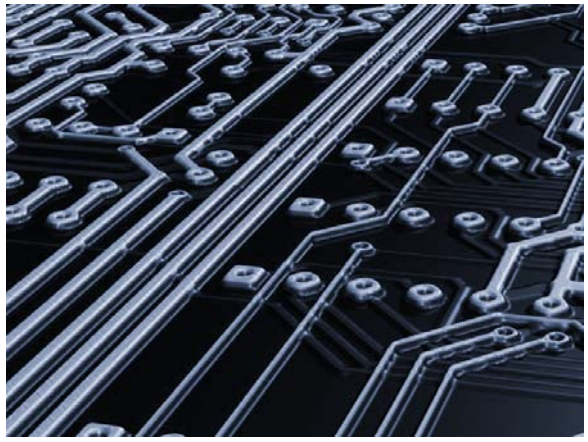
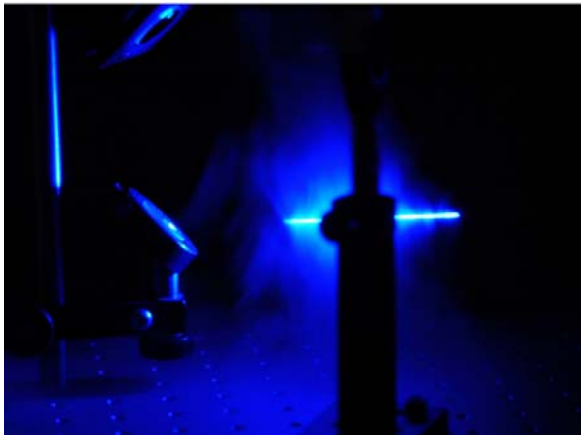
Semiconductor Intellectual Property Conference

Arthur L. Swift
President and CEO
Transmeta Corporation
http://www.transmeta.com

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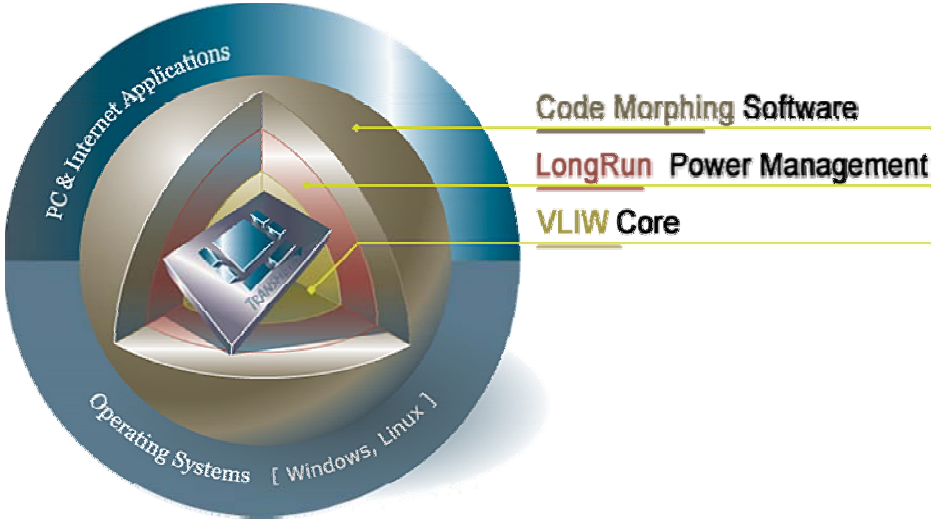
About Transmeta

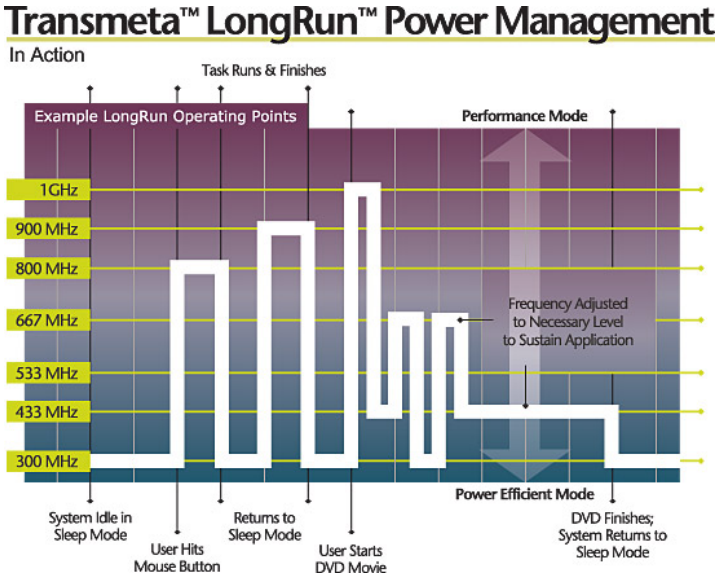
Transmeta develops and provides efficient computing technologies that improve performance, reduce power consumption and control heat generation in electronic devices

- **Transmeta Business Model**
  - **Processors and Customized Processor Development**
  - **Technology and IP Licensing**
  - **Synergistic Engineering Services**
- **Serves Industry Leading Customers**
  - **Sony, Fujitsu, NEC, HP, Sharp …**
- **Headquartered in Santa Clara, CA**
  - **Founded 1995**
  - **Publicly traded NASDAQ:TMTA**
  - **200+ employees**

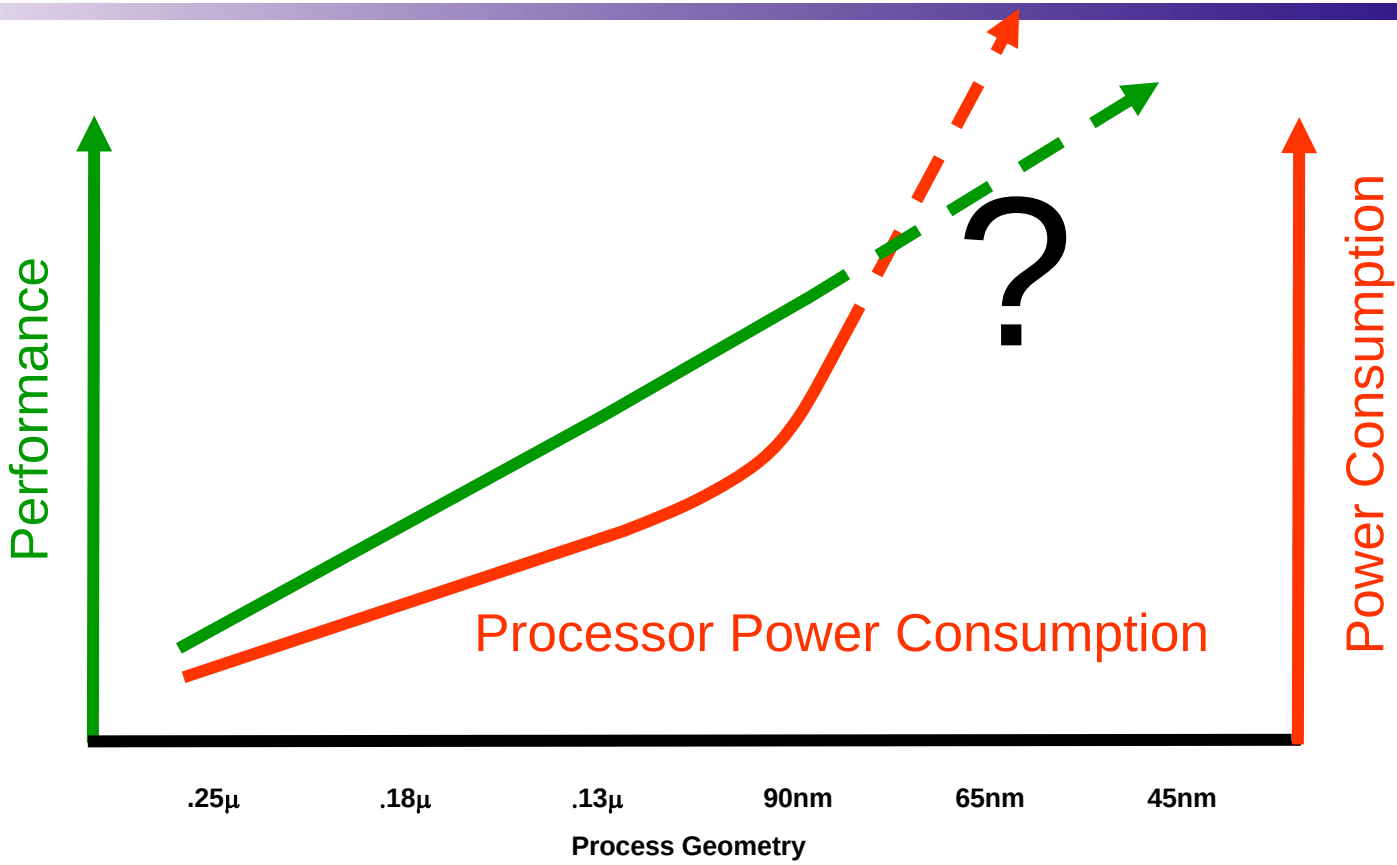
Power Management Panel: History of Innovation

- **Transmeta led the industry with a focus on energy efficient x86-compatible processing**
  - **Looked at things differently and innovated**
    - **Processor Design – VLIW, Software/CMS**
    - **Power Management – LongRun**
    - **Enabled customers to innovate**





Power Management Panel: Moore's Law and Rising Power



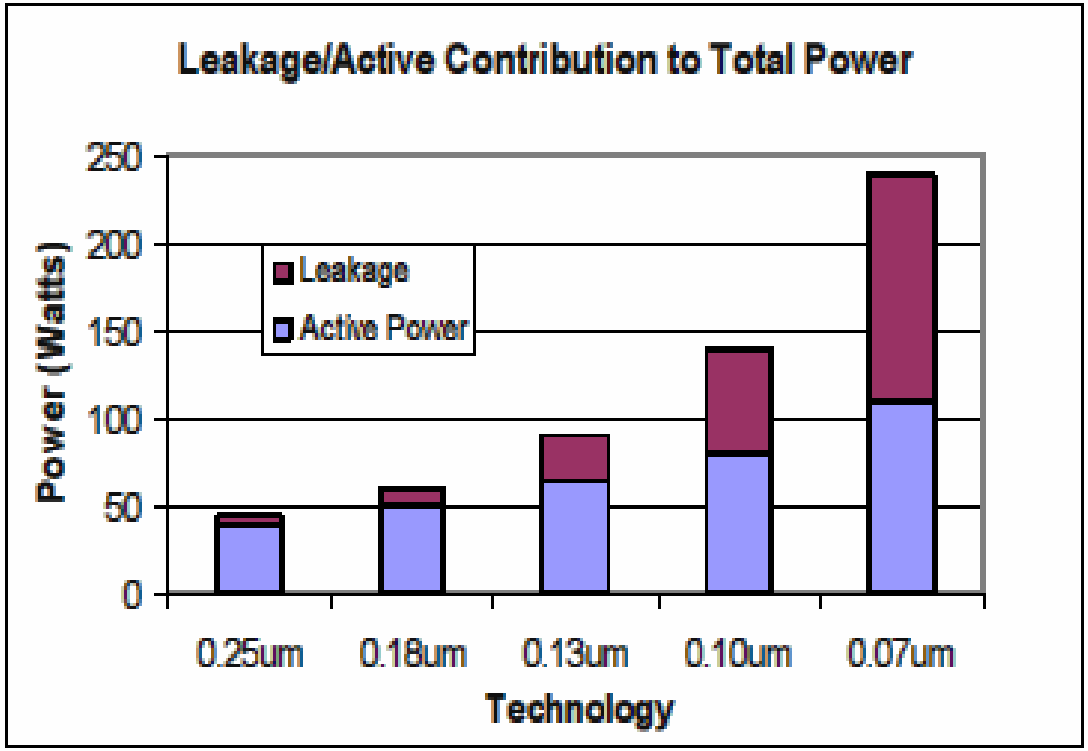
"Moore's law drives the industry for higher performance and lower cost, but… The leakage power explosion and V_t fluctuation will be big stumbling blocks for Moore's law."

-Professor Takayasu Sakurai, Ph.D., University of Tokyo

Power Management Panel: Problem of Leakage

To the future, the largest inhibitor to maintaining low power - Leakage

- **Main sources of leakage are**
  - **Source/Drain leakage**
  - **Gate leakage**
- **Other leakage mechanisms can be controlled by transistor design and process parameters.**



Source: http://www.ece.uci.edu/codes+isss/Invited/JamesLin.pdf

Power Management Panel: Problem of Leakage

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Huge concerns and extensive coverage in the last three years

"Scaling died at 130-nm"

Bernie Meyerson, CTO, IBM Systems & Technology
(Semico Conf., 1/19/04 & In-Stat/MDR Forum, 10/5/04)

"Leakage threatens CMOS scaling, panel warns"

Silicon Strategies Headline (EDA Industry Panel in San Diego, 6/8/2004)

"Power cliff, performance wall"

EE Times Headline (2/5/2004)

"Semiconductor firms find leakage a problem at 90nm"

Electronics Weekly Headline (2/8/2004)

"Power is a growing concern at 90, 65-nm nodes"

Silicon Strategies Headline (2/5/2004)

And, many more headlines, papers, articles, panels, and seminars

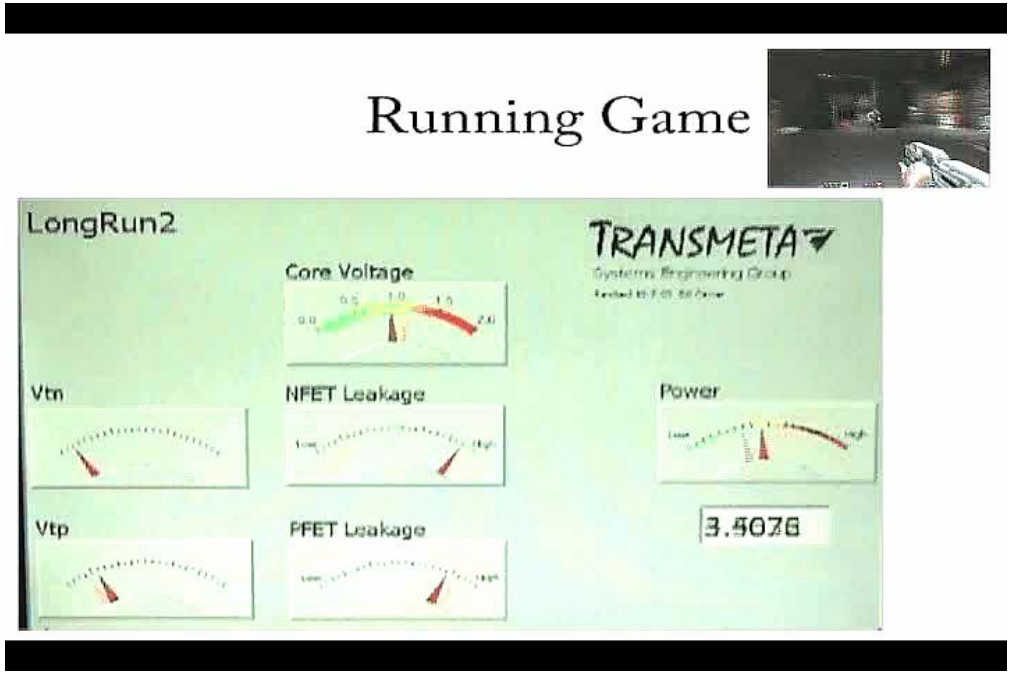
Power Management Panel: Potential Solutions to Leakage and Power Challenges

- New Materials
- Improved Processes
- Design solutions and CAD tools
- Architectural approaches
- Circuit techniques
- Non-planar devices
- Thermal control

Conventional solutions can be very complex and costly

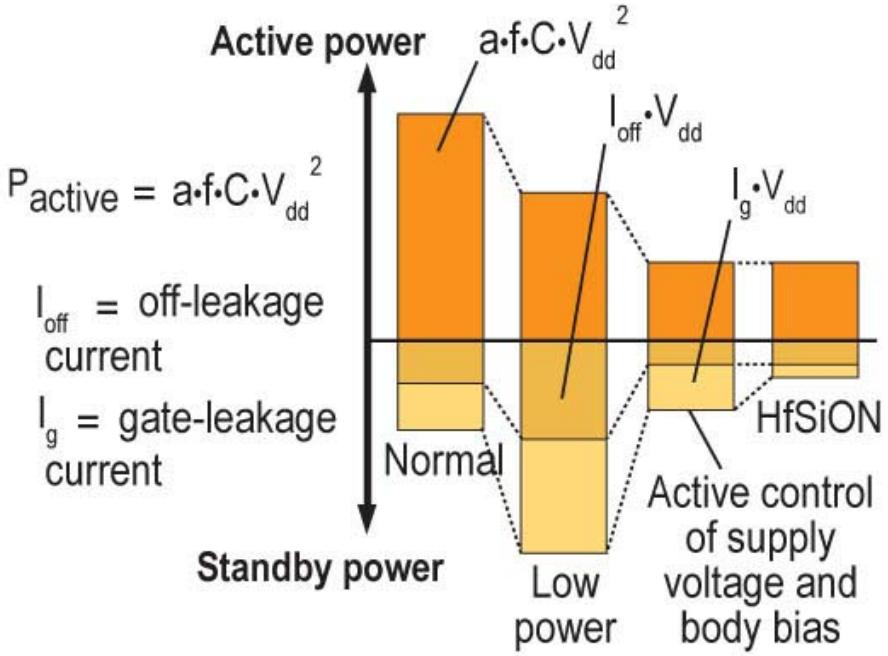
Power Management Panel: LongRun2™ Technologies

- **Mix of multiple technologies that effectively address leakage problem**
  - **Implements Dynamic V_t control in a new way (Process, Circuit & S/W)**
  - **Complementary to other power and leakage control**
  - **Retrofit-able to existing "bulk silicon" designs**
- **Current LongRun2 Licensees: NEC, Fujitsu and Sony**
- **First prototype demonstrated on Efficeon™ Processor, Oct. '03**



Power Management Panel:
NEC Cuts 65nm Standby Power by Two Orders of Magnitude

- **NEC (LongRun2 Licensee) has cut standby current leakage by 30X to 100X using:**
  - **Transmeta's LongRun2**
  - **High-k gate dielectric**



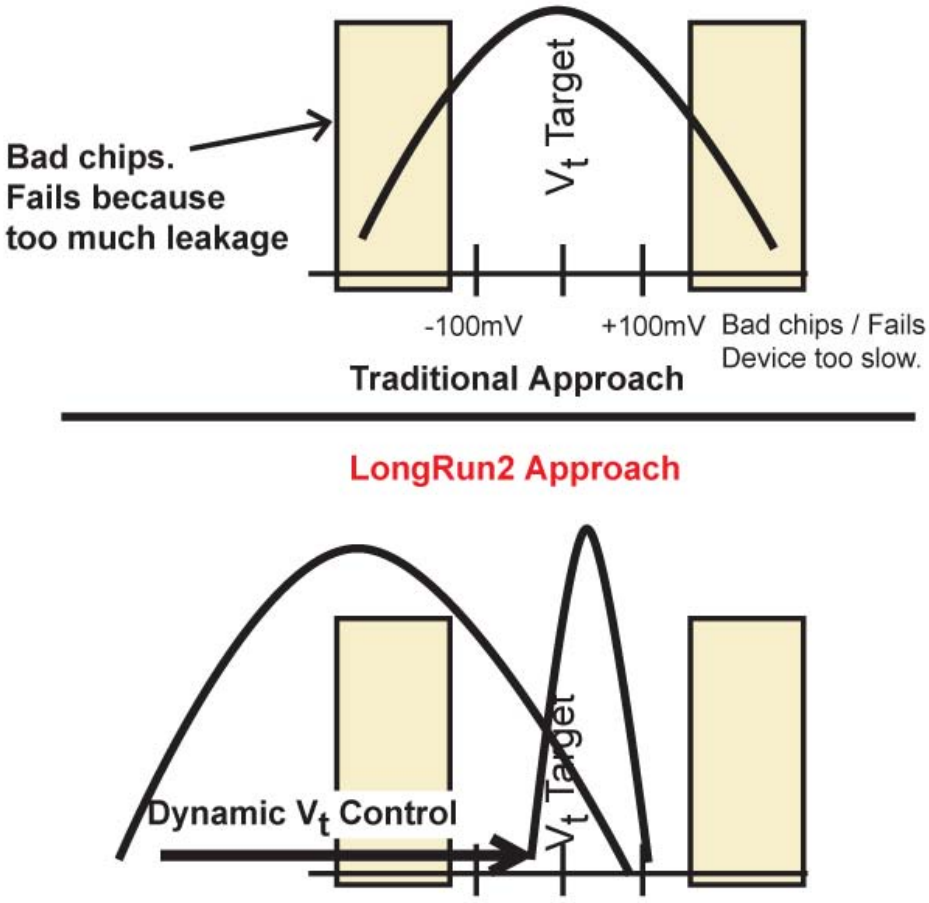
- **As stated in the article, most of the power and leakage reduction is from LongRun2.**

- **NEC also stated that it expects to use LongRun2 enabled low-power technology in applications from low power portable phones to high-performance advanced servers.**

Source: **Yasushi Yamagata and Kiyotaka Imai**
NEC Electronics Corp., Advanced Device Development Div.,
Solid State Technology, November, 2004
Initially published in Nikkei Microdevices (SST partner)

Power Management Panel:LongRun2
Improved Yield & Design for Manufacturability (DFM)

- **Typically, V_t may have a wide distribution**
  - **Lower yields and higher costs.**
- **LongRun2 allows the tuning of the V_t for each die**
  - **Allows a very tight distribution.**
  - **LR2 can result in higher yields and better manufacturability through dynamic V_t control.**



Power Management Panel: Conclusion

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Continued innovation will deliver semiconductor scaling to the future

- **LongRun2 is an excellent example of a practical solution**
  - **Applicable to existing CMOS designs**
  - **Complementary to other proposed leakage control and power management solutions, such as high-k gate dielectrics.**
  - **Effectively addresses**
    - **Active power**
    - **Both main leakage mechanisms (gate leakage and source/drain leakage)**
    - **Threshold voltage fluctuations.**
  - **Improves manufacturing yields**
  - **Offers effective DFM solution for controlling V_t variability**

Thank You!