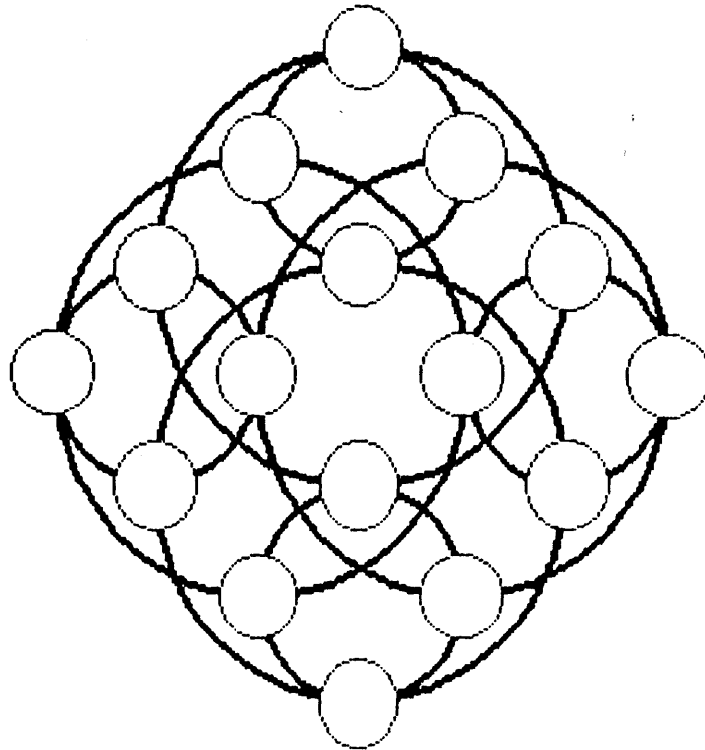


THE FPS T SERIES

A PARALLEL VECTOR SUPERCOMPUTER

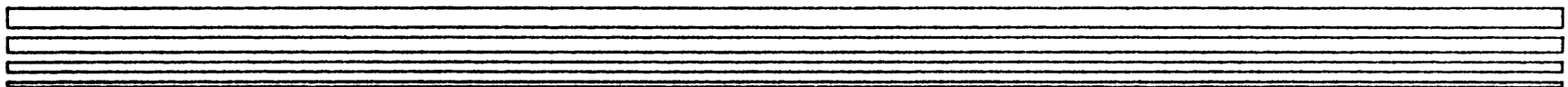
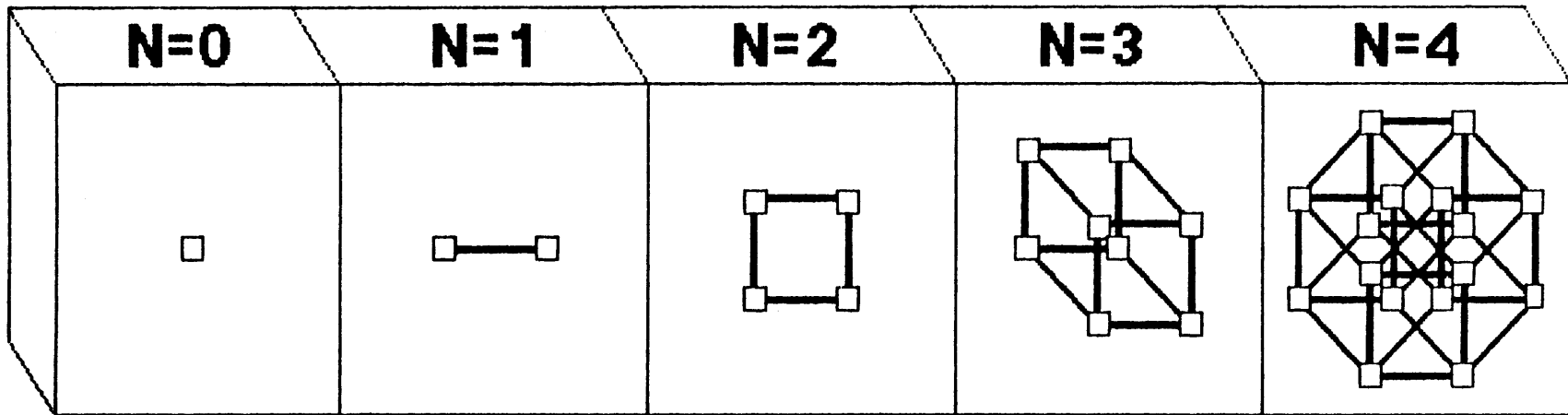


TECHNICAL INFORMATION



BINARY N-CUBES ARE FORMED BY DOUBLING

Number of nodes = 2^N



COSMIC CUBE APPLICATIONS

Caltech has found 25 application areas to run with high (>80%) efficiency on a 64-node system

Examples:

Class of Problems

Examples

Finite Difference Equations

Geophysics

Finite Element Equations

Aerodynamics

Partial Differential Equations

Statistical

Lattice Gauge; Melting; Coulomb Gas

Time Evolution of L/R Potential

N-body Gravity

Fast Fourier Transform

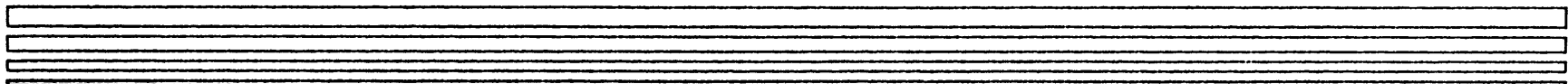
**Fluid Dynamics; Evolution of Universe
Signal/Image Processing**

Network Simulation

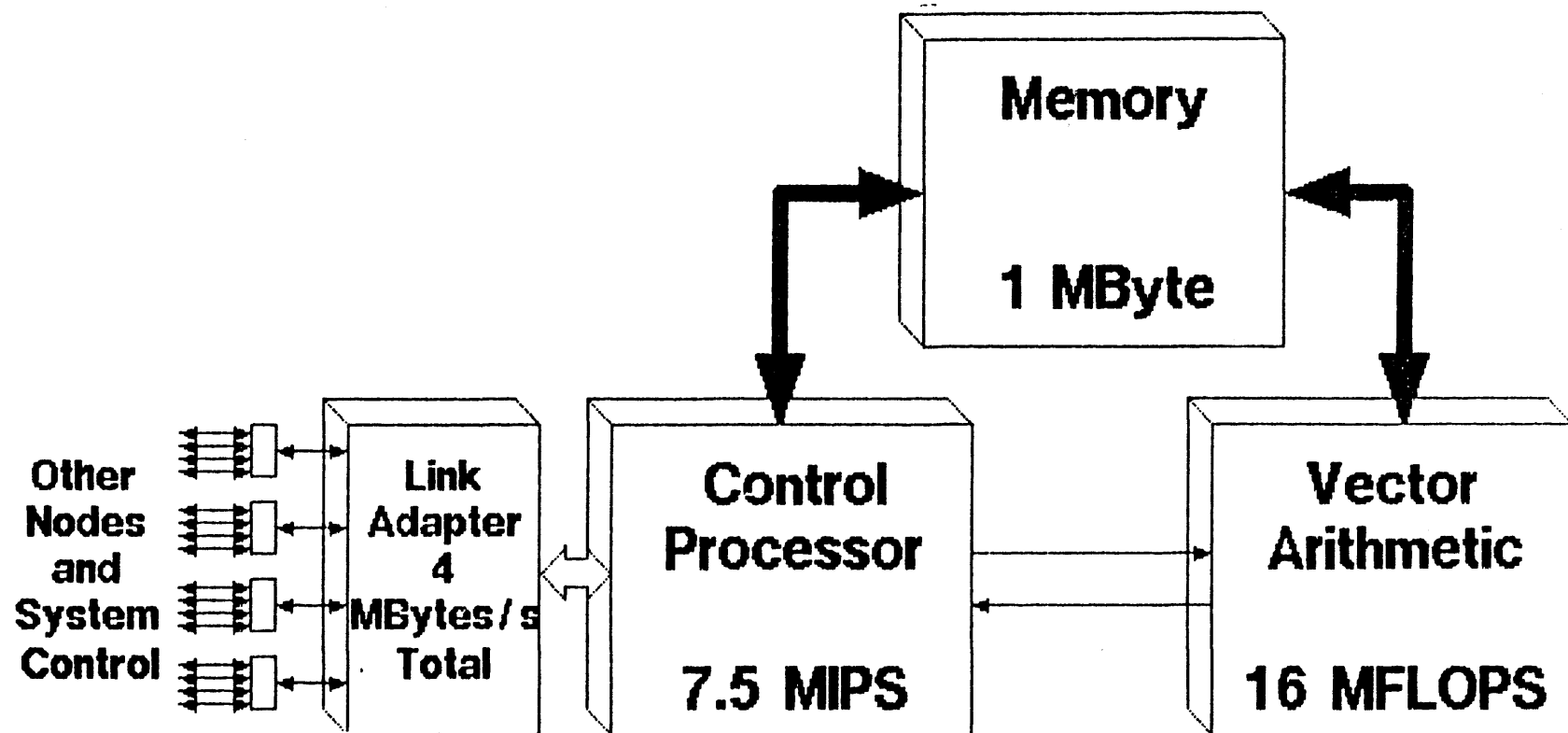
Circuit Analysis

Event-Driven Simulation

War Games; Economic Simulations

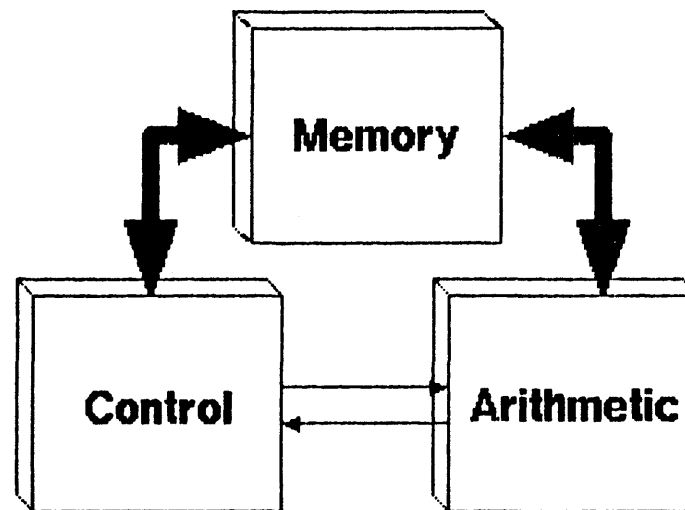


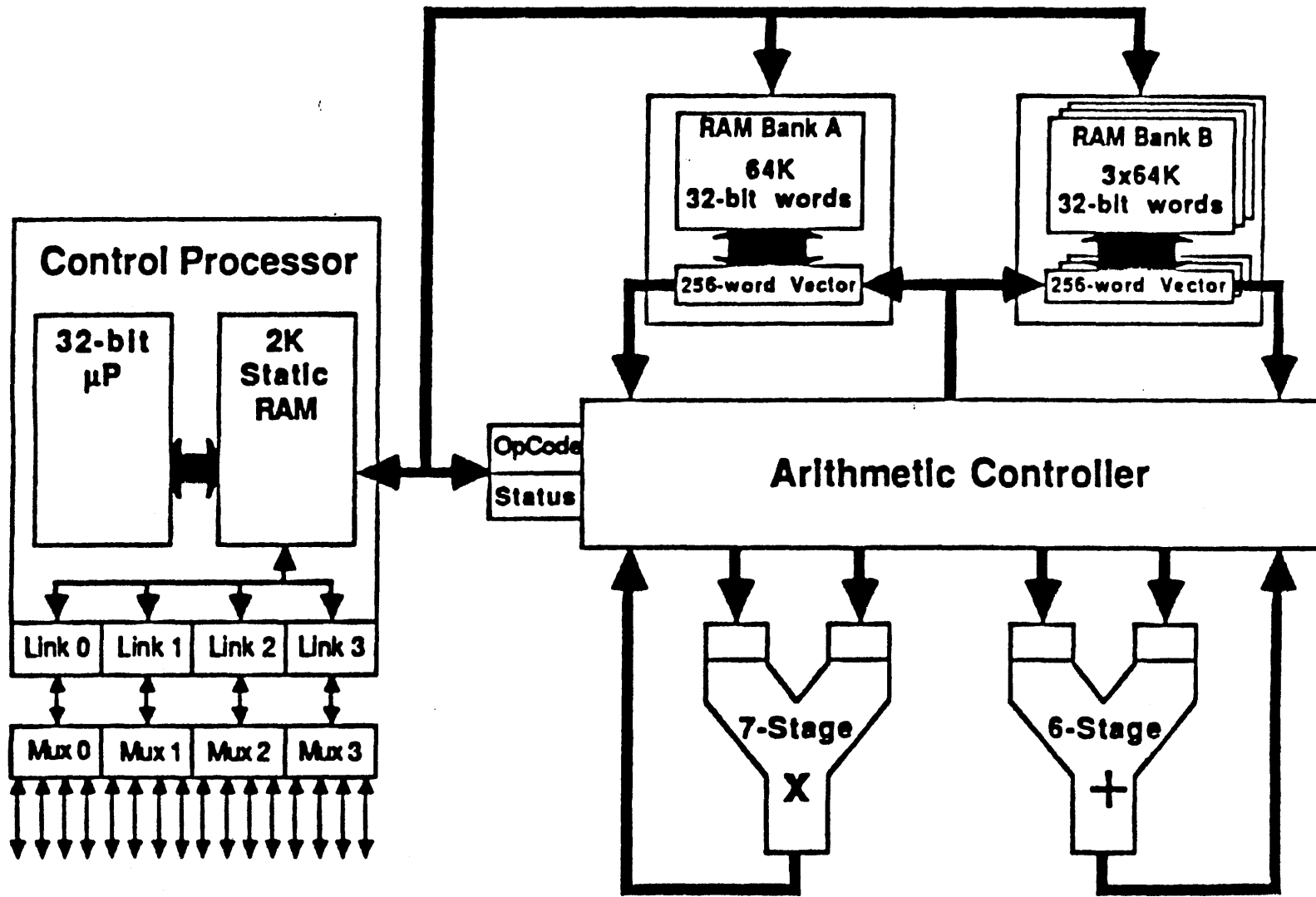
A NODE IS A HIGH-PERFORMANCE VECTOR COMPUTER



THE THREE KEYS TO HIGH PERFORMANCE COMPUTING

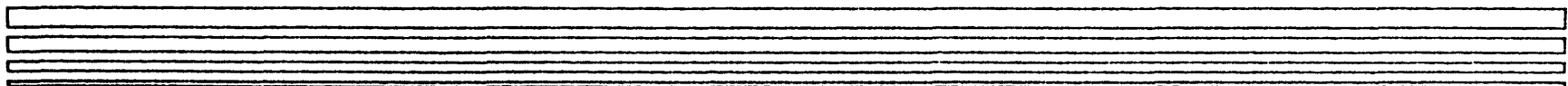
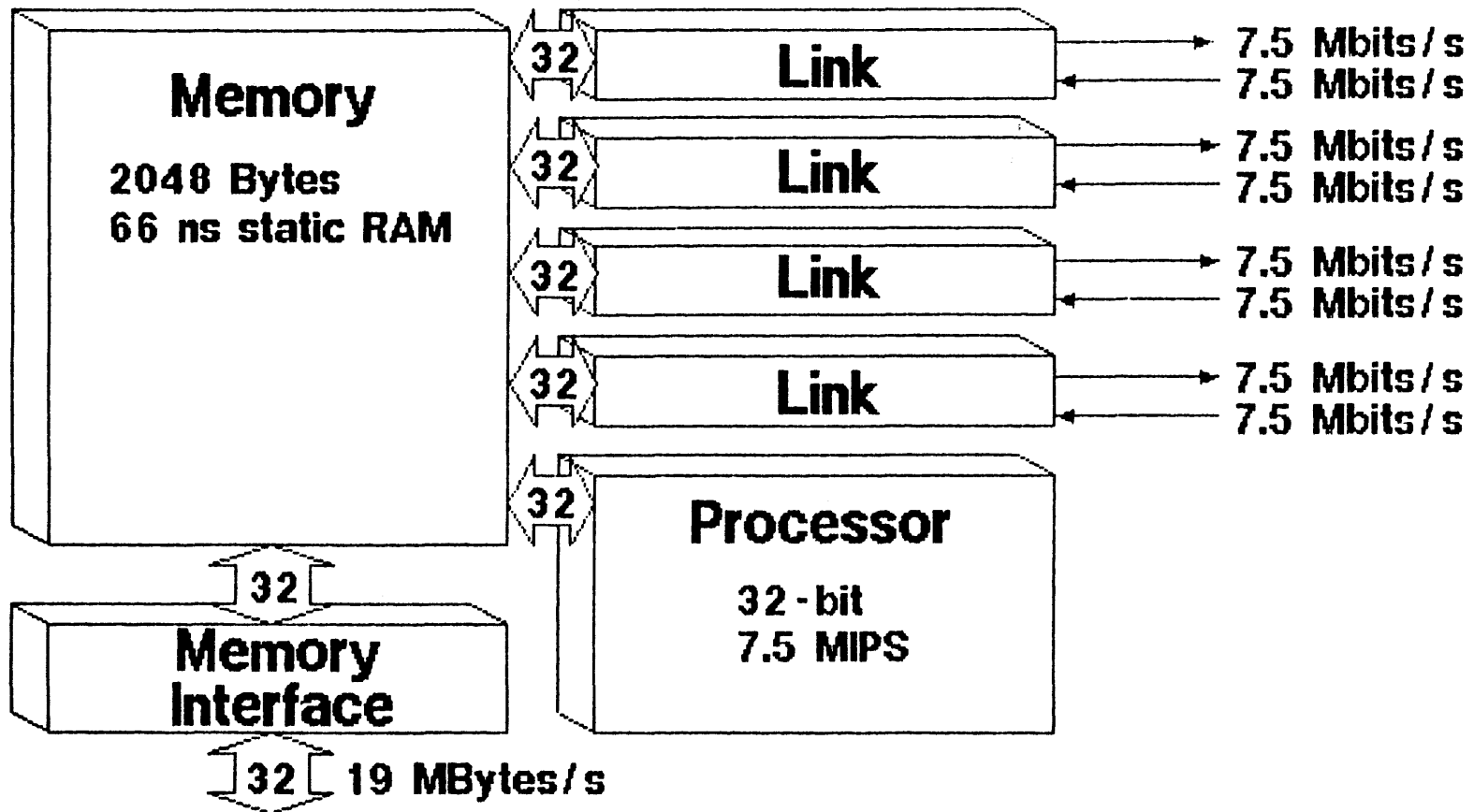
- **Control Processor** - Inmos Transputer
- **Arithmetic** - Weitek 64-bit parts
- **Memory** - TI Multiport Video RAM



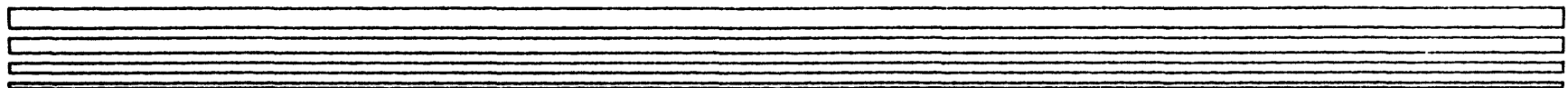
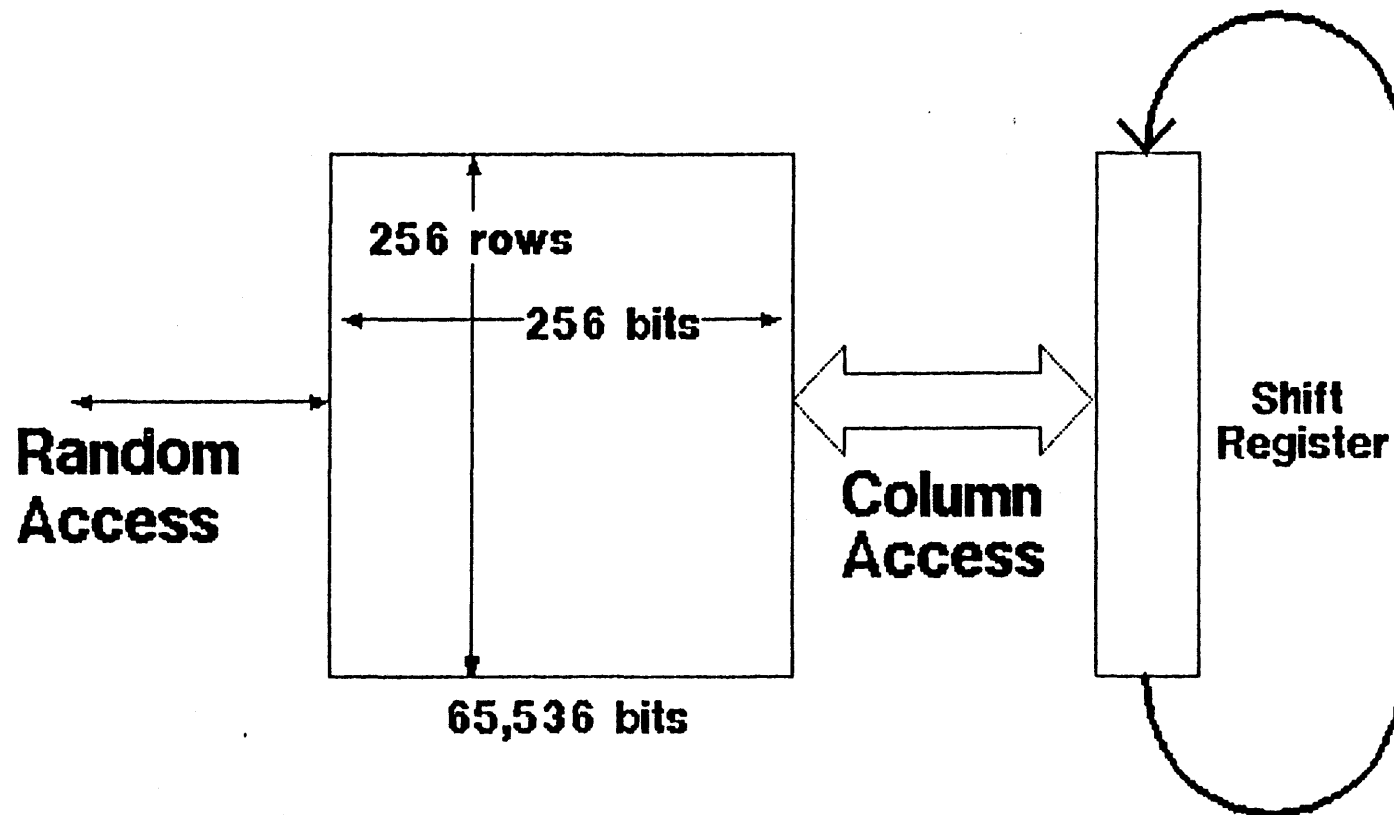


The FPS Tesseract processor

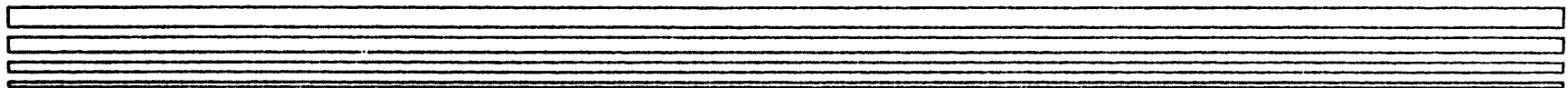
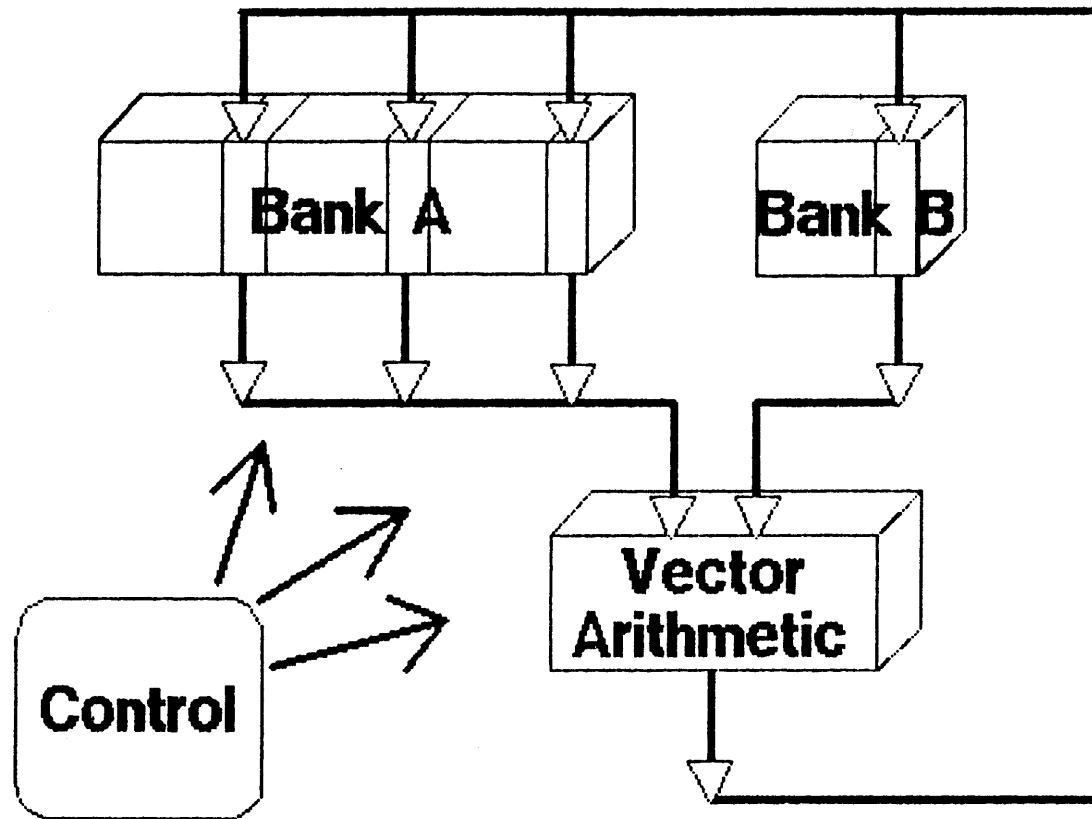
THE TRANSPUTER IS AN INTEGRATED CONTROL PROCESSOR



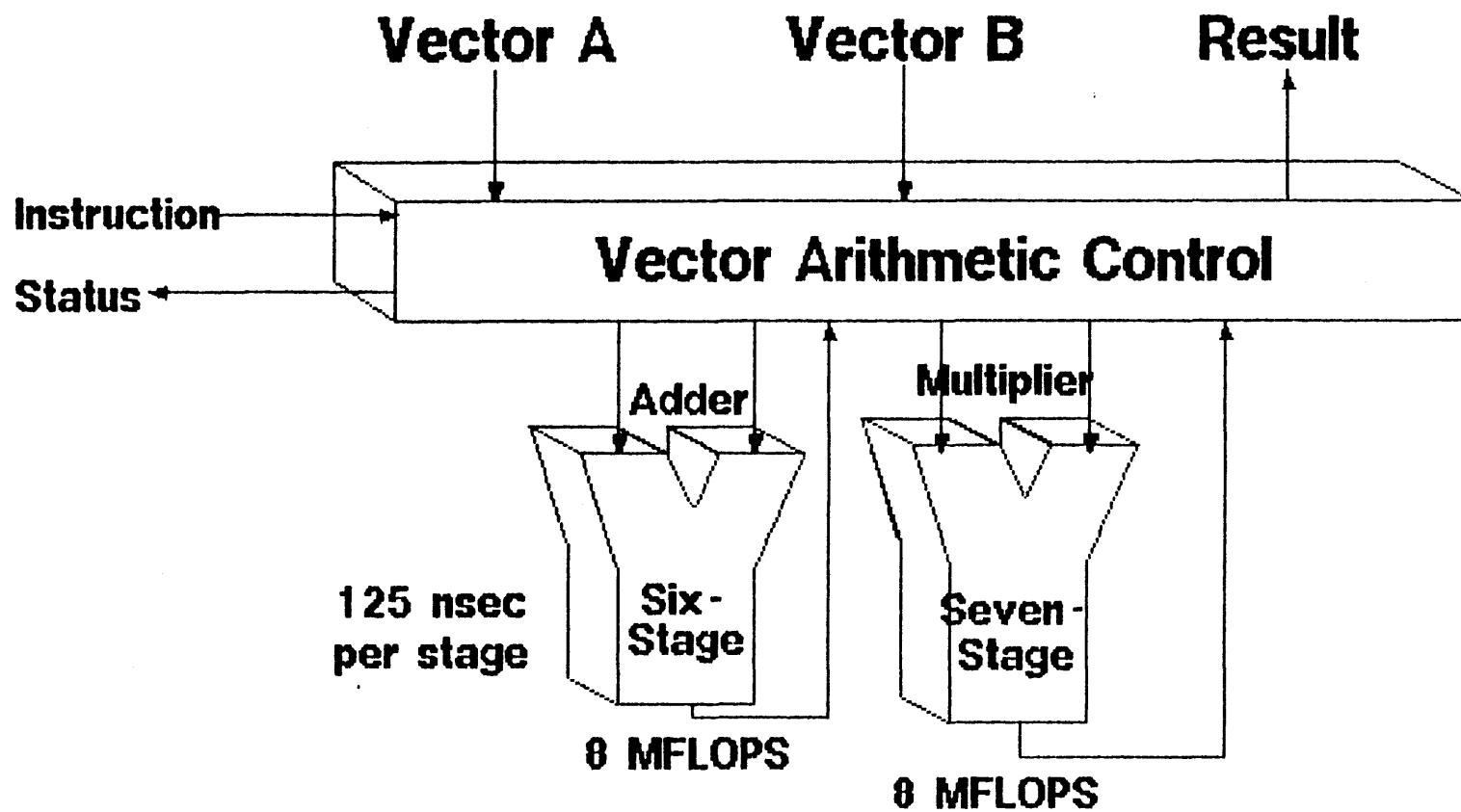
THE DUAL-PORT MEMORY ALLOWS BOTH RANDOM AND VECTOR ACCESS



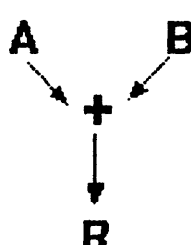
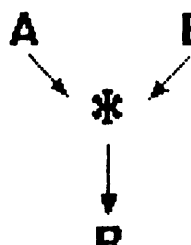
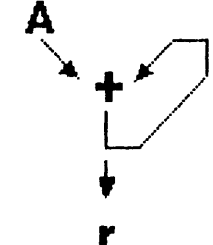
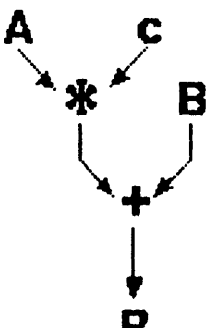
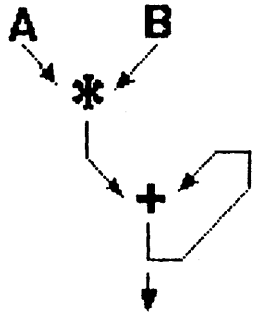
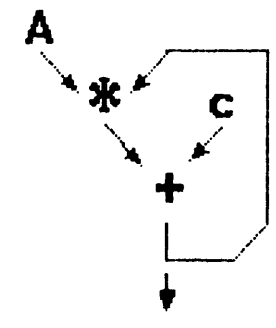
TWO BANKS PROVIDE 1 MBYTE STORE FOR VECTOR ARITHMETIC

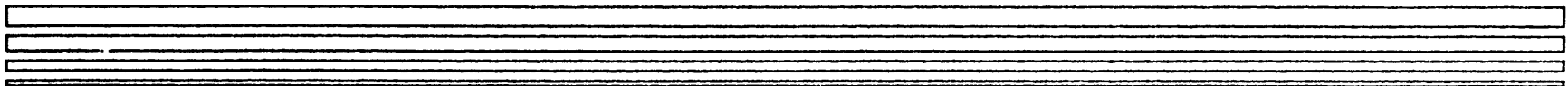


THE ARITHMETIC UNIT IS AN INTEGRATED ARRAY PROCESSOR

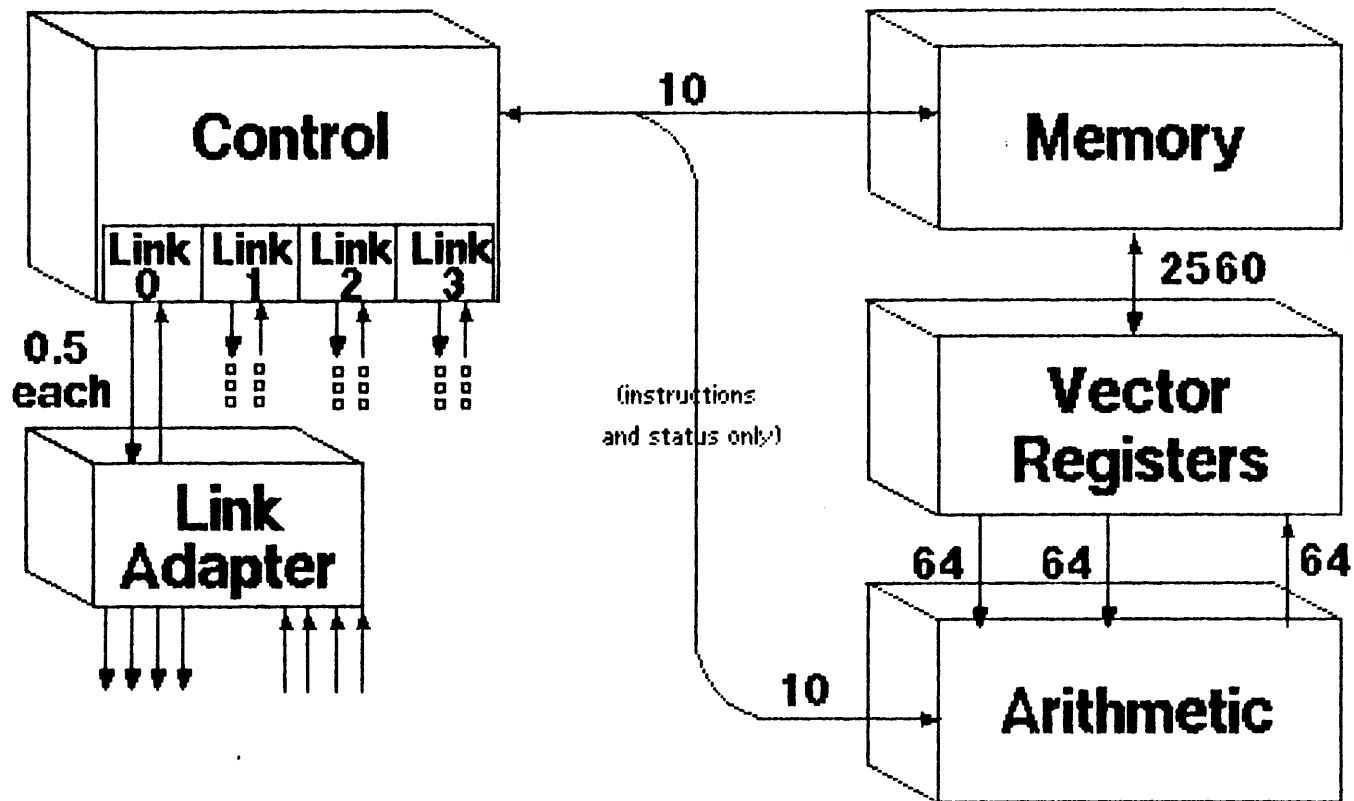


VECTOR FORMS ARE PRE-PROGRAMMED

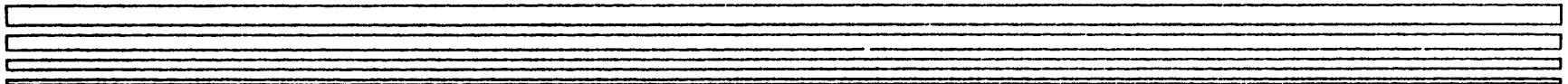
 <p>Vector Add</p>	 <p>Vector Multiply</p>	 <p>Min, Max, Zero Finder</p>
 <p>VSMA (AXPY)</p>	 <p>Dot Product</p>	 <p>Polynomial Evaluation</p>



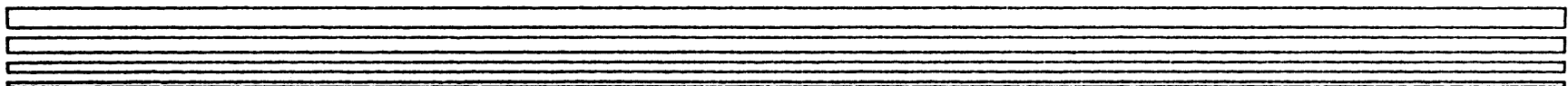
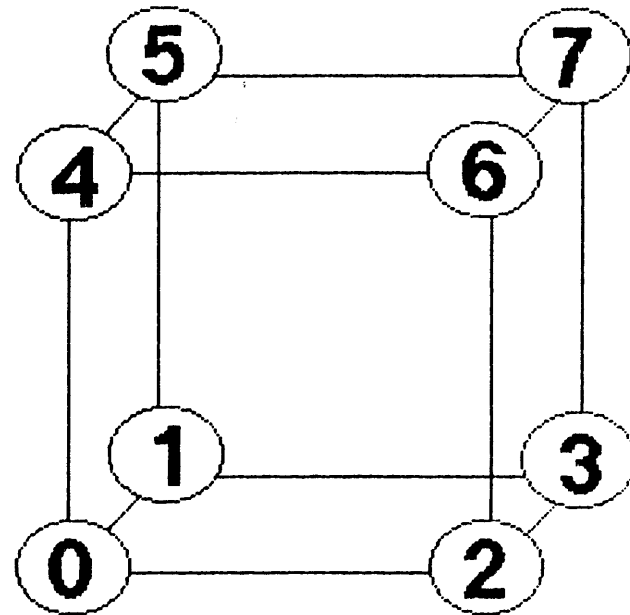
NODE DATA PATHS



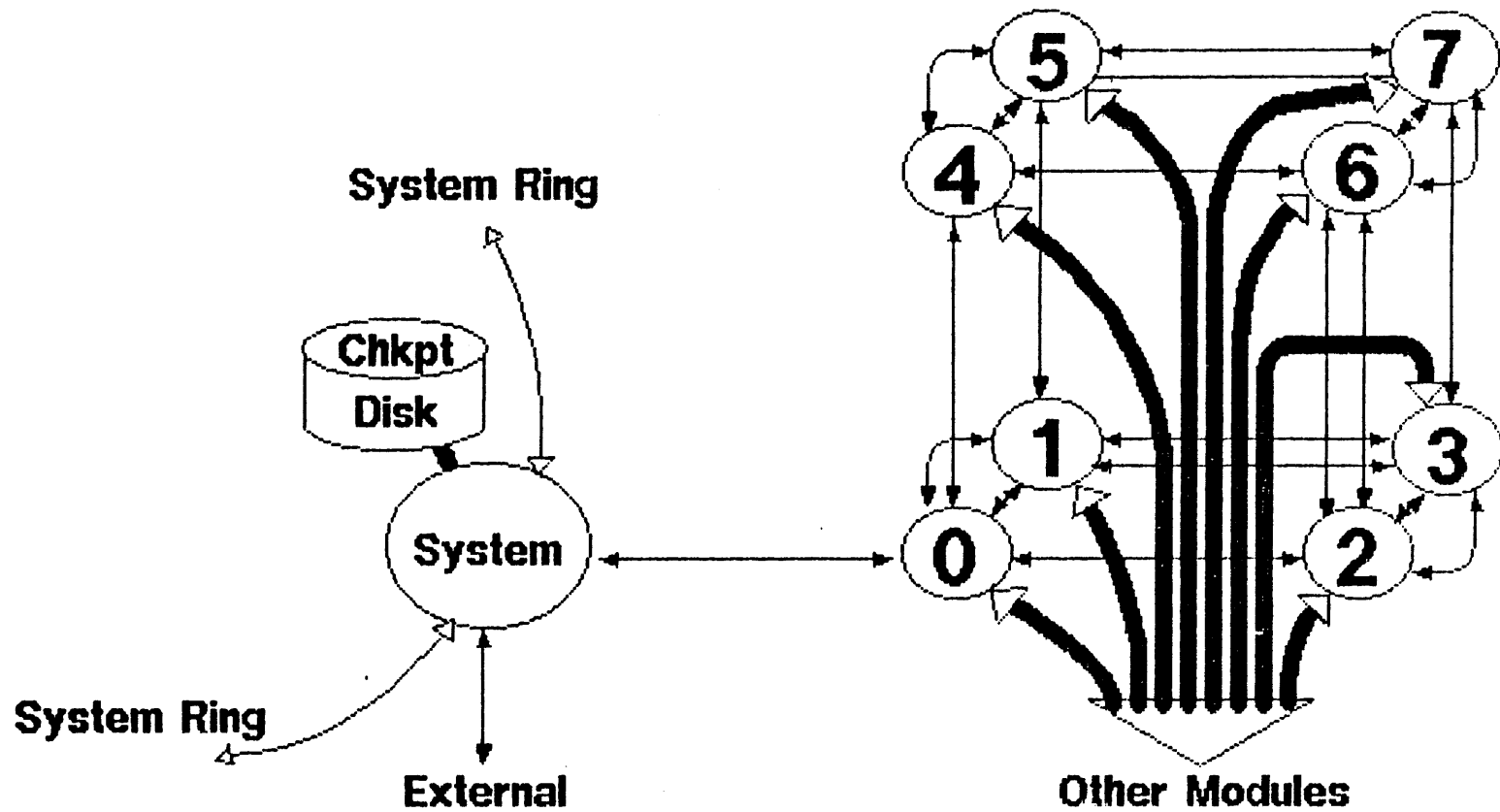
(All Bandwidths in MBytes/second)



A MODULE CONTAINS 8 NODES



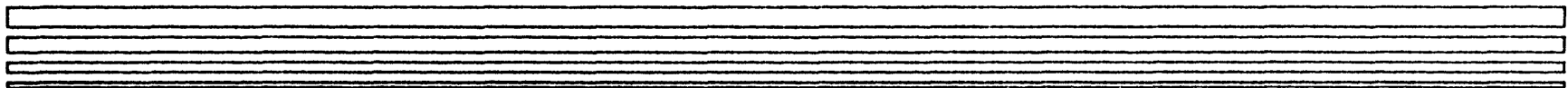
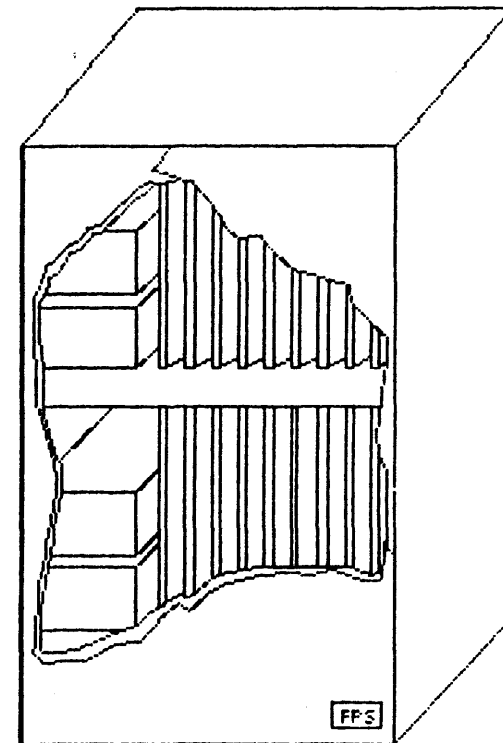
A SEPARATE INTERCONNECT IS USED FOR SYSTEM SUPPORT FUNCTIONS



A CABINET CONTAINS TWO MODULES

Arithmetic: 256 Peak MFLOPS
Control: 120 MIPS
Memory: 16 MBytes
Checkpoint
Disk: 112 MBytes

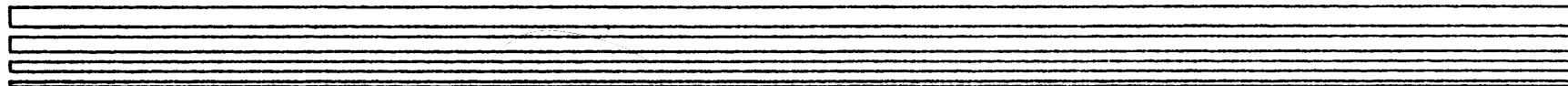
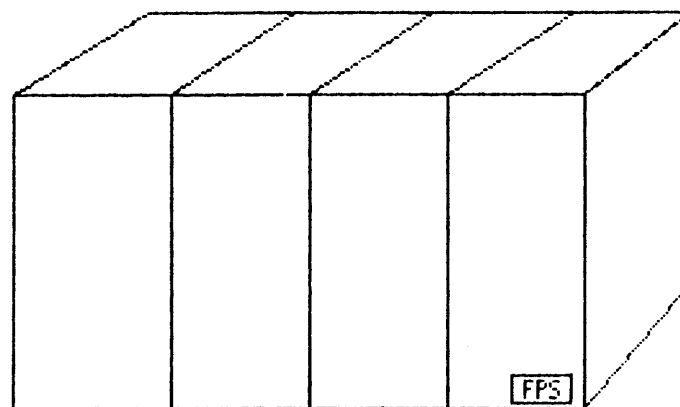
Power: 1000 Watts
Weight: 150 pounds
Cooling: Forced air
Footprint: 5 sq. ft.



THERE ARE 4 CABINETS IN A T/100

Arithmetic: 1.02 GFLOPS
Control: 480 MIPS
Memory: 64 MBytes
Checkpoint
Disk: 448 MBytes

Power: 4000 watts
Weight: 600 pounds
Cooling: Forced air
Footprint: 20 sq. ft.



A T/2000 IS MORE POWERFUL THAN ANY OTHER ANNOUNCED COMPUTER

Arithmetic: 16 GFLOPS

Control: 7.5 BIPS

Memory: 1 GBytes

Checkpoint

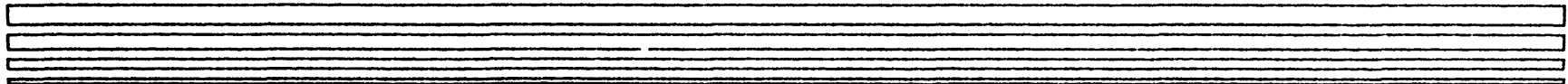
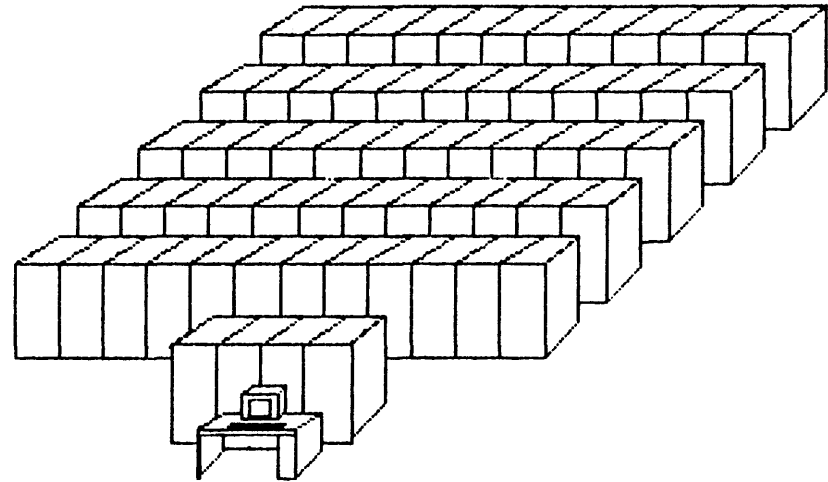
Disk: 7.2 GBytes

Power: 64 KWatts

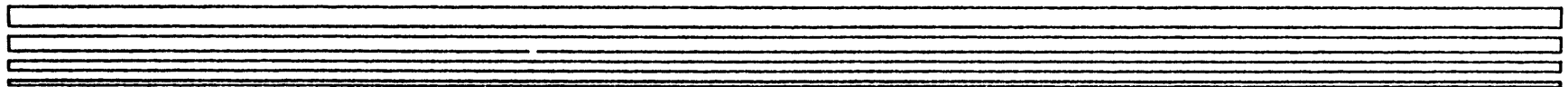
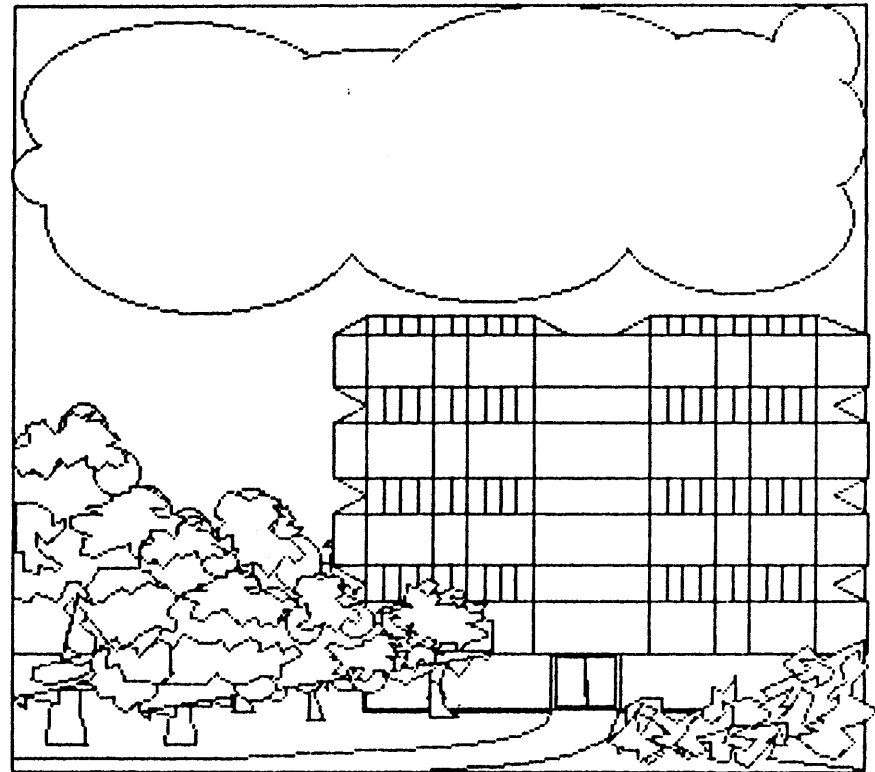
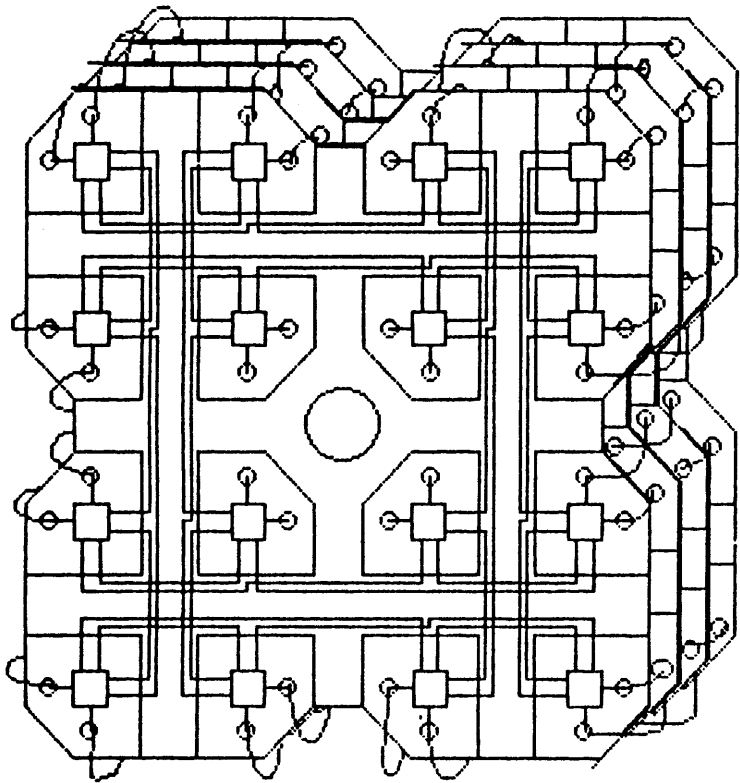
Footprint: 1000 ft.²

Weight: 5 tons

Cooling: Forced air



LARGER SYSTEMS REQUIRE SPECIAL FACILITIES

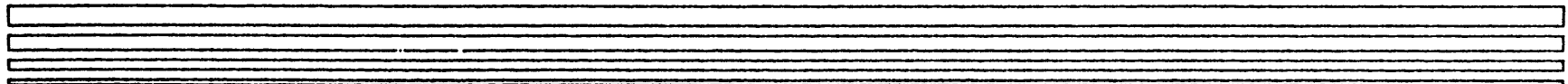
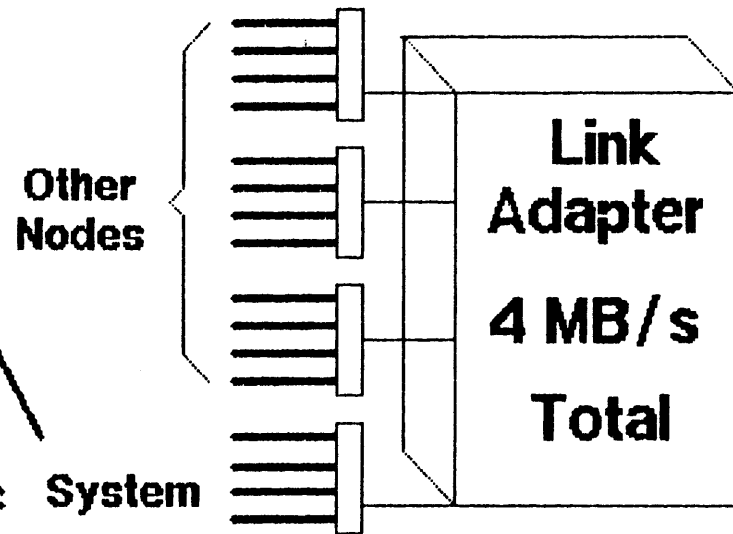


THE I/O FACILITY HAS THREE MAJOR PARTS

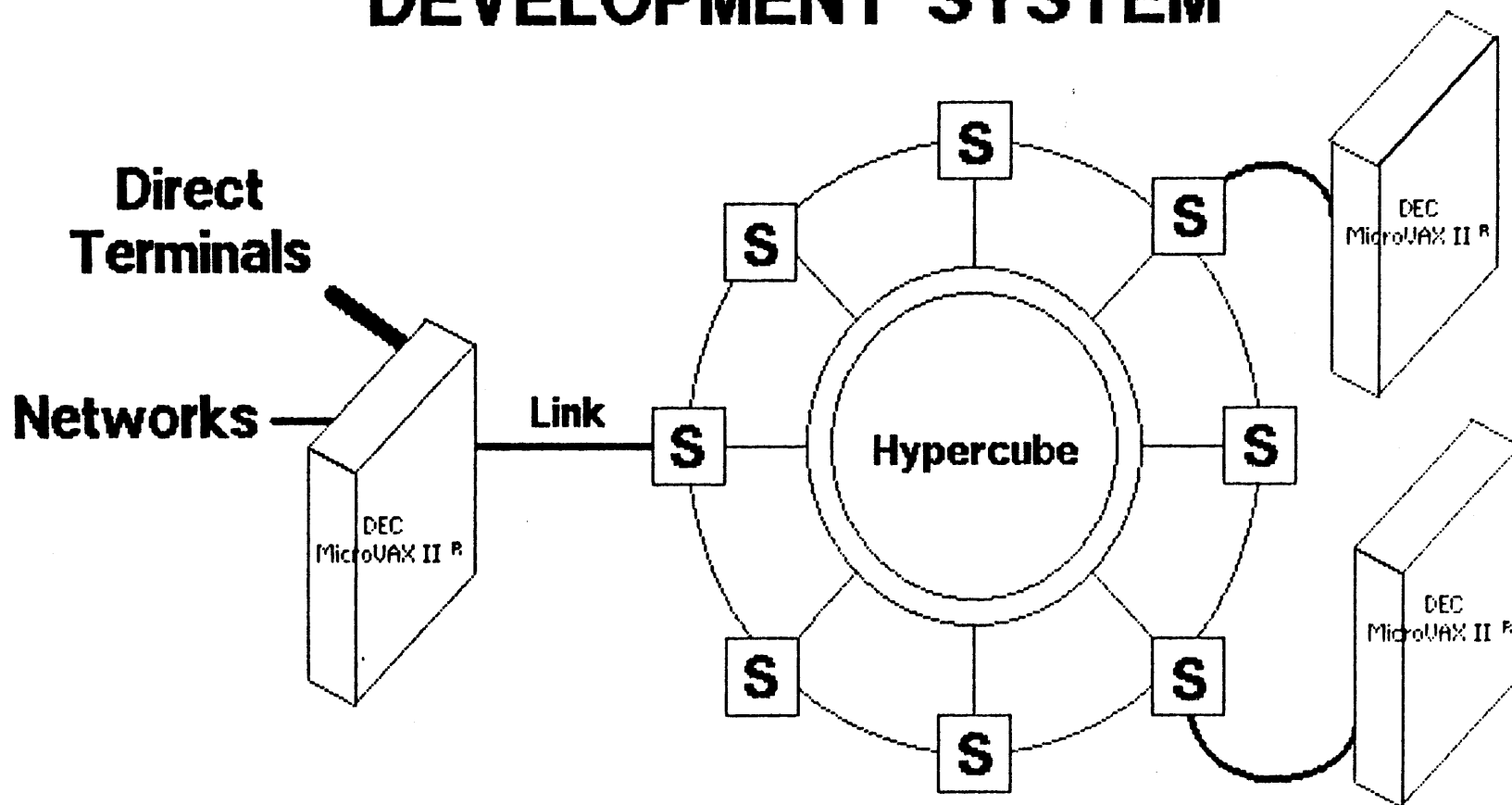
- **Front-End Interface**

- **Disk Subsystem**

- **General I/O**

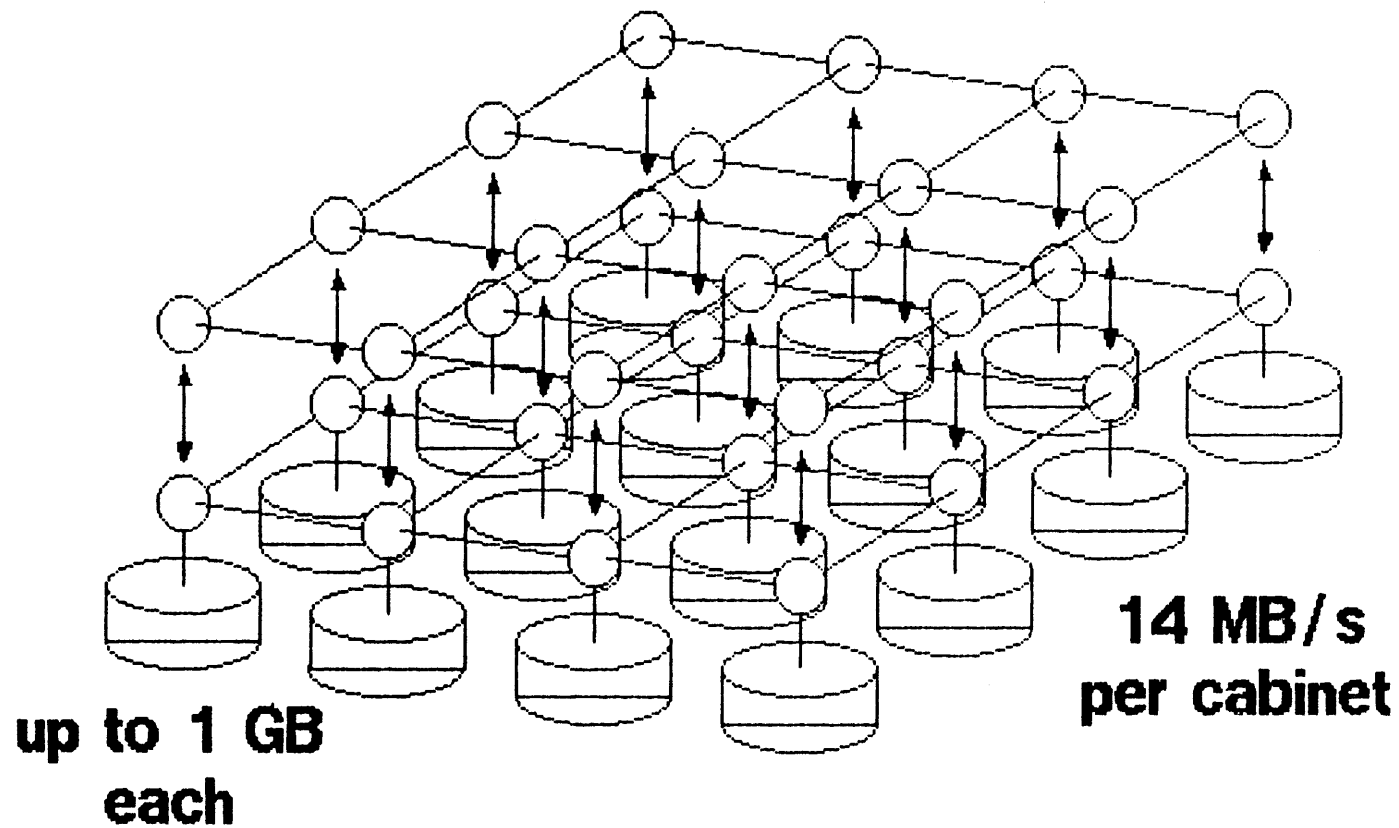


A MICROVAX II SERVES AS A NETWORK GATEWAY AND PROGRAM DEVELOPMENT SYSTEM

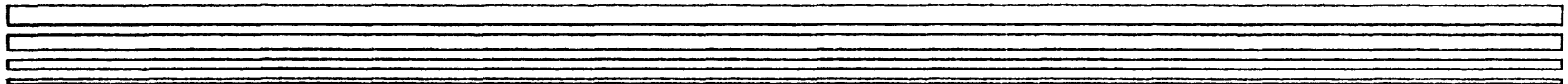
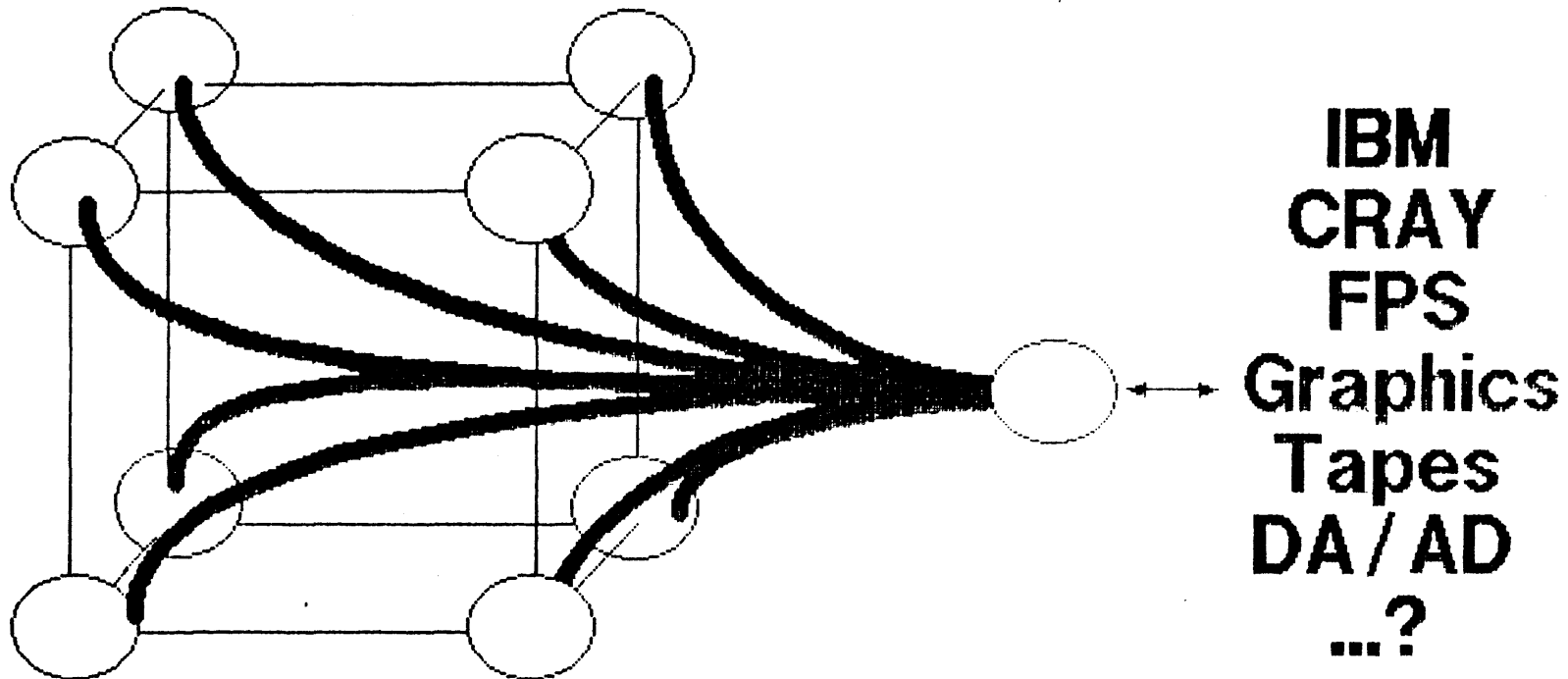


DEC MicroVAX II is a registered trademark of Digital Equipment Corp.

EACH NODE IS DIRECTLY CONNECTED TO THE USER DISK SYSTEM

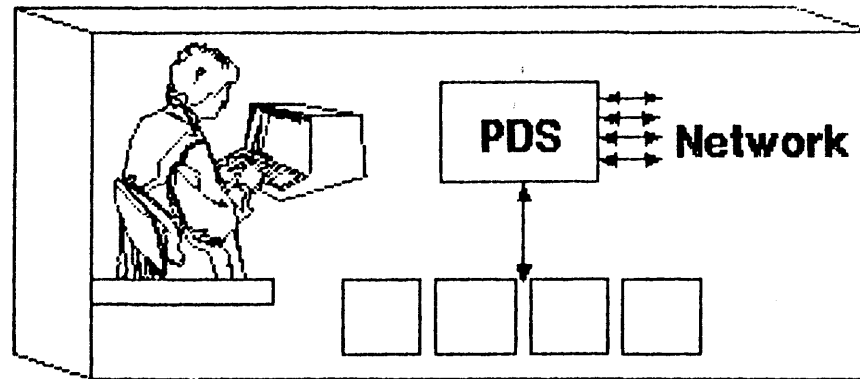


THE GENERAL PURPOSE I/O FACILITY CONNECTS EACH NODE TO AN EXTERNAL SYSTEM

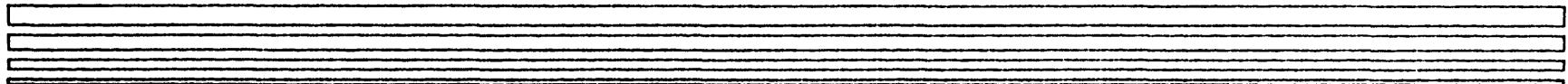
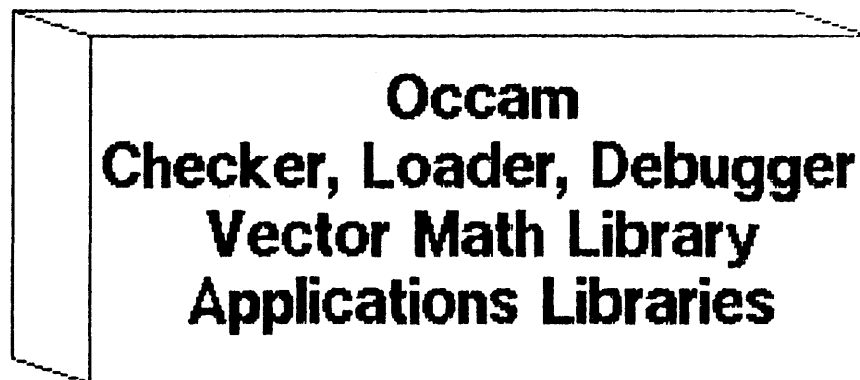


THE PROGRAMMING ENVIRONMENT RESEMBLES THAT OF OTHER SCIENTIFIC COMPUTERS

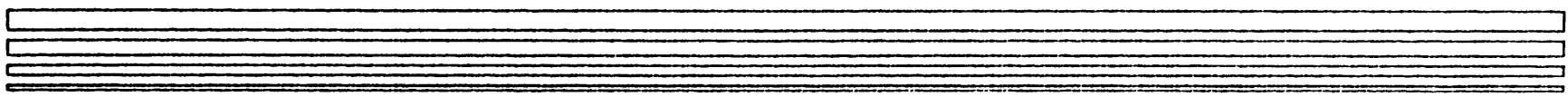
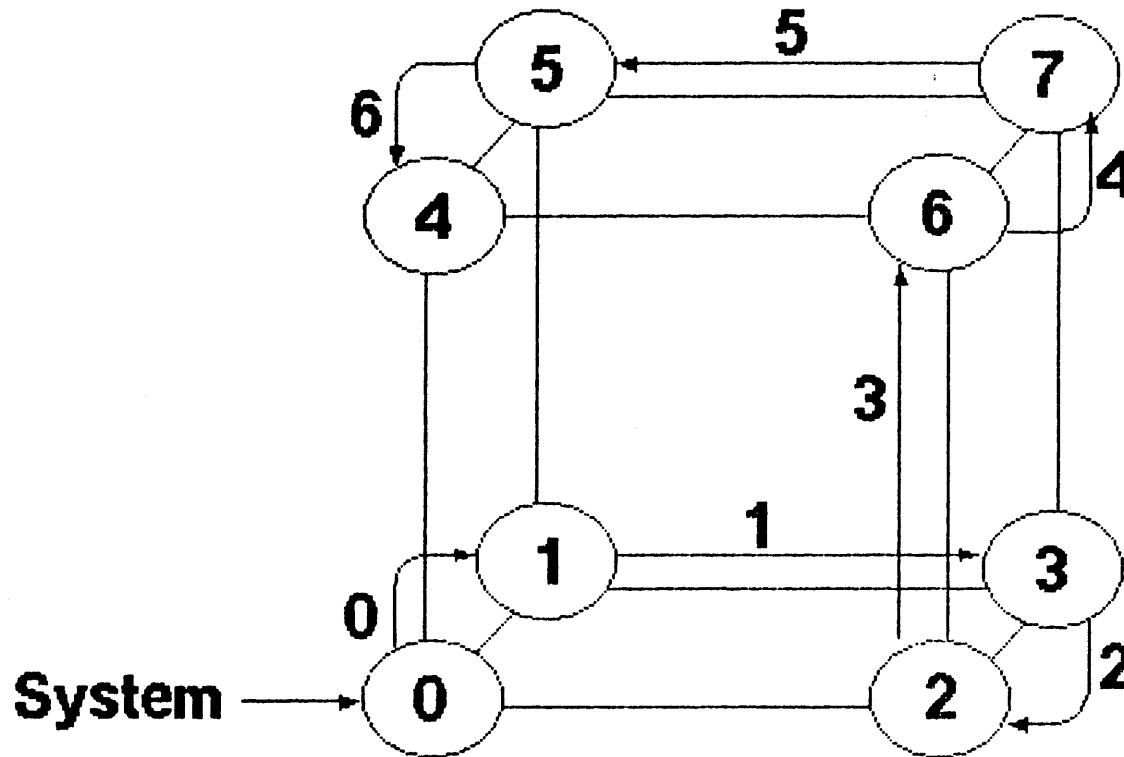
**Program
Development
System**



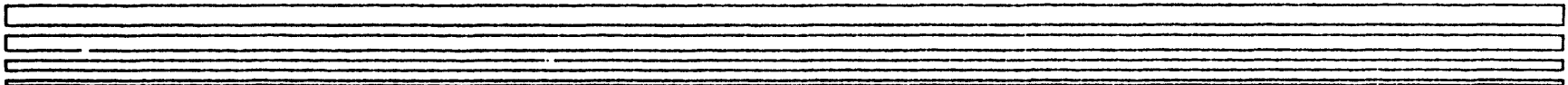
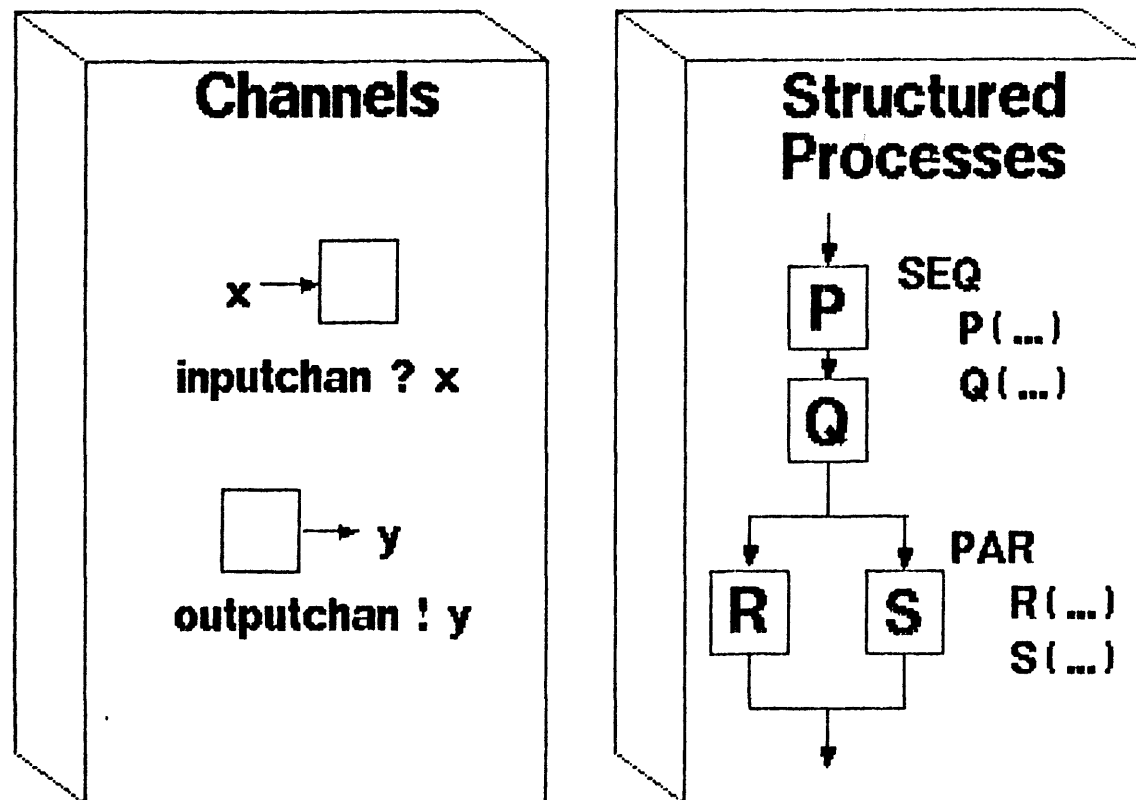
**Software
Tools**



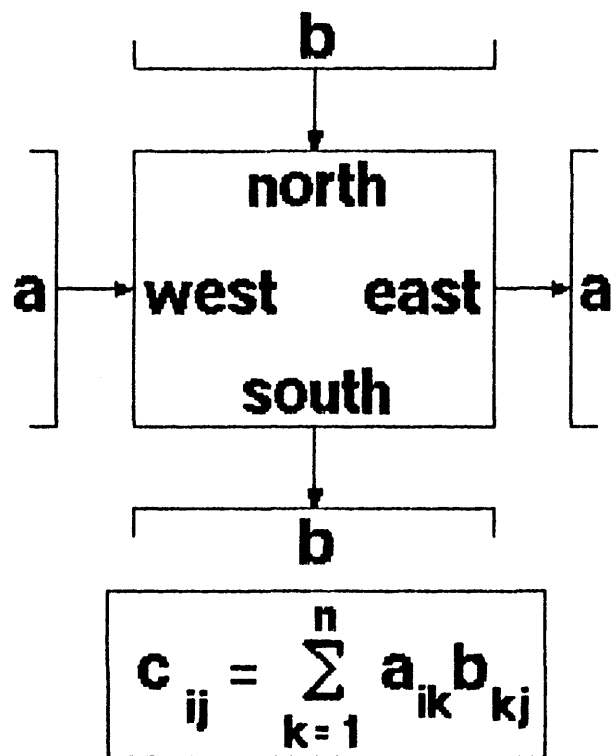
THE SYSTEM RING IS USED TO DOWNLOAD CODE



OCCAM PROVIDES THE TOOLS TO PROGRAM A NETWORK OF COMPUTERS

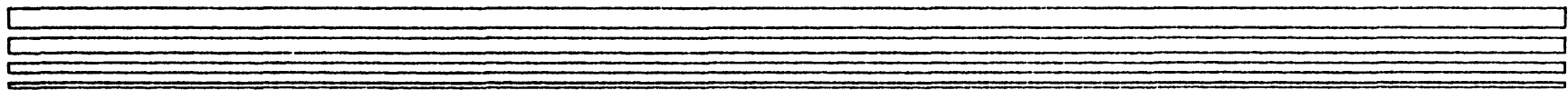


SYSTOLIC ALGORITHMS ARE EXPRESSED NATURALLY IN OCCAM



```

PROC Mult (CHAN north,south,east,west)
  REAL64 sum, a, b
  SEQ
    sum := 0.0
    SEQ i= [ 0 FOR n]
      SEQ
        PAR
          west ? a
          north ? b
          sum := sum + (a * b)
        PAR
          east ! a
          south ! b
  
```



SUMMARY

- **The FPS T Series is configurable over three orders of magnitude. All system facilities expand naturally with the number of nodes.**
- **FPS has solved the problem of balancing control, arithmetic, and memory speed using cost effective VLSI.**
- **The vector/parallel architecture can achieve a high percentage of peak speed on important applications.**

