# Rambus Overview

- What is Rambus?

- Why is Rambus being adopted?

- Who is adopting Rambus?

- Where is Rambus being adopted?

- What is the History of Rambus?

- What are the Rambus design challenges and how does Tektronix help?

Rambus Technology

- High speed memory bus

- Uses CMOS DRAM technology, memory controller, and IC technology

- Unique DRAM (RDRAM) package and channel architecture

- Up to 32 32, 64, or 128 Mb RDRAMs are supported
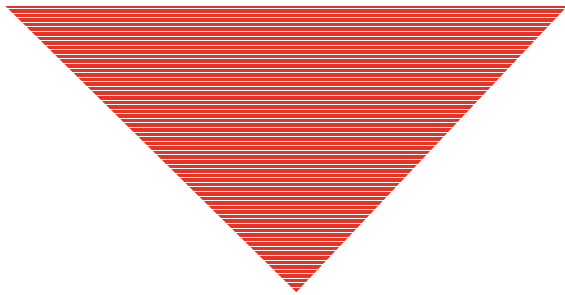
- Replaces PCI/SDRAM
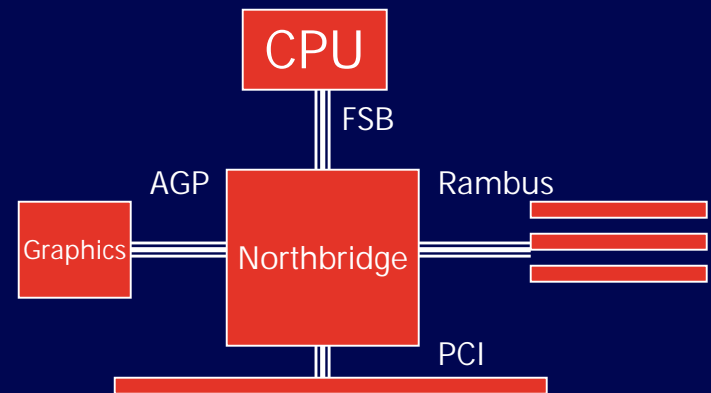
The Rambus Advantage

- 10X Data throughput increase over PCI/SDRAM

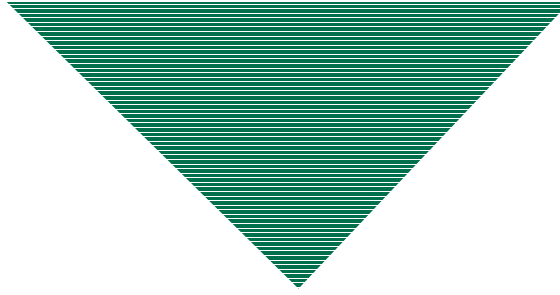- Uses fewer IC's and area than PCI/SDRAM

- Modular and Scalable

RDRAM
1.6 GB/s

DRAM
100 Mb/s

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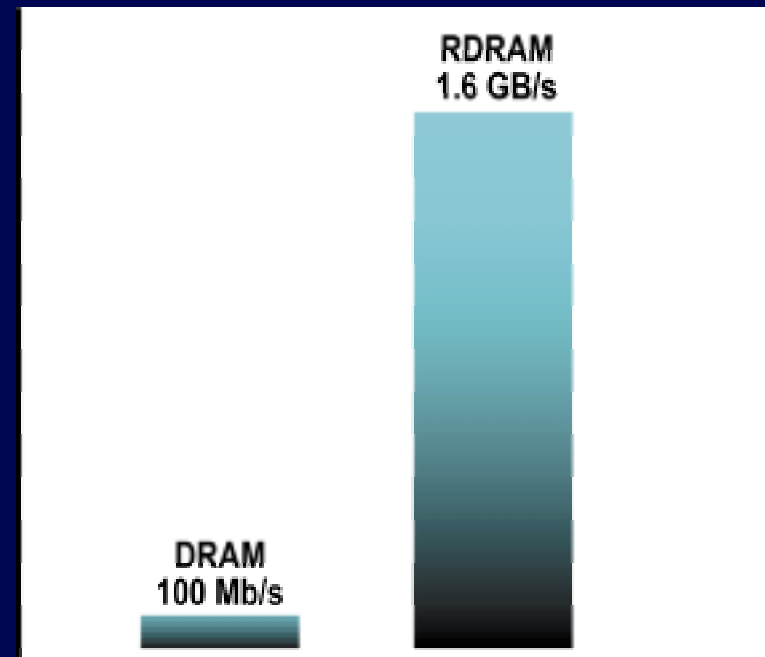
Visual Computing

3D Graphics   **Digital Imaging**   **Video**
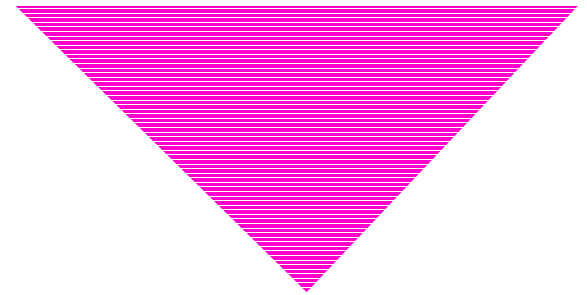
More Intuitive Computing Experience

Source: Intel Corp

Memory Bandwidth Requirements

Main Memory BW

3GB/sec

nDRAM

SDRAM

500MB/sec

100MB/sec

EDO DRAM

Time
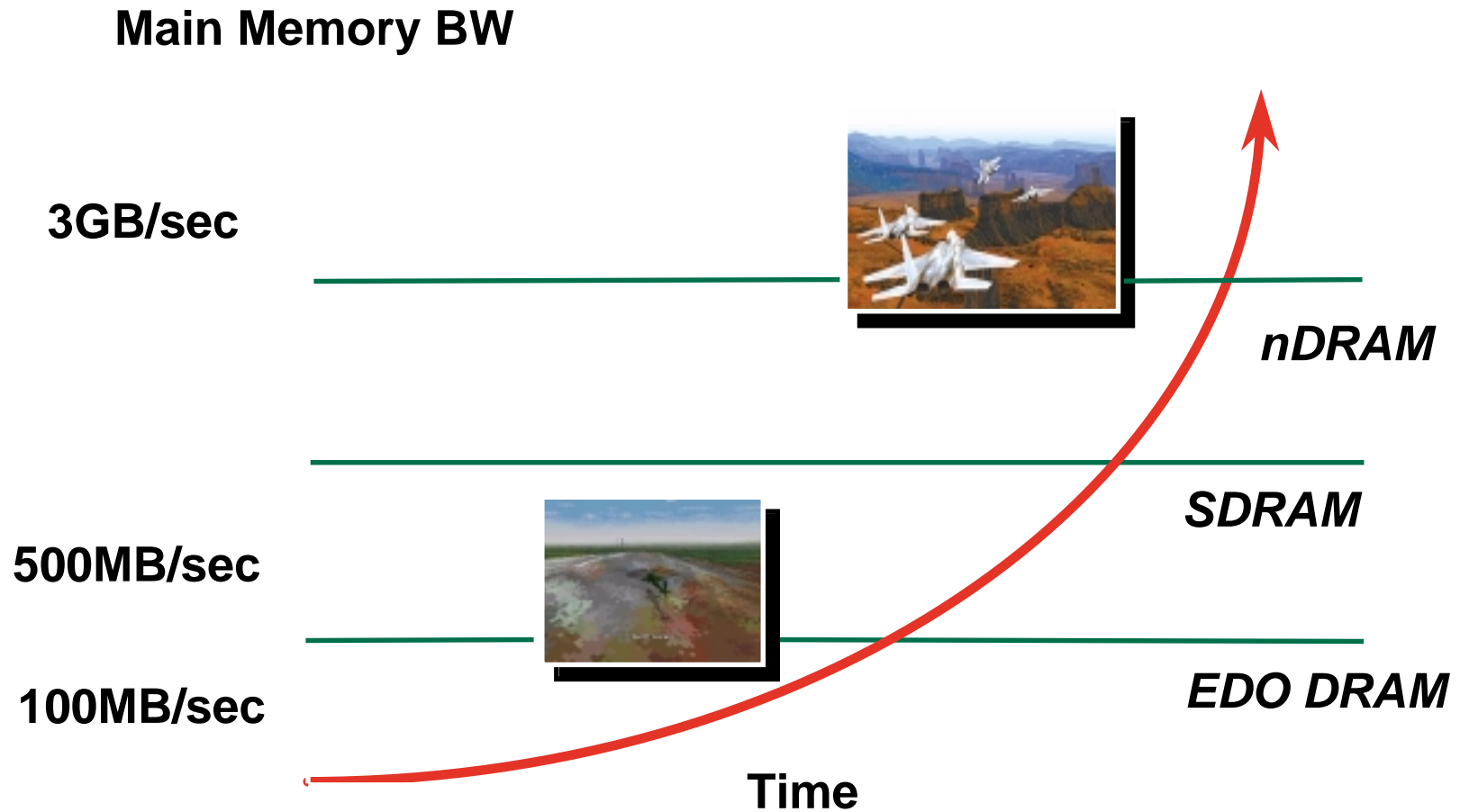
Rambus Adopters

PC & Server

- Acer Laboratories Inc. (ALi) PC main memory chip sets
- AMD chip sets for K7 processors
- Compaq Computer Corporation, AlphaServer enterprise computing systems
- IBM PC 300GL with Pentium II
- Intel Corporation future PC system memory chip sets
- NEC Corporation ValueStar NX and NetFine NX PCs
- National Semiconductor Corporation future PC high-performance processors

PC Graphics

- Evans & Sutherland 3D Visualization Graphics System
- VideoLogic Power VR(TM) Graphics Controller

Datacomm

- Berkeley Networks exponeNT network switch
- Brocade Communications SilkWorm network switch
- TI ThunderSwitch II Gigabit Ethernet devices for network-switching

Video Games

- Nintendo64 3D graphics video game system
- Sony Next Generation PlayStation(R) System

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Tektronix enables Rambus

- Tektronix is a Rambus Developer

- Tektronix recognized by Rambus and Intel for Rambus measurement expertise and measurement solutions

- www.tektronix.com/rambus

Rambus WW Activity

- Component Design & Mfg: US, Japan, Korea

- PCB Manufacture: Taiwan, US

- System Design: US, Japan, Taiwan

Rambus History

- March 1990: Rambus is Incorporated

- June 1992: Toshiba demonstrates working 4Mbit RDRAM

- September 1994: NEC ships 16M RDRAMs to SGI

- July 10, 1995: SGI announces plans to ship Indigo2 IMPACT(TM) workstations with Rambus graphics memory

- December 1995: Nintendo64 ships with Rambus DRAMs

- December 1996: Rambus and Intel disclose agreement to evolve RDRAMs to meet requirements of PC main memory

- June 22, 1998: Rambus, Intel, Toshiba and LG Semicon announce system testing of Direct RDRAM devices at 1.6 Gigabytes per second

- November 1998: Intel demonstrates 800MHz RDRAMS

- February 24, 1999: Mobile system memory components Specs revealed

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Rambus Technology
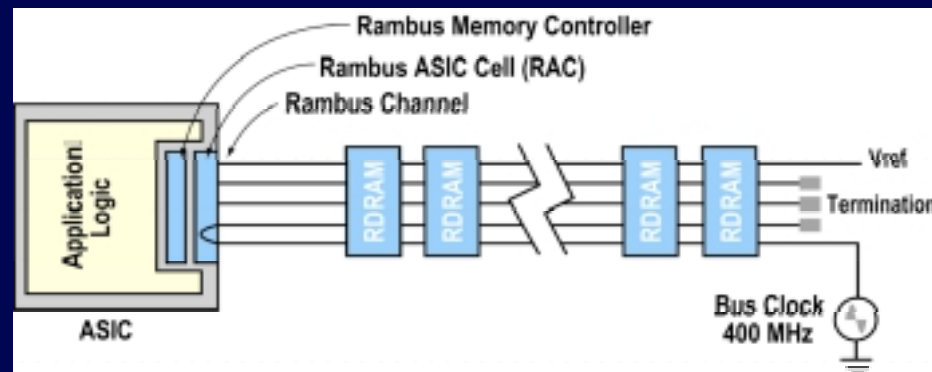
- **Rambus Channel has 30 controlled-impedance, matched transmission lines**
    - Two 9-bit data buses (DQA and DQB)
    - A 3-bit ROW bus
    - A 5-bit COL bus
    - CTM and CFM differential clock buses
- **Single device access on a Rambus Channel**
- **Parallel channels with full-length clock routing**
- **All signals are parallel-terminated to V_{ref} at end**

Rambus Challenges

- Tight Impedance Control

- Rambus Signaling Level (RSL) environment

  - 400 MHz differential clock/800 MHz data rate

  - 800 mV signal level around 1.4V ref

  - 200 ps setup and hold times

  - Bi-directional data flow

- Complex Protocol with high data rates

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