Power Mgmt
5. Product Green Metrics
6. Product Power Profile & Efficiency
7. Solution Architecture
8. Industry Standards & Governance

12 - 18 Months

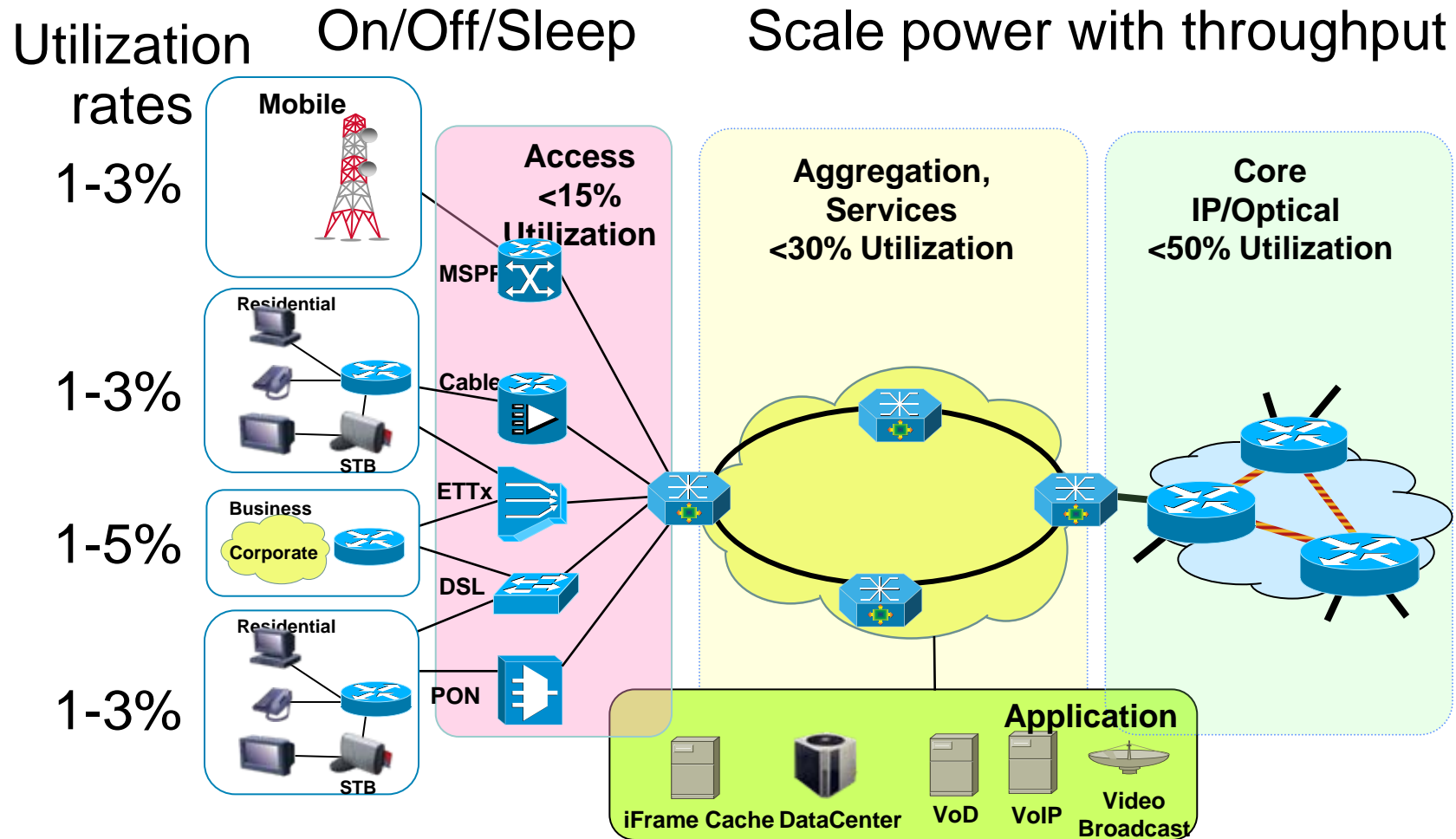
Global IP Traffic Growth

IP traffic will increase 6X from 2007 to 2012
In 2012, half a zettabyte will cross the global network



ZB= 10²¹ Bytes

The Internet - Positions in the Network



4 steps to Energy Efficiency

1. Know the critical functions of your network (using a “typical network” is non-optimal).
2. Measure the real power consumption. Where (in the network) & when (24/7/365) is the energy being used?
3. Examine the network architecture for system-wide improvements. End-to-end functions, consolidation, etc.
4. Look at efficiency of products at points in the network (key product comparisons). This stage must take into account the results in the 1st 3 stages.

Network equipment categories

Economically driven

e.g. Consumer class products



Power efficiency

~1Mbps

~10W

→ Driven by cost

Technology driven

e.g. High-end Internet Core Router



Power efficiency

~1Tbps

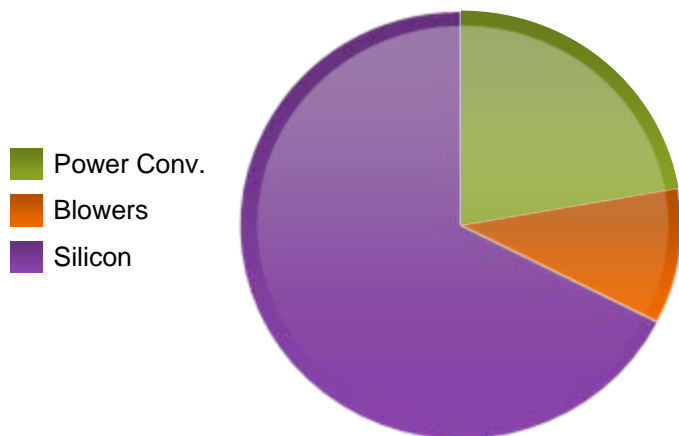
~10kW

→ Driven by technology

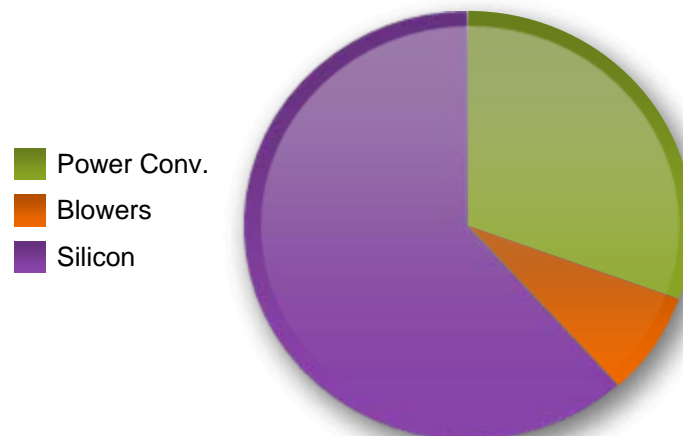
1000 X

Going to the Source

Router - 10kW



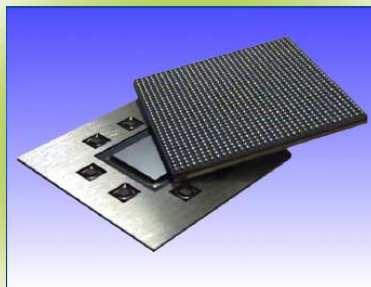
Switch (Average Usage) - 130W



Power Supply



Software

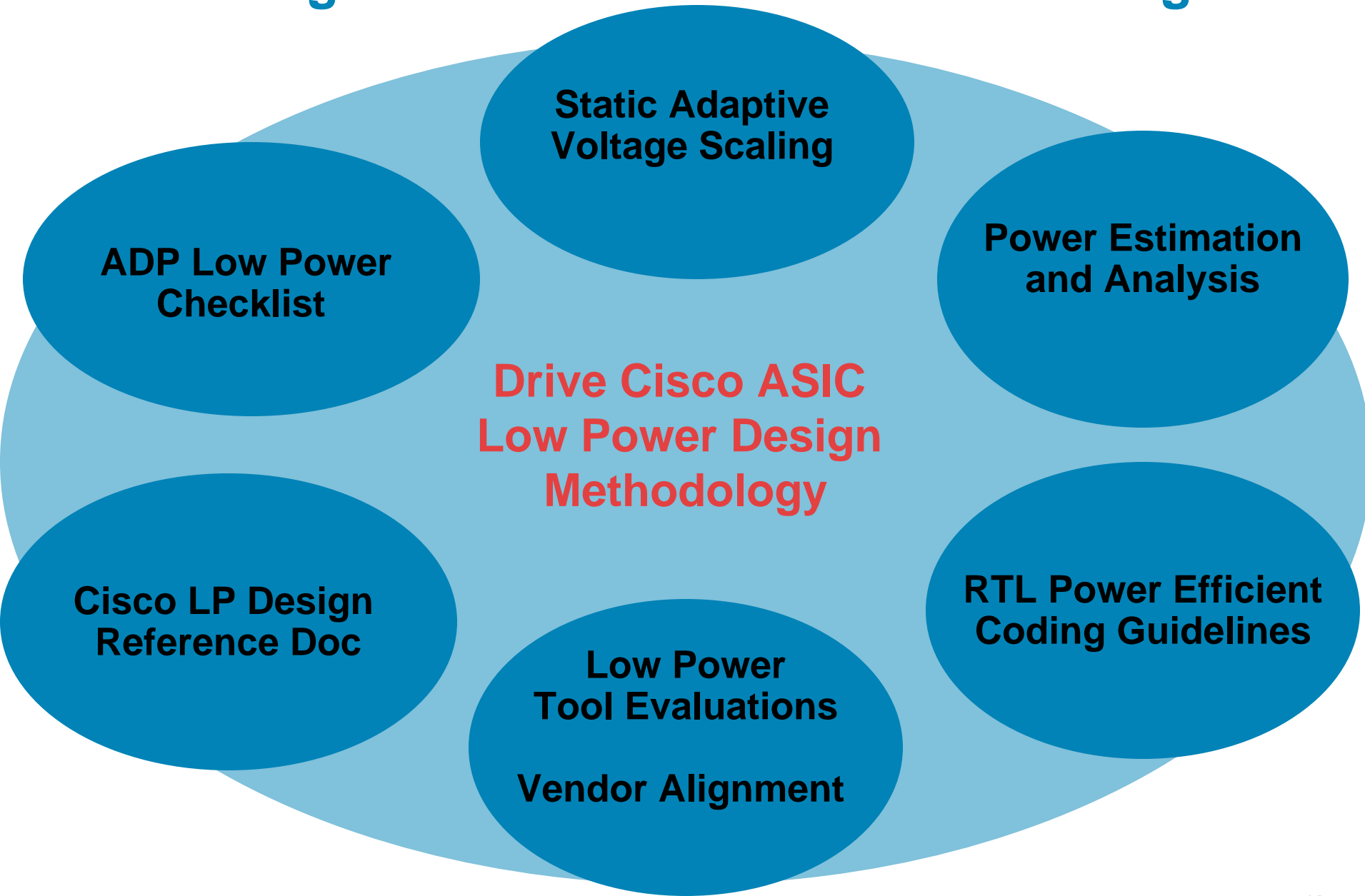


ASIC

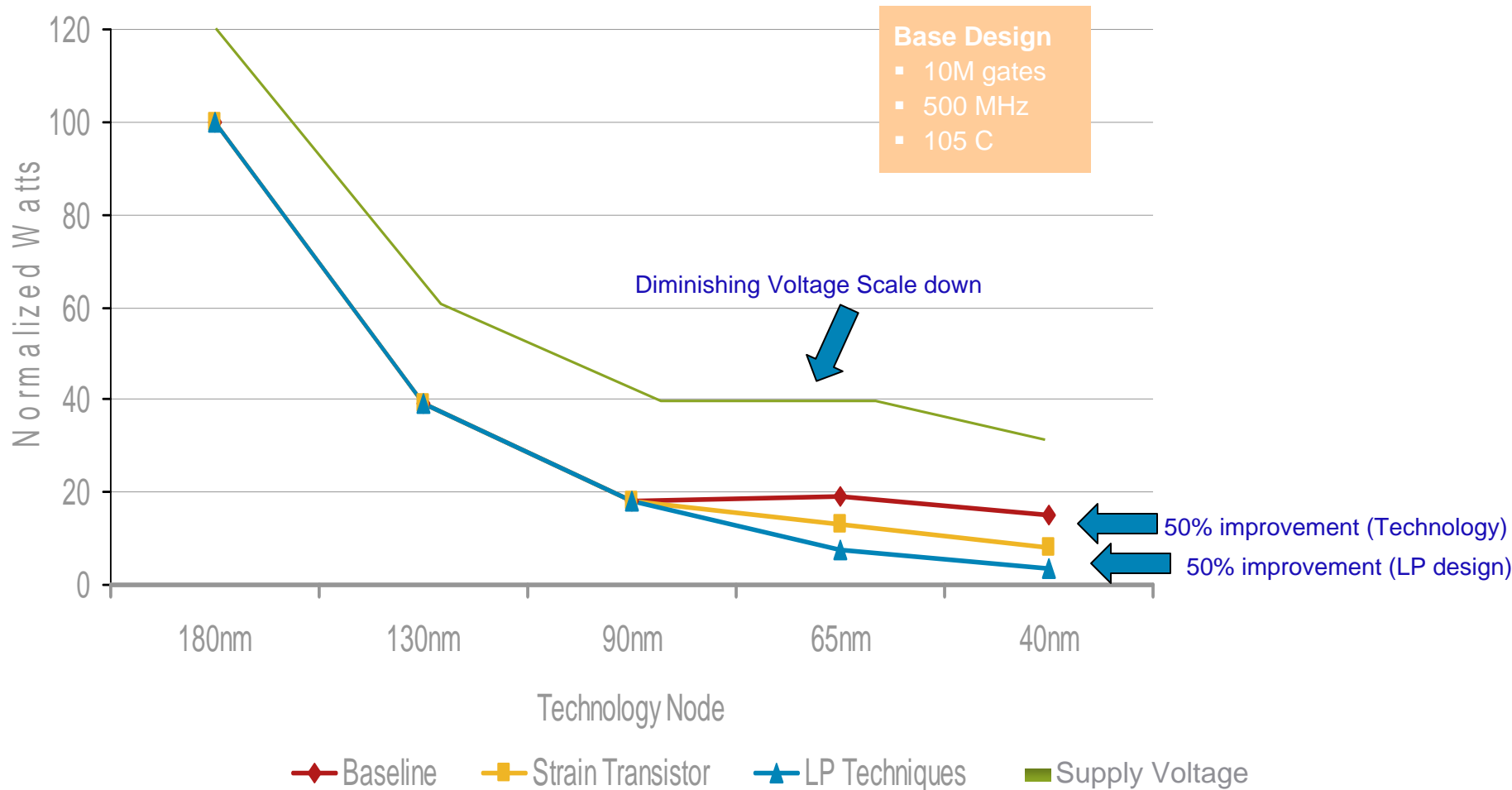
Fan



Taking on the ASIC Low Power Challenge



Silicon Technology Scale and Power Trend



Reducing Silicon Power

- **Architecture**

- Integration—single chip, single external RAM
 - More cores running at lower voltage and freq
 - Low power DRAM IO interface

- **Design & Implementation**

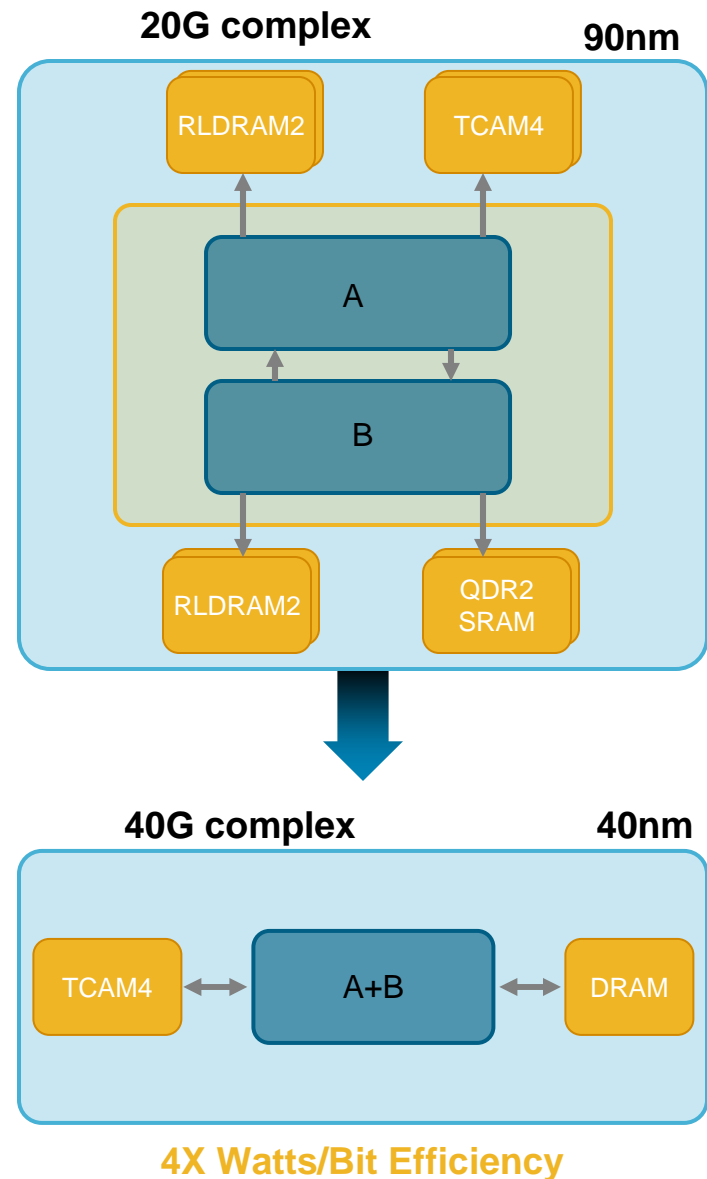
- Clock gating (block and local)
 - Optimized custom circuits and Macros
 - Split power rails for memory and core

- **Technology**

- 40nm Technology
 - SRAM cell leakage reduction
 - Multi VT and multi gate oxide transistors

- **Product Engineering**

- Adaptive Voltage Scaling



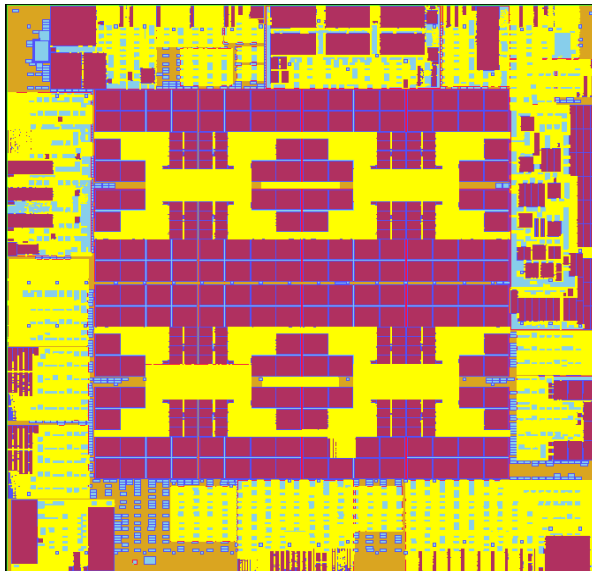
Power-efficient architectures

- More parallelism vs. just cranking on raw frequency

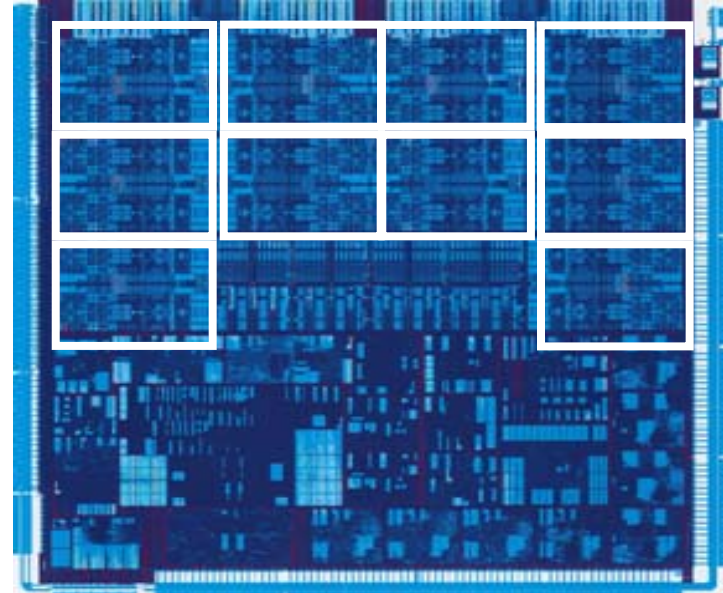
Well-understood in the industry now

Metro: 188 parallel packet processors @250MHz (2004, 130nm)

QFP: 40 multi-threaded CPUs @1.2GHz (2008, 90nm)



Metro



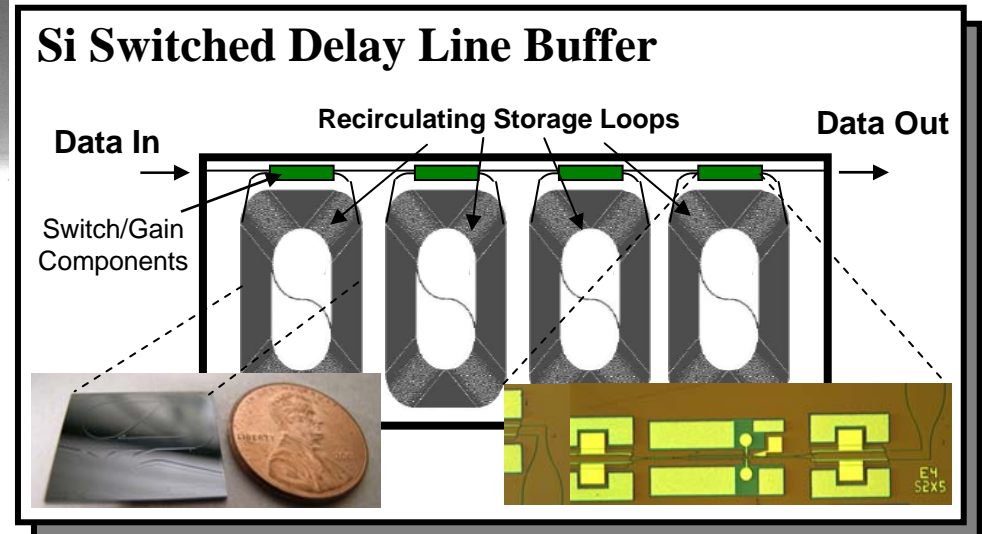
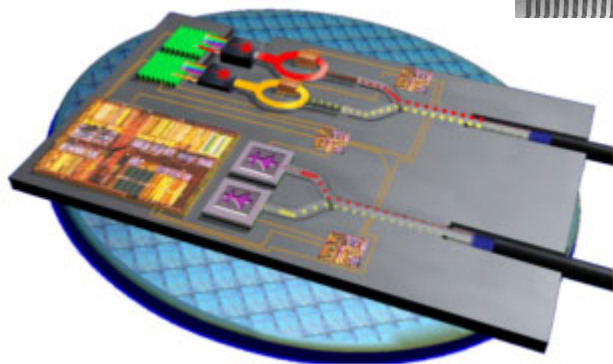
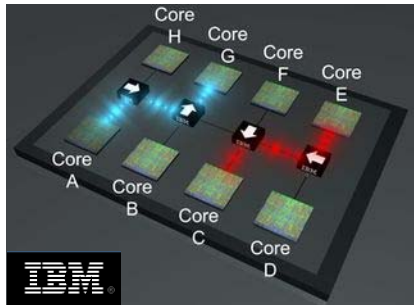
QFP

Alternate Technologies

Move selected functions from electrical to optical domain?

e.g. Waveguides, Holographics, Silicon Photonics

Cisco is engaged and tracking progress in these areas



Source: UCSB LASOR project, funded by DARPA MTO DoD-N

Summary

- Internet Energy Efficiency
 - Core – scale power with throughput
 - Edge/Access – idle/on/off modes
- Internet Energy Efficiency
 - Very visible issue
 - Being addressed broadly
 - Hard & easy problems



Additional Links:

Here is the link to the recent ucsb presentation:

<http://iee.ucsb.edu/sbsee>

Watch these two:

<http://iee.ucsb.edu/content/rod-tucker-video-presentation>

<http://iee.ucsb.edu/content/garry-epps-video-presentation>

Here are public links to articles on what we are doing in engineering:

<http://www.eweek.com/c/a/Green-IT/Ciscos-Marcoux-Charged-Up-for-Designing-a-Corporate-Green-Roadmap/>

http://blogs.cisco.com/sp/comments/ciscos_commitment_to_energy_efficiency_standards/

For the Power Supply Track here are external references to governing metrics standards -

<http://www.80plus.org/>

<http://www.efficientpowersupplies.org/methods.asp>

Q and A



