LEVCO

Transputer Systems

for the Macintosh

TransLink™

Questions & Answers

What is the TransLink?

A modular system offering vastly accelerated performance for the Macintosh II and Macintosh SE. The speed increase is achieved by using high-speed parallel processing and the latest Reduced Instruction Set (RISC) technology.

What makes up the TransLink system?

- Processor modules

The processor modules are based on either the Inmos T414 or T800 Transputer processors. The T414 is either a 15mhz or 20mhz integer processor. The T800 adds on-chip 64-bit IEEE floating-point at 1-1.5 MFLOPS. Each processor module can hold 256KB, 1MB, or 4MB of RAM.

- TransLink II and TransLink SE link adaptor cards

The link adaptor boards interface between the Macintosh II or Macintosh SE and the processor modules. The TransLink SE can hold up to two processor modules. The TransLink II can hold up to 4 processor modules.

- Software development toolsets

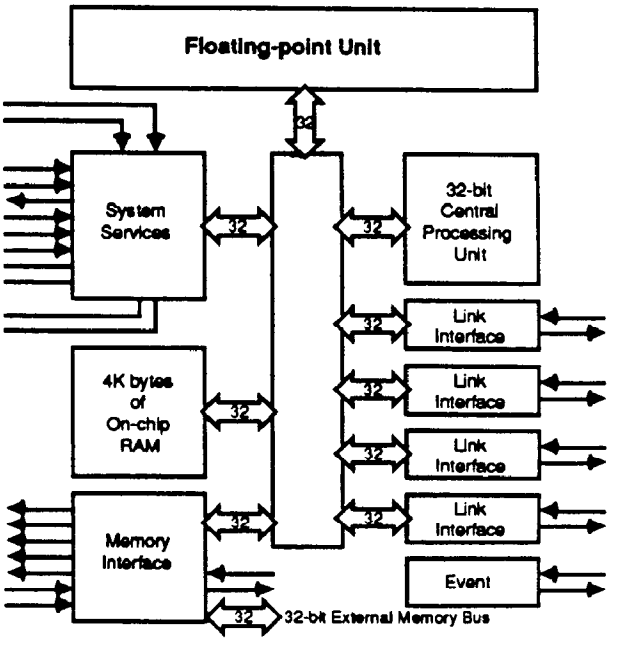
A *"C" language compiler and assembler* which runs under MPW. ANSI-standard "C" with parallel processing support in library routines. *occam*, a block-structured language designec specifically for parallel processing. *TDS*, a self-contained development environment including: a non-Mac-like editor, compiler, linker, loader, and librarian.

What is a Transputer?

The Transputer (transistor-computer) is a 32-bit high-speed reduced instruction set computer (RISC), based on VLSI technology, and designed for parallel processing applications. It is manufactured by Inmos Ltd. in the U.K. and is the basic building block for the Levco Translink system.

Can TransLink boards be connected together?

Yes. A number of communication lines are brought to the card I/O connector to allow the connection of multiple TransLink cards. Any number may be connected together. Up to 20 may be placed in a single Macintosh II. Limitations are generally set by the algorithm or problem being solved.



Inmos T800

What type of applications is TransLink good for?

- Computationally intense and/or naturally parallel: If you can think of a problem that can be broken down into small bits that can be worked on at the same time, then it is parallel.

- High-performance graphics processing: computationally intense - work can be divided by section of display, items being displayed, or location of items.

- CAE: structural analysis, Monte-Carlo circuit simulation, differential equation solving.

- Distributed databases: object-oriented search, parallel search of multiple files.

- AI: neural network simulation, rule-based expert systems, fuzzy logic analysis.

- Digital signal processing.

Who can use the TransLink today?

- Developers of application specific software. This tends to be software designed to solve a specific problem or to aid in other research and is the typical application in industry and universities at this time.

- Developers of general market software who wish to adapt their software to the TransLink.

- Researchers investigating parallel processing, both university and industrial.

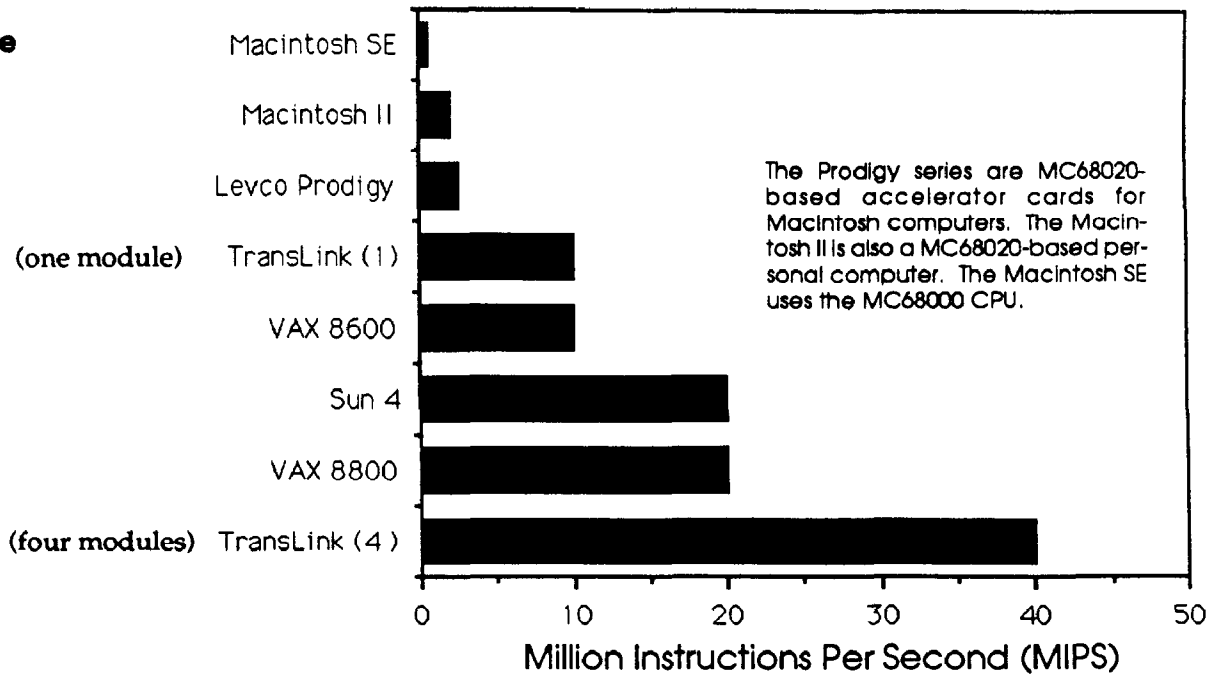
Who is using Transputers?

Just about every major computer company has looked at it and developed a prototype system based on the Transputer. IBM is building a system of 128 T800 processors to study molecular structures. Atari has built a prototype of an engineering workstation, the rumoured Mac II-killer, around the Transputer.

Various research projects in both the U.S. and Europe are based around the Transputer and occam. One research machine reputedly in the Netherlands has 5-7000 Transputers. Here in San Diego, General Dynamics ESD just purchased a system with 1400 Transputers (around $3 million). Xerox has also shown great interest in Transputers as components of an unspecified future product.

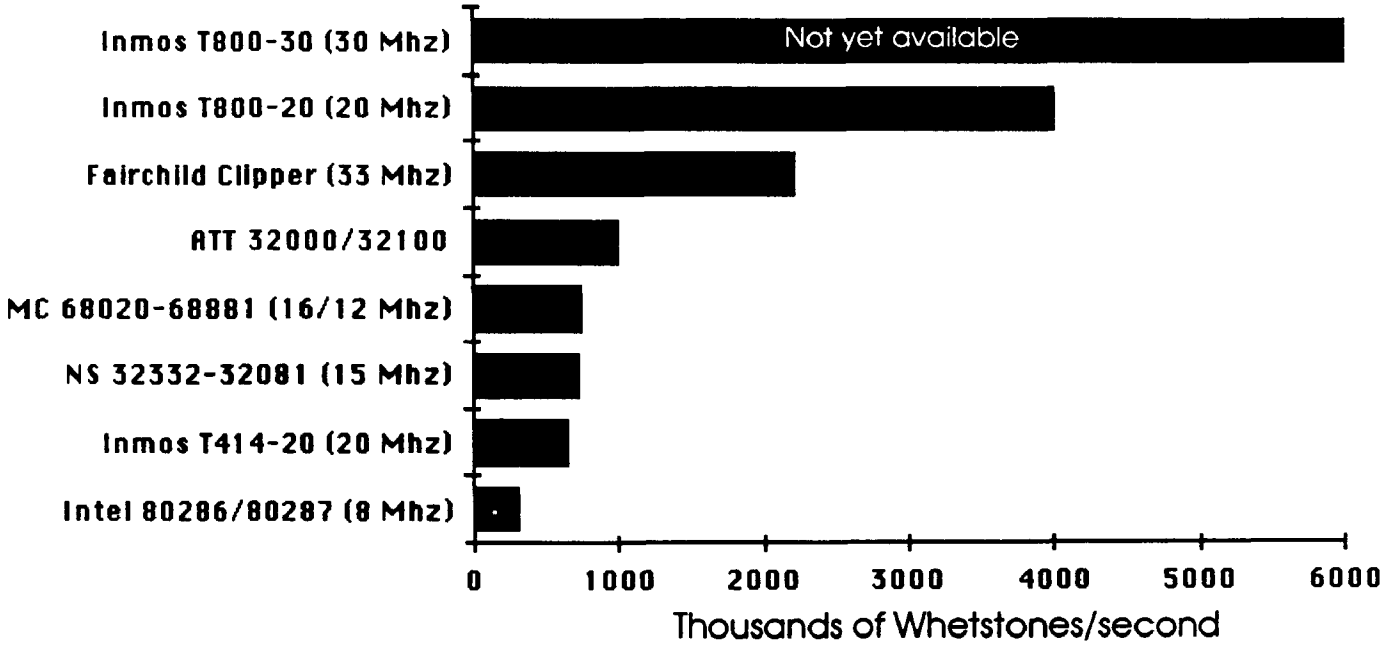
- Chem Designs Ltd. - U.K. - molecular modeling workstation
- Kokusai Denshin Denwa - Japan - image processing for video telephone
- Intelligent Peripherals - U.S. - image processing for laser printing
- Royal Navy - U.K. - CPU's for multi-user computing
- General Dynamics - U.S.
- Atari - U.S.
- IBM - U.S.

How fast is the TransLink?



What about floating-point performance?

Floating-point performance is often measured by the Whetstone benchmark, which provides a good mix of floating-point operations, and also includes procedure calls, array indexing, and transcendental functions.



The 64-bit floating point unit provides single-length and double-length operation according to the ANSI-IEEE 754-1985 standard for floating point arithmetic and is able to perform floating point arithmetic operations concurrently with the processor; sustaining in excess of 1.5 million floating point instructions per second (MegaFlops).

Can more Transputers be placed outside of the Macintosh?

Yes, expansion boxes are available that use the TransLink system and work with the Macintosh II to allow unlimited expansion. Boxes are currently sized at 16, 32, and 64 processors.

Does TransLink run Macintosh software?

No, it requires that you write programs specifically for it using the software tools described in this document.

How does an application use the Transputer?

Applications can make a driver call to see if a Transputer is installed in the system. If there is one in the system, the processor type, memory size, speed, and number of processors can be determined. The application program configures the Transputer(s) in a topology that it needs, loads its Transputer routines onto the Transputer, and then interacts with the Transputer by sending and receiving messages.

What is occam™?

Occam is a language developed by Inmos specifically for programming parallel systems. Occam has its roots in CSP, which is a formal mathematical system for parallel processes. Since the basis for occam is a structure which allows parallel programs to be properly bench-tested, the probability that an occam program will work is quite high.

How does "C" support parallel processing?

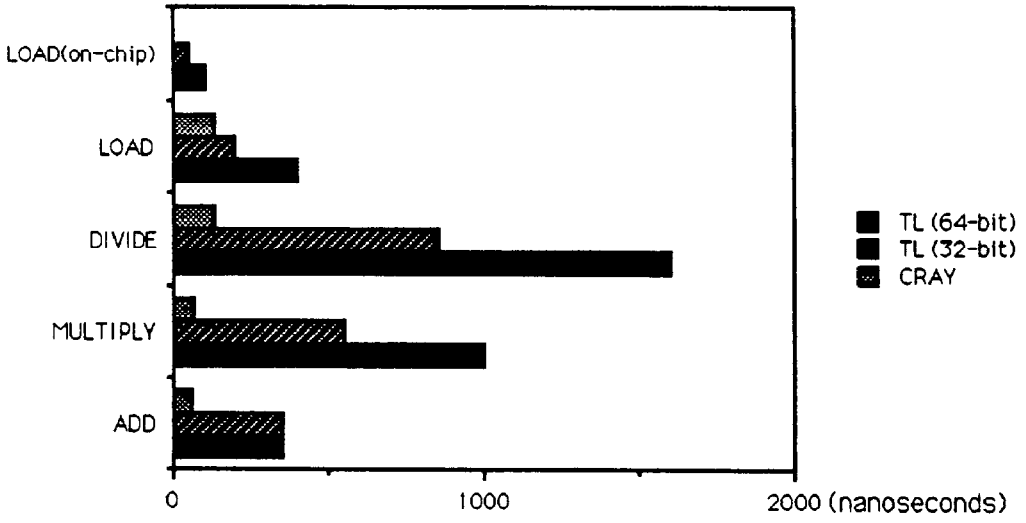
The "C" allows starting of parallel processes in a single processor through library routines. The compiler generates code in line on the Transputer, but allows the porting of the program to other machines such as the Macintosh itself by using appropriate libraries.

What is a Reduced Instruction Set Computer (RISC)?

The processor has short and simple instructions that can be executed very quickly. Most of the simple instructions take only 50-100 nanoseconds.

How does TransLink™ compare to the CRAY supercomputer?

The Cray gets its enormous speed from two factors: a fast processor cycle based on a 105 Mhz clock and the ability to link several operations together in what are called vectors. A vector is a one-dimensional array of numbers. The operations that a CRAY can perform very fast are those that store and make use of numbers in a vector form. The TransLink module with the Inmos T-800 CPU does not have the hardware to take advantage of data organized as vectors and thus does scalar (non-vector) operations. The following table shows the differences in time (nanoseconds) to perform scalar operations.



As you can see, the raw speed of the T-800 floating-point unit is quite good, only 6-15 times slower than the CRAY for 64-bit numbers. When loading values from on-chip memory, the T-800 is actually FASTER than the CRAY.

What does all this mean to the performance of your program?

The real question in performance is, "How many megaflops (million floating-point instructions per second) do you get when you run your program?" On the CRAY this depends on what percentage of code can be vectorized. Most programs have some code that cannot be vectorized and so they do not run at their fastest on the CRAY. While the CRAY has a peak capability of about 115-120 MFlops in extensive vector operations, in an operation such as:

```
for (i=1; i<1000; i++) {   A(i) = B(j(i)) + S }
```

the CRAY will produce only 2.5 MFlops and the TransLink with the T-800 about .24 - .4 MFlops. This is because the CRAY cannot use vector operations when a vector is an index into an array.

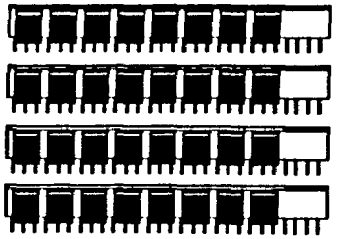
How many TransLink modules will you need to run your program that has the CRAY tied up?

Programs that have little or no vector code, that can be made to run in parallel, and that require little communication between processes like: finite state analysis, Monte-Carlo simulation, ray tracing, image processing, differential equations, etc., would require 6-8 modules on 2 Macintosh II TransLink cards to match the power of the CRAY in these instances. If there is a lot of vector code, 64-128 modules in an expansion box would do the trick.

It is important to note that while some problems will not be suited for parallel programming, those that can be thought of in this way can make use of the TranLink system as a cost-effective alternative to supercomputers.

RAM

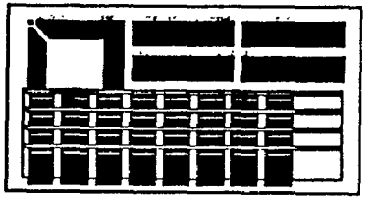
256K-	120 nanosecond
1 MB-	100 nanosecond
4 MB-	100 nanosecond



Transputer CPU

Inmos T414 32-bit integer processor (15 or 20 Mhz clock speed/7.5-10 MIPS)

Inmos T800 32-bit processor with 64-bit IEEE floating-point support (20 Mhz clock speed/10 MIPS)

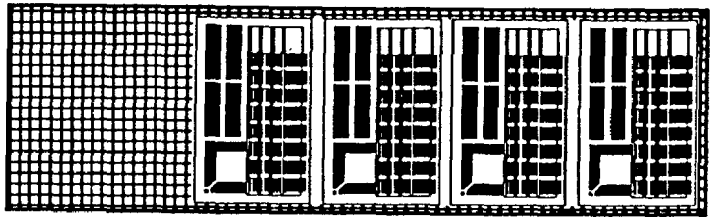


Transputer Module

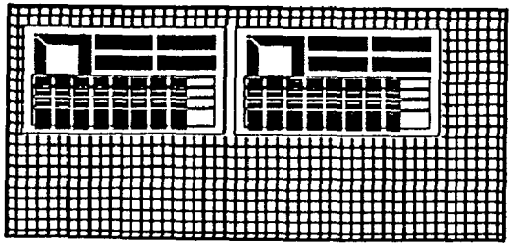
- T414 or T800 CPU
- Up to 4 MB of RAM/module
- 4 high-speed interprocessor links
- Plug-in installation to TransLink cards

- Carries 1-4 Transputer modules/card
- Includes programmable inter-Transputer link switch
- Plugs into Nu Bus slot in Mac II
- Up to 5 TransLink cards in one Mac II

TransLink II
(for Macintosh II)



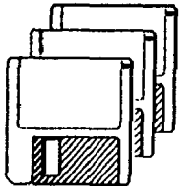
TransLink SE
(for Macintosh SE)



- Plugs into SE bus slot in Macintosh SE
- 1-2 Transputer modules/card

Software Development Toolsets

- Assembler Toolset
  - Assembler
  - Linker
  - Loader
  - Librarian
  - Driver



- Transputer Toolset
  - C compiler
  - Assembler
  - Support programs
- Software Transputer simulator for debugging

870

San Diego Levco Corp. - 6160 Lusk Blvd. - C100 San Diego CA 92121 (619) 457-2011

TransLink™ Pricing

Note: these figures are subject to change at any time without notice.

TransLink Components

Link SE™ (for Macintosh SE™)	$299.00
Link II™ (for Macintosh II™)	$799.00
Assembler	$399.00
when purchased w. system	$299.00
Assembler + "C"	$499.00
when purchased w. system	$399.00

Starter Kits

Starter SE Kit		$1899.00
including:	Link SE card 1 module (T414/15) assembler	
Starter II Kit		$2499.00
including:	Link II card 1 module (T414/15) assembler + "C"	

Transputer Modules

Ram configuration:	256KB	1MB	4MB
T414 (15mhz)	$1299.00	$1599.00	$3399.00
T414 (20mhz)	$1499.00	$1799.00	$3599.00
T800 (20mhz)	$1899.00	$2199.00	$3999.00

Miscellaneous

occam II™ and the Transputer Development System (TDS)	Call for pricing

Apple Equipment

Macintosh SE System $2898.00
- Macintosh SE™ CPU
- Standard Keyboard

Options

Internal 20 MB Hard Disk	$800.00
Internal 45 MB Hard Disk	$1750.00
Large Screen Monitor (19")	$1995.00

Macintosh II™ System $4896.00
- Macintosh II™ CPU
- Extended Keyboard
- Monochrome monitor
- Video Card

Options

RGB monitor w. video RAM expansion	$749.00
4 Megs RAM	$1198.00
Internal 40 MB Hard Disk	$1600.00